I-93 EXIT 4A

SUPPLEMENTAL DRAFT ENVIRONMENTAL IMPACT STATEMENT/SECTION 4(F) EVALUATION

VOLUME III: APPENDICES

NHDOT Project Number: 13065
Federal Project Number: IM-0931(201)
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Federal Highway Administration (FHWA)
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Town of Londonderry
Town of Derry

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I-93 EXIT 4A
PRELIMINARY ADMINISTRATIVE
SUPPLEMENTAL DRAFT ENVIRONMENTAL IMPACT STATEMENT / SECTION 4(F) EVALUATION

VOLUME III: APPENDICES

Prepared for:

Town of Derry
Town of Londonderry
New Hampshire Department of Transportation

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NHDOT Project Number: 13065
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TABLE OF CONTENTS

Appendix A: Traffic Technical Report

EXIT 4A – Traffic and Transportation Technical Report

I-93 Exit 4A Supplemental Draft Environmental Impact Statement

Prepared for:

Town of Derry
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New Hampshire Department of Transportation

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Table of Contents

Table of Contents (Continued)

Tables

Figures

Appendices

1.0 Introduction

The Interstate 93 (I-93) Exit 4A Project (the "Project") involves a new diamond interchange between Interstate 93 Exits 4 and 5 in the Town of Londonderry, approximately one mile north of Exit 4. The new diamond interchange would provide access to the east side of I-93 only. A 1-mile connector roadway would be built on new alignment from the interchange to Folsom Road, near the intersection of North High Street and Madden Road, in the Town of Derry. Folsom Road, and subsequently Tsienneto Road, would be upgraded, and the intersections would be improved.

The Project was the subject of a Draft Environmental Impact Statement (DEIS) in 2007 (FHWA, 2007). Due to the amount of time that has elapsed since the 2007 DEIS, the FHWA has requested the preparation of updated studies that will be documented in a Supplemental Draft Environmental Impact Statement (SDEIS) in accordance with the National Environmental Policy Act (NEPA). The SDEIS will provide an up-to-date assessment of the environmental effects of the Project and the evaluation of reasonable alternatives that will consider updated information including, but not limited to, traffic, socioeconomic projections, land development proposals in the project area, and changes in environmental resources and regulatory requirements.

The purpose of this report is to document the development of traffic projections and operational analyses for the Project as part of the SDEIS. This report is a compilation of previous memoranda issued as the project proceeded as well as to present the findings of the analyses of the various alternatives.

The traffic analysis tasks described in this report includes the following:

- Collection of traffic count data at various roadways and intersections in the Exit 4A study area to develop 2015 Average Weekday Traffic (AWDT) volumes.
- Use of these 2015 counts to calibrate the Southern New Hampshire Planning Commission (SNHPC)'s regional traffic model to be viable to project future traffic volumes in the 2040 design year with and without the proposed Exit 4A.
- Preparation of land use and socioeconomic projections (conducted concurrently by the Land Use Working Group) for the SNHPC model area and allocated to the Traffic Analysis Zone (TAZ) level for each alternative scenario to be used as the basis for traffic generation and trip assignments to the regional roadway network.
- Development of 2040 No-Build (without Exit 4A) and Build (with Exit 4A) traffic volume assignments on key roadway segments and intersections in the study area network.
- Derivation of AM and PM peak hour traffic volumes on the mainline I-93 and interchange ramps as well as key segments and intersections in the study area for the various Exit 4A alternative layouts for analysis purposes (see Figure 1).
- Analysis of interstate operations using the *2010 Highway Capacity Manual* (TRB, 2010) Freeway Facilities methodologies for the existing 2015 and all 2040 No-Build and Build scenarios. Analysis of signalized and unsignalized intersection operations of the existing 2015 and all 2040 scenarios using HCM methodologies and emulated in the *SYNCHRO/Sim-Traffic (Trafficware, 2016)*software for

derivation of Level of Service and estimated queue lengths for conceptual design purposes.

In addition to the traffic data collection, Project Team specialists and the Land Use Working Group conducted interviews and compiled socioeconomic (e.g., population and employment) projections that were used by the SNHPC to allocate these trip-generation characteristics to their traffic zone system to generate traffic assignments to the roadway network under both No-Build (without 4A) and the Build alternatives that were included in the DEIS from 2007. A separate Land Use Scenario Technical Report was prepared that documents the land use and socioeconomic forecasting efforts that were used in conjunction with the traffic modeling. (Louis Berger, 2017).

2.0 Purpose and Need for the Project

The Purpose and Need for the Project, as described in the 2007 DEIS, is as follows:

- Providing for transportation improvements that will promote the safe and efficient movement of people, goods, and services between I-93 and the towns served by NH Route 102, specifically Derry and Londonderry, that are immediately adjacent to I-93 Exit 4;
- Providing an alternative route to the Interstate system for traffic using NH Route 102 to and from the east, thus removing a large volume of through traffic from the heavily congested downtown Derry street network;
- Providing improved Interstate access for commercially and industrially zoned lands near NH Routes 28 and 102 in both Derry and Londonderry, thus allowing for the planned and orderly development of such lands to further locally-defined economic development goals and tax base diversification; and
- Enhancing and promoting the economic vitality of the downtown Derry area, presently characterized by traffic congestion and decreasing vehicular and pedestrian safety, by separating local destination-oriented traffic from through-traffic destined for the Interstate system.

3.0 Traffic Data Collection

The study area for the Project was established and agreed upon as part of the 2007 DEIS document, and encompasses the expected extent of the roadway network that would likely be influenced by the introduction of a new I-93 interchange and associated connector roadways. An updated inventory of the key area roadways and intersections was conducted to ensure that the traffic modeling and subsequent analyses reflect existing conditions.

The various contracts for the I-93 widening project affecting the study area also needed to be considered. The Exit 5 improvements are already in place, and the Exit 4 interchange is being reconstructed now as part of Contract 14633-D. The widening of the mainline I-93 to four lanes between Exits 4 and 5 under Contracts ‘D’ and ‘I’ is also underway.

3.1 Traffic Counts

The traffic counting program was developed for the project, based on the key roadway segments and intersections in the study area, to assist in the development of 2015 base Average Annual Weekday Traffic (AAWDT) volumes for use in the traffic model calibration. Most of these locations were counted in 2005 as part of the preparation of the original 2007 DEIS document. This effort was coordinated with the annual traffic counting programs conducted by both the NHDOT and SNHPC within the study area, and the new data collected in May and June of 2016 while school was still in session. Some of these locations had already been counted in 2014 or 2015 (NHDOT, 2016a, 2016b, 2016c), so all data was evaluated and subsequently adjusted to reflect 2015 AAWDT conditions.

The Automatic Traffic Recorder (ATR) counts were taken for a 3-5 day period. A listing of the locations is included below and shown in Figure 2.

<u>Interstate Locations (15)</u>

I-93 NB and SB, south of Exit 4 (NHDOT permanent recorder)
I-93 Exit 4 – NB and SB on- and off-ramps (5)
I-93 Exit 5 – NB and SB on- and off-ramps (4)
I-93 NB and SB between Exits 4 and 5 (2)
I-93 NB and SB north of Exit 5 (2)

<u>State Highways/Local Streets (22)</u>

Crystal Avenue (NH Route 28), south of Tsienneto Road
Folsom Road, west of NH Route 28
Pinkerton Street, east of Tsienneto Road
Tsienneto Road, east of Pinkerton Street
Chester Road (NH Route 102), east of NH Route 28 Bypass (Sylvestri Circle)
North Main Street (NH Route 28 Bypass), north of Pinkerton Street (Academy Drive)
North Main Street (NH Route 28 Bypass), north of Tsienneto Road
South Main Street (NH Route 28 Bypass), south of Thornton Street
Tsienneto Road, west of NH Route 102
NH Route 102, at Derry Town line
NH Route 28, at Derry/Londonderry Town line
Gilcreast Road, north of NH Route 102
NH Route 102, west of Abbot Street
NH Route 102, east of Griffin Street
Fordway, over Beaver Brook
Franklin Street, north of Folsom Road
Ash Street at Londonderry Town line
Ash Street, east of Londonderry Road
NH Route 28, east of Perkins Road
NH Route 28, south of Rollins Street

NH Route 28, north of Liberty Drive
NH Route 102, east of Hampton Drive

<u>Intersection Turning Movement Counts (TMCs) – AM and PM Peak Periods (19)</u>

The intersection counts were taken in groups of intersections within five general groups or 'zones' in close proximity to each other to facilitate ease of data collection and to minimize significant differences between locations, even if there were intervening roadways or driveways that would not allow balancing between sites. These groups of intersections were numbered as follows and shown in Figure 3:

<u>Zone 1</u>
#3 Exit 5 SB ramps
#4 Exit 5 NB ramps

<u>Zone 2</u>
#1 Exit 4 SB ramps
#2 Exit 4 NB ramps

<u>Zone 3</u>
#5 NH Route 102/Londonderry Road/St. Charles Street
#6 NH Route 102 (Broadway)/Fordway/Madden Hill Road
#7 NH Routes 102/28 (Crystal Avenue/Broadway/Birch Street)
#8 North High Street/Ash Street Extension
#9 North High Street/Madden Road
#10 North High Street/Folsom Road/Franklin Street/Franklin Street Extension

<u>Zone 4</u>
#11 NH Route 28/Folsom Road/Tsienneto Road (Ross' Corner)
#12 Tsienneto Road/Pinkerton Street
#13 NH Route 28/Linlew Drive
#14 NH Route 28/Ashleigh Drive
#15 NH Route 28/Scobie Pond Road

<u>Zone 5</u>
#16 NH Routes 102/28 Bypass/East Derry Road (traffic circle)
#17 NH Route 28 Bypass/Pinkerton Street/Nesmith Street
#18 NH Route 28 Bypass/Tsienneto Road
#19 NH Route 102/Tsienneto Road

Copies of the relevant raw traffic count data are included in Appendix A.

Other new intersections that would be created by some of the Exit 4A alternatives will also need to be evaluated and analyzed. In addition, it was determined as the study progressed that additional intersections at the east end of the study area should be collected, since they will be influenced by any improvements at the NH Route 102/Tsienneto Road intersection. These intersections were at NH Route 102/North Shore Road (#26) and at NH Route 102/English Range Road (#27). This data is also included in Appendix A.

Adjustment Factors used for Data Reduction

Because of the nature of the regional roadway network, there are several different adjustment factors that need to be applied to the raw counts to derive AWDT. In general, there are seasonal factors, annual growth factors, and axle correction factors, based on the type of roadway being considered. NHDOT develops these factors for various roadway types based on their evaluation of permanent traffic recorder stations across the state. NHDOT differentiates between Rural and Urban Interstates (called Groups 1 and 3, respectively), as well as Rural and Urban Highways (Groups 2 and 4, respectively), for which there is a wealth of short-term and long-term factors that are developed annually by NHDOT as part of their normal practice (NHDOT, 2016d). Appendix B includes the tables showing the various seasonal, annual and axle correction factors applied to the raw traffic counts in this report.

Seasonal Factors

In this study area, there are Interstate roadways (I-93) as well as state highways and local streets in an urbanized area, so the Group 3 and 4 seasonal factors in Appendix B were applied here. Since counts were taken on specific dates in May, the 2015 seasonal adjustment factors were applied to each count separately based on the date of the count and the type of roadway.

Annual Growth Factors

Annual growth factors are also applied because of the different years that the counts were taken. There is an NHDOT permanent traffic recorder in the immediate study area on I-93 just south of Exit 4 at the Derry/Windham town line, but it may not be indicative of growth on the local street network because the interstate is more prone to fluctuations in regional traffic. A comparison of May 2015 to May 2016 traffic counts on I-93 indicates a 1.1% growth rate on the Interstate system. It should be noted that this counter is located north of the current construction area, so it should not have been influenced by drivers trying to avoid construction-related delays. This 1.1% annual growth rate was applied to the 2016 mainline I-93 traffic data only to adjust the data downward to the 2015 base year AWDT.

Another permanent recorder is located on NH Route 28 in Windham south of the study area that should be more representative of the urbanized roadways within the Derry/Londonderry area. A comparison of May 2015 to May 2016 traffic counts at the NH Route 28 location indicates a 2.5% growth rate, which was then applied to the rest of the study area roadway system to derive the 2015 AWDT.

There are also ramp volume counts at Exits 4 and 5 that need to be seasonally adjusted**. In discussions with the NHDOT Bureau of Traffic (NHDOT, 2016e), it was agreed that these ramp volumes would exhibit characteristics more in line with the local street network as opposed to seasonal variations in Interstate traffic.** As such, the 2.5% growth rate was also applied to the ramp volumes to derive the 2015 AWDT.

Axle Correction Factors

Axle correction factors are also applied to adjust for differences in vehicle classification on various types of roadways to derive a total number of actual vehicles. It is essentially a correction for the assumed number of two-axle vehicles gathered by the field-counting apparatus (such as road tubes) to account for multi-axle vehicles in the traffic stream, based on the FHWA 13-tiered classification system. These factors are developed by NHDOT based on vehicle classification information collected on the various functional classifications of roadways in the state.

Each of the major roadways in the study area has already been functionally classified based on its overall role in the regional roadway network. Since this is an urbanized area, the classifications that are applied here are urban interstate (FC 11), urban principle arterials (FC 14), urban minor arterials (FC 16), collector roadways (FC 17), and local streets (FC 19). The 2015 axle correction factors table is also provided in Appendix B.

Development of 2015 AAWDT Base Volumes

Table 1 shows a summary of the adjusted 2015 AAWDT volumes derived from applying the various adjustment factors to the 2015 and 2016 raw traffic counts. In some cases, such as for the 2014 counts, the NHDOT has already developed the AAWDT for locations of interest in the study area, which only need to be annually adjusted upward to 2015. This adjustment factor has also been applied to the AM and PM peak hour volumes and ‘k’ factors (the percentage of AAWDT during each peak hour for each movement) calculated for comparison to the intersection TMCs for future analysis purposes.

TABLE 1

ATR Count Summary - Adjusted 2015 AAWDT and Peak Hour Volumes

Annual Growth rates:	
2014->2015	1.025
2015->2015	1.000
2016->2015	0.975

Seasonal: Use Urban Highway Group 4 adjustment factors

Intersection Turning Movement Counts		AM Peak	PM Peak
April	Adj Factor=	0.96	0.99
May		0.96	0.98
June		0.96	0.94
July		1.04	0.96
Sept		0.95	0.97

	Count Location	Count Month/Yr	Raw AAWDT	Adj 2015 AAWDT	700-800am Counted AM Peak Volume	Adj 2015 AM Peak Volume	AM Pk as % of AAWDT	400-500pm Counted PM Peak Volume	Adj 2015 PM Peak Volume	PM Pk as % of AAWDT
Derry	Crystal Ave (NH Route 28), S of Tsienneto	May-16	15585	15195	836	803	5.28%	1418	1390	9.15%
	Folsom Rd W of NH Route 28	May-16	12070	11768	778	747	6.35%	1199	1175	9.98%
	Pinkerton St E of Tsienneto	May-16	10722	10454	695	667	6.38%	1017	997	9.54%
	Tsienneto Rd, W of NH Route 102	May-16	5532	5394	483	464	8.60%	511	501	9.29%
	Tsienneto Rd E of Pinkerton	May-16	15012	14637	1113	1068	7.30%	1499	1469	10.04%
	NH Route 102, E of NH Route 28 Bypass	May-16	7456	7270	595	571	7.85%	661	648	8.91%
	NH Route 28 Byp, N of Academy Dr	May-16	8615	8400	756	726	8.64%	881	863	10.27%
	NH Route 28 Byp, N of Tsienneto Rd	May-16	12250	11944	997	957	8.01%	1201	1177	9.85%
	NH Route 28 Byp, S of Thornton Rd	May-16	14341	13982	1110	1066	7.62%	1392	1364	9.76%
	NH Route 102 E of Griffin St	Apr-14	16000	16400	1054	1012	6.17%	1224	1212	7.39%
	NH Route 102 W of Abbot St	Apr-14	14000	14350	1020	979	6.82%	1148	1137	7.92%
	Fordway over Beaver Brook	Apr-14	5200	5330	410	394	7.39%	481	476	8.93%
	Franklin St Ext, N. of Folsom Rd	Apr-14	1800	1845	99	95	5.15%	171	169	9.16%
	Ash St at Londonderry town line	Apr-14	6600	6765	410	394	5.82%	722	715	10.57%
	Crystal Av (NH Route 28), S of Rollins	Jun-15	13000	13000	819	786	6.05%	1174	1104	8.49%
	average						6.90%			9.28%
L-derry	NH Route 102, E of Hampton Dr	Jul-15	32000	32000	2478	2577	8.05%	2842	2728	8.53%
	NH Route 102 at Derry Town line	May-16	22656	22090	1718	1649	7.46%	1796	1760	7.97%
	NH Route 28 at Derry Town line	May-16	17324	16891	1279	1228	7.27%	1682	1648	9.76%
	NH Route 28 N of Liberty Dr	Sep-15	13000	13000	1176	1117	8.59%	1054	1022	7.86%
	Gilcreast Rd N of NH Route 102	May-16	10070	9818	697	669	6.81%	1008	988	10.06%
	Ash St E of Londonderry Rd	Jun-15	6900	6900	427	410	5.94%	723	680	9.86%
	average						7.36%			9.00%
					700-800am			400-500pm		
	Exit 4 NB Off-ramp	May-16	10249	9993	435	418	4.18%	1223	1199	12.00%
	Exit 4 NB On-ramp	May-16	10303	10045	1079	1036	10.31%	812	796	7.92%
	Exit 4 SB Off-ramp	May-16	9862	9615	753	723	7.52%	952	933	9.70%
	Exit 4 SB On-ramp - EB to SB	May-16	5310	5177	673	646	12.48%	311	305	5.89%
	Exit 4 SB On-ramp - WB to SB	May-16	4767	4648	537	516	11.10%	244	239	5.14%
	average						9.12%			8.13%
	Exit 5 NB Off-ramp	May-16	5745	5601	400	384	6.86%	472	463	8.27%
	Exit 5 NB On-ramp	May-16	9580	9341	992	952	10.19%	793	777	8.32%
	Exit 5 SB Off-ramp	May-16	9520	9282	781	750	8.08%	939	920	9.91%
	Exit 5 SB On-ramp	May-16	5645	5504	519	498	9.05%	427	418	7.59%
	average						8.54%			8.52%

Note - Exit 5 SB off-ramp AM peak volume does not include one count that appears anomalous when compared to other counts in same hour

Red counts are from NHDOT Town summary data - 2014-2015

3.2 Existing Signal Information – Timing and Phasing

Information about the current signal timing and phasing plans at each of the signalized intersections was compiled from records available from the entity with current maintenance responsibility, which is either the NHDOT Bureau of Traffic or the Town of Derry (none of the signals in Londonderry are under their jurisdiction). Current records for one of the locations (NH Route 102/Fordway) were not readily available, so the required information was gathered in the field by observation. This information, combined with the current lane use at each location, was compiled into a data file in the SYNCHRO signal analysis program, which emulates the procedures in Volume 3 (Interrupted Flow) of the *Highway Capacity Manual* 2000 *(HCM)* (TRB, 2000) analysis procedures, for use in future analysis. The HCM 2000 procedures are being used for signalized intersections because these procedures can analyze non-standard timing and phasing parameters, since as leading pedestrian start times, which were found in the field, and to be consistent with the analyses in the Interstate Justification Report (Louis Berger, 2018).

3.3 Crash Data – 2010-2014 – Data Reduction and Summary

Data compiled by the NH Department of Safety for the last five full calendar years was made available by the NHDOT for the two study area towns. Since the crash records are identified by State Plane coordinates, this data search was narrowed further to include only those crashes located within the limits of the study area, roughly bounded by I-93 to the west, NH Route 102 to the south, NH Routes 28 and 28 Bypass north of Tsienneto Road to the north, and the Tsienneto Road/NH Route 102 intersection to the east. The records were assigned to specific roadway segments or individual intersections if sufficient locational information was available. In some cases these identifiers overlapped, so the sum of the segment and intersection crashes is more than the total.

The findings are summarized in Table 2 below. A total of 716 crashes were identified within the project area within the five-year time span, with only one fatality (a single-car incident in 2014 on NH Route 102 in Londonderry). About 24% of the crashes were injury or fatality, with almost 87% of these being on the major roadways in the study area. NH Routes 102 and 28 combined accounted for about 2/3 of the total reported crashes, averaging 48 per year, with the Interstate only accounting for 19%, or 25 per year. The traffic circle at NH Route 28 Bypass and NH Route 102 had the most reported crashes of any intersection during this period, averaging almost 5 per year.

Although there was a consistent number of crashes during three of the five years that data was compiled (between 182 and 185 per year), the other two years show wide fluctuations within this period (115 and 52 crashes). Almost 80% of the crashes involved another motor vehicle, with another 13% involving a crash with a fixed object. Seven of the crashes involved a bicyclist or pedestrian, while another six involved a crash with an animal.

TABLE 2

EXIT 4A STUDY AREA CRASH SUMMARY 2010-2014

Location	Fatal Crashes	Injury Crashes	Property Damage Only	Unknown Damage	Total Crashes
Roadways					
NH Route 102, Exit 4 to Tsienneto Road.	1	58	172	9	240
NH Route 28, Exit 5 to NH Route 102	0	40	162	9	211
I-93, Exit 4 to Exit 5	0	27	97	3	127
NH Route 28 Bypass, NH Route 102 to Auburn Town Line	0	19	39	0	58
Folsom Road/Tsienneto Road	0	3	27	2	32
TOTAL	1	147	497	23	668
% OF TOTAL	0.1%	22.0%	74.4%	3.4%	100.0%
AVG PER YEAR	0.2	29.4	99.4	4.6	133.6
Major Intersections					
NH Route 102/NH Route 28 Bypass	0	7	16	0	23
NH Route 28 Bypass/Tsienneto Road	0	3	14	0	17
NH Route 102/NH Route 28	0	3	14	0	17
NH Route 102/Fordway/High St.	0	3	12	0	15
Tsienneto Road/Pinkerton Street	0	1	10	0	11
Folsom Road/Franklin Street	0	1	8	1	10
NH Route 28/Folsom Road/Tsienneto Road/ (Ross' Corner)	0	1	9	0	10
NH Route 28/Ashleigh Dr.	0	3	6	1	10
NH Route 28/Linlew Dr.	0	0	9	0	9
NH Route 102/Londonderry Road	0	2	5	1	8
NH Route 102/Tsienneto Road	0	1	4	0	5
TOTAL	0	25	107	3	135
% OF TOTAL	0.0%	18.5%	79.3%	2.2%	100.0%
AVG PER YEAR	0	5	21.4	0.6	27

ADDITIONAL INFO BELOW					
Year					
2010	0	45	132	5	182
2011	0	32	83	0	115
2012	0	45	135	5	185
2013	0	8	40	4	52
2014	1	39	133	9	182
	1	169	523	23	716

23.7% (approx. percent that are injury or fatality)

Crash Types	Number	% Total
Animal	6	0.84%
Bicyclist	2	0.28%
Fixed Object	91	12.71%
Jackknife	1	0.14%
Other Motor Vehicle	568	79.33%
Other Object	3	0.42%
Overturn	14	1.96%
Parked Motor Vehicle	9	1.26%
Pedestrian	5	0.70%
Spill (two-wheeled vehicles)	3	0.42%
Other	14	1.96%
	716	

4.0 Development of Base Traffic Networks

The time periods to be analyzed will be the 2015 AM and PM peak hours as determined by the traffic counts. The analysis will focus on operations of both the Interstate system (freeway facilities, ramp terminals, ramp merge/diverge, weaving sections) as well as local intersection Levels of Service, using the methodologies in the current version of the HCM.

There are two different approaches that need to be considered for the Interstate system versus the local roadways. The Interstate section within the study area from south of Exit 4 to north of Exit 5 is a closed system – traffic enters and exits at specific locations, so the entire system needs to balance in both directions. The local roadways are not a closed system; counts between the local intersections may not necessarily balance in most locations because there are other intervening driveways for adjacent land uses and other minor streets where traffic is able to enter or exit the network.

Interstate Volume Balancing

Within the closed Interstate system, there are two adjustments that need to be made. One is for the overall mainline/ramp system, where a starting point was chosen (in this case, at the NHDOT permanent traffic recorder location south of Exit 4) and add or subtract the on- and off-ramp volumes both northbound and southbound to develop the base AM and PM peak hour networks along I-93.

The second adjustment is to balance volumes between the ramp terminals at both Exits 4 and 5, based on the peak hour volume counts and the recent TMCs that were collected in May 2016. This second process will be discussed later in the report.

Directional counts from the I-93 permanent recorder station during May 2015 were reviewed and compiled to determine the AWDT during that period (taking the Memorial Day holiday count out of consideration). These were adjusted seasonally to develop the 2015 AWDT for both northbound and southbound traffic as the starting point. The ramp counts taken in May 2016 were also seasonally and annually adjusted to the 2015 AWDT and then added and subtracted accordingly going north and south on the Interstate. The resulting mainline 2015 AWDT volumes for the AM and PM peak hours are shown in Figures 4 and 5, respectively. The counts and calculations are provided in Appendix C.

Ramp Terminal Balancing – Exits 4 and 5

The turning movement volumes at the ramp terminals at Exits 4 and 5 must also balance between the intersections while agreeing with the overall ramp volumes. While the ramp volumes were collected with automatic traffic recorders, which only summarized data on an hourly basis, the turning movements were collected at 15-minute intervals. Furthermore, the individual intersections also have their own peak hours, which may not necessarily match the adjacent ramp or the hourly ramp volume. Therefore, an overall peak for each interchange was developed from a summary of the turning movement counts at each location and the turning percentages applied to the balanced interstate ramp volumes derived above. The AM peak period was determined to be from 7:30-8:30, while the PM peak was from 4:45-5:45. The balanced 2015 AM and PM peak hour volumes at the two interchanges are also shown in Figures 4 and 5, respectively. The calculations are also provided in Appendix C.

Other Intersection Counts

As noted above, the local intersection turning movement counts were collected in groups of intersections in close proximity to each other to minimize significant differences between locations, even if there were intervening roadways or driveways that would not allow balancing between sites. There are only four intersections on the local network where traffic should essentially balance between adjacent intersections:

- Between Ross' Corner (NH Route 28/Folsom/Tsienneto) and at Pinkerton Street;
- Between North High Street/Madden Road and the North High Street/Folsom/ Franklin/Franklin Street Extension intersection;
- Between the NH Route 28 Bypass/NH Route 102 traffic circle and the intersection at NH Route 28 Bypass/Pinkerton Street/Perkins Street to the north; and
- Between NH Route 102/Tsienneto Road easterly to include the North Shore Road and English Range Road intersections.

Counts at these locations were balanced and all counts were adjusted to the 2015 AWDT using the NHDOT seasonal and annual factors for Group 4 Urban Highways noted above. The 2015 AM and PM peak hour volumes at the local intersections are shown in Figures 6 and 7, respectively.

5.0 Model Calibration

The SNHPC regional traffic model is an Average Annual Weekday Traffic (AAWDT) model for the greater Manchester, NH area that includes Derry and Londonderry as well as other surrounding towns. The model area has expanded since its use in the 2007 DEIS project to include towns to the south, east and west of the Exit 4A area with added roadway links and TAZs to provide traffic generation capabilities for the SNHPC's planning horizon of 2040.

However, to be a useful travel forecasting tool, the model needs to be able to replicate actual traffic volumes throughout its network within certain reasonable margins of error established by the Federal Highway Administration (FHWA) for regional traffic models. As such, the various 2015 traffic volume counts provided in Table 1 for the Exit 4A study area, among other locations in the SNHPC region, were used as a guide to test the validity of the SNHPC traffic model as a predictive tool of actual 2015 counts found in the region. This was found to be the case, and the findings of the calibration process were presented to the Exi4 4A Working Group in October, 2016. A more detailed memo describing the various calibration procedures undertaken as part of this project is included in Appendix D.

6.0 Capacity Analyses – 2015 Base Conditions

The *2010 Highway Capacity Manual (TRB, 2000)* provide the technical procedures to analyze traffic operations of freeway facilities (basic freeways, ramp merge/diverge and weaving sections) used in this report. Chapter 10 of the *2010 HCM* defines the methodologies used to analyze typical freeway facility operations for extended lengths of continuously connected basic freeway, weaving, merge and diverge segments, such as those along I-93 in the Exit 4A study area. This methodology allows for the analysis of multiple/continuous 15-minute time periods and is capable of identifying locations where the facility may break down and the impacts of such on the rest of the facility. As such, the analysis determines where the 'weakest link' in the facility may control overall operations along a freeway network in either direction.

The 2000 *Highway Capacity Manual* (TRB, 2000) provided methodologies for signalized and unsignalized intersections, including roundabouts, that will be used to analyze the NH Route 102/NH Route Bypass 28 traffic circle. Because of the phasing and timing limitations of the existing intersections, the HCM 2000 procedures were used for the signalized intersection analyses, as well as to be consistent with the IJR. Chapters 18 and 19 of the *2000 HCM* define the methodologies for signalized and two-way stop controlled intersections.

The Highway Capacity Software (McTrans, 2018) as well as the SYNCHRO/Sim-Traffic programs (Trafficware, 2016) are common software packages used by traffic engineers to evaluate how traffic volumes react under interrupted and uninterrupted flow conditions under various volume, speed, traffic composition, lane use and signal timing conditions. The Level of Service (LOS) criteria for freeway facilities and intersection operations defined in the HCM are provided in Appendix E. In general, a LOS C is considered desirable for freeway facilities operations; however, LOS D is considered acceptable for both freeways and intersection operations in urbanized areas.

6.1 Mainline Interstate Operations

The 2015 base weekday AM and PM peak hour volumes along I-93 from just south of Exit 4 to north of Exit 5 are shown in Figures 4 and 5.

The existing two-lane I-93 freeway facility was segmented along its length both northbound and southbound, based on the spacing of on- and off-ramps connecting the basic two-lane freeway segments on either side. Northbound, there were five basic freeway segments, two diverge (i.e., off-ramp) and two merge (i.e. on-ramp) segments under existing conditions. Southbound, there is one additional freeway and one more merge segment to account for the SB loop on-ramp at Exit 4 from the east and the segment between the SB on-ramps. Because of the distance between the existing interchanges, there are currently no weaving sections along I-93 in the Exit 4A study area network.

6.1.1 Mainline Freeway Segments

Five freeway segments are contained in the I-93 project study area going northbound, with a sixth one added in the southbound direction because of the additional on-ramp at Exit 4. There will be additional segments created when the Exit 4A alternatives are analyzed.

The demand and geometric factors input for segments and facility analyses include:

Demand
- Vehicles/hour
- Percent trucks and RVs
- Driver population factor

Geometry
- Number of lanes
- Average lane width
- Right-side lateral clearance
- Terrain
- Free-flow speed
- Location of/distance to merge/diverge segments, with number of lanes, length of acceleration/deceleration lanes

A description of the existing facility segments and the detailed reports are summarized in Table 3 and included in Appendix F.

TABLE 3
HCS 2010 - FREEWAY FACILITIES ANALYSIS - 2015 BASE- AM AND PM PEAK HOURS

1-May-17

		AM Peak Hour Level of Service (LOS)/d/c ratio			PM Peak Hour Level of Service (LOS)/d/c ratio		
Segment	Northbound Direction	BASIC	DIVERGE	MERGE	BASIC	DIVERGE	MERGE
1	I-93 Mainline south of Exit 4	B/0.45			D/0.77		
2	Exit 4 NB off-ramp		B/0.26			D/0.62	
3	I-93 Mainline between Exit 4 ramps	B/0.36			B/0.50		
4	Exit 4 NB on-ramp			B/0.57			C/0.44
5	I-93 Mainline between Exit 4 NB on- and Exit 5 NB off-ramps	C/0.60			C/0.68		
6	Exit 5 NB off-ramp		C/0.27			C/0.34	
7	I-93 Mainline between Exit 5 ramps	B/0.51			C/0.57		
8	Exit 5 NB on-ramp			D/0.58			D/0.42
9	I-93 Mainline north of Exit 5	D/0.74			D/0.75		
	Facility Operations	C			C		
	Space Mean Speed (mph)	63.2			62.7		
	Density (veh/mi/hr)	19.8			24.4		
Segment	Southbound Direction						
1	I-93 Mainline north of Exit 5	D/0.74			D/0.76		
2	Exit 5 SB off-ramp		D/0.50			D/0.50	
3	I-93 Mainline between Exit 5 ramps	C/0.57			C/0.55		
4	Exit 5 SB on-ramp			C/0.31			C/0.25
5	I-93 Mainline between Exit 5 SB on- and Exit 4 SB off-ramps	C/0.69			C/0.65		
6	Exit 4 SB off-ramp		C/0.39			C/0.49	
7	I-93 Mainline between Exit 4 SB off- and SB on ramp from east	B/0.51			B/0.44		
8	Exit 4 SB on-ramp from east			B/0.33			B/0.13
9	I-93 Mainline between Exit 4 SB on-ramps	C/0.63			B/0.49		
10	Exit 4 SB on-ramp from west			C/0.40		B/0.18	
11	I-93 Mainline south of Exit 4	D/0.78			C/0.56		
	Facility Operations	C			C		
	Space Mean Speed (mph)	62.5			62.8		
	Density (veh/mi/hr)	24.4			22.1		

Note: d/c = Demand-to-capacity ratio

6.1.2 Merge/Diverge Operations

Merge/diverge operations are the result of off-ramp and on-ramp traffic leaving and/or getting onto the freeway and how the ramp traffic interacts with the mainline freeway traffic. Since all traffic on I-93 in the study area is entering or exiting in the rightmost lane, which is also where most heavy vehicles travel, this Lane 1 volume is critical to the determination of operations. The ramp spacing and order of operation (e.g. off-ramp followed by an on-ramp, as opposed to an off-ramp followed by another off-ramp) also plays a role in how and to what degree these movements impede mainline freeway traffic flow.

There are currently four merge (on-ramp) and diverge (off-ramp) arrangements in the Exit 4A study area in the northbound direction and a fifth in the southbound direction (the second SB on-ramp at Exit 4). The introduction of a new interchange between Exits 4 and 5 will add another merge and diverge in each direction. The differences between the northerly and southerly interchange alternatives and their relative proximity to Exits 4 and 5 will ultimately determine how these new ramps will affect mainline operations. Table 3 provides the analysis results for the merge/diverge operations along I-93 in the study area under 2015 AM and PM peak hour conditions.

6.1.3 Weaving Operations

Weaving operations occur on highway segments between on- and off-ramps where merging and diverging traffic conflict while completing their respective movements. This analysis is mostly governed by the distance between these ramps, the number of lanes available to make such a movement, the volumes making their respective merge and/or diverge movements, and the ability of these movements to occur independently without influencing each other. This is more of an issue in areas where there are closely spaced interchange ramps.

In the current condition, Exits 4 and 5 are more than two miles apart, so there is essentially no weaving that occurs between the ramps. With the introduction of Exit 4A to the I-93 network, weaving between the Exit 4 NB on-ramp and the Exit 4A NB off-ramp may need to be considered for the southerly interchange alternatives. However, the HCS Freeway Facilities calculations allow for an overlap of the 1500-foot ‘influence areas’ between adjacent ramps, which was included in the analyses. At this point, it does not appear that a weaving section will be created between Exit 4A and Exit 5 because of the greater spacing between them.

7.0 Signalized Intersection Operations – 2015 Base Condition

The existing signal timing/phasing information gathered earlier, combined with the current lane use at each location along with the 2015 AM and PM peak hour volumes, was compiled into a data file in the SYNCHRO (Trafficware, 2016) signal analysis program, which emulates the procedures in Volume 3 (Interrupted Flow) of the *Highway Capacity Manual* 2000 *(HCM)* analysis procedures (TRB, 2000). Because of the phasing and timing limitations of the existing intersections, the HCM 2000 procedures were used for the signalized intersection analyses. The overall delay and LOS was determined by using the HCM module in SYNCHRO, while the queuing calculation results came directly from five runs of the Sim-Traffic module within SYNCHRO per NHDOT guidance (NHDOT, 2017a). The volume-to-capacity (v/c) ratios, average delays and LOS for the signalized intersections are shown in Table 4 below. The peak queues by approach are shown in Table 5 later in this report.

Table 4
Summary of 2015 Signalized Intersection Capacity Analyses

Signalized Intersections

		AM Peak Hour			PM Peak Hour		
Intersection	**Existing Lane Use**	**v/c**	**Delay**	**LOS**	**v/c**	**Delay**	**LOS**
#1 - Exit 4 SB Off-Ramp/NH Route 102	**EB**- T, T; **WB**- T, T **SB**- L, R	0.55	17.7	B	0.67	40.2	D
#2 - Exit 4 NB Off-Ramp/NH Route 102	**EB**- L, T, T; **WB**- T, T, R **NB**- L, L, R	0.86	34.6	C	0.71	29.8	C
#3 - Exit 5 SB Off-Ramp/NH Route 28	**EB**- T, T, R; **WB**- L, T, T **SB**- L, L, R	0.74	21.0	C	0.63	21.8	C
#4 - Exit 5 NB Off-Ramp/NH Route 28	**EB**- L, T, T; **WB**- T, T, R **NB**- L, R	0.78	15.9	B	0.66	20.3	C
#6 - NH Route 102/Fordway	**EB**- T, R; **WB-** L/T; **NB-** L/R; **SB-** L/T/R	0.89	25.7	C	0.94	34.1	C
#7 - NH Routes 102/28	**EB**- L,T/R; **WB-** L,T/R; **NB-** L,T/R; **SB**- L, T, R	0.84	39.9	D	0.83	39.9	D
#11- Ross' Corner (Folsom/NH Route 28)	**EB**- L,T,R; **WB**- L,T,R; **NB-** L, T, T, R; **SB-** L, T, T, R	0.61	37.1	D	0.78	47.2	D
#13 -NH Route 28/Linlew Drive	**EB-** L/T, R; **WB-** L/T, R; **NB-** L, T, T/R; **SB-** L, T, T/R	0.41	13.3	B	0.61	18.9	B
#14 - NH Route 28/Ashleigh Drive	**EB-** L,T/R; **WB-** L, L/T, R; **NB-** L, T, T/R; **SB-** L, L, T, T,/R	0.48	16.9	B	0.72	24.0	C
#18 - NH Route 28 Bypass/ Tsienneto Road	**EB-** L,T/R; **WB-** L,T/R; **NB**- L,T/R; **SB-** L, T, R	0.80	36.5	D	0.83	35.4	D

The HCM and SYNCHRO printouts are provided in Appendices G 1-3.

The results of these analyses show which movements at the various intersections exhibit some current capacity constraints (LOS E or worse). Some of these, such as at the Exit 4 ramp terminals, will be addressed by the ongoing I-93 widening project, while issues at other local intersections may need to be addressed in some form, either through added lanes and/or optimized signal timings, by the 2040 design year. These existing deficiencies are discussed briefly below:

- Exit 4 SB Off-Ramp

  The turns from the off-ramp are the most constrained movements, with the higher-volume right turn from a single lane showing the most delay and queuing. A second right-turn lane is proposed as part of the ongoing improvements to Exit 4.

- Exit 4 NB Ramps

  The westbound thru traffic is under duress during the AM peak, while the eastbound left turn to the on-ramp is at LOS E in the PM peak. While the right turn from the off-ramp operates at a good LOS because it is not controlled by the signal, field observations show it is often impeded by either the eastbound traffic through the intersection and/or the downstream queuing of traffic on NH Route 102 east of the interchange.

- NH Route 102/NH Route 28 (Crystal Avenue/Broadway/Birch Street)

  This major crossroads in the heart of downtown Derry has several movements that exhibit substantial delays during AM and/or PM peak hours, and results in queuing along Broadway. The level of parking and pedestrian activity also affects overall traffic operations as the mix of local and through traffic results in significant congestion, even if not directly reflected in the overall capacity/LOS calculations.

  Because the reduction in this through traffic in downtown Derry is one of the primary purposes for the proposed Exit 4A project, it was necessary to find a more qualitative assessment of downtown congestion that may not be reflected in the capacity calculations. To do this, we looked at Google Maps snapshots during the course of typical weekday AM and PM peak hours (Google, 2018). These are based on real-time on-the-ground observations of travel times in the study area. The snapshots for AM and PM peak hours between Monday, January 22, 2018 and Friday, January 26, 2018 are provided in Appendix H. It should be noted that Exit 4 is currently under construction, although there should be minimal work going on during the winter when these snapshots were taken.
  These figures show regular congestion at the NH Route 102/28 intersection as well as other key intersections in the study area during any given weekday peak

hour. Congestion in and around Exit 4 is oriented westbound in the AM peak and eastbound in the PM peak, and is shown to affect other segments along Broadway in both directions to varying degrees. Key intersections along the north-south corridors of NH Route 28 and NH Route 28 Bypass, such as at Ross' Corner, Tsienneto Road, and the traffic circle at NH Route 102, appear to exhibit regular levels of delay and congestion based on this sample of peak hour travel times.

- Ross' Corner (NH Route 28/Tsienneto Road/Folsom Road)

  This intersection leads to the major commercial corridor in north Derry as well as serving as a commuter route. Traffic currently uses the Ash Street Extension and Folsom Road as an alternative route to NH Route 102 to avoid the aforementioned downtown congestion. Several turning movements experience significant delays, even with recent improvements that provided a second SB left-turn lane onto Tsienneto Road. The proximity of the Pinkerton Street unsignalized intersection just east of this location also affects overall traffic flow in this area.

- NH Route28/Ashleigh Drive

  This intersection serves as the primary access drive to the new Wal-Mart supercenter as well as other commercial establishments on the east side of NH Route 28. The heavy turning movements into and out of this town road, combined with significant commuter volumes along the NH Route 28 corridor, result in less than desirable levels of delay for several movements, particularly in the PM peak, even though the overall LOS is at LOS C.

- NH Route 28 Bypass/Tsienneto Road

  The Tsienneto Road corridor west of NH Route 28 Bypass as well as the lands adjacent to this intersection has seen a fair share of new development over the years, as well as increased use by east-west commuter traffic avoiding NH Route 102 and the downtown area. With only a single east-west lane through the intersection, calculated delays now exceed acceptable LOS thresholds for some movements during both peaks.

8.0 Unsignalized Intersection Operations

Similarly, the unsignalized intersections in the study area network were analyzed for the 2015 AM and PM peak hours using the standard 2010 HCM procedures. These results are provided in Table 6, with the printouts in Appendix I. It should be noted that the traffic circle at the intersection of NH Route 28 Bypass, NH Route 102, and East Derry Road was analyzed as a roundabout, since all turns at this location are right turns in the counterclockwise direction. The circle was evaluated using updated roundabout analysis procedures from HCM 6, published in 2016 (TRB, 2016), because it incorporates updated data from actual field operations of the growing number of roundabouts in the USA and, as such, should be more representative of local driver behavior.

As observed in the field and confirmed by the SYNCHRO analyses, left turns from the minor side streets experience significant delays due to the high volumes on the major streets, either on the State highway system or local streets such as Tsienneto Road. Of particular concern is the heavy left-turn volume exiting from Pinkerton Street onto Tsienneto Road in close proximity to the signalized intersection at Ross' Corner. Special attention will be needed to address this condition under future No-Build and Build conditions.

The table also shows the peak design queue by approach for both the signalized and unsignalized intersections, based on the 2015 capacity analysis of base conditions. This will be an important component of evaluating the future 2040 Build condition layouts under the various alternatives.

Table 5
2015 Signalized Intersection Capacity and Queuing Analyses

Signalized Intersections

Intersection	Lane Groups	AM Peak Hour 95% queue (ft)	AM v/c ratio	AM Average Delay	AM LOS	PM Peak Hour 95% queue (ft)	PM v/c ratio	PM Average Delay	PM LOS
#1 - Exit 4 SB Off-Ramp/NH Route 102	EB Thru	212	0.46	11.5	B	230	0.44	11.0	B
	WB Thru	18	0.31	1.9	A	18	0.41	1.8	A
	SB LT	251	0.64	39.5	D	317	0.69	50.4	D
	SB RT	176	0.75	13.6	B	630	1.08	80.9	F
#2 - Exit 4 NB Off-Ramp/NH Route 102	NB LT	107	0.57	46.2	D	281	0.50	33.3	C
	NB RT	0	0.15	0.2	A	0	0.41	0.8	A
	EB LT	610	0.88	43.8	D	548	0.91	62.3	E
	EB Thru	83	0.24	4.3	A	242	0.40	19.5	B
	WB Thru	448	0.97	58.7	E	250	0.76	51.5	D
#3 - Exit 5 SB Off-Ramp/NH Route 28	EB Thru	212	0.68	32.7	C	197	0.56	27.8	C
	EB RT	0	0.21	0.3	A	0	0.21	0.3	A
	WB LT	211	0.81	40.0	D	151	0.62	45.3	D
	WB Thru	59	0.43	7.0	A	52	0.28	4.8	A
	SB LT	138	0.68	29.2	C	254	0.73	36.5	D
	SB RT	148	0.78	28.7	C	63	0.45	6.2	A
#4 - Exit 5 NB Off-Ramp/NH Route 28	EB LT	251	0.86	55.0	D	223	0.72	48.4	D
	EB Thru	5	0.44	2.2	A	308	0.53	12.7	B
	WB Thru	189	0.56	26.1	C	192	0.37	27.4	C
	WB RT	0	0.53	1.3	A	0	0.38	0.7	A
	NB LT	233	0.87	49.4	D	180	0.75	44.1	D
	NB RT	0	0.10	0.1	A	143	0.77	35.2	D
#6 - NH Route 102/Fordway	EB all	247	0.12	17.7	B	591	1.00	47.1	D
	WB all	368	0.94	26.4	C	306	0.81	26.8	C
	NB all	304	0.72	51.7	D	215	0.84	36.6	D
	SB all	22	0.86	12.4	B	90	0.18	15.9	B
#7 - NH Routes 102/28	EB L	148	0.83	83.0	F	155	0.70	55.8	E
	EB T/R	170	0.42	20.1	C	393	0.73	34.2	C
	WB L	47	0.28	40.6	D	119	0.68	69.5	E
	WB T/R	385	0.88	42.7	D	272	0.67	35.1	D
	NB L	101	0.79	90.6	F	80	0.43	42.5	D
	NB T/R	274	0.85	48.3	D	316	0.86	51.3	D
	SB L	121	0.86	103.4	F	174	0.79	67.9	E
	SB Thru	188	0.61	33.9	C	346	0.77	43.3	D
	SB RT	2	0.23	1.1	A	35	0.21	3.5	A

Table 5 (Cont'd)

Signalized Intersections (cont.)

Intersection	Existing Lane Use	AM Peak Hour 95% queue (ft)	AM v/c ratio	AM Average Delay	AM LOS	PM Peak Hour 95% queue (ft)	PM v/c ratio	PM Average Delay	PM LOS
#11- Ross' Corner (Folsom/NH Route 28)	EB L	191	0.16	88.0	F	324	0.89	78.7	E
	EB Thru	169	0.27	45.1	D	310	0.73	49.0	D
	EB R	0	0.25	0.0	A	0	0.17	0.7	A
	WB L	157	0.70	66.1	E	273	1.14	165.5	F
	WB Thru	323	0.21	80.3	F	241	0.75	60.7	E
	WB R	108	0.26	8.0	A	190	0.52	16.4	B
	NB L	35	0.90	40.5	D	134	0.58	66.6	E
	NB Thru	90	0.63	25.5	C	198	0.43	40.0	D
	NB R	0	0.01	1.2	A	0	0.27	1.1	A
	SB L	131	0.74	42.0	D	248	0.76	49.7	D
	SB Thru	72	0.95	19.5	B	419	0.64	35.6	D
	SB RT	27	0.48	4.1	A	51	0.28	4.8	A
#13 -NH Route 28/Linlew Drive	EB L/T	10	0.06	33.0	C	40	0.18	39.4	D
	EB R	0	0.04	0.2	A	0	0.05	0.3	A
	WB L/T	61	0.35	40.6	D	69	0.46	48.8	D
	WB R	93	0.71	18.9	B	43	0.66	13.0	B
	NB L	0	0.00	0.0	A	36	0.19	46.3	D
	NB T/R	675	0.35	12.9	B	296	0.50	15.5	B
	SB L	63	0.35	42.8	D	125	0.64	37.4	D
	SB T/R	134	0.38	4.9	A	437	0.57	14.3	B
#14 - NH Route 28/Ashleigh Drive	EB L	20	0.12	40.8	D	60	0.54	65.2	E
	EB T/R	16	0.11	30.0	C	29	0.25	34.5	C
	WB L	110	0.52	46.5	D	232	0.84	69.2	E
	WB L/T	111	0.53	46.7	D	227	0.83	67.0	E
	WB R	38	0.22	6.0	A	63	0.29	10.9	B
	NB L	56	0.05	61.6	D	3	0.06	65.0	E
	NB T/R	183	0.50	10.1	B	311	0.69	14.8	B
	SB L	8	0.41	42.9	E	39	0.47	47.4	D
	SB T/R	285	0.35	10.3	B	234	0.60	14.0	B
#18 - NH Route 28 Bypass/ Tsienneto Road	EB L	126	0.88	77.5	E	278	0.86	54.0	D
	EB T/R	114	0.49	24.2	C	394	0.69	30.0	C
	WB L	82	0.50	41.9	D	36	0.15	35.1	D
	WB T/R	309	0.95	59.4	E	248	0.86	58.0	E
	NB L	119	0.70	57.5	E	97	0.53	44.2	D
	NB T/R	193	0.48	26.8	C	307	0.69	37.0	D
	SB L	36	0.18	35.8	D	80	0.44	42.4	D
	SB Thru	171	0.63	35.7	D	149	0.39	29.4	C
	SB R	71	0.41	7.9	A	30	0.20	2.3	A

Table 6
2015 Unsignalized Intersection Capacity and Queuing Analyses

Intersection	Existing Lane Use	AM Peak Hour 95% queue (ft)	AM v/c ratio	AM Average Delay	AM LOS	PM Peak Hour 95% queue (ft)	PM v/c ratio	PM Average Delay	PM LOS
#5 - NH Route 102/Londonderry Road	EB L	13	0.142	12.3	B	40	0.354	11.7	B
	WB L	0	0.005	8.6	A	0	0.008	10.7	B
	NB all	0	0.008	11.9	B	65	1.078	*	F
	SB L/T	20	0.253	115.0	F	68	1.130	*	F
	SB R	65	0.505	36.1	E	45	0.395	19.9	C
#8 - North High Street/Ash Street Extension	EB all	45	0.383	15.4	C	445	1.152	123.5	F
	NB LT	0	0.005	8.2	A	0	0.005	8.4	A
#9 - North High Street/Madden Road	EB all	8	0.079	18.7	C	10	0.11	27.2	D
	NB LT	0	0.000	0.0	A	0	0.00	0.0	A
#10 – North High/Folsom/Franklin Streets	EB all	3	0.035	8.3	A	3	0.043	8.4	A
	WB all	3	0.025	8.0	A	3	0.038	9.2	A
	NB all	15	0.160	14.2	B	30	0.293	23.7	C
	SB all	8	0.096	10.5	B	50	0.424	22.5	C
#12 - Tsienneto Road/Pinkerton Street	WB L	8	0.088	8.5	A	13	0.138	9.3	A
	WB L/T	0	0.000	0.0	A	0	0.000	0.7	A
	NB L	309	1.156	154.3	F	340	1.424	282.3	F
	NB R	13	0.154	11.8	B	28	0.279	15.0	C
#15 - NH Route 28/Scobie Pond Road	EB L	3	0.022	9.5	A	5	0.061	10.3	B
	SB all	183	1.011	143.2	F	318	2.116	*	F
#16 - NH Route 102/NH Route 28 Bypass/East Derry Road (Traffic Circle-RT only)	EDR WB	375	1.031	77.5	F	450	1.112	103.3	F
	28 Byp NB	175	0.781	29.5	D	525	1.268	169.4	D
	28 Byp SB	400	1.058	83.5	F	750	1.250	146.4	F
	102 EB	475	1.106	96.6	F	850	1.456	240.0	F
	102 WB	325	1.026	86.1	F	100	0.622	24.6	C
#17 - NH Route 28Bypass/ Pinkerton/Nesmith	EB L/T	125	3.388	*	F	60	0.521	69.4	F
	EB R	40	0.350	13.6	B	140	0.692	20.6	C
	WB all	245	1.371	296.3	F	73	0.599	76.5	F
	NB all	30	0.289	9.5	A	15	0.175	8.5	A
	SB all	0	0.014	8.5	A	3	0.025	8.4	A
#19 - NH Route 102/Tsienneto Road	EB L	3	0.020	9.5	A	0	0.016	8.4	A
	SB L/R	30	0.287	19.3	C	218	0.869	60.9	F

Note- Assumes 25 ft per queued vehicle
* - calculated delay exceeds 300s

9.0 Summary of SNHPC Model Assignments – 2015, 2040

The SNHPC calibration of their regional traffic forecasting model was discussed with the Traffic Working Group (TWG) in October 2016. This calibration process was based on the least-mean squared comparison of the 2015 assignments (based on the various socioeconomic characteristics of each Traffic Analysis Zone (TAZ) used by the model to generate origins and destinations to be assigned to the network) to the calculated 2015 Average Annual Weekday Traffic (AAWDT) on the key links in the study area network that were derived from the extensive traffic counting program initiated at the start of this SDEIS project. This comparison was found to fall within the FHWA's acceptable margin of error for traffic modeling as summarized in Appendix D. **As such, it was agreed by the TWG at this meeting that the model was in compliance with FHWA standards for model accuracy and could be used as a tool to reasonably project future volumes for this project.**

It was further agreed by the TWG that the relative differences between the model AAWDT assignments for 2015 and 2040 would be applied to the calculated 2015 AAWDT volumes. AM and PM peak hour volumes were to be derived as a percentage of the AAWDT as determined in both the roadway and intersection turning movement count data. AAWDT assignments at individual intersections would be used to develop any adjustments to peak hour existing turning movements, based on both the increase/decrease in traffic volume as well as any changes in turning movement percentages of any particular movement. The derivation of these future intersection volumes was completed only after consensus was reached with the TWG on the reasonableness of the 2040 AAWDT traffic assignments for each alternative.

The future model includes known/programmed roadway improvements in the SNHPC's Regional Transportation Plan - 2015-2040 (SNHPC, 2017) that includes Exit 4A; however, this interchange was not included in any of the No-Build networks. While it was recognized that there may be locations where existing/projected capacity deficiencies may exist, only those projects either programmed in the State's Ten-Year Highway Plan (NHDOT, 2018) or the Regional Transportation Plan were included in the 2040 No-Build network.

The 2040 SNHPC model assignments were developed by including the population and employment projections for each community in the SNHPC model area, as outlined in the Lane Use Scenarios report (Louis Berger, 2017) and disaggregated to the TAZ level. This report also included alternative development scenarios without and with the proposed Exit 4A interchange, notably for the Woodmont Commons development on the east side of I-93, since the development of that parcel would be directly impacted by the location of the proposed interchange. In general, the Woodmont Commons–East development was assumed to reach its build-out potential under only the southerly interchange options (A and B), and would have a lesser development scenario under the 2040 No-Build C, D, and F alternatives.

It should also be noted that the Woodmont Commons traffic impact study for the full development project submitted to the Town of Londonderry (TEC, 2013) assumed that, because of the ‘live-work-play’ design intent of the proposed mixed-use development, a certain percentage of site-generated trips would remain ‘internally captured’ within the site itself and would not be assigned to the adjacent street network outside of the development. An adjustment factor of 23% was applied to the total site traffic generation for the various proposed land uses assumed in the Woodmont Commons traffic impact study to account for this estimated internal capture rate.

However, it should be noted that the methodologies used to develop trip generation, distribution and assignments for an individual traffic impact study versus a regional model are quite different. The model applies its trip distribution and assignment algorithms directly to the trip productions and attractions generated by each TAZ, based on their socioeconomic characteristics, which does not differentiate between trips that should or should not be assigned to other TAZs. In addition, the Woodmont Commons development is included as part of several TAZs, so correcting for only some trips from a particular TAZ and not others may appear to be arbitrary and jeopardize the validity of the model.

After consultation with the NHDOT Bureau of Traffic, it was agreed, as the initial step, all the model-generated traffic from all TAZs, including Woodmont Commons, was assigned to the SNHPC model network without regard to the internal capture rate assumptions noted in their site-specific traffic impact study. (NHDOT, 2017b) This should provide a conservatively worst-case estimate of traffic being assigned to the study area roadway network. Should the design intent of Woodmont Commons be realized and less traffic is actually generated as the project evolves, overall operations would be better than projected and the design life of any proposed improvements would be extended.

Individual spreadsheets were created for the key links in the network under each 2040 alternative for purposes of calculating the projected 2040 AAWDT and AM and PM peak hour volumes, based on the relative increase/decrease between 2015 and 2040 model assignments.

9.1 AAWDT Comparisons – 2040

Table 7 presents a summary of the projected 2040 AAWDT on key links in the study area roadway network, including the I-93 mainline and all interchange ramps. As noted above, these were derived by applying the growth rate between SNHPC’s 2015 and 2040 model assignments to the calculated 2015 AAWDT derived from the updated traffic counting program created for this project. These assignments also provide projected volumes for newly created road segments, including the Exit 4A on- and off-ramps as well as the connector roadway between the new proposed interchange and the existing roadway network.

TABLE 7

Adjusted 2040 AAWDT volume comparison - All Alternatives

7-Apr-17
rev 1-26-18

Town	Count Location	Raw 2015 AAWDT	Adj 2015 AAWDT	2015 AAWDT Base Model Assigns	2040 AAWDT No-Build Assigns	% Growth to '15 base No-Build 2015-40	2040 No-Build AAWDT	2040 AAWDT Alt A Assigns	% Growth to '15 base Alt A 2015-40	2040 Alt A AAWDT	AAWDT Difference Alt A vs No-Build	2040 AAWDT Alt B Assigns	% Growth to '15 base Alt B 2015-40	2040 Alt B AAWDT	AAWDT Difference Alt B vs No-Build
	Derry Locations														
Derry	Crystal Av (NH 28), S of Tsienneto	15,585	15,195	13,406	10,220	-23.77%	11,584	7,242	-45.98%	8,208	-29.1%	10,565	-21.19%	11,975	3.4%
	Folsom Rd W of NH 28	12,070	11,768	8,960	10,537	17.60%	13,839	29,612	230.49%	38,892	181.0%	4,730	-47.21%	6,212	-55.1%
	Pinkerton St E of Tsienneto	10,722	10,454	8,776	6,396	-27.12%	7,619	9,059	3.22%	10,791	41.6%	9,178	4.58%	10,933	43.5%
	Tsiennto Rd, W of NH 102	5,532	5,394	5,666	9,072	60.11%	8,636	10,824	91.03%	10,304	19.3%	16,182	185.60%	15,405	78.4%
	Tsienneto Rd E of Pinkerton	15,012	14,637	14,200	18,876	32.93%	19,457	22,226	56.52%	22,910	17.7%	15,241	7.33%	15,710	-19.3%
	NH 102, E of NH 28 Bypass	7,456	7,270	7,016	6,126	-12.69%	6,348	6,924	-1.31%	7,175	13.0%	4,277	-39.04%	4,432	-30.2%
	NH 28 Byp, N of Academy Dr	8,615	8,400	7,318	2,853	-61.01%	3,275	2,333	-68.12%	2,678	-18.2%	2,375	-67.55%	2,726	-16.8%
	NH 28 Byp, N of Tsienneto Rd	12,250	11,944	9,377	4,072	-56.57%	5,187	4,229	-54.90%	5,387	3.9%	2,696	-71.25%	3,434	-33.8%
	NH 28 Byp, S of Thornton Rd S.	14,341	13,982	12,227	7,327	-40.08%	8,379	7,652	-37.42%	8,750	4.4%	7,791	-36.28%	8,909	6.3%
	NH 102 E of Griffin St	16,000	16,400	18,002	20,810	15.60%	18,958	16,885	-6.20%	15,382	-18.9%	16,759	-6.90%	15,268	-19.5%
	NH 102 W of Abbot St	14,000	14,350	11,128	14,902	33.91%	19,217	15,442	38.77%	19,913	3.6%	11,283	1.39%	14,550	-24.3%
	Fordway over Beaver Brook	5,200	5,330	5,114	3,511	-31.35%	3,659	4,748	-7.16%	4,949	35.3%	4,273	-16.45%	4,453	21.7%
	Franklin St Ext, N. of Folsom Rd	1,800	1,845	1,254	1,959	56.22%	2,882	1,367	9.01%	2,011	-30.2%	4,736	277.67%	6,968	141.8%
	Ash St at Londonderry town line	6,600	6,765	5,936	13,790	132.31%	15,716	6,065	2.17%	6,912	-56.0%	5,923	-0.22%	6,750	-57.1%
	Crystal Av (NH 28), S of Rollins St	13,000	13,000	13,215	10,463	-20.82%	10,293	11,087	-16.10%	10,907	6.0%	11,110	-15.93%	10,929	6.2%
	NH 102, at Derry/Chester town line	8,200	8,200	10,839	12,783	17.94%	9,671	14,181	30.83%	10,728	10.9%	14,668	35.33%	11,097	14.7%
	Londonderry Locations														
L-derry	NH 102, E of Hampton Dr	32,000	32,000	30,418	51,401	68.98%	54,074	56,306	85.11%	59,234	9.5%	56,263	84.97%	59,189	9.5%
	NH 102, E of Exit 4		26,800	20,818	32,410	55.68%	41,723	15,723	-24.47%	20,241	-51.5%	16,852	-19.05%	21,694	-48.0%
	NH 102 at Derry/L'derry Town line	22,656	22,090	22,983	29,904	30.11%	28,742	20,413	-11.18%	19,620	-31.7%	20,908	-9.03%	20,096	-30.1%
	NH 28 at Derry/L'derry Town line	17,324	16,891	19,392	15,638	-19.36%	13,621	9,440	-51.32%	8,223	-39.6%	8,125	-58.10%	7,077	-48.0%
	NH 28 N of Liberty Dr	13,000	13,000	15,406	14,733	-4.37%	12,432	9,984	-35.19%	8,425	-32.2%	8,697	-43.55%	7,339	-41.0%
	Gilcreast Rd N of NH 102	10,070	9,818	9,397	16,438	74.93%	17,174	15,318	63.01%	16,004	-6.8%	15,035	60.00%	15,709	-8.5%
	Londonderry Rd, N of NH 102		4,622	4,742	4,823	1.71%	4,701	6,536	37.83%	6,371	35.5%	6,034	27.25%	5,881	25.1%
	Ash St E of Londonderry Rd	6,900	6,900	5,949	14,001	135.35%	16,239	6,065	1.95%	7,035	-56.7%	5,923	-0.44%	6,870	-57.7%
	Connector Rd, E. of Exit 4A (L'derry)	-	-					53,720				54,523			
	Connector Rd, W. of N High St (Derry)	-	-					40,974							
	Connector Rd, W. of NH 28 (Derry)	-	-									35,565			
	Connector Rd, E. of NH 28 (Derry)	-	-									16,193			
	Connector Rd, N. of NH 102 (Derry)											16,182			
	Exit 4 NB Off-ramp	10,249	9,993	10,389	20,215	94.58%	19,444	18,073	73.96%	17,384	-10.6%	18,135	74.56%	17,444	-10.3%
	Exit 4 NB On-ramp	10,303	10,045	9,550	21,343	123.49%	22,449	15,150	58.64%	15,935	-29.0%	17,638	84.69%	18,552	-17.4%
	Exit 4 SB Off-ramp	9,862	9,615	8,157	18,349	124.95%	21,629	13,795	69.12%	16,261	-24.8%	14,795	81.38%	17,439	-19.4%
	Exit 4 SB On-ramp - EB to SB	5,310	5,177	4,907	10,778	119.65%	11,371	11,836	141.21%	12,487	9.8%	11,659	137.60%	12,301	8.2%
	Exit 4 SB On-ramp - WB to SB	4,767	4,648	3,637	7,402	103.52%	9,460	3,879	6.65%	4,957	-47.6%	4,125	13.42%	5,272	-44.3%
	Exit 4A NB Off-ramp	-	-					8,732		8,732		9,488		9,488	
	Exit 4A NB On-ramp	-	-					15,240		15,240		13,208		13,208	
	Exit 4A SB Off-ramp	-	-					18,996		18,996		19,376		19,376	
	Exit 4A SB On-ramp	-	-					10,752		10,752		12,450		12,450	
	Exit 5 NB Off-ramp	5,745	5,601	4,430	6,401	44.49%	8,093	7,521	69.77%	9,509	17.5%	7,036	58.83%	8,896	9.9%
	Exit 5 NB On-ramp	9,580	9,341	9,101	13,499	48.32%	13,855	10,863	19.36%	11,149	-19.5%	10,468	15.02%	10,744	-22.3%
	Exit 5 SB Off-ramp	9,520	9,282	9,234	13,577	47.03%	13,648	7,670	-16.94%	7,710	-43.5%	6,036	-34.63%	6,067	-55.5%
	Exit 5 SB On-ramp	5,645	5,504	3,919	5,884	50.14%	8,264	6,879	75.53%	9,661	16.9%	5,355	36.64%	7,521	-9.0%
	I-93, south of Exit 4 (DOT PATR)		71,060	72,378	118,908	64.29%	116,743	123,109	70.09%	120,867	3.5%	123,558	70.71%	121,308	3.9%
	NB			36,417	59,234	62.65%	-	61,455	68.75%	-		61,615	69.19%	60,470	
	SB			35,961	59,674	65.94%		61,654	71.45%			61,943	72.25%	60,839	
	I-93, between Exits 4 and 4A		71,000	71,152	120,205	68.94%	119,948	118,266	66.22%	118,013	-1.6%	122,072	71.57%	121,811	1.6%
	NB			35,578	60,363	69.66%	0	58,532	64.52%			61,119	71.79%		
	SB			35,574	59,842	68.22%	0	59,734	67.91%	-		60,953	71.34%	-	
	I-93, between Exits 4A and 5		71,000	71,152	120,205	68.94%	119,948	133,018	86.95%	132,734	10.7%	132,718	86.53%	132,434	10.4%
	NB			35,578	60,363	69.66%	-	65,040	82.81%	-		64,839	82.24%	-	
	SB			35,574	59,842	68.22%	-	67,978	91.09%			67,879	90.81%		
	I-93, north of Exit 5		76,000	81,139	134,995	66.37%	126,445	137,153	69.03%	128,466	1.6%	136,851	68.66%	128,183	1.4%
	NB			40,250	67,460	67.60%	-	68,383	69.90%	-		68,290	69.66%	-	
	SB			40,889	67,535	65.17%	-	68,770	68.19%	-		68,561	67.68%	-	
			Adj 2015 AAWDT	2015 AWDT Base Model Assigns	2040 AAWDT No-Build Assigns	% Growth 2015-40	2040 No-Build AAWDT	2040 AAWDT Alt A Assigns	% Growth 2015-40	2040 Alt A AAWDT	AAWDT Difference Alt A vs No-Build	2040 AAWDT Alt B Assigns	% Growth 2015-40	2040 Alt B AAWDT	AAWDT Difference Alt B vs No-Build

Count Location	2040 AAWDT Alt C Assigns	% Growth to '15 base Alt C 2015-40	2040 Alt C AAWDT	AAWDT Difference Alt C vs No-Build	2040 AAWDT Alt D Assigns	% Growth to '15 base Alt D 2015-40	2040 Alt D AAWDT	AAWDT Difference Alt D vs No-Build	2040 AAWDT Alt F Assigns	% Growth to '15 base Alt F 2015-40	2040 Alt F AAWDT	AAWDT Difference Alt F vs No-Build
Derry Locations												
Crystal Av (NH 28), S of Tsienneto	12,279	-8.41%	13,918	20.1%	13,225	-1.35%	14,990	29.4%	10,313	-23.07%	11,689	0.9%
Folsom Rd W of NH 28	9,494	5.96%	12,468	-9.9%	8,646	-3.50%	11,356	-17.9%	9,223	2.94%	12,113	-12.5%
Pinkerton St E of Tsienneto	11,138	26.91%	13,268	74.1%	11,608	32.27%	13,827	81.5%	6,356	-27.58%	7,571	-0.6%
Tsiennto Rd, W of NH 102	15,529	174.07%	14,784	41.6%	11,363	100.55%	10,818	25.3%	9,191	62.21%	8,750	1.3%
Tsienneto Rd E of Pinkerton	15,644	10.17%	16,125	-17.1%	20,041	41.13%	20,658	6.2%	18,976	33.63%	19,560	0.5%
NH 102, E of NH 28 Bypass	3,324	-52.62%	3,444	-45.7%	5,942	-15.31%	6,157	-3.0%	6,450	-8.07%	6,684	5.3%
NH 28 Byp, N of Academy Dr	2,436	-66.71%	2,796	-14.6%	2,420	-66.93%	2,778	-15.2%	2,785	-61.94%	3,197	-2.4%
NH 28 Byp, N of Tsienneto Rd	2,290	-75.58%	2,917	-43.8%	4,218	-55.02%	5,373	3.6%	4,145	-55.80%	5,280	1.8%
NH 28 Byp, S of Thornton Rd S.	8,741	-28.51%	9,996	19.3%	8,136	-33.46%	9,304	11.0%	7,191	-41.19%	8,223	-1.9%
NH 102 E of Griffin St	16,330	-9.29%	14,877	-21.5%	18,591	3.27%	16,937	-10.7%	24,147	34.14%	21,998	16.0%
NH 102 W of Abbot St	9,968	-10.42%	12,854	-33.1%	11,885	6.80%	15,326	-20.2%	15,829	42.24%	20,412	6.2%
Fordway over Beaver Brook	4,206	-17.76%	4,384	19.8%	3,926	-23.23%	4,092	11.8%	3,595	-29.70%	3,747	2.4%
Franklin St Ext, N. of Folsom Rd	2,083	66.11%	3,065	6.3%	2,019	61.00%	2,971	3.1%	1,783	42.19%	2,623	-9.0%
Ash St at Londonderry town line	8,843	48.97%	10,078	-35.9%	8,511	43.38%	9,700	-38.3%	12,825	116.05%	14,616	-7.0%
Crystal Av (NH 28), S of Rollins St	11,753	48.97%	10,078	-2.1%	11,998	-9.21%	11,803	14.7%	11,022	-16.59%	10,843	5.3%
NH 102, at Derry/Chester town line	14,002	-11.06%	11,562	19.6%	14,138	30.44%	10,696	10.6%	12,808	18.17%	9,690	0.2%
Londonderry Locations												
NH 102, E of Hampton Dr	50,680	66.61%	53,316	-1.4%	51,066	67.88%	53,722	-0.7%	52,565	72.81%	55,299	2.3%
NH 102, E of Exit 4	18,986	-8.80%	24,442	-41.4%	20,775	-0.21%	26,745	-35.9%	34,151	64.05%	43,964	5.4%
NH 102 at Derry/L'derry Town line	21,661	-5.75%	20,819	-27.6%	23,215	1.01%	22,313	-22.4%	32,520	41.50%	31,256	8.7%
NH 28 at Derry/L'derry Town line	42,458	118.95%	36,982	171.5%	40,462	108.65%	35,244	158.7%	15,477	-20.19%	13,481	-1.0%
NH 28 N of Liberty Dr	4,904	-68.17%	4,138	-66.7%	4,757	-69.12%	4,014	-67.7%	14,584	-5.34%	12,306	-1.0%
Gilcreast Rd N of NH 102	15,112	60.82%	15,789	-8.1%	14,742	56.88%	15,402	-10.3%	16,006	70.33%	16,723	-2.6%
Londonderry Rd, N of NH 102	7,633	60.97%	7,440	58.3%	7,354	55.08%	7,168	52.5%	4,521	-4.66%	4,407	-6.3%
Ash St E of Londonderry Rd	8,682	45.94%	10,070	-38.0%	8,457	42.16%	9,809	-39.6%	13,023	118.91%	15,105	-7.0%
Connector Rd, E. of Exit 4A (L'derry)	38,516				36,728				0			
Connector Rd, W. of N High St (Derry)												
Connector Rd, W. of NH 28 (Derry)												
Connector Rd, E. of NH 28 (Derry)	13,888											
Connector Rd, N. of NH 102 (Derry)	15,529											
Exit 4 NB Off-ramp	18,728	80.27%	18,014	-7.4%	19,497	87.67%	18,754	-3.5%	20,417	96.53%	19,639	1.0%
Exit 4 NB On-ramp	15,903	66.52%	16,727	-25.5%	15,411	61.37%	16,210	-27.8%	21,378	123.85%	22,486	0.2%
Exit 4 SB Off-ramp	12,694	55.62%	14,963	-30.8%	12,431	52.40%	14,653	-32.3%	18,730	129.62%	22,078	2.1%
Exit 4 SB On-ramp - EB to SB	10,850	121.11%	11,447	0.7%	10,881	121.74%	11,480	1.0%	10,705	118.16%	11,294	-0.7%
Exit 4 SB On-ramp - WB to SB	5,140	41.33%	6,569	-30.6%	5,152	41.66%	6,584	-30.4%	7,494	106.05%	9,577	1.2%
Exit 4A NB Off-ramp	2,795		2,795		1,504		1,504					
Exit 4A NB On-ramp	13,410		13,410		13,630		13,630					
Exit 4A SB Off-ramp	12,790		12,790		16,972		16,972					
Exit 4A SB On-ramp	5,021		5,021		4,621		4,621					
									6,256			
Exit 5 NB Off-ramp	6,626	49.57%	8,377	3.5%	7,054	59.23%	8,919	10.2%	13,329	41.22%	7,910	-2.3%
Exit 5 NB On-ramp	7,829	-13.98%	8,035	-42.0%	7,985	-12.26%	8,196	-40.8%	12,249	46.46%	13,680	-1.3%
Exit 5 SB Off-ramp	5,728	-37.97%	5,758	-57.8%	5,790	-37.30%	5,820	-57.4%	5,882	32.65%	12,313	-9.8%
Exit 5 SB On-ramp	5,916	50.96%	8,309	0.5%	5,879	50.01%	8,257	-0.1%		50.09%	8,261	0.0%
I-93, south of Exit 4 (DOT PATR)	119,322	64.86%	117,149	0.3%	119,380	64.94%	117,206	0.4%	119,129	64.59%	116,960	0.2%
NB	59,601	63.66%	-		59,527	63.46%	-		59,424	63.18%	-	
SB	59,721	66.07%			59,853	66.44%			59,705	66.03%	-	
I-93, between Exits 4 and 4A	113,200	59.10%	112,958	-5.8%	111,723	57.02%	111,484	-7.1%	120,621	69.53%	120,363	0.3%
NB	56,776	59.58%			55,441	55.83%			60,385	69.73%	-	
SB	56,424	58.61%	-		56,282	58.21%	-		60,236	69.33%	-	
I-93, between Exits 4A and 5	136,083	91.26%	135,792	13.2%	136,200	91.42%	135,909	13.3%	120,621	69.53%	120,363	0.3%
NB	67,390	89.41%	-		67,567	89.91%	-		60,385	69.73%	-	
SB	68,693	93.10%			68,633	92.93%			60,236	69.33%	-	
I-93, north of Exit 5	137,099	68.97%	128,416	1.6%	137,042	68.90%	128,362	1.5%	135,061	66.46%	126,507	0.0%
NB	68,593	70.42%	-		68,497	70.18%	-		67,458	67.60%	-	
SB	68,506	67.54%	-		68,545	67.64%	-		67,603	65.33%	-	
	2040 AAWDT Alt C Assigns	% Growth 2015-40	2040 Alt C AAWDT	AAWDT Difference Alt C vs No-Build	2040 AAWDT Alt D Assigns	% Growth 2015-40	2040 Alt D AAWDT	AAWDT Difference Alt D vs No-Build	2040 AAWDT Alt F Assigns	% Growth 2015-40	2040 Alt F AAWDT	AAWDT Difference Alt F vs No-Build

9.1.1 No-Build Conditions

A review of the table indicates that there is a reduction in trips on north-south roadways such as NH Route 28 Bypass, NH Route 28 and Fordway under No-Build conditions. This appears to be as a result of the additional capacity provided by the widening of I-93 to four lanes each way which allows through traffic to use the interstate for these north-south trips as opposed to the local roadways through Derry. Mainline volumes on I-93 increase by between 64-68% from 2015 and 2040, which is about a 2.5% annual growth rate. Volumes on the Exit 4 ramps increase between 95-125% from 2015 to 2040, while ramp volumes at Exit 5 only grow between 45-50% during the same period. This would appear to indicate the influence of the Woodmont Commons development in Londonderry on both sides of the Interstate being accessed from either side of Exit 4, and is also reflected in volume increase on NH Route 102 west of the interchange. Local roads in the Woodmont area, such as Gilcreast Road and Ash Street, also experience marked increases in traffic volumes under 2040 No-Build conditions.

9.1.2 Alternative A

Mainline volumes on I-93 show slightly higher growth rates under 2040 conditions with Exit 4A –Alternative A in place than in the No-Build condition. This is driven in part by Woodmont Commons because this development is assumed to reach its maximum potential with Alternative A in place, as opposed to either No-Build or most other Exit 4A options.

Exit 4 ramp volumes are affected to differing degrees with Alternative A in place. Growth rates for the NB on-ramp and SB off-ramp are about half what they are under the No-Build case, since this traffic is diverted to Exit 4A. The projected NB off-ramp volume of 17,385 vehicles per day (vpd), shows a 10% reduction over 2040 No-Build volumes. The development of Woodmont Commons to the west is reflected in the 10% increase in SB on-ramp volumes from the west side of the interchange, whereas the SB on-ramp volume from the east shows a 48% reduction in traffic that is now presumably using Exit 4A.

Exit 5 ramp volumes show greater increases on the NB off-ramp and SB on-ramp under Alternative A compared to the No-Build case. This would indicate increased interaction between Exit 4A and 5 to and from the north more than between Exits 4 and 4A, which is consistent with the findings in the previous DEIS for this project. (FHWA, 2007) The Exit 5 SB off-ramp actually shows a 43.5% reduction in traffic compared to No-Build, indicating that this traffic is likely continuing on the mainline down to Exit 4A. The NB on-ramp traffic volume is also about 20% lower than under No-Build conditions, indicating redistribution of some NB trips to Exit 4A and away from NH Route 28.

Exit 4A volumes range between 8,700-10,700 vehicles per day (vpd) on the NB off-ramp and SB on-ramp, and from 15,200 to 19,000 vpd on the NB on-ramp and SB off-ramp, respectively. The two northerly-oriented ramps have the higher volumes, consistent with the increased interaction between the new interchange and Exit 5. The projected volume on the connector road east of the Alternative A interchange is 53,700 vpd.

The local roadways are also affected by the introduction of a new interchange to the regional network. Volumes on NH Route 102 just east of Exit 4 are about half of the projected 2040 No-Build condition, while volumes closer to the downtown area show reductions of around 19%. Folsom Road shows significant increases, since it is now the primary connection between the new interchange and the local street network. Some of this increase continues easterly along the Tsienneto Road corridor (+3000 vpd over No-Build) and NH Route 102 east at the Chester town line (+1000 vpd over No-Build).

9.1.3 Alternative B

Mainline volumes on I-93 under this scenario show similar growth rates as Alternative A as compared to 2040 No-Build conditions. This is consistent with the earlier DEIS when comparing southerly versus northerly interchange locations.

Exit 4 ramp volumes show some differences as compared to Alternative A. Projected volumes on the NB on-ramp and SB off-ramp are slightly higher under Alternative B than A, but still 17-19% less than what they are under the No-Build case. This may be because Alternative B provides a section of new roadway onto the Derry street network, which may attract more traffic. The NB off-ramp shows a 10% volume reduction under Alternative B than under No-Build, similar to Alternative A. This development of Woodmont Commons to the west is reflected in an 8% increase in SB on-ramp volumes from the west side of the interchange, whereas the SB on-ramp volume from the east shows about a 44% reduction in projected traffic, similar to Alternative A.

Exit 5 ramp volumes show smaller increases on the NB off-ramp and SB on-ramp than under Alternative A. This continues to indicate the increased interaction between Exit 4A and 5 to and from the north more than between Exits 4 and 4A, which is consistent with the previous DEIS for this project. The Exit 5 SB off-ramp actually shows a greater reduction in traffic under Alternative B than under A, and this is reflected in a similarly higher volume at the Exit 4A SB off-ramp as compared to Alternative A. The Exit 5 NB on-ramp traffic is also lower than under No-Build conditions or Alternative A, indicating redistribution of some NB trips to Exit 4A and away from NH Route 28. These results appear to show that this alternative supports more of a north-south trip pattern than the east-west pattern exhibited under Alternative A.

Exit 4A volumes with Alternative B range between 9,500-12,400 vpd on the NB off-ramp and SB on-ramp, and from 13,200 to 19,400 vpd on the NB on-ramp and SB off-ramp, respectively. The SB on- and off-ramp volumes are higher than under Alternative A, but the NB on-ramp traffic is slightly lower than under Alternative A. The projected connector road volume east of the Alternative B interchange are about 54,500 vpd, and decrease to 16,200 vpd east of NH Route 28 along the Ashleigh Drive alignment.

The projected volumes on the local roadways under Alternative B have similar but generally slightly lower volumes than Alternative A. Volumes on NH Route 102 just east of Exit 4 are about 48% of the projected 2040 No-Build condition, while volumes closer to the downtown area show reductions around 19%. Folsom and Tsienneto Roads do not see the same increases as under Alternative A, since the new main connection road goes north of this area to intersect with Franklin Street Extension and Ashleigh Drive on the new alignment. The existing Tsienneto Road corridor sees minimal change since Alternative B creates a new roadway for the east-west traffic that currently uses this roadway to access the Interstate, but traffic volumes at the east end of the study area are higher than under Alternative A.

9.1.4 Alternative C

Mainline volumes on I-93 south of Exit 5 under this scenario show slightly higher growth rates than the southerly interchange alternatives (A and B) when compared to 2040 No-Build conditions. Projected volumes north of Exit 5 are consistent across all interchange alternatives, being slightly higher than No-Build.

Exit 4 ramp volumes under this alternative are slightly lower than the southerly interchange options, notably on the NB on-ramp and SB off-ramp, but higher for the SB on-ramp from the east than either Alternative A or B. This is likely indicative of the increased distance of the northerly interchange from the NH Route 102 corridor and the expectation of less effectiveness in reducing east-west traffic through the downtown area.

Impacts on Exit 5 ramp volumes show larger reductions in both the NB on-ramp and SB off-ramp volumes than the southerly interchange options. This makes sense, given the greater proximity of Alternatives C (and D) to Exit 5, which further emphasizes the increased interaction between Exit 4A and 5 to and from the north more than between Exits 4 and 4A, which is consistent with the previous DEIS for this project.

Exit 4A ramp volumes for trips to/from the south with Alternative C are noticeably lower than with the southerly interchange options, ranging between 2,800-5,000 vpd on the NB off-ramp and SB on-ramp. Trips on the NB on-ramp are similar to Alternative B but are lower on the SB off-ramp, respectively. The projected connector road volume east of the C interchange is less than under A or B (about 38,500 vpd), and decrease to 13,900 vpd west of NH Route 28 along the Ashleigh Drive alignment.

The projected volumes on the local roadways under Alternative C have similar but slightly larger volume reductions than Alternatives A or B. Volumes on NH Route 102 just east of Exit 4 are slightly lower than 2040 No-Build volumes but slightly higher than 2015 base conditions. Volumes further east on NH Route 102 show slightly larger reductions than under A or B. With the main connection road going north to NH Route 28 near the town line, volumes on this section of NH Route 28 more than double than under existing conditions. The existing Tsienneto Road corridor sees similar volume levels as Alternative B since C follows the new roadway to serve this east-west traffic demand.

9.1.5 Alternative D

Mainline volumes on I-93 under this scenario show similar growth rates as Alternative C as compared to 2040 No-Build conditions. This is consistent with the earlier DEIS where comparing southerly versus northerly interchange locations. Exits 4 and 5 ramp volumes under this option are also quite similar to Alternative C.

Exit 4A volumes with Alternative D are similar to Alternative C - the NB off-ramp and SB on-ramp volumes are lower than Alternative C but the SB off-ramp traffic is slightly higher. The projected connector road volume east of the Alternative D interchange is about 36,700 vpd.

The projected volumes on the local roadways under Alternative D have similarly but generally slightly lower reductions than Alternatives A or B. Volumes on NH Route 102 just east of Exit 4 are about the same as under 2015 base conditions, even if slightly lower than 2040 No-Build volumes. Volumes further east on NH Route 102 show smaller traffic reductions than any of the other interchange options. With the main connection road going north to NH Route 28 near the town line, volumes along this part of the NH Route 28 corridor more than double over existing conditions. The existing Tsienneto Road corridor also sees marked growth over existing volumes with this option since it follows the present roadway for east-west traffic.

9.1.6 Alternative F

Alternative F is essentially the Transportation Systems Management (TSM) option, which from the traffic model's perspective is essentially a third lane along NH Route 102 to provide some additional capacity at intersections east of Exit 4 into downtown Derry.

Mainline volumes on I-93 under this scenario show similar growth rates compared to 2040 No-Build conditions and lower than with an interchange alternative. This is consistent with the lower growth scenario as compared to those with a new interchange. Exits 4 and 5 ramp volumes under this option are also quite similar to 2040 No-Build conditions. With the provision of some additional capacity along the existing NH Route 102 corridor easterly into downtown Derry, traffic volumes are higher than under No-Build conditions or with any of the interchange alternatives, so it does not meet the Purpose and Need for the project.

Figures 8 through 12 graphically show these volume comparisons by alternative for key areas of interest as part of this study: the Exit 4 ramps, Exit 5 ramps, Exit 4A ramps, points along the NH Route 102 corridor, and other local streets of interest, respectively.

9.2 Composition of Through Traffic in Downtown Derry

While the volume reductions may not be as profound on the surface as one might expect, it is the composition of the trips in the downtown area that are of interest, since one of the Purposes and Needs of the project is to reduce through traffic in downtown Derry that had neither an origin nor destination there. Existing travel patterns suggest that a good deal of existing traffic is already finding alternative routes to avoid the downtown area.

To test the sensitivity of the hypothesis of a reduction in ‘through’ traffic as a result of a new interchange, a link on NH Route 102 just west of the main downtown area, which is the location east of Griffin Street near the Beaver Brook bridge, was chosen as a representative location of downtown traffic. The SNHPC model can generate trip tables that will provide the origin and destination zone for trips on any link in the network in either direction. This traffic pattern was evaluated by comparing the number of trips from zones and external stations from the east and northeast that are currently assigned to that link under existing (2015) base, 2040 No-Build and 2040 –Alternative A conditions, which was the Preferred Alternative in the previous DEIS for this project, that might be diverted to another route/path under any Build scenario.

A series of TAZs from the SNHPC traffic model area to the east and northeast were aggregated to see how many trips remained on this link under the different scenarios, as shown in Figures 13 and 14. The ones of primary interest were noted as follows:

- North Derry – TAZs 121-124, 126, 127
- East Derry – TAZs 128-130, 145-147, 221, 225
- Chester – TAZs 148-155
- Raymond/Deerfield/Candia – TAZs 156-191
- External Stations east and northeast – Stations 308-324

Table 8 shows a summary of the assigned trips to this link in each direction as well as combined under the three scenarios. In summary, the table shows that, in general, the trips to and from these zones to the east that now pass through the downtown area are lower with an interchange alternative (in this case, Alternative A) in place than under the 2040 No-Build scenario. However, since the overall link volume is reduced as well, these trips make up a slightly higher percentage of the total trips on that link than under No-Build conditions. This appears logical, because this link is likely the shortest path from these easterly zones to destinations in downtown Derry. Nevertheless, this analysis appears to show that an interchange alternative will reduce the amount of through traffic in downtown Derry for trips to and from the east and northeast.

TABLE 8

SELECT LINK ANALYSIS

NH ROUTE 102, EAST OF GRIFFIN ROAD, DERRY, NH

Eastbound (To)	N Derry	E Derry	Chester	Raymond/Candia/ Deerfield	N/NE/SE External Stations				
Traffic Zones	121-124. 126,127	128-130, 145-147, 221, 225	148-155	156-191	308-324	Target zone total	Increase over 2015 Base	Total trips on link	% of total to target zones
2015 Base	1194	642	162	293	1209	3500		8,806	39.7%
% total on link	13.6%	7.3%	1.8%	3.3%	13.7%				
2040 No-Build	1332	1056	130	78	1282	3878	1.1%	9,642	40.2%
% total on link	13.8%	11.0%	1.3%	0.8%	13.3%				
2040 Alt A	571	1235	236	146	1845	4033	1.2%	9,108	44.3%
% total on link	6.3%	13.6%	2.6%	1.6%	20.3%				
Westbound (From)	N Derry	E Derry	Chester	Raymond/Candia/ Deerfield	N/NE/SE External Stations				
Traffic Zones	121-124. 126,127	128-130, 145-147, 221, 225	148-155	156-191	308-324	Target zone total	Increase over 2015 Base	Total trips on link	% of total to target zones
2015 Base	1177	814	114	192	760	3057		9,191	33.3%
% total on link	12.8%	8.9%	1.2%	2.1%	8.3%				
2040 No-Build	1663	1465	64	37	773	4002	1.1%	11,168	35.8%
% total on link	14.9%	13.1%	0.6%	0.3%	6.9%				
2040 Alt A	307	1097	156	113	1073	2746	0.8%	7,776	35.3%
% total on link	3.9%	14.1%	2.0%	1.5%	13.8%				
Both Directions	N Derry	E Derry	Chester	Raymond/Candia/ Deerfield	N/NE/SE External Stations				
Traffic Zones	121-124. 126,127	128-130, 145-147, 221, 225	148-155	156-191	308-324	Target zone total	Increase over 2015 Base	Total trips on link	% of total to target zones
2015 Base	2371	1456	276	485	1969	6557		18,002	36.4%
% total on link	13.2%	8.1%	1.5%	2.7%	10.9%				
2040 No-Build	2995	2521	194	115	2055	7880	2.3%	20,810	37.9%
% total on link	14.4%	12.1%	0.9%	0.6%	9.9%				
2040 Alt A	878	2332	392	259	2918	6779	1.9%	16,885	40.1%
% total on link	5.2%	13.8%	2.3%	1.5%	17.3%				

9.3 Comparison to I-93 SEIS 2030 Mainline Projections

An additional comparison was made to the projected 2030 mainline volumes on I-93 as shown in the SEIS for the I-93 project (NHDOT, 2009). This document utilized the statewide traffic model that was available at the time, and also included the proposed Exit 4A Preferred Alternative as part of the network.

However, there are some major differences between the two scenarios. First, there are two different design years: the I-93 SEIS went out only to 2030 while this Exit 4A SDEIS extends out to 2040, so there are ten more years of overall growth that contributes additional traffic onto the network. Secondly, the I-93 SEIS did not account for the full Woodmont Commons development scenario included in the Exit 4A project for the Preferred Alternative, which adds a substantial number of trips to the area in and around Exit 4 and the proposed Exit 4A. Given these factors, it is expected that design hourly volumes would be higher under the 2040 case.

Table 9 shows excerpts from Tables 4-12 and 4-13 from the 2009 I-93 SEIS, which includes the projected ADT and DDHV for 2020 and 2030 from that document. The current table includes a projection of these volumes to 2040 using the same growth rates, including Exit 4A which was included in the I-93 SEIS Build condition, and the projected AAWDT and DDHV from the latest SNHPC modeling to the 2040 design year, and a comparison between the two modelling efforts.

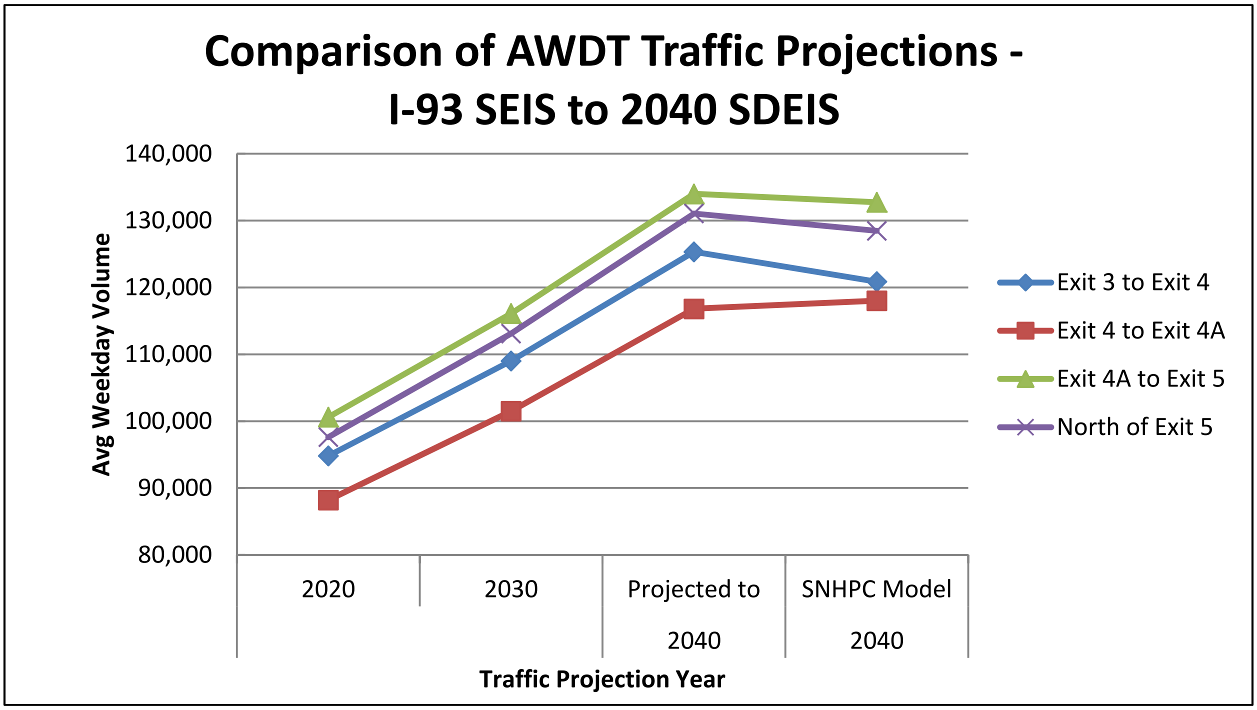
These comparisons show that the more recent SNHPC AAWDT traffic projections are consistent with the growth trend line from the I-93 SEIS if it were extended to the same 2040 design year within less than 4%. Similarly, the differences calculated DDHV extended to 2040 are within 3% when using the same methodology. The last two points on the graphs compare the 2040 projections for both the I-93 numbers and the latest SNHPC projections. Therefore, it would appear that the two modelling efforts are reasonably close to each other when extending the original I-93 design horizon out to 2040.

The original I-93 SEIS also noted that the congested flow capacity for I-93 would be 1,800 vph per lane, which would be 7,200 vph for the projected four-lane Interstate project. Should this volume be exceeded, the volumes would have to be adjusted to account for the effect of peak spreading that would likely occur into the adjacent hours before and after this demand was projected. At first glance, it appears that this scenario may also occur between Exits 4A and 5 and north of Exit 5 when using the SNHPC 2040 model projections, using the same DDHV calculation assumptions as in the I-93 SEIS. However, a more detailed review of the projected 2040 mainline volumes, which are discussed below, indicates that this 7,200 vph threshold will not likely be reached under any Exit 4A scenario.

TABLE 9
COMPARISON OF I-93 SEIS AND EXIT 4A SDEIS TRAFFIC PROJECTIONS
2020, 2030 AND 2040 DESIGN YEARS, INCLUDING EXIT 4A

Average Annual Weekday Traffic (AAWDT) Projections

I-93 Segment	I-93 SEIS 2020 Build	2030 Build	Growth Rate/Year	Projected To 2040	SNHPC 2040 Model Projections Alternative A	% Difference
Exit 3 to Exit 4	94,800	109,000	1.014	125,330	120,860	-3.6%
Exit 4 to Exit 4A	88,200	101,500	1.014	116,810	118,015	1.0%
Exit 4A to Exit 5	100,600	116,100	1.014	133,990	132,734	-0.9%
North of Exit 5	97,600	113,100	1.015	131,060	128,466	-2.0%



Notes:

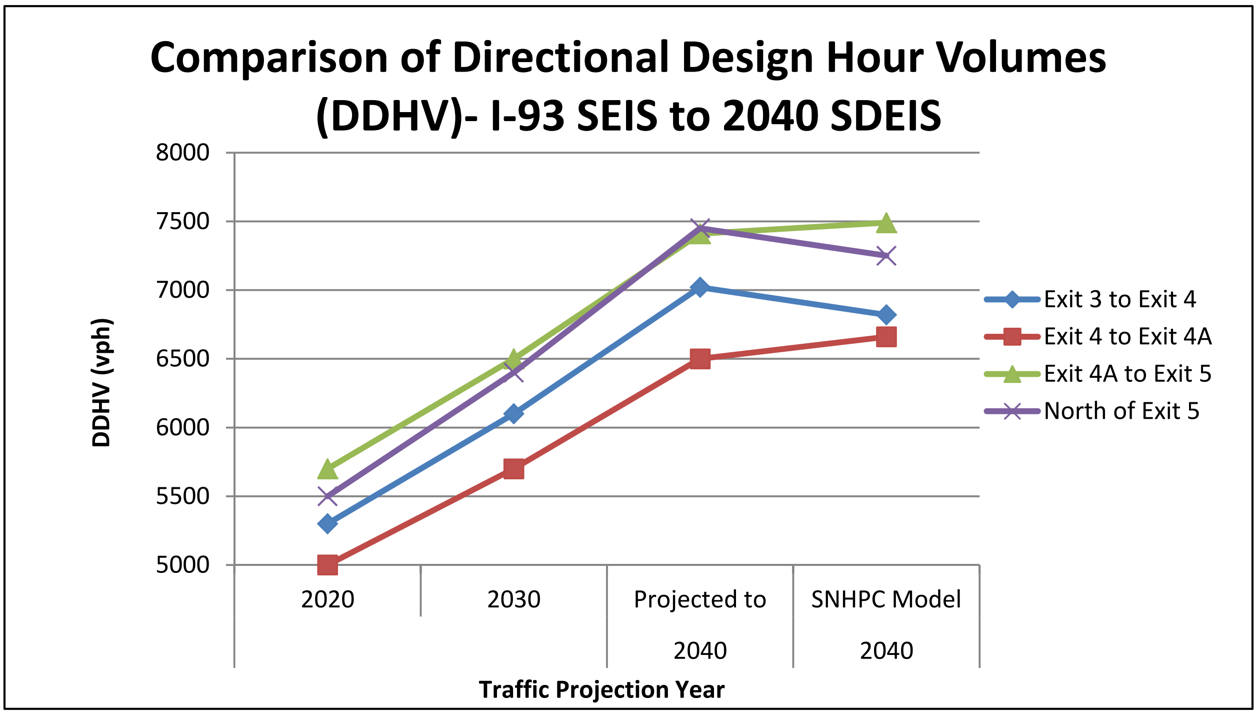
DDHV calculated as 9.4% of ADT with a 60/40 directional split, consistent with I-93 SEIS, using Scenario 2 (OEP Projections)

Source: NHDOT, Supplemental Environmental Impact Statement and Reevaluation/Section4(f) Evaluation, August 2009, Tables 4-12 and 4-13

TABLE 9 (Cont'd)
COMPARISON OF I-93 SEIS AND EXIT 4A SDEIS TRAFFIC PROJECTIONS
2020, 2030 AND 2040 DESIGN YEARS, INCLUDING EXIT 4A

Directional Design Hourly Volume (DDHV) Projections

I-93 Segment	I-93 SEIS 2020 Build	2030 Build	Growth Rate/Year	Projected To 2040	SNHPC 2040 Calculated DDHV Alternative A	% Difference
Exit 3 to Exit 4	5,300	6,100	1.014	7,020	6,820	-2.8%
Exit 4 to Exit 4A	5,000	5,700	1.013	6,500	6,660	2.5%
Exit 4A to Exit 5	5,700	6,500	1.013	7,410	7,490	1.1%
North of Exit 5	5,500	6,400	1.015	7,450	7,250	-2.7%



Notes:
DDHV calculated as 9.4% of ADT with a 60/40 directional split, consistent with I-93 SEIS, using Scenario 2 (OEP Projections)

Source: NHDOT, Supplemental Environmental Impact Statement and Reevaluation/Section4(f) Evaluation, August 2009, Tables 4-12 and 4-13

10.0 Derivation of 2040 Volumes for Analysis Purposes

Now that the projected 2040 AAWDT volumes have been provided by the SNHPC model and appear to be reasonable, these need to be reduced to AM and PM peak volumes for analysis purposes. Since the SNHPC model provides only daily volumes, these must be reduced to peak hours on both the I-93 mainline and interchange ramp terminals as well as at the various study area intersections that may be directly or indirectly affected by any alternative. Different procedures were used to develop these volumes to be used for analysis purposes.

As noted earlier, the full development potential of Woodmont Commons was assigned to the study area traffic model network as a worse-case scenario, but if much of the site-generated traffic is captured internally to the site - as is the design intent of this mixed-use development - operations would be better than projected and the design life of any roadway and intersection improvements would be extended.

10.1 Mainline Interstate Volumes

A different procedure was used to generate the 2040 No-Build interstate networks as was done for deriving the 2015 base network for calibration. The projected 2040 AAWDT was calculated based on the projected growth (positive or negative) reflected in the model assignments on that segment between 2015 and 2040, then this growth rate was applied to the adjusted 2015 AAWDT. Then, the 2040 projected AM and PM peak hour volumes were derived based on the percentage that the existing (2015) AM and/or PM peak hour volume was as a percentage of the adjusted 2015 AAWDT, since these percentages should not change substantially over time. These peak hour percentages generally fell in the range of 6-9% of AAWDT. Tables J-1 through J-6 in Appendix J show summary tables of the projected 2040 peak hour volumes for each alternative on the key links on the interstate and local roadway networks.

As in the 2015 base case, the most logical starting point for developing the balanced interstate networks is south of Exit 4, where NHDOT permanent recorder data should provide more reliability. The various interchange ramp volumes were then taken directly from the appropriate tables in Appendix J, and the mainline volumes were balanced through the network to the point north of Exit 5. This process was followed to develop 2040 AM and PM peak hour volumes along the Interstate for each alternative, which are shown graphically in Figures 15 through 26.

10.2 Local Intersection Volumes

A more detailed procedure was needed to derive peak hour intersection volumes for each alternative from the regional traffic model to be used for design purposes. Since the SNHPC model only provides daily volumes, a relationship needs to be established between the peak hour volumes from the actual turning movement count at any intersection and the model output that can be made available. The SNHPC model can provide daily volumes between any two nodes through one central node that would simulate movements at an intersection. As such, information was requested from SNHPC for the daily model assignments for each study area intersection for each alternative to assist in developing turning movements at each location. Then a procedure was developed to estimate intersection turning movements at each study area location based on the existing turning movement volumes for both the AM and PM peak hours and how the total and individual turn volumes change as a result of the reassignment of traffic under any scenario. This process had to be usable regardless of alternative or the magnitude of change in traffic assignments for any movement at a specific intersection from one alternative to another. The procedure is discussed in greater detail in the memorandum dated September 29, 2017, which is attached in Appendix K. **The memo was reviewed and approved by the NHDOT before the procedure was applied to the rest of the alternatives (NHDOT, 2017c).**

The resulting AM and PM peak hour volumes for each study area intersection for each of the 2040 alternatives are provided in Figures 27 through 38.

11.0 Analysis of Interstate Operations

As in the existing case, the Freeway Facilities procedure from the *2010 HCM* and replicated in the HCS was used to evaluate the mainline interstate operations under all 2040 conditions. A free flow speed of 70 mph and a Peak Hour Factor of 0.94 were agreed upon by NHDOT (NHDOT, 2017d) to be used in the HCM analysis. With the introduction of a northerly or southerly interchanges, certain design parameters consistent with the I-93 layout were agreed upon with the NHDOT to ensure that the appropriate distances would be used in the analyses. A conceptual layout for the southerly interchange for Alternatives A and B had already been provided in the 2007 DEIS as well as part of the I-93 design between Exits 4 and 5, and was used to determine ramps spacing for analysis purposes. The previous conceptual layout for the northerly interchange for Alternatives C and D from the 2007 DEIS was used as the starting point for this study.

The HCM procedure accounts for a 1,500 foot ‘influence area’ in the ramp merge or diverge areas. With the southerly interchange, there is overlap between the influence areas of the Exit 4 NB on-ramp and the Exit 4A NB off-ramp, as well as the Exit 4A SB on-ramp and the Exit 4 SB off-ramp. As such, the HCS analysis software allows for this overlap to be considered, and is reflected in the results.

The Freeway Facilities criteria in the HCS were provided in Appendix E when the 2015 operations were discussed for the existing two-lane facility. The 2040 results for the proposed four-lane facility are summarized in Table 10 with the HCM printouts provided in Appendix L. By definition, if the demand/ capacity (d/c) ratio is greater than 1.00, ramp merge/diverge or mainline operations will be constrained, either by traffic unable to merge onto the interstate and subsequently affecting ‘topside’ operations at the ramp terminals, or by the off-ramp being unable to process the demand for exiting traffic, which may affect mainline traffic free flow speeds.

The 2040 cases where d/c ratios are 0.98 or greater, indicating potential capacity constraints to I-93 operations with a single-lane ramp, are noted below:

- Alternative A – Exit 4A SB off-ramp diverge – AM peak
- Alternative B – Exit 4A SB off-ramp diverge – AM peak
- Alternative B – Exit 4 NB on-ramp merge – AM peak
- Alternative B – Exit 4 SB off-ramp diverge – PM peak
- Alternative F – Exit 4 NB on-ramp merge – AM and PM peaks
- Alternative F – Exit 4 SB off-ramp diverge – PM peak

These results appear to reflect the increased demands from the higher development scenarios from the Woodmont Commons development under Alternatives A and B, as well as the projected limitations at the Exit 4 interchange with Alternative F in place, even with a lesser development scenario for Woodmont Commons.

If the projected Exit 4 NB on-ramp volumes reach levels where the merge with the mainline I-93 is affected as shown, it would likely result in backups of traffic back to the ramp terminal itself, affecting the topside intersections along NH Route 102. Both the Exit 4 and Exit 4A SB off-ramp diverge constraints could be ameliorated by providing a two-lane off-ramp to service the projected traffic should actual volumes meet projections in the future.

However, given the aforementioned discussion about the possible realization of the Woodmont Commons internal capture rate and the subsequent reduction in traffic assignments onto the study area network, a sensitivity analysis was conducted at the Exit 4A SB off-ramp to determine what kind of volume reduction would be needed to provide an acceptable LOS for a single-lane off-ramp at this location. If the projected off-ramp AM peak volume was reduced by only 200 vph, this ramp would function at a LOS D with a demand/capacity ratio of 0.94, which would be acceptable. Therefore, should the full impact of the traffic projections from Woodmont Commons or the overall study area development scenario not be realized, the ramps that are projected to be capacity-constrained may operate better than these analyses would indicate.

19-Jun-17

rev 4-12-18

TABLE 10

HCS 2010 - FREEWAY FACILITIES ANALYSIS - 2040 NO-BUILD AND BUILD (South Interchange) CASES - AM and PM PEAK HOURS

		2040 No Build						4A Alternative A						4A Alternative B					
		AM Peak Hour (LOS) / (d/c ratio)			PM Peak Hour (LOS) / (d/c ratio)			AM Peak Hour (LOS) / (d/c ratio)			PM Peak Hour (LOS) / (d/c ratio)			AM Peak Hour (LOS) / (d/c ratio)			PM Peak Hour (LOS) / (d/c ratio)		
Segment	Northbound Direction	BASIC	DIVERGE	MERGE	BASIC	DIVERGE	MERGE	BASIC	DIVERGE	MERGE	BASIC	DIVERGE	MERGE	BASIC	DIVERGE	MERGE	BASIC	DIVERGE	MERGE
1	I-93 Mainline south of Exit 4	B/0.37			C/0.63			B/0.38			C/0.66			B/0.38			C/0.66		
2	Exit 4 NB off-ramp		A/0.26			B/0.61			A/0.23			B/0.67			A/0.23			B/0.67	
3	I-93 Mainline between Exit 4 ramps	A/0.28			B/0.37			A/0.30			B/0.42			A/0.30			B/0.42		
4	Exit 4 NB on-ramp			C/1.25			C/0.99			B/0.89			C/0.70			C/1.03			C/0.81
5	I-93 Mainline between Exit 4 on-ramp and Exit 4A off-ramp							B/0.49			C/0.56			C/0.52			C/0.59		
6	Exit 4A NB off-ramp				N/A				C/0.48			C/0.41			C/0.52			C/0.44	
7	I-93 Mainline between Exit 4A ramps							B/0.40			B/0.48			B/0.43			B/0.50		
8	Exit 4A NB on-ramp									C/0.84			C/0.72			C/0.73			C/0.48
9	I-93 Mainline between Exit 4(4A) NB on- and Exit 5 NB off-ramps	B/0.55			C/0.57			C/0.56			C/0.62			C/0.56			C/0.62		
10	Exit 5 NB off-ramp		C/0.37			C/0.49			C/0.43			D/0.58			C/0.41			D/0.54	
11	I-93 Mainline between Exit 5 ramps	B/0.48			B/0.49			B/0.49			C/0.53			B/0.49			C/0.54		
12	Exit 5 NB on-ramp			C/0.83			C/0.62			C/0.67			C/0.50			C/0.65			C/0.48
13	I-93 Mainline north of Exit 5	C/0.64			C/0.62			C/0.62			C/0.65			C/0.62			C/0.65		
	Facility operations	B			C			B			C			B			C		
	Space Mean Speed (mph)	68.4			68.6			68.5			67.9			67.6			67.9		
	Density (veh/mi/hr)	15.8			19.2			16.4			20.2			17.3			20.4		
Segment	Southbound Direction																		
1	I-93 Mainline north of Exit 6	C/0.59			C/0.64			C/0.62			C/0.62			C/063			C/0.62		
2	Exit 5 SB off-ramp		D/0.73			D/0.74			C/0.41			C/0.62			C/0.32			C/033	
3	I-93 Mainline between Exit 5 ramps	B/0.46			B/0.49			C/0.55			C/0.53			C/0.57			C/0.55		
4	Exit 5 SB on-ramp			C/0.45			C/0.38			C/0.52			B/0.44			B/0.40			B/0.34
5	I-93 Mainline between Exit 5 SB on- and Exit 4A SB off-ramps							C/0.65			C/0.61			C/0.65			C/0.62		
6	Exit 4A SB off-ramp				N/A				C/0.94			D/0.89			C/0.94			D/0.91	
7	I-93 Mainline between Exit 4A ramps							B/0.46			B/0.44			B/0.45			B/0.44		
8	Exit 4A SB on-ramp									B/0.60			C/0.51			C/0.70			C/0.58
9	I-93 Mainline between Exit 5(4A) SB on- and Exit 4 SB off-ramps	C/0.55			C/0.56			D/0.57			D/0.54			D/0.58			D/055		
10	Exit 4 SB off-ramp		C/0.84			D/1.10			D/0.76*			C/0.91			C/0.81			D/0.98	
11	I-93 Mainline between Exit 4 SB off- and SB on ramp from east	B/0.36			B/0.33			B/0.43			B/0.36			B/0.43			B/0.36		
12	Exit 4 SB on-ramp from east			B/0.66			B/0.30			B/0.49			A/0.16			B/0.37			A/0.17
13	I-93 Mainline between Exit 4 SB on-ramps	B/0.48			B/0.38			B/0.49			B/0.39			B/0.49			B/0.39		
14	Exit 4 SB on-ramp from west			C/0.85		B/0.40				C/0.93			B/0.44			C/0.92		B/0.43	
15	I-93 Mainline south of Exit 5	C/0.64			B/0.46			C/0.66			B/0.47			C/0.66			B/0.47		
	Facility operations	C			C			C			C			C			C		
	Space Mean Speed (mph)	68.5			68.3			67.4			68.6			67.3			68.4		
	Density (veh/mi/hr)	18.8			19.1			20.6			18.4			20.9			18.9		

* = 2-lane off-ramp assumed

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TABLE 10 (cont.)
HCS 2010 - FREEWAY FACILITIES ANALYSIS - 2040 NO-BUILD AND BUILD (North or No Interchange) CASES - AM and PM PEAK HOURS

		2040 No Build						4A Alternative C					
		AM Peak Hour (LOS) / (d/c ratio)			PM Peak Hour (LOS) / (d/c ratio)			AM Peak Hour (LOS) / (d/c ratio)			PM Peak Hour (LOS) / (d/c ratio)		
Segment	Northbound Direction	BASIC	DIVERGE	MERGE	BASIC	DIVERGE	MERGE	BASIC	DIVERGE	MERGE	BASIC	DIVERGE	MERGE
1	I-93 Mainline south of Exit 4	B/0.37			C/0.63			B/0.37			C/0.64		
2	Exit 4 NB off-ramp		A/0.26			B/0.61			A/0.24			B/0.56	
3	I-93 Mainline between Exit 4 ramps	A/0.28			B/0.37			A/0.28			B/0.39		
4	Exit 4 NB on-ramp			C/1.25			C/0.99			B/0.93			B/0.73
5	I-93 Mainline between Exit 4 on-ramp and Exit 4A off-ramp							B/0.49			C/0.54		
6	Exit 4A NB off-ramp				N/A				B/0.15			C/0.13	
7	I-93 Mainline between Exit 4A ramps							B/0.46			B/0.51		
8	Exit 4A NB on-ramp									C/0.74			C/0.63
9	I-93 Mainline between Exit 4 (4A) NB on- and Exit 5 NB off-ramps	B/0.55			C/0.57			C/0.60			C/0.64		
10	Exit 5 NB off-ramp		C/0.37			C/0.49			C/0.40			C/0.51	
11	I-93 Mainline between Exit 5 ramps	B/0.48			B/0.49			C/0.53			C/0.56		
12	Exit 5 NB on-ramp			C/0.83			C/0.62			C/0.48			C/0.36
13	I-93 Mainline north of Exit 5	C/0.64			C/0.62			C/0.63			C/0.63		
	Facility operations	B			C			B			C		
	Space Mean Speed (mph)	68.4			68.6			68.4			68.3		
	Density (veh/mi/hr)	15.8			19.2			16.4			19.7		
Segment	Southbound Direction												
1	I-93 Mainline north of Exit 6	C/0.59			C/0.64			C/0.62			C/0.61		
2	Exit 5 SB off-ramp		D/0.73			D/0.74			C/0.31			C/0.31	
3	I-93 Mainline between Exit 5 ramps	B/0.46			B/0.49			C/0.57			C/0.55		
4	Exit 5 SB on-ramp			C/0.45			C/0.38			C/0.45			C/0.38
5	I-93 Mainline between Exit 5 SB on- and Exit 4A SB off-ramps							C/0.66			C/0.63		
6	Exit 4A SB off-ramp				N/A				D/0.92			D/0.79	
7	I-93 Mainline between Exit 4A ramps							B/0.48			B/0.46		
8	Exit 4A SB on-ramp									B/0.27			B/0.23
9	I-93 Mainline between Exit 5(4A) SB on- and Exit 4 SB off-ramps	C/0.55			C/0.56			B/0.52			B/0.51		
10	Exit 4 SB off-ramp		C/0.84			D/1.10			C/0.64			C/0.76	
11	I-93 Mainline between Exit 4 SB off- and SB on ramp from east	B/0.36			B/0.33			B/0.40			B/0.34		
12	Exit 4 SB on-ramp from east			B/0.66			B/0.30			B/0.46			B/0.21
13	I-93 Mainline between Exit 4 SB on-ramps	B/0.48			B/0.38			C/0.48			B/0.38		
14	Exit 4 SB on-ramp from west			C/0.85		B/0.40				C/0.86			B/0.40
15	I-93 Mainline south of Exit 5	C/0.64			B/0.46			C/0.64			B/0.46		
	Facility operations	C			C			C			C		
	Space Mean Speed (mph)	68.5			68.3			67.9			68.5		
	Density (veh/mi/hr)	18.8			19.1			19.9			17.8		

		4A Alternative D						4A Alternative F					
		AM Peak Hour (LOS) / (d/c ratio)			PM Peak Hour (LOS) / (d/c ratio)			AM Peak Hour (LOS) / (d/c ratio)			PM Peak Hour (LOS) / (d/c ratio)		
Segment	Northbound Direction	BASIC	DIVERGE	MERGE	BASIC	DIVERGE	MERGE	BASIC	DIVERGE	MERGE	BASIC	DIVERGE	MERGE
1	I-93 Mainline south of Exit 4	B/0.37			C/0.64			B/037			C/0.64		
2	Exit 4 NB off-ramp		A/0.25			B/0.59			A/0.26			B/0.62	
3	I-93 Mainline between Exit 4 ramps	A/0.28			B/0.38			A/0.28			B/0.37		
4	Exit 4 NB on-ramp			B/0.90			B/0.71			C/1.25			C/0.99
5	I-93 Mainline between Exit 4 on-ramp and Exit 4A off-ramp	B/0.48			B/0.52			B/0.55			C/0.57		
6	Exit 4A NB off-ramp		B/0.08			B/0.07							
7	I-93 Mainline between Exit 4A ramps	B/0.46			B/0.51								
8	Exit 4A NB on-ramp			C/0.76			C/0.64						
9	I-93 Mainline between Exit 4 (4A) NB on- and Exit 5 NB off-ramps	C/0.60			C/0.64								
10	Exit 5 NB off-ramp		C/0.41			D/0.55			C/0.36			C/0.48	
11	I-93 Mainline between Exit 5 ramps	C/0.53			C/0.55			B/0.49			B/0.49		
12	Exit 5 NB on-ramp			C/0.49			C/0.39			C/0.82			C/0.62
13	I-93 Mainline north of Exit 5	C/0.63			C/0.63			C/0.65			C/0.62		
	Facility operations	B			C			B			C		
	Space Mean Speed (mph)	68.6			68.4			68.4			68.6		
	Density (veh/mi/hr)	16.4			19.5			15.8			19.2		
Segment	Southbound Direction												
1	I-93 Mainline north of Exit 6	C/0.62			C/0.61			C/0.58			C/0.64		
2	Exit 5 SB off-ramp		C/0.31			C/0.32			C/0.66			C/0.67	
3	I-93 Mainline between Exit 5 ramps	C/0.57			C/0.55			B/0.47			B/0.50		
4	Exit 5 SB on-ramp			C/0.44			C/0.38			B/0.45			B/0.38
5	I-93 Mainline between Exit 5 SB on- and Exit 4A SB off-ramps	C/0.66			C/0.62			C/0.55			C/0.57		
6	Exit 4A SB off-ramp		D/0.91			D/0.78							
7	I-93 Mainline between Exit 4A ramps	B/0.48			B/0.46						N/A		
8	Exit 4A SB on-ramp			B/0.25			B/0.21						
9	I-93 Mainline between Exit 5(4A) SB on- and Exit 4 SB off-ramps	B/0.52			B/0.50								
10	Exit 4 SB off-ramp		C/0.63			C/0.75			C/0.85			D/1.12	
11	I-93 Mainline between Exit 4 SB off- and SB on ramp from east	B/0.40			B/0.34			B/0.36			B/0.33		
12	Exit 4 SB on-ramp from east			B/0.46			B/0.21			B/0.67			B/0.30
13	I-93 Mainline between Exit 4 SB on-ramps	B/0.48			B/0.38			B/0.48			B/0.38		
14	Exit 4 SB on-ramp from west			C/0.85			B/0.40			C/0.84			B/0.39
15	I-93 Mainline south of Exit 5	C/0.64			B/0.46			C/0.64			B/0.46		
	Facility operations	C			C			C			B		
	Space Mean Speed (mph)	67.9			68.6			68.5			68.4		
	Density (veh/mi/hr)	19.8			17.8			18.8			19.1		

12.0 Estimated Contribution of Woodmont Commons Traffic to Interstate Ramp Volumes

During the review of the traffic projections, the NHDOT inquired as to the potential impact that traffic from the Woodmont Commons development may have on the Exit 4 ramps under the various alternatives, since the southerly interchange alternatives (A and B) assume a higher intensity of development that under all other alternatives, including the No-Build.

As noted earlier, the 2040 projections from the SNHPC regional traffic model do not account for the same level of 'internally captured' trips within the development itself in the traffic assignments used for the Exit 4A project, as opposed to the site-specific traffic study prepared for the Woodmont project that assumed as much as a 23% internal captured trip rate in their projections and traffic assignments (TEC, 2013). Nevertheless, the model assignments should be able to present an 'order of magnitude' assessment of the relative contribution of traffic to the Exit 4 and 4A ramps from the three traffic analysis zones that Woodmont Commons would eventually occupy.

To accomplish this, SNHPC was tasked with providing 'select link' assignments to the Exit 4 and 4A ramps for trips from the three Woodmont Common zones (Zone 277 to the west, and Zones 69 and 375 to the east) under different scenarios: 2015 No-Build; 2040 No-Build; and 2040 Build with either Alternative A (southern interchange) and Alternative C (northern interchange). This information was summarized in a technical memo provided to the NHDOT for their review and concurrence (CLD, 2018), which is attached in Appendix M.

The results show that under the 2015 No-Build case, the three Woodmont zones only account for about 13% of the total traffic volume on all Exit 4 ramps, almost exclusively from the existing development in Zone 277 on the west side of I-93 in the Garden Lane area. Under the 2040 No-Build condition, the total volumes on the Exit 4 ramps would more than double, even with a lesser Woodmont development scenario, and these three zones now comprise almost 27% of this total Exit 4 ramp traffic and almost 40% of the projected increase in traffic.

With Exit 4A in place under Alternative A, which also assumes the most intense Woodmont development scenario, traffic assignments from the three subject zones account for 36% of the total Exit 4 ramp volume, most of which comes from Zone 277 on the west side. At Exit 4A, the two easterly Woodmont zones also account for 36% of total Exit 4A ramp traffic with no traffic assigned to these ramps from the west side.

With Alternative C in place, which assumes the same development scenario for Woodmont as in the 2040 No-Build case, the total traffic on the Exit 4 ramps is roughly the same as under Alternative A, but the Woodmont contribution is a slightly lower percentage (32%) of the total. At Exit 4A, Woodmont traffic would comprise only about 1% of the total ramp assignments, given that it is further removed from the traffic zones in question.

This analysis is only intended to show the relative potential contribution of Woodmont Commons traffic to both Exits 4 and 4A based on the full assignment of this traffic to the network as reflected in the SNHPC regional traffic model. As the Woodmont Commons development progresses and traffic is added to the adjacent road network, this situation should be monitored to determine how the actual additional traffic impacts affect overall traffic operations. Should the magnitude of the 'internal capture' trip rate be closer to what the TEC study anticipated, operations on the ramps, their intersections with the local road system, and the overall Interstate system would be better than by using the more conservative SNHPC model projections.

13.0 Exit 4A and Connecting Roadways

The Exit 4A interchange is currently proposed as a diamond configuration with access only to and from the east. As such, it creates two new ramp terminal intersections that will be provided with sufficient lanes to operate at an acceptable LOS. The connector road to the existing roadway network was assumed to be a four-lane limited access arterial roadway between the interchange and NH Route 28 to the east, with future breaks in access reserved for the proposed Woodmont Commons-East parcel based on their future development layout. New intersections would be created under all Build alternatives and existing intersections that would be affected by each of the respective layouts would need to be upgraded, which will be discussed in the next section.

The following is a listing of new intersections created by the connector roadway under the various interchange alternatives:

- Alternative A – Connector Road with North High Street.
- Alternative B – Connector Road with Franklin Street Extension, NH Route 28 Bypass, and relocated Tsienneto Road. In addition, the existing intersection with Ashleigh Drive will be reconfigured.
- Alternative C– Connector Road with NH Route 28 near the Londonderry town line, as well as NH Route 28 Bypass and relocated Tsienneto Road.
- Alternative D – Connector Road with NH Route 28 near Londonderry town line.

14.0 Analysis of Local Intersection Operations

Only those known programmed projects in the SNHPC 2040 Long-Range Transportation Plan (SNHPC, 2017) were included as foreseeable projects in the traffic modeling for this study. However, it is also assumed that ongoing State and Town traffic maintenance projects, such as signal retiming and optimization, will occur during the duration of the design horizon. Therefore, any intersection analyses assumes the optimization of signal timing and phasing at a specific location as a base condition, with any additional lane improvements evaluated as an impact associated with a specific alternative.

In addition, the Woodmont Commons development has also developed conceptual plans along the NH Route 102 corridor, as well as other intersections in Londonderry and Derry, to accommodate their projected traffic as that project moves forward (TEC, 2013). **The NHDOT has agreed that these projects should be considered as part of the 2040**

No-Build condition (NHDOT, 2016f). While most of these future improvements on NH Route 102 are west of Exit 4, including the Garden Lane and Gilcreast Road intersections, there are other improvements in the Exit 4A study area east of I-93 that will be considered as part of this No-Build condition for analysis purposes. These include:

- # 5 - NH Route 102/Londonderry Road intersection – signalization and lane additions, including a second east-west through lane on NH Route 102.
- # 8- North High Street/Ash Street Extension – providing a four-way stop controlled intersection, as well as separate left- and right-turn lanes exiting Ash Street, and adding an exclusive SB right-turn lane from North High Street onto Ash Street Extension.

It also should be noted that not all of the study area intersections are directly affected by the Exit 4A alternatives, even though the redistribution of traffic will have an indirect effect. Only those intersections that a specific alternative passes through were considered for any additional improvements as part of the project to maintain an acceptable LOS D or better for the overall intersection as well as on any individual approach. Analyses were conducted for all of the study area intersections, either with or without any required improvements.

It was also assumed that signalization would be required at many of the existing unsignalized locations where an alternative passes through it or where new intersections were being created at major State or local roadways. No formal signal warrants study was performed, but engineering judgment was applied to treat each of these locations the same if they were part of the layout of an alternative. Conversely, if the alternative did not go through that location, the existing traffic control was assumed to remain in place, regardless of operational efficiency, since these locations have not yet been programmed for further improvements.

15. Signalized Intersections

A summary table for the comparison of lane use and operations at each existing or proposed signalized intersection is provided in Table 11. No additional improvements to the lane use at the Exits 4 and 5 ramp terminals were investigated as part of any Build alternative, since these are being reconstructed as part of the ongoing I-93 project. The results are provided using the HCM 2000 procedures, since these procedures can address many non-standard timing and phasing parameters that later versions of the HCM cannot, as well as to be consistent with the Interstate Justification Report being conducted separately. (Louis Berger, 2018). The actual HCM and Synchro printouts for all the 2040 alternatives are provided in Appendices N through S.

Table 11
Summary of 2040 Capacity Analyses by Alternative

Signalized Intersections

Intersection	2040 Alternative	AM Peak Hour			PM Peak Hour			Comments/ Lane Use Revisions
		v/c ratio	Average Delay	LOS	v/c ratio	Average Delay	LOS	
#1 - Exit 4 SB Off Ramp/NH 102	No-Build	1.08	44.5	D	1.22	106.4	f	Current lane use per I93 project
	Alternative A	0.92	25.9	C	1.09	50.9	D	Current lane use per I93 project
	Alternative B	0.93	26.8	C	1.09	53.9	D	Current lane use per I93 project
	Alternative C	1.00	36.1	D	1.09	57.2	E	Current lane use per I93 project
	Alternative D	0.99	35.1	D	1.11	59.6	E	Current lane use per I93 project
	Alternative F	1.09	51.0	D	1.14	61.5	E	Current lane use per I93 project
#2 - Exit 4 NB Off Ramp/NH 102	No-Build	1.10	61.4	E	1.12	92.8	F	Current lane use per I93 project
	Alternative A	1.04	71.2	E	1.11	115.1	F	Current lane use per I93 project
	Alternative B	0.99	54.8	D	1.06	88.0	F	Current lane use per I93 project
	Alternative C	1.02	62.1	E	1.05	82.0	F	Current lane use per I93 project
	Alternative D	1.04	67.3	E	1.06	81.8	F	Current lane use per I93 project
	Alternative F	1.06	57.5	E	1.15	91.8	F	Current lane use per I93 project
#3 - Exit 5 SB Off Ramp/NH 28	No-Build	1.17	77.0	E	0.90	31.2	C	Current lane use per I93 project
	Alternative A	1.06	49.3	D	0.83	20.1	C	Current lane use per I93 project
	Alternative B	0.86	28.0	C	0.70	16.9	B	Current lane use per I93 project
	Alternative C	0.83	22.9	C	0.62	15.0	B	Current lane use per I93 project
	Alternative D	0.82	23.3	C	0.61	15.2	B	Current lane use per I93 project
	Alternative F	1.10	62.1	E	0.87	27.8	C	Current lane use per I93 project
#4 - Exit 5 NB Off Ramp/NH 28	No-Build	1.10	51.7	D	1.04	37.7	D	Current lane use per I93 project
	Alternative A	1.11	63.0	E	0.99	39.2	D	Current lane use per I93 project
	Alternative B	1.03	50.2	D	0.93	33.9	C	Current lane use per I93 project
	Alternative C	1.02	49.9	D	0.87	27.7	C	Current lane use per I93 project
	Alternative D	1.02	50.5	D	0.89	32.6	C	Current lane use per I93 project
	Alternative F	1.07	44.0	D	0.99	35.1	D	Current lane use per I93 project
#5 - NH Rte 102/Londonderry Rd/ St. Charles Street	No-Build	0.85	17.7	B	1.16	67.5	E	Add 2nd E-W lane per Woodmont concept
	Alternative A	0.52	11.4	B	0.58	14.8	B	Add 2nd E-W lane per Woodmont concept
	Alternative B	0.48	7.2	A	0.54	14.2	B	Add 2nd E-W lane per Woodmont concept
	Alternative C	0.52	8.2	A	0.53	13.1	B	Add 2nd E-W lane per Woodmont concept
	Alternative D	0.56	8.3	A	0.65	16.3	B	Add 2nd E-W lane per Woodmont concept
	Alternative F	0.75	12.3	B	0.87	27.9	C	Add 2nd E-W lane per Woodmont concept
#6 - NH Rte 102/Fordway/Madden Hill Road	No-Build	0.92	30.8	C	1.04	47.3	D	Current lane use
	Alternative A	0.79	23.4	C	0.99	42,5	D	Current lane use
	Alternative B	0.80	23.0	C	0.91	29.1	C	Current lane use
	Alternative C	0.78	22.3	C	0.92	30.0	C	Current lane use
	Alternative D	0.81	23.2	C	0.94	30.2	C	Current lane use
	Alternative F	0.93	28.7	C	0.96	29.9	C	Add NB LT, EB RT lanes
#7 - NH Rtes 102/28	No-Build	0.88	47.4	D	0.79	37.5	D	Current lane use
	Alternative A	0.89	55.3	E	0.84	47.9	D	Current lane use
	Alternative B	0.87	44.1	D	0.80	40.5	D	Current lane use
	Alternative C	0.77	35.0	C	0.84	40.2	D	Current lane use
	Alternative D	0.89	48.1	D	0.86	46.2	D	Current lane use
	Alternative F	0.63	28.6	C	0.83	34.0	C	Add NB LT, WB Th, EB RT lanes

Table 11 (Cont'd)
Summary of 2040 Capacity Analyses by Alternative

Signalized Intersections

Intersection	2040 Alternative	AM Peak Hour v/c ratio	AM Peak Hour Average Delay	AM Peak Hour LOS	PM Peak Hour v/c ratio	PM Peak Hour Average Delay	PM Peak Hour LOS	Comments/ Lane Use Revisions
#9A - Connector Rd/N High St	No-Build		n/a/			n/a/		Does not exist
	Alternative A	0.59	25.0	C	0.95	37.5	D	Prop lane use: EB - T,T,R; WB-L,T,T; NB- L,L,R lanes
	Alternative B		n/a/			n/a/		Does not exist
	Alternative C		n/a/			n/a/		Does not exist
	Alternative D		n/a/			n/a/		Does not exist
	Alternative F		n/a/			n/a/		Does not exist
#10 - N High/Folsom/Franklin Sts.	No-Build		n/a/			n/a/		Would remain unsignalized
	Alternative A	0.65	17.9	B	0.92	32.2	C	EB - L,T,T,TR; WB-L,T,TR; SB- LT,R; NB- L,TR lanes
	Alternative B		n/a/			n/a/		Would remain unsignalized
	Alternative C		n/a/			n/a/		Would remain unsignalized
	Alternative D		n/a/			n/a/		Would remain unsignalized
	Alternative F		n/a/			n/a/		Would remain unsignalized
#11- Ross' Corner (Folsom/NH 28)	No-Build	0.72	91.3	F	0.80	56.4	E	Current lane use
	Alternative A	0.56	22.3	C	0.79	32.9	C	Add 2nd EB LT and Th lanes; add 2nd WB Th lane
	Alternative B	0.49	28.4	C	0.66	38.3	D	Current lane use
	Alternative C	0.73	32.5	C	0.83	46.1	D	Current lane use
	Alternative D	0.73	27.0	C	0.80	35.2	D	Add 2nd EB LT lane; add 2nd WB RT lane
	Alternative F	0.61	32.6	C	0.72	42.7	D	Current lane use
#12 - Tsienneto Rd/Pinkerton St	No-Build		n/a/			n/a/		Would remain unsignalized
	Alternative A	0.61	13.7	B	0.65	12.5	B	Signalized and coord with Ross' Corner
	Alternative B		n/a/			n/a/		Would remain unsignalized
	Alternative C		n/a/			n/a/		Would remain unsignalized
	Alternative D	0.69	20.1	C	0.64	24.2	C	Signalized and coord with Ross' Corner
	Alternative F		n/a/			n/a/		Would remain unsignalized
#13 -NH 28/Linlew Dr	No-Build	0.41	18.9	B	0.48	17.2	B	Current lane use
	Alternative A	0.19	11.7	B	0.46	25.0	C	Current lane use
	Alternative B	0.36	6.3	A	0.49	13.8	B	Current lane use
	Alternative C	0.39	5.2	A	0.49	12.9	B	Current lane use
	Alternative D	0.56	14.9	B	0.78	20.4	C	Current lane use
	Alternative F	0.28	11.3	B	0.40	16.1	B	Current lane use
#14 - NH 28/Ashleigh Dr	No-Build	0.43	17.3	B	0.59	24.8	C	Current lane use
	Alternative A	0.35	17.0	B	0.48	21.7	C	Current lane use
#22 - B/C Connector/NH 28	Alternative B	0.73	26.8	C	0.83	35.6	D	Revised Lane Use: EB- L,T,R; WB-L,L,T,TR; NB-L,T,T,R,R; SB-L,T,T,R

Table 11 (Cont'd)
Summary of 2040 Capacity Analyses by Alternative
Signalized Intersections

Intersection	2040 Alternative	AM Peak Hour v/c ratio	AM Peak Hour Average Delay	AM Peak Hour LOS	PM Peak Hour v/c ratio	PM Peak Hour Average Delay	PM Peak Hour LOS	Comments/ Lane Use Revisions
#22 - B/C Connector/NH 28	Alternative C	0.71	22.0	C	0.84	29.7	C	Revised Lane Use: EB- L,L,T,TR; WB-L,T,TR; NB-L,TR; SB-LT,R
	Alternative D	0.58	21.0	C	0.84	34.8	C	Add WB RT lane to current lane use
	Alternative F	0.38	16.9	B	0.55	26.2	C	Current lane use
#18 - NH Byp 28/Tsienneto Rd	No-Build	0.69	58.1	E	0.90	112.0	F	Current lane use
	Alternative A	0.64	33.6	C	0.80	23.8	C	Add 2nd EB/WB Th lanes
	Alternative B	0.54	32.4	C	0.59	33.0	C	Current lane use
	Alternative C	0.58	23.9	C	0.79	28.4	C	Current lane use
	Alternative D	0.56	25.2	C	0.60	22.9	C	Add 2nd EB/WB Th lanes
	Alternative F	0.74	32.4	C	0.87	34.8	C	Current lane use
#19 - NH 102/Tsienneto Rd, coord w/	No-Build *	0.53	24.9	C	1.53	247.7	F	LOS as unsignalized
#26 - NH 102/North Shore Rd	Alternative A	0.62	13.2	B	0.76	19.6	D	Add EB LT, WB RT lanes at signal
	Alternative B	0.60	11.0	B	0.61	9.9	A	Add EB LT, WB RT lanes at signal
	Alternative C	0.60	12.7	B	0.60	9.0	A	Add EB LT, WB RT lanes at signal
	Alternative D	0.63	12.1	B	0.65	6.9	A	Add EB LT, WB RT lanes at signal
	Alternative F*	0.30	24.3	C	1.46	247.5	F	LOS as unsignalized
#20 - Exit 4A SB off ramp/Connector Rd	No-Build		n/a/			n/a/		Does not exist
	Alternative A	0.97	41.2	D	0.88	28.9	C	2 SB LT lanes from off-ramp, 2 WB LT lanes to on-ramp
	Alternative B	1.04	52.3	D	0.94	34.6	C	2 SB LT lanes from off-ramp, 2 WB LT lanes to on-ramp
	Alternative C	0.73	20.1	C	0.65	18.3	B	2 SB LT lanes from off-ramp, 2 WB LT lanes to on-ramp
	Alternative D	0.70	19.2	B	0.63	18.2	B	2 SB LT lanes from off-ramp, 2 WB LT lanes to on-ramp
	Alternative F		n/a/			n/a/		Does not exist
#21 - Exit 4A NB off ramp/Connector Rd	No-Build		n/a/			n/a/		Does not exist
	Alternative A	0.93	20.4	C	0.84	16.1	B	EB - T,T; WB T,T,R,R; NB- LR,R
	Alternative B	0.97	27.5	C	0.88	15.8	B	EB - T,T; WB T,T,R,R; NB- LR,R
	Alternative C	0.65	7.9	A	0.58	7.1	A	EB - T,T; WB T,T,R,R; NB- LR,R
	Alternative D	0.59	5.7	A	0.53	5.1	A	EB - T,T; WB T,T,R,R; NB- LR,R
	Alternative F		n/a/			n/a/		Does not exist
#23 - B/C Connector Road/NH Bypass 28	No-Build		n/a/			n/a/		Does not exist
	Alternative A		n/a/			n/a/		Does not exist
	Alternative B	0.25	17.0	B	0.32	16.9	B	Prop lane use: EB- L,T,TR; WB- L,T,TR; NB-L,TR; SB-L,T,R
	Alternative C	0.37	18.5	B	0.46	20.4	C	Prop lane use: EB- L,TR; WB- L,TR; NB-L,TR; SB-L,T,R
	Alternative D		n/a/			n/a/		Does not exist
	Alternative F		n/a/			n/a/		Does not exist

Table 11 (Cont'd)
Summary of 2040 Capacity Analyses by Alternative
Signalized Intersections

Intersection	2040 Alternative	AM Peak Hour v/c ratio	AM Peak Hour Average Delay	AM Peak Hour LOS	PM Peak Hour v/c ratio	PM Peak Hour Average Delay	PM Peak Hour LOS	Comments/ Lane Use Revisions
#25 - C/D Connector Road/NH 28	No-Build		n/a/			n/a/		Does not exist
	Alternative A		n/a/			n/a/		Does not exist
	Alternative B		n/a/			n/a/		Does not exist
	Alternative C	0.81	10.6	B	0.79	12.2	B	Prop lane use: EB- L,T,T; WB- T TR, SB- L,R
	Alternative D	0.96	13.7	B	0.87	14.1	B	Prop lane use: EB- L,T,T; WB- T TR, SB- L,R
	Alternative F		n/a/			n/a/		Does not exist

#1 – Exit 4 SB off-ramp at NH Route 102
The results show that this ramp terminal as presently proposed will still experience capacity constraints into the 2040 design horizon. All 4A Build interchange alternatives appear to function better than No-Build, with Alternatives A and B doing better than the northerly or no interchange alternatives, even though they both have a higher potential development scenario for Woodmont Commons than the others. The heavy SB right turn onto NH Route 102 from the ramp, even with two lanes, combined with heavy WB flow from the NB ramps located to the east, contribute to the decline in LOS. The single left turn lane from the off-ramp also appears insufficient to handle the peak hour demands.

#2 – Exit 4 NB ramps at NH Route 102
The results show that this ramp terminal as presently proposed will also experience capacity constraints into the 2040 design horizon. All 4A Build interchange alternatives improve 2040 AM peak hour operations, with Alternatives C and D doing slightly better than Alternatives A and B in the PM peak. The heavy EB left-turn onto the on-ramp, even with two lanes, is the dominant volume at this location, as well as the NB left turn from the off-ramp. Alternatives C and D appear to operate at a slightly better LOS, but the Woodmont Commons development scenario is also less intense in these cases than under Alternatives A and B. Alternative F fares worse than any of the alternatives as proposed.

#3 – Exit 5 SB ramps at NH Route 28
The results show that this ramp terminal as presently proposed will still experience some capacity constraints into the 2040 design horizon. All 4A Build interchange alternatives provide better operations than the No-Build condition. The single WB left turn and SB right-turn lanes appear to be the constraints to better operations across all alternatives. Alternatives C and D appear to function better than No-Build or the southerly or no interchange alternatives, likely because of their proximity to this interchange and the increased likelihood of diverting some of the traffic demand, as opposed to the other alternatives.

#4 – Exit 5 NB ramps at NH Route 28
The results show that this ramp terminal as presently proposed will also experience capacity constraints into the 2040 design horizon. All 4A Build interchange alternatives provide slightly better operations than under No-Build conditions. The heavy EB left-turn demand onto the on-ramp in a single lane, as well as the single-lane NB left turn from the off-ramp, are the critical movements at this intersection. Alternatives C and D appear to operate at a slightly better LOS than Alternatives A and B, again because of their proximity to this interchange and increased likelihood of diverting some of the traffic demand. Alternative F fares worse than any of the alternatives as proposed.

#5 – NH Route 102/Londonderry Road/St. Charles Street
With the addition of a second east-west through lane on NH Route 102 as part of the proposed Woodmont Commons improvements, this intersection would operate at acceptable LOS under all alternatives. Alternative F would operate slightly worse than the other alternatives, because of projected increased traffic on NH Route 102, but would still be at an acceptable LOS.

#6 – NH Route 102/Fordway/ Madden Hill Road
This existing intersection would operate at acceptable LOS under all alternatives except Alternative F. Alternative A appears to draw more traffic to the Madden Hill Road approach that opposes the heavy Fordway volumes on the same permissive phase (where both approaches have a concurrent green light and must wait for gaps in opposing traffic to proceed), so it operates slightly worse than the other interchange alternatives, particularly in the 2040 PM peak. Alternative F would necessitate provision of lane separation out of Fordway as well as an exclusive EB right-turn lane to maintain an acceptable LOS.

#7 - NH Routes 102/28
Based solely on the capacity calculations, this existing intersection would operate at acceptable LOS under all alternatives except Alternative F. As noted earlier, there are many other unquantifiable factors in the downtown area, such as pedestrian activity and friction from side street and on-street parking maneuvers, that contribute to reduced traffic speeds and the general diversion/avoidance of the area by through traffic to other routes such as Ash Street Extension, North High Street, Folsom Road, and Tsienneto Road.

The traffic model indicates that Alternative A appears to draw more traffic to the eastern part of downtown that then makes a right turn to NH Route 28 in the direction of Exit 4A and the Woodmont Commons development. In reality, much of this traffic may divert to the traffic circle to the east and use the Pinkerton/Tsienneto corridor to complete such a trip. Other Build alternatives show similar operational/LOS characteristics than under No-Build conditions. With additional traffic through the downtown area and no interchange option, Alternative F would necessitate provision of a second NB left-turn lane, an EB exclusive right-turn lane, and a second WB thru lane to maintain an acceptable LOS in the 2040 design horizon.

#9A - Alternative A Connector Road/North High Street
This new intersection is created by the Alternative A connector road with the local street network. The existing intersection of North High Street with Madden Road would be relocated off the new connector road as a minor roadway serving the small number of residences there. It is envisioned that this new intersection would need to be signalized and widened to provide acceptable operations, given the projected traffic volumes. The Connector Road eastbound approach would consist of two thru lanes and an exclusive right-turn lane to North High Street. The Connector Road westbound approach would consist of an exclusive left-turn lane and two thru lanes. The North High Street northbound approach would

consist of two left-turn lanes and a right-turn lane. Given the projected volumes and this lane use, this intersection would operate at a LOS D in the 2040 PM peak hour.

#10 - Alternative A Connector Road/Franklin Street/Franklin Street Extension
This existing intersection is presently unsignalized and operates at a poor LOS for the north/south side street approaches, which experience difficulty entering the main traffic flow during peak periods. With the increase in development activity nearby, this condition would be exacerbated into the future to the point where there may need to be consideration of additional improvements to provide acceptable operations, even with other interchange alternatives beyond Alternative A.

With the Alternative A connector road in place, this intersection will require significant widening and signalization to provide sufficient lanes to handle the project volumes as a direct result of Exit 4A. The east/west approaches would have at least two thru lanes (the projections suggest a third lane may be needed for the eastbound approach) with exclusive left-turn lanes. The north/south approaches would have two lanes with an exclusive lane oriented to the west to handle the projected traffic. This configuration would operate at a LOS C in the 2040 PM peak hour.

#11 - Ross' Corner (NH Route 28/Folsom Road/Tsienneto Road)
This intersection was upgraded several years ago to provide a second southbound left-turn lane from NH Route 28 onto Tsienneto Road to serve the predominant southbound-to-eastbound travel demand between I-93 and Derry and points to the east. With the projected growth to 2040, the existing lane geometry will no longer be sufficient to meet the expected traffic demands.

With an Exit 4A interchange in place, and with the Alternative A connector road in particular, the existing north-south traffic orientation now becomes an east-west flow. As such, improvements to handle the increase east-west travel demand will be required. With Alternative A, a second EB left-turn lane and second EB thru lane will be needed, as well as a second WB thru lane, to provide an acceptable LOS. Alternatives B and C are on a new east-west alignment north of this intersection so no changes to the existing lane use are required. With Alternative D, the interchange is north of this intersection, so movements oriented in that direction will need to be augmented. This means the addition of a second EB left-turn lane and second WB right-turn lane at this location. Alternative F maintains the existing traffic distribution, and the existing lane use can accommodate the projected traffic volumes.

#12 - Tsienneto Road/Pinkerton Street (Alternatives A and D only)
This intersection is in close proximity (300 feet +/-) from the Ross' Corner signal, but is not currently signalized. As such, left-turn exits experience lengthy delays while waiting for a gap in the Tsienneto Road traffic flow. The eastbound right-

turn movement has been separated from the main traffic stream by a channelizing island to help exiting traffic, but the opposing traffic flow limits the number of available gaps for exiting traffic. At some point in the future, regardless of this project, this intersection may need to be signalized and coordinated with the Ross' Corner signal, but there are no defined plans to do that at this time. Therefore, except for those alternatives that directly impact this intersection, namely Alternatives A and D, the intersection is assumed to remain unsignalized and is expected to operate at a poor LOS for the minor street approach from Pinkerton Street.

For Alternatives A and D, a second lane for thru traffic would be provided in both the eastbound and westbound directions, as well as an exclusive westbound left-turn lane into Pinkerton Street. With this geometry and coordinated phasing with Ross' Corner as a cluster intersection, this location would operate at an acceptable LOS C or better in the 2040 design year.

#13 - NH Route 28/Linlew Drive
No changes to the existing lane use at this intersection are required to accommodate traffic volumes under any of the proposed alternatives.

#14/22 - NH Route 28/Ashleigh Drive/Alternative B-C Connector Road
This intersection would see significant changes depending on which alternative would be in place. For Alternatives B and C, the proposed connector road would create a new east-west roadway that would require reconfiguration of lanes to accommodate the new distribution of traffic for either a southerly or northerly interchange. Under Alternative B, the new roadway would need two thru lanes in the east-west direction, as well as double-turn lanes to and from NH Route 28 to the south, along with other lane use changes. With Alternative C, a double SB left-turn lane into Ashleigh Drive would be needed to serve traffic from the new interchange to the north and the connector road, among other lane use changes. An acceptable LOS C or better can be provided for all alternatives with the appropriate revisions to the lane use.

#18 - NH Route 28 Bypass/Tsienneto Road
The 2040 No-Build analysis shows that the existing intersection would operate at or over capacity during both peak hours, so some improvements would appear to be needed at some point in the future. Alternatives B and C reduce east-west traffic through this intersection, so the existing lane use can provide an acceptable LOS D or better in 2040. Alternatives A and D will require the addition of a second east-west thru lane to accommodate the increased east-west traffic at an acceptable LOS.

#19/26- NH Route 102/Tsienneto Road/North Shore Road (Alternatives A-D)
A review of the existing traffic counts at the North Shore Road and English Range Road intersections indicate that existing 2015 left-turn volumes currently satisfy turn-lane warrants at both locations. As such, any improvements at the Tsienneto

Road/NH Route 102 intersection associated with any of the alternatives should take this into consideration in the design.

Because existing PM peak analyses already indicate a poor LOS for exiting traffic, combined with the projected increase in left-turn volumes exiting Tsienneto Road, it has been assumed that this location will need to be signalized as part of any interchange alternative. Because of the proximity of North Shore Road, that intersection would be incorporated into the signalized intersection, similar to Ross' Corner and Pinkerton Street. An exclusive right-turn lane would be provided for NH Route 102 WB traffic entering Tsienneto Road, as well as a WB left-turn lane into North Shore Road. This left-turn lane would also be carried easterly towards the English Range Road intersection for continuity, where an EB left turn lane would be provided. There would still only be a single lane exiting Tsienneto Road, despite the higher volumes, because of the complexity of accommodating a double left-turn lane onto NH Route 102 and then tapering back to a single lane with North Shore Road being so close.

With signalization of the intersection as proposed, an acceptable LOS C or better can be provided for all interchange alternatives in the 2040 design horizon.

#20/21 - Exit 4A SB and NB Ramp Terminals (Alternatives A-D)
With either a northerly or southerly interchange, it is envisioned that both ramp terminals would be signalized as part of the diamond configuration. The SB off-ramp would have two lanes exiting the ramp, while there would be two lanes provided for the left turn onto the SB on-ramp. This ramp would be close to capacity in the 2040 AM peak hour, assuming full realization of the traffic projections on the SB off-ramp.

At the NB ramps, there would be two east-west thru lanes with a single EB left-turn lane and double WB right-turn lanes onto the NB on-ramp. On the off-ramp, there would be a shared left/right lane and an exclusive right-turn lane, since there is no access to the west. An acceptable LOS D or better can be provided at this ramp terminal under all interchange alternatives.

#23 - NH Route 28 Bypass/B-C Connector Road (Alternatives B and C)
This new intersection is created by the connector road roughly along the alignment of the existing Ashleigh Drive. With Alternative B, two east-west thru lanes need to be provided so that an acceptable LOS C can be achieved. Only one east-west thru lane is required with Alternative C because of less overall traffic volume through the intersection.

#25 - C-D Connector Road/NH Route 28 (Alternatives C-D)
This new intersection is created by the connector road from the northerly interchange where it would intersect with the existing two-lane section of NH Route 28 just north of the Derry/Londonderry town line. NH Route 28 southbound would become the minor approach to the intersection and would have

separate left- and right-turn lanes. The EB approach would have an exclusive left lane and two thru lanes, while the WB approach would have a thru lane and a shared thru/right lane. This configuration would provide a LOS B during the 2040 peak hours.

16. Unsignalized Intersections

A summary table showing a comparison of operations at each existing or proposed unsignalized intersection is provided in Table 12. In most cases, the existing or projected deficiencies for the minor street approaches are exacerbated, except where traffic diversions may reduce the volume of traffic on the major approach that would conflict with traffic turning from the minor street approach(es).

It is not envisioned that any of these intersections would warrant signals, except those that are directly impacted by a specific alternative, such as Tsienneto Road/Pinkerton Street or NH Route 102/Tsienneto Road/North Shore Road. Delays at the North High Street /Ash Street Extension and the North High Street/Folsom Road/Franklin Streets locations are excessive and should be monitored as the Woodmont Commons development progresses to determine if and when signal warrants may be satisfied.

Table 12
Summary of 2040 Capacity Analyses by Alternative
Unsignalized Intersections

Intersection	2040 Alternative	AM Peak Hour v/c ratio	AM Average Delay	AM LOS	PM Peak Hour v/c ratio	PM Average Delay	PM LOS	Comments/ Lane Use Revisions
#8 - N High St/Ash St Ext (Critical Movement - EB LT)	No-Build	1.04	78.0	F	3.04	>300	F	
	Alternative A	0.53	17.4	C	1.47	228.8	F	
	Alternative B	0.42	14.3	B	0.96	56.5	F	
	Alternative C	0.76	29.3	D	1.09	90.6	F	
	Alternative D	0.74	25.7	D	1.70	>300	F	
	Alternative F	0.74	27.1	D	1.79	>300	F	
#10 - N High/Folsom/Franklin Sts. (Critical Movement varies between NB and SB)	No-Build	0.20	21.8	C	0.55	82.0	F	NB all is critical
	Alternative A		n/a/			n/a/		Signalized
	Alternative B	0.94	96.5	F	3.00+	>300*	F	NB all is critical
	Alternative C	1.35	219.6	F	3.31	>300*	F	SB all is critical
	Alternative D	0.22	10.9	B	1.21	160.2	F	
	Alternative F	0.36	31.7	D	2.31	>300	F	NB critical in AM, SB critical in PM
#12 -Tsienneto Rd/Pinkerton St (Critical Movement - NW LT)	No-Build	0.25	16.1	C	0.97	84.0	F	
	Alternative A		n/a/			n/a/		Signalized
	Alternative B	0.89	80.0	F	1.00	126.4	F	
	Alternative C	2.04	>300*	F	2.54	>300*	F	
	Alternative D		n/a/			n/a/		Signalized
	Alternative F	0.65	66.1	F	4.10	>300	F	
#15 - NH 28/Scobie Pond Rd (Critical Movement - SB all)	No-Build	1.01	144.7	F	0.58	32.2	D	
	Alternative A	0.18	14.4	B	0.19	16.4	C	
	Alternative B	0.18	13.3	B	0.23	16.5	C	
	Alternative C	0.67	>300*	F	4.44	>300*	F	
	Alternative D	1.34	>300*	F	6.67	4259.8*	F	
	Alternative F	0.31	27.4	D	0.47	51.0	F	
#16 - NH 102/NH Byp 28/E Derry Rd (Traffic Circle-RT only) (HCM 2010) (Critical Movement - E Derry Rd)	No-Build	0.87	31.9	D	1.26	151.2	F	
	Alternative A	1.11	94.0	F	0.92	41.9	E	
	Alternative B	0.77	21.4	C	0.68	16.4	C	
	Alternative C	0.73	18.8	C	0.78	21.7	C	
	Alternative D	0.84	28.3	D	0.89	33.6	D	
	Alternative F	0.91	40.1	E	1.21	128.7	F	
#17 - NH Byp 28/Pinkerton/Nesmith (HCM 2010) (Critical Movement - WB all)	No-Build	-	-	F	-	-	F	Left turns from Nesmith
	Alternative A	1.01	138.9	F	0.52	55.3	F	
	Alternative B	1.13	188.1	F	0.53	57.3	F	
	Alternative C	0.96	127.6	F	0.41	41.7	E	
	Alternative D	1.35	280.7	F	0.63	78.3	F	
	Alternative F	0.45	26.2	D	0.46	49.1	E	
#24 - B/C Connector Rd/Tsienneto Road (Critical Movement - NB LT)	No-Build		n/a/			n/a/	-	Does not exist
	Alternative A		n/a/			n/a/	-	Does not exist
	Alternative B	0.09	38.9	E	0.00	0.0	A	
	Alternative C	0.00	0.0	A	0.00	0.0	A	
	Alternative D		n/a/			n/a/	-	Does not exist
	Alternative F		n/a/			n/a/		Does not exist

Table 12 (Cont'd)
Summary of 2040 Capacity Analyses by Alternative

Unsignalized Intersections

- Intersection	2040 Alternative	AM Peak Hour v/c ratio	AM Peak Hour Average Delay	AM Peak Hour LOS	PM Peak Hour v/c ratio	PM Peak Hour Average Delay	PM Peak Hour LOS	- Comments/ Lane Use Revisions
#27 - NH 102/English Range Road	No-Build		n/a/			n/a/	-	
(Critical Movement - SEB all)	Alternative A	0.17	20.8	C	0.16	28.4	D	
	Alternative B	0.23	24.5	C	0.22	26.1	D	
	Alternative C	0.17	20.8	C	0.23	42.1	E	
	Alternative D	0.17	21.0	C	0.18	32.8	D	
	Alternative F	0.17	20.8	C	0.16	28.4	D	

* - calculated delay exceeds 300s

17. Findings and Conclusions

The results of the traffic modeling for the Project indicates that the provision of a new interchange on I-93 will provide varying levels of traffic relief to NH Route 102 east of Exit 4 and into the downtown Derry area by the 2040 design year, as shown in Table 7.

Examples on key links include:

- NH Route 102 east of Exit 4: In the 2040 No-Build case, there is projected to be 41,725 vpd on this segment. Alternative A provides the most relief on this segment (-51.5%) to a volume of 20,240 vpd, which is the same magnitude as the 2015 base volume. Alternative B shows a 48% reduction, while Alternatives C and D show lesser reductions. Alternative F shows a slight increase in projected traffic than any interchange alternative.
- NH Route 102 east of Griffin Street (downtown): Alternatives A, B and C show similar reductions, on the order of 19-21%, or 3000-4000 vpd, over 2040 No-Build conditions. Alternative D shows a lesser reduction, but still lower volume than the 2015 base. Alternative F projects higher volumes than any interchange alternative and would be higher than either the 2015 or 2040 No-Build case.
- Volumes on the Exit 4 ramps are lower under most interchange alternatives, with Alternative A providing the most overall relief over No-Build conditions, even under the highest potential development scenario for the Woodmont Commons development.
- Volumes on the Exit 5 ramps see the highest traffic reductions under Alternatives C and D (northerly interchange) than under a southerly interchange scenario.

Mainline freeway facilities operational analyses indicates that the four-lane I-93 mainline will function at an acceptable LOS C or better under all scenarios, with a couple of exceptions where two-lane on- or off-ramps may be needed to accommodate all projected volumes. A sensitivity analyses of the Exit 4A SB off-ramp indicated that a 200-vph reduction in the assigned traffic would allow this ramp to function as a single lane off-ramp if these traffic projections are not fully realized.

The Exit 4 ramps would have slightly higher volumes under either Alternatives A or B, but this is more reflective of the higher potential development scenario assumed for the Woodmont Commons development than for Alternatives C, D or F, which use the same scenario as the No-Build condition. As noted earlier, should the 23% internal capture rate for Woodmont Commons trips be realized in some form, the number of trips assigned to the study area network may be reduced accordingly, which should result in better traffic operations than the worse-case scenario assumed in this study.

The level of intersection improvements needed to accommodate the alternative and connector road corridors vary greatly depending on alternative. In general, all intersections can provide an acceptable LOS under any alternative with appropriate lane use and signalization/coordination as required. The traffic circle at NH Route 102/NH Route 28 Bypass will continue to function at a poor LOS regardless of alternative.

In summary, from a purely traffic standpoint, Alternatives A appears to best satisfy the Purpose and Need for the Project by providing the greatest reductions in NH Route 102 traffic through downtown Derry than the other alternatives evaluated. Volumes on NH Route 102 just east of Exit 4 would be roughly half of 2040 No-Build levels and similar to existing (2015) conditions. Alternative B provides some relief as well, but primarily serves a north-south trip pattern as opposed to the east-west pattern needed to reduce traffic on NH 102 in downtown Derry. Alternatives C and D would provide some, but not as much, relief to the NH Route 102 corridor, because of the increased distance between these northerly interchange alternatives and the NH Route 102 corridor.

Other natural and cultural resource impact criteria will be used to provide the final assessment of the Preferred Alternative, but the previous finding of Alternative A as the Preferred Alternative from a traffic standpoint is supported by the updated analyses contained herein.

18. References

AASHTO (American Association of State Highway Transportation Officials). 2011. Policy on Geometric Design of Highways and Streets. American Association of State Highway Transportation Officials. Washington DC, 2011.

CLD, 2018, Traffic Technical Memo, Estimate of Contribution of Woodmont Commons Traffic to Exits 4 and 4A, February 5, 2018

FHWA. 2007. I-93 Exit 4A Interchange Study Derry-Londonderry Draft Environmental Impact Statement. July 2007.

Google 2018, Google Inc. Google Maps, Accessed January, 2018

Louis Berger. 2017. Land Use Scenarios Technical Report.

Louis Berger, 2018, Interstate Justification Report, April, 2018

McTrans, 2018. McTrans Center, University of Florida, Highway Capacity Software (HCS), Version 6.90, 2018,

NHDOT, 2009, Supplemental Environmental Impact Statement and Reevaluation/Section 4(f) Evaluation, August 2009, Tables 4-12 and 4-13.

NHDOT. 2016a. Bureau of Traffic, Traffic Reports. https://www.nh.gov/dot/org/operations/traffic/tvr/routes/documents/i-93.pdf.

NHDOT. 2016b. Bureau of Traffic, Traffic Reports. Available at: https://www.nh.gov/dot/org/operations/traffic/tvr/routes/documents/nh-28.pdf.

NHDOT. 2016c. Bureau of Traffic, Traffic Reports. Available at: https://www.nh.gov/dot/org/operations/traffic/tvr/routes/documents/nh-102.pdf.

NHDOT, 2016d. Bureau of Traffic, Seasonal Adjustment Factor report, 2015

NHDOT, 2016e. Email from John Butler (NHDOT) to CLD, dated November 7, 2016

NHDOT, 2016f. Email from John Butler (NHDOT) to CLD, dated July 21, 2016

NHDOT. 2017a. Email from John Butler (NHDOT) to CLD, dated May 25, 2017

NHDOT. 2017b. Email from John Butler (NHDOT) to CLD, dated March 8, 2017

NHDOT. 2017c. Email from Nick Sanders (NHDOT) to CLD, dated October 12, 2017

NHDOT. 2017d. Email from John Butler (NHDOT) to CLD, dated June 20, 2017

NHDOT. 2018. FY 2018 – FY 2028 Ten Year Plan. Available at: https://www.nh.gov/dot/org/projectdevelopment/planning/typ/documents/20180116-10-year-transportation-recommendations.pdf.

SNHPC. 2017. FY 2017 – FY 2040 Regional Transportation Plan for the Southern New Hampshire Planning Commission. Available at: http://www.snhpc.org/pdf/FinalRegionalTransportationPlan2017-2040.pdf.

TEC, 2013. Woodmont Commons Planned Unit Development, A Master Plan, Section 4.2 Master Plan Traffic Impact Assessment – Supplemental Documents, Sept. 2013.

Trafficware 2016. Trafficware, LLC, Sugarland TX, Synchro plus Sim-Traffic. Version 9, 1998-2016

Transportation Research Board (TRB), 2000. Highway Capacity Manual, 2000

Transportation Research Board (TRB), 2010. Highway Capacity Manual, 2010

Transportation Research Board (TRB), 2016. Highway Capacity Manual (HCM6), 2016, Chapter 22, Roundabouts

Figure 1 - I-93 Exit 4A Supplemental Draft EIS - Alternative

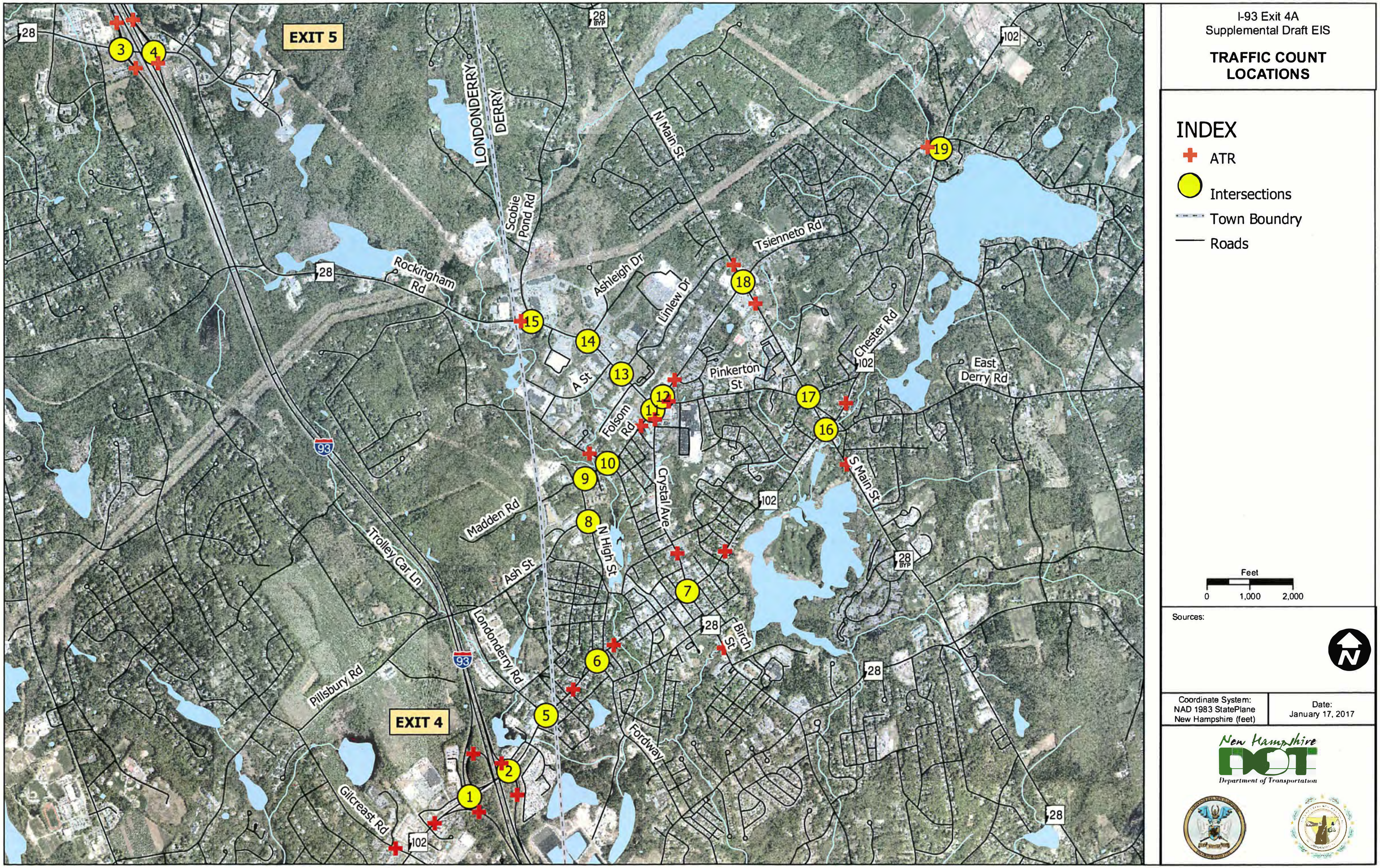
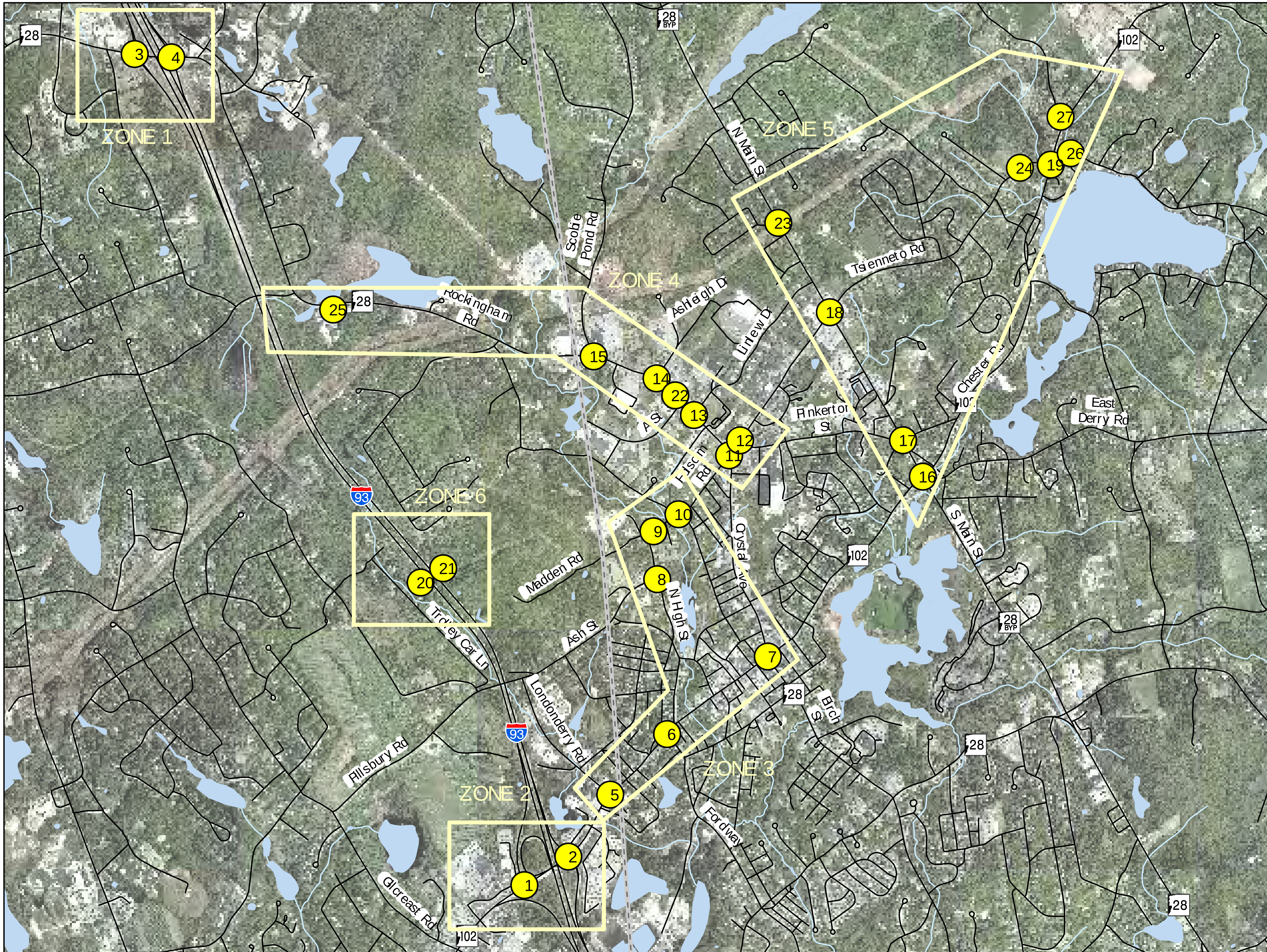


Figure 2 - Traffic Count Locations



I-93 Exit 4A
Supplemental Draft EIS

INDEX

1. Exit 4 SB Ramps
2. Exit 4 NB Ramps
3. Exit 5 SB Ramps
4. Exit 5 NB Ramps
5. NH 102/ Londonderry Road
6. NH 102/ Fordway/ High St.
7. NH 102/ NH 28
8. N. High St./ Ash St. Extension
9. N. High St./ Madden Rd.
10. N. High St./ Folsom Rd./ Franklin St
11. NH 28/ Folsom Rd./ Tsienneto Rd.
12. Tsienneto Rd./ Pinkerton St.
13. NH 28/ Linlew Dr.
14. NH28/ Ashleigh Dr.
15. NH 28/ Scobie Pond Rd.
16. NH 102/ NH 28 Bypass/ E. Derry Rd.
17. NH 28 Bypass/ Pinkerton St.
18. NH 28 Bypass/ Tsienneto Rd.
19. NH 102/ Tsienneto Rd.
20. Exit 4A SB Ramps
21. Exit 4A NB Ramps
22. NH 28/ B-C Connector
23. NH 28 Bypass/ B-C Connector
24. Tsienneto Rd/ B-C Connector
25. NH 28/ C-D Connector
26. NH 102/ North Shore Rd
27. NH 102/ English Range Rd

Feet
0 1,000 2,000

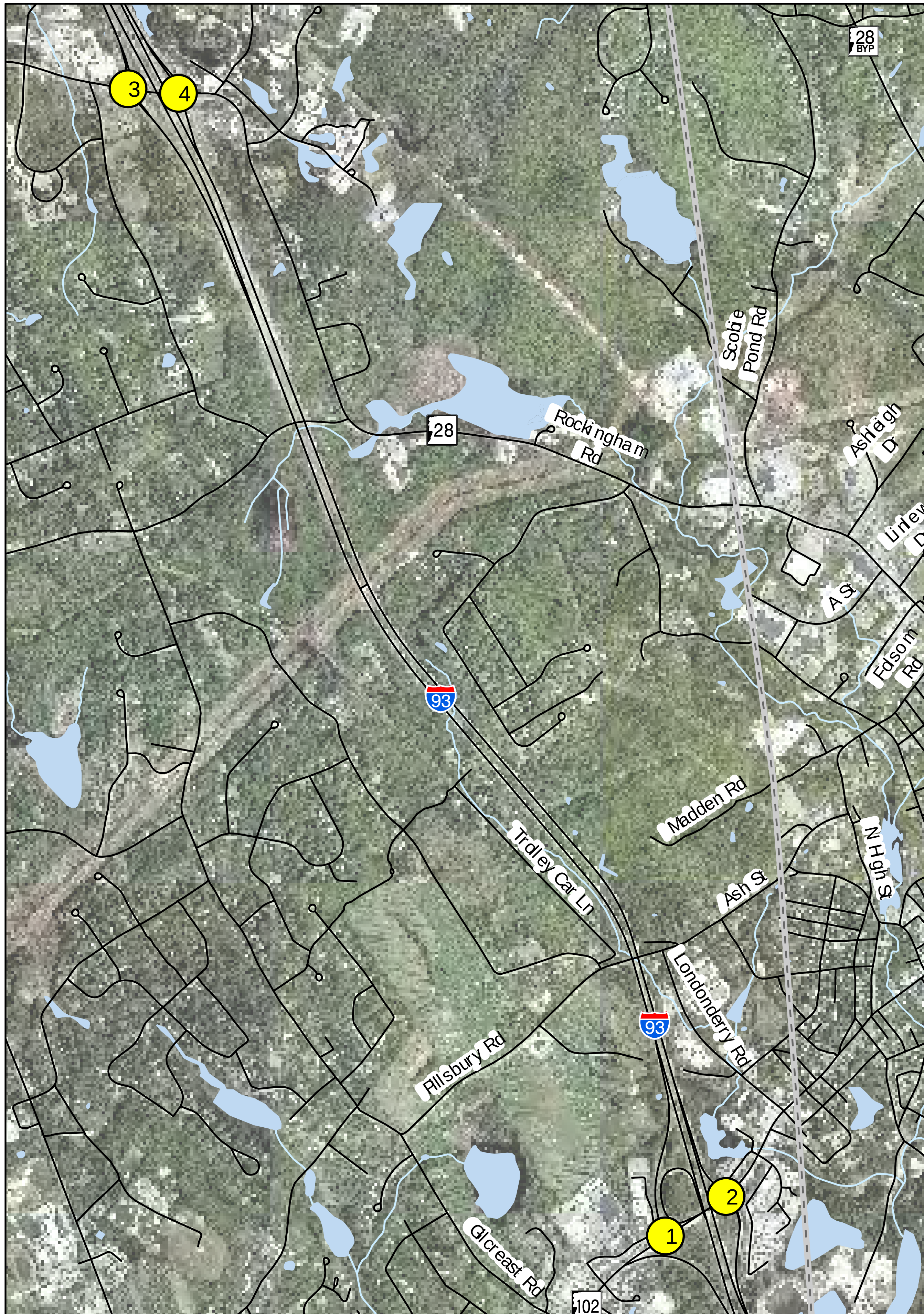
Sources:

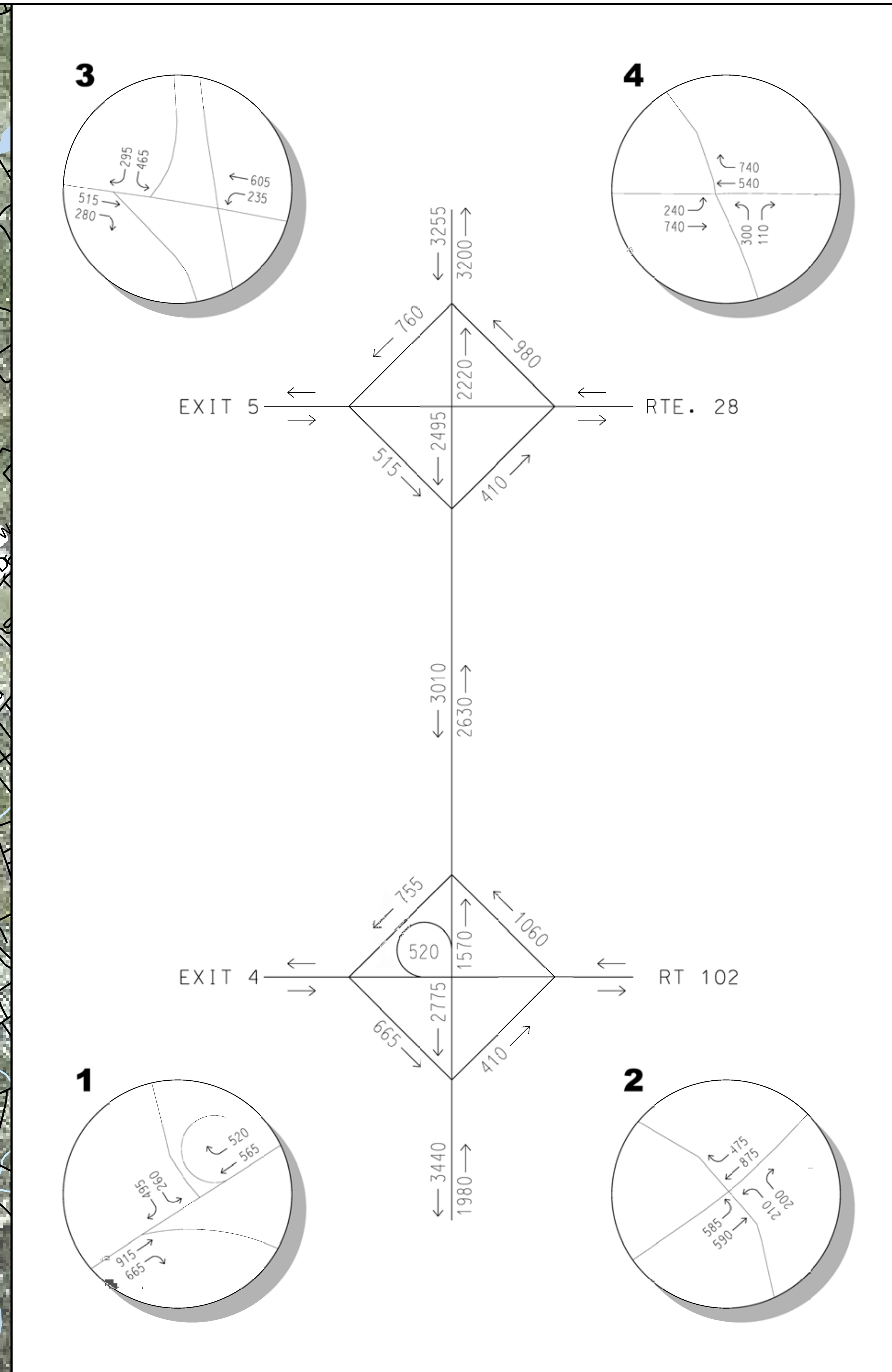
Coordinate System:
NAD 1983 StatePlane
New Hampshire (feet)

Date:
January 24, 2018

New Hampshire DOT
Department of Transportation

Figure 3 - I-93 Exit 4A Supplemental Draft EIS – Zones 1-6 Locus Map





I-93 Exit 4A
Supplemental Draft EIS

2015 NO-BUILD AM PEAK HOUR BASE VOLUMES

INDEX

1. Exit 4 SB Ramps
2. Exit 4 NB Ramps
3. Exit 5 SB Ramps
4. Exit 5 NB Ramps

Feet

0 1,000 2,000

Sources:

Coordinate System:
NAD 1983 StatePlane
New Hampshire (feet)

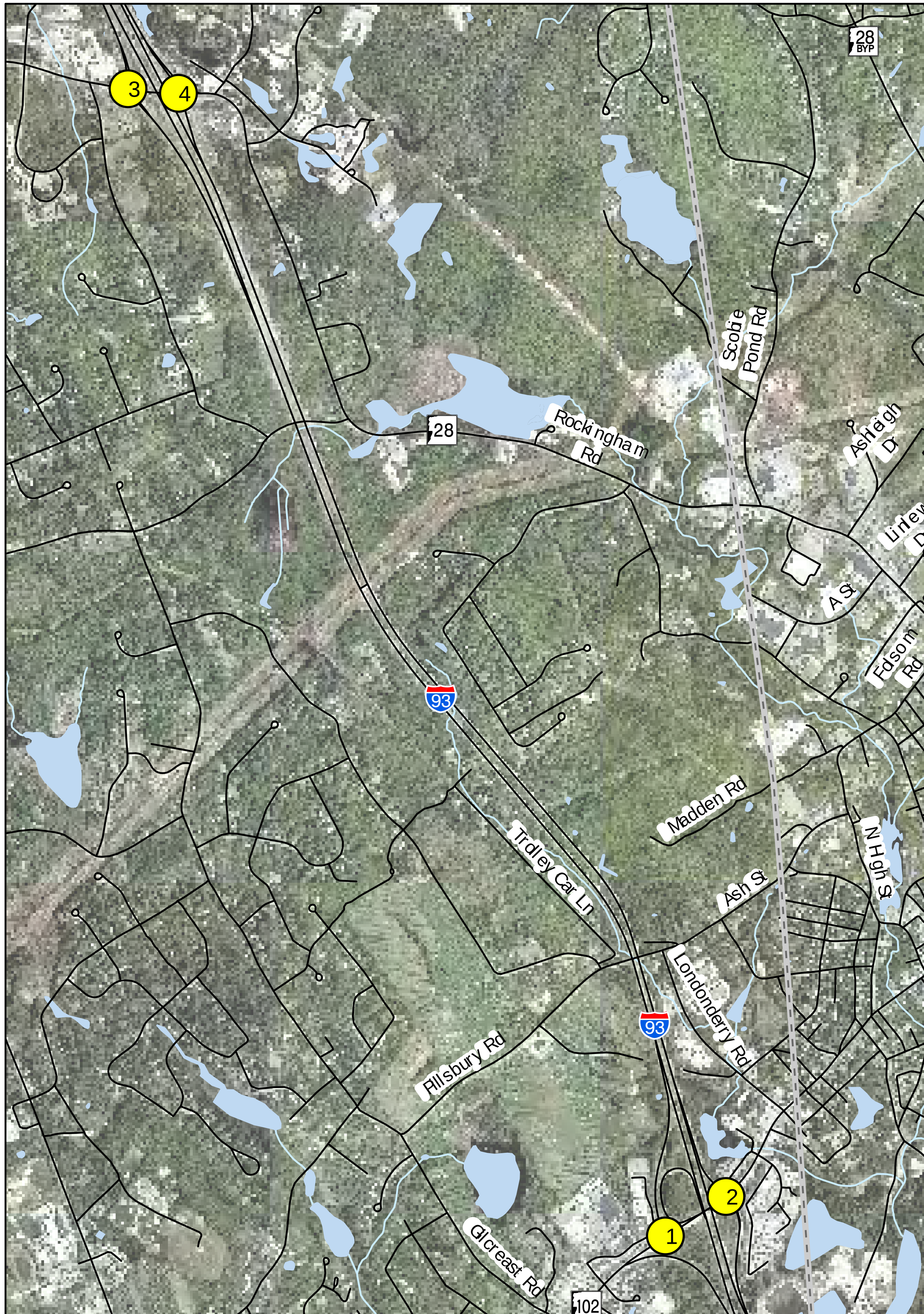
Date:
January 24, 2018

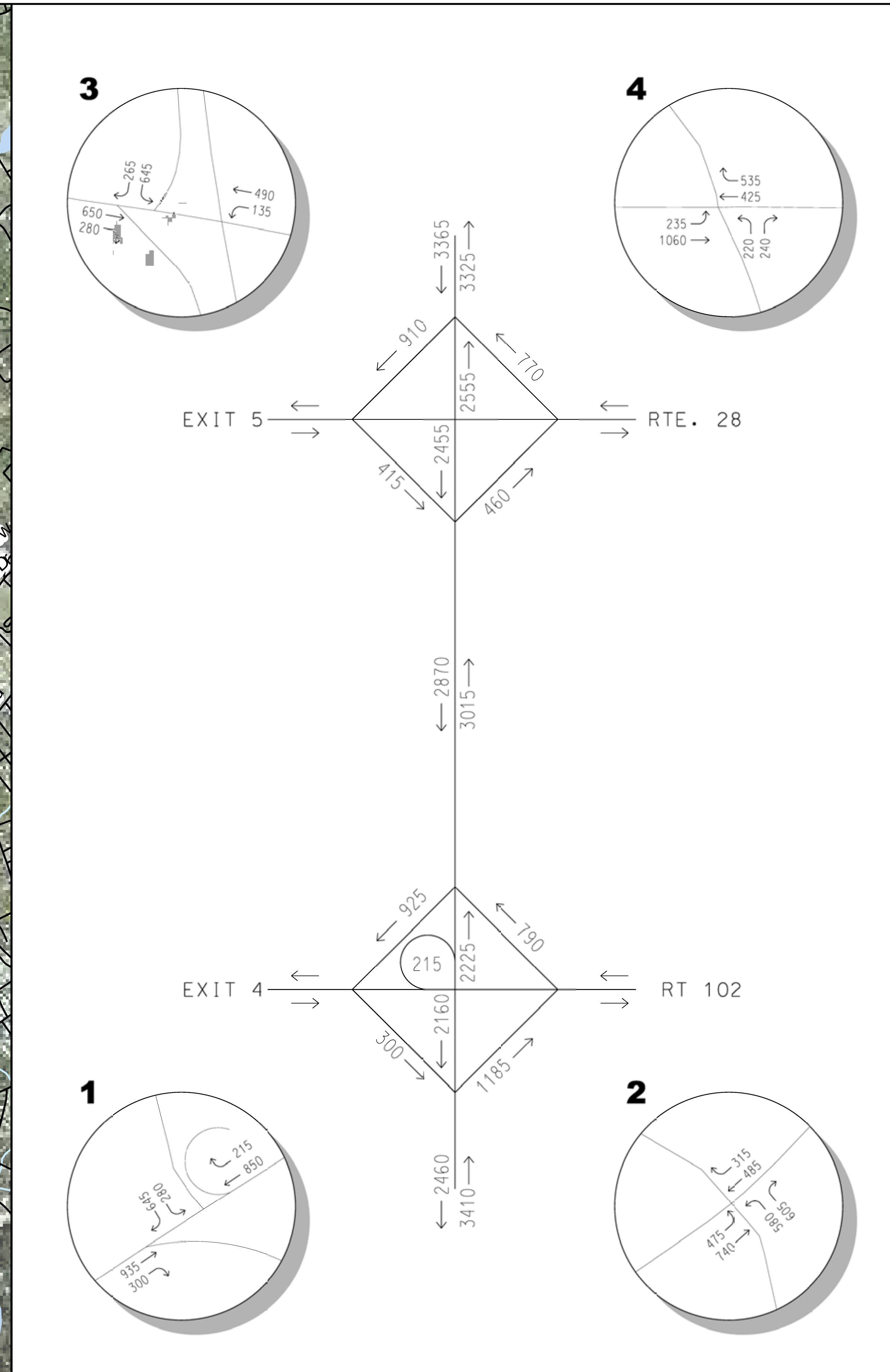
New Hampshire DOT
Department of Transportation

Figure 4 - 2015 No-Build AM Peak Hour Base Volumes - Locations 1-4

I-93 Exit 4A
Supplemental Draft EIS

2015 NO-BUILD PM PEAK HOUR BASE VOLUMES





INDEX

1. Exit 4 SB Ramps
2. Exit 4 NB Ramps
3. Exit 5 SB Ramps
4. Exit 5 NB Ramps

Feet
0 1,000 2,000

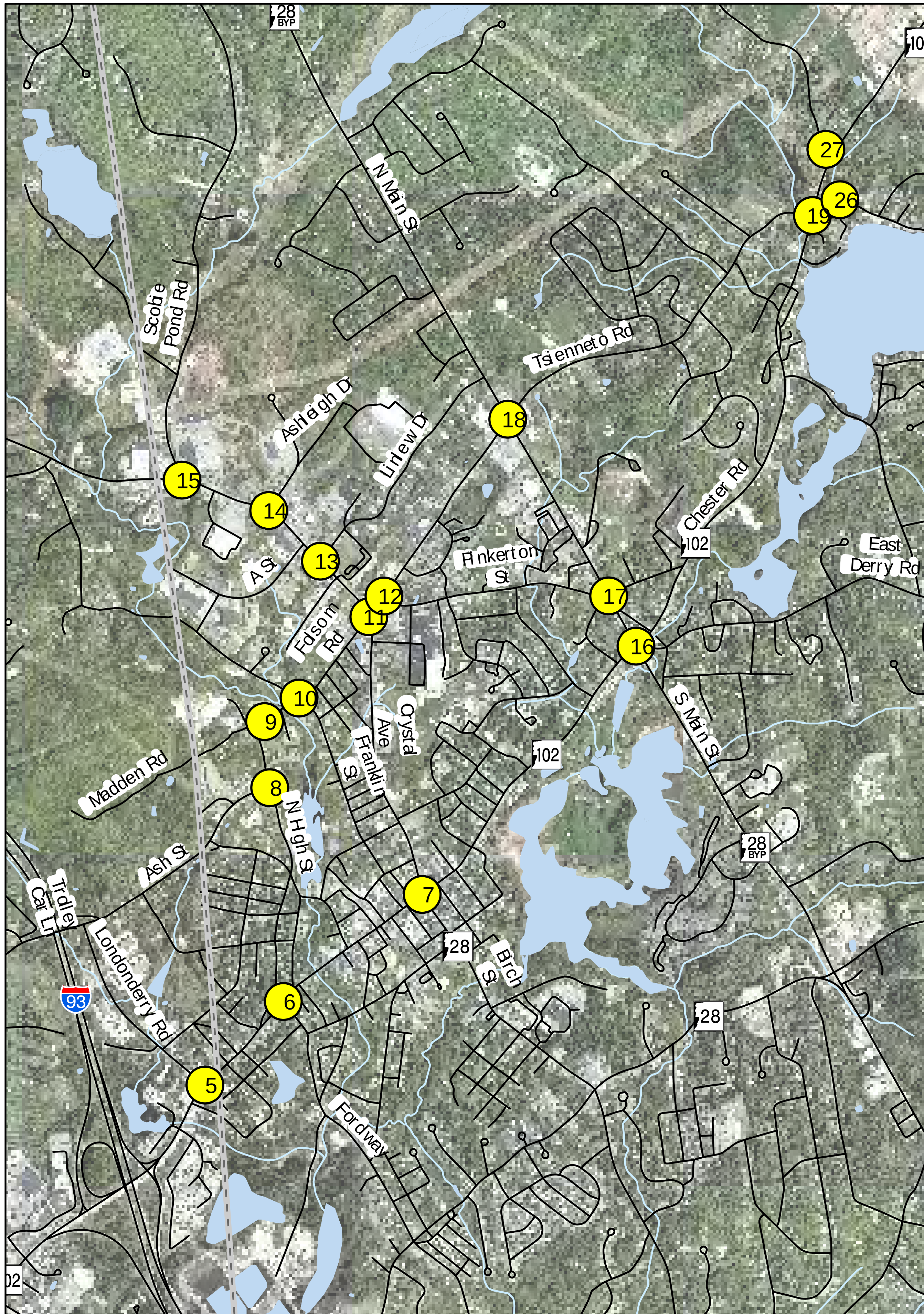
Sources:

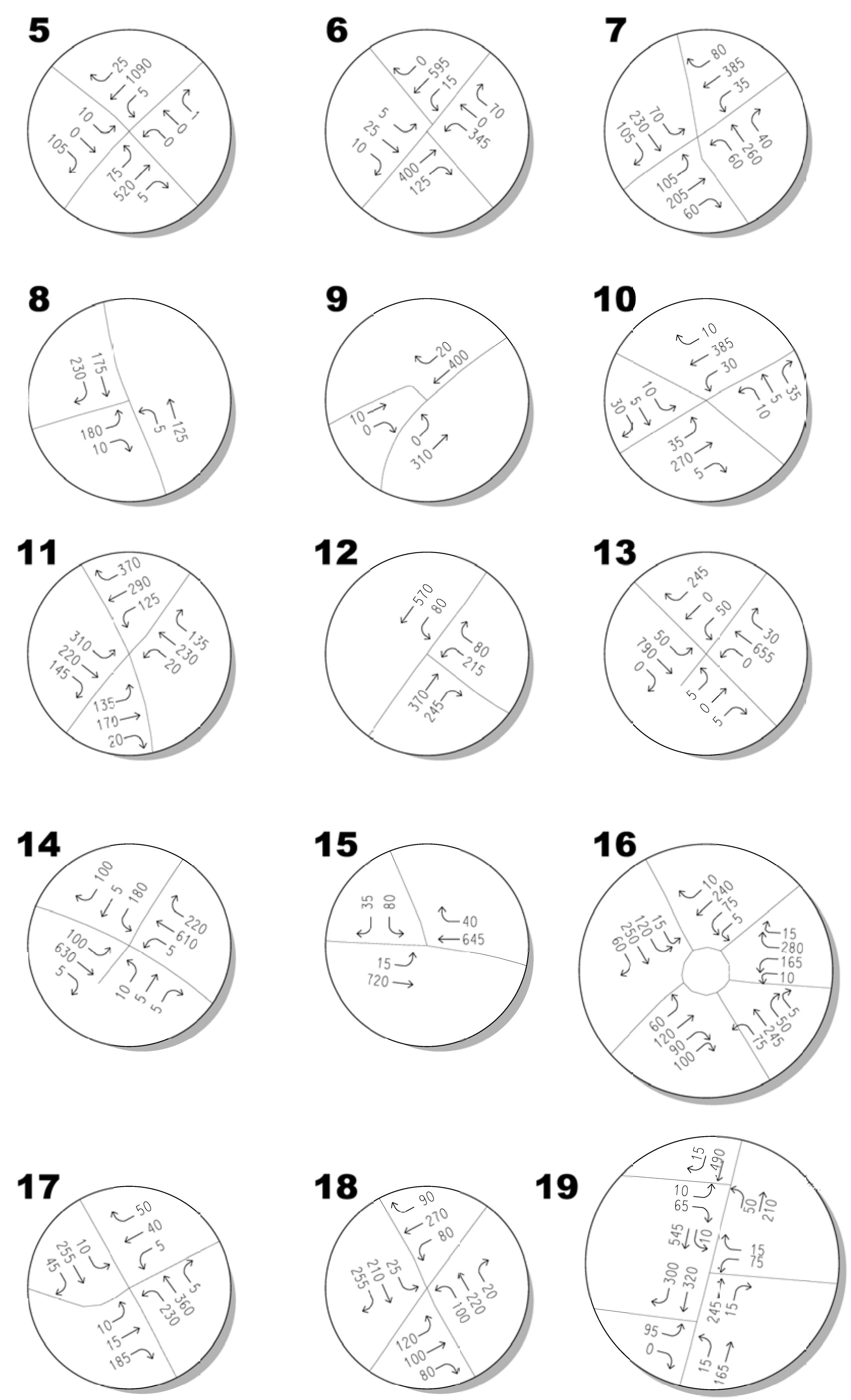
Coordinate System:
NAD 1983 StatePlane
New Hampshire (feet)

Date:
January 24, 2018

New Hampshire DOT
Department of Transportation

Figure 5 - 2015 No-Build PM Peak Hour Base Volumes – Locations 1-4





I-93 Exit 4A
Supplemental Draft EIS

2015 NO-BUILD AM PEAK HOUR BASE VOLUMES

INDEX

5. NH 102/ Londonderry Road
6. NH 102/ Fordway/ High St.
7. NH 102/ NH 28
8. N. High St./ Ash St. Extension
9. N. High St./ Madden Rd.
10. N. High St./ Folsom Rd./ Franklin St
11. NH 28/ Folsom Rd./ Tsienneto Rd.
12. Tsienneto Rd./ Pinkerton St.
13. NH 28/ Linlew Dr.
14. NH28/ Ashleigh Dr.
15. NH 28/ Scobie Pond Rd.
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17. NH 28 Bypass/ Pinkerton St.
18. NH 28 Bypass/ Tsienneto Rd.
19. NH 102/ Tsienneto Rd.
26. NH 102/ North Shore Rd
27. NH 102/ English Range Rd

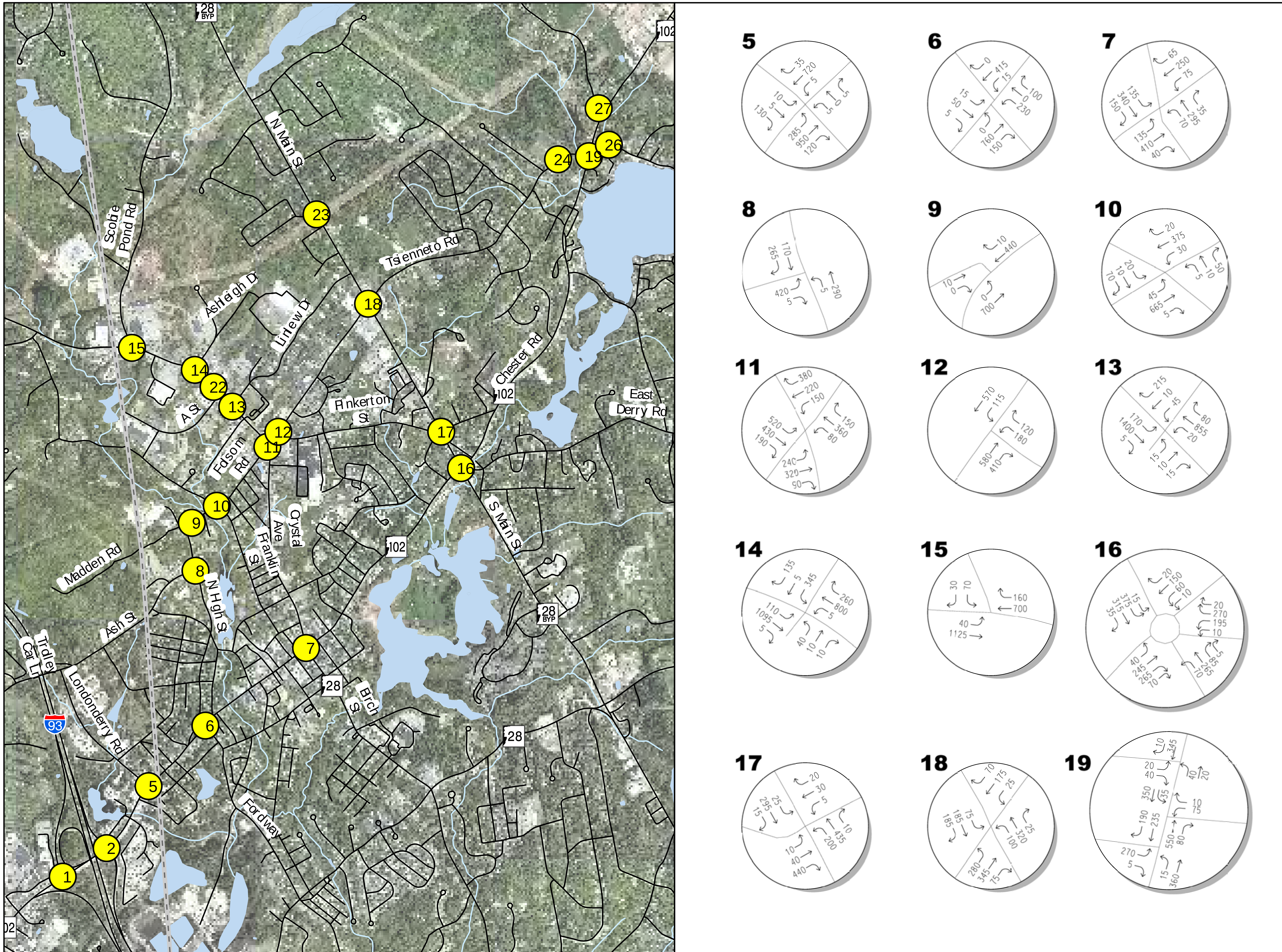
Feet
0 1,000 2,000

Sources:

Coordinate System: NAD 1983 StatePlane New Hampshire (feet)	Date: January 24, 2018

New Hampshire DOT
Department of Transportation

Figure 6 - 2015 No-Build AM Peak Hour Base Volumes - Locations 5-19 and 26-27



I-93 Exit 4A
Supplemental Draft EIS

2015 NO-BUILD PM PEAK HOUR BASE VOLUMES

INDEX

Feet
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Sources:

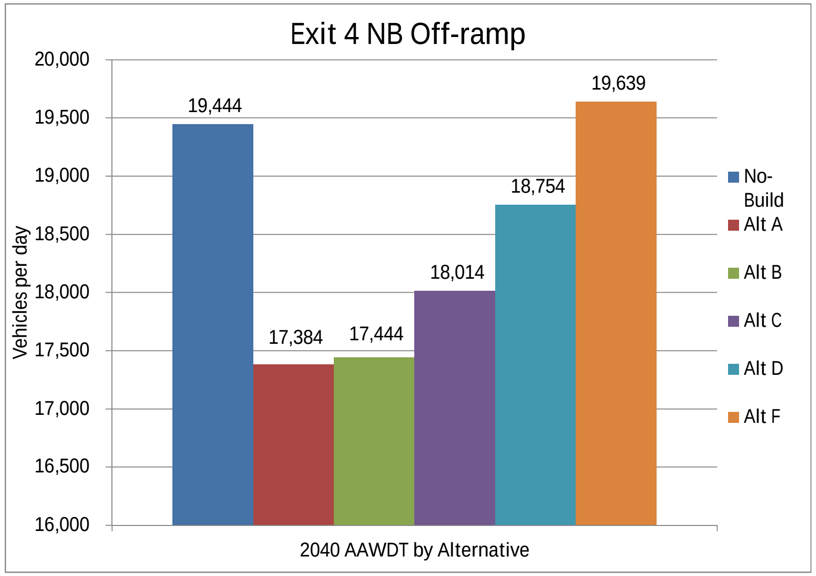
Coordinate System:
NAD 1983 StatePlane
New Hampshire (feet)

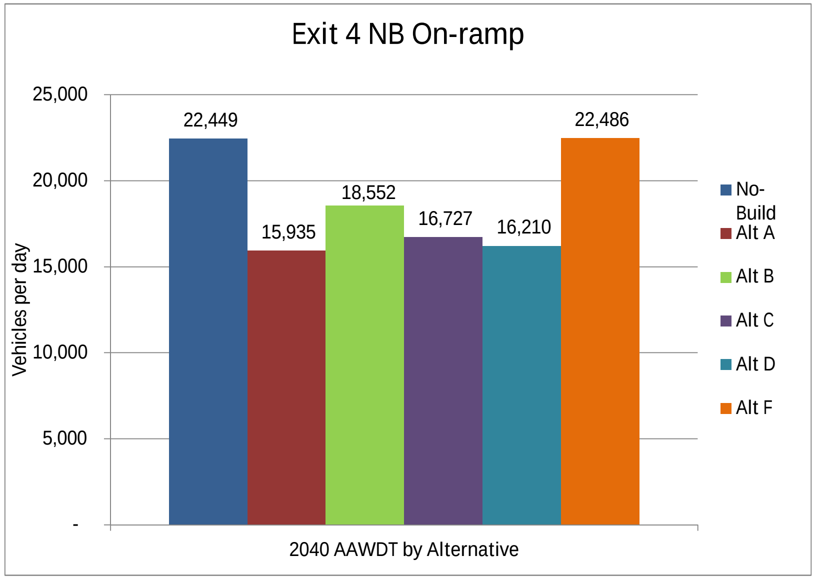
Date:
January 24, 2018

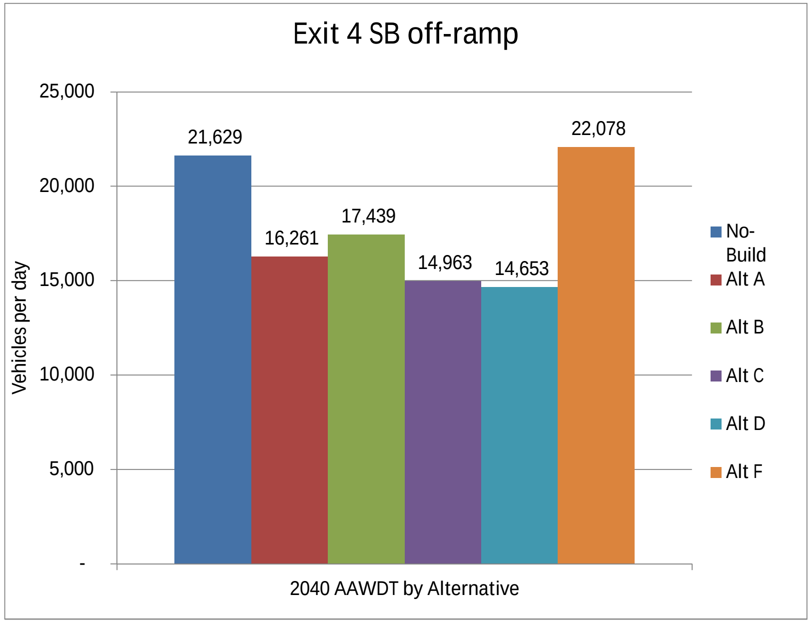
New Hampshire DOT
Department of Transportation

Figure 7 - 2015 No-Build PM Peak Hour Base Volumes – Locations 5-19 and 26-27

FIGURE 8 - VOLUME COMPARISONS - EXIT 4 RAMPS







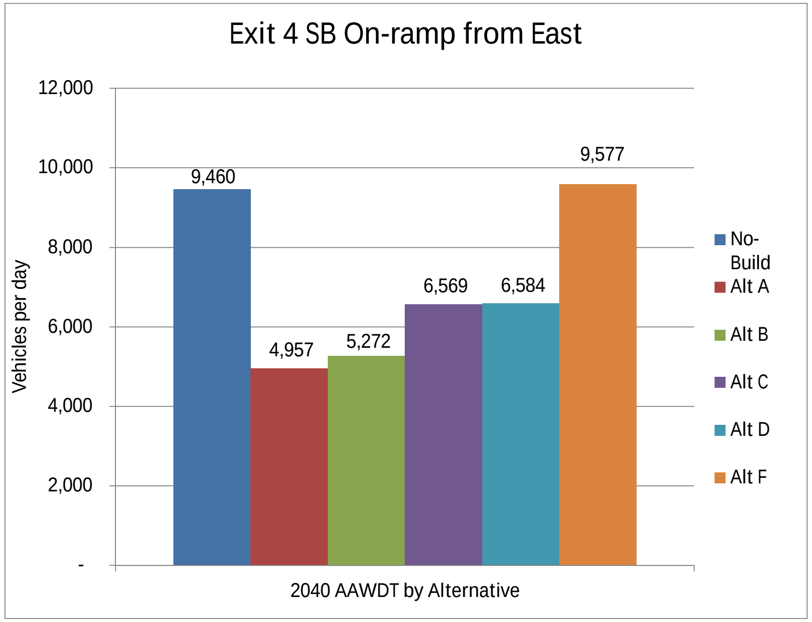
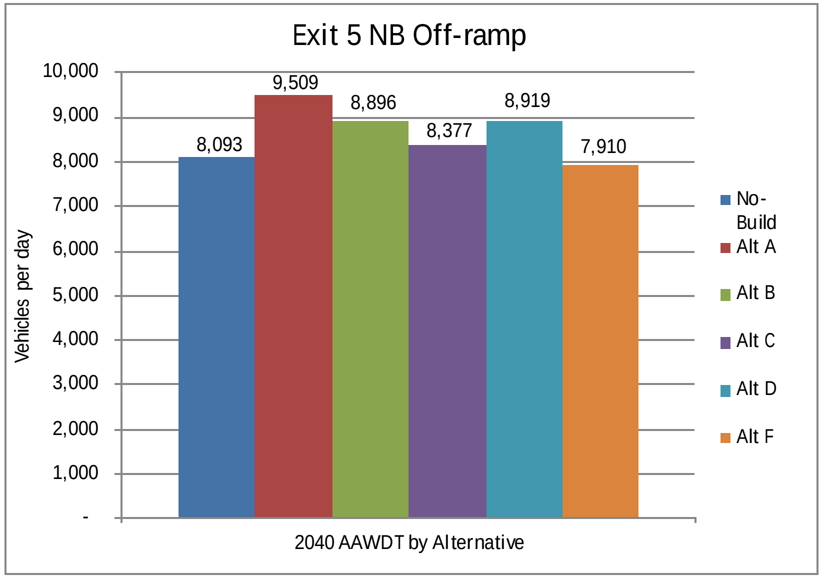
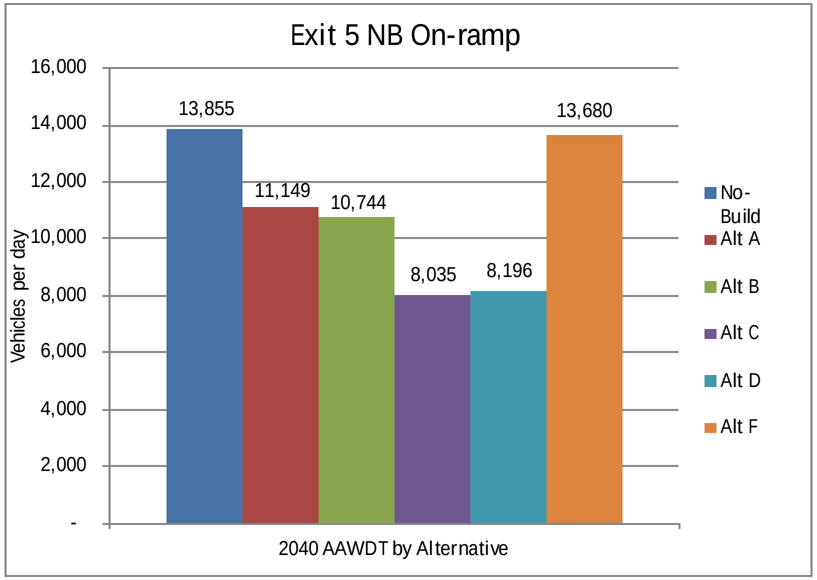
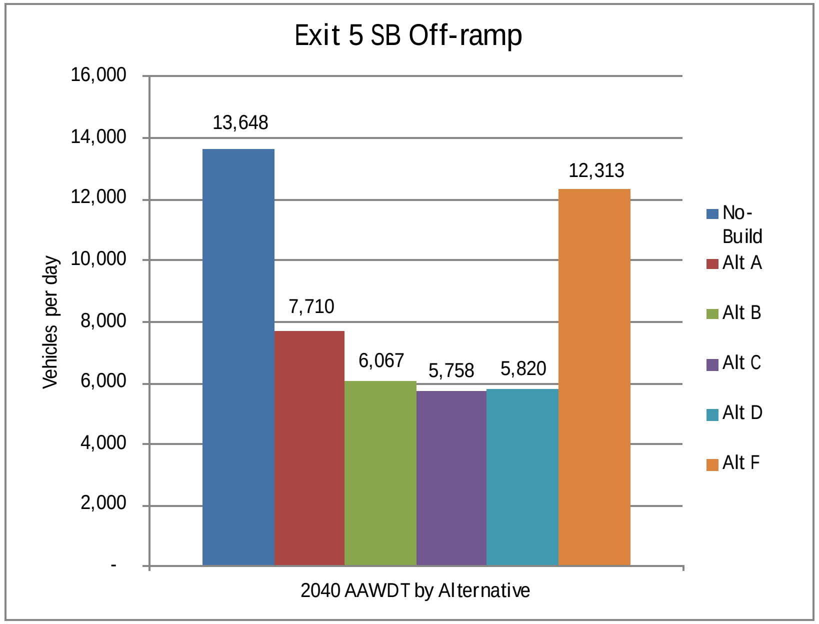


FIGURE 9 - VOLUME COMPARISONS - EXIT 5 RAMPS







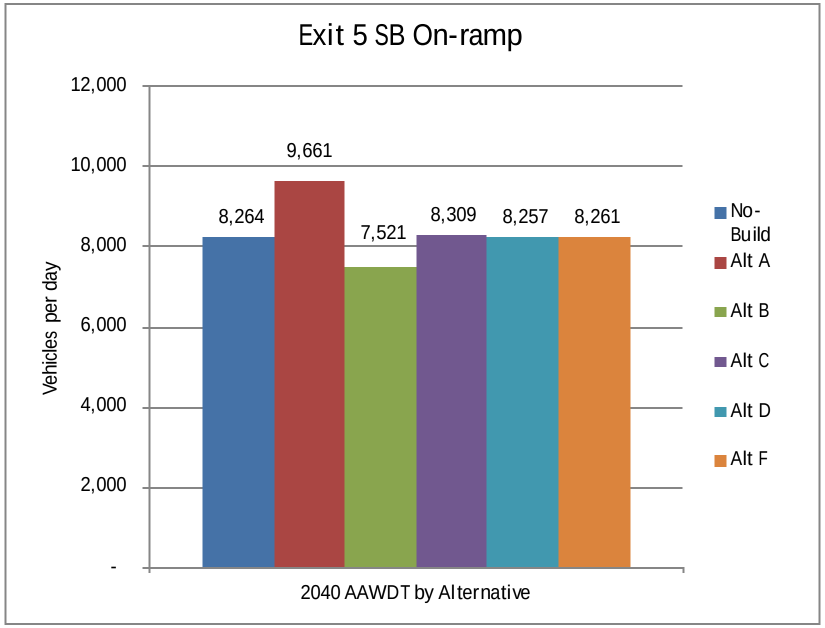
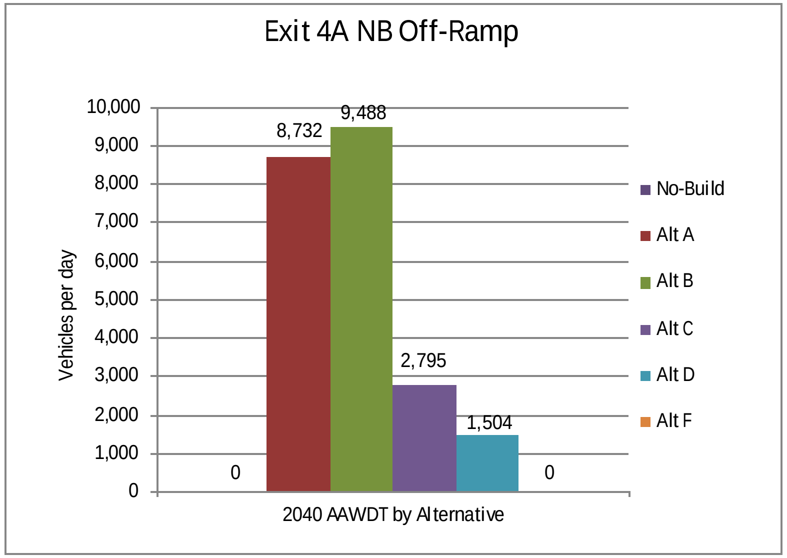
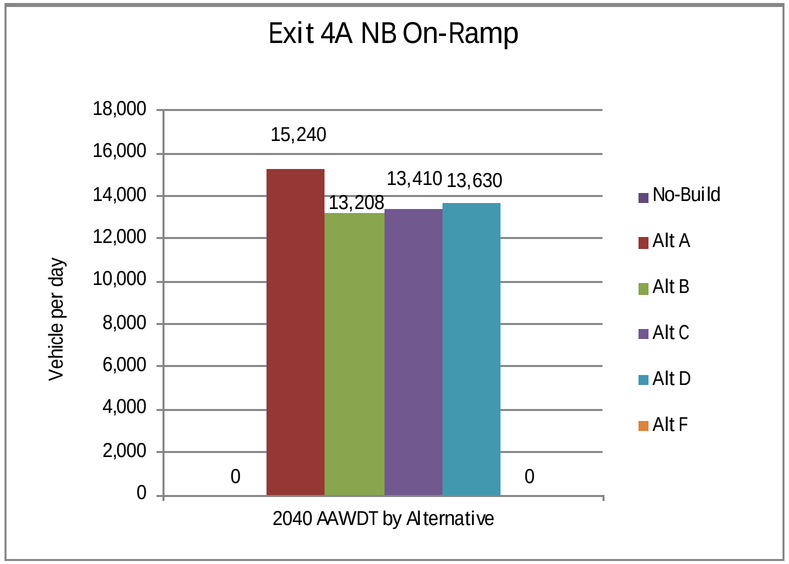
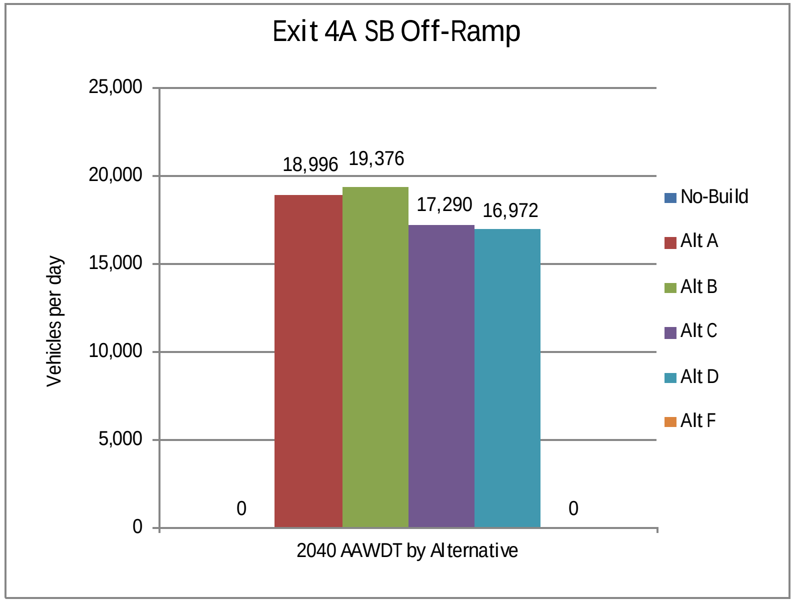


FIGURE 10- VOLUME COMPARISONS - EXIT 4A RAMPS







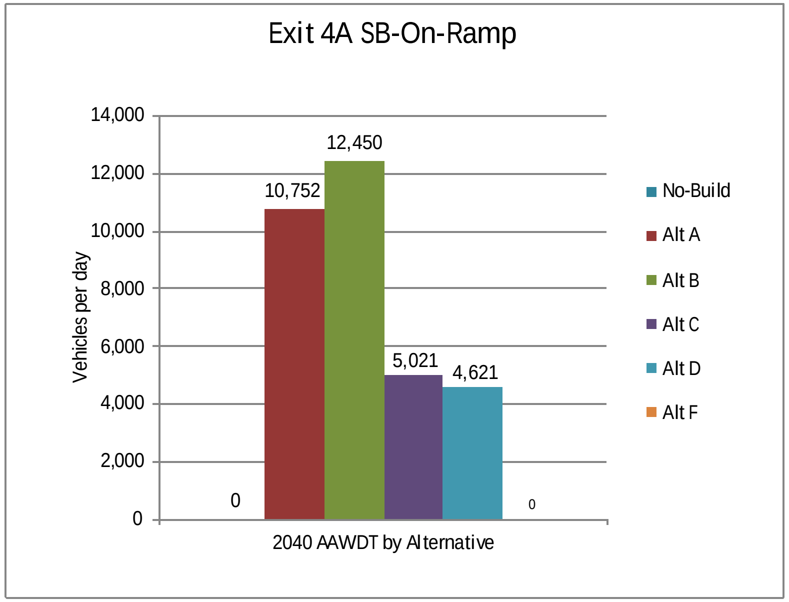
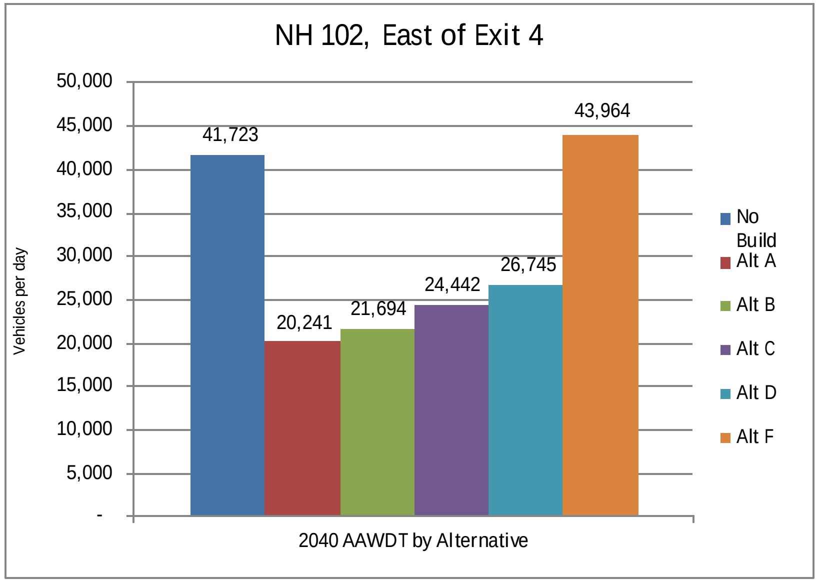
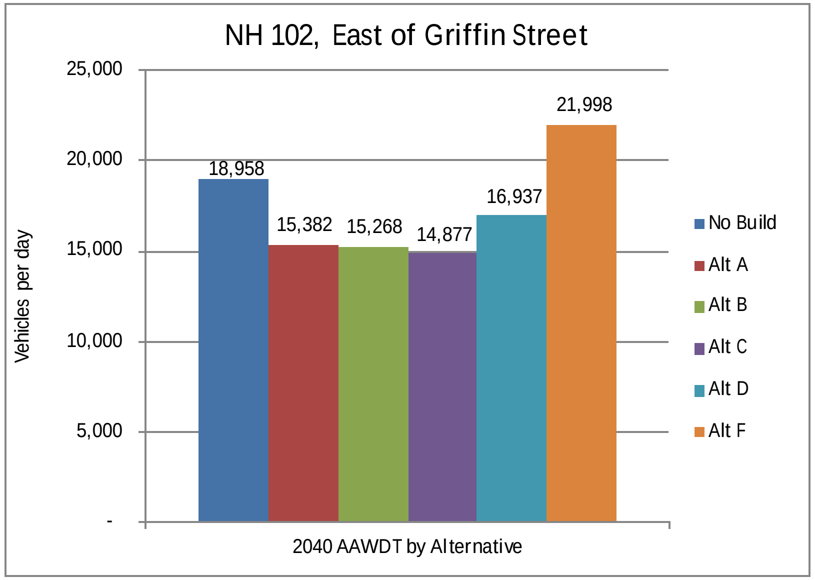
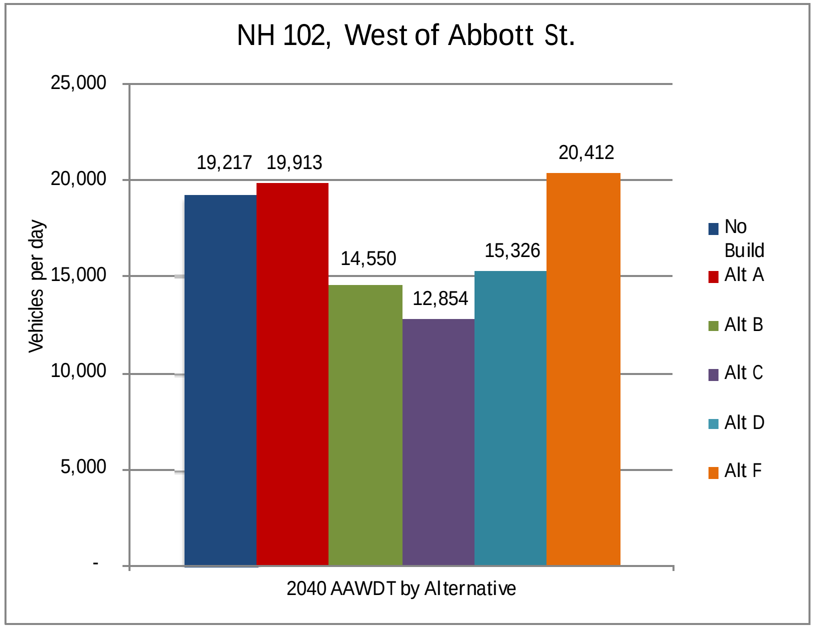


FIGURE 11 - VOLUME COMPARISONS - NH ROUTE 102 CORRIDOR







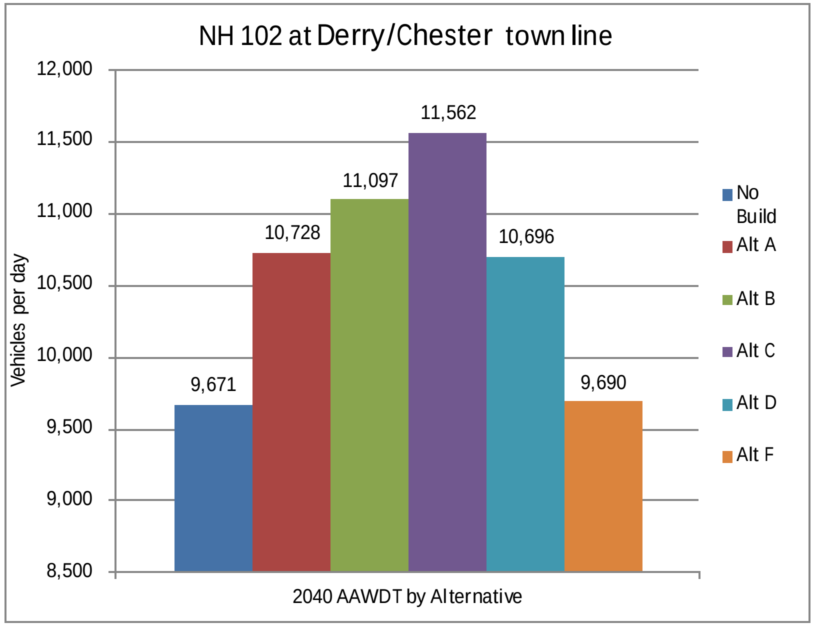
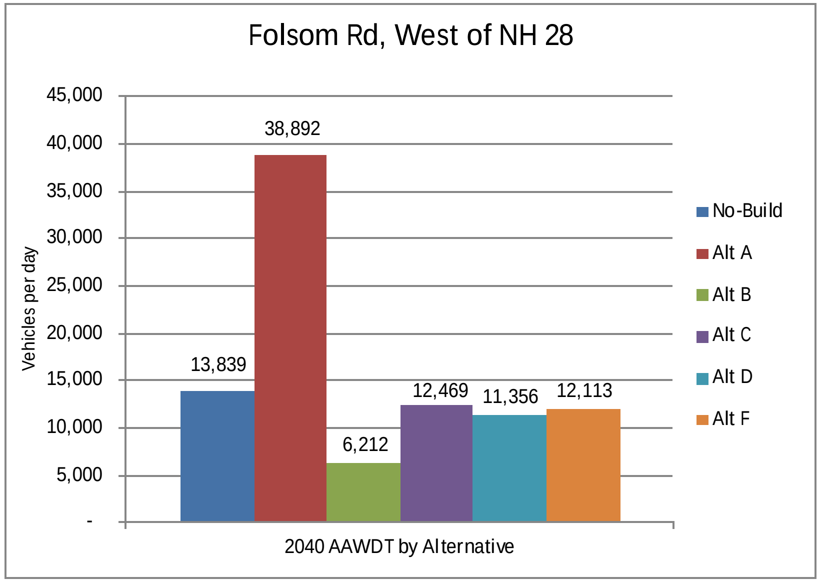
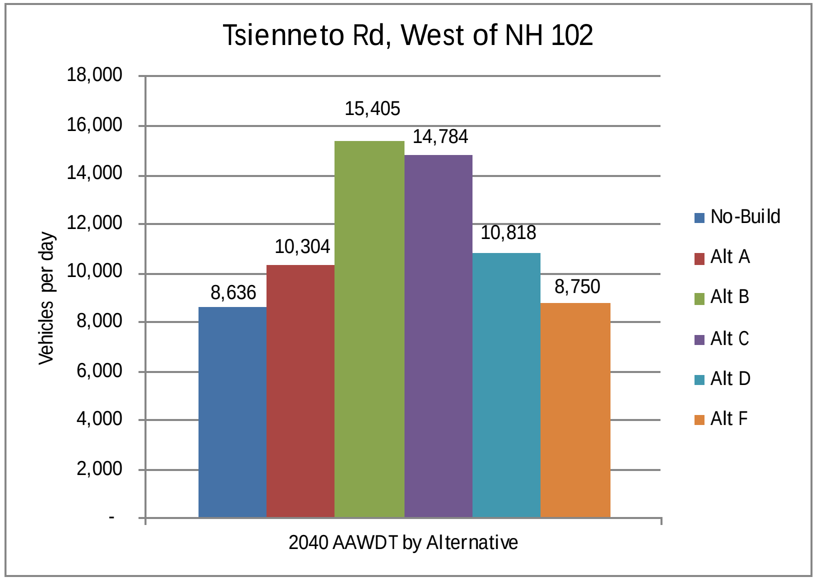
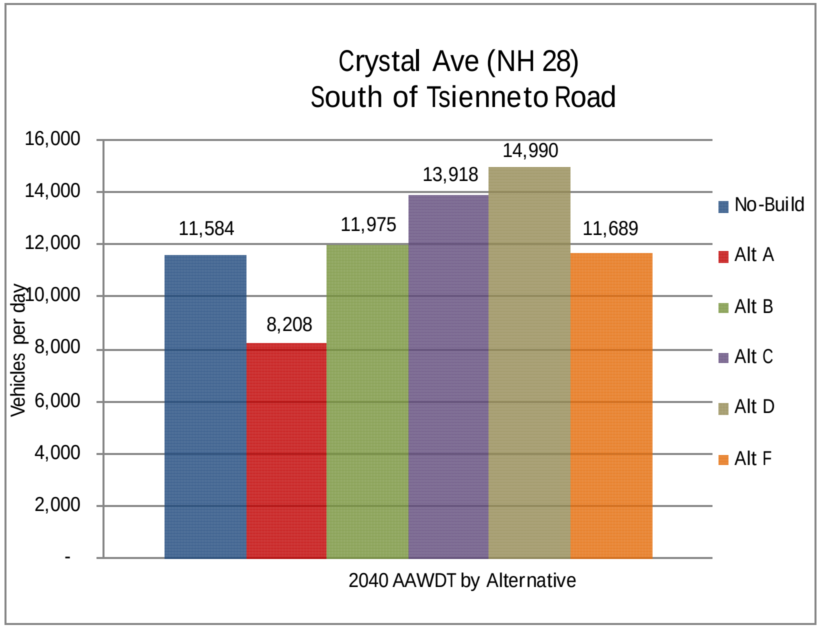
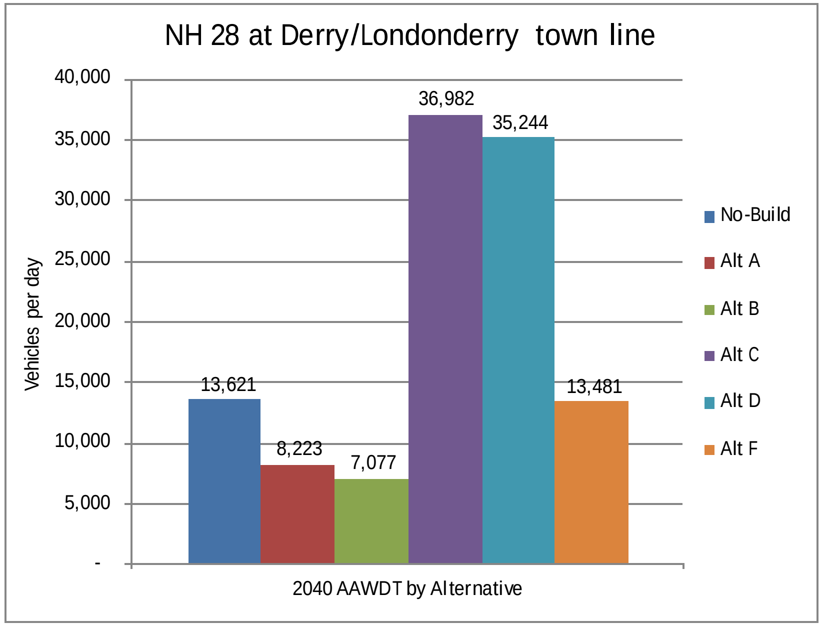


FIGURE 12- VOLUME COMPARISONS- OTHER LOCAL STREETS









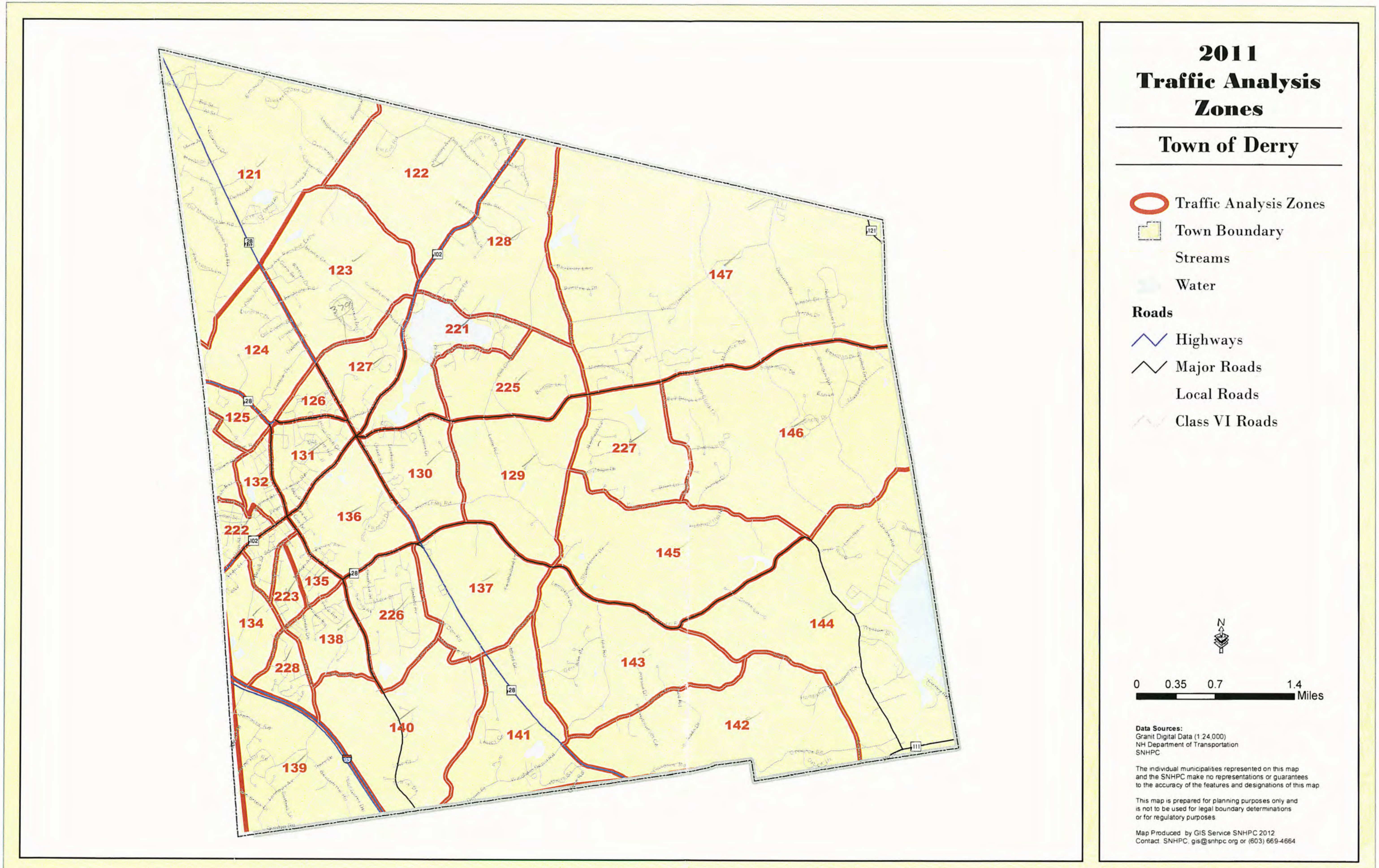


Figure 13 - SNHPC Traffic Analysis Zones - Derry NH

<u>Exhibit #8A</u>- Traffic Analysis Zones in the SNHPC Region

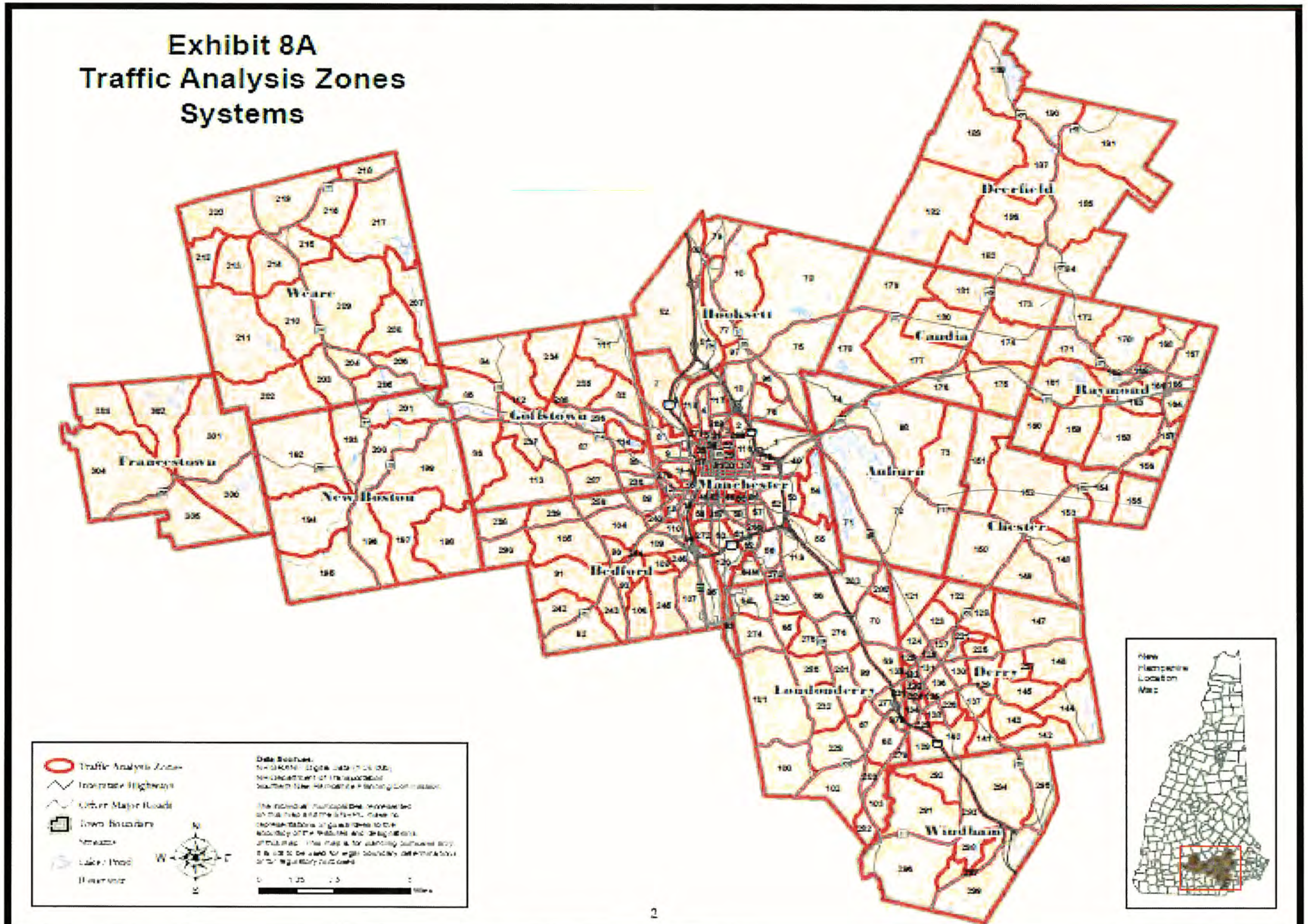
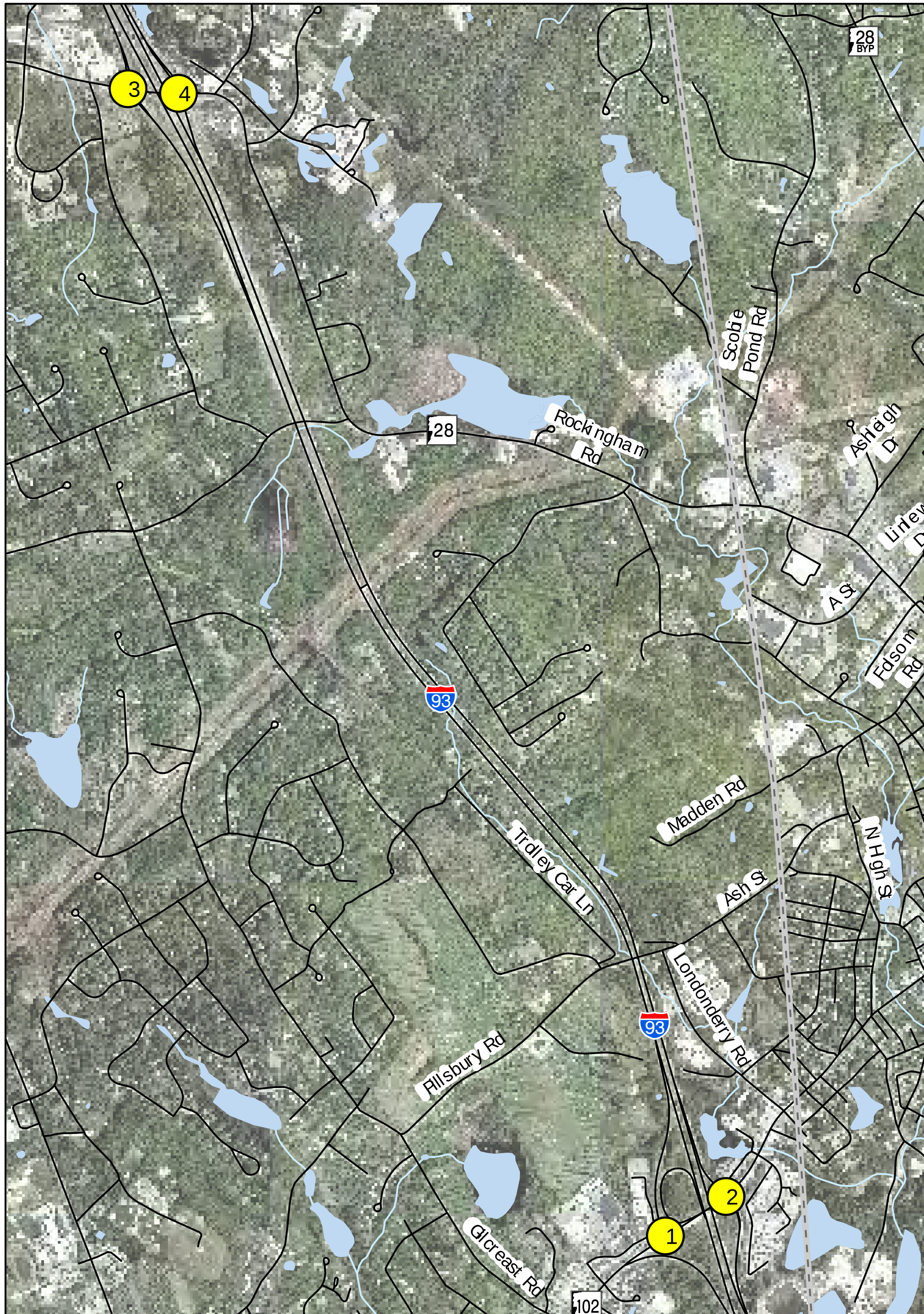
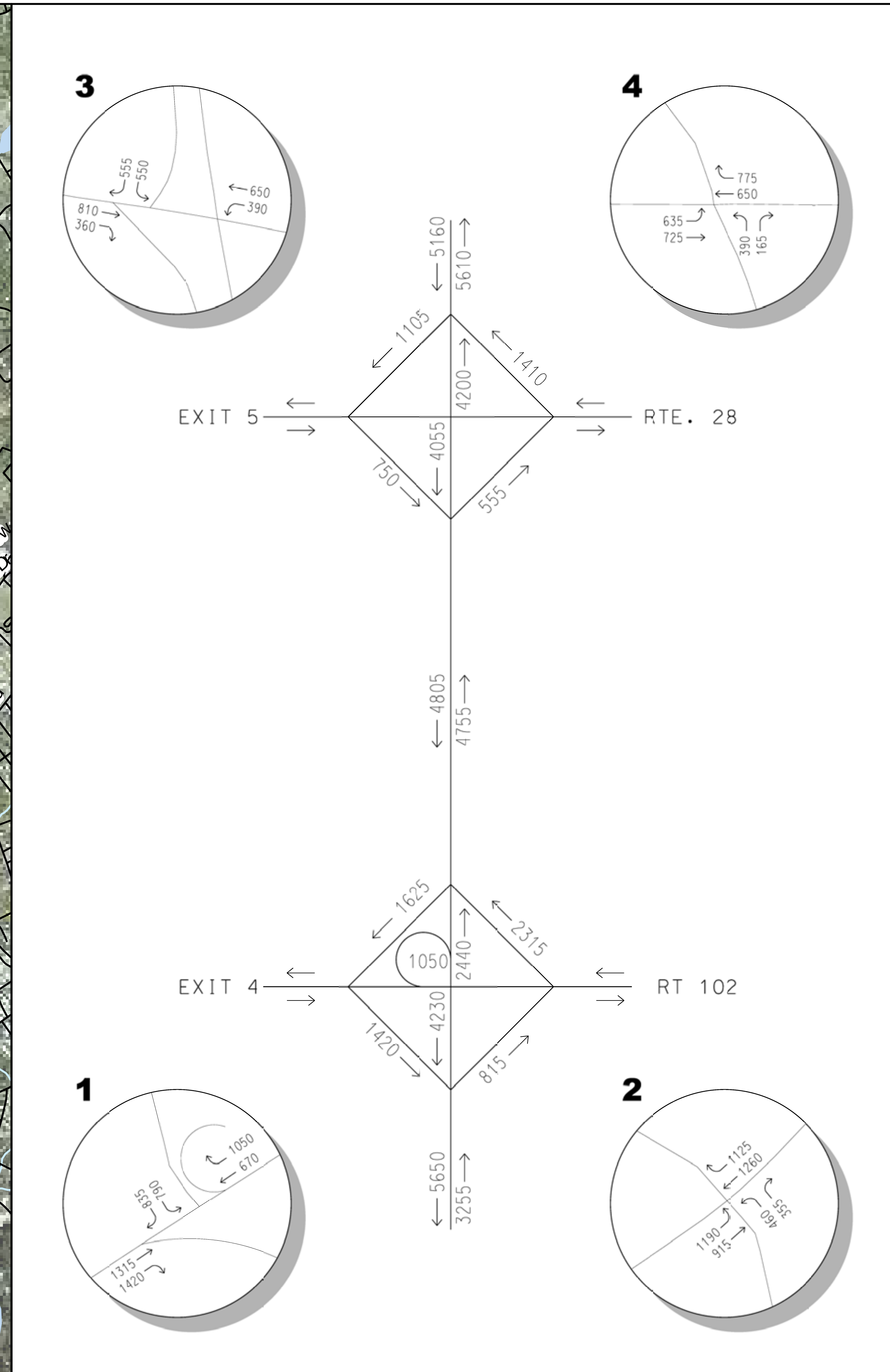


Figure 14 - SNHPC Traffic Analysis Zones - Region wide

I-93 Exit 4A
Supplemental Draft EIS

2040 NO-BUILD AM PEAK HOUR BASE VOLUMES





INDEX

1. Exit 4 SB Ramps
2. Exit 4 NB Ramps
3. Exit 5 SB Ramps
4. Exit 5 NB Ramps

Feet
0 1,000 2,000

Sources:

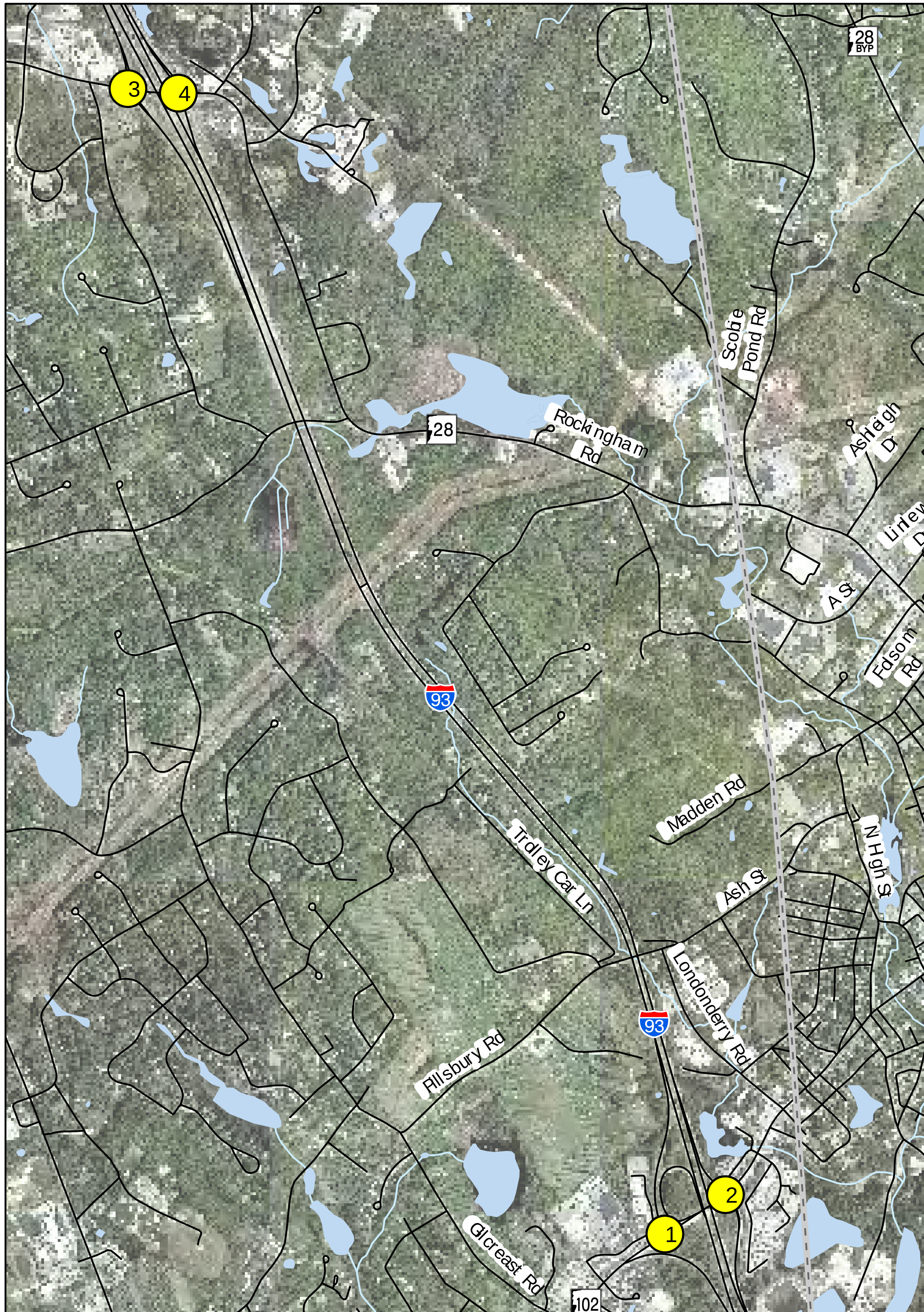
N

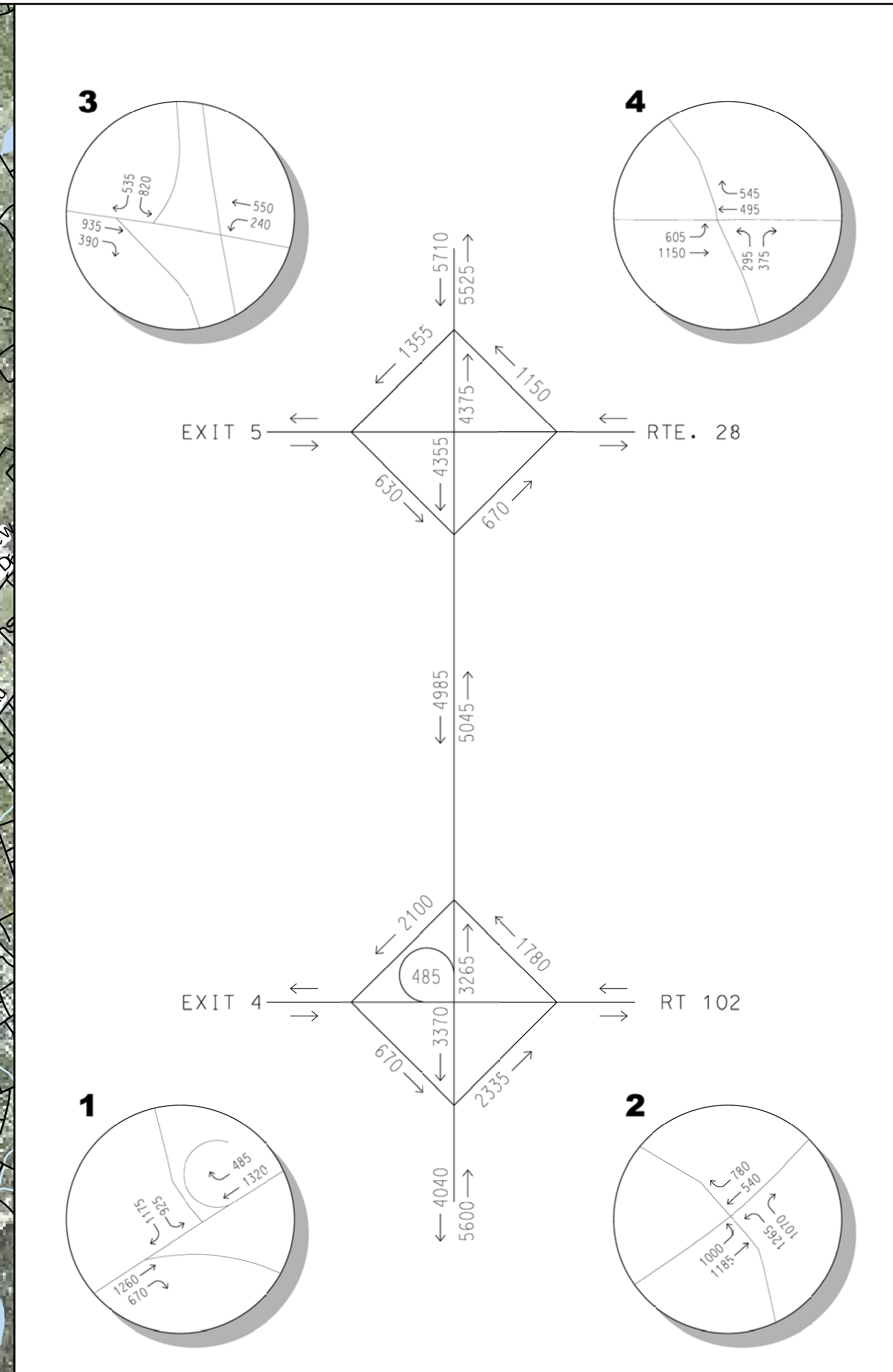
Coordinate System:
NAD 1983 StatePlane
New Hampshire (feet)

Date:
January 24, 2018

New Hampshire DOT
Department of Transportation

Figure 15 - 2040 No-Build AM Peak Hour Base Volumes – Locations 1-4





I-93 Exit 4A
Supplemental Draft EIS

2040 NO-BUILD PM PEAK HOUR BASE VOLUMES

INDEX

1. Exit 4 SB Ramps
2. Exit 4 NB Ramps
3. Exit 5 SB Ramps
4. Exit 5 NB Ramps

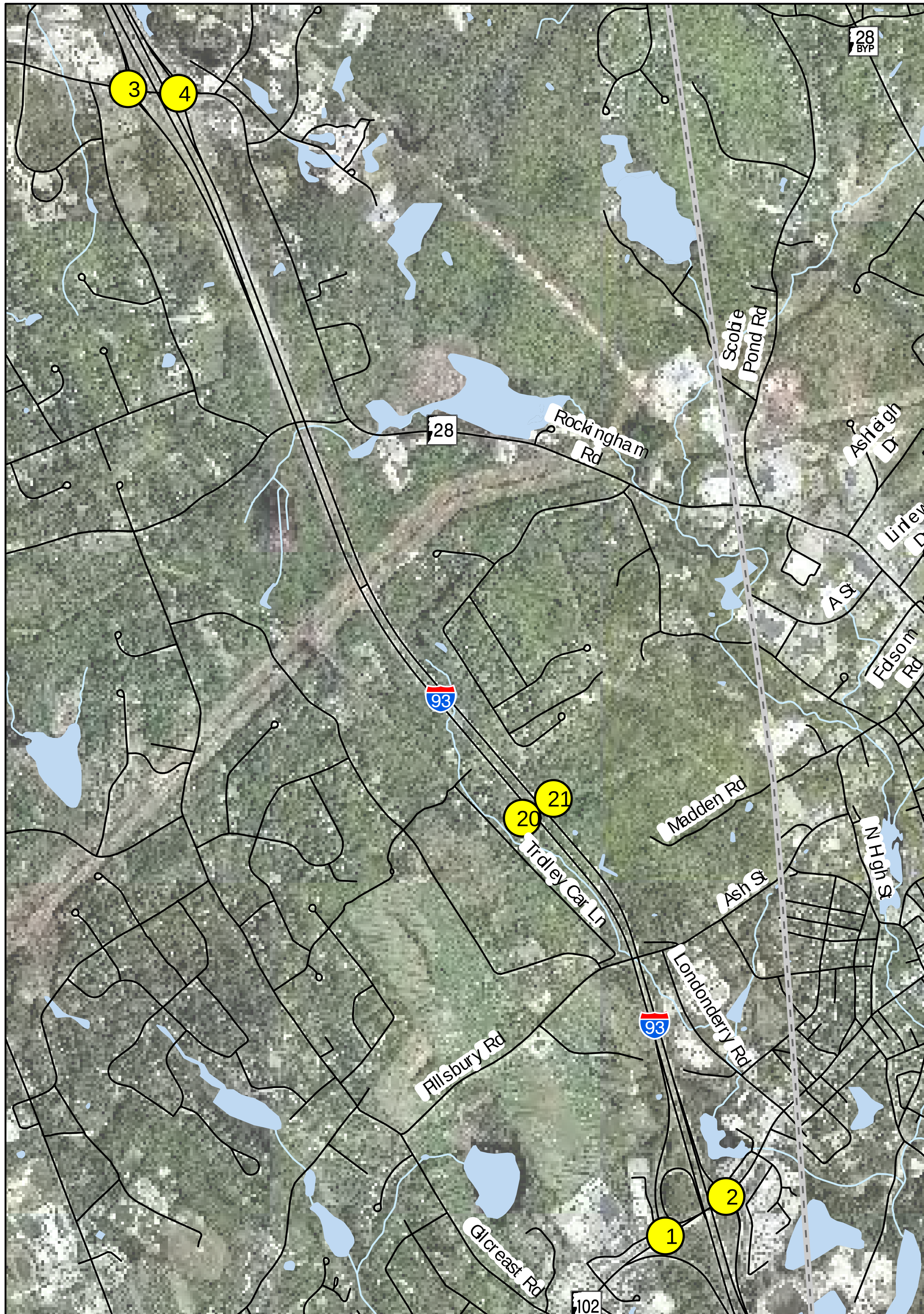
Feet
0 1,000 2,000

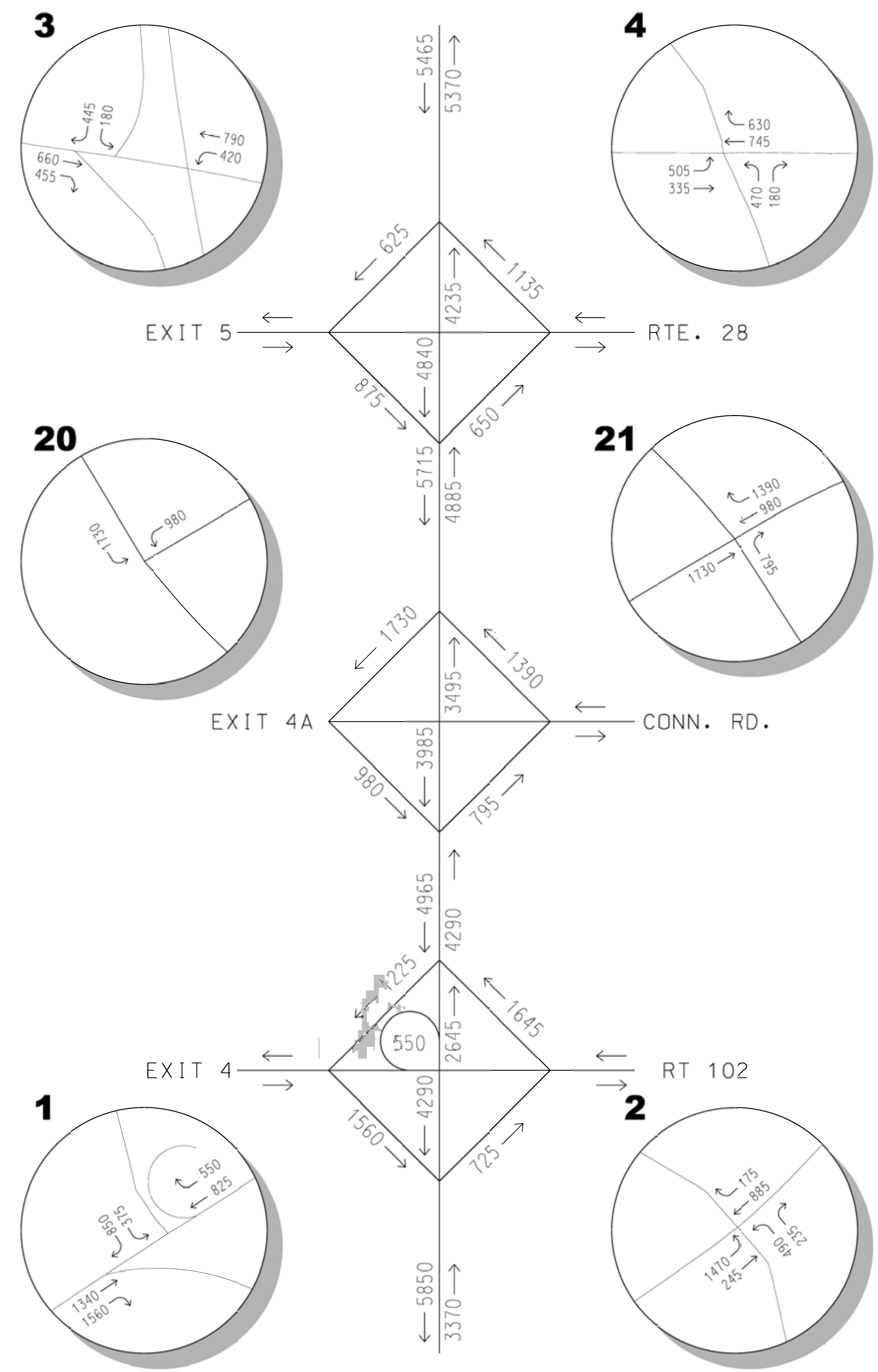
Sources:

Coordinate System: NAD 1983 StatePlane New Hampshire (feet)	Date: January 24, 2018

New Hampshire DOT
Department of Transportation

Figure 16 - 2040 No-Build PM Peak Hour Base Volumes – Locations 1-4





I-93 Exit 4A
Supplemental Draft EIS

2040 ALT A AM PEAK HOUR BASE VOLUMES

INDEX

1. Exit 4 SB Ramps
2. Exit 4 NB Ramps
3. Exit 5 SB Ramps
4. Exit 5 NB Ramps
20. Exit 4A SB Ramps
21. Exit 4A NB Ramps

Feet
0 1,000 2,000

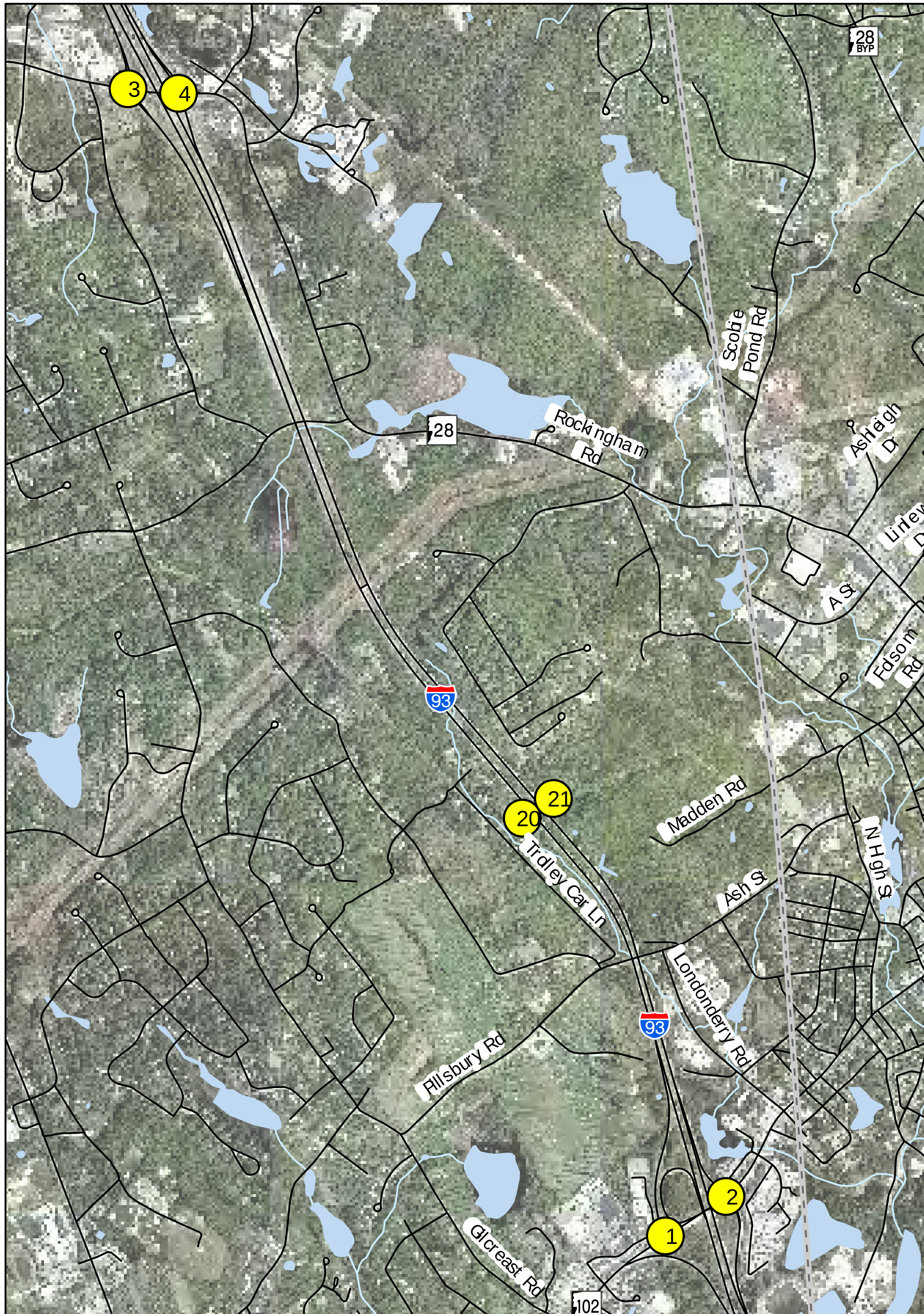
Sources:

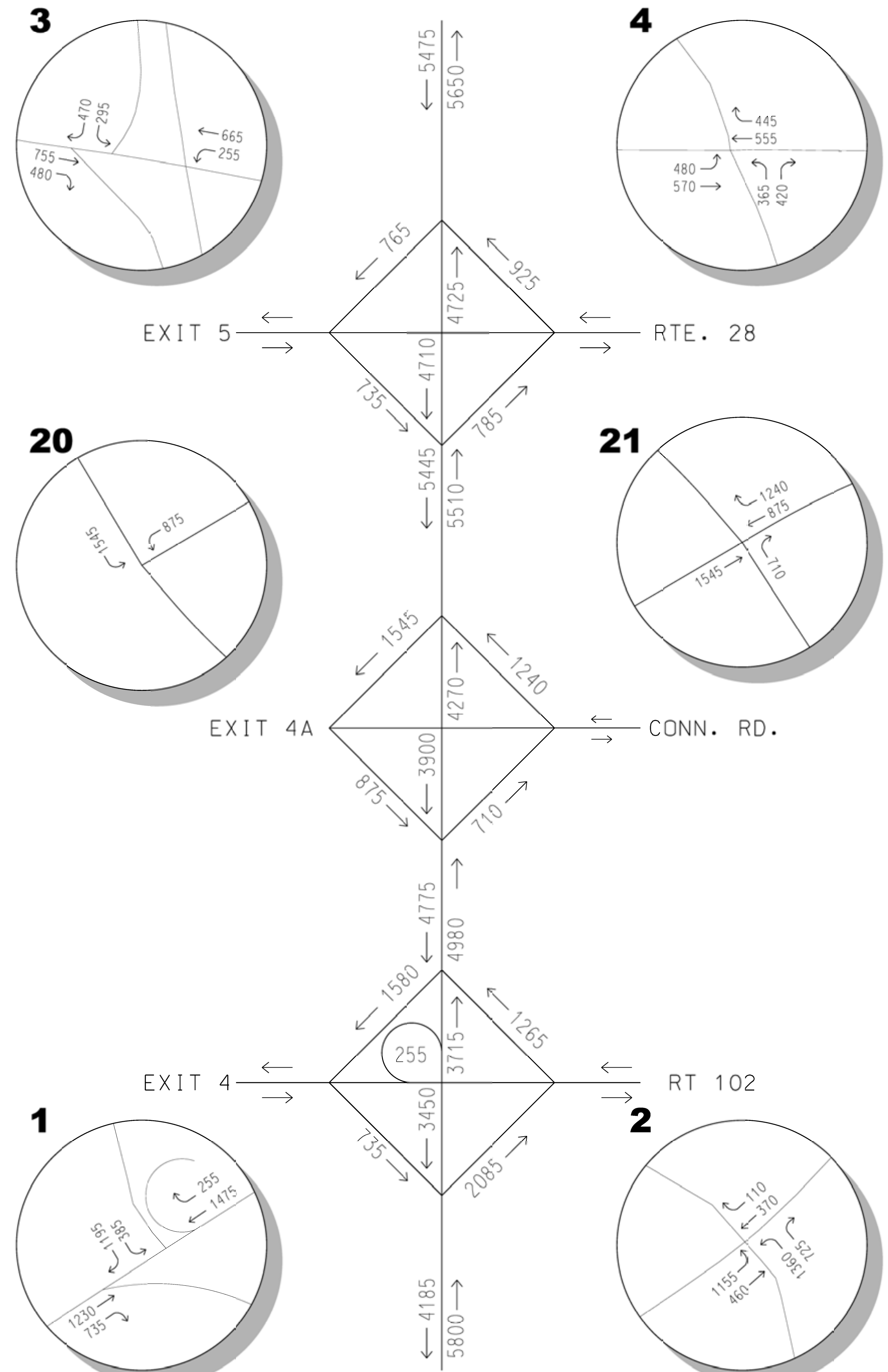
Coordinate System: NAD 1983 StatePlane New Hampshire (feet)

Date: January 24, 2018

New Hampshire DOT Department of Transportation

Figure 17 - 2040 Alternative A AM Peak Hour Base Volumes – Locations 1-4 and 20-21





I-93 Exit 4A
Supplemental Draft EIS

2040 ALT A PM PEAK HOUR BASE VOLUMES

INDEX

1. Exit 4 SB Ramps
2. Exit 4 NB Ramps
3. Exit 5 SB Ramps
4. Exit 5 NB Ramps
20. Exit 4A SB Ramps
21. Exit 4A NB Ramps

Feet
0 1,000 2,000

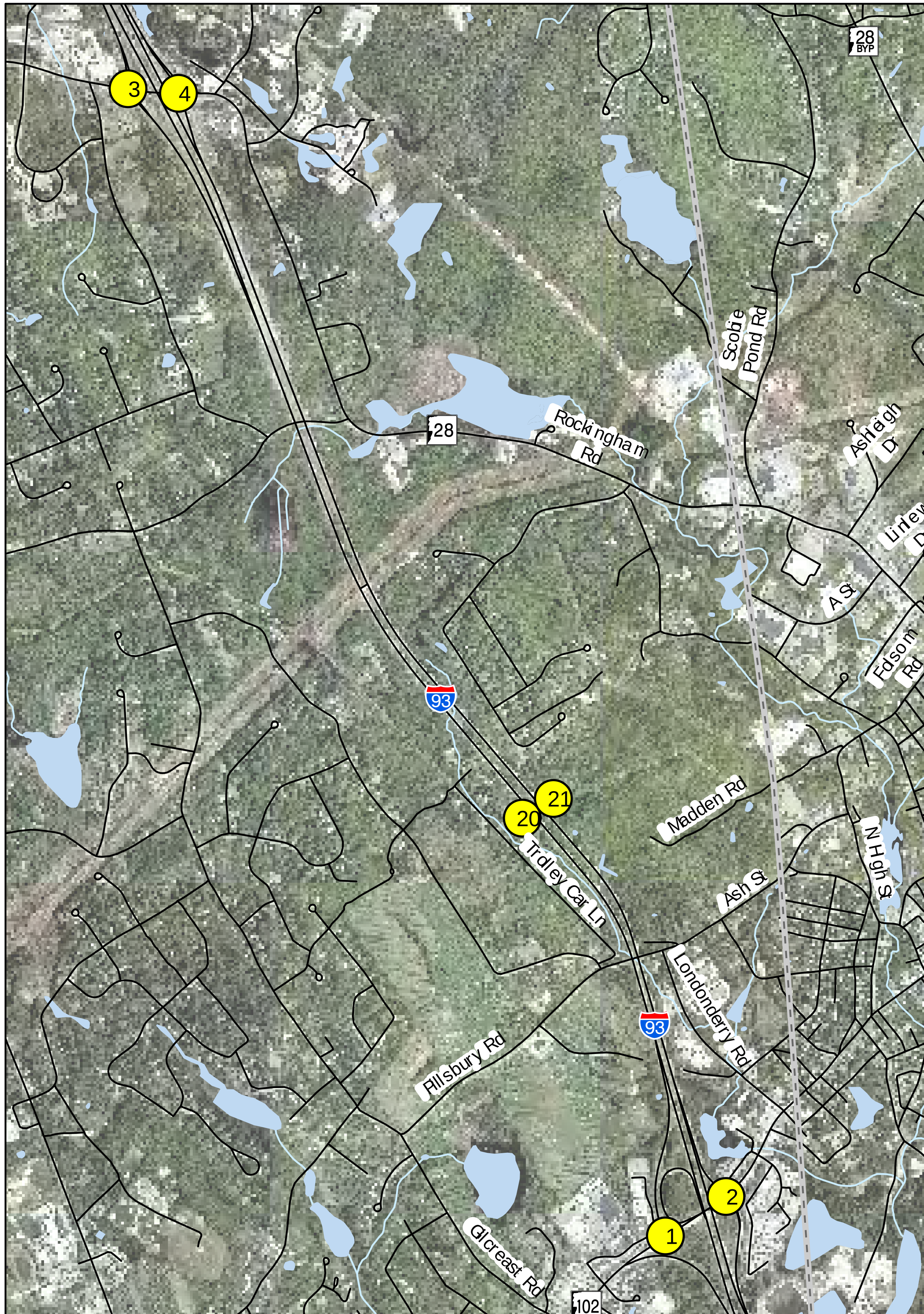
Sources:

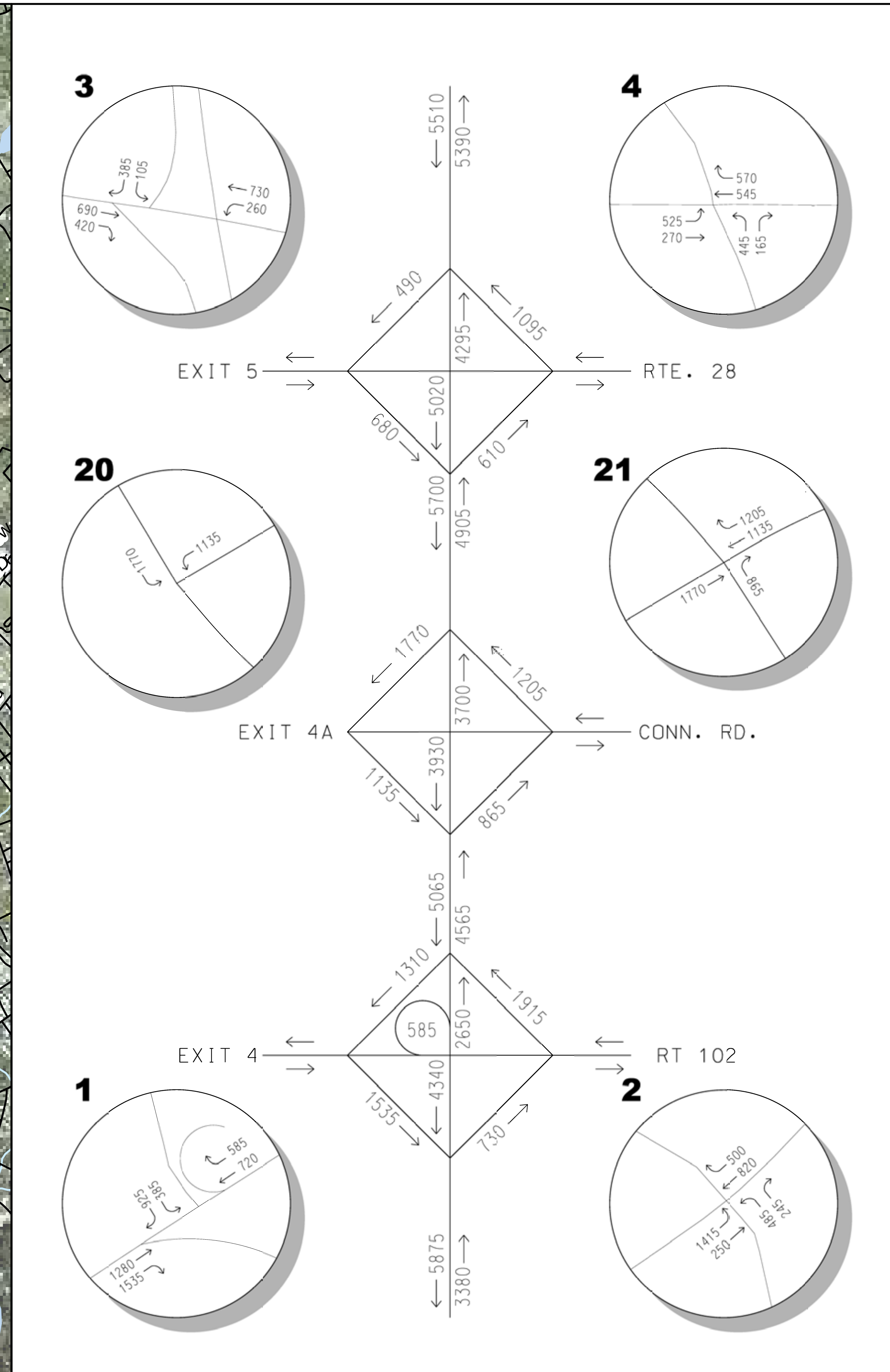
Coordinate System: NAD 1983 StatePlane New Hampshire (feet)

Date: January 24, 2018

New Hampshire DOT
Department of Transportation

Figure 18 - 2040 Alternative A PM Peak Hour Base Volumes – Locations 1-4 and 20-21





I-93 Exit 4A
Supplemental Draft EIS

2040 ALT B AM PEAK HOUR BASE VOLUMES

INDEX

1. Exit 4 SB Ramps
2. Exit 4 NB Ramps
3. Exit 5 SB Ramps
4. Exit 5 NB Ramps
20. Exit 4A SB Ramps
21. Exit 4A NB Ramps

Feet

0 1,000 2,000

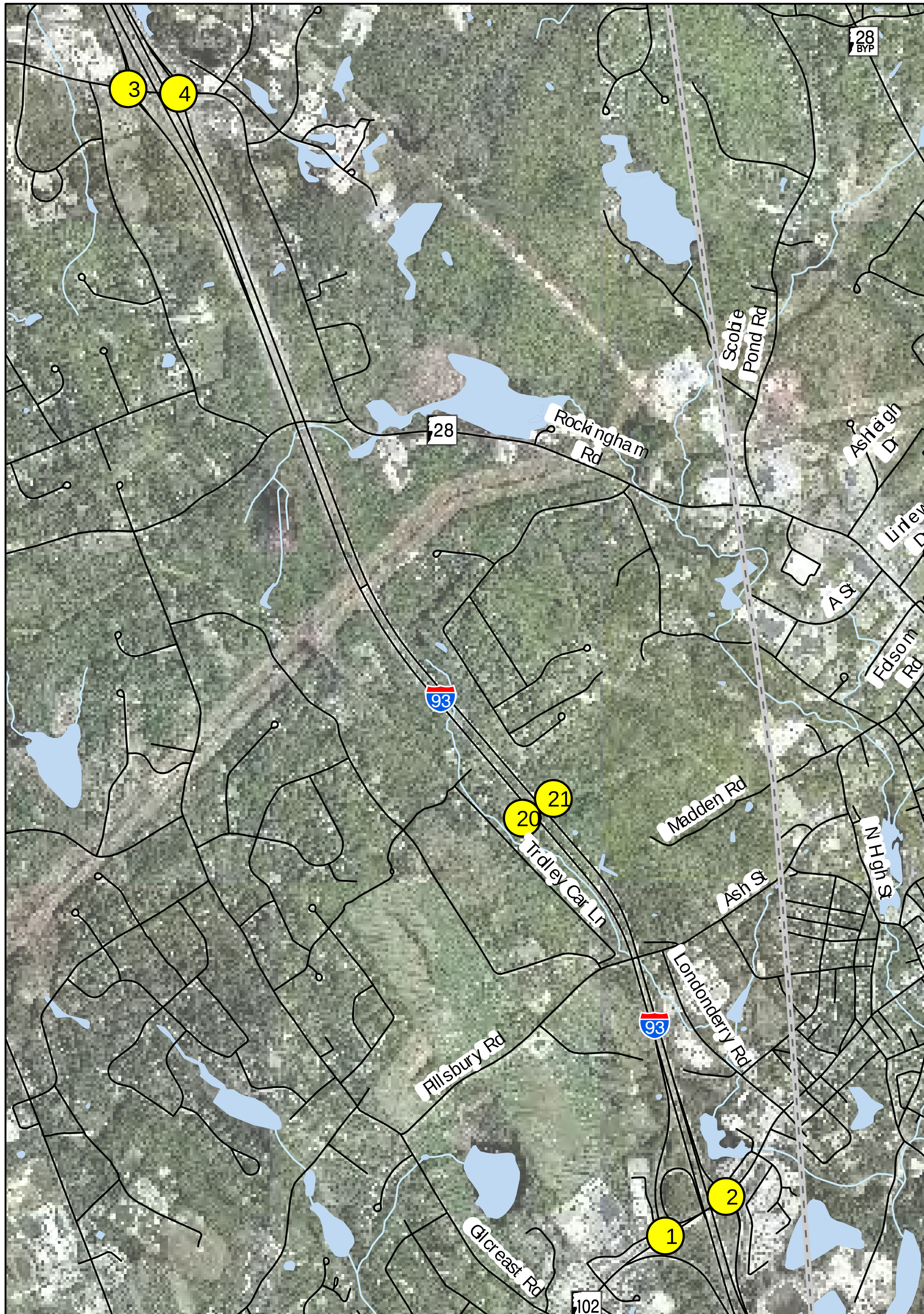
Sources:

Coordinate System:
NAD 1983 StatePlane
New Hampshire (feet)

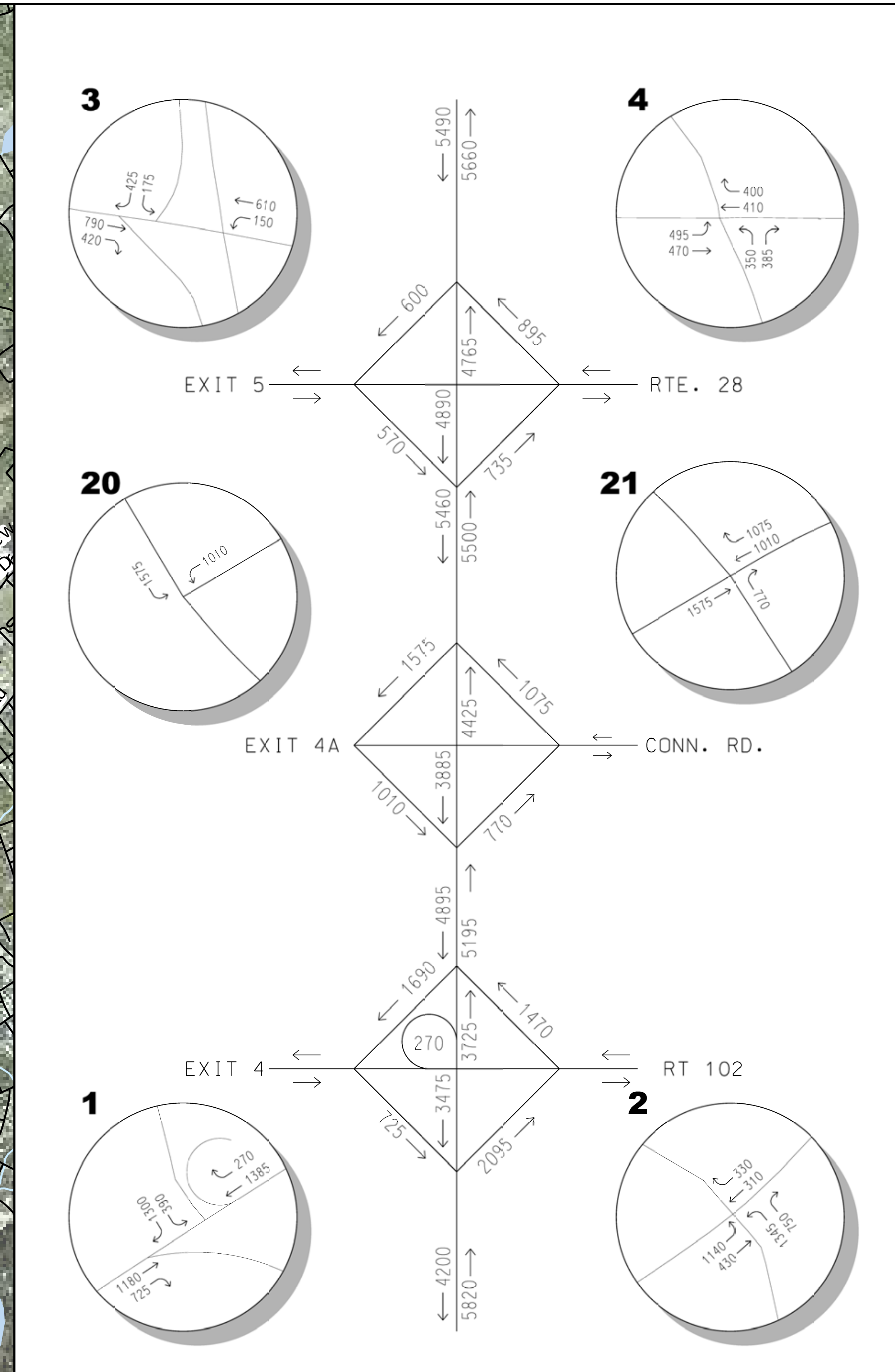
Date:
January 24, 2018

New Hampshire DOT
Department of Transportation

Figure 19 - 2040 Alternative B AM Peak Hour Base Volumes – Locations 1-4 and 20-21



3
4
28 BYP
Scobie Pond Rd
28
Rockingham Rd
Ashleigh Dr
A St
Edson Rd
93
21
20
Madden Rd
Trolley Car Ln
Ash St
N High St
Londonderry Rd
Pillsbury Rd
Gilcrest Rd
102
1
2



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EXIT 5
RTE. 28
4890
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735
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1010
1575
21
1075
1010
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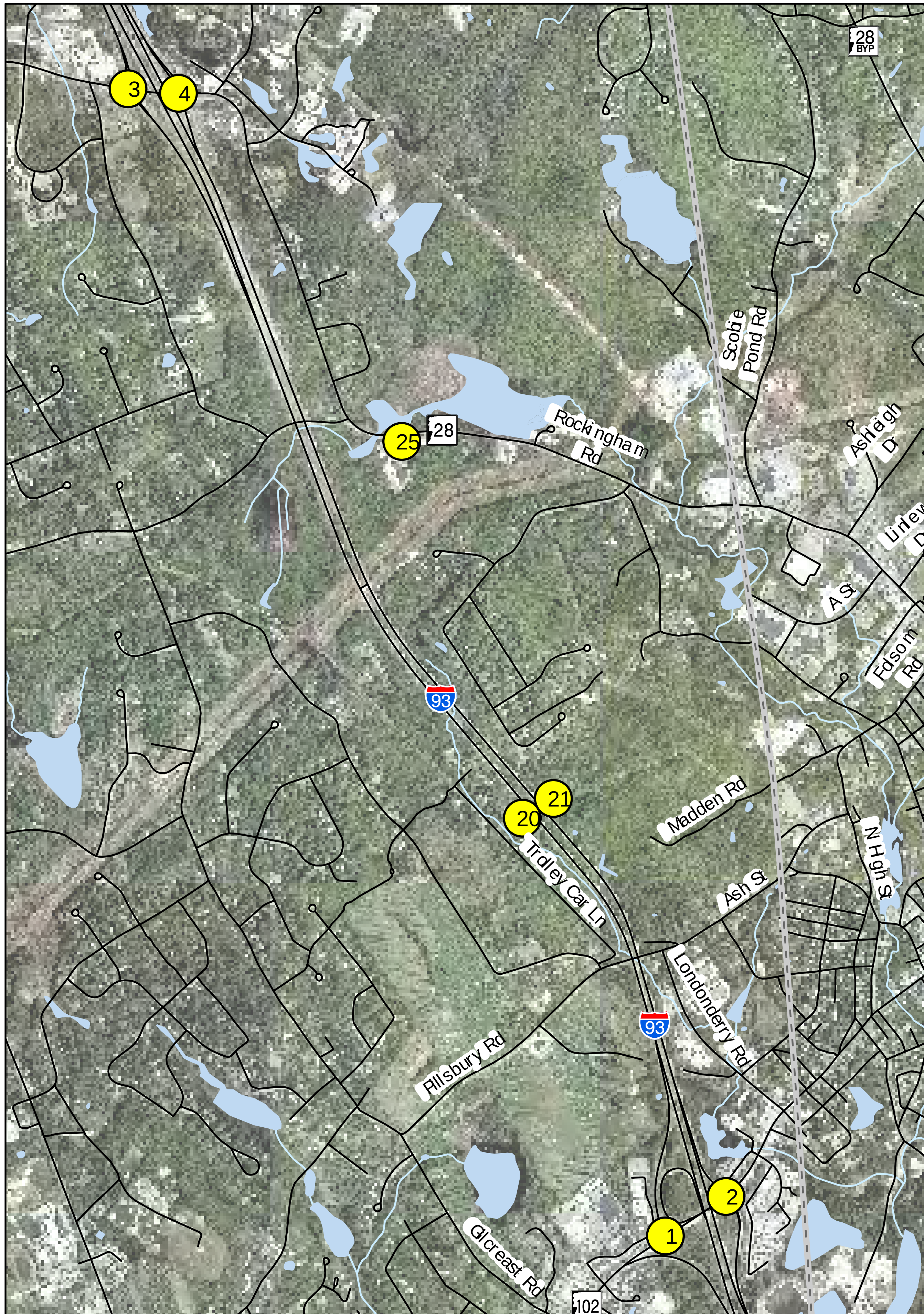
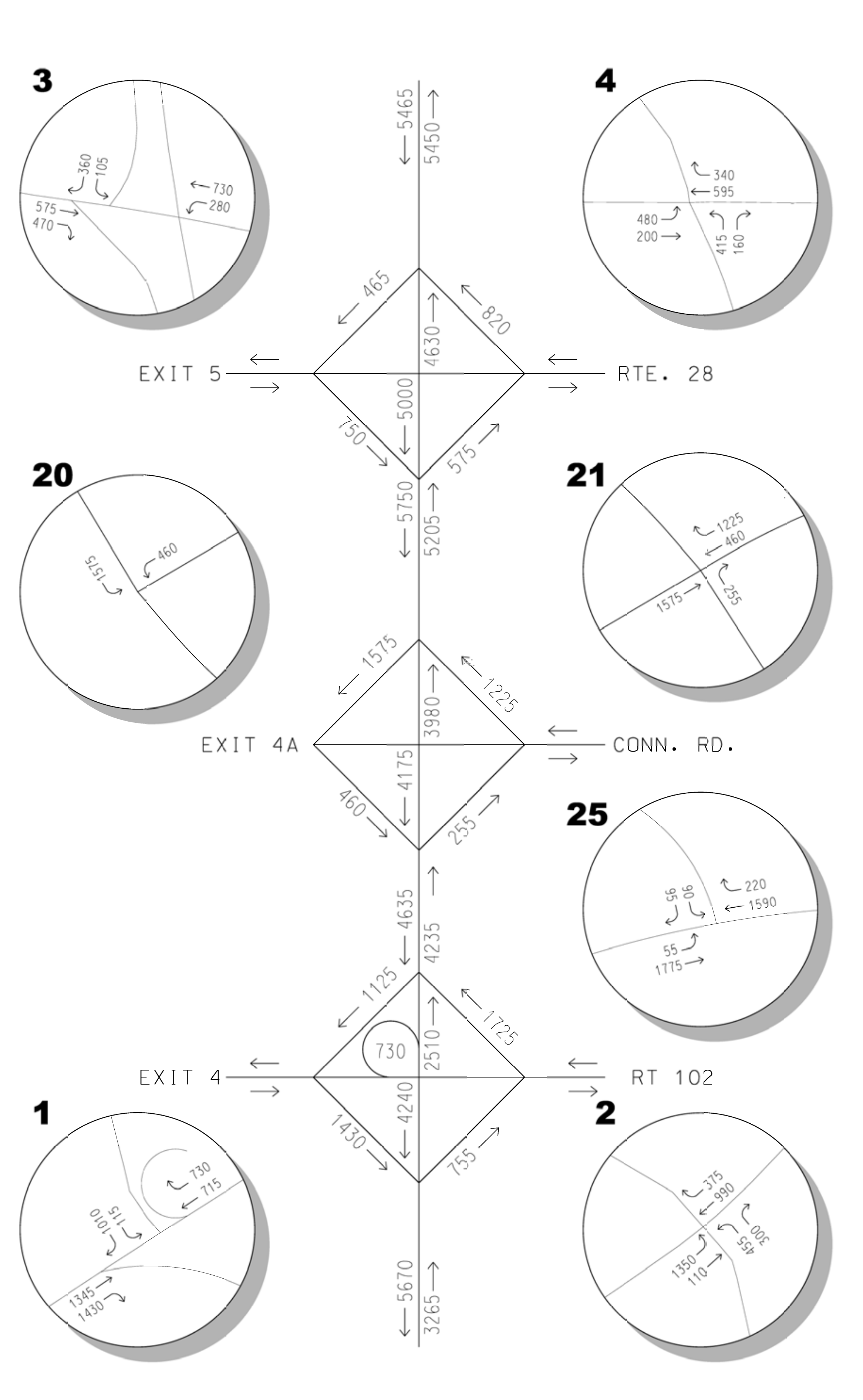
770
5460
5500
1575
1075
4425
EXIT 4A
CONN. RD.
3885
1010
770
4895
5195
1690
1470
270
3725
EXIT 4
RT 102
3475
725
2095
1
270
1385
1300
390
1180
725
2
330
310
750
1345
1140
430
4200
5820





I-93 Exit 4A
Supplemental Draft EIS

2040 ALT C AM PEAK HOUR BASE VOLUMES

INDEX

1. Exit 4 SB Ramps
2. Exit 4 NB Ramps
3. Exit 5 SB Ramps
4. Exit 5 NB Ramps
20. Exit 4A SB Ramps
21. Exit 4A NB Ramps
25. NH 28/ C-D Connector

Feet
0 1,000 2,000

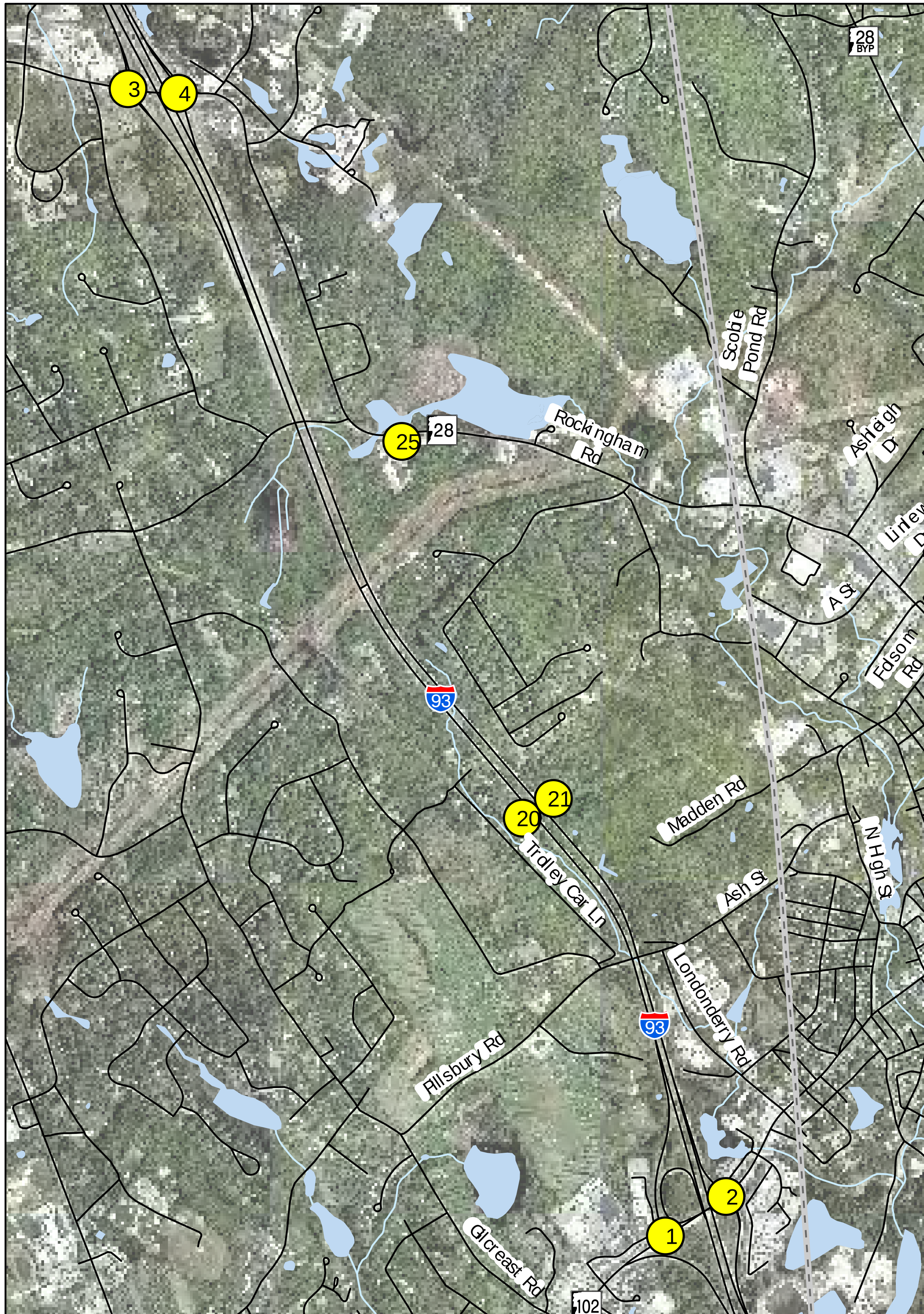
Sources:

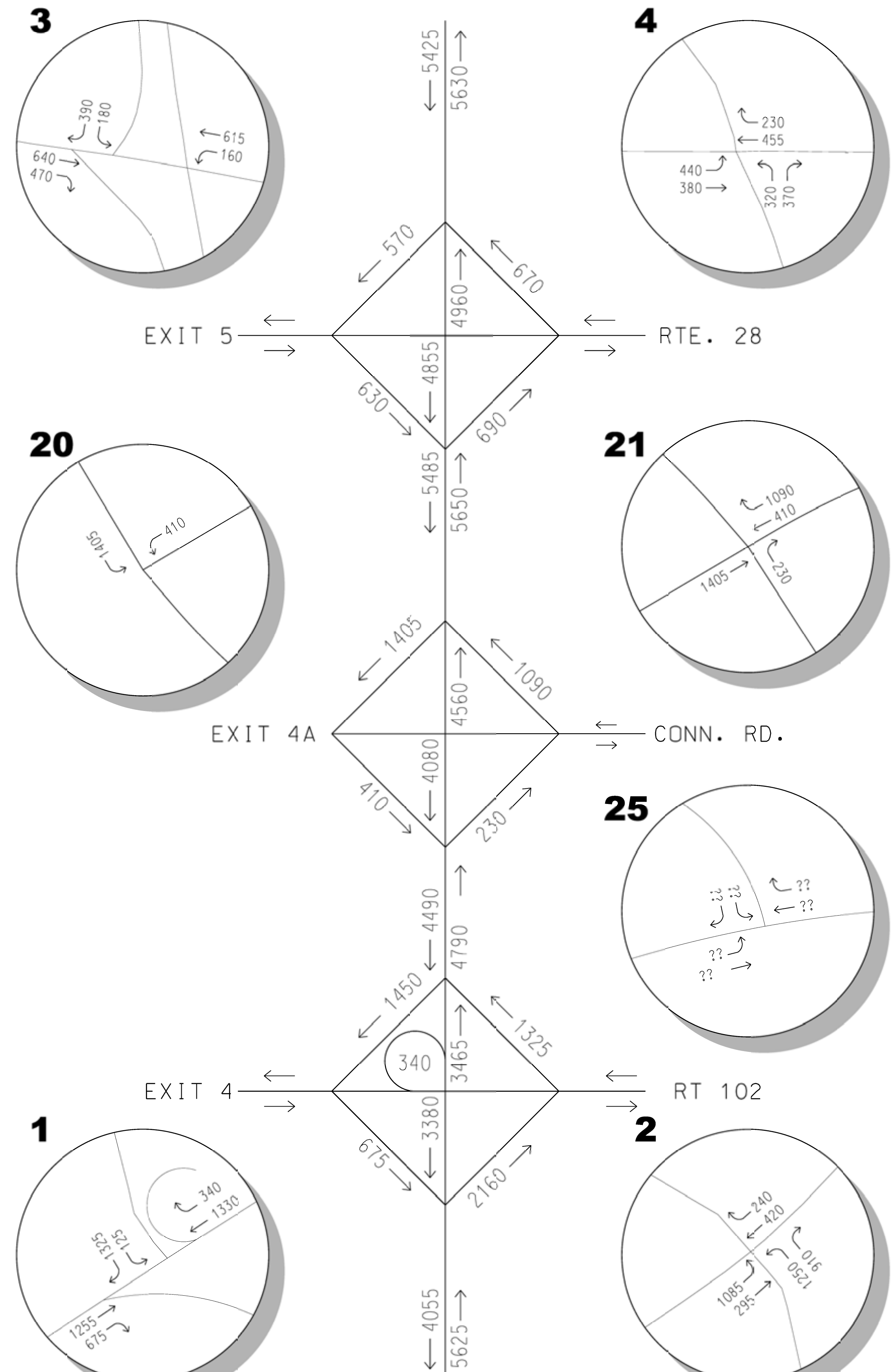
Coordinate System:
NAD 1983 StatePlane
New Hampshire (feet)

Date:
January 24, 2018

New Hampshire DOT
Department of Transportation

Figure 21 - 2040 Alternative C AM Peak Hour Base Volumes – Locations 1-4, 20-21, and 25





I-93 Exit 4A
Supplemental Draft EIS

2040 ALT C PM PEAK HOUR BASE VOLUMES

INDEX

1. Exit 4 SB Ramps
2. Exit 4 NB Ramps
3. Exit 5 SB Ramps
4. Exit 5 NB Ramps
20. Exit 4A SB Ramps
21. Exit 4A NB Ramps
25. NH 28/ C-D Connector

Feet
0 1,000 2,000

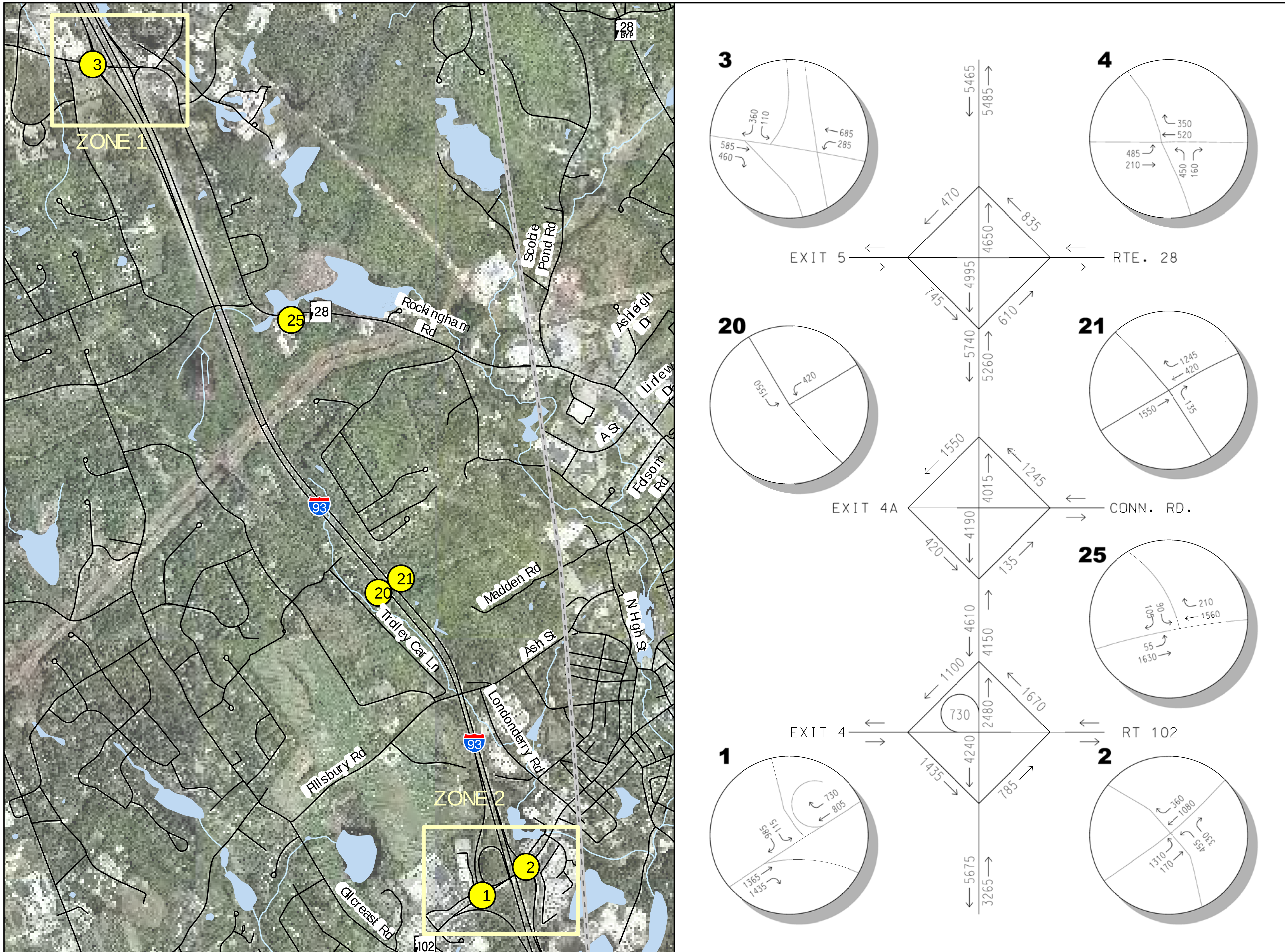
Sources:

Coordinate System:
NAD 1983 StatePlane
New Hampshire (feet)

Date:
January 24, 2018

New Hampshire DOT
Department of Transportation

Figure 22 - 2040 Alternative C PM Peak Hour Base Volumes – Locations 1-4, 20-21, and 25



I-93 Exit 4A
Supplemental Draft EIS

2040 ALT D AM PEAK HOUR BASE VOLUMES

INDEX

1. Exit 4 SB Ramps
2. Exit 4 NB Ramps
3. Exit 5 SB Ramps
4. Exit 5 NB Ramps
20. Exit 4A SB Ramps
21. Exit 4A NB Ramps
25. NH 28/ C-D Connector

Feet
0 1,000 2,000

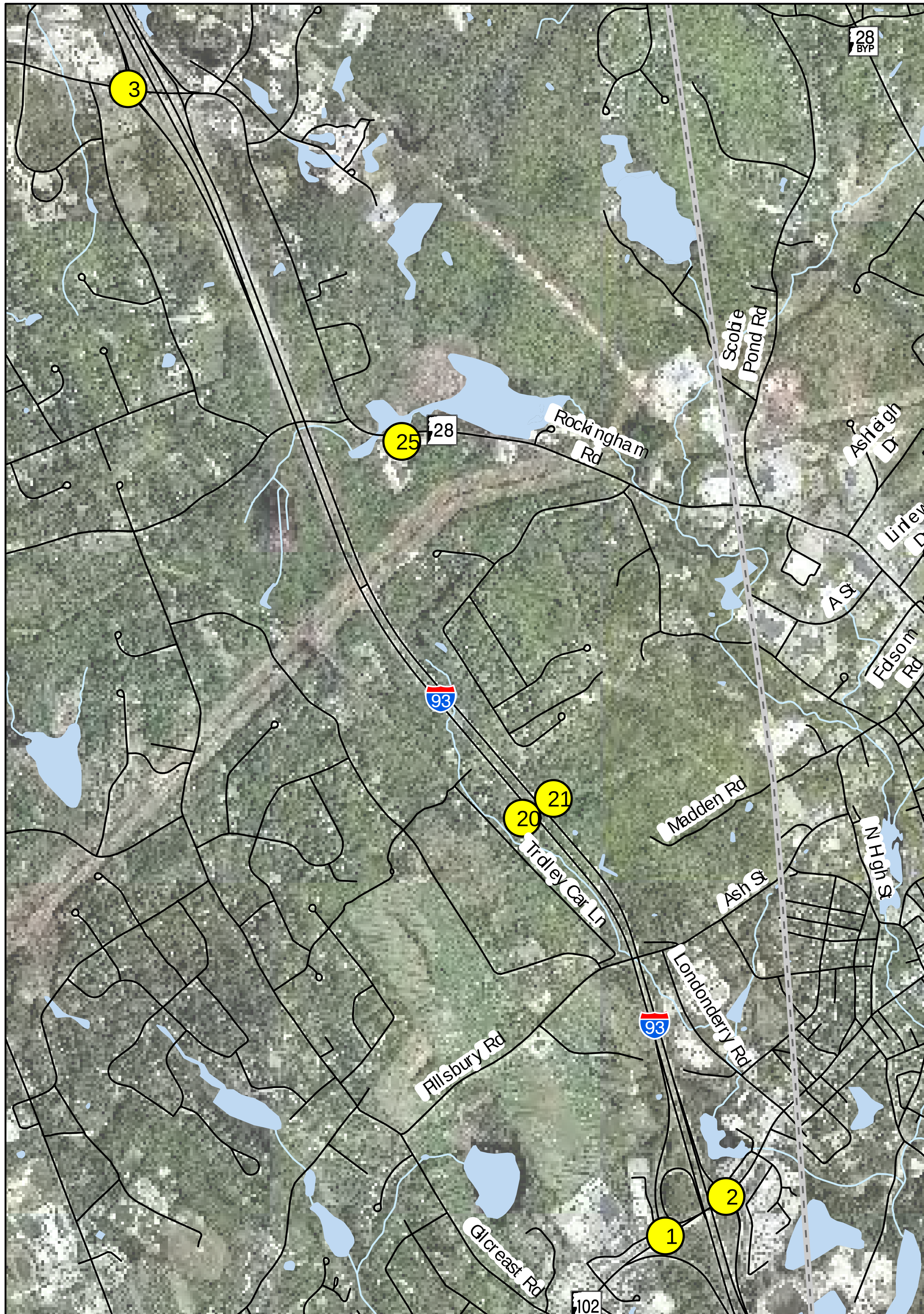
Sources:

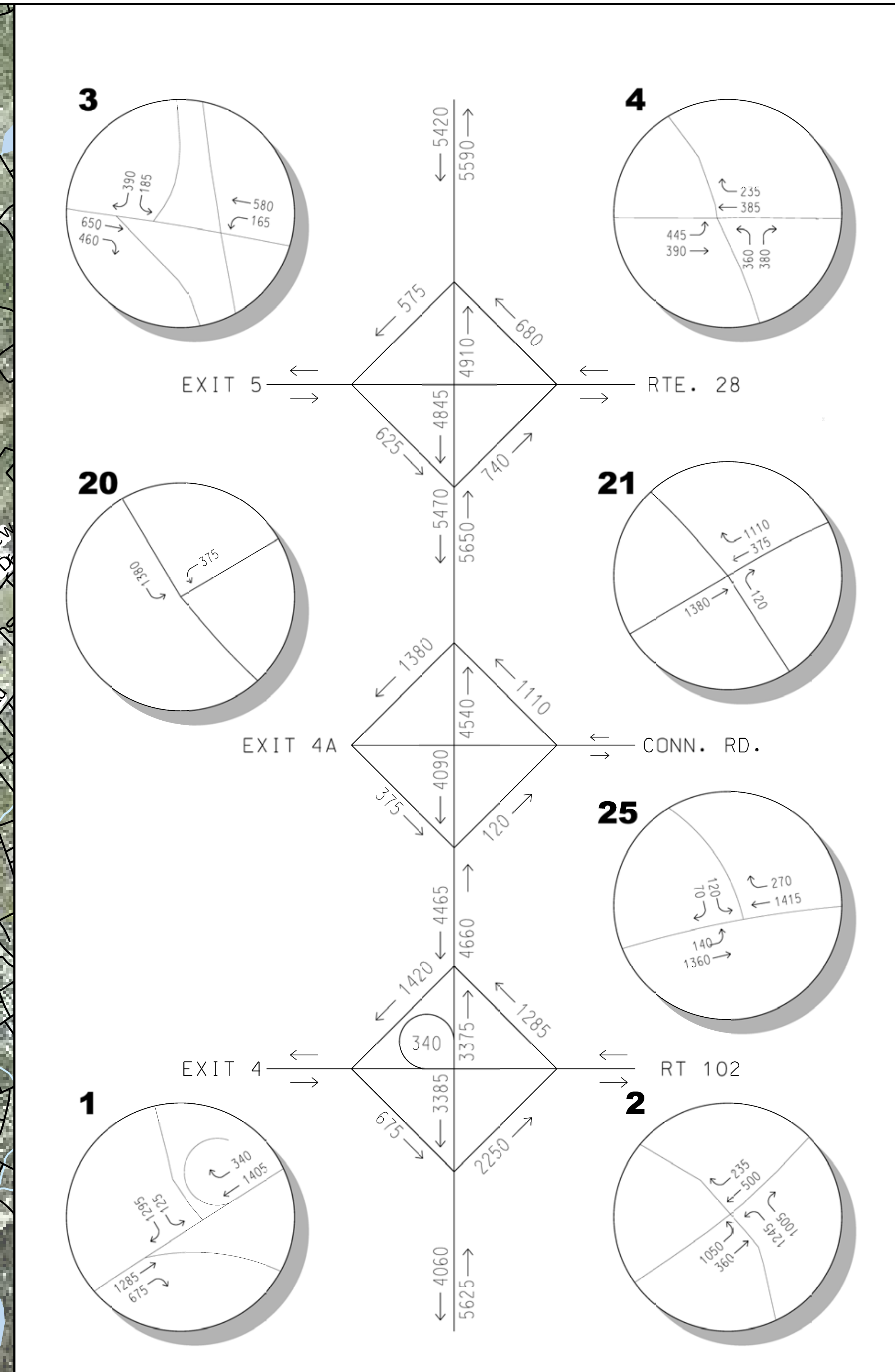
N

Coordinate System: NAD 1983 StatePlane New Hampshire (feet)	Date: January 24, 2018

New Hampshire DOT
Department of Transportation

Figure 23 - 2040 Alternative D AM Peak Hour Base Volumes – Locations 1-4, 20-21, and 25





I-93 Exit 4A
Supplemental Draft EIS

2040 ALT D PM PEAK HOUR BASE VOLUMES

INDEX

1. Exit 4 SB Ramps
2. Exit 4 NB Ramps
3. Exit 5 SB Ramps
4. Exit 5 NB Ramps
20. Exit 4A SB Ramps
21. Exit 4A NB Ramps
25. NH 28/ C-D Connector

Feet
0 1,000 2,000

Sources:

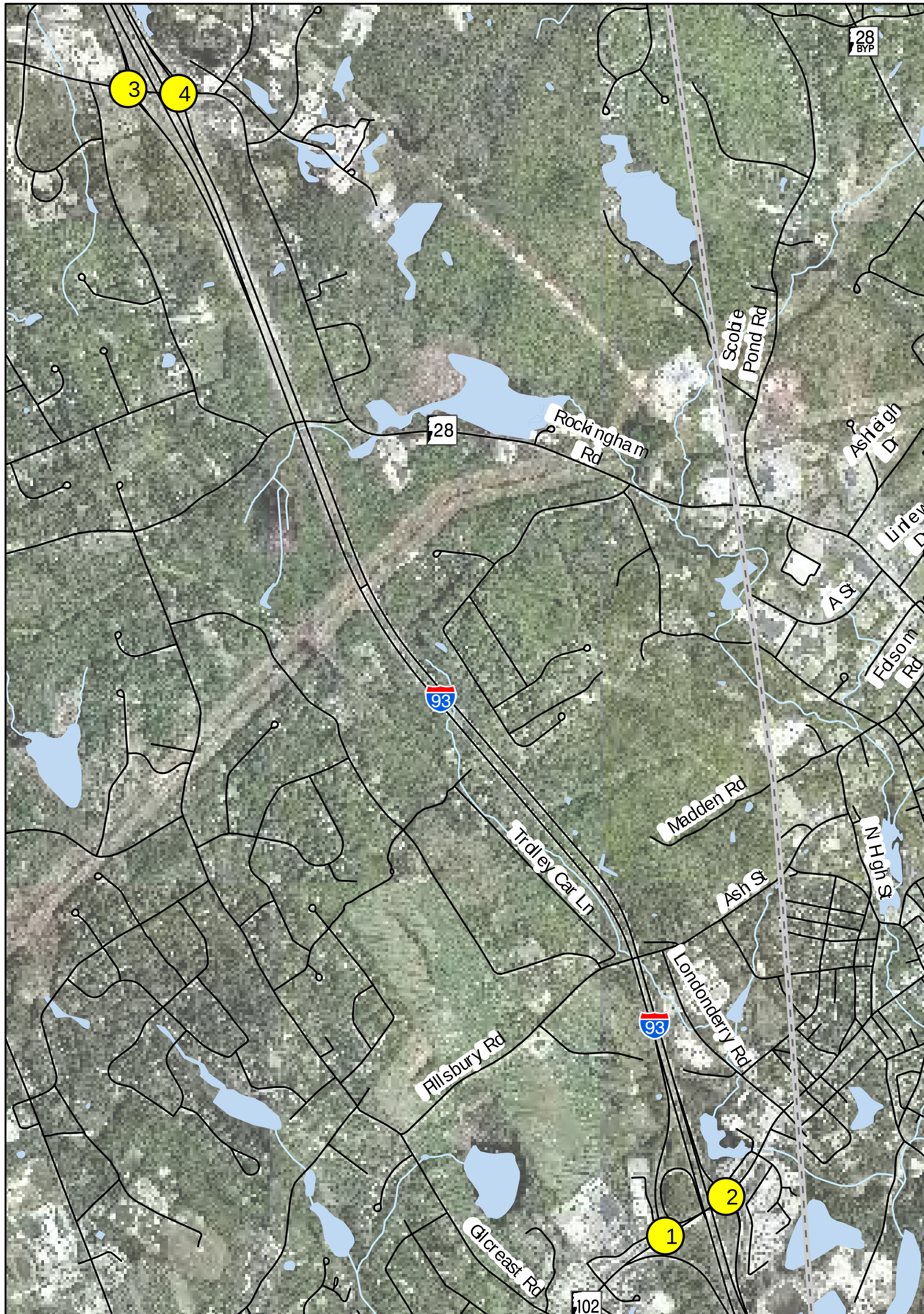
N

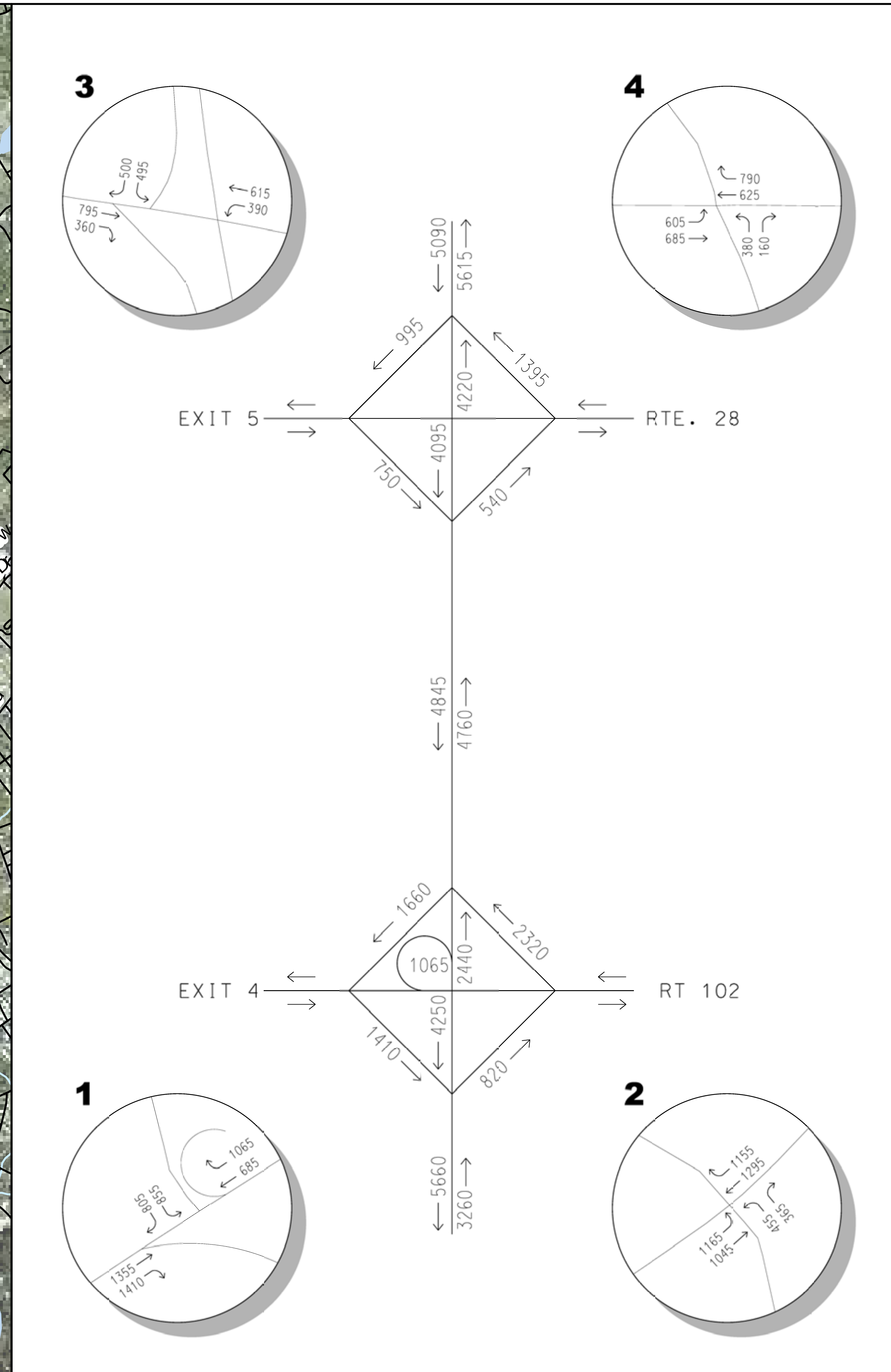
Coordinate System:
NAD 1983 StatePlane
New Hampshire (feet)

Date:
January 24, 2018

New Hampshire DOT
Department of Transportation

Figure 24 - 2040 Alternative D PM Peak Hour Base Volumes – Locations 1-4, 20-21, and 25





I-93 Exit 4A
Supplemental Draft EIS

2040 ALT F AM PEAK HOUR BASE VOLUMES

INDEX

1. Exit 4 SB Ramps
2. Exit 4 NB Ramps
3. Exit 5 SB Ramps
4. Exit 5 NB Ramps

Feet
0 1,000 2,000

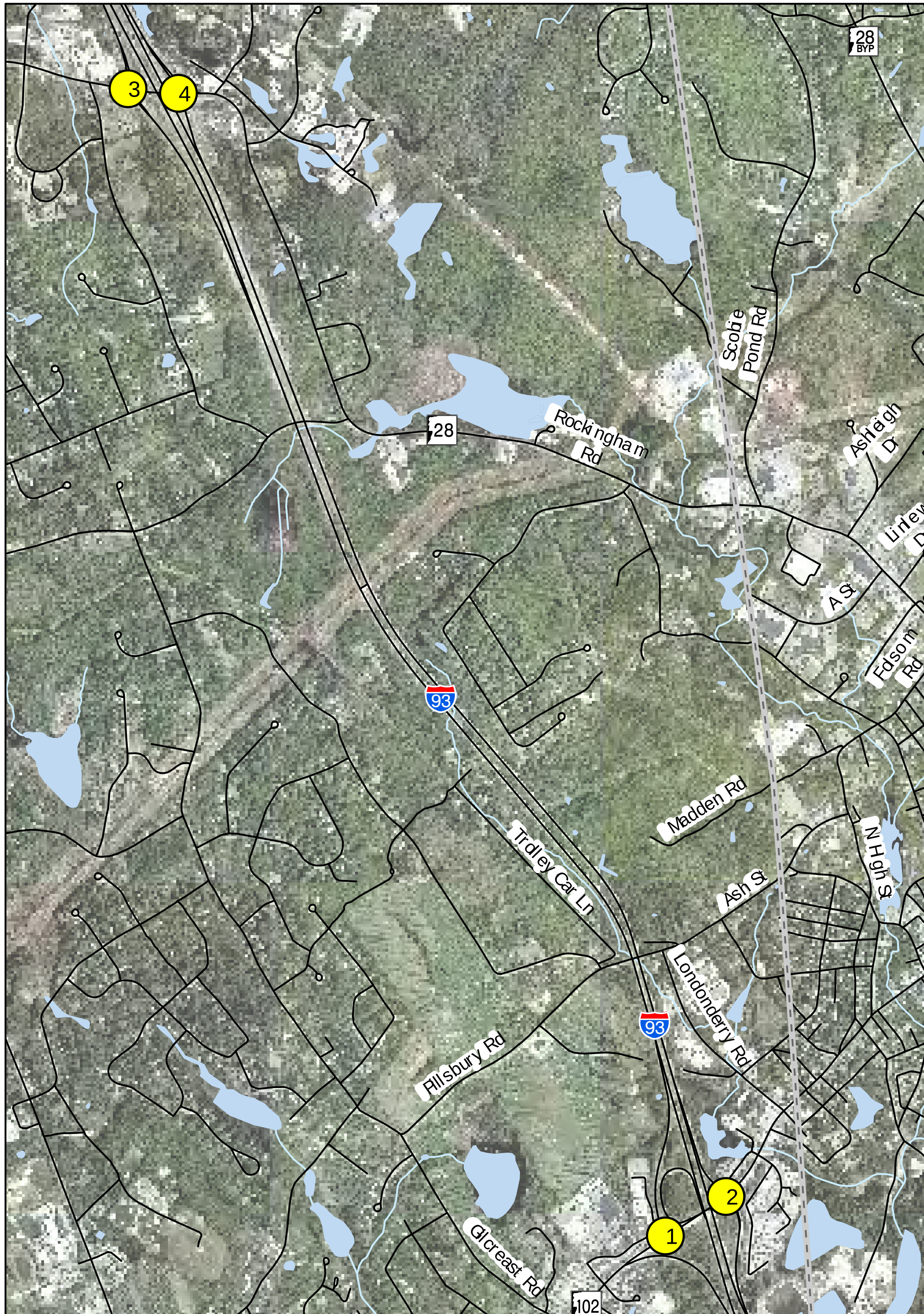
Sources:

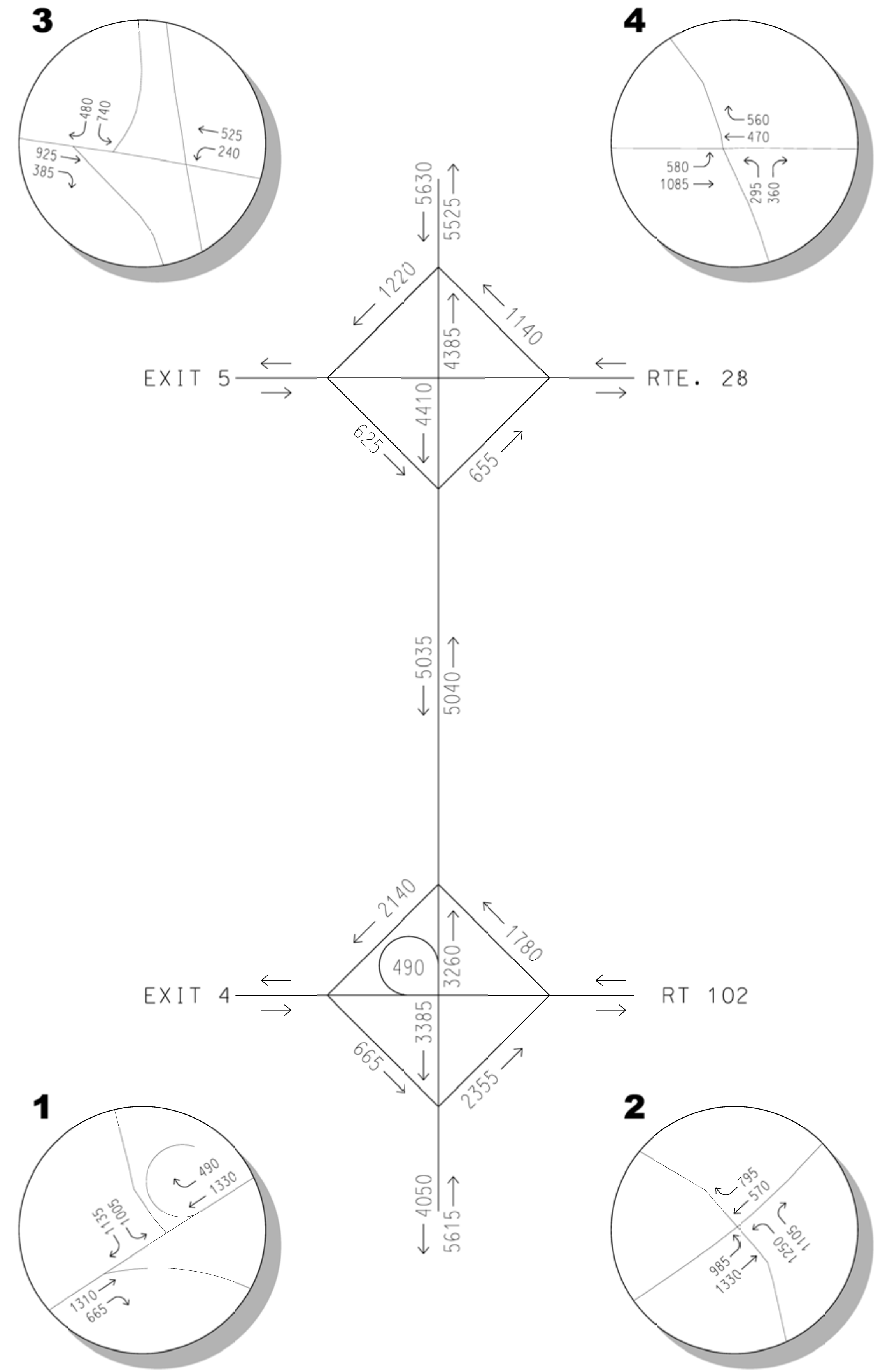
N

Coordinate System: NAD 1983 StatePlane New Hampshire (feet)	Date: January 24, 2018

New Hampshire DOT
Department of Transportation

Figure 25 - 2040 Alternative F AM Peak Hour Base Volumes – Locations 1-4





I-93 Exit 4A
Supplemental Draft EIS

2040 ALT F PM PEAK HOUR BASE VOLUMES

INDEX

1. Exit 4 SB Ramps
2. Exit 4 NB Ramps
3. Exit 5 SB Ramps
4. Exit 5 NB Ramps

Feet
0 1,000 2,000

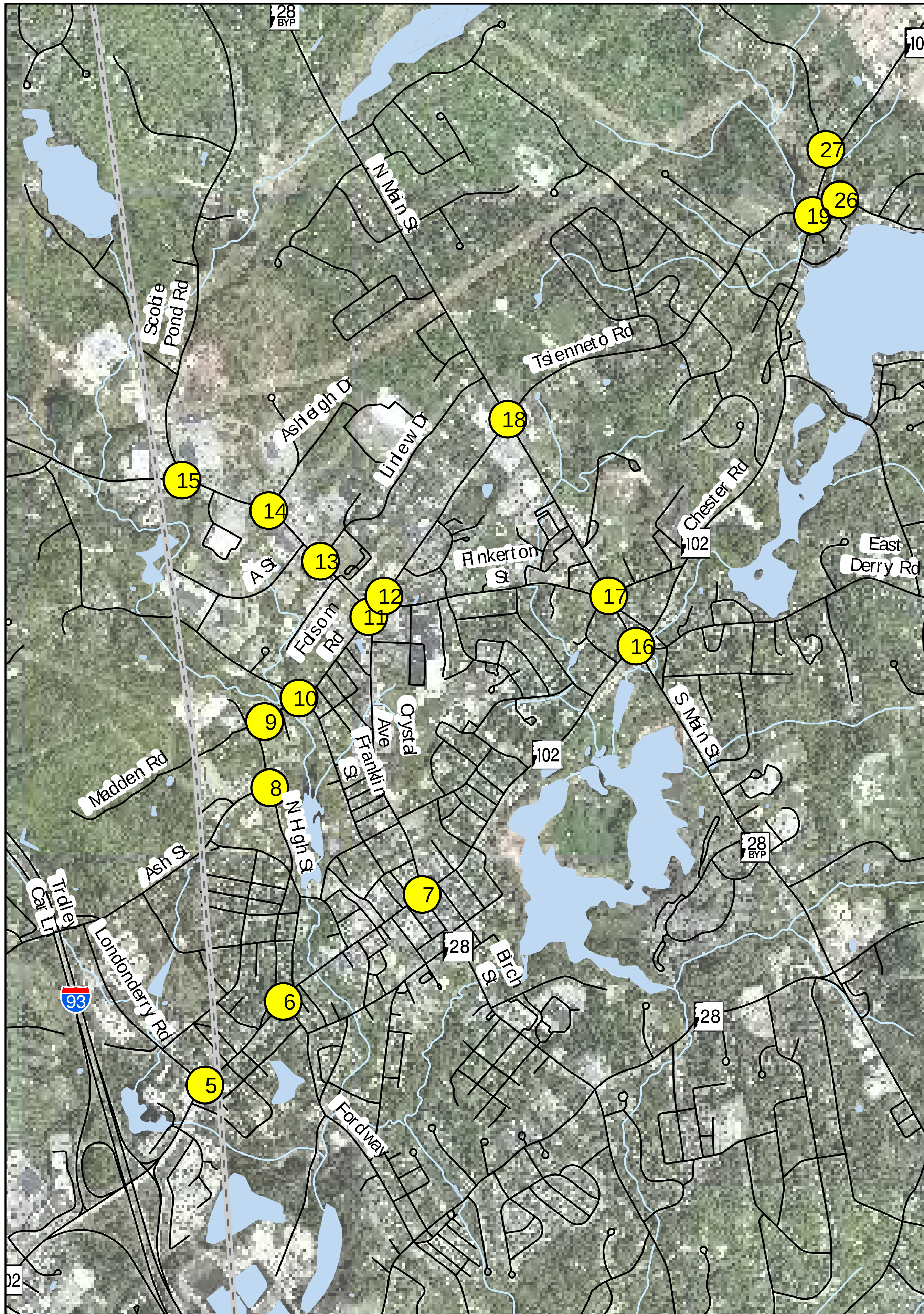
Sources:

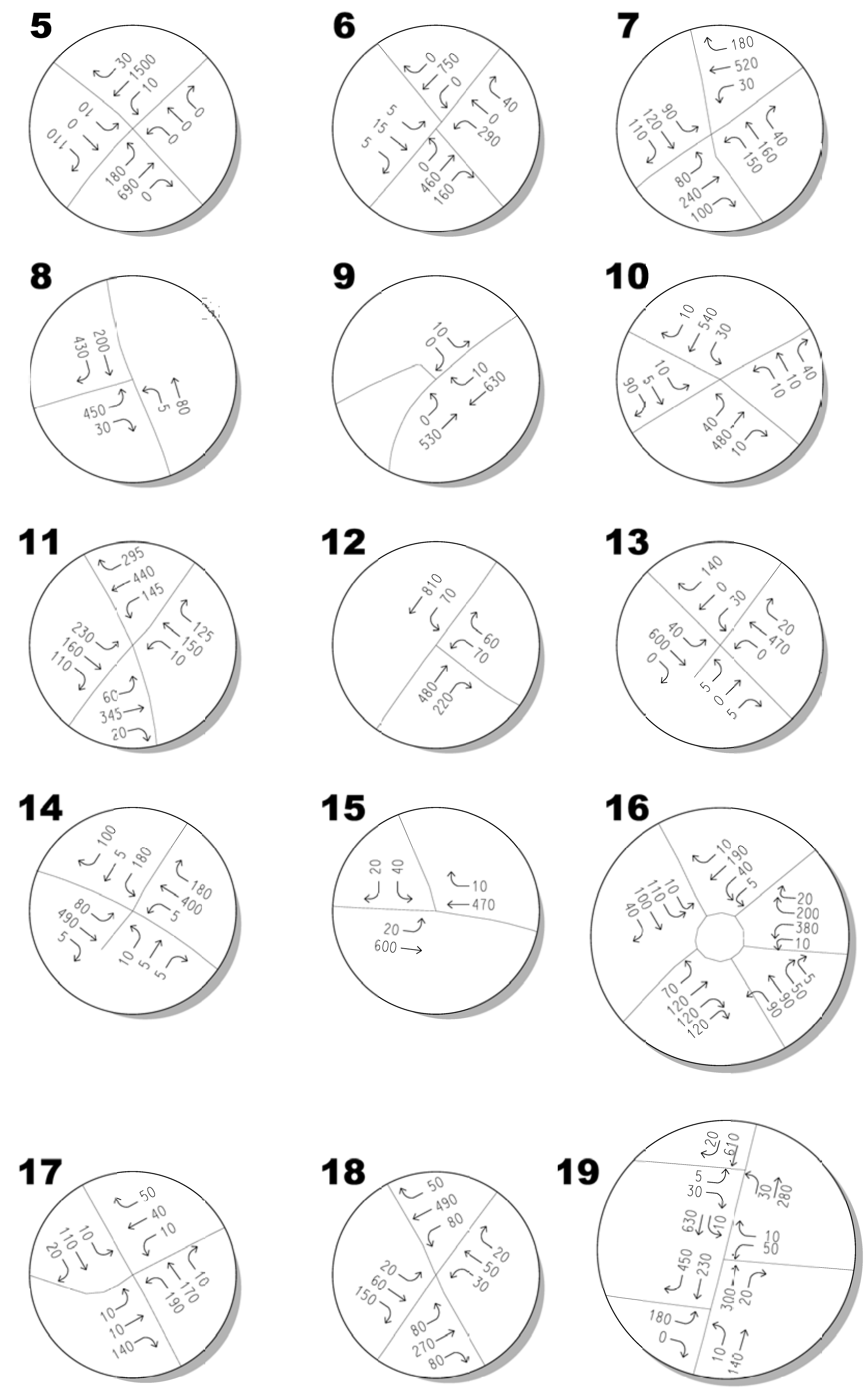
Coordinate System: NAD 1983 StatePlane New Hampshire (feet)

Date: January 24, 2018

New Hampshire DOT Department of Transportation

Figure 26 - 2040 Alternative F PM Peak Hour Base Volumes – Locations 1-4





I-93 Exit 4A
Supplemental Draft EIS

2040 NO-BUILD AM PEAK HOUR BASE VOLUMES

INDEX

5. NH 102/ Londonderry Road
6. NH 102/ Fordway/ High St.
7. NH 102/ NH 28
8. N. High St./ Ash St. Extension
9. N. High St./ Madden Rd.
10. N. High St./ Folsom Rd./ Franklin St
11. NH 28/ Folsom Rd./ Tsienneto Rd.
12. Tsienneto Rd./ Pinkerton St.
13. NH 28/ Linlew Dr.
14. NH28/ Ashleigh Dr.
15. NH 28/ Scobie Pond Rd.
16. NH 102/ NH 28 Bypass/ E. Derry Rd.
17. NH 28 Bypass/ Pinkerton St.
18. NH 28 Bypass/ Tsienneto Rd.
19. NH 102/ Tsienneto Rd.
26. NH 102/ North Shore Rd
27. NH 102/ English Range Rd

Feet
0 1,000 2,000

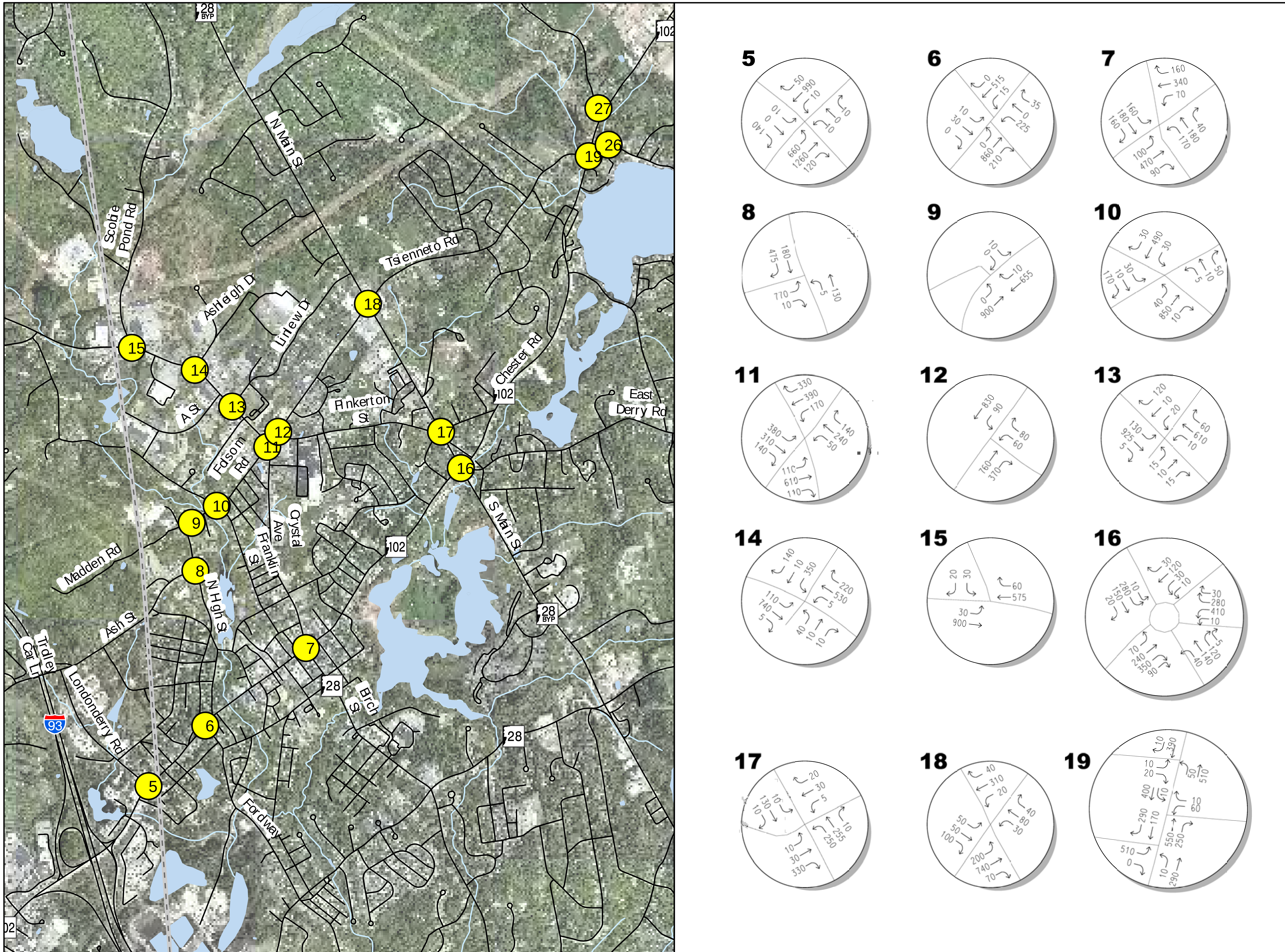
Sources:

Coordinate System: NAD 1983 StatePlane New Hampshire (feet)

Date: January 24, 2018

New Hampshire DOT Department of Transportation

Figure 27 - 2040 No-Build AM Peak Hour Base Volumes – Locations 5-19 and 26-27



I-93 Exit 4A
Supplemental Draft EIS

2040 NO-BUILD PM PEAK HOUR BASE VOLUMES

INDEX

5. NH 102/ Londonderry Road
6. NH 102/ Fordway/ High St.
7. NH 102/ NH 28
8. N. High St./ Ash St. Extension
9. N. High St./ Madden Rd.
10. N. High St./ Folsom Rd./ Franklin St
11. NH 28/ Folsom Rd./ Tsienneto Rd.
12. Tsienneto Rd./ Pinkerton St.
13. NH 28/ Linlew Dr.
14. NH28/ Ashleigh Dr.
15. NH 28/ Scobie Pond Rd.
16. NH 102/ NH 28 Bypass/ E. Derry Rd.
17. NH 28 Bypass/ Pinkerton St.
18. NH 28 Bypass/ Tsienneto Rd.
19. NH 102/ Tsienneto Rd.
26. NH 102/ North Shore Rd
27. NH 102/ English Range Rd

Feet
0 1,000 2,000

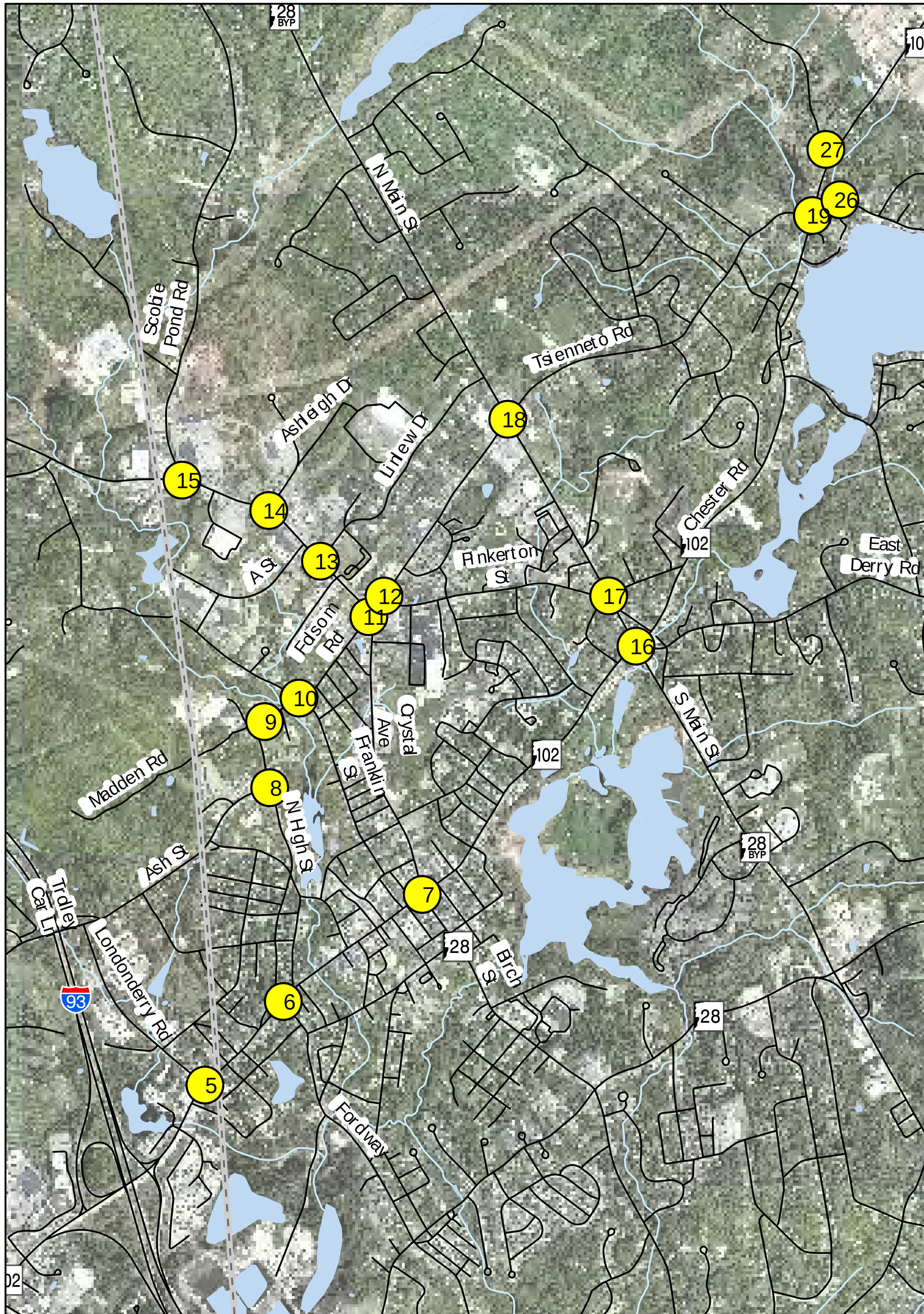
Sources:

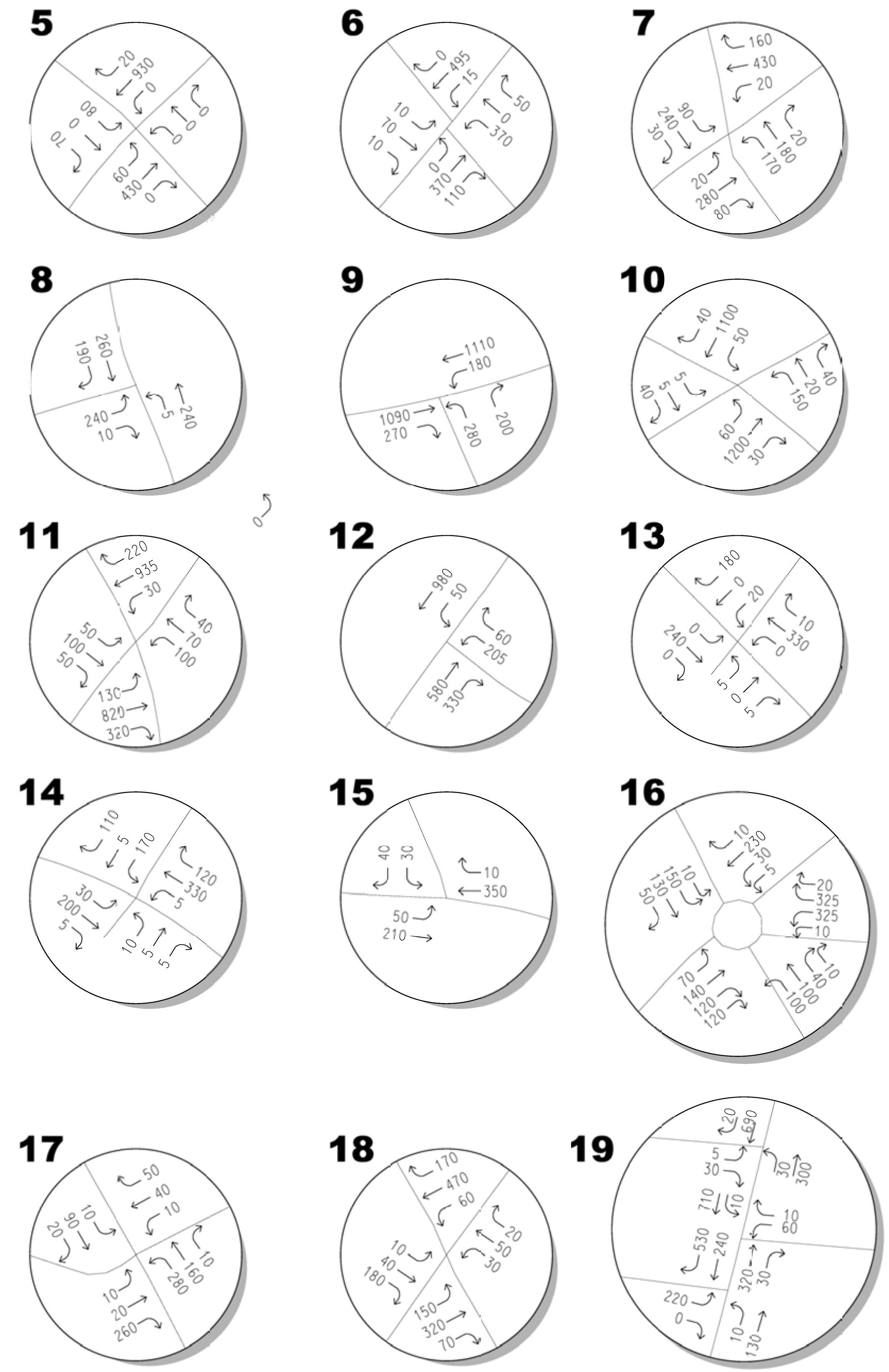
Coordinate System:
NAD 1983 StatePlane
New Hampshire (feet)

Date:
January 24, 2018

New Hampshire DOT
Department of Transportation

Figure 28 - 2040 No-Build PM Peak Hour Base Volumes – Locations 5-19 and 26-27





I-93 Exit 4A
Supplemental Draft EIS

2040 ALT A AM PEAK HOUR BASE VOLUMES

INDEX

5. NH 102/ Londonderry Road
6. NH 102/ Fordway/ High St.
7. NH 102/ NH 28
8. N. High St./ Ash St. Extension
9. N. High St./ Madden Rd.
10. N. High St./ Folsom Rd./ Franklin St
11. NH 28/ Folsom Rd./ Tsienneto Rd.
12. Tsienneto Rd./ Pinkerton St.
13. NH 28/ Linlew Dr.
14. NH28/ Ashleigh Dr.
15. NH 28/ Scobie Pond Rd.
16. NH 102/ NH 28 Bypass/ E. Derry Rd.
17. NH 28 Bypass/ Pinkerton St.
18. NH 28 Bypass/ Tsienneto Rd.
19. NH 102/ Tsienneto Rd.
26. NH 102/ North Shore Rd
27. NH 102/ English Range Rd

Feet
0 1,000 2,000

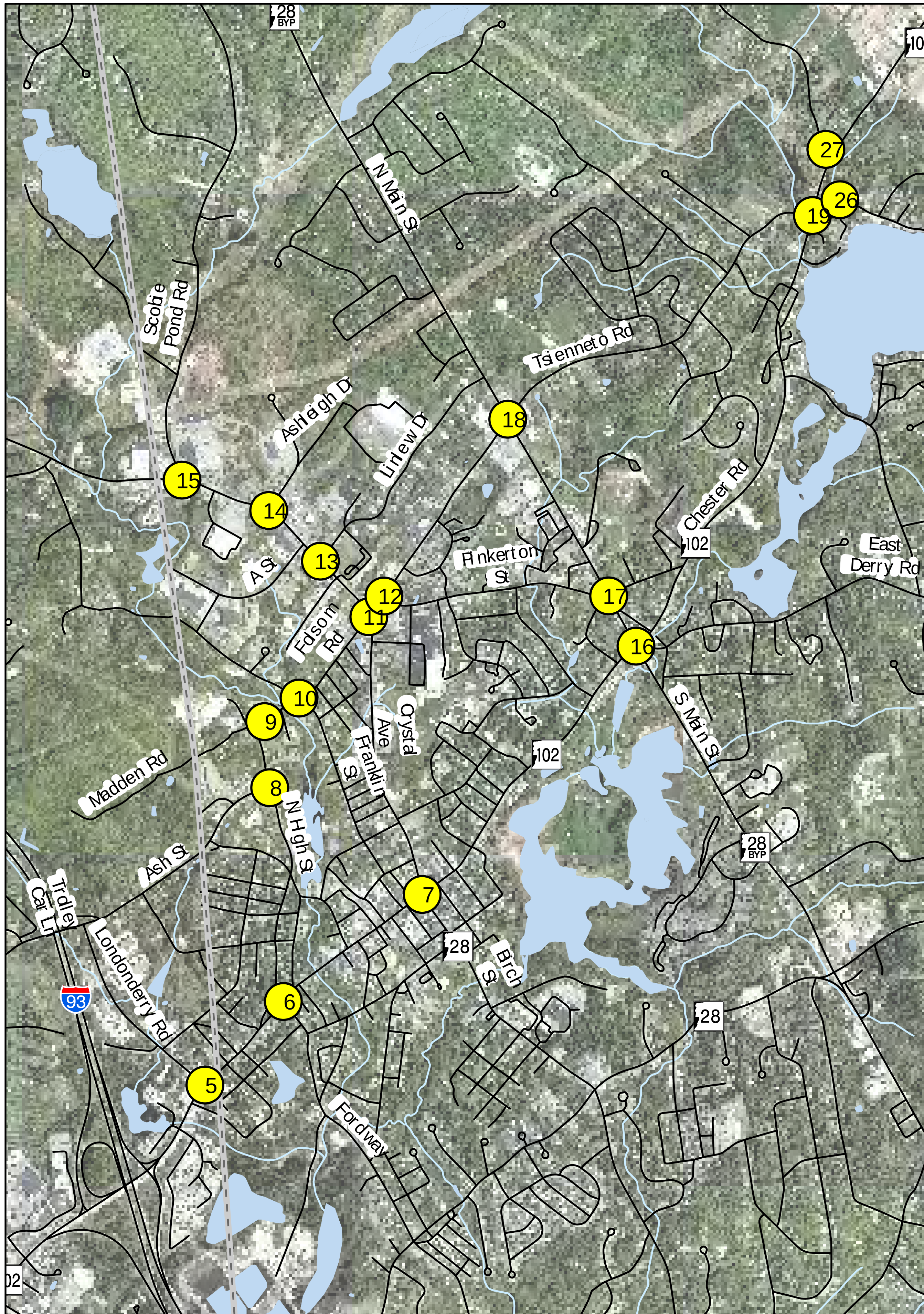
Sources:

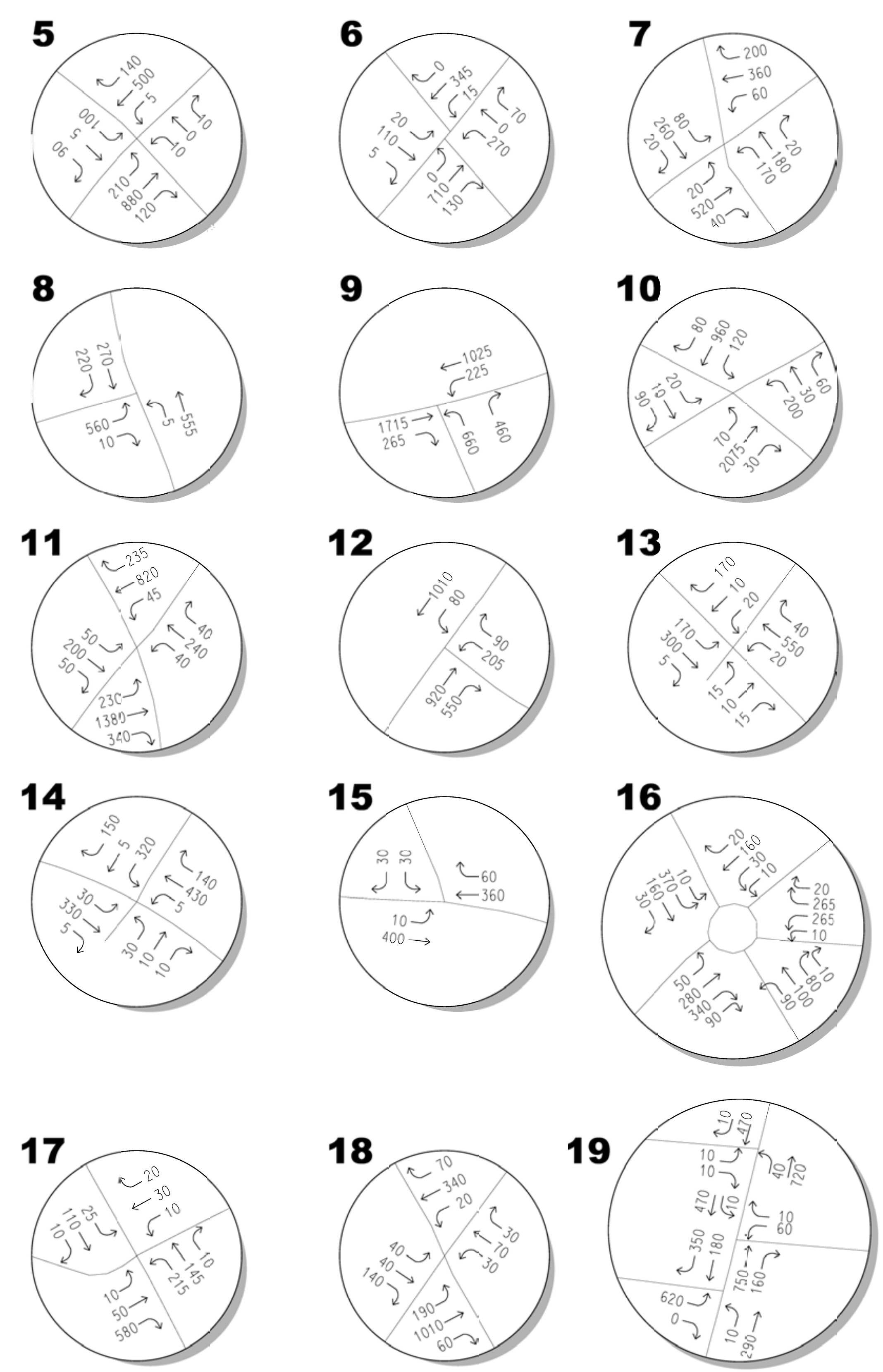
Coordinate System:
NAD 1983 StatePlane
New Hampshire (feet)

Date:
January 24, 2018

New Hampshire DOT
Department of Transportation

Figure 29 - 2040 Alternative A AM Peak Hour Base Volumes – Locations 5-19 and 26-27





I-93 Exit 4A
Supplemental Draft EIS

2040 ALT A PM PEAK HOUR BASE VOLUMES

INDEX

5. NH 102/ Londonderry Road
6. NH 102/ Fordway/ High St.
7. NH 102/ NH 28
8. N. High St./ Ash St. Extension
9. N. High St./ Madden Rd.
10. N. High St./ Folsom Rd./ Franklin St
11. NH 28/ Folsom Rd./ Tsienneto Rd.
12. Tsienneto Rd./ Pinkerton St.
13. NH 28/ Linlew Dr.
14. NH28/ Ashleigh Dr.
15. NH 28/ Scobie Pond Rd.
16. NH 102/ NH 28 Bypass/ E. Derry Rd.
17. NH 28 Bypass/ Pinkerton St.
18. NH 28 Bypass/ Tsienneto Rd.
19. NH 102/ Tsienneto Rd.
26. NH 102/ North Shore Rd
27. NH 102/ English Range Rd

Feet
0 1,000 2,000

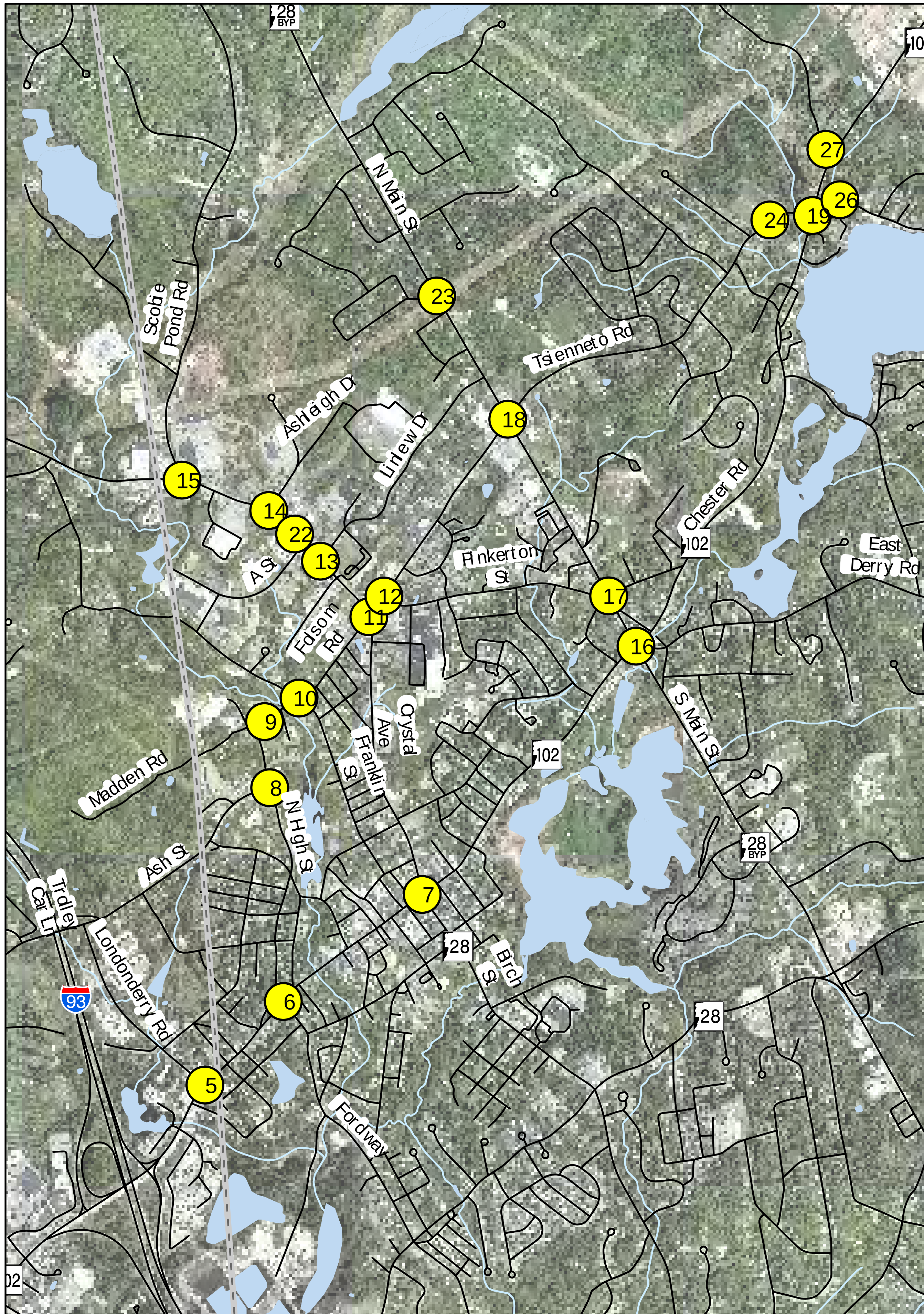
Sources:

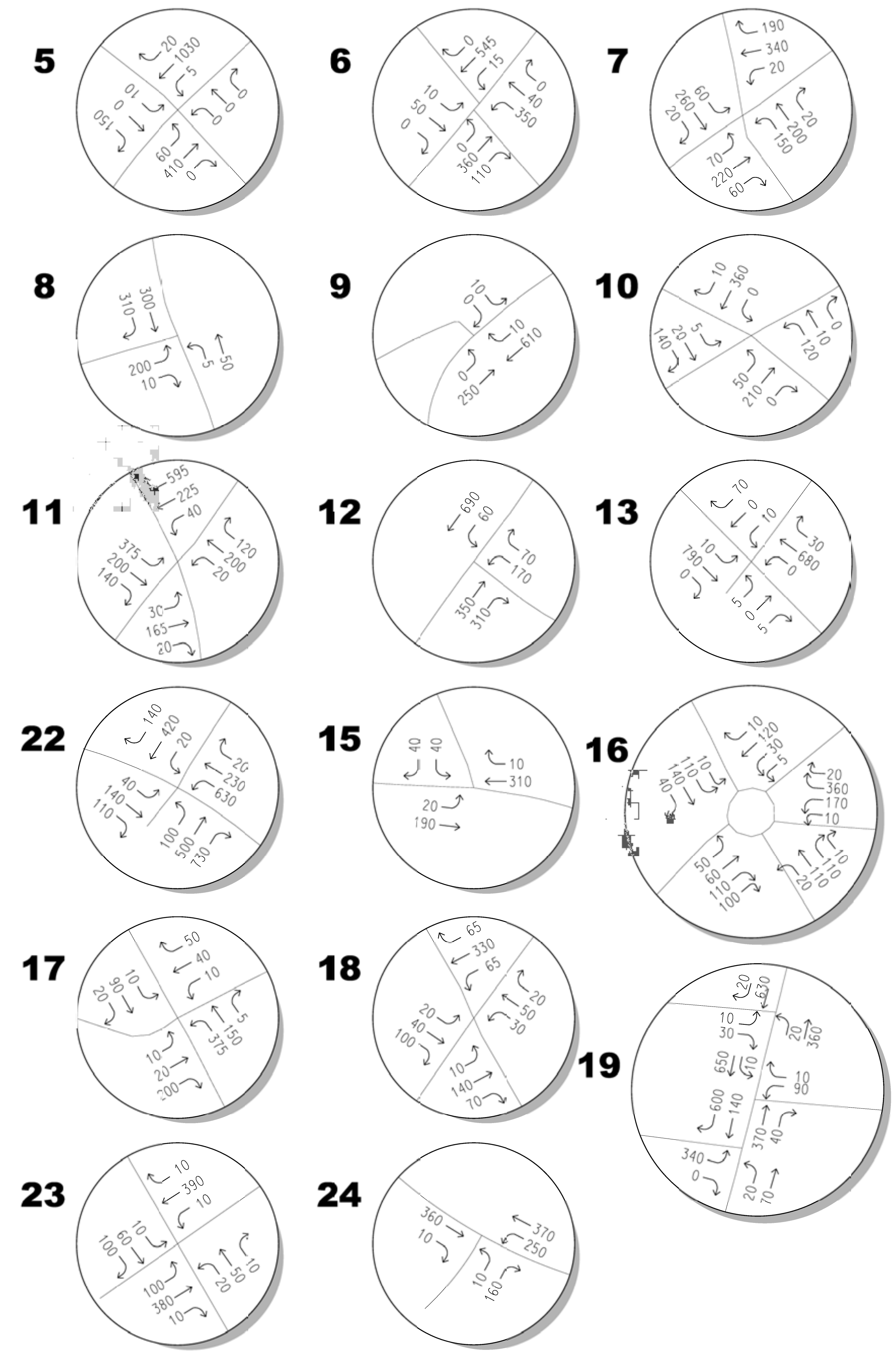
Coordinate System:
NAD 1983 StatePlane
New Hampshire (feet)

Date:
January 24, 2018

New Hampshire DOT
Department of Transportation

Figure 30 - 2040 Alternative A PM Peak Hour Base Volumes – Locations 5-19 and 26-27





I-93 Exit 4A
Supplemental Draft EIS

2040 ALT B AM PEAK HOUR BASE VOLUMES

INDEX

5. NH 102/ Londonderry Road
6. NH 102/ Fordway/ High St.
7. NH 102/ NH 28
8. N. High St./ Ash St. Extension
9. N. High St./ Madden Rd.
10. N. High St./ Folsom Rd./ Franklin St
11. NH 28/ Folsom Rd./ Tsienneto Rd.
12. Tsienneto Rd./ Pinkerton St.
13. NH 28/ Linlew Dr.
14. NH 28/ Ashleigh Dr.
15. NH 28/ Scobie Pond Rd.
16. NH 102/ NH 28 Bypass/ E. Derry Rd.
17. NH 28 Bypass/ Pinkerton St.
18. NH 28 Bypass/ Tsienneto Rd.
19. NH 102/ Tsienneto Rd.
22. NH 28/ B-C Connector
23. NH 28 Bypass/ B-C Connector
24. Tsienneto Rd/ B-C Connector
26. NH 102/ North Shore Rd
27. NH 102/ English Range Rd

Feet
0 1,000 2,000

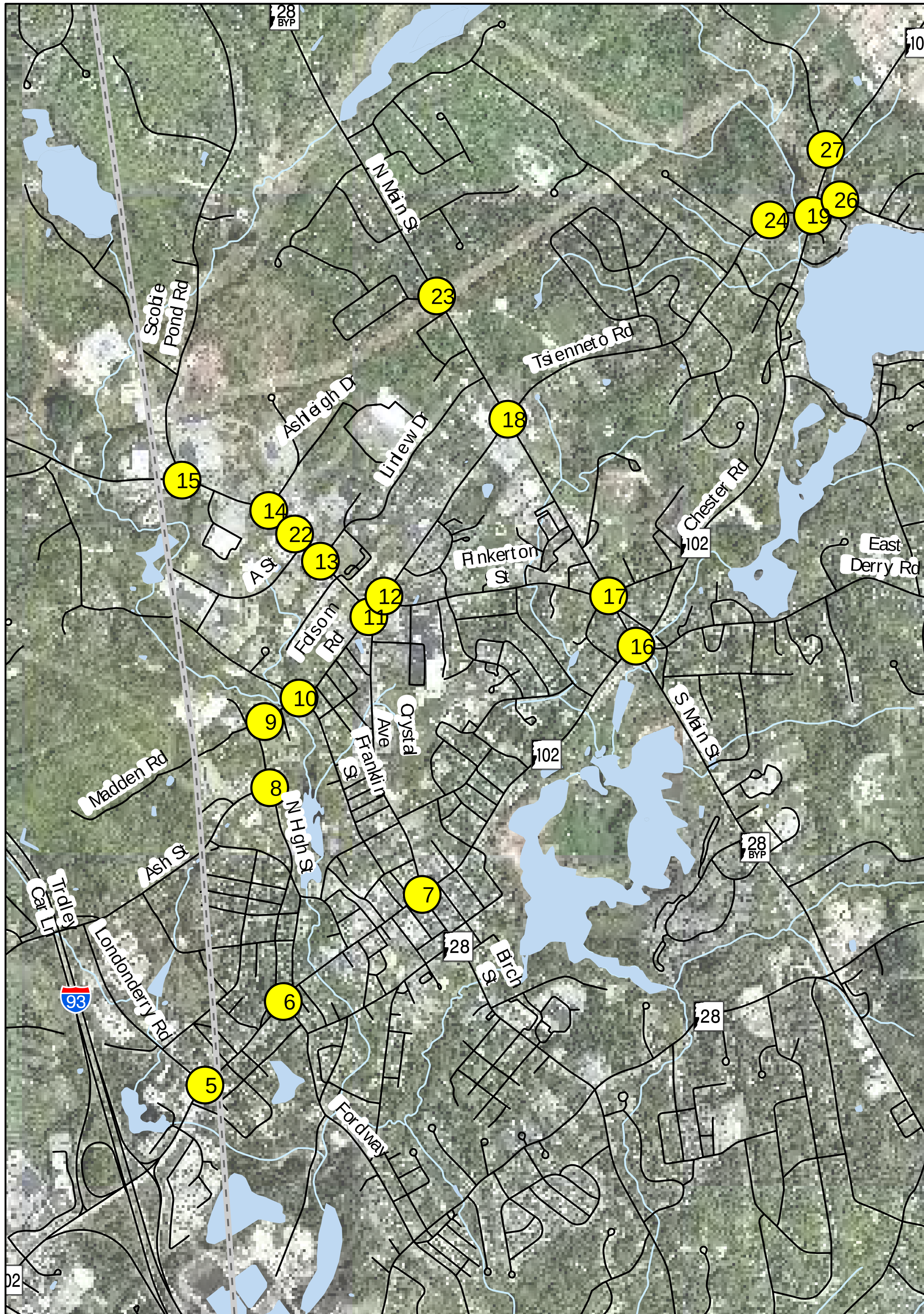
Sources:

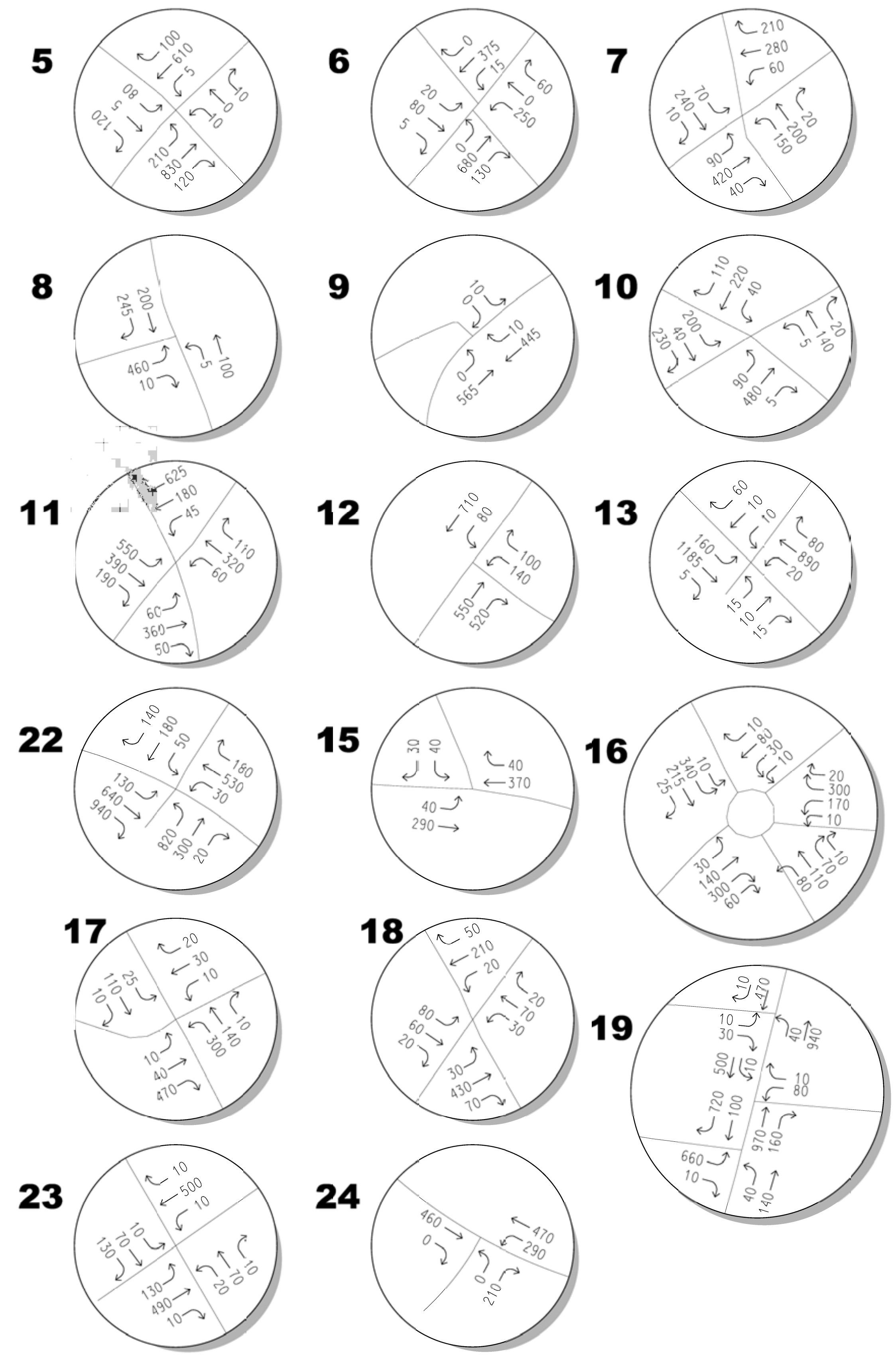
Coordinate System:
NAD 1983 StatePlane
New Hampshire (feet)

Date:
January 24, 2018

New Hampshire DOT
Department of Transportation

Figure 31 - 2040 Alternative B AM Peak Hour Base Volumes – Locations 5-19, 22-24, and 26-27





I-93 Exit 4A
Supplemental Draft EIS

2040 ALT B PM PEAK HOUR BASE VOLUMES

INDEX

5. NH 102/ Londonderry Road
6. NH 102/ Fordway/ High St.
7. NH 102/ NH 28
8. N. High St./ Ash St. Extension
9. N. High St./ Madden Rd.
10. N. High St./ Folsom Rd./ Franklin St
11. NH 28/ Folsom Rd./ Tsienneto Rd.
12. Tsienneto Rd./ Pinkerton St.
13. NH 28/ Linlew Dr.
14. NH 28/ Ashleigh Dr.
15. NH 28/ Scobie Pond Rd.
16. NH 102/ NH 28 Bypass/ E. Derry Rd.
17. NH 28 Bypass/ Pinkerton St.
18. NH 28 Bypass/ Tsienneto Rd.
19. NH 102/ Tsienneto Rd.
22. NH 28/ B-C Connector
23. NH 28 Bypass/ B-C Connector
24. Tsienneto Rd/ B-C Connector
26. NH 102/ North Shore Rd
27. NH 102/ English Range Rd

Feet
0 1,000 2,000

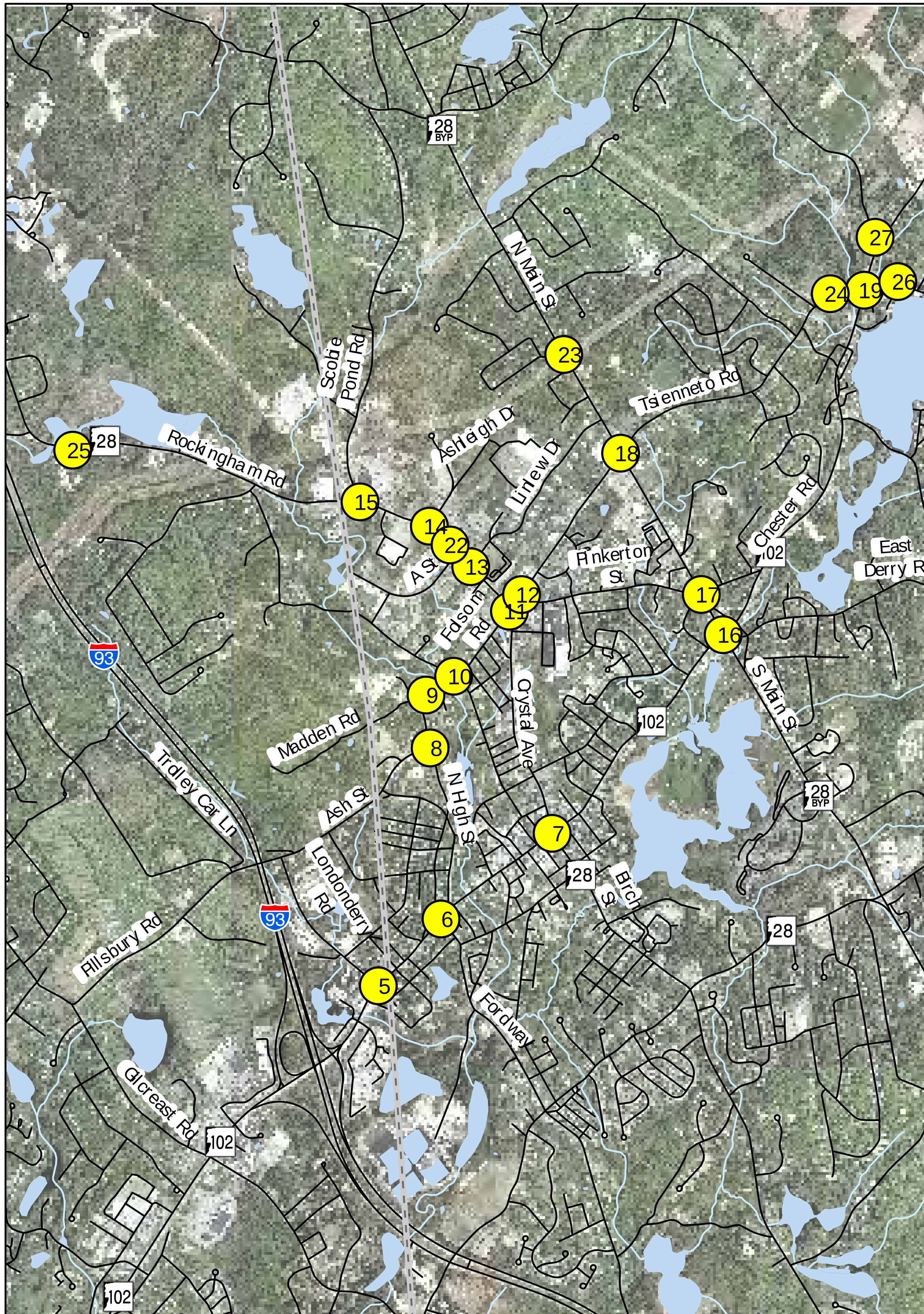
Sources:

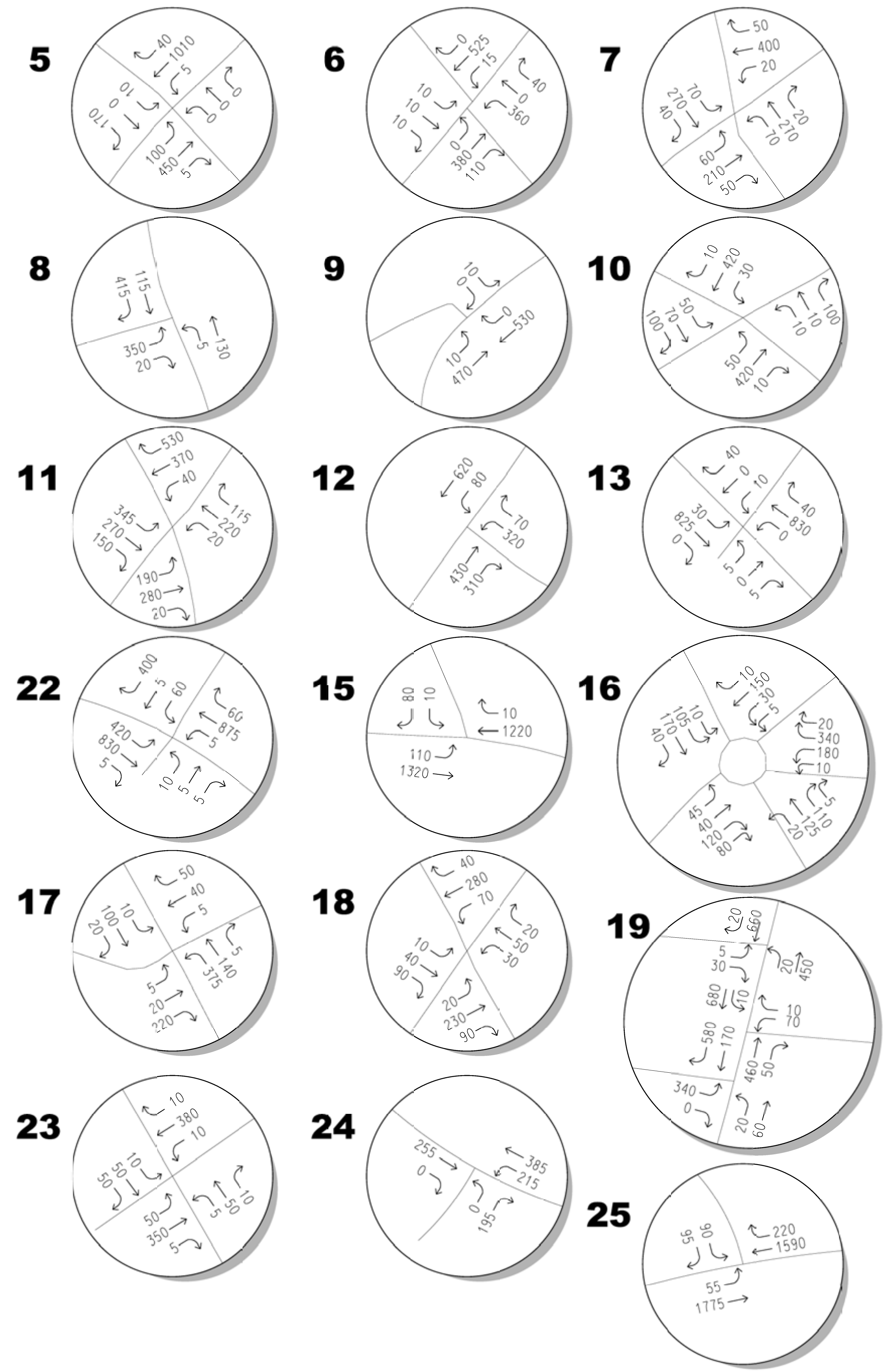
Coordinate System:
NAD 1983 StatePlane
New Hampshire (feet)

Date:
January 24, 2018

New Hampshire DOT
Department of Transportation

Figure 32 - 2040 Alternative B PM Peak Hour Base Volumes – Locations 5-19, 22-24, and 26-27





I-93 Exit 4A
Supplemental Draft EIS

2040 ALT C AM PEAK HOUR BASE VOLUMES

INDEX

5. NH 102/ Londonderry Road
6. NH 102/ Fordway/ High St.
7. NH 102/ NH 28
8. N. High St./ Ash St. Extension
9. N. High St./ Madden Rd.
10. N. High St./ Folsom Rd./ Franklin St
11. NH 28/ Folsom Rd./ Tsienneto Rd.
12. Tsienneto Rd./ Pinkerton St.
13. NH 28/ Linlew Dr.
14. NH 28/ Ashleigh Dr.
15. NH 28/ Scobie Pond Rd.
16. NH 102/ NH 28 Bypass/ E. Derry Rd.
17. NH 28 Bypass/ Pinkerton St.
18. NH 28 Bypass/ Tsienneto Rd.
19. NH 102/ Tsienneto Rd.
22. NH 28/ B-C Connector
23. NH 28 Bypass/ B-C Connector
24. Tsiennetto Rd/ B-C Connector
25. NH 28/ C-D Connector
26. NH 102/ North Shore Rd
27. NH 102/ English Range Rd

Feet
0 1,000 2,000

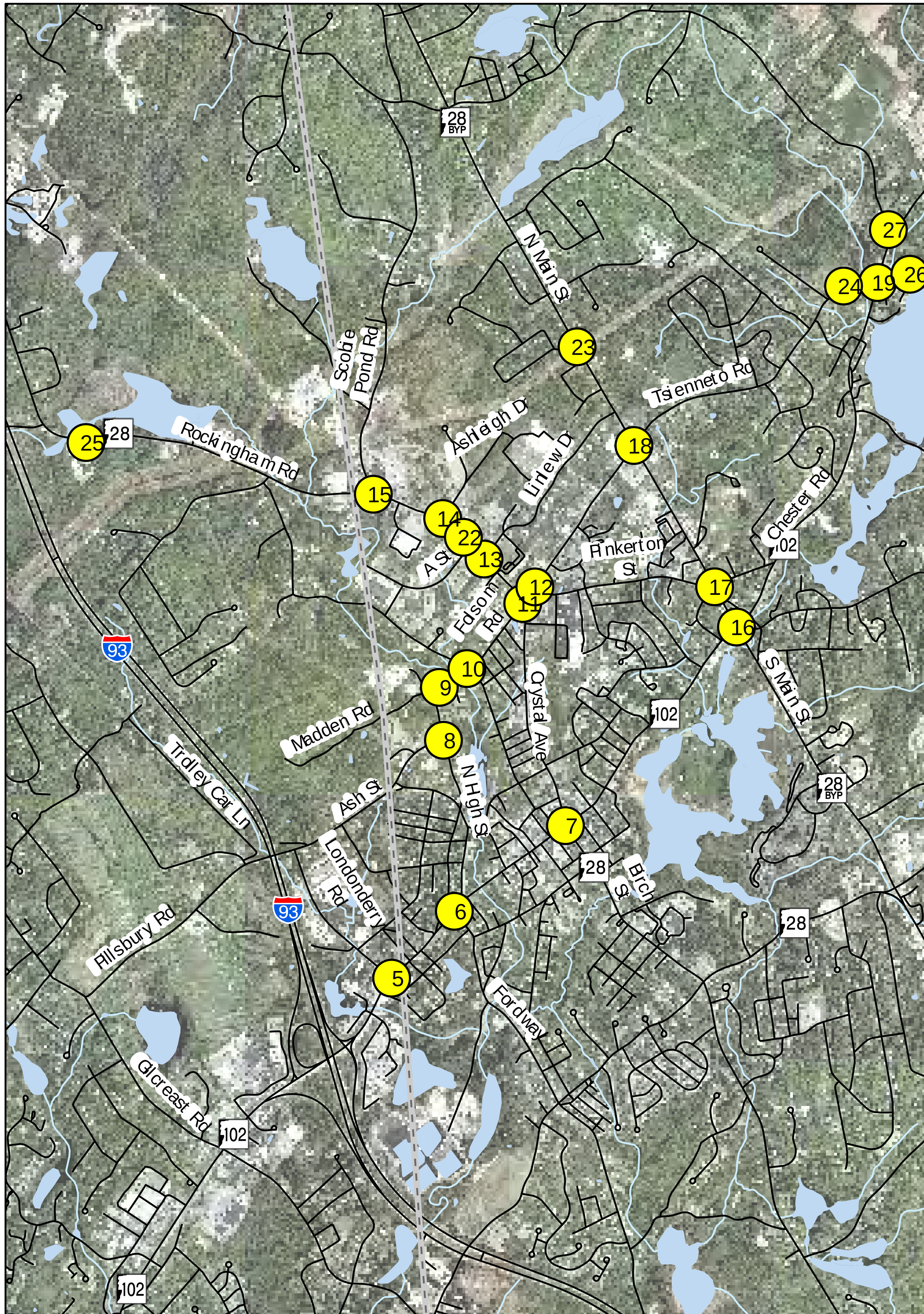
Sources:

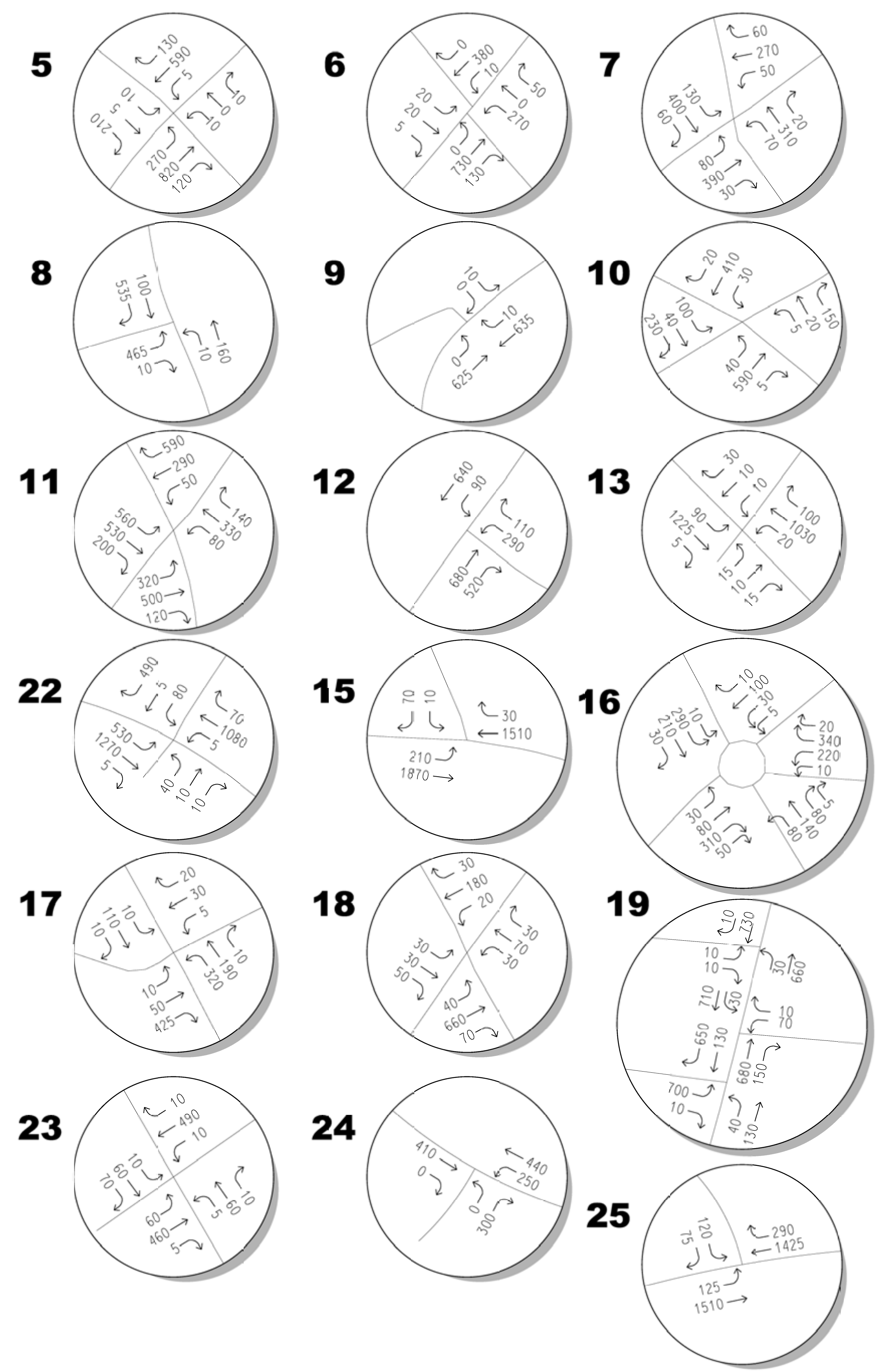
Coordinate System:
NAD 1983 StatePlane
New Hampshire (feet)

Date:
January 24, 2018

New Hampshire DOT
Department of Transportation

Figure 33 - 2040 Alternative C AM Peak Hour Base Volumes – Locations 5-19 and 22-27





I-93 Exit 4A
Supplemental Draft EIS

2040 ALT C PM PEAK HOUR BASE VOLUMES

INDEX

5. NH 102/ Londonderry Road
6. NH 102/ Fordway/ High St.
7. NH 102/ NH 28
8. N. High St./ Ash St. Extension
9. N. High St./ Madden Rd.
10. N. High St./ Folsom Rd./ Franklin St
11. NH 28/ Folsom Rd./ Tsienneto Rd.
12. Tsienneto Rd./ Pinkerton St.
13. NH 28/ Linlew Dr.
14. NH 28/ Ashleigh Dr.
15. NH 28/ Scobie Pond Rd.
16. NH 102/ NH 28 Bypass/ E. Derry Rd.
17. NH 28 Bypass/ Pinkerton St.
18. NH 28 Bypass/ Tsienneto Rd.
19. NH 102/ Tsienneto Rd.
22. NH 28/ B-C Connector
23. NH 28 Bypass/ B-C Connector
24. Tsiennetto Rd/ B-C Connector
25. NH 28/ C-D Connector
26. NH 102/ North Shore Rd
27. NH 102/ English Range Rd

Feet
0 1,000 2,000

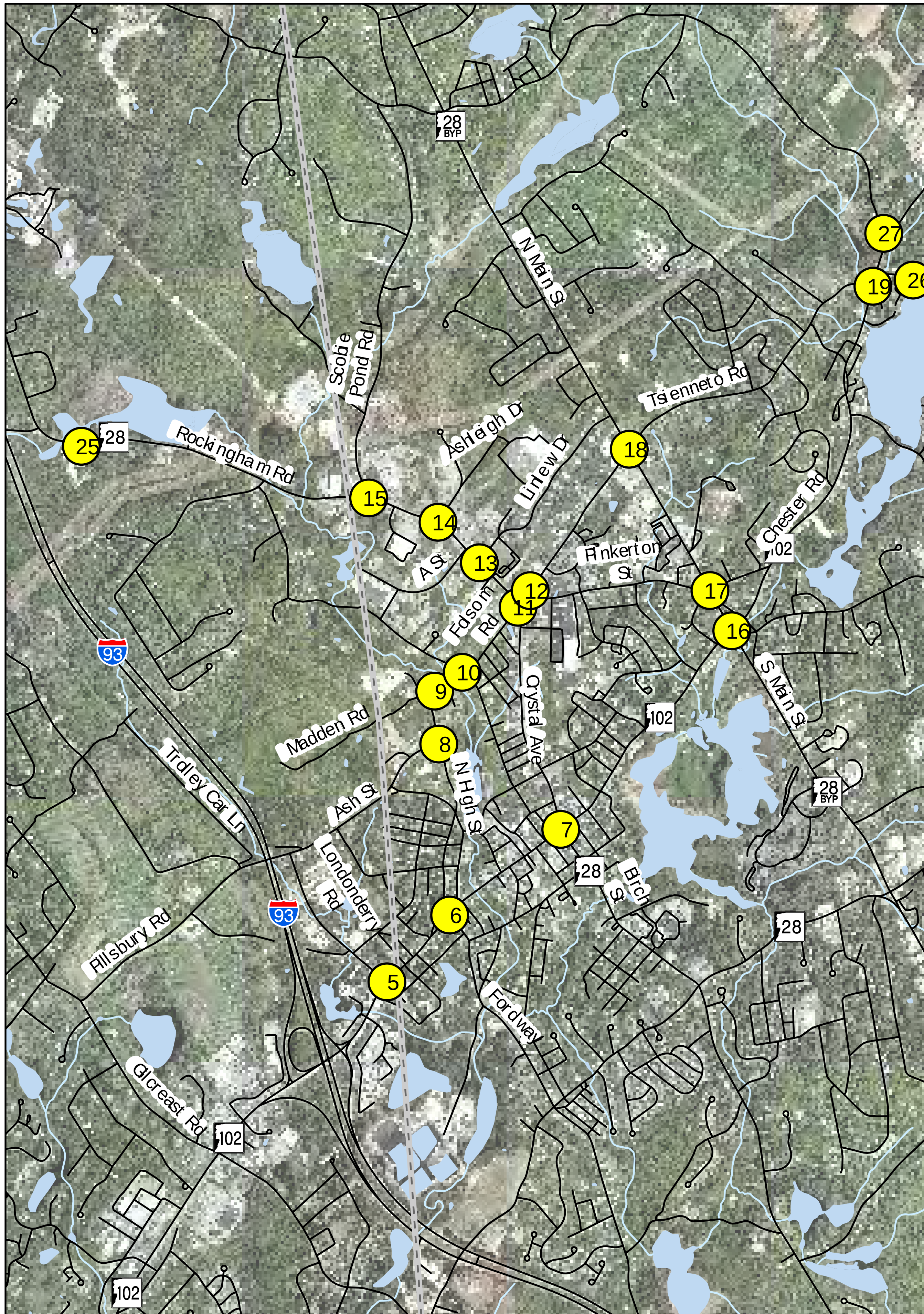
Sources:

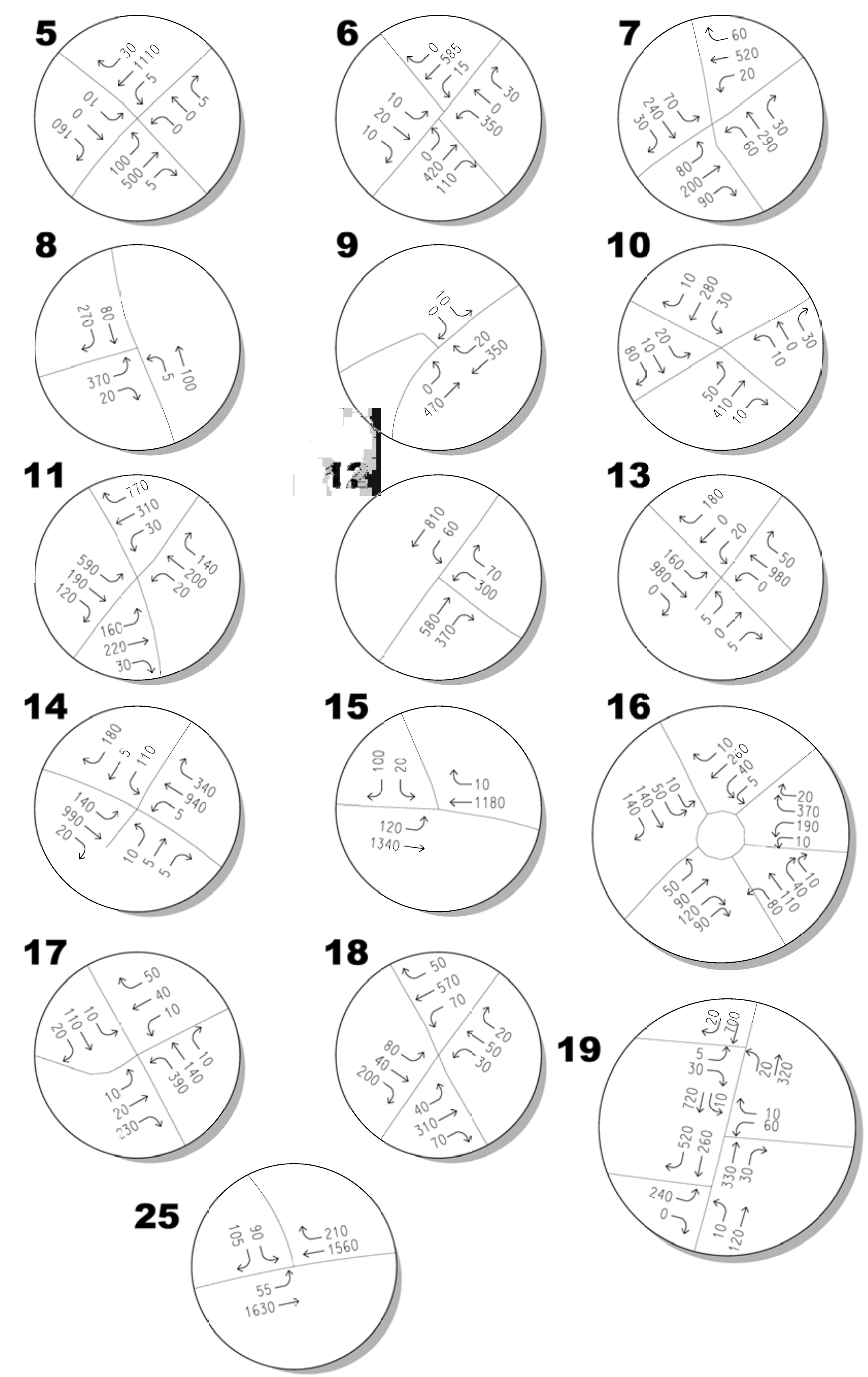
Coordinate System:
NAD 1983 StatePlane
New Hampshire (feet)

Date:
January 24, 2018

New Hampshire DOT
Department of Transportation

Figure 34 - 2040 Alternative C PM Peak Hour Base Volumes – Locations 5-19 and 22-27





I-93 Exit 4A
Supplemental Draft EIS

2040 ALT D AM PEAK HOUR BASE VOLUMES

INDEX

5. NH 102/ Londonderry Road
6. NH 102/ Fordway/ High St.
7. NH 102/ NH 28
8. N. High St./ Ash St. Extension
9. N. High St./ Madden Rd.
10. N. High St./ Folsom Rd./ Franklin St
11. NH 28/ Folsom Rd./ Tsienneto Rd.
12. Tsienneto Rd./ Pinkerton St.
13. NH 28/ Linlew Dr.
14. NH28/ Ashleigh Dr.
15. NH 28/ Scobie Pond Rd.
16. NH 102/ NH 28 Bypass/ E. Derry Rd.
17. NH 28 Bypass/ Pinkerton St.
18. NH 28 Bypass/ Tsienneto Rd.
19. NH 102/ Tsienneto Rd.
25. NH 28/ C-D Connector
26. NH 102/ North Shore Rd
27. NH 102/ English Range Rd

Feet
0 1,000 2,000

Sources:

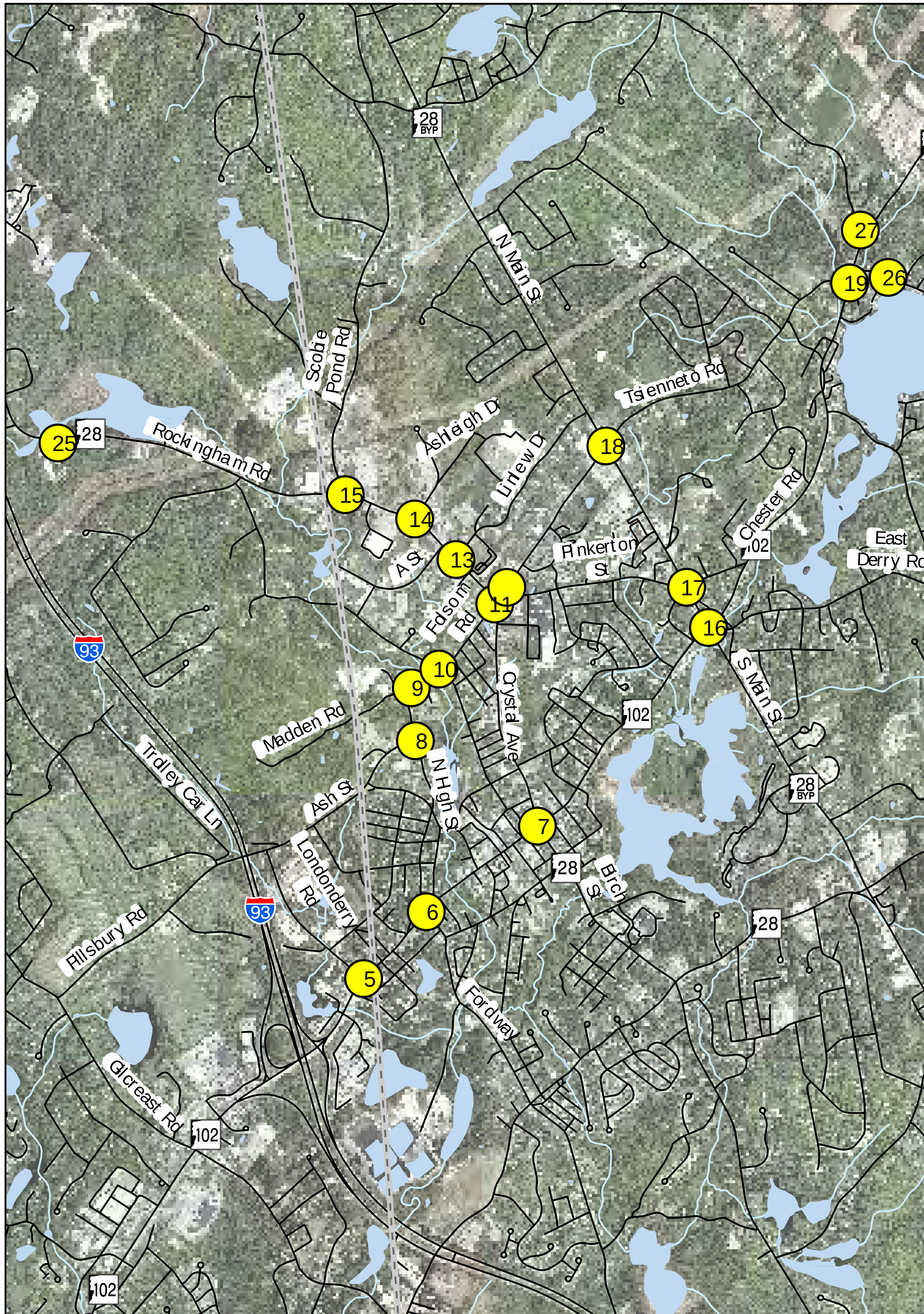
Coordinate System: NAD 1983 StatePlane New Hampshire (feet)	Date: January 24, 2018

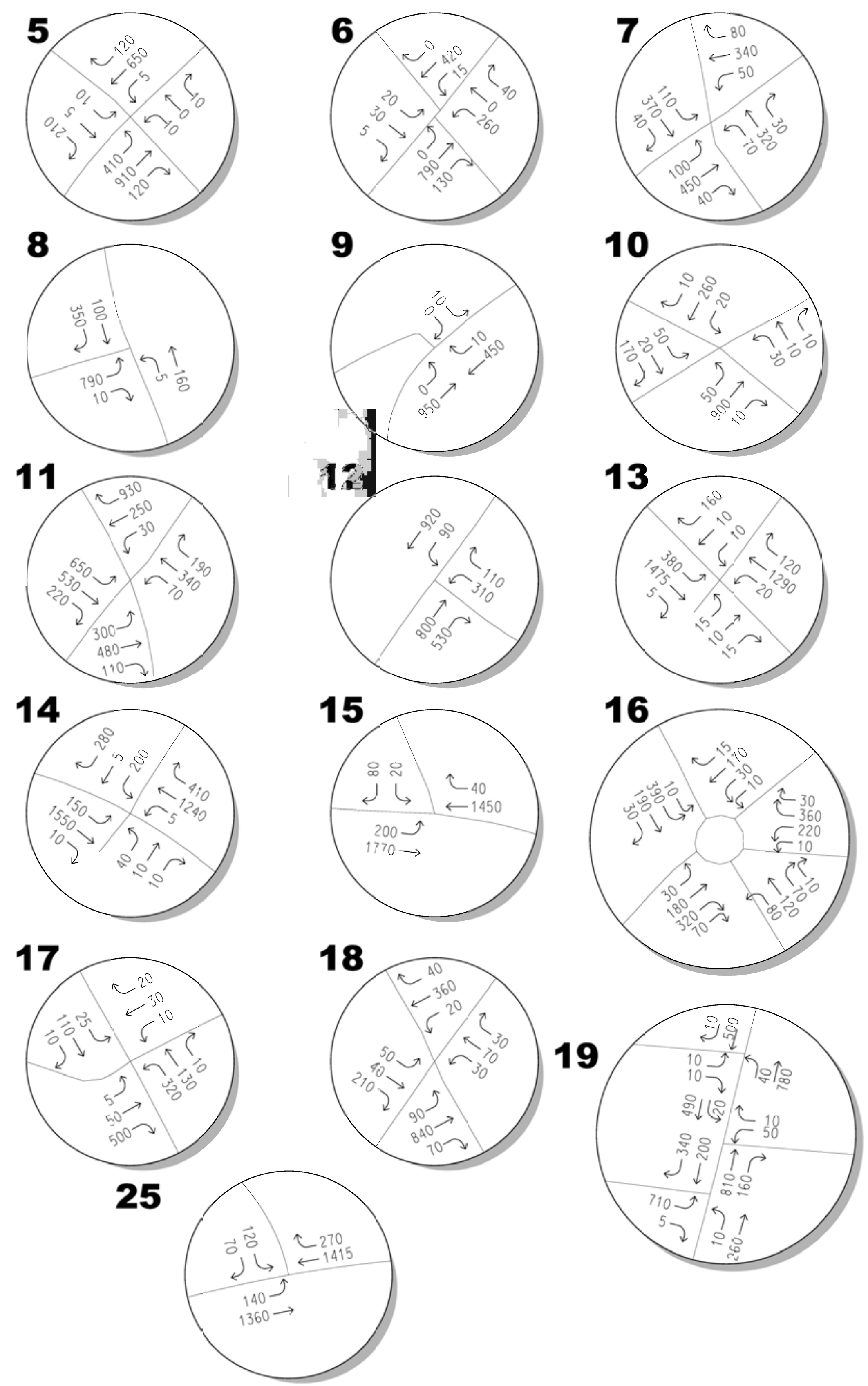
New Hampshire DOT
Department of Transportation

Figure 35 - 2040 Alternative D AM Peak Hour Base Volumes – Locations 5-19 and 25-27

I-93 Exit 4A
Supplemental Draft EIS

2040 ALT D PM PEAK HOUR BASE VOLUMES





INDEX

5. NH 102/ Londonderry Road
6. NH 102/ Fordway/ High St.
7. NH 102/ NH 28
8. N. High St./ Ash St. Extension
9. N. High St./ Madden Rd.
10. N. High St./ Folsom Rd./ Franklin St
11. NH 28/ Folsom Rd./ Tsienneto Rd.
12. Tsienneto Rd./ Pinkerton St.
13. NH 28/ Linlew Dr.
14. NH28/ Ashleigh Dr.
15. NH 28/ Scobie Pond Rd.
16. NH 102/ NH 28 Bypass/ E. Derry Rd.
17. NH 28 Bypass/ Pinkerton St.
18. NH 28 Bypass/ Tsienneto Rd.
19. NH 102/ Tsienneto Rd.
25. NH 28/ C-D Connector
26. NH 102/ North Shore Rd
27. NH 102/ English Range Rd

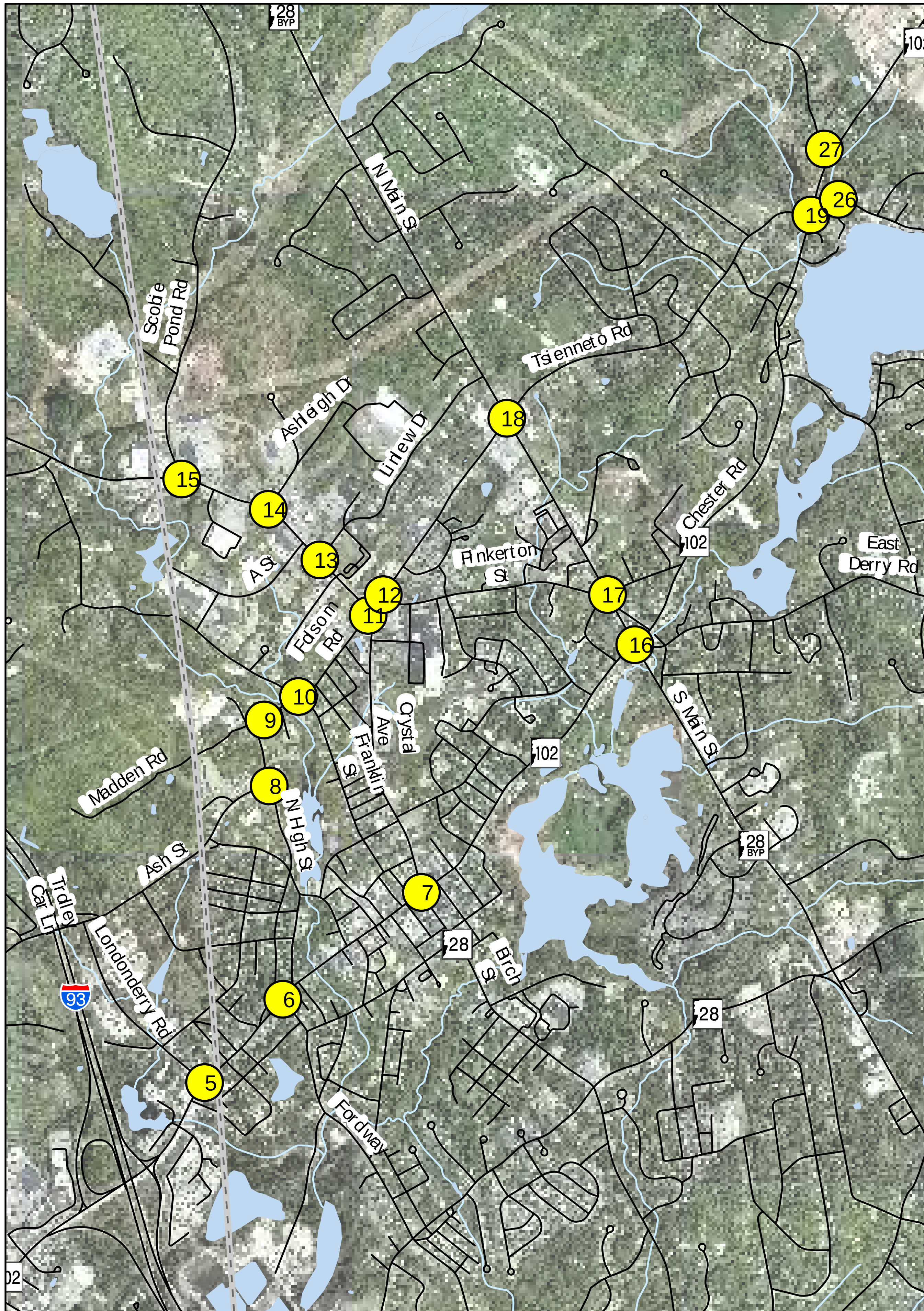
Feet
0 1,000 2,000

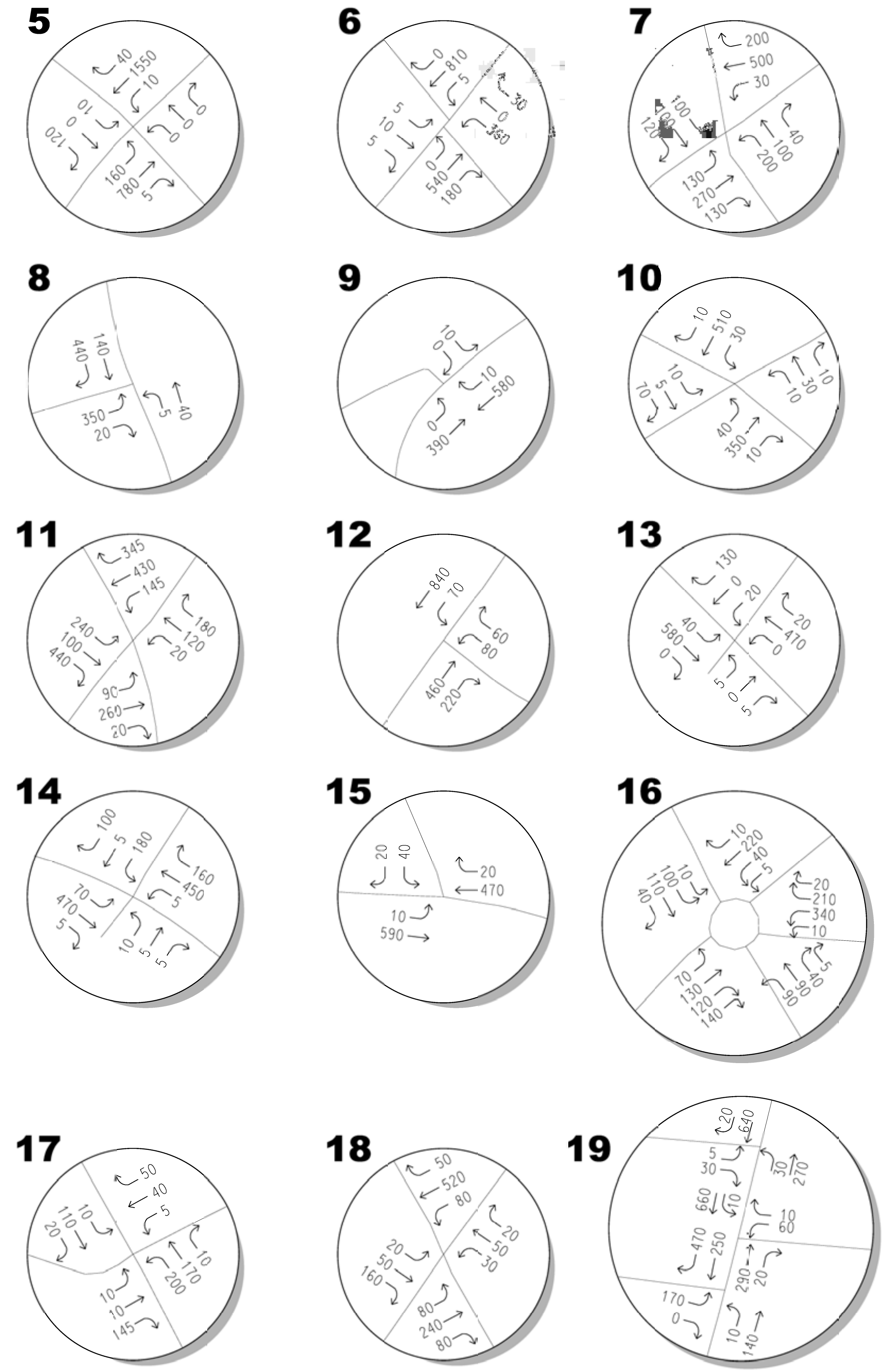
Sources:

Coordinate System: NAD 1983 StatePlane New Hampshire (feet)	Date: January 24, 2018

New Hampshire DOT Department of Transportation

Figure 36 - 2040 Alternative D PM Peak Hour Base Volumes – Locations 5-19 and 25-27





I-93 Exit 4A
Supplemental Draft EIS

2040 ALT F AM PEAK HOUR BASE VOLUMES

INDEX

5. NH 102/ Londonderry Road
6. NH 102/ Fordway/ High St.
7. NH 102/ NH 28
8. N. High St./ Ash St. Extension
9. N. High St./ Madden Rd.
10. N. High St./ Folsom Rd./ Franklin St
11. NH 28/ Folsom Rd./ Tsienneto Rd.
12. Tsienneto Rd./ Pinkerton St.
13. NH 28/ Linlew Dr.
14. NH28/ Ashleigh Dr.
15. NH 28/ Scobie Pond Rd.
16. NH 102/ NH 28 Bypass/ E. Derry Rd.
17. NH 28 Bypass/ Pinkerton St.
18. NH 28 Bypass/ Tsienneto Rd.
19. NH 102/ Tsienneto Rd.
26. NH 102/ North Shore Rd
27. NH 102/ English Range Rd

Feet
0 1,000 2,000

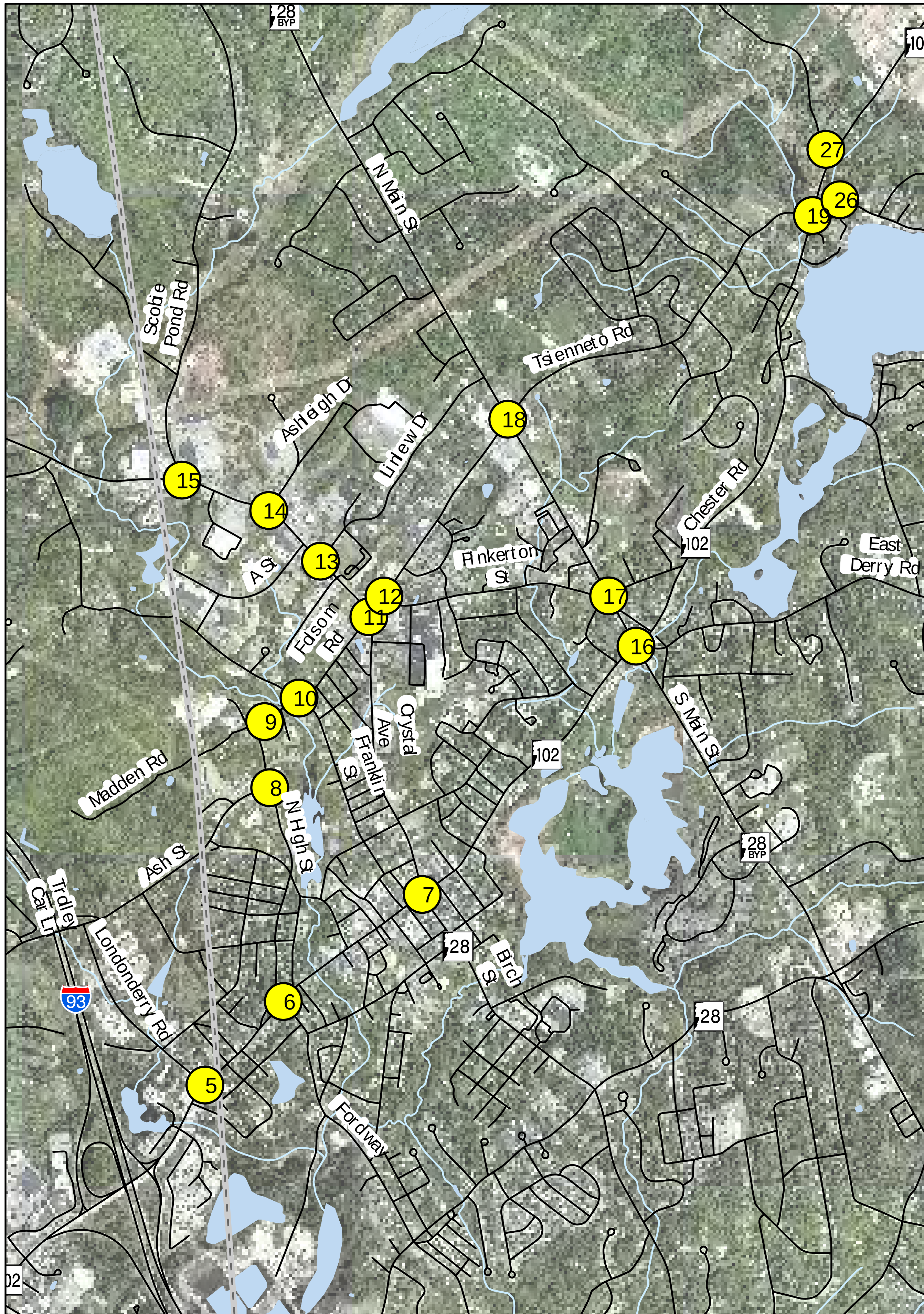
Sources:

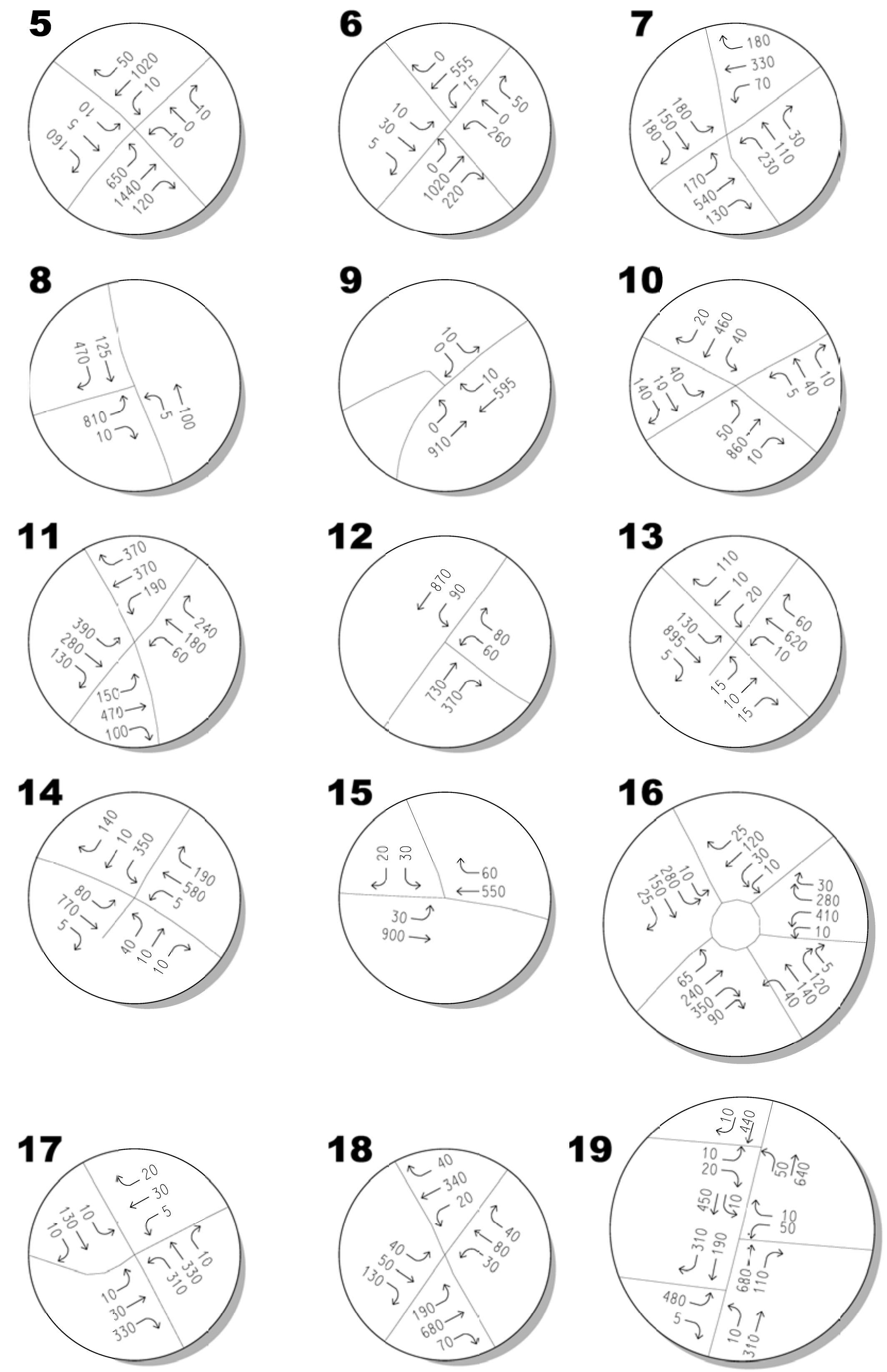
Coordinate System:
NAD 1983 StatePlane
New Hampshire (feet)

Date:
January 24, 2018

New Hampshire DOT
Department of Transportation

Figure 37 - 2040 Alternative F AM Peak Hour Base Volumes – Locations 5-19 and 26-27





I-93 Exit 4A
Supplemental Draft EIS

2040 ALT F PM PEAK HOUR BASE VOLUMES

INDEX

5. NH 102/ Londonderry Road
6. NH 102/ Fordway/ High St.
7. NH 102/ NH 28
8. N. High St./ Ash St. Extension
9. N. High St./ Madden Rd.
10. N. High St./ Folsom Rd./ Franklin St
11. NH 28/ Folsom Rd./ Tsienneto Rd.
12. Tsienneto Rd./ Pinkerton St.
13. NH 28/ Linlew Dr.
14. NH28/ Ashleigh Dr.
15. NH 28/ Scobie Pond Rd.
16. NH 102/ NH 28 Bypass/ E. Derry Rd.
17. NH 28 Bypass/ Pinkerton St.
18. NH 28 Bypass/ Tsienneto Rd.
19. NH 102/ Tsienneto Rd.
26. NH 102/ North Shore Rd
27. NH 102/ English Range Rd

Feet
0 1,000 2,000

Sources:

Coordinate System:
NAD 1983 StatePlane
New Hampshire (feet)

Date:
January 24, 2018

New Hampshire DOT
Department of Transportation

Figure 38 - 2040 Alternative F PM Peak Hour Base Volumes – Locations 5-19 and 26-27

APPENDIX A: TRAFFIC COUNT DATA

NHDOT PERMANENT RECORDER COUNTS - I93 S OF EXIT 4 - MAY 2016

489003

WINDHAM   I-93 **NB** AT BETWEEN EXITS 3-4 (02489002)

	MN	DY	D	H1	H2	H3	H4	H5	H6	H7	**7-8 AM**	H9	H10	H11	H12	H13	H14	H15	H16	H17	**5-6 PM**	H19	H20	H21	H22	H23	H24	txtTotal
	5	1	1	581	372	205	150	153	190	352	837	1171	1368	1826	2164	2335	2287	2153	2245	2267	2067	1912	1485	1104	818	576	465	29083
	5	8	1	376	354	162	129	113	155	333	618	960	1388	2012	2313	2571	2401	2364	2507	2493	2351	2303	1827	1482	976	641	416	31245
	5	2	2	419	209	142	125	262	639	1397	2230	1878	1540	1623	1698	1760	1959	2480	2889	3376	3611	2448	1582	1084	901	610	466	35330
	5	9	2	240	151	111	122	267	689	1476	2290	1979	1600	1629	1588	1911	1840	2459	3260	3642	3628	2578	1714	1314	982	686	581	36757
	5	3	3	270	182	174	141	227	619	1402	2192	1906	1596	1512	1659	1740	1911	2689	3249	3802	3537	2577	1721	1250	1050	682	503	36593
	5	10	3	343	181	139	140	247	653	1468	2292	1923	1705	1724	1684	1795	1971	2615	3315	3768	3699	2737	1851	1364	1068	795	761	38258
	5	4	4	268	199	161	151	268	609	1444	2261	1952	1556	1393	1814	1890	1952	2742	3329	3406	3540	2727	1827	1434	1178	627	524	37272
	5	5	5	338	209	156	156	283	607	1357	2205	1989	1704	1623	1709	1828	1455	3061	3254	3585	3645	2755	2119	1388	1182	618	622	38048
	5	6	6	393	281	173	166	290	625	1408	2230	1941	1669	1821	2177	2282	2564	3228	3665	3833	3546	3004	2252	1573	1413	1066	894	42494
	5	7	7	476	295	191	151	146	351	800	1314	1949	2290	2445	2538	2674	2710	2862	2744	2555	2388	2059	1708	1393	1251	1031	759	37060
ADT-sum				3704	2433	1614	1431	2256	5137	11437	18489	17650	16416	17608	19344	20786	21050	26653	30477	32747	32012	25100	18086	13386	10819	7532	5993	362160
ADT				370	243	161	143	226	514	1144	1849	1765	1642	1761	1934	2079	2105	2665	3048	3275	3201	2510	1809	1339	1082	753	599	36216
AWDT-sum				2271	1412	1056	1001	1844	4441	9952	15720	13570	11370	11325	12329	13206	13652	19274	22981	25432	25206	18826	13066	9407	7774	5284	4353	264752
AWDT				324	202	151	143	263	634	1422	$\boxed{2246}$	1939	1624	1618	1761	1887	1950	2753	3283	3633	$\boxed{3601}$	2689	1867	1344	1111	755	622	37822

WINDHAM   I-93 **SB** BETWEEN EXITS 3-4 (02489002)

	MN	DY	D	H1	H2	H3	H4	H5	H6	H7	**7-8 AM**	H9	H10	H11	H12	H13	H14	H15	H16	H17	**5-6 PM**	H19	H20	H21	H22	H23	H24	txtTotal
	5	1	1	309	243	155	104	172	358	595	930	1240	1692	2299	2623	2726	2805	2662	2645	2747	2286	1895	1478	1077	748	475	260	32524
	5	8	1	331	210	131	105	124	325	512	813	1301	1932	2745	3127	3201	2936	2809	2676	2724	2433	2106	1726	1281	929	580	268	35325
	5	2	2	150	138	187	291	1012	2537	3092	3145	3007	2356	1619	1853	1731	1681	1768	1868	2022	2202	1388	924	784	623	420	254	35072
	5	9	2	174	104	155	285	1050	2682	3407	3344	2974	2377	1757	1879	1736	1615	1989	2106	2200	2461	1550	1079	872	688	481	246	37211
	5	3	3	173	118	171	269	1018	2533	3245	3358	3209	2213	1753	1752	1730	1551	1930	2090	2178	2449	1621	1104	902	683	437	242	36729
	5	10	3	168	135	162	271	1043	2756	3373	3456	3130	2350	1731	1786	1760	1732	1994	2263	2410	2530	1550	1222	899	776	514	277	38288
	5	4	4	203	139	158	255	1026	2633	3317	3452	3005	2288	1730	1714	1765	1783	1930	2184	1792	2701	1623	1158	881	731	498	282	37250
	5	5	5	191	143	171	259	973	2576	3109	3107	3009	2412	1625	1942	1784	1667	2264	2244	2332	2523	1688	1178	933	862	551	321	37664
	5	6	6	202	170	213	289	950	2489	3110	3387	2795	2201	1834	2012	2002	2098	2356	2501	2485	2717	2025	1468	1077	984	741	432	40538
	5	7	7	255	177	133	161	314	713	1044	1426	1877	2178	2339	2615	2582	2480	2555	2756	2780	2563	2109	1667	1283	1002	787	565	36361
ADT-sum				2156	1577	1636	2289	7684	19602	24804	26418	25547	21999	19432	21303	21017	20348	22257	23353	23670	24865	17555	13004	9989	8026	5484	3147	367162
ADT				216	158	164	229	768	1960	2480	2642	2555	2200	1943	2130	2102	2035	2226	2335	2367	2487	1756	1300	999	803	548	315	36716
AWDT-sum				1261	947	1217	1919	7074	18206	22653	23249	21129	16197	12049	12938	12508	12127	14231	15276	15419	17583	11445	8133	6348	5347	3642	2054	262952
AWDT				180	135	174	274	1011	2601	3236	$\boxed{3321}$	3018	2314	1721	1848	1787	1732	2033	2182	2203	$\boxed{2512}$	1635	1162	907	764	520	293	37565

AUTOMATIC TRAFFIC RECORDER DATA FOR THE MONTH OF MAY 2015
WINDHAM- I-93 BETWEEN EXITS 3-4 (SB-NB) (01489004-01489003)

MN	DY	D	H1	H2	H3	H4	H5	H6	H7	7-8 AM	H9	H10	H11	H12	H13	H14	H15	H16	H17	5-6 PM	H19	H20	H21	H22	H23	H24	txtTotal	
5	3	1	811	930	462	287	271	453	906	1562	2248	2717	3696	4386	4753	4741	4579	4844	4780	4656	4166	3156	2542	1797	1267	746	60738	
5	10	1	613	529	290	194	233	421	786	1260	2153	3222	4816	5110	5536	5127	4937	4800	5131	5222	4324	3955	3166	2238	1341	737	66541	
5	17	1	908	573	289	253	295	488	1022	1632	2389	3414	4220	4804	5275	5095	4623	4776	4871	5013	4585	3778	3006	2184	1460	768	65701	
5	24	1	816	511	289	195	254	448	878	1443	2139	3085	4215	4713	4638	4612	4203	3928	4055	4280	3936	3683	3107	2589	1914	1120	61053	
5	31	1	682	645	355	233	234	414	818	1272	1877	2647	3650	4554	4893	4263	4228	4572	4555	4090	3589	2860	2167	1649	1236	743	56226	
5	2	7	948	587	391	301	429	945	1596	2354	3237	3783	4136	5108	4728	4693	4746	4747	4823	4510	3433	3746	2668	2508	1864	1419	67620	
5	9	7	800	584	375	284	479	948	1664	2713	3923	4439	4713	5095	5499	5106	5171	5355	5230	4956	4281	3507	3024	2564	2065	1382	74226	
5	16	7	876	588	416	321	466	997	1778	2600	3492	3975	4487	4968	5069	5057	4840	4917	4613	4520	3865	3110	2494	2786	1910	1303	68860	
5	23	7	844	558	354	266	412	833	1671	2643	3022	4680	5143	5226	5227	4886	4836	4755	4648	4256	3809	3078	2582	2246	2013	1481	70475	
5	30	7	858	562	400	321	456	1066	1700	2556	3425	4258	4717	4810	4894	4688	4525	4576	4488	4216	3541	2976	2508	2379	2011	1291	67314	
5	25	2	648	393	217	182	287	521	850	1189	1763	2614	3667	4565	4905	4683	4476	4580	4489	4003	3734	3431	2947	2153	1429	768	58491	Holiday
5	4	2	558	449	258	340	867	2857	4273	5577	5161	3765	3258	3281	3347	3276	4138	4922	5460	5635	4340	2851	2106	1686	1167	924	70471	
5	11	2	474	399	280	327	898	2866	4351	5535	5326	3856	3614	3491	3552	3645	4186	5060	5536	5865	4626	3147	2248	1829	1183	906	72954	
5	18	2	479	348	278	344	878	2925	4372	5664	5150	4059	3621	3721	3899	3762	4426	5052	5437	5932	4646	3344	2256	1859	1282	822	74446	
5	5	3	511	392	265	337	825	2761	4312	5623	5151	3898	3324	3401	3205	3580	4284	4857	5545	6022	4587	2977	2263	1902	1373	951	72346	
5	12	3	483	347	299	353	899	2926	4279	5488	5148	3789	3302	3441	3353	3651	4264	4841	5506	5508	4730	3284	2293	1926	1289	865	72474	
5	19	3	541	378	363	374	927	2540	4226	5419	5340	4044	3412	3518	3429	3478	4434	5138	5540	6017	4463	3185	2381	1924	1325	1012	73410	
5	26	3	447	290	232	379	927	3007	4456	5832	5143	4058	3748	3841	3736	3708	4432	4695	5240	6012	4551	3306	2309	1998	1301	811	74459	
5	6	4	551	381	323	361	811	2783	4224	5542	5233	3921	3501	3412	3500	3689	4294	5077	5770	6013	4518	3253	2530	2013	1434	1021	74135	
5	13	4	617	353	308	364	881	2913	4294	5792	5193	3811	3454	3510	3566	3365	4422	5018	5756	6002	4652	3345	2511	1998	1408	921	74394	
5	20	4	579	403	348	379	853	2892	4394	5683	5262	4007	3528	3569	3639	3788	4462	5186	5854	6188	4582	3415	2493	2093	1483	1071	76159	
5	27	4	535	356	289	390	861	2882	4358	5625	5360	4039	3661	3636	3649	3726	4502	4956	5412	5890	4781	3333	2542	2036	1391	905	75115	
5	7	5	676	402	316	348	858	2790	4269	5549	5398	4180	3519	3541	3223	4086	4548	5297	5774	6097	3936	3931	2716	2362	1704	1056	76601	
5	14	5	613	390	326	381	880	2907	4294	5558	5248	4124	3586	3692	3696	3981	4498	5144	5724	6135	4743	3368	2991	2233	1590	1060	77190	
5	21	5	633	408	360	370	913	2884	4348	5623	5480	4089	3834	3830	4018	4225	4630	5322	5845	6323	4747	3725	2973	2307	1707	1158	79852	
5	28	5	662	389	333	387	868	2918	4330	5747	5390	4064	3587	3638	3799	4002	4483	5144	5408	5693	4852	3404	2763	2247	1523	1007	76579	
5	1	6	804	506	348	395	784	2485	3819	4871	4787	4046	4025	4331	4383	4565	5103	5645	5856	6241	4822	3645	2837	2225	1769	1311	79703	
5	8	6	610	513	327	398	880	2649	4157	5341	5022	3922	3881	4125	4228	4721	4934	5879	5811	6150	5145	3978	3250	2536	1998	1279	81674	
5	15	6	677	430	354	405	849	2689	4087	5343	5090	4008	4061	4309	4480	4690	5333	5869	5790	6207	5062	4286	3088	2372	1929	1379	82981	
5	22	6	708	460	350	434	847	2588	3907	5146	4968	4177	4236	4708	4962	5200	5327	5811	4871	6050	4997	3846	3454	2698	2184	1459	83408	
5	29	6	607	443	351	380	853	2800	4095	5501	5025	4026	3910	4119	4183	4650	5247	5541	5716	5893	5043	4096	3131	2509	2083	1325	81547	

AVG Weekday 5533 5997 76490

AUTOMATIC TRAFFIC RECORDER DATA FOR THE MONTH OF MAY 2015
WINDHAM- I-93 <u>NB</u> AT BETWEEN EXITS 3-4 (02489002)

MN	DY	D	H1	H2	H3	H4	H5	H6	H7	7-8 AM	H9	H10	H11	H12	H13	H14	H15	H16	H17	5-6 PM	H19	H20	H21	H22	H23	H24	txtTotal	
5	3	1	487	536	301	166	139	169	387	776	1160	1214	1727	1985	2176	2143	2046	2196	2154	2098	1932	1569	1187	960	638	461	28535	
5	10	1	486	313	160	101	132	159	370	549	1032	1417	1921	2240	2324	2177	2215	2171	2327	2432	2110	1998	1554	1205	721	408	30452	
5	17	1	583	366	172	135	130	190	431	786	1186	1663	1998	2501	2403	2198	2037	2072	2199	2143	1983	1636	1347	1064	749	416	29918	
5	24	1	537	311	161	110	109	190	362	762	1224	1644	2143	2340	2186	2166	1983	1806	1653	2096	1730	1619	1351	1175	933	581	29385	
5	31	1	365	435	191	118	117	154	316	571	874	1080	1531	1853	1960	1755	1854	1932	2022	1787	1664	1423	1114	830	651	406	24953	
5	2	7	648	402	236	158	156	307	686	1185	1649	1840	1882	2551	2298	2307	2324	2388	2477	2348	1947	2165	1492	1396	1031	878	34646	
5	9	7	598	387	214	146	178	283	601	1484	2238	2317	2400	2686	2778	2684	2613	2771	2652	2470	2031	1702	1464	1231	1095	760	37728	
5	16	7	501	348	231	151	176	308	726	1310	1845	2027	2329	2458	2521	2505	2446	2456	2266	2250	2005	1686	1309	1227	1118	780	34973	
5	23	7	666	363	202	149	176	327	798	1524	2397	2882	3050	2944	2923	2780	2604	2576	2461	2247	2029	1642	1375	1160	1051	940	39263	
5	30	7	578	353	232	158	184	350	709	1279	1830	2286	2537	2509	2518	2341	2315	2220	2216	2042	1687	1512	1267	1274	1186	784	34387	
5	25	2	372	222	113	87	119	184	305	487	799	1071	1438	1574	1634	1671	1541	1609	1545	1441	1401	1709	1076	810	624	400	21737	Holiday
5	4	2	371	316	139	116	240	575	1173	2076	1964	1542	1452	1563	1603	1683	2276	2922	3375	3310	2699	1804	1192	959	666	646	34605	
5	11	2	268	176	144	112	207	520	1181	1989	2047	1499	1658	1664	1756	1792	2304	2938	3387	3451	2874	2066	1311	1055	670	530	35579	
5	18	2	300	166	131	127	255	545	1235	2047	2019	1668	1633	1788	1803	1855	2454	2942	3345	3447	2878	2167	1330	1083	736	514	36406	
5	5	3	349	247	138	135	198	494	1181	2055	1932	1521	1518	1632	1552	1812	2374	2860	3402	3577	2945	1815	1304	1077	845	620	35559	
5	12	3	323	226	150	130	214	541	1132	2027	1850	1522	1489	1662	1642	1817	2298	2859	3400	3175	3017	2198	1374	1152	796	556	35650	
5	19	3	359	243	188	144	242	496	1164	2025	1994	1613	1550	1658	1591	1725	2487	3070	3311	3567	2812	1972	1402	1155	823	685	36278	
5	26	3	251	146	105	120	241	551	1219	2054	1848	1608	1587	1778	1800	1863	2414	2633	3284	3581	2847	2090	1398	1119	742	486	35530	
5	6	4	387	229	172	136	195	511	1164	1981	1993	1565	1495	1648	1772	1889	2347	3004	3509	3456	2759	1992	1506	1194	817	656	36378	
5	13	4	425	208	167	129	217	521	1169	2020	1978	1502	1543	1652	1750	1844	2388	2934	3517	3556	2909	2177	1484	1144	865	606	36705	
5	20	4	398	227	170	127	228	531	1216	2104	2003	1580	1594	1609	1818	1958	2498	3006	3467	3633	2878	2149	1469	1252	898	718	37591	
5	27	4	343	205	150	127	217	536	1166	1997	2036	1600	1581	1764	1759	1914	2528	2932	3271	3418	2995	2103	1518	1198	818	580	36734	
5	7	5	459	258	158	124	225	480	1184	1980	2042	1790	1668	1748	1417	2208	2427	3037	3413	3586	2102	2642	1636	1449	922	667	37621	
5	14	5	426	248	148	142	231	528	1159	1982	2019	1734	1597	1755	1813	2074	2384	2922	3422	3546	2882	2135	1889	1359	913	652	37950	
5	21	5	440	251	179	125	239	529	1208	2005	2086	1737	1800	1843	2032	2194	2526	3120	3590	3729	2903	2464	1771	1386	992	779	39948	
5	28	5	398	209	180	142	245	512	1177	2107	2053	1705	1623	1743	1867	2074	2492	2986	3149	3265	3101	2256	1693	1323	899	643	37837	
5	1	6	543	333	212	133	204	503	1058	1862	1993	1683	1883	2214	2306	2418	2813	3320	3454	3592	2831	2205	1706	1342	1101	881	40630	
5	8	6	413	289	183	152	225	501	1161	2021	1994	1726	1781	2100	2766	2603	2690	3531	3520	3499	3086	2449	1950	1516	1108	787	41557	
5	15	6	437	240	195	149	239	486	1227	2010	2027	1747	1931	2280	2329	2528	3976	3431	3309	3528	3001	2727	1864	1440	1134	837	42164	
5	22	6	482	308	198	168	218	533	1212	2001	2068	1998	2187	2713	2979	3192	3156	3473	2976	3362	3050	2333	2246	1776	1277	990	44896	
5	29	6	403	284	186	137	229	565	1212	2096	2007	1704	1934	2165	2197	2580	3069	3285	3334	3381	3101	2486	1937	1555	1238	825	41669	

AVG Weekday 2021 3483 38078

AUTOMATIC TRAFFIC RECORDER DATA FOR THE MONTH OF MAY 2015
WINDHAM- I-93 SB BETWEEN EXITS 3-4 (02489002)

MN	DY	D	H1	H2	H3	H4	H5	H6	H7	7-8 AM	H9	H10	H11	H12	H13	H14	H15	H16	H17	5-6 PM	H19	H20	H21	H22	H23	H24	txtTotal	
5	3	1	326	394	161	127	132	284	519	786	1088	1503	1989	2401	2577	2588	2533	2648	2626	2558	2174	1677	1355	897	629	285	32197	
5	10	1	327	216	130	93	121	262	466	711	1121	1805	2895	3070	3212	2950	2722	2629	2804	2790	2214	1957	1612	1033	620	379	36089	
5	17	1	325	207	117	118	165	298	591	844	1201	1751	2312	2703	2872	2887	2590	2654	2672	2870	2612	2142	1659	1120	711	352	35783	
5	24	1	279	202	128	85	145	258	516	881	915	1441	2072	2373	2452	2416	2220	2119	2222	2184	2206	2064	1756	1414	981	539	31668	
5	31	1	317	210	164	115	117	260	502	701	1053	1567	2119	2701	2833	2508	2374	2640	2533	2303	1925	1437	1053	819	585	337	31273	
5	2	7	300	195	155	143	279	638	910	1169	1588	1943	2254	2557	2430	2296	2422	2349	2396	2162	1486	1640	1176	1112	833	541	32974	
5	9	7	302	197	161	138	301	665	873	1229	1685	2127	2313	2409	2721	2502	2558	2584	2587	2486	2210	1805	1620	1333	970	622	36496	
5	16	7	335	250	185	176	289	689	1052	1290	1647	1898	2158	2510	2548	2552	2384	2467	2347	2270	1880	1424	1185	1059	707	523	33895	
5	23	7	276	195	152	117	236	506	873	1119	1525	1884	2093	2282	2304	2098	2232	2179	2187	2080	1780	1436	1257	1056	962	532	33212	
5	30	7	288	209	168	162	272	716	991	1277	1595	1972	2180	2302	2376	2347	2218	2356	2272	2174	1854	1466	1311	1105	825	507	32927	
5	25	2	276	171	104	95	108	337	545	697	964	1543	2229	2891	3271	3812	2935	2971	2944	2562	2333	2222	1871	1341	805	369	36756	Holiday
5	4	2	187	133	120	222	627	2332	3100	3501	3187	2223	1806	1719	1747	1587	1842	2000	2085	2325	1641	1047	914	727	501	284	35806	
5	11	2	155	133	136	215	692	2346	3170	3566	3279	2351	1956	1827	1796	1853	1882	2122	2149	2414	1752	1081	937	774	513	276	37375	
5	18	2	179	182	147	217	673	2380	3137	3617	3131	2381	1990	1933	1896	1907	1972	2110	2092	2485	1768	1177	966	776	546	308	37960	
5	5	3	162	145	127	207	629	2267	3151	3568	3219	2377	1888	1769	1653	1768	1910	1997	2143	2445	1642	1162	959	825	528	331	36787	
5	12	3	170	121	149	223	685	2385	3147	3661	3198	2267	1813	1770	1711	1834	1966	1982	2106	2333	1713	1086	919	774	493	308	36824	
5	19	3	182	135	175	230	685	2044	3082	3394	3346	2431	1867	1860	1838	1753	1947	2068	2229	2456	1651	1213	981	769	502	327	37134	
5	26	3	196	144	127	259	686	2456	3237	3776	3295	2450	2166	2063	1936	1935	2016	2067	2156	2431	1704	1216	941	789	559	325	38929	
5	6	4	164	152	151	225	618	2272	3068	3561	3240	2336	2006	1763	1728	1800	1947	2073	2281	2557	1759	1261	1024	819	617	365	37757	
5	13	4	182	145	141	235	664	2382	3125	3772	3215	2309	1911	1858	1756	1521	2034	2084	2239	2446	1743	1168	1027	854	543	315	37689	
5	20	4	181	176	178	252	625	2361	3178	3579	3259	2427	1934	1900	1821	1830	1964	2180	2387	2563	1704	1266	1024	841	585	353	38568	
5	27	4	192	151	139	263	644	2388	3192	3528	3324	2439	2080	1872	1890	1812	1974	2024	2141	2472	1786	1230	1024	840	573	325	38381	
5	7	5	217	144	158	224	633	2310	3085	3569	3356	2300	1951	1793	1806	1798	2121	2260	2361	2511	1834	1289	1082	914	782	392	38980	
5	14	5	187	142	178	239	649	2379	3135	3560	3229	2390	1989	1937	1883	1907	2112	2222	2302	2589	1861	1263	1122	874	677	408	39240	
5	21	5	193	157	181	245	674	2356	3139	3618	3384	2352	2034	1987	1986	2031	2104	2202	2355	2594	1844	1261	1202	911	715	379	39904	
5	28	5	204	180	153	245	623	2406	3153	3640	3337	2359	1964	1895	1837	1928	1991	2158	2260	2428	1751	1148	1070	924	624	364	38742	
5	1	6	261	173	136	262	580	1982	2721	3089	2794	2363	2142	2117	2077	2147	2290	2325	2502	2649	1901	1440	1131	883	668	430	39073	
5	8	6	187	214	144	247	535	2148	2986	3320	3028	2196	2100	2025	1900	2118	2244	2348	2391	2611	2065	1529	1300	1020	790	491	40117	
5	15	6	240	190	158	256	610	2203	2870	3333	3083	2261	2130	2110	2151	2162	2257	2438	2481	2687	2061	1553	1294	932	795	542	40717	
5	22	6	226	172	152	266	629	2055	2695	3145	2900	2179	2048	1995	1983	2008	2171	2338	1895	2588	1947	1513	1208	922	907	469	38512	
5	29	6	204	158	165	248	625	2235	2983	3405	3023	2322	2006	1954	1996	2070	2178	2256	2382	2612	1942	1610	1194	954	765	500	39878	
							AVG Weekday			3512										2515							38412	

STATE OF NEW HAMPSHIRE, DEPARTMENT OF TRANSPORTATION - BUREAU OF TRAFFIC
IN COOPERATION WITH U.S. DEPARTMENT OF TRANSPORTATION FEDERAL HIGHWAY ADMINISTRATION
AUTOMATIC TRAFFIC RECORDER DATA FOR THE MONTH OF **MAY 2016**

81 269107 LONDONDERRY- I-93 NB OFF RAMP EXIT 4

MON	DATE	DAY	12 AM	1 AM	2 AM	3 AM	4 AM	5 AM	6 AM	7 AM	8 AM	9 AM	10 AM	11 AM	12 PM	1 PM	2 PM	3 PM	4 PM	5 PM	6 PM	7 PM	8 PM	9 PM	10 PM	11 PM	Total
5	8	1	101	137	54	35	26	25	97	199	232	339	480	585	707	705	631	676	660	672	653	509	405	272	148	123	8471
5	3	3	70	45	44	36	45	110	242	**422**	467	423	408	471	492	534	816	1042	1300	1478	1056	615	460	324	210	178	11288
5	4	4	91	59	49	34	41	106	269	442	475	391	453	502	559	572	837	1108	1201	1178	1040	672	480	387	190	194	11330
5	5	5	122	52	50	43	54	90	236	435	494	483	454	398	560	419	911	1076	1152	1128	1024	735	474	359	244	188	11181
5	6	6	122	91	46	41	63	109	254	441	458	405	450	562	587	667	900	1080	1113	1106	913	658	431	392	304	290	11483
5	7	7	150	97	60	42	31	61	138	295	451	644	593	666	754	816	857	791	795	666	627	521	461	365	291	246	10418
Sum	AWDT		405	247	189	154	203	415	1001	1740	1894	1702	1765	1933	2198	2192	3464	4306	4766	4890	4033	2680	1845	1462	948	850	45282
	AWDT		101	62	47	39	51	104	250	**435**	474	426	441	483	550	548	866	1077	1192	**1223**	1008	670	461	366	237	213	11321

STATE OF NEW HAMPSHIRE, DEPARTMENT OF TRANSPORTATION - BUREAU OF TRAFFIC
IN COOPERATION WITH U.S. DEPARTMENT OF TRANSPORTATION FEDERAL HIGHWAY ADMINISTRATION
AUTOMATIC TRAFFIC RECORDER DATA FOR THE MONTH OF **MAY 2016**

81 269106 LONDONDERRY- I-93 NB ON RAMP EXIT 4

MON	DATE	DAY	12 AM	1 AM	2 AM	3 AM	4 AM	5 AM	6 AM	7 AM	8 AM	9 AM	10 AM	11 AM	12 PM	1 PM	2 PM	3 PM	4 PM	5 PM	6 PM	7 PM	8 PM	9 PM	10 PM	11 PM	Total
5	8	1	72	51	35	30	25	58	107	194	274	438	603	609	657	599	639	569	546	439	421	377	303	238	116	76	7476
5	3	3	17	30	31	36	88	224	690	**1091**	856	610	559	542	591	596	680	830	886	729	619	401	305	223	132	68	10834
5	4	4	42	26	19	42	75	235	718	1115	877	608	568	605	619	617	692	798	782	773	572	438	329	206	146	74	10976
5	5	5	39	26	31	35	78	238	697	1068	865	691	591	618	759	654	753	871	930	886	633	433	332	252	167	85	11732
5	6	6	49	37	40	48	62	237	669	1043	899	650	618	625	703	688	806	945	878	859	627	465	377	296	223	134	11978
5	7	7	80	51	43	40	48	87	209	341	500	569	641	733	773	740	715	712	644	556	502	413	338	279	225	153	9392
Sum AWDT			147	119	121	161	303	934	2774	4317	3497	2559	2336	2390	2672	2555	2931	3444	3476	3247	2451	1737	1343	977	668	361	45520
AWDT			37	30	30	40	76	234	694	**1079**	874	640	584	598	668	639	733	861	869	**812**	613	434	336	244	167	90	11380

STATE OF NEW HAMPSHIRE, DEPARTMENT OF TRANSPORTATION - BUREAU OF TRAFFIC
IN COOPERATION WITH U.S. DEPARTMENT OF TRANSPORTATION FEDERAL HIGHWAY ADMINISTRATION
AUTOMATIC TRAFFIC RECORDER DATA FOR THE MONTH OF **MAY 2016**

81 269104 LONDONDERRY- I-93 SB OFF RAMP EXIT 4

MON	DATE	DAY	12 AM	1 AM	2 AM	3 AM	4 AM	5 AM	6 AM	7 AM	8 AM	9 AM	10 AM	11 AM	12 PM	1 PM	2 PM	3 PM	4 PM	5 PM	6 PM	7 PM	8 PM	9 PM	10 PM	11 PM	Total
5	8	1	112	68	45	20	30	68	85	192	318	424	523	629	636	686	554	632	550	496	458	340	300	187	118	63	7534
5	3	3	72	25	27	41	103	265	537	776	784	518	561	528	543	693	674	852	917	949	629	442	347	258	143	101	10785
5	4	4	58	34	28	48	104	277	544	773	770	537	545	598	615	570	689	804	621	953	647	435	318	251	165	88	10472
5	5	5	63	23	26	37	104	270	522	745	752	545	578	577	564	677	658	833	957	948	630	430	340	320	202	110	10911
5	6	6	76	53	45	38	112	263	511	717	734	553	619	604	665	694	724	896	950	956	674	502	357	286	218	155	11402
5	7	7	95	59	43	27	54	92	174	344	444	523	528	626	607	638	623	693	615	636	520	405	325	289	223	155	8738
Sum	AWDT		269	135	126	164	423	1075	2114	3011	3040	2153	2303	2307	2387	2634	2745	3385	3445	3806	2580	1809	1362	1115	728	454	43570
	AWDT		67	34	32	41	106	269	529	**753**	760	538	576	577	597	659	686	846	861	**952**	645	452	341	279	182	114	10893

STATE OF NEW HAMPSHIRE, DEPARTMENT OF TRANSPORTATION - BUREAU OF TRAFFIC
IN COOPERATION WITH U.S. DEPARTMENT OF TRANSPORTATION FEDERAL HIGHWAY ADMINISTRATION
AUTOMATIC TRAFFIC RECORDER DATA FOR THE MONTH OF **MAY 2016**

81 269108 LONDONDERRY- I-93 SB ON RAMP EXIT 4 EB TO SB

MON	DATE	DAY	12 AM	1 AM	2 AM	3 AM	4 AM	5 AM	6 AM	7 AM	8 AM	9 AM	10 AM	11 AM	12 PM	1 PM	2 PM	3 PM	4 PM	5 PM	6 PM	7 PM	8 PM	9 PM	10 PM	11 PM	Total
5	8	1	30	8	12	10	15	53	73	113	192	296	366	384	384	378	315	290	294	259	238	214	126	100	44	20	4214
5	3	3	8	19	17	39	127	438	646	687	587	339	282	259	289	284	288	294	266	296	239	142	99	79	40	18	5782
5	4	4	10	17	25	34	144	450	597	690	546	398	253	295	265	226	313	299	301	330	212	141	112	100	63	24	5845
5	5	5	18	16	18	25	141	419	609	677	619	388	309	261	274	292	288	313	293	298	220	155	103	80	40	18	5874
5	6	6	8	15	29	43	130	422	532	637	514	402	311	325	288	278	305	314	308	319	255	162	125	102	106	29	5959
5	7	7	20	10	12	17	44	99	171	195	268	343	362	437	430	348	379	383	318	260	245	163	154	121	65	70	4914
Sum	AWDT		44	67	89	141	542	1729	2384	2691	2266	1527	1155	1140	1116	1080	1194	1220	1168	1243	926	600	439	361	249	89	23460
	AWDT		11	17	22	35	136	432	596	**673**	567	382	289	285	279	270	299	305	292	**311**	232	150	110	90	62	22	5865

STATE OF NEW HAMPSHIRE, DEPARTMENT OF TRANSPORTATION - BUREAU OF TRAFFIC
IN COOPERATION WITH U.S. DEPARTMENT OF TRANSPORTATION FEDERAL HIGHWAY ADMINISTRATION
AUTOMATIC TRAFFIC RECORDER DATA FOR THE MONTH OF **MAY 2016**

81 269105 LONDONDERRY- I-93 SB ON RAMP EXIT 4 WB TO SB

MON	DATE	DAY	12 AM	1 AM	2 AM	3 AM	4 AM	5 AM	6 AM	7 AM	8 AM	9 AM	10 AM	11 AM	12 PM	1 PM	2 PM	3 PM	4 PM	5 PM	6 PM	7 PM	8 PM	9 PM	10 PM	11 PM	Total
5	8	1	37	29	7	8	22	56	83	88	173	249	383	369	369	331	323	299	283	294	200	232	158	121	115	40	4269
5	3	3	19	14	28	52	198	521	552	**534**	396	309	229	256	184	209	246	243	212	228	167	126	102	94	81	22	5022
5	4	4	17	22	32	52	200	514	568	561	414	280	244	206	240	245	249	264	268	248	160	152	110	88	80	29	5243
5	5	5	21	21	27	48	187	511	548	527	413	302	192	271	300	247	295	274	253	233	176	136	119	116	79	47	5343
5	6	6	19	19	35	50	192	484	527	524	418	283	237	245	243	264	269	260	265	268	260	159	140	110	125	56	5452
5	7	7	19	16	22	21	52	135	190	219	266	273	298	397	352	377	343	346	340	295	335	290	222	120	107	101	5136
Sum	AWDT		76	76	122	202	777	2030	2195	2146	1641	1174	902	978	967	965	1059	1041	998	977	763	573	471	408	365	154	21060
	AWDT		19	19	31	51	194	508	549	**537**	410	294	226	245	242	241	265	260	250	**244**	191	143	118	102	91	39	5265

STATE OF NEW HAMPSHIRE, DEPARTMENT OF TRANSPORTATION - BUREAU OF TRAFFIC
IN COOPERATION WITH U.S. DEPARTMENT OF TRANSPORTATION FEDERAL HIGHWAY ADMINISTRATION
AUTOMATIC TRAFFIC RECORDER DATA FOR THE MONTH OF **MAY 2016**

81 269103 LONDONDERRY- I-93 NB OFF RAMP EXIT 5

MON	DATE	DAY	12 AM	1 AM	2 AM	3 AM	4 AM	5 AM	6 AM	7 AM	8 AM	9 AM	10 AM	11 AM	12 PM	1 PM	2 PM	3 PM	4 PM	5 PM	6 PM	7 PM	8 PM	9 PM	10 PM	11 PM	Total
5	8	1	27	49	28	19	26	17	40	72	106	161	247	269	277	270	282	260	276	234	231	191	173	116	83	53	3507
5	29	1	48	34	25	17	29	18	48	84	129	135	185	231	224	256	234	234	184	193	193	172	120	103	98	71	3065
5	30	2	41	29	19	12	18	17	40	53	85	111	142	173	201	223	218	203	185	176	200	163	125	108	88	49	2679
5	3	3	36	43	41	42	81	165	299	387	327	292	266	299	322	365	418	478	503	356	412	287	187	144	112	88	5950
5	24	3	48	36	34	45	74	178	320	**422**	321	253	240	319	290	305	391	491	555	479	389	308	207	149	132	88	6074
5	31	3	18	23	19	41	60	193	294	375	366	295	310	315	352	318	404	536	553	515	362	292	199	199	126	102	6267
5	25	4	51	39	48	36	88	172	319	443	336	294	273	323	320	311	415	511	507	605	425	289	240	157	140	110	6452
5	26	5	64	40	38	42	93	159	300	371	345	315	256	311	311	258	547	470	491	502	391	304	223	192	142	116	6281
5	6	6	54	53	39	43	67	183	260	386	341	244	305	349	377	379	584	507	525	441	352	254	217	181	153	127	6421
5	27	6	70	37	36	39	91	180	285	419	379	306	321	365	416	405	481	438	450	409	288	253	218	163	136	124	6309
5	7	7	82	60	28	29	38	34	97	118	174	236	246	317	306	301	338	340	303	276	287	220	181	144	139	92	4386
5	28	7	53	49	23	29	22	42	88	131	186	240	277	509	299	259	264	221	205	220	185	178	136	141	120	102	3979
Sum AWDT			341	271	255	288	554	1230	2077	2803	2415	1999	1971	2281	2388	2341	3240	3431	3584	3307	2619	1987	1491	1185	941	755	43754
AWDT			49	39	36	41	79	176	297	**400**	345	286	282	326	341	334	463	490	512	**472**	374	284	213	169	134	108	6251

excl 5/30 - Holiday

STATE OF NEW HAMPSHIRE, DEPARTMENT OF TRANSPORTATION - BUREAU OF TRAFFIC
IN COOPERATION WITH U.S. DEPARTMENT OF TRANSPORTATION FEDERAL HIGHWAY ADMINISTRATION
AUTOMATIC TRAFFIC RECORDER DATA FOR THE MONTH OF **MAY 2016**

81 269102 LONDONDERRY- I-93 NB ON RAMP EXIT 5

MON	DATE	DAY	12 AM	1 AM	2 AM	3 AM	4 AM	5 AM	6 AM	7 AM	8 AM	9 AM	10 AM	11 AM	12 PM	1 PM	2 PM	3 PM	4 PM	5 PM	6 PM	7 PM	8 PM	9 PM	10 PM	11 PM	Total
5	8	1	75	31	27	17	26	53	86	147	256	417	451	530	526	525	541	445	463	397	391	326	254	159	138	53	6334
5	29	1	58	45	30	17	21	60	116	186	237	356	456	485	507	440	475	426	356	333	267	230	216	152	120	94	5683
5	30	2	38	28	23	23	26	58	123	136	182	283	364	451	447	426	418	386	360	305	307	248	241	163	108	78	5222
5	3	3	61	34	26	66	79	197	593	1083	796	512	447	460	491	507	675	825	858	857	555	381	294	192	139	71	10199
5	24	3	82	36	32	75	99	222	615	**1008**	736	513	472	518	454	494	716	806	813	792	544	423	305	205	133	95	10188
5	31	3	42	21	25	54	75	231	624	1007	830	566	557	516	513	481	751	823	799	768	525	458	305	225	151	86	10433
5	4	4	85	35	51	46	70	216	619	986	823	520	511	497	535	528	688	778	820	744	488	384	299	174	144	78	10119
5	25	4	105	69	45	63	80	246	633	965	834	569	478	547	534	553	708	863	823	821	636	436	352	250	166	98	10874
5	5	5	93	30	25	47	89	199	595	990	853	574	510	528	566	529	722	919	859	819	526	484	284	237	135	95	10708
5	26	5	115	68	33	56	108	247	604	1013	884	615	550	578	511	517	738	876	796	841	568	456	360	236	213	117	11100
5	6	6	112	48	39	63	80	220	600	939	800	585	548	591	635	620	733	901	861	821	615	505	380	244	224	136	11300
5	27	6	100	58	38	57	100	242	575	938	797	632	584	610	650	611	780	862	697	674	599	464	324	292	207	140	11031
5	7	7	111	42	32	37	45	98	197	350	443	516	578	634	594	613	647	527	522	502	437	374	301	230	190	126	8146
5	28	7	89	45	32	57	46	94	195	356	442	536	559	493	542	486	586	534	478	431	350	319	264	207	150	104	7395
Sum	AWDT		795	399	314	527	780	2020	5458	8929	7353	5086	4657	4845	4889	4840	6511	7653	7326	7137	5056	3991	2903	2055	1512	916	95952
	AWDT		88	44	35	59	87	224	606	**992**	817	565	517	538	543	538	723	850	814	**793**	562	443	323	228	168	102	10661

STATE OF NEW HAMPSHIRE, DEPARTMENT OF TRANSPORTATION - BUREAU OF TRAFFIC
IN COOPERATION WITH U.S. DEPARTMENT OF TRANSPORTATION FEDERAL HIGHWAY ADMINISTRATION

AUTOMATIC TRAFFIC RECORDER DATA FOR THE MONTH OF MAY 2016

81 269099 LONDONDERRY- I-93 SB OFF RAMP EXIT 5

MON	DATE	DAY	12 AM	1 AM	2 AM	3 AM	4 AM	5 AM	6 AM	7 AM	8 AM	9 AM	10 AM	11 AM	12 PM	1 PM	2 PM	3 PM	4 PM	5 PM	6 PM	7 PM	8 PM	9 PM	10 PM	11 PM	Total
5	8	1	90	63	53	30	35	39	67	141	228	332	447	559	561	562	556	527	472	452	362	346	269	189	131	61	6572
5	29	1	97	62	36	20	18	25	109	152	219	283	345	408	427	444	449	420	422	401	388	304	249	236	150	112	5776
5	30	2	75	38	33	16	26	40	72	129	152	223	305	415	458	441	497	472	419	360	342	340	274	223	161	75	5586
5	3	3	47	37	34	47	149	321	739	737	629	450	394	433	494	513	601	780	905	943	584	436	329	279	150	103	10134
5	24	3	47	35	33	40	157	301	666	**647**	902	465	446	512	495	447	564	752	899	962	584	435	344	283	143	121	10280
5	31	3	56	28	23	40	160	295	741	821	706	501	472	493	547	548	677	820	893	908	544	444	327	291	198	118	10651
5	4	4	56	45	27	42	146	306	704	746	633	442	418	482	496	516	586	793	1127	1090	708	378	337	270	147	99	10594
5	25	4	71	71	33	41	171	323	738	754	610	483	448	510	527	571	622	848	923	977	614	437	433	351	168	126	10850
5	5	5	72	38	35	41	163	305	690	866	414	252	457	499	526	520	674	798	977	890	653	434	369	324	161	139	10297
5	26	5	113	60	34	61	142	313	687	791	674	484	472	535	523	578	639	831	889	971	620	485	374	347	227	158	11008
5	6	6	75	59	44	45	173	273	714	763	649	500	459	512	584	582	644	871	940	996	618	464	356	329	216	169	11035
5	27	6	81	42	28	57	122	256	707	768	601	514	461	539	577	581	669	837	822	718	482	432	336	292	223	169	10314
5	7	7	91	64	37	38	30	100	167	311	399	443	488	523	542	561	620	621	598	547	435	335	307	297	197	159	7910
5	28	7	110	61	53	42	27	60	177	276	391	428	426	457	473	469	463	450	438	456	393	348	309	319	207	159	6992
Sum	AWDT		618	415	291	414	1383	2693	6386	6893	5818	4091	4027	4515	4769	4856	5676	7330	8375	8455	5407	3945	3205	2766	1633	1202	95163
	AWDT		69	46	32	46	154	299	710	**766**	646	455	447	502	530	540	631	814	931	**939**	601	438	356	307	181	134	10574
excl 5-24										6246																	
										781																	

STATE OF NEW HAMPSHIRE, DEPARTMENT OF TRANSPORTATION - BUREAU OF TRAFFIC
IN COOPERATION WITH U.S. DEPARTMENT OF TRANSPORTATION FEDERAL HIGHWAY ADMINISTRATION
AUTOMATIC TRAFFIC RECORDER DATA FOR THE MONTH OF **MAY 2016**

81 269101 LONDONDERRY- I-93 SB ON RAMP EXIT 5

	MON	DATE	DAY	12 AM	1 AM	2 AM	3 AM	4 AM	5 AM	6 AM	7 AM	8 AM	9 AM	10 AM	11 AM	12 PM	1 PM	2 PM	3 PM	4 PM	5 PM	6 PM	7 PM	8 PM	9 PM	10 PM	11 PM	Total
	5	8	1	36	25	18	16	19	45	82	134	170	212	288	297	329	303	275	251	265	214	185	135	104	54	54	23	3534
	5	29	1	31	29	11	21	23	43	68	102	147	192	283	270	266	253	246	200	177	203	164	129	119	89	61	43	3170
	5	30	2	31	15	13	27	35	58	63	80	125	151	194	249	248	212	211	209	180	170	192	146	130	79	43	28	2889
	5	3	3	54	27	39	66	175	390	520	499	453	376	273	275	318	299	341	437	385	393	288	167	129	95	68	47	6114
	5	24	3	51	34	35	61	204	396	521	532	381	331	287	271	316	265	327	393	436	474	191	190	131	93	59	46	6025
	5	31	3	38	18	27	58	185	400	566	523	462	377	327	327	286	312	364	406	460	473	228	139	133	86	94	61	6350
	5	4	4	53	32	39	65	187	423	518	515	456	349	324	275	296	304	327	400	358	449	273	185	124	94	66	55	6167
	5	25	4	54	29	33	65	183	476	527	549	461	363	289	270	298	275	360	465	423	431	264	182	141	95	67	56	6356
	5	5	5	52	34	42	45	184	425	538	499	418	413	312	310	313	262	324	425	442	411	251	173	116	102	82	45	6218
	5	26	5	69	31	34	54	198	413	538	520	476	387	301	252	309	289	297	458	474	405	281	193	138	110	72	64	6363
	5	6	6	57	26	42	42	185	377	479	484	455	384	301	289	353	308	403	458	461	411	299	226	148	119	75	57	6439
	5	27	6	47	34	53	60	183	363	494	504	403	356	337	326	332	318	384	403	343	355	260	167	136	102	77	64	6101
	5	7	7	49	15	15	29	48	119	128	209	259	313	288	322	307	314	309	295	319	262	196	180	134	100	103	68	4381
	5	28	7	45	37	31	20	46	72	136	192	273	254	286	249	242	243	251	228	204	188	172	165	143	102	73	57	3709
ADD	6	1	4	46	30	31	63	190	402	554	561	460	350	368	274	272	268	309	399	389	469	252	162	141	90	79	42	6201
Sum	AWDT			521	295	375	579	1874	4065	5255	5186	4425	3686	3119	2869	3093	2900	3436	4244	4171	4271	2587	1784	1337	986	739	537	62334
	AWDT			52	30	38	58	187	407	526	**519**	443	369	312	287	309	290	344	424	417	**427**	259	178	134	99	74	54	6233

Southern New Hampshire Planning Commission

438 Dubuque Street, Manchester, NH 03102
Tel: 603-669-4664 Fax:603-669-4350
Web: www.snhpc.org

DERRY
CRYSTAL AVE
SO OF TSIENNETO RD
STATE COUNT

Site Code: 82119050
Station ID:

Latitude: 0' 0.0000 Undefined

Start Time	Mon 02-May-16	Tue 03-May-16	Wed 04-May-16	Thu 05-May-16	Fri 06-May-16		Average Day		Sat 07-May-16	Sun 08-May-16		Week Average		
12:00 AM	*	*	90	74	119		94		137	156		115		
01:00	*	*	44	47	54		48		70	73		58		
02:00	*	*	27	30	27		28		49	47		36		
03:00	*	*	29	27	44		33		24	15		28		
04:00	*	*	62	68	77		69		42	29		56		
05:00	*	*	164	170	183		172		93	63		135		
06:00	*	*	434	410	437		427		203	128		322		
07:00	*	*	833	878	797		836		469	273		650		
08:00	*	*	871	950	895		905		710	481		781		
09:00	*	923	884	922	949		920		1116	769		927		
10:00	*	948	968	933	1034		971		1239	948		1012		
11:00	*	**1089**	**1113**	**1083**	**1257**		**1136**		**1468**	**1096**		**1184**		
12:00 PM	*	1271	1295	1307	1477		1338		1373	**1199**		1320		
01:00	*	1161	1223	1219	1360		1241		**1437**	1155		1259		
02:00	*	**1368**	1348	1357	1488		1390		1371	1068		**1333**		
03:00	*	1354	1348	1334	1490		1382		1313	979		1303		
04:00	*	1287	**1478**	1381	**1528**		**1418**		1170	1038		1314		
05:00	*	1304	1257	**1444**	1519		1381		1212	964		1283		
06:00	*	1113	1133	1272	1328		1212		1091	871		1135		
07:00	*	905	844	994	1112		964		1006	824		948		
08:00	*	747	684	767	989		797		796	632		769		
09:00	*	405	433	504	687		507		587	392		501		
10:00	*	253	241	311	468		318		351	258		314		
11:00	*	161	141	170	243		179		276	126		186		
Day Total	0	14289	16944	17652	19562		17766		17603	13584		16969		
% Avg. WkDay	0.0%	80.4%	95.4%	99.4%	110.1%									
% Avg. Week	0.0%	84.2%	99.9%	104.0%	115.3%		104.7%		103.7%	80.1%				
AM Peak	-	11:00	11:00	11:00	11:00	-	11:00	-	11:00	11:00	-	11:00	-	-
Vol.	-	1089	1113	1083	1257	-	1136	-	1468	1096	-	1184	-	-
PM Peak	-	14:00	16:00	17:00	16:00	-	16:00	-	13:00	12:00	-	14:00	-	-
Vol.	-	1368	1478	1444	1528	-	1418	-	1437	1199	-	1333	-	-

DERRY
FOLSOM RD
WEST OF NH 28
STATE COUNT

Southern New Hampshire Planning Commission

438 Dubuque Street, Manchester, NH 03102
Tel: 603-669-4664 Fax:603-669-4350
Web: www.snhpc.org

Site Code: 82119076
Station ID:

Latitude: 0' 0.0000 Undefined

Start Time	Mon 02-May-16	Tue 03-May-16	Wed 04-May-16	Thu 05-May-16	Fri 06-May-16		Average Day		Sat 07-May-16	Sun 08-May-16		Week Average		
12:00 AM	*	*	36	37	43		39		63	78		51		
01:00	*	*	17	18	25		20		35	40		27		
02:00	*	*	15	16	14		15		29	17		18		
03:00	*	*	19	25	26		23		23	15		22		
04:00	*	*	94	95	84		91		26	19		64		
05:00	*	*	233	219	209		220		86	40		157		
06:00	*	*	558	539	524		540		182	110		383		
07:00	*	*	777	818	738		778		426	236		599		
08:00	*	*	**795**	811	835		814		578	360		676		
09:00	*	709	689	672	735		701		800	547		692		
10:00	*	764	747	764	831		776		977	**793**		813		
11:00	*	**776**	787	**843**	**903**		**827**		**1077**	747		**856**		
12:00 PM	*	813	875	938	995		905		1025	**917**		927		
01:00	*	860	904	888	1029		920		**1105**	766		925		
02:00	*	1041	1033	1049	1088		1053		1032	796		1006		
03:00	*	1083	1122	1084	**1211**		1125		991	750		1040		
04:00	*	1126	**1296**	1165	1208		**1199**		918	685		**1066**		
05:00	*	**1188**	1129	**1180**	1185		1170		811	650		1024		
06:00	*	860	834	901	974		892		738	565		812		
07:00	*	523	567	623	681		598		571	475		573		
08:00	*	368	399	415	490		418		438	325		406		
09:00	*	254	244	274	348		280		291	202		269		
10:00	*	133	135	179	252		175		200	132		172		
11:00	*	66	82	93	142		96		145	54		97		
Day Total	0	10564	13387	13646	14570		13675		12567	9319		12675		
% Avg. WkDay	0.0%	77.3%	97.9%	99.8%	106.5%									
% Avg. Week	0.0%	83.3%	105.6%	107.7%	115.0%		107.9%		99.1%	73.5%				
AM Peak	-	11:00	08:00	11:00	11:00	-	11:00	-	11:00	10:00	-	11:00	-	-
Vol.	-	776	795	843	903	-	827	-	1077	793	-	856	-	-
PM Peak	-	17:00	16:00	17:00	15:00	-	16:00	-	13:00	12:00	-	16:00	-	-
Vol.	-	1188	1296	1180	1211	-	1199	-	1105	917	-	1066	-	-

Southern New Hampshire Planning Commission

438 Dubuque Street, Manchester, NH 03102
Tel: 603-669-4664 Fax:603-669-4350
Web: www.snhpc.org

DERRY
PINKERTON ST
EAST OF TSIENNETO RD
STATE COUNT

Site Code: 82119069
Station ID:

Latitude: 0' 0.0000 Undefined

Start Time	Mon 02-May-16	Tue 03-May-16	Wed 04-May-16	Thu 05-May-16	Fri 06-May-16		Average Day		Sat 07-May-16	Sun 08-May-16		Week Average		
12:00 AM	*	*	54	48	78		60		88	101		74		
01:00	*	*	29	27	33		30		37	45		34		
02:00	*	*	23	39	31		31		28	36		31		
03:00	*	*	31	39	38		36		23	34		33		
04:00	*	*	54	68	60		61		38	19		48		
05:00	*	*	197	170	195		187		82	37		136		
06:00	*	*	592	636	637		622		182	109		431		
07:00	*	*	661	**703**	720		**695**		382	279		549		
08:00	*	*	633	583	636		617		429	394		535		
09:00	*	*	521	531	589		547		653	574		574		
10:00	*	*	554	630	656		613		796	746		676		
11:00	*	**613**	**665**	636	**725**		660		**928**	**769**		**723**		
12:00 PM	*	626	709	743	731		702		854	**907**		762		
01:00	*	739	684	705	783		728		932	818		777		
02:00	*	933	917	881	992		931		**984**	812		920		
03:00	*	910	857	890	1016		918		922	780		896		
04:00	*	984	997	**1015**	**1072**		1017		903	740		952		
05:00	*	**1047**	**1036**	1009	1061		**1038**		864	720		**956**		
06:00	*	864	843	889	945		885		768	585		816		
07:00	*	674	607	669	795		686		647	558		658		
08:00	*	518	516	549	529		528		538	442		515		
09:00	*	329	322	357	478		372		392	274		359		
10:00	*	175	160	212	308		214		269	164		215		
11:00	*	109	107	154	199		142		195	68		139		
Day Total	0	8521	11769	12183	13307		12320		11934	10011		11809		
% Avg. WkDay	0.0%	69.2%	95.5%	98.9%	108.0%									
% Avg. Week	0.0%	72.2%	99.7%	103.2%	112.7%		104.3%		101.1%	84.8%				
AM Peak	-	11:00	11:00	07:00	11:00	-	07:00	-	11:00	11:00	-	11:00	-	-
Vol.	-	613	665	703	725	-	695	-	928	769	-	723	-	-
PM Peak	-	17:00	17:00	16:00	16:00	-	17:00	-	14:00	12:00	-	17:00	-	-
Vol.	-	1047	1036	1015	1072	-	1038	-	984	907	-	956	-	-

DERRY
TSIENNETO RD
EAST OF PINKERTON ST
STATE COUNT

Southern New Hampshire Planning Commission

438 Dubuque Street, Manchester, NH 03102
Tel: 603-669-4664 Fax:603-669-4350
Web: www.snhpc.org

Site Code: 82119078
Station ID:

Latitude: 0' 0.0000 Undefined

Start Time	Mon 02-May-16	Tue 03-May-16	Wed 04-May-16	Thu 05-May-16	Fri 06-May-16		Average Day		Sat 07-May-16	Sun 08-May-16		Week Average		
12:00 AM	*	*	31	35	47		38		85	85		57		
01:00	*	*	26	25	24		25		37	32		29		
02:00	*	*	27	27	20		25		35	29		28		
03:00	*	*	37	42	40		40		28	15		32		
04:00	*	*	127	119	109		118		51	29		87		
05:00	*	*	309	320	308		312		112	56		221		
06:00	*	*	938	959	909		935		301	132		648		
07:00	*	*	**1097**	**1159**	1084		**1113**		561	353		851		
08:00	*	*	1021	1102	1042		1055		788	461		883		
09:00	*	*	873	931	946		917		929	676		871		
10:00	*	*	985	950	995		977		1106	822		972		
11:00	*	**1034**	1001	1131	**1202**		1092		**1286**	**879**		**1089**		
12:00 PM	*	1087	1110	1101	1248		1136		1047	**983**		1096		
01:00	*	1085	1083	1010	1309		1122		**1142**	745		1062		
02:00	*	1446	1410	**1505**	1496		1464		1134	821		**1302**		
03:00	*	1441	1382	1363	1495		1420		977	806		1244		
04:00	*	**1457**	**1540**	1476	**1523**		**1499**		1005	741		1290		
05:00	*	1395	1355	1346	1415		1378		886	784		1197		
06:00	*	1050	885	934	998		967		767	640		879		
07:00	*	594	618	666	720		650		572	515		614		
08:00	*	467	393	429	526		454		466	361		440		
09:00	*	247	236	277	417		294		352	218		291		
10:00	*	119	119	166	306		178		241	153		184		
11:00	*	80	89	95	128		98		126	47		94		
Day Total	0	11502	16692	17168	18307		17307		14034	10383		15461		
% Avg. WkDay	0.0%	66.5%	96.4%	99.2%	105.8%									
% Avg. Week	0.0%	74.4%	108.0%	111.0%	118.4%		111.9%		90.8%	67.2%				
AM Peak	-	11:00	07:00	07:00	11:00	-	07:00	-	11:00	11:00	-	11:00	-	-
Vol.	-	1034	1097	1159	1202	-	1113	-	1286	879	-	1089	-	-
PM Peak	-	16:00	16:00	14:00	16:00	-	16:00	-	13:00	12:00	-	14:00	-	-
Vol.	-	1457	1540	1505	1523	-	1499	-	1142	983	-	1302	-	-

DERRY
CHESTER RD
EAST OF SILVESTRI CIR
STATE COUNT

Southern New Hampshire Planning Commission

438 Dubuque Street, Manchester, NH 03102
Tel: 603-669-4664 Fax:603-669-4350
Web: www.snhpc.org

Site Code: 82119064
Station ID:

Latitude: 0' 0.0000 Undefined

Start Time	Mon 02-May-16	Tue 03-May-16	Wed 04-May-16	Thu 05-May-16	Fri 06-May-16		Average Day		Sat 07-May-16	Sun 08-May-16		Week Average		
12:00 AM	*	*	35	36	39		37		72	82		53		
01:00	*	*	24	34	40		33		34	49		36		
02:00	*	*	28	24	34		29		29	25		28		
03:00	*	*	43	47	45		45		28	16		36		
04:00	*	*	139	140	146		142		53	35		103		
05:00	*	*	316	299	304		306		91	70		216		
06:00	*	*	519	499	532		517		215	132		379		
07:00	*	*	**605**	**588**	**592**		**595**		396	251		**486**		
08:00	*	*	581	506	545		544		459	307		480		
09:00	*	*	367	396	390		384		562	418		427		
10:00	*	369	353	400	407		382		581	551		444		
11:00	*	**379**	392	390	417		394		**626**	**605**		468		
12:00 PM	*	377	402	432	505		429		638	585		490		
01:00	*	478	468	460	531		484		599	**620**		526		
02:00	*	491	545	544	595		544		**648**	519		557		
03:00	*	636	606	**647**	702		648		570	543		617		
04:00	*	**663**	**697**	618	665		**661**		539	526		**618**		
05:00	*	633	597	632	**714**		644		556	526		610		
06:00	*	574	529	498	649		562		486	496		539		
07:00	*	410	383	401	512		426		415	431		425		
08:00	*	313	310	305	362		322		344	297		322		
09:00	*	220	234	232	284		242		282	182		239		
10:00	*	143	139	154	216		163		211	116		163		
11:00	*	82	76	93	136		97		157	62		101		
Day Total	0	5768	8388	8375	9362		8630		8591	7444		8363		
% Avg. WkDay	0.0%	66.8%	97.2%	97.0%	108.5%									
% Avg. Week	0.0%	69.0%	100.3%	100.1%	111.9%		103.2%		102.7%	89.0%				
AM Peak	-	11:00	07:00	07:00	07:00	-	07:00	-	11:00	11:00	-	07:00	-	-
Vol.	-	379	605	588	592	-	595	-	626	605	-	486	-	-
PM Peak	-	16:00	16:00	15:00	17:00	-	16:00	-	14:00	13:00	-	16:00	-	-
Vol.	-	663	697	647	714	-	661	-	648	620	-	618	-	-

DERRY
NO. MAIN ST
NO OF ACADEMY DR
STATE COUNT

Southern New Hampshire Planning Commission
438 Dubuque Street, Manchester, NH 03102
Tel: 603-669-4664 Fax:603-669-4350
Web: www.snhpc.org

Site Code: 82119052
Station ID:

Latitude: 0' 0.0000 Undefined

Start Time	Mon 02-May-16	Tue 03-May-16	Wed 04-May-16	Thu 05-May-16	Fri 06-May-16		Average Day		Sat 07-May-16	Sun 08-May-16		Week Average		
12:00 AM	*	*	21	23	39		28		45	74		40		
01:00	*	*	14	13	20		16		23	41		22		
02:00	*	*	11	12	20		14		20	12		15		
03:00	*	*	8	7	12		9		8	12		9		
04:00	*	*	37	39	39		38		19	14		30		
05:00	*	*	111	100	104		105		33	32		76		
06:00	*	*	695	688	644		676		146	62		447		
07:00	*	*	**759**	**752**	**757**		**756**		393	203		**573**		
08:00	*	*	650	679	640		656		390	259		524		
09:00	*	*	459	449	449		452		462	349		434		
10:00	*	*	448	487	497		477		558	442		486		
11:00	*	*	455	467	520		481		**671**	**509**		524		
12:00 PM	*	449	501	493	582		506		654	**646**		554		
01:00	*	512	558	512	652		558		**702**	499		572		
02:00	*	785	782	**850**	834		813		689	568		751		
03:00	*	798	807	798	858		815		663	512		739		
04:00	*	804	**904**	825	**990**		**881**		559	503		**764**		
05:00	*	**833**	856	738	918		836		541	530		736		
06:00	*	588	573	667	694		630		551	428		584		
07:00	*	445	405	356	512		430		380	324		404		
08:00	*	292	254	386	335		317		279	233		296		
09:00	*	154	129	171	213		167		308	177		192		
10:00	*	79	92	129	229		132		163	148		140		
11:00	*	44	54	50	106		64		143	36		72		
Day Total	0	5783	9583	9691	10664		9857		8400	6613		8984		
% Avg. WkDay	0.0%	58.7%	97.2%	98.3%	108.2%									
% Avg. Week	0.0%	64.4%	106.7%	107.9%	118.7%		109.7%		93.5%	73.6%				
AM Peak	-	-	07:00	07:00	07:00	-	07:00	-	11:00	11:00	-	07:00	-	-
Vol.	-	-	759	752	757	-	756	-	671	509	-	573	-	-
PM Peak	-	17:00	16:00	14:00	16:00	-	16:00	-	13:00	12:00	-	16:00	-	-
Vol.	-	833	904	850	990	-	881	-	702	646	-	764	-	-

DERRY
NO. MAIN ST
NO OF TSIENNETO RD
STATE COUNT

Southern New Hampshire Planning Commission
438 Dubuque Street, Manchester, NH 03102
Tel: 603-669-4664 Fax:603-669-4350
Web: www.snhpc.org

Site Code: 82119062
Station ID:

Latitude: 0' 0.0000 Undefined

Start Time	Mon 02-May-16	Tue 03-May-16	Wed 04-May-16	Thu 05-May-16	Fri 06-May-16		Average Day		Sat 07-May-16	Sun 08-May-16		Week Average		
12:00 AM	*	*	67	73	81		74		127	143		98		
01:00	*	*	22	21	44		29		61	81		46		
02:00	*	*	19	26	25		23		40	34		29		
03:00	*	*	31	24	27		27		29	27		28		
04:00	*	*	57	55	56		56		35	14		43		
05:00	*	*	205	186	168		186		64	45		134		
06:00	*	*	456	490	438		461		154	80		324		
07:00	*	*	**1005**	991	**996**		997		349	188		706		
08:00	*	*	996	**1014**	994		**1001**		578	369		**790**		
09:00	*	*	739	727	781		749		709	507		693		
10:00	*	*	568	576	662		602		795	721		664		
11:00	*	*	591	617	702		637		**896**	**764**		714		
12:00 PM	*	672	747	710	774		726		**1015**	**912**		805		
01:00	*	668	708	676	861		728		986	836		789		
02:00	*	826	829	803	959		854		942	765		854		
03:00	*	1065	1042	1145	1215		1117		957	815		1040		
04:00	*	1163	1196	1134	1311		1201		845	793		1074		
05:00	*	**1253**	**1299**	**1199**	**1377**		**1282**		827	799		**1126**		
06:00	*	1102	1094	1102	1149		1112		756	696		983		
07:00	*	758	734	724	835		763		673	657		730		
08:00	*	574	556	575	627		583		522	488		557		
09:00	*	397	342	362	517		404		471	349		406		
10:00	*	224	226	309	392		288		327	233		285		
11:00	*	116	113	141	256		156		238	94		160		
Day Total	0	8818	13642	13680	15247		14056		12396	10410		13078		
% Avg. WkDay	0.0%	62.7%	97.1%	97.3%	108.5%									
% Avg. Week	0.0%	67.4%	104.3%	104.6%	116.6%		107.5%		94.8%	79.6%				
AM Peak	-	-	07:00	08:00	07:00	-	08:00	-	11:00	11:00	-	08:00	-	-
Vol.	-	-	1005	1014	996	-	1001	-	896	764	-	790	-	-
PM Peak	-	17:00	17:00	17:00	17:00	-	17:00	-	12:00	12:00	-	17:00	-	-
Vol.	-	1253	1299	1199	1377	-	1282	-	1015	912	-	1126	-	-

DERRY
SO. MAIN ST
SO OF THORTON ST
STATE COUNT

Southern New Hampshire Planning Commission

438 Dubuque Street, Manchester, NH 03102
Tel: 603-669-4664 Fax:603-669-4350
Web: www.snhpc.org

Site Code: 82119054
Station ID:

Latitude: 0' 0.0000 Undefined

Start Time	Mon 02-May-16	Tue 03-May-16	Wed 04-May-16	Thu 05-May-16	Fri 06-May-16		Average Day		Sat 07-May-16	Sun 08-May-16		Week Average		
12:00 AM	*	*	48	57	85		63		112	133		87		
01:00	*	*	35	30	43		36		53	67		46		
02:00	*	*	24	26	35		28		39	40		33		
03:00	*	*	33	34	37		35		24	36		33		
04:00	*	*	73	84	81		79		39	23		60		
05:00	*	*	230	209	219		219		82	62		160		
06:00	*	*	962	946	943		950		273	154		656		
07:00	*	*	**1095**	**1105**	**1129**		**1110**		623	374		865		
08:00	*	*	1038	1010	1004		1017		640	548		848		
09:00	*	*	797	777	842		805		882	728		805		
10:00	*	*	734	860	859		818		1070	945		894		
11:00	*	*	833	805	921		853		**1244**	**1020**		**965**		
12:00 PM	*	810	896	909	979		898		1209	**1184**		998		
01:00	*	934	890	886	1083		948		1237	980		1002		
02:00	*	1002	1002	1063	1044		1028		**1285**	1085		1080		
03:00	*	1221	1273	1243	1383		1280		1181	980		1214		
04:00	*	1340	1352	**1418**	**1459**		1392		1143	971		**1280**		
05:00	*	**1407**	**1390**	1340	1454		**1398**		1092	989		1279		
06:00	*	1161	1144	1114	1295		1178		1074	806		1099		
07:00	*	898	812	774	992		869		843	660		830		
08:00	*	616	569	695	623		626		617	538		610		
09:00	*	383	357	419	526		421		563	315		427		
10:00	*	189	197	258	429		268		383	264		287		
11:00	*	108	120	162	242		158		295	80		168		
Day Total	0	10069	15904	16224	17707		16477		16003	12982		15726		
% Avg. WkDay	0.0%	61.1%	96.5%	98.5%	107.5%									
% Avg. Week	0.0%	64.0%	101.1%	103.2%	112.6%		104.8%		101.8%	82.6%				
AM Peak	-	-	07:00	07:00	07:00	-	07:00	-	11:00	11:00	-	11:00	-	-
Vol.	-	-	1095	1105	1129	-	1110	-	1244	1020	-	965	-	-
PM Peak	-	17:00	17:00	16:00	16:00	-	17:00	-	14:00	12:00	-	16:00	-	-
Vol.	-	1407	1390	1418	1459	-	1398	-	1285	1184	-	1280	-	-

DERRY
TSIENNETO RD
WEST OF CHESTER RD
STATE COUNT

Southern New Hampshire Planning Commission

438 Dubuque Street, Manchester, NH 03102
Tel: 603-669-4664 Fax:603-669-4350
Web: www.snhpc.org

Site Code: 82119021
Station ID:

Latitude: 0' 0.0000 Undefined

Start Time	Mon 02-May-16	Tue 03-May-16	Wed 04-May-16	Thu 05-May-16	Fri 06-May-16		Average Day		Sat 07-May-16	Sun 08-May-16		Week Average		
12:00 AM	*	*	21	23	27		24		37	49		31		
01:00	*	*	16	10	15		14		15	19		15		
02:00	*	*	12	10	8		10		20	23		15		
03:00	*	*	15	18	11		15		12	7		13		
04:00	*	*	28	29	31		29		20	13		24		
05:00	*	*	122	118	108		116		35	16		80		
06:00	*	*	412	421	417		417		114	37		280		
07:00	*	*	**503**	**495**	**452**		**483**		259	111		**364**		
08:00	*	*	429	433	415		426		297	204		356		
09:00	*	*	301	316	286		301		374	312		318		
10:00	*	*	311	292	323		309		441	382		350		
11:00	*	**330**	330	298	342		325		**497**	**386**		364		
12:00 PM	*	351	296	298	364		327		444	**394**		358		
01:00	*	299	320	336	398		338		459	372		364		
02:00	*	450	493	**507**	502		488		446	373		462		
03:00	*	469	441	461	502		468		**483**	382		456		
04:00	*	501	**499**	485	**559**		**511**		425	366		**472**		
05:00	*	**508**	477	490	503		494		394	357		455		
06:00	*	440	382	441	442		426		388	301		399		
07:00	*	311	279	275	339		301		280	237		287		
08:00	*	216	207	261	295		245		242	171		232		
09:00	*	128	120	135	228		153		189	101		150		
10:00	*	68	58	104	154		96		115	84		97		
11:00	*	31	39	58	78		52		90	29		54		
Day Total	0	4102	6111	6314	6799		6368		6076	4726		5996		
% Avg. WkDay	0.0%	64.4%	96.0%	99.2%	106.8%									
% Avg. Week	0.0%	68.4%	101.9%	105.3%	113.4%		106.2%		101.3%	78.8%				
AM Peak	-	11:00	07:00	07:00	07:00	-	07:00	-	11:00	11:00	-	07:00	-	-
Vol.	-	330	503	495	452	-	483	-	497	386	-	364	-	-
PM Peak	-	17:00	16:00	14:00	16:00	-	16:00	-	15:00	12:00	-	16:00	-	-
Vol.	-	508	499	507	559	-	511	-	483	394	-	472	-	-

LONDERRY
NH 102 (NASHUA RD)
@ DERRY T/L
STAATE COUNT

Southern New Hampshire Planning Commission

438 Dubuque Street, Manchester, NH 03102
Tel: 603-669-4664 Fax:603-669-4350
Web: www.snhpc.org

Site Code: 82269058
Station ID:

Latitude: 0' 0.0000 Undefined

Start Time	Mon 02-May-16	Tue 03-May-16	Wed 04-May-16	Thu 05-May-16	Fri 06-May-16		Average Day		Sat 07-May-16	Sun 08-May-16		Week Average		
12:00 AM	*	*	140	164	194		166		234	260		198		
01:00	*	*	80	81	136		99		171	223		138		
02:00	*	*	86	74	103		88		101	98		92		
03:00	*	*	107	122	111		113		94	66		100		
04:00	*	*	309	347	324		327		124	76		236		
05:00	*	*	858	824	816		833		278	143		584		
06:00	*	*	1327	1280	1244		1284		563	335		950		
07:00	*	*	**1761**	**1750**	**1642**		**1718**		932	599		1337		
08:00	*	*	1596	1665	1605		1622		1275	865		1401		
09:00	*	1376	1337	1502	1404		1405		1549	1223		1398		
10:00	*	1358	1408	1362	1511		1410		1761	1629		1505		
11:00	*	**1411**	1448	1473	1517		1462		**1946**	**1751**		**1591**		
12:00 PM	*	1489	1515	1615	1698		1579		1973	**1777**		1678		
01:00	*	1507	1482	1508	1668		1541		**2014**	1761		1657		
02:00	*	1587	1631	1766	1864		1712		1915	1680		1740		
03:00	*	**1839**	1737	**1846**	**1915**		**1834**		1859	1559		**1792**		
04:00	*	1820	1733	1731	1901		1796		1751	1507		1740		
05:00	*	1730	**1773**	1737	1764		1751		1678	1482		1694		
06:00	*	1616	1567	1633	1766		1646		1581	1269		1572		
07:00	*	1118	1197	1253	1406		1244		1319	1133		1238		
08:00	*	927	873	1021	1037		964		1095	875		971		
09:00	*	691	673	777	869		752		816	580		734		
10:00	*	422	429	540	691		520		631	372		514		
11:00	*	252	256	340	459		327		504	231		340		
Day Total	0	19143	25323	26411	27645		26193		26164	21494		25200		
% Avg. WkDay	0.0%	73.1%	96.7%	100.8%	105.5%									
% Avg. Week	0.0%	76.0%	100.5%	104.8%	109.7%		103.9%		103.8%	85.3%				
AM Peak	-	11:00	07:00	07:00	07:00	-	07:00	-	11:00	11:00	-	11:00	-	-
Vol.	-	1411	1761	1750	1642	-	1718	-	1946	1751	-	1591	-	-
PM Peak	-	15:00	17:00	15:00	15:00	-	15:00	-	13:00	12:00	-	15:00	-	-
Vol.	-	1839	1773	1846	1915	-	1834	-	2014	1777	-	1792	-	-

Southern New Hampshire Planning Commission

438 Dubuque Street, Manchester, NH 03102
Tel: 603-669-4664 Fax:603-669-4350
Web: www.snhpc.org

LONDONDERRY
NH 28 (ROCKINGHAM RD)
@ DERRY T/L
STATE COUNT

Site Code: 62269053
Station ID:

Latitude: 0' 0.0000 Undefined

Start Time	Mon 02-May-16	Tue 03-May-16	Wed 04-May-16	Thu 05-May-16	Fri 06-May-16		Average Day		Sat 07-May-16	Sun 08-May-16		Week Average		
12:00 AM	*	*	88	85	158		110		164	148		129		
01:00	*	*	61	57	76		65		72	92		72		
02:00	*	*	46	54	58		53		54	76		58		
03:00	*	*	45	61	67		58		50	49		54		
04:00	*	*	110	110	139		120		61	34		91		
05:00	*	*	344	304	279		309		132	64		225		
06:00	*	*	826	838	807		824		266	149		577		
07:00	*	*	**1287**	1309	1240		1279		609	338		957		
08:00	*	*	1268	**1397**	**1252**		**1306**		753	446		1023		
09:00	*	*	932	1005	1061		999		1008	776		956		
10:00	*	881	956	918	1009		941		1167	977		985		
11:00	*	**975**	986	994	1105		1015		**1271**	**1157**		**1081**		
12:00 PM	*	1075	1184	1146	1263		1167		1340	**1290**		1216		
01:00	*	1024	1112	1116	1259		1128		1376	1144		1172		
02:00	*	1207	1241	1229	1435		1278		**1471**	1175		1293		
03:00	*	1433	1359	1549	1562		1476		1353	1050		1384		
04:00	*	1563	1732	1682	1751		1682		1328	1060		1519		
05:00	*	**1775**	**1916**	**1811**	**1956**		**1864**		1206	959		**1604**		
06:00	*	1246	1226	1346	1424		1310		1052	812		1184		
07:00	*	871	820	979	1102		943		925	735		905		
08:00	*	641	630	703	823		699		720	565		680		
09:00	*	457	439	583	656		534		497	331		494		
10:00	*	271	277	353	492		348		396	267		343		
11:00	*	182	184	237	296		225		322	130		225		
Day Total	0	13601	19069	19866	21270		19733		17593	13824		18227		
% Avg. WkDay	0.0%	68.9%	96.6%	100.7%	107.8%									
% Avg. Week	0.0%	74.6%	104.6%	109.0%	116.7%		108.3%		96.5%	75.8%				
AM Peak	-	11:00	07:00	08:00	08:00	-	08:00	-	11:00	11:00	-	11:00	-	-
Vol.	-	975	1287	1397	1252	-	1306	-	1271	1157	-	1081	-	-
PM Peak	-	17:00	17:00	17:00	17:00	-	17:00	-	14:00	12:00	-	17:00	-	-
Vol.	-	1775	1916	1811	1956	-	1864	-	1471	1290	-	1604	-	-

LONDONDERRY
GILCREST RD
NO OF NH 102
STATE COUNT

Southern New Hampshire Planning Commission

438 Dubuque Street, Manchester, NH 03102
Tel: 603-669-4664 Fax:603-669-4350
Web: www.snhpc.org

Site Code: 82269082
Station ID:

Latitude: 0' 0.0000 Undefined

Start Time	Mon 02-May-16	Tue 03-May-16	Wed 04-May-16	Thu 05-May-16	Fri 06-May-16		Average Day		Sat 07-May-16	Sun 08-May-16		Week Average		
12:00 AM	*	*	22	26	36		28		51	51		37		
01:00	*	*	14	21	18		18		39	51		29		
02:00	*	*	17	15	19		17		20	11		16		
03:00	*	*	11	15	22		16		18	6		14		
04:00	*	*	53	52	38		48		17	15		35		
05:00	*	*	209	218	184		204		63	36		142		
06:00	*	*	443	417	384		415		117	75		287		
07:00	*	*	690	724	678		697		311	216		524		
08:00	*	**703**	**702**	**858**	**763**		**756**		509	370		651		
09:00	*	554	631	618	618		605		676	563		610		
10:00	*	565	584	561	608		580		877	689		647		
11:00	*	566	627	593	710		624		**991**	**736**		**704**		
12:00 PM	*	701	697	708	806		728		900	**884**		783		
01:00	*	648	678	653	775		688		911	794		743		
02:00	*	708	753	800	836		774		912	738		791		
03:00	*	867	886	938	978		917		**938**	718		888		
04:00	*	946	**1054**	994	1040		1008		877	720		938		
05:00	*	**1113**	1026	**1030**	**1044**		**1053**		777	666		**943**		
06:00	*	892	732	844	896		841		655	563		764		
07:00	*	528	524	537	640		557		510	447		531		
08:00	*	360	365	389	432		386		424	315		381		
09:00	*	212	210	228	308		240		291	144		232		
10:00	*	116	120	122	210		142		174	83		138		
11:00	*	58	67	75	119		80		119	43		80		
Day Total	0	9537	11115	11436	12162		11422		11177	8934		10908		
% Avg. WkDay	0.0%	83.5%	97.3%	100.1%	106.5%									
% Avg. Week	0.0%	87.4%	101.9%	104.8%	111.5%		104.7%		102.5%	81.9%				
AM Peak	-	08:00	08:00	08:00	08:00	-	08:00	-	11:00	11:00	-	11:00	-	-
Vol.	-	703	702	858	763	-	756	-	991	736	-	704	-	-
PM Peak	-	17:00	16:00	17:00	17:00	-	17:00	-	15:00	12:00	-	17:00	-	-
Vol.	-	1113	1054	1030	1044	-	1053	-	938	884	-	943	-	-

STATE OF NEW HAMPSHIRE, DEPARTMENT OF TRANSPORTATION - BUREAU OF TRAFFIC 2/22/2016
IN COOPERATION WITH U.S. DEPARTMENT OF TRANSPORTATION FEDERAL HIGHWAY ADMINISTRATION
AUTOMATIC TRAFFIC RECORDER DATA FOR THE MONTH OF APRIL 2014

82 119071 DERRY- NH 102 (EAST BROADWAY) WEST OF ABBOT ST

MON	DATE	DAY	12 AM	1 AM	2 AM	3 AM	4 AM	5 AM	6 AM	7 AM	8 AM	9 AM	10 AM	11 AM	12 PM	1 PM	2 PM	3 PM	4 PM	5 PM	6 PM	7 PM	8 PM	9 PM	10 PM	11 PM	Total
4	20	1	153	103	64	35	34	85	168	343	438	641	792	931	1073	840	737	669	751	786	878	710	555	326	178	132	11422
4	15	3	64	44	47	48	180	426	861	1021	904	798	745	811	817	824	1008	1096	1031	1048	976	769	608	343	221	165	14855
4	16	4	66	47	49	65	142	420	811	1002	903	717	698	760	735	813	1026	1014	1052	1107	1052	805	652	409	269	139	14753
4	17	5	89	49	44	49	175	458	884	1025	955	741	704	779	821	853	912	1122	1141	1192	1042	856	630	514	273	176	15484
4	18	6	76	59	50	54	155	379	832	1031	941	845	800	893	926	1015	1154	1147	1169	1198	1103	798	563	526	417	311	16442
4	19	7	149	99	47	29	73	145	323	677	780	1060	1081	1131	1136	1092	1153	1049	997	965	867	725	585	507	393	231	15294

TYPE	STATION	YEAR	MONTH	NO. DAYS	AVERAGE SUNDAY	AVERAGE WEEKDAY	AVERAGE SATURDAY	AVERAGE DAILY	COMPUTED VOLUME	PERCENT GAIN	PERCENT LOSS
82	119071	2014	April	6	11422	15384	15294	14843	445301		

PEAK HOUR VOLUMES:

	AVERAGE AM:	AVERAGE MIDDAY:	AVERAGE PM:
SUNDAY	641	1073	878
WEEKDAY	1020	876	1148
SATURDAY	1060	1136	1153

AM - 6 AM TO 10 AM
MIDDAY - 10 AM TO 2 PM
PM - 2 PM TO 8 PM

STATE OF NEW HAMPSHIRE, DEPARTMENT OF TRANSPORTATION - BUREAU OF TRAFFIC 2/22/2016

IN COOPERATION WITH U.S. DEPARTMENT OF TRANSPORTATION FEDERAL HIGHWAY ADMINISTRATION

AUTOMATIC TRAFFIC RECORDER DATA FOR THE MONTH OF APRIL 2014

82 119011 DERRY- NH 102 (BROADWAY) EAST OF GRIFFIN ST

MON	DATE	DAY	12 AM	1 AM	2 AM	3 AM	4 AM	5 AM	6 AM	7 AM	8 AM	9 AM	10 AM	11 AM	12 PM	1 PM	2 PM	3 PM	4 PM	5 PM	6 PM	7 PM	8 PM	9 PM	10 PM	11 PM	Total
4	20	1	175	119	63	49	47	77	151	304	437	665	832	989	1216	941	781	718	809	862	883	742	582	364	221	135	12162
4	15	3	80	65	56	71	202	544	772	1033	1020	976	983	1017	1091	1050	1083	1136	1137	1128	1034	742	645	432	271	210	16778
4	16	4	91	55	50	78	163	519	779	972	1024	970	1054	1073	1007	1030	1207	1229	1155	1150	1103	889	697	536	335	189	17355
4	17	5	112	68	58	76	197	560	794	1065	1056	933	1027	1061	1056	1096	1117	1243	1149	1190	1173	936	844	611	360	234	18016
4	18	6	135	90	73	75	187	483	751	1006	1062	1094	1067	1150	1211	1183	1259	1258	1285	1262	1157	946	735	590	448	354	18861
4	19	7	182	112	75	41	84	165	337	638	868	1073	1251	1289	1359	1344	1302	1245	1121	1090	998	833	699	567	446	283	17402

TYPE	STATION	YEAR	MONTH	NO. DAYS	AVERAGE SUNDAY	AVERAGE WEEKDAY	AVERAGE SATURDAY	AVERAGE DAILY	COMPUTED VOLUME	PERCENT GAIN	PERCENT LOSS
82	119011	2014	April	6	12162	17752	17402	16960	508811		

PEAK HOUR VOLUMES:

	AVERAGE AM:	AVERAGE MIDDAY:	AVERAGE PM:
SUNDAY	665	1216	883
WEEKDAY	1054	1118	1224
SATURDAY	1073	1359	1302

AM - 6 AM TO 10 AM

MIDDAY - 10 AM TO 2 PM

PM - 2 PM TO 8 PM

STATE OF NEW HAMPSHIRE, DEPARTMENT OF TRANSPORTATION - BUREAU OF TRAFFIC
IN COOPERATION WITH U.S. DEPARTMENT OF TRANSPORTATION FEDERAL HIGHWAY ADMINISTRATION
AUTOMATIC TRAFFIC RECORDER DATA FOR THE MONTH OF APRIL 2014

2/22/2016

82 119091 DERRY- FORDWAY ST OVER BEAVER BROOK

MON	DATE	DAY	12 AM	1 AM	2 AM	3 AM	4 AM	5 AM	6 AM	7 AM	8 AM	9 AM	10 AM	11 AM	12 PM	1 PM	2 PM	3 PM	4 PM	5 PM	6 PM	7 PM	8 PM	9 PM	10 PM	11 PM	Total
4	20	1	51	37	22	10	12	17	38	93	102	215	229	325	335	315	240	214	264	237	295	257	181	125	56	33	3703
4	15	3	37	18	13	12	45	112	283	422	442	350	305	289	364	327	364	357	434	432	319	230	168	111	66	54	5554
4	16	4	28	12	14	13	49	98	228	357	375	284	308	298	297	343	386	412	414	448	374	229	177	129	79	59	5411
4	17	5	32	8	14	13	51	117	258	427	393	295	295	349	359	352	410	431	414	504	406	315	203	149	96	72	5963
4	18	6	37	19	11	7	33	116	253	345	398	356	379	393	419	420	487	539	513	493	412	279	211	167	124	86	6497
4	19	7	48	35	12	14	19	37	94	222	368	492	468	570	548	534	589	492	370	352	280	237	169	160	118	73	6301

TYPE	STATION	YEAR	MONTH	NO. DAYS	AVERAGE SUNDAY	AVERAGE WEEKDAY	AVERAGE SATURDAY	AVERAGE DAILY	COMPUTED VOLUME	PERCENT GAIN	PERCENT LOSS
82	119091	2014	April	6	3703	5856	6301	5628	168854		

PEAK HOUR VOLUMES:

	AVERAGE AM:	AVERAGE MIDDAY:	AVERAGE PM:
SUNDAY	215	335	295
WEEKDAY	410	372	481
SATURDAY	492	570	589

AM - 6 AM TO 10 AM
MIDDAY - 10 AM TO 2 PM
PM - 2 PM TO 8 PM

STATE OF NEW HAMPSHIRE, DEPARTMENT OF TRANSPORTATION - BUREAU OF TRAFFIC 2/22/2016
IN COOPERATION WITH U.S. DEPARTMENT OF TRANSPORTATION FEDERAL HIGHWAY ADMINISTRATION
AUTOMATIC TRAFFIC RECORDER DATA FOR THE MONTH OF APRIL 2014

82 119060 DERRY- FRANKLIN ST EXT NORTH OF FOLSOM RD

MON	DATE	DAY	12 AM	1 AM	2 AM	3 AM	4 AM	5 AM	6 AM	7 AM	8 AM	9 AM	10 AM	11 AM	12 PM	1 PM	2 PM	3 PM	4 PM	5 PM	6 PM	7 PM	8 PM	9 PM	10 PM	11 PM	Total
4	27	1	15	2	4	4	3	2	15	47	49	76	97	103	128	119	107	104	79	84	66	51	61	27	35	10	1288
4	23	4	16	4	5	5	10	30	78	86	99	87	103	102	130	100	135	158	162	158	123	90	69	51	32	7	1840
4	24	5	6	9	1	4	7	37	90	97	78	49	87	76	132	101	127	166	175	172	149	128	95	62	28	13	1889
4	25	6	11	10	3	3	10	30	74	101	99	90	94	127	171	143	130	170	175	151	125	101	77	60	34	25	2014
4	26	7	9	7	3	1	3	8	17	51	59	101	109	117	127	129	138	88	89	100	96	67	32	36	32	20	1439

TYPE	STATION	YEAR	MONTH	NO. DAYS	AVERAGE SUNDAY	AVERAGE WEEKDAY	AVERAGE SATURDAY	AVERAGE DAILY	COMPUTED VOLUME	PERCENT GAIN	PERCENT LOSS
82	119060	2014	April	5	1288	1914	1439	1767	53023		

PEAK HOUR VOLUMES:

	AVERAGE AM:	AVERAGE MIDDAY:	AVERAGE PM:
SUNDAY	76	128	107
WEEKDAY	99	144	171
SATURDAY	101	129	138

AM - 6 AM TO 10 AM
MIDDAY - 10 AM TO 2 PM
PM - 2 PM TO 8 PM

STATE OF NEW HAMPSHIRE, DEPARTMENT OF TRANSPORTATION - BUREAU OF TRAFFIC

2/22/2016

IN COOPERATION WITH U.S. DEPARTMENT OF TRANSPORTATION FEDERAL HIGHWAY ADMINISTRATION

AUTOMATIC TRAFFIC RECORDER DATA FOR THE MONTH OF JULY 2014

62 269054 LONDONDERRY- NH 28 (ROCKINGHAM RD) EAST OF PERKINS RD

MON	DATE	DAY	12 AM	1 AM	2 AM	3 AM	4 AM	5 AM	6 AM	7 AM	8 AM	9 AM	10 AM	11 AM	12 PM	1 PM	2 PM	3 PM	4 PM	5 PM	6 PM	7 PM	8 PM	9 PM	10 PM	11 PM	Total
7	20	1	182	77	44	58	65	98	143	281	576	631	811	975	896	1014	994	931	1054	1034	853	769	576	392	249	151	12854
7	16	4	163	96	116	114	233	663	1009	1361	1432	1071	958	1031	1005	1072	1094	1457	1593	1607	1139	818	729	462	334	223	19780
7	17	5	171	105	98	118	257	640	1065	1409	1401	1107	1004	1022	1108	1134	1198	1504	1623	1757	1253	909	752	527	387	240	20789
7	18	6	206	132	103	117	196	564	1003	1289	1376	1141	1060	1006	1143	1147	1455	1605	1758	1721	1312	1090	723	493	452	339	21431
7	19	7	257	132	101	104	117	202	277	435	598	751	902	951	1078	993	1056	975	933	790	686	599	494	453	322	258	13464

TYPE	STATION	YEAR	MONTH	NO. DAYS	AVERAGE SUNDAY	AVERAGE WEEKDAY	AVERAGE SATURDAY	AVERAGE DAILY	COMPUTED VOLUME	PERCENT GAIN	PERCENT LOSS
62	269054	2014	July	5	12854	20667	13464	18729	580605		

PEAK HOUR VOLUMES:

	AVERAGE AM:	AVERAGE MIDDAY:	AVERAGE PM:
SUNDAY	631	1014	1054
WEEKDAY	1406	1118	1707
SATURDAY	751	1078	1056

AM - 6 AM TO 10 AM
MIDDAY - 10 AM TO 2 PM
PM - 2 PM TO 8 PM

STATE OF NEW HAMPSHIRE, DEPARTMENT OF TRANSPORTATION - BUREAU OF TRAFFIC
IN COOPERATION WITH U.S. DEPARTMENT OF TRANSPORTATION FEDERAL HIGHWAY ADMINISTRATION
AUTOMATIC TRAFFIC RECORDER DATA FOR THE MONTH OF JUNE 2015

82 119070 DERRY- NH 28 (CRYSTAL AVE) SOUTH OF ROLLINS ST

MON	DATE	DAY	12 AM	1 AM	2 AM	3 AM	4 AM	5 AM	6 AM	7 AM	8 AM	9 AM	10 AM	11 AM	12 PM	1 PM	2 PM	3 PM	4 PM	5 PM	6 PM	7 PM	8 PM	9 PM	10 PM	11 PM	Total
6	28	1	135	69	39	24	31	52	105	249	313	556	693	809	932	952	875	861	808	789	741	678	456	342	217	101	10827
6	24	4	118	62	26	31	80	185	374	627	771	804	905	973	1040	1028	1040	1011	1137	1161	1012	892	810	576	336	203	15202
6	25	5	117	54	38	29	74	181	392	642	823	816	862	1068	1110	1071	1079	1050	1094	1130	966	854	773	572	394	205	15394
6	26	6	119	59	39	28	75	194	370	620	727	829	867	1036	1125	1144	1127	1081	1139	1230	1137	955	779	694	436	297	16107
6	27	7	178	90	55	41	56	110	207	402	574	842	1051	1061	1128	1054	1018	1003	882	894	815	759	618	529	331	163	13861

TYPE	STATION	YEAR	MONTH	NO. DAYS	AVERAGE SUNDAY	AVERAGE WEEKDAY	AVERAGE SATURDAY	AVERAGE DAILY	COMPUTED VOLUME	PERCENT GAIN	PERCENT LOSS
82	119070	2015	June	5	10827	15568	13861	14708	441241		

PEAK HOUR VOLUMES:

	AVERAGE AM:	AVERAGE MIDDAY:	AVERAGE PM:
SUNDAY	556	952	875
WEEKDAY	819	1098	1174
SATURDAY	842	1128	1018

AM - 6 AM TO 10 AM
MIDDAY - 10 AM TO 2 PM
PM - 2 PM TO 8 PM

STATE OF NEW HAMPSHIRE, DEPARTMENT OF TRANSPORTATION - BUREAU OF TRAFFIC 2/22/2016
IN COOPERATION WITH U.S. DEPARTMENT OF TRANSPORTATION FEDERAL HIGHWAY ADMINISTRATION
AUTOMATIC TRAFFIC RECORDER DATA FOR THE MONTH OF APRIL 2014

82 119059 DERRY- ASH ST AT LONDONDERRY TL

MON	DATE	DAY	12 AM	1 AM	2 AM	3 AM	4 AM	5 AM	6 AM	7 AM	8 AM	9 AM	10 AM	11 AM	12 PM	1 PM	2 PM	3 PM	4 PM	5 PM	6 PM	7 PM	8 PM	9 PM	10 PM	11 PM	Total
4	20	1	25	16	7	10	11	39	51	102	154	224	292	324	404	284	226	235	205	271	249	207	139	68	43	23	3609
4	15	3	12	5	8	5	39	100	306	405	382	331	354	411	488	417	454	551	665	608	461	314	203	107	54	43	6723
4	16	4	15	14	9	4	29	106	281	386	357	369	404	471	483	428	496	603	619	678	561	366	218	108	61	34	7100
4	17	5	18	11	9	8	34	125	327	419	424	345	408	456	548	483	576	613	768	753	556	382	254	182	71	60	7830
4	18	6	21	17	6	6	31	98	255	380	419	427	438	568	559	512	651	724	777	707	574	419	257	196	94	67	8203
4	19	7	24	14	13	9	17	40	89	226	345	457	563	636	662	599	629	613	516	468	449	290	259	146	95	53	7212

TYPE	STATION	YEAR	MONTH	NO. DAYS	AVERAGE SUNDAY	AVERAGE WEEKDAY	AVERAGE SATURDAY	AVERAGE DAILY	COMPUTED VOLUME	PERCENT GAIN	PERCENT LOSS
82	119059	2014	April	6	3609	7464	7212	6916	207492		

PEAK HOUR VOLUMES:

	AVERAGE AM:	AVERAGE MIDDAY:	AVERAGE PM:
SUNDAY	224	404	271
WEEKDAY	410	522	722
SATURDAY	457	662	629

AM - 6 AM TO 10 AM
MIDDAY - 10 AM TO 2 PM
PM - 2 PM TO 8 PM

STATE OF NEW HAMPSHIRE, DEPARTMENT OF TRANSPORTATION - BUREAU OF TRAFFIC

2/22/2016

IN COOPERATION WITH U.S. DEPARTMENT OF TRANSPORTATION FEDERAL HIGHWAY ADMINISTRATION

AUTOMATIC TRAFFIC RECORDER DATA FOR THE MONTH OF JUNE 2015

82 269015 LONDONDERRY- ASH ST EAST OF LONDONDERRY RD

MON	DATE	DAY	12 AM	1 AM	2 AM	3 AM	4 AM	5 AM	6 AM	7 AM	8 AM	9 AM	10 AM	11 AM	12 PM	1 PM	2 PM	3 PM	4 PM	5 PM	6 PM	7 PM	8 PM	9 PM	10 PM	11 PM	Total
6	28	1	40	22	11	12	15	23	58	87	166	273	394	446	468	490	471	441	396	334	259	212	128	119	59	34	4958
6	24	4	28	12	13	15	50	107	282	402	431	400	420	460	544	474	530	627	665	689	555	418	309	158	87	45	7721
6	25	5	29	16	20	18	43	103	276	364	431	386	423	420	444	475	483	636	693	716	523	402	302	169	90	67	7529
6	26	6	37	13	14	11	36	104	233	360	390	419	478	539	567	535	626	667	752	765	564	398	303	201	107	67	8186
6	27	7	25	40	18	13	29	49	103	216	357	524	595	628	630	502	566	495	475	399	336	275	227	138	88	54	6782

TYPE	STATION	YEAR	MONTH	NO. DAYS	AVERAGE SUNDAY	AVERAGE WEEKDAY	AVERAGE SATURDAY	AVERAGE DAILY	COMPUTED VOLUME	PERCENT GAIN	PERCENT LOSS
82	269015	2015	June	5	4958	7812	6782	7294	218824		

PEAK HOUR VOLUMES:

	AVERAGE AM:	AVERAGE MIDDAY:	AVERAGE PM:	
SUNDAY	273	490	471	AM - 6 AM TO 10 AM
WEEKDAY	427	529	723	MIDDAY - 10 AM TO 2 PM
SATURDAY	524	630	566	PM - 2 PM TO 8 PM

STATE OF NEW HAMPSHIRE, DEPARTMENT OF TRANSPORTATION - BUREAU OF TRAFFIC

2/22/2016

IN COOPERATION WITH U.S. DEPARTMENT OF TRANSPORTATION FEDERAL HIGHWAY ADMINISTRATION

AUTOMATIC TRAFFIC RECORDER DATA FOR THE MONTH OF SEPTEMBER 2015

82 269046 LONDONDERRY- NH 28 (ROCKINGHAM RD) NORTH OF LIBERTY DR

MON	DATE	DAY	12 AM	1 AM	2 AM	3 AM	4 AM	5 AM	6 AM	7 AM	8 AM	9 AM	10 AM	11 AM	12 PM	1 PM	2 PM	3 PM	4 PM	5 PM	6 PM	7 PM	8 PM	9 PM	10 PM	11 PM	Total
9	6	1	81	54	47	36	56	86	180	260	371	619	663	657	768	749	623	546	499	516	552	470	424	334	207	177	8975
9	7	2	60	55	36	30	50	109	200	248	382	486	583	642	577	564	467	474	450	434	429	410	311	255	132	101	7485
9	2	4	99	70	57	70	179	469	1026	1402	1136	872	906	862	891	874	946	1107	1169	1172	836	761	582	423	266	192	16367
9	3	5	113	80	71	73	203	480	1045	1471	1208	917	863	922	895	895	1058	1140	1301	1292	908	819	693	410	301	179	17337
9	4	6	104	80	54	84	198	446	1011	1347	1111	984	953	1018	1093	1003	1154	1235	1267	1223	993	780	586	522	340	231	17817
9	5	7	147	91	61	50	82	159	330	544	709	757	886	954	881	852	795	733	663	673	651	573	489	417	286	165	11948

TYPE	STATION	YEAR	MONTH	NO. DAYS	AVERAGE SUNDAY	AVERAGE WEEKDAY	AVERAGE SATURDAY	AVERAGE DAILY	COMPUTED VOLUME	PERCENT GAIN	PERCENT LOSS
82	269046	2015	September	6	8975	14752	11948	13608	408225		

PEAK HOUR VOLUMES:

	AVERAGE AM:	AVERAGE MIDDAY:	AVERAGE PM:
SUNDAY	619	768	623
WEEKDAY	1176	891	1054
SATURDAY	757	954	795

AM - 6 AM TO 10 AM
MIDDAY - 10 AM TO 2 PM
PM - 2 PM TO 8 PM

STATE OF NEW HAMPSHIRE, DEPARTMENT OF TRANSPORTATION - BUREAU OF TRAFFIC
IN COOPERATION WITH U.S. DEPARTMENT OF TRANSPORTATION FEDERAL HIGHWAY ADMINISTRATION
AUTOMATIC TRAFFIC RECORDER DATA FOR THE MONTH OF JULY 2015

2/22/2016

82 269048 LONDONDERRY- NH 102 (NASHUA RD) EAST OF HAMPTON DR

MON	DATE	DAY	12 AM	1 AM	2 AM	3 AM	4 AM	5 AM	6 AM	7 AM	8 AM	9 AM	10 AM	11 AM	12 PM	1 PM	2 PM	3 PM	4 PM	5 PM	6 PM	7 PM	8 PM	9 PM	10 PM	11 PM	Total
7	29	4	195	137	109	154	379	1069	1737	2502	2383	2009	1875	1962	2127	2054	2213	2535	2739	2915	2197	1551	1368	892	554	360	36016
7	30	5	215	132	104	155	399	1039	1761	2560	2453	2022	2032	2258	2418	2347	2404	2731	2885	2876	2233	1546	1202	882	541	331	37526
7	31	6	186	136	115	148	391	958	1615	2332	2371	2294	2266	2343	2501	2454	2476	2686	2725	2690	2179	1622	1390	966	653	469	37966

TYPE	STATION	YEAR	MONTH	NO. DAYS	AVERAGE SUNDAY	AVERAGE WEEKDAY	AVERAGE SATURDAY	AVERAGE DAILY	COMPUTED VOLUME	PERCENT GAIN	PERCENT LOSS
82	269048	2015	July	3	0	37169	0	*	*		

PEAK HOUR VOLUMES:

	AVERAGE AM:	AVERAGE MIDDAY:	AVERAGE PM:
SUNDAY	*	*	*
WEEKDAY	2478	2349	2842
SATURDAY	*	*	*

AM - 6 AM TO 10 AM
MIDDAY - 10 AM TO 2 PM
PM - 2 PM TO 8 PM

Project: Exit 4a SDEIS

Loc 1 Location: **Exit 4 NB ramps**

Growth rates:

Annual	2014->2015	**1.025**
	2016->2015	**0.975**

Seasonal:

	AM Peak	PM Peak
May-16 Adj Factor=	**0.96**	**0.98**

		AM Peak	PM Peak
Total Adjustments:	2014->2015	**0.984**	**1.0045**
	2016->2015	**0.936**	**0.9555**

		2016- Raw		2016 - AADT				2015 - AADT				2015 - AWDT- Balanced from TMC and ATRs			
		AM Peak (730-830)	PM Peak (445-545)	AM Peak (730-830)	Approach Totals	PM Peak (445-545)	Approach Totals	AM Peak (730-830)	Approach Totals	PM Peak (445-545)	Approach Totals	AM Peak (730-830)	Approach Totals	PM Peak (445-545)	Approach Totals
EB	LT	562	536	540	1085	525	1343	527	1058	512	1310	585	1175	475	1215
	Thru	568	835	545		818		531		798		590		740	
	RT	0	0	0		0		0		0		0		0	
WB	LT	0	0	0	1240	0	877	0	1209	0	855	0	1350	0	800
	Thru	836	542	803		531		783		518		875		485	
	RT	455	353	437		346		426		337		475		315	
NB	LT	219	535	210	412	524	1071	205	402	511	1044	210	410	580	1185
	Thru	0	0	0		0		0		0		0		0	
	RT	210	558	202		547		197		533		200		605	
SB	LT	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Thru	0	0	0		0		0		0		0		0	
	RT	0	0	0		0		0		0		0		0	
	total	2850	3359	2737	2737	3291	3291	2669	2669	3209	3209	2935	2935	3200	3200

Use Seasonal Factor

Use Annual Factor
Balance to SB ramp

	WB		NB		EB		
	RT	TH	RT	LT	TH	LT	Total
700-800	518	813	188	187	505	527	2738
715-815	520	803	199	207	534	562	2825
730-830	455	836	210	219	568	562	**2850**
745-845	399	856	217	231	577	540	2820
800-900	346	847	202	223	573	514	2705

		Southbound		Westbound (NH 102)					Northbound (Exit 4 NB Ramp)					Eastbound (NH 102)					
Time Period	**Class.**	**I**	**O**	**R**	**T**	**U**	**I**	**O**	**R**	**T**	**L**	**I**	**O**	**T**	**L**	**U**	**I**	**O**	**Total**
Peak 1	Lights	0	983	441	816	0	1257	737	200	0	196	396	0	537	542	1	1080	1013	2733
Specified Period	%	0%	97%	97%	98%	0%	97%	95%	95%	0%	89%	92%	0%	95%	96%	100%	95%	96%	96%
7:00 AM - 9:15 AM	Other Vehicles	0	34	14	20	0	34	41	10	0	23	33	0	31	20	0	51	43	118
One Hour Peak	%	0%	3%	3%	2%	0%	3%	5%	5%	0%	11%	8%	0%	5%	4%	0%	5%	4%	4%
7:30 AM - 8:30 AM	**Total**	**0**	**1017**	**455**	**836**	**0**	**1291**	**778**	**210**	**0**	**219**	**429**	**0**	**568**	**562**	**1**	**1131**	**1056**	**2851**
	PHF	0	0.9	0.84	0.82	0	0.92	0.9	0.85	0	0.84	0.88	0	0.93	0.88	0.25	0.94	0.85	0.94
	Approach %	0%	36%				45%	27%				15%	0%				40%	37%	

	WB		NB		EB		
	RT	TH	RT	LT	TH	LT	Total
400-500	303	622	533	530	725	517	3230
415-515	357	597	543	524	743	520	3284
430-530	.367	560	538	532	801	525	3323
445-545	353	542	558	535	835	536	**3359**
500-600	314	516	591	570	823	508	3322

		Southbound		Westbound (NH 102)					Northbound (Exit 4 NB off ramp)					Eastbound (NH 102)					
Time Period	**Class.**	**I**	**O**	**R**	**T**	**U**	**I**	**O**	**R**	**T**	**L**	**I**	**O**	**T**	**L**	**U**	**I**	**O**	**Total**
Peak 1	Lights	0	867	342	536	0	878	1369	552	0	527	1079	0	817	525	0	1342	1063	3299
Specified Period	%	0%	98%	97%	99%	0%	98%	98%	99%	0%	99%	99%	0%	98%	98%	0%	98%	99%	98%
4:00 PM - 6:15 PM	Other Vehicles	0	22	11	6	0	17	24	6	0	8	14	0	18	11	0	29	14	60
One Hour Peak	%	0%	2%	3%	1%	0%	2%	2%	1%	0%	1%	1%	0%	2%	2%	0%	2%	1%	2%
4:45 PM - 5:45 PM	**Total**	**0**	**889**	**353**	**542**	**0**	**895**	**1393**	**558**	**0**	**535**	**1093**	**0**	**835**	**536**	**0**	**1371**	**1077**	**3359**
	PHF	0	0.87	0.77	0.95	0	0.87	0.98	0.91	0	0.92	0.92	0	0.92	0.95	0	0.96	0.96	0.96
	Approach %	0%	26%				27%	41%				33%	0%				41%	32%	

Project: Exit 4a SDEIS

Loc 2 Location: **Exit 4 SB ramps**

Growth rates:

Annual	2014->2015	**1.025**
-	2016->2015	**0.975**
Seasonal		

	AM Peak	PM Peak
May-16 Adj Factor=	**0.96**	**0.98**

		AM Peak	PM Peak
Total Adjustments:	2014->2015	**0.984**	**1.0045**
	2016->2015	**0.936**	**0.9555**

		2016- Raw		2016 - AADT				2015 - AADT				2015 - AWDT- Balanced from TMC and ATRs			
		AM Peak (730-830)	PM Peak (445-545)	AM Peak (730-830)	Approach Totals	PM Peak (445-545)	Approach Totals	AM Peak (730-830)	Approach Totals	PM Peak (445-545)	Approach Totals	AM Peak (730-830)	Approach Totals	PM Peak (445-545)	Approach Totals
EB	LT	0	0	0	1475	0	1336	0	1439	0	1302	0	1580	0	1235
	Thru	849	1052	815		1031		795		1005		915		935	
	RT	687	311	660		305		644		297		665		300	
WB	LT	0	0	0	1078	0	1138	0	1051	0	1110	0	1085	0	1065
	Thru	589	917	565		899		551		877		565		850	
	RT	534	244	513		239		500		233		520		215	
NB	LT	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Thru	0	0	0		0		0		0		0		0	
	RT	0	0	0		0		0		0				0	
SB	LT	246	300	236	777	294	963	230	757	287	939	260	755	280	925
	Thru	0	0	0		0		0		0		0		0	
	RT	564	683	541		669		527		652		495		645	
	total	3469	3507	3330	3330	3437	3437	3247	3247	3351	3351	3420	3420	3225	3225

Use Seasonal Factor

Use Annual Factor
Balance to NB ramp

	SB RT	LT	WB T	EB T	Total
700-800	532	219	517	832	2100
715-815	536	240	552	846	2174
730-830	504	246	589	849	**2188**
745-845	503	267	608	816	2194
800-900	510	266	610	794	2180

Time Period	Class.	Southbound (Ex 4 SB Off) R	L	I	O	Westbound (NH 102) T	U	I	O	Eastbound (NH 102) T	U	I	O	Total
Peak 1	Lights	474	251	725	0	570	0	570	1035	784	0	784	1044	2079
Specified Period	%	94%	94%	94%	0%	94%	0%	94%	96%	96%	0%	96%	94%	95%
7:00 AM - 9:15 AM	Other Vehicles	29	16	45	0	38	0	38	48	32	0	32	67	115
One Hour Peak	%	6%	6%	6%	0%	6%	0%	6%	4%	4%	0%	4%	6%	5%
7:45 AM - 8:45 AM	**Total**	**503**	**267**	**770**	**0**	**608**	**0**	**608**	**1083**	**816**	**0**	**816**	**1111**	**2194**
	PHF	0.89	0.89	0.89	0	0.88	0	0.88	0.95	0.93	0	0.93	0.92	0.94
	Approach %			35%	0%			20%	49%			37%	51%	

	SB RT	LT	WB Th	EB TH	LT	Total
400-500	560	247	1013	1014	0	2834
415-515	597	260	973	998	0	2828
430-530	637	286	939	1051	0	2913
445-545	683	300	917	1052	0	2952
500-600	665	307	911	1006	0	2889

Time Period	Class.	Southbound (Exit 4 SB off) R	L	U	I	O	Westbound (NH 102) R	T	U	I	O	Eastbound (NH 102) T	L	U	I	O	Total
Peak 1	Lights	669	286	0	955	0	0	907	0	907	1325	1039	0	0	1039	1576	2901
Specified Period	%	98%	95%	0%	97%	0%	0%	99%	0%	99%	98%	99%	0%	0%	99%	99%	98%
4:00 PM - 6:15 PM	Other Vehicles	14	14	0	28	0	0	10	0	10	27	13	0	0	13	24	51
One Hour Peak	%	2%	5%	0%	3%	0%	0%	1%	0%	1%	2%	1%	0%	0%	1%	2%	2%
4:45 PM - 5:45 PM	**Total**	**683**	**300**	**0**	**983**	**0**	**0**	**917**	**0**	**917**	**1352**	**1052**	**0**	**0**	**1052**	**1600**	**2952**
	PHF	0.92	0.91	0	0.92	0	0	0.89	0	0.89	0.92	0.92	0	0	0.92	0.96	0.95
	Approach %				33%	0%				31%	46%				36%	54%	

Project: Exit 4a SDEIS

Loc 3 Location: **Exit 5 NB ramps**

Growth rates:

Annual	2014->2015	**1.025**
	2016->2015	**0.975**

Seasonal:

	AM Peak	PM Peak
May-16 Adj Factor=	**0.96**	**0.98**

		AM Peak	PM Peak
Total Adjustments:	2014->2015	**0.984**	**1.0045**
	2016->2015	**0.936**	**0.9555**

		2016- Raw		**2016 - AADT**				**2015 - AADT**				**2015 - AWDT- Balanced from TMC and ATRs**			
		AM Peak (730-830)	PM Peak (445-545)	AM Peak (730-830)	Approach Totals	PM Peak (445-545)	Approach Totals	AM Peak (730-830)	Approach Totals	PM Peak (445-545)	Approach Totals	AM Peak (730-830)	Approach Totals	PM Peak (445-545)	Approach Totals
EB	LT	216	228	207	913	223	1310	202	890	217	1277	240	980	235	1295
	Thru	735	1109	706		1087		688		1060		740		1060	
	RT	0	0	0		0		0		0		0		0	
WB	LT	0	0	0	1191	0	898	0	1161	0	875	0	1280	0	960
	Thru	569	401	546		393		532		383		540		425	
	RT	672	515	645		505		629		492		740		535	
NB	LT	273	210	262	358	206	425	255	349	201	415	300	410	220	460
	Thru	0	0	0		0		0		0		0		0	
	RT	100	223	96		219		94		214		110		240	
SB	LT	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Thru	0	0	0		0		0		0		0		0	
	RT	0	0	0		0		0		0		0		0	
	total	2565	2686	2462	2462	2633	2633	2400	2400	2567	2567	2670	2670	2715	2715

Use Seasonal Factor

Use Annual Factor
Balance to SB ramp

	WB		NB		EB		
	RT	TH	RT	LT	TH	LT	Total
700-800	724	607	97	281	573	232	2514
715-815	710	588	96	289	674	221	2578
730-830	672	569	100	273	735	216	**2565**
745-845	592	531	94	244	796	186	2443
800-900	530	470	98	199	788	176	2261

		Southbound		**Westbound (NH 28)**					**Northbound (Ex. 5 NB Off-Ramp)**					**Eastbound (NH 28)**					
Time Period	**Class.**	**I**	**O**	**R**	**T**	**U**	**I**	**O**	**R**	**T**	**L**	**I**	**O**	**T**	**L**	**U**	**I**	**O**	**Total**
Peak 1	Lights	0	875	682	554	0	1236	698	82	0	269	351	0	616	193	0	809	823	2396
Specified Period	%	0%	94%	96%	94%	0%	95%	91%	85%	0%	93%	91%	0%	91%	87%	0%	90%	94%	93%
7:00 AM - 9:00 AM	Other Vehicles	0	56	28	34	0	62	72	14	0	20	34	0	58	28	0	86	54	182
One Hour Peak	%	0%	6%	4%	6%	0%	5%	9%	15%	0%	7%	9%	0%	9%	13%	0%	10%	6%	7%
7:15 AM - 8:15 AM	**Total**	**0**	**931**	**710**	**588**	**0**	**1298**	**770**	**96**	**0**	**289**	**385**	**0**	**674**	**221**	**0**	**895**	**877**	**2578**
	PHF	0	0.87	0.89	0.85	0	0.9	0.78	0.86	0	0.73	0.78	0	0.76	0.8	0	0.87	0.81	0.89
	Approach %	0%	35%				50%	30%				15%	0%				35%	34%	

	WB		NB		EB		
	RT	TH	RT	LT	TH	LT	Total
400-500	500	449	143	143	985	209	2429
415-515	500	429	130	118	1017	232	2426
430-530	514	415	168	161	1066	231	2555
445-545	515	401	223	210	1109	228	**2686**
500-600	507	363	252	247	1055	224	2648

		Southbound		**Westbound (NH 28)**					**Northbound (Ex 5 NB Off-Ramp)**					**Eastbound (NH 28)**					
Time Period	**Class.**	**I**	**O**	**R**	**T**	**U**	**I**	**O**	**R**	**T**	**L**	**I**	**O**	**T**	**L**	**U**	**I**	**O**	**Total**
Peak 1	Lights	0	715	498	388	0	886	1295	211	0	194	405	0	1084	217	0	1301	582	2592
Specified Period	%	0%	96%	97%	97%	0%	97%	97%	95%	0%	92%	94%	0%	98%	95%	0%	97%	95%	97%
4:00 PM - 6:00 PM	Other Vehicles	0	28	17	13	0	30	37	12	0	16	28	0	25	11	0	36	29	94
One Hour Peak	%	0%	4%	3%	3%	0%	3%	3%	5%	0%	8%	6%	0%	2%	5%	0%	3%	5%	3%
4:45 PM - 5:45 PM	**Total**	**0**	**743**	**515**	**401**	**0**	**916**	**1332**	**223**	**0**	**210**	**433**	**0**	**1109**	**228**	**0**	**1337**	**611**	**2686**
	PHF	0	0.89	0.91	0.9	0	0.91	0.91	0.66	0	0.67	0.67	0	0.93	0.84	0	0.92	0.88	0.94
	Approach %	0%	28%				34%	50%				16%	0%				50%	23%	

		Project:	Exit 4a SDEIS
Loc	4	Location:	**Exit 5 SB ramps**

Growth rates:

Annual	2014->2015	**1.025**
	2016->2015	**0.975**

Seasonal:

	AM Peak	PM Peak
May-16 Adj Factor=	**0.96**	**0.98**

		AM Peak	PM Peak
Total Adjustments:	2014->2015	**0.984**	**1.0045**
	2016->2015	**0.936**	**0.9555**

		2016- Raw		**2016 - AADT**				**2015 - AADT**				**2015 - AWDT- Balanced from TMC and ATRs**			
		AM Peak (730-830)	PM Peak (445-545)	AM Peak (730-830)	Approach Totals	PM Peak (445-545)	Approach Totals	AM Peak (730-830)	Approach Totals	PM Peak (445-545)	Approach Totals	AM Peak (730-830)	Approach Totals	PM Peak (445-545)	Approach Totals
EB	LT	0	0	0	661	0	870	0	645	0	848	0	795	0	930
	Thru	463	641	444		628		433		612		515		650	
	RT	226	247	217		242		212		236		280		280	
WB	LT	192	116	184	796	114	586	179	776	111	571	235	840	135	625
	Thru	638	482	612		472		597		460		605		490	
	RT	0	0	0		0		0		0		0		0	
NB	LT	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Thru	0	0	0		0		0		0		0		0	
	RT	0	0	0		0		0		0		0		0	
SB	LT	496	690	476	782	676	957	464	762	659	933	465	760	645	910
	Thru	0	0	0		0		0		0		0		0	
	RT	319	287	306		281		298		274		295		265	
	total	2334	2463	2239	2239	2413	2413	2183	2183	2352	2352	2395	2395	2465	2465
				Use Seasonal Factor				Use Annual Factor Balance to NB ramp							

				SB		WB		EB		
		ramp total		RT	LT	TH	LT	RT	TH	Total
0.41	0.59	595	700-800	242	353	660	235	225	325	2160
0.4	0.6	726	715-815	287	439	673	211	223	359	2298
0.39	0.61	815	**730-830**	319	496	638	192	226	351	**2334**
0.38	0.62	885	745-845	333	552	604	155	206	463	2288
0.38	0.62	870	800-900	329	541	534	126	198	438	2167

		Southbound (Ex 5 SB Off-Ramp)						Westbound (NH 28)				Northbound			Eastbound (NH 28)				
Time Period	**Class.**	**R**	**T**	**L**	**I**	**O**	**T**	**L**	**U**	**I**	**O**	**I**	**O**	**R**	**T**	**U**	**I**	**O**	**Total**
Peak 1	Lights	301	0	467	768	0	589	179	0	768	863	0	377	198	396	0	594	890	2130
Specified Period	%	94%	0%	94%	94%	0%	92%	93%	0%	93%	90%	0%	90%	88%	86%	0%	86%	93%	91%
7:00 AM - 9:15 AM	Other Vehicles	18	0	29	47	0	49	13	0	62	96	0	41	28	67	0	95	67	204
One Hour Peak	%	6%	0%	6%	6%	0%	8%	7%	0%	7%	10%	0%	10%	12%	14%	0%	14%	7%	9%
7:30 AM - 8:30 AM	**Total**	**319**	**0**	**496**	**815**	**0**	**638**	**192**	**0**	**830**	**959**	**0**	**418**	**226**	**463**	**0**	**689**	**957**	**2334**
	PHF	0.72	0	0.76	0.74	0	0.72	0.76	0	0.73	0.89	0	0.84	0.9	0.93	0	0.92	0.82	0.89
	Approach %				35%	0%				36%	41%	0%	18%				30%	41%	

	SB		WB		EB		
	RT	LT	TH	LT	RT	TH	Total
400-500	237	579	459	125	248	441	2233
415-515	262	597	424	119	275	458	2306
430-530	284	650	440	116	271	470	2409
445-545	287	690	482	116	247	648	2463
500-600	266	625	499	114	236	641	2390

		Southbound (Ex 5 SB Off-Ramp)						Westbound (NH 28)				Northbound			Eastbound (NH 28)				
Time Period	**Class.**	**R**	**T**	**L**	**I**	**O**	**T**	**L**	**U**	**I**	**O**	**I**	**O**	**R**	**T**	**U**	**I**	**O**	**Total**
Peak 1	Lights	267	2	672	941	0	452	115	0	567	1293	0	349	232	621	0	853	719	2361
Specified Period	%	93%	100%	97%	96%	0%	94%	99%	0%	95%	97%	0%	96%	94%	97%	0%	96%	93%	96%
4:00 PM - 6:15 PM	Other Vehicles	20	0	18	38	0	30	1	0	31	38	0	16	15	20	0	35	50	104
One Hour Peak	%	7%	0%	3%	4%	0%	6%	1%	0%	5%	3%	0%	4%	6%	3%	0%	4%	7%	4%
4:45 PM - 5:45 PM	**Total**	**287**	**2**	**690**	**979**	**0**	**482**	**116**	**0**	**598**	**1331**	**0**	**365**	**247**	**641**	**0**	**888**	**769**	**2465**
	PHF	0.91	0.5	0.91	0.91	0	0.87	0.83	0	0.86	0.9	0	0.81	0.74	0.9	0	0.87	0.9	0.91
	Approach %				40%	0%				24%	54%	0%	15%				36%	31%	

Project: Exit 4a SDEIS
Loc 5 Location: **NH 102-Londonderry Rd**

Growth rates:

Annual	2014->2015	1.025
	2016->2015	0.975

Seasonal:
Intersection Turning Movement Counts

		AM Peak	PM Peak
May-16	Adj Factor=	0.96	0.98

		2016- Raw		2016 - AADT				2015 - AADT				2015 - AADT- Rounded			
		AM Peak (715-815)	PM Peak (445-545)	AM Peak (730-830)	Approach Totals	PM Peak (430-530)	Approach Totals	AM Peak (715-815)	Approach Totals	PM Peak (430-530)	Approach Totals	AM Peak (715-815)	Approach Totals	PM Peak (430-530)	Approach Totals
EB	LT	80	298	77	612	292	1392	75	597	285	1358	75	600	285	1355
	Thru	556	996	534		976		521		952		520		950	
	RT	1	127	1		124		1		121		5		120	
WB	LT	1	1	1	1148	1	776	1	1119	1	757	5	1120	5	760
	Thru	1167	752	1120		737		1092		719		1090		720	
	RT	28	39	27		38		26		37		25		35	
NB	LT	0	3	0	1	3	7	0	1	3	7	0	1	5	10
	Thru	0	1	0		1		0		1		0		0	
	RT	1	3	1		3		1		3		1		5	
SB	LT	12	9	12	119	9	143	12	116	9	140	10	115	10	145
	Thru	0	1	0		1		0		1		0		5	
	RT	111	136	107		133		104		130		105		130	
	total	1957	2366	1880	1880	2318	2318	1833	1833	2262	2262	1836	1836	2270	2270

Use Seasonal Factor

Use Annual Factor
Balance to SB ramp

	WB RT	TH	LT	NB RT	TH	LT	EB RT	TH	LT	SB RT	TH	LT	Total
700-800													2738
715-815	**28**	**1167**	**1**	**1**	**0**	**0**	**1**	**556**	**80**	**111**	**0**	**12**	**1957**
730-830													2850
745-845													2820
800-900													2705

Time Period	Class.	Southbound (Londonderry Rd.) R	T	L	U	I	O	Westbound (NH 102) R	T	L	U	I	O	Northbound (St. Charles St.) R	T	L	U	I	O	Eastbound (NH 102) R	T	L	U	I	O	Total
Peak 1	Lights	105	0	11	0	116	96	27	1119	1	0	1147	523	1	0	0	0	1	2	1	511	69	0	581	1224	1845
Specified Period	%	95%	0%	92%	0%	94%	89%	96%	96%	100%	0%	96%	92%	100%	0%	0%	0%	100%	100%	100%	92%	86%	0%	91%	96%	94%
7:00 AM - 9:15 AM	Other Vehicles	6	0	1	0	7	12	1	48	0	0	49	46	0	0	0	0	0	0	0	45	11	0	56	54	112
One Hour Peak	%	5%	0%	8%	0%	6%	11%	4%	4%	0%	0%	4%	8%	0%	0%	0%	0%	0%	0%	0%	8%	14%	0%	9%	4%	6%
7:15 AM - 8:15 AM	**Total**	**111**	**0**	**12**	**0**	**123**	**108**	**28**	**1167**	**1**	**0**	**1196**	**569**	**1**	**0**	**0**	**0**	**1**	**2**	**1**	**556**	**80**	**0**	**637**	**1278**	**1957**
	PHF	0.9	0	0.75	0	0.88	0.82	0.78	0.89	0.25	0	0.91	0.89	0.25	0	0	0	0.25	0.5	0.25	0.9	0.83	0	0.89	0.9	0.95
	Approach %					6%	6%					61%	29%					0%	0%					33%	65%	

	WB LT	TH	RT	NB LT	TH	RT	EB LT	TH	RT	SB LT	TH	RT	Total
400-500													0
415-515													0
430-530													0
445-545	**1**	**752**	**39**	**3**	**1**	**3**	**298**	**996**	**127**	**9**	**1**	**136**	**2366**
500-600													0

Time Period	Class.	Southbound (Londonderry Rd.) R	T	L	U	I	O	Westbound (NH 102) R	T	L	U	I	O	Northbound (St. Charles St.) R	T	L	U	I	O	Eastbound (NH 1002) R	T	L	U	I	O	Total
Peak 1	Lights	134	1	8	0	143	330	38	739	1	0	778	995	3	1	3	0	7	127	125	984	291	0	1400	876	2328
Specified Period	%	99%	100%	89%	0%	98%	98%	97%	98%	100%	0%	98%	99%	100%	100%	100%	0%	100%	98%	98%	99%	98%	0%	99%	98%	98%
4:00 PM - 6:15 PM	Other Vehicles	2	0	1	0	3	8	1	13	0	0	14	13	0	0	0	0	0	2	2	12	7	0	21	15	38
One Hour Peak	%	1%	0%	11%	0%	2%	2%	3%	2%	0%	0%	2%	1%	0%	0%	0%	0%	0%	2%	2%	1%	2%	0%	1%	2%	2%
4:45 PM - 5:45 PM	**Total**	**136**	**1**	**9**	**0**	**146**	**338**	**39**	**752**	**1**	**0**	**792**	**1008**	**3**	**1**	**3**	**0**	**7**	**129**	**127**	**996**	**298**	**0**	**1421**	**891**	**2366**
	PHF	0.83	0.25	0.75	0	0.83	0.9	0.89	0.94	0.25	0	0.95	0.96	0.38	0.25	0.75	0	0.58	0.81	0.79	0.96	0.88	0	0.97	0.94	0.97
	Approach %					6%	14%					33%	43%					0%	5%					60%	38%	

Loc. 6

Project: Exit 4a SDEIS
Location: NH 102-Fordway - High St

Growth rates:

Annual	2014->2015	1.025
	2016->2015	0.975

Seasonal:
Intersection Turning Movement Counts

		AM Peak	PM Peak
May-16	Adj Factor=	0.96	0.98

		2016- Raw		2016 - AADT				2015 - AADT				2015 - AADT- Rounded				
		AM Peak (715-815)	PM Peak (430-530)	AM Peak (715-815)	Approach Totals	PM Peak (430-530)	Approach Totals	AM Peak (715-815)	Approach Totals	PM Peak (430-530)	Approach Totals	AM Peak (715-815)	Approach Totals	PM Peak (430-530)	Approach Totals	
EB	LT	0	0	0	539	0	933	0	526	0	910	0	525	0	910	EB
	Thru	428	795	411		779		401		760		400		760		
	RT	133	157	128		154		125		150		125		150		
WB	LT	14	14	13	622	14	440	13	607	14	429	15	610	15	430	WB
	Thru	634	435	609		426		594		415		595		415		
	RT	0	0	0		0		0		0		0		0		
NB	LT	369	241	354	428	236	337	345	417	230	328	345	415	230	330	NB
	Thru	0	0	0		0		0		0		0		0		
	RT	77	103	74		101		72		98		70		100		
SB	LT	7	15	7	42	15	69	7	41	15	68	5	40	15	70	SB
	Thru	28	52	27		51		26		50		25		50		
	RT	8	3	8		3		8		3		10		5		
	total	1698	1815	1631	1631	1779	1779	1591	1591	1735	1735	1590	1590	1740	1740	

Use Seasonal Factor

Use Annual Factor
Balance to NB ramp

CHECK E-W APPRAOCHES =

2015 Peak Hour Link Volumes based on TMC

Approach		AM Peak Inbound	AM Peak Outbound	Total	PM Peak Inbound	PM Peak Outbound	Total	2015 AADT	Adjusted 2015 AM Pk	Adjusted 2015 PM Pk	% AADT in AM Pk	% AADT in PM Pk
North	High St N of Broadway	40	0	40	70	0	70	15568	786	1104	0.26%	0.45%
South	Fordway S of 102	415	165	580	330	215	545	7576			5.46%	7.19%
East	NH 102 WB, E. of Fordway	610	950	1560	430	650	1080	15012			5.46%	7.19%
West	NH 102 EB, W of Fordway	525	475	1000	910	875	1785	24812			5.46%	7.19%
		1590	1590	3180	1740	1740	3480					

Notes: Adjusted 2015 AADT based on ATR counts for comparison purposes
Calculated 2015 AADT based on AM/PM k factors in red
k factors based on ratio of TMC volumes compared to adjusted 2015 AADT from ATR data

	SB LT	TH	RT	WB LT	TH	NB LT	TH	RT	EB TH	RT	Total
700-800											0
715-815	7	28	8	14	634	369	0	77	428	133	1698
730-830											0
745-845											0
800-900											0

Time Period	Class.	Southbound (Madden Hill Rd.) R	T	L	I	O	Westbound (NH 102) T	L	U	I	O	Northbound (Fordway) R	L	U	I	O	Eastbound (NH 102) R	T	U	I	O	Total		Crosswalk Pedestrians	Total
Peak 1	Lights	8	27	7	42	0	605	13	0	618	467	71	362	0	433	165	125	389	0	514	975	1607	SB	0	0
Specified Period	%	100%	96%	100%	98%	0%	95%	93%	0%	95%	91%	92%	98%	0%	97%	94%	94%	91%	0%	92%	96%	95%		0%	
7:00 AM - 9:15 AM	Other Vehicles	0	1	0	1	0	29	1	0	30	45	6	7	0	13	10	8	39	0	47	36	91	WB	0	0
One Hour Peak	%	0%	4%	0%	2%	0%	5%	7%	0%	5%	9%	8%	2%	0%	3%	6%	6%	9%	0%	8%	4%	5%		0%	
7:15 AM - 8:15 AM	Total	8	28	7	43	0	634	14	0	648	512	77	369	0	446	175	133	428	0	561	1011	1698	NB	0	0
	PHF	0.67	0.58	0.44	0.6	0	0.87	0.58	0	0.86	0.88	0.88	0.92	0	0.96	0.84	0.9	0.89	0	0.89	0.89	0.95		0%	
	Approach %				3%	0%				38%	30%				26%	10%				33%	60%		EB	0	0
																								0%	
																								0	0

	SB LT	TH	RT	WB LT	TH	NB LT	RT	EB TH	RT	Total
400-500										0
415-515										0
430-530	15	52	3	14	435	241	103	795	157	1815
445-545										0
500-600										0

Time Period	Class.	Southbound (Madden Hill Rd.) R	T	L	I	O	Westbound (NH 102) T	L	U	I	O	Northbound (Fordway) R	L	U	I	O	Eastbound (NH 102) R	T	U	I	O	Total		Crosswalk Pedestrians	Total
Peak 1	Lights	3	51	15	69	0	422	14	0	436	898	102	239	0	341	220	155	781	0	936	664	1782	SB	0	0
Specified Period	%	100%	98%	100%	99%	0%	97%	100%	0%	97%	98%	99%	99%	0%	99%	99%	99%	98%	0%	98%	98%	98%		0%	
4:00 PM - 6:15 PM	Other Vehicles	0	1	0	1	0	13	0	0	13	15	1	2	0	3	3	2	14	0	16	15	33	WB	0	0
One Hour Peak	%	0%	2%	0%	1%	0%	3%	0%	0%	3%	2%	1%	1%	0%	1%	1%	1%	2%	0%	2%	2%	2%		0%	
4:30 PM - 5:30 PM	Total	3	52	15	70	0	435	14	0	449	913	103	241	0	344	223	157	795	0	952	679	1815	NB	1	1
	PHF	0.38	0.76	0.62	0.83	0	0.89	0.88	0	0.89	0.96	0.92	0.9	0	0.98	0.83	0.73	0.97	0	0.95	0.93	0.97		100%	
	Approach %				4%	0%				25%	50%				19%	12%				52%	37%		EB	0	0
																								0%	
																								1	1

Project: Exit 4a SDEIS
Loc 7 Location: NH 102-NH 28

Growth rates:

Annual	2014->2015	1.025
	2016->2015	0.975

Seasonal:
Intersection Turning Movement Counts

		AM Peak	PM Peak
May-16	Adj Factor=	0.96	0.98

		2016- Raw		2016 - AADT				2015 - AADT				2015 - AADT- Rounded				
		AM Peak (745-845)	PM Peak (445-545)	AM Peak (745-845)	Approach Totals	PM Peak (445-545)	Approach Totals	AM Peak (745-845)	Approach Totals	PM Peak (445-545)	Approach Totals	AM Peak (745-845)	Approach Totals	PM Peak (445-545)	Approach Totals	
EB	LT	110	142	106	374	139	598	103	365	136	584	105	370	135	585	EB
	Thru	218	429	209		420		204		410		205		410		
	RT	61	40	59		39		58		38		60		40		
WB	LT	40	81	38	518	79	404	37	505	77	394	35	500	75	390	WB
	Thru	412	262	396		257		386		251		385		250		
	RT	87	69	84		68		82		66		80		65		
NB	LT	62	75	60	370	74	411	59	361	72	400	60	360	70	400	NB
	Thru	280	307	269		301		262		293		260		295		
	RT	43	37	41		36		40		35		40		35		
SB	LT	76	144	73	416	141	645	71	405	137	628	70	405	135	625	SB
	Thru	246	358	236		351		230		342		230		340		
	RT	111	156	107		153		104		149		105		150		
	total	1746	2100	1678	1678	2058	2058	1636	1636	2006	2006	1635	1635	2000	2000	

Use Seasonal Factor

Use Annual Factor
Balance to SB ramp

2015 Peak Hour Link Volumes based on TMC

Approach		AM Peak Inbound	AM Peak Outbound	Total	PM Peak Inbound	PM Peak Outbound	Total	2015 AADT	Adjusted 2015 AM Pk	Adjusted 2015 PM Pk	% AADT in AM Pk	% AADT in PM Pk
North	Crystal N of Broadway	405	445	850	625	495	1120	15568	786	1104	5.46%	7.19%
South	Birch S of Broadway	360	325	685	400	455	855	11885			5.46%	7.19%
East	NH 102 WB, E. of NH 28	500	550	1050	390	470	860	11954			5.46%	7.19%
West	NH 102 EB, W of NH 28	370	315	685	585	580	1165	16194			5.46%	7.19%
		1635	1635	3270	2000	2000	4000					

Notes: Adjusted 2015 AADT based on ATR counts for comparison purposes
Calculated 2015 AADT based on AM/PM k factors in red
k factors based on ratio of TMC volumes compared to adjusted 2015 AADT from ATR data

	SB LT	TH	RT	WB LT	TH	RT	NB LT	TH	RT	EB LT	TH	RT	Total
700-800													0
715-815													0
730-830													0
745-845	76	246	111	40	412	87	62	280	43	110	218	61	1746
800-900													0

Time Period	Class.	Southbound (NH 28) R	T	L	U	I	O	Westbound (NH 102) R	T	L	U	I	O	R	T	Northbound (NH 28) L	U	I	O	Eastbound (NH 102) R	T	L	U	I	O	Total		Crosswalk Pedestrians	Total
Peak 1	Lights	106	228	73	0	407	453	85	391	32	0	508	306	41	265	58	0	364	319	59	192	103	0	354	555	1633	SB	0	0
Specified Period	%	95%	93%	96%	0%	94%	95%	98%	95%	80%	0%	94%	91%	95%	95%	94%	0%	95%	92%	97%	88%	94%	0%	91%	95%	94%		0%	
7:00 AM - 9:15 AM	Other Vehicles	5	18	3	0	26	24	2	21	8	0	31	31	2	15	4	0	21	28	2	26	7	0	35	30	113	WB	0	0
One Hour Peak	%	5%	7%	4%	0%	6%	5%	2%	5%	20%	0%	6%	9%	5%	5%	6%	0%	5%	8%	3%	12%	6%	0%	9%	5%	6%		0%	
7:45 AM - 8:45 AM	Total	111	246	76	0	433	477	87	412	40	0	539	337	43	280	62	0	385	347	61	218	110	0	389	585	1746	NB	1	1
	PHF	0.92	0.87	0.86	0	0.91	0.95	0.84	0.91	0.77	0	0.94	0.89	0.67	0.97	0.67	0	0.88	0.89	0.85	0.94	0.79	0	0.96	0.94	0.96		100%	
	Approach %					25%	27%					31%	19%					22%	20%					22%	34%		EB	0	0
																												0%	
																												1	1

	SB LT	TH	RT	WB LT	TH	RT	NB LT	TH	RT	EB LT	TH	RT	Total
400-500													0
415-515													0
430-530													0
445-545	144	358	156	81	262	69	75	307	37	142	429	40	2100
500-600													0

Time Period	Class.	Southbound (NH 28) R	T	L	U	I	O	Westbound (NH 102) R	T	L	U	I	O	R	T	Northbound (NH 28) L	U	I	O	Eastbound (NH 102) R	T	L	U	I	O	Total		Crosswalk Pedestrians	Total
Peak 1	Lights	155	356	144	0	655	504	69	258	79	0	406	605	35	296	74	0	405	473	38	426	139	0	603	487	2069	SB	5	5
Specified Period	%	99%	99%	100%	0%	100%	97%	100%	98%	98%	0%	99%	99%	95%	96%	99%	0%	97%	99%	95%	99%	98%	0%	99%	99%	99%		100%	
4:00 PM - 6:15 PM	Other Vehicles	1	2	0	0	3	14	0	4	2	0	6	5	2	11	1	0	14	6	2	3	3	0	8	6	31	WB	0	0
One Hour Peak	%	1%	1%	0%	0%	0%	3%	0%	2%	2%	0%	1%	1%	5%	4%	1%	0%	3%	1%	5%	1%	2%	0%	1%	1%	1%		0%	
4:45 PM - 5:45 PM	Total	156	358	144	0	658	518	69	262	81	0	412	610	37	307	75	0	419	479	40	429	142	0	611	493	2100	NB	2	2
	PHF	0.93	0.88	0.8	0	0.93	0.96	0.75	0.95	0.92	0	0.94	0.96	0.84	0.92	0.75	0	0.91	0.87	0.77	0.93	0.93	0	0.95	0.91	0.97		100%	
	Approach %					31%	25%					20%	29%					20%	23%					29%	23%		EB	3	3
																												100%	
																												10	10

	Project:	Exit 4a SDEIS	
Loc 8	Location:	**North High St at Ash St Ext**	
	Growth rates:		
	Annual	2014->2015	**1.025**
		2016->2015	**0.975**

Seasonal:

Intersection Turning Movement Counts

		AM Peak	PM Peak
May-16	Adj Factor=	**0.96**	**0.98**

		2016- Raw		**2016 - AADT**				**2015 - AADT**				**2015 - AADT- Rounded**			
		AM Peak (730-830)	PM Peak (500-600)	AM Peak (730-830)	Approach Totals	PM Peak (500-600)	Approach Totals	AM Peak (745-845)	Approach Totals	PM Peak (445-545)	Approach Totals	AM Peak (745-845)	Approach Totals	PM Peak (445-545)	Approach Totals
EB	LT	190	442	182	191	433	439	177	186	422	428	180	190	420	425
	Thru	0	0	0		0		0		0		0		0	
	RT	9	6	9		6		9		6		10		5	
WB	LT	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Thru	0	0	0		0		0		0		0		0	
	RT	0	0	0		0		0		0		0		0	
NB	LT	3	2	3	129	2	298	3	126	2	291	5	130	5	295
	Thru	131	302	126		296		123		289		125		290	
	RT	0	0	0		0		0		0		0		0	
SB	LT	0	0	0	414	0	442	0	404	0	431	0	405	0	435
	Thru	184	175	177		172		173		168		175		170	
	RT	247	276	237		270		231		263		230		265	
	total	764	1203	734	734	1179	1179	716	716	1150	1150	725	725	1155	1155

Use Seasonal Factor

Use Annual Factor
Balance to NB ramp

	SB		NB		EB		
	TH	RT	TH	LT	RT	LT	Total
700-800							0
715-815							0
730-830	184	247	131	3	9	190	**764**
745-845							0
800-900							0

		Southbound (N. High St.)					**Northbound (N. High St.)**					**Eastbound (Ash St. Ext.)**					
Time Period	**Class.**	**R**	**T**	**U**	**I**	**O**	**T**	**L**	**U**	**I**	**O**	**R**	**L**	**U**	**I**	**O**	**Total**
Peak 1	Lights	244	177	0	421	307	126	2	0	128	186	9	181	0	190	246	739
Specified Perio	%	99%	96%	0%	98%	96%	96%	67%	0%	96%	96%	100%	95%	0%	95%	98%	97%
7:00 AM - 9:15 A	Other Vehicles	3	7	0	10	14	5	1	0	6	7	0	9	0	9	4	25
One Hour Peal	%	1%	4%	0%	2%	4%	4%	33%	0%	4%	4%	0%	5%	0%	5%	2%	3%
7:30 AM - 8:30 A	**Total**	**247**	**184**	**0**	**431**	**321**	**131**	**3**	**0**	**134**	**193**	**9**	**190**	**0**	**199**	**250**	**764**
	PHF	0.76	0.82	0	0.93	0.89	0.89	0.75	0	0.91	0.85	0.38	0.86	0	0.89	0.76	0.92
	Approach %				56%	42%				18%	25%				26%	33%	

	SB		NB		EB		
	TH	RT	LT	TH	LT	RT	Total
400-500							0
415-515							0
430-530							0
445-545							0
500-600	175	276	2	302	442	6	1203

Loc **8** Location: **North High St at Ash St Ext**

		Southbound (N. High St.)					Northbound (N. High St.)					Eastbound (Ash St. Ext.)					
Time Period	**Class.**	**R**	**T**	**U**	**I**	**O**	**T**	**L**	**U**	**I**	**O**	**R**	**L**	**U**	**I**	**O**	**Total**
Peak 1	Lights	273	173	0	446	735	296	2	0	298	179	6	439	0	445	275	1189
Specified Period	%	99%	99%	0%	99%	99%	98%	100%	0%	98%	99%	100%	99%	0%	99%	99%	99%
4:00 PM - 6:15 PM	Other Vehicles	3	2	0	5	9	6	0	0	6	2	0	3	0	3	3	14
One Hour Peak	%	1%	1%	0%	1%	1%	2%	0%	0%	2%	1%	0%	1%	0%	1%	1%	1%
5:00 PM - 6:00 PM	**Total**	**276**	**175**	**0**	**451**	**744**	**302**	**2**	**0**	**304**	**181**	**6**	**442**	**0**	**448**	**278**	**1203**
	PHF	0.9	0.74	0	0.87	0.94	0.87	0.5	0	0.87	0.75	0.5	0.9	0	0.9	0.89	0.93
	Approach %				37%	62%				25%	15%				37%	23%	

Project: Exit 4a SDEIS

Loc 9 Location: **High St at Madden Rd**

Growth rates:

Annual	2014->2015	**1.025**
	2016->2015	**0.975**

Seasonal:

Intersection Turning Movement Counts

		AM Peak	PM Peak
May-16	Adj Factor=	**0.96**	**0.98**

		2016- Raw		**2016 - AADT**				**2015 - AADT**				**2015 - AADT- Rounded**			
		AM Peak (730-830)	PM Peak (500-600)	AM Peak (730-830)	Approach Totals	PM Peak (500-600)	Approach Totals	AM Peak (745-845)	Approach Totals	PM Peak (445-545)	Approach Totals	AM Peak (745-845)	Approach Totals	PM Peak (445-545)	Approach Totals
EB	LT	12	12	12	14	12	16	12	14	12	16	10	10	10	10
	Thru	0	0	0		0		0		0		0		0	
	RT	2	4	2		4		2		4		0		0	
WB	LT	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Thru	0	0	0		0		0		0		0		0	
	RT	0	0	0		0		0		0		0		0	
NB	LT	0	3	0	313	3	725	0	305	3	707	0	310	0	700
	Thru	326	737	313		722		305		704		310		700	
	RT	0	0	0		0		0		0		0		0	
SB	LT	0	0	0	428	0	456	0	418	0	445	0	420	0	450
	Thru	428	460	411		451		401		440		400		440	
	RT	18	5	17		5		17		5		20		10	
	total	786	1221	755	755	1197	1197	737	737	1168	1168	740	740	1160	1160

Use Seasonal Factor

Use Annual Factor
Balance to NB ramp

	SB		NB		EB		
	TH	RT	TH	LT	RT	LT	Total
700-800							0
715-815							0
730-830	**428**	**18**	**326**	**0**	**2**	**12**	**786**
745-845							0
800-900							0

		Southbound (N. High St.)					Northbound (N. High St.)					Eastbound (Madden Rd.)					
Time Period	**Class.**	**R**	**T**	**U**	**I**	**O**	**T**	**L**	**U**	**I**	**O**	**R**	**L**	**U**	**I**	**O**	**Total**
Peak 1	Lights	4	417	0	421	314	313	0	0	313	419	2	1	0	3	4	737
Specified Period	%	22%	97%	0%	94%	93%	96%	0%	0%	96%	97%	100%	8%	0%	21%	22%	94%
7:00 AM - 9:00 AM	Other Vehicles	14	11	0	25	24	13	0	0	13	11	0	11	0	11	14	49
One Hour Peak	%	78%	3%	0%	6%	7%	4%	0%	0%	4%	3%	0%	92%	0%	79%	78%	6%
7:30 AM - 8:30 AM	**Total**	**18**	**428**	**0**	**446**	**338**	**326**	**0**	**0**	**326**	**430**	**2**	**12**	**0**	**14**	**18**	**786**
	PHF	0.56	0.95	0	0.96	0.9	0.95	0	0	0.95	0.95	0.5	0.38	0	0.44	0.56	0.94
	Approach %				57%	43%				41%	55%				2%	2%	

Loc 9 Location: **High St at Madden Rd**

	SB		NB		EB		
	TH	RT	TH	LT	RT	LT	Total
400-500							0
415-515							0
430-530							0
445-545							0
500-600	**460**	**5**	**737**	**3**	**4**	**12**	**1221**

		Southbound (N. High St.)					Northbound (N. High St.)					Eastbound (Madden Rd.)					
Time Period	**Class.**	**R**	**T**	**U**	**I**	**O**	**T**	**L**	**U**	**I**	**O**	**R**	**L**	**U**	**I**	**O**	**Total**
Peak 1	Lights	5	454	0	459	738	727	3	0	730	458	4	11	0	15	8	1204
Specified Period	%	100%	99%	0%	99%	99%	99%	100%	0%	99%	99%	100%	92%	0%	94%	100%	99%
4:00 PM - 6:15 PM	Other Vehicles	0	6	0	6	11	10	0	0	10	6	0	1	0	1	0	17
One Hour Peak	%	0%	1%	0%	1%	1%	1%	0%	0%	1%	1%	0%	8%	0%	6%	0%	1%
5:00 PM - 6:00 PM	**Total**	**5**	**460**	**0**	**465**	**749**	**737**	**3**	**0**	**740**	**464**	**4**	**12**	**0**	**16**	**8**	**1221**
	PHF	0.62	0.85	0	0.86	0.93	0.94	0.38	0	0.93	0.86	0.33	0.6	0	0.5	0.5	0.94
	Approach %				38%	61%				61%	38%				1%	1%	

Loc 10

Project: Exit 4a SDEIS
Location: **N High St -Folsom Rd-Franklin St**

Growth rates:

Annual	2014->2015	**1.025**
	2016->2015	**0.975**

Seasonal:
Intersection Turning Movement Counts

		AM Peak	PM Peak
May-16	Adj Factor=	**0.96**	**0.98**

		2016- Raw		2016 - AADT				2015 - AADT				2015 - AADT- Rounded			
		AM Peak (730-830)	PM Peak (500-600)	AM Peak (730-830)	Approach Totals	PM Peak (500-600)	Approach Totals	AM Peak (745-845)	Approach Totals	PM Peak (445-545)	Approach Totals	AM Peak (745-845)	Approach Totals	PM Peak (445-545)	Approach Totals
EB	LT	38	46	36	321	45	731	35	313	44	713	35	310	45	715
	Thru	291	696	279		682		272		665		270		665	
	RT	6	4	6		4		6		4		5		5	
WB	LT	31	33	30	436	32	437	29	425	31	426	30	425	30	425
	Thru	411	393	395		385		385		375		385		375	
	RT	11	20	11		20		11		20		10		20	
NB	LT	7	4	7	47	4	65	7	46	4	64	10	50	5	65
	Thru	5	10	5		10		5		10		5		10	
	RT	36	52	35		51		34		50		35		50	
SB	LT	12	18	12	46	18	98	12	45	18	96	10	45	20	100
	Thru	4	10	4		10		4		10		5		10	
	RT	31	71	30		70		29		68		30		70	
	total	883	1357	850	850	1331	1331	829	829	1299	1299	830	830	1305	1305

Use Seasonal Factor

Use Annual Factor
Balance to NB ramp

	SB LT	TH	RT	WB LT	TH	RT	NB LT	TH	RT	EB LT	TH	RT	Total
700-800													
715-815													
730-830	12	4	31	31	411	11	**7**	5	36	38	291	**6**	**883**
745-845													
800-900													

		Southbound (Franklin St. Ext.)						Westbound (Folsom Rd.)						Northbound (Franklin St.)						Eastbound (N. High St.)						
Time Period	**Class.**	**R**	**T**	**L**	**U**	**I**	**O**	**R**	**T**	**L**	**U**	**I**	**O**	**R**	**T**	**L**	**U**	**I**	**O**	**R**	**T**	**L**	**U**	**I**	**O**	**Total**
Peak 1	Lights	30	4	12	0	46	52	10	389	30	0	429	319	36	5	7	0	48	38	4	271	37	0	312	426	835
Specified Period	%	97%	100%	100%	0%	98%	96%	91%	95%	97%	0%	95%	94%	100%	100%	100%	0%	100%	93%	67%	93%	97%	0%	93%	95%	95%
7:00 AM - 9:15 AM	Other Vehicles	1	0	0	0	1	2	1	22	1	0	24	20	0	0	0	0	0	3	2	20	1	0	23	23	48
One Hour Peak	%	3%	0%	0%	0%	2%	4%	9%	5%	3%	0%	5%	6%	0%	0%	0%	0%	0%	7%	33%	7%	3%	0%	7%	5%	5%
7:30 AM - 8:30 AM	**Total**	**31**	**4**	**12**	**0**	**47**	**54**	**11**	**411**	**31**	**0**	**453**	**339**	**36**	**5**	**7**	**0**	**48**	**41**	**6**	**291**	**38**	**0**	**335**	**449**	**883**
	PHF	0.78	0.5	0.5	0	0.65	0.68	0.34	0.97	0.7	0	0.95	0.85	0.69	0.31	0.44	0	0.67	0.85	0.38	0.9	0.79	0	0.89	0.96	0.89
	Approach %					5%	6%					51%	38%					5%	5%					38%	51%	

	SB LT	TH	RT	WB LT	TH	RT	NB LT	TH	RT	EB LT	TH	RT	Total
400-500													0
415-515													0
430-530													0
445-545													0
500-600	**18**	**10**	**71**	**33**	**393**	**20**	**4**	**10**	**52**	**46**	**696**	**4**	**1357**

		Southbound (Franklin St. Ext.)						Westbound (Folsom Rd.)						Northbound (Franklin St.)						Eastbound (N. High St.)						
Time Period	**Class.**	**R**	**T**	**L**	**U**	**I**	**O**	**R**	**T**	**L**	**U**	**I**	**O**	**R**	**T**	**L**	**U**	**I**	**O**	**R**	**T**	**L**	**U**	**I**	**O**	**Total**
Peak 1	Lights	71	10	18	0	99	73	19	387	33	0	439	760	52	10	4	0	66	47	4	690	44	0	738	462	1342
Specified Period	%	100%	100%	100%	0%	100%	96%	95%	98%	100%	0%	98%	99%	100%	100%	100%	0%	100%	100%	100%	99%	96%	0%	99%	99%	99%
4:00 PM - 6:15 PM	Other Vehicles	0	0	0	0	0	3	1	6	0	0	7	6	0	0	0	0	0	0	0	6	2	0	8	6	15
One Hour Peak	%	0%	0%	0%	0%	0%	4%	5%	2%	0%	0%	2%	1%	0%	0%	0%	0%	0%	0%	0%	1%	4%	0%	1%	1%	1%
5:00 PM - 6:00 PM	**Total**	**71**	**10**	**18**	**0**	**99**	**76**	**20**	**393**	**33**	**0**	**446**	**766**	**52**	**10**	**4**	**0**	**66**	**47**	**4**	**696**	**46**	**0**	**746**	**468**	**1357**
	PHF	0.66	0.62	0.64	0	0.67	0.73	0.62	0.89	0.59	0	0.88	0.92	0.72	0.42	0.5	0	0.82	0.65	0.33	0.93	0.77	0	0.94	0.85	0.94
	Approach %					7%	8%					33%	56%					5%	3%					55%	34%	

Project: Exit 4a SDEIS
Loc 11 Location: **Folsom Rd-NH 28 (Ross' Corner)**

Growth rates

Annual	2014 >2015	**1.025**
	2016 >2015	**0.975**

Seasonal:
Intersection Turning Movement Counts

		AM Peak	PM Peak
May 16	Adj Factor=	**0.96**	**0.98**

		2016- Raw AM Peak (745 845)	PM Peak (400 500)	2016 - AADT AM Peak (745 845)	Approach Totals	PM Peak (500-600)	Approach Totals	2015 - AADT AM Peak (745 845)	Approach Totals	PM Peak (445-545)	Approach Totals	2015 - AADT- Rounded AM Peak (745 845)	Approach Totals	PM Peak (445-545)	Approach Totals
Folsom EB	LT	140	539	134	325	528	993	131	317	515	968	135	325	520	965
	Thru	177	399	170		391		166		381		170		375	
	RT	22	76	21		74		20		72		20		70	
Tsienneto WB	LT	130	150	125	809	147	762	122	789	143	742	125	785	140	740
	Thru	312	391	300		383		293		373		290		370	
	RT	400	237	384		232		374		226		370		230	
NH 28 S NB	LT	19	233	18	387	228	830	18	378	222	809	20	385	220	800
	Thru	242	401	232		393		226		383		230		380	
	RT	143	213	137		209		134		204		135		200	
NH 28 N SB	LT	327	561	314	679	550	1176	306	661	536	1146	310	675	525	1135
	Thru	230	230	221		225		215		219		220		220	
	RT	150	409	144		401		140		391		145		390	
	total	2292	3839	2200	2200	3761	3761	2145	2145	3665	3665	2170	2170	3640	3640

Use Seasonal Factor

Use Annual Factor
Balance to NB ramp

2015 Peak Hour Link Volumes based on TMC

Approach		AM Peak Inbound	AM Peak Outbound	PM Peak Inbound	PM Peak Outbound	2015 AADT	% AADT in AM Pk	% AADT in PM Pk
North	NH 28 N of Folsom	675	735	1135	1130			
South	NH 28 S of Folsom	385	365	800	430			
East	Tsienneto E of 28	785	615	740	1100			
West	Folsom W of NH 28	325	455	965	980			
		2170	2170	3640	3640			

	SB RT	SB TH	SB LT	WB RT	WB TH	WB LT	NB RT	NB TH	NB LT	EB RT	EB TH	EB LT	Total
700 800	146	215	333	381	323	116	141	237	29	30	169	126	2246
715 815	159	206	327	399	306	112	126	234	20	21	156	123	2189
730 830	151	233	315	406	302	126	125	227	15	25	178	137	2240
745-845	**150**	**230**	**327**	**400**	**312**	**130**	**143**	**242**	**19**	**22**	**177**	**140**	**2292**
800 900	140	220	308	401	287	144	140	247	14	17	167	145	2230

Time Period	Class:	Southbound (NH 28) R	T	L	U	I	O	Westbound (Tsienneto Rd.) R	T	L	U	I	O	Northbound (NH 28) R	T	L	U	I	O	Eastbound (Folsom Rd.) R	T	L	U	I	O	Total		Crosswalk Pedestrians	Total
Peak 1	Lights	147	214	309	0	670	755	391	298	130	0	819	623	142	228	17	0	387	365	21	172	136	0	329	462	2205	SB	0	0
Specified Period	%	98%	93%	94%	0%	95%	97%	98%	96%	100%	0%	97%	96%	99%	93%	89%	0%	96%	96%	95%	97%	97%	0%	97%	96%	96%		0%	
7:00 AM - 9:00 AM	Other Vehicles	3	16	18	0	37	27	9	14	0	0	23	24	1	14	2	0	17	17	1	5	4	0	10	19	87	WB	5	5
One Hour Peak	%	2%	7%	6%	0%	5%	3%	2%	4%	0%	0%	3%	4%	1%	6%	11%	0%	4%	4%	5%	3%	3%	0%	3%	4%	4%		100%	
7:45 AM - 8:45 AM	**Total**	**150**	**230**	**327**	**0**	**707**	**782**	**400**	**312**	**130**	**0**	**842**	**647**	**143**	**242**	**19**	**0**	**404**	**382**	**22**	**177**	**140**	**0**	**339**	**481**	**2292**	NB	4	4
	PHF	0.77	0.83	0.77	0	0.79	0.95	0.96	0.96	0.93	0	0.99	0.84	0.65	0.86	0.53	0	0.84	0.85	0.55	0.88	0.9	0	0.86	0.88	0.9		100%	
	Approach %					31%	34%					37%	28%					18%	17%					15%	21%		EB	1	1
																												100%	
																												10	10

	SB RT	SB TH	SB LT	WB RT	WB TH	WB LT	NB RT	NB TH	NB LT	EB RT	EB TH	EB LT	Total
400-500	409	230	554	230	379	146	213	401	233	76	394	539	**3804**
415-515	392	246	583	208	376	150	209	418	221	77	394	526	3800
430-530	369	253	553	204	383	160	202	395	228	78	413	532	3770
445-545	345	235	548	207	372	157	212	372	247	83	397	516	3691
500 600	327	227	584	201	374	167	197	375	248	88	391	541	3720

Time Period	Class:	Southbound (NH 28) R	T	L	U	I	O	Westbound (Tsienneto Rd) R	T	L	U	I	O	Northbound (NH 28) R	T	L	U	I	O	Eastbound (Folsom Rd) R	T	L	U	I	O	Total		Crosswalk Pedestrians	Total
Peak 1	Lights	398	220	550	0	1168	1153	229	372	144	0	745	1152	212	392	229	0	833	439	75	390	532	1	998	1000	3744	SB	8	8
Specified Period	%	97%	96%	99%	0%	98%	99%	100%	98%	99%	0%	99%	99%	100%	98%	98%	0%	98%	97%	99%	99%	99%	100%	99%	98%	98%		100%	
4:00 PM - 6:00 PM	Other Vehicles	11	10	4	0	25	16	1	7	2	0	10	9	1	9	4	0	14	13	1	4	6	0	11	22	60	WB	1	1
One Hour Peak	%	3%	4%	1%	0%	2%	1%	0%	2%	1%	0%	1%	1%	0%	2%	2%	0%	2%	3%	1%	1%	1%	0%	1%	2%	2%		100%	
4:00 PM - 5:00 PM	**Total**	**409**	**230**	**554**	**0**	**1193**	**1169**	**230**	**379**	**146**	**0**	**755**	**1161**	**213**	**401**	**233**	**0**	**847**	**452**	**76**	**394**	**538**	**1**	**1009**	**1022**	**3804**	NB	1	1
	PHF	0.95	0.85	0.87	0	0.94	0.93	0.88	0.9	0.79	0	0.95	0.94	0.78	0.84	0.79	0	0.92	0.86	0.76	0.94	0.95	0.25	0.97	0.9	0.98		100%	
	Approach %					31%	31%					20%	31%					22%	12%					27%	27%		EB	0	0
																												0%	
																												8	8

Project: Exit 4a SDEIS

Loc **12** Location: **Tsienneto Rd-Pinkerton St**

Growth rates:

Annual	2014->2015	**1.025**
	2016->2015	**0.975**

Seasonal:

Intersection Turning Movement Counts

		AM Peak	PM Peak
May-16	Adj Factor=	**0.96**	**0.98**

		2016- Raw		**2016 - AADT**				**2015 - AADT**				**2015 - AWDT- Rounded**			
		AM Peak (700-800)	PM Peak (400-500)	AM Peak (700-800)	Approach Totals	PM Peak (500-600)	Approach Totals	AM Peak (745-845)	Approach Totals	PM Peak (445-545)	Approach Totals	AM Peak (745-845)	Approach Totals	PM Peak (445-545)	Approach Totals
EB	LT	0	0	0	635	0	1151	0	619	0	1122	0	620	0	1125
	Thru	399	690	383		676		373		659		375		660	
	RT	263	485	252		475		246		463		245		465	
WB	LT	84	118	81	661	116	693	79	645	113	676	80	645	115	680
	Thru	604	589	580		577		566		563		565		565	
	RT	0	0	0		0		0		0		0		0	
NB	LT	231	189	222	303	185	307	216	295	180	299	215	295	180	300
	Thru	0	0	0		0		0		0		0		0	
	RT	84	124	81		122		79		119		80		120	
SB	LT	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Thru	0	0	0		0		0		0		0		0	
	RT	0	0	0		0		0		0		0		0	
	total	1665	2195	1599	1599	2151	2151	1559	1559	2097	2097	1560	1560	2105	2105

Use Seasonal Factor

Use Annual Factor

Balance to NB ramp

	WB		NB		EB		
	TH	LT	LT	RT	TH	RT	Total
700-800	**578**	**98**	**237**	**105**	**432**	**248**	**1698**
715-815	565	73	235	81	414	231	1599
730-830	595	79	237	74	417	231	1633
745-845	604	84	231	84	399	263	1665
800-900	574	90	243	75	387	254	1623

		Westbound (Tsienneto Rd.)					**Northbound (Pinkerton St.)**					**Eastbound (Tsienneto Rd.)**					
Time Period	**Class.**	**T**	**L**	**U**	**I**	**O**	**R**	**L**	**U**	**I**	**O**	**R**	**T**	**U**	**I**	**O**	**Total**
Peak 1	Lights	568	95	0	663	527	104	232	0	336	334	239	423	0	662	800	1661
Specified Period	%	98%	97%	0%	98%	98%	99%	98%	0%	98%	97%	96%	98%	0%	97%	98%	98%
7:00 AM - 9:15 AM	Other Vehicles	10	3	0	13	10	1	5	0	6	12	9	9	0	18	15	37
One Hour Peak	%	2%	3%	0%	2%	2%	1%	2%	0%	2%	3%	4%	2%	0%	3%	2%	2%
7:00 AM - 8:00 AM	**Total**	**578**	**98**	**0**	**676**	**537**	**105**	**237**	**0**	**342**	**346**	**248**	**432**	**0**	**680**	**815**	**1698**
	PHF	0.9	0.49	0	0.81	0.88	0.58	0.85	0	0.83	0.71	0.82	0.89	0	0.86	0.94	0.87
	Approach %				40%	32%				20%	20%				40%	48%	

Loc **12** Location: **Tsienneto Rd-Pinkerton St**

	WB		NB		EB		
	LT	TH	LT	RT	TH	RT	Total
400-500	**589**	**118**	**189**	**124**	**690**	**485**	**2195**
415-515	592	118	190	113	675	494	2182
430-530	601	119	189	101	674	495	2179
445-545	564	105	195	107	661	502	2134
500-600	552	101	196	96	686	502	2133

		Westbound (Tsienneto Rd)						Northbound (Pinkerton St)						Eastbound (Tsienneto Rd)			
Time Period	**Class.**	**T**	**L**	**U**	**I**	**O**	**R**	**L**	**U**	**I**	**O**	**R**	**T**	**U**	**I**	**O**	**Total**
Peak 1	Lights	581	117	0	698	808	124	186	0	310	598	481	684	0	1165	767	2173
Specified Period	%	99%	99%	0%	99%	99%	100%	98%	0%	99%	99%	99%	99%	0%	99%	99%	99%
4:00 PM - 6:15 PN	Other Vehicles	8	1	0	9	6	0	3	0	3	5	4	6	0	10	11	22
One Hour Peak	%	1%	1%	0%	1%	1%	0%	2%	0%	1%	1%	1%	1%	0%	1%	1%	1%
4:00 PM - 5:00 PN	**Total**	**589**	**118**	**0**	**707**	**814**	**124**	**189**	**0**	**313**	**603**	**485**	**690**	**0**	**1175**	**778**	**2195**
	PHF	0.86	0.78	0	0.85	0.93	0.78	0.93	0	0.86	0.9	0.89	0.96	0	0.96	0.9	0.96
	Approach %				32%	37%				14%	27%				54%	35%	

Loc **13** Project: Exit 4a SDEIS
Location: **NH 28-Linlew Drive**

Growth rates:

Annual	2014->2015	**1.025**
	2016->2015	**0.975**

Seasonal:
Intersection Turning Movement Counts

		AM Peak	PM Peak
May-16	Adj Factor=	**0.96**	**0.98**

		2016- Raw AM Peak (745-845)	2016- Raw PM Peak (445-545)	2016 - AADT AM Peak (745-845)	Approach Totals	PM Peak (500-600)	Approach Totals	2015 - AADT AM Peak (745-845)	Approach Totals	PM Peak (445-545)	Approach Totals	2015 - AADT- Rounded AM Peak (745-845)	Approach Totals	PM Peak (445-545)	Approach Totals
EB	LT	55	177	53	864	173	1610	52	843	169	1570	50	840	170	1575
	Thru	845	1464	811		1435		791		1399		790		1400	
	RT	0	2	0		2		0		2		0		5	
WB	LT	0	18	0	702	18	978	0	684	18	954	0	685	20	955
	Thru	699	897	671		879		654		857		655		855	
	RT	32	83	31		81		30		79		30		80	
NB	LT	2	13	2	3	13	36	2	3	13	35	5	10	15	40
	Thru	0	9	0		9		0		9		0		10	
	RT	1	14	1		14		1		14		5		15	
SB	LT	54	49	52	304	48	277	51	297	47	270	50	295	45	270
	Thru	0	8	0		8		0		8		0		10	
	RT	262	226	252		221		246		215		245		215	
	total	1950	2960	1873	1873	2901	2901	1827	1827	2830	2830	1830	1830	2840	2840

Use Seasonal Factor

Use Annual Factor
Balance to NB ramp

2015 Peak Hour Link Volumes based on TMC

Approach		AM Peak Inbound	AM Peak Outbound	PM Peak Inbound	PM Peak Outbound	2015 AADT	% AADT in AM Pk	% AADT in PM Pk
North	NH 28 N of Linlew	840	905	1575	1085			
South	NH 28 S of Linlew	685	845	955	1460			
East	Linlew E of NH 28	295	80	270	260			
West	Applebees	10	0	40	35			
		1830	1830	2840	2840			

NOTE - EB = NH 28 SB
WB = NH 28 NB
SB = Linlew
NB = Applebees

	SB LT	TH	RT	WB LT	TH	RT	NB LT	TH	RT	EB LT	TH	RT	Total
700-800													2160
715-815													2298
730-830													0
745-845	54	0	262	0	699	32	2	0	1	55	845	0	1950
800-900													2167

Time Period	Class.	Southbound (Linlew Dr.) R	T	L	U	I	O	Westbound (NH 28) R	T	L	U	I	O	Northbound (Applebees Driveway) R	T	L	U	I	O	Eastbound (NH 28) R	T	L	U	I	O	Total		Crosswalk Pedestrians	Total
Peak 1	Lights	260	0	54	0	314	84	30	672	0	0	702	837	1	0	2	1	4	1	0	782	54	2	838	936	1858	SB	0	0
Specified Period	%	99%	0%	100%	0%	99%	97%	94%	96%	0%	0%	96%	93%	100%	0%	100%	100%	100%	100%	0%	93%	98%	100%	93%	93%	95%		0%	
7:00 AM - 9:15 AM	Other Vehicles	2	0	0	0	2	3	2	27	0	0	29	63	0	0	0	0	0	0	0	63	1	0	64	79	95	WB	0	0
One Hour Peak	%	1%	0%	0%	0%	1%	3%	6%	4%	0%	0%	4%	7%	0%	0%	0%	0%	0%	0%	0%	7%	2%	0%	7%	8%	5%		0%	
7:45 AM - 8:45 AM	Total	262	0	54	0	316	87	32	699	0	0	731	900	1	0	2	1	4	1	0	845	55	2	902	955	1953	NB	0	0
	PHF	0.91	0	0.84	0	0.9	0.87	0.73	0.98	0	0	0.96	0.82	0.25	0	0.5	0.25	0.5	0.25	0	0.87	0.76	0.5	0.83	0.96	0.89		0%	
	Approach %					16%	4%					37%	46%					0%	0%					46%	47%		EB	0	0
																												0%	
																												0	0

	SB LT	TH	RT	WB LT	TH	RT	NB LT	TH	RT	EB LT	TH	RT	Total
400-500													0
415-515													0
430-530													0
445-545	49	8	226	18	897	83	13	9	14	177	1464	2	2960
500-600													0

Time Period	Class.	Southbound (Linlew Dr.) R	T	L	U	I	O	Westbound (NH 28) R	T	L	U	I	O	Northbound (Applebees Driveway) R	T	L	U	I	O	Eastbound (NH 28) R	T	L	U	I	O	Total		Crosswalk Pedestrians	Total
Peak 1	Lights	225	8	48	0	281	266	82	886	18	1	987	1506	14	9	13	0	36	28	2	1443	175	1	1621	1125	2925	SB	0	0
Specified Period	%	100%	100%	98%	0%	99%	99%	99%	99%	100%	100%	99%	99%	100%	100%	100%	0%	100%	100%	100%	99%	99%	100%	99%	99%	99%		0%	
4:00 PM - 6:00 PM	Other Vehicles	1	0	1	0	2	3	1	11	0	0	12	22	0	0	0	0	0	0	0	21	2	0	23	12	37	WB	0	0
One Hour Peak	%	0%	0%	2%	0%	1%	1%	1%	1%	0%	0%	1%	1%	0%	0%	0%	0%	0%	0%	0%	1%	1%	0%	1%	1%	1%		0%	
4:45 PM - 5:45 PM	Total	226	8	49	0	283	269	83	897	18	1	999	1528	14	9	13	0	36	28	2	1464	177	1	1644	1137	2962	NB	0	0
	PHF	0.84	0.5	0.68	0	0.8	0.85	0.83	0.96	0.75	0.25	0.95	0.96	0.88	0.75	0.81	0	0.9	0.7	0.5	0.97	0.82	0.25	0.97	0.94	0.95		0%	
	Approach %					10%	9%					34%	52%					1%	1%					56%	38%		EB	0	0
																												0%	
																												0	0

	Project:	Exit 4a SDEIS	
Loc 14	Location:	NH 28-Ashleigh Dr	
	Growth rates:		
	Annual	2014->2015	1.025
		2016->2015	0.975

Seasonal:
Intersection Turning Movement Counts

		AM Peak	PM Peak
May-16	Adj Factor=	0.96	0.98

		2016- Raw		2016 - AADT				2015 - AADT				2015 - AADT- Rounded			
		AM Peak (745-845)	PM Peak (430-530)	AM Peak (745-845)	Approach Totals	PM Peak (500-600)	Approach Totals	AM Peak (745-845)	Approach Totals	PM Peak (445-545)	Approach Totals	AM Peak (745-845)	Approach Totals	PM Peak (445-545)	Approach Totals
EB	LT	105	113	101	751	111	1237	98	732	108	1206	100	735	110	1210
	Thru	671	1147	644		1124		628		1096		630		1095	
	RT	5	2	6		2		6		2		5		5	
WB	LT	6	3	6	859	3	1089	6	837	3	1061	5	835	5	1065
	Thru	652	838	626		821		610		800		610		800	
	RT	236	270	227		265		221		258		220		260	
NB	LT	8	40	8	16	39	55	8	16	38	54	10	20	40	60
	Thru	6	8	6		8		6		8		5		10	
	RT	2	8	2		8		2		8		5		10	
SB	LT	194	359	186	291	352	490	181	284	343	478	180	285	345	485
	Thru	5	1	5		1		5		1		5		5	
	RT	104	140	100		137		98		134		100		135	
	total	1995	2929	1917	1917	2871	2871	1869	1869	2799	2799	1875	1875	2820	2820
				Use Seasonal Factor				Use Annual Factor				Use these in Synchro Existing Cond analyses			

NOTE: EB = NH 28 SB
WB = NH 28 NB
SB = Ashleigh Dr
NB = VIP Driveway

	SB			WB			NB			EB			
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	Total
700-800													0
715-815													0
730-830													0
745-845	194	5	104	6	652	236	8	6	2	105	571	6	1995
800-900													0

		Southbound (Ashleigh Dr.)						Westbound (NH 28)						Northbound (VIP Driveway)						Eastbound (NH 28)								Crosswalk	
Time Period	Class:	R	T	L	U	I	O	R	T	L	U	I	O	R	T	L	U	I	O	R	T	L	U	I	O	Total		Pedestrians	Total
Peak 1	Lights	103	4	186	0	293	333	225	625	6	3	859	816	2	6	8	0	16	16	6	625	102	0	733	736	1901	SB	1	1
Specified Period	%	99%	80%	95%	0%	97%	96%	95%	96%	100%	100%	96%	94%	100%	100%	100%	0%	100%	94%	100%	93%	97%	0%	94%	96%	95%		100%	
7:00 AM - 9:15 AM	Other Vehicles	1	1	8	0	10	14	11	27	0	0	38	54	0	0	0	0	0	1	0	46	3	0	49	28	97	WB	0	0
One Hour Peak	%	1%	20%	4%	0%	3%	4%	5%	4%	0%	0%	4%	6%	0%	0%	0%	0%	0%	6%	0%	7%	3%	0%	6%	4%	5%		0%	
7:45 AM - 8:45 AM	Total	104	5	194	0	303	347	236	652	6	3	897	870	2	6	8	0	16	17	6	671	105	0	782	764	1998	NB	0	0
	PHF	0.79	0.42	0.9	0	0.9	0.92	0.91	0.96	0.75	0.75	0.97	0.85	0.5	0.56	0.5	0	0.67	0.53	0.5	0.81	0.77	0	0.83	0.98	0.91		0%	
	Approach %					15%	17%					45%	44%					1%	1%					39%	38%		EB	1	1
																												100%	
																												2	2

	SB			WB			NB			EB			
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	Total
400-500													0
415-515													0
430-530	359	1	140	3	838	270	40	8	8	113	1147	2	2929
445-545													0
500-600													0

		Southbound (Ashleigh Dr.)						Westbound (NH 28)						Northbound (VIP Driveway)						Eastbound (NH 28)								Crosswalk	
Time Period	Class:	R	T	L	U	I	O	R	T	L	U	I	O	R	T	L	U	I	O	R	T	L	U	I	O	Total		Pedestrians	Total
Peak 1	Lights	139	1	358	0	498	388	269	819	3	13	1104	1511	8	8	40	0	56	6	2	1132	111	1	1246	999	2904	SB	1	1
Specified Period	%	99%	100%	100%	0%	100%	99%	100%	98%	100%	100%	98%	99%	100%	100%	100%	0%	100%	100%	100%	99%	98%	100%	99%	98%	99%		100%	
4:00 PM - 6:15 PM	Other Vehicles	1	0	1	0	2	3	1	19	0	0	20	16	0	0	0	0	0	0	0	15	2	0	17	20	39	WB	0	0
One Hour Peak	%	1%	0%	0%	0%	0%	1%	0%	2%	0%	0%	2%	1%	0%	0%	0%	0%	0%	0%	0%	1%	2%	0%	1%	2%	1%		0%	
4:30 PM - 5:30 PM	Total	140	1	359	0	500	391	270	838	3	13	1124	1527	8	8	40	0	56	6	2	1147	113	1	1263	1019	2943	NB	0	0
	PHF	0.83	0.25	0.87	0	0.86	0.97	0.95	0.89	0.38	0.65	0.9	0.83	0.5	0.5	0.77	0	0.78	0.5	0.5	0.81	0.91	0.25	0.84	0.91	0.88		0%	
	Approach %					17%	13%					38%	52%					2%	0%					43%	35%		EB	0	0
																												0%	
																												1	1

Loc 15

Project: Exit 4a SDEIS

Location: **NH 28-Scobie Pond Rd**

Growth rates:

Annual	2014->2015	**1.025**
	2016->2015	**0.975**

Seasonal:

Intersection Turning Movement Counts

		AM Peak	PM Peak
May-16	Adj Factor=	**0.96**	**0.98**

		2016- Raw		2016 - AADT				2015 - AADT				2015 - AADT- Rounded			
		AM Peak (730-830)	PM Peak (430-530)	AM Peak (730-830)	Approach Totals	PM Peak (500-600)	Approach Totals	AM Peak (745-845)	Approach Totals	PM Peak (445-545)	Approach Totals	AM Peak (745-845)	Approach Totals	PM Peak (445-545)	Approach Totals
EB	LT	17	42	16	752	41	1193	16	734	40	1163	15	735	40	1165
	Thru	767	1175	736		1152		718		1123		720		1125	
	RT	0	0	0		0		0		0		0		0	
WB	LT	0	0	0	701	0	880	0	683	0	858	0	685	0	860
	Thru	689	733	661		718		644		700		645		700	
	RT	42	165	40		162		39		158		40		160	
NB	LT	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Thru	0	0	0		0		0		0		0		0	
	RT	0	0	0		0		0		0		0		0	
SB	LT	83	74	80	116	73	103	78	113	71	100	80	115	70	100
	Thru	0	0	0		0		0		0		0		0	
	RT	37	31	36		30		35		29		35		30	
	total	1635	2220	1569	1569	2176	2176	1530	1530	2121	2121	1535	1535	2125	2125

Use Seasonal Factor

Use Annual Factor

Use these in Synchro Existing Cond analyses

	SB		WB		EB		
	LT	RT	TH	RT	LT	TH	Total
700-800							0
715-815							0
730-830	**83**	**37**	**689**	**42**	**17**	**767**	**1635**
745-845							0
800-900							0

		Southbound (Scobie Pond Rd.)					Westbound (NH 28)					Eastbound (NH 28)					
Time Period	**Class.**	**R**	**L**	**U**	**I**	**O**	**R**	**T**	**U**	**I**	**O**	**T**	**L**	**U**	**I**	**O**	**Total**
Peak 1	Lights	36	77	0	113	47	37	668	0	705	796	719	10	0	729	704	1547
Specified Period	%	97%	93%	0%	94%	80%	88%	97%	0%	96%	94%	94%	59%	0%	93%	97%	95%
7:00 AM - 9:15 AM	Other Vehicles	1	6	0	7	12	5	21	0	26	54	48	7	0	55	22	88
One Hour Peak	%	3%	7%	0%	6%	20%	12%	3%	0%	4%	6%	6%	41%	0%	7%	3%	5%
7:30 AM - 8:30 AM	**Total**	**37**	**83**	**0**	**120**	**59**	**42**	**689**	**0**	**731**	**850**	**767**	**17**	**0**	**784**	**726**	**1635**
	PHF	0.84	0.83	0	0.83	0.82	0.88	0.89	0	0.89	0.85	0.85	0.53	0	0.84	0.89	0.9
	Approach %				7%	4%				45%	52%				48%	44%	

Loc **15** Location: **NH 28-Scobie Pond Rd**

	SB		WB		EB		
	LT	RT	TH	RT	LT	TH	Total
400-500							0
415-515							0
430-530	**74**	**31**	**733**	**165**	**42**	**1175**	**2220**
445-545							0
500-600							0

		Southbound (Scobie Pond Rd.)					Westbound (NH 28)					Eastbound (NH 28)					
Time Period	**Class.**	**R**	**L**	**U**	**I**	**O**	**R**	**T**	**U**	**I**	**O**	**T**	**L**	**U**	**I**	**O**	**Total**
Peak 1	Lights	28	74	0	102	205	164	717	1	882	1232	1157	41	1	1199	746	2183
Specified Period	%	90%	100%	0%	97%	99%	99%	98%	100%	98%	99%	98%	98%	100%	98%	98%	98%
4:00 PM - 6:15 PM	Other Vehicles	3	0	0	3	2	1	16	0	17	18	18	1	0	19	19	39
One Hour Peak	%	10%	0%	0%	3%	1%	1%	2%	0%	2%	1%	2%	2%	0%	2%	2%	2%
4:30 PM - 5:30 PM	**Total**	**31**	**74**	**0**	**105**	**207**	**165**	**733**	**1**	**899**	**1250**	**1175**	**42**	**1**	**1218**	**765**	**2222**
	PHF	0.78	0.74	0	0.75	0.94	0.9	0.9	0.25	0.9	0.91	0.9	0.81	0.25	0.91	0.92	0.96
	Approach %				5%	9%				40%	56%				55%	34%	

Project: Exit 4a SDEIS
Int 16 Location: NH 102-NH 28 Bypass (Rotary)

Growth rates:

Annual	2014->2015	1.025
	2016->2015	0.975

Seasonal:
Intersection Turning Movement Counts

		AM Peak	PM Peak
May-16	Adj Factor=	0.96	0.98

		2016- Raw		2016 - AADT				2015 - AADT				2015 - AADT- Rounded			
		AM Peak (700-800)	PM Peak (500-600)	AM Peak (730-830)	Approach Totals	PM Peak (500-600)	Approach Totals	AM Peak (745-845)	Approach Totals	PM Peak (445-545)	Approach Totals	AM Peak (745-845)	Approach Totals	PM Peak (445-545)	Approach Totals
EB	LT	64	39	61	376	38	630	59	367	37	614	60	370	40	620
	Thru	127	254	122		249		119		243		120		245	
	RT	98	276	94		270		92		263		90		265	
	RT	103	74	99		73		97		71		100		70	
WB	LT	1	9	1	330	9	240	1	322	9	234	5	330	10	240
	LT	79	62	76		61		74		59		75		60	
	Thru	251	156	241		153		235		149		240		150	
	RT	12	17	12		17		12		17		10		20	
NB	LT	78	76	75	380	74	442	73	371	72	431	75	375	70	425
	Thru	263	280	252		274		246		267		245		265	
	RT	51	90	49		88		48		86		50		85	
	RT	4	6	4		6		4		6		5		5	
SB	LT	17	13	16	453	13	754	16	443	13	735	15	445	15	740
	LT	128	393	123		385		120		375		120		375	
	Thru	266	328	255		321		249		313		250		315	
	RT	61	36	59		35		58		34		60		35	
NWB	LT	8	12	8	479	12	230	8	468	12	494	10	470	10	495
	LT	176	202	169		198		165		193		165		195	
	RT	303	282	289		276		282		269		280		270	
	RT	14	20	13		20		13		20		15		20	
	Total	2102	2625	2019	2018	2572	2296	1971	1971	2508	2508	1990	1990	2520	2520

Use Seasonal Factor — Use Annual Factor — Use these in Synchro Existing Cond analyses

	SB LT (NH 102 E)	LT (E. Derry Rd)	TH (Byp 28)	RT (NH 102 W)	EB LT (Byp 28 N)	TH (NH 102)	RT (E Derry Rd)	RT (Byp 28 S)	NB LT (NH 102 W)	TH (Byp 28)	RT (NH 102 E)	RT (E Derry Rd)	NWB (E. Derry Rd) LT (Byp 28 S)	LT (NH 102 W)	RT (Byp 28 N)	RT (NH 102 E)	WB LT (E. Derry Rd)	LT (Byp 28 S)	TH (NH 102 W)	RT (Byp 28 N)	Total
700-800	17	128	266	61	64	127	98	103	78	263	51	4	8	176	303	14	1	79	251	12	2102
715-815																					0
730-830																					0
745-845																					0
800-900																					0

Time Period	Class.	Southbound (NH 28 Byp.) R	T	BL	L	U	I	O	Westbound (NH 102) R	T	L	HL	U	I	O	Northwestbound (East Derry Rd.) HR	BR	BL	HL	U	I	O	Northbound (NH 28 Byp.) HR	R	T	L	U	I	O	Eastbound (NH 102) R	BR	T	L	U	I	O	Total
Peak 1	Lights	57	255	119	8	1	441	628	11	233	74	1	0	319	171	13	294	170	8	1	485	218	3	43	261	76	0	383	436	98	94	109	61	1	363	517	1992
Specified Period	%	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
7:00 AM - 9:15 AM	Other Vehicles	4	10	9	9	1	31	14	1	16	5	0	1	25	37	1	7	6	0	0	14	14	1	8	2	2	0	13	20	5	4	18	3	0	30	50	115
One Hour Peak	%	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
7:00 AM - 8:00 AM	Total	61	266	128	17	2	474	642	12	251	79	1	1	344	210	14	301	176	8	1	500	232	4	51	263	78	0	396	456	103	98	127	64	1	393	567	2107
	PHF	0.51	0.89	0.94	0.89	0.5	0.8	0.81	0.75	0.86	0.79	0.25	0.25	0.83	0.77	0.88	0.92	0.89	0.67	0.25	0.91	0.88	0.33	0.71	0.81	0.78	0	0.86	0.77	0.44	0.72	0.74	0.44	0.25	0.5	0.9	0.86
	Approach %						22%	30%						16%	10%						24%	11%						19%	22%						19%	27%	

	SB LT (NH 102 E)	LT (E. Derry Rd)	TH (Byp 28)	RT (NH 102 W)	EB LT (Byp 28 N)	TH (NH 102)	RT (E Derry Rd)	RT (Byp 28 S)	NB LT (NH 102 W)	TH (Byp 28)	RT (NH 102 E)	RT (E Derry Rd)	NWB (E. Derry Rd) LT (Byp 28 S)	LT (NH 102 W)	RT (Byp 28 N)	RT (NH 102 E)	WB LT (E Derry Rd)	LT (Byp 28 S)	TH (NH 102 W)	RT (Byp 28 N)	Total
400-500																					0
415-515																					0
430-530																					0
445-545																					0
500-600	13	393	328	36	39	254	275	74	76	280	90	6	12	202	282	20	9	62	156	17	2625

Time Period	Class.	Southbound (NH 28 Bypass) R	T	BL	L	U	I	O	Westbound (NH 102) R	T	L	HL	U	I	O	Northwestbound (East Derry Rd.) HR	BR	BL	HL	U	I	O	Northbound (NH 28 bypass) HR	R	T	L	U	I	O	Eastbound (NH 102) R	BR	T	L	U	I	O	Total
Peak 1	Lights	36	323	387	13	1	760	610	17	153	60	9	0	239	372	19	279	200	12	0	510	677	6	89	274	76	0	445	468	73	275	251	39	1	639	466	2593
Specified Period	%	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4:00 PM - 6:15 PM	Other Vehicles	0	5	6	0	0	11	9	0	3	2	0	0	5	5	1	3	2	0	0	6	7	0	1	6	0	0	7	8	1	1	3	0	0	5	5	34
One Hour Peak	%	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5:00 PM - 6:00 PM	Total	36	328	393	13	1	771	619	17	156	62	9	0	244	377	20	282	202	12	0	516	684	6	90	280	76	0	452	476	74	276	254	39	1	644	471	2627
	PHF	0.75	0.85	0.84	0.65	0.25	0.92	0.92	0.71	0.91	0.82	0.55	0	0.91	0.94	0.83	0.93	0.9	0.43	0	0.91	0.92	0.5	0.75	0.83	0.76	0	0.87	0.84	0.97	0.9	0.88	0.81	0.25	0.9	0.91	0.97
	Approach %						28%	24%						9%	15%						20%	26%						17%	18%						25%	18%	

Project: Exit 4a SDEIS

Loc. 17 Location: **NH 28 Bypass-Pinkerton St - Nesmith Rd**

Growth rates:

Annual	2014->2015	1.025
	2016->2015	0.975

Seasonal:

Intersection Turning Movement Counts

		AM Peak	PM Peak
May-16	Adj Factor=	0.96	0.98

		2016- Raw		2016 - AADT				2015 - AADT				2015 - AADT- Rounded			
		AM Peak (700-800)	PM Peak (400-500)	AM Peak (730-830)	Approach Totals	PM Peak (500-600)	Approach Totals	AM Peak (745-845)	Approach Totals	PM Peak (445-545)	Approach Totals	AM Peak (745-845)	Approach Totals	PM Peak (445-545)	Approach Totals
EB	LT	12	9	12	217	9	494	12	212	9	482	10	210	10	485
	Thru	15	42	14		41		14		40		15		40	
	RT	199	453	191		444		186		433		185		435	
WB	LT	6	1	6	98	1	55	6	96	1	53	5	95	5	55
	Thru	43	33	41		32		40		31		40		30	
	RT	53	22	51		22		50		21		50		20	
NB	LT	262	210	252	656	206	659	246	640	201	643	245	640	200	645
	Thru	418	455	401		446		391		435		390		435	
	RT	3	7	3		7		3		7		5		10	
SB	LT	11	24	11	320	24	335	11	312	23	327	10	310	25	330
	Thru	273	304	262		298		255		291		255		290	
	RT	49	13	47		13		46		13		45		15	
	total	1344	1573	1291	1291	1543	1543	1260	1260	1505	1505	1255	1255	1515	1515

Use Seasonal Factor   Use Annual Factor   Use these in Synchro Existing Cond analyses

	SB LT	TH	RT	WB LT	TH	RT	NB LT	TH	RT	EB LT	TH	RT	Total
700-800	11	273	49	6	43	53	262	418	3	12	15	199	1344
715-815													0
730-830													0
745-845													0
800-900													0

Time Period	Class.	Southbound (NH 28 Byp.) R	T	L	U	I	O	Westbound (Nesmith St.) R	T	L	U	I	O
Peak 1	Lights	49	261	10	0	320	468	52	41	4	0	97	25
Specified Period	%	100%	96%	91%	0%	96%	97%	98%	95%	67%	0%	95%	86%
7:00 AM - 9:15 AM	Other Vehicles	0	12	1	0	13	15	1	2	2	0	5	4
One Hour Peak	%	0%	4%	9%	0%	4%	3%	2%	5%	33%	0%	5%	14%
7:00 AM - 8:00 AM	Total	49	273	11	0	333	483	53	43	6	0	102	29
	PHF	0.31	0.59	0.69	0	0.52	0.64	0.34	0.63	0.75	0	0.45	0.81
	Approach %					25%	36%					8%	2%

Time Period	Class.	Northbound (NH 28 Byp.) R	T	L	U	I	O	Eastbound (Pinkerton St.) R	T	L	U	I	O	Total
Peak 1	Lights	3	404	254	0	661	449	184	12	12	0	208	344	1286
Specified Period	%	100%	97%	97%	0%	97%	94%	92%	80%	100%	0%	92%	97%	96%
7:00 AM - 9:15 AM	Other Vehicles	0	14	8	0	22	29	15	3	0	0	18	10	58
One Hour Peak	%	0%	3%	3%	0%	3%	6%	8%	20%	0%	0%	8%	3%	4%
7:00 AM - 8:00 AM	Total	3	418	262	0	683	478	199	15	12	0	226	354	1344
	PHF	0.38	0.72	0.81	0	0.75	0.67	0.8	0.62	0.75	0	0.82	0.64	0.65
	Approach %					51%	36%					17%	26%	

	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	Total
400-500	24	304	13	1	33	22	210	455	7	9	42	453	1573
415-515													0
430-530													0
445-545													0
500-600													0

Time Period	Class.	Southbound (NH 28 Bypass) R	T	L	U	I	O	Westbound (Nesmith St.) R	T	L	U	I	O
Peak 1	Lights	13	299	24	0	336	477	22	33	1	0	56	73
Specified Period	%	100%	98%	100%	0%	99%	98%	100%	100%	100%	0%	100%	100%
4:00 PM - 6:15 PM	Other Vehicles	0	5	0	0	5	9	0	0	0	0	0	0
One Hour Peak	%	0%	2%	0%	0%	1%	2%	0%	0%	0%	0%	0%	0%
4:00 PM - 5:00 PM	Total	13	304	24	0	341	486	22	33	1	0	56	73
	PHF	0.65	0.88	0.75	0	0.91	0.95	0.69	0.92	0.25	0	0.82	0.83
	Approach %					22%	31%					4%	5%

Time Period	Class.	Northbound (NH 28 Bypass) R	T	L	U	I	O	Eastbound (Pinkerton St.) R	T	L	U	I	O	Total
Peak 1	Lights	7	446	209	0	662	744	444	42	9	0	495	255	1549
Specified Period	%	100%	98%	100%	0%	99%	98%	98%	100%	100%	0%	98%	100%	98%
4:00 PM - 6:15 PM	Other Vehicles	0	9	1	0	10	14	9	0	0	0	9	1	24
One Hour Peak	%	0%	2%	0%	0%	1%	2%	2%	0%	0%	0%	2%	0%	2%
4:00 PM - 5:00 PM	Total	7	455	210	0	672	758	453	42	9	0	504	256	1573
	PHF	0.58	0.91	0.92	0	0.93	0.93	0.83	0.88	0.56	0	0.88	0.94	0.95
	Approach %					43%	48%					32%	16%	

Loc 18 Project: Exit 4a SDEIS
Location: NH 28 Bypass-Tsienneto Rd.

Growth rates:
Annual 2014->2015 1.025
2016->2015 0.975

Seasonal:
Intersection Turning Movement Counts

		AM Peak	PM Peak
May-16	Adj Factor=	0.96	0.98

		2016- Raw AM Peak (700-800)	PM Peak (500-600)	2016 - AADT AM Peak (730-830)	Approach Totals	PM Peak (500-600)	Approach Totals	2015 - AADT AM Peak (745-845)	Approach Totals	PM Peak (445-545)	Approach Totals	2015 - AADT- Rounded AM Peak (745-845)	Approach Totals	PM Peak (445-545)	Approach Totals
EB	LT	123	294	118	303	288	717	115	295	281	699	120	300	280	700
	Thru	105	359	101		352		98		343		100		345	
	RT	88	79	84		77		82		75		80		75	
WB	LT	88	29	84	453	28	278	82	442	27	271	80	440	25	270
	Thru	287	184	276		180		269		176		270		175	
	RT	97	71	93		70		91		68		90		70	
NB	LT	104	103	100	346	101	451	98	338	98	439	100	340	100	445
	Thru	238	333	228		326		222		318		220		320	
	RT	19	24	18		24		18		23		20		25	
SB	LT	27	79	26	504	77	457	25	491	75	445	25	490	75	445
	Thru	223	194	214		190		209		185		210		185	
	RT	275	194	264		190		257		185		255		185	
	total	1674	1943	1606	1606	1903	1903	1566	1566	1854	1854	1570	1570	1860	1860

Use Seasonal Factor — Use Annual Factor — Use these in Synchro Existing Cond analyses

	SB LT	TH	RT	WB LT	TH	RT	NB LT	TH	RT	EB LT	TH	RT	Total
700-800	27	223	275	88	287	97	104	238	19	123	105	88	1674
715-815													0
730-830													0
745-845													0
800-900													0

Time Period	Class.	Southbound (NH 28 Bypass) R	T	L	U	I	O	Westbound (Tsienneto Rd.) R	T	L	U	I	O
Peak 1	Lights	266	211	27	0	504	448	97	286	86	1	470	148
Specified Period	%	97%	95%	100%	0%	96%	98%	100%	100%	98%	100%	99%	97%
7:00 AM - 9:15 AM	Other Vehicles	9	12	0	0	21	10	0	1	2	0	3	4
One Hour Peak	%	3%	5%	0%	0%	4%	2%	0%	0%	2%	0%	1%	3%
7:00 AM - 8:00 AM	Total	275	223	27	0	525	458	97	287	88	1	473	152
	PHF	0.83	0.67	0.96	0	0.81	0.85	0.93	0.89	0.37	0.25	0.78	0.88
	Approach %					33%	27%					19%	9%

Class.	Northbound (NH 28 Bypass) R	T	L	U	I	O	Eastbound (Tsienneto Rd.) R	T	L	U	I	O	Total		Crosswalk Pedestrians	Total
Lights	18	232	99	0	349	385	88	102	119	0	309	651	1632	SB	0	0
%	95%	97%	95%	0%	97%	96%	100%	97%	97%	0%	98%	98%	97%		0%	
Other Vehicles	1	6	5	0	12	14	0	3	4	0	7	15	43	WB	0	0
%	5%	3%	5%	0%	3%	4%	0%	3%	3%	0%	2%	2%	3%		0%	
Total	19	238	104	0	361	399	88	105	123	0	316	666	1675	NB	0	0
PHF	0.59	0.82	0.81	0	0.82	0.51	0.42	0.94	0.63	0	0.68	0.9	0.81		0%	
Approach %					22%	24%					19%	40%		EB	9	9
															100%	
															9	9

	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	Total
400-500	79	194	194	29	184	71	103	333	24	294	359	79	1943
415-515													0
430-530													0
445-545													0
500-600													0

Time Period	Class.	Southbound (NH 28 Bypass) R	T	L	U	I	O	Westbound (Tsienneto) R	T	L	U	I	O
Peak 1	Lights	191	191	79	0	461	692	71	183	29	0	283	460
Specified Period	%	98%	98%	100%	0%	99%	99%	100%	99%	100%	0%	100%	100%
4:00 PM - 6:15 PM	Other Vehicles	3	3	0	0	6	6	0	1	0	0	1	2
One Hour Peak	%	2%	2%	0%	0%	1%	1%	0%	1%	0%	0%	0%	0%
5:00 PM - 6:00 PM	Total	194	194	79	0	467	698	71	184	29	0	284	462
	PHF	0.88	0.97	0.86	0	0.95	0.95	0.93	0.88	0.66	0	0.93	0.9
	Approach %					24%	36%					15%	24%

Class.	Northbound (NH 28 Byasss) R	T	L	U	I	O	Eastbound (Tsienneto) R	T	L	U	I	O	Total		Crosswalk Pedestrians	Total
Lights	24	327	102	0	453	299	79	357	294	0	730	476	1927	SB	0	0
%	100%	98%	99%	0%	98%	99%	100%	99%	100%	0%	100%	99%	99%		0%	
Other Vehicles	0	6	1	0	7	3	0	2	0	0	2	5	16	WB	0	0
%	0%	2%	1%	0%	2%	1%	0%	1%	0%	0%	0%	1%	1%		0%	
Total	24	333	103	0	460	302	79	359	294	0	732	481	1943	NB	0	0
PHF	0.67	0.95	0.89	0	0.99	0.89	0.76	0.86	0.92	0	0.89	0.88	0.98		0%	
Approach %					24%	16%					38%	25%		EB	0	0
															0%	
															0	0

Project: Exit 4a SDEIS

Loc 19 Location: NH 102 -Tsienneto Rd

Growth rates:

Annual	2014->2015	1.025
	2016->2015	0.975

Seasonal:

Intersection Turning Movement Counts

		AM Peak	PM Peak
May-16	Adj Factor=	0.96	0.98

		2016- Raw AM Peak (700-800)	PM Peak (415-515)	2016 - AADT AM Peak (730-830)	Approach Totals	PM Peak (500-600)	Approach Totals	2015 - AADT AM Peak (745-845)	Approach Totals	PM Peak (445-545)	Approach Totals	2015 - AADT- Rounded AM Peak (745-845)	Approach Totals	PM Peak (445-545)	Approach Totals	
EB	LT	14	37	13	182	17	387	13	178	17	378	15	180	15	375	EB
	Thru	176	378	169		370		165		361		165		360		
	RT	0	0	0		0		0		0		0		0		
WB	LT	0	0	0	634	0	435	0	618	0	424	0	620	0	425	WB
	Thru	340	247	326		242		318		236		320		235		
	RT	321	197	308		193		300		188		300		190		
NB	LT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	NB
	Thru	0	0	0		0		0		0		0		0		
	RT	0	0	0		0		0		0		0		0		
SB	LT	102	283	98	98	277	284	96	96	270	277	95	95	270	275	SB
	Thru	0	7	0		7		0		7		0		5		
	RT	0	0	0		0		0		0		0		0		
	total	953	1129	914	914	1106	1106	892	892	1079	1079	895	895	1075	1075	

Use Seasonal Factor

Use Annual Factor

Use these in Synchro Existing Cond analyses

2015 Peak Hour Link Volumes based on TMC

Approach		AM Peak Inbound	Outbound	Total	PM Peak Inbound	Outbound	Total	2015 AADT	Adjusted 2015 AM Pk	Adjusted 2015 PM Pk	% AADT in AM Pk	% AADT in PM Pk
North	Tsienneto Rd SB	95	315	410	275	205	480	6209	464	501	6.60%	7.73%
South		0	0	0	0	0	0					
East	NH 102 WB, E. of Ts	620	260	880	425	630	1055	13647			6.60%	7.73%
West	NH 102 EB, W of Ts	180	320	500	375	240	615	7955			6.60%	7.73%
		895	895	1790	1075	1075	2150					

Notes - Adjusted 2015 AADT based on ATR counts for comparison purposes

Calculated 2015 AADT based on AM/PM k factors in red

k factors based on ratio of TMC volumes compared to adjusted 2015 AADT from ATR data

	SB LT	RT	WB TH	RT	EB LT	TH	Total
700-800	102	0	340	321	14	176	953
715-815							0
730-830							0
745-845							0
800-900							0

Time Period	Class.	Southbound (NH 102) R	T	U	I	O	Northbound (NH 102) T	L	U	I	O	Eastbound (Tsienneto Rd.) R	L	U	I	O	Total
Peak 1	Lights	318	332	0	650	258	158	12	0	170	332	0	100	0	100	330	920
Specified Period	%	99%	98%	0%	98%	93%	90%	86%	0%	89%	98%	0%	98%	0%	98%	99%	97%
7:00 AM - 9:15 AM	Other Vehicles	3	8	0	11	20	18	2	0	20	8	0	2	0	2	5	33
One Hour Peak	%	1%	2%	0%	2%	7%	10%	14%	0%	11%	2%	0%	2%	0%	2%	1%	3%
7:00 AM - 8:00 AM	Total	321	340	0	661	278	176	14	0	190	340	0	102	0	102	335	953
	PHF	0.79	0.85	0	0.82	0.93	0.92	0.88	0	0.91	0.85	0	0.94	0	0.94	0.81	0.9
	Approach %				69%	29%				20%	36%				11%	35%	

	LT	RT	TH	RT	LT	TH	Total
400-500							0
415-515	283	7	247	197	17	378	1129
430-530							0
445-545							0
500-600							0

Time Period	Class.	Southbound (NH 102) R	T	U	I	O	Northbound (NH 102) T	L	U	I	O	Eastbound (Tsienneto Rd.) R	L	U	I	O	Total
Peak 1	Lights	194	237	0	431	650	371	17	0	388	244	7	279	0	286	211	1105
Specified Period	%	98%	96%	0%	97%	98%	98%	100%	0%	98%	96%	100%	99%	0%	99%	99%	98%
4:00 PM - 6:15 PM	Other Vehicles	3	10	0	13	11	7	0	0	7	10	0	4	0	4	3	24
One Hour Peak	%	2%	4%	0%	3%	2%	2%	0%	0%	2%	4%	0%	1%	0%	1%	1%	2%
4:15 PM - 5:15 PM	Total	197	247	0	444	661	378	17	0	395	254	7	283	0	290	214	1129
	PHF	0.93	0.86	0	0.89	0.93	0.87	0.71	0	0.87	0.86	0.88	0.9	0	0.9	0.91	0.93
	Approach %				39%	59%				35%	22%				26%	19%	

CLD/Fuss & O'Neill Inc.

540 Commercial Street
Manchester, NH 03101

File Name : NShorePM
Site Code : 00777777
Start Date : 5/30/2017
Page No : 1

Groups Printed- CARS - Trucks

	From North					RT 102 From East					North Shore Rd From South					RT 102 From West					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
04:00 PM	0	0	0	0	0	4	88	0	0	92	21	0	6	0	27	0	110	14	0	124	243
04:15 PM	0	0	0	0	0	6	84	0	0	90	7	0	4	0	11	0	100	10	0	110	211
04:30 PM	0	0	0	0	0	10	99	2	0	111	17	0	7	0	24	0	93	15	0	108	243
04:45 PM	0	0	0	0	0	5	107	0	0	112	18	0	3	0	21	0	106	16	0	122	255
Total	0	0	0	0	0	25	378	2	0	405	63	0	20	0	83	0	409	55	0	464	952
05:00 PM	0	0	0	0	0	5	113	0	0	118	27	0	1	0	28	0	140	20	0	160	306
05:15 PM	0	0	0	0	0	11	107	0	0	118	16	0	3	0	19	0	145	22	0	167	304
05:30 PM	0	0	0	0	0	12	114	0	0	126	24	0	2	0	26	0	124	24	0	148	300
05:45 PM	0	0	0	0	0	7	103	0	0	110	27	0	2	0	29	0	143	15	0	158	297
Total	0	0	0	0	0	35	437	0	0	472	94	0	8	0	102	0	552	81	0	633	1207
Grand Total	0	0	0	0	0	60	815	2	0	877	157	0	28	0	185	0	961	136	0	1097	2159
Apprch %	0	0	0	0		6.8	92.9	0.2	0		84.9	0	15.1	0		0	87.6	12.4	0		
Total %	0	0	0	0	0	2.8	37.7	0.1	0	40.6	7.3	0	1.3	0	8.6	0	44.5	6.3	0	50.8	
CARS	0	0	0	0	0	60	815	2	0	877	156	0	28	0	184	0	961	136	0	1097	2158
% CARS	0	0	0	0	0	100	100	100	0	100	99.4	0	100	0	99.5	0	100	100	0	100	100
Trucks	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	1
% Trucks	0	0	0	0	0	0	0	0	0	0	0.6	0	0	0	0.5	0	0	0	0	0	0

	From North					RT 102 From East					North Shore Rd From South					RT 102 From West					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 05:00 PM																					
05:00 PM	0	0	0	0	0	5	113	0	0	118	27	0	1	0	28	0	140	20	0	160	306
05:15 PM	0	0	0	0	0	11	107	0	0	118	16	0	3	0	19	0	145	22	0	167	304
05:30 PM	0	0	0	0	0	12	114	0	0	126	24	0	2	0	26	0	124	24	0	148	300
05:45 PM	0	0	0	0	0	7	103	0	0	110	27	0	2	0	29	0	143	15	0	158	297
Total Volume	0	0	0	0	0	35	437	0	0	472	94	0	8	0	102	0	552	81	0	633	1207
% App. Total	0	0	0	0		7.4	92.6	0	0		92.2	0	7.8	0		0	87.2	12.8	0		
PHF	.000	.000	.000	.000	.000	.729	.958	.000	.000	.937	.870	.000	.667	.000	.879	.000	.952	.844	.000	.948	.986

CLD/Fuss & O'Neill Inc.

540 Commercial Street
Manchester, NH 03101

File Name : dshore
Site Code : 33333333
Start Date : 5/30/2017
Page No : 1

Groups Printed- Cars - Trucks

	From North					Rt 102 From East					North Shore RD From South					Rt 102 From West					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
07:00 AM	0	0	0	0	0	2	142	0	0	144	25	0	4	0	29	0	73	5	0	78	251
07:15 AM	0	0	0	0	0	3	133	0	0	136	16	0	3	0	19	0	68	3	0	71	226
07:30 AM	0	0	0	0	0	4	155	0	0	159	22	0	4	0	26	0	52	7	0	59	244
07:45 AM	0	0	0	0	0	1	161	0	0	162	18	0	5	0	23	0	65	2	0	67	252
Total	0	0	0	0	0	10	591	0	0	601	81	0	16	0	97	0	258	17	0	275	973
08:00 AM	0	0	0	0	0	2	138	0	0	140	20	0	3	0	23	0	53	1	0	54	217
08:15 AM	0	0	0	0	0	3	158	0	0	161	17	0	2	0	19	0	64	4	0	68	248
08:30 AM	0	0	0	0	0	2	131	0	0	133	15	0	1	0	16	0	23	1	0	24	173
08:45 AM	0	0	0	0	0	1	95	0	0	96	12	0	3	0	15	0	39	1	0	40	151
Total	0	0	0	0	0	8	522	0	0	530	64	0	9	0	73	0	179	7	0	186	789
Grand Total	0	0	0	0	0	18	1113	0	0	1131	145	0	25	0	170	0	437	24	0	461	1762
Apprch %	0	0	0	0		1.6	98.4	0	0		85.3	0	14.7	0		0	94.8	5.2	0		
Total %	0	0	0	0	0	1	63.2	0	0	64.2	8.2	0	1.4	0	9.6	0	24.8	1.4	0	26.2	
Cars	0	0	0	0	0	18	1109	0	0	1127	145	0	25	0	170	0	431	24	0	455	1752
% Cars	0	0	0	0	0	100	99.6	0	0	99.6	100	0	100	0	100	0	98.6	100	0	98.7	99.4
Trucks	0	0	0	0	0	0	4	0	0	4	0	0	0	0	0	0	6	0	0	6	10
% Trucks	0	0	0	0	0	0	0.4	0	0	0.4	0	0	0	0	0	0	1.4	0	0	1.3	0.6

Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1
Peak Hour for Entire Intersection Begins at 07:00 AM

	From North					Rt 102 From East					North Shore RD From South					Rt 102 From West					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
07:00 AM	0	0	0	0	0	2	142	0	0	144	25	0	4	0	29	0	73	5	0	78	251
07:15 AM	0	0	0	0	0	3	133	0	0	136	16	0	3	0	19	0	68	3	0	71	226
07:30 AM	0	0	0	0	0	4	155	0	0	159	22	0	4	0	26	0	52	7	0	59	244
07:45 AM	0	0	0	0	0	1	161	0	0	162	18	0	5	0	23	0	65	2	0	67	252
Total Volume	0	0	0	0	0	10	591	0	0	601	81	0	16	0	97	0	258	17	0	275	973
% App. Total	0	0	0	0		1.7	98.3	0	0		83.5	0	16.5	0		0	93.8	6.2	0		
PHF	.000	.000	.000	.000	.000	.625	.918	.000	.000	.927	.810	.000	.800	.000	.836	.000	.884	.607	.000	.881	.965

CLD/Fuss & O'Neill Inc.

540 Commercial Street
Manchester, NH 03101

File Name : englisham
Site Code : 00666666
Start Date : 5/31/2017
Page No : 1

Groups Printed- Cars - Trucks

	English Range RD From North					Rt 102 From East					From South					Rt 102 From West					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
07:00 AM	4	0	23	0	27	0	121	8	0	129	0	0	0	0	0	10	67	0	0	77	233
07:15 AM	2	0	17	0	19	0	140	4	0	144	0	0	0	0	0	20	49	0	0	69	232
07:30 AM	3	0	16	0	19	0	137	1	0	138	0	0	0	0	0	13	56	1	0	70	227
07:45 AM	1	0	19	0	20	0	152	3	0	155	0	0	0	0	0	11	49	0	0	60	235
Total	10	0	75	0	85	0	550	16	0	566	0	0	0	0	0	54	221	1	0	276	927
08:00 AM	3	0	17	0	20	0	92	3	0	95	0	0	0	0	0	9	48	0	0	57	172
08:15 AM	2	0	14	0	16	0	111	1	0	112	0	0	0	0	0	7	45	0	0	52	180
08:30 AM	2	0	7	0	9	0	107	2	0	109	0	0	0	0	0	11	38	0	0	49	167
08:45 AM	1	0	5	0	6	0	76	1	0	77	0	0	0	0	0	6	32	0	0	38	121
Total	8	0	43	0	51	0	386	7	0	393	0	0	0	0	0	33	163	0	0	196	640
Grand Total	18	0	118	0	136	0	936	23	0	959	0	0	0	0	0	87	384	1	0	472	1567
Apprch %	13.2	0	86.8	0		0	97.6	2.4	0		0	0	0	0		18.4	81.4	0.2	0		
Total %	1.1	0	7.5	0	8.7	0	59.7	1.5	0	61.2	0	0	0	0	0	5.6	24.5	0.1	0	30.1	
Cars	17	0	118	0	135	0	922	23	0	945	0	0	0	0	0	85	376	1	0	462	1542
% Cars	94.4	0	100	0	99.3	0	98.5	100	0	98.5	0	0	0	0	0	97.7	97.9	100	0	97.9	98.4
Trucks	1	0	0	0	1	0	14	0	0	14	0	0	0	0	0	2	8	0	0	10	25
% Trucks	5.6	0	0	0	0.7	0	1.5	0	0	1.5	0	0	0	0	0	2.3	2.1	0	0	2.1	1.6

Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1
Peak Hour for Entire Intersection Begins at 07:00 AM

	English Range RD From North					Rt 102 From East					From South					Rt 102 From West					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
07:00 AM	4	0	23	0	27	0	121	8	0	129	0	0	0	0	0	10	67	0	0	77	233
07:15 AM	2	0	17	0	19	0	140	4	0	144	0	0	0	0	0	20	49	0	0	69	232
07:30 AM	3	0	16	0	19	0	137	1	0	138	0	0	0	0	0	13	56	1	0	70	227
07:45 AM	1	0	19	0	20	0	152	3	0	155	0	0	0	0	0	11	49	0	0	60	235
Total Volume	10	0	75	0	85	0	550	16	0	566	0	0	0	0	0	54	221	1	0	276	927
% App. Total	11.8	0	88.2	0		0	97.2	2.8	0		0	0	0	0		19.6	80.1	0.4	0		
PHF	.625	.000	.815	.000	.787	.000	.905	.500	.000	.913	.000	.000	.000	.000	.000	.675	.825	.250	.000	.896	.986

CLD/Fuss & O'Neill Inc.

540 Commercial Street
Manchester, NH 03101

File Name : EnglishPM
Site Code : 00888877
Start Date : 6/5/2017
Page No : 1

Groups Printed- Cars - Trucks

	English range RD. From North					Rt 102 From East					From South					Rt 102 From West					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
04:00 PM	1	0	5	0	6	1	87	4	0	92	0	0	0	0	0	17	129	0	0	146	244
04:15 PM	4	0	12	0	16	0	82	1	1	84	0	0	0	0	0	8	115	0	0	123	223
04:30 PM	4	0	11	0	15	0	91	3	0	94	0	0	0	0	0	14	150	0	0	164	273
04:45 PM	3	0	10	0	13	0	129	1	0	130	0	0	0	0	0	9	130	0	0	139	282
Total	12	0	38	0	50	1	389	9	1	400	0	0	0	0	0	48	524	0	0	572	1022
05:00 PM	7	0	14	0	21	0	84	2	0	86	0	0	0	0	0	12	136	0	0	148	255
05:15 PM	4	0	8	0	12	0	81	5	0	86	0	0	0	0	0	5	123	0	0	128	226
05:30 PM	0	0	0	0	0	0	115	3	0	118	0	0	0	0	0	2	115	0	0	117	235
05:45 PM	3	0	3	0	6	0	103	1	0	104	0	0	0	0	0	3	119	0	0	122	232
Total	14	0	25	0	39	0	383	11	0	394	0	0	0	0	0	22	493	0	0	515	948
Grand Total	26	0	63	0	89	1	772	20	1	794	0	0	0	0	0	70	1017	0	0	1087	1970
Apprch %	29.2	0	70.8	0		0.1	97.2	2.5	0.1		0	0	0	0		6.4	93.6	0	0		
Total %	1.3	0	3.2	0	4.5	0.1	39.2	1	0.1	40.3	0	0	0	0	0	3.6	51.6	0	0	55.2	
Cars	26	0	63	0	89	0	764	20	1	785	0	0	0	0	0	69	1015	0	0	1084	1958
% Cars	100	0	100	0	100	0	99	100	100	98.9	0	0	0	0	0	98.6	99.8	0	0	99.7	99.4
Trucks	0	0	0	0	0	1	8	0	0	9	0	0	0	0	0	1	2	0	0	3	12
% Trucks	0	0	0	0	0	100	1	0	0	1.1	0	0	0	0	0	1.4	0.2	0	0	0.3	0.6

Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1
Peak Hour for Entire Intersection Begins at 04:30 PM

	English range RD. From North					Rt 102 From East					From South					Rt 102 From West					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
04:30 PM	4	0	11	0	15	0	91	3	0	94	0	0	0	0	0	14	150	0	0	164	273
04:45 PM	3	0	10	0	13	0	129	1	0	130	0	0	0	0	0	9	130	0	0	139	282
05:00 PM	7	0	14	0	21	0	84	2	0	86	0	0	0	0	0	12	136	0	0	148	255
05:15 PM	4	0	8	0	12	0	81	5	0	86	0	0	0	0	0	5	123	0	0	128	226
Total Volume	18	0	43	0	61	0	385	11	0	396	0	0	0	0	0	40	539	0	0	579	1036
% App. Total	29.5	0	70.5	0		0	97.2	2.8	0		0	0	0	0		6.9	93.1	0	0		
PHF	.643	.000	.768	.000	.726	.000	.746	.550	.000	.762	.000	.000	.000	.000	.000	.714	.898	.000	.000	.883	.918

APPENDIX B: SEASONAL, ANNUAL AND AXLE CORRECTION FACTORS

Year 2015 Monthly Data

Peak Hour Data
Group 4 Averages Urban Highways

	Data				Factors			
Month	AM	Mid	PM	Sat Mid	AM	Mid	PM	Sat Mid
Jan	17267	13564	20154	15524	1.11	1.14	1.11	1.17
Feb	17366	13436	20253	17441	1.10	1.16	1.11	1.05
Mar	19827	14389	22267	16671	0.97	1.08	1.01	1.09
Apr	19924	15214	22733	18484	**0.96**	1.02	**0.99**	0.99
May	20046	16198	23476	18916	**0.96**	0.96	**0.96**	0.96
Jun	19952	16451	23779	19485	0.96	0.94	0.94	0.94
Jul	18444	17126	23314	18349	1.04	0.91	0.96	0.99
Aug	18720	16672	23360	19436	1.02	0.93	0.96	0.94
Sep	20260	16000	23092	19374	0.95	0.97	0.97	0.94
Oct	20391	15823	23465	18951	0.94	0.98	0.96	0.96
Nov	19208	15635	21905	17902	1.00	0.99	1.02	1.02
Dec	18348	15787	21589	18339	1.04	0.98	1.04	0.99
Average	19146	15525	22449	18239				

Factors are based on Average Month.

NHDOT Seasonal Adjustment Factors by Roadway Group - 2015

StartDate	FinDate	Group1 Rural Interstate	Group2 Rural Highways	**Group3** Urban Interstate	**Group4** Urban Highways	Group5 Recreational Highways	Group6 Other Recr Highways
1/1/2015	1/2/2015	1.18	1.35	1.24	1.32	1.21	1.35
1/1/2015	1/9/2015	1.35	1.16	1.10	1.02	1.31	1.83
1/12/2015	1/16/2015	1.23	1.12	1.05	1.00	1.21	1.82
1/19/2015	1/23/2015	1.15	1.07	1.02	0.99	1.19	1.59
1/26/2015	1/30/2015	1.67	1.34	1.39	1.27	1.59	2.24
2/2/2015	2/6/2015	1.43	1.20	1.21	1.13	1.40	2.18
2/9/2015	2/13/2015	1.37	1.18	1.17	1.09	1.33	2.10
2/16/2015	2/20/2015	1.11	1.09	1.01	1.01	1.15	1.42
2/23/2015	2/27/2015	1.17	1.10	1.04	1.02	1.17	1.50
3/2/2015	3/6/2015	1.20	1.10	1.04	0.99	1.21	1.50
3/9/2015	3/13/2015	1.14	1.06	0.99	0.96	1.15	1.45
3/16/2015	3/20/2015	1.17	1.09	1.02	0.99	1.20	1.45
3/23/2015	3/27/2015	1.20	1.07	1.02	0.96	1.22	1.55
3/30/2015	4/3/2015	1.15	1.04	0.99	0.94	1.19	1.49
4/6/2015	4/10/2015	1.21	1.07	1.01	0.96	1.25	1.67
4/13/2015	4/17/2015	1.18	1.02	0.99	0.92	1.16	1.52
4/20/2015	4/24/2015	1.11	1.03	0.97	0.93	1.13	1.53
4/27/2015	5/1/2015	1.18	1.01	1.00	0.95	1.15	1.57
5/4/2015	5/8/2015	1.10	0.93	**0.95**	**0.88**	1.02	1.32
5/11/2015	5/15/2015	1.07	0.93	0.94	0.89	1.01	1.36
5/18/2015	5/22/2015	0.98	0.91	0.91	0.88	0.93	1.23
5/25/2015	5/29/2015	0.98	0.93	**0.96**	0.93	0.93	1.08
6/1/2015	6/5/2015	1.07	0.94	0.94	0.89	0.98	1.29
6/8/2015	6/12/2015	1.00	0.90	0.92	0.87	0.92	1.08
6/15/2015	6/19/2015	0.92	0.87	0.89	0.87	0.75	0.85
6/22/2015	6/26/2015	0.90	0.88	0.88	0.88	0.86	0.83
6/29/2015	7/3/2015	0.83	0.86	0.89	0.90	0.77	0.73
7/6/2015	7/10/2015	0.83	0.85	0.87	0.89	0.74	0.73
7/13/2015	7/17/2015	0.83	0.85	0.86	0.88	0.77	0.73
7/20/2015	7/24/2015	0.80	0.84	0.85	0.87	0.73	0.68
7/27/2015	7/31/2015	0.80	0.83	0.85	0.88	0.75	0.66
8/3/2015	8/7/2015	0.78	0.83	0.84	0.88	0.73	0.64
8/10/2015	8/14/2015	0.78	0.86	0.84	0.89	0.75	0.65
8/17/2015	8/21/2015	0.80	0.85	0.85	0.89	0.76	0.67
8/24/2015	8/28/2015	0.85	0.88	0.88	0.89	0.82	0.79
8/31/2015	9/4/2015	0.88	0.87	0.90	0.88	0.86	0.90
9/7/2015	9/11/2015	0.88	0.89	0.92	0.94	0.87	0.92
9/14/2015	9/18/2015	0.96	0.91	0.91	0.90	0.92	0.94
9/21/2015	9/25/2015	0.97	0.91	0.91	0.89	0.94	1.05
9/28/2015	10/2/2015	1.02	0.93	0.93	0.91	0.98	1.08
10/5/2015	10/9/2015	0.92	0.89	0.90	0.90	0.85	0.91
10/12/2015	10/16/2015	0.88	0.89	0.89	0.90	0.87	0.92
10/19/2015	10/23/2015	1.06	0.95	0.94	0.92	1.04	1.29
10/26/2015	10/30/2015	1.12	0.98	0.96	0.92	1.11	1.49
11/2/2015	11/6/2015	1.13	0.97	0.96	0.92	1.11	1.49
11/9/2015	11/13/2015	1.15	1.01	0.98	0.94	1.16	1.68
11/16/2015	11/20/2015	1.16	1.01	0.96	0.93	1.16	1.71
11/23/2015	11/27/2015	1.03	1.05	1.01	1.06	1.15	1.46
11/30/2015	12/4/2015	1.20	1.03	0.97	0.94	1.21	1.79
12/7/2015	12/11/2015	1.18	1.03	0.96	0.93	1.19	1.69
12/14/2015	12/18/2015	1.13	0.99	0.94	0.92	1.17	1.69
12/21/2015	12/25/2015	1.17	1.12	1.05	1.05	1.26	1.56
1/1/2016	1/1/2016	1.10	1.19	1.09	1.14	1.22	1.23

NHDOT Axle Correction Factors
by Functional Classification - 2015

	AcfYear	FC	Description	Factor
Rural	2015	01		0.908
	2015	02		0.962
	2015	06		0.967
	2015	07		0.959
	2015	08		0.993
	2015	09		0.997
Urban	2015	11	Interstate	0.953
	2015	12	Freeways/ Expressways	0.956
	2015	14	Principle Arterials	0.973
	2015	16	Minor Arterials	0.981
	2015	17	Collectors	0.989
	2015	19	Local Streets	0.987
	2015	00		1.000

APPENDIX C: INTERSTATE COUNTS AND BALANCING CALCULATIONS AT RAMP TERMINALS

I-93 Interstate Balancing based on ATR and TMC counts - 2015 and 2016

Last revision Date: **7/29/2016**

	Using May 2015 counts	AWDT =	7-8 AM	% AWDT	5-6 PM	% AWDT
Total	AVG Weekday	76490	5533	7.23%	5997	7.84%
NB	AVG Weekday	38078	2021	5.31%	3483	9.15%
SB	AVG Weekday	38412	3512	9.14%	2515	6.55%

Seasonal Adjustment factor to 2015 AADT= **0.98**

2015 adj AAWDT - I-93 South of Exit 4 at Windham TL

	7-8 AM	5-6 PM
Total	5420	5880
NB	1980	3410
SB	3440	2460

	Using May 2016 counts	7-8 AM	5-6 PM
Total	AVG Weekday	5567	6113
NB	AVG Weekday	2246	3601
SB	AVG Weekday	3321	2512

Ann/Seasonal Adjustment factor to 2015 AADT= **0.9702**

0.99 2016->2015
0.98 May->AADT

2015 AAWDT - I-93 South of Exit 4 at Windham TL

	7-8 AM	5-6 PM
Total	5400	5930
NB	2180	3490
SB	3220	2440

Ramp counts			May-16 AWDT	7-8 AM	% AWDT	5-6 PM	% AWDT	2015 AWDT (adj) 7-8 AM	5-6 PM
May-16	Exit 4	NB Off	11321	422	3.73%	1223	10.80%	409	1187
		NB on	11380	1091	9.59%	812	7.14%	1058	788
		SB off	10893	776	7.12%	952	8.74%	753	924
		SB on E-S	5865	687	11.71%	311	5.30%	667	302
		SB on W-S	5265	534	10.14%	244	4.63%	518	237
	Exit 5	NB Off	6251	422	6.75%	472	7.55%	409	458
		NB on	10661	1008	9.46%	793	7.44%	978	769
		SB off	10574	781	7.39%	939	8.88%	758	911
		SB on	6233	532	8.54%	427	6.85%	516	414

SB off vol fr/7-8 on 5/24 appears inconsistent - use AWDT for that hour

NOTE: Peak Hr Vol either day of TMC or AWDT from May count

2015 AWDT - Mainline I-93
AM Peak

	START I93 S of E4	SUBTRACT E4 NB off	ADD E4 NB on		I93 NB N of E4	SUBTRACT E5 NB off	ADD E5 NB on	I93 NB N of E5	
NB	1980	409	1058		2629	409	978	3198	
	1980	410	1060		2630	410	980	3200	rounded
	START I93 S of E4	**SUBTRACT** E4 SB on E-S	**SUBTRACT** E4 SB on W-S	**ADD** E4 SB off	**I93 SB** N of E4	**SUBTRACT** E5 SB on	**ADD** E5 SB off	**I93 SB** N of E5	
SB	3440	667	518	753	3008	516	758	3250	
	3440	665	520	755	3010	515	760	3255	rounded

2015 AWDT - Mainline I-93
PM Peak

	START I93 S of E4	SUBTRACT E4 NB off	ADD E4 NB on		I93 NB N of E4	SUBTRACT E5 NB off	ADD E5 NB on	I93 NB N of E5	
NB	3410	1187	788		3011	458	769	3322	
	3410	1185	790		3015	460	770	3325	rounded
	START I93 S of E4	**SUBTRACT** E4 SB on E-!	**SUBTRACT** E4 SB on W-	**ADD** E4 SB off	**I93 SB** N of E4	**SUBTRACT** E5 SB on	**ADD** E5 SB off	**I93 SB** N of E5	
SB	2460	302	237	924	2845	414	911	3342	
	2460	300	215	925	2870	415	910	3365	rounded

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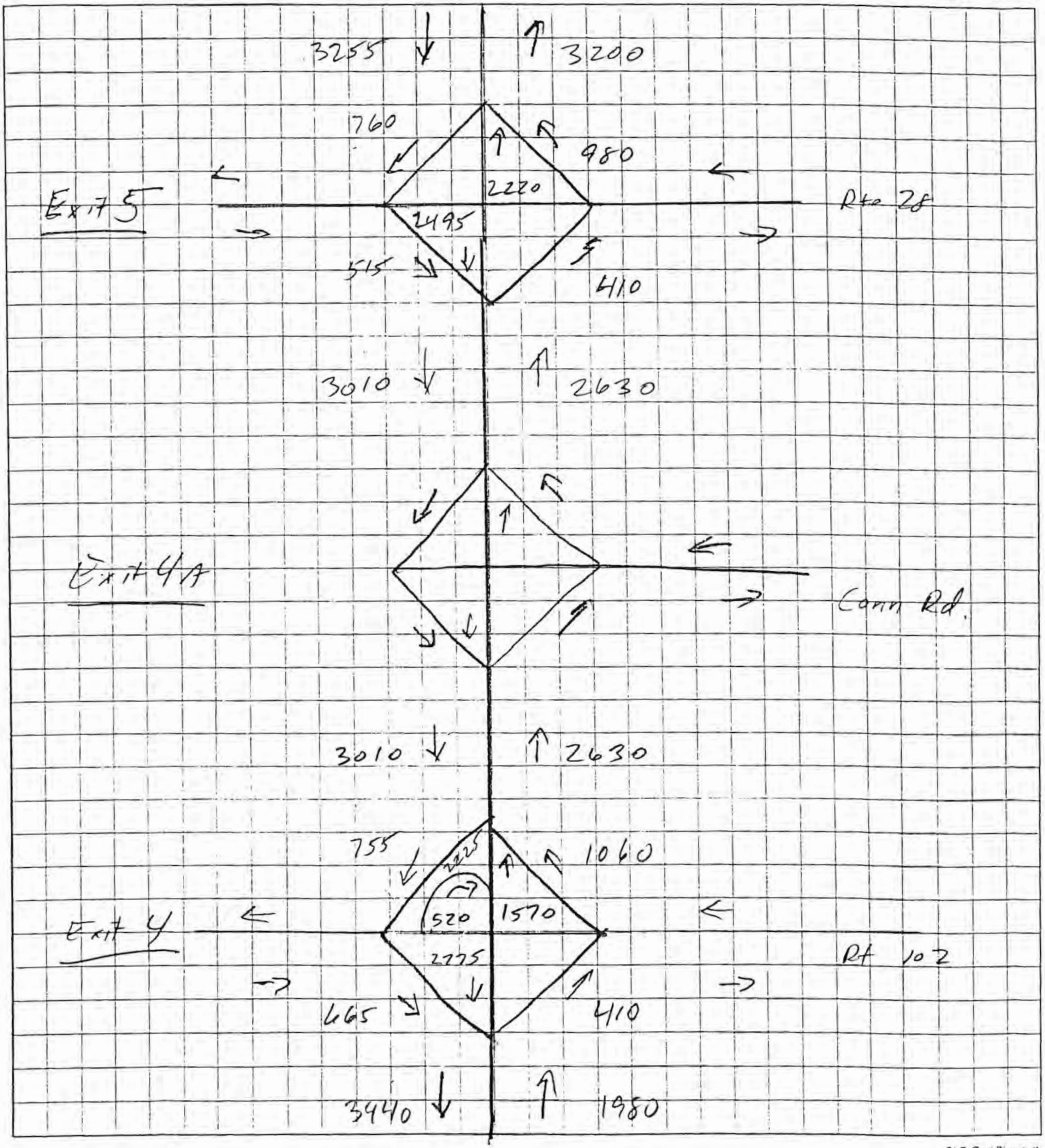
JOB Exit 4A SDEIS JOB NO 05-0244
SHEET NO OF
CALCULATED BY PK DATE 7-27-16
CHECKED BY CCG DATE 8/7/16
SUBJECT 2015 AM Peak - Exist. w/ ATRs SCALE AWDT



CLD Grid Sheet.xlt

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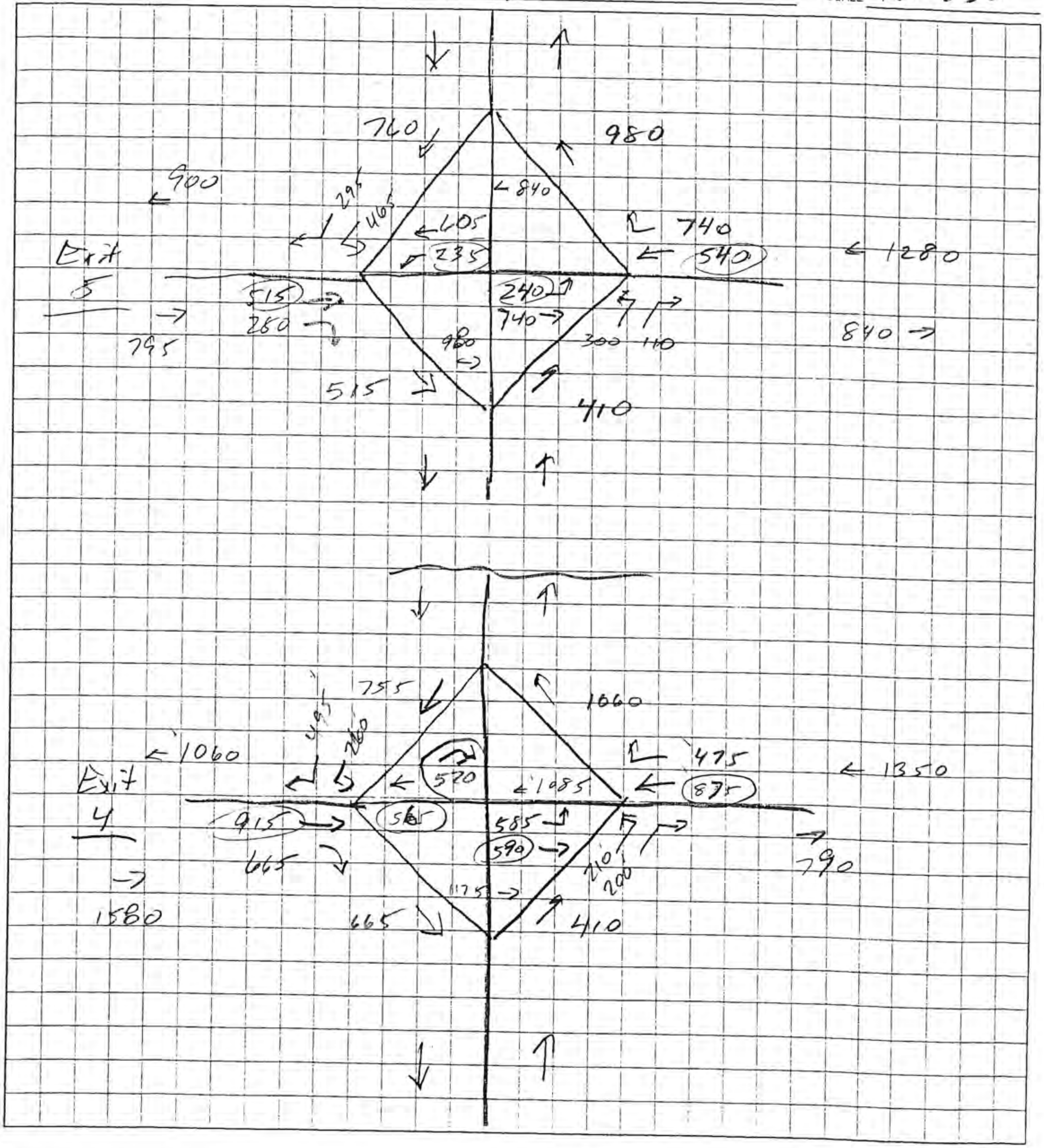
JOB Exit 4A JOB NO
SHEET NO OF
CALCULATED BY PK DATE 7-27-16
CHECKED BY LCG DATE 8/7/16
SUBJECT 2015 AM Peak - Balanced SCALE 730-830



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JOB Exit 4A traffic JOB NO. 05-244
SHEET NO ______ OF ______
CALCULATED BY PK DATE 7-27-16
CHECKED BY LCG DATE 8/7/16

730-830 SUBJECT Balanced Exit 4 volumes SCALE AM PK

1) Start @ NB off ramp intx — NB off = 410
NB on = 1060

NB off fr/TMC LT = 219 → 210
RT = 210 → 200
429 → 410 (x .9557)

NB on fr/TMC LT on = 562 → 585
RT on = 455 → 475
1017 → 1060 (x 1.0423)

2) SB off/on ramps SB on (W-S) = 520 ✓
SB on (E-S) = 665 ✓
SB off = 755

SB off fr/TMC LT = 267 → 260
RT = 503 → 495
770 → 755 (x 0.9805)

3) EB traffic - Start @ NB ramps + Proportional growth
LT 562 → 588 (x 1.0409)
EB th 568 → 590
1130 → 1175 − 260 (LT fr/SB off) = 915 EB thru @ SB ramp.

4) WB traffic - Start @ NB ramp
WB th 836 → 875 + 210 (LT off) = 1085 − 520 (RT on)
WB RT 455 → 475 = 565 WB thru @ SB ramp.
1291 → 1350
(x 1.0439)

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JOB Exit 4a JOB NO 05-244
SHEET NO ______ OF ______
CALCULATED BY PK DATE 7-27-16
CHECKED BY LCG DATE 8/7/16
SUBJECT Balanced Exit 5 volumes - AM SCALE 730-830 TMC

1) Balance exit volumes between ramps + counts are close -

EB - 959 dep @ SB, 951 arr @ NB 959/951 = 1.008

f/TMC @ NB ramp EB LT = 216 218 (220) check
EB th = 735 741 740
951 → 959 → 960 rounded

WB - 842 dep fr/NB, 830 arr @ SB 842/830 = 1.0145

f/TMC @ SB ramp WB LT = 192 195 195
WB th = 638 647 645
830 → 842 → 840 rounded

2) NB off ramp f/TMC LT off = 273 300 840 - 300 = 540 WB th
RT off = 100 110
373 → 410 (×1.0992)

NB on ramp f TMC LT on 214 (.24) (240)
RT on 672 (.76) 740
886 → 980 (×1.1036)

3) SB off ramp f/tmc LT off 496 465
RT off 319 295
815 → 760 (×.9325)

4) SB on ramp (f/TMC) LT on 192 235
RT on 226 280
418 → 515 (×1.232)

EB thru (240 + 740) = 980 - 465 = 515 EB th
LT

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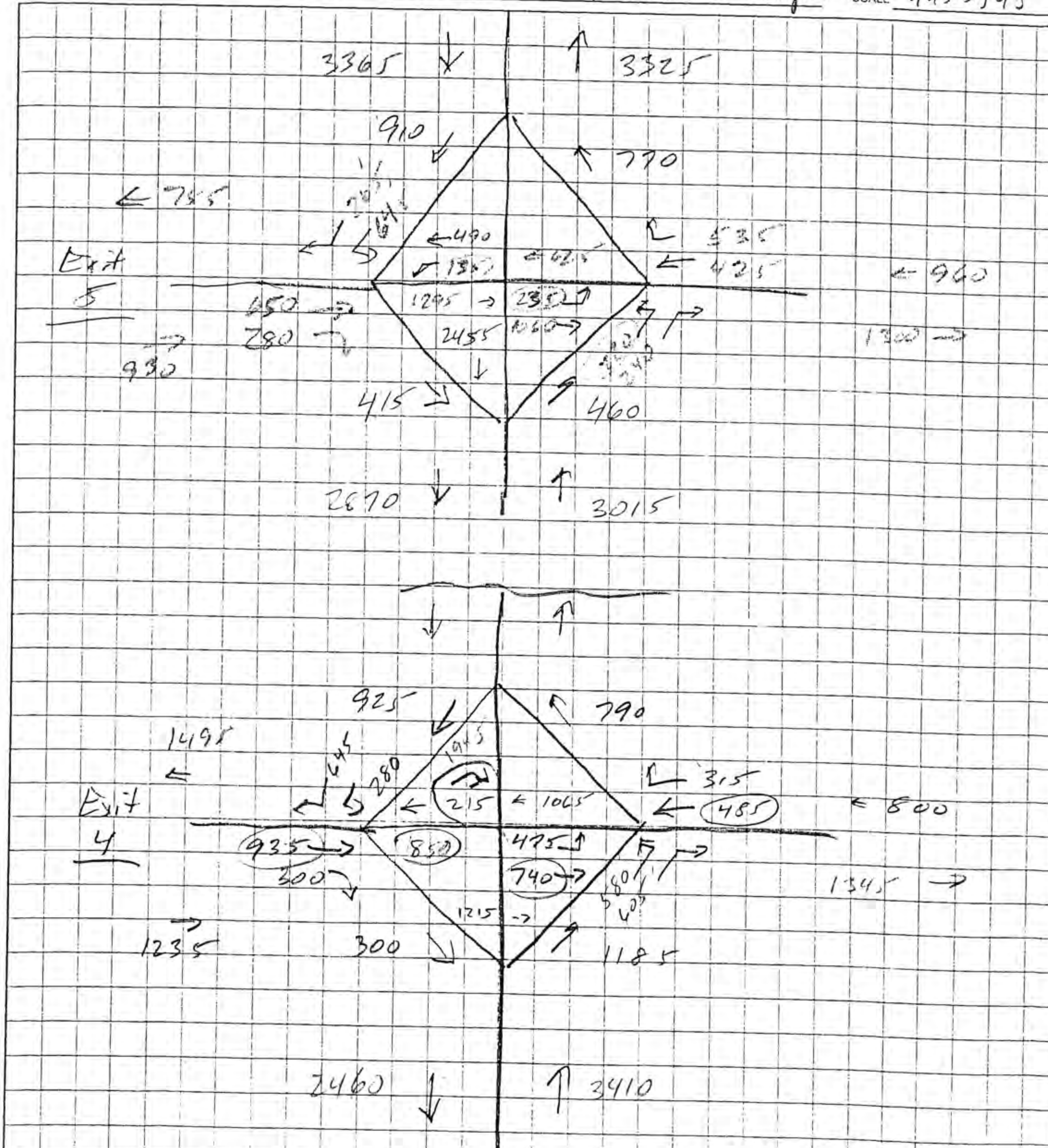
JOB Exit 4A JOB NO 05-244
SHEET NO 1 OF 1
CALCULATED BY PK DATE 7-27-16
CHECKED BY LCG DATE 8/7/16
SUBJECT 2015 PM Peak - Balanced ramps SCALE 445-545



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JOB Exit 4A JOB NO 05-244
SHEET NO OF
CALCULATED BY DK DATE 7-27-16
CHECKED BY LCG DATE 8/7/16
445-545 SUBJECT Balanced Exit 4 volumes SCALE PM Pk

1) Start @ NB off ramp - NB off = 1185
NB on = 740

NB off (f/ TMC)
LT = 535 (.49) 580
RT = 558 (.51) 605
1093 → 1185 (+1.084)

NB on (f/ TMC)
LT on 536 (.60) 475
Rt on 353 (.40) 315
889 → 790 (x .886)

2) SB on/off ramps (f/ ATR)
SB on (W-S) = 215
SB on (E-S) = 300
SB off = 925

SB off (f/ TMC)
LT 300 (.31) 280
RT 683 (.69) 645
983 → 925 (x 0.941)

3) EB traffic - Start @ NB ramp TMC - Proportional growth

LT = 536 → 475 (x 0.886)
EB Th = 835 740
1371 1215 - 280 (SB LT off) = 935

4) WB traffic - Start @ NB ramp TMC

WB Th = 542 485 + 580 (NB LT) = 1065 - 215 (SB on)
WB RT = 353 → 315 (x 0.8924) = 850 WB Thr. @ SB ramp
895 800

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JOB Exit 4a JOB NO 05-244
SHEET NO 1 OF 2
CALCULATED BY PK DATE 7-29-06
CHECKED BY LCG DATE 8/7/10
SUBJECT Balanced Exit I volumes - PM SCALE 445 3-45 TMC

1) Balance exits TMC (between ramps) - counts were close

EB - 1531 dep left SB ramp → 1337 arriving @ NB ramp

left TMC	LT off	690	692	695
@ SB ramp	EB thru	641	644	645
		1331	→ 1337	→ 1340
			(×1.0045)	

WB - 611 dep left NB ramp → 598 arriving @ SB ramp

left TMC	WB LT	116	119	120
@ SB ramp	WB Th	482	492	490
		598	→ 611	→ 610
			(×1.0217)	

2) NB off ramp (left TMC)

LT off	210	218	(219)
RT off	233	242	241
	443	→ 460	460
		(×1.0384)	

NB on ramp (left TMC)

LT on	228	236	→ 235	+15
RT on	515	534	535	
	743	→ 770	770	
		(×1.0363)		

3) SB off ramp left TMC

LT off	640	643	→ 645	-50
RT off	287	267	265	
	927	→ 910	910	
		(×0.9814)		

SB on ramp (left TMC)

LT on	116	133	135	+15
RT on	247	282	→ 280	
	363	→ 415	415	
		(×1.143)		

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JOB: Exit 4a
JOB NO: [illegible]
SHEET NO: 2 OF 2
CALCULATED BY: [illegible] DATE: 7.29.10
CHECKED BY: LCG DATE: 8/7/16
SUBJECT: Balance Exit 5 volumes - PM
SCALE:

4) Adjust EB + WB thru vol to match TMC @ ramp

EB through + NB ramp LT ... = 235 ...
EB Thru = 1110 (base) - 50 = 1060
1345 | 235 | 1295

EB through LT SB ... 645 (adj LT ramp) (+50)
645 EB Th
1290 (- 55) | 645 | 650 | 1295

WB through SB ramp
LT on 1385 (+15)
WB Thr 490
1875 - 220 (WB LT) = 425 WB Thr @ WB ramp

APPENDIX D: TRAVEL DEMAND FORECAST MODEL DEVELOPMENT AND CALIBRATION REPORT – SOUTHERN NH PLANNING COMMISSION, JANUARY 2018

Travel Demand Forecast Model Development and Calibration Report for I-93 Exit 4A Supplemental Draft Environmental Impact Statement

Prepared by the Southern NH Planning Commission and CLD/Fuss & O'Neill

January, 2018

Table of Contents

1. INTRODUCTION

The report serves the purpose of documenting the methodology for development and calibration of the travel demand model for the update of I-93 Exit 4A SDEIS. The report includes development and calibration for the 2015 24-hour base year model, and development for 2040 No-Build 24-hour model. This report doesn't include detailed network and land use description for 2040 build scenarios, alternative A, B, C, D, E and F, because this information is included in the traffic and land use reports prepared by CLD|Fuss & O'Neill and Louis Berger.

2. 2015 BASE YEAR MODEL

2.1 Network

The updated 2015 base year regional travel demand model was built based on the 2010 base year SNHPC regional model. The 2010 Travel Demand Forecast Model Development and Calibration Report [1] detailed development and calibration of the 2010 model. The model covers fifteen communities: Auburn, Bedford, Candia, Chester, Deerfield, Derry, Francestown, Goffstown, Hooksett, Londonderry, Manchester, New Boston, Raymond, Weare, and Windham. The change to the functional classification system for roadway system was incorporated into the 2015 base year model due to changes to the urbanized area from the 2010 U.S. Census. In addition, projects completed between 2010 and 2015, the Manchester Airport Access Road, Pettengill Road in Londonderry, NH 28 Manchester Road improvement in Derry, Hooksett Open Road Tolling, I-93 Exit 5 reconstruction, US 3/NH 28 widening in Hooksett, I-93 Exit 3 area reconstruction, were added to the 2015 model.

2.2 Traffic Analysis Zone (TAZ) System

The fifteen communities in the model area were disaggregated into 306 internal TAZs in the 2010 model. To better reflect traffic patterns around the I-93 Exit 4A study area, TAZs 69 in Londonderry, 123, 124, 125 and 133 in Derry were split into additional smaller TAZs indicated in Table 1. Layouts of these TAZs are displayed in Appendix A.

Table 1 TAZ Splits

TAZ 2010	TAZ 2015 for I-93 Exit 4A
69	69A, 69B and 69C
123	123A and 123B
124	124A, 124B, and 124C
125	125A and 125B
133	133A and 133B

2.3 Population and Households

Population estimates from 2015 Population Estimates of New Hampshire Cities and Towns prepared by the New Hampshire Office of Strategic Initiatives (NHOSI) [2] were used for the 2015 base year model. A summary table including 2015 population estimates for communities within the model area from the NHOSI estimates is presented in Appendix D. Dwelling units collected by SNHPC annually that were issued Certification of Occupancy between 2010 and 2015 by communities were used in allocating change in population into TAZs, and calculating number of households in a TAZ.

The formula used for calculating dwelling unit increases between April 2010 (Census day on April 1) and December 31, 2015 is shown below.

$$\Delta \boldsymbol{D}_{\boldsymbol{TAZ}} = \Delta \boldsymbol{D}_{\boldsymbol{2015TAZ}} + \Delta \boldsymbol{D}_{\boldsymbol{2014TAZ}} + \Delta \boldsymbol{D}_{\boldsymbol{2013TAZ}} + \Delta \boldsymbol{D}_{\boldsymbol{2012TAZ}} + \Delta \boldsymbol{D}_{\boldsymbol{2011TAZ}} + \frac{\boldsymbol{3}}{\boldsymbol{4}} \Delta \boldsymbol{D}_{\boldsymbol{2010TAZ}})$$

Where:

ΔD_{TAZ}=Increase of dwelling units in a TAZ between April 1, 2010 and December 31, 2015

$\Delta D_{2015TAZ}$= Increase of dwelling units in a TAZ in 2015

$\Delta D_{2014TAZ}$= Increase of dwelling units in a TAZ in 2014

$\Delta D_{2013TAZ}$= Increase of dwelling units in a TAZ in 2013

$\Delta D_{2012TAZ}$= Increase of dwelling units in a TAZ in 2012

$\Delta D_{2011TAZ}$= Increase of dwelling units in a TAZ in 2011

$\Delta D_{2010TAZ}$= Increase of dwelling units in a TAZ in 2010

2015 dwelling units were calculated as follows:

$$\boldsymbol{D}_{\boldsymbol{2015TAZ}} = \boldsymbol{D}_{\boldsymbol{2010TAZ}} + \Delta \boldsymbol{D}_{\boldsymbol{TAZ}}$$

The 2015 population in TAZs were calculated by allocating the difference in population between 2010 and 2015 in a community. If the population increased during 2010-2015, the following formula was used.

$$\boldsymbol{P}_{\boldsymbol{2015TAZ}} = \boldsymbol{P}_{\boldsymbol{2010TAZ}} + (\boldsymbol{P}_{\boldsymbol{2015com}} - \boldsymbol{P}_{\boldsymbol{2010com}}) * \frac{\Delta \boldsymbol{D}_{\boldsymbol{TAZ}}}{\Delta \boldsymbol{D}_{\boldsymbol{com}}}$$

Where:

$P_{2015TAZ}$=2015 population in a TAZ

$P_{2010TAZ}$=2010 population in a TAZ

$P_{2015com}$=2015 population in the community (NHOEP estimates) in which the TAZ located

$P_{2010com}$=2010 population in the community (2010 US Census) in which the TAZ located

ΔD_{TAZ}=Increase of dwelling units in a TAZ between April 1, 2010 and December 31, 2015

ΔD_{com}=Increase of dwelling units in the community in which the TAZ located between April 1, 2010 and December 31, 2015

The 2015 population in TAZs were calculated by allocating the difference of population between 2010 and 2015 in a community. If the population decreased during 2010-2015, the following formula was used.

$$\boldsymbol{P}_{\boldsymbol{2015TAZ}} = \boldsymbol{P}_{\boldsymbol{2010TAZ}} + \Delta \boldsymbol{P}_{\boldsymbol{DWTAZ}} + (\boldsymbol{P}_{\boldsymbol{2015com}} - \boldsymbol{P}_{\boldsymbol{2010com}} - \Delta \boldsymbol{P}_{\boldsymbol{DWcom}}) * \frac{\boldsymbol{D}_{\boldsymbol{2015TAZ}}}{\boldsymbol{D}_{\boldsymbol{2015com}}}$$

Where:

$P_{2015TAZ}$=2015 population in a TAZ

$P_{2010TAZ}$=2010 population in a TAZ

$P_{2015com}$=2015 population in the community (NHOEP estimates) in which the TAZ located

$\Delta P_{DWTAZ} = \frac{P_{2010TAZ}}{HH_{2010TAZ}} * \Delta D_{TAZ}$ – Assume population change in a TAZ due to dwelling units change between 2010 and 2015

$HH_{2010TAZ}$=2010 number of households in a TAZ

$\Delta P_{DWcom} = \sum \Delta P_{TAZ}$ – Assume population change in the community in which the TAZ located due to dwelling units change between 2010 and 2015

$P_{2010com}$=2010 population in the community (2010 US Census) in which the TAZ located

$D_{2015TAZ}$=2015 dwelling units in a TAZ

$D_{2015com}$=2015 dwelling units in the community in which the TAZ located

Number of households in a TAZ was calculated as follows.

$$HH_{2015TAZ} = D_{2015TAZ} * OR_{2010TAZ}$$

Where:

$HH_{2015TAZ}$=2015 number of households in a TAZ

$D_{2015TAZ}$=2015 dwelling units in a TAZ

$OR_{2010TAZ}$=2010 Occupancy rate in a TAZ

2.4 Student Enrollment

School enrollments for 2014-2015 for all elementary, middle and high schools in the region were collected from the New Hampshire Department of Education. College enrollments were collected by contacting colleges in the region.

2.5 Employment

The quarterly employment of 2015 for each community in the region including first, second, third and fourth quarters was downloaded from the New Hampshire Employment Security (NHES) website. A Summary table containing these data is shown in Appendix E.

The average annual employment for communities was calculated by averaging the four quarters of employment. Considering that the 2010 SNHPC employment for model input calculated directly from the employer database is slightly higher than NHES's annual average, the 2015 annual employment was adjusted to reflect the difference between the two data sets. The adjustment was made according to the following equation.

$$E_{2015comadjusted} = E_{2015comNHES} + (E_{2010comSNHPC} - E_{2010comNHES})$$

Where:

$E_{2015comadjusted}$ =Adjusted 2015 employment in a community

$E_{2015comNHES}$ =2015 employment average in a community based on NHES data

$E_{2010comNHES}$ =2010 employment average in a community based on NHES data

$E_{2010comSNHPC}$ =2015 employment average in a community based on SNHPC employment database

Building permits issued 2011-2015 were used to identify new businesses in a TAZ. Employment in a new building was estimated based on a similar business type in 2010 employment database obtained from NHES. Employment in businesses we were aware closed during 2011-2015 was estimated based on the 2010 employment database.

To allocate the difference between 2010 and 2015 to TAZs by employment category, the following formula was used.

$$E_{2015TAZ-EC} = E_{2010TAZ-EC} + \Delta E_{DWTAZ-EC} + (E_{Ann2015} - E_{Ann2010} - \Delta E_{DW2011-2015}) * (E_{2010TAZ-EC}/E_{Ann2010})$$

Where:

$E_{2015TAZ-EC}$=2015 Employment in a TAZ by employment category group

$E_{2010TAZ-EC}$=2010 Employment in a TAZ by employment category group

$\Delta E_{DWTAZ-EC}$=Assumed Change of Employment in a TAZ by employment category group due to number of building permits change between 2010 and 2015

$E_{Ann2015}$=2015 Annual employment in the community in which TAZ located

$E_{Ann2010}$=2010 Annual employment in the community in which TAZ located

$\Delta E_{DW2011-2015}$ = Change of employment in the community due to number building permits change between 2010 and 2015

2.6. Base Year Model Calibration and Validation

Highway assignment is crucial for models to produce traffic volume estimates within acceptable ranges of tolerance compared to actual ground counts. For detailed model calibration and validation methodology information, refer to 2010 Travel Demand Forecast Model Development and Calibration Report for the Southern New Hampshire Planning Commission [1]. Model calibration and validation results for the 2015 base year are as follows.

- The difference of Vehicle Mile Traveled (VMT) estimates between the model and the Highway Performance Monitoring System (HPMS) is 1.28%, which is acceptable according to the Model Validation and Reasonableness Checking Manual [3], which is allowed a 3% difference by Environmental Protection Agency (EPA).

- The Coefficient of Determination (R^2) region wide equals 0.91 which is greater than the Model Validation and Reasonableness Checking Manual [3] recommended, which is 0.88 for all roadways with functional class collector and higher. Percent Root Mean Square of the Error (% RMSE) equals 27.28 for all roadways with functional class collector and higher which is less than the commonly accepted standard of 30 [3].
- Absolute percentage differences of total observed versus model estimated volumes at a Merrimack River screen line crossing and external station cordon line crossings are less than 2%.
- Absolute percentage differences of observed versus model estimated volumes at locations within I-93 Exit 4A area shown in Appendix C are within acceptable ranges of tolerance based on FHWA targets [3].

3. FUTURE YEAR 2040 NO-BUILD MODEL

3.1 Network

2040 No-Build model network was built by adding projects documented in Regional Transportation Plan 2017-2040 for the SNHPC Region [6] to the 2015 base year model except I-93 Exit 4A project. The list of the projects is shown in Appendix B.

3.2 Population and Households

Population projections used in the 2040 No-Build model were based on the State of New Hampshire County Population Projections 2015-2040 By Municipality [5] prepared by New Hampshire Office of Strategic Initiatives (NHOSI) in partnership with the state's Regional Planning Commissions and additional adjustments to NHOSI projections were made according to the final numbers in the Land Use Scenarios Report [4] to reflect additional population and households for relevant 2040 No-Build development projects. The population projections from 2015 through 2040 for each community in the region from the NHOSI projections are presented in Appendix D.

Due to the fact that numbers of dwelling units changes in five-year increments was used in distributing population changes to TAZs, and calculating numbers of households in a TAZ, SNHPC dwelling unit projections for 2010 through 2040 (Completed 2012) were adjusted for 2020 through 2040 to reflect number of dwelling units change between 2010 and 2015. An assumption was made that numbers of dwelling unit growth rates 2015-2040 were kept the same as the 2012 Southern NH Planning Commission dwelling unit projection for 2010-2040, which were reviewed by corresponding communities in the region. Two conditions were considered as the population was allocated to TAZs: 1) population increase in a five-year period; 2) Population decrease in a five-year period.

Condition one

When the population increases during a five-year period, the allocation is calculated using the following formula.

$$\Delta \boldsymbol{P}_{\boldsymbol{TAZ}} = \frac{\Delta \boldsymbol{P}_{\boldsymbol{com}}}{\Delta \boldsymbol{D}_{\boldsymbol{com}}} * \Delta \boldsymbol{D}_{\boldsymbol{TAZ}}$$

Where:

ΔP_{TAZ}= population change in a TAZ during a five-year period

ΔP_{com}=Population change in the community in which the TAZ located during the five-year period

ΔD_{TAZ}=Number of dwelling units change in a TAZ during the five-year period

ΔD_{com}= Number of dwelling units change in the community in which the TAZ located during the five-year period

Condition two

When the population decreases during a five-year period, the allocation is calculated using the following formula.

$$\Delta \boldsymbol{P_{TAZ}} = \Delta \boldsymbol{P_{DWTAZ}} + (\Delta \boldsymbol{P_{com}} - \Delta \boldsymbol{P_{DWcom}}) * \frac{\boldsymbol{D_{TAZ}}}{\boldsymbol{D_{com}}}$$

Where:

ΔP_{TAZ}= Population change in a TAZ during a five-year period

$\Delta P_{DWTAZ} = HHS_{2015TAZ} * \Delta D_{TAZ}$ =Assume population change in a TAZ during a five-year period due to number of dwelling units change

$HHS_{2015TAZ}$= 2015 household size within the TAZ

ΔP_{com}= Change of population in the community in which the TAZ located during the 5-year period

$\Delta P_{dwcom} = \sum \Delta P_{dwTAZ}$= Population change in the community in which the TAZ located during the five-year period due to number of dwelling units change

D_{TAZ}=Number of dwelling units in the TAZ at the end of the five-year period

D_{com}
$= \text{Number of dwelling units in the cummunity in which the TAZ located at end of the five}$
$- \text{year period}$

Population within a TAZ at end of a five-year period was calculated as follows.

$$\boldsymbol{P_{TAZ}} = \boldsymbol{P_{TAZ-1}} + \Delta \boldsymbol{P_{TAZ}}$$

Where:

$\mathrm{P_{TAZ}}$ =Population in the TAZ at end of the five-year period

$\mathrm{P_{TAZ-1}}$ =Population in the TAZ at end of the prior five-year period

Number of Households Calculation

Numbers of households for TAZs were calculated using the following formula.

$$\boldsymbol{HH_{TAZ} = (P_{TAZ} - P_{specialTAZ})/HHS_{2015}}$$

Where:

HH_{TAZ} = Number of households in a TAZ

$P_{specialTAZ}$ = Special population such population in nursing homes, jails, etc. in the TAZ

$HHS_{2015TAZ}$ = Household size in the TAZ

3.3 Employment

In order to reflect changes in employment between 2010 and 2015, the original SNHPC employment projection for 2010 through 2040 (completed in 2012) was adjusted for 2020 through 2040. Three steps are followed in calculating the 2015-2040 employment projection. Additional adjustments were made to the final numbers based on the Land Use Scenarios Report [4] to account for additional employment for relevant 2040 No-Build development projects.

Step 1: Growth rates

The study assumes that employment growth rates by employment category group for 2015-2040 were kept the same as the 2012 Southern NH Planning Commission employment projection for 2010-2040, which were reviewed by corresponding communities in the region. The following formula was used in calculating growth rates over a five-year interval.

$$GR_{Com\ EC\ i} = (E_{2012\ Com\ EC\ i} - E_{2012\ Com\ EC\ i-1})/E_{2012\ Com\ EC\ i-1}$$

Where:

i = projection years 2015, 2020, 2025, 2030, 2035 and 2040

$GR_{Com\ EC\ i}$ = Growth rate by employment category group over i to i-1 five-year interval

$E_{2012\ com\ EC\ i}$ = Total employment for an employment category group in a community at projection year i in 2012 projection

$E_{2012\ com\ EC\ i-1}$ = Total employment for the employment category group in community at projection year i-1 in 2012 projection

Step 2: Total employment projection for an employment category group in a community 2020 through 2040

The 2015 total employment estimate for an employment category group in a community was considered as base. Total employment projections for the employment category group in the community 2020 through 2040 were calculated as follows:

$$E_{2016\ Com\ EC\ i} = E_{2016\ Com\ EC\ i-1} * (1 + GR_{Com\ EC\ i})$$

Where:

i = projection years 2020,2025,2030,2035 and 2040

$E_{2016\ com\ EC\ i}$ = Total employment for an employment category group in the community at projection year i in the 2016 projection

$E_{2016\ com\ EC\ i-1}$ = Total employment for the employment category group in the community at projection year i-1 in the 2016 projection

Step 3: Total employment for an employment category group in the community for 2020-2040 projection distributed to TAZs

Two conditions were used as total projected employment for an employment category group in the community was allocated into TAZs.

Condition one

When the data for developable land for a land use category is available and appropriate to use in a community, employment is distributed based on percentage of developable land in a TAZ in total of developable land in the community.

$$E_{2016\ TAZ\ EC\ i} = E_{2016\ TAZ\ EC\ i-1} + (E_{2016\ Com\ EC\ i} - E_{2016\ Com\ EC\ i-1}) * Percentage$$

Where:

$E_{2016\ TAZ\ EC\ i}$ = 2016 Employment projection in a TAZ for an employment category group at projection year i

$E_{2016\ TAZ\ EC\ i-1}$ = 2016 Employment projection in a TAZ for the employment category group at projection year i-1 in the 2016 projection

$E_{2016\ com\ EC\ i}$ = Total employment for the employment category group in the community at projection year i in the 2016 projection

$E_{2016\ com\ EC\ i-1}$ = Total employment for the employment category group in the community at projection year i-1 in the 2016 projection

Condition two

When the data for developable land for the land use category is not available or not appropriate to use in a community, employment in a TAZ is calculated using the same growth rate as that of employment of the employment category.

$$E_{2016\ TAZ\ EC\ i} = E_{2016\ TAZ\ EC\ i-1} * (1 + GR_{2016\ Com\ EC\ i})$$

Where:

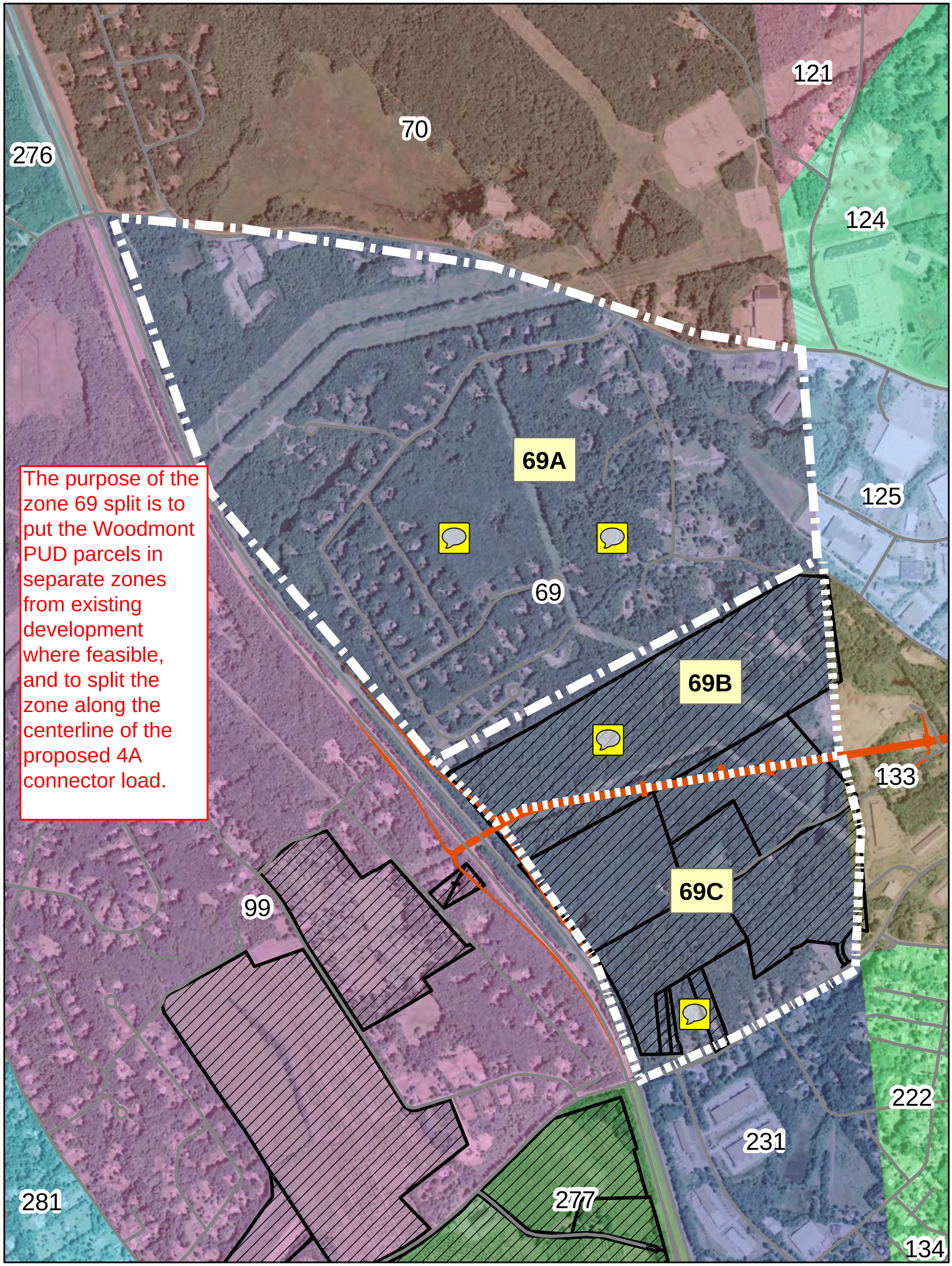
$E_{2016\ TAZ\ EC\ i}$ = 2016 Employment projection in a TAZ for an employment category group at projection year i

$E_{2016\ TAZ\ EC\ i-1}$ = 2016 Employment projection in a TAZ for the employment category group at projection year i-1 in the 2016 projection

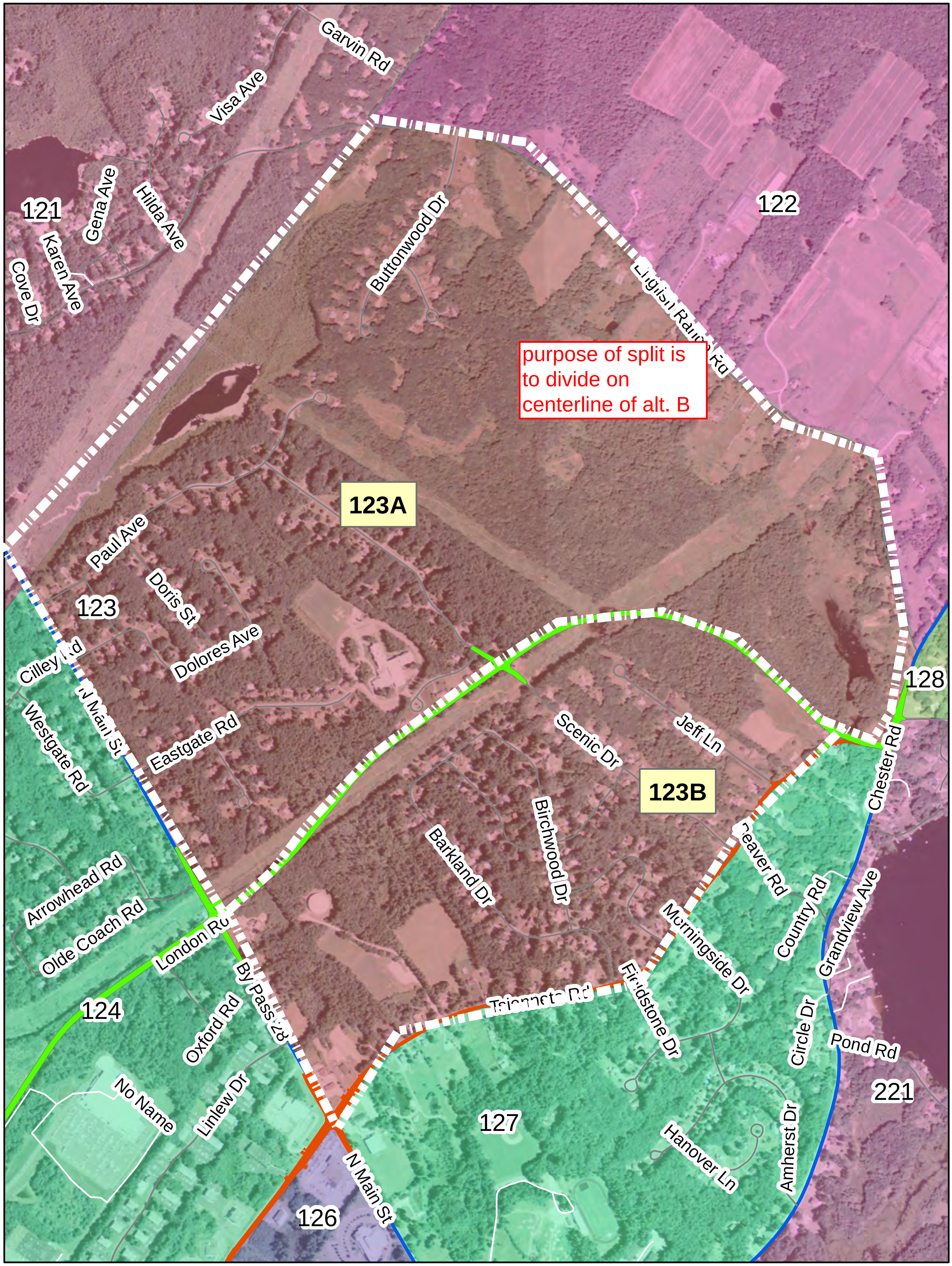
4. REFERENCES

1. 2010 Travel Demand Forecast Model Development and Calibration Report, Southern New Hampshire Planning Commission, 2012.
2. 2015 Population Estimates of New Hampshire Cities and Towns, The New Hampshire Office of Strategic Initiatives (NHOSI), 2016.
3. Model Validation and Reasonableness Checking Manual, Travel Model Improvement Program, 2001.
4. I-93 Exit 4A Supplemental Draft Environmental Impact Statement Land Use Scenarios Report, Louis Berger, 2017.
5. State of New Hampshire County Population Projections, By Municipality, The New Hampshire Office of Strategic Initiatives (NHOSI) in Partnership with the State's Regional Planning Commissions , 2016
6. FY 2017 – FY 2040 Regional Transportation Plan for the Southern NH Planning Commission, Southern New Hampshire Planning Commission, 2017.

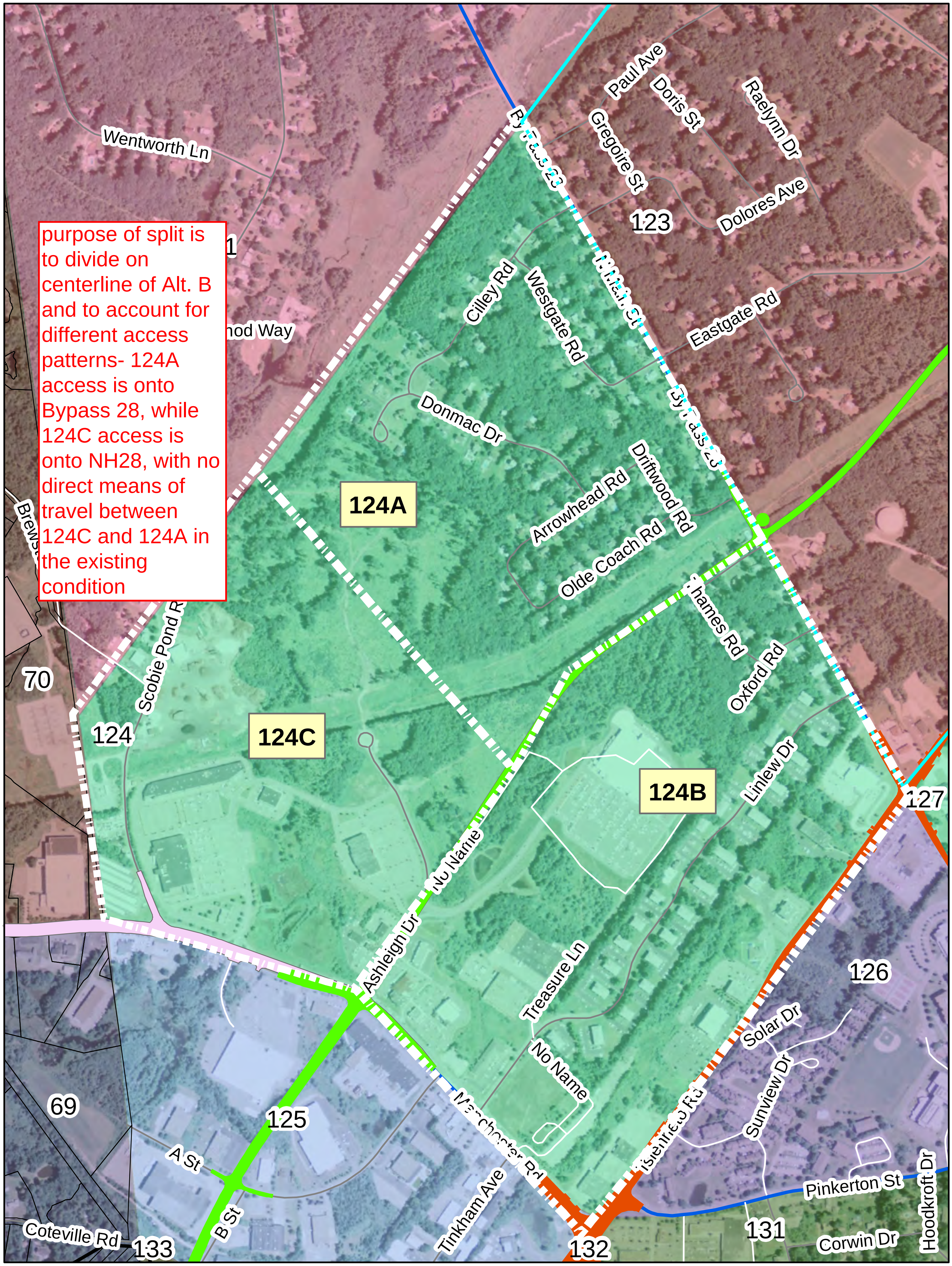
APPENDIX A STUDY AREA TAZ SPLIT



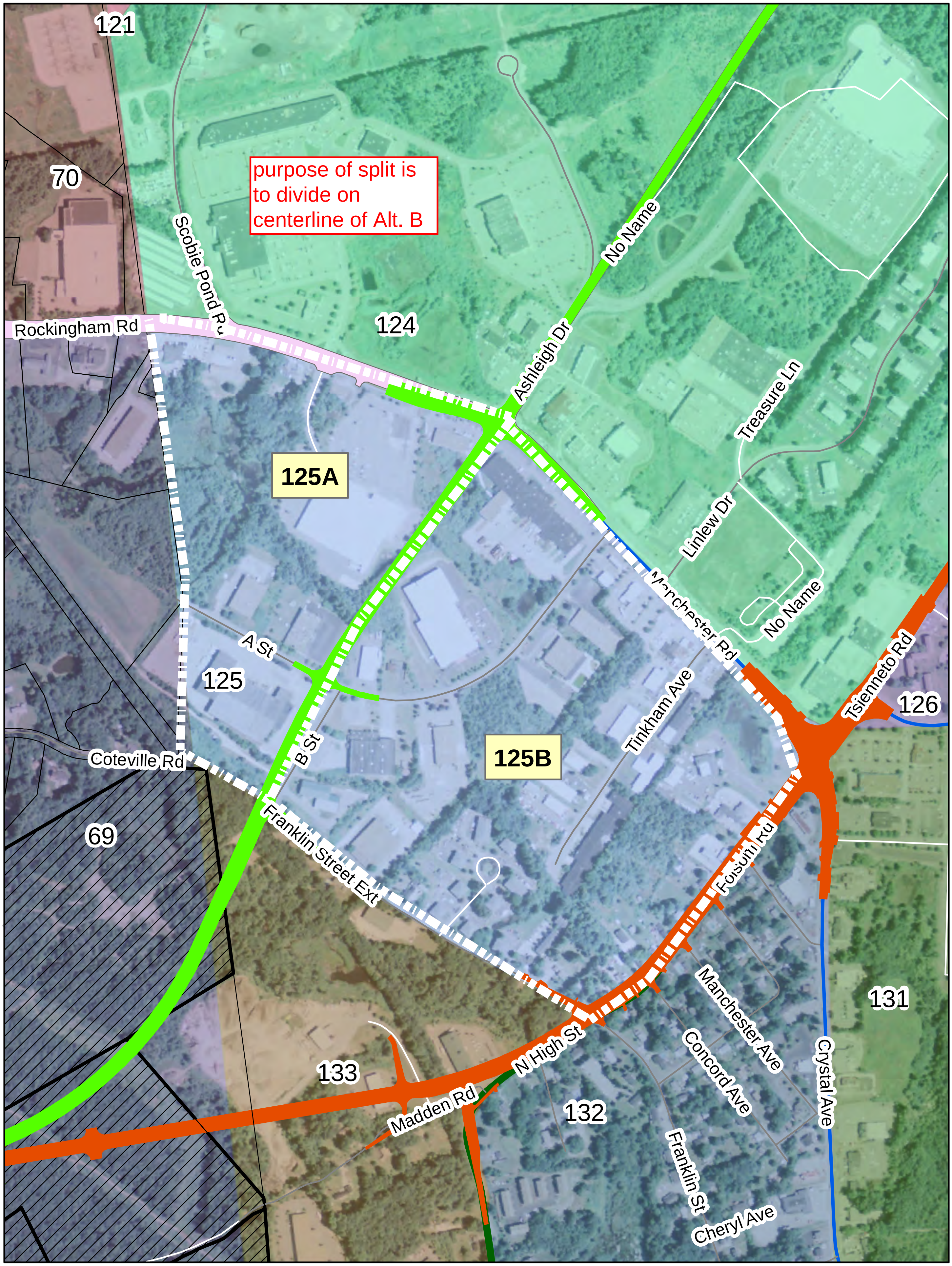
121
70
276
124
69A
125
69
69B
133
69C
99
222
231
277
281
134
The purpose of the zone 69 split is to put the Woodmont PUD parcels in separate zones from existing development where feasible, and to split the zone along the centerline of the proposed 4A connector load.

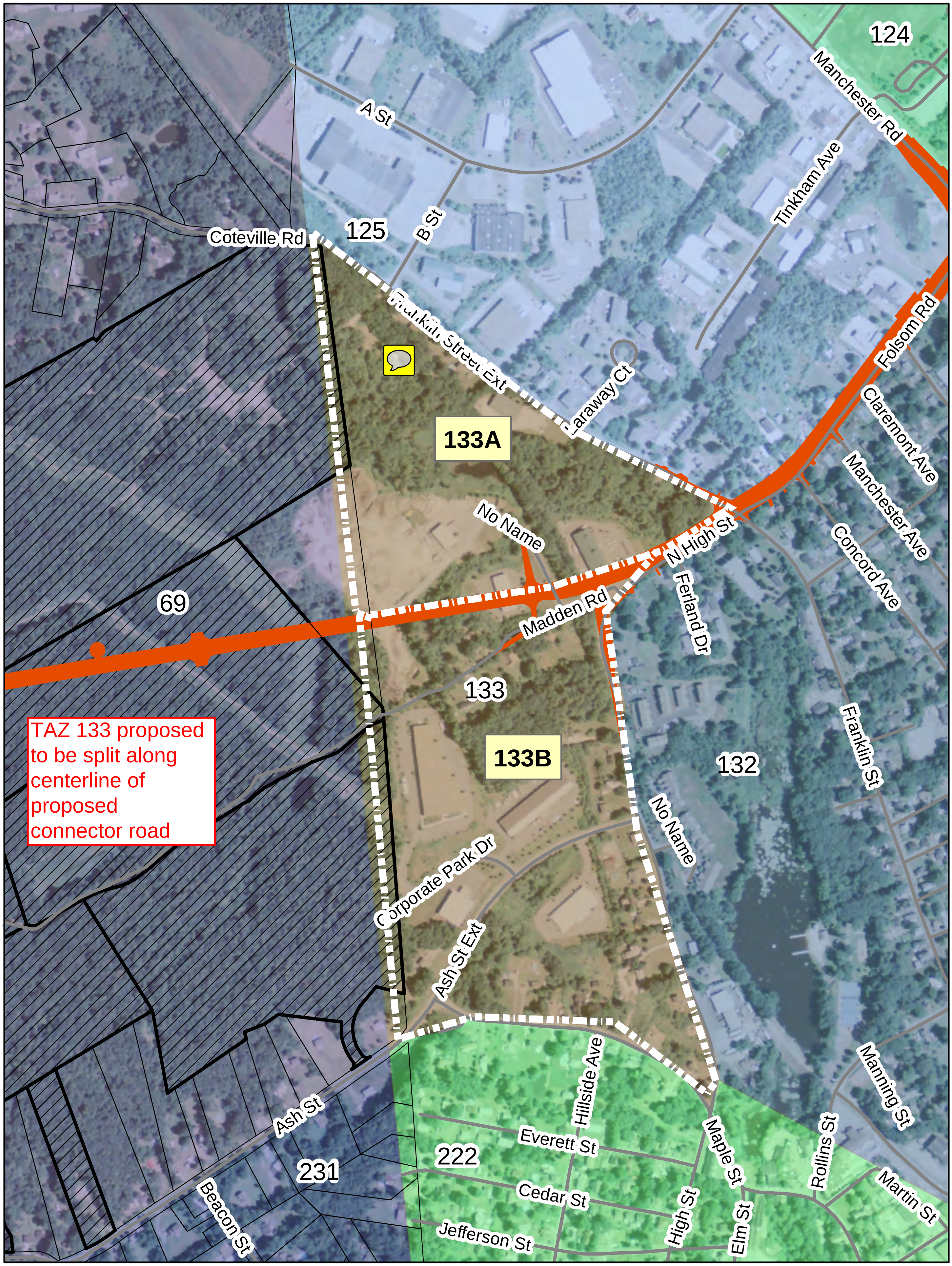


Garvin Rd
Visa Ave
Gena Ave
Hilda Ave
121
Karen Ave
Cove Dr
122
Buttonwood Dr
English Range Rd
purpose of split is
to divide on
centerline of alt. B
123A
Paul Ave
Doris St
123
Dolores Ave
Cilley Rd
N Main St
Westgate Rd
Eastgate Rd
Scenic Dr
Jeff Ln
128
Chester Rd
123B
Barkland Dr
Birchwood Dr
Beaver Rd
Country Rd
Grandview Ave
Arrowhead Rd
Olde Coach Rd
London Rd
By Pass 28
Morningside Dr
Fieldstone Dr
124
Oxford Rd
Circle Dr
Pond Rd
221
No Name
Linlew Dr
127
Hanover Ln
Amherst Dr
126
N Main St



purpose of split is to divide on centerline of Alt. B and to account for different access patterns- 124A access is onto Bypass 28, while 124C access is onto NH28, with no direct means of travel between 124C and 124A in the existing condition
124A
124B
124C
123
124
125
126
127
131
132
133
69
70
Wentworth Ln
Paul Ave
Doris St
Raelynn Dr
Gregoire St
Dolores Ave
Cilley Rd
Westgate Rd
Eastgate Rd
Donmac Dr
Arrowhead Rd
Driftwood Rd
Olde Coach Rd
Thames Rd
Oxford Rd
Linlew Dr
Scobie Pond R
No Name
Ashleigh Dr
Treasure Ln
Solar Dr
Sunview Dr
Pinkerton St
Corwin Dr
Hoodkroft Dr
A St
B St
Coteville Rd
Tinkham Ave


purpose of split is
to divide on
centerline of Alt. B
125A
125B
121
70
124
125
126
69
133
132
131
Rockingham Rd
Scobie Pond Rd
No Name
Ashleigh Dr
Treasure Ln
Linlew Dr
No Name
Manchester Rd
Tsienneto Rd
A St
B St
Tinkham Ave
Coteville Rd
Franklin Street Ext
Folsom Rd
Manchester Ave
Concord Ave
Crystal Ave
N High St
Madden Rd
Franklin St
Cheryl Ave



124
125
Manchester Rd
A St
B St
Tinkham Ave
Coteville Rd
Franklin Street Ext
Laraway Ct
Folsom Rd
133A
Claremont Ave
Manchester Ave
No Name
N High St
Concord Ave
Ferland Dr
Madden Rd
69
133
TAZ 133 proposed to be split along centerline of proposed connector road
133B
132
Franklin St
No Name
Corporate Park Dr
Ash St Ext
Hillside Ave
Manning St
Ash St
Everett St
Maple St
Rollins St
222
231
Cedar St
Martin St
Beacon St
High St
Elm St
Jefferson St

APPENDIX B PROJECT LIST

Projects Coded in the 2040 No-Build Model

Community[1]	Project	Project #
BE	NH 101 - Widen NH 101 to 5 Lanes from NH 114 up to Wallace Rd	13953
BE	NH 101 - Widen NH 101 to 5 Lanes from Wallace Rd up to Amherst TL[2]	
BE	US 3 - Widen US 3 to 5 Lanes from Hawthorne Drive North to Manchester Airport Access Road	40664
BE-ME	F.E.E Turnpike - Improvement to Bedford Mainline Toll Plaza to Institute Open Road Tolling	16100
NA-ME-BE	F.E.E.Turnpike - Widen existing 2-Lane Sections of the Turnpike to a 3-Lane Typical From Exit 8 in Nashua to I-293 in Bedford	13761
CH	NH 102 - NH 102/North Pond Road Intersection Improvements.	
DE-LO	I-93 - Construction of I-93 Exit 4A	13065
HO	US 3/NH 28 - Widen US 3/NH 28 to 5 Lanes from Martins Ferry Rd to West Alice Ave	29611
HO	US 3/NH 28 - Construct Southern Segment of US 3/NH 28 Alternate Bypass[2]	
HO	US 3/NH 28 - Construct Northern Segment of US3/NH28 Alternate Bypass[2]	
HO	Widen US3/NH28 to 5 Lanes from Legends Dr to Hunt Street[2]	
HO	Hackett Hill Road - Reconstruction intersection of NH 3A/Hackett Hill Road	14950
HO	NH 3A - Reconstruct and Widen from Commerce Road North to Goonan Rd.	24862
LO	NH 28 - Widening NH 28 from NH 128 to Page Rd.	
LO	NH 102 - Widen NH 102 to 4 Lanes from Hudson Town Line to NH 128[2] - Lower Corridor	
LO	NH 102 - Widen NH 102 to 5 Lanes from I-93 East to Londonderry Road[2] - Upper Corridor	
LO	NH 102 - Widen NH 102 to 6 Lanes from I-93 to NH 128[2] - Central Corridor	
LO	Intersection Improvements at NH28/NH128 for Safety and Traffic Flow	
MA	I-293 - Reconstruction of Exit 4 on I-293	
MA	I-293 - Reconstruct and Widening of Exit 6 (Amoskeag)	16099A
MA	I-293 - Reconstruct Exit 7	16099B
SA-MA	I-93- Reconstruct and Widen Mainline, Environmental Impact Study and Final Design From Mass S/L in Salem to I-293 in Manchester. Capacity Improvements, Reconstruction, and Widening from North of Exit 3 to I-293	10418C
SA-MA	I-93 - NB & SB Mainline Weigh Station to Kendall	14633B
SA-MA	I-93 - Exit 4 Ramps, NB & SB Mainline, NH 102 Approach Work	14633D
SA-MA	I-93- NB & SB Mainline, Exit 5 to I-293 Split (Londonderry & Manchester)	14633H
SA-MA	I-93- NB & SB Mainline, Exit 4 and 5 (Londonderry)	14633I
SA-MA	I-93 - Exit 1 to Exit 5 - Construct 4th Lane Northbound and Southbound	14633J
SA-MA	I-93 - Final Design (PE) and ROW for I-93 Salem to Manchester	10418X
Windham	NH 111 - Corridor Improvements Within Town Center (Construction not in TYP)	40663
Windham	NH 28 - Intersection NH 28/Roulston Road Improvements	40665

Source: FY 2017 - 2020 Transportation Improvement Program, FY 2017-2026 Ten-Year Transportation Improvement Plan, and 2017-2040 SNHPC Regional Transportation Plan.

[1] BE=Bedford, CH=Chester, DE=Derry, HO=Hooksett, LO=Londonderry, MA=Manchester, NB=New Boston, RA=Raymond, SA=Salem, NA=Nashua

[2] These projects are taken from various studies and are part of the Regional Transportation Plan

Updated 10/21/2016

APPENDIX C 2015 BASE YEAR MODEL STUDY AREA CALIBRATION RESULTS

2015 Base Year Model Study Area Calibration Results

Location	A	B	Assign	Count	% Diff
NH 28 N. of Liberty Dr.	589	3645	15,406	13,000	18.51
NH 102 at Derry Town line	594	3556	20,817	22,270	-6.52
NH 28 at Derry Town line	793	1621	19,392	17,454	11.10
Exit 5 SB Off ramp	999	3650	9,234	9,282	-0.52
Exit 4 SB On ramp	1003	1764	8,157	9,615	-15.16
Exit 4 NB Off ramp	1006	6519	10,389	9,843	5.55
Exit 5 NB Off ramp	1010	3652	4,430	5,601	-20.91
Gilcreast Rd. N. of NH 102	1334	3557	9,397	10,000	-6.03
Ash St. E. of Londonderry Rd.	1348	3555	5,950	6,900	-13.77
Ash St. at Londonderry Town line	1349	2125	5,936	6,765	-12.25
Exit 4 SB On ramp EB to SB	1767	1005	4,907	5,010	-2.06
Exit 4 SB On ramp WB to SB	1770	1004	3,637	4,648	-21.75
NH28 Bypass N. of Tsienneto Rd.	1838	1839	9,377	11,943	-21.49
NH28 Bypass N. of Academy Dr.	1839	3532	7,318	7,329	-0.15
NH28 Bypass S. of Thornton Rd.	1840	2143	12,015	13,981	-14.06
NH102 E. of NH 28 Bypass	1841	1878	7,017	7,329	-4.26
Crystal Ave. NH 28 S of Rollins	1860	1861	13,215	13,000	1.65
Crystal Ave. NH 28 S of Tsienneto	1862	1863	13,407	15,193	-11.76
Folsom Rd. W. of NH 28	1863	3483	8,960	11,672	-23.24
NH 102 E. of Griffin St.	1870	1871	18,002	16,400	9.77
NH 102 W. of Abbot St.	1876	1877	11,128	14,350	-22.45
Tsienneto Rd. W. of NH 102	1883	2082	5,666	5,393	5.06
Franklin St. Ext N. of Folsom Rd.	2106	3484	1,255	1,845	-31.98
Tsienneto Rd. E. of Pinkerton	2107	2108	14,200	14,636	-2.98
Pinkerton St. E. of Tsienneto	2107	2109	8,776	11,672	-24.81
Fordway over Beaver Brook	2135	2136	5,114	5,330	-4.05
NH102 E. of Hampton Dr.	3234	1766	30,419	32,000	-4.94
Exit 5 NB On ramp	3651	1011	9,101	9,341	-2.57
Exit 5 SB On ramp	3653	1000	3,919	5,503	-28.78
Exit 4 NB On ramp	6518	1007	9,550	10,045	-4.93

FHWA Targets

Upper Limit	Lower Limit
25	-25
25	-25
25	-25
29	-29
29	-29
29	-29
29	-29
25	-25
29	-29
29	-29
29	-29
36	-36
25	-25
29	-29
25	-25
29	-29
25	-25
25	-25
25	-25
25	-25
25	-25
29	-29
47	-47
25	-25
25	-25
29	-29
22	-22
29	-29
29	-29
25	-25

Note: Traffic volumes were taken from NHDOT traffic count program, SNHPC traffic count program, and CLD|Fuss & O'Neil traffic counts for the project.

APPENDIX D POPULATION PROJECTION [2] [5]

Population Projection 2015-2040

Town	2015	2020	2025	2030	2035	2040
Auburn	5,315	5,560	5,828	5,959	6,033	6,048
Bedford	22,236	23,451	24,797	25,276	25,576	25,680
Candia	3,909	3,891	3,880	3,967	4,016	4,026
Chester	4,887	5,199	5,536	5,660	5,731	5,744
Deerfield	4,413	4,631	4,869	4,978	5,040	5,052
Derry	32,948	32,459	32,018	32,733	33,144	33,222
Francestown	1,562	1,576	1,597	1,628	1,647	1,654
Goffstown	17,846	18,051	18,335	18,689	18,911	18,988
Hooksett	14,473	15,403	16,508	17,089	17,532	17,823
Londonderry	24,891	25,434	26,057	26,639	26,973	27,036
Manchester	109,419	109,469	109,963	112,087	113,420	113,881
New Boston	5,457	5,818	6,214	6,334	6,409	6,435
Raymond	10,257	10,403	10,577	10,814	10,949	10,975
Weare	8,811	9,051	9,334	9,514	9,627	9,667
Windham	14,301	15,414	16,612	16,983	17,196	17,237
Total	**280,725**	**285,810**	**292,125**	**298,350**	**302,204**	**303,468**

Source: New Hampshire Office of Strategic Initiatives.

APPENDIX E 2015 EMPLOYMENT AVERAGE

2015 Employment Average

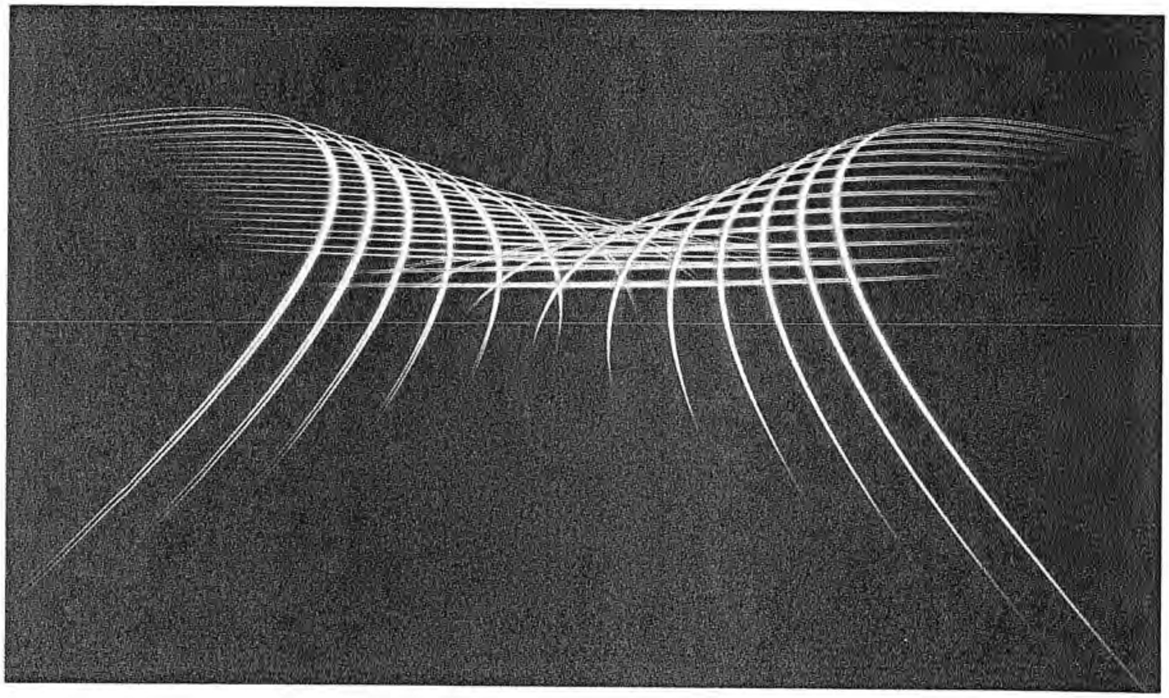
Town	Q1	Q2	Q3	Q4	Average
Auburn	1,706	1,766	1,806	1,852	1,783
Bedford	15,223	15,487	15,446	15,617	15,443
Candia	673	820	865	818	794
Chester	364	371	349	376	365
Deerfield	384	454	437	411	422
Derry	8,123	8,240	7,806	8,251	8,105
Francestown	94	125	136	117	118
Goffstown	3,129	3,304	3,159	3,235	3,207
Hooksett	9,275	9,496	9,591	9,700	9,516
Londonderry	12,812	13,345	13,185	13,454	13,199
Manchester	67,548	68,384	68,349	69,812	68,523
New Boston	727	756	732	794	752
Raymond	2,965	3,051	2,902	3,074	2,998
Weare	1,764	1,852	1,762	1,836	1,804
Windham	3,428	3,534	3,463	3,689	3,529

Source: New Hampshire Department of Employment Security.

APPENDIX E: HCM 2010 LOS CRITERIA

HCM2010

HIGHWAY CAPACITY MANUAL



VOLUME 3: INTERRUPTED FLOW

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leaving basic freeway segments. Thus, the impact on the capacity of the mainline freeway most often is negligible.

This does not mean, however, that the capacity of each component segment of a facility is the same. Each segment has its own demand and demand characteristics. Demand flow rate can change at every entry and exit point along the freeway, and the percent of heavy vehicles can change too. Terrain also can change at various points along the freeway.

Changes in heavy vehicle presence can change the capacity of individual segments within a defined facility. Changes in the split of movements in a weaving segment can change its capacity. In the same way, changes in the relative demand flows at on- and off-ramps can change the location of the critical segment within a defined facility and its capacity.

As noted previously, the capacity of a freeway facility is defined as the capacity of its critical segment.

LOS: COMPONENT SEGMENTS AND THE FREEWAY FACILITY

LOS of Component Segments

Chapters 11, 12, and 13 provide methodologies to determine the LOS in basic, weaving, merge, and diverge segments. In all cases, LOS F is identified when v_d/c is greater than 1.00. Such breakdowns are easily identified, and users are referred to this chapter.

This chapter's methodology provides an analysis of breakdown conditions, including the spatial and time impacts of a breakdown. Thus, in the performance of a facility-level analysis, LOS F in a component segment can be identified (*a*) when the segment v_d/c is greater than 1.00 and (*b*) when a queue from a downstream breakdown extends into an upstream segment. The latter cannot be done by using the individual segment analysis procedures of Chapters 11, 12, and 13.

Thus, when facility-level analysis is undertaken by using the methodology of this chapter, LOS F for a component segment will be identified in two different ways:

- When v_d/c is greater than 1.00, or
- When the density is greater than 45 pc/mi/ln for basic freeway segments or 43 pc/mi/ln for weaving, merge, or diverge segments.

The latter identifies segments in which queues have formed as a result of downstream breakdowns.

LOS for a Freeway Facility

Because LOS for basic, weaving, merge, and diverge segments on a freeway is defined in terms of density, LOS for a freeway facility is also defined on the basis of density.

A facility analysis will result in a density determination and LOS for each component segment. The facility LOS will be based on the weighted average density for all segments within the defined facility. Weighting is done on the basis of segment length and the number of lanes in each segment, as shown in Equation 10-2:

$$D_F = \frac{\sum_{i=1}^{n} D_i \times L_i \times N_i}{\sum_{i=1}^{n} L_i \times N_i}$$

Equation 10-2

where

D_F = average density for the facility (pc/mi/ln),

D_i = density for segment i (pc/mi/ln),

L_i = length of segment i (ft),

N_i = number of lanes in segment i, and

n = number of segments in the defined facility.

The LOS criteria for a freeway facility are shown in Exhibit 10-7. They are the same criteria used for basic freeway segments.

Exhibit 10-7
LOS Criteria for Freeway Facilities

Level of Service	Density (pc/mi/ln)
A	≤11
B	>11–18
C	>18–26
D	>26–35
E	>35–45
F	>45 or any component v_d/c ratio > 1.00

Use of a LOS descriptor for the overall freeway facility must be done with care. It is critical that the LOS for individual segments composing the facility also be reported. Because the overall LOS is an average, it may mask serious problems in individual segments of the facility.

This is particularly important if one or more of the component segments are operating at LOS F. As described in this chapter's methodology section, the freeway facility methodology applies models to estimate the propagation of the effects of a breakdown in time and space. Where breakdowns exist in one or more segments of a facility, the average LOS is of limited use. The average LOS applies to a specific time period, usually 15 min.

While LOS A through D are defined by using the same densities that apply to basic freeway segments, LOS F for a facility is defined as a case in which any component segment of the freeway exceeds a v/c ratio of 1.00 or the average density over the defined facility exceeds 45 pc/mi/ln. In such a case, this chapter's methodology allows the analyst to map the impacts of this breakdown in time and space, and close attention to the individual LOS of component segments is necessary.

18-3. The symbol Φ shown in this exhibit represents the word "phase," and the number following the symbol represents the phase number.

Exhibit 18-3 shows one way that traffic movements can be assigned to each of the eight phases. These assignments are illustrative, but they are not uncommon. Each left-turn movement is assigned to an exclusive phase. During this phase, the left-turn movement is "protected" so that it receives a green arrow indication. Each through, right-turn, and pedestrian movement combination is also assigned to an exclusive phase. The dashed arrows indicate turn movements that are served in a "permitted" manner so that the turn can be completed only after yielding the right-of-way to conflicting movements. Additional information about traffic signal controller operation is provided in Chapter 31, Signalized Intersections: Supplemental.

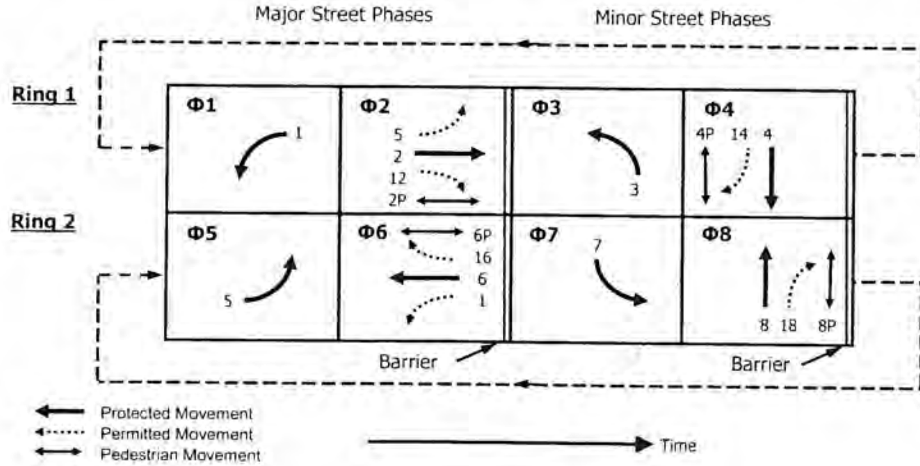


Exhibit 18-3
Dual-Ring Structure with Illustrative Movement Assignments

LOS CRITERIA

This subsection describes the LOS criteria for the automobile, pedestrian, and bicycle modes. The criteria for the automobile mode are different from those for the nonautomobile modes. Specifically, the automobile-mode criteria are based on performance measures that are field measurable and perceivable by travelers. The criteria for the nonautomobile modes are based on scores reported by travelers indicating their perception of service quality.

Automobile Mode

All uses of the word "volume" or the phrase "volume-to-capacity ratio" in this chapter refer to demand volume or demand-volume-to-capacity ratio.

LOS can be characterized for the entire intersection, each intersection approach, and each lane group. Control delay alone is used to characterize LOS for the entire intersection or an approach. Control delay *and* volume-to-capacity ratio are used to characterize LOS for a lane group. Delay quantifies the increase in travel time due to traffic signal control. It is also a surrogate measure of driver discomfort and fuel consumption. The volume-to-capacity ratio quantifies the degree to which a phase's capacity is utilized by a lane group. The following paragraphs describe each LOS.

LOS A describes operations with a control delay of 10 s/veh or less and a volume-to-capacity ratio no greater than 1.0. This level is typically assigned when the volume-to-capacity ratio is low and either progression is exceptionally favorable or the cycle length is very short. If it is due to favorable progression, most vehicles arrive during the green indication and travel through the intersection without stopping.

LOS B describes operations with control delay between 10 and 20 s/veh and a volume-to-capacity ratio no greater than 1.0. This level is typically assigned when the volume-to-capacity ratio is low and either progression is highly favorable or the cycle length is short. More vehicles stop than with LOS A.

LOS C describes operations with control delay between 20 and 35 s/veh and a volume-to-capacity ratio no greater than 1.0. This level is typically assigned when progression is favorable or the cycle length is moderate. Individual *cycle failures* (i.e., one or more queued vehicles are not able to depart as a result of insufficient capacity during the cycle) may begin to appear at this level. The number of vehicles stopping is significant, although many vehicles still pass through the intersection without stopping.

LOS D describes operations with control delay between 35 and 55 s/veh and a volume-to-capacity ratio no greater than 1.0. This level is typically assigned when the volume-to-capacity ratio is high and either progression is ineffective or the cycle length is long. Many vehicles stop and individual cycle failures are noticeable.

LOS E describes operations with control delay between 55 and 80 s/veh and a volume-to-capacity ratio no greater than 1.0. This level is typically assigned when the volume-to-capacity ratio is high, progression is unfavorable, and the cycle length is long. Individual cycle failures are frequent.

LOS F describes operations with control delay exceeding 80 s/veh or a volume-to-capacity ratio greater than 1.0. This level is typically assigned when the volume-to-capacity ratio is very high, progression is very poor, and the cycle length is long. Most cycles fail to clear the queue.

A lane group can incur a delay less than 80 s/veh when the volume-to-capacity ratio exceeds 1.0. This condition typically occurs when the cycle length is short, the signal progression is favorable, or both. As a result, both the delay and volume-to-capacity ratio are considered when lane group LOS is established. A ratio of 1.0 or more indicates that cycle capacity is fully utilized and represents failure from a capacity perspective (just as delay in excess of 80 s/veh represents failure from a delay perspective).

Exhibit 18-4 lists the LOS thresholds established for the automobile mode at a signalized intersection.

Exhibit 18-4
LOS Criteria: Automobile Mode

Control Delay (s/veh)	LOS by Volume-to-Capacity Ratio[a] ≤1.0	>1.0
≤10	A	F
>10–20	B	F
>20–35	C	F
>35–55	D	F
>55–80	E	F
>80	F	F

Note: [a] For approach-based and intersectionwide assessments, LOS is defined solely by control delay.

1. INTRODUCTION

19. TWSC Intersections

Two-way STOP-controlled (TWSC) intersections are common in the United States. One typical configuration is a four-leg intersection, where one street—the *major street*—is uncontrolled, while the other street—the *minor street*—is controlled by STOP signs. The other typical configuration is a three-leg intersection, where the single minor-street approach (i.e., the stem of the T configuration) is controlled by a STOP sign. Minor street approaches can be public streets or private driveways. **Chapter 19, Two-Way STOP-Controlled Intersections,** presents concepts and procedures for analyzing these types of intersections. Chapter 9 provides a glossary and list of symbols, including those used for TWSC intersections.

Three-leg intersections are considered a standard type of TWSC intersection, when the stem of the T is controlled by a STOP sign.

Capacity analysis of TWSC intersections requires a clear description and understanding of the interaction between travelers on the minor, or STOP-controlled, approach with travelers on the major street. Both gap acceptance and empirical models have been developed to describe this interaction. Procedures described in this chapter rely primarily on field measurements of TWSC performance in the United States (*1*) that have been applied to a gap acceptance model developed and refined in Germany (*2*).

INTERSECTION ANALYSIS BOUNDARIES AND TRAVEL MODES

The intersection boundaries for a TWSC intersection analysis are assumed to be those of an isolated intersection (i.e., not affected by upstream or downstream intersections), with the exception of TWSC intersections that are located within 0.25 mi of a signalized intersection (for the major-street approaches). This chapter presents methodologies to assess TWSC intersections for both pedestrians and motor vehicles. A discussion of how the procedures for motor vehicles could potentially apply to an analysis of bicycle movements is also provided.

LEVEL-OF-SERVICE CRITERIA

LOS is not defined for the major-street approaches or for the overall intersection, as major-street through vehicles are assumed to experience no delay.

Level of service (LOS) for a TWSC intersection is determined by the computed or measured control delay. For motor vehicles, LOS is determined for each minor-street movement (or shared movement) as well as major-street left turns by using criteria given in Exhibit 19-1. LOS is not defined for the intersection as a whole or for major-street approaches for three primary reasons: (*a*) major-street through vehicles are assumed to experience zero delay; (*b*) the disproportionate number of major-street through vehicles at a typical TWSC intersection skews the weighted average of all movements, resulting in a very low overall average delay for all vehicles; and (*c*) the resulting low delay can mask important LOS deficiencies for minor movements. As Exhibit 19-1 notes, LOS F is assigned to the movement if the volume-to-capacity ratio for the movement exceeds 1.0, regardless of the control delay.

The LOS criteria for TWSC intersections are somewhat different from the criteria used in Chapter 18 for signalized intersections, primarily because user perceptions differ among transportation facility types. The expectation is that a signalized intersection is designed to carry higher traffic volumes and will present greater delay than an unsignalized intersection. Unsignalized intersections are also associated with more uncertainty for users, as delays are less predictable than they are at signals, which can reduce users' delay tolerance.

Exhibit 19-1
Level-of-Service Criteria: Automobile Mode

Control Delay (s/vehicle)	LOS by Volume-to-Capacity Ratio $v/c \leq 1.0$	$v/c > 1.0$
0–10	A	F
>10–15	B	F
>15–25	C	F
>25–35	D	F
>35–50	E	F
>50	F	F

Note: The LOS criteria apply to each lane on a given approach and to each approach on the minor street. LOS is not calculated for major-street approaches or for the intersection as a whole.

Pedestrian LOS at TWSC intersections is defined for pedestrians crossing a traffic stream not controlled by a STOP sign; it also applies to midblock pedestrian crossings. LOS criteria for pedestrians are given in Exhibit 19-2.

Exhibit 19-2
Level-of-Service Criteria: Pedestrian Mode

LOS	Control Delay (s/pedestrian)	Comments
A	0–5	Usually no conflicting traffic
B	5–10	Occasionally some delay due to conflicting traffic
C	10–20	Delay noticeable to pedestrians, but not inconveniencing
D	20–30	Delay noticeable and irritating, increased likelihood of risk taking
E	30–45	Delay approaches tolerance level, risk-taking behavior likely
F	>45	Delay exceeds tolerance level, high likelihood of pedestrian risk taking

Note: Control delay may be interpreted as s/pedestrian group if groups of pedestrians were counted as opposed to individual pedestrians.

LOS F for pedestrians occurs when there are not enough gaps of suitable size to allow waiting pedestrians to cross through traffic on the major street safely. This situation is typically evident from extremely long control delays. The method is based on a constant critical headway. In the field, however, LOS F may also appear in the form of crossing pedestrians selecting smaller-than-usual gaps. In such cases, safety could be a concern that warrants further study.

REQUIRED INPUT DATA

Analysis of a TWSC intersection requires the following data:

1. Number and configuration of lanes on each approach;
2. Percentage of heavy vehicles for each movement;
3. Either of the following:
   a. Demand flow rate for each entering vehicular movement and each pedestrian crossing movement during the peak 15 min, or
   b. Demand flow rate for each entering vehicular movement and each pedestrian crossing movement during the peak hour and a peak hour factor for the hour;
4. Special geometric factors such as
   a. Unique channelization aspects,
   b. Existence of a two-way left-turn lane or raised or striped median storage (or both),

1. INTRODUCTION

Roundabouts are intersections with a generally circular shape, characterized by yield on entry and circulation around a central island (counterclockwise in the United States). Roundabouts have been used successfully throughout the world and are being used increasingly in the United States, especially since 1990.

Chapter 21, Roundabouts, presents concepts and procedures for analyzing these intersections. National Cooperative Highway Research Program Project 3-65 (*1*) provided a comprehensive database of roundabout operations for U.S. conditions on the basis of a study of 31 sites. The procedures that follow are largely founded on that study's recommendations. These procedures allow the analyst to assess the operational performance of an existing or planned one-lane or two-lane roundabout given traffic demand levels.

INTERSECTION ANALYSIS BOUNDARIES AND TRAVEL MODES

The analytical procedure presented in this chapter assumes that the analysis boundaries are the roundabout itself, including associated pedestrian crosswalks. Alternative tools discussed in this chapter can, in some cases, expand the analysis boundaries to include adjacent intersections. The methodology presented here includes discussion of motor vehicles, pedestrians, and bicycles.

LEVEL OF SERVICE CRITERIA

The level of service (LOS) criteria for automobiles in roundabouts are given in Exhibit 21-1. As the table notes, LOS F is assigned if the volume-to-capacity ratio of a lane exceeds 1.0 regardless of the control delay. For assessment of LOS at the approach and intersection levels, LOS is based solely on control delay.

The thresholds in Exhibit 21-1 are based on the considered judgment of the Transportation Research Board Committee on Highway Capacity and Quality of Service. As discussed later in this chapter, roundabouts share the same basic control delay formulation with two-way and all-way STOP-controlled intersections, adjusting for the effect of YIELD control. However, at the time of publication of this edition of the *Highway Capacity Manual* (HCM), no research was available on traveler perception of quality of service at roundabouts. In the absence of such research, the service measure and thresholds have been made consistent with those for other unsignalized intersections, primarily on the basis of this similar control delay formulation.

Exhibit 21-1
LOS Criteria: Automobile Mode

Control Delay (s/veh)	LOS by Volume-to-Capacity Ratio[a]	
	$v/c \le 1.0$	$v/c > 1.0$
0–10	A	F
>10–15	B	F
>15–25	C	F
>25–35	D	F
>35–50	E	F
>50	F	F

Note: [a] For approaches and intersectionwide assessment, LOS is defined solely by control delay.

APPENDIX F: HCS 2010 FREEWAY FACILITY ANALYSES – 2015 BASE

Segment Identification Listing

Northbound Direction
Segment 1 – Basic – I-93 Mainline south of Exit 4
Segment 2 – Diverge – Exit 4 NB off-ramp
Segment 3 – Basic – I-93 Mainline between Exit 4 ramps
Segment 4 – Merge – Exit 4 NB on-ramp
Segment 5 – Basic – I-93 Mainline between Exit 4 NB on- and Exit 5 NB off-ramps
Segment 6 – Diverge – Exit 5 NB off-ramp
Segment 7 – Basic – I-93 Mainline between Exit 5 ramps
Segment 8 – Merge – Exit 5 NB on-ramp
Segment 9 – Basic – I-93 Mainline north of Exit 5

Southbound Direction
Segment 1 – Basic – I-93 Mainline north of Exit 5
Segment 2 – Diverge – Exit 5 SB off-ramp
Segment 3 – Basic – I-93 Mainline between Exit 5 ramps
Segment 4 – Merge – Exit 5 SB on-ramp
Segment 5 – Basic – I-93 Mainline between Exit 5 SB on- and Exit 4 SB off-ramps
Segment 6 – Diverge – Exit 4 SB off-ramp
Segment 7 – Basic – I-93 Mainline between Exit 4 SB off- and SB on ramp from east
Segment 8 – Merge – Exit 4 SB on-ramp from east
Segment 9 – Basic – I-93 Mainline between Exit 4 SB on-ramps
Segment 10 – Merge – Exit 4 SB on-ramp from west
Segment 11 – Basic – I-93 Mainline south of Exit 4

HCS 2010 Facilities Report

Project Information

Analyst	PK/LCG	Agency	
Jurisdiction		Time Period Analyzed	AM Peak - NB
Analysis Year	2015 Base - AM	Date	5/1/2017
Project Description	I-93 - from S. of Exit 4 to N of Exit 5		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	9
Total Time Periods	4	Time Period Duration, min	15

Segment Geometric Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	a->b	5280	2
2	Diverge	Diverge	b.->c	1500	2
3	Basic	Basic	c->d	2575	2
4	Merge	Merge	d->e	1500	2
5	Basic	Basic	e->f	13225	2
6	Diverge	Diverge	f->g	1500	2
7	Basic	Basic	g->h	4100	2
8	Merge	Merge	h->i	1500	2
9	Basic	Basic	i->j	5280	2

Facility Segment Data

Segment 1: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	1.00	0.979	2022	4700	0.43	65.0	15.6	B
2	1.00	0.979	2022	4700	0.43	65.0	15.6	B
3	1.00	0.979	2022	4700	0.43	65.0	15.6	B
4	1.00	0.979	2022	4700	0.43	65.0	15.6	B

Segment 2: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	1.00	1.00	0.979	0.962	2022	426	4700	1900	0.43	0.22	51.3	51.3	19.7	14.3	B
2	1.00	1.00	0.979	0.962	2022	426	4700	1900	0.43	0.22	51.3	51.3	19.7	14.3	B
3	1.00	1.00	0.979	0.962	2022	426	4700	1900	0.43	0.22	51.3	51.3	19.7	14.3	B
4	1.00	1.00	0.979	0.962	2022	426	4700	1900	0.43	0.22	51.3	51.3	19.7	14.3	B

Segment 3: Basic

2015 - AM - NB

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	1.00	0.984	1596	4700	0.34	65.0	12.3	B
2	1.00	0.984	1596	4700	0.34	65.0	12.3	B
3	1.00	0.984	1596	4700	0.34	65.0	12.3	B
4	1.00	0.984	1596	4700	0.34	65.0	12.3	B

Segment 4: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	1.00	1.00	0.973	0.984	2691	1077	4700	2100	0.57	0.51	59.2	59.2	22.7	17.2	B
2	1.00	1.00	0.973	0.984	2691	1077	4700	2100	0.57	0.51	59.2	59.2	22.7	17.2	B
3	1.00	1.00	0.973	0.984	2691	1077	4700	2100	0.57	0.51	59.2	59.2	22.7	17.2	B
4	1.00	1.00	0.973	0.984	2691	1077	4700	2100	0.57	0.51	59.2	59.2	22.7	17.2	B

Segment 5: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	1.00	0.973	2703	4700	0.58	65.0	20.8	C
2	1.00	0.973	2703	4700	0.58	65.0	20.8	C
3	1.00	0.973	2703	4700	0.58	65.0	20.8	C
4	1.00	0.973	2703	4700	0.58	65.0	20.8	C

Segment 6: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	1.00	1.00	0.973	0.957	2703	428	4700	2000	0.58	0.21	54.3	54.3	24.9	23.2	C
2	1.00	1.00	0.973	0.957	2703	428	4700	2000	0.58	0.21	54.3	54.3	24.9	23.2	C
3	1.00	1.00	0.973	0.957	2703	428	4700	2000	0.58	0.21	54.3	54.3	24.9	23.2	C
4	1.00	1.00	0.973	0.957	2703	428	4700	2000	0.58	0.21	54.3	54.3	24.9	23.2	C

Segment 7: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	1.00	0.976	2275	4700	0.48	65.0	17.5	B
2	1.00	0.976	2275	4700	0.48	65.0	17.5	B
3	1.00	0.976	2275	4700	0.48	65.0	17.5	B
4	1.00	0.976	2275	4700	0.48	65.0	17.5	B

Segment 8: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	1.00	1.00	0.983	0.971	3267	1009	4700	2100	0.70	0.48	56.8	56.8	28.8	25.8	C
2	1.00	1.00	0.983	0.971	3267	1009	4700	2100	0.70	0.48	56.8	56.8	28.8	25.8	C

3	1.00	1.00	0.983	0.971	3267	1009	4700	2100	0.70	0.48	56.8	56.8	28.8	25.8	C
4	1.00	1.00	0.983	0.971	3267	1009	4700	2100	0.70	0.48	56.8	56.8	28.8	25.8	C

Segment 9: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	1.00	0.983	3255	4700	0.69	64.3	25.3	C
2	1.00	0.983	3255	4700	0.69	64.3	25.3	C
3	1.00	0.983	3255	4700	0.69	64.3	25.3	C
4	1.00	0.983	3255	4700	0.69	64.3	25.3	C

Facility Time Period Results

T	Speed, mi/h	Density, pc/mi/ln	Density, veh/mi/ln	Travel Time, min	LOS
1	63.2	20.3	19.8	6.6	C
2	63.2	20.3	19.8	6.6	C
3	63.2	20.3	19.8	6.6	C
4	63.2	20.3	19.8	6.6	C

Facility Overall Results

Space Mean Speed, mi/h	63.2	Density, veh/mi/ln	19.8
Average Travel Time, min	6.6		

HCS 2010 Facilities Report

Project Information

Analyst	PK/LCG	Agency	
Jurisdiction		Time Period Analyzed	AM Peak - SB
Analysis Year	2015 - Base AM (3 pgs)	Date	5/1/2017
Project Description	I-93 SB - from N of Exit 5 to S of Exit 4		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	11
Total Time Periods	4	Time Period Duration, min	15

Segment Geometric Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	a->b	5280	2
2	Diverge	Diverge	b->c	1500	2
3	Basic	Basic	c->d	3920	2
4	Merge	Merge	d->e	1500	2
5	Basic	Basic	e->f	11980	2
6	Diverge	Diverge	f->g	1500	2
7	Basic	Basic	g->h	1600	2
8	Merge	Merge	h->i	1500	2
9	Basic	Basic	i->j	900	2
10	Merge	Merge	j->k	1500	2
11	Basic	Basic	l->m	5230	2

Facility Segment Data

Segment 1: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	1.00	0.980	3321	4700	0.71	64.0	25.9	C
2	1.00	0.980	3321	4700	0.71	64.0	25.9	C
3	1.00	0.980	3321	4700	0.71	64.0	25.9	C
4	1.00	0.980	3321	4700	0.71	64.0	25.9	C

Segment 2: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	1.00	1.00	0.980	0.971	3321	783	4700	2000	0.71	0.39	53.5	53.5	31.0	28.1	D
2	1.00	1.00	0.980	0.971	3321	783	4700	2000	0.71	0.39	53.5	53.5	31.0	28.1	D
3	1.00	1.00	0.980	0.971	3321	783	4700	2000	0.71	0.39	53.5	53.5	31.0	28.1	D

4	1.00	1.00	0.980	0.971	3321	783	4700	2000	0.71	0.39	53.5	53.5	31.0	28.1	D

Segment 3: Basic

2015 AM-SB

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	1.00	0.983	2538	4700	0.54	65.0	19.5	C
2	1.00	0.983	2538	4700	0.54	65.0	19.5	C
3	1.00	0.983	2538	4700	0.54	65.0	19.5	C
4	1.00	0.983	2538	4700	0.54	65.0	19.5	C

Segment 4: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	1.00	1.00	0.983	0.952	3079	541	4700	2100	0.66	0.26	57.5	57.5	26.8	23.7	C
2	1.00	1.00	0.983	0.952	3079	541	4700	2100	0.66	0.26	57.5	57.5	26.8	23.7	C
3	1.00	1.00	0.983	0.952	3079	541	4700	2100	0.66	0.26	57.5	57.5	26.8	23.7	C
4	1.00	1.00	0.983	0.952	3079	541	4700	2100	0.66	0.26	57.5	57.5	26.8	23.7	C

Segment 5: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	1.00	0.983	3062	4700	0.65	64.8	23.6	C
2	1.00	0.983	3062	4700	0.65	64.8	23.6	C
3	1.00	0.983	3062	4700	0.65	64.8	23.6	C
4	1.00	0.983	3062	4700	0.65	64.8	23.6	C

Segment 6: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	1.00	1.00	0.983	0.971	3062	778	4700	1900	0.65	0.41	50.6	50.6	30.3	23.9	C
2	1.00	1.00	0.983	0.971	3062	778	4700	1900	0.65	0.41	50.6	50.6	30.3	23.9	C
3	1.00	1.00	0.983	0.971	3062	778	4700	1900	0.65	0.41	50.6	50.6	30.3	23.9	C
4	1.00	1.00	0.983	0.971	3062	778	4700	1900	0.65	0.41	50.6	50.6	30.3	23.9	C

Segment 7: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	1.00	0.987	2285	4700	0.49	65.0	17.6	B
2	1.00	0.987	2285	4700	0.49	65.0	17.6	B
3	1.00	0.987	2285	4700	0.49	65.0	17.6	B
4	1.00	0.987	2285	4700	0.49	65.0	17.6	B

Segment 8: Merge

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS

	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	1.00	1.00	0.985	0.980	2820	531	4700	2000	0.60	0.27	58.2	58.2	24.2	17.8	B
2	1.00	1.00	0.985	0.980	2820	531	4700	2000	0.60	0.27	58.2	58.2	24.2	17.8	B
3	1.00	1.00	0.985	0.980	2820	531	4700	2000	0.60	0.27	58.2	58.2	24.2	17.8	B
4	1.00	1.00	0.985	0.980	2820	531	4700	2000	0.60	0.27	58.2	58.2	24.2	17.8	B

Segment 9: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	1.00	0.985	2817	4700	0.60	65.0	21.7	C
2	1.00	0.985	2817	4700	0.60	65.0	21.7	C
3	1.00	0.985	2817	4700	0.60	65.0	21.7	C
4	1.00	0.985	2817	4700	0.60	65.0	21.7	C

Segment 10: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	1.00	1.00	0.984	0.980	3499	679	4700	2100	0.74	0.32	57.2	57.2	30.6	23.7	C
2	1.00	1.00	0.984	0.980	3499	679	4700	2100	0.74	0.32	57.2	57.2	30.6	23.7	C
3	1.00	1.00	0.984	0.980	3499	679	4700	2100	0.74	0.32	57.2	57.2	30.6	23.7	C
4	1.00	1.00	0.984	0.980	3499	679	4700	2100	0.74	0.32	57.2	57.2	30.6	23.7	C

Segment 11: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	1.00	0.984	3496	4700	0.74	63.3	27.6	D
2	1.00	0.984	3496	4700	0.74	63.3	27.6	D
3	1.00	0.984	3496	4700	0.74	63.3	27.6	D
4	1.00	0.984	3496	4700	0.74	63.3	27.6	D

Facility Time Period Results

T	Speed, mi/h	Density, pc/mi/ln	Density, veh/mi/ln	Travel Time, min	LOS
1	62.5	24.8	24.4	6.6	C
2	62.5	24.8	24.4	6.6	C
3	62.5	24.8	24.4	6.6	C
4	62.5	24.8	24.4	6.6	C

Facility Overall Results

Space Mean Speed, mi/h	62.5	Density, veh/mi/ln	24.4
Average Travel Time, min	6.6		

HCS 2010 Facilities Report

Project Information

Analyst	PK/LCG	Agency	
Jurisdiction		Time Period Analyzed	2015 PM Peak - NB
Analysis Year	2015- Base PM (3 pgs)	Date	5/1/2017
Project Description			

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	9
Total Time Periods	4	Time Period Duration, min	15

Segment Geometric Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	a->b	5280	2
2	Diverge	Diverge	b.->c	1500	2
3	Basic	Basic	c->d	2575	2
4	Merge	Merge	d->e	1500	2
5	Basic	Basic	e->f	13225	2
6	Diverge	Diverge	f->g	1500	2
7	Basic	Basic	g->h	4100	2
8	Merge	Merge	h->i	1500	2
9	Basic	Basic	i->j	5280	2

Facility Segment Data

Segment 1: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	1.00	0.979	3483	4700	0.74	63.3	27.5	D
2	1.00	0.979	3483	4700	0.74	63.3	27.5	D
3	1.00	0.979	3483	4700	0.74	63.3	27.5	D
4	1.00	0.979	3483	4700	0.74	63.3	27.5	D

Segment 2: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	1.00	1.00	0.979	0.995	3483	1191	4700	1900	0.74	0.63	49.7	49.7	35.0	26.9	C
2	1.00	1.00	0.979	0.995	3483	1191	4700	1900	0.74	0.63	49.7	49.7	35.0	26.9	C
3	1.00	1.00	0.979	0.995	3483	1191	4700	1900	0.74	0.63	49.7	49.7	35.0	26.9	C
4	1.00	1.00	0.979	0.995	3483	1191	4700	1900	0.74	0.63	49.7	49.7	35.0	26.9	C

Segment 3: Basic

|2015 PM-NB |

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	1.00	0.971	2291	4700	0.49	65.0	17.6	B
2	1.00	0.971	2291	4700	0.49	65.0	17.6	B
3	1.00	0.971	2291	4700	0.49	65.0	17.6	B
4	1.00	0.971	2291	4700	0.49	65.0	17.6	B

Segment 4: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	1.00	1.00	0.977	0.988	3077	800	4700	2100	0.65	0.38	58.6	58.6	26.3	20.3	C
2	1.00	1.00	0.977	0.988	3077	800	4700	2100	0.65	0.38	58.6	58.6	26.3	20.3	C
3	1.00	1.00	0.977	0.988	3077	800	4700	2100	0.65	0.38	58.6	58.6	26.3	20.3	C
4	1.00	1.00	0.977	0.988	3077	800	4700	2100	0.65	0.38	58.6	58.6	26.3	20.3	C

Segment 5: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	1.00	0.977	3086	4700	0.66	64.7	23.8	C
2	1.00	0.977	3086	4700	0.66	64.7	23.8	C
3	1.00	0.977	3086	4700	0.66	64.7	23.8	C
4	1.00	0.977	3086	4700	0.66	64.7	23.8	C

Segment 6: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	1.00	1.00	0.977	0.971	3086	474	4700	2000	0.66	0.24	54.2	54.2	28.5	26.5	C
2	1.00	1.00	0.977	0.971	3086	474	4700	2000	0.66	0.24	54.2	54.2	28.5	26.5	C
3	1.00	1.00	0.977	0.971	3086	474	4700	2000	0.66	0.24	54.2	54.2	28.5	26.5	C
4	1.00	1.00	0.977	0.971	3086	474	4700	2000	0.66	0.24	54.2	54.2	28.5	26.5	C

Segment 7: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	1.00	0.978	2612	4700	0.56	65.0	20.1	C
2	1.00	0.978	2612	4700	0.56	65.0	20.1	C
3	1.00	0.978	2612	4700	0.56	65.0	20.1	C
4	1.00	0.978	2612	4700	0.56	65.0	20.1	C

Segment 8: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	1.00	1.00	0.983	0.981	3384	785	4700	2100	0.72	0.37	56.5	56.5	29.9	26.8	C

2	1.00	1.00	0.983	0.981	3384	785	4700	2100	0.72	0.37	56.5	56.5	29.9	26.8	C
3	1.00	1.00	0.983	0.981	3384	785	4700	2100	0.72	0.37	56.5	56.5	29.9	26.8	C
4	1.00	1.00	0.983	0.981	3384	785	4700	2100	0.72	0.37	56.5	56.5	29.9	26.8	C

Segment 9: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	1.00	0.983	3383	4700	0.72	63.8	26.5	D
2	1.00	0.983	3383	4700	0.72	63.8	26.5	D
3	1.00	0.983	3383	4700	0.72	63.8	26.5	D
4	1.00	0.983	3383	4700	0.72	63.8	26.5	D

Facility Time Period Results

T	Speed, mi/h	Density, pc/mi/ln	Density, veh/mi/ln	Travel Time, min	LOS
1	62.7	24.9	24.4	6.6	C
2	62.7	24.9	24.4	6.6	C
3	62.7	24.9	24.4	6.6	C
4	62.7	24.9	24.4	6.6	C

Facility Overall Results

Space Mean Speed, mi/h	62.7	Density, veh/mi/ln	24.4
Average Travel Time, min	6.6		

HCS 2010 Facilities Report

Project Information

Analyst	PK/LCG	Agency	
Jurisdiction		Time Period Analyzed	2015 PM Peak - SB
Analysis Year	2015 Base - PM (3 pgs)	Date	5/1/2017
Project Description	I93 SB - from N of Exit 5 to S of Exit 4		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	11
Total Time Periods	4	Time Period Duration, min	15

Segment Geometric Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	a->b	5280	2
2	Diverge	Diverge	b->c	1500	2
3	Basic	Basic	c->d	3920	2
4	Merge	Merge	d->e	1500	2
5	Basic	Basic	e->f	11980	2
6	Diverge	Diverge	f->g	1500	2
7	Basic	Basic	g->h	1600	2
8	Merge	Merge	h->i	1500	2
9	Basic	Basic	i->j	900	2
10	Merge	Merge	j->k	1500	2
11	Basic	Basic	l->m	5230	2

Facility Segment Data

Segment 1: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	1.00	0.980	3434	4700	0.73	63.6	27.0	D
2	1.00	0.980	3434	4700	0.73	63.6	27.0	D
3	1.00	0.980	3434	4700	0.73	63.6	27.0	D
4	1.00	0.980	3434	4700	0.73	63.6	27.0	D

Segment 2: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	1.00	1.00	0.980	0.980	3434	929	4700	2000	0.73	0.46	53.2	53.2	32.3	29.1	D
2	1.00	1.00	0.980	0.980	3434	929	4700	2000	0.73	0.46	53.2	53.2	32.3	29.1	D
3	1.00	1.00	0.980	0.980	3434	929	4700	2000	0.73	0.46	53.2	53.2	32.3	29.1	D

4	1.00	1.00	0.980	0.980	3434	929	4700	2000	0.73	0.46	53.2	53.2	32.3	29.1	D

Segment 3: Basic

2015 PM-SB

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	1.00	0.980	2505	4700	0.53	65.0	19.3	C
2	1.00	0.980	2505	4700	0.53	65.0	19.3	C
3	1.00	0.980	2505	4700	0.53	65.0	19.3	C
4	1.00	0.980	2505	4700	0.53	65.0	19.3	C

Segment 4: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	1.00	1.00	0.980	0.977	2930	425	4700	2100	0.62	0.20	57.8	57.8	25.3	22.6	C
2	1.00	1.00	0.980	0.977	2930	425	4700	2100	0.62	0.20	57.8	57.8	25.3	22.6	C
3	1.00	1.00	0.980	0.819	3012	507	4700	2100	0.64	0.24	57.6	57.6	26.1	23.2	C
4	1.00	1.00	0.980	0.977	2930	425	4700	2100	0.62	0.20	57.8	57.8	25.3	22.6	C

Segment 5: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	1.00	0.980	2929	4700	0.62	64.9	22.6	C
2	1.00	0.980	2929	4700	0.62	64.9	22.6	C
3	1.00	0.980	2929	4700	0.62	64.9	22.6	C
4	1.00	0.980	2929	4700	0.62	64.9	22.6	C

Segment 6: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	1.00	1.00	0.980	0.985	2929	939	4700	1900	0.62	0.49	50.2	50.2	29.2	22.8	C
2	1.00	1.00	0.980	0.985	2929	939	4700	1900	0.62	0.49	50.2	50.2	29.2	22.8	C
3	1.00	1.00	0.980	0.985	2929	939	4700	1900	0.62	0.49	50.2	50.2	29.2	22.8	C
4	1.00	1.00	0.980	0.985	2929	939	4700	1900	0.62	0.49	50.2	50.2	29.2	22.8	C

Segment 7: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	1.00	0.978	1989	4700	0.42	65.0	15.3	B
2	1.00	0.978	1989	4700	0.42	65.0	15.3	B
3	1.00	0.978	1989	4700	0.42	65.0	15.3	B
4	1.00	0.978	1989	4700	0.42	65.0	15.3	B

Segment 8: Merge

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS

	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	1.00	1.00	0.978	0.980	2208	219	4700	2000	0.47	0.11	58.9	58.9	18.7	13.2	B
2	1.00	1.00	0.978	0.980	2208	219	4700	2000	0.47	0.11	58.9	58.9	18.7	13.2	B
3	1.00	1.00	0.978	0.980	2208	219	4700	2000	0.47	0.11	58.9	58.9	18.7	13.2	B
4	1.00	1.00	0.978	0.980	2208	219	4700	2000	0.47	0.11	58.9	58.9	18.7	13.2	B

Segment 9: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	1.00	0.978	2209	4700	0.47	65.0	17.0	B
2	1.00	0.978	2209	4700	0.47	65.0	17.0	B
3	1.00	0.978	2209	4700	0.47	65.0	17.0	B
4	1.00	0.978	2209	4700	0.47	65.0	17.0	B

Segment 10: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	1.00	1.00	0.978	0.980	2515	306	4700	2100	0.54	0.15	59.1	59.1	21.3	16.2	B
2	1.00	1.00	0.978	0.980	2515	306	4700	2100	0.54	0.15	59.1	59.1	21.3	16.2	B
3	1.00	1.00	0.978	0.980	2515	306	4700	2100	0.54	0.15	59.1	59.1	21.3	16.2	B
4	1.00	1.00	0.978	0.980	2515	306	4700	2100	0.54	0.15	59.1	59.1	21.3	16.2	B

Segment 11: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	1.00	0.978	2515	4700	0.54	65.0	19.4	C
2	1.00	0.978	2515	4700	0.54	65.0	19.4	C
3	1.00	0.978	2515	4700	0.54	65.0	19.4	C
4	1.00	0.978	2515	4700	0.54	65.0	19.4	C

Facility Time Period Results

T	Speed, mi/h	Density, pc/mi/ln	Density, veh/mi/ln	Travel Time, min	LOS
1	62.8	22.5	22.1	6.6	C
2	62.8	22.5	22.1	6.6	C
3	62.8	22.6	22.1	6.6	C
4	62.8	22.5	22.1	6.6	C

Facility Overall Results

Space Mean Speed, mi/h	62.8	Density, veh/mi/ln	22.1
Average Travel Time, min	6.6		

APPENDIX G-1: HCM AND SYNCHRO PRINTOUTS – SIGNALIZED INTERSECTION CAPACITY ANALYSES – 2015 AM PEAK HOURS – SYNCHRO PRINTOUTS

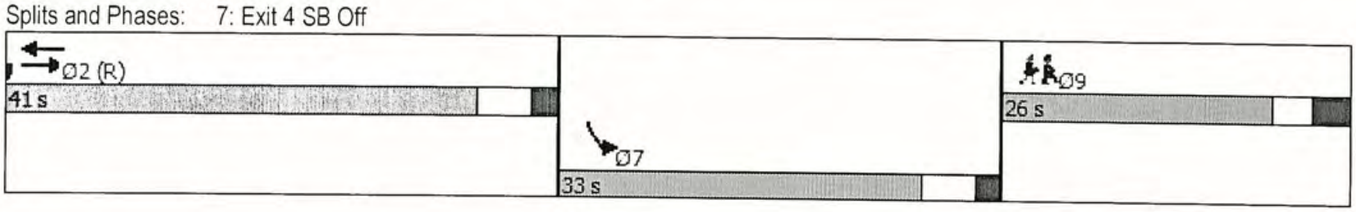
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR	Ø9
Lane Configurations		↑↑	↑↑		↰	↱	
Traffic Volume (vph)	0	915	565	0	260	495	
Future Volume (vph)	0	915	565	0	260	495	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	
Lane Util. Factor	1.00	0.95	0.95	1.00	1.00	1.00	
Frt						0.850	
Flt Protected					0.950		
Satd. Flow (prot)	0	3471	3406	0	1703	1524	
Flt Permitted					0.950		
Satd. Flow (perm)	0	3471	3406	0	1703	1524	
Right Turn on Red				Yes		Yes	
Satd. Flow (RTOR)						458	
Link Speed (mph)		30	30		25		
Link Distance (ft)		317	266		752		
Travel Time (s)		7.2	6.0		20.5		
Peak Hour Factor	0.93	0.93	0.88	0.88	0.89	0.89	
Heavy Vehicles (%)	4%	4%	6%	6%	6%	6%	
Adj. Flow (vph)	0	984	642	0	292	556	
Shared Lane Traffic (%)							
Lane Group Flow (vph)	0	984	642	0	292	556	
Turn Type		NA	NA		Prot	Perm	
Protected Phases		2	2		7		9
Permitted Phases						7	
Detector Phase		2	2		7	7	
Switch Phase							
Minimum Initial (s)		10.0	10.0		7.0	7.0	4.0
Minimum Split (s)		41.0	41.0		33.0	33.0	14.0
Total Split (s)		41.0	41.0		33.0	33.0	26.0
Total Split (%)		41.0%	41.0%		33.0%	33.0%	26%
Maximum Green (s)		35.0	35.0		27.0	27.0	20.0
Yellow Time (s)		4.0	4.0		4.0	4.0	3.0
All-Red Time (s)		2.0	2.0		2.0	2.0	3.0
Lost Time Adjust (s)		0.0	0.0		0.0	0.0	
Total Lost Time (s)		6.0	6.0		6.0	6.0	
Lead/Lag							
Lead-Lag Optimize?							
Vehicle Extension (s)		3.0	3.0		3.0	3.0	3.0
Recall Mode		C-Max	C-Max		Max	Max	None
Walk Time (s)		7.0	7.0		7.0	7.0	
Flash Dont Walk (s)		11.0	11.0		11.0	11.0	
Pedestrian Calls (#/hr)		0	0		0	0	
Act Effct Green (s)		61.0	61.0		27.0	27.0	
Actuated g/C Ratio		0.61	0.61		0.27	0.27	
v/c Ratio		0.46	0.31		0.64	0.75	
Control Delay		11.5	1.9		39.5	13.6	
Queue Delay		0.0	0.0		0.0	0.0	
Total Delay		11.5	1.9		39.5	13.6	
LOS		B	A		D	B	
Approach Delay		11.5	1.9		22.5		

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR	Ø9
Approach LOS		B	A		C		
Queue Length 50th (ft)		165	17		164	49	
Queue Length 95th (ft)		212	m18		251	176	
Internal Link Dist (ft)		237	186		672		
Turn Bay Length (ft)							
Base Capacity (vph)		2117	2077		459	745	
Starvation Cap Reductn		0	0		0	0	
Spillback Cap Reductn		0	0		0	0	
Storage Cap Reductn		0	0		0	0	
Reduced v/c Ratio		0.46	0.31		0.64	0.75	

Intersection Summary

Area Type: Other
Cycle Length: 100
Actuated Cycle Length: 100
Offset: 0 (0%), Referenced to phase 2:EBWB, Start of Green
Natural Cycle: 90
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.75
Intersection Signal Delay: 12.8 Intersection LOS: B
Intersection Capacity Utilization 58.3% ICU Level of Service B
Analysis Period (min) 15
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 7: Exit 4 SB Off



2.

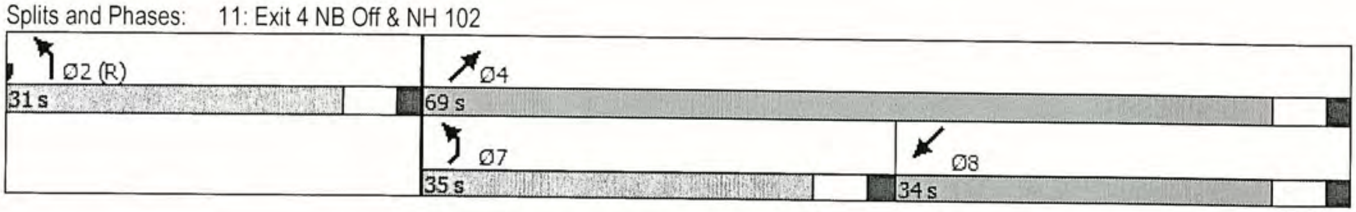
Lane Group	NBL	NBR	SEL	SER	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations	↰↰	↱			↰	↑↑			↑↑	↱
Traffic Volume (vph)	210	200	0	0	585	590	0	0	875	0
Future Volume (vph)	210	200	0	0	585	590	0	0	875	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0	0	0	0	350		0	0		0
Storage Lanes	2	1	0	0	1		0	0		1
Taper Length (ft)	25		25		25			25		
Lane Util. Factor	0.97	1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt		0.850								
Flt Protected	0.950				0.950					
Satd. Flow (prot)	3242	1495	0	0	1719	3438	0	0	3505	1845
Flt Permitted	0.950				0.950					
Satd. Flow (perm)	3242	1495	0	0	1719	3438	0	0	3505	1845
Right Turn on Red		Yes					Yes			Yes
Satd. Flow (RTOR)		227								
Link Speed (mph)	25		30			30			30	
Link Distance (ft)	347		390			494			346	
Travel Time (s)	9.5		8.9			11.2			7.9	
Peak Hour Factor	0.88	0.88	0.92	0.92	0.94	0.94	0.94	0.92	0.92	0.92
Heavy Vehicles (%)	8%	8%	2%	2%	5%	5%	5%	3%	3%	3%
Adj. Flow (vph)	239	227	0	0	622	628	0	0	951	0
Shared Lane Traffic (%)										
Lane Group Flow (vph)	239	227	0	0	622	628	0	0	951	0
Turn Type	Prot	Free			Prot	NA			NA	Free
Protected Phases	2				7	4			8	
Permitted Phases		Free								Free
Detector Phase	2				7	4			8	
Switch Phase										
Minimum Initial (s)	10.0				5.0	10.0			10.0	
Minimum Split (s)	46.0				11.0	46.0			46.0	
Total Split (s)	31.0				35.0	69.0			34.0	
Total Split (%)	31.0%				35.0%	69.0%			34.0%	
Maximum Green (s)	25.0				29.0	63.0			28.0	
Yellow Time (s)	4.0				4.0	4.0			4.0	
All-Red Time (s)	2.0				2.0	2.0			2.0	
Lost Time Adjust (s)	0.0				0.0	0.0			0.0	
Total Lost Time (s)	6.0				6.0	6.0			6.0	
Lead/Lag					Lead				Lag	
Lead-Lag Optimize?										
Vehicle Extension (s)	3.0				3.0	3.0			3.0	
Recall Mode	C-Min				None	Min			Min	
Walk Time (s)	7.0					7.0			7.0	
Flash Dont Walk (s)	11.0					11.0			11.0	
Pedestrian Calls (#/hr)	0					0			0	
Act Effct Green (s)	12.9	100.0			41.1	75.1			28.0	
Actuated g/C Ratio	0.13	1.00			0.41	0.75			0.28	
v/c Ratio	0.57	0.15			0.88	0.24			0.97	
Control Delay	46.2	0.2			43.8	4.3			58.7	
Queue Delay	0.0	0.0			0.0	0.0			0.0	

Lane Group	NBL	NBR	SEL	SER	NEL	NET	NER	SWL	SWT	SWR
Total Delay	46.2	0.2			43.8	4.3			58.7	
LOS	D	A			D	A			E	
Approach Delay	23.8					23.9			58.7	
Approach LOS	C					C			E	
Queue Length 50th (ft)	75	0			357	52			315	
Queue Length 95th (ft)	107	0			#610	83			#448	
Internal Link Dist (ft)	267		310			414			266	
Turn Bay Length (ft)					350					
Base Capacity (vph)	810	1495			706	2582			981	
Starvation Cap Reductn	0	0			0	0			0	
Spillback Cap Reductn	0	0			0	0			0	
Storage Cap Reductn	0	0			0	0			0	
Reduced v/c Ratio	0.30	0.15			0.88	0.24			0.97	

Intersection Summary

Area Type: Other
Cycle Length: 100
Actuated Cycle Length: 100
Offset: 0 (0%), Referenced to phase 2:NBL and 6:, Start of Green
Natural Cycle: 145
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.97
Intersection Signal Delay: 36.3 Intersection LOS: D
Intersection Capacity Utilization 84.6% ICU Level of Service E
Analysis Period (min) 15
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 11: Exit 4 NB Off & NH 102



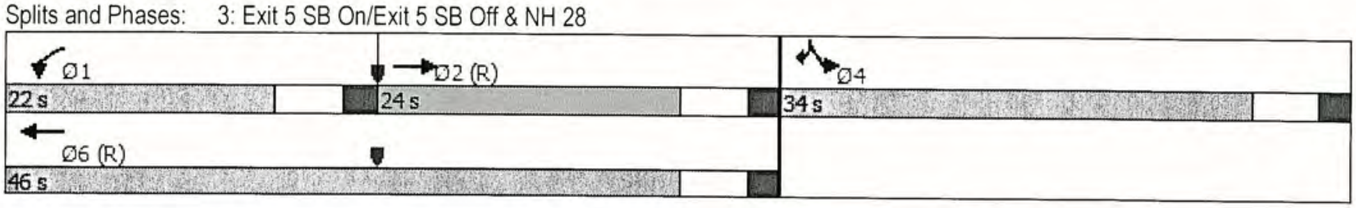
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑	↱	↰	↑↑					↰↰		↱
Traffic Volume (vph)	0	515	280	235	605	0	0	0	0	465	0	295
Future Volume (vph)	0	515	280	235	605	0	0	0	0	465	0	295
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	0.97	1.00	1.00
Frt			0.850									0.850
Flt Protected				0.950						0.950		
Satd. Flow (prot)	0	3167	1417	1687	3374	0	0	0	0	3303	0	1524
Flt Permitted				0.950						0.950		
Satd. Flow (perm)	0	3167	1417	1687	3374	0	0	0	0	3303	0	1524
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			304									123
Link Speed (mph)		30			30			30			35	
Link Distance (ft)		410			242			486			444	
Travel Time (s)		9.3			5.5			11.0			8.6	
Peak Hour Factor	0.92	0.92	0.92	0.73	0.73	0.73	0.92	0.92	0.92	0.74	0.74	0.74
Heavy Vehicles (%)	14%	14%	14%	7%	7%	7%	2%	2%	2%	6%	6%	6%
Adj. Flow (vph)	0	560	304	322	829	0	0	0	0	628	0	399
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	560	304	322	829	0	0	0	0	628	0	399
Turn Type		NA	Free	Prot	NA					Prot		Prot
Protected Phases		2		1	6					4		4
Permitted Phases			Free									
Detector Phase		2		1	6					4		4
Switch Phase												
Minimum Initial (s)		5.0		4.0	5.0					3.0		3.0
Minimum Split (s)		26.0		24.0	26.0					36.0		36.0
Total Split (s)		24.0		22.0	46.0					34.0		34.0
Total Split (%)		30.0%		27.5%	57.5%					42.5%		42.5%
Maximum Green (s)		18.0		16.0	40.0					28.0		28.0
Yellow Time (s)		4.0		4.0	4.0					4.0		4.0
All-Red Time (s)		2.0		2.0	2.0					2.0		2.0
Lost Time Adjust (s)		0.0		0.0	0.0					0.0		0.0
Total Lost Time (s)		6.0		6.0	6.0					6.0		6.0
Lead/Lag		Lag		Lead								
Lead-Lag Optimize?		Yes		Yes								
Vehicle Extension (s)		3.0		3.0	3.0					3.0		3.0
Recall Mode		C-Max		None	C-Max					None		None
Walk Time (s)		7.0		7.0	7.0					7.0		7.0
Flash Dont Walk (s)		11.0		11.0	11.0					11.0		11.0
Pedestrian Calls (#/hr)		0		0	0					0		0
Act Effct Green (s)		20.9	80.0	18.8	45.7					22.3		22.3
Actuated g/C Ratio		0.26	1.00	0.24	0.57					0.28		0.28
v/c Ratio		0.68	0.21	0.81	0.43					0.68		0.78
Control Delay		32.7	0.3	40.0	7.0					29.2		28.7
Queue Delay		0.0	0.0	0.0	0.0					0.0		0.0
Total Delay		32.7	0.3	40.0	7.0					29.2		28.7
LOS		C	A	D	A					C		C
Approach Delay		21.3			16.3						29.0	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach LOS		C			B						C	
Queue Length 50th (ft)		139	0	87	46					142		127
Queue Length 95th (ft)		#212	0	#211	59					138		146
Internal Link Dist (ft)		330			162			406			364	
Turn Bay Length (ft)												
Base Capacity (vph)		828	1417	396	1929					1156		613
Starvation Cap Reductn		0	0	0	0					0		0
Spillback Cap Reductn		0	0	0	0					0		0
Storage Cap Reductn		0	0	0	0					0		0
Reduced v/c Ratio		0.68	0.21	0.81	0.43					0.54		0.65

Intersection Summary

Area Type: Other
Cycle Length: 80
Actuated Cycle Length: 80
Offset: 38 (48%), Referenced to phase 2:EBT and 6:WBT, Start of Green
Natural Cycle: 90
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.81
Intersection Signal Delay: 22.0 Intersection LOS: C
Intersection Capacity Utilization 65.7% ICU Level of Service C
Analysis Period (min) 15
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 3: Exit 5 SB On/Exit 5 SB Off & NH 28



4

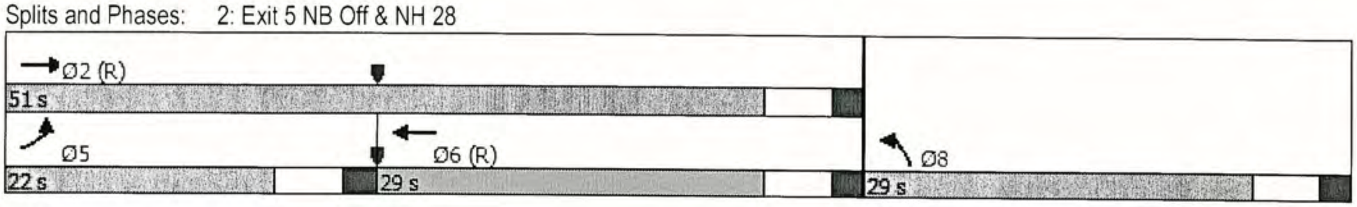
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑			↑↑	↱	↰		↱			
Traffic Volume (vph)	240	740	0	0	540	740	300	0	110	0	0	0
Future Volume (vph)	240	740	0	0	540	740	300	0	110	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt						0.850			0.850			
Flt Protected	0.950						0.950					
Satd. Flow (prot)	1641	3282	0	0	3438	1538	1656	0	1482	0	0	0
Flt Permitted	0.950						0.950					
Satd. Flow (perm)	1641	3282	0	0	3438	1538	1656	0	1482	0	0	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						822			205			
Link Speed (mph)		30			30			35			30	
Link Distance (ft)		196			451			450			368	
Travel Time (s)		4.5			10.3			8.8			8.4	
Peak Hour Factor	0.87	0.87	0.87	0.90	0.90	0.90	0.78	0.78	0.78	0.92	0.92	0.92
Heavy Vehicles (%)	10%	10%	10%	5%	5%	5%	9%	9%	9%	2%	2%	2%
Adj. Flow (vph)	276	851	0	0	600	822	385	0	141	0	0	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	276	851	0	0	600	822	385	0	141	0	0	0
Turn Type	Prot	NA			NA	Free	Prot		Free			
Protected Phases	5	2			6		8					
Permitted Phases		2			6	Free			Free			
Detector Phase	5	2			6		8					
Switch Phase												
Minimum Initial (s)	5.0	5.0			5.0		5.0					
Minimum Split (s)	24.0	24.0			24.0		11.0					
Total Split (s)	22.0	51.0			29.0		29.0					
Total Split (%)	27.5%	63.8%			36.3%		36.3%					
Maximum Green (s)	16.0	45.0			23.0		23.0					
Yellow Time (s)	4.0	4.0			4.0		4.0					
All-Red Time (s)	2.0	2.0			2.0		2.0					
Lost Time Adjust (s)	0.0	0.0			0.0		0.0					
Total Lost Time (s)	6.0	6.0			6.0		6.0					
Lead/Lag	Lead				Lag							
Lead-Lag Optimize?	Yes				Yes							
Vehicle Extension (s)	3.0	3.0			3.0		3.0					
Recall Mode	None	C-Max			C-Max		None					
Walk Time (s)	7.0	7.0			7.0							
Flash Dont Walk (s)	11.0	11.0			11.0							
Pedestrian Calls (#/hr)	0	0			0							
Act Effct Green (s)	15.7	46.6			24.9	80.0	21.4		80.0			
Actuated g/C Ratio	0.20	0.58			0.31	1.00	0.27		1.00			
v/c Ratio	0.86	0.44			0.56	0.53	0.87		0.10			
Control Delay	55.0	2.2			26.1	1.3	49.4		0.1			
Queue Delay	0.0	0.0			0.0	0.0	0.0		0.0			
Total Delay	55.0	2.2			26.1	1.3	49.4		0.1			
LOS	D	A			C	A	D		A			
Approach Delay		15.1			11.8			36.2				

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach LOS		B			B			D				
Queue Length 50th (ft)	130	0			135	0	178		0			
Queue Length 95th (ft)	#251	5			189	0	233		0			
Internal Link Dist (ft)		116			371			370			288	
Turn Bay Length (ft)												
Base Capacity (vph)	333	1913			1071	1538	476		1482			
Starvation Cap Reductn	0	0			0	0	0		0			
Spillback Cap Reductn	0	0			0	0	0		0			
Storage Cap Reductn	0	0			0	0	0		0			
Reduced v/c Ratio	0.83	0.44			0.56	0.53	0.81		0.10			

Intersection Summary

Area Type: Other
Cycle Length: 80
Actuated Cycle Length: 80
Offset: 0 (0%), Referenced to phase 2:EBT and 6:WBT, Start of Green
Natural Cycle: 70
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.87
Intersection Signal Delay: 17.2 Intersection LOS: B
Intersection Capacity Utilization 65.7% ICU Level of Service C
Analysis Period (min) 15
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 2: Exit 5 NB Off & NH 28



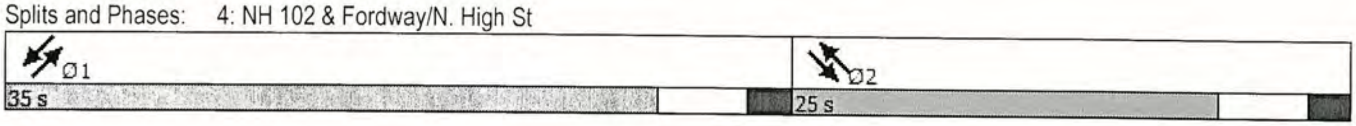
Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations		✥			✥			↱			↰	
Traffic Volume (vph)	5	25	10	345	0	70	0	400	125	15	595	0
Future Volume (vph)	5	25	10	345	0	70	0	400	125	15	595	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.966			0.977			0.968				
Flt Protected		0.994			0.960						0.999	
Satd. Flow (prot)	0	1789	0	0	1730	0	0	1703	0	0	1808	0
Flt Permitted		0.937			0.716						0.981	
Satd. Flow (perm)	0	1686	0	0	1290	0	0	1703	0	0	1775	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		17			55			36				
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		285			644			243			338	
Travel Time (s)		6.5			14.6			5.5			7.7	
Peak Hour Factor	0.60	0.60	0.60	0.96	0.96	0.96	0.89	0.89	0.89	0.86	0.86	0.86
Heavy Vehicles (%)	2%	2%	2%	3%	3%	3%	8%	8%	8%	5%	5%	5%
Adj. Flow (vph)	8	42	17	359	0	73	0	449	140	17	692	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	67	0	0	432	0	0	589	0	0	709	0
Turn Type	Perm	NA		Perm	NA			NA		Perm	NA	
Protected Phases		2			2			1			1	
Permitted Phases	2			2						1		
Detector Phase	2	2		2	2			1		1	1	
Switch Phase												
Minimum Initial (s)	5.0	5.0		5.0	5.0			5.0		5.0	5.0	
Minimum Split (s)	24.0	24.0		24.0	24.0			24.0		24.0	24.0	
Total Split (s)	25.0	25.0		25.0	25.0			35.0		35.0	35.0	
Total Split (%)	41.7%	41.7%		41.7%	41.7%			58.3%		58.3%	58.3%	
Maximum Green (s)	19.0	19.0		19.0	19.0			29.0		29.0	29.0	
Yellow Time (s)	4.0	4.0		4.0	4.0			4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0			2.0		2.0	2.0	
Lost Time Adjust (s)		0.0			0.0			0.0			0.0	
Total Lost Time (s)		6.0			6.0			6.0			6.0	
Lead/Lag	Lag	Lag		Lag	Lag			Lead		Lead	Lead	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes			Yes		Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0		3.0	3.0	
Recall Mode	None	None		None	None			Min		Min	Min	
Walk Time (s)	7.0	7.0		7.0	7.0			7.0		7.0	7.0	
Flash Dont Walk (s)	11.0	11.0		11.0	11.0			11.0		11.0	11.0	
Pedestrian Calls (#/hr)	0	0		0	0			0		0	0	
Act Effct Green (s)		19.1			19.1			27.3			27.3	
Actuated g/C Ratio		0.33			0.33			0.47			0.47	
v/c Ratio		0.12			0.94			0.72			0.86	
Control Delay		12.4			51.7			17.7			26.4	
Queue Delay		0.0			0.0			0.0			0.0	
Total Delay		12.4			51.7			17.7			26.4	
LOS		B			D			B			C	
Approach Delay		12.4			51.7			17.7			26.4	

Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Approach LOS		B			D			B			C	
Queue Length 50th (ft)		13			135			145			206	
Queue Length 95th (ft)		22			#304			247			#368	
Internal Link Dist (ft)		205			564			163			258	
Turn Bay Length (ft)												
Base Capacity (vph)		562			458			866			884	
Starvation Cap Reductn		0			0			0			0	
Spillback Cap Reductn		0			0			0			0	
Storage Cap Reductn		0			0			0			0	
Reduced v/c Ratio		0.12			0.94			0.68			0.80	

Intersection Summary

Area Type: Other
Cycle Length: 60
Actuated Cycle Length: 58.4
Natural Cycle: 70
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.94
Intersection Signal Delay: 29.1 — Intersection LOS: C
Intersection Capacity Utilization 83.4% — ICU Level of Service E
Analysis Period (min) 15
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 4: NH 102 & Fordway/N. High St



7,

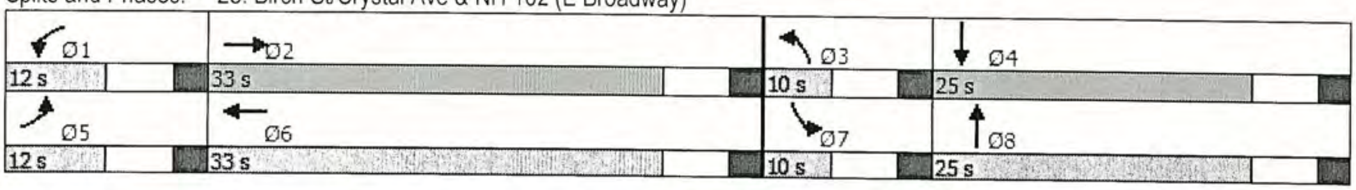
	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↱		↰	↱		↰	↑	↱
Traffic Volume (vph)	105	205	60	35	385	80	60	260	40	70	230	105
Future Volume (vph)	105	205	60	35	385	80	60	260	40	70	230	105
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.966			0.974			0.980				0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1656	1684	0	1703	1746	0	1719	1773	0	1703	1792	1524
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1656	1684	0	1703	1746	0	1719	1773	0	1703	1792	1524
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		20			14			9				205
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		505			530			361			411	
Travel Time (s)		11.5			12.0			8.2			9.3	
Peak Hour Factor	0.96	0.96	0.96	0.94	0.94	0.94	0.85	0.85	0.85	0.91	0.91	0.91
Heavy Vehicles (%)	9%	9%	9%	6%	6%	6%	5%	5%	5%	6%	6%	6%
Parking (#/hr)			0									
Adj. Flow (vph)	109	214	63	37	410	85	71	306	47	77	253	115
Shared Lane Traffic (%)												
Lane Group Flow (vph)	109	277	0	37	495	0	71	353	0	77	253	115
Turn Type	Prot	NA		Prot	NA		Prot	NA		Prot	NA	Perm
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases												4
Detector Phase	5	2		1	6		3	8		7	4	4
Switch Phase												
Minimum Initial (s)	4.0	5.0		4.0	10.0		4.0	10.0		4.0	9.0	9.0
Minimum Split (s)	10.0	30.0		10.0	30.0		10.0	25.0		10.0	25.0	25.0
Total Split (s)	12.0	33.0		12.0	33.0		10.0	25.0		10.0	25.0	25.0
Total Split (%)	15.0%	41.3%		15.0%	41.3%		12.5%	31.3%		12.5%	31.3%	31.3%
Maximum Green (s)	6.0	27.0		6.0	27.0		4.0	19.0		4.0	19.0	19.0
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	6.0
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lag		Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes	Yes
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Recall Mode	None	Min		None	Min		Min	None		Min	None	None
Walk Time (s)		7.0			7.0			7.0			7.0	7.0
Flash Dont Walk (s)		11.0			11.0			11.0			11.0	11.0
Pedestrian Calls (#/hr)		10			10			0			10	10
Act Effct Green (s)	6.0	29.4		5.9	24.1		4.0	17.5		4.0	17.5	17.5
Actuated g/C Ratio	0.08	0.39		0.08	0.32		0.05	0.23		0.05	0.23	0.23
v/c Ratio	0.83	0.42		0.28	0.88		0.79	0.85		0.86	0.61	0.23
Control Delay	83.0	20.1		40.6	42.7		90.6	48.3		103.4	33.9	1.1
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Total Delay	83.0	20.1		40.6	42.7		90.6	48.3		103.4	33.9	1.1
LOS	F	C		D	D		F	D		F	C	A

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		37.8			42.6			55.4			37.4	
Approach LOS		D			D			E			D	
Queue Length 50th (ft)	55	99		18	218		36	164		39	113	0
Queue Length 95th (ft)	#148	170		47	#385		#101	#274		#121	188	2
Internal Link Dist (ft)		425			450			281			331	
Turn Bay Length (ft)												
Base Capacity (vph)	132	663		135	634		90	453		90	452	537
Starvation Cap Reductn	0	0		0	0		0	0		0	0	0
Spillback Cap Reductn	0	0		0	0		0	0		0	0	0
Storage Cap Reductn	0	0		0	0		0	0		0	0	0
Reduced v/c Ratio	0.83	0.42		0.27	0.78		0.79	0.78		0.86	0.56	0.21

Intersection Summary

Area Type: Other
Cycle Length: 80
Actuated Cycle Length: 75.9
Natural Cycle: 80
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.88
Intersection Signal Delay: 43.3 — Intersection LOS: D
Intersection Capacity Utilization 70.9% — ICU Level of Service C
Analysis Period (min) 15
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 23: Birch St/Crystal Ave & NH 102 (E Broadway)



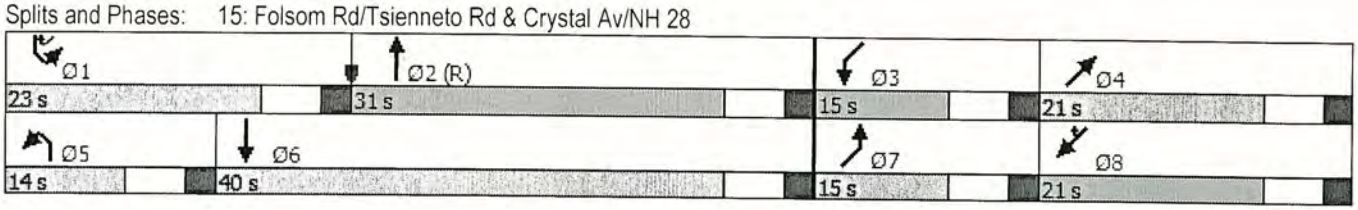
Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations	↰	↑↑	↱	↰↰	↑↑	↱	↰	↑	↱	↰	↑	↱
Traffic Volume (vph)	20	230	135	310	220	145	135	170	20	125	290	370
Future Volume (vph)	20	230	135	310	220	145	135	170	20	125	290	370
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	150		150	0		0	0		0	0		0
Storage Lanes	1		1	2		1	1		1	1		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850			0.850			0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1736	3471	1553	3335	3438	1538	1752	1845	1568	1752	1845	1568
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1736	3471	1553	3335	3438	1538	1752	1845	1568	1752	1845	1568
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			255			184			327			259
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		639			394			532			387	
Travel Time (s)		14.5			9.0			12.1			8.8	
Peak Hour Factor	0.84	0.84	0.84	0.79	0.79	0.79	0.86	0.86	0.86	0.99	0.99	0.99
Heavy Vehicles (%)	4%	4%	4%	5%	5%	5%	3%	3%	3%	3%	3%	3%
Adj. Flow (vph)	24	274	161	392	278	184	157	198	23	126	293	374
Shared Lane Traffic (%)												
Lane Group Flow (vph)	24	274	161	392	278	184	157	198	23	126	293	374
Turn Type	Prot	NA	Perm	Prot	NA	Perm	Prot	NA	Free	Prot	NA	pt+ov
Protected Phases	5	2		1	6		7	4		3	8	8 1
Permitted Phases		2	2		6	6		4	Free		8	
Detector Phase	5	2	2	1	6	6	7	4		3	8	8 1
Switch Phase												
Minimum Initial (s)	8.0	8.0	8.0	8.0	8.0	8.0	6.0	8.0		7.0	8.0	
Minimum Split (s)	14.0	31.0	31.0	14.0	40.0	40.0	12.0	21.0		13.0	21.0	
Total Split (s)	14.0	31.0	31.0	23.0	40.0	40.0	15.0	21.0		15.0	21.0	
Total Split (%)	15.6%	34.4%	34.4%	25.6%	44.4%	44.4%	16.7%	23.3%		16.7%	23.3%	
Maximum Green (s)	8.0	25.0	25.0	17.0	34.0	34.0	9.0	15.0		9.0	15.0	
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0		2.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag		Lead	Lag	
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Recall Mode	Max	C-Max	C-Max	None	Max	Max	None	None		None	None	
Walk Time (s)	5.0	5.0	5.0		5.0	5.0		5.0			5.0	
Flash Dont Walk (s)	11.0	11.0	11.0		11.0	11.0		11.0			11.0	
Pedestrian Calls (#/hr)	0	0	0		0	0		0			0	
Act Effct Green (s)	8.0	26.8	26.8	15.2	34.0	34.0	9.0	15.3	90.0	8.7	15.0	36.2
Actuated g/C Ratio	0.09	0.30	0.30	0.17	0.38	0.38	0.10	0.17	1.00	0.10	0.17	0.40
v/c Ratio	0.16	0.27	0.25	0.70	0.21	0.26	0.90	0.63	0.01	0.74	0.95	0.48
Control Delay	40.5	25.5	1.2	42.0	19.5	4.1	88.0	45.1	0.0	66.1	80.3	8.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Total Delay	40.5	25.5	1.2	42.0	19.5	4.1	88.0	45.1	0.0	66.1	80.3	8.0
LOS	D	C	A	D	B	A	F	D	A	E	F	A
Approach Delay		17.8			26.5			60.2			44.0	
Approach LOS		B			C			E			D	
Queue Length 50th (ft)	13	63	0	107	55	0	90	106	0	71	167	40
Queue Length 95th (ft)	35	90	0	131	72	27	#191	169	0	#157	#323	108
Internal Link Dist (ft)		559			314			452			307	
Turn Bay Length (ft)	150		150									
Base Capacity (vph)	154	1032	641	629	1298	695	175	312	1568	175	307	811
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.16	0.27	0.25	0.62	0.21	0.26	0.90	0.63	0.01	0.72	0.95	0.46

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 90
Offset: 0 (0%), Referenced to phase 2:NBT, Start of Green
Natural Cycle: 90
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.95
Intersection Signal Delay: 35.6 Intersection LOS: D
Intersection Capacity Utilization 58.3% ICU Level of Service B
Analysis Period (min) 15
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 15: Folsom Rd/Tsienneto Rd & Crystal Av/NH 28



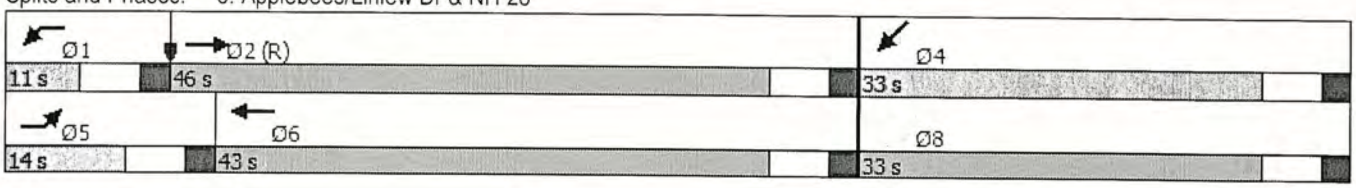
	SB			NB			EB			WB		
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	50	790	0	0	655	30	5	0	5	50	0	245
Future Volume (vph)	50	790	0	0	655	30	5	0	5	50	0	245
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	75		0	150		150	0		0	0		0
Storage Lanes	1		0	1		0	0		1	0		1
Taper Length (ft)	50			25			25			25		
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt					0.993				0.850			0.850
Flt Protected	0.950							0.950			0.950	
Satd. Flow (prot)	1687	3374	0	1863	3514	0	0	1805	1615	0	1787	1599
Flt Permitted	0.950							0.720			0.751	
Satd. Flow (perm)	1687	3374	0	1863	3514	0	0	1368	1615	0	1413	1599
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)					6				109			227
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		277			755			218			433	
Travel Time (s)		6.3			17.2			5.0			9.8	
Peak Hour Factor	0.83	0.83	0.83	0.92	0.92	0.92	0.50	0.50	0.50	0.90	0.90	0.90
Heavy Vehicles (%)	7%	7%	7%	2%	2%	2%	0%	0%	0%	1%	1%	1%
Adj. Flow (vph)	60	952	0	0	712	33	10	0	10	56	0	272
Shared Lane Traffic (%)												
Lane Group Flow (vph)	60	952	0	0	745	0	0	10	10	0	56	272
Turn Type	Prot	NA		Prot	NA		custom	NA	custom	Perm	NA	Perm
Protected Phases	5	2		1	6						4	
Permitted Phases					6		8	8	8	4		4
Detector Phase	5	2		1	6		8	8	8	4	4	4
Switch Phase												
Minimum Initial (s)	8.0	8.0		5.0	8.0		5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	14.0	46.0		11.0	43.0		33.0	33.0	33.0	33.0	33.0	33.0
Total Split (s)	14.0	46.0		11.0	43.0		33.0	33.0	33.0	33.0	33.0	33.0
Total Split (%)	15.6%	51.1%		12.2%	47.8%		36.7%	36.7%	36.7%	36.7%	36.7%	36.7%
Maximum Green (s)	8.0	40.0		5.0	37.0		27.0	27.0	27.0	27.0	27.0	27.0
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0			0.0	0.0		0.0	0.0
Total Lost Time (s)	6.0	6.0		6.0	6.0			6.0	6.0		6.0	6.0
Lead/Lag	Lead	Lag		Lead	Lag							
Lead-Lag Optimize?	Yes	Yes		Yes	Yes							
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	C-Max		None	None		None	None	None	None	None	None
Act Effct Green (s)	9.2	67.7			55.2			10.3	10.3		10.3	10.3
Actuated g/C Ratio	0.10	0.75			0.61			0.11	0.11		0.11	0.11
v/c Ratio	0.35	0.38			0.35			0.06	0.04		0.35	0.71
Control Delay	42.8	4.9			12.9			33.0	0.2		40.6	18.9
Queue Delay	0.0	0.0			0.0			0.0	0.0		0.0	0.0
Total Delay	42.8	4.9			12.9			33.0	0.2		40.6	18.9
LOS	D	A			B			C	A		D	B
Approach Delay		7.1			12.9			16.6			22.6	

Lane Group	EBL	SB EBT	EBR	WBL	NB WBT	WBR	NEL	EB NET	NER	SWL	WB SWT	SWR
Approach LOS		A			B			B			C	
Queue Length 50th (ft)	33	72			119			5	0		30	24
Queue Length 95th (ft)	63	134			m208			10	0		61	93
Internal Link Dist (ft)		197			675			138			353	
Turn Bay Length (ft)	75											
Base Capacity (vph)	173	2537			2159			410	560		423	638
Starvation Cap Reductn	0	0			0			0	0		0	0
Spillback Cap Reductn	0	0			0			0	0		0	0
Storage Cap Reductn	0	0			0			0	0		0	0
Reduced v/c Ratio	0.35	0.38			0.35			0.02	0.02		0.13	0.43

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 90
Offset: 63 (70%), Referenced to phase 2:EBT, Start of Green
Natural Cycle: 90
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.71
Intersection Signal Delay: 11.7 Intersection LOS: B
Intersection Capacity Utilization 53.4% ICU Level of Service A
Analysis Period (min) 15
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 6: Applebees/Linlew Dr & NH 28



14

		SB			NC			EB			WB	
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰↰	↑↱		↰	↑↱		↰	↱		↰	↰↑	↱
Traffic Volume (vph)	100	630	5	5	610	220	10	5	5	180	5	100
Future Volume (vph)	100	630	5	5	610	220	10	5	5	180	5	100
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	150		150	150		150	0		0	0		0
Storage Lanes	2		0	1		0	1		0	1		1
Taper Length (ft)	200			25			25			25		
Lane Util. Factor	0.97	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	0.95	0.95	1.00
Frt		0.999			0.960			0.925				0.850
Flt Protected	0.950			0.950			0.950			0.950	0.955	
Satd. Flow (prot)	3303	3402	0	1736	3332	0	1805	1758	0	1665	1674	1568
Flt Permitted	0.950			0.950			0.950			0.950	0.955	
Satd. Flow (perm)	3303	3402	0	1736	3332	0	1805	1758	0	1665	1674	1568
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		1			79			7				111
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		412			486			151			343	
Travel Time (s)		9.4			11.0			3.4			7.8	
Peak Hour Factor	0.83	0.83	0.83	0.97	0.97	0.97	0.67	0.67	0.67	0.90	0.90	0.90
Heavy Vehicles (%)	6%	6%	6%	4%	4%	4%	0%	0%	0%	3%	3%	3%
Adj. Flow (vph)	120	759	6	5	629	227	15	7	7	200	6	111
Shared Lane Traffic (%)										49%		
Lane Group Flow (vph)	120	765	0	5	856	0	15	14	0	102	104	111
Turn Type	Prot	NA		Prot	NA		Split	NA		Split	NA	pt+ov
Protected Phases	5	2		1	6		3	3		4	4	4 5
Permitted Phases								3				
Detector Phase	5	2		1	6		3	3		4	4	4 5
Switch Phase												
Minimum Initial (s)	5.0	8.0		5.0	8.0		5.0	5.0		8.0	8.0	
Minimum Split (s)	14.0	53.0		11.0	50.0		11.0	11.0		15.0	15.0	
Total Split (s)	14.0	53.0		11.0	50.0		11.0	11.0		15.0	15.0	
Total Split (%)	15.6%	58.9%		12.2%	55.6%		12.2%	12.2%		16.7%	16.7%	
Maximum Green (s)	8.0	47.0		5.0	44.0		5.0	5.0		9.0	9.0	
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lead		Lag	Lag	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	Min		None	C-Min		None	None		None	None	
Walk Time (s)		5.0			5.0		5.0	5.0		5.0	5.0	
Flash Dont Walk (s)		11.0			11.0		11.0	11.0		11.0	11.0	
Pedestrian Calls (#/hr)		0			0		0	0		0	0	
Act Effct Green (s)	8.0	57.4		5.6	45.5		6.3	6.3		10.7	10.7	24.7
Actuated g/C Ratio	0.09	0.64		0.06	0.51		0.07	0.07		0.12	0.12	0.27
v/c Ratio	0.41	0.35		0.05	0.50		0.12	0.11		0.52	0.53	0.22
Control Delay	42.9	10.3		61.6	10.1		40.8	30.0		46.5	46.7	6.0
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0

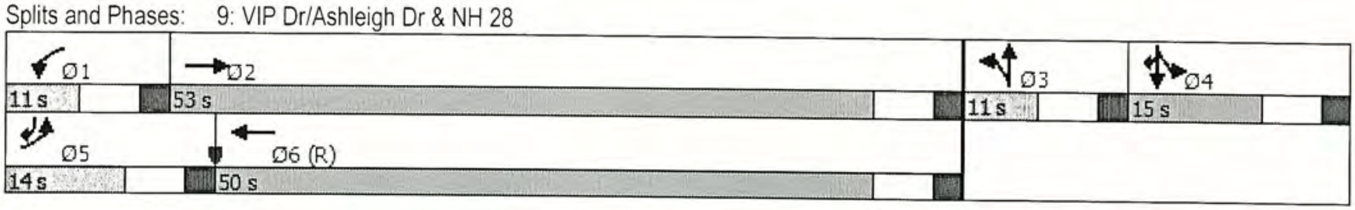
14.

		SB			NB			EB			WB	
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Total Delay	42.9	10.3		61.6	10.1		40.8	30.0		46.5	46.7	6.0
LOS	D	B		E	B		D	C		D	D	A
Approach Delay		14.7			10.4			35.6			32.4	
Approach LOS		B			B			D			C	
Queue Length 50th (ft)	33	105		3	94		8	4		57	58	0
Queue Length 95th (ft)	56	183		m8	285		20	16		110	111	38
Internal Link Dist (ft)		332			406			71			263	
Turn Bay Length (ft)	150			150								
Base Capacity (vph)	309	2212		107	1847		127	130		201	202	501
Starvation Cap Reductn	0	0		0	0		0	0		0	0	0
Spillback Cap Reductn	0	0		0	0		0	0		0	0	0
Storage Cap Reductn	0	0		0	0		0	0		0	0	0
Reduced v/c Ratio	0.39	0.35		0.05	0.46		0.12	0.11		0.51	0.51	0.22

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 90
Offset: 0 (0%), Referenced to phase 6:WBT, Start of Green
Natural Cycle: 90
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.53
Intersection Signal Delay: 15.9 Intersection LOS: B
Intersection Capacity Utilization 54.8% ICU Level of Service A
Analysis Period (min) 15
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 9: VIP Dr/Ashleigh Dr & NH 28



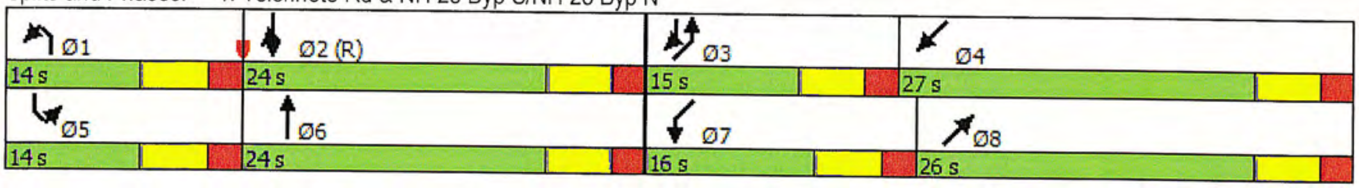
							EB			WB		
Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	100	220	20	25	210	255	120	100	80	80	270	90
Future Volume (vph)	100	220	20	25	210	255	120	100	80	80	270	90
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	150		150	150		150	150		150	150		150
Storage Lanes	1		0	1		1	1		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.988				0.850		0.933			0.963	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1752	1823	0	1736	1827	1553	1770	1738	0	1787	1812	0
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1752	1823	0	1736	1827	1553	1770	1738	0	1787	1812	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		5				202		48			20	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		481			347			479			371	
Travel Time (s)		10.9			7.9			10.9			8.4	
Peak Hour Factor	0.82	0.82	0.82	0.81	0.81	0.81	0.68	0.68	0.68	0.78	0.78	0.78
Heavy Vehicles (%)	3%	3%	3%	4%	4%	4%	2%	2%	2%	1%	1%	1%
Adj. Flow (vph)	122	268	24	31	259	315	176	147	118	103	346	115
Shared Lane Traffic (%)												
Lane Group Flow (vph)	122	292	0	31	259	315	176	265	0	103	461	0
Turn Type	Prot	NA		Prot	NA	pt+ov	Prot	NA		Prot	NA	
Protected Phases	1	6		5	2	2 3	3	8		7	4	
Permitted Phases												
Detector Phase	1	6		5	2	2 3	3	8		7	4	
Switch Phase												
Minimum Initial (s)	8.0	8.0		8.0	8.0		8.0	8.0		8.0	8.0	
Minimum Split (s)	14.0	20.0		14.0	20.0		14.0	20.0		14.0	20.0	
Total Split (s)	14.0	24.0		14.0	24.0		15.0	26.0		16.0	27.0	
Total Split (%)	17.5%	30.0%		17.5%	30.0%		18.8%	32.5%		20.0%	33.8%	
Maximum Green (s)	8.0	18.0		8.0	18.0		9.0	20.0		10.0	21.0	
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lag		Lead	Lag	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	C-Max		None	None		None	None	
Act Effct Green (s)	8.0	26.5		8.0	18.1	33.1	9.0	23.4		9.2	20.9	
Actuated g/C Ratio	0.10	0.33		0.10	0.23	0.41	0.11	0.29		0.12	0.26	
v/c Ratio	0.70	0.48		0.18	0.63	0.41	0.88	0.49		0.50	0.95	
Control Delay	57.5	26.8		35.8	35.7	7.9	77.5	24.2		41.9	59.4	
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Total Delay	57.5	26.8		35.8	35.7	7.9	77.5	24.2		41.9	59.4	
LOS	E	C		D	D	A	E	C		D	E	
Approach Delay		35.9			21.2			45.5			56.2	

Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Approach LOS		D			C			D			E	
Queue Length 50th (ft)	60	99		15	117	35	88	94		49	217	
Queue Length 95th (ft)	#119	193		36	171	71	#126	114		82	#309	
Internal Link Dist (ft)		401			267			399			291	
Turn Bay Length (ft)	150			150		150	150			150		
Base Capacity (vph)	175	607		173	414	761	199	543		223	490	
Starvation Cap Reductn	0	0		0	0	0	0	0		0	0	
Spillback Cap Reductn	0	0		0	0	0	0	0		0	0	
Storage Cap Reductn	0	0		0	0	0	0	0		0	0	
Reduced v/c Ratio	0.70	0.48		0.18	0.63	0.41	0.88	0.49		0.46	0.94	

Intersection Summary

Area Type: Other
Cycle Length: 80
Actuated Cycle Length: 80
Offset: 0 (0%), Referenced to phase 2:SBT, Start of Green
Natural Cycle: 80
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.95
Intersection Signal Delay: 39.2 Intersection LOS: D
Intersection Capacity Utilization 65.8% ICU Level of Service C
Analysis Period (min) 15
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 1: Tsienneto Rd & NH 28 Byp S/NH 28 Byp N



APPENDIX G-2: HCM AND SYNCHRO PRINTOUTS – SIGNALIZED INTERSECTION CAPACITY ANALYSES – 2015 PM PEAK HOURS – SYNCHRO PRINTOUTS

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR	Ø9
Lane Configurations							
Traffic Volume (vph)	0	935	850	0	280	645	
Future Volume (vph)	0	935	850	0	280	645	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	
Lane Util. Factor	1.00	0.95	0.95	1.00	1.00	1.00	
Frt						0.850	
Flt Protected					0.950		
Satd. Flow (prot)	0	3574	3574	0	1752	1568	
Flt Permitted					0.950		
Satd. Flow (perm)	0	3574	3574	0	1752	1568	
Right Turn on Red				Yes		Yes	
Satd. Flow (RTOR)						344	
Link Speed (mph)		30	30		25		
Link Distance (ft)		317	266		431		
Travel Time (s)		7.2	6.0		11.8		
Peak Hour Factor	0.92	0.92	0.89	0.89	0.92	0.92	
Heavy Vehicles (%)	1%	1%	1%	1%	3%	3%	
Adj. Flow (vph)	0	1016	955	0	304	701	
Shared Lane Traffic (%)							
Lane Group Flow (vph)	0	1016	955	0	304	701	
Turn Type		NA	NA		Prot	Perm	
Protected Phases		2	2		7		9
Permitted Phases						7	
Detector Phase		2	2		7	7	
Switch Phase							
Minimum Initial (s)		10.0	10.0		7.0	7.0	4.0
Minimum Split (s)		40.0	40.0		29.0	29.0	22.0
Total Split (s)		58.0	58.0		36.0	36.0	26.0
Total Split (%)		48.3%	48.3%		30.0%	30.0%	22%
Maximum Green (s)		52.0	52.0		30.0	30.0	20.0
Yellow Time (s)		4.0	4.0		4.0	4.0	3.0
All-Red Time (s)		2.0	2.0		2.0	2.0	3.0
Lost Time Adjust (s)		0.0	0.0		0.0	0.0	
Total Lost Time (s)		6.0	6.0		6.0	6.0	
Lead/Lag							
Lead-Lag Optimize?							
Vehicle Extension (s)		3.0	3.0		3.0	3.0	3.0
Recall Mode		C-Max	C-Max		Max	Max	None
Walk Time (s)		7.0	7.0		7.0	7.0	
Flash Dont Walk (s)		11.0	11.0		11.0	11.0	
Pedestrian Calls (#/hr)		0	0		0	0	
Act Effct Green (s)		78.0	78.0		30.0	30.0	
Actuated g/C Ratio		0.65	0.65		0.25	0.25	
v/c Ratio		0.44	0.41		0.69	1.08	
Control Delay		11.0	1.8		50.4	80.9	
Queue Delay		0.0	0.0		0.0	0.0	
Total Delay		11.0	1.8		50.4	80.9	
LOS		B	A		D	F	
Approach Delay		11.0	1.8		71.7		

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR	Ø9
Approach LOS		B	A		E		
Queue Length 50th (ft)		186	15		214	~392	
Queue Length 95th (ft)		230	18		317	#630	
Internal Link Dist (ft)		237	186		351		
Turn Bay Length (ft)							
Base Capacity (vph)		2323	2323		438	650	
Starvation Cap Reductn		0	0		0	0	
Spillback Cap Reductn		0	0		0	0	
Storage Cap Reductn		0	0		0	0	
Reduced v/c Ratio		0.44	0.41		0.69	1.08	

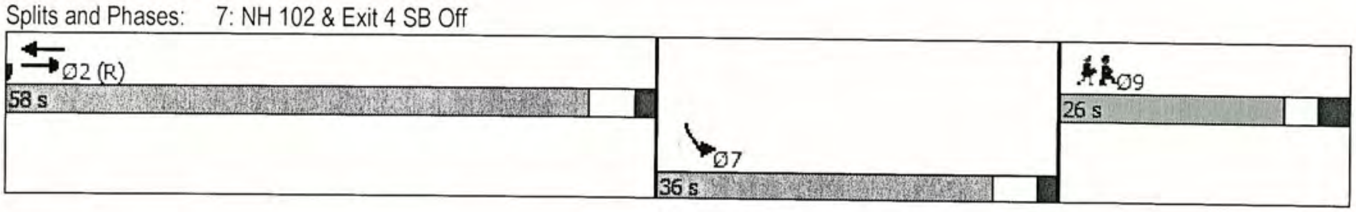
Intersection Summary

Area Type: Other
Cycle Length: 120
Actuated Cycle Length: 120
Offset: 0 (0%), Referenced to phase 2:EBWB, Start of Green
Natural Cycle: 95
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 1.08
Intersection Signal Delay: 28.5 Intersection LOS: C
Intersection Capacity Utilization 73.4% ICU Level of Service D
Analysis Period (min) 15

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 7: NH 102 & Exit 4 SB Off



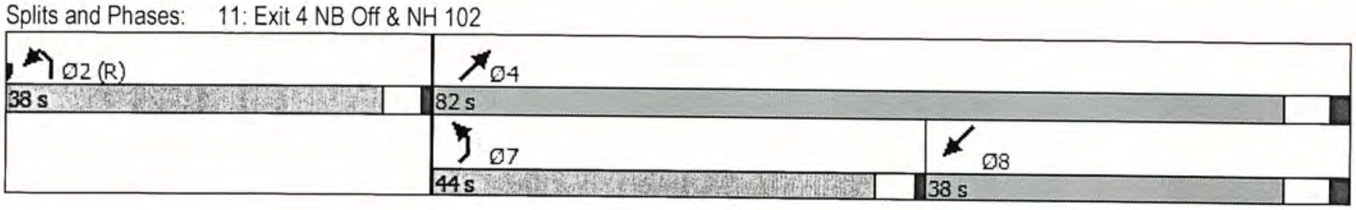
Lane Group	NBL2	NBL	NBR	SEL	SER	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations											
Traffic Volume (vph)	580	0	605	0	0	475	740	0	0	485	0
Future Volume (vph)	580	0	605	0	0	475	740	0	0	485	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	0.97	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt			0.850								
Flt Protected	0.950					0.950					
Satd. Flow (prot)	3467	0	1599	0	0	1770	3539	0	0	3539	1863
Flt Permitted	0.950					0.950					
Satd. Flow (perm)	3467	0	1599	0	0	1770	3539	0	0	3539	1863
Right Turn on Red			Yes					Yes			Yes
Satd. Flow (RTOR)			499								
Link Speed (mph)		25		30			30			30	
Link Distance (ft)		347		390			361			346	
Travel Time (s)		9.5		8.9			8.2			7.9	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.96	0.96	0.96	0.87	0.87	0.87
Heavy Vehicles (%)	1%	1%	1%	2%	2%	2%	2%	2%	2%	2%	2%
Adj. Flow (vph)	630	0	658	0	0	495	771	0	0	557	0
Shared Lane Traffic (%)											
Lane Group Flow (vph)	630	0	658	0	0	495	771	0	0	557	0
Turn Type	Prot		Free			Prot	NA			NA	Free
Protected Phases	2					7	4			8	
Permitted Phases			Free				7				Free
Detector Phase	2					7	4			8	
Switch Phase											
Minimum Initial (s)	5.0					5.0	10.0			10.0	
Minimum Split (s)	9.5					9.5	66.0			66.0	
Total Split (s)	38.0					44.0	82.0			38.0	
Total Split (%)	31.7%					36.7%	68.3%			31.7%	
Maximum Green (s)	33.5					39.5	76.0			32.0	
Yellow Time (s)	3.5					3.5	4.0			4.0	
All-Red Time (s)	1.0					1.0	2.0			2.0	
Lost Time Adjust (s)	0.0					0.0	0.0			0.0	
Total Lost Time (s)	4.5					4.5	6.0			6.0	
Lead/Lag						Lead				Lag	
Lead-Lag Optimize?						Yes				Yes	
Vehicle Extension (s)	3.0					3.0	3.0			3.0	
Recall Mode	C-Max					None	None			None	
Walk Time (s)							7.0			7.0	
Flash Dont Walk (s)							11.0			11.0	
Pedestrian Calls (#/hr)							0			0	
Act Effct Green (s)	43.4		120.0			36.7	66.1			24.9	
Actuated g/C Ratio	0.36		1.00			0.31	0.55			0.21	
v/c Ratio	0.50		0.41			0.91	0.40			0.76	
Control Delay	33.3		0.8			62.3	19.5			51.5	
Queue Delay	0.0		0.0			0.0	0.0			0.0	
Total Delay	33.3		0.8			62.3	19.5			51.5	
LOS	C		A			E	B			D	
Approach Delay		16.7					36.2			51.5	

Lane Group	NBL2	NBL	NBR	SEL	SER	NEL	NET	NER	SWL	SWT	SWR
Approach LOS		B					D			D	
Queue Length 50th (ft)	202		0			374	200			215	
Queue Length 95th (ft)	281		0			#548	242			250	
Internal Link Dist (ft)		267		310			281			266	
Turn Bay Length (ft)											
Base Capacity (vph)	1253		1599			582	2241			943	
Starvation Cap Reductn	0		0			0	0			0	
Spillback Cap Reductn	0		0			0	0			0	
Storage Cap Reductn	0		0			0	0			0	
Reduced v/c Ratio	0.50		0.41			0.85	0.34			0.59	

Intersection Summary

Area Type: Other
Cycle Length: 120
Actuated Cycle Length: 120
Offset: 0 (0%), Referenced to phase 2:NBL and 6:, Start of Green
Natural Cycle: 135
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.91
Intersection Signal Delay: 30.9 Intersection LOS: C
Intersection Capacity Utilization 68.4% ICU Level of Service C
Analysis Period (min) 15
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 11: Exit 4 NB Off & NH 102



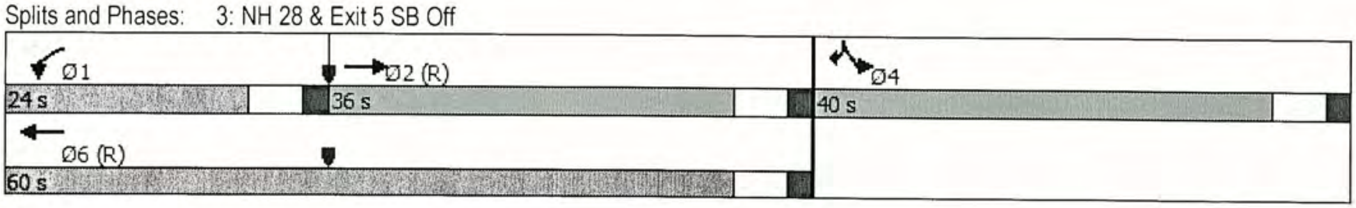
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑	↱	↰	↑↑					↰↰		↱
Traffic Volume (vph)	0	650	280	135	490	0	0	0	0	645	0	265
Future Volume (vph)	0	650	280	135	490	0	0	0	0	645	0	265
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	500		0	0		0	0		0
Storage Lanes	0		1	1		0	0		0	2		1
Taper Length (ft)	25			30			25			25		
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	0.97	1.00	1.00
Frt			0.850									0.850
Flt Protected				0.950						0.950		
Satd. Flow (prot)	0	3471	1553	1719	3438	0	0	0	0	3367	0	1553
Flt Permitted				0.950						0.950		
Satd. Flow (perm)	0	3471	1553	1719	3438	0	0	0	0	3367	0	1553
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			322									276
Link Speed (mph)		30			30			30			35	
Link Distance (ft)		410			699			486			444	
Travel Time (s)		9.3			15.9			11.0			8.6	
Peak Hour Factor	0.87	0.87	0.87	0.86	0.86	0.86	0.92	0.92	0.92	0.91	0.91	0.91
Heavy Vehicles (%)	4%	4%	4%	5%	5%	5%	2%	2%	2%	4%	4%	4%
Adj. Flow (vph)	0	747	322	157	570	0	0	0	0	709	0	291
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	747	322	157	570	0	0	0	0	709	0	291
Turn Type		NA	Free	Prot	NA					Prot		Prot
Protected Phases		2		1	6					4		4
Permitted Phases			Free		1							
Detector Phase		2		1	6					4		4
Switch Phase												
Minimum Initial (s)		5.0		4.0	5.0					3.0		3.0
Minimum Split (s)		41.0		10.0	41.0					36.0		36.0
Total Split (s)		36.0		24.0	60.0					40.0		40.0
Total Split (%)		36.0%		24.0%	60.0%					40.0%		40.0%
Maximum Green (s)		30.0		18.0	54.0					34.0		34.0
Yellow Time (s)		4.0		4.0	4.0					4.0		4.0
All-Red Time (s)		2.0		2.0	2.0					2.0		2.0
Lost Time Adjust (s)		0.0		0.0	0.0					0.0		0.0
Total Lost Time (s)		6.0		6.0	6.0					6.0		6.0
Lead/Lag		Lag		Lead								
Lead-Lag Optimize?		Yes		Yes								
Vehicle Extension (s)		4.0		4.0	4.0					4.0		4.0
Recall Mode		C-Min		None	C-Min					None		None
Walk Time (s)		7.0			7.0					7.0		7.0
Flash Dont Walk (s)		11.0			11.0					11.0		11.0
Pedestrian Calls (#/hr)		0			0					0		0
Act Effct Green (s)		38.4	100.0	14.7	59.2					28.8		28.8
Actuated g/C Ratio		0.38	1.00	0.15	0.59					0.29		0.29
v/c Ratio		0.56	0.21	0.62	0.28					0.73		0.45
Control Delay		27.8	0.3	45.3	4.8					36.5		6.2
Queue Delay		0.0	0.0	0.0	0.0					0.0		0.0

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Total Delay		27.8	0.3	45.3	4.8					36.5		6.2
LOS		C	A	D	A					D		A
Approach Delay		19.5			13.5						27.7	
Approach LOS		B			B						C	
Queue Length 50th (ft)		197	0	101	97					207		7
Queue Length 95th (ft)		277	0	151	52					254		63
Internal Link Dist (ft)		330			619			406			364	
Turn Bay Length (ft)				500								
Base Capacity (vph)		1334	1553	309	2034					1144		710
Starvation Cap Reductn		0	0	0	0					0		0
Spillback Cap Reductn		0	0	0	0					0		0
Storage Cap Reductn		0	0	0	0					0		0
Reduced v/c Ratio		0.56	0.21	0.51	0.28					0.62		0.41

Intersection Summary

Area Type: Other
Cycle Length: 100
Actuated Cycle Length: 100
Offset: 48 (48%), Referenced to phase 2:EBT and 6:WBT, Start of Green
Natural Cycle: 90
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.73
Intersection Signal Delay: 20.9 Intersection LOS: C
Intersection Capacity Utilization 58.8% ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 3: NH 28 & Exit 5 SB Off



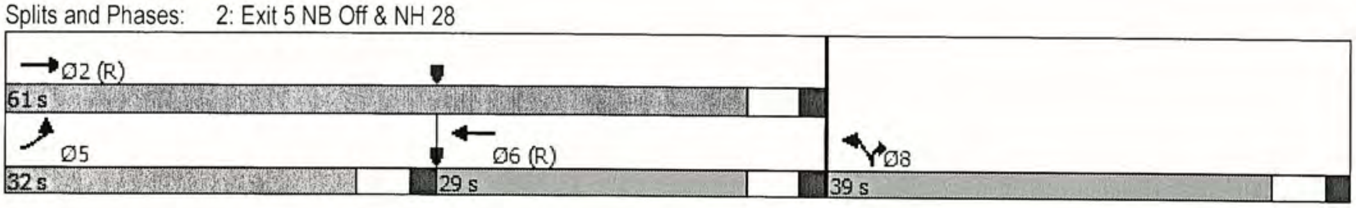
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑			↑↑	↱	↰		↱			
Traffic Volume (vph)	235	1060	0	0	425	535	220	0	240	0	0	0
Future Volume (vph)	235	1060	0	0	425	535	220	0	240	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	500		0	0		0	0		0	0		0
Storage Lanes	1		0	0		1	1		1	0		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt						0.850			0.850			
Flt Protected	0.950						0.950					
Satd. Flow (prot)	1752	3505	0	0	3505	1568	1703	0	1524	0	0	0
Flt Permitted	0.950						0.950					
Satd. Flow (perm)	1752	3505	0	0	3505	1568	1703	0	1524	0	0	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						588			98			
Link Speed (mph)		30			30			35			35	
Link Distance (ft)		699			492			450			828	
Travel Time (s)		15.9			11.2			8.8			16.1	
Peak Hour Factor	0.92	0.92	0.92	0.91	0.91	0.91	0.67	0.67	0.67	0.92	0.92	0.92
Heavy Vehicles (%)	3%	3%	3%	3%	3%	3%	6%	6%	6%	2%	2%	2%
Adj. Flow (vph)	255	1152	0	0	467	588	328	0	358	0	0	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	255	1152	0	0	467	588	328	0	358	0	0	0
Turn Type	Prot	NA			NA	Free	Prot		Prot			
Protected Phases	5	2			6		8		8			
Permitted Phases		5 2				Free						
Detector Phase	5	2			6		8		8			
Switch Phase												
Minimum Initial (s)	4.0	16.0			16.0		4.0		4.0			
Minimum Split (s)	26.0	55.0			24.0		33.0		33.0			
Total Split (s)	32.0	61.0			29.0		39.0		39.0			
Total Split (%)	32.0%	61.0%			29.0%		39.0%		39.0%			
Maximum Green (s)	26.0	55.0			23.0		33.0		33.0			
Yellow Time (s)	4.0	4.0			4.0		4.0		4.0			
All-Red Time (s)	2.0	2.0			2.0		2.0		2.0			
Lost Time Adjust (s)	0.0	0.0			0.0		0.0		0.0			
Total Lost Time (s)	6.0	6.0			6.0		6.0		6.0			
Lead/Lag	Lead				Lag							
Lead-Lag Optimize?	Yes				Yes							
Vehicle Extension (s)	4.0	4.0			4.0		4.0		4.0			
Recall Mode	None	C-Max			C-Max		None		None			
Walk Time (s)		7.0			7.0							
Flash Dont Walk (s)		11.0			11.0							
Pedestrian Calls (#/hr)		0			0							
Act Effct Green (s)	20.3	62.1			35.8	100.0	25.9		25.9			
Actuated g/C Ratio	0.20	0.62			0.36	1.00	0.26		0.26			
v/c Ratio	0.72	0.53			0.37	0.38	0.75		0.77			
Control Delay	48.4	12.7			27.4	0.7	44.1		35.2			
Queue Delay	0.0	0.0			0.0	0.0	0.0		0.0			

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Total Delay	48.4	12.7			27.4	0.7	44.1		35.2			
LOS	D	B			C	A	D		D			
Approach Delay		19.2			12.5			39.5				
Approach LOS		B			B			D				
Queue Length 50th (ft)	152	202			115	0	191		155			
Queue Length 95th (ft)	223	308			192	0	180		143			
Internal Link Dist (ft)		619			412			370			748	
Turn Bay Length (ft)	500											
Base Capacity (vph)	455	2176			1254	1568	561		568			
Starvation Cap Reductn	0	0			0	0	0		0			
Spillback Cap Reductn	0	0			0	0	0		0			
Storage Cap Reductn	0	0			0	0	0		0			
Reduced v/c Ratio	0.56	0.53			0.37	0.38	0.58		0.63			

Intersection Summary

Area Type: Other
Cycle Length: 100
Actuated Cycle Length: 100
Offset: 0 (0%), Referenced to phase 2:EBT and 6:WBT, Start of Green
Natural Cycle: 90
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.77
Intersection Signal Delay: 21.4 — Intersection LOS: C
Intersection Capacity Utilization 58.8% — ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 2: Exit 5 NB Off & NH 28



6.

	SB			NB			EB			WB		
Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	15	50	5	230	0	100	0	760	150	15	415	0
Future Volume (vph)	15	50	5	230	0	100	0	760	150	15	415	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.990			0.959			0.978				
Flt Protected		0.989			0.966						0.998	
Satd. Flow (prot)	0	1842	0	0	1743	0	0	1822	0	0	1841	0
Flt Permitted		0.902			0.740						0.620	
Satd. Flow (perm)	0	1680	0	0	1335	0	0	1822	0	0	1144	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		6			55			24				
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		170			373			245			336	
Travel Time (s)		3.9			8.5			5.6			7.6	
Peak Hour Factor	0.83	0.83	0.83	0.98	0.98	0.98	0.95	0.95	0.95	0.89	0.89	0.89
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	2%	2%	2%	3%	3%	3%
Adj. Flow (vph)	18	60	6	235	0	102	0	800	158	17	466	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	84	0	0	337	0	0	958	0	0	483	0
Turn Type	Perm	NA		Perm	NA			NA		Perm	NA	
Protected Phases		2			2			1			1	
Permitted Phases	2			2						1		
Detector Phase	2	2		2	2			1		1	1	
Switch Phase												
Minimum Initial (s)	5.0	5.0		5.0	5.0			5.0		5.0	5.0	
Minimum Split (s)	24.0	24.0		24.0	24.0			24.0		24.0	24.0	
Total Split (s)	24.0	24.0		24.0	24.0			36.0		36.0	36.0	
Total Split (%)	40.0%	40.0%		40.0%	40.0%			60.0%		60.0%	60.0%	
Maximum Green (s)	18.0	18.0		18.0	18.0			30.0		30.0	30.0	
Yellow Time (s)	4.0	4.0		4.0	4.0			4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0			2.0		2.0	2.0	
Lost Time Adjust (s)		0.0			0.0			0.0			0.0	
Total Lost Time (s)		6.0			6.0			6.0			6.0	
Lead/Lag	Lag	Lag		Lag	Lag			Lead		Lead	Lead	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes			Yes		Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0		3.0	3.0	
Recall Mode	Min	Min		Min	Min			None		None	None	
Walk Time (s)	7.0	7.0		7.0	7.0			7.0		7.0	7.0	
Flash Dont Walk (s)	11.0	11.0		11.0	11.0			11.0		11.0	11.0	
Pedestrian Calls (#/hr)	0	0		0	0			0		0	0	
Act Effct Green (s)		15.8			15.8			30.1			30.1	
Actuated g/C Ratio		0.27			0.27			0.52			0.52	
v/c Ratio		0.18			0.84			1.00			0.81	
Control Delay		15.9			36.6			47.1			26.8	
Queue Delay		0.0			0.0			0.0			0.0	
Total Delay		15.9			36.6			47.1			26.8	
LOS		B			D			D			C	
Approach Delay		15.9			36.6			47.1			26.8	

Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Approach LOS		B			D			D			C	
Queue Length 50th (ft)		21			91			~382			140	
Queue Length 95th (ft)		45			#215			#591			#306	
Internal Link Dist (ft)		90			293			165			256	
Turn Bay Length (ft)												
Base Capacity (vph)		528			454			959			595	
Starvation Cap Reductn		0			0			0			0	
Spillback Cap Reductn		0			0			0			0	
Storage Cap Reductn		0			0			0			0	
Reduced v/c Ratio		0.16			0.74			1.00			0.81	

Intersection Summary

Area Type: Other
Cycle Length: 60
Actuated Cycle Length: 57.9
Natural Cycle: 80
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 1.00
Intersection Signal Delay: 38.5 Intersection LOS: D
Intersection Capacity Utilization 95.4% ICU Level of Service F
Analysis Period (min) 15

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 4: NH 102 & Fordway/N. High St

Ø1	Ø2
36 s	24 s

							EB			WB		
Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	70	295	35	135	340	150	135	410	40	75	250	65
Future Volume (vph)	70	295	35	135	340	150	135	410	40	75	250	65
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.984				0.850		0.987			0.969	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1752	1815	0	1752	1845	1568	1787	1857	0	1787	1823	0
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1752	1815	0	1752	1845	1568	1787	1857	0	1787	1823	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		7				161		6			15	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		361			411			477			530	
Travel Time (s)		8.2			9.3			10.8			12.0	
Peak Hour Factor	0.91	0.91	0.91	0.93	0.93	0.93	0.95	0.95	0.95	0.94	0.94	0.94
Heavy Vehicles (%)	3%	3%	3%	3%	3%	3%	1%	1%	1%	1%	1%	1%
Adj. Flow (vph)	77	324	38	145	366	161	142	432	42	80	266	69
Shared Lane Traffic (%)												
Lane Group Flow (vph)	77	362	0	145	366	161	142	474	0	80	335	0
Turn Type	Prot	NA		Prot	NA	pm+ov	Prot	NA		Prot	NA	
Protected Phases	3	8		7	4	5	5	2		1	6	
Permitted Phases						4						
Detector Phase	3	8		7	4	5	5	2		1	6	
Switch Phase												
Minimum Initial (s)	4.0	5.0		4.0	10.0	4.0	4.0	10.0		4.0	9.0	
Minimum Split (s)	17.0	24.0		11.0	24.0	16.0	16.0	24.0		11.0	24.0	
Total Split (s)	17.0	27.0		15.0	25.0	16.0	16.0	32.0		11.0	27.0	
Total Split (%)	20.0%	31.8%		17.6%	29.4%	18.8%	18.8%	37.6%		12.9%	31.8%	
Maximum Green (s)	11.0	21.0		9.0	19.0	10.0	10.0	26.0		5.0	21.0	
Yellow Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0	2.0	2.0	2.0		2.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Lead/Lag	Lead	Lag		Lead	Lag	Lead	Lead	Lag		Lead	Lag	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes	Yes	Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None	None	None	C-Max		None	None	
Act Effct Green (s)	8.8	19.5		8.9	22.0	37.6	9.7	29.5		5.6	22.9	
Actuated g/C Ratio	0.10	0.23		0.10	0.26	0.44	0.11	0.35		0.07	0.27	
v/c Ratio	0.43	0.86		0.79	0.77	0.21	0.70	0.73		0.68	0.67	
Control Delay	42.5	51.3		67.9	43.3	3.5	55.8	34.2		69.5	35.1	
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Total Delay	42.5	51.3		67.9	43.3	3.5	55.8	34.2		69.5	35.1	
LOS	D	D		E	D	A	E	C		E	D	
Approach Delay		49.7			39.1			39.1			41.7	
Approach LOS		D			D			D			D	
Queue Length 50th (ft)	39	178		77	184	0	74	231		43	157	
Queue Length 95th (ft)	80	#316		#174	#346	35	#155	#393		#119	#272	

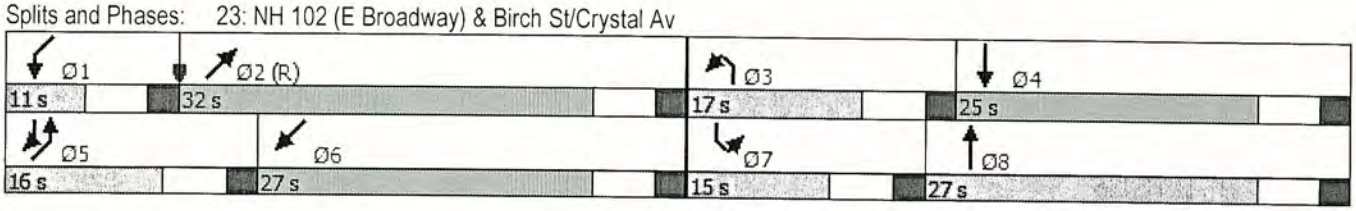
7.

Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Internal Link Dist (ft)		281			331			397			450	
Turn Bay Length (ft)												
Base Capacity (vph)	226	453		185	477	791	212	647		118	501	
Starvation Cap Reductn	0	0		0	0	0	0	0		0	0	
Spillback Cap Reductn	0	0		0	0	0	0	0		0	0	
Storage Cap Reductn	0	0		0	0	0	0	0		0	0	
Reduced v/c Ratio	0.34	0.80		0.78	0.77	0.20	0.67	0.73		0.68	0.67	

Intersection Summary

Area Type: Other
Cycle Length: 85
Actuated Cycle Length: 85
Offset: 0 (0%), Referenced to phase 2:NET, Start of Green
Natural Cycle: 85
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.86
Intersection Signal Delay: 41.8 | Intersection LOS: D
Intersection Capacity Utilization 87.5% | ICU Level of Service E
Analysis Period (min) 15
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 23: NH 102 (E Broadway) & Birch St/Crystal Av



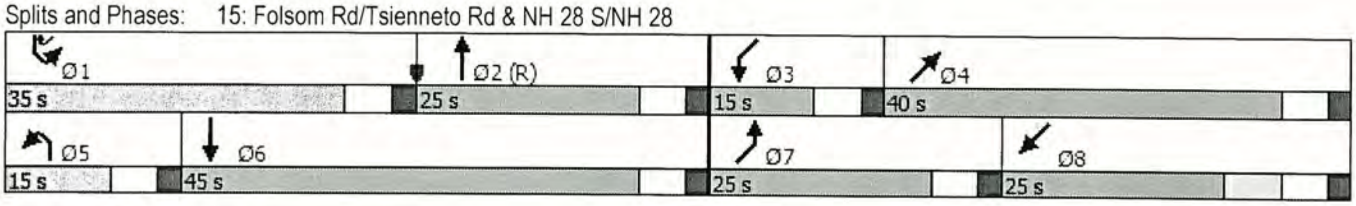
							EB			WB		
Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	80	360	150	520	430	190	240	320	90	150	220	380
Future Volume (vph)	80	360	150	520	430	190	240	320	90	150	220	380
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	150		150	0		0	0		0	0		0
Storage Lanes	1		1	2		1	1		1	1		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	0.95	1.00	0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850			0.850			0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1770	3539	1583	3433	1863	1583	1770	1863	1583	1787	1881	1599
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1770	3539	1583	3433	1863	1583	1770	1863	1583	1787	1881	1599
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			256			202			199			142
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		639			394			532			387	
Travel Time (s)		14.5			9.0			12.1			8.8	
Peak Hour Factor	0.92	0.92	0.92	0.94	0.94	0.94	0.96	0.96	0.96	0.95	0.95	0.95
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	1%	1%	1%
Adj. Flow (vph)	87	391	163	553	457	202	250	333	94	158	232	400
Shared Lane Traffic (%)												
Lane Group Flow (vph)	87	391	163	553	457	202	250	333	94	158	232	400
Turn Type	Prot	NA	Perm	Prot	NA	Perm	Prot	NA	Perm	Prot	NA	pm+ov
Protected Phases	5	2		1	6		7	4		3	8	1
Permitted Phases			2			6			4			8
Detector Phase	5	2	2	1	6	6	7	4	4	3	8	1
Switch Phase												
Minimum Initial (s)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Minimum Split (s)	15.0	25.0	25.0	35.0	45.0	45.0	14.0	40.0	40.0	15.0	25.0	35.0
Total Split (s)	15.0	25.0	25.0	35.0	45.0	45.0	25.0	40.0	40.0	15.0	25.0	35.0
Total Split (%)	13.0%	21.7%	21.7%	30.4%	39.1%	39.1%	21.7%	34.8%	34.8%	13.0%	21.7%	30.4%
Maximum Green (s)	9.0	19.0	19.0	29.0	39.0	39.0	19.0	34.0	34.0	9.0	19.0	29.0
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lead
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	C-Max	C-Max	None	None	None	None	None	None	None	None	None
Walk Time (s)		5.0	5.0		5.0	5.0		5.0	5.0		5.0	
Flash Dont Walk (s)		11.0	11.0		11.0	11.0		11.0	11.0		11.0	
Pedestrian Calls (#/hr)		0	0		0	0		0	0		0	
Act Effct Green (s)	9.8	29.4	29.4	24.3	44.0	44.0	18.4	28.3	28.3	9.0	18.9	49.2
Actuated g/C Ratio	0.09	0.26	0.26	0.21	0.38	0.38	0.16	0.25	0.25	0.08	0.16	0.43
v/c Ratio	0.58	0.43	0.27	0.76	0.64	0.28	0.89	0.73	0.17	1.14	0.75	0.52
Control Delay	66.6	40.0	1.1	49.7	35.6	4.8	78.7	49.0	0.7	165.5	60.7	16.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Total Delay	66.6	40.0	1.1	49.7	35.6	4.8	78.7	49.0	0.7	165.5	60.7	16.4
LOS	E	D	A	D	D	A	E	D	A	F	E	B
Approach Delay		33.7			36.9			53.3			59.2	
Approach LOS		C			D			D			E	
Queue Length 50th (ft)	62	130	0	199	284	0	182	224	0	~136	165	134
Queue Length 95th (ft)	#134	198	0	248	419	51	#324	310	0	#273	241	190
Internal Link Dist (ft)		559			314			452			307	
Turn Bay Length (ft)	150		150									
Base Capacity (vph)	153	905	595	865	712	730	292	550	608	139	392	824
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.57	0.43	0.27	0.64	0.64	0.28	0.86	0.61	0.15	1.14	0.59	0.49

Intersection Summary

Area Type: Other
Cycle Length: 115
Actuated Cycle Length: 115
Offset: 0 (0%), Referenced to phase 2:NBT, Start of Green
Natural Cycle: 115
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 1.14
Intersection Signal Delay: 44.9 Intersection LOS: D
Intersection Capacity Utilization 74.5% ICU Level of Service D
Analysis Period (min) 15
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 15: Folsom Rd/Tsienneto Rd & NH 28 S/NH 28



13

								EB		WB		
Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	170	1400	5	20	855	80	15	10	15	45	10	215
Future Volume (vph)	170	1400	5	20	855	80	15	10	15	45	10	215
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.999			0.987				0.850			0.850
Flt Protected	0.950			0.950				0.971			0.961	
Satd. Flow (prot)	1787	3571	0	1787	3528	0	0	1845	1615	0	1808	1599
Flt Permitted	0.950			0.950				0.774			0.747	
Satd. Flow (perm)	1787	3571	0	1787	3528	0	0	1471	1615	0	1405	1599
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		1			13				172			269
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		277			755			230			387	
Travel Time (s)		6.3			17.2			5.2			8.8	
Peak Hour Factor	0.97	0.97	0.97	0.95	0.95	0.95	0.90	0.90	0.90	0.80	0.80	0.80
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	0%	0%	0%	1%	1%	1%
Adj. Flow (vph)	175	1443	5	21	900	84	17	11	17	56	13	269
Shared Lane Traffic (%)												
Lane Group Flow (vph)	175	1448	0	21	984	0	0	28	17	0	69	269
Turn Type	Prot	NA		Prot	NA		Perm	NA	Perm	Perm	NA	Perm
Protected Phases	5	2		1	6			8			4	
Permitted Phases							8		8	4	4	4
Detector Phase	5	2		1	6		8	8	8	4	4	4
Switch Phase												
Minimum Initial (s)	5.0	8.0		5.0	8.0		5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	26.0	63.0		11.0	48.0		21.0	21.0	21.0	21.0	21.0	21.0
Total Split (s)	26.0	63.0		11.0	48.0		21.0	21.0	21.0	21.0	21.0	21.0
Total Split (%)	27.4%	66.3%		11.6%	50.5%		22.1%	22.1%	22.1%	22.1%	22.1%	22.1%
Maximum Green (s)	20.0	57.0		5.0	42.0		15.0	15.0	15.0	15.0	15.0	15.0
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0			0.0	0.0		0.0	0.0
Total Lost Time (s)	6.0	6.0		6.0	6.0			6.0	6.0		6.0	6.0
Lead/Lag	Lead	Lag		Lead	Lag							
Lead-Lag Optimize?	Yes	Yes		Yes	Yes							
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	C-Max		None	C-Max		None	None	None	None	None	None
Walk Time (s)		7.0			7.0		7.0	7.0	7.0	7.0	7.0	7.0
Flash Dont Walk (s)		11.0			11.0		11.0	11.0	11.0	11.0	11.0	11.0
Pedestrian Calls (#/hr)		0			0		0	0	0	0	0	0
Act Effct Green (s)	14.5	68.0		6.0	52.4			10.1	10.1		10.1	10.1
Actuated g/C Ratio	0.15	0.72		0.06	0.55			0.11	0.11		0.11	0.11
v/c Ratio	0.64	0.57		0.19	0.50			0.18	0.05		0.46	0.66
Control Delay	37.4	14.3		46.3	15.5			39.4	0.3		48.8	13.0
Queue Delay	0.0	0.0		0.0	0.0			0.0	0.0		0.0	0.0
Total Delay	37.4	14.3		46.3	15.5			39.4	0.3		48.8	13.0
LOS	D	B		D	B			D	A		D	B
Approach Delay		16.8			16.2			24.7			20.3	

Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Approach LOS		B			B			C			C	
Queue Length 50th (ft)	104	284		12	179			16	0		40	0
Queue Length 95th (ft)	m125	437		36	296			40	0		69	43
Internal Link Dist (ft)		197			675			150			307	
Turn Bay Length (ft)												
Base Capacity (vph)	376	2557		113	1951			232	399		221	479
Starvation Cap Reductn	0	0		0	0			0	0		0	0
Spillback Cap Reductn	0	0		0	0			0	0		0	0
Storage Cap Reductn	0	0		0	0			0	0		0	0
Reduced v/c Ratio	0.47	0.57		0.19	0.50			0.12	0.04		0.31	0.56

Intersection Summary

Area Type: Other
Cycle Length: 95
Actuated Cycle Length: 95
Offset: 69 (73%), Referenced to phase 2:SET and 6:NWT, Start of Green
Natural Cycle: 95
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.66
Intersection Signal Delay: 17.1 Intersection LOS: B
Intersection Capacity Utilization 67.7% ICU Level of Service C
Analysis Period (min) 15
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 6: Applebee's/Linlew Dr & NH 28

14

		SB			NB			NB			WB	
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰↰	↑↱		↰	↑↱		↰	↱		↰	↰	↱
Traffic Volume (vph)	110	1095	5	5	800	260	40	10	10	345	5	135
Future Volume (vph)	110	1095	5	5	800	260	40	10	10	345	5	135
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	150		150	150		150	0		0	0		0
Storage Lanes	2		0	1		0	1		0	1		1
Taper Length (ft)	150			25			25			25		
Lane Util. Factor	0.97	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	0.95	0.95	1.00
Frt		0.999			0.963			0.925				0.850
Flt Protected	0.950			0.950			0.950			0.950	0.954	
Satd. Flow (prot)	3467	3571	0	1770	3408	0	1805	1758	0	1715	1722	1615
Flt Permitted	0.950			0.950			0.950			0.950	0.954	
Satd. Flow (perm)	3467	3571	0	1770	3408	0	1805	1758	0	1715	1722	1615
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		1			62			13				108
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		877			261			151			343	
Travel Time (s)		19.9			5.9			3.4			7.8	
Peak Hour Factor	0.84	0.84	0.84	0.90	0.90	0.90	0.78	0.78	0.78	0.86	0.86	0.86
Heavy Vehicles (%)	1%	1%	1%	2%	2%	2%	0%	0%	0%	0%	0%	0%
Adj. Flow (vph)	131	1304	6	6	889	289	51	13	13	401	6	157
Shared Lane Traffic (%)										49%		
Lane Group Flow (vph)	131	1310	0	6	1178	0	51	26	0	205	202	157
Turn Type	Prot	NA		Prot	NA		Split	NA		Split	NA	pt+ov
Protected Phases	5	2		1	6		3	3		4	4	4 5
Permitted Phases		2			6							
Detector Phase	5	2		1	6		3	3		4	4	4 5
Switch Phase												
Minimum Initial (s)	5.0	8.0		5.0	8.0		5.0	5.0		8.0	8.0	
Minimum Split (s)	11.0	53.0		11.0	50.0		11.0	11.0		20.0	20.0	
Total Split (s)	14.0	53.0		11.0	50.0		11.0	11.0		20.0	20.0	
Total Split (%)	14.7%	55.8%		11.6%	52.6%		11.6%	11.6%		21.1%	21.1%	
Maximum Green (s)	8.0	47.0		5.0	44.0		5.0	5.0		14.0	14.0	
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lead		Lag	Lag	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	C-Max		None	None		None	None		None	None	
Walk Time (s)		5.0			5.0		5.0	5.0		5.0	5.0	
Flash Dont Walk (s)		11.0			11.0		11.0	11.0		11.0	11.0	
Pedestrian Calls (#/hr)		0			0		0	0		0	0	
Act Effct Green (s)	7.7	58.5		5.1	47.0		5.0	5.0		13.5	13.5	27.2
Actuated g/C Ratio	0.08	0.62		0.05	0.49		0.05	0.05		0.14	0.14	0.29
v/c Ratio	0.47	0.60		0.06	0.69		0.54	0.25		0.84	0.83	0.29
Control Delay	47.4	14.0		65.0	14.8		65.2	34.5		69.2	67.0	10.9
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0

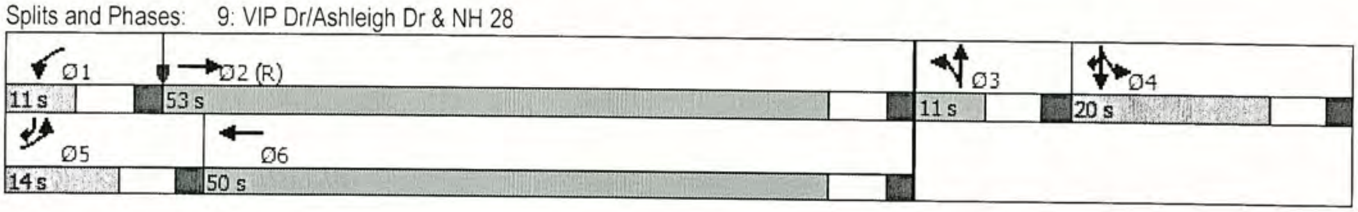
14

		SB			NB			EB			WB	
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Total Delay	47.4	14.0		65.0	14.8		65.2	34.5		69.2	67.0	10.9
LOS	D	B		E	B		E	C		E	E	B
Approach Delay		17.1			15.0			54.8			52.2	
Approach LOS		B			B			D			D	
Queue Length 50th (ft)	39	234		3	311		31	8		127	125	21
Queue Length 95th (ft)	63	356		m7	408		#60	29		#232	#227	63
Internal Link Dist (ft)		797			181			71			263	
Turn Bay Length (ft)	150			150								
Base Capacity (vph)	291	2198		95	1717		95	104		252	253	533
Starvation Cap Reductn	0	0		0	0		0	0		0	0	0
Spillback Cap Reductn	0	0		0	0		0	0		0	0	0
Storage Cap Reductn	0	0		0	0		0	0		0	0	0
Reduced v/c Ratio	0.45	0.60		0.06	0.69		0.54	0.25		0.81	0.80	0.29

Intersection Summary

Area Type: Other
Cycle Length: 95
Actuated Cycle Length: 95
Offset: 0 (0%), Referenced to phase 2:EBT, Start of Green
Natural Cycle: 95
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.84
Intersection Signal Delay: 23.3 Intersection LOS: C
Intersection Capacity Utilization 65.9% ICU Level of Service C
Analysis Period (min) 15
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 9: VIP Dr/Ashleigh Dr & NH 28



18

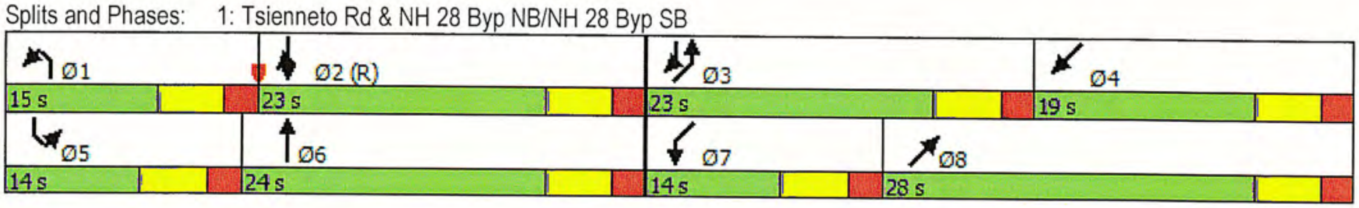
Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL (EB)	NET	NER	SWL (WB)	SWT	SWR
Lane Configurations	↰	↱		↰	↑	↱	↰	↱		↰	↱	
Traffic Volume (vph)	100	320	25	75	185	185	280	345	75	25	175	70
Future Volume (vph)	100	320	25	75	185	185	280	345	75	25	175	70
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	150		150	150		150	150		150	150		150
Storage Lanes	1		0	1		1	1		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.989				0.850		0.973			0.957	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1770	1842	0	1787	1881	1599	1805	1849	0	1805	1818	0
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1770	1842	0	1787	1881	1599	1805	1849	0	1805	1818	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		4				195		13			21	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		481			347			479			371	
Travel Time (s)		10.9			7.9			10.9			8.4	
Peak Hour Factor	0.99	0.99	0.99	0.95	0.95	0.95	0.89	0.89	0.89	0.93	0.93	0.93
Heavy Vehicles (%)	2%	2%	2%	1%	1%	1%	0%	0%	0%	0%	0%	0%
Adj. Flow (vph)	101	323	25	79	195	195	315	388	84	27	188	75
Shared Lane Traffic (%)												
Lane Group Flow (vph)	101	348	0	79	195	195	315	472	0	27	263	0
Turn Type	Prot	NA		Prot	NA	pt+ov	Prot	NA		Prot	NA	
Protected Phases	1	6		5	2	2 3	3	8		7	4	
Permitted Phases		6			2							
Detector Phase	1	6		5	2	2 3	3	8		7	4	
Switch Phase												
Minimum Initial (s)	8.0	8.0		8.0	8.0		8.0	8.0		8.0	8.0	
Minimum Split (s)	14.0	20.0		14.0	20.0		14.0	28.0		14.0	14.0	
Total Split (s)	15.0	24.0		14.0	23.0		23.0	28.0		14.0	19.0	
Total Split (%)	18.8%	30.0%		17.5%	28.8%		28.8%	35.0%		17.5%	23.8%	
Maximum Green (s)	9.0	18.0		8.0	17.0		17.0	22.0		8.0	13.0	
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lag		Lead	Lag	
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	C-Max		None	None		None	None	
Walk Time (s)								7.0				
Flash Dont Walk (s)								15.0				
Pedestrian Calls (#/hr)								0				
Act Effct Green (s)	8.7	21.8		8.0	21.2	43.5	16.3	29.4		8.0	12.7	
Actuated g/C Ratio	0.11	0.27		0.10	0.26	0.54	0.20	0.37		0.10	0.16	
v/c Ratio	0.53	0.69		0.44	0.39	0.20	0.86	0.69		0.15	0.86	
Control Delay	44.2	37.0		42.4	29.4	2.3	54.0	30.0		35.1	58.0	
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	

Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Total Delay	44.2	37.0		42.4	29.4	2.3	54.0	30.0		35.1	58.0	
LOS	D	D		D	C	A	D	C		D	E	
Approach Delay		38.6			20.4			39.6			55.9	
Approach LOS		D			C			D			E	
Queue Length 50th (ft)	48	165		38	86	0	151	162		13	119	
Queue Length 95th (ft)	97	#307		80	149	30	#278	#394		36	#248	
Internal Link Dist (ft)		401			267			399			291	
Turn Bay Length (ft)	150			150		150	150			150		
Base Capacity (vph)	199	505		178	497	970	383	687		180	313	
Starvation Cap Reductn	0	0		0	0	0	0	0		0	0	
Spillback Cap Reductn	0	0		0	0	0	0	0		0	0	
Storage Cap Reductn	0	0		0	0	0	0	0		0	0	
Reduced v/c Ratio	0.51	0.69		0.44	0.39	0.20	0.82	0.69		0.15	0.84	

Intersection Summary

Area Type: Other
Cycle Length: 80
Actuated Cycle Length: 80
Offset: 0 (0%), Referenced to phase 2:SBT, Start of Green
Natural Cycle: 80
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.86
Intersection Signal Delay: 37.2 Intersection LOS: D
Intersection Capacity Utilization 74.4% ICU Level of Service D
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 1: Tsienneto Rd & NH 28 Byp NB/NH 28 Byp SB



APPENDIX G-3: HCM PRINTOUTS – SIGNALIZED INTERSECTION CAPACITY ANALYSES – 2015 AM AND PM PEAK HOURS

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑↑		↰	↱
Traffic Volume (vph)	0	915	565	0	260	495
Future Volume (vph)	0	915	565	0	260	495
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0	6.0		6.0	6.0
Lane Util. Factor		0.95	0.95		1.00	1.00
Frt		1.00	1.00		1.00	0.85
Flt Protected		1.00	1.00		0.95	1.00
Satd. Flow (prot)		3471	3406		1703	1524
Flt Permitted		1.00	1.00		0.95	1.00
Satd. Flow (perm)		3471	3406		1703	1524
Peak-hour factor, PHF	0.93	0.93	0.88	0.88	0.89	0.89
Adj. Flow (vph)	0	984	642	0	292	556
RTOR Reduction (vph)	0	0	0	0	0	334
Lane Group Flow (vph)	0	984	642	0	292	222
Heavy Vehicles (%)	4%	4%	6%	6%	6%	6%
Turn Type		NA	NA		Prot	Perm
Protected Phases		2	2		7	
Permitted Phases						7
Actuated Green, G (s)		61.0	61.0		27.0	27.0
Effective Green, g (s)		61.0	61.0		27.0	27.0
Actuated g/C Ratio		0.61	0.61		0.27	0.27
Clearance Time (s)		6.0	6.0		6.0	6.0
Vehicle Extension (s)		3.0	3.0		3.0	3.0
Lane Grp Cap (vph)		2117	2077		459	411
v/s Ratio Prot		c0.28	0.19		c0.17	
v/s Ratio Perm						0.15
v/c Ratio		0.46	0.31		0.64	0.54
Uniform Delay, d1		10.6	9.4		32.2	31.2
Progression Factor		1.00	0.18		1.00	1.00
Incremental Delay, d2		0.7	0.2		6.6	5.0
Delay (s)		11.4	1.9		38.8	36.2
Level of Service		B	A		D	D
Approach Delay (s)		11.4	1.9		37.1	
Approach LOS		B	A		D	

Intersection Summary			
HCM 2000 Control Delay	17.7	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.55		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	58.3%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

2,

Movement	NBL	NBR	SEL	SER	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations	↰↰	↱			↰	↑↑			↑↑	↱
Traffic Volume (vph)	210	200	0	0	585	590	0	0	875	0
Future Volume (vph)	210	200	0	0	585	590	0	0	875	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	4.0			6.0	6.0			6.0	
Lane Util. Factor	0.97	1.00			1.00	0.95			0.95	
Frt	1.00	0.85			1.00	1.00			1.00	
Flt Protected	0.95	1.00			0.95	1.00			1.00	
Satd. Flow (prot)	3242	1495			1719	3438			3505	
Flt Permitted	0.95	1.00			0.95	1.00			1.00	
Satd. Flow (perm)	3242	1495			1719	3438			3505	
Peak-hour factor, PHF	0.88	0.88	0.92	0.92	0.94	0.94	0.94	0.92	0.92	0.92
Adj. Flow (vph)	239	227	0	0	622	628	0	0	951	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	239	227	0	0	622	628	0	0	951	0
Heavy Vehicles (%)	8%	8%	2%	2%	5%	5%	5%	3%	3%	3%
Turn Type	Prot	Free			Prot	NA			NA	Free
Protected Phases	2				7	4			8	
Permitted Phases		Free								Free
Actuated Green, G (s)	12.9	100.0			41.1	75.1			28.0	
Effective Green, g (s)	12.9	100.0			41.1	75.1			28.0	
Actuated g/C Ratio	0.13	1.00			0.41	0.75			0.28	
Clearance Time (s)	6.0				6.0	6.0			6.0	
Vehicle Extension (s)	3.0				3.0	3.0			3.0	
Lane Grp Cap (vph)	418	1495			706	2581			981	
v/s Ratio Prot	c0.07				c0.36	0.18			c0.27	
v/s Ratio Perm		0.15								
v/c Ratio	0.57	0.15			0.88	0.24			0.97	
Uniform Delay, d1	41.0	0.0			27.2	3.8			35.6	
Progression Factor	1.00	1.00			1.00	1.00			1.00	
Incremental Delay, d2	5.6	0.2			12.4	0.0			21.3	
Delay (s)	46.5	0.2			39.6	3.8			56.9	
Level of Service	D	A			D	A			E	
Approach Delay (s)	24.0		0.0			21.6			56.9	
Approach LOS	C		A			C			E	

Intersection Summary			
HCM 2000 Control Delay	34.6	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	84.6%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑	↱	↰	↑↑					↰↰		↱
Traffic Volume (vph)	0	515	280	235	605	0	0	0	0	465	0	295
Future Volume (vph)	0	515	280	235	605	0	0	0	0	465	0	295
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0	4.0	6.0	6.0					6.0		6.0
Lane Util. Factor		0.95	1.00	1.00	0.95					0.97		1.00
Frt		1.00	0.85	1.00	1.00					1.00		0.85
Flt Protected		1.00	1.00	0.95	1.00					0.95		1.00
Satd. Flow (prot)		3167	1417	1687	3374					3303		1524
Flt Permitted		1.00	1.00	0.95	1.00					0.95		1.00
Satd. Flow (perm)		3167	1417	1687	3374					3303		1524
Peak-hour factor, PHF	0.92	0.92	0.92	0.73	0.73	0.73	0.92	0.92	0.92	0.74	0.74	0.74
Adj. Flow (vph)	0	560	304	322	829	0	0	0	0	628	0	399
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	89
Lane Group Flow (vph)	0	560	304	322	829	0	0	0	0	628	0	310
Heavy Vehicles (%)	14%	14%	14%	7%	7%	7%	2%	2%	2%	6%	6%	6%
Turn Type		NA	Free	Prot	NA					Prot		Prot
Protected Phases		2		1	6					4		4
Permitted Phases			Free									
Actuated Green, G (s)		20.9	80.0	18.8	45.7					22.3		22.3
Effective Green, g (s)		20.9	80.0	18.8	45.7					22.3		22.3
Actuated g/C Ratio		0.26	1.00	0.24	0.57					0.28		0.28
Clearance Time (s)		6.0		6.0	6.0					6.0		6.0
Vehicle Extension (s)		3.0		3.0	3.0					3.0		3.0
Lane Grp Cap (vph)		827	1417	396	1927					920		424
v/s Ratio Prot		c0.18		c0.19	0.25					0.19		c0.20
v/s Ratio Perm			0.21									
v/c Ratio		0.68	0.21	0.81	0.43					0.68		0.73
Uniform Delay, d1		26.5	0.0	28.9	9.7					25.7		26.1
Progression Factor		1.00	1.00	0.78	0.60					1.00		1.00
Incremental Delay, d2		4.4	0.3	10.2	0.6					2.1		6.4
Delay (s)		31.0	0.3	32.7	6.4					27.8		32.5
Level of Service		C	A	C	A					C		C
Approach Delay (s)		20.2			13.8			0.0			29.6	
Approach LOS		C			B			A			C	

Intersection Summary			
HCM 2000 Control Delay	21.0	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.74		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	65.7%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑			↑↑	↱	↰		↱			
Traffic Volume (vph)	240	740	0	0	540	740	300	0	110	0	0	0
Future Volume (vph)	240	740	0	0	540	740	300	0	110	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0			6.0	4.0	6.0		4.0			
Lane Util. Factor	1.00	0.95			0.95	1.00	1.00		1.00			
Frt	1.00	1.00			1.00	0.85	1.00		0.85			
Flt Protected	0.95	1.00			1.00	1.00	0.95		1.00			
Satd. Flow (prot)	1641	3282			3438	1538	1656		1482			
Flt Permitted	0.95	1.00			1.00	1.00	0.95		1.00			
Satd. Flow (perm)	1641	3282			3438	1538	1656		1482			
Peak-hour factor, PHF	0.87	0.87	0.87	0.90	0.90	0.90	0.78	0.78	0.78	0.92	0.92	0.92
Adj. Flow (vph)	276	851	0	0	600	822	385	0	141	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	276	851	0	0	600	822	385	0	141	0	0	0
Heavy Vehicles (%)	10%	10%	10%	5%	5%	5%	9%	9%	9%	2%	2%	2%
Turn Type	Prot	NA			NA	Free	Prot		Free			
Protected Phases	5	2			6		8					
Permitted Phases		2			6	Free			Free			
Actuated Green, G (s)	15.7	46.6			24.9	80.0	21.4		80.0			
Effective Green, g (s)	15.7	46.6			24.9	80.0	21.4		80.0			
Actuated g/C Ratio	0.20	0.58			0.31	1.00	0.27		1.00			
Clearance Time (s)	6.0	6.0			6.0		6.0					
Vehicle Extension (s)	3.0	3.0			3.0		3.0					
Lane Grp Cap (vph)	322	1911			1070	1538	442		1482			
v/s Ratio Prot	c0.17	0.26			0.17		c0.23					
v/s Ratio Perm						c0.53			0.10			
v/c Ratio	0.86	0.45			0.56	0.53	0.87		0.10			
Uniform Delay, d1	31.1	9.4			23.0	0.0	28.0		0.0			
Progression Factor	1.05	0.16			1.00	1.00	1.00		1.00			
Incremental Delay, d2	16.2	0.6			2.1	1.3	16.9		0.1			
Delay (s)	49.0	2.1			25.1	1.3	44.9		0.1			
Level of Service	D	A			C	A	D		A			
Approach Delay (s)		13.6			11.4			32.9			0.0	
Approach LOS		B			B			C			A	

Intersection Summary				
HCM 2000 Control Delay	15.9	HCM 2000 Level of Service	B	
HCM 2000 Volume to Capacity ratio	0.78			
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	18.0	
Intersection Capacity Utilization	65.7%	ICU Level of Service	C	
Analysis Period (min)	15			
c Critical Lane Group				

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	5	25	10	345	0	70	0	400	125	15	595	0
Future Volume (vph)	5	25	10	345	0	70	0	400	125	15	595	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0			6.0			6.0			6.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		0.97			0.98			0.97			1.00	
Flt Protected		0.99			0.96			1.00			1.00	
Satd. Flow (prot)		1788			1731			1703			1807	
Flt Permitted		0.94			0.72			1.00			0.98	
Satd. Flow (perm)		1685			1291			1703			1776	
Peak-hour factor, PHF	0.60	0.60	0.60	0.96	0.96	0.96	0.89	0.89	0.89	0.86	0.86	0.86
Adj. Flow (vph)	8	42	17	359	0	73	0	449	140	17	692	0
RTOR Reduction (vph)	0	11	0	0	37	0	0	19	0	0	0	0
Lane Group Flow (vph)	0	56	0	0	395	0	0	570	0	0	709	0
Heavy Vehicles (%)	2%	2%	2%	3%	3%	3%	8%	8%	8%	5%	5%	5%
Turn Type	Perm	NA		Perm	NA			NA		Perm	NA	
Protected Phases		2			2			1			1	
Permitted Phases	2			2						1		
Actuated Green, G (s)		19.1			19.1			27.3			27.3	
Effective Green, g (s)		19.1			19.1			27.3			27.3	
Actuated g/C Ratio		0.33			0.33			0.47			0.47	
Clearance Time (s)		6.0			6.0			6.0			6.0	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		551			422			796			830	
v/s Ratio Prot								0.33				
v/s Ratio Perm		0.03			c0.31						c0.40	
v/c Ratio		0.10			0.94			0.72			0.85	
Uniform Delay, d1		13.7			19.1			12.4			13.8	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		0.1			28.1			3.1			8.5	
Delay (s)		13.8			47.1			15.5			22.3	
Level of Service		B			D			B			C	
Approach Delay (s)		13.8			47.1			15.5			22.3	
Approach LOS		B			D			B			C	

Intersection Summary			
HCM 2000 Control Delay	25.7	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.89		
Actuated Cycle Length (s)	58.4	Sum of lost time (s)	12.0
Intersection Capacity Utilization	83.4%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

7.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↱		↰	↱		↰	↑	↱
Traffic Volume (vph)	105	205	60	35	385	80	60	260	40	70	230	105
Future Volume (vph)	105	205	60	35	385	80	60	260	40	70	230	105
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	6.0
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.97		1.00	0.97		1.00	0.98		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1656	1684		1703	1746		1719	1773		1703	1792	1524
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1656	1684		1703	1746		1719	1773		1703	1792	1524
Peak-hour factor, PHF	0.96	0.96	0.96	0.94	0.94	0.94	0.85	0.85	0.85	0.91	0.91	0.91
Adj. Flow (vph)	109	214	62	37	410	85	71	306	47	77	253	115
RTOR Reduction (vph)	0	13	0	0	9	0	0	7	0	0	0	89
Lane Group Flow (vph)	109	264	0	37	486	0	71	346	0	77	253	26
Heavy Vehicles (%)	9%	9%	9%	6%	6%	6%	5%	5%	5%	6%	6%	6%
Parking (#/hr)			0									
Turn Type	Prot	NA		Prot	NA		Prot	NA		Prot	NA	Perm
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases												4
Actuated Green, G (s)	6.0	29.3		3.4	26.7		4.0	17.5		4.0	17.5	17.5
Effective Green, g (s)	6.0	29.3		3.4	26.7		4.0	17.5		4.0	17.5	17.5
Actuated g/C Ratio	0.08	0.37		0.04	0.34		0.05	0.22		0.05	0.22	0.22
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	127	630		74	596		87	396		87	401	341
v/s Ratio Prot	c0.07	c0.16		0.02	c0.28		0.04	c0.20		c0.05	0.14	
v/s Ratio Perm												0.02
v/c Ratio	0.86	0.42		0.50	0.82		0.82	0.87		0.89	0.63	0.08
Uniform Delay, d1	35.7	18.1		36.6	23.5		36.7	29.3		36.9	27.4	24.0
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	40.1	0.5		5.2	8.4		42.3	18.7		59.7	3.2	0.1
Delay (s)	75.7	18.6		41.8	31.9		79.0	48.0		96.6	30.7	24.1
Level of Service	E	B		D	C		E	D		F	C	C
Approach Delay (s)		34.7			32.6			53.2			40.4	
Approach LOS		C			C			D			D	

Intersection Summary			
HCM 2000 Control Delay	39.9	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.84		
Actuated Cycle Length (s)	78.2	Sum of lost time (s)	24.0
Intersection Capacity Utilization	70.9%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations	↰	↑↑	↱	↰↰	↑↑	↱	↰	↑	↱	↰	↑	↱
Traffic Volume (vph)	20	230	135	310	220	145	135	170	20	125	290	370
Future Volume (vph)	20	230	135	310	220	145	135	170	20	125	290	370
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	4.0	6.0	6.0	6.0
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1736	3471	1553	3335	3438	1538	1752	1845	1568	1752	1845	1568
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1736	3471	1553	3335	3438	1538	1752	1845	1568	1752	1845	1568
Peak-hour factor, PHF	0.84	0.84	0.84	0.79	0.79	0.79	0.86	0.86	0.86	0.99	0.99	0.99
Adj. Flow (vph)	24	274	161	392	278	184	157	198	23	126	293	374
RTOR Reduction (vph)	0	0	113	0	0	114	0	0	0	0	0	155
Lane Group Flow (vph)	24	274	48	392	278	70	157	198	23	126	293	219
Heavy Vehicles (%)	4%	4%	4%	5%	5%	5%	3%	3%	3%	3%	3%	3%
Turn Type	Prot	NA	Perm	Prot	NA	Perm	Prot	NA	Free	Prot	NA	pt+ov
Protected Phases	5	2		1	6		7	4		3	8	8 1
Permitted Phases		2	2		6	6		4	Free		8	
Actuated Green, G (s)	8.0	26.8	26.8	15.2	34.0	34.0	9.0	15.3	90.0	8.7	15.0	36.2
Effective Green, g (s)	8.0	26.8	26.8	15.2	34.0	34.0	9.0	15.3	90.0	8.7	15.0	36.2
Actuated g/C Ratio	0.09	0.30	0.30	0.17	0.38	0.38	0.10	0.17	1.00	0.10	0.17	0.40
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	154	1033	462	563	1298	581	175	313	1568	169	307	630
v/s Ratio Prot	0.01	c0.08		c0.12	0.08		c0.09	0.11		0.07	c0.16	0.14
v/s Ratio Perm			0.03			0.05			c0.01			
v/c Ratio	0.16	0.27	0.10	0.70	0.21	0.12	0.90	0.63	0.01	0.75	0.95	0.35
Uniform Delay, d1	37.9	24.1	22.9	35.2	19.0	18.2	40.0	34.7	0.0	39.6	37.2	18.7
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	2.1	0.6	0.5	3.7	0.4	0.4	39.8	4.1	0.0	16.3	39.0	0.3
Delay (s)	40.0	24.7	23.3	39.0	19.3	18.7	79.8	38.9	0.0	55.9	76.1	19.0
Level of Service	D	C	C	D	B	B	E	D	A	E	E	B
Approach Delay (s)		25.0			28.2			53.5			46.0	
Approach LOS		C			C			D			D	

Intersection Summary			
HCM 2000 Control Delay	37.1	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.61		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	24.0
Intersection Capacity Utilization	58.3%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	50	790	0	0	655	30	5	0	5	50	0	245
Future Volume (vph)	50	790	0	0	655	30	5	0	5	50	0	245
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0			6.0			6.0	6.0		6.0	6.0
Lane Util. Factor	1.00	0.95			0.95			1.00	1.00		1.00	1.00
Frt	1.00	1.00			0.99			1.00	0.85		1.00	0.85
Flt Protected	0.95	1.00			1.00			0.95	1.00		0.95	1.00
Satd. Flow (prot)	1687	3374			3516			1805	1615		1787	1599
Flt Permitted	0.95	1.00			1.00			0.72	1.00		0.75	1.00
Satd. Flow (perm)	1687	3374			3516			1369	1615		1413	1599
Peak-hour factor, PHF	0.83	0.83	0.83	0.92	0.92	0.92	0.50	0.50	0.50	0.90	0.90	0.90
Adj. Flow (vph)	60	952	0	0	712	33	10	0	10	56	0	272
RTOR Reduction (vph)	0	0	0	0	2	0	0	0	9	0	0	201
Lane Group Flow (vph)	60	952	0	0	743	0	0	10	1	0	56	71
Heavy Vehicles (%)	7%	7%	7%	2%	2%	2%	0%	0%	0%	1%	1%	1%
Turn Type	Prot	NA		Prot	NA		custom	NA	custom	Perm	NA	Perm
Protected Phases	5	2		1	6						4	
Permitted Phases					6		8	8	8	4		4
Actuated Green, G (s)	7.6	67.7			54.1			10.3	10.3		10.3	10.3
Effective Green, g (s)	7.6	67.7			54.1			10.3	10.3		10.3	10.3
Actuated g/C Ratio	0.08	0.75			0.60			0.11	0.11		0.11	0.11
Clearance Time (s)	6.0	6.0			6.0			6.0	6.0		6.0	6.0
Vehicle Extension (s)	3.0	3.0			3.0			3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	142	2537			2113			156	184		161	182
v/s Ratio Prot	0.04	c0.28			0.21							
v/s Ratio Perm								0.01	0.00		0.04	c0.04
v/c Ratio	0.42	0.38			0.35			0.06	0.01		0.35	0.39
Uniform Delay, d1	39.1	3.8			9.1			35.6	35.3		36.8	36.9
Progression Factor	1.00	1.00			1.20			1.00	1.00		1.00	1.00
Incremental Delay, d2	2.0	0.4			0.1			0.2	0.0		1.3	1.4
Delay (s)	41.1	4.3			11.0			35.7	35.3		38.1	38.3
Level of Service	D	A			B			D	D		D	D
Approach Delay (s)		6.5			11.0			35.5			38.3	
Approach LOS		A			B			D			D	

Intersection Summary			
HCM 2000 Control Delay	13.3	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.41		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	53.4%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

14

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰↰	↑↱		↰	↑↱		↰	↱		↰	↰↑	↱
Traffic Volume (vph)	100	630	5	5	610	220	10	5	5	180	5	100
Future Volume (vph)	100	630	5	5	610	220	10	5	5	180	5	100
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	6.0
Lane Util. Factor	0.97	0.95		1.00	0.95		1.00	1.00		0.95	0.95	1.00
Frt	1.00	1.00		1.00	0.96		1.00	0.93		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	0.96	1.00
Satd. Flow (prot)	3303	3402		1736	3333		1805	1758		1665	1674	1568
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	0.96	1.00
Satd. Flow (perm)	3303	3402		1736	3333		1805	1758		1665	1674	1568
Peak-hour factor, PHF	0.83	0.83	0.83	0.97	0.97	0.97	0.67	0.67	0.67	0.90	0.90	0.90
Adj. Flow (vph)	120	759	6	5	629	227	15	7	7	200	6	111
RTOR Reduction (vph)	0	0	0	0	41	0	0	7	0	0	0	81
Lane Group Flow (vph)	120	765	0	5	815	0	15	7	0	102	104	30
Heavy Vehicles (%)	6%	6%	6%	4%	4%	4%	0%	0%	0%	3%	3%	3%
Turn Type	Prot	NA		Prot	NA		Split	NA		Split	NA	pt+ov
Protected Phases	5	2		1	6		3	3		4	4	4 5
Permitted Phases								3				
Actuated Green, G (s)	8.0	50.2		1.0	43.2		4.1	4.1		10.7	10.7	24.7
Effective Green, g (s)	8.0	50.2		1.0	43.2		4.1	4.1		10.7	10.7	24.7
Actuated g/C Ratio	0.09	0.56		0.01	0.48		0.05	0.05		0.12	0.12	0.27
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	293	1897		19	1599		82	80		197	199	430
v/s Ratio Prot	c0.04	c0.22		0.00	c0.24		c0.01	0.00		0.06	c0.06	0.02
v/s Ratio Perm												
v/c Ratio	0.41	0.40		0.26	0.51		0.18	0.09		0.52	0.52	0.07
Uniform Delay, d1	38.8	11.4		44.1	16.1		41.3	41.2		37.2	37.3	24.2
Progression Factor	1.00	1.00		1.52	0.60		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	0.9	0.1		6.9	1.1		1.1	0.5		2.3	2.5	0.1
Delay (s)	39.7	11.5		73.9	10.8		42.4	41.7		39.5	39.7	24.2
Level of Service	D	B		E	B		D	D		D	D	C
Approach Delay (s)		15.3			11.2			42.1			34.2	
Approach LOS		B			B			D			C	

Intersection Summary

HCM 2000 Control Delay	16.9	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.48		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	24.0
Intersection Capacity Utilization	54.8%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

18

Movement	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	100	220	20	25	210	255	120	100	80	80	270	90
Future Volume (vph)	100	220	20	25	210	255	120	100	80	80	270	90
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	1.00	0.85	1.00	0.93		1.00	0.96	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1752	1822		1736	1827	1553	1770	1738		1787	1811	
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1752	1822		1736	1827	1553	1770	1738		1787	1811	
Peak-hour factor, PHF	0.82	0.82	0.82	0.81	0.81	0.81	0.68	0.68	0.68	0.78	0.78	0.78
Adj. Flow (vph)	122	268	24	31	259	315	176	147	118	103	346	115
RTOR Reduction (vph)	0	4	0	0	0	121	0	34	0	0	15	0
Lane Group Flow (vph)	122	288	0	31	259	194	176	231	0	103	447	0
Heavy Vehicles (%)	3%	3%	3%	4%	4%	4%	2%	2%	2%	1%	1%	1%
Turn Type	Prot	NA		Prot	NA	pt+ov	Prot	NA		Prot	NA	
Protected Phases	1	6		5	2	2 3	3	8		7	4	
Permitted Phases												
Actuated Green, G (s)	8.0	21.8		3.2	17.0	32.0	9.0	23.4		7.6	22.0	
Effective Green, g (s)	8.0	21.8		3.2	17.0	32.0	9.0	23.4		7.6	22.0	
Actuated g/C Ratio	0.10	0.27		0.04	0.21	0.40	0.11	0.29		0.09	0.28	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	175	496		69	388	621	199	508		169	498	
v/s Ratio Prot	c0.07	c0.16		0.02	c0.14	0.12	c0.10	0.13		0.06	c0.25	
v/s Ratio Perm												
v/c Ratio	0.70	0.58		0.45	0.67	0.31	0.88	0.45		0.61	0.90	
Uniform Delay, d1	34.8	25.2		37.5	28.9	16.5	35.0	23.1		34.8	27.9	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	11.4	1.7		4.6	8.8	0.3	33.9	0.6		6.1	18.5	
Delay (s)	46.3	26.9		42.1	37.7	16.7	68.9	23.7		40.9	46.4	
Level of Service	D	C		D	D	B	E	C		D	D	
Approach Delay (s)		32.6			27.0			41.7			45.4	
Approach LOS		C			C			D			D	

Intersection Summary			
HCM 2000 Control Delay	36.5	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.80		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	24.0
Intersection Capacity Utilization	65.8%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑↑		↰	↱
Traffic Volume (vph)	0	935	850	0	280	645
Future Volume (vph)	0	935	850	0	280	645
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0	6.0		6.0	6.0
Lane Util. Factor		0.95	0.95		1.00	1.00
Frt		1.00	1.00		1.00	0.85
Flt Protected		1.00	1.00		0.95	1.00
Satd. Flow (prot)		3574	3574		1752	1568
Flt Permitted		1.00	1.00		0.95	1.00
Satd. Flow (perm)		3574	3574		1752	1568
Peak-hour factor, PHF	0.92	0.92	0.89	0.89	0.92	0.92
Adj. Flow (vph)	0	1016	955	0	304	701
RTOR Reduction (vph)	0	0	0	0	0	258
Lane Group Flow (vph)	0	1016	955	0	304	443
Heavy Vehicles (%)	1%	1%	1%	1%	3%	3%
Turn Type		NA	NA		Prot	Perm
Protected Phases		2	2		7	
Permitted Phases						7
Actuated Green, G (s)		78.0	78.0		30.0	30.0
Effective Green, g (s)		78.0	78.0		30.0	30.0
Actuated g/C Ratio		0.65	0.65		0.25	0.25
Clearance Time (s)		6.0	6.0		6.0	6.0
Vehicle Extension (s)		3.0	3.0		3.0	3.0
Lane Grp Cap (vph)		2323	2323		438	392
v/s Ratio Prot		c0.28	0.27		0.17	
v/s Ratio Perm						c0.28
v/c Ratio		0.44	0.41		0.69	1.13
Uniform Delay, d1		10.3	10.0		40.8	45.0
Progression Factor		1.00	0.13		1.00	1.00
Incremental Delay, d2		0.6	0.5		8.8	85.8
Delay (s)		10.9	1.8		49.6	130.8
Level of Service		B	A		D	F
Approach Delay (s)		10.9	1.8		106.2	
Approach LOS		B	A		F	

Intersection Summary			
HCM 2000 Control Delay	40.2	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.67		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	73.4%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	NBL2	NBL	NBR	SEL	SER	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations	↰↰		↱			↰	↑↑			↑↑	↱
Traffic Volume (vph)	580	0	605	0	0	475	740	0	0	485	0
Future Volume (vph)	580	0	605	0	0	475	740	0	0	485	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5		4.0			4.5	6.0			6.0	
Lane Util. Factor	0.97		1.00			1.00	0.95			0.95	
Frt	1.00		0.85			1.00	1.00			1.00	
Flt Protected	0.95		1.00			0.95	1.00			1.00	
Satd. Flow (prot)	3467		1599			1770	3539			3539	
Flt Permitted	0.95		1.00			0.95	1.00			1.00	
Satd. Flow (perm)	3467		1599			1770	3539			3539	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.96	0.96	0.96	0.87	0.87	0.87
Adj. Flow (vph)	630	0	658	0	0	495	771	0	0	557	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	630	0	658	0	0	495	771	0	0	557	0
Heavy Vehicles (%)	1%	1%	1%	2%	2%	2%	2%	2%	2%	2%	2%
Turn Type	Prot		Free			Prot	NA			NA	Free
Protected Phases	2					7	4			8	
Permitted Phases			Free				7				Free
Actuated Green, G (s)	43.4		120.0			36.7	66.1			24.9	
Effective Green, g (s)	43.4		120.0			36.7	66.1			24.9	
Actuated g/C Ratio	0.36		1.00			0.31	0.55			0.21	
Clearance Time (s)	4.5					4.5	6.0			6.0	
Vehicle Extension (s)	3.0					3.0	3.0			3.0	
Lane Grp Cap (vph)	1253		1599			541	1949			734	
v/s Ratio Prot	c0.18					c0.28	0.22			c0.16	
v/s Ratio Perm			0.41								
v/c Ratio	0.50		0.41			0.91	0.40			0.76	
Uniform Delay, d1	29.9		0.0			40.1	15.5			44.7	
Progression Factor	1.00		1.00			1.04	1.26			1.00	
Incremental Delay, d2	1.4		0.8			18.3	0.1			4.5	
Delay (s)	31.3		0.8			60.2	19.7			49.2	
Level of Service	C		A			E	B			D	
Approach Delay (s)		15.7		0.0			35.5			49.2	
Approach LOS		B		A			D			D	

Intersection Summary			
HCM 2000 Control Delay	29.8	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.71		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	68.4%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑	↱	↰	↑↑					↰↰		↱
Traffic Volume (vph)	0	650	280	135	490	0	0	0	0	645	0	265
Future Volume (vph)	0	650	280	135	490	0	0	0	0	645	0	265
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0	4.0	6.0	6.0					6.0		6.0
Lane Util. Factor		0.95	1.00	1.00	0.95					0.97		1.00
Frt		1.00	0.85	1.00	1.00					1.00		0.85
Flt Protected		1.00	1.00	0.95	1.00					0.95		1.00
Satd. Flow (prot)		3471	1553	1719	3438					3367		1553
Flt Permitted		1.00	1.00	0.95	1.00					0.95		1.00
Satd. Flow (perm)		3471	1553	1719	3438					3367		1553
Peak-hour factor, PHF	0.87	0.87	0.87	0.86	0.86	0.86	0.92	0.92	0.92	0.91	0.91	0.91
Adj. Flow (vph)	0	747	322	157	570	0	0	0	0	709	0	291
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	197
Lane Group Flow (vph)	0	747	322	157	570	0	0	0	0	709	0	94
Heavy Vehicles (%)	4%	4%	4%	5%	5%	5%	2%	2%	2%	4%	4%	4%
Turn Type		NA	Free	Prot	NA					Prot		Prot
Protected Phases		2		1	6					4		4
Permitted Phases			Free		1							
Actuated Green, G (s)		38.5	100.0	14.7	59.2					28.8		28.8
Effective Green, g (s)		38.5	100.0	14.7	59.2					28.8		28.8
Actuated g/C Ratio		0.38	1.00	0.15	0.59					0.29		0.29
Clearance Time (s)		6.0		6.0	6.0					6.0		6.0
Vehicle Extension (s)		4.0		4.0	4.0					4.0		4.0
Lane Grp Cap (vph)		1336	1553	252	2035					969		447
v/s Ratio Prot		c0.22		c0.09	0.17					c0.21		0.06
v/s Ratio Perm			0.21									
v/c Ratio		0.56	0.21	0.62	0.28					0.73		0.21
Uniform Delay, d1		24.1	0.0	40.0	10.0					32.1		27.0
Progression Factor		1.00	1.00	0.90	0.42					1.00		1.00
Incremental Delay, d2		1.7	0.3	4.9	0.1					3.1		0.3
Delay (s)		25.8	0.3	40.7	4.3					35.2		27.3
Level of Service		C	A	D	A					D		C
Approach Delay (s)		18.1			12.1			0.0			32.9	
Approach LOS		B			B			A			C	

Intersection Summary			
HCM 2000 Control Delay	21.8	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.63		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	58.8%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	235	1060	0	0	425	535	220	0	240	0	0	0
Future Volume (vph)	235	1060	0	0	425	535	220	0	240	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0			6.0	4.0	6.0		6.0			
Lane Util. Factor	1.00	0.95			0.95	1.00	1.00		1.00			
Frt	1.00	1.00			1.00	0.85	1.00		0.85			
Flt Protected	0.95	1.00			1.00	1.00	0.95		1.00			
Satd. Flow (prot)	1752	3505			3505	1568	1703		1524			
Flt Permitted	0.95	1.00			1.00	1.00	0.95		1.00			
Satd. Flow (perm)	1752	3505			3505	1568	1703		1524			
Peak-hour factor, PHF	0.92	0.92	0.92	0.91	0.91	0.91	0.67	0.67	0.67	0.92	0.92	0.92
Adj. Flow (vph)	255	1152	0	0	467	588	328	0	358	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	73	0	0	0
Lane Group Flow (vph)	255	1152	0	0	467	588	328	0	285	0	0	0
Heavy Vehicles (%)	3%	3%	3%	3%	3%	3%	6%	6%	6%	2%	2%	2%
Turn Type	Prot	NA			NA	Free	Prot		Prot			
Protected Phases	5	2			6		8		8			
Permitted Phases		5 2				Free						
Actuated Green, G (s)	20.3	62.1			35.8	100.0	25.9		25.9			
Effective Green, g (s)	20.3	62.1			35.8	100.0	25.9		25.9			
Actuated g/C Ratio	0.20	0.62			0.36	1.00	0.26		0.26			
Clearance Time (s)	6.0	6.0			6.0		6.0		6.0			
Vehicle Extension (s)	4.0	4.0			4.0		4.0		4.0			
Lane Grp Cap (vph)	355	2176			1254	1568	441		394			
v/s Ratio Prot	c0.15	c0.33			0.13		c0.19		0.19			
v/s Ratio Perm						0.38						
v/c Ratio	0.72	0.53			0.37	0.38	0.74		0.72			
Uniform Delay, d1	37.2	10.7			23.8	0.0	34.0		33.8			
Progression Factor	1.00	1.00			1.00	1.00	1.00		1.00			
Incremental Delay, d2	7.3	0.3			0.8	0.7	7.1		6.9			
Delay (s)	44.4	11.0			24.6	0.7	41.1		40.7			
Level of Service	D	B			C	A	D		D			
Approach Delay (s)		17.1			11.3			40.9			0.0	
Approach LOS		B			B			D			A	

Intersection Summary			
HCM 2000 Control Delay	20.3	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.66		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	58.8%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations		✣			✣			↱			↰	
Traffic Volume (vph)	15	50	5	230	0	100	0	760	150	15	415	0
Future Volume (vph)	15	50	5	230	0	100	0	760	150	15	415	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0			6.0			6.0			6.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		0.99			0.96			0.98			1.00	
Flt Protected		0.99			0.97			1.00			1.00	
Satd. Flow (prot)		1843			1744			1821			1841	
Flt Permitted		0.90			0.74			1.00			0.62	
Satd. Flow (perm)		1681			1335			1821			1144	
Peak-hour factor, PHF	0.83	0.83	0.83	0.98	0.98	0.98	0.95	0.95	0.95	0.89	0.89	0.89
Adj. Flow (vph)	18	60	6	235	0	102	0	800	158	17	466	0
RTOR Reduction (vph)	0	4	0	0	40	0	0	12	0	0	0	0
Lane Group Flow (vph)	0	80	0	0	297	0	0	946	0	0	483	0
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	2%	2%	2%	3%	3%	3%
Turn Type	Perm	NA		Perm	NA			NA		Perm	NA	
Protected Phases		2			2			1			1	
Permitted Phases	2			2						1		
Actuated Green, G (s)		15.8			15.8			30.1			30.1	
Effective Green, g (s)		15.8			15.8			30.1			30.1	
Actuated g/C Ratio		0.27			0.27			0.52			0.52	
Clearance Time (s)		6.0			6.0			6.0			6.0	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		458			364			946			594	
v/s Ratio Prot								c0.52				
v/s Ratio Perm		0.05			c0.22						0.42	
v/c Ratio		0.17			0.82			1.00			0.81	
Uniform Delay, d1		16.1			19.7			13.9			11.6	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		0.2			13.2			29.4			8.3	
Delay (s)		16.3			32.9			43.3			19.9	
Level of Service		B			C			D			B	
Approach Delay (s)		16.3			32.9			43.3			19.9	
Approach LOS		B			C			D			B	

Intersection Summary

HCM 2000 Control Delay	34.1	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.94		
Actuated Cycle Length (s)	57.9	Sum of lost time (s)	12.0
Intersection Capacity Utilization	95.4%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

7

Movement	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations	↰	↑↱		↰	↑	↱	↰	↑↱		↰	↑↱	
Traffic Volume (vph)	70	295	35	135	340	150	135	410	40	75	250	65
Future Volume (vph)	70	295	35	135	340	150	135	410	40	75	250	65
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	0.98		1.00	1.00	0.85	1.00	0.99		1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1752	1816		1752	1845	1568	1787	1856		1787	1823	
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1752	1816		1752	1845	1568	1787	1856		1787	1823	
Peak-hour factor, PHF	0.91	0.91	0.91	0.93	0.93	0.93	0.95	0.95	0.95	0.94	0.94	0.94
Adj. Flow (vph)	77	324	38	145	366	161	142	432	42	80	266	69
RTOR Reduction (vph)	0	5	0	0	0	101	0	4	0	0	11	0
Lane Group Flow (vph)	77	357	0	145	366	60	142	470	0	80	324	0
Heavy Vehicles (%)	3%	3%	3%	3%	3%	3%	1%	1%	1%	1%	1%	1%
Turn Type	Prot	NA		Prot	NA	pm+ov	Prot	NA		Prot	NA	
Protected Phases	3	8		7	4	5	5	2		1	6	
Permitted Phases						4						
Actuated Green, G (s)	7.7	20.8		8.9	22.0	31.7	9.7	27.0		4.3	21.6	
Effective Green, g (s)	7.7	20.8		8.9	22.0	31.7	9.7	27.0		4.3	21.6	
Actuated g/C Ratio	0.09	0.24		0.10	0.26	0.37	0.11	0.32		0.05	0.25	
Clearance Time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	158	444		183	477	695	203	589		90	463	
v/s Ratio Prot	0.04	0.20		c0.08	c0.20	0.01	c0.08	c0.25		0.04	0.18	
v/s Ratio Perm						0.03						
v/c Ratio	0.49	0.80		0.79	0.77	0.09	0.70	0.80		0.89	0.70	
Uniform Delay, d1	36.8	30.2		37.1	29.1	17.3	36.2	26.5		40.1	28.8	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	2.4	10.1		20.5	7.3	0.1	10.1	10.8		59.2	4.6	
Delay (s)	39.1	40.3		57.6	36.4	17.3	46.3	37.3		99.3	33.3	
Level of Service	D	D		E	D	B	D	D		F	C	
Approach Delay (s)		40.1			36.4			39.4			46.1	
Approach LOS		D			D			D			D	

Intersection Summary

HCM 2000 Control Delay	39.9	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	85.0	Sum of lost time (s)	24.0
Intersection Capacity Utilization	87.5%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations	↰	↑↑	↱	↰↰	↑	↱	↰	↑	↱	↰	↑	↱
Traffic Volume (vph)	80	360	150	520	430	190	240	320	90	150	220	380
Future Volume (vph)	80	360	150	520	430	190	240	320	90	150	220	380
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	0.95	1.00	0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	3539	1583	3433	1863	1583	1770	1863	1583	1787	1881	1599
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	3539	1583	3433	1863	1583	1770	1863	1583	1787	1881	1599
Peak-hour factor, PHF	0.92	0.92	0.92	0.94	0.94	0.94	0.96	0.96	0.96	0.95	0.95	0.95
Adj. Flow (vph)	87	391	163	553	457	202	250	333	94	158	232	400
RTOR Reduction (vph)	0	0	121	0	0	125	0	0	71	0	0	89
Lane Group Flow (vph)	87	391	42	553	457	77	250	333	23	158	232	311
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	1%	1%	1%
Turn Type	Prot	NA	Perm	Prot	NA	Perm	Prot	NA	Perm	Prot	NA	pm+ov
Protected Phases	5	2		1	6		7	4		3	8	1
Permitted Phases			2			6			4			8
Actuated Green, G (s)	9.8	29.4	29.4	24.3	43.9	43.9	18.4	28.3	28.3	9.0	18.9	43.2
Effective Green, g (s)	9.8	29.4	29.4	24.3	43.9	43.9	18.4	28.3	28.3	9.0	18.9	43.2
Actuated g/C Ratio	0.09	0.26	0.26	0.21	0.38	0.38	0.16	0.25	0.25	0.08	0.16	0.38
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	150	904	404	725	711	604	283	458	389	139	309	684
v/s Ratio Prot	0.05	0.11		c0.16	c0.25		c0.14	c0.18		0.09	0.12	0.10
v/s Ratio Perm			0.03			0.05			0.01			0.10
v/c Ratio	0.58	0.43	0.10	0.76	0.64	0.13	0.88	0.73	0.06	1.14	0.75	0.46
Uniform Delay, d1	50.6	35.8	32.7	42.6	29.1	23.1	47.3	39.8	33.2	53.0	45.8	27.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	5.4	1.5	0.5	4.8	2.0	0.1	26.0	5.7	0.1	117.8	9.8	0.5
Delay (s)	56.0	37.3	33.2	47.4	31.1	23.2	73.3	45.5	33.2	170.8	55.6	27.5
Level of Service	E	D	C	D	C	C	E	D	C	F	E	C
Approach Delay (s)		38.8			37.2			54.0			64.4	
Approach LOS		D			D			D			E	

Intersection Summary			
HCM 2000 Control Delay	47.4	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	115.0	Sum of lost time (s)	24.0
Intersection Capacity Utilization	74.5%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations	↰	↑↱		↰	↑↱			↰↑	↱		↰↑	↱
Traffic Volume (vph)	170	1400	5	20	855	80	15	10	15	45	10	215
Future Volume (vph)	170	1400	5	20	855	80	15	10	15	45	10	215
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0			6.0	6.0		6.0	6.0
Lane Util. Factor	1.00	0.95		1.00	0.95			1.00	1.00		1.00	1.00
Frt	1.00	1.00		1.00	0.99			1.00	0.85		1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00			0.97	1.00		0.96	1.00
Satd. Flow (prot)	1787	3572		1787	3528			1844	1615		1808	1599
Flt Permitted	0.95	1.00		0.95	1.00			0.77	1.00		0.75	1.00
Satd. Flow (perm)	1787	3572		1787	3528			1471	1615		1405	1599
Peak-hour factor, PHF	0.97	0.97	0.97	0.95	0.95	0.95	0.90	0.90	0.90	0.80	0.80	0.80
Adj. Flow (vph)	175	1443	5	21	900	84	17	11	17	56	12	269
RTOR Reduction (vph)	0	0	0	0	6	0	0	0	15	0	0	240
Lane Group Flow (vph)	175	1448	0	21	978	0	0	28	2	0	69	29
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	0%	0%	0%	1%	1%	1%
Turn Type	Prot	NA		Prot	NA		Perm	NA	Perm	Perm	NA	Perm
Protected Phases	5	2		1	6			8			4	
Permitted Phases							8		8	4	4	4
Actuated Green, G (s)	14.5	64.4		2.5	52.4			10.1	10.1		10.1	10.1
Effective Green, g (s)	14.5	64.4		2.5	52.4			10.1	10.1		10.1	10.1
Actuated g/C Ratio	0.15	0.68		0.03	0.55			0.11	0.11		0.11	0.11
Clearance Time (s)	6.0	6.0		6.0	6.0			6.0	6.0		6.0	6.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	272	2421		47	1945			156	171		149	169
v/s Ratio Prot	c0.10	c0.41		0.01	0.28							
v/s Ratio Perm								0.02	0.00		c0.05	0.02
v/c Ratio	0.64	0.60		0.45	0.50			0.18	0.01		0.46	0.17
Uniform Delay, d1	37.8	8.3		45.6	13.2			38.7	38.0		39.9	38.6
Progression Factor	0.77	1.64		1.00	1.00			1.00	1.00		1.00	1.00
Incremental Delay, d2	4.0	0.8		6.6	0.9			0.6	0.0		2.3	0.5
Delay (s)	33.3	14.5		52.2	14.2			39.2	38.0		42.2	39.1
Level of Service	C	B		D	B			D	D		D	D
Approach Delay (s)		16.5			14.9			38.8			39.7	
Approach LOS		B			B			D			D	

Intersection Summary

HCM 2000 Control Delay	18.9	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.61		
Actuated Cycle Length (s)	95.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	67.7%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

14

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	110	1095	5	5	800	260	40	10	10	345	5	135
Future Volume (vph)	110	1095	5	5	800	260	40	10	10	345	5	135
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	6.0
Lane Util. Factor	0.97	0.95		1.00	0.95		1.00	1.00		0.95	0.95	1.00
Frt	1.00	1.00		1.00	0.96		1.00	0.93		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	0.95	1.00
Satd. Flow (prot)	3467	3572		1770	3409		1805	1758		1715	1721	1615
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	0.95	1.00
Satd. Flow (perm)	3467	3572		1770	3409		1805	1758		1715	1721	1615
Peak-hour factor, PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.78	0.78	0.78	0.86	0.86	0.86
Adj. Flow (vph)	131	1304	6	6	889	289	51	13	13	401	6	157
RTOR Reduction (vph)	0	0	0	0	32	0	0	12	0	0	0	77
Lane Group Flow (vph)	131	1310	0	6	1146	0	51	14	0	205	202	80
Heavy Vehicles (%)	1%	1%	1%	2%	2%	2%	0%	0%	0%	0%	0%	0%
Turn Type	Prot	NA		Prot	NA		Split	NA		Split	NA	pt+ov
Protected Phases	5	2		1	6		3	3		4	4	4 5
Permitted Phases		2			6							
Actuated Green, G (s)	7.7	52.5		1.0	45.8		4.0	4.0		13.5	13.5	27.2
Effective Green, g (s)	7.7	52.5		1.0	45.8		4.0	4.0		13.5	13.5	27.2
Actuated g/C Ratio	0.08	0.55		0.01	0.48		0.04	0.04		0.14	0.14	0.29
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	281	1974		18	1643		76	74		243	244	462
v/s Ratio Prot	c0.04	c0.37		0.00	0.34		c0.03	0.01		c0.12	0.12	0.05
v/s Ratio Perm												
v/c Ratio	0.47	0.66		0.33	0.70		0.67	0.18		0.84	0.83	0.17
Uniform Delay, d1	41.7	15.0		46.7	19.2		44.9	43.9		39.7	39.6	25.5
Progression Factor	1.00	1.00		1.48	0.69		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	1.2	1.8		9.3	1.1		20.8	1.2		22.5	20.1	0.2
Delay (s)	42.9	16.8		78.4	14.4		65.7	45.1		62.2	59.7	25.6
Level of Service	D	B		E	B		E	D		E	E	C
Approach Delay (s)		19.2			14.7			58.7			51.1	
Approach LOS		B			B			E			D	

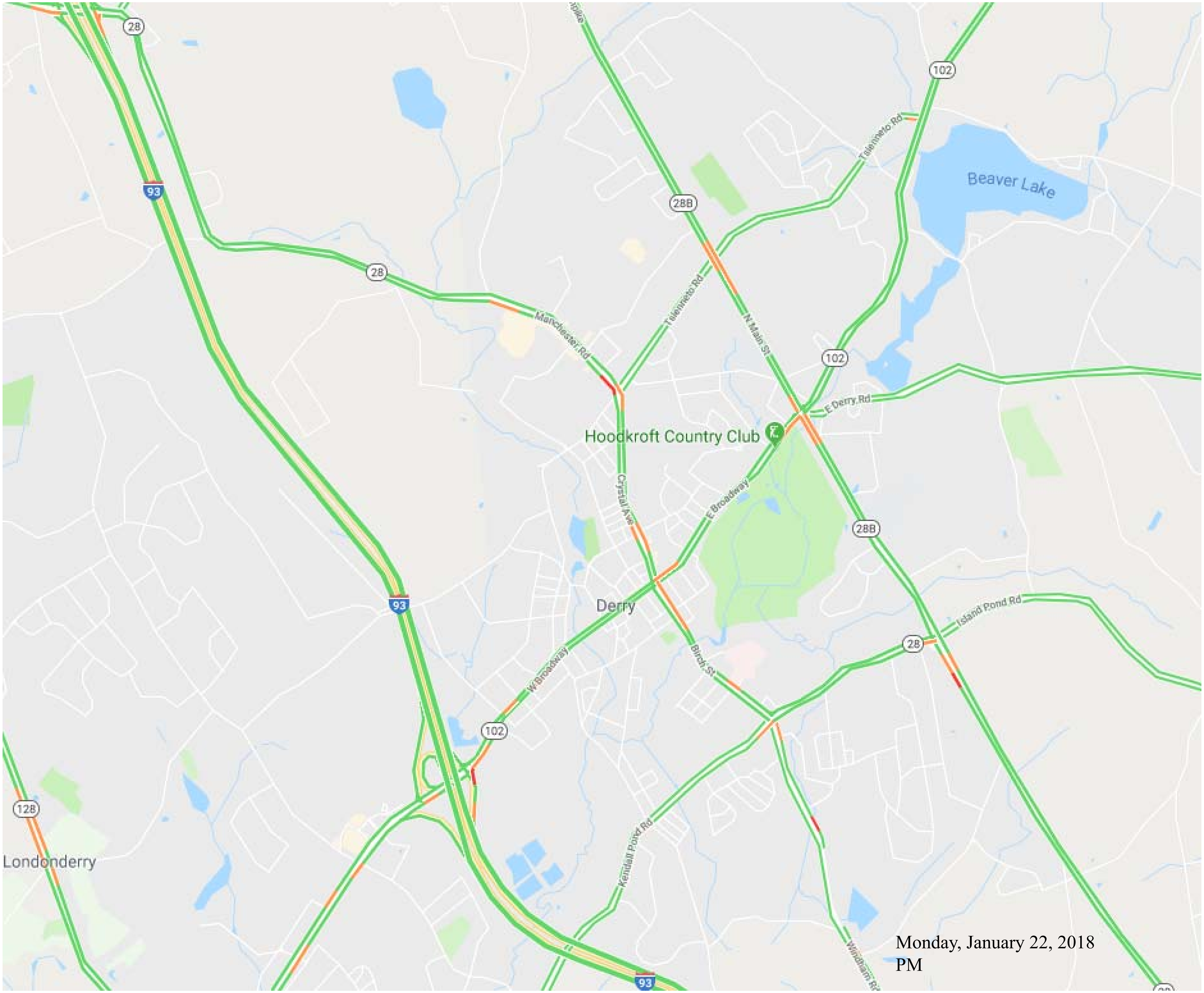
Intersection Summary			
HCM 2000 Control Delay	24.0	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.72		
Actuated Cycle Length (s)	95.0	Sum of lost time (s)	24.0
Intersection Capacity Utilization	65.9%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

18

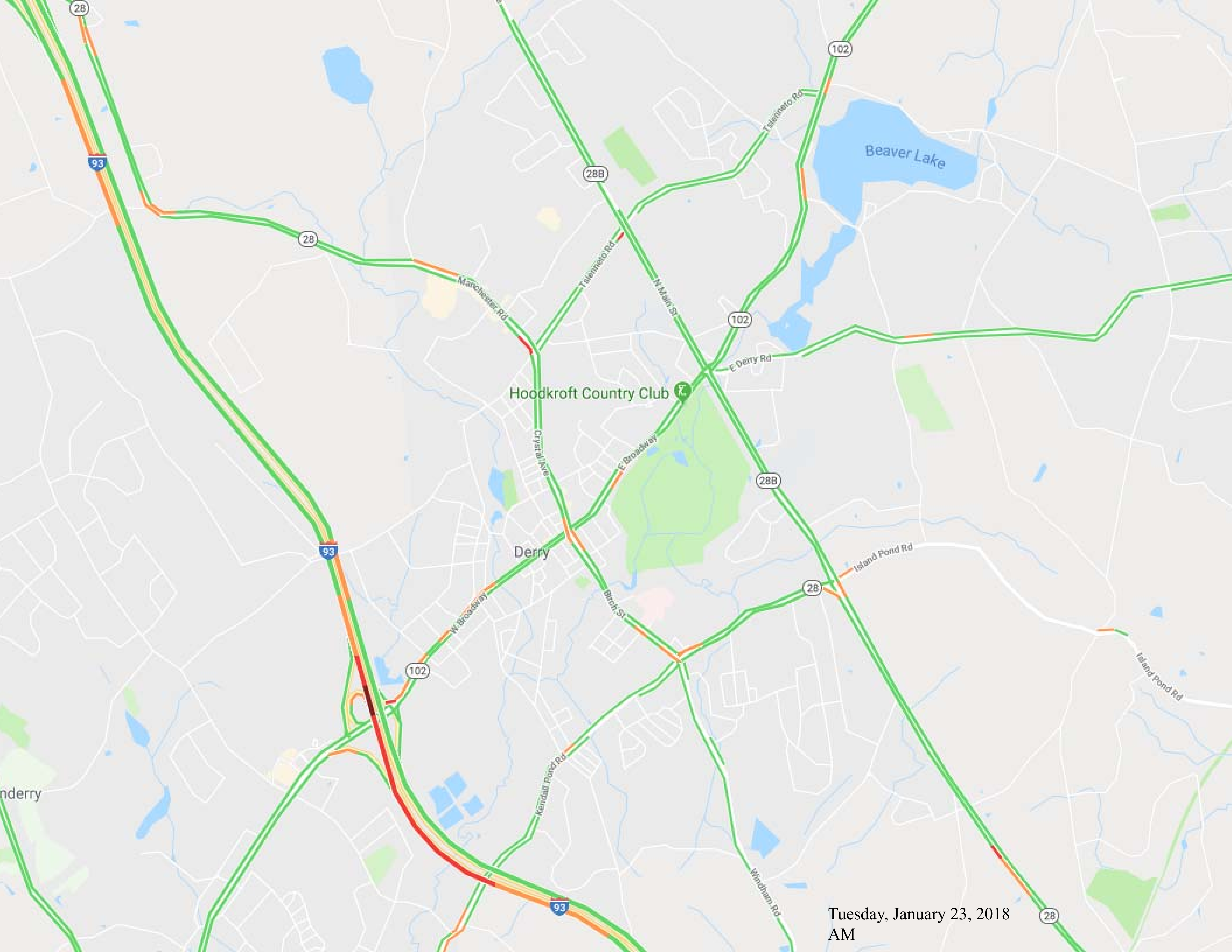
Movement	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	100	320	25	75	185	185	280	345	75	25	175	70
Future Volume (vph)	100	320	25	75	185	185	280	345	75	25	175	70
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	1.00	0.85	1.00	0.97		1.00	0.96	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	1843		1787	1881	1599	1805	1849		1805	1819	
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	1843		1787	1881	1599	1805	1849		1805	1819	
Peak-hour factor, PHF	0.99	0.99	0.99	0.95	0.95	0.95	0.89	0.89	0.89	0.93	0.93	0.93
Adj. Flow (vph)	101	323	25	79	195	195	315	388	84	27	188	75
RTOR Reduction (vph)	0	3	0	0	0	101	0	8	0	0	17	0
Lane Group Flow (vph)	101	345	0	79	195	94	315	464	0	27	246	0
Heavy Vehicles (%)	2%	2%	2%	1%	1%	1%	0%	0%	0%	0%	0%	0%
Turn Type	Prot	NA		Prot	NA	pt+ov	Prot	NA		Prot	NA	
Protected Phases	1	6		5	2	2 3	3	8		7	4	
Permitted Phases		6			2							
Actuated Green, G (s)	7.1	17.0		6.4	16.3	38.6	16.3	29.4		3.2	16.3	
Effective Green, g (s)	7.1	17.0		6.4	16.3	38.6	16.3	29.4		3.2	16.3	
Actuated g/C Ratio	0.09	0.21		0.08	0.20	0.48	0.20	0.37		0.04	0.20	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	157	391		142	383	771	367	679		72	370	
v/s Ratio Prot	c0.06	c0.19		0.04	0.10	0.06	c0.17	c0.25		0.01	0.14	
v/s Ratio Perm												
v/c Ratio	0.64	0.88		0.56	0.51	0.12	0.86	0.68		0.38	0.67	
Uniform Delay, d1	35.2	30.5		35.4	28.3	11.4	30.7	21.4		37.4	29.3	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	8.7	20.2		4.7	4.8	0.1	17.7	2.8		3.3	4.5	
Delay (s)	43.9	50.7		40.1	33.1	11.5	48.4	24.2		40.7	33.8	
Level of Service	D	D		D	C	B	D	C		D	C	
Approach Delay (s)		49.2			25.3			33.9			34.5	
Approach LOS		D			C			C			C	

Intersection Summary			
HCM 2000 Control Delay	35.4	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	24.0
Intersection Capacity Utilization	74.4%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

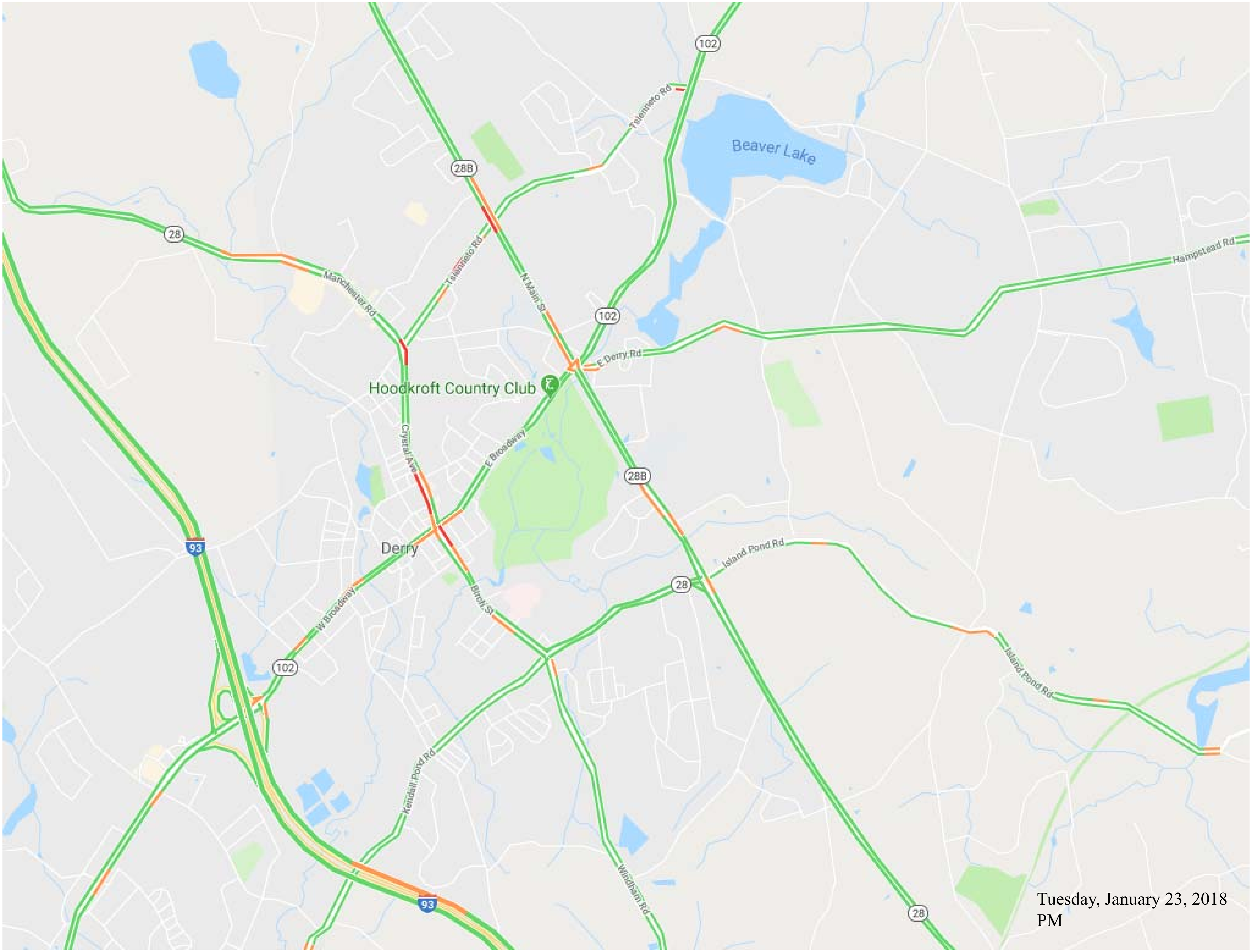
APPENDIX H: GOOGLE MAPS PRINTOUT OF TRAFFIC CONDITIONS – DERRY AREA – JANUARY 2018



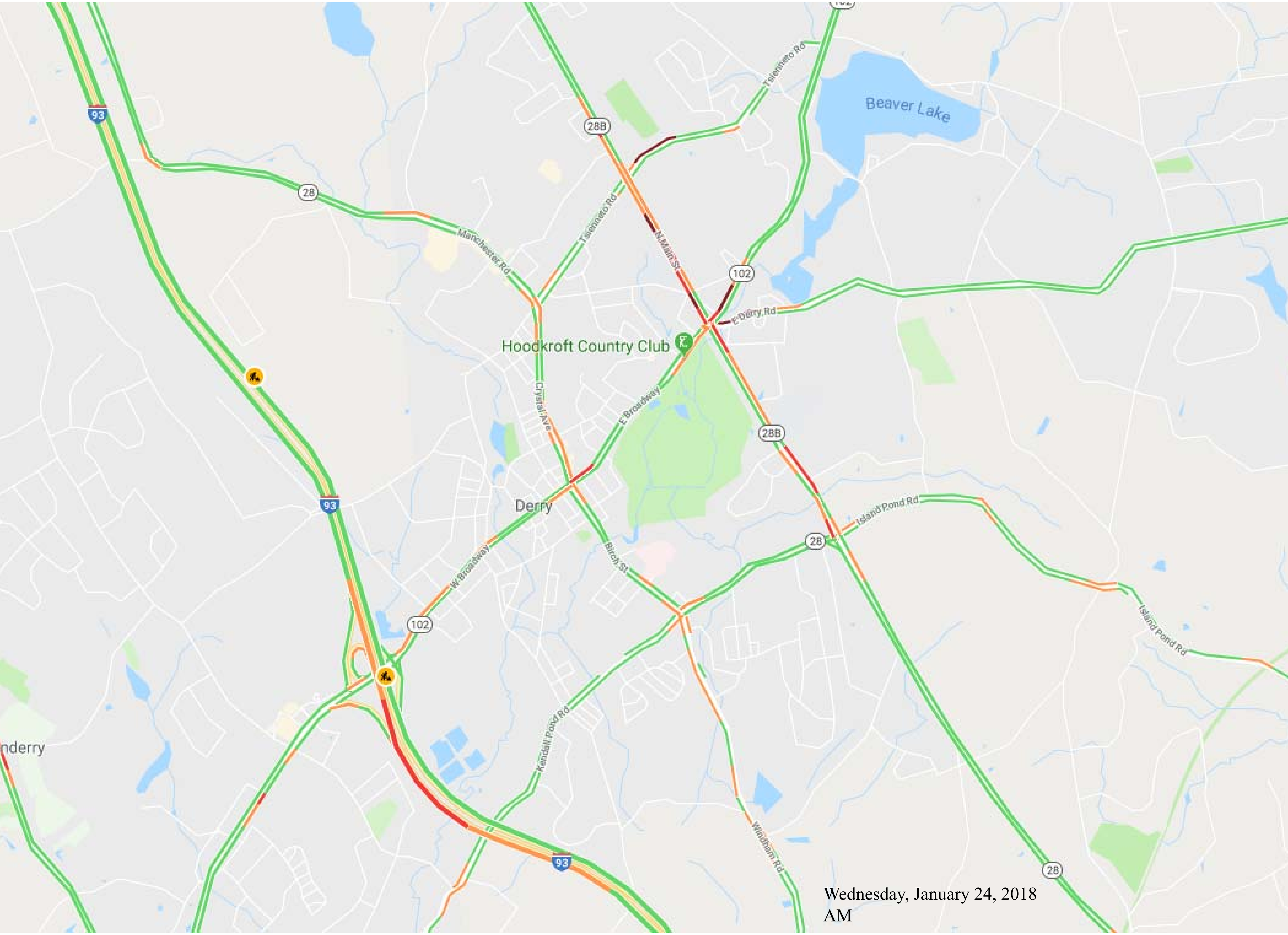
Monday, January 22, 2018
PM



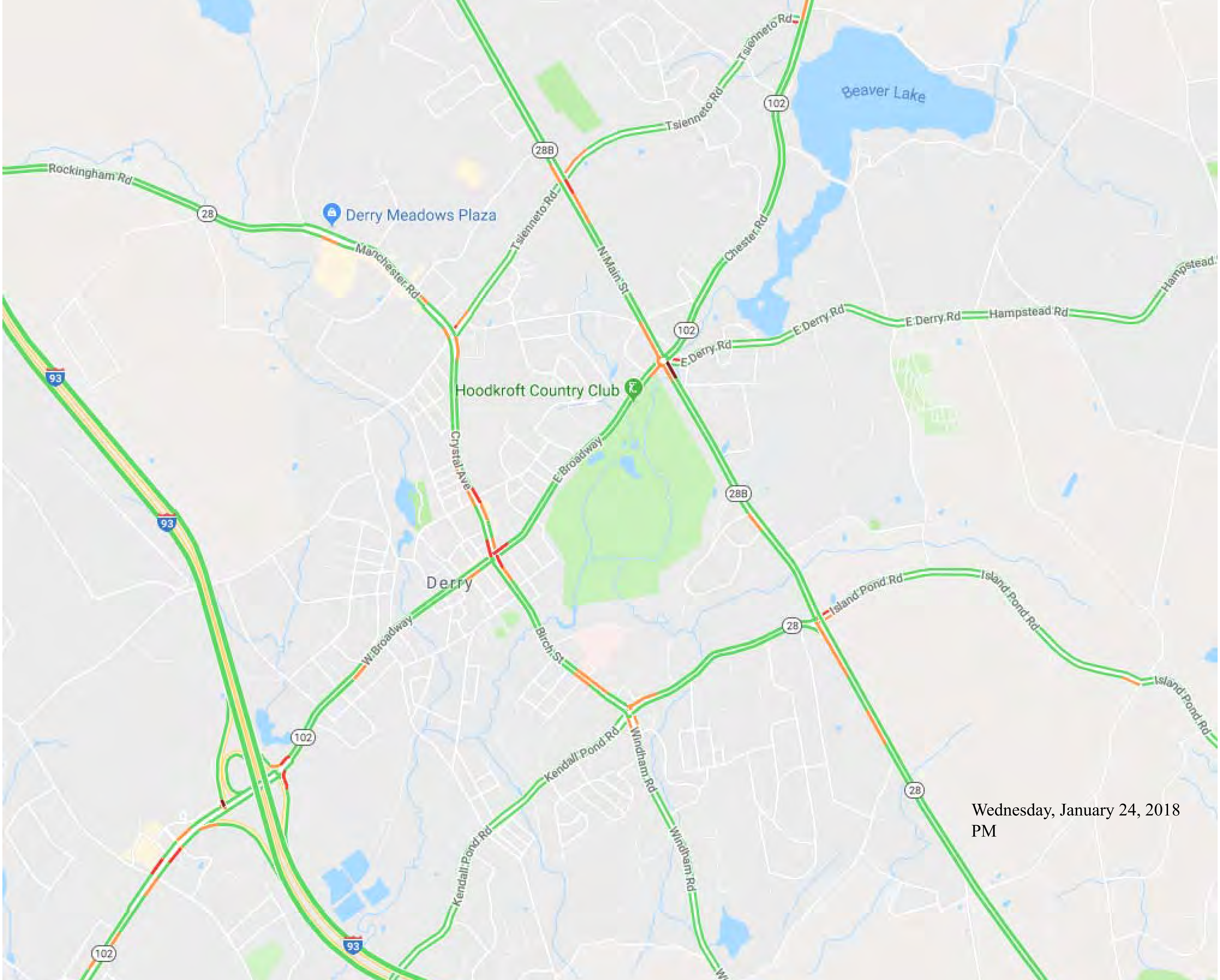
Tuesday, January 23, 2018
AM



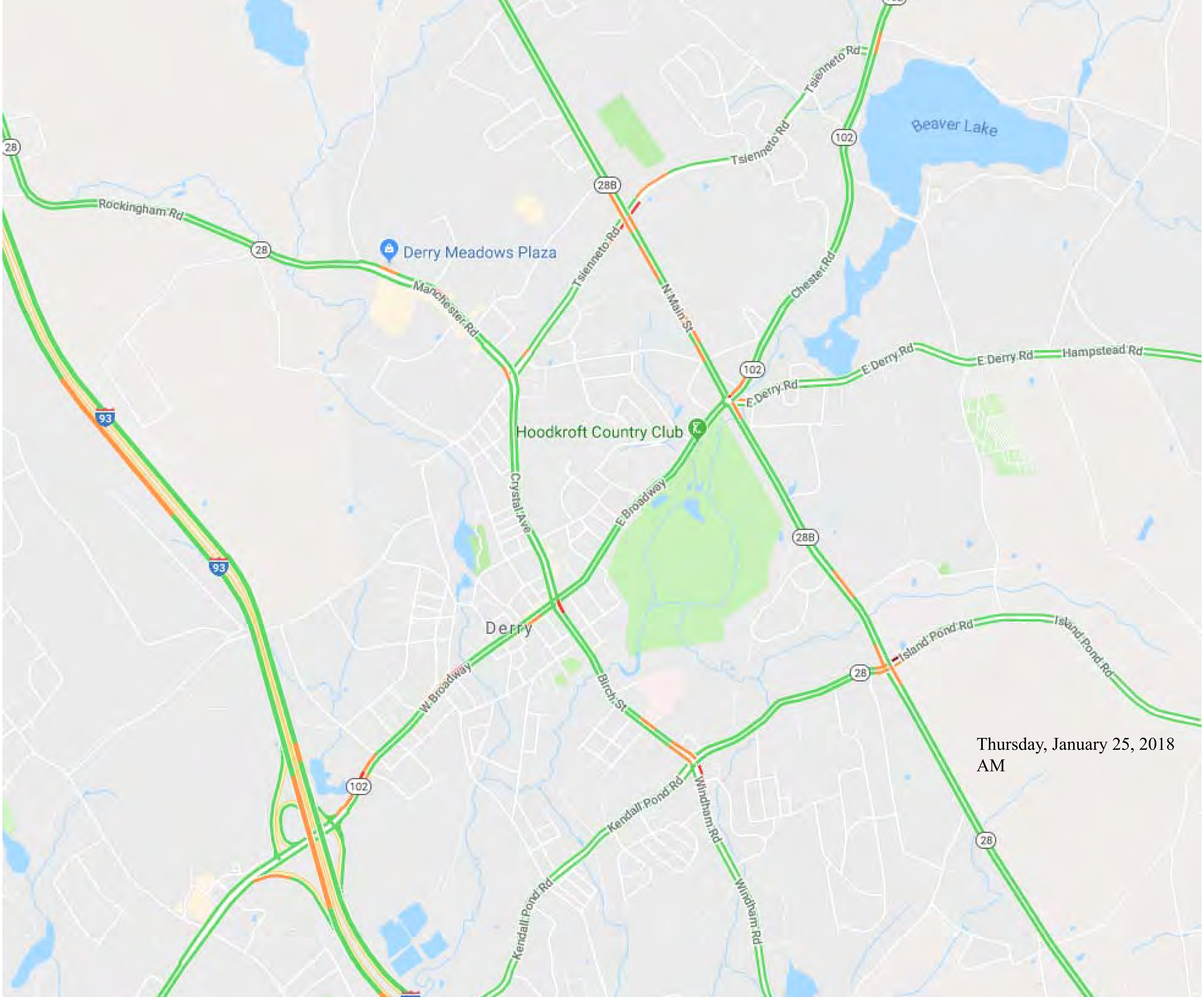
Tuesday, January 23, 2018
PM



Wednesday, January 24, 2018
AM

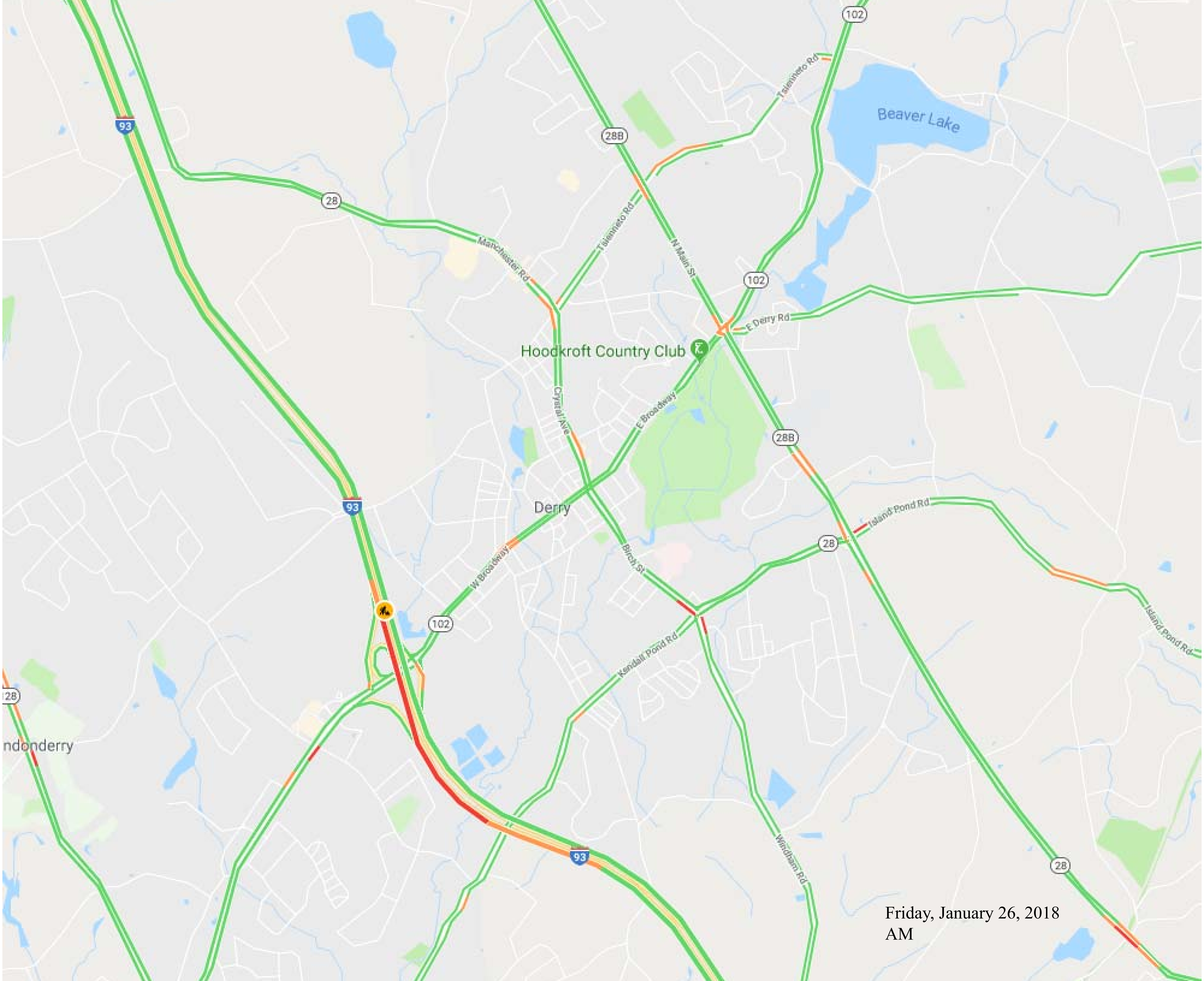


Wednesday, January 24, 2018
PM

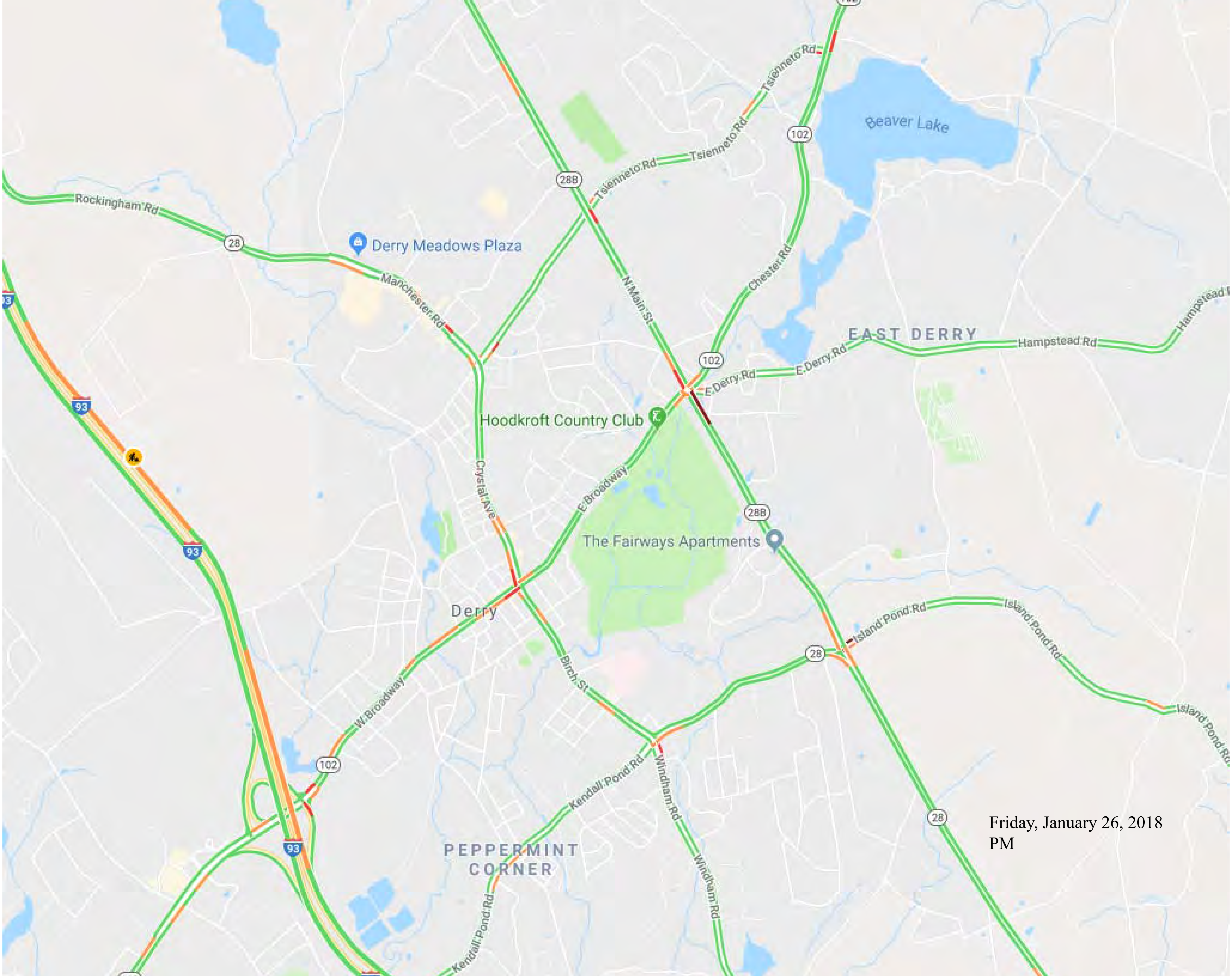


Thursday, January 25, 2018
AM

Thursday, January 25, 2018
PM



Friday, January 26, 2018
AM



Friday, January 26, 2018
PM

APPENDIX I: HCM PRINTOUTS – UNSIGNALIZED INTERSECTION CAPACITY ANALYSES – 2015 AM AND PM PEAK HCM PRINTOUTS

Intersection	
Int Delay, s/veh	3.2

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Vol, veh/h	10	0	105	0	0	1	75	520	5	5	1090	25
Future Vol, veh/h	10	0	105	0	0	1	75	520	5	5	1090	25
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	150	-	-	-	150	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	25	25	25	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	0	0	0	2	2	2	2	2	2
Mvmt Flow	11	0	114	0	0	4	82	565	5	5	1185	27

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1942	1943	1198	1940	1954	568	1212	0	0	571	0	0
Stage 1	1209	1209	-	731	731	-	-	-	-	-	-	-
Stage 2	733	734	-	1209	1223	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.1	6.5	6.2	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.1	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.1	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.5	4	3.3	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	49	65	226	50	65	526	576	-	-	1002	-	-
Stage 1	223	256	-	416	430	-	-	-	-	-	-	-
Stage 2	412	426	-	225	254	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	43	55	226	22	55	526	576	-	-	1002	-	-
Mov Cap-2 Maneuver	43	55	-	22	55	-	-	-	-	-	-	-
Stage 1	191	252	-	357	369	-	-	-	-	-	-	-
Stage 2	351	365	-	110	250	-	-	-	-	-	-	-

Approach	SE	NW	NE	SW
HCM Control Delay, s	43	11.9	1.5	0
HCM LOS	E	B		

	EB			NB	SB		WB		
Minor Lane/Major Mvmt	NEL	NET	NER	NWLn1	SELn1	SELn2	SWL	SWT	SWR
Capacity (veh/h)	576	-	-	526	43	226	1002	-	-
HCM Lane V/C Ratio	0.142	-	-	0.008	0.253	0.505	0.005	-	-
HCM Control Delay (s)	12.3	-	-	11.9	115	36.1	8.6	0	-
HCM Lane LOS	B	-	-	B	F	E	A	A	-
HCM 95th %tile Q(veh)	0.5	-	-	0	0.8	2.6	0	-	-

Intersection	
Int Delay, s/veh	4.2

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	180	10	5	125	175	230
Future Vol, veh/h	180	10	5	125	175	230
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	89	89	91	91	93	93
Heavy Vehicles, %	5	5	4	4	2	2
Mvmt Flow	202	11	5	137	188	247

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	460	312	435	0	-	0
Stage 1	312	-	-	-	-	-
Stage 2	148	-	-	-	-	-
Critical Hdwy	6.45	6.25	4.14	-	-	-
Critical Hdwy Stg 1	5.45	-	-	-	-	-
Critical Hdwy Stg 2	5.45	-	-	-	-	-
Follow-up Hdwy	3.545	3.345	2.236	-	-	-
Pot Cap-1 Maneuver	554	721	1114	-	-	-
Stage 1	735	-	-	-	-	-
Stage 2	872	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	551	721	1114	-	-	-
Mov Cap-2 Maneuver	551	-	-	-	-	-
Stage 1	735	-	-	-	-	-
Stage 2	868	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	15.4	0.3	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1114	-	558	-	-
HCM Lane V/C Ratio	0.005	-	0.383	-	-
HCM Control Delay (s)	8.2	0	15.4	-	-
HCM Lane LOS	A	A	C	-	-
HCM 95th %tile Q(veh)	0	-	1.8	-	-

Intersection	
Int Delay, s/veh	0.5

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	10	0	0	310	400	20
Future Vol, veh/h	10	0	0	310	400	20
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	44	44	95	95	96	96
Heavy Vehicles, %	79	79	4	4	6	6
Mvmt Flow	23	0	0	326	417	21

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	753	427	438	0	-	0
Stage 1	427	-	-	-	-	-
Stage 2	326	-	-	-	-	-
Critical Hdwy	7.19	6.99	4.14	-	-	-
Critical Hdwy Stg 1	6.19	-	-	-	-	-
Critical Hdwy Stg 2	6.19	-	-	-	-	-
Follow-up Hdwy	4.211	4.011	2.236	-	-	-
Pot Cap-1 Maneuver	286	492	1111	-	-	-
Stage 1	521	-	-	-	-	-
Stage 2	587	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	286	492	1111	-	-	-
Mov Cap-2 Maneuver	286	-	-	-	-	-
Stage 1	521	-	-	-	-	-
Stage 2	587	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	18.7	0	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1111	-	286	-	-
HCM Lane V/C Ratio	-	-	0.079	-	-
HCM Control Delay (s)	0	-	18.7	-	-
HCM Lane LOS	A	-	C	-	-
HCM 95th %tile Q(veh)	0	-	0.3	-	-

Intersection	
Int Delay, s/veh	2.5

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations		↱			✥			✥			✥	
Traffic Vol, veh/h	35	270	5	30	385	10	10	5	30	10	5	35
Future Vol, veh/h	35	270	5	30	385	10	10	5	30	10	5	35
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	Yield	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	89	89	89	96	96	96	65	65	65	67	67	67
Heavy Vehicles, %	7	7	7	5	5	5	2	2	2	0	0	0
Mvmt Flow	39	303	6	31	401	10	15	8	46	15	7	52

Major/Minor	Major1			Major2			Minor2			Minor1		
Conflicting Flow All	411	0	0	309	0	0	884	857	406	858	859	306
Stage 1	-	-	-	-	-	-	469	469	-	385	385	-
Stage 2	-	-	-	-	-	-	415	388	-	473	474	-
Critical Hdwy	4.17	-	-	4.15	-	-	7.12	6.52	6.22	7.1	6.5	6.2
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.1	5.5	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.1	5.5	-
Follow-up Hdwy	2.263	-	-	2.245	-	-	3.518	4.018	3.318	3.5	4	3.3
Pot Cap-1 Maneuver	1121	-	-	1235	-	-	266	295	645	279	296	739
Stage 1	-	-	-	-	-	-	575	561	-	642	614	-
Stage 2	-	-	-	-	-	-	615	609	-	576	561	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1121	-	-	1235	-	-	228	273	645	239	274	739
Mov Cap-2 Maneuver	-	-	-	-	-	-	228	273	-	239	274	-
Stage 1	-	-	-	-	-	-	551	542	-	615	588	-
Stage 2	-	-	-	-	-	-	541	583	-	510	542	-

Approach	EB	WB	SE	NW
HCM Control Delay, s	0.9	0.6	10.5	14.2
HCM LOS			B	B

Minor Lane/Major Mvmt	NWLn1	EBL	EBT	EBR	WBL	WBT	WBR	SELn1
Capacity (veh/h)	465	1121	-	-	1235	-	-	724
HCM Lane V/C Ratio	0.16	0.035	-	-	0.025	-	-	0.096
HCM Control Delay (s)	14.2	8.3	-	-	8	0	-	10.5
HCM Lane LOS	B	A	-	-	A	A	-	B
HCM 95th %tile Q(veh)	0.6	0.1	-	-	0.1	-	-	0.3

17

Intersection	
Int Delay, s/veh	22.6

Movement	NWL	NWR	NET	NER	SWL	SWT
Lane Configurations	↰	↱	↑	↱		↰↑
Traffic Vol, veh/h	215	80	370	245	80	570
Future Vol, veh/h	215	80	370	245	80	570
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	Yield	-	None
Storage Length	-	150	-	0	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	83	83	86	86	81	81
Heavy Vehicles, %	2	2	3	3	2	2
Mvmt Flow	259	96	430	285	99	704

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	979	430	0	0	430	0
Stage 1	430	-	-	-	-	-
Stage 2	549	-	-	-	-	-
Critical Hdwy	6.63	6.23	-	-	4.13	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.83	-	-	-	-	-
Follow-up Hdwy	3.519	3.319	-	-	2.219	-
Pot Cap-1 Maneuver	262	624	-	-	1128	-
Stage 1	655	-	-	-	-	-
Stage 2	543	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	~ 224	624	-	-	1128	-
Mov Cap-2 Maneuver	~ 224	-	-	-	-	-
Stage 1	655	-	-	-	-	-
Stage 2	465	-	-	-	-	-

Approach	NW	NE	SW
HCM Control Delay, s	115.7	0	1.5
HCM LOS	F		

Minor Lane/Major Mvmt	NET	NER	NWLn1	NWLn2	SWL	SWT
Capacity (veh/h)	-	-	224	624	1128	-
HCM Lane V/C Ratio	-	-	1.156	0.154	0.088	-
HCM Control Delay (s)	-	-	154.3	11.8	8.5	0.5
HCM Lane LOS	-	-	F	B	A	A
HCM 95th %tile Q(veh)	-	-	12.3	0.5	0.3	-

Notes

~: Volume exceeds capacity $: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Intersection	
Int Delay, s/veh	11.2

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↰	↑	↱		Y	
Traffic Vol, veh/h	15	720	645	40	80	35
Future Vol, veh/h	15	720	645	40	80	35
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	84	84	89	89	83	83
Heavy Vehicles, %	7	7	4	4	6	6
Mvmt Flow	18	857	725	45	96	42

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	770	0	-	0	1640	747
Stage 1	-	-	-	-	747	-
Stage 2	-	-	-	-	893	-
Critical Hdwy	4.17	-	-	-	6.46	6.26
Critical Hdwy Stg 1	-	-	-	-	5.46	-
Critical Hdwy Stg 2	-	-	-	-	5.46	-
Follow-up Hdwy	2.263	-	-	-	3.554	3.354
Pot Cap-1 Maneuver	823	-	-	-	108	406
Stage 1	-	-	-	-	461	-
Stage 2	-	-	-	-	393	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	823	-	-	-	106	406
Mov Cap-2 Maneuver	-	-	-	-	106	-
Stage 1	-	-	-	-	461	-
Stage 2	-	-	-	-	384	-

Approach	EB	WB	SB
HCM Control Delay, s	0.2	0	143.2
HCM LOS			F

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	823	-	-	-	137
HCM Lane V/C Ratio	0.022	-	-	-	1.011
HCM Control Delay (s)	9.5	-	-	-	143.2
HCM Lane LOS	A	-	-	-	F
HCM 95th %tile Q(veh)	0.1	-	-	-	7.3

Intersection					
Intersection Delay, s/veh	76.6				
Intersection LOS	F	EDR	Byp 28	Byp 28	102 EB	102 WB

Approach	WB	NB	SB	NE	SW
Entry Lanes	1	1	1	1	1
Conflicting Circle Lanes	1	1	1	1	1
Adj Approach Flow, veh/h	516	436	557	617	397
Demand Flow Rate, veh/h	530	450	595	666	424
Vehicles Circulating, veh/h	788	673	698	629	1006
Vehicles Exiting, veh/h	335	622	732	665	312
Follow-Up Headway, s	3.186	3.186	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	0	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000	1.000
Approach Delay, s/veh	77.5	29.5	83.5	96.6	86.1
Approach LOS	F	D	F	F	F

Lane	Left	Left	Left	Left	Left
Designated Moves	LR	LTR	LTR	LTR	LTR
Assumed Moves	LR	LTR	LTR	LTR	LTR
RT Channelized					
Lane Util	1.000	1.000	1.000	1.000	1.000
Critical Headway, s	5.193	5.193	5.193	5.193	5.193
Entry Flow, veh/h	530	450	595	666	424
Cap Entry Lane, veh/h	514	576	562	602	413
Entry HV Adj Factor	0.973	0.970	0.936	0.926	0.935
Flow Entry, veh/h	516	436	557	617	396
Cap Entry, veh/h	500	559	526	558	386
V/C Ratio	1.031	0.781	1.058	1.106	1.026
Control Delay, s/veh	77.5	29.5	83.5	96.6	86.1
LOS	F	D	F	F	F
95th %tile Queue, veh	15	7	16	19	13

Intersection	
Int Delay, s/veh	61.9

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	10	15	185	5	40	50	245	390	5	10	255	45
Future Vol, veh/h	10	15	185	5	40	50	245	390	5	10	255	45
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	30	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	82	82	82	70	70	70	75	75	75	71	71	71
Heavy Vehicles, %	8	8	8	5	5	5	3	3	3	4	4	4
Mvmt Flow	12	18	226	7	57	71	327	520	7	14	359	63

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1660	1599	391	1605	1628	523	423	0	0	527	0	0
Stage 1	419	419	-	1177	1177	-	-	-	-	-	-	-
Stage 2	1241	1180	-	428	451	-	-	-	-	-	-	-
Critical Hdwy	7.18	6.58	6.28	7.15	6.55	6.25	4.13	-	-	4.14	-	-
Critical Hdwy Stg 1	6.18	5.58	-	6.15	5.55	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.18	5.58	-	6.15	5.55	-	-	-	-	-	-	-
Follow-up Hdwy	3.572	4.072	3.372	3.545	4.045	3.345	2.227	-	-	2.236	-	-
Pot Cap-1 Maneuver	75	103	645	83	100	548	1131	-	-	1030	-	-
Stage 1	600	580	-	230	261	-	-	-	-	-	-	-
Stage 2	208	257	-	599	566	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	~ 4	60	645	28	58	548	1131	-	-	1030	-	-
Mov Cap-2 Maneuver	~ 4	60	-	28	58	-	-	-	-	-	-	-
Stage 1	355	570	-	136	154	-	-	-	-	-	-	-
Stage 2	67	152	-	370	556	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	237	296.3	3.6	0.3
HCM LOS	F	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1131	-	-	9	645	99	1030	-	-
HCM Lane V/C Ratio	0.289	-	-	3.388	0.35	1.371	0.014	-	-
HCM Control Delay (s)	9.5	0	-	$ 1890	13.6	296.3	8.5	0	-
HCM Lane LOS	A	A	-	F	B	F	A	A	-
HCM 95th %tile Q(veh)	1.2	-	-	5	1.6	9.8	0	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection						
Int Delay, s/veh	2					

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	95	0	15	165	320	300
Future Vol, veh/h	95	0	15	165	320	300
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	94	94	91	91	82	82
Heavy Vehicles, %	2	2	11	11	2	2
Mvmt Flow	101	0	16	181	390	366

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	787	573	756	0	-	0
Stage 1	573	-	-	-	-	-
Stage 2	214	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.21	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.299	-	-	-
Pot Cap-1 Maneuver	360	519	816	-	-	-
Stage 1	564	-	-	-	-	-
Stage 2	822	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	352	519	816	-	-	-
Mov Cap-2 Maneuver	352	-	-	-	-	-
Stage 1	564	-	-	-	-	-
Stage 2	804	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	19.3	0.8	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	816	-	352	-	-
HCM Lane V/C Ratio	0.02	-	0.287	-	-
HCM Control Delay (s)	9.5	0	19.3	-	-
HCM Lane LOS	A	A	C	-	-
HCM 95th %tile Q(veh)	0.1	-	1.2	-	-

Intersection	
Int Delay, s/veh	11.5

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations		↰	↱		✥		↰	↱			✥	
Traffic Vol, veh/h	10	5	130	5	0	5	285	950	120	5	720	35
Future Vol, veh/h	10	5	130	5	0	5	285	950	120	5	720	35
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	150	-	-	-	150	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	83	83	83	58	58	58	97	97	97	95	95	95
Heavy Vehicles, %	2	2	2	0	0	0	1	1	1	2	2	2
Mvmt Flow	12	6	157	9	0	9	294	979	124	5	758	37

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	2420	2478	776	2419	2434	1041	795	0	0	1103	0	0
Stage 1	787	787	-	1629	1629	-	-	-	-	-	-	-
Stage 2	1633	1691	-	790	805	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.1	6.5	6.2	4.11	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.1	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.1	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.5	4	3.3	2.209	-	-	2.218	-	-
Pot Cap-1 Maneuver	22	30	397	23	32	282	831	-	-	633	-	-
Stage 1	385	403	-	130	162	-	-	-	-	-	-	-
Stage 2	128	149	-	386	398	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	15	19	397	~ 8	20	282	831	-	-	633	-	-
Mov Cap-2 Maneuver	15	19	-	~ 8	20	-	-	-	-	-	-	-
Stage 1	249	397	-	84	105	-	-	-	-	-	-	-
Stage 2	80	96	-	227	392	-	-	-	-	-	-	-

Approach	SE	NW	NE	SW
HCM Control Delay, s	79.8	$ 578.2	2.5	0.1
HCM LOS	F	F		

	EB			NB	SB		WB		
Minor Lane/Major Mvmt	NEL	NET	NER	NWLn1	SELn1	SELn2	SWL	SWT	SWR
Capacity (veh/h)	831	-	-	16	16	397	633	-	-
HCM Lane V/C Ratio	0.354	-	-	1.078	1.13	0.395	0.008	-	-
HCM Control Delay (s)	11.7	-	-	$ 578.2	$ 598.6	19.9	10.7	0	-
HCM Lane LOS	B	-	-	F	F	C	B	A	-
HCM 95th %tile Q(veh)	1.6	-	-	2.6	2.7	1.8	0	-	-

Notes

~: Volume exceeds capacity $: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Intersection	
Int Delay, s/veh	44.5

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	420	5	5	290	170	265
Future Vol, veh/h	420	5	5	290	170	265
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	87	87	87	87
Heavy Vehicles, %	1	1	2	2	1	1
Mvmt Flow	467	6	6	333	195	305

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	693	348	500	0	-	0
Stage 1	348	-	-	-	-	-
Stage 2	345	-	-	-	-	-
Critical Hdwy	6.41	6.21	4.12	-	-	-
Critical Hdwy Stg 1	5.41	-	-	-	-	-
Critical Hdwy Stg 2	5.41	-	-	-	-	-
Follow-up Hdwy	3.509	3.309	2.218	-	-	-
Pot Cap-1 Maneuver	~ 411	697	1064	-	-	-
Stage 1	717	-	-	-	-	-
Stage 2	719	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	~ 408	697	1064	-	-	-
Mov Cap-2 Maneuver	~ 408	-	-	-	-	-
Stage 1	717	-	-	-	-	-
Stage 2	714	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	123.5	0.1	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1064	-	410	-	-
HCM Lane V/C Ratio	0.005	-	1.152	-	-
HCM Control Delay (s)	8.4	0	123.5	-	-
HCM Lane LOS	A	A	F	-	-
HCM 95th %tile Q(veh)	0	-	17.8	-	-

Notes

~: Volume exceeds capacity $: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Intersection	
Int Delay, s/veh	0.4

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	10	0	0	700	440	10
Future Vol, veh/h	10	0	0	700	440	10
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	50	50	93	93	86	86
Heavy Vehicles, %	6	6	1	1	1	1
Mvmt Flow	20	0	0	753	512	12

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1270	517	523	0	-	0
Stage 1	517	-	-	-	-	-
Stage 2	753	-	-	-	-	-
Critical Hdwy	6.46	6.26	4.11	-	-	-
Critical Hdwy Stg 1	5.46	-	-	-	-	-
Critical Hdwy Stg 2	5.46	-	-	-	-	-
Follow-up Hdwy	3.554	3.354	2.209	-	-	-
Pot Cap-1 Maneuver	182	550	1049	-	-	-
Stage 1	590	-	-	-	-	-
Stage 2	458	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	182	550	1049	-	-	-
Mov Cap-2 Maneuver	182	-	-	-	-	-
Stage 1	590	-	-	-	-	-
Stage 2	458	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	27.2	0	0
HCM LOS	D		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1049	-	182	-	-
HCM Lane V/C Ratio	-	-	0.11	-	-
HCM Control Delay (s)	0	-	27.2	-	-
HCM Lane LOS	A	-	D	-	-
HCM 95th %tile Q(veh)	0	-	0.4	-	-

Intersection	
Int Delay, s/veh	4

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations		✥			✥			✥			✥	
Traffic Vol, veh/h	45	665	5	30	375	20	20	10	70	5	10	50
Future Vol, veh/h	45	665	5	30	375	20	20	10	70	5	10	50
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	Yield	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	94	94	94	88	88	88	67	67	67	82	82	82
Heavy Vehicles, %	1	1	1	2	2	2	0	0	0	0	0	0
Mvmt Flow	48	707	5	34	426	23	30	15	104	6	12	61

Major/Minor	Major1			Major2			Minor2			Minor1		
Conflicting Flow All	449	0	0	713	0	0	1348	1315	438	1319	1323	710
Stage 1	-	-	-	-	-	-	506	506	-	806	806	-
Stage 2	-	-	-	-	-	-	842	809	-	513	517	-
Critical Hdwy	4.11	-	-	4.12	-	-	7.1	6.5	6.2	7.1	6.5	6.2
Critical Hdwy Stg 1	-	-	-	-	-	-	6.1	5.5	-	6.1	5.5	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.1	5.5	-	6.1	5.5	-
Follow-up Hdwy	2.209	-	-	2.218	-	-	3.5	4	3.3	3.5	4	3.3
Pot Cap-1 Maneuver	1117	-	-	887	-	-	129	159	623	135	158	437
Stage 1	-	-	-	-	-	-	552	543	-	379	398	-
Stage 2	-	-	-	-	-	-	362	396	-	548	537	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1117	-	-	887	-	-	94	140	623	94	139	437
Mov Cap-2 Maneuver	-	-	-	-	-	-	94	140	-	94	139	-
Stage 1	-	-	-	-	-	-	513	515	-	352	370	-
Stage 2	-	-	-	-	-	-	280	368	-	420	510	-

Approach	EB	WB	SE	NW
HCM Control Delay, s	0.5	0.7	22.5	23.7
HCM LOS			C	C

Minor Lane/Major Mvmt	NWLn1	EBL	EBT	EBR	WBL	WBT	WBR	SELn1
Capacity (veh/h)	271	1117	-	-	887	-	-	352
HCM Lane V/C Ratio	0.293	0.043	-	-	0.038	-	-	0.424
HCM Control Delay (s)	23.7	8.4	0	-	9.2	0	-	22.5
HCM Lane LOS	C	A	A	-	A	A	-	C
HCM 95th %tile Q(veh)	1.2	0.1	-	-	0.1	-	-	2

Intersection	
Int Delay, s/veh	28.8

Movement	NWL	NWR	NET	NER	SWL	SWT
Lane Configurations	↰	↱	↑	↱		↰↑
Traffic Vol, veh/h	180	120	580	410	115	570
Future Vol, veh/h	180	120	580	410	115	570
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	Yield	-	None
Storage Length	-	150	-	0	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	86	86	96	96	85	85
Heavy Vehicles, %	1	1	1	1	1	1
Mvmt Flow	209	140	604	427	135	671

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1210	604	0	0	604	0
Stage 1	604	-	-	-	-	-
Stage 2	606	-	-	-	-	-
Critical Hdwy	6.615	6.215	-	-	4.115	-
Critical Hdwy Stg 1	5.415	-	-	-	-	-
Critical Hdwy Stg 2	5.815	-	-	-	-	-
Follow-up Hdwy	3.5095	3.3095	-	-	2.2095	-
Pot Cap-1 Maneuver	~ 189	500	-	-	978	-
Stage 1	547	-	-	-	-	-
Stage 2	510	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	~ 147	500	-	-	978	-
Mov Cap-2 Maneuver	~ 147	-	-	-	-	-
Stage 1	547	-	-	-	-	-
Stage 2	398	-	-	-	-	-

Approach	NW	NE	SW
HCM Control Delay, s	175.4	0	2.1
HCM LOS	F		

Minor Lane/Major Mvmt	NET	NER	NWLn1	NWLn2	SWL	SWT
Capacity (veh/h)	-	-	147	500	978	-
HCM Lane V/C Ratio	-	-	1.424	0.279	0.138	-
HCM Control Delay (s)	-	-	282.3	15	9.3	0.7
HCM Lane LOS	-	-	F	C	A	A
HCM 95th %tile Q(veh)	-	-	13.6	1.1	0.5	-

Notes

~: Volume exceeds capacity $: Delay exceeds 300s   +: Computation Not Defined   *: All major volume in platoon

Intersection	
Int Delay, s/veh	37.1

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↰	↑	↱		Y	
Traffic Vol, veh/h	40	1125	700	160	70	30
Future Vol, veh/h	40	1125	700	160	70	30
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	91	91	90	90	75	75
Heavy Vehicles, %	2	2	2	2	3	3
Mvmt Flow	44	1236	778	178	93	40

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	956	0	-	0	2191	867
Stage 1	-	-	-	-	867	-
Stage 2	-	-	-	-	1324	-
Critical Hdwy	4.12	-	-	-	6.43	6.23
Critical Hdwy Stg 1	-	-	-	-	5.43	-
Critical Hdwy Stg 2	-	-	-	-	5.43	-
Follow-up Hdwy	2.218	-	-	-	3.527	3.327
Pot Cap-1 Maneuver	719	-	-	-	~ 50	351
Stage 1	-	-	-	-	410	-
Stage 2	-	-	-	-	247	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	719	-	-	-	~ 47	351
Mov Cap-2 Maneuver	-	-	-	-	~ 47	-
Stage 1	-	-	-	-	410	-
Stage 2	-	-	-	-	232	-

Approach	EB	WB	SB
HCM Control Delay, s	0.4	0	$ 656.1
HCM LOS			F

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	719	-	-	-	63
HCM Lane V/C Ratio	0.061	-	-	-	2.116
HCM Control Delay (s)	10.3	-	-	-	$ 656.1
HCM Lane LOS	B	-	-	-	F
HCM 95th %tile Q(veh)	0.2	-	-	-	12.7

Notes

~: Volume exceeds capacity $: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Intersection					
Intersection Delay, s/veh	153.6				
Intersection LOS	F	EDR	Byp 28	Byp 28	102 EB	102 WB

Approach	WB	NB	SB	NE	SW
Entry Lanes	1	1	1	1	1
Conflicting Circle Lanes	1	1	1	1	1
Adj Approach Flow, veh/h	544	489	804	688	264
Demand Flow Rate, veh/h	549	499	811	695	268
Vehicles Circulating, veh/h	828	1055	555	862	964
Vehicles Exiting, veh/h	726	502	677	504	413
Follow-Up Headway, s	3.186	3.186	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	0	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000	1.000
Approach Delay, s/veh	103.3	169.4	146.4	240.0	24.6
Approach LOS	F	F	F	F	C

Lane	Left	Left	Left	Left	Left
Designated Moves	LR	LTR	LTR	LTR	LTR
Assumed Moves	LR	LTR	LTR	LTR	LTR
RT Channelized					
Lane Util	1.000	1.000	1.000	1.000	1.000
Critical Headway, s	5.193	5.193	5.193	5.193	5.193
Entry Flow, veh/h	549	499	811	695	268
Cap Entry Lane, veh/h	494	393	649	477	431
Entry HV Adj Factor	0.991	0.980	0.991	0.990	0.983
Flow Entry, veh/h	544	489	803	688	263
Cap Entry, veh/h	489	385	643	473	424
V/C Ratio	1.112	1.268	1.250	1.456	0.622
Control Delay, s/veh	103.3	169.4	146.4	240.0	24.6
LOS	F	F	F	F	C
95th %tile Queue, veh	18	21	30	34	4

Intersection	
Int Delay, s/veh	12.7

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	10	40	435	5	30	20	200	435	10	25	290	15
Future Vol, veh/h	10	40	435	5	30	20	200	435	10	25	290	15
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	0	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	88	88	88	82	82	82	93	93	93	91	91	91
Heavy Vehicles, %	2	2	2	0	0	0	1	1	1	1	1	1
Mvmt Flow	11	45	494	6	37	24	215	468	11	27	319	16

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1316	1291	327	1308	1293	473	335	0	0	478	0	0
Stage 1	382	382	-	903	903	-	-	-	-	-	-	-
Stage 2	934	909	-	405	390	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.1	6.5	6.2	4.11	-	-	4.11	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.1	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.1	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.5	4	3.3	2.209	-	-	2.209	-	-
Pot Cap-1 Maneuver	135	163	714	138	164	595	1230	-	-	1090	-	-
Stage 1	640	613	-	335	359	-	-	-	-	-	-	-
Stage 2	319	354	-	626	611	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	80	120	714	24	121	595	1230	-	-	1090	-	-
Mov Cap-2 Maneuver	80	120	-	24	121	-	-	-	-	-	-	-
Stage 1	488	594	-	255	274	-	-	-	-	-	-	-
Stage 2	202	270	-	172	592	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	25.6	76.5	2.6	0.6
HCM LOS	D	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1230	-	-	109	714	112	1090	-	-
HCM Lane V/C Ratio	0.175	-	-	0.521	0.692	0.599	0.025	-	-
HCM Control Delay (s)	8.5	0	-	69.4	20.6	76.5	8.4	0	-
HCM Lane LOS	A	A	-	F	C	F	A	A	-
HCM 95th %tile Q(veh)	0.6	-	-	2.4	5.6	2.9	0.1	-	-

Intersection	
Int Delay, s/veh	15.4

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	270	5	15	360	235	190
Future Vol, veh/h	270	5	15	360	235	190
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	87	87	89	89
Heavy Vehicles, %	1	1	2	2	3	3
Mvmt Flow	300	6	17	414	264	213

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	819	371	478	0	-	0
Stage 1	371	-	-	-	-	-
Stage 2	448	-	-	-	-	-
Critical Hdwy	6.41	6.21	4.12	-	-	-
Critical Hdwy Stg 1	5.41	-	-	-	-	-
Critical Hdwy Stg 2	5.41	-	-	-	-	-
Follow-up Hdwy	3.509	3.309	2.218	-	-	-
Pot Cap-1 Maneuver	346	677	1084	-	-	-
Stage 1	700	-	-	-	-	-
Stage 2	646	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	339	677	1084	-	-	-
Mov Cap-2 Maneuver	339	-	-	-	-	-
Stage 1	700	-	-	-	-	-
Stage 2	633	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	60.9	0.3	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1084	-	342	-	-
HCM Lane V/C Ratio	0.016	-	0.893	-	-
HCM Control Delay (s)	8.4	0	60.9	-	-
HCM Lane LOS	A	A	F	-	-
HCM 95th %tile Q(veh)	0	-	8.7	-	-

APPENDIX J: 2040 AWDT PEAK HOUR VOLUMES

11-Apr-17

rev 5-17-17

rev 9-14-17

TABLE I-1

Adjusted 2040 AAWDT and Peak Hour No-Build volumes based on 2015 counts

Annual Growth rates:		Seasonal: Use Urban Highway Group 4 adjustment factors Intersection Turning Movement Counts		AM Peak	PM Peak
2014->2015	1.025	April	Adj Factor=	0.96	0.99
2015->2015	1.000	May		0.96	0.98
2016->2015	0.975	June		0.96	0.94
		July		1.04	0.96
		Sept		0.95	0.97

	Count Location	Count Month/Yr	Raw AAWDT	Adj 2015 AAWDT	Counted AM Peak Volume	Adj 2015 AM Peak Volume	AM Pk as % of AAWDT	Counted PM Peak Volume	Adj 2015 PM Peak Volume	PM Pk as % of AAWDT	2015 AWDT Base Model Assigns	2040 AAWDT No-Build Assigns	% Growth 2015-40	(Apply % to 2015 adj AAWDT) 2040 NB AAWDT	2040 NoBd AM Pk	2040 NoBd PM Pk
Derry	Crystal Av (NH 28), S of Tsienneto	May-16	15,585	15,195	836	803	5.28%	1418	1390	9.15%	13,406	10,220	-23.77%	11,584	612	1060
	Folsom Rd W of NH 28	May-16	12,070	11,768	778	747	6.35%	1199	1175	9.98%	8,960	10,537	17.60%	13,839	878	1382
	Pinkerton St E of Tsienneto	May-16	10,722	10,454	695	667	6.38%	1017	997	9.54%	8,776	6,396	-27.12%	7,619	486	727
	Tsiennto Rd, W of NH 102	May-16	5,532	5,394	483	464	8.60%	511	501	9.29%	5,666	9,072	60.11%	8,636	743	802
	Tsienneto Rd E of Pinkerton	May-16	15,012	14,637	1113	1068	7.30%	1499	1469	10.04%	14,200	18,876	32.93%	19,457	1420	1953
	NH 102, E of NH 28 Bypass	May-16	7,456	7,270	595	571	7.85%	661	648	8.91%	7,016	6,126	-12.69%	6,348	499	566
	NH 28 Byp, N of Academy Dr	May-16	8,615	8,400	756	726	8.64%	881	863	10.27%	7,318	2,853	-61.01%	3,275	283	336
	NH 28 Byp, N of Tsienneto Rd	May-16	12,250	11,944	997	957	8.01%	1201	1177	9.85%	9,377	4,072	-56.57%	5,187	416	511
	NH 28 Byp, S of Thornton Rd (south)	May-16	14,341	13,982	1110	1066	7.62%	1392	1364	9.76%	12,227	7,327	-40.08%	8,379	639	817
	NH 102 E of Griffin St	Apr-14	16,410	16,820	1080	1037	6.17%	1224	1212	7.21%	18,002	20,810	15.60%	19,444	1199	1401
	NH 102 W of Abbot St	Apr-14	14,220	14,576	1020	979	6.72%	1148	1137	7.80%	11,128	14,902	33.91%	19,519	1311	1523
	Fordway over Beaver Brook	Apr-14	5,500	5,638	411	395	7.01%	481	476	8.44%	5,114	3,511	-31.35%	3,871	271	327
	Franklin St Ext, N. of Folsom Rd	Apr-14	1,795	1,840	109	105	5.71%	171	169	9.18%	1,254	1,959	56.22%	2,874	164	264
	Ash St at Londonderry town line	Apr-14	6,956	7,130	477	458	6.42%	722	715	10.03%	5,936	13,790	132.31%	16,564	1064	1661
	Crystal Av (NH 28), S of Rollins	Jun-15	13,134	13,134	1026	985	7.50%	1174	1104	8.41%	13,215	10,463	-20.82%	10,399	780	874
	NH 102, at Derry/Chester town line	Jul-15	8,200	8,200	644	670	8.17%	841	807	9.84%	10,839	12,783	17.94%	9,671	790	952
	average						7.11%			9.23%						
L-derry	NH 102, E of Hampton Dr	Jul-15	31,102	31,102	2478	2577	8.29%	2842	2728	8.77%	30,418	51,401	68.98%	52,557	4355	4610
	NH 102, E of Exit 4			26,800	2140		7.99%	2145		8.00%	20,818	32,410	55.68%	41,723	3332	3339
	NH 102 at Derry Town line	May-16	22,656	22,090	1718	1649	7.46%	1796	1760	7.97%	22,983	29,904	30.11%	28,742	2146	2290
	NH 28 at Derry Town line	May-16	17,324	16,891	1279	1228	7.27%	1682	1648	9.76%	19,392	15,638	-19.36%	13,621	990	1329
	NH 28 N of Liberty Dr	Sep-15	14,994	14,994	1407	1337	8.92%	1247	1210	8.07%	15,406	14,733	-4.37%	14,339	1279	1157
	Gilcreast Rd N of NH 102	May-16	10,070	9,818	697	669	6.81%	1008	988	10.06%	9,397	16,438	74.93%	17,174	1170	1728
	Londonderry Rd, N of NH 102			4,622	215	215	4.65%	465	465	10.06%	4,742	4,823	1.71%	4,701	219	473
	Ash St E of Londonderry Rd	Jun-15	6,591	6,591	477	458	6.95%	723	680	10.32%	5,949	14,001	135.35%	15,512	1078	1600
	average						7.29%			9.13%						
	Exit 4 NB Off-ramp	May-16	10,249	9,993	435	418	4.18%	1223	1199	12.00%	10,389	20,215	94.58%	19,444	813	2333
	Exit 4 NB On-ramp	May-16	10,303	10,045	1079	1036	10.31%	812	796	7.92%	9,550	21,343	123.49%	22,449	2315	1779
	Exit 4 SB Off-ramp	May-16	9,862	9,615	753	723	7.52%	952	933	9.70%	8,157	18,349	124.95%	21,629	1626	2099
	Exit 4 SB On-ramp - EB to SB	May-16	5,310	5,177	673	646	12.48%	311	305	5.89%	4,907	10,778	119.65%	11,371	1419	670
	Exit 4 SB On-ramp - WB to SB	May-16	4,767	4,648	537	516	11.10%	244	239	5.14%	3,637	7,402	103.52%	9,460	1050	486
	average						9.12%			8.13%						
	Exit 5 NB Off-ramp	May-16	5,745	5,601	400	384	6.86%	. 472	463	8.27%	4,430	6,401	44.49%	8,093	555	669
	Exit 5 NB On-ramp	May-16	9,580	9,341	992	952	10.19%	793	777	8.32%	9,101	13,499	48.32%	13,855	1412	1152
	Exit 5 SB Off-ramp	May-16	9,520	9,282	781	750	8.08%	939	920	9.91%	9,234	13,577	47.03%	13,648	1103	1353
	Exit 5 SB On-ramp	May-16	5,645	5,504	519	498	9.05%	427	418	7.59%	3,919	5,884	50.14%	8,264	748	628
	average						8.54%			8.52%						
	I-93, south of Exit 4 (DOT PATR)			71,060		5420	7.63%		5870	8.26%	72,378	118,908	64.29%	116,743	8,904	9,644
	NB			35,740		1980	36.5%		3410	58.1%	36,417	59,234	62.65%	58,133	3,253	5,602
	SB			35,320		3440	63.5%		2460	41.9%	35,961	59,674	65.94%	58,610	5,651	4,042
	I-93, between Exits 4 and 5			71,000		5640	7.94%		5885	8.29%	71,152	120,205	68.94%	119,948	9,528	9,942
	NB					2630	46.6%		3015	51.2%	35,578	60,363	69.66%	-	4,443	5,093
	SB					3010	53.4%		2870	48.8%	35,574	59,842	68.22%	-	5,085	4,849
	I-93, north of Exit 5			76,000		6425	8.45%		6690	8.80%	81,139	134,995	66.37%	126,445	10,690	11,130
	NB					3200	49.8%		3325	49.7%	40,250	67,460	67.60%	-	5,324	5,532
	SB					3225	50.2%		3365	50.3%	40,889	67,535	65.17%	-	5,366	5,598
				Adj 2015 AAWDT	Counted AM Peak Volume	Adj 2015 AM Peak Volume	AM Pk as % of AAWDT	Counted PM Peak Volume	Adj 2015 PM Peak Volume	PM Pk as % of AAWDT	2015 AWDT Base Model Assigns	2040 AWDT No-Build Assigns	% Growth 2015-40	AAWDT) 2040 NB AAWDT	2040 NoBd AM Pk	2040 NoBd PM Pk

Note - Exit 5 SB off ramp AM peak volume does not include one count that appears anomalous when compared to other counts in same hour

Red counts are from NHDOT Town summary data - 2014 or 2015

11-Apr-17
rev 5-17-17
rev 9-14-17

TABLE J-1

Adjusted 2040 AAWDT and Peak Hour No-Build volumes based on 2015 counts

Annual Growth rates:		Seasonal: Use Urban Highway Group 4 adjustment factors	
		Intersection Turning Movement Counts	
		Adj Factor= AM Peak	PM Peak
2014->2015	1.025	April 0.96	0.99
2015->2015	1.000	May 0.96	0.98
2016->2015	0.975	June 0.96	0.94
		July 1.04	0.96
		Sept 0.95	0.97

	Count Location	Count Month/Yr	Raw AAWDT	Adj 2015 AAWDT	Counted AM Peak Volume	Adj 2015 AM Peak Volume	AM Pk as % of AAWDT	Counted PM Peak Volume	Adj 2015 PM Peak Volume	PM Pk as % of AAWDT	2015 AWDT Base Model Assigns	2040 AAWDT No-Build Assigns	% Growth 2015-40	(Apply % to 2015 adj AAWDT) 2040 NB AAWDT	2040 NoBd AM Pk	2040 NoBd PM Pk
Derry	Crystal Av (NH 28), S of Tsienneto	May-16	15,585	15,195	836	803	5.28%	1418	1390	9.15%	13,406	10,220	-23.77%	11,584	612	1060
	Folsom Rd W of NH 28	May-16	12,070	11,768	778	747	6.35%	1199	1175	9.98%	8,960	10,537	17.60%	13,839	878	1382
	Pinkerton St E of Tsienneto	May-16	10,722	10,454	695	667	6.38%	1017	997	9.54%	8,776	6,396	-27.12%	7,619	486	727
	Tsiennto Rd, W of NH 102	May-16	5,532	5,394	483	464	8.60%	511	501	9.29%	5,666	9,072	60.11%	8,636	743	802
	Tsienneto Rd E of Pinkerton	May-16	15,012	14,637	1113	1068	7.30%	1499	1469	10.04%	14,200	18,876	32.93%	19,457	1420	1953
	NH 102, E of NH 28 Bypass	May-16	7,456	7,270	595	571	7.85%	661	648	8.91%	7,016	6,126	-12.69%	6,348	499	566
	NH 28 Byp, N of Academy Dr	May-16	8,615	8,400	756	726	8.64%	881	863	10.27%	7,318	2,853	-61.01%	3,275	283	336
	NH 28 Byp, N of Tsienneto Rd	May-16	12,250	11,944	997	957	8.01%	1201	1177	9.85%	9,377	4,072	-56.57%	5,187	416	511
	NH 28 Byp, S of Thornton Rd (south)	May-16	14,341	13,982	1110	1066	7.62%	1392	1364	9.76%	12,227	7,327	-40.08%	8,379	639	817
	NH 102 E of Griffin St	Apr-14	16,410	16,820	1080	1037	6.17%	1224	1212	7.21%	18,002	20,810	15.60%	19,444	1199	1401
	NH 102 W of Abbot St	Apr-14	14,220	14,576	1020	979	6.72%	1148	1137	7.80%	11,128	14,902	33.91%	19,519	1311	1523
	Fordway over Beaver Brook	Apr-14	5,500	5,638	411	395	7.01%	481	476	8.44%	5,114	3,511	-31.35%	3,871	271	327
	Franklin St Ext, N. of Folsom Rd	Apr-14	1,795	1,840	109	105	5.71%	171	169	9.18%	1,254	1,959	56.22%	2,874	164	264
	Ash St at Londonderry town line	Apr-14	6,956	7,130	477	458	6.42%	722	715	10.03%	5,936	13,790	132.31%	16,564	1064	1661
	Crystal Av (NH 28), S of Rollins	Jun-15	13,134	13,134	1026	985	7.50%	1174	1104	8.41%	13,215	10,463	-20.82%	10,399	780	874
	NH 102, at Derry/Chester town line	Jul-15	8,200	8,200	644	670	8.17%	841	807	9.84%	10,839	12,783	17.94%	9,671	790	952
	average						7.11%			9.23%						
L-derry	NH 102, E of Hampton Dr	Jul-15	31,102	31,102	2478	2577	8.29%	2842	2728	8.77%	30,418	51,401	68.98%	52,557	4355	4610
	NH 102, E of Exit 4			26,800	2140		7.99%	2145		8.00%	20,818	32,410	55.68%	41,723	3332	3339
	NH 102 at Derry Town line	May-16	22,656	22,090	1718	1649	7.46%	1796	1760	7.97%	22,983	29,904	30.11%	28,742	2146	2290
	NH 28 at Derry Town line	May-16	17,324	16,891	1279	1228	7.27%	1682	1648	9.76%	19,392	15,638	-19.36%	13,621	990	1329
	NH 28 N of Liberty Dr	Sep-15	14,994	14,994	1407	1337	8.92%	1247	1210	8.07%	15,406	14,733	-4.37%	14,339	1279	1157
	Gilcreast Rd N of NH 102	May-16	10,070	9,818	697	669	6.81%	1008	988	10.06%	9,397	16,438	74.93%	17,174	1170	1728
	Londonderry Rd, N of NH 102			4,622	215	215	4.65%	465	465	10.06%	4,742	4,823	1.71%	4,701	219	473
	Ash St E of Londonderry Rd	Jun-15	6,591	6,591	477	458	6.95%	723	680	10.32%	5,949	14,001	135.35%	15,512	1078	1600
	average						7.29%			9.13%						
	Exit 4 NB Off-ramp	May-16	10,249	9,993	435	418	4.18%	1223	1199	12.00%	10,389	20,215	94.58%	19,444	813	2333
	Exit 4 NB On-ramp	May-16	10,303	10,045	1079	1036	10.31%	812	796	7.92%	9,550	21,343	123.49%	22,449	2315	1779
	Exit 4 SB Off-ramp	May-16	9,862	9,615	753	723	7.52%	952	933	9.70%	8,157	18,349	124.95%	21,629	1626	2099
	Exit 4 SB On-ramp - EB to SB	May-16	5,310	5,177	673	646	12.48%	311	305	5.89%	4,907	10,778	119.65%	11,371	1419	670
	Exit 4 SB On-ramp - WB to SB	May-16	4,767	4,648	537	516	11.10%	244	239	5.14%	3,637	7,402	103.52%	9,460	1050	486
	average						9.12%			8.13%						
	Exit 5 NB Off-ramp	May-16	5,745	5,601	400	384	6.86%	472	463	8.27%	4,430	6,401	44.49%	8,093	555	669
	Exit 5 NB On-ramp	May-16	9,580	9,341	992	952	10.19%	793	777	8.32%	9,101	13,499	48.32%	13,855	1412	1152
	Exit 5 SB Off-ramp	May-16	9,520	9,282	781	750	8.08%	939	920	9.91%	9,234	13,577	47.03%	13,648	1103	1353
	Exit 5 SB On-ramp	May-16	5,645	5,504	519	498	9.05%	427	418	7.59%	3,919	5,884	50.14%	8,264	748	628
	average						8.54%			8.52%						
	I-93, south of Exit 4 (DOT PATR)			71,060		5420	7.63%		5870	8.26%	72,378	118,908	64.29%	116,743	8,904	9,644
	NB			35,740		1980	36.5%		3410	58.1%	36,417	59,234	62.65%	58,133	3,253	5,602
	SB			35,320		3440	63.5%		2460	41.9%	35,961	59,674	65.94%	58,610	5,651	4,042
	I-93, between Exits 4 and 5			71,000		5640	7.94%		5885	8.29%	71,152	120,205	68.94%	119,948	9,528	9,942
	NB					2630	46.6%		3015	51.2%	35,578	60,363	69.66%	-	4,443	5,093
	SB					3010	53.4%		2870	48.8%	35,574	59,842	68.22%	-	5,085	4,849
	I-93, north of Exit 5			76,000		6425	8.45%		6690	8.80%	81,139	134,995	66.37%	126,445	10,690	11,130
	NB					3200	49.8%		3325	49.7%	40,250	67,460	67.60%	-	5,324	5,532
	SB					3225	50.2%		3365	50.3%	40,889	67,535	65.17%	-	5,366	5,598
				Adj 2015 AAWDT	Counted AM Peak Volume	Adj 2015 AM Peak Volume	AM Pk as % of AAWDT	Counted PM Peak Volume	Adj 2015 PM Peak Volume	PM Pk as % of AAWDT	2015 AWDT Base Model Assigns	2040 AAWDT No-Build Assigns	% Growth 2015-40	AAWDT) 2040 NB AAWDT	2040 NoBd AM Pk	2040 NoBd PM Pk

Note - Exit 5 SB off ramp AM peak volume does not include one count that appears anomalous when compared to other counts in same hour

Red counts are from NHDOT Town summary data - 2014 or 2015

11-Apr-17

rev 5-17-17

rev 9-14-17

TABLE J-2

Adjusted 2040 AAWDT and Peak Hour Alternative A volumes based on 2015 counts

Annual Growth rates:	
2014->2015	1.025
2015->2015	1.000
2016->2015	0.975

Seasonal: Use Urban Highway Group 4 adjustment factors

Intersection Turning Movement Counts		AM Peak	PM Peak
April	Adj Factor=	0.96	0.99
May		0.96	0.98
June		0.96	0.94
July		1.04	0.96
Sept		0.95	0.97

	Count Location	Count Month/Yr	Raw AAWDT	Adj 2015 AAWDT	Counted AM Peak Volume	Adj 2015 AM Peak Volume	AM Pk as % of AAWDT	Counted PM Peak Volume	Adj 2015 PM Peak Volume	PM Pk as % of AAWDT	2015 AWDT Base Model Assigns	2040 AWDT Alt A Assigns	% Growth 2015-40	(Apply % to Adj 2015 AAWDT) 2040 Alt A AAWDT	2040 NB AAWDT	%Difference 2040 Alt A to 2040 NB	2040 Alt A AM Pk	2040 Alt A PM Pk
Derry	Crystal Av (NH 28), S of Tsienneto	May-16	15,585	15,195	836	803	5.28%	1418	1390	9.15%	13,406	7,242	-45.98%	8,208	11,584	-41.13%	434	751
	Folsom Rd W of NH 28	May-16	12,070	11,768	778	747	6.35%	1199	1175	9.98%	8,960	29,612	230.49%	38,892	13,839	64.42%	2,469	3,883
	Pinkerton St E of Tsienneto	May-16	10,722	10,454	695	667	6.38%	1017	997	9.54%	8,776	9,059	3.22%	10,791	7,619	29.39%	689	1,029
	Tsiennto Rd, W of NH 102	May-16	5,532	5,394	483	464	8.60%	511	501	9.29%	5,666	10,824	91.03%	10,304	8,636	16.19%	886	957
	Tsienneto Rd E of Pinkerton	May-16	15,012	14,637	1113	1068	7.30%	1499	1469	10.04%	14,200	22,226	56.52%	22,910	19,457	15.07%	1,672	2,299
	NH 102, E of NH 28 Bypass	May-16	7,456	7,270	595	571	7.85%	661	648	8.91%	7,016	6,924	-1.31%	7,175	6,348	11.53%	564	640
	NH 28 Byp, N of Academy Dr	May-16	8,615	8,400	756	726	8.64%	881	863	10.27%	7,318	2,333	-68.12%	2,678	3,275	-22.29%	231	275
	NH 28 Byp, N of Tsienneto Rd	May-16	12,250	11,944	997	957	8.01%	1201	1177	9.85%	9,377	4,229	-54.90%	5,387	5,187	3.71%	432	531
	NH 28 Byp, S of Thornton Rd (south)	May-16	14,341	13,982	1110	1066	7.62%	1392	1364	9.76%	12,227	7,652	-37.42%	8,750	8,379	4.24%	667	854
	NH 102 E of Griffin St	Apr-14	16,410	16,820	1080	1037	6.17%	1224	1212	7.21%	18,002	16,885	-6.20%	15,776	19,444	-23.25%	973	1,137
	NH 102 W of Abbot St	Apr-14	14,220	14,576	1020	979	6.72%	1148	1137	7.80%	11,128	15,442	38.77%	20,227	19,519	3.50%	1,359	1,578
	Fordway over Beaver Brook	Apr-14	5,500	5,638	411	395	7.01%	481	476	8.44%	5,114	4,748	-7.16%	5,234	3,871	26.04%	367	442
	Franklin St Ext, N. of Folsom Rd	Apr-14	1,795	1,840	109	105	5.71%	171	169	9.18%	1,254	1,367	9.01%	2,006	2,874	-43.27%	114	184
	Ash St at Londonderry town line	Apr-14	6,956	7,130	477	458	6.42%	722	715	10.03%	5,936	6,065	2.17%	7,285	16,564	-127.37%	468	731
	Crystal Av (NH 28), S of Rollins	Jun-15	13,134	13,134	1026	985	7.50%	1174	1104	8.41%	13,215	11,087	-16.10%	11,019	10,399	5.63%	826	926
	NH 102, at Derry/Chester town line	Jul-15	8,200	8,200	644	670	8.17%	841	807	9.84%	10,839	14,181	30.83%	10,728	9,671	9.85%	877	1,056
	average						7.04%			9.19%								
L-derry	NH 102, E of Hampton Dr	Jul-15	31,102	31,102	2478	2577	8.29%	2842	2728	8.77%	30,418	56,306	85.11%	57,572	52,557	8.71%	4,770	5,050
	NH 102, E of Exit 4			26,800	2140		7.99%	2145		8.00%	20,818	15,723	-24.47%	20,241	41,723	-106.13%	1,616	1,620
	NH 102 at Derry Town line	May-16	22,656	22,090	1718	1649	7.46%	1796	1760	7.97%	22,983	20,413	-11.18%	19,620	28,742	-46.49%	1,465	1,563
	NH 28 at Derry Town line	May-16	17,324	16,891	1279	1228	7.27%	1682	1648	9.76%	19,392	9,440	-51.32%	8,223	13,621	-65.65%	598	802
	NH 28 N of Liberty Dr	Sep-15	14,994	14,994	1407	1337	8.92%	1247	1210	8.07%	15,406	9,984	-35.19%	9,717	14,339	-47.57%	866	784
	Gilcreast Rd N of NH 102	May-16	10,070	9,818	697	669	6.81%	1008	988	10.06%	9,397	15,318	63.01%	16,004	17,174	-7.31%	1,091	1,611
	Londonderry Rd, N of NH 102			4,622	215	215	4.65%	465	465	10.06%	4,742	6,536	37.83%	6,371	4,701	26.21%	296	641
	Ash St E of Londonderry Rd	Jun-15	6,591	6,591	477	458	6.95%	723	680	10.32%	5,949	6,065	1.95%	6,720	15,512	-130.83%	467	693
	average						7.29%			9.13%								
	Connector Rd, E. of Exit 4A						7.46%			7.97%		53,720					4,010	4,280
	Connector Rd, W. of N High St						7.46%			7.97%		40,974					3,059	3,265
	Exit 4 NB Off-ramp	May-16	10,249	9,993	435	418	4.18%	1223	1199	12.00%	10,389	18,073	73.96%	17,384	19,444	-11.85%	727	2,086
	Exit 4 NB On-ramp	May-16	10,303	10,045	1079	1036	10.31%	812	796	7.92%	9,550	15,150	58.64%	15,935	22,449	-40.88%	1,643	1,263
	Exit 4 SB Off-ramp	May-16	9,862	9,615	753	723	7.52%	952	933	9.70%	8,157	13,795	69.12%	16,261	21,629	-33.01%	1,223	1,578
	Exit 4 SB On-ramp - EB to SB	May-16	5,310	5,177	673	646	12.48%	311	305	5.89%	4,907	11,836	141.21%	12,487	11,371	8.94%	1,558	736
	Exit 4 SB On-ramp - WB to SB	May-16	4,767	4,648	537	516	11.10%	244	239	5.14%	3,637	3,879	6.65%	4,957	9,460	-90.84%	550	255
	average						9.12%			8.13%								
	Exit 4A NB Off-ramp											8,732		8,732			796	710
	Exit 4A NB On-ramp											15,240		15,240			1,390	1,239
	Exit 4A SB Off-ramp											18,996		18,996			1,732	1,545
	Exit 4A SB On-ramp											10,752		10,752			980	874
	Exit 5 NB Off-ramp	May-16	5,745	5,601	400	384	6.86%	472	463	8.27%	4,430	7,521	69.77%	9,509	8,093	14.89%	652	786
	Exit 5 NB On-ramp	May-16	9,580	9,341	992	952	10.19%	793	777	8.32%	9,101	10,863	19.36%	11,149	13,855	-24.27%	1,136	927
	Exit 5 SB Off-ramp	May-16	9,520	9,282	781	750	8.08%	939	920	9.91%	9,234	7,670	-16.94%	7,710	13,648	-77.02%	623	764
	Exit 5 SB On-ramp	May-16	5,645	5,504	519	498	9.05%	427	418	7.59%	3,919	6,879	75.53%	9,661	8,264	14.46%	874	734
	average						8.54%			8.52%								
	I-93, south of Exit 4 (DOT PATR)			71,060		5420	7.63%		5870	8.26%	72,378	123,109	70.09%	120,867	116,743	3.41%	9,219	9,984
	NB			35,740		1980	36.5%		3410	58.1%	36,417	61,455	68.75%	60,313	58,133	3.61%	3,368	5,800
	SB			35,320		3440	63.5%		2460	41.9%	35,961	61,654	71.45%	60,555	58,610	3.21%	5,851	4,184
	I-93, between Exits 4 and 4A			71,000		5640	7.94%		5885	8.29%	71,152	118,266	66.22%	118,013			9,375	9,782
	NB					2630	46.6%		3015	51.2%	35,578	58,532	64.52%	-			4,372	5,012
	SB					3010	53.4%		2870	48.8%	35,574	59,734	67.91%	-			5,003	4,770
	I-93, between Exits 4A and 5			71,000			7.94%			8.29%	71,152	133,018	86.95%	132,734	119,948	9.63%	10,544	11,002
	NB						46.63%			51.23%	35,578	65,040	82.81%		-		4,917	5,637
	SB						53.37%			48.77%	35,574	67,978	91.09%				5,627	5,365
	I-93, north of Exit 5			76,000		6425	8.45%		6690	8.80%	81,139	137,153	69.03%	128,466	126,445	1.57%	10,860	11,308
	NB					3200	49.8%		3325	49.7%	40,250	68,383	69.90%	-	-		5,409	5,620
	SB					3225	50.2%		3365	50.3%	40,889	68,770	68.19%	-	-		5,451	5,688
				Adj 2015 AAWDT	Counted AM Peak Volume	Adj 2015 AM Peak Volume	AM Pk as % of AAWDT	Counted PM Peak Volume	Adj 2015 PM Peak Volume	PM Pk as % of AAWDT	2015 AWDT Base Model Assigns	2040 AWDT Alt A Assigns	% Growth 2015-40	2040 Alt A AAWDT	2040 NB AAWDT	%Difference 2040 Alt A to 2040 NB	2040 Alt A AM Pk	2040 Alt A PM Pk

Note - Exit 5 SB off ramp AM peak volume does not include one count that appears anomalous when compared to other counts in same hour

Red counts are from NHDOT Town summary data - 2014 or 2015

11-Apr-17

rev 5-17-17

rev 9-14-17

TABLE J-3

Adjusted 2040 AAWDT and Peak Hour Alternative B volumes based on 2015 counts

Annual Growth rates:	
2014->2015	1.025
2015->2015	1.000
2016->2015	0.975

Seasonal: Use Urban Highway Group 4 adjustment factors

Intersection Turning Movement Counts		AM Peak	PM Peak
April	Adj Factor=	0.96	0.99
May		0.96	0.98
June		0.96	0.94
July		1.04	0.96
Sept		0.95	0.97

	Count Location	Count Month/Yr	Raw AAWDT	Adj 2015 AAWDT	Counted AM Peak Volume	Adj 2015 AM Peak Volume	AM Pk as % of AAWDT	Counted PM Peak Volume	Adj 2015 PM Peak Volume	PM Pk as % of AAWDT	2015 AWDT Base Model Assigns	2040 AWDT Alt B Assigns	% Growth 2015-40	(Apply % to Adj 2015 AAWDT) 2040 Alt B AAWDT	2040 NB AAWDT	%Difference 2040 Alt B to 2040 NB	2040 Alt B AM Pk	2040 Alt B PM Pk
Derry	Crystal Av (NH 28), S of Tsienneto	May-16	15,585	15,195	836	803	5.28%	1418	1390	9.15%	13,406	10,565	-21.19%	11,975	11,584	3.27%	633	1095
	Folsom Rd W of NH 28	May-16	12,070	11,768	778	747	6.35%	1199	1175	9.98%	8,960	4,730	-47.21%	6,212	13,839	-122.78%	394	620
	Pinkerton St E of Tsienneto	May-16	10,722	10,454	695	667	6.38%	1017	997	9.54%	8,776	9,178	4.58%	10,933	7,619	30.31%	698	1043
	Tsiennto Rd, W of NH 102	May-16	5,532	5,394	483	464	8.60%	511	501	9.29%	5,666	16,182	185.60%	15,405	8,636	43.94%	1325	1431
	Tsienneto Rd E of Pinkerton	May-16	15,012	14,637	1113	1068	7.30%	1499	1469	10.04%	14,200	15,241	7.33%	15,710	19,457	-23.85%	1146	1577
	NH 102, E of NH 28 Bypass	May-16	7,456	7,270	595	571	7.85%	661	648	8.91%	7,016	4,277	-39.04%	4,432	6,348	-43.23%	348	395
	NH 28 Byp, N of Academy Dr	May-16	8,615	8,400	756	726	8.64%	881	863	10.27%	7,318	2,375	-67.55%	2,726	3,275	-20.14%	236	280
	NH 28 Byp, N of Tsienneto Rd	May-16	12,250	11,944	997	957	8.01%	1201	1177	9.85%	9,377	2,696	-71.25%	3,434	5,187	-51.05%	275	338
	NH 28 Byp, S of Thornton Rd (south)	May-16	14,341	13,982	1110	1066	7.62%	1392	1364	9.76%	12,227	7,791	-36.28%	8,909	8,379	5.95%	679	869
	NH 102 E of Griffin St	Apr-14	16,410	16,820	1080	1037	6.17%	1224	1212	7.21%	18,002	16,759	-6.90%	15,659	19,444	-24.17%	965	1128
	NH 102 W of Abbot St	Apr-14	14,220	14,576	1020	979	6.72%	1148	1137	7.80%	11,128	11,283	1.39%	14,779	19,519	-32.07%	993	1153
	Fordway over Beaver Brook	Apr-14	5,500	5,638	411	395	7.01%	481	476	8.44%	5,114	4,273	-16.45%	4,711	3,871	17.83%	330	398
	Franklin St Ext, N. of Folsom Rd	Apr-14	1,795	1,840	109	105	5.71%	171	169	9.18%	1,254	4,736	277.67%	6,949	2,874	58.64%	397	638
	Ash St at Londonderry town line	Apr-14	6,956	7,130	477	458	6.42%	722	715	10.03%	5,936	5,923	-0.22%	7,114	16,564	-132.84%	457	713
	Crystal Av (NH 28), S of Rollins	Jun-15	13,134	13,134	1026	985	7.50%	1174	1104	8.41%	13,215	11,110	-15.93%	11,042	10,399	5.82%	828	928
	NH 102, at Derry/Chester town line	Jul-15	8,200	8,200	644	670	8.17%	841	807	9.84%	10,839	14,668	35.33%	11,097	9,671	12.85%	907	1092
	average						7.11%			9.23%								
L-derry	NH 102, E of Hampton Dr	Jul-15	31,102	31,102	2478	2577	8.29%	2842	2728	8.77%	30,418	56,263	84.97%	57,528	52,557	8.64%	4767	5046
	NH 102, E of Exit 4			26,800	2140		7.99%	2145		8.00%	20,818	16,852	-19.05%	21,694	41,723	-92.33%	1732	1736
	NH 102 at Derry Town line	May-16	22,656	22,090	1718	1649	7.46%	1796	1760	7.97%	22,983	20,908	-9.03%	20,096	28,742	-43.02%	1500	1601
	NH 28 at Derry Town line	May-16	17,324	16,891	1279	1228	7.27%	1682	1648	9.76%	19,392	8,125	-58.10%	7,077	13,621	-92.47%	515	690
	NH 28 N of Liberty Dr	Sep-15	14,994	14,994	1407	1337	8.92%	1054	1022	6.82%	15,406	8,697	-43.55%	8,464	14,339	-69.41%	755	577
	Gilcreast Rd N of NH 102	May-16	10,070	9,818	697	669	6.81%	1008	988	10.06%	9,397	15,035	60.00%	15,709	17,174	-9.33%	1070	1581
	Londonderry Rd, N of NH 102			4,622	215	215	4.65%	446	465	10.06%	4,742	6,034	27.25%	5,881	4,701	20.06%	274	592
	Ash St E of Londonderry Rd	Jun-15	6,591	6,591	477	458	6.95%	723	680	10.32%	5,949	5,923	-0.44%	6,562	15,512	-136.39%	456	677
	average						7.29%			8.97%								
	Connector Rd, E. of Exit 4A											54,523					3,820	4,910
	Connector Rd, W. of NH 28											35,565					2,490	3,200
	Connector Rd, E. of NH 28											16,193					1,130	1,460
	Exit 4 NB Off-ramp	May-16	10,249	9,993	435	418	4.18%	1223	1199	12.00%	10,389	18,135	74.56%	17,444	19,444	-11.47%	730	2093
	Exit 4 NB On-ramp	May-16	10,303	10,045	1079	1036	10.31%	812	796	7.92%	9,550	17,638	84.69%	18,552	22,449	-21.01%	1913	1470
	Exit 4 SB Off-ramp	May-16	9,862	9,615	753	723	7.52%	952	933	9.70%	8,157	14,795	81.38%	17,439	21,629	-24.03%	1311	1692
	Exit 4 SB On-ramp - EB to SB	May-16	5,310	5,177	673	646	12.48%	311	305	5.89%	4,907	11,659	137.60%	12,301	11,371	7.56%	1535	725
	Exit 4 SB On-ramp - WB to SB	May-16	4,767	4,648	537	516	11.10%	244	239	5.14%	3,637	4,125	13.42%	5,272	9,460	-79.44%	585	271
	average						9.12%			8.13%								
	Exit 4A NB Off-ramp											9,488		9,488			865	772
	Exit 4A NB On-ramp											13,208		13,208			1,204	1,074
	Exit 4A SB Off-ramp											19,376		19,376			1,767	1,576
	Exit 4A SB On-ramp											12,450		12,450			1,135	1,012
	Exit 5 NB Off-ramp	May-16	5,745	5,601	400	384	6.86%	472	463	8.27%	4,430	7,036	58.83%	8,896	8,093	9.03%	610	735
	Exit 5 NB On-ramp	May-16	9,580	9,341	992	952	10.19%	793	777	8.32%	9,101	10,468	15.02%	10,744	13,855	-28.96%	1095	894
	Exit 5 SB Off-ramp	May-16	9,520	9,282	781	750	8.08%	939	920	9.91%	9,234	6,036	-34.63%	6,067	13,648	-124.95%	490	601
	Exit 5 SB On-ramp	May-16	5,645	5,504	519	498	9.05%	427	418	7.59%	3,919	5,355	36.64%	7,521	8,264	-9.88%	680	571
	average						8.54%			8.52%								
	I-93, south of Exit 4 (DOT PATR)			71,060		5420	7.63%		5870	8.26%	72,378	123,558	70.71%	121,308	116,743	3.76%	9,253	10,021
	NB			35,740		1980	36.53%		3410	58.1%	36,417	61,615	69.19%	60,470	58,133	3.86%	3,380	5,821
	SB			35,320		3440	63.47%		2460	41.9%	35,961	61,943	72.25%	60,839	58,610	3.66%	5,873	4,200
	I-93, between Exits 4 and 4A			71,000		5640	7.94%		5885	8.29%	71,152	122,072	71.57%	121,811			9,676	10,097
	NB					2630	46.63%		3015	51.2%	35,578	61,119	71.79%	-			4,512	5,173
	SB					3010	53.37%		2870	48.8%	35,574	60,953	71.34%	-			5,164	4,924
	I-93, between Exits 4A and 5			71,000			7.94%			8.29%	71,152	132,718	86.53%	132,434	119,948	9.43%	10,520	10,977
	NB						46.63%			51.2%	35,578	64,839	82.24%		-		4,906	5,624
	SB						53.37%			48.8%	35,574	67,879	90.81%				5,614	5,353
	I-93, north of Exit 5			76,000		6425	8.45%		6690	8.80%	81,139	136,851	68.66%	128,183	126,445	1.36%	10,837	11,283
	NB					3200	49.81%		3325	49.7%	40,250	68,290	69.66%	-	-		5,397	5,608
	SB					3225	50.19%		3365	50.3%	40,889	68,561	67.68%	-			5,440	5,675
				Adj 2015 AAWDT	Counted AM Peak Volume	Adj 2015 AM Peak Volume	AM Pk as % of AAWDT	Counted PM Peak Volume	Adj 2015 PM Peak Volume	PM Pk as % of AAWDT	2015 AWDT Base Model Assigns	2040 AWDT Alt B Assigns	% Growth 2015-40	AAWDT) 2040 Alt B AAWDT	2040 NB AAWDT	%Difference 2040 Alt B to 2040 NB	2040 Alt B AM Pk	2040 Alt B PM Pk

Note - Exit 5 SB off ramp AM peak volume does not include one count that appears anomalous when compared to other counts in same hour

Red counts are from NHDOT Town summary data - 2014 or 2015

11-Apr-17

rev 6-27-17

rev 9-14-17

TABLE J-4

Adjusted 2040 AAWDT and Peak Hour Alternative C volumes based on 2015 counts

Annual Growth rates:	
2014->2015	1.025
2015->2015	1.000
2016->2015	0.975

Seasonal: Use Urban Highway Group 4 adjustment factors

Intersection Turning Movement Counts

Month		AM Peak	PM Peak
April	Adj Factor=	0.96	0.99
May		0.96	0.98
June		0.96	0.94
July		1.04	0.96
Sept		0.95	0.97

	Count Location	Count Month/Yr	Raw AAWDT	Adj 2015 AAWDT	Counted AM Peak Volume	Adj 2015 AM Peak Volume	AM Pk as % of AAWDT	Counted PM Peak Volume	Adj 2015 PM Peak Volume	PM Pk as % of AAWDT	2015 AWDT Base Model Assigns	2040 AWDT Alt C Assigns	% Growth 2015-40	(Apply % to Adj 2015 AAWDT) 2040 Alt C AAWDT	2040 NB AAWDT	%Difference 2040 Alt C to 2040 NB	2040 Alt C AM Pk	2040 Alt C PM Pk
Derry	Crystal Av (NH 28), S of Tsienneto	May-16	15,585	15,195	836	803	5.28%	1418	1390	9.15%	13,406	12,279	-8.41%	13,918	11,584	16.77%	736	1273
	Folsom Rd W of NH 28	May-16	12,070	11,768	778	747	6.35%	1199	1175	9.98%	8,960	9,494	5.96%	12,469	13,839	-10.99%	791	1245
	Pinkerton St E of Tsienneto	May-16	10,722	10,454	695	667	6.38%	1017	997	9.54%	8,776	11,138	26.91%	13,268	7,619	42.58%	847	1265
	Tsiennto Rd, W of NH 102	May-16	5,532	5,394	483	464	8.60%	511	501	9.29%	5,666	6,156	8.65%	5,860	8,636	-47.37%	504	544
	Tsienneto Rd E of Pinkerton	May-16	15,012	14,637	1113	1068	7.30%	1499	1469	10.04%	14,200	15,644	10.17%	16,125	19,457	-20.66%	1177	1618
	NH 102, E of NH 28 Bypass	May-16	7,456	7,270	595	571	7.85%	661	648	8.91%	7,016	3,324	-52.62%	3,444	6,348	-84.32%	270	307
	NH 28 Byp, N of Academy Dr	May-16	8,615	8,400	756	726	8.64%	881	863	10.27%	7,318	2,436	-66.71%	2,796	3,275	-17.13%	242	287
	NH 28 Byp, N of Tsienneto Rd	May-16	12,250	11,944	997	957	8.01%	1201	1177	9.85%	9,377	2,290	-75.58%	2,917	5,187	-77.82%	234	287
	NH 28 Byp, S of Thornton Rd (south)	May-16	14,341	13,982	1110	1066	7.62%	1392	1364	9.76%	12,227	8,741	-28.51%	9,996	8,379	16.18%	762	975
	NH 102 E of Griffin St	Apr-14	16,410	16,820	1080	1037	6.17%	1224	1212	7.21%	18,002	16,330	-9.29%	15,258	19,444	-27.43%	941	1099
	NH 102 W of Abbot St	Apr-14	14,220	14,576	1020	979	6.72%	1148	1137	7.80%	11,128	9,968	-10.42%	13,057	19,519	-49.49%	877	1019
	Fordway over Beaver Brook	Apr-14	5,500	5,638	411	395	7.01%	481	476	8.44%	5,114	4,206	-17.76%	4,637	3,871	16.52%	325	391
	Franklin St Ext, N. of Folsom Rd	Apr-14	1,795	1,840	109	105	5.71%	171	169	9.18%	1,254	2,083	66.11%	3,056	2,874	5.96%	174	281
	Ash St at Londonderry town line	Apr-14	6,956	7,130	477	458	6.42%	722	715	10.03%	5,936	8,843	48.97%	10,622	16,564	-55.94%	682	1065
	Crystal Av (NH 28), S of Rollins	Jun-15	13,134	13,134	1026	985	7.50%	1174	1104	8.41%	13,215	11,753	-11.06%	6,341	10,399	-64.00%	407	636
	NH 102, at Derry/Chester town line	Jul-15	8,200	8,200	644	670	8.17%	841	807	9.84%	10,839	14,002	29.18%	16,967	9,671	43.00%	1272	1426
	average						7.11%			9.23%								
L-derry	NH 102, E of Hampton Dr	Jul-15	31,102	31,102	2478	2577	8.29%	2842	2728	8.77%	30,418	50,680	66.61%	51,820	52,557	-1.42%	4294	4545
	NH 102, E of Exit 4			26,800	2140		7.99%	2145		8.00%	20,818	18,986	-8.80%	24,442	41,723	-70.70%	1952	1956
	NH 102 at Derry Town line	May-16	22,656	22,090	1718	1649	7.46%	1796	1760	7.97%	22,983	21,661	-5.75%	20,819	28,742	-38.06%	1554	1659
	NH 28 at Derry Town line	May-16	17,324	16,891	1279	1228	7.27%	1682	1648	9.76%	19,392	42,458	118.95%	36,982	13,621	63.17%	2689	3608
	NH 28 N of Liberty Dr	Sep-15	14,994	14,994	1407	1337	8.92%	1247	1210	8.07%	15,406	4,904	-68.17%	4,773	14,339	-200.42%	426	385
	Gilcreast Rd N of NH 102	May-16	10,070	9,818	697	669	6.81%	1008	988	10.06%	9,397	15,112	60.82%	15,789	17,174	-8.77%	1076	1589
	Londonderry Rd, N of NH 102			4,622	215	215	4.65%	465	465	10.06%	4,742	7,633	60.97%	7,440	4,701	36.81%	346	749
	Ash St E of Londonderry Rd	Jun-15	6,591	6,591	477	458	6.95%	723	680	10.32%	5,949	8,682	45.94%	9,619	15,512	-61.26%	668	992
	average						7.29%			9.13%								
	Connector Rd, E. of Exit 4A											38,516					2,700	3,470
	Connector Rd, E. of NH 28											13,888					970	1,250
	Connector Rd, N. of NH 102											15,529					1,090	1,400
	Exit 4 NB Off-ramp	May-16	10,249	9,993	435	418	4.18%	1223	1199	12.00%	10,389	18,728	80.27%	18,014	19,444	-7.94%	754	2161
	Exit 4 NB On-ramp	May-16	10,303	10,045	1079	1036	10.31%	812	796	7.92%	9,550	15,903	66.52%	16,727	22,449	-34.21%	1725	1326
	Exit 4 SB Off-ramp	May-16	9,862	9,615	753	723	7.52%	952	933	9.70%	8,157	12,694	55.62%	14,963	21,629	-44.55%	1125	1452
	Exit 4 SB On-ramp - EB to SB	May-16	5,310	5,177	673	646	12.48%	311	305	5.89%	4,907	10,850	121.11%	11,447	11,371	0.66%	1428	674
	Exit 4 SB On-ramp - WB to SB	May-16	4,767	4,648	537	516	11.10%	244	239	5.14%	3,637	5,140	41.33%	6,569	9,460	-44.01%	729	338
	average						9.12%			8.13%								
	Exit 4A NB Off-ramp											2,795		2,795			255	227
	Exit 4A NB On-ramp											13,410		13,410			1,223	1,090
	Exit 4A SB Off-ramp											17,290		17,290			1,577	1,406
	Exit 4A SB On-ramp											5,021		5,021			458	408
	Exit 5 NB Off-ramp	May-16	5,745	5,601	400	384	6.86%	472	463	8.27%	4,430	6,626	49.57%	8,377	8,093	3.39%	574	692
	Exit 5 NB On-ramp	May-16	9,580	9,341	992	952	10.19%	793	777	8.32%	9,101	7,829	-13.98%	8,035	13,855	-72.43%	819	668
	Exit 5 SB Off-ramp	May-16	9,520	9,282	781	750	8.08%	939	920	9.91%	9,234	5,728	-37.97%	5,758	13,648	-137.03%	465	571
	Exit 5 SB On-ramp	May-16	5,645	5,504	519	498	9.05%	427	418	7.59%	3,919	5,916	50.96%	8,309	8,264	0.54%	752	631
	average						8.54%			8.52%								
	I-93, south of Exit 4 (DOT PATR)			71,060		5420	7.63%		5870	8.26%	72,378	119,322	64.86%	117,149	116,743	0.35%	8,935	9,677
	NB					1980	36.53%		3410	58.1%	36,417	59,601	63.66%	-	58,133		3,264	5,622
	SB					3440	63.47%		2460	41.9%	35,961	59,721	66.07%	-	58,610		5,671	4,055
	I-93, between Exits 4 and 4A			71,000		5640	7.94%		5885	8.29%	71,152	113,200	59.10%	112,958			8,973	9,363
	NB					2630	46.63%		3015	51.2%	35,578	56,776	59.58%	-			4,184	4,797
	SB					3010	53.37%		2870	48.8%	35,574	56,424	58.61%	-			4,789	4,566
	I-93, between Exits 4A and 5			71,000			7.94%			8.29%	71,152	136,083	91.26%	135,792	119,948	11.67%	10,787	11,255
	NB						46.63%			51.2%	35,578	67,390	89.41%		-		5,030	5,766
	SB						53.37%			48.8%	35,574	68,693	93.10%		-		5,757	5,489
	I-93, north of Exit 5			76,000		6425	8.45%		6690	8.80%	81,139	137,099	68.97%	128,416	126,445	1.53%	10,856	11,304
	NB					3200	49.81%		3325	49.7%	40,250	68,593	70.42%	-			5,407	5,618
	SB					3225	50.19%		3365	50.3%	40,889	68,506	67.54%	-			5,449	5,686
				Adj 2015 AAWDT	Counted AM Peak Volume	Adj 2015 AM Peak Volume	AM Pk as % of AAWDT	Counted PM Peak Volume	Adj 2015 PM Peak Volume	PM Pk as % of AAWDT	2015 AWDT Base Model Assigns	2040 AWDT Alt C Assigns	% Growth 2015-40	AAWDT) 2040 Alt C AAWDT	AAWDT) 2040 NB AAWDT	%Difference 2040 Alt C to 2040 NB	2040 Alt C AM Pk	2040 Alt C PM Pk

Note - Exit 5 SB off ramp AM peak volume does not include one count that appears anomalous when compared to other counts in same hour

Red counts are from NHDOT Town summary data - 2014 or 2015

11-Apr-17
rev 5-17-17
rev 9-14-17

TABLE J-5

Adjusted 2040 AAWDT and Peak Hour Alternative D volumes based on 2015 counts

Annual Growth rates:	
2014->2015	1.025
2015->2015	1.000
2016->2015	0.975

Seasonal: Use Urban Highway Group 4 adjustment factors
Intersection Turning Movement Counts

		AM Peak	PM Peak
April	Adj Factor=	0.96	0.99
May		0.96	0.98
June		0.96	0.94
July		1.04	0.96
Sept		0.95	0.97

	Count Location	Count Month/Yr	Raw AAWDT	Adj 2015 AAWDT	Counted AM Peak Volume	Adj 2015 AM Peak Volume	AM Pk as % of AAWDT	Counted PM Peak Volume	Adj 2015 PM Peak Volume	PM Pk as % of AAWDT	2015 AWDT Base Model Assigns	2040 AWDT Alt D Assigns	% Growth 2015-40	(Apply % to Adj 2015 AAWDT) 2040 Alt D AAWDT	2040 NB AAWDT	%Difference 2040 Alt D to 2040 NB	2040 Alt D AM Pk	2040 Alt D PM Pk
Derry	Crystal Av (NH 28), S of Tsienneto	May-16	15,585	15,195	836	803	5.28%	1418	1390	9.15%	13,406	13,225	-1.35%	14,990	11,584	22.72%	792	1371
	Folsom Rd W of NH 28	May-16	12,070	11,768	778	747	6.35%	1199	1175	9.98%	8,960	8,646	-3.50%	11,356	13,839	-21.87%	721	1134
	Pinkerton St E of Tsienneto	May-16	10,722	10,454	695	667	6.38%	1017	997	9.54%	8,776	11,608	32.27%	13,827	7,619	44.90%	882	1319
	Tsiennto Rd, W of NH 102	May-16	5,532	5,394	483	464	8.60%	511	501	9.29%	5,666	11,363	100.55%	10,818	8,636	20.17%	931	1005
	Tsienneto Rd E of Pinkerton	May-16	15,012	14,637	1113	1068	7.30%	1499	1469	10.04%	14,200	20,041	41.13%	20,658	19,457	5.81%	1507	2073
	NH 102, E of NH 28 Bypass	May-16	7,456	7,270	595	571	7.85%	661	648	8.91%	7,016	5,942	-15.31%	6,157	6,348	-3.10%	484	549
	NH 28 Byp, N of Academy Dr	May-16	8,615	8,400	756	726	8.64%	881	863	10.27%	7,318	2,420	-66.93%	2,778	3,275	-17.89%	240	285
	NH 28 Byp, N of Tsienneto Rd	May-16	12,250	11,944	997	957	8.01%	1201	1177	9.85%	9,377	4,218	-55.02%	5,373	5,187	3.46%	431	529
	NH 28 Byp, S of Thornton Rd (south)	May-16	14,341	13,982	1110	1066	7.62%	1392	1364	9.76%	12,227	8,136	-33.46%	9,304	8,379	9.94%	709	908
	NH 102 E of Griffin St	Apr-14	16,410	16,820	1080	1037	6.17%	1224	1212	7.21%	18,002	18,591	3.27%	17,370	19,444	-11.94%	1071	1252
	NH 102 W of Abbot St	Apr-14	14,220	14,576	1020	979	6.72%	1148	1137	7.80%	11,128	11,885	6.80%	15,568	19,519	-25.38%	1046	1214
	Fordway over Beaver Brook	Apr-14	5,500	5,638	411	395	7.01%	481	476	8.44%	5,114	3,926	-23.23%	4,328	3,871	10.56%	303	365
	Franklin St Ext, N. of Folsom Rd	Apr-14	1,795	1,840	109	105	5.71%	171	169	9.18%	1,254	2,019	61.00%	2,962	2,874	2.97%	169	272
	Ash St at Londonderry town line	Apr-14	6,956	7,130	477	458	6.42%	722	715	10.03%	5,936	8,511	43.38%	10,223	16,564	-62.03%	657	1025
	Crystal Av (NH 28), S of Rollins	Jun-15	13,134	13,134	1026	985	7.50%	1174	1104	8.41%	13,215	11,998	-9.21%	11,924	10,399	12.79%	894	1002
	NH 102, at Derry/Chester town line	Jul-15	8,200	8,200	644	670	8.17%	841	807	9.84%	10,839	14,138	30.44%	10,696	9,671	9.58%	874	1053
	average						7.11%			9.23%								
L-derry	NH 102, E of Hampton Dr	Jul-15	31,102	31,102	2478	2577	8.29%	2842	2728	8.77%	30,418	51,066	67.88%	52,214	52,557	-0.66%	4326	4580
	NH 102, E of Exit 4			26,800	2140		7.99%	2145		8.00%	20,818	20,775	-0.21%	26,745	41,723	-56.00%	2136	2141
	NH 102 at Derry Town line	May-16	22,656	22,090	1718	1649	7.46%	1796	1760	7.97%	22,983	23,215	1.01%	22,313	28,742	-28.81%	1666	1778
	NH 28 at Derry Town line	May-16	17,324	16,891	1279	1228	7.27%	1682	1648	9.76%	19,392	40,462	108.65%	35,244	13,621	61.35%	2562	3439
	NH 28 N of Liberty Dr	Sep-15	14,994	14,994	1407	1337	8.92%	1247	1210	8.07%	15,406	4,757	-69.12%	4,630	14,339	-209.70%	413	374
	Gilcreast Rd N of NH 102	May-16	10,070	9,818	697	669	6.81%	1008	988	10.06%	9,397	14,742	56.88%	15,402	17,174	-11.50%	1049	1550
	Londonderry Rd, N of NH 102			4,622	215	215	4.65%	465	465	10.06%	4,742	7,354	55.08%	7,168	4,701	34.42%	333	721
	Ash St E of Londonderry Rd	Jun-15	6,591	6,591	477	458	6.95%	723	680	10.32%	5,949	8,457	42.16%	9,370	15,512	-65.55%	651	967
	average						7.29%			9.13%								
	Connector Rd, E. of Exit 4A											36,728					2,570	3,310
	Exit 4 NB Off-ramp	May-16	10,249	9,993	435	418	4.18%	1223	1199	12.00%	10,389	19,497	87.67%	18,754	19,444	-3.68%	784	2250
	Exit 4 NB On-ramp	May-16	10,303	10,045	1079	1036	10.31%	812	796	7.92%	9,550	15,411	61.37%	16,210	22,449	-38.49%	1672	1285
	Exit 4 SB Off-ramp	May-16	9,862	9,615	753	723	7.52%	952	933	9.70%	8,157	12,431	52.40%	14,653	21,629	-47.61%	1102	1422
	Exit 4 SB On-ramp - EB to SB	May-16	5,310	5,177	673	646	12.48%	311	305	5.89%	4,907	10,881	121.74%	11,480	11,371	0.95%	1433	676
	Exit 4 SB On-ramp - WB to SB	May-16	4,767	4,648	537	516	11.10%	244	239	5.14%	3,637	5,152	41.66%	6,584	9,460	-43.68%	731	339
	average						9.12%			8.13%								
	Exit 4A NB Off-ramp											1,504		1,504			137	122
	Exit 4A NB On-ramp											13,630		13,630			1,243	1,108
	Exit 4A SB Off-ramp											16,972		16,972			1,548	1,380
	Exit 4A SB On-ramp											4,621		4,621			421	376
	Exit 5 NB Off-ramp	May-16	5,745	5,601	400	384	6.86%	472	463	8.27%	4,430	7,054	59.23%	8,919	8,093	9.26%	611	737
	Exit 5 NB On-ramp	May-16	9,580	9,341	992	952	10.19%	793	777	8.32%	9,101	7,985	-12.26%	8,196	13,855	-69.05%	835	682
	Exit 5 SB Off-ramp	May-16	9,520	9,282	781	750	8.08%	939	920	9.91%	9,234	5,790	-37.30%	5,820	13,648	-134.50%	470	577
	Exit 5 SB On-ramp	May-16	5,645	5,504	519	498	9.05%	427	418	7.59%	3,919	5,879	50.01%	8,257	8,264	-0.08%	747	627
	average						8.54%			8.52%								
	I-93, south of Exit 4 (DOT PATR)			71,060		5420	7.63%		5870	8.26%	72,378	119,380	64.94%	117,206	116,743	0.40%	8,940	9,682
	NB					1980	36.53%		3410	58.1%	36,417	59,527	63.46%	-	58,133		3,266	5,624
	SB					3440	63.47%		2460	41.9%	35,961	59,853	66.44%	-	58,610		5,674	4,058
	I-93, between Exits 4 and 4A			71,000		5640	7.94%		5885	8.29%	71,152	111,723	57.02%	111,484			8,856	9,241
	NB					2630	46.63%		3015	51.2%	35,578	55,441	55.83%	-			4,130	4,734
	SB					3010	53.37%		2870	48.8%	35,574	56,282	58.21%	-			4,726	4,507
	I-93, between Exits 4A and 5			71,000			7.94%			8.29%	71,152	136,200	91.42%	135,909	119,948	11.74%	10,796	11,265
	NB						46.63%			51.2%	35,578	67,567	89.91%		-		5,034	5,771
	SB						53.37%			48.8%	35,574	68,633	92.93%		-		5,762	5,494
	I-93, north of Exit 5			76,000		6425	8.45%		6690	8.80%	81,139	137,042	68.90%	128,362	126,445	1.49%	10,852	11,299
	NB					3200	49.81%		3325	49.7%	40,250	68,497	70.18%	-	-		5,405	5,616
	SB					3225	50.19%		3365	50.3%	40,889	68,545	67.64%	-	-		5,447	5,683
				Adj 2015 AAWDT	Counted AM Peak Volume	Adj 2015 AM Peak Volume	AM Pk as % of AAWDT	Counted PM Peak Volume	Adj 2015 PM Peak Volume	PM Pk as % of AAWDT	2015 AWDT Base Model Assigns	2040 AWDT Alt D Assigns	% Growth 2015-40	AAWDT) 2040 Alt D AAWDT	AAWDT) 2040 NB AAWDT	%Difference 2040 Alt D to 2040 NB	2040 Alt D AM Pk	2040 Alt D PM Pk

Note - Exit 5 SB off ramp AM peak volume does not include one count that appears anomalous when compared to other counts in same hour
Red counts are from NHDOT Town summary data - 2014 or 2015

11-Apr-17
rev 5-17-17
rev 9-14-17

TABLE J-6

Adjusted 2040 AAWDT and Peak Hour Alternative F volumes based on 2015 counts

Annual Growth rates:	
2014->2015	1.025
2015->2015	1.000
2016->2015	0.975

Seasonal: Use Urban Highway Group 4 adjustment factors

Intersection Turning Movement Counts		AM Peak	PM Peak
April	Adj Factor=	0.96	0.99
May		0.96	0.98
June		0.96	0.94
July		1.04	0.96
Sept		0.95	0.97

	Count Location	Count Month/Yr	Raw AAWDT	Adj 2015 AAWDT	Counted AM Peak Volume	Adj 2015 AM Peak Volume	AM Pk as % of AAWDT	Counted PM Peak Volume	Adj 2015 PM Peak Volume	PM Pk as % of AAWDT	2015 AWDT Base Model Assigns	2040 AWDT Alt F Assigns	% Growth 2015-40	(Apply % to Adj 2015 AAWDT) 2040 Alt F AAWDT	2040 NB AAWDT	%Difference 2040 Alt F to 2040 NB	2040 Alt F AM Pk	2040 Alt F PM Pk
Derry	Crystal Av (NH 28), S of Tsienneto	May-16	15,585	15,195	836	803	5.28%	1418	1390	9.15%	13,406	10,313	-23.07%	11,689	11,584	0.90%	618	1069
	Folsom Rd W of NH 28	May-16	12,070	11,768	778	747	6.35%	1199	1175	9.98%	8,960	9,223	2.94%	12,113	13,839	-14.25%	769	1209
	Pinkerton St E of Tsienneto	May-16	10,722	10,454	695	667	6.38%	1017	997	9.54%	8,776	6,356	-27.58%	7,571	7,619	-0.63%	483	722
	Tsiennto Rd, W of NH 102	May-16	5,532	5,394	483	464	8.60%	511	501	9.29%	5,666	9,191	62.21%	8,750	8,636	1.30%	753	813
	Tsienneto Rd E of Pinkerton	May-16	15,012	14,637	1113	1068	7.30%	1499	1469	10.04%	14,200	18,976	33.63%	19,560	19,457	0.53%	1427	1963
	NH 102, E of NH 28 Bypass	May-16	7,456	7,270	595	571	7.85%	661	648	8.91%	7,016	6,450	-8.07%	6,684	6,348	5.03%	525	596
	NH 28 Byp, N of Academy Dr	May-16	8,615	8,400	756	726	8.64%	881	863	10.27%	7,318	2,785	-61.94%	3,197	3,275	-2.44%	276	328
	NH 28 Byp, N of Tsienneto Rd	May-16	12,250	11,944	997	957	8.01%	1201	1177	9.85%	9,377	4,145	-55.80%	5,280	5,187	1.76%	423	520
	NH 28 Byp, S of Thornton Rd (south)	May-16	14,341	13,982	1110	1066	7.62%	1392	1364	9.76%	12,227	7,191	-41.19%	8,223	8,379	-1.90%	627	802
	NH 102 E of Griffin St	Apr-14	16,410	16,820	1080	1037	6.17%	1224	1212	7.21%	18,002	24,147	34.14%	22,562	19,444	13.82%	1391	1626
	NH 102 W of Abbot St	Apr-14	14,220	14,576	1020	979	6.72%	1148	1137	7.80%	11,128	15,829	42.24%	20,734	19,519	5.86%	1393	1617
	Fordway over Beaver Brook	Apr-14	5,500	5,638	411	395	7.01%	481	476	8.44%	5,114	3,595	-29.70%	3,963	3,871	2.32%	278	335
	Franklin St Ext, N. of Folsom Rd	Apr-14	1,795	1,840	109	105	5.71%	171	169	9.18%	1,254	1,783	42.19%	2,616	2,874	-9.86%	149	240
	Ash St at Londonderry town line	Apr-14	6,956	7,130	477	458	6.42%	722	715	10.03%	5,936	12,825	116.05%	15,405	16,564	-7.52%	990	1545
	Crystal Av (NH 28), S of Rollins	Jun-15	13,134	13,134	1026	985	7.50%	1174	1104	8.41%	13,215	11,022	-16.59%	10,954	10,399	5.07%	822	921
	NH 102, at Derry/Chester town line	Jul-15	8,200	8,200	644	670	8.17%	841	807	9.84%	10,839	12,808	18.17%	9,690	9,671	0.20%	792	954
	average						7.11%			9.23%								
L-derry	NH 102, E of Hampton Dr	Jul-15	31,102	31,102	2478	2577	8.29%	2842	2728	8.77%	30,418	52,565	72.81%	53,747	52,557	2.21%	4453	4714
	NH 102, E of Exit 4			26,800	2140		7.99%	2145		8.00%	20,818	34,151	64.05%	43,964	41,723	5.10%	3511	3519
	NH 102 at Derry Town line	May-16	22,656	22,090	1718	1649	7.46%	1796	1760	7.97%	22,983	32,520	41.50%	31,256	28,742	8.04%	2333	2490
	NH 28 at Derry Town line	May-16	17,324	16,891	1279	1228	7.27%	1682	1648	9.76%	19,392	15,477	-20.19%	13,481	13,621	-1.04%	980	1315
	NH 28 N of Liberty Dr	Sep-15	14,994	14,994	1407	1337	8.92%	1247	1210	8.07%	15,406	14,584	-5.34%	14,194	14,339	-1.02%	1266	1145
	Gilcreast Rd N of NH 102	May-16	10,070	9,818	697	669	6.81%	1008	988	10.06%	9,397	16,006	70.33%	16,723	17,174	-2.70%	1140	1683
	Londonderry Rd, N of NH 102			4,622	215	215	4.65%	465	465	10.06%	4,742	4,521	-4.66%	4,407	4,701	-6.67%	205	443
	Ash St E of Londonderry Rd	Jun-15	6,591	6,591	477	458	6.95%	723	680	10.32%	5,949	13,023	118.91%	14,428	15,512	-7.51%	1003	1489
	average						7.29%			9.13%								
	Exit 4 NB Off-ramp	May-16	10,249	9,993	435	418	4.18%	1223	1199	12.00%	10,389	20,417	96.53%	19,639	19,444	0.99%	821	2356
	Exit 4 NB On-ramp	May-16	10,303	10,045	1079	1036	10.31%	812	796	7.92%	9,550	21,378	123.85%	22,486	22,449	0.16%	2319	1782
	Exit 4 SB Off-ramp	May-16	9,862	9,615	753	723	7.52%	952	933	9.70%	8,157	18,730	129.62%	22,078	21,629	2.03%	1660	2142
	Exit 4 SB On-ramp - EB to SB	May-16	5,310	5,177	673	646	12.48%	311	305	5.89%	4,907	10,705	118.16%	11,294	11,371	-0.68%	1409	665
	Exit 4 SB On-ramp - WB to SB	May-16	4,767	4,648	537	516	11.10%	244	239	5.14%	3,637	7,494	106.05%	9,577	9,460	1.22%	1063	492
	average						9.12%			8.13%								
	Exit 5 NB Off-ramp	May-16	5,745	5,601	400	384	6.86%	472	463	8.27%	4,430	6,256	41.22%	7,910	8,093	-2.31%	542	654
	Exit 5 NB On-ramp	May-16	9,580	9,341	992	952	10.19%	793	777	8.32%	9,101	13,329	46.46%	13,680	13,855	-1.28%	1394	1138
	Exit 5 SB Off-ramp	May-16	9,520	9,282	781	750	8.08%	939	920	9.91%	9,234	12,249	32.65%	12,313	13,648	-10.84%	995	1220
	Exit 5 SB On-ramp	May-16	5,645	5,504	519	498	9.05%	427	418	7.59%	3,919	5,882	50.09%	8,261	8,264	-0.04%	747	627
	average						8.54%			8.52%								
	I-93, south of Exit 4 (DOT PATR)			71,060		5420	7.63%		5870	8.26%	72,378	119,129	64.59%	116,960	116,743	0.19%	8,921	9,662
	NB					1980	36.53%		3410	58.09%	36,417	59,424	63.18%	-	58,133		3,259	5,613
	SB					3440	63.47%		2460	41.91%	35,961	59,705	66.03%	-	58,610		5,662	4,049
	I-93, between Exits 4 and 5			71,000		5640	7.94%		5885	8.29%	71,152	120,621	69.53%	120,363	119,948	0.34%	9,561	9,977
	NB					2630	46.63%		3015	51.23%	35,578	60,385	69.73%	-	-		4,458	5,111
	SB					3010	53.37%		2870	48.77%	35,574	60,236	69.33%	-	-		5,103	4,866
	I-93, north of Exit 5			76,000		6425	8.45%		6690	8.80%	81,139	135,061	66.46%	126,507	126,445	0.05%	10,695	11,136
	NB					3200	49.81%		3325	49.7%	40,250	67,458	67.60%	-	-		5,327	5,535
	SB					3225	50.19%		3365	50.3%	40,889	67,603	65.33%	-	-		5,368	5,601
				Adj 2015 AAWDT	Counted AM Peak Volume	Adj 2015 AM Peak Volume	AM Pk as % of AAWDT	Counted PM Peak Volume	Adj 2015 PM Peak Volume	PM Pk as % of AAWDT	2015 AWDT Base Model Assigns	2040 AWDT Alt F Assigns	% Growth 2015-40	AAWDT) 2040 Alt F AAWDT	AAWDT) 2040 NB AAWDT	%Difference 2040 Alt F to 2040 NB	2040 Alt F AM Pk	2040 Alt F PM Pk

Note - Exit 5 SB off ramp AM peak volume does not include one count that appears anomalous when compared to other counts in same hour

Red counts are from NHDOT Town summary data - 2014 or 2015

APPENDIX K: PROCEDURE TO ESTIMATE TMC FROM AWDT

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TO: File

FROM: Paul Konieczka, AICP PK
Linda C. Greer, PE, PTOE L.G.

DATE: September 29, 2017

RE: Traffic Technical Memo
Procedure for Estimating Intersection Turning Movement Volumes from Exit 4A Model AWDT's
CLD | Fuss & O'Neill Reference No. 05-0244

The Exit 4A project has been using the Southern New Hampshire Planning Commission's (SNHPC) regional travel demand model to develop traffic projections for the 2015 base year and 2040 design year for the No-Build and the five 4A alternative interchange/connector road configurations. This model provides Average Weekday Traffic volumes (AWDTs) based on existing traffic volume information and existing/projected land use and socio-economic data for the SNHPC region, and has been calibrated by SNHPC to replicate base conditions to current standards.

However, the model is only calibrated to daily volumes on the primary roadway segments in the SNHPC area and not down to the intersection level. Therefore, for design purposes, these AWDT volumes must be converted into AM and PM peak hour turning movement volumes at the key intersections in the Exit 4A study area for each alternative for analysis so that the appropriate level of roadway and intersection improvements can be determined to serve the expected traffic demands in the 2040 design year, as well as to determine the expected level of impact of each alternative on natural and cultural resources for the SDEIS document.

The base AM and PM peak hour intersection turning movement volumes collected by the NHDOT at 19 study area intersections in 2016 were adjusted to develop base year 2015 volumes to be consistent with the base year of the SNHPC model. The SNHPC model is able to provide AWDTs at intersections by using the node and the intersecting links to create a series of 'From Link->Through Node> To Link' paths to simulate the allowed turning movement volumes at any particular node on a daily basis, including new intersections that will be created under some of the Exit 4A alternatives. This intersection-level information from the model was provided by SNHPC for all alternatives and was used as guidance to develop turning movement volume estimates for the 2040 No-Build and Build conditions for design and analysis purposes.

Basic Procedure

A separate spreadsheet was developed for each alternative that included all the intersections to be analyzed for that alternative. The 2015 base AM and PM peak hour turning movement volumes for each approach were inserted, along with the corresponding From Link>Thru Node>To Link volumes representing each turning movement for that scenario. The total approach volume was calculated for each peak hour, as well as the existing percentage of the total volume represented by each turning movement on that approach. This was then compared to the model-provided AWDT for each of these movements, as well as the percent of the total approach AWDT from the model that each of these movements represented.

It should be noted that some of the movements on any intersection approach may not have a corresponding model link associated with it, since the model does not include every minor street or driveway in its network. In these cases, the existing counted volumes were either perpetuated or adjusted to reflect a reasonable growth rate, depending on the characteristics of that particular approach and/or movement.

Intersection-level AWDTs were then provided for each alternative, and the percentage of the total approach AWDT for each movement calculated again for that alternative. The total AWDT for that approach was compared to the 2015 model results, and the ratio between the two was calculated. This ratio was then applied to the total 2015 peak hour volume on that approach to derive the peak hour volume for that approach. If the ratio was greater than 1.0, the total approach volume was increased proportionately, and vice versa.

Since the model volumes should reflect changes in traffic distribution associated with the alternative being analyzed, the change in the percentage of the AWDT for each movement should be indicative of how turning movements at any intersection would be affected by an Exit 4A interchange alternative being added to the network. As such, the ratio comparing the turn percentage for an alternative to the base 2015 model was calculated on an AWDT basis. This turn percentage ratio was then multiplied by the existing turn percentages as reflected in the 2015 traffic counts on each approach. In some cases, this ratio may be greater than 1.0, indicating that movement should now represent a higher percentage of the total approach movements than exhibited in the 2015 base condition. At no time should the sum of the adjusted turn percentages be greater than 1.0, so in some cases engineering judgment was applied to make one of the movements (usually the highest percentage one, but not always) balance the approach so that the total turn percentages were equal to 1.0.

There were also other individual manual adjustments made to balance volumes between adjacent intersections where there should be little, if any, differences in directional volumes, such as between Ross' Corner (Crystal Avenue, Folsom Road and Tsienneto Road) and the Tsienneto/Pinkerton Street intersection. Resulting peak hour volumes at an intersection were also compared to model-projected volumes on adjacent links as a reasonableness test. Traffic volumes directly added to the network from zone connections in the vicinity of these intersections were also evaluated to determine if any differences between intersections could be attributed to the traffic heading to and from these zones, based on an assumed AM peak/PM peak split of 7% and 9% of AWDT, respectively, as reflected in the actual field counts.

Other Adjustments

One notable traffic distribution challenge was discovered under Alternative A. The SNHPC model showed a larger than expected increase in westbound AWDT for the right turn movement from NH 102 to Crystal Avenue northbound, then a left turn at Rollins Street, followed by a right turn onto Franklin Street. This resulted in a substantial increase in left turns from Franklin Street onto North

High Street, which appeared to be an unreasonable path given the existing characteristics of Franklin Street. At our request, SNHPC performed a 'trace' of the path of westbound trips that were on the NH 102 link just east of Crystal Avenue that were destined for the Franklin/North High Street intersection. The attached graphics show the eastbound and westbound traces for the 2015, 2040 No-Build and 2040 Alternative A scenarios.

This trace found that a large number of trips from both East Derry Road and the traffic zone serving the Pinkerton Street area north of NH 102 were being directed along this path. These trips were manually redistributed to the NH 102/NH 28 Bypass traffic circle and to Pinkerton Street directly to adjust to what was considered a more reasonable path between these locations.

This basic procedure will be used for all alternatives to develop 2040 AM and PM peak hour intersection volumes for analysis purposes. Other alternative-specific adjustments may also be needed at certain locations based on the model-generated AWDT intersection assignments as we proceed further.

PK:LCG:ams

Attachments

- Alternative A intersection volume spreadsheet
- Alternative A – 2040 AM and PM peak hour intersection volumes - final
- SNHPC trace for westbound trips to Franklin Street (2015, 2040 No-Build, 2040 Alt A)

#5 NH 102 at Londonderry Road

AM Traffic

Nodes From	Thru	To		7:45 AM Adjusted 2015	Exist Turn %	2015 exist Model ADT	2015 exist Model % ADT	2040 Alt A ADT	% ADT	Change in ADT ratio	Adj Turn %	Adj Turn Vols	2040 Alt A Model	2040 Alt B Model	2040 Alt C Model	2040 Alt D Model	2040 Alt F Model	2040 NoBd Model
3556	791	3251	EB Left	75	12.5%	638	6.0%	515	6.0%	0.99	12.3%	60	515	523	1105	1083	1569	2136
		792	EB Thru	520	86.7%	9915	94.0%	8111	94.0%	1.00	87.7%	430	8111	7748	8555	9509	14981	13168
			EB Right	5	0.8%	0	0.0%	0	0.0%	#DIV/0!	0.0%	0	0	0	0	0	0	0
				600		10553		8626		0.817	1	490	8626	8271	9660	10592	16550	15304
792	791		WB Left	5	0.4%	0	0.0%	0	0.0%	-	0.4%	5	0	0	0	0	0	0
		3556	WB Thru	1090	97.3%	9567	83.0%	6688	67.5%	0.81	97.3%	930	6688	8105	7803	8660	15931	15412
		3251	WB Right	25	2.2%	1959	17.0%	3221	32.5%	1.91	2.2%	20	3221	2764	3132	3070	464	449
				1120		11526		9909		0.860	1	960	9909	10869	10935	11730	16395	15861
None			NB Left	0	0.0%	0	#DIV/0!	0	#DIV/0!	-	0.0%	#DIV/0!	0	0	0	0	0	0
			NB Thru	0	0.0%	0	#DIV/0!	0	#DIV/0!	#DIV/0!	0.0%	#DIV/0!	0	0	0	0	0	0
			NB Right	1	100.0%	0	#DIV/0!	0	#DIV/0!	#DIV/0!	100.0%	#DIV/0!	0	0	0	0	0	0
				1		0		0		#DIV/0!	1	#DIV/0!	0	0	0	0	0	0
3251	791	792	SB Left	10	8.7%	1543	71.9%	2394	85.5%	1.19	52.7%	80	2394	2465	2170	1975	1143	875
			SB Thru	0	0.0%	0	0.0%	0	0.0%	1.00	0.0%	0	0	0	0	0	0	0
		3556	SB Right	105	91.3%	602	28.1%	407	14.5%	0.52	47.3%	70	407	556	1226	1225	1345	1364
				115		2145		2801		1.306	1	150	2801	3021	3396	3200	2488	2239

#5 NH 102 at Londonderry Road

PM Traffic

	Adjusted 2015	Exist Turn %	2015 exist Model ADT	2015 exist Model % ADT	2040 Alt A ADT	% ADT	Change in ADT ratio	Adj Turn %	Adj Turn Vols	2040 Alt A Model	2040 Alt B Model	2040 Alt C Model	2040 Alt D Model	2040 Alt F Model	2040 NoBd Model
EB Left	285	21.0%	638	6.0%	515	6.0%	0.99	20.8%	210	515	523	1105	1083	1569	2136
EB Thru	950	70.1%	9915	94.0%	8111	94.0%	1.00	79.2%	880	8111	7748	8555	9509	14981	13168
EB Right	120	8.9%	0	0.0%	0	0.0%	#DIV/0!	0.0%	120	0	0	0	0	0	0
	1355		10553		8626		0.817	1	1110	8626	8271	9660	10592	16550	15304
WB Left	5	0.7%	0	0.0%	0	0.0%	-	0.7%	5	0	0	0	0	0	0
WB Thru	720	94.7%	9567	83.0%	6688	67.5%	0.81	77.0%	500	6688	8105	7803	8660	15931	15412
WB Right	35	4.6%	1959	17.0%	3221	32.5%	1.91	22.3%	140	3221	2764	3132	3070	464	449
	760		11526		9909		0.860	1	650	9909	10869	10935	11730	16395	15861
NB Left	5	50.0%	0	#DIV/0!	0	#DIV/0!	-	50.0%	10	0	0	0	0	0	0
NB Thru	0	0.0%	0	#DIV/0!	0	#DIV/0!	#DIV/0!	0.0%	0	0	0	0	0	0	0
NB Right	5	50.0%	0	#DIV/0!	0	#DIV/0!	#DIV/0!	50.0%	10	0	0	0	0	0	0
	10		0		0		#DIV/0!	1	10	0	0	0	0	0	0
SB Left	10	6.9%	1543	71.9%	2394	85.5%	1.19	53.6%	100	2394	2465	2170	1975	1143	875
SB Thru	5	3.4%	0	0.0%	0	0.0%	#DIV/0!	0.0%	5	0	0	0	0	0	0
SB Right	130	89.7%	602	28.1%	407	14.5%	0.52	46.4%	90	407	556	1226	1225	1345	1364
	145		2145		2801		1.306	1	190	2801	3021	3396	3200	2488	2239

Percetage adjusted manually to add to 100% on approach

Existing percentages or volumes carried forward

#6 **NH 102 at Fordway/High**

AM Traffic

Nodes From	Nodes Thru	Nodes To		7:45 AM Adjusted 2015	Exist Turn %	2015 existing model ADT	2015 existing model % ADT	2040 Alt A ADT	2040 Alt A % ADT	Change in ADT ratio	Adj Turn %	Adj Turn Vols	2040 Alt A Model	2040 Alt B Model	2040 Alt C Model	2040 Alt D Model	2040 Alt F Model	2040 NoBd Model
1868	1869	2128	EB Left	0	0.0%	0	0.0%	0	0.0%	#DIV/0!	0.0%	0	0	0	0	0	0	0
		1870	EB Thru	400	76.2%	9909	86.8%	9173	87.3%	1.01	77.1%	370	9173	8916	9394	10147	13316	11221
		2138	EB Right	125	23.8%	1501	13.2%	1331	12.7%	0.96	22.9%	110	1331	1297	1331	1333	2257	2165
				525		11410		10504		0.921	1	480	10504	10213	10725	11480	15573	13386
1870	1869	2138	WB Left	15	2.5%	771	8.7%	220	2.9%	0.34	0.8%	15	220	273	607	847	162	165
		1868	WB Thru	595	97.5%	8089	91.3%	7252	97.1%	1.06	99.2%	495	7252	7969	7404	8193	11666	10773
		2128	WB Right	0	0.0%	0	0.0%	0	0.0%	#DIV/0!	0.0%	0	0	0	0	0	0	0
				610		8860		7472		0.843	1	510	7472	8242	8011	9040	11828	10938
2138	1869	1868	NB Left	345	83.1%	1681	60.0%	2024	71.1%	1.18	87.8%	370	2024	1971	2129	2122	2059	1674
		2128	NB Thru	0	0.0%	0	0.0%	0	0.0%	-	0.0%	0	0	0	0	0	0	0
		1870	NB Right	70	16.9%	1121	40.0%	824	28.9%	0.72	12.2%	50	824	676	585	433	556	575
				415		2802		2848		1.016417	1	420	2848	2647	2714	2555	2615	2249
2128	1869	1870	SB Left	5	12.5%	234	28.4%	246	15.7%	0.55	6.9%	10	246	231	266	262	97	99
		2138	SB Thru	25	62.5%	570	69.2%	1316	84.3%	1.22	86.1%	70	1316	925	238	331	329	365
		1868	SB Right	10	25.0%	20	2.4%	0	0.0%	-	6.9%	10	0	0	0	0	4	9
				40		824		1562		1.896	1	80	1562	1156	504	593	430	473

#6 **NH 102 at Fordway/High**

PM Traffic

	4:30 PM Adjusted 2015	Exist Turn %	2015 existing model ADT	2015 existing model % ADT	2040 Alt A ADT	2040 Alt A % ADT	Change in ADT ratio	Adj Turn %	Adj Turn Vols	2040 Alt A Model	2040 Alt B Model	2040 Alt C Model	2040 Alt D Model	2040 Alt F Model	2040 NoBd Model
EB Left	0	0.0%	0	0.0%	0	0.0%	#DIV/0!	0.0%	0	0	0	0	0	0	0
EB Thru	760	83.5%	9909	86.8%	9173	87.3%	1.01	84.1%	710	9173	8916	9394	10147	13316	11221
EB Right	150	16.5%	1501	13.2%	1331	12.7%	0.96	15.9%	130	1331	1297	1331	1333	2257	2165
	910		11410		10504		0.921	1	840	10504	10213	10725	11480	15573	13386
WB Left	15	3.5%	771	8.7%	220	2.9%	0.34	1.2%	15	220	273	607	847	162	165
WB Thru	415	96.5%	8089	91.3%	7252	97.1%	1.06	98.8%	345	7252	7969	7404	8193	11666	10773
WB Right	0	0.0%	0	0.0%	0	0.0%	#DIV/0!	0.0%	0	0	0	0	0	0	0
	430		8860		7472		0.843	1	360	7472	8242	8011	9040	11828	10938
NB Left	230	69.7%	1681	60.0%	2024	71.1%	1.18	78.1%	270	2024	1971	2129	2122	2059	1674
NB Thru	0	0.0%	0	0.0%	0	0.0%	#DIV/0!	0.0%	0	0	0	0	0	0	0
NB Right	100	30.3%	1121	40.0%	824	28.9%	0.72	21.9%	70	824	676	585	433	556	575
	330		2802		2848		1.016	1	340	2848	2647	2714	2555	2615	2249
SB Left	15	21.4%	234	28.4%	246	15.7%	0.55	11.9%	20	246	231	266	262	97	99
SB Thru	50	71.4%	570	69.2%	1316	84.3%	1.22	88.1%	110	1316	925	238	331	329	365
SB Right	5	7.1%	20	2.4%	0	0.0%	-	0.0%	5	0	0	0	0	4	9
	70		824		1562		1.896	1	130	1562	1156	504	593	430	473

Percetage adjusted manually to add to 100% on approach

Existing percentages or volumes carried forward

#7 NH 102 at NH 28

AM Traffic

Nodes From	Thru	To		7:45 AM Adjusted 2015	Exist Turn %	2015 existing model ADT	% ADT	2040 Alt A ADT	% ADT	Change in ADT ratio	Adj Turn %	Adj Turn Vols	2040 Alt A Model	2040 Alt B Model	2040 Alt C Model	2040 Alt D Model	2040 Alt F Model	2040 NoBd Model
1875	1859	1860	EB Left	105	28.4%	2405	27.1%	375	4.3%	0.16	4.5%	20	375	1565	1348	1792	3054	1799
		1876	EB Thru	205	55.4%	4357	49.2%	5768	65.6%	1.33	74.9%	280	5768	3920	3358	4339	5751	5008
		3534	EB Right	60	16.2%	2100	23.7%	2647	30.1%	1.27	20.6%	80	2647	2815	2862	2791	3882	3150
				370		8862		8790		0.992	1	370	8790	8300	7568	8922	12687	9957
1876	1859	3534	WB Left	35	7.0%	1298	24.4%	771	11.9%	0.49	3.4%	20	771	847	834	859	1255	1222
		1875	WB Thru	385	77.0%	3928	74.0%	4383	67.7%	0.91	70.4%	430	4383	3454	4156	5280	5144	5297
		1860	WB Right	80	16.0%	84	1.6%	1322.25	20.4%	12.91	26.1%	160	3075	1564	144	198	1483	1269
				500		5310		6476.25		1.220	1	610	8229	5865	5134	6337	7882	7788
3534	1859	1875	NB Left	60	16.7%	2775	33.5%	4982	58.2%	1.74	46.5%	170	4982	4502	3174	3158	4832	4065
		1860	NB Thru	260	72.2%	4129	49.9%	2810	32.8%	0.66	47.5%	180	2810	3102	4277	4515	1567	2545
		1876	NB Right	40	11.1%	1372	16.6%	765	8.9%	0.54	6.0%	20	765	808	775	982	1217	1376
				360		8276		8557		1.034	1	370	8557	8412	8226	8655	7616	7986
1860	1859	1876	SB Left	70	17.3%	89	1.3%	681	11.3%	8.51	25.4%	90	681	551	702	227	980	731
		3534	SB Thru	230	56.8%	4520	67.4%	4817	79.9%	1.19	67.3%	240	4817	4558	4701	4840	2009	2409
		1875	SB Right	105	25.9%	2093	31.2%	529	8.8%	0.28	7.3%	30	529	299	805	593	2474	2247
				405		6702		6027		0.899	1	360	6027	5408	6208	5660	5463	5387

0.10279

#7 NH 102 at NH 28

PM Traffic

	4:30 PM Adjusted 2015	Exist Turn %	2015 existing model ADT	% ADT	2040 Alt A ADT	% ADT	Change in ADT ratio	Adj Turn %	Adj Turn Vols	2040 Alt A Model	2040 Alt B Model	2040 Alt C Model	2040 Alt D Model	2040 Alt F Model	2040 NoBd Model
EB Left	135	23.1%	2405	27.1%	375	4.3%	0.16	3.6%	20	375	1565	1348	1792	3054	1799
EB Thru	410	70.1%	4357	49.2%	5768	65.6%	1.33	89.6%	520	5768	3920	3358	4339	5751	5008
EB Right	40	6.8%	2100	23.7%	2647	30.1%	1.27	6.8%	40	2647	2815	2862	2791	3882	3150
	585		8862		8790		0.992	1	580	8790	8300	7568	8922	12687	9957
WB Left	75	19.2%	1298	24.4%	771	11.9%	0.49	9.4%	60	771	847	834	859	1255	1222
WB Thru	250	64.1%	3928	74.0%	4383	67.7%	0.91	58.6%	360	4383	3454	4156	5280	5144	5297
WB Right	65	16.7%	84	1.6%	1322.25	20.4%	12.91	32.0%	200	3075	1564	144	198	1483	1269
	390		5310		6476.25		1.220	1	480	8229	5865	5134	6337	7882	7788
NB Left	70	17.5%	2775	33.5%	4982	58.2%	1.74	46.7%	170	4982	4502	3174	3158	4832	4065
NB Thru	295	73.8%	4129	49.9%	2810	32.8%	0.66	48.5%	180	2810	3102	4277	4515	1567	2545
NB Right	35	8.8%	1372	16.6%	765	8.9%	0.54	4.7%	20	765	808	775	982	1217	1376
	400		8276		8557		1.034	1	410	8557	8412	8226	8655	7616	7986
SB Left	135	21.6%	89	1.3%	681	11.3%	8.51	21.6%	80	681	551	702	227	980	731
SB Thru	340	54.4%	4520	67.4%	4817	79.9%	1.19	71.7%	260	4817	4558	4701	4840	2009	2409
SB Right	150	24.0%	2093	31.2%	529	8.8%	0.28	6.7%	20	529	299	805	593	2474	2247
	625		6702		6027		0.899	1	560	6027	5408	6208	5660	5463	5387

Percetage adjusted manually to add to 100% on approach
Existing percentages or volumes carried forward
Adjusted WB RT volume to divert excess trips destined for Franklin via Rollins (43% of total trips)

#8 **N High St/ Ash St Extension**

AM Traffic

Nodes From	Nodes Thru	To	To		7:45 AM Adjusted 2015	Exist Turn %	2015 existing model ADT	2015 existing model % ADT	2040 Alt A ADT	2040 Alt A % ADT	Change in ADT ratio	Adj Turn %	Adj Turn Vols	2040 Alt A Model	2040 Alt B Model	2040 Alt C Model	2040 Alt D Model	2040 Alt F Model	2040 NoBd Model
2125	3485	2124		EB Left	180	94.7%	1654	100.0%	2217	100.0%	1.00	94.7%	240	2217	1875	3213	3387	3746	4501
				EB Thru	0	0.0%	0	0.0%	0	0.0%	-	0.0%	0						0
		2123		EB Right	10	5.3%	0	0.0%	0	0.0%	1.00	5.3%	10	0	0	0	0	0	0
					190		1654		2217		1.340	1	250						4501
None	3485			WB Left	0	#DIV/0!	0	#DIV/0!	0	#DIV/0!	#DIV/0!	0.0%	0						0
				WB Thru	0	#DIV/0!	0	#DIV/0!	0	#DIV/0!	#DIV/0!	0.0%	0						0
				WB Right	0	#DIV/0!	0	#DIV/0!	0	#DIV/0!	#DIV/0!	0.0%	0						0
					0		0		0		#DIV/0!	0	0						0
2123	3485	2125	133	NB Left	5	3.8%	0	0.0%	0	0.0%	1.00	3.8%	5	0	0	0	0	0	0
		2124		NB Thru	125	96.2%	1630	100.0%	3167	100.0%	1.00	96.2%	240	3167	601	1604	1014	678	1110
				NB Right	0	0.0%	0	0.0%		0.0%	1.00	0.0%	0						0
					130		1630		3167		1.943	1	250						1110
2124	3485			SB Left	0	0.0%	0	0.0%	0	0.0%	#DIV/0!	0.0%	0						0
		2123		SB Thru	175	43.2%	1464	38.2%	2317	54.2%	1.42	57.9%	260	2317	1432	570	664	1045	1461
		2125		SB Right	230	56.8%	2366	61.8%	1961	45.8%	0.74	42.1%	190	1961	1832	3315	2618	4026	4049
					405		3830		4278		1.117	1	450						5510

Notes:

133=Zone Centroid

2123 to 133 = 143, 2124 to 133 = 139, 2125 to 133 = 59

133 to 2123 =164, to 2124=124, to 2125 = 52

#8 **N High St/ Ash St Extension**

PM Traffic

	4:30 PM Adjusted 2015	Exist Turn %	2015 existing model ADT	2015 existing model % ADT	2040 Alt A ADT	2040 Alt A % ADT	Change in ADT ratio	Adj Turn %	Adj Turn Vols	2040 Alt A Model	2040 Alt B Model	2040 Alt C Model	2040 Alt D Model	2040 Alt F Model	2040 NoBd Model
EB Left	420	98.8%	1654	100.0%	2217	100.0%	1.00	98.8%	560	2217	1875	3213	3387	3746	4501
EB Thru	0	0.0%	0	0.0%	0	0.0%	1.00	0.0%	0	0	0	0	0	0	0
EB Right	5	1.2%	0	0.0%	0	0.0%	1.00	1.2%	10	0	0	0	0	0	0
	425		1654		2217		1.340	1	570						4501
WB Left	0	#DIV/0!	0	#DIV/0!	0	0.0%	-	0.0%	0	0	0	0	0	0	0
WB Thru	0	#DIV/0!	0	#DIV/0!	0	0.0%	-	0.0%	0	0	0	0	0	0	0
WB Right	0	#DIV/0!	0	#DIV/0!	0	0.0%	-	0.0%	0	0	0	0	0	0	0
	0		0				0.000	0	0						0
NB Left	5	1.7%	0	0.0%	0	0.0%	1.00	1.7%	5	0	0	0	0	0	0
NB Thru	290	98.3%	1630	100.0%	3167	100.0%	1.00	98.3%	555	3167	601	1604	1014	678	1110
NB Right	0	0.0%	0	0.0%	0	0.0%	1.00	0.0%	0	0	0	0	0	0	0
	295		1630		3167		1.943	1	570						1110
SB Left	0	0.0%	0	0.0%	0	0.0%	#DIV/0!	0.0%	0	0	0	0	0	0	0
SB Thru	170	39.1%	1464	38.2%	2317	54.2%	1.42	54.8%	270	2317	1432	570	664	1045	1461
SB Right	265	60.9%	2366	61.8%	1961	45.8%	0.74	45.2%	220	1961	1832	3315	2618	4026	4049
	435		3830		4278		1.117	1	490						5510

Percetage adjusted manually to add to 100% on approach

Existing percentages or volumes carried forward

#9 **N High St/ Madden Road**

AM Traffic

From (Nodes)	Thru (Nodes)	To (Nodes)		7:45 AM Adjusted 2015	Exist Turn %	2015 existing model ADT	2015 existing model % ADT	2040 Alt A ADT	% ADT	Change in ADT ratio	Adj Turn %	Adj Turn Vols	NOT USED 2040 Alt A Model	2040 Alt B Model	2040 Alt C Model	2040 Alt D Model	2040 Alt F Model	2040 NoBd Model
377	2124	2106	EB Left	10	100.0%	149	60.8%	0	#DIV/0!	#DIV/0!	100.0%	0		117	146	146	100	100
			EB Thru	0	0.0%	0	0.0%	0	#DIV/0!	1.00	0	0						0
		3485	EB Right	0	0.0%	96	39.2%	0	#DIV/0!	#DIV/0!	0	0		57	85	85	131	131
				10		245		0		0.000	1	0						231
None			WB Left	0	0.0%	0	0.0%	0	0.0%	1.00	0	0						0
			WB Thru	0	0.0%	0	0.0%	0	0.0%	1.00	0	0						0
			WB Right	0	0.0%	0	0.0%	0	0.0%	1.00	0	0						0
				0		0		0		0.000	0	0						0
3485	2124	377	NB Left	0	0.0%	92	2.7%	0	#DIV/0!	-	0.0%	0		85	87	87	121	129
		2106	NB Thru	310	100.0%	3316	97.3%	0	#DIV/0!	1.00	100.0%	0		2758	4901	4486	4376	5557
			NB Right	0	0.0%	0	0.0%	0	#DIV/0!	-	0.0%	0						0
				310		3408		0		0.000	1	0						5686
2106	2124		SB Left	0	0.0%	0	0.0%	0	#DIV/0!	#DIV/0!	0.0%	0						0
		3485	SB Thru	400	95.2%	3873	96.2%	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!		3468	3967	3366	5003	5488
		377	SB Right	20	4.8%	153	3.8%	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!		112	144	144	110	102
				420		4026		0		0.000	#DIV/0!	0						5590

Notes: 377 is zone centroid for Madden Rd

#9 **N High St/ Madden Road**

PM Traffic

	4:30 PM Adjusted 2015	Exist Turn %	2015 existing model ADT	2015 existing model % ADT	2040 Alt A ADT	% ADT	Change in ADT ratio	Adj Turn %	Adj Turn Vols	NOT USED 2040 Alt A Model	2040 Alt B Model	2040 Alt C Model	2040 Alt D Model	2040 Alt F Model	2040 NoBd Model
EB Left	10	100.0%	149	60.8%	0	#DIV/0!	#DIV/0!	100.0%	0	0	117	146	146	100	100
EB Thru	0	0.0%	0	0.0%	0	#DIV/0!	1.00	0	0	0	0	0	0	0	0
EB Right	0	0.0%	96	39.2%	0	#DIV/0!	#DIV/0!	0	0	0	57	85	85	131	131
	10		245		0		0.000	1	0						231
WB Left	0	0.0%	0	0.0%	0	0.0%	1.00	0	0	0	0	0	0	0	0
WB Thru	0	0.0%	0	0.0%	0	0.0%	1.00	0	0	0	0	0	0	0	0
WB Right	0	0.0%	0	0.0%	0	0.0%	1.00	0	0	0	0	0	0	0	0
	0		0		0		0.000	0	0						0
NB Left	0	0.0%	92	2.7%	0	#DIV/0!	#DIV/0!	0.0%	0	0	85	87	87	121	129
NB Thru	700	100.0%	3316	97.3%	0	#DIV/0!	1.00	100.0%	0	0	2758	4901	4486	4376	5557
NB Right	0	0.0%	0	0.0%	0	#DIV/0!	#DIV/0!	0.0%	0	0	0	0	0	0	0
	700		3408		0		0.000	1	0						5686
SB Left	0	0.0%	0	0.0%	0	#DIV/0!	#DIV/0!	0.0%	0	0	0	0	0	0	0
SB Thru	440	97.8%	3873	96.2%	0	#DIV/0!	1.00	#DIV/0!	#DIV/0!	0	3468	3967	3366	5003	5488
SB Right	10	2.2%	153	3.8%	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0	112	144	144	110	102
	450		4026		0		0.000	#DIV/0!	0						5590

Percetage adjusted manually to add to 100% on approach

Existing percentages or volumes carried forward

#9A N High St/Connector Road

AM Traffic

Nodes From	Thru	To		7:45 AM Adjusted 2015	2015 ex Model	2040 NBld Model	2040 NBld Turn	2040 Alt A Model	2040 Alt A Turn	Est AM Peak as 7% of ADT	Manual Alt A Adjustments	Comments	2040 Alt B Turn	2040 Alt C Model	2040 Alt C Turn	2040 Alt D Model	2040 Alt D Turn	2040 Alt F Model	2040 Alt F Turn
6531	2124		EB Left				#DIV/0!	0	0.0%	-			#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
		2106	EB Thru				#DIV/0!	18553	88.4%	1,670	1090		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
		3485	EB Right				#DIV/0!	2429	11.6%	220	270		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
								20982		1890									
2106	2124	3485	WB Left				#DIV/0!	2095	11.6%	150	180		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
		6531	WB Thru				#DIV/0!	15953	88.4%	1,110	1110		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
			WB Right				#DIV/0!	0	0.0%	-			#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
								18048		1260									
3485	2124	6531	NB Left				#DIV/0!	3301	58.0%	230	280		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
			NB Thru				#DIV/0!	0	0.0%	-			#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
		2106	NB Right				#DIV/0!	2393	42.0%	170	200		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
								5694		400	480	Balance to Ash St Ext							
None			SB Left				#DIV/0!	0	#DIV/0!				#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
			SB Thru				#DIV/0!	0	#DIV/0!				#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
			SB Right				#DIV/0!	0	#DIV/0!				#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!
								0		0									

#9A N High St/Connector Road

PM Traffic

	4:30 PM Adjusted 2015	2015 ex Model	2040 NBld Model	2040 NBld Turn	2040 Alt A Model	2040 Alt A Turn	PM Peak as 9% of ADT			2040 Alt B Turn	2040 Alt C Model	2040 Alt C Turn	2040 Alt D Model	2040 Alt D Turn	2040 Alt F Model	2040 Alt F Turn
EB Left	10	0	0	#DIV/0!	0	0.0%	-			#DIV/0!	0	#DIV/0!	0	#DIV/0!	0	#DIV/0!
EB Thru	0	0	0	#DIV/0!	18553	88.4%	1,670			#DIV/0!	0	#DIV/0!	0	#DIV/0!	0	#DIV/0!
EB Right	0	0	0	#DIV/0!	2429	11.6%	220	220	262.9268293	#DIV/0!	0	#DIV/0!	0	#DIV/0!	0	#DIV/0!
					20982		1890									
WB Left	0	0	0	#DIV/0!	2095	11.6%	190			#DIV/0!	0	#DIV/0!	0	#DIV/0!	0	#DIV/0!
WB Thru	0	0	0	#DIV/0!	15953	88.4%	1,430			#DIV/0!	0	#DIV/0!	0	#DIV/0!	0	#DIV/0!
WB Right	0	0	0	#DIV/0!	0	0.0%	-	190	227.0731707	#DIV/0!	0	#DIV/0!	0	#DIV/0!	0	#DIV/0!
					18048		1620	410	490							
NB Left	0	0	0	#DIV/0!	3301	58.0%	300	660	0	#DIV/0!	0	#DIV/0!	0	#DIV/0!	0	#DIV/0!
NB Thru	700	700	0	0	0	0.0%	-		0	0	0	0	0	0	0	0
NB Right	0	0	0	#DIV/0!	2393	42.0%	210	460	0	#DIV/0!	0	#DIV/0!	0	#DIV/0!	0	#DIV/0!
					5694		510	1115	Balance to Ash St Ext							
SB Left	0	0	0	#DIV/0!	0	#DIV/0!			0	#DIV/0!	0	#DIV/0!	0	#DIV/0!	0	#DIV/0!
SB Thru	440	440	0	0	0	#DIV/0!			0	0	0	0	0	0	0	0
SB Right	10	10	0	0	0	#DIV/0!			0	0	0	0	0	0	0	0
					0											

#10 Folsom Rd at Franklin St

AM Traffic

Nodes From	Thru	To		7:45 AM Adjusted 2015	Exist Turn %	2015 existing model ADT	2015 existing model % ADT	2040 Alt A ADT	% ADT	Change in ADT ratio	Adj Turn %	Adj Turn Vols	2040 Alt A Model	2040 Alt B Model	2040 Alt C Model	2040 Alt D Model	2040 Alt F Model	2040 NoBd Model	Manual Alt A Adjustments	
2124	2106	3484	EB Left	35	11.3%	470	13.6%	764	3.6%	0.27	3.0%	60	764	627	537	530	557	546		
		3483	EB Thru	270	87.1%	2958	85.4%	18004	85.5%	1.00	95.4%	1790	18004	2206	4484	4076	3892	5083	1200	-590
		2113	EB Right	5	1.6%	37	1.1%	2301	10.9%	1.00	1.6%	30	2301	41	26	26	27	28		
				310		3465		21069		6.081	1	1880						5657		
3483	2106	2113	WB Left	30	7.1%	1	0.0%	0	0.0%	-	3.0%	50	0	4	0	0	0	0		
		2124	WB Thru	385	90.6%	3535	100.0%	13719	100.0%	1.00	94.6%	1560	13719	2059	3012	2499	4261	4518	1100	-460
		3484	WB Right	10	2.4%	0	0.0%	0	0.0%	1.00	2.4%	40		974	21	37	39	39		
				425		3536		13719		3.880	1	1650						4557		
2113	2106	2124	NB Left	10	20.0%	43	14.1%	1307	99.7%	7.09	70.0%	150	3844	58	32	33	35	35		
		3484	NB Thru	5	10.0%	259	84.6%	4	0.3%	1.00	10.0%	20	4	620	188	194	242	244		
		3483	NB Right	35	70.0%	4	1.3%	0	0.0%	1.00	20.0%	40	0	100	1	1	1	2		
				50		306		1310.96		4.284	1	210						281		
3484	2106	3483	SB Left	10	22.2%	0	0.0%	0	0.0%	1.00	22.0%	5		700	150	141	64	67		
		2113	SB Thru	5	11.1%	77	14.7%	3	0.5%	0.03	0.4%	5	3	324	121	138	63	67		
		2124	SB Right	30	66.7%	448	85.3%	596	99.5%	1.17	77.6%	40	596	1462	1067	978	817	996		
				45		525		599		1.141	1	50						1130		

#10 Folsom Rd at Franklin St

	4:30 PM Adjusted 2015	Exist Turn %	2015 existing model ADT	2015 existing model % ADT	2040 Alt A Model	% ADT	Change in ADT ratio	Adj Turn %	Adj Turn Vols	2040 Alt A Model	2040 Alt B Model	2040 Alt C Model	2040 Alt D Model	2040 Alt F Model	2040 NoBd Model	Manual Alt A Adjustments	
EB Left	45	6.3%	470	13.6%	764	3.6%	0.27	1.7%	70	764	627	537	530	557	546		
EB Thru	665	93.0%	2958	85.4%	18004	85.5%	1.00	97.6%	4250	18004	2206	4484	4076	3892	5083	2075	-2175
EB Right	5	0.7%	37	1.1%	2301	10.9%	1.00	0.7%	30	2301	41	26	26	27	28		
	715		3465		21069		6.081	1	4350						5657		
WB Left	30	7.1%	1	0.0%	0	0.0%	1.00	7.1%	120	0	4	0	0	0	0		
WB Thru	375	88.2%	3535	100.0%	13719	100.0%	1.00	88.2%	1460	13719	2059	3012	2499	4261	4518	960	250
WB Right	20	4.7%	0	0.0%	0	0.0%	1.00	4.7%	80	0	974	21	37	39	39		
	425		3536		13719		3.880	1	1650						4557		
NB Left	5	7.7%	43	14.1%	1307	99.7%	7.09	70.0%	200	3844	58	32	33	35	35		
NB Thru	10	15.4%	259	84.6%	4	0.3%	0.00	10.0%	30	4	620	188	194	242	244		
NB Right	50	76.9%	4	1.3%	0	0.0%	-	20.0%	60	0	100	1	1	1	2		
	65		306		1310.96		4.284	1	280						281		
SB Left	20	20.0%	0	0.0%	0	0.0%	1.00	20.0%	20	0	700	150	141	64	67		
SB Thru	10	10.0%	77	14.7%	3	0.5%	0.03	0.3%	10	3	324	121	138	63	67		
SB Right	70	70.0%	448	85.3%	596	99.5%	1.17	79.7%	90	596	1462	1067	978	817	996		
	100		525		599		1.141	1	110						1130		

Percetage adjusted manually to add to 100% on approach

Existing percentages or volumes carried forward

Adjusted NB LT volume to divert excess trips destined for Franklin via Rollins and Rt 102 WB onto Crystal (34% of total)

#11 Ross' Corner (Folsom/Tsienneto at NH 28/Crystal)

AM Traffic

Nodes From	Nodes Thru	Nodes To		7:45 AM Adjusted 2015	Exist Turn %	2015 existing model ADT	2015 existing model % ADT	2040 Alt A ADT	2040 Alt A % ADT	Change in ADT ratio	Adj Turn %	Adj Turn Vols	2040 Alt A Model	2040 Alt B Model	2040 Alt C Model	2040 Alt D Model	2040 Alt F Model	2040 NoBd Model	Manual Alt A Adjustments
3483	1863	1864	EB Left	135	41.5%	1215	26.5%	1139	6.5%	0.24	10.2%	130	1139	13	1780	1518	768	582	
		2107	EB Thru	170	52.3%	3242	70.8%	15176	86.5%	1.22	63.9%	800	15176	2671	4489	4351	4100	5269	820
		1862	EB Right	20	6.2%	123	2.7%	1228	7.0%	2.61	25.9%	320	1228	0	0	0	0	0	
				325		4580		17543		3.830	1	1245						5851	
2107	1863	1862	WB Left	125	15.9%	1495	14.6%	385	2.8%	0.20	3.1%	30	385	427	509	348	1693	1629	
		3483	WB Thru	290	36.9%	2578	25.1%	9700	71.7%	2.85	77.0%	800	9700	1965	3171	2746	4354	4686	935
		1864	WB Right	370	47.1%	6179	60.3%	3444	25.5%	0.42	19.9%	210	3444	8568	8302	12265	5564	4901	220
				785		10252		13529		1.320	1	1040						11216	
1862	1863	3483	NB Left	20	5.2%	0	0.0%	1627	44.3%	1.50	47.8%	100	1627	81	0	0	0	0	
		1864	NB Thru	230	59.7%	4742	70.0%	1495	40.7%	0.58	34.7%	70	1495	4035	4496	4547	2411	3115	
		2107	NB Right	135	35.1%	2028	30.0%	548	14.9%	0.50	17.5%	40	548	1510	1569	2144	2901	1831	
				385		6770		3670		0.542	1	210						4946	
1864	1863	2107	SB Left	310	45.9%	5682	45.4%	567	17.4%	1.50	29.8%	50	567	7758	7168	8224	5165	5388	
		1862	SB Thru	220	32.6%	5019	40.1%	1959	59.9%	1.49	48.7%	100	1959	4512	6154	6186	3308	3644	
		3483	SB Right	145	21.5%	1803	14.4%	742	22.7%	1.00	21.5%	50	742	0	54	31	0	0	
				675		12504		3268		0.261	1	180						9032	

#11 Ross' Corner (Folsom/Tsienneto at NH 28/Crystal)

PM Traffic (rev per new TMC)

	4:30 PM Adjusted 2015	Exist Turn %	2015 existing model ADT	2015 existing model % ADT	2040 Alt A ADT	2040 Alt A % ADT	Change in ADT ratio	Adj Turn %	Adj Turn Vols	2040 Alt A Model	2040 Alt B Model	2040 Alt C Model	2040 Alt D Model	2040 Alt F Model	2040 NoBd Model		
EB Left	240	36.9%	1215	26.5%	1139	6.5%	0.24	9.0%	230	1139	13	1780	1518	768	582		
EB Thru	320	49.2%	3242	70.8%	15176	86.5%	1.22	77.1%	1920	15176	2671	4489	4351	4100	5269	1380	
EB Right	90	13.8%	123	2.7%	1228	7.0%	1.00	13.8%	340	1228	0	0	0	0	0		
	650		4580		17543		3.830	1	2490						5851		
WB Left	150	20.0%	1495	14.6%	385	2.8%	0.20	3.9%	40	385	427	509	348	1693	1629	44.44444	45
WB Thru	220	29.3%	2578	25.1%	9700	71.7%	2.85	74.7%	740	9700	1965	3171	2746	4354	4686	822.2222	820
WB Right	380	50.7%	6179	60.3%	3444	25.5%	0.42	21.4%	210	3444	8568	8302	12265	5564	4901	233.3333	235
	750		10252		13529		1.320	1	990						11216	1100	
NB Left	80	13.6%	0	0.0%	1627	44.3%	0.90	12.2%	40	1627	81	0	0	0	0		
NB Thru	360	61.0%	4742	70.0%	1495	40.7%	0.58	75.1%	240	1495	4035	4496	4547	2411	3115		
NB Right	150	25.4%	2028	30.0%	548	14.9%	0.50	12.7%	40	548	1510	1569	2144	2901	1831		
	590		6770		3670		0.542	1	320						4946		
SB Left	520	45.6%	5682	45.4%	567	17.4%	0.38	17.4%	50	567	7758	7168	8224	5165	5388		
SB Thru	430	37.7%	5019	40.1%	1959	59.9%	1.49	65.9%	200	1959	4512	6154	6186	3308	3644		
SB Right	190	16.7%	1803	14.4%	742	22.7%	1.00	16.7%	50	742	0	54	31	0	0		
	1140		12504		3268		0.261	1	300						9032		

Percetage adjusted manually to add to 100% on approach
Existing percentages or volumes carried forward
Manual adjustment to balance to Pinkerton intx

#12 Tsienneto Rd at Pinkerton St

AM Traffic

Nodes From	Thru	To		7:45 AM Adjusted 2015	Exist Turn %	2015 existing model ADT	% ADT	2040 Alt A ADT	% ADT	Change in ADT ratio	Adj Turn %	Adj Turn Vols	2040 Alt A Model	2040 Alt B Model	2040 Alt C Model	2040 Alt D Model	2040 Alt F Model	2040 NoBd Model	Manual Alt A Adjustments	
1863	2107	2108	EB Thru	370	60.2%	5732	52.3%	9325	57.2%	1.09	64.3%	580	9325	5372	6699	7959	7499	7778		
		2109	EB Right	245	39.8%	5220	47.7%	6966	42.8%	0.90	35.7%	330	6966	6431	6527	6761	4667	4710		
				615		10952		16291		1.487	1.00	910						12488		
2108	2107	2109	WB Left	80	12.3%	159	2.1%	106	0.9%	0.42	5.2%	50	106	111	126	124	131	131		
		1863	WB Thru	570	87.7%	7582	97.9%	12168	99.1%	1.01	94.8%	980	12168	8817	8159	11297	10700	10314		
				650		7741		12274		1.586	1.00	1030						10445		
2109	2107	1863	NB Left	215	72.9%	2670	78.6%	1361	68.5%	0.87	63.5%	110	1361	2116	3824	4062	911	902	205	95
		2108	NB Right	80	27.1%	728	21.4%	626	31.5%	1.47	36.5%	60	626	655	660	661	646	653		
				295		3398		1987		0.585	1.00	170						1555		

Base volumes balanced to match Ross' Corner data

#12 Tsienneto Rd at Pinkerton St

PM Traffic

	4:30 PM Adjusted 2015	Exist Turn %	2015 existing model ADT	% ADT	2040 Alt A ADT	% ADT	Change in ADT ratio	Adj Turn %	Adj Turn Vols	2040 Alt A Model	2040 Alt B Model	2040 Alt C Model	2040 Alt D Model	2040 Alt F Model	2040 NoBd Model	Manual Alt A Adjustments
EB Thru	580	58.6%	5732	52.3%	9325	57.2%	1.09	62.8%	920	9325	5372	6699	7959	7499	7778	
EB Right	410	41.4%	5220	47.7%	6966	42.8%	0.90	37.2%	550	6966	6431	6527	6761	4667	4710	
	990		10952		16291		1.487	1.00	1470						12488	
WB Left	115	16.8%	159	2.1%	106	0.9%	0.42	7.1%	80	106	111	126	124	131	131	
WB Thru	570	83.2%	7582	97.9%	12168	99.1%	1.01	92.9%	1010	12168	8817	8159	11297	10700	10314	
	685		7741		12274		1.586	1.00	1090						10445	
NB Left	180	60.0%	2670	78.6%	1361	68.5%	0.87	52.3%	90	1361	2116	3824	4062	911	902	115
NB Right	120	40.0%	728	21.4%	626	31.5%	1.47	47.7%	90	626	655	660	661	646	653	
	300		3398		1987		0.585	1.00	180						1555	

Base volumes balanced to match Ross' Corner data

Percentage adjusted manually to add to 100% on approach
Existing percentages or volumes carried forward
Adjusted NB LT volume to divert excess trips destined for Franklin via Rollins and Rt 102 WB onto Crystal (34% of total)

#13 **NH 28 at Linlew Dr**

AM Traffic

Nodes From	Thru	To		7:45 AM Adjusted 2015	Exist Turn %	2015 existing model ADT	2015 existing model % ADT	2040 Alt A ADT	% ADT	Change in ADT ratio	Adj Turn %	Adj Turn Vols	2040 Alt A Model	2040 Alt B Model	2040 Alt C Model	2040 Alt D Model	2040 Alt F Model	2040 NoBd Model
None	1865		EB Left	5	50.0%	0	#DIV/0!	0	#DIV/0!	1.00	50.0%	5	0	0	0	0	0	0
			EB Thru	0	0.0%	0	#DIV/0!	0	#DIV/0!	1.00	0.0%	0	0	0	0	0	0	0
			EB Right	5	50.0%	0	#DIV/0!	0	#DIV/0!	1.00	50.0%	5	0	0	0	0	0	0
				10		0		0		1.000	1	10						0
2100	1865	1864	WB Left	50	16.9%	1319	98.0%	437	47.0%	0.48	8.1%	20	437	262	213	418	618	710
			WB Thru	0	0.0%	0	0.0%	0	0.0%	1.00	0.0%	0	0	0	0	0	0	0
		1866	WB Right	245	83.1%	27	2.0%	493	53.0%	26.43	91.9%	180	493	86	0	478	77	44
				295		1346		930		0.691	1	200						754
1864	1865		NB Left	0	0.0%	0	0.0%	0	0.0%	1.00	0.0%	0	0	0	0	0	0	0
		1866	NB Thru	655	95.6%	12136	100.0%	6017	99.0%	1.00	95.6%	330	6017	12591	14578	18330	8743	8598
		2100	NB Right	30	4.4%	1	0.0%	61	1.0%	121.81	4.4%	10	61	0	0	0	1	1
				685		12137		6078		0.501	1	340						8599
1866	1865	2100	SB Left	50	6.0%	790	6.2%	810	21.0%	1.00	6.0%	20	810	208	427	2384	878	693
		1864	SB Thru	790	94.0%	11898	93.8%	3055	79.0%	1.00	94.0%	240	3055	11940	13963	14812	8462	8943
			SB Right	0	0.0%	0	0.0%	0	0.0%	1.00	0.0%	0	0	0	0	0	0	0
				840		12688		3865		0.305	1	260						9636

#13 **NH 28 at Linlew Dr**

PM Traffic

	4:30 PM Adjusted 2015	Exist Turn %	2015 existing model ADT	2015 existing model % ADT	2040 Alt A ADT	% ADT	Change in ADT ratio	Adj Turn %	Adj Turn Vols	2040 Alt A Model	2040 Alt B Model	2040 Alt C Model	2040 Alt D Model	2040 Alt F Model	2040 NoBd Model	
EB Left	15	37.5%	0	#DIV/0!	0	#DIV/0!	1.00	37.5%	15	0	0	0	0	0	0	
EB Thru	10	25.0%	0	#DIV/0!	0	#DIV/0!	1.00	25.0%	10	0	0	0	0	0	0	
EB Right	15	37.5%	0	#DIV/0!	0	#DIV/0!	1.00	37.5%	15	0	0	0	0	0	0	
	40		0		0		1.000	1	40						0	
WB Left	45	16.7%	1319	98.0%	437	47.0%	0.48	8.0%	20	437	262	213	418	618	710	
WB Thru	10	3.7%	0	0.0%	0	0.0%	1.00	3.7%	10	0	0	0	0	0	0	
WB Right	215	79.6%	27	2.0%	493	53.0%	26.43	88.3%	170	493	86	0	478	77	44	
	270		1346		930		0.691	1	190						754	
NB Left	20	2.1%	0	0.0%	0	0.0%	1.00	2.1%	20	0	0	0	0	0	0	
NB Thru	855	89.5%	12136	100.0%	6017	99.0%	1.00	89.5%	430	6017	12591	14578	18330	8743	8598	120
NB Right	80	8.4%	1	0.0%	61	1.0%	121.81	8.4%	40	61	0	0	0	1	1	
	955		12137		6078		0.501	1	480						8599	
SB Left	170	10.8%	790	6.2%	810	21.0%	3.37	36.3%	170	810	208	427	2384	878	693	
SB Thru	1400	88.9%	11898	93.8%	3055	79.0%	1.00	63.4%	300	3055	11940	13963	14812	8462	8943	
SB Right	5	0.3%	0	0.0%	0	0.0%	1.00	0.3%	5	0	0	0	0	0	0	
	1575		12688		3865		0.305	1	480						9636	

Percetage adjusted manually to add to 100% on approach

Existing percentages or volumes carried forward

Manual adjustment to balance between intersections

#14 NH 28 at Ashleigh Dr

AM Traffic

Nodes From	Nodes Thru	Nodes To		7:45 AM Adjusted 2015	Exist Turn %	2015 existing model ADT	2015 existing model % ADT	2040 Alt A ADT	2040 Alt A % ADT	Change in ADT ratio	Adj Turn %	Adj Turn Vols	2040 Alt A Model	2040 Alt B Model	2040 Alt C Model	2040 Alt D Model	2040 Alt F Model	2040 NoBd Model
125	3295	1867	EB Left	10	50.0%	664	37.0%	646	40.3%	1.09	51.3%	10	646	523	988	1052	623	613
		381	EB Thru	5	25.0%	13	0.7%	9	0.6%	1.00	25.0%	5	9	8	7	9	10	10
		3378	EB Right	5	25.0%	1117	62.3%	947	59.1%	0.95	23.7%	5	947	1072	663	597	1022	1033
				20		1794		1602		0.893	1.000	20						1656
381	3295	3378	WB Left	180	63.2%	952	60.9%	885	57.6%	0.95	59.7%	170	885	1011	902	565	952	964
		125	WB Thru	5	1.8%	13	0.8%	9	0.6%	1.00	1.8%	5	9	8	100	9	10	10
		1867	WB Right	100	35.1%	599	38.3%	643	41.8%	1.09	38.5%	110	643	518	6144	1008	618	606
				285		1564		1537		0.983	1	280						1580
3378	3295	125	NB Left	5	0.6%	1121	9.2%	934	14.3%	1.56	0.6%	5	934	1391	676	597	1018	1013
		1867	NB Thru	610	73.1%	10087	82.9%	4709	72.3%	1.00	73.1%	330	4709	4314	19350	17663	6854	6685
		381	NB Right	220	26.3%	955	7.9%	867	13.3%	1.70	26.3%	120	867	1332	805	566	949	944
				835		12163		6510		0.535	1	450						8642
1867	3295	381	SB Left	100	13.6%	596	5.0%	660	17.9%	3.58	12.3%	30	660	197	5937	1008	621	626
		3378	SB Thru	630	85.7%	10619	89.4%	2358	64.1%	1.00	85.7%	200	2358	3258	19426	16605	7697	7927
		125	SB Right	5	0.7%	660	5.6%	659	17.9%	3.22	2.0%	5	659	204	982	1052	627	632
				735		11875		3677		0.310	1	230						9185

#14 NH 28 at Ashleigh Dr

PM Traffic

	4:30 PM Adjusted 2015	Exist Turn %	2015 existing model ADT	2015 existing model % ADT	2040 Alt A ADT	2040 Alt A % ADT	Change in ADT ratio	Adj Turn %	Adj Turn Vols	2040 Alt A Model	2040 Alt B Model	2040 Alt C Model	2040 Alt D Model	2040 Alt F Model	2040 NoBd Model
EB Left	40	66.7%	664	37.0%	646	40.3%	1.09	67.5%	30	646	523	988	1052	623	613
EB Thru	10	16.7%	13	0.7%	9	0.6%	1.00	16.7%	10	9	8	7	9	10	10
EB Right	10	16.7%	1117	62.3%	947	59.1%	0.95	15.8%	10	947	1072	663	597	1022	1033
	60		1794		1602		0.893	1.000	50						1656
WB Left	345	71.1%	952	60.9%	885	57.6%	0.95	67.3%	320	885	1011	902	565	952	964
WB Thru	5	1.0%	13	0.8%	9	0.6%	1.00	1.0%	5	9	8	100	9	10	10
WB Right	135	27.8%	599	38.3%	643	41.8%	1.09	31.7%	150	643	518	6144	1008	618	606
	485		1564		1537		0.983	1.000	480						1580
NB Left	5	0.5%	1121	9.2%	934	14.3%	1.56	0.7%	5	934	1391	676	597	1018	1013
NB Thru	800	75.1%	10087	82.9%	4709	72.3%	1.00	75.1%	430	4709	4314	19350	17663	6854	6685
NB Right	260	24.4%	955	7.9%	867	13.3%	1.70	24.2%	140	867	1332	805	566	949	944
	1065		12163		6510		0.535	1.000	570						8642
SB Left	110	9.1%	596	5.0%	660	17.9%	3.58	8.2%	30	660	197	5937	1008	621	626
SB Thru	1095	90.5%	10619	89.4%	2358	64.1%	1.00	90.5%	330	2358	3258	19426	16605	7697	7927
SB Right	5	0.4%	660	5.6%	659	17.9%	3.22	1.3%	5	659	204	982	1052	627	632
	1210		11875		3677		0.310	1.000	370						9185

Percetage adjusted manually to add to 100% on approach

Existing percentages or volumes carried forward

#15 NH 28 at Scobie Pond Rd

AM Traffic

Nodes From	Nodes Thru	Nodes To		7:45 AM Adjusted 2015	Exist Turn %	2015 existing model ADT	2015 existing model % ADT	2040 Alt A ADT	2040 Alt A % ADT	Change in ADT ratio	Adj Turn %	Adj Turn Vols	2040 Alt A Model	2040 Alt B Model	2040 Alt C Model	2040 Alt D Model	2040 Alt F Model	2040 NoBd Model
2099	1867	3295	WB Left	80	69.6%	2115	98.6%	850	61.5%	0.62	43.4%	30	850	1139	387	507	1026	958
		793	WB Right	35	30.4%	29	1.4%	531	38.5%	28.43	56.6%	40	531	307	1328	1681	85	95
				115		2144		1381		0.644	1.00	70						1053
3295	1867	793	NB Thru	645	94.2%	9581	84.4%	5429	90.5%	1.07	96.4%	350	5429	4912	20011	19301	7425	7245
		2099	NB Right	40	5.8%	1769	15.6%	569	9.5%	0.61	3.6%	10	569	444	327	423	669	659
				685		11350		5998		0.528	1.00	360						7904
793	1867	2099	SB Left	15	2.0%	21	0.2%	652	18.7%	87.26	20.2%	50	652	254	1099	1324	47	71
		3295	SB Thru	720	98.0%	9760	99.8%	2828	81.3%	0.81	79.8%	210	2828	2520	20020	18157	7919	8227
				735		9781		3480		0.356	1.00	260						8298

#15 NH 28 at Scobie Pond Rd

PM Traffic

	4:30 PM Adjusted 2015	Exist Turn %	2015 existing model ADT	2015 existing model % ADT	2040 Alt A ADT	2040 Alt A % ADT	Change in ADT ratio	Adj Turn %	Adj Turn Vols	2040 Alt A Model	2040 Alt B Model	2040 Alt C Model	2040 Alt D Model	2040 Alt F Model	2040 NoBd Model
WB Left	70	70.0%	2115	98.6%	850	61.5%	0.62	43.7%	30	850	1139	387	507	1026	958
WB Right	30	30.0%	29	1.4%	531	38.5%	28.43	56.3%	30	531	307	1328	1681	85	95
	100		2144		1381		0.644	1.00	60						1053
NB Thru	700	81.4%	9581	84.4%	5429	90.5%	1.07	87.3%	390	5429	4912	20011	19301	7425	7245
NB Right	160	18.6%	1769	15.6%	569	9.5%	0.61	12.7%	60	569	444	327	423	669	659
	860		11350		5998		0.528	1.00	450						7904
SB Left	40	3.4%	21	0.2%	652	18.7%	87.26	3.4%	10	652	254	1099	1324	47	71
SB Thru	1125	96.6%	9760	99.8%	2828	81.3%	0.81	96.6%	400	2828	2520	20020	18157	7919	8227
	1165		9781		3480		0.356	1.00	410						8298

Percetage adjusted manually to add to 100% on approach

Existing percentages or volumes carried forward

#16 NH 102/NH Rt 28 Bypass/E Derry Rd (circle)

AM Traffic

Nodes From	Nodes Thru	Nodes To		7:45 AM Adjusted 2015	Exist Turn %	2015 existing model ADT	2015 existing model % ADT	2040 Alt A ADT	% ADT	Change in ADT ratio	Adj Turn %	Adj Turn Vols	2040 Alt A Model	2040 Alt B Model	2040 Alt C Model	2040 Alt D Model	2040 Alt F Model	2040 NoBd Model	Manual Alt A Adjustments	
3535	1841	2143	EB Left	60	16.2%	0	0.0%	0	0.0%	1.00	16.2%	70	0	0	0	0	0	0		
		1878	EB Thru(102)	120	32.4%	3246	60.5%	3757	56.9%	0.94	30.5%	140	3757	1873	1034	2402	3392	3182		
		2054	EB Thru (EDR)	90	24.3%	1277	23.8%	1695	25.7%	1.08	26.2%	120	1695	1754	1882	1785	2091	2018		
		1842	EB Right	100	27.0%	839	15.6%	1153	17.5%	1.12	27.1%	120	1153	1063	1125	1092	1155	1051		
				370		5362		6605		1.232	1.00	460						6251		
1878	1841	2054	WB Left (EDR)	5	1.5%	0	0.0%	0	0.0%	1.00	1.5%	5	0	0	0	0	0	0		
		1842	WB Left (28 Byp S)	75	22.7%	1261	40.0%	562	20.8%	0.52	11.8%	30	562	536	546	599	654	724		
		3535	WB Thru	240	72.7%	1889	60.0%	2145	79.2%	1.32	83.7%	230	2145	984	1258	2402	1886	1655		
		2143	WB Right	10	3.0%	0	0.0%	1	0.0%	1.00	3.0%	10	1	0	0	1	0	0		
				330		3150		2708		0.860	1.000	280						2379		
1842	1841	3535	NB Left	75	20.0%	928	16.1%	1371	37.5%	2.33	45.0%	108	1371	1070	1055	1044	1042	1066	100	-10
		2143	NB Thru	245	65.3%	3939	68.2%	1382	37.8%	0.55	36.2%	90	1382	1670	2118	1890	1377	1404	100	10
		1878	NB Right (102)	50	13.3%	620	10.7%	459	12.6%	1.17	15.6%	40	459	340	485	539	518	565		
		2054	NB Right (EDR)	5	1.3%	287	5.0%	444	12.1%	2.44	3.3%	10	444	555	469	439	420	444		
				375		5774		3656		0.633	1.000	240						3479		
2143	1841	1878	SB Left (102)	15	3.4%	0	0.0%	0	0.0%	1.00	3.4%	10	0	0	0	0	0	0		
		2054	SB Left (EDR)	120	27.0%	2453	37.0%	2983	58.2%	1.57	44.4%	150	2983	2077	1980	2620	1970	1971		
		1842	SB Thru	250	56.2%	4120	62.2%	2096	40.9%	0.66	36.9%	130	2096	2334	2684	2268	1783	1796		
		3535	SB Right	60	13.5%	56	0.8%	49	1.0%	1.13	15.3%	50	49	48	66	129	70	77		
				445		6629		5128		0.774	1.000	340	5128					3844		
2054	1841	1842	EDR LT (28 B S)	10	2.1%	232	7.2%	184	3.9%	0.55	1.2%	10	184	212	260	264	241	277		
		3535	EDR LT (102 WB)	165	35.1%	1548	48.0%	3057	65.1%	1.36	54.5%	370	3057	1728	1784	1779	2631	2879	325	-45
		2143	EDR Thru (28 B N)	280	59.6%	1447	44.8%	1454	31.0%	0.69	41.1%	280	1454	1853	1885	2319	1073	1052	325	45
		1878	EDR RT (102 EB)	15	3.2%	0	0.0%	0	0.0%	1.00	3.2%	20	0	0	0	0	0	0		
				470		3227		4695		1.455	1.000	680						4208		

#16 NH 102/NH Rt 28 Bypass/E Derry Rd (circle)

PM Traffic

	4:30 PM Adjusted 2015	Exist Turn %	2015 existing model ADT	2015 existing model % ADT	2040 Alt A ADT	% ADT	Change in ADT ratio	Adj Turn %	Adj Turn Vols	2040 Alt A Model	2040 Alt B Model	2040 Alt C Model	2040 Alt D Model	2040 Alt F Model	2040 NoBd Model	Manual Alt A Adjustments
EB Left	40	6.5%	0	0.0%	0	0.0%	1.00	6.5%	50	0	0	0	0	0	0	
EB Thru(102)	245	39.5%	3246	60.5%	3757	56.9%	0.94	37.1%	280	3757	1873	1034	2402	3392	3182	
EB Thru (EDR)	265	42.7%	1277	23.8%	1695	25.7%	1.08	45.1%	340	1695	1754	1882	1785	2091	2018	
EB Right	70	11.3%	839	15.6%	1153	17.5%	1.12	11.3%	90	1153	1063	1125	1092	1155	1051	
	620		5362		6605		1.232	1.000	760						6251	
WB Left (EDR)	10	4.2%	0	0.0%	0	0.0%	1.00	4.2%	10	0	0	0	0	0	0	
WB Left (28 By)	60	25.0%	1261	40.0%	562	20.8%	0.52	13.0%	30	562	536	546	599	654	724	
WB Thru	150	62.5%	1889	60.0%	2145	79.2%	1.32	74.5%	160	2145	984	1258	2402	1886	1655	
WB Right	20	8.3%	0	0.0%	1	0.0%	1.00	8.3%	20	1	0	0	1	0	0	
	240		3150		2708		0.860	1.000	210						2379	
NB Left	70	16.5%	928	16.1%	1371	37.5%	2.33	38.4%	100	1371	1070	1055	1044	1042	1066	-10
NB Thru	265	62.4%	3939	68.2%	1382	37.8%	0.55	34.6%	90	1382	1670	2118	1890	1377	1404	10
NB Right (102)	85	20.0%	620	10.7%	459	12.6%	1.17	24.1%	70	459	340	485	539	518	565	
NB Right (EDR)	5	1.2%	287	5.0%	444	12.1%	2.44	2.9%	10	444	555	469	439	420	444	
	425		5774		3656		0.633	1.000	270						3479	
SB Left (102)	15	2.0%	0	0.0%	0	0.0%	1.00	2.0%	10	0	0	0	0	0	0	
SB Left (EDR)	375	50.7%	2453	37.0%	2983	58.2%	1.57	64.6%	370	2983	2077	1980	2620	1970	1971	
SB Thru	315	42.6%	4120	62.2%	2096	40.9%	0.66	28.0%	160	2096	2334	2684	2268	1783	1796	
SB Right	35	4.7%	56	0.8%	49	1.0%	1.13	5.3%	30	49	48	66	129	70	77	
	740		6629		5128		0.774	1.000	570						3844	
EDR LT (28 B S)	10	2.0%	232	7.2%	184	3.9%	1.00	2.0%	10	184	212	260	264	241	277	
EDR LT (102 WB)	195	39.4%	1548	48.0%	3057	65.1%	1.36	56.3%	320	3057	1728	1784	1779	2631	2879	-55
EDR Thru (28 B N)	270	54.5%	1447	44.8%	1454	31.0%	0.69	37.7%	210	1454	1853	1885	2319	1073	1052	55
EDR RT (102 EB)	20	4.0%	0	0.0%	0	0.0%	1.00	4.0%	20	0	0	0	0	0	0	
	495		3227		4695		1.455	1.000	720						4208	

Percetage adjusted manually to add to 100% on approach

Existing percentages or volumes carried forward

Adjusted NB LT volume to divert excess trips destined for Franklin via Rollins and Rt 102 WB onto Crystal (34% of total)

#17 **NH 28 Bypass/Pinkerton St/Nesmith St**

Nodes From	Nodes Thru	Nodes To		7:45 AM Adjusted 2015	Exist Turn %	2015 existing model ADT	2015 existing model % ADT	AM Traffic 2040 Alt A ADT	% ADT	Change in ADT ratio	Adj Turn %	Adj Turn Vols	2040 Alt A Model	2040 Alt B Model	2040 Alt C Model	2040 Alt D Model	2040 Alt F Model	2040 NoBd Model	Manual Alt A Adjustments		
2110	1840	3532	EB Left	10	4.8%	331	11.6%	109	2.9%	0.25	1.2%	10	109	107	146	149	129	133			
			EB Thru	15	7.1%	0	0.0%		0.0%	1.00	7.1%	20						0			
		2143	EB Right	185	88.1%	2534	88.4%	3662	97.1%	1.10	91.7%	260	3662	2972	3153	3371	2038	2040		5128	
				210		2865		3771		1.316	1.000	280						2173			
	1840		WB Left	5	5.3%	0	#DIV/0!	0	#DIV/0!	1.00	5.3%	10						0			
			WB Thru	40	42.1%	0	#DIV/0!	0	#DIV/0!	1.00	42.1%	40						0			
			WB Right	50	52.6%	0	#DIV/0!	0	#DIV/0!	1.00	52.6%	50						0			
				95		0		0		1.000	1.000	100						0			
2143	1840	2110	NB Left	230	38.7%	2353	43.7%	1881	66.3%	1.52	62.3%	190	1881	2597	3004	3223	1399	1403	55	275.8065	280
		3532	NB Thru	360	60.5%	3033	56.3%	955	33.7%	0.60	36.2%	110	955	926	999	986	1051	1053		159.6774	160
			NB Right	5	0.8%	0	0.0%		0.0%	1.00	1.5%	5						0		7.258065	10
				595		5386		2836		0.527	1.000	310						2456		450	450
																				1.451613	
3532	1840		SB Left	10	3.2%	0	0.0%	0	0.0%	1.00	3.2%	10						0		442.7419	
		2143	SB Thru	255	82.3%	4095	92.9%	1466	92.5%	1.00	81.9%	90	1466	1487	1577	1645	1785	1804			
		2110	SB Right	45	14.5%	313	7.1%	119	7.5%	1.00	14.9%	20	119	135	146	144	180	222			
				310		4408		1585		0.360	1.000	110						2026			

#17 **NH 28 Bypass/Pinkerton St/Nesmith St**

	4:30 PM Adjusted 2015	Exist Turn %	2015 existing model ADT	2015 existing model % ADT	PM Traffic 2040 Alt A ADT	% ADT	Change in ADT ratio	Adj Turn %	Adj Turn Vols	2040 Alt A Model	2040 Alt B Model	2040 Alt C Model	2040 Alt D Model	2040 Alt F Model	2040 NoBd Model	Manual Alt A Adjustments		
EB Left	10	2.1%	331	11.6%	109	2.9%	0.25	1.6%	10	109	107	146	149	129	133			
EB Thru	40	8.2%	0	0.0%	0	0.0%	1.00	8.2%	50	0	0	0	0	0	0			
EB Right	435	89.7%	2534	88.4%	3662	97.1%	1.10	90.2%	580	3662	2972	3153	3371	2038	2040			
	485		2865		3771		1.316	1.000	640						2173			
WB Left	5	9.1%	0	#DIV/0!	0	#DIV/0!	1.00	9.1%	10	0	0	0	0	0	0			
WB Thru	30	54.5%	0	#DIV/0!	0	#DIV/0!	1.00	54.5%	30	0	0	0	0	0	0			
WB Right	20	36.4%	0	#DIV/0!	0	#DIV/0!	1.00	36.4%	20	0	0	0	0	0	0			
	55		0		0		1.000	1.000	60						0			
NB Left	185	31.1%	2353	43.7%	1881	66.3%	1.52	58.1%	180	1881	2597	3004	3223	1399	1403	65	214.8387	215
NB Thru	400	67.2%	3033	56.3%	955	33.7%	0.60	40.2%	120	955	926	999	986	1051	1053		143.2258	145
NB Right	10	1.7%	0	0.0%	0	0.0%	1.00	1.7%	10	0	0	0	0	0	0		11.93548	10
	595		5386		2836		0.527	1.000	310						2456		370	370
																	1.193548	
SB Left	25	7.5%	0	0.0%	0	0.0%	1.00	7.5%	25	0	0	0	0	0	0		370	
SB Thru	295	88.1%	4095	92.9%	1466	92.5%	1.00	88.1%	110	1466	1487	1577	1645	1785	1804			
SB Right	15	4.5%	313	7.1%	119	7.5%	1.00	4.5%	10	119	135	146	144	180	222			
	335		4408		1585		0.360	1.000	120						2026			

Percetage adjusted manually to add to 100% on approach
Existing percentages or volumes carried forward
Manual adjustment to balance to traffic circle
Adjusted NB LT volume to divert excess trips destined for Franklin via Rollins and Rt 102 WB onto Crystal (34% of total)

#18 NH 28 Bypass at Tsienneto Rd

AM Traffic

Nodes From	Nodes Thru	Nodes To		7:45 AM Adjusted 2015	Exist Turn %	2015 existing model ADT	2015 existing model % ADT	2040 Alt A ADT	2040 Alt A % ADT	Change in ADT ratio	Adj Turn %	Adj Turn Vols	2040 Alt A Model	2040 Alt B Model	2040 Alt C Model	2040 Alt D Model	2040 Alt F Model	2040 NBld Model
2108	1839	1838	EB Left	120	40.0%	1564	41.2%	1080	15.7%	0.38	28.0%	150	1080	159	202	475	1070	1096
		2086	EB Thru	100	33.3%	1630	43.0%	5298	77.1%	1.79	59.8%	320	5298	2144	3385	4367	3469	3786
		3532	EB Right	80	26.7%	601	15.8%	497	7.2%	0.46	12.2%	70	497	532	542	527	582	585
				300		3795		6875		1.812	1.000	540						
2086	1839	3532	WB Left	80	18.2%	387	8.9%	310	4.4%	0.50	9.1%	60	310	310	318	348	372	370
		2108	WB Thru	270	61.4%	3623	83.0%	6341	90.4%	1.09	66.8%	470	6341	3975	3287	6292	5854	5536
		1838	WB Right	90	20.5%	355	8.1%	366	5.2%	0.64	24.1%	170	366	252	151	193	200	210
				440		4365		7017		1.608	1.000	710						
3532	1839	2108	NB Left	100	29.4%	0	0.0%	0	0.0%	1.00	29.4%	30	0	0	0	0	0	0
		1838	NB Thru	220	64.7%	2910	88.7%	623	66.3%	0.75	53.0%	50	623	597	675	615	708	716
		2086	NB Right	20	5.9%	370	11.3%	316	33.7%	2.98	17.5%	20	316	315	310	346	362	361
				340		3280		939		0.286	1.000	100						
1838	1839	2086	SB Left	25	5.1%	1044	23.0%	554	25.6%	1.12	5.7%	10	554	756	474	2003	935	752
		3532	SB Thru	210	42.9%	3049	67.1%	588	27.2%	0.41	17.4%	40	588	577	591	583	761	821
		2108	SB Right	255	52.0%	453	10.0%	1018	47.1%	4.73	76.9%	180	1018	149	197	349	472	476
				490		4546		2160		0.475	1.000	230						

#18 NH 28 Bypass at Tsienneto Rd

PM Traffic

	4:30 PM Adjusted 2015	Exist Turn %	2015 existing model ADT	2015 existing model % ADT	2040 Alt A ADT	2040 Alt A % ADT	Change in ADT ratio	Adj Turn %	Adj Turn Vols	2040 Alt A Model	2040 Alt B Model	2040 Alt C Model	2040 Alt D Model	2040 Alt F Model	2040 NBld Model
EB Left	280	40.0%	1564	41.2%	1080	15.7%	0.38	15.2%	190	1080	159	202	475	1070	1096
EB Thru	345	49.3%	1630	43.0%	5298	77.1%	1.79	79.9%	1010	5298	2144	3385	4367	3469	3786
EB Right	75	10.7%	601	15.8%	497	7.2%	0.46	4.9%	60	497	532	542	527	582	585
	700		3795		6875		1.812	1.000	1270						
WB Left	25	9.3%	387	8.9%	310	4.4%	0.50	4.6%	20	310	310	318	348	372	370
WB Thru	175	64.8%	3623	83.0%	6341	90.4%	1.09	78.8%	340	6341	3975	3287	6292	5854	5536
WB Right	70	25.9%	355	8.1%	366	5.2%	0.64	16.6%	70	366	252	151	193	200	210
	270		4365		7017		1.608	1.000	430						
NB Left	100	22.5%	0	0.0%	0	0.0%	1.00	22.5%	30	0	0	0	0	0	0
NB Thru	320	71.9%	2910	88.7%	623	66.3%	0.75	53.8%	70	623	597	675	615	708	716
NB Right	25	5.6%	370	11.3%	316	33.7%	2.98	23.8%	30	316	315	310	346	362	361
	445		3280		939		0.286	1.000	130						
SB Left	75	16.9%	1044	23.0%	554	25.6%	1.00	16.9%	40	554	756	474	2003	935	752
SB Thru	185	41.6%	3049	67.1%	588	27.2%	0.41	16.9%	40	588	577	591	583	761	821
SB Right	185	41.6%	453	10.0%	1018	47.1%	4.73	66.3%	140	1018	149	197	349	472	476
	445		4546		2160		0.475	1.000	210						

Percetage adjusted manually to add to 100% on approach

Existing percentages or volumes carried forward

#19 NH 102 at Tsienneto Rd

AM Traffic

Nodes From	Thru	To		7:45 AM Adjusted 2015	Exist Turn %	2015 existing model ADT	2015 existing model % ADT	2040 Alt A ADT	% ADT	Change in ADT ratio	Adj Turn %	Adj Turn Vols	2040 Alt A Model	2040 Alt B Model	2040 Alt C Model	2040 Alt D Model	2040 Alt F Model	2040 NBld Model
1882	1883	2082	EB Left	15	8.3%	404	7.9%	173	4.2%	0.53	4.4%	10	173	601	495	202	325	282
		1884	EB Thru	165	91.7%	4687	92.1%	3917	95.8%	1.04	95.4%	130	3917	1895	1639	3497	3962	3825
				180		5091		4090		0.803	1.00	140						
1884	1883	1882	WB Thru	320	51.6%	3861	55.7%	2954	34.2%	0.61	31.7%	240	2954	1706	2079	3185	3075	2811
		2082	WB Right	300	48.4%	3071	44.3%	5681	65.8%	1.49	68.3%	530	5681	7788	7145	5545	5011	4751
				620		6932		8635		1.246	1.00	770						
2082	1883	1884	SB Left	95	100.0%	1934	88.3%	4803	96.7%	1.09	100.0%	220	4803	7507	7450	5441	3682	3867
		1882	SB Right	0	0.0%	256	11.7%	166	3.3%	0.29	0.0%	0	166	431	439	174	173	172
				95		2190		4969		2.269	1.00	220						

#19 NH 102 at Tsienneto Rd

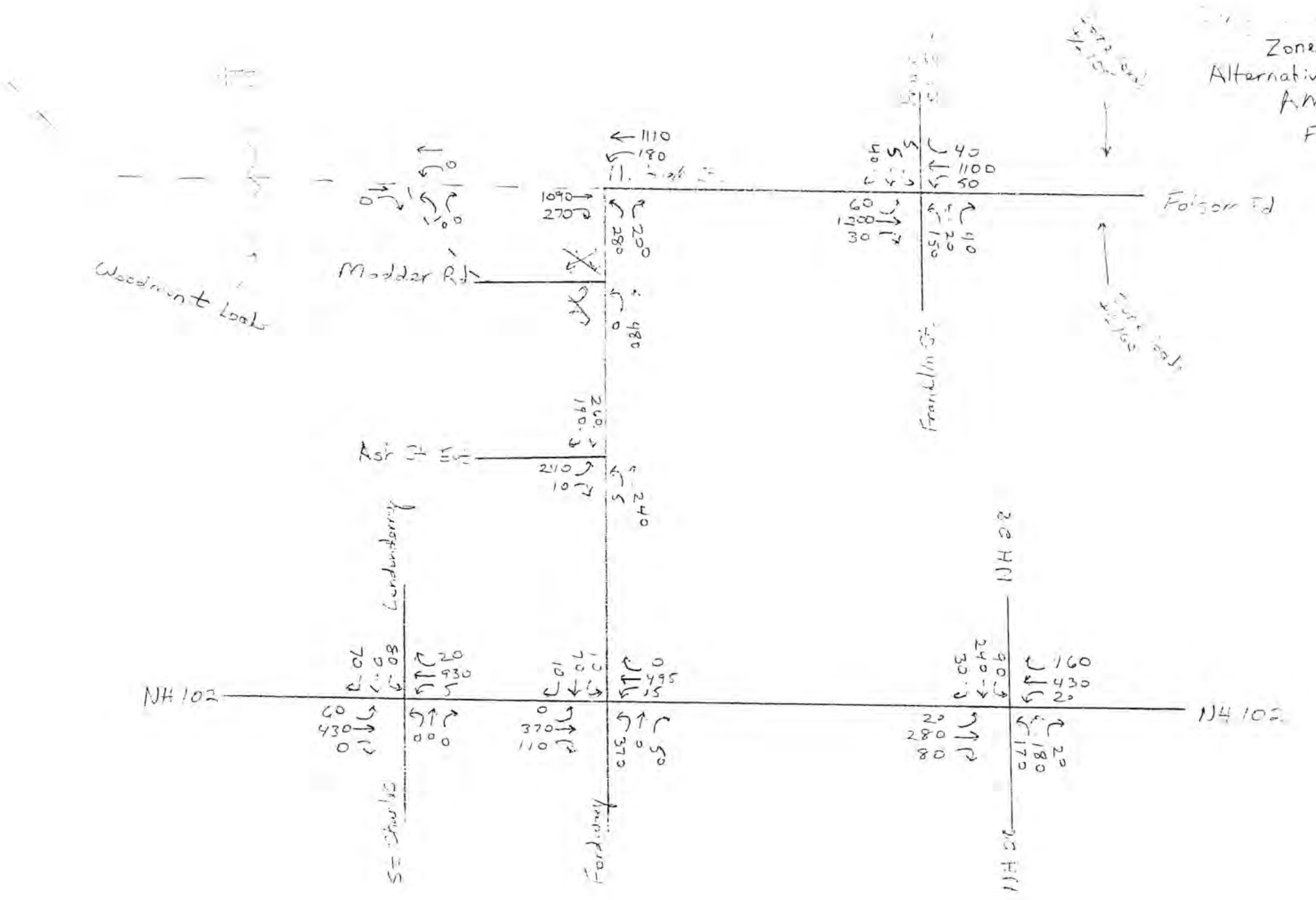
PM Traffic

	4:30 PM Adjusted 2015	Exist Turn %	2015 existing model ADT	2015 existing model % ADT	2040 Alt A ADT	% ADT	Change in ADT ratio	Adj Turn %	Adj Turn Vols	2040 Alt A Model	2040 Alt B Model	2040 Alt C Model	2040 Alt D Model	2040 Alt F Model	2040 NBld Model
EB Left	15	4.0%	404	7.9%	173	4.2%	0.53	2.1%	10	173	601	495	202	325	282
EB Thru	360	96.0%	4687	92.1%	3917	95.8%	1.04	97.9%	290	3917	1895	1639	3497	3962	3825
	375		5091		4090		0.803	1.00	300						
WB Thru	235	55.3%	3861	55.7%	2954	34.2%	0.61	34.0%	180	2954	1706	2079	3185	3075	2811
WB Right	190	44.7%	3071	44.3%	5681	65.8%	1.49	66.0%	350	5681	7788	7145	5545	5011	4751
	425		6932		8635		1.246	1.00	530						
SB Left	270	98.2%	1934	88.3%	4803	96.7%	1.09	99.5%	620	4803	7507	7450	5441	3682	3867
SB Right	5	1.8%	256	11.7%	166	3.3%	0.29	0.5%	0	166	431	439	174	173	172
	275		2190		4969		2.269	1.00	620						

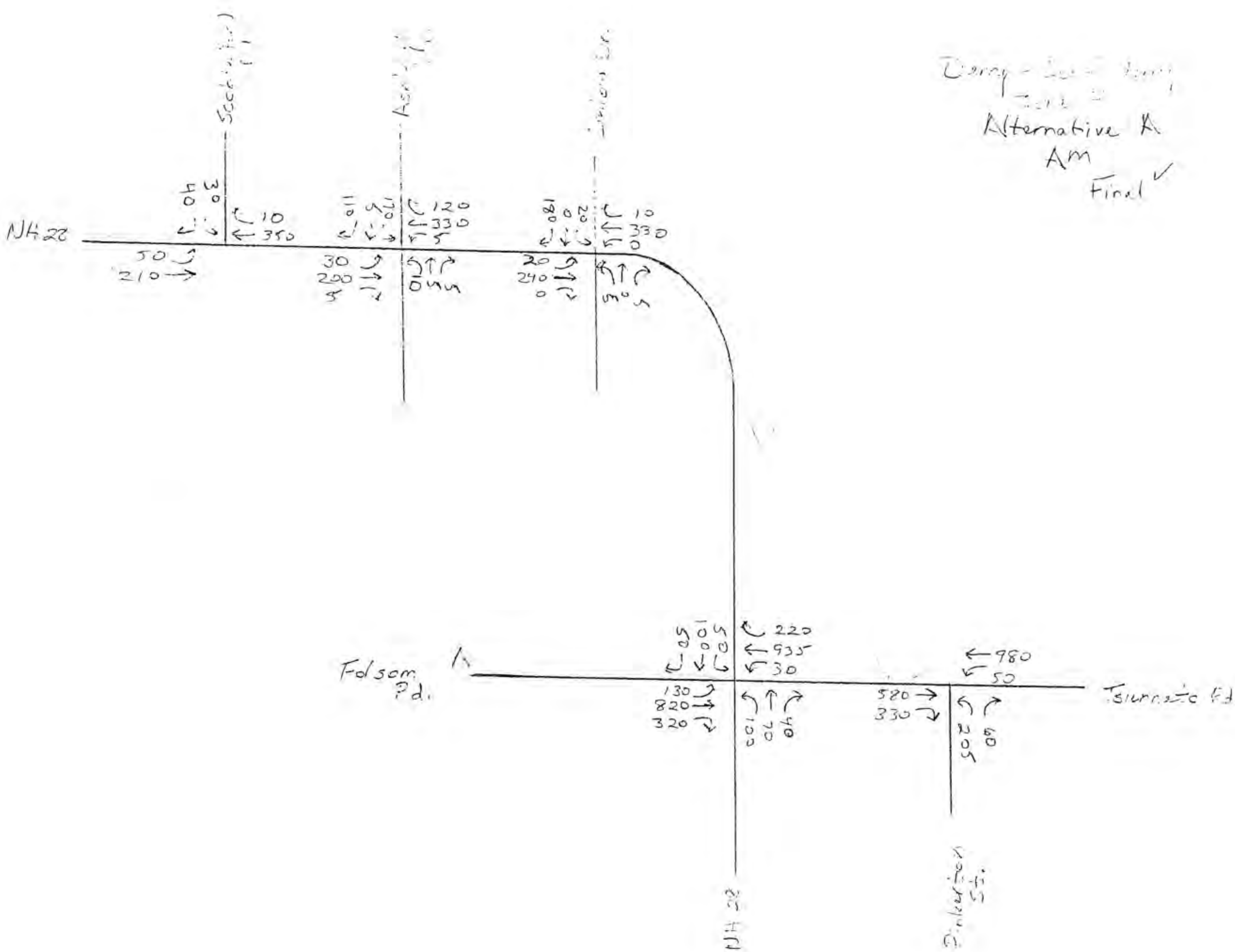
Percetage adjusted manually to add to 100% on approach

Existing percentages or volumes carried forward

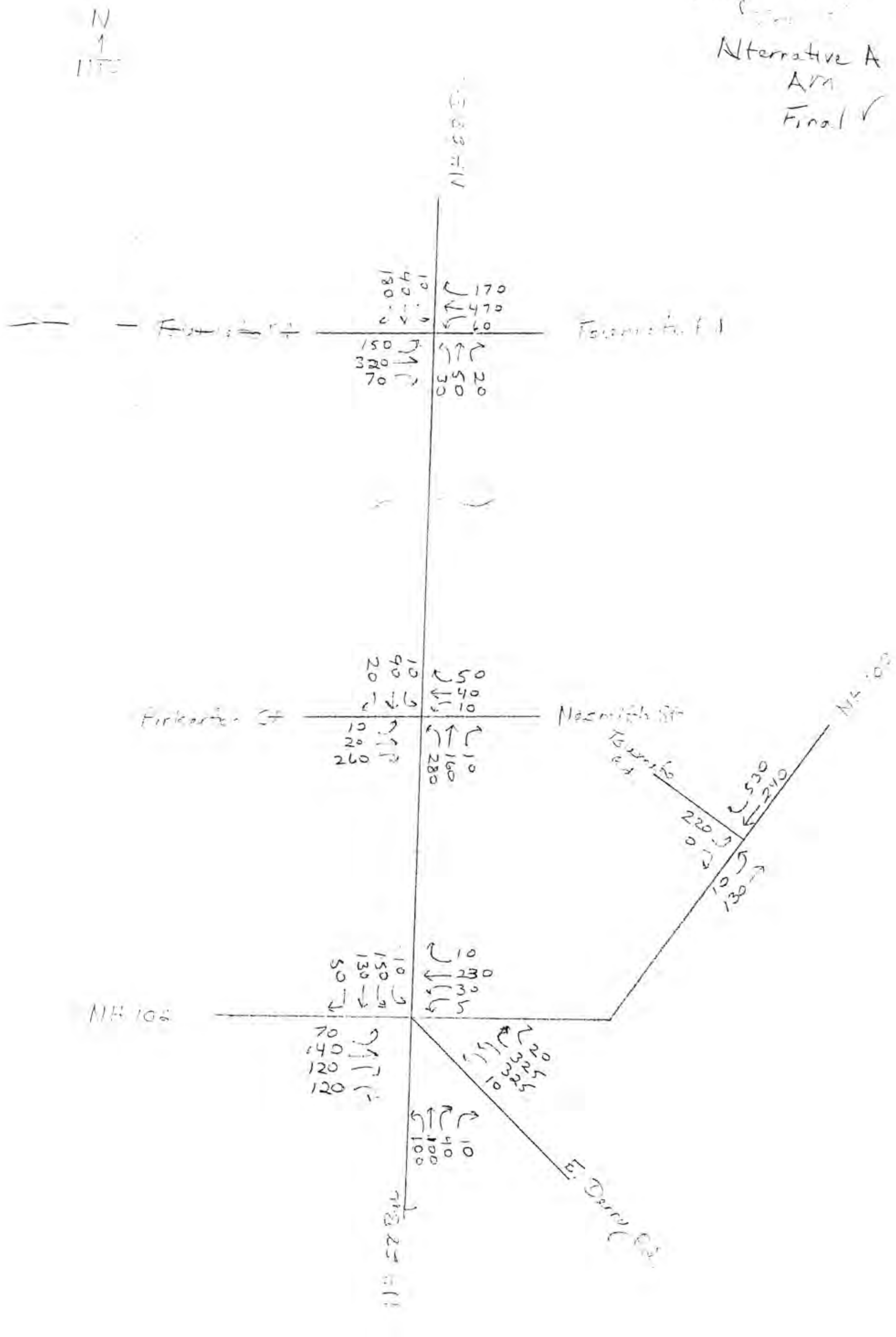
Zone 3
Alternative A
AM
Final ✓

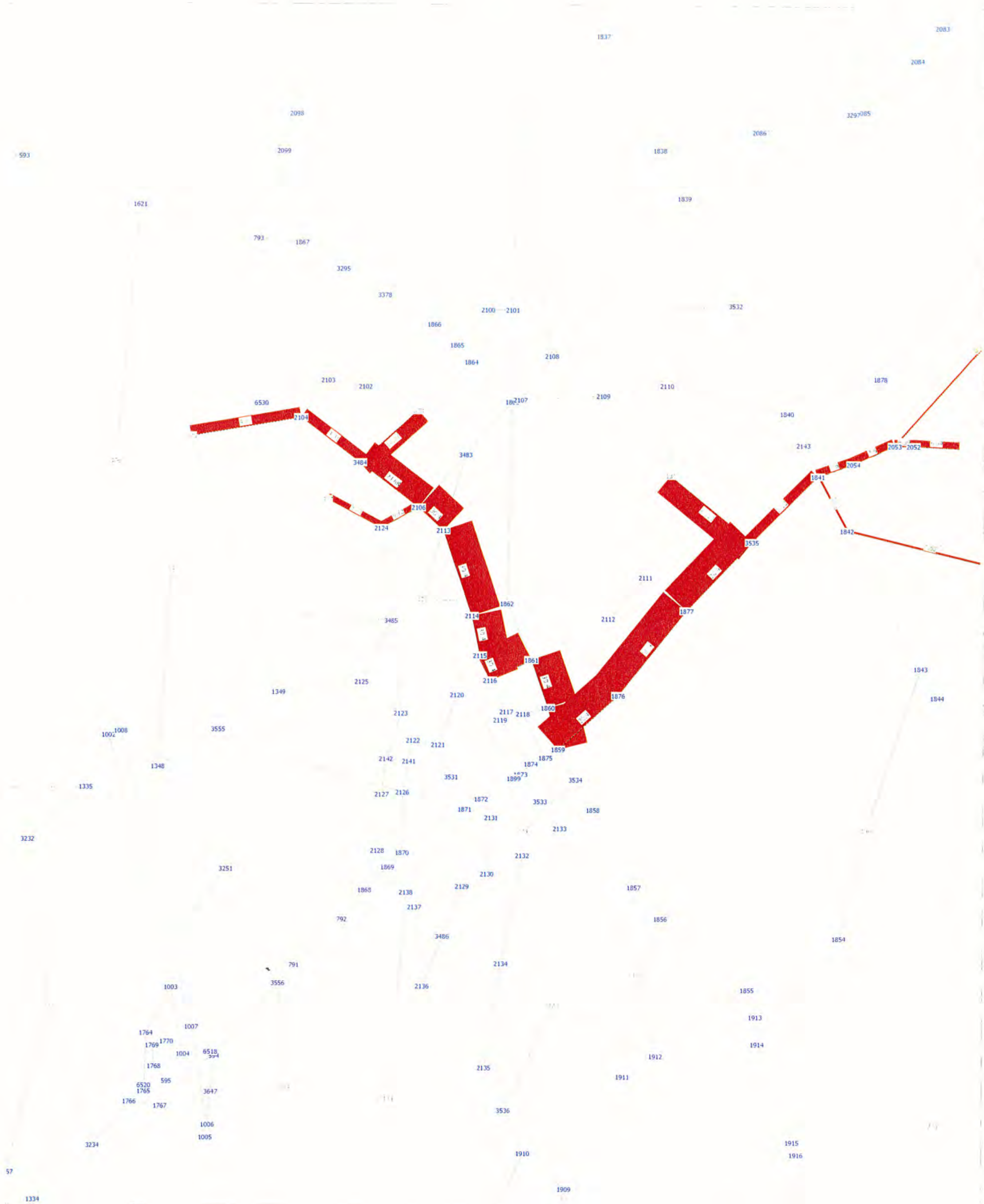


Alternative A
AM
Final ✓



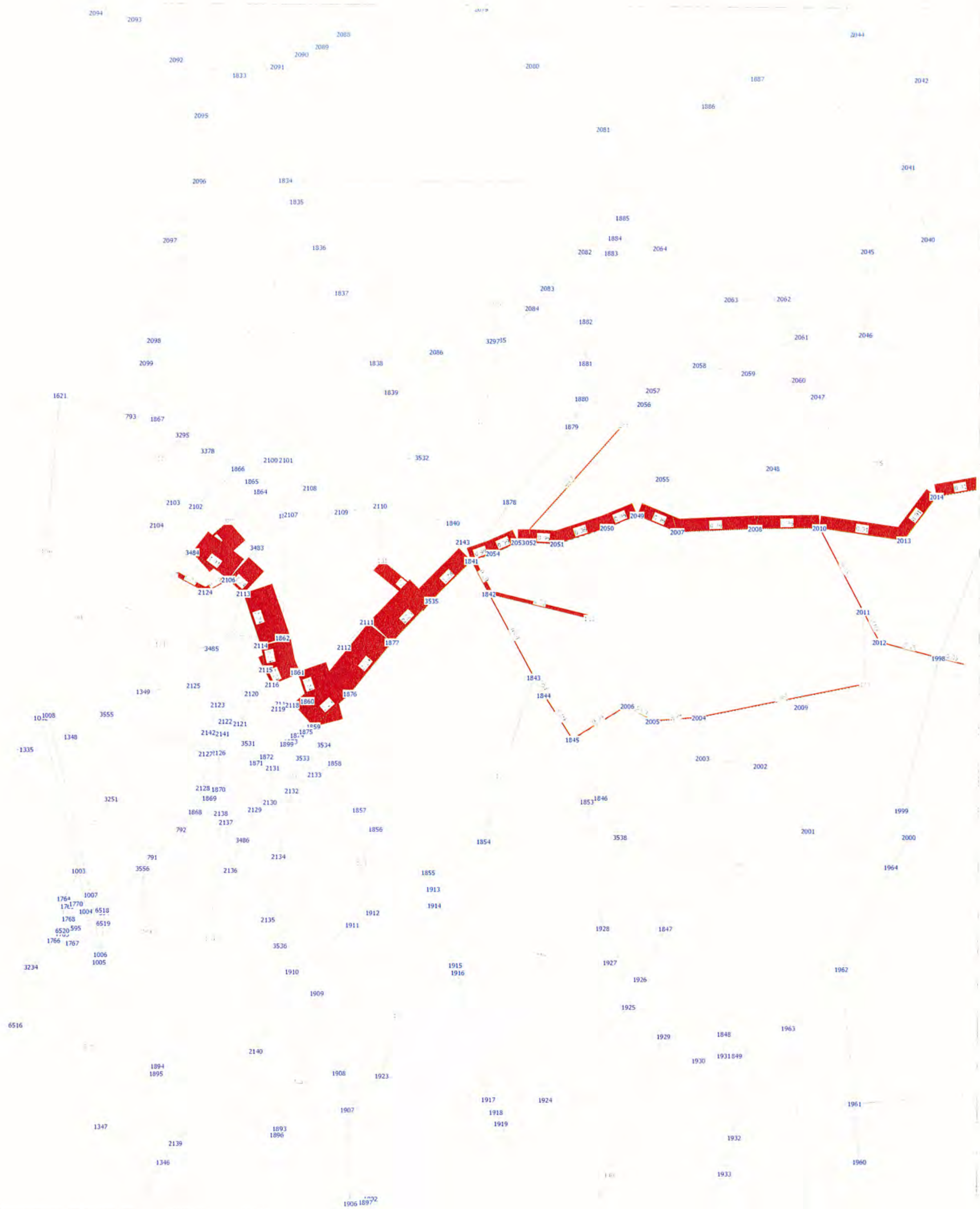
Alternative A
AM
Final



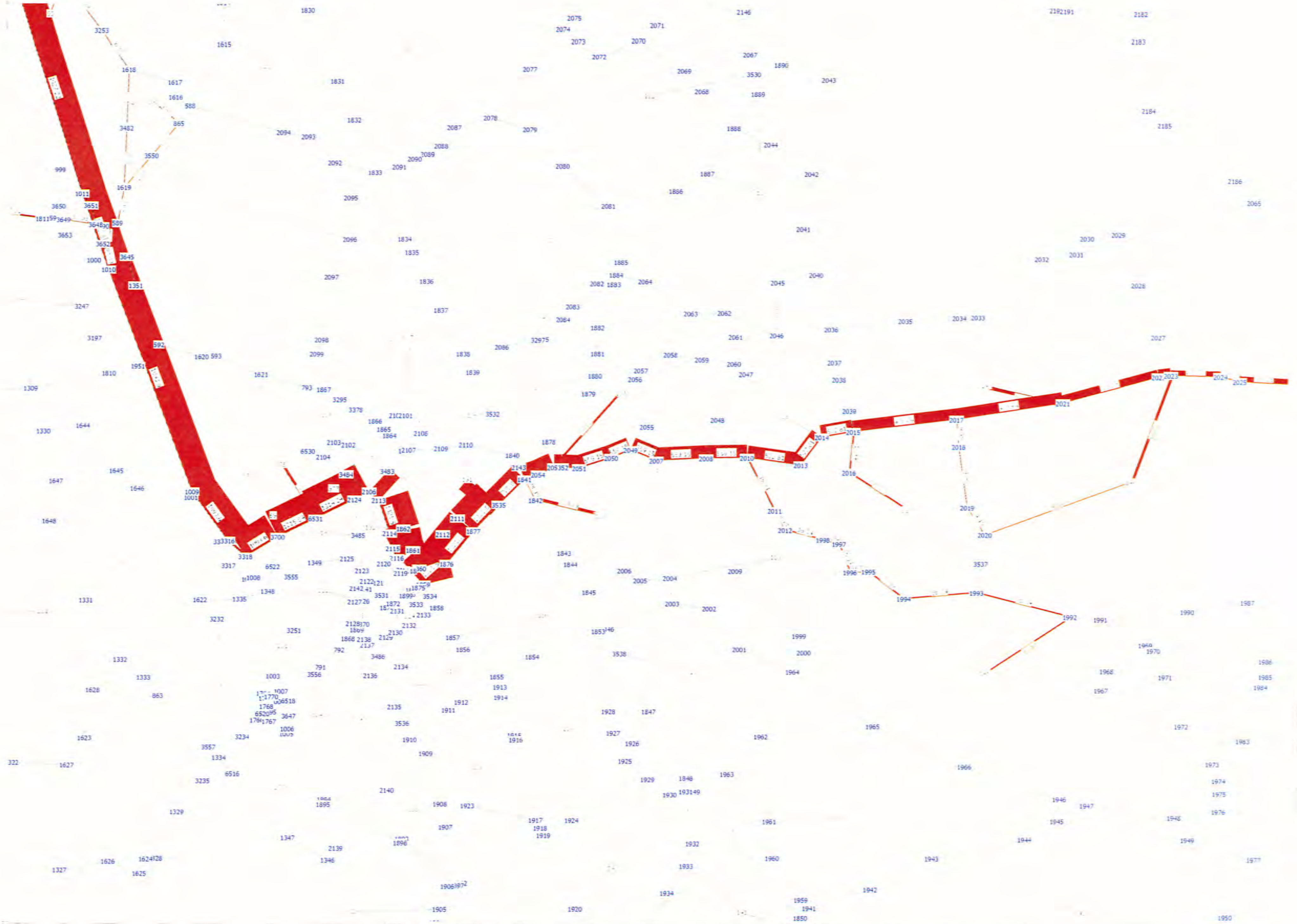


WB1876-1859 - 2040 No. Build

cube



WB1876-1859 - 2015



2040 Alt A WB 1859-1876

cube

APPENDIX L: HCS FREEWAY FACILITY APPENDIX

19-Jun-17

TABLE 10

HCS 2010 - FREEWAY FACILITIES ANALYSIS - 2040 NO-BUILD AND BUILD (South Interchange) CASES - AM and PM PEAK HOURS

		2040 No Build						4A Alternative A						4A Alternative B					
		AM Peak Hour (LOS) / (d/c ratio)			PM Peak Hour (LOS) / (d/c ratio)			AM Peak Hour (LOS) / (d/c ratio)			PM Peak Hour (LOS) / (d/c ratio)			AM Peak Hour (LOS) / (d/c ratio)			PM Peak Hour (LOS) / (d/c ratio)		
Segment	Northbound Direction	BASIC	DIVERGE	MERGE	BASIC	DIVERGE	MERGE	BASIC	DIVERGE	MERGE	BASIC	DIVERGE	MERGE	BASIC	DIVERGE	MERGE	BASIC	DIVERGE	MERGE
1	I-93 Mainline south of Exit 4	B/0.37			C/0.63			B/0.38			C/0.66			B/0.38			C.0.66		
2	Exit 4 NB off-ramp		A/0.26			B/0.61			A0.23			B/0.67			A/0.23			B/0.67	
3	I-93 Mainline between Exit 4 ramps	A/0.28			B/0.37			A/0.30			B/0.42			A/0.30			B/0.42		
4	Exit 4 NB on-ramp			C/1.25			C/0.99			B/0.89			C/0.70			C/1.03			C/0.81
5	I-93 Mainline between Exit 4 on-ramp and Exit 4A off-ramp							B/0.49			C/0.56			C/0.52			C/0.59		
6	Exit 4A NB off-ramp	N/A							C/0.48			C/0.41			C/0.52			C/0.44	
7	I-93 Mainline between Exit 4A ramps							B/0.40			B/0.48			B/0.43			B/0.50		
8	Exit 4A NB on-ramp									C/0.84			C/0.72			C/0.73			B/0.50
9	I-93 Mainline between Exit 4(4A) NB on- and Exit 5 NB off-ramps	B/0.55			C/0.57			C/0.56			C/0.62			C/0.56			C/0.62		
10	Exit 5 NB off-ramp		C/0.37			C/0.49			C/0.43			D/0.58			C/0.41			D/0.54	
11	I-93 Mainline between Exit 5 ramps	B/0.48			B/0.49			B/0.49			C/0.53			B/0.49			C/0.54		
12	Exit 5 NB on-ramp			C/0.83			C/0.62			C/0.67			C0.50			C/0.65			C/0.48
13	I-93 Mainline north of Exit 5	C/0.64			C/0.62			C/0.62			C/0.65			C/0.62			C/0.65		
	Facility operations	B			C			B			C			B			C		
	Space Mean Speed (mph)	68.4			68.6			68.5			67.9			67.6			67.9		
	Density (veh/mi/hr)	15.8			19.2			16.4			20.2			17.3			20.4		
Segment	Southbound Direction																		
1	I-93 Mainline north of Exit 6	C/0.59			C/0.64			C/0.62			C/0.62			C/063			C/0.62		
2	Exit 5 SB off-ramp		D/0.73			D/0.74			C/0.41			C/0.62			C/0.32			C/033	
3	I-93 Mainline between Exit 5 ramps	B/0.46			B/0.49			C/0.55			C/0.53			C/0.57			C/0.55		
4	Exit 5 SB on-ramp			C/0.45			C/0.38			C/0.52			B/0.44			B/0.40			B/0.34
5	I-93 Mainline between Exit 5 SB on- and Exit 4A SB off-ramps							C/0.65			C/0.61			C/0.65			C/0.62		
6	Exit 4A SB off-ramp	N/A							D/1.07			D/0.89			D/1.09			D/0.91	
7	I-93 Mainline between Exit 4A ramps							B/0.46			B/0.44			B/0.45			B/0.44		
8	Exit 4A SB on-ramp									C/0.60			C/0.51			C/0.70			C/0.58
9	I-93 Mainline between Exit 5(4A) SB on- and Exit 4 SB off-ramps	C/0.55			C/0.56			C/0.57			D/0.54			C/0.58			D/055		
10	Exit 4 SB off-ramp		C/0.84			D/1.10			C/0.76			C/0.91			C/0.81			D/0.98	
11	I-93 Mainline between Exit 4 SB off- and SB on ramp from east	B/0.36			B/0.33			B/0.43			B/0.36			B/0.43			B/0.36		
12	Exit 4 SB on-ramp from east			B/0.66			B/0.30			B/0.49			A/0.16			B/0.37			A/0.17
13	I-93 Mainline between Exit 4 SB on-ramps	B/0.48			B/0.38			B/0.49			B/0.39			B/0.49			B/0.39		
14	Exit 4 SB on-ramp from west			C/0.85			B/0.40			C/0.93			B/0.44			C/0.92		B/0.43	
15	I-93 Mainline south of Exit 5	C/0.64			B/0.46			C/0.66			B/0.47			C/0.66			B/0.47		
	Facility operations	C			C			C			C			C			C		
	Space Mean Speed (mph)	68.5			68.3			67.4			68.6			67.3			68.4		
	Density (veh/mi/hr)	18.8			19.1			20.6			18.4			20.9			18.9		

19-Jun-17

TABLE 10 (cont.)

HCS 2010 - FREEWAY FACILITIES ANALYSIS - 2040 NO-BUILD AND BUILD (North or No Interchange) CASES - AM and PM PEAK HOURS

		2040 No Build						4A Alternative C						4A Alternative D						4A Alternative F					
		AM Peak Hour (LOS) / (d/c ratio)			PM Peak Hour (LOS) / (d/c ratio)			AM Peak Hour (LOS) / (d/c ratio)			PM Peak Hour (LOS) / (d/c ratio)			AM Peak Hour (LOS) / (d/c ratio)			PM Peak Hour (LOS) / (d/c ratio)			AM Peak Hour (LOS) / (d/c ratio)			PM Peak Hour (LOS) / (d/c ratio)		
Segment	Northbound Direction	BASIC	DIVERGE	MERGE	BASIC	DIVERGE	MERGE	BASIC	DIVERGE	MERGE	BASIC	DIVERGE	MERGE	BASIC	DIVERGE	MERGE	BASIC	DIVERGE	MERGE	BASIC	DIVERGE	MERGE	BASIC	DIVERGE	MERGE
1	I-93 Mainline south of Exit 4	B/0.37			C/0.63			B/0.37			C/0.64			B/0.37			C/0.64			B/037			C/0.64		
2	Exit 4 NB off-ramp		A/0.26			B/0.61			A/0.24			B/0.56			A/0.25			B/0.59			A/0.26			B/0.62	
3	I-93 Mainline between Exit 4 ramps	A/0.28			B/0.37			A/0.28			B/0.39			A/0.28			B/0.38			A/0.28			B/037		
4	Exit 4 NB on-ramp			C/1.25			C/0.99			B/0.93			B/0.73			B/0.90			B/0.71			C/1.25			C/0.99
5	I-93 Mainline between Exit 4 on-ramp and Exit 4A off-ramp							B/0.49			C/0.54			B/0.48			B/0.52			B/0.55			C/0.57		
6	Exit 4A NB off-ramp				N/A				B/0.15			C/0.13			B/0.08			B/0.07							
7	I-93 Mainline between Exit 4A ramps							B/0.46			B/0.51			B/0.46			B/0.51								
8	Exit 4A NB on-ramp									C/0.74			C/0.63			C/0.76			C/0.64						
9	I-93 Mainline between Exit 4(4A) NB on- and Exit 5 NB off-ramps	B/0.55			C/0.57			C/0.60			C/0.64			C/0.60			C/0.64								
10	Exit 5 NB off-ramp		C/0.37			C/0.49			C/0.40			C/0.51			C/0.41			D/0.55			C/0.36			C/0.48	
11	I-93 Mainline between Exit 5 ramps	B/0.48			B/0.49			C/0.53			C/0.56			C/0.53			C/0.55			B/0.49			B/0.49		
12	Exit 5 NB on-ramp			C/0.83			C/0.62			C/0.48			C/0.36			C/0.49			C/0.39			C/0.82			C/0.62
13	I-93 Mainline north of Exit 5	C/0.64			C/0.62			C/0.63			C/0.63			C/0.63			C/0.63			C/0.65			C/0.62		
	Facility operations	B			C			B			C			B			C			B			C		
	Space Mean Speed (mph)	68.4			68.6			68.4			68.3			68.6			68.4			68.4			68.6		
	Density (veh/mi/hr)	15.8			19.2			16.4			19.7			16.4			19.5			15.8			19.2		
Segment	Southbound Direction																								
1	I-93 Mainline north of Exit 6	C/0.59			C/0.64			C/0.62			C/0.61			C/0.62			C/0.61			C/0.58			C/064		
2	Exit 5 SB off-ramp		D/0.73			D/0.74			C/0.31			C/0.31			C/0.31			C/0.32			C/0.66			C/0.67	
3	I-93 Mainline between Exit 5 ramps	B/0.46			B/0.49			C/0.57			C/0.55			C/0.57			C/0.55			B/0.47			B/0.50		
4	Exit 5 SB on-ramp			C/0.45			C/0.38			C/0.45			C/0.38			C/0.44			C/0.38			B/0.45			B/0.38
5	I-93 Mainline between Exit 5 SB on- and Exit 4A SB off-ramps							C/0.66			C/0.63			C/0.66			C/0.62			C/0.55			C/0.57		
6	Exit 4A SB off-ramp				N/A				D/0.92			D/0.79			D/0.91			D/0.78							
7	I-93 Mainline between Exit 4A ramps							B/0.48			B/0.46			B/0.48			B/0.46								
8	Exit 4A SB on-ramp									B/0.27			B/0.23			B/0.25			B/0.21						
9	I-93 Mainline between Exit 5(4A) SB on- and Exit 4 SB off-ramps	C/0.55			C/0.56			B/0.52			B/0.51			B/0.52			B/0.50								
10	Exit 4 SB off-ramp		C/0.84			D/1.10			C/0.64			C/0.76			C/0.63			C/0.75			C/0.85			D/1.12	
11	I-93 Mainline between Exit 4 SB off- and SB on ramp from east	B/0.36			B/0.33			B/0.40			B/0.34			B/0.40			B/0.34			B/0.36			B/0.33		
12	Exit 4 SB on-ramp from east			B/0.66			B/0.30			B/0.46			B/0.21			B/0.46			B/0.21			B/0.67			B/0.30
13	I-93 Mainline between Exit 4 SB on-ramps	B/0.48			B/0.38			C/0.48			B/0.38			B/0.48			B/0.38			B/0.48			B/0.38		
14	Exit 4 SB on-ramp from west			C/0.85		B/0.40				C/0.86			B/0.40			C/0.85			B/0.40			C/0.84			B/0.39
15	I-93 Mainline south of Exit 5	C/0.64			B/0.46			C/0.64			B/0.46			C/0.64			B/0.46			C/0.64			B/0.46		
	Facility operations	C			C			C			C			C			C			C			B		
	Space Mean Speed (mph)	68.5			68.3			67.9			68.5			67.9			68.6			68.5			68.4		
	Density (veh/mi/hr)	18.8			19.1			19.9			17.8			19.8			17.8			18.8			19.1		

4A 2015 Freeway Facility - Northbound

Station	Length	Node	Description	Accel/Decel		Lanes	FFS	%Trucks/RV	PHF						
1526+70		a													
	5280	1	Basic Highway			1 lanes	70 mph	4.11 / 0.57		AM & PM From Permanent Recorder Station South of Exit 4					
1579+50		b							0.94	Default Value for all Mainline Segments per NHDOT					
	1500	2	Diverge- Exit 4 off Ramp	Decel	814	1 lane	50 mph	7.4	0.77	AM	NB Right and Left intersection turning movements				
1594+50	PVM	c						1.8	0.92	PM					
	3275	3	Basic Highway					4.11 / 0.57		AM & PM From Permanent Recorder Station South of Exit 4					
1627+25	PVM	d													
	1500	4	Merge - Exit 4 on Ramp	Accel	1400	1 lane	50 mph	3.4	0.90	AM	WB Right intersection turning movements				
1642+25		e						2.5	0.87	PM					
	13025	5	Basic Highway					7.5 / 0.0		AM From Noise Study Counts Location A-B					
1772+50		f						3 / 0.3		PM From Noise Study Counts Location A-B					
	1500	6	Diverge- Exit 5 off Ramp	Decel	480	1 lane	50 mph	9.1	0.75	AM	NB Right and Left intersection turning movements				
1787+50		g						7.5	0.67	PM					
	4100	7	Basic Highway					7.5 / 0.0		AM From Noise Study Counts Location A-B					
1828+50		h						3 / 0.3		PM From Noise Study Counts Location A-B					
	1500	8	Merge - Exit 5 on Ramp	Accel	750	1 lane	50 mph	5.7	0.83	AM	WB Right intersection turning movements				
1843+50		i						2.4	0.89	PM					
	5280	9	Basic Highway					7.5 / 0.0		AM From Noise Study Counts Location A-B					
1896+30		j						3 / 0.3		PM From Noise Study Counts Location A-B					

4A 2015 Freeway Facility - Southbound

Station	Length	Node	Description		Accel/Decel		Lane	FFS	%Trucks/%RV	PHF		
3892+80		a							6.2 / 0.1		AM - From Noise Study Counts Location A-B	
	5280	1	Basic Highway				2 lanes	70 mph	3.62 / 0.3		PM - From Noise Study Counts Location A-B	
3840+00		b								0.94	AM & PM Default Value for all Mainline	
	1500	2	Diverge- Exit 5 off Ramp		Decel	520	1 lane	50 mph	5.77	0.74	AM	SB Right and Left Intersection turning movements
3825+00		c							4.28	0.885	PM	
	3920	3	Basic Highway						6.2 / 0.1		AM - From Noise Study Counts Location A-B	
3785+80		d							3.62 / 0.3		PM - From Noise Study Counts Location A-B	
	1500	4	Merge - Exit 5 on Ramp		Accel	880	1 lane	50 mph	9.81	0.84	AM	EB right & WB Left intersection turning movements
3770+80		e							4.41	0.81	PM	
	11730	5	Basic Highway						6.2 / 0.1		AM - From Noise Study Counts Location A-B	
3653+50		f							3.62 / 0.3		PM - From Noise Study Counts Location A-B	
	1500	6	Diverge- Exit 4 off Ramp		Decel	739	1 lane	50 mph	5.2	0.95	AM	
3638+50	PVM	g							2.85	0.92	PM	
	2550	7	Basic Highway						3.78 / 0.62			AM & PM From Permanent Recorder Station South of Exit 4
3613+00	PVM	h								0.94	AM/PM	Default Value
	1500	8	Merge - Exit 4 on Ramp		Accel	1612	1 lane	30 mph	6.20	0.82	AM	Default value
3598+00		i		30 mph					4.0	0.82	PM	Default value
	600	9	Basic Highway							0.94	AM/PM	Default Value
3592+00	PVM	j							3.78 / 0.62			AM & PM From Permanent Recorder Station South of Exit 4
	1500	10	Merge - Exit 4 on Ramp		Accel	1400	1 lane	50 mph	6.2	0.82	AM	Default Value
3577+00		k							4.0	0.82	PM	Default Value
	5280	11	Basic Highway						3.78 / 0.62	0.94		AM & PM From Permanent Recorder Station South of Exit 4
3524+20		l										

4A 2040 Freeway Facility - No Build - Northbound

Station	Length	Node	Description		Accel/Decel		Lanes	FFS
1526+20		a						
	5280	1	Basic Highway					70 mph
1579+00		b						
	1500	2	Diverge- Exit 4 off Ramp		Decel	814	2 lanes	50 mph
1594+00	PVM	c		2 Lane				
	4525	3	Basic Highway					
1639+25	PVM	d						
	1500	4	Merge - Exit 4 on Ramp		Accel	1400	1 lane	50 mph
1654+25		e						
	11825	5	Basic Highway					
1772+50		f						
	1500	6	Diverge- Exit 5 off Ramp		Decel	480	1 lane	50 mph
1787+50	PVM	g						
	4100	7	Basic Highway					
1828+50	PVM	h						
	1500	8	Merge - Exit 5 on Ramp		Accel	900	1 lane	50 mph
1843+50		i						
	5280	000+09	Basic Highway					
1896+30		j						

Use same Truck% and PHF as Existing

Contract D

1594+00 PVM for Exit 4 off ramp

1639+25 PMV for Exit 4 on ramp

Contract I

1787+50 PVM for Exit 5 off ramp

1828+50 PCM for Exit 5 on ramp

4A 2040 Freeway Facility - No Build - Southbound

Station	Length	Node	Description	Accel/Decel		Lanes	FFS
3892+80		a					
	5280	1	Basic Highway				
3840+00		b					
	1500	2	Diverge- Exit 5 off Ramp	Decel	750	1 lane	50 mph
3825+00		c					
	3920	3	Basic Highway				
3785+80		d					
	1500	4	Merge - Exit 5 on Ramp	Accel	1420	1 lane	50 mph
3770+80		e					
	11730	5	Basic Highway				
3653+50		f					
	1500	6	Diverge- Exit 4 off Ramp	Decel	738	1 lane	50 mph
3638+50	PVM	g					
	2550	7	Basic Highway				
3613+00	PVM	h					
	1500	8	Merge - Exit 4 on loop Ramp	Accel	1376	1 lane	30 mph
3598+00		i					0
	600	9	Basic Highway				
3592+00	PVM	j					
	1500	10	Merge - Exit 4 on Ramp	Accel	1390	1 lane	50 mph
3577+00		k					
	5280	11	Basic Highway				
3524+20		l					

Use same Truck% and PHF as Existing

4A 2040 Freeway Facility - Alts A&B - Northbound

Station	Length	Node	Description	Accel/Decel		Lanes	FFS	%Trucks/RV	PHF	
1526+20		a								
	5280	1	Basic Highway				70 mph	4.11 / 0.57		AM & PM From Permanent Recorder Station South of Exit 4
1579+00		b							0.94	Default Value for all Mainline Segments per NHDOT
	1500	2	Diverge- Exit 4 off Ramp	Decel	814	2 Lane	50 mph	7.4	0.77	AM
1594+00	PVM	c						1.8	0.92	PM
	4525	3	Basic Highway					4.11 / 0.57		AM & PM From Permanent Recorder Station South of Exit 4
1639+25	PVM	d								
	1500	4	Merge - Exit 4 on Ramp	Accel	1400	1 Lane	50 mph	3.4	0.90	AM
1654+25		e						2.5	0.87	PM
	-700	5	Overlap					7.5 / 0.0		
1647+25		f						3 / 0.3		PM From Noise Study Counts Location A-B
	1500	6	Diverge- Exit 4A off ramp	Decel	750	1 Lane	50 mph	6.41	0.81	AM
1662+25	PVM	g						3.53	0.84	PM
	3310	7	Basic Highway		4A Ramps			7.5 / 0.0		
1695+35	PVM	h						3 / 0.3		
	1500	8	Merge - Exit 4A on Ramp	Accel	890	1 Lane	50 mph	6.41	0.81	AM
1710+35		i						3.53	0.84	PM
	6215	9	Basic Highway					7.5 / 0.0		
1772+50		j						3 / 0.3		
	1500	10	Diverge- Exit 5 off Ramp	Decel	480	1 Lane	50 mph	9.1	0.75	AM
1787+50	PVM	k						7.5	0.67	PM
	4100	11	Basic Highway					7.5 / 0.0		AM From Noise Study Counts Location A-B
1828+50	PVM	l						3 / 0.3		PM From Noise Study Counts Location A-B
	1500	12	Merge - Exit 5 on Ramp	Accel	750	1 Lane	50 mph	5.7	0.83	AM
1843+50		m						2.4	0.89	PM
	5280	13	Basic Highway					7.5 / 0.0		AM From Noise Study Counts Location A-B
1896+30		n						3 / 0.3		PM From Noise Study Counts Location A-B

4A 2040 Freeway Facility - Alts A&B - Southbound

Station	Length	Node	Description	Accel/Decel		Lane	FFS	%Trucks/%RV	PHF	
3892+80		a						6.2 / 0.1		AM - From Noise Study Counts Location A-B
	5280	1	Basic Highway			4 lanes	70 mph	3.62 / 0.3		PM - From Noise Study Counts Location A-B
3840+00		b							0.94	AM & PM Default Value for all Mainline
	1500	2	Diverge- Exit 5 off Ramp	Decel	750	1 lane	50 mph	5.77	0.74	AM
3825+00		c						4.28	0.885	PM
	3920	3	Basic Highway					6.2 / 0.1		AM - From Noise Study Counts Location A-B
3785+80		d						3.62 / 0.3		PM - From Noise Study Counts Location A-B
	1500	4	Merge - Exit 5 on Ramp	Accel	1420	1 lane	50 mph	9.81	0.84	AM
3770+80		e						4.41	0.81	PM
	7615	5	Basic Highway					6.2 / 0.1		AM - From Noise Study Counts Location A-B
3709+65		f						3.62 / 0.3		PM - From Noise Study Counts Location A-B
	1500	6	Diverge- Exit 4A off Ramp	Decel	500	1 lane	50 mph	7.26	0.80	AM Average of known ramps
3694+65		g						4.23	0.84	PM Average of known ramps
	3165	7	Basic Highway		4A Ramps			6.2 / 0.1	0.94	
		h						3.62 / 0.3		
3663+00	PVM	8	Merge	Accel	815	1 lane	50 mph	7.26	0.80	AM Average of known ramps
	1500	i						4.23	0.84	PM Average of known ramps
	-650	9	Overlap							
	1500	j								
3639+50	PVM	10	Diverge	Decel	735	1 lane	50 mph	7.26	0.80	AM Average of known ramps
		k						4.23	0.84	PM Average of known ramps
	2650	11	Basic Highway						0.94	AM/PM Default Value
3613+00	PVM	l						3.78 / 0.62		AM & PM From Permanent Recorder Station South of Exit 4
	1500	12	Merge - Exit 4 on Ramp (loop)	Accel	1376	1 lane	30 mph	6.20	0.82	AM Default Value
3598+00		m						4.0	0.82	PM Default Value
	600	13	Basic Highway						0.94	AM/PM Default Value
3592+00	PVM	n						3.78 / 0.62		AM & PM From Permanent Recorder Station South of Exit 4
	1500	14	Merge - Exit 4 on Ramp	Accel	1390	1 lane	50 mph	6.2	0.82	AM Default Value
3577+00		o						4.0	0.82	PM Default Value
	5280	15	Basic Highway					3.78 / 0.62		AM & PM From Permanent Recorder Station South of Exit 4
3524+20		p								

4A 2040 Freeway Facility - Alts C&D - Northbound

Station	Length	Node	Description	Accel/Decel		Lanes	FFS	%Trucks/RV	PHF	
1526+20		a								
	5280	1	Basic Highway					4.11 / 0.57		AM & PM From Permanent Recorder Station South of Exit 4
1579+00		b							0.94	Default Value for all Mainline Segments per NHDOT
	1500	2	Diverge- Exit 4 off Ramp	Decel	814	2 Lane	50	7.4	0.77	AM
1594+00	PVM	c						1.8	0.92	PM
	4525	3	Basic Highway					4.11 / 0.57		AM & PM From Permanent Recorder Station South of Exit 4
1639+25	PVM	d								
	1500	4	Merge - Exit 4 on Ramp	Accel	1400	1 Lane	50	3.4	0.90	AM
1654+25		e						2.5	0.87	PM
	4497	5	Basic Highway					7.5 / 0.0		AM From Noise Study Counts Location A-B
1699+22		f						3 / 0.3		PM From Noise Study Counts Location A-B
	1500	6	Diverge- Exit 4A off ramp	Decel	734	1 Lane	50	6.41	0.81	AM Average of known ramps
1714+22		g			4A Ramps			3.53	0.84	PM Average of known ramps
	2702	7	Basic Highway					7.5 / 0.0		
1741+24		h						3 / 0.3		
	1500	8	Merge - Exit 4A on Ramp	Accel	1400	1 Lane	50	6.41	0.81	AM Average of known ramps
1756+24		i						3.53	0.84	PM Average of known ramps
	1626	9	Basic Highway					7.5 / 0.0		
1772+50		j						3 / 0.3		
	1500	10	Diverge- Exit 5 off Ramp	Decel	480	1 Lane	50	9.1	0.75	AM
1787+50	PVM	k						7.5	0.67	PM
	4100	11	Basic Highway					7.5 / 0.0		AM From Noise Study Counts Location A-B
1828+50	PVM	l						3 / 0.3		PM From Noise Study Counts Location A-B
	1500	12	Merge - Exit 5 on Ramp	Accel	750	1 Lane	50	5.7	0.83	AM
1843+50		m						2.4	0.89	PM
	5280	13	Basic Highway					7.5 / 0.0		AM From Noise Study Counts Location A-B
1896+30		n						3 / 0.3		PM From Noise Study Counts Location A-B

4A 2040 Freeway Facility - Alts C&D - Southbound

Station	Length	Node	Description	Accel/Decel		Lanes	FFS	Trucks/%R	PHF	
3892+80		a						6.2 / 0.1		AM - From Noise Study Counts Location A-B
	5280	1	Basic Highway					3.62 / 0.3		PM - From Noise Study Counts Location A-B
3840+00		b							0.94	AM & PM Default Value for all Mainline
	1500	2	Diverge- Exit 5 off Ramp	Decel	750	1 lane	50 mph	5.77	0.74	AM
3825+00		c						4.28	0.885	PM
	3920	3	Basic Highway					6.2 / 0.1		AM - From Noise Study Counts Location A-B
3785+80		d						3.62 / 0.3		PM - From Noise Study Counts Location A-B
	1500	4	Merge - Exit 5 on Ramp	Accel	1420	1 lane	50 mph	9.81	0.84	AM
3770+80		e						4.41	0.81	PM
	2705	5	Basic Highway					6.2 / 0.1		AM - From Noise Study Counts Location A-B
3758+75		f						3.62 / 0.3		PM - From Noise Study Counts Location A-B
	1500	6	Diverge- Exit 4A off Ram	Decel	485	1 lane	50 mph	6.74	0.84	AM Average of known ramps
3743+75		g						3.89	0.86	PM Average of known ramps
	2850	7	Basic Highway		4A Ramps			6.2 / 0.1		
3715+25		h						3 / 0.3		
	1500	8	Merge - Exit 4A on Ramp	Accel	1400	1 lane	50 mph	6.74	0.84	AM Average of known ramps
3700+25		i						3.89	0.86	PM Average of known ramps
	4675	9	Basic Highway						0.94	AM/PM - Default Value
3653+50		j						3.78 / 0.62		AM & PM From Permanent Recorder Station South of Exit 4
	1500	10	Diverge- Exit 4 off Ramp	Decel	738	1 lane	50 mph	5.2	0.95	AM
3638+50	PVM	k						2.85	0.92	PM
	2550	11	Basic Highway					3.78 / 0.62		AM & PM From Permanent Recorder Station South of Exit 4
3613+00	PVM	l							0.94	AM/PM - Default Value
	1500	12	Merge - Exit 4 on Ramp	Accel	1376	1 lane	30 mph	6.20	0.82	AM
3598+00		m						4.0	0.82	PM
	600	13	Basic Highway						0.94	AM/PM - Default Value
3592+00	PVM	n						3.78 / 0.62		AM & PM From Permanent Recorder Station South of Exit 4
	1500	14	Merge - Exit 4 on Ramp	Accel	1390	1 lane	50 mph	6.2	0.82	AM Default Value
3577+00		o						4.0	0.82	PM Default Value
	5280	15	Basic Highway					3.78 / 0.62		AM & PM From Permanent Recorder Station South of Exit 4
3524+20		p								

HCS 2010 Facilities Report

Project Information

Analyst	PK/LCG	Agency	CLD
Jurisdiction		Time Period Analyzed	AM Peak - NB
Analysis Year	2040 No Build - AM	Date	6/8/2017
Project Description	I-93 NB - from S. of Exit 4 to N of Exit 5		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	9
Total Time Periods	1	Time Period Duration, min	15

Segment Geometric Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	a->b	5280	4
2	Diverge	Diverge	b.->c	1500	4
3	Basic	Basic	c->d	4525	4
4	Merge	Merge	d->e	1500	4
5	Basic	Basic	e->f	11825	4
6	Diverge	Diverge	f->g	1500	4
7	Basic	Basic	g->h	4100	4
8	Merge	Merge	h->i	1500	4
9	Basic	Basic	i->j	5280	4

Facility Segment Data

Segment 1: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.979	3537	9600	0.37	70.0	12.6	B

Segment 2: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.77	0.979	0.964	3537	1098	9600	4200	0.37	0.26	68.0	60.7	13.0	-2.7	A

Segment 3: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.979	2439	9600	0.28	70.0	8.7	A

Segment 4: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	

1	0.94	0.90	0.979	0.983	4539	2617	9600	2100	0.55	1.25	53.3	61.7	45.0	21.9	C

Segment 5: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.964	4539	9600	0.55	70.0	16.2	B

Segment 6: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.75	0.964	0.956	4539	774	9600	2100	0.55	0.37	67.7	61.5	16.8	20.7	C

Segment 7: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.964	3765	9600	0.48	70.0	13.4	B

Segment 8: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.83	0.964	0.972	5513	1748	9600	2100	0.66	0.83	63.1	60.3	21.8	25.3	C

Segment 9: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.964	5513	9600	0.64	69.6	19.8	C

Facility Time Period Results

T	Speed, mi/h	Density, pc/mi/ln	Density, veh/mi/ln	Travel Time, min	LOS
1	68.4	16.3	15.8	6.1	B

Facility Overall Results

Space Mean Speed, mi/h	68.4	Density, veh/mi/ln	15.8
Average Travel Time, min	6.1		

HCS 2010 Facilities Report

Project Information

Analyst	PK/LCG	Agency	
Jurisdiction		Time Period Analyzed	AM Peak - SB
Analysis Year	2040 - No Build AM	Date	6/8/2017
Project Description	I-93 SB - from N of Exit 5 to S of Exit 4		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	11
Total Time Periods	1	Time Period Duration, min	15

Segment Geometric Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	a->b	5280	4
2	Diverge	Diverge	b->c	1500	4
3	Basic	Basic	c->d	3920	4
4	Merge	Merge	d->e	1500	4
5	Basic	Basic	e->f	11730	4
6	Diverge	Diverge	f->g	1500	4
7	Basic	Basic	g->h	2550	4
8	Merge	Merge	h->i	1500	4
9	Basic	Basic	i->j	600	4
10	Merge	Merge	j->k	1500	4
11	Basic	Basic	l->m	5280	4

Facility Segment Data

Segment 1: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.970	5659	9600	0.59	69.5	20.4	C

Segment 2: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.74	0.970	0.972	5659	1536	9600	2100	0.59	0.73	65.5	59.6	21.6	28.2	D

Segment 3: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.970	4447	9600	0.46	70.0	15.9	B

Segment 4: Merge

Time	PHF	fHV	Flow Rate	Capacity	d/c	Speed	Density	LOS

Period					(pc/h)		(pc/h)		Ratio		(mi/h)		(pc/mi/ln)		
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.84	0.970	0.953	5384	937	9600	2100	0.56	0.45	64.3	61.8	20.9	20.7	C

Segment 5: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.970	5270	9600	0.55	69.8	18.9	C

Segment 6: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.95	0.970	0.975	5270	1754	9600	2100	0.55	0.84	64.7	59.1	20.4	25.9	C

Segment 7: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.980	3452	9600	0.36	70.0	12.3	B

Segment 8: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.82	0.980	0.970	4772	1320	9600	2000	0.50	0.66	64.4	61.9	18.5	16.5	B

Segment 9: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.980	4592	9600	0.48	70.0	16.4	B

Segment 10: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.82	0.980	0.970	6377	1785	9600	2100	0.66	0.85	63.3	60.8	25.2	24.1	C

Segment 11: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.980	6133	9600	0.64	68.7	22.3	C

Facility Time Period Results

T	Speed, mi/h	Density, pc/mi/ln	Density, veh/mi/ln	Travel Time, min	LOS
1	68.5	19.3	18.8	6.1	C

Facility Overall Results

Space Mean Speed, mi/h	68.5	Density, veh/mi/ln	18.8
Average Travel Time, min	6.1		

HCS 2010 Facilities Report

Project Information

Analyst	PK/LCG	Agency	CLD
Jurisdiction		Time Period Analyzed	PM Peak - NB
Analysis Year	2040 No Build PM - NB	Date	6/8/2017
Project Description	I-93 NB - from S. of Exit 4 to N of Exit 5		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	9
Total Time Periods	1	Time Period Duration, min	15

Segment Geometric Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	a->b	5280	4
2	Diverge	Diverge	b.->c	1500	4
3	Basic	Basic	c->d	4525	4
4	Merge	Merge	d->e	1500	4
5	Basic	Basic	e->f	11825	4
6	Diverge	Diverge	f->g	1500	4
7	Basic	Basic	g->h	4100	4
8	Merge	Merge	h->i	1500	4
9	Basic	Basic	i->j	5280	4

Facility Segment Data

Segment 1: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.979	6085	9600	0.63	68.8	22.1	C

Segment 2: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.92	0.979	0.991	6085	2561	9600	4200	0.63	0.61	63.7	57.0	23.9	12.3	B

Segment 3: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.979	3548	9600	0.37	70.0	12.7	B

Segment 4: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	

1	0.94	0.87	0.979	0.988	5619	2071	9600	2100	0.59	0.99	63.7	61.3	22.1	23.0	C

Segment 5: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.985	5449	9600	0.57	69.7	19.5	C

Segment 6: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.67	0.985	0.964	5449	1037	9600	2100	0.57	0.49	66.9	60.9	20.4	25.4	C

Segment 7: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.985	4725	9600	0.49	70.0	16.9	B

Segment 8: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.89	0.985	0.988	6033	1308	9600	2100	0.63	0.62	63.3	60.5	23.8	25.1	C

Segment 9: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.985	5967	9600	0.62	69.0	21.6	C

Facility Time Period Results

T	Speed, mi/h	Density, pc/mi/ln	Density, veh/mi/ln	Travel Time, min	LOS
1	68.6	19.6	19.2	6.1	C

Facility Overall Results

Space Mean Speed, mi/h	68.6	Density, veh/mi/ln	19.2
Average Travel Time, min	6.1		

HCS 2010 Facilities Report

Project Information

Analyst	PK/LCG	Agency	
Jurisdiction		Time Period Analyzed	PM Peak - SB
Analysis Year	2040 No Build - PM	Date	6/10/2017
Project Description	I-93 SB - from N of Exit 5 to S of Exit 4		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	11
Total Time Periods	1	Time Period Duration, min	15

Segment Geometric Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	a->b	5280	4
2	Diverge	Diverge	b->c	1500	4
3	Basic	Basic	c->d	3920	4
4	Merge	Merge	d->e	1500	4
5	Basic	Basic	e->f	11730	4
6	Diverge	Diverge	f->g	1500	4
7	Basic	Basic	g->h	2550	4
8	Merge	Merge	h->i	1500	4
9	Basic	Basic	i->j	600	4
10	Merge	Merge	j->k	1500	4
11	Basic	Basic	l->m	5280	4

Facility Segment Data

Segment 1: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.982	6186	9600	0.64	68.6	22.5	C

Segment 2: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.89	0.982	0.979	6186	1555	9600	2100	0.64	0.74	65.4	59.6	23.6	30.3	D

Segment 3: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.982	4631	9600	0.49	70.0	16.5	B

Segment 4: Merge

Time	PHF	fHV	Flow Rate	Capacity	d/c	Speed	Density	LOS

Period					(pc/h)		(pc/h)		Ratio		(mi/h)		(pc/mi/ln)		
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.81	0.982	0.978	5426	795	9600	2100	0.57	0.38	64.3	61.9	21.1	20.2	C

Segment 5: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.982	5426	9600	0.56	69.7	19.5	C

Segment 6: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.92	0.982	0.986	5426	2315	9600	2100	0.56	1.10	53.3	57.7	45.0	29.2	D

Segment 7: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.980	3111	9600	0.33	70.0	11.1	B

Segment 8: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.82	0.980	0.980	3715	604	9600	2000	0.39	0.30	65.5	62.8	14.2	10.2	B

Segment 9: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.980	3715	9600	0.38	70.0	13.3	B

Segment 10: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.82	0.980	0.980	4549	834	9600	2100	0.47	0.40	65.7	63.8	17.3	14.4	B

Segment 11: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.980	4549	9600	0.46	70.0	16.2	B

Facility Time Period Results

T	Speed, mi/h	Density, pc/mi/ln	Density, veh/mi/ln	Travel Time, min	LOS
1	68.3	19.4	19.1	6.1	C

Facility Overall Results

Space Mean Speed, mi/h	68.3	Density, veh/mi/ln	19.1
Average Travel Time, min	6.1		

HCS 2010 Facilities Report

Project Information

Analyst	PK/LCG	Agency	CLD
Jurisdiction		Time Period Analyzed	AM Peak - NB w/Overlap
Analysis Year	2040 4A South Alt. A - AM-NB	Date	6/30/2017
Project Description	I-93 NB - from S. of Exit 4 to N of Exit 5		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	13
Total Time Periods	1	Time Period Duration, min	15

Segment Geometric Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	a>b	5280	4
2	Diverge	Diverge	b>c	1500	4
3	Basic	Basic	c>d	4525	4
4	Merge	Merge	d>e	1500	4
5	Overlap	Basic	e>f	700	4
6	Diverge	Diverge	f>g	1500	4
7	Basic	Basic	g>h	3310	4
8	Merge	Merge	h>i	1500	4
9	Basic	Basic	i>j	6215	4
10	Diverge	Diverge	j>k	1500	4
11	Basic	Basic	k>l	4100	4
12	Merge	Merge	l>m	1500	4
13	Basic	Basic	m>n	5280	4

Facility Segment Data

Segment 1: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.979	3662	9600	0.38	70.0	13.1	B

Segment 2: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.77	0.979	0.964	3662	977	9600	4200	0.38	0.23	68.7	61.0	13.3	-3.2	A

Segment 3: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.979	2874	9600	0.30	70.0	10.3	A

Segment 4: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.90	0.979	0.983	4733	1859	9600	2100	0.49	0.89	64.8	62.7	18.3	19.3	B

Segment 5: Overlap

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.979	4662	9600	0.49	64.8	18.3	B

Segment 6: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.81	0.964	0.969	4734	1013	9600	2100	0.49	0.48	67.0	60.9	17.7	20.2	C

Segment 7: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.964	3857	9600	0.40	70.0	13.8	B

Segment 8: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.81	0.964	0.969	5628	1771	9600	2100	0.59	0.84	63.2	60.5	22.3	24.9	C

Segment 9: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.964	5391	9600	0.56	69.7	19.3	C

Segment 10: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.75	0.964	0.956	5391	907	9600	2100	0.56	0.43	67.3	61.2	20.0	24.5	C

Segment 11: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.964	4674	9600	0.49	70.0	16.7	B

Segment 12: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.83	0.964	0.972	6081	1407	9600	2100	0.63	0.67	63.1	60.2	24.1	25.7	C

Segment 13: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.964	5926	9600	0.62	69.1	21.4	C

Facility Time Period Results

T	Speed, mi/h	Density, pc/mi/ln	Density, veh/mi/ln	Travel Time, min	LOS
1	68.5	16.9	16.4	6.4	B

Facility Overall Results

Space Mean Speed, mi/h	68.5	Density, veh/mi/ln	16.4
Average Travel Time, min	6.4		

HCS 2010 Facilities Report

Project Information

Analyst	PK/LCG	Agency	
Jurisdiction		Time Period Analyzed	AM Peak - SB
Analysis Year	2040 - 4A South Alt. A AM - SB Overlap	Date	6/30/2017
Project Description	I-93 SB - from N of Exit 5 to S of Exit 4		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	15
Total Time Periods	1	Time Period Duration, min	15

Segment Geometric Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	a->b	5280	4
2	Diverge	Diverge	b->c	1500	4
3	Basic	Basic	c->d	3920	4
4	Merge	Merge	d->e	1500	4
5	Basic	Basic	e->f	7615	4
6	Diverge	Diverge	f>g	1500	4
7	Basic	Basic	g>h	3165	4
8	Merge	Merge	h>i4A on ramp	1500	4
9	Overlap	Basic	i>j	650	4
10	Diverge	Diverge	j>k	1500	4
11	Basic	Basic	k>l	2650	4
12	Merge	Merge	l>m	1500	4
13	Basic	Basic	m>n	1580	4
14	Merge	Merge	l>m	1500	4
15	Basic	Basic	m>n	5280	4

Facility Segment Data

Segment 1: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.970	5994	9600	0.62	69.0	21.7	C

Segment 2: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.74	0.970	0.972	5994	869	9600	2100	0.62	0.41	67.3	61.3	22.3	24.2	C

Segment 3: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.970	5125	9600	0.55	69.9	18.3	C

Segment 4: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.84	0.970	0.953	6218	1093	9600	2100	0.67	0.52	64.3	62.5	24.2	20.6	C

Segment 5: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.970	6218	9600	0.65	68.5	22.7	C

Segment 6: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.80	0.970	0.965	6218	2241	9600	2100	0.65	1.07	53.3	57.8	45.0	33.9	D

Segment 7: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.964	3977	9600	0.46	70.0	14.2	B

Segment 8: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.80	0.970	0.965	5246	1269	9600	2100	0.59	0.60	64.0	61.3	20.5	22.2	C

Segment 9: Overlap

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.970	5246	9600	0.57	64.0	20.5	C

Segment 10: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.80	0.970	0.965	5246	1587	9600	2100	0.57	0.76	65.3	59.5	20.1	24.4	C

Segment 11: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.970	3659	9600	0.43	70.0	13.1	B

Segment 12: Merge

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS

	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.82	0.980	0.970	4350	691	9600	2000	0.49	0.35	65.1	62.6	16.7	12.6	B

Segment 13: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.980	4350	9600	0.49	70.0	15.5	B

Segment 14: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.82	0.980	0.970	6311	1961	9600	2100	0.69	0.93	63.1	60.5	25.0	24.7	C

Segment 15: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.980	6311	9600	0.66	68.3	23.1	C

Facility Time Period Results

T	Speed, mi/h	Density, pc/mi/ln	Density, veh/mi/ln	Travel Time, min	LOS
1	67.4	21.1	20.6	6.9	C

Facility Overall Results

Space Mean Speed, mi/h	67.4	Density, veh/mi/ln	20.6
Average Travel Time, min	6.9		

HCS 2010 Facilities Report

Project Information

Analyst	PK/LCG	Agency	
Jurisdiction		Time Period Analyzed	AM Peak - SB
Analysis Year	2040 - 4A South Alt. A AM - SB Overlap	Date	6/30/2017
Project Description	I-93 SB - from N of Exit 5 to S of Exit 4		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	15
Total Time Periods	1	Time Period Duration, min	15

Segment Geometric Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	a->b	5280	4
2	Diverge	Diverge	b->c	1500	4
3	Basic	Basic	c->d	3920	4
4	Merge	Merge	d->e	1500	4
5	Basic	Basic	e->f	7615	4
6	Diverge	Diverge	f>g	1500	4
7	Basic	Basic	g>h	3165	4
8	Merge	Basic	h>i4A on ramp	1500	3
9	Overlap	Basic	i>j	650	4
10	Diverge	Diverge	j>k	1500	4
11	Basic	Basic	k>l	2650	4
12	Merge	Merge	l>m	1500	4
13	Basic	Basic	m>n	1580	4
14	Merge	Merge	l>m	1500	4
15	Basic	Basic	m>n	5280	4

Facility Segment Data

Segment 1: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.970	5994	9600	0.62	69.0	21.7	C

Segment 2: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.74	0.970	0.972	5994	869	9600	2100	0.62	0.41	67.3	61.3	22.3	24.2	C

Segment 3: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.970	5308	9600	0.55	69.8	19.0	C

Segment 4: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.84	0.970	0.953	6401	1093	9600	2100	0.67	0.52	64.1	62.3	25.0	21.2	C

Segment 5: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.970	6268	9600	0.65	68.4	22.9	C

Segment 6: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.80	0.970	0.965	6268	2241	9600	4200	0.65	0.53	64.8	57.8	24.2	16.3	B

Segment 7: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.964	4398	9600	0.46	70.0	15.7	B

Segment 8: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.80	0.970	0.965	5639	1269	7200	2100	0.61	0.60	69.2	57.9	21.1	30.2	C

Segment 9: Overlap

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.970	5445	9600	0.57	69.2	21.1	C

Segment 10: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.80	0.970	0.965	5445	1587	9600	2100	0.57	0.76	65.3	59.5	20.8	25.2	C

Segment 11: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.970	4102	9600	0.43	70.0	14.7	B

Segment 12: Merge

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS

	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.82	0.980	0.970	4751	691	9600	2000	0.49	0.35	64.9	62.4	18.3	13.8	B

Segment 13: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.980	4657	9600	0.49	70.0	16.6	B

Segment 14: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.82	0.980	0.970	6618	1961	9600	2100	0.69	0.93	62.6	59.9	26.4	25.6	C

Segment 15: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.980	6350	9600	0.66	68.3	23.3	C

Facility Time Period Results

T	Speed, mi/h	Density, pc/mi/ln	Density, veh/mi/ln	Travel Time, min	LOS
1	68.0	21.0	20.4	6.8	C

Facility Overall Results

Space Mean Speed, mi/h	68.0	Density, veh/mi/ln	20.4
Average Travel Time, min	6.8		

HCS 2010 Facilities Report

Project Information

Analyst	PK/LCG	Agency	CLD
Jurisdiction		Time Period Analyzed	PM Peak - NB Overlap
Analysis Year	2040 4A South Alt. A - PM-NB	Date	6/30/2017
Project Description	I-93 NB - from S. of Exit 4 to N of Exit 5		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	13
Total Time Periods	1	Time Period Duration, min	15

Segment Geometric Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	a->b	5280	4
2	Diverge	Diverge	b.->c	1500	4
3	Basic	Basic	c->d	4525	4
4	Merge	Merge	d>e	1500	4
5	Overlap	Basic	e>f	700	4
6	Diverge	Diverge	f>g	1500	4
7	Basic	Basic	g > h	3310	4
8	Merge	Merge	h > j	1500	4
9	Basic	Basic	i > j	6215	4
10	Diverge	Diverge	j > k	1500	4
11	Basic	Basic	k > l	4100	4
12	Merge	Merge	l > m	1500	4
13	Basic	Basic	m > n	5280	4

Facility Segment Data

Segment 1: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.979	6303	9600	0.66	68.4	23.0	C

Segment 2: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.77	0.979	0.964	6303	2809	9600	4200	0.66	0.67	63.0	56.4	25.0	14.4	B

Segment 3: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.979	4037	9600	0.42	70.0	14.4	B

Segment 4: Merge														
Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.87	0.979	0.988	5509	1472	9600	2100	0.57	0.70	64.6	62.6	21.3	20.1	C

Segment 5: Overlap								
Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.979	5412	9600	0.56	64.6	21.3	C

Segment 6: Diverge															
Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.84	0.979	0.983	5412	860	9600	2100	0.56	0.41	67.4	61.3	20.1	24.3	C

Segment 7: Basic								
Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.985	4612	9600	0.48	70.0	16.5	B

Segment 8: Merge															
Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.84	1.000	0.983	6045	1502	9600	2100	0.63	0.72	63.2	60.5	23.9	25.1	C

Segment 9: Basic								
Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.985	5951	9600	0.62	69.0	21.6	C

Segment 10: Diverge															
Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.67	0.964	0.964	6081	1215	9600	2100	0.63	0.58	66.3	60.4	22.9	28.6	D

Segment 11: Basic								
Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.985	5103	9600	0.53	69.9	18.3	C

Segment 12: Merge															
Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.89	0.964	0.988	6266	1052	9600	2100	0.65	0.50	63.3	60.6	24.7	24.8	C

Segment 13: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.964	6235	9600	0.65	68.5	22.8	C

Facility Time Period Results

T	Speed, mi/h	Density, pc/mi/ln	Density, veh/mi/ln	Travel Time, min	LOS
1	67.9	20.6	20.2	6.4	C

Facility Overall Results

Space Mean Speed, mi/h	67.9	Density, veh/mi/ln	20.2
Average Travel Time, min	6.4		

HCS 2010 Facilities Report

Project Information

Analyst	PK/LCG	Agency	
Jurisdiction		Time Period Analyzed	PM Peak - SB
Analysis Year	2040 - 4A South Alt. A PM - SB Overlap	Date	6/30/2017
Project Description	I-93 SB - from N of Exit 5 to S of Exit 4		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	15
Total Time Periods	1	Time Period Duration, min	15

Segment Geometric Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	a->b	5280	4
2	Diverge	Diverge	b->c	1500	4
3	Basic	Basic	c->d	3920	4
4	Merge	Merge	d->e	1500	4
5	Basic	Basic	e->f	7615	4
6	Diverge	Diverge	f>g	1500	4
7	Basic	Basic	g>h	3165	4
8	Merge	Merge	h>i	1500	4
9	Overlap	Basic	i>j	650	4
10	Diverge	Diverge	j>k	1500	4
11	Basic	Basic	k>l	2650	4
12	Merge	Merge	l>m	1500	4
13	Basic	Basic	m>n	600	4
14	Merge	Merge	n>o	1500	4
15	Basic	Basic	o>p	5280	4

Facility Segment Data

Segment 1: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.982	5931	9600	0.62	69.1	21.5	C

Segment 2: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.89	0.982	0.979	5931	883	9600	2100	0.62	0.42	67.2	61.3	22.1	24.0	C

Segment 3: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.982	5102	9600	0.53	69.9	18.3	C

Segment 4: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.81	0.970	0.978	6094	928	9600	2100	0.63	0.44	64.5	62.8	23.6	19.5	B

Segment 5: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.982	5899	9600	0.61	69.1	21.3	C

Segment 6: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.84	0.982	0.979	5899	1879	9600	2100	0.61	0.89	64.4	58.7	22.9	31.0	D

Segment 7: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.982	4225	9600	0.44	75.3	14.0	B

Segment 8: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.84	0.982	0.979	5289	1064	9600	2100	0.55	0.51	64.2	61.6	20.6	21.4	C

Segment 9: Overlap

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.982	5173	9600	0.54	64.2	20.6	C

Segment 10: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.84	0.982	0.979	5173	1921	9600	2100	0.54	0.91	64.0	58.6	20.2	26.4	C

Segment 11: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.980	3468	9600	0.36	70.0	12.4	B

Segment 12: Merge

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS

	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.82	0.980	0.980	3785	317	9600	2000	0.39	0.16	65.7	62.9	14.4	9.2	A

Segment 13: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.980	3745	9600	0.39	70.0	13.4	B

Segment 14: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.82	0.980	0.980	4660	915	9600	2100	0.49	0.44	65.2	62.9	17.9	15.1	B

Segment 15: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.980	4543	9600	0.47	70.0	16.2	B

Facility Time Period Results

T	Speed, mi/h	Density, pc/mi/ln	Density, veh/mi/ln	Travel Time, min	LOS
1	68.6	18.8	18.4	6.6	C

Facility Overall Results

Space Mean Speed, mi/h	68.6	Density, veh/mi/ln	18.4
Average Travel Time, min	6.6		

HCS 2010 Facilities Report

Project Information

Analyst	PK/LCG	Agency	CLD
Jurisdiction		Time Period Analyzed	AM Peak - NB w/Overlap
Analysis Year	2040 4A South Alt. B - AM-NB	Date	6/30/2017
Project Description	I-93 NB - from S. of Exit 4 to N of Exit 5		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	13
Total Time Periods	1	Time Period Duration, min	15

Segment Geometric Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	a>b	5280	4
2	Diverge	Diverge	b>c	1500	4
3	Basic	Basic	c>d	4525	4
4	Merge	Merge	d>e	1500	4
5	Overlap	Basic	e>f	700	4
6	Diverge	Diverge	f>g	1500	4
7	Basic	Basic	g>h	3310	4
8	Merge	Merge	h>i	1500	4
9	Basic	Basic	i>j	6215	4
10	Diverge	Diverge	j>k	1500	4
11	Basic	Basic	k>l	4100	4
12	Merge	Merge	l>m	1500	4
13	Basic	Basic	m>n	5280	4

Facility Segment Data

Segment 1: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.979	3673	9600	0.38	70.0	13.1	B

Segment 2: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.77	0.979	0.964	3673	983	9600	4200	0.38	0.23	68.7	61.0	13.4	-3.1	A

Segment 3: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.979	2690	9600	0.30	70.0	9.6	A

Segment 4: Merge														
Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.90	0.979	0.983	4790	2165	9600	2100	0.53	1.03	53.3	62.2	45.0	20.8	C

Segment 5: Overlap								
Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.979	4790	9600	0.52	53.3	45.0	C

Segment 6: Diverge															
Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.81	0.964	0.969	4790	1102	9600	2100	0.52	0.52	66.7	60.7	18.0	23.2	C

Segment 7: Basic								
Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.964	3688	9600	0.43	70.0	13.2	B

Segment 8: Merge															
Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.81	0.964	0.969	5223	1535	9600	2100	0.59	0.73	63.9	61.3	20.4	22.7	C

Segment 9: Basic								
Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.964	5223	9600	0.56	69.9	18.7	C

Segment 10: Diverge															
Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.75	0.964	0.956	5223	851	9600	2100	0.56	0.41	67.4	61.3	19.4	23.6	C

Segment 11: Basic								
Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.964	4372	9600	0.49	70.0	15.6	B

Segment 12: Merge															
Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.83	0.964	0.972	5729	1357	9600	2100	0.64	0.65	63.5	60.7	22.6	24.4	C

Segment 13: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.964	5729	9600	0.62	69.4	20.6	C

Facility Time Period Results

T	Speed, mi/h	Density, pc/mi/ln	Density, veh/mi/ln	Travel Time, min	LOS
1	67.6	17.8	17.3	6.5	B

Facility Overall Results

Space Mean Speed, mi/h	67.6	Density, veh/mi/ln	17.3
Average Travel Time, min	6.5		

HCS 2010 Facilities Report

Project Information

Analyst	PK/LCG	Agency	
Jurisdiction		Time Period Analyzed	AM Peak - SB
Analysis Year	2040 - 4A South Alt. B AM - SB Overlap	Date	6/30/2017
Project Description	I-93 SB - from N of Exit 5 to S of Exit 4		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	15
Total Time Periods	1	Time Period Duration, min	15

Segment Geometric Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	a->b	5280	4
2	Diverge	Diverge	b->c	1500	4
3	Basic	Basic	c->d	3920	4
4	Merge	Merge	d->e	1500	4
5	Basic	Basic	e->f	7615	4
6	Diverge	Diverge	f>g	1500	4
7	Basic	Basic	g>h	3165	4
8	Merge	Merge	h>i4A on ramp	1500	4
9	Overlap	Basic	i>j	650	4
10	Diverge	Diverge	j>k	1500	4
11	Basic	Basic	k>l	2650	4
12	Merge	Merge	l>m	1500	4
13	Basic	Basic	m>n	600	4
14	Merge	Merge	l>m	1500	4
15	Basic	Basic	m>n	5280	4

Facility Segment Data

Segment 1: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.970	6043	9600	0.63	68.9	21.9	C

Segment 2: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.74	0.970	0.972	6043	681	9600	2100	0.63	0.32	67.7	61.8	22.3	23.5	C

Segment 3: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.970	5362	9600	0.57	69.8	19.2	C

Segment 4: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.84	0.970	0.953	6211	849	9600	2100	0.66	0.40	64.4	62.8	24.1	19.5	B

Segment 5: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.970	6211	9600	0.65	68.6	22.6	C

Segment 6: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.80	0.970	0.965	6211	2293	9600	2100	0.65	1.09	53.3	57.7	45.0	34.2	D

Segment 7: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.964	3918	9600	0.45	70.0	14.0	B

Segment 8: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.80	0.970	0.965	5388	1470	9600	2100	0.60	0.70	63.7	61.0	21.1	23.5	C

Segment 9: Overlap

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.970	5388	9600	0.58	63.7	21.1	C

Segment 10: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.80	0.970	0.965	5388	1697	9600	2100	0.58	0.81	64.9	59.2	20.8	25.5	C

Segment 11: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.970	3691	9600	0.43	70.0	13.2	B

Segment 12: Merge

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS

	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.82	0.980	0.970	4426	735	9600	2000	0.50	0.37	65.0	62.5	17.0	13.0	B

Segment 13: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.980	4426	9600	0.49	70.0	15.8	B

Segment 14: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.82	0.980	0.970	6356	1930	9600	2100	0.69	0.92	63.1	60.5	25.2	24.7	C

Segment 15: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.980	6356	9600	0.66	68.2	23.3	C

Facility Time Period Results

T	Speed, mi/h	Density, pc/mi/ln	Density, veh/mi/ln	Travel Time, min	LOS
1	67.3	21.5	20.9	6.7	C

Facility Overall Results

Space Mean Speed, mi/h	67.3	Density, veh/mi/ln	20.9
Average Travel Time, min	6.7		

HCS 2010 Facilities Report

Project Information

Analyst	PK/LCG	Agency	CLD
Jurisdiction		Time Period Analyzed	PM Peak - NB Overlap
Analysis Year	2040 4A South Alt. B - PM-NB	Date	6/30/2017
Project Description	I-93 NB - from S. of Exit 4 to N of Exit 5		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	13
Total Time Periods	1	Time Period Duration, min	15

Segment Geometric Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	a->b	5280	4
2	Diverge	Diverge	b.->c	1500	4
3	Basic	Basic	c->d	4525	4
4	Merge	Merge	d>e	1500	4
5	Overlap	Basic	e>f	700	4
6	Diverge	Diverge	f>g	1500	4
7	Basic	Basic	g > h	3310	4
8	Merge	Merge	h > j	1500	4
9	Basic	Basic	i > j	6215	4
10	Diverge	Diverge	j > k	1500	4
11	Basic	Basic	k > l	4100	4
12	Merge	Merge	l > m	1500	4
13	Basic	Basic	m > n	5280	4

Facility Segment Data

Segment 1: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.979	6324	9600	0.66	68.3	23.1	C

Segment 2: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.77	0.979	0.964	6324	2822	9600	4200	0.66	0.67	63.0	56.4	25.1	14.5	B

Segment 3: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.979	4048	9600	0.42	70.0	14.5	B

Segment 4: Merge															
Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.87	0.979	0.988	5758	1710	9600	2100	0.60	0.81	64.1	61.9	22.5	21.9	C

Segment 5: Overlap								
Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.979	5645	9600	0.59	64.1	22.5	C

Segment 6: Diverge															
Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.84	0.979	0.983	5645	933	9600	2100	0.59	0.44	67.1	61.1	21.0	23.2	C

Segment 7: Basic								
Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.985	4779	9600	0.50	70.0	17.1	B

Segment 8: Merge															
Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.84	1.000	0.983	6009	1302	9600	2100	0.63	0.62	63.5	60.9	23.7	24.1	C

Segment 9: Basic								
Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.985	5940	9600	0.62	69.1	21.5	C

Segment 10: Diverge															
Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.67	0.964	0.964	6070	1138	9600	2100	0.63	0.54	66.6	60.6	22.8	28.2	D

Segment 11: Basic								
Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.985	5146	9600	0.54	69.9	18.4	C

Segment 12: Merge															
Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.89	0.964	0.988	6276	1018	9600	2100	0.65	0.48	63.2	60.6	24.8	24.6	C

Segment 13: Basic								
Time Period	**PHF**	**fHV**	**Flow Rate (pc/h)**	**Capacity (pc/h)**	**d/c Ratio**	**Speed (mi/h)**	**Density (pc/mi/ln)**	**LOS**
1	0.94	0.964	6246	9600	0.65	68.5	22.8	C

Facility Time Period Results

T	Speed, mi/h	Density, pc/mi/ln	Density, veh/mi/ln	Travel Time, min	LOS
1	67.9	20.8	20.4	6.4	C

Facility Overall Results

Space Mean Speed, mi/h	67.9	Density, veh/mi/ln	20.4
Average Travel Time, min	6.4		

HCS 2010 Facilities Report

Project Information

Analyst	PK/LCG	Agency	
Jurisdiction		Time Period Analyzed	PM Peak - SB
Analysis Year	2040 - 4A South Alt. B PM - SB Overlap	Date	6/30/2017
Project Description	I-93 SB - from N of Exit 5 to S of Exit 4		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	15
Total Time Periods	1	Time Period Duration, min	15

Segment Geometric Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	a->b	5280	4
2	Diverge	Diverge	b->c	1500	4
3	Basic	Basic	c->d	3920	4
4	Merge	Merge	d->e	1500	4
5	Basic	Basic	e->f	7615	4
6	Diverge	Diverge	f>g	1500	4
7	Basic	Basic	g>h	3990	4
8	Merge	Basic	h>i	1500	3
9	Overlap	Basic	i>j	650	4
10	Diverge	Diverge	j>k	1500	3
11	Basic	Basic	k>l	2325	4
12	Merge	Merge	l>m	1500	4
13	Basic	Basic	m>n	600	4
14	Merge	Merge	n>o	1500	4
15	Basic	Basic	o>p	5280	4

Facility Segment Data

Segment 1: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.982	5947	9600	0.62	69.0	21.6	C

Segment 2: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.89	0.982	0.979	5947	693	9600	2100	0.62	0.33	67.6	61.7	22.0	23.2	C

Segment 3: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.982	5297	9600	0.55	69.8	19.0	C

Segment 4: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.81	0.970	0.978	6083	720	9600	2100	0.63	0.34	64.6	63.1	23.5	18.6	B

Segment 5: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.982	5915	9600	0.62	69.1	21.4	C

Segment 6: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.84	0.982	0.979	5915	1915	9600	2100	0.62	0.91	64.4	58.7	23.0	31.2	D

Segment 7: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.982	4209	9600	0.44	70.0	15.0	B

Segment 8: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.84	0.982	0.979	5437	1228	7200	2100	0.58	0.58	69.5	58.6	20.2	29.1	C

Segment 9: Overlap

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.982	5303	9600	0.55	62.2	28.4	D

Segment 10: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.84	0.982	0.979	5303	2055	7200	2100	0.74	0.98	62.2	58.3	28.4	30.2	D

Segment 11: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.980	3479	9600	0.36	70.0	12.4	B

Segment 12: Merge

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS

	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.82	0.980	0.980	3815	336	9600	2000	0.40	0.17	65.6	62.9	14.5	9.4	A

Segment 13: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.980	3772	9600	0.39	70.0	13.5	B

Segment 14: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.82	0.980	0.980	4674	902	9600	2100	0.49	0.43	65.1	62.9	17.9	15.1	B

Segment 15: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.980	4559	9600	0.47	70.0	16.3	B

Facility Time Period Results

T	Speed, mi/h	Density, pc/mi/ln	Density, veh/mi/ln	Travel Time, min	LOS
1	68.4	19.3	18.9	6.7	C

Facility Overall Results

Space Mean Speed, mi/h	68.4	Density, veh/mi/ln	18.9
Average Travel Time, min	6.7		

HCS 2010 Facilities Report

Project Information

Analyst	PK/LCG	Agency	CLD
Jurisdiction		Time Period Analyzed	AM Peak - NB
Analysis Year	2040 4A North Alt. C - AM-NB	Date	6/30/2017
Project Description	I-93 NB - from S. of Exit 4 to N of Exit 5		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	13
Total Time Periods	1	Time Period Duration, min	15

Segment Geometric Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	a->b	5280	4
2	Diverge	Diverge	b.->c	1500	4
3	Basic	Basic	c->d	4525	4
4	Merge	Merge	d->e	1500	4
5	Basic	Basic	e->f	4497	4
6	Diverge	Diverge	f > g	1500	4
7	Basic	Basic	g > h	2702	4
8	Merge	Merge	h > j	1500	4
9	Basic	Basic	i > j	1626	4
10	Diverge	Diverge	j > k	1500	4
11	Basic	Basic	k > l	4100	4
12	Merge	Merge	l > m	1500	4
13	Basic	Basic	m > n	5280	4

Facility Segment Data

Segment 1: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.979	3548	9600	0.37	70.0	12.7	B

Segment 2: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.77	0.979	0.964	3548	1017	9600	4200	0.37	0.24	68.4	60.9	13.0	-3.2	A

Segment 3: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.979	2727	9600	0.28	70.0	9.7	A

Segment 4: Merge														
Time Period	**PHF**		**fHV**		**Flow Rate (pc/h)**		**Capacity (pc/h)**		**d/c Ratio**		**Speed (mi/h)**		**Density (pc/mi/ln)**		**LOS**
	F	**R**	**F**	**R**	**Freeway**	**Ramp**	**Freeway**	**Ramp**	**F**	**R**	**F**	**R**	**Freeway**	**Ramp**	
1	0.94	0.90	0.979	0.983	4677	1950	9600	2100	0.49	0.93	64.7	62.6	18.1	19.5	B

Segment 5: Basic								
Time Period	**PHF**	**fHV**	**Flow Rate (pc/h)**	**Capacity (pc/h)**	**d/c Ratio**	**Speed (mi/h)**	**Density (pc/mi/ln)**	**LOS**
1	0.94	0.964	4674	9600	0.49	70.0	16.7	B

Segment 6: Diverge															
Time Period	**PHF**		**fHV**		**Flow Rate (pc/h)**		**Capacity (pc/h)**		**d/c Ratio**		**Speed (mi/h)**		**Density (pc/mi/ln)**		**LOS**
	F	**R**	**F**	**R**	**Freeway**	**Ramp**	**Freeway**	**Ramp**	**F**	**R**	**F**	**R**	**Freeway**	**Ramp**	
1	0.94	0.81	0.964	0.969	4674	325	9600	2100	0.49	0.15	69.0	62.7	16.9	19.0	B

Segment 7: Basic								
Time Period	**PHF**	**fHV**	**Flow Rate (pc/h)**	**Capacity (pc/h)**	**d/c Ratio**	**Speed (mi/h)**	**Density (pc/mi/ln)**	**LOS**
1	0.94	0.964	4392	9600	0.46	70.0	15.7	B

Segment 8: Merge															
Time Period	**PHF**		**fHV**		**Flow Rate (pc/h)**		**Capacity (pc/h)**		**d/c Ratio**		**Speed (mi/h)**		**Density (pc/mi/ln)**		**LOS**
	F	**R**	**F**	**R**	**Freeway**	**Ramp**	**Freeway**	**Ramp**	**F**	**R**	**F**	**R**	**Freeway**	**Ramp**	
1	0.94	0.81	0.964	0.969	5953	1561	9600	2100	0.62	0.74	64.1	61.9	23.2	21.9	C

Segment 9: Basic								
Time Period	**PHF**	**fHV**	**Flow Rate (pc/h)**	**Capacity (pc/h)**	**d/c Ratio**	**Speed (mi/h)**	**Density (pc/mi/ln)**	**LOS**
1	0.94	0.964	5744	9600	0.60	69.4	20.7	C

Segment 10: Diverge															
Time Period	**PHF**		**fHV**		**Flow Rate (pc/h)**		**Capacity (pc/h)**		**d/c Ratio**		**Speed (mi/h)**		**Density (pc/mi/ln)**		**LOS**
	F	**R**	**F**	**R**	**Freeway**	**Ramp**	**Freeway**	**Ramp**	**F**	**R**	**F**	**R**	**Freeway**	**Ramp**	
1	0.95	0.75	0.964	0.956	5684	802	9600	2000	0.59	0.40	63.9	56.0	22.2	25.1	C

Segment 11: Basic								
Time Period	**PHF**	**fHV**	**Flow Rate (pc/h)**	**Capacity (pc/h)**	**d/c Ratio**	**Speed (mi/h)**	**Density (pc/mi/ln)**	**LOS**
1	0.94	0.964	5109	9600	0.53	69.9	18.3	C

Segment 12: Merge															
Time Period	**PHF**		**fHV**		**Flow Rate (pc/h)**		**Capacity (pc/h)**		**d/c Ratio**		**Speed (mi/h)**		**Density (pc/mi/ln)**		**LOS**
	F	**R**	**F**	**R**	**Freeway**	**Ramp**	**Freeway**	**Ramp**	**F**	**R**	**F**	**R**	**Freeway**	**Ramp**	
1	0.94	0.83	0.964	0.972	6125	1016	9600	2100	0.64	0.48	63.3	60.6	24.2	24.2	C

Segment 13: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.964	6014	9600	0.63	68.9	21.8	C

Facility Time Period Results

T	Speed, mi/h	Density, pc/mi/ln	Density, veh/mi/ln	Travel Time, min	LOS
1	68.4	17.0	16.4	6.1	B

Facility Overall Results

Space Mean Speed, mi/h	68.4	Density, veh/mi/ln	16.4
Average Travel Time, min	6.1		

HCS 2010 Facilities Report

Project Information

Analyst	PK/LCG	Agency	
Jurisdiction		Time Period Analyzed	AM Peak - SB
Analysis Year	2040 4A North Alt C AM - SB	Date	7/6/2017
Project Description	I-93 SB - from N of Exit 5 to S of Exit 4		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	15
Total Time Periods	1	Time Period Duration, min	15

Segment Geometric Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	a->b	5280	4
2	Diverge	Diverge	b->c	1500	4
3	Basic	Basic	c->d	3920	4
4	Merge	Merge	d->e	1500	4
5	Basic	Basic	e->f	2705	4
6	Diverge	Diverge	f>g	1500	4
7	Basic	Basic	g>h	2850	4
8	Merge	Merge	h>i	1500	4
9	Basic	Basic	i>j	4675	4
10	Diverge	Diverge	j>k	1500	4
11	Basic	Basic	k>l	2550	4
12	Merge	Merge	l>m	1500	4
13	Basic	Basic	m>n	600	4
14	Merge	Merge	n>o	1500	4
15	Basic	Basic	o>p	5280	4

Facility Segment Data

Segment 1: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.970	5994	9600	0.62	69.0	21.7	C

Segment 2: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.74	0.970	0.972	5994	646	9600	2100	0.62	0.31	67.8	61.9	22.1	25.2	C

Segment 3: Basic

Time	PHF	fHV	Flow Rate	Capacity	d/c	Speed	Density	LOS

Period			(pc/h)	(pc/h)	Ratio	(mi/h)	(pc/mi/ln)	
1	0.94	0.970	5484	9600	0.57	69.7	19.7	C

Segment 4: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.84	0.970	0.953	6421	937	9600	2100	0.67	0.45	63.4	61.0	25.3	23.9	C

Segment 5: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.970	6306	9600	0.66	68.4	23.0	C

Segment 6: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.84	0.970	0.967	6306	1939	9600	2100	0.66	0.92	64.3	58.6	24.5	32.9	D

Segment 7: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.970	4579	9600	0.48	70.0	16.4	B

Segment 8: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.84	1.000	0.967	5007	566	9600	2100	0.52	0.27	65.5	63.8	19.1	14.7	B

Segment 9: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.980	5031	9600	0.52	70.0	18.0	B

Segment 10: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.95	0.970	0.975	5083	1215	9600	1900	0.53	0.64	59.7	51.3	21.3	22.5	C

Segment 11: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.980	3810	9600	0.40	70.0	13.6	B

Segment 12: Merge

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS

	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.82	0.980	0.970	4728	918	9600	2000	0.49	0.46	64.7	62.1	18.3	15.5	B

Segment 13: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.980	4603	9600	0.48	70.0	16.4	B

Segment 14: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.82	0.980	0.970	6401	1798	9600	2100	0.67	0.86	63.3	60.8	25.3	24.3	C

Segment 15: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.980	6155	9600	0.64	68.7	22.4	C

Facility Time Period Results

T	Speed, mi/h	Density, pc/mi/ln	Density, veh/mi/ln	Travel Time, min	LOS
1	67.9	20.4	19.9	6.4	C

Facility Overall Results

Space Mean Speed, mi/h	67.9	Density, veh/mi/ln	19.9
Average Travel Time, min	6.4		

HCS 2010 Facilities Report

Project Information

Analyst	PK/LCG	Agency	CLD
Jurisdiction		Time Period Analyzed	PM Peak - NB
Analysis Year	2040 4A North Alt. C - PM-NB	Date	6/30/2017
Project Description	I-93 NB - from S. of Exit 4 to N of Exit 5		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	13
Total Time Periods	1	Time Period Duration, min	15

Segment Geometric Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	a->b	5280	4
2	Diverge	Diverge	b.->c	1500	4
3	Basic	Basic	c->d	4525	4
4	Merge	Merge	d->e	1500	4
5	Basic	Basic	e->f	4497	4
6	Diverge	Diverge	f > g	1500	4
7	Basic	Basic	g > h	2702	4
8	Merge	Merge	h > j	1500	4
9	Basic	Basic	i > j	1626	4
10	Diverge	Diverge	j > k	1500	4
11	Basic	Basic	k > l	4100	4
12	Merge	Merge	l > m	1500	4
13	Basic	Basic	m > n	5280	4

Facility Segment Data

Segment 1: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.979	6112	9600	0.64	68.8	22.2	C

Segment 2: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.92	0.979	0.991	6112	2369	9600	4200	0.64	0.56	64.4	57.5	23.7	11.1	B

Segment 3: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.979	3765	9600	0.39	70.0	13.4	B

Segment 4: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.87	0.979	0.988	5306	1541	9600	2100	0.55	0.73	64.7	62.6	20.5	19.8	B

Segment 5: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.985	5173	9600	0.54	69.9	18.5	C

Segment 6: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.84	0.985	0.983	5173	279	9600	2100	0.54	0.13	68.9	62.8	18.8	20.6	C

Segment 7: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.985	4925	9600	0.51	70.0	17.6	B

Segment 8: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.84	0.985	0.983	6245	1320	9600	2100	0.65	0.63	64.1	62.0	24.4	21.8	C

Segment 9: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.985	6102	9600	0.64	68.8	22.2	C

Segment 10: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.67	0.985	0.964	6102	1068	9600	2100	0.64	0.51	66.7	60.8	22.9	28.0	C

Segment 11: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.985	5357	9600	0.56	69.8	19.2	C

Segment 12: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.89	0.985	0.988	6119	762	9600	2100	0.64	0.36	63.6	61.1	24.1	23.1	C

Segment 13: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.985	6081	9600	0.63	68.8	22.1	C

Facility Time Period Results

T	Speed, mi/h	Density, pc/mi/ln	Density, veh/mi/ln	Travel Time, min	LOS
1	68.3	20.0	19.7	6.2	C

Facility Overall Results

Space Mean Speed, mi/h	68.3	Density, veh/mi/ln	19.7
Average Travel Time, min	6.2		

HCS 2010 Facilities Report

Project Information

Analyst	PK/LCG	Agency	
Jurisdiction		Time Period Analyzed	PM Peak - SB
Analysis Year	2040 4A North Alt C PM - SB	Date	7/6/2017
Project Description	I-93 SB - from N of Exit 5 to S of Exit 4		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	15
Total Time Periods	1	Time Period Duration, min	15

Segment Geometric Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	a->b	5280	4
2	Diverge	Diverge	b->c	1500	4
3	Basic	Basic	c->d	3920	4
4	Merge	Merge	d->e	1500	4
5	Basic	Basic	e->f	2705	4
6	Diverge	Diverge	f>g	1500	4
7	Basic	Basic	g>h	2850	4
8	Merge	Merge	h>i	1500	4
9	Basic	Basic	i>j	4675	4
10	Diverge	Diverge	j>k	1500	4
11	Basic	Basic	k>l	2550	4
12	Merge	Merge	l>m	1500	4
13	Basic	Basic	m>n	600	4
14	Merge	Merge	n>o	1500	4
15	Basic	Basic	o>p	5280	4

Facility Segment Data

Segment 1: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.982	5877	9600	0.61	69.2	21.2	C

Segment 2: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.89	0.982	0.979	5877	658	9600	2100	0.61	0.31	67.7	61.8	21.7	24.8	C

Segment 3: Basic

Time	PHF	fHV	Flow Rate	Capacity	d/c	Speed	Density	LOS

Period			(pc/h)	(pc/h)	Ratio	(mi/h)	(pc/mi/ln)	
1	0.94	0.982	5260	9600	0.55	69.8	18.8	C

Segment 4: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.81	0.982	0.978	6055	795	9600	2100	0.63	0.38	63.8	61.5	23.7	22.2	C

Segment 5: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.970	6016	9600	0.63	68.9	21.8	C

Segment 6: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.86	0.982	0.981	5942	1665	9600	2100	0.62	0.79	65.1	59.3	22.8	30.2	D

Segment 7: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.982	4420	9600	0.46	70.0	15.8	B

Segment 8: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.86	0.982	0.981	4906	486	9600	2100	0.51	0.23	65.5	63.9	18.7	14.1	B

Segment 9: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.980	4874	9600	0.51	70.0	17.4	B

Segment 10: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.92	0.980	0.986	4874	1598	9600	2100	0.51	0.76	65.0	59.4	18.7	23.6	C

Segment 11: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.980	3300	9600	0.34	70.0	11.8	B

Segment 12: Merge

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS

	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.82	0.980	0.980	3723	423	9600	2000	0.39	0.21	65.5	62.7	14.2	10.2	B

Segment 13: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.980	3669	9600	0.38	70.0	13.1	B

Segment 14: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.82	0.980	0.980	4509	840	9600	2100	0.47	0.40	65.7	63.8	17.2	14.3	B

Segment 15: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.980	4402	9600	0.46	70.0	15.7	B

Facility Time Period Results

T	Speed, mi/h	Density, pc/mi/ln	Density, veh/mi/ln	Travel Time, min	LOS
1	68.5	18.2	17.8	6.4	C

Facility Overall Results

Space Mean Speed, mi/h	68.5	Density, veh/mi/ln	17.8
Average Travel Time, min	6.4		

HCS 2010 Facilities Report

Project Information

Analyst	PK/LCG	Agency	CLD
Jurisdiction		Time Period Analyzed	AM Peak - NB
Analysis Year	2040 4A North Alt D - AM - NB	Date	6/20/2017
Project Description	I-93 NB - from S. of Exit 4 to N of Exit 5		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	13
Total Time Periods	1	Time Period Duration, min	15

Segment Geometric Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	a->b	5280	4
2	Diverge	Diverge	b.->c	1500	4
3	Basic	Basic	c->d	4525	4
4	Merge	Merge	d->e	1500	4
5	Basic	Basic	e->f	4497	4
6	Diverge	Diverge	f > g	1500	4
7	Basic	Basic	g > h	2702	4
8	Merge	Merge	h > j	1500	4
9	Basic	Basic	i > j	1626	4
10	Diverge	Diverge	j > k	1500	4
11	Basic	Basic	k > l	4100	4
12	Merge	Merge	l > m	1500	4
13	Basic	Basic	m > n	5280	4

Facility Segment Data

Segment 1: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.979	3548	9600	0.37	70.0	12.7	B

Segment 2: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.77	0.979	0.964	3548	1058	9600	4200	0.37	0.25	68.2	60.8	13.0	-2.9	A

Segment 3: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS

1	0.94	0.979	2695	9600	0.28	70.0	9.6	A

Segment 4: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.90	0.979	0.983	4583	1888	9600	2100	0.48	0.90	64.8	62.8	17.7	19.0	B

Segment 5: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.964	4580	9600	0.48	70.0	16.4	B

Segment 6: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.81	0.964	0.969	4580	172	9600	2100	0.48	0.08	69.4	63.1	16.5	17.9	B

Segment 7: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.964	4431	9600	0.46	70.0	15.8	B

Segment 8: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.81	0.964	0.969	6017	1586	9600	2100	0.63	0.76	64.0	61.8	23.5	22.2	C

Segment 9: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.964	5805	9600	0.60	69.3	20.9	C

Segment 10: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.75	0.964	0.956	5805	851	9600	2100	0.60	0.41	67.3	61.3	21.6	25.8	C

Segment 11: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.964	5132	9600	0.53	69.9	18.4	C

Segment 12: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	

1	0.94	0.83	0.964	0.972	6167	1035	9600	2100	0.64	0.49	63.4	60.7	24.3	24.4	C

Segment 13: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.964	6053	9600	0.63	68.9	22.0	C

Facility Time Period Results

T	Speed, mi/h	Density, pc/mi/ln	Density, veh/mi/ln	Travel Time, min	LOS
1	68.6	17.0	16.4	6.1	B

Facility Overall Results

Space Mean Speed, mi/h	68.6	Density, veh/mi/ln	16.4
Average Travel Time, min	6.1		

HCS 2010 Facilities Report

Project Information

Analyst	PK/LCG	Agency	
Jurisdiction		Time Period Analyzed	AM Peak - SB
Analysis Year	2040 4A North Alt D AM - SB	Date	7/6/2017
Project Description	I-93 SB - from N of Exit 5 to S of Exit 4		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	15
Total Time Periods	1	Time Period Duration, min	15

Segment Geometric Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	a->b	5280	4
2	Diverge	Diverge	b->c	1500	4
3	Basic	Basic	c->d	3920	4
4	Merge	Merge	d->e	1500	4
5	Basic	Basic	e->f	2705	4
6	Diverge	Diverge	f>g	1500	4
7	Basic	Basic	g>h	2850	4
8	Merge	Merge	h>i	1500	4
9	Basic	Basic	i>j	4675	4
10	Diverge	Diverge	j>k	1500	4
11	Basic	Basic	k>l	2550	4
12	Merge	Merge	l>m	1500	4
13	Basic	Basic	m>n	600	4
14	Merge	Merge	n>o	1500	4
15	Basic	Basic	o>p	5280	4

Facility Segment Data

Segment 1: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.970	5994	9600	0.62	69.0	21.7	C

Segment 2: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.74	0.970	0.972	5994	653	9600	2100	0.62	0.31	67.7	61.8	22.1	25.2	C

Segment 3: Basic

Time	PHF	fHV	Flow Rate	Capacity	d/c	Speed	Density	LOS

Period			(pc/h)	(pc/h)	Ratio	(mi/h)	(pc/mi/ln)	
1	0.94	0.970	5478	9600	0.57	69.7	19.7	C

Segment 4: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.84	0.970	0.953	6409	931	9600	2100	0.67	0.44	63.4	61.0	25.3	23.9	C

Segment 5: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.970	6295	9600	0.66	68.4	23.0	C

Segment 6: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.84	0.970	0.967	6295	1908	9600	2100	0.66	0.91	64.4	58.7	24.4	32.7	D

Segment 7: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.970	4595	9600	0.48	70.0	16.4	B

Segment 8: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.84	1.000	0.967	4974	517	9600	2100	0.52	0.25	65.5	63.8	19.0	14.4	B

Segment 9: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.980	5004	9600	0.52	70.0	17.9	B

Segment 10: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.95	0.970	0.975	5056	1188	9600	1900	0.53	0.63	59.9	51.4	21.1	22.3	C

Segment 11: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.980	3810	9600	0.40	70.0	13.6	B

Segment 12: Merge

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS

	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.82	0.980	0.970	4728	918	9600	2000	0.49	0.46	64.7	62.1	18.3	15.5	B

Segment 13: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.980	4603	9600	0.48	70.0	16.4	B

Segment 14: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.82	0.980	0.970	6388	1785	9600	2100	0.67	0.85	63.3	60.8	25.2	24.2	C

Segment 15: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.980	6144	9600	0.64	68.7	22.4	C

Facility Time Period Results

T	Speed, mi/h	Density, pc/mi/ln	Density, veh/mi/ln	Travel Time, min	LOS
1	67.9	20.3	19.8	6.4	C

Facility Overall Results

Space Mean Speed, mi/h	67.9	Density, veh/mi/ln	19.8
Average Travel Time, min	6.4		

HCS 2010 Facilities Report

Project Information

Analyst	PK/LCG	Agency	CLD
Jurisdiction		Time Period Analyzed	PM Peak - NB
Analysis Year	2040 4A North Alt D - PM-NB	Date	6/20/2017
Project Description	I-93 NB - from S. of Exit 4 to N of Exit 5		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	13
Total Time Periods	1	Time Period Duration, min	15

Segment Geometric Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	a->b	5280	4
2	Diverge	Diverge	b.->c	1500	4
3	Basic	Basic	c->d	4525	4
4	Merge	Merge	d->e	1500	4
5	Basic	Basic	e->f	4497	4
6	Diverge	Diverge	f > g	1500	4
7	Basic	Basic	g > h	2702	4
8	Merge	Merge	h > j	1500	4
9	Basic	Basic	i > j	1626	4
10	Diverge	Diverge	j > k	1500	4
11	Basic	Basic	k > l	4100	4
12	Merge	Merge	l > m	1500	4
13	Basic	Basic	m > n	5280	4

Facility Segment Data

Segment 1: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.979	6112	9600	0.64	68.8	22.2	C

Segment 2: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.92	0.979	0.991	6112	2468	9600	4200	0.64	0.59	64.1	57.3	23.8	11.6	B

Segment 3: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.979	3667	9600	0.38	70.0	13.1	B

Segment 4: Merge															
Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.87	0.979	0.988	5162	1495	9600	2100	0.54	0.71	64.8	62.8	19.9	19.1	B

Segment 5: Basic								
Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.985	5033	9600	0.52	70.0	18.0	B

Segment 6: Diverge															
Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.84	0.985	0.983	5033	145	9600	2100	0.52	0.07	69.2	63.1	18.2	19.5	B

Segment 7: Basic								
Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.985	4903	9600	0.51	70.0	17.5	B

Segment 8: Merge															
Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.84	0.985	0.983	6247	1344	9600	2100	0.65	0.64	64.0	62.0	24.4	21.9	C

Segment 9: Basic								
Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.985	6102	9600	0.64	68.8	22.2	C

Segment 10: Diverge															
Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.67	0.985	0.964	6102	1146	9600	2100	0.64	0.55	66.5	60.6	22.9	28.4	D

Segment 11: Basic								
Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.985	5303	9600	0.55	69.8	19.0	C

Segment 12: Merge															
Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.83	0.985	0.988	6132	829	9600	2100	0.64	0.39	63.5	61.0	24.1	23.4	C

Segment 13: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.985	6037	9600	0.63	68.9	21.9	C

Facility Time Period Results

T	Speed, mi/h	Density, pc/mi/ln	Density, veh/mi/ln	Travel Time, min	LOS
1	68.4	19.8	19.5	6.2	C

Facility Overall Results

Space Mean Speed, mi/h	68.4	Density, veh/mi/ln	19.5
Average Travel Time, min	6.2		

HCS 2010 Facilities Report

Project Information

Analyst	PK/LCG	Agency	
Jurisdiction		Time Period Analyzed	PM Peak - SB
Analysis Year	2040 4A North Alt D PM - SB	Date	7/6/2017
Project Description	I-93 SB - from N of Exit 5 to S of Exit 4		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	15
Total Time Periods	1	Time Period Duration, min	15

Segment Geometric Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	a->b	5280	4
2	Diverge	Diverge	b->c	1500	4
3	Basic	Basic	c->d	3920	4
4	Merge	Merge	d->e	1500	4
5	Basic	Basic	e->f	2705	4
6	Diverge	Diverge	f>g	1500	4
7	Basic	Basic	g>h	2850	4
8	Merge	Merge	h>i	1500	4
9	Basic	Basic	i>j	4675	4
10	Diverge	Diverge	j>k	1500	4
11	Basic	Basic	k>l	2550	4
12	Merge	Merge	l>m	1500	4
13	Basic	Basic	m>n	600	4
14	Merge	Merge	n>o	1500	4
15	Basic	Basic	o>p	5280	4

Facility Segment Data

Segment 1: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.982	5872	9600	0.61	69.2	21.2	C

Segment 2: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.89	0.982	0.979	5872	664	9600	2100	0.61	0.32	67.8	61.8	21.7	24.8	C

Segment 3: Basic

Time	PHF	fHV	Flow Rate	Capacity	d/c	Speed	Density	LOS

Period			(pc/h)	(pc/h)	Ratio	(mi/h)	(pc/mi/ln)	
1	0.94	0.982	5249	9600	0.55	69.9	18.8	C

Segment 4: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.81	0.982	0.978	6038	789	9600	2100	0.63	0.38	63.8	61.5	23.7	22.1	C

Segment 5: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.970	5999	9600	0.62	69.0	21.7	C

Segment 6: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.86	0.982	0.981	5926	1636	9600	2100	0.62	0.78	65.2	59.4	22.7	30.0	D

Segment 7: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.982	4431	9600	0.46	70.0	15.8	B

Segment 8: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.86	0.982	0.981	4875	444	9600	2100	0.51	0.21	65.6	63.9	18.6	13.8	B

Segment 9: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.980	4847	9600	0.50	70.0	17.3	B

Segment 10: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.92	0.980	0.986	4847	1565	9600	2100	0.50	0.75	65.1	59.5	18.6	23.4	C

Segment 11: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.980	3305	9600	0.34	70.0	11.8	B

Segment 12: Merge

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS

	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.82	0.980	0.980	3728	423	9600	2000	0.39	0.21	65.5	62.7	14.2	10.3	B

Segment 13: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.980	3675	9600	0.38	70.0	13.1	B

Segment 14: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.82	0.980	0.980	4515	840	9600	2100	0.47	0.40	65.7	63.8	17.2	14.3	B

Segment 15: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.980	4407	9600	0.46	70.0	15.7	B

Facility Time Period Results

T	Speed, mi/h	Density, pc/mi/ln	Density, veh/mi/ln	Travel Time, min	LOS
1	68.6	18.2	17.8	6.4	C

Facility Overall Results

Space Mean Speed, mi/h	68.6	Density, veh/mi/ln	17.8
Average Travel Time, min	6.4		

HCS 2010 Facilities Report

Project Information

Analyst	PK/LCG	Agency	CLD
Jurisdiction		Time Period Analyzed	AM Peak - NB
Analysis Year	2040 Alternative F - AM-NB	Date	6/8/2017
Project Description	I-93 NB - from S. of Exit 4 to N of Exit 5		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	9
Total Time Periods	1	Time Period Duration, min	15

Segment Geometric Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	a->b	5280	4
2	Diverge	Diverge	b.->c	1500	4
3	Basic	Basic	c->d	4525	4
4	Merge	Merge	d->e	1500	4
5	Basic	Basic	e->f	11825	4
6	Diverge	Diverge	f->g	1500	4
7	Basic	Basic	g->h	4100	4
8	Merge	Merge	h->i	1500	4
9	Basic	Basic	i->j	5280	4

Facility Segment Data

Segment 1: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.979	3542	9600	0.37	70.0	12.7	B

Segment 2: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.77	0.979	0.964	3542	1105	9600	4200	0.37	0.26	68.0	60.7	13.0	-2.6	A

Segment 3: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.979	2437	9600	0.28	70.0	8.7	A

Segment 4: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	

1	0.94	0.90	0.973	0.983	4537	2622	9600	2100	0.55	1.25	53.3	61.7	45.0	21.9	C

Segment 5: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.964	4537	9600	0.55	70.0	16.2	B

Segment 6: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.75	0.964	0.956	4537	753	9600	2100	0.55	0.36	67.8	61.6	16.7	20.6	C

Segment 7: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.964	3784	9600	0.49	70.0	13.5	B

Segment 8: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.83	0.964	0.972	5513	1729	9600	2100	0.67	0.82	63.1	60.3	21.8	25.3	C

Segment 9: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.964	5513	9600	0.65	69.6	19.8	C

Facility Time Period Results

T	Speed, mi/h	Density, pc/mi/ln	Density, veh/mi/ln	Travel Time, min	LOS
1	68.4	16.3	15.8	6.1	B

Facility Overall Results

Space Mean Speed, mi/h	68.4	Density, veh/mi/ln	15.8
Average Travel Time, min	6.1		

HCS 2010 Facilities Report

Project Information

Analyst	PK/LCG	Agency	
Jurisdiction		Time Period Analyzed	AM Peak - SB
Analysis Year	2040 - Alternative F AM-SB	Date	6/18/2017
Project Description	I-93 SB - from N of Exit 5 to S of Exit 4		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	11
Total Time Periods	1	Time Period Duration, min	15

Segment Geometric Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	a->b	5280	4
2	Diverge	Diverge	b->c	1500	4
3	Basic	Basic	c->d	3920	4
4	Merge	Merge	d->e	1500	4
5	Basic	Basic	e->f	11730	4
6	Diverge	Diverge	f->g	1500	4
7	Basic	Basic	g->h	2550	4
8	Merge	Merge	h->i	1500	4
9	Basic	Basic	i->j	600	4
10	Merge	Merge	j->k	1500	4
11	Basic	Basic	l->m	5280	4

Facility Segment Data

Segment 1: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.970	5582	9600	0.58	69.6	20.1	C

Segment 2: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.74	0.970	0.972	5582	1383	9600	2100	0.58	0.66	65.9	60.0	21.2	25.1	C

Segment 3: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.970	4491	9600	0.47	70.0	16.0	B

Segment 4: Merge

Time	PHF	fHV	Flow Rate	Capacity	d/c	Speed	Density	LOS

Period					(pc/h)		(pc/h)		Ratio		(mi/h)		(pc/mi/ln)		
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.84	0.970	0.953	5428	937	9600	2100	0.57	0.45	64.8	62.9	20.9	17.5	B

Segment 5: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.970	5314	9600	0.55	69.8	19.0	C

Segment 6: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.95	0.970	0.975	5314	1792	9600	2100	0.55	0.85	64.6	59.0	20.6	26.2	C

Segment 7: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.980	3457	9600	0.36	70.0	12.3	B

Segment 8: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.82	0.980	0.970	4796	1339	9600	2000	0.50	0.67	64.3	61.7	18.6	17.5	B

Segment 9: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.980	4614	9600	0.48	70.0	16.5	B

Segment 10: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.82	0.980	0.970	6387	1773	9600	2100	0.67	0.84	62.8	60.1	25.4	24.2	C

Segment 11: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.980	6144	9600	0.64	68.7	22.4	C

Facility Time Period Results

T	Speed, mi/h	Density, pc/mi/ln	Density, veh/mi/ln	Travel Time, min	LOS
1	68.5	19.3	18.8	6.1	C

Facility Overall Results

Space Mean Speed, mi/h	68.5	Density, veh/mi/ln	18.8
Average Travel Time, min	6.1		

HCS 2010 Facilities Report

Project Information

Analyst	PK/LCG	Agency	CLD
Jurisdiction		Time Period Analyzed	PM Peak - NB
Analysis Year	2040 Alternative F PM - NB	Date	6/27/2017
Project Description	I-93 NB - from S. of Exit 4 to N of Exit 5		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	9
Total Time Periods	1	Time Period Duration, min	15

Segment Geometric Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	a->b	5280	4
2	Diverge	Diverge	b.->c	1500	4
3	Basic	Basic	c->d	4525	4
4	Merge	Merge	d->e	1500	4
5	Basic	Basic	e->f	11825	4
6	Diverge	Diverge	f->g	1500	4
7	Basic	Basic	g->h	4100	4
8	Merge	Merge	h->i	1500	4
9	Basic	Basic	i->j	5280	4

Facility Segment Data

Segment 1: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.979	6102	9600	0.64	68.8	22.2	C

Segment 2: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.92	0.979	0.991	6102	2583	9600	4200	0.64	0.62	63.7	57.0	23.9	12.5	B

Segment 3: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.979	3542	9600	0.37	70.0	12.7	B

Segment 4: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	

1	0.94	0.87	0.979	0.988	5613	2071	9600	2100	0.58	0.99	63.7	61.3	22.0	23.0	C

Segment 5: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.985	5443	9600	0.57	69.7	19.5	C

Segment 6: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.67	0.985	0.964	5443	1014	9600	2100	0.57	0.48	66.9	60.9	20.3	25.3	C

Segment 7: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.985	4736	9600	0.49	70.0	16.9	B

Segment 8: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.89	0.985	0.988	6032	1296	9600	2100	0.63	0.62	63.5	60.9	23.7	24.1	C

Segment 9: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.985	5967	9600	0.62	69.0	21.6	C

Facility Time Period Results

T	Speed, mi/h	Density, pc/mi/ln	Density, veh/mi/ln	Travel Time, min	LOS
1	68.6	19.6	19.2	6.1	C

Facility Overall Results

Space Mean Speed, mi/h	68.6	Density, veh/mi/ln	19.2
Average Travel Time, min	6.1		

HCS 2010 Facilities Report

Project Information

Analyst	PK/LCG	Agency	
Jurisdiction		Time Period Analyzed	PM Peak - SB
Analysis Year	2040 Alternative F - PM	Date	6/18/2017
Project Description	I-93 SB - from N of Exit 5 to S of Exit 4		

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	11
Total Time Periods	3	Time Period Duration, min	15

Segment Geometric Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	a->b	5280	4
2	Diverge	Diverge	b->c	1500	4
3	Basic	Basic	c->d	3920	4
4	Merge	Merge	d->e	1500	4
5	Basic	Basic	e->f	11730	4
6	Diverge	Diverge	f->g	1500	4
7	Basic	Basic	g->h	2550	4
8	Merge	Merge	h->i	1500	4
9	Basic	Basic	i->j	600	4
10	Merge	Merge	j->k	1500	4
11	Basic	Basic	l->m	5230	4

Facility Segment Data

Segment 1: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.982	6099	9600	0.64	68.8	22.2	C
2	0.94	0.982	6099	9600	0.64	68.8	22.2	C
3	0.94	0.982	6099	9600	0.64	68.8	22.2	C

Segment 2: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.89	0.980	0.979	6099	1400	9600	2100	0.64	0.67	65.8	59.9	23.2	27.2	C
2	0.94	0.89	0.980	0.979	6099	1400	9600	2100	0.64	0.67	65.8	59.9	23.2	27.2	C
3	0.94	0.89	0.980	0.979	6099	1400	9600	2100	0.64	0.67	65.8	59.9	23.2	27.2	C

Segment 3: Basic

Time	PHF	fHV	Flow Rate	Capacity	d/c	Speed	Density	LOS

Period			(pc/h)	(pc/h)	Ratio	(mi/h)	(pc/mi/ln)	
1	0.94	0.982	4699	9600	0.50	70.0	16.8	B
2	0.94	0.982	4699	9600	0.50	70.0	16.8	B
3	0.94	0.982	4699	9600	0.50	70.0	16.8	B

Segment 4: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.81	0.982	0.978	5488	789	9600	2100	0.58	0.38	65.1	63.4	21.1	17.0	B
2	0.94	0.81	0.980	0.978	5488	789	9600	2100	0.58	0.38	65.1	63.4	21.1	17.0	B
3	0.94	0.81	0.980	0.978	5488	789	9600	2100	0.58	0.38	65.1	63.4	21.1	17.0	B

Segment 5: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.982	5488	9600	0.57	69.7	19.7	C
2	0.94	0.982	5488	9600	0.57	69.7	19.7	C
3	0.94	0.982	5488	9600	0.57	69.7	19.7	C

Segment 6: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.92	0.980	0.986	5488	2359	9600	2100	0.57	1.12	53.3	57.5	45.0	29.6	D
2	1.00	0.92	0.980	0.986	5488	2359	9600	2100	0.54	1.12	53.3	57.5	45.0	29.6	D
3	1.00	0.92	0.980	0.986	5488	2359	9600	2100	0.54	1.12	53.3	57.5	45.0	29.6	D

Segment 7: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.980	3129	9600	0.33	70.0	11.2	B
2	0.94	0.980	3129	9600	0.33	70.0	11.2	B
3	0.94	0.980	3129	9600	0.33	70.0	11.2	B

Segment 8: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.90	0.82	0.978	0.980	3739	610	9600	2000	0.41	0.30	65.4	62.6	14.3	11.1	B
2	0.90	0.82	0.978	0.980	3739	610	9600	2000	0.41	0.30	65.4	62.6	14.3	11.1	B
3	0.90	0.82	0.978	0.980	3739	610	9600	2000	0.41	0.30	65.4	62.6	14.3	11.1	B

Segment 9: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.980	3739	9600	0.38	70.0	13.4	B
2	0.94	0.980	3739	9600	0.38	70.0	13.4	B

3	0.94	0.980	3739	9600	0.38	70.0	13.4	B

Segment 10: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.82	0.980	0.980	4567	828	9600	2100	0.47	0.39	65.7	63.8	17.4	14.5	B
2	0.94	0.82	0.980	0.980	4567	828	9600	2100	0.47	0.39	65.7	63.8	17.4	14.5	B
3	0.94	0.82	0.980	0.980	4567	828	9600	2100	0.47	0.39	65.7	63.8	17.4	14.5	B

Segment 11: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.980	4567	9600	0.46	70.0	16.3	B
2	0.94	0.980	4567	9600	0.46	70.0	16.3	B
3	0.94	0.980	4567	9600	0.46	70.0	16.3	B

Facility Time Period Results

T	Speed, mi/h	Density, pc/mi/ln	Density, veh/mi/ln	Travel Time, min	LOS
1	68.4	19.5	19.1	6.1	C
2	68.4	19.5	19.1	6.1	C
3	68.4	19.5	19.1	6.1	C

Facility Overall Results

Space Mean Speed, mi/h	68.4	Density, veh/mi/ln	19.1
Average Travel Time, min	6.1		

APPENDIX M: ESTIMATE OF CONTRIBUTION OF WOODMONT COMMONS TRAFFIC TO EXITS 4 AND 4A

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TO: File

FROM: Paul Konieczka, AICP PK
Linda C. Greer, PE, PTOE LG

DATE: February 5, 2018

RE: Traffic Technical Memo
Estimate of Contribution of Woodmont Commons Traffic to Exits 4 and 4A
CLD | Fuss & O'Neill Reference No. 05-0244

The Freeway Facilities analysis for the Exit 4A project showed a few cases, such as the Exit 4A SB off-ramp under Alternative A, where a single lane on- or off-ramp would not provide an acceptable operating condition, or Level of Service (LOS). Ameliorating this condition would require either a two-lane ramp or a reduction in volume that would improve the LOS. The NHDOT requested that the project team investigate the potential contribution of traffic from the proposed Woodmont Commons development to the various Exit 4 and Exit 4A ramps for the various interchange alternatives under consideration. This information should provide some guidance as to the sensitivity of these analyses to the assumed development scenarios for Woodmont Commons, especially since the full traffic impact of that development project has been assigned to the Exit 4A modeling network without any consideration for the 23% of potential internally captured trips estimated in the Woodmont Commons master transportation study. This approach was agreed upon between CLD | Fuss and O'Neill and the NHDOT per an email dated March 8, 2017.

It should be restated that the 2040 land use scenarios for the Woodmont Commons development vary by alternative. The southerly interchange alternatives (A and B) assume the maximum potential development scenario as allowed by the proposed zoning and the conditional use permit issued by the Town of Londonderry. The No-Build case as well as the remaining Build alternatives, either with or without an interchange (C, D and F), have assumed a less intense development scenario for the Woodmont Commons project.

To develop these traffic estimates, we worked with the Southern New Hampshire Planning Commission (SNHPC) to provide information on the allocation of trips to the various Exit 4 and 4A ramps from the various traffic zones in their network, including the Woodmont Commons traffic zones (Zone 277 on the west side of I-93 and Zones 69 and 375 on the east side), from the regional travel demand model that was used for this project. We requested this information for the 2015 base year to set a pre-Woodmont development condition as well as the 2040 design year for the No-Build alternative and two of the five 4A Build alternative interchange/connector road configurations (Alternative A with a southerly interchange, and Alternative C with a northerly interchange). This model only provides Average Weekday Traffic volumes (AWDTs) so a percentage of the projected daily traffic assignments attributable to these three zones could be calculated. Color plots of the trip assignments to the existing and proposed ramps were provided by

SNHPC for all the ramps and scenarios requested, which are attached to this memo. This information was also summarized in tabular form, which is also attached to this memo.

Findings

The data shows that the 2015 development of the three subject zones has only a small contribution to the Exit 4 ramps, mostly from the Zone 277 area (Garden Lane), and totals only about 12.7% of daily traffic on all Exit 4 ramps. The two zones to the east have minimal existing development and contribute few trips to Exit 4.

By the 2040 No-Build case, assumed the lesser Woodmont Commons development scenario, traffic from the three zones contribute almost 27% of total daily ramp traffic at Exit 4. The total number of trips assigned to the ramps by the model would more than double by 2040, and the contribution of Woodmont traffic from the three zones to each individual ramp would increase by approximately a factor of 2 over 2015 conditions. Woodmont-related trips would account for almost 40% of the total increase in ramp traffic at Exit 4 in the 2040 No-Build case. Except for the SB on-ramp from the east, Woodmont traffic accounts for between 24-44% of the traffic assigned to any one ramp on a daily basis.

With Alternative A in place, total ramp assignments at Exit 4 are reduced by about 20% to 62,773 trips per day. However, because that the Woodmont development scenario is maximized with a southerly interchange in place, the traffic assignments from the three Woodmont zones make up a larger proportion of total ramp traffic at Exit 4, to about 36% of the total, even with Exit 4A in place. The NB on-ramp and SB off-ramp see increases in traffic over the No-Build case with Alternative A in place, while the SB on-ramp traffic sees modest reductions. The NB off-ramp sees a small increase in traffic with Alternative A over the 2040 No-Build case.

At Exit 4A, Woodmont-related traffic assignments account for roughly the same percentage of total ramp traffic (36.3%) as they do at Exit 4 (36.2%). Woodmont-related traffic contributions range from between 26% (4,887 of the 18,996 total daily trips assigned to the SB Off-ramp) to 55% (4,795 of the 8,732 total daily trips assigned to the NB off-ramp) of total traffic on any one ramp at Exit 4A. The sensitivity analysis of the operations of the Exit 4A SB off-ramp as a single-lane off-ramp, as presented in the Traffic Technical Report, indicated that a reduction of 200 AM peak hour trips at this ramp would allow it to operate below capacity under 2040 conditions, so if the Woodmont development does not generate as much external traffic as projected in the SDEIS, this ramp may function acceptably as a single-lane off-ramp.

With a northerly interchange and a new roadway in Derry, as provided in Alternative C, the potential impacts of Woodmont-related traffic assignments on Exit 4A ramp volumes are much less in 2040 as compared to Alternative A. For one thing, the Woodmont development scenario is similar to the No-Build case, so it is not as intense as with a southerly interchange (Alternatives A or B). Furthermore, the interchange is further north of Exit 4, and not directly proximate to the Woodmont development itself, so its attractiveness as an alternate route from I-93 is diminished. As the table shows, Woodmont-related traffic comprises only 1% of total ramp traffic or individual ramp traffic at a northerly interchange. At Exit 4, there is slightly less total ramp traffic than under Alternative A, and Woodmont-related traffic accounts for just under a third of the total. The Exit 4

NB on-ramp and SB off-ramp see the greatest increases in traffic assignments with Alternative C in place, as compared to the 2040 No-Build condition, but not to the same degree as with Alternative A in place.

Summary

In summary, based on the SNHPC traffic model, the different development scenarios for the Woodmont Commons project have varying effects on projected 2040 traffic assignments at both Exits 4 and 4A, depending on the location of the interchange. In the 2040 No-Build case, Woodmont traffic is projected to comprise about 27% of total daily ramp traffic at Exit 4, but will be a larger share (36%) of Exit 4 traffic with Alternative A and the maximum projected development scenario that was assumed for this case. Woodmont-related traffic will also account for more than a third of ramp traffic at Exit 4A with Alternative A, but substantially less with a northerly interchange (Alternative C).

It should be stressed that these are raw model assignments only to provide a broad-brush, order of magnitude level of impact on ramp traffic without any consideration of possible 'internally captured trips' within the mixed-use development itself that may not be assigned to the local street network per the 'live, work, play' design intent of the Woodmont project. Consideration of a 'credit' for any internally captured trips would also not directly translate into a similar reduction in any particular ramp volume (i.e., using a 10% capture rate does not necessarily mean that all ramps would see a 10% reduction in volumes) since the characteristics of the 'captured' trips may be different. The NHDOT and the developer are and will continue to coordinate efforts to monitor traffic conditions and the need for any additional improvements as the Woodmont project progresses and actual traffic volumes are realized.

PK:LCG:ams

Attachments
- Table – Contribution of Woodmont Commons Traffic Zones to Exit 4 and 4A Ramp Volumes
- SNHPC Traffic Assignments – Selected Links at Exit 4 and 4A Interchange Ramps – 2015 Base Case, 2040 No-Build, 2040 Alternative A, and 2040 Alternative C

CONTRIBUTION OF WOODMONT COMMONS TRAFFIC ZONES TO EXIT 4 AND 4A RAMP VOLUMES

2/1/2018

Scenario:
2015 No-Build

Ramp	Total Trips Assigned	Woodmont zones 277	69	375	WC sum	% ramp total
Exit 4						
NB Off-ramp	10,389	1,053	10	-	1,063	10.2%
NB On-ramp	9,550	1,171	3	-	1,174	12.3%
SB On-ramp fr/ East	3,637	-	10	-	10	0.3%
SB On-ramp fr. West	4,907	1,087	-	-	1,087	22.2%
SB Off-ramp	8,157	1,306	-	-	1,306	16.0%
Total	36,640				4,640	12.7%

Scenario:
2040 No-Build

Ramp	Total Trips Assigned	Woodmont zones 277	69	375	WC sum	% ramp total	Diff from 2015 NoBd
Exit 4							
NB Off-ramp	20,215	4,670	163	98	4,931	24.4%	14.2%
NB On-ramp	21,343	5,292	150	90	5,532	25.9%	13.6%
SB On-ramp fr/ East	7,402	-	151	94	245	3.3%	3.0%
SB On-ramp fr. West	10,778	4,724	-	-	4,724	43.8%	21.7%
SB Off-ramp	18,349	5,375	140	57	5,572	30.4%	14.4%
Total	78,087				21,004	26.9%	14.2%

Scenario:
2040 Build - Alternative A

Ramp	Total Trips Assigned	Woodmont zones 277	69	375	WC sum	% ramp total	Diff from 2040 NoBd
Exit 4							
NB Off-ramp	18,073	5,062	-	-	5,062	28.0%	3.6%
NB On-ramp	15,150	5,823	485	325	6,633	43.8%	17.9%
SB On-ramp fr/ East	3,879	-	-	-	-	0.0%	-3.3%
SB On-ramp fr. West	11,836	5,093	-	-	5,093	43.0%	-0.8%
SB Off-ramp	13,795	5,919	-	-	5,919	42.9%	12.5%
Total	62,733				22,707	36.2%	9.3%

Scenario:
2040 Build - Alternative A

Ramp	Total Trips Assigned	Woodmont zones 277	69	375	WC sum	% ramp total
Exit 4A						
NB Off-ramp	8,732	-	2,833	1,962	4,795	54.9%
NB On-ramp	15,240	-	2,940	2,063	5,003	32.8%
SB Off-ramp	18,996	-	2,864	2,023	4,887	25.7%
SB On-ramp	10,752	-	2,831	1,996	4,827	44.9%
Total	53,720				19,512	36.3%

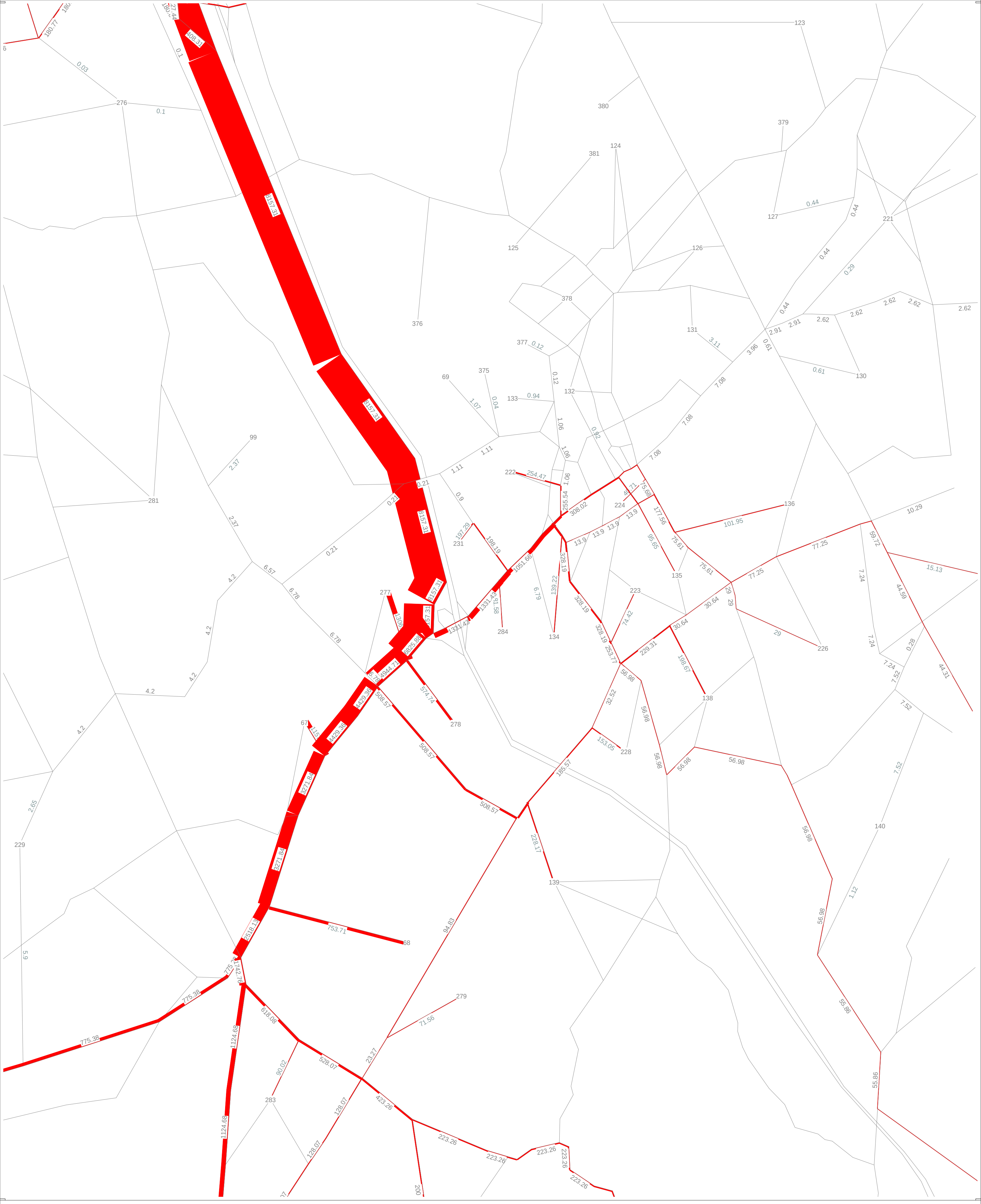
Scenario:
2040 Build - Alternative C

Ramp	Total Trips Assigned	Woodmont zones 277	69	375	WC sum	% ramp total	Diff from 2040 NoBd
Exit 4							
NB Off-ramp	18,728	4,589	163	95	4,847	25.9%	1.5%
NB On-ramp	15,903	5,309	146	-	5,455	34.3%	8.4%
SB On-ramp fr/ East	5,140	-	152	92	244	4.7%	1.4%
SB On-ramp fr. West	10,850	4,618	-	-	4,618	42.6%	-1.3%
SB Off-ramp	12,694	5,347	-	-	5,347	42.1%	11.8%
Total	63,315				20,511	32.4%	5.5%

Scenario:
2040 Build - Alternative C

Ramp	Total Trips Assigned	Woodmont zones 277	69	375	WC sum	% ramp total
Exit 4A						
NB Off-ramp	2,795	23	-	-	23	0.8%
NB On-ramp	13,410	-	-	89	89	0.7%
SB Off-ramp	17,920	-	132	113	245	1.4%
SB On-ramp	5,021	43	-	-	43	0.9%
Total	39,146				400	1.0%

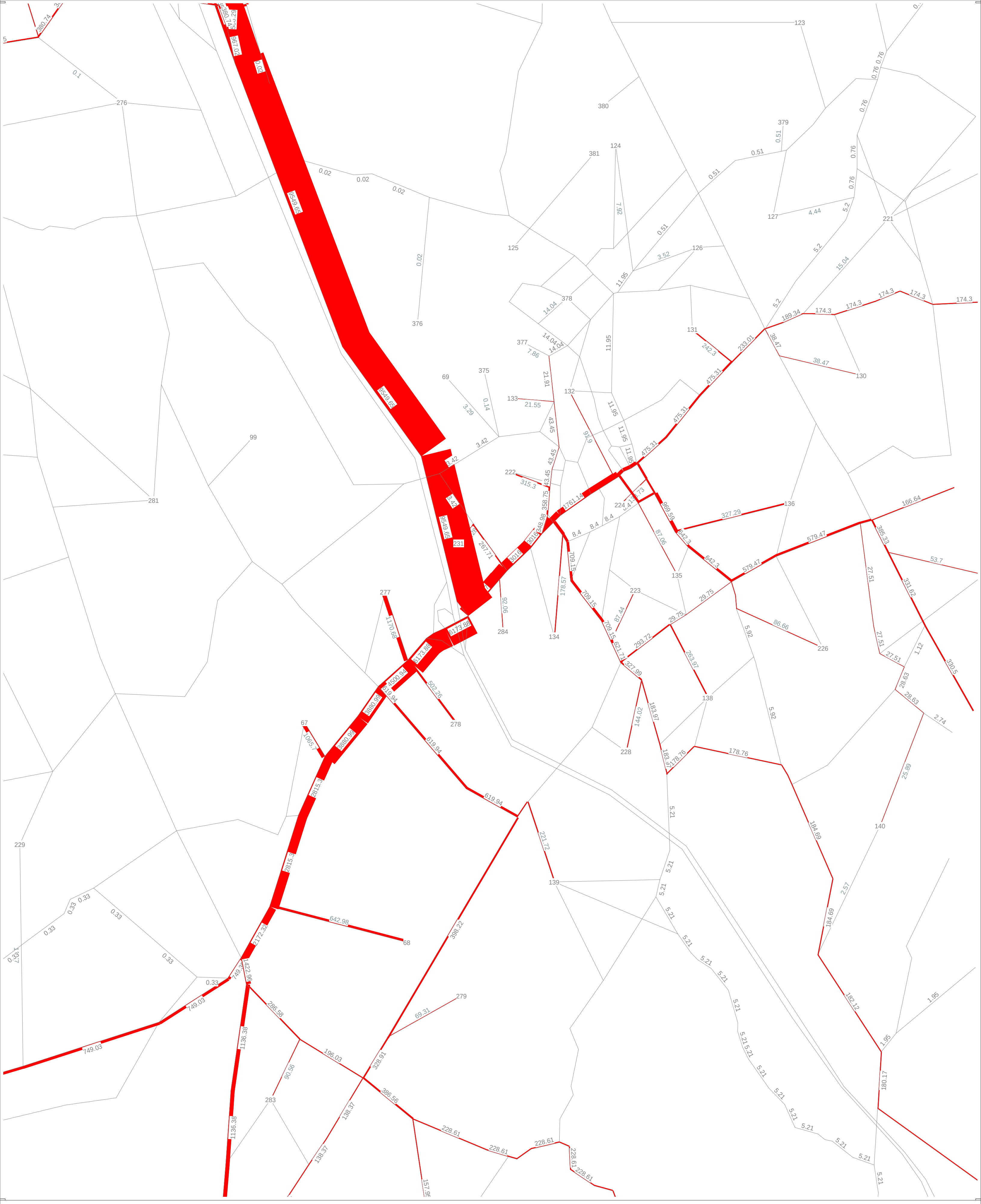
2015 Exit 4 SB On Ramp from West



2015 Exit 4 SB Off Ramp

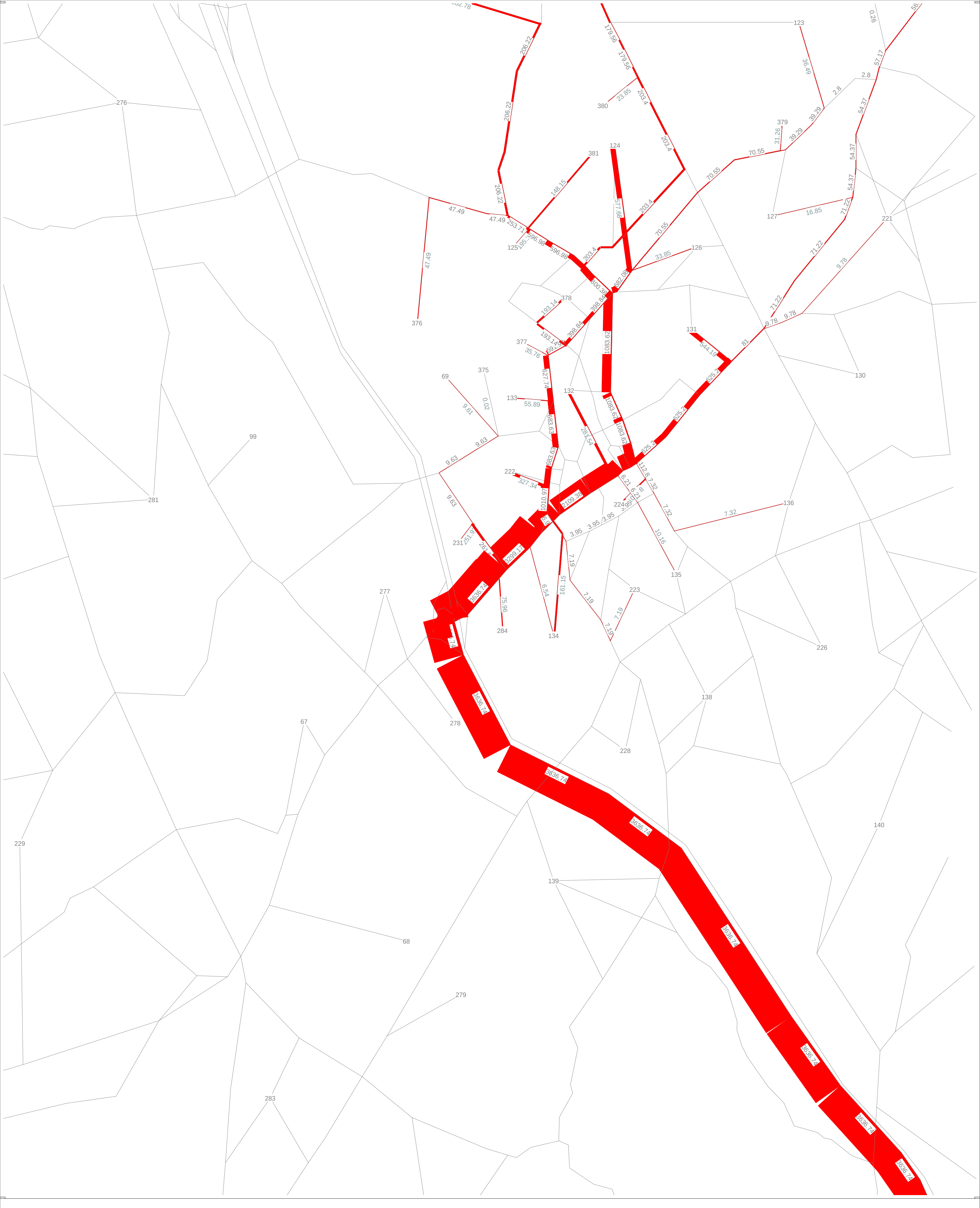
cube

2015 Exit 4 NB Off Ramp



2015 Exit 4 NB On Ramp

(Licensed to Southern New Hampshire Planning Commission)



2015 Exit 4 SB On Ramp From East

2015NB Exit 4 SB on Ramp from East

(Licensed to Southern New Hampshire Planning Commission)

2040NB Exit 4 SB on Ramp from West

2040NB Exit 4 SB off Ramp

cube

(Licensed to Southern New Hampshire Planning Commission)

2040NB Exit 4 NB off Ramp

2040NB Exit 4 NB on Ramp

(Licensed to Southern New Hampshire Planning Commission)

2040 Alt A Exit 4A NB off Ramp

(Licensed to Southern New Hampshire Planning Commission)

2040 Alt A Exit 4A NB on Ramp

2040 Alt A Exit 4A SB off Ramp

cube

2040 Alt A Exit 4A SB on Ramp

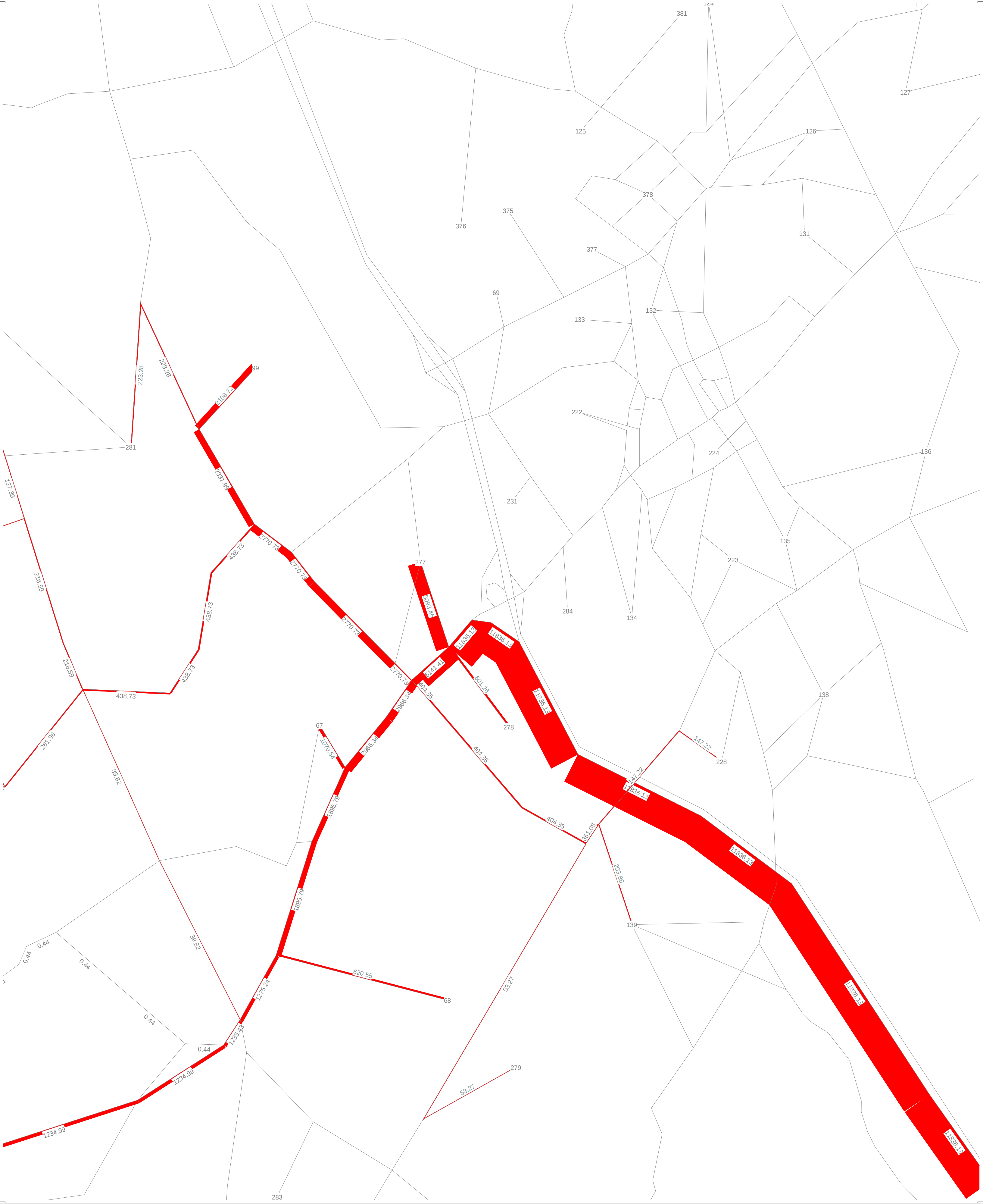
2040 Alt A Exit 4 NB Off Ramp

2040 Alt A Exit 4 NB On Ramp

cube

2040 Alt A Exit 4 SB On Ramp from East

(Licensed to Southern New Hampshire Planning Commission)



2040 Alt A Exit 4 SB On Ramp from West

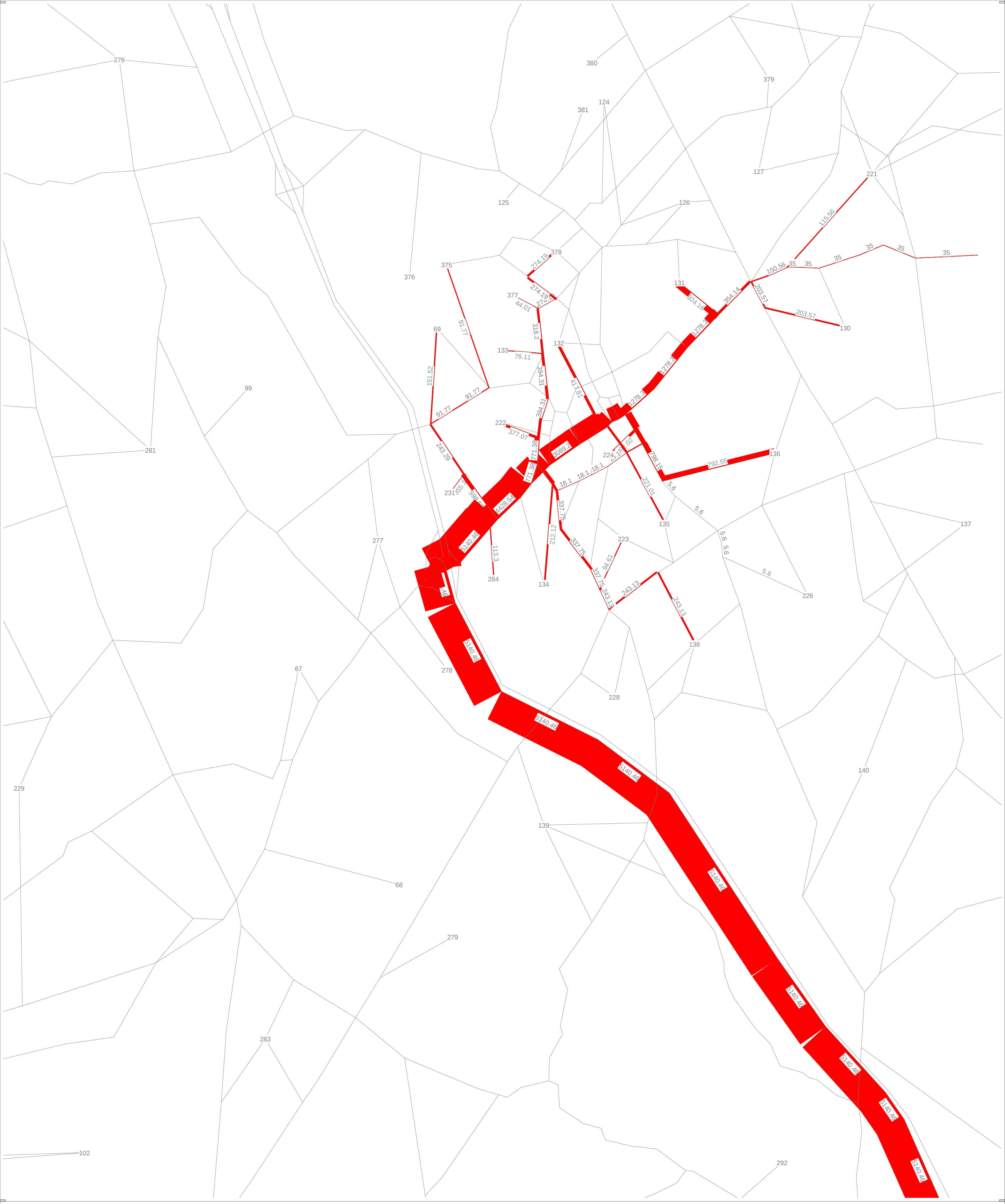
cube

(Licensed to Southern New Hampshire Planning Commission)

2040 Alt A Exit 4 SB Off Ramp

cube

2040 Alt C Exit 4 NB on Ramp



2040 Alt C Exit 4 SB on Ramp from East

cube

2040 Alt C Exit 4 SB on Ramp from West

cube

2040 Alt C Exit 4 SB off Ramp

2040 Alt C Exit 4A off Ramp

(Licensed to Southern New Hampshire Planning Commission)

2040 Alt C Exit 4A NB on Ramp

2040 Alt C Exit 4A SB off Ramp

2040 Alt C Exit 4A SB on Ramp

(Licensed to Southern New Hampshire Planning Commission)

2040 Alt C Exit 4 NB off Ramp

APPENDIX N-1: 2040 NO-BUILD INTERSECTION CAPACITY ANALYSES – HCM 2000 PRINTOUTS – AM PEAK HOUR

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	0	1260	1320	0	925	1175
Future Volume (vph)	0	1260	1320	0	925	1175
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	16	12
Total Lost time (s)		6.0	6.0		6.0	6.0
Lane Util. Factor		0.95	0.95		1.00	0.88
Frt		1.00	1.00		1.00	0.85
Flt Protected		1.00	1.00		0.95	1.00
Satd. Flow (prot)		3471	3406		1930	2682
Flt Permitted		1.00	1.00		0.95	1.00
Satd. Flow (perm)		3471	3406		1930	2682
Peak-hour factor, PHF	0.93	0.93	0.88	0.88	0.89	0.89
Adj. Flow (vph)	0	1355	1500	0	1039	1320
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	1355	1500	0	1039	1320
Heavy Vehicles (%)	4%	4%	6%	6%	6%	6%
Turn Type		NA	NA		Prot	Prot
Protected Phases		2	6		4	4
Permitted Phases						
Actuated Green, G (s)		21.0	21.0		27.0	27.0
Effective Green, g (s)		21.0	21.0		27.0	27.0
Actuated g/C Ratio		0.35	0.35		0.45	0.45
Clearance Time (s)		6.0	6.0		6.0	6.0
Vehicle Extension (s)		3.0	3.0		3.0	3.0
Lane Grp Cap (vph)		1214	1192		868	1206
v/s Ratio Prot		0.39	c0.44		c0.54	0.49
v/s Ratio Perm						
v/c Ratio		1.12	1.26		1.20	1.09
Uniform Delay, d1		19.5	19.5		16.5	16.5
Progression Factor		1.44	1.52		1.00	1.00
Incremental Delay, d2		59.3	116.9		99.8	55.7
Delay (s)		87.4	146.7		116.3	72.2
Level of Service		F	F		F	E
Approach Delay (s)		87.4	146.7		91.7	
Approach LOS		F	F		F	

Intersection Summary			
HCM 2000 Control Delay	106.4	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.22		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	99.7%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Movement	NBL2	NBL	NBR	SEL	SER	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations											
Traffic Volume (vph)	1265	0	1070	0	0	1000	1185	0	0	540	780
Future Volume (vph)	1265	0	1070	0	0	1000	1185	0	0	540	780
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0		6.0			6.0	6.0			6.0	4.0
Lane Util. Factor	0.97		0.88			0.97	0.95			0.95	1.00
Frt	1.00		0.85			1.00	1.00			1.00	0.85
Flt Protected	0.95		1.00			0.95	1.00			1.00	1.00
Satd. Flow (prot)	3242		2632			3335	3438			3505	1568
Flt Permitted	0.95		1.00			0.95	1.00			1.00	1.00
Satd. Flow (perm)	3242		2632			3335	3438			3505	1568
Peak-hour factor, PHF	0.88	0.88	0.88	0.92	0.92	0.94	0.94	0.94	0.92	0.92	0.92
Adj. Flow (vph)	1438	0	1216	0	0	1064	1261	0	0	587	848
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	1438	0	1216	0	0	1064	1261	0	0	587	848
Heavy Vehicles (%)	8%	8%	8%	2%	2%	5%	5%	5%	3%	3%	3%
Turn Type	Prot		Prot			Prot	NA			NA	Free
Protected Phases	8		8			5	2			6	
Permitted Phases											Free
Actuated Green, G (s)	44.0		44.0			32.0	64.0			26.0	120.0
Effective Green, g (s)	44.0		44.0			32.0	64.0			26.0	120.0
Actuated g/C Ratio	0.37		0.37			0.27	0.53			0.22	1.00
Clearance Time (s)	6.0		6.0			6.0	6.0			6.0	
Vehicle Extension (s)	3.0		3.0			3.0	3.0			3.0	
Lane Grp Cap (vph)	1188		965			889	1833			759	1568
v/s Ratio Prot	0.44		c0.46			c0.32	0.37			c0.17	
v/s Ratio Perm											0.54
v/c Ratio	1.21		1.26			1.20	0.69			0.77	0.54
Uniform Delay, d1	38.0		38.0			44.0	20.6			44.2	0.0
Progression Factor	1.00		1.00			0.86	1.02			1.00	1.00
Incremental Delay, d2	102.7		125.5			89.7	0.2			7.5	1.3
Delay (s)	140.7		163.5			127.6	21.2			51.8	1.3
Level of Service	F		F			F	C			D	A
Approach Delay (s)		151.2		0.0			69.9			22.0	
Approach LOS		F		A			E			C	

Intersection Summary			
HCM 2000 Control Delay	92.8	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.12		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	95.5%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑	↱	↰	↑↑					↰↰		↱
Traffic Volume (vph)	0	935	390	240	550	0	0	0	0	820	0	535
Future Volume (vph)	0	935	390	240	550	0	0	0	0	820	0	535
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0	4.0	6.0	6.0					6.0		6.0
Lane Util. Factor		0.95	1.00	1.00	0.95					0.97		1.00
Frt		1.00	0.85	1.00	1.00					1.00		0.85
Flt Protected		1.00	1.00	0.95	1.00					0.95		1.00
Satd. Flow (prot)		3471	1553	1719	3438					3367		1553
Flt Permitted		1.00	1.00	0.95	1.00					0.95		1.00
Satd. Flow (perm)		3471	1553	1719	3438					3367		1553
Peak-hour factor, PHF	0.87	0.87	0.87	0.86	0.86	0.86	0.92	0.92	0.92	0.91	0.91	0.91
Adj. Flow (vph)	0	1075	448	279	640	0	0	0	0	901	0	588
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	189
Lane Group Flow (vph)	0	1075	448	279	640	0	0	0	0	901	0	399
Heavy Vehicles (%)	4%	4%	4%	5%	5%	5%	2%	2%	2%	4%	4%	4%
Turn Type		NA	Free	Prot	NA					Prot		Prot
Protected Phases		2		1	6					4		4
Permitted Phases			Free									
Actuated Green, G (s)		35.3	100.0	17.7	59.0					29.0		29.0
Effective Green, g (s)		35.3	100.0	17.7	59.0					29.0		29.0
Actuated g/C Ratio		0.35	1.00	0.18	0.59					0.29		0.29
Clearance Time (s)		6.0		6.0	6.0					6.0		6.0
Vehicle Extension (s)		5.0		3.0	5.0					3.0		3.0
Lane Grp Cap (vph)		1225	1553	304	2028					976		450
v/s Ratio Prot		c0.31		c0.16	0.19					c0.27		0.26
v/s Ratio Perm			0.29									
v/c Ratio		0.88	0.29	0.92	0.32					0.92		0.89
Uniform Delay, d1		30.3	0.0	40.4	10.3					34.4		33.9
Progression Factor		1.00	1.00	0.12	0.00					1.00		1.00
Incremental Delay, d2		9.0	0.5	16.0	0.2					13.8		18.6
Delay (s)		39.4	0.5	20.7	0.2					48.2		52.5
Level of Service		D	A	C	A					D		D
Approach Delay (s)		27.9			6.4			0.0			49.9	
Approach LOS		C			A			A			D	

Intersection Summary			
HCM 2000 Control Delay	31.2	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.90		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	78.5%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
3: Exit 5 NB Off & NH 28

01/19/2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑			↑↑	↱	↰		↱			
Traffic Volume (vph)	605	1150	0	0	495	545	295	0	375	0	0	0
Future Volume (vph)	605	1150	0	0	495	545	295	0	375	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0			6.0	4.0	6.0		6.0			
Lane Util. Factor	1.00	0.95			0.95	1.00	1.00		1.00			
Frt	1.00	1.00			1.00	0.85	1.00		0.85			
Flt Protected	0.95	1.00			1.00	1.00	0.95		1.00			
Satd. Flow (prot)	1752	3505			3505	1568	1703		1524			
Flt Permitted	0.95	1.00			1.00	1.00	0.95		1.00			
Satd. Flow (perm)	1752	3505			3505	1568	1703		1524			
Peak-hour factor, PHF	0.92	0.92	0.92	0.91	0.91	0.91	0.67	0.67	0.67	0.92	0.92	0.92
Adj. Flow (vph)	658	1250	0	0	544	599	440	0	560	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	69	0	0	0
Lane Group Flow (vph)	658	1250	0	0	544	599	440	0	491	0	0	0
Heavy Vehicles (%)	3%	3%	3%	3%	3%	3%	6%	6%	6%	2%	2%	2%
Turn Type	Prot	NA			NA	Free	Prot		Prot			
Protected Phases	5	2			6		8		8			
Permitted Phases		2			6	Free						
Actuated Green, G (s)	35.0	58.0			17.0	100.0	30.0		30.0			
Effective Green, g (s)	35.0	58.0			17.0	100.0	30.0		30.0			
Actuated g/C Ratio	0.35	0.58			0.17	1.00	0.30		0.30			
Clearance Time (s)	6.0	6.0			6.0		6.0		6.0			
Vehicle Extension (s)	5.0	5.0			5.0		3.0		3.0			
Lane Grp Cap (vph)	613	2032			595	1568	510		457			
v/s Ratio Prot	c0.38	0.36			c0.16		0.26		c0.32			
v/s Ratio Perm						0.38						
v/c Ratio	1.07	0.62			0.91	0.38	0.86		1.08			
Uniform Delay, d1	32.5	13.7			40.8	0.0	33.1		35.0			
Progression Factor	0.20	0.41			1.00	1.00	1.00		1.00			
Incremental Delay, d2	46.9	0.6			20.9	0.7	14.0		63.8			
Delay (s)	53.5	6.1			61.7	0.7	47.1		98.8			
Level of Service	D	A			E	A	D		F			
Approach Delay (s)		22.5			29.7			76.0			0.0	
Approach LOS		C			C			E			A	

Intersection Summary			
HCM 2000 Control Delay	37.7	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	1.04		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	78.5%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	5	0	295	0	0	0	955	1260	0	5	1160	10
Future Volume (vph)	5	0	295	0	0	0	955	1260	0	5	1160	10
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0	6.0				6.0	6.0		6.0	6.0	
Lane Util. Factor		1.00	1.00				1.00	0.95		1.00	0.95	
Frt		1.00	0.85				1.00	1.00		1.00	1.00	
Flt Protected		0.95	1.00				0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1770	1583				1770	3539		1770	3535	
Flt Permitted		1.00	1.00				0.95	1.00		0.95	1.00	
Satd. Flow (perm)		1863	1583				1770	3539		1770	3535	
Peak-hour factor, PHF	0.92	0.92	0.92	0.25	0.25	0.25	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	5	0	321	0	0	0	1038	1370	0	5	1261	11
RTOR Reduction (vph)	0	0	207	0	0	0	0	0	0	0	1	0
Lane Group Flow (vph)	0	5	114	0	0	0	1038	1370	0	5	1271	0
Heavy Vehicles (%)	2%	2%	2%	0%	0%	0%	2%	2%	2%	2%	2%	2%
Turn Type	Perm	NA	custom				Prot	NA		Prot	NA	
Protected Phases		8			4		5	2		1	6	
Permitted Phases	8		6	4								
Actuated Green, G (s)		1.3	35.1				44.1	78.3		0.9	35.1	
Effective Green, g (s)		1.3	35.1				44.1	78.3		0.9	35.1	
Actuated g/C Ratio		0.01	0.36				0.45	0.79		0.01	0.36	
Clearance Time (s)		6.0	6.0				6.0	6.0		6.0	6.0	
Vehicle Extension (s)		3.0	3.0				3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		24	564				792	2813		16	1259	
v/s Ratio Prot							c0.59	0.39		0.00	c0.36	
v/s Ratio Perm		c0.00	0.07									
v/c Ratio		0.21	0.20				1.31	0.49		0.31	1.01	
Uniform Delay, d1		48.1	22.0				27.2	3.4		48.5	31.7	
Progression Factor		1.00	1.00				1.00	1.00		1.00	1.00	
Incremental Delay, d2		4.3	0.2				148.8	0.1		10.9	27.8	
Delay (s)		52.4	22.2				176.0	3.5		59.4	59.5	
Level of Service		D	C				F	A		E	E	
Approach Delay (s)		22.6			0.0			77.9			59.5	
Approach LOS		C			A			E			E	

Intersection Summary			
HCM 2000 Control Delay	67.5	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.16		
Actuated Cycle Length (s)	98.5	Sum of lost time (s)	18.0
Intersection Capacity Utilization	108.3%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	5	30	0	230	0	50	0	860	215	5	555	0
Future Volume (vph)	5	30	0	230	0	50	0	860	215	5	555	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0			6.0			6.0			6.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		1.00			0.98			0.97			1.00	
Flt Protected		0.99			0.96			1.00			1.00	
Satd. Flow (prot)		1850			1729			1712			1809	
Flt Permitted		0.96			0.72			1.00			0.75	
Satd. Flow (perm)		1782			1304			1712			1364	
Peak-hour factor, PHF	0.60	0.60	0.60	0.96	0.96	0.96	0.89	0.89	0.89	0.86	0.86	0.86
Adj. Flow (vph)	8	50	0	240	0	52	0	966	242	6	645	0
RTOR Reduction (vph)	0	0	0	0	29	0	0	10	0	0	0	0
Lane Group Flow (vph)	0	58	0	0	263	0	0	1198	0	0	651	0
Heavy Vehicles (%)	2%	2%	2%	3%	3%	3%	8%	8%	8%	5%	5%	5%
Turn Type	Perm	NA		Perm	NA			NA		Perm	NA	
Protected Phases		4			4			2			2	
Permitted Phases	4			4						2		
Actuated Green, G (s)		18.0			18.0			60.4			60.4	
Effective Green, g (s)		18.0			18.0			60.4			60.4	
Actuated g/C Ratio		0.20			0.20			0.67			0.67	
Clearance Time (s)		6.0			6.0			6.0			6.0	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		354			259			1143			911	
v/s Ratio Prot								c0.70				
v/s Ratio Perm		0.03			c0.20						0.48	
v/c Ratio		0.16			1.02			1.05			0.71	
Uniform Delay, d1		30.0			36.2			15.0			9.5	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		0.2			60.1			40.2			2.7	
Delay (s)		30.2			96.3			55.2			12.2	
Level of Service		C			F			E			B	
Approach Delay (s)		30.2			96.3			55.2			12.2	
Approach LOS		C			F			E			B	

Intersection Summary			
HCM 2000 Control Delay	47.3	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	1.04		
Actuated Cycle Length (s)	90.4	Sum of lost time (s)	12.0
Intersection Capacity Utilization	94.1%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Movement	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	105	180	35	135	180	160	100	470	60	70	335	65
Future Volume (vph)	105	180	35	135	180	160	100	470	60	70	335	65
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	0.98		1.00	1.00	0.85	1.00	0.98		1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1752	1800		1752	1845	1568	1787	1849		1787	1835	
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1752	1800		1752	1845	1568	1787	1849		1787	1835	
Peak-hour factor, PHF	0.91	0.91	0.91	0.93	0.93	0.93	0.95	0.95	0.95	0.94	0.94	0.94
Adj. Flow (vph)	115	198	38	145	194	172	105	495	63	74	356	69
RTOR Reduction (vph)	0	9	0	0	0	118	0	5	0	0	8	0
Lane Group Flow (vph)	115	227	0	145	194	54	105	553	0	74	417	0
Heavy Vehicles (%)	3%	3%	3%	3%	3%	3%	1%	1%	1%	1%	1%	1%
Turn Type	Prot	NA		Prot	NA	pm+ov	Prot	NA		Prot	NA	
Protected Phases	3	8		7	4	5	5	2		1	6	
Permitted Phases						4						
Actuated Green, G (s)	8.4	16.9		8.9	17.4	26.9	9.5	29.1		6.1	25.7	
Effective Green, g (s)	8.4	16.9		8.9	17.4	26.9	9.5	29.1		6.1	25.7	
Actuated g/C Ratio	0.10	0.20		0.10	0.20	0.32	0.11	0.34		0.07	0.30	
Clearance Time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	173	357		183	377	606	199	633		128	554	
v/s Ratio Prot	0.07	c0.13		c0.08	0.11	0.01	c0.06	c0.30		0.04	0.23	
v/s Ratio Perm						0.02						
v/c Ratio	0.66	0.64		0.79	0.51	0.09	0.53	0.87		0.58	0.75	
Uniform Delay, d1	36.9	31.2		37.1	30.0	20.4	35.6	26.2		38.2	26.8	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	9.3	3.7		20.5	1.2	0.1	2.5	15.4		6.2	5.8	
Delay (s)	46.2	34.9		57.6	31.2	20.5	38.1	41.6		44.4	32.5	
Level of Service	D	C		E	C	C	D	D		D	C	
Approach Delay (s)		38.6			35.1			41.1			34.3	
Approach LOS		D			D			D			C	

Intersection Summary			
HCM 2000 Control Delay	37.5	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	85.0	Sum of lost time (s)	24.0
Intersection Capacity Utilization	86.2%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	1145	0	0	195	170	455
Future Volume (vph)	1145	0	0	195	170	455
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt					0.902	
Flt Protected	0.950					
Satd. Flow (prot)	1787	0	0	1863	1697	0
Flt Permitted	0.950					
Satd. Flow (perm)	1787	0	0	1863	1697	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	322			309	249	
Travel Time (s)	7.3			7.0	5.7	
Peak Hour Factor	0.90	0.90	0.87	0.87	0.87	0.87
Heavy Vehicles (%)	1%	1%	2%	2%	1%	1%
Adj. Flow (vph)	1272	0	0	224	195	523
Shared Lane Traffic (%)						
Lane Group Flow (vph)	1272	0	0	224	718	0
Sign Control	Stop			Free	Free	

Intersection Summary	
Area Type: Other	
Control Type: Unsignalized	
Intersection Capacity Utilization 111.3%	ICU Level of Service H
Analysis Period (min) 15	

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	1145	0	0	195	170	455
Future Volume (Veh/h)	1145	0	0	195	170	455
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.90	0.90	0.87	0.87	0.87	0.87
Hourly flow rate (vph)	1272	0	0	224	195	523
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	680	456	718			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	680	456	718			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	0	100	100			
cM capacity (veh/h)	418	606	883			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	1272	224	718
Volume Left	1272	0	0
Volume Right	0	0	523
cSH	418	883	1700
Volume to Capacity	3.04	0.00	0.42
Queue Length 95th (ft)	Err	0	0
Control Delay (s)	Err	0.0	0.0
Lane LOS	F		
Approach Delay (s)	Err	0.0	0.0
Approach LOS	F		

Intersection Summary			
Average Delay	5744.7		
Intersection Capacity Utilization	111.3%	ICU Level of Service	H
Analysis Period (min)	15		

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	5	0	0	1173	625	5
Future Volume (vph)	5	0	0	1173	625	5
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt					0.999	
Flt Protected	0.950					
Satd. Flow (prot)	1703	0	0	1881	1879	0
Flt Permitted	0.950					
Satd. Flow (perm)	1703	0	0	1881	1879	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	160			224	319	
Travel Time (s)	3.6			5.1	7.3	
Peak Hour Factor	0.50	0.50	0.93	0.93	0.86	0.86
Heavy Vehicles (%)	6%	6%	1%	1%	1%	1%
Adj. Flow (vph)	10	0	0	1261	727	6
Shared Lane Traffic (%)						
Lane Group Flow (vph)	10	0	0	1261	733	0
Sign Control	Stop			Free	Free	

Intersection Summary

Area Type: Other
Control Type: Unsignalized
Intersection Capacity Utilization 78.2% ICU Level of Service D
Analysis Period (min) 15

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	5	0	0	1173	625	5
Future Volume (Veh/h)	5	0	0	1173	625	5
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.50	0.50	0.93	0.93	0.86	0.86
Hourly flow rate (vph)	10	0	0	1261	727	6
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1991	730	733			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1991	730	733			
tC, single (s)	6.5	6.3	4.1			
tC, 2 stage (s)						
tF (s)	3.6	3.4	2.2			
p0 queue free %	85	100	100			
cM capacity (veh/h)	65	416	876			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	10	1261	733
Volume Left	10	0	0
Volume Right	0	0	6
cSH	65	876	1700
Volume to Capacity	0.15	0.00	0.43
Queue Length 95th (ft)	13	0	0
Control Delay (s)	70.2	0.0	0.0
Lane LOS	F		
Approach Delay (s)	70.2	0.0	0.0
Approach LOS	F		

Intersection Summary			
Average Delay	0.4		
Intersection Capacity Utilization	78.2%	ICU Level of Service	D
Analysis Period (min)	15		

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations		✥			✥			✥			✥	
Traffic Volume (vph)	50	1145	5	0	480	0	0	10	155	5	10	25
Future Volume (vph)	50	1145	5	0	480	0	0	10	155	5	10	25
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	150		150	150		150	0		0	150		150
Storage Lanes	0		0	0		0	0		0	0		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.999						0.873			0.916	
Flt Protected		0.998									0.994	
Satd. Flow (prot)	0	1876	0	0	1863	0	0	1659	0	0	1730	0
Flt Permitted		0.998									0.994	
Satd. Flow (perm)	0	1876	0	0	1863	0	0	1659	0	0	1730	0
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		327			240			246			251	
Travel Time (s)		7.4			5.5			5.6			5.7	
Peak Hour Factor	0.94	0.94	0.94	0.88	0.88	0.88	0.67	0.67	0.67	0.82	0.82	0.82
Heavy Vehicles (%)	1%	1%	1%	2%	2%	2%	0%	0%	0%	0%	0%	0%
Adj. Flow (vph)	53	1218	5	0	545	0	0	15	231	6	12	30
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	1276	0	0	545	0	0	246	0	0	48	0
Sign Control		Free			Free			Stop			Stop	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 106.4% ICU Level of Service G

Analysis Period (min) 15

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations		✣			✣			✣			✣	
Traffic Volume (veh/h)	50	1145	5	0	480	0	0	10	155	5	10	25
Future Volume (Veh/h)	50	1145	5	0	480	0	0	10	155	5	10	25
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.94	0.94	0.94	0.88	0.88	0.88	0.67	0.67	0.67	0.82	0.82	0.82
Hourly flow rate (vph)	53	1218	5	0	545	0	0	15	231	6	12	30
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	545			1223			1908	1874	545	1879	1872	1220
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	545			1223			1908	1874	545	1879	1872	1220
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	95			100			100	78	57	76	83	86
cM capacity (veh/h)	1029			570			38	69	542	25	69	222

Direction, Lane #	EB 1	WB 1	SE 1	NW 1
Volume Total	1276	545	246	48
Volume Left	53	0	0	6
Volume Right	5	0	231	30
cSH	1029	570	382	88
Volume to Capacity	0.05	0.00	0.64	0.55
Queue Length 95th (ft)	4	0	108	61
Control Delay (s)	1.9	0.0	29.9	87.0
Lane LOS	A		D	F
Approach Delay (s)	1.9	0.0	29.9	87.0
Approach LOS			D	F

Intersection Summary			
Average Delay	6.6		
Intersection Capacity Utilization	106.4%	ICU Level of Service	G
Analysis Period (min)	15		

Movement	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	0	235	135	495	310	0	115	520	0	165	400	300
Future Volume (vph)	0	235	135	495	310	0	115	520	0	165	400	300
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0	6.0	6.0	6.0		6.0	6.0		6.0	6.0	6.0
Lane Util. Factor		0.95	1.00	0.97	1.00		1.00	1.00		1.00	1.00	1.00
Frt		1.00	0.85	1.00	1.00		1.00	1.00		1.00	1.00	0.85
Flt Protected		1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)		3539	1583	3433	1863		1770	1863		1787	1881	1599
Flt Permitted		1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)		3539	1583	3433	1863		1770	1863		1787	1881	1599
Peak-hour factor, PHF	0.92	0.92	0.92	0.94	0.94	0.94	0.96	0.96	0.96	0.95	0.95	0.95
Adj. Flow (vph)	0	255	147	527	330	0	120	542	0	174	421	316
RTOR Reduction (vph)	0	0	116	0	0	0	0	0	0	0	0	138
Lane Group Flow (vph)	0	255	31	527	330	0	120	542	0	174	421	178
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	1%	1%	1%
Turn Type	Prot	NA	Perm	Prot	NA	Perm	Prot	NA	Perm	Prot	NA	pm+ov
Protected Phases	5	2		1	6		7	4		3	8	1
Permitted Phases			2			6			4			8
Actuated Green, G (s)		24.5	24.5	23.5	54.0		13.1	34.0		9.0	29.9	53.4
Effective Green, g (s)		24.5	24.5	23.5	54.0		13.1	34.0		9.0	29.9	53.4
Actuated g/C Ratio		0.21	0.21	0.20	0.47		0.11	0.30		0.08	0.26	0.46
Clearance Time (s)		6.0	6.0	6.0	6.0		6.0	6.0		6.0	6.0	6.0
Vehicle Extension (s)		3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)		753	337	701	874		201	550		139	489	825
v/s Ratio Prot		0.07		c0.15	c0.18		0.07	c0.29		c0.10	0.22	0.04
v/s Ratio Perm			0.02									0.07
v/c Ratio		0.34	0.09	0.75	0.38		0.60	0.99		1.25	0.86	0.22
Uniform Delay, d1		38.4	36.3	43.0	19.7		48.4	40.3		53.0	40.6	18.3
Progression Factor		1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2		1.2	0.5	4.6	0.3		4.7	34.4		159.1	14.4	0.1
Delay (s)		39.6	36.9	47.6	19.9		53.1	74.6		212.1	54.9	18.5
Level of Service		D	D	D	B		D	E		F	D	B
Approach Delay (s)		38.6			36.9			70.7			72.3	
Approach LOS		D			D			E			E	

Intersection Summary			
HCM 2000 Control Delay	56.4	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	0.80		
Actuated Cycle Length (s)	115.0	Sum of lost time (s)	24.0
Intersection Capacity Utilization	79.5%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	NWL	NWR	NET	NER	SWL	SWT
Lane Configurations						
Traffic Volume (vph)	60	110	785	370	95	775
Future Volume (vph)	60	110	785	370	95	775
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	150	150		0	0	
Storage Lanes	0	1		1	0	
Taper Length (ft)	25				25	
Lane Util. Factor	1.00	1.00	1.00	1.00	0.95	0.95
Frt		0.850		0.850		
Flt Protected	0.950					0.995
Satd. Flow (prot)	1787	1599	1881	1599	0	3556
Flt Permitted	0.950					0.995
Satd. Flow (perm)	1787	1599	1881	1599	0	3556
Link Speed (mph)	30		30			30
Link Distance (ft)	403		387			233
Travel Time (s)	9.2		8.8			5.3
Peak Hour Factor	0.86	0.86	0.96	0.96	0.85	0.85
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%
Adj. Flow (vph)	70	128	818	385	112	912
Shared Lane Traffic (%)						
Lane Group Flow (vph)	70	128	818	385	0	1024
Sign Control	Stop		Free			Free

Intersection Summary

Area Type: Other
Control Type: Unsignalized
Intersection Capacity Utilization 78.8% ICU Level of Service D
Analysis Period (min) 15

Movement	NWL	NWR	NET	NER	SWL	SWT
Lane Configurations						
Traffic Volume (veh/h)	60	110	785	370	95	775
Future Volume (Veh/h)	60	110	785	370	95	775
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.86	0.86	0.96	0.96	0.85	0.85
Hourly flow rate (vph)	70	128	818	385	112	912
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)		6				
Median type			None			None
Median storage veh)						
Upstream signal (ft)			387			
pX, platoon unblocked	0.74	0.74			0.74	
vC, conflicting volume	1498	818			818	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1497	581			581	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	3	62			85	
cM capacity (veh/h)	72	341			739	

Direction, Lane #	NW 1	NE 1	NE 2	SW 1	SW 2
Volume Total	198	818	385	416	608
Volume Left	70	0	0	112	0
Volume Right	128	0	385	0	0
cSH	204	1700	1700	739	1700
Volume to Capacity	0.97	0.48	0.23	0.15	0.36
Queue Length 95th (ft)	207	0	0	13	0
Control Delay (s)	83.7	0.0	0.0	4.3	0.0
Lane LOS	F			A	
Approach Delay (s)	83.7	0.0		1.8	
Approach LOS	F				

Intersection Summary			
Average Delay	7.6		
Intersection Capacity Utilization	78.8%	ICU Level of Service	D
Analysis Period (min)	15		

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	150	1050	0	0	605	80	0	0	0	25	0	350
Future Volume (vph)	150	1050	0	0	605	80	0	0	0	25	0	350
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0			6.0						6.0	6.0
Lane Util. Factor	1.00	0.95			0.95						1.00	1.00
Frt	1.00	1.00			0.98						1.00	0.85
Flt Protected	0.95	1.00			1.00						0.95	1.00
Satd. Flow (prot)	1787	3574			3512						1787	1599
Flt Permitted	0.95	1.00			1.00						0.76	1.00
Satd. Flow (perm)	1787	3574			3512						1424	1599
Peak-hour factor, PHF	0.97	0.97	0.97	0.95	0.95	0.95	0.90	0.90	0.90	0.80	0.80	0.80
Adj. Flow (vph)	155	1082	0	0	637	84	0	0	0	31	0	438
RTOR Reduction (vph)	0	0	0	0	8	0	0	0	0	0	0	353
Lane Group Flow (vph)	155	1082	0	0	713	0	0	0	0	0	31	85
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	0%	0%	0%	1%	1%	1%
Turn Type	Prot	NA		Prot	NA				Perm	Perm	NA	Perm
Protected Phases	5	2		1	6			8			4	
Permitted Phases							8		8	4	4	4
Actuated Green, G (s)	13.5	72.6			53.1						10.4	10.4
Effective Green, g (s)	13.5	72.6			53.1						10.4	10.4
Actuated g/C Ratio	0.14	0.76			0.56						0.11	0.11
Clearance Time (s)	6.0	6.0			6.0						6.0	6.0
Vehicle Extension (s)	3.0	3.0			3.0						3.0	3.0
Lane Grp Cap (vph)	253	2731			1963						155	175
v/s Ratio Prot	c0.09	c0.30			0.20							
v/s Ratio Perm											0.02	c0.05
v/c Ratio	0.61	0.40			0.36						0.20	0.49
Uniform Delay, d1	38.3	3.8			11.6						38.5	39.8
Progression Factor	0.84	1.80			1.00						1.00	1.00
Incremental Delay, d2	3.7	0.4			0.5						0.6	2.1
Delay (s)	35.9	7.2			12.1						39.2	41.9
Level of Service	D	A			B						D	D
Approach Delay (s)		10.8			12.1			0.0			41.7	
Approach LOS		B			B			A			D	

Intersection Summary			
HCM 2000 Control Delay	17.2	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.46		
Actuated Cycle Length (s)	95.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	52.4%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	115	815	5	5	530	255	35	10	10	350	5	135
Future Volume (vph)	115	815	5	5	530	255	35	10	10	350	5	135
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	6.0
Lane Util. Factor	0.97	0.95		1.00	0.95		1.00	1.00		0.95	0.95	1.00
Frt	1.00	1.00		1.00	0.95		1.00	0.93		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	0.95	1.00
Satd. Flow (prot)	3467	3571		1770	3367		1805	1758		1715	1721	1615
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	0.95	1.00
Satd. Flow (perm)	3467	3571		1770	3367		1805	1758		1715	1721	1615
Peak-hour factor, PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.78	0.78	0.78	0.86	0.86	0.86
Adj. Flow (vph)	137	970	6	6	589	283	45	13	13	407	6	157
RTOR Reduction (vph)	0	0	0	0	59	0	0	12	0	0	0	112
Lane Group Flow (vph)	137	976	0	6	813	0	45	14	0	208	205	45
Heavy Vehicles (%)	1%	1%	1%	2%	2%	2%	0%	0%	0%	0%	0%	0%
Turn Type	Prot	NA		Prot	NA		Split	NA		Split	NA	pt+ov
Protected Phases	5	2		1	6		3	3		4	4	4 5
Permitted Phases		2			6							
Actuated Green, G (s)	7.7	52.4		1.0	45.7		4.0	4.0		13.6	13.6	27.3
Effective Green, g (s)	7.7	52.4		1.0	45.7		4.0	4.0		13.6	13.6	27.3
Actuated g/C Ratio	0.08	0.55		0.01	0.48		0.04	0.04		0.14	0.14	0.29
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	281	1969		18	1619		76	74		245	246	464
v/s Ratio Prot	c0.04	c0.27		0.00	0.24		c0.02	0.01		c0.12	0.12	0.03
v/s Ratio Perm												
v/c Ratio	0.49	0.50		0.33	0.50		0.59	0.18		0.85	0.83	0.10
Uniform Delay, d1	41.8	13.1		46.7	16.9		44.7	43.9		39.7	39.6	24.8
Progression Factor	1.00	1.00		1.38	0.82		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	1.3	0.9		9.2	0.2		11.8	1.2		23.0	20.8	0.1
Delay (s)	43.1	14.0		73.8	14.1		56.5	45.1		62.7	60.4	24.9
Level of Service	D	B		E	B		E	D		E	E	C
Approach Delay (s)		17.6			14.5			52.3			51.5	
Approach LOS		B			B			D			D	

Intersection Summary				
HCM 2000 Control Delay	24.8	HCM 2000 Level of Service	C	
HCM 2000 Volume to Capacity ratio	0.59			
Actuated Cycle Length (s)	95.0	Sum of lost time (s)	24.0	
Intersection Capacity Utilization	58.5%	ICU Level of Service	B	
Analysis Period (min)	15			
c Critical Lane Group				

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	40	630	515	20	40	90
Future Volume (vph)	40	630	515	20	40	90
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.995		0.906	
Flt Protected	0.950				0.985	
Satd. Flow (prot)	1770	1863	1853	0	1646	0
Flt Permitted	0.950				0.985	
Satd. Flow (perm)	1770	1863	1853	0	1646	0
Link Speed (mph)		30	30		30	
Link Distance (ft)		535	210		522	
Travel Time (s)		12.2	4.8		11.9	
Peak Hour Factor	0.91	0.91	0.90	0.90	0.75	0.75
Heavy Vehicles (%)	2%	2%	2%	2%	3%	3%
Adj. Flow (vph)	44	692	572	22	53	120
Shared Lane Traffic (%)						
Lane Group Flow (vph)	44	692	594	0	173	0
Sign Control		Free	Free		Stop	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 47.7% ICU Level of Service A

Analysis Period (min) 15

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	40	630	515	20	40	90
Future Volume (Veh/h)	40	630	515	20	40	90
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.91	0.91	0.90	0.90	0.75	0.75
Hourly flow rate (vph)	44	692	572	22	53	120
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	594				1363	583
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	594				1363	583
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	96				66	76
cM capacity (veh/h)	982				155	510

Direction, Lane #	EB 1	EB 2	WB 1	SB 1
Volume Total	44	692	594	173
Volume Left	44	0	0	53
Volume Right	0	0	22	120
cSH	982	1700	1700	300
Volume to Capacity	0.04	0.41	0.35	0.58
Queue Length 95th (ft)	4	0	0	84
Control Delay (s)	8.8	0.0	0.0	32.2
Lane LOS	A			D
Approach Delay (s)	0.5		0.0	32.2
Approach LOS				D

Intersection Summary			
Average Delay	4.0		
Intersection Capacity Utilization	47.7%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	WBL2	WBL	WBR	NBL	NBT	NBR	NBR2	SBL	SBT	SBR	NET	NER
Lane Configurations												
Traffic Volume (vph)	10	365	195	10	95	75	10	300	135	50	240	420
Future Volume (vph)	10	365	195	10	95	75	10	300	135	50	240	420
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.954			0.940				0.986		0.908	
Flt Protected		0.968			0.997				0.970			
Satd. Flow (prot)	0	1737	0	0	1746	0	0	0	1799	0	1708	0
Flt Permitted		0.968			0.997				0.970			
Satd. Flow (perm)	0	1737	0	0	1746	0	0	0	1799	0	1708	0
Link Speed (mph)		30			30				30		30	
Link Distance (ft)		449			456				370		390	
Travel Time (s)		10.2			10.4				8.4		8.9	
Peak Hour Factor	0.91	0.91	0.91	0.87	0.87	0.87	0.87	0.92	0.92	0.92	0.90	0.90
Heavy Vehicles (%)	1%	1%	1%	2%	2%	2%	2%	1%	1%	1%	1%	1%
Adj. Flow (vph)	11	401	214	11	109	86	11	326	147	54	267	467
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	626	0	0	217	0	0	0	527	0	834	0
Sign Control		Yield			Yield				Yield		Yield	

Intersection Summary

Area Type: Other

Control Type: Roundabout

Intersection Capacity Utilization 127.5% ICU Level of Service H

Analysis Period (min) 15

Lane Group	NER2	SWL	SWT
Lane Configurations			
Traffic Volume (vph)	90	35	130
Future Volume (vph)	90	35	130
Ideal Flow (vphpl)	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00
Frt			
Flt Protected			0.990
Satd. Flow (prot)	0	0	1844
Flt Permitted			0.990
Satd. Flow (perm)	0	0	1844
Link Speed (mph)			30
Link Distance (ft)			523
Travel Time (s)			11.9
Peak Hour Factor	0.90	0.91	0.91
Heavy Vehicles (%)	1%	2%	2%
Adj. Flow (vph)	100	38	143
Shared Lane Traffic (%)			
Lane Group Flow (vph)	0	0	181
Sign Control			Yield

Movement	WBL2	WBL	WBR	NBL	NBT	NBR	NBR2	SBL	SBT	SBR	NET	NER
Right Turn Channelized												
Traffic Volume (veh/h)	10	365	195	10	95	75	10	300	135	50	240	420
Future Volume (veh/h)	10	365	195	10	95	75	10	300	135	50	240	420
Peak Hour Factor	0.91	0.91	0.91	0.87	0.87	0.87	0.87	0.92	0.92	0.92	0.90	0.90
Hourly flow rate (vph)	11	401	214	11	109	86	11	326	147	54	267	467
Approach Volume (veh/h)		626			217				527		834	
Crossing Volume (veh/h)		473			1060				604		522	
High Capacity (veh/h)		954			593				859		917	
High v/c (veh/h)		0.66			0.37				0.61		0.91	
Low Capacity (veh/h)		773			457				688		740	
Low v/c (veh/h)		0.81			0.47				0.77		1.13	

Intersection Summary				
Maximum v/c High	0.91			
Maximum v/c Low	1.13			
Intersection Capacity Utilization	127.5%	ICU Level of Service		H

Movement	NER2	SWL	SWT
Right Turn Channelized			
Traffic Volume (veh/h)	90	35	130
Future Volume (veh/h)	90	35	130
Peak Hour Factor	0.90	0.91	0.91
Hourly flow rate (vph)	100	38	143
Approach Volume (veh/h)			181
Crossing Volume (veh/h)			746
High Capacity (veh/h)			766
High v/c (veh/h)			0.24
Low Capacity (veh/h)			607
Low v/c (veh/h)			0.30

Intersection Summary

Intersection	
Intersection Delay, s/veh	74.4
Intersection LOS	F

Approach	WB	NB	SB	NE
Entry Lanes	1	1	1	1
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	626	217	527	834
Demand Flow Rate, veh/h	632	221	532	843
Vehicles Circulating, veh/h	480	1071	612	527
Vehicles Exiting, veh/h	812	299	327	617
Follow-Up Headway, s	3.186	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	38.9	24.2	37.2	151.2
Approach LOS	E	C	E	F

Lane	Left	Left	Left	Left
Designated Moves	LR	LTR	LTR	LTR
Assumed Moves	LR	LTR	LTR	LTR
RT Channelized				
Lane Util	1.000	1.000	1.000	1.000
Critical Headway, s	5.193	5.193	5.193	5.193
Entry Flow, veh/h	632	221	532	843
Cap Entry Lane, veh/h	699	387	613	667
Entry HV Adj Factor	0.990	0.981	0.990	0.990
Flow Entry, veh/h	626	217	527	834
Cap Entry, veh/h	692	380	606	660
V/C Ratio	0.904	0.571	0.868	1.264
Control Delay, s/veh	38.9	24.2	37.2	151.2
LOS	E	C	E	F
95th %tile Queue, veh	12	3	10	32

Intersection	
Intersection Delay, s/veh	
Intersection LOS	

Approach	SW
Entry Lanes	1
Conflicting Circle Lanes	1
Adj Approach Flow, veh/h	181
Demand Flow Rate, veh/h	185
Vehicles Circulating, veh/h	754
Vehicles Exiting, veh/h	358
Follow-Up Headway, s	3.186
Ped Vol Crossing Leg, #/h	0
Ped Cap Adj	1.000
Approach Delay, s/veh	12.3
Approach LOS	B

Lane	Left
Designated Moves	LTR
Assumed Moves	LTR
RT Channelized	
Lane Util	1.000
Critical Headway, s	5.193
Entry Flow, veh/h	185
Cap Entry Lane, veh/h	532
Entry HV Adj Factor	0.979
Flow Entry, veh/h	181
Cap Entry, veh/h	521
V/C Ratio	0.348
Control Delay, s/veh	12.3
LOS	B
95th %tile Queue, veh	2

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	5	0	350	0	0	0	120	150	0	0	130	10
Future Volume (vph)	5	0	350	0	0	0	120	150	0	0	130	10
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850								0.990	
Flt Protected		0.950						0.978				
Satd. Flow (prot)	0	1770	1583	0	1900	0	0	1840	0	0	1862	0
Flt Permitted		0.950						0.978				
Satd. Flow (perm)	0	1770	1583	0	1900	0	0	1840	0	0	1862	0
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		113			453			475			436	
Travel Time (s)		2.6			10.3			10.8			9.9	
Peak Hour Factor	0.88	0.88	0.88	0.82	0.82	0.82	0.93	0.93	0.93	0.91	0.91	0.91
Heavy Vehicles (%)	2%	2%	2%	0%	0%	0%	1%	1%	1%	1%	1%	1%
Adj. Flow (vph)	6	0	398	0	0	0	129	161	0	0	143	11
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	6	398	0	0	0	0	290	0	0	154	0
Sign Control		Stop			Stop			Free			Free	

Intersection Summary		
Area Type:	Other	
Control Type: Unsignalized		
Intersection Capacity Utilization 35.8%		ICU Level of Service A
Analysis Period (min) 15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	5	0	350	0	0	0	120	150	0	0	130	10
Future Volume (Veh/h)	5	0	350	0	0	0	120	150	0	0	130	10
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.88	0.88	0.88	0.82	0.82	0.82	0.93	0.93	0.93	0.91	0.91	0.91
Hourly flow rate (vph)	6	0	398	0	0	0	129	161	0	0	143	11
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	568	568	148	966	573	161	154			161		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	568	568	148	966	573	161	154			161		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	99	100	56	100	100	100	91			100		
cM capacity (veh/h)	404	394	898	122	393	889	1433			1424		

Direction, Lane #	EB 1	EB 2	WB 1	NB 1	SB 1
Volume Total	6	398	0	290	154
Volume Left	6	0	0	129	0
Volume Right	0	398	0	0	11
cSH	404	898	1700	1433	1424
Volume to Capacity	0.01	0.44	0.00	0.09	0.00
Queue Length 95th (ft)	1	58	0	7	0
Control Delay (s)	14.0	12.2	0.0	3.9	0.0
Lane LOS	B	B	A	A	
Approach Delay (s)	12.2		0.0	3.9	0.0
Approach LOS	B		A		

Intersection Summary				
Average Delay		7.1		
Intersection Capacity Utilization		35.8%	ICU Level of Service	A
Analysis Period (min)		15		

Movement	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	100	80	25	55	50	195	195	800	75	25	265	40
Future Volume (vph)	100	80	25	55	50	195	195	800	75	25	265	40
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	0.96		1.00	1.00	0.85	1.00	0.99		1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	1797		1787	1881	1599	1805	1876		1805	1863	
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	1797		1787	1881	1599	1805	1876		1805	1863	
Peak-hour factor, PHF	0.99	0.99	0.99	0.95	0.95	0.95	0.89	0.89	0.89	0.93	0.93	0.93
Adj. Flow (vph)	101	81	25	58	53	205	219	899	84	27	285	43
RTOR Reduction (vph)	0	14	0	0	0	109	0	4	0	0	6	0
Lane Group Flow (vph)	101	92	0	58	53	96	219	979	0	27	322	0
Heavy Vehicles (%)	2%	2%	2%	1%	1%	1%	0%	0%	0%	0%	0%	0%
Turn Type	Prot	NA		Prot	NA	pt+ov	Prot	NA		Prot	NA	
Protected Phases	1	6		5	2	2 3	3	8		7	4	
Permitted Phases		6			2							
Actuated Green, G (s)	7.1	17.6		4.8	15.3	35.5	14.2	30.4		3.2	19.4	
Effective Green, g (s)	7.1	17.6		4.8	15.3	35.5	14.2	30.4		3.2	19.4	
Actuated g/C Ratio	0.09	0.22		0.06	0.19	0.44	0.18	0.38		0.04	0.24	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	157	395		107	359	709	320	712		72	451	
v/s Ratio Prot	c0.06	c0.05		0.03	0.03	0.06	c0.12	c0.52		0.01	0.17	
v/s Ratio Perm												
v/c Ratio	0.64	0.23		0.54	0.15	0.14	0.68	1.38		0.38	0.71	
Uniform Delay, d1	35.2	25.6		36.5	26.9	13.2	30.8	24.8		37.4	27.8	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	8.7	0.3		5.5	0.9	0.1	5.9	177.7		3.3	5.3	
Delay (s)	43.9	26.0		42.0	27.8	13.3	36.7	202.5		40.7	33.1	
Level of Service	D	C		D	C	B	D	F		D	C	
Approach Delay (s)		34.7			21.0			172.3			33.6	
Approach LOS		C			C			F			C	

Intersection Summary			
HCM 2000 Control Delay	112.0	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	0.98		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	24.0
Intersection Capacity Utilization	80.5%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	540	0	10	295	170	295
Future Volume (vph)	540	0	10	295	170	295
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt					0.914	
Flt Protected	0.950			0.998		
Satd. Flow (prot)	1787	0	0	1859	1686	0
Flt Permitted	0.950			0.998		
Satd. Flow (perm)	1787	0	0	1859	1686	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	348			709	425	
Travel Time (s)	7.9			16.1	9.7	
Peak Hour Factor	0.90	0.90	0.87	0.87	0.89	0.89
Heavy Vehicles (%)	1%	1%	2%	2%	3%	3%
Adj. Flow (vph)	600	0	11	339	191	331
Shared Lane Traffic (%)						
Lane Group Flow (vph)	600	0	0	350	522	0
Sign Control	Stop			Free	Free	

Intersection Summary	
Area Type: Other	
Control Type: Unsignalized	
Intersection Capacity Utilization 63.6%	ICU Level of Service B
Analysis Period (min) 15	

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	540	0	10	295	170	295
Future Volume (Veh/h)	540	0	10	295	170	295
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.90	0.90	0.87	0.87	0.89	0.89
Hourly flow rate (vph)	600	0	11	339	191	331
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	718	356	522			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	718	356	522			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	0	100	99			
cM capacity (veh/h)	393	690	1044			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	600	350	522
Volume Left	600	11	0
Volume Right	0	0	331
cSH	393	1044	1700
Volume to Capacity	1.53	0.01	0.31
Queue Length 95th (ft)	818	1	0
Control Delay (s)	274.7	0.4	0.0
Lane LOS	F	A	
Approach Delay (s)	274.7	0.4	0.0
Approach LOS	F		

Intersection Summary			
Average Delay	112.1		
Intersection Capacity Utilization	63.6%	ICU Level of Service	B
Analysis Period (min)	15		

APPENDIX N-2: 2040 NO-BUILD INTERSECTION CAPACITY ANALYSES – HCM 2000 PRINTOUTS – PM PEAK HOUR

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑↑		↰	↱↱
Traffic Volume (vph)	0	1315	670	0	790	835
Future Volume (vph)	0	1315	670	0	790	835
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	16	12
Total Lost time (s)		6.0	6.0		6.0	6.0
Lane Util. Factor		0.95	0.95		1.00	0.88
Frt		1.00	1.00		1.00	0.85
Flt Protected		1.00	1.00		0.95	1.00
Satd. Flow (prot)		3471	3406		1930	2682
Flt Permitted		1.00	1.00		0.95	1.00
Satd. Flow (perm)		3471	3406		1930	2682
Peak-hour factor, PHF	0.93	0.93	0.88	0.88	0.89	0.89
Adj. Flow (vph)	0	1414	761	0	888	938
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	1414	761	0	888	938
Heavy Vehicles (%)	4%	4%	6%	6%	6%	6%
Turn Type		NA	NA		Prot	Prot
Protected Phases		2	6		4	4
Permitted Phases						
Actuated Green, G (s)		23.0	23.0		25.0	25.0
Effective Green, g (s)		23.0	23.0		25.0	25.0
Actuated g/C Ratio		0.38	0.38		0.42	0.42
Clearance Time (s)		6.0	6.0		6.0	6.0
Vehicle Extension (s)		3.0	3.0		3.0	3.0
Lane Grp Cap (vph)		1330	1305		804	1117
v/s Ratio Prot		c0.41	0.22		c0.46	0.35
v/s Ratio Perm						
v/c Ratio		1.06	0.58		1.10	0.84
Uniform Delay, d1		18.5	14.7		17.5	15.7
Progression Factor		1.03	0.90		1.00	1.00
Incremental Delay, d2		34.1	0.2		64.3	5.7
Delay (s)		53.2	13.4		81.8	21.4
Level of Service		D	B		F	C
Approach Delay (s)		53.2	13.4		50.8	
Approach LOS		D	B		D	

Intersection Summary			
HCM 2000 Control Delay	44.5	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	1.08		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	92.1%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Movement	NBL2	NBL	NBR	SEL	SER	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations											
Traffic Volume (vph)	460	0	355	0	0	1190	915	0	0	1260	1125
Future Volume (vph)	460	0	355	0	0	1190	915	0	0	1260	1125
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0		6.0			6.0	6.0			6.0	4.0
Lane Util. Factor	0.97		0.88			0.97	0.95			0.95	1.00
Frt	1.00		0.85			1.00	1.00			1.00	0.85
Flt Protected	0.95		1.00			0.95	1.00			1.00	1.00
Satd. Flow (prot)	3242		2632			3335	3438			3505	1568
Flt Permitted	0.95		1.00			0.95	1.00			1.00	1.00
Satd. Flow (perm)	3242		2632			3335	3438			3505	1568
Peak-hour factor, PHF	0.88	0.88	0.88	0.92	0.92	0.94	0.94	0.94	0.92	0.92	0.92
Adj. Flow (vph)	523	0	403	0	0	1266	973	0	0	1370	1223
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	523	0	403	0	0	1266	973	0	0	1370	1223
Heavy Vehicles (%)	8%	8%	8%	2%	2%	5%	5%	5%	3%	3%	3%
Turn Type	Prot		Prot			Prot	NA			NA	Free
Protected Phases	8		8			5	2			6	
Permitted Phases											Free
Actuated Green, G (s)	17.0		17.0			41.0	91.0			44.0	120.0
Effective Green, g (s)	17.0		17.0			41.0	91.0			44.0	120.0
Actuated g/C Ratio	0.14		0.14			0.34	0.76			0.37	1.00
Clearance Time (s)	6.0		6.0			6.0	6.0			6.0	
Vehicle Extension (s)	3.0		3.0			3.0	3.0			3.0	
Lane Grp Cap (vph)	459		372			1139	2607			1285	1568
v/s Ratio Prot	c0.16		0.15			c0.38	0.28			c0.39	
v/s Ratio Perm											0.78
v/c Ratio	1.14		1.08			1.11	0.37			1.07	0.78
Uniform Delay, d1	51.5		51.5			39.5	4.9			38.0	0.0
Progression Factor	1.00		1.00			0.86	1.15			1.00	1.00
Incremental Delay, d2	86.1		70.8			51.6	0.0			44.8	3.9
Delay (s)	137.6		122.3			85.6	5.7			82.8	3.9
Level of Service	F		F			F	A			F	A
Approach Delay (s)		130.9		0.0			50.9			45.6	
Approach LOS		F		A			D			D	

Intersection Summary			
HCM 2000 Control Delay	61.4	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.10		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	97.9%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑	↱	↰	↑↑					↰↰		↱
Traffic Volume (vph)	0	810	360	390	650	0	0	0	0	550	0	555
Future Volume (vph)	0	810	360	390	650	0	0	0	0	550	0	555
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0	4.0	6.0	6.0					6.0		6.0
Lane Util. Factor		0.95	1.00	1.00	0.95					0.97		1.00
Frt		1.00	0.85	1.00	1.00					1.00		0.85
Flt Protected		1.00	1.00	0.95	1.00					0.95		1.00
Satd. Flow (prot)		3167	1417	1687	3374					3303		1524
Flt Permitted		1.00	1.00	0.95	1.00					0.95		1.00
Satd. Flow (perm)		3167	1417	1687	3374					3303		1524
Peak-hour factor, PHF	0.92	0.92	0.92	0.73	0.73	0.73	0.92	0.92	0.92	0.74	0.74	0.74
Adj. Flow (vph)	0	880	391	534	890	0	0	0	0	743	0	750
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	106
Lane Group Flow (vph)	0	880	391	534	890	0	0	0	0	743	0	644
Heavy Vehicles (%)	14%	14%	14%	7%	7%	7%	2%	2%	2%	6%	6%	6%
Turn Type		NA	Free	Prot	NA					Prot		Prot
Protected Phases		2		1	6					4		4
Permitted Phases			Free									
Actuated Green, G (s)		40.0	140.0	38.0	84.0					44.0		44.0
Effective Green, g (s)		40.0	140.0	38.0	84.0					44.0		44.0
Actuated g/C Ratio		0.29	1.00	0.27	0.60					0.31		0.31
Clearance Time (s)		6.0		6.0	6.0					6.0		6.0
Vehicle Extension (s)		5.0		3.0	5.0					3.0		3.0
Lane Grp Cap (vph)		904	1417	457	2024					1038		478
v/s Ratio Prot		c0.28		c0.32	0.26					0.22		c0.42
v/s Ratio Perm			0.28									
v/c Ratio		0.97	0.28	1.17	0.44					0.72		1.35
Uniform Delay, d1		49.5	0.0	51.0	15.2					42.5		48.0
Progression Factor		1.00	1.00	0.36	0.10					1.00		1.00
Incremental Delay, d2		24.2	0.5	92.9	0.3					2.4		169.5
Delay (s)		73.6	0.5	111.5	1.8					44.8		217.5
Level of Service		E	A	F	A					D		F
Approach Delay (s)		51.1			42.9			0.0			131.6	
Approach LOS		D			D			A			F	

Intersection Summary			
HCM 2000 Control Delay	77.0	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.17		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	89.8%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑			↑↑	↱	↰		↱			
Traffic Volume (vph)	635	725	0	0	650	775	390	0	165	0	0	0
Future Volume (vph)	635	725	0	0	650	775	390	0	165	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0			6.0	4.0	6.0		6.0			
Lane Util. Factor	1.00	0.95			0.95	1.00	1.00		1.00			
Frt	1.00	1.00			1.00	0.85	1.00		0.85			
Flt Protected	0.95	1.00			1.00	1.00	0.95		1.00			
Satd. Flow (prot)	1641	3282			3438	1538	1656		1482			
Flt Permitted	0.95	1.00			1.00	1.00	0.95		1.00			
Satd. Flow (perm)	1641	3282			3438	1538	1656		1482			
Peak-hour factor, PHF	0.87	0.87	0.87	0.90	0.90	0.90	0.78	0.78	0.78	0.92	0.92	0.92
Adj. Flow (vph)	730	833	0	0	722	861	500	0	212	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	120	0	0	0
Lane Group Flow (vph)	730	833	0	0	722	861	500	0	92	0	0	0
Heavy Vehicles (%)	10%	10%	10%	5%	5%	5%	9%	9%	9%	2%	2%	2%
Turn Type	Prot	NA			NA	Free	Prot		Prot			
Protected Phases	5	2			6		8		8			
Permitted Phases		2			6	Free						
Actuated Green, G (s)	56.0	90.0			28.0	140.0	38.0		38.0			
Effective Green, g (s)	56.0	90.0			28.0	140.0	38.0		38.0			
Actuated g/C Ratio	0.40	0.64			0.20	1.00	0.27		0.27			
Clearance Time (s)	6.0	6.0			6.0		6.0		6.0			
Vehicle Extension (s)	5.0	5.0			5.0		3.0		3.0			
Lane Grp Cap (vph)	656	2109			687	1538	449		402			
v/s Ratio Prot	c0.44	0.25			c0.21		c0.30		0.06			
v/s Ratio Perm						0.56						
v/c Ratio	1.11	0.39			1.05	0.56	1.11		0.23			
Uniform Delay, d1	42.0	12.0			56.0	0.0	51.0		39.6			
Progression Factor	0.22	0.02			1.00	1.00	1.00		1.00			
Incremental Delay, d2	58.7	0.3			48.5	1.5	77.2		0.3			
Delay (s)	67.9	0.6			104.5	1.5	128.2		39.9			
Level of Service	E	A			F	A	F		D			
Approach Delay (s)		32.0			48.5			101.9			0.0	
Approach LOS		C			D			F			A	

Intersection Summary			
HCM 2000 Control Delay	51.7	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	1.10		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	89.8%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	5	0	240	0	0	0	250	690	5	5	1755	5
Future Volume (vph)	5	0	240	0	0	0	250	690	5	5	1755	5
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0	6.0				6.0	6.0		6.0	6.0	
Lane Util. Factor		1.00	1.00				1.00	0.95		1.00	0.95	
Frt		1.00	0.85				1.00	1.00		1.00	1.00	
Flt Protected		0.95	1.00				0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1770	1583				1770	3536		1770	3538	
Flt Permitted		1.00	1.00				0.95	1.00		0.95	1.00	
Satd. Flow (perm)		1863	1583				1770	3536		1770	3538	
Peak-hour factor, PHF	0.92	0.92	0.92	0.25	0.25	0.25	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	5	0	261	0	0	0	272	750	5	5	1908	5
RTOR Reduction (vph)	0	0	98	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	5	163	0	0	0	272	755	0	5	1913	0
Heavy Vehicles (%)	2%	2%	2%	0%	0%	0%	2%	2%	2%	2%	2%	2%
Turn Type	Perm	NA	custom				Prot	NA		Prot	NA	
Protected Phases		8			4		5	2		1	6	
Permitted Phases	8		6	4								
Actuated Green, G (s)		1.2	61.1				17.7	77.9		0.9	61.1	
Effective Green, g (s)		1.2	61.1				17.7	77.9		0.9	61.1	
Actuated g/C Ratio		0.01	0.62				0.18	0.79		0.01	0.62	
Clearance Time (s)		6.0	6.0				6.0	6.0		6.0	6.0	
Vehicle Extension (s)		3.0	3.0				3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		22	986				319	2810		16	2205	
v/s Ratio Prot							c0.15	0.21		0.00	c0.54	
v/s Ratio Perm		c0.00	0.10									
v/c Ratio		0.23	0.17				0.85	0.27		0.31	0.87	
Uniform Delay, d1		47.9	7.7				38.9	2.6		48.2	15.1	
Progression Factor		1.00	1.00				1.00	1.00		1.00	1.00	
Incremental Delay, d2		5.2	0.1				19.2	0.1		10.9	3.9	
Delay (s)		53.2	7.8				58.1	2.7		59.1	19.0	
Level of Service		D	A				E	A		E	B	
Approach Delay (s)		8.7			0.0			17.4			19.1	
Approach LOS		A			A			B			B	

Intersection Summary			
HCM 2000 Control Delay	17.7	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.85		
Actuated Cycle Length (s)	98.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	85.5%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	0	15	5	345	0	35	0	453	180	5	790	0
Future Volume (vph)	0	15	5	345	0	35	0	453	180	5	790	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0			6.0			6.0			6.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		0.97			0.99			0.96			1.00	
Flt Protected		1.00			0.96			1.00			1.00	
Satd. Flow (prot)		1802			1743			1692			1809	
Flt Permitted		1.00			0.72			1.00			1.00	
Satd. Flow (perm)		1802			1315			1692			1802	
Peak-hour factor, PHF	0.60	0.60	0.60	0.96	0.96	0.96	0.89	0.89	0.89	0.86	0.86	0.86
Adj. Flow (vph)	0	25	8	359	0	36	0	509	202	6	919	0
RTOR Reduction (vph)	0	6	0	0	25	0	0	16	0	0	0	0
Lane Group Flow (vph)	0	27	0	0	370	0	0	695	0	0	925	0
Heavy Vehicles (%)	2%	2%	2%	3%	3%	3%	8%	8%	8%	5%	5%	5%
Turn Type		NA		Perm	NA			NA		Perm	NA	
Protected Phases		4			4			2			2	
Permitted Phases	4			4						2		
Actuated Green, G (s)		26.1			26.1			49.1			49.1	
Effective Green, g (s)		26.1			26.1			49.1			49.1	
Actuated g/C Ratio		0.30			0.30			0.56			0.56	
Clearance Time (s)		6.0			6.0			6.0			6.0	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		539			393			952			1014	
v/s Ratio Prot		0.02						0.41				
v/s Ratio Perm					c0.28						c0.51	
v/c Ratio		0.05			0.94			0.73			0.91	
Uniform Delay, d1		21.7			29.8			14.1			17.1	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		0.0			30.6			2.8			12.1	
Delay (s)		21.8			60.4			17.0			29.2	
Level of Service		C			E			B			C	
Approach Delay (s)		21.8			60.4			17.0			29.2	
Approach LOS		C			E			B			C	

Intersection Summary			
HCM 2000 Control Delay	30.8	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.92		
Actuated Cycle Length (s)	87.2	Sum of lost time (s)	12.0
Intersection Capacity Utilization	86.1%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	80	235	90	35	520	80	90	160	40	70	125	115
Future Volume (vph)	80	235	90	35	520	80	90	160	40	70	125	115
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	6.0
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.96		1.00	0.98		1.00	0.97		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1656	1671		1703	1757		1719	1755		1703	1792	1524
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1656	1671		1703	1757		1719	1755		1703	1792	1524
Peak-hour factor, PHF	0.96	0.96	0.96	0.94	0.94	0.94	0.85	0.85	0.85	0.91	0.91	0.91
Adj. Flow (vph)	83	245	94	37	553	85	106	188	47	77	137	126
RTOR Reduction (vph)	0	16	0	0	6	0	0	12	0	0	0	102
Lane Group Flow (vph)	83	323	0	37	632	0	106	223	0	77	137	24
Heavy Vehicles (%)	9%	9%	9%	6%	6%	6%	5%	5%	5%	6%	6%	6%
Parking (#/hr)			0									
Turn Type	Prot	NA		Prot	NA		Prot	NA		Prot	NA	Perm
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases												4
Actuated Green, G (s)	4.6	29.7		3.4	28.5		4.0	14.4		4.0	14.4	14.4
Effective Green, g (s)	4.6	29.7		3.4	28.5		4.0	14.4		4.0	14.4	14.4
Actuated g/C Ratio	0.06	0.39		0.05	0.38		0.05	0.19		0.05	0.19	0.19
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	100	657		76	663		91	334		90	341	290
v/s Ratio Prot	c0.05	0.19		0.02	c0.36		c0.06	c0.13		0.05	0.08	
v/s Ratio Perm												0.02
v/c Ratio	0.83	0.49		0.49	0.95		1.16	0.67		0.86	0.40	0.08
Uniform Delay, d1	35.1	17.2		35.2	22.8		35.8	28.3		35.5	26.8	25.1
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	40.8	0.6		4.8	23.8		145.5	5.0		50.6	0.8	0.1
Delay (s)	75.9	17.8		40.0	46.7		181.2	33.3		86.1	27.6	25.2
Level of Service	E	B		D	D		F	C		F	C	C
Approach Delay (s)		29.2			46.3			79.3			40.0	
Approach LOS		C			D			E			D	

Intersection Summary			
HCM 2000 Control Delay	47.4	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.88		
Actuated Cycle Length (s)	75.5	Sum of lost time (s)	24.0
Intersection Capacity Utilization	71.4%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	490	0	0	85	175	395
Future Volume (vph)	490	0	0	85	175	395
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt					0.906	
Flt Protected	0.950					
Satd. Flow (prot)	1719	0	0	1827	1688	0
Flt Permitted	0.950					
Satd. Flow (perm)	1719	0	0	1827	1688	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	322			309	249	
Travel Time (s)	7.3			7.0	5.7	
Peak Hour Factor	0.89	0.89	0.91	0.91	0.93	0.93
Heavy Vehicles (%)	5%	5%	4%	4%	2%	2%
Adj. Flow (vph)	551	0	0	93	188	425
Shared Lane Traffic (%)						
Lane Group Flow (vph)	551	0	0	93	613	0
Sign Control	Stop			Free	Free	

Intersection Summary	
Area Type: Other	
Control Type: Unsignalized	
Intersection Capacity Utilization 67.3%	ICU Level of Service C
Analysis Period (min) 15	

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	490	0	0	85	175	395
Future Volume (Veh/h)	490	0	0	85	175	395
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.89	0.89	0.91	0.91	0.93	0.93
Hourly flow rate (vph)	551	0	0	93	188	425
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	494	400	613			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	494	400	613			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	0	100	100			
cM capacity (veh/h)	530	643	957			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	551	93	613
Volume Left	551	0	0
Volume Right	0	0	425
cSH	530	957	1700
Volume to Capacity	1.04	0.00	0.36
Queue Length 95th (ft)	394	0	0
Control Delay (s)	78.0	0.0	0.0
Lane LOS	F		
Approach Delay (s)	78.0	0.0	0.0
Approach LOS	F		

Intersection Summary			
Average Delay	34.2		
Intersection Capacity Utilization	67.3%	ICU Level of Service	C
Analysis Period (min)	15		

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	5	0	0	520	565	15
Future Volume (vph)	5	0	0	520	565	15
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt					0.996	
Flt Protected	0.950					
Satd. Flow (prot)	1008	0	0	1827	1785	0
Flt Permitted	0.950					
Satd. Flow (perm)	1008	0	0	1827	1785	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	160			224	319	
Travel Time (s)	3.6			5.1	7.3	
Peak Hour Factor	0.44	0.44	0.95	0.95	0.96	0.96
Heavy Vehicles (%)	79%	79%	4%	4%	6%	6%
Adj. Flow (vph)	11	0	0	547	589	16
Shared Lane Traffic (%)						
Lane Group Flow (vph)	11	0	0	547	605	0
Sign Control	Stop			Free	Free	

Intersection Summary

Area Type: Other
Control Type: Unsignalized
Intersection Capacity Utilization 40.6% ICU Level of Service A
Analysis Period (min) 15

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	5	0	0	520	565	15
Future Volume (Veh/h)	5	0	0	520	565	15
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.44	0.44	0.95	0.95	0.96	0.96
Hourly flow rate (vph)	11	0	0	547	589	16
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1144	597	605			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1144	597	605			
tC, single (s)	7.2	7.0	4.1			
tC, 2 stage (s)						
tF (s)	4.2	4.0	2.2			
p0 queue free %	93	100	100			
cM capacity (veh/h)	158	386	963			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	11	547	605
Volume Left	11	0	0
Volume Right	0	0	16
cSH	158	963	1700
Volume to Capacity	0.07	0.00	0.36
Queue Length 95th (ft)	6	0	0
Control Delay (s)	29.5	0.0	0.0
Lane LOS	D		
Approach Delay (s)	29.5	0.0	0.0
Approach LOS	D		

Intersection Summary			
Average Delay	0.3		
Intersection Capacity Utilization	40.6%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Traffic Volume (vph)	40	465	5	0	490	0	0	5	65	10	5	20
Future Volume (vph)	40	465	5	0	490	0	0	5	65	10	5	20
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	150		150	150		150	0		0	150		150
Storage Lanes	0		0	0		0	0		0	0		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.999						0.875			0.922	
Flt Protected		0.996									0.986	
Satd. Flow (prot)	0	1767	0	0	1810	0	0	1630	0	0	1727	0
Flt Permitted		0.996									0.986	
Satd. Flow (perm)	0	1767	0	0	1810	0	0	1630	0	0	1727	0
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		327			240			246			251	
Travel Time (s)		7.4			5.5			5.6			5.7	
Peak Hour Factor	0.89	0.89	0.89	0.96	0.96	0.96	0.65	0.65	0.65	0.67	0.67	0.67
Heavy Vehicles (%)	7%	7%	7%	5%	5%	5%	2%	2%	2%	0%	0%	0%
Adj. Flow (vph)	45	522	6	0	510	0	0	8	100	15	7	30
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	573	0	0	510	0	0	108	0	0	52	0
Sign Control		Free			Free			Stop			Stop	

Intersection Summary	
Area Type: Other	
Control Type: Unsignalized	
Intersection Capacity Utilization 71.5%	ICU Level of Service C
Analysis Period (min) 15	

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Traffic Volume (veh/h)	40	465	5	0	490	0	0	5	65	10	5	20
Future Volume (Veh/h)	40	465	5	0	490	0	0	5	65	10	5	20
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.89	0.89	0.89	0.96	0.96	0.96	0.65	0.65	0.65	0.67	0.67	0.67
Hourly flow rate (vph)	45	522	6	0	510	0	0	8	100	15	7	30
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	510			528			1158	1128	510	1129	1125	525
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	510			528			1158	1128	510	1129	1125	525
tC, single (s)	4.2			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.3			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	96			100			100	96	82	89	96	95
cM capacity (veh/h)	1030			1024			154	195	563	141	198	556

Direction, Lane #	EB 1	WB 1	SE 1	NW 1
Volume Total	573	510	108	52
Volume Left	45	0	0	15
Volume Right	6	0	100	30
cSH	1030	1024	494	266
Volume to Capacity	0.04	0.00	0.22	0.20
Queue Length 95th (ft)	3	0	21	18
Control Delay (s)	1.2	0.0	14.3	21.8
Lane LOS	A		B	C
Approach Delay (s)	1.2	0.0	14.3	21.8
Approach LOS			B	C

Intersection Summary			
Average Delay	2.7		
Intersection Capacity Utilization	71.5%	ICU Level of Service	C
Analysis Period (min)	15		

Movement	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	0	150	120	295	160	0	65	276	0	135	525	295
Future Volume (vph)	0	150	120	295	160	0	65	276	0	135	525	295
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0	6.0	6.0	6.0		6.0	6.0		6.0	6.0	6.0
Lane Util. Factor		0.95	1.00	0.97	0.95		1.00	1.00		1.00	1.00	1.00
Frt		1.00	0.85	1.00	1.00		1.00	1.00		1.00	1.00	0.85
Flt Protected		1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)		3471	1553	3335	3438		1752	1845		1752	1845	1568
Flt Permitted		1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)		3471	1553	3335	3438		1752	1845		1752	1845	1568
Peak-hour factor, PHF	0.84	0.84	0.84	0.79	0.79	0.79	0.86	0.86	0.86	0.99	0.99	0.99
Adj. Flow (vph)	0	179	143	373	203	0	76	321	0	136	530	298
RTOR Reduction (vph)	0	0	101	0	0	0	0	0	0	0	0	169
Lane Group Flow (vph)	0	179	42	373	203	0	76	321	0	136	530	129
Heavy Vehicles (%)	4%	4%	4%	5%	5%	5%	3%	3%	3%	3%	3%	3%
Turn Type	Prot	NA	Perm	Prot	NA	Perm	Prot	NA	Free	Prot	NA	pt+ov
Protected Phases	5	2		1	6		7	4		3	8	8 1
Permitted Phases		2	2		6	6		4	Free		8	
Actuated Green, G (s)		26.7	26.7	15.1	32.8		6.4	16.2		8.0	17.8	38.9
Effective Green, g (s)		26.7	26.7	15.1	32.8		6.4	16.2		8.0	17.8	38.9
Actuated g/C Ratio		0.30	0.30	0.17	0.36		0.07	0.18		0.09	0.20	0.43
Clearance Time (s)		6.0	6.0	6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)		3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		1029	460	559	1252		124	332		155	364	677
v/s Ratio Prot		0.05		c0.11	c0.06		0.04	0.17		c0.08	c0.29	0.08
v/s Ratio Perm			0.03									
v/c Ratio		0.17	0.09	0.67	0.16		0.61	0.97		0.88	1.46	0.19
Uniform Delay, d1		23.5	22.9	35.1	19.3		40.6	36.6		40.5	36.1	15.8
Progression Factor		1.00	1.00	1.20	0.56		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2		0.4	0.4	2.9	0.3		8.7	40.1		38.7	220.0	0.1
Delay (s)		23.8	23.3	45.1	11.0		49.3	76.8		79.2	256.1	15.9
Level of Service		C	C	D	B		D	E		E	F	B
Approach Delay (s)		23.6			33.1			71.5			156.9	
Approach LOS		C			C			E			F	

Intersection Summary			
HCM 2000 Control Delay	91.3	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	0.72		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	24.0
Intersection Capacity Utilization	67.7%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	NWL	NWR	NET	NER	SWL	SWT
Lane Configurations						
Traffic Volume (vph)	75	70	500	220	65	775
Future Volume (vph)	75	70	500	220	65	775
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	150	150		0	0	
Storage Lanes	0	1		1	0	
Taper Length (ft)	25				25	
Lane Util. Factor	1.00	1.00	1.00	1.00	0.95	0.95
Frt		0.850		0.850		
Flt Protected	0.950					0.996
Satd. Flow (prot)	1770	1583	1845	1568	0	3525
Flt Permitted	0.950					0.996
Satd. Flow (perm)	1770	1583	1845	1568	0	3525
Link Speed (mph)	30		30			30
Link Distance (ft)	408		387			233
Travel Time (s)	9.3		8.8			5.3
Peak Hour Factor	0.83	0.83	0.86	0.86	0.81	0.81
Heavy Vehicles (%)	2%	2%	3%	3%	2%	2%
Adj. Flow (vph)	90	84	581	256	80	957
Shared Lane Traffic (%)						
Lane Group Flow (vph)	90	84	581	256	0	1037
Sign Control	Stop		Free			Free

Intersection Summary	
Area Type: Other	
Control Type: Unsignalized	
Intersection Capacity Utilization 63.8%	ICU Level of Service B
Analysis Period (min) 15	

Movement	NWL	NWR	NET	NER	SWL	SWT
Lane Configurations						
Traffic Volume (veh/h)	75	70	500	220	65	775
Future Volume (Veh/h)	75	70	500	220	65	775
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.83	0.83	0.86	0.86	0.81	0.81
Hourly flow rate (vph)	90	84	581	256	80	957
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)		6				
Median type			None			TWLTL
Median storage veh)						2
Upstream signal (ft)			387			
pX, platoon unblocked	0.86	0.86			0.86	
vC, conflicting volume	1220	581			581	
vC1, stage 1 conf vol	581					
vC2, stage 2 conf vol	638					
vCu, unblocked vol	1176	437			437	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)	5.8					
tF (s)	3.5	3.3			2.2	
p0 queue free %	75	83			92	
cM capacity (veh/h)	363	490			968	

Direction, Lane #	NW 1	NE 1	NE 2	SW 1	SW 2
Volume Total	174	581	256	399	638
Volume Left	90	0	0	80	0
Volume Right	84	0	256	0	0
cSH	701	1700	1700	968	1700
Volume to Capacity	0.25	0.34	0.15	0.08	0.38
Queue Length 95th (ft)	24	0	0	7	0
Control Delay (s)	16.1	0.0	0.0	2.6	0.0
Lane LOS	C			A	
Approach Delay (s)	16.1	0.0		1.0	
Approach LOS	C				

Intersection Summary			
Average Delay	1.9		
Intersection Capacity Utilization	63.8%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	45	595	0	0	465	30	0	0	0	25	0	400
Future Volume (vph)	45	595	0	0	465	30	0	0	0	25	0	400
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0			6.0						6.0	6.0
Lane Util. Factor	1.00	0.95			0.95						1.00	1.00
Frt	1.00	1.00			0.99						1.00	0.85
Flt Protected	0.95	1.00			1.00						0.95	1.00
Satd. Flow (prot)	1687	3374			3507						1787	1599
Flt Permitted	0.95	1.00			1.00						0.76	1.00
Satd. Flow (perm)	1687	3374			3507						1424	1599
Peak-hour factor, PHF	0.83	0.83	0.83	0.92	0.92	0.92	0.50	0.50	0.50	0.90	0.90	0.90
Adj. Flow (vph)	54	717	0	0	505	33	0	0	0	28	0	444
RTOR Reduction (vph)	0	0	0	0	4	0	0	0	0	0	0	269
Lane Group Flow (vph)	54	717	0	0	534	0	0	0	0	0	28	175
Heavy Vehicles (%)	7%	7%	7%	2%	2%	2%	0%	0%	0%	1%	1%	1%
Turn Type	Prot	NA		Prot	NA				Perm	Perm	NA	Perm
Protected Phases	5	2		1	6			8			4	
Permitted Phases					6		8	8	8	4		4
Actuated Green, G (s)	5.2	62.9			51.7						15.1	15.1
Effective Green, g (s)	5.2	62.9			51.7						15.1	15.1
Actuated g/C Ratio	0.06	0.70			0.57						0.17	0.17
Clearance Time (s)	6.0	6.0			6.0						6.0	6.0
Vehicle Extension (s)	3.0	3.0			3.0						3.0	3.0
Lane Grp Cap (vph)	97	2358			2014						238	268
v/s Ratio Prot	c0.03	c0.21			0.15							
v/s Ratio Perm											0.02	c0.11
v/c Ratio	0.56	0.30			0.27						0.12	0.65
Uniform Delay, d1	41.3	5.2			9.6						31.8	35.0
Progression Factor	1.01	1.33			1.34						1.00	1.00
Incremental Delay, d2	6.4	0.3			0.1						0.2	5.6
Delay (s)	48.1	7.2			12.9						32.0	40.6
Level of Service	D	A			B						C	D
Approach Delay (s)		10.0			12.9			0.0			40.1	
Approach LOS		B			B			A			D	

Intersection Summary			
HCM 2000 Control Delay	18.9	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.41		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	48.6%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰↰	↑↱		↰	↑↱		↰	↱		↰	↰↑	↱
Traffic Volume (vph)	105	630	5	5	405	215	10	5	5	180	5	100
Future Volume (vph)	105	630	5	5	405	215	10	5	5	180	5	100
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	6.0
Lane Util. Factor	0.97	0.95		1.00	0.95		1.00	1.00		0.95	0.95	1.00
Frt	1.00	1.00		1.00	0.95		1.00	0.93		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	0.96	1.00
Satd. Flow (prot)	3303	3402		1736	3291		1805	1758		1665	1674	1568
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	0.96	1.00
Satd. Flow (perm)	3303	3402		1736	3291		1805	1758		1665	1674	1568
Peak-hour factor, PHF	0.83	0.83	0.83	0.97	0.97	0.97	0.67	0.67	0.67	0.90	0.90	0.90
Adj. Flow (vph)	127	759	6	5	418	222	15	7	7	200	6	111
RTOR Reduction (vph)	0	0	0	0	81	0	0	7	0	0	0	79
Lane Group Flow (vph)	127	765	0	5	559	0	15	7	0	102	104	32
Heavy Vehicles (%)	6%	6%	6%	4%	4%	4%	0%	0%	0%	3%	3%	3%
Turn Type	Prot	NA		Prot	NA		Split	NA		Split	NA	pt+ov
Protected Phases	5	2		1	6		3	3		4	4	4 5
Permitted Phases								3				
Actuated Green, G (s)	8.8	49.1		1.3	41.6		4.1	4.1		11.5	11.5	26.3
Effective Green, g (s)	8.8	49.1		1.3	41.6		4.1	4.1		11.5	11.5	26.3
Actuated g/C Ratio	0.10	0.55		0.01	0.46		0.05	0.05		0.13	0.13	0.29
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	322	1855		25	1521		82	80		212	213	458
v/s Ratio Prot	c0.04	c0.22		0.00	0.17		c0.01	0.00		0.06	c0.06	0.02
v/s Ratio Perm												
v/c Ratio	0.39	0.41		0.20	0.37		0.18	0.09		0.48	0.49	0.07
Uniform Delay, d1	38.1	12.0		43.8	15.7		41.3	41.2		36.5	36.5	23.0
Progression Factor	1.00	1.00		1.17	0.60		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	0.8	0.1		3.6	0.6		1.1	0.5		1.7	1.8	0.1
Delay (s)	38.9	12.1		55.1	10.1		42.4	41.7		38.2	38.3	23.1
Level of Service	D	B		E	B		D	D		D	D	C
Approach Delay (s)		15.9			10.4			42.1			32.9	
Approach LOS		B			B			D			C	

Intersection Summary				
HCM 2000 Control Delay	17.3	HCM 2000 Level of Service	B	
HCM 2000 Volume to Capacity ratio	0.43			
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	24.0	
Intersection Capacity Utilization	49.0%	ICU Level of Service	A	
Analysis Period (min)	15			
c Critical Lane Group				

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	15	720	645	40	80	35
Future Volume (vph)	15	720	645	40	80	35
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.992		0.959	
Flt Protected	0.950				0.966	
Satd. Flow (prot)	1687	1776	1812	0	1661	0
Flt Permitted	0.950				0.966	
Satd. Flow (perm)	1687	1776	1812	0	1661	0
Link Speed (mph)		30	30		30	
Link Distance (ft)		535	210		522	
Travel Time (s)		12.2	4.8		11.9	
Peak Hour Factor	0.84	0.84	0.89	0.89	0.83	0.83
Heavy Vehicles (%)	7%	7%	4%	4%	6%	6%
Adj. Flow (vph)	18	857	725	45	96	42
Shared Lane Traffic (%)						
Lane Group Flow (vph)	18	857	770	0	138	0
Sign Control		Free	Free		Stop	

Intersection Summary	
Area Type: Other	
Control Type: Unsignalized	
Intersection Capacity Utilization 51.1%	ICU Level of Service A
Analysis Period (min) 15	

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	15	720	645	40	80	35
Future Volume (Veh/h)	15	720	645	40	80	35
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.84	0.84	0.89	0.89	0.83	0.83
Hourly flow rate (vph)	18	857	725	45	96	42
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	770				1640	748
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	770				1640	748
tC, single (s)	4.2				6.5	6.3
tC, 2 stage (s)						
tF (s)	2.3				3.6	3.4
p0 queue free %	98				9	90
cM capacity (veh/h)	823				105	406

Direction, Lane #	EB 1	EB 2	WB 1	SB 1
Volume Total	18	857	770	138
Volume Left	18	0	0	96
Volume Right	0	0	45	42
cSH	823	1700	1700	136
Volume to Capacity	0.02	0.50	0.45	1.01
Queue Length 95th (ft)	2	0	0	183
Control Delay (s)	9.5	0.0	0.0	144.7
Lane LOS	A			F
Approach Delay (s)	0.2		0.0	144.7
Approach LOS				F

Intersection Summary			
Average Delay	11.3		
Intersection Capacity Utilization	51.1%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	WBL2	WBL	WBR	NBL	NBT	NBR	NBR2	SBL	SBT	SBR	NET	NER
Lane Configurations												
Traffic Volume (vph)	10	305	205	15	85	45	10	95	110	85	120	140
Future Volume (vph)	10	305	205	15	85	45	10	95	110	85	120	140
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)		0	150	0		150		0		0		150
Storage Lanes		1	0	0		0		0		0		0
Taper Length (ft)		25		25				25				
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.947			0.952				0.961		0.907	
Flt Protected		0.971			0.995				0.984			
Satd. Flow (prot)	0	1696	0	0	1747	0	0	0	1679	0	1596	0
Flt Permitted		0.971			0.995				0.984			
Satd. Flow (perm)	0	1696	0	0	1747	0	0	0	1679	0	1596	0
Link Speed (mph)		30			30				30		30	
Link Distance (ft)		465			456				371		400	
Travel Time (s)		10.6			10.4				8.4		9.1	
Peak Hour Factor	0.91	0.91	0.91	0.86	0.86	0.86	0.86	0.80	0.80	0.80	0.60	0.60
Heavy Vehicles (%)	3%	3%	3%	3%	3%	3%	3%	7%	7%	7%	8%	8%
Adj. Flow (vph)	11	335	225	17	99	52	12	119	138	106	200	233
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	571	0	0	180	0	0	0	363	0	641	0
Sign Control		Yield			Yield				Yield		Yield	

Intersection Summary		
Area Type:	Other	
Control Type: Roundabout		
Intersection Capacity Utilization 107.7%		ICU Level of Service G
Analysis Period (min) 15		

Lane Group	NER2	SWL	SWT
Lane Configurations			
Traffic Volume (vph)	125	45	210
Future Volume (vph)	125	45	210
Ideal Flow (vphpl)	1900	1900	1900
Storage Length (ft)		150	
Storage Lanes		0	
Taper Length (ft)		25	
Lane Util. Factor	1.00	1.00	1.00
Frt			
Flt Protected			0.991
Satd. Flow (prot)	0	0	1760
Flt Permitted			0.991
Satd. Flow (perm)	0	0	1760
Link Speed (mph)			30
Link Distance (ft)			530
Travel Time (s)			12.0
Peak Hour Factor	0.60	0.83	0.83
Heavy Vehicles (%)	8%	7%	7%
Adj. Flow (vph)	208	54	253
Shared Lane Traffic (%)			
Lane Group Flow (vph)	0	0	307
Sign Control			Yield

Intersection Summary

Intersection	
Intersection Delay, s/veh	24.3
Intersection LOS	C

Approach	WB	NB	SB	NE
Entry Lanes	1	1	1	1
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	571	180	363	641
Demand Flow Rate, veh/h	588	186	388	693
Vehicles Circulating, veh/h	390	595	703	344
Vehicles Exiting, veh/h	391	442	334	747
Follow-Up Headway, s	3.186	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	22.9	10.0	24.5	31.9
Approach LOS	C	A	C	D

Lane	Left	Left	Left	Left
Designated Moves	LR	LTR	LTR	LTR
Assumed Moves	LR	LTR	LTR	LTR
RT Channelized				
Lane Util	1.000	1.000	1.000	1.000
Critical Headway, s	5.193	5.193	5.193	5.193
Entry Flow, veh/h	588	186	388	693
Cap Entry Lane, veh/h	765	623	559	801
Entry HV Adj Factor	0.971	0.968	0.936	0.925
Flow Entry, veh/h	571	180	363	641
Cap Entry, veh/h	743	603	524	741
V/C Ratio	0.769	0.298	0.694	0.865
Control Delay, s/veh	22.9	10.0	24.5	31.9
LOS	C	A	C	D
95th %tile Queue, veh	7	1	5	10

Intersection	
Intersection Delay, s/veh	
Intersection LOS	

Approach	SW
Entry Lanes	1
Conflicting Circle Lanes	1
Adj Approach Flow, veh/h	307
Demand Flow Rate, veh/h	329
Vehicles Circulating, veh/h	708
Vehicles Exiting, veh/h	270
Follow-Up Headway, s	3.186
Ped Vol Crossing Leg, #/h	0
Ped Cap Adj	1.000
Approach Delay, s/veh	19.4
Approach LOS	C

Lane	Left
Designated Moves	LTR
Assumed Moves	LTR
RT Channelized	
Lane Util	1.000
Critical Headway, s	5.193
Entry Flow, veh/h	329
Cap Entry Lane, veh/h	557
Entry HV Adj Factor	0.934
Flow Entry, veh/h	307
Cap Entry, veh/h	520
V/C Ratio	0.591
Control Delay, s/veh	19.4
LOS	C
95th %tile Queue, veh	4

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	5	0	150	0	0	0	145	135	0	0	110	30
Future Volume (Veh/h)	5	0	150	0	0	0	145	135	0	0	110	30
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.82	0.82	0.82	0.70	0.70	0.70	0.75	0.75	0.75	0.71	0.71	0.71
Hourly flow rate (vph)	6	0	183	0	0	0	193	180	0	0	155	42
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)			1									
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	742	742	176	834	763	180	197			180		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	742	742	176	834	763	180	197			180		
tC, single (s)	7.2	6.6	6.3	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.6	4.1	3.4	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	98	100	79	100	100	100	86			100		
cM capacity (veh/h)	289	289	852	199	284	855	1370			1384		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	189	0	373	197
Volume Left	6	0	193	0
Volume Right	183	0	0	42
cSH	880	1700	1370	1384
Volume to Capacity	0.21	0.00	0.14	0.00
Queue Length 95th (ft)	20	0	12	0
Control Delay (s)	10.6	0.0	4.8	0.0
Lane LOS	B	A	A	
Approach Delay (s)	10.6	0.0	4.8	0.0
Approach LOS	B	A		

Intersection Summary			
Average Delay	5.0		
Intersection Capacity Utilization	36.1%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	0	55	20	20	55	270	85	230	80	75	415	55
Future Volume (vph)	0	55	20	20	55	270	85	230	80	75	415	55
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0		6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Lane Util. Factor		1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt		0.96		1.00	1.00	0.85	1.00	0.96		1.00	0.98	
Flt Protected		1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1772		1736	1827	1553	1770	1790		1787	1848	
Flt Permitted		1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)		1772		1736	1827	1553	1770	1790		1787	1848	
Peak-hour factor, PHF	0.82	0.82	0.82	0.81	0.81	0.81	0.68	0.68	0.68	0.78	0.78	0.78
Adj. Flow (vph)	0	67	24	25	68	333	125	338	118	96	532	71
RTOR Reduction (vph)	0	15	0	0	0	143	0	15	0	0	6	0
Lane Group Flow (vph)	0	76	0	25	68	190	125	441	0	96	597	0
Heavy Vehicles (%)	3%	3%	3%	4%	4%	4%	2%	2%	2%	1%	1%	1%
Turn Type	Prot	NA		Prot	NA	pt+ov	Prot	NA		Prot	NA	
Protected Phases	1	6		5	2	2 3	3	8		7	4	
Permitted Phases												
Actuated Green, G (s)		21.6		3.2	30.8	45.6	8.8	23.7		7.5	22.4	
Effective Green, g (s)		21.6		3.2	30.8	45.6	8.8	23.7		7.5	22.4	
Actuated g/C Ratio		0.27		0.04	0.39	0.57	0.11	0.30		0.09	0.28	
Clearance Time (s)		6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)		3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		478		69	703	885	194	530		167	517	
v/s Ratio Prot		0.04		0.01	0.04	c0.12	c0.07	0.25		0.05	c0.32	
v/s Ratio Perm												
v/c Ratio		0.16		0.36	0.10	0.21	0.64	0.83		0.57	1.16	
Uniform Delay, d1		22.3		37.4	15.7	8.4	34.1	26.3		34.7	28.8	
Progression Factor		1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2		0.2		3.2	0.3	0.1	7.1	10.8		4.7	90.0	
Delay (s)		22.4		40.6	16.0	8.5	41.2	37.0		39.4	118.8	
Level of Service		C		D	B	A	D	D		D	F	
Approach Delay (s)		22.4			11.6			38.0			107.9	
Approach LOS		C			B			D			F	

Intersection Summary			
HCM 2000 Control Delay	58.1	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	24.0
Intersection Capacity Utilization	54.6%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	190	0	10	135	235	465
Future Volume (Veh/h)	190	0	10	135	235	465
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.94	0.94	0.91	0.91	0.82	0.82
Hourly flow rate (vph)	202	0	11	148	287	567
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	740	570	854			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	740	570	854			
tC, single (s)	6.4	6.2	4.2			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.3			
p0 queue free %	47	100	99			
cM capacity (veh/h)	378	521	748			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	202	159	854
Volume Left	202	11	0
Volume Right	0	0	567
cSH	378	748	1700
Volume to Capacity	0.53	0.01	0.50
Queue Length 95th (ft)	76	1	0
Control Delay (s)	24.9	0.8	0.0
Lane LOS	C	A	
Approach Delay (s)	24.9	0.8	0.0
Approach LOS	C		

Intersection Summary			
Average Delay	4.3		
Intersection Capacity Utilization	58.1%	ICU Level of Service	B
Analysis Period (min)	15		

APPENDIX N-3: 2040 NO-BUILD INTERSECTION CAPACITY ANALYSES – SYNCHRO PRINTOUTS – AM PEAK HOUR

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑↑		↰	↱↱
Traffic Volume (vph)	0	1315	670	0	790	835
Future Volume (vph)	0	1315	670	0	790	835
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	16	12
Lane Util. Factor	1.00	0.95	0.95	1.00	1.00	0.88
Frt						0.850
Flt Protected					0.950	
Satd. Flow (prot)	0	3471	3406	0	1930	2682
Flt Permitted					0.950	
Satd. Flow (perm)	0	3471	3406	0	1930	2682
Right Turn on Red				Yes		No
Satd. Flow (RTOR)						
Link Speed (mph)		30	30		25	
Link Distance (ft)		712	388		212	
Travel Time (s)		16.2	8.8		5.8	
Peak Hour Factor	0.93	0.93	0.88	0.88	0.89	0.89
Heavy Vehicles (%)	4%	4%	6%	6%	6%	6%
Adj. Flow (vph)	0	1414	761	0	888	938
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	1414	761	0	888	938
Turn Type		NA	NA		Prot	Prot
Protected Phases		2	6		4	4
Permitted Phases						
Detector Phase		2	6		4	4
Switch Phase						
Minimum Initial (s)		8.0	8.0		5.0	5.0
Minimum Split (s)		14.0	21.0		27.0	27.0
Total Split (s)		29.0	29.0		31.0	31.0
Total Split (%)		48.3%	48.3%		51.7%	51.7%
Maximum Green (s)		23.0	23.0		25.0	25.0
Yellow Time (s)		2.0	2.0		2.0	2.0
All-Red Time (s)		4.0	4.0		4.0	4.0
Lost Time Adjust (s)		0.0	0.0		0.0	0.0
Total Lost Time (s)		6.0	6.0		6.0	6.0
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)		3.0	3.0		3.0	3.0
Recall Mode		C-Min	C-Min		None	None
Walk Time (s)			7.0		7.0	7.0
Flash Dont Walk (s)			8.0		14.0	14.0
Pedestrian Calls (#/hr)			0		0	0
Act Effct Green (s)		23.0	23.0		25.0	25.0
Actuated g/C Ratio		0.38	0.38		0.42	0.42
v/c Ratio		1.06	0.58		1.10	0.84
Control Delay		55.2	13.5		85.5	24.7
Queue Delay		0.0	0.0		0.0	0.0
Total Delay		55.2	13.5		85.5	24.7
LOS		E	B		F	C

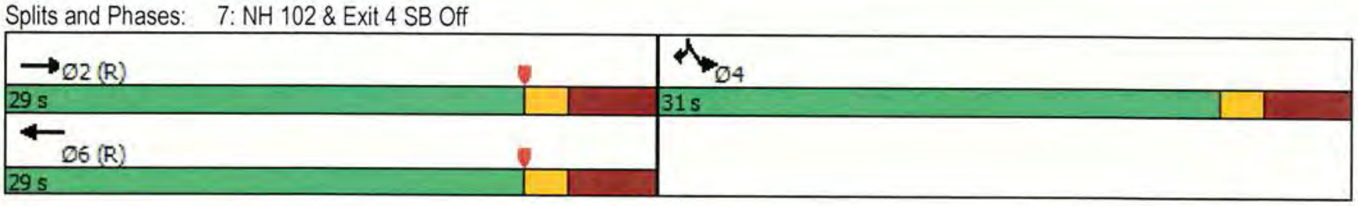
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Approach Delay		55.2	13.5		54.3	
Approach LOS		E	B		D	
Queue Length 50th (ft)		~332	95		~378	165
Queue Length 95th (ft)		m#347	m85		#566	#275
Internal Link Dist (ft)		632	308		132	
Turn Bay Length (ft)						
Base Capacity (vph)		1330	1305		804	1117
Starvation Cap Reductn		0	0		0	0
Spillback Cap Reductn		0	0		0	0
Storage Cap Reductn		0	0		0	0
Reduced v/c Ratio		1.06	0.58		1.10	0.84

Intersection Summary

Area Type: Other
Cycle Length: 60
Actuated Cycle Length: 60
Offset: 0 (0%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow, Master Intersection
Natural Cycle: 90
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 1.10
Intersection Signal Delay: 46.9 Intersection LOS: D
Intersection Capacity Utilization 92.1% ICU Level of Service F
Analysis Period (min) 15

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 7: NH 102 & Exit 4 SB Off



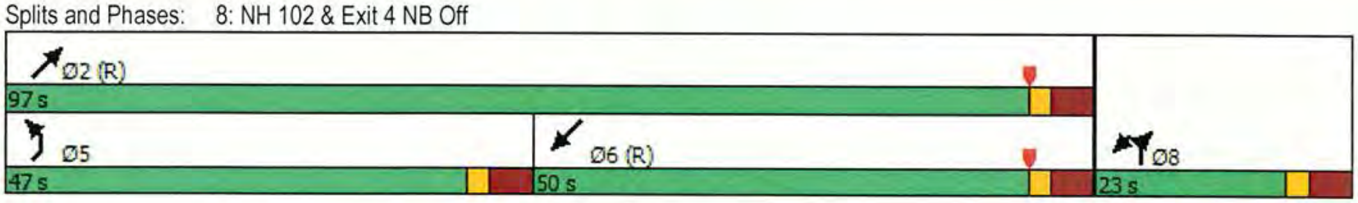
Lane Group	NBL2	NBL	NBR	SEL	SER	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations											
Traffic Volume (vph)	460	0	355	0	0	1190	915	0	0	1260	1125
Future Volume (vph)	460	0	355	0	0	1190	915	0	0	1260	1125
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)		0	0	0	0	550		0	0		0
Storage Lanes		2	2	0	0	2		0	0		1
Taper Length (ft)		25		25		25			25		
Lane Util. Factor	0.97	1.00	0.88	1.00	1.00	0.97	0.95	1.00	1.00	0.95	1.00
Frt			0.850								0.850
Flt Protected	0.950					0.950					
Satd. Flow (prot)	3242	0	2632	0	0	3335	3438	0	0	3505	1568
Flt Permitted	0.950					0.950					
Satd. Flow (perm)	3242	0	2632	0	0	3335	3438	0	0	3505	1568
Right Turn on Red			No					Yes			Yes
Satd. Flow (RTOR)											560
Link Speed (mph)		25		30			30			30	
Link Distance (ft)		856		390			760			857	
Travel Time (s)		23.3		8.9			17.3			19.5	
Peak Hour Factor	0.88	0.88	0.88	0.92	0.92	0.94	0.94	0.94	0.92	0.92	0.92
Heavy Vehicles (%)	8%	8%	8%	2%	2%	5%	5%	5%	3%	3%	3%
Adj. Flow (vph)	523	0	403	0	0	1266	973	0	0	1370	1223
Shared Lane Traffic (%)											
Lane Group Flow (vph)	523	0	403	0	0	1266	973	0	0	1370	1223
Turn Type	Prot		Prot			Prot	NA			NA	Free
Protected Phases	8		8			5	2			6	
Permitted Phases											Free
Detector Phase	8		2			5	2			6	
Switch Phase											
Minimum Initial (s)	10.0		10.0			5.0	8.0			8.0	
Minimum Split (s)	16.0		16.0			11.0	42.0			31.0	
Total Split (s)	23.0		23.0			47.0	97.0			50.0	
Total Split (%)	19.2%		19.2%			39.2%	80.8%			41.7%	
Maximum Green (s)	17.0		17.0			41.0	91.0			44.0	
Yellow Time (s)	2.0		2.0			2.0	2.0			2.0	
All-Red Time (s)	4.0		4.0			4.0	4.0			4.0	
Lost Time Adjust (s)	0.0		0.0			0.0	0.0			0.0	
Total Lost Time (s)	6.0		6.0			6.0	6.0			6.0	
Lead/Lag						Lead				Lag	
Lead-Lag Optimize?											
Vehicle Extension (s)	3.0		3.0			3.0	3.0			3.0	
Recall Mode	None		None			None	C-Min			C-Min	
Walk Time (s)							7.0			7.0	
Flash Dont Walk (s)							29.0			17.0	
Pedestrian Calls (#/hr)							0			0	
Act Effct Green (s)	17.0		17.0			41.0	91.0			44.0	120.0
Actuated g/C Ratio	0.14		0.14			0.34	0.76			0.37	1.00
v/c Ratio	1.14		1.08			1.11	0.37			1.07	0.78
Control Delay	132.3		119.1			84.7	5.7			81.8	3.9
Queue Delay	0.0		0.0			0.0	0.0			0.0	0.0

Lane Group	NBL2	NBL	NBR	SEL	SER	NEL	NET	NER	SWL	SWT	SWR
Total Delay	132.3		119.1			84.7	5.7			81.8	3.9
LOS	F		F			F	A			F	A
Approach Delay		126.5					50.4			45.1	
Approach LOS		F					D			D	
Queue Length 50th (ft)	~243		~198			~569	118			~616	0
Queue Length 95th (ft)	#342		#300			m#492	m107			#755	0
Internal Link Dist (ft)		776		310			680			777	
Turn Bay Length (ft)						550					
Base Capacity (vph)	459		372			1139	2607			1285	1568
Starvation Cap Reductn	0		0			0	0			0	0
Spillback Cap Reductn	0		0			0	0			0	0
Storage Cap Reductn	0		0			0	0			0	0
Reduced v/c Ratio	1.14		1.08			1.11	0.37			1.07	0.78

Intersection Summary

Area Type: Other
Cycle Length: 120
Actuated Cycle Length: 120
Offset: 13 (11%), Referenced to phase 2:NET and 6:SWT, Start of Yellow
Natural Cycle: 140
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 1.14
Intersection Signal Delay: 60.2 Intersection LOS: E
Intersection Capacity Utilization 97.9% ICU Level of Service F
Analysis Period (min) 15
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 8: NH 102 & Exit 4 NB Off



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑	↱	↰	↑↑					↰↰		↱
Traffic Volume (vph)	0	810	360	390	650	0	0	0	0	550	0	555
Future Volume (vph)	0	810	360	390	650	0	0	0	0	550	0	555
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		350	0		0	0		0	0		0
Storage Lanes	0		1	1		0	0		0	2		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	0.97	1.00	1.00
Frt			0.850									0.850
Flt Protected				0.950						0.950		
Satd. Flow (prot)	0	3167	1417	1687	3374	0	0	0	0	3303	0	1524
Flt Permitted				0.950						0.950		
Satd. Flow (perm)	0	3167	1417	1687	3374	0	0	0	0	3303	0	1524
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			326									155
Link Speed (mph)		30			30			30			35	
Link Distance (ft)		851			693			486			581	
Travel Time (s)		19.3			15.8			11.0			11.3	
Peak Hour Factor	0.92	0.92	0.92	0.73	0.73	0.73	0.92	0.92	0.92	0.74	0.74	0.74
Heavy Vehicles (%)	14%	14%	14%	7%	7%	7%	2%	2%	2%	6%	6%	6%
Adj. Flow (vph)	0	880	391	534	890	0	0	0	0	743	0	750
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	880	391	534	890	0	0	0	0	743	0	750
Turn Type		NA	Free	Prot	NA					Prot		Prot
Protected Phases		2		1	6					4		4
Permitted Phases			Free									
Detector Phase		2		1	6					4		4
Switch Phase												
Minimum Initial (s)		9.0		4.0	9.0					4.0		4.0
Minimum Split (s)		21.0		10.0	21.0					10.0		10.0
Total Split (s)		46.0		44.0	90.0					50.0		50.0
Total Split (%)		32.9%		31.4%	64.3%					35.7%		35.7%
Maximum Green (s)		40.0		38.0	84.0					44.0		44.0
Yellow Time (s)		4.0		4.0	4.0					4.0		4.0
All-Red Time (s)		2.0		2.0	2.0					2.0		2.0
Lost Time Adjust (s)		0.0		0.0	0.0					0.0		0.0
Total Lost Time (s)		6.0		6.0	6.0					6.0		6.0
Lead/Lag		Lag		Lead								
Lead-Lag Optimize?												
Vehicle Extension (s)		5.0		3.0	5.0					3.0		3.0
Recall Mode		C-Min		None	C-Min					None		None
Walk Time (s)		7.0			7.0							
Flash Dont Walk (s)		8.0			8.0							
Pedestrian Calls (#/hr)		0			0							
Act Effct Green (s)		40.0	140.0	38.0	84.0					44.0		44.0
Actuated g/C Ratio		0.29	1.00	0.27	0.60					0.31		0.31
v/c Ratio		0.97	0.28	1.17	0.44					0.72		1.28
Control Delay		73.4	0.5	111.0	1.8					47.1		171.4
Queue Delay		0.0	0.0	0.0	0.0					0.0		0.0

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Total Delay		73.4	0.5	111.0	1.8					47.1		171.4
LOS		E	A	F	A					D		F
Approach Delay		51.0			42.7						109.5	
Approach LOS		D			D						F	
Queue Length 50th (ft)		418	0	423	16					308		~765
Queue Length 95th (ft)		#558	0	m208	m13					295		#716
Internal Link Dist (ft)		771			613			406			501	
Turn Bay Length (ft)			350									
Base Capacity (vph)		904	1417	457	2024					1038		585
Starvation Cap Reductn		0	0	0	0					0		0
Spillback Cap Reductn		0	0	0	0					0		0
Storage Cap Reductn		0	0	0	0					0		0
Reduced v/c Ratio		0.97	0.28	1.17	0.44					0.72		1.28

Intersection Summary

Area Type: Other
Cycle Length: 140
Actuated Cycle Length: 140
Offset: 75 (54%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow
Natural Cycle: 140
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 1.28
Intersection Signal Delay: 69.1 Intersection LOS: E
Intersection Capacity Utilization 89.8% ICU Level of Service E
Analysis Period (min) 15
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 2: Exit 5 SB On/Exit 5 SB Off & NH 28

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑			↑↑	↱	↰		↱			
Traffic Volume (vph)	635	725	0	0	650	775	390	0	165	0	0	0
Future Volume (vph)	635	725	0	0	650	775	390	0	165	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt						0.850			0.850			
Flt Protected	0.950						0.950					
Satd. Flow (prot)	1641	3282	0	0	3438	1538	1656	0	1482	0	0	0
Flt Permitted	0.950						0.950					
Satd. Flow (perm)	1641	3282	0	0	3438	1538	1656	0	1482	0	0	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						635			165			
Link Speed (mph)		30			30			35			30	
Link Distance (ft)		693			542			867			392	
Travel Time (s)		15.8			12.3			16.9			8.9	
Peak Hour Factor	0.87	0.87	0.87	0.90	0.90	0.90	0.78	0.78	0.78	0.92	0.92	0.92
Heavy Vehicles (%)	10%	10%	10%	5%	5%	5%	9%	9%	9%	2%	2%	2%
Adj. Flow (vph)	730	833	0	0	722	861	500	0	212	0	0	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	730	833	0	0	722	861	500	0	212	0	0	0
Turn Type	Prot	NA			NA	Free	Prot		Prot			
Protected Phases	5	2			6		8		8			
Permitted Phases		2			6	Free						
Detector Phase	5	2			6		8		8			
Switch Phase												
Minimum Initial (s)	4.0	16.0			16.0		4.0		4.0			
Minimum Split (s)	10.0	23.0			23.0		10.0		10.0			
Total Split (s)	62.0	96.0			34.0		44.0		44.0			
Total Split (%)	44.3%	68.6%			24.3%		31.4%		31.4%			
Maximum Green (s)	56.0	90.0			28.0		38.0		38.0			
Yellow Time (s)	4.0	4.0			4.0		4.0		4.0			
All-Red Time (s)	2.0	2.0			2.0		2.0		2.0			
Lost Time Adjust (s)	0.0	0.0			0.0		0.0		0.0			
Total Lost Time (s)	6.0	6.0			6.0		6.0		6.0			
Lead/Lag	Lead				Lag							
Lead-Lag Optimize?												
Vehicle Extension (s)	5.0	5.0			5.0		3.0		3.0			
Recall Mode	None	C-Min			C-Min		None		None			
Walk Time (s)		7.0			7.0							
Flash Dont Walk (s)		10.0			10.0							
Pedestrian Calls (#/hr)		0			0							
Act Effct Green (s)	56.0	90.0			28.0	140.0	38.0		38.0			
Actuated g/C Ratio	0.40	0.64			0.20	1.00	0.27		0.27			
v/c Ratio	1.11	0.39			1.05	0.56	1.11		0.41			
Control Delay	71.9	0.6			101.6	1.5	123.6		13.1			
Queue Delay	0.4	0.0			0.0	0.0	0.0		0.0			
Total Delay	72.3	0.6			101.6	1.5	123.6		13.1			
LOS	E	A			F	A	F		B			
Approach Delay		34.1			47.1			90.7				

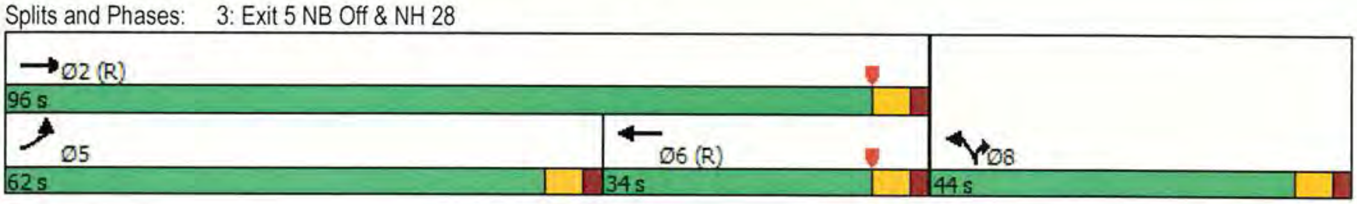
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach LOS		C			D			F				
Queue Length 50th (ft)	~291	2			~376	0	~520		32			
Queue Length 95th (ft)	m#267	m2			#504	0	#588		68			
Internal Link Dist (ft)		613			462			787			312	
Turn Bay Length (ft)												
Base Capacity (vph)	656	2109			687	1538	449		522			
Starvation Cap Reductn	38	0			0	0	0		0			
Spillback Cap Reductn	0	0			0	0	0		0			
Storage Cap Reductn	0	0			0	0	0		0			
Reduced v/c Ratio	1.18	0.39			1.05	0.56	1.11		0.41			

Intersection Summary

Area Type: Other
Cycle Length: 140
Actuated Cycle Length: 140
Offset: 0 (0%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow, Master Intersection
Natural Cycle: 140
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 1.11
Intersection Signal Delay: 49.9 Intersection LOS: D
Intersection Capacity Utilization 89.8% ICU Level of Service E
Analysis Period (min) 15

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 3: Exit 5 NB Off & NH 28



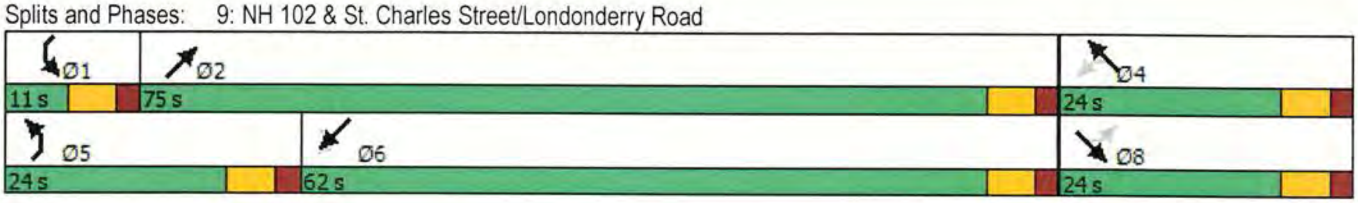
Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	5	0	240	0	0	0	250	690	5	5	1755	5
Future Volume (vph)	5	0	240	0	0	0	250	690	5	5	1755	5
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		225	0		0	350		0	100		0
Storage Lanes	0		1	0		0	1		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00	0.95	0.95
Frt			0.850					0.999				
Flt Protected		0.950					0.950			0.950		
Satd. Flow (prot)	0	1770	1583	0	1900	0	1770	3536	0	1770	3539	0
Flt Permitted							0.950			0.950		
Satd. Flow (perm)	0	1863	1583	0	1900	0	1770	3536	0	1770	3539	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			261					1				
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		593			447			750			330	
Travel Time (s)		13.5			10.2			17.0			7.5	
Peak Hour Factor	0.92	0.92	0.92	0.25	0.25	0.25	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	2%	2%	2%	0%	0%	0%	2%	2%	2%	2%	2%	2%
Adj. Flow (vph)	5	0	261	0	0	0	272	750	5	5	1908	5
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	5	261	0	0	0	272	755	0	5	1913	0
Turn Type	Perm	NA	custom				Prot	NA		Prot	NA	
Protected Phases		8			4		5	2		1	6	
Permitted Phases	8		6	4								
Detector Phase	8	8	6	4	4		5	2		1	6	
Switch Phase												
Minimum Initial (s)	5.0	5.0	8.0	5.0	5.0		5.0	8.0		5.0	8.0	
Minimum Split (s)	24.0	24.0	24.0	24.0	24.0		24.0	24.0		11.0	24.0	
Total Split (s)	24.0	24.0	62.0	24.0	24.0		24.0	75.0		11.0	62.0	
Total Split (%)	21.8%	21.8%	56.4%	21.8%	21.8%		21.8%	68.2%		10.0%	56.4%	
Maximum Green (s)	18.0	18.0	56.0	18.0	18.0		18.0	69.0		5.0	56.0	
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)		0.0	0.0		0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)		6.0	6.0		6.0		6.0	6.0		6.0	6.0	
Lead/Lag			Lag				Lead	Lag		Lead	Lag	
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None	Min	None	None		None	Min		None	Min	
Walk Time (s)	7.0	7.0	7.0	7.0	7.0		7.0	7.0			7.0	
Flash Dont Walk (s)	11.0	11.0	11.0	11.0	11.0		11.0	11.0			11.0	
Pedestrian Calls (#/hr)	0	0	0	0	0		0	0			0	
Act Effct Green (s)		6.1	56.2				17.7	82.9		5.0	56.2	
Actuated g/C Ratio		0.07	0.64				0.20	0.94		0.06	0.64	
v/c Ratio		0.04	0.24				0.77	0.23		0.05	0.85	
Control Delay		41.2	1.7				50.1	1.8		43.0	18.6	
Queue Delay		0.0	0.0				0.0	0.0		0.0	0.0	

Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Total Delay		41.2	1.7				50.1	1.8		43.0	18.6	
LOS		D	A				D	A		D	B	
Approach Delay		2.5						14.6			18.6	
Approach LOS		A						B			B	
Queue Length 50th (ft)		3	0				138	0		3	365	
Queue Length 95th (ft)		15	33				#305	110		15	#772	
Internal Link Dist (ft)		513			367			670			250	
Turn Bay Length (ft)			225				350			100		
Base Capacity (vph)		381	1102				362	3322		100	2253	
Starvation Cap Reductn		0	0				0	0		0	0	
Spillback Cap Reductn		0	0				0	0		0	0	
Storage Cap Reductn		0	0				0	0		0	0	
Reduced v/c Ratio		0.01	0.24				0.75	0.23		0.05	0.85	

Intersection Summary	
Area Type: Other	
Cycle Length: 110	
Actuated Cycle Length: 88.2	
Natural Cycle: 110	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.85	
Intersection Signal Delay: 16.0	Intersection LOS: B
Intersection Capacity Utilization 85.5%	ICU Level of Service E
Analysis Period (min) 15	

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 9: NH 102 & St. Charles Street/Londonderry Road



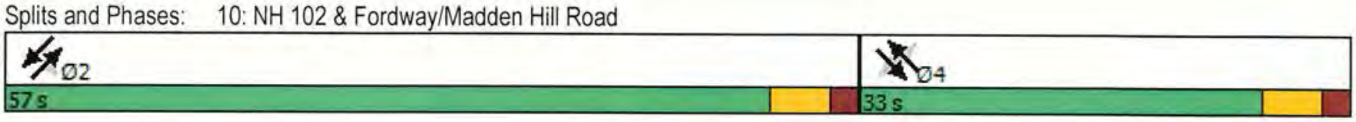
Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	0	15	5	345	0	35	0	453	180	5	790	0
Future Volume (vph)	0	15	5	345	0	35	0	453	180	5	790	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.967			0.988			0.962				
Flt Protected					0.957							
Satd. Flow (prot)	0	1801	0	0	1744	0	0	1692	0	0	1810	0
Flt Permitted					0.722						0.996	
Satd. Flow (perm)	0	1801	0	0	1316	0	0	1692	0	0	1802	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		8			36			37				
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		356			493			1124			603	
Travel Time (s)		8.1			11.2			25.5			13.7	
Peak Hour Factor	0.60	0.60	0.60	0.96	0.96	0.96	0.89	0.89	0.89	0.86	0.86	0.86
Heavy Vehicles (%)	2%	2%	2%	3%	3%	3%	8%	8%	8%	5%	5%	5%
Adj. Flow (vph)	0	25	8	359	0	36	0	509	202	6	919	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	33	0	0	395	0	0	711	0	0	925	0
Turn Type		NA		Perm	NA			NA		Perm	NA	
Protected Phases		4			4			2			2	
Permitted Phases	4			4						2		
Detector Phase	4	4		4	4			2		2	2	
Switch Phase												
Minimum Initial (s)	5.0	5.0		5.0	5.0			5.0		5.0	5.0	
Minimum Split (s)	24.0	24.0		24.0	24.0			24.0		24.0	24.0	
Total Split (s)	33.0	33.0		33.0	33.0			57.0		57.0	57.0	
Total Split (%)	36.7%	36.7%		36.7%	36.7%			63.3%		63.3%	63.3%	
Maximum Green (s)	27.0	27.0		27.0	27.0			51.0		51.0	51.0	
Yellow Time (s)	4.0	4.0		4.0	4.0			4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0			2.0		2.0	2.0	
Lost Time Adjust (s)		0.0			0.0			0.0			0.0	
Total Lost Time (s)		6.0			6.0			6.0			6.0	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0		3.0	3.0	
Recall Mode	None	None		None	None			Min		Min	Min	
Walk Time (s)	7.0	7.0		7.0	7.0			7.0		7.0	7.0	
Flash Dont Walk (s)	11.0	11.0		11.0	11.0			11.0		11.0	11.0	
Pedestrian Calls (#/hr)	0	0		0	0			0		0	0	
Act Effct Green (s)		26.1			26.1			49.2			49.2	
Actuated g/C Ratio		0.30			0.30			0.56			0.56	
v/c Ratio		0.06			0.94			0.73			0.91	
Control Delay		18.9			61.7			19.1			32.3	
Queue Delay		0.0			0.0			0.0			0.0	
Total Delay		18.9			61.7			19.1			32.3	
LOS		B			E			B			C	
Approach Delay		18.9			61.7			19.1			32.3	

Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Approach LOS		B			E			B			C	
Queue Length 50th (ft)		10			201			264			437	
Queue Length 95th (ft)		20			#384			399			#665	
Internal Link Dist (ft)		276			413			1044			523	
Turn Bay Length (ft)												
Base Capacity (vph)		564			434			1007			1057	
Starvation Cap Reductn		0			0			0			0	
Spillback Cap Reductn		0			0			0			0	
Storage Cap Reductn		0			0			0			0	
Reduced v/c Ratio		0.06			0.91			0.71			0.88	

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 87.3
Natural Cycle: 90
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.94
Intersection Signal Delay: 33.2 Intersection LOS: C
Intersection Capacity Utilization 86.1% ICU Level of Service E
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 10: NH 102 & Fordway/Madden Hill Road



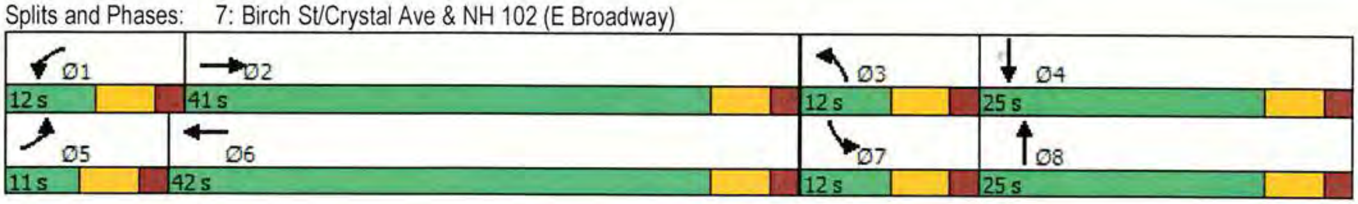
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↱		↰	↱		↰	↑	↱
Traffic Volume (vph)	80	235	90	35	520	80	90	160	40	70	125	115
Future Volume (vph)	80	235	90	35	520	80	90	160	40	70	125	115
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	12	12	12	12	12	12	12	12
Grade (%)		0%			0%			0%			0%	
Storage Length (ft)	0		0	0		0	0		0	0		0
Storage Lanes	1		0	1		0	1		0	1		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.958			0.980			0.970				0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1656	1670	0	1703	1757	0	1719	1755	0	1703	1792	1524
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1656	1670	0	1703	1757	0	1719	1755	0	1703	1792	1524
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		25			10			13				182
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		505			530			361			411	
Travel Time (s)		11.5			12.0			8.2			9.3	
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.96	0.96	0.96	0.94	0.94	0.94	0.85	0.85	0.85	0.91	0.91	0.91
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	9%	9%	9%	6%	6%	6%	5%	5%	5%	6%	6%	6%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)			0									
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	83	245	94	37	553	85	106	188	47	77	137	126
Shared Lane Traffic (%)												
Lane Group Flow (vph)	83	339	0	37	638	0	106	235	0	77	137	126
Turn Type	Prot	NA		Prot	NA		Prot	NA		Prot	NA	Perm
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases												4
Detector Phase	5	2		1	6		3	8		7	4	4
Switch Phase												
Minimum Initial (s)	4.0	5.0		4.0	10.0		4.0	10.0		4.0	9.0	9.0
Minimum Split (s)	10.0	30.0		10.0	30.0		10.0	25.0		10.0	25.0	25.0
Total Split (s)	11.0	41.0		12.0	42.0		12.0	25.0		12.0	25.0	25.0
Total Split (%)	12.2%	45.6%		13.3%	46.7%		13.3%	27.8%		13.3%	27.8%	27.8%
Maximum Green (s)	5.0	35.0		6.0	36.0		6.0	19.0		6.0	19.0	19.0
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	6.0
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lag		Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes	Yes
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Minimum Gap (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Time Before Reduce (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Time To Reduce (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Recall Mode	None	Min		None	Min		Min	None		Min	None	None
Walk Time (s)		7.0			7.0			7.0			7.0	7.0
Flash Dont Walk (s)		11.0			11.0			11.0			11.0	11.0
Pedestrian Calls (#/hr)		10			10			0			10	10
Act Effct Green (s)	5.1	37.3		5.9	32.9		6.1	15.3		6.1	15.3	15.3
Actuated g/C Ratio	0.06	0.45		0.07	0.39		0.07	0.18		0.07	0.18	0.18
v/c Ratio	0.83	0.45		0.31	0.92		0.85	0.71		0.63	0.42	0.29
Control Delay	97.8	19.2		46.5	44.1		92.7	43.1		63.9	35.0	3.4
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Total Delay	97.8	19.2		46.5	44.1		92.7	43.1		63.9	35.0	3.4
LOS	F	B		D	D		F	D		E	C	A
Approach Delay		34.7			44.2			58.6			29.8	
Approach LOS		C			D			E			C	
Queue Length 50th (ft)	46	125		20	309		59	115		42	67	0
Queue Length 95th (ft)	#136	215		51	#545		#148	179		#113	121	17
Internal Link Dist (ft)		425			450			281			331	
Turn Bay Length (ft)												
Base Capacity (vph)	100	758		123	770		124	412		123	411	490
Starvation Cap Reductn	0	0		0	0		0	0		0	0	0
Spillback Cap Reductn	0	0		0	0		0	0		0	0	0
Storage Cap Reductn	0	0		0	0		0	0		0	0	0
Reduced v/c Ratio	0.83	0.45		0.30	0.83		0.85	0.57		0.63	0.33	0.26

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 83.6
Natural Cycle: 90
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.92
Intersection Signal Delay: 42.0   Intersection LOS: D
Intersection Capacity Utilization 71.4%   ICU Level of Service C
Analysis Period (min) 15
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 7: Birch St/Crystal Ave & NH 102 (E Broadway)



Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	0	150	120	295	160	0	65	275	0	135	530	295
Future Volume (vph)	0	150	120	295	160	0	65	275	0	135	530	295
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	12	12	12	12	12	12	12	12
Grade (%)		0%			0%			0%			0%	
Storage Length (ft)	150		150	0		0	0		0	0		0
Storage Lanes	1		1	2		1	1		1	1		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt			0.850									0.850
Flt Protected				0.950			0.950			0.950		
Satd. Flow (prot)	1827	3471	1553	3335	3438	1810	1752	1845	1845	1752	1845	1568
Flt Permitted				0.950			0.950			0.950		
Satd. Flow (perm)	1827	3471	1553	3335	3438	1810	1752	1845	1845	1752	1845	1568
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			255									298
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		639			394			532			387	
Travel Time (s)		14.5			9.0			12.1			8.8	
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.84	0.84	0.84	0.79	0.79	0.79	0.86	0.86	0.86	0.99	0.99	0.99
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	4%	4%	4%	5%	5%	5%	3%	3%	3%	3%	3%	3%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	0	179	143	373	203	0	76	320	0	136	535	298
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	179	143	373	203	0	76	320	0	136	535	298
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		24			24			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	2	1	1	2	1	1	2	1	1	2	1
Detector Template	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Leading Detector (ft)	20	100	20	20	100	20	20	100	20	20	100	20
Trailing Detector (ft)	0	0	0	0	0	0	0	0	0	0	0	0
Turn Type	Prot	NA	Perm	Prot	NA	Perm	Prot	NA	Free	Prot	NA	pt+ov
Protected Phases	5	2		1	6		7	4		3	8	8 1
Permitted Phases		2	2		6	6		4	Free		8	
Detector Phase	5	2	2	1	6	6	7	4		3	8	8 1
Switch Phase												

Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Minimum Initial (s)	8.0	8.0	8.0	8.0	8.0	8.0	6.0	8.0		7.0	8.0	
Minimum Split (s)	14.0	31.0	31.0	14.0	40.0	40.0	12.0	21.0		13.0	21.0	
Total Split (s)	14.0	33.0	33.0	22.0	41.0	41.0	12.0	22.0		13.0	23.0	
Total Split (%)	15.6%	36.7%	36.7%	24.4%	45.6%	45.6%	13.3%	24.4%		14.4%	25.6%	
Maximum Green (s)	8.0	27.0	27.0	16.0	35.0	35.0	6.0	16.0		7.0	17.0	
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0		2.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag		Lead	Lag	
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Minimum Gap (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Time Before Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Time To Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Recall Mode	Max	C-Max	C-Max	None	Max	Max	None	None		None	None	
Walk Time (s)		5.0	5.0		5.0	5.0		5.0			5.0	
Flash Dont Walk (s)		10.0	10.0		10.0	10.0		10.0			10.0	
Pedestrian Calls (#/hr)		0	0		0	0		0			0	
Act Effct Green (s)		28.6	28.6	14.4	35.0		6.0	16.0		7.0	19.4	39.8
Actuated g/C Ratio		0.32	0.32	0.16	0.39		0.07	0.18		0.08	0.22	0.44
v/c Ratio		0.16	0.21	0.70	0.15		0.66	0.98		1.00	1.35	0.35
Control Delay		23.1	0.7	51.0	9.6		68.3	82.9		122.0	204.2	3.2
Queue Delay		0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	0.0
Total Delay		23.1	0.7	51.0	9.6		68.3	82.9		122.0	204.2	3.2
LOS		C	A	D	A		E	F		F	F	A
Approach Delay		13.2			36.4			80.1			130.9	
Approach LOS		B			D			F			F	
Queue Length 50th (ft)		38	0	120	25		43	183		79	~431	0
Queue Length 95th (ft)		60	0	112	3		#102	#324		#195	#626	45
Internal Link Dist (ft)		559			314			452			307	
Turn Bay Length (ft)			150									
Base Capacity (vph)		1104	668	592	1337		116	328		136	397	882
Starvation Cap Reductn		0	0	0	0		0	0		0	0	0
Spillback Cap Reductn		0	0	0	0		0	0		0	0	0
Storage Cap Reductn		0	0	0	0		0	0		0	0	0
Reduced v/c Ratio		0.16	0.21	0.63	0.15		0.66	0.98		1.00	1.35	0.34

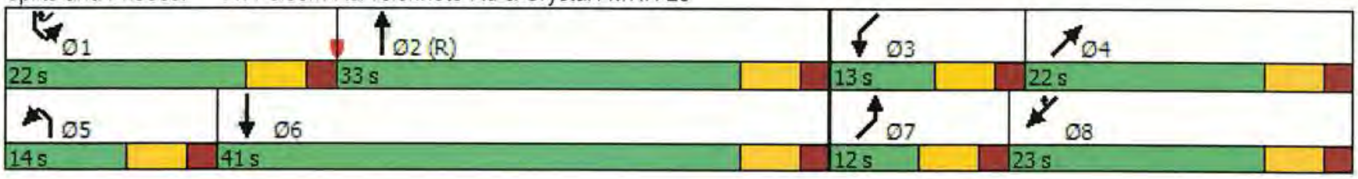
Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 90
Offset: 0 (0%), Referenced to phase 2:NBT, Start of Green
Natural Cycle: 100
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 1.35
Intersection Signal Delay: 81.2 Intersection LOS: F
Intersection Capacity Utilization 68.0% ICU Level of Service C
Analysis Period (min) 15

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 11: Folsom Rd/Tsienneto Rd & Crystal Av/NH 28



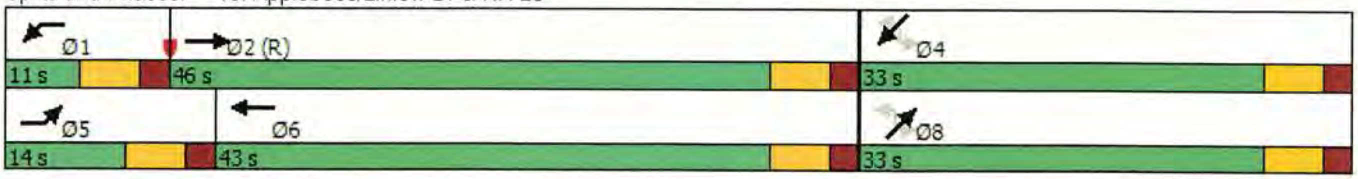
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations	↰	↑↱		↰	↑↱			↰↑	↱		↰↑	↱
Traffic Volume (vph)	45	595	0	0	465	30	0	0	0	25	0	400
Future Volume (vph)	45	595	0	0	465	30	0	0	0	25	0	400
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	12	12	12	12	12	12	12	12
Grade (%)		0%			0%			0%			0%	
Storage Length (ft)	75		0	150		150	0		0	0		0
Storage Lanes	1		0	1		0	0		1	0		1
Taper Length (ft)	50			25			25			25		
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt					0.991							0.850
Flt Protected	0.950										0.950	
Satd. Flow (prot)	1687	3374	0	1863	3507	0	0	1900	1900	0	1787	1599
Flt Permitted	0.950										0.757	
Satd. Flow (perm)	1687	3374	0	1863	3507	0	0	1900	1900	0	1424	1599
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)					9							323
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		277			755			218			433	
Travel Time (s)		6.3			17.2			5.0			9.8	
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.83	0.83	0.83	0.92	0.92	0.92	0.50	0.50	0.50	0.90	0.90	0.90
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	7%	7%	7%	2%	2%	2%	0%	0%	0%	1%	1%	1%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	54	717	0	0	505	33	0	0	0	28	0	444
Shared Lane Traffic (%)												
Lane Group Flow (vph)	54	717	0	0	538	0	0	0	0	0	28	444
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			0			0	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	2		1	2		1	2	1	1	2	1
Detector Template	Left	Thru		Left	Thru		Left	Thru	Right	Left	Thru	Right
Leading Detector (ft)	20	100		20	100		20	100	20	20	100	20
Trailing Detector (ft)	0	0		0	0		0	0	0	0	0	0
Turn Type	Prot	NA		Prot	NA				Perm	Perm	NA	Perm
Protected Phases	5	2		1	6			8			4	
Permitted Phases					6		8	8	8	4		4
Detector Phase	5	2		1	6		8	8	8	4	4	4
Switch Phase												

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Minimum Initial (s)	8.0	8.0		5.0	8.0		5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	14.0	46.0		11.0	43.0		33.0	33.0	33.0	33.0	33.0	33.0
Total Split (s)	14.0	46.0		11.0	43.0		33.0	33.0	33.0	33.0	33.0	33.0
Total Split (%)	15.6%	51.1%		12.2%	47.8%		36.7%	36.7%	36.7%	36.7%	36.7%	36.7%
Maximum Green (s)	8.0	40.0		5.0	37.0		27.0	27.0	27.0	27.0	27.0	27.0
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0			0.0	0.0		0.0	0.0
Total Lost Time (s)	6.0	6.0		6.0	6.0			6.0	6.0		6.0	6.0
Lead/Lag	Lead	Lag		Lead	Lag							
Lead-Lag Optimize?	Yes	Yes		Yes	Yes							
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Minimum Gap (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Time Before Reduce (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Time To Reduce (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Recall Mode	None	C-Max		None	None		None	None	None	None	None	None
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effct Green (s)	8.4	62.9			54.1						15.1	15.1
Actuated g/C Ratio	0.09	0.70			0.60						0.17	0.17
v/c Ratio	0.35	0.30			0.25						0.12	0.83
Control Delay	44.8	8.9			15.0						28.3	22.9
Queue Delay	0.0	0.0			0.0						0.0	0.0
Total Delay	44.8	8.9			15.0						28.3	22.9
LOS	D	A			B						C	C
Approach Delay		11.4			15.0						23.3	
Approach LOS		B			B						C	
Queue Length 50th (ft)	32	52			101						14	63
Queue Length 95th (ft)	66	214			175						31	152
Internal Link Dist (ft)		197			675			138			353	
Turn Bay Length (ft)	75											
Base Capacity (vph)	156	2356			2111						427	705
Starvation Cap Reductn	0	0			0						0	0
Spillback Cap Reductn	0	0			0						0	0
Storage Cap Reductn	0	0			0						0	0
Reduced v/c Ratio	0.35	0.30			0.25						0.07	0.63

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 90
Offset: 63 (70%), Referenced to phase 2:EBT, Start of Green
Natural Cycle: 90
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.83
Intersection Signal Delay: 15.6 Intersection LOS: B
Intersection Capacity Utilization 48.6% ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 13: Applebees/Linlew Dr & NH 28



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰↰	↑↱		↰	↑↱		↰	↱		↰	↰↑	↱
Traffic Volume (vph)	105	630	5	5	405	215	10	5	5	180	5	100
Future Volume (vph)	105	630	5	5	405	215	10	5	5	180	5	100
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	12	12	12	12	12	12	12	12
Grade (%)		0%			0%			0%			0%	
Storage Length (ft)	150		150	150		150	0		0	0		0
Storage Lanes	2		0	1		0	1		0	1		1
Taper Length (ft)	200			25			25			25		
Lane Util. Factor	0.97	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	0.95	0.95	1.00
Ped Bike Factor												
Frt		0.999			0.948			0.925				0.850
Flt Protected	0.950			0.950			0.950			0.950	0.955	
Satd. Flow (prot)	3303	3402	0	1736	3291	0	1805	1758	0	1665	1674	1568
Flt Permitted	0.950			0.950			0.950			0.950	0.955	
Satd. Flow (perm)	3303	3402	0	1736	3291	0	1805	1758	0	1665	1674	1568
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		1			151			7				111
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		412			486			151			343	
Travel Time (s)		9.4			11.0			3.4			7.8	
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.83	0.83	0.83	0.97	0.97	0.97	0.67	0.67	0.67	0.90	0.90	0.90
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	6%	6%	6%	4%	4%	4%	0%	0%	0%	3%	3%	3%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	127	759	6	5	418	222	15	7	7	200	6	111
Shared Lane Traffic (%)										49%		
Lane Group Flow (vph)	127	765	0	5	640	0	15	14	0	102	104	111
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		24			24			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	2		1	2		1	2		1	2	1
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	Right
Leading Detector (ft)	20	100		20	100		20	100		20	100	20
Trailing Detector (ft)	0	0		0	0		0	0		0	0	0
Turn Type	Prot	NA		Prot	NA		Split	NA		Split	NA	pt+ov
Protected Phases	5	2		1	6		3	3		4	4	4 5
Permitted Phases								3				
Detector Phase	5	2		1	6		3	3		4	4	4 5
Switch Phase												

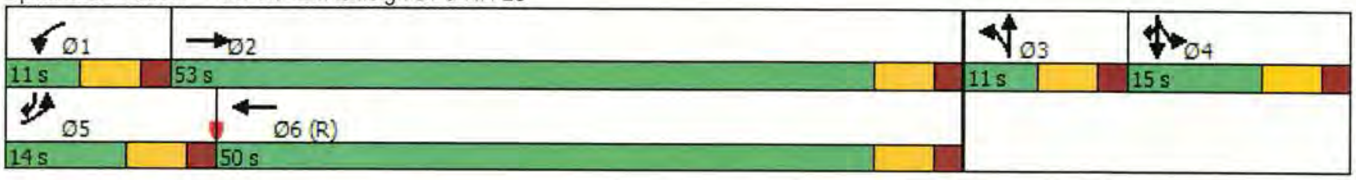
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Minimum Initial (s)	5.0	8.0		5.0	8.0		5.0	5.0		8.0	8.0	
Minimum Split (s)	14.0	53.0		11.0	50.0		11.0	11.0		15.0	15.0	
Total Split (s)	14.0	53.0		11.0	50.0		11.0	11.0		15.0	15.0	
Total Split (%)	15.6%	58.9%		12.2%	55.6%		12.2%	12.2%		16.7%	16.7%	
Maximum Green (s)	8.0	47.0		5.0	44.0		5.0	5.0		9.0	9.0	
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lead		Lag	Lag	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Minimum Gap (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Time Before Reduce (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Time To Reduce (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Recall Mode	None	Min		None	C-Min		None	None		None	None	
Walk Time (s)		5.0			5.0		5.0	5.0		5.0	5.0	
Flash Dont Walk (s)		11.0			11.0		11.0	11.0		11.0	11.0	
Pedestrian Calls (#/hr)		0			0		0	0		0	0	
Act Effct Green (s)	8.8	56.3		5.9	44.0		6.3	6.3		11.5	11.5	26.3
Actuated g/C Ratio	0.10	0.63		0.07	0.49		0.07	0.07		0.13	0.13	0.29
v/c Ratio	0.39	0.36		0.04	0.38		0.12	0.11		0.48	0.49	0.21
Control Delay	41.3	11.5		46.8	8.4		40.8	30.0		43.5	43.7	5.2
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Total Delay	41.3	11.5		46.8	8.4		40.8	30.0		43.5	43.7	5.2
LOS	D	B		D	A		D	C		D	D	A
Approach Delay		15.7			8.7			35.6			30.1	
Approach LOS		B			A			D			C	
Queue Length 50th (ft)	35	105		3	53		8	4		57	58	0
Queue Length 95th (ft)	56	206		m8	77		20	16		104	106	33
Internal Link Dist (ft)		332			406			71			263	
Turn Bay Length (ft)	150			150								
Base Capacity (vph)	336	2212		113	1856		127	130		215	216	525
Starvation Cap Reductn	0	0		0	0		0	0		0	0	0
Spillback Cap Reductn	0	0		0	0		0	0		0	0	0
Storage Cap Reductn	0	0		0	0		0	0		0	0	0
Reduced v/c Ratio	0.38	0.35		0.04	0.34		0.12	0.11		0.47	0.48	0.21

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 90
Offset: 0 (0%), Referenced to phase 6:WBT, Start of Green
Natural Cycle: 90
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.49
Intersection Signal Delay: 16.0 Intersection LOS: B
Intersection Capacity Utilization 49.0% ICU Level of Service A
Analysis Period (min) 15

m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 14: VIP Dr/Ashleigh Dr & NH 28



Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations	↰	↑↱		↰	↑	↱	↰	↑↱		↰	↑↱	
Traffic Volume (vph)	100	55	20	20	55	270	85	230	80	75	415	55
Future Volume (vph)	100	55	20	20	55	270	85	230	80	75	415	55
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	12	12	12	12	12	12	12	12
Grade (%)		0%			0%			0%			0%	
Storage Length (ft)	150		150	150		150	150		150	150		150
Storage Lanes	1		0	1		1	1		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.960				0.850		0.961			0.982	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1752	1771	0	1736	1827	1553	1770	1790	0	1787	1847	0
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1752	1771	0	1736	1827	1553	1770	1790	0	1787	1847	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		20				148		23			9	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		481			347			479			371	
Travel Time (s)		10.9			7.9			10.9			8.4	
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.82	0.82	0.82	0.81	0.81	0.81	0.68	0.68	0.68	0.78	0.78	0.78
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	3%	3%	3%	4%	4%	4%	2%	2%	2%	1%	1%	1%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	122	67	24	25	68	333	125	338	118	96	532	71
Shared Lane Traffic (%)												
Lane Group Flow (vph)	122	91	0	25	68	333	125	456	0	96	603	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	2		1	2	1	1	2		1	2	
Detector Template	Left	Thru		Left	Thru	Right	Left	Thru		Left	Thru	
Leading Detector (ft)	20	100		20	100	20	20	100		20	100	
Trailing Detector (ft)	0	0		0	0	0	0	0		0	0	
Turn Type	Prot	NA		Prot	NA	pt+ov	Prot	NA		Prot	NA	
Protected Phases	1	6		5	2	2 3	3	8		7	4	
Permitted Phases												
Detector Phase	1	6		5	2	2 3	3	8		7	4	
Switch Phase												

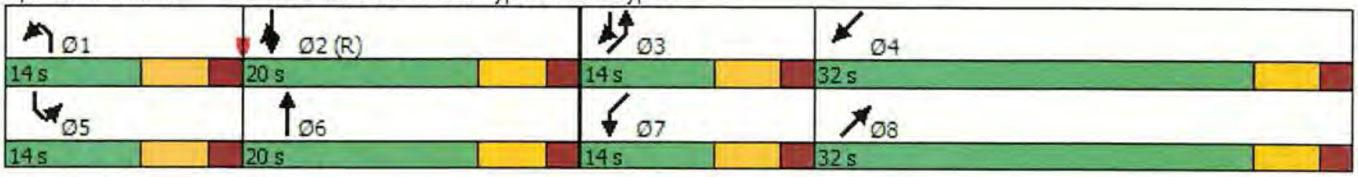
Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Minimum Initial (s)	8.0	8.0		8.0	8.0		8.0	8.0		8.0	8.0	
Minimum Split (s)	14.0	20.0		14.0	20.0		14.0	20.0		14.0	20.0	
Total Split (s)	14.0	20.0		14.0	20.0		14.0	32.0		14.0	32.0	
Total Split (%)	17.5%	25.0%		17.5%	25.0%		17.5%	40.0%		17.5%	40.0%	
Maximum Green (s)	8.0	14.0		8.0	14.0		8.0	26.0		8.0	26.0	
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lag		Lead	Lag	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Minimum Gap (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Time Before Reduce (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Time To Reduce (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Recall Mode	None	None		None	C-Max		None	None		None	None	
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effct Green (s)	8.0	22.4		8.0	14.0	28.0	8.0	28.8		8.0	26.0	
Actuated g/C Ratio	0.10	0.28		0.10	0.18	0.35	0.10	0.36		0.10	0.32	
v/c Ratio	0.70	0.18		0.14	0.21	0.52	0.71	0.69		0.54	1.00	
Control Delay	57.5	21.6		35.1	30.3	14.5	58.0	28.9		46.3	64.3	
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Total Delay	57.5	21.6		35.1	30.3	14.5	58.0	28.9		46.3	64.3	
LOS	E	C		D	C	B	E	C		D	E	
Approach Delay		42.2			18.2			35.2			61.8	
Approach LOS		D			B			D			E	
Queue Length 50th (ft)	60	24		12	29	67	62	193		46	293	
Queue Length 95th (ft)	#119	64		31	58	118	86	202		80	#399	
Internal Link Dist (ft)		401			267			399			291	
Turn Bay Length (ft)	150			150		150	150			150		
Base Capacity (vph)	175	510		173	319	639	177	659		178	606	
Starvation Cap Reductn	0	0		0	0	0	0	0		0	0	
Spillback Cap Reductn	0	0		0	0	0	0	0		0	0	
Storage Cap Reductn	0	0		0	0	0	0	0		0	0	
Reduced v/c Ratio	0.70	0.18		0.14	0.21	0.52	0.71	0.69		0.54	1.00	

Intersection Summary

Area Type: Other
Cycle Length: 80
Actuated Cycle Length: 80
Offset: 0 (0%), Referenced to phase 2:SBT, Start of Green
Natural Cycle: 80
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 1.00
Intersection Signal Delay: 41.9 — Intersection LOS: D
Intersection Capacity Utilization 63.6% — ICU Level of Service B
Analysis Period (min) 15

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 18: Tsienneto Rd & NH 28 Byp S/NH 28 Byp N



APPENDIX N-4: 2040 NO-BUILD INTERSECTION CAPACITY ANALYSES – SYNCHRO PRINTOUTS – PM PEAK HOUR

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑↑		↰	↱↱
Traffic Volume (vph)	0	1260	1320	0	925	1175
Future Volume (vph)	0	1260	1320	0	925	1175
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	16	12
Lane Util. Factor	1.00	0.95	0.95	1.00	1.00	0.88
Frt						0.850
Flt Protected					0.950	
Satd. Flow (prot)	0	3471	3406	0	1930	2682
Flt Permitted					0.950	
Satd. Flow (perm)	0	3471	3406	0	1930	2682
Right Turn on Red				Yes		No
Satd. Flow (RTOR)						
Link Speed (mph)		30	30		25	
Link Distance (ft)		712	388		212	
Travel Time (s)		16.2	8.8		5.8	
Peak Hour Factor	0.93	0.93	0.88	0.88	0.89	0.89
Heavy Vehicles (%)	4%	4%	6%	6%	6%	6%
Adj. Flow (vph)	0	1355	1500	0	1039	1320
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	1355	1500	0	1039	1320
Turn Type		NA	NA		Prot	Prot
Protected Phases		2	6		4	4
Permitted Phases						
Detector Phase		2	6		4	4
Switch Phase						
Minimum Initial (s)		8.0	8.0		5.0	5.0
Minimum Split (s)		14.0	21.0		27.0	27.0
Total Split (s)		27.0	27.0		33.0	33.0
Total Split (%)		45.0%	45.0%		55.0%	55.0%
Maximum Green (s)		21.0	21.0		27.0	27.0
Yellow Time (s)		2.0	2.0		2.0	2.0
All-Red Time (s)		4.0	4.0		4.0	4.0
Lost Time Adjust (s)		0.0	0.0		0.0	0.0
Total Lost Time (s)		6.0	6.0		6.0	6.0
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)		3.0	3.0		3.0	3.0
Recall Mode		C-Min	C-Min		None	None
Walk Time (s)			7.0		7.0	7.0
Flash Dont Walk (s)			8.0		14.0	14.0
Pedestrian Calls (#/hr)			0		0	0
Act Effct Green (s)		21.0	21.0		27.0	27.0
Actuated g/C Ratio		0.35	0.35		0.45	0.45
v/c Ratio		1.12	1.26		1.20	1.09
Control Delay		87.7	146.0		120.4	75.5
Queue Delay		0.0	0.0		0.0	0.0
Total Delay		87.7	146.0		120.4	75.5
LOS		F	F		F	E

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Approach Delay		87.7	146.0		95.3	
Approach LOS		F	F		F	
Queue Length 50th (ft)		~403	~828		~471	~317
Queue Length 95th (ft)		m#656	m#654		#667	#435
Internal Link Dist (ft)		632	308		132	
Turn Bay Length (ft)						
Base Capacity (vph)		1214	1192		868	1206
Starvation Cap Reductn		0	0		0	0
Spillback Cap Reductn		0	0		0	0
Storage Cap Reductn		0	0		0	0
Reduced v/c Ratio		1.12	1.26		1.20	1.09

Intersection Summary

Area Type: Other

Cycle Length: 60

Actuated Cycle Length: 60

Offset: 0 (0%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow, Master Intersection

Natural Cycle: 140

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 1.26

Intersection Signal Delay: 107.9 Intersection LOS: F

Intersection Capacity Utilization 99.7% ICU Level of Service F

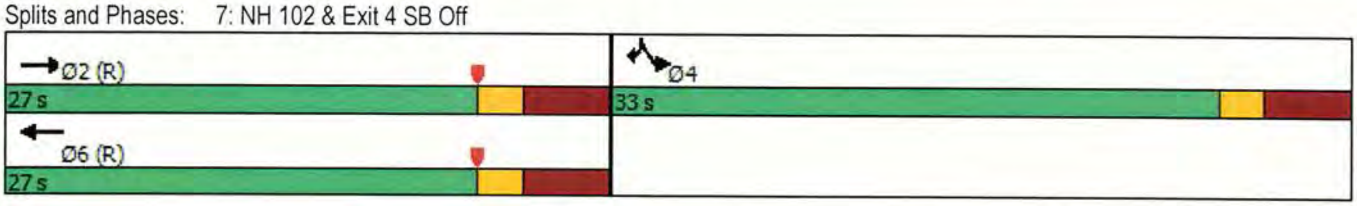
Analysis Period (min) 15

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 7: NH 102 & Exit 4 SB Off



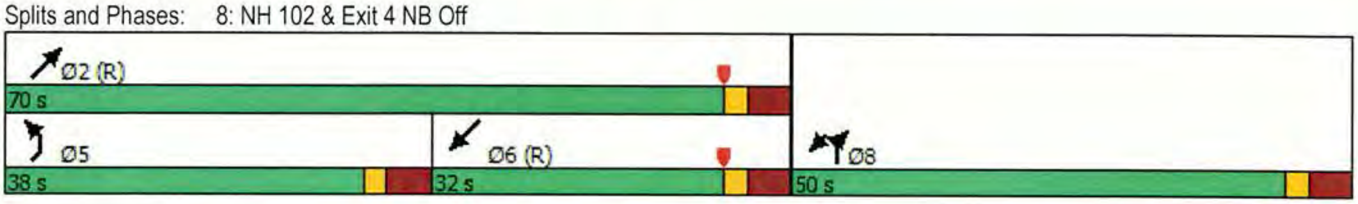
Lane Group	NBL2	NBL	NBR	SEL	SER	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations	↰↰		↱↱			↰↰	↑↑			↑↑	↱
Traffic Volume (vph)	1265	0	1070	0	0	1000	1185	0	0	540	780
Future Volume (vph)	1265	0	1070	0	0	1000	1185	0	0	540	780
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)		0	0	0	0	550		0	0		0
Storage Lanes		2	2	0	0	2		0	0		1
Taper Length (ft)		25		25		25			25		
Lane Util. Factor	0.97	1.00	0.88	1.00	1.00	0.97	0.95	1.00	1.00	0.95	1.00
Frt			0.850								0.850
Flt Protected	0.950					0.950					
Satd. Flow (prot)	3242	0	2632	0	0	3335	3438	0	0	3505	1568
Flt Permitted	0.950					0.950					
Satd. Flow (perm)	3242	0	2632	0	0	3335	3438	0	0	3505	1568
Right Turn on Red			No					Yes			Yes
Satd. Flow (RTOR)											750
Link Speed (mph)		25		30			30			30	
Link Distance (ft)		856		390			760			857	
Travel Time (s)		23.3		8.9			17.3			19.5	
Peak Hour Factor	0.88	0.88	0.88	0.92	0.92	0.94	0.94	0.94	0.92	0.92	0.92
Heavy Vehicles (%)	8%	8%	8%	2%	2%	5%	5%	5%	3%	3%	3%
Adj. Flow (vph)	1438	0	1216	0	0	1064	1261	0	0	587	848
Shared Lane Traffic (%)											
Lane Group Flow (vph)	1438	0	1216	0	0	1064	1261	0	0	587	848
Turn Type	Prot		Prot			Prot	NA			NA	Free
Protected Phases	8		8			5	2			6	
Permitted Phases											Free
Detector Phase	8		2			5	2			6	
Switch Phase											
Minimum Initial (s)	10.0		10.0			5.0	8.0			8.0	
Minimum Split (s)	16.0		16.0			11.0	42.0			31.0	
Total Split (s)	50.0		50.0			38.0	70.0			32.0	
Total Split (%)	41.7%		41.7%			31.7%	58.3%			26.7%	
Maximum Green (s)	44.0		44.0			32.0	64.0			26.0	
Yellow Time (s)	2.0		2.0			2.0	2.0			2.0	
All-Red Time (s)	4.0		4.0			4.0	4.0			4.0	
Lost Time Adjust (s)	0.0		0.0			0.0	0.0			0.0	
Total Lost Time (s)	6.0		6.0			6.0	6.0			6.0	
Lead/Lag						Lead				Lag	
Lead-Lag Optimize?											
Vehicle Extension (s)	3.0		3.0			3.0	3.0			3.0	
Recall Mode	None		None			None	C-Min			C-Min	
Walk Time (s)							7.0			7.0	
Flash Dont Walk (s)							29.0			17.0	
Pedestrian Calls (#/hr)							0			0	
Act Effct Green (s)	44.0		44.0			32.0	64.0			26.0	120.0
Actuated g/C Ratio	0.37		0.37			0.27	0.53			0.22	1.00
v/c Ratio	1.21		1.26			1.20	0.69			0.77	0.54
Control Delay	137.3		159.2			124.5	21.6			52.2	1.3
Queue Delay	0.0		0.0			0.0	0.0			0.0	0.0

Lane Group	NBL2	NBL	NBR	SEL	SER	NEL	NET	NER	SWL	SWT	SWR
Total Delay	137.3		159.2			124.5	21.6			52.2	1.3
LOS	F		F			F	C			D	A
Approach Delay		147.3					68.7			22.1	
Approach LOS		F					E			C	
Queue Length 50th (ft)	~701		~671			~508	378			226	0
Queue Length 95th (ft)	#807		#790			m#393	m277			294	0
Internal Link Dist (ft)		776		310			680			777	
Turn Bay Length (ft)						550					
Base Capacity (vph)	1188		965			889	1833			759	1568
Starvation Cap Reductn	0		0			0	0			0	0
Spillback Cap Reductn	0		0			0	0			0	0
Storage Cap Reductn	0		0			0	0			0	0
Reduced v/c Ratio	1.21		1.26			1.20	0.69			0.77	0.54

Intersection Summary

Area Type: Other
Cycle Length: 120
Actuated Cycle Length: 120
Offset: 118 (98%), Referenced to phase 2:NET and 6:SWT, Start of Yellow
Natural Cycle: 150
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 1.26
Intersection Signal Delay: 90.8 — Intersection LOS: F
Intersection Capacity Utilization 95.5% — ICU Level of Service F
Analysis Period (min) 15
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 8: NH 102 & Exit 4 NB Off



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑	↱	↰	↑↑					↰↰		↱
Traffic Volume (vph)	0	935	390	240	550	0	0	0	0	820	0	535
Future Volume (vph)	0	935	390	240	550	0	0	0	0	820	0	535
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		350	0		0	0		0	0		0
Storage Lanes	0		1	1		0	0		0	2		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	0.97	1.00	1.00
Frt			0.850									0.850
Flt Protected				0.950						0.950		
Satd. Flow (prot)	0	3471	1553	1719	3438	0	0	0	0	3367	0	1553
Flt Permitted				0.950						0.950		
Satd. Flow (perm)	0	3471	1553	1719	3438	0	0	0	0	3367	0	1553
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			427									266
Link Speed (mph)		30			30			30			35	
Link Distance (ft)		851			693			486			581	
Travel Time (s)		19.3			15.8			11.0			11.3	
Peak Hour Factor	0.87	0.87	0.87	0.86	0.86	0.86	0.92	0.92	0.92	0.91	0.91	0.91
Heavy Vehicles (%)	4%	4%	4%	5%	5%	5%	2%	2%	2%	4%	4%	4%
Adj. Flow (vph)	0	1075	448	279	640	0	0	0	0	901	0	588
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	1075	448	279	640	0	0	0	0	901	0	588
Turn Type		NA	Free	Prot	NA					Prot		Prot
Protected Phases		2		1	6					4		4
Permitted Phases			Free									
Detector Phase		2		1	6					4		4
Switch Phase												
Minimum Initial (s)		9.0		4.0	9.0					4.0		4.0
Minimum Split (s)		21.0		10.0	21.0					10.0		10.0
Total Split (s)		41.0		24.0	65.0					35.0		35.0
Total Split (%)		41.0%		24.0%	65.0%					35.0%		35.0%
Maximum Green (s)		35.0		18.0	59.0					29.0		29.0
Yellow Time (s)		4.0		4.0	4.0					4.0		4.0
All-Red Time (s)		2.0		2.0	2.0					2.0		2.0
Lost Time Adjust (s)		0.0		0.0	0.0					0.0		0.0
Total Lost Time (s)		6.0		6.0	6.0					6.0		6.0
Lead/Lag		Lag		Lead								
Lead-Lag Optimize?												
Vehicle Extension (s)		5.0		3.0	5.0					3.0		3.0
Recall Mode		C-Min		None	C-Min					None		None
Walk Time (s)		7.0			7.0							
Flash Dont Walk (s)		8.0			8.0							
Pedestrian Calls (#/hr)		0			0							
Act Effct Green (s)		35.3	100.0	17.7	59.0					29.0		29.0
Actuated g/C Ratio		0.35	1.00	0.18	0.59					0.29		0.29
v/c Ratio		0.88	0.29	0.91	0.32					0.92		0.92
Control Delay		40.2	0.5	27.1	0.2					50.5		40.5
Queue Delay		0.0	0.0	0.0	0.0					0.0		0.0

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Total Delay		40.2	0.5	27.1	0.2					50.5		40.5
LOS		D	A	C	A					D		D
Approach Delay		28.5			8.3						46.6	
Approach LOS		C			A						D	
Queue Length 50th (ft)		336	0	5	0					286		216
Queue Length 95th (ft)		#405	0	m16	m0					#404		#438
Internal Link Dist (ft)		771			613			406			501	
Turn Bay Length (ft)			350									
Base Capacity (vph)		1223	1553	309	2028					976		639
Starvation Cap Reductn		0	0	0	0					0		0
Spillback Cap Reductn		0	0	0	0					0		0
Storage Cap Reductn		0	0	0	0					0		0
Reduced v/c Ratio		0.88	0.29	0.90	0.32					0.92		0.92

Intersection Summary

Area Type: Other

Cycle Length: 100

Actuated Cycle Length: 100

Offset: 56 (56%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow

Natural Cycle: 90

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.92

Intersection Signal Delay: 30.6 Intersection LOS: C

Intersection Capacity Utilization 78.5% ICU Level of Service D

Analysis Period (min) 15

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 2: Exit 5 SB On/Exit 5 SB Off & NH 28

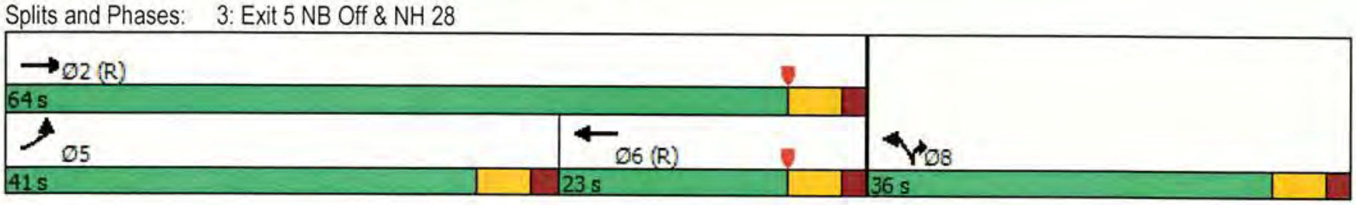
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑			↑↑	↱	↰		↱			
Traffic Volume (vph)	605	1150	0	0	495	545	295	0	375	0	0	0
Future Volume (vph)	605	1150	0	0	495	545	295	0	375	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt						0.850			0.850			
Flt Protected	0.950						0.950					
Satd. Flow (prot)	1752	3505	0	0	3505	1568	1703	0	1524	0	0	0
Flt Permitted	0.950						0.950					
Satd. Flow (perm)	1752	3505	0	0	3505	1568	1703	0	1524	0	0	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						599			98			
Link Speed (mph)		30			30			35			30	
Link Distance (ft)		693			542			867			392	
Travel Time (s)		15.8			12.3			16.9			8.9	
Peak Hour Factor	0.92	0.92	0.92	0.91	0.91	0.91	0.67	0.67	0.67	0.92	0.92	0.92
Heavy Vehicles (%)	3%	3%	3%	3%	3%	3%	6%	6%	6%	2%	2%	2%
Adj. Flow (vph)	658	1250	0	0	544	599	440	0	560	0	0	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	658	1250	0	0	544	599	440	0	560	0	0	0
Turn Type	Prot	NA			NA	Free	Prot		Prot			
Protected Phases	5	2			6		8		8			
Permitted Phases		2			6	Free						
Detector Phase	5	2			6		8		8			
Switch Phase												
Minimum Initial (s)	4.0	16.0			16.0		4.0		4.0			
Minimum Split (s)	10.0	23.0			23.0		11.0		11.0			
Total Split (s)	41.0	64.0			23.0		36.0		36.0			
Total Split (%)	41.0%	64.0%			23.0%		36.0%		36.0%			
Maximum Green (s)	35.0	58.0			17.0		30.0		30.0			
Yellow Time (s)	4.0	4.0			4.0		4.0		4.0			
All-Red Time (s)	2.0	2.0			2.0		2.0		2.0			
Lost Time Adjust (s)	0.0	0.0			0.0		0.0		0.0			
Total Lost Time (s)	6.0	6.0			6.0		6.0		6.0			
Lead/Lag	Lead				Lag							
Lead-Lag Optimize?												
Vehicle Extension (s)	5.0	5.0			5.0		3.0		3.0			
Recall Mode	None	C-Min			C-Min		None		None			
Walk Time (s)		7.0			7.0							
Flash Dont Walk (s)		10.0			10.0							
Pedestrian Calls (#/hr)		0			0							
Act Effct Green (s)	35.0	58.0			17.0	100.0	30.0		30.0			
Actuated g/C Ratio	0.35	0.58			0.17	1.00	0.30		0.30			
v/c Ratio	1.07	0.62			0.91	0.38	0.86		1.07			
Control Delay	59.0	6.2			62.6	0.7	51.6		87.7			
Queue Delay	0.0	0.0			0.0	0.0	0.0		0.0			
Total Delay	59.0	6.2			62.6	0.7	51.6		87.7			
LOS	E	A			E	A	D		F			
Approach Delay		24.4			30.1			71.8				

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach LOS		C			C			E				
Queue Length 50th (ft)	~483	77			181	0	264		~350			
Queue Length 95th (ft)	m#602	m119			#280	0	258		#297			
Internal Link Dist (ft)		613			462			787			312	
Turn Bay Length (ft)												
Base Capacity (vph)	613	2032			595	1568	510		525			
Starvation Cap Reductn	0	0			0	0	0		0			
Spillback Cap Reductn	0	0			0	0	0		0			
Storage Cap Reductn	0	0			0	0	0		0			
Reduced v/c Ratio	1.07	0.62			0.91	0.38	0.86		1.07			

Intersection Summary

Area Type: Other
Cycle Length: 100
Actuated Cycle Length: 100
Offset: 0 (0%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow, Master Intersection
Natural Cycle: 110
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 1.07
Intersection Signal Delay: 37.7 Intersection LOS: D
Intersection Capacity Utilization 78.5% ICU Level of Service D
Analysis Period (min) 15
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 3: Exit 5 NB Off & NH 28



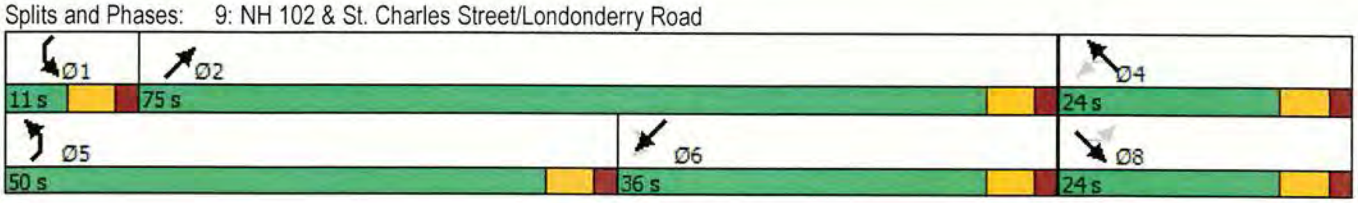
Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	5	0	295	0	0	0	955	1260	0	5	1160	10
Future Volume (vph)	5	0	295	0	0	0	955	1260	0	5	1160	10
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		225	0		0	350		0	100		0
Storage Lanes	0		1	0		0	1		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00	0.95	0.95
Frt			0.850								0.999	
Flt Protected		0.950					0.950			0.950		
Satd. Flow (prot)	0	1770	1583	0	1900	0	1770	3539	0	1770	3536	0
Flt Permitted							0.950			0.950		
Satd. Flow (perm)	0	1863	1583	0	1900	0	1770	3539	0	1770	3536	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			321								1	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		593			447			750			330	
Travel Time (s)		13.5			10.2			17.0			7.5	
Peak Hour Factor	0.92	0.92	0.92	0.25	0.25	0.25	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	2%	2%	2%	0%	0%	0%	2%	2%	2%	2%	2%	2%
Adj. Flow (vph)	5	0	321	0	0	0	1038	1370	0	5	1261	11
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	5	321	0	0	0	1038	1370	0	5	1272	0
Turn Type	Perm	NA	custom				Prot	NA		Prot	NA	
Protected Phases		8			4		5	2		1	6	
Permitted Phases	8		6	4								
Detector Phase	8	8	6	4	4		5	2		1	6	
Switch Phase												
Minimum Initial (s)	5.0	5.0	8.0	5.0	5.0		5.0	8.0		5.0	8.0	
Minimum Split (s)	24.0	24.0	24.0	24.0	24.0		24.0	24.0		11.0	24.0	
Total Split (s)	24.0	24.0	36.0	24.0	24.0		50.0	75.0		11.0	36.0	
Total Split (%)	21.8%	21.8%	32.7%	21.8%	21.8%		45.5%	68.2%		10.0%	32.7%	
Maximum Green (s)	18.0	18.0	30.0	18.0	18.0		44.0	69.0		5.0	30.0	
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)		0.0	0.0		0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)		6.0	6.0		6.0		6.0	6.0		6.0	6.0	
Lead/Lag			Lag				Lead	Lag		Lead	Lag	
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None	Min	None	None		None	Min		None	Min	
Walk Time (s)	7.0	7.0	7.0	7.0	7.0		7.0	7.0			7.0	
Flash Dont Walk (s)	11.0	11.0	11.0	11.0	11.0		11.0	11.0			11.0	
Pedestrian Calls (#/hr)	0	0	0	0	0		0	0			0	
Act Effct Green (s)		6.1	30.1				44.1	83.2		5.0	30.1	
Actuated g/C Ratio		0.07	0.34				0.50	0.94		0.06	0.34	
v/c Ratio		0.04	0.43				1.18	0.41		0.05	1.06	
Control Delay		41.2	4.9				115.9	2.4		43.0	73.1	
Queue Delay		0.0	0.0				0.0	0.0		0.0	0.0	

Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Total Delay		41.2	4.9				115.9	2.4		43.0	73.1	
LOS		D	A				F	A		D	E	
Approach Delay		5.4						51.4			72.9	
Approach LOS		A						D			E	
Queue Length 50th (ft)		3	0				~667	0		3	~393	
Queue Length 95th (ft)		15	61				#1094	245		15	#649	
Internal Link Dist (ft)		513			367			670			250	
Turn Bay Length (ft)			225				350			100		
Base Capacity (vph)		379	749				881	3324		99	1202	
Starvation Cap Reductn		0	0				0	0		0	0	
Spillback Cap Reductn		0	0				0	0		0	0	
Storage Cap Reductn		0	0				0	0		0	0	
Reduced v/c Ratio		0.01	0.43				1.18	0.41		0.05	1.06	

Intersection Summary

Area Type: Other
Cycle Length: 110
Actuated Cycle Length: 88.6
Natural Cycle: 150
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 1.18
Intersection Signal Delay: 54.5 Intersection LOS: D
Intersection Capacity Utilization 108.3% ICU Level of Service G
Analysis Period (min) 15
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 9: NH 102 & St. Charles Street/Londonderry Road



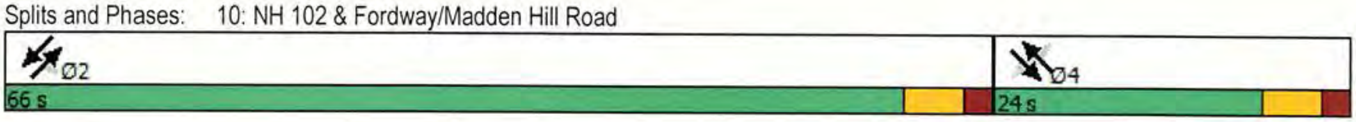
Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	5	30	0	230	0	50	0	860	215	5	555	0
Future Volume (vph)	5	30	0	230	0	50	0	860	215	5	555	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt					0.976			0.973				
Flt Protected		0.993			0.961							
Satd. Flow (prot)	0	1850	0	0	1730	0	0	1712	0	0	1810	0
Flt Permitted		0.957			0.724						0.754	
Satd. Flow (perm)	0	1783	0	0	1303	0	0	1712	0	0	1364	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)					36			30				
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		356			493			1124			603	
Travel Time (s)		8.1			11.2			25.5			13.7	
Peak Hour Factor	0.60	0.60	0.60	0.96	0.96	0.96	0.89	0.89	0.89	0.86	0.86	0.86
Heavy Vehicles (%)	2%	2%	2%	3%	3%	3%	8%	8%	8%	5%	5%	5%
Adj. Flow (vph)	8	50	0	240	0	52	0	966	242	6	645	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	58	0	0	292	0	0	1208	0	0	651	0
Turn Type	Perm	NA		Perm	NA			NA		Perm	NA	
Protected Phases		4			4			2			2	
Permitted Phases	4			4						2		
Detector Phase	4	4		4	4			2		2	2	
Switch Phase												
Minimum Initial (s)	5.0	5.0		5.0	5.0			5.0		5.0	5.0	
Minimum Split (s)	24.0	24.0		24.0	24.0			24.0		24.0	24.0	
Total Split (s)	24.0	24.0		24.0	24.0			66.0		66.0	66.0	
Total Split (%)	26.7%	26.7%		26.7%	26.7%			73.3%		73.3%	73.3%	
Maximum Green (s)	18.0	18.0		18.0	18.0			60.0		60.0	60.0	
Yellow Time (s)	4.0	4.0		4.0	4.0			4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0			2.0		2.0	2.0	
Lost Time Adjust (s)		0.0			0.0			0.0			0.0	
Total Lost Time (s)		6.0			6.0			6.0			6.0	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0		3.0	3.0	
Recall Mode	None	None		None	None			Min		Min	Min	
Walk Time (s)	7.0	7.0		7.0	7.0			7.0		7.0	7.0	
Flash Dont Walk (s)	11.0	11.0		11.0	11.0			11.0		11.0	11.0	
Pedestrian Calls (#/hr)	0	0		0	0			0		0	0	
Act Effct Green (s)		18.0			18.0			60.4			60.4	
Actuated g/C Ratio		0.20			0.20			0.67			0.67	
v/c Ratio		0.16			1.01			1.05			0.71	
Control Delay		31.3			90.7			56.8			15.2	
Queue Delay		0.0			0.0			0.0			0.0	
Total Delay		31.3			90.7			56.8			15.2	
LOS		C			F			E			B	
Approach Delay		31.3			90.7			56.8			15.1	

Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Approach LOS		C			F			E			B	
Queue Length 50th (ft)		28			~151			~751			208	
Queue Length 95th (ft)		39			#318			#982			312	
Internal Link Dist (ft)		276			413			1044			523	
Turn Bay Length (ft)												
Base Capacity (vph)		354			288			1154			911	
Starvation Cap Reductn		0			0			0			0	
Spillback Cap Reductn		0			0			0			0	
Storage Cap Reductn		0			0			0			0	
Reduced v/c Ratio		0.16			1.01			1.05			0.71	

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 90.4
Natural Cycle: 110
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 1.05
Intersection Signal Delay: 48.4 Intersection LOS: D
Intersection Capacity Utilization 94.1% ICU Level of Service F
Analysis Period (min) 15
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 10: NH 102 & Fordway/Madden Hill Road



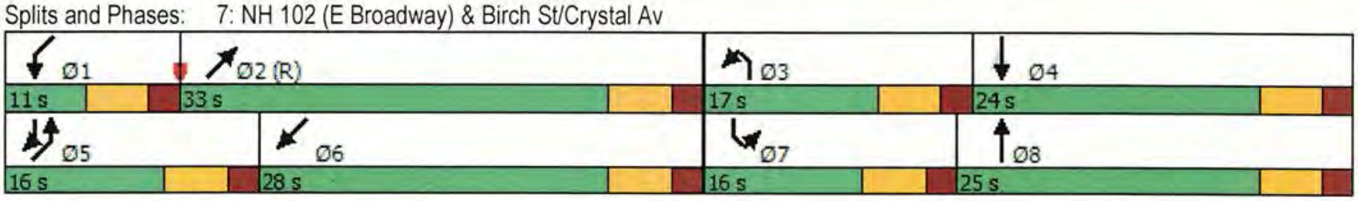
Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	105	180	35	135	180	160	100	470	60	70	335	65
Future Volume (vph)	105	180	35	135	180	160	100	470	60	70	335	65
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.976				0.850		0.983			0.976	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1752	1800	0	1752	1845	1568	1787	1849	0	1787	1836	0
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1752	1800	0	1752	1845	1568	1787	1849	0	1787	1836	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		10				172		8			11	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		361			411			477			530	
Travel Time (s)		8.2			9.3			10.8			12.0	
Peak Hour Factor	0.91	0.91	0.91	0.93	0.93	0.93	0.95	0.95	0.95	0.94	0.94	0.94
Heavy Vehicles (%)	3%	3%	3%	3%	3%	3%	1%	1%	1%	1%	1%	1%
Adj. Flow (vph)	115	198	38	145	194	172	105	495	63	74	356	69
Shared Lane Traffic (%)												
Lane Group Flow (vph)	115	236	0	145	194	172	105	558	0	74	425	0
Turn Type	Prot	NA		Prot	NA	pm+ov	Prot	NA		Prot	NA	
Protected Phases	3	8		7	4	5	5	2		1	6	
Permitted Phases						4						
Detector Phase	3	8		7	4	5	5	2		1	6	
Switch Phase												
Minimum Initial (s)	4.0	5.0		4.0	10.0	4.0	4.0	10.0		4.0	9.0	
Minimum Split (s)	17.0	24.0		11.0	24.0	16.0	16.0	24.0		11.0	24.0	
Total Split (s)	17.0	25.0		16.0	24.0	16.0	16.0	33.0		11.0	28.0	
Total Split (%)	20.0%	29.4%		18.8%	28.2%	18.8%	18.8%	38.8%		12.9%	32.9%	
Maximum Green (s)	11.0	19.0		10.0	18.0	10.0	10.0	27.0		5.0	22.0	
Yellow Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0	2.0	2.0	2.0		2.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Lead/Lag	Lead	Lag		Lead	Lag	Lead	Lead	Lag		Lead	Lag	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes	Yes	Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None	None	None	C-Max		None	None	
Act Effct Green (s)	9.7	15.3		9.6	17.7	33.0	9.2	31.9		6.6	26.8	
Actuated g/C Ratio	0.11	0.18		0.11	0.21	0.39	0.11	0.38		0.08	0.32	
v/c Ratio	0.57	0.71		0.73	0.51	0.24	0.54	0.80		0.53	0.72	
Control Delay	47.2	43.0		59.2	35.6	3.7	46.3	36.8		54.4	36.0	
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Total Delay	47.2	43.0		59.2	35.6	3.7	46.3	36.8		54.4	36.0	
LOS	D	D		E	D	A	D	D		D	D	
Approach Delay		44.4			31.6			38.3			38.7	
Approach LOS		D			C			D			D	
Queue Length 50th (ft)	58	113		76	96	0	53	284		38	202	
Queue Length 95th (ft)	111	182		#162	157	37	104	#489		#109	#380	

Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Internal Link Dist (ft)		281			331			397			450	
Turn Bay Length (ft)												
Base Capacity (vph)	226	410		206	416	729	215	698		139	587	
Starvation Cap Reductn	0	0		0	0	0	0	0		0	0	
Spillback Cap Reductn	0	0		0	0	0	0	0		0	0	
Storage Cap Reductn	0	0		0	0	0	0	0		0	0	
Reduced v/c Ratio	0.51	0.58		0.70	0.47	0.24	0.49	0.80		0.53	0.72	

Intersection Summary

Area Type: Other
Cycle Length: 85
Actuated Cycle Length: 85
Offset: 0 (0%), Referenced to phase 2:NET, Start of Green
Natural Cycle: 85
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.80
Intersection Signal Delay: 37.8 Intersection LOS: D
Intersection Capacity Utilization 86.2% ICU Level of Service E
Analysis Period (min) 15
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 7: NH 102 (E Broadway) & Birch St/Crystal Av



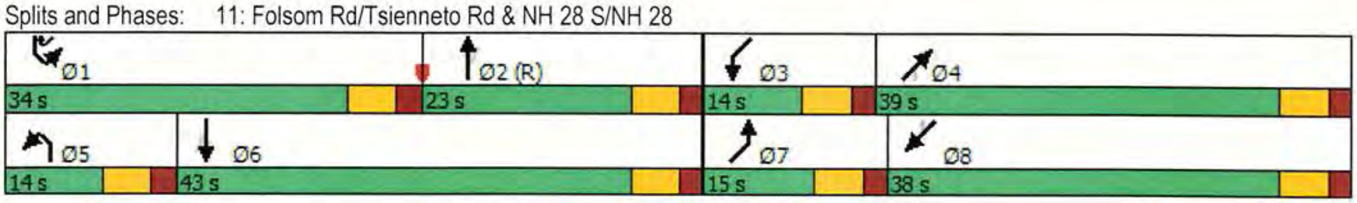
Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	0	235	135	495	310	0	115	520	0	165	400	300
Future Volume (vph)	0	235	135	495	310	0	115	520	0	165	400	300
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	150		150	0		0	0		0	0		0
Storage Lanes	1		1	2		1	1		1	1		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	0.95	1.00	0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850									0.850
Flt Protected				0.950			0.950			0.950		
Satd. Flow (prot)	1863	3539	1583	3433	1863	1863	1770	1863	1863	1787	1881	1599
Flt Permitted				0.950			0.950			0.950		
Satd. Flow (perm)	1863	3539	1583	3433	1863	1863	1770	1863	1863	1787	1881	1599
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			208									134
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		639			394			532			387	
Travel Time (s)		14.5			9.0			12.1			8.8	
Peak Hour Factor	0.92	0.92	0.92	0.94	0.94	0.94	0.96	0.96	0.96	0.95	0.95	0.95
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	1%	1%	1%
Adj. Flow (vph)	0	255	147	527	330	0	120	542	0	174	421	316
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	255	147	527	330	0	120	542	0	174	421	316
Turn Type	Prot	NA	Perm	Prot	NA	Perm	Prot	NA	Perm	Prot	NA	pm+ov
Protected Phases	5	2		1	6		7	4		3	8	1
Permitted Phases			2			6			4			8
Detector Phase	5	2	2	1	6	6	7	4	4	3	8	1
Switch Phase												
Minimum Initial (s)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Minimum Split (s)	15.0	25.0	25.0	35.0	45.0	45.0	14.0	40.0	40.0	15.0	25.0	35.0
Total Split (s)	14.0	23.0	23.0	34.0	43.0	43.0	15.0	39.0	39.0	14.0	38.0	34.0
Total Split (%)	12.7%	20.9%	20.9%	30.9%	39.1%	39.1%	13.6%	35.5%	35.5%	12.7%	34.5%	30.9%
Maximum Green (s)	8.0	17.0	17.0	28.0	37.0	37.0	9.0	33.0	33.0	8.0	32.0	28.0
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lead
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	C-Max	C-Max	None	None	None	None	None	None	None	None	None
Walk Time (s)		5.0	5.0		5.0	5.0		5.0	5.0		5.0	
Flash Dont Walk (s)		11.0	11.0		11.0	11.0		11.0	11.0		11.0	
Pedestrian Calls (#/hr)		0	0		0	0		0	0		0	
Act Effct Green (s)		22.3	22.3	22.7	51.0		9.0	33.0		8.0	32.0	60.7
Actuated g/C Ratio		0.20	0.20	0.21	0.46		0.08	0.30		0.07	0.29	0.55
v/c Ratio		0.36	0.30	0.74	0.38		0.83	0.97		1.35	0.77	0.34
Control Delay		40.5	3.1	56.3	23.0		91.5	70.6		239.2	46.5	7.9
Queue Delay		0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	0.0

Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Total Delay		40.5	3.1	56.3	23.0		91.5	70.6		239.2	46.5	7.9
LOS		D	A	E	C		F	E		F	D	A
Approach Delay		26.8			43.5			74.4			69.9	
Approach LOS		C			D			E			E	
Queue Length 50th (ft)		82	0	189	160		85	377		~161	271	62
Queue Length 95th (ft)		129	17	262	206		#189	#597		#299	#398	102
Internal Link Dist (ft)		559			314			452			307	
Turn Bay Length (ft)			150									
Base Capacity (vph)		717	486	873	863		144	558		129	547	1013
Starvation Cap Reductn		0	0	0	0		0	0		0	0	0
Spillback Cap Reductn		0	0	0	0		0	0		0	0	0
Storage Cap Reductn		0	0	0	0		0	0		0	0	0
Reduced v/c Ratio		0.36	0.30	0.60	0.38		0.83	0.97		1.35	0.77	0.31

Intersection Summary

Area Type: Other
Cycle Length: 110
Actuated Cycle Length: 110
Offset: 0 (0%), Referenced to phase 2:NBT, Start of Green
Natural Cycle: 115
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 1.35
Intersection Signal Delay: 56.9 Intersection LOS: E
Intersection Capacity Utilization 79.5% ICU Level of Service D
Analysis Period (min) 15
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 11: Folsom Rd/Tsienneto Rd & NH 28 S/NH 28



Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	150	1050	0	0	605	80	0	0	0	25	0	350
Future Volume (vph)	150	1050	0	0	605	80	0	0	0	25	0	350
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt					0.983							0.850
Flt Protected	0.950										0.950	
Satd. Flow (prot)	1787	3574	0	1881	3513	0	0	1900	1900	0	1787	1599
Flt Permitted	0.950										0.757	
Satd. Flow (perm)	1787	3574	0	1881	3513	0	0	1900	1900	0	1424	1599
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)					16							366
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		277			755			230			387	
Travel Time (s)		6.3			17.2			5.2			8.8	
Peak Hour Factor	0.97	0.97	0.97	0.95	0.95	0.95	0.90	0.90	0.90	0.80	0.80	0.80
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	0%	0%	0%	1%	1%	1%
Adj. Flow (vph)	155	1082	0	0	637	84	0	0	0	31	0	438
Shared Lane Traffic (%)												
Lane Group Flow (vph)	155	1082	0	0	721	0	0	0	0	0	31	438
Turn Type	Prot	NA		Prot	NA				Perm	Perm	NA	Perm
Protected Phases	5	2		1	6			8			4	
Permitted Phases							8		8	4	4	4
Detector Phase	5	2		1	6		8	8	8	4	4	4
Switch Phase												
Minimum Initial (s)	5.0	8.0		5.0	8.0		5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	26.0	63.0		11.0	48.0		21.0	21.0	21.0	21.0	21.0	21.0
Total Split (s)	26.0	66.0		11.0	51.0		33.0	33.0	33.0	33.0	33.0	33.0
Total Split (%)	23.6%	60.0%		10.0%	46.4%		30.0%	30.0%	30.0%	30.0%	30.0%	30.0%
Maximum Green (s)	20.0	60.0		5.0	45.0		27.0	27.0	27.0	27.0	27.0	27.0
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0			0.0	0.0		0.0	0.0
Total Lost Time (s)	6.0	6.0		6.0	6.0			6.0	6.0		6.0	6.0
Lead/Lag	Lead	Lag		Lead	Lag							
Lead-Lag Optimize?	Yes	Yes		Yes	Yes							
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	C-Max		None	C-Max		None	None	None	None	None	None
Walk Time (s)		7.0			7.0		7.0	7.0	7.0	7.0	7.0	7.0
Flash Dont Walk (s)		11.0			11.0		8.0	8.0	8.0	8.0	8.0	8.0
Pedestrian Calls (#/hr)		0			0		0	0	0	0	0	0
Act Effct Green (s)	14.8	84.1			63.3						13.9	13.9
Actuated g/C Ratio	0.13	0.76			0.58						0.13	0.13
v/c Ratio	0.65	0.40			0.36						0.17	0.84
Control Delay	65.5	4.8			16.4						40.6	23.3
Queue Delay	0.0	0.0			0.0						0.0	0.0
Total Delay	65.5	4.8			16.4						40.6	23.3
LOS	E	A			B						D	C
Approach Delay		12.4			16.4						24.5	

Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Approach LOS		B			B						C	
Queue Length 50th (ft)	118	66			127						20	48
Queue Length 95th (ft)	m160	158			m192						37	90
Internal Link Dist (ft)		197			675			150			307	
Turn Bay Length (ft)												
Base Capacity (vph)	325	2732			2028						349	668
Starvation Cap Reductn	0	0			0						0	0
Spillback Cap Reductn	0	0			0						0	0
Storage Cap Reductn	0	0			0						0	0
Reduced v/c Ratio	0.48	0.40			0.36						0.09	0.66

Intersection Summary

Area Type: Other

Cycle Length: 110

Actuated Cycle Length: 110

Offset: 0 (0%), Referenced to phase 2:SET and 6:NWT, Start of Green

Natural Cycle: 95

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.84

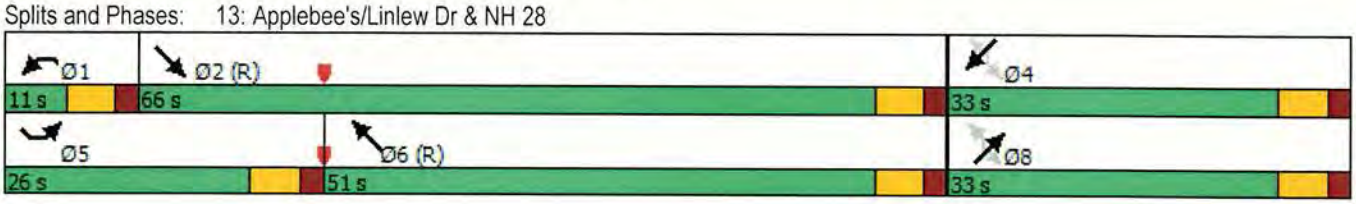
Intersection Signal Delay: 15.9 Intersection LOS: B

Intersection Capacity Utilization 52.4% ICU Level of Service A

Analysis Period (min) 15

m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 13: Applebee's/Linlew Dr & NH 28



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	115	815	5	5	530	255	35	10	10	350	5	135
Future Volume (vph)	115	815	5	5	530	255	35	10	10	350	5	135
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	150		150	150		150	0		0	0		0
Storage Lanes	2		0	1		0	1		0	1		1
Taper Length (ft)	150			25			25			25		
Lane Util. Factor	0.97	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	0.95	0.95	1.00
Frt		0.999			0.951			0.925				0.850
Flt Protected	0.950			0.950			0.950			0.950	0.954	
Satd. Flow (prot)	3467	3571	0	1770	3366	0	1805	1758	0	1715	1722	1615
Flt Permitted	0.950			0.950			0.950			0.950	0.954	
Satd. Flow (perm)	3467	3571	0	1770	3366	0	1805	1758	0	1715	1722	1615
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		1			88			13				157
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		877			261			151			343	
Travel Time (s)		19.9			5.9			3.4			7.8	
Peak Hour Factor	0.84	0.84	0.84	0.90	0.90	0.90	0.78	0.78	0.78	0.86	0.86	0.86
Heavy Vehicles (%)	1%	1%	1%	2%	2%	2%	0%	0%	0%	0%	0%	0%
Adj. Flow (vph)	137	970	6	6	589	283	45	13	13	407	6	157
Shared Lane Traffic (%)										49%		
Lane Group Flow (vph)	137	976	0	6	872	0	45	26	0	208	205	157
Turn Type	Prot	NA		Prot	NA		Split	NA		Split	NA	pt+ov
Protected Phases	5	2		1	6		3	3		4	4	4 5
Permitted Phases		2			6							
Detector Phase	5	2		1	6		3	3		4	4	4 5
Switch Phase												
Minimum Initial (s)	5.0	8.0		5.0	8.0		5.0	5.0		8.0	8.0	
Minimum Split (s)	11.0	53.0		11.0	50.0		22.0	22.0		22.0	22.0	
Total Split (s)	14.0	53.0		11.0	50.0		22.0	22.0		24.0	24.0	
Total Split (%)	12.7%	48.2%		10.0%	45.5%		20.0%	20.0%		21.8%	21.8%	
Maximum Green (s)	8.0	47.0		5.0	44.0		16.0	16.0		18.0	18.0	
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lead		Lag	Lag	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	C-Max		None	None		None	None		None	None	
Walk Time (s)		5.0			5.0		5.0	5.0		5.0	5.0	
Flash Dont Walk (s)		11.0			11.0		11.0	11.0		11.0	11.0	
Pedestrian Calls (#/hr)		0			0		0	0		0	0	
Act Effct Green (s)	8.6	65.0		5.6	52.6		8.2	8.2		18.9	18.9	33.5
Actuated g/C Ratio	0.08	0.59		0.05	0.48		0.07	0.07		0.17	0.17	0.30
v/c Ratio	0.51	0.46		0.07	0.53		0.34	0.18		0.71	0.69	0.26
Control Delay	55.6	16.1		55.0	20.8		54.4	32.8		55.6	54.7	5.2
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Total Delay	55.6	16.1		55.0	20.8		54.4	32.8		55.6	54.7	5.2
LOS	E	B		D	C		D	C		E	D	A
Approach Delay		20.9			21.1			46.5			41.4	
Approach LOS		C			C			D			D	
Queue Length 50th (ft)	47	195		4	150		31	9		145	143	0
Queue Length 95th (ft)	75	316		m10	215		57	30		211	208	39
Internal Link Dist (ft)		797			181			71			263	
Turn Bay Length (ft)	150			150								
Base Capacity (vph)	276	2110		90	1656		262	266		317	319	591
Starvation Cap Reductn	0	0		0	0		0	0		0	0	0
Spillback Cap Reductn	0	0		0	0		0	0		0	0	0
Storage Cap Reductn	0	0		0	0		0	0		0	0	0
Reduced v/c Ratio	0.50	0.46		0.07	0.53		0.17	0.10		0.66	0.64	0.27

Intersection Summary

Area Type: Other
Cycle Length: 110
Actuated Cycle Length: 110
Offset: 0 (0%), Referenced to phase 2:EBT, Start of Green
Natural Cycle: 110
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.71
Intersection Signal Delay: 26.1 — Intersection LOS: C
Intersection Capacity Utilization 58.5% — ICU Level of Service B
Analysis Period (min) 15
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 14: VIP Dr/Ashleigh Dr & NH 28

Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	100	80	25	55	50	195	195	800	75	25	265	40
Future Volume (vph)	100	80	25	55	50	195	195	800	75	25	265	40
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	150		150	150		150	150		150	150		150
Storage Lanes	1		0	1		1	1		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.965				0.850		0.987			0.980	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1770	1798	0	1787	1881	1599	1805	1875	0	1805	1862	0
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1770	1798	0	1787	1881	1599	1805	1875	0	1805	1862	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		17				205		6			9	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		481			347			479			371	
Travel Time (s)		10.9			7.9			10.9			8.4	
Peak Hour Factor	0.99	0.99	0.99	0.95	0.95	0.95	0.89	0.89	0.89	0.93	0.93	0.93
Heavy Vehicles (%)	2%	2%	2%	1%	1%	1%	0%	0%	0%	0%	0%	0%
Adj. Flow (vph)	101	81	25	58	53	205	219	899	84	27	285	43
Shared Lane Traffic (%)												
Lane Group Flow (vph)	101	106	0	58	53	205	219	983	0	27	328	0
Turn Type	Prot	NA		Prot	NA	pt+ov	Prot	NA		Prot	NA	
Protected Phases	1	6		5	2	2 3	3	8		7	4	
Permitted Phases		6			2							
Detector Phase	1	6		5	2	2 3	3	8		7	4	
Switch Phase												
Minimum Initial (s)	8.0	8.0		8.0	8.0		8.0	8.0		8.0	8.0	
Minimum Split (s)	14.0	20.0		14.0	20.0		14.0	28.0		14.0	14.0	
Total Split (s)	14.0	20.0		14.0	20.0		19.0	32.0		14.0	27.0	
Total Split (%)	17.5%	25.0%		17.5%	25.0%		23.8%	40.0%		17.5%	33.8%	
Maximum Green (s)	8.0	14.0		8.0	14.0		13.0	26.0		8.0	21.0	
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lag		Lead	Lag	
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	C-Max		None	None		None	None	
Walk Time (s)								7.0				
Flash Dont Walk (s)								15.0				
Pedestrian Calls (#/hr)								0				
Act Effct Green (s)	8.0	19.6		8.0	16.8	35.2	12.4	34.4		8.0	21.6	
Actuated g/C Ratio	0.10	0.24		0.10	0.21	0.44	0.16	0.43		0.10	0.27	
v/c Ratio	0.57	0.23		0.33	0.13	0.25	0.78	1.22		0.15	0.64	
Control Delay	48.2	24.8		38.9	29.2	3.2	53.3	132.8		35.1	32.2	
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	

Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Total Delay	48.2	24.8		38.9	29.2	3.2	53.3	132.8		35.1	32.2	
LOS	D	C		D	C	A	D	F		D	C	
Approach Delay		36.2			14.1			118.3			32.4	
Approach LOS		D			B			F			C	
Queue Length 50th (ft)	49	39		28	23	0	106	~541		13	142	
Queue Length 95th (ft)	#108	84		63	53	38	#204	#939		36	230	
Internal Link Dist (ft)		401			267			399			291	
Turn Bay Length (ft)	150			150		150	150			150		
Base Capacity (vph)	177	453		178	395	829	293	809		180	509	
Starvation Cap Reductn	0	0		0	0	0	0	0		0	0	
Spillback Cap Reductn	0	0		0	0	0	0	0		0	0	
Storage Cap Reductn	0	0		0	0	0	0	0		0	0	
Reduced v/c Ratio	0.57	0.23		0.33	0.13	0.25	0.75	1.22		0.15	0.64	

Intersection Summary

Area Type: Other

Cycle Length: 80

Actuated Cycle Length: 80

Offset: 0 (0%), Referenced to phase 2:SBT, Start of Green

Natural Cycle: 110

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 1.22

Intersection Signal Delay: 79.7 Intersection LOS: E

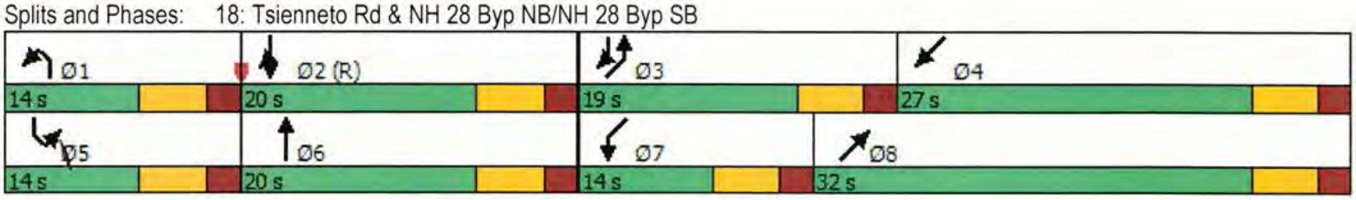
Intersection Capacity Utilization 80.5% ICU Level of Service D

Analysis Period (min) 15

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 18: Tsienneto Rd & NH 28 Byp NB/NH 28 Byp SB



APPENDIX O-1: 2040 ALTERNATIVE A INTERSECTION CAPACITY ANALYSES – HCM 2000 PRINTOUTS – AM PEAK HOUR

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑↑		↰	↱↱
Traffic Volume (vph)	0	1340	825	0	375	850
Future Volume (vph)	0	1340	825	0	375	850
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	16	12
Total Lost time (s)		6.0	6.0		6.0	6.0
Lane Util. Factor		0.95	0.95		1.00	0.88
Frt		1.00	1.00		1.00	0.85
Flt Protected		1.00	1.00		0.95	1.00
Satd. Flow (prot)		3471	3406		1930	2682
Flt Permitted		1.00	1.00		0.95	1.00
Satd. Flow (perm)		3471	3406		1930	2682
Peak-hour factor, PHF	0.93	0.93	0.88	0.88	0.89	0.89
Adj. Flow (vph)	0	1441	938	0	421	955
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	1441	938	0	421	955
Heavy Vehicles (%)	4%	4%	6%	6%	6%	6%
Turn Type		NA	NA		Prot	Prot
Protected Phases		2	6		4	4
Permitted Phases						
Actuated Green, G (s)		34.0	34.0		29.0	29.0
Effective Green, g (s)		34.0	34.0		29.0	29.0
Actuated g/C Ratio		0.45	0.45		0.39	0.39
Clearance Time (s)		6.0	6.0		6.0	6.0
Vehicle Extension (s)		3.0	3.0		3.0	3.0
Lane Grp Cap (vph)		1573	1544		746	1037
v/s Ratio Prot		c0.42	0.28		0.22	c0.36
v/s Ratio Perm						
v/c Ratio		0.92	0.61		0.56	0.92
Uniform Delay, d1		19.2	15.5		18.0	21.9
Progression Factor		1.07	1.41		1.00	1.00
Incremental Delay, d2		3.9	0.2		1.0	12.9
Delay (s)		24.4	22.0		19.0	34.8
Level of Service		C	C		B	C
Approach Delay (s)		24.4	22.0		30.0	
Approach LOS		C	C		C	

Intersection Summary			
HCM 2000 Control Delay	25.9	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.92		
Actuated Cycle Length (s)	75.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	69.8%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	NBL2	NBL	NBR	SEL	SER	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations											
Traffic Volume (vph)	490	0	235	0	0	1470	245	0	0	885	175
Future Volume (vph)	490	0	235	0	0	1470	245	0	0	885	175
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0		6.0			6.0	6.0			6.0	4.0
Lane Util. Factor	0.97		0.88			0.97	0.95			0.95	1.00
Frt	1.00		0.85			1.00	1.00			1.00	0.85
Flt Protected	0.95		1.00			0.95	1.00			1.00	1.00
Satd. Flow (prot)	3242		2632			3335	3438			3505	1568
Flt Permitted	0.95		1.00			0.95	1.00			1.00	1.00
Satd. Flow (perm)	3242		2632			3335	3438			3505	1568
Peak-hour factor, PHF	0.88	0.88	0.88	0.92	0.92	0.94	0.94	0.94	0.92	0.92	0.92
Adj. Flow (vph)	557	0	267	0	0	1564	261	0	0	962	190
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	557	0	267	0	0	1564	261	0	0	962	190
Heavy Vehicles (%)	8%	8%	8%	2%	2%	5%	5%	5%	3%	3%	3%
Turn Type	Prot		Prot			Prot	NA			NA	Free
Protected Phases	8		8			5	2			6	
Permitted Phases											Free
Actuated Green, G (s)	25.0		25.0			67.0	113.0			40.0	150.0
Effective Green, g (s)	25.0		25.0			67.0	113.0			40.0	150.0
Actuated g/C Ratio	0.17		0.17			0.45	0.75			0.27	1.00
Clearance Time (s)	6.0		6.0			6.0	6.0			6.0	
Vehicle Extension (s)	3.0		3.0			3.0	3.0			3.0	
Lane Grp Cap (vph)	540		438			1489	2589			934	1568
v/s Ratio Prot	c0.17		0.10			c0.47	0.08			c0.27	
v/s Ratio Perm											0.12
v/c Ratio	1.03		0.61			1.05	0.10			1.03	0.12
Uniform Delay, d1	62.5		58.0			41.5	4.9			55.0	0.0
Progression Factor	1.00		1.00			0.80	1.82			1.00	1.00
Incremental Delay, d2	47.1		2.4			32.0	0.0			37.4	0.2
Delay (s)	109.6		60.4			65.4	9.0			92.4	0.2
Level of Service	F		E			E	A			F	A
Approach Delay (s)		93.6		0.0			57.3			77.2	
Approach LOS		F		A			E			E	

Intersection Summary			
HCM 2000 Control Delay	71.2	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.04		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	96.4%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑	↱	↰	↑↑					↰↰		↱
Traffic Volume (vph)	0	660	455	420	790	0	0	0	0	180	0	445
Future Volume (vph)	0	660	455	420	790	0	0	0	0	180	0	445
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0	4.0	6.0	6.0					6.0		6.0
Lane Util. Factor		0.95	1.00	1.00	0.95					0.97		1.00
Frt		1.00	0.85	1.00	1.00					1.00		0.85
Flt Protected		1.00	1.00	0.95	1.00					0.95		1.00
Satd. Flow (prot)		3167	1417	1687	3374					3303		1524
Flt Permitted		1.00	1.00	0.95	1.00					0.95		1.00
Satd. Flow (perm)		3167	1417	1687	3374					3303		1524
Peak-hour factor, PHF	0.92	0.92	0.92	0.73	0.73	0.73	0.92	0.92	0.92	0.74	0.74	0.74
Adj. Flow (vph)	0	717	495	575	1082	0	0	0	0	243	0	601
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	72
Lane Group Flow (vph)	0	717	495	575	1082	0	0	0	0	243	0	529
Heavy Vehicles (%)	14%	14%	14%	7%	7%	7%	2%	2%	2%	6%	6%	6%
Turn Type		NA	Free	Prot	NA					Prot		Prot
Protected Phases		2		1	6					4		4
Permitted Phases			Free									
Actuated Green, G (s)		31.0	130.0	42.0	79.0					39.0		39.0
Effective Green, g (s)		31.0	130.0	42.0	79.0					39.0		39.0
Actuated g/C Ratio		0.24	1.00	0.32	0.61					0.30		0.30
Clearance Time (s)		6.0		6.0	6.0					6.0		6.0
Vehicle Extension (s)		5.0		3.0	5.0					3.0		3.0
Lane Grp Cap (vph)		755	1417	545	2050					990		457
v/s Ratio Prot		c0.23		c0.34	0.32					0.07		c0.35
v/s Ratio Perm			0.35									
v/c Ratio		0.95	0.35	1.06	0.53					0.25		1.16
Uniform Delay, d1		48.7	0.0	44.0	14.7					34.4		45.5
Progression Factor		1.00	1.00	0.39	0.09					1.00		1.00
Incremental Delay, d2		22.5	0.7	49.0	0.4					0.1		92.9
Delay (s)		71.3	0.7	66.0	1.8					34.5		138.4
Level of Service		E	A	E	A					C		F
Approach Delay (s)		42.4			24.1			0.0			108.5	
Approach LOS		D			C			A			F	

Intersection Summary			
HCM 2000 Control Delay	49.3	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	1.06		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	86.0%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
4 ~~3~~: Exit 5 NB Off & NH 28

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑			↑↑	↱	↰		↱			
Traffic Volume (vph)	505	335	0	0	740	630	470	0	180	0	0	0
Future Volume (vph)	505	335	0	0	740	630	470	0	180	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0			6.0	4.0	6.0		6.0			
Lane Util. Factor	1.00	0.95			0.95	1.00	1.00		1.00			
Frt	1.00	1.00			1.00	0.85	1.00		0.85			
Flt Protected	0.95	1.00			1.00	1.00	0.95		1.00			
Satd. Flow (prot)	1641	3282			3438	1538	1656		1482			
Flt Permitted	0.95	1.00			1.00	1.00	0.95		1.00			
Satd. Flow (perm)	1641	3282			3438	1538	1656		1482			
Peak-hour factor, PHF	0.87	0.87	0.87	0.90	0.90	0.90	0.78	0.78	0.78	0.92	0.92	0.92
Adj. Flow (vph)	580	385	0	0	822	700	603	0	231	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	116	0	0	0
Lane Group Flow (vph)	580	385	0	0	822	700	603	0	115	0	0	0
Heavy Vehicles (%)	10%	10%	10%	5%	5%	5%	9%	9%	9%	2%	2%	2%
Turn Type	Prot	NA			NA	Free	Prot		Prot			
Protected Phases	5	2			6		8		8			
Permitted Phases		2			6	Free						
Actuated Green, G (s)	41.0	76.0			29.0	130.0	42.0		42.0			
Effective Green, g (s)	41.0	76.0			29.0	130.0	42.0		42.0			
Actuated g/C Ratio	0.32	0.58			0.22	1.00	0.32		0.32			
Clearance Time (s)	6.0	6.0			6.0		6.0		6.0			
Vehicle Extension (s)	5.0	5.0			5.0		3.0		3.0			
Lane Grp Cap (vph)	517	1918			766	1538	535		478			
v/s Ratio Prot	c0.35	0.12			c0.24		c0.36		0.08			
v/s Ratio Perm						0.46						
v/c Ratio	1.12	0.20			1.07	0.46	1.13		0.24			
Uniform Delay, d1	44.5	12.7			50.5	0.0	44.0		32.3			
Progression Factor	0.14	0.01			1.00	1.00	1.00		1.00			
Incremental Delay, d2	64.7	0.2			53.9	1.0	78.8		0.3			
Delay (s)	70.9	0.3			104.4	1.0	122.8		32.5			
Level of Service	E	A			F	A	F		C			
Approach Delay (s)		42.7			56.9			97.8			0.0	
Approach LOS		D			E			F			A	

Intersection Summary			
HCM 2000 Control Delay	63.0	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.11		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	86.0%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	80	0	25	0	1	0	60	430	0	5	930	20
Future Volume (vph)	80	0	25	0	1	0	60	430	0	5	930	20
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0	6.0		6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor		1.00	1.00		1.00		1.00	0.95		1.00	0.95	
Frt		1.00	0.85		1.00		1.00	1.00		1.00	1.00	
Flt Protected		0.95	1.00		1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1770	1583		1900		1770	3539		1770	3528	
Flt Permitted		0.76	1.00		1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)		1407	1583		1900		1770	3539		1770	3528	
Peak-hour factor, PHF	0.92	0.92	0.92	0.25	0.25	0.25	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	87	0	27	0	4	0	65	467	0	5	1011	22
RTOR Reduction (vph)	0	0	12	0	0	0	0	0	0	0	1	0
Lane Group Flow (vph)	0	87	15	0	4	0	65	467	0	5	1032	0
Heavy Vehicles (%)	2%	2%	2%	0%	0%	0%	2%	2%	2%	2%	2%	2%
Turn Type	Perm	NA	custom		NA		Prot	NA		Prot	NA	
Protected Phases		8			4		5	2		1	6	
Permitted Phases	8		6	4								
Actuated Green, G (s)		7.9	40.1		7.9		6.4	45.7		0.8	40.1	
Effective Green, g (s)		7.9	40.1		7.9		6.4	45.7		0.8	40.1	
Actuated g/C Ratio		0.11	0.55		0.11		0.09	0.63		0.01	0.55	
Clearance Time (s)		6.0	6.0		6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)		3.0	3.0		3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		153	876		207		156	2233		19	1954	
v/s Ratio Prot					0.00		c0.04	c0.13		0.00	c0.29	
v/s Ratio Perm		c0.06	0.01									
v/c Ratio		0.57	0.02		0.02		0.42	0.21		0.26	0.53	
Uniform Delay, d1		30.6	7.3		28.8		31.2	5.7		35.5	10.2	
Progression Factor		1.00	1.00		1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		4.8	0.0		0.0		1.8	0.0		7.3	0.3	
Delay (s)		35.4	7.3		28.8		33.0	5.7		42.8	10.4	
Level of Service		D	A		C		C	A		D	B	
Approach Delay (s)		28.8			28.8			9.1			10.6	
Approach LOS		C			C			A			B	

Intersection Summary			
HCM 2000 Control Delay	11.4	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.52		
Actuated Cycle Length (s)	72.4	Sum of lost time (s)	18.0
Intersection Capacity Utilization	61.8%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	10	70	10	370	0	50	0	370	110	15	495	0
Future Volume (vph)	10	70	10	370	0	50	0	370	110	15	495	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0			6.0			6.0			6.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		0.98			0.98			0.97			1.00	
Flt Protected		0.99			0.96			1.00			1.00	
Satd. Flow (prot)		1824			1738			1705			1807	
Flt Permitted		0.94			0.68			1.00			0.98	
Satd. Flow (perm)		1716			1243			1705			1772	
Peak-hour factor, PHF	0.60	0.60	0.60	0.96	0.96	0.96	0.89	0.89	0.89	0.86	0.86	0.86
Adj. Flow (vph)	17	117	17	385	0	52	0	416	124	17	576	0
RTOR Reduction (vph)	0	5	0	0	22	0	0	12	0	0	0	0
Lane Group Flow (vph)	0	146	0	0	415	0	0	528	0	0	593	0
Heavy Vehicles (%)	2%	2%	2%	3%	3%	3%	8%	8%	8%	5%	5%	5%
Turn Type	Perm	NA		Perm	NA			NA		Perm	NA	
Protected Phases		4			4			2			2	
Permitted Phases	4			4						2		
Actuated Green, G (s)		30.7			30.7			33.9			33.9	
Effective Green, g (s)		30.7			30.7			33.9			33.9	
Actuated g/C Ratio		0.40			0.40			0.44			0.44	
Clearance Time (s)		6.0			6.0			6.0			6.0	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		687			498			754			784	
v/s Ratio Prot								0.31				
v/s Ratio Perm		0.08			c0.33						c0.33	
v/c Ratio		0.21			0.83			0.70			0.76	
Uniform Delay, d1		15.0			20.7			17.2			17.9	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		0.2			11.5			2.9			4.2	
Delay (s)		15.2			32.1			20.1			22.1	
Level of Service		B			C			C			C	
Approach Delay (s)		15.2			32.1			20.1			22.1	
Approach LOS		B			C			C			C	

Intersection Summary			
HCM 2000 Control Delay	23.4	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	76.6	Sum of lost time (s)	12.0
Intersection Capacity Utilization	79.7%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	20	280	80	20	430	265	170	180	20	90	240	30
Future Volume (vph)	20	280	80	20	430	265	170	180	20	90	240	30
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	6.0
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.97		1.00	0.94		1.00	0.98		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1656	1685		1703	1690		1719	1782		1703	1792	1524
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1656	1685		1703	1690		1719	1782		1703	1792	1524
Peak-hour factor, PHF	0.96	0.96	0.96	0.94	0.94	0.94	0.85	0.85	0.85	0.91	0.91	0.91
Adj. Flow (vph)	21	292	83	21	457	282	200	212	24	99	264	33
RTOR Reduction (vph)	0	8	0	0	17	0	0	4	0	0	0	27
Lane Group Flow (vph)	21	367	0	21	722	0	200	232	0	99	264	6
Heavy Vehicles (%)	9%	9%	9%	6%	6%	6%	5%	5%	5%	6%	6%	6%
Parking (#/hr)			0									
Turn Type	Prot	NA		Prot	NA		Prot	NA		Prot	NA	pm+ov
Protected Phases	5	2		1	6		3	8		7	4	5
Permitted Phases												4
Actuated Green, G (s)	3.1	51.3		1.5	49.7		18.0	29.5		7.1	18.6	21.7
Effective Green, g (s)	3.1	51.3		1.5	49.7		18.0	29.5		7.1	18.6	21.7
Actuated g/C Ratio	0.03	0.45		0.01	0.44		0.16	0.26		0.06	0.16	0.19
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	45	762		22	740		272	463		106	293	372
v/s Ratio Prot	c0.01	0.22		0.01	c0.43		c0.12	0.13		0.06	c0.15	0.00
v/s Ratio Perm												0.00
v/c Ratio	0.47	0.48		0.95	0.98		0.74	0.50		0.93	0.90	0.02
Uniform Delay, d1	54.3	21.7		55.9	31.3		45.4	35.7		52.9	46.5	37.2
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	7.5	0.5		169.9	26.9		9.9	0.9		66.1	28.6	0.0
Delay (s)	61.8	22.2		225.8	58.2		55.3	36.6		119.0	75.1	37.2
Level of Service	E	C		F	E		E	D		F	E	D
Approach Delay (s)		24.3			62.8			45.2			82.9	
Approach LOS		C			E			D			F	

Intersection Summary			
HCM 2000 Control Delay	55.3	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	0.89		
Actuated Cycle Length (s)	113.4	Sum of lost time (s)	24.0
Intersection Capacity Utilization	75.8%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	240	10	5	240	260	190
Future Volume (vph)	240	10	5	240	260	190
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.850			0.943	
Flt Protected	0.950			0.999		
Satd. Flow (prot)	1719	1538	0	1825	1757	0
Flt Permitted	0.950			0.999		
Satd. Flow (perm)	1719	1538	0	1825	1757	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	322			309	249	
Travel Time (s)	7.3			7.0	5.7	
Peak Hour Factor	0.89	0.89	0.91	0.91	0.93	0.93
Heavy Vehicles (%)	5%	5%	4%	4%	2%	2%
Adj. Flow (vph)	270	11	5	264	280	204
Shared Lane Traffic (%)						
Lane Group Flow (vph)	270	11	0	269	484	0
Sign Control	Stop			Stop	Stop	

Intersection Summary		
Area Type:	Other	
Control Type: Unsignalized		
Intersection Capacity Utilization 45.2%		ICU Level of Service A
Analysis Period (min) 15		

Intersection	
Intersection Delay, s/veh	16.9
Intersection LOS	C

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	240	10	5	240	260	190
Future Vol, veh/h	240	10	5	240	260	190
Peak Hour Factor	0.89	0.89	0.91	0.91	0.93	0.93
Heavy Vehicles, %	5	5	4	4	2	2
Mvmt Flow	270	11	5	264	280	204
Number of Lanes	1	1	0	1	1	0

Approach	EB	NB	SB
Opposing Approach		SB	NB
Opposing Lanes	0	1	1
Conflicting Approach Left	SB	EB	
Conflicting Lanes Left	1	2	0
Conflicting Approach Right	NB		EB
Conflicting Lanes Right	1	0	2
HCM Control Delay	17.1	13	18.9
HCM LOS	C	B	C

Lane	NBLn1	EBLn1	EBLn2	SBLn1
Vol Left, %	2%	100%	0%	0%
Vol Thru, %	98%	0%	0%	58%
Vol Right, %	0%	0%	100%	42%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	245	240	10	450
LT Vol	5	240	0	0
Through Vol	240	0	0	260
RT Vol	0	0	10	190
Lane Flow Rate	269	270	11	484
Geometry Grp	2	7	7	2
Degree of Util (X)	0.427	0.527	0.018	0.69
Departure Headway (Hd)	5.703	7.036	5.816	5.131
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	630	512	614	702
Service Time	3.758	4.786	3.565	3.18
HCM Lane V/C Ratio	0.427	0.527	0.018	0.689
HCM Control Delay	13	17.4	8.7	18.9
HCM Lane LOS	B	C	A	C
HCM 95th-tile Q	2.1	3	0.1	5.5

	→	↘	↙	←	↖	↗
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑	↱	↰	↑↑	↰↰	↱
Traffic Volume (vph)	1090	270	180	1110	280	200
Future Volume (vph)	1090	270	180	1110	280	200
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5	4.5	4.5	4.5	4.5
Lane Util. Factor	0.95	1.00	1.00	0.95	0.97	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (prot)	3539	1583	1770	3539	3433	1583
Flt Permitted	1.00	1.00	0.09	1.00	0.95	1.00
Satd. Flow (perm)	3539	1583	160	3539	3433	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	1185	293	196	1207	304	217
RTOR Reduction (vph)	0	167	0	0	0	17
Lane Group Flow (vph)	1185	126	196	1207	304	200
Turn Type	NA	Perm	pm+pt	NA	Prot	pm+ov
Protected Phases	4		3	8	2	3
Permitted Phases		4	8			2
Actuated Green, G (s)	42.9	42.9	59.1	59.1	31.9	43.6
Effective Green, g (s)	42.9	42.9	59.1	59.1	31.9	43.6
Actuated g/C Ratio	0.43	0.43	0.59	0.59	0.32	0.44
Clearance Time (s)	4.5	4.5	4.5	4.5	4.5	4.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	1518	679	282	2091	1095	761
v/s Ratio Prot	c0.33		c0.08	0.34	0.09	c0.03
v/s Ratio Perm		0.08	0.33			0.10
v/c Ratio	0.78	0.19	0.70	0.58	0.28	0.26
Uniform Delay, d1	24.5	17.7	21.3	12.7	25.4	18.0
Progression Factor	1.00	1.00	1.00	1.96	1.00	1.00
Incremental Delay, d2	2.7	0.1	5.9	0.3	0.6	0.2
Delay (s)	27.2	17.8	27.2	25.3	26.1	18.1
Level of Service	C	B	C	C	C	B
Approach Delay (s)	25.3			25.5	22.8	
Approach LOS	C			C	C	

Intersection Summary			
HCM 2000 Control Delay	25.0	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.59		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	13.5
Intersection Capacity Utilization	59.3%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations	↰	↑↑↱		↰	↑↱			↰↑	↱	↰	↱	
Traffic Volume (vph)	60	1200	30	50	1100	10	5	5	40	150	20	40
Future Volume (vph)	60	1200	30	50	1100	10	5	5	40	150	20	40
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0			6.0	6.0	6.0	6.0	
Lane Util. Factor	1.00	0.91		1.00	0.95			1.00	1.00	1.00	1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00			1.00	1.00	1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00			0.98	1.00	1.00	1.00	
Frt	1.00	1.00		1.00	1.00			1.00	0.85	1.00	0.90	
Flt Protected	0.95	1.00		0.95	1.00			0.98	1.00	0.95	1.00	
Satd. Flow (prot)	1687	4830		1719	3434			1779	1583	1805	1710	
Flt Permitted	0.95	1.00		0.95	1.00			0.88	1.00	0.75	1.00	
Satd. Flow (perm)	1687	4830		1719	3434			1608	1583	1419	1710	
Peak-hour factor, PHF	0.89	0.89	0.89	0.96	0.96	0.96	0.65	0.65	0.65	0.67	0.67	0.67
Adj. Flow (vph)	67	1348	34	52	1146	10	8	8	62	224	30	60
RTOR Reduction (vph)	0	2	0	0	0	0	0	0	24	0	48	0
Lane Group Flow (vph)	67	1380	0	52	1156	0	0	16	38	224	42	0
Confl. Peds. (#/hr)							40					
Heavy Vehicles (%)	7%	7%	7%	5%	5%	5%	2%	2%	2%	0%	0%	0%
Turn Type	Prot	NA		Prot	NA		Perm	NA	pm+ov	Perm	NA	
Protected Phases	1	6		5	2			4	1		8	
Permitted Phases							4		4	8		
Actuated Green, G (s)	8.2	54.1		7.4	53.3			20.5	28.7	20.5	20.5	
Effective Green, g (s)	8.2	54.1		7.4	53.3			20.5	28.7	20.5	20.5	
Actuated g/C Ratio	0.08	0.54		0.07	0.53			0.20	0.29	0.20	0.20	
Clearance Time (s)	6.0	6.0		6.0	6.0			6.0	6.0	6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	138	2613		127	1830			329	549	290	350	
v/s Ratio Prot	c0.04	0.29		0.03	c0.34				0.01		0.02	
v/s Ratio Perm								0.01	0.02	c0.16		
v/c Ratio	0.49	0.53		0.41	0.63			0.05	0.07	0.77	0.12	
Uniform Delay, d1	43.9	14.7		44.2	16.4			31.9	25.9	37.5	32.4	
Progression Factor	1.38	0.49		1.00	1.00			1.00	1.00	1.00	1.00	
Incremental Delay, d2	2.0	0.6		2.1	1.7			0.1	0.1	12.0	0.2	
Delay (s)	62.4	7.8		46.4	18.1			32.0	26.0	49.6	32.6	
Level of Service	E	A		D	B			C	C	D	C	
Approach Delay (s)		10.3			19.3			27.2			44.7	
Approach LOS		B			B			C			D	

Intersection Summary			
HCM 2000 Control Delay	17.9	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.65		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	64.9%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations	↰	↑↑	↱	↰↰	↑↑		↰↰	↑↑	↱	↰	↑↑	↱
Traffic Volume (vph)	100	70	40	50	100	0	130	820	320	30	935	220
Future Volume (vph)	100	70	40	50	100	0	130	820	320	30	935	220
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0		6.0	6.0	4.0	6.0	6.0	6.0
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95		0.97	0.95	1.00	1.00	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1736	3471	1553	3335	3438		3400	3505	1568	1752	3505	1568
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1736	3471	1553	3335	3438		3400	3505	1568	1752	3505	1568
Peak-hour factor, PHF	0.84	0.84	0.84	0.79	0.79	0.79	0.86	0.86	0.86	0.99	0.99	0.99
Adj. Flow (vph)	119	83	48	63	127	0	151	953	372	30	944	222
RTOR Reduction (vph)	0	0	35	0	0	0	0	0	0	0	0	73
Lane Group Flow (vph)	119	83	13	63	127	0	151	953	372	30	944	149
Heavy Vehicles (%)	4%	4%	4%	5%	5%	5%	3%	3%	3%	3%	3%	3%
Turn Type	Prot	NA	pm+ov	Prot	NA		Prot	NA	Free	Prot	NA	pt+ov
Protected Phases	1	6	7	5	2		3	8		7	4	4 5
Permitted Phases		6	6		2			8	Free		4	
Actuated Green, G (s)	14.2	25.0	30.5	7.0	17.8		10.0	49.5	111.0	5.5	45.0	58.0
Effective Green, g (s)	14.2	25.0	30.5	7.0	17.8		10.0	49.5	111.0	5.5	45.0	58.0
Actuated g/C Ratio	0.13	0.23	0.27	0.06	0.16		0.09	0.45	1.00	0.05	0.41	0.52
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	222	781	510	210	551		306	1563	1568	86	1420	819
v/s Ratio Prot	c0.07	0.02	0.00	0.02	0.04		c0.04	c0.27		0.02	c0.27	0.10
v/s Ratio Perm			0.01						c0.24			
v/c Ratio	0.54	0.11	0.03	0.30	0.23		0.49	0.61	0.24	0.35	0.66	0.18
Uniform Delay, d1	45.3	34.1	29.4	49.7	40.6		48.1	23.4	0.0	51.0	26.9	14.0
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.43	0.64	0.28
Incremental Delay, d2	2.5	0.3	0.0	0.8	1.0		1.3	0.7	0.4	2.0	1.0	0.1
Delay (s)	47.8	34.4	29.4	50.5	41.6		49.3	24.1	0.4	75.2	18.2	4.1
Level of Service	D	C	C	D	D		D	C	A	E	B	A
Approach Delay (s)		39.8			44.5			20.7			17.0	
Approach LOS		D			D			C			B	

Intersection Summary			
HCM 2000 Control Delay	22.3	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.56		
Actuated Cycle Length (s)	111.0	Sum of lost time (s)	24.0
Intersection Capacity Utilization	58.9%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	NWL	NWR	NET	NER	SWL	SWT
Lane Configurations						
Traffic Volume (vph)	205	60	580	330	50	980
Future Volume (vph)	205	60	580	330	50	980
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	4.0	6.0	6.0
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1583	3505	1568	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.29	1.00
Satd. Flow (perm)	1770	1583	3505	1568	536	3539
Peak-hour factor, PHF	0.83	0.83	0.86	0.86	0.81	0.81
Adj. Flow (vph)	247	72	674	384	62	1210
RTOR Reduction (vph)	0	44	0	0	0	0
Lane Group Flow (vph)	247	28	674	384	62	1210
Heavy Vehicles (%)	2%	2%	3%	3%	2%	2%
Turn Type	Prot	pm+ov	NA	Free	pm+pt	NA
Protected Phases	1 2 5 6	7	8		7	3 4
Permitted Phases		1 2 5 6		Free	3 4	
Actuated Green, G (s)	38.0	43.5	49.5	111.0	61.0	61.0
Effective Green, g (s)	38.0	43.5	49.5	111.0	61.0	61.0
Actuated g/C Ratio	0.34	0.39	0.45	1.00	0.55	0.55
Clearance Time (s)		6.0	6.0		6.0	
Vehicle Extension (s)		3.0	3.0		3.0	
Lane Grp Cap (vph)	605	705	1563	1568	355	1944
v/s Ratio Prot	c0.14	0.00	0.19		0.01	c0.34
v/s Ratio Perm		0.02		0.24	0.09	
v/c Ratio	0.41	0.04	0.43	0.24	0.17	0.62
Uniform Delay, d1	27.9	20.9	21.1	0.0	12.8	17.1
Progression Factor	1.00	1.00	0.37	1.00	1.00	1.00
Incremental Delay, d2	0.5	0.0	0.2	0.3	0.2	0.6
Delay (s)	28.4	20.9	7.9	0.3	13.0	17.7
Level of Service	C	C	A	A	B	B
Approach Delay (s)	26.7		5.1			17.5
Approach LOS	C		A			B

Intersection Summary			
HCM 2000 Control Delay	13.7	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.61		
Actuated Cycle Length (s)	111.0	Sum of lost time (s)	24.0
Intersection Capacity Utilization	48.4%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	20	240	0	0	330	10	5	0	5	20	0	180
Future Volume (vph)	20	240	0	0	330	10	5	0	5	20	0	180
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0			6.0			6.0	6.0		6.0	6.0
Lane Util. Factor	1.00	0.95			0.95			1.00	1.00		1.00	1.00
Frt	1.00	1.00			1.00			1.00	0.85		1.00	0.85
Flt Protected	0.95	1.00			1.00			0.95	1.00		0.95	1.00
Satd. Flow (prot)	1687	3374			3523			1805	1615		1787	1599
Flt Permitted	0.95	1.00			1.00			0.74	1.00		0.75	1.00
Satd. Flow (perm)	1687	3374			3523			1412	1615		1413	1599
Peak-hour factor, PHF	0.83	0.83	0.83	0.92	0.92	0.92	0.50	0.50	0.50	0.90	0.90	0.90
Adj. Flow (vph)	24	289	0	0	359	11	10	0	10	22	0	200
RTOR Reduction (vph)	0	0	0	0	2	0	0	0	9	0	0	178
Lane Group Flow (vph)	24	289	0	0	368	0	0	10	1	0	22	22
Heavy Vehicles (%)	7%	7%	7%	2%	2%	2%	0%	0%	0%	1%	1%	1%
Turn Type	Prot	NA		Prot	NA		Perm	NA	Perm	Perm	NA	Perm
Protected Phases	5	2		1	6			8			4	
Permitted Phases					6		8	8	8	4		4
Actuated Green, G (s)	1.5	44.9			37.4			7.0	7.0		7.0	7.0
Effective Green, g (s)	1.5	44.9			37.4			7.0	7.0		7.0	7.0
Actuated g/C Ratio	0.02	0.70			0.59			0.11	0.11		0.11	0.11
Clearance Time (s)	6.0	6.0			6.0			6.0	6.0		6.0	6.0
Vehicle Extension (s)	3.0	3.0			3.0			3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	39	2370			2061			154	176		154	175
v/s Ratio Prot	c0.01	0.09			c0.10							
v/s Ratio Perm								0.01	0.00		c0.02	0.01
v/c Ratio	0.62	0.12			0.18			0.06	0.01		0.14	0.13
Uniform Delay, d1	30.9	3.1			6.1			25.5	25.4		25.7	25.7
Progression Factor	1.00	1.00			1.00			1.00	1.00		1.00	1.00
Incremental Delay, d2	25.5	0.1			0.0			0.2	0.0		0.4	0.3
Delay (s)	56.4	3.2			6.2			25.7	25.4		26.2	26.0
Level of Service	E	A			A			C	C		C	C
Approach Delay (s)		7.3			6.2			25.5			26.0	
Approach LOS		A			A			C			C	

Intersection Summary			
HCM 2000 Control Delay	11.7	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.19		
Actuated Cycle Length (s)	63.9	Sum of lost time (s)	18.0
Intersection Capacity Utilization	39.8%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	30	200	5	5	330	120	10	5	5	170	5	110
Future Volume (vph)	30	200	5	5	330	120	10	5	5	170	5	110
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	6.0
Lane Util. Factor	0.97	0.95		1.00	0.95		1.00	1.00		0.95	0.95	1.00
Frt	1.00	1.00		1.00	0.96		1.00	0.93		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	0.96	1.00
Satd. Flow (prot)	3303	3393		1736	3332		1805	1758		1665	1674	1568
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	0.96	1.00
Satd. Flow (perm)	3303	3393		1736	3332		1805	1758		1665	1674	1568
Peak-hour factor, PHF	0.83	0.83	0.83	0.97	0.97	0.97	0.67	0.67	0.67	0.90	0.90	0.90
Adj. Flow (vph)	36	241	6	5	340	124	15	7	7	189	6	122
RTOR Reduction (vph)	0	2	0	0	39	0	0	7	0	0	0	80
Lane Group Flow (vph)	36	245	0	5	425	0	15	7	0	98	97	42
Heavy Vehicles (%)	6%	6%	6%	4%	4%	4%	0%	0%	0%	3%	3%	3%
Turn Type	Prot	NA		Prot	NA		Split	NA		Split	NA	pt+ov
Protected Phases	5	2		1	6		3	3		4	4	4 5
Permitted Phases								3				
Actuated Green, G (s)	5.0	23.9		0.9	19.8		2.1	2.1		9.8	9.8	20.8
Effective Green, g (s)	5.0	23.9		0.9	19.8		2.1	2.1		9.8	9.8	20.8
Actuated g/C Ratio	0.08	0.39		0.01	0.33		0.03	0.03		0.16	0.16	0.34
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	272	1335		25	1086		62	60		268	270	537
v/s Ratio Prot	c0.01	c0.07		0.00	c0.13		c0.01	0.00		c0.06	0.06	0.03
v/s Ratio Perm												
v/c Ratio	0.13	0.18		0.20	0.39		0.24	0.12		0.37	0.36	0.08
Uniform Delay, d1	25.8	12.0		29.5	15.8		28.5	28.4		22.7	22.7	13.5
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	0.2	0.1		3.9	0.2		2.0	0.9		0.8	0.8	0.1
Delay (s)	26.1	12.1		33.5	16.0		30.6	29.3		23.5	23.5	13.5
Level of Service	C	B		C	B		C	C		C	C	B
Approach Delay (s)		13.9			16.2			30.0			19.7	
Approach LOS		B			B			C			B	

Intersection Summary			
HCM 2000 Control Delay	17.0	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.35		
Actuated Cycle Length (s)	60.7	Sum of lost time (s)	24.0
Intersection Capacity Utilization	38.9%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Intersection						
Int Delay, s/veh	2.1					

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	50	210	350	10	30	40
Future Vol, veh/h	50	210	350	10	30	40
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	84	84	89	89	83	83
Heavy Vehicles, %	7	7	4	4	6	6
Mvmt Flow	60	250	393	11	36	48

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	404	0	-	0	769	399
Stage 1	-	-	-	-	399	-
Stage 2	-	-	-	-	370	-
Critical Hdwy	4.17	-	-	-	6.46	6.26
Critical Hdwy Stg 1	-	-	-	-	5.46	-
Critical Hdwy Stg 2	-	-	-	-	5.46	-
Follow-up Hdwy	2.263	-	-	-	3.554	3.354
Pot Cap-1 Maneuver	1128	-	-	-	364	642
Stage 1	-	-	-	-	669	-
Stage 2	-	-	-	-	690	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1128	-	-	-	345	642
Mov Cap-2 Maneuver	-	-	-	-	345	-
Stage 1	-	-	-	-	634	-
Stage 2	-	-	-	-	690	-

Approach	EB	WB	SB
HCM Control Delay, s	1.6	0	14.4
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1128	-	-	-	469
HCM Lane V/C Ratio	0.053	-	-	-	0.18
HCM Control Delay (s)	8.4	-	-	-	14.4
HCM Lane LOS	A	-	-	-	B
HCM 95th %tile Q(veh)	0.2	-	-	-	0.6

Lane Group	WBL2	WBL	WBR	WBR2	NBL	NBT	NBR	NBR2	SBL2	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	10	325	325	20	100	100	40	10	10	150	130	50
Future Volume (vph)	10	325	325	20	100	100	40	10	10	150	130	50
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)		0	150		0		150			0		0
Storage Lanes		1	0		0		0			0		0
Taper Length (ft)		25			25					25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.932				0.973					0.980	
Flt Protected		0.976				0.980					0.977	
Satd. Flow (prot)	0	1678	0	0	0	1759	0	0	0	0	1700	0
Flt Permitted		0.976				0.980					0.977	
Satd. Flow (perm)	0	1678	0	0	0	1759	0	0	0	0	1700	0
Link Speed (mph)		30				30					30	
Link Distance (ft)		465				456					371	
Travel Time (s)		10.6				10.4					8.4	
Peak Hour Factor	0.91	0.91	0.91	0.91	0.86	0.86	0.86	0.86	0.80	0.80	0.80	0.80
Heavy Vehicles (%)	3%	3%	3%	3%	3%	3%	3%	3%	7%	7%	7%	7%
Adj. Flow (vph)	11	357	357	22	116	116	47	12	13	188	163	63
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	747	0	0	0	291	0	0	0	0	427	0
Sign Control		Yield				Yield					Yield	

Intersection Summary

Area Type: Other
Control Type: Roundabout
Intersection Capacity Utilization 112.5% ICU Level of Service H
Analysis Period (min) 15

Lane Group	NEL	NET	NER	NER2	SWL2	SWL	SWT	SWR
Lane Configurations		✥					✥	
Traffic Volume (vph)	70	140	120	120	5	30	230	10
Future Volume (vph)	70	140	120	120	5	30	230	10
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		150			150		0
Storage Lanes	0		0			0		0
Taper Length (ft)	25					25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.928					0.995	
Flt Protected		0.992					0.994	
Satd. Flow (prot)	0	1620	0	0	0	0	1756	0
Flt Permitted		0.992					0.994	
Satd. Flow (perm)	0	1620	0	0	0	0	1756	0
Link Speed (mph)		30					30	
Link Distance (ft)		400					528	
Travel Time (s)		9.1					12.0	
Peak Hour Factor	0.60	0.60	0.60	0.60	0.83	0.83	0.83	0.83
Heavy Vehicles (%)	8%	8%	8%	8%	7%	7%	7%	7%
Adj. Flow (vph)	117	233	200	200	6	36	277	12
Shared Lane Traffic (%)								
Lane Group Flow (vph)	0	750	0	0	0	0	331	0
Sign Control		Yield					Yield	

Intersection Summary

Intersection	
Intersection Delay, s/veh	50.5
Intersection LOS	F

Approach	WB	NB	SB	NE	SW
Entry Lanes	1	1	1	1	1
Conflicting Circle Lanes	1	1	1	1	1
Adj Approach Flow, veh/h	747	291	427	750	331
Demand Flow Rate, veh/h	770	298	456	810	354
Vehicles Circulating, veh/h	678	815	839	445	1111
Vehicles Exiting, veh/h	435	440	626	850	337
Ped Vol Crossing Leg, #/h	0	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000	1.000
Approach Delay, s/veh	94.0	14.5	29.7	38.2	39.1
Approach LOS	F	B	D	E	E

Lane	Left	Left	Left	Left	Left
Designated Moves	LR	LTR	LTR	LTR	LTR
Assumed Moves	LR	LTR	LTR	LTR	LTR
RT Channelized					
Lane Util	1.000	1.000	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976	4.976	4.976
Entry Flow, veh/h	770	298	456	810	354
Cap Entry Lane, veh/h	691	601	586	876	444
Entry HV Adj Factor	0.970	0.975	0.936	0.926	0.933
Flow Entry, veh/h	747	291	427	750	330
Cap Entry, veh/h	670	586	549	812	415
V/C Ratio	1.114	0.496	0.778	0.924	0.797
Control Delay, s/veh	94.0	14.5	29.7	38.2	39.1
LOS	F	B	D	E	E
95th %tile Queue, veh	22	3	7	13	7

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↰	↱		✣			✣			✣	
Traffic Volume (vph)	10	20	260	10	40	50	280	160	10	10	90	20
Future Volume (vph)	10	20	260	10	40	50	280	160	10	10	90	20
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		30	0		0	0		0	0		0
Storage Lanes	0		1	0		0	0		0	0		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt			0.850		0.932			0.997			0.978	
Flt Protected		0.984			0.995			0.970			0.996	
Satd. Flow (prot)	0	1731	1495	0	1678	0	0	1784	0	0	1780	0
Flt Permitted		0.984			0.995			0.970			0.996	
Satd. Flow (perm)	0	1731	1495	0	1678	0	0	1784	0	0	1780	0
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		113			453			475			436	
Travel Time (s)		2.6			10.3			10.8			9.9	
Confl. Peds. (#/hr)			155									
Peak Hour Factor	0.82	0.82	0.82	0.70	0.70	0.70	0.75	0.75	0.75	0.71	0.71	0.71
Heavy Vehicles (%)	8%	8%	8%	5%	5%	5%	3%	3%	3%	4%	4%	4%
Adj. Flow (vph)	12	24	317	14	57	71	373	213	13	14	127	28
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	36	317	0	142	0	0	599	0	0	169	0
Sign Control		Stop			Stop			Free			Free	

Intersection Summary		
Area Type:	Other	
Control Type: Unsignalized		
Intersection Capacity Utilization 51.1%		ICU Level of Service A
Analysis Period (min) 15		

Intersection	
Int Delay, s/veh	24.1

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	10	20	260	10	40	50	280	160	10	10	90	20
Future Vol, veh/h	10	20	260	10	40	50	280	160	10	10	90	20
Conflicting Peds, #/hr	0	0	155	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	30	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	82	82	82	70	70	70	75	75	75	71	71	71
Heavy Vehicles, %	8	8	8	5	5	5	3	3	3	4	4	4
Mvmt Flow	12	24	317	14	57	71	373	213	13	14	127	28

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1199	1141	296	1461	1149	220	155	0	0	226	0	0
Stage 1	169	169	-	966	966	-	-	-	-	-	-	-
Stage 2	1030	972	-	495	183	-	-	-	-	-	-	-
Critical Hdwy	7.18	6.58	6.28	7.15	6.55	6.25	4.13	-	-	4.14	-	-
Critical Hdwy Stg 1	6.18	5.58	-	6.15	5.55	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.18	5.58	-	6.15	5.55	-	-	-	-	-	-	-
Follow-up Hdwy	3.572	4.072	3.372	3.545	4.045	3.345	2.227	-	-	2.236	-	-
Pot Cap-1 Maneuver	158	196	729	105	196	812	1419	-	-	1331	-	-
Stage 1	819	747	-	302	329	-	-	-	-	-	-	-
Stage 2	275	323	-	551	743	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	75	135	621	29	135	812	1419	-	-	1331	-	-
Mov Cap-2 Maneuver	75	135	-	29	135	-	-	-	-	-	-	-
Stage 1	572	738	-	211	230	-	-	-	-	-	-	-
Stage 2	132	226	-	220	734	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	20.7	138.9	5.3	0.6
HCM LOS	C	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1419	-	-	107	621	142	1331	-	-
HCM Lane V/C Ratio	0.263	-	-	0.342	0.511	1.006	0.011	-	-
HCM Control Delay (s)	8.4	0	-	55.2	16.7	138.9	7.7	0	-
HCM Lane LOS	A	A	-	F	C	F	A	A	-
HCM 95th %tile Q(veh)	1.1	-	-	1.4	2.9	7.4	0	-	-

Movement	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations	↰	↑↱		↰	↑	↱	↰	↑↑↱		↰	↑↑↱	
Traffic Volume (vph)	30	50	20	10	40	180	150	320	70	60	470	170
Future Volume (vph)	30	50	20	10	40	180	150	320	70	60	470	170
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	0.95		1.00	0.95	
Frt	1.00	0.96		1.00	1.00	0.85	1.00	0.97		1.00	0.96	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1752	1767		1736	1827	1553	1770	3444		1787	3432	
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1752	1767		1736	1827	1553	1770	3444		1787	3432	
Peak-hour factor, PHF	0.82	0.82	0.82	0.81	0.81	0.81	0.68	0.68	0.68	0.78	0.78	0.78
Adj. Flow (vph)	37	61	24	12	49	222	221	471	103	77	603	218
RTOR Reduction (vph)	0	18	0	0	0	128	0	24	0	0	49	0
Lane Group Flow (vph)	37	67	0	12	49	94	221	550	0	77	772	0
Heavy Vehicles (%)	3%	3%	3%	4%	4%	4%	2%	2%	2%	1%	1%	1%
Turn Type	Prot	NA		Prot	NA	pt+ov	Prot	NA		Prot	NA	
Protected Phases	1	6		5	2	2 3	3	8		7	4	
Permitted Phases												
Actuated Green, G (s)	2.8	16.6		1.4	15.2	29.3	8.1	22.4		4.6	18.9	
Effective Green, g (s)	2.8	16.6		1.4	15.2	29.3	8.1	22.4		4.6	18.9	
Actuated g/C Ratio	0.04	0.24		0.02	0.22	0.42	0.12	0.32		0.07	0.27	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	71	425		35	402	659	207	1118		119	940	
v/s Ratio Prot	c0.02	0.04		0.01	0.03	c0.06	c0.12	c0.16		0.04	c0.22	
v/s Ratio Perm												
v/c Ratio	0.52	0.16		0.34	0.12	0.14	1.07	0.49		0.65	0.82	
Uniform Delay, d1	32.4	20.7		33.3	21.6	12.2	30.4	18.7		31.4	23.5	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	6.7	0.2		5.8	0.6	0.1	81.6	0.3		11.5	5.8	
Delay (s)	39.2	20.9		39.1	22.2	12.3	112.1	19.1		42.9	29.3	
Level of Service	D	C		D	C	B	F	B		D	C	
Approach Delay (s)		26.4			15.1			44.9			30.5	
Approach LOS		C			B			D			C	

Intersection Summary

HCM 2000 Control Delay	33.6	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.64		
Actuated Cycle Length (s)	69.0	Sum of lost time (s)	24.0
Intersection Capacity Utilization	51.2%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	220	0	10	130	240	530
Future Volume (vph)	220	0	10	130	240	530
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0		6.0	4.0	4.0	6.0
Lane Util. Factor	1.00		1.00	1.00	1.00	1.00
Frt	1.00		1.00	1.00	1.00	0.85
Flt Protected	0.95		0.95	1.00	1.00	1.00
Satd. Flow (prot)	1787		1770	1863	1845	1568
Flt Permitted	0.95		0.53	1.00	1.00	1.00
Satd. Flow (perm)	1787		984	1863	1845	1568
Peak-hour factor, PHF	0.90	0.90	0.87	0.87	0.89	0.89
Adj. Flow (vph)	244	0	11	149	270	596
RTOR Reduction (vph)	0	0	0	0	0	139
Lane Group Flow (vph)	244	0	11	149	270	457
Heavy Vehicles (%)	1%	1%	2%	2%	3%	3%
Turn Type	Prot		pm+pt	NA	NA	custom
Protected Phases	8		1	6 7	2 7	7 8
Permitted Phases			6 7			2
Actuated Green, G (s)	21.2		32.6	31.9	31.9	55.1
Effective Green, g (s)	21.2		28.6	31.9	31.9	55.1
Actuated g/C Ratio	0.30		0.40	0.44	0.44	0.77
Clearance Time (s)	6.0		6.0			
Vehicle Extension (s)	3.0		3.0			
Lane Grp Cap (vph)	527		399	827	819	1203
v/s Ratio Prot	c0.14		c0.00	0.08	0.15	c0.21
v/s Ratio Perm			0.01			0.09
v/c Ratio	0.46		0.03	0.18	0.33	0.38
Uniform Delay, d1	20.7		13.1	12.1	13.0	2.7
Progression Factor	1.00		1.00	1.00	1.06	1.74
Incremental Delay, d2	0.6		0.0	0.1	0.2	0.2
Delay (s)	21.3		13.2	12.2	13.9	5.0
Level of Service	C		B	B	B	A
Approach Delay (s)	21.3			12.2	7.8	
Approach LOS	C			B	A	

Intersection Summary			
HCM 2000 Control Delay	10.9	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.44		
Actuated Cycle Length (s)	71.8	Sum of lost time (s)	22.0
Intersection Capacity Utilization	47.0%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰↰				↰↰	
Traffic Volume (vph)	980	0	0	0	1730	0
Future Volume (vph)	980	0	0	0	1730	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0				6.0	
Lane Util. Factor	0.97				0.97	
Frt	1.00				1.00	
Flt Protected	0.95				0.95	
Satd. Flow (prot)	3433				3433	
Flt Permitted	0.95				0.95	
Satd. Flow (perm)	3433				3433	
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	1043	0	0	0	1840	0
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	1043	0	0	0	1840	0
Turn Type	Prot				Prot	
Protected Phases	2				4	
Permitted Phases						
Actuated Green, G (s)	28.0				50.0	
Effective Green, g (s)	28.0				50.0	
Actuated g/C Ratio	0.31				0.56	
Clearance Time (s)	6.0				6.0	
Vehicle Extension (s)	3.0				3.0	
Lane Grp Cap (vph)	1068				1907	
v/s Ratio Prot	c0.30				c0.54	
v/s Ratio Perm						
v/c Ratio	0.98				0.96	
Uniform Delay, d1	30.7				19.2	
Progression Factor	1.14				1.00	
Incremental Delay, d2	20.6				13.8	
Delay (s)	55.7				33.0	
Level of Service	E				C	
Approach Delay (s)	55.7		0.0			33.0
Approach LOS	E		A			C

Intersection Summary			
HCM 2000 Control Delay	41.2	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.97		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	145.8%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SBL	SBR	NWL	NWR
Lane Configurations										
Traffic Volume (vph)	0	1730	0	0	980	1390	0	0	0	795
Future Volume (vph)	0	1730	0	0	980	1390	0	0	0	795
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0			6.0	6.0			6.0	6.0
Lane Util. Factor		0.95			0.95	0.88			1.00	0.95
Frt		1.00			1.00	0.85			0.85	0.85
Flt Protected		1.00			1.00	1.00			1.00	1.00
Satd. Flow (prot)		3539			3539	2787			1583	1504
Flt Permitted		1.00			1.00	1.00			1.00	1.00
Satd. Flow (perm)		3539			3539	2787			1583	1504
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	0	1840	0	0	1043	1479	0	0	0	846
RTOR Reduction (vph)	0	0	0	0	0	18	0	0	0	0
Lane Group Flow (vph)	0	1840	0	0	1043	1461	0	0	423	423
Turn Type		NA			NA	Perm			Prot	Prot
Protected Phases		2			2				4	4
Permitted Phases	2					2				
Actuated Green, G (s)		51.0			51.0	51.0			27.0	27.0
Effective Green, g (s)		51.0			51.0	51.0			27.0	27.0
Actuated g/C Ratio		0.57			0.57	0.57			0.30	0.30
Clearance Time (s)		6.0			6.0	6.0			6.0	6.0
Vehicle Extension (s)		3.0			3.0	3.0			3.0	3.0
Lane Grp Cap (vph)		2005			2005	1579			474	451
v/s Ratio Prot		0.52			0.29				0.27	c0.28
v/s Ratio Perm						c0.52				
v/c Ratio		0.92			0.52	0.93			0.89	0.94
Uniform Delay, d1		17.6			12.0	17.8			30.1	30.7
Progression Factor		0.01			1.00	1.00			1.00	1.00
Incremental Delay, d2		2.7			1.0	10.7			18.7	27.2
Delay (s)		3.0			13.0	28.5			48.8	57.8
Level of Service		A			B	C			D	E
Approach Delay (s)		3.0			22.0		0.0		53.3	
Approach LOS		A			C		A		D	

Intersection Summary			
HCM 2000 Control Delay	20.4	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.93		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	131.6%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	60	10	320	30	10	710
Future Volume (vph)	60	10	320	30	10	710
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0		4.0	4.0	6.0	4.0
Lane Util. Factor	1.00		1.00	1.00	1.00	1.00
Frt	0.98		1.00	0.85	1.00	1.00
Flt Protected	0.96		1.00	1.00	0.95	1.00
Satd. Flow (prot)	1767		1900	1615	1805	1900
Flt Permitted	0.96		1.00	1.00	0.42	1.00
Satd. Flow (perm)	1767		1900	1615	806	1900
Peak-hour factor, PHF	0.87	0.67	0.95	0.84	0.73	0.96
Adj. Flow (vph)	69	15	337	36	14	740
RTOR Reduction (vph)	8	0	0	17	0	0
Lane Group Flow (vph)	76	0	337	19	14	740
Heavy Vehicles (%)	1%	0%	0%	0%	0%	0%
Turn Type	Prot		NA	Perm	custom	NA
Protected Phases	7		6 8		5	2 8
Permitted Phases				6 8	2	
Actuated Green, G (s)	11.6		37.5	37.5	17.0	37.5
Effective Green, g (s)	11.6		37.5	37.5	17.0	37.5
Actuated g/C Ratio	0.16		0.52	0.52	0.24	0.52
Clearance Time (s)	6.0				6.0	
Vehicle Extension (s)	3.0				3.0	
Lane Grp Cap (vph)	285		992	843	200	992
v/s Ratio Prot	c0.04		0.18		c0.00	c0.39
v/s Ratio Perm				0.01	0.02	
v/c Ratio	0.27		0.34	0.02	0.07	0.75
Uniform Delay, d1	26.4		10.0	8.3	21.2	13.4
Progression Factor	1.00		0.35	0.07	1.00	1.00
Incremental Delay, d2	0.5		0.2	0.0	0.1	3.1
Delay (s)	26.9		3.7	0.6	21.3	16.5
Level of Service	C		A	A	C	B
Approach Delay (s)	26.9		3.4			16.6
Approach LOS	C		A			B

Intersection Summary			
HCM 2000 Control Delay	13.2	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.62		
Actuated Cycle Length (s)	71.8	Sum of lost time (s)	22.0
Intersection Capacity Utilization	49.9%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	Y		↰	↑	↱	
Traffic Volume (vph)	5	30	30	300	690	20
Future Volume (vph)	5	30	30	300	690	20
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0	0	100			0
Storage Lanes	1	0	1			0
Taper Length (ft)	25		25			
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.888				0.995	
Flt Protected	0.992		0.950			
Satd. Flow (prot)	1674	0	1787	1900	1872	0
Flt Permitted	0.992		0.950			
Satd. Flow (perm)	1674	0	1787	1900	1872	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	332			288	365	
Travel Time (s)	7.5			6.5	8.3	
Peak Hour Factor	0.64	0.77	0.71	0.90	0.75	0.55
Heavy Vehicles (%)	0%	0%	1%	0%	1%	0%
Adj. Flow (vph)	8	39	42	333	920	36
Shared Lane Traffic (%)						
Lane Group Flow (vph)	47	0	42	333	956	0
Sign Control	Stop			Free	Free	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 47.5% ICU Level of Service A

Analysis Period (min) 15

Intersection						
Int Delay, s/veh	1					

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	5	30	30	300	690	20
Future Vol, veh/h	5	30	30	300	690	20
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	100	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	64	77	71	90	75	55
Heavy Vehicles, %	0	0	1	0	1	0
Mvmt Flow	8	39	42	333	920	36

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1355	938	956	0	-	0
Stage 1	938	-	-	-	-	-
Stage 2	417	-	-	-	-	-
Critical Hdwy	6.4	6.2	4.11	-	-	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.3	2.209	-	-	-
Pot Cap-1 Maneuver	166	323	723	-	-	-
Stage 1	384	-	-	-	-	-
Stage 2	669	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	156	323	723	-	-	-
Mov Cap-2 Maneuver	156	-	-	-	-	-
Stage 1	362	-	-	-	-	-
Stage 2	669	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	20.8	1.2	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	723	-	274	-	-
HCM Lane V/C Ratio	0.058	-	0.171	-	-
HCM Control Delay (s)	10.3	-	20.8	-	-
HCM Lane LOS	B	-	C	-	-
HCM 95th %tile Q(veh)	0.2	-	0.6	-	-

APPENDIX O-2: 2040 ALTERNATIVE A INTERSECTION CAPACITY ANALYSES – HCM 2000 PRINTOUTS – PM PEAK HOUR

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑↑		↰	↱↱
Traffic Volume (vph)	0	1230	1475	0	385	1195
Future Volume (vph)	0	1230	1475	0	385	1195
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	16	12
Total Lost time (s)		6.0	6.0		6.0	6.0
Lane Util. Factor		0.95	0.95		1.00	0.88
Frt		1.00	1.00		1.00	0.85
Flt Protected		1.00	1.00		0.95	1.00
Satd. Flow (prot)		3471	3406		1930	2682
Flt Permitted		1.00	1.00		0.95	1.00
Satd. Flow (perm)		3471	3406		1930	2682
Peak-hour factor, PHF	0.93	0.93	0.88	0.88	0.89	0.89
Adj. Flow (vph)	0	1323	1676	0	433	1343
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	1323	1676	0	433	1343
Heavy Vehicles (%)	4%	4%	6%	6%	6%	6%
Turn Type		NA	NA		Prot	Prot
Protected Phases		2	6		4	4
Permitted Phases						
Actuated Green, G (s)		59.0	59.0		59.0	59.0
Effective Green, g (s)		59.0	59.0		59.0	59.0
Actuated g/C Ratio		0.45	0.45		0.45	0.45
Clearance Time (s)		6.0	6.0		6.0	6.0
Vehicle Extension (s)		3.0	3.0		3.0	3.0
Lane Grp Cap (vph)		1575	1545		875	1217
v/s Ratio Prot		0.38	c0.49		0.22	c0.50
v/s Ratio Perm						
v/c Ratio		0.84	1.08		0.49	1.10
Uniform Delay, d1		31.3	35.5		25.0	35.5
Progression Factor		0.66	0.12		1.00	1.00
Incremental Delay, d2		3.4	39.5		0.4	59.0
Delay (s)		23.9	43.9		25.4	94.5
Level of Service		C	D		C	F
Approach Delay (s)		23.9	43.9		77.7	
Approach LOS		C	D		E	

Intersection Summary			
HCM 2000 Control Delay	50.9	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	1.09		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	94.6%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Movement	NBL2	NBL	NBR	SEL	SER	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations											
Traffic Volume (vph)	1360	0	725	0	0	1155	460	0	0	370	110
Future Volume (vph)	1360	0	725	0	0	1155	460	0	0	370	110
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0		6.0			6.0	6.0			6.0	4.0
Lane Util. Factor	0.97		0.88			0.97	0.95			0.95	1.00
Frt	1.00		0.85			1.00	1.00			1.00	0.85
Flt Protected	0.95		1.00			0.95	1.00			1.00	1.00
Satd. Flow (prot)	3242		2632			3335	3438			3505	1568
Flt Permitted	0.95		1.00			0.95	1.00			1.00	1.00
Satd. Flow (perm)	3242		2632			3335	3438			3505	1568
Peak-hour factor, PHF	0.88	0.88	0.88	0.92	0.92	0.94	0.94	0.94	0.92	0.92	0.92
Adj. Flow (vph)	1545	0	824	0	0	1229	489	0	0	402	120
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	1545	0	824	0	0	1229	489	0	0	402	120
Heavy Vehicles (%)	8%	8%	8%	2%	2%	5%	5%	5%	3%	3%	3%
Turn Type	Prot		Prot			Prot	NA			NA	Free
Protected Phases	8		8			5	2			6	
Permitted Phases											Free
Actuated Green, G (s)	48.0		48.0			38.0	70.0			26.0	130.0
Effective Green, g (s)	48.0		48.0			38.0	70.0			26.0	130.0
Actuated g/C Ratio	0.37		0.37			0.29	0.54			0.20	1.00
Clearance Time (s)	6.0		6.0			6.0	6.0			6.0	
Vehicle Extension (s)	3.0		3.0			3.0	3.0			3.0	
Lane Grp Cap (vph)	1197		971			974	1851			701	1568
v/s Ratio Prot	c0.48		0.31			c0.37	0.14			c0.11	
v/s Ratio Perm											0.08
v/c Ratio	1.29		0.85			1.26	0.26			0.57	0.08
Uniform Delay, d1	41.0		37.7			46.0	16.1			47.0	0.0
Progression Factor	1.00		1.00			0.76	0.46			1.00	1.00
Incremental Delay, d2	137.2		7.0			123.2	0.2			3.4	0.1
Delay (s)	178.2		44.7			158.2	7.7			50.4	0.1
Level of Service	F		D			F	A			D	A
Approach Delay (s)		131.8		0.0			115.3			38.8	
Approach LOS		F		A			F			D	

Intersection Summary			
HCM 2000 Control Delay	115.1	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.11		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	98.0%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑	↱	↰	↑↑					↰↰		↱
Traffic Volume (vph)	0	755	480	255	665	0	0	0	0	295	0	470
Future Volume (vph)	0	755	480	255	665	0	0	0	0	295	0	470
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0	4.0	6.0	6.0					6.0		6.0
Lane Util. Factor		0.95	1.00	1.00	0.95					0.97		1.00
Frt		1.00	0.85	1.00	1.00					1.00		0.85
Flt Protected		1.00	1.00	0.95	1.00					0.95		1.00
Satd. Flow (prot)		3471	1553	1719	3438					3367		1553
Flt Permitted		1.00	1.00	0.95	1.00					0.95		1.00
Satd. Flow (perm)		3471	1553	1719	3438					3367		1553
Peak-hour factor, PHF	0.87	0.87	0.87	0.86	0.86	0.86	0.92	0.92	0.92	0.91	0.91	0.91
Adj. Flow (vph)	0	868	552	297	773	0	0	0	0	324	0	516
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	137
Lane Group Flow (vph)	0	868	552	297	773	0	0	0	0	324	0	379
Heavy Vehicles (%)	4%	4%	4%	5%	5%	5%	2%	2%	2%	4%	4%	4%
Turn Type		NA	Free	Prot	NA					Prot		Prot
Protected Phases		2		1	6					4		4
Permitted Phases			Free									
Actuated Green, G (s)		29.1	90.0	18.1	53.2					24.8		24.8
Effective Green, g (s)		29.1	90.0	18.1	53.2					24.8		24.8
Actuated g/C Ratio		0.32	1.00	0.20	0.59					0.28		0.28
Clearance Time (s)		6.0		6.0	6.0					6.0		6.0
Vehicle Extension (s)		5.0		3.0	5.0					3.0		3.0
Lane Grp Cap (vph)		1122	1553	345	2032					927		427
v/s Ratio Prot		c0.25		c0.17	0.22					0.10		c0.24
v/s Ratio Perm			0.36									
v/c Ratio		0.77	0.36	0.86	0.38					0.35		0.89
Uniform Delay, d1		27.5	0.0	34.7	9.7					26.1		31.3
Progression Factor		1.00	1.00	0.04	0.00					1.00		1.00
Incremental Delay, d2		5.2	0.6	10.1	0.2					0.2		19.5
Delay (s)		32.7	0.6	11.6	0.2					26.4		50.7
Level of Service		C	A	B	A					C		D
Approach Delay (s)		20.2			3.3			0.0			41.3	
Approach LOS		C			A			A			D	

Intersection Summary			
HCM 2000 Control Delay	20.1	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	77.2%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑			↑↑	↱	↰		↱			
Traffic Volume (vph)	480	570	0	0	555	445	365	0	420	0	0	0
Future Volume (vph)	480	570	0	0	555	445	365	0	420	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0			6.0	4.0	6.0		6.0			
Lane Util. Factor	1.00	0.95			0.95	1.00	1.00		1.00			
Frt	1.00	1.00			1.00	0.85	1.00		0.85			
Flt Protected	0.95	1.00			1.00	1.00	0.95		1.00			
Satd. Flow (prot)	1752	3505			3505	1568	1703		1524			
Flt Permitted	0.95	1.00			1.00	1.00	0.95		1.00			
Satd. Flow (perm)	1752	3505			3505	1568	1703		1524			
Peak-hour factor, PHF	0.92	0.92	0.92	0.91	0.91	0.91	0.67	0.67	0.67	0.92	0.92	0.92
Adj. Flow (vph)	522	620	0	0	610	489	545	0	627	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	176	0	0	0
Lane Group Flow (vph)	522	620	0	0	610	489	545	0	451	0	0	0
Heavy Vehicles (%)	3%	3%	3%	3%	3%	3%	6%	6%	6%	2%	2%	2%
Turn Type	Prot	NA			NA	Free	Prot		Prot			
Protected Phases	5	2			6		8		8			
Permitted Phases		2			6	Free						
Actuated Green, G (s)	26.0	50.0			18.0	90.0	28.0		28.0			
Effective Green, g (s)	26.0	50.0			18.0	90.0	28.0		28.0			
Actuated g/C Ratio	0.29	0.56			0.20	1.00	0.31		0.31			
Clearance Time (s)	6.0	6.0			6.0		6.0		6.0			
Vehicle Extension (s)	5.0	5.0			5.0		3.0		3.0			
Lane Grp Cap (vph)	506	1947			701	1568	529		474			
v/s Ratio Prot	c0.30	0.18			c0.17		c0.32		0.30			
v/s Ratio Perm						0.31						
v/c Ratio	1.03	0.32			0.87	0.31	1.03		0.95			
Uniform Delay, d1	32.0	10.8			34.9	0.0	31.0		30.3			
Progression Factor	0.10	0.17			1.00	1.00	1.00		1.00			
Incremental Delay, d2	39.7	0.4			13.9	0.5	47.1		29.4			
Delay (s)	42.8	2.2			48.8	0.5	78.1		59.7			
Level of Service	D	A			D	A	E		E			
Approach Delay (s)		20.7			27.3			68.3			0.0	
Approach LOS		C			C			E			A	

Intersection Summary				
HCM 2000 Control Delay	39.2	HCM 2000 Level of Service	D	
HCM 2000 Volume to Capacity ratio	0.99			
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	18.0	
Intersection Capacity Utilization	77.2%	ICU Level of Service	D	
Analysis Period (min)	15			
c Critical Lane Group				

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	100	5	90	10	0	10	210	880	120	5	520	140
Future Volume (vph)	100	5	90	10	0	10	210	880	120	5	520	140
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0	6.0		6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor		1.00	1.00		1.00		1.00	0.95		1.00	0.95	
Frt		1.00	0.85		0.93		1.00	0.98		1.00	0.97	
Flt Protected		0.95	1.00		0.98		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1778	1583		1729		1770	3476		1770	3427	
Flt Permitted		0.78	1.00		0.78		0.95	1.00		0.95	1.00	
Satd. Flow (perm)		1461	1583		1388		1770	3476		1770	3427	
Peak-hour factor, PHF	0.92	0.92	0.92	0.25	0.25	0.25	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	109	5	98	40	0	40	228	957	130	5	565	152
RTOR Reduction (vph)	0	0	57	0	70	0	0	10	0	0	24	0
Lane Group Flow (vph)	0	114	41	0	10	0	228	1077	0	5	693	0
Heavy Vehicles (%)	2%	2%	2%	0%	0%	0%	2%	2%	2%	2%	2%	2%
Turn Type	Perm	NA	custom	Perm	NA		Prot	NA		Prot	NA	
Protected Phases		8			4		5	2		1	6	
Permitted Phases	8		6	4								
Actuated Green, G (s)		9.3	30.8		9.3		14.7	44.7		0.8	30.8	
Effective Green, g (s)		9.3	30.8		9.3		14.7	44.7		0.8	30.8	
Actuated g/C Ratio		0.13	0.42		0.13		0.20	0.61		0.01	0.42	
Clearance Time (s)		6.0	6.0		6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)		3.0	3.0		3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		186	669		177		357	2134		19	1449	
v/s Ratio Prot							c0.13	c0.31		0.00	0.20	
v/s Ratio Perm		c0.08	0.03		0.01							
v/c Ratio		0.61	0.06		0.06		0.64	0.50		0.26	0.48	
Uniform Delay, d1		30.0	12.4		27.9		26.6	7.9		35.7	15.2	
Progression Factor		1.00	1.00		1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		5.9	0.0		0.1		3.7	0.2		7.3	0.3	
Delay (s)		35.9	12.5		28.0		30.3	8.0		43.0	15.4	
Level of Service		D	B		C		C	A		D	B	
Approach Delay (s)		25.1			28.0			11.9			15.6	
Approach LOS		C			C			B			B	

Intersection Summary			
HCM 2000 Control Delay	14.8	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.58		
Actuated Cycle Length (s)	72.8	Sum of lost time (s)	18.0
Intersection Capacity Utilization	60.9%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations		✥			✥			↱			↰	
Traffic Volume (vph)	20	110	5	270	0	70	0	710	130	15	345	0
Future Volume (vph)	20	110	5	270	0	70	0	710	130	15	345	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0			6.0			6.0			6.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		1.00			0.97			0.98			1.00	
Flt Protected		0.99			0.96			1.00			1.00	
Satd. Flow (prot)		1840			1725			1723			1806	
Flt Permitted		0.92			0.58			1.00			0.70	
Satd. Flow (perm)		1706			1046			1723			1268	
Peak-hour factor, PHF	0.60	0.60	0.60	0.96	0.96	0.96	0.89	0.89	0.89	0.86	0.86	0.86
Adj. Flow (vph)	33	183	8	281	0	73	0	798	146	17	401	0
RTOR Reduction (vph)	0	1	0	0	25	0	0	7	0	0	0	0
Lane Group Flow (vph)	0	223	0	0	329	0	0	937	0	0	418	0
Heavy Vehicles (%)	2%	2%	2%	3%	3%	3%	8%	8%	8%	5%	5%	5%
Turn Type	Perm	NA		Perm	NA			NA		Perm	NA	
Protected Phases		4			4			2			2	
Permitted Phases	4			4						2		
Actuated Green, G (s)		28.0			28.0			50.0			50.0	
Effective Green, g (s)		28.0			28.0			50.0			50.0	
Actuated g/C Ratio		0.31			0.31			0.56			0.56	
Clearance Time (s)		6.0			6.0			6.0			6.0	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		530			325			957			704	
v/s Ratio Prot								c0.54				
v/s Ratio Perm		0.13			c0.31						0.33	
v/c Ratio		0.42			1.01			0.98			0.59	
Uniform Delay, d1		24.6			31.0			19.5			13.3	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		0.5			53.2			23.8			1.4	
Delay (s)		25.1			84.2			43.2			14.6	
Level of Service		C			F			D			B	
Approach Delay (s)		25.1			84.2			43.2			14.6	
Approach LOS		C			F			D			B	

Intersection Summary			
HCM 2000 Control Delay	42.5	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.99		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	84.5%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↱		↰	↱		↰	↑	↗
Traffic Volume (vph)	20	520	40	60	360	195	170	180	20	80	260	20
Future Volume (vph)	20	520	40	60	360	195	170	180	20	80	260	20
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	6.0
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.99		1.00	0.95		1.00	0.98		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1656	1724		1703	1698		1719	1782		1703	1792	1524
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1656	1724		1703	1698		1719	1782		1703	1792	1524
Peak-hour factor, PHF	0.96	0.96	0.96	0.94	0.94	0.94	0.85	0.85	0.85	0.91	0.91	0.91
Adj. Flow (vph)	21	542	42	64	383	207	200	212	24	88	286	22
RTOR Reduction (vph)	0	2	0	0	15	0	0	4	0	0	0	17
Lane Group Flow (vph)	21	582	0	64	575	0	200	232	0	88	286	5
Heavy Vehicles (%)	9%	9%	9%	6%	6%	6%	5%	5%	5%	6%	6%	6%
Parking (#/hr)			0									
Turn Type	Prot	NA		Prot	NA		Prot	NA		Prot	NA	pm+ov
Protected Phases	5	2		1	6		3	8		7	4	5
Permitted Phases												4
Actuated Green, G (s)	2.2	42.8		4.1	44.7		17.6	29.1		9.2	20.7	22.9
Effective Green, g (s)	2.2	42.8		4.1	44.7		17.6	29.1		9.2	20.7	22.9
Actuated g/C Ratio	0.02	0.39		0.04	0.41		0.16	0.27		0.08	0.19	0.21
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	33	675		63	695		277	474		143	339	403
v/s Ratio Prot	0.01	0.34		c0.04	c0.34		c0.12	0.13		0.05	c0.16	0.00
v/s Ratio Perm												0.00
v/c Ratio	0.64	0.86		1.02	0.83		0.72	0.49		0.62	0.84	0.01
Uniform Delay, d1	53.1	30.5		52.6	28.8		43.5	33.8		48.3	42.7	34.2
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	33.9	11.0		117.9	8.0		8.9	0.8		7.6	17.1	0.0
Delay (s)	87.0	41.4		170.5	36.8		52.4	34.6		55.9	59.8	34.2
Level of Service	F	D		F	D		D	C		E	E	C
Approach Delay (s)		43.0			49.9			42.8			57.5	
Approach LOS		D			D			D			E	

Intersection Summary			
HCM 2000 Control Delay	47.9	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.84		
Actuated Cycle Length (s)	109.2	Sum of lost time (s)	24.0
Intersection Capacity Utilization	77.3%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	560	10	5	555	270	220
Future Volume (vph)	560	10	5	555	270	220
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.850			0.939	
Flt Protected	0.950					
Satd. Flow (prot)	1719	1538	0	1827	1749	0
Flt Permitted	0.950					
Satd. Flow (perm)	1719	1538	0	1827	1749	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	322			309	450	
Travel Time (s)	7.3			7.0	10.2	
Peak Hour Factor	0.89	0.89	0.91	0.91	0.93	0.93
Heavy Vehicles (%)	5%	5%	4%	4%	2%	2%
Adj. Flow (vph)	629	11	5	610	290	237
Shared Lane Traffic (%)						
Lane Group Flow (vph)	629	11	0	615	527	0
Sign Control	Stop			Stop	Stop	

Intersection Summary

Area Type: Other
Control Type: Unsignalized
Intersection Capacity Utilization 70.9% ICU Level of Service C
Analysis Period (min) 15

Intersection	
Intersection Delay, s/veh	148.5
Intersection LOS	F

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↰	↱		↰↑	↑↱	
Traffic Vol, veh/h	560	10	5	555	270	220
Future Vol, veh/h	560	10	5	555	270	220
Peak Hour Factor	0.89	0.89	0.91	0.91	0.93	0.93
Heavy Vehicles, %	5	5	4	4	2	2
Mvmt Flow	629	11	5	610	290	237
Number of Lanes	1	1	0	1	1	0

Approach	EB	NB	SB
Opposing Approach		SB	NB
Opposing Lanes	0	1	1
Conflicting Approach Left	SB	EB	
Conflicting Lanes Left	1	2	0
Conflicting Approach Right	NB		EB
Conflicting Lanes Right	1	0	2
HCM Control Delay	225	138.3	67.4
HCM LOS	F	F	F

Lane	NBLn1	EBLn1	EBLn2	SBLn1
Vol Left, %	1%	100%	0%	0%
Vol Thru, %	99%	0%	0%	55%
Vol Right, %	0%	0%	100%	45%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	560	560	10	490
LT Vol	5	560	0	0
Through Vol	555	0	0	270
RT Vol	0	0	10	220
Lane Flow Rate	615	629	11	527
Geometry Grp	2	7	7	2
Degree of Util (X)	1.205	1.427	0.022	0.982
Departure Headway (Hd)	8.184	8.587	7.347	8.193
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	449	428	490	448
Service Time	6.184	6.287	5.047	6.193
HCM Lane V/C Ratio	1.37	1.47	0.022	1.176
HCM Control Delay	138.3	228.8	10.2	67.4
HCM Lane LOS	F	F	B	F
HCM 95th-tile Q	20.8	29.9	0.1	12.2

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑	↱	↰	↑↑	↰↰	↱
Traffic Volume (vph)	1715	265	225	1025	660	460
Future Volume (vph)	1715	265	225	1025	660	460
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5	4.5	4.5	4.5	4.5
Lane Util. Factor	0.95	1.00	1.00	0.95	0.97	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (prot)	3539	1583	1770	3539	3433	1583
Flt Permitted	1.00	1.00	0.06	1.00	0.95	1.00
Satd. Flow (perm)	3539	1583	107	3539	3433	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	1864	288	245	1114	717	500
RTOR Reduction (vph)	0	96	0	0	0	6
Lane Group Flow (vph)	1864	192	245	1114	717	494
Turn Type	NA	Perm	pm+pt	NA	Prot	pm+ov
Protected Phases	4		3	8	2	3
Permitted Phases		4	8			2
Actuated Green, G (s)	65.0	65.0	83.5	83.5	27.5	41.5
Effective Green, g (s)	65.0	65.0	83.5	83.5	27.5	41.5
Actuated g/C Ratio	0.54	0.54	0.70	0.70	0.23	0.35
Clearance Time (s)	4.5	4.5	4.5	4.5	4.5	4.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	1916	857	268	2462	786	606
v/s Ratio Prot	c0.53		0.11	0.31	c0.21	c0.09
v/s Ratio Perm		0.12	0.53			0.22
v/c Ratio	0.97	0.22	0.91	0.45	0.91	0.82
Uniform Delay, d1	26.6	14.3	40.9	8.1	45.1	35.8
Progression Factor	1.00	1.00	1.05	1.39	1.00	1.00
Incremental Delay, d2	14.6	0.1	27.6	0.1	16.7	8.3
Delay (s)	41.2	14.5	70.5	11.4	61.8	44.1
Level of Service	D	B	E	B	E	D
Approach Delay (s)	37.7			22.0	54.5	
Approach LOS	D			C	D	

Intersection Summary			
HCM 2000 Control Delay	37.5	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.95		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	13.5
Intersection Capacity Utilization	90.0%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Traffic Volume (vph)	70	2075	30	120	960	80	20	10	90	200	30	60
Future Volume (vph)	70	2075	30	120	960	80	20	10	90	200	30	60
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0			6.0	6.0	6.0	6.0	
Lane Util. Factor	1.00	0.91		1.00	0.95			1.00	1.00	1.00	1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00			1.00	1.00	1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00			0.97	1.00	1.00	1.00	
Frt	1.00	1.00		1.00	0.99			1.00	0.85	1.00	0.90	
Flt Protected	0.95	1.00		0.95	1.00			0.97	1.00	0.95	1.00	
Satd. Flow (prot)	1687	4837		1719	3399			1746	1583	1805	1710	
Flt Permitted	0.95	1.00		0.95	1.00			0.77	1.00	0.73	1.00	
Satd. Flow (perm)	1687	4837		1719	3399			1390	1583	1381	1710	
Peak-hour factor, PHF	0.89	0.89	0.89	0.96	0.96	0.96	0.65	0.65	0.65	0.67	0.67	0.67
Adj. Flow (vph)	79	2331	34	125	1000	83	31	15	138	299	45	90
RTOR Reduction (vph)	0	1	0	0	4	0	0	0	31	0	60	0
Lane Group Flow (vph)	79	2364	0	125	1079	0	0	46	107	299	75	0
Confl. Peds. (#/hr)							40					
Heavy Vehicles (%)	7%	7%	7%	5%	5%	5%	2%	2%	2%	0%	0%	0%
Turn Type	Prot	NA		Prot	NA		Perm	NA	pm+ov	Perm	NA	
Protected Phases	1	6		5	2			4	1		8	
Permitted Phases							4		4	8		
Actuated Green, G (s)	11.0	61.5		14.0	64.5			26.5	37.5	26.5	26.5	
Effective Green, g (s)	11.0	61.5		14.0	64.5			26.5	37.5	26.5	26.5	
Actuated g/C Ratio	0.09	0.51		0.12	0.54			0.22	0.31	0.22	0.22	
Clearance Time (s)	6.0	6.0		6.0	6.0			6.0	6.0	6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	154	2478		200	1826			306	573	304	377	
v/s Ratio Prot	0.05	c0.49		c0.07	c0.32				0.02		0.04	
v/s Ratio Perm								0.03	0.05	c0.22		
v/c Ratio	0.51	0.95		0.62	0.59			0.15	0.19	0.98	0.20	
Uniform Delay, d1	51.9	27.9		50.5	18.8			37.7	30.1	46.5	38.1	
Progression Factor	1.22	0.80		1.00	1.00			1.00	1.00	1.00	1.00	
Incremental Delay, d2	1.2	4.9		6.0	1.4			0.2	0.2	46.8	0.3	
Delay (s)	64.4	27.3		56.5	20.2			37.9	30.3	93.3	38.4	
Level of Service	E	C		E	C			D	C	F	D	
Approach Delay (s)		28.5			24.0			32.2			76.2	
Approach LOS		C			C			C			E	

Intersection Summary			
HCM 2000 Control Delay	32.2	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.92		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	80.2%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	40	240	40	50	200	0	230	1380	340	45	820	235
Future Volume (vph)	40	240	40	50	200	0	230	1380	340	45	820	235
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0		6.0	6.0	4.0	6.0	6.0	6.0
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95		0.97	0.95	1.00	1.00	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1736	3471	1553	3335	3438		3400	3505	1568	1752	3505	1568
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1736	3471	1553	3335	3438		3400	3505	1568	1752	3505	1568
Peak-hour factor, PHF	0.84	0.84	0.84	0.79	0.79	0.79	0.86	0.86	0.86	0.99	0.99	0.99
Adj. Flow (vph)	48	286	48	63	253	0	267	1605	395	45	828	237
RTOR Reduction (vph)	0	0	35	0	0	0	0	0	0	0	0	62
Lane Group Flow (vph)	48	286	13	63	253	0	267	1605	395	45	828	175
Heavy Vehicles (%)	4%	4%	4%	5%	5%	5%	3%	3%	3%	3%	3%	3%
Turn Type	Prot	NA	pm+ov	Prot	NA		Prot	NA	Free	Prot	NA	pt+ov
Protected Phases	1	6	7	5	2		3	8		7	4	4 5
Permitted Phases		6	6		2			8	Free		4	
Actuated Green, G (s)	9.0	24.0	32.6	5.0	20.0		15.0	57.5	119.1	8.6	51.1	62.1
Effective Green, g (s)	9.0	24.0	32.6	5.0	20.0		15.0	57.5	119.1	8.6	51.1	62.1
Actuated g/C Ratio	0.08	0.20	0.27	0.04	0.17		0.13	0.48	1.00	0.07	0.43	0.52
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	131	699	503	140	577		428	1692	1568	126	1503	817
v/s Ratio Prot	c0.03	c0.08	0.00	0.02	0.07		c0.08	c0.46		0.03	0.24	0.11
v/s Ratio Perm			0.01						c0.25			
v/c Ratio	0.37	0.41	0.03	0.45	0.44		0.62	0.95	0.25	0.36	0.55	0.21
Uniform Delay, d1	52.3	41.4	31.6	55.7	44.5		49.4	29.4	0.0	52.6	25.4	15.4
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.39	0.72	0.45
Incremental Delay, d2	1.7	1.8	0.0	2.3	2.4		2.8	12.7	0.4	1.4	0.4	0.1
Delay (s)	54.1	43.2	31.7	58.0	46.9		52.2	42.1	0.4	74.8	18.7	7.0
Level of Service	D	D	C	E	D		D	D	A	E	B	A
Approach Delay (s)		43.1			49.1			36.0			18.5	
Approach LOS		D			D			D			B	

Intersection Summary			
HCM 2000 Control Delay	32.9	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	119.1	Sum of lost time (s)	24.0
Intersection Capacity Utilization	74.8%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	NWL	NWR	NET	NER	SWL	SWT
Lane Configurations						
Traffic Volume (vph)	205	90	920	550	80	1010
Future Volume (vph)	205	90	920	550	80	1010
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	4.0	6.0	6.0
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1583	3505	1568	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.15	1.00
Satd. Flow (perm)	1770	1583	3505	1568	278	3539
Peak-hour factor, PHF	0.83	0.83	0.86	0.86	0.81	0.81
Adj. Flow (vph)	247	108	1070	640	99	1247
RTOR Reduction (vph)	0	33	0	0	0	0
Lane Group Flow (vph)	247	75	1070	640	99	1247
Heavy Vehicles (%)	2%	2%	3%	3%	2%	2%
Turn Type	Prot	pm+ov	NA	Free	pm+pt	NA
Protected Phases	1 2 5 6	7	8		7	3 4
Permitted Phases		1 2 5 6		Free	3 4	
Actuated Green, G (s)	33.0	41.6	57.5	119.1	72.1	72.1
Effective Green, g (s)	33.0	41.6	57.5	119.1	72.1	72.1
Actuated g/C Ratio	0.28	0.35	0.48	1.00	0.61	0.61
Clearance Time (s)		6.0	6.0		6.0	
Vehicle Extension (s)		3.0	3.0		3.0	
Lane Grp Cap (vph)	490	632	1692	1568	276	2142
v/s Ratio Prot	c0.14	0.01	c0.31		0.03	c0.35
v/s Ratio Perm		0.04		c0.41	0.19	
v/c Ratio	0.50	0.12	0.63	0.41	0.36	0.58
Uniform Delay, d1	36.2	26.3	22.9	0.0	13.9	14.3
Progression Factor	1.00	1.00	0.40	1.00	1.00	1.00
Incremental Delay, d2	0.8	0.1	0.7	0.3	0.8	0.4
Delay (s)	37.0	26.4	10.0	0.3	14.7	14.7
Level of Service	D	C	B	A	B	B
Approach Delay (s)	33.8		6.4			14.7
Approach LOS	C		A			B

Intersection Summary			
HCM 2000 Control Delay	12.5	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.65		
Actuated Cycle Length (s)	119.1	Sum of lost time (s)	24.0
Intersection Capacity Utilization	56.2%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	170	300	5	20	550	40	15	10	15	20	10	170
Future Volume (vph)	170	300	5	20	550	40	15	10	15	20	10	170
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0			6.0	6.0		6.0	6.0
Lane Util. Factor	1.00	0.95		1.00	0.95			1.00	1.00		1.00	1.00
Frt	1.00	1.00		1.00	0.99			1.00	0.85		1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00			0.97	1.00		0.97	1.00
Satd. Flow (prot)	1687	3366		1770	3504			1845	1615		1821	1599
Flt Permitted	0.95	1.00		0.95	1.00			0.80	1.00		0.77	1.00
Satd. Flow (perm)	1687	3366		1770	3504			1514	1615		1446	1599
Peak-hour factor, PHF	0.83	0.83	0.83	0.92	0.92	0.92	0.50	0.50	0.50	0.90	0.90	0.90
Adj. Flow (vph)	205	361	6	22	598	43	30	20	30	22	11	189
RTOR Reduction (vph)	0	1	0	0	5	0	0	0	27	0	0	168
Lane Group Flow (vph)	205	366	0	22	636	0	0	50	3	0	33	21
Heavy Vehicles (%)	7%	7%	7%	2%	2%	2%	0%	0%	0%	1%	1%	1%
Turn Type	Prot	NA		Prot	NA		Perm	NA	Perm	Perm	NA	Perm
Protected Phases	5	2		1	6			8			4	
Permitted Phases					6		8	8	8	4		4
Actuated Green, G (s)	8.1	40.5		1.8	34.2			7.6	7.6		7.6	7.6
Effective Green, g (s)	8.1	40.5		1.8	34.2			7.6	7.6		7.6	7.6
Actuated g/C Ratio	0.12	0.60		0.03	0.50			0.11	0.11		0.11	0.11
Clearance Time (s)	6.0	6.0		6.0	6.0			6.0	6.0		6.0	6.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	201	2007		46	1764			169	180		161	178
v/s Ratio Prot	c0.12	0.11		0.01	c0.18							
v/s Ratio Perm								c0.03	0.00		0.02	0.01
v/c Ratio	1.02	0.18		0.48	0.36			0.30	0.02		0.20	0.12
Uniform Delay, d1	29.9	6.2		32.6	10.2			27.7	26.8		27.4	27.1
Progression Factor	1.00	1.00		1.00	1.00			1.00	1.00		1.00	1.00
Incremental Delay, d2	68.7	0.2		7.6	0.1			1.0	0.0		0.6	0.3
Delay (s)	98.6	6.4		40.2	10.3			28.7	26.9		28.0	27.4
Level of Service	F	A		D	B			C	C		C	C
Approach Delay (s)		39.5			11.3			28.0			27.5	
Approach LOS		D			B			C			C	

Intersection Summary			
HCM 2000 Control Delay	25.0	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.46		
Actuated Cycle Length (s)	67.9	Sum of lost time (s)	18.0
Intersection Capacity Utilization	49.2%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	30	330	5	5	430	140	30	10	10	320	5	150
Future Volume (vph)	30	330	5	5	430	140	30	10	10	320	5	150
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	6.0
Lane Util. Factor	0.97	0.95		1.00	0.95		1.00	1.00		0.95	0.95	1.00
Frt	1.00	1.00		1.00	0.96		1.00	0.93		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	0.95	1.00
Satd. Flow (prot)	3303	3398		1736	3343		1805	1758		1665	1672	1568
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	0.95	1.00
Satd. Flow (perm)	3303	3398		1736	3343		1805	1758		1665	1672	1568
Peak-hour factor, PHF	0.83	0.83	0.83	0.97	0.97	0.97	0.67	0.67	0.67	0.90	0.90	0.90
Adj. Flow (vph)	36	398	6	5	443	144	45	15	15	356	6	167
RTOR Reduction (vph)	0	1	0	0	34	0	0	14	0	0	0	108
Lane Group Flow (vph)	36	403	0	5	553	0	45	16	0	182	180	59
Heavy Vehicles (%)	6%	6%	6%	4%	4%	4%	0%	0%	0%	3%	3%	3%
Turn Type	Prot	NA		Prot	NA		Split	NA		Split	NA	pt+ov
Protected Phases	5	2		1	6		3	3		4	4	4 5
Permitted Phases								3				
Actuated Green, G (s)	6.5	28.3		1.0	22.8		5.7	5.7		13.2	13.2	25.7
Effective Green, g (s)	6.5	28.3		1.0	22.8		5.7	5.7		13.2	13.2	25.7
Actuated g/C Ratio	0.09	0.39		0.01	0.32		0.08	0.08		0.18	0.18	0.36
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	297	1331		24	1055		142	138		304	305	558
v/s Ratio Prot	0.01	c0.12		0.00	c0.17		c0.02	0.01		c0.11	0.11	c0.04
v/s Ratio Perm												
v/c Ratio	0.12	0.30		0.21	0.52		0.32	0.12		0.60	0.59	0.11
Uniform Delay, d1	30.2	15.1		35.2	20.3		31.4	30.9		27.1	27.0	15.6
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	0.2	0.1		4.3	0.5		1.3	0.4		3.2	3.0	0.1
Delay (s)	30.4	15.3		39.5	20.7		32.7	31.3		30.2	30.1	15.6
Level of Service	C	B		D	C		C	C		C	C	B
Approach Delay (s)		16.5			20.9			32.1			25.6	
Approach LOS		B			C			C			C	

Intersection Summary				
HCM 2000 Control Delay	21.7	HCM 2000 Level of Service	C	
HCM 2000 Volume to Capacity ratio	0.48			
Actuated Cycle Length (s)	72.2	Sum of lost time (s)	24.0	
Intersection Capacity Utilization	44.8%	ICU Level of Service	A	
Analysis Period (min)	15			
c Critical Lane Group				

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	10	400	360	60	30	30
Future Volume (vph)	10	400	360	60	30	30
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.981		0.932	
Flt Protected	0.950				0.976	
Satd. Flow (prot)	1687	1776	1792	0	1630	0
Flt Permitted	0.950				0.976	
Satd. Flow (perm)	1687	1776	1792	0	1630	0
Link Speed (mph)		30	30		30	
Link Distance (ft)		535	210		522	
Travel Time (s)		12.2	4.8		11.9	
Peak Hour Factor	0.84	0.84	0.89	0.89	0.83	0.83
Heavy Vehicles (%)	7%	7%	4%	4%	6%	6%
Adj. Flow (vph)	12	476	404	67	36	36
Shared Lane Traffic (%)						
Lane Group Flow (vph)	12	476	471	0	72	0
Sign Control		Free	Free		Stop	

Intersection Summary

Area Type: Other
Control Type: Unsignalized
Intersection Capacity Utilization 32.8% ICU Level of Service A
Analysis Period (min) 15

Intersection						
Int Delay, s/veh	1.2					

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↰	↑	↱		Y	
Traffic Vol, veh/h	10	400	360	60	30	30
Future Vol, veh/h	10	400	360	60	30	30
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	84	84	89	89	83	83
Heavy Vehicles, %	7	7	4	4	6	6
Mvmt Flow	12	476	404	67	36	36

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	471	0	-	0	938	438
Stage 1	-	-	-	-	438	-
Stage 2	-	-	-	-	500	-
Critical Hdwy	4.17	-	-	-	6.46	6.26
Critical Hdwy Stg 1	-	-	-	-	5.46	-
Critical Hdwy Stg 2	-	-	-	-	5.46	-
Follow-up Hdwy	2.263	-	-	-	3.554	3.354
Pot Cap-1 Maneuver	1065	-	-	-	289	610
Stage 1	-	-	-	-	642	-
Stage 2	-	-	-	-	601	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1065	-	-	-	286	610
Mov Cap-2 Maneuver	-	-	-	-	286	-
Stage 1	-	-	-	-	635	-
Stage 2	-	-	-	-	601	-

Approach	EB	WB	SB
HCM Control Delay, s	0.2	0	16.4
HCM LOS			C

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1065	-	-	-	389
HCM Lane V/C Ratio	0.011	-	-	-	0.186
HCM Control Delay (s)	8.4	-	-	-	16.4
HCM Lane LOS	A	-	-	-	C
HCM 95th %tile Q(veh)	0	-	-	-	0.7

Lane Group	WBL2	WBL	WBR	WBR2	NBL	NBT	NBR	NBR2	SBL2	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	10	265	265	20	90	100	80	10	10	370	160	30
Future Volume (vph)	10	265	265	20	90	100	80	10	10	370	160	30
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.931				0.957					0.993	
Flt Protected		0.976				0.984					0.968	
Satd. Flow (prot)	0	1709	0	0	0	1754	0	0	0	0	1808	0
Flt Permitted		0.976				0.984					0.968	
Satd. Flow (perm)	0	1709	0	0	0	1754	0	0	0	0	1808	0
Link Speed (mph)		30				30					30	
Link Distance (ft)		449				456					370	
Travel Time (s)		10.2				10.4					8.4	
Peak Hour Factor	0.91	0.91	0.91	0.91	0.87	0.87	0.87	0.87	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	1%	1%	1%	1%	2%	2%	2%	2%	1%	1%	1%	1%
Adj. Flow (vph)	11	291	291	22	103	115	92	11	11	402	174	33
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	615	0	0	0	321	0	0	0	0	620	0
Sign Control		Yield				Yield					Yield	

Intersection Summary

Area Type: Other
Control Type: Roundabout
Intersection Capacity Utilization 141.4% ICU Level of Service H
Analysis Period (min) 15

Lane Group	NEL	NET	NER	NER2	SWL2	SWL	SWT	SWR
Lane Configurations								
Traffic Volume (vph)	50	280	340	90	10	30	160	20
Future Volume (vph)	50	280	340	90	10	30	160	20
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.924					0.988	
Flt Protected		0.997					0.991	
Satd. Flow (prot)	0	1733	0	0	0	0	1824	0
Flt Permitted		0.997					0.991	
Satd. Flow (perm)	0	1733	0	0	0	0	1824	0
Link Speed (mph)		30					30	
Link Distance (ft)		390					523	
Travel Time (s)		8.9					11.9	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.91	0.91	0.91	0.91
Heavy Vehicles (%)	1%	1%	1%	1%	2%	2%	2%	2%
Adj. Flow (vph)	56	311	378	100	11	33	176	22
Shared Lane Traffic (%)								
Lane Group Flow (vph)	0	845	0	0	0	0	242	0
Sign Control		Yield					Yield	

Intersection Summary

Intersection					
Intersection Delay, s/veh	63.2				
Intersection LOS	F				

Approach	WB	NB	SB	NE	SW
Entry Lanes	1	1	1	1	1
Conflicting Circle Lanes	1	1	1	1	1
Adj Approach Flow, veh/h	615	321	620	845	242
Demand Flow Rate, veh/h	621	327	626	854	247
Vehicles Circulating, veh/h	698	1181	635	649	878
Vehicles Exiting, veh/h	810	322	490	612	441
Ped Vol Crossing Leg, #/h	0	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000	1.000
Approach Delay, s/veh	41.9	39.0	32.9	124.2	13.7
Approach LOS	E	E	D	F	B

Lane	Left	Left	Left	Left	Left
Designated Moves	LR	LTR	LTR	LTR	LTR
Assumed Moves	LR	LTR	LTR	LTR	LTR
RT Channelized					
Lane Util	1.000	1.000	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976	4.976	4.976
Entry Flow, veh/h	621	327	626	854	247
Cap Entry Lane, veh/h	677	414	722	712	564
Entry HV Adj Factor	0.990	0.981	0.991	0.989	0.981
Flow Entry, veh/h	615	321	620	845	242
Cap Entry, veh/h	670	406	715	704	553
V/C Ratio	0.917	0.790	0.867	1.200	0.438
Control Delay, s/veh	41.9	39.0	32.9	124.2	13.7
LOS	E	E	D	F	B
95th %tile Queue, veh	12	7	10	29	2

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	10	50	580	10	30	20	215	145	10	25	110	10
Future Volume (vph)	10	50	580	10	30	20	215	145	10	25	110	10
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850		0.956			0.996			0.991	
Flt Protected		0.992			0.992			0.972			0.992	
Satd. Flow (prot)	0	1848	1583	0	1802	0	0	1821	0	0	1849	0
Flt Permitted		0.992			0.992			0.972			0.992	
Satd. Flow (perm)	0	1848	1583	0	1802	0	0	1821	0	0	1849	0
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		113			453			475			436	
Travel Time (s)		2.6			10.3			10.8			9.9	
Peak Hour Factor	0.88	0.88	0.88	0.82	0.82	0.82	0.93	0.93	0.93	0.91	0.91	0.91
Heavy Vehicles (%)	2%	2%	2%	0%	0%	0%	1%	1%	1%	1%	1%	1%
Adj. Flow (vph)	11	57	659	12	37	24	231	156	11	27	121	11
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	68	659	0	73	0	0	398	0	0	159	0
Sign Control		Stop			Stop			Free			Free	

Intersection Summary	
Area Type: Other	
Control Type: Unsignalized	
Intersection Capacity Utilization 57.0%	ICU Level of Service B
Analysis Period (min) 15	

Intersection	
Int Delay, s/veh	14.5

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	10	50	580	10	30	20	215	145	10	25	110	10
Future Vol, veh/h	10	50	580	10	30	20	215	145	10	25	110	10
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	0	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	88	88	88	82	82	82	93	93	93	91	91	91
Heavy Vehicles, %	2	2	2	0	0	0	1	1	1	1	1	1
Mvmt Flow	11	57	659	12	37	24	231	156	11	27	121	11

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	835	810	127	1163	810	162	132	0	0	167	0	0
Stage 1	181	181	-	624	624	-	-	-	-	-	-	-
Stage 2	654	629	-	539	186	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.1	6.5	6.2	4.11	-	-	4.11	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.1	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.1	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.5	4	3.3	2.209	-	-	2.209	-	-
Pot Cap-1 Maneuver	287	314	923	173	316	888	1459	-	-	1417	-	-
Stage 1	821	750	-	477	481	-	-	-	-	-	-	-
Stage 2	456	475	-	530	750	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	212	254	923	35	255	888	1459	-	-	1417	-	-
Mov Cap-2 Maneuver	212	254	-	35	255	-	-	-	-	-	-	-
Stage 1	677	734	-	394	397	-	-	-	-	-	-	-
Stage 2	332	392	-	137	734	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	18.7	55.3	4.6	1.3
HCM LOS	C	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1459	-	-	246	923	141	1417	-	-
HCM Lane V/C Ratio	0.158	-	-	0.277	0.714	0.519	0.019	-	-
HCM Control Delay (s)	7.9	0	-	25.2	18	55.3	7.6	0	-
HCM Lane LOS	A	A	-	D	C	F	A	A	-
HCM 95th %tile Q(veh)	0.6	-	-	1.1	6.3	2.5	0.1	-	-

Movement	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations	↰	↱		↰	↑	↱	↰	↑↱		↰	↑↱	
Traffic Volume (vph)	30	70	30	40	40	140	190	1010	60	20	340	70
Future Volume (vph)	30	70	30	40	40	140	190	1010	60	20	340	70
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	0.95		1.00	0.95	
Frt	1.00	0.96		1.00	1.00	0.85	1.00	0.99		1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	1780		1787	1881	1599	1805	3580		1805	3518	
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	1780		1787	1881	1599	1805	3580		1805	3518	
Peak-hour factor, PHF	0.99	0.99	0.99	0.95	0.95	0.95	0.89	0.89	0.89	0.93	0.93	0.93
Adj. Flow (vph)	30	71	30	42	42	147	213	1135	67	22	366	75
RTOR Reduction (vph)	0	25	0	0	0	91	0	5	0	0	27	0
Lane Group Flow (vph)	30	76	0	42	42	56	213	1197	0	22	414	0
Heavy Vehicles (%)	2%	2%	2%	1%	1%	1%	0%	0%	0%	0%	0%	0%
Turn Type	Prot	NA		Prot	NA	pt+ov	Prot	NA		Prot	NA	
Protected Phases	1	6		5	2	2 3	3	8		7	4	
Permitted Phases		6			2							
Actuated Green, G (s)	1.7	8.2		1.7	8.2	22.4	8.2	23.2		1.3	16.3	
Effective Green, g (s)	1.7	8.2		1.7	8.2	22.4	8.2	23.2		1.3	16.3	
Actuated g/C Ratio	0.03	0.14		0.03	0.14	0.38	0.14	0.40		0.02	0.28	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	51	249		52	264	613	253	1422		40	981	
v/s Ratio Prot	0.02	c0.04		c0.02	0.02	0.04	c0.12	c0.33		0.01	0.12	
v/s Ratio Perm												
v/c Ratio	0.59	0.31		0.81	0.16	0.09	0.84	0.84		0.55	0.42	
Uniform Delay, d1	28.0	22.5		28.2	22.1	11.5	24.5	15.9		28.3	17.2	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	16.1	0.7		58.8	1.3	0.1	21.6	4.7		15.3	0.3	
Delay (s)	44.1	23.2		87.0	23.4	11.6	46.1	20.6		43.6	17.5	
Level of Service	D	C		F	C	B	D	C		D	B	
Approach Delay (s)		28.0			27.4			24.5			18.7	
Approach LOS		C			C			C			B	

Intersection Summary			
HCM 2000 Control Delay	23.8	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.80		
Actuated Cycle Length (s)	58.4	Sum of lost time (s)	24.0
Intersection Capacity Utilization	60.4%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	620	0	10	290	180	350
Future Volume (vph)	620	0	10	290	180	350
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0		6.0	4.0	4.0	6.0
Lane Util. Factor	1.00		1.00	1.00	1.00	1.00
Frt	1.00		1.00	1.00	1.00	0.85
Flt Protected	0.95		0.95	1.00	1.00	1.00
Satd. Flow (prot)	1787		1770	1863	1845	1568
Flt Permitted	0.95		0.53	1.00	1.00	1.00
Satd. Flow (perm)	1787		987	1863	1845	1568
Peak-hour factor, PHF	0.90	0.90	0.87	0.87	0.89	0.89
Adj. Flow (vph)	689	0	11	333	202	393
RTOR Reduction (vph)	0	0	0	0	0	78
Lane Group Flow (vph)	689	0	11	333	202	315
Heavy Vehicles (%)	1%	1%	2%	2%	3%	3%
Turn Type	Prot		pm+pt	NA	NA	custom
Protected Phases	8		1	6 7	2 7	7 8
Permitted Phases			6 7			2
Actuated Green, G (s)	40.3		26.6	25.7	25.7	68.0
Effective Green, g (s)	40.3		22.6	25.7	25.7	68.0
Actuated g/C Ratio	0.47		0.27	0.30	0.30	0.80
Clearance Time (s)	6.0		6.0			
Vehicle Extension (s)	3.0		3.0			
Lane Grp Cap (vph)	848		271	563	558	1255
v/s Ratio Prot	c0.39		c0.00	c0.18	0.11	0.15
v/s Ratio Perm			0.01			0.05
v/c Ratio	0.81		0.04	0.59	0.36	0.25
Uniform Delay, d1	19.1		23.1	25.1	23.2	2.1
Progression Factor	1.00		1.00	1.00	1.12	0.16
Incremental Delay, d2	6.0		0.1	1.7	0.4	0.1
Delay (s)	25.0		23.1	26.8	26.2	0.4
Level of Service	C		C	C	C	A
Approach Delay (s)	25.0			26.7	9.2	
Approach LOS	C			C	A	

Intersection Summary			
HCM 2000 Control Delay	19.6	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.76		
Actuated Cycle Length (s)	84.9	Sum of lost time (s)	22.0
Intersection Capacity Utilization	57.9%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	875	0	0	0	1545	0
Future Volume (vph)	875	0	0	0	1545	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0				6.0	
Lane Util. Factor	0.97				0.97	
Frt	1.00				1.00	
Flt Protected	0.95				0.95	
Satd. Flow (prot)	3433				3433	
Flt Permitted	0.95				0.95	
Satd. Flow (perm)	3433				3433	
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	931	0	0	0	1644	0
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	931	0	0	0	1644	0
Turn Type	Prot				Prot	
Protected Phases	2				4	
Permitted Phases						
Actuated Green, G (s)	26.0				42.0	
Effective Green, g (s)	26.0				42.0	
Actuated g/C Ratio	0.32				0.52	
Clearance Time (s)	6.0				6.0	
Vehicle Extension (s)	3.0				3.0	
Lane Grp Cap (vph)	1115				1802	
v/s Ratio Prot	c0.27				c0.48	
v/s Ratio Perm						
v/c Ratio	0.83				0.91	
Uniform Delay, d1	25.0				17.3	
Progression Factor	1.18				1.00	
Incremental Delay, d2	6.6				7.5	
Delay (s)	36.1				24.8	
Level of Service	D				C	
Approach Delay (s)	36.1		0.0			24.8
Approach LOS	D		A			C

Intersection Summary			
HCM 2000 Control Delay	28.9	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.88		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	131.8%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SBL	SBR	NWL	NWR
Lane Configurations		↑↑			↑↑	↱↱			↰↱	↱
Traffic Volume (vph)	0	1545	0	0	875	1240	0	0	0	710
Future Volume (vph)	0	1545	0	0	875	1240	0	0	0	710
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0			6.0	6.0			6.0	6.0
Lane Util. Factor		0.95			0.95	0.88			1.00	0.95
Frt		1.00			1.00	0.85			0.85	0.85
Flt Protected		1.00			1.00	1.00			1.00	1.00
Satd. Flow (prot)		3539			3539	2787			1583	1504
Flt Permitted		1.00			1.00	1.00			1.00	1.00
Satd. Flow (perm)		3539			3539	2787			1583	1504
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	0	1644	0	0	931	1319	0	0	0	755
RTOR Reduction (vph)	0	0	0	0	0	34	0	0	0	0
Lane Group Flow (vph)	0	1644	0	0	931	1285	0	0	378	377
Turn Type		NA			NA	Perm			Prot	Prot
Protected Phases		2			2				4	4
Permitted Phases						2				
Actuated Green, G (s)		43.0			43.0	43.0			25.0	25.0
Effective Green, g (s)		43.0			43.0	43.0			25.0	25.0
Actuated g/C Ratio		0.54			0.54	0.54			0.31	0.31
Clearance Time (s)		6.0			6.0	6.0			6.0	6.0
Vehicle Extension (s)		3.0			3.0	3.0			3.0	3.0
Lane Grp Cap (vph)		1902			1902	1498			494	470
v/s Ratio Prot		c0.46			0.26				0.24	c0.25
v/s Ratio Perm						0.46				
v/c Ratio		0.86			0.49	0.86			0.77	0.80
Uniform Delay, d1		16.0			11.6	15.9			24.8	25.2
Progression Factor		0.07			1.00	1.00			1.00	1.00
Incremental Delay, d2		2.3			0.9	6.6			10.8	13.5
Delay (s)		3.5			12.5	22.4			35.6	38.7
Level of Service		A			B	C			D	D
Approach Delay (s)		3.5			18.3		0.0		37.2	
Approach LOS		A			B		A		D	

Intersection Summary			
HCM 2000 Control Delay	16.1	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.84		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	117.6%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	60	10	750	160	10	470
Future Volume (vph)	60	10	750	160	10	470
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0		4.0	4.0	6.0	4.0
Lane Util. Factor	1.00		1.00	1.00	1.00	1.00
Frt	0.98		1.00	0.85	1.00	1.00
Flt Protected	0.96		1.00	1.00	0.95	1.00
Satd. Flow (prot)	1767		1900	1615	1805	1900
Flt Permitted	0.96		1.00	1.00	0.25	1.00
Satd. Flow (perm)	1767		1900	1615	484	1900
Peak-hour factor, PHF	0.87	0.67	0.95	0.84	0.73	0.96
Adj. Flow (vph)	69	15	789	190	14	490
RTOR Reduction (vph)	8	0	0	44	0	0
Lane Group Flow (vph)	76	0	789	146	14	490
Heavy Vehicles (%)	1%	0%	0%	0%	0%	0%
Turn Type	Prot		NA	Perm	custom	NA
Protected Phases	7		6 8		5	2 8
Permitted Phases				6 8	2	
Actuated Green, G (s)	6.0		56.0	56.0	16.6	56.0
Effective Green, g (s)	6.0		56.0	56.0	16.6	56.0
Actuated g/C Ratio	0.07		0.66	0.66	0.20	0.66
Clearance Time (s)	6.0				6.0	
Vehicle Extension (s)	3.0				3.0	
Lane Grp Cap (vph)	124		1253	1065	108	1253
v/s Ratio Prot	c0.04		c0.42		c0.00	0.26
v/s Ratio Perm				0.09	0.02	
v/c Ratio	0.61		0.63	0.14	0.13	0.39
Uniform Delay, d1	38.3		8.4	5.4	28.5	6.6
Progression Factor	1.00		0.49	0.68	1.00	1.00
Incremental Delay, d2	8.2		0.7	0.0	0.5	0.2
Delay (s)	46.6		4.8	3.7	29.0	6.8
Level of Service	D		A	A	C	A
Approach Delay (s)	46.6		4.6			7.4
Approach LOS	D		A			A

Intersection Summary			
HCM 2000 Control Delay	7.8	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.62		
Actuated Cycle Length (s)	84.9	Sum of lost time (s)	22.0
Intersection Capacity Utilization	52.0%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	10	10	40	720	470	10
Future Volume (vph)	10	10	40	720	470	10
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0	0	100			0
Storage Lanes	1	0	1			0
Taper Length (ft)	25		25			
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.939				0.996	
Flt Protected	0.973		0.950			
Satd. Flow (prot)	1736	0	1787	1900	1874	0
Flt Permitted	0.973		0.950			
Satd. Flow (perm)	1736	0	1787	1900	1874	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	332			288	365	
Travel Time (s)	7.5			6.5	8.3	
Peak Hour Factor	0.64	0.77	0.71	0.90	0.75	0.55
Heavy Vehicles (%)	0%	0%	1%	0%	1%	0%
Adj. Flow (vph)	16	13	56	800	627	18
Shared Lane Traffic (%)						
Lane Group Flow (vph)	29	0	56	800	645	0
Sign Control	Stop			Free	Free	

Intersection Summary	
Area Type: Other	
Control Type: Unsignalized	
Intersection Capacity Utilization 47.9%	ICU Level of Service A
Analysis Period (min) 15	

Intersection						
Int Delay, s/veh	0.9					

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	10	10	40	720	470	10
Future Vol, veh/h	10	10	40	720	470	10
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	100	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	64	77	71	90	75	55
Heavy Vehicles, %	0	0	1	0	1	0
Mvmt Flow	16	13	56	800	627	18

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1548	636	645	0	-	0
Stage 1	636	-	-	-	-	-
Stage 2	912	-	-	-	-	-
Critical Hdwy	6.4	6.2	4.11	-	-	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.3	2.209	-	-	-
Pot Cap-1 Maneuver	127	481	945	-	-	-
Stage 1	531	-	-	-	-	-
Stage 2	395	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	120	481	945	-	-	-
Mov Cap-2 Maneuver	120	-	-	-	-	-
Stage 1	500	-	-	-	-	-
Stage 2	395	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	28.4	0.6	0
HCM LOS	D		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	945	-	182	-	-
HCM Lane V/C Ratio	0.06	-	0.157	-	-
HCM Control Delay (s)	9.1	-	28.4	-	-
HCM Lane LOS	A	-	D	-	-
HCM 95th %tile Q(veh)	0.2	-	0.5	-	-

APPENDIX O-3: 2040 ALTERNATIVE A INTERSECTION CAPACITY ANALYSES – SYNCHRO PRINTOUTS – AM PEAK HOUR

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑↑		↰	↱↱
Traffic Volume (vph)	0	1340	825	0	375	850
Future Volume (vph)	0	1340	825	0	375	850
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	16	12
Lane Util. Factor	1.00	0.95	0.95	1.00	1.00	0.88
Frt						0.850
Flt Protected					0.950	
Satd. Flow (prot)	0	3471	3406	0	1930	2682
Flt Permitted					0.950	
Satd. Flow (perm)	0	3471	3406	0	1930	2682
Right Turn on Red				Yes		No
Satd. Flow (RTOR)						
Link Speed (mph)		30	30		25	
Link Distance (ft)		712	388		212	
Travel Time (s)		16.2	8.8		5.8	
Peak Hour Factor	0.93	0.93	0.88	0.88	0.89	0.89
Heavy Vehicles (%)	4%	4%	6%	6%	6%	6%
Adj. Flow (vph)	0	1441	938	0	421	955
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	1441	938	0	421	955
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(ft)		24	24		16	
Link Offset(ft)		0	0		0	
Crosswalk Width(ft)		16	16		16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	0.85	1.00
Turning Speed (mph)	15			9	15	9
Number of Detectors		3	3		3	3
Detector Template		Thru	Thru		Left	
Leading Detector (ft)		256	256		256	256
Trailing Detector (ft)		-5	-5		-5	-5
Detector 1 Position(ft)		-5	-5		-5	-5
Detector 1 Size(ft)		50	50		50	50
Detector 1 Type		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex
Detector 1 Channel						
Detector 1 Extend (s)		0.0	0.0		0.0	0.0
Detector 1 Queue (s)		0.0	0.0		0.0	0.0
Detector 1 Delay (s)		0.0	0.0		0.0	0.0
Detector 2 Position(ft)		125	125		125	125
Detector 2 Size(ft)		6	6		6	6
Detector 2 Type		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex
Detector 2 Channel						
Detector 2 Extend (s)		0.0	0.0		0.0	0.0
Detector 3 Position(ft)		250	250		250	250
Detector 3 Size(ft)		6	6		6	6
Detector 3 Type		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex
Detector 3 Channel						

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Detector 3 Extend (s)		0.0	0.0		0.0	0.0
Turn Type		NA	NA		Prot	Prot
Protected Phases		2	6		4	4
Permitted Phases						
Detector Phase		2	6		4	4
Switch Phase						
Minimum Initial (s)		8.0	8.0		5.0	5.0
Minimum Split (s)		14.0	21.0		27.0	27.0
Total Split (s)		40.0	40.0		35.0	35.0
Total Split (%)		53.3%	53.3%		46.7%	46.7%
Maximum Green (s)		34.0	34.0		29.0	29.0
Yellow Time (s)		2.0	2.0		2.0	2.0
All-Red Time (s)		4.0	4.0		4.0	4.0
Lost Time Adjust (s)		0.0	0.0		0.0	0.0
Total Lost Time (s)		6.0	6.0		6.0	6.0
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)		3.0	3.0		3.0	3.0
Recall Mode		C-Min	C-Min		None	None
Walk Time (s)			7.0		7.0	7.0
Flash Dont Walk (s)			8.0		14.0	14.0
Pedestrian Calls (#/hr)			0		0	0
Act Effct Green (s)		34.0	34.0		29.0	29.0
Actuated g/C Ratio		0.45	0.45		0.39	0.39
v/c Ratio		0.92	0.61		0.56	0.92
Control Delay		25.0	22.2		21.7	37.9
Queue Delay		0.0	0.0		0.0	0.0
Total Delay		25.0	22.2		21.7	37.9
LOS		C	C		C	D
Approach Delay		25.0	22.2		32.9	
Approach LOS		C	C		C	
Queue Length 50th (ft)		354	397		150	234
Queue Length 95th (ft)		m373	m385		232	#361
Internal Link Dist (ft)		632	308		132	
Turn Bay Length (ft)						
Base Capacity (vph)		1573	1544		746	1037
Starvation Cap Reductn		0	0		0	0
Spillback Cap Reductn		0	0		0	0
Storage Cap Reductn		0	0		0	0
Reduced v/c Ratio		0.92	0.61		0.56	0.92

Intersection Summary

Area Type: Other
Cycle Length: 75
Actuated Cycle Length: 75
Offset: 0 (0%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow, Master Intersection
Natural Cycle: 80
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.92

Intersection Signal Delay: 27.2 Intersection LOS: C
Intersection Capacity Utilization 69.8% ICU Level of Service C
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 7: NH 102 & Exit 4 SB Off

Lane Group	NBL2	NBL	NBR	SEL	SER	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations											
Traffic Volume (vph)	490	0	235	0	0	1470	245	0	0	885	175
Future Volume (vph)	490	0	235	0	0	1470	245	0	0	885	175
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)		0	0	0	0	550		0	0		0
Storage Lanes		2	2	0	0	2		0	0		1
Taper Length (ft)		25		25		25			25		
Lane Util. Factor	0.97	1.00	0.88	1.00	1.00	0.97	0.95	1.00	1.00	0.95	1.00
Frt			0.850								0.850
Flt Protected	0.950					0.950					
Satd. Flow (prot)	3242	0	2632	0	0	3335	3438	0	0	3505	1568
Flt Permitted	0.950					0.950					
Satd. Flow (perm)	3242	0	2632	0	0	3335	3438	0	0	3505	1568
Right Turn on Red			No					Yes			Yes
Satd. Flow (RTOR)											109
Link Speed (mph)		25		30			30			30	
Link Distance (ft)		856		390			760			857	
Travel Time (s)		23.3		8.9			17.3			19.5	
Peak Hour Factor	0.88	0.88	0.88	0.92	0.92	0.94	0.94	0.94	0.92	0.92	0.92
Heavy Vehicles (%)	8%	8%	8%	2%	2%	5%	5%	5%	3%	3%	3%
Adj. Flow (vph)	557	0	267	0	0	1564	261	0	0	962	190
Shared Lane Traffic (%)											
Lane Group Flow (vph)	557	0	267	0	0	1564	261	0	0	962	190
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Right	Left	Left	Right	Left	Right	Right
Median Width(ft)		24		0			24			24	
Link Offset(ft)		12		0			0			0	
Crosswalk Width(ft)		16		16			16			16	
Two way Left Turn Lane											
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15	15	25	15	9	15		9	15		25
Number of Detectors	3		3			3	3			3	0
Detector Template											
Leading Detector (ft)	256		256			256	256			256	0
Trailing Detector (ft)	-5		-5			-5	-5			-5	0
Detector 1 Position(ft)	-5		-5			-5	-5			-5	-5
Detector 1 Size(ft)	55		55			55	55			55	50
Detector 1 Type	Cl+Ex		Cl+Ex			Cl+Ex	Cl+Ex			Cl+Ex	Cl+Ex
Detector 1 Channel											
Detector 1 Extend (s)	0.0		0.0			0.0	0.0			0.0	0.0
Detector 1 Queue (s)	0.0		0.0			0.0	0.0			0.0	0.0
Detector 1 Delay (s)	0.0		0.0			0.0	0.0			0.0	0.0
Detector 2 Position(ft)	125		125			125	125			125	
Detector 2 Size(ft)	6		6			6	6			6	
Detector 2 Type	Cl+Ex		Cl+Ex			Cl+Ex	Cl+Ex			Cl+Ex	
Detector 2 Channel											
Detector 2 Extend (s)	0.0		0.0			0.0	0.0			0.0	
Detector 3 Position(ft)	250		250			250	250			250	
Detector 3 Size(ft)	6		6			6	6			6	

Lane Group	NBL2	NBL	NBR	SEL	SER	NEL	NET	NER	SWL	SWT	SWR
Detector 3 Type	Cl+Ex		Cl+Ex			Cl+Ex	Cl+Ex			Cl+Ex	
Detector 3 Channel											
Detector 3 Extend (s)	0.0		0.0			0.0	0.0			0.0	
Turn Type	Prot		Prot			Prot	NA			NA	Free
Protected Phases	8		8			5	2			6	
Permitted Phases											Free
Detector Phase	8		2			5	2			6	
Switch Phase											
Minimum Initial (s)	10.0		10.0			5.0	8.0			8.0	
Minimum Split (s)	16.0		16.0			11.0	42.0			31.0	
Total Split (s)	31.0		31.0			73.0	119.0			46.0	
Total Split (%)	20.7%		20.7%			48.7%	79.3%			30.7%	
Maximum Green (s)	25.0		25.0			67.0	113.0			40.0	
Yellow Time (s)	2.0		2.0			2.0	2.0			2.0	
All-Red Time (s)	4.0		4.0			4.0	4.0			4.0	
Lost Time Adjust (s)	0.0		0.0			0.0	0.0			0.0	
Total Lost Time (s)	6.0		6.0			6.0	6.0			6.0	
Lead/Lag						Lead				Lag	
Lead-Lag Optimize?											
Vehicle Extension (s)	3.0		3.0			3.0	3.0			3.0	
Recall Mode	None		None			None	C-Min			C-Min	
Walk Time (s)							7.0			7.0	
Flash Dont Walk (s)							29.0			17.0	
Pedestrian Calls (#/hr)							0			0	
Act Effct Green (s)	25.0		25.0			67.0	113.0			40.0	150.0
Actuated g/C Ratio	0.17		0.17			0.45	0.75			0.27	1.00
v/c Ratio	1.03		0.61			1.05	0.10			1.03	0.12
Control Delay	106.8		64.7			65.1	9.1			90.4	0.2
Queue Delay	0.0		0.0			0.0	0.0			0.0	0.0
Total Delay	106.8		64.7			65.1	9.1			90.4	0.2
LOS	F		E			E	A			F	A
Approach Delay		93.1					57.1			75.5	
Approach LOS		F					E			E	
Queue Length 50th (ft)	~300		139			~849	55			~527	0
Queue Length 95th (ft)	#404		190			#980	m63			#665	0
Internal Link Dist (ft)		776		310			680			777	
Turn Bay Length (ft)						550					
Base Capacity (vph)	540		438			1489	2589			934	1568
Starvation Cap Reductn	0		0			0	0			0	0
Spillback Cap Reductn	0		0			0	0			0	0
Storage Cap Reductn	0		0			0	0			0	0
Reduced v/c Ratio	1.03		0.61			1.05	0.10			1.03	0.12

Intersection Summary

Area Type: Other
Cycle Length: 150
Actuated Cycle Length: 150
Offset: 67 (45%), Referenced to phase 2:NET and 6:SWT, Start of Yellow
Natural Cycle: 150

Control Type: Actuated-Coordinated
Maximum v/c Ratio: 1.05
Intersection Signal Delay: 70.5 Intersection LOS: E
Intersection Capacity Utilization 96.4% ICU Level of Service F
Analysis Period (min) 15
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 8: NH 102 & Exit 4 NB Off

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑	↱	↰	↑↑					↰↰		↱
Traffic Volume (vph)	0	660	455	420	790	0	0	0	0	180	0	445
Future Volume (vph)	0	660	455	420	790	0	0	0	0	180	0	445
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		350	0		0	0		0	0		0
Storage Lanes	0		1	1		0	0		0	2		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	0.97	1.00	1.00
Frt			0.850									0.850
Flt Protected				0.950						0.950		
Satd. Flow (prot)	0	3167	1417	1687	3374	0	0	0	0	3303	0	1524
Flt Permitted				0.950						0.950		
Satd. Flow (perm)	0	3167	1417	1687	3374	0	0	0	0	3303	0	1524
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			495									103
Link Speed (mph)		30			30			30			35	
Link Distance (ft)		851			693			486			581	
Travel Time (s)		19.3			15.8			11.0			11.3	
Peak Hour Factor	0.92	0.92	0.92	0.73	0.73	0.73	0.92	0.92	0.92	0.74	0.74	0.74
Heavy Vehicles (%)	14%	14%	14%	7%	7%	7%	2%	2%	2%	6%	6%	6%
Adj. Flow (vph)	0	717	495	575	1082	0	0	0	0	243	0	601
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	717	495	575	1082	0	0	0	0	243	0	601
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Right	Right	Left	Left	Right	Left	Left	Right	R NA	Left	Right
Median Width(ft)		36			36			24			24	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		25	15		9	15		9	15		9
Number of Detectors		3	2	3	3					3		2
Detector Template		Thru	Right	Left	Thru					Left		
Leading Detector (ft)		256	131	256	256					256		206
Trailing Detector (ft)		-5	-5	-5	-5					-5		-5
Detector 1 Position(ft)		-5	-5	-5	-5					-5		-5
Detector 1 Size(ft)		50	50	50	50					50		50
Detector 1 Type		Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex					Cl+Ex		Cl+Ex
Detector 1 Channel												
Detector 1 Extend (s)		0.0	0.0	0.0	0.0					0.0		0.0
Detector 1 Queue (s)		0.0	0.0	0.0	0.0					0.0		0.0
Detector 1 Delay (s)		0.0	0.0	0.0	0.0					0.0		0.0
Detector 2 Position(ft)		125	125	125	125					125		200
Detector 2 Size(ft)		6	6	6	6					6		6
Detector 2 Type		Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex					Cl+Ex		Cl+Ex
Detector 2 Channel												
Detector 2 Extend (s)		0.0	0.0	0.0	0.0					0.0		0.0
Detector 3 Position(ft)		250		250	250					250		
Detector 3 Size(ft)		6		6	6					6		

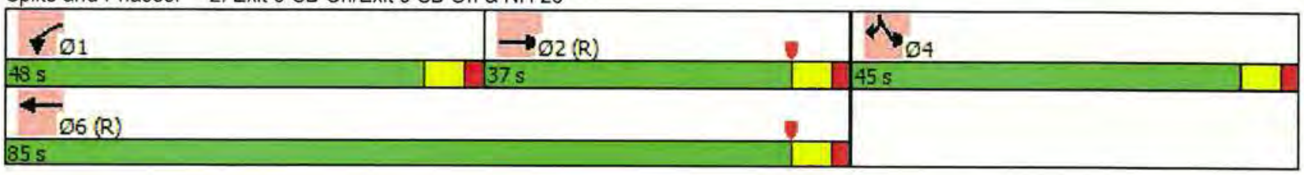
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Detector 3 Type		Cl+Ex		Cl+Ex	Cl+Ex					Cl+Ex		
Detector 3 Channel												
Detector 3 Extend (s)		0.0		0.0	0.0					0.0		
Turn Type		NA	Free	Prot	NA					Prot		Prot
Protected Phases		2		1	6					4		4
Permitted Phases			Free									
Detector Phase		2		1	6					4		4
Switch Phase												
Minimum Initial (s)		9.0		4.0	9.0					4.0		4.0
Minimum Split (s)		21.0		10.0	21.0					10.0		10.0
Total Split (s)		37.0		48.0	85.0					45.0		45.0
Total Split (%)		28.5%		36.9%	65.4%					34.6%		34.6%
Maximum Green (s)		31.0		42.0	79.0					39.0		39.0
Yellow Time (s)		4.0		4.0	4.0					4.0		4.0
All-Red Time (s)		2.0		2.0	2.0					2.0		2.0
Lost Time Adjust (s)		0.0		0.0	0.0					0.0		0.0
Total Lost Time (s)		6.0		6.0	6.0					6.0		6.0
Lead/Lag		Lag		Lead								
Lead-Lag Optimize?												
Vehicle Extension (s)		5.0		3.0	5.0					3.0		3.0
Recall Mode		C-Min		None	C-Min					None		None
Walk Time (s)		7.0			7.0							
Flash Dont Walk (s)		8.0			8.0							
Pedestrian Calls (#/hr)		0			0							
Act Effct Green (s)		31.0	130.0	42.0	79.0					39.0		39.0
Actuated g/C Ratio		0.24	1.00	0.32	0.61					0.30		0.30
v/c Ratio		0.95	0.35	1.06	0.53					0.25		1.14
Control Delay		71.4	0.7	65.8	1.8					35.2		117.1
Queue Delay		0.0	0.0	0.0	0.4					0.0		0.0
Total Delay		71.4	0.7	65.8	2.2					35.2		117.1
LOS		E	A	E	A					D		F
Approach Delay		42.5			24.3						93.5	
Approach LOS		D			C						F	
Queue Length 50th (ft)		315	0	418	17					79		~526
Queue Length 95th (ft)		#438	0	m150	m14					93		#528
Internal Link Dist (ft)		771			613			406			501	
Turn Bay Length (ft)			350									
Base Capacity (vph)		755	1417	545	2050					990		529
Starvation Cap Reductn		0	0	0	443					0		0
Spillback Cap Reductn		0	0	0	0					0		0
Storage Cap Reductn		0	0	0	0					0		0
Reduced v/c Ratio		0.95	0.35	1.06	0.67					0.25		1.14

Intersection Summary

Area Type: Other
Cycle Length: 130
Actuated Cycle Length: 130
Offset: 69 (53%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow
Natural Cycle: 130

Control Type: Actuated-Coordinated
Maximum v/c Ratio: 1.14
Intersection Signal Delay: 46.0 Intersection LOS: D
Intersection Capacity Utilization 86.0% ICU Level of Service E
Analysis Period (min) 15
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 2: Exit 5 SB On/Exit 5 SB Off & NH 28



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑			↑↑	↱	↰		↱			
Traffic Volume (vph)	505	335	0	0	740	630	470	0	180	0	0	0
Future Volume (vph)	505	335	0	0	740	630	470	0	180	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt						0.850			0.850			
Flt Protected	0.950						0.950					
Satd. Flow (prot)	1641	3282	0	0	3438	1538	1656	0	1482	0	0	0
Flt Permitted	0.950						0.950					
Satd. Flow (perm)	1641	3282	0	0	3438	1538	1656	0	1482	0	0	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						492			172			
Link Speed (mph)		30			30			35			30	
Link Distance (ft)		693			542			867			392	
Travel Time (s)		15.8			12.3			16.9			8.9	
Peak Hour Factor	0.87	0.87	0.87	0.90	0.90	0.90	0.78	0.78	0.78	0.92	0.92	0.92
Heavy Vehicles (%)	10%	10%	10%	5%	5%	5%	9%	9%	9%	2%	2%	2%
Adj. Flow (vph)	580	385	0	0	822	700	603	0	231	0	0	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	580	385	0	0	822	700	603	0	231	0	0	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Right	Right	Right	Left	Right	Left	Left	Right
Median Width(ft)		36			42			12			12	
Link Offset(ft)		0			0			0			36	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		25	15		9	15		9
Number of Detectors	3	3			3	2	3		0			
Detector Template	Left	Thru			Thru	Right	Left					
Leading Detector (ft)	256	256			256	131	256		0			
Trailing Detector (ft)	-5	-5			-5	-5	-5		0			
Detector 1 Position(ft)	-5	-5			-5	-5	-5		-5			
Detector 1 Size(ft)	50	50			50	50	50		50			
Detector 1 Type	Cl+Ex	Cl+Ex			Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex			
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0			0.0	0.0	0.0		0.0			
Detector 1 Queue (s)	0.0	0.0			0.0	0.0	0.0		0.0			
Detector 1 Delay (s)	0.0	0.0			0.0	0.0	0.0		0.0			
Detector 2 Position(ft)	125	125			125	125	125					
Detector 2 Size(ft)	6	6			6	6	6					
Detector 2 Type	Cl+Ex	Cl+Ex			Cl+Ex	Cl+Ex	Cl+Ex					
Detector 2 Channel												
Detector 2 Extend (s)	0.0	0.0			0.0	0.0	0.0					
Detector 3 Position(ft)	250	250			250		250					
Detector 3 Size(ft)	6	6			6		6					
Detector 3 Type	Cl+Ex	Cl+Ex			Cl+Ex		Cl+Ex					
Detector 3 Channel												
Detector 3 Extend (s)	0.0	0.0			0.0		0.0					

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Type	Prot	NA			NA	Free	Prot		Prot			
Protected Phases	5	2			6		8		8			
Permitted Phases		2			6	Free						
Detector Phase	5	2			6		8		8			
Switch Phase												
Minimum Initial (s)	4.0	16.0			16.0		4.0		4.0			
Minimum Split (s)	10.0	23.0			23.0		10.0		10.0			
Total Split (s)	47.0	82.0			35.0		48.0		48.0			
Total Split (%)	36.2%	63.1%			26.9%		36.9%		36.9%			
Maximum Green (s)	41.0	76.0			29.0		42.0		42.0			
Yellow Time (s)	4.0	4.0			4.0		4.0		4.0			
All-Red Time (s)	2.0	2.0			2.0		2.0		2.0			
Lost Time Adjust (s)	0.0	0.0			0.0		0.0		0.0			
Total Lost Time (s)	6.0	6.0			6.0		6.0		6.0			
Lead/Lag	Lead				Lag							
Lead-Lag Optimize?												
Vehicle Extension (s)	5.0	5.0			5.0		3.0		3.0			
Recall Mode	None	C-Min			C-Min		None		None			
Walk Time (s)		7.0			7.0							
Flash Dont Walk (s)		10.0			10.0							
Pedestrian Calls (#/hr)		0			0							
Act Effct Green (s)	41.0	76.0			29.0	130.0	42.0		42.0			
Actuated g/C Ratio	0.32	0.58			0.22	1.00	0.32		0.32			
v/c Ratio	1.12	0.20			1.07	0.46	1.13		0.39			
Control Delay	76.7	0.3			101.5	1.0	119.5		11.5			
Queue Delay	0.0	0.0			0.0	0.0	0.0		0.0			
Total Delay	76.7	0.3			101.5	1.0	119.5		11.5			
LOS	E	A			F	A	F		B			
Approach Delay		46.2			55.3			89.6				
Approach LOS		D			E			F				
Queue Length 50th (ft)	~567	1			~404	0	~587		35			
Queue Length 95th (ft)	m#607	m1			#534	0	#645		69			
Internal Link Dist (ft)		613			462			787			312	
Turn Bay Length (ft)												
Base Capacity (vph)	517	1918			766	1538	535		595			
Starvation Cap Reductn	0	0			0	0	0		0			
Spillback Cap Reductn	0	0			0	0	0		0			
Storage Cap Reductn	0	0			0	0	0		0			
Reduced v/c Ratio	1.12	0.20			1.07	0.46	1.13		0.39			

Intersection Summary

Area Type: Other

Cycle Length: 130

Actuated Cycle Length: 130

Offset: 0 (0%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow, Master Intersection

Natural Cycle: 150

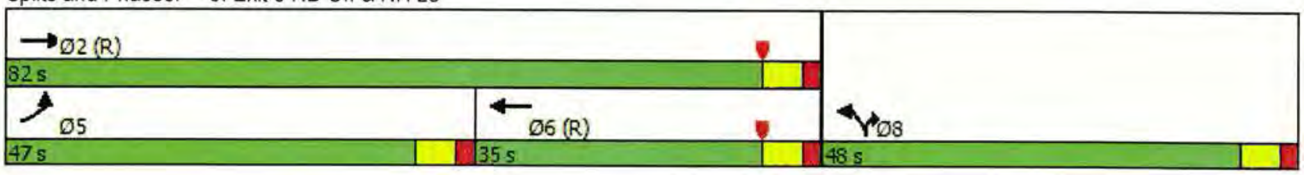
Control Type: Actuated-Coordinated

Maximum v/c Ratio: 1.13

Intersection Signal Delay: 61.2 Intersection LOS: E

Intersection Capacity Utilization 86.0% ICU Level of Service E
Analysis Period (min) 15
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 3: Exit 5 NB Off & NH 28



Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	80	0	25	0	1	0	60	430	0	5	930	20
Future Volume (vph)	80	0	25	0	1	0	60	430	0	5	930	20
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		225	0		0	350		0	100		0
Storage Lanes	0		1	0		0	1		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00	0.95	0.95
Frt			0.850								0.997	
Flt Protected		0.950					0.950			0.950		
Satd. Flow (prot)	0	1770	1583	0	1900	0	1770	3539	0	1770	3529	0
Flt Permitted		0.755					0.950			0.950		
Satd. Flow (perm)	0	1406	1583	0	1900	0	1770	3539	0	1770	3529	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			182								3	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		593			447			750			330	
Travel Time (s)		13.5			10.2			17.0			7.5	
Peak Hour Factor	0.92	0.92	0.92	0.25	0.25	0.25	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	2%	2%	2%	0%	0%	0%	2%	2%	2%	2%	2%	2%
Adj. Flow (vph)	87	0	27	0	4	0	65	467	0	5	1011	22
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	87	27	0	4	0	65	467	0	5	1033	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	3	3	1	3	1		3	3		3	3	
Detector Template	Left	Thru	Right	Left			Left	Thru		Left	Thru	
Leading Detector (ft)	256	256	45	256	45		256	256		256	256	
Trailing Detector (ft)	-5	-5	-5	-5	-5		-5	-5		-5	-5	
Detector 1 Position(ft)	-5	-5	-5	-5	-5		-5	-5		-5	-5	
Detector 1 Size(ft)	50	50	50	50	50		50	50		50	50	
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(ft)	125	125		125			125	125		125	125	
Detector 2 Size(ft)	6	6		6			6	6		6	6	
Detector 2 Type	Cl+Ex	Cl+Ex		Cl+Ex			Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)	0.0	0.0		0.0			0.0	0.0		0.0	0.0	
Detector 3 Position(ft)	250	250		250			250	250		250	250	
Detector 3 Size(ft)	6	6		6			6	6		6	6	

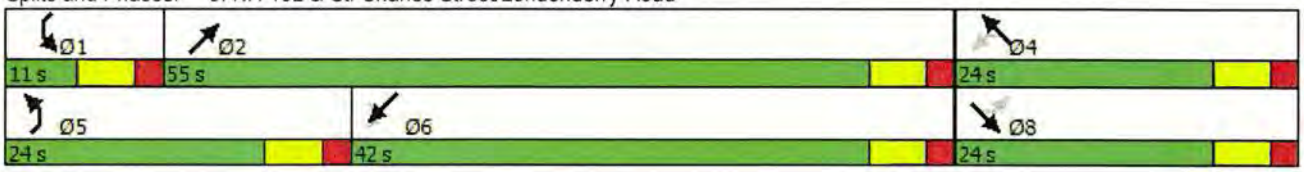
Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Detector 3 Type	Cl+Ex	Cl+Ex		Cl+Ex			Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 3 Channel												
Detector 3 Extend (s)	0.0	0.0		0.0			0.0	0.0		0.0	0.0	
Turn Type	Perm	NA	custom		NA		Prot	NA		Prot	NA	
Protected Phases		8			4		5	2		1	6	
Permitted Phases	8		6	4								
Detector Phase	8	8	6	4	4		5	2		1	6	
Switch Phase												
Minimum Initial (s)	5.0	5.0	8.0	5.0	5.0		5.0	8.0		5.0	8.0	
Minimum Split (s)	24.0	24.0	24.0	24.0	24.0		24.0	24.0		11.0	24.0	
Total Split (s)	24.0	24.0	42.0	24.0	24.0		24.0	55.0		11.0	42.0	
Total Split (%)	26.7%	26.7%	46.7%	26.7%	26.7%		26.7%	61.1%		12.2%	46.7%	
Maximum Green (s)	18.0	18.0	36.0	18.0	18.0		18.0	49.0		5.0	36.0	
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)		0.0	0.0		0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)		6.0	6.0		6.0		6.0	6.0		6.0	6.0	
Lead/Lag			Lag				Lead	Lag		Lead	Lag	
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None	Min	None	None		None	Min		None	Min	
Walk Time (s)	7.0	7.0	7.0	7.0	7.0		7.0	7.0			7.0	
Flash Dont Walk (s)	11.0	11.0	11.0	11.0	11.0		11.0	11.0			11.0	
Pedestrian Calls (#/hr)	0	0	0	0	0		0	0			0	
Act Effct Green (s)		10.0	38.9		9.8		8.3	47.8		5.4	38.9	
Actuated g/C Ratio		0.15	0.59		0.15		0.13	0.72		0.08	0.59	
v/c Ratio		0.41	0.03		0.01		0.29	0.18		0.03	0.50	
Control Delay		35.0	0.0		27.0		33.7	5.7		34.6	13.8	
Queue Delay		0.0	0.0		0.0		0.0	0.0		0.0	0.0	
Total Delay		35.0	0.0		27.0		33.7	5.7		34.6	13.8	
LOS		D	A		C		C	A		C	B	
Approach Delay		26.8			27.0			9.1			13.9	
Approach LOS		C			C			A			B	
Queue Length 50th (ft)		36	0		2		27	31		2	159	
Queue Length 95th (ft)		80	0		3		66	88		13	265	
Internal Link Dist (ft)		513			367			670			250	
Turn Bay Length (ft)			225				350			100		
Base Capacity (vph)		409	999		554		516	2641		143	2059	
Starvation Cap Reductn		0	0		0		0	0		0	0	
Spillback Cap Reductn		0	0		0		0	0		0	0	
Storage Cap Reductn		0	0		0		0	0		0	0	
Reduced v/c Ratio		0.21	0.03		0.01		0.13	0.18		0.03	0.50	

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 66.3
Natural Cycle: 75
Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.50
Intersection Signal Delay: 13.3 Intersection LOS: B
Intersection Capacity Utilization 61.8% ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 9: NH 102 & St. Charles Street/Londonderry Road



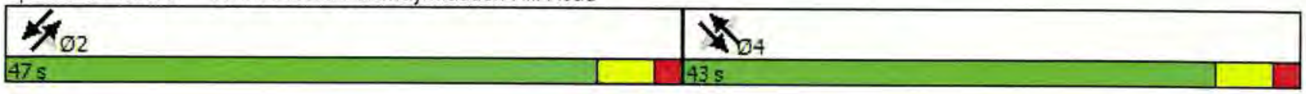
Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	10	70	10	370	0	50	0	370	110	15	495	0
Future Volume (vph)	10	70	10	370	0	50	0	370	110	15	495	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.985			0.984			0.969				
Flt Protected		0.994			0.958						0.999	
Satd. Flow (prot)	0	1824	0	0	1739	0	0	1705	0	0	1808	0
Flt Permitted		0.935			0.685						0.979	
Satd. Flow (perm)	0	1716	0	0	1243	0	0	1705	0	0	1772	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		9			36			22				
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		356			493			1124			603	
Travel Time (s)		8.1			11.2			25.5			13.7	
Peak Hour Factor	0.60	0.60	0.60	0.96	0.96	0.96	0.89	0.89	0.89	0.86	0.86	0.86
Heavy Vehicles (%)	2%	2%	2%	3%	3%	3%	8%	8%	8%	5%	5%	5%
Adj. Flow (vph)	17	117	17	385	0	52	0	416	124	17	576	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	151	0	0	437	0	0	540	0	0	593	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0			0	
Link Offset(ft)		-22			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	3	1		3	2			2		3	2	
Detector Template	Left			Left						Left		
Leading Detector (ft)	256	45		256	131			131		256	131	
Trailing Detector (ft)	-5	-5		-5	-5			-5		-5	-5	
Detector 1 Position(ft)	-5	-5		-5	-5			-5		-5	-5	
Detector 1 Size(ft)	50	50		50	50			50		50	50	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex			Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0			0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0			0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0			0.0		0.0	0.0	
Detector 2 Position(ft)	125			125	125			125		125	125	
Detector 2 Size(ft)	6			6	6			6		6	6	
Detector 2 Type	Cl+Ex			Cl+Ex	Cl+Ex			Cl+Ex		Cl+Ex	Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)	0.0			0.0	0.0			0.0		0.0	0.0	
Detector 3 Position(ft)	250			250						250		
Detector 3 Size(ft)	6			6						6		
Detector 3 Type	Cl+Ex			Cl+Ex						Cl+Ex		
Detector 3 Channel												
Detector 3 Extend (s)	0.0			0.0						0.0		

Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Turn Type	Perm	NA		Perm	NA			NA		Perm	NA	
Protected Phases		4			4			2			2	
Permitted Phases	4			4						2		
Detector Phase	4	4		4	4			2		2	2	
Switch Phase												
Minimum Initial (s)	5.0	5.0		5.0	5.0			5.0		5.0	5.0	
Minimum Split (s)	24.0	24.0		24.0	24.0			24.0		24.0	24.0	
Total Split (s)	43.0	43.0		43.0	43.0			47.0		47.0	47.0	
Total Split (%)	47.8%	47.8%		47.8%	47.8%			52.2%		52.2%	52.2%	
Maximum Green (s)	37.0	37.0		37.0	37.0			41.0		41.0	41.0	
Yellow Time (s)	4.0	4.0		4.0	4.0			4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0			2.0		2.0	2.0	
Lost Time Adjust (s)		0.0			0.0			0.0			0.0	
Total Lost Time (s)		6.0			6.0			6.0			6.0	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0		3.0	3.0	
Recall Mode	None	None		None	None			Min		Min	Min	
Walk Time (s)	7.0	7.0		7.0	7.0			7.0		7.0	7.0	
Flash Dont Walk (s)	11.0	11.0		11.0	11.0			11.0		11.0	11.0	
Pedestrian Calls (#/hr)	0	0		0	0			0		0	0	
Act Effct Green (s)		30.7			30.7			33.9			33.9	
Actuated g/C Ratio		0.40			0.40			0.44			0.44	
v/c Ratio		0.22			0.85			0.71			0.76	
Control Delay		16.6			37.8			23.8			26.8	
Queue Delay		0.0			0.0			0.0			0.0	
Total Delay		16.6			37.8			23.8			26.8	
LOS		B			D			C			C	
Approach Delay		16.6			37.8			23.8			26.8	
Approach LOS		B			D			C			C	
Queue Length 50th (ft)		50			198			225			266	
Queue Length 95th (ft)		57			#374			339			369	
Internal Link Dist (ft)		276			413			1044			523	
Turn Bay Length (ft)												
Base Capacity (vph)		876			649			969			998	
Starvation Cap Reductn		0			0			0			0	
Spillback Cap Reductn		0			0			0			0	
Storage Cap Reductn		0			0			0			0	
Reduced v/c Ratio		0.17			0.67			0.56			0.59	

Intersection Summary	
Area Type: Other	
Cycle Length: 90	
Actuated Cycle Length: 77.3	
Natural Cycle: 60	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.85	
Intersection Signal Delay: 27.8	Intersection LOS: C
Intersection Capacity Utilization 79.7%	ICU Level of Service D

Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 10: NH 102 & Fordway/Madden Hill Road



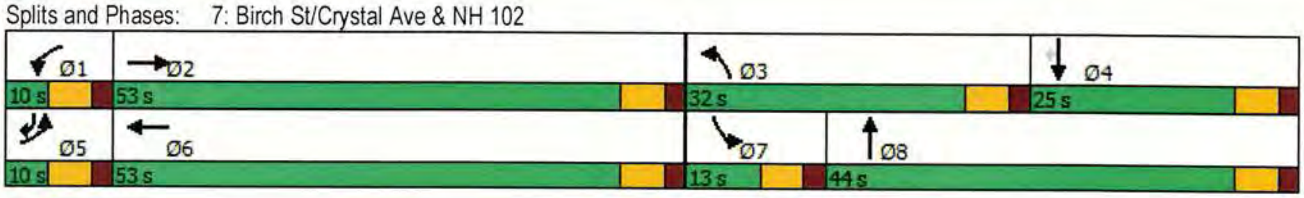
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↱		↰	↑↱		↰	↑↱		↰	↑	↱
Traffic Volume (vph)	20	280	80	20	430	265	170	180	20	90	240	30
Future Volume (vph)	20	280	80	20	430	265	170	180	20	90	240	30
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.967			0.943			0.985				0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1656	1686	0	1703	1690	0	1719	1782	0	1703	1792	1524
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1656	1686	0	1703	1690	0	1719	1782	0	1703	1792	1524
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		14			30			5				136
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		505			530			361			411	
Travel Time (s)		11.5			12.0			8.2			9.3	
Peak Hour Factor	0.96	0.96	0.96	0.94	0.94	0.94	0.85	0.85	0.85	0.91	0.91	0.91
Heavy Vehicles (%)	9%	9%	9%	6%	6%	6%	5%	5%	5%	6%	6%	6%
Parking (#/hr)			0									
Adj. Flow (vph)	21	292	83	21	457	282	200	212	24	99	264	33
Shared Lane Traffic (%)												
Lane Group Flow (vph)	21	375	0	21	739	0	200	236	0	99	264	33
Turn Type	Prot	NA		Prot	NA		Prot	NA		Prot	NA	pm+ov
Protected Phases	5	2		1	6		3	8		7	4	5
Permitted Phases												4
Detector Phase	5	2		1	6		3	8		7	4	5
Switch Phase												
Minimum Initial (s)	4.0	5.0		4.0	10.0		4.0	10.0		4.0	9.0	4.0
Minimum Split (s)	10.0	30.0		10.0	30.0		10.0	25.0		10.0	25.0	10.0
Total Split (s)	10.0	53.0		10.0	53.0		32.0	44.0		13.0	25.0	10.0
Total Split (%)	8.3%	44.2%		8.3%	44.2%		26.7%	36.7%		10.8%	20.8%	8.3%
Maximum Green (s)	4.0	47.0		4.0	47.0		26.0	38.0		7.0	19.0	4.0
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	6.0
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lag		Lead	Lag	Lead
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes	Yes
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Recall Mode	None	Min		None	Min		Min	None		Min	None	None
Walk Time (s)		7.0			7.0			7.0			7.0	
Flash Dont Walk (s)		11.0			11.0			11.0			11.0	
Pedestrian Calls (#/hr)		10			10			0			10	
Act Effct Green (s)	4.0	51.4		4.0	47.4		18.0	29.5		7.1	18.6	28.7
Actuated g/C Ratio	0.04	0.47		0.04	0.43		0.16	0.27		0.06	0.17	0.26
v/c Ratio	0.35	0.47		0.34	0.99		0.71	0.49		0.91	0.87	0.07
Control Delay	70.7	23.8		69.8	62.7		58.2	36.9		117.8	74.1	0.3
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Total Delay	70.7	23.8		69.8	62.7		58.2	36.9		117.8	74.1	0.3
LOS	E	C		E	E		E	D		F	E	A

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		26.2			62.9			46.7			78.9	
Approach LOS		C			E			D			E	
Queue Length 50th (ft)	15	158		15	~553		138	140		72	188	0
Queue Length 95th (ft)	#45	315		44	#868		204	202		#194	#367	0
Internal Link Dist (ft)		425			450			281			331	
Turn Bay Length (ft)												
Base Capacity (vph)	60	796		62	746		410	625		109	312	498
Starvation Cap Reductn	0	0		0	0		0	0		0	0	0
Spillback Cap Reductn	0	0		0	0		0	0		0	0	0
Storage Cap Reductn	0	0		0	0		0	0		0	0	0
Reduced v/c Ratio	0.35	0.47		0.34	0.99		0.49	0.38		0.91	0.85	0.07

Intersection Summary

Area Type: Other
Cycle Length: 120
Actuated Cycle Length: 109.8
Natural Cycle: 100
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.99
Intersection Signal Delay: 55.2 — Intersection LOS: E
Intersection Capacity Utilization 75.8% — ICU Level of Service D
Analysis Period (min) 15
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 7: Birch St/Crystal Ave & NH 102



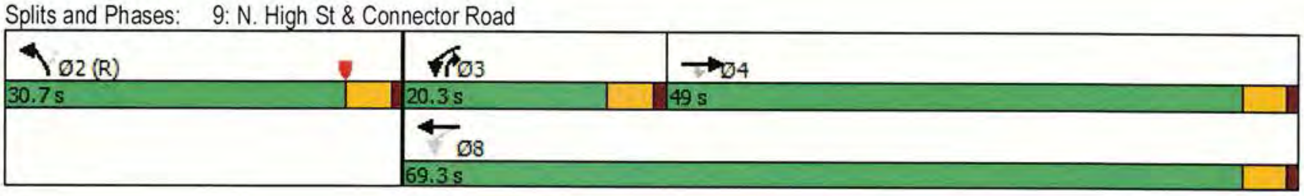
Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑	↱	↰	↑↑	↰↰	↱
Traffic Volume (vph)	1090	270	180	1110	280	200
Future Volume (vph)	1090	270	180	1110	280	200
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)		0	250		0	400
Storage Lanes		1	1		2	1
Taper Length (ft)			25		25	
Lane Util. Factor	0.95	1.00	1.00	0.95	0.97	1.00
Frt		0.850				0.850
Flt Protected			0.950		0.950	
Satd. Flow (prot)	3539	1583	1770	3539	3433	1583
Flt Permitted			0.086		0.950	
Satd. Flow (perm)	3539	1583	160	3539	3433	1583
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)		293				30
Link Speed (mph)	30			30	30	
Link Distance (ft)	511			427	520	
Travel Time (s)	11.6			9.7	11.8	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	1185	293	196	1207	304	217
Shared Lane Traffic (%)						
Lane Group Flow (vph)	1185	293	196	1207	304	217
Turn Type	NA	Perm	pm+pt	NA	Prot	pm+ov
Protected Phases	4		3	8	2	3
Permitted Phases		4	8			2
Detector Phase	4	4	3	8	2	3
Switch Phase						
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	29.5	29.5	9.5	29.5	29.5	9.5
Total Split (s)	49.0	49.0	20.3	69.3	30.7	20.3
Total Split (%)	49.0%	49.0%	20.3%	69.3%	30.7%	20.3%
Maximum Green (s)	44.5	44.5	15.8	64.8	26.2	15.8
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	4.5	4.5	4.5	4.5	4.5
Lead/Lag	Lag	Lag	Lead			Lead
Lead-Lag Optimize?	Yes	Yes	Yes			Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	None	None	None	C-Max	None
Walk Time (s)	5.0	5.0		5.0	5.0	
Flash Dont Walk (s)	20.0	20.0		20.0	20.0	
Pedestrian Calls (#/hr)	0	0		0	0	
Act Effct Green (s)	42.9	42.9	59.1	59.1	31.9	48.1
Actuated g/C Ratio	0.43	0.43	0.59	0.59	0.32	0.48
v/c Ratio	0.78	0.35	0.70	0.58	0.28	0.28
Control Delay	28.4	3.2	28.7	25.2	27.9	15.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	28.4	3.2	28.7	25.2	27.9	15.3

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
LOS	C	A	C	C	C	B
Approach Delay	23.4			25.7	22.6	
Approach LOS	C			C	C	
Queue Length 50th (ft)	315	0	5	388	76	72
Queue Length 95th (ft)	406	46	145	457	119	121
Internal Link Dist (ft)	431			347	440	
Turn Bay Length (ft)			250			400
Base Capacity (vph)	1600	876	349	2293	1095	840
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.74	0.33	0.56	0.53	0.28	0.26

Intersection Summary

Area Type: Other
Cycle Length: 100
Actuated Cycle Length: 100
Offset: 0 (0%), Referenced to phase 2:NBL and 6:, Start of Yellow
Natural Cycle: 75
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.78
Intersection Signal Delay: 24.3 Intersection LOS: C
Intersection Capacity Utilization 59.3% ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 9: N. High St & Connector Road



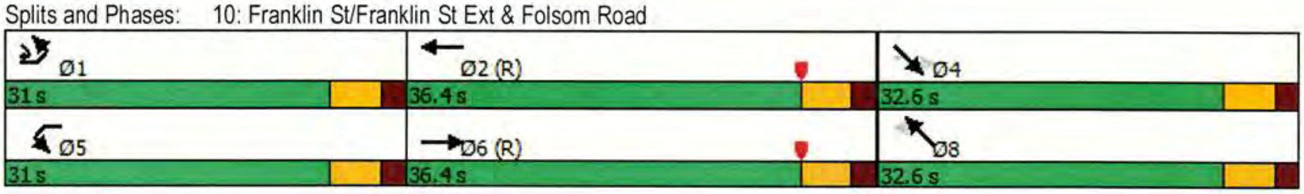
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Traffic Volume (vph)	60	1200	30	50	1100	10	5	5	40	150	20	40
Future Volume (vph)	60	1200	30	50	1100	10	5	5	40	150	20	40
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	50		100	100		0	0		200	100		0
Storage Lanes	1		0	1		0	0		1	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	0.91	0.91	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor								0.98				
Frt		0.996			0.999				0.850		0.900	
Flt Protected	0.950			0.950				0.976		0.950		
Satd. Flow (prot)	1687	4828	0	1719	3435	0	0	1818	1583	1805	1710	0
Flt Permitted	0.950			0.950				0.882		0.747		
Satd. Flow (perm)	1687	4828	0	1719	3435	0	0	1608	1583	1419	1710	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		4			1				33		60	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		333			347			309			251	
Travel Time (s)		7.6			7.9			7.0			5.7	
Confl. Peds. (#/hr)							40					
Peak Hour Factor	0.89	0.89	0.89	0.96	0.96	0.96	0.65	0.65	0.65	0.67	0.67	0.67
Heavy Vehicles (%)	7%	7%	7%	5%	5%	5%	2%	2%	2%	0%	0%	0%
Adj. Flow (vph)	67	1348	34	52	1146	10	8	8	62	224	30	60
Shared Lane Traffic (%)												
Lane Group Flow (vph)	67	1382	0	52	1156	0	0	16	62	224	90	0
Turn Type	Prot	NA		Prot	NA		Perm	NA	pm+ov	Perm	NA	
Protected Phases	1	6		5	2			4	1		8	
Permitted Phases							4		4	8		
Detector Phase	1	6		5	2		4	4	1	8	8	
Switch Phase												
Minimum Initial (s)	5.0	5.0		5.0	5.0		5.0	5.0	5.0	5.0	5.0	
Minimum Split (s)	31.0	31.0		31.0	31.0		31.0	31.0	31.0	32.5	32.5	
Total Split (s)	31.0	36.4		31.0	36.4		32.6	32.6	31.0	32.6	32.6	
Total Split (%)	31.0%	36.4%		31.0%	36.4%		32.6%	32.6%	31.0%	32.6%	32.6%	
Maximum Green (s)	25.0	30.4		25.0	30.4		26.6	26.6	25.0	26.6	26.6	
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0	2.0	2.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0			0.0	0.0	0.0	0.0	
Total Lost Time (s)	6.0	6.0		6.0	6.0			6.0	6.0	6.0	6.0	
Lead/Lag	Lead	Lag		Lead	Lag				Lead			
Lead-Lag Optimize?	Yes	Yes		Yes	Yes				Yes			
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Recall Mode	None	C-Max		None	C-Max		None	None	None	None	None	
Walk Time (s)	5.0	5.0		5.0	5.0		5.0	5.0	5.0	5.0	5.0	
Flash Dont Walk (s)	20.0	20.0		20.0	20.0		20.0	20.0	20.0	20.0	20.0	
Pedestrian Calls (#/hr)	0	0		0	0		0	0	0	0	0	
Act Effct Green (s)	9.3	55.4		8.5	54.5			20.5	35.8	20.5	20.5	
Actuated g/C Ratio	0.09	0.55		0.08	0.54			0.20	0.36	0.20	0.20	
v/c Ratio	0.43	0.52		0.36	0.62			0.05	0.11	0.77	0.23	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Control Delay	64.2	8.4		49.3	19.9			29.3	10.3	54.8	14.0	
Queue Delay	0.0	0.0		0.0	0.0			0.0	0.0	0.0	0.0	
Total Delay	64.2	8.4		49.3	19.9			29.3	10.3	54.8	14.0	
LOS	E	A		D	B			C	B	D	B	
Approach Delay		11.0			21.2			14.2			43.1	
Approach LOS		B			C			B			D	
Queue Length 50th (ft)	40	205		32	268			8	12	135	16	
Queue Length 95th (ft)	m55	299		68	415			17	20	141	31	
Internal Link Dist (ft)		253			267			229			171	
Turn Bay Length (ft)	50			100					200	100		
Base Capacity (vph)	421	2674		429	1874			427	831	377	498	
Starvation Cap Reductn	0	0		0	0			0	0	0	0	
Spillback Cap Reductn	0	0		0	0			0	0	0	0	
Storage Cap Reductn	0	0		0	0			0	0	0	0	
Reduced v/c Ratio	0.16	0.52		0.12	0.62			0.04	0.07	0.59	0.18	

Intersection Summary

Area Type: Other
Cycle Length: 100
Actuated Cycle Length: 100
Offset: 0 (0%), Referenced to phase 2:WBT and 6:EBT, Start of Yellow
Natural Cycle: 95
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.77
Intersection Signal Delay: 18.4 Intersection LOS: B
Intersection Capacity Utilization 64.9% ICU Level of Service C
Analysis Period (min) 15
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 10: Franklin St/Franklin St Ext & Folsom Road



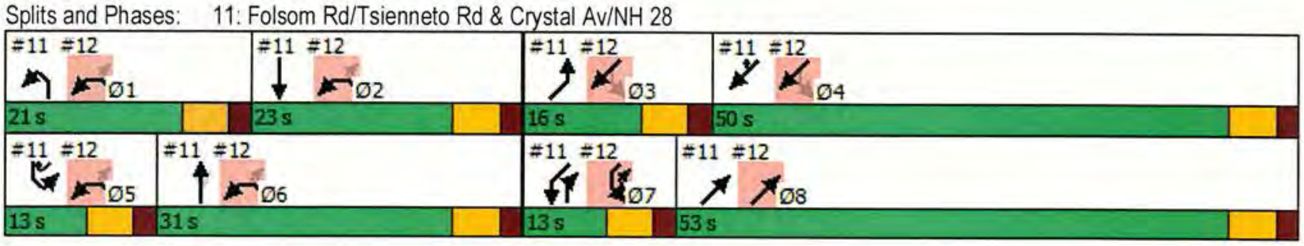
Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations	↰	↑↑	↱	↰↰	↑↑		↰↰	↑↑	↱	↰	↑↑	↱
Traffic Volume (vph)	100	70	40	50	100	0	130	820	320	30	935	220
Future Volume (vph)	100	70	40	50	100	0	130	820	320	30	935	220
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	150		150	360		400	250		100	0		100
Storage Lanes	1		0	2		0	2		1	1		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95	1.00	0.97	0.95	1.00	1.00	0.95	1.00
Frt			0.850						0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1736	3471	1553	3335	3438	0	3400	3505	1568	1752	3505	1568
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1736	3471	1553	3335	3438	0	3400	3505	1568	1752	3505	1568
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			89						268			152
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		639			1148			921			387	
Travel Time (s)		14.5			26.1			20.9			8.8	
Peak Hour Factor	0.84	0.84	0.84	0.79	0.79	0.79	0.86	0.86	0.86	0.99	0.99	0.99
Heavy Vehicles (%)	4%	4%	4%	5%	5%	5%	3%	3%	3%	3%	3%	3%
Adj. Flow (vph)	119	83	48	63	127	0	151	953	372	30	944	222
Shared Lane Traffic (%)												
Lane Group Flow (vph)	119	83	48	63	127	0	151	953	372	30	944	222
Turn Type	Prot	NA	pm+ov	Prot	NA		Prot	NA	Free	Prot	NA	pt+ov
Protected Phases	1	6	7	5	2		3	8		7	4	4 5
Permitted Phases		6	6		2			8	Free		4	
Detector Phase	1	6	7	5	2		3	8		7	4	4 5
Switch Phase												
Minimum Initial (s)	8.0	8.0	6.0	7.0	8.0		7.0	8.0		6.0	8.0	
Minimum Split (s)	14.0	40.0	12.0	13.0	31.0		13.0	21.0		12.0	21.0	
Total Split (s)	21.0	31.0	13.0	13.0	23.0		16.0	53.0		13.0	50.0	
Total Split (%)	19.1%	28.2%	11.8%	11.8%	20.9%		14.5%	48.2%		11.8%	45.5%	
Maximum Green (s)	15.0	25.0	7.0	7.0	17.0		10.0	47.0		7.0	44.0	
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0		6.0	6.0		6.0	6.0	
Lead/Lag	Lead	Lag	Lead	Lead	Lag		Lead	Lag		Lead	Lag	
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes		Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	Max	None	None	Max		None	None		None	None	
Act Effct Green (s)	14.2	25.0	37.7	7.0	17.8		10.0	49.5	109.8	6.7	43.8	56.8
Actuated g/C Ratio	0.13	0.23	0.34	0.06	0.16		0.09	0.45	1.00	0.06	0.40	0.52
v/c Ratio	0.53	0.11	0.08	0.30	0.23		0.49	0.60	0.24	0.28	0.68	0.25
Control Delay	53.8	34.1	1.2	53.0	41.8		53.3	25.5	0.4	76.5	19.8	2.0
Queue Delay	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.9	0.0
Total Delay	53.8	34.1	1.2	53.0	41.8		53.3	25.5	0.4	76.5	20.7	2.0
LOS	D	C	A	D	D		D	C	A	E	C	A
Approach Delay		37.2			45.5			22.0			18.6	

Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Approach LOS		D			D			C			B	
Queue Length 50th (ft)	79	24	0	22	42		53	273	0	23	291	5
Queue Length 95th (ft)	129	42	3	39	62		82	321	0	m40	316	11
Internal Link Dist (ft)		559			1068			841			307	
Turn Bay Length (ft)	150		150	360			250		100			100
Base Capacity (vph)	236	789	595	212	558		309	1580	1568	111	1404	871
Starvation Cap Reductn	0	0	0	0	0		0	0	0	0	209	0
Spillback Cap Reductn	0	0	0	0	0		0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0		0	0	0	0	0	0
Reduced v/c Ratio	0.50	0.11	0.08	0.30	0.23		0.49	0.60	0.24	0.27	0.79	0.25

Intersection Summary

Area Type: Other
Cycle Length: 110
Actuated Cycle Length: 109.8
Natural Cycle: 90
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.68
Intersection Signal Delay: 23.3 Intersection LOS: C
Intersection Capacity Utilization 58.9% ICU Level of Service B
Analysis Period (min) 15
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 11: Folsom Rd/Tsienneto Rd & Crystal Av/NH 28



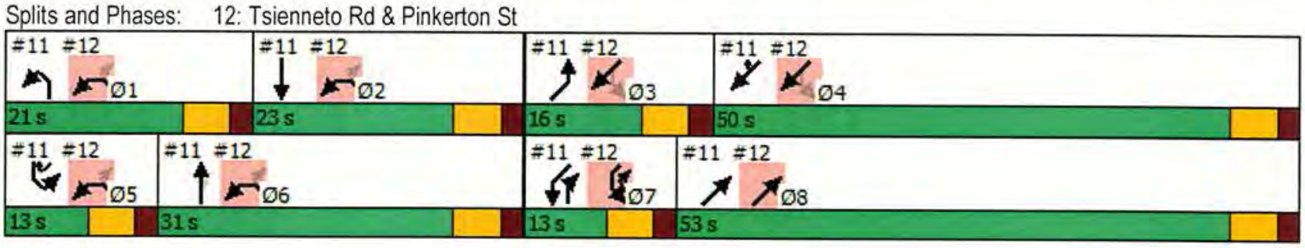
Lane Group	NWL	NWR	NET	NER	SWL	SWT	Ø1	Ø2	Ø3	Ø4	Ø5	Ø6
Lane Configurations												
Traffic Volume (vph)	205	60	580	330	50	980						
Future Volume (vph)	205	60	580	330	50	980						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900						
Storage Length (ft)	180	0		0	220							
Storage Lanes	1	1		1	1							
Taper Length (ft)	25				25							
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95						
Frt		0.850		0.850								
Flt Protected	0.950				0.950							
Satd. Flow (prot)	1770	1583	3505	1568	1770	3539						
Flt Permitted	0.950				0.288							
Satd. Flow (perm)	1770	1583	3505	1568	536	3539						
Right Turn on Red		Yes		Yes								
Satd. Flow (RTOR)		72		384								
Link Speed (mph)	30		30			30						
Link Distance (ft)	408		387			376						
Travel Time (s)	9.3		8.8			8.5						
Peak Hour Factor	0.83	0.83	0.86	0.86	0.81	0.81						
Heavy Vehicles (%)	2%	2%	3%	3%	2%	2%						
Adj. Flow (vph)	247	72	674	384	62	1210						
Shared Lane Traffic (%)												
Lane Group Flow (vph)	247	72	674	384	62	1210						
Turn Type	Prot	pm+ov	NA	Free	pm+pt	NA						
Protected Phases	1 2 5 6	7	8		7	3 4	1	2	3	4	5	6
Permitted Phases		1 2 5 6		Free	3 4							
Detector Phase	1 2 5 6	7	8		7	3 4						
Switch Phase												
Minimum Initial (s)		6.0	8.0		6.0		8.0	8.0	7.0	8.0	7.0	8.0
Minimum Split (s)		12.0	21.0		12.0		14.0	31.0	13.0	21.0	13.0	40.0
Total Split (s)		13.0	53.0		13.0		21.0	23.0	16.0	50.0	13.0	31.0
Total Split (%)		11.8%	48.2%		11.8%		19%	21%	15%	45%	12%	28%
Maximum Green (s)		7.0	47.0		7.0		15.0	17.0	10.0	44.0	7.0	25.0
Yellow Time (s)		4.0	4.0		4.0		4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)		2.0	2.0		2.0		2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)		0.0	0.0		0.0							
Total Lost Time (s)		6.0	6.0		6.0							
Lead/Lag		Lead	Lag		Lead		Lead	Lag	Lead	Lag	Lead	Lag
Lead-Lag Optimize?		Yes	Yes		Yes		Yes	Yes	Yes	Yes	Yes	Yes
Vehicle Extension (s)		3.0	3.0		3.0		3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode		None	None		None		None	Max	None	None	None	Max
Act Effct Green (s)	37.6	50.3	49.5	109.8	59.8	59.8						
Actuated g/C Ratio	0.34	0.46	0.45	1.00	0.54	0.54						
v/c Ratio	0.41	0.09	0.43	0.24	0.17	0.63						
Control Delay	29.9	4.2	8.5	0.3	12.9	19.1						
Queue Delay	0.0	0.0	0.2	0.0	0.0	0.1						
Total Delay	29.9	4.2	8.7	0.3	12.9	19.2						
LOS	C	A	A	A	B	B						
Approach Delay	24.1		5.7			18.9						

Lane Group	NWL	NWR	NET	NER	SWL	SWT	Ø1	Ø2	Ø3	Ø4	Ø5	Ø6
Approach LOS	C		A			B						
Queue Length 50th (ft)	132	0	42	0	20	295						
Queue Length 95th (ft)	184	21	50	0	36	308						
Internal Link Dist (ft)	328		307			296						
Turn Bay Length (ft)	180				220							
Base Capacity (vph)	612	768	1580	1568	370	1933						
Starvation Cap Reductn	0	0	253	0	0	0						
Spillback Cap Reductn	0	0	0	0	0	97						
Storage Cap Reductn	0	0	0	0	0	0						
Reduced v/c Ratio	0.40	0.09	0.51	0.24	0.17	0.66						

Intersection Summary

Area Type: Other
Cycle Length: 110
Actuated Cycle Length: 109.8
Natural Cycle: 90
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.68
Intersection Signal Delay: 14.2 — Intersection LOS: B
Intersection Capacity Utilization 48.4% — ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 12: Tsienneto Rd & Pinkerton St



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	20	240	0	0	330	10	5	0	5	20	0	180
Future Volume (vph)	20	240	0	0	330	10	5	0	5	20	0	180
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	75		0	150		150	0		0	0		0
Storage Lanes	1		0	1		0	0		1	0		1
Taper Length (ft)	50			25			25			25		
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt					0.996				0.850			0.850
Flt Protected	0.950							0.950			0.950	
Satd. Flow (prot)	1687	3374	0	1863	3525	0	0	1805	1615	0	1787	1599
Flt Permitted	0.950							0.743			0.751	
Satd. Flow (perm)	1687	3374	0	1863	3525	0	0	1412	1615	0	1413	1599
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)					4				109			200
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		277			1148			218			433	
Travel Time (s)		6.3			26.1			5.0			9.8	
Peak Hour Factor	0.83	0.83	0.83	0.92	0.92	0.92	0.50	0.50	0.50	0.90	0.90	0.90
Heavy Vehicles (%)	7%	7%	7%	2%	2%	2%	0%	0%	0%	1%	1%	1%
Adj. Flow (vph)	24	289	0	0	359	11	10	0	10	22	0	200
Shared Lane Traffic (%)												
Lane Group Flow (vph)	24	289	0	0	370	0	0	10	10	0	22	200
Turn Type	Prot	NA		Prot	NA		Perm	NA	Perm	Perm	NA	Perm
Protected Phases	5	2		1	6			8			4	
Permitted Phases					6		8	8	8	4		4
Detector Phase	5	2		1	6		8	8	8	4	4	4
Switch Phase												
Minimum Initial (s)	8.0	8.0		5.0	8.0		5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	14.0	46.0		11.0	43.0		33.0	33.0	33.0	33.0	33.0	33.0
Total Split (s)	14.0	46.0		11.0	43.0		33.0	33.0	33.0	33.0	33.0	33.0
Total Split (%)	15.6%	51.1%		12.2%	47.8%		36.7%	36.7%	36.7%	36.7%	36.7%	36.7%
Maximum Green (s)	8.0	40.0		5.0	37.0		27.0	27.0	27.0	27.0	27.0	27.0
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0			0.0	0.0		0.0	0.0
Total Lost Time (s)	6.0	6.0		6.0	6.0			6.0	6.0		6.0	6.0
Lead/Lag	Lead	Lag		Lead	Lag							
Lead-Lag Optimize?	Yes	Yes		Yes	Yes							
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	Max		None	None		None	None	None	None	None	None
Act Effct Green (s)	8.0	40.0			37.4			7.0	7.0		7.0	7.0
Actuated g/C Ratio	0.14	0.68			0.63			0.12	0.12		0.12	0.12
v/c Ratio	0.11	0.13			0.17			0.06	0.03		0.13	0.55
Control Delay	24.5	3.7			6.1			23.4	0.2		24.8	10.5
Queue Delay	0.0	0.0			0.0			0.0	0.0		0.0	0.0
Total Delay	24.5	3.7			6.1			23.4	0.2		24.8	10.5
LOS	C	A			A			C	A		C	B
Approach Delay		5.3			6.1			11.8			11.9	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Approach LOS		A			A			B			B	
Queue Length 50th (ft)	8	14			18			3	0		7	0
Queue Length 95th (ft)	25	28			71			8	0		25	49
Internal Link Dist (ft)		197			1068			138			353	
Turn Bay Length (ft)	75											
Base Capacity (vph)	228	2288			2358			646	798		647	840
Starvation Cap Reductn	0	0			0			0	0		0	0
Spillback Cap Reductn	0	0			0			0	0		0	0
Storage Cap Reductn	0	0			0			0	0		0	0
Reduced v/c Ratio	0.11	0.13			0.16			0.02	0.01		0.03	0.24

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 59
Natural Cycle: 90
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.55
Intersection Signal Delay: 7.4 Intersection LOS: A
Intersection Capacity Utilization 39.8% ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 13: Applebees/Linlew Dr & NH 28

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰↰	↑↱		↰	↑↱		↰	↱		↰	↰	↱
Traffic Volume (vph)	30	200	5	5	330	120	10	5	5	170	5	110
Future Volume (vph)	30	200	5	5	330	120	10	5	5	170	5	110
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	150		150	150		150	0		0	0		0
Storage Lanes	2		0	1		0	1		0	1		1
Taper Length (ft)	200			25			25			25		
Lane Util. Factor	0.97	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	0.95	0.95	1.00
Frt		0.996			0.960			0.925				0.850
Flt Protected	0.950			0.950			0.950			0.950	0.955	
Satd. Flow (prot)	3303	3392	0	1736	3332	0	1805	1758	0	1665	1674	1568
Flt Permitted	0.950			0.950			0.950			0.950	0.955	
Satd. Flow (perm)	3303	3392	0	1736	3332	0	1805	1758	0	1665	1674	1568
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		3			58			7				122
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		412			486			151			343	
Travel Time (s)		9.4			11.0			3.4			7.8	
Peak Hour Factor	0.83	0.83	0.83	0.97	0.97	0.97	0.67	0.67	0.67	0.90	0.90	0.90
Heavy Vehicles (%)	6%	6%	6%	4%	4%	4%	0%	0%	0%	3%	3%	3%
Adj. Flow (vph)	36	241	6	5	340	124	15	7	7	189	6	122
Shared Lane Traffic (%)										48%		
Lane Group Flow (vph)	36	247	0	5	464	0	15	14	0	98	97	122
Turn Type	Prot	NA		Prot	NA		Split	NA		Split	NA	pt+ov
Protected Phases	5	2		1	6		3	3		4	4	4 5
Permitted Phases								3				
Detector Phase	5	2		1	6		3	3		4	4	4 5
Switch Phase												
Minimum Initial (s)	5.0	8.0		5.0	8.0		5.0	5.0		8.0	8.0	
Minimum Split (s)	14.0	53.0		11.0	50.0		22.0	22.0		22.0	22.0	
Total Split (s)	14.0	53.0		13.0	52.0		22.0	22.0		22.0	22.0	
Total Split (%)	12.7%	48.2%		11.8%	47.3%		20.0%	20.0%		20.0%	20.0%	
Maximum Green (s)	8.0	47.0		7.0	46.0		16.0	16.0		16.0	16.0	
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lead		Lag	Lag	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	Min		None	Min		None	None		None	None	
Walk Time (s)		5.0			5.0		5.0	5.0		5.0	5.0	
Flash Dont Walk (s)		11.0			11.0		11.0	11.0		11.0	11.0	
Pedestrian Calls (#/hr)		0			0		0	0		0	0	
Act Effct Green (s)	6.4	23.8		6.0	15.9		6.3	6.3		9.8	9.8	22.5
Actuated g/C Ratio	0.12	0.46		0.12	0.31		0.12	0.12		0.19	0.19	0.43
v/c Ratio	0.09	0.16		0.03	0.44		0.07	0.06		0.31	0.31	0.16
Control Delay	25.8	11.9		27.4	16.8		26.9	21.2		24.6	24.4	4.0
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Total Delay	25.8	11.9		27.4	16.8		26.9	21.2		24.6	24.4	4.0
LOS	C	B		C	B		C	C		C	C	A
Approach Delay		13.7			16.9			24.2			16.6	
Approach LOS		B			B			C			B	
Queue Length 50th (ft)	4	14		1	45		4	2		23	23	0
Queue Length 95th (ft)	18	65		12	121		16	13		81	81	30
Internal Link Dist (ft)		332			406			71			263	
Turn Bay Length (ft)	150			150								
Base Capacity (vph)	533	2996		245	2929		583	572		537	540	786
Starvation Cap Reductn	0	0		0	0		0	0		0	0	0
Spillback Cap Reductn	0	0		0	0		0	0		0	0	0
Storage Cap Reductn	0	0		0	0		0	0		0	0	0
Reduced v/c Ratio	0.07	0.08		0.02	0.16		0.03	0.02		0.18	0.18	0.16

Intersection Summary

Area Type: Other
Cycle Length: 110
Actuated Cycle Length: 52.1
Natural Cycle: 110
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.44
Intersection Signal Delay: 16.2 Intersection LOS: B
Intersection Capacity Utilization 38.9% ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 14: VIP Dr/Ashleigh Dr & NH 28

Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations	↰	↑↱		↰	↑	↱	↰	↑↑↱		↰	↑↑↱	
Traffic Volume (vph)	30	50	20	10	40	180	150	320	70	60	470	170
Future Volume (vph)	30	50	20	10	40	180	150	320	70	60	470	170
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	150		150	150		150	150		150	150		150
Storage Lanes	1		0	1		1	1		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00	0.95	0.95
Frt		0.958				0.850		0.973			0.960	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1752	1767	0	1736	1827	1553	1770	3444	0	1787	3431	0
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1752	1767	0	1736	1827	1553	1770	3444	0	1787	3431	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		24				222		35			68	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		481			347			479			371	
Travel Time (s)		10.9			7.9			10.9			8.4	
Peak Hour Factor	0.82	0.82	0.82	0.81	0.81	0.81	0.68	0.68	0.68	0.78	0.78	0.78
Heavy Vehicles (%)	3%	3%	3%	4%	4%	4%	2%	2%	2%	1%	1%	1%
Adj. Flow (vph)	37	61	24	12	49	222	221	471	103	77	603	218
Shared Lane Traffic (%)												
Lane Group Flow (vph)	37	85	0	12	49	222	221	574	0	77	821	0
Turn Type	Prot	NA		Prot	NA	pt+ov	Prot	NA		Prot	NA	
Protected Phases	1	6		5	2	2 3	3	8		7	4	
Permitted Phases												
Detector Phase	1	6		5	2	2 3	3	8		7	4	
Switch Phase												
Minimum Initial (s)	8.0	8.0		8.0	8.0		8.0	8.0		8.0	8.0	
Minimum Split (s)	14.0	20.0		14.0	20.0		14.0	20.0		14.0	20.0	
Total Split (s)	14.0	20.0		14.0	20.0		14.0	22.0		14.0	22.0	
Total Split (%)	20.0%	28.6%		20.0%	28.6%		20.0%	31.4%		20.0%	31.4%	
Maximum Green (s)	8.0	14.0		8.0	14.0		8.0	16.0		8.0	16.0	
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lag		Lead	Lag	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	Max		None	None		None	None	
Act Effct Green (s)	8.1	16.6		8.1	14.2	28.3	8.1	22.4		8.1	16.2	
Actuated g/C Ratio	0.13	0.27		0.13	0.23	0.46	0.13	0.36		0.13	0.26	
v/c Ratio	0.16	0.17		0.05	0.12	0.27	0.95	0.45		0.33	0.86	
Control Delay	28.4	15.5		27.4	22.2	3.2	81.8	19.0		30.9	33.5	
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Total Delay	28.4	15.5		27.4	22.2	3.2	81.8	19.0		30.9	33.5	
LOS	C	B		C	C	A	F	B		C	C	
Approach Delay		19.4			7.5			36.4			33.3	

Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Approach LOS		B			A			D			C	
Queue Length 50th (ft)	11	16		4	13	0	74	79		23	121	
Queue Length 95th (ft)	37	51		17	39	27	#154	114		60	#222	
Internal Link Dist (ft)		401			267			399			291	
Turn Bay Length (ft)	150			150		150	150			150		
Base Capacity (vph)	230	494		228	420	834	232	1272		235	951	
Starvation Cap Reductn	0	0		0	0	0	0	0		0	0	
Spillback Cap Reductn	0	0		0	0	0	0	0		0	0	
Storage Cap Reductn	0	0		0	0	0	0	0		0	0	
Reduced v/c Ratio	0.16	0.17		0.05	0.12	0.27	0.95	0.45		0.33	0.86	

Intersection Summary

Area Type: Other
Cycle Length: 70
Actuated Cycle Length: 61.6
Natural Cycle: 75
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.95
Intersection Signal Delay: 30.2 Intersection LOS: C
Intersection Capacity Utilization 51.2% ICU Level of Service A
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 18: Tsienneto Rd & NH 28 Byp S

Ø1	Ø2	Ø3	Ø4
14 s	20 s	14 s	22 s
Ø5	Ø6	Ø7	Ø8
14 s	20 s	14 s	22 s

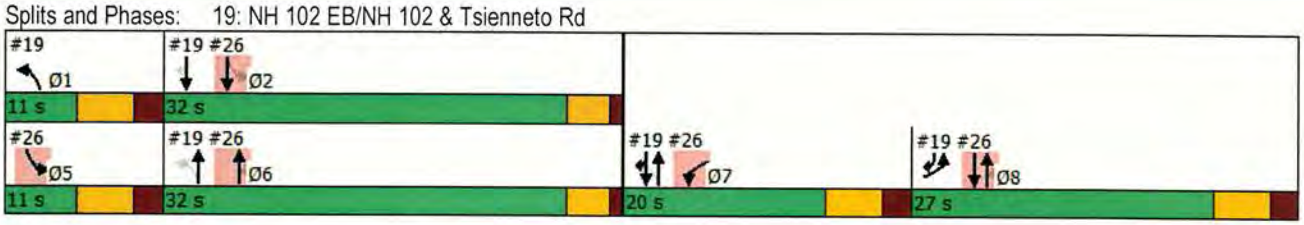
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR	Ø2	Ø5	Ø6	Ø7
Lane Configurations										
Traffic Volume (vph)	220	0	10	130	240	530				
Future Volume (vph)	220	0	10	130	240	530				
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900				
Storage Length (ft)	200	0	100			90				
Storage Lanes	0	0	1			1				
Taper Length (ft)	25		25							
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00				
Frt						0.850				
Flt Protected	0.950		0.950							
Satd. Flow (prot)	1787	0	1770	1863	1845	1568				
Flt Permitted	0.950		0.528							
Satd. Flow (perm)	1787	0	984	1863	1845	1568				
Right Turn on Red		Yes				Yes				
Satd. Flow (RTOR)						596				
Link Speed (mph)	30			30	30					
Link Distance (ft)	392			704	263					
Travel Time (s)	8.9			16.0	6.0					
Peak Hour Factor	0.90	0.90	0.87	0.87	0.89	0.89				
Heavy Vehicles (%)	1%	1%	2%	2%	3%	3%				
Adj. Flow (vph)	244	0	11	149	270	596				
Shared Lane Traffic (%)										
Lane Group Flow (vph)	244	0	11	149	270	596				
Turn Type	Prot		pm+pt	NA	NA	custom				
Protected Phases	8		1	6 7	2 7	7 8	2	5	6	7
Permitted Phases			6 7			2				
Detector Phase	8		1	6 7	2 7	7 8				
Switch Phase										
Minimum Initial (s)	5.0		5.0				5.0	5.0	5.0	5.0
Minimum Split (s)	26.5		11.0				9.0	11.0	9.0	11.0
Total Split (s)	27.0		11.0				32.0	11.0	32.0	20.0
Total Split (%)	30.0%		12.2%				36%	12%	36%	22%
Maximum Green (s)	21.0		5.0				28.0	5.0	28.0	14.0
Yellow Time (s)	4.0		4.0				3.0	4.0	3.0	4.0
All-Red Time (s)	2.0		2.0				1.0	2.0	1.0	2.0
Lost Time Adjust (s)	0.0		0.0							
Total Lost Time (s)	6.0		6.0							
Lead/Lag	Lag		Lead				Lag	Lead	Lag	Lead
Lead-Lag Optimize?	Yes		Yes				Yes	Yes	Yes	Yes
Vehicle Extension (s)	3.0		3.0				3.0	3.0	3.0	3.0
Recall Mode	None		None				Min	None	Min	None
Act Effct Green (s)	21.2		32.8	34.1	34.1	64.8				
Actuated g/C Ratio	0.32		0.49	0.51	0.51	0.96				
v/c Ratio	0.43		0.02	0.16	0.29	0.39				
Control Delay	24.7		7.2	9.5	11.1	0.9				
Queue Delay	0.0		0.0	0.0	1.0	0.1				
Total Delay	24.7		7.2	9.5	12.1	1.0				
LOS	C		A	A	B	A				
Approach Delay	24.7			9.3	4.5					

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR	Ø2	Ø5	Ø6	Ø7
Approach LOS	C			A	A					
Queue Length 50th (ft)	78		2	28	77	0				
Queue Length 95th (ft)	201		8	69	116	19				
Internal Link Dist (ft)	312			624	183					
Turn Bay Length (ft)	200		100			90				
Base Capacity (vph)	577		540	1024	1014	1494				
Starvation Cap Reductn	0		0	0	506	152				
Spillback Cap Reductn	0		0	0	0	0				
Storage Cap Reductn	0		0	0	0	0				
Reduced v/c Ratio	0.42		0.02	0.15	0.53	0.44				

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 67.3
Natural Cycle: 60
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.61
Intersection Signal Delay: 9.0 Intersection LOS: A
Intersection Capacity Utilization 47.0% ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 19: NH 102 EB/NH 102 & Tsienneto Rd

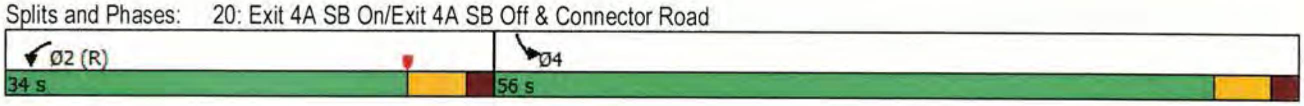


Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	980	0	0	0	1730	0
Future Volume (vph)	980	0	0	0	1730	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	0.97	1.00	1.00	1.00	0.97	1.00
Frt						
Flt Protected	0.950				0.950	
Satd. Flow (prot)	3433	0	0	0	3433	0
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	3433	0	0	0	3433	0
Right Turn on Red		Yes		Yes		
Satd. Flow (RTOR)						
Link Speed (mph)	30		30			30
Link Distance (ft)	372		529			557
Travel Time (s)	8.5		12.0			12.7
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	1043	0	0	0	1840	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	1043	0	0	0	1840	0
Turn Type	Prot				Prot	
Protected Phases	2				4	
Permitted Phases						
Detector Phase	2				4	
Switch Phase						
Minimum Initial (s)	5.0				9.0	
Minimum Split (s)	24.0				24.0	
Total Split (s)	34.0				56.0	
Total Split (%)	37.8%				62.2%	
Maximum Green (s)	28.0				50.0	
Yellow Time (s)	4.0				4.0	
All-Red Time (s)	2.0				2.0	
Lost Time Adjust (s)	0.0				0.0	
Total Lost Time (s)	6.0				6.0	
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)	3.0				3.0	
Recall Mode	C-Max				Max	
Act Effct Green (s)	28.0				50.0	
Actuated g/C Ratio	0.31				0.56	
v/c Ratio	0.98				0.96	
Control Delay	56.5				34.1	
Queue Delay	40.4				0.0	
Total Delay	96.9				34.1	
LOS	F				C	
Approach Delay	96.9					34.1
Approach LOS	F					C
Queue Length 50th (ft)	336				482	
Queue Length 95th (ft)	#456				#679	
Internal Link Dist (ft)	292		449			477

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Turn Bay Length (ft)						
Base Capacity (vph)	1068				1907	
Starvation Cap Reductn	186				0	
Spillback Cap Reductn	0				0	
Storage Cap Reductn	0				0	
Reduced v/c Ratio	1.18				0.96	

Intersection Summary	
Area Type: Other	
Cycle Length: 90	
Actuated Cycle Length: 90	
Offset: 25 (28%), Referenced to phase 2:WBL, Start of Yellow	
Natural Cycle: 90	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 0.98	
Intersection Signal Delay: 56.8	Intersection LOS: E
Intersection Capacity Utilization 145.8%	ICU Level of Service H
Analysis Period (min) 15	
# 95th percentile volume exceeds capacity, queue may be longer.	
Queue shown is maximum after two cycles.	

Splits and Phases: 20: Exit 4A SB On/Exit 4A SB Off & Connector Road



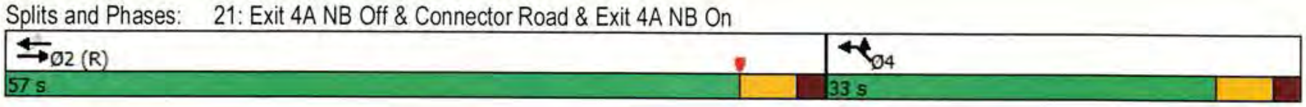
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	SBL	SBR	NWL	NWR
Lane Configurations										
Traffic Volume (vph)	0	1730	0	0	980	1390	0	0	0	795
Future Volume (vph)	0	1730	0	0	980	1390	0	0	0	795
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		200	0	0	0	0
Storage Lanes	0		0	0		2	0	0	1	1
Taper Length (ft)	25			25			25		25	
Lane Util. Factor	0.95	0.95	1.00	1.00	0.95	0.88	1.00	1.00	1.00	0.95
Frt						0.850			0.850	0.850
Flt Protected										
Satd. Flow (prot)	0	3539	0	0	3539	2787	0	0	1583	1504
Flt Permitted										
Satd. Flow (perm)	0	3539	0	0	3539	2787	0	0	1583	1504
Right Turn on Red			Yes			Yes		Yes		
Satd. Flow (RTOR)						42				
Link Speed (mph)		30			30		30		30	
Link Distance (ft)		372			394		598		519	
Travel Time (s)		8.5			9.0		13.6		11.8	
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	0	1840	0	0	1043	1479	0	0	0	846
Shared Lane Traffic (%)										50%
Lane Group Flow (vph)	0	1840	0	0	1043	1479	0	0	423	423
Turn Type		NA			NA	Perm			Prot	Prot
Protected Phases		2			2				4	4
Permitted Phases	2					2				
Detector Phase	2	2			2	2			4	4
Switch Phase										
Minimum Initial (s)	5.0	5.0			5.0	5.0			9.0	9.0
Minimum Split (s)	24.0	24.0			24.0	24.0			24.0	24.0
Total Split (s)	57.0	57.0			57.0	57.0			33.0	33.0
Total Split (%)	63.3%	63.3%			63.3%	63.3%			36.7%	36.7%
Maximum Green (s)	51.0	51.0			51.0	51.0			27.0	27.0
Yellow Time (s)	4.0	4.0			4.0	4.0			4.0	4.0
All-Red Time (s)	2.0	2.0			2.0	2.0			2.0	2.0
Lost Time Adjust (s)		0.0			0.0	0.0			0.0	0.0
Total Lost Time (s)		6.0			6.0	6.0			6.0	6.0
Lead/Lag										
Lead-Lag Optimize?										
Vehicle Extension (s)	3.0	3.0			3.0	3.0			3.0	3.0
Recall Mode	C-Max	C-Max			C-Max	C-Max			Min	Min
Act Effct Green (s)		51.0			51.0	51.0			27.0	27.0
Actuated g/C Ratio		0.57			0.57	0.57			0.30	0.30
v/c Ratio		0.92			0.52	0.93			0.89	0.94
Control Delay		4.2			13.1	29.0			53.6	62.1
Queue Delay		1.1			1.7	0.0			0.0	0.0
Total Delay		5.3			14.8	29.0			53.6	62.1
LOS		A			B	C			D	E
Approach Delay		5.3			23.1				57.8	
Approach LOS		A			C				E	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	SBL	SBR	NWL	NWR
Queue Length 50th (ft)		0			178	397			229	245
Queue Length 95th (ft)		m0			230	#601			#401	#436
Internal Link Dist (ft)		292			314		518		439	
Turn Bay Length (ft)						200				
Base Capacity (vph)		2005			2005	1597			474	451
Starvation Cap Reductn		53			0	0			0	0
Spillback Cap Reductn		0			742	0			0	0
Storage Cap Reductn		0			0	0			0	0
Reduced v/c Ratio		0.94			0.83	0.93			0.89	0.94

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 90
Offset: 0 (0%), Referenced to phase 2:EBWB, Start of Yellow
Natural Cycle: 90
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.94
Intersection Signal Delay: 22.5 Intersection LOS: C
Intersection Capacity Utilization 131.6% ICU Level of Service H
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 21: Exit 4A NB Off & Connector Road & Exit 4A NB On



Lane Group	WBL	WBR	NBT	NBR	SBL	SBT	Ø1	Ø2	Ø6	Ø8
Lane Configurations										
Traffic Volume (vph)	60	10	320	30	10	710				
Future Volume (vph)	60	10	320	30	10	710				
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900				
Storage Length (ft)	0	0		90	100					
Storage Lanes	1	0		1	1					
Taper Length (ft)	25				25					
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00				
Frt	0.976			0.850						
Flt Protected	0.961				0.950					
Satd. Flow (prot)	1768	0	1900	1615	1805	1900				
Flt Permitted	0.961				0.424					
Satd. Flow (perm)	1768	0	1900	1615	806	1900				
Right Turn on Red		Yes		Yes						
Satd. Flow (RTOR)	10			36						
Link Speed (mph)	30		30			30				
Link Distance (ft)	524		263			288				
Travel Time (s)	11.9		6.0			6.5				
Peak Hour Factor	0.87	0.67	0.95	0.84	0.73	0.96				
Heavy Vehicles (%)	1%	0%	0%	0%	0%	0%				
Adj. Flow (vph)	69	15	337	36	14	740				
Shared Lane Traffic (%)										
Lane Group Flow (vph)	84	0	337	36	14	740				
Turn Type	Prot		NA	Perm	custom	NA				
Protected Phases	7		6 8		5	2 8	1	2	6	8
Permitted Phases				6 8	2					
Detector Phase	7		6 8	6 8	5	2 8				
Switch Phase										
Minimum Initial (s)	5.0				5.0		5.0	5.0	5.0	5.0
Minimum Split (s)	11.0				11.0		11.0	9.0	9.0	26.5
Total Split (s)	20.0				11.0		11.0	32.0	32.0	27.0
Total Split (%)	22.2%				12.2%		12%	36%	36%	30%
Maximum Green (s)	14.0				5.0		5.0	28.0	28.0	21.0
Yellow Time (s)	4.0				4.0		4.0	3.0	3.0	4.0
All-Red Time (s)	2.0				2.0		2.0	1.0	1.0	2.0
Lost Time Adjust (s)	0.0				0.0					
Total Lost Time (s)	6.0				6.0					
Lead/Lag	Lead				Lead		Lead	Lag	Lag	Lag
Lead-Lag Optimize?	Yes				Yes		Yes	Yes	Yes	Yes
Vehicle Extension (s)	3.0				3.0		3.0	3.0	3.0	3.0
Recall Mode	None				None		None	Min	Min	None
Act Effct Green (s)	11.6		43.1	43.1	15.0	43.1				
Actuated g/C Ratio	0.17		0.64	0.64	0.22	0.64				
v/c Ratio	0.27		0.28	0.03	0.05	0.61				
Control Delay	26.9		2.3	0.2	18.9	9.3				
Queue Delay	0.0		0.1	0.0	0.0	0.0				
Total Delay	26.9		2.4	0.2	18.9	9.3				
LOS	C		A	A	B	A				
Approach Delay	26.9		2.2			9.5				

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT	Ø1	Ø2	Ø6	Ø8
Approach LOS	C		A			A				
Queue Length 50th (ft)	25		17	0	5	151				
Queue Length 95th (ft)	77		25	0	13	224				
Internal Link Dist (ft)	444		183			208				
Turn Bay Length (ft)				90	100					
Base Capacity (vph)	388		1550	1324	256	1550				
Starvation Cap Reductn	0		428	0	0	0				
Spillback Cap Reductn	0		0	0	0	0				
Storage Cap Reductn	0		0	0	0	0				
Reduced v/c Ratio	0.22		0.30	0.03	0.05	0.48				

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 67.3
Natural Cycle: 60
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.61
Intersection Signal Delay: 8.4 Intersection LOS: A
Intersection Capacity Utilization 49.9% ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 26: NH 102 & North Shore Road

APPENDIX O-4: 2040 ALTERNATIVE A INTERSECTION CAPACITY ANALYSES – SYNCHRO PRINTOUTS – PM PEAK HOUR

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	0	1230	1475	0	385	1195
Future Volume (vph)	0	1230	1475	0	385	1195
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	16	12
Lane Util. Factor	1.00	0.95	0.95	1.00	1.00	0.88
Frt						0.850
Flt Protected					0.950	
Satd. Flow (prot)	0	3471	3406	0	1930	2682
Flt Permitted					0.950	
Satd. Flow (perm)	0	3471	3406	0	1930	2682
Right Turn on Red				Yes		No
Satd. Flow (RTOR)						
Link Speed (mph)		30	30		25	
Link Distance (ft)		712	388		212	
Travel Time (s)		16.2	8.8		5.8	
Peak Hour Factor	0.93	0.93	0.88	0.88	0.89	0.89
Heavy Vehicles (%)	4%	4%	6%	6%	6%	6%
Adj. Flow (vph)	0	1323	1676	0	433	1343
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	1323	1676	0	433	1343
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(ft)		24	24		16	
Link Offset(ft)		0	0		0	
Crosswalk Width(ft)		16	16		16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	0.85	1.00
Turning Speed (mph)	15			9	15	9
Number of Detectors		3	3		3	3
Detector Template		Thru	Thru		Left	
Leading Detector (ft)		256	256		256	256
Trailing Detector (ft)		-5	-5		-5	-5
Detector 1 Position(ft)		-5	-5		-5	-5
Detector 1 Size(ft)		50	50		50	50
Detector 1 Type		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex
Detector 1 Channel						
Detector 1 Extend (s)		0.0	0.0		0.0	0.0
Detector 1 Queue (s)		0.0	0.0		0.0	0.0
Detector 1 Delay (s)		0.0	0.0		0.0	0.0
Detector 2 Position(ft)		125	125		125	125
Detector 2 Size(ft)		6	6		6	6
Detector 2 Type		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex
Detector 2 Channel						
Detector 2 Extend (s)		0.0	0.0		0.0	0.0
Detector 3 Position(ft)		250	250		250	250
Detector 3 Size(ft)		6	6		6	6
Detector 3 Type		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex
Detector 3 Channel						

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Detector 3 Extend (s)		0.0	0.0		0.0	0.0
Turn Type		NA	NA		Prot	Prot
Protected Phases		2	6		4	4
Permitted Phases						
Detector Phase		2	6		4	4
Switch Phase						
Minimum Initial (s)		8.0	8.0		5.0	5.0
Minimum Split (s)		14.0	21.0		27.0	27.0
Total Split (s)		65.0	65.0		65.0	65.0
Total Split (%)		50.0%	50.0%		50.0%	50.0%
Maximum Green (s)		59.0	59.0		59.0	59.0
Yellow Time (s)		2.0	2.0		2.0	2.0
All-Red Time (s)		4.0	4.0		4.0	4.0
Lost Time Adjust (s)		0.0	0.0		0.0	0.0
Total Lost Time (s)		6.0	6.0		6.0	6.0
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)		3.0	3.0		3.0	3.0
Recall Mode		C-Min	C-Min		None	None
Walk Time (s)			7.0		7.0	7.0
Flash Dont Walk (s)			8.0		14.0	14.0
Pedestrian Calls (#/hr)			0		0	0
Act Effct Green (s)		59.0	59.0		59.0	59.0
Actuated g/C Ratio		0.45	0.45		0.45	0.45
v/c Ratio		0.84	1.08		0.49	1.10
Control Delay		24.2	48.6		27.4	93.3
Queue Delay		0.0	0.0		0.0	0.0
Total Delay		24.2	48.6		27.4	93.3
LOS		C	D		C	F
Approach Delay		24.2	48.6		77.2	
Approach LOS		C	D		E	
Queue Length 50th (ft)		307	~866		252	~730
Queue Length 95th (ft)		m358	m53		344	#863
Internal Link Dist (ft)		632	308		132	
Turn Bay Length (ft)						
Base Capacity (vph)		1575	1545		875	1217
Starvation Cap Reductn		0	0		0	0
Spillback Cap Reductn		0	0		0	0
Storage Cap Reductn		0	0		0	0
Reduced v/c Ratio		0.84	1.08		0.49	1.10

Intersection Summary

Area Type: Other

Cycle Length: 130

Actuated Cycle Length: 130

Offset: 0 (0%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow, Master Intersection

Natural Cycle: 130

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 1.10

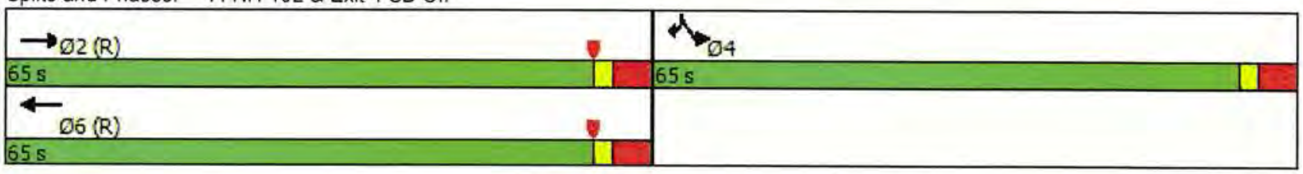
Intersection Signal Delay: 52.5 Intersection LOS: D
Intersection Capacity Utilization 94.6% ICU Level of Service F
Analysis Period (min) 15

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 7: NH 102 & Exit 4 SB Off



Lane Group	NBL2	NBL	NBR	SEL	SER	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations											
Traffic Volume (vph)	1360	0	725	0	0	1155	460	0	0	370	110
Future Volume (vph)	1360	0	725	0	0	1155	460	0	0	370	110
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)		0	0	0	0	550		0	0		0
Storage Lanes		2	2	0	0	2		0	0		1
Taper Length (ft)		25		25		25			25		
Lane Util. Factor	0.97	1.00	0.88	1.00	1.00	0.97	0.95	1.00	1.00	0.95	1.00
Frt			0.850								0.850
Flt Protected	0.950					0.950					
Satd. Flow (prot)	3242	0	2632	0	0	3335	3438	0	0	3505	1568
Flt Permitted	0.950					0.950					
Satd. Flow (perm)	3242	0	2632	0	0	3335	3438	0	0	3505	1568
Right Turn on Red			No					Yes			Yes
Satd. Flow (RTOR)											126
Link Speed (mph)		25		30			30			30	
Link Distance (ft)		856		390			760			857	
Travel Time (s)		23.3		8.9			17.3			19.5	
Peak Hour Factor	0.88	0.88	0.88	0.92	0.92	0.94	0.94	0.94	0.92	0.92	0.92
Heavy Vehicles (%)	8%	8%	8%	2%	2%	5%	5%	5%	3%	3%	3%
Adj. Flow (vph)	1545	0	824	0	0	1229	489	0	0	402	120
Shared Lane Traffic (%)											
Lane Group Flow (vph)	1545	0	824	0	0	1229	489	0	0	402	120
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Right	Left	Left	Right	Left	Right	Right
Median Width(ft)		24		0			24			24	
Link Offset(ft)		12		0			0			0	
Crosswalk Width(ft)		16		16			16			16	
Two way Left Turn Lane											
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15	15	25	15	9	15		9	15		25
Number of Detectors	3		3			3	3			3	0
Detector Template											
Leading Detector (ft)	256		256			256	256			256	0
Trailing Detector (ft)	-5		-5			-5	-5			-5	0
Detector 1 Position(ft)	-5		-5			-5	-5			-5	-5
Detector 1 Size(ft)	55		55			55	55			55	50
Detector 1 Type	Cl+Ex		Cl+Ex			Cl+Ex	Cl+Ex			Cl+Ex	Cl+Ex
Detector 1 Channel											
Detector 1 Extend (s)	0.0		0.0			0.0	0.0			0.0	0.0
Detector 1 Queue (s)	0.0		0.0			0.0	0.0			0.0	0.0
Detector 1 Delay (s)	0.0		0.0			0.0	0.0			0.0	0.0
Detector 2 Position(ft)	125		125			125	125			125	
Detector 2 Size(ft)	6		6			6	6			6	
Detector 2 Type	Cl+Ex		Cl+Ex			Cl+Ex	Cl+Ex			Cl+Ex	
Detector 2 Channel											
Detector 2 Extend (s)	0.0		0.0			0.0	0.0			0.0	
Detector 3 Position(ft)	250		250			250	250			250	
Detector 3 Size(ft)	6		6			6	6			6	

Lane Group	NBL2	NBL	NBR	SEL	SER	NEL	NET	NER	SWL	SWT	SWR
Detector 3 Type	Cl+Ex		Cl+Ex			Cl+Ex	Cl+Ex			Cl+Ex	
Detector 3 Channel											
Detector 3 Extend (s)	0.0		0.0			0.0	0.0			0.0	
Turn Type	Prot		Prot			Prot	NA			NA	Free
Protected Phases	8		8			5	2			6	
Permitted Phases											Free
Detector Phase	8		2			5	2			6	
Switch Phase											
Minimum Initial (s)	10.0		10.0			5.0	8.0			8.0	
Minimum Split (s)	16.0		16.0			11.0	42.0			31.0	
Total Split (s)	54.0		54.0			44.0	76.0			32.0	
Total Split (%)	41.5%		41.5%			33.8%	58.5%			24.6%	
Maximum Green (s)	48.0		48.0			38.0	70.0			26.0	
Yellow Time (s)	2.0		2.0			2.0	2.0			2.0	
All-Red Time (s)	4.0		4.0			4.0	4.0			4.0	
Lost Time Adjust (s)	0.0		0.0			0.0	0.0			0.0	
Total Lost Time (s)	6.0		6.0			6.0	6.0			6.0	
Lead/Lag						Lead				Lag	
Lead-Lag Optimize?											
Vehicle Extension (s)	3.0		3.0			3.0	3.0			3.0	
Recall Mode	None		None			None	C-Min			C-Min	
Walk Time (s)							7.0			7.0	
Flash Dont Walk (s)							29.0			17.0	
Pedestrian Calls (#/hr)							0			0	
Act Effct Green (s)	48.0		48.0			38.0	70.0			26.0	130.0
Actuated g/C Ratio	0.37		0.37			0.29	0.54			0.20	1.00
v/c Ratio	1.29		0.85			1.26	0.26			0.57	0.08
Control Delay	172.3		47.4			155.0	7.7			50.7	0.1
Queue Delay	0.0		0.0			0.0	0.0			0.0	0.0
Total Delay	172.3		47.4			155.0	7.7			50.7	0.1
LOS	F		D			F	A			D	A
Approach Delay		128.8					113.1			39.1	
Approach LOS		F					F			D	
Queue Length 50th (ft)	~854		359			~670	51			162	0
Queue Length 95th (ft)	#957		440			#797	m71			217	0
Internal Link Dist (ft)		776		310			680			777	
Turn Bay Length (ft)						550					
Base Capacity (vph)	1197		971			974	1851			701	1568
Starvation Cap Reductn	0		0			0	0			0	0
Spillback Cap Reductn	0		0			0	0			0	0
Storage Cap Reductn	0		0			0	0			0	0
Reduced v/c Ratio	1.29		0.85			1.26	0.26			0.57	0.08

Intersection Summary

Area Type: Other
Cycle Length: 130
Actuated Cycle Length: 130
Offset: 44 (34%), Referenced to phase 2:NET and 6:SWT, Start of Yellow
Natural Cycle: 150

Control Type: Actuated-Coordinated
Maximum v/c Ratio: 1.29
Intersection Signal Delay: 112.8 Intersection LOS: F
Intersection Capacity Utilization 98.0% ICU Level of Service F
Analysis Period (min) 15
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 8: NH 102 & Exit 4 NB Off

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑	↱	↰	↑↑					↰↰		↱
Traffic Volume (vph)	0	755	480	255	665	0	0	0	0	295	0	470
Future Volume (vph)	0	755	480	255	665	0	0	0	0	295	0	470
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		350	0		0	0		0	0		0
Storage Lanes	0		1	1		0	0		0	2		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	0.97	1.00	1.00
Frt			0.850									0.850
Flt Protected				0.950						0.950		
Satd. Flow (prot)	0	3471	1553	1719	3438	0	0	0	0	3367	0	1553
Flt Permitted				0.950						0.950		
Satd. Flow (perm)	0	3471	1553	1719	3438	0	0	0	0	3367	0	1553
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			552									189
Link Speed (mph)		30			30			30			35	
Link Distance (ft)		851			693			486			581	
Travel Time (s)		19.3			15.8			11.0			11.3	
Peak Hour Factor	0.87	0.87	0.87	0.86	0.86	0.86	0.92	0.92	0.92	0.91	0.91	0.91
Heavy Vehicles (%)	4%	4%	4%	5%	5%	5%	2%	2%	2%	4%	4%	4%
Adj. Flow (vph)	0	868	552	297	773	0	0	0	0	324	0	516
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	868	552	297	773	0	0	0	0	324	0	516
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Right	Left	Right
Median Width(ft)		36			36			24			24	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		25	15		9	15		9	15		25
Number of Detectors		3	3	3	3					3		3
Detector Template		Thru	Right	Left	Thru					Left		Right
Leading Detector (ft)		256	256	256	256					256		256
Trailing Detector (ft)		-5	-5	-5	-5					-5		-5
Detector 1 Position(ft)		-5	-5	-5	-5					-5		-5
Detector 1 Size(ft)		50	50	50	50					50		50
Detector 1 Type		Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex					Cl+Ex		Cl+Ex
Detector 1 Channel												
Detector 1 Extend (s)		0.0	0.0	0.0	0.0					0.0		0.0
Detector 1 Queue (s)		0.0	0.0	0.0	0.0					0.0		0.0
Detector 1 Delay (s)		0.0	0.0	0.0	0.0					0.0		0.0
Detector 2 Position(ft)		125	125	125	125					125		125
Detector 2 Size(ft)		6	6	6	6					6		6
Detector 2 Type		Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex					Cl+Ex		Cl+Ex
Detector 2 Channel												
Detector 2 Extend (s)		0.0	0.0	0.0	0.0					0.0		0.0
Detector 3 Position(ft)		250	250	250	250					250		250
Detector 3 Size(ft)		6	6	6	6					6		6

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Detector 3 Type		Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex					Cl+Ex		Cl+Ex
Detector 3 Channel												
Detector 3 Extend (s)		0.0	0.0	0.0	0.0					0.0		0.0
Turn Type		NA	Free	Prot	NA					Prot		Prot
Protected Phases		2		1	6					4		4
Permitted Phases			Free									
Detector Phase		2		1	6					4		4
Switch Phase												
Minimum Initial (s)		9.0		4.0	9.0					4.0		4.0
Minimum Split (s)		21.0		10.0	21.0					10.0		10.0
Total Split (s)		33.0		25.0	58.0					32.0		32.0
Total Split (%)		36.7%		27.8%	64.4%					35.6%		35.6%
Maximum Green (s)		27.0		19.0	52.0					26.0		26.0
Yellow Time (s)		4.0		4.0	4.0					4.0		4.0
All-Red Time (s)		2.0		2.0	2.0					2.0		2.0
Lost Time Adjust (s)		0.0		0.0	0.0					0.0		0.0
Total Lost Time (s)		6.0		6.0	6.0					6.0		6.0
Lead/Lag		Lag		Lead								
Lead-Lag Optimize?												
Vehicle Extension (s)		5.0		3.0	5.0					3.0		3.0
Recall Mode		C-Min		None	C-Min					None		None
Walk Time (s)		7.0			7.0							
Flash Dont Walk (s)		8.0			8.0							
Pedestrian Calls (#/hr)		0			0							
Act Effct Green (s)		29.0	90.0	18.1	53.2					24.8		24.8
Actuated g/C Ratio		0.32	1.00	0.20	0.59					0.28		0.28
v/c Ratio		0.78	0.36	0.86	0.38					0.35		0.91
Control Delay		34.2	0.6	16.9	0.2					27.0		42.4
Queue Delay		0.0	0.0	0.0	0.0					0.0		0.0
Total Delay		34.2	0.6	16.9	0.2					27.0		42.4
LOS		C	A	B	A					C		D
Approach Delay		21.1			4.8						36.4	
Approach LOS		C			A						D	
Queue Length 50th (ft)		241	0	0	0					74		185
Queue Length 95th (ft)		301	0	m0	m0					110		#379
Internal Link Dist (ft)		771			613			406			501	
Turn Bay Length (ft)			350									
Base Capacity (vph)		1120	1553	362	2030					972		583
Starvation Cap Reductn		0	0	0	0					0		0
Spillback Cap Reductn		0	0	0	0					0		0
Storage Cap Reductn		0	0	0	0					0		0
Reduced v/c Ratio		0.78	0.36	0.82	0.38					0.33		0.89

Intersection Summary

Area Type: Other

Cycle Length: 90

Actuated Cycle Length: 90

Offset: 50 (56%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow

Natural Cycle: 80

Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.91
Intersection Signal Delay: 19.7 Intersection LOS: B
Intersection Capacity Utilization 77.2% ICU Level of Service D
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 2: Exit 5 SB On/Exit 5 SB Off & NH 28

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑			↑↑	↱	↰		↱			
Traffic Volume (vph)	480	570	0	0	555	445	365	0	420	0	0	0
Future Volume (vph)	480	570	0	0	555	445	365	0	420	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt						0.850			0.850			
Flt Protected	0.950						0.950					
Satd. Flow (prot)	1752	3505	0	0	3505	1568	1703	0	1524	0	0	0
Flt Permitted	0.950						0.950					
Satd. Flow (perm)	1752	3505	0	0	3505	1568	1703	0	1524	0	0	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						489			255			
Link Speed (mph)		30			30			35			30	
Link Distance (ft)		693			542			867			392	
Travel Time (s)		15.8			12.3			16.9			8.9	
Peak Hour Factor	0.92	0.92	0.92	0.91	0.91	0.91	0.67	0.67	0.67	0.92	0.92	0.92
Heavy Vehicles (%)	3%	3%	3%	3%	3%	3%	6%	6%	6%	2%	2%	2%
Adj. Flow (vph)	522	620	0	0	610	489	545	0	627	0	0	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	522	620	0	0	610	489	545	0	627	0	0	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Right	Left	Right	Left	Left	Right
Median Width(ft)		36			42			12			12	
Link Offset(ft)		0			0			0			36	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		25	15		25	15		9
Number of Detectors	3	3			3	3	3		0			
Detector Template	Left					Right	Left					
Leading Detector (ft)	256	256			256	256	256		0			
Trailing Detector (ft)	-5	-5			-5	-5	-5		0			
Detector 1 Position(ft)	-5	-5			-5	-5	-5		-5			
Detector 1 Size(ft)	50	50			50	50	50		50			
Detector 1 Type	Cl+Ex	Cl+Ex			Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex			
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0			0.0	0.0	0.0		0.0			
Detector 1 Queue (s)	0.0	0.0			0.0	0.0	0.0		0.0			
Detector 1 Delay (s)	0.0	0.0			0.0	0.0	0.0		0.0			
Detector 2 Position(ft)	125	125			125	125	125					
Detector 2 Size(ft)	6	6			6	6	6					
Detector 2 Type	Cl+Ex	Cl+Ex			Cl+Ex	Cl+Ex	Cl+Ex					
Detector 2 Channel												
Detector 2 Extend (s)	0.0	0.0			0.0	0.0	0.0					
Detector 3 Position(ft)	250	250			250	250	250					
Detector 3 Size(ft)	6	6			6	6	6					
Detector 3 Type	Cl+Ex	Cl+Ex			Cl+Ex	Cl+Ex	Cl+Ex					
Detector 3 Channel												
Detector 3 Extend (s)	0.0	0.0			0.0	0.0	0.0					

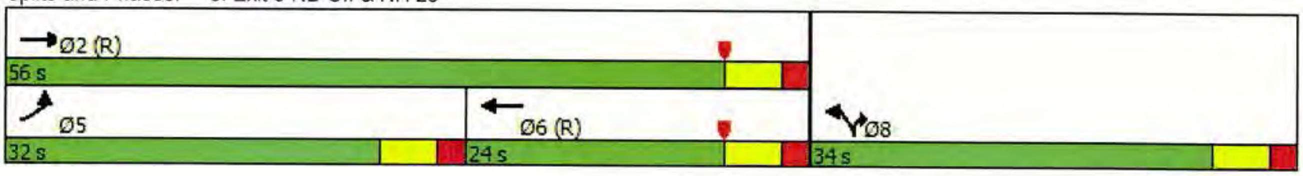
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Type	Prot	NA			NA	Free	Prot		Prot			
Protected Phases	5	2			6		8		8			
Permitted Phases		2			6	Free						
Detector Phase	5	2			6		8		8			
Switch Phase												
Minimum Initial (s)	4.0	16.0			16.0		4.0		4.0			
Minimum Split (s)	10.0	23.0			23.0		11.0		11.0			
Total Split (s)	32.0	56.0			24.0		34.0		34.0			
Total Split (%)	35.6%	62.2%			26.7%		37.8%		37.8%			
Maximum Green (s)	26.0	50.0			18.0		28.0		28.0			
Yellow Time (s)	4.0	4.0			4.0		4.0		4.0			
All-Red Time (s)	2.0	2.0			2.0		2.0		2.0			
Lost Time Adjust (s)	0.0	0.0			0.0		0.0		0.0			
Total Lost Time (s)	6.0	6.0			6.0		6.0		6.0			
Lead/Lag	Lead				Lag							
Lead-Lag Optimize?												
Vehicle Extension (s)	5.0	5.0			5.0		3.0		3.0			
Recall Mode	None	C-Min			C-Min		None		None			
Walk Time (s)		7.0			7.0							
Flash Dont Walk (s)		10.0			10.0							
Pedestrian Calls (#/hr)		0			0							
Act Effct Green (s)	26.0	50.0			18.0	90.0	28.0		28.0			
Actuated g/C Ratio	0.29	0.56			0.20	1.00	0.31		0.31			
v/c Ratio	1.03	0.32			0.87	0.31	1.03		0.97			
Control Delay	49.0	2.2			49.7	0.5	79.7		47.8			
Queue Delay	0.0	0.0			0.0	0.0	0.0		0.0			
Total Delay	49.0	2.2			49.7	0.5	79.7		47.8			
LOS	D	A			D	A	E		D			
Approach Delay		23.6			27.8			62.6				
Approach LOS		C			C			E				
Queue Length 50th (ft)	~321	8			177	0	~335		228			
Queue Length 95th (ft)	m#449	11			#270	0	298		199			
Internal Link Dist (ft)		613			462			787			312	
Turn Bay Length (ft)												
Base Capacity (vph)	506	1947			701	1568	529		649			
Starvation Cap Reductn	0	0			0	0	0		0			
Spillback Cap Reductn	0	0			0	0	0		0			
Storage Cap Reductn	0	0			0	0	0		0			
Reduced v/c Ratio	1.03	0.32			0.87	0.31	1.03		0.97			

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 90
Offset: 0 (0%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow, Master Intersection
Natural Cycle: 90
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 1.03
Intersection Signal Delay: 38.3 Intersection LOS: D

Intersection Capacity Utilization 77.2% ICU Level of Service D
Analysis Period (min) 15
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 3: Exit 5 NB Off & NH 28



Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	100	5	90	10	0	10	210	880	120	5	520	140
Future Volume (vph)	100	5	90	10	0	10	210	880	120	5	520	140
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		225	0		0	350		0	100		0
Storage Lanes	0		1	0		0	1		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00	0.95	0.95
Frt			0.850		0.932			0.982			0.968	
Flt Protected		0.954			0.976		0.950			0.950		
Satd. Flow (prot)	0	1777	1583	0	1728	0	1770	3476	0	1770	3426	0
Flt Permitted		0.784			0.784		0.950			0.950		
Satd. Flow (perm)	0	1460	1583	0	1388	0	1770	3476	0	1770	3426	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			182		182			25			41	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		593			447			750			330	
Travel Time (s)		13.5			10.2			17.0			7.5	
Peak Hour Factor	0.92	0.92	0.92	0.25	0.25	0.25	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	2%	2%	2%	0%	0%	0%	2%	2%	2%	2%	2%	2%
Adj. Flow (vph)	109	5	98	40	0	40	228	957	130	5	565	152
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	114	98	0	80	0	228	1087	0	5	717	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	3	3	1	3	1		3	3		3	3	
Detector Template	Left	Thru	Right	Left			Left	Thru		Left	Thru	
Leading Detector (ft)	256	256	45	256	45		256	256		256	256	
Trailing Detector (ft)	-5	-5	-5	-5	-5		-5	-5		-5	-5	
Detector 1 Position(ft)	-5	-5	-5	-5	-5		-5	-5		-5	-5	
Detector 1 Size(ft)	50	50	50	50	50		50	50		50	50	
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(ft)	125	125		125			125	125		125	125	
Detector 2 Size(ft)	6	6		6			6	6		6	6	
Detector 2 Type	Cl+Ex	Cl+Ex		Cl+Ex			Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)	0.0	0.0		0.0			0.0	0.0		0.0	0.0	
Detector 3 Position(ft)	250	250		250			250	250		250	250	
Detector 3 Size(ft)	6	6		6			6	6		6	6	

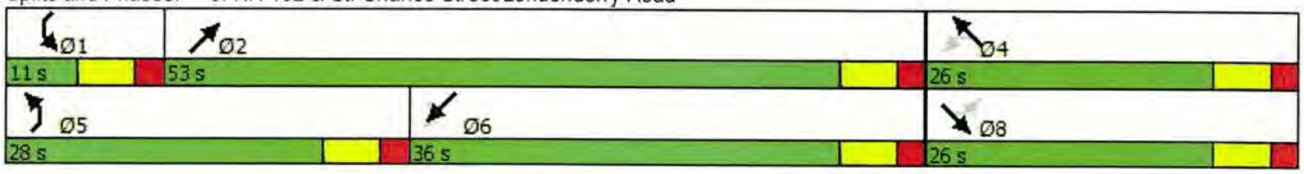
Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Detector 3 Type	Cl+Ex	Cl+Ex		Cl+Ex			Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 3 Channel												
Detector 3 Extend (s)	0.0	0.0		0.0			0.0	0.0		0.0	0.0	
Turn Type	Perm	NA	custom	Perm	NA		Prot	NA		Prot	NA	
Protected Phases		8			4		5	2		1	6	
Permitted Phases	8		6	4								
Detector Phase	8	8	6	4	4		5	2		1	6	
Switch Phase												
Minimum Initial (s)	5.0	5.0	8.0	5.0	5.0		5.0	8.0		5.0	8.0	
Minimum Split (s)	24.0	24.0	24.0	24.0	24.0		24.0	24.0		11.0	24.0	
Total Split (s)	26.0	26.0	36.0	26.0	26.0		28.0	53.0		11.0	36.0	
Total Split (%)	28.9%	28.9%	40.0%	28.9%	28.9%		31.1%	58.9%		12.2%	40.0%	
Maximum Green (s)	20.0	20.0	30.0	20.0	20.0		22.0	47.0		5.0	30.0	
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)		0.0	0.0		0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)		6.0	6.0		6.0		6.0	6.0		6.0	6.0	
Lead/Lag			Lag				Lead	Lag		Lead	Lag	
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None	Min	None	None		None	Min		None	Min	
Walk Time (s)	7.0	7.0	7.0	7.0	7.0		7.0	7.0			7.0	
Flash Dont Walk (s)	11.0	11.0	11.0	11.0	11.0		11.0	11.0			11.0	
Pedestrian Calls (#/hr)	0	0	0	0	0		0	0			0	
Act Effct Green (s)		11.8	24.9		11.5		14.7	47.1		5.6	24.9	
Actuated g/C Ratio		0.18	0.37		0.17		0.22	0.71		0.08	0.37	
v/c Ratio		0.44	0.14		0.21		0.58	0.44		0.03	0.55	
Control Delay		34.9	0.4		1.2		33.3	7.9		37.6	19.3	
Queue Delay		0.0	0.0		0.0		0.0	0.0		0.0	0.0	
Total Delay		34.9	0.4		1.2		33.3	7.9		37.6	19.3	
LOS		C	A		A		C	A		D	B	
Approach Delay		18.9			1.2			12.4			19.4	
Approach LOS		B			A			B			B	
Queue Length 50th (ft)		47	0		0		93	98		2	118	
Queue Length 95th (ft)		105	0		0		181	257		14	220	
Internal Link Dist (ft)		513			367			670			250	
Turn Bay Length (ft)			225				350			100		
Base Capacity (vph)		493	891		589		657	2546		149	1755	
Starvation Cap Reductn		0	0		0		0	0		0	0	
Spillback Cap Reductn		0	0		0		0	0		0	0	
Storage Cap Reductn		0	0		0		0	0		0	0	
Reduced v/c Ratio		0.23	0.11		0.14		0.35	0.43		0.03	0.41	

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 66.7
Natural Cycle: 75
Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.58
Intersection Signal Delay: 14.8 Intersection LOS: B
Intersection Capacity Utilization 60.9% ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 9: NH 102 & St. Charles Street/Londonderry Road



Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	20	110	5	270	0	70	0	710	130	15	345	0
Future Volume (vph)	20	110	5	270	0	70	0	710	130	15	345	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.995			0.972			0.979				
Flt Protected		0.993			0.962						0.998	
Satd. Flow (prot)	0	1840	0	0	1725	0	0	1722	0	0	1806	0
Flt Permitted		0.920			0.583						0.701	
Satd. Flow (perm)	0	1705	0	0	1045	0	0	1722	0	0	1268	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		2			36			16				
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		356			493			1124			603	
Travel Time (s)		8.1			11.2			25.5			13.7	
Peak Hour Factor	0.60	0.60	0.60	0.96	0.96	0.96	0.89	0.89	0.89	0.86	0.86	0.86
Heavy Vehicles (%)	2%	2%	2%	3%	3%	3%	8%	8%	8%	5%	5%	5%
Adj. Flow (vph)	33	183	8	281	0	73	0	798	146	17	401	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	224	0	0	354	0	0	944	0	0	418	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0			0	
Link Offset(ft)		-22			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	3	1		3	2			2		3	2	
Detector Template	Left			Left						Left		
Leading Detector (ft)	256	45		256	131			131		256	131	
Trailing Detector (ft)	-5	-5		-5	-5			-5		-5	-5	
Detector 1 Position(ft)	-5	-5		-5	-5			-5		-5	-5	
Detector 1 Size(ft)	50	50		50	50			50		50	50	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex			Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0			0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0			0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0			0.0		0.0	0.0	
Detector 2 Position(ft)	125			125	125			125		125	125	
Detector 2 Size(ft)	6			6	6			6		6	6	
Detector 2 Type	Cl+Ex			Cl+Ex	Cl+Ex			Cl+Ex		Cl+Ex	Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)	0.0			0.0	0.0			0.0		0.0	0.0	
Detector 3 Position(ft)	250			250						250		
Detector 3 Size(ft)	6			6						6		
Detector 3 Type	Cl+Ex			Cl+Ex						Cl+Ex		
Detector 3 Channel												
Detector 3 Extend (s)	0.0			0.0						0.0		

Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Turn Type	Perm	NA		Perm	NA			NA		Perm	NA	
Protected Phases		4			4			2			2	
Permitted Phases	4			4						2		
Detector Phase	4	4		4	4			2		2	2	
Switch Phase												
Minimum Initial (s)	5.0	5.0		5.0	5.0			5.0		5.0	5.0	
Minimum Split (s)	24.0	24.0		24.0	24.0			24.0		24.0	24.0	
Total Split (s)	34.0	34.0		34.0	34.0			56.0		56.0	56.0	
Total Split (%)	37.8%	37.8%		37.8%	37.8%			62.2%		62.2%	62.2%	
Maximum Green (s)	28.0	28.0		28.0	28.0			50.0		50.0	50.0	
Yellow Time (s)	4.0	4.0		4.0	4.0			4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0			2.0		2.0	2.0	
Lost Time Adjust (s)		0.0			0.0			0.0			0.0	
Total Lost Time (s)		6.0			6.0			6.0			6.0	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0		3.0	3.0	
Recall Mode	None	None		None	None			Min		Min	Min	
Walk Time (s)	7.0	7.0		7.0	7.0			7.0		7.0	7.0	
Flash Dont Walk (s)	11.0	11.0		11.0	11.0			11.0		11.0	11.0	
Pedestrian Calls (#/hr)	0	0		0	0			0		0	0	
Act Effct Green (s)		28.0			28.0			50.0			50.0	
Actuated g/C Ratio		0.31			0.31			0.56			0.56	
v/c Ratio		0.42			1.01			0.98			0.59	
Control Delay		27.4			82.1			45.6			17.7	
Queue Delay		0.0			0.0			0.0			0.0	
Total Delay		27.4			82.1			45.6			17.7	
LOS		C			F			D			B	
Approach Delay		27.4			82.1			45.6			17.7	
Approach LOS		C			F			D			B	
Queue Length 50th (ft)		99			~189			484			147	
Queue Length 95th (ft)		101			#371			#769			224	
Internal Link Dist (ft)		276			413			1044			523	
Turn Bay Length (ft)												
Base Capacity (vph)		531			349			963			704	
Starvation Cap Reductn		0			0			0			0	
Spillback Cap Reductn		0			0			0			0	
Storage Cap Reductn		0			0			0			0	
Reduced v/c Ratio		0.42			1.01			0.98			0.59	

Intersection Summary	
Area Type: Other	
Cycle Length: 90	
Actuated Cycle Length: 90	
Natural Cycle: 80	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 1.01	
Intersection Signal Delay: 44.1	Intersection LOS: D
Intersection Capacity Utilization 84.5%	ICU Level of Service E

Analysis Period (min) 15

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 10: NH 102 & Fordway/Madden Hill Road

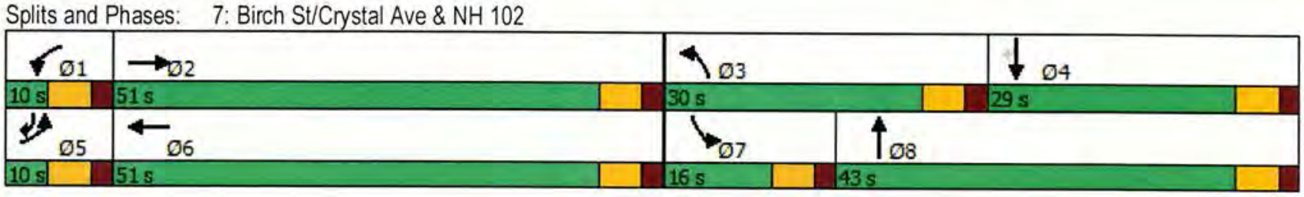
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	20	520	40	60	360	195	170	180	20	80	260	20
Future Volume (vph)	20	520	40	60	360	195	170	180	20	80	260	20
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.989			0.947			0.985				0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1656	1724	0	1703	1697	0	1719	1782	0	1703	1792	1524
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1656	1724	0	1703	1697	0	1719	1782	0	1703	1792	1524
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		4			26			5				136
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		505			530			361			411	
Travel Time (s)		11.5			12.0			8.2			9.3	
Peak Hour Factor	0.96	0.96	0.96	0.94	0.94	0.94	0.85	0.85	0.85	0.91	0.91	0.91
Heavy Vehicles (%)	9%	9%	9%	6%	6%	6%	5%	5%	5%	6%	6%	6%
Parking (#/hr)			0									
Adj. Flow (vph)	21	542	42	64	383	207	200	212	24	88	286	22
Shared Lane Traffic (%)												
Lane Group Flow (vph)	21	584	0	64	590	0	200	236	0	88	286	22
Turn Type	Prot	NA		Prot	NA		Prot	NA		Prot	NA	pm+ov
Protected Phases	5	2		1	6		3	8		7	4	5
Permitted Phases												4
Detector Phase	5	2		1	6		3	8		7	4	5
Switch Phase												
Minimum Initial (s)	4.0	5.0		4.0	10.0		4.0	10.0		4.0	9.0	4.0
Minimum Split (s)	10.0	30.0		10.0	30.0		10.0	25.0		10.0	25.0	10.0
Total Split (s)	10.0	51.0		10.0	51.0		30.0	43.0		16.0	29.0	10.0
Total Split (%)	8.3%	42.5%		8.3%	42.5%		25.0%	35.8%		13.3%	24.2%	8.3%
Maximum Green (s)	4.0	45.0		4.0	45.0		24.0	37.0		10.0	23.0	4.0
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	6.0
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lag		Lead	Lag	Lead
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes	Yes
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Recall Mode	None	Min		None	Min		Min	None		Min	None	None
Walk Time (s)		7.0			7.0			7.0			7.0	
Flash Dont Walk (s)		11.0			11.0			11.0			11.0	
Pedestrian Calls (#/hr)		10			10			0			10	
Act Effct Green (s)	4.1	40.0		4.1	44.7		17.6	29.1		9.2	20.7	30.9
Actuated g/C Ratio	0.04	0.37		0.04	0.42		0.16	0.27		0.09	0.19	0.29
v/c Ratio	0.33	0.90		1.00	0.81		0.71	0.48		0.60	0.82	0.04
Control Delay	69.8	51.2		167.1	39.2		58.0	36.3		68.5	63.4	0.1
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Total Delay	69.8	51.2		167.1	39.2		58.0	36.3		68.5	63.4	0.1
LOS	E	D		F	D		E	D		E	E	A

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		51.8			51.7			46.2			61.0	
Approach LOS		D			D			D			E	
Queue Length 50th (ft)	15	386		~53	379		141	142		63	202	0
Queue Length 95th (ft)	#45	#641		#151	#636		208	204		#137	#358	0
Internal Link Dist (ft)		425			450			281			331	
Turn Bay Length (ft)												
Base Capacity (vph)	63	743		64	757		394	633		162	394	537
Starvation Cap Reductn	0	0		0	0		0	0		0	0	0
Spillback Cap Reductn	0	0		0	0		0	0		0	0	0
Storage Cap Reductn	0	0		0	0		0	0		0	0	0
Reduced v/c Ratio	0.33	0.79		1.00	0.78		0.51	0.37		0.54	0.73	0.04

Intersection Summary

Area Type: Other
Cycle Length: 120
Actuated Cycle Length: 106.9
Natural Cycle: 90
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 1.00
Intersection Signal Delay: 52.4 Intersection LOS: D
Intersection Capacity Utilization 77.3% ICU Level of Service D
Analysis Period (min) 15
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 7: Birch St/Crystal Ave & NH 102



Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑	↱	↰	↑↑	↰↰	↱
Traffic Volume (vph)	1715	265	225	1025	660	460
Future Volume (vph)	1715	265	225	1025	660	460
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)		0	250		0	400
Storage Lanes		1	1		2	1
Taper Length (ft)			25		25	
Lane Util. Factor	0.95	1.00	1.00	0.95	0.97	1.00
Frt		0.850				0.850
Flt Protected			0.950		0.950	
Satd. Flow (prot)	3539	1583	1770	3539	3433	1583
Flt Permitted			0.058		0.950	
Satd. Flow (perm)	3539	1583	108	3539	3433	1583
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)		209				9
Link Speed (mph)	30			30	30	
Link Distance (ft)	511			427	520	
Travel Time (s)	11.6			9.7	11.8	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	1864	288	245	1114	717	500
Shared Lane Traffic (%)						
Lane Group Flow (vph)	1864	288	245	1114	717	500
Turn Type	NA	Perm	pm+pt	NA	Prot	pm+ov
Protected Phases	4		3	8	2	3
Permitted Phases		4	8			2
Detector Phase	4	4	3	8	2	3
Switch Phase						
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	29.5	29.5	9.5	29.5	29.5	9.5
Total Split (s)	69.0	69.0	19.0	88.0	32.0	19.0
Total Split (%)	57.5%	57.5%	15.8%	73.3%	26.7%	15.8%
Maximum Green (s)	64.5	64.5	14.5	83.5	27.5	14.5
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	4.5	4.5	4.5	4.5	4.5
Lead/Lag	Lag	Lag	Lead			Lead
Lead-Lag Optimize?	Yes	Yes	Yes			Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	None	None	None	C-Max	None
Walk Time (s)	5.0	5.0		5.0	5.0	
Flash Dont Walk (s)	20.0	20.0		20.0	20.0	
Pedestrian Calls (#/hr)	0	0		0	0	
Act Effct Green (s)	65.0	65.0	83.5	83.5	27.5	46.0
Actuated g/C Ratio	0.54	0.54	0.70	0.70	0.23	0.38
v/c Ratio	0.97	0.30	0.91	0.45	0.91	0.82
Control Delay	42.3	5.2	64.8	11.9	62.2	44.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	42.3	5.2	64.8	11.9	62.2	44.9

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
LOS	D	A	E	B	E	D
Approach Delay	37.3			21.4	55.1	
Approach LOS	D			C	E	
Queue Length 50th (ft)	713	29	147	200	280	336
Queue Length 95th (ft)	#913	75	m#258	m294	#389	#514
Internal Link Dist (ft)	431			347	440	
Turn Bay Length (ft)			250			400
Base Capacity (vph)	1916	953	275	2462	786	618
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.97	0.30	0.89	0.45	0.91	0.81

Intersection Summary

Area Type: Other
Cycle Length: 120
Actuated Cycle Length: 120
Offset: 0 (0%), Referenced to phase 2:NBL and 6:, Start of Yellow
Natural Cycle: 100
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.97
Intersection Signal Delay: 37.3 Intersection LOS: D
Intersection Capacity Utilization 90.0% ICU Level of Service E
Analysis Period (min) 15
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 9: N. High St & Connector Road

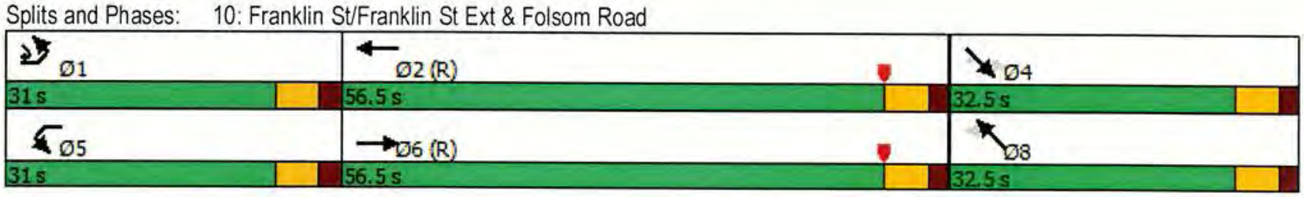
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Traffic Volume (vph)	70	2075	30	120	960	80	20	10	90	200	30	60
Future Volume (vph)	70	2075	30	120	960	80	20	10	90	200	30	60
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	50		100	100		0	0		200	100		0
Storage Lanes	1		0	1		0	0		1	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	0.91	0.91	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor								0.97				
Frt		0.998			0.989				0.850		0.900	
Flt Protected	0.950			0.950				0.967		0.950		
Satd. Flow (prot)	1687	4838	0	1719	3400	0	0	1801	1583	1805	1710	0
Flt Permitted	0.950			0.950				0.770		0.727		
Satd. Flow (perm)	1687	4838	0	1719	3400	0	0	1390	1583	1381	1710	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		2			9				45		77	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		333			347			309			251	
Travel Time (s)		7.6			7.9			7.0			5.7	
Confl. Peds. (#/hr)							40					
Peak Hour Factor	0.89	0.89	0.89	0.96	0.96	0.96	0.65	0.65	0.65	0.67	0.67	0.67
Heavy Vehicles (%)	7%	7%	7%	5%	5%	5%	2%	2%	2%	0%	0%	0%
Adj. Flow (vph)	79	2331	34	125	1000	83	31	15	138	299	45	90
Shared Lane Traffic (%)												
Lane Group Flow (vph)	79	2365	0	125	1083	0	0	46	138	299	135	0
Turn Type	Prot	NA		Prot	NA		Perm	NA	pm+ov	Perm	NA	
Protected Phases	1	6		5	2			4	1		8	
Permitted Phases							4		4	8		
Detector Phase	1	6		5	2		4	4	1	8	8	
Switch Phase												
Minimum Initial (s)	5.0	5.0		5.0	5.0		5.0	5.0	5.0	5.0	5.0	
Minimum Split (s)	31.0	31.0		31.0	31.0		31.0	31.0	31.0	32.5	32.5	
Total Split (s)	31.0	56.5		31.0	56.5		32.5	32.5	31.0	32.5	32.5	
Total Split (%)	25.8%	47.1%		25.8%	47.1%		27.1%	27.1%	25.8%	27.1%	27.1%	
Maximum Green (s)	25.0	50.5		25.0	50.5		26.5	26.5	25.0	26.5	26.5	
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0	2.0	2.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0			0.0	0.0	0.0	0.0	
Total Lost Time (s)	6.0	6.0		6.0	6.0			6.0	6.0	6.0	6.0	
Lead/Lag	Lead	Lag		Lead	Lag				Lead			
Lead-Lag Optimize?	Yes	Yes		Yes	Yes				Yes			
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Recall Mode	None	C-Max		None	C-Max		None	None	None	None	None	
Walk Time (s)	5.0	5.0		5.0	5.0		5.0	5.0	5.0	5.0	5.0	
Flash Dont Walk (s)	20.0	20.0		20.0	20.0		20.0	20.0	20.0	20.0	20.0	
Pedestrian Calls (#/hr)	0	0		0	0		0	0	0	0	0	
Act Effct Green (s)	11.0	61.5		14.0	64.5			26.5	43.5	26.5	26.5	
Actuated g/C Ratio	0.09	0.51		0.12	0.54			0.22	0.36	0.22	0.22	
v/c Ratio	0.52	0.95		0.62	0.59			0.15	0.23	0.98	0.31	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Control Delay	67.1	28.4		63.5	20.8			39.3	18.0	94.7	19.9	
Queue Delay	0.0	0.0		0.0	0.0			0.0	0.0	0.0	0.0	
Total Delay	67.1	28.4		63.5	20.8			39.3	18.0	94.7	19.9	
LOS	E	C		E	C			D	B	F	B	
Approach Delay		29.7			25.2			23.3			71.5	
Approach LOS		C			C			C			E	
Queue Length 50th (ft)	59	679		94	284			29	48	232	36	
Queue Length 95th (ft)	m61	m#789		151	382			45	56	#238	54	
Internal Link Dist (ft)		253			267			229			171	
Turn Bay Length (ft)	50			100					200	100		
Base Capacity (vph)	351	2480		358	1832			306	781	304	437	
Starvation Cap Reductn	0	0		0	0			0	0	0	0	
Spillback Cap Reductn	0	0		0	0			0	0	0	0	
Storage Cap Reductn	0	0		0	0			0	0	0	0	
Reduced v/c Ratio	0.23	0.95		0.35	0.59			0.15	0.18	0.98	0.31	

Intersection Summary

Area Type: Other
Cycle Length: 120
Actuated Cycle Length: 120
Offset: 0 (0%), Referenced to phase 2:WBT and 6:EBT, Start of Yellow
Natural Cycle: 145
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.98
Intersection Signal Delay: 32.4 — Intersection LOS: C
Intersection Capacity Utilization 80.2% — ICU Level of Service D
Analysis Period (min) 15
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 10: Franklin St/Franklin St Ext & Folsom Road



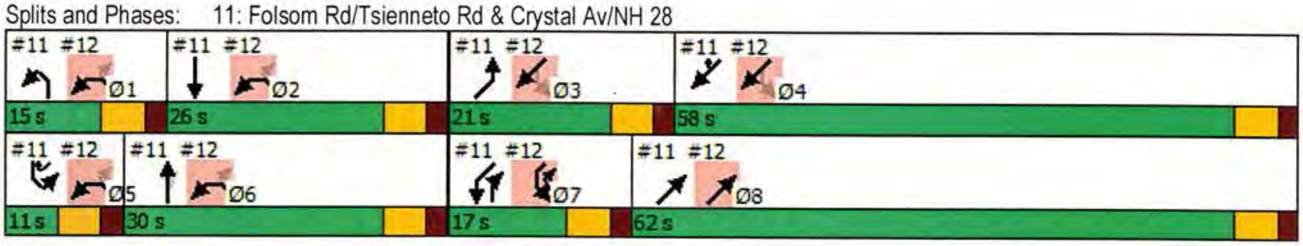
Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations	↰	↑↑	↱	↰↰	↑↑		↰↰	↑↑	↱	↰	↑↑	↱
Traffic Volume (vph)	40	240	40	50	200	0	230	1380	340	45	820	235
Future Volume (vph)	40	240	40	50	200	0	230	1380	340	45	820	235
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	150		150	360		300	250		100	0		100
Storage Lanes	1		0	2		0	2		1	1		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95	1.00	0.97	0.95	1.00	1.00	0.95	1.00
Frt			0.850						0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1736	3471	1553	3335	3438	0	3400	3505	1568	1752	3505	1568
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1736	3471	1553	3335	3438	0	3400	3505	1568	1752	3505	1568
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			82						191			130
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		622			1162			532			412	
Travel Time (s)		14.1			26.4			12.1			9.4	
Peak Hour Factor	0.84	0.84	0.84	0.79	0.79	0.79	0.86	0.86	0.86	0.99	0.99	0.99
Heavy Vehicles (%)	4%	4%	4%	5%	5%	5%	3%	3%	3%	3%	3%	3%
Adj. Flow (vph)	48	286	48	63	253	0	267	1605	395	45	828	237
Shared Lane Traffic (%)												
Lane Group Flow (vph)	48	286	48	63	253	0	267	1605	395	45	828	237
Turn Type	Prot	NA	pm+ov	Prot	NA		Prot	NA	Free	Prot	NA	pt+ov
Protected Phases	1	6	7	5	2		3	8		7	4	4 5
Permitted Phases		6	6		2			8	Free		4	
Detector Phase	1	6	7	5	2		3	8		7	4	4 5
Switch Phase												
Minimum Initial (s)	6.0	8.0	5.0	7.0	8.0		7.0	8.0		5.0	8.0	
Minimum Split (s)	12.0	40.0	11.0	13.0	31.0		13.0	40.0		11.0	21.0	
Total Split (s)	15.0	30.0	17.0	11.0	26.0		21.0	62.0		17.0	58.0	
Total Split (%)	12.5%	25.0%	14.2%	9.2%	21.7%		17.5%	51.7%		14.2%	48.3%	
Maximum Green (s)	9.0	24.0	11.0	5.0	20.0		15.0	56.0		11.0	52.0	
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0		6.0	6.0		6.0	6.0	
Lead/Lag	Lead	Lag	Lead	Lead	Lag		Lead	Lag		Lead	Lag	
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes		Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	Max	None	None	Max		None	Max		None	None	
Act Effct Green (s)	9.0	24.0	38.6	5.0	20.0		15.0	57.5	119.1	8.6	51.1	62.1
Actuated g/C Ratio	0.08	0.20	0.32	0.04	0.17		0.13	0.48	1.00	0.07	0.43	0.52
v/c Ratio	0.37	0.41	0.09	0.45	0.44		0.62	0.95	0.25	0.36	0.55	0.27
Control Delay	61.2	43.7	1.9	66.8	47.5		56.7	42.8	0.4	79.9	19.7	3.7
Queue Delay	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.5	0.0
Total Delay	61.2	43.7	1.9	66.8	47.5		56.7	42.8	0.4	79.9	20.2	3.7
LOS	E	D	A	E	D		E	D	A	E	C	A
Approach Delay		40.6			51.3			37.0			19.1	

Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Approach LOS		D			D			D			B	
Queue Length 50th (ft)	36	102	0	25	93		102	601	0	37	270	23
Queue Length 95th (ft)	71	135	5	43	118		140	#740	0	m65	310	45
Internal Link Dist (ft)		542			1082			452			332	
Turn Bay Length (ft)	150		150	360			250		100			100
Base Capacity (vph)	131	699	588	139	577		428	1691	1568	161	1530	875
Starvation Cap Reductn	0	0	0	0	0		0	0	0	0	319	0
Spillback Cap Reductn	0	0	0	0	0		0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0		0	0	0	0	0	0
Reduced v/c Ratio	0.37	0.41	0.08	0.45	0.44		0.62	0.95	0.25	0.28	0.68	0.27

Intersection Summary

Area Type: Other
Cycle Length: 120
Actuated Cycle Length: 119.1
Natural Cycle: 125
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.95
Intersection Signal Delay: 33.6 Intersection LOS: C
Intersection Capacity Utilization 74.8% ICU Level of Service D
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 11: Folsom Rd/Tsienneto Rd & Crystal Av/NH 28

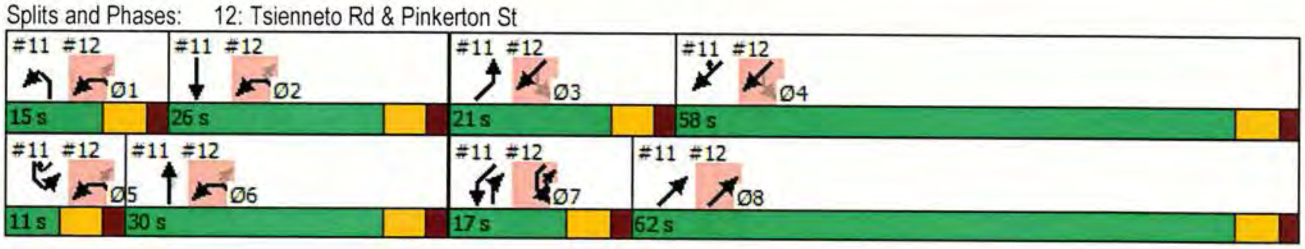


Lane Group	NWL	NWR	NET	NER	SWL	SWT	Ø1	Ø2	Ø3	Ø4	Ø5	Ø6
Lane Configurations												
Traffic Volume (vph)	205	90	920	550	80	1010						
Future Volume (vph)	205	90	920	550	80	1010						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900						
Storage Length (ft)	150	150		100	220							
Storage Lanes	0	1		1	1							
Taper Length (ft)	25				25							
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95						
Frt		0.850		0.850								
Flt Protected	0.950				0.950							
Satd. Flow (prot)	1770	1583	3505	1568	1770	3539						
Flt Permitted	0.950				0.149							
Satd. Flow (perm)	1770	1583	3505	1568	278	3539						
Right Turn on Red		Yes		Yes								
Satd. Flow (RTOR)		50		171								
Link Speed (mph)	30		30			30						
Link Distance (ft)	408		412			410						
Travel Time (s)	9.3		9.4			9.3						
Peak Hour Factor	0.83	0.83	0.86	0.86	0.81	0.81						
Heavy Vehicles (%)	2%	2%	3%	3%	2%	2%						
Adj. Flow (vph)	247	108	1070	640	99	1247						
Shared Lane Traffic (%)												
Lane Group Flow (vph)	247	108	1070	640	99	1247						
Turn Type	Prot	pm+ov	NA	Free	pm+pt	NA						
Protected Phases	1 2 5 6	7	8		7	3 4	1	2	3	4	5	6
Permitted Phases		1 2 5 6		Free	3 4							
Detector Phase	1 2 5 6	7	8		7	3 4						
Switch Phase												
Minimum Initial (s)		5.0	8.0		5.0		6.0	8.0	7.0	8.0	7.0	8.0
Minimum Split (s)		11.0	40.0		11.0		12.0	31.0	13.0	21.0	13.0	40.0
Total Split (s)		17.0	62.0		17.0		15.0	26.0	21.0	58.0	11.0	30.0
Total Split (%)		14.2%	51.7%		14.2%		13%	22%	18%	48%	9%	25%
Maximum Green (s)		11.0	56.0		11.0		9.0	20.0	15.0	52.0	5.0	24.0
Yellow Time (s)		4.0	4.0		4.0		4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)		2.0	2.0		2.0		2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)		0.0	0.0		0.0							
Total Lost Time (s)		6.0	6.0		6.0							
Lead/Lag		Lead	Lag		Lead		Lead	Lag	Lead	Lag	Lead	Lag
Lead-Lag Optimize?		Yes	Yes		Yes		Yes	Yes	Yes	Yes	Yes	Yes
Vehicle Extension (s)		3.0	3.0		3.0		3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode		None	Max		None		None	Max	None	None	None	Max
Act Effct Green (s)	33.0	47.6	57.5	119.1	72.1	72.1						
Actuated g/C Ratio	0.28	0.40	0.48	1.00	0.61	0.61						
v/c Ratio	0.50	0.16	0.63	0.41	0.36	0.58						
Control Delay	39.7	12.6	10.2	0.7	13.5	15.7						
Queue Delay	0.0	0.0	0.9	0.0	0.0	0.0						
Total Delay	39.7	12.6	11.1	0.7	13.5	15.7						
LOS	D	B	B	A	B	B						
Approach Delay	31.4		7.2			15.5						

Lane Group	NWL	NWR	NET	NER	SWL	SWT	Ø1	Ø2	Ø3	Ø4	Ø5	Ø6
Approach LOS	C		A			B						
Queue Length 50th (ft)	158	27	70	0	30	288						
Queue Length 95th (ft)	217	55	m104	m0	48	296						
Internal Link Dist (ft)	328		332			330						
Turn Bay Length (ft)	150	150		100	220							
Base Capacity (vph)	490	693	1691	1568	305	2169						
Starvation Cap Reductn	0	0	332	0	0	0						
Spillback Cap Reductn	0	0	0	0	0	41						
Storage Cap Reductn	0	0	0	0	0	0						
Reduced v/c Ratio	0.50	0.16	0.79	0.41	0.32	0.59						

Intersection Summary	
Area Type: Other	
Cycle Length: 120	
Actuated Cycle Length: 119.1	
Natural Cycle: 125	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.95	
Intersection Signal Delay: 13.0	Intersection LOS: B
Intersection Capacity Utilization 56.2%	ICU Level of Service B
Analysis Period (min) 15	
m Volume for 95th percentile queue is metered by upstream signal.	

Splits and Phases: 12: Tsienneto Rd & Pinkerton St



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	170	300	5	20	550	40	15	10	15	20	10	170
Future Volume (vph)	170	300	5	20	550	40	15	10	15	20	10	170
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	75		0	150		150	0		0	0		0
Storage Lanes	1		0	1		0	0		1	0		1
Taper Length (ft)	50			25			25			25		
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.998			0.990				0.850			0.850
Flt Protected	0.950			0.950				0.971			0.968	
Satd. Flow (prot)	1687	3367	0	1770	3504	0	0	1845	1615	0	1821	1599
Flt Permitted	0.950			0.950				0.797			0.769	
Satd. Flow (perm)	1687	3367	0	1770	3504	0	0	1514	1615	0	1447	1599
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		2			10				109			189
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		277			1162			218			433	
Travel Time (s)		6.3			26.4			5.0			9.8	
Peak Hour Factor	0.83	0.83	0.83	0.92	0.92	0.92	0.50	0.50	0.50	0.90	0.90	0.90
Heavy Vehicles (%)	7%	7%	7%	2%	2%	2%	0%	0%	0%	1%	1%	1%
Adj. Flow (vph)	205	361	6	22	598	43	30	20	30	22	11	189
Shared Lane Traffic (%)												
Lane Group Flow (vph)	205	367	0	22	641	0	0	50	30	0	33	189
Turn Type	Prot	NA		Prot	NA		Perm	NA	Perm	Perm	NA	Perm
Protected Phases	5	2		1	6			8			4	
Permitted Phases					6		8	8	8	4		4
Detector Phase	5	2		1	6		8	8	8	4	4	4
Switch Phase												
Minimum Initial (s)	8.0	8.0		5.0	8.0		5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	14.0	46.0		11.0	43.0		33.0	33.0	33.0	33.0	33.0	33.0
Total Split (s)	14.0	46.0		11.0	43.0		33.0	33.0	33.0	33.0	33.0	33.0
Total Split (%)	15.6%	51.1%		12.2%	47.8%		36.7%	36.7%	36.7%	36.7%	36.7%	36.7%
Maximum Green (s)	8.0	40.0		5.0	37.0		27.0	27.0	27.0	27.0	27.0	27.0
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0			0.0	0.0		0.0	0.0
Total Lost Time (s)	6.0	6.0		6.0	6.0			6.0	6.0		6.0	6.0
Lead/Lag	Lead	Lag		Lead	Lag							
Lead-Lag Optimize?	Yes	Yes		Yes	Yes							
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	Max		None	None		None	None	None	None	None	None
Act Effct Green (s)	8.1	40.5		5.1	30.2			7.6	7.6		7.6	7.6
Actuated g/C Ratio	0.13	0.63		0.08	0.47			0.12	0.12		0.12	0.12
v/c Ratio	0.97	0.17		0.16	0.39			0.28	0.10		0.19	0.53
Control Delay	88.4	6.3		33.6	11.6			31.4	0.7		29.8	11.1
Queue Delay	0.0	0.0		0.0	0.0			0.0	0.0		0.0	0.0
Total Delay	88.4	6.3		33.6	11.6			31.4	0.7		29.8	11.1
LOS	F	A		C	B			C	A		C	B
Approach Delay		35.8			12.3			19.9			13.9	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Approach LOS		D			B			B			B	
Queue Length 50th (ft)	73	20		7	76			17	0		11	0
Queue Length 95th (ft)	#209	57		31	123			27	0		38	53
Internal Link Dist (ft)		197			1082			138			353	
Turn Bay Length (ft)	75			150								
Base Capacity (vph)	212	2125		139	2050			644	750		616	789
Starvation Cap Reductn	0	0		0	0			0	0		0	0
Spillback Cap Reductn	0	0		0	0			0	0		0	0
Storage Cap Reductn	0	0		0	0			0	0		0	0
Reduced v/c Ratio	0.97	0.17		0.16	0.31			0.08	0.04		0.05	0.24

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 64.1
Natural Cycle: 90
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.97
Intersection Signal Delay: 21.7 Intersection LOS: C
Intersection Capacity Utilization 49.2% ICU Level of Service A
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 13: Applebees/Linlew Dr & NH 28

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰↰	↑↱		↰	↑↱		↰	↱		↰	↰↑	↱
Traffic Volume (vph)	30	330	5	5	430	140	30	10	10	320	5	150
Future Volume (vph)	30	330	5	5	430	140	30	10	10	320	5	150
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	150		150	150		150	0		0	0		0
Storage Lanes	2		0	1		0	1		0	1		1
Taper Length (ft)	200			25			25			25		
Lane Util. Factor	0.97	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	0.95	0.95	1.00
Frt		0.998			0.963			0.925				0.850
Flt Protected	0.950			0.950			0.950			0.950	0.954	
Satd. Flow (prot)	3303	3399	0	1736	3343	0	1805	1758	0	1665	1672	1568
Flt Permitted	0.950			0.950			0.950			0.950	0.954	
Satd. Flow (perm)	3303	3399	0	1736	3343	0	1805	1758	0	1665	1672	1568
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		2			49			15				167
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		412			486			151			343	
Travel Time (s)		9.4			11.0			3.4			7.8	
Peak Hour Factor	0.83	0.83	0.83	0.97	0.97	0.97	0.67	0.67	0.67	0.90	0.90	0.90
Heavy Vehicles (%)	6%	6%	6%	4%	4%	4%	0%	0%	0%	3%	3%	3%
Adj. Flow (vph)	36	398	6	5	443	144	45	15	15	356	6	167
Shared Lane Traffic (%)										49%		
Lane Group Flow (vph)	36	404	0	5	587	0	45	30	0	182	180	167
Turn Type	Prot	NA		Prot	NA		Split	NA		Split	NA	pt+ov
Protected Phases	5	2		1	6		3	3		4	4	4 5
Permitted Phases								3				
Detector Phase	5	2		1	6		3	3		4	4	4 5
Switch Phase												
Minimum Initial (s)	5.0	8.0		5.0	8.0		5.0	5.0		8.0	8.0	
Minimum Split (s)	14.0	53.0		11.0	50.0		22.0	22.0		22.0	22.0	
Total Split (s)	14.0	53.0		13.0	52.0		22.0	22.0		22.0	22.0	
Total Split (%)	12.7%	48.2%		11.8%	47.3%		20.0%	20.0%		20.0%	20.0%	
Maximum Green (s)	8.0	47.0		7.0	46.0		16.0	16.0		16.0	16.0	
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lead		Lag	Lag	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	Min		None	Min		None	None		None	None	
Walk Time (s)		5.0			5.0		5.0	5.0		5.0	5.0	
Flash Dont Walk (s)		11.0			11.0		11.0	11.0		11.0	11.0	
Pedestrian Calls (#/hr)		0			0		0	0		0	0	
Act Effct Green (s)	6.5	28.3		6.1	17.4		7.5	7.5		13.2	13.2	26.1
Actuated g/C Ratio	0.10	0.43		0.09	0.26		0.11	0.11		0.20	0.20	0.39
v/c Ratio	0.11	0.28		0.03	0.64		0.22	0.14		0.55	0.54	0.23
Control Delay	33.0	15.6		33.8	24.4		33.9	22.9		33.8	33.5	4.2
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Total Delay	33.0	15.6		33.8	24.4		33.9	22.9		33.8	33.5	4.2
LOS	C	B		C	C		C	C		C	C	A
Approach Delay		17.0			24.4			29.5			24.3	
Approach LOS		B			C			C			C	
Queue Length 50th (ft)	7	56		2	108		18	6		73	72	0
Queue Length 95th (ft)	21	111		13	172		38	21		156	154	38
Internal Link Dist (ft)		332			406			71			263	
Turn Bay Length (ft)	150			150								
Base Capacity (vph)	421	2460		193	2396		460	459		424	426	733
Starvation Cap Reductn	0	0		0	0		0	0		0	0	0
Spillback Cap Reductn	0	0		0	0		0	0		0	0	0
Storage Cap Reductn	0	0		0	0		0	0		0	0	0
Reduced v/c Ratio	0.09	0.16		0.03	0.24		0.10	0.07		0.43	0.42	0.23

Intersection Summary

Area Type: Other
Cycle Length: 110
Actuated Cycle Length: 66.3
Natural Cycle: 110
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.64
Intersection Signal Delay: 22.6 Intersection LOS: C
Intersection Capacity Utilization 44.8% ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 14: VIP Dr/Ashleigh Dr & NH 28

Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations	↰	↱		↰	↑	↱	↰	↑↑↱		↰	↑↑↱	
Traffic Volume (vph)	30	70	30	40	40	140	190	1010	60	20	340	70
Future Volume (vph)	30	70	30	40	40	140	190	1010	60	20	340	70
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	150		150	150		150	150		0	150		150
Storage Lanes	1		0	1		1	1		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00	0.95	0.95
Frt		0.955				0.850		0.992			0.974	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1770	1779	0	1787	1881	1599	1805	3581	0	1805	3516	0
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1770	1779	0	1787	1881	1599	1805	3581	0	1805	3516	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		29				164		9			38	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		481			347			479			371	
Travel Time (s)		10.9			7.9			10.9			8.4	
Peak Hour Factor	0.99	0.99	0.99	0.95	0.95	0.95	0.89	0.89	0.89	0.93	0.93	0.93
Heavy Vehicles (%)	2%	2%	2%	1%	1%	1%	0%	0%	0%	0%	0%	0%
Adj. Flow (vph)	30	71	30	42	42	147	213	1135	67	22	366	75
Shared Lane Traffic (%)												
Lane Group Flow (vph)	30	101	0	42	42	147	213	1202	0	22	441	0
Turn Type	Prot	NA		Prot	NA	pt+ov	Prot	NA		Prot	NA	
Protected Phases	1	6		5	2	2 3	3	8		7	4	
Permitted Phases		6			2							
Detector Phase	1	6		5	2	2 3	3	8		7	4	
Switch Phase												
Minimum Initial (s)	5.0	8.0		5.0	8.0		8.0	8.0		8.0	8.0	
Minimum Split (s)	11.0	14.0		11.0	14.0		14.0	14.0		14.0	14.0	
Total Split (s)	11.0	14.0		11.0	14.0		14.0	21.0		14.0	21.0	
Total Split (%)	18.3%	23.3%		18.3%	23.3%		23.3%	35.0%		23.3%	35.0%	
Maximum Green (s)	5.0	8.0		5.0	8.0		8.0	15.0		8.0	15.0	
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lag		Lead	Lag	
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	Max		None	None		None	None	
Act Effct Green (s)	5.1	8.2		5.1	8.2	22.6	8.2	23.2		8.2	11.2	
Actuated g/C Ratio	0.10	0.16		0.10	0.16	0.45	0.16	0.47		0.16	0.23	
v/c Ratio	0.16	0.32		0.23	0.14	0.18	0.72	0.72		0.07	0.54	
Control Delay	26.3	19.6		27.2	22.4	2.9	40.7	18.8		22.2	18.7	
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Total Delay	26.3	19.6		27.2	22.4	2.9	40.7	18.8		22.2	18.7	
LOS	C	B		C	C	A	D	B		C	B	
Approach Delay		21.1			10.9			22.1			18.9	

Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Approach LOS		C			B			C			B	
Queue Length 50th (ft)	7	16		10	9	0	51	92		5	46	
Queue Length 95th (ft)	32	63		41	38	26	#183	#421		25	103	
Internal Link Dist (ft)		401			267			399			291	
Turn Bay Length (ft)	150			150		150	150			150		
Base Capacity (vph)	182	317		184	310	815	297	1676		297	1114	
Starvation Cap Reductn	0	0		0	0	0	0	0		0	0	
Spillback Cap Reductn	0	0		0	0	0	0	0		0	0	
Storage Cap Reductn	0	0		0	0	0	0	0		0	0	
Reduced v/c Ratio	0.16	0.32		0.23	0.14	0.18	0.72	0.72		0.07	0.40	

Intersection Summary

Area Type: Other
Cycle Length: 60
Actuated Cycle Length: 49.7
Natural Cycle: 70
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.72
Intersection Signal Delay: 20.2 Intersection LOS: C
Intersection Capacity Utilization 60.4% ICU Level of Service B
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 18: Tsienneto Rd & NH 28 Byp NB/NH 28 Byp SB

Ø1	Ø2	Ø3	Ø4
11 s	14 s	14 s	21 s
Ø5	Ø6	Ø7	Ø8
11 s	14 s	14 s	21 s

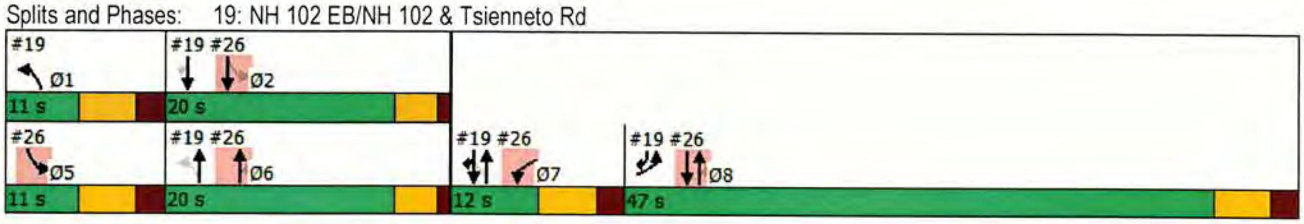
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR	Ø2	Ø5	Ø6	Ø7
Lane Configurations										
Traffic Volume (vph)	620	0	10	290	180	350				
Future Volume (vph)	620	0	10	290	180	350				
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900				
Storage Length (ft)	200	0	100			90				
Storage Lanes	0	0	1			1				
Taper Length (ft)	25		25							
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00				
Frt						0.850				
Flt Protected	0.950		0.950							
Satd. Flow (prot)	1787	0	1770	1863	1845	1568				
Flt Permitted	0.950		0.530							
Satd. Flow (perm)	1787	0	987	1863	1845	1568				
Right Turn on Red		Yes				Yes				
Satd. Flow (RTOR)						393				
Link Speed (mph)	30			30	30					
Link Distance (ft)	392			704	263					
Travel Time (s)	8.9			16.0	6.0					
Peak Hour Factor	0.90	0.90	0.87	0.87	0.89	0.89				
Heavy Vehicles (%)	1%	1%	2%	2%	3%	3%				
Adj. Flow (vph)	689	0	11	333	202	393				
Shared Lane Traffic (%)										
Lane Group Flow (vph)	689	0	11	333	202	393				
Turn Type	Prot		pm+pt	NA	NA	custom				
Protected Phases	8		1	6 7	2 7	7 8	2	5	6	7
Permitted Phases			6 7			2				
Detector Phase	8		1	6 7	2 7	7 8				
Switch Phase										
Minimum Initial (s)	5.0		5.0				5.0	5.0	5.0	5.0
Minimum Split (s)	26.5		11.0				9.0	11.0	9.0	11.0
Total Split (s)	47.0		11.0				20.0	11.0	20.0	12.0
Total Split (%)	52.2%		12.2%				22%	12%	22%	13%
Maximum Green (s)	41.0		5.0				16.0	5.0	16.0	6.0
Yellow Time (s)	4.0		4.0				3.0	4.0	3.0	4.0
All-Red Time (s)	2.0		2.0				1.0	2.0	1.0	2.0
Lost Time Adjust (s)	0.0		0.0							
Total Lost Time (s)	6.0		6.0							
Lead/Lag	Lag		Lead				Lag	Lead	Lag	Lead
Lead-Lag Optimize?	Yes		Yes				Yes	Yes	Yes	Yes
Vehicle Extension (s)	3.0		3.0				3.0	3.0	3.0	3.0
Recall Mode	None		None				Min	None	Min	None
Act Effct Green (s)	40.3		26.6	27.7	27.7	77.0				
Actuated g/C Ratio	0.50		0.33	0.35	0.35	0.96				
v/c Ratio	0.77		0.03	0.52	0.32	0.26				
Control Delay	24.2		17.1	25.2	24.3	0.4				
Queue Delay	0.1		0.0	0.0	1.4	0.0				
Total Delay	24.3		17.1	25.2	25.6	0.5				
LOS	C		B	C	C	A				
Approach Delay	24.3			25.0	9.0					

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR	Ø2	Ø5	Ø6	Ø7
Approach LOS	C			C	A					
Queue Length 50th (ft)	250		4	127	76	0				
Queue Length 95th (ft)	#549		13	234	129	1				
Internal Link Dist (ft)	312			624	183					
Turn Bay Length (ft)	200		100			90				
Base Capacity (vph)	919		377	634	628	1517				
Starvation Cap Reductn	0		0	0	259	164				
Spillback Cap Reductn	12		0	0	0	0				
Storage Cap Reductn	0		0	0	0	0				
Reduced v/c Ratio	0.76		0.03	0.53	0.55	0.29				

Intersection Summary			
Area Type:	Other		
Cycle Length: 90			
Actuated Cycle Length: 80			
Natural Cycle: 80			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.77			
Intersection Signal Delay: 18.9		Intersection LOS: B	
Intersection Capacity Utilization 57.9%		ICU Level of Service B	
Analysis Period (min) 15			

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 19: NH 102 EB/NH 102 & Tsienneto Rd



Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	ኘኘ				ኘኘ	
Traffic Volume (vph)	875	0	0	0	1545	0
Future Volume (vph)	875	0	0	0	1545	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	0.97	1.00	1.00	1.00	0.97	1.00
Frt						
Flt Protected	0.950				0.950	
Satd. Flow (prot)	3433	0	0	0	3433	0
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	3433	0	0	0	3433	0
Right Turn on Red		Yes		Yes		
Satd. Flow (RTOR)						
Link Speed (mph)	30		30			30
Link Distance (ft)	372		529			557
Travel Time (s)	8.5		12.0			12.7
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	931	0	0	0	1644	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	931	0	0	0	1644	0
Turn Type	Prot				Prot	
Protected Phases	2				4	
Permitted Phases						
Detector Phase	2				4	
Switch Phase						
Minimum Initial (s)	5.0				9.0	
Minimum Split (s)	24.0				24.0	
Total Split (s)	32.0				48.0	
Total Split (%)	40.0%				60.0%	
Maximum Green (s)	26.0				42.0	
Yellow Time (s)	4.0				4.0	
All-Red Time (s)	2.0				2.0	
Lost Time Adjust (s)	0.0				0.0	
Total Lost Time (s)	6.0				6.0	
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)	3.0				3.0	
Recall Mode	C-Max				Min	
Act Effct Green (s)	26.0				42.0	
Actuated g/C Ratio	0.32				0.52	
v/c Ratio	0.83				0.91	
Control Delay	36.8				26.9	
Queue Delay	4.4				0.0	
Total Delay	41.2				26.9	
LOS	D				C	
Approach Delay	41.2					26.9
Approach LOS	D					C
Queue Length 50th (ft)	267				361	
Queue Length 95th (ft)	#334				#534	
Internal Link Dist (ft)	292		449			477

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Turn Bay Length (ft)						
Base Capacity (vph)	1115				1802	
Starvation Cap Reductn	124				0	
Spillback Cap Reductn	0				0	
Storage Cap Reductn	0				0	
Reduced v/c Ratio	0.94				0.91	

Intersection Summary

Area Type: Other
Cycle Length: 80
Actuated Cycle Length: 80
Offset: 25 (31%), Referenced to phase 2:WBL, Start of Yellow
Natural Cycle: 70
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.91
Intersection Signal Delay: 32.1 Intersection LOS: C
Intersection Capacity Utilization 131.8% ICU Level of Service H
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 20: Exit 4A SB On/Exit 4A SB Off & Connector Road

Ø2 (R)	Ø4
32 s	48 s

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰↰				↰↰	
Traffic Volume (vph)	875	0	0	0	1545	0
Future Volume (vph)	875	0	0	0	1545	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0				6.0	
Lane Util. Factor	0.97				0.97	
Frt	1.00				1.00	
Flt Protected	0.95				0.95	
Satd. Flow (prot)	3433				3433	
Flt Permitted	0.95				0.95	
Satd. Flow (perm)	3433				3433	
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	931	0	0	0	1644	0
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	931	0	0	0	1644	0
Turn Type	Prot				Prot	
Protected Phases	2				4	
Permitted Phases						
Actuated Green, G (s)	26.0				42.0	
Effective Green, g (s)	26.0				42.0	
Actuated g/C Ratio	0.32				0.52	
Clearance Time (s)	6.0				6.0	
Vehicle Extension (s)	3.0				3.0	
Lane Grp Cap (vph)	1115				1802	
v/s Ratio Prot	c0.27				c0.48	
v/s Ratio Perm						
v/c Ratio	0.83				0.91	
Uniform Delay, d1	25.0				17.3	
Progression Factor	1.18				1.00	
Incremental Delay, d2	6.6				7.5	
Delay (s)	36.1				24.8	
Level of Service	D				C	
Approach Delay (s)	36.1		0.0			24.8
Approach LOS	D		A			C

Intersection Summary			
HCM 2000 Control Delay	28.9	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.88		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	131.8%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	875	0	0	0	1545	0
Future Volume (veh/h)	875	0	0	0	1545	0
Number	5	12			7	4
Initial Q (Qb), veh	0	0			0	0
Ped-Bike Adj(A_pbT)	1.00	1.00			1.00	
Parking Bus, Adj	1.00	1.00			1.00	1.00
Adj Sat Flow, veh/h/ln	1863	0			1863	0
Adj Flow Rate, veh/h	931	0			1644	0
Adj No. of Lanes	2	0			2	0
Peak Hour Factor	0.94	0.94			0.94	0.94
Percent Heavy Veh, %	2	0			2	0
Cap, veh/h	0	0			0	0
Arrive On Green	0.00	0.00			0.00	0.00
Sat Flow, veh/h	0					0
Grp Volume(v), veh/h	0.0					0.0
Grp Sat Flow(s),veh/h/ln						
Q Serve(g_s), s						
Cycle Q Clear(g_c), s						
Prop In Lane						
Lane Grp Cap(c), veh/h						
V/C Ratio(X)						
Avail Cap(c_a), veh/h						
HCM Platoon Ratio						
Upstream Filter(I)						
Uniform Delay (d), s/veh						
Incr Delay (d2), s/veh						
Initial Q Delay(d3),s/veh						
%ile BackOfQ(50%),veh/ln						
LnGrp Delay(d),s/veh						
LnGrp LOS						
Approach Vol, veh/h						
Approach Delay, s/veh						
Approach LOS						

Timer	1	2	3	4	5	6	7	8
Assigned Phs								
Phs Duration (G+Y+Rc), s								
Change Period (Y+Rc), s								
Max Green Setting (Gmax), s								
Max Q Clear Time (g_c+I1), s								
Green Ext Time (p_c), s								

Intersection Summary			
HCM 2010 Ctrl Delay			0.0
HCM 2010 LOS			A

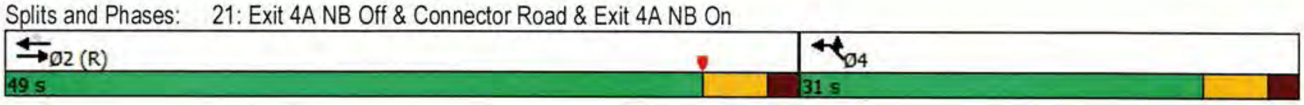
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	SBL	SBR	NWL	NWR
Lane Configurations		↑↑			↑↑	↱↱			↖↗	↗
Traffic Volume (vph)	0	1545	0	0	875	1240	0	0	0	710
Future Volume (vph)	0	1545	0	0	875	1240	0	0	0	710
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		200	0	0	0	0
Storage Lanes	0		0	0		2	0	0	1	1
Taper Length (ft)	25			25			25		25	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	0.88	1.00	1.00	1.00	0.95
Frt						0.850			0.850	0.850
Flt Protected										
Satd. Flow (prot)	0	3539	0	0	3539	2787	0	0	1583	1504
Flt Permitted										
Satd. Flow (perm)	0	3539	0	0	3539	2787	0	0	1583	1504
Right Turn on Red			Yes			Yes		Yes		
Satd. Flow (RTOR)						74				
Link Speed (mph)		30			30		30		30	
Link Distance (ft)		372			394		598		519	
Travel Time (s)		8.5			9.0		13.6		11.8	
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	0	1644	0	0	931	1319	0	0	0	755
Shared Lane Traffic (%)										50%
Lane Group Flow (vph)	0	1644	0	0	931	1319	0	0	378	377
Turn Type		NA			NA	Perm			Prot	Prot
Protected Phases		2			2				4	4
Permitted Phases						2				
Detector Phase		2			2	2			4	4
Switch Phase										
Minimum Initial (s)		5.0			5.0	5.0			9.0	9.0
Minimum Split (s)		24.0			24.0	24.0			24.0	24.0
Total Split (s)		49.0			49.0	49.0			31.0	31.0
Total Split (%)		61.3%			61.3%	61.3%			38.8%	38.8%
Maximum Green (s)		43.0			43.0	43.0			25.0	25.0
Yellow Time (s)		4.0			4.0	4.0			4.0	4.0
All-Red Time (s)		2.0			2.0	2.0			2.0	2.0
Lost Time Adjust (s)		0.0			0.0	0.0			0.0	0.0
Total Lost Time (s)		6.0			6.0	6.0			6.0	6.0
Lead/Lag										
Lead-Lag Optimize?										
Vehicle Extension (s)		3.0			3.0	3.0			3.0	3.0
Recall Mode		C-Max			C-Max	C-Max			Max	Max
Act Effct Green (s)		43.0			43.0	43.0			25.0	25.0
Actuated g/C Ratio		0.54			0.54	0.54			0.31	0.31
v/c Ratio		0.86			0.49	0.86			0.77	0.80
Control Delay		4.1			12.7	22.5			37.0	40.4
Queue Delay		0.2			0.1	0.0			0.0	0.0
Total Delay		4.4			12.8	22.5			37.0	40.4
LOS		A			B	C			D	D
Approach Delay		4.4			18.5				38.7	
Approach LOS		A			B				D	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	SBL	SBR	NWL	NWR
Queue Length 50th (ft)		8			143	286			169	180
Queue Length 95th (ft)		m18			191	#413			#303	#330
Internal Link Dist (ft)		292			314		518		439	
Turn Bay Length (ft)						200				
Base Capacity (vph)		1902			1902	1532			494	470
Starvation Cap Reductn		28			0	0			0	0
Spillback Cap Reductn		0			200	0			0	0
Storage Cap Reductn		0			0	0			0	0
Reduced v/c Ratio		0.88			0.55	0.86			0.77	0.80

Intersection Summary

Area Type: Other
Cycle Length: 80
Actuated Cycle Length: 80
Offset: 0 (0%), Referenced to phase 2:EBWB, Start of Yellow
Natural Cycle: 60
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.86
Intersection Signal Delay: 16.8 Intersection LOS: B
Intersection Capacity Utilization 117.6% ICU Level of Service H
Analysis Period (min) 15
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 21: Exit 4A NB Off & Connector Road & Exit 4A NB On



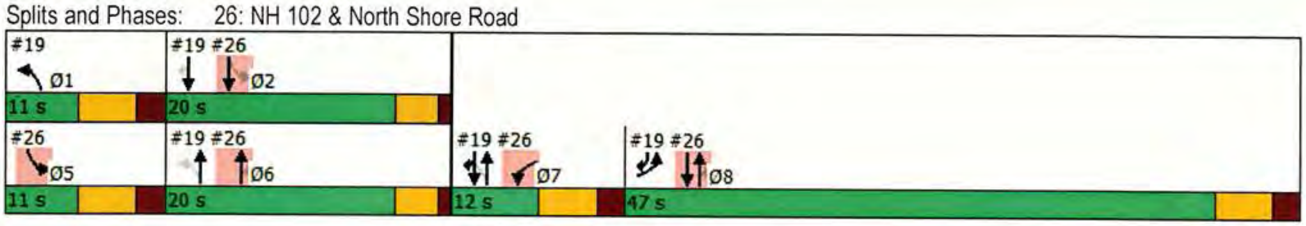
Lane Group	WBL	WBR	NBT	NBR	SBL	SBT	Ø1	Ø2	Ø6	Ø8
Lane Configurations										
Traffic Volume (vph)	60	10	750	160	10	470				
Future Volume (vph)	60	10	750	160	10	470				
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900				
Storage Length (ft)	0	0		90	100					
Storage Lanes	1	0		1	1					
Taper Length (ft)	25				25					
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00				
Frt	0.976			0.850						
Flt Protected	0.961				0.950					
Satd. Flow (prot)	1768	0	1900	1615	1805	1900				
Flt Permitted	0.961				0.255					
Satd. Flow (perm)	1768	0	1900	1615	484	1900				
Right Turn on Red		Yes		Yes						
Satd. Flow (RTOR)	9			129						
Link Speed (mph)	30		30			30				
Link Distance (ft)	524		263			288				
Travel Time (s)	11.9		6.0			6.5				
Peak Hour Factor	0.87	0.67	0.95	0.84	0.73	0.96				
Heavy Vehicles (%)	1%	0%	0%	0%	0%	0%				
Adj. Flow (vph)	69	15	789	190	14	490				
Shared Lane Traffic (%)										
Lane Group Flow (vph)	84	0	789	190	14	490				
Turn Type	Prot		NA	Perm	custom	NA				
Protected Phases	7		6 8		5	2 8	1	2	6	8
Permitted Phases				6 8	2					
Detector Phase	7		6 8	6 8	5	2 8				
Switch Phase										
Minimum Initial (s)	5.0				5.0		5.0	5.0	5.0	5.0
Minimum Split (s)	11.0				11.0		11.0	9.0	9.0	26.5
Total Split (s)	12.0				11.0		11.0	20.0	20.0	47.0
Total Split (%)	13.3%				12.2%		12%	22%	22%	52%
Maximum Green (s)	6.0				5.0		5.0	16.0	16.0	41.0
Yellow Time (s)	4.0				4.0		4.0	3.0	3.0	4.0
All-Red Time (s)	2.0				2.0		2.0	1.0	1.0	2.0
Lost Time Adjust (s)	0.0				0.0					
Total Lost Time (s)	6.0				6.0					
Lead/Lag	Lead				Lead		Lead	Lag	Lag	Lag
Lead-Lag Optimize?	Yes				Yes		Yes	Yes	Yes	Yes
Vehicle Extension (s)	3.0				3.0		3.0	3.0	3.0	3.0
Recall Mode	None				None		None	Min	Min	None
Act Effct Green (s)	6.0		61.3	61.3	14.5	61.3				
Actuated g/C Ratio	0.08		0.77	0.77	0.18	0.77				
v/c Ratio	0.60		0.54	0.15	0.08	0.34				
Control Delay	53.1		2.8	0.8	26.6	3.3				
Queue Delay	0.0		0.7	0.3	0.0	0.0				
Total Delay	53.1		3.5	1.1	26.6	3.3				
LOS	D		A	A	C	A				
Approach Delay	53.1		3.1			4.0				

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT	Ø1	Ø2	Ø6	Ø8
Approach LOS	D		A			A				
Queue Length 50th (ft)	36		31	0	6	46				
Queue Length 95th (ft)	#107		113	m9	16	69				
Internal Link Dist (ft)	444		183			208				
Turn Bay Length (ft)				90	100					
Base Capacity (vph)	141		1465	1275	170	1465				
Starvation Cap Reductn	0		349	659	0	0				
Spillback Cap Reductn	0		0	0	0	0				
Storage Cap Reductn	0		0	0	0	0				
Reduced v/c Ratio	0.60		0.71	0.31	0.08	0.33				

Intersection Summary	
Area Type: Other	
Cycle Length: 90	
Actuated Cycle Length: 80	
Natural Cycle: 80	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.77	
Intersection Signal Delay: 6.0	Intersection LOS: A
Intersection Capacity Utilization 52.0%	ICU Level of Service A
Analysis Period (min) 15	

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 26: NH 102 & North Shore Road



APPENDIX P-1: 2040 ALTERNATIVE B INTERSECTION CAPACITY ANALYSES – HCM 2000 PRINOUTS – AM PEAK HOUR

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑↑		↰	↱↱
Traffic Volume (vph)	0	1280	720	0	385	925
Future Volume (vph)	0	1280	720	0	385	925
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	16	12
Total Lost time (s)		6.0	6.0		6.0	6.0
Lane Util. Factor		0.95	0.95		1.00	0.88
Frt		1.00	1.00		1.00	0.85
Flt Protected		1.00	1.00		0.95	1.00
Satd. Flow (prot)		3471	3406		1930	2682
Flt Permitted		1.00	1.00		0.95	1.00
Satd. Flow (perm)		3471	3406		1930	2682
Peak-hour factor, PHF	0.93	0.93	0.88	0.88	0.89	0.89
Adj. Flow (vph)	0	1376	818	0	433	1039
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	1376	818	0	433	1039
Heavy Vehicles (%)	4%	4%	6%	6%	6%	6%
Turn Type		NA	NA		Prot	Prot
Protected Phases		2	6		4	4
Permitted Phases						
Actuated Green, G (s)		32.0	32.0		31.0	31.0
Effective Green, g (s)		32.0	32.0		31.0	31.0
Actuated g/C Ratio		0.43	0.43		0.41	0.41
Clearance Time (s)		6.0	6.0		6.0	6.0
Vehicle Extension (s)		3.0	3.0		3.0	3.0
Lane Grp Cap (vph)		1480	1453		797	1108
v/s Ratio Prot		c0.40	0.24		0.22	c0.39
v/s Ratio Perm						
v/c Ratio		0.93	0.56		0.54	0.94
Uniform Delay, d1		20.4	16.2		16.6	21.1
Progression Factor		1.01	1.36		1.00	1.00
Incremental Delay, d2		5.3	0.4		0.8	14.4
Delay (s)		25.8	22.5		17.4	35.4
Level of Service		C	C		B	D
Approach Delay (s)		25.8	22.5		30.1	
Approach LOS		C	C		C	

Intersection Summary			
HCM 2000 Control Delay	26.8	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.93		
Actuated Cycle Length (s)	75.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	68.7%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
2. ~~8~~: NH 102 & Exit 4 NB Off

12/28/2017

Movement	NBL2	NBL	NBR	SEL	SER	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations											
Traffic Volume (vph)	485	0	245	0	0	1415	250	0	0	820	500
Future Volume (vph)	485	0	245	0	0	1415	250	0	0	820	500
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0		6.0			6.0	6.0			6.0	4.0
Lane Util. Factor	0.97		0.88			0.97	0.95			0.95	1.00
Frt	1.00		0.85			1.00	1.00			1.00	0.85
Flt Protected	0.95		1.00			0.95	1.00			1.00	1.00
Satd. Flow (prot)	3242		2632			3335	3438			3505	1568
Flt Permitted	0.95		1.00			0.95	1.00			1.00	1.00
Satd. Flow (perm)	3242		2632			3335	3438			3505	1568
Peak-hour factor, PHF	0.88	0.88	0.88	0.92	0.92	0.94	0.94	0.94	0.92	0.92	0.92
Adj. Flow (vph)	551	0	278	0	0	1505	266	0	0	891	543
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	551	0	278	0	0	1505	266	0	0	891	543
Heavy Vehicles (%)	8%	8%	8%	2%	2%	5%	5%	5%	3%	3%	3%
Turn Type	Prot		Prot			Prot	NA			NA	Free
Protected Phases	8		8			5	2			6	
Permitted Phases											Free
Actuated Green, G (s)	25.0		25.0			67.0	113.0			40.0	150.0
Effective Green, g (s)	25.0		25.0			67.0	113.0			40.0	150.0
Actuated g/C Ratio	0.17		0.17			0.45	0.75			0.27	1.00
Clearance Time (s)	6.0		6.0			6.0	6.0			6.0	
Vehicle Extension (s)	3.0		3.0			3.0	3.0			3.0	
Lane Grp Cap (vph)	540		438			1489	2589			934	1568
v/s Ratio Prot	c0.17		0.11			c0.45	0.08			c0.25	
v/s Ratio Perm											0.35
v/c Ratio	1.02		0.63			1.01	0.10			0.95	0.35
Uniform Delay, d1	62.5		58.2			41.5	4.9			54.1	0.0
Progression Factor	1.00		1.00			0.75	1.80			1.00	1.00
Incremental Delay, d2	44.0		3.0			19.5	0.0			20.2	0.6
Delay (s)	106.5		61.2			50.8	8.9			74.3	0.6
Level of Service	F		E			D	A			E	A
Approach Delay (s)		91.3		0.0			44.5			46.4	
Approach LOS		F		A			D			D	

Intersection Summary			
HCM 2000 Control Delay	54.8	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.99		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	92.9%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
3 ~~2~~: Exit 5 SB On/Exit 5 SB Off & NH 28

12/28/2017

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑	↱	↰	↑↑					↰↰		↱
Traffic Volume (vph)	0	690	420	260	730	0	0	0	0	105	0	385
Future Volume (vph)	0	690	420	260	730	0	0	0	0	105	0	385
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0	4.0	6.0	6.0					6.0		6.0
Lane Util. Factor		0.95	1.00	1.00	0.95					0.97		1.00
Frt		1.00	0.85	1.00	1.00					1.00		0.85
Flt Protected		1.00	1.00	0.95	1.00					0.95		1.00
Satd. Flow (prot)		3167	1417	1687	3374					3303		1524
Flt Permitted		1.00	1.00	0.95	1.00					0.95		1.00
Satd. Flow (perm)		3167	1417	1687	3374					3303		1524
Peak-hour factor, PHF	0.92	0.92	0.92	0.73	0.73	0.73	0.92	0.92	0.92	0.74	0.74	0.74
Adj. Flow (vph)	0	750	457	356	1000	0	0	0	0	142	0	520
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	75
Lane Group Flow (vph)	0	750	457	356	1000	0	0	0	0	142	0	445
Heavy Vehicles (%)	14%	14%	14%	7%	7%	7%	2%	2%	2%	6%	6%	6%
Turn Type		NA	Free	Prot	NA					Prot		Prot
Protected Phases		2		1	6					4		4
Permitted Phases			Free									
Actuated Green, G (s)		40.3	130.0	30.7	77.0					41.0		41.0
Effective Green, g (s)		40.3	130.0	30.7	77.0					41.0		41.0
Actuated g/C Ratio		0.31	1.00	0.24	0.59					0.32		0.32
Clearance Time (s)		6.0		6.0	6.0					6.0		6.0
Vehicle Extension (s)		5.0		3.0	5.0					3.0		3.0
Lane Grp Cap (vph)		981	1417	398	1998					1041		480
v/s Ratio Prot		c0.24		c0.21	0.30					0.04		c0.29
v/s Ratio Perm			0.32									
v/c Ratio		0.76	0.32	0.89	0.50					0.14		0.93
Uniform Delay, d1		40.6	0.0	48.1	15.4					31.8		43.0
Progression Factor		1.00	1.00	0.38	0.15					1.00		1.00
Incremental Delay, d2		5.7	0.6	18.4	0.5					0.1		23.9
Delay (s)		46.2	0.6	36.9	2.7					31.9		67.0
Level of Service		D	A	D	A					C		E
Approach Delay (s)		28.9			11.7			0.0			59.4	
Approach LOS		C			B			A			E	

Intersection Summary			
HCM 2000 Control Delay	28.0	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	76.3%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑			↑↑	↱	↰		↱			
Traffic Volume (vph)	525	270	0	0	545	570	445	0	165	0	0	0
Future Volume (vph)	525	270	0	0	545	570	445	0	165	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0			6.0	4.0	6.0		6.0			
Lane Util. Factor	1.00	0.95			0.95	1.00	1.00		1.00			
Frt	1.00	1.00			1.00	0.85	1.00		0.85			
Flt Protected	0.95	1.00			1.00	1.00	0.95		1.00			
Satd. Flow (prot)	1641	3282			3438	1538	1656		1482			
Flt Permitted	0.95	1.00			1.00	1.00	0.95		1.00			
Satd. Flow (perm)	1641	3282			3438	1538	1656		1482			
Peak-hour factor, PHF	0.87	0.87	0.87	0.90	0.90	0.90	0.78	0.78	0.78	0.92	0.92	0.92
Adj. Flow (vph)	603	310	0	0	606	633	571	0	212	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	113	0	0	0
Lane Group Flow (vph)	603	310	0	0	606	633	571	0	99	0	0	0
Heavy Vehicles (%)	10%	10%	10%	5%	5%	5%	9%	9%	9%	2%	2%	2%
Turn Type	Prot	NA			NA	Free	Prot		Prot			
Protected Phases	5	2			6		8		8			
Permitted Phases		2			6	Free						
Actuated Green, G (s)	46.0	75.0			23.0	130.0	43.0		43.0			
Effective Green, g (s)	46.0	75.0			23.0	130.0	43.0		43.0			
Actuated g/C Ratio	0.35	0.58			0.18	1.00	0.33		0.33			
Clearance Time (s)	6.0	6.0			6.0		6.0		6.0			
Vehicle Extension (s)	5.0	5.0			5.0		3.0		3.0			
Lane Grp Cap (vph)	580	1893			608	1538	547		490			
v/s Ratio Prot	c0.37	0.09			c0.18		c0.34		0.07			
v/s Ratio Perm						0.41						
v/c Ratio	1.04	0.16			1.00	0.41	1.04		0.20			
Uniform Delay, d1	42.0	12.8			53.5	0.0	43.5		31.2			
Progression Factor	0.26	0.20			1.00	1.00	1.00		1.00			
Incremental Delay, d2	41.6	0.2			35.7	0.8	50.4		0.2			
Delay (s)	52.6	2.7			89.2	0.8	93.9		31.4			
Level of Service	D	A			F	A	F		C			
Approach Delay (s)		35.7			44.0			77.0			0.0	
Approach LOS		D			D			E			A	

Intersection Summary			
HCM 2000 Control Delay	50.2	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	1.03		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	76.3%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	10	0	150	0	1	0	60	410	0	5	1030	20
Future Volume (vph)	10	0	150	0	1	0	60	410	0	5	1030	20
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0	6.0		6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor		1.00	1.00		1.00		1.00	0.95		1.00	0.95	
Frt		1.00	0.85		1.00		1.00	1.00		1.00	1.00	
Flt Protected		0.95	1.00		1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1770	1583		1900		1770	3539		1770	3529	
Flt Permitted		1.00	1.00		1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)		1863	1583		1900		1770	3539		1770	3529	
Peak-hour factor, PHF	0.92	0.92	0.92	0.25	0.25	0.25	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	11	0	163	0	4	0	65	446	0	5	1120	22
RTOR Reduction (vph)	0	0	59	0	0	0	0	0	0	0	1	0
Lane Group Flow (vph)	0	11	104	0	4	0	65	446	0	5	1141	0
Heavy Vehicles (%)	2%	2%	2%	0%	0%	0%	2%	2%	2%	2%	2%	2%
Turn Type	Perm	NA	custom		NA		Prot	NA		Prot	NA	
Protected Phases		8			4		5	2		1	6	
Permitted Phases	8		6	4								
Actuated Green, G (s)		1.3	45.3		1.3		6.3	50.8		0.8	45.3	
Effective Green, g (s)		1.3	45.3		1.3		6.3	50.8		0.8	45.3	
Actuated g/C Ratio		0.02	0.64		0.02		0.09	0.72		0.01	0.64	
Clearance Time (s)		6.0	6.0		6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)		3.0	3.0		3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		34	1011		34		157	2535		19	2254	
v/s Ratio Prot					0.00		c0.04	c0.13		0.00	c0.32	
v/s Ratio Perm		c0.01	0.07									
v/c Ratio		0.32	0.10		0.12		0.41	0.18		0.26	0.51	
Uniform Delay, d1		34.4	4.9		34.2		30.6	3.3		34.8	6.8	
Progression Factor		1.00	1.00		1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		5.5	0.0		1.5		1.8	0.0		7.3	0.2	
Delay (s)		39.8	5.0		35.8		32.3	3.3		42.0	7.0	
Level of Service		D	A		D		C	A		D	A	
Approach Delay (s)		7.2			35.8			7.0			7.2	
Approach LOS		A			D			A			A	

Intersection Summary			
HCM 2000 Control Delay	7.2	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.48		
Actuated Cycle Length (s)	70.9	Sum of lost time (s)	18.0
Intersection Capacity Utilization	61.4%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	10	50	0	350	0	40	0	360	110	15	545	0
Future Volume (vph)	10	50	0	350	0	40	0	360	110	15	545	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0			6.0			6.0			6.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		1.00			0.99			0.97			1.00	
Flt Protected		0.99			0.96			1.00			1.00	
Satd. Flow (prot)		1847			1741			1703			1807	
Flt Permitted		0.91			0.68			1.00			0.98	
Satd. Flow (perm)		1694			1233			1703			1776	
Peak-hour factor, PHF	0.60	0.60	0.60	0.96	0.96	0.96	0.89	0.89	0.89	0.86	0.86	0.86
Adj. Flow (vph)	17	83	0	365	0	42	0	404	124	17	634	0
RTOR Reduction (vph)	0	0	0	0	23	0	0	13	0	0	0	0
Lane Group Flow (vph)	0	100	0	0	384	0	0	515	0	0	651	0
Heavy Vehicles (%)	2%	2%	2%	3%	3%	3%	8%	8%	8%	5%	5%	5%
Turn Type	Perm	NA		Perm	NA			NA		Perm	NA	
Protected Phases		4			4			2			2	
Permitted Phases	4			4						2		
Actuated Green, G (s)		28.5			28.5			36.1			36.1	
Effective Green, g (s)		28.5			28.5			36.1			36.1	
Actuated g/C Ratio		0.37			0.37			0.47			0.47	
Clearance Time (s)		6.0			6.0			6.0			6.0	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		630			458			802			836	
v/s Ratio Prot								0.30				
v/s Ratio Perm		0.06			c0.31						c0.37	
v/c Ratio		0.16			0.84			0.64			0.78	
Uniform Delay, d1		16.0			22.0			15.4			16.9	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		0.1			12.7			1.8			4.6	
Delay (s)		16.2			34.7			17.1			21.5	
Level of Service		B			C			B			C	
Approach Delay (s)		16.2			34.7			17.1			21.5	
Approach LOS		B			C			B			C	

Intersection Summary			
HCM 2000 Control Delay	23.0	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.80		
Actuated Cycle Length (s)	76.6	Sum of lost time (s)	12.0
Intersection Capacity Utilization	80.6%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↱		↰	↱		↰	↑	↱
Traffic Volume (vph)	70	220	60	20	340	190	150	200	20	60	260	20
Future Volume (vph)	70	220	60	20	340	190	150	200	20	60	260	20
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	6.0
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.97		1.00	0.95		1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1656	1687		1703	1696		1719	1784		1703	1792	1524
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1656	1687		1703	1696		1719	1784		1703	1792	1524
Peak-hour factor, PHF	0.96	0.96	0.96	0.94	0.94	0.94	0.85	0.85	0.85	0.91	0.91	0.91
Adj. Flow (vph)	73	229	62	21	362	202	176	235	24	66	286	22
RTOR Reduction (vph)	0	10	0	0	22	0	0	4	0	0	0	18
Lane Group Flow (vph)	73	282	0	21	542	0	176	255	0	66	286	4
Heavy Vehicles (%)	9%	9%	9%	6%	6%	6%	5%	5%	5%	6%	6%	6%
Parking (#/hr)			0									
Turn Type	Prot	NA		Prot	NA		Prot	NA		Prot	NA	Perm
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases												4
Actuated Green, G (s)	3.7	33.6		1.9	31.8		10.3	19.8		7.4	16.9	16.9
Effective Green, g (s)	3.7	33.6		1.9	31.8		10.3	19.8		7.4	16.9	16.9
Actuated g/C Ratio	0.04	0.39		0.02	0.37		0.12	0.23		0.09	0.19	0.19
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	70	653		37	622		204	407		145	349	297
v/s Ratio Prot	c0.04	0.17		0.01	c0.32		c0.10	c0.14		0.04	c0.16	
v/s Ratio Perm												0.00
v/c Ratio	1.04	0.43		0.57	0.87		0.86	0.63		0.46	0.82	0.01
Uniform Delay, d1	41.5	19.5		42.0	25.5		37.5	30.1		37.7	33.4	28.2
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	119.9	0.5		18.4	12.7		29.2	3.0		2.3	13.9	0.0
Delay (s)	161.4	20.0		60.4	38.3		66.7	33.1		40.0	47.4	28.2
Level of Service	F	B		E	D		E	C		D	D	C
Approach Delay (s)		48.3			39.0			46.7			44.9	
Approach LOS		D			D			D			D	

Intersection Summary			
HCM 2000 Control Delay	44.1	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	86.7	Sum of lost time (s)	24.0
Intersection Capacity Utilization	75.4%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	200	10	5	50	300	310
Future Volume (vph)	200	10	5	50	300	310
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0	120	0			220
Storage Lanes	1	1	0			1
Taper Length (ft)	25		25			
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.850				0.850
Flt Protected	0.950			0.996		
Satd. Flow (prot)	1719	1538	0	1820	1863	1583
Flt Permitted	0.950			0.996		
Satd. Flow (perm)	1719	1538	0	1820	1863	1583
Link Speed (mph)	30			30	30	
Link Distance (ft)	322			309	295	
Travel Time (s)	7.3			7.0	6.7	
Peak Hour Factor	0.89	0.89	0.91	0.91	0.93	0.93
Heavy Vehicles (%)	5%	5%	4%	4%	2%	2%
Adj. Flow (vph)	225	11	5	55	323	333
Shared Lane Traffic (%)						
Lane Group Flow (vph)	225	11	0	60	323	333
Sign Control	Stop			Stop	Stop	

Intersection Summary	
Area Type:	Other
Control Type: Unsignalized	
Intersection Capacity Utilization 33.5%	ICU Level of Service A
Analysis Period (min) 15	

Intersection	
Intersection Delay, s/veh	12.4
Intersection LOS	B

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	200	10	5	50	300	310
Future Vol, veh/h	200	10	5	50	300	310
Peak Hour Factor	0.89	0.89	0.91	0.91	0.93	0.93
Heavy Vehicles, %	5	5	4	4	2	2
Mvmt Flow	225	11	5	55	323	333
Number of Lanes	1	1	0	1	1	1

Approach	EB	NB	SB
Opposing Approach		SB	NB
Opposing Lanes	0	2	1
Conflicting Approach Left	SB	EB	
Conflicting Lanes Left	2	2	0
Conflicting Approach Right	NB		EB
Conflicting Lanes Right	1	0	2
HCM Control Delay	14	9.6	12.1
HCM LOS	B	A	B

Lane	NBLn1	EBLn1	EBLn2	SBLn1	SBLn2
Vol Left, %	9%	100%	0%	0%	0%
Vol Thru, %	91%	0%	0%	100%	0%
Vol Right, %	0%	0%	100%	0%	100%
Sign Control	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	55	200	10	300	310
LT Vol	5	200	0	0	0
Through Vol	50	0	0	300	0
RT Vol	0	0	10	0	310
Lane Flow Rate	60	225	11	323	333
Geometry Grp	4	7	7	7	7
Degree of Util (X)	0.1	0.422	0.017	0.483	0.434
Departure Headway (Hd)	5.946	6.76	5.548	5.388	4.683
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes
Cap	605	535	649	665	760
Service Time	3.962	4.463	3.251	3.17	2.465
HCM Lane V/C Ratio	0.099	0.421	0.017	0.486	0.438
HCM Control Delay	9.6	14.3	8.3	13.2	11.1
HCM Lane LOS	A	B	A	B	B
HCM 95th-tile Q	0.3	2.1	0.1	2.6	2.2

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	10	0	0	250	610	10
Future Volume (vph)	10	0	0	250	610	10
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt					0.998	
Flt Protected	0.950					
Satd. Flow (prot)	1008	0	0	1827	1789	0
Flt Permitted	0.950					
Satd. Flow (perm)	1008	0	0	1827	1789	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	160			224	319	
Travel Time (s)	3.6			5.1	7.3	
Peak Hour Factor	0.44	0.44	0.95	0.95	0.96	0.96
Heavy Vehicles (%)	79%	79%	4%	4%	6%	6%
Adj. Flow (vph)	23	0	0	263	635	10
Shared Lane Traffic (%)						
Lane Group Flow (vph)	23	0	0	263	645	0
Sign Control	Stop			Free	Free	

Intersection Summary		
Area Type:	Other	
Control Type: Unsignalized		
Intersection Capacity Utilization 42.7%		ICU Level of Service A
Analysis Period (min) 15		

Intersection	
Int Delay, s/veh	0.5

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	Y			↰	↱	
Traffic Vol, veh/h	10	0	0	250	610	10
Future Vol, veh/h	10	0	0	250	610	10
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	44	44	95	95	96	96
Heavy Vehicles, %	79	79	4	4	6	6
Mvmt Flow	23	0	0	263	635	10

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	903	640	645	0	-	0
Stage 1	640	-	-	-	-	-
Stage 2	263	-	-	-	-	-
Critical Hdwy	7.19	6.99	4.14	-	-	-
Critical Hdwy Stg 1	6.19	-	-	-	-	-
Critical Hdwy Stg 2	6.19	-	-	-	-	-
Follow-up Hdwy	4.211	4.011	2.236	-	-	-
Pot Cap-1 Maneuver	228	362	931	-	-	-
Stage 1	404	-	-	-	-	-
Stage 2	632	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	228	362	931	-	-	-
Mov Cap-2 Maneuver	228	-	-	-	-	-
Stage 1	404	-	-	-	-	-
Stage 2	632	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	22.5	0	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	931	-	228	-	-
HCM Lane V/C Ratio	-	-	0.1	-	-
HCM Control Delay (s)	0	-	22.5	-	-
HCM Lane LOS	A	-	C	-	-
HCM 95th %tile Q(veh)	0	-	0.3	-	-

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Traffic Volume (vph)	50	210	0	0	360	10	5	20	140	120	10	0
Future Volume (vph)	50	210	0	0	360	10	5	20	140	120	10	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	150		150	150		150	0		0	150		150
Storage Lanes	0		0	0		0	0		0	0		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt					0.996			0.886				
Flt Protected		0.991						0.998			0.956	
Satd. Flow (prot)	0	1760	0	0	1802	0	0	1647	0	0	1816	0
Flt Permitted		0.991						0.998			0.956	
Satd. Flow (perm)	0	1760	0	0	1802	0	0	1647	0	0	1816	0
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		327			240			246			251	
Travel Time (s)		7.4			5.5			5.6			5.7	
Peak Hour Factor	0.89	0.89	0.89	0.96	0.96	0.96	0.65	0.65	0.65	0.67	0.67	0.67
Heavy Vehicles (%)	7%	7%	7%	5%	5%	5%	2%	2%	2%	0%	0%	0%
Adj. Flow (vph)	56	236	0	0	375	10	8	31	215	179	15	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	292	0	0	385	0	0	254	0	0	194	0
Sign Control		Free			Free			Stop			Stop	

Intersection Summary

Area Type: Other
Control Type: Unsignalized
Intersection Capacity Utilization 63.8% ICU Level of Service B
Analysis Period (min) 15

Intersection	
Int Delay, s/veh	19.7

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations		✥			✥			✥			✥	
Traffic Vol, veh/h	50	210	0	0	360	10	5	20	140	120	10	0
Future Vol, veh/h	50	210	0	0	360	10	5	20	140	120	10	0
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	Yield	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	89	89	89	96	96	96	65	65	65	67	67	67
Heavy Vehicles, %	7	7	7	5	5	5	2	2	2	0	0	0
Mvmt Flow	56	236	0	0	375	10	8	31	215	179	15	0

Major/Minor	Major1			Major2			Minor2			Minor1		
Conflicting Flow All	385	0	0	236	0	0	736	728	380	744	733	236
Stage 1	-	-	-	-	-	-	380	380	-	348	348	-
Stage 2	-	-	-	-	-	-	356	348	-	396	385	-
Critical Hdwy	4.17	-	-	4.15	-	-	7.12	6.52	6.22	7.1	6.5	6.2
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.1	5.5	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.1	5.5	-
Follow-up Hdwy	2.263	-	-	2.245	-	-	3.518	4.018	3.318	3.5	4	3.3
Pot Cap-1 Maneuver	1147	-	-	1314	-	-	335	350	667	333	350	808
Stage 1	-	-	-	-	-	-	642	614	-	672	638	-
Stage 2	-	-	-	-	-	-	661	634	-	633	614	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1147	-	-	1314	-	-	310	330	667	200	330	808
Mov Cap-2 Maneuver	-	-	-	-	-	-	310	330	-	200	330	-
Stage 1	-	-	-	-	-	-	606	614	-	634	602	-
Stage 2	-	-	-	-	-	-	609	598	-	407	614	-

Approach	EB	WB	SE	NW
HCM Control Delay, s	1.6	0	11.8	96.5
HCM LOS			B	F

Minor Lane/Major Mvmt	NWLn1	EBL	EBT	EBR	WBL	WBT	WBR	SELn1
Capacity (veh/h)	206	1147	-	-	1314	-	-	786
HCM Lane V/C Ratio	0.942	0.049	-	-	-	-	-	0.323
HCM Control Delay (s)	96.5	8.3	0	-	0	-	-	11.8
HCM Lane LOS	F	A	A	-	A	-	-	B
HCM 95th %tile Q(veh)	7.8	0.2	-	-	0	-	-	1.4

Movement	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	20	200	120	375	200	0	30	165	20	40	225	595
Future Volume (vph)	20	200	120	375	200	0	30	165	20	40	225	595
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0		6.0	6.0	4.0	6.0	6.0	6.0
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1736	3471	1553	3335	3438		1752	1845	1568	1752	1845	1568
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1736	3471	1553	3335	3438		1752	1845	1568	1752	1845	1568
Peak-hour factor, PHF	0.84	0.84	0.84	0.79	0.79	0.79	0.86	0.86	0.86	0.99	0.99	0.99
Adj. Flow (vph)	24	238	143	475	253	0	35	192	23	40	227	601
RTOR Reduction (vph)	0	0	95	0	0	0	0	0	0	0	0	237
Lane Group Flow (vph)	24	238	48	475	253	0	35	192	23	40	227	364
Heavy Vehicles (%)	4%	4%	4%	5%	5%	5%	3%	3%	3%	3%	3%	3%
Turn Type	Prot	NA	Perm	Prot	NA		Prot	NA	Free	Prot	NA	pt+ov
Protected Phases	5	2		1	6		7	4		3	8	8 1
Permitted Phases		2	2		6			4	Free		8	
Actuated Green, G (s)	14.2	30.5	30.5	16.3	32.6		3.6	15.0	90.0	4.2	15.6	37.9
Effective Green, g (s)	14.2	30.5	30.5	16.3	32.6		3.6	15.0	90.0	4.2	15.6	37.9
Actuated g/C Ratio	0.16	0.34	0.34	0.18	0.36		0.04	0.17	1.00	0.05	0.17	0.42
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	273	1176	526	604	1245		70	307	1568	81	319	660
v/s Ratio Prot	0.01	0.07		c0.14	c0.07		0.02	0.10		c0.02	c0.12	0.23
v/s Ratio Perm			0.03						c0.01			
v/c Ratio	0.09	0.20	0.09	0.79	0.20		0.50	0.63	0.01	0.49	0.71	0.55
Uniform Delay, d1	32.4	21.1	20.3	35.2	19.8		42.3	34.9	0.0	41.9	35.1	19.6
Progression Factor	1.00	1.00	1.00	0.85	0.93		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.6	0.4	0.3	6.4	0.4		5.5	3.9	0.0	4.7	7.3	1.0
Delay (s)	33.0	21.5	20.6	36.4	18.7		47.8	38.8	0.0	46.5	42.4	20.6
Level of Service	C	C	C	D	B		D	D	A	D	D	C
Approach Delay (s)		21.9			30.3			36.5			27.5	
Approach LOS		C			C			D			C	

Intersection Summary

HCM 2000 Control Delay	28.4	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.49		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	24.0
Intersection Capacity Utilization	63.5%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	NWL	NWR	NET	NER	SWL	SWT
Lane Configurations						
Traffic Volume (vph)	170	70	350	310	60	690
Future Volume (vph)	170	70	350	310	60	690
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	180	0		0	180	
Storage Lanes	1	1		1	0	
Taper Length (ft)	25				25	
Lane Util. Factor	1.00	1.00	1.00	1.00	0.95	0.95
Frt		0.850		0.850		
Flt Protected	0.950					0.996
Satd. Flow (prot)	1770	1583	1845	1568	0	3525
Flt Permitted	0.950					0.996
Satd. Flow (perm)	1770	1583	1845	1568	0	3525
Link Speed (mph)	30		30			30
Link Distance (ft)	408		387			233
Travel Time (s)	9.3		8.8			5.3
Peak Hour Factor	0.83	0.83	0.86	0.86	0.81	0.81
Heavy Vehicles (%)	2%	2%	3%	3%	2%	2%
Adj. Flow (vph)	205	84	407	360	74	852
Shared Lane Traffic (%)						
Lane Group Flow (vph)	205	84	407	360	0	926
Sign Control	Stop		Free			Free

Intersection Summary	
Area Type: Other	
Control Type: Unsignalized	
Intersection Capacity Utilization 58.7%	ICU Level of Service B
Analysis Period (min) 15	

Intersection	
Int Delay, s/veh	9.2

Movement	NWL	NWR	NET	NER	SWL	SWT
Lane Configurations	↰	↱	↑	↱		↰↑
Traffic Vol, veh/h	170	70	350	310	60	690
Future Vol, veh/h	170	70	350	310	60	690
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	Yield	-	None
Storage Length	180	0	-	0	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	83	83	86	86	81	81
Heavy Vehicles, %	2	2	3	3	2	2
Mvmt Flow	205	84	407	360	74	852

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	981	407	0	0	407	0
Stage 1	407	-	-	-	-	-
Stage 2	574	-	-	-	-	-
Critical Hdwy	6.63	6.23	-	-	4.13	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.83	-	-	-	-	-
Follow-up Hdwy	3.519	3.319	-	-	2.219	-
Pot Cap-1 Maneuver	261	643	-	-	1150	-
Stage 1	671	-	-	-	-	-
Stage 2	528	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	229	643	-	-	1150	-
Mov Cap-2 Maneuver	229	-	-	-	-	-
Stage 1	589	-	-	-	-	-
Stage 2	528	-	-	-	-	-

Approach	NW	NE	SW
HCM Control Delay, s	60	0	1
HCM LOS	F		

Minor Lane/Major Mvmt	NET	NER	NWLn1	NWLn2	SWL	SWT
Capacity (veh/h)	-	-	229	643	1150	-
HCM Lane V/C Ratio	-	-	0.894	0.131	0.064	-
HCM Control Delay (s)	-	-	80	11.4	8.3	0.4
HCM Lane LOS	-	-	F	B	A	A
HCM 95th %tile Q(veh)	-	-	7.4	0.5	0.2	-

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations	↰	↑↱		↰	↑↱			↰	↱		↰	↱
Traffic Volume (vph)	10	790	0	0	680	30	5	0	5	10	0	70
Future Volume (vph)	10	790	0	0	680	30	5	0	5	10	0	70
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0			6.0			6.0	6.0		6.0	6.0
Lane Util. Factor	1.00	0.95			0.95			1.00	1.00		1.00	1.00
Frt	1.00	1.00			0.99			1.00	0.85		1.00	0.85
Flt Protected	0.95	1.00			1.00			0.95	1.00		0.95	1.00
Satd. Flow (prot)	1687	3374			3517			1805	1615		1787	1599
Flt Permitted	0.95	1.00			1.00			0.75	1.00		0.75	1.00
Satd. Flow (perm)	1687	3374			3517			1434	1615		1420	1599
Peak-hour factor, PHF	0.83	0.83	0.83	0.92	0.92	0.92	0.50	0.50	0.50	0.90	0.90	0.90
Adj. Flow (vph)	12	952	0	0	739	33	10	0	10	11	0	78
RTOR Reduction (vph)	0	0	0	0	2	0	0	0	9	0	0	73
Lane Group Flow (vph)	12	952	0	0	770	0	0	10	1	0	11	5
Heavy Vehicles (%)	7%	7%	7%	2%	2%	2%	0%	0%	0%	1%	1%	1%
Turn Type	Prot	NA		Prot	NA		Perm	NA	Perm	Perm	NA	Perm
Protected Phases	5	2		1	6			8			4	
Permitted Phases					6		8	8	8	4		4
Actuated Green, G (s)	1.6	72.7			65.1			5.3	5.3		5.3	5.3
Effective Green, g (s)	1.6	72.7			65.1			5.3	5.3		5.3	5.3
Actuated g/C Ratio	0.02	0.81			0.72			0.06	0.06		0.06	0.06
Clearance Time (s)	6.0	6.0			6.0			6.0	6.0		6.0	6.0
Vehicle Extension (s)	3.0	3.0			3.0			3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	29	2725			2543			84	95		83	94
v/s Ratio Prot	0.01	c0.28			0.22							
v/s Ratio Perm								0.01	0.00		c0.01	0.00
v/c Ratio	0.41	0.35			0.30			0.12	0.01		0.13	0.05
Uniform Delay, d1	43.7	2.3			4.4			40.1	39.9		40.2	40.0
Progression Factor	1.17	0.94			1.23			1.00	1.00		1.00	1.00
Incremental Delay, d2	8.1	0.3			0.1			0.6	0.0		0.7	0.2
Delay (s)	59.4	2.5			5.5			40.8	39.9		40.9	40.2
Level of Service	E	A			A			D	D		D	D
Approach Delay (s)		3.2			5.5			40.3			40.3	
Approach LOS		A			A			D			D	

Intersection Summary			
HCM 2000 Control Delay	6.3	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.36		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	45.2%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑	↱	↰↰	↑↱		↰	↑↑	↱↱	↰	↑↑	↱
Traffic Volume (vph)	40	140	100	630	230	20	100	500	730	20	420	140
Future Volume (vph)	40	140	100	630	230	20	100	500	730	20	420	140
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0		6.0	6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	0.97	0.95		1.00	0.95	0.88	1.00	0.95	1.00
Frt	1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1703	1792	1524	3367	3429		1805	3610	2842	1752	3505	1568
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1703	1792	1524	3367	3429		1805	3610	2842	1752	3505	1568
Peak-hour factor, PHF	0.83	0.83	0.83	0.97	0.97	0.97	0.67	0.67	0.67	0.90	0.90	0.90
Adj. Flow (vph)	48	169	120	649	237	21	149	746	1090	22	467	156
RTOR Reduction (vph)	0	0	79	0	7	0	0	0	338	0	0	107
Lane Group Flow (vph)	48	169	41	649	251	0	149	746	752	22	467	49
Heavy Vehicles (%)	6%	6%	6%	4%	4%	4%	0%	0%	0%	3%	3%	3%
Turn Type	Prot	NA	pm+ov	Prot	NA		Prot	NA	pm+ov	Prot	NA	pm+ov
Protected Phases	5	2	3	1	6		3	8	1	7	4	5
Permitted Phases			2						8		4	4
Actuated Green, G (s)	8.8	14.0	25.0	21.6	26.8		11.0	28.0	49.6	2.4	19.4	28.2
Effective Green, g (s)	8.8	14.0	25.0	21.6	26.8		11.0	28.0	49.6	2.4	19.4	28.2
Actuated g/C Ratio	0.10	0.16	0.28	0.24	0.30		0.12	0.31	0.55	0.03	0.22	0.31
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0		6.0	6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	166	278	524	808	1021		220	1123	1755	46	755	595
v/s Ratio Prot	0.03	c0.09	0.01	c0.19	0.07		c0.08	c0.21	0.10	0.01	0.13	0.01
v/s Ratio Perm			0.02						0.16			0.02
v/c Ratio	0.29	0.61	0.08	0.80	0.25		0.68	0.66	0.43	0.48	0.62	0.08
Uniform Delay, d1	37.7	35.4	24.0	32.2	23.9		37.8	26.9	11.9	43.2	32.0	21.8
Progression Factor	1.00	1.00	1.00	1.00	0.89		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.0	9.5	0.1	5.7	0.1		8.0	1.5	0.2	7.6	1.5	0.1
Delay (s)	38.7	45.0	24.1	38.0	21.5		45.8	28.4	12.0	50.8	33.5	21.8
Level of Service	D	D	C	D	C		D	C	B	D	C	C
Approach Delay (s)		36.6			33.3			20.7			31.2	
Approach LOS		D			C			C			C	

Intersection Summary			
HCM 2000 Control Delay	26.8	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.73		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	24.0
Intersection Capacity Utilization	63.3%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	20	190	310	10	40	40
Future Volume (vph)	20	190	310	10	40	40
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	140			0	0	0
Storage Lanes	1			0	1	0
Taper Length (ft)	25				25	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.996		0.932	
Flt Protected	0.950				0.976	
Satd. Flow (prot)	1687	1776	1820	0	1630	0
Flt Permitted	0.950				0.976	
Satd. Flow (perm)	1687	1776	1820	0	1630	0
Link Speed (mph)		30	30		30	
Link Distance (ft)		535	210		522	
Travel Time (s)		12.2	4.8		11.9	
Peak Hour Factor	0.84	0.84	0.89	0.89	0.83	0.83
Heavy Vehicles (%)	7%	7%	4%	4%	6%	6%
Adj. Flow (vph)	24	226	348	11	48	48
Shared Lane Traffic (%)						
Lane Group Flow (vph)	24	226	359	0	96	0
Sign Control		Free	Free		Stop	

Intersection Summary

Area Type: Other
Control Type: Unsignalized
Intersection Capacity Utilization 28.3% ICU Level of Service A
Analysis Period (min) 15

Intersection	
Int Delay, s/veh	2.1

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↰	↑	↱		Y	
Traffic Vol, veh/h	20	190	310	10	40	40
Future Vol, veh/h	20	190	310	10	40	40
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	140	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	84	84	89	89	83	83
Heavy Vehicles, %	7	7	4	4	6	6
Mvmt Flow	24	226	348	11	48	48

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	359	0	-	0	628	354
Stage 1	-	-	-	-	354	-
Stage 2	-	-	-	-	274	-
Critical Hdwy	4.17	-	-	-	6.46	6.26
Critical Hdwy Stg 1	-	-	-	-	5.46	-
Critical Hdwy Stg 2	-	-	-	-	5.46	-
Follow-up Hdwy	2.263	-	-	-	3.554	3.354
Pot Cap-1 Maneuver	1172	-	-	-	440	681
Stage 1	-	-	-	-	702	-
Stage 2	-	-	-	-	763	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1172	-	-	-	431	681
Mov Cap-2 Maneuver	-	-	-	-	431	-
Stage 1	-	-	-	-	688	-
Stage 2	-	-	-	-	763	-

Approach	EB	WB	SB
HCM Control Delay, s	0.8	0	13.3
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1172	-	-	-	528
HCM Lane V/C Ratio	0.02	-	-	-	0.183
HCM Control Delay (s)	8.1	-	-	-	13.3
HCM Lane LOS	A	-	-	-	B
HCM 95th %tile Q(veh)	0.1	-	-	-	0.7

Lane Group	WBL2	WBL	WBR	WBR2	NBL	NBT	NBR	NBR2	SBL2	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	10	170	360	20	20	110	110	10	10	110	140	40
Future Volume (vph)	10	170	360	20	20	110	110	10	10	110	140	40
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)		0	150		0		150			0		0
Storage Lanes		1	0		0		0			0		0
Taper Length (ft)		25			25					25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.908				0.935					0.982	
Flt Protected		0.984				0.996					0.980	
Satd. Flow (prot)	0	1648	0	0	0	1718	0	0	0	0	1709	0
Flt Permitted		0.984				0.996					0.980	
Satd. Flow (perm)	0	1648	0	0	0	1718	0	0	0	0	1709	0
Link Speed (mph)		30				30					30	
Link Distance (ft)		465				456					371	
Travel Time (s)		10.6				10.4					8.4	
Peak Hour Factor	0.91	0.91	0.91	0.91	0.86	0.86	0.86	0.86	0.80	0.80	0.80	0.80
Heavy Vehicles (%)	3%	3%	3%	3%	3%	3%	3%	3%	7%	7%	7%	7%
Adj. Flow (vph)	11	187	396	22	23	128	128	12	13	138	175	50
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	616	0	0	0	291	0	0	0	0	376	0
Sign Control		Yield				Yield					Yield	

Intersection Summary	
Area Type: Other	
Control Type: Roundabout	
Intersection Capacity Utilization 100.5%	ICU Level of Service G
Analysis Period (min) 15	

Lane Group	NEL	NET	NER	NER2	SWL2	SWL	SWT	SWR
Lane Configurations		✣					✣	
Traffic Volume (vph)	50	60	110	100	5	30	120	10
Future Volume (vph)	50	60	110	100	5	30	120	10
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		150			150		0
Storage Lanes	0		0			0		0
Taper Length (ft)	25					25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.911					0.992	
Flt Protected		0.992					0.990	
Satd. Flow (prot)	0	1590	0	0	0	0	1744	0
Flt Permitted		0.992					0.990	
Satd. Flow (perm)	0	1590	0	0	0	0	1744	0
Link Speed (mph)		30					30	
Link Distance (ft)		400					530	
Travel Time (s)		9.1					12.0	
Peak Hour Factor	0.60	0.60	0.60	0.60	0.83	0.83	0.83	0.83
Heavy Vehicles (%)	8%	8%	8%	8%	7%	7%	7%	7%
Adj. Flow (vph)	83	100	183	167	6	36	145	12
Shared Lane Traffic (%)								
Lane Group Flow (vph)	0	533	0	0	0	0	199	0
Sign Control		Yield					Yield	

Intersection Summary

Intersection	
Intersection Delay, s/veh	14.9
Intersection LOS	B

Approach	WB	NB	SB	NE	SW
Entry Lanes	1	1	1	1	1
Conflicting Circle Lanes	1	1	1	1	1
Adj Approach Flow, veh/h	616	291	376	533	199
Demand Flow Rate, veh/h	635	300	403	576	213
Vehicles Circulating, veh/h	500	564	428	405	858
Vehicles Exiting, veh/h	364	417	643	426	277
Ped Vol Crossing Leg, #/h	0	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000	1.000
Approach Delay, s/veh	21.4	9.7	10.1	14.4	12.5
Approach LOS	C	A	B	B	B

Lane	Left	Left	Left	Left	Left
Designated Moves	LR	LTR	LTR	LTR	LTR
Assumed Moves	LR	LTR	LTR	LTR	LTR
RT Channelized					
Lane Util	1.000	1.000	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976	4.976	4.976
Entry Flow, veh/h	635	300	403	576	213
Cap Entry Lane, veh/h	829	776	892	913	575
Entry HV Adj Factor	0.970	0.971	0.933	0.925	0.932
Flow Entry, veh/h	616	291	376	533	198
Cap Entry, veh/h	803	753	832	845	536
V/C Ratio	0.766	0.386	0.452	0.631	0.370
Control Delay, s/veh	21.4	9.7	10.1	14.4	12.5
LOS	C	A	B	B	B
95th %tile Queue, veh	7	2	2	5	2

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	10	20	200	10	40	50	375	150	5	10	90	20
Future Volume (vph)	10	20	200	10	40	50	375	150	5	10	90	20
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		50	0		0	0		0	0		0
Storage Lanes	0		1	0		0	0		0	0		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850		0.932			0.999			0.978	
Flt Protected		0.984			0.995			0.966			0.996	
Satd. Flow (prot)	0	1731	1495	0	1678	0	0	1780	0	0	1780	0
Flt Permitted		0.984			0.995			0.966			0.996	
Satd. Flow (perm)	0	1731	1495	0	1678	0	0	1780	0	0	1780	0
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		162			453			475			436	
Travel Time (s)		3.7			10.3			10.8			9.9	
Peak Hour Factor	0.82	0.82	0.82	0.70	0.70	0.70	0.75	0.75	0.75	0.71	0.71	0.71
Heavy Vehicles (%)	8%	8%	8%	5%	5%	5%	3%	3%	3%	4%	4%	4%
Adj. Flow (vph)	12	24	244	14	57	71	500	200	7	14	127	28
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	36	244	0	142	0	0	707	0	0	169	0
Sign Control		Stop			Stop			Free			Free	

Intersection Summary	
Area Type: Other	
Control Type: Unsignalized	
Intersection Capacity Utilization 54.7%	ICU Level of Service A
Analysis Period (min) 15	

Intersection	
Int Delay, s/veh	30.7

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	10	20	200	10	40	50	375	150	5	10	90	20
Future Vol, veh/h	10	20	200	10	40	50	375	150	5	10	90	20
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	50	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	82	82	82	70	70	70	75	75	75	71	71	71
Heavy Vehicles, %	8	8	8	5	5	5	3	3	3	4	4	4
Mvmt Flow	12	24	244	14	57	71	500	200	7	14	127	28

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1437	1376	141	1507	1387	204	155	0	0	207	0	0
Stage 1	169	169	-	1204	1204	-	-	-	-	-	-	-
Stage 2	1268	1207	-	303	183	-	-	-	-	-	-	-
Critical Hdwy	7.18	6.58	6.28	7.15	6.55	6.25	4.13	-	-	4.14	-	-
Critical Hdwy Stg 1	6.18	5.58	-	6.15	5.55	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.18	5.58	-	6.15	5.55	-	-	-	-	-	-	-
Follow-up Hdwy	3.572	4.072	3.372	3.545	4.045	3.345	2.227	-	-	2.236	-	-
Pot Cap-1 Maneuver	108	141	891	98	141	829	1419	-	-	1352	-	-
Stage 1	819	747	-	222	254	-	-	-	-	-	-	-
Stage 2	201	250	-	700	743	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	32	84	891	39	84	829	1419	-	-	1352	-	-
Mov Cap-2 Maneuver	32	84	-	39	84	-	-	-	-	-	-	-
Stage 1	493	739	-	134	153	-	-	-	-	-	-	-
Stage 2	69	151	-	486	735	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	30	188.1	6.3	0.6
HCM LOS	D	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1419	-	-	54	891	126	1352	-	-
HCM Lane V/C Ratio	0.352	-	-	0.678	0.274	1.134	0.01	-	-
HCM Control Delay (s)	8.9	0	-	159.1	10.6	188.1	7.7	0	-
HCM Lane LOS	A	A	-	F	B	F	A	A	-
HCM 95th %tile Q(veh)	1.6	-	-	2.8	1.1	8.4	0	-	-

Movement	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	30	50	20	20	40	100	10	140	70	65	330	65
Future Volume (vph)	30	50	20	20	40	100	10	140	70	65	330	65
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	0.96		1.00	1.00	0.85	1.00	0.95		1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1752	1767		1736	1827	1553	1770	1770		1787	1835	
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1752	1767		1736	1827	1553	1770	1770		1787	1835	
Peak-hour factor, PHF	0.82	0.82	0.82	0.81	0.81	0.81	0.68	0.68	0.68	0.78	0.78	0.78
Adj. Flow (vph)	37	61	24	25	49	123	15	206	103	83	423	83
RTOR Reduction (vph)	0	15	0	0	0	73	0	23	0	0	9	0
Lane Group Flow (vph)	37	70	0	25	49	50	15	286	0	83	497	0
Heavy Vehicles (%)	3%	3%	3%	4%	4%	4%	2%	2%	2%	1%	1%	1%
Turn Type	Prot	NA		Prot	NA	pt+ov	Prot	NA		Prot	NA	
Protected Phases	1	6		5	2	2 3	3	8		7	4	
Permitted Phases												
Actuated Green, G (s)	4.8	22.0		3.2	20.4	32.8	6.4	23.8		7.0	24.4	
Effective Green, g (s)	4.8	22.0		3.2	20.4	32.8	6.4	23.8		7.0	24.4	
Actuated g/C Ratio	0.06	0.28		0.04	0.25	0.41	0.08	0.30		0.09	0.30	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	105	485		69	465	636	141	526		156	559	
v/s Ratio Prot	c0.02	c0.04		0.01	0.03	0.03	0.01	0.16		c0.05	c0.27	
v/s Ratio Perm												
v/c Ratio	0.35	0.14		0.36	0.11	0.08	0.11	0.54		0.53	0.89	
Uniform Delay, d1	36.1	21.9		37.4	22.8	14.4	34.1	23.5		34.9	26.5	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	2.0	0.1		3.2	0.5	0.1	0.3	1.2		3.5	15.8	
Delay (s)	38.1	22.0		40.6	23.3	14.4	34.5	24.7		38.4	42.3	
Level of Service	D	C		D	C	B	C	C		D	D	
Approach Delay (s)		26.9			20.0			25.1			41.8	
Approach LOS		C			B			C			D	

Intersection Summary			
HCM 2000 Control Delay	32.4	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.54		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	24.0
Intersection Capacity Utilization	51.3%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	510	10	20	70	140	600
Future Volume (vph)	510	10	20	70	140	600
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0		6.0	6.0	6.0	6.0
Lane Util. Factor	1.00		1.00	1.00	1.00	1.00
Frt	1.00		1.00	1.00	1.00	0.85
Flt Protected	0.95		0.95	1.00	1.00	1.00
Satd. Flow (prot)	1771		1626	1712	1863	1583
Flt Permitted	0.95		0.63	1.00	1.00	1.00
Satd. Flow (perm)	1771		1078	1712	1863	1583
Peak-hour factor, PHF	0.94	0.94	0.91	0.91	0.82	0.82
Adj. Flow (vph)	543	11	22	77	171	732
RTOR Reduction (vph)	1	0	0	0	0	180
Lane Group Flow (vph)	553	0	22	77	171	552
Heavy Vehicles (%)	2%	2%	11%	11%	2%	2%
Turn Type	Prot		pm+pt	NA	NA	custom
Protected Phases	8		1	6 7	2 7	7 8
Permitted Phases			6 7			2
Actuated Green, G (s)	30.6		32.3	30.6	29.7	60.3
Effective Green, g (s)	30.6		32.3	30.6	29.7	60.3
Actuated g/C Ratio	0.38		0.40	0.38	0.37	0.75
Clearance Time (s)	6.0		6.0			
Vehicle Extension (s)	3.0		3.0			
Lane Grp Cap (vph)	677		446	654	691	1311
v/s Ratio Prot	c0.31		c0.00	0.04	0.09	c0.23
v/s Ratio Perm			0.02			0.11
v/c Ratio	0.82		0.05	0.12	0.25	0.42
Uniform Delay, d1	22.2		14.4	16.0	17.4	3.6
Progression Factor	1.00		1.00	1.00	1.12	0.87
Incremental Delay, d2	7.6		0.0	0.1	0.2	0.2
Delay (s)	29.8		14.5	16.1	19.6	3.3
Level of Service	C		B	B	B	A
Approach Delay (s)	29.8			15.7	6.4	
Approach LOS	C			B	A	

Intersection Summary			
HCM 2000 Control Delay	15.3	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.70		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	24.0
Intersection Capacity Utilization	55.4%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	ㄱㄱ				ㄱㄱ	
Traffic Volume (vph)	1135	0	0	0	1770	0
Future Volume (vph)	1135	0	0	0	1770	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0				6.0	
Lane Util. Factor	0.97				0.97	
Frt	1.00				1.00	
Flt Protected	0.95				0.95	
Satd. Flow (prot)	3433				3433	
Flt Permitted	0.95				0.95	
Satd. Flow (perm)	3433				3433	
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	1207	0	0	0	1883	0
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	1207	0	0	0	1883	0
Turn Type	Prot				Prot	
Protected Phases	2				4	
Permitted Phases						
Actuated Green, G (s)	31.0				47.0	
Effective Green, g (s)	31.0				47.0	
Actuated g/C Ratio	0.34				0.52	
Clearance Time (s)	6.0				6.0	
Vehicle Extension (s)	3.0				3.0	
Lane Grp Cap (vph)	1182				1792	
v/s Ratio Prot	c0.35				c0.55	
v/s Ratio Perm						
v/c Ratio	1.02				1.05	
Uniform Delay, d1	29.5				21.5	
Progression Factor	0.53				1.00	
Incremental Delay, d2	28.7				36.0	
Delay (s)	44.3				57.5	
Level of Service	D				E	
Approach Delay (s)	44.3		0.0			57.5
Approach LOS	D		A			E

Intersection Summary			
HCM 2000 Control Delay	52.3	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	1.04		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	143.4%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SBL	SBR	NWL	NWR
Lane Configurations										
Traffic Volume (vph)	0	1770	0	0	1135	1205	0	0	0	865
Future Volume (vph)	0	1770	0	0	1135	1205	0	0	0	865
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0			6.0	6.0			6.0	6.0
Lane Util. Factor		0.95			0.95	0.88			1.00	0.95
Frt		1.00			1.00	0.85			0.85	0.85
Flt Protected		1.00			1.00	1.00			1.00	1.00
Satd. Flow (prot)		3539			3539	2787			1583	1504
Flt Permitted		1.00			1.00	1.00			1.00	1.00
Satd. Flow (perm)		3539			3539	2787			1583	1504
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	0	1883	0	0	1207	1282	0	0	0	920
RTOR Reduction (vph)	0	0	0	0	0	16	0	0	0	0
Lane Group Flow (vph)	0	1883	0	0	1207	1266	0	0	460	460
Turn Type	Perm	NA			NA	Perm			Prot	Prot
Protected Phases		2			2				4	4
Permitted Phases	2					2				
Actuated Green, G (s)		50.0			50.0	50.0			28.0	28.0
Effective Green, g (s)		50.0			50.0	50.0			28.0	28.0
Actuated g/C Ratio		0.56			0.56	0.56			0.31	0.31
Clearance Time (s)		6.0			6.0	6.0			6.0	6.0
Vehicle Extension (s)		3.0			3.0	3.0			3.0	3.0
Lane Grp Cap (vph)		1966			1966	1548			492	467
v/s Ratio Prot		c0.53			0.34				0.29	c0.31
v/s Ratio Perm						0.45				
v/c Ratio		0.96			0.61	0.82			0.93	0.99
Uniform Delay, d1		19.0			13.5	16.3			30.1	30.8
Progression Factor		1.13			1.00	1.00			1.00	1.00
Incremental Delay, d2		1.7			1.4	4.9			25.1	37.4
Delay (s)		23.1			14.9	21.2			55.2	68.2
Level of Service		C			B	C			E	E
Approach Delay (s)		23.1			18.2		0.0		61.7	
Approach LOS		C			B		A		E	

Intersection Summary			
HCM 2000 Control Delay	27.5	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.97		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	129.2%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↱		↰	↑↱		↰	↑↱		↰	↑	↱
Traffic Volume (vph)	100	380	10	10	390	10	20	50	10	10	60	100
Future Volume (vph)	100	380	10	10	390	10	20	50	10	10	60	100
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	6.0
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00		1.00	1.00		1.00	0.97		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1770	1855		1770	1856		1770	1815		1770	1863	1583
Flt Permitted	0.29	1.00		0.42	1.00		0.71	1.00		0.71	1.00	1.00
Satd. Flow (perm)	540	1855		789	1856		1331	1815		1331	1863	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	109	413	11	11	424	11	22	54	11	11	65	109
RTOR Reduction (vph)	0	1	0	0	1	0	0	7	0	0	0	66
Lane Group Flow (vph)	109	423	0	11	434	0	22	58	0	11	65	43
Turn Type	pm+pt	NA		pm+pt	NA		Perm	NA		Perm	NA	pm+ov
Protected Phases	7	4		3	8			2			6	7
Permitted Phases	4			8			2			6		6
Actuated Green, G (s)	29.0	25.3		23.4	22.5		22.6	22.6		22.6	22.6	26.3
Effective Green, g (s)	29.0	25.3		23.4	22.5		22.6	22.6		22.6	22.6	26.3
Actuated g/C Ratio	0.43	0.38		0.35	0.34		0.34	0.34		0.34	0.34	0.39
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	302	702		289	625		450	614		450	630	765
v/s Ratio Prot	c0.02	c0.23		0.00	c0.23			0.03			c0.03	0.00
v/s Ratio Perm	0.14			0.01			0.02			0.01		0.02
v/c Ratio	0.36	0.60		0.04	0.69		0.05	0.09		0.02	0.10	0.06
Uniform Delay, d1	12.4	16.7		14.3	19.2		14.9	15.1		14.7	15.2	12.6
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	0.7	1.5		0.1	3.3		0.2	0.3		0.1	0.3	0.0
Delay (s)	13.1	18.2		14.4	22.5		15.1	15.4		14.8	15.5	12.6
Level of Service	B	B		B	C		B	B		B	B	B
Approach Delay (s)		17.1			22.3			15.3			13.7	
Approach LOS		B			C			B			B	

Intersection Summary			
HCM 2000 Control Delay	18.4	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.40		
Actuated Cycle Length (s)	66.8	Sum of lost time (s)	18.0
Intersection Capacity Utilization	49.4%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	360	10	250	370	10	160
Future Volume (vph)	360	10	250	370	10	160
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)		0	0		0	80
Storage Lanes		0	0		1	1
Taper Length (ft)			25		25	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.996					0.850
Flt Protected				0.980	0.950	
Satd. Flow (prot)	1855	0	0	1825	1770	1583
Flt Permitted				0.980	0.950	
Satd. Flow (perm)	1855	0	0	1825	1770	1583
Link Speed (mph)	30			30	30	
Link Distance (ft)	354			472	168	
Travel Time (s)	8.0			10.7	3.8	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	391	11	272	402	11	174
Shared Lane Traffic (%)						
Lane Group Flow (vph)	402	0	0	674	11	174
Sign Control	Free			Free	Stop	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 66.2% ICU Level of Service C

Analysis Period (min) 15

Intersection	
Int Delay, s/veh	4

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	360	10	250	370	10	160
Future Vol, veh/h	360	10	250	370	10	160
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	80
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	391	11	272	402	11	174

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	402	0	1343	397
Stage 1	-	-	-	-	397	-
Stage 2	-	-	-	-	946	-
Critical Hdwy	-	-	4.12	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	1157	-	168	652
Stage 1	-	-	-	-	679	-
Stage 2	-	-	-	-	377	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1157	-	117	652
Mov Cap-2 Maneuver	-	-	-	-	117	-
Stage 1	-	-	-	-	473	-
Stage 2	-	-	-	-	377	-

Approach	EB	WB	NB
HCM Control Delay, s	0	3.7	14.1
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	117	652	-	-	1157	-
HCM Lane V/C Ratio	0.093	0.267	-	-	0.235	-
HCM Control Delay (s)	38.9	12.5	-	-	9.1	0
HCM Lane LOS	E	B	-	-	A	A
HCM 95th %tile Q(veh)	0.3	1.1	-	-	0.9	-

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	90	10	540	40	10	650
Future Volume (vph)	90	10	540	40	10	650
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0		6.0	6.0	6.0	6.0
Lane Util. Factor	1.00		1.00	1.00	1.00	1.00
Frt	0.98		1.00	0.85	1.00	1.00
Flt Protected	0.96		1.00	1.00	0.95	1.00
Satd. Flow (prot)	1774		1900	1615	1805	1900
Flt Permitted	0.96		1.00	1.00	0.26	1.00
Satd. Flow (perm)	1774		1900	1615	487	1900
Peak-hour factor, PHF	0.87	0.67	0.95	0.84	0.73	0.96
Adj. Flow (vph)	103	15	568	48	14	677
RTOR Reduction (vph)	5	0	0	16	0	0
Lane Group Flow (vph)	113	0	568	32	14	677
Heavy Vehicles (%)	1%	0%	0%	0%	0%	0%
Turn Type	Prot		NA	Perm	custom	NA
Protected Phases	7		6 8		5	2 8
Permitted Phases				6 8	2	
Actuated Green, G (s)	8.1		47.1	47.1	16.4	46.2
Effective Green, g (s)	8.1		47.1	47.1	16.4	46.2
Actuated g/C Ratio	0.10		0.59	0.59	0.20	0.58
Clearance Time (s)	6.0				6.0	
Vehicle Extension (s)	3.0				3.0	
Lane Grp Cap (vph)	179		1118	950	113	1097
v/s Ratio Prot	c0.06		0.30		c0.00	c0.36
v/s Ratio Perm				0.02	0.02	
v/c Ratio	0.63		0.51	0.03	0.12	0.62
Uniform Delay, d1	34.5		9.7	6.9	25.9	11.1
Progression Factor	1.00		0.33	0.53	1.00	1.00
Incremental Delay, d2	6.8		0.3	0.0	0.5	1.0
Delay (s)	41.3		3.5	3.7	26.4	12.1
Level of Service	D		A	A	C	B
Approach Delay (s)	41.3		3.5			12.4
Approach LOS	D		A			B

Intersection Summary			
HCM 2000 Control Delay	11.0	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.60		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	24.0
Intersection Capacity Utilization	49.8%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	10	30	20	530	630	20
Future Volume (vph)	10	30	20	530	630	20
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0	0	100			0
Storage Lanes	1	0	1			0
Taper Length (ft)	25		25			
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.904				0.994	
Flt Protected	0.986		0.950			
Satd. Flow (prot)	1694	0	1787	1900	1871	0
Flt Permitted	0.986		0.950			
Satd. Flow (perm)	1694	0	1787	1900	1871	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	332			288	365	
Travel Time (s)	7.5			6.5	8.3	
Peak Hour Factor	0.64	0.77	0.71	0.90	0.75	0.55
Heavy Vehicles (%)	0%	0%	1%	0%	1%	0%
Adj. Flow (vph)	16	39	28	589	840	36
Shared Lane Traffic (%)						
Lane Group Flow (vph)	55	0	28	589	876	0
Sign Control	Stop			Free	Free	

Intersection Summary	
Area Type:	Other
Control Type: Unsignalized	
Intersection Capacity Utilization 44.4%	ICU Level of Service A
Analysis Period (min) 15	

Intersection	
Int Delay, s/veh	1

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	10	30	20	530	630	20
Future Vol, veh/h	10	30	20	530	630	20
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	100	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	64	77	71	90	75	55
Heavy Vehicles, %	0	0	1	0	1	0
Mvmt Flow	16	39	28	589	840	36

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1503	858	876	0	-	0
Stage 1	858	-	-	-	-	-
Stage 2	645	-	-	-	-	-
Critical Hdwy	6.4	6.2	4.11	-	-	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.3	2.209	-	-	-
Pot Cap-1 Maneuver	135	359	775	-	-	-
Stage 1	419	-	-	-	-	-
Stage 2	526	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	130	359	775	-	-	-
Mov Cap-2 Maneuver	130	-	-	-	-	-
Stage 1	404	-	-	-	-	-
Stage 2	526	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	24.5	0.4	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	775	-	239	-	-
HCM Lane V/C Ratio	0.036	-	0.228	-	-
HCM Control Delay (s)	9.8	-	24.5	-	-
HCM Lane LOS	A	-	C	-	-
HCM 95th %tile Q(veh)	0.1	-	0.9	-	-

APPENDIX P-2: 2040 ALTERNATIVE B INTERSECTION CAPACITY ANALYSES – HCM 2000 PRINOUTS – PM PEAK HOUR

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑↑		↰	↱↱
Traffic Volume (vph)	0	1180	1385	0	390	1300
Future Volume (vph)	0	1180	1385	0	390	1300
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	16	12
Total Lost time (s)		6.0	6.0		6.0	6.0
Lane Util. Factor		0.95	0.95		1.00	0.88
Frt		1.00	1.00		1.00	0.85
Flt Protected		1.00	1.00		0.95	1.00
Satd. Flow (prot)		3471	3406		1930	2682
Flt Permitted		1.00	1.00		0.95	1.00
Satd. Flow (perm)		3471	3406		1930	2682
Peak-hour factor, PHF	0.93	0.93	0.88	0.88	0.89	0.89
Adj. Flow (vph)	0	1269	1574	0	438	1461
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	1269	1574	0	438	1461
Heavy Vehicles (%)	4%	4%	6%	6%	6%	6%
Turn Type		NA	NA		Prot	Prot
Protected Phases		2	6		4	4
Permitted Phases						
Actuated Green, G (s)		64.0	64.0		74.0	74.0
Effective Green, g (s)		64.0	64.0		74.0	74.0
Actuated g/C Ratio		0.43	0.43		0.49	0.49
Clearance Time (s)		6.0	6.0		6.0	6.0
Vehicle Extension (s)		3.0	3.0		3.0	3.0
Lane Grp Cap (vph)		1480	1453		952	1323
v/s Ratio Prot		0.37	c0.46		0.23	c0.54
v/s Ratio Perm						
v/c Ratio		0.86	1.08		0.46	1.10
Uniform Delay, d1		38.9	43.0		24.9	38.0
Progression Factor		0.68	0.04		1.00	1.00
Incremental Delay, d2		4.6	38.9		0.4	58.5
Delay (s)		31.0	40.7		25.3	96.5
Level of Service		C	D		C	F
Approach Delay (s)		31.0	40.7		80.1	
Approach LOS		C	D		F	

Intersection Summary			
HCM 2000 Control Delay	53.9	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	1.09		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	95.8%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Movement	NBL2	NBL	NBR	SEL	SER	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations											
Traffic Volume (vph)	1345	0	750	0	0	1140	430	0	0	310	330
Future Volume (vph)	1345	0	750	0	0	1140	430	0	0	310	330
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0		6.0			6.0	6.0			6.0	4.0
Lane Util. Factor	0.97		0.88			0.97	0.95			0.95	1.00
Frt	1.00		0.85			1.00	1.00			1.00	0.85
Flt Protected	0.95		1.00			0.95	1.00			1.00	1.00
Satd. Flow (prot)	3242		2632			3335	3438			3505	1568
Flt Permitted	0.95		1.00			0.95	1.00			1.00	1.00
Satd. Flow (perm)	3242		2632			3335	3438			3505	1568
Peak-hour factor, PHF	0.88	0.88	0.88	0.92	0.92	0.94	0.94	0.94	0.92	0.92	0.92
Adj. Flow (vph)	1528	0	852	0	0	1213	457	0	0	337	359
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	1528	0	852	0	0	1213	457	0	0	337	359
Heavy Vehicles (%)	8%	8%	8%	2%	2%	5%	5%	5%	3%	3%	3%
Turn Type	Prot		Prot			Prot	NA			NA	Free
Protected Phases	8		8			5	2			6	
Permitted Phases											Free
Actuated Green, G (s)	60.0		60.0			46.0	78.0			26.0	150.0
Effective Green, g (s)	60.0		60.0			46.0	78.0			26.0	150.0
Actuated g/C Ratio	0.40		0.40			0.31	0.52			0.17	1.00
Clearance Time (s)	6.0		6.0			6.0	6.0			6.0	
Vehicle Extension (s)	3.0		3.0			3.0	3.0			3.0	
Lane Grp Cap (vph)	1296		1052			1022	1787			607	1568
v/s Ratio Prot	c0.47		0.32			c0.36	0.13			c0.10	
v/s Ratio Perm											0.23
v/c Ratio	1.18		0.81			1.19	0.26			0.56	0.23
Uniform Delay, d1	45.0		39.9			52.0	19.9			56.7	0.0
Progression Factor	1.00		1.00			0.65	0.40			1.00	1.00
Incremental Delay, d2	88.8		4.7			90.7	0.2			3.6	0.3
Delay (s)	133.8		44.6			124.3	8.1			60.3	0.3
Level of Service	F		D			F	A			E	A
Approach Delay (s)		101.9		0.0			92.5			29.4	
Approach LOS		F		A			F			C	

Intersection Summary			
HCM 2000 Control Delay	88.0	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.06		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	95.5%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑	↱	↰	↑↑					↰↰		↱
Traffic Volume (vph)	0	790	420	150	610	0	0	0	0	175	0	425
Future Volume (vph)	0	790	420	150	610	0	0	0	0	175	0	425
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0	4.0	6.0	6.0					6.0		6.0
Lane Util. Factor		0.95	1.00	1.00	0.95					0.97		1.00
Frt		1.00	0.85	1.00	1.00					1.00		0.85
Flt Protected		1.00	1.00	0.95	1.00					0.95		1.00
Satd. Flow (prot)		3471	1553	1719	3438					3367		1553
Flt Permitted		1.00	1.00	0.95	1.00					0.95		1.00
Satd. Flow (perm)		3471	1553	1719	3438					3367		1553
Peak-hour factor, PHF	0.87	0.87	0.87	0.86	0.86	0.86	0.92	0.92	0.92	0.91	0.91	0.91
Adj. Flow (vph)	0	908	483	174	709	0	0	0	0	192	0	467
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	159
Lane Group Flow (vph)	0	908	483	174	709	0	0	0	0	192	0	308
Heavy Vehicles (%)	4%	4%	4%	5%	5%	5%	2%	2%	2%	4%	4%	4%
Turn Type		NA	Free	Prot	NA					Prot		Prot
Protected Phases		2		1	6					4		4
Permitted Phases			Free									
Actuated Green, G (s)		36.5	90.0	12.8	55.3					22.7		22.7
Effective Green, g (s)		36.5	90.0	12.8	55.3					22.7		22.7
Actuated g/C Ratio		0.41	1.00	0.14	0.61					0.25		0.25
Clearance Time (s)		6.0		6.0	6.0					6.0		6.0
Vehicle Extension (s)		5.0		3.0	5.0					3.0		3.0
Lane Grp Cap (vph)		1407	1553	244	2112					849		391
v/s Ratio Prot		c0.26		c0.10	0.21					0.06		c0.20
v/s Ratio Perm			0.31									
v/c Ratio		0.65	0.31	0.71	0.34					0.23		0.79
Uniform Delay, d1		21.5	0.0	36.8	8.4					26.7		31.4
Progression Factor		1.00	1.00	0.26	0.01					1.00		1.00
Incremental Delay, d2		2.3	0.5	7.4	0.2					0.1		10.0
Delay (s)		23.8	0.5	17.0	0.3					26.8		41.4
Level of Service		C	A	B	A					C		D
Approach Delay (s)		15.7			3.6			0.0			37.2	
Approach LOS		B			A			A			D	

Intersection Summary			
HCM 2000 Control Delay	16.9	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.70		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	75.1%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑			↑↑	↱	↰		↱			
Traffic Volume (vph)	495	470	0	0	410	400	350	0	385	0	0	0
Future Volume (vph)	495	470	0	0	410	400	350	0	385	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0			6.0	4.0	6.0		6.0			
Lane Util. Factor	1.00	0.95			0.95	1.00	1.00		1.00			
Frt	1.00	1.00			1.00	0.85	1.00		0.85			
Flt Protected	0.95	1.00			1.00	1.00	0.95		1.00			
Satd. Flow (prot)	1752	3505			3505	1568	1703		1524			
Flt Permitted	0.95	1.00			1.00	1.00	0.95		1.00			
Satd. Flow (perm)	1752	3505			3505	1568	1703		1524			
Peak-hour factor, PHF	0.92	0.92	0.92	0.91	0.91	0.91	0.67	0.67	0.67	0.92	0.92	0.92
Adj. Flow (vph)	538	511	0	0	451	440	522	0	575	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	236	0	0	0
Lane Group Flow (vph)	538	511	0	0	451	440	522	0	339	0	0	0
Heavy Vehicles (%)	3%	3%	3%	3%	3%	3%	6%	6%	6%	2%	2%	2%
Turn Type	Prot	NA			NA	Free	Prot		Prot			
Protected Phases	5	2			6		8		8			
Permitted Phases		2			6	Free						
Actuated Green, G (s)	27.0	50.6			17.6	90.0	27.4		27.4			
Effective Green, g (s)	27.0	50.6			17.6	90.0	27.4		27.4			
Actuated g/C Ratio	0.30	0.56			0.20	1.00	0.30		0.30			
Clearance Time (s)	6.0	6.0			6.0		6.0		6.0			
Vehicle Extension (s)	5.0	5.0			5.0		3.0		3.0			
Lane Grp Cap (vph)	525	1970			685	1568	518		463			
v/s Ratio Prot	c0.31	0.15			c0.13		c0.31		0.22			
v/s Ratio Perm						0.28						
v/c Ratio	1.02	0.26			0.66	0.28	1.01		0.73			
Uniform Delay, d1	31.5	10.1			33.4	0.0	31.3		28.0			
Progression Factor	0.25	0.30			1.00	1.00	1.00		1.00			
Incremental Delay, d2	40.8	0.3			4.9	0.4	41.5		5.9			
Delay (s)	48.7	3.3			38.3	0.4	72.8		33.9			
Level of Service	D	A			D	A	E		C			
Approach Delay (s)		26.6			19.6			52.4			0.0	
Approach LOS		C			B			D			A	

Intersection Summary			
HCM 2000 Control Delay	33.9	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.93		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	75.1%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	80	5	120	10	0	10	210	830	120	5	610	100
Future Volume (vph)	80	5	120	10	0	10	210	830	120	5	610	100
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0	6.0		6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor		1.00	1.00		1.00		1.00	0.95		1.00	0.95	
Frt		1.00	0.85		0.93		1.00	0.98		1.00	0.98	
Flt Protected		0.95	1.00		0.98		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1779	1583		1729		1770	3472		1770	3464	
Flt Permitted		0.81	1.00		0.79		0.95	1.00		0.95	1.00	
Satd. Flow (perm)		1505	1583		1408		1770	3472		1770	3464	
Peak-hour factor, PHF	0.92	0.92	0.92	0.25	0.25	0.25	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	87	5	130	40	0	40	228	902	130	5	663	109
RTOR Reduction (vph)	0	0	72	0	71	0	0	10	0	0	13	0
Lane Group Flow (vph)	0	92	58	0	9	0	228	1022	0	5	759	0
Heavy Vehicles (%)	2%	2%	2%	0%	0%	0%	2%	2%	2%	2%	2%	2%
Turn Type	Perm	NA	custom	Perm	NA		Prot	NA		Prot	NA	
Protected Phases		8			4		5	2		1	6	
Permitted Phases	8		6	4								
Actuated Green, G (s)		8.3	33.1		8.3		14.8	47.1		0.8	33.1	
Effective Green, g (s)		8.3	33.1		8.3		14.8	47.1		0.8	33.1	
Actuated g/C Ratio		0.11	0.45		0.11		0.20	0.63		0.01	0.45	
Clearance Time (s)		6.0	6.0		6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)		3.0	3.0		3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		168	706		157		353	2203		19	1545	
v/s Ratio Prot							c0.13	c0.29		0.00	0.22	
v/s Ratio Perm		c0.06	0.04		0.01							
v/c Ratio		0.55	0.08		0.06		0.65	0.46		0.26	0.49	
Uniform Delay, d1		31.2	11.8		29.5		27.3	7.0		36.4	14.6	
Progression Factor		1.00	1.00		1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		3.6	0.1		0.2		4.0	0.2		7.3	0.2	
Delay (s)		34.8	11.9		29.6		31.3	7.2		43.7	14.8	
Level of Service		C	B		C		C	A		D	B	
Approach Delay (s)		21.4			29.6			11.5			15.0	
Approach LOS		C			C			B			B	

Intersection Summary			
HCM 2000 Control Delay	14.2	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.54		
Actuated Cycle Length (s)	74.2	Sum of lost time (s)	18.0
Intersection Capacity Utilization	58.4%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	20	80	5	250	0	60	0	680	130	15	345	0
Future Volume (vph)	20	80	5	250	0	60	0	680	130	15	345	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0			6.0			6.0			6.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		0.99			0.97			0.98			1.00	
Flt Protected		0.99			0.96			1.00			1.00	
Satd. Flow (prot)		1834			1727			1721			1806	
Flt Permitted		0.91			0.64			1.00			0.82	
Satd. Flow (perm)		1677			1157			1721			1481	
Peak-hour factor, PHF	0.60	0.60	0.60	0.96	0.96	0.96	0.89	0.89	0.89	0.86	0.86	0.86
Adj. Flow (vph)	33	133	8	260	0	62	0	764	146	17	401	0
RTOR Reduction (vph)	0	2	0	0	26	0	0	8	0	0	0	0
Lane Group Flow (vph)	0	172	0	0	297	0	0	902	0	0	418	0
Heavy Vehicles (%)	2%	2%	2%	3%	3%	3%	8%	8%	8%	5%	5%	5%
Turn Type	Perm	NA		Perm	NA			NA		Perm	NA	
Protected Phases		4			4			2			2	
Permitted Phases	4			4						2		
Actuated Green, G (s)		24.5			24.5			48.8			48.8	
Effective Green, g (s)		24.5			24.5			48.8			48.8	
Actuated g/C Ratio		0.29			0.29			0.57			0.57	
Clearance Time (s)		6.0			6.0			6.0			6.0	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		481			332			984			847	
v/s Ratio Prot								c0.52				
v/s Ratio Perm		0.10			c0.26						0.28	
v/c Ratio		0.36			0.90			0.92			0.49	
Uniform Delay, d1		24.1			29.2			16.4			10.9	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		0.5			25.0			12.9			0.5	
Delay (s)		24.6			54.2			29.3			11.3	
Level of Service		C			D			C			B	
Approach Delay (s)		24.6			54.2			29.3			11.3	
Approach LOS		C			D			C			B	

Intersection Summary			
HCM 2000 Control Delay	29.1	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.91		
Actuated Cycle Length (s)	85.3	Sum of lost time (s)	12.0
Intersection Capacity Utilization	81.2%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations	↰	↱		↰	↑	↱	↰	↱		↰	↱	
Traffic Volume (vph)	150	200	20	70	240	10	90	420	40	60	280	210
Future Volume (vph)	150	200	20	70	240	10	90	420	40	60	280	210
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	1.00	0.85	1.00	0.99		1.00	0.94	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1752	1820		1752	1845	1568	1787	1857		1787	1760	
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1752	1820		1752	1845	1568	1787	1857		1787	1760	
Peak-hour factor, PHF	0.91	0.91	0.91	0.93	0.93	0.93	0.95	0.95	0.95	0.94	0.94	0.94
Adj. Flow (vph)	165	220	22	75	258	11	95	442	42	64	298	223
RTOR Reduction (vph)	0	5	0	0	0	8	0	4	0	0	30	0
Lane Group Flow (vph)	165	237	0	75	258	3	95	480	0	64	491	0
Heavy Vehicles (%)	3%	3%	3%	3%	3%	3%	1%	1%	1%	1%	1%	1%
Turn Type	Prot	NA		Prot	NA	pm+ov	Prot	NA		Prot	NA	
Protected Phases	3	8		7	4	5	5	2		1	6	
Permitted Phases						4						
Actuated Green, G (s)	10.5	20.5		6.9	16.9	24.5	7.6	28.9		4.7	26.0	
Effective Green, g (s)	10.5	20.5		6.9	16.9	24.5	7.6	28.9		4.7	26.0	
Actuated g/C Ratio	0.12	0.24		0.08	0.20	0.29	0.09	0.34		0.06	0.31	
Clearance Time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	216	438		142	366	562	159	631		98	538	
v/s Ratio Prot	c0.09	c0.13		0.04	c0.14	0.00	c0.05	c0.26		0.04	c0.28	
v/s Ratio Perm						0.00						
v/c Ratio	0.76	0.54		0.53	0.70	0.01	0.60	0.76		0.65	0.91	
Uniform Delay, d1	36.1	28.2		37.5	31.7	21.6	37.2	25.0		39.4	28.4	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	14.8	1.4		3.5	6.1	0.0	5.9	8.4		14.5	19.9	
Delay (s)	50.8	29.5		41.0	37.8	21.6	43.2	33.4		53.9	48.3	
Level of Service	D	C		D	D	C	D	C		D	D	
Approach Delay (s)		38.2			38.0			35.0			48.9	
Approach LOS		D			D			C			D	

Intersection Summary			
HCM 2000 Control Delay	40.5	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.80		
Actuated Cycle Length (s)	85.0	Sum of lost time (s)	24.0
Intersection Capacity Utilization	87.9%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	460	10	5	100	200	245
Future Volume (vph)	460	10	5	100	200	245
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0	120	0			220
Storage Lanes	1	1	0			1
Taper Length (ft)	25		25			
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.850				0.850
Flt Protected	0.950			0.998		
Satd. Flow (prot)	1787	1599	0	1859	1881	1599
Flt Permitted	0.950			0.998		
Satd. Flow (perm)	1787	1599	0	1859	1881	1599
Link Speed (mph)	30			30	30	
Link Distance (ft)	322			309	305	
Travel Time (s)	7.3			7.0	6.9	
Peak Hour Factor	0.90	0.90	0.87	0.87	0.87	0.87
Heavy Vehicles (%)	1%	1%	2%	2%	1%	1%
Adj. Flow (vph)	511	11	6	115	230	282
Shared Lane Traffic (%)						
Lane Group Flow (vph)	511	11	0	121	230	282
Sign Control	Stop			Stop	Stop	

Intersection Summary	
Area Type: Other	
Control Type: Unsignalized	
Intersection Capacity Utilization 47.0%	ICU Level of Service A
Analysis Period (min) 15	

Intersection	
Intersection Delay, s/veh	32.6
Intersection LOS	D

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	460	10	5	100	200	245
Future Vol, veh/h	460	10	5	100	200	245
Peak Hour Factor	0.90	0.90	0.87	0.87	0.87	0.87
Heavy Vehicles, %	1	1	2	2	1	1
Mvmt Flow	511	11	6	115	230	282
Number of Lanes	1	1	0	1	1	1

Approach	EB	NB	SB
Opposing Approach		SB	NB
Opposing Lanes	0	2	1
Conflicting Approach Left	SB	EB	
Conflicting Lanes Left	2	2	0
Conflicting Approach Right	NB		EB
Conflicting Lanes Right	1	0	2
HCM Control Delay	55.5	12.3	14
HCM LOS	F	B	B

Lane	NBLn1	EBLn1	EBLn2	SBLn1	SBLn2
Vol Left, %	5%	100%	0%	0%	0%
Vol Thru, %	95%	0%	0%	100%	0%
Vol Right, %	0%	0%	100%	0%	100%
Sign Control	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	105	460	10	200	245
LT Vol	5	460	0	0	0
Through Vol	100	0	0	200	0
RT Vol	0	0	10	0	245
Lane Flow Rate	121	511	11	230	282
Geometry Grp	4	7	7	7	7
Degree of Util (X)	0.236	0.964	0.017	0.424	0.463
Departure Headway (Hd)	7.03	6.791	5.577	6.635	5.922
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes
Cap	507	532	640	540	605
Service Time	5.123	4.543	3.328	4.414	3.7
HCM Lane V/C Ratio	0.239	0.961	0.017	0.426	0.466
HCM Control Delay	12.3	56.5	8.4	14.3	13.8
HCM Lane LOS	B	F	A	B	B
HCM 95th-tile Q	0.9	12.7	0.1	2.1	2.4

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	10	0	0	565	445	10
Future Volume (vph)	10	0	0	565	445	10
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt					0.997	
Flt Protected	0.950					
Satd. Flow (prot)	1703	0	0	1881	1876	0
Flt Permitted	0.950					
Satd. Flow (perm)	1703	0	0	1881	1876	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	160			224	319	
Travel Time (s)	3.6			5.1	7.3	
Peak Hour Factor	0.50	0.50	0.93	0.93	0.86	0.86
Heavy Vehicles (%)	6%	6%	1%	1%	1%	1%
Adj. Flow (vph)	20	0	0	608	517	12
Shared Lane Traffic (%)						
Lane Group Flow (vph)	20	0	0	608	529	0
Sign Control	Stop			Free	Free	

Intersection Summary	
Area Type: Other	
Control Type: Unsignalized	
Intersection Capacity Utilization 46.2%	ICU Level of Service A
Analysis Period (min) 15	

Intersection						
Int Delay, s/veh	0.4					

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	10	0	0	565	445	10
Future Vol, veh/h	10	0	0	565	445	10
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	50	50	93	93	86	86
Heavy Vehicles, %	6	6	1	1	1	1
Mvmt Flow	20	0	0	608	517	12

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1131	523	529	0	-	0
Stage 1	523	-	-	-	-	-
Stage 2	608	-	-	-	-	-
Critical Hdwy	6.46	6.26	4.11	-	-	-
Critical Hdwy Stg 1	5.46	-	-	-	-	-
Critical Hdwy Stg 2	5.46	-	-	-	-	-
Follow-up Hdwy	3.554	3.354	2.209	-	-	-
Pot Cap-1 Maneuver	221	546	1043	-	-	-
Stage 1	587	-	-	-	-	-
Stage 2	536	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	221	546	1043	-	-	-
Mov Cap-2 Maneuver	221	-	-	-	-	-
Stage 1	587	-	-	-	-	-
Stage 2	536	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	22.9	0	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1043	-	221	-	-
HCM Lane V/C Ratio	-	-	0.09	-	-
HCM Control Delay (s)	0	-	22.9	-	-
HCM Lane LOS	A	-	C	-	-
HCM 95th %tile Q(veh)	0	-	0.3	-	-

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations		♣			♣			♣			♣	
Traffic Volume (vph)	90	480	5	40	220	110	200	40	230	5	140	20
Future Volume (vph)	90	480	5	40	220	110	200	40	230	5	140	20
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	150		150	150		150	0		0	150		150
Storage Lanes	0		0	0		0	0		0	0		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.999			0.960			0.934			0.984	
Flt Protected		0.992			0.995			0.979			0.999	
Satd. Flow (prot)	0	1864	0	0	1779	0	0	1737	0	0	1868	0
Flt Permitted		0.992			0.995			0.979			0.999	
Satd. Flow (perm)	0	1864	0	0	1779	0	0	1737	0	0	1868	0
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		327			240			246			251	
Travel Time (s)		7.4			5.5			5.6			5.7	
Peak Hour Factor	0.94	0.94	0.94	0.88	0.88	0.88	0.67	0.67	0.67	0.82	0.82	0.82
Heavy Vehicles (%)	1%	1%	1%	2%	2%	2%	0%	0%	0%	0%	0%	0%
Adj. Flow (vph)	96	511	5	45	250	125	299	60	343	6	171	24
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	612	0	0	420	0	0	702	0	0	201	0
Sign Control		Free			Free			Stop			Stop	

Intersection Summary	
Area Type: Other	
Control Type: Unsignalized	
Intersection Capacity Utilization 95.6%	ICU Level of Service F
Analysis Period (min) 15	

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations		✥			✥			✥			✥	
Traffic Volume (veh/h)	90	480	5	40	220	110	200	40	230	5	140	20
Future Volume (Veh/h)	90	480	5	40	220	110	200	40	230	5	140	20
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.94	0.94	0.94	0.88	0.88	0.88	0.67	0.67	0.67	0.82	0.82	0.82
Hourly flow rate (vph)	96	511	5	45	250	125	299	60	343	6	171	24
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	375			516			1218	1110	312	1138	1170	514
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	375			516			1218	1110	312	1138	1170	514
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	92			96			0	68	53	91	0	96
cM capacity (veh/h)	1189			1050			1	186	732	66	171	565

Direction, Lane #	EB 1	WB 1	SE 1	NW 1
Volume Total	612	420	702	201
Volume Left	96	45	299	6
Volume Right	5	125	343	24
cSH	1189	1050	2	177
Volume to Capacity	0.08	0.04	353.23	1.13
Queue Length 95th (ft)	7	3	Err	257
Control Delay (s)	2.1	1.3	Err	161.6
Lane LOS	A	A	F	F
Approach Delay (s)	2.1	1.3	Err	161.6
Approach LOS			F	F

Intersection Summary				
Average Delay		3645.3		
Intersection Capacity Utilization		95.6%	ICU Level of Service	F
Analysis Period (min)		15		

Movement	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations	↰	↑↑	↱	↰↰	↑↑		↰	↑	↱	↰	↑	↱
Traffic Volume (vph)	60	320	110	550	390	0	60	360	50	45	180	625
Future Volume (vph)	60	320	110	550	390	0	60	360	50	45	180	625
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0		6.0	6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	3539	1583	3433	3539		1770	1863	1583	1787	1881	1599
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	3539	1583	3433	3539		1770	1863	1583	1787	1881	1599
Peak-hour factor, PHF	0.92	0.92	0.92	0.94	0.94	0.94	0.96	0.96	0.96	0.95	0.95	0.95
Adj. Flow (vph)	65	348	120	585	415	0	62	375	52	47	189	658
RTOR Reduction (vph)	0	0	90	0	0	0	0	0	39	0	0	88
Lane Group Flow (vph)	65	348	30	585	415	0	63	375	13	47	189	570
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	1%	1%	1%
Turn Type	Prot	NA	Perm	Prot	NA		Prot	NA	Perm	Prot	NA	pm+ov
Protected Phases	5	2		1	6		7	4		3	8	1
Permitted Phases			2						4			8
Actuated Green, G (s)	6.8	27.6	27.6	25.2	46.0		7.0	26.8	26.8	6.4	26.2	51.4
Effective Green, g (s)	6.8	27.6	27.6	25.2	46.0		7.0	26.8	26.8	6.4	26.2	51.4
Actuated g/C Ratio	0.06	0.25	0.25	0.23	0.42		0.06	0.24	0.24	0.06	0.24	0.47
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0		6.0	6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	109	887	397	786	1479		112	453	385	103	448	834
v/s Ratio Prot	0.04	c0.10		c0.17	0.12		c0.04	c0.20		0.03	0.10	c0.16
v/s Ratio Perm			0.02						0.01			0.20
v/c Ratio	0.60	0.39	0.08	0.74	0.28		0.56	0.83	0.03	0.46	0.42	0.68
Uniform Delay, d1	50.3	34.2	31.5	39.4	21.1		50.0	39.4	31.7	50.1	35.5	22.9
Progression Factor	1.00	1.00	1.00	1.27	1.16		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	8.5	1.3	0.4	3.6	0.1		6.3	11.8	0.0	3.2	0.6	2.3
Delay (s)	58.7	35.5	31.8	53.5	24.5		56.3	51.2	31.8	53.3	36.1	25.3
Level of Service	E	D	C	D	C		E	D	C	D	D	C
Approach Delay (s)		37.5			41.5			49.8			29.0	
Approach LOS		D			D			D			C	

Intersection Summary			
HCM 2000 Control Delay	38.3	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.66		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	24.0
Intersection Capacity Utilization	70.2%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	NWL	NWR	NET	NER	SWL	SWT
Lane Configurations						
Traffic Volume (vph)	140	100	550	520	80	710
Future Volume (vph)	140	100	550	520	80	710
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	180	150		0	180	
Storage Lanes	1	0		1	0	
Taper Length (ft)	25				25	
Lane Util. Factor	1.00	1.00	1.00	1.00	0.95	0.95
Frt		0.850		0.850		
Flt Protected	0.950					0.995
Satd. Flow (prot)	1787	1599	1881	1599	0	3556
Flt Permitted	0.950					0.995
Satd. Flow (perm)	1787	1599	1881	1599	0	3556
Link Speed (mph)	30		30			30
Link Distance (ft)	403		387			233
Travel Time (s)	9.2		8.8			5.3
Peak Hour Factor	0.86	0.86	0.96	0.96	0.85	0.85
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%
Adj. Flow (vph)	163	116	573	542	94	835
Shared Lane Traffic (%)						
Lane Group Flow (vph)	163	116	573	542	0	929
Sign Control	Stop		Free			Free

Intersection Summary

Area Type: Other
Control Type: Unsignalized
Intersection Capacity Utilization 68.7% ICU Level of Service C
Analysis Period (min) 15

Intersection	
Int Delay, s/veh	10.1

Movement	NWL	NWR	NET	NER	SWL	SWT
Lane Configurations	↰	↱	↑	↱		↰↑
Traffic Vol, veh/h	140	100	550	520	80	710
Future Vol, veh/h	140	100	550	520	80	710
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	Yield	-	None
Storage Length	180	-	-	0	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	86	86	96	96	85	85
Heavy Vehicles, %	1	1	1	1	1	1
Mvmt Flow	163	116	573	542	94	835

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1179	573	0	0	573	0
Stage 1	573	-	-	-	-	-
Stage 2	606	-	-	-	-	-
Critical Hdwy	6.615	6.215	-	-	4.115	-
Critical Hdwy Stg 1	5.415	-	-	-	-	-
Critical Hdwy Stg 2	5.815	-	-	-	-	-
Follow-up Hdwy	3.5095	3.3095	-	-	2.2095	-
Pot Cap-1 Maneuver	198	520	-	-	1004	-
Stage 1	565	-	-	-	-	-
Stage 2	510	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	163	520	-	-	1004	-
Mov Cap-2 Maneuver	163	-	-	-	-	-
Stage 1	466	-	-	-	-	-
Stage 2	510	-	-	-	-	-

Approach	NW	NE	SW
HCM Control Delay, s	79.5	0	1.4
HCM LOS	F		

Minor Lane/Major Mvmt	NET	NER	NWLn1	NWLn2	SWL	SWT
Capacity (veh/h)	-	-	163	520	1004	-
HCM Lane V/C Ratio	-	-	0.999	0.224	0.094	-
HCM Control Delay (s)	-	-	126.4	13.9	9	0.6
HCM Lane LOS	-	-	F	B	A	A
HCM 95th %tile Q(veh)	-	-	7.8	0.8	0.3	-

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	160	1185	5	20	890	80	15	10	15	10	10	60
Future Volume (vph)	160	1185	5	20	890	80	15	10	15	10	10	60
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0			6.0	6.0		6.0	6.0
Lane Util. Factor	1.00	0.95		1.00	0.95			1.00	1.00		1.00	1.00
Frt	1.00	1.00		1.00	0.99			1.00	0.85		1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00			0.97	1.00		0.98	1.00
Satd. Flow (prot)	1787	3572		1787	3530			1844	1615		1835	1599
Flt Permitted	0.95	1.00		0.95	1.00			0.80	1.00		0.83	1.00
Satd. Flow (perm)	1787	3572		1787	3530			1518	1615		1557	1599
Peak-hour factor, PHF	0.97	0.97	0.97	0.95	0.95	0.95	0.90	0.90	0.90	0.80	0.80	0.80
Adj. Flow (vph)	165	1222	5	21	937	84	17	11	17	12	12	75
RTOR Reduction (vph)	0	0	0	0	4	0	0	0	16	0	0	71
Lane Group Flow (vph)	165	1227	0	21	1017	0	0	28	1	0	26	4
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	0%	0%	0%	1%	1%	1%
Turn Type	Prot	NA		Prot	NA		Perm	NA	Perm	Perm	NA	Perm
Protected Phases	5	2		1	6			8			4	
Permitted Phases							8		8	4	4	4
Actuated Green, G (s)	15.4	82.4		3.2	70.2			6.4	6.4		6.4	6.4
Effective Green, g (s)	15.4	82.4		3.2	70.2			6.4	6.4		6.4	6.4
Actuated g/C Ratio	0.14	0.75		0.03	0.64			0.06	0.06		0.06	0.06
Clearance Time (s)	6.0	6.0		6.0	6.0			6.0	6.0		6.0	6.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	250	2675		51	2252			88	93		90	93
v/s Ratio Prot	c0.09	c0.34		0.01	0.29							
v/s Ratio Perm								c0.02	0.00		0.02	0.00
v/c Ratio	0.66	0.46		0.41	0.45			0.32	0.01		0.29	0.05
Uniform Delay, d1	44.8	5.3		52.5	10.1			49.7	48.8		49.6	48.9
Progression Factor	0.99	1.15		1.02	0.98			1.00	1.00		1.00	1.00
Incremental Delay, d2	5.3	0.5		4.4	0.5			2.1	0.0		1.8	0.2
Delay (s)	49.8	6.5		58.0	10.5			51.8	48.9		51.4	49.1
Level of Service	D	A		E	B			D	D		D	D
Approach Delay (s)		11.7			11.5			50.7			49.7	
Approach LOS		B			B			D			D	

Intersection Summary

HCM 2000 Control Delay	13.8	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.49		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	60.1%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑	↱	↰↰	↑↱		↰	↑↑	↱↱	↰	↑↑	↱
Traffic Volume (vph)	50	180	140	820	300	20	130	640	940	30	530	180
Future Volume (vph)	50	180	140	820	300	20	130	640	940	30	530	180
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	4.5	6.0	6.0		4.5	6.0	6.0	4.5	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	0.97	0.95		1.00	0.95	0.88	1.00	0.95	1.00
Frt	1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1787	1881	1599	3433	3506		1805	3610	2842	1805	3610	1615
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1787	1881	1599	3433	3506		1805	3610	2842	1805	3610	1615
Peak-hour factor, PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.78	0.78	0.78	0.86	0.86	0.86
Adj. Flow (vph)	60	214	167	911	333	22	167	821	1205	35	616	209
RTOR Reduction (vph)	0	0	107	0	4	0	0	0	329	0	0	132
Lane Group Flow (vph)	60	214	60	911	351	0	167	821	876	35	616	77
Heavy Vehicles (%)	1%	1%	1%	2%	2%	2%	0%	0%	0%	0%	0%	0%
Turn Type	Prot	NA	pm+ov	Prot	NA		Prot	NA	pm+ov	Prot	NA	pm+ov
Protected Phases	5	2	3	1	6		3	8	1	7	4	5
Permitted Phases			2						8		4	4
Actuated Green, G (s)	16.0	17.2	31.1	32.0	33.2		13.9	33.1	65.1	5.2	24.4	40.4
Effective Green, g (s)	16.0	17.2	31.1	32.0	33.2		13.9	33.1	65.1	5.2	24.4	40.4
Actuated g/C Ratio	0.15	0.16	0.28	0.29	0.30		0.13	0.30	0.59	0.05	0.22	0.37
Clearance Time (s)	6.0	6.0	4.5	6.0	6.0		4.5	6.0	6.0	4.5	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	259	294	452	998	1058		228	1086	1836	85	800	681
v/s Ratio Prot	0.03	c0.11	0.02	c0.27	0.10		c0.09	c0.23	0.14	0.02	0.17	0.02
v/s Ratio Perm			0.02						0.17			0.03
v/c Ratio	0.23	0.73	0.13	0.91	0.33		0.73	0.76	0.48	0.41	0.77	0.11
Uniform Delay, d1	41.6	44.2	29.4	37.7	29.8		46.3	34.8	12.8	50.9	40.2	23.0
Progression Factor	1.00	1.00	1.00	0.97	1.40		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	2.1	14.6	0.1	11.9	0.2		11.5	3.0	0.2	3.2	4.6	0.1
Delay (s)	43.6	58.8	29.5	48.3	41.8		57.7	37.8	13.0	54.1	44.8	23.0
Level of Service	D	E	C	D	D		E	D	B	D	D	C
Approach Delay (s)		45.7			46.5			25.7			39.9	
Approach LOS		D			D			C			D	

Intersection Summary			
HCM 2000 Control Delay	35.6	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	22.5
Intersection Capacity Utilization	73.5%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	40	290	370	40	40	30
Future Volume (vph)	40	290	370	40	40	30
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	140			0	0	0
Storage Lanes	1			0	1	0
Taper Length (ft)	25				25	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.987		0.942	
Flt Protected	0.950				0.972	
Satd. Flow (prot)	1770	1863	1839	0	1689	0
Flt Permitted	0.950				0.972	
Satd. Flow (perm)	1770	1863	1839	0	1689	0
Link Speed (mph)		30	30		30	
Link Distance (ft)		535	210		522	
Travel Time (s)		12.2	4.8		11.9	
Peak Hour Factor	0.91	0.91	0.90	0.90	0.75	0.75
Heavy Vehicles (%)	2%	2%	2%	2%	3%	3%
Adj. Flow (vph)	44	319	411	44	53	40
Shared Lane Traffic (%)						
Lane Group Flow (vph)	44	319	455	0	93	0
Sign Control		Free	Free		Stop	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 39.3% ICU Level of Service A

Analysis Period (min) 15

Intersection	
Int Delay, s/veh	2.1

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↰	↑	↱		Y	
Traffic Vol, veh/h	40	290	370	40	40	30
Future Vol, veh/h	40	290	370	40	40	30
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	140	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	91	91	90	90	75	75
Heavy Vehicles, %	2	2	2	2	3	3
Mvmt Flow	44	319	411	44	53	40

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	455	0	-	0	840	433
Stage 1	-	-	-	-	433	-
Stage 2	-	-	-	-	407	-
Critical Hdwy	4.12	-	-	-	6.43	6.23
Critical Hdwy Stg 1	-	-	-	-	5.43	-
Critical Hdwy Stg 2	-	-	-	-	5.43	-
Follow-up Hdwy	2.218	-	-	-	3.527	3.327
Pot Cap-1 Maneuver	1106	-	-	-	334	621
Stage 1	-	-	-	-	652	-
Stage 2	-	-	-	-	670	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1106	-	-	-	321	621
Mov Cap-2 Maneuver	-	-	-	-	321	-
Stage 1	-	-	-	-	626	-
Stage 2	-	-	-	-	670	-

Approach	EB	WB	SB
HCM Control Delay, s	1	0	16.5
HCM LOS			C

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1106	-	-	-	405
HCM Lane V/C Ratio	0.04	-	-	-	0.23
HCM Control Delay (s)	8.4	-	-	-	16.5
HCM Lane LOS	A	-	-	-	C
HCM 95th %tile Q(veh)	0.1	-	-	-	0.9

Lane Group	WBL2	WBL	WBR	WBR2	NBL	NBT	NBR	NBR2	SBL2	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	10	170	360	20	20	110	110	10	10	110	140	40
Future Volume (vph)	10	170	360	20	20	110	110	10	10	110	140	40
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)		0	150		0		150			0		0
Storage Lanes		1	0		0		0			0		0
Taper Length (ft)		25			25					25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.908				0.935					0.982	
Flt Protected		0.984				0.996					0.980	
Satd. Flow (prot)	0	1648	0	0	0	1718	0	0	0	0	1709	0
Flt Permitted		0.984				0.996					0.980	
Satd. Flow (perm)	0	1648	0	0	0	1718	0	0	0	0	1709	0
Link Speed (mph)		30				30					30	
Link Distance (ft)		465				456					371	
Travel Time (s)		10.6				10.4					8.4	
Peak Hour Factor	0.91	0.91	0.91	0.91	0.86	0.86	0.86	0.86	0.80	0.80	0.80	0.80
Heavy Vehicles (%)	3%	3%	3%	3%	3%	3%	3%	3%	7%	7%	7%	7%
Adj. Flow (vph)	11	187	396	22	23	128	128	12	13	138	175	50
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	616	0	0	0	291	0	0	0	0	376	0
Sign Control		Yield				Yield					Yield	

Intersection Summary

Area Type: Other

Control Type: Roundabout

Intersection Capacity Utilization 100.5% ICU Level of Service G

Analysis Period (min) 15

Intersection	
Intersection Delay, s/veh	21.1
Intersection LOS	C

Approach	WB	NB	SB	NE	SW
Entry Lanes	1	1	1	1	1
Conflicting Circle Lanes	1	1	1	1	1
Adj Approach Flow, veh/h	550	309	642	589	143
Demand Flow Rate, veh/h	555	316	648	595	146
Vehicles Circulating, veh/h	507	923	429	677	789
Vehicles Exiting, veh/h	732	349	506	400	273
Ped Vol Crossing Leg, #/h	0	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000	1.000
Approach Delay, s/veh	16.4	19.0	17.8	33.1	9.0
Approach LOS	C	C	C	D	A

Lane	Left	Left	Left	Left	Left
Designated Moves	LR	LTR	LTR	LTR	LTR
Assumed Moves	LR	LTR	LTR	LTR	LTR
RT Channelized					
Lane Util	1.000	1.000	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976	4.976	4.976
Entry Flow, veh/h	555	316	648	595	146
Cap Entry Lane, veh/h	823	538	891	692	617
Entry HV Adj Factor	0.991	0.979	0.990	0.991	0.980
Flow Entry, veh/h	550	309	642	589	143
Cap Entry, veh/h	815	527	882	685	605
V/C Ratio	0.675	0.587	0.727	0.860	0.237
Control Delay, s/veh	16.4	19.0	17.8	33.1	9.0
LOS	C	C	C	D	A
95th %tile Queue, veh	5	4	7	10	1

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↰	↱		✥			✥			✥	
Traffic Volume (vph)	10	40	470	10	30	20	300	140	10	25	110	10
Future Volume (vph)	10	40	470	10	30	20	300	140	10	25	110	10
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		50	0		0	0		0	0		0
Storage Lanes	0		1	0		0	0		0	0		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850		0.956			0.997			0.991	
Flt Protected		0.990			0.992			0.968			0.992	
Satd. Flow (prot)	0	1844	1583	0	1802	0	0	1816	0	0	1849	0
Flt Permitted		0.990			0.992			0.968			0.992	
Satd. Flow (perm)	0	1844	1583	0	1802	0	0	1816	0	0	1849	0
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		152			453			475			436	
Travel Time (s)		3.5			10.3			10.8			9.9	
Peak Hour Factor	0.88	0.88	0.88	0.82	0.82	0.82	0.93	0.93	0.93	0.91	0.91	0.91
Heavy Vehicles (%)	2%	2%	2%	0%	0%	0%	1%	1%	1%	1%	1%	1%
Adj. Flow (vph)	11	45	534	12	37	24	323	151	11	27	121	11
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	56	534	0	73	0	0	485	0	0	159	0
Sign Control		Stop			Stop			Free			Free	

Intersection Summary		
Area Type:	Other	
Control Type: Unsignalized		
Intersection Capacity Utilization 50.1%		ICU Level of Service A
Analysis Period (min) 15		

Intersection	
Int Delay, s/veh	12.6

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	10	40	470	10	30	20	300	140	10	25	110	10
Future Vol, veh/h	10	40	470	10	30	20	300	140	10	25	110	10
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	50	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	88	88	88	82	82	82	93	93	93	91	91	91
Heavy Vehicles, %	2	2	2	0	0	0	1	1	1	1	1	1
Mvmt Flow	11	45	534	12	37	24	323	151	11	27	121	11

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1014	989	127	1273	989	157	132	0	0	162	0	0
Stage 1	181	181	-	803	803	-	-	-	-	-	-	-
Stage 2	833	808	-	470	186	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.1	6.5	6.2	4.11	-	-	4.11	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.1	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.1	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.5	4	3.3	2.209	-	-	2.209	-	-
Pot Cap-1 Maneuver	217	247	923	146	249	894	1459	-	-	1423	-	-
Stage 1	821	750	-	380	399	-	-	-	-	-	-	-
Stage 2	363	394	-	578	750	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	144	183	923	40	185	894	1459	-	-	1423	-	-
Mov Cap-2 Maneuver	144	183	-	40	185	-	-	-	-	-	-	-
Stage 1	621	734	-	288	302	-	-	-	-	-	-	-
Stage 2	235	298	-	224	734	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	16.1	57.3	5.4	1.3
HCM LOS	C	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1459	-	-	174	923	138	1423	-	-
HCM Lane V/C Ratio	0.221	-	-	0.327	0.579	0.53	0.019	-	-
HCM Control Delay (s)	8.2	0	-	35.4	14.1	57.3	7.6	0	-
HCM Lane LOS	A	A	-	E	B	F	A	A	-
HCM 95th %tile Q(veh)	0.8	-	-	1.3	3.8	2.6	0.1	-	-

Movement	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	30	70	20	80	60	20	30	430	70	20	210	50
Future Volume (vph)	30	70	20	80	60	20	30	430	70	20	210	50
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	0.97		1.00	1.00	0.85	1.00	0.98		1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	1801		1787	1881	1599	1805	1860		1805	1845	
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	1801		1787	1881	1599	1805	1860		1805	1845	
Peak-hour factor, PHF	0.99	0.99	0.99	0.95	0.95	0.95	0.89	0.89	0.89	0.93	0.93	0.93
Adj. Flow (vph)	30	71	20	84	63	21	34	483	79	22	226	54
RTOR Reduction (vph)	0	11	0	0	0	12	0	7	0	0	11	0
Lane Group Flow (vph)	30	80	0	84	63	9	34	555	0	22	269	0
Heavy Vehicles (%)	2%	2%	2%	1%	1%	1%	0%	0%	0%	0%	0%	0%
Turn Type	Prot	NA		Prot	NA	pt+ov	Prot	NA		Prot	NA	
Protected Phases	1	6		5	2	2 3	3	8		7	4	
Permitted Phases		6			2							
Actuated Green, G (s)	3.2	19.3		6.6	22.7	33.5	4.8	26.9		3.2	25.3	
Effective Green, g (s)	3.2	19.3		6.6	22.7	33.5	4.8	26.9		3.2	25.3	
Actuated g/C Ratio	0.04	0.24		0.08	0.28	0.42	0.06	0.34		0.04	0.32	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	70	434		147	533	669	108	625		72	583	
v/s Ratio Prot	0.02	c0.04		c0.05	c0.03	0.01	c0.02	c0.30		0.01	0.15	
v/s Ratio Perm												
v/c Ratio	0.43	0.18		0.57	0.12	0.01	0.31	0.89		0.31	0.46	
Uniform Delay, d1	37.5	24.1		35.3	21.2	13.6	36.0	25.1		37.3	21.9	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	4.2	0.2		5.3	0.5	0.0	1.7	14.3		2.4	0.6	
Delay (s)	41.7	24.3		40.6	21.7	13.6	37.7	39.4		39.7	22.5	
Level of Service	D	C		D	C	B	D	D		D	C	
Approach Delay (s)		28.6			30.1			39.3			23.7	
Approach LOS		C			C			D			C	

Intersection Summary			
HCM 2000 Control Delay	33.0	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.59		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	24.0
Intersection Capacity Utilization	48.0%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	660	10	40	140	100	720
Future Volume (vph)	660	10	40	140	100	720
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0		6.0	6.0	6.0	6.0
Lane Util. Factor	1.00		1.00	1.00	1.00	1.00
Frt	1.00		1.00	1.00	1.00	0.85
Flt Protected	0.95		0.95	1.00	1.00	1.00
Satd. Flow (prot)	1789		1770	1863	1845	1568
Flt Permitted	0.95		0.65	1.00	1.00	1.00
Satd. Flow (perm)	1789		1217	1863	1845	1568
Peak-hour factor, PHF	0.90	0.90	0.87	0.87	0.89	0.89
Adj. Flow (vph)	733	11	46	161	112	809
RTOR Reduction (vph)	1	0	0	0	0	168
Lane Group Flow (vph)	743	0	46	161	112	641
Heavy Vehicles (%)	1%	1%	2%	2%	3%	3%
Turn Type	Prot		pm+pt	NA	NA	custom
Protected Phases	8		1	6 7	2 7	7 8
Permitted Phases			6 7			2
Actuated Green, G (s)	40.1		44.2	41.3	39.4	79.5
Effective Green, g (s)	40.1		44.2	41.3	39.4	79.5
Actuated g/C Ratio	0.40		0.44	0.41	0.39	0.79
Clearance Time (s)	6.0		6.0			
Vehicle Extension (s)	3.0		3.0			
Lane Grp Cap (vph)	714		551	766	724	1335
v/s Ratio Prot	c0.42		c0.00	0.09	0.06	c0.26
v/s Ratio Perm			0.03			0.15
v/c Ratio	1.04		0.08	0.21	0.15	0.48
Uniform Delay, d1	30.2		16.2	19.0	19.7	3.5
Progression Factor	1.00		1.00	1.00	1.13	3.12
Incremental Delay, d2	44.9		0.1	0.1	0.1	0.2
Delay (s)	75.0		16.2	19.2	22.3	11.2
Level of Service	E		B	B	C	B
Approach Delay (s)	75.0			18.5	12.5	
Approach LOS	E			B	B	

Intersection Summary			
HCM 2000 Control Delay	38.0	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.82		
Actuated Cycle Length (s)	100.4	Sum of lost time (s)	24.0
Intersection Capacity Utilization	58.7%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	ﾞﾞ				ﾞﾞ	
Traffic Volume (vph)	1010	0	0	0	1575	0
Future Volume (vph)	1010	0	0	0	1575	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0				6.0	
Lane Util. Factor	0.97				0.97	
Frt	1.00				1.00	
Flt Protected	0.95				0.95	
Satd. Flow (prot)	3433				3433	
Flt Permitted	0.95				0.95	
Satd. Flow (perm)	3433				3433	
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	1074	0	0	0	1676	0
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	1074	0	0	0	1676	0
Turn Type	Prot				Prot	
Protected Phases	2				4	
Permitted Phases						
Actuated Green, G (s)	27.0				41.0	
Effective Green, g (s)	27.0				41.0	
Actuated g/C Ratio	0.34				0.51	
Clearance Time (s)	6.0				6.0	
Vehicle Extension (s)	3.0				3.0	
Lane Grp Cap (vph)	1158				1759	
v/s Ratio Prot	c0.31				c0.49	
v/s Ratio Perm						
v/c Ratio	0.93				0.95	
Uniform Delay, d1	25.6				18.6	
Progression Factor	1.13				1.00	
Incremental Delay, d2	11.9				12.1	
Delay (s)	40.7				30.7	
Level of Service	D				C	
Approach Delay (s)	40.7		0.0			30.7
Approach LOS	D		A			C

Intersection Summary			
HCM 2000 Control Delay	34.6	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.94		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	129.3%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SBL	SBR	NWL	NWR
Lane Configurations										
Traffic Volume (vph)	0	1575	0	0	1010	1075	0	0	0	770
Future Volume (vph)	0	1575	0	0	1010	1075	0	0	0	770
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0			6.0	6.0			6.0	6.0
Lane Util. Factor		0.95			0.95	0.88			1.00	0.95
Frt		1.00			1.00	0.85			0.85	0.85
Flt Protected		1.00			1.00	1.00			1.00	1.00
Satd. Flow (prot)		3539			3539	2787			1583	1504
Flt Permitted		1.00			1.00	1.00			1.00	1.00
Satd. Flow (perm)		3539			3539	2787			1583	1504
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	0	1676	0	0	1074	1144	0	0	0	819
RTOR Reduction (vph)	0	0	0	0	0	30	0	0	0	0
Lane Group Flow (vph)	0	1676	0	0	1074	1114	0	0	410	409
Turn Type	Perm	NA			NA	Perm			Prot	Prot
Protected Phases		2			2				4	4
Permitted Phases	2					2				
Actuated Green, G (s)		42.0			42.0	42.0			26.0	26.0
Effective Green, g (s)		42.0			42.0	42.0			26.0	26.0
Actuated g/C Ratio		0.52			0.52	0.52			0.32	0.32
Clearance Time (s)		6.0			6.0	6.0			6.0	6.0
Vehicle Extension (s)		3.0			3.0	3.0			3.0	3.0
Lane Grp Cap (vph)		1857			1857	1463			514	488
v/s Ratio Prot		c0.47			0.30				0.26	c0.27
v/s Ratio Perm						0.40				
v/c Ratio		0.90			0.58	0.76			0.80	0.84
Uniform Delay, d1		17.2			13.0	15.0			24.6	25.0
Progression Factor		0.04			1.00	1.00			1.00	1.00
Incremental Delay, d2		2.7			1.3	3.8			12.2	15.7
Delay (s)		3.4			14.3	18.8			36.8	40.8
Level of Service		A			B	B			D	D
Approach Delay (s)		3.4			16.6		0.0		38.8	
Approach LOS		A			B		A		D	

Intersection Summary			
HCM 2000 Control Delay	15.8	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.88		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	115.2%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↱		↰	↱		↰	↑	↱
Traffic Volume (vph)	130	490	10	10	500	10	20	70	10	10	70	130
Future Volume (vph)	130	490	10	10	500	10	20	70	10	10	70	130
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	6.0
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00		1.00	1.00		1.00	0.98		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1770	1857		1770	1857		1770	1827		1770	1863	1583
Flt Permitted	0.20	1.00		0.33	1.00		0.71	1.00		0.70	1.00	1.00
Satd. Flow (perm)	369	1857		619	1857		1318	1827		1305	1863	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	141	533	11	11	543	11	22	76	11	11	76	141
RTOR Reduction (vph)	0	1	0	0	1	0	0	8	0	0	0	89
Lane Group Flow (vph)	141	543	0	11	553	0	22	79	0	11	76	52
Turn Type	pm+pt	NA		pm+pt	NA		Perm	NA		Perm	NA	pm+ov
Protected Phases	7	4		3	8			2			6	7
Permitted Phases	4			8			2			6		6
Actuated Green, G (s)	36.8	31.8		28.8	27.8		22.0	22.0		22.0	22.0	27.0
Effective Green, g (s)	36.8	31.8		28.8	27.8		22.0	22.0		22.0	22.0	27.0
Actuated g/C Ratio	0.51	0.44		0.40	0.38		0.30	0.30		0.30	0.30	0.37
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	282	811		260	709		398	552		394	562	717
v/s Ratio Prot	c0.03	c0.29		0.00	c0.30			c0.04			0.04	0.01
v/s Ratio Perm	0.22			0.02			0.02			0.01		0.03
v/c Ratio	0.50	0.67		0.04	0.78		0.06	0.14		0.03	0.14	0.07
Uniform Delay, d1	12.3	16.3		13.8	19.8		18.0	18.5		17.9	18.5	14.8
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	1.4	4.4		0.1	5.4		0.3	0.5		0.0	0.1	0.0
Delay (s)	13.7	20.7		13.9	25.2		18.3	19.1		17.9	18.6	14.9
Level of Service	B	C		B	C		B	B		B	B	B
Approach Delay (s)		19.3			25.0			18.9			16.2	
Approach LOS		B			C			B			B	

Intersection Summary			
HCM 2000 Control Delay	20.8	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.51		
Actuated Cycle Length (s)	72.8	Sum of lost time (s)	18.0
Intersection Capacity Utilization	56.9%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	460	0	290	470	0	210
Future Volume (vph)	460	0	290	470	0	210
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)		0	0		0	80
Storage Lanes		0	0		1	1
Taper Length (ft)			25		25	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt						0.850
Flt Protected				0.981		
Satd. Flow (prot)	1863	0	0	1827	1863	1583
Flt Permitted				0.981		
Satd. Flow (perm)	1863	0	0	1827	1863	1583
Link Speed (mph)	30			30	30	
Link Distance (ft)	410			475	676	
Travel Time (s)	9.3			10.8	15.4	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	500	0	315	511	0	228
Shared Lane Traffic (%)						
Lane Group Flow (vph)	500	0	0	826	0	228
Sign Control	Free			Free	Stop	

Intersection Summary	
Area Type: Other	
Control Type: Unsignalized	
Intersection Capacity Utilization 71.7%	ICU Level of Service C
Analysis Period (min) 15	

Intersection	
Int Delay, s/veh	4.2

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↱			↰	↰	↱
Traffic Vol, veh/h	460	0	290	470	0	210
Future Vol, veh/h	460	0	290	470	0	210
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	80
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	500	0	315	511	0	228

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	500	0	1641	500
Stage 1	-	-	-	-	500	-
Stage 2	-	-	-	-	1141	-
Critical Hdwy	-	-	4.12	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	1064	-	110	571
Stage 1	-	-	-	-	609	-
Stage 2	-	-	-	-	305	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1064	-	65	571
Mov Cap-2 Maneuver	-	-	-	-	65	-
Stage 1	-	-	-	-	357	-
Stage 2	-	-	-	-	305	-

Approach	EB	WB	NB
HCM Control Delay, s	0	3.7	15.4
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	-	571	-	-	1064	-
HCM Lane V/C Ratio	-	0.4	-	-	0.296	-
HCM Control Delay (s)	0	15.4	-	-	9.8	0
HCM Lane LOS	A	C	-	-	A	A
HCM 95th %tile Q(veh)	-	1.9	-	-	1.2	-

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	80	10	640	160	10	740
Future Volume (vph)	80	10	640	160	10	740
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0		6.0	6.0	6.0	6.0
Lane Util. Factor	1.00		1.00	1.00	1.00	1.00
Frt	0.98		1.00	0.85	1.00	1.00
Flt Protected	0.96		1.00	1.00	0.95	1.00
Satd. Flow (prot)	1772		1900	1615	1805	1900
Flt Permitted	0.96		1.00	1.00	0.22	1.00
Satd. Flow (perm)	1772		1900	1615	414	1900
Peak-hour factor, PHF	0.87	0.67	0.95	0.84	0.73	0.96
Adj. Flow (vph)	92	15	674	190	14	771
RTOR Reduction (vph)	6	0	0	41	0	0
Lane Group Flow (vph)	101	0	674	149	14	771
Heavy Vehicles (%)	1%	0%	0%	0%	0%	0%
Turn Type	Prot		NA	Perm	custom	NA
Protected Phases	7		6 8		5	2 8
Permitted Phases				6 8	2	
Actuated Green, G (s)	8.0		67.4	67.4	26.4	65.5
Effective Green, g (s)	8.0		67.4	67.4	26.4	65.5
Actuated g/C Ratio	0.08		0.67	0.67	0.26	0.65
Clearance Time (s)	6.0				6.0	
Vehicle Extension (s)	3.0				3.0	
Lane Grp Cap (vph)	141		1275	1084	122	1239
v/s Ratio Prot	c0.06		0.35		c0.00	c0.41
v/s Ratio Perm				0.09	0.03	
v/c Ratio	0.72		0.53	0.14	0.11	0.62
Uniform Delay, d1	45.1		8.4	6.0	28.2	10.2
Progression Factor	1.00		0.23	0.31	1.00	1.00
Incremental Delay, d2	16.1		0.2	0.0	0.4	1.0
Delay (s)	61.2		2.2	1.9	28.6	11.2
Level of Service	E		A	A	C	B
Approach Delay (s)	61.2		2.1			11.5
Approach LOS	E		A			B

Intersection Summary			
HCM 2000 Control Delay	9.9	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.61		
Actuated Cycle Length (s)	100.4	Sum of lost time (s)	24.0
Intersection Capacity Utilization	54.0%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	5	30	40	610	720	10
Future Volume (vph)	5	30	40	610	720	10
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0	0	100			0
Storage Lanes	1	0	1			0
Taper Length (ft)	25		25			
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.888				0.998	
Flt Protected	0.992		0.950			
Satd. Flow (prot)	1674	0	1787	1900	1878	0
Flt Permitted	0.992		0.950			
Satd. Flow (perm)	1674	0	1787	1900	1878	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	332			288	365	
Travel Time (s)	7.5			6.5	8.3	
Peak Hour Factor	0.64	0.77	0.71	0.90	0.75	0.55
Heavy Vehicles (%)	0%	0%	1%	0%	1%	0%
Adj. Flow (vph)	8	39	56	678	960	18
Shared Lane Traffic (%)						
Lane Group Flow (vph)	47	0	56	678	978	0
Sign Control	Stop			Free	Free	

Intersection Summary	
Area Type: Other	
Control Type: Unsignalized	
Intersection Capacity Utilization 48.5%	ICU Level of Service A
Analysis Period (min) 15	

Intersection						
Int Delay, s/veh	1					

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	5	30	40	610	720	10
Future Vol, veh/h	5	30	40	610	720	10
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	100	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	64	77	71	90	75	55
Heavy Vehicles, %	0	0	1	0	1	0
Mvmt Flow	8	39	56	678	960	18

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1759	969	978	0	-	0
Stage 1	969	-	-	-	-	-
Stage 2	790	-	-	-	-	-
Critical Hdwy	6.4	6.2	4.11	-	-	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.3	2.209	-	-	-
Pot Cap-1 Maneuver	94	310	710	-	-	-
Stage 1	371	-	-	-	-	-
Stage 2	451	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	87	310	710	-	-	-
Mov Cap-2 Maneuver	87	-	-	-	-	-
Stage 1	342	-	-	-	-	-
Stage 2	451	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	26.1	0.8	0
HCM LOS	D		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	710	-	217	-	-
HCM Lane V/C Ratio	0.079	-	0.216	-	-
HCM Control Delay (s)	10.5	-	26.1	-	-
HCM Lane LOS	B	-	D	-	-
HCM 95th %tile Q(veh)	0.3	-	0.8	-	-

APPENDIX P-3: 2040 ALTERNATIVE B INTERSECTION CAPACITY ANALYSES – SYNCHRO PRINOUTS – AM PEAK HOUR

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑↑		↰	↱↱
Traffic Volume (vph)	0	1280	720	0	385	925
Future Volume (vph)	0	1280	720	0	385	925
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	16	12
Lane Util. Factor	1.00	0.95	0.95	1.00	1.00	0.88
Frt						0.850
Flt Protected					0.950	
Satd. Flow (prot)	0	3471	3406	0	1930	2682
Flt Permitted					0.950	
Satd. Flow (perm)	0	3471	3406	0	1930	2682
Right Turn on Red				Yes		No
Satd. Flow (RTOR)						
Link Speed (mph)		30	30		25	
Link Distance (ft)		712	388		212	
Travel Time (s)		16.2	8.8		5.8	
Peak Hour Factor	0.93	0.93	0.88	0.88	0.89	0.89
Heavy Vehicles (%)	4%	4%	6%	6%	6%	6%
Adj. Flow (vph)	0	1376	818	0	433	1039
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	1376	818	0	433	1039
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(ft)		24	24		16	
Link Offset(ft)		0	0		0	
Crosswalk Width(ft)		16	16		16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	0.85	1.00
Turning Speed (mph)	15			9	15	9
Number of Detectors		3	3		3	3
Detector Template		Thru	Thru		Left	
Leading Detector (ft)		256	256		256	256
Trailing Detector (ft)		-5	-5		-5	-5
Detector 1 Position(ft)		-5	-5		-5	-5
Detector 1 Size(ft)		50	50		50	50
Detector 1 Type		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex
Detector 1 Channel						
Detector 1 Extend (s)		0.0	0.0		0.0	0.0
Detector 1 Queue (s)		0.0	0.0		0.0	0.0
Detector 1 Delay (s)		0.0	0.0		0.0	0.0
Detector 2 Position(ft)		125	125		125	125
Detector 2 Size(ft)		6	6		6	6
Detector 2 Type		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex
Detector 2 Channel						
Detector 2 Extend (s)		0.0	0.0		0.0	0.0
Detector 3 Position(ft)		250	250		250	250
Detector 3 Size(ft)		6	6		6	6
Detector 3 Type		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex
Detector 3 Channel						

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Detector 3 Extend (s)		0.0	0.0		0.0	0.0
Turn Type		NA	NA		Prot	Prot
Protected Phases		2	6		4	4
Permitted Phases						
Detector Phase		2	6		4	4
Switch Phase						
Minimum Initial (s)		8.0	8.0		5.0	5.0
Minimum Split (s)		14.0	21.0		27.0	27.0
Total Split (s)		38.0	38.0		37.0	37.0
Total Split (%)		50.7%	50.7%		49.3%	49.3%
Maximum Green (s)		32.0	32.0		31.0	31.0
Yellow Time (s)		2.0	2.0		2.0	2.0
All-Red Time (s)		4.0	4.0		4.0	4.0
Lost Time Adjust (s)		0.0	0.0		0.0	0.0
Total Lost Time (s)		6.0	6.0		6.0	6.0
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)		3.0	3.0		3.0	3.0
Recall Mode		C-Min	C-Min		None	None
Walk Time (s)			7.0		7.0	7.0
Flash Dont Walk (s)			8.0		14.0	14.0
Pedestrian Calls (#/hr)			0		0	0
Act Effct Green (s)		32.0	32.0		31.0	31.0
Actuated g/C Ratio		0.43	0.43		0.41	0.41
v/c Ratio		0.93	0.56		0.54	0.94
Control Delay		26.5	22.7		19.8	38.4
Queue Delay		0.0	0.0		0.0	0.0
Total Delay		26.5	22.7		19.8	38.4
LOS		C	C		B	D
Approach Delay		26.5	22.7		32.9	
Approach LOS		C	C		C	
Queue Length 50th (ft)		306	382		148	254
Queue Length 95th (ft)		m333	m387		228	#390
Internal Link Dist (ft)		632	308		132	
Turn Bay Length (ft)						
Base Capacity (vph)		1480	1453		797	1108
Starvation Cap Reductn		0	0		0	0
Spillback Cap Reductn		0	0		0	0
Storage Cap Reductn		0	0		0	0
Reduced v/c Ratio		0.93	0.56		0.54	0.94

Intersection Summary

Area Type: Other

Cycle Length: 75

Actuated Cycle Length: 75

Offset: 0 (0%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow, Master Intersection

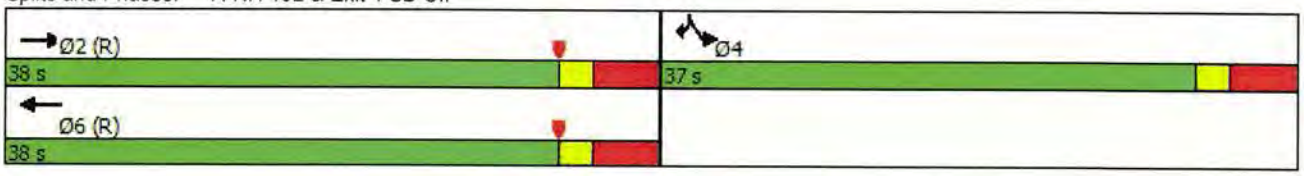
Natural Cycle: 80

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.94

Intersection Signal Delay: 28.2 Intersection LOS: C
Intersection Capacity Utilization 68.7% ICU Level of Service C
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 7: NH 102 & Exit 4 SB Off



Lane Group	NBL2	NBL	NBR	SEL	SER	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations											
Traffic Volume (vph)	485	0	245	0	0	1415	250	0	0	820	500
Future Volume (vph)	485	0	245	0	0	1415	250	0	0	820	500
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)		0	0	0	0	550		0	0		0
Storage Lanes		2	2	0	0	2		0	0		1
Taper Length (ft)		25		25		25			25		
Lane Util. Factor	0.97	1.00	0.88	1.00	1.00	0.97	0.95	1.00	1.00	0.95	1.00
Frt			0.850								0.850
Flt Protected	0.950					0.950					
Satd. Flow (prot)	3242	0	2632	0	0	3335	3438	0	0	3505	1568
Flt Permitted	0.950					0.950					
Satd. Flow (perm)	3242	0	2632	0	0	3335	3438	0	0	3505	1568
Right Turn on Red			No					Yes			Yes
Satd. Flow (RTOR)											306
Link Speed (mph)		25		30			30			30	
Link Distance (ft)		856		390			760			857	
Travel Time (s)		23.3		8.9			17.3			19.5	
Peak Hour Factor	0.88	0.88	0.88	0.92	0.92	0.94	0.94	0.94	0.92	0.92	0.92
Heavy Vehicles (%)	8%	8%	8%	2%	2%	5%	5%	5%	3%	3%	3%
Adj. Flow (vph)	551	0	278	0	0	1505	266	0	0	891	543
Shared Lane Traffic (%)											
Lane Group Flow (vph)	551	0	278	0	0	1505	266	0	0	891	543
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Right	Left	Left	Right	Left	Right	Right
Median Width(ft)		24		0			24			24	
Link Offset(ft)		12		0			0			0	
Crosswalk Width(ft)		16		16			16			16	
Two way Left Turn Lane											
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15	15	25	15	9	15		9	15		25
Number of Detectors	3		3			3	3			3	0
Detector Template											
Leading Detector (ft)	256		256			256	256			256	0
Trailing Detector (ft)	-5		-5			-5	-5			-5	0
Detector 1 Position(ft)	-5		-5			-5	-5			-5	-5
Detector 1 Size(ft)	55		55			55	55			55	50
Detector 1 Type	Cl+Ex		Cl+Ex			Cl+Ex	Cl+Ex			Cl+Ex	Cl+Ex
Detector 1 Channel											
Detector 1 Extend (s)	0.0		0.0			0.0	0.0			0.0	0.0
Detector 1 Queue (s)	0.0		0.0			0.0	0.0			0.0	0.0
Detector 1 Delay (s)	0.0		0.0			0.0	0.0			0.0	0.0
Detector 2 Position(ft)	125		125			125	125			125	
Detector 2 Size(ft)	6		6			6	6			6	
Detector 2 Type	Cl+Ex		Cl+Ex			Cl+Ex	Cl+Ex			Cl+Ex	
Detector 2 Channel											
Detector 2 Extend (s)	0.0		0.0			0.0	0.0			0.0	
Detector 3 Position(ft)	250		250			250	250			250	
Detector 3 Size(ft)	6		6			6	6			6	

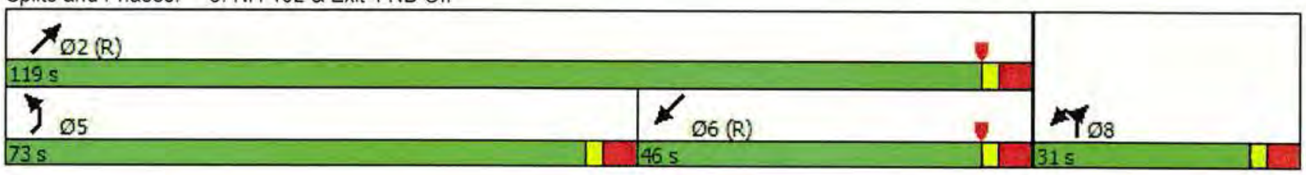
Lane Group	NBL2	NBL	NBR	SEL	SER	NEL	NET	NER	SWL	SWT	SWR
Detector 3 Type	Cl+Ex		Cl+Ex			Cl+Ex	Cl+Ex			Cl+Ex	
Detector 3 Channel											
Detector 3 Extend (s)	0.0		0.0			0.0	0.0			0.0	
Turn Type	Prot		Prot			Prot	NA			NA	Free
Protected Phases	8		8			5	2			6	
Permitted Phases											Free
Detector Phase	8		2			5	2			6	
Switch Phase											
Minimum Initial (s)	10.0		10.0			5.0	8.0			8.0	
Minimum Split (s)	16.0		16.0			11.0	42.0			31.0	
Total Split (s)	31.0		31.0			73.0	119.0			46.0	
Total Split (%)	20.7%		20.7%			48.7%	79.3%			30.7%	
Maximum Green (s)	25.0		25.0			67.0	113.0			40.0	
Yellow Time (s)	2.0		2.0			2.0	2.0			2.0	
All-Red Time (s)	4.0		4.0			4.0	4.0			4.0	
Lost Time Adjust (s)	0.0		0.0			0.0	0.0			0.0	
Total Lost Time (s)	6.0		6.0			6.0	6.0			6.0	
Lead/Lag						Lead				Lag	
Lead-Lag Optimize?											
Vehicle Extension (s)	3.0		3.0			3.0	3.0			3.0	
Recall Mode	None		None			None	C-Min			C-Min	
Walk Time (s)							7.0			7.0	
Flash Dont Walk (s)							29.0			17.0	
Pedestrian Calls (#/hr)							0			0	
Act Effct Green (s)	25.0		25.0			67.0	113.0			40.0	150.0
Actuated g/C Ratio	0.17		0.17			0.45	0.75			0.27	1.00
v/c Ratio	1.02		0.63			1.01	0.10			0.95	0.35
Control Delay	104.4		65.6			51.1	9.0			74.0	0.6
Queue Delay	0.0		0.0			0.0	0.0			0.0	0.0
Total Delay	104.4		65.6			51.1	9.0			74.0	0.6
LOS	F		E			D	A			E	A
Approach Delay		91.3					44.7			46.2	
Approach LOS		F					D			D	
Queue Length 50th (ft)	~293		146			~706	51			454	0
Queue Length 95th (ft)	#398		197			m#903	m57			#588	0
Internal Link Dist (ft)		776		310			680			777	
Turn Bay Length (ft)						550					
Base Capacity (vph)	540		438			1489	2589			934	1568
Starvation Cap Reductn	0		0			0	0			0	0
Spillback Cap Reductn	0		0			0	0			0	0
Storage Cap Reductn	0		0			0	0			0	0
Reduced v/c Ratio	1.02		0.63			1.01	0.10			0.95	0.35

Intersection Summary

Area Type: Other
Cycle Length: 150
Actuated Cycle Length: 150
Offset: 147 (98%), Referenced to phase 2:NET and 6:SWT, Start of Yellow
Natural Cycle: 130

Control Type: Actuated-Coordinated
Maximum v/c Ratio: 1.02
Intersection Signal Delay: 54.9 Intersection LOS: D
Intersection Capacity Utilization 92.9% ICU Level of Service F
Analysis Period (min) 15
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 8: NH 102 & Exit 4 NB Off



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑	↱	↰	↑↑					↰↰		↱
Traffic Volume (vph)	0	690	420	260	730	0	0	0	0	105	0	385
Future Volume (vph)	0	690	420	260	730	0	0	0	0	105	0	385
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		350	0		0	0		0	0		0
Storage Lanes	0		1	1		0	0		0	2		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	0.97	1.00	1.00
Frt			0.850									0.850
Flt Protected				0.950						0.950		
Satd. Flow (prot)	0	3167	1417	1687	3374	0	0	0	0	3303	0	1524
Flt Permitted				0.950						0.950		
Satd. Flow (perm)	0	3167	1417	1687	3374	0	0	0	0	3303	0	1524
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			457									110
Link Speed (mph)		30			30			30			35	
Link Distance (ft)		851			693			486			581	
Travel Time (s)		19.3			15.8			11.0			11.3	
Peak Hour Factor	0.92	0.92	0.92	0.73	0.73	0.73	0.92	0.92	0.92	0.74	0.74	0.74
Heavy Vehicles (%)	14%	14%	14%	7%	7%	7%	2%	2%	2%	6%	6%	6%
Adj. Flow (vph)	0	750	457	356	1000	0	0	0	0	142	0	520
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	750	457	356	1000	0	0	0	0	142	0	520
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Right	Right	Left	Left	Right	Left	Left	Right	R NA	Left	Right
Median Width(ft)		36			36			24			24	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		25	15		9	15		9	15		9
Number of Detectors		3	2	3	3					3		2
Detector Template		Thru	Right	Left	Thru					Left		
Leading Detector (ft)		256	131	256	256					256		206
Trailing Detector (ft)		-5	-5	-5	-5					-5		-5
Detector 1 Position(ft)		-5	-5	-5	-5					-5		-5
Detector 1 Size(ft)		50	50	50	50					50		50
Detector 1 Type		Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex					Cl+Ex		Cl+Ex
Detector 1 Channel												
Detector 1 Extend (s)		0.0	0.0	0.0	0.0					0.0		0.0
Detector 1 Queue (s)		0.0	0.0	0.0	0.0					0.0		0.0
Detector 1 Delay (s)		0.0	0.0	0.0	0.0					0.0		0.0
Detector 2 Position(ft)		125	125	125	125					125		200
Detector 2 Size(ft)		6	6	6	6					6		6
Detector 2 Type		Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex					Cl+Ex		Cl+Ex
Detector 2 Channel												
Detector 2 Extend (s)		0.0	0.0	0.0	0.0					0.0		0.0
Detector 3 Position(ft)		250		250	250					250		
Detector 3 Size(ft)		6		6	6					6		

Lanes, Volumes, Timings
3 ~~2~~: Exit 5 SB On/Exit 5 SB Off & NH 28

01/23/2018

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Detector 3 Type		Cl+Ex		Cl+Ex	Cl+Ex					Cl+Ex		
Detector 3 Channel												
Detector 3 Extend (s)		0.0		0.0	0.0					0.0		
Turn Type		NA	Free	Prot	NA					Prot		Prot
Protected Phases		2		1	6					4		4
Permitted Phases			Free									
Detector Phase		2		1	6					4		4
Switch Phase												
Minimum Initial (s)		9.0		4.0	9.0					4.0		4.0
Minimum Split (s)		21.0		10.0	21.0					10.0		10.0
Total Split (s)		42.0		39.0	81.0					49.0		49.0
Total Split (%)		32.3%		30.0%	62.3%					37.7%		37.7%
Maximum Green (s)		36.0		33.0	75.0					43.0		43.0
Yellow Time (s)		4.0		4.0	4.0					4.0		4.0
All-Red Time (s)		2.0		2.0	2.0					2.0		2.0
Lost Time Adjust (s)		0.0		0.0	0.0					0.0		0.0
Total Lost Time (s)		6.0		6.0	6.0					6.0		6.0
Lead/Lag		Lag		Lead								
Lead-Lag Optimize?												
Vehicle Extension (s)		5.0		3.0	5.0					3.0		3.0
Recall Mode		C-Min		None	C-Min					None		None
Walk Time (s)		7.0			7.0							
Flash Dont Walk (s)		8.0			8.0							
Pedestrian Calls (#/hr)		0			0							
Act Effct Green (s)		40.3	130.0	30.7	77.0					41.0		41.0
Actuated g/C Ratio		0.31	1.00	0.24	0.59					0.32		0.32
v/c Ratio		0.76	0.32	0.89	0.50					0.14		0.94
Control Delay		47.8	0.6	39.7	2.8					31.5		59.3
Queue Delay		0.0	0.0	0.0	0.0					0.0		0.0
Total Delay		47.8	0.6	39.7	2.8					31.5		59.3
LOS		D	A	D	A					C		E
Approach Delay		30.0			12.5						53.3	
Approach LOS		C			B						D	
Queue Length 50th (ft)		316	0	255	53					43		343
Queue Length 95th (ft)		#404	0	m142	39					55		356
Internal Link Dist (ft)		771			613			406			501	
Turn Bay Length (ft)			350									
Base Capacity (vph)		981	1417	428	1998					1092		577
Starvation Cap Reductn		0	0	0	0					0		0
Spillback Cap Reductn		0	0	0	0					0		0
Storage Cap Reductn		0	0	0	0					0		0
Reduced v/c Ratio		0.76	0.32	0.83	0.50					0.13		0.90

Intersection Summary	
Area Type:	Other
Cycle Length: 130	
Actuated Cycle Length: 130	
Offset: 75 (58%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow	
Natural Cycle: 80	

Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.94
Intersection Signal Delay: 27.4 Intersection LOS: C
Intersection Capacity Utilization 76.3% ICU Level of Service D
Analysis Period (min) 15
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 2: Exit 5 SB On/Exit 5 SB Off & NH 28

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑			↑↑	↱	↰		↱			
Traffic Volume (vph)	525	270	0	0	545	570	445	0	165	0	0	0
Future Volume (vph)	525	270	0	0	545	570	445	0	165	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt						0.850			0.850			
Flt Protected	0.950						0.950					
Satd. Flow (prot)	1641	3282	0	0	3438	1538	1656	0	1482	0	0	0
Flt Permitted	0.950						0.950					
Satd. Flow (perm)	1641	3282	0	0	3438	1538	1656	0	1482	0	0	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						604			169			
Link Speed (mph)		30			30			35			30	
Link Distance (ft)		693			542			867			392	
Travel Time (s)		15.8			12.3			16.9			8.9	
Peak Hour Factor	0.87	0.87	0.87	0.90	0.90	0.90	0.78	0.78	0.78	0.92	0.92	0.92
Heavy Vehicles (%)	10%	10%	10%	5%	5%	5%	9%	9%	9%	2%	2%	2%
Adj. Flow (vph)	603	310	0	0	606	633	571	0	212	0	0	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	603	310	0	0	606	633	571	0	212	0	0	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Right	Right	Right	Left	Right	Left	Left	Right
Median Width(ft)		36			42			12			12	
Link Offset(ft)		0			0			0			36	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		25	15		9	15		9
Number of Detectors	3	3			3	2	3		0			
Detector Template	Left	Thru			Thru	Right	Left					
Leading Detector (ft)	256	256			256	131	256		0			
Trailing Detector (ft)	-5	-5			-5	-5	-5		0			
Detector 1 Position(ft)	-5	-5			-5	-5	-5		-5			
Detector 1 Size(ft)	50	50			50	50	50		50			
Detector 1 Type	Cl+Ex	Cl+Ex			Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex			
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0			0.0	0.0	0.0		0.0			
Detector 1 Queue (s)	0.0	0.0			0.0	0.0	0.0		0.0			
Detector 1 Delay (s)	0.0	0.0			0.0	0.0	0.0		0.0			
Detector 2 Position(ft)	125	125			125	125	125					
Detector 2 Size(ft)	6	6			6	6	6					
Detector 2 Type	Cl+Ex	Cl+Ex			Cl+Ex	Cl+Ex	Cl+Ex					
Detector 2 Channel												
Detector 2 Extend (s)	0.0	0.0			0.0	0.0	0.0					
Detector 3 Position(ft)	250	250			250		250					
Detector 3 Size(ft)	6	6			6		6					
Detector 3 Type	Cl+Ex	Cl+Ex			Cl+Ex		Cl+Ex					
Detector 3 Channel												
Detector 3 Extend (s)	0.0	0.0			0.0		0.0					

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Type	Prot	NA			NA	Free	Prot		Prot			
Protected Phases	5	2			6		8		8			
Permitted Phases		2			6	Free						
Detector Phase	5	2			6		8		8			
Switch Phase												
Minimum Initial (s)	4.0	16.0			16.0		4.0		4.0			
Minimum Split (s)	10.0	23.0			23.0		10.0		10.0			
Total Split (s)	52.0	81.0			29.0		49.0		49.0			
Total Split (%)	40.0%	62.3%			22.3%		37.7%		37.7%			
Maximum Green (s)	46.0	75.0			23.0		43.0		43.0			
Yellow Time (s)	4.0	4.0			4.0		4.0		4.0			
All-Red Time (s)	2.0	2.0			2.0		2.0		2.0			
Lost Time Adjust (s)	0.0	0.0			0.0		0.0		0.0			
Total Lost Time (s)	6.0	6.0			6.0		6.0		6.0			
Lead/Lag	Lead				Lag							
Lead-Lag Optimize?												
Vehicle Extension (s)	5.0	5.0			5.0		3.0		3.0			
Recall Mode	None	C-Min			C-Min		None		None			
Walk Time (s)		7.0			7.0							
Flash Dont Walk (s)		10.0			10.0							
Pedestrian Calls (#/hr)		0			0							
Act Effct Green (s)	46.0	75.0			23.0	130.0	43.0		43.0			
Actuated g/C Ratio	0.35	0.58			0.18	1.00	0.33		0.33			
v/c Ratio	1.04	0.16			1.00	0.41	1.04		0.35			
Control Delay	55.8	2.7			89.0	0.8	92.8		9.7			
Queue Delay	0.0	0.0			0.0	0.0	0.0		0.0			
Total Delay	55.8	2.7			89.0	0.8	92.8		9.7			
LOS	E	A			F	A	F		A			
Approach Delay		37.8			43.9			70.3				
Approach LOS		D			D			E				
Queue Length 50th (ft)	~534	5			271	0	~520		25			
Queue Length 95th (ft)	#684	7			#398	0	#583		57			
Internal Link Dist (ft)		613			462			787			312	
Turn Bay Length (ft)												
Base Capacity (vph)	580	1893			608	1538	547		603			
Starvation Cap Reductn	0	0			0	0	0		0			
Spillback Cap Reductn	0	0			0	0	0		0			
Storage Cap Reductn	0	0			0	0	0		0			
Reduced v/c Ratio	1.04	0.16			1.00	0.41	1.04		0.35			

Intersection Summary

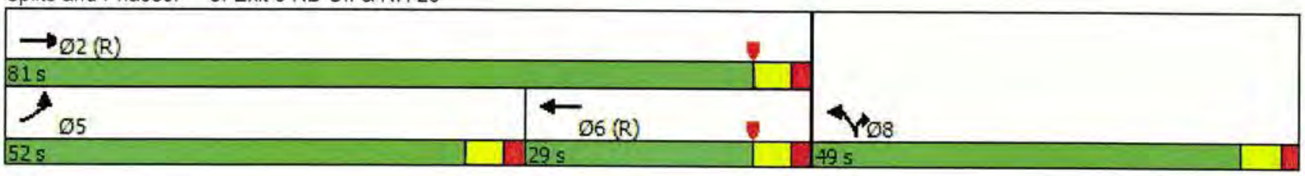
Area Type: Other
Cycle Length: 130
Actuated Cycle Length: 130
Offset: 0 (0%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow, Master Intersection
Natural Cycle: 130
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 1.04
Intersection Signal Delay: 49.1 Intersection LOS: D

Intersection Capacity Utilization 76.3% ICU Level of Service D
Analysis Period (min) 15

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 3: Exit 5 NB Off & NH 28



Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	10	0	150	0	1	0	60	410	0	5	1030	20
Future Volume (vph)	10	0	150	0	1	0	60	410	0	5	1030	20
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		225	0		0	350		0	100		0
Storage Lanes	0		1	0		0	1		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00	0.95	0.95
Frt			0.850								0.997	
Flt Protected		0.950					0.950			0.950		
Satd. Flow (prot)	0	1770	1583	0	1900	0	1770	3539	0	1770	3529	0
Flt Permitted							0.950			0.950		
Satd. Flow (perm)	0	1863	1583	0	1900	0	1770	3539	0	1770	3529	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			182								3	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		593			447			750			330	
Travel Time (s)		13.5			10.2			17.0			7.5	
Peak Hour Factor	0.92	0.92	0.92	0.25	0.25	0.25	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	2%	2%	2%	0%	0%	0%	2%	2%	2%	2%	2%	2%
Adj. Flow (vph)	11	0	163	0	4	0	65	446	0	5	1120	22
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	11	163	0	4	0	65	446	0	5	1142	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	3	3	1	3	1		3	3		3	3	
Detector Template	Left	Thru	Right	Left			Left	Thru		Left	Thru	
Leading Detector (ft)	256	256	45	256	45		256	256		256	256	
Trailing Detector (ft)	-5	-5	-5	-5	-5		-5	-5		-5	-5	
Detector 1 Position(ft)	-5	-5	-5	-5	-5		-5	-5		-5	-5	
Detector 1 Size(ft)	50	50	50	50	50		50	50		50	50	
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(ft)	125	125		125			125	125		125	125	
Detector 2 Size(ft)	6	6		6			6	6		6	6	
Detector 2 Type	Cl+Ex	Cl+Ex		Cl+Ex			Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)	0.0	0.0		0.0			0.0	0.0		0.0	0.0	
Detector 3 Position(ft)	250	250		250			250	250		250	250	
Detector 3 Size(ft)	6	6		6			6	6		6	6	

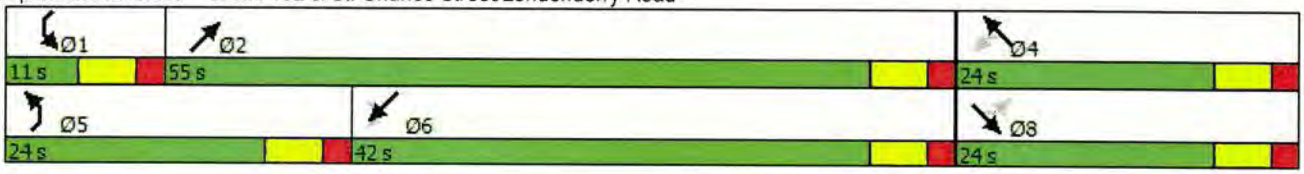
Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Detector 3 Type	Cl+Ex	Cl+Ex		Cl+Ex			Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 3 Channel												
Detector 3 Extend (s)	0.0	0.0		0.0			0.0	0.0		0.0	0.0	
Turn Type	Perm	NA	custom		NA		Prot	NA		Prot	NA	
Protected Phases		8			4		5	2		1	6	
Permitted Phases	8		6	4								
Detector Phase	8	8	6	4	4		5	2		1	6	
Switch Phase												
Minimum Initial (s)	5.0	5.0	8.0	5.0	5.0		5.0	8.0		5.0	8.0	
Minimum Split (s)	24.0	24.0	24.0	24.0	24.0		24.0	24.0		11.0	24.0	
Total Split (s)	24.0	24.0	42.0	24.0	24.0		24.0	55.0		11.0	42.0	
Total Split (%)	26.7%	26.7%	46.7%	26.7%	26.7%		26.7%	61.1%		12.2%	46.7%	
Maximum Green (s)	18.0	18.0	36.0	18.0	18.0		18.0	49.0		5.0	36.0	
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)		0.0	0.0		0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)		6.0	6.0		6.0		6.0	6.0		6.0	6.0	
Lead/Lag			Lag				Lead	Lag		Lead	Lag	
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None	Min	None	None		None	Min		None	Min	
Walk Time (s)	7.0	7.0	7.0	7.0	7.0		7.0	7.0			7.0	
Flash Dont Walk (s)	11.0	11.0	11.0	11.0	11.0		11.0	11.0			11.0	
Pedestrian Calls (#/hr)	0	0	0	0	0		0	0			0	
Act Effct Green (s)		6.3	43.5		6.2		7.9	55.9		5.2	43.5	
Actuated g/C Ratio		0.10	0.71		0.10		0.13	0.91		0.09	0.71	
v/c Ratio		0.06	0.14		0.02		0.29	0.14		0.03	0.45	
Control Delay		27.3	1.6		27.0		29.0	2.4		29.0	7.4	
Queue Delay		0.0	0.0		0.0		0.0	0.0		0.0	0.0	
Total Delay		27.3	1.6		27.0		29.0	2.4		29.0	7.4	
LOS		C	A		C		C	A		C	A	
Approach Delay		3.2			27.0			5.8			7.5	
Approach LOS		A			C			A			A	
Queue Length 50th (ft)		4	0		1		23	0		2	85	
Queue Length 95th (ft)		19	22		3		60	67		12	248	
Internal Link Dist (ft)		513			367			670			250	
Turn Bay Length (ft)			225				350			100		
Base Capacity (vph)		567	1178		578		538	3313		149	2511	
Starvation Cap Reductn		0	0		0		0	0		0	0	
Spillback Cap Reductn		0	0		0		0	0		0	0	
Storage Cap Reductn		0	0		0		0	0		0	0	
Reduced v/c Ratio		0.02	0.14		0.01		0.12	0.13		0.03	0.45	

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 61.1
Natural Cycle: 80
Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.45
Intersection Signal Delay: 6.6 Intersection LOS: A
Intersection Capacity Utilization 61.4% ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 9: NH 102 & St. Charles Street/Londonderry Road



Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	10	50	0	350	0	40	0	360	110	15	545	0
Future Volume (vph)	10	50	0	350	0	40	0	360	110	15	545	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt					0.986			0.968				
Flt Protected		0.992			0.957						0.999	
Satd. Flow (prot)	0	1848	0	0	1741	0	0	1703	0	0	1808	0
Flt Permitted		0.910			0.678						0.982	
Satd. Flow (perm)	0	1695	0	0	1233	0	0	1703	0	0	1777	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)					36			24				
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		356			493			1124			603	
Travel Time (s)		8.1			11.2			25.5			13.7	
Peak Hour Factor	0.60	0.60	0.60	0.96	0.96	0.96	0.89	0.89	0.89	0.86	0.86	0.86
Heavy Vehicles (%)	2%	2%	2%	3%	3%	3%	8%	8%	8%	5%	5%	5%
Adj. Flow (vph)	17	83	0	365	0	42	0	404	124	17	634	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	100	0	0	407	0	0	528	0	0	651	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0			0	
Link Offset(ft)		-22			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	3	1		3	2			2		3	2	
Detector Template	Left			Left						Left		
Leading Detector (ft)	256	45		256	131			131		256	131	
Trailing Detector (ft)	-5	-5		-5	-5			-5		-5	-5	
Detector 1 Position(ft)	-5	-5		-5	-5			-5		-5	-5	
Detector 1 Size(ft)	50	50		50	50			50		50	50	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex			Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0			0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0			0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0			0.0		0.0	0.0	
Detector 2 Position(ft)	125			125	125			125		125	125	
Detector 2 Size(ft)	6			6	6			6		6	6	
Detector 2 Type	Cl+Ex			Cl+Ex	Cl+Ex			Cl+Ex		Cl+Ex	Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)	0.0			0.0	0.0			0.0		0.0	0.0	
Detector 3 Position(ft)	250			250						250		
Detector 3 Size(ft)	6			6						6		
Detector 3 Type	Cl+Ex			Cl+Ex						Cl+Ex		
Detector 3 Channel												
Detector 3 Extend (s)	0.0			0.0						0.0		

Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Turn Type	Perm	NA		Perm	NA			NA		Perm	NA	
Protected Phases		4			4			2			2	
Permitted Phases	4			4						2		
Detector Phase	4	4		4	4			2		2	2	
Switch Phase												
Minimum Initial (s)	5.0	5.0		5.0	5.0			5.0		5.0	5.0	
Minimum Split (s)	24.0	24.0		24.0	24.0			24.0		24.0	24.0	
Total Split (s)	41.0	41.0		41.0	41.0			49.0		49.0	49.0	
Total Split (%)	45.6%	45.6%		45.6%	45.6%			54.4%		54.4%	54.4%	
Maximum Green (s)	35.0	35.0		35.0	35.0			43.0		43.0	43.0	
Yellow Time (s)	4.0	4.0		4.0	4.0			4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0			2.0		2.0	2.0	
Lost Time Adjust (s)		0.0			0.0			0.0			0.0	
Total Lost Time (s)		6.0			6.0			6.0			6.0	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0		3.0	3.0	
Recall Mode	None	None		None	None			Min		Min	Min	
Walk Time (s)	7.0	7.0		7.0	7.0			7.0		7.0	7.0	
Flash Dont Walk (s)	11.0	11.0		11.0	11.0			11.0		11.0	11.0	
Pedestrian Calls (#/hr)	0	0		0	0			0		0	0	
Act Effct Green (s)		28.5			28.5			36.1			36.1	
Actuated g/C Ratio		0.37			0.37			0.47			0.47	
v/c Ratio		0.16			0.86			0.65			0.78	
Control Delay		18.5			40.4			20.3			26.2	
Queue Delay		0.0			0.0			0.0			0.0	
Total Delay		18.5			40.4			20.3			26.2	
LOS		B			D			C			C	
Approach Delay		18.5			40.4			20.3			26.2	
Approach LOS		B			D			C			C	
Queue Length 50th (ft)		36			187			203			288	
Queue Length 95th (ft)		45			#351			312			404	
Internal Link Dist (ft)		276			413			1044			523	
Turn Bay Length (ft)												
Base Capacity (vph)		813			610			1014			1048	
Starvation Cap Reductn		0			0			0			0	
Spillback Cap Reductn		0			0			0			0	
Storage Cap Reductn		0			0			0			0	
Reduced v/c Ratio		0.12			0.67			0.52			0.62	

Intersection Summary	
Area Type: Other	
Cycle Length: 90	
Actuated Cycle Length: 77.3	
Natural Cycle: 60	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.86	
Intersection Signal Delay: 27.3	Intersection LOS: C
Intersection Capacity Utilization 80.6%	ICU Level of Service D

Analysis Period (min) 15

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 10: NH 102 & Fordway/Madden Hill Road

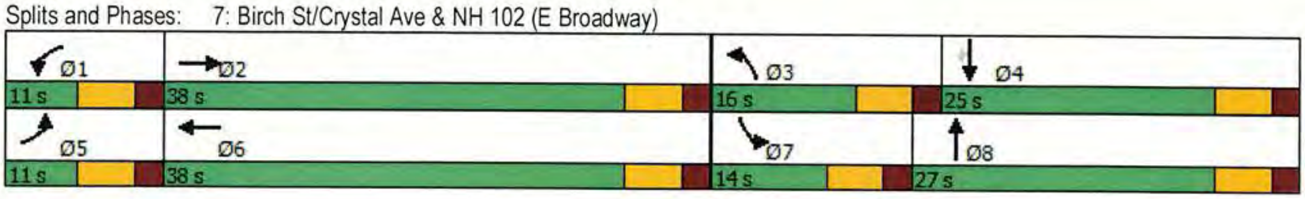
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↱		↰	↱		↰	↑	↱
Traffic Volume (vph)	70	220	60	20	340	190	150	200	20	60	260	20
Future Volume (vph)	70	220	60	20	340	190	150	200	20	60	260	20
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	390		0	110		0	70		0	245		245
Storage Lanes	1		0	1		0	1		0	1		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.968			0.946			0.986				0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1656	1687	0	1703	1696	0	1719	1784	0	1703	1792	1524
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1656	1687	0	1703	1696	0	1719	1784	0	1703	1792	1524
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		17			35			5				182
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		505			530			361			411	
Travel Time (s)		11.5			12.0			8.2			9.3	
Peak Hour Factor	0.96	0.96	0.96	0.94	0.94	0.94	0.85	0.85	0.85	0.91	0.91	0.91
Heavy Vehicles (%)	9%	9%	9%	6%	6%	6%	5%	5%	5%	6%	6%	6%
Parking (#/hr)			0									
Adj. Flow (vph)	73	229	63	21	362	202	176	235	24	66	286	22
Shared Lane Traffic (%)												
Lane Group Flow (vph)	73	292	0	21	564	0	176	259	0	66	286	22
Turn Type	Prot	NA		Prot	NA		Prot	NA		Prot	NA	Perm
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases												4
Detector Phase	5	2		1	6		3	8		7	4	4
Switch Phase												
Minimum Initial (s)	4.0	5.0		4.0	10.0		4.0	10.0		4.0	9.0	9.0
Minimum Split (s)	10.0	30.0		10.0	30.0		10.0	25.0		10.0	25.0	25.0
Total Split (s)	11.0	38.0		11.0	38.0		16.0	27.0		14.0	25.0	25.0
Total Split (%)	12.2%	42.2%		12.2%	42.2%		17.8%	30.0%		15.6%	27.8%	27.8%
Maximum Green (s)	5.0	32.0		5.0	32.0		10.0	21.0		8.0	19.0	19.0
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	6.0
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lag		Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes	Yes
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Recall Mode	None	Min		None	Min		Min	None		Min	None	None
Walk Time (s)		7.0			7.0			7.0			7.0	7.0
Flash Dont Walk (s)		11.0			11.0			11.0			11.0	11.0
Pedestrian Calls (#/hr)		10			10			0			10	10
Act Effct Green (s)	5.1	33.6		5.1	29.4		10.3	19.8		7.4	16.9	16.9
Actuated g/C Ratio	0.06	0.40		0.06	0.35		0.12	0.24		0.09	0.20	0.20
v/c Ratio	0.72	0.42		0.20	0.91		0.83	0.61		0.44	0.79	0.05
Control Delay	79.9	20.4		45.4	45.8		71.2	36.5		48.5	49.8	0.2

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Total Delay	79.9	20.4		45.4	45.8		71.2	36.5		48.5	49.8	0.2
LOS	E	C		D	D		E	D		D	D	A
Approach Delay		32.3			45.8			50.5			46.7	
Approach LOS		C			D			D			D	
Queue Length 50th (ft)	42	94		12	285		101	130		36	154	0
Queue Length 95th (ft)	#120	195		35	#487		#205	196		78	#271	0
Internal Link Dist (ft)		425			450			281			331	
Turn Bay Length (ft)	390			110			70			245		245
Base Capacity (vph)	102	758		104	691		212	466		168	420	496
Starvation Cap Reductn	0	0		0	0		0	0		0	0	0
Spillback Cap Reductn	0	0		0	0		0	0		0	0	0
Storage Cap Reductn	0	0		0	0		0	0		0	0	0
Reduced v/c Ratio	0.72	0.39		0.20	0.82		0.83	0.56		0.39	0.68	0.04

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 83.3
Natural Cycle: 90
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.91
Intersection Signal Delay: 44.3 Intersection LOS: D
Intersection Capacity Utilization 75.4% ICU Level of Service D
Analysis Period (min) 15
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 7: Birch St/Crystal Ave & NH 102 (E Broadway)



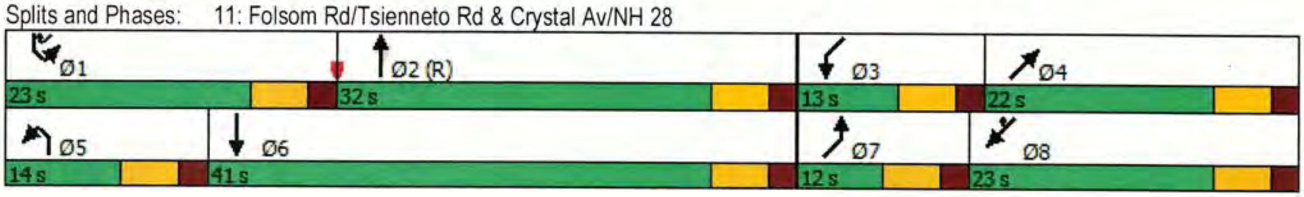
Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations	↰	↑↑	↱	↰↰	↑↑		↰	↑	↱	↰	↑	↱
Traffic Volume (vph)	20	200	120	375	200	0	30	165	20	40	225	595
Future Volume (vph)	20	200	120	375	200	0	30	165	20	40	225	595
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	110		90	360		0	190		180	0		210
Storage Lanes	1		1	2		0	1		1	1		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850						0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1736	3471	1553	3335	3438	0	1752	1845	1568	1752	1845	1568
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1736	3471	1553	3335	3438	0	1752	1845	1568	1752	1845	1568
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			255						327			409
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		639			546			532			387	
Travel Time (s)		14.5			12.4			12.1			8.8	
Peak Hour Factor	0.84	0.84	0.84	0.79	0.79	0.79	0.86	0.86	0.86	0.99	0.99	0.99
Heavy Vehicles (%)	4%	4%	4%	5%	5%	5%	3%	3%	3%	3%	3%	3%
Adj. Flow (vph)	24	238	143	475	253	0	35	192	23	40	227	601
Shared Lane Traffic (%)												
Lane Group Flow (vph)	24	238	143	475	253	0	35	192	23	40	227	601
Turn Type	Prot	NA	Perm	Prot	NA		Prot	NA	Free	Prot	NA	pt+ov
Protected Phases	5	2		1	6		7	4		3	8	8 1
Permitted Phases		2	2		6			4	Free		8	
Detector Phase	5	2	2	1	6		7	4		3	8	8 1
Switch Phase												
Minimum Initial (s)	8.0	8.0	8.0	8.0	8.0		6.0	8.0		7.0	8.0	
Minimum Split (s)	14.0	31.0	31.0	14.0	40.0		12.0	21.0		13.0	21.0	
Total Split (s)	14.0	32.0	32.0	23.0	41.0		12.0	22.0		13.0	23.0	
Total Split (%)	15.6%	35.6%	35.6%	25.6%	45.6%		13.3%	24.4%		14.4%	25.6%	
Maximum Green (s)	8.0	26.0	26.0	17.0	35.0		6.0	16.0		7.0	17.0	
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0		6.0	6.0		6.0	6.0	
Lead/Lag	Lead	Lag	Lag	Lead	Lag		Lead	Lag		Lead	Lag	
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes		Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	Max	C-Max	C-Max	None	Max		None	None		None	None	
Walk Time (s)		5.0	5.0		5.0			5.0			5.0	
Flash Dont Walk (s)		10.0	10.0		10.0			10.0			10.0	
Pedestrian Calls (#/hr)		0	0		0			0			0	
Act Effct Green (s)	14.2	32.9	32.9	16.3	35.0		6.0	15.0	90.0	7.0	15.6	37.9
Actuated g/C Ratio	0.16	0.37	0.37	0.18	0.39		0.07	0.17	1.00	0.08	0.17	0.42
v/c Ratio	0.09	0.19	0.20	0.79	0.19		0.30	0.63	0.01	0.29	0.71	0.67
Control Delay	38.4	22.3	0.6	40.0	17.3		47.2	44.3	0.0	45.2	47.8	10.0
Queue Delay	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0

Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Total Delay	38.4	22.3	0.6	40.0	17.3		47.2	44.3	0.0	45.2	47.8	10.0
LOS	D	C	A	D	B		D	D	A	D	D	B
Approach Delay		15.6			32.1			40.6			21.5	
Approach LOS		B			C			D			C	
Queue Length 50th (ft)	13	54	0	136	54		19	101	0	22	121	68
Queue Length 95th (ft)	35	78	0	139	68		47	162	0	54	198	184
Internal Link Dist (ft)		559			466			452			307	
Turn Bay Length (ft)	110		90	360			190		180			210
Base Capacity (vph)	273	1269	729	629	1337		116	328	1568	136	348	893
Starvation Cap Reductn	0	0	0	0	0		0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0		0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0		0	0	0	0	0	0
Reduced v/c Ratio	0.09	0.19	0.20	0.76	0.19		0.30	0.59	0.01	0.29	0.65	0.67

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 90
Offset: 0 (0%), Referenced to phase 2:NBT, Start of Green
Natural Cycle: 90
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.79
Intersection Signal Delay: 26.0 Intersection LOS: C
Intersection Capacity Utilization 63.5% ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 11: Folsom Rd/Tsienneto Rd & Crystal Av/NH 28



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations	↰	↑↱		↰	↑↱			↰	↱		↰	↱
Traffic Volume (vph)	10	790	0	0	680	30	5	0	5	10	0	70
Future Volume (vph)	10	790	0	0	680	30	5	0	5	10	0	70
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	100		0	115		0	0		0	0		0
Storage Lanes	1		0	1		0	0		1	0		1
Taper Length (ft)	50			25			25			25		
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt					0.994				0.850			0.850
Flt Protected	0.950							0.950			0.950	
Satd. Flow (prot)	1687	3374	0	1863	3518	0	0	1805	1615	0	1787	1599
Flt Permitted	0.950							0.755			0.755	
Satd. Flow (perm)	1687	3374	0	1863	3518	0	0	1434	1615	0	1420	1599
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)					6				109			109
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		277			601			218			433	
Travel Time (s)		6.3			13.7			5.0			9.8	
Peak Hour Factor	0.83	0.83	0.83	0.92	0.92	0.92	0.50	0.50	0.50	0.90	0.90	0.90
Heavy Vehicles (%)	7%	7%	7%	2%	2%	2%	0%	0%	0%	1%	1%	1%
Adj. Flow (vph)	12	952	0	0	739	33	10	0	10	11	0	78
Shared Lane Traffic (%)												
Lane Group Flow (vph)	12	952	0	0	772	0	0	10	10	0	11	78
Turn Type	Prot	NA		Prot	NA		Perm	NA	Perm	Perm	NA	Perm
Protected Phases	5	2		1	6			8			4	
Permitted Phases					6		8	8	8	4		4
Detector Phase	5	2		1	6		8	8	8	4	4	4
Switch Phase												
Minimum Initial (s)	8.0	8.0		5.0	8.0		5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	14.0	46.0		11.0	43.0		33.0	33.0	33.0	33.0	33.0	33.0
Total Split (s)	14.0	46.0		11.0	43.0		33.0	33.0	33.0	33.0	33.0	33.0
Total Split (%)	15.6%	51.1%		12.2%	47.8%		36.7%	36.7%	36.7%	36.7%	36.7%	36.7%
Maximum Green (s)	8.0	40.0		5.0	37.0		27.0	27.0	27.0	27.0	27.0	27.0
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0			0.0	0.0		0.0	0.0
Total Lost Time (s)	6.0	6.0		6.0	6.0			6.0	6.0		6.0	6.0
Lead/Lag	Lead	Lag		Lead	Lag							
Lead-Lag Optimize?	Yes	Yes		Yes	Yes							
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	C-Max		None	None		None	None	None	None	None	None
Act Effct Green (s)	8.0	75.1			72.3			6.4	6.4		6.4	6.4
Actuated g/C Ratio	0.09	0.83			0.80			0.07	0.07		0.07	0.07
v/c Ratio	0.08	0.34			0.27			0.10	0.05		0.11	0.36
Control Delay	45.5	2.6			4.7			40.6	0.4		41.0	8.8
Queue Delay	0.0	0.0			0.0			0.0	0.0		0.0	0.0
Total Delay	45.5	2.6			4.7			40.6	0.4		41.0	8.8
LOS	D	A			A			D	A		D	A
Approach Delay		3.1			4.7			20.5			12.8	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Approach LOS		A			A			C			B	
Queue Length 50th (ft)	6	81			82			6	0		6	0
Queue Length 95th (ft)	m14	61			140			12	0		22	24
Internal Link Dist (ft)		197			521			138			353	
Turn Bay Length (ft)	100											
Base Capacity (vph)	149	2816			2829			430	560		426	556
Starvation Cap Reductn	0	0			0			0	0		0	0
Spillback Cap Reductn	0	0			0			0	0		0	0
Storage Cap Reductn	0	0			0			0	0		0	0
Reduced v/c Ratio	0.08	0.34			0.27			0.02	0.02		0.03	0.14

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 90
Offset: 63 (70%), Referenced to phase 2:EBT, Start of Green
Natural Cycle: 90
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.36
Intersection Signal Delay: 4.4 Intersection LOS: A
Intersection Capacity Utilization 45.2% ICU Level of Service A
Analysis Period (min) 15
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 13: Applebees/Linlew Dr & NH 28

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	40	140	100	630	230	20	100	500	730	20	420	140
Future Volume (vph)	40	140	100	630	230	20	100	500	730	20	420	140
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	100		0	220		0	100		265	200		0
Storage Lanes	1		1	2		0	1		2	1		1
Taper Length (ft)	200			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	0.97	0.95	0.95	1.00	0.95	0.88	1.00	0.95	1.00
Frt			0.850		0.988				0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1703	1792	1524	3367	3429	0	1805	3610	2842	1752	3505	1568
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1703	1792	1524	3367	3429	0	1805	3610	2842	1752	3505	1568
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			109		10				754			156
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		412			486			387			343	
Travel Time (s)		9.4			11.0			8.8			7.8	
Peak Hour Factor	0.83	0.83	0.83	0.97	0.97	0.97	0.67	0.67	0.67	0.90	0.90	0.90
Heavy Vehicles (%)	6%	6%	6%	4%	4%	4%	0%	0%	0%	3%	3%	3%
Adj. Flow (vph)	48	169	120	649	237	21	149	746	1090	22	467	156
Shared Lane Traffic (%)												
Lane Group Flow (vph)	48	169	120	649	258	0	149	746	1090	22	467	156
Turn Type	Prot	NA	pm+ov	Prot	NA		Prot	NA	pm+ov	Prot	NA	pm+ov
Protected Phases	5	2	3	1	6		3	8	1	7	4	5
Permitted Phases			2						8		4	4
Detector Phase	5	2	3	1	6		3	8	1	7	4	5
Switch Phase												
Minimum Initial (s)	8.0	8.0	5.0	8.0	8.0		5.0	5.0	8.0	5.0	8.0	8.0
Minimum Split (s)	22.0	22.0	11.0	22.0	22.0		11.0	22.0	22.0	11.0	22.0	22.0
Total Split (s)	22.0	24.0	16.0	27.0	29.0		16.0	28.0	27.0	11.0	23.0	22.0
Total Split (%)	24.4%	26.7%	17.8%	30.0%	32.2%		17.8%	31.1%	30.0%	12.2%	25.6%	24.4%
Maximum Green (s)	16.0	18.0	10.0	21.0	23.0		10.0	22.0	21.0	5.0	17.0	16.0
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0		6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag	Lead	Lag	Lead	Lead	Lag		Lead	Lag	Lead	Lead	Lag	Lead
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes	Yes	Yes	Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	Min	C-Min	None	Min	Min		None	None	Min	None	None	Min
Walk Time (s)	5.0	5.0		5.0	5.0			5.0	5.0		5.0	5.0
Flash Dont Walk (s)	11.0	11.0		11.0	11.0			11.0	11.0		11.0	11.0
Pedestrian Calls (#/hr)	0	0		0	0			0	0		0	0
Act Effct Green (s)	8.8	17.6	34.6	21.6	30.4		11.0	28.0	55.6	6.0	15.8	30.6
Actuated g/C Ratio	0.10	0.20	0.38	0.24	0.34		0.12	0.31	0.62	0.07	0.18	0.34
v/c Ratio	0.29	0.48	0.18	0.81	0.22		0.67	0.66	0.53	0.19	0.76	0.25
Control Delay	42.0	38.3	5.5	41.4	19.6		54.5	31.6	4.0	43.9	43.8	4.4
Queue Delay	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Total Delay	42.0	38.3	5.5	41.4	19.6		54.5	31.6	4.0	43.9	43.8	4.4
LOS	D	D	A	D	B		D	C	A	D	D	A
Approach Delay		27.2			35.2			18.2			34.3	
Approach LOS		C			D			B			C	
Queue Length 50th (ft)	26	91	4	133	37		80	164	29	12	132	0
Queue Length 95th (ft)	54	134	31	#276	62		106	193	30	36	185	38
Internal Link Dist (ft)		332			406			307			263	
Turn Bay Length (ft)	100			220			100		265	200		
Base Capacity (vph)	302	385	658	813	1164		227	1123	2047	116	662	748
Starvation Cap Reductn	0	0	0	0	0		0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0		0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0		0	0	0	0	0	0
Reduced v/c Ratio	0.16	0.44	0.18	0.80	0.22		0.66	0.66	0.53	0.19	0.71	0.21

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 90
Offset: 0 (0%), Referenced to phase 2:EBT, Start of Yellow
Natural Cycle: 80
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.81
Intersection Signal Delay: 25.6 Intersection LOS: C
Intersection Capacity Utilization 63.3% ICU Level of Service B
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

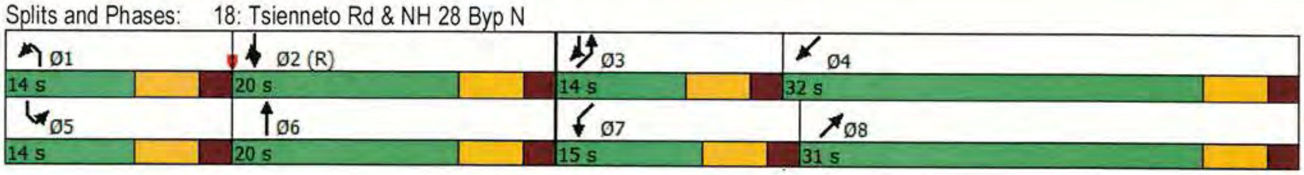
Splits and Phases: 22: Connector Road & NH 28

Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations	↰	↑↱		↰	↑	↱	↰	↑↱		↰	↑↱	
Traffic Volume (vph)	30	50	20	20	40	100	10	140	70	65	330	65
Future Volume (vph)	30	50	20	20	40	100	10	140	70	65	330	65
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200		150	190		190	135		150	120		150
Storage Lanes	1		0	1		1	1		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.958				0.850		0.950			0.975	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1752	1767	0	1736	1827	1553	1770	1770	0	1787	1834	0
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1752	1767	0	1736	1827	1553	1770	1770	0	1787	1834	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		21				123		33			13	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		481			347			479			371	
Travel Time (s)		10.9			7.9			10.9			8.4	
Peak Hour Factor	0.82	0.82	0.82	0.81	0.81	0.81	0.68	0.68	0.68	0.78	0.78	0.78
Heavy Vehicles (%)	3%	3%	3%	4%	4%	4%	2%	2%	2%	1%	1%	1%
Adj. Flow (vph)	37	61	24	25	49	123	15	206	103	83	423	83
Shared Lane Traffic (%)												
Lane Group Flow (vph)	37	85	0	25	49	123	15	309	0	83	506	0
Turn Type	Prot	NA		Prot	NA	pt+ov	Prot	NA		Prot	NA	
Protected Phases	1	6		5	2	2 3	3	8		7	4	
Permitted Phases												
Detector Phase	1	6		5	2	2 3	3	8		7	4	
Switch Phase												
Minimum Initial (s)	8.0	8.0		8.0	8.0		8.0	8.0		8.0	8.0	
Minimum Split (s)	14.0	20.0		14.0	20.0		14.0	20.0		14.0	20.0	
Total Split (s)	14.0	20.0		14.0	20.0		14.0	31.0		15.0	32.0	
Total Split (%)	17.5%	25.0%		17.5%	25.0%		17.5%	38.8%		18.8%	40.0%	
Maximum Green (s)	8.0	14.0		8.0	14.0		8.0	25.0		9.0	26.0	
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lag		Lead	Lag	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	C-Max		None	None		None	None	
Act Effct Green (s)	8.0	26.8		8.0	24.0	38.0	8.0	23.8		8.6	24.4	
Actuated g/C Ratio	0.10	0.34		0.10	0.30	0.48	0.10	0.30		0.11	0.30	
v/c Ratio	0.21	0.14		0.14	0.09	0.15	0.08	0.56		0.43	0.89	
Control Delay	36.4	20.8		35.1	27.7	4.3	34.0	25.3		40.8	45.7	
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Total Delay	36.4	20.8		35.1	27.7	4.3	34.0	25.3		40.8	45.7	
LOS	D	C		D	C	A	C	C		D	D	
Approach Delay		25.5			14.0			25.7			45.0	

Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Approach LOS		C			B			C			D	
Queue Length 50th (ft)	17	21		12	21	0	7	112		39	226	
Queue Length 95th (ft)	41	59		31	45	25	18	129		71	282	
Internal Link Dist (ft)		401			267			399			291	
Turn Bay Length (ft)	200			190		190	135			120		
Base Capacity (vph)	175	606		173	548	803	177	575		201	604	
Starvation Cap Reductn	0	0		0	0	0	0	0		0	0	
Spillback Cap Reductn	0	0		0	0	0	0	0		0	0	
Storage Cap Reductn	0	0		0	0	0	0	0		0	0	
Reduced v/c Ratio	0.21	0.14		0.14	0.09	0.15	0.08	0.54		0.41	0.84	

Intersection Summary	
Area Type: Other	
Cycle Length: 80	
Actuated Cycle Length: 80	
Offset: 0 (0%), Referenced to phase 2:SBT, Start of Green	
Natural Cycle: 75	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 0.89	
Intersection Signal Delay: 33.1	Intersection LOS: C
Intersection Capacity Utilization 51.3%	ICU Level of Service A
Analysis Period (min) 15	

Splits and Phases: 18: Tsienneto Rd & NH 28 Byp N



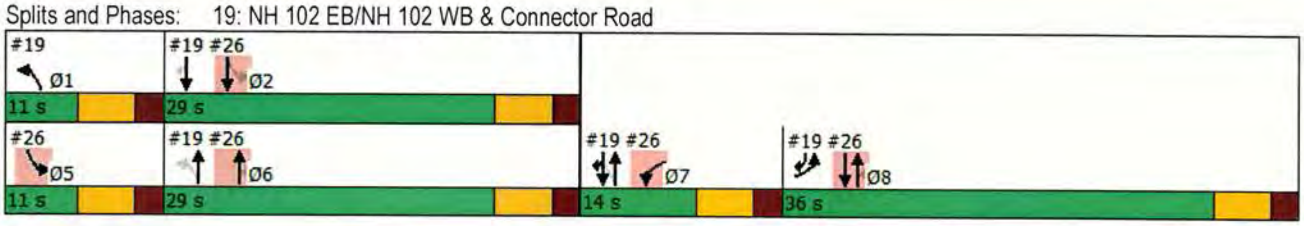
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR	Ø2	Ø5	Ø6	Ø7
Lane Configurations										
Traffic Volume (vph)	510	10	20	70	140	600				
Future Volume (vph)	510	10	20	70	140	600				
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900				
Storage Length (ft)	0	0	120			90				
Storage Lanes	1	0	1			1				
Taper Length (ft)	25		25							
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00				
Frt	0.997					0.850				
Flt Protected	0.953		0.950							
Satd. Flow (prot)	1770	0	1626	1712	1863	1583				
Flt Permitted	0.953		0.630							
Satd. Flow (perm)	1770	0	1078	1712	1863	1583				
Right Turn on Red		Yes				Yes				
Satd. Flow (RTOR)	1					732				
Link Speed (mph)	30			30	30					
Link Distance (ft)	472			739	258					
Travel Time (s)	10.7			16.8	5.9					
Peak Hour Factor	0.94	0.94	0.91	0.91	0.82	0.82				
Heavy Vehicles (%)	2%	2%	11%	11%	2%	2%				
Adj. Flow (vph)	543	11	22	77	171	732				
Shared Lane Traffic (%)										
Lane Group Flow (vph)	554	0	22	77	171	732				
Turn Type	Prot		pm+pt	NA	NA	custom				
Protected Phases	8		1	6 7	2 7	7 8	2	5	6	7
Permitted Phases			6 7			2				
Detector Phase	8		1	6 7	2 7	7 8				
Switch Phase										
Minimum Initial (s)	5.0		5.0				5.0	5.0	5.0	5.0
Minimum Split (s)	26.5		11.0				28.0	11.0	28.0	11.0
Total Split (s)	36.0		11.0				29.0	11.0	29.0	14.0
Total Split (%)	40.0%		12.2%				32%	12%	32%	16%
Maximum Green (s)	30.0		5.0				23.0	5.0	23.0	8.0
Yellow Time (s)	4.0		4.0				4.0	4.0	4.0	4.0
All-Red Time (s)	2.0		2.0				2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0		0.0							
Total Lost Time (s)	6.0		6.0							
Lead/Lag	Lag		Lead				Lag	Lead	Lag	Lead
Lead-Lag Optimize?	Yes		Yes				Yes	Yes	Yes	Yes
Vehicle Extension (s)	3.0		3.0				3.0	3.0	3.0	3.0
Recall Mode	None		None				Min	None	Min	None
Walk Time (s)							7.0		7.0	
Flash Dont Walk (s)							15.0		15.0	
Pedestrian Calls (#/hr)							0		0	
Act Effct Green (s)	30.6		31.6	30.7	28.9	69.7				
Actuated g/C Ratio	0.41		0.42	0.41	0.38	0.92				
v/c Ratio	0.77		0.05	0.11	0.24	0.48				
Control Delay	31.6		11.1	14.4	19.2	1.2				
Queue Delay	0.0		0.0	0.0	1.1	0.1				

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR	Ø2	Ø5	Ø6	Ø7
Total Delay	31.6		11.1	14.4	20.3	1.2				
LOS	C		B	B	C	A				
Approach Delay	31.6			13.7	4.9					
Approach LOS	C			B	A					
Queue Length 50th (ft)	183		6	20	54	2				
Queue Length 95th (ft)	#509		17	54	92	0				
Internal Link Dist (ft)	392			659	178					
Turn Bay Length (ft)			120			90				
Base Capacity (vph)	719		488	701	700	1502				
Starvation Cap Reductn	0		0	0	342	104				
Spillback Cap Reductn	0		0	0	0	0				
Storage Cap Reductn	0		0	0	0	0				
Reduced v/c Ratio	0.77		0.05	0.11	0.48	0.52				

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 75.5
Natural Cycle: 90
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.77
Intersection Signal Delay: 15.0 Intersection LOS: B
Intersection Capacity Utilization 55.4% ICU Level of Service B
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 19: NH 102 EB/NH 102 WB & Connector Road



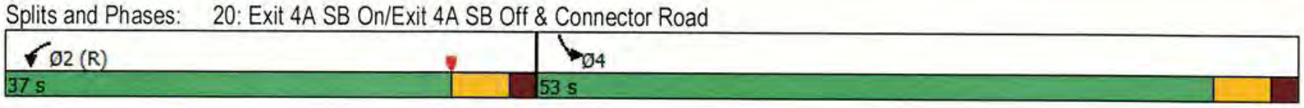
Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	ᵞᵞ				ᵞᵞ	
Traffic Volume (vph)	1135	0	0	0	1770	0
Future Volume (vph)	1135	0	0	0	1770	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	0.97	1.00	1.00	1.00	0.97	1.00
Frt						
Flt Protected	0.950				0.950	
Satd. Flow (prot)	3433	0	0	0	3433	0
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	3433	0	0	0	3433	0
Right Turn on Red		Yes		Yes		
Satd. Flow (RTOR)						
Link Speed (mph)	30		30			30
Link Distance (ft)	372		529			557
Travel Time (s)	8.5		12.0			12.7
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	1207	0	0	0	1883	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	1207	0	0	0	1883	0
Turn Type	Prot				Prot	
Protected Phases	2				4	
Permitted Phases						
Detector Phase	2				4	
Switch Phase						
Minimum Initial (s)	5.0				9.0	
Minimum Split (s)	24.0				24.0	
Total Split (s)	37.0				53.0	
Total Split (%)	41.1%				58.9%	
Maximum Green (s)	31.0				47.0	
Yellow Time (s)	4.0				4.0	
All-Red Time (s)	2.0				2.0	
Lost Time Adjust (s)	0.0				0.0	
Total Lost Time (s)	6.0				6.0	
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)	3.0				3.0	
Recall Mode	C-Max				Max	
Act Effct Green (s)	31.0				47.0	
Actuated g/C Ratio	0.34				0.52	
v/c Ratio	1.02				1.05	
Control Delay	47.0				58.9	
Queue Delay	0.0				22.6	
Total Delay	47.0				81.5	
LOS	D				F	
Approach Delay	47.0					81.5
Approach LOS	D					F
Queue Length 50th (ft)	~366				~607	
Queue Length 95th (ft)	#508				#742	
Internal Link Dist (ft)	292		449			477

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Turn Bay Length (ft)						
Base Capacity (vph)	1182				1792	
Starvation Cap Reductn	0				0	
Spillback Cap Reductn	0				841	
Storage Cap Reductn	0				0	
Reduced v/c Ratio	1.02				1.98	

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 90
Offset: 5 (6%), Referenced to phase 2:WBL, Start of Yellow
Natural Cycle: 110
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 1.05
Intersection Signal Delay: 68.0 Intersection LOS: E
Intersection Capacity Utilization 143.4% ICU Level of Service H
Analysis Period (min) 15
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 20: Exit 4A SB On/Exit 4A SB Off & Connector Road



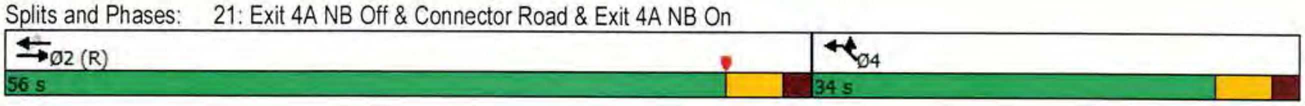
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	SBL	SBR	NWL	NWR
Lane Configurations	↰	↑↑			↑↑	↱↱			Y	↱
Traffic Volume (vph)	0	1770	0	0	1135	1205	0	0	0	865
Future Volume (vph)	0	1770	0	0	1135	1205	0	0	0	865
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	100		0	0		200	0	0	0	0
Storage Lanes	1		0	0		2	0	0	1	1
Taper Length (ft)	75			25			25		25	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	0.88	1.00	1.00	1.00	0.95
Frt						0.850			0.850	0.850
Flt Protected										
Satd. Flow (prot)	1863	3539	0	0	3539	2787	0	0	1583	1504
Flt Permitted										
Satd. Flow (perm)	1863	3539	0	0	3539	2787	0	0	1583	1504
Right Turn on Red			Yes			Yes		Yes		
Satd. Flow (RTOR)						36				
Link Speed (mph)		30			30		30		30	
Link Distance (ft)		372			394		598		519	
Travel Time (s)		8.5			9.0		13.6		11.8	
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	0	1883	0	0	1207	1282	0	0	0	920
Shared Lane Traffic (%)										50%
Lane Group Flow (vph)	0	1883	0	0	1207	1282	0	0	460	460
Turn Type	Perm	NA			NA	Perm			Prot	Prot
Protected Phases		2			2				4	4
Permitted Phases	2					2				
Detector Phase	2	2			2	2			4	4
Switch Phase										
Minimum Initial (s)	5.0	5.0			5.0	5.0			9.0	9.0
Minimum Split (s)	24.0	24.0			24.0	24.0			24.0	24.0
Total Split (s)	56.0	56.0			56.0	56.0			34.0	34.0
Total Split (%)	62.2%	62.2%			62.2%	62.2%			37.8%	37.8%
Maximum Green (s)	50.0	50.0			50.0	50.0			28.0	28.0
Yellow Time (s)	4.0	4.0			4.0	4.0			4.0	4.0
All-Red Time (s)	2.0	2.0			2.0	2.0			2.0	2.0
Lost Time Adjust (s)	0.0	0.0			0.0	0.0			0.0	0.0
Total Lost Time (s)	6.0	6.0			6.0	6.0			6.0	6.0
Lead/Lag										
Lead-Lag Optimize?										
Vehicle Extension (s)	3.0	3.0			3.0	3.0			3.0	3.0
Recall Mode	C-Max	C-Max			C-Max	C-Max			Min	Min
Act Effct Green (s)		50.0			50.0	50.0			28.0	28.0
Actuated g/C Ratio		0.56			0.56	0.56			0.31	0.31
v/c Ratio		0.96			0.61	0.82			0.93	0.99
Control Delay		24.0			15.2	21.4			59.2	71.0
Queue Delay		45.2			4.2	0.0			0.0	0.0
Total Delay		69.2			19.4	21.4			59.2	71.0
LOS		E			B	C			E	E
Approach Delay		69.2			20.4				65.1	
Approach LOS		E			C				E	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	SBL	SBR	NWL	NWR
Queue Length 50th (ft)		619			227	308			252	271
Queue Length 95th (ft)		m590			291	418			#441	#478
Internal Link Dist (ft)		292			314		518		439	
Turn Bay Length (ft)						200				
Base Capacity (vph)		1966			1966	1564			492	467
Starvation Cap Reductn		929			0	0			0	0
Spillback Cap Reductn		0			664	0			0	0
Storage Cap Reductn		0			0	0			0	0
Reduced v/c Ratio		1.82			0.93	0.82			0.93	0.99

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 90
Offset: 0 (0%), Referenced to phase 2:EBWB, Start of Yellow
Natural Cycle: 90
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.99
Intersection Signal Delay: 45.5 Intersection LOS: D
Intersection Capacity Utilization 129.2% ICU Level of Service H
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 21: Exit 4A NB Off & Connector Road & Exit 4A NB On



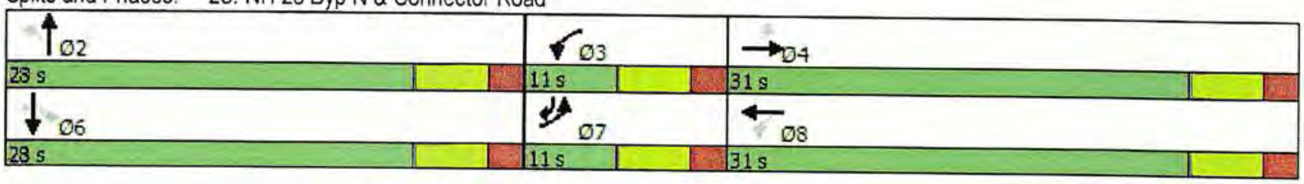
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↱		↰	↱		↰	↑	↱
Traffic Volume (vph)	100	380	10	10	390	10	20	50	10	10	60	100
Future Volume (vph)	100	380	10	10	390	10	20	50	10	10	60	100
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	275		0	75		100	75		0	210		210
Storage Lanes	1		0	1		0	1		0	1		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.996			0.996			0.975				0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1770	1855	0	1770	1855	0	1770	1816	0	1770	1863	1583
Flt Permitted	0.290			0.424			0.715			0.715		
Satd. Flow (perm)	540	1855	0	790	1855	0	1332	1816	0	1332	1863	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		2			2			11				109
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		314			303			290			341	
Travel Time (s)		7.1			6.9			6.6			7.8	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	109	413	11	11	424	11	22	54	11	11	65	109
Shared Lane Traffic (%)												
Lane Group Flow (vph)	109	424	0	11	435	0	22	65	0	11	65	109
Turn Type	pm+pt	NA		pm+pt	NA		Perm	NA		Perm	NA	pm+ov
Protected Phases	7	4		3	8			2			6	7
Permitted Phases	4			8			2			6		6
Detector Phase	7	4		3	8		2	2		6	6	7
Switch Phase												
Minimum Initial (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	5.0
Minimum Split (s)	11.0	28.0		11.0	28.0		28.0	28.0		28.0	28.0	11.0
Total Split (s)	11.0	31.0		11.0	31.0		28.0	28.0		28.0	28.0	11.0
Total Split (%)	15.7%	44.3%		15.7%	44.3%		40.0%	40.0%		40.0%	40.0%	15.7%
Maximum Green (s)	5.0	25.0		5.0	25.0		22.0	22.0		22.0	22.0	5.0
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	6.0
Lead/Lag	Lead	Lag		Lead	Lag							Lead
Lead-Lag Optimize?	Yes	Yes		Yes	Yes							Yes
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Recall Mode	None	None		None	None		Max	Max		Max	Max	None
Walk Time (s)		7.0			7.0		7.0	7.0		7.0	7.0	
Flash Dont Walk (s)		15.0			15.0		15.0	15.0		15.0	15.0	
Pedestrian Calls (#/hr)		0			0		0	0		0	0	
Act Effct Green (s)	26.2	25.3		22.8	19.0		22.6	22.6		22.6	22.6	33.9
Actuated g/C Ratio	0.42	0.41		0.37	0.31		0.36	0.36		0.36	0.36	0.55
v/c Ratio	0.33	0.56		0.03	0.76		0.05	0.10		0.02	0.10	0.12
Control Delay	12.2	17.6		8.9	29.5		16.7	14.7		16.5	16.8	2.9
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Total Delay	12.2	17.6		8.9	29.5		16.7	14.7		16.5	16.8	2.9

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
LOS	B	B		A	C		B	B		B	B	A
Approach Delay		16.5			29.0			15.2			8.6	
Approach LOS		B			C			B			A	
Queue Length 50th (ft)	23	107		2	153		6	14		3	17	0
Queue Length 95th (ft)	46	239		9	247		21	42		14	46	23
Internal Link Dist (ft)		234			223			210			261	
Turn Bay Length (ft)	275			75			75			210		210
Base Capacity (vph)	329	872		370	766		483	666		483	676	911
Starvation Cap Reductn	0	0		0	0		0	0		0	0	0
Spillback Cap Reductn	0	0		0	0		0	0		0	0	0
Storage Cap Reductn	0	0		0	0		0	0		0	0	0
Reduced v/c Ratio	0.33	0.49		0.03	0.57		0.05	0.10		0.02	0.10	0.12

Intersection Summary

Area Type: Other
Cycle Length: 70
Actuated Cycle Length: 62.2
Natural Cycle: 70
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.76
Intersection Signal Delay: 19.7 Intersection LOS: B
Intersection Capacity Utilization 49.4% ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 23: NH 28 Byp N & Connector Road



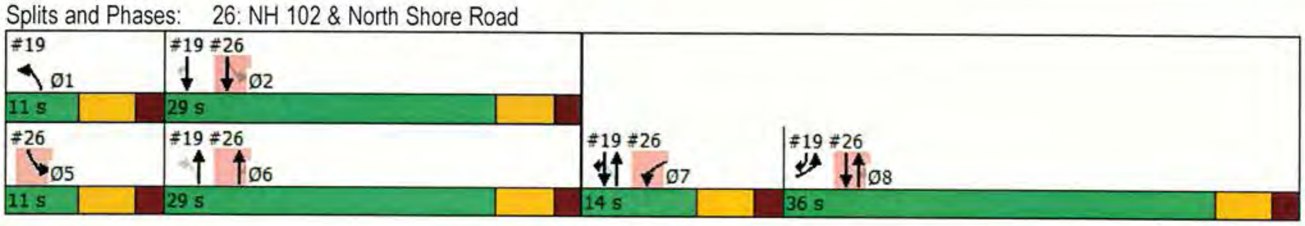
Lane Group	WBL	WBR	NBT	NBR	SBL	SBT	Ø1	Ø2	Ø6	Ø8
Lane Configurations										
Traffic Volume (vph)	90	10	540	40	10	650				
Future Volume (vph)	90	10	540	40	10	650				
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900				
Storage Length (ft)	0	0		90	100					
Storage Lanes	1	0		1	1					
Taper Length (ft)	25				25					
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00				
Frt	0.983			0.850						
Flt Protected	0.958				0.950					
Satd. Flow (prot)	1774	0	1900	1615	1805	1900				
Flt Permitted	0.958				0.256					
Satd. Flow (perm)	1774	0	1900	1615	486	1900				
Right Turn on Red		Yes		Yes						
Satd. Flow (RTOR)	6			38						
Link Speed (mph)	30		30			30				
Link Distance (ft)	524		258			288				
Travel Time (s)	11.9		5.9			6.5				
Peak Hour Factor	0.87	0.67	0.95	0.84	0.73	0.96				
Heavy Vehicles (%)	1%	0%	0%	0%	0%	0%				
Adj. Flow (vph)	103	15	568	48	14	677				
Shared Lane Traffic (%)										
Lane Group Flow (vph)	118	0	568	48	14	677				
Turn Type	Prot		NA	Perm	custom	NA				
Protected Phases	7		6 8		5	2 8	1	2	6	8
Permitted Phases				6 8	2					
Detector Phase	7		6 8	6 8	5	2 8				
Switch Phase										
Minimum Initial (s)	5.0				5.0		5.0	5.0	5.0	5.0
Minimum Split (s)	11.0				11.0		11.0	28.0	28.0	26.5
Total Split (s)	14.0				11.0		11.0	29.0	29.0	36.0
Total Split (%)	15.6%				12.2%		12%	32%	32%	40%
Maximum Green (s)	8.0				5.0		5.0	23.0	23.0	30.0
Yellow Time (s)	4.0				4.0		4.0	4.0	4.0	4.0
All-Red Time (s)	2.0				2.0		2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0				0.0					
Total Lost Time (s)	6.0				6.0					
Lead/Lag	Lead				Lead		Lead	Lag	Lag	Lag
Lead-Lag Optimize?	Yes				Yes		Yes	Yes	Yes	Yes
Vehicle Extension (s)	3.0				3.0		3.0	3.0	3.0	3.0
Recall Mode	None				None		None	Min	Min	None
Walk Time (s)								7.0	7.0	
Flash Dont Walk (s)								15.0	15.0	
Pedestrian Calls (#/hr)								0	0	
Act Effct Green (s)	8.1		52.3	52.3	16.3	49.3				
Actuated g/C Ratio	0.11		0.69	0.69	0.22	0.65				
v/c Ratio	0.60		0.43	0.04	0.07	0.55				
Control Delay	48.5		2.2	0.8	19.7	7.3				
Queue Delay	0.0		0.2	0.0	0.0	0.0				

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT	Ø1	Ø2	Ø6	Ø8
Total Delay	48.5		2.5	0.8	19.7	7.3				
LOS	D		A	A	B	A				
Approach Delay	48.5		2.3			7.6				
Approach LOS	D		A			A				
Queue Length 50th (ft)	45		7	0	5	103				
Queue Length 95th (ft)	#140		m78	m0	14	151				
Internal Link Dist (ft)	444		178			208				
Turn Bay Length (ft)				90	100					
Base Capacity (vph)	197		1529	1308	194	1465				
Starvation Cap Reductn	0		360	0	0	0				
Spillback Cap Reductn	0		0	0	0	0				
Storage Cap Reductn	0		0	0	0	0				
Reduced v/c Ratio	0.60		0.49	0.04	0.07	0.46				

Intersection Summary	
Area Type: Other	
Cycle Length: 90	
Actuated Cycle Length: 75.5	
Natural Cycle: 90	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.77	
Intersection Signal Delay: 8.7	Intersection LOS: A
Intersection Capacity Utilization 49.8%	ICU Level of Service A
Analysis Period (min) 15	

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 26: NH 102 & North Shore Road



APPENDIX P-4: 2040 ALTERNATIVE B INTERSECTION CAPACITY ANALYSES – SYNCHRO PRINOUTS – PM PEAK HOUR

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑↑		↰	↱↱
Traffic Volume (vph)	0	1180	1385	0	390	1300
Future Volume (vph)	0	1180	1385	0	390	1300
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	16	12
Lane Util. Factor	1.00	0.95	0.95	1.00	1.00	0.88
Frt						0.850
Flt Protected					0.950	
Satd. Flow (prot)	0	3471	3406	0	1930	2682
Flt Permitted					0.950	
Satd. Flow (perm)	0	3471	3406	0	1930	2682
Right Turn on Red				Yes		No
Satd. Flow (RTOR)						
Link Speed (mph)		30	30		25	
Link Distance (ft)		712	388		212	
Travel Time (s)		16.2	8.8		5.8	
Peak Hour Factor	0.93	0.93	0.88	0.88	0.89	0.89
Heavy Vehicles (%)	4%	4%	6%	6%	6%	6%
Adj. Flow (vph)	0	1269	1574	0	438	1461
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	1269	1574	0	438	1461
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(ft)		24	24		16	
Link Offset(ft)		0	0		0	
Crosswalk Width(ft)		16	16		16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	0.85	1.00
Turning Speed (mph)	15			9	15	9
Number of Detectors		3	3		3	3
Detector Template		Thru	Thru		Left	
Leading Detector (ft)		256	256		256	256
Trailing Detector (ft)		-5	-5		-5	-5
Detector 1 Position(ft)		-5	-5		-5	-5
Detector 1 Size(ft)		50	50		50	50
Detector 1 Type		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex
Detector 1 Channel						
Detector 1 Extend (s)		0.0	0.0		0.0	0.0
Detector 1 Queue (s)		0.0	0.0		0.0	0.0
Detector 1 Delay (s)		0.0	0.0		0.0	0.0
Detector 2 Position(ft)		125	125		125	125
Detector 2 Size(ft)		6	6		6	6
Detector 2 Type		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex
Detector 2 Channel						
Detector 2 Extend (s)		0.0	0.0		0.0	0.0
Detector 3 Position(ft)		250	250		250	250
Detector 3 Size(ft)		6	6		6	6
Detector 3 Type		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex
Detector 3 Channel						

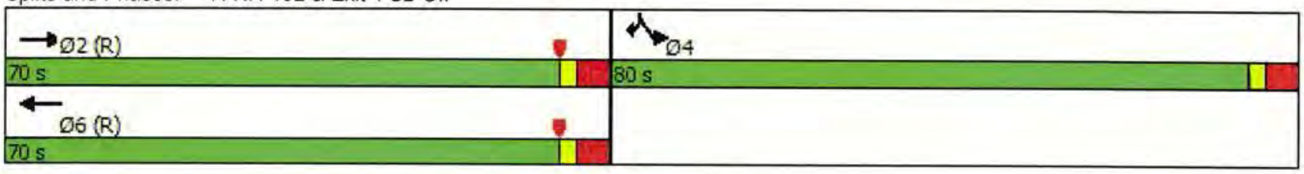
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Detector 3 Extend (s)		0.0	0.0		0.0	0.0
Turn Type		NA	NA		Prot	Prot
Protected Phases		2	6		4	4
Permitted Phases						
Detector Phase		2	6		4	4
Switch Phase						
Minimum Initial (s)		8.0	8.0		5.0	5.0
Minimum Split (s)		14.0	21.0		27.0	27.0
Total Split (s)		70.0	70.0		80.0	80.0
Total Split (%)		46.7%	46.7%		53.3%	53.3%
Maximum Green (s)		64.0	64.0		74.0	74.0
Yellow Time (s)		2.0	2.0		2.0	2.0
All-Red Time (s)		4.0	4.0		4.0	4.0
Lost Time Adjust (s)		0.0	0.0		0.0	0.0
Total Lost Time (s)		6.0	6.0		6.0	6.0
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)		3.0	3.0		3.0	3.0
Recall Mode		C-Min	C-Min		None	None
Walk Time (s)			7.0		7.0	7.0
Flash Dont Walk (s)			8.0		14.0	14.0
Pedestrian Calls (#/hr)			0		0	0
Act Effct Green (s)		64.0	64.0		74.0	74.0
Actuated g/C Ratio		0.43	0.43		0.49	0.49
v/c Ratio		0.86	1.08		0.46	1.10
Control Delay		31.3	46.1		26.9	94.6
Queue Delay		0.0	1.2		0.0	0.0
Total Delay		31.3	47.4		26.9	94.6
LOS		C	D		C	F
Approach Delay		31.3	47.4		79.0	
Approach LOS		C	D		E	
Queue Length 50th (ft)		373	~913		276	~921
Queue Length 95th (ft)		443	m34		365	#1051
Internal Link Dist (ft)		632	308		132	
Turn Bay Length (ft)						
Base Capacity (vph)		1480	1453		952	1323
Starvation Cap Reductn		0	0		0	0
Spillback Cap Reductn		0	4		0	0
Storage Cap Reductn		0	0		0	0
Reduced v/c Ratio		0.86	1.09		0.46	1.10

Intersection Summary

Area Type: Other
Cycle Length: 150
Actuated Cycle Length: 150
Offset: 0 (0%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow, Master Intersection
Natural Cycle: 130
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 1.10

Intersection Signal Delay: 55.7 Intersection LOS: E
Intersection Capacity Utilization 95.8% ICU Level of Service F
Analysis Period (min) 15
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 7: NH 102 & Exit 4 SB Off



Lane Group	NBL2	NBL	NBR	SEL	SER	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations	↰↰		↱↱			↰↰	↑↑			↑↑	↱
Traffic Volume (vph)	1345	0	750	0	0	1140	430	0	0	310	330
Future Volume (vph)	1345	0	750	0	0	1140	430	0	0	310	330
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)		0	0	0	0	550		0	0		0
Storage Lanes		2	2	0	0	2		0	0		1
Taper Length (ft)		25		25		25			25		
Lane Util. Factor	0.97	1.00	0.88	1.00	1.00	0.97	0.95	1.00	1.00	0.95	1.00
Frt			0.850								0.850
Flt Protected	0.950					0.950					
Satd. Flow (prot)	3242	0	2632	0	0	3335	3438	0	0	3505	1568
Flt Permitted	0.950					0.950					
Satd. Flow (perm)	3242	0	2632	0	0	3335	3438	0	0	3505	1568
Right Turn on Red			No					Yes			Yes
Satd. Flow (RTOR)											359
Link Speed (mph)		25		30			30			30	
Link Distance (ft)		856		390			760			857	
Travel Time (s)		23.3		8.9			17.3			19.5	
Peak Hour Factor	0.88	0.88	0.88	0.92	0.92	0.94	0.94	0.94	0.92	0.92	0.92
Heavy Vehicles (%)	8%	8%	8%	2%	2%	5%	5%	5%	3%	3%	3%
Adj. Flow (vph)	1528	0	852	0	0	1213	457	0	0	337	359
Shared Lane Traffic (%)											
Lane Group Flow (vph)	1528	0	852	0	0	1213	457	0	0	337	359
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Right	Left	Left	Right	Left	Right	Right
Median Width(ft)		24		0			24			24	
Link Offset(ft)		12		0			0			0	
Crosswalk Width(ft)		16		16			16			16	
Two way Left Turn Lane											
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15	15	25	15	9	15		9	15		25
Number of Detectors	3		3			3	3			3	0
Detector Template											
Leading Detector (ft)	256		256			256	256			256	0
Trailing Detector (ft)	-5		-5			-5	-5			-5	0
Detector 1 Position(ft)	-5		-5			-5	-5			-5	-5
Detector 1 Size(ft)	55		55			55	55			55	50
Detector 1 Type	Cl+Ex		Cl+Ex			Cl+Ex	Cl+Ex			Cl+Ex	Cl+Ex
Detector 1 Channel											
Detector 1 Extend (s)	0.0		0.0			0.0	0.0			0.0	0.0
Detector 1 Queue (s)	0.0		0.0			0.0	0.0			0.0	0.0
Detector 1 Delay (s)	0.0		0.0			0.0	0.0			0.0	0.0
Detector 2 Position(ft)	125		125			125	125			125	
Detector 2 Size(ft)	6		6			6	6			6	
Detector 2 Type	Cl+Ex		Cl+Ex			Cl+Ex	Cl+Ex			Cl+Ex	
Detector 2 Channel											
Detector 2 Extend (s)	0.0		0.0			0.0	0.0			0.0	
Detector 3 Position(ft)	250		250			250	250			250	
Detector 3 Size(ft)	6		6			6	6			6	

Lane Group	NBL2	NBL	NBR	SEL	SER	NEL	NET	NER	SWL	SWT	SWR
Detector 3 Type	Cl+Ex		Cl+Ex			Cl+Ex	Cl+Ex			Cl+Ex	
Detector 3 Channel											
Detector 3 Extend (s)	0.0		0.0			0.0	0.0			0.0	
Turn Type	Prot		Prot			Prot	NA			NA	Free
Protected Phases	8		8			5	2			6	
Permitted Phases											Free
Detector Phase	8		2			5	2			6	
Switch Phase											
Minimum Initial (s)	10.0		10.0			5.0	8.0			8.0	
Minimum Split (s)	16.0		16.0			11.0	42.0			31.0	
Total Split (s)	66.0		66.0			52.0	84.0			32.0	
Total Split (%)	44.0%		44.0%			34.7%	56.0%			21.3%	
Maximum Green (s)	60.0		60.0			46.0	78.0			26.0	
Yellow Time (s)	2.0		2.0			2.0	2.0			2.0	
All-Red Time (s)	4.0		4.0			4.0	4.0			4.0	
Lost Time Adjust (s)	0.0		0.0			0.0	0.0			0.0	
Total Lost Time (s)	6.0		6.0			6.0	6.0			6.0	
Lead/Lag						Lead				Lag	
Lead-Lag Optimize?											
Vehicle Extension (s)	3.0		3.0			3.0	3.0			3.0	
Recall Mode	None		None			None	C-Min			C-Min	
Walk Time (s)							7.0			7.0	
Flash Dont Walk (s)							29.0			17.0	
Pedestrian Calls (#/hr)							0			0	
Act Effct Green (s)	60.0		60.0			46.0	78.0			26.0	150.0
Actuated g/C Ratio	0.40		0.40			0.31	0.52			0.17	1.00
v/c Ratio	1.18		0.81			1.19	0.26			0.56	0.23
Control Delay	128.9		47.3			122.6	8.2			60.7	0.3
Queue Delay	0.0		0.0			0.0	0.0			0.0	0.0
Total Delay	128.9		47.3			122.6	8.2			60.7	0.3
LOS	F		D			F	A			E	A
Approach Delay		99.7					91.3			29.6	
Approach LOS		F					F			C	
Queue Length 50th (ft)	~919		417			~734	80			161	0
Queue Length 95th (ft)	#1018		498			#863	m97			215	0
Internal Link Dist (ft)		776		310			680			777	
Turn Bay Length (ft)						550					
Base Capacity (vph)	1296		1052			1022	1787			607	1568
Starvation Cap Reductn	0		0			0	0			0	0
Spillback Cap Reductn	0		0			0	0			0	0
Storage Cap Reductn	0		0			0	0			0	0
Reduced v/c Ratio	1.18		0.81			1.19	0.26			0.56	0.23

Intersection Summary

Area Type: Other
Cycle Length: 150
Actuated Cycle Length: 150
Offset: 57 (38%), Referenced to phase 2:NET and 6:SWT, Start of Yellow
Natural Cycle: 150

Control Type: Actuated-Coordinated
Maximum v/c Ratio: 1.19
Intersection Signal Delay: 86.4 Intersection LOS: F
Intersection Capacity Utilization 95.5% ICU Level of Service F
Analysis Period (min) 15
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 8: NH 102 & Exit 4 NB Off

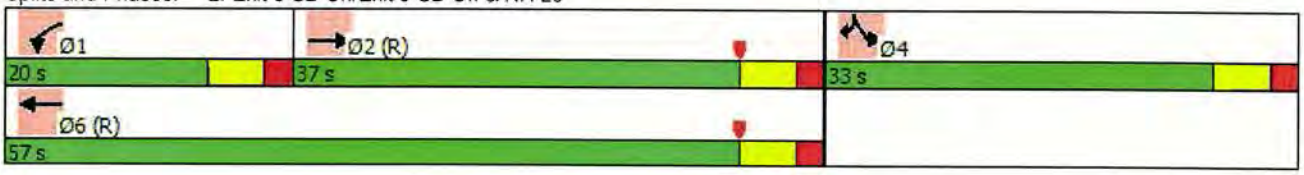
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑	↱	↰	↑↑					↰↰		↱
Traffic Volume (vph)	0	790	420	150	610	0	0	0	0	175	0	425
Future Volume (vph)	0	790	420	150	610	0	0	0	0	175	0	425
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		350	0		0	0		0	0		0
Storage Lanes	0		1	1		0	0		0	2		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	0.97	1.00	1.00
Frt			0.850									0.850
Flt Protected				0.950						0.950		
Satd. Flow (prot)	0	3471	1553	1719	3438	0	0	0	0	3367	0	1553
Flt Permitted				0.950						0.950		
Satd. Flow (perm)	0	3471	1553	1719	3438	0	0	0	0	3367	0	1553
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			483									213
Link Speed (mph)		30			30			30			35	
Link Distance (ft)		851			693			486			581	
Travel Time (s)		19.3			15.8			11.0			11.3	
Peak Hour Factor	0.87	0.87	0.87	0.86	0.86	0.86	0.92	0.92	0.92	0.91	0.91	0.91
Heavy Vehicles (%)	4%	4%	4%	5%	5%	5%	2%	2%	2%	4%	4%	4%
Adj. Flow (vph)	0	908	483	174	709	0	0	0	0	192	0	467
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	908	483	174	709	0	0	0	0	192	0	467
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Right	Left	Right
Median Width(ft)		36			36			24			24	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		25	15		9	15		9	15		25
Number of Detectors		3	3	3	3					3		3
Detector Template		Thru	Right	Left	Thru					Left		Right
Leading Detector (ft)		256	256	256	256					256		256
Trailing Detector (ft)		-5	-5	-5	-5					-5		-5
Detector 1 Position(ft)		-5	-5	-5	-5					-5		-5
Detector 1 Size(ft)		50	50	50	50					50		50
Detector 1 Type		Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex					Cl+Ex		Cl+Ex
Detector 1 Channel												
Detector 1 Extend (s)		0.0	0.0	0.0	0.0					0.0		0.0
Detector 1 Queue (s)		0.0	0.0	0.0	0.0					0.0		0.0
Detector 1 Delay (s)		0.0	0.0	0.0	0.0					0.0		0.0
Detector 2 Position(ft)		125	125	125	125					125		125
Detector 2 Size(ft)		6	6	6	6					6		6
Detector 2 Type		Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex					Cl+Ex		Cl+Ex
Detector 2 Channel												
Detector 2 Extend (s)		0.0	0.0	0.0	0.0					0.0		0.0
Detector 3 Position(ft)		250	250	250	250					250		250
Detector 3 Size(ft)		6	6	6	6					6		6

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Detector 3 Type		Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex					Cl+Ex		Cl+Ex
Detector 3 Channel												
Detector 3 Extend (s)		0.0	0.0	0.0	0.0					0.0		0.0
Turn Type		NA	Free	Prot	NA					Prot		Prot
Protected Phases		2		1	6					4		4
Permitted Phases			Free									
Detector Phase		2		1	6					4		4
Switch Phase												
Minimum Initial (s)		9.0		4.0	9.0					4.0		4.0
Minimum Split (s)		21.0		10.0	21.0					10.0		10.0
Total Split (s)		37.0		20.0	57.0					33.0		33.0
Total Split (%)		41.1%		22.2%	63.3%					36.7%		36.7%
Maximum Green (s)		31.0		14.0	51.0					27.0		27.0
Yellow Time (s)		4.0		4.0	4.0					4.0		4.0
All-Red Time (s)		2.0		2.0	2.0					2.0		2.0
Lost Time Adjust (s)		0.0		0.0	0.0					0.0		0.0
Total Lost Time (s)		6.0		6.0	6.0					6.0		6.0
Lead/Lag		Lag		Lead								
Lead-Lag Optimize?												
Vehicle Extension (s)		5.0		3.0	5.0					3.0		3.0
Recall Mode		C-Min		None	C-Min					None		None
Walk Time (s)		7.0			7.0							
Flash Dont Walk (s)		8.0			8.0							
Pedestrian Calls (#/hr)		0			0							
Act Effct Green (s)		36.6	90.0	12.8	55.3					22.7		22.7
Actuated g/C Ratio		0.41	1.00	0.14	0.61					0.25		0.25
v/c Ratio		0.64	0.31	0.72	0.34					0.23		0.85
Control Delay		25.8	0.5	23.2	0.3					26.0		31.8
Queue Delay		0.0	0.0	0.0	0.0					0.0		0.0
Total Delay		25.8	0.5	23.2	0.3					26.0		31.8
LOS		C	A	C	A					C		C
Approach Delay		17.0			4.8						30.1	
Approach LOS		B			A						C	
Queue Length 50th (ft)		238	0	2	0					41		132
Queue Length 95th (ft)		296	0	3	m0					67		#265
Internal Link Dist (ft)		771			613			406			501	
Turn Bay Length (ft)			350									
Base Capacity (vph)		1410	1553	269	2114					1010		615
Starvation Cap Reductn		0	0	0	0					0		0
Spillback Cap Reductn		0	0	0	0					0		0
Storage Cap Reductn		0	0	0	0					0		0
Reduced v/c Ratio		0.64	0.31	0.65	0.34					0.19		0.76

Intersection Summary	
Area Type:	Other
Cycle Length: 90	
Actuated Cycle Length: 90	
Offset: 51 (57%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow	
Natural Cycle: 60	

Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.85
Intersection Signal Delay: 16.3 Intersection LOS: B
Intersection Capacity Utilization 75.1% ICU Level of Service D
Analysis Period (min) 15
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 2: Exit 5 SB On/Exit 5 SB Off & NH 28



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑			↑↑	↱	↰		↱			
Traffic Volume (vph)	495	470	0	0	410	400	350	0	385	0	0	0
Future Volume (vph)	495	470	0	0	410	400	350	0	385	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt						0.850			0.850			
Flt Protected	0.950						0.950					
Satd. Flow (prot)	1752	3505	0	0	3505	1568	1703	0	1524	0	0	0
Flt Permitted	0.950						0.950					
Satd. Flow (perm)	1752	3505	0	0	3505	1568	1703	0	1524	0	0	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						440			339			
Link Speed (mph)		30			30			35			30	
Link Distance (ft)		693			542			867			392	
Travel Time (s)		15.8			12.3			16.9			8.9	
Peak Hour Factor	0.92	0.92	0.92	0.91	0.91	0.91	0.67	0.67	0.67	0.92	0.92	0.92
Heavy Vehicles (%)	3%	3%	3%	3%	3%	3%	6%	6%	6%	2%	2%	2%
Adj. Flow (vph)	538	511	0	0	451	440	522	0	575	0	0	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	538	511	0	0	451	440	522	0	575	0	0	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Right	Left	Right	Left	Left	Right
Median Width(ft)		36			42			12			12	
Link Offset(ft)		0			0			0			36	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		25	15		25	15		9
Number of Detectors	3	3			3	3	3		0			
Detector Template	Left					Right	Left					
Leading Detector (ft)	256	256			256	256	256		0			
Trailing Detector (ft)	-5	-5			-5	-5	-5		0			
Detector 1 Position(ft)	-5	-5			-5	-5	-5		-5			
Detector 1 Size(ft)	50	50			50	50	50		50			
Detector 1 Type	Cl+Ex	Cl+Ex			Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex			
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0			0.0	0.0	0.0		0.0			
Detector 1 Queue (s)	0.0	0.0			0.0	0.0	0.0		0.0			
Detector 1 Delay (s)	0.0	0.0			0.0	0.0	0.0		0.0			
Detector 2 Position(ft)	125	125			125	125	125					
Detector 2 Size(ft)	6	6			6	6	6					
Detector 2 Type	Cl+Ex	Cl+Ex			Cl+Ex	Cl+Ex	Cl+Ex					
Detector 2 Channel												
Detector 2 Extend (s)	0.0	0.0			0.0	0.0	0.0					
Detector 3 Position(ft)	250	250			250	250	250					
Detector 3 Size(ft)	6	6			6	6	6					
Detector 3 Type	Cl+Ex	Cl+Ex			Cl+Ex	Cl+Ex	Cl+Ex					
Detector 3 Channel												
Detector 3 Extend (s)	0.0	0.0			0.0	0.0	0.0					

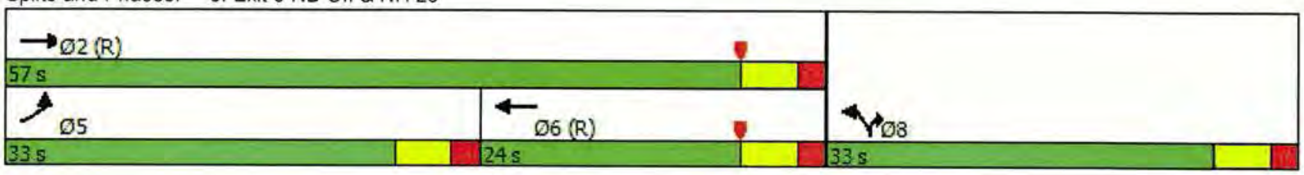
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Type	Prot	NA			NA	Free	Prot		Prot			
Protected Phases	5	2			6		8		8			
Permitted Phases		2			6	Free						
Detector Phase	5	2			6		8		8			
Switch Phase												
Minimum Initial (s)	4.0	16.0			16.0		4.0		4.0			
Minimum Split (s)	10.0	23.0			23.0		11.0		11.0			
Total Split (s)	33.0	57.0			24.0		33.0		33.0			
Total Split (%)	36.7%	63.3%			26.7%		36.7%		36.7%			
Maximum Green (s)	27.0	51.0			18.0		27.0		27.0			
Yellow Time (s)	4.0	4.0			4.0		4.0		4.0			
All-Red Time (s)	2.0	2.0			2.0		2.0		2.0			
Lost Time Adjust (s)	0.0	0.0			0.0		0.0		0.0			
Total Lost Time (s)	6.0	6.0			6.0		6.0		6.0			
Lead/Lag	Lead				Lag							
Lead-Lag Optimize?												
Vehicle Extension (s)	5.0	5.0			5.0		3.0		3.0			
Recall Mode	None	C-Min			C-Min		None		None			
Walk Time (s)		7.0			7.0							
Flash Dont Walk (s)		10.0			10.0							
Pedestrian Calls (#/hr)		0			0							
Act Effct Green (s)	27.0	50.6			17.6	90.0	27.4		27.4			
Actuated g/C Ratio	0.30	0.56			0.20	1.00	0.30		0.30			
v/c Ratio	1.02	0.26			0.66	0.28	1.01		0.82			
Control Delay	53.9	3.3			38.5	0.4	75.1		23.2			
Queue Delay	0.0	0.0			0.0	0.0	0.0		0.0			
Total Delay	53.9	3.3			38.5	0.4	75.1		23.2			
LOS	D	A			D	A	E		C			
Approach Delay		29.3			19.7			47.9				
Approach LOS		C			B			D				
Queue Length 50th (ft)	~316	6			124	0	~307		127			
Queue Length 95th (ft)	#493	8			176	0	287		110			
Internal Link Dist (ft)		613			462			787			312	
Turn Bay Length (ft)												
Base Capacity (vph)	525	1986			701	1568	518		699			
Starvation Cap Reductn	0	0			0	0	0		0			
Spillback Cap Reductn	0	0			0	0	0		0			
Storage Cap Reductn	0	0			0	0	0		0			
Reduced v/c Ratio	1.02	0.26			0.64	0.28	1.01		0.82			

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 90
Offset: 0 (0%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow, Master Intersection
Natural Cycle: 90
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 1.02
Intersection Signal Delay: 33.2 Intersection LOS: C

Intersection Capacity Utilization 75.1% ICU Level of Service D
Analysis Period (min) 15
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 3: Exit 5 NB Off & NH 28



Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations		↰↑	↱		✣		↰	↑↱		↰	↑↱	
Traffic Volume (vph)	80	5	120	10	0	10	210	830	120	5	610	100
Future Volume (vph)	80	5	120	10	0	10	210	830	120	5	610	100
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		225	0		0	350		0	100		0
Storage Lanes	0		1	0		0	1		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00	0.95	0.95
Frt			0.850		0.932			0.981			0.979	
Flt Protected		0.955			0.976		0.950			0.950		
Satd. Flow (prot)	0	1779	1583	0	1728	0	1770	3472	0	1770	3465	0
Flt Permitted		0.808			0.795		0.950			0.950		
Satd. Flow (perm)	0	1505	1583	0	1408	0	1770	3472	0	1770	3465	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			182		182			28			23	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		593			447			750			330	
Travel Time (s)		13.5			10.2			17.0			7.5	
Peak Hour Factor	0.92	0.92	0.92	0.25	0.25	0.25	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	2%	2%	2%	0%	0%	0%	2%	2%	2%	2%	2%	2%
Adj. Flow (vph)	87	5	130	40	0	40	228	902	130	5	663	109
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	92	130	0	80	0	228	1032	0	5	772	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	3	3	1	3	1		3	3		3	3	
Detector Template	Left	Thru	Right	Left			Left	Thru		Left	Thru	
Leading Detector (ft)	256	256	45	256	45		256	256		256	256	
Trailing Detector (ft)	-5	-5	-5	-5	-5		-5	-5		-5	-5	
Detector 1 Position(ft)	-5	-5	-5	-5	-5		-5	-5		-5	-5	
Detector 1 Size(ft)	50	50	50	50	50		50	50		50	50	
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(ft)	125	125		125			125	125		125	125	
Detector 2 Size(ft)	6	6		6			6	6		6	6	
Detector 2 Type	Cl+Ex	Cl+Ex		Cl+Ex			Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)	0.0	0.0		0.0			0.0	0.0		0.0	0.0	
Detector 3 Position(ft)	250	250		250			250	250		250	250	
Detector 3 Size(ft)	6	6		6			6	6		6	6	

Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Detector 3 Type	Cl+Ex	Cl+Ex		Cl+Ex			Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 3 Channel												
Detector 3 Extend (s)	0.0	0.0		0.0			0.0	0.0		0.0	0.0	
Turn Type	Perm	NA	custom	Perm	NA		Prot	NA		Prot	NA	
Protected Phases		8			4		5	2		1	6	
Permitted Phases	8		6	4								
Detector Phase	8	8	6	4	4		5	2		1	6	
Switch Phase												
Minimum Initial (s)	5.0	5.0	8.0	5.0	5.0		5.0	8.0		5.0	8.0	
Minimum Split (s)	24.0	24.0	24.0	24.0	24.0		24.0	24.0		11.0	24.0	
Total Split (s)	24.0	24.0	38.0	24.0	24.0		28.0	55.0		11.0	38.0	
Total Split (%)	26.7%	26.7%	42.2%	26.7%	26.7%		31.1%	61.1%		12.2%	42.2%	
Maximum Green (s)	18.0	18.0	32.0	18.0	18.0		22.0	49.0		5.0	32.0	
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)		0.0	0.0		0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)		6.0	6.0		6.0		6.0	6.0		6.0	6.0	
Lead/Lag			Lag				Lead	Lag		Lead	Lag	
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None	Min	None	None		None	Min		None	Min	
Walk Time (s)	7.0	7.0	7.0	7.0	7.0		7.0	7.0			7.0	
Flash Dont Walk (s)	11.0	11.0	11.0	11.0	11.0		11.0	11.0			11.0	
Pedestrian Calls (#/hr)	0	0	0	0	0		0	0			0	
Act Effct Green (s)		10.7	27.3		10.5		14.8	49.5		5.6	27.3	
Actuated g/C Ratio		0.16	0.40		0.15		0.22	0.73		0.08	0.40	
v/c Ratio		0.39	0.17		0.22		0.59	0.41		0.03	0.55	
Control Delay		35.6	1.8		1.4		34.2	6.9		38.0	18.8	
Queue Delay		0.0	0.0		0.0		0.0	0.0		0.0	0.0	
Total Delay		35.6	1.8		1.4		34.2	6.9		38.0	18.8	
LOS		D	A		A		C	A		D	B	
Approach Delay		15.8			1.4			11.8			18.9	
Approach LOS		B			A			B			B	
Queue Length 50th (ft)		40	0		0		99	85		2	131	
Queue Length 95th (ft)		90	15		0		181	224		14	235	
Internal Link Dist (ft)		513			367			670			250	
Turn Bay Length (ft)			225				350			100		
Base Capacity (vph)		443	915		542		637	2595		144	1824	
Starvation Cap Reductn		0	0		0		0	0		0	0	
Spillback Cap Reductn		0	0		0		0	0		0	0	
Storage Cap Reductn		0	0		0		0	0		0	0	
Reduced v/c Ratio		0.21	0.14		0.15		0.36	0.40		0.03	0.42	

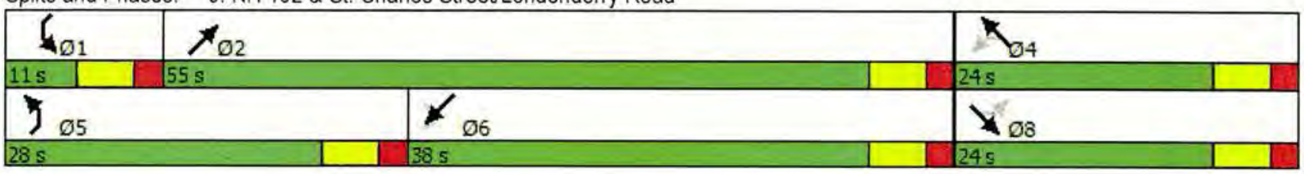
Intersection Summary	
Area Type:	Other
Cycle Length: 90	
Actuated Cycle Length: 68.2	
Natural Cycle: 75	
Control Type: Actuated-Uncoordinated	

Lanes, Volumes, Timings
5 ~~9~~: NH 102 & St. Charles Street/Londonderry Road

01/23/2018

Maximum v/c Ratio: 0.59
Intersection Signal Delay: 14.2 | Intersection LOS: B
Intersection Capacity Utilization 58.4% | ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 9: NH 102 & St. Charles Street/Londonderry Road



Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations		✣			✣			↱			↰	
Traffic Volume (vph)	20	80	5	250	0	60	0	680	130	15	345	0
Future Volume (vph)	20	80	5	250	0	60	0	680	130	15	345	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.994			0.974			0.978				
Flt Protected		0.991			0.961						0.998	
Satd. Flow (prot)	0	1835	0	0	1727	0	0	1721	0	0	1806	0
Flt Permitted		0.906			0.644						0.819	
Satd. Flow (perm)	0	1678	0	0	1157	0	0	1721	0	0	1482	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		3			36			18				
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		356			493			1124			603	
Travel Time (s)		8.1			11.2			25.5			13.7	
Peak Hour Factor	0.60	0.60	0.60	0.96	0.96	0.96	0.89	0.89	0.89	0.86	0.86	0.86
Heavy Vehicles (%)	2%	2%	2%	3%	3%	3%	8%	8%	8%	5%	5%	5%
Adj. Flow (vph)	33	133	8	260	0	63	0	764	146	17	401	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	174	0	0	323	0	0	910	0	0	418	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0			0	
Link Offset(ft)		-22			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	3	1		3	2			2		3	2	
Detector Template	Left			Left						Left		
Leading Detector (ft)	256	45		256	131			131		256	131	
Trailing Detector (ft)	-5	-5		-5	-5			-5		-5	-5	
Detector 1 Position(ft)	-5	-5		-5	-5			-5		-5	-5	
Detector 1 Size(ft)	50	50		50	50			50		50	50	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex			Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0			0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0			0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0			0.0		0.0	0.0	
Detector 2 Position(ft)	125			125	125			125		125	125	
Detector 2 Size(ft)	6			6	6			6		6	6	
Detector 2 Type	Cl+Ex			Cl+Ex	Cl+Ex			Cl+Ex		Cl+Ex	Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)	0.0			0.0	0.0			0.0		0.0	0.0	
Detector 3 Position(ft)	250			250						250		
Detector 3 Size(ft)	6			6						6		
Detector 3 Type	Cl+Ex			Cl+Ex						Cl+Ex		
Detector 3 Channel												
Detector 3 Extend (s)	0.0			0.0						0.0		

Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Turn Type	Perm	NA		Perm	NA			NA		Perm	NA	
Protected Phases		4			4			2			2	
Permitted Phases	4			4						2		
Detector Phase	4	4		4	4			2		2	2	
Switch Phase												
Minimum Initial (s)	5.0	5.0		5.0	5.0			5.0		5.0	5.0	
Minimum Split (s)	24.0	24.0		24.0	24.0			24.0		24.0	24.0	
Total Split (s)	32.0	32.0		32.0	32.0			58.0		58.0	58.0	
Total Split (%)	35.6%	35.6%		35.6%	35.6%			64.4%		64.4%	64.4%	
Maximum Green (s)	26.0	26.0		26.0	26.0			52.0		52.0	52.0	
Yellow Time (s)	4.0	4.0		4.0	4.0			4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0			2.0		2.0	2.0	
Lost Time Adjust (s)		0.0			0.0			0.0			0.0	
Total Lost Time (s)		6.0			6.0			6.0			6.0	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0		3.0	3.0	
Recall Mode	None	None		None	None			Min		Min	Min	
Walk Time (s)	7.0	7.0		7.0	7.0			7.0		7.0	7.0	
Flash Dont Walk (s)	11.0	11.0		11.0	11.0			11.0		11.0	11.0	
Pedestrian Calls (#/hr)	0	0		0	0			0		0	0	
Act Effct Green (s)		24.5			24.5			48.8			48.8	
Actuated g/C Ratio		0.29			0.29			0.57			0.57	
v/c Ratio		0.36			0.91			0.92			0.49	
Control Delay		27.3			58.1			32.6			13.5	
Queue Delay		0.0			0.0			0.0			0.0	
Total Delay		27.3			58.1			32.6			13.5	
LOS		C			E			C			B	
Approach Delay		27.3			58.1			32.6			13.5	
Approach LOS		C			E			C			B	
Queue Length 50th (ft)		77			158			420			130	
Queue Length 95th (ft)		83			#320			#700			191	
Internal Link Dist (ft)		276			413			1044			523	
Turn Bay Length (ft)												
Base Capacity (vph)		519			381			1069			915	
Starvation Cap Reductn		0			0			0			0	
Spillback Cap Reductn		0			0			0			0	
Storage Cap Reductn		0			0			0			0	
Reduced v/c Ratio		0.34			0.85			0.85			0.46	

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 85.4
Natural Cycle: 70
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.92
Intersection Signal Delay: 32.2 Intersection LOS: C
Intersection Capacity Utilization 81.2% ICU Level of Service D

Analysis Period (min) 15

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 10: NH 102 & Fordway/Madden Hill Road

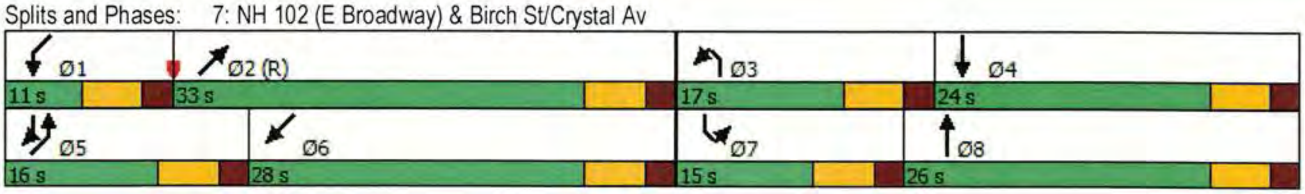
Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	150	200	20	70	240	10	90	420	40	60	280	210
Future Volume (vph)	150	200	20	70	240	10	90	420	40	60	280	210
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	70		0	245		245	390		0	110		0
Storage Lanes	1		0	1		1	1		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.986				0.850		0.987			0.936	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1752	1819	0	1752	1845	1568	1787	1857	0	1787	1761	0
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1752	1819	0	1752	1845	1568	1787	1857	0	1787	1761	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		6				116		6			43	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		361			411			477			530	
Travel Time (s)		8.2			9.3			10.8			12.0	
Peak Hour Factor	0.91	0.91	0.91	0.93	0.93	0.93	0.95	0.95	0.95	0.94	0.94	0.94
Heavy Vehicles (%)	3%	3%	3%	3%	3%	3%	1%	1%	1%	1%	1%	1%
Adj. Flow (vph)	165	220	22	75	258	11	95	442	42	64	298	223
Shared Lane Traffic (%)												
Lane Group Flow (vph)	165	242	0	75	258	11	95	484	0	64	521	0
Turn Type	Prot	NA		Prot	NA	pm+ov	Prot	NA		Prot	NA	
Protected Phases	3	8		7	4	5	5	2		1	6	
Permitted Phases						4						
Detector Phase	3	8		7	4	5	5	2		1	6	
Switch Phase												
Minimum Initial (s)	4.0	5.0		4.0	10.0	4.0	4.0	10.0		4.0	9.0	
Minimum Split (s)	17.0	24.0		11.0	24.0	16.0	16.0	24.0		11.0	24.0	
Total Split (s)	17.0	26.0		15.0	24.0	16.0	16.0	33.0		11.0	28.0	
Total Split (%)	20.0%	30.6%		17.6%	28.2%	18.8%	18.8%	38.8%		12.9%	32.9%	
Maximum Green (s)	11.0	20.0		9.0	18.0	10.0	10.0	27.0		5.0	22.0	
Yellow Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0	2.0	2.0	2.0		2.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Lead/Lag	Lead	Lag		Lead	Lag	Lead	Lead	Lag		Lead	Lag	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes	Yes	Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None	None	None	C-Max		None	None	
Act Effct Green (s)	10.5	20.5		8.0	15.7	30.6	8.8	31.2		5.9	28.3	
Actuated g/C Ratio	0.12	0.24		0.09	0.18	0.36	0.10	0.37		0.07	0.33	
v/c Ratio	0.76	0.55		0.45	0.76	0.02	0.51	0.71		0.52	0.85	
Control Delay	59.4	33.3		45.1	47.3	0.0	45.7	31.9		55.6	42.9	
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Total Delay	59.4	33.3		45.1	47.3	0.0	45.7	31.9		55.6	42.9	
LOS	E	C		D	D	A	D	C		E	D	
Approach Delay		43.9			45.3			34.2			44.3	

Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Approach LOS		D			D			C			D	
Queue Length 50th (ft)	86	113		38	129	0	48	233		34	~268	
Queue Length 95th (ft)	#180	186		80	207	0	95	#394		#93	#488	
Internal Link Dist (ft)		281			331			397			450	
Turn Bay Length (ft)	70			245		245	390			110		
Base Capacity (vph)	226	456		185	390	657	210	686		123	615	
Starvation Cap Reductn	0	0		0	0	0	0	0		0	0	
Spillback Cap Reductn	0	0		0	0	0	0	0		0	0	
Storage Cap Reductn	0	0		0	0	0	0	0		0	0	
Reduced v/c Ratio	0.73	0.53		0.41	0.66	0.02	0.45	0.71		0.52	0.85	

Intersection Summary

Area Type: Other
Cycle Length: 85
Actuated Cycle Length: 85
Offset: 0 (0%), Referenced to phase 2:NET, Start of Green
Natural Cycle: 85
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.85
Intersection Signal Delay: 41.3 Intersection LOS: D
Intersection Capacity Utilization 87.9% ICU Level of Service E
Analysis Period (min) 15
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 7: NH 102 (E Broadway) & Birch St/Crystal Av



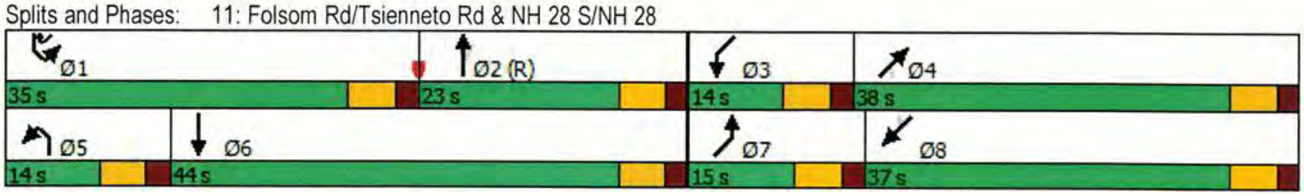
Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations	↰	↑↑	↱	↰↰	↑↑		↰	↑	↱	↰	↑	↱
Traffic Volume (vph)	60	320	110	550	390	0	60	360	50	45	180	625
Future Volume (vph)	60	320	110	550	390	0	60	360	50	45	180	625
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	110		90	360		0	190		180	0		210
Storage Lanes	1		1	2		0	1		1	1		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850						0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1770	3539	1583	3433	3539	0	1770	1863	1583	1787	1881	1599
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1770	3539	1583	3433	3539	0	1770	1863	1583	1787	1881	1599
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			208						208			165
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		639			503			532			387	
Travel Time (s)		14.5			11.4			12.1			8.8	
Peak Hour Factor	0.92	0.92	0.92	0.94	0.94	0.94	0.96	0.96	0.96	0.95	0.95	0.95
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	1%	1%	1%
Adj. Flow (vph)	65	348	120	585	415	0	63	375	52	47	189	658
Shared Lane Traffic (%)												
Lane Group Flow (vph)	65	348	120	585	415	0	63	375	52	47	189	658
Turn Type	Prot	NA	Perm	Prot	NA		Prot	NA	Perm	Prot	NA	pm+ov
Protected Phases	5	2		1	6		7	4		3	8	1
Permitted Phases			2						4			8
Detector Phase	5	2	2	1	6		7	4	4	3	8	1
Switch Phase												
Minimum Initial (s)	8.0	8.0	8.0	8.0	8.0		7.0	8.0	8.0	8.0	8.0	8.0
Minimum Split (s)	14.0	22.0	22.0	14.0	22.0		13.0	22.0	22.0	14.0	22.0	14.0
Total Split (s)	14.0	23.0	23.0	35.0	44.0		15.0	38.0	38.0	14.0	37.0	35.0
Total Split (%)	12.7%	20.9%	20.9%	31.8%	40.0%		13.6%	34.5%	34.5%	12.7%	33.6%	31.8%
Maximum Green (s)	8.0	17.0	17.0	29.0	38.0		9.0	32.0	32.0	8.0	31.0	29.0
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0		6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag		Lead	Lag	Lag	Lead	Lag	Lead
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes	Yes	Yes	Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	C-Max	C-Max	None	None		None	None	None	None	None	None
Walk Time (s)		5.0	5.0		5.0			5.0	5.0		5.0	
Flash Dont Walk (s)		11.0	11.0		11.0			11.0	11.0		11.0	
Pedestrian Calls (#/hr)		0	0		0			0	0		0	
Act Effct Green (s)	8.4	28.9	28.9	25.2	48.4		8.4	26.7	26.7	8.0	26.2	57.4
Actuated g/C Ratio	0.08	0.26	0.26	0.23	0.44		0.08	0.24	0.24	0.07	0.24	0.52
v/c Ratio	0.48	0.38	0.21	0.74	0.27		0.47	0.83	0.10	0.36	0.42	0.72
Control Delay	61.1	38.3	0.8	55.3	26.8		60.4	55.0	0.4	57.0	37.7	18.7
Queue Delay	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0

Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Total Delay	61.1	38.3	0.8	55.3	26.8		60.4	55.0	0.4	57.0	37.7	18.7
LOS	E	D	A	E	C		E	E	A	E	D	B
Approach Delay		32.6			43.5			49.9			24.7	
Approach LOS		C			D			D			C	
Queue Length 50th (ft)	44	112	0	226	102		43	250	0	32	113	253
Queue Length 95th (ft)	91	173	0	288	155		88	343	0	71	171	330
Internal Link Dist (ft)		559			423			452			307	
Turn Bay Length (ft)	110		90	360			190		180			210
Base Capacity (vph)	135	928	568	905	1558		144	541	608	129	530	962
Starvation Cap Reductn	0	0	0	0	0		0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0		0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0		0	0	0	0	0	0
Reduced v/c Ratio	0.48	0.38	0.21	0.65	0.27		0.44	0.69	0.09	0.36	0.36	0.68

Intersection Summary

Area Type: Other
Cycle Length: 110
Actuated Cycle Length: 110
Offset: 0 (0%), Referenced to phase 2:NBT, Start of Green
Natural Cycle: 80
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.83
Intersection Signal Delay: 36.8 — Intersection LOS: D
Intersection Capacity Utilization 70.2% — ICU Level of Service C
Analysis Period (min) 15

Splits and Phases: 11: Folsom Rd/Tsienneto Rd & NH 28 S/NH 28



Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	160	1185	5	20	890	80	15	10	15	10	10	60
Future Volume (vph)	160	1185	5	20	890	80	15	10	15	10	10	60
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	100		0	115		0	0		0	0		0
Storage Lanes	1		0	1		0	0		1	0		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.999			0.988				0.850			0.850
Flt Protected	0.950			0.950				0.971			0.976	
Satd. Flow (prot)	1787	3571	0	1787	3531	0	0	1845	1615	0	1836	1599
Flt Permitted	0.950			0.950				0.799			0.827	
Satd. Flow (perm)	1787	3571	0	1787	3531	0	0	1518	1615	0	1556	1599
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		1			11				149			149
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		277			644			230			387	
Travel Time (s)		6.3			14.6			5.2			8.8	
Peak Hour Factor	0.97	0.97	0.97	0.95	0.95	0.95	0.90	0.90	0.90	0.80	0.80	0.80
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	0%	0%	0%	1%	1%	1%
Adj. Flow (vph)	165	1222	5	21	937	84	17	11	17	13	13	75
Shared Lane Traffic (%)												
Lane Group Flow (vph)	165	1227	0	21	1021	0	0	28	17	0	26	75
Turn Type	Prot	NA		Prot	NA		Perm	NA	Perm	Perm	NA	Perm
Protected Phases	5	2		1	6			8			4	
Permitted Phases							8		8	4	4	4
Detector Phase	5	2		1	6		8	8	8	4	4	4
Switch Phase												
Minimum Initial (s)	5.0	8.0		5.0	8.0		5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	26.0	63.0		11.0	48.0		21.0	21.0	21.0	21.0	21.0	21.0
Total Split (s)	30.0	74.0		13.0	57.0		23.0	23.0	23.0	23.0	23.0	23.0
Total Split (%)	27.3%	67.3%		11.8%	51.8%		20.9%	20.9%	20.9%	20.9%	20.9%	20.9%
Maximum Green (s)	24.0	68.0		7.0	51.0		17.0	17.0	17.0	17.0	17.0	17.0
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0			0.0	0.0		0.0	0.0
Total Lost Time (s)	6.0	6.0		6.0	6.0			6.0	6.0		6.0	6.0
Lead/Lag	Lead	Lag		Lead	Lag							
Lead-Lag Optimize?	Yes	Yes		Yes	Yes							
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	C-Max		None	C-Max		None	None	None	None	None	None
Walk Time (s)		7.0			7.0		7.0	7.0	7.0	7.0	7.0	7.0
Flash Dont Walk (s)		11.0			11.0		8.0	8.0	8.0	8.0	8.0	8.0
Pedestrian Calls (#/hr)		0			0		0	0	0	0	0	0
Act Effct Green (s)	15.4	88.4		6.9	71.4			7.5	7.5		7.5	7.5
Actuated g/C Ratio	0.14	0.80		0.06	0.65			0.07	0.07		0.07	0.07
v/c Ratio	0.66	0.43		0.19	0.44			0.27	0.07		0.25	0.30
Control Delay	54.6	6.4		52.7	11.3			54.7	0.5		53.5	3.1
Queue Delay	0.0	0.0		0.0	0.0			0.0	0.0		0.0	0.0

Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Total Delay	54.6	6.4		52.7	11.3			54.7	0.5		53.5	3.1
LOS	D	A		D	B			D	A		D	A
Approach Delay		12.1			12.1			34.2			16.1	
Approach LOS		B			B			C			B	
Queue Length 50th (ft)	115	82		13	190			19	0		18	0
Queue Length 95th (ft)	m177	284		m27	253			48	0		40	0
Internal Link Dist (ft)		197			564			150			307	
Turn Bay Length (ft)	100			115								
Base Capacity (vph)	389	2869		120	2296			234	375		240	373
Starvation Cap Reductn	0	0		0	0			0	0		0	0
Spillback Cap Reductn	0	0		0	0			0	0		0	0
Storage Cap Reductn	0	0		0	0			0	0		0	0
Reduced v/c Ratio	0.42	0.43		0.17	0.44			0.12	0.05		0.11	0.20

Intersection Summary

Area Type: Other
Cycle Length: 110
Actuated Cycle Length: 110
Offset: 0 (0%), Referenced to phase 2:SET and 6:NWT, Start of Green
Natural Cycle: 95
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.66
Intersection Signal Delay: 12.7 Intersection LOS: B
Intersection Capacity Utilization 60.1% ICU Level of Service B
Analysis Period (min) 15
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 13: Applebee's/Linlew Dr & NH 28

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑	↱	↰↰	↑↱		↰	↑↑	↱↱	↰	↑↑	↱
Traffic Volume (vph)	50	180	140	820	300	20	130	640	940	30	530	180
Future Volume (vph)	50	180	140	820	300	20	130	640	940	30	530	180
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	100		0	220		0	100		265	200		0
Storage Lanes	1		1	2		0	1		2	1		1
Taper Length (ft)	150			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	0.97	0.95	0.95	1.00	0.95	0.88	1.00	0.95	1.00
Frt			0.850		0.991				0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1787	1881	1599	3433	3507	0	1805	3610	2842	1805	3610	1615
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1787	1881	1599	3433	3507	0	1805	3610	2842	1805	3610	1615
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			149		6				806			209
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		877			438			391			343	
Travel Time (s)		19.9			10.0			8.9			7.8	
Peak Hour Factor	0.84	0.84	0.84	0.90	0.90	0.90	0.78	0.78	0.78	0.86	0.86	0.86
Heavy Vehicles (%)	1%	1%	1%	2%	2%	2%	0%	0%	0%	0%	0%	0%
Adj. Flow (vph)	60	214	167	911	333	22	167	821	1205	35	616	209
Shared Lane Traffic (%)												
Lane Group Flow (vph)	60	214	167	911	355	0	167	821	1205	35	616	209
Turn Type	Prot	NA	pm+ov	Prot	NA		Prot	NA	pm+ov	Prot	NA	pm+ov
Protected Phases	5	2	3	1	6		3	8	1	7	4	5
Permitted Phases			2						8		4	4
Detector Phase	5	2	3	1	6		3	8	1	7	4	5
Switch Phase												
Minimum Initial (s)	8.0	8.0	5.0	8.0	8.0		5.0	5.0	8.0	5.0	8.0	8.0
Minimum Split (s)	22.0	22.0	9.5	22.0	22.0		9.5	22.0	22.0	9.5	22.0	22.0
Total Split (s)	22.0	25.0	20.0	38.0	41.0		20.0	28.0	38.0	19.0	27.0	22.0
Total Split (%)	20.0%	22.7%	18.2%	34.5%	37.3%		18.2%	25.5%	34.5%	17.3%	24.5%	20.0%
Maximum Green (s)	16.0	19.0	15.5	32.0	35.0		15.5	22.0	32.0	14.5	21.0	16.0
Yellow Time (s)	4.0	4.0	3.5	4.0	4.0		3.5	4.0	4.0	3.5	4.0	4.0
All-Red Time (s)	2.0	2.0	1.0	2.0	2.0		1.0	2.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	4.5	6.0	6.0		4.5	6.0	6.0	4.5	6.0	6.0
Lead/Lag	Lead	Lag	Lead	Lead	Lag		Lead	Lag	Lead	Lead	Lag	Lead
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes	Yes	Yes	Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	Max	C-Max	None	None	None		None	None	None	None	None	Max
Walk Time (s)	5.0	5.0		5.0	5.0			5.0	5.0		5.0	5.0
Flash Dont Walk (s)	11.0	11.0		11.0	11.0			11.0	11.0		11.0	11.0
Pedestrian Calls (#/hr)	0	0		0	0			0	0		0	0
Act Effct Green (s)	16.0	19.0	38.9	32.0	35.0		13.9	33.1	71.1	7.6	22.6	44.6
Actuated g/C Ratio	0.15	0.17	0.35	0.29	0.32		0.13	0.30	0.65	0.07	0.21	0.41
v/c Ratio	0.23	0.66	0.25	0.91	0.32		0.73	0.76	0.57	0.28	0.83	0.27
Control Delay	44.2	53.3	6.2	50.5	40.1		65.0	41.7	4.7	53.5	53.4	4.0
Queue Delay	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Total Delay	44.2	53.3	6.2	50.5	40.1		65.0	41.7	4.7	53.5	53.4	4.0
LOS	D	D	A	D	D		E	D	A	D	D	A
Approach Delay		34.2			47.5			23.1			41.4	
Approach LOS		C			D			C			D	
Queue Length 50th (ft)	38	142	8	344	128		113	291	68	24	225	0
Queue Length 95th (ft)	73	207	44	#445	176		158	315	72	53	#299	39
Internal Link Dist (ft)		797			358			311			263	
Turn Bay Length (ft)	100			220			100		265	200		
Base Capacity (vph)	259	324	682	998	1119		254	1084	2121	237	741	778
Starvation Cap Reductn	0	0	0	0	0		0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0		0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0		0	0	0	0	0	0
Reduced v/c Ratio	0.23	0.66	0.24	0.91	0.32		0.66	0.76	0.57	0.15	0.83	0.27

Intersection Summary

Area Type: Other
Cycle Length: 110
Actuated Cycle Length: 110
Offset: 0 (0%), Referenced to phase 2:EBT, Start of Yellow
Natural Cycle: 90
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.91
Intersection Signal Delay: 33.9 Intersection LOS: C
Intersection Capacity Utilization 73.5% ICU Level of Service D
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 22: Connector Road & NH 28

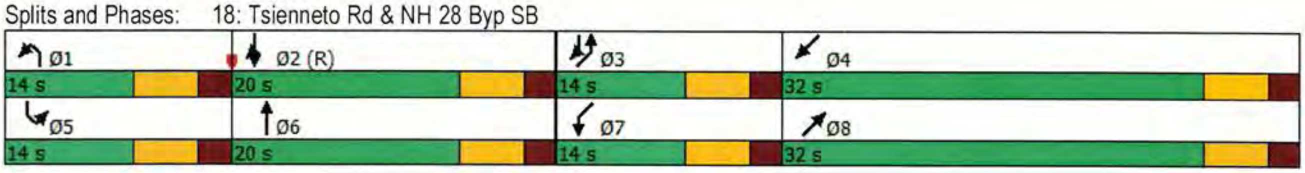
Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	30	70	20	80	60	20	30	430	70	20	210	50
Future Volume (vph)	30	70	20	80	60	20	30	430	70	20	210	50
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200		150	190		190	135		150	120		150
Storage Lanes	1		0	1		1	1		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.967				0.850		0.979			0.971	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1770	1801	0	1787	1881	1599	1805	1860	0	1805	1845	0
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1770	1801	0	1787	1881	1599	1805	1860	0	1805	1845	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		15				123		11			16	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		481			347			479			371	
Travel Time (s)		10.9			7.9			10.9			8.4	
Peak Hour Factor	0.99	0.99	0.99	0.95	0.95	0.95	0.89	0.89	0.89	0.93	0.93	0.93
Heavy Vehicles (%)	2%	2%	2%	1%	1%	1%	0%	0%	0%	0%	0%	0%
Adj. Flow (vph)	30	71	20	84	63	21	34	483	79	22	226	54
Shared Lane Traffic (%)												
Lane Group Flow (vph)	30	91	0	84	63	21	34	562	0	22	280	0
Turn Type	Prot	NA		Prot	NA	pt+ov	Prot	NA		Prot	NA	
Protected Phases	1	6		5	2	2 3	3	8		7	4	
Permitted Phases		6			2							
Detector Phase	1	6		5	2	2 3	3	8		7	4	
Switch Phase												
Minimum Initial (s)	8.0	8.0		8.0	8.0		8.0	8.0		8.0	8.0	
Minimum Split (s)	14.0	20.0		14.0	20.0		14.0	28.0		14.0	14.0	
Total Split (s)	14.0	20.0		14.0	20.0		14.0	32.0		14.0	32.0	
Total Split (%)	17.5%	25.0%		17.5%	25.0%		17.5%	40.0%		17.5%	40.0%	
Maximum Green (s)	8.0	14.0		8.0	14.0		8.0	26.0		8.0	26.0	
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lag		Lead	Lag	
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	C-Max		None	None		None	None	
Walk Time (s)								7.0				
Flash Dont Walk (s)								15.0				
Pedestrian Calls (#/hr)								0				
Act Effct Green (s)	8.0	24.1		8.2	29.9	43.9	8.0	26.9		8.0	24.1	
Actuated g/C Ratio	0.10	0.30		0.10	0.37	0.55	0.10	0.34		0.10	0.30	
v/c Ratio	0.17	0.16		0.46	0.09	0.02	0.19	0.89		0.12	0.49	
Control Delay	35.5	23.4		42.6	23.8	0.1	35.8	43.8		34.6	25.1	
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	

Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Total Delay	35.5	23.4		42.6	23.8	0.1	35.8	43.8		34.6	25.1	
LOS	D	C		D	C	A	D	D		C	C	
Approach Delay		26.4			30.2			43.3			25.8	
Approach LOS		C			C			D			C	
Queue Length 50th (ft)	14	29		40	17	0	16	236		10	123	
Queue Length 95th (ft)	39	74		85	61	0	42	#450		32	173	
Internal Link Dist (ft)		401			267			399			291	
Turn Bay Length (ft)	200			190		190	135			120		
Base Capacity (vph)	177	553		183	704	933	180	644		180	621	
Starvation Cap Reductn	0	0		0	0	0	0	0		0	0	
Spillback Cap Reductn	0	0		0	0	0	0	0		0	0	
Storage Cap Reductn	0	0		0	0	0	0	0		0	0	
Reduced v/c Ratio	0.17	0.16		0.46	0.09	0.02	0.19	0.87		0.12	0.45	

Intersection Summary

Area Type: Other
Cycle Length: 80
Actuated Cycle Length: 80
Offset: 0 (0%), Referenced to phase 2:SBT, Start of Green
Natural Cycle: 80
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.89
Intersection Signal Delay: 35.3 Intersection LOS: D
Intersection Capacity Utilization 48.0% ICU Level of Service A
Analysis Period (min) 15
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 18: Tsienneto Rd & NH 28 Byp SB



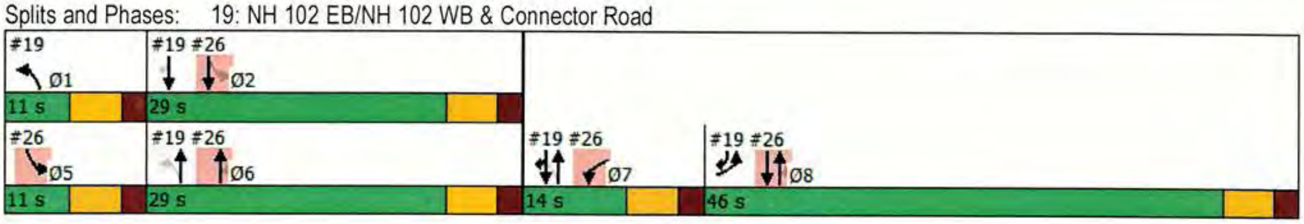
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR	Ø2	Ø5	Ø6	Ø7
Lane Configurations										
Traffic Volume (vph)	660	10	40	140	100	720				
Future Volume (vph)	660	10	40	140	100	720				
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900				
Storage Length (ft)	0	0	120			90				
Storage Lanes	1	0	1			1				
Taper Length (ft)	25		25							
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00				
Frt	0.998					0.850				
Flt Protected	0.953		0.950							
Satd. Flow (prot)	1789	0	1770	1863	1845	1568				
Flt Permitted	0.953		0.653							
Satd. Flow (perm)	1789	0	1216	1863	1845	1568				
Right Turn on Red		Yes				Yes				
Satd. Flow (RTOR)	1					809				
Link Speed (mph)	30			30	30					
Link Distance (ft)	475			709	258					
Travel Time (s)	10.8			16.1	5.9					
Peak Hour Factor	0.90	0.90	0.87	0.87	0.89	0.89				
Heavy Vehicles (%)	1%	1%	2%	2%	3%	3%				
Adj. Flow (vph)	733	11	46	161	112	809				
Shared Lane Traffic (%)										
Lane Group Flow (vph)	744	0	46	161	112	809				
Turn Type	Prot		pm+pt	NA	NA	custom				
Protected Phases	8		1	6 7	2 7	7 8	2	5	6	7
Permitted Phases			6 7			2				
Detector Phase	8		1	6 7	2 7	7 8				
Switch Phase										
Minimum Initial (s)	5.0		5.0				5.0	5.0	5.0	5.0
Minimum Split (s)	26.5		11.0				28.0	11.0	28.0	11.0
Total Split (s)	46.0		11.0				29.0	11.0	29.0	14.0
Total Split (%)	46.0%		11.0%				29%	11%	29%	14%
Maximum Green (s)	40.0		5.0				23.0	5.0	23.0	8.0
Yellow Time (s)	4.0		4.0				4.0	4.0	4.0	4.0
All-Red Time (s)	2.0		2.0				2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0		0.0							
Total Lost Time (s)	6.0		6.0							
Lead/Lag	Lag		Lead				Lag	Lead	Lag	Lead
Lead-Lag Optimize?	Yes		Yes				Yes	Yes	Yes	Yes
Vehicle Extension (s)	3.0		3.0				3.0	3.0	3.0	3.0
Recall Mode	None		None				Max	None	Max	None
Walk Time (s)							7.0		7.0	
Flash Dont Walk (s)							15.0		15.0	
Pedestrian Calls (#/hr)							0		0	
Act Effct Green (s)	40.1		42.3	41.3	37.1	85.8				
Actuated g/C Ratio	0.42		0.44	0.43	0.39	0.90				
v/c Ratio	0.99		0.08	0.20	0.16	0.54				
Control Delay	60.5		14.6	18.4	23.6	1.6				
Queue Delay	0.0		0.0	0.0	0.0	0.5				

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR	Ø2	Ø5	Ø6	Ø7
Total Delay	60.5		14.6	18.4	23.6	2.1				
LOS	E		B	B	C	A				
Approach Delay	60.5			17.5	4.7					
Approach LOS	E			B	A					
Queue Length 50th (ft)	~515		15	56	47	9				
Queue Length 95th (ft)	#744		33	114	m80	7				
Internal Link Dist (ft)	395			629	178					
Turn Bay Length (ft)			120			90				
Base Capacity (vph)	751		566	805	716	1490				
Starvation Cap Reductn	0		0	0	0	287				
Spillback Cap Reductn	0		0	0	0	0				
Storage Cap Reductn	0		0	0	0	0				
Reduced v/c Ratio	0.99		0.08	0.20	0.16	0.67				

Intersection Summary

Area Type: Other
Cycle Length: 100
Actuated Cycle Length: 95.6
Natural Cycle: 100
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.99
Intersection Signal Delay: 28.3 Intersection LOS: C
Intersection Capacity Utilization 58.7% ICU Level of Service B
Analysis Period (min) 15
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 19: NH 102 EB/NH 102 WB & Connector Road

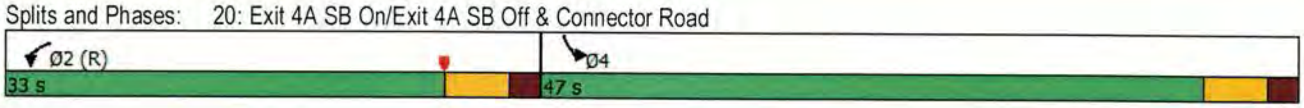


Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	՟՟				՟՟	
Traffic Volume (vph)	1010	0	0	0	1575	0
Future Volume (vph)	1010	0	0	0	1575	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	0.97	1.00	1.00	1.00	0.97	1.00
Frt						
Flt Protected	0.950				0.950	
Satd. Flow (prot)	3433	0	0	0	3433	0
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	3433	0	0	0	3433	0
Right Turn on Red		Yes		Yes		
Satd. Flow (RTOR)						
Link Speed (mph)	30		30			30
Link Distance (ft)	372		529			557
Travel Time (s)	8.5		12.0			12.7
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	1074	0	0	0	1676	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	1074	0	0	0	1676	0
Turn Type	Prot				Prot	
Protected Phases	2				4	
Permitted Phases						
Detector Phase	2				4	
Switch Phase						
Minimum Initial (s)	5.0				9.0	
Minimum Split (s)	24.0				24.0	
Total Split (s)	33.0				47.0	
Total Split (%)	41.3%				58.8%	
Maximum Green (s)	27.0				41.0	
Yellow Time (s)	4.0				4.0	
All-Red Time (s)	2.0				2.0	
Lost Time Adjust (s)	0.0				0.0	
Total Lost Time (s)	6.0				6.0	
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)	3.0				3.0	
Recall Mode	C-Max				Min	
Act Effct Green (s)	27.0				41.0	
Actuated g/C Ratio	0.34				0.51	
v/c Ratio	0.93				0.95	
Control Delay	41.8				32.7	
Queue Delay	38.6				0.0	
Total Delay	80.4				32.7	
LOS	F				C	
Approach Delay	80.4					32.7
Approach LOS	F					C
Queue Length 50th (ft)	307				387	
Queue Length 95th (ft)	#408				#563	
Internal Link Dist (ft)	292		449			477

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Turn Bay Length (ft)						
Base Capacity (vph)	1158				1759	
Starvation Cap Reductn	167				0	
Spillback Cap Reductn	0				0	
Storage Cap Reductn	0				0	
Reduced v/c Ratio	1.08				0.95	

Intersection Summary	
Area Type: Other	
Cycle Length: 80	
Actuated Cycle Length: 80	
Offset: 25 (31%), Referenced to phase 2:WBL, Start of Yellow	
Natural Cycle: 90	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 0.95	
Intersection Signal Delay: 51.3	Intersection LOS: D
Intersection Capacity Utilization 129.3%	ICU Level of Service H
Analysis Period (min) 15	
# 95th percentile volume exceeds capacity, queue may be longer.	
Queue shown is maximum after two cycles.	

Splits and Phases: 20: Exit 4A SB On/Exit 4A SB Off & Connector Road



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	SBL	SBR	NWL	NWR
Lane Configurations	↰	↑↑			↑↑	↱↱			Y	↱
Traffic Volume (vph)	0	1575	0	0	1010	1075	0	0	0	770
Future Volume (vph)	0	1575	0	0	1010	1075	0	0	0	770
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	100		0	0		200	0	0	0	0
Storage Lanes	1		0	0		2	0	0	1	1
Taper Length (ft)	75			25			25		25	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	0.88	1.00	1.00	1.00	0.95
Frt						0.850			0.850	0.850
Flt Protected										
Satd. Flow (prot)	1863	3539	0	0	3539	2787	0	0	1583	1504
Flt Permitted										
Satd. Flow (perm)	1863	3539	0	0	3539	2787	0	0	1583	1504
Right Turn on Red			Yes			Yes		Yes		
Satd. Flow (RTOR)						64				
Link Speed (mph)		30			30		30		30	
Link Distance (ft)		372			394		598		519	
Travel Time (s)		8.5			9.0		13.6		11.8	
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	0	1676	0	0	1074	1144	0	0	0	819
Shared Lane Traffic (%)										50%
Lane Group Flow (vph)	0	1676	0	0	1074	1144	0	0	410	409
Turn Type	Perm	NA			NA	Perm			Prot	Prot
Protected Phases		2			2				4	4
Permitted Phases	2					2				
Detector Phase	2	2			2	2			4	4
Switch Phase										
Minimum Initial (s)	5.0	5.0			5.0	5.0			9.0	9.0
Minimum Split (s)	24.0	24.0			24.0	24.0			24.0	24.0
Total Split (s)	48.0	48.0			48.0	48.0			32.0	32.0
Total Split (%)	60.0%	60.0%			60.0%	60.0%			40.0%	40.0%
Maximum Green (s)	42.0	42.0			42.0	42.0			26.0	26.0
Yellow Time (s)	4.0	4.0			4.0	4.0			4.0	4.0
All-Red Time (s)	2.0	2.0			2.0	2.0			2.0	2.0
Lost Time Adjust (s)	0.0	0.0			0.0	0.0			0.0	0.0
Total Lost Time (s)	6.0	6.0			6.0	6.0			6.0	6.0
Lead/Lag										
Lead-Lag Optimize?										
Vehicle Extension (s)	3.0	3.0			3.0	3.0			3.0	3.0
Recall Mode	C-Max	C-Max			C-Max	C-Max			Max	Max
Act Effct Green (s)		42.0			42.0	42.0			26.0	26.0
Actuated g/C Ratio		0.52			0.52	0.52			0.32	0.32
v/c Ratio		0.90			0.58	0.77			0.80	0.84
Control Delay		4.6			14.5	18.5			38.3	42.6
Queue Delay		0.4			0.9	0.0			0.0	0.0
Total Delay		5.0			15.5	18.5			38.3	42.6
LOS		A			B	B			D	D
Approach Delay		5.0			17.0				40.5	
Approach LOS		A			B				D	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	SBL	SBR	NWL	NWR
Queue Length 50th (ft)		3			180	228			184	196
Queue Length 95th (ft)		m5			238	319			#330	#361
Internal Link Dist (ft)		292			314		518		439	
Turn Bay Length (ft)						200				
Base Capacity (vph)		1857			1857	1493			514	488
Starvation Cap Reductn		26			0	0			0	0
Spillback Cap Reductn		0			474	0			0	0
Storage Cap Reductn		0			0	0			0	0
Reduced v/c Ratio		0.92			0.78	0.77			0.80	0.84

Intersection Summary

Area Type: Other
Cycle Length: 80
Actuated Cycle Length: 80
Offset: 0 (0%), Referenced to phase 2:EBWB, Start of Yellow
Natural Cycle: 70
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.90
Intersection Signal Delay: 16.8 Intersection LOS: B
Intersection Capacity Utilization 115.2% ICU Level of Service H
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 21: Exit 4A NB Off & Connector Road & Exit 4A NB On

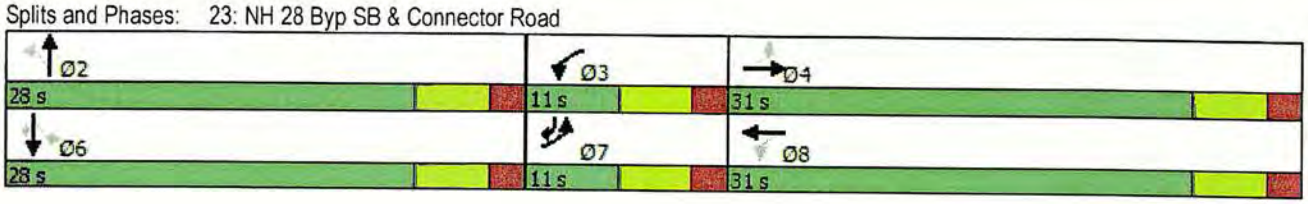
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	130	490	10	10	500	10	20	70	10	10	70	130
Future Volume (vph)	130	490	10	10	500	10	20	70	10	10	70	130
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	275		0	75		100	75		0	210		210
Storage Lanes	1		0	1		0	1		0	1		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.997			0.997			0.981				0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1770	1857	0	1770	1857	0	1770	1827	0	1770	1863	1583
Flt Permitted	0.198			0.332			0.708			0.701		
Satd. Flow (perm)	369	1857	0	618	1857	0	1319	1827	0	1306	1863	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		2			2			11				141
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		310			410			481			432	
Travel Time (s)		7.0			9.3			10.9			9.8	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	141	533	11	11	543	11	22	76	11	11	76	141
Shared Lane Traffic (%)												
Lane Group Flow (vph)	141	544	0	11	554	0	22	87	0	11	76	141
Turn Type	pm+pt	NA		pm+pt	NA		Perm	NA		Perm	NA	pm+ov
Protected Phases	7	4		3	8			2			6	7
Permitted Phases	4			8			2			6		6
Detector Phase	7	4		3	8		2	2		6	6	7
Switch Phase												
Minimum Initial (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	5.0
Minimum Split (s)	11.0	28.0		11.0	28.0		28.0	28.0		28.0	28.0	11.0
Total Split (s)	11.0	31.0		11.0	31.0		28.0	28.0		28.0	28.0	11.0
Total Split (%)	15.7%	44.3%		15.7%	44.3%		40.0%	40.0%		40.0%	40.0%	15.7%
Maximum Green (s)	5.0	25.0		5.0	25.0		22.0	22.0		22.0	22.0	5.0
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	6.0
Lead/Lag	Lead	Lag		Lead	Lag							Lead
Lead-Lag Optimize?	Yes	Yes		Yes	Yes							Yes
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Recall Mode	None	Max		None	None		Max	Max		None	None	None
Walk Time (s)		7.0			7.0		7.0	7.0		7.0	7.0	
Flash Dont Walk (s)		15.0			15.0		15.0	15.0		15.0	15.0	
Pedestrian Calls (#/hr)		0			0		0	0		0	0	
Act Effct Green (s)	32.8	31.8		27.9	22.9		22.0	22.0		22.0	22.0	33.1
Actuated g/C Ratio	0.48	0.47		0.41	0.34		0.32	0.32		0.32	0.32	0.49
v/c Ratio	0.50	0.63		0.03	0.88		0.05	0.15		0.03	0.13	0.17
Control Delay	16.3	19.4		8.8	39.3		17.2	16.2		17.0	17.8	2.7
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Total Delay	16.3	19.4		8.8	39.3		17.2	16.2		17.0	17.8	2.7

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
LOS	B	B		A	D		B	B		B	B	A
Approach Delay		18.8			38.7			16.4			8.5	
Approach LOS		B			D			B			A	
Queue Length 50th (ft)	30	149		2	213		7	23		3	23	0
Queue Length 95th (ft)	58	#373		9	#384		21	53		14	51	26
Internal Link Dist (ft)		230			330			401			352	
Turn Bay Length (ft)	275			75			75			210		210
Base Capacity (vph)	281	869		338	685		427	599		423	603	841
Starvation Cap Reductn	0	0		0	0		0	0		0	0	0
Spillback Cap Reductn	0	0		0	0		0	0		0	0	0
Storage Cap Reductn	0	0		0	0		0	0		0	0	0
Reduced v/c Ratio	0.50	0.63		0.03	0.81		0.05	0.15		0.03	0.13	0.17

Intersection Summary

Area Type: Other
Cycle Length: 70
Actuated Cycle Length: 68
Natural Cycle: 70
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.88
Intersection Signal Delay: 24.2 Intersection LOS: C
Intersection Capacity Utilization 56.9% ICU Level of Service B
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 23: NH 28 Byp SB & Connector Road



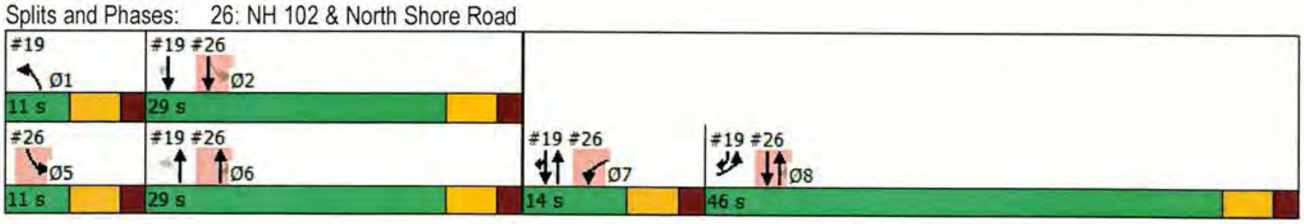
Lane Group	WBL	WBR	NBT	NBR	SBL	SBT	Ø1	Ø2	Ø6	Ø8
Lane Configurations										
Traffic Volume (vph)	80	10	640	160	10	740				
Future Volume (vph)	80	10	640	160	10	740				
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900				
Storage Length (ft)	0	0		90	100					
Storage Lanes	1	0		1	1					
Taper Length (ft)	25				25					
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00				
Frt	0.981			0.850						
Flt Protected	0.959				0.950					
Satd. Flow (prot)	1772	0	1900	1615	1805	1900				
Flt Permitted	0.959				0.218					
Satd. Flow (perm)	1772	0	1900	1615	414	1900				
Right Turn on Red		Yes		Yes						
Satd. Flow (RTOR)	6			126						
Link Speed (mph)	30		30			30				
Link Distance (ft)	524		258			288				
Travel Time (s)	11.9		5.9			6.5				
Peak Hour Factor	0.87	0.67	0.95	0.84	0.73	0.96				
Heavy Vehicles (%)	1%	0%	0%	0%	0%	0%				
Adj. Flow (vph)	92	15	674	190	14	771				
Shared Lane Traffic (%)										
Lane Group Flow (vph)	107	0	674	190	14	771				
Turn Type	Prot		NA	Perm	custom	NA				
Protected Phases	7		6 8		5	2 8	1	2	6	8
Permitted Phases				6 8	2					
Detector Phase	7		6 8	6 8	5	2 8				
Switch Phase										
Minimum Initial (s)	5.0				5.0		5.0	5.0	5.0	5.0
Minimum Split (s)	11.0				11.0		11.0	28.0	28.0	26.5
Total Split (s)	14.0				11.0		11.0	29.0	29.0	46.0
Total Split (%)	14.0%				11.0%		11%	29%	29%	46%
Maximum Green (s)	8.0				5.0		5.0	23.0	23.0	40.0
Yellow Time (s)	4.0				4.0		4.0	4.0	4.0	4.0
All-Red Time (s)	2.0				2.0		2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0				0.0					
Total Lost Time (s)	6.0				6.0					
Lead/Lag	Lead				Lead		Lead	Lag	Lag	Lag
Lead-Lag Optimize?	Yes				Yes		Yes	Yes	Yes	Yes
Vehicle Extension (s)	3.0				3.0		3.0	3.0	3.0	3.0
Recall Mode	None				None		None	Max	Max	None
Walk Time (s)								7.0	7.0	
Flash Dont Walk (s)								15.0	15.0	
Pedestrian Calls (#/hr)								0	0	
Act Effct Green (s)	8.0		72.3	72.3	25.9	65.8				
Actuated g/C Ratio	0.08		0.76	0.76	0.27	0.69				
v/c Ratio	0.69		0.47	0.15	0.08	0.59				
Control Delay	65.8		1.5	0.5	23.2	7.4				
Queue Delay	0.0		1.6	0.5	0.0	0.0				

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT	Ø1	Ø2	Ø6	Ø8
Total Delay	65.8		3.1	1.0	23.2	7.4				
LOS	E		A	A	C	A				
Approach Delay	65.8		2.6			7.7				
Approach LOS	E		A			A				
Queue Length 50th (ft)	64		13	0	6	127				
Queue Length 95th (ft)	#142		m59	m0	16	182				
Internal Link Dist (ft)	444		178			208				
Turn Bay Length (ft)				90	100					
Base Capacity (vph)	154		1437	1252	185	1307				
Starvation Cap Reductn	0		555	726	0	0				
Spillback Cap Reductn	0		0	0	0	0				
Storage Cap Reductn	0		0	0	0	0				
Reduced v/c Ratio	0.69		0.76	0.36	0.08	0.59				

Intersection Summary

Area Type: Other
Cycle Length: 100
Actuated Cycle Length: 95.6
Natural Cycle: 100
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.99
Intersection Signal Delay: 8.8 Intersection LOS: A
Intersection Capacity Utilization 54.0% ICU Level of Service A
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 26: NH 102 & North Shore Road



APPENDIX Q-1: ALTERNATIVE C INTERSECTION CAPACITY ANALYSES – HCM 2000 PRINTSOUTS – AM PEAK HOUR

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑↑		↰	↱↱
Traffic Volume (vph)	0	1255	1330	0	125	1325
Future Volume (vph)	0	1255	1330	0	125	1325
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	16	12
Total Lost time (s)		6.0	6.0		6.0	6.0
Lane Util. Factor		0.95	0.95		1.00	0.88
Frt		1.00	1.00		1.00	0.85
Flt Protected		1.00	1.00		0.95	1.00
Satd. Flow (prot)		3471	3406		1930	2682
Flt Permitted		1.00	1.00		0.95	1.00
Satd. Flow (perm)		3471	3406		1930	2682
Peak-hour factor, PHF	0.93	0.93	0.88	0.88	0.89	0.89
Adj. Flow (vph)	0	1349	1511	0	140	1489
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	1349	1511	0	140	1489
Heavy Vehicles (%)	4%	4%	6%	6%	6%	6%
Turn Type		NA	NA		Prot	Prot
Protected Phases		2	6		4	4
Permitted Phases						
Actuated Green, G (s)		57.0	57.0		71.0	71.0
Effective Green, g (s)		57.0	57.0		71.0	71.0
Actuated g/C Ratio		0.41	0.41		0.51	0.51
Clearance Time (s)		6.0	6.0		6.0	6.0
Vehicle Extension (s)		3.0	3.0		3.0	3.0
Lane Grp Cap (vph)		1413	1386		978	1360
v/s Ratio Prot		0.39	c0.44		0.07	c0.56
v/s Ratio Perm						
v/c Ratio		0.95	1.09		0.14	1.09
Uniform Delay, d1		40.2	41.5		18.3	34.5
Progression Factor		0.71	0.07		1.00	1.00
Incremental Delay, d2		11.0	42.0		0.1	54.6
Delay (s)		39.6	45.0		18.4	89.1
Level of Service		D	D		B	F
Approach Delay (s)		39.6	45.0		83.0	
Approach LOS		D	D		F	

Intersection Summary			
HCM 2000 Control Delay	57.2	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.09		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	95.1%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Movement	NBL2	NBL	NBR	SEL	SER	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations											
Traffic Volume (vph)	1250	0	910	0	0	1085	295	0	0	420	240
Future Volume (vph)	1250	0	910	0	0	1085	295	0	0	420	240
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0		6.0			6.0	6.0			6.0	4.0
Lane Util. Factor	0.97		0.88			0.97	0.95			0.95	1.00
Frt	1.00		0.85			1.00	1.00			1.00	0.85
Flt Protected	0.95		1.00			0.95	1.00			1.00	1.00
Satd. Flow (prot)	3242		2632			3335	3438			3505	1568
Flt Permitted	0.95		1.00			0.95	1.00			1.00	1.00
Satd. Flow (perm)	3242		2632			3335	3438			3505	1568
Peak-hour factor, PHF	0.88	0.88	0.88	0.92	0.92	0.94	0.94	0.94	0.92	0.92	0.92
Adj. Flow (vph)	1420	0	1034	0	0	1154	314	0	0	457	261
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	1420	0	1034	0	0	1154	314	0	0	457	261
Heavy Vehicles (%)	8%	8%	8%	2%	2%	5%	5%	5%	3%	3%	3%
Turn Type	Prot		Prot			Prot	NA			NA	Free
Protected Phases	8		8			5	2			6	
Permitted Phases											Free
Actuated Green, G (s)	54.0		54.0			42.0	74.0			26.0	140.0
Effective Green, g (s)	54.0		54.0			42.0	74.0			26.0	140.0
Actuated g/C Ratio	0.39		0.39			0.30	0.53			0.19	1.00
Clearance Time (s)	6.0		6.0			6.0	6.0			6.0	
Vehicle Extension (s)	3.0		3.0			3.0	3.0			3.0	
Lane Grp Cap (vph)	1250		1015			1000	1817			650	1568
v/s Ratio Prot	c0.44		0.39			c0.35	0.09			c0.13	
v/s Ratio Perm											0.17
v/c Ratio	1.14		1.02			1.15	0.17			0.70	0.17
Uniform Delay, d1	43.0		43.0			49.0	17.1			53.4	0.0
Progression Factor	1.00		1.00			0.44	0.15			1.00	1.00
Incremental Delay, d2	71.5		33.0			75.1	0.1			6.3	0.2
Delay (s)	114.5		76.0			96.4	2.7			59.6	0.2
Level of Service	F		E			F	A			E	A
Approach Delay (s)		98.3		0.0			76.4			38.0	
Approach LOS		F		A			E			D	

Intersection Summary			
HCM 2000 Control Delay	82.0	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.05		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	94.2%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	640	470	160	615	0	0	0	0	180	0	390
Future Volume (vph)	0	640	470	160	615	0	0	0	0	180	0	390
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0	4.0	6.0	6.0					6.0		6.0
Lane Util. Factor		0.95	1.00	1.00	0.95					0.97		1.00
Frt		1.00	0.85	1.00	1.00					1.00		0.85
Flt Protected		1.00	1.00	0.95	1.00					0.95		1.00
Satd. Flow (prot)		3471	1553	1719	3438					3367		1553
Flt Permitted		1.00	1.00	0.95	1.00					0.95		1.00
Satd. Flow (perm)		3471	1553	1719	3438					3367		1553
Peak-hour factor, PHF	0.87	0.87	0.87	0.86	0.86	0.86	0.92	0.92	0.92	0.91	0.91	0.91
Adj. Flow (vph)	0	736	540	186	715	0	0	0	0	198	0	429
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	154
Lane Group Flow (vph)	0	736	540	186	715	0	0	0	0	198	0	275
Heavy Vehicles (%)	4%	4%	4%	5%	5%	5%	2%	2%	2%	4%	4%	4%
Turn Type		NA	Free	Prot	NA					Prot		Prot
Protected Phases		2		1	6					4		4
Permitted Phases			Free									
Actuated Green, G (s)		36.1	90.0	14.2	56.3					21.7		21.7
Effective Green, g (s)		36.1	90.0	14.2	56.3					21.7		21.7
Actuated g/C Ratio		0.40	1.00	0.16	0.63					0.24		0.24
Clearance Time (s)		6.0		6.0	6.0					6.0		6.0
Vehicle Extension (s)		5.0		3.0	5.0					3.0		3.0
Lane Grp Cap (vph)		1392	1553	271	2150					811		374
v/s Ratio Prot		c0.21		c0.11	0.21					0.06		c0.18
v/s Ratio Perm			0.35									
v/c Ratio		0.53	0.35	0.69	0.33					0.24		0.74
Uniform Delay, d1		20.5	0.0	35.8	8.0					27.5		31.5
Progression Factor		1.00	1.00	0.35	0.02					1.00		1.00
Incremental Delay, d2		1.4	0.6	4.6	0.2					0.2		7.3
Delay (s)		21.9	0.6	17.3	0.4					27.7		38.8
Level of Service		C	A	B	A					C		D
Approach Delay (s)		12.9			3.9			0.0			35.3	
Approach LOS		B			A			A			D	

Intersection Summary			
HCM 2000 Control Delay	15.0	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.62		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	70.4%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑			↑↑	↱	↰		↱			
Traffic Volume (vph)	440	380	0	0	455	230	320	0	370	0	0	0
Future Volume (vph)	440	380	0	0	455	230	320	0	370	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0			6.0	4.0	6.0		6.0			
Lane Util. Factor	1.00	0.95			0.95	1.00	1.00		1.00			
Frt	1.00	1.00			1.00	0.85	1.00		0.85			
Flt Protected	0.95	1.00			1.00	1.00	0.95		1.00			
Satd. Flow (prot)	1752	3505			3505	1568	1703		1524			
Flt Permitted	0.95	1.00			1.00	1.00	0.95		1.00			
Satd. Flow (perm)	1752	3505			3505	1568	1703		1524			
Peak-hour factor, PHF	0.92	0.92	0.92	0.91	0.91	0.91	0.67	0.67	0.67	0.92	0.92	0.92
Adj. Flow (vph)	478	413	0	0	500	253	478	0	552	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	288	0	0	0
Lane Group Flow (vph)	478	413	0	0	500	253	478	0	264	0	0	0
Heavy Vehicles (%)	3%	3%	3%	3%	3%	3%	6%	6%	6%	2%	2%	2%
Turn Type	Prot	NA			NA	Free	Prot		Prot			
Protected Phases	5	2			6		8		8			
Permitted Phases		2			6	Free						
Actuated Green, G (s)	26.9	50.1			17.2	90.0	27.9		27.9			
Effective Green, g (s)	26.9	50.1			17.2	90.0	27.9		27.9			
Actuated g/C Ratio	0.30	0.56			0.19	1.00	0.31		0.31			
Clearance Time (s)	6.0	6.0			6.0		6.0		6.0			
Vehicle Extension (s)	5.0	5.0			5.0		3.0		3.0			
Lane Grp Cap (vph)	523	1951			669	1568	527		472			
v/s Ratio Prot	c0.27	0.12			c0.14		c0.28		0.17			
v/s Ratio Perm						0.16						
v/c Ratio	0.91	0.21			0.75	0.16	0.91		0.56			
Uniform Delay, d1	30.4	10.0			34.3	0.0	29.8		25.9			
Progression Factor	0.27	0.33			1.00	1.00	1.00		1.00			
Incremental Delay, d2	19.1	0.2			7.5	0.2	19.2		1.4			
Delay (s)	27.2	3.6			41.8	0.2	49.0		27.3			
Level of Service	C	A			D	A	D		C			
Approach Delay (s)		16.3			27.8			37.4			0.0	
Approach LOS		B			C			D			A	

Intersection Summary			
HCM 2000 Control Delay	27.7	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	70.4%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	10	5	210	10	0	10	270	820	120	5	590	130
Future Volume (vph)	10	5	210	10	0	10	270	820	120	5	590	130
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0	6.0		6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor		1.00	1.00		1.00		1.00	0.95		1.00	0.95	
Frt		1.00	0.85		0.93		1.00	0.98		1.00	0.97	
Flt Protected		0.97	1.00		0.98		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1801	1583		1729		1770	3472		1770	3443	
Flt Permitted		0.87	1.00		0.83		0.95	1.00		0.95	1.00	
Satd. Flow (perm)		1622	1583		1477		1770	3472		1770	3443	
Peak-hour factor, PHF	0.92	0.92	0.92	0.25	0.25	0.25	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	11	5	228	40	0	40	293	891	130	5	641	141
RTOR Reduction (vph)	0	0	125	0	75	0	0	9	0	0	17	0
Lane Group Flow (vph)	0	16	103	0	5	0	293	1012	0	5	765	0
Heavy Vehicles (%)	2%	2%	2%	0%	0%	0%	2%	2%	2%	2%	2%	2%
Turn Type	Perm	NA	custom	Perm	NA		Prot	NA		Prot	NA	
Protected Phases		8			4		5	2		1	6	
Permitted Phases	8		6	4								
Actuated Green, G (s)		4.8	32.6		4.8		16.9	48.7		0.8	32.6	
Effective Green, g (s)		4.8	32.6		4.8		16.9	48.7		0.8	32.6	
Actuated g/C Ratio		0.07	0.45		0.07		0.23	0.67		0.01	0.45	
Clearance Time (s)		6.0	6.0		6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)		3.0	3.0		3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		107	713		98		413	2338		19	1552	
v/s Ratio Prot							c0.17	0.29		0.00	c0.22	
v/s Ratio Perm		c0.01	0.06		0.00							
v/c Ratio		0.15	0.14		0.05		0.71	0.43		0.26	0.49	
Uniform Delay, d1		31.8	11.7		31.6		25.4	5.4		35.5	14.0	
Progression Factor		1.00	1.00		1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		0.6	0.1		0.2		5.5	0.1		7.3	0.2	
Delay (s)		32.5	11.8		31.9		31.0	5.6		42.7	14.3	
Level of Service		C	B		C		C	A		D	B	
Approach Delay (s)		13.1			31.9			11.2			14.4	
Approach LOS		B			C			B			B	

Intersection Summary			
HCM 2000 Control Delay	13.1	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.53		
Actuated Cycle Length (s)	72.3	Sum of lost time (s)	18.0
Intersection Capacity Utilization	62.0%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	20	20	5	270	0	50	0	730	130	10	380	0
Future Volume (vph)	20	20	5	270	0	50	0	730	130	10	380	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0			6.0			6.0			6.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		0.99			0.98			0.98			1.00	
Flt Protected		0.98			0.96			1.00			1.00	
Satd. Flow (prot)		1796			1733			1723			1807	
Flt Permitted		0.83			0.71			1.00			0.89	
Satd. Flow (perm)		1530			1279			1723			1610	
Peak-hour factor, PHF	0.60	0.60	0.60	0.96	0.96	0.96	0.89	0.89	0.89	0.86	0.86	0.86
Adj. Flow (vph)	33	33	8	281	0	52	0	820	146	12	442	0
RTOR Reduction (vph)	0	5	0	0	27	0	0	7	0	0	0	0
Lane Group Flow (vph)	0	69	0	0	306	0	0	959	0	0	454	0
Heavy Vehicles (%)	2%	2%	2%	3%	3%	3%	8%	8%	8%	5%	5%	5%
Turn Type	Perm	NA		Perm	NA			NA		Perm	NA	
Protected Phases		4			4			2			2	
Permitted Phases	4			4						2		
Actuated Green, G (s)		22.3			22.3			52.1			52.1	
Effective Green, g (s)		22.3			22.3			52.1			52.1	
Actuated g/C Ratio		0.26			0.26			0.60			0.60	
Clearance Time (s)		6.0			6.0			6.0			6.0	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		394			330			1038			970	
v/s Ratio Prot								c0.56				
v/s Ratio Perm		0.04			c0.24						0.28	
v/c Ratio		0.17			0.93			0.92			0.47	
Uniform Delay, d1		24.9			31.3			15.4			9.5	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		0.2			31.2			13.2			0.4	
Delay (s)		25.1			62.5			28.6			9.8	
Level of Service		C			E			C			A	
Approach Delay (s)		25.1			62.5			28.6			9.8	
Approach LOS		C			E			C			A	

Intersection Summary			
HCM 2000 Control Delay	30.0	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.92		
Actuated Cycle Length (s)	86.4	Sum of lost time (s)	12.0
Intersection Capacity Utilization	84.3%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations	↰	↑↱		↰	↑	↱	↰	↑↱		↰	↑↱	
Traffic Volume (vph)	70	310	20	130	400	60	80	390	30	50	270	60
Future Volume (vph)	70	310	20	130	400	60	80	390	30	50	270	60
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	1.00	0.85	1.00	0.99		1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1752	1828		1752	1845	1568	1787	1861		1787	1830	
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1752	1828		1752	1845	1568	1787	1861		1787	1830	
Peak-hour factor, PHF	0.91	0.91	0.91	0.93	0.93	0.93	0.95	0.95	0.95	0.94	0.94	0.94
Adj. Flow (vph)	77	341	22	140	430	65	84	411	32	53	287	64
RTOR Reduction (vph)	0	3	0	0	0	42	0	3	0	0	9	0
Lane Group Flow (vph)	77	360	0	140	430	23	84	440	0	53	342	0
Heavy Vehicles (%)	3%	3%	3%	3%	3%	3%	1%	1%	1%	1%	1%	1%
Turn Type	Prot	NA		Prot	NA	pm+ov	Prot	NA		Prot	NA	
Protected Phases	3	8		7	4	5	5	2		1	6	
Permitted Phases						4						
Actuated Green, G (s)	5.8	18.7		8.4	21.3	28.1	6.8	26.7		2.7	22.6	
Effective Green, g (s)	5.8	18.7		8.4	21.3	28.1	6.8	26.7		2.7	22.6	
Actuated g/C Ratio	0.07	0.23		0.10	0.26	0.35	0.08	0.33		0.03	0.28	
Clearance Time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	126	424		182	488	664	150	617		59	513	
v/s Ratio Prot	0.04	0.20		c0.08	c0.23	0.00	c0.05	c0.24		0.03	0.19	
v/s Ratio Perm						0.01						
v/c Ratio	0.61	0.85		0.77	0.88	0.03	0.56	0.71		0.90	0.67	
Uniform Delay, d1	36.3	29.5		35.1	28.4	17.3	35.4	23.5		38.8	25.6	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	8.5	14.6		17.6	16.8	0.0	4.7	6.9		80.5	3.3	
Delay (s)	44.7	44.2		52.7	45.2	17.3	40.1	30.4		119.3	28.9	
Level of Service	D	D		D	D	B	D	C		F	C	
Approach Delay (s)		44.3			44.0			32.0			40.8	
Approach LOS		D			D			C			D	

Intersection Summary			
HCM 2000 Control Delay	40.2	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.84		
Actuated Cycle Length (s)	80.5	Sum of lost time (s)	24.0
Intersection Capacity Utilization	87.2%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	465	10	10	160	100	535
Future Volume (vph)	465	10	10	160	100	535
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0	120	0			220
Storage Lanes	1	1	0			1
Taper Length (ft)	25		25			
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.850				0.850
Flt Protected	0.950			0.997		
Satd. Flow (prot)	1787	1599	0	1857	1881	1599
Flt Permitted	0.950			0.997		
Satd. Flow (perm)	1787	1599	0	1857	1881	1599
Link Speed (mph)	30			30	30	
Link Distance (ft)	322			309	354	
Travel Time (s)	7.3			7.0	8.0	
Peak Hour Factor	0.90	0.90	0.87	0.87	0.87	0.87
Heavy Vehicles (%)	1%	1%	2%	2%	1%	1%
Adj. Flow (vph)	517	11	11	184	115	615
Shared Lane Traffic (%)						
Lane Group Flow (vph)	517	11	0	195	115	615
Sign Control	Stop			Stop	Stop	

Intersection Summary	
Area Type: Other	
Control Type: Unsignalized	
Intersection Capacity Utilization 53.1%	ICU Level of Service A
Analysis Period (min) 15	

Intersection	
Intersection Delay, s/veh	68.8
Intersection LOS	F

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	465	10	10	160	100	535
Future Vol, veh/h	465	10	10	160	100	535
Peak Hour Factor	0.90	0.90	0.87	0.87	0.87	0.87
Heavy Vehicles, %	1	1	2	2	1	1
Mvmt Flow	517	11	11	184	115	615
Number of Lanes	1	1	0	1	1	1

Approach	EB	NB	SB
Opposing Approach		SB	NB
Opposing Lanes	0	2	1
Conflicting Approach Left	SB	EB	
Conflicting Lanes Left	2	2	0
Conflicting Approach Right	NB		EB
Conflicting Lanes Right	1	0	2
HCM Control Delay	88.9	16.1	68.3
HCM LOS	F	C	F

Lane	NBLn1	EBLn1	EBLn2	SBLn1	SBLn2
Vol Left, %	6%	100%	0%	0%	0%
Vol Thru, %	94%	0%	0%	100%	0%
Vol Right, %	0%	0%	100%	0%	100%
Sign Control	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	170	465	10	100	535
LT Vol	10	465	0	0	0
Through Vol	160	0	0	100	0
RT Vol	0	0	10	0	535
Lane Flow Rate	195	517	11	115	615
Geometry Grp	4	7	7	7	7
Degree of Util (X)	0.404	1.075	0.019	0.22	1.057
Departure Headway (Hd)	7.845	7.695	6.471	7.175	6.458
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes
Cap	461	475	556	503	566
Service Time	5.845	5.395	4.171	4.875	4.158
HCM Lane V/C Ratio	0.423	1.088	0.02	0.229	1.087
HCM Control Delay	16.1	90.6	9.3	11.9	78.9
HCM Lane LOS	C	F	A	B	F
HCM 95th-tile Q	1.9	16.1	0.1	0.8	17

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	10	0	0	625	635	10
Future Volume (vph)	10	0	0	625	635	10
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt					0.998	
Flt Protected	0.950					
Satd. Flow (prot)	1703	0	0	1881	1877	0
Flt Permitted	0.950					
Satd. Flow (perm)	1703	0	0	1881	1877	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	160			224	319	
Travel Time (s)	3.6			5.1	7.3	
Peak Hour Factor	0.50	0.50	0.93	0.93	0.86	0.86
Heavy Vehicles (%)	6%	6%	1%	1%	1%	1%
Adj. Flow (vph)	20	0	0	672	738	12
Shared Lane Traffic (%)						
Lane Group Flow (vph)	20	0	0	672	750	0
Sign Control	Stop			Free	Free	

Intersection Summary	
Area Type: Other	
Control Type: Unsignalized	
Intersection Capacity Utilization 50.5%	ICU Level of Service A
Analysis Period (min) 15	

Intersection						
Int Delay, s/veh	0.5					

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	10	0	0	625	635	10
Future Vol, veh/h	10	0	0	625	635	10
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	50	50	93	93	86	86
Heavy Vehicles, %	6	6	1	1	1	1
Mvmt Flow	20	0	0	672	738	12

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1416	744	750	0	-	0
Stage 1	744	-	-	-	-	-
Stage 2	672	-	-	-	-	-
Critical Hdwy	6.46	6.26	4.11	-	-	-
Critical Hdwy Stg 1	5.46	-	-	-	-	-
Critical Hdwy Stg 2	5.46	-	-	-	-	-
Follow-up Hdwy	3.554	3.354	2.209	-	-	-
Pot Cap-1 Maneuver	148	408	864	-	-	-
Stage 1	463	-	-	-	-	-
Stage 2	500	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	148	408	864	-	-	-
Mov Cap-2 Maneuver	148	-	-	-	-	-
Stage 1	463	-	-	-	-	-
Stage 2	500	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	33.1	0	0
HCM LOS	D		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	864	-	148	-	-
HCM Lane V/C Ratio	-	-	0.135	-	-
HCM Control Delay (s)	0	-	33.1	-	-
HCM Lane LOS	A	-	D	-	-
HCM 95th %tile Q(veh)	0	-	0.5	-	-

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations		✣			✣			✣			✣	
Traffic Volume (vph)	40	590	5	30	410	20	100	40	230	5	20	150
Future Volume (vph)	40	590	5	30	410	20	100	40	230	5	20	150
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	150		150	150		150	0		0	150		150
Storage Lanes	0		0	0		0	0		0	0		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.999			0.994			0.916			0.884	
Flt Protected		0.997			0.997			0.987			0.999	
Satd. Flow (prot)	0	1874	0	0	1846	0	0	1718	0	0	1678	0
Flt Permitted		0.997			0.997			0.987			0.999	
Satd. Flow (perm)	0	1874	0	0	1846	0	0	1718	0	0	1678	0
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		327			240			246			251	
Travel Time (s)		7.4			5.5			5.6			5.7	
Peak Hour Factor	0.94	0.94	0.94	0.88	0.88	0.88	0.67	0.67	0.67	0.82	0.82	0.82
Heavy Vehicles (%)	1%	1%	1%	2%	2%	2%	0%	0%	0%	0%	0%	0%
Adj. Flow (vph)	43	628	5	34	466	23	149	60	343	6	24	183
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	676	0	0	523	0	0	552	0	0	213	0
Sign Control		Free			Free			Stop			Stop	

Intersection Summary		
Area Type: Other		
Control Type: Unsignalized		
Intersection Capacity Utilization 89.7%	ICU Level of Service E	
Analysis Period (min) 15		

Intersection	
Int Delay, s/veh	312.5

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations		✥			✥			✥			✥	
Traffic Vol, veh/h	40	590	5	30	410	20	100	40	230	5	20	150
Future Vol, veh/h	40	590	5	30	410	20	100	40	230	5	20	150
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	Yield	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	94	94	94	88	88	88	67	67	67	82	82	82
Heavy Vehicles, %	1	1	1	2	2	2	0	0	0	0	0	0
Mvmt Flow	43	628	5	34	466	23	149	60	343	6	24	183

Major/Minor	Major1			Major2			Minor2			Minor1		
Conflicting Flow All	489	0	0	633	0	0	1366	1265	478	1293	1274	631
Stage 1	-	-	-	-	-	-	546	546	-	717	717	-
Stage 2	-	-	-	-	-	-	820	719	-	576	557	-
Critical Hdwy	4.11	-	-	4.12	-	-	7.1	6.5	6.2	7.1	6.5	6.2
Critical Hdwy Stg 1	-	-	-	-	-	-	6.1	5.5	-	6.1	5.5	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.1	5.5	-	6.1	5.5	-
Follow-up Hdwy	2.209	-	-	2.218	-	-	3.5	4	3.3	3.5	4	3.3
Pot Cap-1 Maneuver	1079	-	-	950	-	-	~ 126	171	591	141	169	485
Stage 1	-	-	-	-	-	-	526	521	-	424	437	-
Stage 2	-	-	-	-	-	-	372	436	-	506	515	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1079	-	-	950	-	-	~ 63	153	591	38	151	485
Mov Cap-2 Maneuver	-	-	-	-	-	-	~ 63	153	-	38	151	-
Stage 1	-	-	-	-	-	-	493	495	-	398	410	-
Stage 2	-	-	-	-	-	-	204	409	-	177	490	-

Approach	EB	WB	SE	NW
HCM Control Delay, s	0.5	0.6	$ 1094.7	40.2
HCM LOS			F	E

Minor Lane/Major Mvmt	NWLn1	EBL	EBT	EBR	WBL	WBT	WBR	SELn1
Capacity (veh/h)	305	1079	-	-	950	-	-	167
HCM Lane V/C Ratio	0.7	0.039	-	-	0.036	-	-	3.307
HCM Control Delay (s)	40.2	8.5	0	-	8.9	0	-	$ 1094.7
HCM Lane LOS	E	A	A	-	A	A	-	F
HCM 95th %tile Q(veh)	4.9	0.1	-	-	0.1	-	-	52.1

Notes

~: Volume exceeds capacity $: Delay exceeds 300s   +: Computation Not Defined   *: All major volume in platoon

Movement	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations	↰	↑↑	↱	↰↰	↑↑		↰	↑	↱	↰	↑	↱
Traffic Volume (vph)	80	330	140	560	530	0	320	500	120	50	290	590
Future Volume (vph)	80	330	140	560	530	0	320	500	120	50	290	590
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0		6.0	6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	3539	1583	3433	3539		1770	1863	1583	1787	1881	1599
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	3539	1583	3433	3539		1770	1863	1583	1787	1881	1599
Peak-hour factor, PHF	0.92	0.92	0.92	0.94	0.94	0.94	0.96	0.96	0.96	0.95	0.95	0.95
Adj. Flow (vph)	87	359	152	596	564	0	333	521	125	53	305	621
RTOR Reduction (vph)	0	0	126	0	0	0	0	0	82	0	0	89
Lane Group Flow (vph)	87	359	26	596	564	0	333	521	43	53	305	532
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	1%	1%	1%
Turn Type	Prot	NA	Perm	Prot	NA		Prot	NA	Perm	Prot	NA	pm+ov
Protected Phases	5	2		1	6		7	4		3	8	1
Permitted Phases			2						4			8
Actuated Green, G (s)	8.3	18.6	18.6	22.1	32.4		23.4	37.6	37.6	7.7	21.9	44.0
Effective Green, g (s)	8.3	18.6	18.6	22.1	32.4		23.4	37.6	37.6	7.7	21.9	44.0
Actuated g/C Ratio	0.08	0.17	0.17	0.20	0.29		0.21	0.34	0.34	0.07	0.20	0.40
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0		6.0	6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	133	598	267	689	1042		376	636	541	125	374	726
v/s Ratio Prot	0.05	0.10		c0.17	c0.16		c0.19	c0.28		0.03	0.16	c0.15
v/s Ratio Perm			0.02						0.03			0.19
v/c Ratio	0.65	0.60	0.10	0.87	0.54		0.89	0.82	0.08	0.42	0.82	0.73
Uniform Delay, d1	49.5	42.3	38.6	42.5	32.6		42.0	33.1	24.5	49.0	42.1	28.0
Progression Factor	1.00	1.00	1.00	1.32	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	11.0	4.4	0.7	10.2	0.5		21.2	8.1	0.1	2.3	12.8	3.8
Delay (s)	60.5	46.7	39.3	66.5	33.1		63.2	41.2	24.6	51.3	54.9	31.8
Level of Service	E	D	D	E	C		E	D	C	D	D	C
Approach Delay (s)		46.8			50.3			46.6			40.1	
Approach LOS		D			D			D			D	

Intersection Summary			
HCM 2000 Control Delay	46.1	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	24.0
Intersection Capacity Utilization	78.4%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	NWL	NWR	NET	NER	SWL	SWT
Lane Configurations						
Traffic Volume (vph)	290	110	680	520	90	640
Future Volume (vph)	290	110	680	520	90	640
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	180	0		0	180	
Storage Lanes	1	1		1	0	
Taper Length (ft)	25				25	
Lane Util. Factor	1.00	1.00	1.00	1.00	0.95	0.95
Frt		0.850		0.850		
Flt Protected	0.950					0.994
Satd. Flow (prot)	1787	1599	1881	1599	0	3553
Flt Permitted	0.950					0.994
Satd. Flow (perm)	1787	1599	1881	1599	0	3553
Link Speed (mph)	30		30			30
Link Distance (ft)	403		387			233
Travel Time (s)	9.2		8.8			5.3
Peak Hour Factor	0.86	0.86	0.96	0.96	0.85	0.85
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%
Adj. Flow (vph)	337	128	708	542	106	753
Shared Lane Traffic (%)						
Lane Group Flow (vph)	337	128	708	542	0	859
Sign Control	Stop		Free			Free

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 82.2% ICU Level of Service E

Analysis Period (min) 15

Intersection	
Int Delay, s/veh	101.7

Movement	NWL	NWR	NET	NER	SWL	SWT
Lane Configurations						
Traffic Vol, veh/h	290	110	680	520	90	640
Future Vol, veh/h	290	110	680	520	90	640
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	Yield	-	None
Storage Length	180	0	-	0	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	86	86	96	96	85	85
Heavy Vehicles, %	1	1	1	1	1	1
Mvmt Flow	337	128	708	542	106	753

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1297	708	0	0	708	0
Stage 1	708	-	-	-	-	-
Stage 2	589	-	-	-	-	-
Critical Hdwy	6.615	6.215	-	-	4.115	-
Critical Hdwy Stg 1	5.415	-	-	-	-	-
Critical Hdwy Stg 2	5.815	-	-	-	-	-
Follow-up Hdwy	3.5095	3.3095	-	-	2.2095	-
Pot Cap-1 Maneuver	~ 167	436	-	-	894	-
Stage 1	490	-	-	-	-	-
Stage 2	521	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	~ 133	436	-	-	894	-
Mov Cap-2 Maneuver	~ 133	-	-	-	-	-
Stage 1	390	-	-	-	-	-
Stage 2	521	-	-	-	-	-

Approach	NW	NE	SW
HCM Control Delay, s	$ 559.3	0	1.9
HCM LOS	F		

Minor Lane/Major Mvmt	NET	NER	NWLn1	NWLn2	SWL	SWT
Capacity (veh/h)	-	-	133	436	894	-
HCM Lane V/C Ratio	-	-	2.535	0.293	0.118	-
HCM Control Delay (s)	-	-	$ 765.1	16.6	9.6	0.8
HCM Lane LOS	-	-	F	C	A	A
HCM 95th %tile Q(veh)	-	-	29.8	1.2	0.4	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations	↰	↑↱		↰	↑↱			↰↑	↱		↰↑	↱
Traffic Volume (vph)	90	1225	5	20	1030	100	15	10	15	10	10	30
Future Volume (vph)	90	1225	5	20	1030	100	15	10	15	10	10	30
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0			6.0	6.0		6.0	6.0
Lane Util. Factor	1.00	0.95		1.00	0.95			1.00	1.00		1.00	1.00
Frt	1.00	1.00		1.00	0.99			1.00	0.85		1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00			0.97	1.00		0.98	1.00
Satd. Flow (prot)	1787	3572		1787	3527			1844	1615		1835	1599
Flt Permitted	0.95	1.00		0.95	1.00			0.80	1.00		0.83	1.00
Satd. Flow (perm)	1787	3572		1787	3527			1518	1615		1557	1599
Peak-hour factor, PHF	0.97	0.97	0.97	0.95	0.95	0.95	0.90	0.90	0.90	0.80	0.80	0.80
Adj. Flow (vph)	93	1263	5	21	1084	105	17	11	17	12	12	38
RTOR Reduction (vph)	0	0	0	0	4	0	0	0	16	0	0	36
Lane Group Flow (vph)	93	1268	0	21	1185	0	0	28	1	0	26	2
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	0%	0%	0%	1%	1%	1%
Turn Type	Prot	NA		Prot	NA		Perm	NA	Perm	Perm	NA	Perm
Protected Phases	5	2		1	6			8			4	
Permitted Phases							8		8	4	4	4
Actuated Green, G (s)	9.7	82.4		3.2	75.9			6.4	6.4		6.4	6.4
Effective Green, g (s)	9.7	82.4		3.2	75.9			6.4	6.4		6.4	6.4
Actuated g/C Ratio	0.09	0.75		0.03	0.69			0.06	0.06		0.06	0.06
Clearance Time (s)	6.0	6.0		6.0	6.0			6.0	6.0		6.0	6.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	157	2675		51	2433			88	93		90	93
v/s Ratio Prot	c0.05	c0.35		0.01	0.34							
v/s Ratio Perm								c0.02	0.00		0.02	0.00
v/c Ratio	0.59	0.47		0.41	0.49			0.32	0.01		0.29	0.02
Uniform Delay, d1	48.2	5.4		52.5	8.0			49.7	48.8		49.6	48.9
Progression Factor	0.99	1.64		1.00	1.13			1.00	1.00		1.00	1.00
Incremental Delay, d2	5.0	0.5		3.6	0.5			2.1	0.0		1.8	0.1
Delay (s)	52.7	9.3		56.1	9.5			51.8	48.9		51.4	49.0
Level of Service	D	A		E	A			D	D		D	D
Approach Delay (s)		12.3			10.3			50.7			49.9	
Approach LOS		B			B			D			D	

Intersection Summary			
HCM 2000 Control Delay	12.9	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.49		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	61.2%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰↰	↑↱		↰	↑↱		↰	↱			↰	↱
Traffic Volume (vph)	530	1270	5	5	1080	70	40	10	10	80	5	490
Future Volume (vph)	530	1270	5	5	1080	70	40	10	10	80	5	490
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0		6.0	6.0			6.0	6.0
Lane Util. Factor	0.97	0.95		1.00	0.95		1.00	1.00			1.00	1.00
Frt	1.00	1.00		1.00	0.99		1.00	0.93			1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00			0.96	1.00
Satd. Flow (prot)	3467	3572		1770	3507		1805	1758			1815	1615
Flt Permitted	0.95	1.00		0.95	1.00		0.69	1.00			0.72	1.00
Satd. Flow (perm)	3467	3572		1770	3507		1317	1758			1368	1615
Peak-hour factor, PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.78	0.78	0.78	0.86	0.86	0.86
Adj. Flow (vph)	631	1512	6	6	1200	78	51	13	13	93	6	570
RTOR Reduction (vph)	0	0	0	0	4	0	0	11	0	0	0	18
Lane Group Flow (vph)	631	1518	0	6	1274	0	51	15	0	0	99	552
Heavy Vehicles (%)	1%	1%	1%	2%	2%	2%	0%	0%	0%	0%	0%	0%
Turn Type	Prot	NA		Prot	NA		Perm	NA		Perm	NA	pm+ov
Protected Phases	5	2		1	6			8			4	5
Permitted Phases							8	8		4		4
Actuated Green, G (s)	29.0	77.3		1.4	49.7		13.3	13.3			13.3	42.3
Effective Green, g (s)	29.0	77.3		1.4	49.7		13.3	13.3			13.3	42.3
Actuated g/C Ratio	0.26	0.70		0.01	0.45		0.12	0.12			0.12	0.38
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0			6.0	6.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0			3.0	3.0
Lane Grp Cap (vph)	914	2510		22	1584		159	212			165	709
v/s Ratio Prot	0.18	0.42		0.00	c0.36			0.01				c0.21
v/s Ratio Perm							0.04				0.07	0.14
v/c Ratio	0.69	0.60		0.27	0.80		0.32	0.07			0.60	0.78
Uniform Delay, d1	36.5	8.5		53.8	26.0		44.2	42.9			45.8	29.7
Progression Factor	1.00	1.00		0.81	1.59		1.00	1.00			1.00	1.00
Incremental Delay, d2	2.3	1.1		6.2	2.9		1.2	0.1			5.8	5.4
Delay (s)	38.7	9.5		50.0	44.0		45.4	43.0			51.6	35.1
Level of Service	D	A		D	D		D	D			D	D
Approach Delay (s)		18.1			44.1			44.6			37.5	
Approach LOS		B			D			D			D	

Intersection Summary			
HCM 2000 Control Delay	29.7	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.84		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	81.6%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↰	↑↑	↑↱		↰	↱
Traffic Volume (vph)	210	1870	1510	30	10	70
Future Volume (vph)	210	1870	1510	30	10	70
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	300			0	0	175
Storage Lanes	1			0	1	1
Taper Length (ft)	25				25	
Lane Util. Factor	1.00	0.95	0.95	0.95	1.00	1.00
Frt			0.997			0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1770	3539	3529	0	1752	1568
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1770	3539	3529	0	1752	1568
Link Speed (mph)		30	30		30	
Link Distance (ft)		535	210		522	
Travel Time (s)		12.2	4.8		11.9	
Peak Hour Factor	0.91	0.91	0.90	0.90	0.75	0.75
Heavy Vehicles (%)	2%	2%	2%	2%	3%	3%
Adj. Flow (vph)	231	2055	1678	33	13	93
Shared Lane Traffic (%)						
Lane Group Flow (vph)	231	2055	1711	0	13	93
Sign Control		Free	Free		Stop	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 67.7% ICU Level of Service C

Analysis Period (min) 15

Intersection	
Int Delay, s/veh	14.2

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	210	1870	1510	30	10	70
Future Vol, veh/h	210	1870	1510	30	10	70
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	300	-	-	-	0	175
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	91	91	90	90	75	75
Heavy Vehicles, %	2	2	2	2	3	3
Mvmt Flow	231	2055	1678	33	13	93

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	1711	0	-	0	3185	856
Stage 1	-	-	-	-	1695	-
Stage 2	-	-	-	-	1490	-
Critical Hdwy	4.14	-	-	-	6.86	6.96
Critical Hdwy Stg 1	-	-	-	-	5.86	-
Critical Hdwy Stg 2	-	-	-	-	5.86	-
Follow-up Hdwy	2.22	-	-	-	3.53	3.33
Pot Cap-1 Maneuver	367	-	-	-	~ 8	299
Stage 1	-	-	-	-	133	-
Stage 2	-	-	-	-	172	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	367	-	-	-	~ 3	299
Mov Cap-2 Maneuver	-	-	-	-	~ 3	-
Stage 1	-	-	-	-	49	-
Stage 2	-	-	-	-	172	-

Approach	EB	WB	SB
HCM Control Delay, s	3	0	$ 483.6
HCM LOS			F

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1	SBLn2
Capacity (veh/h)	367	-	-	-	3	299
HCM Lane V/C Ratio	0.629	-	-	-	4.444	0.312
HCM Control Delay (s)	30	-	-	-	$ 3712.2	22.4
HCM Lane LOS	D	-	-	-	F	C
HCM 95th %tile Q(veh)	4.1	-	-	-	3	1.3

Notes

~: Volume exceeds capacity $: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Lane Group	WBL2	WBL	WBR	WBR2	NBL	NBT	NBR	NBR2	SBL2	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	10	220	340	20	80	140	80	5	10	290	210	30
Future Volume (vph)	10	220	340	20	80	140	80	5	10	290	210	30
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.918				0.962					0.992	
Flt Protected		0.981				0.987					0.973	
Satd. Flow (prot)	0	1694	0	0	0	1769	0	0	0	0	1816	0
Flt Permitted		0.981				0.987					0.973	
Satd. Flow (perm)	0	1694	0	0	0	1769	0	0	0	0	1816	0
Link Speed (mph)		30				30					30	
Link Distance (ft)		449				456					370	
Travel Time (s)		10.2				10.4					8.4	
Peak Hour Factor	0.91	0.91	0.91	0.91	0.87	0.87	0.87	0.87	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	1%	1%	1%	1%	2%	2%	2%	2%	1%	1%	1%	1%
Adj. Flow (vph)	11	242	374	22	92	161	92	6	11	315	228	33
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	649	0	0	0	351	0	0	0	0	587	0
Sign Control		Yield				Yield					Yield	

Intersection Summary

Area Type: Other

Control Type: Roundabout

Intersection Capacity Utilization 124.5% ICU Level of Service H

Analysis Period (min) 15

Lane Group	NEL	NET	NER	NER2	SWL2	SWL	SWT	SWR
Lane Configurations								
Traffic Volume (vph)	30	80	310	50	5	30	100	10
Future Volume (vph)	30	80	310	50	5	30	100	10
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.897					0.991	
Flt Protected		0.997					0.988	
Satd. Flow (prot)	0	1682	0	0	0	0	1824	0
Flt Permitted		0.997					0.988	
Satd. Flow (perm)	0	1682	0	0	0	0	1824	0
Link Speed (mph)		30					30	
Link Distance (ft)		390					523	
Travel Time (s)		8.9					11.9	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.91	0.91	0.91	0.91
Heavy Vehicles (%)	1%	1%	1%	1%	2%	2%	2%	2%
Adj. Flow (vph)	33	89	344	56	5	33	110	11
Shared Lane Traffic (%)								
Lane Group Flow (vph)	0	522	0	0	0	0	159	0
Sign Control		Yield					Yield	

Intersection Summary

Intersection	
Intersection Delay, s/veh	18.9
Intersection LOS	C

Approach	WB	NB	SB	NE	SW
Entry Lanes	1	1	1	1	1
Conflicting Circle Lanes	1	1	1	1	1
Adj Approach Flow, veh/h	649	351	587	522	159
Demand Flow Rate, veh/h	655	358	592	527	162
Vehicles Circulating, veh/h	486	804	500	609	924
Vehicles Exiting, veh/h	676	332	586	483	217
Ped Vol Crossing Leg, #/h	0	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000	1.000
Approach Delay, s/veh	21.7	17.3	18.1	19.6	11.3
Approach LOS	C	C	C	C	B

Lane	Left	Left	Left	Left	Left
Designated Moves	LR	LTR	LTR	LTR	LTR
Assumed Moves	LR	LTR	LTR	LTR	LTR
RT Channelized					
Lane Util	1.000	1.000	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976	4.976	4.976
Entry Flow, veh/h	655	358	592	527	162
Cap Entry Lane, veh/h	841	608	829	741	538
Entry HV Adj Factor	0.991	0.980	0.991	0.991	0.980
Flow Entry, veh/h	649	351	587	522	159
Cap Entry, veh/h	833	595	821	735	527
V/C Ratio	0.779	0.589	0.714	0.711	0.301
Control Delay, s/veh	21.7	17.3	18.1	19.6	11.3
LOS	C	C	C	C	B
95th %tile Queue, veh	8	4	6	6	1

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	10	50	425	5	30	20	320	190	10	10	110	10
Future Volume (vph)	10	50	425	5	30	20	320	190	10	10	110	10
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		50	0		0	0		0	0		0
Storage Lanes	0		1	0		0	0		0	0		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850		0.952			0.997			0.990	
Flt Protected		0.992			0.996			0.970			0.996	
Satd. Flow (prot)	0	1848	1583	0	1802	0	0	1819	0	0	1855	0
Flt Permitted		0.992			0.996			0.970			0.996	
Satd. Flow (perm)	0	1848	1583	0	1802	0	0	1819	0	0	1855	0
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		168			453			475			436	
Travel Time (s)		3.8			10.3			10.8			9.9	
Peak Hour Factor	0.88	0.88	0.88	0.82	0.82	0.82	0.93	0.93	0.93	0.91	0.91	0.91
Heavy Vehicles (%)	2%	2%	2%	0%	0%	0%	1%	1%	1%	1%	1%	1%
Adj. Flow (vph)	11	57	483	6	37	24	344	204	11	11	121	11
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	68	483	0	67	0	0	559	0	0	143	0
Sign Control		Stop			Stop			Free			Free	

Intersection Summary	
Area Type: Other	
Control Type: Unsignalized	
Intersection Capacity Utilization 48.8%	ICU Level of Service A
Analysis Period (min) 15	

Intersection	
Int Delay, s/veh	11.4

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	10	50	425	5	30	20	320	190	10	10	110	10
Future Vol, veh/h	10	50	425	5	30	20	320	190	10	10	110	10
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	50	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	88	88	88	82	82	82	93	93	93	91	91	91
Heavy Vehicles, %	2	2	2	0	0	0	1	1	1	1	1	1
Mvmt Flow	11	57	483	6	37	24	344	204	11	11	121	11

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1077	1052	127	1317	1052	210	132	0	0	215	0	0
Stage 1	149	149	-	898	898	-	-	-	-	-	-	-
Stage 2	928	903	-	419	154	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.1	6.5	6.2	4.11	-	-	4.11	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.1	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.1	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.5	4	3.3	2.209	-	-	2.209	-	-
Pot Cap-1 Maneuver	197	227	923	136	228	835	1459	-	-	1361	-	-
Stage 1	854	774	-	337	361	-	-	-	-	-	-	-
Stage 2	321	356	-	616	774	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	126	165	923	38	165	835	1459	-	-	1361	-	-
Mov Cap-2 Maneuver	126	165	-	38	165	-	-	-	-	-	-	-
Stage 1	625	767	-	247	264	-	-	-	-	-	-	-
Stage 2	196	261	-	269	767	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	17	41.7	5.1	0.6
HCM LOS	C	E		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1459	-	-	157	923	163	1361	-	-
HCM Lane V/C Ratio	0.236	-	-	0.434	0.523	0.411	0.008	-	-
HCM Control Delay (s)	8.2	0	-	44.5	13.1	41.7	7.7	0	-
HCM Lane LOS	A	A	-	E	B	E	A	A	-
HCM 95th %tile Q(veh)	0.9	-	-	2	3.1	1.8	0	-	-

Movement	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations	↰	↑↱		↰	↑	↱	↰	↑↱		↰	↑↱	
Traffic Volume (vph)	30	70	30	30	30	50	40	660	70	20	180	30
Future Volume (vph)	30	70	30	30	30	50	40	660	70	20	180	30
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	0.96		1.00	1.00	0.85	1.00	0.99		1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	1780		1787	1881	1599	1805	1873		1805	1860	
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	1780		1787	1881	1599	1805	1873		1805	1860	
Peak-hour factor, PHF	0.99	0.99	0.99	0.95	0.95	0.95	0.89	0.89	0.89	0.93	0.93	0.93
Adj. Flow (vph)	30	71	30	32	32	53	45	742	79	22	194	32
RTOR Reduction (vph)	0	19	0	0	0	39	0	5	0	0	7	0
Lane Group Flow (vph)	30	82	0	32	32	14	45	816	0	22	219	0
Heavy Vehicles (%)	2%	2%	2%	1%	1%	1%	0%	0%	0%	0%	0%	0%
Turn Type	Prot	NA		Prot	NA	pt+ov	Prot	NA		Prot	NA	
Protected Phases	1	6		5	2	2 3	3	8		7	4	
Permitted Phases		6			2							
Actuated Green, G (s)	1.6	8.3		1.6	8.3	18.7	4.4	34.8		2.4	32.8	
Effective Green, g (s)	1.6	8.3		1.6	8.3	18.7	4.4	34.8		2.4	32.8	
Actuated g/C Ratio	0.02	0.12		0.02	0.12	0.26	0.06	0.49		0.03	0.46	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	39	207		40	219	420	111	916		60	858	
v/s Ratio Prot	0.02	c0.05		c0.02	0.02	0.01	c0.02	c0.44		0.01	0.12	
v/s Ratio Perm												
v/c Ratio	0.77	0.40		0.80	0.15	0.03	0.41	0.89		0.37	0.26	
Uniform Delay, d1	34.6	29.1		34.6	28.2	19.5	32.1	16.4		33.6	11.7	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	60.6	1.3		69.2	1.4	0.0	2.4	10.9		3.8	0.2	
Delay (s)	95.2	30.3		103.8	29.6	19.5	34.5	27.3		37.4	11.9	
Level of Service	F	C		F	C	B	C	C		D	B	
Approach Delay (s)		45.2			45.3			27.7			14.1	
Approach LOS		D			D			C			B	

Intersection Summary			
HCM 2000 Control Delay	28.4	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	71.1	Sum of lost time (s)	24.0
Intersection Capacity Utilization	57.3%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	700	10	40	130	130	650
Future Volume (vph)	700	10	40	130	130	650
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0		6.0	4.0	4.0	6.0
Lane Util. Factor	1.00		1.00	1.00	1.00	1.00
Frt	1.00		1.00	1.00	1.00	0.85
Flt Protected	0.95		0.95	1.00	1.00	1.00
Satd. Flow (prot)	1772		1626	1712	1863	1583
Flt Permitted	0.95		0.60	1.00	1.00	1.00
Satd. Flow (perm)	1772		1020	1712	1863	1583
Peak-hour factor, PHF	0.94	0.94	0.91	0.91	0.82	0.82
Adj. Flow (vph)	745	11	44	143	159	793
RTOR Reduction (vph)	1	0	0	0	0	173
Lane Group Flow (vph)	755	0	44	143	159	620
Heavy Vehicles (%)	2%	2%	11%	11%	2%	2%
Turn Type	Prot		pm+pt	NA	NA	custom
Protected Phases	8		1	6 7	2 7	7 8
Permitted Phases			6 7			2
Actuated Green, G (s)	40.4		27.7	24.9	24.9	67.3
Effective Green, g (s)	40.4		23.7	24.9	24.9	67.3
Actuated g/C Ratio	0.47		0.28	0.29	0.29	0.78
Clearance Time (s)	6.0		6.0			
Vehicle Extension (s)	3.0		3.0			
Lane Grp Cap (vph)	831		300	495	538	1237
v/s Ratio Prot	c0.43		c0.00	0.08	0.09	c0.32
v/s Ratio Perm			0.04			0.07
v/c Ratio	0.91		0.15	0.29	0.30	0.50
Uniform Delay, d1	21.2		23.3	23.7	23.8	3.4
Progression Factor	1.00		1.00	1.00	1.06	1.66
Incremental Delay, d2	13.6		0.2	0.3	0.3	0.3
Delay (s)	34.8		23.5	24.1	25.4	5.9
Level of Service	C		C	C	C	A
Approach Delay (s)	34.8			23.9	9.1	
Approach LOS	C			C	A	

Intersection Summary			
HCM 2000 Control Delay	20.8	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.77		
Actuated Cycle Length (s)	86.1	Sum of lost time (s)	22.0
Intersection Capacity Utilization	63.7%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	NBT	NBR	SBL	SBT	SWL	SWR
Lane Configurations			↰↰		↰↰	
Traffic Volume (vph)	0	0	1405	0	410	0
Future Volume (vph)	0	0	1405	0	410	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)			6.0		6.0	
Lane Util. Factor			0.97		0.97	
Frt			1.00		1.00	
Flt Protected			0.95		0.95	
Satd. Flow (prot)			3433		3433	
Flt Permitted			0.95		0.95	
Satd. Flow (perm)			3433		3433	
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	0	0	1495	0	436	0
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	1495	0	436	0
Turn Type			Prot		Prot	
Protected Phases			4		2	
Permitted Phases						
Actuated Green, G (s)			57.0		21.0	
Effective Green, g (s)			57.0		21.0	
Actuated g/C Ratio			0.63		0.23	
Clearance Time (s)			6.0		6.0	
Vehicle Extension (s)			3.0		3.0	
Lane Grp Cap (vph)			2174		801	
v/s Ratio Prot			c0.44		c0.13	
v/s Ratio Perm						
v/c Ratio			0.69		0.54	
Uniform Delay, d1			10.7		30.3	
Progression Factor			1.00		1.17	
Incremental Delay, d2			1.8		2.6	
Delay (s)			12.5		38.1	
Level of Service			B		D	
Approach Delay (s)	0.0			12.5	38.1	
Approach LOS	A			B	D	

Intersection Summary			
HCM 2000 Control Delay	18.3	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.65		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	112.7%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

Movement	SBL	SBR	NWL	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations										
Traffic Volume (vph)	0	0	0	225	0	1405	0	0	410	1090
Future Volume (vph)	0	0	0	225	0	1405	0	0	410	1090
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)			6.0	6.0		6.0			6.0	6.0
Lane Util. Factor			1.00	0.95		0.95			0.95	0.88
Frt			0.85	0.85		1.00			1.00	0.85
Flt Protected			1.00	1.00		1.00			1.00	1.00
Satd. Flow (prot)			1583	1504		3539			3539	2787
Flt Permitted			1.00	1.00		1.00			1.00	1.00
Satd. Flow (perm)			1583	1504		3539			3539	2787
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	0	0	0	239	0	1495	0	0	436	1160
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	133
Lane Group Flow (vph)	0	0	120	119	0	1495	0	0	436	1027
Turn Type			Prot	Prot	Perm	NA			NA	Perm
Protected Phases			4	4		2			2	
Permitted Phases					2					2
Actuated Green, G (s)			13.3	13.3		64.7			64.7	64.7
Effective Green, g (s)			13.3	13.3		64.7			64.7	64.7
Actuated g/C Ratio			0.15	0.15		0.72			0.72	0.72
Clearance Time (s)			6.0	6.0		6.0			6.0	6.0
Vehicle Extension (s)			3.0	3.0		3.0			3.0	3.0
Lane Grp Cap (vph)			233	222		2544			2544	2003
v/s Ratio Prot			0.08	c0.08		c0.42			0.12	
v/s Ratio Perm										0.37
v/c Ratio			0.52	0.54		0.59			0.17	0.51
Uniform Delay, d1			35.4	35.5		6.2			4.1	5.6
Progression Factor			1.00	1.00		0.45			1.00	1.00
Incremental Delay, d2			1.9	2.5		0.7			0.1	0.9
Delay (s)			37.3	38.0		3.5			4.2	6.6
Level of Service			D	D		A			A	A
Approach Delay (s)	0.0		37.6			3.5			5.9	
Approach LOS	A		D			A			A	

Intersection Summary			
HCM 2000 Control Delay	7.1	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.58		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	88.2%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	60	460	5	10	490	10	5	60	10	10	60	70
Future Volume (vph)	60	460	5	10	490	10	5	60	10	10	60	70
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	6.0
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00		1.00	1.00		1.00	0.98		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1770	1860		1770	1857		1770	1822		1770	1863	1583
Flt Permitted	0.22	1.00		0.36	1.00		0.71	1.00		0.71	1.00	1.00
Satd. Flow (perm)	415	1860		664	1857		1331	1822		1318	1863	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	65	500	5	11	533	11	5	65	11	11	65	76
RTOR Reduction (vph)	0	1	0	0	1	0	0	8	0	0	0	49
Lane Group Flow (vph)	65	504	0	11	543	0	5	68	0	11	65	27
Turn Type	pm+pt	NA		pm+pt	NA		Perm	NA		Perm	NA	pm+ov
Protected Phases	7	4		3	8			2			6	7
Permitted Phases	4			8			2			6		6
Actuated Green, G (s)	34.8	30.9		29.0	28.0		22.1	22.1		22.1	22.1	26.0
Effective Green, g (s)	34.8	30.9		29.0	28.0		22.1	22.1		22.1	22.1	26.0
Actuated g/C Ratio	0.48	0.43		0.40	0.39		0.31	0.31		0.31	0.31	0.36
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	273	798		282	722		408	559		404	571	703
v/s Ratio Prot	c0.01	c0.27		0.00	c0.29			c0.04			0.03	0.00
v/s Ratio Perm	0.10			0.02			0.00			0.01		0.02
v/c Ratio	0.24	0.63		0.04	0.75		0.01	0.12		0.03	0.11	0.04
Uniform Delay, d1	11.9	16.1		13.3	19.0		17.4	18.0		17.4	17.9	14.9
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	0.5	3.8		0.1	4.4		0.1	0.4		0.0	0.1	0.0
Delay (s)	12.3	19.9		13.3	23.4		17.4	18.4		17.5	18.0	14.9
Level of Service	B	B		B	C		B	B		B	B	B
Approach Delay (s)		19.0			23.2			18.4			16.4	
Approach LOS		B			C			B			B	

Intersection Summary				
HCM 2000 Control Delay	20.4	HCM 2000 Level of Service	C	
HCM 2000 Volume to Capacity ratio	0.46			
Actuated Cycle Length (s)	72.0	Sum of lost time (s)	18.0	
Intersection Capacity Utilization	52.8%	ICU Level of Service	A	
Analysis Period (min)	15			

c Critical Lane Group

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↱			↰	↰	↱
Traffic Volume (vph)	410	0	250	440	0	300
Future Volume (vph)	410	0	250	440	0	300
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)		0	0		0	80
Storage Lanes		0	0		1	1
Taper Length (ft)			25		25	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt						0.850
Flt Protected				0.982		
Satd. Flow (prot)	1863	0	0	1829	1863	1583
Flt Permitted				0.982		
Satd. Flow (perm)	1863	0	0	1829	1863	1583
Link Speed (mph)	30			30	30	
Link Distance (ft)	410			475	676	
Travel Time (s)	9.3			10.8	15.4	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	446	0	272	478	0	326
Shared Lane Traffic (%)						
Lane Group Flow (vph)	446	0	0	750	0	326
Sign Control	Free			Free	Stop	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 65.2% ICU Level of Service C

Analysis Period (min) 15

Intersection						
Int Delay, s/veh	5.4					

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	410	0	250	440	0	300
Future Vol, veh/h	410	0	250	440	0	300
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	80
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	446	0	272	478	0	326

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	446	0	1468	446
Stage 1	-	-	-	-	446	-
Stage 2	-	-	-	-	1022	-
Critical Hdwy	-	-	4.12	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	1114	-	141	612
Stage 1	-	-	-	-	645	-
Stage 2	-	-	-	-	347	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1114	-	94	612
Mov Cap-2 Maneuver	-	-	-	-	94	-
Stage 1	-	-	-	-	430	-
Stage 2	-	-	-	-	347	-

Approach	EB	WB	NB
HCM Control Delay, s	0	3.4	17.4
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	-	612	-	-	1114	-
HCM Lane V/C Ratio	-	0.533	-	-	0.244	-
HCM Control Delay (s)	0	17.4	-	-	9.3	0
HCM Lane LOS	A	C	-	-	A	A
HCM 95th %tile Q(veh)	-	3.1	-	-	1	-

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↰	↑↑	↑↑	↱	↰	↱
Traffic Volume (vph)	125	1510	1425	290	120	75
Future Volume (vph)	125	1510	1425	290	120	75
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	0.95	0.95	1.00	1.00	1.00
Frt	1.00	1.00	1.00	0.85	1.00	0.85
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	3539	3539	1583	1770	1583
Flt Permitted	0.09	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	174	3539	3539	1583	1770	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	136	1641	1549	315	130	82
RTOR Reduction (vph)	0	0	0	83	0	14
Lane Group Flow (vph)	136	1641	1549	232	130	68
Turn Type	pm+pt	NA	NA	pm+ov	Prot	pm+ov
Protected Phases	5	2	6	4	4	5
Permitted Phases	2			6		4
Actuated Green, G (s)	46.4	46.4	36.7	47.0	10.3	14.0
Effective Green, g (s)	46.4	46.4	36.7	47.0	10.3	14.0
Actuated g/C Ratio	0.68	0.68	0.53	0.68	0.15	0.20
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	203	2390	1890	1221	265	460
v/s Ratio Prot	0.04	c0.46	c0.44	0.03	c0.07	0.01
v/s Ratio Perm	0.41			0.12		0.04
v/c Ratio	0.67	0.69	0.82	0.19	0.49	0.15
Uniform Delay, d1	11.2	6.7	13.3	3.9	26.8	22.5
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	8.1	0.8	2.9	0.1	1.4	0.2
Delay (s)	19.3	7.6	16.2	4.0	28.2	22.6
Level of Service	B	A	B	A	C	C
Approach Delay (s)		8.5	14.1		26.1	
Approach LOS		A	B		C	

Intersection Summary			
HCM 2000 Control Delay	12.2	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	68.7	Sum of lost time (s)	18.0
Intersection Capacity Utilization	68.0%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	70	10	680	150	30	710
Future Volume (vph)	70	10	680	150	30	710
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0		4.0	4.0	6.0	4.0
Lane Util. Factor	1.00		1.00	1.00	1.00	1.00
Frt	0.98		1.00	0.85	1.00	1.00
Flt Protected	0.96		1.00	1.00	0.95	1.00
Satd. Flow (prot)	1769		1900	1615	1805	1900
Flt Permitted	0.96		1.00	1.00	0.31	1.00
Satd. Flow (perm)	1769		1900	1615	594	1900
Peak-hour factor, PHF	0.87	0.67	0.95	0.84	0.73	0.96
Adj. Flow (vph)	80	15	716	179	41	740
RTOR Reduction (vph)	7	0	0	48	0	0
Lane Group Flow (vph)	88	0	716	131	41	740
Heavy Vehicles (%)	1%	0%	0%	0%	0%	0%
Turn Type	Prot		NA	Perm	custom	NA
Protected Phases	7		6 8		5	2 8
Permitted Phases				6 8	2	
Actuated Green, G (s)	8.1		53.2	53.2	15.6	53.2
Effective Green, g (s)	8.1		53.2	53.2	15.6	53.2
Actuated g/C Ratio	0.09		0.62	0.62	0.18	0.62
Clearance Time (s)	6.0				6.0	
Vehicle Extension (s)	3.0				3.0	
Lane Grp Cap (vph)	166		1173	997	147	1173
v/s Ratio Prot	c0.05		0.38		c0.01	c0.39
v/s Ratio Perm				0.08	0.04	
v/c Ratio	0.53		0.61	0.13	0.28	0.63
Uniform Delay, d1	37.2		10.1	6.8	30.0	10.3
Progression Factor	1.00		0.24	0.23	1.00	1.00
Incremental Delay, d2	3.0		0.6	0.0	1.0	1.1
Delay (s)	40.2		3.0	1.6	31.0	11.4
Level of Service	D		A	A	C	B
Approach Delay (s)	40.2		2.7			12.4
Approach LOS	D		A			B

Intersection Summary			
HCM 2000 Control Delay	9.0	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.60		
Actuated Cycle Length (s)	86.1	Sum of lost time (s)	22.0
Intersection Capacity Utilization	50.2%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	10	10	30	660	730	10
Future Volume (vph)	10	10	30	660	730	10
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0	0	100			0
Storage Lanes	1	0	1			0
Taper Length (ft)	25		25			
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.939				0.998	
Flt Protected	0.973		0.950			
Satd. Flow (prot)	1736	0	1787	1900	1878	0
Flt Permitted	0.973		0.950			
Satd. Flow (perm)	1736	0	1787	1900	1878	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	332			288	365	
Travel Time (s)	7.5			6.5	8.3	
Peak Hour Factor	0.64	0.77	0.71	0.90	0.75	0.55
Heavy Vehicles (%)	0%	0%	1%	0%	1%	0%
Adj. Flow (vph)	16	13	42	733	973	18
Shared Lane Traffic (%)						
Lane Group Flow (vph)	29	0	42	733	991	0
Sign Control	Stop			Free	Free	

Intersection Summary	
Area Type: Other	
Control Type: Unsignalized	
Intersection Capacity Utilization 49.0%	ICU Level of Service A
Analysis Period (min) 15	

Intersection	
Int Delay, s/veh	0.9

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	10	10	30	660	730	10
Future Vol, veh/h	10	10	30	660	730	10
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	100	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	64	77	71	90	75	55
Heavy Vehicles, %	0	0	1	0	1	0
Mvmt Flow	16	13	42	733	973	18

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1799	982	991	0	-	0
Stage 1	982	-	-	-	-	-
Stage 2	817	-	-	-	-	-
Critical Hdwy	6.4	6.2	4.11	-	-	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.3	2.209	-	-	-
Pot Cap-1 Maneuver	89	305	702	-	-	-
Stage 1	366	-	-	-	-	-
Stage 2	438	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	84	305	702	-	-	-
Mov Cap-2 Maneuver	84	-	-	-	-	-
Stage 1	344	-	-	-	-	-
Stage 2	438	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	42.1	0.6	0
HCM LOS	E		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	702	-	125	-	-
HCM Lane V/C Ratio	0.06	-	0.229	-	-
HCM Control Delay (s)	10.5	-	42.1	-	-
HCM Lane LOS	B	-	E	-	-
HCM 95th %tile Q(veh)	0.2	-	0.8	-	-

APPENDIX Q-2: ALTERNATIVE C INTERSECTION CAPACITY ANALYSES – HCM 2000 PRINTSOUTS – PM PEAK HOUR

HCM Signalized Intersection Capacity Analysis
1. ~~7~~: NH 102 & Exit 4 SB Off 12/27/2017

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	0	1345	715	0	115	1010
Future Volume (vph)	0	1345	715	0	115	1010
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	16	12
Total Lost time (s)		6.0	6.0		6.0	6.0
Lane Util. Factor		0.95	0.95		1.00	0.88
Frt		1.00	1.00		1.00	0.85
Flt Protected		1.00	1.00		0.95	1.00
Satd. Flow (prot)		3471	3406		1930	2682
Flt Permitted		1.00	1.00		0.95	1.00
Satd. Flow (perm)		3471	3406		1930	2682
Peak-hour factor, PHF	0.93	0.93	0.88	0.88	0.89	0.89
Adj. Flow (vph)	0	1446	812	0	129	1135
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	1446	813	0	129	1135
Heavy Vehicles (%)	4%	4%	6%	6%	6%	6%
Turn Type		NA	NA		Prot	Prot
Protected Phases		2	6		4	4
Permitted Phases						
Actuated Green, G (s)		32.0	32.0		31.0	31.0
Effective Green, g (s)		32.0	32.0		31.0	31.0
Actuated g/C Ratio		0.43	0.43		0.41	0.41
Clearance Time (s)		6.0	6.0		6.0	6.0
Vehicle Extension (s)		3.0	3.0		3.0	3.0
Lane Grp Cap (vph)		1480	1453		797	1108
v/s Ratio Prot		c0.42	0.24		0.07	c0.42
v/s Ratio Perm						
v/c Ratio		0.98	0.56		0.16	1.02
Uniform Delay, d1		21.1	16.2		13.8	22.0
Progression Factor		1.00	1.23		1.00	1.00
Incremental Delay, d2		10.9	0.1		0.1	33.4
Delay (s)		32.0	20.0		13.9	55.4
Level of Service		C	B		B	E
Approach Delay (s)		32.0	20.0		51.2	
Approach LOS		C	B		D	

Intersection Summary			
HCM 2000 Control Delay	36.1	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	1.00		
Actuated Cycle Length (s)	75.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	67.1%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	NBL2	NBL	NBR	SEL	SER	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations	↰↰		↱↱			↰↰	↑↑			↑↑	↱
Traffic Volume (vph)	455	0	300	0	0	1350	110	0	0	990	375
Future Volume (vph)	455	0	300	0	0	1350	110	0	0	990	375
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0		6.0			6.0	6.0			6.0	4.0
Lane Util. Factor	0.97		0.88			0.97	0.95			0.95	1.00
Frt	1.00		0.85			1.00	1.00			1.00	0.85
Flt Protected	0.95		1.00			0.95	1.00			1.00	1.00
Satd. Flow (prot)	3242		2632			3335	3438			3505	1568
Flt Permitted	0.95		1.00			0.95	1.00			1.00	1.00
Satd. Flow (perm)	3242		2632			3335	3438			3505	1568
Peak-hour factor, PHF	0.88	0.88	0.88	0.92	0.92	0.94	0.94	0.94	0.92	0.92	0.92
Adj. Flow (vph)	517	0	341	0	0	1436	117	0	0	1076	408
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	517	0	341	0	0	1436	117	0	0	1076	408
Heavy Vehicles (%)	8%	8%	8%	2%	2%	5%	5%	5%	3%	3%	3%
Turn Type	Prot		Prot			Prot	NA			NA	Free
Protected Phases	8		8			5	2			6	
Permitted Phases											Free
Actuated Green, G (s)	23.0		23.0			63.0	115.0			46.0	150.0
Effective Green, g (s)	23.0		23.0			63.0	115.0			46.0	150.0
Actuated g/C Ratio	0.15		0.15			0.42	0.77			0.31	1.00
Clearance Time (s)	6.0		6.0			6.0	6.0			6.0	
Vehicle Extension (s)	3.0		3.0			3.0	3.0			3.0	
Lane Grp Cap (vph)	497		403			1400	2635			1074	1568
v/s Ratio Prot	c0.16		0.13			c0.43	0.03			c0.31	
v/s Ratio Perm											0.26
v/c Ratio	1.04		0.85			1.03	0.04			1.00	0.26
Uniform Delay, d1	63.5		61.8			43.5	4.2			52.0	0.0
Progression Factor	1.00		1.00			0.59	1.90			1.00	1.00
Incremental Delay, d2	51.2		15.0			22.4	0.0			27.9	0.4
Delay (s)	114.7		76.8			48.2	8.0			79.9	0.4
Level of Service	F		E			D	A			E	A
Approach Delay (s)		99.6		0.0			45.2			58.1	
Approach LOS		F		A			D			E	

Intersection Summary			
HCM 2000 Control Delay	62.1	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.02		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	94.9%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑	↱	↰	↑↑					↰↰		↱
Traffic Volume (vph)	0	575	470	280	730	0	0	0	0	105	0	360
Future Volume (vph)	0	575	470	280	730	0	0	0	0	105	0	360
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0	4.0	6.0	6.0					6.0		6.0
Lane Util. Factor		0.95	1.00	1.00	0.95					0.97		1.00
Frt		1.00	0.85	1.00	1.00					1.00		0.85
Flt Protected		1.00	1.00	0.95	1.00					0.95		1.00
Satd. Flow (prot)		3167	1417	1687	3374					3303		1524
Flt Permitted		1.00	1.00	0.95	1.00					0.95		1.00
Satd. Flow (perm)		3167	1417	1687	3374					3303		1524
Peak-hour factor, PHF	0.92	0.92	0.92	0.73	0.73	0.73	0.92	0.92	0.92	0.74	0.74	0.74
Adj. Flow (vph)	0	625	511	384	1000	0	0	0	0	142	0	486
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	79
Lane Group Flow (vph)	0	625	511	384	1000	0	0	0	0	142	0	407
Heavy Vehicles (%)	14%	14%	14%	7%	7%	7%	2%	2%	2%	6%	6%	6%
Turn Type		NA	Free	Prot	NA					Prot		Prot
Protected Phases		2		1	6					4		4
Permitted Phases			Free									
Actuated Green, G (s)		31.6	110.0	28.1	65.7					32.3		32.3
Effective Green, g (s)		31.6	110.0	28.1	65.7					32.3		32.3
Actuated g/C Ratio		0.29	1.00	0.26	0.60					0.29		0.29
Clearance Time (s)		6.0		6.0	6.0					6.0		6.0
Vehicle Extension (s)		5.0		3.0	5.0					3.0		3.0
Lane Grp Cap (vph)		909	1417	430	2015					969		447
v/s Ratio Prot		c0.20		c0.23	0.30					0.04		c0.27
v/s Ratio Perm			0.36									
v/c Ratio		0.69	0.36	0.89	0.50					0.15		0.91
Uniform Delay, d1		34.8	0.0	39.5	12.7					28.7		37.5
Progression Factor		1.00	1.00	0.38	0.10					1.00		1.00
Incremental Delay, d2		4.2	0.7	17.4	0.5					0.1		22.5
Delay (s)		39.0	0.7	32.5	1.7					28.7		59.9
Level of Service		D	A	C	A					C		E
Approach Delay (s)		21.8			10.3			0.0			52.9	
Approach LOS		C			B			A			D	

Intersection Summary			
HCM 2000 Control Delay	22.9	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	71.3%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	480	200	0	0	595	340	415	0	160	0	0	0
Future Volume (vph)	480	200	0	0	595	340	415	0	160	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0			6.0	4.0	6.0		6.0			
Lane Util. Factor	1.00	0.95			0.95	1.00	1.00		1.00			
Frt	1.00	1.00			1.00	0.85	1.00		0.85			
Flt Protected	0.95	1.00			1.00	1.00	0.95		1.00			
Satd. Flow (prot)	1641	3282			3438	1538	1656		1482			
Flt Permitted	0.95	1.00			1.00	1.00	0.95		1.00			
Satd. Flow (perm)	1641	3282			3438	1538	1656		1482			
Peak-hour factor, PHF	0.87	0.87	0.87	0.90	0.90	0.90	0.78	0.78	0.78	0.92	0.92	0.92
Adj. Flow (vph)	552	230	0	0	661	378	532	0	205	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	139	0	0	0
Lane Group Flow (vph)	552	230	0	0	661	378	532	0	66	0	0	0
Heavy Vehicles (%)	10%	10%	10%	5%	5%	5%	9%	9%	9%	2%	2%	2%
Turn Type	Prot	NA			NA	Free	Prot		Prot			
Protected Phases	5	2			6		8		8			
Permitted Phases		2			6	Free						
Actuated Green, G (s)	36.0	64.0			22.0	110.0	34.0		34.0			
Effective Green, g (s)	36.0	64.0			22.0	110.0	34.0		34.0			
Actuated g/C Ratio	0.33	0.58			0.20	1.00	0.31		0.31			
Clearance Time (s)	6.0	6.0			6.0		6.0		6.0			
Vehicle Extension (s)	5.0	5.0			5.0		3.0		3.0			
Lane Grp Cap (vph)	537	1909			687	1538	511		458			
v/s Ratio Prot	c0.34	0.07			c0.19		c0.32		0.04			
v/s Ratio Perm						0.25						
v/c Ratio	1.03	0.12			0.96	0.25	1.04		0.14			
Uniform Delay, d1	37.0	10.3			43.6	0.0	38.0		27.5			
Progression Factor	0.26	0.14			1.00	1.00	1.00		1.00			
Incremental Delay, d2	41.1	0.1			26.2	0.4	50.9		0.1			
Delay (s)	50.8	1.6			69.8	0.4	88.9		27.6			
Level of Service	D	A			E	A	F		C			
Approach Delay (s)		36.3			44.6			71.9			0.0	
Approach LOS		D			D			E			A	

Intersection Summary			
HCM 2000 Control Delay	49.9	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	1.02		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	71.3%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
5 ~~9~~: NH 102 & St. Charles Street/Londonderry Road

12/27/2017

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	10	0	170	0	0	0	100	450	5	5	1010	40
Future Volume (vph)	10	0	170	0	0	0	100	450	5	5	1010	40
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0	6.0				6.0	6.0		6.0	6.0	
Lane Util. Factor		1.00	1.00				1.00	0.95		1.00	0.95	
Frt		1.00	0.85				1.00	1.00		1.00	0.99	
Flt Protected		0.95	1.00				0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1770	1583				1770	3534		1770	3519	
Flt Permitted		1.00	1.00				0.95	1.00		0.95	1.00	
Satd. Flow (perm)		1863	1583				1770	3534		1770	3519	
Peak-hour factor, PHF	0.92	0.92	0.92	0.25	0.25	0.25	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	11	0	185	0	0	0	109	489	5	5	1098	43
RTOR Reduction (vph)	0	0	70	0	0	0	0	1	0	0	2	0
Lane Group Flow (vph)	0	11	115	0	0	0	109	493	0	5	1139	0
Heavy Vehicles (%)	2%	2%	2%	0%	0%	0%	2%	2%	2%	2%	2%	2%
Turn Type	Perm	NA	custom				Prot	NA		Prot	NA	
Protected Phases		8			4		5	2		1	6	
Permitted Phases	8		6	4								
Actuated Green, G (s)		1.2	43.9				7.6	50.7		0.8	43.9	
Effective Green, g (s)		1.2	43.9				7.6	50.7		0.8	43.9	
Actuated g/C Ratio		0.02	0.62				0.11	0.72		0.01	0.62	
Clearance Time (s)		6.0	6.0				6.0	6.0		6.0	6.0	
Vehicle Extension (s)		3.0	3.0				3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		31	982				190	2534		20	2185	
v/s Ratio Prot							c0.06	0.14		0.00	c0.32	
v/s Ratio Perm		c0.01	0.07									
v/c Ratio		0.35	0.12				0.57	0.19		0.25	0.52	
Uniform Delay, d1		34.4	5.5				30.0	3.3		34.7	7.5	
Progression Factor		1.00	1.00				1.00	1.00		1.00	1.00	
Incremental Delay, d2		6.9	0.1				4.1	0.0		6.5	0.2	
Delay (s)		41.2	5.5				34.2	3.3		41.1	7.7	
Level of Service		D	A				C	A		D	A	
Approach Delay (s)		7.5			0.0			8.9			7.9	
Approach LOS		A			A			A			A	

Intersection Summary			
HCM 2000 Control Delay	8.2	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.52		
Actuated Cycle Length (s)	70.7	Sum of lost time (s)	18.0
Intersection Capacity Utilization	57.7%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	10	10	10	360	0	40	0	380	110	15	525	0
Future Volume (vph)	10	10	10	360	0	40	0	380	110	15	525	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0			6.0			6.0			6.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		0.95			0.99			0.97			1.00	
Flt Protected		0.98			0.96			1.00			1.00	
Satd. Flow (prot)		1750			1741			1706			1807	
Flt Permitted		0.84			0.71			1.00			0.98	
Satd. Flow (perm)		1501			1293			1706			1774	
Peak-hour factor, PHF	0.60	0.60	0.60	0.96	0.96	0.96	0.89	0.89	0.89	0.86	0.86	0.86
Adj. Flow (vph)	17	17	17	375	0	42	0	427	124	17	610	0
RTOR Reduction (vph)	0	11	0	0	23	0	0	12	0	0	0	0
Lane Group Flow (vph)	0	40	0	0	394	0	0	539	0	0	627	0
Heavy Vehicles (%)	2%	2%	2%	3%	3%	3%	8%	8%	8%	5%	5%	5%
Turn Type	Perm	NA		Perm	NA			NA		Perm	NA	
Protected Phases		4			4			2			2	
Permitted Phases	4			4						2		
Actuated Green, G (s)		27.9			27.9			34.8			34.8	
Effective Green, g (s)		27.9			27.9			34.8			34.8	
Actuated g/C Ratio		0.37			0.37			0.47			0.47	
Clearance Time (s)		6.0			6.0			6.0			6.0	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		560			482			794			826	
v/s Ratio Prot								0.32				
v/s Ratio Perm		0.03			c0.30						c0.35	
v/c Ratio		0.07			0.82			0.68			0.76	
Uniform Delay, d1		15.1			21.1			15.6			16.5	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		0.1			10.4			2.3			4.0	
Delay (s)		15.1			31.5			17.9			20.5	
Level of Service		B			C			B			C	
Approach Delay (s)		15.1			31.5			17.9			20.5	
Approach LOS		B			C			B			C	

Intersection Summary			
HCM 2000 Control Delay	22.3	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	74.7	Sum of lost time (s)	12.0
Intersection Capacity Utilization	80.1%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
7: Birch St/Crystal Ave & NH 102 (E Broadway)

03/13/2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↱		↰	↑↱		↰	↑↱		↰	↑	↱
Traffic Volume (vph)	60	210	50	20	400	50	70	270	20	70	270	40
Future Volume (vph)	60	210	50	20	400	50	70	270	20	70	270	40
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	6.0
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.97		1.00	0.98		1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1656	1693		1703	1763		1719	1790		1703	1792	1524
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1656	1693		1703	1763		1719	1790		1703	1792	1524
Peak-hour factor, PHF	0.96	0.96	0.96	0.94	0.94	0.94	0.85	0.85	0.85	0.91	0.91	0.91
Adj. Flow (vph)	62	219	52	21	426	53	82	318	24	77	297	44
RTOR Reduction (vph)	0	9	0	0	5	0	0	3	0	0	0	34
Lane Group Flow (vph)	63	262	0	21	474	0	82	339	0	77	297	10
Heavy Vehicles (%)	9%	9%	9%	6%	6%	6%	5%	5%	5%	6%	6%	6%
Parking (#/hr)			0									
Turn Type	Prot	NA		Prot	NA		Prot	NA		Prot	NA	Perm
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases												4
Actuated Green, G (s)	4.4	30.7		1.8	28.1		7.0	18.6		7.0	18.6	18.6
Effective Green, g (s)	4.4	30.7		1.8	28.1		7.0	18.6		7.0	18.6	18.6
Actuated g/C Ratio	0.05	0.37		0.02	0.34		0.09	0.23		0.09	0.23	0.23
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	88	633		37	603		146	405		145	405	345
v/s Ratio Prot	c0.04	c0.15		0.01	c0.27		c0.05	c0.19		0.05	0.17	
v/s Ratio Perm												0.01
v/c Ratio	0.72	0.41		0.57	0.79		0.56	0.84		0.53	0.73	0.03
Uniform Delay, d1	38.2	19.0		39.8	24.3		36.1	30.3		36.0	29.4	24.7
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	24.0	0.4		18.4	6.7		4.9	13.9		3.7	6.7	0.0
Delay (s)	62.3	19.5		58.2	31.0		40.9	44.2		39.7	36.2	24.8
Level of Service	E	B		E	C		D	D		D	D	C
Approach Delay (s)		27.5			32.1			43.6			35.6	
Approach LOS		C			C			D			D	

Intersection Summary

HCM 2000 Control Delay	35.0	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.77		
Actuated Cycle Length (s)	82.1	Sum of lost time (s)	24.0
Intersection Capacity Utilization	66.7%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	350	20	5	130	115	415
Future Volume (vph)	350	20	5	130	115	415
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0	120	0			220
Storage Lanes	1	1	0			1
Taper Length (ft)	25		25			
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.850				0.850
Flt Protected	0.950			0.998		
Satd. Flow (prot)	1719	1538	0	1823	1863	1583
Flt Permitted	0.950			0.998		
Satd. Flow (perm)	1719	1538	0	1823	1863	1583
Link Speed (mph)	30			30	30	
Link Distance (ft)	322			309	292	
Travel Time (s)	7.3			7.0	6.6	
Peak Hour Factor	0.89	0.89	0.91	0.91	0.93	0.93
Heavy Vehicles (%)	5%	5%	4%	4%	2%	2%
Adj. Flow (vph)	393	22	5	143	124	446
Shared Lane Traffic (%)						
Lane Group Flow (vph)	393	22	0	148	124	446
Sign Control	Stop			Stop	Stop	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 39.5% ICU Level of Service A

Analysis Period (min) 15

Intersection	
Intersection Delay, s/veh	21.1
Intersection LOS	C

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	350	20	5	130	115	415
Future Vol, veh/h	350	20	5	130	115	415
Peak Hour Factor	0.89	0.89	0.91	0.91	0.93	0.93
Heavy Vehicles, %	5	5	4	4	2	2
Mvmt Flow	393	22	5	143	124	446
Number of Lanes	1	1	0	1	1	1

Approach	EB	NB	SB
Opposing Approach		SB	NB
Opposing Lanes	0	2	1
Conflicting Approach Left	SB	EB	
Conflicting Lanes Left	2	2	0
Conflicting Approach Right	NB		EB
Conflicting Lanes Right	1	0	2
HCM Control Delay	28.2	12.4	18.2
HCM LOS	D	B	C

Lane	NBLn1	EBLn1	EBLn2	SBLn1	SBLn2
Vol Left, %	4%	100%	0%	0%	0%
Vol Thru, %	96%	0%	0%	100%	0%
Vol Right, %	0%	0%	100%	0%	100%
Sign Control	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	135	350	20	115	415
LT Vol	5	350	0	0	0
Through Vol	130	0	0	115	0
RT Vol	0	0	20	0	415
Lane Flow Rate	148	393	22	124	446
Geometry Grp	4	7	7	7	7
Degree of Util (X)	0.277	0.766	0.036	0.217	0.694
Departure Headway (Hd)	6.722	7.011	5.795	6.311	5.6
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes
Cap	531	515	616	566	643
Service Time	4.802	4.763	3.547	4.078	3.367
HCM Lane V/C Ratio	0.279	0.763	0.036	0.219	0.694
HCM Control Delay	12.4	29.3	8.8	10.8	20.2
HCM Lane LOS	B	D	A	B	C
HCM 95th-tile Q	1.1	6.8	0.1	0.8	5.5

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	10	0	10	470	530	0
Future Volume (vph)	10	0	10	470	530	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt						
Flt Protected	0.950			0.999		
Satd. Flow (prot)	1008	0	0	1825	1792	0
Flt Permitted	0.950			0.999		
Satd. Flow (perm)	1008	0	0	1825	1792	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	160			224	319	
Travel Time (s)	3.6			5.1	7.3	
Peak Hour Factor	0.44	0.44	0.95	0.95	0.96	0.96
Heavy Vehicles (%)	79%	79%	4%	4%	6%	6%
Adj. Flow (vph)	23	0	11	495	552	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	23	0	0	506	552	0
Sign Control	Stop			Free	Free	

Intersection Summary		
Area Type:	Other	
Control Type: Unsignalized		
Intersection Capacity Utilization 42.8%		ICU Level of Service A
Analysis Period (min) 15		

Intersection	
Int Delay, s/veh	0.7

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	10	0	10	470	530	0
Future Vol, veh/h	10	0	10	470	530	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	44	44	95	95	96	96
Heavy Vehicles, %	79	79	4	4	6	6
Mvmt Flow	23	0	11	495	552	0

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1069	552	552	0	-	0
Stage 1	552	-	-	-	-	-
Stage 2	517	-	-	-	-	-
Critical Hdwy	7.19	6.99	4.14	-	-	-
Critical Hdwy Stg 1	6.19	-	-	-	-	-
Critical Hdwy Stg 2	6.19	-	-	-	-	-
Follow-up Hdwy	4.211	4.011	2.236	-	-	-
Pot Cap-1 Maneuver	177	411	1008	-	-	-
Stage 1	449	-	-	-	-	-
Stage 2	468	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	174	411	1008	-	-	-
Mov Cap-2 Maneuver	174	-	-	-	-	-
Stage 1	442	-	-	-	-	-
Stage 2	468	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	28.8	0.2	0
HCM LOS	D		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1008	-	174	-	-
HCM Lane V/C Ratio	0.01	-	0.131	-	-
HCM Control Delay (s)	8.6	0	28.8	-	-
HCM Lane LOS	A	A	D	-	-
HCM 95th %tile Q(veh)	0	-	0.4	-	-

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations		✣			✣			✣			✣	
Traffic Volume (vph)	50	420	10	30	420	10	50	70	100	10	10	100
Future Volume (vph)	50	420	10	30	420	10	50	70	100	10	10	100
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	150		150	150		150	0		0	150		150
Storage Lanes	0		0	0		0	0		0	0		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.997			0.997			0.939			0.888	
Flt Protected		0.995			0.997			0.989			0.996	
Satd. Flow (prot)	0	1762	0	0	1799	0	0	1730	0	0	1680	0
Flt Permitted		0.995			0.997			0.989			0.996	
Satd. Flow (perm)	0	1762	0	0	1799	0	0	1730	0	0	1680	0
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		327			240			246			251	
Travel Time (s)		7.4			5.5			5.6			5.7	
Peak Hour Factor	0.89	0.89	0.89	0.96	0.96	0.96	0.65	0.65	0.65	0.67	0.67	0.67
Heavy Vehicles (%)	7%	7%	7%	5%	5%	5%	2%	2%	2%	0%	0%	0%
Adj. Flow (vph)	56	472	11	31	438	10	77	108	154	15	15	149
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	539	0	0	479	0	0	339	0	0	179	0
Sign Control		Free			Free			Stop			Stop	

Intersection Summary

Area Type: Other
Control Type: Unsignalized
Intersection Capacity Utilization 63.8% ICU Level of Service B
Analysis Period (min) 15

Intersection	
Int Delay, s/veh	52.3

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations		✣			✣			✣			✣	
Traffic Vol, veh/h	50	420	10	30	420	10	50	70	100	10	10	100
Future Vol, veh/h	50	420	10	30	420	10	50	70	100	10	10	100
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	Yield	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	89	89	89	96	96	96	65	65	65	67	67	67
Heavy Vehicles, %	7	7	7	5	5	5	2	2	2	0	0	0
Mvmt Flow	56	472	11	31	438	10	77	108	154	15	15	149

Major/Minor	Major1			Major2			Minor2			Minor1		
Conflicting Flow All	448	0	0	483	0	0	1177	1100	443	1149	1100	478
Stage 1	-	-	-	-	-	-	505	505	-	590	590	-
Stage 2	-	-	-	-	-	-	672	595	-	559	510	-
Critical Hdwy	4.17	-	-	4.15	-	-	7.12	6.52	6.22	7.1	6.5	6.2
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.1	5.5	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.1	5.5	-
Follow-up Hdwy	2.263	-	-	2.245	-	-	3.518	4.018	3.318	3.5	4	3.3
Pot Cap-1 Maneuver	1086	-	-	1064	-	-	168	212	615	177	214	591
Stage 1	-	-	-	-	-	-	549	540	-	497	498	-
Stage 2	-	-	-	-	-	-	445	492	-	517	541	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1086	-	-	1064	-	-	109	189	615	67	191	591
Mov Cap-2 Maneuver	-	-	-	-	-	-	109	189	-	67	191	-
Stage 1	-	-	-	-	-	-	510	519	-	462	463	-
Stage 2	-	-	-	-	-	-	299	457	-	295	520	-

Approach	EB	WB	SE	NW
HCM Control Delay, s	0.9	0.6	219.6	29
HCM LOS			F	D

Minor Lane/Major Mvmt	NWLn1	EBL	EBT	EBR	WBL	WBT	WBR	SELn1
Capacity (veh/h)	324	1086	-	-	1064	-	-	251
HCM Lane V/C Ratio	0.553	0.052	-	-	0.029	-	-	1.348
HCM Control Delay (s)	29	8.5	0	-	8.5	0	-	219.6
HCM Lane LOS	D	A	A	-	A	A	-	F
HCM 95th %tile Q(veh)	3.2	0.2	-	-	0.1	-	-	18

HCM Signalized Intersection Capacity Analysis
11: Folsom Rd/Tsienneto Rd & Crystal Av/NH 28

03/13/2018

Movement	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations	↰	↑↑	↱	↰↰	↑↑		↰	↑	↱	↰	↑	↱
Traffic Volume (vph)	20	220	115	345	270	0	190	280	20	40	370	530
Future Volume (vph)	20	220	115	345	270	0	190	280	20	40	370	530
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0		6.0	6.0	4.0	6.0	6.0	6.0
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1736	3471	1553	3335	3438		1752	1845	1568	1752	1845	1568
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1736	3471	1553	3335	3438		1752	1845	1568	1752	1845	1568
Peak-hour factor, PHF	0.84	0.84	0.84	0.79	0.79	0.79	0.86	0.86	0.86	0.99	0.99	0.99
Adj. Flow (vph)	24	262	137	437	342	0	221	326	23	40	374	535
RTOR Reduction (vph)	0	0	113	0	0	0	0	0	0	0	0	95
Lane Group Flow (vph)	24	262	24	437	342	0	221	326	23	40	374	440
Heavy Vehicles (%)	4%	4%	4%	5%	5%	5%	3%	3%	3%	3%	3%	3%
Turn Type	Prot	NA	Perm	Prot	NA		Prot	NA	Free	Prot	NA	pt+ov
Protected Phases	5	2		1	6		7	4		3	8	8 1
Permitted Phases		2	2		6			4	Free		8	
Actuated Green, G (s)	8.6	15.6	15.6	14.6	21.6		13.5	31.6	90.0	4.2	22.3	42.9
Effective Green, g (s)	8.6	15.6	15.6	14.6	21.6		13.5	31.6	90.0	4.2	22.3	42.9
Actuated g/C Ratio	0.10	0.17	0.17	0.16	0.24		0.15	0.35	1.00	0.05	0.25	0.48
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	165	601	269	541	825		262	647	1568	81	457	747
v/s Ratio Prot	0.01	0.08		c0.13	c0.10		c0.13	0.18		0.02	c0.20	0.28
v/s Ratio Perm			0.02						0.01			
v/c Ratio	0.15	0.44	0.09	0.81	0.41		0.84	0.50	0.01	0.49	0.82	0.59
Uniform Delay, d1	37.3	33.3	31.2	36.3	28.9		37.2	23.0	0.0	41.9	31.9	17.1
Progression Factor	1.00	1.00	1.00	0.91	0.70		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.8	2.3	0.6	8.3	1.5		21.2	0.6	0.0	4.7	10.9	1.2
Delay (s)	39.2	35.6	31.9	41.5	21.8		58.4	23.6	0.0	46.5	42.8	18.3
Level of Service	D	D	C	D	C		E	C	A	D	D	B
Approach Delay (s)		34.6			32.8			36.2			29.2	
Approach LOS		C			C			D			C	

Intersection Summary			
HCM 2000 Control Delay	32.5	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.73		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	24.0
Intersection Capacity Utilization	66.5%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	NWL	NWR	NET	NER	SWL	SWT
Lane Configurations						
Traffic Volume (vph)	320	70	430	310	80	620
Future Volume (vph)	320	70	430	310	80	620
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	180	0		0	180	
Storage Lanes	1	1		1	0	
Taper Length (ft)	25				25	
Lane Util. Factor	1.00	1.00	1.00	1.00	0.95	0.95
Frt		0.850		0.850		
Flt Protected	0.950					0.994
Satd. Flow (prot)	1770	1583	1845	1568	0	3518
Flt Permitted	0.950					0.994
Satd. Flow (perm)	1770	1583	1845	1568	0	3518
Link Speed (mph)	30		30			30
Link Distance (ft)	408		387			233
Travel Time (s)	9.3		8.8			5.3
Peak Hour Factor	0.83	0.83	0.86	0.86	0.81	0.81
Heavy Vehicles (%)	2%	2%	3%	3%	2%	2%
Adj. Flow (vph)	386	84	500	360	99	765
Shared Lane Traffic (%)						
Lane Group Flow (vph)	386	84	500	360	0	864
Sign Control	Stop		Free			Free

Intersection Summary

Area Type: Other
Control Type: Unsignalized
Intersection Capacity Utilization 69.8% ICU Level of Service C
Analysis Period (min) 15

Intersection	
Int Delay, s/veh	93.6

Movement	NWL	NWR	NET	NER	SWL	SWT
Lane Configurations	↰	↱	↑	↱		↰↑
Traffic Vol, veh/h	320	70	430	310	80	620
Future Vol, veh/h	320	70	430	310	80	620
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	Yield	-	None
Storage Length	180	0	-	0	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	83	83	86	86	81	81
Heavy Vehicles, %	2	2	3	3	2	2
Mvmt Flow	386	84	500	360	99	765

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1081	500	0	0	500	0
Stage 1	500	-	-	-	-	-
Stage 2	581	-	-	-	-	-
Critical Hdwy	6.63	6.23	-	-	4.13	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.83	-	-	-	-	-
Follow-up Hdwy	3.519	3.319	-	-	2.219	-
Pot Cap-1 Maneuver	~ 226	570	-	-	1062	-
Stage 1	608	-	-	-	-	-
Stage 2	523	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	~ 189	570	-	-	1062	-
Mov Cap-2 Maneuver	~ 189	-	-	-	-	-
Stage 1	510	-	-	-	-	-
Stage 2	523	-	-	-	-	-

Approach	NW	NE	SW
HCM Control Delay, s	$ 434.5	0	1.5
HCM LOS	F		

Minor Lane/Major Mvmt	NET	NER	NWLn1	NWLn2	SWL	SWT
Capacity (veh/h)	-	-	189	570	1062	-
HCM Lane V/C Ratio	-	-	2.04	0.148	0.093	-
HCM Control Delay (s)	-	-	$ 526.8	12.4	8.7	0.6
HCM Lane LOS	-	-	F	B	A	A
HCM 95th %tile Q(veh)	-	-	29.5	0.5	0.3	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations	↰	↑↱		↰	↑↱			↰	↱		↰	↱
Traffic Volume (vph)	30	825	0	0	830	40	5	0	5	10	0	40
Future Volume (vph)	30	825	0	0	830	40	5	0	5	10	0	40
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0			6.0			6.0	6.0		6.0	6.0
Lane Util. Factor	1.00	0.95			0.95			1.00	1.00		1.00	1.00
Frt	1.00	1.00			0.99			1.00	0.85		1.00	0.85
Flt Protected	0.95	1.00			1.00			0.95	1.00		0.95	1.00
Satd. Flow (prot)	1687	3374			3515			1805	1615		1787	1599
Flt Permitted	0.95	1.00			1.00			0.98	1.00		0.98	1.00
Satd. Flow (perm)	1687	3374			3515			1854	1615		1835	1599
Peak-hour factor, PHF	0.83	0.83	0.83	0.92	0.92	0.92	0.50	0.50	0.50	0.90	0.90	0.90
Adj. Flow (vph)	36	994	0	0	902	43	10	0	10	11	0	44
RTOR Reduction (vph)	0	0	0	0	2	0	0	0	10	0	0	42
Lane Group Flow (vph)	36	994	0	0	943	0	0	10	0	0	11	2
Heavy Vehicles (%)	7%	7%	7%	2%	2%	2%	0%	0%	0%	1%	1%	1%
Turn Type	Prot	NA		Prot	NA		Perm	NA	Perm	Perm	NA	Perm
Protected Phases	5	2		1	6			8			4	
Permitted Phases					6		8	8	8	4		4
Actuated Green, G (s)	5.2	73.9			62.7			4.1	4.1		4.1	4.1
Effective Green, g (s)	5.2	73.9			62.7			4.1	4.1		4.1	4.1
Actuated g/C Ratio	0.06	0.82			0.70			0.05	0.05		0.05	0.05
Clearance Time (s)	6.0	6.0			6.0			6.0	6.0		6.0	6.0
Vehicle Extension (s)	3.0	3.0			3.0			3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	97	2770			2448			84	73		83	72
v/s Ratio Prot	0.02	c0.29			c0.27							
v/s Ratio Perm								0.01	0.00		c0.01	0.00
v/c Ratio	0.37	0.36			0.39			0.12	0.01		0.13	0.03
Uniform Delay, d1	40.8	2.0			5.7			41.2	41.0		41.2	41.0
Progression Factor	1.16	0.57			0.80			1.00	1.00		1.00	1.00
Incremental Delay, d2	2.2	0.3			0.1			0.6	0.0		0.7	0.2
Delay (s)	49.5	1.5			4.6			41.9	41.0		42.0	41.2
Level of Service	D	A			A			D	D		D	D
Approach Delay (s)		3.2			4.6			41.4			41.4	
Approach LOS		A			A			D			D	

Intersection Summary			
HCM 2000 Control Delay	5.2	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.39		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	47.5%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
22: VIP Dr/Connector Rd & NH 28

03/13/2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰↰	↑↱		↰	↑↱		↰	↱			↰↑	↱
Traffic Volume (vph)	420	830	5	5	875	60	10	5	5	60	5	400
Future Volume (vph)	420	830	5	5	875	60	10	5	5	60	5	400
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0		6.0	6.0			6.0	6.0
Lane Util. Factor	0.97	0.95		1.00	0.95		1.00	1.00			1.00	1.00
Frt	1.00	1.00		1.00	0.99		1.00	0.93			1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00			0.96	1.00
Satd. Flow (prot)	3303	3403		1736	3438		1805	1758			1764	1568
Flt Permitted	0.95	1.00		0.95	1.00		0.71	1.00			0.73	1.00
Satd. Flow (perm)	3303	3403		1736	3438		1348	1758			1353	1568
Peak-hour factor, PHF	0.83	0.83	0.83	0.97	0.97	0.97	0.67	0.67	0.67	0.90	0.90	0.90
Adj. Flow (vph)	506	1000	6	5	902	62	15	7	7	67	6	444
RTOR Reduction (vph)	0	0	0	0	6	0	0	6	0	0	0	37
Lane Group Flow (vph)	506	1006	0	5	958	0	15	8	0	0	73	407
Heavy Vehicles (%)	6%	6%	6%	4%	4%	4%	0%	0%	0%	3%	3%	3%
Turn Type	Prot	NA		Prot	NA		Perm	NA		Perm	NA	pt+ov
Protected Phases	5	2		1	6			8			4	4 5
Permitted Phases							8	8		4		
Actuated Green, G (s)	16.7	53.2		1.0	37.5		17.8	17.8			17.8	40.5
Effective Green, g (s)	16.7	53.2		1.0	37.5		17.8	17.8			17.8	40.5
Actuated g/C Ratio	0.19	0.59		0.01	0.42		0.20	0.20			0.20	0.45
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0			6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0			3.0	
Lane Grp Cap (vph)	612	2011		19	1432		266	347			267	705
v/s Ratio Prot	c0.15	0.30		0.00	c0.28			0.00				c0.26
v/s Ratio Perm							0.01				0.05	
v/c Ratio	0.83	0.50		0.26	0.67		0.06	0.02			0.27	0.58
Uniform Delay, d1	35.3	10.7		44.1	21.2		29.3	29.1			30.6	18.4
Progression Factor	1.00	1.00		0.80	0.95		1.00	1.00			1.00	1.00
Incremental Delay, d2	9.0	0.9		7.0	1.2		0.1	0.0			0.6	1.1
Delay (s)	44.2	11.6		42.3	21.4		29.4	29.1			31.2	19.5
Level of Service	D	B		D	C		C	C			C	B
Approach Delay (s)		22.5			21.5			29.3			21.2	
Approach LOS		C			C			C			C	

Intersection Summary			
HCM 2000 Control Delay	22.0	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.71		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	70.0%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	110	1320	1220	10	10	80
Future Volume (vph)	110	1320	1220	10	10	80
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	300			0	0	175
Storage Lanes	1			0	1	1
Taper Length (ft)	25				25	
Lane Util. Factor	1.00	0.95	0.95	0.95	1.00	1.00
Frt			0.999			0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1687	3374	3468	0	1703	1524
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1687	3374	3468	0	1703	1524
Link Speed (mph)		30	30		30	
Link Distance (ft)		535	210		522	
Travel Time (s)		12.2	4.8		11.9	
Peak Hour Factor	0.84	0.84	0.89	0.89	0.83	0.83
Heavy Vehicles (%)	7%	7%	4%	4%	6%	6%
Adj. Flow (vph)	131	1571	1371	11	12	96
Shared Lane Traffic (%)						
Lane Group Flow (vph)	131	1571	1382	0	12	96
Sign Control		Free	Free		Stop	

Intersection Summary

Area Type: Other
Control Type: Unsignalized
Intersection Capacity Utilization 53.5% ICU Level of Service A
Analysis Period (min) 15

Intersection	
Int Delay, s/veh	2.6

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↰	↑↑	↑↱		↰	↱
Traffic Vol, veh/h	110	1320	1220	10	10	80
Future Vol, veh/h	110	1320	1220	10	10	80
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	300	-	-	-	0	175
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	84	84	89	89	83	83
Heavy Vehicles, %	7	7	4	4	6	6
Mvmt Flow	131	1571	1371	11	12	96

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	1382	0	-	0	2425	691
Stage 1	-	-	-	-	1377	-
Stage 2	-	-	-	-	1048	-
Critical Hdwy	4.24	-	-	-	6.92	7.02
Critical Hdwy Stg 1	-	-	-	-	5.92	-
Critical Hdwy Stg 2	-	-	-	-	5.92	-
Follow-up Hdwy	2.27	-	-	-	3.56	3.36
Pot Cap-1 Maneuver	467	-	-	-	25	378
Stage 1	-	-	-	-	192	-
Stage 2	-	-	-	-	290	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	467	-	-	-	18	378
Mov Cap-2 Maneuver	-	-	-	-	18	-
Stage 1	-	-	-	-	138	-
Stage 2	-	-	-	-	290	-

Approach	EB	WB	SB
HCM Control Delay, s	1.2	0	58.8
HCM LOS			F

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1	SBLn2
Capacity (veh/h)	467	-	-	-	18	378
HCM Lane V/C Ratio	0.28	-	-	-	0.669	0.255
HCM Control Delay (s)	15.7	-	-	-	$ 387.1	17.8
HCM Lane LOS	C	-	-	-	F	C
HCM 95th %tile Q(veh)	1.1	-	-	-	1.8	1

Lane Group	WBL2	WBL	WBR	WBR2	NBL	NBT	NBR	NBR2	SBL2	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	10	180	340	20	20	125	110	5	10	105	170	40
Future Volume (vph)	10	180	340	20	20	125	110	5	10	105	170	40
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)		0	150		0		150			0		0
Storage Lanes		1	0		0		0			0		0
Taper Length (ft)		25			25					25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.912				0.940					0.983	
Flt Protected		0.983				0.996					0.983	
Satd. Flow (prot)	0	1654	0	0	0	1727	0	0	0	0	1716	0
Flt Permitted		0.983				0.996					0.983	
Satd. Flow (perm)	0	1654	0	0	0	1727	0	0	0	0	1716	0
Link Speed (mph)		30				30					30	
Link Distance (ft)		465				456					371	
Travel Time (s)		10.6				10.4					8.4	
Peak Hour Factor	0.91	0.91	0.91	0.91	0.86	0.86	0.86	0.86	0.80	0.80	0.80	0.80
Heavy Vehicles (%)	3%	3%	3%	3%	3%	3%	3%	3%	7%	7%	7%	7%
Adj. Flow (vph)	11	198	374	22	23	145	128	6	13	131	213	50
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	605	0	0	0	302	0	0	0	0	407	0
Sign Control		Yield				Yield					Yield	

Intersection Summary

Area Type: Other
Control Type: Roundabout
Intersection Capacity Utilization 100.3% ICU Level of Service G
Analysis Period (min) 15

Intersection	
Intersection Delay, s/veh	14.1
Intersection LOS	B

Approach	WB	NB	SB	NE	SW
Entry Lanes	1	1	1	1	1
Conflicting Circle Lanes	1	1	1	1	1
Adj Approach Flow, veh/h	605	302	407	475	235
Demand Flow Rate, veh/h	623	311	436	513	252
Vehicles Circulating, veh/h	472	529	478	438	854
Vehicles Exiting, veh/h	368	422	628	476	241
Ped Vol Crossing Leg, #/h	0	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000	1.000
Approach Delay, s/veh	18.8	9.4	11.8	13.2	13.9
Approach LOS	C	A	B	B	B

Lane	Left	Left	Left	Left	Left
Designated Moves	LR	LTR	LTR	LTR	LTR
Assumed Moves	LR	LTR	LTR	LTR	LTR
RT Channelized					
Lane Util	1.000	1.000	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976	4.976	4.976
Entry Flow, veh/h	623	311	436	513	252
Cap Entry Lane, veh/h	853	804	847	883	578
Entry HV Adj Factor	0.971	0.970	0.934	0.925	0.932
Flow Entry, veh/h	605	302	407	475	235
Cap Entry, veh/h	828	780	791	817	538
V/C Ratio	0.731	0.387	0.514	0.581	0.436
Control Delay, s/veh	18.8	9.4	11.8	13.2	13.9
LOS	C	A	B	B	B
95th %tile Queue, veh	7	2	3	4	2

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	5	20	220	5	40	50	375	140	5	10	100	20
Future Volume (vph)	5	20	220	5	40	50	375	140	5	10	100	20
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		50	0		0	0		0	0		0
Storage Lanes	0		1	0		0	0		0	0		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850		0.929			0.999			0.979	
Flt Protected		0.990			0.997			0.965			0.996	
Satd. Flow (prot)	0	1742	1495	0	1676	0	0	1778	0	0	1781	0
Flt Permitted		0.990			0.997			0.965			0.996	
Satd. Flow (perm)	0	1742	1495	0	1676	0	0	1778	0	0	1781	0
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		144			453			475			436	
Travel Time (s)		3.3			10.3			10.8			9.9	
Peak Hour Factor	0.82	0.82	0.82	0.70	0.70	0.70	0.75	0.75	0.75	0.71	0.71	0.71
Heavy Vehicles (%)	8%	8%	8%	5%	5%	5%	3%	3%	3%	4%	4%	4%
Adj. Flow (vph)	6	24	268	7	57	71	500	187	7	14	141	28
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	30	268	0	135	0	0	694	0	0	183	0
Sign Control		Stop			Stop			Free			Free	

Intersection Summary		
Area Type:	Other	
Control Type: Unsignalized		
Intersection Capacity Utilization 51.3%		ICU Level of Service A
Analysis Period (min) 15		

Intersection	
Int Delay, s/veh	21.4

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↰	↱		✥			✥			✥	
Traffic Vol, veh/h	5	20	220	5	40	50	375	140	5	10	100	20
Future Vol, veh/h	5	20	220	5	40	50	375	140	5	10	100	20
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	50	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	82	82	82	70	70	70	75	75	75	71	71	71
Heavy Vehicles, %	8	8	8	5	5	5	3	3	3	4	4	4
Mvmt Flow	6	24	268	7	57	71	500	187	7	14	141	28

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1438	1377	155	1520	1388	191	169	0	0	194	0	0
Stage 1	183	183	-	1191	1191	-	-	-	-	-	-	-
Stage 2	1255	1194	-	329	197	-	-	-	-	-	-	-
Critical Hdwy	7.18	6.58	6.28	7.15	6.55	6.25	4.13	-	-	4.14	-	-
Critical Hdwy Stg 1	6.18	5.58	-	6.15	5.55	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.18	5.58	-	6.15	5.55	-	-	-	-	-	-	-
Follow-up Hdwy	3.572	4.072	3.372	3.545	4.045	3.345	2.227	-	-	2.236	-	-
Pot Cap-1 Maneuver	108	141	875	96	141	843	1402	-	-	1367	-	-
Stage 1	805	737	-	225	257	-	-	-	-	-	-	-
Stage 2	204	253	-	678	732	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	32	84	875	36	84	843	1402	-	-	1367	-	-
Mov Cap-2 Maneuver	32	84	-	36	84	-	-	-	-	-	-	-
Stage 1	483	729	-	135	154	-	-	-	-	-	-	-
Stage 2	70	152	-	449	724	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	20.7	127.6	6.5	0.6
HCM LOS	C	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1402	-	-	63	875	141	1367	-	-
HCM Lane V/C Ratio	0.357	-	-	0.484	0.307	0.963	0.01	-	-
HCM Control Delay (s)	9	0	-	107	10.9	127.6	7.7	0	-
HCM Lane LOS	A	A	-	F	B	F	A	A	-
HCM 95th %tile Q(veh)	1.6	-	-	1.9	1.3	6.8	0	-	-

Movement	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations	↰	↱		↰	↑	↱	↰	↱		↰	↱	
Traffic Volume (vph)	30	50	20	10	40	90	20	230	90	70	280	40
Future Volume (vph)	30	50	20	10	40	90	20	230	90	70	280	40
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	0.96		1.00	1.00	0.85	1.00	0.96		1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1752	1767		1736	1827	1553	1770	1784		1787	1846	
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1752	1767		1736	1827	1553	1770	1784		1787	1846	
Peak-hour factor, PHF	0.82	0.82	0.82	0.81	0.81	0.81	0.68	0.68	0.68	0.78	0.78	0.78
Adj. Flow (vph)	37	61	24	12	49	111	29	338	132	90	359	51
RTOR Reduction (vph)	0	16	0	0	0	83	0	19	0	0	7	0
Lane Group Flow (vph)	37	69	0	12	49	28	29	451	0	90	403	0
Heavy Vehicles (%)	3%	3%	3%	4%	4%	4%	2%	2%	2%	1%	1%	1%
Turn Type	Prot	NA		Prot	NA	pm+ov	Prot	NA		Prot	NA	
Protected Phases	1	6		5	2	3	3	8		7	4	
Permitted Phases						2						
Actuated Green, G (s)	2.4	11.3		1.2	10.1	16.0	5.9	20.9		5.9	20.9	
Effective Green, g (s)	2.4	11.3		1.2	10.1	16.0	5.9	20.9		5.9	20.9	
Actuated g/C Ratio	0.04	0.18		0.02	0.16	0.25	0.09	0.33		0.09	0.33	
Clearance Time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	66	315		32	291	539	164	589		166	609	
v/s Ratio Prot	c0.02	c0.04		0.01	0.03	0.00	0.02	c0.25		c0.05	0.22	
v/s Ratio Perm						0.01						
v/c Ratio	0.56	0.22		0.38	0.17	0.05	0.18	0.76		0.54	0.66	
Uniform Delay, d1	29.9	22.2		30.7	23.0	17.9	26.5	19.0		27.4	18.2	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	10.4	0.3		7.2	1.2	0.0	0.5	5.9		3.6	2.7	
Delay (s)	40.4	22.6		37.9	24.2	17.9	27.0	24.9		31.0	20.9	
Level of Service	D	C		D	C	B	C	C		C	C	
Approach Delay (s)		28.0			21.1			25.0			22.7	
Approach LOS		C			C			C			C	

Intersection Summary			
HCM 2000 Control Delay	23.9	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.58		
Actuated Cycle Length (s)	63.3	Sum of lost time (s)	24.0
Intersection Capacity Utilization	47.6%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	450	0	20	60	170	580
Future Volume (vph)	450	0	20	60	170	580
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0		6.0	4.0	4.0	6.0
Lane Util. Factor	1.00		1.00	1.00	1.00	1.00
Frt	1.00		1.00	1.00	1.00	0.85
Flt Protected	0.95		0.95	1.00	1.00	1.00
Satd. Flow (prot)	1770		1626	1712	1863	1583
Flt Permitted	0.95		0.58	1.00	1.00	1.00
Satd. Flow (perm)	1770		993	1712	1863	1583
Peak-hour factor, PHF	0.94	0.94	0.91	0.91	0.82	0.82
Adj. Flow (vph)	479	0	22	66	207	707
RTOR Reduction (vph)	0	0	0	0	0	169
Lane Group Flow (vph)	479	0	22	66	207	538
Heavy Vehicles (%)	2%	2%	11%	11%	2%	2%
Turn Type	Prot		pm+pt	NA	NA	custom
Protected Phases	8		1	6 7	2 7	7 8
Permitted Phases			6 7			2
Actuated Green, G (s)	22.0		34.6	33.0	32.2	56.2
Effective Green, g (s)	22.0		30.6	33.0	32.2	56.2
Actuated g/C Ratio	0.30		0.41	0.45	0.44	0.76
Clearance Time (s)	6.0		6.0			
Vehicle Extension (s)	3.0		3.0			
Lane Grp Cap (vph)	527		425	765	812	1205
v/s Ratio Prot	c0.27		c0.00	0.04	0.11	c0.24
v/s Ratio Perm			0.02			0.10
v/c Ratio	0.91		0.05	0.09	0.25	0.45
Uniform Delay, d1	24.9		12.9	11.7	13.2	3.2
Progression Factor	1.00		1.00	1.00	1.05	1.72
Incremental Delay, d2	19.4		0.1	0.0	0.2	0.2
Delay (s)	44.4		12.9	11.8	14.0	5.7
Level of Service	D		B	B	B	A
Approach Delay (s)	44.4			12.1	7.6	
Approach LOS	D			B	A	

Intersection Summary			
HCM 2000 Control Delay	19.7	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.66		
Actuated Cycle Length (s)	73.8	Sum of lost time (s)	22.0
Intersection Capacity Utilization	49.7%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	NBT	NBR	SBL	SBT	SWL	SWR
Lane Configurations						
Traffic Volume (vph)	0	0	1575	0	460	0
Future Volume (vph)	0	0	1575	0	460	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)			6.0		6.0	
Lane Util. Factor			0.97		0.97	
Frt			1.00		1.00	
Flt Protected			0.95		0.95	
Satd. Flow (prot)			3433		3433	
Flt Permitted			0.95		0.95	
Satd. Flow (perm)			3433		3433	
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	0	0	1676	0	489	0
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	1676	0	489	0
Turn Type			Prot		Prot	
Protected Phases			4		2	
Permitted Phases						
Actuated Green, G (s)			57.0		21.0	
Effective Green, g (s)			57.0		21.0	
Actuated g/C Ratio			0.63		0.23	
Clearance Time (s)			6.0		6.0	
Vehicle Extension (s)			3.0		3.0	
Lane Grp Cap (vph)			2174		801	
v/s Ratio Prot			c0.49		c0.14	
v/s Ratio Perm						
v/c Ratio			0.77		0.61	
Uniform Delay, d1			11.8		30.8	
Progression Factor			1.00		1.16	
Incremental Delay, d2			2.7		3.4	
Delay (s)			14.5		39.3	
Level of Service			B		D	
Approach Delay (s)	0.0			14.5	39.3	
Approach LOS	A			B	D	

Intersection Summary			
HCM 2000 Control Delay	20.1	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.73		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	122.3%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

Movement	SBL	SBR	NWL	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations										
Traffic Volume (vph)	0	0	0	255	0	1575	0	0	460	1225
Future Volume (vph)	0	0	0	255	0	1575	0	0	460	1225
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)			6.0	6.0		6.0			6.0	6.0
Lane Util. Factor			1.00	0.95		0.95			0.95	0.88
Frt			0.85	0.85		1.00			1.00	0.85
Flt Protected			1.00	1.00		1.00			1.00	1.00
Satd. Flow (prot)			1583	1504		3539			3539	2787
Flt Permitted			1.00	1.00		1.00			1.00	1.00
Satd. Flow (perm)			1583	1504		3539			3539	2787
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	0	0	0	271	0	1676	0	0	489	1303
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	102
Lane Group Flow (vph)	0	0	136	135	0	1676	0	0	489	1201
Turn Type			Prot	Prot	Perm	NA			NA	Perm
Protected Phases			4	4		2			2	
Permitted Phases					2					2
Actuated Green, G (s)			13.7	13.7		64.3			64.3	64.3
Effective Green, g (s)			13.7	13.7		64.3			64.3	64.3
Actuated g/C Ratio			0.15	0.15		0.71			0.71	0.71
Clearance Time (s)			6.0	6.0		6.0			6.0	6.0
Vehicle Extension (s)			3.0	3.0		3.0			3.0	3.0
Lane Grp Cap (vph)			240	228		2528			2528	1991
v/s Ratio Prot			0.09	c0.09		c0.47			0.14	
v/s Ratio Perm										0.43
v/c Ratio			0.57	0.59		0.66			0.19	0.60
Uniform Delay, d1			35.4	35.5		7.0			4.3	6.4
Progression Factor			1.00	1.00		0.43			1.00	1.00
Incremental Delay, d2			3.1	4.1		0.9			0.2	1.4
Delay (s)			38.4	39.6		3.9			4.4	7.8
Level of Service			D	D		A			A	A
Approach Delay (s)	0.0		39.0			3.9			6.9	
Approach LOS	A		D			A			A	

Intersection Summary			
HCM 2000 Control Delay	7.9	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.65		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	97.8%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	50	350	5	10	380	10	5	50	10	10	50	50
Future Volume (vph)	50	350	5	10	380	10	5	50	10	10	50	50
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	6.0
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00		1.00	1.00		1.00	0.97		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1770	1859		1770	1855		1770	1815		1770	1863	1583
Flt Permitted	0.30	1.00		0.48	1.00		0.72	1.00		0.71	1.00	1.00
Satd. Flow (perm)	553	1859		887	1855		1345	1815		1331	1863	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	54	380	5	11	413	11	5	54	11	11	54	54
RTOR Reduction (vph)	0	1	0	0	1	0	0	7	0	0	0	33
Lane Group Flow (vph)	54	384	0	11	423	0	5	58	0	11	54	21
Turn Type	pm+pt	NA		pm+pt	NA		Perm	NA		Perm	NA	pm+ov
Protected Phases	7	4		3	8			2			6	7
Permitted Phases	4			8			2			6		6
Actuated Green, G (s)	28.8	25.0		23.0	22.1		22.6	22.6		22.6	22.6	26.4
Effective Green, g (s)	28.8	25.0		23.0	22.1		22.6	22.6		22.6	22.6	26.4
Actuated g/C Ratio	0.43	0.38		0.35	0.33		0.34	0.34		0.34	0.34	0.40
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	309	698		318	616		457	616		452	633	771
v/s Ratio Prot	c0.01	c0.21		0.00	c0.23			c0.03			0.03	0.00
v/s Ratio Perm	0.07			0.01			0.00			0.01		0.01
v/c Ratio	0.17	0.55		0.03	0.69		0.01	0.09		0.02	0.09	0.03
Uniform Delay, d1	11.9	16.3		14.4	19.2		14.5	15.0		14.6	14.9	12.2
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	0.3	0.9		0.0	3.2		0.0	0.3		0.1	0.3	0.0
Delay (s)	12.2	17.3		14.4	22.4		14.6	15.3		14.7	15.2	12.2
Level of Service	B	B		B	C		B	B		B	B	B
Approach Delay (s)		16.6			22.2			15.2			13.8	
Approach LOS		B			C			B			B	

Intersection Summary				
HCM 2000 Control Delay	18.5	HCM 2000 Level of Service	B	
HCM 2000 Volume to Capacity ratio	0.37			
Actuated Cycle Length (s)	66.5	Sum of lost time (s)	18.0	
Intersection Capacity Utilization	47.0%	ICU Level of Service	A	
Analysis Period (min)	15			

c Critical Lane Group

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	255	0	215	385	0	195
Future Volume (vph)	255	0	215	385	0	195
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)		0	0		0	80
Storage Lanes		0	0		1	1
Taper Length (ft)			25		25	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt						0.850
Flt Protected				0.982		
Satd. Flow (prot)	1863	0	0	1829	1863	1583
Flt Permitted				0.982		
Satd. Flow (perm)	1863	0	0	1829	1863	1583
Link Speed (mph)	30			30	30	
Link Distance (ft)	354			472	168	
Travel Time (s)	8.0			10.7	3.8	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	277	0	234	418	0	212
Shared Lane Traffic (%)						
Lane Group Flow (vph)	277	0	0	652	0	212
Sign Control	Free			Free	Stop	

Intersection Summary

Area Type: Other
Control Type: Unsignalized
Intersection Capacity Utilization 52.2% ICU Level of Service A
Analysis Period (min) 15

Intersection	
Int Delay, s/veh	3.9

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	255	0	215	385	0	195
Future Vol, veh/h	255	0	215	385	0	195
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	80
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	277	0	234	418	0	212

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	277	0	1163	277
Stage 1	-	-	-	-	277	-
Stage 2	-	-	-	-	886	-
Critical Hdwy	-	-	4.12	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	1286	-	215	762
Stage 1	-	-	-	-	770	-
Stage 2	-	-	-	-	403	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1286	-	164	762
Mov Cap-2 Maneuver	-	-	-	-	164	-
Stage 1	-	-	-	-	588	-
Stage 2	-	-	-	-	403	-

Approach	EB	WB	NB
HCM Control Delay, s	0	3	11.5
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	-	762	-	-	1286	-
HCM Lane V/C Ratio	-	0.278	-	-	0.182	-
HCM Control Delay (s)	0	11.5	-	-	8.4	0
HCM Lane LOS	A	B	-	-	A	A
HCM 95th %tile Q(veh)	-	1.1	-	-	0.7	-

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↰	↑↑	↑↑	↱	↰	↱
Traffic Volume (vph)	55	1775	1590	220	90	95
Future Volume (vph)	55	1775	1590	220	90	95
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	0.95	0.95	1.00	1.00	1.00
Frt	1.00	1.00	1.00	0.85	1.00	0.85
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	3539	3539	1583	1770	1583
Flt Permitted	0.08	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	144	3539	3539	1583	1770	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	60	1929	1728	239	98	103
RTOR Reduction (vph)	0	0	0	69	0	20
Lane Group Flow (vph)	60	1929	1728	170	98	83
Turn Type	pm+pt	NA	NA	pm+ov	Prot	pm+ov
Protected Phases	5	2	6	4	4	5
Permitted Phases	2			6		4
Actuated Green, G (s)	55.5	55.5	45.8	53.4	7.6	11.3
Effective Green, g (s)	55.5	55.5	45.8	53.4	7.6	11.3
Actuated g/C Ratio	0.74	0.74	0.61	0.71	0.10	0.15
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	186	2615	2158	1252	179	364
v/s Ratio Prot	0.02	c0.55	c0.49	0.01	c0.06	0.01
v/s Ratio Perm	0.22			0.09		0.04
v/c Ratio	0.32	0.74	0.80	0.14	0.55	0.23
Uniform Delay, d1	9.9	5.6	11.2	3.5	32.1	28.1
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.0	1.1	2.2	0.0	3.4	0.3
Delay (s)	10.9	6.7	13.4	3.5	35.5	28.4
Level of Service	B	A	B	A	D	C
Approach Delay (s)		6.9	12.2		31.9	
Approach LOS		A	B		C	

Intersection Summary			
HCM 2000 Control Delay	10.6	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.81		
Actuated Cycle Length (s)	75.1	Sum of lost time (s)	18.0
Intersection Capacity Utilization	64.1%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	Y		↑	↱	↰	↑
Traffic Volume (vph)	70	10	460	50	10	680
Future Volume (vph)	70	10	460	50	10	680
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0		4.0	4.0	6.0	4.0
Lane Util. Factor	1.00		1.00	1.00	1.00	1.00
Frt	0.98		1.00	0.85	1.00	1.00
Flt Protected	0.96		1.00	1.00	0.95	1.00
Satd. Flow (prot)	1769		1900	1615	1805	1900
Flt Permitted	0.96		1.00	1.00	0.26	1.00
Satd. Flow (perm)	1769		1900	1615	488	1900
Peak-hour factor, PHF	0.87	0.67	0.95	0.84	0.73	0.96
Adj. Flow (vph)	80	15	484	60	14	708
RTOR Reduction (vph)	8	0	0	25	0	0
Lane Group Flow (vph)	87	0	484	35	14	708
Heavy Vehicles (%)	1%	0%	0%	0%	0%	0%
Turn Type	Prot		NA	Perm	custom	NA
Protected Phases	7		6 8		5	2 8
Permitted Phases				6 8	2	
Actuated Green, G (s)	11.6		39.4	39.4	17.4	38.6
Effective Green, g (s)	11.6		39.4	39.4	17.4	38.6
Actuated g/C Ratio	0.16		0.53	0.53	0.24	0.52
Clearance Time (s)	6.0				6.0	
Vehicle Extension (s)	3.0				3.0	
Lane Grp Cap (vph)	278		1014	862	129	993
v/s Ratio Prot	c0.05		0.25		c0.00	c0.37
v/s Ratio Perm				0.02	0.02	
v/c Ratio	0.31		0.48	0.04	0.11	0.71
Uniform Delay, d1	27.6		10.8	8.2	22.1	13.4
Progression Factor	1.00		0.53	0.42	1.00	1.00
Incremental Delay, d2	0.7		0.2	0.0	0.4	2.4
Delay (s)	28.2		5.9	3.4	22.5	15.8
Level of Service	C		A	A	C	B
Approach Delay (s)	28.2		5.6			16.0
Approach LOS	C		A			B

Intersection Summary			
HCM 2000 Control Delay	12.7	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.60		
Actuated Cycle Length (s)	73.8	Sum of lost time (s)	22.0
Intersection Capacity Utilization	48.6%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	5	30	20	450	660	20
Future Volume (vph)	5	30	20	450	660	20
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0	0	100			0
Storage Lanes	1	0	1			0
Taper Length (ft)	25		25			
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.888				0.995	
Flt Protected	0.992		0.950			
Satd. Flow (prot)	1674	0	1787	1900	1873	0
Flt Permitted	0.992		0.950			
Satd. Flow (perm)	1674	0	1787	1900	1873	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	332			288	365	
Travel Time (s)	7.5			6.5	8.3	
Peak Hour Factor	0.64	0.77	0.71	0.90	0.75	0.55
Heavy Vehicles (%)	0%	0%	1%	0%	1%	0%
Adj. Flow (vph)	8	39	28	500	880	36
Shared Lane Traffic (%)						
Lane Group Flow (vph)	47	0	28	500	916	0
Sign Control	Stop			Free	Free	

Intersection Summary	
Area Type:	Other
Control Type: Unsignalized	
Intersection Capacity Utilization 45.9%	ICU Level of Service A
Analysis Period (min) 15	

Intersection						
Int Delay, s/veh	0.8					

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	Y		↰	↑	↱	
Traffic Vol, veh/h	5	30	20	450	660	20
Future Vol, veh/h	5	30	20	450	660	20
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	100	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	64	77	71	90	75	55
Heavy Vehicles, %	0	0	1	0	1	0
Mvmt Flow	8	39	28	500	880	36

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1454	898	916	0	-	0
Stage 1	898	-	-	-	-	-
Stage 2	556	-	-	-	-	-
Critical Hdwy	6.4	6.2	4.11	-	-	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.3	2.209	-	-	-
Pot Cap-1 Maneuver	145	341	749	-	-	-
Stage 1	401	-	-	-	-	-
Stage 2	578	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	140	341	749	-	-	-
Mov Cap-2 Maneuver	140	-	-	-	-	-
Stage 1	386	-	-	-	-	-
Stage 2	578	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	20.8	0.5	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	749	-	275	-	-
HCM Lane V/C Ratio	0.038	-	0.17	-	-
HCM Control Delay (s)	10	-	20.8	-	-
HCM Lane LOS	A	-	C	-	-
HCM 95th %tile Q(veh)	0.1	-	0.6	-	-

APPENDIX Q-3: ALTERNATIVE C INTERSECTION CAPACITY ANALYSES – SYNCHRO PRINTSOUTS – AM PEAK HOUR

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑↑		↰	↱↱
Traffic Volume (vph)	0	1345	715	0	115	1010
Future Volume (vph)	0	1345	715	0	115	1010
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	16	12
Lane Util. Factor	1.00	0.95	0.95	1.00	1.00	0.88
Frt						0.850
Flt Protected					0.950	
Satd. Flow (prot)	0	3471	3406	0	1930	2682
Flt Permitted					0.950	
Satd. Flow (perm)	0	3471	3406	0	1930	2682
Right Turn on Red				Yes		No
Satd. Flow (RTOR)						
Link Speed (mph)		30	30		25	
Link Distance (ft)		712	388		212	
Travel Time (s)		16.2	8.8		5.8	
Peak Hour Factor	0.93	0.93	0.88	0.88	0.89	0.89
Heavy Vehicles (%)	4%	4%	6%	6%	6%	6%
Adj. Flow (vph)	0	1446	813	0	129	1135
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	1446	813	0	129	1135
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(ft)		24	24		16	
Link Offset(ft)		0	0		0	
Crosswalk Width(ft)		16	16		16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	0.85	1.00
Turning Speed (mph)	15			9	15	9
Number of Detectors		3	3		3	3
Detector Template		Thru	Thru		Left	
Leading Detector (ft)		256	256		256	256
Trailing Detector (ft)		-5	-5		-5	-5
Detector 1 Position(ft)		-5	-5		-5	-5
Detector 1 Size(ft)		50	50		50	50
Detector 1 Type		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex
Detector 1 Channel						
Detector 1 Extend (s)		0.0	0.0		0.0	0.0
Detector 1 Queue (s)		0.0	0.0		0.0	0.0
Detector 1 Delay (s)		0.0	0.0		0.0	0.0
Detector 2 Position(ft)		125	125		125	125
Detector 2 Size(ft)		6	6		6	6
Detector 2 Type		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex
Detector 2 Channel						
Detector 2 Extend (s)		0.0	0.0		0.0	0.0
Detector 3 Position(ft)		250	250		250	250
Detector 3 Size(ft)		6	6		6	6
Detector 3 Type		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex
Detector 3 Channel						

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Detector 3 Extend (s)		0.0	0.0		0.0	0.0
Turn Type		NA	NA		Prot	Prot
Protected Phases		2	6		4	4
Permitted Phases						
Detector Phase		2	6		4	4
Switch Phase						
Minimum Initial (s)		8.0	8.0		5.0	5.0
Minimum Split (s)		14.0	21.0		27.0	27.0
Total Split (s)		38.0	38.0		37.0	37.0
Total Split (%)		50.7%	50.7%		49.3%	49.3%
Maximum Green (s)		32.0	32.0		31.0	31.0
Yellow Time (s)		2.0	2.0		2.0	2.0
All-Red Time (s)		4.0	4.0		4.0	4.0
Lost Time Adjust (s)		0.0	0.0		0.0	0.0
Total Lost Time (s)		6.0	6.0		6.0	6.0
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)		3.0	3.0		3.0	3.0
Recall Mode		C-Min	C-Min		None	None
Walk Time (s)			7.0		7.0	7.0
Flash Dont Walk (s)			8.0		14.0	14.0
Pedestrian Calls (#/hr)			0		0	0
Act Effct Green (s)		32.0	32.0		31.0	31.0
Actuated g/C Ratio		0.43	0.43		0.41	0.41
v/c Ratio		0.98	0.56		0.16	1.02
Control Delay		33.0	20.1		14.6	57.4
Queue Delay		0.0	0.0		0.0	0.0
Total Delay		33.0	20.1		14.6	57.4
LOS		C	C		B	E
Approach Delay		33.0	20.1		53.1	
Approach LOS		C	C		D	
Queue Length 50th (ft)		334	385		37	~307
Queue Length 95th (ft)		m#453	m376		69	#447
Internal Link Dist (ft)		632	308		132	
Turn Bay Length (ft)						
Base Capacity (vph)		1480	1453		797	1108
Starvation Cap Reductn		0	0		0	0
Spillback Cap Reductn		0	0		0	0
Storage Cap Reductn		0	0		0	0
Reduced v/c Ratio		0.98	0.56		0.16	1.02

Intersection Summary

Area Type: Other
Cycle Length: 75
Actuated Cycle Length: 75
Offset: 0 (0%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow, Master Intersection
Natural Cycle: 90
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 1.02

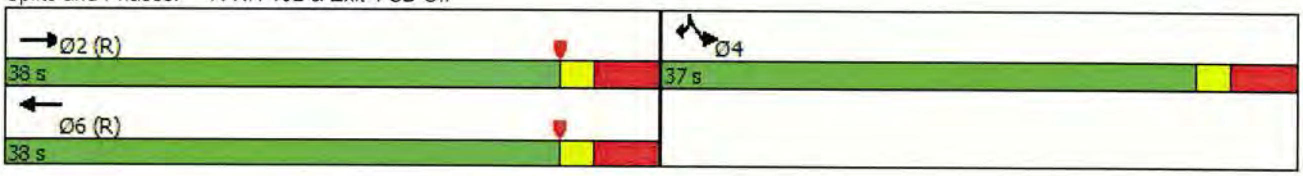
Intersection Signal Delay: 37.2 | Intersection LOS: D
Intersection Capacity Utilization 67.1% | ICU Level of Service C
Analysis Period (min) 15

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 7: NH 102 & Exit 4 SB Off



Lane Group	NBL2	NBL	NBR	SEL	SER	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations											
Traffic Volume (vph)	455	0	300	0	0	1350	110	0	0	990	375
Future Volume (vph)	455	0	300	0	0	1350	110	0	0	990	375
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)		0	0	0	0	550		0	0		0
Storage Lanes		2	2	0	0	2		0	0		1
Taper Length (ft)		25		25		25			25		
Lane Util. Factor	0.97	1.00	0.88	1.00	1.00	0.97	0.95	1.00	1.00	0.95	1.00
Frt			0.850								0.850
Flt Protected	0.950					0.950					
Satd. Flow (prot)	3242	0	2632	0	0	3335	3438	0	0	3505	1568
Flt Permitted	0.950					0.950					
Satd. Flow (perm)	3242	0	2632	0	0	3335	3438	0	0	3505	1568
Right Turn on Red			No					Yes			Yes
Satd. Flow (RTOR)											190
Link Speed (mph)		25		30			30			30	
Link Distance (ft)		856		390			760			857	
Travel Time (s)		23.3		8.9			17.3			19.5	
Peak Hour Factor	0.88	0.88	0.88	0.92	0.92	0.94	0.94	0.94	0.92	0.92	0.92
Heavy Vehicles (%)	8%	8%	8%	2%	2%	5%	5%	5%	3%	3%	3%
Adj. Flow (vph)	517	0	341	0	0	1436	117	0	0	1076	408
Shared Lane Traffic (%)											
Lane Group Flow (vph)	517	0	341	0	0	1436	117	0	0	1076	408
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Right	Left	Left	Right	Left	Right	Right
Median Width(ft)		24		0			24			24	
Link Offset(ft)		12		0			0			0	
Crosswalk Width(ft)		16		16			16			16	
Two way Left Turn Lane											
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15	15	25	15	9	15		9	15		25
Number of Detectors	3		3			3	3			3	0
Detector Template											
Leading Detector (ft)	256		256			256	256			256	0
Trailing Detector (ft)	-5		-5			-5	-5			-5	0
Detector 1 Position(ft)	-5		-5			-5	-5			-5	-5
Detector 1 Size(ft)	55		55			55	55			55	50
Detector 1 Type	Cl+Ex		Cl+Ex			Cl+Ex	Cl+Ex			Cl+Ex	Cl+Ex
Detector 1 Channel											
Detector 1 Extend (s)	0.0		0.0			0.0	0.0			0.0	0.0
Detector 1 Queue (s)	0.0		0.0			0.0	0.0			0.0	0.0
Detector 1 Delay (s)	0.0		0.0			0.0	0.0			0.0	0.0
Detector 2 Position(ft)	125		125			125	125			125	
Detector 2 Size(ft)	6		6			6	6			6	
Detector 2 Type	Cl+Ex		Cl+Ex			Cl+Ex	Cl+Ex			Cl+Ex	
Detector 2 Channel											
Detector 2 Extend (s)	0.0		0.0			0.0	0.0			0.0	
Detector 3 Position(ft)	250		250			250	250			250	
Detector 3 Size(ft)	6		6			6	6			6	

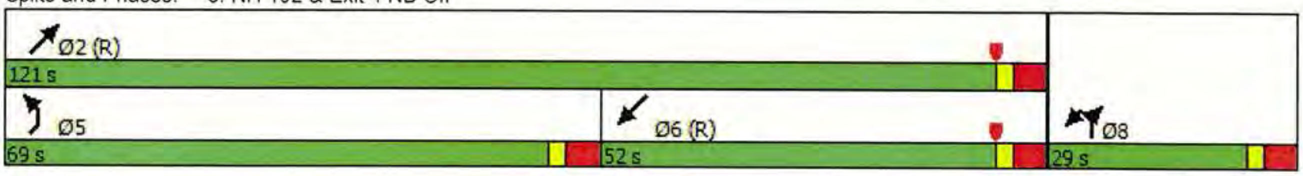
Lane Group	NBL2	NBL	NBR	SEL	SER	NEL	NET	NER	SWL	SWT	SWR
Detector 3 Type	Cl+Ex		Cl+Ex			Cl+Ex	Cl+Ex			Cl+Ex	
Detector 3 Channel											
Detector 3 Extend (s)	0.0		0.0			0.0	0.0			0.0	
Turn Type	Prot		Prot			Prot	NA			NA	Free
Protected Phases	8		8			5	2			6	
Permitted Phases											Free
Detector Phase	8		2			5	2			6	
Switch Phase											
Minimum Initial (s)	10.0		10.0			5.0	8.0			8.0	
Minimum Split (s)	16.0		16.0			11.0	42.0			31.0	
Total Split (s)	29.0		29.0			69.0	121.0			52.0	
Total Split (%)	19.3%		19.3%			46.0%	80.7%			34.7%	
Maximum Green (s)	23.0		23.0			63.0	115.0			46.0	
Yellow Time (s)	2.0		2.0			2.0	2.0			2.0	
All-Red Time (s)	4.0		4.0			4.0	4.0			4.0	
Lost Time Adjust (s)	0.0		0.0			0.0	0.0			0.0	
Total Lost Time (s)	6.0		6.0			6.0	6.0			6.0	
Lead/Lag						Lead				Lag	
Lead-Lag Optimize?											
Vehicle Extension (s)	3.0		3.0			3.0	3.0			3.0	
Recall Mode	None		None			None	C-Min			C-Min	
Walk Time (s)							7.0			7.0	
Flash Dont Walk (s)							29.0			17.0	
Pedestrian Calls (#/hr)							0			0	
Act Effct Green (s)	23.0		23.0			63.0	115.0			46.0	150.0
Actuated g/C Ratio	0.15		0.15			0.42	0.77			0.31	1.00
v/c Ratio	1.04		0.85			1.03	0.04			1.00	0.26
Control Delay	111.4		81.0			49.1	8.1			79.3	0.4
Queue Delay	0.0		0.0			0.0	0.0			0.0	0.0
Total Delay	111.4		81.0			49.1	8.1			79.3	0.4
LOS	F		F			D	A			E	A
Approach Delay		99.3					46.0			57.6	
Approach LOS		F					D			E	
Queue Length 50th (ft)	~280		186			~434	21			~557	0
Queue Length 95th (ft)	#384		#264			m#791	m23			#713	0
Internal Link Dist (ft)		776		310			680			777	
Turn Bay Length (ft)						550					
Base Capacity (vph)	497		403			1400	2635			1074	1568
Starvation Cap Reductn	0		0			0	0			0	0
Spillback Cap Reductn	0		0			0	0			0	0
Storage Cap Reductn	0		0			0	0			0	0
Reduced v/c Ratio	1.04		0.85			1.03	0.04			1.00	0.26

Intersection Summary

Area Type: Other
Cycle Length: 150
Actuated Cycle Length: 150
Offset: 3 (2%), Referenced to phase 2:NET and 6:SWT, Start of Yellow
Natural Cycle: 140

Control Type: Actuated-Coordinated
Maximum v/c Ratio: 1.04
Intersection Signal Delay: 62.1 Intersection LOS: E
Intersection Capacity Utilization 94.9% ICU Level of Service F
Analysis Period (min) 15
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 8: NH 102 & Exit 4 NB Off



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑	↱	↰	↑↑					↰↰		↱
Traffic Volume (vph)	0	575	470	280	730	0	0	0	0	105	0	360
Future Volume (vph)	0	575	470	280	730	0	0	0	0	105	0	360
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		350	0		0	0		0	0		0
Storage Lanes	0		1	1		0	0		0	2		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	0.97	1.00	1.00
Frt			0.850									0.850
Flt Protected				0.950						0.950		
Satd. Flow (prot)	0	3167	1417	1687	3374	0	0	0	0	3303	0	1524
Flt Permitted				0.950						0.950		
Satd. Flow (perm)	0	3167	1417	1687	3374	0	0	0	0	3303	0	1524
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			511									112
Link Speed (mph)		30			30			30			35	
Link Distance (ft)		851			693			486			581	
Travel Time (s)		19.3			15.8			11.0			11.3	
Peak Hour Factor	0.92	0.92	0.92	0.73	0.73	0.73	0.92	0.92	0.92	0.74	0.74	0.74
Heavy Vehicles (%)	14%	14%	14%	7%	7%	7%	2%	2%	2%	6%	6%	6%
Adj. Flow (vph)	0	625	511	384	1000	0	0	0	0	142	0	486
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	625	511	384	1000	0	0	0	0	142	0	486
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Right	Right	Left	Left	Right	Left	Left	Right	R NA	Left	Right
Median Width(ft)		36			36			24			24	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		25	15		9	15		9	15		9
Number of Detectors		3	2	3	3					3		2
Detector Template		Thru	Right	Left	Thru					Left		
Leading Detector (ft)		256	131	256	256					256		206
Trailing Detector (ft)		-5	-5	-5	-5					-5		-5
Detector 1 Position(ft)		-5	-5	-5	-5					-5		-5
Detector 1 Size(ft)		50	50	50	50					50		50
Detector 1 Type		Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex					Cl+Ex		Cl+Ex
Detector 1 Channel												
Detector 1 Extend (s)		0.0	0.0	0.0	0.0					0.0		0.0
Detector 1 Queue (s)		0.0	0.0	0.0	0.0					0.0		0.0
Detector 1 Delay (s)		0.0	0.0	0.0	0.0					0.0		0.0
Detector 2 Position(ft)		125	125	125	125					125		200
Detector 2 Size(ft)		6	6	6	6					6		6
Detector 2 Type		Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex					Cl+Ex		Cl+Ex
Detector 2 Channel												
Detector 2 Extend (s)		0.0	0.0	0.0	0.0					0.0		0.0
Detector 3 Position(ft)		250		250	250					250		
Detector 3 Size(ft)		6		6	6					6		

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Detector 3 Type		Cl+Ex		Cl+Ex	Cl+Ex					Cl+Ex		
Detector 3 Channel												
Detector 3 Extend (s)		0.0		0.0	0.0					0.0		
Turn Type		NA	Free	Prot	NA					Prot		Prot
Protected Phases		2		1	6					4		4
Permitted Phases			Free									
Detector Phase		2		1	6					4		4
Switch Phase												
Minimum Initial (s)		9.0		4.0	9.0					4.0		4.0
Minimum Split (s)		21.0		10.0	21.0					10.0		10.0
Total Split (s)		34.0		36.0	70.0					40.0		40.0
Total Split (%)		30.9%		32.7%	63.6%					36.4%		36.4%
Maximum Green (s)		28.0		30.0	64.0					34.0		34.0
Yellow Time (s)		4.0		4.0	4.0					4.0		4.0
All-Red Time (s)		2.0		2.0	2.0					2.0		2.0
Lost Time Adjust (s)		0.0		0.0	0.0					0.0		0.0
Total Lost Time (s)		6.0		6.0	6.0					6.0		6.0
Lead/Lag		Lag		Lead								
Lead-Lag Optimize?												
Vehicle Extension (s)		5.0		3.0	5.0					3.0		3.0
Recall Mode		C-Min		None	C-Min					None		None
Walk Time (s)		7.0			7.0							
Flash Dont Walk (s)		8.0			8.0							
Pedestrian Calls (#/hr)		0			0							
Act Effct Green (s)		31.7	110.0	28.1	65.7					32.3		32.3
Actuated g/C Ratio		0.29	1.00	0.26	0.60					0.29		0.29
v/c Ratio		0.69	0.36	0.89	0.50					0.15		0.92
Control Delay		40.6	0.7	35.2	1.8					28.5		53.7
Queue Delay		0.0	0.0	0.0	0.0					0.0		0.0
Total Delay		40.6	0.7	35.2	1.8					28.5		53.7
LOS		D	A	D	A					C		D
Approach Delay		22.7			11.0						48.0	
Approach LOS		C			B						D	
Queue Length 50th (ft)		216	0	47	16					37		260
Queue Length 95th (ft)		284	0	m40	13					50		287
Internal Link Dist (ft)		771			613			406			501	
Turn Bay Length (ft)			350									
Base Capacity (vph)		912	1417	460	2016					1020		548
Starvation Cap Reductn		0	0	0	0					0		0
Spillback Cap Reductn		0	0	0	0					0		0
Storage Cap Reductn		0	0	0	0					0		0
Reduced v/c Ratio		0.69	0.36	0.83	0.50					0.14		0.89

Intersection Summary

Area Type: Other

Cycle Length: 110

Actuated Cycle Length: 110

Offset: 58 (53%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow

Natural Cycle: 70

Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.92
Intersection Signal Delay: 22.6 Intersection LOS: C
Intersection Capacity Utilization 71.3% ICU Level of Service C
Analysis Period (min) 15
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 2: Exit 5 SB On/Exit 5 SB Off & NH 28

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑			↑↑	↱	↰		↱			
Traffic Volume (vph)	480	200	0	0	595	340	415	0	160	0	0	0
Future Volume (vph)	480	200	0	0	595	340	415	0	160	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt						0.850			0.850			
Flt Protected	0.950						0.950					
Satd. Flow (prot)	1641	3282	0	0	3438	1538	1656	0	1482	0	0	0
Flt Permitted	0.950						0.950					
Satd. Flow (perm)	1641	3282	0	0	3438	1538	1656	0	1482	0	0	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						378			201			
Link Speed (mph)		30			30			35			30	
Link Distance (ft)		693			542			867			392	
Travel Time (s)		15.8			12.3			16.9			8.9	
Peak Hour Factor	0.87	0.87	0.87	0.90	0.90	0.90	0.78	0.78	0.78	0.92	0.92	0.92
Heavy Vehicles (%)	10%	10%	10%	5%	5%	5%	9%	9%	9%	2%	2%	2%
Adj. Flow (vph)	552	230	0	0	661	378	532	0	205	0	0	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	552	230	0	0	661	378	532	0	205	0	0	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Right	Right	Right	Left	Right	Left	Left	Right
Median Width(ft)		36			42			12			12	
Link Offset(ft)		0			0			0			36	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		25	15		9	15		9
Number of Detectors	3	3			3	2	3		0			
Detector Template	Left	Thru			Thru	Right	Left					
Leading Detector (ft)	256	256			256	131	256		0			
Trailing Detector (ft)	-5	-5			-5	-5	-5		0			
Detector 1 Position(ft)	-5	-5			-5	-5	-5		-5			
Detector 1 Size(ft)	50	50			50	50	50		50			
Detector 1 Type	Cl+Ex	Cl+Ex			Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex			
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0			0.0	0.0	0.0		0.0			
Detector 1 Queue (s)	0.0	0.0			0.0	0.0	0.0		0.0			
Detector 1 Delay (s)	0.0	0.0			0.0	0.0	0.0		0.0			
Detector 2 Position(ft)	125	125			125	125	125					
Detector 2 Size(ft)	6	6			6	6	6					
Detector 2 Type	Cl+Ex	Cl+Ex			Cl+Ex	Cl+Ex	Cl+Ex					
Detector 2 Channel												
Detector 2 Extend (s)	0.0	0.0			0.0	0.0	0.0					
Detector 3 Position(ft)	250	250			250		250					
Detector 3 Size(ft)	6	6			6		6					
Detector 3 Type	Cl+Ex	Cl+Ex			Cl+Ex		Cl+Ex					
Detector 3 Channel												
Detector 3 Extend (s)	0.0	0.0			0.0		0.0					

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Type	Prot	NA			NA	Free	Prot		Prot			
Protected Phases	5	2			6		8		8			
Permitted Phases		2			6	Free						
Detector Phase	5	2			6		8		8			
Switch Phase												
Minimum Initial (s)	4.0	16.0			16.0		4.0		4.0			
Minimum Split (s)	10.0	23.0			23.0		10.0		10.0			
Total Split (s)	42.0	70.0			28.0		40.0		40.0			
Total Split (%)	38.2%	63.6%			25.5%		36.4%		36.4%			
Maximum Green (s)	36.0	64.0			22.0		34.0		34.0			
Yellow Time (s)	4.0	4.0			4.0		4.0		4.0			
All-Red Time (s)	2.0	2.0			2.0		2.0		2.0			
Lost Time Adjust (s)	0.0	0.0			0.0		0.0		0.0			
Total Lost Time (s)	6.0	6.0			6.0		6.0		6.0			
Lead/Lag	Lead				Lag							
Lead-Lag Optimize?												
Vehicle Extension (s)	5.0	5.0			5.0		3.0		3.0			
Recall Mode	None	C-Min			C-Min		None		None			
Walk Time (s)		7.0			7.0							
Flash Dont Walk (s)		10.0			10.0							
Pedestrian Calls (#/hr)		0			0							
Act Effct Green (s)	36.0	64.0			22.0	110.0	34.0		34.0			
Actuated g/C Ratio	0.33	0.58			0.20	1.00	0.31		0.31			
v/c Ratio	1.03	0.12			0.96	0.25	1.04		0.34			
Control Delay	54.7	1.6			70.4	0.4	88.9		6.0			
Queue Delay	0.0	0.0			0.0	0.0	0.0		0.0			
Total Delay	54.7	1.6			70.4	0.4	88.9		6.0			
LOS	D	A			E	A	F		A			
Approach Delay		39.1			44.9			65.9				
Approach LOS		D			D			E				
Queue Length 50th (ft)	~412	2			245	0	~407		2			
Queue Length 95th (ft)	#569	3			#363	0	#483		33			
Internal Link Dist (ft)		613			462			787			312	
Turn Bay Length (ft)												
Base Capacity (vph)	537	1909			687	1538	511		596			
Starvation Cap Reductn	0	0			0	0	0		0			
Spillback Cap Reductn	0	0			0	0	0		0			
Storage Cap Reductn	0	0			0	0	0		0			
Reduced v/c Ratio	1.03	0.12			0.96	0.25	1.04		0.34			

Intersection Summary

Area Type: Other

Cycle Length: 110

Actuated Cycle Length: 110

Offset: 0 (0%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow, Master Intersection

Natural Cycle: 110

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 1.04

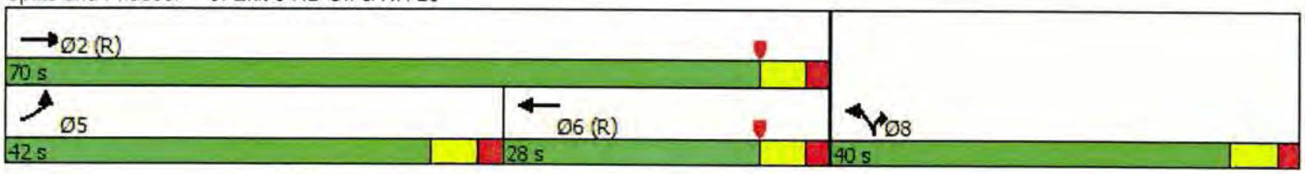
Intersection Signal Delay: 49.2 Intersection LOS: D

Intersection Capacity Utilization 71.3% ICU Level of Service C
Analysis Period (min) 15

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 3: Exit 5 NB Off & NH 28



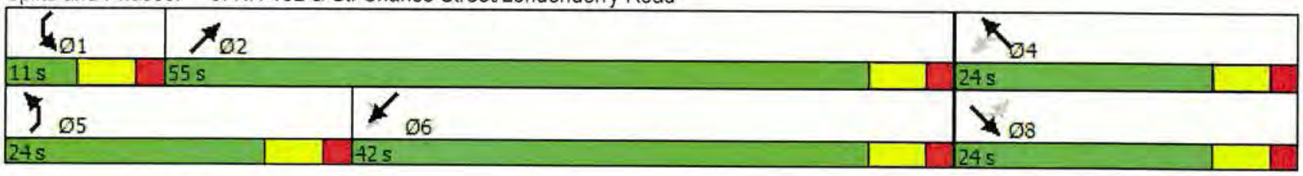
Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	10	0	170	0	0	0	100	450	5	5	1010	40
Future Volume (vph)	10	0	170	0	0	0	100	450	5	5	1010	40
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		225	0		0	350		0	100		0
Storage Lanes	0		1	0		0	1		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00	0.95	0.95
Frt			0.850					0.998			0.994	
Flt Protected		0.950					0.950			0.950		
Satd. Flow (prot)	0	1770	1583	0	1900	0	1770	3532	0	1770	3518	0
Flt Permitted							0.950			0.950		
Satd. Flow (perm)	0	1863	1583	0	1900	0	1770	3532	0	1770	3518	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			185					2			5	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		593			447			750			330	
Travel Time (s)		13.5			10.2			17.0			7.5	
Peak Hour Factor	0.92	0.92	0.92	0.25	0.25	0.25	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	2%	2%	2%	0%	0%	0%	2%	2%	2%	2%	2%	2%
Adj. Flow (vph)	11	0	185	0	0	0	109	489	5	5	1098	43
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	11	185	0	0	0	109	494	0	5	1141	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	3	3	1	3	1		3	3		3	3	
Detector Template	Left	Thru	Right	Left			Left	Thru		Left	Thru	
Leading Detector (ft)	256	256	45	256	45		256	256		256	256	
Trailing Detector (ft)	-5	-5	-5	-5	-5		-5	-5		-5	-5	
Detector 1 Position(ft)	-5	-5	-5	-5	-5		-5	-5		-5	-5	
Detector 1 Size(ft)	50	50	50	50	50		50	50		50	50	
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(ft)	125	125		125			125	125		125	125	
Detector 2 Size(ft)	6	6		6			6	6		6	6	
Detector 2 Type	Cl+Ex	Cl+Ex		Cl+Ex			Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)	0.0	0.0		0.0			0.0	0.0		0.0	0.0	
Detector 3 Position(ft)	250	250		250			250	250		250	250	
Detector 3 Size(ft)	6	6		6			6	6		6	6	

Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Detector 3 Type	Cl+Ex	Cl+Ex		Cl+Ex			Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 3 Channel												
Detector 3 Extend (s)	0.0	0.0		0.0			0.0	0.0		0.0	0.0	
Turn Type	Perm	NA	custom				Prot	NA		Prot	NA	
Protected Phases		8			4		5	2		1	6	
Permitted Phases	8		6	4								
Detector Phase	8	8	6	4	4		5	2		1	6	
Switch Phase												
Minimum Initial (s)	5.0	5.0	8.0	5.0	5.0		5.0	8.0		5.0	8.0	
Minimum Split (s)	24.0	24.0	24.0	24.0	24.0		24.0	24.0		11.0	24.0	
Total Split (s)	24.0	24.0	42.0	24.0	24.0		24.0	55.0		11.0	42.0	
Total Split (%)	26.7%	26.7%	46.7%	26.7%	26.7%		26.7%	61.1%		12.2%	46.7%	
Maximum Green (s)	18.0	18.0	36.0	18.0	18.0		18.0	49.0		5.0	36.0	
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)		0.0	0.0		0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)		6.0	6.0		6.0		6.0	6.0		6.0	6.0	
Lead/Lag			Lag				Lead	Lag		Lead	Lag	
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None	Min	None	None		None	Min		None	Min	
Walk Time (s)	7.0	7.0	7.0	7.0	7.0		7.0	7.0			7.0	
Flash Dont Walk (s)	11.0	11.0	11.0	11.0	11.0		11.0	11.0			11.0	
Pedestrian Calls (#/hr)	0	0	0	0	0		0	0			0	
Act Effct Green (s)		6.3	41.9				9.4	55.9		5.2	41.9	
Actuated g/C Ratio		0.10	0.69				0.15	0.92		0.09	0.69	
v/c Ratio		0.06	0.16				0.40	0.15		0.03	0.47	
Control Delay		27.8	2.1				29.5	2.3		29.6	8.4	
Queue Delay		0.0	0.0				0.0	0.0		0.0	0.0	
Total Delay		27.8	2.1				29.5	2.3		29.6	8.4	
LOS		C	A				C	A		C	A	
Approach Delay		3.5						7.2			8.5	
Approach LOS		A						A			A	
Queue Length 50th (ft)		3	0				34	0		2	91	
Queue Length 95th (ft)		19	30				89	74		13	270	
Internal Link Dist (ft)		513			367			670			250	
Turn Bay Length (ft)			225				350			100		
Base Capacity (vph)		568	1147				540	3288		150	2424	
Starvation Cap Reductn		0	0				0	0		0	0	
Spillback Cap Reductn		0	0				0	0		0	0	
Storage Cap Reductn		0	0				0	0		0	0	
Reduced v/c Ratio		0.02	0.16				0.20	0.15		0.03	0.47	

Intersection Summary	
Area Type:	Other
Cycle Length: 90	
Actuated Cycle Length: 60.9	
Natural Cycle: 80	
Control Type: Actuated-Uncoordinated	

Maximum v/c Ratio: 0.47
Intersection Signal Delay: 7.6 Intersection LOS: A
Intersection Capacity Utilization 57.7% ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 9: NH 102 & St. Charles Street/Londonderry Road



Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	10	10	10	360	0	40	0	380	110	15	525	0
Future Volume (vph)	10	10	10	360	0	40	0	380	110	15	525	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.955			0.986			0.970				
Flt Protected		0.984			0.957						0.999	
Satd. Flow (prot)	0	1750	0	0	1741	0	0	1706	0	0	1808	0
Flt Permitted		0.844			0.711						0.980	
Satd. Flow (perm)	0	1501	0	0	1293	0	0	1706	0	0	1773	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		17			36			22				
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		356			493			1124			603	
Travel Time (s)		8.1			11.2			25.5			13.7	
Peak Hour Factor	0.60	0.60	0.60	0.96	0.96	0.96	0.89	0.89	0.89	0.86	0.86	0.86
Heavy Vehicles (%)	2%	2%	2%	3%	3%	3%	8%	8%	8%	5%	5%	5%
Adj. Flow (vph)	17	17	17	375	0	42	0	427	124	17	610	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	51	0	0	417	0	0	551	0	0	627	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0			0	
Link Offset(ft)		-22			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	3	1		3	2			2		3	2	
Detector Template	Left			Left						Left		
Leading Detector (ft)	256	45		256	131			131		256	131	
Trailing Detector (ft)	-5	-5		-5	-5			-5		-5	-5	
Detector 1 Position(ft)	-5	-5		-5	-5			-5		-5	-5	
Detector 1 Size(ft)	50	50		50	50			50		50	50	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex			Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0			0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0			0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0			0.0		0.0	0.0	
Detector 2 Position(ft)	125			125	125			125		125	125	
Detector 2 Size(ft)	6			6	6			6		6	6	
Detector 2 Type	Cl+Ex			Cl+Ex	Cl+Ex			Cl+Ex		Cl+Ex	Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)	0.0			0.0	0.0			0.0		0.0	0.0	
Detector 3 Position(ft)	250			250						250		
Detector 3 Size(ft)	6			6						6		
Detector 3 Type	Cl+Ex			Cl+Ex						Cl+Ex		
Detector 3 Channel												
Detector 3 Extend (s)	0.0			0.0						0.0		

Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Turn Type	Perm	NA		Perm	NA			NA		Perm	NA	
Protected Phases		4			4			2			2	
Permitted Phases	4			4						2		
Detector Phase	4	4		4	4			2		2	2	
Switch Phase												
Minimum Initial (s)	5.0	5.0		5.0	5.0			5.0		5.0	5.0	
Minimum Split (s)	24.0	24.0		24.0	24.0			24.0		24.0	24.0	
Total Split (s)	42.0	42.0		42.0	42.0			48.0		48.0	48.0	
Total Split (%)	46.7%	46.7%		46.7%	46.7%			53.3%		53.3%	53.3%	
Maximum Green (s)	36.0	36.0		36.0	36.0			42.0		42.0	42.0	
Yellow Time (s)	4.0	4.0		4.0	4.0			4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0			2.0		2.0	2.0	
Lost Time Adjust (s)		0.0			0.0			0.0			0.0	
Total Lost Time (s)		6.0			6.0			6.0			6.0	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0		3.0	3.0	
Recall Mode	None	None		None	None			Min		Min	Min	
Walk Time (s)	7.0	7.0		7.0	7.0			7.0		7.0	7.0	
Flash Dont Walk (s)	11.0	11.0		11.0	11.0			11.0		11.0	11.0	
Pedestrian Calls (#/hr)	0	0		0	0			0		0	0	
Act Effct Green (s)		27.9			27.9			34.8			34.8	
Actuated g/C Ratio		0.37			0.37			0.46			0.46	
v/c Ratio		0.09			0.83			0.69			0.77	
Control Delay		12.8			37.0			21.7			25.4	
Queue Delay		0.0			0.0			0.0			0.0	
Total Delay		12.8			37.0			21.7			25.4	
LOS		B			D			C			C	
Approach Delay		12.8			37.0			21.7			25.4	
Approach LOS		B			D			C			C	
Queue Length 50th (ft)		11			182			207			258	
Queue Length 95th (ft)		20			#342			341			392	
Internal Link Dist (ft)		276			413			1044			523	
Turn Bay Length (ft)												
Base Capacity (vph)		771			675			1021			1052	
Starvation Cap Reductn		0			0			0			0	
Spillback Cap Reductn		0			0			0			0	
Storage Cap Reductn		0			0			0			0	
Reduced v/c Ratio		0.07			0.62			0.54			0.60	

Intersection Summary	
Area Type: Other	
Cycle Length: 90	
Actuated Cycle Length: 75.5	
Natural Cycle: 55	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.83	
Intersection Signal Delay: 26.7	Intersection LOS: C
Intersection Capacity Utilization 80.1%	ICU Level of Service D

Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 10: NH 102 & Fordway/Madden Hill Road

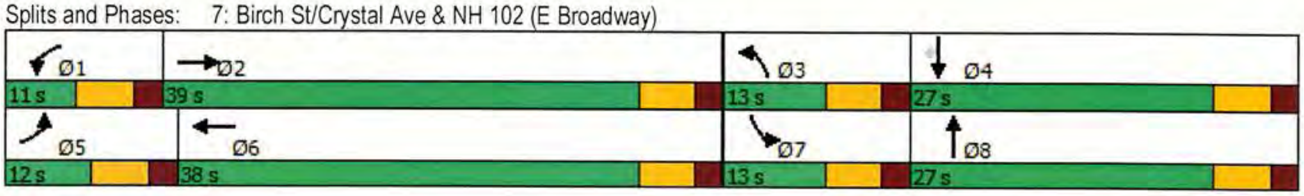
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	60	210	50	20	400	50	70	270	20	70	270	40
Future Volume (vph)	60	210	50	20	400	50	70	270	20	70	270	40
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	390		0	110		0	70		0	245		245
Storage Lanes	1		0	1		0	1		0	1		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.971			0.983			0.989				0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1656	1693	0	1703	1762	0	1719	1790	0	1703	1792	1524
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1656	1693	0	1703	1762	0	1719	1790	0	1703	1792	1524
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		15			8			4				182
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		505			530			361			411	
Travel Time (s)		11.5			12.0			8.2			9.3	
Peak Hour Factor	0.96	0.96	0.96	0.94	0.94	0.94	0.85	0.85	0.85	0.91	0.91	0.91
Heavy Vehicles (%)	9%	9%	9%	6%	6%	6%	5%	5%	5%	6%	6%	6%
Parking (#/hr)			0									
Adj. Flow (vph)	63	219	52	21	426	53	82	318	24	77	297	44
Shared Lane Traffic (%)												
Lane Group Flow (vph)	63	271	0	21	479	0	82	342	0	77	297	44
Turn Type	Prot	NA		Prot	NA		Prot	NA		Prot	NA	Perm
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases												4
Detector Phase	5	2		1	6		3	8		7	4	4
Switch Phase												
Minimum Initial (s)	4.0	5.0		4.0	10.0		4.0	10.0		4.0	9.0	9.0
Minimum Split (s)	10.0	30.0		10.0	30.0		10.0	25.0		10.0	25.0	25.0
Total Split (s)	12.0	39.0		11.0	38.0		13.0	27.0		13.0	27.0	27.0
Total Split (%)	13.3%	43.3%		12.2%	42.2%		14.4%	30.0%		14.4%	30.0%	30.0%
Maximum Green (s)	6.0	33.0		5.0	32.0		7.0	21.0		7.0	21.0	21.0
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	6.0
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lag		Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes	Yes
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Recall Mode	None	Min		None	Min		Min	None		Min	None	None
Walk Time (s)		7.0			7.0			7.0			7.0	7.0
Flash Dont Walk (s)		11.0			11.0			11.0			11.0	11.0
Pedestrian Calls (#/hr)		10			10			0			10	10
Act Effct Green (s)	6.2	30.7		5.3	25.7		7.0	18.5		7.0	18.5	18.5
Actuated g/C Ratio	0.08	0.39		0.07	0.33		0.09	0.23		0.09	0.23	0.23
v/c Ratio	0.48	0.41		0.19	0.83		0.54	0.81		0.51	0.71	0.09
Control Delay	53.8	19.7		44.2	38.6		53.6	46.9		52.3	40.4	0.3

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Total Delay	53.8	19.7		44.2	38.6		53.6	46.9		52.3	40.4	0.3
LOS	D	B		D	D		D	D		D	D	A
Approach Delay		26.2			38.9			48.2			38.4	
Approach LOS		C			D			D			D	
Queue Length 50th (ft)	34	84		11	233		44	174		41	149	0
Queue Length 95th (ft)	#91	177		35	#359		#99	#290		#101	#254	0
Internal Link Dist (ft)		425			450			281			331	
Turn Bay Length (ft)	390			110			70			245		245
Base Capacity (vph)	132	792		113	755		160	503		158	501	557
Starvation Cap Reductn	0	0		0	0		0	0		0	0	0
Spillback Cap Reductn	0	0		0	0		0	0		0	0	0
Storage Cap Reductn	0	0		0	0		0	0		0	0	0
Reduced v/c Ratio	0.48	0.34		0.19	0.63		0.51	0.68		0.49	0.59	0.08

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 79
Natural Cycle: 75
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.83
Intersection Signal Delay: 38.6 Intersection LOS: D
Intersection Capacity Utilization 66.7% ICU Level of Service C
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 7: Birch St/Crystal Ave & NH 102 (E Broadway)



Lane Group	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑	↱	↰↰	↑↑	
Traffic Volume (vph)	20	220	115	345	270	0
Future Volume (vph)	20	220	115	345	270	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	110		90	360		0
Storage Lanes	1		1	2		0
Taper Length (ft)	25			25		
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95	1.00
Frt			0.850			
Flt Protected	0.950			0.950		
Satd. Flow (prot)	1736	3471	1553	3335	3438	0
Flt Permitted	0.950			0.950		
Satd. Flow (perm)	1736	3471	1553	3335	3438	0
Right Turn on Red			Yes			Yes
Satd. Flow (RTOR)			327			
Link Speed (mph)		30			30	
Link Distance (ft)		639			476	
Travel Time (s)		14.5			10.8	
Peak Hour Factor	0.84	0.84	0.84	0.79	0.79	0.79
Heavy Vehicles (%)	4%	4%	4%	5%	5%	5%
Adj. Flow (vph)	24	262	137	437	342	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	24	262	137	437	342	0
Turn Type	Prot	NA	Perm	Prot	NA	
Protected Phases	5	2		1	6	
Permitted Phases		2	2		6	
Detector Phase	5	2	2	1	6	
Switch Phase						
Minimum Initial (s)	8.0	8.0	8.0	8.0	8.0	
Minimum Split (s)	14.0	21.0	21.0	14.0	21.0	
Total Split (s)	14.0	23.0	23.0	21.0	30.0	
Total Split (%)	15.6%	25.6%	25.6%	23.3%	33.3%	
Maximum Green (s)	8.0	17.0	17.0	15.0	24.0	
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	
Lead/Lag	Lead	Lag	Lag	Lead	Lag	
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Recall Mode	Max	C-Max	C-Max	None	Max	
Walk Time (s)		5.0	5.0		5.0	
Flash Dont Walk (s)		10.0	10.0		10.0	
Pedestrian Calls (#/hr)		0	0		0	
Act Effct Green (s)	8.6	18.1	18.1	14.6	24.0	
Actuated g/C Ratio	0.10	0.20	0.20	0.16	0.27	
v/c Ratio	0.14	0.38	0.24	0.81	0.37	
Control Delay	40.2	33.5	1.0	45.9	20.2	
Queue Delay	0.0	0.0	0.0	0.0	0.0	

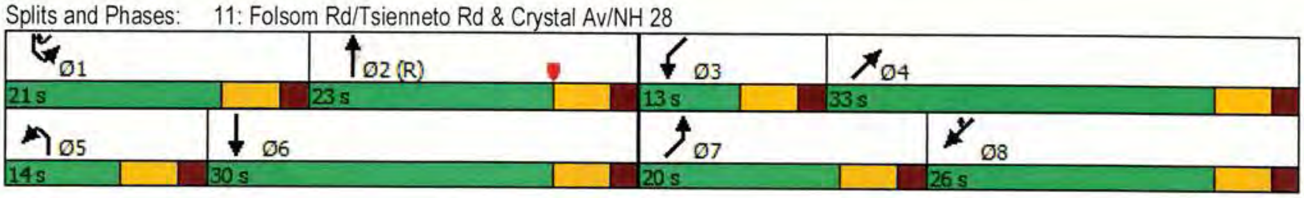
Lane Group	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations	↰	↑	↱	↰	↑	↱
Traffic Volume (vph)	190	280	20	40	370	530
Future Volume (vph)	190	280	20	40	370	530
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	190		180	0		210
Storage Lanes	1		1	1		1
Taper Length (ft)	25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850			0.850
Flt Protected	0.950			0.950		
Satd. Flow (prot)	1752	1845	1568	1752	1845	1568
Flt Permitted	0.950			0.950		
Satd. Flow (perm)	1752	1845	1568	1752	1845	1568
Right Turn on Red			Yes			Yes
Satd. Flow (RTOR)			400			182
Link Speed (mph)		30			30	
Link Distance (ft)		532			387	
Travel Time (s)		12.1			8.8	
Peak Hour Factor	0.86	0.86	0.86	0.99	0.99	0.99
Heavy Vehicles (%)	3%	3%	3%	3%	3%	3%
Adj. Flow (vph)	221	326	23	40	374	535
Shared Lane Traffic (%)						
Lane Group Flow (vph)	221	326	23	40	374	535
Turn Type	Prot	NA	Free	Prot	NA	pt+ov
Protected Phases	7	4		3	8	8 1
Permitted Phases		4	Free		8	
Detector Phase	7	4		3	8	8 1
Switch Phase						
Minimum Initial (s)	6.0	8.0		7.0	8.0	
Minimum Split (s)	12.0	21.0		13.0	21.0	
Total Split (s)	20.0	33.0		13.0	26.0	
Total Split (%)	22.2%	36.7%		14.4%	28.9%	
Maximum Green (s)	14.0	27.0		7.0	20.0	
Yellow Time (s)	4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.0	6.0		6.0	6.0	
Lead/Lag	Lead	Lag		Lead	Lag	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None	
Walk Time (s)		5.0			5.0	
Flash Dont Walk (s)		10.0			10.0	
Pedestrian Calls (#/hr)		0			0	
Act Effct Green (s)	13.5	31.6	90.0	7.0	19.9	40.4
Actuated g/C Ratio	0.15	0.35	1.00	0.08	0.22	0.45
v/c Ratio	0.84	0.50	0.01	0.29	0.92	0.67
Control Delay	65.1	27.9	0.0	45.2	64.3	17.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0

Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Total Delay	40.2	33.5	1.0	45.9	20.2		65.1	27.9	0.0	45.2	64.3	17.0
LOS	D	C	A	D	C		E	C	A	D	E	B
Approach Delay		23.3			34.6			41.2			36.8	
Approach LOS		C			C			D			D	
Queue Length 50th (ft)	13	69	0	91	85		123	157	0	22	208	149
Queue Length 95th (ft)	35	98	0	131	61		#223	230	0	54	#374	265
Internal Link Dist (ft)		559			396			452			307	
Turn Bay Length (ft)	110		90	360			190		180			210
Base Capacity (vph)	166	696	572	555	916		272	647	1568	136	410	795
Starvation Cap Reductn	0	0	0	0	0		0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0		0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0		0	0	0	0	0	0
Reduced v/c Ratio	0.14	0.38	0.24	0.79	0.37		0.81	0.50	0.01	0.29	0.91	0.67

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 90
Offset: 30 (33%), Referenced to phase 2:NBT, Start of Yellow
Natural Cycle: 80
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.92
Intersection Signal Delay: 35.0 Intersection LOS: D
Intersection Capacity Utilization 66.5% ICU Level of Service C
Analysis Period (min) 15
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 11: Folsom Rd/Tsienneto Rd & Crystal Av/NH 28



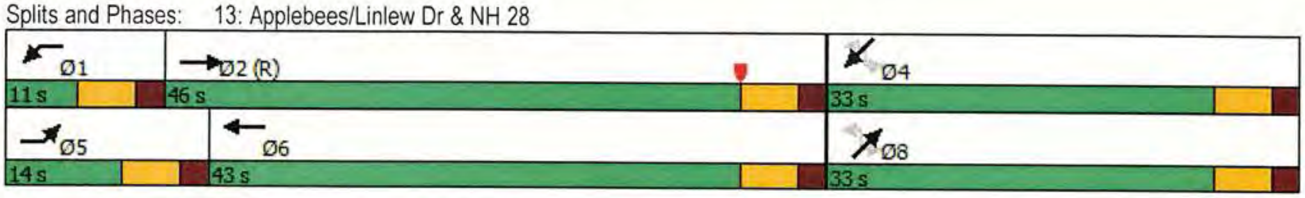
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations	↰	↑↱		↰	↑↱			↰↑	↱		↰↑	↱
Traffic Volume (vph)	30	825	0	0	830	40	5	0	5	10	0	40
Future Volume (vph)	30	825	0	0	830	40	5	0	5	10	0	40
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	110		0	115		150	0		0	0		0
Storage Lanes	1		0	1		0	0		1	0		1
Taper Length (ft)	50			25			25			25		
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt					0.993				0.850			0.850
Flt Protected	0.950							0.950			0.950	
Satd. Flow (prot)	1687	3374	0	1863	3514	0	0	1805	1615	0	1787	1599
Flt Permitted	0.950							0.976			0.976	
Satd. Flow (perm)	1687	3374	0	1863	3514	0	0	1854	1615	0	1836	1599
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)					6				109			109
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		277			671			218			433	
Travel Time (s)		6.3			15.3			5.0			9.8	
Peak Hour Factor	0.83	0.83	0.83	0.92	0.92	0.92	0.50	0.50	0.50	0.90	0.90	0.90
Heavy Vehicles (%)	7%	7%	7%	2%	2%	2%	0%	0%	0%	1%	1%	1%
Adj. Flow (vph)	36	994	0	0	902	43	10	0	10	11	0	44
Shared Lane Traffic (%)												
Lane Group Flow (vph)	36	994	0	0	945	0	0	10	10	0	11	44
Turn Type	Prot	NA		Prot	NA		Perm	NA	Perm	Perm	NA	Perm
Protected Phases	5	2		1	6			8			4	
Permitted Phases					6		8	8	8	4		4
Detector Phase	5	2		1	6		8	8	8	4	4	4
Switch Phase												
Minimum Initial (s)	8.0	8.0		5.0	8.0		5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	14.0	46.0		11.0	43.0		33.0	33.0	33.0	33.0	33.0	33.0
Total Split (s)	14.0	46.0		11.0	43.0		33.0	33.0	33.0	33.0	33.0	33.0
Total Split (%)	15.6%	51.1%		12.2%	47.8%		36.7%	36.7%	36.7%	36.7%	36.7%	36.7%
Maximum Green (s)	8.0	40.0		5.0	37.0		27.0	27.0	27.0	27.0	27.0	27.0
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0			0.0	0.0		0.0	0.0
Total Lost Time (s)	6.0	6.0		6.0	6.0			6.0	6.0		6.0	6.0
Lead/Lag	Lead	Lag		Lead	Lag							
Lead-Lag Optimize?	Yes	Yes		Yes	Yes							
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	C-Max		None	None		None	None	None	None	None	None
Act Effct Green (s)	8.4	78.7			69.8			6.3	6.3		6.3	6.3
Actuated g/C Ratio	0.09	0.87			0.78			0.07	0.07		0.07	0.07
v/c Ratio	0.23	0.34			0.35			0.08	0.05		0.09	0.21
Control Delay	47.1	1.4			5.2			39.8	0.4		40.0	2.2
Queue Delay	0.0	0.0			0.0			0.0	0.0		0.0	0.0
Total Delay	47.1	1.4			5.2			39.8	0.4		40.0	2.2
LOS	D	A			A			D	A		D	A
Approach Delay		3.0			5.2			20.1			9.7	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Approach LOS		A			A			C			A	
Queue Length 50th (ft)	22	33			118			6	0		6	0
Queue Length 95th (ft)	m47	42			179			12	0		22	0
Internal Link Dist (ft)		197			591			138			353	
Turn Bay Length (ft)	110											
Base Capacity (vph)	157	2949			2728			556	560		550	556
Starvation Cap Reductn	0	0			0			0	0		0	0
Spillback Cap Reductn	0	0			0			0	0		0	0
Storage Cap Reductn	0	0			0			0	0		0	0
Reduced v/c Ratio	0.23	0.34			0.35			0.02	0.02		0.02	0.08

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 90
Offset: 13 (14%), Referenced to phase 2:EBT, Start of Yellow
Natural Cycle: 90
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.35
Intersection Signal Delay: 4.4 Intersection LOS: A
Intersection Capacity Utilization 47.5% ICU Level of Service A
Analysis Period (min) 15
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 13: Applebees/Linlew Dr & NH 28



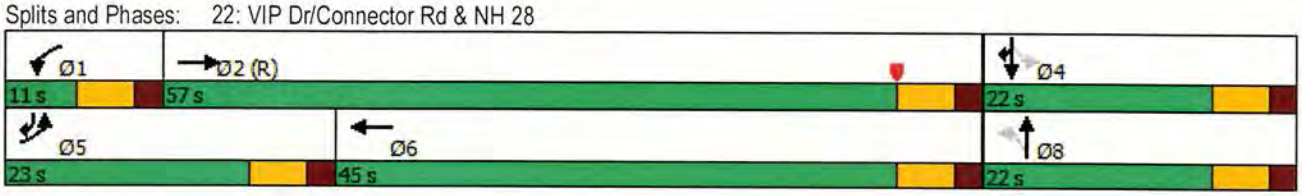
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	420	830	5	5	875	60	10	5	5	60	5	400
Future Volume (vph)	420	830	5	5	875	60	10	5	5	60	5	400
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200		0	205		150	0		0	0		220
Storage Lanes	2		0	1		0	1		0	0		1
Taper Length (ft)	200			25			25			25		
Lane Util. Factor	0.97	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.999			0.990			0.925				0.850
Flt Protected	0.950			0.950			0.950				0.956	
Satd. Flow (prot)	3303	3402	0	1736	3436	0	1805	1758	0	0	1763	1568
Flt Permitted	0.950			0.950			0.709				0.733	
Satd. Flow (perm)	3303	3402	0	1736	3436	0	1347	1758	0	0	1352	1568
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		1			10			7				68
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		412			486			151			446	
Travel Time (s)		9.4			11.0			3.4			10.1	
Peak Hour Factor	0.83	0.83	0.83	0.97	0.97	0.97	0.67	0.67	0.67	0.90	0.90	0.90
Heavy Vehicles (%)	6%	6%	6%	4%	4%	4%	0%	0%	0%	3%	3%	3%
Adj. Flow (vph)	506	1000	6	5	902	62	15	7	7	67	6	444
Shared Lane Traffic (%)												
Lane Group Flow (vph)	506	1006	0	5	964	0	15	14	0	0	73	444
Turn Type	Prot	NA		Prot	NA		Perm	NA		Perm	NA	pt+ov
Protected Phases	5	2		1	6			8			4	4 5
Permitted Phases							8	8		4		
Detector Phase	5	2		1	6		8	8		4	4	4 5
Switch Phase												
Minimum Initial (s)	5.0	8.0		5.0	8.0		5.0	5.0		8.0	8.0	
Minimum Split (s)	14.0	53.0		11.0	22.0		22.0	22.0		22.0	22.0	
Total Split (s)	23.0	57.0		11.0	45.0		22.0	22.0		22.0	22.0	
Total Split (%)	25.6%	63.3%		12.2%	50.0%		24.4%	24.4%		24.4%	24.4%	
Maximum Green (s)	17.0	51.0		5.0	39.0		16.0	16.0		16.0	16.0	
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0			0.0	
Total Lost Time (s)	6.0	6.0		6.0	6.0		6.0	6.0			6.0	
Lead/Lag	Lead	Lag		Lead	Lag							
Lead-Lag Optimize?	Yes	Yes		Yes	Yes							
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	C-Min		None	Min		None	None		None	None	
Walk Time (s)		5.0			5.0		5.0	5.0		5.0	5.0	
Flash Dont Walk (s)		11.0			11.0		11.0	11.0		11.0	11.0	
Pedestrian Calls (#/hr)		0			0		0	0		0	0	
Act Effct Green (s)	16.7	58.0		5.2	37.5		17.8	17.8			17.8	40.5
Actuated g/C Ratio	0.19	0.64		0.06	0.42		0.20	0.20			0.20	0.45
v/c Ratio	0.83	0.46		0.05	0.67		0.06	0.04			0.27	0.60
Control Delay	48.2	9.5		33.2	23.0		30.2	22.0			33.6	19.4
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0			0.0	0.0

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Total Delay	48.2	9.5		33.2	23.0		30.2	22.0			33.6	19.4
LOS	D	A		C	C		C	C			C	B
Approach Delay		22.5			23.0			26.2			21.4	
Approach LOS		C			C			C			C	
Queue Length 50th (ft)	143	144		0	184		7	3			33	139
Queue Length 95th (ft)	180	198		m8	177		18	14			77	262
Internal Link Dist (ft)		332			406			71			366	
Turn Bay Length (ft)	200			205								220
Base Capacity (vph)	631	2192		100	1529		271	360			272	737
Starvation Cap Reductn	0	0		0	0		0	0			0	0
Spillback Cap Reductn	0	0		0	0		0	0			0	0
Storage Cap Reductn	0	0		0	0		0	0			0	0
Reduced v/c Ratio	0.80	0.46		0.05	0.63		0.06	0.04			0.27	0.60

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 90
Offset: 0 (0%), Referenced to phase 2:EBT, Start of Yellow
Natural Cycle: 90
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.83
Intersection Signal Delay: 22.5 Intersection LOS: C
Intersection Capacity Utilization 70.0% ICU Level of Service C
Analysis Period (min) 15
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 22: VIP Dr/Connector Rd & NH 28



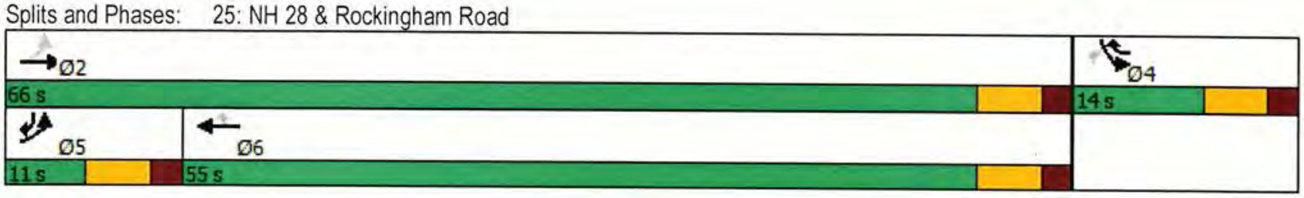
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	55	1775	1590	220	90	95
Future Volume (vph)	55	1775	1590	220	90	95
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200			150	360	0
Storage Lanes	1			1	1	1
Taper Length (ft)	25				25	
Lane Util. Factor	1.00	0.95	0.95	1.00	1.00	1.00
Frt				0.850		0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1770	3539	3539	1583	1770	1583
Flt Permitted	0.077				0.950	
Satd. Flow (perm)	143	3539	3539	1583	1770	1583
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)				239		24
Link Speed (mph)		30	30		30	
Link Distance (ft)		463	580		704	
Travel Time (s)		10.5	13.2		16.0	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	60	1929	1728	239	98	103
Shared Lane Traffic (%)						
Lane Group Flow (vph)	60	1929	1728	239	98	103
Turn Type	pm+pt	NA	NA	pm+ov	Prot	pm+ov
Protected Phases	5	2	6	4	4	5
Permitted Phases	2			6		4
Detector Phase	5	2	6	4	4	5
Switch Phase						
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	11.0	20.0	20.0	11.0	11.0	11.0
Total Split (s)	11.0	66.0	55.0	14.0	14.0	11.0
Total Split (%)	13.8%	82.5%	68.8%	17.5%	17.5%	13.8%
Maximum Green (s)	5.0	60.0	49.0	8.0	8.0	5.0
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag	Lead		Lag			Lead
Lead-Lag Optimize?	Yes		Yes			Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	None	None	None	None	None
Act Effct Green (s)	54.0	54.0	45.8	61.3	7.6	18.9
Actuated g/C Ratio	0.73	0.73	0.62	0.83	0.10	0.26
v/c Ratio	0.28	0.75	0.79	0.18	0.54	0.24
Control Delay	5.8	7.9	14.5	0.6	46.1	21.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	5.8	7.9	14.5	0.6	46.1	21.6
LOS	A	A	B	A	D	C
Approach Delay		7.9	12.8		33.5	
Approach LOS		A	B		C	

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Queue Length 50th (ft)	6	217	308	0	48	32
Queue Length 95th (ft)	14	289	405	11	#103	73
Internal Link Dist (ft)		383	500		624	
Turn Bay Length (ft)	200			150	360	
Base Capacity (vph)	217	2848	2409	1332	197	423
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.28	0.68	0.72	0.18	0.50	0.24

Intersection Summary

Area Type: Other
Cycle Length: 80
Actuated Cycle Length: 74
Natural Cycle: 60
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.79
Intersection Signal Delay: 11.4 Intersection LOS: B
Intersection Capacity Utilization 64.1% ICU Level of Service C
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 25: NH 28 & Rockingham Road



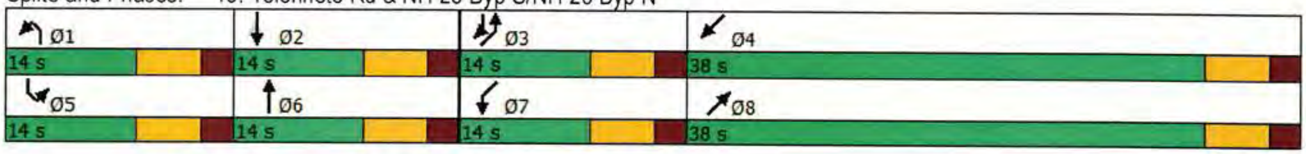
Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	30	50	20	10	40	90	20	230	90	70	280	40
Future Volume (vph)	30	50	20	10	40	90	20	230	90	70	280	40
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200		150	190		190	135		0	120		0
Storage Lanes	1		0	1		1	1		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.958				0.850		0.958			0.981	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1752	1767	0	1736	1827	1553	1770	1785	0	1787	1845	0
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1752	1767	0	1736	1827	1553	1770	1785	0	1787	1845	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		20				123		29			11	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		481			347			479			371	
Travel Time (s)		10.9			7.9			10.9			8.4	
Peak Hour Factor	0.82	0.82	0.82	0.81	0.81	0.81	0.68	0.68	0.68	0.78	0.78	0.78
Heavy Vehicles (%)	3%	3%	3%	4%	4%	4%	2%	2%	2%	1%	1%	1%
Adj. Flow (vph)	37	61	24	12	49	111	29	338	132	90	359	51
Shared Lane Traffic (%)												
Lane Group Flow (vph)	37	85	0	12	49	111	29	470	0	90	410	0
Turn Type	Prot	NA		Prot	NA	pm+ov	Prot	NA		Prot	NA	
Protected Phases	1	6		5	2	3	3	8		7	4	
Permitted Phases						2						
Detector Phase	1	6		5	2	3	3	8		7	4	
Switch Phase												
Minimum Initial (s)	8.0	8.0		8.0	8.0	8.0	8.0	8.0		8.0	8.0	
Minimum Split (s)	14.0	14.0		14.0	14.0	14.0	14.0	20.0		14.0	20.0	
Total Split (s)	14.0	14.0		14.0	14.0	14.0	14.0	38.0		14.0	38.0	
Total Split (%)	17.5%	17.5%		17.5%	17.5%	17.5%	17.5%	47.5%		17.5%	47.5%	
Maximum Green (s)	8.0	8.0		8.0	8.0	8.0	8.0	32.0		8.0	32.0	
Yellow Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0	2.0	2.0	2.0		2.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Lead/Lag	Lead	Lag		Lead	Lag	Lead	Lead	Lag		Lead	Lag	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes	Yes	Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	Max	None	None	None		None	None	
Act Effct Green (s)	9.1	11.3		9.1	9.1	25.0	9.1	20.9		9.1	20.9	
Actuated g/C Ratio	0.16	0.19		0.16	0.16	0.43	0.16	0.36		0.16	0.36	
v/c Ratio	0.14	0.24		0.04	0.17	0.15	0.11	0.71		0.32	0.61	
Control Delay	31.0	23.2		30.9	31.1	4.7	30.9	23.1		33.1	20.6	
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Total Delay	31.0	23.2		30.9	31.1	4.7	30.9	23.1		33.1	20.6	
LOS	C	C		C	C	A	C	C		C	C	
Approach Delay		25.6			14.1			23.6			22.9	

Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Approach LOS		C			B			C			C	
Queue Length 50th (ft)	11	20		4	15	0	9	115		29	99	
Queue Length 95th (ft)	41	66		19	50	23	29	179		76	192	
Internal Link Dist (ft)		401			267			399			291	
Turn Bay Length (ft)	200			190		190	135			120		
Base Capacity (vph)	274	357		271	285	737	276	1094		279	1124	
Starvation Cap Reductn	0	0		0	0	0	0	0		0	0	
Spillback Cap Reductn	0	0		0	0	0	0	0		0	0	
Storage Cap Reductn	0	0		0	0	0	0	0		0	0	
Reduced v/c Ratio	0.14	0.24		0.04	0.17	0.15	0.11	0.43		0.32	0.36	

Intersection Summary

Area Type: Other
Cycle Length: 80
Actuated Cycle Length: 58.2
Natural Cycle: 65
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.71
Intersection Signal Delay: 22.2 — Intersection LOS: C
Intersection Capacity Utilization 47.6% — ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 18: Tsienneto Rd & NH 28 Byp S/NH 28 Byp N



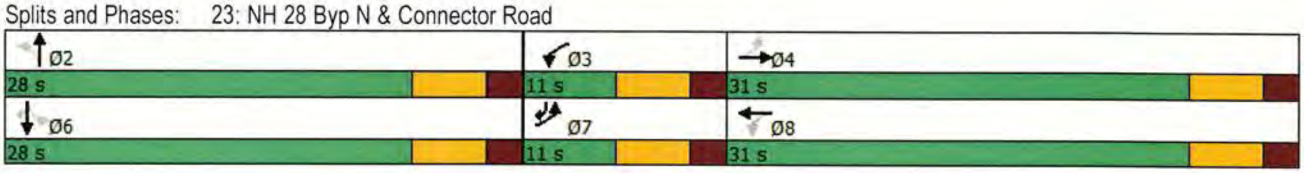
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	50	350	5	10	380	10	5	50	10	10	50	50
Future Volume (vph)	50	350	5	10	380	10	5	50	10	10	50	50
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	275		0	75		100	75		0	210		210
Storage Lanes	1		0	1		0	1		0	1		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.998			0.996			0.975				0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1770	1859	0	1770	1855	0	1770	1816	0	1770	1863	1583
Flt Permitted	0.297			0.476			0.722			0.715		
Satd. Flow (perm)	553	1859	0	887	1855	0	1345	1816	0	1332	1863	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		1			2			11				54
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		314			303			290			341	
Travel Time (s)		7.1			6.9			6.6			7.8	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	54	380	5	11	413	11	5	54	11	11	54	54
Shared Lane Traffic (%)												
Lane Group Flow (vph)	54	385	0	11	424	0	5	65	0	11	54	54
Turn Type	pm+pt	NA		pm+pt	NA		Perm	NA		Perm	NA	pm+ov
Protected Phases	7	4		3	8			2			6	7
Permitted Phases	4			8			2			6		6
Detector Phase	7	4		3	8		2	2		6	6	7
Switch Phase												
Minimum Initial (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	5.0
Minimum Split (s)	11.0	28.0		11.0	28.0		28.0	28.0		28.0	28.0	11.0
Total Split (s)	11.0	31.0		11.0	31.0		28.0	28.0		28.0	28.0	11.0
Total Split (%)	15.7%	44.3%		15.7%	44.3%		40.0%	40.0%		40.0%	40.0%	15.7%
Maximum Green (s)	5.0	25.0		5.0	25.0		22.0	22.0		22.0	22.0	5.0
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	6.0
Lead/Lag	Lead	Lag		Lead	Lag							Lead
Lead-Lag Optimize?	Yes	Yes		Yes	Yes							Yes
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Recall Mode	None	None		None	None		Max	Max		Max	Max	None
Walk Time (s)		7.0			7.0		7.0	7.0		7.0	7.0	
Flash Dont Walk (s)		15.0			15.0		15.0	15.0		15.0	15.0	
Pedestrian Calls (#/hr)		0			0		0	0		0	0	
Act Effct Green (s)	25.9	25.0		22.5	18.7		22.6	22.6		22.6	22.6	33.9
Actuated g/C Ratio	0.42	0.40		0.36	0.30		0.37	0.37		0.37	0.37	0.55
v/c Ratio	0.16	0.51		0.03	0.75		0.01	0.10		0.02	0.08	0.06
Control Delay	10.2	16.8		8.9	29.1		16.4	14.6		16.4	16.5	3.5
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Total Delay	10.2	16.8		8.9	29.1		16.4	14.6		16.4	16.5	3.5

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
LOS	B	B		A	C		B	B		B	B	A
Approach Delay		16.0			28.6			14.7			10.6	
Approach LOS		B			C			B			B	
Queue Length 50th (ft)	11	94		2	148		1	14		3	14	0
Queue Length 95th (ft)	27	213		9	239		8	42		14	40	17
Internal Link Dist (ft)		234			223			210			261	
Turn Bay Length (ft)	275			75			75			210		210
Base Capacity (vph)	332	871		395	770		490	669		486	680	891
Starvation Cap Reductn	0	0		0	0		0	0		0	0	0
Spillback Cap Reductn	0	0		0	0		0	0		0	0	0
Storage Cap Reductn	0	0		0	0		0	0		0	0	0
Reduced v/c Ratio	0.16	0.44		0.03	0.55		0.01	0.10		0.02	0.08	0.06

Intersection Summary

Area Type: Other
Cycle Length: 70
Actuated Cycle Length: 61.9
Natural Cycle: 70
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.75
Intersection Signal Delay: 20.4 Intersection LOS: C
Intersection Capacity Utilization 47.0% ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 23: NH 28 Byp N & Connector Road



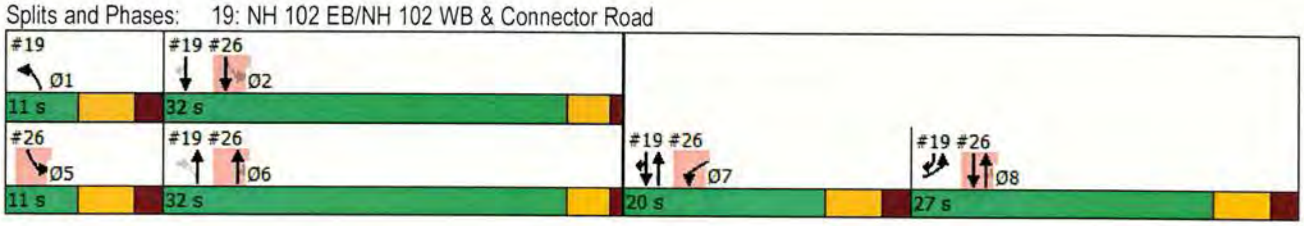
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR	Ø2	Ø5	Ø6	Ø7
Lane Configurations										
Traffic Volume (vph)	450	0	20	60	170	580				
Future Volume (vph)	450	0	20	60	170	580				
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900				
Storage Length (ft)	0	0	120			90				
Storage Lanes	1	0	1			1				
Taper Length (ft)	25		25							
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00				
Frt						0.850				
Flt Protected	0.950		0.950							
Satd. Flow (prot)	1770	0	1626	1712	1863	1583				
Flt Permitted	0.950		0.580							
Satd. Flow (perm)	1770	0	993	1712	1863	1583				
Right Turn on Red		Yes				Yes				
Satd. Flow (RTOR)						707				
Link Speed (mph)	30			30	30					
Link Distance (ft)	472			739	258					
Travel Time (s)	10.7			16.8	5.9					
Peak Hour Factor	0.94	0.94	0.91	0.91	0.82	0.82				
Heavy Vehicles (%)	2%	2%	11%	11%	2%	2%				
Adj. Flow (vph)	479	0	22	66	207	707				
Shared Lane Traffic (%)										
Lane Group Flow (vph)	479	0	22	66	207	707				
Turn Type	Prot		pm+pt	NA	NA	custom				
Protected Phases	8		1	6 7	2 7	7 8	2	5	6	7
Permitted Phases			6 7			2				
Detector Phase	8		1	6 7	2 7	7 8				
Switch Phase										
Minimum Initial (s)	5.0		5.0				5.0	5.0	5.0	5.0
Minimum Split (s)	26.5		11.0				9.0	11.0	9.0	11.0
Total Split (s)	27.0		11.0				32.0	11.0	32.0	20.0
Total Split (%)	30.0%		12.2%				36%	12%	36%	22%
Maximum Green (s)	21.0		5.0				28.0	5.0	28.0	14.0
Yellow Time (s)	4.0		4.0				3.0	4.0	3.0	4.0
All-Red Time (s)	2.0		2.0				1.0	2.0	1.0	2.0
Lost Time Adjust (s)	0.0		0.0							
Total Lost Time (s)	6.0		6.0							
Lead/Lag	Lag		Lead				Lag	Lead	Lag	Lead
Lead-Lag Optimize?	Yes		Yes				Yes	Yes	Yes	Yes
Vehicle Extension (s)	3.0		3.0				3.0	3.0	3.0	3.0
Recall Mode	None		None				Min	None	Min	None
Act Effct Green (s)	22.0		34.0	35.3	33.5	63.9				
Actuated g/C Ratio	0.32		0.49	0.51	0.48	0.92				
v/c Ratio	0.86		0.04	0.08	0.23	0.47				
Control Delay	44.3		7.2	8.7	11.8	1.3				
Queue Delay	0.0		0.0	0.0	0.7	0.1				
Total Delay	44.3		7.2	8.7	12.5	1.4				
LOS	D		A	A	B	A				
Approach Delay	44.3			8.3	3.9					

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR	Ø2	Ø5	Ø6	Ø7
Approach LOS	D			A	A					
Queue Length 50th (ft)	167		4	12	54	0				
Queue Length 95th (ft)	#513		13	37	87	17				
Internal Link Dist (ft)	392			659	178					
Turn Bay Length (ft)			120			90				
Base Capacity (vph)	560		533	946	980	1493				
Starvation Cap Reductn	0		0	0	509	120				
Spillback Cap Reductn	0		0	0	0	0				
Storage Cap Reductn	0		0	0	0	0				
Reduced v/c Ratio	0.86		0.04	0.07	0.44	0.51				

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 69.4
Natural Cycle: 65
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.86
Intersection Signal Delay: 17.2 Intersection LOS: B
Intersection Capacity Utilization 49.7% ICU Level of Service A
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 19: NH 102 EB/NH 102 WB & Connector Road



Lane Group	WBL	WBR	NBT	NBR	SBL	SBT	Ø1	Ø2	Ø6	Ø8
Lane Configurations										
Traffic Volume (vph)	70	10	460	50	10	680				
Future Volume (vph)	70	10	460	50	10	680				
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900				
Storage Length (ft)	0	0		90	100					
Storage Lanes	1	0		1	1					
Taper Length (ft)	25				25					
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00				
Frt	0.979			0.850						
Flt Protected	0.960				0.950					
Satd. Flow (prot)	1771	0	1900	1615	1805	1900				
Flt Permitted	0.960				0.257					
Satd. Flow (perm)	1771	0	1900	1615	488	1900				
Right Turn on Red		Yes		Yes						
Satd. Flow (RTOR)	9			53						
Link Speed (mph)	30		30			30				
Link Distance (ft)	524		258			288				
Travel Time (s)	11.9		5.9			6.5				
Peak Hour Factor	0.87	0.67	0.95	0.84	0.73	0.96				
Heavy Vehicles (%)	1%	0%	0%	0%	0%	0%				
Adj. Flow (vph)	80	15	484	60	14	708				
Shared Lane Traffic (%)										
Lane Group Flow (vph)	95	0	484	60	14	708				
Turn Type	Prot		NA	Perm	custom	NA				
Protected Phases	7		6 8		5	2 8	1	2	6	8
Permitted Phases				6 8	2					
Detector Phase	7		6 8	6 8	5	2 8				
Switch Phase										
Minimum Initial (s)	5.0				5.0		5.0	5.0	5.0	5.0
Minimum Split (s)	11.0				11.0		11.0	9.0	9.0	26.5
Total Split (s)	20.0				11.0		11.0	32.0	32.0	27.0
Total Split (%)	22.2%				12.2%		12%	36%	36%	30%
Maximum Green (s)	14.0				5.0		5.0	28.0	28.0	21.0
Yellow Time (s)	4.0				4.0		4.0	3.0	3.0	4.0
All-Red Time (s)	2.0				2.0		2.0	1.0	1.0	2.0
Lost Time Adjust (s)	0.0				0.0					
Total Lost Time (s)	6.0				6.0					
Lead/Lag	Lead				Lead		Lead	Lag	Lag	Lag
Lead-Lag Optimize?	Yes				Yes		Yes	Yes	Yes	Yes
Vehicle Extension (s)	3.0				3.0		3.0	3.0	3.0	3.0
Recall Mode	None				None		None	Min	Min	None
Act Effct Green (s)	11.6		45.1	45.1	15.1	42.6				
Actuated g/C Ratio	0.17		0.65	0.65	0.22	0.61				
v/c Ratio	0.31		0.39	0.06	0.07	0.61				
Control Delay	29.8		3.4	0.7	18.1	9.3				
Queue Delay	0.0		0.2	0.0	0.0	0.0				
Total Delay	29.8		3.5	0.7	18.1	9.3				
LOS	C		A	A	B	A				
Approach Delay	29.8		3.2			9.5				

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT	Ø1	Ø2	Ø6	Ø8
Approach LOS	C		A			A				
Queue Length 50th (ft)	28		7	0	5	135				
Queue Length 95th (ft)	87		m79	m0	13	209				
Internal Link Dist (ft)	444		178			208				
Turn Bay Length (ft)				90	100					
Base Capacity (vph)	380		1552	1329	205	1515				
Starvation Cap Reductn	0		403	0	0	0				
Spillback Cap Reductn	0		0	0	0	0				
Storage Cap Reductn	0		0	0	0	0				
Reduced v/c Ratio	0.25		0.42	0.05	0.07	0.47				

Intersection Summary	
Area Type: Other	
Cycle Length: 90	
Actuated Cycle Length: 69.4	
Natural Cycle: 65	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.86	
Intersection Signal Delay: 8.4	Intersection LOS: A
Intersection Capacity Utilization 48.6%	ICU Level of Service A
Analysis Period (min) 15	
m Volume for 95th percentile queue is metered by upstream signal.	

Splits and Phases: 26: NH 102 & North Shore Road

APPENDIX Q-4: ALTERNATIVE C INTERSECTION CAPACITY ANALYSES – SYNCHRO PRINTSOUTS – PM PEAK HOUR

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑↑		↰	↱↱
Traffic Volume (vph)	0	1255	1330	0	125	1325
Future Volume (vph)	0	1255	1330	0	125	1325
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	16	12
Lane Util. Factor	1.00	0.95	0.95	1.00	1.00	0.88
Frt						0.850
Flt Protected					0.950	
Satd. Flow (prot)	0	3471	3406	0	1930	2682
Flt Permitted					0.950	
Satd. Flow (perm)	0	3471	3406	0	1930	2682
Right Turn on Red				Yes		No
Satd. Flow (RTOR)						
Link Speed (mph)		30	30		25	
Link Distance (ft)		712	388		212	
Travel Time (s)		16.2	8.8		5.8	
Peak Hour Factor	0.93	0.93	0.88	0.88	0.89	0.89
Heavy Vehicles (%)	4%	4%	6%	6%	6%	6%
Adj. Flow (vph)	0	1349	1511	0	140	1489
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	1349	1511	0	140	1489
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(ft)		24	24		16	
Link Offset(ft)		0	0		0	
Crosswalk Width(ft)		16	16		16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	0.85	1.00
Turning Speed (mph)	15			9	15	9
Number of Detectors		3	3		3	3
Detector Template		Thru	Thru		Left	
Leading Detector (ft)		256	256		256	256
Trailing Detector (ft)		-5	-5		-5	-5
Detector 1 Position(ft)		-5	-5		-5	-5
Detector 1 Size(ft)		50	50		50	50
Detector 1 Type		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex
Detector 1 Channel						
Detector 1 Extend (s)		0.0	0.0		0.0	0.0
Detector 1 Queue (s)		0.0	0.0		0.0	0.0
Detector 1 Delay (s)		0.0	0.0		0.0	0.0
Detector 2 Position(ft)		125	125		125	125
Detector 2 Size(ft)		6	6		6	6
Detector 2 Type		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex
Detector 2 Channel						
Detector 2 Extend (s)		0.0	0.0		0.0	0.0
Detector 3 Position(ft)		250	250		250	250
Detector 3 Size(ft)		6	6		6	6
Detector 3 Type		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex
Detector 3 Channel						

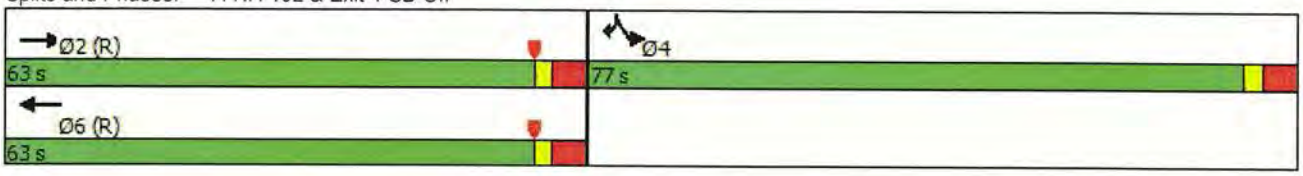
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Detector 3 Extend (s)		0.0	0.0		0.0	0.0
Turn Type		NA	NA		Prot	Prot
Protected Phases		2	6		4	4
Permitted Phases						
Detector Phase		2	6		4	4
Switch Phase						
Minimum Initial (s)		8.0	8.0		5.0	5.0
Minimum Split (s)		14.0	21.0		27.0	27.0
Total Split (s)		63.0	63.0		77.0	77.0
Total Split (%)		45.0%	45.0%		55.0%	55.0%
Maximum Green (s)		57.0	57.0		71.0	71.0
Yellow Time (s)		2.0	2.0		2.0	2.0
All-Red Time (s)		4.0	4.0		4.0	4.0
Lost Time Adjust (s)		0.0	0.0		0.0	0.0
Total Lost Time (s)		6.0	6.0		6.0	6.0
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)		3.0	3.0		3.0	3.0
Recall Mode		C-Min	C-Min		None	None
Walk Time (s)			7.0		7.0	7.0
Flash Dont Walk (s)			8.0		14.0	14.0
Pedestrian Calls (#/hr)			0		0	0
Act Effct Green (s)		57.0	57.0		71.0	71.0
Actuated g/C Ratio		0.41	0.41		0.51	0.51
v/c Ratio		0.95	1.09		0.14	1.09
Control Delay		40.2	50.4		18.8	88.1
Queue Delay		0.0	0.0		0.0	0.0
Total Delay		40.2	50.4		18.8	88.1
LOS		D	D		B	F
Approach Delay		40.2	50.4		82.1	
Approach LOS		D	D		F	
Queue Length 50th (ft)		494	~818		66	~868
Queue Length 95th (ft)		m#739	m#55		105	#1000
Internal Link Dist (ft)		632	308		132	
Turn Bay Length (ft)						
Base Capacity (vph)		1413	1386		978	1360
Starvation Cap Reductn		0	0		0	0
Spillback Cap Reductn		0	0		0	0
Storage Cap Reductn		0	0		0	0
Reduced v/c Ratio		0.95	1.09		0.14	1.09

Intersection Summary

Area Type: Other
Cycle Length: 140
Actuated Cycle Length: 140
Offset: 0 (0%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow, Master Intersection
Natural Cycle: 140
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 1.09

Intersection Signal Delay: 58.9 Intersection LOS: E
Intersection Capacity Utilization 95.1% ICU Level of Service F
Analysis Period (min) 15
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 7: NH 102 & Exit 4 SB Off



Lane Group	NBL2	NBL	NBR	SEL	SER	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations	↰↰		↱↱			↰↰	↑↑			↑↑	↱
Traffic Volume (vph)	1250	0	910	0	0	1085	295	0	0	420	240
Future Volume (vph)	1250	0	910	0	0	1085	295	0	0	420	240
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)		0	0	0	0	550		0	0		0
Storage Lanes		2	2	0	0	2		0	0		1
Taper Length (ft)		25		25		25			25		
Lane Util. Factor	0.97	1.00	0.88	1.00	1.00	0.97	0.95	1.00	1.00	0.95	1.00
Frt			0.850								0.850
Flt Protected	0.950					0.950					
Satd. Flow (prot)	3242	0	2632	0	0	3335	3438	0	0	3505	1568
Flt Permitted	0.950					0.950					
Satd. Flow (perm)	3242	0	2632	0	0	3335	3438	0	0	3505	1568
Right Turn on Red			No					Yes			Yes
Satd. Flow (RTOR)											261
Link Speed (mph)		25		30			30			30	
Link Distance (ft)		856		390			760			857	
Travel Time (s)		23.3		8.9			17.3			19.5	
Peak Hour Factor	0.88	0.88	0.88	0.92	0.92	0.94	0.94	0.94	0.92	0.92	0.92
Heavy Vehicles (%)	8%	8%	8%	2%	2%	5%	5%	5%	3%	3%	3%
Adj. Flow (vph)	1420	0	1034	0	0	1154	314	0	0	457	261
Shared Lane Traffic (%)											
Lane Group Flow (vph)	1420	0	1034	0	0	1154	314	0	0	457	261
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Right	Left	Left	Right	Left	Right	Right
Median Width(ft)		24		0			24			24	
Link Offset(ft)		12		0			0			0	
Crosswalk Width(ft)		16		16			16			16	
Two way Left Turn Lane											
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15	15	25	15	9	15		9	15		25
Number of Detectors	3		3			3	3			3	0
Detector Template											
Leading Detector (ft)	256		256			256	256			256	0
Trailing Detector (ft)	-5		-5			-5	-5			-5	0
Detector 1 Position(ft)	-5		-5			-5	-5			-5	-5
Detector 1 Size(ft)	55		55			55	55			55	50
Detector 1 Type	Cl+Ex		Cl+Ex			Cl+Ex	Cl+Ex			Cl+Ex	Cl+Ex
Detector 1 Channel											
Detector 1 Extend (s)	0.0		0.0			0.0	0.0			0.0	0.0
Detector 1 Queue (s)	0.0		0.0			0.0	0.0			0.0	0.0
Detector 1 Delay (s)	0.0		0.0			0.0	0.0			0.0	0.0
Detector 2 Position(ft)	125		125			125	125			125	
Detector 2 Size(ft)	6		6			6	6			6	
Detector 2 Type	Cl+Ex		Cl+Ex			Cl+Ex	Cl+Ex			Cl+Ex	
Detector 2 Channel											
Detector 2 Extend (s)	0.0		0.0			0.0	0.0			0.0	
Detector 3 Position(ft)	250		250			250	250			250	
Detector 3 Size(ft)	6		6			6	6			6	

Lane Group	NBL2	NBL	NBR	SEL	SER	NEL	NET	NER	SWL	SWT	SWR
Detector 3 Type	Cl+Ex		Cl+Ex			Cl+Ex	Cl+Ex			Cl+Ex	
Detector 3 Channel											
Detector 3 Extend (s)	0.0		0.0			0.0	0.0			0.0	
Turn Type	Prot		Prot			Prot	NA			NA	Free
Protected Phases	8		8			5	2			6	
Permitted Phases											Free
Detector Phase	8		2			5	2			6	
Switch Phase											
Minimum Initial (s)	10.0		10.0			5.0	8.0			8.0	
Minimum Split (s)	16.0		16.0			11.0	42.0			31.0	
Total Split (s)	60.0		60.0			48.0	80.0			32.0	
Total Split (%)	42.9%		42.9%			34.3%	57.1%			22.9%	
Maximum Green (s)	54.0		54.0			42.0	74.0			26.0	
Yellow Time (s)	2.0		2.0			2.0	2.0			2.0	
All-Red Time (s)	4.0		4.0			4.0	4.0			4.0	
Lost Time Adjust (s)	0.0		0.0			0.0	0.0			0.0	
Total Lost Time (s)	6.0		6.0			6.0	6.0			6.0	
Lead/Lag						Lead				Lag	
Lead-Lag Optimize?											
Vehicle Extension (s)	3.0		3.0			3.0	3.0			3.0	
Recall Mode	None		None			None	C-Min			C-Min	
Walk Time (s)							7.0			7.0	
Flash Dont Walk (s)							29.0			17.0	
Pedestrian Calls (#/hr)							0			0	
Act Effct Green (s)	54.0		54.0			42.0	74.0			26.0	140.0
Actuated g/C Ratio	0.39		0.39			0.30	0.53			0.19	1.00
v/c Ratio	1.14		1.02			1.15	0.17			0.70	0.17
Control Delay	111.0		75.3			98.3	2.8			60.0	0.2
Queue Delay	0.0		0.0			0.0	0.0			0.0	0.0
Total Delay	111.0		75.3			98.3	2.8			60.0	0.2
LOS	F		E			F	A			E	A
Approach Delay		96.0					77.9			38.3	
Approach LOS		F					E			D	
Queue Length 50th (ft)	~774		~565			~625	20			207	0
Queue Length 95th (ft)	#877		#685			m#680	m21			270	0
Internal Link Dist (ft)		776		310			680			777	
Turn Bay Length (ft)						550					
Base Capacity (vph)	1250		1015			1000	1817			650	1568
Starvation Cap Reductn	0		0			0	0			0	0
Spillback Cap Reductn	0		0			0	0			0	0
Storage Cap Reductn	0		0			0	0			0	0
Reduced v/c Ratio	1.14		1.02			1.15	0.17			0.70	0.17

Intersection Summary	
Area Type:	Other
Cycle Length: 140	
Actuated Cycle Length: 140	
Offset: 53 (38%), Referenced to phase 2:NET and 6:SWT, Start of Yellow	
Natural Cycle: 150	

Control Type: Actuated-Coordinated
Maximum v/c Ratio: 1.15
Intersection Signal Delay: 81.3 Intersection LOS: F
Intersection Capacity Utilization 94.2% ICU Level of Service F
Analysis Period (min) 15
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 8: NH 102 & Exit 4 NB Off

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑	↱	↰	↑↑					↰↰		↱
Traffic Volume (vph)	0	640	470	160	615	0	0	0	0	180	0	390
Future Volume (vph)	0	640	470	160	615	0	0	0	0	180	0	390
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		350	0		0	0		0	0		0
Storage Lanes	0		1	1		0	0		0	2		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	0.97	1.00	1.00
Frt			0.850									0.850
Flt Protected				0.950						0.950		
Satd. Flow (prot)	0	3471	1553	1719	3438	0	0	0	0	3367	0	1553
Flt Permitted				0.950						0.950		
Satd. Flow (perm)	0	3471	1553	1719	3438	0	0	0	0	3367	0	1553
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			540									203
Link Speed (mph)		30			30			30			35	
Link Distance (ft)		851			693			486			581	
Travel Time (s)		19.3			15.8			11.0			11.3	
Peak Hour Factor	0.87	0.87	0.87	0.86	0.86	0.86	0.92	0.92	0.92	0.91	0.91	0.91
Heavy Vehicles (%)	4%	4%	4%	5%	5%	5%	2%	2%	2%	4%	4%	4%
Adj. Flow (vph)	0	736	540	186	715	0	0	0	0	198	0	429
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	736	540	186	715	0	0	0	0	198	0	429
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Right	Left	Right
Median Width(ft)		36			36			24			24	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		25	15		9	15		9	15		25
Number of Detectors		3	3	3	3					3		3
Detector Template		Thru	Right	Left	Thru					Left		Right
Leading Detector (ft)		256	256	256	256					256		256
Trailing Detector (ft)		-5	-5	-5	-5					-5		-5
Detector 1 Position(ft)		-5	-5	-5	-5					-5		-5
Detector 1 Size(ft)		50	50	50	50					50		50
Detector 1 Type		Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex					Cl+Ex		Cl+Ex
Detector 1 Channel												
Detector 1 Extend (s)		0.0	0.0	0.0	0.0					0.0		0.0
Detector 1 Queue (s)		0.0	0.0	0.0	0.0					0.0		0.0
Detector 1 Delay (s)		0.0	0.0	0.0	0.0					0.0		0.0
Detector 2 Position(ft)		125	125	125	125					125		125
Detector 2 Size(ft)		6	6	6	6					6		6
Detector 2 Type		Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex					Cl+Ex		Cl+Ex
Detector 2 Channel												
Detector 2 Extend (s)		0.0	0.0	0.0	0.0					0.0		0.0
Detector 3 Position(ft)		250	250	250	250					250		250
Detector 3 Size(ft)		6	6	6	6					6		6

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Detector 3 Type		Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex					Cl+Ex		Cl+Ex
Detector 3 Channel												
Detector 3 Extend (s)		0.0	0.0	0.0	0.0					0.0		0.0
Turn Type		NA	Free	Prot	NA					Prot		Prot
Protected Phases		2		1	6					4		4
Permitted Phases			Free									
Detector Phase		2		1	6					4		4
Switch Phase												
Minimum Initial (s)		9.0		4.0	9.0					4.0		4.0
Minimum Split (s)		21.0		10.0	21.0					10.0		10.0
Total Split (s)		33.0		23.0	56.0					34.0		34.0
Total Split (%)		36.7%		25.6%	62.2%					37.8%		37.8%
Maximum Green (s)		27.0		17.0	50.0					28.0		28.0
Yellow Time (s)		4.0		4.0	4.0					4.0		4.0
All-Red Time (s)		2.0		2.0	2.0					2.0		2.0
Lost Time Adjust (s)		0.0		0.0	0.0					0.0		0.0
Total Lost Time (s)		6.0		6.0	6.0					6.0		6.0
Lead/Lag		Lag		Lead								
Lead-Lag Optimize?												
Vehicle Extension (s)		5.0		3.0	5.0					3.0		3.0
Recall Mode		C-Min		None	C-Min					None		None
Walk Time (s)		7.0			7.0							
Flash Dont Walk (s)		8.0			8.0							
Pedestrian Calls (#/hr)		0			0							
Act Effct Green (s)		36.1	90.0	14.2	56.3					21.7		21.7
Actuated g/C Ratio		0.40	1.00	0.16	0.63					0.24		0.24
v/c Ratio		0.53	0.35	0.69	0.33					0.24		0.81
Control Delay		24.5	0.6	21.4	0.4					26.6		28.6
Queue Delay		0.0	0.0	0.0	0.0					0.0		0.0
Total Delay		24.5	0.6	21.4	0.4					26.6		28.6
LOS		C	A	C	A					C		C
Approach Delay		14.4			4.7						28.0	
Approach LOS		B			A						C	
Queue Length 50th (ft)		172	0	5	0					45		120
Queue Length 95th (ft)		247	0	m0	m0					68		221
Internal Link Dist (ft)		771			613			406			501	
Turn Bay Length (ft)			350									
Base Capacity (vph)		1392	1553	324	2151					1047		623
Starvation Cap Reductn		0	0	0	0					0		0
Spillback Cap Reductn		0	0	0	0					0		0
Storage Cap Reductn		0	0	0	0					0		0
Reduced v/c Ratio		0.53	0.35	0.57	0.33					0.19		0.69

Intersection Summary

Area Type: Other

Cycle Length: 90

Actuated Cycle Length: 90

Offset: 51 (57%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow

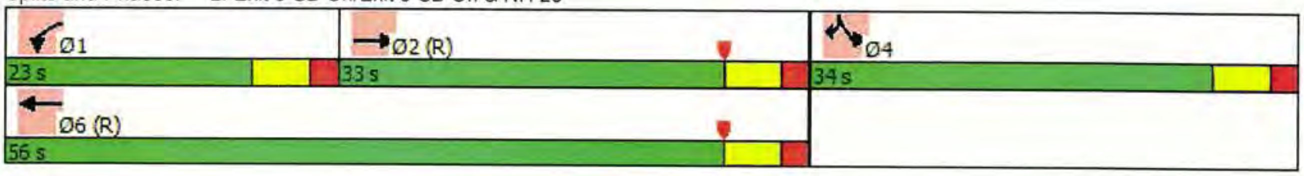
Natural Cycle: 60

Lanes, Volumes, Timings
3 ~~2~~: Exit 5 SB On/Exit 5 SB Off & NH 28

01/23/2018

Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.81
Intersection Signal Delay: 14.3 Intersection LOS: B
Intersection Capacity Utilization 70.4% ICU Level of Service C
Analysis Period (min) 15
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 2: Exit 5 SB On/Exit 5 SB Off & NH 28



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑			↑↑	↱	↰		↱			
Traffic Volume (vph)	440	380	0	0	455	230	320	0	370	0	0	0
Future Volume (vph)	440	380	0	0	455	230	320	0	370	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt						0.850			0.850			
Flt Protected	0.950						0.950					
Satd. Flow (prot)	1752	3505	0	0	3505	1568	1703	0	1524	0	0	0
Flt Permitted	0.950						0.950					
Satd. Flow (perm)	1752	3505	0	0	3505	1568	1703	0	1524	0	0	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						253			418			
Link Speed (mph)		30			30			35			30	
Link Distance (ft)		693			542			867			392	
Travel Time (s)		15.8			12.3			16.9			8.9	
Peak Hour Factor	0.92	0.92	0.92	0.91	0.91	0.91	0.67	0.67	0.67	0.92	0.92	0.92
Heavy Vehicles (%)	3%	3%	3%	3%	3%	3%	6%	6%	6%	2%	2%	2%
Adj. Flow (vph)	478	413	0	0	500	253	478	0	552	0	0	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	478	413	0	0	500	253	478	0	552	0	0	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Right	Left	Right	Left	Left	Right
Median Width(ft)		36			42			12			12	
Link Offset(ft)		0			0			0			36	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		25	15		25	15		9
Number of Detectors	3	3			3	3	3		0			
Detector Template	Left					Right	Left					
Leading Detector (ft)	256	256			256	256	256		0			
Trailing Detector (ft)	-5	-5			-5	-5	-5		0			
Detector 1 Position(ft)	-5	-5			-5	-5	-5		-5			
Detector 1 Size(ft)	50	50			50	50	50		50			
Detector 1 Type	Cl+Ex	Cl+Ex			Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex			
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0			0.0	0.0	0.0		0.0			
Detector 1 Queue (s)	0.0	0.0			0.0	0.0	0.0		0.0			
Detector 1 Delay (s)	0.0	0.0			0.0	0.0	0.0		0.0			
Detector 2 Position(ft)	125	125			125	125	125					
Detector 2 Size(ft)	6	6			6	6	6					
Detector 2 Type	Cl+Ex	Cl+Ex			Cl+Ex	Cl+Ex	Cl+Ex					
Detector 2 Channel												
Detector 2 Extend (s)	0.0	0.0			0.0	0.0	0.0					
Detector 3 Position(ft)	250	250			250	250	250					
Detector 3 Size(ft)	6	6			6	6	6					
Detector 3 Type	Cl+Ex	Cl+Ex			Cl+Ex	Cl+Ex	Cl+Ex					
Detector 3 Channel												
Detector 3 Extend (s)	0.0	0.0			0.0	0.0	0.0					

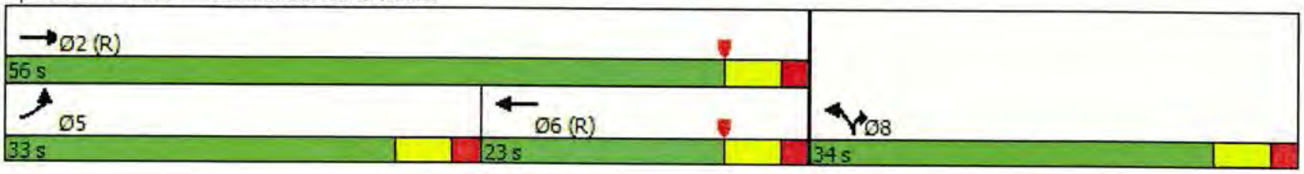
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Type	Prot	NA			NA	Free	Prot		Prot			
Protected Phases	5	2			6		8		8			
Permitted Phases		2			6	Free						
Detector Phase	5	2			6		8		8			
Switch Phase												
Minimum Initial (s)	4.0	16.0			16.0		4.0		4.0			
Minimum Split (s)	10.0	23.0			23.0		11.0		11.0			
Total Split (s)	33.0	56.0			23.0		34.0		34.0			
Total Split (%)	36.7%	62.2%			25.6%		37.8%		37.8%			
Maximum Green (s)	27.0	50.0			17.0		28.0		28.0			
Yellow Time (s)	4.0	4.0			4.0		4.0		4.0			
All-Red Time (s)	2.0	2.0			2.0		2.0		2.0			
Lost Time Adjust (s)	0.0	0.0			0.0		0.0		0.0			
Total Lost Time (s)	6.0	6.0			6.0		6.0		6.0			
Lead/Lag	Lead				Lag							
Lead-Lag Optimize?												
Vehicle Extension (s)	5.0	5.0			5.0		3.0		3.0			
Recall Mode	None	C-Min			C-Min		None		None			
Walk Time (s)		7.0			7.0							
Flash Dont Walk (s)		10.0			10.0							
Pedestrian Calls (#/hr)		0			0							
Act Effct Green (s)	26.9	50.1			17.1	90.0	27.9		27.9			
Actuated g/C Ratio	0.30	0.56			0.19	1.00	0.31		0.31			
v/c Ratio	0.91	0.21			0.75	0.16	0.91		0.73			
Control Delay	31.8	3.6			42.5	0.2	53.0		13.2			
Queue Delay	0.0	0.0			0.0	0.0	0.0		0.0			
Total Delay	31.8	3.6			42.5	0.2	53.0		13.2			
LOS	C	A			D	A	D		B			
Approach Delay		18.8			28.3			31.7				
Approach LOS		B			C			C				
Queue Length 50th (ft)	261	10			142	0	258		57			
Queue Length 95th (ft)	#440	9			198	0	254		48			
Internal Link Dist (ft)		613			462			787			312	
Turn Bay Length (ft)												
Base Capacity (vph)	525	1949			667	1568	529		762			
Starvation Cap Reductn	0	0			0	0	0		0			
Spillback Cap Reductn	0	0			0	0	0		0			
Storage Cap Reductn	0	0			0	0	0		0			
Reduced v/c Ratio	0.91	0.21			0.75	0.16	0.90		0.72			

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 90
Offset: 0 (0%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow, Master Intersection
Natural Cycle: 90
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.91
Intersection Signal Delay: 26.4 Intersection LOS: C

Intersection Capacity Utilization 70.4% ICU Level of Service C
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 3: Exit 5 NB Off & NH 28



Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	10	5	210	10	0	10	270	820	120	5	590	130
Future Volume (vph)	10	5	210	10	0	10	270	820	120	5	590	130
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		225	0		0	350		0	100		0
Storage Lanes	0		1	0		0	1		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00	0.95	0.95
Frt			0.850		0.932			0.981			0.973	
Flt Protected		0.967			0.976		0.950			0.950		
Satd. Flow (prot)	0	1801	1583	0	1728	0	1770	3472	0	1770	3444	0
Flt Permitted		0.871			0.834		0.950			0.950		
Satd. Flow (perm)	0	1622	1583	0	1477	0	1770	3472	0	1770	3444	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			228		182			28			31	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		593			447			750			330	
Travel Time (s)		13.5			10.2			17.0			7.5	
Peak Hour Factor	0.92	0.92	0.92	0.25	0.25	0.25	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	2%	2%	2%	0%	0%	0%	2%	2%	2%	2%	2%	2%
Adj. Flow (vph)	11	5	228	40	0	40	293	891	130	5	641	141
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	16	228	0	80	0	293	1021	0	5	782	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	3	3	1	3	1		3	3		3	3	
Detector Template	Left	Thru	Right	Left			Left	Thru		Left	Thru	
Leading Detector (ft)	256	256	45	256	45		256	256		256	256	
Trailing Detector (ft)	-5	-5	-5	-5	-5		-5	-5		-5	-5	
Detector 1 Position(ft)	-5	-5	-5	-5	-5		-5	-5		-5	-5	
Detector 1 Size(ft)	50	50	50	50	50		50	50		50	50	
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(ft)	125	125		125			125	125		125	125	
Detector 2 Size(ft)	6	6		6			6	6		6	6	
Detector 2 Type	Cl+Ex	Cl+Ex		Cl+Ex			Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)	0.0	0.0		0.0			0.0	0.0		0.0	0.0	
Detector 3 Position(ft)	250	250		250			250	250		250	250	
Detector 3 Size(ft)	6	6		6			6	6		6	6	

Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Detector 3 Type	Cl+Ex	Cl+Ex		Cl+Ex			Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 3 Channel												
Detector 3 Extend (s)	0.0	0.0		0.0			0.0	0.0		0.0	0.0	
Turn Type	Perm	NA	custom	Perm	NA		Prot	NA		Prot	NA	
Protected Phases		8			4		5	2		1	6	
Permitted Phases	8		6	4								
Detector Phase	8	8	6	4	4		5	2		1	6	
Switch Phase												
Minimum Initial (s)	5.0	5.0	8.0	5.0	5.0		5.0	8.0		5.0	8.0	
Minimum Split (s)	24.0	24.0	24.0	24.0	24.0		24.0	24.0		11.0	24.0	
Total Split (s)	24.0	24.0	36.0	24.0	24.0		30.0	55.0		11.0	36.0	
Total Split (%)	26.7%	26.7%	40.0%	26.7%	26.7%		33.3%	61.1%		12.2%	40.0%	
Maximum Green (s)	18.0	18.0	30.0	18.0	18.0		24.0	49.0		5.0	30.0	
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)		0.0	0.0		0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)		6.0	6.0		6.0		6.0	6.0		6.0	6.0	
Lead/Lag			Lag				Lead	Lag		Lead	Lag	
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None	Min	None	None		None	Min		None	Min	
Walk Time (s)	7.0	7.0	7.0	7.0	7.0		7.0	7.0			7.0	
Flash Dont Walk (s)	11.0	11.0	11.0	11.0	11.0		11.0	11.0			11.0	
Pedestrian Calls (#/hr)	0	0	0	0	0		0	0			0	
Act Effct Green (s)		6.8	27.1		6.8		16.9	50.8		5.4	27.1	
Actuated g/C Ratio		0.10	0.41		0.10		0.26	0.77		0.08	0.41	
v/c Ratio		0.10	0.29		0.25		0.65	0.38		0.03	0.55	
Control Delay		33.5	3.7		1.9		31.0	4.8		34.8	17.5	
Queue Delay		0.0	0.0		0.0		0.0	0.0		0.0	0.0	
Total Delay		33.5	3.7		1.9		31.0	4.8		34.8	17.5	
LOS		C	A		A		C	A		C	B	
Approach Delay		5.7			1.9			10.7			17.6	
Approach LOS		A			A			B			B	
Queue Length 50th (ft)		7	0		0		118	63		2	127	
Queue Length 95th (ft)		26	43		0		199	170		13	212	
Internal Link Dist (ft)		513			367			670			250	
Turn Bay Length (ft)			225				350			100		
Base Capacity (vph)		475	890		561		692	2683		144	1700	
Starvation Cap Reductn		0	0		0		0	0		0	0	
Spillback Cap Reductn		0	0		0		0	0		0	0	
Storage Cap Reductn		0	0		0		0	0		0	0	
Reduced v/c Ratio		0.03	0.26		0.14		0.42	0.38		0.03	0.46	

Intersection Summary

Area Type: Other

Cycle Length: 90

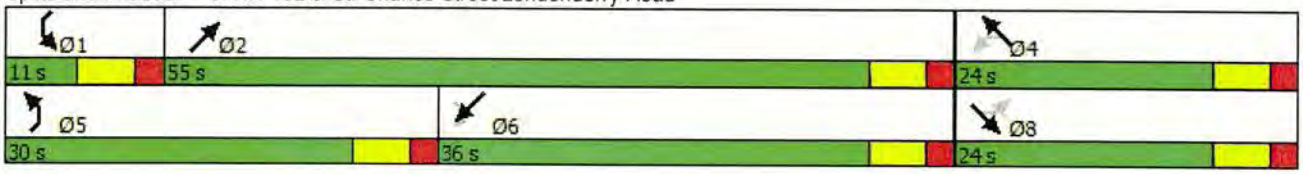
Actuated Cycle Length: 66.2

Natural Cycle: 75

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.65
Intersection Signal Delay: 12.1 Intersection LOS: B
Intersection Capacity Utilization 62.0% ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 9: NH 102 & St. Charles Street/Londonderry Road



Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	20	20	5	270	0	50	0	730	130	10	380	0
Future Volume (vph)	20	20	5	270	0	50	0	730	130	10	380	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.985			0.979			0.980				
Flt Protected		0.978			0.960						0.999	
Satd. Flow (prot)	0	1794	0	0	1734	0	0	1724	0	0	1808	0
Flt Permitted		0.834			0.708						0.890	
Satd. Flow (perm)	0	1530	0	0	1279	0	0	1724	0	0	1610	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		7			36			18				
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		356			493			1124			603	
Travel Time (s)		8.1			11.2			25.5			13.7	
Peak Hour Factor	0.60	0.60	0.60	0.96	0.96	0.96	0.89	0.89	0.89	0.86	0.86	0.86
Heavy Vehicles (%)	2%	2%	2%	3%	3%	3%	8%	8%	8%	5%	5%	5%
Adj. Flow (vph)	33	33	8	281	0	52	0	820	146	12	442	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	74	0	0	333	0	0	966	0	0	454	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0			0	
Link Offset(ft)		-22			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	3	1		3	2			2		3	2	
Detector Template	Left			Left						Left		
Leading Detector (ft)	256	45		256	131			131		256	131	
Trailing Detector (ft)	-5	-5		-5	-5			-5		-5	-5	
Detector 1 Position(ft)	-5	-5		-5	-5			-5		-5	-5	
Detector 1 Size(ft)	50	50		50	50			50		50	50	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex			Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0			0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0			0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0			0.0		0.0	0.0	
Detector 2 Position(ft)	125			125	125			125		125	125	
Detector 2 Size(ft)	6			6	6			6		6	6	
Detector 2 Type	Cl+Ex			Cl+Ex	Cl+Ex			Cl+Ex		Cl+Ex	Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)	0.0			0.0	0.0			0.0		0.0	0.0	
Detector 3 Position(ft)	250			250						250		
Detector 3 Size(ft)	6			6						6		
Detector 3 Type	Cl+Ex			Cl+Ex						Cl+Ex		
Detector 3 Channel												
Detector 3 Extend (s)	0.0			0.0						0.0		

Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Turn Type	Perm	NA		Perm	NA			NA		Perm	NA	
Protected Phases		4			4			2			2	
Permitted Phases	4			4						2		
Detector Phase	4	4		4	4			2		2	2	
Switch Phase												
Minimum Initial (s)	5.0	5.0		5.0	5.0			5.0		5.0	5.0	
Minimum Split (s)	24.0	24.0		24.0	24.0			24.0		24.0	24.0	
Total Split (s)	29.0	29.0		29.0	29.0			61.0		61.0	61.0	
Total Split (%)	32.2%	32.2%		32.2%	32.2%			67.8%		67.8%	67.8%	
Maximum Green (s)	23.0	23.0		23.0	23.0			55.0		55.0	55.0	
Yellow Time (s)	4.0	4.0		4.0	4.0			4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0			2.0		2.0	2.0	
Lost Time Adjust (s)		0.0			0.0			0.0			0.0	
Total Lost Time (s)		6.0			6.0			6.0			6.0	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0		3.0	3.0	
Recall Mode	None	None		None	None			Min		Min	Min	
Walk Time (s)	7.0	7.0		7.0	7.0			7.0		7.0	7.0	
Flash Dont Walk (s)	11.0	11.0		11.0	11.0			11.0		11.0	11.0	
Pedestrian Calls (#/hr)	0	0		0	0			0		0	0	
Act Effct Green (s)		22.3			22.3			52.1			52.1	
Actuated g/C Ratio		0.26			0.26			0.60			0.60	
v/c Ratio		0.18			0.94			0.92			0.47	
Control Delay		25.7			64.8			31.3			11.5	
Queue Delay		0.0			0.0			0.0			0.0	
Total Delay		25.7			64.8			31.3			11.5	
LOS		C			E			C			B	
Approach Delay		25.7			64.8			31.3			11.5	
Approach LOS		C			E			C			B	
Queue Length 50th (ft)		30			168			433			128	
Queue Length 95th (ft)		41			#338			#735			183	
Internal Link Dist (ft)		276			413			1044			523	
Turn Bay Length (ft)												
Base Capacity (vph)		415			368			1111			1031	
Starvation Cap Reductn		0			0			0			0	
Spillback Cap Reductn		0			0			0			0	
Storage Cap Reductn		0			0			0			0	
Reduced v/c Ratio		0.18			0.90			0.87			0.44	

Intersection Summary

Area Type: Other

Cycle Length: 90

Actuated Cycle Length: 86.5

Natural Cycle: 90

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.94

Intersection Signal Delay: 32.3 Intersection LOS: C

Intersection Capacity Utilization 84.3% ICU Level of Service E

Analysis Period (min) 15

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 10: NH 102 & Fordway/Madden Hill Road

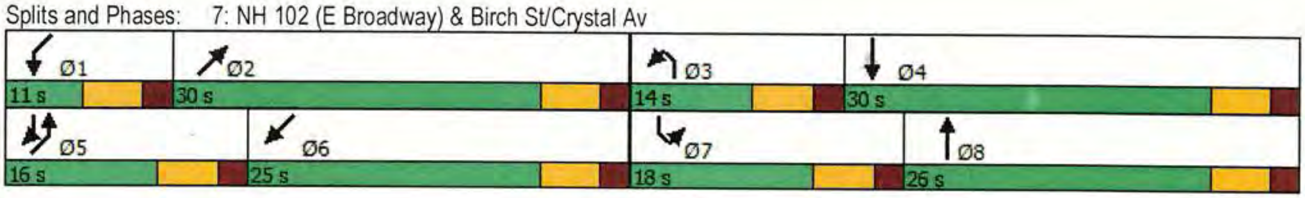
Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	70	310	20	130	400	60	80	390	30	50	270	60
Future Volume (vph)	70	310	20	130	400	60	80	390	30	50	270	60
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	70		0	245		245	390		0	110		0
Storage Lanes	1		0	1		1	1		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.991				0.850		0.989			0.973	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1752	1828	0	1752	1845	1568	1787	1860	0	1787	1830	0
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1752	1828	0	1752	1845	1568	1787	1860	0	1787	1830	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		4				116		5			12	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		361			411			477			530	
Travel Time (s)		8.2			9.3			10.8			12.0	
Peak Hour Factor	0.91	0.91	0.91	0.93	0.93	0.93	0.95	0.95	0.95	0.94	0.94	0.94
Heavy Vehicles (%)	3%	3%	3%	3%	3%	3%	1%	1%	1%	1%	1%	1%
Adj. Flow (vph)	77	341	22	140	430	65	84	411	32	53	287	64
Shared Lane Traffic (%)												
Lane Group Flow (vph)	77	363	0	140	430	65	84	443	0	53	351	0
Turn Type	Prot	NA		Prot	NA	pm+ov	Prot	NA		Prot	NA	
Protected Phases	3	8		7	4	5	5	2		1	6	
Permitted Phases						4						
Detector Phase	3	8		7	4	5	5	2		1	6	
Switch Phase												
Minimum Initial (s)	4.0	5.0		4.0	10.0	4.0	4.0	10.0		4.0	9.0	
Minimum Split (s)	10.0	24.0		11.0	24.0	16.0	16.0	24.0		11.0	24.0	
Total Split (s)	14.0	26.0		18.0	30.0	16.0	16.0	30.0		11.0	25.0	
Total Split (%)	16.5%	30.6%		21.2%	35.3%	18.8%	18.8%	35.3%		12.9%	29.4%	
Maximum Green (s)	8.0	20.0		12.0	24.0	10.0	10.0	24.0		5.0	19.0	
Yellow Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0	2.0	2.0	2.0		2.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Lead/Lag	Lead	Lag		Lead	Lag	Lead	Lead	Lag		Lead	Lag	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes	Yes	Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None	None	None	Max		None	None	
Act Effct Green (s)	7.5	18.7		10.6	21.3	36.1	8.6	26.7		5.2	21.5	
Actuated g/C Ratio	0.10	0.24		0.14	0.28	0.47	0.11	0.35		0.07	0.28	
v/c Ratio	0.45	0.81		0.58	0.84	0.08	0.42	0.68		0.43	0.68	
Control Delay	45.3	45.4		44.4	44.1	0.8	41.9	32.2		50.7	36.7	
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Total Delay	45.3	45.4		44.4	44.1	0.8	41.9	32.2		50.7	36.7	
LOS	D	D		D	D	A	D	C		D	D	
Approach Delay		45.3			39.8			33.7			38.5	

Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Approach LOS		D			D			C			D	
Queue Length 50th (ft)	40	183		71	214	0	43	219		28	172	
Queue Length 95th (ft)	83	#331		129	#368	5	87	#379		#74	#321	
Internal Link Dist (ft)		281			331			397			450	
Turn Bay Length (ft)	70			245		245	390			110		
Base Capacity (vph)	190	501		286	603	836	243	650		122	523	
Starvation Cap Reductn	0	0		0	0	0	0	0		0	0	
Spillback Cap Reductn	0	0		0	0	0	0	0		0	0	
Storage Cap Reductn	0	0		0	0	0	0	0		0	0	
Reduced v/c Ratio	0.41	0.72		0.49	0.71	0.08	0.35	0.68		0.43	0.67	

Intersection Summary

Area Type: Other
Cycle Length: 85
Actuated Cycle Length: 76.7
Natural Cycle: 75
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.84
Intersection Signal Delay: 39.2 Intersection LOS: D
Intersection Capacity Utilization 87.2% ICU Level of Service E
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 7: NH 102 (E Broadway) & Birch St/Crystal Av



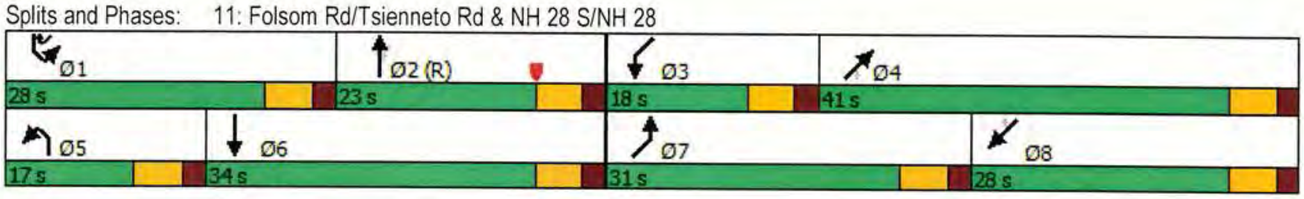
Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	80	330	140	560	530	0	320	500	120	50	290	590
Future Volume (vph)	80	330	140	560	530	0	320	500	120	50	290	590
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	110		90	360		0	190		180	0		210
Storage Lanes	1		1	2		0	1		1	1		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850						0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1770	3539	1583	3433	3539	0	1770	1863	1583	1787	1881	1599
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1770	3539	1583	3433	3539	0	1770	1863	1583	1787	1881	1599
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			268						208			149
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		639			495			532			387	
Travel Time (s)		14.5			11.3			12.1			8.8	
Peak Hour Factor	0.92	0.92	0.92	0.94	0.94	0.94	0.96	0.96	0.96	0.95	0.95	0.95
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	1%	1%	1%
Adj. Flow (vph)	87	359	152	596	564	0	333	521	125	53	305	621
Shared Lane Traffic (%)												
Lane Group Flow (vph)	87	359	152	596	564	0	333	521	125	53	305	621
Turn Type	Prot	NA	Perm	Prot	NA		Prot	NA	Perm	Prot	NA	pm+ov
Protected Phases	5	2		1	6		7	4		3	8	1
Permitted Phases			2						4			8
Detector Phase	5	2	2	1	6		7	4	4	3	8	1
Switch Phase												
Minimum Initial (s)	8.0	8.0	8.0	8.0	8.0		8.0	8.0	8.0	8.0	8.0	8.0
Minimum Split (s)	14.0	22.0	22.0	14.0	22.0		14.0	22.0	22.0	14.0	22.0	14.0
Total Split (s)	17.0	23.0	23.0	28.0	34.0		31.0	41.0	41.0	18.0	28.0	28.0
Total Split (%)	15.5%	20.9%	20.9%	25.5%	30.9%		28.2%	37.3%	37.3%	16.4%	25.5%	25.5%
Maximum Green (s)	11.0	17.0	17.0	22.0	28.0		25.0	35.0	35.0	12.0	22.0	22.0
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0		6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag		Lead	Lag	Lag	Lead	Lag	Lead
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes	Yes	Yes	Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	C-Max	C-Max	None	None		None	None	None	None	None	None
Walk Time (s)		5.0	5.0		5.0			5.0	5.0		5.0	
Flash Dont Walk (s)		11.0	11.0		11.0			11.0	11.0		11.0	
Pedestrian Calls (#/hr)		0	0		0			0	0		0	
Act Effct Green (s)	9.9	19.9	19.9	22.1	34.8		23.4	37.6	37.6	9.3	20.6	48.7
Actuated g/C Ratio	0.09	0.18	0.18	0.20	0.32		0.21	0.34	0.34	0.08	0.19	0.44
v/c Ratio	0.54	0.56	0.30	0.87	0.50		0.89	0.82	0.18	0.35	0.87	0.79
Control Delay	60.7	46.1	1.5	69.2	34.7		67.2	45.7	0.6	53.8	67.4	27.5
Queue Delay	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0

Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Total Delay	60.7	46.1	1.5	69.2	34.7		67.2	45.7	0.6	53.8	67.4	27.5
LOS	E	D	A	E	C		E	D	A	D	E	C
Approach Delay		36.9			52.4			47.3			41.4	
Approach LOS		D			D			D			D	
Queue Length 50th (ft)	59	126	0	184	121		225	329	0	36	207	280
Queue Length 95th (ft)	112	177	0	#316	200		#374	#536	0	75	#345	438
Internal Link Dist (ft)		559			415			452			307	
Turn Bay Length (ft)	110		90	360			190		180			210
Base Capacity (vph)	177	640	506	700	1120		402	636	677	194	376	795
Starvation Cap Reductn	0	0	0	0	0		0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0		0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0		0	0	0	0	0	0
Reduced v/c Ratio	0.49	0.56	0.30	0.85	0.50		0.83	0.82	0.18	0.27	0.81	0.78

Intersection Summary

Area Type: Other
Cycle Length: 110
Actuated Cycle Length: 110
Offset: 16 (15%), Referenced to phase 2:NBT, Start of Yellow
Natural Cycle: 90
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.89
Intersection Signal Delay: 45.7 Intersection LOS: D
Intersection Capacity Utilization 78.4% ICU Level of Service D
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 11: Folsom Rd/Tsienneto Rd & NH 28 S/NH 28



Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	90	1225	5	20	1030	100	15	10	15	10	10	30
Future Volume (vph)	90	1225	5	20	1030	100	15	10	15	10	10	30
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	100		0	115		0	0		0	0		0
Storage Lanes	1		0	1		0	0		1	0		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.999			0.987				0.850			0.850
Flt Protected	0.950			0.950				0.971			0.976	
Satd. Flow (prot)	1787	3571	0	1787	3528	0	0	1845	1615	0	1836	1599
Flt Permitted	0.950			0.950				0.799			0.827	
Satd. Flow (perm)	1787	3571	0	1787	3528	0	0	1518	1615	0	1556	1599
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		1			13				149			149
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		277			652			230			387	
Travel Time (s)		6.3			14.8			5.2			8.8	
Peak Hour Factor	0.97	0.97	0.97	0.95	0.95	0.95	0.90	0.90	0.90	0.80	0.80	0.80
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	0%	0%	0%	1%	1%	1%
Adj. Flow (vph)	93	1263	5	21	1084	105	17	11	17	13	13	38
Shared Lane Traffic (%)												
Lane Group Flow (vph)	93	1268	0	21	1189	0	0	28	17	0	26	38
Turn Type	Prot	NA		Prot	NA		Perm	NA	Perm	Perm	NA	Perm
Protected Phases	5	2		1	6			8			4	
Permitted Phases							8		8	4	4	4
Detector Phase	5	2		1	6		8	8	8	4	4	4
Switch Phase												
Minimum Initial (s)	5.0	8.0		5.0	8.0		5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	26.0	63.0		11.0	48.0		21.0	21.0	21.0	21.0	21.0	21.0
Total Split (s)	27.0	78.0		11.0	62.0		21.0	21.0	21.0	21.0	21.0	21.0
Total Split (%)	24.5%	70.9%		10.0%	56.4%		19.1%	19.1%	19.1%	19.1%	19.1%	19.1%
Maximum Green (s)	21.0	72.0		5.0	56.0		15.0	15.0	15.0	15.0	15.0	15.0
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0			0.0	0.0		0.0	0.0
Total Lost Time (s)	6.0	6.0		6.0	6.0			6.0	6.0		6.0	6.0
Lead/Lag	Lead	Lag		Lead	Lag							
Lead-Lag Optimize?	Yes	Yes		Yes	Yes							
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	C-Max		None	Max		None	None	None	None	None	None
Walk Time (s)		7.0			7.0		7.0	7.0	7.0	7.0	7.0	7.0
Flash Dont Walk (s)		11.0			11.0		8.0	8.0	8.0	8.0	8.0	8.0
Pedestrian Calls (#/hr)		0			0		0	0	0	0	0	0
Act Effct Green (s)	11.0	88.4		6.9	79.5			7.5	7.5		7.5	7.5
Actuated g/C Ratio	0.10	0.80		0.06	0.72			0.07	0.07		0.07	0.07
v/c Ratio	0.52	0.44		0.19	0.47			0.27	0.07		0.25	0.15
Control Delay	54.5	9.2		51.0	10.5			54.6	0.5		53.5	1.3
Queue Delay	0.0	0.0		0.0	0.0			0.0	0.0		0.0	0.0

Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Total Delay	54.5	9.2		51.0	10.5			54.6	0.5		53.5	1.3
LOS	D	A		D	B			D	A		D	A
Approach Delay		12.3			11.2			34.1			22.5	
Approach LOS		B			B			C			C	
Queue Length 50th (ft)	63	247		15	221			19	0		18	0
Queue Length 95th (ft)	m96	442		m20	280			48	0		40	0
Internal Link Dist (ft)		197			572			150			307	
Turn Bay Length (ft)	100			115								
Base Capacity (vph)	341	2868		111	2554			207	348		212	346
Starvation Cap Reductn	0	0		0	0			0	0		0	0
Spillback Cap Reductn	0	0		0	0			0	0		0	0
Storage Cap Reductn	0	0		0	0			0	0		0	0
Reduced v/c Ratio	0.27	0.44		0.19	0.47			0.14	0.05		0.12	0.11

Intersection Summary

Area Type: Other
Cycle Length: 110
Actuated Cycle Length: 110
Offset: 49 (45%), Referenced to phase 2:SET, Start of Yellow
Natural Cycle: 95
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.52
Intersection Signal Delay: 12.4 Intersection LOS: B
Intersection Capacity Utilization 61.2% ICU Level of Service B
Analysis Period (min) 15
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 13: Applebee's/Linlew Dr & NH 28

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	530	1270	5	5	1080	70	40	10	10	80	5	490
Future Volume (vph)	530	1270	5	5	1080	70	40	10	10	80	5	490
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200		150	205		150	0		0	0		220
Storage Lanes	2		0	1		0	1		0	0		1
Taper Length (ft)	150			25			25			25		
Lane Util. Factor	0.97	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.999			0.991			0.925				0.850
Flt Protected	0.950			0.950			0.950				0.955	
Satd. Flow (prot)	3467	3571	0	1770	3507	0	1805	1758	0	0	1814	1615
Flt Permitted	0.950			0.950			0.693				0.720	
Satd. Flow (perm)	3467	3571	0	1770	3507	0	1317	1758	0	0	1368	1615
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		1			7			13				30
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		877			314			151			476	
Travel Time (s)		19.9			7.1			3.4			10.8	
Peak Hour Factor	0.84	0.84	0.84	0.90	0.90	0.90	0.78	0.78	0.78	0.86	0.86	0.86
Heavy Vehicles (%)	1%	1%	1%	2%	2%	2%	0%	0%	0%	0%	0%	0%
Adj. Flow (vph)	631	1512	6	6	1200	78	51	13	13	93	6	570
Shared Lane Traffic (%)												
Lane Group Flow (vph)	631	1518	0	6	1278	0	51	26	0	0	99	570
Turn Type	Prot	NA		Prot	NA		Perm	NA		Perm	NA	pm+ov
Protected Phases	5	2		1	6			8			4	5
Permitted Phases							8	8		4		4
Detector Phase	5	2		1	6		8	8		4	4	5
Switch Phase												
Minimum Initial (s)	5.0	8.0		5.0	8.0		5.0	5.0		8.0	8.0	5.0
Minimum Split (s)	11.0	53.0		11.0	50.0		22.0	22.0		22.0	22.0	11.0
Total Split (s)	34.0	72.0		11.0	49.0		27.0	27.0		27.0	27.0	34.0
Total Split (%)	30.9%	65.5%		10.0%	44.5%		24.5%	24.5%		24.5%	24.5%	30.9%
Maximum Green (s)	28.0	66.0		5.0	43.0		21.0	21.0		21.0	21.0	28.0
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0			0.0	0.0
Total Lost Time (s)	6.0	6.0		6.0	6.0		6.0	6.0			6.0	6.0
Lead/Lag	Lead	Lag		Lead	Lag							Lead
Lead-Lag Optimize?	Yes	Yes		Yes	Yes							Yes
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Recall Mode	None	C-Max		None	None		None	None		None	None	None
Walk Time (s)		5.0			5.0		5.0	5.0		5.0	5.0	
Flash Dont Walk (s)		11.0			11.0		11.0	11.0		11.0	11.0	
Pedestrian Calls (#/hr)		0			0		0	0		0	0	
Act Effct Green (s)	29.0	82.1		6.0	49.7		13.3	13.3			13.3	48.3
Actuated g/C Ratio	0.26	0.75		0.05	0.45		0.12	0.12			0.12	0.44
v/c Ratio	0.69	0.57		0.06	0.80		0.32	0.12			0.60	0.79
Control Delay	40.5	8.6		41.2	47.6		47.9	26.9			59.8	32.6
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0			0.0	0.0

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Total Delay	40.5	8.6		41.2	47.6		47.9	26.9			59.8	32.6
LOS	D	A		D	D		D	C			E	C
Approach Delay		18.0			47.5			40.8			36.7	
Approach LOS		B			D			D			D	
Queue Length 50th (ft)	198	185		4	498		33	8			67	304
Queue Length 95th (ft)	243	393		m9	#610		58	27			112	384
Internal Link Dist (ft)		797			234			71			396	
Turn Bay Length (ft)	200			205								220
Base Capacity (vph)	961	2664		96	1588		251	346			261	748
Starvation Cap Reductn	0	0		0	0		0	0			0	0
Spillback Cap Reductn	0	0		0	0		0	0			0	0
Storage Cap Reductn	0	0		0	0		0	0			0	0
Reduced v/c Ratio	0.66	0.57		0.06	0.80		0.20	0.08			0.38	0.76

Intersection Summary

Area Type: Other
Cycle Length: 110
Actuated Cycle Length: 110
Offset: 0 (0%), Referenced to phase 2:EBT, Start of Yellow
Natural Cycle: 90
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.80
Intersection Signal Delay: 30.5 Intersection LOS: C
Intersection Capacity Utilization 81.6% ICU Level of Service D
Analysis Period (min) 15
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 22: VIP Dr/Connector Rd & NH 28

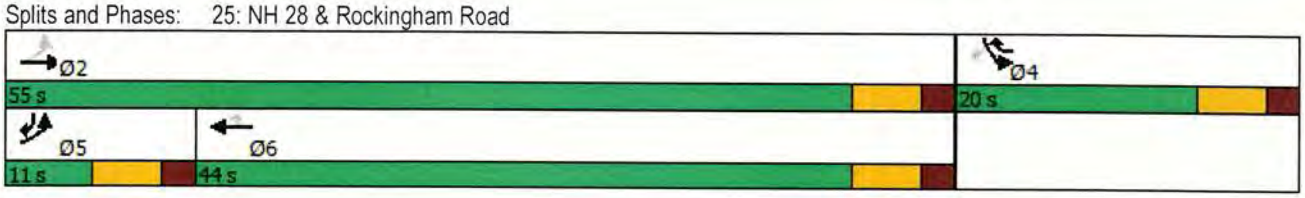
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	125	1510	1425	290	120	75
Future Volume (vph)	125	1510	1425	290	120	75
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200			150	360	0
Storage Lanes	1			1	1	1
Taper Length (ft)	25				25	
Lane Util. Factor	1.00	0.95	0.95	1.00	1.00	1.00
Frt				0.850		0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1770	3539	3539	1583	1770	1583
Flt Permitted	0.094				0.950	
Satd. Flow (perm)	175	3539	3539	1583	1770	1583
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)				263		17
Link Speed (mph)		30	30		30	
Link Distance (ft)		463	580		704	
Travel Time (s)		10.5	13.2		16.0	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	136	1641	1549	315	130	82
Shared Lane Traffic (%)						
Lane Group Flow (vph)	136	1641	1549	315	130	82
Turn Type	pm+pt	NA	NA	pm+ov	Prot	pm+ov
Protected Phases	5	2	6	4	4	5
Permitted Phases	2			6		4
Detector Phase	5	2	6	4	4	5
Switch Phase						
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	11.0	20.0	20.0	20.0	20.0	11.0
Total Split (s)	11.0	55.0	44.0	20.0	20.0	11.0
Total Split (%)	14.7%	73.3%	58.7%	26.7%	26.7%	14.7%
Maximum Green (s)	5.0	49.0	38.0	14.0	14.0	5.0
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag	Lead		Lag			Lead
Lead-Lag Optimize?	Yes		Yes			Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	None	None	None	None	None
Act Effct Green (s)	44.9	44.9	36.7	54.8	10.3	21.6
Actuated g/C Ratio	0.67	0.67	0.54	0.81	0.15	0.32
v/c Ratio	0.57	0.70	0.81	0.24	0.49	0.16
Control Delay	18.0	9.2	18.2	1.0	34.3	15.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	18.0	9.2	18.2	1.0	34.3	15.9
LOS	B	A	B	A	C	B
Approach Delay		9.8	15.3		27.2	
Approach LOS		A	B		C	

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Queue Length 50th (ft)	17	185	277	4	54	21
Queue Length 95th (ft)	#77	298	#417	18	103	51
Internal Link Dist (ft)		383	500		624	
Turn Bay Length (ft)	200			150	360	
Base Capacity (vph)	237	2626	2046	1373	377	517
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.57	0.62	0.76	0.23	0.34	0.16

Intersection Summary

Area Type: Other
Cycle Length: 75
Actuated Cycle Length: 67.5
Natural Cycle: 70
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.81
Intersection Signal Delay: 13.4 Intersection LOS: B
Intersection Capacity Utilization 68.0% ICU Level of Service C
Analysis Period (min) 15
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 25: NH 28 & Rockingham Road



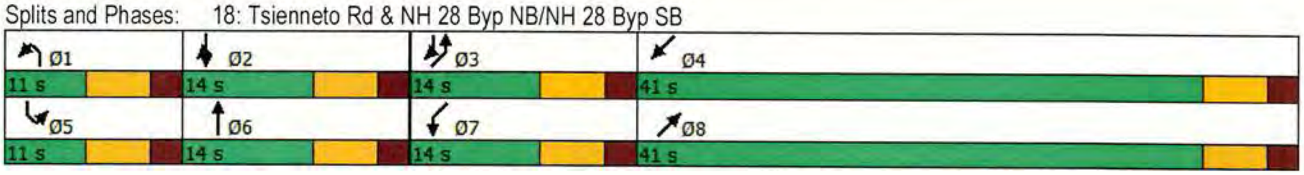
Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations	↰	↑↱		↰	↑	↱	↰	↑↱		↰	↑↱	
Traffic Volume (vph)	30	70	30	30	30	50	40	660	70	20	180	30
Future Volume (vph)	30	70	30	30	30	50	40	660	70	20	180	30
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200		0	190		190	135		0	120		0
Storage Lanes	1		0	1		1	1		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.955				0.850		0.986			0.979	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1770	1779	0	1787	1881	1599	1805	1873	0	1805	1860	0
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1770	1779	0	1787	1881	1599	1805	1873	0	1805	1860	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		21				123		9			13	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		481			347			479			371	
Travel Time (s)		10.9			7.9			10.9			8.4	
Peak Hour Factor	0.99	0.99	0.99	0.95	0.95	0.95	0.89	0.89	0.89	0.93	0.93	0.93
Heavy Vehicles (%)	2%	2%	2%	1%	1%	1%	0%	0%	0%	0%	0%	0%
Adj. Flow (vph)	30	71	30	32	32	53	45	742	79	22	194	32
Shared Lane Traffic (%)												
Lane Group Flow (vph)	30	101	0	32	32	53	45	821	0	22	226	0
Turn Type	Prot	NA		Prot	NA	pt+ov	Prot	NA		Prot	NA	
Protected Phases	1	6		5	2	2 3	3	8		7	4	
Permitted Phases		6			2							
Detector Phase	1	6		5	2	2 3	3	8		7	4	
Switch Phase												
Minimum Initial (s)	5.0	8.0		5.0	8.0		8.0	8.0		5.0	8.0	
Minimum Split (s)	11.0	14.0		11.0	14.0		14.0	28.0		11.0	14.0	
Total Split (s)	11.0	14.0		11.0	14.0		14.0	41.0		14.0	41.0	
Total Split (%)	13.8%	17.5%		13.8%	17.5%		17.5%	51.3%		17.5%	51.3%	
Maximum Green (s)	5.0	8.0		5.0	8.0		8.0	35.0		8.0	35.0	
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lag		Lead	Lag	
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	Max		None	None		None	None	
Walk Time (s)								7.0				
Flash Dont Walk (s)								15.0				
Pedestrian Calls (#/hr)								0				
Act Effct Green (s)	5.2	8.3		5.2	8.3	22.9	8.3	34.8		6.5	31.4	
Actuated g/C Ratio	0.08	0.13		0.08	0.13	0.36	0.13	0.55		0.10	0.49	
v/c Ratio	0.21	0.40		0.22	0.13	0.08	0.19	0.80		0.12	0.24	
Control Delay	36.5	30.2		36.6	31.4	0.2	32.0	23.4		32.5	12.3	
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	

Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Total Delay	36.5	30.2		36.6	31.4	0.2	32.0	23.4		32.5	12.3	
LOS	D	C		D	C	A	C	C		C	B	
Approach Delay		31.6			18.7			23.9			14.1	
Approach LOS		C			B			C			B	
Queue Length 50th (ft)	9	24		10	9	0	13	140		7	47	
Queue Length 95th (ft)	41	86		43	41	0	52	#636		32	113	
Internal Link Dist (ft)		401			267			399			291	
Turn Bay Length (ft)	200			190		190	135			120		
Base Capacity (vph)	145	251		146	247	655	236	1079		236	1074	
Starvation Cap Reductn	0	0		0	0	0	0	0		0	0	
Spillback Cap Reductn	0	0		0	0	0	0	0		0	0	
Storage Cap Reductn	0	0		0	0	0	0	0		0	0	
Reduced v/c Ratio	0.21	0.40		0.22	0.13	0.08	0.19	0.76		0.09	0.21	

Intersection Summary

Area Type: Other
Cycle Length: 80
Actuated Cycle Length: 63.5
Natural Cycle: 80
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.80
Intersection Signal Delay: 22.4 Intersection LOS: C
Intersection Capacity Utilization 57.3% ICU Level of Service B
Analysis Period (min) 15
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 18: Tsienneto Rd & NH 28 Byp NB/NH 28 Byp SB



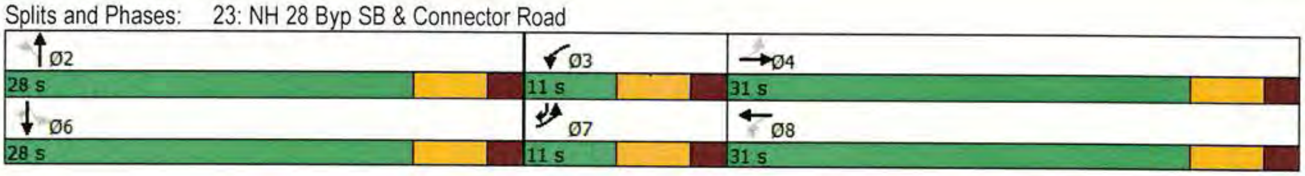
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	60	460	5	10	490	10	5	60	10	10	60	70
Future Volume (vph)	60	460	5	10	490	10	5	60	10	10	60	70
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	275		0	75		100	75		0	210		210
Storage Lanes	1		0	1		0	1		0	1		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.999			0.997			0.978				0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1770	1861	0	1770	1857	0	1770	1822	0	1770	1863	1583
Flt Permitted	0.223			0.356			0.715			0.708		
Satd. Flow (perm)	415	1861	0	663	1857	0	1332	1822	0	1319	1863	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		1			2			11				76
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		310			410			481			432	
Travel Time (s)		7.0			9.3			10.9			9.8	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	65	500	5	11	533	11	5	65	11	11	65	76
Shared Lane Traffic (%)												
Lane Group Flow (vph)	65	505	0	11	544	0	5	76	0	11	65	76
Turn Type	pm+pt	NA		pm+pt	NA		Perm	NA		Perm	NA	pm+ov
Protected Phases	7	4		3	8			2			6	7
Permitted Phases	4			8			2			6		6
Detector Phase	7	4		3	8		2	2		6	6	7
Switch Phase												
Minimum Initial (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	5.0
Minimum Split (s)	11.0	28.0		11.0	28.0		28.0	28.0		28.0	28.0	11.0
Total Split (s)	11.0	31.0		11.0	31.0		28.0	28.0		28.0	28.0	11.0
Total Split (%)	15.7%	44.3%		15.7%	44.3%		40.0%	40.0%		40.0%	40.0%	15.7%
Maximum Green (s)	5.0	25.0		5.0	25.0		22.0	22.0		22.0	22.0	5.0
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	6.0
Lead/Lag	Lead	Lag		Lead	Lag							Lead
Lead-Lag Optimize?	Yes	Yes		Yes	Yes							Yes
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Recall Mode	None	Max		None	None		Max	Max		None	None	None
Walk Time (s)		7.0			7.0		7.0	7.0		7.0	7.0	
Flash Dont Walk (s)		15.0			15.0		15.0	15.0		15.0	15.0	
Pedestrian Calls (#/hr)		0			0		0	0		0	0	
Act Effct Green (s)	31.9	30.9		28.4	24.5		22.1	22.1		22.1	22.1	33.1
Actuated g/C Ratio	0.47	0.46		0.42	0.36		0.33	0.33		0.33	0.33	0.49
v/c Ratio	0.22	0.59		0.03	0.80		0.01	0.13		0.03	0.11	0.09
Control Delay	10.6	18.3		8.8	31.2		16.8	15.8		17.0	17.6	3.2
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Total Delay	10.6	18.3		8.8	31.2		16.8	15.8		17.0	17.6	3.2

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
LOS	B	B		A	C		B	B		B	B	A
Approach Delay		17.4			30.8			15.8			10.4	
Approach LOS		B			C			B			B	
Queue Length 50th (ft)	13	135		2	208		2	20		3	20	0
Queue Length 95th (ft)	31	#331		9	#373		8	48		14	46	19
Internal Link Dist (ft)		230			330			401			352	
Turn Bay Length (ft)	275			75			75			210		210
Base Capacity (vph)	298	857		362	695		437	606		433	612	819
Starvation Cap Reductn	0	0		0	0		0	0		0	0	0
Spillback Cap Reductn	0	0		0	0		0	0		0	0	0
Storage Cap Reductn	0	0		0	0		0	0		0	0	0
Reduced v/c Ratio	0.22	0.59		0.03	0.78		0.01	0.13		0.03	0.11	0.09

Intersection Summary

Area Type: Other
Cycle Length: 70
Actuated Cycle Length: 67.2
Natural Cycle: 70
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.80
Intersection Signal Delay: 22.0 Intersection LOS: C
Intersection Capacity Utilization 52.8% ICU Level of Service A
Analysis Period (min) 15
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 23: NH 28 Byp SB & Connector Road



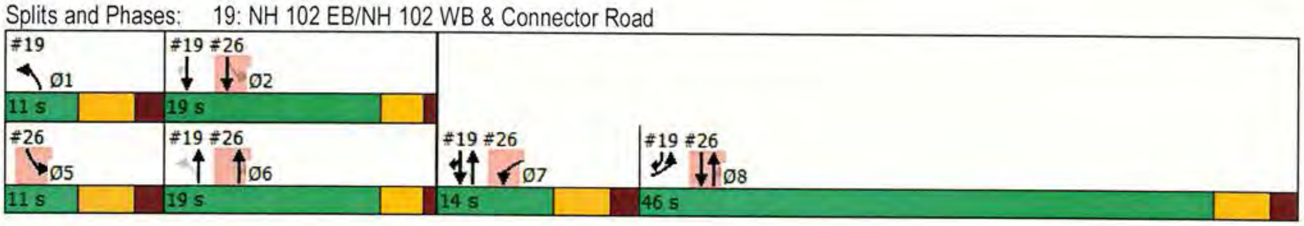
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR	Ø2	Ø5	Ø6	Ø7
Lane Configurations										
Traffic Volume (vph)	700	10	40	130	130	650				
Future Volume (vph)	700	10	40	130	130	650				
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900				
Storage Length (ft)	0	0	120			90				
Storage Lanes	1	0	1			1				
Taper Length (ft)	25		25							
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00				
Frt	0.998					0.850				
Flt Protected	0.953		0.950							
Satd. Flow (prot)	1772	0	1626	1712	1863	1583				
Flt Permitted	0.953		0.596							
Satd. Flow (perm)	1772	0	1020	1712	1863	1583				
Right Turn on Red		Yes				Yes				
Satd. Flow (RTOR)	1					793				
Link Speed (mph)	30			30	30					
Link Distance (ft)	475			739	258					
Travel Time (s)	10.8			16.8	5.9					
Peak Hour Factor	0.94	0.94	0.91	0.91	0.82	0.82				
Heavy Vehicles (%)	2%	2%	11%	11%	2%	2%				
Adj. Flow (vph)	745	11	44	143	159	793				
Shared Lane Traffic (%)										
Lane Group Flow (vph)	756	0	44	143	159	793				
Turn Type	Prot		pm+pt	NA	NA	custom				
Protected Phases	8		1	6 7	2 7	7 8	2	5	6	7
Permitted Phases			6 7			2				
Detector Phase	8		1	6 7	2 7	7 8				
Switch Phase										
Minimum Initial (s)	5.0		5.0				5.0	5.0	5.0	5.0
Minimum Split (s)	26.5		11.0				9.0	11.0	9.0	11.0
Total Split (s)	46.0		11.0				19.0	11.0	19.0	14.0
Total Split (%)	51.1%		12.2%				21%	12%	21%	16%
Maximum Green (s)	40.0		5.0				15.0	5.0	15.0	8.0
Yellow Time (s)	4.0		4.0				3.0	4.0	3.0	4.0
All-Red Time (s)	2.0		2.0				1.0	2.0	1.0	2.0
Lost Time Adjust (s)	0.0		0.0							
Total Lost Time (s)	6.0		6.0							
Lead/Lag	Lag		Lead				Lag	Lead	Lag	Lead
Lead-Lag Optimize?	Yes		Yes				Yes	Yes	Yes	Yes
Vehicle Extension (s)	3.0		3.0				3.0	3.0	3.0	3.0
Recall Mode	None		None				Min	None	Min	None
Act Effct Green (s)	40.4		27.7	26.9	26.9	74.0				
Actuated g/C Ratio	0.48		0.33	0.32	0.32	0.89				
v/c Ratio	0.88		0.12	0.26	0.27	0.53				
Control Delay	35.7		16.8	23.4	24.4	1.5				
Queue Delay	0.0		0.0	0.0	1.3	0.4				
Total Delay	35.7		16.8	23.4	25.7	1.9				
LOS	D		B	C	C	A				
Approach Delay	35.7			21.8	5.9					

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR	Ø2	Ø5	Ø6	Ø7
Approach LOS	D			C	A					
Queue Length 50th (ft)	403		14	60	62	5				
Queue Length 95th (ft)	#654		35	107	98	0				
Internal Link Dist (ft)	395			659	178					
Turn Bay Length (ft)			120			90				
Base Capacity (vph)	857		374	548	597	1480				
Starvation Cap Reductn	0		0	0	276	260				
Spillback Cap Reductn	0		0	0	0	0				
Storage Cap Reductn	0		0	0	0	0				
Reduced v/c Ratio	0.88		0.12	0.26	0.50	0.65				

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 83.5
Natural Cycle: 90
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.88
Intersection Signal Delay: 19.4 Intersection LOS: B
Intersection Capacity Utilization 63.7% ICU Level of Service B
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 19: NH 102 EB/NH 102 WB & Connector Road



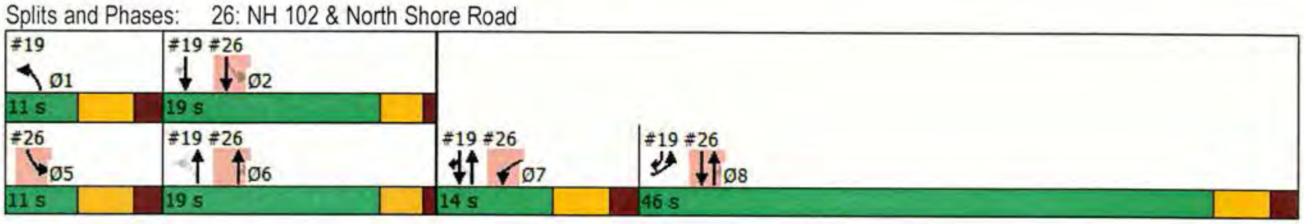
Lane Group	WBL	WBR	NBT	NBR	SBL	SBT	Ø1	Ø2	Ø6	Ø8
Lane Configurations										
Traffic Volume (vph)	70	10	680	150	30	710				
Future Volume (vph)	70	10	680	150	30	710				
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900				
Storage Length (ft)	0	0		90	100					
Storage Lanes	1	0		1	1					
Taper Length (ft)	25				25					
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00				
Frt	0.979			0.850						
Flt Protected	0.960				0.950					
Satd. Flow (prot)	1771	0	1900	1615	1805	1900				
Flt Permitted	0.960				0.312					
Satd. Flow (perm)	1771	0	1900	1615	593	1900				
Right Turn on Red		Yes		Yes						
Satd. Flow (RTOR)	8			125						
Link Speed (mph)	30		30			30				
Link Distance (ft)	524		258			288				
Travel Time (s)	11.9		5.9			6.5				
Peak Hour Factor	0.87	0.67	0.95	0.84	0.73	0.96				
Heavy Vehicles (%)	1%	0%	0%	0%	0%	0%				
Adj. Flow (vph)	80	15	716	179	41	740				
Shared Lane Traffic (%)										
Lane Group Flow (vph)	95	0	716	179	41	740				
Turn Type	Prot		NA	Perm	custom	NA				
Protected Phases	7		6 8		5	2 8	1	2	6	8
Permitted Phases				6 8	2					
Detector Phase	7		6 8	6 8	5	2 8				
Switch Phase										
Minimum Initial (s)	5.0				5.0		5.0	5.0	5.0	5.0
Minimum Split (s)	11.0				11.0		11.0	9.0	9.0	26.5
Total Split (s)	14.0				11.0		11.0	19.0	19.0	46.0
Total Split (%)	15.6%				12.2%		12%	21%	21%	51%
Maximum Green (s)	8.0				5.0		5.0	15.0	15.0	40.0
Yellow Time (s)	4.0				4.0		4.0	3.0	3.0	4.0
All-Red Time (s)	2.0				2.0		2.0	1.0	1.0	2.0
Lost Time Adjust (s)	0.0				0.0					
Total Lost Time (s)	6.0				6.0					
Lead/Lag	Lead				Lead		Lead	Lag	Lag	Lag
Lead-Lag Optimize?	Yes				Yes		Yes	Yes	Yes	Yes
Vehicle Extension (s)	3.0				3.0		3.0	3.0	3.0	3.0
Recall Mode	None				None		None	Min	Min	None
Act Effct Green (s)	8.1		57.0	57.0	13.6	57.0				
Actuated g/C Ratio	0.10		0.68	0.68	0.16	0.68				
v/c Ratio	0.54		0.55	0.16	0.24	0.57				
Control Delay	47.4		2.1	0.5	29.1	6.7				
Queue Delay	0.0		0.3	0.1	0.0	0.0				
Total Delay	47.4		2.4	0.6	29.1	6.7				
LOS	D		A	A	C	A				
Approach Delay	47.4		2.1			7.9				

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT	Ø1	Ø2	Ø6	Ø8
Approach LOS	D		A			A				
Queue Length 50th (ft)	48		22	0	18	101				
Queue Length 95th (ft)	#102		m42	m1	34	149				
Internal Link Dist (ft)	444		178			208				
Turn Bay Length (ft)				90	100					
Base Capacity (vph)	178		1350	1184	169	1350				
Starvation Cap Reductn	0		180	377	0	0				
Spillback Cap Reductn	0		0	0	0	0				
Storage Cap Reductn	0		0	0	0	0				
Reduced v/c Ratio	0.53		0.61	0.22	0.24	0.55				

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 83.5
Natural Cycle: 90
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.88
Intersection Signal Delay: 7.0 — Intersection LOS: A
Intersection Capacity Utilization 50.2% — ICU Level of Service A
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 26: NH 102 & North Shore Road



APPENDIX R-1: ALTERNATIVE D INTERSECTION CAPACITY ANALYSES – HCM 2000 PRINTOUTS – AM PEAK HOUR

HCM Signalized Intersection Capacity Analysis
1 ~~7~~: NH 102 & Exit 4 SB Off

01/02/2018

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	0	1365	805	0	115	985
Future Volume (vph)	0	1365	805	0	115	985
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	16	12
Total Lost time (s)		6.0	6.0		6.0	6.0
Lane Util. Factor		0.95	0.95		1.00	0.88
Frt		1.00	1.00		1.00	0.85
Flt Protected		1.00	1.00		0.95	1.00
Satd. Flow (prot)		3471	3406		1930	2682
Flt Permitted		1.00	1.00		0.95	1.00
Satd. Flow (perm)		3471	3406		1930	2682
Peak-hour factor, PHF	0.93	0.93	0.88	0.88	0.89	0.89
Adj. Flow (vph)	0	1468	915	0	129	1107
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	1468	915	0	129	1107
Heavy Vehicles (%)	4%	4%	6%	6%	6%	6%
Turn Type		NA	NA		Prot	Prot
Protected Phases		2	6		4	4
Permitted Phases						
Actuated Green, G (s)		32.0	32.0		31.0	31.0
Effective Green, g (s)		32.0	32.0		31.0	31.0
Actuated g/C Ratio		0.43	0.43		0.41	0.41
Clearance Time (s)		6.0	6.0		6.0	6.0
Vehicle Extension (s)		3.0	3.0		3.0	3.0
Lane Grp Cap (vph)		1480	1453		797	1108
v/s Ratio Prot		c0.42	0.27		0.07	c0.41
v/s Ratio Perm						
v/c Ratio		0.99	0.63		0.16	1.00
Uniform Delay, d1		21.4	16.9		13.8	22.0
Progression Factor		0.99	1.32		1.00	1.00
Incremental Delay, d2		13.3	0.2		0.1	26.6
Delay (s)		34.6	22.4		13.9	48.6
Level of Service		C	C		B	D
Approach Delay (s)		34.6	22.4		45.0	
Approach LOS		C	C		D	

Intersection Summary			
HCM 2000 Control Delay	35.1	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.99		
Actuated Cycle Length (s)	75.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	68.7%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	NBL2	NBL	NBR	SEL	SER	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations											
Traffic Volume (vph)	455	0	330	0	0	1310	170	0	0	1080	360
Future Volume (vph)	455	0	330	0	0	1310	170	0	0	1080	360
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0		6.0			6.0	6.0			6.0	4.0
Lane Util. Factor	0.97		0.88			0.97	0.95			0.95	1.00
Frt	1.00		0.85			1.00	1.00			1.00	0.85
Flt Protected	0.95		1.00			0.95	1.00			1.00	1.00
Satd. Flow (prot)	3242		2632			3335	3438			3505	1568
Flt Permitted	0.95		1.00			0.95	1.00			1.00	1.00
Satd. Flow (perm)	3242		2632			3335	3438			3505	1568
Peak-hour factor, PHF	0.88	0.88	0.88	0.92	0.92	0.94	0.94	0.94	0.92	0.92	0.92
Adj. Flow (vph)	517	0	375	0	0	1394	181	0	0	1174	391
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	517	0	375	0	0	1394	181	0	0	1174	391
Heavy Vehicles (%)	8%	8%	8%	2%	2%	5%	5%	5%	3%	3%	3%
Turn Type	Prot		Prot			Prot	NA			NA	Free
Protected Phases	8		8			5	2			6	
Permitted Phases											Free
Actuated Green, G (s)	23.0		23.0			60.0	115.0			49.0	150.0
Effective Green, g (s)	23.0		23.0			60.0	115.0			49.0	150.0
Actuated g/C Ratio	0.15		0.15			0.40	0.77			0.33	1.00
Clearance Time (s)	6.0		6.0			6.0	6.0			6.0	
Vehicle Extension (s)	3.0		3.0			3.0	3.0			3.0	
Lane Grp Cap (vph)	497		403			1334	2635			1144	1568
v/s Ratio Prot	c0.16		0.14			c0.42	0.05			c0.33	
v/s Ratio Perm											0.25
v/c Ratio	1.04		0.93			1.04	0.07			1.03	0.25
Uniform Delay, d1	63.5		62.7			45.0	4.3			50.5	0.0
Progression Factor	1.00		1.00			0.61	1.73			1.00	1.00
Incremental Delay, d2	51.2		28.0			28.7	0.0			33.5	0.4
Delay (s)	114.7		90.7			56.0	7.5			84.0	0.4
Level of Service	F		F			E	A			F	A
Approach Delay (s)		104.6		0.0			50.5			63.1	
Approach LOS		F		A			D			E	

Intersection Summary			
HCM 2000 Control Delay	67.3	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.04		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	96.2%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑	↱	↰	↑↑					↰↰		↱
Traffic Volume (vph)	0	585	460	285	685	0	0	0	0	110	0	360
Future Volume (vph)	0	585	460	285	685	0	0	0	0	110	0	360
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0	4.0	6.0	6.0					6.0		6.0
Lane Util. Factor		0.95	1.00	1.00	0.95					0.97		1.00
Frt		1.00	0.85	1.00	1.00					1.00		0.85
Flt Protected		1.00	1.00	0.95	1.00					0.95		1.00
Satd. Flow (prot)		3167	1417	1687	3374					3303		1524
Flt Permitted		1.00	1.00	0.95	1.00					0.95		1.00
Satd. Flow (perm)		3167	1417	1687	3374					3303		1524
Peak-hour factor, PHF	0.92	0.92	0.92	0.73	0.73	0.73	0.92	0.92	0.92	0.74	0.74	0.74
Adj. Flow (vph)	0	636	500	390	938	0	0	0	0	149	0	486
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	96
Lane Group Flow (vph)	0	636	500	390	938	0	0	0	0	149	0	390
Heavy Vehicles (%)	14%	14%	14%	7%	7%	7%	2%	2%	2%	6%	6%	6%
Turn Type		NA	Free	Prot	NA					Prot		Prot
Protected Phases		2		1	6					4		4
Permitted Phases			Free									
Actuated Green, G (s)		32.1	110.0	28.8	66.9					31.1		31.1
Effective Green, g (s)		32.1	110.0	28.8	66.9					31.1		31.1
Actuated g/C Ratio		0.29	1.00	0.26	0.61					0.28		0.28
Clearance Time (s)		6.0		6.0	6.0					6.0		6.0
Vehicle Extension (s)		5.0		3.0	5.0					3.0		3.0
Lane Grp Cap (vph)		924	1417	441	2052					933		430
v/s Ratio Prot		c0.20		c0.23	0.28					0.05		c0.26
v/s Ratio Perm			0.35									
v/c Ratio		0.69	0.35	0.88	0.46					0.16		0.91
Uniform Delay, d1		34.5	0.0	39.0	11.7					29.6		38.1
Progression Factor		1.00	1.00	0.40	0.08					1.00		1.00
Incremental Delay, d2		4.2	0.7	16.0	0.4					0.1		22.3
Delay (s)		38.7	0.7	31.4	1.3					29.7		60.4
Level of Service		D	A	C	A					C		E
Approach Delay (s)		22.0			10.1			0.0			53.2	
Approach LOS		C			B			A			D	

Intersection Summary			
HCM 2000 Control Delay	23.3	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.82		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	71.4%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis

4 ~~3~~: Exit 5 NB Off & NH 28 | 12/28/2017

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	485	210	0	0	520	350	450	0	160	0	0	0
Future Volume (vph)	485	210	0	0	520	350	450	0	160	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0			6.0	4.0	6.0		6.0			
Lane Util. Factor	1.00	0.95			0.95	1.00	1.00		1.00			
Frt	1.00	1.00			1.00	0.85	1.00		0.85			
Flt Protected	0.95	1.00			1.00	1.00	0.95		1.00			
Satd. Flow (prot)	1641	3282			3438	1538	1656		1482			
Flt Permitted	0.95	1.00			1.00	1.00	0.95		1.00			
Satd. Flow (perm)	1641	3282			3438	1538	1656		1482			
Peak-hour factor, PHF	0.87	0.87	0.87	0.90	0.90	0.90	0.78	0.78	0.78	0.92	0.92	0.92
Adj. Flow (vph)	557	241	0	0	578	389	577	0	205	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	128	0	0	0
Lane Group Flow (vph)	557	241	0	0	578	389	577	0	77	0	0	0
Heavy Vehicles (%)	10%	10%	10%	5%	5%	5%	9%	9%	9%	2%	2%	2%
Turn Type	Prot	NA			NA	Free	Prot		Prot			
Protected Phases	5	2			6		8		8			
Permitted Phases		2			6	Free						
Actuated Green, G (s)	36.0	61.0			19.0	110.0	37.0		37.0			
Effective Green, g (s)	36.0	61.0			19.0	110.0	37.0		37.0			
Actuated g/C Ratio	0.33	0.55			0.17	1.00	0.34		0.34			
Clearance Time (s)	6.0	6.0			6.0		6.0		6.0			
Vehicle Extension (s)	5.0	5.0			5.0		3.0		3.0			
Lane Grp Cap (vph)	537	1820			593	1538	557		498			
v/s Ratio Prot	c0.34	0.07			c0.17		c0.35		0.05			
v/s Ratio Perm						0.25						
v/c Ratio	1.04	0.13			0.97	0.25	1.04		0.15			
Uniform Delay, d1	37.0	11.8			45.3	0.0	36.5		25.6			
Progression Factor	0.27	0.17			1.00	1.00	1.00		1.00			
Incremental Delay, d2	43.7	0.1			31.2	0.4	47.7		0.1			
Delay (s)	53.5	2.1			76.5	0.4	84.2		25.7			
Level of Service	D	A			E	A	F		C			
Approach Delay (s)		38.0			45.9			68.9			0.0	
Approach LOS		D			D			E			A	

Intersection Summary			
HCM 2000 Control Delay	50.5	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	1.02		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	71.4%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	10	0	160	0	0	1	100	500	5	5	1110	30
Future Volume (vph)	10	0	160	0	0	1	100	500	5	5	1110	30
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0	6.0		6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor		1.00	1.00		1.00		1.00	0.95		1.00	0.95	
Frt		1.00	0.85		0.86		1.00	1.00		1.00	1.00	
Flt Protected		0.95	1.00		1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1770	1583		1644		1770	3534		1770	3525	
Flt Permitted		1.00	1.00		1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)		1863	1583		1644		1770	3534		1770	3525	
Peak-hour factor, PHF	0.92	0.92	0.92	0.25	0.25	0.25	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	11	0	174	0	0	4	109	543	5	5	1207	33
RTOR Reduction (vph)	0	0	65	0	4	0	0	1	0	0	2	0
Lane Group Flow (vph)	0	11	109	0	0	0	109	547	0	5	1238	0
Heavy Vehicles (%)	2%	2%	2%	0%	0%	0%	2%	2%	2%	2%	2%	2%
Turn Type	Perm	NA	custom		NA		Prot	NA		Prot	NA	
Protected Phases		8			4		5	2		1	6	
Permitted Phases	8		6	4								
Actuated Green, G (s)		1.2	44.8		1.2		7.8	51.8		0.8	44.8	
Effective Green, g (s)		1.2	44.8		1.2		7.8	51.8		0.8	44.8	
Actuated g/C Ratio		0.02	0.62		0.02		0.11	0.72		0.01	0.62	
Clearance Time (s)		6.0	6.0		6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)		3.0	3.0		3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		31	987		27		192	2549		19	2199	
v/s Ratio Prot					0.00		c0.06	0.15		0.00	c0.35	
v/s Ratio Perm		c0.01	0.07									
v/c Ratio		0.35	0.11		0.00		0.57	0.21		0.26	0.56	
Uniform Delay, d1		34.9	5.5		34.7		30.4	3.3		35.2	7.8	
Progression Factor		1.00	1.00		1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		6.9	0.0		0.0		3.8	0.0		7.3	0.3	
Delay (s)		41.8	5.5		34.7		34.2	3.3		42.5	8.2	
Level of Service		D	A		C		C	A		D	A	
Approach Delay (s)		7.7			34.7			8.5			8.3	
Approach LOS		A			C			A			A	

Intersection Summary			
HCM 2000 Control Delay	8.3	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.56		
Actuated Cycle Length (s)	71.8	Sum of lost time (s)	18.0
Intersection Capacity Utilization	64.5%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	10	20	10	350	0	30	0	420	110	15	585	0
Future Volume (vph)	10	20	10	350	0	30	0	420	110	15	585	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0			6.0			6.0			6.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		0.97			0.99			0.97			1.00	
Flt Protected		0.99			0.96			1.00			1.00	
Satd. Flow (prot)		1776			1745			1710			1807	
Flt Permitted		0.87			0.69			1.00			0.98	
Satd. Flow (perm)		1573			1268			1710			1776	
Peak-hour factor, PHF	0.60	0.60	0.60	0.96	0.96	0.96	0.89	0.89	0.89	0.86	0.86	0.86
Adj. Flow (vph)	17	33	17	365	0	31	0	472	124	17	680	0
RTOR Reduction (vph)	0	11	0	0	23	0	0	11	0	0	0	0
Lane Group Flow (vph)	0	56	0	0	373	0	0	585	0	0	697	0
Heavy Vehicles (%)	2%	2%	2%	3%	3%	3%	8%	8%	8%	5%	5%	5%
Turn Type	Perm	NA		Perm	NA			NA		Perm	NA	
Protected Phases		4			4			2			2	
Permitted Phases	4			4						2		
Actuated Green, G (s)		27.3			27.3			38.4			38.4	
Effective Green, g (s)		27.3			27.3			38.4			38.4	
Actuated g/C Ratio		0.35			0.35			0.49			0.49	
Clearance Time (s)		6.0			6.0			6.0			6.0	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		552			445			845			877	
v/s Ratio Prot								0.34				
v/s Ratio Perm		0.04			c0.29						c0.39	
v/c Ratio		0.10			0.84			0.69			0.79	
Uniform Delay, d1		16.9			23.2			15.1			16.4	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		0.1			12.9			2.5			5.0	
Delay (s)		17.0			36.1			17.6			21.4	
Level of Service		B			D			B			C	
Approach Delay (s)		17.0			36.1			17.6			21.4	
Approach LOS		B			D			B			C	

Intersection Summary			
HCM 2000 Control Delay	23.2	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.81		
Actuated Cycle Length (s)	77.7	Sum of lost time (s)	12.0
Intersection Capacity Utilization	82.1%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↱		↰	↱		↰	↑	↱
Traffic Volume (vph)	80	200	90	20	520	60	60	290	30	70	240	30
Future Volume (vph)	80	200	90	20	520	60	60	290	30	70	240	30
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	6.0
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.95		1.00	0.98		1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1656	1662		1703	1765		1719	1784		1703	1792	1524
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1656	1662		1703	1765		1719	1784		1703	1792	1524
Peak-hour factor, PHF	0.96	0.96	0.96	0.94	0.94	0.94	0.85	0.85	0.85	0.91	0.91	0.91
Adj. Flow (vph)	83	208	94	21	553	64	71	341	35	77	264	33
RTOR Reduction (vph)	0	17	0	0	4	0	0	4	0	0	0	26
Lane Group Flow (vph)	83	285	0	21	613	0	71	372	0	77	264	7
Heavy Vehicles (%)	9%	9%	9%	6%	6%	6%	5%	5%	5%	6%	6%	6%
Parking (#/hr)			0									
Turn Type	Prot	NA		Prot	NA		Prot	NA		Prot	NA	Perm
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases												4
Actuated Green, G (s)	4.6	36.0		2.3	33.7		7.4	19.2		7.5	19.3	19.3
Effective Green, g (s)	4.6	36.0		2.3	33.7		7.4	19.2		7.5	19.3	19.3
Actuated g/C Ratio	0.05	0.40		0.03	0.38		0.08	0.22		0.08	0.22	0.22
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	85	672		44	668		142	384		143	388	330
v/s Ratio Prot	c0.05	0.17		0.01	c0.35		0.04	c0.21		c0.05	0.15	
v/s Ratio Perm												0.00
v/c Ratio	0.98	0.42		0.48	0.92		0.50	0.97		0.54	0.68	0.02
Uniform Delay, d1	42.1	19.0		42.8	26.3		39.0	34.6		39.1	32.0	27.4
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	89.0	0.4		7.9	17.4		2.8	37.3		3.9	4.9	0.0
Delay (s)	131.1	19.5		50.7	43.7		41.8	71.9		43.0	36.9	27.4
Level of Service	F	B		D	D		D	E		D	D	C
Approach Delay (s)		43.5			44.0			67.1			37.3	
Approach LOS		D			D			E			D	

Intersection Summary			
HCM 2000 Control Delay	48.1	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.89		
Actuated Cycle Length (s)	89.0	Sum of lost time (s)	24.0
Intersection Capacity Utilization	76.4%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	370	20	5	100	80	270
Future Volume (vph)	370	20	5	100	80	270
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0	120	0			220
Storage Lanes	1	1	0			1
Taper Length (ft)	25		25			
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.850				0.850
Flt Protected	0.950			0.998		
Satd. Flow (prot)	1719	1538	0	1823	1863	1583
Flt Permitted	0.950			0.998		
Satd. Flow (perm)	1719	1538	0	1823	1863	1583
Link Speed (mph)	30			30	30	
Link Distance (ft)	322			309	292	
Travel Time (s)	7.3			7.0	6.6	
Peak Hour Factor	0.89	0.89	0.91	0.91	0.93	0.93
Heavy Vehicles (%)	5%	5%	4%	4%	2%	2%
Adj. Flow (vph)	416	22	5	110	86	290
Shared Lane Traffic (%)						
Lane Group Flow (vph)	416	22	0	115	86	290
Sign Control	Stop			Stop	Stop	

Intersection Summary

Area Type: Other
Control Type: Unsignalized
Intersection Capacity Utilization 36.5% ICU Level of Service A
Analysis Period (min) 15

Intersection	
Intersection Delay, s/veh	17.9
Intersection LOS	C

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	370	20	5	100	80	270
Future Vol, veh/h	370	20	5	100	80	270
Peak Hour Factor	0.89	0.89	0.91	0.91	0.93	0.93
Heavy Vehicles, %	5	5	4	4	2	2
Mvmt Flow	416	22	5	110	86	290
Number of Lanes	1	1	0	1	1	1

Approach	EB	NB	SB
Opposing Approach		SB	NB
Opposing Lanes	0	2	1
Conflicting Approach Left	SB	EB	
Conflicting Lanes Left	2	2	0
Conflicting Approach Right	NB		EB
Conflicting Lanes Right	1	0	2
HCM Control Delay	24.8	11.2	12
HCM LOS	C	B	B

Lane	NBLn1	EBLn1	EBLn2	SBLn1	SBLn2
Vol Left, %	5%	100%	0%	0%	0%
Vol Thru, %	95%	0%	0%	100%	0%
Vol Right, %	0%	0%	100%	0%	100%
Sign Control	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	105	370	20	80	270
LT Vol	5	370	0	0	0
Through Vol	100	0	0	80	0
RT Vol	0	0	20	0	270
Lane Flow Rate	115	416	22	86	290
Geometry Grp	4	7	7	7	7
Degree of Util (X)	0.206	0.745	0.033	0.148	0.443
Departure Headway (Hd)	6.428	6.453	5.242	6.209	5.499
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes
Cap	557	561	683	577	653
Service Time	4.479	4.182	2.97	3.953	3.242
HCM Lane V/C Ratio	0.206	0.742	0.032	0.149	0.444
HCM Control Delay	11.2	25.7	8.1	10	12.6
HCM Lane LOS	B	D	A	A	B
HCM 95th-tile Q	0.8	6.4	0.1	0.5	2.3

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	10	0	0	470	350	20
Future Volume (vph)	10	0	0	470	350	20
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt					0.993	
Flt Protected	0.950					
Satd. Flow (prot)	1008	0	0	1827	1780	0
Flt Permitted	0.950					
Satd. Flow (perm)	1008	0	0	1827	1780	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	160			224	319	
Travel Time (s)	3.6			5.1	7.3	
Peak Hour Factor	0.44	0.44	0.95	0.95	0.96	0.96
Heavy Vehicles (%)	79%	79%	4%	4%	6%	6%
Adj. Flow (vph)	23	0	0	495	365	21
Shared Lane Traffic (%)						
Lane Group Flow (vph)	23	0	0	495	386	0
Sign Control	Stop			Free	Free	

Intersection Summary

Area Type: Other
Control Type: Unsignalized
Intersection Capacity Utilization 34.7% ICU Level of Service A
Analysis Period (min) 15

Intersection						
Int Delay, s/veh	0.5					

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	10	0	0	470	350	20
Future Vol, veh/h	10	0	0	470	350	20
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	44	44	95	95	96	96
Heavy Vehicles, %	79	79	4	4	6	6
Mvmt Flow	23	0	0	495	365	21

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	871	376	386	0	-	0
Stage 1	376	-	-	-	-	-
Stage 2	495	-	-	-	-	-
Critical Hdwy	7.19	6.99	4.14	-	-	-
Critical Hdwy Stg 1	6.19	-	-	-	-	-
Critical Hdwy Stg 2	6.19	-	-	-	-	-
Follow-up Hdwy	4.211	4.011	2.236	-	-	-
Pot Cap-1 Maneuver	239	529	1162	-	-	-
Stage 1	554	-	-	-	-	-
Stage 2	481	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	239	529	1162	-	-	-
Mov Cap-2 Maneuver	239	-	-	-	-	-
Stage 1	554	-	-	-	-	-
Stage 2	481	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	21.6	0	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1162	-	239	-	-
HCM Lane V/C Ratio	-	-	0.095	-	-
HCM Control Delay (s)	0	-	21.6	-	-
HCM Lane LOS	A	-	C	-	-
HCM 95th %tile Q(veh)	0	-	0.3	-	-

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations		✣			✣			✣			✣	
Traffic Volume (vph)	50	410	10	30	280	10	20	10	80	10	0	30
Future Volume (vph)	50	410	10	30	280	10	20	10	80	10	0	30
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	150		150	150		150	0		0	150		150
Storage Lanes	0		0	0		0	0		0	0		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.997			0.996			0.902			0.899	
Flt Protected		0.995			0.995			0.991			0.988	
Satd. Flow (prot)	0	1762	0	0	1793	0	0	1665	0	0	1688	0
Flt Permitted		0.995			0.995			0.991			0.988	
Satd. Flow (perm)	0	1762	0	0	1793	0	0	1665	0	0	1688	0
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		327			240			246			251	
Travel Time (s)		7.4			5.5			5.6			5.7	
Peak Hour Factor	0.89	0.89	0.89	0.96	0.96	0.96	0.65	0.65	0.65	0.67	0.67	0.67
Heavy Vehicles (%)	7%	7%	7%	5%	5%	5%	2%	2%	2%	0%	0%	0%
Adj. Flow (vph)	56	461	11	31	292	10	31	15	123	15	0	45
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	528	0	0	333	0	0	169	0	0	60	0
Sign Control		Free			Free			Stop			Stop	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 48.8% ICU Level of Service A

Analysis Period (min) 15

Intersection	
Int Delay, s/veh	3.3

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations		✢			✢			✢			✢	
Traffic Vol, veh/h	50	410	10	30	280	10	20	10	80	10	0	30
Future Vol, veh/h	50	410	10	30	280	10	20	10	80	10	0	30
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	Yield	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	89	89	89	96	96	96	65	65	65	67	67	67
Heavy Vehicles, %	7	7	7	5	5	5	2	2	2	0	0	0
Mvmt Flow	56	461	11	31	292	10	31	15	123	15	0	45

Major/Minor	Major1			Major2			Minor2			Minor1		
Conflicting Flow All	302	0	0	472	0	0	960	943	297	946	943	467
Stage 1	-	-	-	-	-	-	359	359	-	579	579	-
Stage 2	-	-	-	-	-	-	601	584	-	367	364	-
Critical Hdwy	4.17	-	-	4.15	-	-	7.12	6.52	6.22	7.1	6.5	6.2
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.1	5.5	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.1	5.5	-
Follow-up Hdwy	2.263	-	-	2.245	-	-	3.518	4.018	3.318	3.5	4	3.3
Pot Cap-1 Maneuver	1231	-	-	1074	-	-	236	263	742	243	265	600
Stage 1	-	-	-	-	-	-	659	627	-	504	504	-
Stage 2	-	-	-	-	-	-	487	498	-	657	627	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1231	-	-	1074	-	-	202	238	742	179	240	600
Mov Cap-2 Maneuver	-	-	-	-	-	-	202	238	-	179	240	-
Stage 1	-	-	-	-	-	-	618	605	-	473	473	-
Stage 2	-	-	-	-	-	-	423	467	-	515	605	-

Approach	EB	WB	SE	NW
HCM Control Delay, s	0.9	0.8	10.9	16.3
HCM LOS			B	C

Minor Lane/Major Mvmt	NWLn1	EBL	EBT	EBR	WBL	WBT	WBR	SELn1
Capacity (veh/h)	378	1231	-	-	1074	-	-	780
HCM Lane V/C Ratio	0.158	0.046	-	-	0.029	-	-	0.217
HCM Control Delay (s)	16.3	8.1	0	-	8.5	0	-	10.9
HCM Lane LOS	C	A	A	-	A	A	-	B
HCM 95th %tile Q(veh)	0.6	0.1	-	-	0.1	-	-	0.8

Movement	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	20	200	140	590	190	0	160	220	30	30	310	770
Future Volume (vph)	20	200	140	590	190	0	160	220	30	30	310	770
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0		6.0	6.0	4.0	6.0	6.0	6.0
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95		0.97	1.00	1.00	1.00	1.00	0.88
Frt	1.00	1.00	0.85	1.00	1.00		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1736	3471	1553	3335	3438		3400	1845	1568	1752	1845	2760
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1736	3471	1553	3335	3438		3400	1845	1568	1752	1845	2760
Peak-hour factor, PHF	0.84	0.84	0.84	0.79	0.79	0.79	0.86	0.86	0.86	0.99	0.99	0.99
Adj. Flow (vph)	24	238	167	747	241	0	186	256	35	30	313	778
RTOR Reduction (vph)	0	0	125	0	0	0	0	0	0	0	0	124
Lane Group Flow (vph)	24	238	42	747	241	0	186	256	35	30	313	654
Heavy Vehicles (%)	4%	4%	4%	5%	5%	5%	3%	3%	3%	3%	3%	3%
Turn Type	Prot	NA	pm+ov	Prot	NA		Prot	NA	Free	Prot	NA	pt+ov
Protected Phases	1	6	7	5	2		3	8		7	4	4 5
Permitted Phases		6	6		2			8	Free		4	
Actuated Green, G (s)	12.7	15.1	22.6	22.9	25.3		7.0	20.5	90.0	7.5	21.0	43.9
Effective Green, g (s)	12.7	15.1	22.6	22.9	25.3		7.0	20.5	90.0	7.5	21.0	43.9
Actuated g/C Ratio	0.14	0.17	0.25	0.25	0.28		0.08	0.23	1.00	0.08	0.23	0.49
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	244	582	493	848	966		264	420	1568	146	430	1346
v/s Ratio Prot	0.01	c0.07	0.01	c0.22	0.07		0.05	c0.14		0.02	c0.17	0.24
v/s Ratio Perm			0.02						c0.02			
v/c Ratio	0.10	0.41	0.09	0.88	0.25		0.70	0.61	0.02	0.21	0.73	0.49
Uniform Delay, d1	33.7	33.5	25.8	32.2	25.0		40.5	31.2	0.0	38.5	31.9	15.5
Progression Factor	1.00	1.00	1.00	0.90	0.89		1.00	1.00	1.00	0.72	0.64	0.58
Incremental Delay, d2	0.2	0.5	0.1	10.1	0.6		8.3	2.5	0.0	0.5	4.5	0.2
Delay (s)	33.8	33.9	25.9	39.2	22.8		48.8	33.7	0.0	28.4	24.8	9.2
Level of Service	C	C	C	D	C		D	C	A	C	C	A
Approach Delay (s)		30.8			35.2			37.1			14.1	
Approach LOS		C			D			D			B	

Intersection Summary			
HCM 2000 Control Delay	27.0	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.73		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	24.0
Intersection Capacity Utilization	64.5%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	NWL	NWR	NET	NER	SWL	SWT
Lane Configurations	↰	↱	↑↑	↱	↰	↑↑
Traffic Volume (vph)	300	70	580	370	60	810
Future Volume (vph)	300	70	580	370	60	810
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	4.0	6.0	6.0
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1583	3505	1568	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.23	1.00
Satd. Flow (perm)	1770	1583	3505	1568	429	3539
Peak-hour factor, PHF	0.83	0.83	0.86	0.86	0.81	0.81
Adj. Flow (vph)	361	84	674	430	74	1000
RTOR Reduction (vph)	0	10	0	0	0	0
Lane Group Flow (vph)	361	74	674	430	74	1000
Heavy Vehicles (%)	2%	2%	3%	3%	2%	2%
Turn Type	Prot	pm+ov	NA	Free	pm+pt	NA
Protected Phases	1 2 5 6	7	8		7	3 4
Permitted Phases		1 2 5 6		Free	3 4	
Actuated Green, G (s)	40.4	47.9	20.5	90.0	34.0	34.0
Effective Green, g (s)	40.4	47.9	20.5	90.0	34.0	34.0
Actuated g/C Ratio	0.45	0.53	0.23	1.00	0.38	0.38
Clearance Time (s)		6.0	6.0		6.0	
Vehicle Extension (s)		3.0	3.0		3.0	
Lane Grp Cap (vph)	794	948	798	1568	273	1336
v/s Ratio Prot	c0.20	0.01	c0.19		0.02	c0.28
v/s Ratio Perm		0.04		c0.27	0.08	
v/c Ratio	0.45	0.08	0.84	0.27	0.27	0.75
Uniform Delay, d1	17.2	10.3	33.2	0.0	27.8	24.3
Progression Factor	1.00	1.00	0.58	1.00	1.00	1.00
Incremental Delay, d2	0.4	0.0	5.6	0.3	0.5	2.3
Delay (s)	17.6	10.3	24.7	0.3	28.3	26.6
Level of Service	B	B	C	A	C	C
Approach Delay (s)	16.2		15.2			26.7
Approach LOS	B		B			C

Intersection Summary			
HCM 2000 Control Delay	20.1	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	24.0
Intersection Capacity Utilization	53.5%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations	↰	↑↱		↰	↑↱			↰↑	↱		↰↑	↱
Traffic Volume (vph)	160	980	0	0	980	50	5	0	5	20	0	180
Future Volume (vph)	160	980	0	0	980	50	5	0	5	20	0	180
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0			6.0			6.0	6.0		6.0	6.0
Lane Util. Factor	1.00	0.95			0.95			1.00	1.00		1.00	1.00
Frt	1.00	1.00			0.99			1.00	0.85		1.00	0.85
Flt Protected	0.95	1.00			1.00			0.95	1.00		0.95	1.00
Satd. Flow (prot)	1687	3374			3514			1805	1615		1787	1599
Flt Permitted	0.95	1.00			1.00			1.00	1.00		1.00	1.00
Satd. Flow (perm)	1687	3374			3514			1900	1615		1881	1599
Peak-hour factor, PHF	0.83	0.83	0.83	0.92	0.92	0.92	0.50	0.50	0.50	0.90	0.90	0.90
Adj. Flow (vph)	193	1181	0	0	1065	54	10	0	10	22	0	200
RTOR Reduction (vph)	0	0	0	0	3	0	0	0	10	0	0	82
Lane Group Flow (vph)	193	1181	0	0	1116	0	0	10	0	0	22	118
Heavy Vehicles (%)	7%	7%	7%	2%	2%	2%	0%	0%	0%	1%	1%	1%
Turn Type	Prot	NA		Prot	NA		Perm	NA	Perm	Perm	NA	pm+ov
Protected Phases	5	2		1	6			8			4	5
Permitted Phases					6		8	8	8	4		4
Actuated Green, G (s)	18.9	74.6			49.7			3.4	3.4		3.4	22.3
Effective Green, g (s)	18.9	74.6			49.7			3.4	3.4		3.4	22.3
Actuated g/C Ratio	0.21	0.83			0.55			0.04	0.04		0.04	0.25
Clearance Time (s)	6.0	6.0			6.0			6.0	6.0		6.0	6.0
Vehicle Extension (s)	3.0	3.0			3.0			3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	354	2796			1940			71	61		71	502
v/s Ratio Prot	c0.11	0.35			c0.32							c0.05
v/s Ratio Perm								0.01	0.00		0.01	0.02
v/c Ratio	0.55	0.42			0.58			0.14	0.01		0.31	0.24
Uniform Delay, d1	31.7	2.0			13.2			41.9	41.7		42.2	27.0
Progression Factor	0.97	1.99			1.46			1.00	1.00		1.00	1.00
Incremental Delay, d2	1.5	0.4			0.4			0.9	0.0		2.5	0.2
Delay (s)	32.2	4.4			19.7			42.8	41.7		44.6	27.3
Level of Service	C	A			B			D	D		D	C
Approach Delay (s)		8.3			19.7			42.3			29.0	
Approach LOS		A			B			D			C	

Intersection Summary			
HCM 2000 Control Delay	14.9	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.56		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	60.3%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰↰	↑↱		↰	↑↑	↱	↰	↱		↰	↰↑	↱
Traffic Volume (vph)	140	990	20	5	940	340	10	5	5	110	5	180
Future Volume (vph)	140	990	20	5	940	340	10	5	5	110	5	180
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0		6.0	6.0	6.0
Lane Util. Factor	0.97	0.95		1.00	0.95	1.00	1.00	1.00		0.95	0.95	1.00
Frt	1.00	1.00		1.00	1.00	0.85	1.00	0.93		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.96	1.00
Satd. Flow (prot)	3303	3396		1736	3471	1553	1805	1758		1665	1676	1568
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.00	1.00
Satd. Flow (perm)	3303	3396		1736	3471	1553	1805	1758		1665	0	1568
Peak-hour factor, PHF	0.83	0.83	0.83	0.97	0.97	0.97	0.67	0.67	0.67	0.90	0.90	0.90
Adj. Flow (vph)	169	1193	24	5	969	351	15	7	7	122	6	200
RTOR Reduction (vph)	0	1	0	0	0	133	0	7	0	0	0	135
Lane Group Flow (vph)	169	1216	0	5	969	218	15	7	0	63	65	65
Heavy Vehicles (%)	6%	6%	6%	4%	4%	4%	0%	0%	0%	3%	3%	3%
Turn Type	Prot	NA		Prot	NA	pm+ov	Prot	NA		Prot	NA	pt+ov
Protected Phases	5	2		1	6	7	3	8		7	4	4 5
Permitted Phases						6		8				
Actuated Green, G (s)	9.2	55.4		1.0	47.2	55.8	1.5	1.0		8.6	8.6	23.3
Effective Green, g (s)	9.2	55.4		1.0	47.2	55.8	1.5	1.0		8.6	8.6	23.3
Actuated g/C Ratio	0.10	0.62		0.01	0.52	0.62	0.02	0.01		0.10	0.10	0.26
Clearance Time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	337	2090		19	1820	962	30	19		159	160	405
v/s Ratio Prot	0.05	c0.36		0.00	c0.28	0.02	c0.01	0.00		0.04	c0.04	0.04
v/s Ratio Perm						0.12						
v/c Ratio	0.50	0.58		0.26	0.53	0.23	0.50	0.37		0.40	0.41	0.16
Uniform Delay, d1	38.2	10.4		44.1	14.1	7.6	43.9	44.2		38.3	38.3	25.8
Progression Factor	1.00	1.00		1.08	0.90	7.08	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	1.2	1.2		6.5	0.3	0.1	12.5	11.9		1.6	1.7	0.2
Delay (s)	39.4	11.6		54.0	12.9	53.6	56.4	56.1		39.9	40.0	26.0
Level of Service	D	B		D	B	D	E	E		D	D	C
Approach Delay (s)		14.9			23.9			56.2			31.4	
Approach LOS		B			C			E			C	

Intersection Summary				
HCM 2000 Control Delay	21.0	HCM 2000 Level of Service	C	
HCM 2000 Volume to Capacity ratio	0.58			
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	24.0	
Intersection Capacity Utilization	57.0%	ICU Level of Service	B	
Analysis Period (min)	15			
c Critical Lane Group				

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	120	1340	1180	10	20	100
Future Volume (vph)	120	1340	1180	10	20	100
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	300			0	175	0
Storage Lanes	1			0	1	1
Taper Length (ft)	25				25	
Lane Util. Factor	1.00	0.95	0.95	0.95	1.00	1.00
Frt			0.999			0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1687	3374	3468	0	1703	1524
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1687	3374	3468	0	1703	1524
Link Speed (mph)		30	30		30	
Link Distance (ft)		535	210		522	
Travel Time (s)		12.2	4.8		11.9	
Peak Hour Factor	0.84	0.84	0.89	0.89	0.83	0.83
Heavy Vehicles (%)	7%	7%	4%	4%	6%	6%
Adj. Flow (vph)	143	1595	1326	11	24	120
Shared Lane Traffic (%)						
Lane Group Flow (vph)	143	1595	1337	0	24	120
Sign Control		Free	Free		Stop	

Intersection Summary	
Area Type: Other	
Control Type: Unsignalized	
Intersection Capacity Utilization 52.9%	ICU Level of Service A
Analysis Period (min) 15	

Intersection	
Int Delay, s/veh	6.2

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	120	1340	1180	10	20	100
Future Vol, veh/h	120	1340	1180	10	20	100
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	300	-	-	-	175	0
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	84	84	89	89	83	83
Heavy Vehicles, %	7	7	4	4	6	6
Mvmt Flow	143	1595	1326	11	24	120

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	1337	0	-	0	2416	669
Stage 1	-	-	-	-	1332	-
Stage 2	-	-	-	-	1084	-
Critical Hdwy	4.24	-	-	-	6.92	7.02
Critical Hdwy Stg 1	-	-	-	-	5.92	-
Critical Hdwy Stg 2	-	-	-	-	5.92	-
Follow-up Hdwy	2.27	-	-	-	3.56	3.36
Pot Cap-1 Maneuver	486	-	-	-	26	391
Stage 1	-	-	-	-	204	-
Stage 2	-	-	-	-	277	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	486	-	-	-	~ 18	391
Mov Cap-2 Maneuver	-	-	-	-	~ 18	-
Stage 1	-	-	-	-	144	-
Stage 2	-	-	-	-	277	-

Approach	EB	WB	SB
HCM Control Delay, s	1.3	0	121.4
HCM LOS			F

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1	SBLn2
Capacity (veh/h)	486	-	-	-	18	391
HCM Lane V/C Ratio	0.294	-	-	-	1.339	0.308
HCM Control Delay (s)	15.5	-	-	-	$ 636.6	18.3
HCM Lane LOS	C	-	-	-	F	C
HCM 95th %tile Q(veh)	1.2	-	-	-	3.4	1.3

Notes

~: Volume exceeds capacity $: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↰	↑↑	↑↱		↰	↱
Traffic Volume (vph)	55	1630	1560	210	90	105
Future Volume (vph)	55	1630	1560	210	90	105
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0		6.0	6.0
Lane Util. Factor	1.00	0.95	0.95		1.00	1.00
Frt	1.00	1.00	0.98		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1770	3539	3476		1770	1583
Flt Permitted	0.10	1.00	1.00		0.95	1.00
Satd. Flow (perm)	184	3539	3476		1770	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	60	1772	1696	228	98	114
RTOR Reduction (vph)	0	0	16	0	0	16
Lane Group Flow (vph)	60	1772	1908	0	98	98
Turn Type	pm+pt	NA	NA		Prot	pm+ov
Protected Phases	5	2	6		4	5
Permitted Phases	2					4
Actuated Green, G (s)	41.9	41.9	34.4		4.4	5.9
Effective Green, g (s)	41.9	41.9	34.4		4.4	5.9
Actuated g/C Ratio	0.72	0.72	0.59		0.08	0.10
Clearance Time (s)	6.0	6.0	6.0		6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	173	2543	2051		133	323
v/s Ratio Prot	0.01	c0.50	c0.55		c0.06	0.01
v/s Ratio Perm	0.24					0.05
v/c Ratio	0.35	0.70	0.93		0.74	0.30
Uniform Delay, d1	11.2	4.6	10.9		26.4	24.3
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	1.2	0.8	8.2		19.0	0.5
Delay (s)	12.4	5.5	19.1		45.4	24.8
Level of Service	B	A	B		D	C
Approach Delay (s)		5.7	19.1		34.3	
Approach LOS		A	B		C	

Intersection Summary			
HCM 2000 Control Delay	13.7	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.96		
Actuated Cycle Length (s)	58.3	Sum of lost time (s)	18.0
Intersection Capacity Utilization	66.3%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	NBT	NBR	SBL	SBT	SWL	SWR
Lane Configurations			ๆ		ๆ	
Traffic Volume (vph)	0	0	1550	0	420	0
Future Volume (vph)	0	0	1550	0	420	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)			6.0		6.0	
Lane Util. Factor			0.97		0.97	
Frt			1.00		1.00	
Flt Protected			0.95		0.95	
Satd. Flow (prot)			3433		3433	
Flt Permitted			0.95		0.95	
Satd. Flow (perm)			3433		3433	
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	0	0	1649	0	447	0
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	1649	0	447	0
Turn Type			Prot		Prot	
Protected Phases			4		2	
Permitted Phases						
Actuated Green, G (s)			58.0		20.0	
Effective Green, g (s)			58.0		20.0	
Actuated g/C Ratio			0.64		0.22	
Clearance Time (s)			6.0		6.0	
Vehicle Extension (s)			3.0		3.0	
Lane Grp Cap (vph)			2212		762	
v/s Ratio Prot			c0.48		c0.13	
v/s Ratio Perm						
v/c Ratio			0.75		0.59	
Uniform Delay, d1			10.9		31.3	
Progression Factor			1.00		1.20	
Incremental Delay, d2			2.3		3.3	
Delay (s)			13.3		40.9	
Level of Service			B		D	
Approach Delay (s)	0.0			13.3	40.9	
Approach LOS	A			B	D	

Intersection Summary			
HCM 2000 Control Delay	19.2	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.70		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	122.3%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

Movement	SBL	SBR	NWL	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations										
Traffic Volume (vph)	0	0	0	135	0	1550	0	0	420	1245
Future Volume (vph)	0	0	0	135	0	1550	0	0	420	1245
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)			6.0	6.0		6.0			6.0	6.0
Lane Util. Factor			1.00	0.95		0.95			0.95	0.88
Frt			0.85	0.85		1.00			1.00	0.85
Flt Protected			1.00	1.00		1.00			1.00	1.00
Satd. Flow (prot)			1583	1504		3539			3539	2787
Flt Permitted			1.00	1.00		1.00			1.00	1.00
Satd. Flow (perm)			1583	1504		3539			3539	2787
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	0	0	0	144	0	1649	0	0	447	1324
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	201
Lane Group Flow (vph)	0	0	72	72	0	1649	0	0	447	1123
Turn Type			Prot	Prot	Perm	NA			NA	Perm
Protected Phases			4	4		2			2	
Permitted Phases					2					2
Actuated Green, G (s)			10.7	10.7		67.3			67.3	67.3
Effective Green, g (s)			10.7	10.7		67.3			67.3	67.3
Actuated g/C Ratio			0.12	0.12		0.75			0.75	0.75
Clearance Time (s)			6.0	6.0		6.0			6.0	6.0
Vehicle Extension (s)			3.0	3.0		3.0			3.0	3.0
Lane Grp Cap (vph)			188	178		2646			2646	2084
v/s Ratio Prot			0.05	c0.05		c0.47			0.13	
v/s Ratio Perm										0.40
v/c Ratio			0.38	0.40		0.62			0.17	0.54
Uniform Delay, d1			36.6	36.7		5.4			3.3	4.8
Progression Factor			1.00	1.00		0.51			1.00	1.00
Incremental Delay, d2			1.3	1.5		0.7			0.1	1.0
Delay (s)			37.9	38.2		3.4			3.4	5.8
Level of Service			D	D		A			A	A
Approach Delay (s)	0.0		38.1			3.4			5.2	
Approach LOS	A		D			A			A	

Intersection Summary			
HCM 2000 Control Delay	5.7	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.59		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	97.8%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	WBL2	WBL	WBR	WBR2	NBL	NBT	NBR	NBR2	SBL2	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	10	190	370	20	80	110	40	10	10	50	140	140
Future Volume (vph)	10	190	370	20	80	110	40	10	10	50	140	140
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)		0	150		0		150			0		0
Storage Lanes		1	0		0		0			0		0
Taper Length (ft)		25			25					25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.911				0.972					0.945	
Flt Protected		0.983				0.984					0.991	
Satd. Flow (prot)	0	1652	0	0	0	1764	0	0	0	0	1663	0
Flt Permitted		0.983				0.984					0.991	
Satd. Flow (perm)	0	1652	0	0	0	1764	0	0	0	0	1663	0
Link Speed (mph)		30				30					30	
Link Distance (ft)		465				456					371	
Travel Time (s)		10.6				10.4					8.4	
Peak Hour Factor	0.91	0.91	0.91	0.91	0.86	0.86	0.86	0.86	0.80	0.80	0.80	0.80
Heavy Vehicles (%)	3%	3%	3%	3%	3%	3%	3%	3%	7%	7%	7%	7%
Adj. Flow (vph)	11	209	407	22	93	128	47	12	13	63	175	175
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	649	0	0	0	280	0	0	0	0	426	0
Sign Control		Yield				Yield					Yield	

Intersection Summary

Area Type: Other
Control Type: Roundabout
Intersection Capacity Utilization 95.8% ICU Level of Service F
Analysis Period (min) 15

Lane Group	NEL	NET	NER	NER2	SWL2	SWL	SWT	SWR
Lane Configurations		✣					✣	
Traffic Volume (vph)	50	90	120	90	5	40	260	10
Future Volume (vph)	50	90	120	90	5	40	260	10
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		150			150		0
Storage Lanes	0		0			0		0
Taper Length (ft)	25					25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.919					0.996	
Flt Protected		0.993					0.993	
Satd. Flow (prot)	0	1605	0	0	0	0	1756	0
Flt Permitted		0.993					0.993	
Satd. Flow (perm)	0	1605	0	0	0	0	1756	0
Link Speed (mph)		30					30	
Link Distance (ft)		400					528	
Travel Time (s)		9.1					12.0	
Peak Hour Factor	0.60	0.60	0.60	0.60	0.83	0.83	0.83	0.83
Heavy Vehicles (%)	8%	8%	8%	8%	7%	7%	7%	7%
Adj. Flow (vph)	83	150	200	150	6	48	313	12
Shared Lane Traffic (%)								
Lane Group Flow (vph)	0	583	0	0	0	0	379	0
Sign Control		Yield					Yield	

Intersection Summary

Intersection	
Intersection Delay, s/veh	21.9
Intersection LOS	C

Approach	WB	NB	SB	NE	SW
Entry Lanes	1	1	1	1	1
Conflicting Circle Lanes	1	1	1	1	1
Adj Approach Flow, veh/h	649	280	426	583	379
Demand Flow Rate, veh/h	668	288	455	630	405
Vehicles Circulating, veh/h	542	555	714	336	963
Vehicles Exiting, veh/h	301	411	654	833	247
Ped Vol Crossing Leg, #/h	0	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000	1.000
Approach Delay, s/veh	28.3	9.3	20.7	14.1	33.4
Approach LOS	D	A	C	B	D

Lane	Left	Left	Left	Left	Left
Designated Moves	LR	LTR	LTR	LTR	LTR
Assumed Moves	LR	LTR	LTR	LTR	LTR
RT Channelized					
Lane Util	1.000	1.000	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976	4.976	4.976
Entry Flow, veh/h	668	288	455	630	405
Cap Entry Lane, veh/h	794	783	666	980	517
Entry HV Adj Factor	0.971	0.973	0.936	0.925	0.935
Flow Entry, veh/h	649	280	426	583	379
Cap Entry, veh/h	771	762	623	906	483
V/C Ratio	0.841	0.368	0.683	0.643	0.784
Control Delay, s/veh	28.3	9.3	20.7	14.1	33.4
LOS	D	A	C	B	D
95th %tile Queue, veh	10	2	5	5	7

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	10	20	230	10	40	50	390	140	10	10	110	20
Future Volume (vph)	10	20	230	10	40	50	390	140	10	10	110	20
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		50	0		0	0		0	0		0
Storage Lanes	0		1	0		0	0		0	0		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850		0.932			0.998			0.981	
Flt Protected		0.984			0.995			0.965			0.996	
Satd. Flow (prot)	0	1731	1495	0	1678	0	0	1777	0	0	1785	0
Flt Permitted		0.984			0.995			0.965			0.996	
Satd. Flow (perm)	0	1731	1495	0	1678	0	0	1777	0	0	1785	0
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		144			453			475			436	
Travel Time (s)		3.3			10.3			10.8			9.9	
Peak Hour Factor	0.82	0.82	0.82	0.70	0.70	0.70	0.75	0.75	0.75	0.71	0.71	0.71
Heavy Vehicles (%)	8%	8%	8%	5%	5%	5%	3%	3%	3%	4%	4%	4%
Adj. Flow (vph)	12	24	280	14	57	71	520	187	13	14	155	28
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	36	280	0	142	0	0	720	0	0	197	0
Sign Control		Stop			Stop			Free			Free	

Intersection Summary		
Area Type: Other		
Control Type: Unsignalized		
Intersection Capacity Utilization 59.5%		ICU Level of Service B
Analysis Period (min) 15		

Intersection	
Int Delay, s/veh	41.2

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↰	↱		✥			✥			✥	
Traffic Vol, veh/h	10	20	230	10	40	50	390	140	10	10	110	20
Future Vol, veh/h	10	20	230	10	40	50	390	140	10	10	110	20
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	50	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	82	82	82	70	70	70	75	75	75	71	71	71
Heavy Vehicles, %	8	8	8	5	5	5	3	3	3	4	4	4
Mvmt Flow	12	24	280	14	57	71	520	187	13	14	155	28

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1495	1437	169	1583	1445	194	183	0	0	200	0	0
Stage 1	197	197	-	1234	1234	-	-	-	-	-	-	-
Stage 2	1298	1240	-	349	211	-	-	-	-	-	-	-
Critical Hdwy	7.18	6.58	6.28	7.15	6.55	6.25	4.13	-	-	4.14	-	-
Critical Hdwy Stg 1	6.18	5.58	-	6.15	5.55	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.18	5.58	-	6.15	5.55	-	-	-	-	-	-	-
Follow-up Hdwy	3.572	4.072	3.372	3.545	4.045	3.345	2.227	-	-	2.236	-	-
Pot Cap-1 Maneuver	98	129	860	86	130	840	1386	-	-	1360	-	-
Stage 1	791	727	-	213	245	-	-	-	-	-	-	-
Stage 2	193	241	-	661	722	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	23	74	860	29	74	840	1386	-	-	1360	-	-
Mov Cap-2 Maneuver	23	74	-	29	74	-	-	-	-	-	-	-
Stage 1	456	719	-	123	141	-	-	-	-	-	-	-
Stage 2	61	139	-	426	714	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	37.3	280.7	6.6	0.5
HCM LOS	E	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1386	-	-	43	860	106	1360	-	-
HCM Lane V/C Ratio	0.375	-	-	0.851	0.326	1.348	0.01	-	-
HCM Control Delay (s)	9.1	0	-	237.3	11.2	280.7	7.7	0	-
HCM Lane LOS	A	A	-	F	B	F	A	A	-
HCM 95th %tile Q(veh)	1.8	-	-	3.3	1.4	10	0	-	-

Movement	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations	↰	↱		↰	↑	↱	↰	↑↱		↰	↑↱	
Traffic Volume (vph)	30	50	20	80	40	200	40	310	70	70	570	50
Future Volume (vph)	30	50	20	80	40	200	40	310	70	70	570	50
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	0.95		1.00	0.95	
Frt	1.00	0.96		1.00	1.00	0.85	1.00	0.97		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1752	1767		1736	1827	1553	1770	3441		1787	3531	
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1752	1767		1736	1827	1553	1770	3441		1787	3531	
Peak-hour factor, PHF	0.82	0.82	0.82	0.81	0.81	0.81	0.68	0.68	0.68	0.78	0.78	0.78
Adj. Flow (vph)	37	61	24	99	49	247	59	456	103	90	731	64
RTOR Reduction (vph)	0	17	0	0	0	121	0	24	0	0	8	0
Lane Group Flow (vph)	37	68	0	99	49	126	59	535	0	90	787	0
Heavy Vehicles (%)	3%	3%	3%	4%	4%	4%	2%	2%	2%	1%	1%	1%
Turn Type	Prot	NA		Prot	NA	pt+ov	Prot	NA		Prot	NA	
Protected Phases	1	6		5	2	2 3	3	8		7	4	
Permitted Phases												
Actuated Green, G (s)	4.4	14.3		6.1	16.0	30.2	8.2	25.6		6.1	23.5	
Effective Green, g (s)	4.4	14.3		6.1	16.0	30.2	8.2	25.6		6.1	23.5	
Actuated g/C Ratio	0.06	0.19		0.08	0.21	0.40	0.11	0.34		0.08	0.31	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	101	332		139	384	616	190	1157		143	1090	
v/s Ratio Prot	0.02	0.04		c0.06	0.03	c0.08	0.03	0.16		c0.05	c0.22	
v/s Ratio Perm												
v/c Ratio	0.37	0.20		0.71	0.13	0.20	0.31	0.46		0.63	0.72	
Uniform Delay, d1	34.5	26.1		34.1	24.4	15.1	31.3	19.8		33.9	23.4	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	2.2	0.3		15.8	0.7	0.2	0.9	0.3		8.4	2.4	
Delay (s)	36.8	26.4		50.0	25.1	15.2	32.3	20.1		42.3	25.8	
Level of Service	D	C		D	C	B	C	C		D	C	
Approach Delay (s)		29.5			25.2			21.3			27.5	
Approach LOS		C			C			C			C	

Intersection Summary			
HCM 2000 Control Delay	25.2	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.56		
Actuated Cycle Length (s)	76.1	Sum of lost time (s)	24.0
Intersection Capacity Utilization	51.4%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	240	0	10	120	260	520
Future Volume (vph)	240	0	10	120	260	520
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0		6.0	4.0	4.0	6.0
Lane Util. Factor	1.00		1.00	1.00	1.00	1.00
Frt	1.00		1.00	1.00	1.00	0.85
Flt Protected	0.95		0.95	1.00	1.00	1.00
Satd. Flow (prot)	1787		1770	1863	1845	1568
Flt Permitted	0.95		0.50	1.00	1.00	1.00
Satd. Flow (perm)	1787		928	1863	1845	1568
Peak-hour factor, PHF	0.90	0.90	0.87	0.87	0.89	0.89
Adj. Flow (vph)	267	0	11	138	292	584
RTOR Reduction (vph)	0	0	0	0	0	136
Lane Group Flow (vph)	267	0	11	138	292	448
Heavy Vehicles (%)	1%	1%	2%	2%	3%	3%
Turn Type	Prot		pm+pt	NA	NA	custom
Protected Phases	8		1	6 7	2 7	7 8
Permitted Phases			6 7			2
Actuated Green, G (s)	22.1		32.3	31.5	31.5	55.6
Effective Green, g (s)	22.1		28.3	31.5	31.5	55.6
Actuated g/C Ratio	0.31		0.39	0.44	0.44	0.77
Clearance Time (s)	6.0		6.0			
Vehicle Extension (s)	3.0		3.0			
Lane Grp Cap (vph)	545		372	810	802	1204
v/s Ratio Prot	c0.15		c0.00	0.07	c0.16	c0.20
v/s Ratio Perm			0.01			0.09
v/c Ratio	0.49		0.03	0.17	0.36	0.37
Uniform Delay, d1	20.5		13.6	12.5	13.7	2.7
Progression Factor	1.00		1.00	1.00	1.04	1.33
Incremental Delay, d2	0.7		0.0	0.1	0.3	0.2
Delay (s)	21.2		13.7	12.6	14.5	3.8
Level of Service	C		B	B	B	A
Approach Delay (s)	21.2			12.7	7.4	
Approach LOS	C			B	A	

Intersection Summary			
HCM 2000 Control Delay	10.8	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.45		
Actuated Cycle Length (s)	72.4	Sum of lost time (s)	22.0
Intersection Capacity Utilization	46.4%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	60	10	330	30	10	720
Future Volume (vph)	60	10	330	30	10	720
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0		4.0	4.0	6.0	4.0
Lane Util. Factor	1.00		1.00	1.00	1.00	1.00
Frt	0.98		1.00	0.85	1.00	1.00
Flt Protected	0.96		1.00	1.00	0.95	1.00
Satd. Flow (prot)	1767		1900	1615	1805	1900
Flt Permitted	0.96		1.00	1.00	0.43	1.00
Satd. Flow (perm)	1767		1900	1615	820	1900
Peak-hour factor, PHF	0.87	0.67	0.95	0.84	0.73	0.96
Adj. Flow (vph)	69	15	347	36	14	750
RTOR Reduction (vph)	9	0	0	16	0	0
Lane Group Flow (vph)	75	0	347	20	14	750
Heavy Vehicles (%)	1%	0%	0%	0%	0%	0%
Turn Type	Prot		NA	Perm	custom	NA
Protected Phases	7		6 8		5	2 8
Permitted Phases				6 8	2	
Actuated Green, G (s)	10.0		39.6	39.6	18.3	39.6
Effective Green, g (s)	10.0		39.6	39.6	18.3	39.6
Actuated g/C Ratio	0.14		0.55	0.55	0.25	0.55
Clearance Time (s)	6.0				6.0	
Vehicle Extension (s)	3.0				3.0	
Lane Grp Cap (vph)	244		1039	883	218	1039
v/s Ratio Prot	c0.04		0.18		c0.00	c0.39
v/s Ratio Perm				0.01	0.02	
v/c Ratio	0.31		0.33	0.02	0.06	0.72
Uniform Delay, d1	28.1		9.1	7.5	20.5	12.3
Progression Factor	1.00		0.33	0.14	1.00	1.00
Incremental Delay, d2	0.7		0.2	0.0	0.1	2.5
Delay (s)	28.8		3.2	1.1	20.6	14.8
Level of Service	C		A	A	C	B
Approach Delay (s)	28.8		3.0			14.9
Approach LOS	C		A			B

Intersection Summary			
HCM 2000 Control Delay	12.1	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.63		
Actuated Cycle Length (s)	72.4	Sum of lost time (s)	22.0
Intersection Capacity Utilization	50.4%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	5	30	20	320	700	20
Future Volume (vph)	5	30	20	320	700	20
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0	0	100			0
Storage Lanes	1	0	1			0
Taper Length (ft)	25		25			
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.888				0.995	
Flt Protected	0.992		0.950			
Satd. Flow (prot)	1674	0	1787	1900	1872	0
Flt Permitted	0.992		0.950			
Satd. Flow (perm)	1674	0	1787	1900	1872	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	332			288	365	
Travel Time (s)	7.5			6.5	8.3	
Peak Hour Factor	0.64	0.77	0.71	0.90	0.75	0.55
Heavy Vehicles (%)	0%	0%	1%	0%	1%	0%
Adj. Flow (vph)	8	39	28	356	933	36
Shared Lane Traffic (%)						
Lane Group Flow (vph)	47	0	28	356	969	0
Sign Control	Stop			Free	Free	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 48.1% ICU Level of Service A

Analysis Period (min) 15

Intersection	
Int Delay, s/veh	0.9

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	5	30	20	320	700	20
Future Vol, veh/h	5	30	20	320	700	20
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	100	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	64	77	71	90	75	55
Heavy Vehicles, %	0	0	1	0	1	0
Mvmt Flow	8	39	28	356	933	36

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1363	951	969	0	-	0
Stage 1	951	-	-	-	-	-
Stage 2	412	-	-	-	-	-
Critical Hdwy	6.4	6.2	4.11	-	-	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.3	2.209	-	-	-
Pot Cap-1 Maneuver	165	318	715	-	-	-
Stage 1	379	-	-	-	-	-
Stage 2	673	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	159	318	715	-	-	-
Mov Cap-2 Maneuver	159	-	-	-	-	-
Stage 1	364	-	-	-	-	-
Stage 2	673	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	21	0.8	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	715	-	272	-	-
HCM Lane V/C Ratio	0.039	-	0.172	-	-
HCM Control Delay (s)	10.2	-	21	-	-
HCM Lane LOS	B	-	C	-	-
HCM 95th %tile Q(veh)	0.1	-	0.6	-	-

APPENDIX R-2: ALTERNATIVE D INTERSECTION CAPACITY ANALYSES – HCM 2000 PRINTOUTS – PM PEAK HOUR

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑↑		↰	↗↗
Traffic Volume (vph)	0	1285	1405	0	125	1295
Future Volume (vph)	0	1285	1405	0	125	1295
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	16	12
Total Lost time (s)		6.0	6.0		6.0	6.0
Lane Util. Factor		0.95	0.95		1.00	0.88
Frt		1.00	1.00		1.00	0.85
Flt Protected		1.00	1.00		0.95	1.00
Satd. Flow (prot)		3471	3406		1930	2682
Flt Permitted		1.00	1.00		0.95	1.00
Satd. Flow (perm)		3471	3406		1930	2682
Peak-hour factor, PHF	0.93	0.93	0.88	0.88	0.89	0.89
Adj. Flow (vph)	0	1382	1597	0	140	1455
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	1382	1597	0	140	1455
Heavy Vehicles (%)	4%	4%	6%	6%	6%	6%
Turn Type		NA	NA		Prot	Prot
Protected Phases		2	6		4	4
Permitted Phases						
Actuated Green, G (s)		60.0	60.0		68.0	68.0
Effective Green, g (s)		60.0	60.0		68.0	68.0
Actuated g/C Ratio		0.43	0.43		0.49	0.49
Clearance Time (s)		6.0	6.0		6.0	6.0
Vehicle Extension (s)		3.0	3.0		3.0	3.0
Lane Grp Cap (vph)		1487	1459		937	1302
v/s Ratio Prot		0.40	c0.47		0.07	c0.54
v/s Ratio Perm						
v/c Ratio		0.93	1.09		0.15	1.12
Uniform Delay, d1		38.0	40.0		20.0	36.0
Progression Factor		0.74	0.08		1.00	1.00
Incremental Delay, d2		7.9	43.8		0.1	63.8
Delay (s)		35.8	47.1		20.0	99.8
Level of Service		D	D		C	F
Approach Delay (s)		35.8	47.1		92.8	
Approach LOS		D	D		F	

Intersection Summary			
HCM 2000 Control Delay	59.6	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.11		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	96.1%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Movement	NBL2	NBL	NBR	SEL	SER	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations											
Traffic Volume (vph)	1245	0	1005	0	0	1050	360	0	0	500	235
Future Volume (vph)	1245	0	1005	0	0	1050	360	0	0	500	235
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0		6.0			6.0	6.0			6.0	4.0
Lane Util. Factor	0.97		0.88			0.97	0.95			0.95	1.00
Frt	1.00		0.85			1.00	1.00			1.00	0.85
Flt Protected	0.95		1.00			0.95	1.00			1.00	1.00
Satd. Flow (prot)	3242		2632			3335	3438			3505	1568
Flt Permitted	0.95		1.00			0.95	1.00			1.00	1.00
Satd. Flow (perm)	3242		2632			3335	3438			3505	1568
Peak-hour factor, PHF	0.88	0.88	0.88	0.92	0.92	0.94	0.94	0.94	0.92	0.92	0.92
Adj. Flow (vph)	1415	0	1142	0	0	1117	383	0	0	543	255
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	1415	0	1142	0	0	1117	383	0	0	543	255
Heavy Vehicles (%)	8%	8%	8%	2%	2%	5%	5%	5%	3%	3%	3%
Turn Type	Prot		Prot			Prot	NA			NA	Free
Protected Phases	8		8			5	2			6	
Permitted Phases											Free
Actuated Green, G (s)	55.0		55.0			42.0	73.0			25.0	140.0
Effective Green, g (s)	55.0		55.0			42.0	73.0			25.0	140.0
Actuated g/C Ratio	0.39		0.39			0.30	0.52			0.18	1.00
Clearance Time (s)	6.0		6.0			6.0	6.0			6.0	
Vehicle Extension (s)	3.0		3.0			3.0	3.0			3.0	
Lane Grp Cap (vph)	1273		1034			1000	1792			625	1568
v/s Ratio Prot	c0.44		0.43			c0.33	0.11			c0.15	
v/s Ratio Perm											0.16
v/c Ratio	1.11		1.10			1.12	0.21			0.87	0.16
Uniform Delay, d1	42.5		42.5			49.0	18.0			55.9	0.0
Progression Factor	1.00		1.00			0.44	0.21			1.00	1.00
Incremental Delay, d2	61.7		61.2			60.1	0.1			15.2	0.2
Delay (s)	104.2		103.7			81.8	3.9			71.1	0.2
Level of Service	F		F			F	A			E	A
Approach Delay (s)		103.9		0.0			61.9			48.4	
Approach LOS		F		A			E			D	

Intersection Summary			
HCM 2000 Control Delay	81.8	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.06		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	95.3%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
3 ~~2~~: Exit 5 SB On/Exit 5 SB Off & NH 28

12/28/2017

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑	↱	↰	↑↑					↰↰		↱
Traffic Volume (vph)	0	650	460	165	580	0	0	0	0	185	0	390
Future Volume (vph)	0	650	460	165	580	0	0	0	0	185	0	390
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0	4.0	6.0	6.0					6.0		6.0
Lane Util. Factor		0.95	1.00	1.00	0.95					0.97		1.00
Frt		1.00	0.85	1.00	1.00					1.00		0.85
Flt Protected		1.00	1.00	0.95	1.00					0.95		1.00
Satd. Flow (prot)		3471	1553	1719	3438					3367		1553
Flt Permitted		1.00	1.00	0.95	1.00					0.95		1.00
Satd. Flow (perm)		3471	1553	1719	3438					3367		1553
Peak-hour factor, PHF	0.87	0.87	0.87	0.86	0.86	0.86	0.92	0.92	0.92	0.91	0.91	0.91
Adj. Flow (vph)	0	747	529	192	674	0	0	0	0	203	0	429
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	179
Lane Group Flow (vph)	0	747	529	192	674	0	0	0	0	203	0	250
Heavy Vehicles (%)	4%	4%	4%	5%	5%	5%	2%	2%	2%	4%	4%	4%
Turn Type		NA	Free	Prot	NA					Prot		Prot
Protected Phases		2		1	6					4		4
Permitted Phases			Free									
Actuated Green, G (s)		37.2	90.0	14.4	57.6					20.4		20.4
Effective Green, g (s)		37.2	90.0	14.4	57.6					20.4		20.4
Actuated g/C Ratio		0.41	1.00	0.16	0.64					0.23		0.23
Clearance Time (s)		6.0		6.0	6.0					6.0		6.0
Vehicle Extension (s)		5.0		3.0	5.0					3.0		3.0
Lane Grp Cap (vph)		1434	1553	275	2200					763		352
v/s Ratio Prot		c0.22		c0.11	0.20					0.06		c0.16
v/s Ratio Perm			0.34									
v/c Ratio		0.52	0.34	0.70	0.31					0.27		0.71
Uniform Delay, d1		19.7	0.0	35.7	7.3					28.6		32.1
Progression Factor		1.00	1.00	0.33	0.03					1.00		1.00
Incremental Delay, d2		1.4	0.6	6.1	0.2					0.2		6.6
Delay (s)		21.1	0.6	18.0	0.4					28.8		38.7
Level of Service		C	A	B	A					C		D
Approach Delay (s)		12.6			4.3			0.0			35.5	
Approach LOS		B			A			A			D	

Intersection Summary			
HCM 2000 Control Delay	15.2	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.61		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	72.6%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑			↑↑	↱	↰		↱			
Traffic Volume (vph)	445	390	0	0	385	235	360	0	380	0	0	0
Future Volume (vph)	445	390	0	0	385	235	360	0	380	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0			6.0	4.0	6.0		6.0			
Lane Util. Factor	1.00	0.95			0.95	1.00	1.00		1.00			
Frt	1.00	1.00			1.00	0.85	1.00		0.85			
Flt Protected	0.95	1.00			1.00	1.00	0.95		1.00			
Satd. Flow (prot)	1752	3505			3505	1568	1703		1524			
Flt Permitted	0.95	1.00			1.00	1.00	0.95		1.00			
Satd. Flow (perm)	1752	3505			3505	1568	1703		1524			
Peak-hour factor, PHF	0.92	0.92	0.92	0.91	0.91	0.91	0.67	0.67	0.67	0.92	0.92	0.92
Adj. Flow (vph)	484	424	0	0	423	258	537	0	567	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	269	0	0	0
Lane Group Flow (vph)	484	424	0	0	423	258	537	0	298	0	0	0
Heavy Vehicles (%)	3%	3%	3%	3%	3%	3%	6%	6%	6%	2%	2%	2%
Turn Type	Prot	NA			NA	Free	Prot		Prot			
Protected Phases	5	2			6		8		8			
Permitted Phases		2			6	Free						
Actuated Green, G (s)	25.0	48.6			17.6	90.0	29.4		29.4			
Effective Green, g (s)	25.0	48.6			17.6	90.0	29.4		29.4			
Actuated g/C Ratio	0.28	0.54			0.20	1.00	0.33		0.33			
Clearance Time (s)	6.0	6.0			6.0		6.0		6.0			
Vehicle Extension (s)	5.0	5.0			5.0		3.0		3.0			
Lane Grp Cap (vph)	486	1892			685	1568	556		497			
v/s Ratio Prot	c0.28	0.12			c0.12		c0.32		0.20			
v/s Ratio Perm						0.16						
v/c Ratio	1.00	0.22			0.62	0.16	0.97		0.60			
Uniform Delay, d1	32.4	10.8			33.1	0.0	29.8		25.4			
Progression Factor	0.33	0.34			1.00	1.00	1.00		1.00			
Incremental Delay, d2	36.8	0.3			4.1	0.2	29.4		2.0			
Delay (s)	47.5	3.9			37.3	0.2	59.2		27.4			
Level of Service	D	A			D	A	E		C			
Approach Delay (s)		27.1			23.2			42.9			0.0	
Approach LOS		C			C			D			A	

Intersection Summary			
HCM 2000 Control Delay	32.6	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.89		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	72.6%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	10	5	210	10	0	10	410	910	120	5	650	120
Future Volume (vph)	10	5	210	10	0	10	410	910	120	5	650	120
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0	6.0		6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor		1.00	1.00		1.00		1.00	0.95		1.00	0.95	
Frt		1.00	0.85		0.93		1.00	0.98		1.00	0.98	
Flt Protected		0.97	1.00		0.98		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1801	1583		1729		1770	3478		1770	3457	
Flt Permitted		0.88	1.00		0.83		0.95	1.00		0.95	1.00	
Satd. Flow (perm)		1636	1583		1477		1770	3478		1770	3457	
Peak-hour factor, PHF	0.92	0.92	0.92	0.25	0.25	0.25	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	11	5	228	40	0	40	446	989	130	5	707	130
RTOR Reduction (vph)	0	0	138	0	75	0	0	8	0	0	14	0
Lane Group Flow (vph)	0	16	90	0	5	0	446	1111	0	5	823	0
Heavy Vehicles (%)	2%	2%	2%	0%	0%	0%	2%	2%	2%	2%	2%	2%
Turn Type	Perm	NA	custom	Perm	NA		Prot	NA		Prot	NA	
Protected Phases		8			4		5	2		1	6	
Permitted Phases	8		6	4								
Actuated Green, G (s)		4.9	30.5		4.9		23.6	53.2		0.9	30.5	
Effective Green, g (s)		4.9	30.5		4.9		23.6	53.2		0.9	30.5	
Actuated g/C Ratio		0.06	0.40		0.06		0.31	0.69		0.01	0.40	
Clearance Time (s)		6.0	6.0		6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)		3.0	3.0		3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		104	627		93		542	2402		20	1369	
v/s Ratio Prot							c0.25	0.32		0.00	c0.24	
v/s Ratio Perm		c0.01	0.06		0.00							
v/c Ratio		0.15	0.14		0.05		0.82	0.46		0.25	0.60	
Uniform Delay, d1		34.1	14.9		33.9		24.8	5.4		37.7	18.4	
Progression Factor		1.00	1.00		1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		0.7	0.1		0.2		9.8	0.1		6.5	0.7	
Delay (s)		34.8	15.0		34.1		34.5	5.5		44.2	19.2	
Level of Service		C	B		C		C	A		D	B	
Approach Delay (s)		16.3			34.1			13.8			19.3	
Approach LOS		B			C			B			B	

Intersection Summary			
HCM 2000 Control Delay	16.3	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.65		
Actuated Cycle Length (s)	77.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	71.1%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	20	30	5	260	0	40	0	790	130	15	420	0
Future Volume (vph)	20	30	5	260	0	40	0	790	130	15	420	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0			6.0			6.0			6.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		0.99			0.98			0.98			1.00	
Flt Protected		0.98			0.96			1.00			1.00	
Satd. Flow (prot)		1808			1736			1726			1806	
Flt Permitted		0.87			0.74			1.00			0.80	
Satd. Flow (perm)		1610			1338			1726			1455	
Peak-hour factor, PHF	0.60	0.60	0.60	0.96	0.96	0.96	0.89	0.89	0.89	0.86	0.86	0.86
Adj. Flow (vph)	33	50	8	271	0	42	0	888	146	17	488	0
RTOR Reduction (vph)	0	4	0	0	28	0	0	7	0	0	0	0
Lane Group Flow (vph)	0	87	0	0	285	0	0	1027	0	0	505	0
Heavy Vehicles (%)	2%	2%	2%	3%	3%	3%	8%	8%	8%	5%	5%	5%
Turn Type	Perm	NA		Perm	NA			NA		Perm	NA	
Protected Phases		4			4			2			2	
Permitted Phases	4			4						2		
Actuated Green, G (s)		20.1			20.1			55.8			55.8	
Effective Green, g (s)		20.1			20.1			55.8			55.8	
Actuated g/C Ratio		0.23			0.23			0.63			0.63	
Clearance Time (s)		6.0			6.0			6.0			6.0	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		368			305			1095			923	
v/s Ratio Prot								c0.60				
v/s Ratio Perm		0.05			c0.21						0.35	
v/c Ratio		0.24			0.94			0.94			0.55	
Uniform Delay, d1		27.6			33.3			14.5			9.0	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		0.3			34.6			14.6			0.7	
Delay (s)		28.0			67.9			29.1			9.6	
Level of Service		C			E			C			A	
Approach Delay (s)		28.0			67.9			29.1			9.6	
Approach LOS		C			E			C			A	

Intersection Summary			
HCM 2000 Control Delay	30.2	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.94		
Actuated Cycle Length (s)	87.9	Sum of lost time (s)	12.0
Intersection Capacity Utilization	86.3%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations	↰	↱		↰	↑	↱	↰	↱		↰	↱	
Traffic Volume (vph)	70	320	30	110	370	40	100	450	40	50	340	80
Future Volume (vph)	70	320	30	110	370	40	100	450	40	50	340	80
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	1.00	0.85	1.00	0.99		1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1752	1821		1752	1845	1568	1787	1858		1787	1828	
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1752	1821		1752	1845	1568	1787	1858		1787	1828	
Peak-hour factor, PHF	0.91	0.91	0.91	0.93	0.93	0.93	0.95	0.95	0.95	0.94	0.94	0.94
Adj. Flow (vph)	77	352	33	118	398	43	105	474	42	53	362	85
RTOR Reduction (vph)	0	4	0	0	0	29	0	3	0	0	9	0
Lane Group Flow (vph)	77	381	0	118	398	14	105	513	0	53	438	0
Heavy Vehicles (%)	3%	3%	3%	3%	3%	3%	1%	1%	1%	1%	1%	1%
Turn Type	Prot	NA		Prot	NA	pm+ov	Prot	NA		Prot	NA	
Protected Phases	3	8		7	4	5	5	2		1	6	
Permitted Phases						4						
Actuated Green, G (s)	7.1	18.4		7.9	19.2	26.4	7.2	29.5		2.8	25.1	
Effective Green, g (s)	7.1	18.4		7.9	19.2	26.4	7.2	29.5		2.8	25.1	
Actuated g/C Ratio	0.09	0.22		0.10	0.23	0.32	0.09	0.36		0.03	0.30	
Clearance Time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	150	405		167	428	615	155	663		60	555	
v/s Ratio Prot	0.04	0.21		c0.07	c0.22	0.00	c0.06	c0.28		0.03	0.24	
v/s Ratio Perm						0.01						
v/c Ratio	0.51	0.94		0.71	0.93	0.02	0.68	0.77		0.88	0.79	
Uniform Delay, d1	36.1	31.6		36.2	31.0	19.3	36.6	23.6		39.7	26.3	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	2.9	30.1		12.8	26.5	0.0	11.1	8.6		75.4	7.3	
Delay (s)	39.0	61.6		49.0	57.5	19.3	47.7	32.1		115.1	33.7	
Level of Service	D	E		D	E	B	D	C		F	C	
Approach Delay (s)		57.9			52.8			34.8			42.3	
Approach LOS		E			D			C			D	

Intersection Summary			
HCM 2000 Control Delay	46.2	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	82.6	Sum of lost time (s)	24.0
Intersection Capacity Utilization	89.4%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	790	10	5	160	100	350
Future Volume (vph)	790	10	5	160	100	350
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0	120	0			220
Storage Lanes	1	1	0			1
Taper Length (ft)	25		25			
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.850				0.850
Flt Protected	0.950			0.998		
Satd. Flow (prot)	1787	1599	0	1859	1881	1599
Flt Permitted	0.950			0.998		
Satd. Flow (perm)	1787	1599	0	1859	1881	1599
Link Speed (mph)	30			30	30	
Link Distance (ft)	322			309	354	
Travel Time (s)	7.3			7.0	8.0	
Peak Hour Factor	0.90	0.90	0.87	0.87	0.87	0.87
Heavy Vehicles (%)	1%	1%	2%	2%	1%	1%
Adj. Flow (vph)	878	11	6	184	115	402
Shared Lane Traffic (%)						
Lane Group Flow (vph)	878	11	0	190	115	402
Sign Control	Stop			Stop	Stop	

Intersection Summary	
Area Type: Other	
Control Type: Unsignalized	
Intersection Capacity Utilization 65.6%	ICU Level of Service C
Analysis Period (min) 15	

Intersection	
Intersection Delay, s/veh	205.3
Intersection LOS	F

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	790	10	5	160	100	350
Future Vol, veh/h	790	10	5	160	100	350
Peak Hour Factor	0.90	0.90	0.87	0.87	0.87	0.87
Heavy Vehicles, %	1	1	2	2	1	1
Mvmt Flow	878	11	6	184	115	402
Number of Lanes	1	1	0	1	1	1

Approach	EB	NB	SB
Opposing Approach		SB	NB
Opposing Lanes	0	2	1
Conflicting Approach Left	SB	EB	
Conflicting Lanes Left	2	2	0
Conflicting Approach Right	NB		EB
Conflicting Lanes Right	1	0	2
HCM Control Delay	351.4	17.2	23.2
HCM LOS	F	C	C

Lane	NBLn1	EBLn1	EBLn2	SBLn1	SBLn2
Vol Left, %	3%	100%	0%	0%	0%
Vol Thru, %	97%	0%	0%	100%	0%
Vol Right, %	0%	0%	100%	0%	100%
Sign Control	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	165	790	10	100	350
LT Vol	5	790	0	0	0
Through Vol	160	0	0	100	0
RT Vol	0	0	10	0	350
Lane Flow Rate	190	878	11	115	402
Geometry Grp	4	7	7	7	7
Degree of Util (X)	0.372	1.733	0.018	0.217	0.683
Departure Headway (Hd)	8.951	7.109	5.891	8.584	7.859
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes
Cap	406	518	611	421	463
Service Time	6.951	4.809	3.591	6.284	5.559
HCM Lane V/C Ratio	0.468	1.695	0.018	0.273	0.868
HCM Control Delay	17.2	355.7	8.7	13.6	25.9
HCM Lane LOS	C	F	A	B	D
HCM 95th-tile Q	1.7	52.6	0.1	0.8	5.1

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	10	0	0	950	450	10
Future Volume (vph)	10	0	0	950	450	10
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt					0.997	
Flt Protected	0.950					
Satd. Flow (prot)	1703	0	0	1881	1876	0
Flt Permitted	0.950					
Satd. Flow (perm)	1703	0	0	1881	1876	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	160			224	319	
Travel Time (s)	3.6			5.1	7.3	
Peak Hour Factor	0.50	0.50	0.93	0.93	0.86	0.86
Heavy Vehicles (%)	6%	6%	1%	1%	1%	1%
Adj. Flow (vph)	20	0	0	1022	523	12
Shared Lane Traffic (%)						
Lane Group Flow (vph)	20	0	0	1022	535	0
Sign Control	Stop			Free	Free	

Intersection Summary	
Area Type: Other	
Control Type: Unsignalized	
Intersection Capacity Utilization 66.4%	ICU Level of Service C
Analysis Period (min) 15	

Intersection	
Int Delay, s/veh	0.5

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	10	0	0	950	450	10
Future Vol, veh/h	10	0	0	950	450	10
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	50	50	93	93	86	86
Heavy Vehicles, %	6	6	1	1	1	1
Mvmt Flow	20	0	0	1022	523	12

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1551	529	535	0	-	0
Stage 1	529	-	-	-	-	-
Stage 2	1022	-	-	-	-	-
Critical Hdwy	6.46	6.26	4.11	-	-	-
Critical Hdwy Stg 1	5.46	-	-	-	-	-
Critical Hdwy Stg 2	5.46	-	-	-	-	-
Follow-up Hdwy	3.554	3.354	2.209	-	-	-
Pot Cap-1 Maneuver	122	542	1038	-	-	-
Stage 1	583	-	-	-	-	-
Stage 2	341	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	122	542	1038	-	-	-
Mov Cap-2 Maneuver	122	-	-	-	-	-
Stage 1	583	-	-	-	-	-
Stage 2	341	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	40.2	0	0
HCM LOS	E		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1038	-	122	-	-
HCM Lane V/C Ratio	-	-	0.164	-	-
HCM Control Delay (s)	0	-	40.2	-	-
HCM Lane LOS	A	-	E	-	-
HCM 95th %tile Q(veh)	0	-	0.6	-	-

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations		✣			✣			✣			✣	
Traffic Volume (vph)	50	900	10	20	260	10	50	20	170	30	10	10
Future Volume (vph)	50	900	10	20	260	10	50	20	170	30	10	10
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	150		150	150		150	0		0	150		150
Storage Lanes	0		0	0		0	0		0	0		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.999			0.995			0.904			0.973	
Flt Protected		0.997			0.997			0.990			0.971	
Satd. Flow (prot)	0	1874	0	0	1848	0	0	1700	0	0	1795	0
Flt Permitted		0.997			0.997			0.990			0.971	
Satd. Flow (perm)	0	1874	0	0	1848	0	0	1700	0	0	1795	0
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		327			240			246			251	
Travel Time (s)		7.4			5.5			5.6			5.7	
Peak Hour Factor	0.94	0.94	0.94	0.88	0.88	0.88	0.67	0.67	0.67	0.82	0.82	0.82
Heavy Vehicles (%)	1%	1%	1%	2%	2%	2%	0%	0%	0%	0%	0%	0%
Adj. Flow (vph)	53	957	11	23	295	11	75	30	254	37	12	12
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	1021	0	0	329	0	0	359	0	0	61	0
Sign Control		Free			Free			Stop			Stop	

Intersection Summary

Area Type: Other
Control Type: Unsignalized
Intersection Capacity Utilization 84.6% ICU Level of Service E
Analysis Period (min) 15

Intersection	
Int Delay, s/veh	37.8

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations		✥			✥			✥			✥	
Traffic Vol, veh/h	50	900	10	20	260	10	50	20	170	30	10	10
Future Vol, veh/h	50	900	10	20	260	10	50	20	170	30	10	10
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	Yield	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	94	94	94	88	88	88	67	67	67	82	82	82
Heavy Vehicles, %	1	1	1	2	2	2	0	0	0	0	0	0
Mvmt Flow	53	957	11	23	295	11	75	30	254	37	12	12

Major/Minor	Major1			Major2			Minor2			Minor1		
Conflicting Flow All	306	0	0	968	0	0	1428	1421	301	1431	1421	963
Stage 1	-	-	-	-	-	-	347	347	-	1069	1069	-
Stage 2	-	-	-	-	-	-	1081	1074	-	362	352	-
Critical Hdwy	4.11	-	-	4.12	-	-	7.1	6.5	6.2	7.1	6.5	6.2
Critical Hdwy Stg 1	-	-	-	-	-	-	6.1	5.5	-	6.1	5.5	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.1	5.5	-	6.1	5.5	-
Follow-up Hdwy	2.209	-	-	2.218	-	-	3.5	4	3.3	3.5	4	3.3
Pot Cap-1 Maneuver	1260	-	-	712	-	-	114	138	743	113	138	313
Stage 1	-	-	-	-	-	-	673	638	-	270	300	-
Stage 2	-	-	-	-	-	-	266	299	-	661	635	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1260	-	-	712	-	-	91	121	743	55	121	313
Mov Cap-2 Maneuver	-	-	-	-	-	-	91	121	-	55	121	-
Stage 1	-	-	-	-	-	-	612	613	-	245	273	-
Stage 2	-	-	-	-	-	-	222	272	-	398	610	-

Approach	EB	WB	SE	NW
HCM Control Delay, s	0.4	0.7	160.2	146
HCM LOS			F	F

Minor Lane/Major Mvmt	NWLn1	EBL	EBT	EBR	WBL	WBT	WBR	SELn1
Capacity (veh/h)	76	1260	-	-	712	-	-	295
HCM Lane V/C Ratio	0.802	0.042	-	-	0.032	-	-	1.214
HCM Control Delay (s)	146	8	0	-	10.2	0	-	160.2
HCM Lane LOS	F	A	A	-	B	A	-	F
HCM 95th %tile Q(veh)	3.9	0.1	-	-	0.1	-	-	16.2

Movement	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	70	340	190	650	530	0	300	480	110	30	250	930
Future Volume (vph)	70	340	190	650	530	0	300	480	110	30	250	930
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0		6.0	6.0	4.0	6.0	6.0	6.0
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95		0.97	1.00	1.00	1.00	1.00	0.88
Frt	1.00	1.00	0.85	1.00	1.00		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	3539	1583	3433	3539		3433	1863	1583	1787	1881	2814
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	3539	1583	3433	3539		3433	1863	1583	1787	1881	2814
Peak-hour factor, PHF	0.92	0.92	0.92	0.94	0.94	0.94	0.96	0.96	0.96	0.95	0.95	0.95
Adj. Flow (vph)	76	370	207	691	564	0	312	500	115	32	263	979
RTOR Reduction (vph)	0	0	151	0	0	0	0	0	0	0	0	57
Lane Group Flow (vph)	76	370	56	691	564	0	313	500	115	32	263	922
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	1%	1%	1%
Turn Type	Prot	NA	pm+ov	Prot	NA		Prot	NA	Free	Prot	NA	pt+ov
Protected Phases	1	6	7	5	2		3	8		7	4	4 5
Permitted Phases		6	6		2			8	Free		4	
Actuated Green, G (s)	11.0	16.7	25.4	29.3	35.0		16.0	41.3	120.0	8.7	34.0	69.3
Effective Green, g (s)	11.0	16.7	25.4	29.3	35.0		16.0	41.3	120.0	8.7	34.0	69.3
Actuated g/C Ratio	0.09	0.14	0.21	0.24	0.29		0.13	0.34	1.00	0.07	0.28	0.58
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	162	492	414	838	1032		457	641	1583	129	532	1625
v/s Ratio Prot	0.04	c0.10	0.01	c0.20	0.16		c0.09	c0.27		0.02	0.14	0.33
v/s Ratio Perm			0.03						0.07			
v/c Ratio	0.47	0.75	0.14	0.82	0.55		0.68	0.78	0.07	0.25	0.49	0.57
Uniform Delay, d1	51.7	49.7	38.4	42.9	35.8		49.6	35.3	0.0	52.6	35.8	15.9
Progression Factor	1.00	1.00	1.00	1.13	0.76		1.00	1.00	1.00	1.47	0.67	0.62
Incremental Delay, d2	2.1	10.2	0.2	5.9	1.8		4.2	6.1	0.1	0.8	0.6	0.4
Delay (s)	53.9	59.8	38.5	54.5	28.9		53.8	41.4	0.1	78.0	24.7	10.3
Level of Service	D	E	D	D	C		D	D	A	E	C	B
Approach Delay (s)		52.4			43.0			40.5			14.9	
Approach LOS		D			D			D			B	

Intersection Summary			
HCM 2000 Control Delay	35.2	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.80		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	24.0
Intersection Capacity Utilization	79.9%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	NWL	NWR	NET	NER	SWL	SWT
Lane Configurations						
Traffic Volume (vph)	310	110	800	530	90	920
Future Volume (vph)	310	110	800	530	90	920
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	4.0	6.0	6.0
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1787	1599	3574	1599	1787	3574
Flt Permitted	0.95	1.00	1.00	1.00	0.16	1.00
Satd. Flow (perm)	1787	1599	3574	1599	295	3574
Peak-hour factor, PHF	0.86	0.86	0.96	0.96	0.85	0.85
Adj. Flow (vph)	360	128	833	552	106	1082
RTOR Reduction (vph)	0	20	0	0	0	0
Lane Group Flow (vph)	360	108	833	552	106	1082
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%
Turn Type	Prot	pm+ov	NA	Free	pm+pt	NA
Protected Phases	1 2 5 6	7	8		7	3 4
Permitted Phases		1 2 5 6		Free	3 4	
Actuated Green, G (s)	52.0	60.7	41.3	120.0	56.0	56.0
Effective Green, g (s)	52.0	60.7	41.3	120.0	56.0	56.0
Actuated g/C Ratio	0.43	0.51	0.34	1.00	0.47	0.47
Clearance Time (s)		6.0	6.0		6.0	
Vehicle Extension (s)		3.0	3.0		3.0	
Lane Grp Cap (vph)	774	888	1230	1599	245	1667
v/s Ratio Prot	c0.20	0.01	c0.23		0.03	c0.30
v/s Ratio Perm		0.06		0.35	0.17	
v/c Ratio	0.47	0.12	0.68	0.35	0.43	0.65
Uniform Delay, d1	24.1	15.6	33.7	0.0	21.4	24.5
Progression Factor	1.00	1.00	1.15	1.00	1.00	1.00
Incremental Delay, d2	0.4	0.1	1.0	0.4	1.2	0.9
Delay (s)	24.6	15.7	39.8	0.4	22.6	25.4
Level of Service	C	B	D	A	C	C
Approach Delay (s)	22.2		24.1			25.1
Approach LOS	C		C			C

Intersection Summary			
HCM 2000 Control Delay	24.2	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.64		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	24.0
Intersection Capacity Utilization	61.0%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations	↰	↑↱		↰	↑↱			↰↑	↱		↰↑	↱
Traffic Volume (vph)	380	1475	5	20	1290	120	15	10	15	10	10	160
Future Volume (vph)	380	1475	5	20	1290	120	15	10	15	10	10	160
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0			6.0	6.0		6.0	6.0
Lane Util. Factor	1.00	0.95		1.00	0.95			1.00	1.00		1.00	1.00
Frt	1.00	1.00		1.00	0.99			1.00	0.85		1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00			0.97	1.00		0.98	1.00
Satd. Flow (prot)	1787	3573		1787	3529			1844	1615		1835	1599
Flt Permitted	0.95	1.00		0.95	1.00			0.80	1.00		0.83	1.00
Satd. Flow (perm)	1787	3573		1787	3529			1518	1615		1557	1599
Peak-hour factor, PHF	0.97	0.97	0.97	0.95	0.95	0.95	0.90	0.90	0.90	0.80	0.80	0.80
Adj. Flow (vph)	392	1521	5	21	1358	126	17	11	17	12	12	200
RTOR Reduction (vph)	0	0	0	0	5	0	0	0	16	0	0	19
Lane Group Flow (vph)	392	1526	0	21	1479	0	0	28	1	0	26	181
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	0%	0%	0%	1%	1%	1%
Turn Type	Prot	NA		Prot	NA		Perm	NA	Perm	Perm	NA	pm+ov
Protected Phases	5	2		1	6			8			4	5
Permitted Phases							8		8	4	4	4
Actuated Green, G (s)	31.2	93.4		3.3	65.5			5.3	5.3		5.3	36.5
Effective Green, g (s)	31.2	93.4		3.3	65.5			5.3	5.3		5.3	36.5
Actuated g/C Ratio	0.26	0.78		0.03	0.55			0.04	0.04		0.04	0.30
Clearance Time (s)	6.0	6.0		6.0	6.0			6.0	6.0		6.0	6.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	464	2780		49	1926			67	71		68	566
v/s Ratio Prot	c0.22	0.43		0.01	c0.42							c0.08
v/s Ratio Perm								0.02	0.00		0.02	0.03
v/c Ratio	0.84	0.55		0.43	0.77			0.42	0.01		0.38	0.32
Uniform Delay, d1	42.1	5.1		57.4	21.3			55.8	54.8		55.8	32.2
Progression Factor	0.97	1.30		1.20	0.94			1.00	1.00		1.00	1.00
Incremental Delay, d2	7.6	0.4		4.6	2.3			4.2	0.1		3.6	0.3
Delay (s)	48.5	7.1		73.7	22.4			60.0	54.9		59.3	32.5
Level of Service	D	A		E	C			E	D		E	C
Approach Delay (s)		15.6			23.1			58.1			35.6	
Approach LOS		B			C			E			D	

Intersection Summary			
HCM 2000 Control Delay	20.4	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	83.6%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	150	1550	10	5	1240	410	40	10	10	200	5	280
Future Volume (vph)	150	1550	10	5	1240	410	40	10	10	200	5	280
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0		6.0	6.0	6.0
Lane Util. Factor	0.97	0.95		1.00	0.95	1.00	1.00	1.00		0.95	0.95	1.00
Frt	1.00	1.00		1.00	1.00	0.85	1.00	0.93		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.95	1.00
Satd. Flow (prot)	3467	3571		1770	3539	1583	1805	1758		1715	1723	1615
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.45	1.00
Satd. Flow (perm)	3467	3571		1770	3539	1583	1805	1758		1715	813	1615
Peak-hour factor, PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.78	0.78	0.78	0.86	0.86	0.86
Adj. Flow (vph)	179	1845	12	6	1378	456	51	13	13	233	6	326
RTOR Reduction (vph)	0	0	0	0	0	133	0	12	0	0	0	111
Lane Group Flow (vph)	179	1857	0	6	1378	323	51	14	0	119	120	215
Heavy Vehicles (%)	1%	1%	1%	2%	2%	2%	0%	0%	0%	0%	0%	0%
Turn Type	Prot	NA		Prot	NA	pm+ov	Prot	NA		Prot	NA	pt+ov
Protected Phases	5	2		1	6	7	3	8		7	4	4 5
Permitted Phases		2			6	6		8				
Actuated Green, G (s)	9.1	63.0		1.0	54.9	76.8	7.7	10.1		21.9	38.0	39.4
Effective Green, g (s)	9.1	63.0		1.0	54.9	76.8	7.7	10.1		21.9	38.0	39.4
Actuated g/C Ratio	0.08	0.52		0.01	0.46	0.64	0.06	0.08		0.18	0.32	0.33
Clearance Time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	262	1874		14	1619	1092	115	147		312	423	530
v/s Ratio Prot	c0.05	c0.52		0.00	0.39	0.05	0.03	0.01		c0.07	0.05	c0.13
v/s Ratio Perm						0.15					0.04	
v/c Ratio	0.68	0.99		0.43	0.85	0.30	0.44	0.10		0.38	0.28	0.41
Uniform Delay, d1	54.0	28.2		59.2	28.9	9.6	54.1	50.7		43.1	30.8	31.2
Progression Factor	1.00	1.00		1.00	0.74	0.07	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	7.2	18.7		16.3	3.7	0.1	2.7	0.3		0.8	0.4	0.5
Delay (s)	61.2	46.9		75.5	25.1	0.8	56.8	51.0		43.9	31.2	31.7
Level of Service	E	D		E	C	A	E	D		D	C	C
Approach Delay (s)		48.2			19.3			54.8			34.2	
Approach LOS		D			B			D			C	

Intersection Summary			
HCM 2000 Control Delay	34.8	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.84		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	24.0
Intersection Capacity Utilization	74.7%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↰	↑↑	↑↱		↰	↱
Traffic Volume (vph)	200	1770	1450	40	20	80
Future Volume (vph)	200	1770	1450	40	20	80
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	300			0	0	175
Storage Lanes	1			0	1	1
Taper Length (ft)	25				25	
Lane Util. Factor	1.00	0.95	0.95	0.95	1.00	1.00
Frt			0.996			0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1770	3539	3525	0	1752	1568
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1770	3539	3525	0	1752	1568
Link Speed (mph)		30	30		30	
Link Distance (ft)		535	210		522	
Travel Time (s)		12.2	4.8		11.9	
Peak Hour Factor	0.91	0.91	0.90	0.90	0.75	0.75
Heavy Vehicles (%)	2%	2%	2%	2%	3%	3%
Adj. Flow (vph)	220	1945	1611	44	27	107
Shared Lane Traffic (%)						
Lane Group Flow (vph)	220	1945	1655	0	27	107
Sign Control		Free	Free		Stop	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 65.8% ICU Level of Service C

Analysis Period (min) 15

Intersection	
Int Delay, s/veh	30.8

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↰	↑↑	↑↱		↰	↱
Traffic Vol, veh/h	200	1770	1450	40	20	80
Future Vol, veh/h	200	1770	1450	40	20	80
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	300	-	-	-	0	175
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	91	91	90	90	75	75
Heavy Vehicles, %	2	2	2	2	3	3
Mvmt Flow	220	1945	1611	44	27	107

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	1655	0	-	0	3046	828
Stage 1	-	-	-	-	1633	-
Stage 2	-	-	-	-	1413	-
Critical Hdwy	4.14	-	-	-	6.86	6.96
Critical Hdwy Stg 1	-	-	-	-	5.86	-
Critical Hdwy Stg 2	-	-	-	-	5.86	-
Follow-up Hdwy	2.22	-	-	-	3.53	3.33
Pot Cap-1 Maneuver	386	-	-	-	~ 10	312
Stage 1	-	-	-	-	143	-
Stage 2	-	-	-	-	189	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	386	-	-	-	~ 4	312
Mov Cap-2 Maneuver	-	-	-	-	~ 4	-
Stage 1	-	-	-	-	61	-
Stage 2	-	-	-	-	189	-

Approach	EB	WB	SB
HCM Control Delay, s	2.6	0	$ 869.9
HCM LOS			F

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1	SBLn2
Capacity (veh/h)	386	-	-	-	4	312
HCM Lane V/C Ratio	0.569	-	-	-	6.667	0.342
HCM Control Delay (s)	26	-	-	$	4259.8	22.4
HCM Lane LOS	D	-	-	-	F	C
HCM 95th %tile Q(veh)	3.4	-	-	-	4.9	1.5

Notes

~: Volume exceeds capacity $: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	140	1360	1415	270	120	70
Future Volume (vph)	140	1360	1415	270	120	70
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0		6.0	6.0
Lane Util. Factor	1.00	0.95	0.95		1.00	1.00
Frt	1.00	1.00	0.98		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1770	3539	3454		1770	1583
Flt Permitted	0.08	1.00	1.00		0.95	1.00
Satd. Flow (perm)	148	3539	3454		1770	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	152	1478	1538	293	130	76
RTOR Reduction (vph)	0	0	20	0	0	27
Lane Group Flow (vph)	152	1478	1811	0	130	49
Turn Type	pm+pt	NA	NA		Prot	pm+ov
Protected Phases	5	2	6		4	5
Permitted Phases	2					4
Actuated Green, G (s)	55.7	55.7	44.5		7.3	12.5
Effective Green, g (s)	55.7	55.7	44.5		7.3	12.5
Actuated g/C Ratio	0.74	0.74	0.59		0.10	0.17
Clearance Time (s)	6.0	6.0	6.0		6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	222	2628	2049		172	390
v/s Ratio Prot	0.05	c0.42	c0.52		c0.07	0.01
v/s Ratio Perm	0.46					0.02
v/c Ratio	0.68	0.56	0.88		0.76	0.13
Uniform Delay, d1	15.1	4.3	13.0		33.0	26.6
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	8.4	0.3	4.9		17.1	0.1
Delay (s)	23.6	4.5	18.0		50.1	26.7
Level of Service	C	A	B		D	C
Approach Delay (s)		6.3	18.0		41.5	
Approach LOS		A	B		D	

Intersection Summary			
HCM 2000 Control Delay	14.1	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	75.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	77.1%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	NBT	NBR	SBL	SBT	SWL	SWR
Lane Configurations			٦٦		٦٦	
Traffic Volume (vph)	0	0	1380	0	375	0
Future Volume (vph)	0	0	1380	0	375	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)			6.0		6.0	
Lane Util. Factor			0.97		0.97	
Frt			1.00		1.00	
Flt Protected			0.95		0.95	
Satd. Flow (prot)			3433		3433	
Flt Permitted			0.95		0.95	
Satd. Flow (perm)			3433		3433	
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	0	0	1468	0	399	0
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	1468	0	399	0
Turn Type			Prot		Prot	
Protected Phases			4		2	
Permitted Phases						
Actuated Green, G (s)			56.0		22.0	
Effective Green, g (s)			56.0		22.0	
Actuated g/C Ratio			0.62		0.24	
Clearance Time (s)			6.0		6.0	
Vehicle Extension (s)			3.0		3.0	
Lane Grp Cap (vph)			2136		839	
v/s Ratio Prot			c0.43		c0.12	
v/s Ratio Perm						
v/c Ratio			0.69		0.48	
Uniform Delay, d1			11.2		29.1	
Progression Factor			1.00		1.21	
Incremental Delay, d2			1.8		1.9	
Delay (s)			13.0		37.2	
Level of Service			B		D	
Approach Delay (s)	0.0			13.0	37.2	
Approach LOS	A			B	D	

Intersection Summary			
HCM 2000 Control Delay	18.2	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.63		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	112.7%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

Movement	SBL	SBR	NWL	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations										
Traffic Volume (vph)	0	0	0	120	0	1380	0	0	375	1110
Future Volume (vph)	0	0	0	120	0	1380	0	0	375	1110
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)			6.0	6.0		6.0			6.0	6.0
Lane Util. Factor			1.00	0.95		0.95			0.95	0.88
Frt			0.85	0.85		1.00			1.00	0.85
Flt Protected			1.00	1.00		1.00			1.00	1.00
Satd. Flow (prot)			1583	1504		3539			3539	2787
Flt Permitted			1.00	1.00		1.00			1.00	1.00
Satd. Flow (perm)			1583	1504		3539			3539	2787
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	0	0	0	128	0	1468	0	0	399	1181
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	226
Lane Group Flow (vph)	0	0	64	64	0	1468	0	0	399	955
Turn Type			Prot	Prot	Perm	NA			NA	Perm
Protected Phases			4	4		2			2	
Permitted Phases					2					2
Actuated Green, G (s)			10.2	10.2		67.8			67.8	67.8
Effective Green, g (s)			10.2	10.2		67.8			67.8	67.8
Actuated g/C Ratio			0.11	0.11		0.75			0.75	0.75
Clearance Time (s)			6.0	6.0		6.0			6.0	6.0
Vehicle Extension (s)			3.0	3.0		3.0			3.0	3.0
Lane Grp Cap (vph)			179	170		2666			2666	2099
v/s Ratio Prot			0.04	c0.04		c0.41			0.11	
v/s Ratio Perm										0.34
v/c Ratio			0.36	0.38		0.55			0.15	0.46
Uniform Delay, d1			36.9	37.0		4.7			3.1	4.2
Progression Factor			1.00	1.00		0.50			1.00	1.00
Incremental Delay, d2			1.2	1.4		0.6			0.1	0.7
Delay (s)			38.1	38.4		2.9			3.2	4.9
Level of Service			D	D		A			A	A
Approach Delay (s)	0.0		38.2			2.9			4.5	
Approach LOS	A		D			A			A	

Intersection Summary			
HCM 2000 Control Delay	5.1	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.53		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	88.2%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	WBL2	WBL	WBR	WBR2	NBL	NBT	NBR	NBR2	SBL2	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	10	220	360	30	80	120	70	10	10	390	190	30
Future Volume (vph)	10	220	360	30	80	120	70	10	10	390	190	30
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.915				0.962					0.993	
Flt Protected		0.982				0.986					0.969	
Satd. Flow (prot)	0	1690	0	0	0	1767	0	0	0	0	1810	0
Flt Permitted		0.982				0.986					0.969	
Satd. Flow (perm)	0	1690	0	0	0	1767	0	0	0	0	1810	0
Link Speed (mph)		30				30					30	
Link Distance (ft)		449				456					370	
Travel Time (s)		10.2				10.4					8.4	
Peak Hour Factor	0.91	0.91	0.91	0.91	0.87	0.87	0.87	0.87	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	1%	1%	1%	1%	2%	2%	2%	2%	1%	1%	1%	1%
Adj. Flow (vph)	11	242	396	33	92	138	80	11	11	424	207	33
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	682	0	0	0	321	0	0	0	0	675	0
Sign Control		Yield				Yield					Yield	

Intersection Summary

Area Type: Other
Control Type: Roundabout
Intersection Capacity Utilization 137.4% ICU Level of Service H
Analysis Period (min) 15

Lane Group	NEL	NET	NER	NER2	SWL2	SWL	SWT	SWR
Lane Configurations								
Traffic Volume (vph)	30	180	320	70	10	30	170	15
Future Volume (vph)	30	180	320	70	10	30	170	15
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.912					0.991	
Flt Protected		0.998					0.991	
Satd. Flow (prot)	0	1712	0	0	0	0	1829	0
Flt Permitted		0.998					0.991	
Satd. Flow (perm)	0	1712	0	0	0	0	1829	0
Link Speed (mph)		30					30	
Link Distance (ft)		390					523	
Travel Time (s)		8.9					11.9	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.91	0.91	0.91	0.91
Heavy Vehicles (%)	1%	1%	1%	1%	2%	2%	2%	2%
Adj. Flow (vph)	33	200	356	78	11	33	187	16
Shared Lane Traffic (%)								
Lane Group Flow (vph)	0	667	0	0	0	0	247	0
Sign Control		Yield					Yield	

Intersection Summary

Intersection					
Intersection Delay, s/veh	38.3				
Intersection LOS	E				

Approach	WB	NB	SB	NE	SW
Entry Lanes	1	1	1	1	1
Conflicting Circle Lanes	1	1	1	1	1
Adj Approach Flow, veh/h	682	321	675	667	247
Demand Flow Rate, veh/h	688	328	681	674	252
Vehicles Circulating, veh/h	563	1045	585	704	923
Vehicles Exiting, veh/h	810	333	590	562	328
Ped Vol Crossing Leg, #/h	0	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000	1.000
Approach Delay, s/veh	33.6	26.7	35.6	60.1	15.0
Approach LOS	D	D	E	F	C

Lane	Left	Left	Left	Left	Left
Designated Moves	LR	LTR	LTR	LTR	LTR
Assumed Moves	LR	LTR	LTR	LTR	LTR
RT Channelized					
Lane Util	1.000	1.000	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976	4.976	4.976
Entry Flow, veh/h	688	328	681	674	252
Cap Entry Lane, veh/h	777	475	760	673	538
Entry HV Adj Factor	0.991	0.979	0.991	0.990	0.980
Flow Entry, veh/h	682	321	675	667	247
Cap Entry, veh/h	770	466	753	666	528
V/C Ratio	0.885	0.690	0.896	1.001	0.468
Control Delay, s/veh	33.6	26.7	35.6	60.1	15.0
LOS	D	D	E	F	C
95th %tile Queue, veh	11	5	12	16	2

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↰	↱		✥			✥			✥	
Traffic Volume (vph)	5	50	500	10	30	20	320	130	10	25	110	10
Future Volume (vph)	5	50	500	10	30	20	320	130	10	25	110	10
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		50	0		0	0		0	0		0
Storage Lanes	0		1	0		0	0		0	0		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850		0.956			0.997			0.991	
Flt Protected		0.995			0.992			0.966			0.992	
Satd. Flow (prot)	0	1853	1583	0	1802	0	0	1812	0	0	1849	0
Flt Permitted		0.995			0.992			0.966			0.992	
Satd. Flow (perm)	0	1853	1583	0	1802	0	0	1812	0	0	1849	0
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		168			453			475			436	
Travel Time (s)		3.8			10.3			10.8			9.9	
Peak Hour Factor	0.88	0.88	0.88	0.82	0.82	0.82	0.93	0.93	0.93	0.91	0.91	0.91
Heavy Vehicles (%)	2%	2%	2%	0%	0%	0%	1%	1%	1%	1%	1%	1%
Adj. Flow (vph)	6	57	568	12	37	24	344	140	11	27	121	11
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	63	568	0	73	0	0	495	0	0	159	0
Sign Control		Stop			Stop			Free			Free	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 51.9% ICU Level of Service A

Analysis Period (min) 15

Intersection	
Int Delay, s/veh	14.4

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	5	50	500	10	30	20	320	130	10	25	110	10
Future Vol, veh/h	5	50	500	10	30	20	320	130	10	25	110	10
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	50	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	88	88	88	82	82	82	93	93	93	91	91	91
Heavy Vehicles, %	2	2	2	0	0	0	1	1	1	1	1	1
Mvmt Flow	6	57	568	12	37	24	344	140	11	27	121	11

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1045	1020	127	1327	1020	146	132	0	0	151	0	0
Stage 1	181	181	-	834	834	-	-	-	-	-	-	-
Stage 2	864	839	-	493	186	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.1	6.5	6.2	4.11	-	-	4.11	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.1	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.1	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.5	4	3.3	2.209	-	-	2.209	-	-
Pot Cap-1 Maneuver	207	237	923	134	239	906	1459	-	-	1436	-	-
Stage 1	821	750	-	365	386	-	-	-	-	-	-	-
Stage 2	349	381	-	562	750	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	134	172	923	31	174	906	1459	-	-	1436	-	-
Mov Cap-2 Maneuver	134	172	-	31	174	-	-	-	-	-	-	-
Stage 1	609	735	-	271	286	-	-	-	-	-	-	-
Stage 2	220	283	-	195	735	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	17.2	78.3	5.7	1.3
HCM LOS	C	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1459	-	-	168	923	116	1436	-	-
HCM Lane V/C Ratio	0.236	-	-	0.372	0.616	0.631	0.019	-	-
HCM Control Delay (s)	8.2	0	-	38.6	14.9	78.3	7.6	0	-
HCM Lane LOS	A	A	-	E	B	F	A	A	-
HCM 95th %tile Q(veh)	0.9	-	-	1.6	4.4	3.2	0.1	-	-

Movement	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	30	70	30	50	40	210	90	840	70	20	360	40
Future Volume (vph)	30	70	30	50	40	210	90	840	70	20	360	40
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	0.95		1.00	0.95	
Frt	1.00	0.96		1.00	1.00	0.85	1.00	0.99		1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	1780		1787	1881	1599	1805	3568		1805	3556	
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	1780		1787	1881	1599	1805	3568		1805	3556	
Peak-hour factor, PHF	0.99	0.99	0.99	0.95	0.95	0.95	0.89	0.89	0.89	0.93	0.93	0.93
Adj. Flow (vph)	30	71	30	53	42	221	101	944	79	22	387	43
RTOR Reduction (vph)	0	18	0	0	0	125	0	7	0	0	11	0
Lane Group Flow (vph)	30	83	0	53	42	96	101	1016	0	22	419	0
Heavy Vehicles (%)	2%	2%	2%	1%	1%	1%	0%	0%	0%	0%	0%	0%
Turn Type	Prot	NA		Prot	NA	pt+ov	Prot	NA		Prot	NA	
Protected Phases	1	6		5	2	2 3	3	8		7	4	
Permitted Phases		6			2							
Actuated Green, G (s)	2.6	14.8		4.2	16.4	31.3	8.9	26.1		2.6	19.8	
Effective Green, g (s)	2.6	14.8		4.2	16.4	31.3	8.9	26.1		2.6	19.8	
Actuated g/C Ratio	0.04	0.21		0.06	0.23	0.44	0.12	0.36		0.04	0.28	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	64	367		104	430	698	224	1298		65	981	
v/s Ratio Prot	0.02	c0.05		c0.03	0.02	0.06	c0.06	c0.28		0.01	0.12	
v/s Ratio Perm												
v/c Ratio	0.47	0.23		0.51	0.10	0.14	0.45	0.78		0.34	0.43	
Uniform Delay, d1	33.9	23.7		32.8	21.8	12.1	29.1	20.3		33.7	21.3	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	5.3	0.3		3.9	0.5	0.1	1.4	3.2		3.1	0.3	
Delay (s)	39.2	24.0		36.6	22.3	12.2	30.6	23.4		36.8	21.6	
Level of Service	D	C		D	C	B	C	C		D	C	
Approach Delay (s)		27.5			17.6			24.1			22.3	
Approach LOS		C			B			C			C	

Intersection Summary			
HCM 2000 Control Delay	22.9	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.60		
Actuated Cycle Length (s)	71.7	Sum of lost time (s)	24.0
Intersection Capacity Utilization	56.6%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	710	5	10	260	200	340
Future Volume (vph)	710	5	10	260	200	340
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0		6.0	4.0	4.0	6.0
Lane Util. Factor	1.00		1.00	1.00	1.00	1.00
Frt	1.00		1.00	1.00	1.00	0.85
Flt Protected	0.95		0.95	1.00	1.00	1.00
Satd. Flow (prot)	1790		1770	1863	1845	1568
Flt Permitted	0.95		0.52	1.00	1.00	1.00
Satd. Flow (perm)	1790		962	1863	1845	1568
Peak-hour factor, PHF	0.90	0.90	0.87	0.87	0.89	0.89
Adj. Flow (vph)	789	6	11	299	225	382
RTOR Reduction (vph)	1	0	0	0	0	74
Lane Group Flow (vph)	794	0	11	299	225	308
Heavy Vehicles (%)	1%	1%	2%	2%	3%	3%
Turn Type	Prot		pm+pt	NA	NA	custom
Protected Phases	8		1	6 7	2 7	7 8
Permitted Phases			6 7			2
Actuated Green, G (s)	41.2		27.3	26.4	27.3	70.5
Effective Green, g (s)	41.2		23.3	26.4	27.3	70.5
Actuated g/C Ratio	0.47		0.27	0.30	0.31	0.81
Clearance Time (s)	6.0		6.0			
Vehicle Extension (s)	3.0		3.0			
Lane Grp Cap (vph)	843		264	562	576	1264
v/s Ratio Prot	c0.44		c0.00	c0.16	0.12	0.15
v/s Ratio Perm			0.01			0.05
v/c Ratio	0.94		0.04	0.53	0.39	0.24
Uniform Delay, d1	22.0		23.7	25.4	23.5	2.0
Progression Factor	1.00		1.00	1.00	1.13	0.18
Incremental Delay, d2	18.5		0.1	1.0	0.4	0.1
Delay (s)	40.4		23.8	26.3	27.0	0.5
Level of Service	D		C	C	C	A
Approach Delay (s)	40.4			26.2	10.3	
Approach LOS	D			C	B	

Intersection Summary			
HCM 2000 Control Delay	27.2	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.81		
Actuated Cycle Length (s)	87.4	Sum of lost time (s)	22.0
Intersection Capacity Utilization	61.7%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	50	10	810	160	20	490
Future Volume (vph)	50	10	810	160	20	490
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0		4.0	4.0	6.0	4.0
Lane Util. Factor	1.00		1.00	1.00	1.00	1.00
Frt	0.97		1.00	0.85	1.00	1.00
Flt Protected	0.96		1.00	1.00	0.95	1.00
Satd. Flow (prot)	1762		1900	1615	1805	1900
Flt Permitted	0.96		1.00	1.00	0.22	1.00
Satd. Flow (perm)	1762		1900	1615	415	1900
Peak-hour factor, PHF	0.87	0.67	0.95	0.84	0.73	0.96
Adj. Flow (vph)	57	15	853	190	27	510
RTOR Reduction (vph)	10	0	0	41	0	0
Lane Group Flow (vph)	62	0	853	149	27	510
Heavy Vehicles (%)	1%	0%	0%	0%	0%	0%
Turn Type	Prot		NA	Perm	custom	NA
Protected Phases	7		6 8		5	2 8
Permitted Phases				6 8	2	
Actuated Green, G (s)	5.0		58.6	58.6	20.1	59.5
Effective Green, g (s)	5.0		58.6	58.6	20.1	59.5
Actuated g/C Ratio	0.06		0.67	0.67	0.23	0.68
Clearance Time (s)	6.0				6.0	
Vehicle Extension (s)	3.0				3.0	
Lane Grp Cap (vph)	100		1273	1082	124	1293
v/s Ratio Prot	c0.03		c0.45		c0.00	0.27
v/s Ratio Perm				0.09	0.05	
v/c Ratio	0.62		0.67	0.14	0.22	0.39
Uniform Delay, d1	40.3		8.6	5.2	27.5	6.1
Progression Factor	1.00		0.35	0.52	1.00	1.00
Incremental Delay, d2	10.8		0.8	0.0	0.9	0.2
Delay (s)	51.0		3.9	2.8	28.4	6.3
Level of Service	D		A	A	C	A
Approach Delay (s)	51.0		3.7			7.4
Approach LOS	D		A			A

Intersection Summary			
HCM 2000 Control Delay	6.9	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.65		
Actuated Cycle Length (s)	87.4	Sum of lost time (s)	22.0
Intersection Capacity Utilization	55.1%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	10	10	40	780	500	10
Future Volume (vph)	10	10	40	780	500	10
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0	0	100			0
Storage Lanes	1	0	1			0
Taper Length (ft)	25		25			
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.939				0.996	
Flt Protected	0.973		0.950			
Satd. Flow (prot)	1736	0	1787	1900	1874	0
Flt Permitted	0.973		0.950			
Satd. Flow (perm)	1736	0	1787	1900	1874	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	332			288	365	
Travel Time (s)	7.5			6.5	8.3	
Peak Hour Factor	0.64	0.77	0.71	0.90	0.75	0.55
Heavy Vehicles (%)	0%	0%	1%	0%	1%	0%
Adj. Flow (vph)	16	13	56	867	667	18
Shared Lane Traffic (%)						
Lane Group Flow (vph)	29	0	56	867	685	0
Sign Control	Stop			Free	Free	

Intersection Summary		
Area Type:	Other	
Control Type: Unsignalized		
Intersection Capacity Utilization 51.1%		ICU Level of Service A
Analysis Period (min) 15		

Intersection	
Int Delay, s/veh	0.9

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	10	10	40	780	500	10
Future Vol, veh/h	10	10	40	780	500	10
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	100	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	64	77	71	90	75	55
Heavy Vehicles, %	0	0	1	0	1	0
Mvmt Flow	16	13	56	867	667	18

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1655	676	685	0	-	0
Stage 1	676	-	-	-	-	-
Stage 2	979	-	-	-	-	-
Critical Hdwy	6.4	6.2	4.11	-	-	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.3	2.209	-	-	-
Pot Cap-1 Maneuver	109	457	913	-	-	-
Stage 1	509	-	-	-	-	-
Stage 2	367	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	102	457	913	-	-	-
Mov Cap-2 Maneuver	102	-	-	-	-	-
Stage 1	478	-	-	-	-	-
Stage 2	367	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	32.8	0.6	0
HCM LOS	D		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	913	-	158	-	-
HCM Lane V/C Ratio	0.062	-	0.181	-	-
HCM Control Delay (s)	9.2	-	32.8	-	-
HCM Lane LOS	A	-	D	-	-
HCM 95th %tile Q(veh)	0.2	-	0.6	-	-

APPENDIX R-3: ALTERNATIVE D INTERSECTION CAPACITY ANALYSES – SYNCHRO PRINTOUTS – AM PEAK HOUR

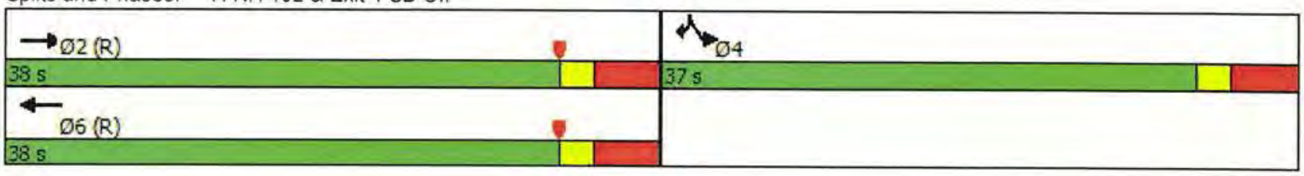
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Detector 3 Extend (s)		0.0	0.0		0.0	0.0
Turn Type		NA	NA		Prot	Prot
Protected Phases		2	6		4	4
Permitted Phases						
Detector Phase		2	6		4	4
Switch Phase						
Minimum Initial (s)		8.0	8.0		5.0	5.0
Minimum Split (s)		14.0	21.0		27.0	27.0
Total Split (s)		38.0	38.0		37.0	37.0
Total Split (%)		50.7%	50.7%		49.3%	49.3%
Maximum Green (s)		32.0	32.0		31.0	31.0
Yellow Time (s)		2.0	2.0		2.0	2.0
All-Red Time (s)		4.0	4.0		4.0	4.0
Lost Time Adjust (s)		0.0	0.0		0.0	0.0
Total Lost Time (s)		6.0	6.0		6.0	6.0
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)		3.0	3.0		3.0	3.0
Recall Mode		C-Min	C-Min		None	None
Walk Time (s)			7.0		7.0	7.0
Flash Dont Walk (s)			8.0		14.0	14.0
Pedestrian Calls (#/hr)			0		0	0
Act Effct Green (s)		32.0	32.0		31.0	31.0
Actuated g/C Ratio		0.43	0.43		0.41	0.41
v/c Ratio		0.99	0.63		0.16	1.00
Control Delay		35.7	22.6		14.6	50.9
Queue Delay		0.0	0.0		0.0	0.0
Total Delay		35.7	22.6		14.6	50.9
LOS		D	C		B	D
Approach Delay		35.7	22.6		47.1	
Approach LOS		D	C		D	
Queue Length 50th (ft)		340	424		37	282
Queue Length 95th (ft)		m#465	m409		69	#431
Internal Link Dist (ft)		632	308		132	
Turn Bay Length (ft)						
Base Capacity (vph)		1480	1453		797	1108
Starvation Cap Reductn		0	0		0	0
Spillback Cap Reductn		0	0		0	0
Storage Cap Reductn		0	0		0	0
Reduced v/c Ratio		0.99	0.63		0.16	1.00

Intersection Summary

Area Type: Other
Cycle Length: 75
Actuated Cycle Length: 75
Offset: 0 (0%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow, Master Intersection
Natural Cycle: 90
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 1.00

Intersection Signal Delay: 36.3 Intersection LOS: D
Intersection Capacity Utilization 68.7% ICU Level of Service C
Analysis Period (min) 15
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 7: NH 102 & Exit 4 SB Off



Lane Group	NBL2	NBL	NBR	SEL	SER	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations											
Traffic Volume (vph)	455	0	330	0	0	1310	170	0	0	1080	360
Future Volume (vph)	455	0	330	0	0	1310	170	0	0	1080	360
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)		0	0	0	0	550		0	0		0
Storage Lanes		2	2	0	0	2		0	0		1
Taper Length (ft)		25		25		25			25		
Lane Util. Factor	0.97	1.00	0.88	1.00	1.00	0.97	0.95	1.00	1.00	0.95	1.00
Frt			0.850								0.850
Flt Protected	0.950					0.950					
Satd. Flow (prot)	3242	0	2632	0	0	3335	3438	0	0	3505	1568
Flt Permitted	0.950					0.950					
Satd. Flow (perm)	3242	0	2632	0	0	3335	3438	0	0	3505	1568
Right Turn on Red			No					Yes			Yes
Satd. Flow (RTOR)											167
Link Speed (mph)		25		30			30			30	
Link Distance (ft)		856		390			760			857	
Travel Time (s)		23.3		8.9			17.3			19.5	
Peak Hour Factor	0.88	0.88	0.88	0.92	0.92	0.94	0.94	0.94	0.92	0.92	0.92
Heavy Vehicles (%)	8%	8%	8%	2%	2%	5%	5%	5%	3%	3%	3%
Adj. Flow (vph)	517	0	375	0	0	1394	181	0	0	1174	391
Shared Lane Traffic (%)											
Lane Group Flow (vph)	517	0	375	0	0	1394	181	0	0	1174	391
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Right	Left	Left	Right	Left	Right	Right
Median Width(ft)		24		0			24			24	
Link Offset(ft)		12		0			0			0	
Crosswalk Width(ft)		16		16			16			16	
Two way Left Turn Lane											
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15	15	25	15	9	15		9	15		25
Number of Detectors	3		3			3	3			3	0
Detector Template											
Leading Detector (ft)	256		256			256	256			256	0
Trailing Detector (ft)	-5		-5			-5	-5			-5	0
Detector 1 Position(ft)	-5		-5			-5	-5			-5	-5
Detector 1 Size(ft)	55		55			55	55			55	50
Detector 1 Type	Cl+Ex		Cl+Ex			Cl+Ex	Cl+Ex			Cl+Ex	Cl+Ex
Detector 1 Channel											
Detector 1 Extend (s)	0.0		0.0			0.0	0.0			0.0	0.0
Detector 1 Queue (s)	0.0		0.0			0.0	0.0			0.0	0.0
Detector 1 Delay (s)	0.0		0.0			0.0	0.0			0.0	0.0
Detector 2 Position(ft)	125		125			125	125			125	
Detector 2 Size(ft)	6		6			6	6			6	
Detector 2 Type	Cl+Ex		Cl+Ex			Cl+Ex	Cl+Ex			Cl+Ex	
Detector 2 Channel											
Detector 2 Extend (s)	0.0		0.0			0.0	0.0			0.0	
Detector 3 Position(ft)	250		250			250	250			250	
Detector 3 Size(ft)	6		6			6	6			6	

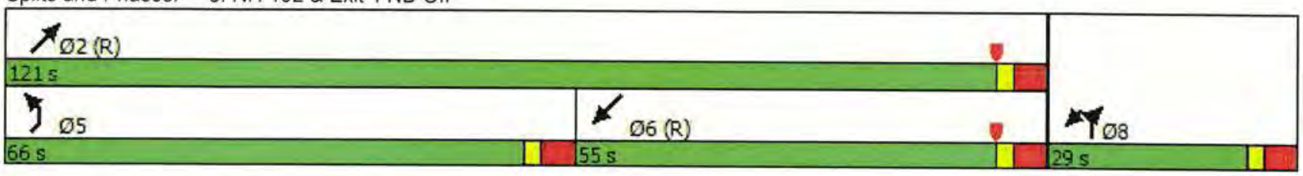
Lane Group	NBL2	NBL	NBR	SEL	SER	NEL	NET	NER	SWL	SWT	SWR
Detector 3 Type	Cl+Ex		Cl+Ex			Cl+Ex	Cl+Ex			Cl+Ex	
Detector 3 Channel											
Detector 3 Extend (s)	0.0		0.0			0.0	0.0			0.0	
Turn Type	Prot		Prot			Prot	NA			NA	Free
Protected Phases	8		8			5	2			6	
Permitted Phases											Free
Detector Phase	8		2			5	2			6	
Switch Phase											
Minimum Initial (s)	10.0		10.0			5.0	8.0			8.0	
Minimum Split (s)	16.0		16.0			11.0	42.0			31.0	
Total Split (s)	29.0		29.0			66.0	121.0			55.0	
Total Split (%)	19.3%		19.3%			44.0%	80.7%			36.7%	
Maximum Green (s)	23.0		23.0			60.0	115.0			49.0	
Yellow Time (s)	2.0		2.0			2.0	2.0			2.0	
All-Red Time (s)	4.0		4.0			4.0	4.0			4.0	
Lost Time Adjust (s)	0.0		0.0			0.0	0.0			0.0	
Total Lost Time (s)	6.0		6.0			6.0	6.0			6.0	
Lead/Lag						Lead				Lag	
Lead-Lag Optimize?											
Vehicle Extension (s)	3.0		3.0			3.0	3.0			3.0	
Recall Mode	None		None			None	C-Min			C-Min	
Walk Time (s)							7.0			7.0	
Flash Dont Walk (s)							29.0			17.0	
Pedestrian Calls (#/hr)							0			0	
Act Effct Green (s)	23.0		23.0			60.0	115.0			49.0	150.0
Actuated g/C Ratio	0.15		0.15			0.40	0.77			0.33	1.00
v/c Ratio	1.04		0.93			1.04	0.07			1.03	0.25
Control Delay	111.4		92.5			56.7	7.5			82.5	0.4
Queue Delay	0.0		0.0			0.0	0.0			0.0	0.0
Total Delay	111.4		92.5			56.7	7.5			82.5	0.4
LOS	F		F			E	A			F	A
Approach Delay		103.4					51.1			62.0	
Approach LOS		F					D			E	
Queue Length 50th (ft)	~280		209			~738	30			~642	0
Queue Length 95th (ft)	#384		#305			m#763	m32			#782	0
Internal Link Dist (ft)		776		310			680			777	
Turn Bay Length (ft)						550					
Base Capacity (vph)	497		403			1334	2635			1144	1568
Starvation Cap Reductn	0		0			0	0			0	0
Spillback Cap Reductn	0		0			0	0			0	0
Storage Cap Reductn	0		0			0	0			0	0
Reduced v/c Ratio	1.04		0.93			1.04	0.07			1.03	0.25

Intersection Summary

Area Type: Other
Cycle Length: 150
Actuated Cycle Length: 150
Offset: 6 (4%), Referenced to phase 2:NET and 6:SWT, Start of Yellow
Natural Cycle: 150

Control Type: Actuated-Coordinated
Maximum v/c Ratio: 1.04
Intersection Signal Delay: 66.9 Intersection LOS: E
Intersection Capacity Utilization 96.2% ICU Level of Service F
Analysis Period (min) 15
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 8: NH 102 & Exit 4 NB Off



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑	↱	↰	↑↑					↰↰		↱
Traffic Volume (vph)	0	585	460	285	685	0	0	0	0	110	0	360
Future Volume (vph)	0	585	460	285	685	0	0	0	0	110	0	360
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		350	0		0	0		0	0		0
Storage Lanes	0		1	1		0	0		0	2		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	0.97	1.00	1.00
Frt			0.850									0.850
Flt Protected				0.950						0.950		
Satd. Flow (prot)	0	3167	1417	1687	3374	0	0	0	0	3303	0	1524
Flt Permitted				0.950						0.950		
Satd. Flow (perm)	0	3167	1417	1687	3374	0	0	0	0	3303	0	1524
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			500									134
Link Speed (mph)		30			30			30			35	
Link Distance (ft)		851			693			486			581	
Travel Time (s)		19.3			15.8			11.0			11.3	
Peak Hour Factor	0.92	0.92	0.92	0.73	0.73	0.73	0.92	0.92	0.92	0.74	0.74	0.74
Heavy Vehicles (%)	14%	14%	14%	7%	7%	7%	2%	2%	2%	6%	6%	6%
Adj. Flow (vph)	0	636	500	390	938	0	0	0	0	149	0	486
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	636	500	390	938	0	0	0	0	149	0	486
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Right	Right	Left	Left	Right	Left	Left	Right	R NA	Left	Right
Median Width(ft)		36			36			24			24	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		25	15		9	15		9	15		9
Number of Detectors		3	2	3	3					3		2
Detector Template		Thru	Right	Left	Thru					Left		
Leading Detector (ft)		256	131	256	256					256		206
Trailing Detector (ft)		-5	-5	-5	-5					-5		-5
Detector 1 Position(ft)		-5	-5	-5	-5					-5		-5
Detector 1 Size(ft)		50	50	50	50					50		50
Detector 1 Type		Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex					Cl+Ex		Cl+Ex
Detector 1 Channel												
Detector 1 Extend (s)		0.0	0.0	0.0	0.0					0.0		0.0
Detector 1 Queue (s)		0.0	0.0	0.0	0.0					0.0		0.0
Detector 1 Delay (s)		0.0	0.0	0.0	0.0					0.0		0.0
Detector 2 Position(ft)		125	125	125	125					125		200
Detector 2 Size(ft)		6	6	6	6					6		6
Detector 2 Type		Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex					Cl+Ex		Cl+Ex
Detector 2 Channel												
Detector 2 Extend (s)		0.0	0.0	0.0	0.0					0.0		0.0
Detector 3 Position(ft)		250		250	250					250		
Detector 3 Size(ft)		6		6	6					6		

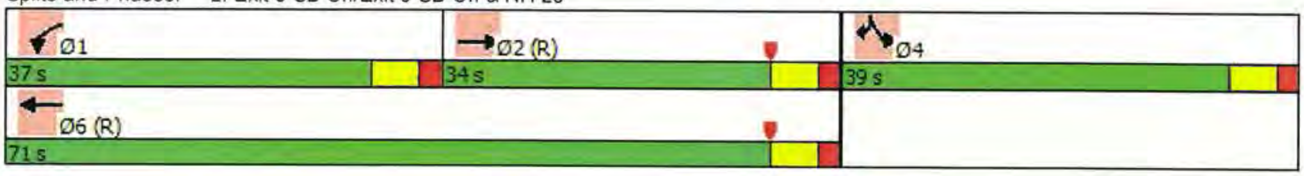
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Detector 3 Type		Cl+Ex		Cl+Ex	Cl+Ex					Cl+Ex		
Detector 3 Channel												
Detector 3 Extend (s)		0.0		0.0	0.0					0.0		
Turn Type		NA	Free	Prot	NA					Prot		Prot
Protected Phases		2		1	6					4		4
Permitted Phases			Free									
Detector Phase		2		1	6					4		4
Switch Phase												
Minimum Initial (s)		9.0		4.0	9.0					4.0		4.0
Minimum Split (s)		21.0		10.0	21.0					10.0		10.0
Total Split (s)		34.0		37.0	71.0					39.0		39.0
Total Split (%)		30.9%		33.6%	64.5%					35.5%		35.5%
Maximum Green (s)		28.0		31.0	65.0					33.0		33.0
Yellow Time (s)		4.0		4.0	4.0					4.0		4.0
All-Red Time (s)		2.0		2.0	2.0					2.0		2.0
Lost Time Adjust (s)		0.0		0.0	0.0					0.0		0.0
Total Lost Time (s)		6.0		6.0	6.0					6.0		6.0
Lead/Lag		Lag		Lead								
Lead-Lag Optimize?												
Vehicle Extension (s)		5.0		3.0	5.0					3.0		3.0
Recall Mode		C-Min		None	C-Min					None		None
Walk Time (s)		7.0			7.0							
Flash Dont Walk (s)		8.0			8.0							
Pedestrian Calls (#/hr)		0			0							
Act Effct Green (s)		32.1	110.0	28.8	66.9					31.1		31.1
Actuated g/C Ratio		0.29	1.00	0.26	0.61					0.28		0.28
v/c Ratio		0.69	0.35	0.88	0.46					0.16		0.92
Control Delay		40.5	0.7	34.3	1.4					29.4		52.0
Queue Delay		0.0	0.0	0.0	0.0					0.0		0.0
Total Delay		40.5	0.7	34.3	1.4					29.4		52.0
LOS		D	A	C	A					C		D
Approach Delay		23.0			11.0						46.7	
Approach LOS		C			B						D	
Queue Length 50th (ft)		221	0	48	12					39		247
Queue Length 95th (ft)		290	0	m41	11					52		273
Internal Link Dist (ft)		771			613			406			501	
Turn Bay Length (ft)			350									
Base Capacity (vph)		925	1417	475	2051					990		551
Starvation Cap Reductn		0	0	0	0					0		0
Spillback Cap Reductn		0	0	0	0					0		0
Storage Cap Reductn		0	0	0	0					0		0
Reduced v/c Ratio		0.69	0.35	0.82	0.46					0.15		0.88

Intersection Summary

Area Type: Other
Cycle Length: 110
Actuated Cycle Length: 110
Offset: 61 (55%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow
Natural Cycle: 90

Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.92
Intersection Signal Delay: 22.7 Intersection LOS: C
Intersection Capacity Utilization 71.4% ICU Level of Service C
Analysis Period (min) 15
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 2: Exit 5 SB On/Exit 5 SB Off & NH 28



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	485	210	0	0	520	350	450	0	160	0	0	0
Future Volume (vph)	485	210	0	0	520	350	450	0	160	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt						0.850			0.850			
Flt Protected	0.950						0.950					
Satd. Flow (prot)	1641	3282	0	0	3438	1538	1656	0	1482	0	0	0
Flt Permitted	0.950						0.950					
Satd. Flow (perm)	1641	3282	0	0	3438	1538	1656	0	1482	0	0	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						389			193			
Link Speed (mph)		30			30			35			30	
Link Distance (ft)		693			542			867			392	
Travel Time (s)		15.8			12.3			16.9			8.9	
Peak Hour Factor	0.87	0.87	0.87	0.90	0.90	0.90	0.78	0.78	0.78	0.92	0.92	0.92
Heavy Vehicles (%)	10%	10%	10%	5%	5%	5%	9%	9%	9%	2%	2%	2%
Adj. Flow (vph)	557	241	0	0	578	389	577	0	205	0	0	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	557	241	0	0	578	389	577	0	205	0	0	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Right	Right	Right	Left	Right	Left	Left	Right
Median Width(ft)		36			42			12			12	
Link Offset(ft)		0			0			0			36	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		25	15		9	15		9
Number of Detectors	3	3			3	2	3		0			
Detector Template	Left	Thru			Thru	Right	Left					
Leading Detector (ft)	256	256			256	131	256		0			
Trailing Detector (ft)	-5	-5			-5	-5	-5		0			
Detector 1 Position(ft)	-5	-5			-5	-5	-5		-5			
Detector 1 Size(ft)	50	50			50	50	50		50			
Detector 1 Type	Cl+Ex	Cl+Ex			Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex			
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0			0.0	0.0	0.0		0.0			
Detector 1 Queue (s)	0.0	0.0			0.0	0.0	0.0		0.0			
Detector 1 Delay (s)	0.0	0.0			0.0	0.0	0.0		0.0			
Detector 2 Position(ft)	125	125			125	125	125					
Detector 2 Size(ft)	6	6			6	6	6					
Detector 2 Type	Cl+Ex	Cl+Ex			Cl+Ex	Cl+Ex	Cl+Ex					
Detector 2 Channel												
Detector 2 Extend (s)	0.0	0.0			0.0	0.0	0.0					
Detector 3 Position(ft)	250	250			250		250					
Detector 3 Size(ft)	6	6			6		6					
Detector 3 Type	Cl+Ex	Cl+Ex			Cl+Ex		Cl+Ex					
Detector 3 Channel												
Detector 3 Extend (s)	0.0	0.0			0.0		0.0					

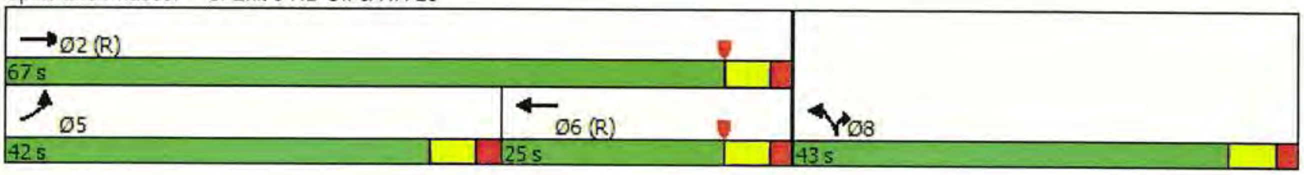
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Type	Prot	NA			NA	Free	Prot		Prot			
Protected Phases	5	2			6		8		8			
Permitted Phases		2			6	Free						
Detector Phase	5	2			6		8		8			
Switch Phase												
Minimum Initial (s)	4.0	16.0			16.0		4.0		4.0			
Minimum Split (s)	10.0	23.0			23.0		10.0		10.0			
Total Split (s)	42.0	67.0			25.0		43.0		43.0			
Total Split (%)	38.2%	60.9%			22.7%		39.1%		39.1%			
Maximum Green (s)	36.0	61.0			19.0		37.0		37.0			
Yellow Time (s)	4.0	4.0			4.0		4.0		4.0			
All-Red Time (s)	2.0	2.0			2.0		2.0		2.0			
Lost Time Adjust (s)	0.0	0.0			0.0		0.0		0.0			
Total Lost Time (s)	6.0	6.0			6.0		6.0		6.0			
Lead/Lag	Lead				Lag							
Lead-Lag Optimize?												
Vehicle Extension (s)	5.0	5.0			5.0		3.0		3.0			
Recall Mode	None	C-Min			C-Min		None		None			
Walk Time (s)		7.0			7.0							
Flash Dont Walk (s)		10.0			10.0							
Pedestrian Calls (#/hr)		0			0							
Act Effct Green (s)	36.0	61.0			19.0	110.0	37.0		37.0			
Actuated g/C Ratio	0.33	0.55			0.17	1.00	0.34		0.34			
v/c Ratio	1.04	0.13			0.97	0.25	1.04		0.33			
Control Delay	57.4	2.2			77.1	0.4	84.5		6.1			
Queue Delay	0.0	0.0			0.0	0.0	0.0		0.0			
Total Delay	57.4	2.2			77.1	0.4	84.5		6.1			
LOS	E	A			E	A	F		A			
Approach Delay		40.7			46.3			63.9				
Approach LOS		D			D			E				
Queue Length 50th (ft)	~419	3			215	0	~440		6			
Queue Length 95th (ft)	#573	4			#331	0	#512		35			
Internal Link Dist (ft)		613			462			787			312	
Turn Bay Length (ft)												
Base Capacity (vph)	537	1820			593	1538	557		626			
Starvation Cap Reductn	0	0			0	0	0		0			
Spillback Cap Reductn	0	0			0	0	0		0			
Storage Cap Reductn	0	0			0	0	0		0			
Reduced v/c Ratio	1.04	0.13			0.97	0.25	1.04		0.33			

Intersection Summary

Area Type: Other
Cycle Length: 110
Actuated Cycle Length: 110
Offset: 0 (0%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow, Master Intersection
Natural Cycle: 110
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 1.04
Intersection Signal Delay: 50.0 Intersection LOS: D

Intersection Capacity Utilization 71.4% ICU Level of Service C
Analysis Period (min) 15
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 3: Exit 5 NB Off & NH 28



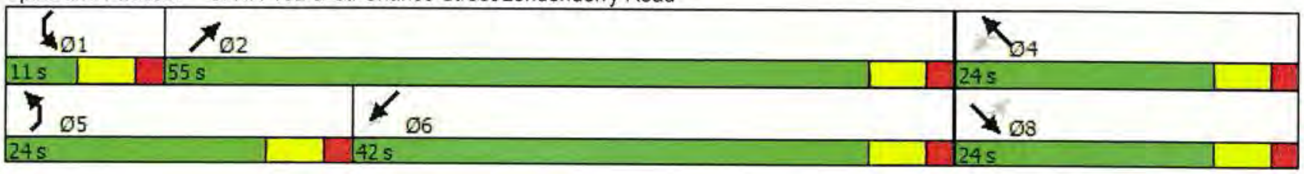
Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	10	0	160	0	0	1	100	500	5	5	1110	30
Future Volume (vph)	10	0	160	0	0	1	100	500	5	5	1110	30
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		225	0		0	350		0	100		0
Storage Lanes	0		1	0		0	1		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00	0.95	0.95
Frt			0.850		0.865			0.999			0.996	
Flt Protected		0.950					0.950			0.950		
Satd. Flow (prot)	0	1770	1583	0	1644	0	1770	3536	0	1770	3525	0
Flt Permitted							0.950			0.950		
Satd. Flow (perm)	0	1863	1583	0	1644	0	1770	3536	0	1770	3525	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			182		381			2			4	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		593			447			750			330	
Travel Time (s)		13.5			10.2			17.0			7.5	
Peak Hour Factor	0.92	0.92	0.92	0.25	0.25	0.25	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	2%	2%	2%	0%	0%	0%	2%	2%	2%	2%	2%	2%
Adj. Flow (vph)	11	0	174	0	0	4	109	543	5	5	1207	33
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	11	174	0	4	0	109	548	0	5	1240	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	3	3	1	3	1		3	3		3	3	
Detector Template	Left	Thru	Right	Left			Left	Thru		Left	Thru	
Leading Detector (ft)	256	256	45	256	45		256	256		256	256	
Trailing Detector (ft)	-5	-5	-5	-5	-5		-5	-5		-5	-5	
Detector 1 Position(ft)	-5	-5	-5	-5	-5		-5	-5		-5	-5	
Detector 1 Size(ft)	50	50	50	50	50		50	50		50	50	
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(ft)	125	125		125			125	125		125	125	
Detector 2 Size(ft)	6	6		6			6	6		6	6	
Detector 2 Type	Cl+Ex	Cl+Ex		Cl+Ex			Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)	0.0	0.0		0.0			0.0	0.0		0.0	0.0	
Detector 3 Position(ft)	250	250		250			250	250		250	250	
Detector 3 Size(ft)	6	6		6			6	6		6	6	

Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Detector 3 Type	Cl+Ex	Cl+Ex		Cl+Ex			Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 3 Channel												
Detector 3 Extend (s)	0.0	0.0		0.0			0.0	0.0		0.0	0.0	
Turn Type	Perm	NA	custom		NA		Prot	NA		Prot	NA	
Protected Phases		8			4		5	2		1	6	
Permitted Phases	8		6	4								
Detector Phase	8	8	6	4	4		5	2		1	6	
Switch Phase												
Minimum Initial (s)	5.0	5.0	8.0	5.0	5.0		5.0	8.0		5.0	8.0	
Minimum Split (s)	24.0	24.0	24.0	24.0	24.0		24.0	24.0		11.0	24.0	
Total Split (s)	24.0	24.0	42.0	24.0	24.0		24.0	55.0		11.0	42.0	
Total Split (%)	26.7%	26.7%	46.7%	26.7%	26.7%		26.7%	61.1%		12.2%	46.7%	
Maximum Green (s)	18.0	18.0	36.0	18.0	18.0		18.0	49.0		5.0	36.0	
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)		0.0	0.0		0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)		6.0	6.0		6.0		6.0	6.0		6.0	6.0	
Lead/Lag			Lag				Lead	Lag		Lead	Lag	
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None	Min	None	None		None	Min		None	Min	
Walk Time (s)	7.0	7.0	7.0	7.0	7.0		7.0	7.0			7.0	
Flash Dont Walk (s)	11.0	11.0	11.0	11.0	11.0		11.0	11.0			11.0	
Pedestrian Calls (#/hr)	0	0	0	0	0		0	0			0	
Act Effct Green (s)		6.3	42.7		6.0		9.3	57.0		5.1	42.7	
Actuated g/C Ratio		0.10	0.69		0.10		0.15	0.92		0.08	0.69	
v/c Ratio		0.06	0.15		0.01		0.41	0.17		0.03	0.51	
Control Delay		27.9	1.9		0.0		29.7	2.3		29.8	8.8	
Queue Delay		0.0	0.0		0.0		0.0	0.0		0.0	0.0	
Total Delay		27.9	1.9		0.0		29.7	2.3		29.8	8.8	
LOS		C	A		A		C	A		C	A	
Approach Delay		3.5						6.9			8.9	
Approach LOS		A						A			A	
Queue Length 50th (ft)		3	0		0		34	0		2	104	
Queue Length 95th (ft)		19	27		0		89	82		13	305	
Internal Link Dist (ft)		513			367			670			250	
Turn Bay Length (ft)			225				350			100		
Base Capacity (vph)		552	1146		755		524	3276		145	2428	
Starvation Cap Reductn		0	0		0		0	0		0	0	
Spillback Cap Reductn		0	0		0		0	0		0	0	
Storage Cap Reductn		0	0		0		0	0		0	0	
Reduced v/c Ratio		0.02	0.15		0.01		0.21	0.17		0.03	0.51	

Intersection Summary	
Area Type:	Other
Cycle Length: 90	
Actuated Cycle Length: 62	
Natural Cycle: 80	
Control Type: Actuated-Uncoordinated	

Maximum v/c Ratio: 0.51
Intersection Signal Delay: 7.8 Intersection LOS: A
Intersection Capacity Utilization 64.5% ICU Level of Service C
Analysis Period (min) 15

Splits and Phases: 9: NH 102 & St. Charles Street/Londonderry Road



Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	10	20	10	350	0	30	0	420	110	15	585	0
Future Volume (vph)	10	20	10	350	0	30	0	420	110	15	585	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.966			0.989			0.972				
Flt Protected		0.987			0.956						0.999	
Satd. Flow (prot)	0	1776	0	0	1744	0	0	1710	0	0	1808	0
Flt Permitted		0.874			0.694						0.981	
Satd. Flow (perm)	0	1573	0	0	1266	0	0	1710	0	0	1775	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		17			36			21				
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		356			493			1124			603	
Travel Time (s)		8.1			11.2			25.5			13.7	
Peak Hour Factor	0.60	0.60	0.60	0.96	0.96	0.96	0.89	0.89	0.89	0.86	0.86	0.86
Heavy Vehicles (%)	2%	2%	2%	3%	3%	3%	8%	8%	8%	5%	5%	5%
Adj. Flow (vph)	17	33	17	365	0	31	0	472	124	17	680	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	67	0	0	396	0	0	596	0	0	697	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0			0	
Link Offset(ft)		-22			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	3	1		3	2			2		3	2	
Detector Template	Left			Left						Left		
Leading Detector (ft)	256	45		256	131			131		256	131	
Trailing Detector (ft)	-5	-5		-5	-5			-5		-5	-5	
Detector 1 Position(ft)	-5	-5		-5	-5			-5		-5	-5	
Detector 1 Size(ft)	50	50		50	50			50		50	50	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex			Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0			0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0			0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0			0.0		0.0	0.0	
Detector 2 Position(ft)	125			125	125			125		125	125	
Detector 2 Size(ft)	6			6	6			6		6	6	
Detector 2 Type	Cl+Ex			Cl+Ex	Cl+Ex			Cl+Ex		Cl+Ex	Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)	0.0			0.0	0.0			0.0		0.0	0.0	
Detector 3 Position(ft)	250			250						250		
Detector 3 Size(ft)	6			6						6		
Detector 3 Type	Cl+Ex			Cl+Ex						Cl+Ex		
Detector 3 Channel												
Detector 3 Extend (s)	0.0			0.0						0.0		

Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Turn Type	Perm	NA		Perm	NA			NA		Perm	NA	
Protected Phases		4			4			2			2	
Permitted Phases	4			4						2		
Detector Phase	4	4		4	4			2		2	2	
Switch Phase												
Minimum Initial (s)	5.0	5.0		5.0	5.0			5.0		5.0	5.0	
Minimum Split (s)	24.0	24.0		24.0	24.0			24.0		24.0	24.0	
Total Split (s)	39.0	39.0		39.0	39.0			51.0		51.0	51.0	
Total Split (%)	43.3%	43.3%		43.3%	43.3%			56.7%		56.7%	56.7%	
Maximum Green (s)	33.0	33.0		33.0	33.0			45.0		45.0	45.0	
Yellow Time (s)	4.0	4.0		4.0	4.0			4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0			2.0		2.0	2.0	
Lost Time Adjust (s)		0.0			0.0			0.0			0.0	
Total Lost Time (s)		6.0			6.0			6.0			6.0	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0		3.0	3.0	
Recall Mode	None	None		None	None			Min		Min	Min	
Walk Time (s)	7.0	7.0		7.0	7.0			7.0		7.0	7.0	
Flash Dont Walk (s)	11.0	11.0		11.0	11.0			11.0		11.0	11.0	
Pedestrian Calls (#/hr)	0	0		0	0			0		0	0	
Act Effct Green (s)		27.3			27.3			38.5			38.5	
Actuated g/C Ratio		0.35			0.35			0.49			0.49	
v/c Ratio		0.12			0.85			0.70			0.80	
Control Delay		15.4			41.6			21.0			26.0	
Queue Delay		0.0			0.0			0.0			0.0	
Total Delay		15.4			41.6			21.0			26.0	
LOS		B			D			C			C	
Approach Delay		15.4			41.6			21.0			26.0	
Approach LOS		B			D			C			C	
Queue Length 50th (ft)		18			183			238			311	
Queue Length 95th (ft)		28			#345			356			428	
Internal Link Dist (ft)		276			413			1044			523	
Turn Bay Length (ft)												
Base Capacity (vph)		706			581			1041			1072	
Starvation Cap Reductn		0			0			0			0	
Spillback Cap Reductn		0			0			0			0	
Storage Cap Reductn		0			0			0			0	
Reduced v/c Ratio		0.09			0.68			0.57			0.65	

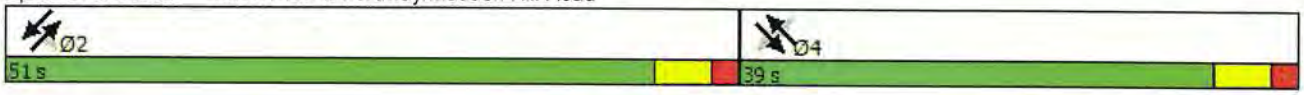
Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 78.4
Natural Cycle: 65
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.85
Intersection Signal Delay: 27.4 — Intersection LOS: C
Intersection Capacity Utilization 82.1% — ICU Level of Service E

Analysis Period (min) 15

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 10: NH 102 & Fordway/Madden Hill Road



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	80	200	90	20	520	60	60	290	30	70	240	30
Future Volume (vph)	80	200	90	20	520	60	60	290	30	70	240	30
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	390		0	110		0	70		0	245		245
Storage Lanes	1		0	1		0	1		0	1		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.953			0.984			0.986				0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1656	1661	0	1703	1764	0	1719	1784	0	1703	1792	1524
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1656	1661	0	1703	1764	0	1719	1784	0	1703	1792	1524
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		29			7			5				182
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		505			530			361			411	
Travel Time (s)		11.5			12.0			8.2			9.3	
Peak Hour Factor	0.96	0.96	0.96	0.94	0.94	0.94	0.85	0.85	0.85	0.91	0.91	0.91
Heavy Vehicles (%)	9%	9%	9%	6%	6%	6%	5%	5%	5%	6%	6%	6%
Parking (#/hr)			0									
Adj. Flow (vph)	83	208	94	21	553	64	71	341	35	77	264	33
Shared Lane Traffic (%)												
Lane Group Flow (vph)	83	302	0	21	617	0	71	376	0	77	264	33
Turn Type	Prot	NA		Prot	NA		Prot	NA		Prot	NA	Perm
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases												4
Detector Phase	5	2		1	6		3	8		7	4	4
Switch Phase												
Minimum Initial (s)	4.0	5.0		4.0	10.0		4.0	10.0		4.0	9.0	9.0
Minimum Split (s)	10.0	30.0		10.0	30.0		10.0	25.0		10.0	25.0	25.0
Total Split (s)	12.0	39.0		12.0	39.0		14.0	25.0		14.0	25.0	25.0
Total Split (%)	13.3%	43.3%		13.3%	43.3%		15.6%	27.8%		15.6%	27.8%	27.8%
Maximum Green (s)	6.0	33.0		6.0	33.0		8.0	19.0		8.0	19.0	19.0
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	6.0
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lag		Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes	Yes
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Recall Mode	None	Min		None	Min		Min	None		Min	None	None
Walk Time (s)		7.0			7.0			7.0			7.0	7.0
Flash Dont Walk (s)		11.0			11.0			11.0			11.0	11.0
Pedestrian Calls (#/hr)		10			10			0			10	10
Act Effct Green (s)	6.1	36.0		5.9	31.5		7.4	19.3		7.5	19.3	19.3
Actuated g/C Ratio	0.07	0.42		0.07	0.37		0.09	0.23		0.09	0.23	0.23
v/c Ratio	0.71	0.42		0.18	0.94		0.48	0.93		0.52	0.65	0.07
Control Delay	74.1	19.0		43.5	52.4		50.4	66.0		52.2	40.8	0.3

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Total Delay	74.1	19.0		43.5	52.4		50.4	66.0		52.2	40.8	0.3
LOS	E	B		D	D		D	E		D	D	A
Approach Delay		30.9			52.1			63.6			39.6	
Approach LOS		C			D			E			D	
Queue Length 50th (ft)	47	89		12	332		39	212		43	140	0
Queue Length 95th (ft)	#125	193		35	#554		77	#360		87	#240	0
Internal Link Dist (ft)		425			450			281			331	
Turn Bay Length (ft)	390			110			70			245		245
Base Capacity (vph)	117	753		120	693		162	404		161	404	485
Starvation Cap Reductn	0	0		0	0		0	0		0	0	0
Spillback Cap Reductn	0	0		0	0		0	0		0	0	0
Storage Cap Reductn	0	0		0	0		0	0		0	0	0
Reduced v/c Ratio	0.71	0.40		0.17	0.89		0.44	0.93		0.48	0.65	0.07

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 85.6
Natural Cycle: 90
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.94
Intersection Signal Delay: 47.9 Intersection LOS: D
Intersection Capacity Utilization 76.4% ICU Level of Service D
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 7: Birch St/Crystal Ave & NH 102 (E Broadway)

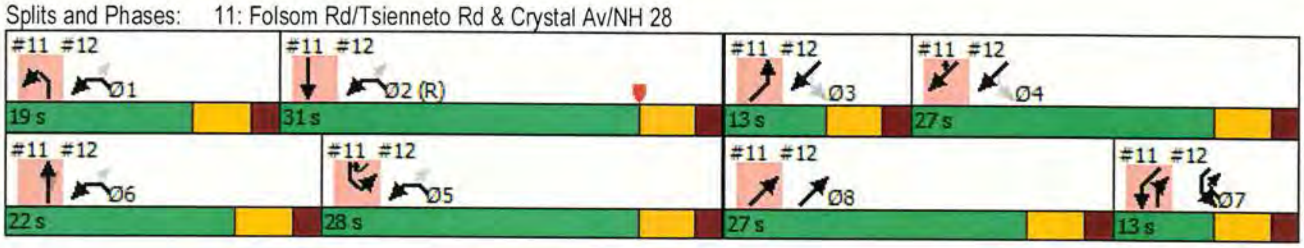
Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	20	200	140	590	190	0	160	220	30	30	310	770
Future Volume (vph)	20	200	140	590	190	0	160	220	30	30	310	770
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	80		180	525		190	200		200	160		0
Storage Lanes	1		1	2		0	2		1	1		2
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95	1.00	0.97	1.00	1.00	1.00	1.00	0.88
Frt			0.850						0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1736	3471	1553	3335	3438	0	3400	1845	1568	1752	1845	2760
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1736	3471	1553	3335	3438	0	3400	1845	1568	1752	1845	2760
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			182						327			243
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		639			723			532			387	
Travel Time (s)		14.5			16.4			12.1			8.8	
Peak Hour Factor	0.84	0.84	0.84	0.79	0.79	0.79	0.86	0.86	0.86	0.99	0.99	0.99
Heavy Vehicles (%)	4%	4%	4%	5%	5%	5%	3%	3%	3%	3%	3%	3%
Adj. Flow (vph)	24	238	167	747	241	0	186	256	35	30	313	778
Shared Lane Traffic (%)												
Lane Group Flow (vph)	24	238	167	747	241	0	186	256	35	30	313	778
Turn Type	Prot	NA	pm+ov	Prot	NA		Prot	NA	Free	Prot	NA	pt+ov
Protected Phases	1	6	7	5	2		3	8		7	4	4 5
Permitted Phases		6	6		2			8	Free		4	
Detector Phase	1	6	7	5	2		3	8		7	4	4 5
Switch Phase												
Minimum Initial (s)	8.0	5.0	7.0	7.0	5.0		7.0	5.0		7.0	5.0	
Minimum Split (s)	14.0	20.0	13.0	13.0	20.0		13.0	20.0		13.0	20.0	
Total Split (s)	19.0	22.0	13.0	28.0	31.0		13.0	27.0		13.0	27.0	
Total Split (%)	21.1%	24.4%	14.4%	31.1%	34.4%		14.4%	30.0%		14.4%	30.0%	
Maximum Green (s)	13.0	16.0	7.0	22.0	25.0		7.0	21.0		7.0	21.0	
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0		6.0	6.0		6.0	6.0	
Lead/Lag	Lead	Lead	Lag	Lag	Lag		Lead	Lead		Lag	Lag	
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes		Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None	None	None	C-Max		None	None		None	None	
Act Effct Green (s)	12.7	15.1	28.6	22.9	25.3		7.0	20.5	90.0	7.5	21.0	43.9
Actuated g/C Ratio	0.14	0.17	0.32	0.25	0.28		0.08	0.23	1.00	0.08	0.23	0.49
v/c Ratio	0.10	0.41	0.27	0.88	0.25		0.70	0.61	0.02	0.21	0.73	0.53
Control Delay	34.6	35.5	4.2	42.6	23.1		56.0	38.1	0.0	30.9	29.0	4.3
Queue Delay	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	34.6	35.5	4.2	42.6	23.1		56.0	38.1	0.0	30.9	29.0	4.3
LOS	C	D	A	D	C		E	D	A	C	C	A
Approach Delay		23.3			37.8			42.3			11.9	

Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Approach LOS		C			D			D			B	
Queue Length 50th (ft)	12	63	0	217	46		54	130	0	14	100	30
Queue Length 95th (ft)	32	92	28	#212	74		#92	198	0	m22	m196	75
Internal Link Dist (ft)		559			643			452			307	
Turn Bay Length (ft)	80		180	525			200		200	160		
Base Capacity (vph)	250	617	617	850	966		264	430	1568	146	430	1471
Starvation Cap Reductn	0	0	0	0	0		0	0	0	0	0	27
Spillback Cap Reductn	0	0	0	0	0		0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0		0	0	0	0	0	0
Reduced v/c Ratio	0.10	0.39	0.27	0.88	0.25		0.70	0.60	0.02	0.21	0.73	0.54

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 90
Offset: 38 (42%), Referenced to phase 2:SBT, Start of Yellow
Natural Cycle: 80
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.88
Intersection Signal Delay: 26.8 Intersection LOS: C
Intersection Capacity Utilization 64.5% ICU Level of Service C
Analysis Period (min) 15
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 11: Folsom Rd/Tsienneto Rd & Crystal Av/NH 28



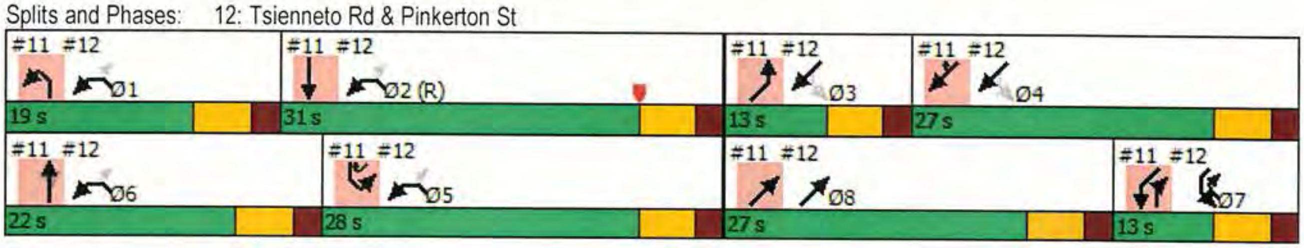
Lane Group	NWL	NWR	NET	NER	SWL	SWT	Ø1	Ø2	Ø3	Ø4	Ø5	Ø6
Lane Configurations												
Traffic Volume (vph)	300	70	580	370	60	810						
Future Volume (vph)	300	70	580	370	60	810						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900						
Storage Length (ft)	90	0		0	175							
Storage Lanes	1	1		1	1							
Taper Length (ft)	25				25							
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95						
Frt		0.850		0.850								
Flt Protected	0.950				0.950							
Satd. Flow (prot)	1770	1583	3505	1568	1770	3539						
Flt Permitted	0.950				0.230							
Satd. Flow (perm)	1770	1583	3505	1568	428	3539						
Right Turn on Red		Yes		Yes								
Satd. Flow (RTOR)		21		430								
Link Speed (mph)	30		30			30						
Link Distance (ft)	408		387			258						
Travel Time (s)	9.3		8.8			5.9						
Peak Hour Factor	0.83	0.83	0.86	0.86	0.81	0.81						
Heavy Vehicles (%)	2%	2%	3%	3%	2%	2%						
Adj. Flow (vph)	361	84	674	430	74	1000						
Shared Lane Traffic (%)												
Lane Group Flow (vph)	361	84	674	430	74	1000						
Turn Type	Prot	pm+ov	NA	Free	pm+pt	NA						
Protected Phases	1 2 5 6	7	8		7	3 4	1	2	3	4	5	6
Permitted Phases		1 2 5 6		Free	3 4							
Detector Phase	1 2 5 6	7	8		7	3 4						
Switch Phase												
Minimum Initial (s)		7.0	5.0		7.0		8.0	5.0	7.0	5.0	7.0	5.0
Minimum Split (s)		13.0	20.0		13.0		14.0	20.0	13.0	20.0	13.0	20.0
Total Split (s)		13.0	27.0		13.0		19.0	31.0	13.0	27.0	28.0	22.0
Total Split (%)		14.4%	30.0%		14.4%		21%	34%	14%	30%	31%	24%
Maximum Green (s)		7.0	21.0		7.0		13.0	25.0	7.0	21.0	22.0	16.0
Yellow Time (s)		4.0	4.0		4.0		4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)		2.0	2.0		2.0		2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)		0.0	0.0		0.0							
Total Lost Time (s)		6.0	6.0		6.0							
Lead/Lag		Lag	Lead		Lag		Lead	Lag	Lead	Lag	Lag	Lead
Lead-Lag Optimize?		Yes	Yes		Yes		Yes	Yes	Yes	Yes	Yes	Yes
Vehicle Extension (s)		3.0	3.0		3.0		3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode		None	None		None		None	C-Max	None	None	None	None
Act Effct Green (s)	41.6	55.1	20.5	90.0	34.0	34.0						
Actuated g/C Ratio	0.46	0.61	0.23	1.00	0.38	0.38						
v/c Ratio	0.44	0.09	0.85	0.27	0.27	0.75						
Control Delay	17.0	5.2	27.4	0.4	25.8	28.6						
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0						
Total Delay	17.0	5.2	27.4	0.4	25.8	28.6						
LOS	B	A	C	A	C	C						
Approach Delay	14.8		16.9			28.4						

Lane Group	NWL	NWR	NET	NER	SWL	SWT	Ø1	Ø2	Ø3	Ø4	Ø5	Ø6
Approach LOS	B		B			C						
Queue Length 50th (ft)	126	12	173	0	27	254						
Queue Length 95th (ft)	175	26	m227	m0	50	282						
Internal Link Dist (ft)	328		307			178						
Turn Bay Length (ft)	90				175							
Base Capacity (vph)	812	977	817	1568	274	1336						
Starvation Cap Reductn	0	0	0	0	0	0						
Spillback Cap Reductn	0	0	0	0	0	0						
Storage Cap Reductn	0	0	0	0	0	0						
Reduced v/c Ratio	0.44	0.09	0.82	0.27	0.27	0.75						

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 90
Offset: 38 (42%), Referenced to phase 2:SBT, Start of Yellow
Natural Cycle: 80
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.88
Intersection Signal Delay: 21.2 Intersection LOS: C
Intersection Capacity Utilization 53.5% ICU Level of Service A
Analysis Period (min) 15
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 12: Tsienneto Rd & Pinkerton St



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	160	980	0	0	980	50	5	0	5	20	0	180
Future Volume (vph)	160	980	0	0	980	50	5	0	5	20	0	180
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	300		0	115		150	0		0	0		0
Storage Lanes	1		0	1		0	0		1	0		1
Taper Length (ft)	50			25			25			25		
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt					0.993				0.850			0.850
Flt Protected	0.950							0.950			0.950	
Satd. Flow (prot)	1687	3374	0	1863	3514	0	0	1805	1615	0	1787	1599
Flt Permitted	0.950											
Satd. Flow (perm)	1687	3374	0	1863	3514	0	0	1900	1615	0	1881	1599
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)					7				182			109
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		463			420			218			433	
Travel Time (s)		10.5			9.5			5.0			9.8	
Peak Hour Factor	0.83	0.83	0.83	0.92	0.92	0.92	0.50	0.50	0.50	0.90	0.90	0.90
Heavy Vehicles (%)	7%	7%	7%	2%	2%	2%	0%	0%	0%	1%	1%	1%
Adj. Flow (vph)	193	1181	0	0	1065	54	10	0	10	22	0	200
Shared Lane Traffic (%)												
Lane Group Flow (vph)	193	1181	0	0	1119	0	0	10	10	0	22	200
Turn Type	Prot	NA		Prot	NA		Perm	NA	Perm	Perm	NA	pm+ov
Protected Phases	5	2		1	6			8			4	5
Permitted Phases					6		8	8	8	4		4
Detector Phase	5	2		1	6		8	8	8	4	4	5
Switch Phase												
Minimum Initial (s)	8.0	8.0		5.0	8.0		5.0	5.0	5.0	5.0	5.0	8.0
Minimum Split (s)	14.0	46.0		11.0	43.0		33.0	33.0	33.0	33.0	33.0	14.0
Total Split (s)	14.0	46.0		11.0	43.0		33.0	33.0	33.0	33.0	33.0	14.0
Total Split (%)	15.6%	51.1%		12.2%	47.8%		36.7%	36.7%	36.7%	36.7%	36.7%	15.6%
Maximum Green (s)	8.0	40.0		5.0	37.0		27.0	27.0	27.0	27.0	27.0	8.0
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0			0.0	0.0		0.0	0.0
Total Lost Time (s)	6.0	6.0		6.0	6.0			6.0	6.0		6.0	6.0
Lead/Lag	Lag	Lag		Lead	Lead							Lag
Lead-Lag Optimize?	Yes	Yes		Yes	Yes							Yes
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	C-Max		None	None		None	None	None	None	None	None
Act Effct Green (s)	18.9	81.8			53.3			6.8	6.8		7.0	24.7
Actuated g/C Ratio	0.21	0.91			0.59			0.08	0.08		0.08	0.27
v/c Ratio	0.55	0.39			0.54			0.07	0.03		0.15	0.39
Control Delay	41.6	4.0			17.0			38.6	0.2		40.2	14.9
Queue Delay	0.0	0.0			0.0			0.0	0.0		0.0	0.0
Total Delay	41.6	4.0			17.0			38.6	0.2		40.2	14.9
LOS	D	A			B			D	A		D	B
Approach Delay		9.3			17.0			19.4			17.5	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Approach LOS		A			B			B			B	
Queue Length 50th (ft)	94	0			244			6	0		12	41
Queue Length 95th (ft)	#242	274			283			12	0		34	101
Internal Link Dist (ft)		383			340			138			353	
Turn Bay Length (ft)	300											
Base Capacity (vph)	353	3066			2085			570	611		564	517
Starvation Cap Reductn	0	0			0			0	0		0	0
Spillback Cap Reductn	0	0			0			0	0		0	0
Storage Cap Reductn	0	0			0			0	0		0	0
Reduced v/c Ratio	0.55	0.39			0.54			0.02	0.02		0.04	0.39

Intersection Summary

Area Type: Other

Cycle Length: 90

Actuated Cycle Length: 90

Offset: 14 (16%), Referenced to phase 2:EBT, Start of Yellow

Natural Cycle: 90

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.55

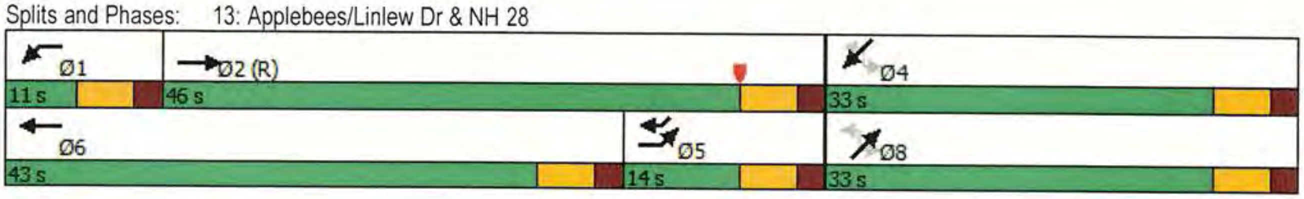
Intersection Signal Delay: 13.2 Intersection LOS: B

Intersection Capacity Utilization 60.3% ICU Level of Service B

Analysis Period (min) 15

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 13: Applebees/Linlew Dr & NH 28



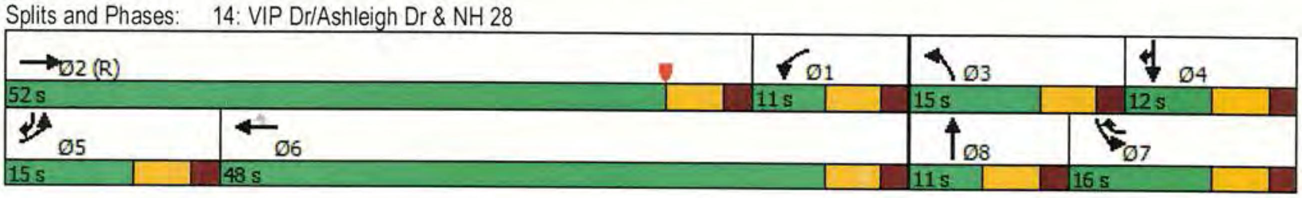
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰↰	↑↱		↰	↑↑	↱	↰	↱		↰	↰↑	↱
Traffic Volume (vph)	140	990	20	5	940	340	10	5	5	110	5	180
Future Volume (vph)	140	990	20	5	940	340	10	5	5	110	5	180
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200		150	205		150	0		0	325		150
Storage Lanes	2		0	1		1	1		0	1		1
Taper Length (ft)	200			25			25			25		
Lane Util. Factor	0.97	0.95	0.95	1.00	0.95	1.00	1.00	1.00	1.00	0.95	0.95	1.00
Frt		0.997				0.850		0.925				0.850
Flt Protected	0.950			0.950			0.950			0.950	0.957	
Satd. Flow (prot)	3303	3395	0	1736	3471	1553	1805	1758	0	1665	1677	1568
Flt Permitted	0.950			0.950			0.950			0.950	0.000	
Satd. Flow (perm)	3303	3395	0	1736	3471	1553	1805	1758	0	1665	0	1568
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		3				351		7				182
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		412			486			151			446	
Travel Time (s)		9.4			11.0			3.4			10.1	
Peak Hour Factor	0.83	0.83	0.83	0.97	0.97	0.97	0.67	0.67	0.67	0.90	0.90	0.90
Heavy Vehicles (%)	6%	6%	6%	4%	4%	4%	0%	0%	0%	3%	3%	3%
Adj. Flow (vph)	169	1193	24	5	969	351	15	7	7	122	6	200
Shared Lane Traffic (%)										48%		
Lane Group Flow (vph)	169	1217	0	5	969	351	15	14	0	63	65	200
Turn Type	Prot	NA		Prot	NA	pm+ov	Prot	NA		Prot	NA	pt+ov
Protected Phases	5	2		1	6	7	3	8		7	4	4 5
Permitted Phases						6		8				
Detector Phase	5	2		1	6	7	3	8		7	4	4 5
Switch Phase												
Minimum Initial (s)	5.0	8.0		5.0	8.0	8.0	5.0	5.0		8.0	8.0	
Minimum Split (s)	11.0	14.0		11.0	14.0	14.0	11.0	11.0		14.0	14.0	
Total Split (s)	15.0	52.0		11.0	48.0	16.0	15.0	11.0		16.0	12.0	
Total Split (%)	16.7%	57.8%		12.2%	53.3%	17.8%	16.7%	12.2%		17.8%	13.3%	
Maximum Green (s)	9.0	46.0		5.0	42.0	10.0	9.0	5.0		10.0	6.0	
Yellow Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0	2.0	2.0	2.0		2.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Lead/Lag	Lead	Lead		Lag	Lag	Lag	Lead	Lead		Lag	Lag	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes	Yes	Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Recall Mode	None	C-Min		None	Min	None	None	None		None	None	
Act Effct Green (s)	9.2	65.0		5.6	52.0	65.4	6.3	5.6		8.6	8.6	23.3
Actuated g/C Ratio	0.10	0.72		0.06	0.58	0.73	0.07	0.06		0.10	0.10	0.26
v/c Ratio	0.50	0.50		0.05	0.48	0.29	0.12	0.12		0.40	0.41	0.37
Control Delay	43.5	8.1		44.0	11.8	4.2	40.8	31.7		45.8	46.1	7.7
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Total Delay	43.5	8.1		44.0	11.8	4.2	40.8	31.7		45.8	46.1	7.7
LOS	D	A		D	B	A	D	C		D	D	A
Approach Delay		12.4			9.9			36.4			22.6	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach LOS		B			A			D			C	
Queue Length 50th (ft)	47	96		3	231	80	8	4		36	37	8
Queue Length 95th (ft)	73	296		m6	310	101	20	16		76	78	61
Internal Link Dist (ft)		332			406			71			366	
Turn Bay Length (ft)	200			205		150				325		150
Base Capacity (vph)	354	2452		107	2004	1242	180	116		185	160	547
Starvation Cap Reductn	0	0		0	0	0	0	0		0	0	0
Spillback Cap Reductn	0	0		0	0	0	0	0		0	0	0
Storage Cap Reductn	0	0		0	0	0	0	0		0	0	0
Reduced v/c Ratio	0.48	0.50		0.05	0.48	0.28	0.08	0.12		0.34	0.41	0.37

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 90
Offset: 25 (28%), Referenced to phase 2:EBT, Start of Yellow
Natural Cycle: 65
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.50
Intersection Signal Delay: 12.6 Intersection LOS: B
Intersection Capacity Utilization 57.0% ICU Level of Service B
Analysis Period (min) 15
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 14: VIP Dr/Ashleigh Dr & NH 28



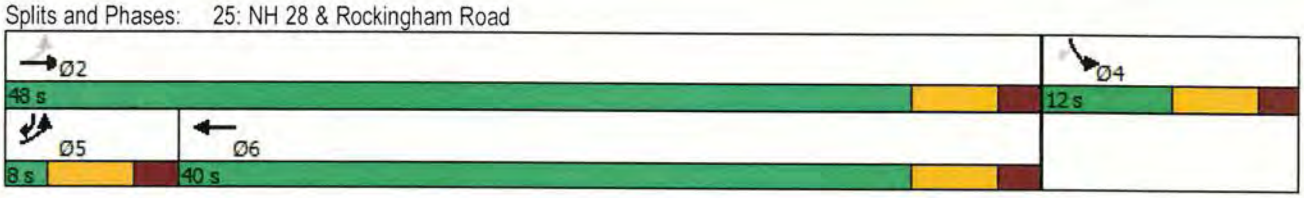
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	55	1630	1560	210	90	105
Future Volume (vph)	55	1630	1560	210	90	105
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200			0	360	0
Storage Lanes	1			0	1	1
Taper Length (ft)	25				25	
Lane Util. Factor	1.00	0.95	0.95	0.95	1.00	1.00
Frt			0.982			0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1770	3539	3476	0	1770	1583
Flt Permitted	0.099				0.950	
Satd. Flow (perm)	184	3539	3476	0	1770	1583
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			40			18
Link Speed (mph)		30	30		30	
Link Distance (ft)		463	580		704	
Travel Time (s)		10.5	13.2		16.0	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	60	1772	1696	228	98	114
Shared Lane Traffic (%)						
Lane Group Flow (vph)	60	1772	1924	0	98	114
Turn Type	pm+pt	NA	NA		Prot	pm+ov
Protected Phases	5	2	6		4	5
Permitted Phases	2					4
Detector Phase	5	2	6		4	5
Switch Phase						
Minimum Initial (s)	5.0	5.0	5.0		5.0	5.0
Minimum Split (s)	11.0	20.0	20.0		11.0	11.0
Total Split (s)	8.0	48.0	40.0		12.0	8.0
Total Split (%)	13.3%	80.0%	66.7%		20.0%	13.3%
Maximum Green (s)	2.0	42.0	34.0		6.0	2.0
Yellow Time (s)	4.0	4.0	4.0		4.0	4.0
All-Red Time (s)	2.0	2.0	2.0		2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0		0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0		6.0	6.0
Lead/Lag	Lead		Lag			Lead
Lead-Lag Optimize?	Yes		Yes			Yes
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Recall Mode	None	None	None		None	None
Act Effct Green (s)	40.3	42.1	36.2		6.1	10.9
Actuated g/C Ratio	0.73	0.76	0.65		0.11	0.20
v/c Ratio	0.31	0.66	0.84		0.50	0.35
Control Delay	7.0	6.4	16.8		36.5	19.9
Queue Delay	0.0	0.0	0.0		0.0	0.0
Total Delay	7.0	6.4	16.8		36.5	19.9
LOS	A	A	B		D	B
Approach Delay		6.4	16.8		27.6	
Approach LOS		A	B		C	

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Queue Length 50th (ft)	5	156	306		35	28
Queue Length 95th (ft)	13	220	#508		#88	66
Internal Link Dist (ft)		383	500		624	
Turn Bay Length (ft)	200				360	
Base Capacity (vph)	193	2689	2232		199	327
Starvation Cap Reductn	0	0	0		0	0
Spillback Cap Reductn	0	0	0		0	0
Storage Cap Reductn	0	0	0		0	0
Reduced v/c Ratio	0.31	0.66	0.86		0.49	0.35

Intersection Summary

Area Type: Other
Cycle Length: 60
Actuated Cycle Length: 55.4
Natural Cycle: 65
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.84
Intersection Signal Delay: 12.6 — Intersection LOS: B
Intersection Capacity Utilization 66.3% — ICU Level of Service C
Analysis Period (min) 15
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 25: NH 28 & Rockingham Road



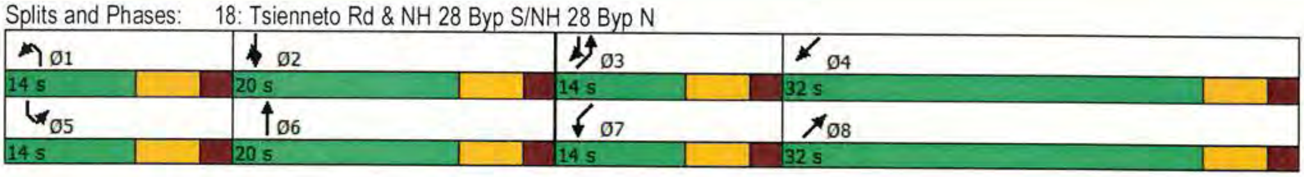
Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations	↰	↱		↰	↑	↱	↰	↑↱		↰	↑↱	
Traffic Volume (vph)	30	50	20	80	40	200	40	310	70	70	570	50
Future Volume (vph)	30	50	20	80	40	200	40	310	70	70	570	50
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	145		110	280		280	360		0	120		0
Storage Lanes	1		0	1		1	1		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00	0.95	0.95
Frt		0.958				0.850		0.972			0.988	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1752	1767	0	1736	1827	1553	1770	3440	0	1787	3531	0
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1752	1767	0	1736	1827	1553	1770	3440	0	1787	3531	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		21				201		36			12	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		481			484			479			371	
Travel Time (s)		10.9			11.0			10.9			8.4	
Peak Hour Factor	0.82	0.82	0.82	0.81	0.81	0.81	0.68	0.68	0.68	0.78	0.78	0.78
Heavy Vehicles (%)	3%	3%	3%	4%	4%	4%	2%	2%	2%	1%	1%	1%
Adj. Flow (vph)	37	61	24	99	49	247	59	456	103	90	731	64
Shared Lane Traffic (%)												
Lane Group Flow (vph)	37	85	0	99	49	247	59	559	0	90	795	0
Turn Type	Prot	NA		Prot	NA	pt+ov	Prot	NA		Prot	NA	
Protected Phases	1	6		5	2	2 3	3	8		7	4	
Permitted Phases												
Detector Phase	1	6		5	2	2 3	3	8		7	4	
Switch Phase												
Minimum Initial (s)	8.0	8.0		8.0	8.0		8.0	8.0		8.0	8.0	
Minimum Split (s)	14.0	20.0		14.0	20.0		14.0	20.0		14.0	20.0	
Total Split (s)	14.0	20.0		14.0	20.0		14.0	32.0		14.0	32.0	
Total Split (%)	17.5%	25.0%		17.5%	25.0%		17.5%	40.0%		17.5%	40.0%	
Maximum Green (s)	8.0	14.0		8.0	14.0		8.0	26.0		8.0	26.0	
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lag		Lead	Lag	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	Max		None	None		None	None	
Act Effct Green (s)	8.2	13.0		8.2	16.0	30.4	8.2	25.6		8.2	21.8	
Actuated g/C Ratio	0.11	0.18		0.11	0.22	0.42	0.11	0.36		0.11	0.30	
v/c Ratio	0.19	0.25		0.50	0.12	0.32	0.29	0.45		0.45	0.74	
Control Delay	35.1	24.7		43.6	27.9	6.2	37.1	20.1		40.9	27.3	
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Total Delay	35.1	24.7		43.6	27.9	6.2	37.1	20.1		40.9	27.3	
LOS	D	C		D	C	A	D	C		D	C	
Approach Delay		27.9			18.3			21.7			28.7	

Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Approach LOS		C			B			C			C	
Queue Length 50th (ft)	17	27		47	20	15	27	108		43	176	
Queue Length 95th (ft)	41	59		86	45	49	48	108		76	197	
Internal Link Dist (ft)		401			404			399			291	
Turn Bay Length (ft)	145			280		280	360			120		
Base Capacity (vph)	199	367		197	406	770	201	1320		202	1310	
Starvation Cap Reductn	0	0		0	0	0	0	0		0	0	
Spillback Cap Reductn	0	0		0	0	0	0	0		0	0	
Storage Cap Reductn	0	0		0	0	0	0	0		0	0	
Reduced v/c Ratio	0.19	0.23		0.50	0.12	0.32	0.29	0.42		0.45	0.61	

Intersection Summary

Area Type: Other
Cycle Length: 80
Actuated Cycle Length: 72.1
Natural Cycle: 70
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.74
Intersection Signal Delay: 24.5 — Intersection LOS: C
Intersection Capacity Utilization 51.4% — ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 18: Tsienneto Rd & NH 28 Byp S/NH 28 Byp N



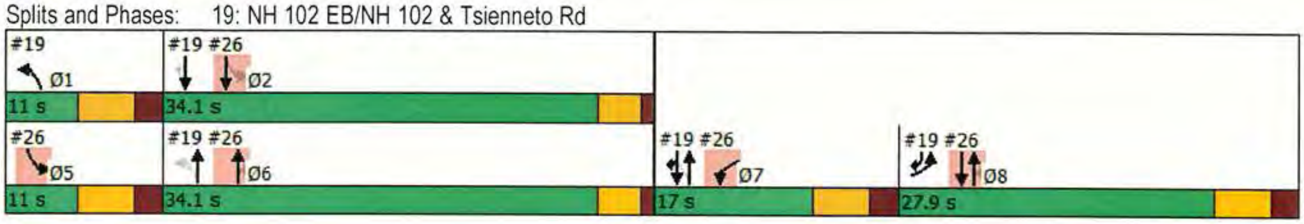
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR	Ø2	Ø5	Ø6	Ø7
Lane Configurations										
Traffic Volume (vph)	240	0	10	120	260	520				
Future Volume (vph)	240	0	10	120	260	520				
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900				
Storage Length (ft)	200	0	100			90				
Storage Lanes	0	0	1			1				
Taper Length (ft)	25		25							
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00				
Frt						0.850				
Flt Protected	0.950		0.950							
Satd. Flow (prot)	1787	0	1770	1863	1845	1568				
Flt Permitted	0.950		0.498							
Satd. Flow (perm)	1787	0	928	1863	1845	1568				
Right Turn on Red		Yes				Yes				
Satd. Flow (RTOR)						584				
Link Speed (mph)	30			30	30					
Link Distance (ft)	392			704	263					
Travel Time (s)	8.9			16.0	6.0					
Peak Hour Factor	0.90	0.90	0.87	0.87	0.89	0.89				
Heavy Vehicles (%)	1%	1%	2%	2%	3%	3%				
Adj. Flow (vph)	267	0	11	138	292	584				
Shared Lane Traffic (%)										
Lane Group Flow (vph)	267	0	11	138	292	584				
Turn Type	Prot		pm+pt	NA	NA	custom				
Protected Phases	8		1	6 7	2 7	7 8	2	5	6	7
Permitted Phases			6 7			2				
Detector Phase	8		1	6 7	2 7	7 8				
Switch Phase										
Minimum Initial (s)	5.0		5.0				5.0	5.0	5.0	5.0
Minimum Split (s)	26.5		11.0				9.0	11.0	9.0	11.0
Total Split (s)	27.9		11.0				34.1	11.0	34.1	17.0
Total Split (%)	31.0%		12.2%				38%	12%	38%	19%
Maximum Green (s)	21.9		5.0				30.1	5.0	30.1	11.0
Yellow Time (s)	4.0		4.0				3.0	4.0	3.0	4.0
All-Red Time (s)	2.0		2.0				1.0	2.0	1.0	2.0
Lost Time Adjust (s)	0.0		0.0							
Total Lost Time (s)	6.0		6.0							
Lead/Lag	Lag		Lead				Lag	Lead	Lag	Lead
Lead-Lag Optimize?	Yes		Yes				Yes	Yes	Yes	Yes
Vehicle Extension (s)	3.0		3.0				3.0	3.0	3.0	3.0
Recall Mode	None		None				Min	None	Min	None
Act Effct Green (s)	22.0		32.4	33.7	33.7	65.1				
Actuated g/C Ratio	0.32		0.48	0.50	0.50	0.96				
v/c Ratio	0.46		0.02	0.15	0.32	0.38				
Control Delay	24.4		7.7	9.9	11.7	0.8				
Queue Delay	0.0		0.0	0.0	1.0	0.1				
Total Delay	24.4		7.7	9.9	12.7	0.9				
LOS	C		A	A	B	A				
Approach Delay	24.4			9.7	4.8					

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR	Ø2	Ø5	Ø6	Ø7
Approach LOS	C			A	A					
Queue Length 50th (ft)	82		2	27	81	0				
Queue Length 95th (ft)	217		8	66	122	19				
Internal Link Dist (ft)	312			624	183					
Turn Bay Length (ft)	200		100			90				
Base Capacity (vph)	595		508	985	975	1494				
Starvation Cap Reductn	0		0	0	449	142				
Spillback Cap Reductn	0		0	0	0	0				
Storage Cap Reductn	0		0	0	0	0				
Reduced v/c Ratio	0.45		0.02	0.14	0.56	0.43				

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 67.7
Natural Cycle: 60
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.59
Intersection Signal Delay: 9.4 Intersection LOS: A
Intersection Capacity Utilization 46.4% ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 19: NH 102 EB/NH 102 & Tsienneto Rd

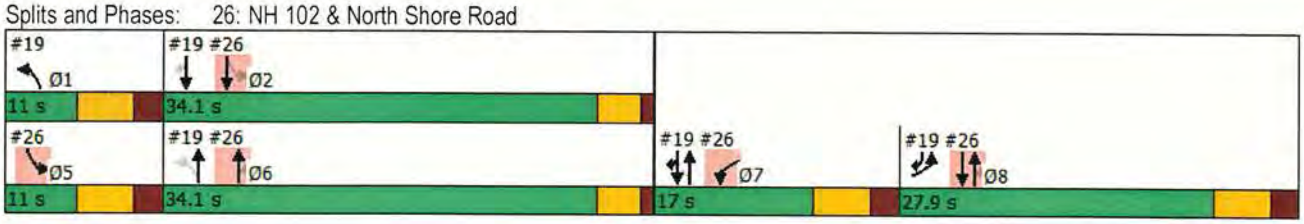


Lane Group	WBL	WBR	NBT	NBR	SBL	SBT	Ø1	Ø2	Ø6	Ø8
Lane Configurations										
Traffic Volume (vph)	60	10	330	30	10	720				
Future Volume (vph)	60	10	330	30	10	720				
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900				
Storage Length (ft)	0	0		90	100					
Storage Lanes	1	0		1	1					
Taper Length (ft)	25				25					
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00				
Frt	0.976			0.850						
Flt Protected	0.961				0.950					
Satd. Flow (prot)	1768	0	1900	1615	1805	1900				
Flt Permitted	0.961				0.432					
Satd. Flow (perm)	1768	0	1900	1615	821	1900				
Right Turn on Red		Yes		Yes						
Satd. Flow (RTOR)	10			36						
Link Speed (mph)	30		30			30				
Link Distance (ft)	524		263			288				
Travel Time (s)	11.9		6.0			6.5				
Peak Hour Factor	0.87	0.67	0.95	0.84	0.73	0.96				
Heavy Vehicles (%)	1%	0%	0%	0%	0%	0%				
Adj. Flow (vph)	69	15	347	36	14	750				
Shared Lane Traffic (%)										
Lane Group Flow (vph)	84	0	347	36	14	750				
Turn Type	Prot		NA	Perm	custom	NA				
Protected Phases	7		6 8		5	2 8	1	2	6	8
Permitted Phases				6 8	2					
Detector Phase	7		6 8	6 8	5	2 8				
Switch Phase										
Minimum Initial (s)	5.0				5.0		5.0	5.0	5.0	5.0
Minimum Split (s)	11.0				11.0		11.0	9.0	9.0	26.5
Total Split (s)	17.0				11.0		11.0	34.1	34.1	27.9
Total Split (%)	18.9%				12.2%		12%	38%	38%	31%
Maximum Green (s)	11.0				5.0		5.0	30.1	30.1	21.9
Yellow Time (s)	4.0				4.0		4.0	3.0	3.0	4.0
All-Red Time (s)	2.0				2.0		2.0	1.0	1.0	2.0
Lost Time Adjust (s)	0.0				0.0					
Total Lost Time (s)	6.0				6.0					
Lead/Lag	Lead				Lead		Lead	Lag	Lag	Lag
Lead-Lag Optimize?	Yes				Yes		Yes	Yes	Yes	Yes
Vehicle Extension (s)	3.0				3.0		3.0	3.0	3.0	3.0
Recall Mode	None				None		None	Min	Min	None
Act Effct Green (s)	10.0		45.2	45.2	16.2	45.2				
Actuated g/C Ratio	0.15		0.67	0.67	0.24	0.67				
v/c Ratio	0.31		0.27	0.03	0.05	0.59				
Control Delay	29.9		1.9	0.2	17.5	7.8				
Queue Delay	0.0		0.1	0.0	0.0	0.0				
Total Delay	29.9		2.0	0.2	17.5	7.8				
LOS	C		A	A	B	A				
Approach Delay	29.9		1.9			8.0				

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT	Ø1	Ø2	Ø6	Ø8
Approach LOS	C		A			A				
Queue Length 50th (ft)	26		13	0	4	129				
Queue Length 95th (ft)	81		21	m0	12	191				
Internal Link Dist (ft)	444		183			208				
Turn Bay Length (ft)				90	100					
Base Capacity (vph)	304		1608	1372	271	1608				
Starvation Cap Reductn	0		460	0	0	0				
Spillback Cap Reductn	0		0	0	0	0				
Storage Cap Reductn	0		0	0	0	0				
Reduced v/c Ratio	0.28		0.30	0.03	0.05	0.47				

Intersection Summary	
Area Type: Other	
Cycle Length: 90	
Actuated Cycle Length: 67.7	
Natural Cycle: 60	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.59	
Intersection Signal Delay: 7.6	Intersection LOS: A
Intersection Capacity Utilization 50.4%	ICU Level of Service A
Analysis Period (min) 15	
m Volume for 95th percentile queue is metered by upstream signal.	

Splits and Phases: 26: NH 102 & North Shore Road



APPENDIX R-4: ALTERNATIVE D INTERSECTION CAPACITY ANALYSES – SYNCHRO PRINTOUTS – PM PEAK HOUR

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑↑		↰	↱↱
Traffic Volume (vph)	0	1285	1405	0	125	1295
Future Volume (vph)	0	1285	1405	0	125	1295
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	16	12
Lane Util. Factor	1.00	0.95	0.95	1.00	1.00	0.88
Frt						0.850
Flt Protected					0.950	
Satd. Flow (prot)	0	3471	3406	0	1930	2682
Flt Permitted					0.950	
Satd. Flow (perm)	0	3471	3406	0	1930	2682
Right Turn on Red				Yes		No
Satd. Flow (RTOR)						
Link Speed (mph)		30	30		25	
Link Distance (ft)		712	388		212	
Travel Time (s)		16.2	8.8		5.8	
Peak Hour Factor	0.93	0.93	0.88	0.88	0.89	0.89
Heavy Vehicles (%)	4%	4%	6%	6%	6%	6%
Adj. Flow (vph)	0	1382	1597	0	140	1455
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	1382	1597	0	140	1455
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(ft)		24	24		16	
Link Offset(ft)		0	0		0	
Crosswalk Width(ft)		16	16		16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	0.85	1.00
Turning Speed (mph)	15			9	15	9
Number of Detectors		3	3		3	3
Detector Template		Thru	Thru		Left	
Leading Detector (ft)		256	256		256	256
Trailing Detector (ft)		-5	-5		-5	-5
Detector 1 Position(ft)		-5	-5		-5	-5
Detector 1 Size(ft)		50	50		50	50
Detector 1 Type		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex
Detector 1 Channel						
Detector 1 Extend (s)		0.0	0.0		0.0	0.0
Detector 1 Queue (s)		0.0	0.0		0.0	0.0
Detector 1 Delay (s)		0.0	0.0		0.0	0.0
Detector 2 Position(ft)		125	125		125	125
Detector 2 Size(ft)		6	6		6	6
Detector 2 Type		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex
Detector 2 Channel						
Detector 2 Extend (s)		0.0	0.0		0.0	0.0
Detector 3 Position(ft)		250	250		250	250
Detector 3 Size(ft)		6	6		6	6
Detector 3 Type		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex
Detector 3 Channel						

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Detector 3 Extend (s)		0.0	0.0		0.0	0.0
Turn Type		NA	NA		Prot	Prot
Protected Phases		2	6		4	4
Permitted Phases						
Detector Phase		2	6		4	4
Switch Phase						
Minimum Initial (s)		8.0	8.0		5.0	5.0
Minimum Split (s)		14.0	21.0		27.0	27.0
Total Split (s)		66.0	66.0		74.0	74.0
Total Split (%)		47.1%	47.1%		52.9%	52.9%
Maximum Green (s)		60.0	60.0		68.0	68.0
Yellow Time (s)		2.0	2.0		2.0	2.0
All-Red Time (s)		4.0	4.0		4.0	4.0
Lost Time Adjust (s)		0.0	0.0		0.0	0.0
Total Lost Time (s)		6.0	6.0		6.0	6.0
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)		3.0	3.0		3.0	3.0
Recall Mode		C-Min	C-Min		None	None
Walk Time (s)			7.0		7.0	7.0
Flash Dont Walk (s)			8.0		14.0	14.0
Pedestrian Calls (#/hr)			0		0	0
Act Effct Green (s)		60.0	60.0		68.0	68.0
Actuated g/C Ratio		0.43	0.43		0.49	0.49
v/c Ratio		0.93	1.09		0.15	1.12
Control Delay		36.3	52.2		20.5	98.2
Queue Delay		0.0	0.0		0.0	0.0
Total Delay		36.3	52.2		20.5	98.2
LOS		D	D		C	F
Approach Delay		36.3	52.2		91.4	
Approach LOS		D	D		F	
Queue Length 50th (ft)		440	~843		69	~863
Queue Length 95th (ft)		m629	m#104		110	#994
Internal Link Dist (ft)		632	308		132	
Turn Bay Length (ft)						
Base Capacity (vph)		1487	1459		937	1302
Starvation Cap Reductn		0	0		0	0
Spillback Cap Reductn		0	0		0	0
Storage Cap Reductn		0	0		0	0
Reduced v/c Ratio		0.93	1.09		0.15	1.12

Intersection Summary

Area Type: Other
Cycle Length: 140
Actuated Cycle Length: 140
Offset: 0 (0%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow, Master Intersection
Natural Cycle: 140
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 1.12

Intersection Signal Delay: 61.1 Intersection LOS: E
Intersection Capacity Utilization 96.1% ICU Level of Service F
Analysis Period (min) 15

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 7: NH 102 & Exit 4 SB Off

Lane Group	NBL2	NBL	NBR	SEL	SER	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations											
Traffic Volume (vph)	1245	0	1005	0	0	1050	360	0	0	500	235
Future Volume (vph)	1245	0	1005	0	0	1050	360	0	0	500	235
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)		0	0	0	0	550		0	0		0
Storage Lanes		2	2	0	0	2		0	0		1
Taper Length (ft)		25		25		25			25		
Lane Util. Factor	0.97	1.00	0.88	1.00	1.00	0.97	0.95	1.00	1.00	0.95	1.00
Frt			0.850								0.850
Flt Protected	0.950					0.950					
Satd. Flow (prot)	3242	0	2632	0	0	3335	3438	0	0	3505	1568
Flt Permitted	0.950					0.950					
Satd. Flow (perm)	3242	0	2632	0	0	3335	3438	0	0	3505	1568
Right Turn on Red			No					Yes			Yes
Satd. Flow (RTOR)											252
Link Speed (mph)		25		30			30			30	
Link Distance (ft)		856		390			760			857	
Travel Time (s)		23.3		8.9			17.3			19.5	
Peak Hour Factor	0.88	0.88	0.88	0.92	0.92	0.94	0.94	0.94	0.92	0.92	0.92
Heavy Vehicles (%)	8%	8%	8%	2%	2%	5%	5%	5%	3%	3%	3%
Adj. Flow (vph)	1415	0	1142	0	0	1117	383	0	0	543	255
Shared Lane Traffic (%)											
Lane Group Flow (vph)	1415	0	1142	0	0	1117	383	0	0	543	255
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Right	Left	Left	Right	Left	Right	Right
Median Width(ft)		24		0			24			24	
Link Offset(ft)		12		0			0			0	
Crosswalk Width(ft)		16		16			16			16	
Two way Left Turn Lane											
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15	15	25	15	9	15		9	15		25
Number of Detectors	3		3			3	3			3	0
Detector Template											
Leading Detector (ft)	256		256			256	256			256	0
Trailing Detector (ft)	-5		-5			-5	-5			-5	0
Detector 1 Position(ft)	-5		-5			-5	-5			-5	-5
Detector 1 Size(ft)	55		55			55	55			55	50
Detector 1 Type	Cl+Ex		Cl+Ex			Cl+Ex	Cl+Ex			Cl+Ex	Cl+Ex
Detector 1 Channel											
Detector 1 Extend (s)	0.0		0.0			0.0	0.0			0.0	0.0
Detector 1 Queue (s)	0.0		0.0			0.0	0.0			0.0	0.0
Detector 1 Delay (s)	0.0		0.0			0.0	0.0			0.0	0.0
Detector 2 Position(ft)	125		125			125	125			125	
Detector 2 Size(ft)	6		6			6	6			6	
Detector 2 Type	Cl+Ex		Cl+Ex			Cl+Ex	Cl+Ex			Cl+Ex	
Detector 2 Channel											
Detector 2 Extend (s)	0.0		0.0			0.0	0.0			0.0	
Detector 3 Position(ft)	250		250			250	250			250	
Detector 3 Size(ft)	6		6			6	6			6	

Lane Group	NBL2	NBL	NBR	SEL	SER	NEL	NET	NER	SWL	SWT	SWR
Detector 3 Type	Cl+Ex		Cl+Ex			Cl+Ex	Cl+Ex			Cl+Ex	
Detector 3 Channel											
Detector 3 Extend (s)	0.0		0.0			0.0	0.0			0.0	
Turn Type	Prot		Prot			Prot	NA			NA	Free
Protected Phases	8		8			5	2			6	
Permitted Phases											Free
Detector Phase	8		2			5	2			6	
Switch Phase											
Minimum Initial (s)	10.0		10.0			5.0	8.0			8.0	
Minimum Split (s)	16.0		16.0			11.0	42.0			31.0	
Total Split (s)	61.0		61.0			48.0	79.0			31.0	
Total Split (%)	43.6%		43.6%			34.3%	56.4%			22.1%	
Maximum Green (s)	55.0		55.0			42.0	73.0			25.0	
Yellow Time (s)	2.0		2.0			2.0	2.0			2.0	
All-Red Time (s)	4.0		4.0			4.0	4.0			4.0	
Lost Time Adjust (s)	0.0		0.0			0.0	0.0			0.0	
Total Lost Time (s)	6.0		6.0			6.0	6.0			6.0	
Lead/Lag						Lead				Lag	
Lead-Lag Optimize?											
Vehicle Extension (s)	3.0		3.0			3.0	3.0			3.0	
Recall Mode	None		None			None	C-Min			C-Min	
Walk Time (s)							7.0			7.0	
Flash Dont Walk (s)							29.0			17.0	
Pedestrian Calls (#/hr)							0			0	
Act Effct Green (s)	55.0		55.0			42.0	73.0			25.0	140.0
Actuated g/C Ratio	0.39		0.39			0.30	0.52			0.18	1.00
v/c Ratio	1.11		1.10			1.12	0.21			0.87	0.16
Control Delay	101.4		101.0			83.6	3.9			71.2	0.2
Queue Delay	0.0		0.0			0.0	0.0			0.0	0.0
Total Delay	101.4		101.0			83.6	3.9			71.2	0.2
LOS	F		F			F	A			E	A
Approach Delay		101.2					63.3			48.5	
Approach LOS		F					E			D	
Queue Length 50th (ft)	~757		~671			~595	42			255	0
Queue Length 95th (ft)	#862		#790			m#674	m44			#347	0
Internal Link Dist (ft)		776		310			680			777	
Turn Bay Length (ft)						550					
Base Capacity (vph)	1273		1034			1000	1792			625	1568
Starvation Cap Reductn	0		0			0	0			0	0
Spillback Cap Reductn	0		0			0	0			0	0
Storage Cap Reductn	0		0			0	0			0	0
Reduced v/c Ratio	1.11		1.10			1.12	0.21			0.87	0.16

Intersection Summary

Area Type: Other
Cycle Length: 140
Actuated Cycle Length: 140
Offset: 53 (38%), Referenced to phase 2:NET and 6:SWT, Start of Yellow
Natural Cycle: 150

2 ~~8~~: NH 102 & Exit 4 NB Off

Control Type: Actuated-Coordinated
Maximum v/c Ratio: 1.12
Intersection Signal Delay: 80.8 — Intersection LOS: F
Intersection Capacity Utilization 95.3% — ICU Level of Service F
Analysis Period (min) 15

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 8: NH 102 & Exit 4 NB Off

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑	↱	↰	↑↑					↰↰		↱
Traffic Volume (vph)	0	650	460	165	580	0	0	0	0	185	0	390
Future Volume (vph)	0	650	460	165	580	0	0	0	0	185	0	390
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		350	0		0	0		0	0		0
Storage Lanes	0		1	1		0	0		0	2		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	0.97	1.00	1.00
Frt			0.850									0.850
Flt Protected				0.950						0.950		
Satd. Flow (prot)	0	3471	1553	1719	3438	0	0	0	0	3367	0	1553
Flt Permitted				0.950						0.950		
Satd. Flow (perm)	0	3471	1553	1719	3438	0	0	0	0	3367	0	1553
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			529									231
Link Speed (mph)		30			30			30			35	
Link Distance (ft)		851			693			486			581	
Travel Time (s)		19.3			15.8			11.0			11.3	
Peak Hour Factor	0.87	0.87	0.87	0.86	0.86	0.86	0.92	0.92	0.92	0.91	0.91	0.91
Heavy Vehicles (%)	4%	4%	4%	5%	5%	5%	2%	2%	2%	4%	4%	4%
Adj. Flow (vph)	0	747	529	192	674	0	0	0	0	203	0	429
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	747	529	192	674	0	0	0	0	203	0	429
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Right	Left	Right
Median Width(ft)		36			36			24			24	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		25	15		9	15		9	15		25
Number of Detectors		3	3	3	3					3		3
Detector Template		Thru	Right	Left	Thru					Left		Right
Leading Detector (ft)		256	256	256	256					256		256
Trailing Detector (ft)		-5	-5	-5	-5					-5		-5
Detector 1 Position(ft)		-5	-5	-5	-5					-5		-5
Detector 1 Size(ft)		50	50	50	50					50		50
Detector 1 Type		Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex					Cl+Ex		Cl+Ex
Detector 1 Channel												
Detector 1 Extend (s)		0.0	0.0	0.0	0.0					0.0		0.0
Detector 1 Queue (s)		0.0	0.0	0.0	0.0					0.0		0.0
Detector 1 Delay (s)		0.0	0.0	0.0	0.0					0.0		0.0
Detector 2 Position(ft)		125	125	125	125					125		125
Detector 2 Size(ft)		6	6	6	6					6		6
Detector 2 Type		Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex					Cl+Ex		Cl+Ex
Detector 2 Channel												
Detector 2 Extend (s)		0.0	0.0	0.0	0.0					0.0		0.0
Detector 3 Position(ft)		250	250	250	250					250		250
Detector 3 Size(ft)		6	6	6	6					6		6

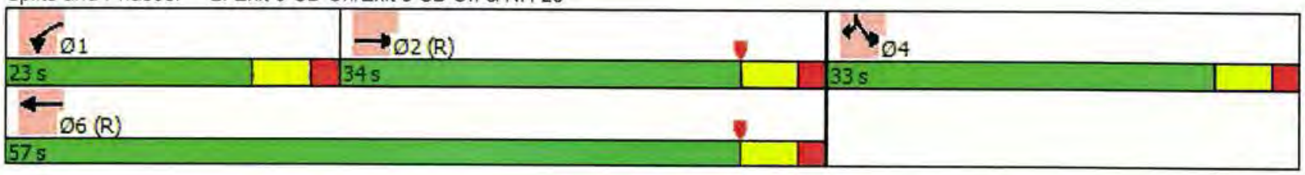
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Detector 3 Type		Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex					Cl+Ex		Cl+Ex
Detector 3 Channel												
Detector 3 Extend (s)		0.0	0.0	0.0	0.0					0.0		0.0
Turn Type		NA	Free	Prot	NA					Prot		Prot
Protected Phases		2		1	6					4		4
Permitted Phases			Free									
Detector Phase		2		1	6					4		4
Switch Phase												
Minimum Initial (s)		9.0		4.0	9.0					4.0		4.0
Minimum Split (s)		21.0		10.0	21.0					10.0		10.0
Total Split (s)		34.0		23.0	57.0					33.0		33.0
Total Split (%)		37.8%		25.6%	63.3%					36.7%		36.7%
Maximum Green (s)		28.0		17.0	51.0					27.0		27.0
Yellow Time (s)		4.0		4.0	4.0					4.0		4.0
All-Red Time (s)		2.0		2.0	2.0					2.0		2.0
Lost Time Adjust (s)		0.0		0.0	0.0					0.0		0.0
Total Lost Time (s)		6.0		6.0	6.0					6.0		6.0
Lead/Lag		Lag		Lead								
Lead-Lag Optimize?												
Vehicle Extension (s)		5.0		3.0	5.0					3.0		3.0
Recall Mode		C-Min		None	C-Min					None		None
Walk Time (s)		7.0			7.0							
Flash Dont Walk (s)		8.0			8.0							
Pedestrian Calls (#/hr)		0			0							
Act Effct Green (s)		37.3	90.0	14.4	57.6					20.4		20.4
Actuated g/C Ratio		0.41	1.00	0.16	0.64					0.23		0.23
v/c Ratio		0.52	0.34	0.70	0.31					0.27		0.81
Control Delay		23.7	0.6	23.2	0.4					27.8		26.5
Queue Delay		0.0	0.0	0.0	0.0					0.0		0.0
Total Delay		23.7	0.6	23.2	0.4					27.8		26.5
LOS		C	A	C	A					C		C
Approach Delay		14.1			5.5						27.0	
Approach LOS		B			A						C	
Queue Length 50th (ft)		172	0	6	0					47		105
Queue Length 95th (ft)		247	0	0	m0					71		205
Internal Link Dist (ft)		771			613			406			501	
Turn Bay Length (ft)			350									
Base Capacity (vph)		1436	1553	324	2202					1010		627
Starvation Cap Reductn		0	0	0	0					0		0
Spillback Cap Reductn		0	0	0	0					0		0
Storage Cap Reductn		0	0	0	0					0		0
Reduced v/c Ratio		0.52	0.34	0.59	0.31					0.20		0.68

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 90
Offset: 52 (58%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow
Natural Cycle: 60

Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.81
Intersection Signal Delay: 14.3 Intersection LOS: B
Intersection Capacity Utilization 72.6% ICU Level of Service C
Analysis Period (min) 15
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 2: Exit 5 SB On/Exit 5 SB Off & NH 28



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑			↑↑	↱	↰		↱			
Traffic Volume (vph)	445	390	0	0	385	235	360	0	380	0	0	0
Future Volume (vph)	445	390	0	0	385	235	360	0	380	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt						0.850			0.850			
Flt Protected	0.950						0.950					
Satd. Flow (prot)	1752	3505	0	0	3505	1568	1703	0	1524	0	0	0
Flt Permitted	0.950						0.950					
Satd. Flow (perm)	1752	3505	0	0	3505	1568	1703	0	1524	0	0	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						258			399			
Link Speed (mph)		30			30			35			30	
Link Distance (ft)		693			542			867			392	
Travel Time (s)		15.8			12.3			16.9			8.9	
Peak Hour Factor	0.92	0.92	0.92	0.91	0.91	0.91	0.67	0.67	0.67	0.92	0.92	0.92
Heavy Vehicles (%)	3%	3%	3%	3%	3%	3%	6%	6%	6%	2%	2%	2%
Adj. Flow (vph)	484	424	0	0	423	258	537	0	567	0	0	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	484	424	0	0	423	258	537	0	567	0	0	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Right	Left	Right	Left	Left	Right
Median Width(ft)		36			42			12			12	
Link Offset(ft)		0			0			0			36	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		25	15		25	15		9
Number of Detectors	3	3			3	3	3		0			
Detector Template	Left					Right	Left					
Leading Detector (ft)	256	256			256	256	256		0			
Trailing Detector (ft)	-5	-5			-5	-5	-5		0			
Detector 1 Position(ft)	-5	-5			-5	-5	-5		-5			
Detector 1 Size(ft)	50	50			50	50	50		50			
Detector 1 Type	Cl+Ex	Cl+Ex			Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex			
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0			0.0	0.0	0.0		0.0			
Detector 1 Queue (s)	0.0	0.0			0.0	0.0	0.0		0.0			
Detector 1 Delay (s)	0.0	0.0			0.0	0.0	0.0		0.0			
Detector 2 Position(ft)	125	125			125	125	125					
Detector 2 Size(ft)	6	6			6	6	6					
Detector 2 Type	Cl+Ex	Cl+Ex			Cl+Ex	Cl+Ex	Cl+Ex					
Detector 2 Channel												
Detector 2 Extend (s)	0.0	0.0			0.0	0.0	0.0					
Detector 3 Position(ft)	250	250			250	250	250					
Detector 3 Size(ft)	6	6			6	6	6					
Detector 3 Type	Cl+Ex	Cl+Ex			Cl+Ex	Cl+Ex	Cl+Ex					
Detector 3 Channel												
Detector 3 Extend (s)	0.0	0.0			0.0	0.0	0.0					

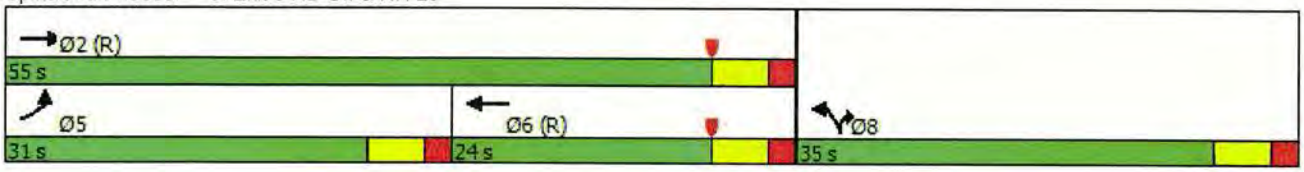
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Type	Prot	NA			NA	Free	Prot		Prot			
Protected Phases	5	2			6		8		8			
Permitted Phases		2			6	Free						
Detector Phase	5	2			6		8		8			
Switch Phase												
Minimum Initial (s)	4.0	16.0			16.0		4.0		4.0			
Minimum Split (s)	10.0	23.0			23.0		11.0		11.0			
Total Split (s)	31.0	55.0			24.0		35.0		35.0			
Total Split (%)	34.4%	61.1%			26.7%		38.9%		38.9%			
Maximum Green (s)	25.0	49.0			18.0		29.0		29.0			
Yellow Time (s)	4.0	4.0			4.0		4.0		4.0			
All-Red Time (s)	2.0	2.0			2.0		2.0		2.0			
Lost Time Adjust (s)	0.0	0.0			0.0		0.0		0.0			
Total Lost Time (s)	6.0	6.0			6.0		6.0		6.0			
Lead/Lag	Lead				Lag							
Lead-Lag Optimize?												
Vehicle Extension (s)	5.0	5.0			5.0		3.0		3.0			
Recall Mode	None	C-Min			C-Min		None		None			
Walk Time (s)		7.0			7.0							
Flash Dont Walk (s)		10.0			10.0							
Pedestrian Calls (#/hr)		0			0							
Act Effct Green (s)	25.0	48.6			17.6	90.0	29.4		29.4			
Actuated g/C Ratio	0.28	0.54			0.20	1.00	0.33		0.33			
v/c Ratio	1.00	0.22			0.62	0.16	0.97		0.74			
Control Delay	52.3	3.9			37.5	0.2	62.7		14.7			
Queue Delay	0.0	0.0			0.0	0.0	0.0		0.0			
Total Delay	52.3	3.9			37.5	0.2	62.7		14.7			
LOS	D	A			D	A	E		B			
Approach Delay		29.7			23.3			38.0				
Approach LOS		C			C			D				
Queue Length 50th (ft)	273	16			115	0	300		76			
Queue Length 95th (ft)	#454	10			165	0	287		62			
Internal Link Dist (ft)		613			462			787			312	
Turn Bay Length (ft)												
Base Capacity (vph)	486	1908			701	1568	556		766			
Starvation Cap Reductn	0	0			0	0	0		0			
Spillback Cap Reductn	0	0			0	0	0		0			
Storage Cap Reductn	0	0			0	0	0		0			
Reduced v/c Ratio	1.00	0.22			0.60	0.16	0.97		0.74			

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 90
Offset: 0 (0%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow, Master Intersection
Natural Cycle: 90
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 1.00
Intersection Signal Delay: 31.5 Intersection LOS: C

Intersection Capacity Utilization 72.6% ICU Level of Service C
Analysis Period (min) 15
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 3: Exit 5 NB Off & NH 28



Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	10	5	210	10	0	10	410	910	120	5	650	120
Future Volume (vph)	10	5	210	10	0	10	410	910	120	5	650	120
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		225	0		0	350		0	100		0
Storage Lanes	0		1	0		0	1		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00	0.95	0.95
Frt			0.850		0.932			0.983			0.977	
Flt Protected		0.967			0.976		0.950			0.950		
Satd. Flow (prot)	0	1801	1583	0	1728	0	1770	3479	0	1770	3458	0
Flt Permitted		0.878			0.834		0.950			0.950		
Satd. Flow (perm)	0	1635	1583	0	1477	0	1770	3479	0	1770	3458	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			228		182			25			24	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		593			447			750			330	
Travel Time (s)		13.5			10.2			17.0			7.5	
Peak Hour Factor	0.92	0.92	0.92	0.25	0.25	0.25	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	2%	2%	2%	0%	0%	0%	2%	2%	2%	2%	2%	2%
Adj. Flow (vph)	11	5	228	40	0	40	446	989	130	5	707	130
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	16	228	0	80	0	446	1119	0	5	837	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	3	3	1	3	1		3	3		3	3	
Detector Template	Left	Thru	Right	Left			Left	Thru		Left	Thru	
Leading Detector (ft)	256	256	45	256	45		256	256		256	256	
Trailing Detector (ft)	-5	-5	-5	-5	-5		-5	-5		-5	-5	
Detector 1 Position(ft)	-5	-5	-5	-5	-5		-5	-5		-5	-5	
Detector 1 Size(ft)	50	50	50	50	50		50	50		50	50	
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(ft)	125	125		125			125	125		125	125	
Detector 2 Size(ft)	6	6		6			6	6		6	6	
Detector 2 Type	Cl+Ex	Cl+Ex		Cl+Ex			Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)	0.0	0.0		0.0			0.0	0.0		0.0	0.0	
Detector 3 Position(ft)	250	250		250			250	250		250	250	
Detector 3 Size(ft)	6	6		6			6	6		6	6	

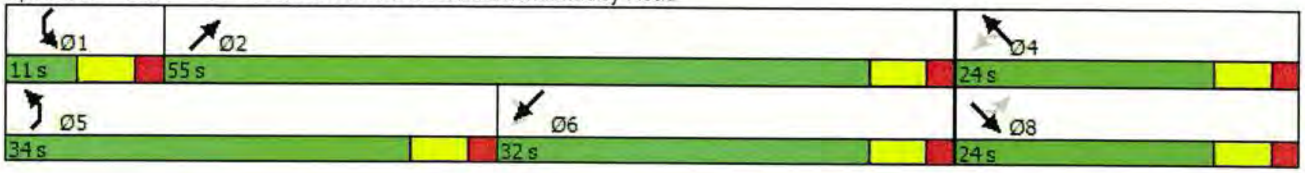
Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Detector 3 Type	Cl+Ex	Cl+Ex		Cl+Ex			Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 3 Channel												
Detector 3 Extend (s)	0.0	0.0		0.0			0.0	0.0		0.0	0.0	
Turn Type	Perm	NA	custom	Perm	NA		Prot	NA		Prot	NA	
Protected Phases		8			4		5	2		1	6	
Permitted Phases	8		6	4								
Detector Phase	8	8	6	4	4		5	2		1	6	
Switch Phase												
Minimum Initial (s)	5.0	5.0	8.0	5.0	5.0		5.0	8.0		5.0	8.0	
Minimum Split (s)	24.0	24.0	24.0	24.0	24.0		24.0	24.0		11.0	24.0	
Total Split (s)	24.0	24.0	32.0	24.0	24.0		34.0	55.0		11.0	32.0	
Total Split (%)	26.7%	26.7%	35.6%	26.7%	26.7%		37.8%	61.1%		12.2%	35.6%	
Maximum Green (s)	18.0	18.0	26.0	18.0	18.0		28.0	49.0		5.0	26.0	
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)		0.0	0.0		0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)		6.0	6.0		6.0		6.0	6.0		6.0	6.0	
Lead/Lag			Lag				Lead	Lag		Lead	Lag	
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None	Min	None	None		None	Min		None	Min	
Walk Time (s)	7.0	7.0	7.0	7.0	7.0		7.0	7.0			7.0	
Flash Dont Walk (s)	11.0	11.0	11.0	11.0	11.0		11.0	11.0			11.0	
Pedestrian Calls (#/hr)	0	0	0	0	0		0	0			0	
Act Effct Green (s)		6.7	25.2		6.7		23.6	55.0		5.2	25.2	
Actuated g/C Ratio		0.09	0.36		0.09		0.33	0.78		0.07	0.36	
v/c Ratio		0.10	0.32		0.26		0.75	0.41		0.04	0.67	
Control Delay		34.6	4.5		2.1		31.3	4.9		35.6	23.7	
Queue Delay		0.0	0.0		0.0		0.0	0.0		0.0	0.0	
Total Delay		34.6	4.5		2.1		31.3	4.9		35.6	23.7	
LOS		C	A		A		C	A		D	C	
Approach Delay		6.5			2.1			12.4			23.8	
Approach LOS		A			A			B			C	
Queue Length 50th (ft)		7	0		0		184	71		2	174	
Queue Length 95th (ft)		26	46		0		298	193		13	254	
Internal Link Dist (ft)		513			367			670			250	
Turn Bay Length (ft)			225				350			100		
Base Capacity (vph)		435	748		526		732	2712		131	1344	
Starvation Cap Reductn		0	0		0		0	0		0	0	
Spillback Cap Reductn		0	0		0		0	0		0	0	
Storage Cap Reductn		0	0		0		0	0		0	0	
Reduced v/c Ratio		0.04	0.30		0.15		0.61	0.41		0.04	0.62	

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 70.7
Natural Cycle: 80
Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.75
Intersection Signal Delay: 15.1 Intersection LOS: B
Intersection Capacity Utilization 71.1% ICU Level of Service C
Analysis Period (min) 15

Splits and Phases: 9: NH 102 & St. Charles Street/Londonderry Road



Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	20	30	5	260	0	40	0	790	130	15	420	0
Future Volume (vph)	20	30	5	260	0	40	0	790	130	15	420	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.988			0.982			0.981				
Flt Protected		0.982			0.959						0.998	
Satd. Flow (prot)	0	1807	0	0	1737	0	0	1726	0	0	1806	0
Flt Permitted		0.875			0.739						0.804	
Satd. Flow (perm)	0	1610	0	0	1339	0	0	1726	0	0	1455	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		5			36			18				
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		356			493			1124			603	
Travel Time (s)		8.1			11.2			25.5			13.7	
Peak Hour Factor	0.60	0.60	0.60	0.96	0.96	0.96	0.89	0.89	0.89	0.86	0.86	0.86
Heavy Vehicles (%)	2%	2%	2%	3%	3%	3%	8%	8%	8%	5%	5%	5%
Adj. Flow (vph)	33	50	8	271	0	42	0	888	146	17	488	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	91	0	0	313	0	0	1034	0	0	505	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0			0	
Link Offset(ft)		-22			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	3	1		3	2			2		3	2	
Detector Template	Left			Left						Left		
Leading Detector (ft)	256	45		256	131			131		256	131	
Trailing Detector (ft)	-5	-5		-5	-5			-5		-5	-5	
Detector 1 Position(ft)	-5	-5		-5	-5			-5		-5	-5	
Detector 1 Size(ft)	50	50		50	50			50		50	50	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex			Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0			0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0			0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0			0.0		0.0	0.0	
Detector 2 Position(ft)	125			125	125			125		125	125	
Detector 2 Size(ft)	6			6	6			6		6	6	
Detector 2 Type	Cl+Ex			Cl+Ex	Cl+Ex			Cl+Ex		Cl+Ex	Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)	0.0			0.0	0.0			0.0		0.0	0.0	
Detector 3 Position(ft)	250			250						250		
Detector 3 Size(ft)	6			6						6		
Detector 3 Type	Cl+Ex			Cl+Ex						Cl+Ex		
Detector 3 Channel												
Detector 3 Extend (s)	0.0			0.0						0.0		

Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Turn Type	Perm	NA		Perm	NA			NA		Perm	NA	
Protected Phases		4			4			2			2	
Permitted Phases	4			4						2		
Detector Phase	4	4		4	4			2		2	2	
Switch Phase												
Minimum Initial (s)	5.0	5.0		5.0	5.0			5.0		5.0	5.0	
Minimum Split (s)	24.0	24.0		24.0	24.0			24.0		24.0	24.0	
Total Split (s)	26.0	26.0		26.0	26.0			64.0		64.0	64.0	
Total Split (%)	28.9%	28.9%		28.9%	28.9%			71.1%		71.1%	71.1%	
Maximum Green (s)	20.0	20.0		20.0	20.0			58.0		58.0	58.0	
Yellow Time (s)	4.0	4.0		4.0	4.0			4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0			2.0		2.0	2.0	
Lost Time Adjust (s)		0.0			0.0			0.0			0.0	
Total Lost Time (s)		6.0			6.0			6.0			6.0	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0		3.0	3.0	
Recall Mode	None	None		None	None			Min		Min	Min	
Walk Time (s)	7.0	7.0		7.0	7.0			7.0		7.0	7.0	
Flash Dont Walk (s)	11.0	11.0		11.0	11.0			11.0		11.0	11.0	
Pedestrian Calls (#/hr)	0	0		0	0			0		0	0	
Act Effct Green (s)		20.0			20.0			55.7			55.7	
Actuated g/C Ratio		0.23			0.23			0.63			0.63	
v/c Ratio		0.25			0.94			0.94			0.55	
Control Delay		29.3			68.7			31.6			11.6	
Queue Delay		0.0			0.0			0.0			0.0	
Total Delay		29.3			68.7			31.6			11.6	
LOS		C			E			C			B	
Approach Delay		29.3			68.7			31.6			11.6	
Approach LOS		C			E			C			B	
Queue Length 50th (ft)		40			159			456			140	
Queue Length 95th (ft)		52			#326			#786			204	
Internal Link Dist (ft)		276			413			1044			523	
Turn Bay Length (ft)												
Base Capacity (vph)		371			333			1148			963	
Starvation Cap Reductn		0			0			0			0	
Spillback Cap Reductn		0			0			0			0	
Storage Cap Reductn		0			0			0			0	
Reduced v/c Ratio		0.25			0.94			0.90			0.52	

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 87.8
Natural Cycle: 90
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.94
Intersection Signal Delay: 32.3 — Intersection LOS: C
Intersection Capacity Utilization 86.3% — ICU Level of Service E

Analysis Period (min) 15

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 10: NH 102 & Fordway/Madden Hill Road

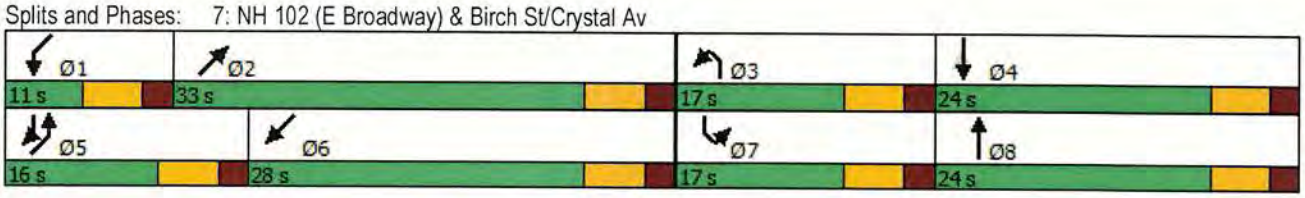
Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	70	320	30	110	370	40	100	450	40	50	340	80
Future Volume (vph)	70	320	30	110	370	40	100	450	40	50	340	80
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	70		0	245		245	390		0	110		0
Storage Lanes	1		0	1		1	1		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.987				0.850		0.988			0.971	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1752	1821	0	1752	1845	1568	1787	1859	0	1787	1827	0
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1752	1821	0	1752	1845	1568	1787	1859	0	1787	1827	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		5				116		5			13	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		361			411			477			530	
Travel Time (s)		8.2			9.3			10.8			12.0	
Peak Hour Factor	0.91	0.91	0.91	0.93	0.93	0.93	0.95	0.95	0.95	0.94	0.94	0.94
Heavy Vehicles (%)	3%	3%	3%	3%	3%	3%	1%	1%	1%	1%	1%	1%
Adj. Flow (vph)	77	352	33	118	398	43	105	474	42	53	362	85
Shared Lane Traffic (%)												
Lane Group Flow (vph)	77	385	0	118	398	43	105	516	0	53	447	0
Turn Type	Prot	NA		Prot	NA	pm+ov	Prot	NA		Prot	NA	
Protected Phases	3	8		7	4	5	5	2		1	6	
Permitted Phases						4						
Detector Phase	3	8		7	4	5	5	2		1	6	
Switch Phase												
Minimum Initial (s)	4.0	5.0		4.0	10.0	4.0	4.0	10.0		4.0	9.0	
Minimum Split (s)	17.0	24.0		11.0	24.0	16.0	16.0	24.0		11.0	24.0	
Total Split (s)	17.0	24.0		17.0	24.0	16.0	16.0	33.0		11.0	28.0	
Total Split (%)	20.0%	28.2%		20.0%	28.2%	18.8%	18.8%	38.8%		12.9%	32.9%	
Maximum Green (s)	11.0	18.0		11.0	18.0	10.0	10.0	27.0		5.0	22.0	
Yellow Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0	2.0	2.0	2.0		2.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Lead/Lag	Lead	Lag		Lead	Lag	Lead	Lead	Lag		Lead	Lag	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes	Yes	Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None	None	None	Max		None	None	
Act Effct Green (s)	8.7	18.4		9.6	19.2	34.2	8.9	29.5		5.1	23.9	
Actuated g/C Ratio	0.11	0.23		0.12	0.24	0.43	0.11	0.37		0.06	0.30	
v/c Ratio	0.40	0.90		0.55	0.89	0.06	0.52	0.74		0.46	0.79	
Control Delay	41.1	57.6		45.2	55.6	0.1	45.2	32.3		52.3	40.7	
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Total Delay	41.1	57.6		45.2	55.6	0.1	45.2	32.3		52.3	40.7	
LOS	D	E		D	E	A	D	C		D	D	
Approach Delay		54.8			49.2			34.4			41.9	

Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Approach LOS		D			D			C			D	
Queue Length 50th (ft)	39	204		60	209	0	53	255		28	227	
Queue Length 95th (ft)	80	#386		113	#400	0	104	#435		#74	#408	
Internal Link Dist (ft)		281			331			397			450	
Turn Bay Length (ft)	70			245		245	390			110		
Base Capacity (vph)	250	430		250	449	772	232	699		116	564	
Starvation Cap Reductn	0	0		0	0	0	0	0		0	0	
Spillback Cap Reductn	0	0		0	0	0	0	0		0	0	
Storage Cap Reductn	0	0		0	0	0	0	0		0	0	
Reduced v/c Ratio	0.31	0.90		0.47	0.89	0.06	0.45	0.74		0.46	0.79	

Intersection Summary	
Area Type: Other	
Cycle Length: 85	
Actuated Cycle Length: 78.7	
Natural Cycle: 85	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.90	
Intersection Signal Delay: 44.4	Intersection LOS: D
Intersection Capacity Utilization 89.4%	ICU Level of Service E
Analysis Period (min) 15	

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 7: NH 102 (E Broadway) & Birch St/Crystal Av



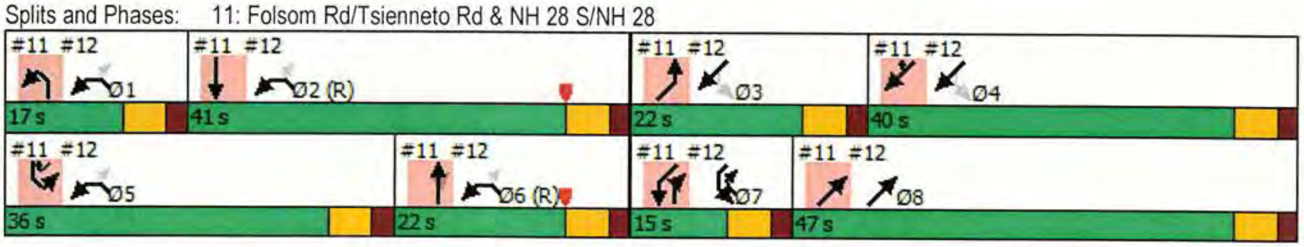
Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	70	340	190	650	530	0	300	480	110	30	250	930
Future Volume (vph)	70	340	190	650	530	0	300	480	110	30	250	930
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	80		180	525		190	190		180	160		0
Storage Lanes	1		1	2		0	2		1	1		2
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95	1.00	0.97	1.00	1.00	1.00	1.00	0.88
Frt			0.850						0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1770	3539	1583	3433	3539	0	3433	1863	1583	1787	1881	2814
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1770	3539	1583	3433	3539	0	3433	1863	1583	1787	1881	2814
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			191						300			136
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		639			801			532			387	
Travel Time (s)		14.5			18.2			12.1			8.8	
Peak Hour Factor	0.92	0.92	0.92	0.94	0.94	0.94	0.96	0.96	0.96	0.95	0.95	0.95
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	1%	1%	1%
Adj. Flow (vph)	76	370	207	691	564	0	313	500	115	32	263	979
Shared Lane Traffic (%)												
Lane Group Flow (vph)	76	370	207	691	564	0	313	500	115	32	263	979
Turn Type	Prot	NA	pm+ov	Prot	NA		Prot	NA	Free	Prot	NA	pt+ov
Protected Phases	1	6	7	5	2		3	8		7	4	4 5
Permitted Phases		6	6		2			8	Free		4	
Detector Phase	1	6	7	5	2		3	8		7	4	4 5
Switch Phase												
Minimum Initial (s)	8.0	8.0	8.0	8.0	8.0		8.0	5.0		8.0	5.0	
Minimum Split (s)	14.0	22.0	14.0	14.0	22.0		14.0	39.0		14.0	39.0	
Total Split (s)	17.0	22.0	15.0	36.0	41.0		22.0	47.0		15.0	40.0	
Total Split (%)	14.2%	18.3%	12.5%	30.0%	34.2%		18.3%	39.2%		12.5%	33.3%	
Maximum Green (s)	11.0	16.0	9.0	30.0	35.0		16.0	41.0		9.0	34.0	
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0		6.0	6.0		6.0	6.0	
Lead/Lag	Lead	Lag	Lead	Lead	Lag		Lead	Lag		Lead	Lag	
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes		Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	C-Max	None	None	C-Max		None	None		None	None	
Walk Time (s)		5.0			5.0			7.0			7.0	
Flash Dont Walk (s)		11.0			11.0			26.0			26.0	
Pedestrian Calls (#/hr)		0			0			0			0	
Act Effct Green (s)	11.0	16.7	31.4	29.3	35.0		16.0	41.3	120.0	8.7	34.0	69.3
Actuated g/C Ratio	0.09	0.14	0.26	0.24	0.29		0.13	0.34	1.00	0.07	0.28	0.58
v/c Ratio	0.47	0.75	0.37	0.83	0.55		0.68	0.78	0.07	0.25	0.49	0.58
Control Delay	61.9	60.4	8.4	56.9	29.1		58.1	45.2	0.1	81.4	27.1	9.7
Queue Delay	0.0	0.0	0.0	0.0	0.0		0.0	2.0	0.0	0.0	1.1	1.4

Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Total Delay	61.9	60.4	8.4	56.9	29.1		58.1	47.2	0.1	81.4	28.2	11.1
LOS	E	E	A	E	C		E	D	A	F	C	B
Approach Delay		44.1			44.4			45.0			16.4	
Approach LOS		D			D			D			B	
Queue Length 50th (ft)	57	147	9	236	143		120	346	0	26	152	283
Queue Length 95th (ft)	109	#214	70	339	190		170	484	0	m44	219	374
Internal Link Dist (ft)		559			721			452			307	
Turn Bay Length (ft)	80		180	525			190		180	160		
Base Capacity (vph)	162	492	558	858	1032		457	641	1583	134	532	1698
Starvation Cap Reductn	0	0	0	0	0		0	0	0	0	109	491
Spillback Cap Reductn	0	0	5	0	0		0	53	0	0	0	0
Storage Cap Reductn	0	0	0	0	0		0	0	0	0	0	0
Reduced v/c Ratio	0.47	0.75	0.37	0.81	0.55		0.68	0.85	0.07	0.24	0.62	0.81

Intersection Summary

Area Type: Other
Cycle Length: 120
Actuated Cycle Length: 120
Offset: 17 (14%), Referenced to phase 2:SBT and 6:NBT, Start of Yellow
Natural Cycle: 100
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.83
Intersection Signal Delay: 35.8 Intersection LOS: D
Intersection Capacity Utilization 79.9% ICU Level of Service D
Analysis Period (min) 15
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 11: Folsom Rd/Tsienneto Rd & NH 28 S/NH 28



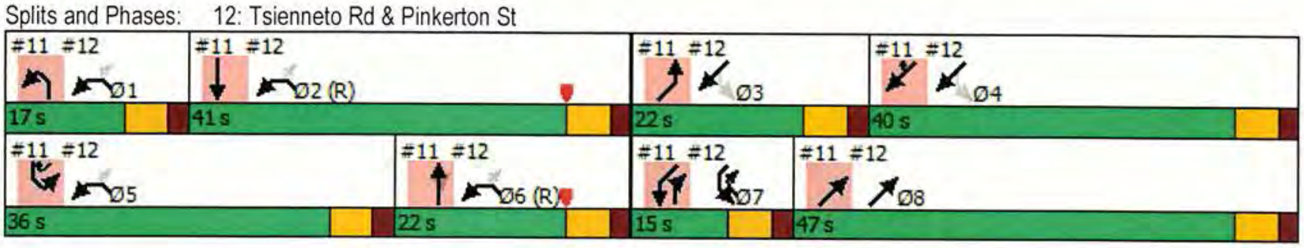
Lane Group	NWL	NWR	NET	NER	SWL	SWT	Ø1	Ø2	Ø3	Ø4	Ø5	Ø6
Lane Configurations												
Traffic Volume (vph)	310	110	800	530	90	920						
Future Volume (vph)	310	110	800	530	90	920						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900						
Storage Length (ft)	90	0		0	175							
Storage Lanes	1	1		1	1							
Taper Length (ft)	25				25							
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95						
Frt		0.850		0.850								
Flt Protected	0.950				0.950							
Satd. Flow (prot)	1787	1599	3574	1599	1787	3574						
Flt Permitted	0.950				0.157							
Satd. Flow (perm)	1787	1599	3574	1599	295	3574						
Right Turn on Red		Yes		Yes								
Satd. Flow (RTOR)		41		416								
Link Speed (mph)	30		30			30						
Link Distance (ft)	403		387			233						
Travel Time (s)	9.2		8.8			5.3						
Peak Hour Factor	0.86	0.86	0.96	0.96	0.85	0.85						
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%						
Adj. Flow (vph)	360	128	833	552	106	1082						
Shared Lane Traffic (%)												
Lane Group Flow (vph)	360	128	833	552	106	1082						
Turn Type	Prot	pm+ov	NA	Free	pm+pt	NA						
Protected Phases	1 2 5 6	7	8		7	3 4	1	2	3	4	5	6
Permitted Phases		1 2 5 6		Free	3 4							
Detector Phase	1 2 5 6	7	8		7	3 4						
Switch Phase												
Minimum Initial (s)		8.0	5.0		8.0		8.0	8.0	8.0	5.0	8.0	8.0
Minimum Split (s)		14.0	39.0		14.0		14.0	22.0	14.0	39.0	14.0	22.0
Total Split (s)		15.0	47.0		15.0		17.0	41.0	22.0	40.0	36.0	22.0
Total Split (%)		12.5%	39.2%		12.5%		14%	34%	18%	33%	30%	18%
Maximum Green (s)		9.0	41.0		9.0		11.0	35.0	16.0	34.0	30.0	16.0
Yellow Time (s)		4.0	4.0		4.0		4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)		2.0	2.0		2.0		2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)		0.0	0.0		0.0							
Total Lost Time (s)		6.0	6.0		6.0							
Lead/Lag		Lead	Lag		Lead		Lead	Lag	Lead	Lag	Lead	Lag
Lead-Lag Optimize?		Yes	Yes		Yes		Yes	Yes	Yes	Yes	Yes	Yes
Vehicle Extension (s)		3.0	3.0		3.0		3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode		None	None		None		None	C-Max	None	None	None	C-Max
Walk Time (s)			7.0					5.0		7.0		5.0
Flash Dont Walk (s)			26.0					11.0		26.0		11.0
Pedestrian Calls (#/hr)			0					0		0		0
Act Effct Green (s)	52.0	66.7	41.3	120.0	56.0	56.0						
Actuated g/C Ratio	0.43	0.56	0.34	1.00	0.47	0.47						
v/c Ratio	0.47	0.14	0.68	0.35	0.43	0.65						
Control Delay	26.6	9.0	41.3	0.4	23.9	26.8						
Queue Delay	0.0	0.0	5.8	0.0	0.0	0.1						

Lane Group	NWL	NWR	NET	NER	SWL	SWT	Ø1	Ø2	Ø3	Ø4	Ø5	Ø6
Total Delay	26.6	9.0	47.0	0.4	23.9	26.9						
LOS	C	A	D	A	C	C						
Approach Delay	22.0		28.4			26.6						
Approach LOS	C		C			C						
Queue Length 50th (ft)	194	30	251	0	45	328						
Queue Length 95th (ft)	265	57	348	m0	75	368						
Internal Link Dist (ft)	323		307			153						
Turn Bay Length (ft)	90				175							
Base Capacity (vph)	774	910	1231	1599	249	1667						
Starvation Cap Reductn	0	0	336	0	0	0						
Spillback Cap Reductn	0	0	0	0	0	74						
Storage Cap Reductn	0	0	0	0	0	0						
Reduced v/c Ratio	0.47	0.14	0.93	0.35	0.43	0.68						

Intersection Summary

Area Type: Other
Cycle Length: 120
Actuated Cycle Length: 120
Offset: 17 (14%), Referenced to phase 2:SBT and 6:NBT, Start of Yellow
Natural Cycle: 100
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.83
Intersection Signal Delay: 26.7 Intersection LOS: C
Intersection Capacity Utilization 61.0% ICU Level of Service B
Analysis Period (min) 15
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 12: Tsienneto Rd & Pinkerton St



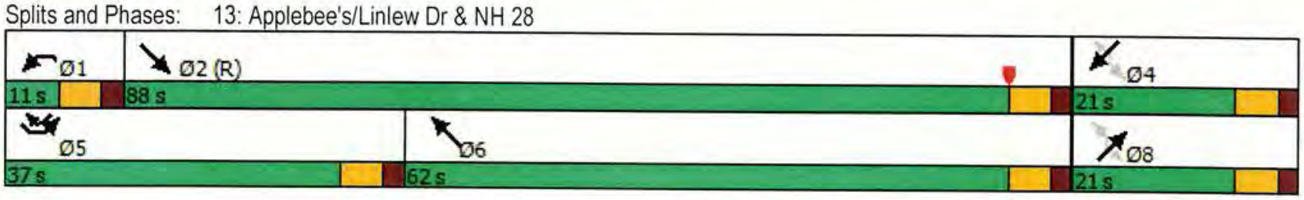
Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	380	1475	5	20	1290	120	15	10	15	10	10	160
Future Volume (vph)	380	1475	5	20	1290	120	15	10	15	10	10	160
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	300		0	115		0	0		0	0		0
Storage Lanes	1		0	1		0	0		1	0		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt					0.987				0.850			0.850
Flt Protected	0.950			0.950				0.971			0.976	
Satd. Flow (prot)	1787	3574	0	1787	3528	0	0	1845	1615	0	1836	1599
Flt Permitted	0.950			0.950				0.799			0.827	
Satd. Flow (perm)	1787	3574	0	1787	3528	0	0	1518	1615	0	1556	1599
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		1			11				136			27
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		439			341			230			387	
Travel Time (s)		10.0			7.8			5.2			8.8	
Peak Hour Factor	0.97	0.97	0.97	0.95	0.95	0.95	0.90	0.90	0.90	0.80	0.80	0.80
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	0%	0%	0%	1%	1%	1%
Adj. Flow (vph)	392	1521	5	21	1358	126	17	11	17	13	13	200
Shared Lane Traffic (%)												
Lane Group Flow (vph)	392	1526	0	21	1484	0	0	28	17	0	26	200
Turn Type	Prot	NA		Prot	NA		Perm	NA	Perm	Perm	NA	pm+ov
Protected Phases	5	2		1	6			8			4	5
Permitted Phases							8		8	4	4	4
Detector Phase	5	2		1	6		8	8	8	4	4	5
Switch Phase												
Minimum Initial (s)	5.0	8.0		5.0	8.0		5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	26.0	63.0		11.0	48.0		21.0	21.0	21.0	21.0	21.0	26.0
Total Split (s)	37.0	88.0		11.0	62.0		21.0	21.0	21.0	21.0	21.0	37.0
Total Split (%)	30.8%	73.3%		9.2%	51.7%		17.5%	17.5%	17.5%	17.5%	17.5%	30.8%
Maximum Green (s)	31.0	82.0		5.0	56.0		15.0	15.0	15.0	15.0	15.0	31.0
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0			0.0	0.0		0.0	0.0
Total Lost Time (s)	6.0	6.0		6.0	6.0			6.0	6.0		6.0	6.0
Lead/Lag	Lead	Lag		Lead	Lag							Lead
Lead-Lag Optimize?	Yes	Yes		Yes	Yes							Yes
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	C-Max		None	Max		None	None	None	None	None	None
Walk Time (s)		7.0			7.0		7.0	7.0	7.0	7.0	7.0	
Flash Dont Walk (s)		11.0			11.0		8.0	8.0	8.0	8.0	8.0	
Pedestrian Calls (#/hr)		0			0		0	0	0	0	0	
Act Effct Green (s)	31.2	101.8		7.0	68.0			7.7	7.7		7.6	40.0
Actuated g/C Ratio	0.26	0.85		0.06	0.57			0.06	0.06		0.06	0.33
v/c Ratio	0.85	0.50		0.20	0.74			0.29	0.07		0.27	0.36
Control Delay	50.6	7.1		67.7	23.0			60.5	0.6		59.3	25.7
Queue Delay	0.0	0.0		0.0	0.0			0.0	0.0		0.0	0.0

Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Total Delay	50.6	7.1		67.7	23.0			60.5	0.6		59.3	25.7
LOS	D	A		E	C			E	A		E	C
Approach Delay		16.0			23.6			37.9			29.6	
Approach LOS		B			C			D			C	
Queue Length 50th (ft)	325	159		17	614			21	0		20	92
Queue Length 95th (ft)	m375	355		m26	720			51	0		43	120
Internal Link Dist (ft)		359			261			150			307	
Turn Bay Length (ft)	300			115								
Base Capacity (vph)	492	3032		103	2002			189	320		194	577
Starvation Cap Reductn	0	0		0	0			0	0		0	0
Spillback Cap Reductn	0	0		0	0			0	0		0	0
Storage Cap Reductn	0	0		0	0			0	0		0	0
Reduced v/c Ratio	0.80	0.50		0.20	0.74			0.15	0.05		0.13	0.35

Intersection Summary

Area Type: Other
Cycle Length: 120
Actuated Cycle Length: 120
Offset: 0 (0%), Referenced to phase 2:SET, Start of Yellow
Natural Cycle: 95
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.85
Intersection Signal Delay: 20.2 Intersection LOS: C
Intersection Capacity Utilization 83.6% ICU Level of Service E
Analysis Period (min) 15
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 13: Applebee's/Linlew Dr & NH 28



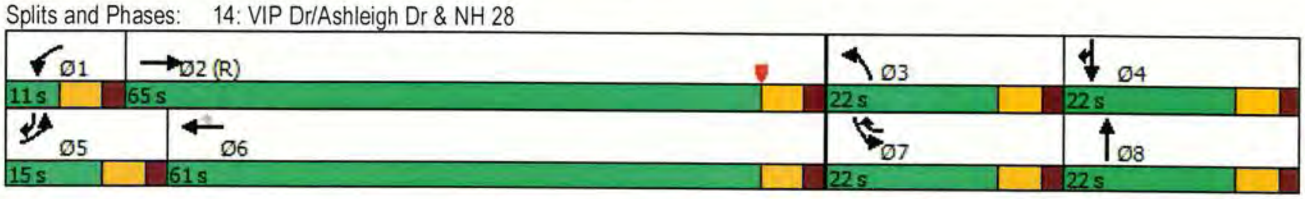
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰↰	↑↱		↰	↑↑	↱	↰	↱		↰	↰↑	↱
Traffic Volume (vph)	150	1550	10	5	1240	410	40	10	10	200	5	280
Future Volume (vph)	150	1550	10	5	1240	410	40	10	10	200	5	280
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200		150	205		150	0		0	325		150
Storage Lanes	2		0	1		1	1		0	1		1
Taper Length (ft)	150			25			25			25		
Lane Util. Factor	0.97	0.95	0.95	1.00	0.95	1.00	1.00	1.00	1.00	0.95	0.95	1.00
Frt		0.999				0.850		0.925				0.850
Flt Protected	0.950			0.950			0.950			0.950	0.955	
Satd. Flow (prot)	3467	3571	0	1770	3539	1583	1805	1758	0	1715	1724	1615
Flt Permitted	0.950			0.950			0.950			0.950	0.450	
Satd. Flow (perm)	3467	3571	0	1770	3539	1583	1805	1758	0	1715	812	1615
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		1				369		13				165
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		877			314			151			476	
Travel Time (s)		19.9			7.1			3.4			10.8	
Peak Hour Factor	0.84	0.84	0.84	0.90	0.90	0.90	0.78	0.78	0.78	0.86	0.86	0.86
Heavy Vehicles (%)	1%	1%	1%	2%	2%	2%	0%	0%	0%	0%	0%	0%
Adj. Flow (vph)	179	1845	12	6	1378	456	51	13	13	233	6	326
Shared Lane Traffic (%)										49%		
Lane Group Flow (vph)	179	1857	0	6	1378	456	51	26	0	119	120	326
Turn Type	Prot	NA		Prot	NA	pm+ov	Prot	NA		Prot	NA	pt+ov
Protected Phases	5	2		1	6	7	3	8		7	4	4 5
Permitted Phases		2			6	6		8				
Detector Phase	5	2		1	6	7	3	8		7	4	4 5
Switch Phase												
Minimum Initial (s)	5.0	8.0		5.0	8.0	8.0	5.0	5.0		8.0	8.0	
Minimum Split (s)	11.0	53.0		11.0	50.0	22.0	22.0	22.0		22.0	22.0	
Total Split (s)	15.0	65.0		11.0	61.0	22.0	22.0	22.0		22.0	22.0	
Total Split (%)	12.5%	54.2%		9.2%	50.8%	18.3%	18.3%	18.3%		18.3%	18.3%	
Maximum Green (s)	9.0	59.0		5.0	55.0	16.0	16.0	16.0		16.0	16.0	
Yellow Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0	2.0	2.0	2.0		2.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Lead/Lag	Lead	Lag		Lead	Lag	Lead	Lead	Lag		Lead	Lag	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes	Yes	Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Recall Mode	None	C-Max		None	None	None	None	None		None	None	
Walk Time (s)											5.0	
Flash Dont Walk (s)											11.0	
Pedestrian Calls (#/hr)											0	
Act Effct Green (s)	9.1	70.1		5.1	57.2	85.1	8.8	12.3		21.9	21.9	38.3
Actuated g/C Ratio	0.08	0.58		0.04	0.48	0.71	0.07	0.10		0.18	0.18	0.32
v/c Ratio	0.68	0.89		0.08	0.82	0.37	0.39	0.14		0.38	0.38	0.52
Control Delay	67.6	29.2		57.4	24.3	0.8	60.8	30.8		50.6	50.6	20.1
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Total Delay	67.6	29.2		57.4	24.3	0.8	60.8	30.8		50.6	50.6	20.1
LOS	E	C		E	C	A	E	C		D	D	C
Approach Delay		32.5			18.6			50.7			33.0	
Approach LOS		C			B			D			C	
Queue Length 50th (ft)	71	622		5	234	2	38	9		93	94	98
Queue Length 95th (ft)	102	#856		m10	365	4	67	30		150	151	181
Internal Link Dist (ft)		797			234			71			396	
Turn Bay Length (ft)	200			205		150				325		150
Base Capacity (vph)	267	2087		75	1687	1235	240	253		320	314	622
Starvation Cap Reductn	0	0		0	0	0	0	0		0	0	0
Spillback Cap Reductn	0	0		0	0	0	0	0		0	0	0
Storage Cap Reductn	0	0		0	0	0	0	0		0	0	0
Reduced v/c Ratio	0.67	0.89		0.08	0.82	0.37	0.21	0.10		0.37	0.38	0.52

Intersection Summary

Area Type: Other
Cycle Length: 120
Actuated Cycle Length: 120
Offset: 0 (0%), Referenced to phase 2:EBT, Start of Yellow
Natural Cycle: 120
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.89
Intersection Signal Delay: 27.2 Intersection LOS: C
Intersection Capacity Utilization 74.7% ICU Level of Service D
Analysis Period (min) 15
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 14: VIP Dr/Ashleigh Dr & NH 28



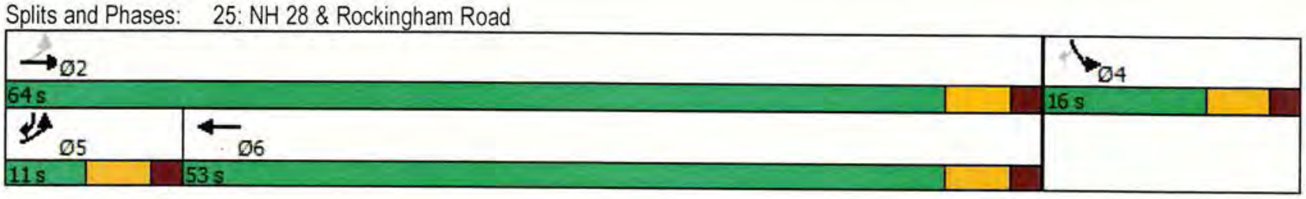
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	140	1360	1415	270	120	70
Future Volume (vph)	140	1360	1415	270	120	70
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200			150	360	0
Storage Lanes	1			0	1	1
Taper Length (ft)	25				25	
Lane Util. Factor	1.00	0.95	0.95	0.95	1.00	1.00
Frt			0.976			0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1770	3539	3454	0	1770	1583
Flt Permitted	0.079				0.950	
Satd. Flow (perm)	147	3539	3454	0	1770	1583
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			48			32
Link Speed (mph)		30	30		30	
Link Distance (ft)		463	580		704	
Travel Time (s)		10.5	13.2		16.0	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	152	1478	1538	293	130	76
Shared Lane Traffic (%)						
Lane Group Flow (vph)	152	1478	1831	0	130	76
Turn Type	pm+pt	NA	NA		Prot	pm+ov
Protected Phases	5	2	6		4	5
Permitted Phases	2					4
Detector Phase	5	2	6		4	5
Switch Phase						
Minimum Initial (s)	5.0	5.0	5.0		5.0	5.0
Minimum Split (s)	11.0	20.0	20.0		11.0	11.0
Total Split (s)	11.0	64.0	53.0		16.0	11.0
Total Split (%)	13.8%	80.0%	66.3%		20.0%	13.8%
Maximum Green (s)	5.0	58.0	47.0		10.0	5.0
Yellow Time (s)	4.0	4.0	4.0		4.0	4.0
All-Red Time (s)	2.0	2.0	2.0		2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0		0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0		6.0	6.0
Lead/Lag	Lead		Lag			Lead
Lead-Lag Optimize?	Yes		Yes			Yes
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Recall Mode	None	None	None		None	None
Act Effct Green (s)	55.7	57.5	44.2		9.3	16.9
Actuated g/C Ratio	0.76	0.78	0.60		0.13	0.23
v/c Ratio	0.67	0.53	0.87		0.59	0.20
Control Delay	27.5	5.4	19.2		44.9	16.4
Queue Delay	0.0	0.0	0.0		0.0	0.0
Total Delay	27.5	5.4	19.2		44.9	16.4
LOS	C	A	B		D	B
Approach Delay		7.5	19.2		34.4	
Approach LOS		A	B		C	

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Queue Length 50th (ft)	21	148	372		62	17
Queue Length 95th (ft)	#111	194	#516		#126	49
Internal Link Dist (ft)		383	500		624	
Turn Bay Length (ft)	200				360	
Base Capacity (vph)	226	2764	2308		249	387
Starvation Cap Reductn	0	0	0		0	0
Spillback Cap Reductn	0	0	0		0	0
Storage Cap Reductn	0	0	0		0	0
Reduced v/c Ratio	0.67	0.53	0.79		0.52	0.20

Intersection Summary

Area Type: Other
Cycle Length: 80
Actuated Cycle Length: 73.6
Natural Cycle: 65
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.87
Intersection Signal Delay: 14.8 Intersection LOS: B
Intersection Capacity Utilization 77.1% ICU Level of Service D
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 25: NH 28 & Rockingham Road



Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations	↰	↑↱		↰	↑	↱	↰	↑↑↱		↰	↑↑↱	
Traffic Volume (vph)	30	70	30	50	40	210	90	840	70	20	360	40
Future Volume (vph)	30	70	30	50	40	210	90	840	70	20	360	40
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	145		110	280		280	360		0	120		0
Storage Lanes	1		0	1		1	1		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00	0.95	0.95
Frt		0.955				0.850		0.988			0.985	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1770	1779	0	1787	1881	1599	1805	3567	0	1805	3556	0
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1770	1779	0	1787	1881	1599	1805	3567	0	1805	3556	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		23				221		11			15	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		481			490			479			371	
Travel Time (s)		10.9			11.1			10.9			8.4	
Peak Hour Factor	0.99	0.99	0.99	0.95	0.95	0.95	0.89	0.89	0.89	0.93	0.93	0.93
Heavy Vehicles (%)	2%	2%	2%	1%	1%	1%	0%	0%	0%	0%	0%	0%
Adj. Flow (vph)	30	71	30	53	42	221	101	944	79	22	387	43
Shared Lane Traffic (%)												
Lane Group Flow (vph)	30	101	0	53	42	221	101	1023	0	22	430	0
Turn Type	Prot	NA		Prot	NA	pt+ov	Prot	NA		Prot	NA	
Protected Phases	1	6		5	2	2 3	3	8		7	4	
Permitted Phases		6			2							
Detector Phase	1	6		5	2	2 3	3	8		7	4	
Switch Phase												
Minimum Initial (s)	8.0	8.0		8.0	8.0		8.0	8.0		8.0	8.0	
Minimum Split (s)	14.0	20.0		14.0	20.0		14.0	28.0		14.0	14.0	
Total Split (s)	14.0	20.0		14.0	20.0		15.0	32.0		14.0	31.0	
Total Split (%)	17.5%	25.0%		17.5%	25.0%		18.8%	40.0%		17.5%	38.8%	
Maximum Green (s)	8.0	14.0		8.0	14.0		9.0	26.0		8.0	25.0	
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lag		Lead	Lag	
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	Max		None	None		None	None	
Walk Time (s)								7.0				
Flash Dont Walk (s)								15.0				
Pedestrian Calls (#/hr)								0				
Act Effct Green (s)	8.4	13.5		8.4	16.4	31.5	8.9	26.1		8.4	15.4	
Actuated g/C Ratio	0.13	0.21		0.13	0.26	0.49	0.14	0.41		0.13	0.24	
v/c Ratio	0.13	0.26		0.23	0.09	0.25	0.40	0.70		0.09	0.50	
Control Delay	32.3	23.5		33.2	24.9	3.7	35.3	22.0		32.2	22.3	
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	

Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Total Delay	32.3	23.5		33.2	24.9	3.7	35.3	22.0		32.2	22.3	
LOS	C	C		C	C	A	D	C		C	C	
Approach Delay		25.5			11.4			23.2			22.8	
Approach LOS		C			B			C			C	
Queue Length 50th (ft)	10	27		18	10	0	35	145		7	73	
Queue Length 95th (ft)	39	77		59	45	43	95	#355		32	123	
Internal Link Dist (ft)		401			410			399			291	
Turn Bay Length (ft)	145			280		280	360			120		
Base Capacity (vph)	232	425		234	481	912	266	1539		236	1465	
Starvation Cap Reductn	0	0		0	0	0	0	0		0	0	
Spillback Cap Reductn	0	0		0	0	0	0	0		0	0	
Storage Cap Reductn	0	0		0	0	0	0	0		0	0	
Reduced v/c Ratio	0.13	0.24		0.23	0.09	0.24	0.38	0.66		0.09	0.29	

Intersection Summary

Area Type: Other
Cycle Length: 80
Actuated Cycle Length: 64
Natural Cycle: 80
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.70
Intersection Signal Delay: 21.4 Intersection LOS: C
Intersection Capacity Utilization 56.6% ICU Level of Service B
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 18: Tsienneto Rd & NH 28 Byp NB/NH 28 Byp SB

Ø1	Ø2	Ø3	Ø4
14 s	20 s	15 s	31 s
Ø5	Ø6	Ø7	Ø8
14 s	20 s	14 s	32 s

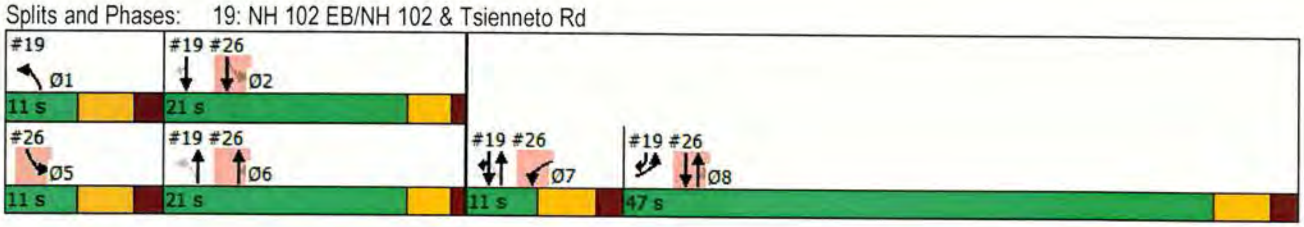
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR	Ø2	Ø5	Ø6	Ø7
Lane Configurations										
Traffic Volume (vph)	710	5	10	260	200	340				
Future Volume (vph)	710	5	10	260	200	340				
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900				
Storage Length (ft)	200	0	100			90				
Storage Lanes	0	0	1			1				
Taper Length (ft)	25		25							
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00				
Frt	0.999					0.850				
Flt Protected	0.953		0.950							
Satd. Flow (prot)	1791	0	1770	1863	1845	1568				
Flt Permitted	0.953		0.516							
Satd. Flow (perm)	1791	0	961	1863	1845	1568				
Right Turn on Red		Yes				Yes				
Satd. Flow (RTOR)	1					382				
Link Speed (mph)	30			30	30					
Link Distance (ft)	392			704	263					
Travel Time (s)	8.9			16.0	6.0					
Peak Hour Factor	0.90	0.90	0.87	0.87	0.89	0.89				
Heavy Vehicles (%)	1%	1%	2%	2%	3%	3%				
Adj. Flow (vph)	789	6	11	299	225	382				
Shared Lane Traffic (%)										
Lane Group Flow (vph)	795	0	11	299	225	382				
Turn Type	Prot		pm+pt	NA	NA	custom				
Protected Phases	8		1	6 7	2 7	7 8	2	5	6	7
Permitted Phases			6 7			2				
Detector Phase	8		1	6 7	2 7	7 8				
Switch Phase										
Minimum Initial (s)	5.0		5.0				5.0	5.0	5.0	5.0
Minimum Split (s)	26.5		11.0				9.0	11.0	9.0	11.0
Total Split (s)	47.0		11.0				21.0	11.0	21.0	11.0
Total Split (%)	52.2%		12.2%				23%	12%	23%	12%
Maximum Green (s)	41.0		5.0				17.0	5.0	17.0	5.0
Yellow Time (s)	4.0		4.0				3.0	4.0	3.0	4.0
All-Red Time (s)	2.0		2.0				1.0	2.0	1.0	2.0
Lost Time Adjust (s)	0.0		0.0							
Total Lost Time (s)	6.0		6.0							
Lead/Lag	Lag		Lead				Lag	Lead	Lag	Lead
Lead-Lag Optimize?	Yes		Yes				Yes	Yes	Yes	Yes
Vehicle Extension (s)	3.0		3.0				3.0	3.0	3.0	3.0
Recall Mode	None		None				Min	None	Min	None
Act Effct Green (s)	41.2		27.1	27.3	29.3	79.5				
Actuated g/C Ratio	0.50		0.33	0.33	0.35	0.96				
v/c Ratio	0.89		0.03	0.49	0.34	0.25				
Control Delay	34.8		16.5	26.2	24.5	0.4				
Queue Delay	0.0		0.0	0.0	1.3	0.0				
Total Delay	34.8		16.5	26.2	25.8	0.4				
LOS	C		B	C	C	A				
Approach Delay	34.8			25.9	9.8					

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR	Ø2	Ø5	Ø6	Ø7
Approach LOS	C			C	A					
Queue Length 50th (ft)	318		4	111	87	0				
Queue Length 95th (ft)	#686		13	209	141	1				
Internal Link Dist (ft)	312			624	183					
Turn Bay Length (ft)	200		100			90				
Base Capacity (vph)	893		364	614	653	1523				
Starvation Cap Reductn	0		0	0	252	166				
Spillback Cap Reductn	1		0	0	0	0				
Storage Cap Reductn	0		0	0	0	0				
Reduced v/c Ratio	0.89		0.03	0.49	0.56	0.28				

Intersection Summary	
Area Type: Other	
Cycle Length: 90	
Actuated Cycle Length: 82.6	
Natural Cycle: 90	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.89	
Intersection Signal Delay: 24.3	Intersection LOS: C
Intersection Capacity Utilization 61.7%	ICU Level of Service B
Analysis Period (min) 15	

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 19: NH 102 EB/NH 102 & Tsienneto Rd



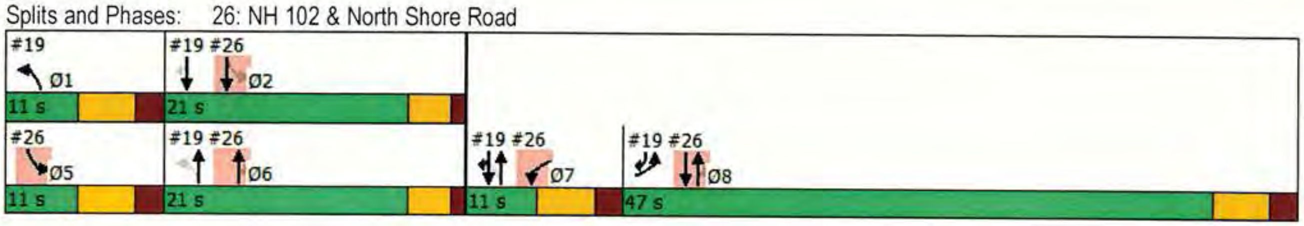
Lane Group	WBL	WBR	NBT	NBR	SBL	SBT	Ø1	Ø2	Ø6	Ø8
Lane Configurations										
Traffic Volume (vph)	50	10	810	160	20	490				
Future Volume (vph)	50	10	810	160	20	490				
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900				
Storage Length (ft)	0	0		90	100					
Storage Lanes	1	0		1	1					
Taper Length (ft)	25				25					
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00				
Frt	0.972			0.850						
Flt Protected	0.962				0.950					
Satd. Flow (prot)	1763	0	1900	1615	1805	1900				
Flt Permitted	0.962				0.219					
Satd. Flow (perm)	1763	0	1900	1615	416	1900				
Right Turn on Red		Yes		Yes						
Satd. Flow (RTOR)	11			123						
Link Speed (mph)	30		30			30				
Link Distance (ft)	524		263			288				
Travel Time (s)	11.9		6.0			6.5				
Peak Hour Factor	0.87	0.67	0.95	0.84	0.73	0.96				
Heavy Vehicles (%)	1%	0%	0%	0%	0%	0%				
Adj. Flow (vph)	57	15	853	190	27	510				
Shared Lane Traffic (%)										
Lane Group Flow (vph)	72	0	853	190	27	510				
Turn Type	Prot		NA	Perm	custom	NA				
Protected Phases	7		6 8		5	2 8	1	2	6	8
Permitted Phases				6 8	2					
Detector Phase	7		6 8	6 8	5	2 8				
Switch Phase										
Minimum Initial (s)	5.0				5.0		5.0	5.0	5.0	5.0
Minimum Split (s)	11.0				11.0		11.0	9.0	9.0	26.5
Total Split (s)	11.0				11.0		11.0	21.0	21.0	47.0
Total Split (%)	12.2%				12.2%		12%	23%	23%	52%
Maximum Green (s)	5.0				5.0		5.0	17.0	17.0	41.0
Yellow Time (s)	4.0				4.0		4.0	3.0	3.0	4.0
All-Red Time (s)	2.0				2.0		2.0	1.0	1.0	2.0
Lost Time Adjust (s)	0.0				0.0					
Total Lost Time (s)	6.0				6.0					
Lead/Lag	Lead				Lead		Lead	Lag	Lag	Lag
Lead-Lag Optimize?	Yes				Yes		Yes	Yes	Yes	Yes
Vehicle Extension (s)	3.0				3.0		3.0	3.0	3.0	3.0
Recall Mode	None				None		None	Min	Min	None
Act Effct Green (s)	5.0		62.0	62.0	17.2	64.8				
Actuated g/C Ratio	0.06		0.75	0.75	0.21	0.78				
v/c Ratio	0.62		0.60	0.15	0.16	0.34				
Control Delay	58.9		2.6	0.7	26.2	3.0				
Queue Delay	0.0		1.3	0.4	0.0	0.0				
Total Delay	58.9		3.8	1.1	26.2	3.0				
LOS	E		A	A	C	A				
Approach Delay	58.9		3.3			4.2				

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT	Ø1	Ø2	Ø6	Ø8
Approach LOS	E		A			A				
Queue Length 50th (ft)	30		17	0	11	44				
Queue Length 95th (ft)	#96		m77	m2	25	65				
Internal Link Dist (ft)	444		183			208				
Turn Bay Length (ft)				90	100					
Base Capacity (vph)	117		1445	1258	170	1509				
Starvation Cap Reductn	0		359	686	0	0				
Spillback Cap Reductn	0		0	0	0	16				
Storage Cap Reductn	0		0	0	0	0				
Reduced v/c Ratio	0.62		0.79	0.33	0.16	0.34				

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 82.6
Natural Cycle: 90
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.89
Intersection Signal Delay: 6.0 — Intersection LOS: A
Intersection Capacity Utilization 55.1% — ICU Level of Service B
Analysis Period (min) 15
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 26: NH 102 & North Shore Road



APPENDIX S-1: 2040 ALTERNATIVE F INTERSECTION CAPACITY ANALYSES – HCM 2000 PRINTOUTS – AM PEAK HOUR

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	0	1355	685	0	855	805
Future Volume (vph)	0	1355	685	0	855	805
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	16	12
Total Lost time (s)		6.0	6.0		6.0	6.0
Lane Util. Factor		0.95	0.95		1.00	0.88
Frt		1.00	1.00		1.00	0.85
Flt Protected		1.00	1.00		0.95	1.00
Satd. Flow (prot)		3471	3406		1930	2682
Flt Permitted		1.00	1.00		0.95	1.00
Satd. Flow (perm)		3471	3406		1930	2682
Peak-hour factor, PHF	0.93	0.93	0.88	0.88	0.89	0.89
Adj. Flow (vph)	0	1457	778	0	961	904
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	1457	778	0	961	904
Heavy Vehicles (%)	4%	4%	6%	6%	6%	6%
Turn Type		NA	NA		Prot	Prot
Protected Phases		2	6		4	4
Permitted Phases						
Actuated Green, G (s)		29.0	29.0		34.0	34.0
Effective Green, g (s)		29.0	29.0		34.0	34.0
Actuated g/C Ratio		0.39	0.39		0.45	0.45
Clearance Time (s)		6.0	6.0		6.0	6.0
Vehicle Extension (s)		3.0	3.0		3.0	3.0
Lane Grp Cap (vph)		1342	1316		874	1215
v/s Ratio Prot		c0.42	0.23		c0.50	0.34
v/s Ratio Perm						
v/c Ratio		1.09	0.59		1.10	0.74
Uniform Delay, d1		23.0	18.3		20.5	16.9
Progression Factor		1.01	0.94		1.00	1.00
Incremental Delay, d2		44.9	0.2		61.4	2.5
Delay (s)		68.1	17.3		81.9	19.4
Level of Service		E	B		F	B
Approach Delay (s)		68.1	17.3		51.6	
Approach LOS		E	B		D	

Intersection Summary			
HCM 2000 Control Delay	51.0	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	1.09		
Actuated Cycle Length (s)	75.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	96.8%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
2 ~~8~~: NH 102 & Exit 4 NB Off

01/04/2018

Movement	NBL2	NBL	NBR	SEL	SER	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations											
Traffic Volume (vph)	455	0	365	0	0	1165	1045	0	0	1295	1155
Future Volume (vph)	455	0	365	0	0	1165	1045	0	0	1295	1155
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0		6.0			6.0	6.0			6.0	4.0
Lane Util. Factor	0.97		0.88			0.97	0.95			0.95	1.00
Frt	1.00		0.85			1.00	1.00			1.00	0.85
Flt Protected	0.95		1.00			0.95	1.00			1.00	1.00
Satd. Flow (prot)	3242		2632			3335	3438			3505	1568
Flt Permitted	0.95		1.00			0.95	1.00			1.00	1.00
Satd. Flow (perm)	3242		2632			3335	3438			3505	1568
Peak-hour factor, PHF	0.88	0.88	0.88	0.92	0.92	0.94	0.94	0.94	0.92	0.92	0.92
Adj. Flow (vph)	517	0	415	0	0	1239	1112	0	0	1408	1255
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	517	0	415	0	0	1239	1112	0	0	1408	1255
Heavy Vehicles (%)	8%	8%	8%	2%	2%	5%	5%	5%	3%	3%	3%
Turn Type	Prot		Prot			Prot	NA			NA	Free
Protected Phases	8		8			5	2			6	
Permitted Phases											Free
Actuated Green, G (s)	22.0		22.0			52.0	116.0			58.0	150.0
Effective Green, g (s)	22.0		22.0			52.0	116.0			58.0	150.0
Actuated g/C Ratio	0.15		0.15			0.35	0.77			0.39	1.00
Clearance Time (s)	6.0		6.0			6.0	6.0			6.0	
Vehicle Extension (s)	3.0		3.0			3.0	3.0			3.0	
Lane Grp Cap (vph)	475		386			1156	2658			1355	1568
v/s Ratio Prot	c0.16		0.16			c0.37	0.32			c0.40	
v/s Ratio Perm											0.80
v/c Ratio	1.09		1.08			1.07	0.42			1.04	0.80
Uniform Delay, d1	64.0		64.0			49.0	5.7			46.0	0.0
Progression Factor	1.00		1.00			0.84	0.96			1.00	1.00
Incremental Delay, d2	67.3		67.3			34.3	0.0			35.2	4.4
Delay (s)	131.3		131.3			75.5	5.5			81.2	4.4
Level of Service	F		F			E	A			F	A
Approach Delay (s)		131.3		0.0			42.4			45.0	
Approach LOS		F		A			D			D	

Intersection Summary			
HCM 2000 Control Delay	57.5	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.06		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	98.0%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
3 ~~2~~: Exit 5 SB On/Exit 5 SB Off & NH 28 12/28/2017

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑	↱	↰	↑↑					↰↰		↱
Traffic Volume (vph)	0	795	360	390	615	0	0	0	0	495	0	500
Future Volume (vph)	0	795	360	390	615	0	0	0	0	495	0	500
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0	4.0	6.0	6.0					6.0		6.0
Lane Util. Factor		0.95	1.00	1.00	0.95					0.97		1.00
Frt		1.00	0.85	1.00	1.00					1.00		0.85
Flt Protected		1.00	1.00	0.95	1.00					0.95		1.00
Satd. Flow (prot)		3167	1417	1687	3374					3303		1524
Flt Permitted		1.00	1.00	0.95	1.00					0.95		1.00
Satd. Flow (perm)		3167	1417	1687	3374					3303		1524
Peak-hour factor, PHF	0.92	0.92	0.92	0.73	0.73	0.73	0.92	0.92	0.92	0.74	0.74	0.74
Adj. Flow (vph)	0	864	391	534	842	0	0	0	0	669	0	676
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	124
Lane Group Flow (vph)	0	864	391	534	842	0	0	0	0	669	0	552
Heavy Vehicles (%)	14%	14%	14%	7%	7%	7%	2%	2%	2%	6%	6%	6%
Turn Type		NA	Free	Prot	NA					Prot		Prot
Protected Phases		2		1	6					4		4
Permitted Phases			Free									
Actuated Green, G (s)		35.0	130.0	38.0	79.0					39.0		39.0
Effective Green, g (s)		35.0	130.0	38.0	79.0					39.0		39.0
Actuated g/C Ratio		0.27	1.00	0.29	0.61					0.30		0.30
Clearance Time (s)		6.0		6.0	6.0					6.0		6.0
Vehicle Extension (s)		5.0		3.0	5.0					3.0		3.0
Lane Grp Cap (vph)		852	1417	493	2050					990		457
v/s Ratio Prot		c0.27		c0.32	0.25					0.20		c0.36
v/s Ratio Perm			0.28									
v/c Ratio		1.01	0.28	1.08	0.41					0.68		1.21
Uniform Delay, d1		47.5	0.0	46.0	13.3					39.9		45.5
Progression Factor		1.00	1.00	0.31	0.08					1.00		1.00
Incremental Delay, d2		34.4	0.5	60.7	0.3					1.8		112.7
Delay (s)		81.9	0.5	74.8	1.3					41.8		158.2
Level of Service		F	A	E	A					D		F
Approach Delay (s)		56.5			29.8			0.0			100.3	
Approach LOS		E			C			A			F	

Intersection Summary			
HCM 2000 Control Delay	62.1	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.10		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	85.2%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑			↑↑	↱	↰		↱			
Traffic Volume (vph)	605	685	0	0	625	790	380	0	160	0	0	0
Future Volume (vph)	605	685	0	0	625	790	380	0	160	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0			6.0	4.0	6.0		6.0			
Lane Util. Factor	1.00	0.95			0.95	1.00	1.00		1.00			
Frt	1.00	1.00			1.00	0.85	1.00		0.85			
Flt Protected	0.95	1.00			1.00	1.00	0.95		1.00			
Satd. Flow (prot)	1641	3282			3438	1538	1656		1482			
Flt Permitted	0.95	1.00			1.00	1.00	0.95		1.00			
Satd. Flow (perm)	1641	3282			3438	1538	1656		1482			
Peak-hour factor, PHF	0.87	0.87	0.87	0.90	0.90	0.90	0.78	0.78	0.78	0.92	0.92	0.92
Adj. Flow (vph)	695	787	0	0	694	878	487	0	205	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	128	0	0	0
Lane Group Flow (vph)	695	787	0	0	694	878	487	0	77	0	0	0
Heavy Vehicles (%)	10%	10%	10%	5%	5%	5%	9%	9%	9%	2%	2%	2%
Turn Type	Prot	NA			NA	Free	Prot		Prot			
Protected Phases	5	2			6		8		8			
Permitted Phases		2			6	Free						
Actuated Green, G (s)	51.0	83.0			26.0	130.0	35.0		35.0			
Effective Green, g (s)	51.0	83.0			26.0	130.0	35.0		35.0			
Actuated g/C Ratio	0.39	0.64			0.20	1.00	0.27		0.27			
Clearance Time (s)	6.0	6.0			6.0		6.0		6.0			
Vehicle Extension (s)	5.0	5.0			5.0		3.0		3.0			
Lane Grp Cap (vph)	643	2095			687	1538	445		399			
v/s Ratio Prot	c0.42	0.24			c0.20		c0.29		0.05			
v/s Ratio Perm						0.57						
v/c Ratio	1.08	0.38			1.01	0.57	1.09		0.19			
Uniform Delay, d1	39.5	11.2			52.0	0.0	47.5		36.6			
Progression Factor	0.22	0.00			1.00	1.00	1.00		1.00			
Incremental Delay, d2	44.0	0.3			36.9	1.5	70.7		0.2			
Delay (s)	52.6	0.3			88.9	1.5	118.2		36.9			
Level of Service	D	A			F	A	F		D			
Approach Delay (s)		24.9			40.1			94.1			0.0	
Approach LOS		C			D			F			A	

Intersection Summary			
HCM 2000 Control Delay	44.0	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	1.07		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	85.2%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	10	0	120	0	1	0	160	780	5	10	1550	40
Future Volume (vph)	10	0	120	0	1	0	160	780	5	10	1550	40
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0	6.0		6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor		1.00	1.00		1.00		1.00	0.95		1.00	0.95	
Frt		1.00	0.85		1.00		1.00	1.00		1.00	1.00	
Flt Protected		0.95	1.00		1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1770	1583		1900		1770	3536		1770	3526	
Flt Permitted		1.00	1.00		1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)		1863	1583		1900		1770	3536		1770	3526	
Peak-hour factor, PHF	0.92	0.92	0.92	0.25	0.25	0.25	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	11	0	130	0	4	0	174	848	5	11	1685	43
RTOR Reduction (vph)	0	0	48	0	0	0	0	0	0	0	1	0
Lane Group Flow (vph)	0	11	82	0	4	0	174	853	0	11	1727	0
Heavy Vehicles (%)	2%	2%	2%	0%	0%	0%	2%	2%	2%	2%	2%	2%
Turn Type	Perm	NA	custom		NA		Prot	NA		Prot	NA	
Protected Phases		8			4		5	2		1	6	
Permitted Phases	8		6	4								
Actuated Green, G (s)		1.3	54.2		1.3		12.6	66.0		0.8	54.2	
Effective Green, g (s)		1.3	54.2		1.3		12.6	66.0		0.8	54.2	
Actuated g/C Ratio		0.02	0.63		0.02		0.15	0.77		0.01	0.63	
Clearance Time (s)		6.0	6.0		6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)		3.0	3.0		3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		28	996		28		259	2710		16	2219	
v/s Ratio Prot					0.00		c0.10	0.24		0.01	c0.49	
v/s Ratio Perm		c0.01	0.05									
v/c Ratio		0.39	0.08		0.14		0.67	0.31		0.69	0.78	
Uniform Delay, d1		42.0	6.2		41.9		34.8	3.1		42.5	11.6	
Progression Factor		1.00	1.00		1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		8.9	0.0		2.3		6.7	0.1		80.1	1.8	
Delay (s)		50.9	6.3		44.2		41.5	3.2		122.6	13.4	
Level of Service		D	A		D		D	A		F	B	
Approach Delay (s)		9.7			44.2			9.7			14.1	
Approach LOS		A			D			A			B	

Intersection Summary			
HCM 2000 Control Delay	12.3	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	86.1	Sum of lost time (s)	18.0
Intersection Capacity Utilization	77.9%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	5	10	5	360	0	30	0	540	180	5	810	0
Future Volume (vph)	5	10	5	360	0	30	0	540	180	5	810	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0		6.0		4.5		6.0	6.0		6.0	
Lane Util. Factor		1.00		1.00		1.00		1.00	1.00		1.00	
Frt		0.97		1.00		0.85		1.00	0.85		1.00	
Flt Protected		0.99		0.95		1.00		1.00	1.00		1.00	
Satd. Flow (prot)		1780		1752		1568		1759	1495		1809	
Flt Permitted		0.99		0.74		1.00		1.00	1.00		1.00	
Satd. Flow (perm)		1780		1357		1568		1759	1495		1803	
Peak-hour factor, PHF	0.60	0.60	0.60	0.96	0.96	0.96	0.89	0.89	0.89	0.86	0.86	0.86
Adj. Flow (vph)	8	17	8	375	0	31	0	607	202	6	942	0
RTOR Reduction (vph)	0	6	0	0	0	21	0	0	67	0	0	0
Lane Group Flow (vph)	0	27	0	375	0	10	0	607	135	0	948	0
Heavy Vehicles (%)	2%	2%	2%	3%	3%	3%	8%	8%	8%	5%	5%	5%
Turn Type	Perm	NA		D.Pm		Perm		NA	Perm	Perm	NA	
Protected Phases		4						2			2	
Permitted Phases	4			4		8			2	2		
Actuated Green, G (s)		25.6		25.6		27.1		50.6	50.6		50.6	
Effective Green, g (s)		25.6		25.6		27.1		50.6	50.6		50.6	
Actuated g/C Ratio		0.29		0.29		0.31		0.57	0.57		0.57	
Clearance Time (s)		6.0		6.0		4.5		6.0	6.0		6.0	
Vehicle Extension (s)		3.0		3.0		3.0		3.0	3.0		3.0	
Lane Grp Cap (vph)		516		393		481		1009	857		1034	
v/s Ratio Prot								0.35				
v/s Ratio Perm		0.02		c0.28		0.01			0.09		c0.53	
v/c Ratio		0.05		0.95		0.02		0.60	0.16		0.92	
Uniform Delay, d1		22.6		30.7		21.3		12.2	8.8		16.9	
Progression Factor		1.00		1.00		1.00		1.00	1.00		1.00	
Incremental Delay, d2		0.0		33.5		0.0		1.0	0.1		12.4	
Delay (s)		22.6		64.2		21.3		13.3	8.9		29.3	
Level of Service		C		E		C		B	A		C	
Approach Delay (s)		22.6			60.9			12.2			29.3	
Approach LOS		C			E			B			C	

Intersection Summary			
HCM 2000 Control Delay	28.7	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.93		
Actuated Cycle Length (s)	88.2	Sum of lost time (s)	12.0
Intersection Capacity Utilization	83.9%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	130	270	130	30	500	200	200	100	40	100	100	120
Future Volume (vph)	130	270	130	30	500	200	200	100	40	100	100	120
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0		6.0	6.0		6.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	1.00	0.95		0.97	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.96		1.00	0.96		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1656	1743	1333	1703	3260		3335	1732		1703	1792	1524
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1656	1743	1333	1703	3260		3335	1732		1703	1792	1524
Peak-hour factor, PHF	0.96	0.96	0.96	0.94	0.94	0.94	0.85	0.85	0.85	0.91	0.91	0.91
Adj. Flow (vph)	135	281	135	32	532	213	235	118	47	110	110	132
RTOR Reduction (vph)	0	0	62	0	49	0	0	16	0	0	0	98
Lane Group Flow (vph)	135	281	73	32	696	0	235	149	0	110	110	34
Heavy Vehicles (%)	9%	9%	9%	6%	6%	6%	5%	5%	5%	6%	6%	6%
Parking (#/hr)			0									
Turn Type	Prot	NA	pm+ov	Prot	NA		Prot	NA		Prot	NA	pm+ov
Protected Phases	5	2	3	1	6		3	8		7	4	5
Permitted Phases			2									4
Actuated Green, G (s)	8.1	32.3	43.1	2.1	26.3		10.8	13.9		7.1	10.2	18.3
Effective Green, g (s)	8.1	32.3	43.1	2.1	26.3		10.8	13.9		7.1	10.2	18.3
Actuated g/C Ratio	0.10	0.41	0.54	0.03	0.33		0.14	0.18		0.09	0.13	0.23
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0		6.0	6.0		6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	168	709	824	45	1079		453	303		152	230	466
v/s Ratio Prot	c0.08	c0.16	0.01	0.02	c0.21		c0.07	c0.09		0.06	0.06	0.01
v/s Ratio Perm			0.04									0.01
v/c Ratio	0.80	0.40	0.09	0.71	0.64		0.52	0.49		0.72	0.48	0.07
Uniform Delay, d1	34.9	16.7	8.7	38.3	22.6		31.9	29.6		35.2	32.1	23.9
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	23.5	0.4	0.0	41.4	1.3		1.0	1.2		15.6	1.6	0.1
Delay (s)	58.4	17.0	8.8	79.7	23.9		32.9	30.8		50.8	33.7	24.0
Level of Service	E	B	A	E	C		C	C		D	C	C
Approach Delay (s)		25.1			26.2			32.0			35.4	
Approach LOS		C			C			C			D	

Intersection Summary			
HCM 2000 Control Delay	28.6	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.63		
Actuated Cycle Length (s)	79.4	Sum of lost time (s)	24.0
Intersection Capacity Utilization	61.3%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	350	20	5	40	140	440
Future Volume (vph)	350	20	5	40	140	440
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0	120	0			220
Storage Lanes	1	1	0			1
Taper Length (ft)	25		25			
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.850				0.850
Flt Protected	0.950			0.995		
Satd. Flow (prot)	1719	1538	0	1818	1863	1583
Flt Permitted	0.950			0.995		
Satd. Flow (perm)	1719	1538	0	1818	1863	1583
Link Speed (mph)	30			30	30	
Link Distance (ft)	322			309	292	
Travel Time (s)	7.3			7.0	6.6	
Peak Hour Factor	0.89	0.89	0.91	0.91	0.93	0.93
Heavy Vehicles (%)	5%	5%	4%	4%	2%	2%
Adj. Flow (vph)	393	22	5	44	151	473
Shared Lane Traffic (%)						
Lane Group Flow (vph)	393	22	0	49	151	473
Sign Control	Stop			Stop	Stop	

Intersection Summary	
Area Type: Other	
Control Type: Unsignalized	
Intersection Capacity Utilization 37.2%	ICU Level of Service A
Analysis Period (min) 15	

Intersection	
Intersection Delay, s/veh	20.7
Intersection LOS	C

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↰	↱		↰↑	↑	↱
Traffic Vol, veh/h	350	20	5	40	140	440
Future Vol, veh/h	350	20	5	40	140	440
Peak Hour Factor	0.89	0.89	0.91	0.91	0.93	0.93
Heavy Vehicles, %	5	5	4	4	2	2
Mvmt Flow	393	22	5	44	151	473
Number of Lanes	1	1	0	1	1	1

Approach	EB	NB	SB
Opposing Approach		SB	NB
Opposing Lanes	0	2	1
Conflicting Approach Left	SB	EB	
Conflicting Lanes Left	2	2	0
Conflicting Approach Right	NB		EB
Conflicting Lanes Right	1	0	2
HCM Control Delay	26.1	10.5	17.9
HCM LOS	D	B	C

Lane	NBLn1	EBLn1	EBLn2	SBLn1	SBLn2
Vol Left, %	11%	100%	0%	0%	0%
Vol Thru, %	89%	0%	0%	100%	0%
Vol Right, %	0%	0%	100%	0%	100%
Sign Control	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	45	350	20	140	440
LT Vol	5	350	0	0	0
Through Vol	40	0	0	140	0
RT Vol	0	0	20	0	440
Lane Flow Rate	49	393	22	151	473
Geometry Grp	4	7	7	7	7
Degree of Util (X)	0.093	0.747	0.035	0.255	0.707
Departure Headway (Hd)	6.734	6.836	5.624	6.087	5.378
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes
Cap	530	531	636	589	672
Service Time	4.799	4.571	3.359	3.835	3.126
HCM Lane V/C Ratio	0.092	0.74	0.035	0.256	0.704
HCM Control Delay	10.5	27.1	8.6	10.9	20.1
HCM Lane LOS	B	D	A	B	C
HCM 95th-tile Q	0.3	6.4	0.1	1	5.8

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	10	0	0	390	580	10
Future Volume (vph)	10	0	0	390	580	10
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt					0.998	
Flt Protected	0.950					
Satd. Flow (prot)	1008	0	0	1827	1789	0
Flt Permitted	0.950					
Satd. Flow (perm)	1008	0	0	1827	1789	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	160			224	319	
Travel Time (s)	3.6			5.1	7.3	
Peak Hour Factor	0.44	0.44	0.95	0.95	0.96	0.96
Heavy Vehicles (%)	79%	79%	4%	4%	6%	6%
Adj. Flow (vph)	23	0	0	411	604	10
Shared Lane Traffic (%)						
Lane Group Flow (vph)	23	0	0	411	614	0
Sign Control	Stop			Free	Free	

Intersection Summary	
Area Type: Other	
Control Type: Unsignalized	
Intersection Capacity Utilization 41.1%	ICU Level of Service A
Analysis Period (min) 15	

Intersection						
Int Delay, s/veh	0.6					

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	10	0	0	390	580	10
Future Vol, veh/h	10	0	0	390	580	10
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	44	44	95	95	96	96
Heavy Vehicles, %	79	79	4	4	6	6
Mvmt Flow	23	0	0	411	604	10

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1020	609	614	0	-	0
Stage 1	609	-	-	-	-	-
Stage 2	411	-	-	-	-	-
Critical Hdwy	7.19	6.99	4.14	-	-	-
Critical Hdwy Stg 1	6.19	-	-	-	-	-
Critical Hdwy Stg 2	6.19	-	-	-	-	-
Follow-up Hdwy	4.211	4.011	2.236	-	-	-
Pot Cap-1 Maneuver	191	379	956	-	-	-
Stage 1	419	-	-	-	-	-
Stage 2	531	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	191	379	956	-	-	-
Mov Cap-2 Maneuver	191	-	-	-	-	-
Stage 1	419	-	-	-	-	-
Stage 2	531	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	26.4	0	0
HCM LOS	D		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	956	-	191	-	-
HCM Lane V/C Ratio	-	-	0.119	-	-
HCM Control Delay (s)	0	-	26.4	-	-
HCM Lane LOS	A	-	D	-	-
HCM 95th %tile Q(veh)	0	-	0.4	-	-

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations		+			+			+			+	
Traffic Volume (vph)	40	350	10	30	510	10	10	5	70	10	30	10
Future Volume (vph)	40	350	10	30	510	10	10	5	70	10	30	10
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	100		150	100		150	0		0	150		150
Storage Lanes	0		0	0		0	0		0	0		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.997			0.998			0.889			0.973	
Flt Protected		0.995			0.997			0.994			0.990	
Satd. Flow (prot)	0	1762	0	0	1800	0	0	1646	0	0	1830	0
Flt Permitted		0.995			0.997			0.994			0.990	
Satd. Flow (perm)	0	1762	0	0	1800	0	0	1646	0	0	1830	0
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		327			240			246			251	
Travel Time (s)		7.4			5.5			5.6			5.7	
Peak Hour Factor	0.89	0.89	0.89	0.96	0.96	0.96	0.65	0.65	0.65	0.67	0.67	0.67
Heavy Vehicles (%)	7%	7%	7%	5%	5%	5%	2%	2%	2%	0%	0%	0%
Adj. Flow (vph)	45	393	11	31	531	10	15	8	108	15	45	15
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	449	0	0	572	0	0	131	0	0	75	0
Sign Control		Free			Free			Stop			Stop	

Intersection Summary

Area Type: Other
Control Type: Unsignalized
Intersection Capacity Utilization 46.6% ICU Level of Service A
Analysis Period (min) 15

Intersection	
Int Delay, s/veh	3.7

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations		✥			✥			✥			✥	
Traffic Vol, veh/h	40	350	10	30	510	10	10	5	70	10	30	10
Future Vol, veh/h	40	350	10	30	510	10	10	5	70	10	30	10
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	Stop	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	89	89	89	96	96	96	65	65	65	67	67	67
Heavy Vehicles, %	7	7	7	5	5	5	2	2	2	0	0	0
Mvmt Flow	45	393	11	31	531	10	15	8	108	15	45	15

Major/Minor	Major1			Major2			Minor2			Minor1		
Conflicting Flow All	541	0	0	404	0	0	1117	1092	536	1091	1092	399
Stage 1	-	-	-	-	-	-	598	598	-	489	489	-
Stage 2	-	-	-	-	-	-	519	494	-	602	603	-
Critical Hdwy	4.17	-	-	4.15	-	-	7.12	6.52	6.22	7.1	6.5	6.2
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.1	5.5	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.1	5.5	-
Follow-up Hdwy	2.263	-	-	2.245	-	-	3.518	4.018	3.318	3.5	4	3.3
Pot Cap-1 Maneuver	1003	-	-	1139	-	-	185	215	545	194	216	655
Stage 1	-	-	-	-	-	-	489	491	-	564	553	-
Stage 2	-	-	-	-	-	-	540	546	-	490	492	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1003	-	-	1139	-	-	138	195	545	140	195	655
Mov Cap-2 Maneuver	-	-	-	-	-	-	138	195	-	140	195	-
Stage 1	-	-	-	-	-	-	461	472	-	531	521	-
Stage 2	-	-	-	-	-	-	454	514	-	372	473	-

Approach	EB	WB	SE	NW
HCM Control Delay, s	0.9	0.5	11.8	31.7
HCM LOS			B	D

Minor Lane/Major Mvmt	NWLn1	EBL	EBT	EBR	WBL	WBT	WBR	SELn1
Capacity (veh/h)	208	1003	-	-	1139	-	-	662
HCM Lane V/C Ratio	0.359	0.045	-	-	0.027	-	-	0.198
HCM Control Delay (s)	31.7	8.8	0	-	8.2	0	-	11.8
HCM Lane LOS	D	A	A	-	A	A	-	B
HCM 95th %tile Q(veh)	1.5	0.1	-	-	0.1	-	-	0.7

Movement	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	20	120	180	240	100	0	90	260	20	145	430	345
Future Volume (vph)	20	120	180	240	100	0	90	260	20	145	430	345
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0		6.0	6.0	4.0	6.0	6.0	6.0
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1736	3471	1553	3335	3438		1752	1845	1568	1752	1845	1568
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1736	3471	1553	3335	3438		1752	1845	1568	1752	1845	1568
Peak-hour factor, PHF	0.84	0.84	0.84	0.79	0.79	0.79	0.86	0.86	0.86	0.99	0.99	0.99
Adj. Flow (vph)	24	143	214	304	127	0	105	302	23	146	434	348
RTOR Reduction (vph)	0	0	166	0	0	0	0	0	0	0	0	176
Lane Group Flow (vph)	24	143	48	304	127	0	105	302	23	146	434	172
Heavy Vehicles (%)	4%	4%	4%	5%	5%	5%	3%	3%	3%	3%	3%	3%
Turn Type	Prot	NA	Perm	Prot	NA		Prot	NA	Free	Prot	NA	pt+ov
Protected Phases	5	2		1	6		7	4		3	8	8 1
Permitted Phases		2	2		6			4	Free		8	
Actuated Green, G (s)	11.9	20.2	20.2	11.5	19.8		7.2	22.9	90.0	11.4	27.1	44.6
Effective Green, g (s)	11.9	20.2	20.2	11.5	19.8		7.2	22.9	90.0	11.4	27.1	44.6
Actuated g/C Ratio	0.13	0.22	0.22	0.13	0.22		0.08	0.25	1.00	0.13	0.30	0.50
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	229	779	348	426	756		140	469	1568	221	555	777
v/s Ratio Prot	0.01	c0.04		c0.09	0.04		0.06	0.16		c0.08	c0.24	0.11
v/s Ratio Perm			0.03						c0.01			
v/c Ratio	0.10	0.18	0.14	0.71	0.17		0.75	0.64	0.01	0.66	0.78	0.22
Uniform Delay, d1	34.4	28.2	27.9	37.7	28.4		40.5	29.9	0.0	37.5	28.7	12.9
Progression Factor	1.00	1.00	1.00	1.04	0.86		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.9	0.5	0.8	5.5	0.5		20.0	3.0	0.0	7.2	7.1	0.1
Delay (s)	35.3	28.7	28.8	44.5	24.8		60.5	32.9	0.0	44.7	35.8	13.0
Level of Service	D	C	C	D	C		E	C	A	D	D	B
Approach Delay (s)		29.2			38.7			37.9			28.7	
Approach LOS		C			D			D			C	

Intersection Summary			
HCM 2000 Control Delay	32.6	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.61		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	24.0
Intersection Capacity Utilization	56.1%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	NWL	NWR	NET	NER	SWL	SWT
Lane Configurations						
Traffic Volume (vph)	80	60	460	220	70	840
Future Volume (vph)	80	60	460	220	70	840
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	180	0		0	180	
Storage Lanes	1	1		1	0	
Taper Length (ft)	25				25	
Lane Util. Factor	1.00	1.00	1.00	1.00	0.95	0.95
Frt		0.850		0.850		
Flt Protected	0.950					0.996
Satd. Flow (prot)	1770	1583	1845	1568	0	3525
Flt Permitted	0.950					0.996
Satd. Flow (perm)	1770	1583	1845	1568	0	3525
Link Speed (mph)	30		30			30
Link Distance (ft)	408		387			233
Travel Time (s)	9.3		8.8			5.3
Peak Hour Factor	0.83	0.83	0.86	0.86	0.81	0.81
Heavy Vehicles (%)	2%	2%	3%	3%	2%	2%
Adj. Flow (vph)	96	72	535	256	86	1037
Shared Lane Traffic (%)						
Lane Group Flow (vph)	96	72	535	256	0	1123
Sign Control	Stop		Free			Free

Intersection Summary

Area Type: Other
Control Type: Unsignalized
Intersection Capacity Utilization 63.9% ICU Level of Service B
Analysis Period (min) 15

Intersection						
Int Delay, s/veh	4.2					

Movement	NWL	NWR	NET	NER	SWL	SWT
Lane Configurations	↰	↱	↑	↱		↰↑
Traffic Vol, veh/h	80	60	460	220	70	840
Future Vol, veh/h	80	60	460	220	70	840
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	Yield	-	None
Storage Length	180	0	-	0	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	83	83	86	86	81	81
Heavy Vehicles, %	2	2	3	3	2	2
Mvmt Flow	96	72	535	256	86	1037

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1226	535	0	0	535	0
Stage 1	535	-	-	-	-	-
Stage 2	691	-	-	-	-	-
Critical Hdwy	6.63	6.23	-	-	4.13	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.83	-	-	-	-	-
Follow-up Hdwy	3.519	3.319	-	-	2.219	-
Pot Cap-1 Maneuver	184	544	-	-	1031	-
Stage 1	586	-	-	-	-	-
Stage 2	460	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	148	544	-	-	1031	-
Mov Cap-2 Maneuver	148	-	-	-	-	-
Stage 1	471	-	-	-	-	-
Stage 2	460	-	-	-	-	-

Approach	NW	NE	SW
HCM Control Delay, s	43.2	0	1.3
HCM LOS	E		

Minor Lane/Major Mvmt	NET	NER	NWLn1	NWLn2	SWL	SWT
Capacity (veh/h)	-	-	148	544	1031	-
HCM Lane V/C Ratio	-	-	0.651	0.133	0.084	-
HCM Control Delay (s)	-	-	66.1	12.6	8.8	0.7
HCM Lane LOS	-	-	F	B	A	A
HCM 95th %tile Q(veh)	-	-	3.6	0.5	0.3	-

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	40	580	0	0	470	20	5	0	5	20	0	130
Future Volume (vph)	40	580	0	0	470	20	5	0	5	20	0	130
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0			6.0			6.0	6.0		6.0	6.0
Lane Util. Factor	1.00	0.95			0.95			1.00	1.00		1.00	1.00
Frt	1.00	1.00			0.99			1.00	0.85		1.00	0.85
Flt Protected	0.95	1.00			1.00			0.95	1.00		0.95	1.00
Satd. Flow (prot)	1687	3374			3517			1805	1615		1787	1599
Flt Permitted	0.95	1.00			1.00			0.74	1.00		0.75	1.00
Satd. Flow (perm)	1687	3374			3517			1412	1615		1413	1599
Peak-hour factor, PHF	0.83	0.83	0.83	0.92	0.92	0.92	0.50	0.50	0.50	0.90	0.90	0.90
Adj. Flow (vph)	48	699	0	0	511	22	10	0	10	22	0	144
RTOR Reduction (vph)	0	0	0	0	2	0	0	0	9	0	0	132
Lane Group Flow (vph)	48	699	0	0	531	0	0	10	1	0	22	12
Heavy Vehicles (%)	7%	7%	7%	2%	2%	2%	0%	0%	0%	1%	1%	1%
Turn Type	Prot	NA		Prot	NA		Perm	NA	Perm	Perm	NA	Perm
Protected Phases	5	2		1	6			8			4	
Permitted Phases					6		8	8	8	4		4
Actuated Green, G (s)	5.6	70.5			58.9			7.5	7.5		7.5	7.5
Effective Green, g (s)	5.6	70.5			58.9			7.5	7.5		7.5	7.5
Actuated g/C Ratio	0.06	0.78			0.65			0.08	0.08		0.08	0.08
Clearance Time (s)	6.0	6.0			6.0			6.0	6.0		6.0	6.0
Vehicle Extension (s)	3.0	3.0			3.0			3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	104	2642			2301			117	134		117	133
v/s Ratio Prot	c0.03	c0.21			0.15							
v/s Ratio Perm								0.01	0.00		c0.02	0.01
v/c Ratio	0.46	0.26			0.23			0.09	0.01		0.19	0.09
Uniform Delay, d1	40.7	2.7			6.3			38.1	37.8		38.4	38.1
Progression Factor	0.89	1.66			1.25			1.00	1.00		1.00	1.00
Incremental Delay, d2	3.1	0.2			0.0			0.3	0.0		0.8	0.3
Delay (s)	39.2	4.7			8.0			38.4	37.9		39.2	38.4
Level of Service	D	A			A			D	D		D	D
Approach Delay (s)		6.9			8.0			38.1			38.5	
Approach LOS		A			A			D			D	

Intersection Summary				
HCM 2000 Control Delay	11.3	HCM 2000 Level of Service	B	
HCM 2000 Volume to Capacity ratio	0.28			
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	18.0	
Intersection Capacity Utilization	43.1%	ICU Level of Service	A	
Analysis Period (min)	15			
c Critical Lane Group				

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰↰	↑↱		↰	↑↱		↰	↱		↰	↰	↱
Traffic Volume (vph)	70	470	5	5	450	160	10	5	5	180	5	100
Future Volume (vph)	70	470	5	5	450	160	10	5	5	180	5	100
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	6.0
Lane Util. Factor	0.97	0.95		1.00	0.95		1.00	1.00		0.95	0.95	1.00
Frt	1.00	1.00		1.00	0.96		1.00	0.93		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	0.96	1.00
Satd. Flow (prot)	3303	3400		1736	3335		1805	1758		1665	1674	1568
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	0.96	1.00
Satd. Flow (perm)	3303	3400		1736	3335		1805	1758		1665	1674	1568
Peak-hour factor, PHF	0.83	0.83	0.83	0.97	0.97	0.97	0.67	0.67	0.67	0.90	0.90	0.90
Adj. Flow (vph)	84	566	6	5	464	165	15	7	7	200	6	111
RTOR Reduction (vph)	0	1	0	0	41	0	0	7	0	0	0	80
Lane Group Flow (vph)	84	571	0	5	588	0	15	7	0	102	104	31
Heavy Vehicles (%)	6%	6%	6%	4%	4%	4%	0%	0%	0%	3%	3%	3%
Turn Type	Prot	NA		Prot	NA		Split	NA		Split	NA	pt+ov
Protected Phases	5	2		1	6		3	3		4	4	4 5
Permitted Phases								3				
Actuated Green, G (s)	7.7	49.1		1.3	42.7		4.1	4.1		11.5	11.5	25.2
Effective Green, g (s)	7.7	49.1		1.3	42.7		4.1	4.1		11.5	11.5	25.2
Actuated g/C Ratio	0.09	0.55		0.01	0.47		0.05	0.05		0.13	0.13	0.28
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	282	1854		25	1582		82	80		212	213	439
v/s Ratio Prot	c0.03	c0.17		0.00	c0.18		c0.01	0.00		0.06	c0.06	0.02
v/s Ratio Perm												
v/c Ratio	0.30	0.31		0.20	0.37		0.18	0.09		0.48	0.49	0.07
Uniform Delay, d1	38.6	11.2		43.8	15.1		41.3	41.2		36.5	36.5	23.8
Progression Factor	1.00	1.00		1.58	0.57		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	0.6	0.1		3.9	0.7		1.1	0.5		1.7	1.8	0.1
Delay (s)	39.2	11.3		73.0	9.3		42.4	41.7		38.2	38.3	23.9
Level of Service	D	B		E	A		D	D		D	D	C
Approach Delay (s)		14.8			9.8			42.1			33.2	
Approach LOS		B			A			D			C	

Intersection Summary			
HCM 2000 Control Delay	16.9	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.38		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	24.0
Intersection Capacity Utilization	48.5%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	10	590	470	20	40	20
Future Volume (vph)	10	590	470	20	40	20
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	140			0	0	0
Storage Lanes	1			0	1	0
Taper Length (ft)	25				25	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.995		0.955	
Flt Protected	0.950				0.968	
Satd. Flow (prot)	1687	1776	1818	0	1657	0
Flt Permitted	0.950				0.968	
Satd. Flow (perm)	1687	1776	1818	0	1657	0
Link Speed (mph)		30	30		30	
Link Distance (ft)		535	210		522	
Travel Time (s)		12.2	4.8		11.9	
Peak Hour Factor	0.84	0.84	0.89	0.89	0.83	0.83
Heavy Vehicles (%)	7%	7%	4%	4%	6%	6%
Adj. Flow (vph)	12	702	528	22	48	24
Shared Lane Traffic (%)						
Lane Group Flow (vph)	12	702	550	0	72	0
Sign Control		Free	Free		Stop	

Intersection Summary

Area Type: Other
Control Type: Unsignalized
Intersection Capacity Utilization 41.2% ICU Level of Service A
Analysis Period (min) 15

Intersection	
Int Delay, s/veh	1.5

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↰	↑	↱		Y	
Traffic Vol, veh/h	10	590	470	20	40	20
Future Vol, veh/h	10	590	470	20	40	20
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	140	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	84	84	89	89	83	83
Heavy Vehicles, %	7	7	4	4	6	6
Mvmt Flow	12	702	528	22	48	24

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	550	0	-	0	1265	539
Stage 1	-	-	-	-	539	-
Stage 2	-	-	-	-	726	-
Critical Hdwy	4.17	-	-	-	6.46	6.26
Critical Hdwy Stg 1	-	-	-	-	5.46	-
Critical Hdwy Stg 2	-	-	-	-	5.46	-
Follow-up Hdwy	2.263	-	-	-	3.554	3.354
Pot Cap-1 Maneuver	995	-	-	-	183	535
Stage 1	-	-	-	-	577	-
Stage 2	-	-	-	-	472	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	995	-	-	-	181	535
Mov Cap-2 Maneuver	-	-	-	-	181	-
Stage 1	-	-	-	-	570	-
Stage 2	-	-	-	-	472	-

Approach	EB		WB		SB	
HCM Control Delay, s	0.1		0		27.4	
HCM LOS					D	

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	995	-	-	-	232
HCM Lane V/C Ratio	0.012	-	-	-	0.312
HCM Control Delay (s)	8.7	-	-	-	27.4
HCM Lane LOS	A	-	-	-	D
HCM 95th %tile Q(veh)	0	-	-	-	1.3

Lane Group	WBL2	WBL	WBR	WBR2	NBL	NBT	NBR	NBR2	SBL2	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	10	340	210	20	90	90	40	5	10	100	110	40
Future Volume (vph)	10	340	210	20	90	90	40	5	10	100	110	40
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)		0	150		0		150			0		0
Storage Lanes		1	0		0		0			0		0
Taper Length (ft)		25			25					25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.946				0.973					0.979	
Flt Protected		0.971				0.980					0.979	
Satd. Flow (prot)	0	1694	0	0	0	1759	0	0	0	0	1702	0
Flt Permitted		0.971				0.980					0.979	
Satd. Flow (perm)	0	1694	0	0	0	1759	0	0	0	0	1702	0
Link Speed (mph)		30				30					30	
Link Distance (ft)		465				456					371	
Travel Time (s)		10.6				10.4					8.4	
Peak Hour Factor	0.91	0.91	0.91	0.91	0.86	0.86	0.86	0.86	0.80	0.80	0.80	0.80
Heavy Vehicles (%)	3%	3%	3%	3%	3%	3%	3%	3%	7%	7%	7%	7%
Adj. Flow (vph)	11	374	231	22	105	105	47	6	13	125	138	50
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	638	0	0	0	263	0	0	0	0	326	0
Sign Control		Yield				Yield					Yield	

Intersection Summary

Area Type: Other

Control Type: Roundabout

Intersection Capacity Utilization 97.3% ICU Level of Service F

Analysis Period (min) 15

Lane Group	NEL	NET	NER	NER2	SWL2	SWL	SWT	SWR
Lane Configurations		✣					✣	
Traffic Volume (vph)	70	130	120	140	5	40	220	10
Future Volume (vph)	70	130	120	140	5	40	220	10
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		150			150		0
Storage Lanes	0		0			0		0
Taper Length (ft)	25					25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.924					0.995	
Flt Protected		0.992					0.992	
Satd. Flow (prot)	0	1613	0	0	0	0	1753	0
Flt Permitted		0.992					0.992	
Satd. Flow (perm)	0	1613	0	0	0	0	1753	0
Link Speed (mph)		30					30	
Link Distance (ft)		400					530	
Travel Time (s)		9.1					12.0	
Peak Hour Factor	0.60	0.60	0.60	0.60	0.83	0.83	0.83	0.83
Heavy Vehicles (%)	8%	8%	8%	8%	7%	7%	7%	7%
Adj. Flow (vph)	117	217	200	233	6	48	265	12
Shared Lane Traffic (%)								
Lane Group Flow (vph)	0	767	0	0	0	0	331	0
Sign Control		Yield					Yield	

Intersection Summary

Intersection	
Intersection Delay, s/veh	28.2
Intersection LOS	D

Approach	WB	NB	SB	NE	SW
Entry Lanes	1	1	1	1	1
Conflicting Circle Lanes	1	1	1	1	1
Adj Approach Flow, veh/h	638	263	326	767	331
Demand Flow Rate, veh/h	657	270	350	828	354
Vehicles Circulating, veh/h	638	730	845	364	976
Vehicles Exiting, veh/h	362	462	485	831	319
Ped Vol Crossing Leg, #/h	0	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000	1.000
Approach Delay, s/veh	40.1	11.6	19.1	28.7	26.4
Approach LOS	E	B	C	D	D

Lane	Left	Left	Left	Left	Left
Designated Moves	LR	LTR	LTR	LTR	LTR
Assumed Moves	LR	LTR	LTR	LTR	LTR
RT Channelized					
Lane Util	1.000	1.000	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976	4.976	4.976
Entry Flow, veh/h	657	270	350	828	354
Cap Entry Lane, veh/h	720	655	583	952	510
Entry HV Adj Factor	0.971	0.974	0.933	0.926	0.935
Flow Entry, veh/h	638	263	326	767	331
Cap Entry, veh/h	699	638	544	881	477
V/C Ratio	0.913	0.412	0.600	0.870	0.694
Control Delay, s/veh	40.1	11.6	19.1	28.7	26.4
LOS	E	B	C	D	D
95th %tile Queue, veh	12	2	4	11	5

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	10	10	145	5	40	50	200	170	10	10	110	20
Future Volume (vph)	10	10	145	5	40	50	200	170	10	10	110	20
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		50	0		0	0		0	0		0
Storage Lanes	0		1	0		0	0		0	0		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850		0.929			0.997			0.981	
Flt Protected		0.976			0.997			0.974			0.996	
Satd. Flow (prot)	0	1717	1495	0	1676	0	0	1791	0	0	1785	0
Flt Permitted		0.976			0.997			0.974			0.996	
Satd. Flow (perm)	0	1717	1495	0	1676	0	0	1791	0	0	1785	0
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		144			453			475			436	
Travel Time (s)		3.3			10.3			10.8			9.9	
Peak Hour Factor	0.82	0.82	0.82	0.70	0.70	0.70	0.75	0.75	0.75	0.71	0.71	0.71
Heavy Vehicles (%)	8%	8%	8%	5%	5%	5%	3%	3%	3%	4%	4%	4%
Adj. Flow (vph)	12	12	177	7	57	71	267	227	13	14	155	28
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	24	177	0	135	0	0	507	0	0	197	0
Sign Control		Stop			Stop			Free			Free	

Intersection Summary

Area Type: Other
Control Type: Unsignalized
Intersection Capacity Utilization 47.8% ICU Level of Service A
Analysis Period (min) 15

Intersection	
Int Delay, s/veh	8.2

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	10	10	145	5	40	50	200	170	10	10	110	20
Future Vol, veh/h	10	10	145	5	40	50	200	170	10	10	110	20
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	50	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	82	82	82	70	70	70	75	75	75	71	71	71
Heavy Vehicles, %	8	8	8	5	5	5	3	3	3	4	4	4
Mvmt Flow	12	12	177	7	57	71	267	227	13	14	155	28

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1029	971	169	1060	979	234	183	0	0	240	0	0
Stage 1	197	197	-	768	768	-	-	-	-	-	-	-
Stage 2	832	774	-	292	211	-	-	-	-	-	-	-
Critical Hdwy	7.18	6.58	6.28	7.15	6.55	6.25	4.13	-	-	4.14	-	-
Critical Hdwy Stg 1	6.18	5.58	-	6.15	5.55	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.18	5.58	-	6.15	5.55	-	-	-	-	-	-	-
Follow-up Hdwy	3.572	4.072	3.372	3.545	4.045	3.345	2.227	-	-	2.236	-	-
Pot Cap-1 Maneuver	207	247	860	199	247	798	1386	-	-	1315	-	-
Stage 1	791	727	-	390	407	-	-	-	-	-	-	-
Stage 2	355	400	-	710	722	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	120	190	860	124	190	798	1386	-	-	1315	-	-
Mov Cap-2 Maneuver	120	190	-	124	190	-	-	-	-	-	-	-
Stage 1	615	718	-	303	316	-	-	-	-	-	-	-
Stage 2	206	311	-	548	713	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	13.2	26.2	4.3	0.6
HCM LOS	B	D		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1386	-	-	147	860	303	1315	-	-
HCM Lane V/C Ratio	0.192	-	-	0.166	0.206	0.448	0.011	-	-
HCM Control Delay (s)	8.2	0	-	34.3	10.3	26.2	7.8	0	-
HCM Lane LOS	A	A	-	D	B	D	A	A	-
HCM 95th %tile Q(veh)	0.7	-	-	0.6	0.8	2.2	0	-	-

Movement	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	30	50	20	20	50	160	80	240	80	80	520	50
Future Volume (vph)	30	50	20	20	50	160	80	240	80	80	520	50
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	0.96		1.00	1.00	0.85	1.00	0.96		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1752	1767		1736	1827	1553	1770	1793		1787	1856	
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1752	1767		1736	1827	1553	1770	1793		1787	1856	
Peak-hour factor, PHF	0.82	0.82	0.82	0.81	0.81	0.81	0.68	0.68	0.68	0.78	0.78	0.78
Adj. Flow (vph)	37	61	24	25	62	198	118	353	118	103	667	64
RTOR Reduction (vph)	0	17	0	0	0	139	0	14	0	0	4	0
Lane Group Flow (vph)	37	68	0	25	62	59	118	457	0	103	727	0
Heavy Vehicles (%)	3%	3%	3%	4%	4%	4%	2%	2%	2%	1%	1%	1%
Turn Type	Prot	NA		Prot	NA	pt+ov	Prot	NA		Prot	NA	
Protected Phases	1	6		5	2	2 3	3	8		7	4	
Permitted Phases												
Actuated Green, G (s)	4.4	10.7		3.0	9.3	23.4	8.1	35.0		6.2	33.1	
Effective Green, g (s)	4.4	10.7		3.0	9.3	23.4	8.1	35.0		6.2	33.1	
Actuated g/C Ratio	0.06	0.14		0.04	0.12	0.30	0.10	0.44		0.08	0.42	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	97	239		66	215	460	181	795		140	778	
v/s Ratio Prot	c0.02	c0.04		0.01	0.03	0.04	c0.07	0.25		0.06	c0.39	
v/s Ratio Perm												
v/c Ratio	0.38	0.28		0.38	0.29	0.13	0.65	0.57		0.74	0.93	
Uniform Delay, d1	35.9	30.7		37.0	31.8	20.3	34.0	16.4		35.5	21.9	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	2.5	0.7		3.6	3.4	0.1	8.1	1.0		18.1	18.1	
Delay (s)	38.4	31.3		40.7	35.1	20.4	42.2	17.4		53.6	40.0	
Level of Service	D	C		D	D	C	D	B		D	D	
Approach Delay (s)		33.5			25.4			22.4			41.7	
Approach LOS		C			C			C			D	

Intersection Summary			
HCM 2000 Control Delay	32.4	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.74		
Actuated Cycle Length (s)	78.9	Sum of lost time (s)	24.0
Intersection Capacity Utilization	62.0%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	170	0	10	140	250	470
Future Volume (vph)	170	0	10	140	250	470
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt					0.912	
Flt Protected	0.950			0.997		
Satd. Flow (prot)	1770	0	0	1707	1699	0
Flt Permitted	0.950			0.997		
Satd. Flow (perm)	1770	0	0	1707	1699	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	348			739	425	
Travel Time (s)	7.9			16.8	9.7	
Peak Hour Factor	0.94	0.94	0.91	0.91	0.82	0.82
Heavy Vehicles (%)	2%	2%	11%	11%	2%	2%
Adj. Flow (vph)	181	0	11	154	305	573
Shared Lane Traffic (%)						
Lane Group Flow (vph)	181	0	0	165	878	0
Sign Control	Stop			Free	Free	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 58.1% ICU Level of Service B

Analysis Period (min) 15

Intersection	
Int Delay, s/veh	3.7

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	170	0	10	140	250	470
Future Vol, veh/h	170	0	10	140	250	470
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	94	94	91	91	82	82
Heavy Vehicles, %	2	2	11	11	2	2
Mvmt Flow	181	0	11	154	305	573

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	768	592	878	0	-	0
Stage 1	592	-	-	-	-	-
Stage 2	176	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.21	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.299	-	-	-
Pot Cap-1 Maneuver	370	506	733	-	-	-
Stage 1	553	-	-	-	-	-
Stage 2	855	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	364	506	733	-	-	-
Mov Cap-2 Maneuver	364	-	-	-	-	-
Stage 1	544	-	-	-	-	-
Stage 2	855	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	24.3	0.7	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	733	-	364	-	-
HCM Lane V/C Ratio	0.015	-	0.497	-	-
HCM Control Delay (s)	10	0	24.3	-	-
HCM Lane LOS	A	A	C	-	-
HCM 95th %tile Q(veh)	0	-	2.7	-	-

APPENDIX S-2: 2040 ALTERNATIVE F INTERSECTION CAPACITY ANALYSES – HCM 2000 PRINTOUTS – PM PEAK HOUR

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑↑		↰	↱↱
Traffic Volume (vph)	0	1310	1330	0	1005	1135
Future Volume (vph)	0	1310	1330	0	1005	1135
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	16	12
Total Lost time (s)		6.0	6.0		6.0	6.0
Lane Util. Factor		0.95	0.95		1.00	0.88
Frt		1.00	1.00		1.00	0.85
Flt Protected		1.00	1.00		0.95	1.00
Satd. Flow (prot)		3471	3406		1930	2682
Flt Permitted		1.00	1.00		0.95	1.00
Satd. Flow (perm)		3471	3406		1930	2682
Peak-hour factor, PHF	0.93	0.93	0.88	0.88	0.89	0.89
Adj. Flow (vph)	0	1409	1511	0	1129	1275
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	1409	1511	0	1129	1275
Heavy Vehicles (%)	4%	4%	6%	6%	6%	6%
Turn Type		NA	NA		Prot	Prot
Protected Phases		2	6		4	4
Permitted Phases						
Actuated Green, G (s)		48.0	48.0		60.0	60.0
Effective Green, g (s)		48.0	48.0		60.0	60.0
Actuated g/C Ratio		0.40	0.40		0.50	0.50
Clearance Time (s)		6.0	6.0		6.0	6.0
Vehicle Extension (s)		3.0	3.0		3.0	3.0
Lane Grp Cap (vph)		1388	1362		965	1341
v/s Ratio Prot		0.41	c0.44		c0.59	0.48
v/s Ratio Perm						
v/c Ratio		1.02	1.11		1.17	0.95
Uniform Delay, d1		36.0	36.0		30.0	28.6
Progression Factor		0.59	0.05		1.00	1.00
Incremental Delay, d2		21.8	50.4		87.7	14.4
Delay (s)		43.0	52.2		117.7	43.0
Level of Service		D	D		F	D
Approach Delay (s)		43.0	52.2		78.1	
Approach LOS		D	D		E	

Intersection Summary			
HCM 2000 Control Delay	61.5	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.14		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	104.4%	ICU Level of Service	G
Analysis Period (min)	15		

c Critical Lane Group

Movement	NBL2	NBL	NBR	SEL	SER	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations											
Traffic Volume (vph)	1250	0	1105	0	0	985	1330	0	0	570	795
Future Volume (vph)	1250	0	1105	0	0	985	1330	0	0	570	795
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0		6.0			6.0	6.0			6.0	4.0
Lane Util. Factor	0.97		0.88			0.97	0.95			0.95	1.00
Frt	1.00		0.85			1.00	1.00			1.00	0.85
Flt Protected	0.95		1.00			0.95	1.00			1.00	1.00
Satd. Flow (prot)	3242		2632			3335	3438			3505	1568
Flt Permitted	0.95		1.00			0.95	1.00			1.00	1.00
Satd. Flow (perm)	3242		2632			3335	3438			3505	1568
Peak-hour factor, PHF	0.88	0.88	0.88	0.92	0.92	0.94	0.94	0.94	0.92	0.92	0.92
Adj. Flow (vph)	1420	0	1256	0	0	1048	1415	0	0	620	864
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	1420	0	1256	0	0	1048	1415	0	0	620	864
Heavy Vehicles (%)	8%	8%	8%	2%	2%	5%	5%	5%	3%	3%	3%
Turn Type	Prot		Prot			Prot	NA			NA	Free
Protected Phases	8		8			5	2			6	
Permitted Phases											Free
Actuated Green, G (s)	44.0		44.0			32.0	64.0			26.0	120.0
Effective Green, g (s)	44.0		44.0			32.0	64.0			26.0	120.0
Actuated g/C Ratio	0.37		0.37			0.27	0.53			0.22	1.00
Clearance Time (s)	6.0		6.0			6.0	6.0			6.0	
Vehicle Extension (s)	3.0		3.0			3.0	3.0			3.0	
Lane Grp Cap (vph)	1188		965			889	1833			759	1568
v/s Ratio Prot	0.44		c0.48			c0.31	c0.41			0.18	
v/s Ratio Perm											0.55
v/c Ratio	1.20		1.30			1.18	0.77			0.82	0.55
Uniform Delay, d1	38.0		38.0			44.0	22.2			44.7	0.0
Progression Factor	1.00		1.00			0.87	0.91			1.00	1.00
Incremental Delay, d2	96.3		143.3			81.7	0.3			9.5	1.4
Delay (s)	134.3		181.3			120.1	20.5			54.2	1.4
Level of Service	F		F			F	C			D	A
Approach Delay (s)		156.4		0.0			62.9			23.5	
Approach LOS		F		A			E			C	

Intersection Summary			
HCM 2000 Control Delay	91.8	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.15		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	95.5%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑	↱	↰	↑↑					↰↰		↱
Traffic Volume (vph)	0	925	385	240	525	0	0	0	0	740	0	480
Future Volume (vph)	0	925	385	240	525	0	0	0	0	740	0	480
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0	4.0	6.0	6.0					6.0		6.0
Lane Util. Factor		0.95	1.00	1.00	0.95					0.97		1.00
Frt		1.00	0.85	1.00	1.00					1.00		0.85
Flt Protected		1.00	1.00	0.95	1.00					0.95		1.00
Satd. Flow (prot)		3471	1553	1719	3438					3367		1553
Flt Permitted		1.00	1.00	0.95	1.00					0.95		1.00
Satd. Flow (perm)		3471	1553	1719	3438					3367		1553
Peak-hour factor, PHF	0.87	0.87	0.87	0.86	0.86	0.86	0.92	0.92	0.92	0.91	0.91	0.91
Adj. Flow (vph)	0	1063	443	279	610	0	0	0	0	813	0	527
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	218
Lane Group Flow (vph)	0	1063	443	279	610	0	0	0	0	813	0	309
Heavy Vehicles (%)	4%	4%	4%	5%	5%	5%	2%	2%	2%	4%	4%	4%
Turn Type		NA	Free	Prot	NA					Prot		Prot
Protected Phases		2		1	6					4		4
Permitted Phases			Free									
Actuated Green, G (s)		36.6	100.0	18.4	61.0					27.0		27.0
Effective Green, g (s)		36.6	100.0	18.4	61.0					27.0		27.0
Actuated g/C Ratio		0.37	1.00	0.18	0.61					0.27		0.27
Clearance Time (s)		6.0		6.0	6.0					6.0		6.0
Vehicle Extension (s)		5.0		3.0	5.0					3.0		3.0
Lane Grp Cap (vph)		1270	1553	316	2097					909		419
v/s Ratio Prot		c0.31		c0.16	0.18					c0.24		0.20
v/s Ratio Perm			0.29									
v/c Ratio		0.84	0.29	0.88	0.29					0.89		0.74
Uniform Delay, d1		29.0	0.0	39.8	9.2					35.1		33.3
Progression Factor		1.00	1.00	0.20	0.00					1.00		1.00
Incremental Delay, d2		6.7	0.5	16.3	0.2					11.2		6.7
Delay (s)		35.6	0.5	24.2	0.2					46.3		40.0
Level of Service		D	A	C	A					D		D
Approach Delay (s)		25.3			7.7			0.0			43.8	
Approach LOS		C			A			A			D	

Intersection Summary			
HCM 2000 Control Delay	27.8	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	76.8%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑			↑↑	↱	↰		↱			
Traffic Volume (vph)	580	1085	0	0	470	560	295	0	360	0	0	0
Future Volume (vph)	580	1085	0	0	470	560	295	0	360	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0			6.0	4.0	6.0		6.0			
Lane Util. Factor	1.00	0.95			0.95	1.00	1.00		1.00			
Frt	1.00	1.00			1.00	0.85	1.00		0.85			
Flt Protected	0.95	1.00			1.00	1.00	0.95		1.00			
Satd. Flow (prot)	1752	3505			3505	1568	1703		1524			
Flt Permitted	0.95	1.00			1.00	1.00	0.95		1.00			
Satd. Flow (perm)	1752	3505			3505	1568	1703		1524			
Peak-hour factor, PHF	0.92	0.92	0.92	0.91	0.91	0.91	0.67	0.67	0.67	0.92	0.92	0.92
Adj. Flow (vph)	630	1179	0	0	516	615	440	0	537	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	71	0	0	0
Lane Group Flow (vph)	630	1179	0	0	516	615	440	0	466	0	0	0
Heavy Vehicles (%)	3%	3%	3%	3%	3%	3%	6%	6%	6%	2%	2%	2%
Turn Type	Prot	NA			NA	Free	Prot		Prot			
Protected Phases	5	2			6		8		8			
Permitted Phases		2			6	Free						
Actuated Green, G (s)	35.0	60.0			19.0	100.0	28.0		28.0			
Effective Green, g (s)	35.0	60.0			19.0	100.0	28.0		28.0			
Actuated g/C Ratio	0.35	0.60			0.19	1.00	0.28		0.28			
Clearance Time (s)	6.0	6.0			6.0		6.0		6.0			
Vehicle Extension (s)	5.0	5.0			5.0		3.0		3.0			
Lane Grp Cap (vph)	613	2103			665	1568	476		426			
v/s Ratio Prot	c0.36	0.34			c0.15		0.26		c0.31			
v/s Ratio Perm						0.39						
v/c Ratio	1.03	0.56			0.78	0.39	0.92		1.09			
Uniform Delay, d1	32.5	12.1			38.5	0.0	35.0		36.0			
Progression Factor	0.20	0.22			1.00	1.00	1.00		1.00			
Incremental Delay, d2	33.7	0.5			8.6	0.7	23.7		71.7			
Delay (s)	40.2	3.2			47.1	0.7	58.7		107.7			
Level of Service	D	A			D	A	E		F			
Approach Delay (s)		16.1			21.9			85.7			0.0	
Approach LOS		B			C			F			A	

Intersection Summary			
HCM 2000 Control Delay	35.1	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.99		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	76.8%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	10	5	160	10	0	10	650	1440	120	10	1020	50
Future Volume (vph)	10	5	160	10	0	10	650	1440	120	10	1020	50
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0	6.0		6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor		1.00	1.00		1.00		1.00	0.95		1.00	0.95	
Frt		1.00	0.85		0.93		1.00	0.99		1.00	0.99	
Flt Protected		0.97	1.00		0.98		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1801	1583		1729		1770	3498		1770	3515	
Flt Permitted		0.74	1.00		0.83		0.95	1.00		0.95	1.00	
Satd. Flow (perm)		1378	1583		1477		1770	3498		1770	3515	
Peak-hour factor, PHF	0.92	0.92	0.92	0.25	0.25	0.25	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	11	5	174	40	0	40	707	1565	130	11	1109	54
RTOR Reduction (vph)	0	0	106	0	76	0	0	3	0	0	2	0
Lane Group Flow (vph)	0	16	68	0	4	0	707	1692	0	11	1161	0
Heavy Vehicles (%)	2%	2%	2%	0%	0%	0%	2%	2%	2%	2%	2%	2%
Turn Type	Perm	NA	custom	Perm	NA		Prot	NA		Prot	NA	
Protected Phases		8			4		5	2		1	6	
Permitted Phases	8		6	4								
Actuated Green, G (s)		5.7	48.0		5.7		51.1	98.1		1.0	48.0	
Effective Green, g (s)		5.7	48.0		5.7		51.1	98.1		1.0	48.0	
Actuated g/C Ratio		0.05	0.39		0.05		0.42	0.80		0.01	0.39	
Clearance Time (s)		6.0	6.0		6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)		3.0	3.0		3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		63	618		68		736	2794		14	1373	
v/s Ratio Prot							c0.40	0.48		0.01	c0.33	
v/s Ratio Perm		c0.01	0.04		0.00							
v/c Ratio		0.25	0.11		0.05		0.96	0.61		0.79	0.85	
Uniform Delay, d1		56.5	23.8		56.0		34.9	4.8		60.8	34.0	
Progression Factor		1.00	1.00		1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		2.1	0.1		0.3		23.8	0.4		130.6	5.0	
Delay (s)		58.6	23.9		56.3		58.7	5.2		191.4	39.0	
Level of Service		E	C		E		E	A		F	D	
Approach Delay (s)		26.8			56.3			20.9			40.4	
Approach LOS		C			E			C			D	

Intersection Summary			
HCM 2000 Control Delay	27.9	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	122.8	Sum of lost time (s)	18.0
Intersection Capacity Utilization	92.4%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	10	30	5	260	0	50	0	1020	220	15	555	0
Future Volume (vph)	10	30	5	260	0	50	0	1020	220	15	555	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0		6.0		4.5		6.0	6.0		6.0	
Lane Util. Factor		1.00		1.00		1.00		1.00	1.00		1.00	
Frt		0.99		1.00		0.85		1.00	0.85		1.00	
Flt Protected		0.99		0.95		1.00		1.00	1.00		1.00	
Satd. Flow (prot)		1815		1752		1568		1759	1495		1807	
Flt Permitted		0.99		0.80		1.00		1.00	1.00		0.72	
Satd. Flow (perm)		1815		1469		1568		1759	1495		1295	
Peak-hour factor, PHF	0.60	0.60	0.60	0.96	0.96	0.96	0.89	0.89	0.89	0.86	0.86	0.86
Adj. Flow (vph)	17	50	8	271	0	52	0	1146	247	17	645	0
RTOR Reduction (vph)	0	5	0	0	0	38	0	0	43	0	0	0
Lane Group Flow (vph)	0	70	0	271	0	14	0	1146	204	0	662	0
Heavy Vehicles (%)	2%	2%	2%	3%	3%	3%	8%	8%	8%	5%	5%	5%
Turn Type	Perm	NA		D.Pm		Perm		NA	Perm	Perm	NA	
Protected Phases		4						2			2	
Permitted Phases	4			4		8			2	2		
Actuated Green, G (s)		17.9		17.9		19.4		60.1	60.1		60.1	
Effective Green, g (s)		17.9		17.9		19.4		60.1	60.1		60.1	
Actuated g/C Ratio		0.20		0.20		0.22		0.67	0.67		0.67	
Clearance Time (s)		6.0		6.0		4.5		6.0	6.0		6.0	
Vehicle Extension (s)		3.0		3.0		3.0		3.0	3.0		3.0	
Lane Grp Cap (vph)		360		292		337		1174	998		864	
v/s Ratio Prot								c0.65				
v/s Ratio Perm		0.04		c0.18		0.01			0.14		0.51	
v/c Ratio		0.19		0.93		0.04		0.98	0.20		0.77	
Uniform Delay, d1		30.0		35.4		27.9		14.3	5.8		10.2	
Progression Factor		1.00		1.00		1.00		1.00	1.00		1.00	
Incremental Delay, d2		0.3		33.9		0.0		20.5	0.1		4.1	
Delay (s)		30.3		69.3		28.0		34.8	5.9		14.3	
Level of Service		C		E		C		C	A		B	
Approach Delay (s)		30.3			62.7			29.7			14.3	
Approach LOS		C			E			C			B	

Intersection Summary			
HCM 2000 Control Delay	29.9	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.96		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	86.1%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	230	110	30	180	150	180	170	540	130	70	330	180
Future Volume (vph)	230	110	30	180	150	180	170	540	130	70	330	180
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	
Lane Util. Factor	0.97	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	
Frt	1.00	0.97		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.95	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	3400	1785		1752	1845	1568	1787	1881	1599	1787	3385	
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	3400	1785		1752	1845	1568	1787	1881	1599	1787	3385	
Peak-hour factor, PHF	0.91	0.91	0.91	0.93	0.93	0.93	0.95	0.95	0.95	0.94	0.94	0.94
Adj. Flow (vph)	253	121	33	194	161	194	179	568	137	74	351	191
RTOR Reduction (vph)	0	13	0	0	0	106	0	0	71	0	84	0
Lane Group Flow (vph)	253	141	0	194	161	88	179	568	66	74	458	0
Heavy Vehicles (%)	3%	3%	3%	3%	3%	3%	1%	1%	1%	1%	1%	1%
Turn Type	Prot	NA		Prot	NA	pm+ov	Prot	NA	pm+ov	Prot	NA	
Protected Phases	3	8		7	4	5	5	2	3	1	6	
Permitted Phases						4			2			
Actuated Green, G (s)	10.0	12.0		10.8	12.8	22.7	9.9	27.3	37.3	3.8	21.2	
Effective Green, g (s)	10.0	12.0		10.8	12.8	22.7	9.9	27.3	37.3	3.8	21.2	
Actuated g/C Ratio	0.13	0.15		0.14	0.16	0.29	0.13	0.35	0.48	0.05	0.27	
Clearance Time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	436	274		242	303	577	227	659	888	87	921	
v/s Ratio Prot	0.07	0.08		c0.11	c0.09	0.02	c0.10	c0.30	0.01	0.04	0.14	
v/s Ratio Perm						0.04			0.03			
v/c Ratio	0.58	0.52		0.80	0.53	0.15	0.79	0.86	0.07	0.85	0.50	
Uniform Delay, d1	32.0	30.3		32.5	29.8	20.5	33.0	23.5	11.0	36.8	23.9	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	2.0	1.6		17.1	1.8	0.1	16.4	13.9	0.0	50.9	0.4	
Delay (s)	33.9	31.9		49.7	31.6	20.6	49.4	37.5	11.0	87.7	24.3	
Level of Service	C	C		D	C	C	D	D	B	F	C	
Approach Delay (s)		33.2			34.1			35.8			31.9	
Approach LOS		C			C			D			C	

Intersection Summary			
HCM 2000 Control Delay	34.0	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	77.9	Sum of lost time (s)	24.0
Intersection Capacity Utilization	87.0%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	810	10	5	100	125	470
Future Volume (vph)	810	10	5	100	125	470
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0	120	0			220
Storage Lanes	1	1	0			1
Taper Length (ft)	25		25			
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.850				0.850
Flt Protected	0.950			0.998		
Satd. Flow (prot)	1787	1599	0	1859	1881	1599
Flt Permitted	0.950			0.998		
Satd. Flow (perm)	1787	1599	0	1859	1881	1599
Link Speed (mph)	30			30	30	
Link Distance (ft)	322			309	354	
Travel Time (s)	7.3			7.0	8.0	
Peak Hour Factor	0.90	0.90	0.87	0.87	0.87	0.87
Heavy Vehicles (%)	1%	1%	2%	2%	1%	1%
Adj. Flow (vph)	900	11	6	115	144	540
Shared Lane Traffic (%)						
Lane Group Flow (vph)	900	11	0	121	144	540
Sign Control	Stop			Stop	Stop	

Intersection Summary	
Area Type:	Other
Control Type: Unsignalized	
Intersection Capacity Utilization 63.6%	ICU Level of Service B
Analysis Period (min) 15	

Intersection	
Intersection Delay, s/veh	225.6
Intersection LOS	F

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↰	↱		↰↑	↑	↱
Traffic Vol, veh/h	810	10	5	100	125	470
Future Vol, veh/h	810	10	5	100	125	470
Peak Hour Factor	0.90	0.90	0.87	0.87	0.87	0.87
Heavy Vehicles, %	1	1	2	2	1	1
Mvmt Flow	900	11	6	115	144	540
Number of Lanes	1	1	0	1	1	1

Approach	EB	NB	SB
Opposing Approach		SB	NB
Opposing Lanes	0	2	1
Conflicting Approach Left	SB	EB	
Conflicting Lanes Left	2	2	0
Conflicting Approach Right	NB		EB
Conflicting Lanes Right	1	0	2
HCM Control Delay	392	15.5	40.9
HCM LOS	F	C	E

Lane	NBLn1	EBLn1	EBLn2	SBLn1	SBLn2
Vol Left, %	5%	100%	0%	0%	0%
Vol Thru, %	95%	0%	0%	100%	0%
Vol Right, %	0%	0%	100%	0%	100%
Sign Control	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	105	810	10	125	470
LT Vol	5	810	0	0	0
Through Vol	100	0	0	125	0
RT Vol	0	0	10	0	470
Lane Flow Rate	121	900	11	144	540
Geometry Grp	4	7	7	7	7
Degree of Util (X)	0.244	1.825	0.019	0.266	0.896
Departure Headway (Hd)	9.45	7.298	6.08	8.544	7.82
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes
Cap	383	504	592	424	470
Service Time	7.45	4.998	3.78	6.244	5.52
HCM Lane V/C Ratio	0.316	1.786	0.019	0.34	1.149
HCM Control Delay	15.5	396.7	8.9	14.3	48
HCM Lane LOS	C	F	A	B	E
HCM 95th-tile Q	0.9	56.8	0.1	1.1	9.8

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	10	0	0	910	595	10
Future Volume (vph)	10	0	0	910	595	10
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt					0.998	
Flt Protected	0.950					
Satd. Flow (prot)	1703	0	0	1881	1877	0
Flt Permitted	0.950					
Satd. Flow (perm)	1703	0	0	1881	1877	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	160			224	319	
Travel Time (s)	3.6			5.1	7.3	
Peak Hour Factor	0.50	0.50	0.93	0.93	0.86	0.86
Heavy Vehicles (%)	6%	6%	1%	1%	1%	1%
Adj. Flow (vph)	20	0	0	978	692	12
Shared Lane Traffic (%)						
Lane Group Flow (vph)	20	0	0	978	704	0
Sign Control	Stop			Free	Free	

Intersection Summary	
Area Type: Other	
Control Type: Unsignalized	
Intersection Capacity Utilization 64.3%	ICU Level of Service C
Analysis Period (min) 15	

Intersection	
Int Delay, s/veh	0.6

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	10	0	0	910	595	10
Future Vol, veh/h	10	0	0	910	595	10
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	50	50	93	93	86	86
Heavy Vehicles, %	6	6	1	1	1	1
Mvmt Flow	20	0	0	978	692	12

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1676	698	704	0	-	0
Stage 1	698	-	-	-	-	-
Stage 2	978	-	-	-	-	-
Critical Hdwy	6.46	6.26	4.11	-	-	-
Critical Hdwy Stg 1	5.46	-	-	-	-	-
Critical Hdwy Stg 2	5.46	-	-	-	-	-
Follow-up Hdwy	3.554	3.354	2.209	-	-	-
Pot Cap-1 Maneuver	102	434	898	-	-	-
Stage 1	486	-	-	-	-	-
Stage 2	358	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	102	434	898	-	-	-
Mov Cap-2 Maneuver	102	-	-	-	-	-
Stage 1	486	-	-	-	-	-
Stage 2	358	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	48.7	0	0
HCM LOS	E		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	898	-	102	-	-
HCM Lane V/C Ratio	-	-	0.196	-	-
HCM Control Delay (s)	0	-	48.7	-	-
HCM Lane LOS	A	-	E	-	-
HCM 95th %tile Q(veh)	0	-	0.7	-	-

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations		✥			✥			✥			✥	
Traffic Volume (vph)	50	860	10	40	460	20	40	10	140	5	40	10
Future Volume (vph)	50	860	10	40	460	20	40	10	140	5	40	10
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	100		150	100		150	0		0	150		150
Storage Lanes	0		0	0		0	0		0	0		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.998			0.995			0.901			0.976	
Flt Protected		0.997			0.996			0.990			0.996	
Satd. Flow (prot)	0	1872	0	0	1846	0	0	1695	0	0	1847	0
Flt Permitted		0.997			0.996			0.990			0.996	
Satd. Flow (perm)	0	1872	0	0	1846	0	0	1695	0	0	1847	0
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		327			240			246			251	
Travel Time (s)		7.4			5.5			5.6			5.7	
Peak Hour Factor	0.94	0.94	0.94	0.88	0.88	0.88	0.67	0.67	0.67	0.82	0.82	0.82
Heavy Vehicles (%)	1%	1%	1%	2%	2%	2%	0%	0%	0%	0%	0%	0%
Adj. Flow (vph)	53	915	11	45	523	23	60	15	209	6	49	12
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	979	0	0	591	0	0	284	0	0	67	0
Sign Control		Free			Free			Stop			Stop	

Intersection Summary

Area Type: Other
Control Type: Unsignalized
Intersection Capacity Utilization 86.5% ICU Level of Service E
Analysis Period (min) 15

Intersection	
Int Delay, s/veh	104.3

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations		✣			✣			✣			✣	
Traffic Vol, veh/h	50	860	10	40	460	20	40	10	140	5	40	10
Future Vol, veh/h	50	860	10	40	460	20	40	10	140	5	40	10
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	Stop	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	94	94	94	88	88	88	67	67	67	82	82	82
Heavy Vehicles, %	1	1	1	2	2	2	0	0	0	0	0	0
Mvmt Flow	53	915	11	45	523	23	60	15	209	6	49	12

Major/Minor	Major1			Major2			Minor2			Minor1		
Conflicting Flow All	546	0	0	926	0	0	1682	1657	535	1659	1663	921
Stage 1	-	-	-	-	-	-	625	625	-	1027	1027	-
Stage 2	-	-	-	-	-	-	1057	1032	-	632	636	-
Critical Hdwy	4.11	-	-	4.12	-	-	7.1	6.5	6.2	7.1	6.5	6.2
Critical Hdwy Stg 1	-	-	-	-	-	-	6.1	5.5	-	6.1	5.5	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.1	5.5	-	6.1	5.5	-
Follow-up Hdwy	2.209	-	-	2.218	-	-	3.5	4	3.3	3.5	4	3.3
Pot Cap-1 Maneuver	1028	-	-	738	-	-	76	99	549	79	98	331
Stage 1	-	-	-	-	-	-	476	480	-	285	314	-
Stage 2	-	-	-	-	-	-	275	313	-	472	475	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1028	-	-	738	-	-	~ 33	81	549	36	80	331
Mov Cap-2 Maneuver	-	-	-	-	-	-	~ 33	81	-	36	80	-
Stage 1	-	-	-	-	-	-	426	438	-	255	281	-
Stage 2	-	-	-	-	-	-	196	280	-	258	433	-

Approach	EB	WB	SE	NW
HCM Control Delay, s	0.5	0.8	$ 669.6	141.5
HCM LOS			F	F

Minor Lane/Major Mvmt	NWLn1	EBL	EBT	EBR	WBL	WBT	WBR	SELn1
Capacity (veh/h)	82	1028	-	-	738	-	-	123
HCM Lane V/C Ratio	0.818	0.052	-	-	0.062	-	-	2.306
HCM Control Delay (s)	141.5	8.7	0	-	10.2	0	-	$ 669.6
HCM Lane LOS	F	A	A	-	B	A	-	F
HCM 95th %tile Q(veh)	4.2	0.2	-	-	0.2	-	-	24.4

Notes

~: Volume exceeds capacity $: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Movement	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	60	180	240	390	280	0	150	470	100	190	370	370
Future Volume (vph)	60	180	240	390	280	0	150	470	100	190	370	370
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0		6.0	6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	3539	1583	3433	3539		1770	1863	1583	1787	1881	1599
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	3539	1583	3433	3539		1770	1863	1583	1787	1881	1599
Peak-hour factor, PHF	0.92	0.92	0.92	0.94	0.94	0.94	0.96	0.96	0.96	0.95	0.95	0.95
Adj. Flow (vph)	65	196	261	415	298	0	156	490	104	200	389	389
RTOR Reduction (vph)	0	0	212	0	0	0	0	0	72	0	0	129
Lane Group Flow (vph)	65	196	49	415	298	0	156	490	32	200	389	260
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	1%	1%	1%
Turn Type	Prot	NA	Perm	Prot	NA		Prot	NA	Perm	Prot	NA	pm+ov
Protected Phases	5	2		1	6		7	4		3	8	1
Permitted Phases			2						4			8
Actuated Green, G (s)	6.7	20.7	20.7	16.4	30.4		14.2	33.8	33.8	15.1	34.7	51.1
Effective Green, g (s)	6.7	20.7	20.7	16.4	30.4		14.2	33.8	33.8	15.1	34.7	51.1
Actuated g/C Ratio	0.06	0.19	0.19	0.15	0.28		0.13	0.31	0.31	0.14	0.32	0.46
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0		6.0	6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	107	665	297	511	978		228	572	486	245	593	830
v/s Ratio Prot	0.04	0.06		c0.12	c0.08		0.09	c0.26		c0.11	0.21	0.05
v/s Ratio Perm			0.03						0.02			0.12
v/c Ratio	0.61	0.29	0.17	0.81	0.30		0.68	0.86	0.07	0.82	0.66	0.31
Uniform Delay, d1	50.4	38.4	37.4	45.3	31.4		45.8	35.8	26.9	46.1	32.5	18.5
Progression Factor	1.00	1.00	1.00	1.23	0.97		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	9.4	1.1	1.2	9.2	0.2		8.2	12.0	0.1	18.6	2.6	0.2
Delay (s)	59.8	39.5	38.6	65.2	30.7		54.0	47.9	27.0	64.7	35.1	18.7
Level of Service	E	D	D	E	C		D	D	C	E	D	B
Approach Delay (s)		41.6			50.8			46.2			34.6	
Approach LOS		D			D			D			C	

Intersection Summary			
HCM 2000 Control Delay	42.7	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.72		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	24.0
Intersection Capacity Utilization	73.1%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	NWL	NWR	NET	NER	SWL	SWT
Lane Configurations						
Traffic Volume (vph)	60	80	760	370	90	870
Future Volume (vph)	60	80	760	370	90	870
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	180	0		0	180	
Storage Lanes	1	1		1	0	
Taper Length (ft)	25				25	
Lane Util. Factor	1.00	1.00	1.00	1.00	0.95	0.95
Ped Bike Factor						
Frt		0.850		0.850		
Flt Protected	0.950					0.995
Satd. Flow (prot)	1787	1599	1881	1599	0	3556
Flt Permitted	0.950					0.995
Satd. Flow (perm)	1787	1599	1881	1599	0	3556
Link Speed (mph)	30		30			30
Link Distance (ft)	403		387			233
Travel Time (s)	9.2		8.8			5.3
Confl. Peds. (#/hr)				370		
Peak Hour Factor	0.86	0.86	0.96	0.96	0.85	0.85
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%
Adj. Flow (vph)	70	93	792	385	106	1024
Shared Lane Traffic (%)						
Lane Group Flow (vph)	70	93	792	385	0	1130
Sign Control	Stop		Free			Free

Intersection Summary

Area Type: Other
Control Type: Unsignalized
Intersection Capacity Utilization 80.0% ICU Level of Service D
Analysis Period (min) 15

Intersection	
Int Delay, s/veh	57.2

Movement	NWL	NWR	NET	NER	SWL	SWT
Lane Configurations						
Traffic Vol, veh/h	60	80	760	370	90	870
Future Vol, veh/h	60	80	760	370	90	870
Conflicting Peds, #/hr	0	0	0	370	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	Yield	-	None
Storage Length	180	0	-	0	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	86	86	96	96	85	85
Heavy Vehicles, %	1	1	1	1	1	1
Mvmt Flow	70	93	792	385	106	1024

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1886	1162	0	0	1162	0
Stage 1	1162	-	-	-	-	-
Stage 2	724	-	-	-	-	-
Critical Hdwy	6.615	6.215	-	-	4.115	-
Critical Hdwy Stg 1	5.415	-	-	-	-	-
Critical Hdwy Stg 2	5.815	-	-	-	-	-
Follow-up Hdwy	3.5095	3.3095	-	-	2.2095	-
Pot Cap-1 Maneuver	70	238	-	-	604	-
Stage 1	299	-	-	-	-	-
Stage 2	444	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	~ 17	154	-	-	391	-
Mov Cap-2 Maneuver	~ 17	-	-	-	-	-
Stage 1	72	-	-	-	-	-
Stage 2	444	-	-	-	-	-

Approach	NW	NE	SW
HCM Control Delay, s	$ 827.6	0	5.8
HCM LOS	F		

Minor Lane/Major Mvmt	NET	NER	NWLn1	NWLn2	SWL	SWT
Capacity (veh/h)	-	-	17	154	391	-
HCM Lane V/C Ratio	-	-	4.104	0.604	0.271	-
HCM Control Delay (s)	-		$ 1852.6	58.8	17.6	4.6
HCM Lane LOS	-	-	F	F	C	A
HCM 95th %tile Q(veh)	-	-	9.4	3.2	1.1	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	130	895	5	10	620	60	15	10	15	20	10	110
Future Volume (vph)	130	895	5	10	620	60	15	10	15	20	10	110
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0			6.0	6.0		6.0	6.0
Lane Util. Factor	1.00	0.95		1.00	0.95			1.00	1.00		1.00	1.00
Frt	1.00	1.00		1.00	0.99			1.00	0.85		1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00			0.97	1.00		0.97	1.00
Satd. Flow (prot)	1787	3571		1787	3527			1844	1615		1821	1599
Flt Permitted	0.95	1.00		0.95	1.00			0.79	1.00		0.78	1.00
Satd. Flow (perm)	1787	3571		1787	3527			1505	1615		1476	1599
Peak-hour factor, PHF	0.97	0.97	0.97	0.95	0.95	0.95	0.90	0.90	0.90	0.80	0.80	0.80
Adj. Flow (vph)	134	923	5	11	653	63	17	11	17	25	12	138
RTOR Reduction (vph)	0	0	0	0	4	0	0	0	16	0	0	128
Lane Group Flow (vph)	134	928	0	11	712	0	0	28	1	0	38	10
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	0%	0%	0%	1%	1%	1%
Turn Type	Prot	NA		Prot	NA		Perm	NA	Perm	Perm	NA	Perm
Protected Phases	5	2		1	6			8			4	
Permitted Phases							8		8	4	4	4
Actuated Green, G (s)	13.5	82.3		1.5	70.3			8.2	8.2		8.2	8.2
Effective Green, g (s)	13.5	82.3		1.5	70.3			8.2	8.2		8.2	8.2
Actuated g/C Ratio	0.12	0.75		0.01	0.64			0.07	0.07		0.07	0.07
Clearance Time (s)	6.0	6.0		6.0	6.0			6.0	6.0		6.0	6.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	219	2671		24	2254			112	120		110	119
v/s Ratio Prot	c0.07	c0.26		0.01	0.20							
v/s Ratio Perm								0.02	0.00		c0.03	0.01
v/c Ratio	0.61	0.35		0.46	0.32			0.25	0.01		0.35	0.09
Uniform Delay, d1	45.8	4.7		53.8	9.0			48.0	47.1		48.4	47.4
Progression Factor	1.27	0.68		0.87	1.41			1.00	1.00		1.00	1.00
Incremental Delay, d2	4.5	0.3		12.3	0.3			1.2	0.0		1.9	0.3
Delay (s)	62.5	3.5		59.0	13.0			49.2	47.2		50.2	47.7
Level of Service	E	A		E	B			D	D		D	D
Approach Delay (s)		11.0			13.7			48.4			48.3	
Approach LOS		B			B			D			D	

Intersection Summary				
HCM 2000 Control Delay	16.1	HCM 2000 Level of Service	B	
HCM 2000 Volume to Capacity ratio	0.40			
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	18.0	
Intersection Capacity Utilization	52.4%	ICU Level of Service	A	
Analysis Period (min)	15			
c Critical Lane Group				

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	80	770	5	5	580	190	40	10	10	350	10	140
Future Volume (vph)	80	770	5	5	580	190	40	10	10	350	10	140
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	6.0
Lane Util. Factor	0.97	0.95		1.00	0.95		1.00	1.00		0.95	0.95	1.00
Frt	1.00	1.00		1.00	0.96		1.00	0.93		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	0.95	1.00
Satd. Flow (prot)	3467	3571		1770	3408		1805	1758		1715	1724	1615
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	0.95	1.00
Satd. Flow (perm)	3467	3571		1770	3408		1805	1758		1715	1724	1615
Peak-hour factor, PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.78	0.78	0.78	0.86	0.86	0.86
Adj. Flow (vph)	95	917	6	6	644	211	51	13	13	407	12	163
RTOR Reduction (vph)	0	0	0	0	23	0	0	12	0	0	0	113
Lane Group Flow (vph)	95	923	0	6	832	0	51	14	0	208	211	50
Heavy Vehicles (%)	1%	1%	1%	2%	2%	2%	0%	0%	0%	0%	0%	0%
Turn Type	Prot	NA		Prot	NA		Split	NA		Split	NA	pt+ov
Protected Phases	5	2		1	6		3	3		4	4	4 5
Permitted Phases		2			6							
Actuated Green, G (s)	8.4	57.6		1.4	50.6		7.4	7.4		19.6	19.6	34.0
Effective Green, g (s)	8.4	57.6		1.4	50.6		7.4	7.4		19.6	19.6	34.0
Actuated g/C Ratio	0.08	0.52		0.01	0.46		0.07	0.07		0.18	0.18	0.31
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	264	1869		22	1567		121	118		305	307	499
v/s Ratio Prot	c0.03	c0.26		0.00	c0.24		c0.03	0.01		0.12	c0.12	0.03
v/s Ratio Perm												
v/c Ratio	0.36	0.49		0.27	0.53		0.42	0.12		0.68	0.69	0.10
Uniform Delay, d1	48.2	16.8		53.8	21.2		49.2	48.2		42.3	42.3	27.1
Progression Factor	1.00	1.00		1.19	0.89		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	0.8	0.9		6.4	0.3		2.4	0.4		6.2	6.3	0.1
Delay (s)	49.1	17.8		70.3	19.1		51.6	48.7		48.4	48.6	27.2
Level of Service	D	B		E	B		D	D		D	D	C
Approach Delay (s)		20.7			19.5			50.6			42.5	
Approach LOS		C			B			D			D	

Intersection Summary			
HCM 2000 Control Delay	26.2	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.55		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	24.0
Intersection Capacity Utilization	57.9%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	30	900	550	60	30	20
Future Volume (vph)	30	900	550	60	30	20
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	140			0	0	0
Storage Lanes	1			0	1	0
Taper Length (ft)	25				25	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.987		0.946	
Flt Protected	0.950				0.971	
Satd. Flow (prot)	1770	1863	1839	0	1694	0
Flt Permitted	0.950				0.971	
Satd. Flow (perm)	1770	1863	1839	0	1694	0
Link Speed (mph)		30	30		30	
Link Distance (ft)		535	210		522	
Travel Time (s)		12.2	4.8		11.9	
Peak Hour Factor	0.91	0.91	0.90	0.90	0.75	0.75
Heavy Vehicles (%)	2%	2%	2%	2%	3%	3%
Adj. Flow (vph)	33	989	611	67	40	27
Shared Lane Traffic (%)						
Lane Group Flow (vph)	33	989	678	0	67	0
Sign Control		Free	Free		Stop	

Intersection Summary	
Area Type: Other	
Control Type: Unsignalized	
Intersection Capacity Utilization 57.4%	ICU Level of Service B
Analysis Period (min) 15	

Intersection	
Int Delay, s/veh	2.1

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	30	900	550	60	30	20
Future Vol, veh/h	30	900	550	60	30	20
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	140	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	91	91	90	90	75	75
Heavy Vehicles, %	2	2	2	2	3	3
Mvmt Flow	33	989	611	67	40	27

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	678	0	-	0	1700	645
Stage 1	-	-	-	-	645	-
Stage 2	-	-	-	-	1055	-
Critical Hdwy	4.12	-	-	-	6.43	6.23
Critical Hdwy Stg 1	-	-	-	-	5.43	-
Critical Hdwy Stg 2	-	-	-	-	5.43	-
Follow-up Hdwy	2.218	-	-	-	3.527	3.327
Pot Cap-1 Maneuver	914	-	-	-	101	470
Stage 1	-	-	-	-	520	-
Stage 2	-	-	-	-	333	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	914	-	-	-	97	470
Mov Cap-2 Maneuver	-	-	-	-	97	-
Stage 1	-	-	-	-	501	-
Stage 2	-	-	-	-	333	-

Approach	EB	WB	SB
HCM Control Delay, s	0.3	0	51
HCM LOS			F

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	914	-	-	-	142
HCM Lane V/C Ratio	0.036	-	-	-	0.469
HCM Control Delay (s)	9.1	-	-	-	51
HCM Lane LOS	A	-	-	-	F
HCM 95th %tile Q(veh)	0.1	-	-	-	2.2

Lane Group	WBL2	WBL	WBR	WBR2	NBL	NBT	NBR	NBR2	SBL2	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	10	410	280	30	40	140	120	5	10	280	150	25
Future Volume (vph)	10	410	280	30	40	140	120	5	10	280	150	25
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.943				0.945					0.993	
Flt Protected		0.972				0.993					0.970	
Satd. Flow (prot)	0	1724	0	0	0	1748	0	0	0	0	1812	0
Flt Permitted		0.972				0.993					0.970	
Satd. Flow (perm)	0	1724	0	0	0	1748	0	0	0	0	1812	0
Link Speed (mph)		30				30					30	
Link Distance (ft)		449				456					370	
Travel Time (s)		10.2				10.4					8.4	
Peak Hour Factor	0.91	0.91	0.91	0.91	0.87	0.87	0.87	0.87	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	1%	1%	1%	1%	2%	2%	2%	2%	1%	1%	1%	1%
Adj. Flow (vph)	11	451	308	33	46	161	138	6	11	304	163	27
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	803	0	0	0	351	0	0	0	0	505	0
Sign Control		Yield				Yield					Yield	

Intersection Summary

Area Type: Other
Control Type: Roundabout
Intersection Capacity Utilization 146.2% ICU Level of Service H
Analysis Period (min) 15

Lane Group	NEL	NET	NER	NER2	SWL2	SWL	SWT	SWR
Lane Configurations								
Traffic Volume (vph)	65	240	350	90	10	30	120	25
Future Volume (vph)	65	240	350	90	10	30	120	25
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.920					0.982	
Flt Protected		0.996					0.989	
Satd. Flow (prot)	0	1724	0	0	0	0	1809	0
Flt Permitted		0.996					0.989	
Satd. Flow (perm)	0	1724	0	0	0	0	1809	0
Link Speed (mph)		30					30	
Link Distance (ft)		390					523	
Travel Time (s)		8.9					11.9	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.91	0.91	0.91	0.91
Heavy Vehicles (%)	1%	1%	1%	1%	2%	2%	2%	2%
Adj. Flow (vph)	72	267	389	100	11	33	132	27
Shared Lane Traffic (%)								
Lane Group Flow (vph)	0	828	0	0	0	0	203	0
Sign Control		Yield					Yield	

Intersection Summary

Intersection	
Intersection Delay, s/veh	69.6
Intersection LOS	F

Approach	WB	NB	SB	NE	SW
Entry Lanes	1	1	1	1	1
Conflicting Circle Lanes	1	1	1	1	1
Adj Approach Flow, veh/h	803	351	505	828	203
Demand Flow Rate, veh/h	811	358	510	837	208
Vehicles Circulating, veh/h	706	1065	694	539	1062
Vehicles Exiting, veh/h	717	311	576	665	455
Ped Vol Crossing Leg, #/h	0	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000	1.000
Approach Delay, s/veh	128.7	33.4	23.3	68.9	16.3
Approach LOS	F	D	C	F	C

Lane	Left	Left	Left	Left	Left
Designated Moves	LR	LTR	LTR	LTR	LTR
Assumed Moves	LR	LTR	LTR	LTR	LTR
RT Channelized					
Lane Util	1.000	1.000	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976	4.976	4.976
Entry Flow, veh/h	811	358	510	837	208
Cap Entry Lane, veh/h	672	466	680	796	467
Entry HV Adj Factor	0.990	0.980	0.991	0.990	0.977
Flow Entry, veh/h	803	351	505	828	203
Cap Entry, veh/h	665	456	674	788	456
V/C Ratio	1.208	0.769	0.750	1.051	0.445
Control Delay, s/veh	128.7	33.4	23.3	68.9	16.3
LOS	F	D	C	F	C
95th %tile Queue, veh	28	7	7	20	2

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	10	30	330	5	30	20	310	330	10	10	130	10
Future Volume (vph)	10	30	330	5	30	20	310	330	10	10	130	10
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		50	0		0	0		0	0		0
Storage Lanes	0		1	0		0	0		0	0		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850		0.952			0.998			0.991	
Flt Protected		0.988			0.996			0.977			0.997	
Satd. Flow (prot)	0	1840	1583	0	1802	0	0	1834	0	0	1859	0
Flt Permitted		0.988			0.996			0.977			0.997	
Satd. Flow (perm)	0	1840	1583	0	1802	0	0	1834	0	0	1859	0
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		168			453			475			436	
Travel Time (s)		3.8			10.3			10.8			9.9	
Peak Hour Factor	0.88	0.88	0.88	0.82	0.82	0.82	0.93	0.93	0.93	0.91	0.91	0.91
Heavy Vehicles (%)	2%	2%	2%	0%	0%	0%	1%	1%	1%	1%	1%	1%
Adj. Flow (vph)	11	34	375	6	37	24	333	355	11	11	143	11
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	45	375	0	67	0	0	699	0	0	165	0
Sign Control		Stop			Stop			Free			Free	

Intersection Summary		
Area Type: Other		
Control Type: Unsignalized		
Intersection Capacity Utilization 60.3%		ICU Level of Service B
Analysis Period (min) 15		

Intersection												
Int Delay, s/veh	9.6											

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	10	30	330	5	30	20	310	330	10	10	130	10
Future Vol, veh/h	10	30	330	5	30	20	310	330	10	10	130	10
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	50	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	88	88	88	82	82	82	93	93	93	91	91	91
Heavy Vehicles, %	2	2	2	0	0	0	1	1	1	1	1	1
Mvmt Flow	11	34	375	6	37	24	333	355	11	11	143	11

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1228	1203	149	1402	1203	361	154	0	0	366	0	0
Stage 1	171	171	-	1027	1027	-	-	-	-	-	-	-
Stage 2	1057	1032	-	375	176	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.1	6.5	6.2	4.11	-	-	4.11	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.1	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.1	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.5	4	3.3	2.209	-	-	2.209	-	-
Pot Cap-1 Maneuver	155	184	898	119	186	688	1433	-	-	1198	-	-
Stage 1	831	757	-	285	314	-	-	-	-	-	-	-
Stage 2	272	310	-	650	757	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	91	129	898	43	130	688	1433	-	-	1198	-	-
Mov Cap-2 Maneuver	91	129	-	43	130	-	-	-	-	-	-	-
Stage 1	588	749	-	202	222	-	-	-	-	-	-	-
Stage 2	155	219	-	358	749	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	16.5	49.1	3.9	0.5
HCM LOS	C	E		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1433	-	-	117	898	146	1198	-	-
HCM Lane V/C Ratio	0.233	-	-	0.389	0.418	0.459	0.009	-	-
HCM Control Delay (s)	8.3	0	-	54.1	11.9	49.1	8	0	-
HCM Lane LOS	A	A	-	F	B	E	A	A	-
HCM 95th %tile Q(veh)	0.9	-	-	1.6	2.1	2.1	0	-	-

Movement	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations	↰	↱		↰	↑	↱	↰	↱		↰	↱	
Traffic Volume (vph)	30	80	40	40	50	130	190	680	70	20	340	40
Future Volume (vph)	30	80	40	40	50	130	190	680	70	20	340	40
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	0.95		1.00	1.00	0.85	1.00	0.99		1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	1770		1787	1881	1599	1805	1873		1805	1870	
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	1770		1787	1881	1599	1805	1873		1805	1870	
Peak-hour factor, PHF	0.99	0.99	0.99	0.95	0.95	0.95	0.89	0.89	0.89	0.93	0.93	0.93
Adj. Flow (vph)	30	81	40	42	53	137	213	764	79	22	366	43
RTOR Reduction (vph)	0	22	0	0	0	85	0	4	0	0	5	0
Lane Group Flow (vph)	30	99	0	42	53	52	213	839	0	22	404	0
Heavy Vehicles (%)	2%	2%	2%	1%	1%	1%	0%	0%	0%	0%	0%	0%
Turn Type	Prot	NA		Prot	NA	pt+ov	Prot	NA		Prot	NA	
Protected Phases	1	6		5	2	2 3	3	8		7	4	
Permitted Phases		6			2							
Actuated Green, G (s)	2.7	9.4		4.2	10.9	28.6	11.7	34.7		2.7	25.7	
Effective Green, g (s)	2.7	9.4		4.2	10.9	28.6	11.7	34.7		2.7	25.7	
Actuated g/C Ratio	0.04	0.13		0.06	0.15	0.38	0.16	0.46		0.04	0.34	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	63	221		100	273	609	281	866		64	640	
v/s Ratio Prot	0.02	c0.06		c0.02	0.03	0.03	c0.12	c0.45		0.01	0.22	
v/s Ratio Perm												
v/c Ratio	0.48	0.45		0.42	0.19	0.09	0.76	0.97		0.34	0.63	
Uniform Delay, d1	35.5	30.4		34.2	28.2	14.8	30.3	19.6		35.3	20.7	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	5.6	1.4		2.8	1.6	0.1	11.1	22.9		3.2	2.0	
Delay (s)	41.0	31.8		37.1	29.8	14.9	41.4	42.5		38.5	22.7	
Level of Service	D	C		D	C	B	D	D		D	C	
Approach Delay (s)		33.7			22.3			42.3			23.5	
Approach LOS		C			C			D			C	

Intersection Summary			
HCM 2000 Control Delay	34.8	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	75.0	Sum of lost time (s)	24.0
Intersection Capacity Utilization	70.6%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	480	5	10	310	190	310
Future Volume (vph)	480	5	10	310	190	310
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.998				0.916	
Flt Protected	0.953			0.999		
Satd. Flow (prot)	1789	0	0	1861	1690	0
Flt Permitted	0.953			0.999		
Satd. Flow (perm)	1789	0	0	1861	1690	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	348			709	425	
Travel Time (s)	7.9			16.1	9.7	
Peak Hour Factor	0.90	0.90	0.87	0.87	0.89	0.89
Heavy Vehicles (%)	1%	1%	2%	2%	3%	3%
Adj. Flow (vph)	533	6	11	356	213	348
Shared Lane Traffic (%)						
Lane Group Flow (vph)	539	0	0	367	561	0
Sign Control	Stop			Free	Free	

Intersection Summary	
Area Type: Other	
Control Type: Unsignalized	
Intersection Capacity Utilization 62.6%	ICU Level of Service B
Analysis Period (min) 15	

Intersection						
Int Delay, s/veh	90.9					

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	480	5	10	310	190	310
Future Vol, veh/h	480	5	10	310	190	310
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	87	87	89	89
Heavy Vehicles, %	1	1	2	2	3	3
Mvmt Flow	533	6	11	356	213	348

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	765	387	561	0	-	0
Stage 1	387	-	-	-	-	-
Stage 2	378	-	-	-	-	-
Critical Hdwy	6.41	6.21	4.12	-	-	-
Critical Hdwy Stg 1	5.41	-	-	-	-	-
Critical Hdwy Stg 2	5.41	-	-	-	-	-
Follow-up Hdwy	3.509	3.309	2.218	-	-	-
Pot Cap-1 Maneuver	~ 373	663	1010	-	-	-
Stage 1	688	-	-	-	-	-
Stage 2	695	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	~ 368	663	1010	-	-	-
Mov Cap-2 Maneuver	~ 368	-	-	-	-	-
Stage 1	678	-	-	-	-	-
Stage 2	695	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	247.5	0.3	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1010	-	370	-	-
HCM Lane V/C Ratio	0.011	-	1.456	-	-
HCM Control Delay (s)	8.6	0	247.5	-	-
HCM Lane LOS	A	A	F	-	-
HCM 95th %tile Q(veh)	0	-	28.3	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

APPENDIX S-3: 2040 ALTERNATIVE F INTERSECTION CAPACITY ANALYSES – SYNCHRO PRINTOUTS – AM PEAK HOUR

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑↑		↰	↱↱
Traffic Volume (vph)	0	1355	685	0	855	805
Future Volume (vph)	0	1355	685	0	855	805
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	16	12
Lane Util. Factor	1.00	0.95	0.95	1.00	1.00	0.88
Frt						0.850
Flt Protected					0.950	
Satd. Flow (prot)	0	3471	3406	0	1930	2682
Flt Permitted					0.950	
Satd. Flow (perm)	0	3471	3406	0	1930	2682
Right Turn on Red				Yes		No
Satd. Flow (RTOR)						
Link Speed (mph)		30	30		25	
Link Distance (ft)		712	388		212	
Travel Time (s)		16.2	8.8		5.8	
Peak Hour Factor	0.93	0.93	0.88	0.88	0.89	0.89
Heavy Vehicles (%)	4%	4%	6%	6%	6%	6%
Adj. Flow (vph)	0	1457	778	0	961	904
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	1457	778	0	961	904
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(ft)		24	24		16	
Link Offset(ft)		0	0		0	
Crosswalk Width(ft)		16	16		16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	0.85	1.00
Turning Speed (mph)	15			9	15	9
Number of Detectors		3	3		3	3
Detector Template		Thru	Thru		Left	
Leading Detector (ft)		256	256		256	256
Trailing Detector (ft)		-5	-5		-5	-5
Detector 1 Position(ft)		-5	-5		-5	-5
Detector 1 Size(ft)		50	50		50	50
Detector 1 Type		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex
Detector 1 Channel						
Detector 1 Extend (s)		0.0	0.0		0.0	0.0
Detector 1 Queue (s)		0.0	0.0		0.0	0.0
Detector 1 Delay (s)		0.0	0.0		0.0	0.0
Detector 2 Position(ft)		125	125		125	125
Detector 2 Size(ft)		6	6		6	6
Detector 2 Type		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex
Detector 2 Channel						
Detector 2 Extend (s)		0.0	0.0		0.0	0.0
Detector 3 Position(ft)		250	250		250	250
Detector 3 Size(ft)		6	6		6	6
Detector 3 Type		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex
Detector 3 Channel						

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Detector 3 Extend (s)		0.0	0.0		0.0	0.0
Turn Type		NA	NA		Prot	Prot
Protected Phases		2	6		4	4
Permitted Phases						
Detector Phase		2	6		4	4
Switch Phase						
Minimum Initial (s)		8.0	8.0		5.0	5.0
Minimum Split (s)		14.0	21.0		27.0	27.0
Total Split (s)		35.0	35.0		40.0	40.0
Total Split (%)		46.7%	46.7%		53.3%	53.3%
Maximum Green (s)		29.0	29.0		34.0	34.0
Yellow Time (s)		2.0	2.0		2.0	2.0
All-Red Time (s)		4.0	4.0		4.0	4.0
Lost Time Adjust (s)		0.0	0.0		0.0	0.0
Total Lost Time (s)		6.0	6.0		6.0	6.0
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)		3.0	3.0		3.0	3.0
Recall Mode		C-Min	C-Min		None	None
Walk Time (s)			7.0		7.0	7.0
Flash Dont Walk (s)			8.0		14.0	14.0
Pedestrian Calls (#/hr)			0		0	0
Act Effct Green (s)		29.0	29.0		34.0	34.0
Actuated g/C Ratio		0.39	0.39		0.45	0.45
v/c Ratio		1.09	0.59		1.10	0.74
Control Delay		69.3	17.5		84.4	21.6
Queue Delay		0.0	0.0		0.0	0.0
Total Delay		69.3	17.5		84.4	21.6
LOS		E	B		F	C
Approach Delay		69.3	17.5		53.9	
Approach LOS		E	B		D	
Queue Length 50th (ft)		~485	388		~517	188
Queue Length 95th (ft)		m#586	m366		#722	261
Internal Link Dist (ft)		632	308		132	
Turn Bay Length (ft)						
Base Capacity (vph)		1342	1316		874	1215
Starvation Cap Reductn		0	0		0	0
Spillback Cap Reductn		0	0		0	0
Storage Cap Reductn		0	0		0	0
Reduced v/c Ratio		1.09	0.59		1.10	0.74

Intersection Summary

Area Type: Other
Cycle Length: 75
Actuated Cycle Length: 75
Offset: 0 (0%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow, Master Intersection
Natural Cycle: 120
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 1.10

Intersection Signal Delay: 52.5
Intersection LOS: D
Intersection Capacity Utilization 96.8%
ICU Level of Service F
Analysis Period (min) 15

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 7: NH 102 & Exit 4 SB Off

Lane Group	NBL2	NBL	NBR	SEL	SER	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations	↰↰		↱↱			↰↰	↑↑			↑↑	↱
Traffic Volume (vph)	455	0	365	0	0	1165	1045	0	0	1295	1155
Future Volume (vph)	455	0	365	0	0	1165	1045	0	0	1295	1155
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)		0	0	0	0	550		0	0		0
Storage Lanes		2	2	0	0	2		0	0		1
Taper Length (ft)		25		25		25			25		
Lane Util. Factor	0.97	1.00	0.88	1.00	1.00	0.97	0.95	1.00	1.00	0.95	1.00
Frt			0.850								0.850
Flt Protected	0.950					0.950					
Satd. Flow (prot)	3242	0	2632	0	0	3335	3438	0	0	3505	1568
Flt Permitted	0.950					0.950					
Satd. Flow (perm)	3242	0	2632	0	0	3335	3438	0	0	3505	1568
Right Turn on Red			No					Yes			Yes
Satd. Flow (RTOR)											447
Link Speed (mph)		25		30			30			30	
Link Distance (ft)		856		390			760			857	
Travel Time (s)		23.3		8.9			17.3			19.5	
Peak Hour Factor	0.88	0.88	0.88	0.92	0.92	0.94	0.94	0.94	0.92	0.92	0.92
Heavy Vehicles (%)	8%	8%	8%	2%	2%	5%	5%	5%	3%	3%	3%
Adj. Flow (vph)	517	0	415	0	0	1239	1112	0	0	1408	1255
Shared Lane Traffic (%)											
Lane Group Flow (vph)	517	0	415	0	0	1239	1112	0	0	1408	1255
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Right	Left	Left	Right	Left	Right	Right
Median Width(ft)		24		0			24			24	
Link Offset(ft)		12		0			0			0	
Crosswalk Width(ft)		16		16			16			16	
Two way Left Turn Lane											
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15	15	25	15	9	15		9	15		25
Number of Detectors	3		3			3	3			3	0
Detector Template											
Leading Detector (ft)	256		256			256	256			256	0
Trailing Detector (ft)	-5		-5			-5	-5			-5	0
Detector 1 Position(ft)	-5		-5			-5	-5			-5	-5
Detector 1 Size(ft)	55		55			55	55			55	50
Detector 1 Type	Cl+Ex		Cl+Ex			Cl+Ex	Cl+Ex			Cl+Ex	Cl+Ex
Detector 1 Channel											
Detector 1 Extend (s)	0.0		0.0			0.0	0.0			0.0	0.0
Detector 1 Queue (s)	0.0		0.0			0.0	0.0			0.0	0.0
Detector 1 Delay (s)	0.0		0.0			0.0	0.0			0.0	0.0
Detector 2 Position(ft)	125		125			125	125			125	
Detector 2 Size(ft)	6		6			6	6			6	
Detector 2 Type	Cl+Ex		Cl+Ex			Cl+Ex	Cl+Ex			Cl+Ex	
Detector 2 Channel											
Detector 2 Extend (s)	0.0		0.0			0.0	0.0			0.0	
Detector 3 Position(ft)	250		250			250	250			250	
Detector 3 Size(ft)	6		6			6	6			6	

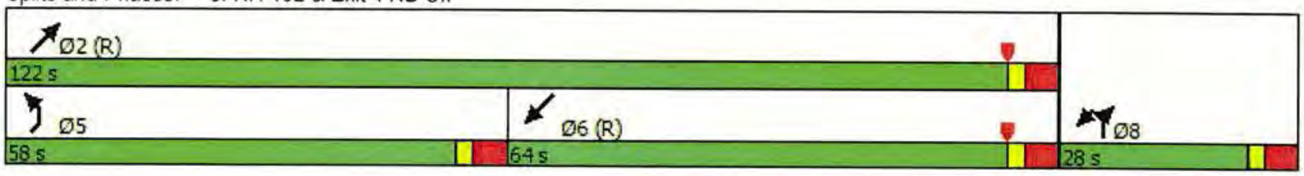
Lane Group	NBL2	NBL	NBR	SEL	SER	NEL	NET	NER	SWL	SWT	SWR
Detector 3 Type	Cl+Ex		Cl+Ex			Cl+Ex	Cl+Ex			Cl+Ex	
Detector 3 Channel											
Detector 3 Extend (s)	0.0		0.0			0.0	0.0			0.0	
Turn Type	Prot		Prot			Prot	NA			NA	Free
Protected Phases	8		8			5	2			6	
Permitted Phases											Free
Detector Phase	8		2			5	2			6	
Switch Phase											
Minimum Initial (s)	10.0		10.0			5.0	8.0			8.0	
Minimum Split (s)	16.0		16.0			11.0	42.0			31.0	
Total Split (s)	28.0		28.0			58.0	122.0			64.0	
Total Split (%)	18.7%		18.7%			38.7%	81.3%			42.7%	
Maximum Green (s)	22.0		22.0			52.0	116.0			58.0	
Yellow Time (s)	2.0		2.0			2.0	2.0			2.0	
All-Red Time (s)	4.0		4.0			4.0	4.0			4.0	
Lost Time Adjust (s)	0.0		0.0			0.0	0.0			0.0	
Total Lost Time (s)	6.0		6.0			6.0	6.0			6.0	
Lead/Lag						Lead				Lag	
Lead-Lag Optimize?											
Vehicle Extension (s)	3.0		3.0			3.0	3.0			3.0	
Recall Mode	None		None			None	C-Min			C-Min	
Walk Time (s)							7.0			7.0	
Flash Dont Walk (s)							29.0			17.0	
Pedestrian Calls (#/hr)							0			0	
Act Effct Green (s)	22.0		22.0			52.0	116.0			58.0	150.0
Actuated g/C Ratio	0.15		0.15			0.35	0.77			0.39	1.00
v/c Ratio	1.09		1.08			1.07	0.42			1.04	0.80
Control Delay	125.3		125.9			73.9	5.6			79.7	4.4
Queue Delay	0.0		0.0			0.0	0.0			0.0	0.0
Total Delay	125.3		125.9			73.9	5.6			79.7	4.4
LOS	F		F			E	A			E	A
Approach Delay		125.6					41.6			44.2	
Approach LOS		F					D			D	
Queue Length 50th (ft)	~291		~255			~682	152			~780	0
Queue Length 95th (ft)	#395		#365			m518	m135			#919	0
Internal Link Dist (ft)		776		310			680			777	
Turn Bay Length (ft)						550					
Base Capacity (vph)	475		386			1156	2658			1355	1568
Starvation Cap Reductn	0		0			0	0			0	0
Spillback Cap Reductn	0		0			0	0			0	0
Storage Cap Reductn	0		0			0	0			0	0
Reduced v/c Ratio	1.09		1.08			1.07	0.42			1.04	0.80

Intersection Summary

Area Type: Other
Cycle Length: 150
Actuated Cycle Length: 150
Offset: 15 (10%), Referenced to phase 2:NET and 6:SWT, Start of Yellow
Natural Cycle: 140

Control Type: Actuated-Coordinated
Maximum v/c Ratio: 1.09
Intersection Signal Delay: 55.9 Intersection LOS: E
Intersection Capacity Utilization 98.0% ICU Level of Service F
Analysis Period (min) 15
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 8: NH 102 & Exit 4 NB Off



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	795	360	390	615	0	0	0	0	495	0	500
Future Volume (vph)	0	795	360	390	615	0	0	0	0	495	0	500
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		350	0		0	0		0	0		0
Storage Lanes	0		1	1		0	0		0	2		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	0.97	1.00	1.00
Frt			0.850									0.850
Flt Protected				0.950						0.950		
Satd. Flow (prot)	0	3167	1417	1687	3374	0	0	0	0	3303	0	1524
Flt Permitted				0.950						0.950		
Satd. Flow (perm)	0	3167	1417	1687	3374	0	0	0	0	3303	0	1524
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			357									177
Link Speed (mph)		30			30			30			35	
Link Distance (ft)		851			693			486			581	
Travel Time (s)		19.3			15.8			11.0			11.3	
Peak Hour Factor	0.92	0.92	0.92	0.73	0.73	0.73	0.92	0.92	0.92	0.74	0.74	0.74
Heavy Vehicles (%)	14%	14%	14%	7%	7%	7%	2%	2%	2%	6%	6%	6%
Adj. Flow (vph)	0	864	391	534	842	0	0	0	0	669	0	676
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	864	391	534	842	0	0	0	0	669	0	676
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Right	Right	Left	Left	Right	Left	Left	Right	R NA	Left	Right
Median Width(ft)		36			36			24			24	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		25	15		9	15		9	15		9
Number of Detectors		3	2	3	3					3		2
Detector Template		Thru	Right	Left	Thru					Left		
Leading Detector (ft)		256	131	256	256					256		206
Trailing Detector (ft)		-5	-5	-5	-5					-5		-5
Detector 1 Position(ft)		-5	-5	-5	-5					-5		-5
Detector 1 Size(ft)		50	50	50	50					50		50
Detector 1 Type		Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex					Cl+Ex		Cl+Ex
Detector 1 Channel												
Detector 1 Extend (s)		0.0	0.0	0.0	0.0					0.0		0.0
Detector 1 Queue (s)		0.0	0.0	0.0	0.0					0.0		0.0
Detector 1 Delay (s)		0.0	0.0	0.0	0.0					0.0		0.0
Detector 2 Position(ft)		125	125	125	125					125		200
Detector 2 Size(ft)		6	6	6	6					6		6
Detector 2 Type		Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex					Cl+Ex		Cl+Ex
Detector 2 Channel												
Detector 2 Extend (s)		0.0	0.0	0.0	0.0					0.0		0.0
Detector 3 Position(ft)		250		250	250					250		
Detector 3 Size(ft)		6		6	6					6		

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Detector 3 Type		Cl+Ex		Cl+Ex	Cl+Ex					Cl+Ex		
Detector 3 Channel												
Detector 3 Extend (s)		0.0		0.0	0.0					0.0		
Turn Type		NA	Free	Prot	NA					Prot		Prot
Protected Phases		2		1	6					4		4
Permitted Phases			Free									
Detector Phase		2		1	6					4		4
Switch Phase												
Minimum Initial (s)		9.0		4.0	9.0					4.0		4.0
Minimum Split (s)		21.0		10.0	21.0					10.0		10.0
Total Split (s)		41.0		44.0	85.0					45.0		45.0
Total Split (%)		31.5%		33.8%	65.4%					34.6%		34.6%
Maximum Green (s)		35.0		38.0	79.0					39.0		39.0
Yellow Time (s)		4.0		4.0	4.0					4.0		4.0
All-Red Time (s)		2.0		2.0	2.0					2.0		2.0
Lost Time Adjust (s)		0.0		0.0	0.0					0.0		0.0
Total Lost Time (s)		6.0		6.0	6.0					6.0		6.0
Lead/Lag		Lag		Lead								
Lead-Lag Optimize?												
Vehicle Extension (s)		5.0		3.0	5.0					3.0		3.0
Recall Mode		C-Min		None	C-Min					None		None
Walk Time (s)		7.0			7.0							
Flash Dont Walk (s)		8.0			8.0							
Pedestrian Calls (#/hr)		0			0							
Act Effct Green (s)		35.0	130.0	38.0	79.0					39.0		39.0
Actuated g/C Ratio		0.27	1.00	0.29	0.61					0.30		0.30
v/c Ratio		1.01	0.28	1.08	0.41					0.68		1.16
Control Delay		81.3	0.5	74.9	1.3					44.0		121.9
Queue Delay		0.0	0.0	0.0	0.0					0.0		0.0
Total Delay		81.3	0.5	74.9	1.3					44.0		121.9
LOS		F	A	E	A					D		F
Approach Delay		56.1			29.9						83.2	
Approach LOS		E			C						F	
Queue Length 50th (ft)		~393	0	76	13					255		~566
Queue Length 95th (ft)		#534	0	m61	m11					251		#550
Internal Link Dist (ft)		771			613			406			501	
Turn Bay Length (ft)			350									
Base Capacity (vph)		852	1417	493	2050					990		581
Starvation Cap Reductn		0	0	0	0					0		0
Spillback Cap Reductn		0	0	0	0					0		0
Storage Cap Reductn		0	0	0	0					0		0
Reduced v/c Ratio		1.01	0.28	1.08	0.41					0.68		1.16

Intersection Summary	
Area Type:	Other
Cycle Length: 130	
Actuated Cycle Length: 130	
Offset: 67 (52%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow	
Natural Cycle: 130	

Lanes, Volumes, Timings
3 ~~2~~: Exit 5 SB On/Exit 5 SB Off & NH 28

01/23/2018

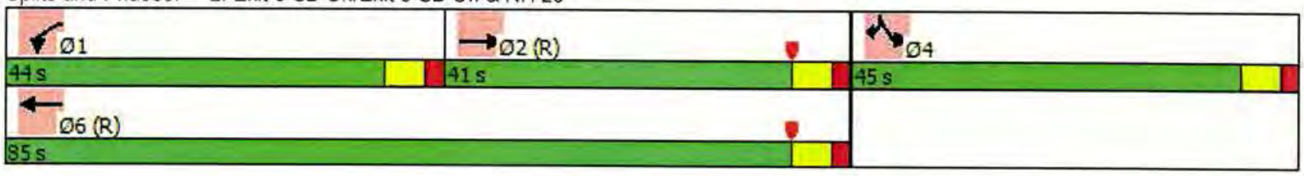
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 1.16
Intersection Signal Delay: 56.2 — Intersection LOS: E
Intersection Capacity Utilization 85.2% — ICU Level of Service E
Analysis Period (min) 15

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 2: Exit 5 SB On/Exit 5 SB Off & NH 28



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑			↑↑	↱	↰		↱			
Traffic Volume (vph)	605	685	0	0	625	790	380	0	160	0	0	0
Future Volume (vph)	605	685	0	0	625	790	380	0	160	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt						0.850			0.850			
Flt Protected	0.950						0.950					
Satd. Flow (prot)	1641	3282	0	0	3438	1538	1656	0	1482	0	0	0
Flt Permitted	0.950						0.950					
Satd. Flow (perm)	1641	3282	0	0	3438	1538	1656	0	1482	0	0	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						642			175			
Link Speed (mph)		30			30			35			30	
Link Distance (ft)		693			542			867			392	
Travel Time (s)		15.8			12.3			16.9			8.9	
Peak Hour Factor	0.87	0.87	0.87	0.90	0.90	0.90	0.78	0.78	0.78	0.92	0.92	0.92
Heavy Vehicles (%)	10%	10%	10%	5%	5%	5%	9%	9%	9%	2%	2%	2%
Adj. Flow (vph)	695	787	0	0	694	878	487	0	205	0	0	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	695	787	0	0	694	878	487	0	205	0	0	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Right	Right	Right	Left	Right	Left	Left	Right
Median Width(ft)		36			42			12			12	
Link Offset(ft)		0			0			0			36	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		25	15		9	15		9
Number of Detectors	3	3			3	2	3		0			
Detector Template	Left	Thru			Thru	Right	Left					
Leading Detector (ft)	256	256			256	131	256		0			
Trailing Detector (ft)	-5	-5			-5	-5	-5		0			
Detector 1 Position(ft)	-5	-5			-5	-5	-5		-5			
Detector 1 Size(ft)	50	50			50	50	50		50			
Detector 1 Type	Cl+Ex	Cl+Ex			Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex			
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0			0.0	0.0	0.0		0.0			
Detector 1 Queue (s)	0.0	0.0			0.0	0.0	0.0		0.0			
Detector 1 Delay (s)	0.0	0.0			0.0	0.0	0.0		0.0			
Detector 2 Position(ft)	125	125			125	125	125					
Detector 2 Size(ft)	6	6			6	6	6					
Detector 2 Type	Cl+Ex	Cl+Ex			Cl+Ex	Cl+Ex	Cl+Ex					
Detector 2 Channel												
Detector 2 Extend (s)	0.0	0.0			0.0	0.0	0.0					
Detector 3 Position(ft)	250	250			250		250					
Detector 3 Size(ft)	6	6			6		6					
Detector 3 Type	Cl+Ex	Cl+Ex			Cl+Ex		Cl+Ex					
Detector 3 Channel												
Detector 3 Extend (s)	0.0	0.0			0.0		0.0					

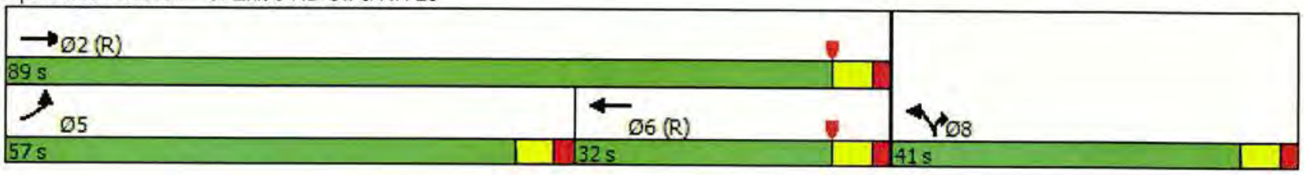
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Type	Prot	NA			NA	Free	Prot		Prot			
Protected Phases	5	2			6		8		8			
Permitted Phases		2			6	Free						
Detector Phase	5	2			6		8		8			
Switch Phase												
Minimum Initial (s)	4.0	16.0			16.0		4.0		4.0			
Minimum Split (s)	10.0	23.0			23.0		10.0		10.0			
Total Split (s)	57.0	89.0			32.0		41.0		41.0			
Total Split (%)	43.8%	68.5%			24.6%		31.5%		31.5%			
Maximum Green (s)	51.0	83.0			26.0		35.0		35.0			
Yellow Time (s)	4.0	4.0			4.0		4.0		4.0			
All-Red Time (s)	2.0	2.0			2.0		2.0		2.0			
Lost Time Adjust (s)	0.0	0.0			0.0		0.0		0.0			
Total Lost Time (s)	6.0	6.0			6.0		6.0		6.0			
Lead/Lag	Lead				Lag							
Lead-Lag Optimize?												
Vehicle Extension (s)	5.0	5.0			5.0		3.0		3.0			
Recall Mode	None	C-Min			C-Min		None		None			
Walk Time (s)		7.0			7.0							
Flash Dont Walk (s)		10.0			10.0							
Pedestrian Calls (#/hr)		0			0							
Act Effct Green (s)	51.0	83.0			26.0	130.0	35.0		35.0			
Actuated g/C Ratio	0.39	0.64			0.20	1.00	0.27		0.27			
v/c Ratio	1.08	0.38			1.01	0.57	1.09		0.39			
Control Delay	56.7	0.3			88.3	1.5	115.0		10.5			
Queue Delay	0.0	0.0			0.0	0.0	0.0		0.0			
Total Delay	56.7	0.3			88.3	1.5	115.0		10.5			
LOS	E	A			F	A	F		B			
Approach Delay		26.8			39.8			84.0				
Approach LOS		C			D			F				
Queue Length 50th (ft)	~238	0			~315	0	~462		19			
Queue Length 95th (ft)	m#195	m0			#447	0	#536		54			
Internal Link Dist (ft)		613			462			787			312	
Turn Bay Length (ft)												
Base Capacity (vph)	643	2095			687	1538	445		526			
Starvation Cap Reductn	0	0			0	0	0		0			
Spillback Cap Reductn	0	0			0	0	0		0			
Storage Cap Reductn	0	0			0	0	0		0			
Reduced v/c Ratio	1.08	0.38			1.01	0.57	1.09		0.39			

Intersection Summary

Area Type: Other
Cycle Length: 130
Actuated Cycle Length: 130
Offset: 0 (0%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow, Master Intersection
Natural Cycle: 130
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 1.09
Intersection Signal Delay: 42.8 Intersection LOS: D

Intersection Capacity Utilization 85.2% ICU Level of Service E
Analysis Period (min) 15
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 3: Exit 5 NB Off & NH 28



Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	10	0	120	0	1	0	160	780	5	10	1550	40
Future Volume (vph)	10	0	120	0	1	0	160	780	5	10	1550	40
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		180	0		0	360		0	65		0
Storage Lanes	0		1	0		0	1		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00	0.95	0.95
Frt			0.850					0.999			0.996	
Flt Protected		0.950					0.950			0.950		
Satd. Flow (prot)	0	1770	1583	0	1900	0	1770	3536	0	1770	3525	0
Flt Permitted							0.950			0.950		
Satd. Flow (perm)	0	1863	1583	0	1900	0	1770	3536	0	1770	3525	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			164					1			3	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		593			447			750			186	
Travel Time (s)		13.5			10.2			17.0			4.2	
Peak Hour Factor	0.92	0.92	0.92	0.25	0.25	0.25	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	2%	2%	2%	0%	0%	0%	2%	2%	2%	2%	2%	2%
Adj. Flow (vph)	11	0	130	0	4	0	174	848	5	11	1685	43
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	11	130	0	4	0	174	853	0	11	1728	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	3	3	1	3	1		3	3		3	3	
Detector Template	Left	Thru	Right	Left			Left	Thru		Left	Thru	
Leading Detector (ft)	256	256	45	256	45		256	256		256	256	
Trailing Detector (ft)	-5	-5	-5	-5	-5		-5	-5		-5	-5	
Detector 1 Position(ft)	-5	-5	-5	-5	-5		-5	-5		-5	-5	
Detector 1 Size(ft)	50	50	50	50	50		50	50		50	50	
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(ft)	125	125		125			125	125		125	125	
Detector 2 Size(ft)	6	6		6			6	6		6	6	
Detector 2 Type	Cl+Ex	Cl+Ex		Cl+Ex			Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)	0.0	0.0		0.0			0.0	0.0		0.0	0.0	
Detector 3 Position(ft)	250	250		250			250	250		250	250	
Detector 3 Size(ft)	6	6		6			6	6		6	6	

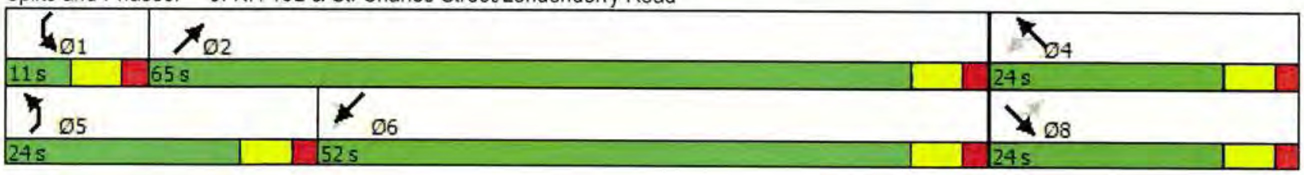
Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Detector 3 Type	Cl+Ex	Cl+Ex		Cl+Ex			Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 3 Channel												
Detector 3 Extend (s)	0.0	0.0		0.0			0.0	0.0		0.0	0.0	
Turn Type	Perm	NA	custom		NA		Prot	NA		Prot	NA	
Protected Phases		8			4		5	2		1	6	
Permitted Phases	8		6	4								
Detector Phase	8	8	6	4	4		5	2		1	6	
Switch Phase												
Minimum Initial (s)	5.0	5.0	8.0	5.0	5.0		5.0	8.0		5.0	8.0	
Minimum Split (s)	24.0	24.0	24.0	24.0	24.0		24.0	24.0		11.0	24.0	
Total Split (s)	24.0	24.0	52.0	24.0	24.0		24.0	65.0		11.0	52.0	
Total Split (%)	24.0%	24.0%	52.0%	24.0%	24.0%		24.0%	65.0%		11.0%	52.0%	
Maximum Green (s)	18.0	18.0	46.0	18.0	18.0		18.0	59.0		5.0	46.0	
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)		0.0	0.0		0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)		6.0	6.0		6.0		6.0	6.0		6.0	6.0	
Lead/Lag			Lag				Lead	Lag		Lead	Lag	
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None	Min	None	None		None	Min		None	Min	
Walk Time (s)	7.0	7.0	7.0	7.0	7.0		7.0	7.0			7.0	
Flash Dont Walk (s)	11.0	11.0	11.0	11.0	11.0		11.0	11.0			11.0	
Pedestrian Calls (#/hr)	0	0	0	0	0		0	0			0	
Act Effct Green (s)		6.4	49.2		6.1		12.6	71.1		5.1	49.2	
Actuated g/C Ratio		0.08	0.64		0.08		0.17	0.93		0.07	0.64	
v/c Ratio		0.07	0.12		0.03		0.59	0.26		0.09	0.76	
Control Delay		35.2	1.3		35.0		38.1	2.1		37.9	14.5	
Queue Delay		0.0	0.0		0.0		0.0	0.0		0.0	0.0	
Total Delay		35.2	1.3		35.0		38.1	2.1		37.9	14.5	
LOS		D	A		C		D	A		D	B	
Approach Delay		4.0			35.0			8.2			14.7	
Approach LOS		A			C			A			B	
Queue Length 50th (ft)		4	0		2		70	0		5	224	
Queue Length 95th (ft)		22	16		3		152	133		23	#655	
Internal Link Dist (ft)		513			367			670			106	
Turn Bay Length (ft)			180				360			65		
Base Capacity (vph)		444	1078		453		422	3293		117	2273	
Starvation Cap Reductn		0	0		0		0	0		0	0	
Spillback Cap Reductn		0	0		0		0	0		0	0	
Storage Cap Reductn		0	0		0		0	0		0	0	
Reduced v/c Ratio		0.02	0.12		0.01		0.41	0.26		0.09	0.76	

Intersection Summary

Area Type: Other
Cycle Length: 100
Actuated Cycle Length: 76.3
Natural Cycle: 100
Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.76
Intersection Signal Delay: 11.9 Intersection LOS: B
Intersection Capacity Utilization 77.9% ICU Level of Service D
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 9: NH 102 & St. Charles Street/Londonderry Road



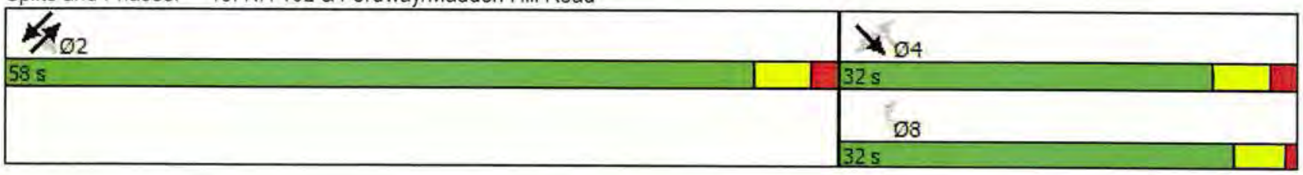
Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	5	10	5	360	0	30	0	540	180	5	810	0
Future Volume (vph)	5	10	5	360	0	30	0	540	180	5	810	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		100	0		100	0		0
Storage Lanes	0		0	1		1	0		1	0		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.967				0.850			0.850			
Flt Protected		0.988		0.950								
Satd. Flow (prot)	0	1780	0	1752	0	1568	0	1759	1495	0	1810	0
Flt Permitted		0.988		0.736							0.997	
Satd. Flow (perm)	0	1780	0	1358	0	1568	0	1759	1495	0	1804	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		8				36			158			
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		356			493			234			339	
Travel Time (s)		8.1			11.2			5.3			7.7	
Peak Hour Factor	0.60	0.60	0.60	0.96	0.96	0.96	0.89	0.89	0.89	0.86	0.86	0.86
Heavy Vehicles (%)	2%	2%	2%	3%	3%	3%	8%	8%	8%	5%	5%	5%
Adj. Flow (vph)	8	17	8	375	0	31	0	607	202	6	942	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	33	0	375	0	31	0	607	202	0	948	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			0			0	
Link Offset(ft)		-22			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	3	1		3		1		2	1	3	2	
Detector Template	Left			Left		Right			Right	Left		
Leading Detector (ft)	256	45		256		45		131	45	256	131	
Trailing Detector (ft)	-5	-5		-5		-5		-5	-5	-5	-5	
Detector 1 Position(ft)	-5	-5		-5		-5		-5	-5	-5	-5	
Detector 1 Size(ft)	50	50		50		50		50	50	50	50	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex		Cl+Ex		Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0		0.0		0.0	0.0	0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0		0.0		0.0	0.0	0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0		0.0		0.0	0.0	0.0	0.0	
Detector 2 Position(ft)	125			125				125		125	125	
Detector 2 Size(ft)	6			6				6		6	6	
Detector 2 Type	Cl+Ex			Cl+Ex				Cl+Ex		Cl+Ex	Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)	0.0			0.0				0.0		0.0	0.0	
Detector 3 Position(ft)	250			250						250		
Detector 3 Size(ft)	6			6						6		

Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Detector 3 Type	Cl+Ex			Cl+Ex						Cl+Ex		
Detector 3 Channel												
Detector 3 Extend (s)	0.0			0.0						0.0		
Turn Type	Perm	NA		D.Pm		Perm		NA	Perm	Perm	NA	
Protected Phases		4						2			2	
Permitted Phases	4			4		8			2	2		
Detector Phase	4	4		4		8		2	2	2	2	
Switch Phase												
Minimum Initial (s)	5.0	5.0		5.0		5.0		5.0	5.0	5.0	5.0	
Minimum Split (s)	24.0	24.0		24.0		22.5		24.0	24.0	24.0	24.0	
Total Split (s)	32.0	32.0		32.0		32.0		58.0	58.0	58.0	58.0	
Total Split (%)	35.6%	35.6%		35.6%		35.6%		64.4%	64.4%	64.4%	64.4%	
Maximum Green (s)	26.0	26.0		26.0		27.5		52.0	52.0	52.0	52.0	
Yellow Time (s)	4.0	4.0		4.0		3.5		4.0	4.0	4.0	4.0	
All-Red Time (s)	2.0	2.0		2.0		1.0		2.0	2.0	2.0	2.0	
Lost Time Adjust (s)		0.0		0.0		0.0		0.0	0.0		0.0	
Total Lost Time (s)		6.0		6.0		4.5		6.0	6.0		6.0	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0		3.0		3.0	3.0	3.0	3.0	
Recall Mode	None	None		None		None		Min	Min	Min	Min	
Walk Time (s)	7.0	7.0		7.0		7.0		7.0	7.0	7.0	7.0	
Flash Dont Walk (s)	11.0	11.0		11.0		11.0		11.0	11.0	11.0	11.0	
Pedestrian Calls (#/hr)	0	0		0		0		0	0	0	0	
Act Effct Green (s)		25.6		25.6		27.1		50.6	50.6		50.6	
Actuated g/C Ratio		0.29		0.29		0.31		0.57	0.57		0.57	
v/c Ratio		0.06		0.95		0.06		0.60	0.22		0.92	
Control Delay		19.5		67.9		7.2		15.4	3.1		32.4	
Queue Delay		0.0		0.0		0.0		0.0	0.0		0.0	
Total Delay		19.5		67.9		7.2		15.4	3.1		32.4	
LOS		B		E		A		B	A		C	
Approach Delay		19.5			63.3			12.3			32.4	
Approach LOS		B			E			B			C	
Queue Length 50th (ft)		10		209		0		206	10		444	
Queue Length 95th (ft)		20		#385		18		303	38		#680	
Internal Link Dist (ft)		276			413			154			259	
Turn Bay Length (ft)						100			100			
Base Capacity (vph)		530		400		514		1038	947		1065	
Starvation Cap Reductn		0		0		0		0	0		0	
Spillback Cap Reductn		0		0		0		0	0		0	
Storage Cap Reductn		0		0		0		0	0		0	
Reduced v/c Ratio		0.06		0.94		0.06		0.58	0.21		0.89	

Intersection Summary	
Area Type:	Other
Cycle Length: 90	
Actuated Cycle Length: 88.2	
Natural Cycle: 90	
Control Type: Actuated-Uncoordinated	

Maximum v/c Ratio: 0.95
Intersection Signal Delay: 30.5 Intersection LOS: C
Intersection Capacity Utilization 83.9% ICU Level of Service E
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 10: NH 102 & Fordway/Madden Hill Road



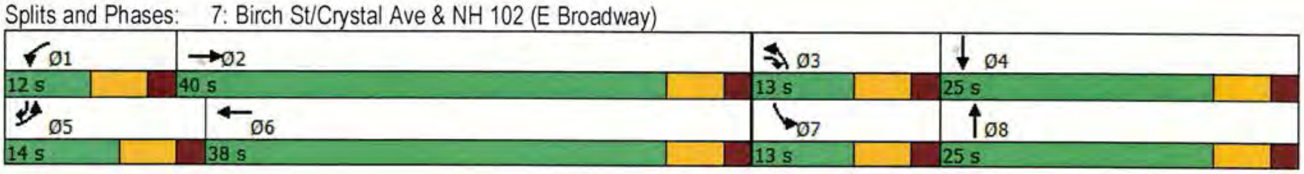
	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑	↱	↰	↑↱		↰↰	↱		↰	↑	↱
Traffic Volume (vph)	130	270	130	30	500	200	200	100	40	100	100	120
Future Volume (vph)	130	270	130	30	500	200	200	100	40	100	100	120
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	390		0	110		0	70		0	245		245
Storage Lanes	1		1	1		0	1		0	1		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	0.95	0.95	0.97	1.00	1.00	1.00	1.00	1.00
Frt			0.850		0.957			0.957				0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1656	1743	1333	1703	3259	0	3335	1732	0	1703	1792	1524
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1656	1743	1333	1703	3259	0	3335	1732	0	1703	1792	1524
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			135		74			20				128
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		505			530			361			411	
Travel Time (s)		11.5			12.0			8.2			9.3	
Peak Hour Factor	0.96	0.96	0.96	0.94	0.94	0.94	0.85	0.85	0.85	0.91	0.91	0.91
Heavy Vehicles (%)	9%	9%	9%	6%	6%	6%	5%	5%	5%	6%	6%	6%
Parking (#/hr)			0									
Adj. Flow (vph)	135	281	135	32	532	213	235	118	47	110	110	132
Shared Lane Traffic (%)												
Lane Group Flow (vph)	135	281	135	32	745	0	235	165	0	110	110	132
Turn Type	Prot	NA	pm+ov	Prot	NA		Prot	NA		Prot	NA	pm+ov
Protected Phases	5	2	3	1	6		3	8		7	4	5
Permitted Phases			2									4
Detector Phase	5	2	3	1	6		3	8		7	4	5
Switch Phase												
Minimum Initial (s)	4.0	5.0	4.0	4.0	10.0		4.0	10.0		4.0	9.0	4.0
Minimum Split (s)	10.0	30.0	10.0	10.0	30.0		10.0	25.0		10.0	25.0	10.0
Total Split (s)	14.0	40.0	13.0	12.0	38.0		13.0	25.0		13.0	25.0	14.0
Total Split (%)	15.6%	44.4%	14.4%	13.3%	42.2%		14.4%	27.8%		14.4%	27.8%	15.6%
Maximum Green (s)	8.0	34.0	7.0	6.0	32.0		7.0	19.0		7.0	19.0	8.0
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0		2.0	2.0		2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0		6.0	6.0		6.0	6.0	6.0
Lead/Lag	Lead	Lag	Lead	Lead	Lag		Lead	Lag		Lead	Lag	Lead
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes		Yes	Yes		Yes	Yes	Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	3.0
Recall Mode	None	Min	Min	None	Min		Min	None		Min	None	None
Walk Time (s)		7.0			7.0			7.0			7.0	
Flash Dont Walk (s)		11.0			11.0			11.0			11.0	
Pedestrian Calls (#/hr)		10			10			0			10	
Act Effct Green (s)	8.1	32.3	50.6	6.0	22.4		10.8	12.5		7.1	12.3	23.0
Actuated g/C Ratio	0.11	0.43	0.68	0.08	0.30		0.15	0.17		0.10	0.17	0.31
v/c Ratio	0.75	0.37	0.14	0.24	0.72		0.49	0.54		0.68	0.37	0.24
Control Delay	62.3	18.0	2.5	40.3	25.2		38.9	32.8		58.7	32.7	5.3

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Delay	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	0.0
Total Delay	62.3	18.0	2.5	40.3	25.2		38.9	32.8		58.7	32.7	5.3
LOS	E	B	A	D	C		D	C		E	C	A
Approach Delay		25.0			25.8			36.4			30.6	
Approach LOS		C			C			D			C	
Queue Length 50th (ft)	60	71	0	14	139		53	60		49	45	1
Queue Length 95th (ft)	#185	183	26	46	220		#124	123		#155	101	38
Internal Link Dist (ft)		425			450			281			331	
Turn Bay Length (ft)	390			110			70			245		245
Base Capacity (vph)	180	815	949	139	1461		484	463		162	463	559
Starvation Cap Reductn	0	0	0	0	0		0	0		0	0	0
Spillback Cap Reductn	0	0	0	0	0		0	0		0	0	0
Storage Cap Reductn	0	0	0	0	0		0	0		0	0	0
Reduced v/c Ratio	0.75	0.34	0.14	0.23	0.51		0.49	0.36		0.68	0.24	0.24

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 74.4
Natural Cycle: 80
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.75
Intersection Signal Delay: 28.5 — Intersection LOS: C
Intersection Capacity Utilization 61.3% — ICU Level of Service B
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 7: Birch St/Crystal Ave & NH 102 (E Broadway)



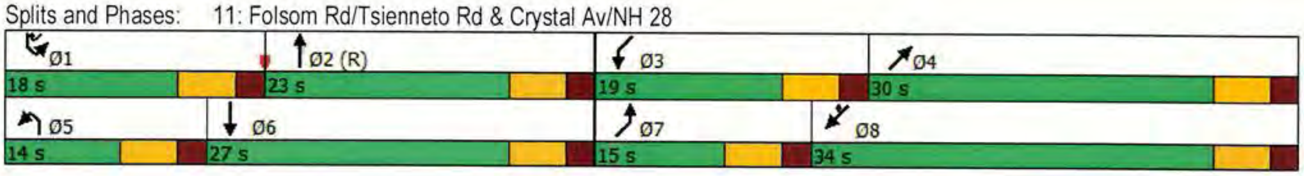
Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations	↰	↑↑	↱	↰↰	↑↑		↰	↑	↱	↰	↑	↱
Traffic Volume (vph)	20	120	180	240	100	0	90	260	20	145	430	345
Future Volume (vph)	20	120	180	240	100	0	90	260	20	145	430	345
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	110		90	360		0	190		180	0		210
Storage Lanes	1		1	2		0	1		1	1		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850						0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1736	3471	1553	3335	3438	0	1752	1845	1568	1752	1845	1568
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1736	3471	1553	3335	3438	0	1752	1845	1568	1752	1845	1568
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			214						255			348
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		639			476			532			387	
Travel Time (s)		14.5			10.8			12.1			8.8	
Peak Hour Factor	0.84	0.84	0.84	0.79	0.79	0.79	0.86	0.86	0.86	0.99	0.99	0.99
Heavy Vehicles (%)	4%	4%	4%	5%	5%	5%	3%	3%	3%	3%	3%	3%
Adj. Flow (vph)	24	143	214	304	127	0	105	302	23	146	434	348
Shared Lane Traffic (%)												
Lane Group Flow (vph)	24	143	214	304	127	0	105	302	23	146	434	348
Turn Type	Prot	NA	Perm	Prot	NA		Prot	NA	Free	Prot	NA	pt+ov
Protected Phases	5	2		1	6		7	4		3	8	8 1
Permitted Phases		2	2		6			4	Free		8	
Detector Phase	5	2	2	1	6		7	4		3	8	8 1
Switch Phase												
Minimum Initial (s)	8.0	8.0	8.0	8.0	8.0		6.0	8.0		7.0	8.0	
Minimum Split (s)	14.0	21.0	21.0	14.0	21.0		12.0	21.0		13.0	21.0	
Total Split (s)	14.0	23.0	23.0	18.0	27.0		15.0	30.0		19.0	34.0	
Total Split (%)	15.6%	25.6%	25.6%	20.0%	30.0%		16.7%	33.3%		21.1%	37.8%	
Maximum Green (s)	8.0	17.0	17.0	12.0	21.0		9.0	24.0		13.0	28.0	
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0		6.0	6.0		6.0	6.0	
Lead/Lag	Lead	Lag	Lag	Lead	Lag		Lead	Lag		Lead	Lag	
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes		Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	Max	C-Max	C-Max	None	Max		None	None		None	None	
Walk Time (s)		5.0	5.0		5.0			5.0			5.0	
Flash Dont Walk (s)		10.0	10.0		10.0			10.0			10.0	
Pedestrian Calls (#/hr)		0	0		0			0			0	
Act Effct Green (s)	11.9	21.3	21.3	11.5	21.0		8.5	21.7	90.0	11.4	27.1	44.7
Actuated g/C Ratio	0.13	0.24	0.24	0.13	0.23		0.09	0.24	1.00	0.13	0.30	0.50
v/c Ratio	0.11	0.17	0.40	0.71	0.16		0.63	0.68	0.01	0.66	0.78	0.37
Control Delay	39.1	30.4	7.3	48.8	24.1		56.9	38.8	0.0	51.5	39.9	2.6
Queue Delay	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0

Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Total Delay	39.1	30.4	7.3	48.8	24.1		56.9	38.8	0.0	51.5	39.9	2.6
LOS	D	C	A	D	C		E	D	A	D	D	A
Approach Delay		18.0			41.5			41.2			27.7	
Approach LOS		B			D			D			C	
Queue Length 50th (ft)	13	36	0	97	23		58	150	0	79	221	0
Queue Length 95th (ft)	35	58	46	91	48		#113	223	0	140	#345	41
Internal Link Dist (ft)		559			396			452			307	
Turn Bay Length (ft)	110		90	360			190		180			210
Base Capacity (vph)	228	822	531	444	802		175	493	1568	253	574	939
Starvation Cap Reductn	0	0	0	0	0		0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0		0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0		0	0	0	0	0	0
Reduced v/c Ratio	0.11	0.17	0.40	0.68	0.16		0.60	0.61	0.01	0.58	0.76	0.37

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 90
Offset: 0 (0%), Referenced to phase 2:NBT, Start of Green
Natural Cycle: 70
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.78
Intersection Signal Delay: 31.4 Intersection LOS: C
Intersection Capacity Utilization 56.1% ICU Level of Service B
Analysis Period (min) 15
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 11: Folsom Rd/Tsienneto Rd & Crystal Av/NH 28



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	40	580	0	0	470	20	5	0	5	20	0	130
Future Volume (vph)	40	580	0	0	470	20	5	0	5	20	0	130
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	110		0	115		150	0		0	0		0
Storage Lanes	1		0	1		0	0		1	0		1
Taper Length (ft)	50			25			25			25		
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt					0.994				0.850			0.850
Flt Protected	0.950							0.950			0.950	
Satd. Flow (prot)	1687	3374	0	1863	3518	0	0	1805	1615	0	1787	1599
Flt Permitted	0.950							0.743			0.751	
Satd. Flow (perm)	1687	3374	0	1863	3518	0	0	1412	1615	0	1413	1599
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)					6				109			144
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		277			671			218			433	
Travel Time (s)		6.3			15.3			5.0			9.8	
Peak Hour Factor	0.83	0.83	0.83	0.92	0.92	0.92	0.50	0.50	0.50	0.90	0.90	0.90
Heavy Vehicles (%)	7%	7%	7%	2%	2%	2%	0%	0%	0%	1%	1%	1%
Adj. Flow (vph)	48	699	0	0	511	22	10	0	10	22	0	144
Shared Lane Traffic (%)												
Lane Group Flow (vph)	48	699	0	0	533	0	0	10	10	0	22	144
Turn Type	Prot	NA		Prot	NA		Perm	NA	Perm	Perm	NA	Perm
Protected Phases	5	2		1	6			8			4	
Permitted Phases					6		8	8	8	4		4
Detector Phase	5	2		1	6		8	8	8	4	4	4
Switch Phase												
Minimum Initial (s)	8.0	8.0		5.0	8.0		5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	14.0	46.0		11.0	43.0		33.0	33.0	33.0	33.0	33.0	33.0
Total Split (s)	14.0	46.0		11.0	43.0		33.0	33.0	33.0	33.0	33.0	33.0
Total Split (%)	15.6%	51.1%		12.2%	47.8%		36.7%	36.7%	36.7%	36.7%	36.7%	36.7%
Maximum Green (s)	8.0	40.0		5.0	37.0		27.0	27.0	27.0	27.0	27.0	27.0
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0			0.0	0.0		0.0	0.0
Total Lost Time (s)	6.0	6.0		6.0	6.0			6.0	6.0		6.0	6.0
Lead/Lag	Lead	Lag		Lead	Lag							
Lead-Lag Optimize?	Yes	Yes		Yes	Yes							
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	C-Max		None	None		None	None	None	None	None	None
Act Effct Green (s)	8.8	70.5			61.4			7.5	7.5		7.5	7.5
Actuated g/C Ratio	0.10	0.78			0.68			0.08	0.08		0.08	0.08
v/c Ratio	0.29	0.26			0.22			0.09	0.04		0.19	0.55
Control Delay	37.7	5.0			8.8			38.0	0.4		41.0	15.0
Queue Delay	0.0	0.0			0.0			0.0	0.0		0.0	0.0
Total Delay	37.7	5.0			8.8			38.0	0.4		41.0	15.0
LOS	D	A			A			D	A		D	B
Approach Delay		7.1			8.8			19.2			18.4	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Approach LOS		A			A			B			B	
Queue Length 50th (ft)	27	28			78			5	0		12	0
Queue Length 95th (ft)	56	182			144			11	0		34	53
Internal Link Dist (ft)		197			591			138			353	
Turn Bay Length (ft)	110											
Base Capacity (vph)	164	2644			2400			423	560		423	580
Starvation Cap Reductn	0	0			0			0	0		0	0
Spillback Cap Reductn	0	0			0			0	0		0	0
Storage Cap Reductn	0	0			0			0	0		0	0
Reduced v/c Ratio	0.29	0.26			0.22			0.02	0.02		0.05	0.25

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 90
Offset: 63 (70%), Referenced to phase 2:EBT, Start of Green
Natural Cycle: 90
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.55
Intersection Signal Delay: 9.2 Intersection LOS: A
Intersection Capacity Utilization 43.1% ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 13: Applebees/Linlew Dr & NH 28

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	70	470	5	5	450	160	10	5	5	180	5	100
Future Volume (vph)	70	470	5	5	450	160	10	5	5	180	5	100
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	280		150	205		150	0		0	325		150
Storage Lanes	2		0	1		0	1		0	1		1
Taper Length (ft)	200			25			25			25		
Lane Util. Factor	0.97	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	0.95	0.95	1.00
Frt		0.998			0.961			0.925				0.850
Flt Protected	0.950			0.950			0.950			0.950	0.955	
Satd. Flow (prot)	3303	3399	0	1736	3336	0	1805	1758	0	1665	1674	1568
Flt Permitted	0.950			0.950			0.950			0.950	0.955	
Satd. Flow (perm)	3303	3399	0	1736	3336	0	1805	1758	0	1665	1674	1568
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		2			78			7				111
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		412			486			151			446	
Travel Time (s)		9.4			11.0			3.4			10.1	
Peak Hour Factor	0.83	0.83	0.83	0.97	0.97	0.97	0.67	0.67	0.67	0.90	0.90	0.90
Heavy Vehicles (%)	6%	6%	6%	4%	4%	4%	0%	0%	0%	3%	3%	3%
Adj. Flow (vph)	84	566	6	5	464	165	15	7	7	200	6	111
Shared Lane Traffic (%)										49%		
Lane Group Flow (vph)	84	572	0	5	629	0	15	14	0	102	104	111
Turn Type	Prot	NA		Prot	NA		Split	NA		Split	NA	pt+ov
Protected Phases	5	2		1	6		3	3		4	4	4 5
Permitted Phases								3				
Detector Phase	5	2		1	6		3	3		4	4	4 5
Switch Phase												
Minimum Initial (s)	5.0	8.0		5.0	8.0		5.0	5.0		8.0	8.0	
Minimum Split (s)	14.0	53.0		11.0	50.0		11.0	11.0		15.0	15.0	
Total Split (s)	14.0	53.0		11.0	50.0		11.0	11.0		15.0	15.0	
Total Split (%)	15.6%	58.9%		12.2%	55.6%		12.2%	12.2%		16.7%	16.7%	
Maximum Green (s)	8.0	47.0		5.0	44.0		5.0	5.0		9.0	9.0	
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lead		Lag	Lag	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	Min		None	C-Min		None	None		None	None	
Walk Time (s)		5.0			5.0		5.0	5.0		5.0	5.0	
Flash Dont Walk (s)		11.0			11.0		11.0	11.0		11.0	11.0	
Pedestrian Calls (#/hr)		0			0		0	0		0	0	
Act Effct Green (s)	7.7	56.3		5.9	45.1		6.3	6.3		11.5	11.5	25.1
Actuated g/C Ratio	0.09	0.63		0.07	0.50		0.07	0.07		0.13	0.13	0.28
v/c Ratio	0.30	0.27		0.04	0.37		0.12	0.11		0.48	0.49	0.21
Control Delay	40.9	10.6		62.6	8.7		40.8	30.0		43.5	43.7	5.4
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Total Delay	40.9	10.6		62.6	8.7		40.8	30.0		43.5	43.7	5.4
LOS	D	B		E	A		D	C		D	D	A
Approach Delay		14.5			9.1			35.6			30.2	
Approach LOS		B			A			D			C	
Queue Length 50th (ft)	23	73		3	34		8	4		57	58	0
Queue Length 95th (ft)	41	149		m13	210		20	16		104	106	34
Internal Link Dist (ft)		332			406			71			366	
Turn Bay Length (ft)	280			205						325		150
Base Capacity (vph)	308	2210		113	1858		127	130		215	216	513
Starvation Cap Reductn	0	0		0	0		0	0		0	0	0
Spillback Cap Reductn	0	0		0	0		0	0		0	0	0
Storage Cap Reductn	0	0		0	0		0	0		0	0	0
Reduced v/c Ratio	0.27	0.26		0.04	0.34		0.12	0.11		0.47	0.48	0.22

Intersection Summary

Area Type: Other

Cycle Length: 90

Actuated Cycle Length: 90

Offset: 0 (0%), Referenced to phase 6:WBT, Start of Green

Natural Cycle: 90

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.49

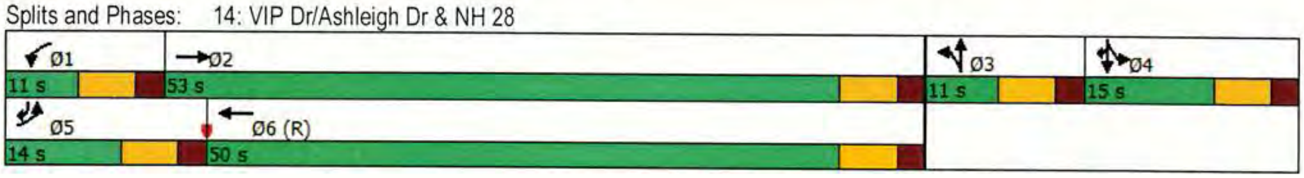
Intersection Signal Delay: 15.8 Intersection LOS: B

Intersection Capacity Utilization 48.5% ICU Level of Service A

Analysis Period (min) 15

m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 14: VIP Dr/Ashleigh Dr & NH 28



Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	30	50	20	20	50	160	80	240	80	80	520	50
Future Volume (vph)	30	50	20	20	50	160	80	240	80	80	520	50
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200		150	190		190	135		0	120		0
Storage Lanes	1		0	1		1	1		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.958				0.850		0.962			0.987	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1752	1767	0	1736	1827	1553	1770	1792	0	1787	1857	0
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1752	1767	0	1736	1827	1553	1770	1792	0	1787	1857	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		20				198		25			7	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		481			347			479			371	
Travel Time (s)		10.9			7.9			10.9			8.4	
Peak Hour Factor	0.82	0.82	0.82	0.81	0.81	0.81	0.68	0.68	0.68	0.78	0.78	0.78
Heavy Vehicles (%)	3%	3%	3%	4%	4%	4%	2%	2%	2%	1%	1%	1%
Adj. Flow (vph)	37	61	24	25	62	198	118	353	118	103	667	64
Shared Lane Traffic (%)												
Lane Group Flow (vph)	37	85	0	25	62	198	118	471	0	103	731	0
Turn Type	Prot	NA		Prot	NA	pt+ov	Prot	NA		Prot	NA	
Protected Phases	1	6		5	2	2 3	3	8		7	4	
Permitted Phases												
Detector Phase	1	6		5	2	2 3	3	8		7	4	
Switch Phase												
Minimum Initial (s)	8.0	8.0		8.0	8.0		8.0	8.0		8.0	8.0	
Minimum Split (s)	14.0	14.0		14.0	14.0		14.0	14.0		14.0	14.0	
Total Split (s)	14.0	14.0		14.0	14.0		14.0	38.0		14.0	38.0	
Total Split (%)	17.5%	17.5%		17.5%	17.5%		17.5%	47.5%		17.5%	47.5%	
Maximum Green (s)	8.0	8.0		8.0	8.0		8.0	32.0		8.0	32.0	
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lag		Lead	Lag	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	Max		None	None		None	None	
Act Effct Green (s)	8.1	10.7		8.1	8.1	22.2	8.1	35.0		8.1	31.8	
Actuated g/C Ratio	0.11	0.14		0.11	0.11	0.30	0.11	0.47		0.11	0.43	
v/c Ratio	0.19	0.31		0.13	0.31	0.33	0.61	0.55		0.53	0.91	
Control Delay	35.4	28.5		34.5	37.5	5.4	49.0	18.9		44.5	39.6	
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Total Delay	35.4	28.5		34.5	37.5	5.4	49.0	18.9		44.5	39.6	
LOS	D	C		C	D	A	D	B		D	D	
Approach Delay		30.6			15.0			25.0			40.2	

Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Approach LOS		C			B			C			D	
Queue Length 50th (ft)	17	24		12	29	0	58	175		50	348	
Queue Length 95th (ft)	41	66		31	60	34	82	181		85	#453	
Internal Link Dist (ft)		401			267			399			291	
Turn Bay Length (ft)	200			190		190	135			120		
Base Capacity (vph)	191	272		189	199	605	193	862		195	816	
Starvation Cap Reductn	0	0		0	0	0	0	0		0	0	
Spillback Cap Reductn	0	0		0	0	0	0	0		0	0	
Storage Cap Reductn	0	0		0	0	0	0	0		0	0	
Reduced v/c Ratio	0.19	0.31		0.13	0.31	0.33	0.61	0.55		0.53	0.90	

Intersection Summary

Area Type: Other
Cycle Length: 80
Actuated Cycle Length: 73.9
Natural Cycle: 80
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.91
Intersection Signal Delay: 30.7 Intersection LOS: C
Intersection Capacity Utilization 62.0% ICU Level of Service B
Analysis Period (min) 15
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 18: Tsienneto Rd & NH 28 Byp S/NH 28 Byp N

Ø1	Ø2	Ø3	Ø4
14 s	14 s	14 s	38 s
Ø5	**Ø6**	**Ø7**	**Ø8**
14 s	14 s	14 s	38 s

APPENDIX S-4: 2040 ALTERNATIVE F INTERSECTION CAPACITY ANALYSES – SYNCHRO PRINTOUTS – PM PEAK HOUR

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑↑		↰	↱↱
Traffic Volume (vph)	0	1310	1330	0	1005	1135
Future Volume (vph)	0	1310	1330	0	1005	1135
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	16	12
Lane Util. Factor	1.00	0.95	0.95	1.00	1.00	0.88
Frt						0.850
Flt Protected					0.950	
Satd. Flow (prot)	0	3471	3406	0	1930	2682
Flt Permitted					0.950	
Satd. Flow (perm)	0	3471	3406	0	1930	2682
Right Turn on Red				Yes		No
Satd. Flow (RTOR)						
Link Speed (mph)		30	30		25	
Link Distance (ft)		712	388		212	
Travel Time (s)		16.2	8.8		5.8	
Peak Hour Factor	0.93	0.93	0.88	0.88	0.89	0.89
Heavy Vehicles (%)	4%	4%	6%	6%	6%	6%
Adj. Flow (vph)	0	1409	1511	0	1129	1275
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	1409	1511	0	1129	1275
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(ft)		24	24		16	
Link Offset(ft)		0	0		0	
Crosswalk Width(ft)		16	16		16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	0.85	1.00
Turning Speed (mph)	15			9	15	9
Number of Detectors		3	3		3	3
Detector Template		Thru	Thru		Left	
Leading Detector (ft)		256	256		256	256
Trailing Detector (ft)		-5	-5		-5	-5
Detector 1 Position(ft)		-5	-5		-5	-5
Detector 1 Size(ft)		50	50		50	50
Detector 1 Type		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex
Detector 1 Channel						
Detector 1 Extend (s)		0.0	0.0		0.0	0.0
Detector 1 Queue (s)		0.0	0.0		0.0	0.0
Detector 1 Delay (s)		0.0	0.0		0.0	0.0
Detector 2 Position(ft)		125	125		125	125
Detector 2 Size(ft)		6	6		6	6
Detector 2 Type		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex
Detector 2 Channel						
Detector 2 Extend (s)		0.0	0.0		0.0	0.0
Detector 3 Position(ft)		250	250		250	250
Detector 3 Size(ft)		6	6		6	6
Detector 3 Type		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex
Detector 3 Channel						

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Detector 3 Extend (s)		0.0	0.0		0.0	0.0
Turn Type		NA	NA		Prot	Prot
Protected Phases		2	6		4	4
Permitted Phases						
Detector Phase		2	6		4	4
Switch Phase						
Minimum Initial (s)		8.0	8.0		5.0	5.0
Minimum Split (s)		14.0	21.0		27.0	27.0
Total Split (s)		54.0	54.0		66.0	66.0
Total Split (%)		45.0%	45.0%		55.0%	55.0%
Maximum Green (s)		48.0	48.0		60.0	60.0
Yellow Time (s)		2.0	2.0		2.0	2.0
All-Red Time (s)		4.0	4.0		4.0	4.0
Lost Time Adjust (s)		0.0	0.0		0.0	0.0
Total Lost Time (s)		6.0	6.0		6.0	6.0
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)		3.0	3.0		3.0	3.0
Recall Mode		C-Min	C-Min		None	None
Walk Time (s)			7.0		7.0	7.0
Flash Dont Walk (s)			8.0		14.0	14.0
Pedestrian Calls (#/hr)			0		0	0
Act Effct Green (s)		48.0	48.0		60.0	60.0
Actuated g/C Ratio		0.40	0.40		0.50	0.50
v/c Ratio		1.02	1.11		1.17	0.95
Control Delay		44.5	58.9		117.1	44.5
Queue Delay		0.0	0.0		0.0	0.0
Total Delay		44.5	58.9		117.1	44.5
LOS		D	E		F	D
Approach Delay		44.5	58.9		78.6	
Approach LOS		D	E		E	
Queue Length 50th (ft)		~553	~704		~1042	518
Queue Length 95th (ft)		m#702	m50		#1276	#687
Internal Link Dist (ft)		632	308		132	
Turn Bay Length (ft)						
Base Capacity (vph)		1388	1362		965	1341
Starvation Cap Reductn		0	0		0	0
Spillback Cap Reductn		0	0		0	0
Storage Cap Reductn		0	0		0	0
Reduced v/c Ratio		1.02	1.11		1.17	0.95

Intersection Summary

Area Type: Other

Cycle Length: 120

Actuated Cycle Length: 120

Offset: 0 (0%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow, Master Intersection

Natural Cycle: 120

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 1.17

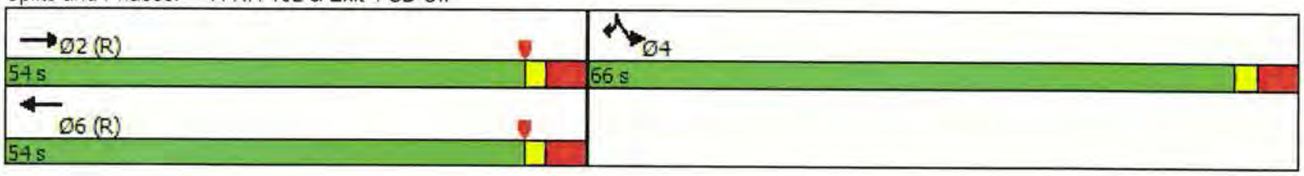
Intersection Signal Delay: 64.0 Intersection LOS: E
Intersection Capacity Utilization 104.4% ICU Level of Service G
Analysis Period (min) 15

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 7: NH 102 & Exit 4 SB Off



Lane Group	NBL2	NBL	NBR	SEL	SER	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations											
Traffic Volume (vph)	1250	0	1105	0	0	985	1330	0	0	570	795
Future Volume (vph)	1250	0	1105	0	0	985	1330	0	0	570	795
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)		0	0	0	0	550		0	0		0
Storage Lanes		2	2	0	0	2		0	0		1
Taper Length (ft)		25		25		25			25		
Lane Util. Factor	0.97	1.00	0.88	1.00	1.00	0.97	0.95	1.00	1.00	0.95	1.00
Frt			0.850								0.850
Flt Protected	0.950					0.950					
Satd. Flow (prot)	3242	0	2632	0	0	3335	3438	0	0	3505	1568
Flt Permitted	0.950					0.950					
Satd. Flow (perm)	3242	0	2632	0	0	3335	3438	0	0	3505	1568
Right Turn on Red			No					Yes			Yes
Satd. Flow (RTOR)											750
Link Speed (mph)		25		30			30			30	
Link Distance (ft)		856		390			760			857	
Travel Time (s)		23.3		8.9			17.3			19.5	
Peak Hour Factor	0.88	0.88	0.88	0.92	0.92	0.94	0.94	0.94	0.92	0.92	0.92
Heavy Vehicles (%)	8%	8%	8%	2%	2%	5%	5%	5%	3%	3%	3%
Adj. Flow (vph)	1420	0	1256	0	0	1048	1415	0	0	620	864
Shared Lane Traffic (%)											
Lane Group Flow (vph)	1420	0	1256	0	0	1048	1415	0	0	620	864
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Right	Left	Left	Right	Left	Right	Right
Median Width(ft)		24		0			24			24	
Link Offset(ft)		12		0			0			0	
Crosswalk Width(ft)		16		16			16			16	
Two way Left Turn Lane											
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15	15	25	15	9	15		9	15		25
Number of Detectors	3		3			3	3			3	0
Detector Template											
Leading Detector (ft)	256		256			256	256			256	0
Trailing Detector (ft)	-5		-5			-5	-5			-5	0
Detector 1 Position(ft)	-5		-5			-5	-5			-5	-5
Detector 1 Size(ft)	55		55			55	55			55	50
Detector 1 Type	Cl+Ex		Cl+Ex			Cl+Ex	Cl+Ex			Cl+Ex	Cl+Ex
Detector 1 Channel											
Detector 1 Extend (s)	0.0		0.0			0.0	0.0			0.0	0.0
Detector 1 Queue (s)	0.0		0.0			0.0	0.0			0.0	0.0
Detector 1 Delay (s)	0.0		0.0			0.0	0.0			0.0	0.0
Detector 2 Position(ft)	125		125			125	125			125	
Detector 2 Size(ft)	6		6			6	6			6	
Detector 2 Type	Cl+Ex		Cl+Ex			Cl+Ex	Cl+Ex			Cl+Ex	
Detector 2 Channel											
Detector 2 Extend (s)	0.0		0.0			0.0	0.0			0.0	
Detector 3 Position(ft)	250		250			250	250			250	
Detector 3 Size(ft)	6		6			6	6			6	

Lane Group	NBL2	NBL	NBR	SEL	SER	NEL	NET	NER	SWL	SWT	SWR
Detector 3 Type	Cl+Ex		Cl+Ex			Cl+Ex	Cl+Ex			Cl+Ex	
Detector 3 Channel											
Detector 3 Extend (s)	0.0		0.0			0.0	0.0			0.0	
Turn Type	Prot		Prot			Prot	NA			NA	Free
Protected Phases	8		8			5	2			6	
Permitted Phases											Free
Detector Phase	8		2			5	2			6	
Switch Phase											
Minimum Initial (s)	10.0		10.0			5.0	8.0			8.0	
Minimum Split (s)	16.0		16.0			11.0	42.0			31.0	
Total Split (s)	50.0		50.0			38.0	70.0			32.0	
Total Split (%)	41.7%		41.7%			31.7%	58.3%			26.7%	
Maximum Green (s)	44.0		44.0			32.0	64.0			26.0	
Yellow Time (s)	2.0		2.0			2.0	2.0			2.0	
All-Red Time (s)	4.0		4.0			4.0	4.0			4.0	
Lost Time Adjust (s)	0.0		0.0			0.0	0.0			0.0	
Total Lost Time (s)	6.0		6.0			6.0	6.0			6.0	
Lead/Lag						Lead				Lag	
Lead-Lag Optimize?											
Vehicle Extension (s)	3.0		3.0			3.0	3.0			3.0	
Recall Mode	None		None			None	C-Min			C-Min	
Walk Time (s)							7.0			7.0	
Flash Dont Walk (s)							29.0			17.0	
Pedestrian Calls (#/hr)							0			0	
Act Effct Green (s)	44.0		44.0			32.0	64.0			26.0	120.0
Actuated g/C Ratio	0.37		0.37			0.27	0.53			0.22	1.00
v/c Ratio	1.20		1.30			1.18	0.77			0.82	0.55
Control Delay	131.1		176.4			117.1	20.9			54.6	1.4
Queue Delay	0.0		0.0			0.0	0.0			0.0	0.0
Total Delay	131.1		176.4			117.1	20.9			54.6	1.4
LOS	F		F			F	C			D	A
Approach Delay		152.4					61.8			23.6	
Approach LOS		F					E			C	
Queue Length 50th (ft)	~686		~708			~497	447			242	0
Queue Length 95th (ft)	#793		#827			m#434	m379			#312	0
Internal Link Dist (ft)		776		310			680			777	
Turn Bay Length (ft)						550					
Base Capacity (vph)	1188		965			889	1833			759	1568
Starvation Cap Reductn	0		0			0	0			0	0
Spillback Cap Reductn	0		0			0	0			0	0
Storage Cap Reductn	0		0			0	0			0	0
Reduced v/c Ratio	1.20		1.30			1.18	0.77			0.82	0.55

Intersection Summary

Area Type: Other
Cycle Length: 120
Actuated Cycle Length: 120
Offset: 44 (37%), Referenced to phase 2:NET and 6:SWT, Start of Yellow
Natural Cycle: 150

Control Type: Actuated-Coordinated
Maximum v/c Ratio: 1.30
Intersection Signal Delay: 89.9 Intersection LOS: F
Intersection Capacity Utilization 95.5% ICU Level of Service F
Analysis Period (min) 15

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 8: NH 102 & Exit 4 NB Off

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑	↱	↰	↑↑					↰↰		↱
Traffic Volume (vph)	0	925	385	240	525	0	0	0	0	740	0	480
Future Volume (vph)	0	925	385	240	525	0	0	0	0	740	0	480
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		350	0		0	0		0	0		0
Storage Lanes	0		1	1		0	0		0	2		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	0.97	1.00	1.00
Frt			0.850									0.850
Flt Protected				0.950						0.950		
Satd. Flow (prot)	0	3471	1553	1719	3438	0	0	0	0	3367	0	1553
Flt Permitted				0.950						0.950		
Satd. Flow (perm)	0	3471	1553	1719	3438	0	0	0	0	3367	0	1553
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			428									298
Link Speed (mph)		30			30			30			35	
Link Distance (ft)		851			693			486			581	
Travel Time (s)		19.3			15.8			11.0			11.3	
Peak Hour Factor	0.87	0.87	0.87	0.86	0.86	0.86	0.92	0.92	0.92	0.91	0.91	0.91
Heavy Vehicles (%)	4%	4%	4%	5%	5%	5%	2%	2%	2%	4%	4%	4%
Adj. Flow (vph)	0	1063	443	279	610	0	0	0	0	813	0	527
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	1063	443	279	610	0	0	0	0	813	0	527
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Right	Left	Right
Median Width(ft)		36			36			24			24	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		25	15		9	15		9	15		25
Number of Detectors		3	3	3	3					3		3
Detector Template		Thru	Right	Left	Thru					Left		Right
Leading Detector (ft)		256	256	256	256					256		256
Trailing Detector (ft)		-5	-5	-5	-5					-5		-5
Detector 1 Position(ft)		-5	-5	-5	-5					-5		-5
Detector 1 Size(ft)		50	50	50	50					50		50
Detector 1 Type		Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex					Cl+Ex		Cl+Ex
Detector 1 Channel												
Detector 1 Extend (s)		0.0	0.0	0.0	0.0					0.0		0.0
Detector 1 Queue (s)		0.0	0.0	0.0	0.0					0.0		0.0
Detector 1 Delay (s)		0.0	0.0	0.0	0.0					0.0		0.0
Detector 2 Position(ft)		125	125	125	125					125		125
Detector 2 Size(ft)		6	6	6	6					6		6
Detector 2 Type		Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex					Cl+Ex		Cl+Ex
Detector 2 Channel												
Detector 2 Extend (s)		0.0	0.0	0.0	0.0					0.0		0.0
Detector 3 Position(ft)		250	250	250	250					250		250
Detector 3 Size(ft)		6	6	6	6					6		6

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Detector 3 Type		Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex					Cl+Ex		Cl+Ex
Detector 3 Channel												
Detector 3 Extend (s)		0.0	0.0	0.0	0.0					0.0		0.0
Turn Type		NA	Free	Prot	NA					Prot		Prot
Protected Phases		2		1	6					4		4
Permitted Phases			Free									
Detector Phase		2		1	6					4		4
Switch Phase												
Minimum Initial (s)		9.0		4.0	9.0					4.0		4.0
Minimum Split (s)		21.0		10.0	21.0					10.0		10.0
Total Split (s)		42.0		25.0	67.0					33.0		33.0
Total Split (%)		42.0%		25.0%	67.0%					33.0%		33.0%
Maximum Green (s)		36.0		19.0	61.0					27.0		27.0
Yellow Time (s)		4.0		4.0	4.0					4.0		4.0
All-Red Time (s)		2.0		2.0	2.0					2.0		2.0
Lost Time Adjust (s)		0.0		0.0	0.0					0.0		0.0
Total Lost Time (s)		6.0		6.0	6.0					6.0		6.0
Lead/Lag		Lag		Lead								
Lead-Lag Optimize?												
Vehicle Extension (s)		5.0		3.0	5.0					3.0		3.0
Recall Mode		C-Min		None	C-Min					None		None
Walk Time (s)		7.0			7.0							
Flash Dont Walk (s)		8.0			8.0							
Pedestrian Calls (#/hr)		0			0							
Act Effct Green (s)		36.6	100.0	18.4	61.0					27.0		27.0
Actuated g/C Ratio		0.37	1.00	0.18	0.61					0.27		0.27
v/c Ratio		0.84	0.29	0.89	0.29					0.89		0.83
Control Delay		36.3	0.5	30.6	0.2					49.0		27.3
Queue Delay		0.0	0.0	0.0	0.0					0.0		0.0
Total Delay		36.3	0.5	30.6	0.2					49.0		27.3
LOS		D	A	C	A					D		C
Approach Delay		25.8			9.7						40.4	
Approach LOS		C			A						D	
Queue Length 50th (ft)		325	0	11	0					257		143
Queue Length 95th (ft)		391	0	m#57	m0					#364		#331
Internal Link Dist (ft)		771			613			406			501	
Turn Bay Length (ft)			350									
Base Capacity (vph)		1271	1553	326	2097					909		636
Starvation Cap Reductn		0	0	0	0					0		0
Spillback Cap Reductn		0	0	0	0					0		0
Storage Cap Reductn		0	0	0	0					0		0
Reduced v/c Ratio		0.84	0.29	0.86	0.29					0.89		0.83

Intersection Summary

Area Type: Other

Cycle Length: 100

Actuated Cycle Length: 100

Offset: 55 (55%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow

Natural Cycle: 90

Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.89
Intersection Signal Delay: 27.2 Intersection LOS: C
Intersection Capacity Utilization 76.8% ICU Level of Service D
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 2: Exit 5 SB On/Exit 5 SB Off & NH 28

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑			↑↑	↱	↰		↱			
Traffic Volume (vph)	580	1085	0	0	470	560	295	0	360	0	0	0
Future Volume (vph)	580	1085	0	0	470	560	295	0	360	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt						0.850			0.850			
Flt Protected	0.950						0.950					
Satd. Flow (prot)	1752	3505	0	0	3505	1568	1703	0	1524	0	0	0
Flt Permitted	0.950						0.950					
Satd. Flow (perm)	1752	3505	0	0	3505	1568	1703	0	1524	0	0	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						615			98			
Link Speed (mph)		30			30			35			30	
Link Distance (ft)		693			542			867			392	
Travel Time (s)		15.8			12.3			16.9			8.9	
Peak Hour Factor	0.92	0.92	0.92	0.91	0.91	0.91	0.67	0.67	0.67	0.92	0.92	0.92
Heavy Vehicles (%)	3%	3%	3%	3%	3%	3%	6%	6%	6%	2%	2%	2%
Adj. Flow (vph)	630	1179	0	0	516	615	440	0	537	0	0	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	630	1179	0	0	516	615	440	0	537	0	0	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Right	Left	Right	Left	Left	Right
Median Width(ft)		36			42			12			12	
Link Offset(ft)		0			0			0			36	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		25	15		25	15		9
Number of Detectors	3	3			3	3	3		0			
Detector Template	Left					Right	Left					
Leading Detector (ft)	256	256			256	256	256		0			
Trailing Detector (ft)	-5	-5			-5	-5	-5		0			
Detector 1 Position(ft)	-5	-5			-5	-5	-5		-5			
Detector 1 Size(ft)	50	50			50	50	50		50			
Detector 1 Type	Cl+Ex	Cl+Ex			Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex			
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0			0.0	0.0	0.0		0.0			
Detector 1 Queue (s)	0.0	0.0			0.0	0.0	0.0		0.0			
Detector 1 Delay (s)	0.0	0.0			0.0	0.0	0.0		0.0			
Detector 2 Position(ft)	125	125			125	125	125					
Detector 2 Size(ft)	6	6			6	6	6					
Detector 2 Type	Cl+Ex	Cl+Ex			Cl+Ex	Cl+Ex	Cl+Ex					
Detector 2 Channel												
Detector 2 Extend (s)	0.0	0.0			0.0	0.0	0.0					
Detector 3 Position(ft)	250	250			250	250	250					
Detector 3 Size(ft)	6	6			6	6	6					
Detector 3 Type	Cl+Ex	Cl+Ex			Cl+Ex	Cl+Ex	Cl+Ex					
Detector 3 Channel												
Detector 3 Extend (s)	0.0	0.0			0.0	0.0	0.0					

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Type	Prot	NA			NA	Free	Prot		Prot			
Protected Phases	5	2			6		8		8			
Permitted Phases		2			6	Free						
Detector Phase	5	2			6		8		8			
Switch Phase												
Minimum Initial (s)	4.0	16.0			16.0		4.0		4.0			
Minimum Split (s)	10.0	23.0			23.0		11.0		11.0			
Total Split (s)	41.0	66.0			25.0		34.0		34.0			
Total Split (%)	41.0%	66.0%			25.0%		34.0%		34.0%			
Maximum Green (s)	35.0	60.0			19.0		28.0		28.0			
Yellow Time (s)	4.0	4.0			4.0		4.0		4.0			
All-Red Time (s)	2.0	2.0			2.0		2.0		2.0			
Lost Time Adjust (s)	0.0	0.0			0.0		0.0		0.0			
Total Lost Time (s)	6.0	6.0			6.0		6.0		6.0			
Lead/Lag	Lead				Lag							
Lead-Lag Optimize?												
Vehicle Extension (s)	5.0	5.0			5.0		3.0		3.0			
Recall Mode	None	C-Min			C-Min		None		None			
Walk Time (s)		7.0			7.0							
Flash Dont Walk (s)		10.0			10.0							
Pedestrian Calls (#/hr)		0			0							
Act Effct Green (s)	35.0	60.0			19.0	100.0	28.0		28.0			
Actuated g/C Ratio	0.35	0.60			0.19	1.00	0.28		0.28			
v/c Ratio	1.03	0.56			0.78	0.39	0.92		1.08			
Control Delay	45.0	3.2			47.7	0.7	62.2		93.1			
Queue Delay	0.0	0.0			0.0	0.0	0.0		0.0			
Total Delay	45.0	3.2			47.7	0.7	62.2		93.1			
LOS	D	A			D	A	E		F			
Approach Delay		17.8			22.2			79.2				
Approach LOS		B			C			E				
Queue Length 50th (ft)	~446	11			165	0	272		~337			
Queue Length 95th (ft)	m#611	m64			#225	0	266		#304			
Internal Link Dist (ft)		613			462			787			312	
Turn Bay Length (ft)												
Base Capacity (vph)	613	2103			665	1568	477		498			
Starvation Cap Reductn	0	0			0	0	0		0			
Spillback Cap Reductn	0	0			0	0	0		0			
Storage Cap Reductn	0	0			0	0	0		0			
Reduced v/c Ratio	1.03	0.56			0.78	0.39	0.92		1.08			

Intersection Summary

Area Type: Other
Cycle Length: 100
Actuated Cycle Length: 100
Offset: 0 (0%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow, Master Intersection
Natural Cycle: 100
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 1.08
Intersection Signal Delay: 34.4 Intersection LOS: C

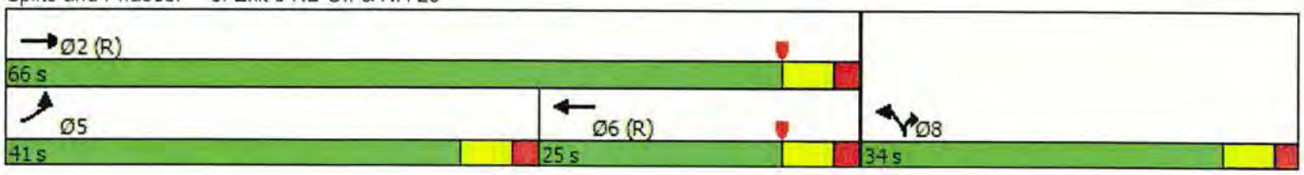
Intersection Capacity Utilization 76.8% ICU Level of Service D
Analysis Period (min) 15

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 3: Exit 5 NB Off & NH 28



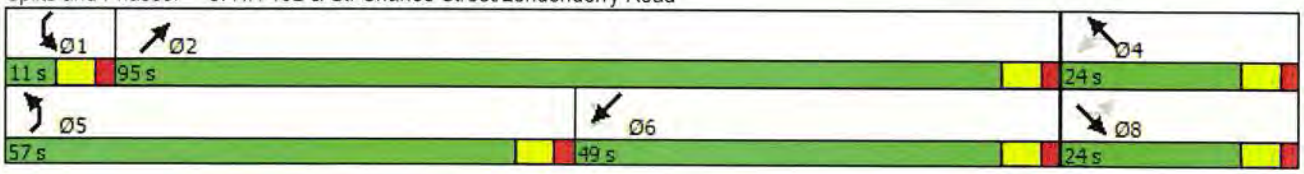
Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	10	5	160	10	0	10	650	1440	120	10	1020	50
Future Volume (vph)	10	5	160	10	0	10	650	1440	120	10	1020	50
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		180	0		0	360		0	65		0
Storage Lanes	0		1	0		0	1		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00	0.95	0.95
Frt			0.850		0.932			0.988			0.993	
Flt Protected		0.967			0.976		0.950			0.950		
Satd. Flow (prot)	0	1801	1583	0	1728	0	1770	3497	0	1770	3514	0
Flt Permitted		0.740			0.834		0.950			0.950		
Satd. Flow (perm)	0	1378	1583	0	1477	0	1770	3497	0	1770	3514	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			174		126			15			4	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		593			447			750			186	
Travel Time (s)		13.5			10.2			17.0			4.2	
Peak Hour Factor	0.92	0.92	0.92	0.25	0.25	0.25	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	2%	2%	2%	0%	0%	0%	2%	2%	2%	2%	2%	2%
Adj. Flow (vph)	11	5	174	40	0	40	707	1565	130	11	1109	54
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	16	174	0	80	0	707	1695	0	11	1163	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	3	3	1	3	1		3	3		3	3	
Detector Template	Left	Thru	Right	Left			Left	Thru		Left	Thru	
Leading Detector (ft)	256	256	45	256	45		256	256		256	256	
Trailing Detector (ft)	-5	-5	-5	-5	-5		-5	-5		-5	-5	
Detector 1 Position(ft)	-5	-5	-5	-5	-5		-5	-5		-5	-5	
Detector 1 Size(ft)	50	50	50	50	50		50	50		50	50	
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(ft)	125	125		125			125	125		125	125	
Detector 2 Size(ft)	6	6		6			6	6		6	6	
Detector 2 Type	Cl+Ex	Cl+Ex		Cl+Ex			Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)	0.0	0.0		0.0			0.0	0.0		0.0	0.0	
Detector 3 Position(ft)	250	250		250			250	250		250	250	
Detector 3 Size(ft)	6	6		6			6	6		6	6	

Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Detector 3 Type	Cl+Ex	Cl+Ex		Cl+Ex			Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 3 Channel												
Detector 3 Extend (s)	0.0	0.0		0.0			0.0	0.0		0.0	0.0	
Turn Type	Perm	NA	custom	Perm	NA		Prot	NA		Prot	NA	
Protected Phases		8			4		5	2		1	6	
Permitted Phases	8		6	4								
Detector Phase	8	8	6	4	4		5	2		1	6	
Switch Phase												
Minimum Initial (s)	5.0	5.0	8.0	5.0	5.0		5.0	8.0		5.0	8.0	
Minimum Split (s)	24.0	24.0	24.0	24.0	24.0		24.0	24.0		11.0	24.0	
Total Split (s)	24.0	24.0	49.0	24.0	24.0		57.0	95.0		11.0	49.0	
Total Split (%)	18.5%	18.5%	37.7%	18.5%	18.5%		43.8%	73.1%		8.5%	37.7%	
Maximum Green (s)	18.0	18.0	43.0	18.0	18.0		51.0	89.0		5.0	43.0	
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)		0.0	0.0		0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)		6.0	6.0		6.0		6.0	6.0		6.0	6.0	
Lead/Lag			Lag				Lead	Lag		Lead	Lag	
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None	Min	None	None		None	Min		None	Min	
Walk Time (s)	7.0	7.0	7.0	7.0	7.0		7.0	7.0			7.0	
Flash Dont Walk (s)	11.0	11.0	11.0	11.0	11.0		11.0	11.0			11.0	
Pedestrian Calls (#/hr)	0	0	0	0	0		0	0			0	
Act Effct Green (s)		6.9	43.1		6.9		51.1	99.4		5.0	43.1	
Actuated g/C Ratio		0.06	0.37		0.06		0.44	0.85		0.04	0.37	
v/c Ratio		0.20	0.25		0.39		0.91	0.57		0.14	0.89	
Control Delay		58.9	4.8		7.7		49.3	4.8		60.0	45.3	
Queue Delay		0.0	0.0		0.0		0.0	0.0		0.0	0.0	
Total Delay		58.9	4.8		7.7		49.3	4.8		60.0	45.3	
LOS		E	A		A		D	A		E	D	
Approach Delay		9.4			7.7			17.9			45.4	
Approach LOS		A			A			B			D	
Queue Length 50th (ft)		12	0		0		505	152		8	441	
Queue Length 95th (ft)		36	47		0		#776	373		29	#594	
Internal Link Dist (ft)		513			367			670			106	
Turn Bay Length (ft)			180				360			65		
Base Capacity (vph)		213	694		335		775	2983		76	1300	
Starvation Cap Reductn		0	0		0		0	0		0	0	
Spillback Cap Reductn		0	0		0		0	0		0	0	
Storage Cap Reductn		0	0		0		0	0		0	0	
Reduced v/c Ratio		0.08	0.25		0.24		0.91	0.57		0.14	0.89	

Intersection Summary	
Area Type:	Other
Cycle Length: 130	
Actuated Cycle Length: 116.6	
Natural Cycle: 130	
Control Type: Actuated-Uncoordinated	

Maximum v/c Ratio: 0.91
Intersection Signal Delay: 25.7 Intersection LOS: C
Intersection Capacity Utilization 92.4% ICU Level of Service F
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 9: NH 102 & St. Charles Street/Londonderry Road



Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	10	30	5	260	0	50	0	1020	220	15	555	0
Future Volume (vph)	10	30	5	260	0	50	0	1020	220	15	555	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		100	0		100	0		0
Storage Lanes	0		0	1		1	0		1	0		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.986				0.850			0.850			
Flt Protected		0.989		0.950							0.999	
Satd. Flow (prot)	0	1816	0	1752	0	1568	0	1759	1495	0	1808	0
Flt Permitted		0.989		0.797							0.716	
Satd. Flow (perm)	0	1816	0	1470	0	1568	0	1759	1495	0	1296	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		6				49			129			
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		356			493			234			339	
Travel Time (s)		8.1			11.2			5.3			7.7	
Peak Hour Factor	0.60	0.60	0.60	0.96	0.96	0.96	0.89	0.89	0.89	0.86	0.86	0.86
Heavy Vehicles (%)	2%	2%	2%	3%	3%	3%	8%	8%	8%	5%	5%	5%
Adj. Flow (vph)	17	50	8	271	0	52	0	1146	247	17	645	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	75	0	271	0	52	0	1146	247	0	662	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			0			0	
Link Offset(ft)		-22			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	3	1		3		1		2	1	3	2	
Detector Template	Left			Left		Right			Right	Left		
Leading Detector (ft)	256	45		256		45		131	45	256	131	
Trailing Detector (ft)	-5	-5		-5		-5		-5	-5	-5	-5	
Detector 1 Position(ft)	-5	-5		-5		-5		-5	-5	-5	-5	
Detector 1 Size(ft)	50	50		50		50		50	50	50	50	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex		Cl+Ex		Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0		0.0		0.0	0.0	0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0		0.0		0.0	0.0	0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0		0.0		0.0	0.0	0.0	0.0	
Detector 2 Position(ft)	125			125				125		125	125	
Detector 2 Size(ft)	6			6				6		6	6	
Detector 2 Type	Cl+Ex			Cl+Ex				Cl+Ex		Cl+Ex	Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)	0.0			0.0				0.0		0.0	0.0	
Detector 3 Position(ft)	250			250						250		
Detector 3 Size(ft)	6			6						6		

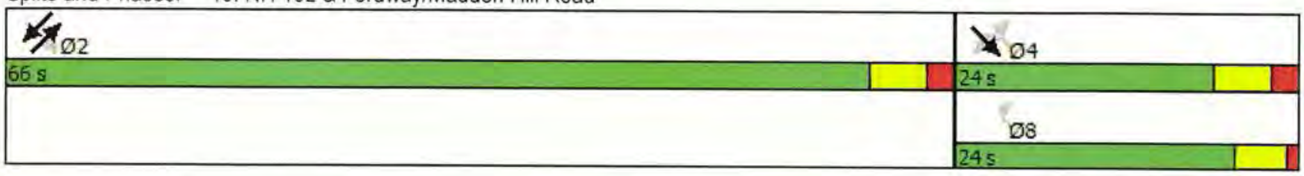
Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Detector 3 Type	Cl+Ex			Cl+Ex						Cl+Ex		
Detector 3 Channel												
Detector 3 Extend (s)	0.0			0.0						0.0		
Turn Type	Perm	NA		D.Pm		Perm		NA	Perm	Perm	NA	
Protected Phases		4						2			2	
Permitted Phases	4			4		8			2	2		
Detector Phase	4	4		4		8		2	2	2	2	
Switch Phase												
Minimum Initial (s)	5.0	5.0		5.0		5.0		5.0	5.0	5.0	5.0	
Minimum Split (s)	24.0	24.0		24.0		22.5		24.0	24.0	24.0	24.0	
Total Split (s)	24.0	24.0		24.0		24.0		66.0	66.0	66.0	66.0	
Total Split (%)	26.7%	26.7%		26.7%		26.7%		73.3%	73.3%	73.3%	73.3%	
Maximum Green (s)	18.0	18.0		18.0		19.5		60.0	60.0	60.0	60.0	
Yellow Time (s)	4.0	4.0		4.0		3.5		4.0	4.0	4.0	4.0	
All-Red Time (s)	2.0	2.0		2.0		1.0		2.0	2.0	2.0	2.0	
Lost Time Adjust (s)		0.0		0.0		0.0		0.0	0.0		0.0	
Total Lost Time (s)		6.0		6.0		4.5		6.0	6.0		6.0	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0		3.0		3.0	3.0	3.0	3.0	
Recall Mode	None	None		None		None		Min	Min	Min	Min	
Walk Time (s)	7.0	7.0		7.0		7.0		7.0	7.0	7.0	7.0	
Flash Dont Walk (s)	11.0	11.0		11.0		11.0		11.0	11.0	11.0	11.0	
Pedestrian Calls (#/hr)	0	0		0		0		0	0	0	0	
Act Effct Green (s)		17.9		17.9		19.4		60.1	60.1		60.1	
Actuated g/C Ratio		0.20		0.20		0.22		0.67	0.67		0.67	
v/c Ratio		0.20		0.93		0.14		0.98	0.24		0.76	
Control Delay		29.4		74.6		10.5		37.2	3.3		17.7	
Queue Delay		0.0		0.0		0.0		0.0	0.0		0.0	
Total Delay		29.4		74.6		10.5		37.2	3.3		17.7	
LOS		C		E		B		D	A		B	
Approach Delay		29.4			64.3			31.2			17.7	
Approach LOS		C			E			C			B	
Queue Length 50th (ft)		33		152		1		549	21		226	
Queue Length 95th (ft)		45		#300		30		#892	47		349	
Internal Link Dist (ft)		276			413			154			259	
Turn Bay Length (ft)						100			100			
Base Capacity (vph)		368		294		378		1174	1041		866	
Starvation Cap Reductn		0		0		0		0	0		0	
Spillback Cap Reductn		0		0		0		0	0		0	
Storage Cap Reductn		0		0		0		0	0		0	
Reduced v/c Ratio		0.20		0.92		0.14		0.98	0.24		0.76	

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 90
Natural Cycle: 90
Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.98
Intersection Signal Delay: 31.9 Intersection LOS: C
Intersection Capacity Utilization 86.1% ICU Level of Service E
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 10: NH 102 & Fordway/Madden Hill Road



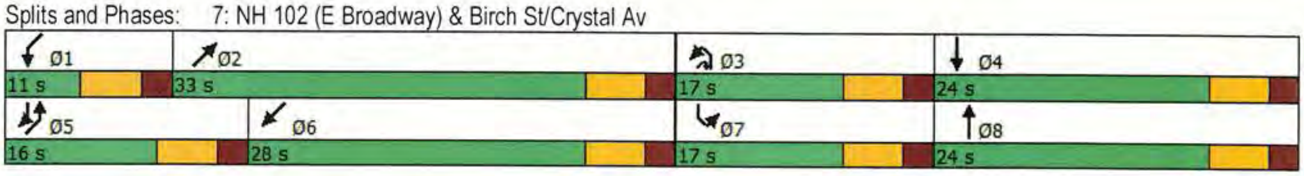
Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	230	110	30	180	150	180	170	540	130	70	330	180
Future Volume (vph)	230	110	30	180	150	180	170	540	130	70	330	180
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	70		0	245		245	390		0	110		0
Storage Lanes	1		0	1		1	1		1	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95
Frt		0.968				0.850			0.850		0.947	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	3400	1786	0	1752	1845	1568	1787	1881	1599	1787	3385	0
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	3400	1786	0	1752	1845	1568	1787	1881	1599	1787	3385	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		15				150			137		116	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		361			411			477			530	
Travel Time (s)		8.2			9.3			10.8			12.0	
Peak Hour Factor	0.91	0.91	0.91	0.93	0.93	0.93	0.95	0.95	0.95	0.94	0.94	0.94
Heavy Vehicles (%)	3%	3%	3%	3%	3%	3%	1%	1%	1%	1%	1%	1%
Adj. Flow (vph)	253	121	33	194	161	194	179	568	137	74	351	191
Shared Lane Traffic (%)												
Lane Group Flow (vph)	253	154	0	194	161	194	179	568	137	74	542	0
Turn Type	Prot	NA		Prot	NA	pm+ov	Prot	NA	pm+ov	Prot	NA	
Protected Phases	3	8		7	4	5	5	2	3	1	6	
Permitted Phases						4			2			
Detector Phase	3	8		7	4	5	5	2	3	1	6	
Switch Phase												
Minimum Initial (s)	4.0	5.0		4.0	10.0	4.0	4.0	10.0	4.0	4.0	9.0	
Minimum Split (s)	17.0	24.0		11.0	24.0	16.0	16.0	24.0	17.0	11.0	24.0	
Total Split (s)	17.0	24.0		17.0	24.0	16.0	16.0	33.0	17.0	11.0	28.0	
Total Split (%)	20.0%	28.2%		20.0%	28.2%	18.8%	18.8%	38.8%	20.0%	12.9%	32.9%	
Maximum Green (s)	11.0	18.0		11.0	18.0	10.0	10.0	27.0	11.0	5.0	22.0	
Yellow Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	
Lead/Lag	Lead	Lag		Lead	Lag	Lead	Lead	Lag	Lead	Lead	Lag	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Recall Mode	None	None		None	None	None	None	Max	None	None	None	
Act Effct Green (s)	10.0	12.0		10.8	12.8	28.7	9.9	27.3	43.4	5.1	19.7	
Actuated g/C Ratio	0.13	0.16		0.14	0.17	0.37	0.13	0.36	0.57	0.07	0.26	
v/c Ratio	0.57	0.53		0.79	0.53	0.28	0.78	0.85	0.14	0.63	0.57	
Control Delay	37.9	34.4		58.0	36.9	6.5	58.8	39.1	2.3	63.1	22.0	
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Delay	37.9	34.4		58.0	36.9	6.5	58.8	39.1	2.3	63.1	22.0	
LOS	D	C		E	D	A	E	D	A	E	C	
Approach Delay		36.6			33.6			37.4			26.9	

Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Approach LOS		D			C			D			C	
Queue Length 50th (ft)	60	64		94	75	14	87	261	0	37	91	
Queue Length 95th (ft)	103	120		#218	132	56	#206	#491	25	#108	152	
Internal Link Dist (ft)		281			331			397			450	
Turn Bay Length (ft)	70			245		245	390			110		
Base Capacity (vph)	492	435		253	437	684	235	669	984	117	1063	
Starvation Cap Reductn	0	0		0	0	0	0	0	0	0	0	
Spillback Cap Reductn	0	0		0	0	0	0	0	0	0	0	
Storage Cap Reductn	0	0		0	0	0	0	0	0	0	0	
Reduced v/c Ratio	0.51	0.35		0.77	0.37	0.28	0.76	0.85	0.14	0.63	0.51	

Intersection Summary

Area Type: Other
Cycle Length: 85
Actuated Cycle Length: 76.7
Natural Cycle: 85
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.85
Intersection Signal Delay: 33.8 — Intersection LOS: C
Intersection Capacity Utilization 87.0% — ICU Level of Service E
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 7: NH 102 (E Broadway) & Birch St/Crystal Av



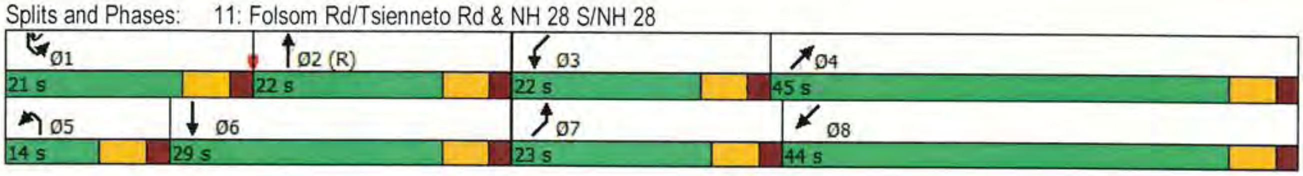
Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations	↰	↑↑	↱	↰↰	↑↑		↰	↑	↱	↰	↑	↱
Traffic Volume (vph)	60	180	240	390	280	0	150	470	100	190	370	370
Future Volume (vph)	60	180	240	390	280	0	150	470	100	190	370	370
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	110		90	360		0	190		180	0		210
Storage Lanes	1		1	2		0	1		1	1		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850						0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1770	3539	1583	3433	3539	0	1770	1863	1583	1787	1881	1599
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1770	3539	1583	3433	3539	0	1770	1863	1583	1787	1881	1599
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			261						208			240
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		639			495			532			387	
Travel Time (s)		14.5			11.3			12.1			8.8	
Peak Hour Factor	0.92	0.92	0.92	0.94	0.94	0.94	0.96	0.96	0.96	0.95	0.95	0.95
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	1%	1%	1%
Adj. Flow (vph)	65	196	261	415	298	0	156	490	104	200	389	389
Shared Lane Traffic (%)												
Lane Group Flow (vph)	65	196	261	415	298	0	156	490	104	200	389	389
Turn Type	Prot	NA	Perm	Prot	NA		Prot	NA	Perm	Prot	NA	pm+ov
Protected Phases	5	2		1	6		7	4		3	8	1
Permitted Phases			2						4			8
Detector Phase	5	2	2	1	6		7	4	4	3	8	1
Switch Phase												
Minimum Initial (s)	8.0	8.0	8.0	8.0	8.0		8.0	8.0	8.0	8.0	8.0	8.0
Minimum Split (s)	14.0	22.0	22.0	14.0	22.0		14.0	22.0	22.0	14.0	22.0	14.0
Total Split (s)	14.0	22.0	22.0	21.0	29.0		23.0	45.0	45.0	22.0	44.0	21.0
Total Split (%)	12.7%	20.0%	20.0%	19.1%	26.4%		20.9%	40.9%	40.9%	20.0%	40.0%	19.1%
Maximum Green (s)	8.0	16.0	16.0	15.0	23.0		17.0	39.0	39.0	16.0	38.0	15.0
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0		6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag		Lead	Lag	Lag	Lead	Lag	Lead
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes	Yes	Yes	Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	C-Max	C-Max	None	None		None	None	None	None	None	None
Walk Time (s)		5.0	5.0		5.0			5.0	5.0		5.0	
Flash Dont Walk (s)		11.0	11.0		11.0			11.0	11.0		11.0	
Pedestrian Calls (#/hr)		0	0		0			0	0		0	
Act Effct Green (s)	8.3	20.7	20.7	16.4	31.6		14.2	33.8	33.8	15.1	34.7	57.1
Actuated g/C Ratio	0.08	0.19	0.19	0.15	0.29		0.13	0.31	0.31	0.14	0.32	0.52
v/c Ratio	0.49	0.29	0.51	0.81	0.29		0.69	0.86	0.17	0.82	0.66	0.41
Control Delay	61.7	41.8	9.2	68.9	33.6		61.0	50.6	0.6	71.8	37.8	6.7
Queue Delay	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0

Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Total Delay	61.7	41.8	9.2	68.9	33.6		61.0	50.6	0.6	71.8	37.8	6.7
LOS	E	D	A	E	C		E	D	A	E	D	A
Approach Delay		28.0			54.2			45.8			32.4	
Approach LOS		C			D			D			C	
Queue Length 50th (ft)	44	66	0	148	85		106	319	0	138	232	49
Queue Length 95th (ft)	91	103	75	#245	104		173	428	0	#250	328	114
Internal Link Dist (ft)		559			415			452			307	
Turn Bay Length (ft)	110		90	360			190		180			210
Base Capacity (vph)	133	667	510	511	1015		273	660	695	259	649	945
Starvation Cap Reductn	0	0	0	0	0		0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0		0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0		0	0	0	0	0	0
Reduced v/c Ratio	0.49	0.29	0.51	0.81	0.29		0.57	0.74	0.15	0.77	0.60	0.41

Intersection Summary

Area Type: Other
Cycle Length: 110
Actuated Cycle Length: 110
Offset: 0 (0%), Referenced to phase 2:NBT, Start of Green
Natural Cycle: 90
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.86
Intersection Signal Delay: 40.3 Intersection LOS: D
Intersection Capacity Utilization 73.1% ICU Level of Service D
Analysis Period (min) 15
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 11: Folsom Rd/Tsienneto Rd & NH 28 S/NH 28



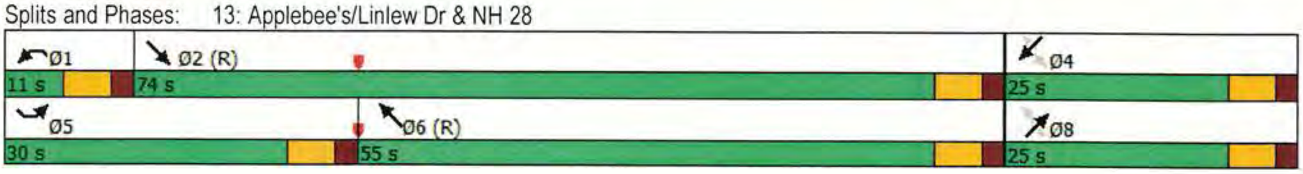
Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	130	895	5	10	620	60	15	10	15	20	10	110
Future Volume (vph)	130	895	5	10	620	60	15	10	15	20	10	110
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	100		0	115		0	0		0	0		0
Storage Lanes	1		0	1		0	0		1	0		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.999			0.987				0.850			0.850
Flt Protected	0.950			0.950				0.971			0.968	
Satd. Flow (prot)	1787	3571	0	1787	3528	0	0	1845	1615	0	1821	1599
Flt Permitted	0.950			0.950				0.792			0.785	
Satd. Flow (perm)	1787	3571	0	1787	3528	0	0	1505	1615	0	1477	1599
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		1			12				149			149
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		277			652			230			387	
Travel Time (s)		6.3			14.8			5.2			8.8	
Peak Hour Factor	0.97	0.97	0.97	0.95	0.95	0.95	0.90	0.90	0.90	0.80	0.80	0.80
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	0%	0%	0%	1%	1%	1%
Adj. Flow (vph)	134	923	5	11	653	63	17	11	17	25	13	138
Shared Lane Traffic (%)												
Lane Group Flow (vph)	134	928	0	11	716	0	0	28	17	0	38	138
Turn Type	Prot	NA		Prot	NA		Perm	NA	Perm	Perm	NA	Perm
Protected Phases	5	2		1	6			8			4	
Permitted Phases							8		8	4	4	4
Detector Phase	5	2		1	6		8	8	8	4	4	4
Switch Phase												
Minimum Initial (s)	5.0	8.0		5.0	8.0		5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	26.0	63.0		11.0	48.0		21.0	21.0	21.0	21.0	21.0	21.0
Total Split (s)	30.0	74.0		11.0	55.0		25.0	25.0	25.0	25.0	25.0	25.0
Total Split (%)	27.3%	67.3%		10.0%	50.0%		22.7%	22.7%	22.7%	22.7%	22.7%	22.7%
Maximum Green (s)	24.0	68.0		5.0	49.0		19.0	19.0	19.0	19.0	19.0	19.0
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0			0.0	0.0		0.0	0.0
Total Lost Time (s)	6.0	6.0		6.0	6.0			6.0	6.0		6.0	6.0
Lead/Lag	Lead	Lag		Lead	Lag							
Lead-Lag Optimize?	Yes	Yes		Yes	Yes							
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	C-Max		None	C-Max		None	None	None	None	None	None
Walk Time (s)		7.0			7.0		7.0	7.0	7.0	7.0	7.0	7.0
Flash Dont Walk (s)		11.0			11.0		8.0	8.0	8.0	8.0	8.0	8.0
Pedestrian Calls (#/hr)		0			0		0	0	0	0	0	0
Act Effct Green (s)	13.5	87.1		6.3	70.3			8.2	8.2		8.2	8.2
Actuated g/C Ratio	0.12	0.79		0.06	0.64			0.07	0.07		0.07	0.07
v/c Ratio	0.61	0.33		0.11	0.32			0.25	0.07		0.35	0.54
Control Delay	67.9	3.0		44.4	14.0			52.5	0.5		56.2	14.6
Queue Delay	0.0	0.0		0.0	0.0			0.0	0.0		0.0	0.0

Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Total Delay	67.9	3.0		44.4	14.0			52.5	0.5		56.2	14.6
LOS	E	A		D	B			D	A		E	B
Approach Delay		11.2			14.4			32.8			23.6	
Approach LOS		B			B			C			C	
Queue Length 50th (ft)	102	34		8	128			19	0		26	0
Queue Length 95th (ft)	157	84		m19	187			47	0		52	33
Internal Link Dist (ft)		197			572			150			307	
Turn Bay Length (ft)	100			115								
Base Capacity (vph)	389	2827		101	2257			259	402		255	399
Starvation Cap Reductn	0	0		0	0			0	0		0	0
Spillback Cap Reductn	0	0		0	0			0	0		0	0
Storage Cap Reductn	0	0		0	0			0	0		0	0
Reduced v/c Ratio	0.34	0.33		0.11	0.32			0.11	0.04		0.15	0.35

Intersection Summary

Area Type: Other
Cycle Length: 110
Actuated Cycle Length: 110
Offset: 0 (0%), Referenced to phase 2:SET and 6:NWT, Start of Green
Natural Cycle: 95
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.61
Intersection Signal Delay: 13.9 Intersection LOS: B
Intersection Capacity Utilization 52.4% ICU Level of Service A
Analysis Period (min) 15
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 13: Applebee's/Linlew Dr & NH 28



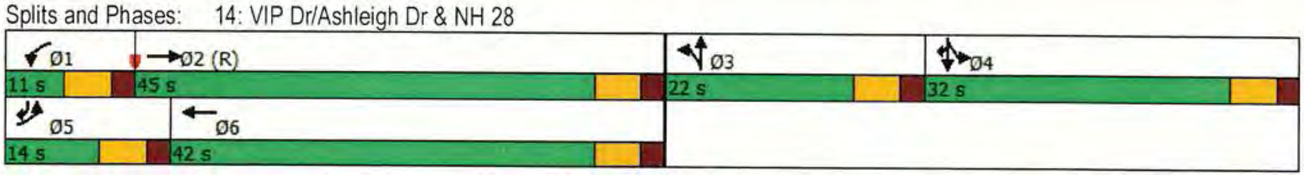
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	80	770	5	5	580	190	40	10	10	350	10	140
Future Volume (vph)	80	770	5	5	580	190	40	10	10	350	10	140
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	280		150	205		150	0		0	325		150
Storage Lanes	2		0	1		0	1		0	1		1
Taper Length (ft)	150			25			25			25		
Lane Util. Factor	0.97	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	0.95	0.95	1.00
Frt		0.999			0.963			0.925				0.850
Flt Protected	0.950			0.950			0.950			0.950	0.955	
Satd. Flow (prot)	3467	3571	0	1770	3408	0	1805	1758	0	1715	1724	1615
Flt Permitted	0.950			0.950			0.950			0.950	0.955	
Satd. Flow (perm)	3467	3571	0	1770	3408	0	1805	1758	0	1715	1724	1615
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		1			43			13				163
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		877			314			151			476	
Travel Time (s)		19.9			7.1			3.4			10.8	
Peak Hour Factor	0.84	0.84	0.84	0.90	0.90	0.90	0.78	0.78	0.78	0.86	0.86	0.86
Heavy Vehicles (%)	1%	1%	1%	2%	2%	2%	0%	0%	0%	0%	0%	0%
Adj. Flow (vph)	95	917	6	6	644	211	51	13	13	407	12	163
Shared Lane Traffic (%)										49%		
Lane Group Flow (vph)	95	923	0	6	855	0	51	26	0	208	211	163
Turn Type	Prot	NA		Prot	NA		Split	NA		Split	NA	pt+ov
Protected Phases	5	2		1	6		3	3		4	4	4 5
Permitted Phases		2			6							
Detector Phase	5	2		1	6		3	3		4	4	4 5
Switch Phase												
Minimum Initial (s)	5.0	8.0		5.0	8.0		5.0	5.0		8.0	8.0	
Minimum Split (s)	11.0	22.0		11.0	22.0		22.0	22.0		22.0	22.0	
Total Split (s)	14.0	45.0		11.0	42.0		22.0	22.0		32.0	32.0	
Total Split (%)	12.7%	40.9%		10.0%	38.2%		20.0%	20.0%		29.1%	29.1%	
Maximum Green (s)	8.0	39.0		5.0	36.0		16.0	16.0		26.0	26.0	
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lead		Lag	Lag	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	C-Max		None	None		None	None		None	None	
Walk Time (s)		5.0			5.0		5.0	5.0		5.0	5.0	
Flash Dont Walk (s)		11.0			11.0		11.0	11.0		11.0	11.0	
Pedestrian Calls (#/hr)		0			0		0	0		0	0	
Act Effct Green (s)	8.4	63.6		6.0	51.8		8.5	8.5		19.6	19.6	34.0
Actuated g/C Ratio	0.08	0.58		0.05	0.47		0.08	0.08		0.18	0.18	0.31
v/c Ratio	0.36	0.45		0.06	0.53		0.37	0.18		0.68	0.69	0.27
Control Delay	51.6	17.3		59.6	21.0		54.8	32.2		52.7	53.0	4.6
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Total Delay	51.6	17.3		59.6	21.0		54.8	32.2		52.7	53.0	4.6
LOS	D	B		E	C		D	C		D	D	A
Approach Delay		20.5			21.2			47.2			39.4	
Approach LOS		C			C			D			D	
Queue Length 50th (ft)	33	182		4	147		35	9		146	148	0
Queue Length 95th (ft)	55	332		m15	255		62	30		200	202	35
Internal Link Dist (ft)		797			234			71			396	
Turn Bay Length (ft)	280			205						325		150
Base Capacity (vph)	279	2064		96	1626		262	266		410	412	610
Starvation Cap Reductn	0	0		0	0		0	0		0	0	0
Spillback Cap Reductn	0	0		0	0		0	0		0	0	0
Storage Cap Reductn	0	0		0	0		0	0		0	0	0
Reduced v/c Ratio	0.34	0.45		0.06	0.53		0.19	0.10		0.51	0.51	0.27

Intersection Summary

Area Type: Other
Cycle Length: 110
Actuated Cycle Length: 110
Offset: 0 (0%), Referenced to phase 2:EBT, Start of Green
Natural Cycle: 80
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.69
Intersection Signal Delay: 25.9 Intersection LOS: C
Intersection Capacity Utilization 57.9% ICU Level of Service B
Analysis Period (min) 15
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 14: VIP Dr/Ashleigh Dr & NH 28



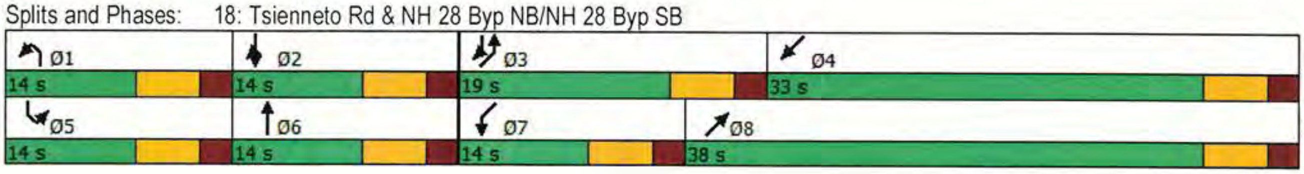
Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	30	80	40	40	50	130	190	680	70	20	340	40
Future Volume (vph)	30	80	40	40	50	130	190	680	70	20	340	40
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200		0	190		190	135		0	120		0
Storage Lanes	1		0	1		1	1		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.950				0.850		0.986			0.984	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1770	1770	0	1787	1881	1599	1805	1873	0	1805	1870	0
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1770	1770	0	1787	1881	1599	1805	1873	0	1805	1870	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		25				137		8			8	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		481			347			479			371	
Travel Time (s)		10.9			7.9			10.9			8.4	
Peak Hour Factor	0.99	0.99	0.99	0.95	0.95	0.95	0.89	0.89	0.89	0.93	0.93	0.93
Heavy Vehicles (%)	2%	2%	2%	1%	1%	1%	0%	0%	0%	0%	0%	0%
Adj. Flow (vph)	30	81	40	42	53	137	213	764	79	22	366	43
Shared Lane Traffic (%)												
Lane Group Flow (vph)	30	121	0	42	53	137	213	843	0	22	409	0
Turn Type	Prot	NA		Prot	NA	pt+ov	Prot	NA		Prot	NA	
Protected Phases	1	6		5	2	2 3	3	8		7	4	
Permitted Phases		6			2							
Detector Phase	1	6		5	2	2 3	3	8		7	4	
Switch Phase												
Minimum Initial (s)	8.0	8.0		8.0	8.0		8.0	8.0		8.0	8.0	
Minimum Split (s)	14.0	14.0		14.0	14.0		14.0	28.0		14.0	14.0	
Total Split (s)	14.0	14.0		14.0	14.0		19.0	38.0		14.0	33.0	
Total Split (%)	17.5%	17.5%		17.5%	17.5%		23.8%	47.5%		17.5%	41.3%	
Maximum Green (s)	8.0	8.0		8.0	8.0		13.0	32.0		8.0	27.0	
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lag		Lead	Lag	
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	Max		None	None		None	None	
Walk Time (s)								7.0				
Flash Dont Walk (s)								15.0				
Pedestrian Calls (#/hr)								0				
Act Effct Green (s)	8.3	8.3		8.3	10.9	28.8	11.6	34.7		8.3	21.5	
Actuated g/C Ratio	0.12	0.12		0.12	0.16	0.43	0.17	0.51		0.12	0.32	
v/c Ratio	0.14	0.50		0.19	0.17	0.18	0.68	0.87		0.10	0.68	
Control Delay	33.7	35.1		34.2	31.2	4.6	42.0	31.7		33.4	27.5	
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	

Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Total Delay	33.7	35.1		34.2	31.2	4.6	42.0	31.7		33.4	27.5	
LOS	C	D		C	C	A	D	C		C	C	
Approach Delay		34.8			16.0			33.8			27.8	
Approach LOS		C			B			C			C	
Queue Length 50th (ft)	13	42		18	17	0	92	295		9	167	
Queue Length 95th (ft)	39	#113		50	59	36	#197	#700		32	263	
Internal Link Dist (ft)		401			267			399			291	
Turn Bay Length (ft)	200			190		190	135			120		
Base Capacity (vph)	218	240		219	303	800	361	966		222	782	
Starvation Cap Reductn	0	0		0	0	0	0	0		0	0	
Spillback Cap Reductn	0	0		0	0	0	0	0		0	0	
Storage Cap Reductn	0	0		0	0	0	0	0		0	0	
Reduced v/c Ratio	0.14	0.50		0.19	0.17	0.17	0.59	0.87		0.10	0.52	

Intersection Summary

Area Type: Other
Cycle Length: 80
Actuated Cycle Length: 67.5
Natural Cycle: 90
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.87
Intersection Signal Delay: 30.3 Intersection LOS: C
Intersection Capacity Utilization 70.6% ICU Level of Service C
Analysis Period (min) 15
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 18: Tsienneto Rd & NH 28 Byp NB/NH 28 Byp SB



Appendix B: Land Use Scenarios Technical Report

Land Use Scenarios Technical Report

I-93 Exit 4A Supplemental Draft Environmental Impact Statement

Prepared for:

Town of Derry
Town of Londonderry
New Hampshire Department of Transportation

Prepared by:

Louis Berger

Version: #5
March 2017

NHDOT Project Number: 13065
Federal Project Number: IM-0931(201)
CLD/Towns Project Number 05-0244

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

ABBREVIATIONS AND ACRONYMS

CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
EIS	environmental impact statement
2007 DEIS	2007 Draft Environmental Impact Statement
FHWA	Federal Highway Administration
gsf	gross square feet
NEPA	National Environmental Policy Act
NHDOT	New Hampshire Department of Transportation
NHES	New Hampshire Employment Security
OEP	New Hampshire Office of Energy and Planning
Project	I-93 Exit 4A Project
PUD	planned unit development
RPC	Rockingham Planning Commission
SDEIS	Supplemental Draft Environmental Impact Statement
SNHPC	Southern New Hampshire Planning Commission
TAZ	traffic analysis zone

1.0 INTRODUCTION

The Towns of Derry and Londonderry and the New Hampshire Department of Transportation (NHDOT), in cooperation with the Federal Highway Administration (FHWA), are preparing a Supplemental Draft Environmental Impact Statement (SDEIS) for the I-93 Exit 4A Project (Project). The Proposed Project consists of a new diamond interchange on I-93 in the Town of Londonderry, approximately 1 mile north of Exit 4. The new diamond interchange would provide access to the east side of I-93. A 1-mile connector roadway would be built on new alignment from the interchange to Folsom Road, near the intersection of North High Street and Madden Road, in the Town of Derry. Folsom Road, and subsequently Tsienneto Road, would be upgraded, and the intersections would be improved. In total, the Proposed Project corridor from I-93 to the intersection of Tsienneto Road and NH Route 102/Chester Road would be 3.2 miles. The purpose of the Project is to reduce congestion and improve safety along NH 102, from I-93 east through downtown Derry and to promote economic vitality in the Derry/Londonderry area.

As part of the SDEIS, the Southern New Hampshire Planning Commission's (SNHPC's) regional travel demand model will be used to assess how the Project and alternatives may affect travel patterns in the 2040 design year. The travel demand model requires information on local-level population and employment patterns to forecast the number of trip origin and end points in the future. In addition to estimating the number of trips, type of trips, and destination of trips, the travel demand model includes a representation of the roadway network (including highway capacity and speed). The travel demand model assigns trips to specific routes, which forms the basis for the total traffic volumes forecasted for each roadway. Separate model runs are required to represent the 2040 roadway network without the Project (e.g., the 2040 No Build) and with the Project completed (2040 Build). The travel demand model output of volumes for each roadway link in the network on a 24-hour basis will be further processed as part of a detailed traffic impact analysis for the peak hours. The traffic impact analysis will be documented in the SDEIS traffic and transportation technical report and will in turn inform several other SDEIS technical analyses, including air quality and noise.

The purpose of this report is to document the basis for the local level population and employment inputs used in the travel demand modeling for the 2040 No Build and Build conditions. Given that the purpose of the Project includes encouraging economic development in Londonderry and Derry, a critical objective for the SDEIS is to estimate the quantity and location of potential future development potentially caused by the Project and to account for that growth in the travel demand modeling. As a result of including potential induced growth impacts in the travel demand model for the 2040 Build condition, the SDEIS will ensure consistency between the traffic analysis and the other land use-related portions of the SDEIS, including indirect and cumulative impacts. The overall land use forecasting process used is consistent with the recommendations of FHWA's *Interim Guidance on the Application of Travel and Land Use Forecasting in NEPA* (FHWA, 2010). Specifically, the forecasting effort included reviewing the suitability of existing forecasts; collaborating with land use/socioeconomic forecast experts, local planners, and the development community; and documenting the basis for assumptions.

1.1 Regulatory Framework

The Council on Environmental Quality (CEQ) regulates implementation the National Environmental Policy Act (NEPA) and defines three types of effects: direct, indirect, and cumulative.

"**Direct impacts** are caused by the action and occur at the same time and place (40 Code of Federal Regulations [CFR] 1508.8)." Examples of direct impacts include displacements resulting from the acquisition of right-of-way or the fill placed in wetlands in order to construct a roadway improvement. The uncertainty associated with assessing direct impacts is very low relative to indirect and cumulative impacts.

"**Indirect effects** are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. Indirect effects may include growth-inducing effects and other effects related to induced changes in the pattern of land use, population density, or growth rate, and related effects on air and water and other natural systems, including ecosystems (40 CFR 1508.8)."

The National Cooperative Highway Research Program Report 403: *Estimating the Indirect Effects of Proposed Transportation Projects* identifies three types of indirect effects:

- Encroachment-Alteration Effects - alteration of the behavior and functioning of the affected environment caused by project encroachment (physical, chemical, or biological) on the environment.
- Induced Growth Effects - changes in the intensity of the use to which land is put that are caused by the action/project. These changes would not occur if the action/project does not occur. For transportation projects, induced growth is attributed to changes in accessibility caused by the project.
- Induced Growth Related Effects - alteration of the behavior and functioning of the affected environment attributable to induced growth.

"**Cumulative impact** is the impact on the environment, which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 CFR 1508.7)." According to FHWA's *Interim Guidance: Questions and Answers Regarding the Consideration of Indirect and Cumulative Impacts in the NEPA Process*, cumulative impacts include the total of all impacts to a particular resource that have occurred, are occurring, and will likely occur as a result of any action or influence, including the direct and reasonably foreseeable indirect impacts of a proposed project (FHWA, 2003).

1.1.1 FHWA Interim Guidance on Travel and Land Use Forecasting

In 2010, FHWA issued *Interim Guidance on the Application of Travel and Land Use Forecasting in NEPA*. Among other items, the guidance identifies considerations for improving how project-level forecasting is applied in the context of the process for meeting the requirements of NEPA and related project development. The interim guidance outlines the following key procedural and process considerations for land use and travel forecasting for NEPA:

Access project conditions and scope the forecasting needs of the study: It is crucial to scope and forecasting effort to meet the project analysis, decision-maker and stakeholder needs in the study area. For this reason, it is useful to begin the forecasting process by understanding the requirements of the study and anticipating the decision-maker and stakeholder interests with respect to forecasting.

Review the suitability of modeling methods, tools, and underlying data: It is important that the study team review the suitability of available modeling methods and the underlying data, including consideration of the currency and quality of the model data and methods, and that they analyze the data and methods' ability to adequately examine alternatives.

Conduct scoping and collaborate on methodologies: Scoping is a collaborative process involving the lead agencies, resource and regulatory agencies, and the public and is typically how a NEPA study begins. It is critical for the study team to document the broad agreements reached during scoping on the assumptions to be used for the land use and travel forecasting.

Objective application of forecasting in alternatives analysis: The requirement for the alternatives analysis to be an objective evaluation makes it essential for the study team to apply forecasting data and methods objectively without any bias towards a particular alternative. Important considerations include understanding uncertainty in assumptions and forecasts and how induced demand and land development effects are taken into account.

Project management considerations: NEPA studies are often complex undertakings and may be accompanied by various special considerations that warrant extra attention, such as the potential for re-do analysis loops and ensuring documentation consistency.

Forecasting for noise and air emissions analyses: Land use and travel demand forecasting models are used to provide inputs to noise and air quality assessments. It is important that assumptions that are made in general forecasting applications as part of the NEPA study are consistent with those used in the noise and air quality analyses.

Documentation and archiving: It is important for NEPA documentation to include enough technical detail to explain complex information in an understandable manner, and to describe how analytical methods were chosen, what assumptions were made, and who made those choices. (FHWA, 2010)

1.2 Relationship to Other Technical Reports

Within the overall regulatory framework discussed in section 1.1, the focus of this report is the portion of indirect effects related to land use change/induced growth, as well as cumulative impacts on population and employment levels. The potential indirect environmental impacts of the land use changes discussed in this report (such as additional habitat loss or additional stormwater runoff for example) will be documented separately in the SDEIS Indirect Effects Technical Report. The SDEIS and Indirect Effects Technical Report will also address encroachment-alteration type effects, such as habitat fragmentation. Similarly, cumulative impacts on specific environmental resources will be thoroughly documented through a separate Cumulative Impacts Technical Report and in the SDEIS. However, the subsequent further indirect and cumulative impact analyses will utilize the population and employment levels and growth patterns identified in this report as a key input.

The travel demand modeling and traffic impact analyses will utilize the socioeconomic data results of this study as an input, but the details of these analyses will be documented separately in the Traffic and Transportation Technical Report.

2.0 METHODOLOGY

The methodology used to develop the 2040 No Build and Build conditions land use forecasts included obtaining existing population and employment forecasts and interviewing local land use planners, socioeconomic data experts, and representatives of the development community.

2.1.1 Study Area

The study area for the Build and No Build conditions is the "economic study area" described in the 2007 Draft EIS (DEIS), as shown in Figure 1. This study area encompasses 143 square miles within the two Towns of Derry and Londonderry, as well as Auburn, Chester, and Sandown. The five-town study area was determined by considering the likely geographic extent of potential direct, indirect, and cumulative effects related to land use and development—Derry and Londonderry would be directly affected, and Auburn, Chester, and Sandown may experience indirect effects due to improved access and travel time to I-93. The limits of the economic study area were agreed upon in consultation with state and federal agency staff at a meeting held on August 25, 2005. Given that there are no major changes in the basic alignment of the alternatives under consideration since the 2007 DEIS, the previously agreed on study area remains reasonable for this SDEIS.

2.1.2 Analysis Timeframe

The temporal scope of analysis for the land use scenarios is based on past development trends and a future-planning horizon for which information on reasonably foreseeable future development is available. The Towns of Derry and Londonderry experienced rapid growth beginning in the 1960s and 1980s, respectively, based on available and affordable housing and favorable schools. Londonderry adopted a growth management ordinance (a subset of its zoning ordinance) in 1988 and readopted it in 1998. The ordinance was allowed to expire in 2015. Derry adopted a growth management ordinance (also a subset of its zoning ordinance) in 1999, which is still active. As a result, the past time horizon for consideration of development trends is 1990, the point at which the rapid growth began to be controlled (see section 3.1 – Past Population and Employment Trends). The future time horizon is 2040, which is the design year for the Project as well as a time horizon that encompasses the long-range comprehensive plans and long-range transportation plans for the study area. The 2040 future analysis year is also the analysis year that will be used for the transportation and air quality/noise impact analyses for the Project. The baseline or existing conditions model year for the transportation analyses for the Project is 2015, consequently 2015 land use and socioeconomic data is also reviewed in this report.

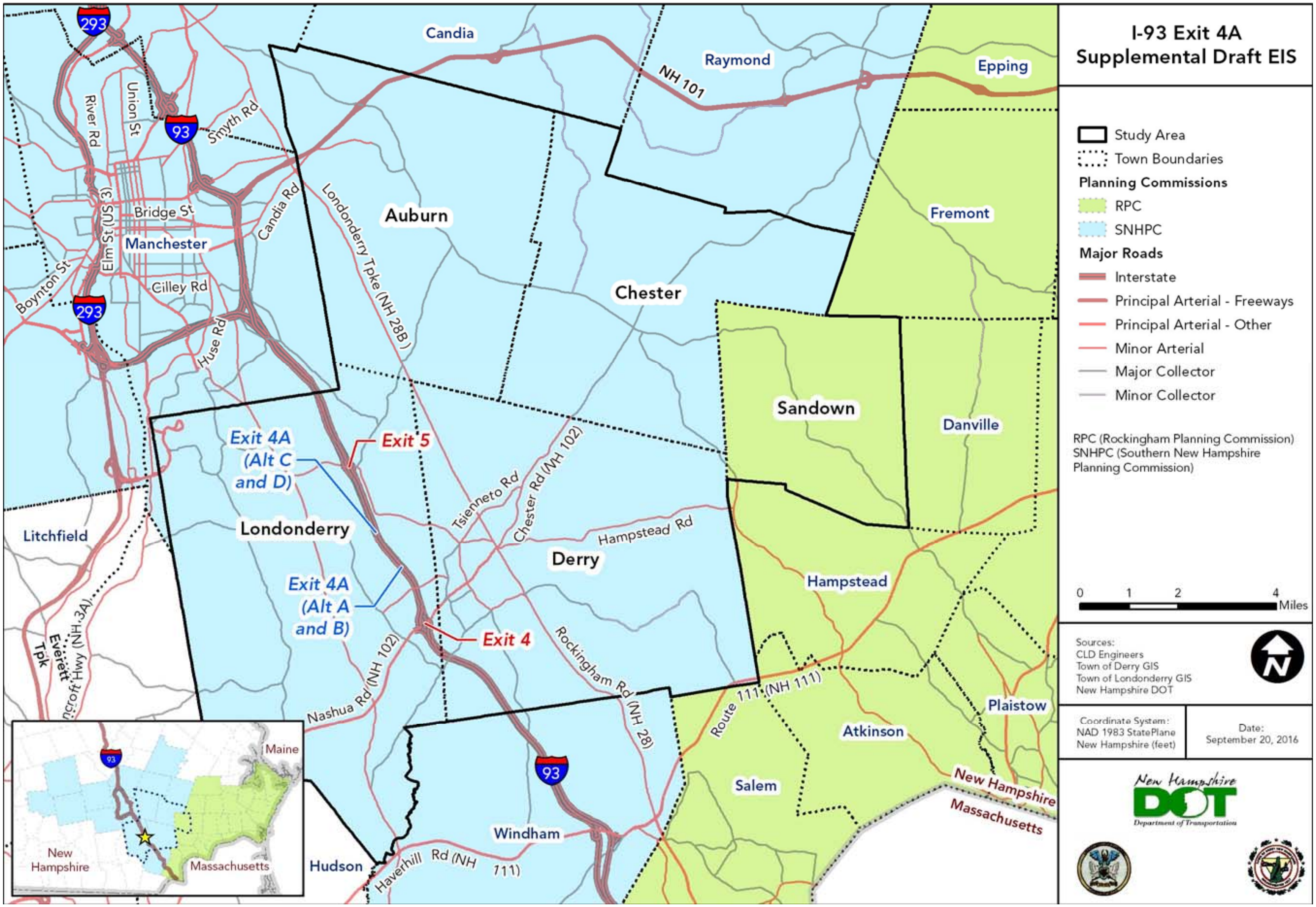

Figure 1. Study area

2.2 Data Reviewed

Existing population and employment forecasts, comprehensive plans, and available development data were reviewed, including the following:

- U.S. Census Bureau 1990, 2000, and 2010 Decennial Census data (U.S. Census Bureau, 1990, 2000, and 2010)
- New Hampshire Employment Security (NHES) Economic and Labor Market Information Bureau employment data from 2004 and 2014 (NHES, 2015)
- New Hampshire Office of Energy and Planning (OEP) County and Municipal Populations Projections 2010–2040 (OEP, 2016a, 2016b)
- SNHPC's Moving Southern New Hampshire Forward: 2015-2035 Regional Comprehensive Plan (SNHPC, 2014) and letter to the Director of Derry Planning Department regarding population and dwelling unit projections (SNHPC, 2012a)
- SNHPC Population and Household Projections 2010-2050 (SNHPC, 2012b), and updated 2015-2040 Household Projections based on OEP Population Projections (SNHPC, 2016a)
- SNHPC Employment Projections for 2010-2050 based on New Hampshire Employment Security and NHDOT data (SNHPC, 2012c), SNHPC Updated Employment Estimates for 2015 (SNHPC, 2016b), and SNHPC Updated Employment Projections for 2020-2040 (SNHPC, 2016c)
- Rockingham Planning Commission (RPC) 2015 Regional Master Plan (RPC, 2015)
- Woodmont Commons Planned Unit Development (PUD) Application Materials (Pillsbury Realty Development, 2013)
- Master Plans of Derry and Londonderry (Town of Derry, 2010; Town of Londonderry, 2013)
- Master Plans of Chester, Auburn, and Sandown (Chester Planning Board, 2015; SNHPC, 2007; Sandown Master Plan Steering Committee et al., 2013)
- SNHPC Regional Comprehensive Plan (SNHPC, 2010)
- Regional Economic Development Center of Southern New Hampshire 2016 Comprehensive Economic Development Strategy (REDC, 2016)
- Environmental constraints on development, and local land use controls

2.3 Land Use Interviews

The purpose of these structured interviews and outreach was to inform and support the analysis of reasonably foreseeable future growth, identify predicted future growth areas under the No Build and Build conditions, and estimate the indirect land use effects of the Project and alternatives.

In conjunction with the information gathered through the interviews, the data detailed in section 2.2 were reviewed to develop the forecasts associated with the 2040 No Build and Build conditions.

Interviews were conducted with the following planners and town staff on July 25–26, 2016:

- Town of Derry
  - George Sioras, Planning Director
  - Elizabeth Robidoux, Planning Assistant
  - Mike Fowler, Public Works Director
- Town of Londonderry
  - Colleen Mailloux, Town Planner
  - John Vogl, GIS Manager/Comprehensive Planner
- SNHPC
  - Julie Chen, Senior Transportation Planner
  - Jack Munn, Chief Planner
  - Adam Hlasny, Transportation Planner
- OEP
  - Ken Gallager, Principal Planner

In addition, because the Woodmont Commons Project is planned adjacent to Exit 4A, Ari Pollack, the developer's representative, was interviewed. Finally, to gather information from municipalities identified in the economic/secondary impacts study area in the 2007 DEIS (i.e., Auburn, Chester, and Sandown), the following people were contacted via telephone.

- Bill Herman, Town Administrator, Auburn
- Andrew Hadik, Planning Coordinator, Chester; Dick Trask, Vice Chair, Chester Board of Selectmen
- Mark Traeger, Planning Board Member, Sandown

Materials, including maps and interview summaries, used to gather information via in-person and telephone interviews are included in Appendix A.

2.4 Uncertainty/Limitations

As with any attempt to forecast future growth or development, there are limitations to the accuracy and certainty of the results of the land use forecasts. This uncertainty is impossible to quantify given that land use change occurs as result of numerous individual private land use decisions and other factors such as global and local economic conditions, housing trends and costs, availability of public water and sewer service, fuel prices and long-term technological changes. The 2040 No Build and Build conditions were developed through consideration of the latest available population and employment projections from state and regional agencies as well as input from planners and others knowledgeable of local conditions and trends. The forecasting process was consistent with the best practices recommended in FHWA's interim guidance on travel and land use forecasting. As a result, the land use forecasts provide a reasonable basis for comparing alternatives in the SDEIS and assessing potential indirect and cumulative impacts as required by CEQ's NEPA regulations. The land use forecasts also provide a logical construct and ensure that the SDEIS evaluation of transportation and land use impacts is consistent.

The No Build and Build land use forecasts developed as a result of this analysis should be considered as possible outcomes, and the addition and/or shift in type of development anticipated with the proposed Project should be considered as trends rather than absolute predictions that a certain number of residential units or gross square feet of commercial or industrial development will occur in any specific location. Ultimately, the development that occurs within the study area under the No Build and Build conditions will be based upon what the Towns will permit and what the market can support.

3.0 POPULATION, HOUSEHOLD, AND EMPLOYMENT PROJECTIONS

The purpose of this section is to provide an overview of the existing population, household, and employment estimates and projections available for the study area.

3.1 Past Population, Household, and Employment Trends

In mid to late 1990s, the towns in the study area implemented growth management strategies to control the substantial population growth and residential development. As Table 1 shows, between 1990 and 2000, the towns experienced average annual population increases between 1.37 percent (Auburn) and 3.49 percent (Chester), with an average annual increase of 1.64 percent across the study area. Between 2000 and 2010, the rate of population growth slowed in the study area for various reasons, including growth management ordinances and the economic downturn in 2007-2008. Chester and Sandown still experienced substantial population growth, increasing by an average annual rate of 2.32 percent and 1.53 percent, respectively. Auburn and Londonderry experienced a much lower rate of population growth, with annual average increases of 0.53 percent and 0.38 percent. During the same 2000 to 2010 timeframe, Derry's population decreased by an annual average rate of 0.27 percent.

Household data for 1990, 2000, and 2010 reveal that Chester and Sandown had the highest average annual household growth rates between 1990 and 2000 as well as between 2000 and 2010. Between 1990 and 2000, the average annual growth rates in Chester and Sandown were 3.48 percent and 2.65 percent, respectively. Between 2000 and 2010, the average annual growth rates in Chester and Sandown were 2.37 percent and 2.03 percent, respectively. The smallest household growth occurred in Derry with an average annual household growth rate of 1.36 percent between 1990 and 2000 and 0.17 percent between 2000 and 2010. Table 1 presents available household data.

Employment information in the form of number of jobs in each jurisdiction was not available for 1990 or 2000. SNHPC's 2010 employment data were calculated from NHES employer database and are presented in Table 2 along with NHES data provided in the community profiles of each jurisdiction (SNHPC, 2012c; NHES, 2015). Sandown is included in the RPC area, and its employment in 2010 as recorded in the RPC 2015 Master Plan is 399 (RPC, 2015). Overall, the data shows very limited growth in employment in the study area since 2004, with some jurisdictions showing declines. The largest growth in jobs occurred in Auburn (550 jobs added between 2004 and 2014).

Table 1. Population and households 1990-2010

Municipality	1990		2000		2010		Average Annual Population Growth Rate		Average Annual Household Growth Rate	
	Population	Households	Population	Households	Population	Households	1990-2000	2000-2010	1990-2000	2000-2010
Derry	29,603	10,767	34,021	12,327	33,109	12,537	1.40%	-0.27%	1.36%	0.17%
Londonderry	19,781	6,386	23,236	7,623	24,129	8,438	1.62%	0.38%	1.79%	1.02%
Auburn	4,085	1,302	4,682	1,580	4,953	1,765	1.37%	0.56%	1.95%	1.11%
Chester	2,691	862	3,792	1,214	4,768	1,534	3.49%	2.32%	3.48%	2.37%
Sandown	4,060	1,304	5,143	1,694	5,986	2,072	2.39%	1.53%	2.65%	2.03%
Study Area Total	60,220	20,621	70,874	24,438	72,945	26,346	1.64%	0.29%	1.71%	0.75%

Source: U.S. Census Bureau (1990, 2000, 2010); NHGIS, 1990
Note: 1990 household data not readily available for the towns in the study area.

Table 2. Past employment (number of jobs) by municipality

Municipality	2004 (NHES)	2010 (SNHPC/RPC)	2014 (NHES)
Derry	8,150	7,825	8,003
Londonderry	13,240	13,624	13,094
Auburn	1,186	1,651	1,736
Chester	437	528	347
Sandown[a]	244	399	268
Study Area Total	22,257	22,551[a]	23,448

Source: SNHPC (2012c), NHES (2015), RPC (2015)
[a] 2010 Sandown employment data are from the RPC 2015 Master Plan.

3.2 New Hampshire Office of Energy and Planning

OEP provides population projections for the state, counties, and municipalities. The latest projections were generated in 2016 (Table 3) (OEP, 2016a). OEP data show a slight decline in population in Derry between 2015 and 2025 and that Chester, Sandown, and Auburn are projected to be the fastest growing communities in terms of annual average growth rates (0.65 percent, 0.59 percent, and 0.52 percent, respectively). These 2016 projections reflect OEP's 2015 population estimates and the change in migration of populations within the state. According to the interview with OEP, the previous 2013 vital statistics/trends have not changed, but migration to southern New Hampshire is greater than anticipated at the time of the previous 2013 OEP projections, while migration to the northern and western portions of the state is less than anticipated.

The 2016 projections are based on the same methods used to generate the population projections outlined in the 2013 report (OEP, 2013) (i.e., cohort projections, Internal Revenue Service data, and migration rates). OEP worked with the regional planning commissions and conducted a meeting with them on June 20, 2016, to reach consensus on the migration rates to be used in the population projections. The group agreed to use 2000–2005 migration rates, reflecting a moderate growth outlook that is more positive than the outlook from the late 2000s, but not as robust as that of the 1990s. For Rockingham County, the 2000-2005 migration rate was 2.9%, compared to a 0% migration rate between 1990-1995 and a 6.3% migration rate between 1995-2000.

To allocate county-level population projections to towns, OEP reviewed each town's share of the total population and how that share has changed between 2000, 2010, and 2015. OEP assumed that the current trend in each town would continue: faster growing towns would experience more rapid growth than the county average, and slower growing towns would experience less growth.

The population decline between 2035 and 2040 is based on the aging population of the state. For example, Derry experienced a population loss of approximately 1,000 people between the 2000 and 2010 census; however, the population losses in the younger cohorts were greater.

Although OEP does not typically consider individual projects in its projections, the widening of I-93 was included based on the direct connection between the population and employment centers of Boston and Manchester. Appendix C of the SEIS for the I-93 widening project provides more detailed information regarding the OEP's inclusion of the build alternative for the I-93 widening project (8-lanes from Boston to Manchester) in its population projections.

Projects such as the I-93 Exit 4A Project that are not expected to have a large regional effect are not considered in OEP's projection process. As a result, during the interview, OEP agreed that its projections best represent a "No Build" condition for the Project because the OEP projections do not include growth that would potentially be caused by the I-93 Exit 4A Project. Large-scale planned developments, such as Woodmont Commons, are similarly not included in the OEP population projections.

3.3 Southern New Hampshire Planning Commission

SNHPC develops whole-town and zonal (traffic analysis zone [TAZ]) population, household, and employment projections for the towns within its region for purposes of coordinated regional and local planning. Because SNHPC is also the official Metropolitan Planning Organization of the region, its future projections are also used in the travel demand modeling for the regional long-range transportation plan.

3.3.1 Population and Household Projections

SNHPC prepared population projections covering 2010 through 2050 in 2012. Therefore, the more recent OEP population projections were used by SNHPC at the municipal level for this report (2016a). Based on additional input from the Town of Chester (Appendix A), the population projections were updated for SNHPC's use. The revised numbers were based on the number of building permits issued since 2014 and the anticipated development proposals to subdivide large tracts of land. Table 4 presents the revised population projections for the Town of Chester. Additional details on the assumptions used in the revised projections for Chester are provided in Appendix A. SNHPC estimated the number of households at the town level based on the OEP population projections and the revised Town of Chester population projections (Tables 3 and 4). SNHPC's 2016 whole-town household projections for municipalities in the Project's study area are included in Table 5 (SNHPC, 2016a). To distribute population changes to TAZ, SNHPC dwelling unit projections adjusted based on 2015 dwelling unit estimates were used. Appendix B contains the 2015-2040 TAZ-level estimates for population and households and the memoranda outlining the technical methodology used by SNHPC to develop the model inputs.

Because Sandown is located in the RPC area and not the SNHPC area, information on Sandown households was derived from the RPC 2015 Master Plan (RPC, 2015). The number of Sandown households in 2010 is estimated to be 2,072. Future household projections for Sandown were only available for 2040 and were based on a scenario planning exercise by RPC to explore ways the region might grow. The Exit 4A Project was not considered by RPC in the scenario analysis. The "strong, dispersed growth" scenario is used in this report for Sandown's 2040 household projections because the report uses this scenario for employment projections (see section 3.3.3). The "strong, dispersed growth" scenario projects 2,914 households in Sandown in 2040. For comparison, the "slow growth" scenario projects 2,448 households and the "strong, concentrated growth" projects 2,325 households. Because household numbers between 2010 and 2040 were not available, Table 4 assumes straight-line growth between 2010 and 2040.

3.3.2 Employment Projections

SNHPC also makes TAZ-level projections for employment based on quarterly employment averages from NHES that it compares to building permit data to estimate the number of jobs per square foot of non-residential development. The method used by SNHPC to generate updated TAZ-level projections is detailed in memoranda provided in Appendix B.

Table 6 includes updated 2015 projections based on state data that were adjusted to reflect the fact that SNHPC's 2010 employment information calculated directly from the employer database is slightly higher than the state data. Table 6 then uses the 5-year percent increases from SNHPC's 2012 employment projections to recalculate projections for 2020 through 2040 using the updated 2015 projections. Appendix B includes a memorandum outlining the methodology used to project employment. The notable decline in Chester employment in 2015 is due to the closing of Chester College in 2012, while the rebound in employment in 2020 is projected based on the proposed opening of a Chinese School at the old Chester College (Jaschik, 2012; Williams, 2015). This dip in Chester employment values creates an elevated average annual growth rate for the town for years 2015-2040 (2.21 percent); for comparison, the average annual growth rate from 2010-2040 was 0.62 percent.

Appendix C includes a sensitivity analysis of the 2040 SNHPC employment projections. The evaluation included the review of historical data from Woods & Poole, a firm specializing in county-level economic projections. Employment data from Woods & Poole measure the number of full- and part-time jobs by location of work (rather than location of residence) (U.S. Census Bureau, 2016a). In addition, population growth from the U.S. Census Bureau for 2003-2014, the time range for which town-level data were available, was reviewed (U.S. Census Bureau, 2016b; 2016c). Based on the evaluation, SNHPC's projection for average annual employment growth of 1.04 percent[1] for the study area for 2015 through 2040 is similar to the Woods & Poole's projection for employment growth in Rockingham County (1.07 percent). In addition, regression models were developed from the 2003-2014 Census data to investigate the relationships between growth rates in employment in the study area, population in the study area, employment in Rockingham County, and employment in New Hampshire. Two models were found to have the most predictive power: one relating study area employment to county-level employment, and a second relating it to county-level employment and study area population. Both regression models suggest study area employment growth rates that are comparable to the rate of growth implied by the SNHPC projection.

The employment sensitivity analysis shows that the SNHPC employment projection is consistent with the OEP population projection based on the historic relationship between population and employment in the region. Since the OEP population projection is considered to represent the future condition with the widening of I-93 to four-lanes in each direction (see section 3.2), the SNHPC employment projections is also considered to include the potential land use impacts of the I-93 widening. As noted previously, neither the OEP nor the SNHPC projections considered the Exit 4A project. Therefore, it is appropriate to use the OEP and SNHPC projections as the basis for the No Build condition for this project (since the widening of I-93 would occur with or without the completion of Exit 4A).

Like household data, information on Sandown employment was derived from the RPC 2015 Master Plan (RPC, 2015). Similar to household data, future employment projections for Sandown were only available for 2040 and were based on various possible future scenarios. The "strong, dispersed growth" scenario is used in this report because it is based directly on the NHES employment projections, which is similar to the methodology used for the employment projections developed by SNHPC. The "strong, dispersed growth" scenario projects 536 jobs in Sandown in 2040. For comparison, the "slow growth" scenario projects 390 jobs, and the "strong, concentrated growth" projects 446 jobs. Because employment numbers between 2010 and 2040 were not available, Table 6 assumes straight-line growth between 2010 and 2040.

[1] The average annual growth rate for the study area is 1.04 percent regardless of whether Sandown is included.

Table 3. OEP 2016 population projection by municipality for 2015–2040

Municipality	2015[a]	2020	2025	2030	2035	2040	Average Annual Growth Rate 2015–2040
Derry	32,948	32,459	32,018	32,733	33,144	33,222	0.03%
Londonderry	24,891	25,434	26,057	26,639	26,973	27,036	0.33%
Auburn	5,315	5,560	5,828	5,959	6,033	6,048	0.52%
Chester	4,887	5,199	5,536	5,660	5,731	5,744	0.65%
Sandown	6,255	6,604	6,984	7,140	7,229	7,246	0.59%
Study Area Total	74,296	75,256	76,423	78,131	79,110	79,296	0.26%
Rockingham County	300,569	307,013	314,418	321,441	325,474	326,238	0.33%

Source: OEP (2016a)

[a] 2015 data are an estimate.

Table 4. Revised Chester population projection for 2015–2040

Municipality	2015[a]	2020	2025	2030	2035	2040	Average Annual Growth Rate 2015–2040
Chester	4,887	5,457	6,027	6,101	6,177	6,253	0.99%

Source: Town of Chester (Appendix A)

[a] 2015 data are the estimate provided by OEP.

Table 5. SNHPC and RPC household projections

Municipality	2010[a]	2015[b]	2020	2025	2030	2035	2040	Average Annual Growth Rate 2015–2040
Derry	12,537	12,656	12,436	12,236	12,496	12,645	12,673	0.01%
Londonderry	8,438	8,628	8,812	9,022	9,219	9,332	9,353	0.32%
Auburn	1,765	1,923	2,012	2,108	2,156	2,182	2,188	0.52%
Chester	1,534	1,621	1,811	2,001	2,026	2,051	2,077	0.99%
Sandown[c]	2,072	2,193	2,321	2,457	2,601	2,753	2,914	1.14%
Study Area Total	26,346	27,021	27,392	27,825	28,497	28,963	29,205	0.31%

Source: SNHPC (2016a; 2017), RPC (2015)

[a] 2010 households were provided by SNHPC and based on U.S. Census information.

[b] 2015 data are an estimate.

[c] Data are from the RPC 2015 Regional Master Plan, with 2040 projections based on the "strong, dispersed growth" scenario. Household data were not available for 2015-2035; therefore, this table includes straight-line growth between 2010 and 2040.

Table 6. SNHPC and RPC employment projections (number of jobs)

Municipality	2010	2015	2020	2025	2030	2035	2040	Average Annual Growth Rate 2015–2040
Derry	7,825	8,384	8,373	8,785	9,254	9,760	10,322	0.84%
Londonderry	13,624	13,517	14,008	14,961	16,000	16,751	17,550	1.05%
Auburn	1,651	1,846	1,960	2,135	2,331	2,534	2,760	1.62%
Chester[a]	528	368	418	459	506	565	635	2.21%
Sandown[b]	399	419	440	463	486	510	536	0.99%
Study Area Total	24,027	24,534	25,199	26,803	28,576	30,121	31,802	1.04%

Source: SNHPC (2012c, 2016b, 2016c), RPC (2015)

Notes: 2010 values were developed in 2012. 2015 projections were updated in 2016. 2020 through 2040 projections were then adjusted to reflect the 2012 5-year projection increases based on the updated 2015 projections.

[a] The notable decline in Chester employment in 2015 is due to the closing of Chester College in 2012, while the rebound in employment in 2020 is projected based on the proposed opening of a Chinese School at the old Chester College (Jaschik, 2012; Williams, 2015). For reference, average annual growth rate in Chester between 2010 and 2040 is 0.65% compared to the elevated 2.24% shown in the table.

[b] Data from the RPC 2015 Regional Master Plan, with 2040 projections based on the "strong, dispersed growth" scenario. Employment data were not available for 2015-2035; therefore, this table includes straight-line growth between 2010 and 2040.

4.0 INTERVIEW SUMMARIES

Interviews with local land use planners assisted with the development of the No Build and Build land use forecasts by identifying development trends in their respective towns and providing spatial and temporal information on planned and proposed developments. The following summaries of development trends are based on these interviews. More detailed summaries of these interviews are provided in Appendix A. The draft interview summaries were provided to all participants for review and comment, and the final interview summaries were approved by the participants.

4.1 Derry

Since 1990, the rapid growth that Derry experienced from the 1960s through the 1980s has slowed. Derry's growth management ordinance was instituted in the mid-1990s along with changes in zoning to control density of residential development. In addition, the segmented ownership in the central business district and lack of large parcels of available land for development make substantial future growth impracticable. Currently, Derry is experiencing a trend of population decline related to an aging population and an outward migration of young adults as they seek employment and educational opportunities elsewhere.

The area immediately to the east of I-93, along Folsom Road north of North High Street, has been rezoned to encourage higher quality industrial and commercial development near the proposed Project. Additionally, residential areas south of Folsom Road and North High Street might be re-zoned to Industrial/Commercial zoning. The Derry planning staff indicated that the Project could have an effect on the timing and intensity of development/redevelopment in this small industrial-zoned area. Effects on commercial/industrial development in other areas of the town are not anticipated. The commercial zoning district along the southern end of Rockingham Road (Route 28) was revised in 2013, and some commercial development has occurred in that area. In addition, water and sewer services are being expanded along Rockingham Road to continue to encourage commercial development along that corridor.

Although no large parcels are suitable for large-scale developments, a 13-unit market-rate apartment building is planned near the central business district. An area along South Main Street/Rockingham Road is zoned for commercial development, and the town is extending water and sewer service to allow the area to develop at a higher density.

The limits of water and sewer service, the lack of large parcels, and the topography in the eastern portion of Derry serve to limit development. Lot size requirements and conserved land are also factors constraining any major single-family home developments in Derry. Because of the large number of development constraints, Derry planning staff suggested that the Project would be unlikely to induce additional residential development in Derry. However, the Project would encourage areas recently rezoned as industrial and commercial to develop by providing direct access to I-93.

4.2 Londonderry

Since 2000, the rapid growth experienced in the 1980s and 1990s has slowed, and the current development trends are based on access to undeveloped or underdeveloped land and the presence or absence of municipal services (water/sewer), which affects the density of development. For example, the industrial development on Pettengill Road is driven by undeveloped land with access to Raymond Wieczorek Drive (Manchester Airport Access Road). The Project would not affect this industrial development in northwest Londonderry. While a few parcels are available in west Londonderry, the proposed Project would not likely affect their future development because the Project would provide access only to the east of I-93.

On the east side of I-93, the Project would affect the timing and type of growth in Londonderry—the interchange and connector road would provide access and opportunity for commercial, institutional, and higher density residential development.

Woodmont Commons is a planned mixed-use urban village in the Town of Londonderry. The developer, Pillsbury Realty Development, LLC, owns approximately 630 acres bordering the east and west sides of I-93. Based on the PUD Master Plan (Pillsbury Realty Development, 2013), Woodmont Commons is divided into several phases, and development will occur over a 20-year period. The Town of Londonderry issued a conditional approval for the Phase I design plans in November 2016.

The Woodmont Commons development density with and without the Project is presented in the PUD Master Plan (Pillsbury Realty Development, 2013), and town planning staff indicated that the "without Exit 4A" scenario presented in the approved 2013 PUD Master Plan was based on design review meetings that included town staff, project engineers/planners, and the town's review consultant. Thus, the "with" and "without" Exit 4A scenarios (i.e., with Project and without Project scenarios) presented in the PUD Master Plan should not be construed as projections of growth, but rather should provide an upper cap on the maximum amount of development that could occur. This explains why less commercial development is allowed on the west side of I-93 without the Project than with it, even though the Project would provide no westerly access.

Without the Project, the Woodmont Commons development on the east side of I-93 would likely be a residential development model (up to 330 units as allowed by the PUD). The Londonderry planning staff agreed that the 400,000 gross square feet (gsf) of office development potentially allowed according to the PUD east of I-93 without the Project would likely not occur given the amount of traffic mitigation that would be required. Instead, a more realistic development scenario without the Project would be the aforementioned residential development with a small number of commercial businesses serving the needs of the 330 residential units (such as a convenience store or pharmacy).

With the Project, the current programming for the east side, which is also preferred by the Town of Londonderry, is for commercial land use accessed via Exit 4A. The developer expects a mixed-use build-out on the east side of I-93 to the level indicated by the caps in 2013 PUD Master Plan by 2040. In other words, the PUD caps represent a reasonable "Build" Scenario for the Project. No development would be expected to start until after the completion of the Project (currently expected by 2022). No potential development east of I-93 has been pre-sold or pre-leased (see Woodmont Commons Land Use Interview Summary, Appendix A).

With regard to development associated with Build Alternatives A, B, C, D, and F (from the 2007 DEIS), planners stated that growth in Londonderry under Alternatives C and D would be more in line with a No Build Alternative (or without the Project) because these alternatives would not provide access to the parcels that Woodmont Commons plans to develop for commercial and/or institutional use. Given the easterly only access of the Project, development of the interchange would likely have little effect on the job growth or attraction of industries west of I-93.

4.3 Auburn, Chester, and Sandown

4.3.1 Auburn

Auburn is largely a bedroom community of about 16,000 acres with limited businesses. About a quarter of its area (4,200 acres) is the watershed for Massabesic Lake, which is the water supply for the City of Manchester. This limits the area available for development.

The primary drivers of growth are location and, more recently, the change in high school from Manchester to Pinkerton Academy. Auburn is located near Exits 1 and 2 of NH Route 101, which provides convenient access to I-93. Auburn's development has been different from most of the surrounding communities because it did not experience a decrease in development associated with the 2007–2008 recession. Auburn has issued approximately 35 new home building permits per year, and that did not change after 2007–2008. The Town Administrator stated that these new home permits are typically for custom homes on larger lots, and this trend of type and rate of residential development is expected to continue.

The Town Administrator indicated that the proposed Project is not likely to affect development and population growth in Auburn. Travel time may improve if some of the traffic on I-93 is pulled off the interstate by the Project, but this effect would likely be minor. Auburn residents would not be likely to use Exit 4A to travel from I-93 to Auburn because NH Route 101 already provides convenient access to the northern portion of the town, and the southern portion is closer to the existing Exit 5 than to Exit 4A.

4.3.2 Chester

Chester is a rural community east of Derry. Access to I-93 is primarily through the Town of Derry. Chester is currently experiencing significant growth pressure in the form of a recent resurgence (spring 2016) of single-family residential development. Development activity has recently restarted on many of the subdivisions that have been dormant or partially complete since the 2007–2008 recession. Chester currently has approved or pending permits to develop about 300 lots, which are anticipated to be developed in the next 5 to 7 years (2022-2024) (Appendix A). In addition, the Town has two 30-lot and three 5-lot subdivisions that will be approved in the near future. One of the 30-lot subdivisions is a Phase I – there will likely be an additional 90 lots in that 550-acre subdivision. The Chester Master Plan 2015 also recognizes this trend for residential growth in Chester. The plan notes that SNHPC projects that approximately 96 dwelling units would be constructed every 5 years through 2050 based on the town's historic growth rate and past building permit trends (Chester Planning Board, 2015). This long-term projection equates to an average of about 19 new home permits per year.

The primary drivers for additional residential development in Chester are good schools and the desire for rural living. Because the resurgence of residential/subdivision development is recent, it will likely be a year or two before Chester experiences a significant increase in elementary school enrollment. It is too early to determine whether a commensurate increase in school-age population or a shift in demographics of the population would occur; however, an increase is expected because most of the new homebuyers in Chester have one or more children.

Given Chester's access to I-93 through Derry, the planning coordinator indicated it was likely that the Project would induce additional residential development in Chester because of improved access to I-93.

Although the Project would enable additional growth in Chester, the town has a growth management provision in its zoning ordinance that would go into effect if pressure on school, fire, and police services outstrips the town's ability to keep pace with development. An open space subdivision provision is in place to encourage subdivisions to be creatively designed in a way that reduces sprawl and protects natural resources and rural character.

4.3.3 Sandown

Sandown is a rural community east of Derry, and highway access to the town is either by I-93 (via Route 102 through Derry) or by I-495 (via 121A through Plaistow). The primary driver for growth in Sandown is affordable housing—the bulk of housing in Sandown would be considered starter homes with regard to price and size. In addition, the Planning Board member interviewed indicated that transportation access to I-495 and an increase in telecommuting have contributed to population growth due to an increase in people seeking affordable housing. Sandown experienced a major influx of people during the 1990s until the recession in 2007–2008; however, Sandown is experiencing a resurgence of development similar to Chester. A 50-unit apartment building was recently approved, and two developments initially planned for residents ages 55 and older are now being developed for individuals of any age.

Although Sandown has had growth management ordinances in the past, these ordinances are no longer in place because of lawsuits by developers. Sandown is now focused on buying and conserving land to reduce the available developable land in the town. Sandown purchased 200 acres for conserved open space that had been approved for 154 dwellings for residents ages 55 and older, resulting in a reduction of housing potential in Sandown. The Planning Board is considering applying for another community technical assistance program grant to acquire and conserve more land. Most of the larger tracts have been developed, and Sandown has only a few 100-acre tracts left that could be developed as larger subdivisions.

Sandown has numerous wetlands and rivers, and in addition to purchasing land for conservation purposes, the town has a vernal pool protection provision in its zoning ordinance that includes a 25-foot buffer around vernal pools and a building setback requirement of 50 feet. In addition, the Planning Board has passed variable road width and stormwater regulations to reduce impervious surface and promote low impact development. The conservation measures are designed to improve the quality of natural resources and allow the town to reduce the amount of development and associated increase in school enrollment.

The Planning Board member stated during the interview that the widening of I-93 is having a substantial effect on growth in Sandown by reducing travel times on I-93, which makes Sandown more attractive for young homebuyers. The Planning Board member believes the proposed Project has the potential to induce additional residential development in Sandown by providing better access and reduced travel time to I-93.

5.0 DEVELOPMENT UNDER THE 2040 NO BUILD AND BUILD CONDITIONS

The 2040 No Build condition is the reasonably foreseeable future development anticipated without construction of the proposed Project. The 2040 Build condition is the reasonably foreseeable future development anticipated if the proposed Project is built and includes both the growth that is attributable to the improved transportation access created by the Project, as well as growth that is independent of the Project. The difference between the No Build and Build conditions is the indirect land use–or incremental–impact of the Project.

Both the 2040 No Build and 2040 Build conditions were developed after analyzing a variety of data sources and based on interviews with planners in local jurisdictions to ensure a collaborative process for land use and travel forecasting assumptions. Forecasting assumptions were also developed for the alternatives, as discussed in section 5.2 of this document. The overall process was guided by FHWA's *Interim Guidance on the Application of Travel and Land Use Forecasting in NEPA* (FHWA, 2010).

5.1 2040 No Build Condition

The 2040 No Build condition includes population, household, and employment information. As discussed, in sections 3.2 and 3.3, OEP and revised Chester population projections and the resulting SNHPC household projections account for the growth associated with the I-93 widening project. As noted in the memorandum in Appendix C, the employment growth rates projected by SNHPC are consistent with the historic relationship between population and employment growth in the region. In other words, because the SNHPC employment projections are consistent with the OEP population projections that include the I-93 widening effects, the SNHPC employment projections are also considered representative of the future condition with the widening of I-93 (even though specific projects were not considered in making the employment projections as documented in the correspondence with SNHPC). Each component is developed from the 2015 estimates or projections documented in sections 3.2 and 3.3; background growth, calculated as the difference in 2015 estimates and 2040 projections; and growth from known development projects. Each component (population, households, and employment) is discussed in more detail in the following sections.

5.1.1 Population, Household, and Employment Growth

Average annual population growth is projected to be 0.29 percent throughout the study area between 2015 and 2040, with annual population growth as high as 0.99 percent in Chester and as low as 0.03 percent in Derry. Annual household growth is projected to be 0.31 percent throughout the study area, with the highest annual household growth in Chester and Sandown at 0.99 and 1.14 percent, respectively. The lowest household average annual growth is projected to be in Derry at 0.32 percent, similar to the lower population growth in this town.

Based on updated SNHPC 2015 employment estimates and SNHPC 2016 projection 5-year growth trends through 2040, employment is projected to grow at an average of 1.04 percent average annual growth in the study area. Although 2015-2040 average annual employment growth for Chester is the highest of the jurisdictions at 2.21 percent, this value is elevated because of decreased 2015 employment values (see Section 3.3.3 for an explanation of the decreased 2015 Chester employment values). Analyzing the average annual employment growth in Chester between 2010 and 2040 reveals a 0.62 percent annual employment growth rate as noted in section 3.3.2. Therefore, Auburn has the highest consistent average annual employment growth at 1.63 percent. Table 7 provides an overview of the 2040 No Build population, household, and employment components.

Table 7. 2040 No Build population, households, and employment

Municipality	Existing Population (2015 Projection)	Background Population Growth (2015-2040)	Average Annual Population Growth Rate (2015-2040)	Existing Households (2015 Projection)	Background Household Growth (2015-2040)	Average Annual Household Growth Rate (2015-2040)	Existing Employment (2015 Projection)	Background Employment Growth (2015-2040)	Average Annual Employment Growth Rate (2015-2040)
Derry	32,948	274	0.03%	12,656	17	0.01%	8,384	1,938	0.84%
Londonderry	24,891	2,145	0.33%	8,628	725	0.32%	13,517	4,033	1.05%
Auburn	5,315	733	0.52%	1,923	264	0.52%	1,846	914	1.62%
Chester	4,887	1,366	0.99%	1,621	456	0.99%	368	267	2.21%
Sandown	6,255	991	0.59%	2,193	721	1.14%	419	117	0.99%
Total Study Area	74,296	5,509	0.29%	27,021	2,183	0.31%	24,534	7,268	1.04%

Source: OEP (2016a); SNHPC (2016a, 2016b, 2016c; 2017), RPC (2015)
Note: See notes for Tables 3, 4, and 5 for information about projections.

5.1.2 Known Development Proposals

Reasonably foreseeable future development under the No Build condition includes known development proposals identified from land use planner interviews.

There are no large-scale planned developments in Derry—the extent of water and sewer service, the lack of large undeveloped parcels, and the topography in the eastern portion of Derry limit development. Lot size requirements and conserved land also constrain major single-family home developments in Derry. There is a 13-unit market-rate apartment building planned near the central business district. In addition, an area along South Main Street/Rockingham Road is zoned for commercial development, and the town is extending water and sewer service to allow the area to develop at a higher density. Both the 13-unit building and the infrastructure extension were judged to be accounted for in the background growth rate (e.g., the OEP population and SNHPC employment projections).

Londonderry has several known planned or proposed developments. The Woodmont Commons PUD is planned on the east and west sides of I-93 (see Figure 2 for the limits of the PUD). The Market Basket redevelopment area, shown in Figure 2, is owned by DeMoulas Super Markets, Inc. and is part of the Woodmont Commons Subarea WC-1GL, on the west side of I-93. The redevelopment area was approved by the Town of Londonderry in October 2015. The new Market Basket was constructed on the other side of the plaza from the original grocery store. The redevelopment approved in 2015 involved the demolition of about 74,000 gsf of commercial space and the addition of about 42,000 gsf of commercial development (Town of Londonderry, 2015). Construction is complete; as of May 2016, the 42,000 gsf were occupied by a state liquor store, a card store, TJ Maxx, and Marshall’s Home Goods. In addition, there are four commercial pads available for development within the redevelopment area along John R. Michels Way, the roadway running through the Woodmont Commons development area connecting Garden Lane and Pillsbury Road. DeMoulas is currently looking for potential tenants and has received interest from multiple parties. The development of these parcels would occur with or without the Exit 4A Project. At this time, the types of tenants and buildings that would be constructed are unknown (see Appendix A, Woodmont Commons: Market Basket Redevelopment). Although the four pad sites have not been approved for development, it is possible that they could provide an additional 20,000 to 30,000 gsf of commercial development (see Appendix A: Londonderry Market Basket Redevelopment). As such, 30,000 gsf of potential additional commercial development has been included in the 2040 No Build condition.

In November 2016, the Town of Londonderry planning staff conditionally approved the Phase I plans for the initial Woodmont Commons development west of I-93, and Phase I is anticipated to be built by 2020. Phase I would include mixed use residential and commercial space, with approximately 60 percent retail space and 40 percent office space; five restaurants, including one restaurant/brewery; a hotel; a concert venue; and individual elderly living. Figure 2 shows the approximate location of Phase 1 of Woodmont Commons, and Table 8 shows a summary of uses planned for Phase I. Build Alternatives A though F are shown in Figure 2 for geographic reference.

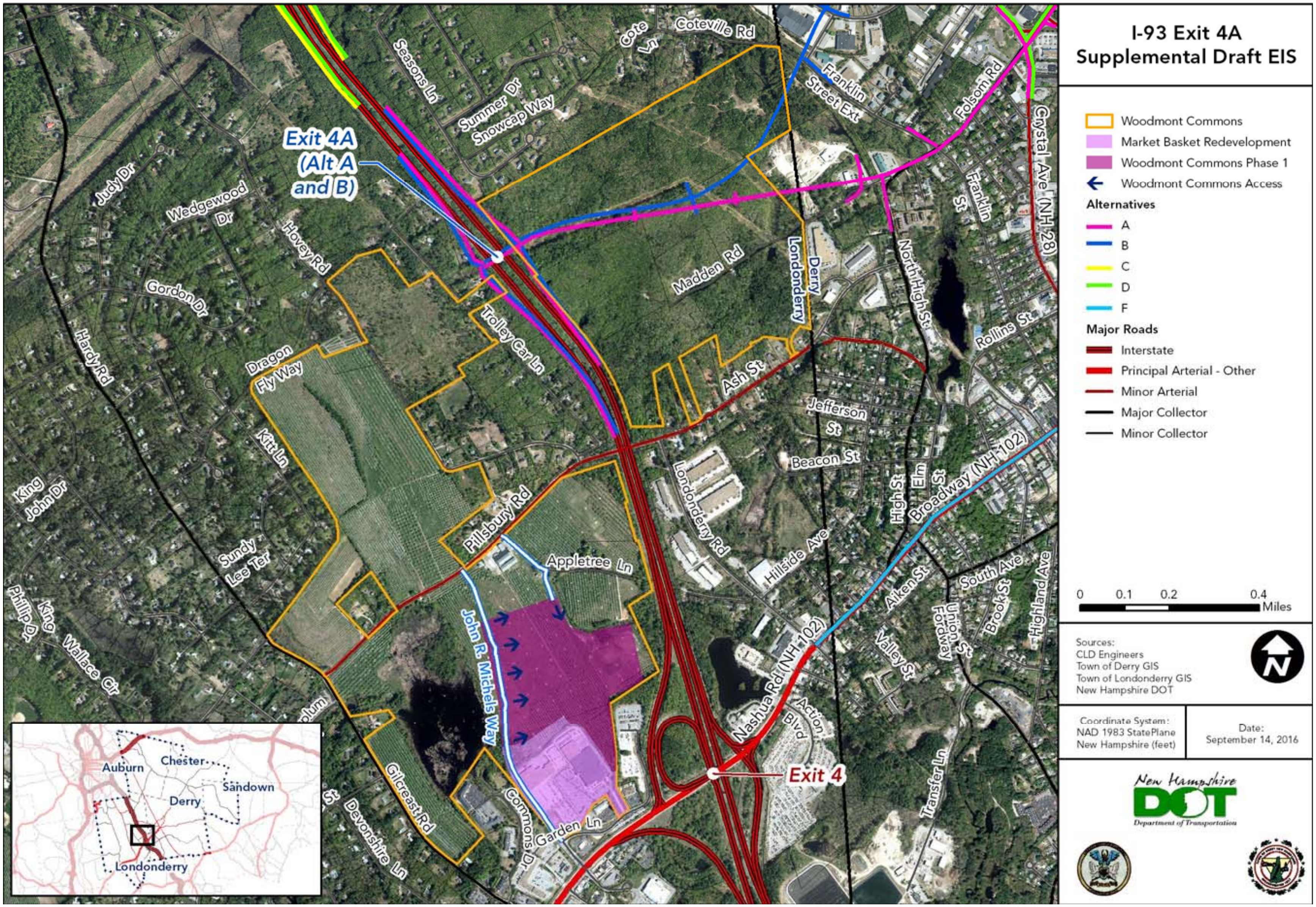

Figure 2. Woodmont Commons

Table 8. Woodmont Commons Phase I: summary of uses

Use		Quantity	Total
Residential	Any age	260 units	510 units
	Independent elderly living	250 units	
Commercial	Retail	163,611 gsf	312,574 gsf
	Office	107,800 gsf	
	Restaurant	568 seats or 15,593 gsf	
	Production (brewery)	11,400 gsf	
	Assembly	350 seats or 14,170 gsf	
Hotel		135 rooms	135 rooms

Source: Pillsbury Realty Development, LLC (2016)

Based on discussions with the Town of Londonderry and the developer, the remainder of the Woodmont Commons PUD area (east and west of I-93) is anticipated to be built out by 2040. The Woodmont Commons PUD Master Plan includes maximum development caps that would be permitted by Town of Londonderry for the PUD (east and west of I-93) with the Exit 4A Project and without the Exit 4A Project. The maximum growth caps outlined in the Woodmont Commons PUD Master Plan were used in the development of the No Build and Build conditions to provide a conservative estimate of indirect impacts (i.e., using the upper bound allowable growth results in predicting greater environmental impacts). The actual development that occurs within the Woodmont Commons PUD by 2040 may be less than this maximum depending on economic conditions and regulatory approvals (see section 2.4 for a discussion of the uncertainty associated with future growth impacts).

The Woodmont Commons PUD allows more growth on the east side of I-93 with Exit 4A than without Exit 4A, and this difference in growth forms the basis for the estimated indirect land use effects of Exit 4A on the east side of I-93 (see section 5.2.1, Table 14). The greater growth allowed with Exit 4A in Woodmont East is consistent with the direct interstate access to the east that would be provided by Alternatives A and B, increasing accessibility to undeveloped land along the interstate.

The Woodmont Commons PUD also allows more growth on the west side of I-93 with Exit 4A compared to the No Build condition. From a transportation access perspective, this increase in growth on the west side was not immediately intuitive given that Alternatives A and B would provide a direct connection to the east only. However, the project team identified several ways in which the Exit 4A Project could support increased development on the west side of I-93:

- Exit 4A would provide indirect interstate access to Woodmont West via internal roadways within Woodmont East, which would link to Pillsbury Road/Ash St. Pillsbury Road/Ash St. is an east-west roadway that crosses over I-93 and through the Woodmont West PUD area.
- Exit 4A has the potential to reduce demand on Exit 4 by diverting a portion of drivers currently using Exit 4 to the new Exit 4A. As a result, the Town of Londonderry would allow more development on the west side of I-93 because the potential constraint posed by Exit 4 operations would be lessened. Additional

information on traffic impacts will be available when the traffic technical report is completed.

- The large-scale economic development anticipated on the east side of I-93 with Exit 4A could have synergistic economic impacts on the west side of I-93. For example, additional office space would result in a large population in the area during the day and increase the demand for retail/restaurants.

The PUD "No Exit 4A" growth caps for Woodmont Commons were the primary basis for the No Build condition because the PUD itself provides a regulatory framework that would prohibit higher levels of growth without the appropriate transportation network support Exit 4A would provide. The developer would still attempt to maximize their return on investment by developing both the east and west sides of I-93 within the limits imposed by the PUD. The No Build condition forecast used for this project differs from the PUD "No Exit 4A" development caps in one important respect—it was determined through the interviews that the build-out of 400,000 gsf of commercial development on the east side of I-93 as included in the "No Exit 4A" PUD caps was not likely without Exit 4A due to the level of traffic mitigation that would be required. This level of development would require direct interstate access as would be provided with Exit 4A. Therefore, a predominately residential development is anticipated on the east side of I-93 without Exit 4A (330 households as allowed by the PUD). A small amount of supporting commercial was also included (20 sf/household).

In addition to Woodmont Commons, substantial industrial development is projected along the new Pettengill Road in Londonderry, which opened in December 2015. The relocated and new road extends from its former terminus at Industrial Drive to the new Raymond Wieczorek Drive (Applied Economic Research, 2012). The new road provides easier access to the Manchester-Boston Regional Airport and the F. E. Everett Turnpike/South Manchester from Londonderry and opened up nearly 1,000 acres of prime, non-residential land for business users. Based on SNHPC projections, the Pettengill Road Industrial Area would support a total of 1,750 industrial jobs in TAZ 64 and TAZ 274 in Londonderry from 2010 through 2050 (SNHPC, 2016b; 2016c). Assuming linear job growth for that 40-year period, five-eighths of that job growth would coincide with the analysis years of this report (2015–2040).[2] Therefore, this report assumes approximately 1,094 jobs would be added across this industrial area by 2040. These jobs would include at least a portion of the jobs associated with the proposed F.W. Webb distribution center, which is planned to include a 785,000-square-foot facility along Webb Drive, an extension of Pettengill Road (Heritage Commission, 2016).

Figure 3 shows future known, large-scale developments in Londonderry, and Table 9 presents a summary of these developments, including Woodmont Commons and future reasonable foreseeable development along Pettengill Road. Build Alternatives A though F are shown in Figure 3 for geographic reference.

[2] This report assumes that the first 5 years of Pettengill Road employment growth were incorporated into SNHPC 2015 updated employment projections. Overall Pettengill Road employment growth was added starting in 2010 because the estimate for Pettengill Road growth was designed to be added over the 2010-2050 time period.

Table 9. Summary of known large-scale development proposals in Londonderry (2040 No Build)

Development Name	Type/Land Use	Residential Units	Hotel Rooms	Commercial Area (gsf)	Industrial Area (Jobs)
Market Basket Redevelopment Area	Commercial	NA	NA	30,000	NA
Woodmont Commons Phase I (2020) – West of I-93[a]	Mixed Use – Commercial/ Residential	510	135	312,574	NA
Woodmont Commons Remainder (2040) – West of I-93[a]	Mixed Use – Commercial/ Residential	570	215	519,926	NA
Woodmont Commons – East of I-93[a]	Residential	330	0	6,600[c]	NA
Pettengill Road Industrial Area[b]	Industrial	NA	NA	NA	1,094
Total		**1,410**	**350**	**869,100**	**1,094**

Source: Pillsbury Realty Development (2013), SNHPC (2012a), Interviews with the Town of Londonderry and a Woodmont Commons representative (see Appendix A)

[a] Phase I includes development shown in Table 8 (Pillsbury Realty Development, 2013). The Woodmont Commons Remainder is the remaining development that would be permitted without Exit 4A that could be built by 2040.

[b] Job projections for Pettengill Road Industrial Area based on full projection of 1,750 jobs from 2010–2050 (SNHPC, 20116b; 2016c). This table assumes five-eighths (25 of 40 years or 2015–2040) of the projected jobs to match the timeframe of this report. It is assumed development along Pettengill Road would include the proposed approximately 785,000 gsf of development for the F.W. Webb distribution center.

c Based on the interview with the Woodmont Commons representative on August 7, 2016, it was agreed that developing the upper cap of 400,000 gsf of commercial on the east side of I-93 was unlikely without Exit 4A due to the traffic mitigation that would be required (see Appendix A). This new total assumes about 20 gsf of support commercial space per residential unit planned.

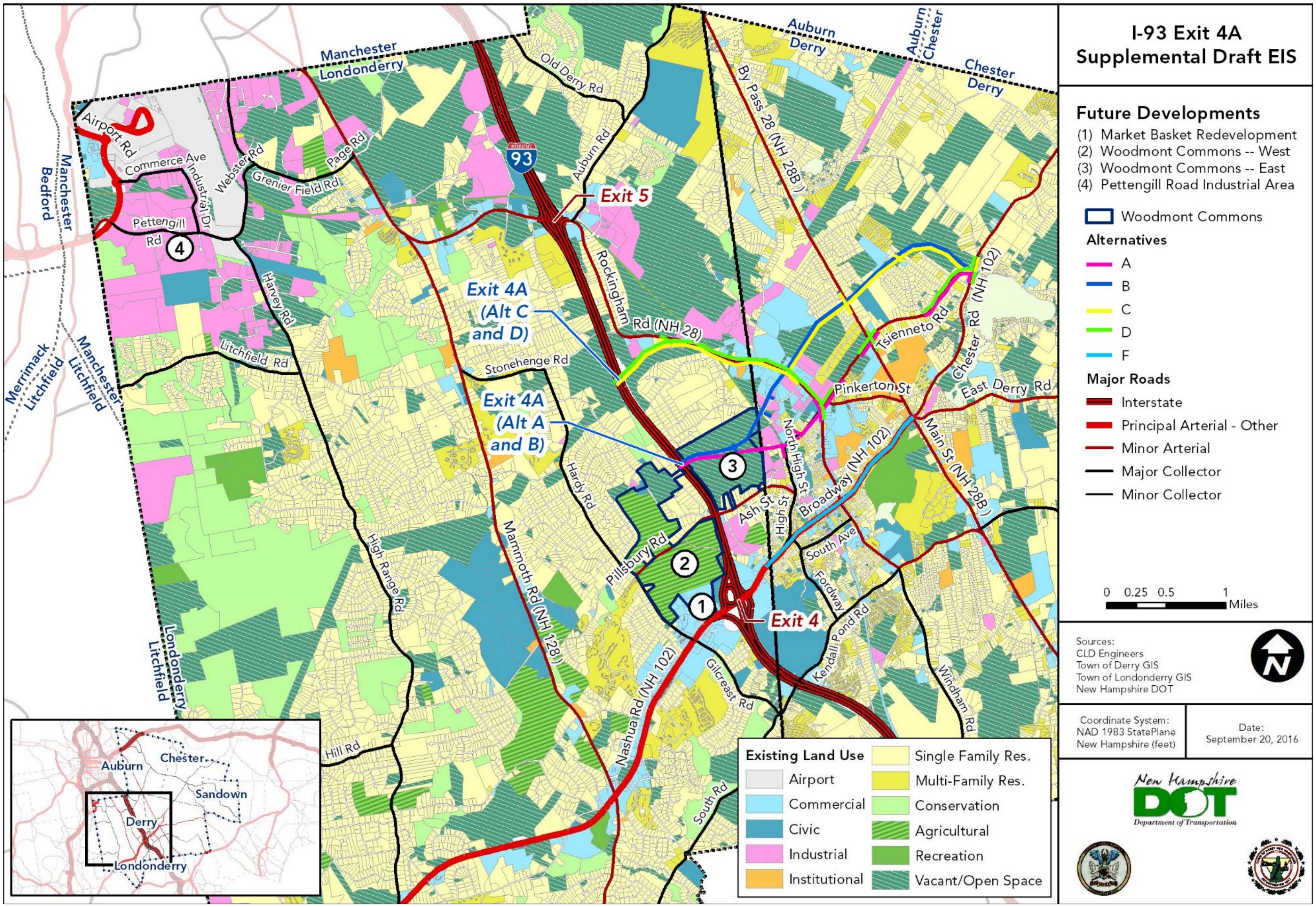

Figure 3. Large-scale developments in Londonderry

Population growth from known development projects, the last element used to calculate the 2040 No Build population, was calculated for residential units using average household size for the study area based on SNHPC population information.[3] Average household size was calculated following SNHPC's methods and used the occupancy rate from the 2010 Census (U.S. Census Bureau, 2010) and the existing (2015) population and housing units.[4] Based on a study area average household size of 2.73 persons and a total of 1,410 residential units under the No Build condition, the total 2040 No Build known development project population would be approximately 3,849 people. No adjustment to population was made to attempt to account for people moving to the study area for new employment opportunities, such as at Woodmont Commons. Given the dispersed nature of the local employment market, the employees in future industrial jobs, commercial development, or hotels would likely be spread throughout the region and would include people changing jobs, not simply migration.

Household growth from known development projects, also the last element used to calculate the 2040 No Build households, is based on the sum of residential units produced from the No Build known development projects in Table 9 multiplied by the occupancy rate. Because 2040 occupancy rates are unknown, the 2010 SNHPC weighted average occupancy rate of 95.4 percent was used to calculate households in 2040 (2016c).[5] Based on the known development projects including 1,410 residential housing units and an occupancy rate of 95.4 percent, the total No Build condition known development project households would be approximately 1,345. Because Woodmont Commons is the source of all of the known development project households, and Woodmont Commons is in Londonderry, all 1,345 known development project households are assigned to Londonderry in section 5.1.3.

Employment growth from known development projects is based on calculating the number of employees based on the size and type of known development project, unless the total number of jobs for a known development project was known as in the case of the Pettengill Road redevelopment. Using industry standard employee to gross square foot comparison factors by type of development, Table 10 calculates employees for each known development project given the retail assumptions noted in the "Conversion to Jobs" column (RKG Associates, 2016; MWCOG, n.d.). The remainder of the development associated with Woodmont Commons (post-phase 1) creates the most employment of any project with approximately 1,864 jobs produced based on an assumed mix of one-half general retail, one-quarter restaurants, and one-quarter other services. In total, approximately 4,219 No Build condition jobs are anticipated from the known development projects.

[3] Sandown is in the RPC boundary, and therefore is not included in the SNHPC data. However, none of the known development projects included residential units in Sandown, therefore it was reasonable not to include Sandown information in the population calculation.

[4] Household size = (Population – special population) / (housing units*occupancy rate). Special populations accounts for those living in dormitories, nursing homes, prisons, and drug treatment facilities – i.e., not standard housing units.

[5] Average occupancy rate was weighted based on number of dwelling units within each jurisdiction's TAZs. Footnote #2 regarding omission of Sandown information also applies to this calculation.

Table 10. 2040 No Build employment as a result of known developments in Londonderry

Development Name	Development Size and Type (or Jobs)	Conversion to Jobs	Jobs	Total Jobs per Project Phase
Market Basket Redevelopment Area	30,000 gsf of Commercial	¾ of gsf at Restaurants: 175 gsf / employee ¼ of gsf at Other Services: 400 gsf / employee	129 + 19	148
Woodmont Commons Phase I (2020) – West of I-93	135 Hotel Rooms	0.6 employees / room	81	1,113
Woodmont Commons Phase I (2020) – West of I-93	312,574 gsf of Commercial	½ of gsf at General Retail: 400 gsf / employee ¼ of gsf at Restaurants: 175 gsf/employee ¼ of gsf at Other Services: 400 gsf/employee	391 + 446 + 195	
Woodmont Commons Remainder (2040) – West of I-93	215 Hotel Rooms	0.6 employees / room	129	1,864
Woodmont Commons Remainder (2040) – West of I-93	519,926 gsf of Commercial	½ of gsf at General Retail: 400 gsf / employee ¼ of gsf at Restaurants: 175 gsf/employee ¼ of gsf at Other Services: 400 gsf/employee	650 + 743 + 325	
Woodmont Commons – East of I-93	6,600 gsf of Commercial	General Retail: 400 gsf/employee	17	
Pettengill Road Industrial Area	1,094 industrial jobs[a]	NA	1,094	1,094
Total			**4,219**	**4,219**

Source: Pillsbury Realty Development (2013), SNHPC (2012a), Interviews with the Town of Londonderry and a Woodmont Commons representative (see Appendix A), RKG Associates (2016), MWCOG (n.d.)

[a] See Table 8, footnote "b" for how Pettengill Road Industrial Area jobs were calculated.

5.1.3 Summary of 2040 No Build Condition

Based on the information presented above, the total 2040 No Build population for the study area would be approximately 83,654 as outlined in Table 11. Table 12 shows the total 2040 No Build households, and Table 13 shows the total 2040 No Build employment for the study area.

Table 11. Total 2040 No Build population for study area

Municipality	Existing Population (2015 Projection)	Background Population Growth from OEP/Chester Projections (2015–2040)	Population Growth from Known Development Proposals	Total 2040 No Build Population
Derry	32,948	274	0	33,222
Londonderry	24,891	2,145	3,849	30,885
Auburn	5,315	733	0	6,048
Chester	4,887	1,366	0	6,253
Sandown	6,255	991	0	7,246
Study Area Total	74,296	5,509	3,849	83,654

Source: OEP (2016a), Town of Chester (Appendix A), Pillsbury Realty Development (2013), U.S. Census (2010)

Note: See notes for Table 3 for information about projections.

Table 12. Total 2040 No Build households for study area

Municipality	Existing Households (2015 Projection)	Background Household Growth (2015–2040)	Household Growth from Known Development Proposals	Total 2040 No Build Households
Derry	12,656	17	0	12,673
Londonderry	8,628	725	1,345	10,968
Auburn	1,923	264	0	2,188
Chester	1,621	456	0	2,077
Sandown	2,193	721	0	2,914
Study Area Total	27,021	2,183	1,345	30,546

Sources: SNHPC (2012b, 2016a, 2016d; 2017), RPC (2015), Pillsbury Realty Development (2013)

Note: See notes for Table 4 for information about projections.

Table 13. Total 2040 No Build employment for study area

Municipality	Existing Employment (2015 Projection)	Background Employment Growth from SNHPC/ RPC Projections (2015–2040)	Employment Growth From Known Development Proposals	Total 2040 No Build Employment
Derry	8,384	1,938	0	10,322
Londonderry	13,517	4,033	4,219	21,769
Auburn	1,846	914	0	2,760
Chester	368	267	0	635
Sandown	419	117	0	536
Study Area Total	24,534	7,268	4,219	36,021

Sources: SNHPC (2012b, 2016b, 2016c), RPC (2015), Pillsbury Realty Development (2013), RKG Associates (2016), MWCOG (n.d.), Interviews with the Town of Londonderry and a Woodmont Commons representative (see Appendix A)

Note: See notes for Table 6 for information about projections.

5.2 2040 Build Condition

The 2040 Build condition is developed by adding the population, households, and employment growth from development anticipated to be induced by the proposed Project to the 2040 No Build condition values. The induced development presented for the 2040 Build condition is based on Alternative A, which was identified as the preferred alternative in the 2007 DEIS. Alternatives A and B would induce the greatest amount of development relative to the other build alternatives. A comparison of Alternatives B, C, D, and F to the 2040 Build condition (Alternative A) follows the presentation of the anticipated growth for Alternative A.

5.2.1 Alternative A

This section first discusses the incremental impact of Alternative A (e.g., indirect land use effects), and then provides a summary of the total 2040 Build condition land use forecast.

Indirect Land Use Effects

The additional reasonably foreseeable future development under Alternative A was identified through the land use planner interviews. Table 14 provides a summary of the incremental growth anticipated to be induced by Alternative A, which includes changes in the density and type of development anticipated for Woodmont Commons, as well as commercial and industrial growth in Derry induced by improved access to I-93.

Table 14. Summary of indirect land use effects of Alternative A

Development Name	Type/Land Use	Residential Units	Hotel Rooms	Commercial Area (gsf)	Institutional (gsf)	Industrial Area (jobs)
Derry	Commercial/ Industrial	NA	NA	0	NA	168[b]

Development Name	Type/Land Use	Residential Units	Hotel Rooms	Commercial Area (gsf)	Institutional (gsf)	Industrial Area (jobs)
Woodmont Commons – West of I-93	Mixed Use – Commercial/ Residential	6	0	322,000	40,000	NA
Woodmont Commons – East of I-93[a]	Mixed Use – Commercial/ Residential	3	200	693,400[a]	420,000	NA
Chester	Residential	371	NA	NA	NA	NA
Sandown	Residential	9	NA	NA	NA	NA
Total		**389**	**200**	**1,015,400**	**460,000**	**168**

Source: Pillsbury Realty Development (2013), Interviews with the Towns and a Woodmont Commons representative (see Appendix A).

[a] Based on the interview with the Woodmont Commons representative on August 7, 2016, it was agreed that developing the upper cap of 400,000 gsf of commercial uses on the East side of I-93 for Phase 1 was unlikely without Exit 4A due to the traffic mitigation that would be required (see Appendix A and footnotes to Table 8). This Build condition value total assumes the difference between the likely No Build Phase 1 commercial development (400,000 gsf – 6,600 gsf) plus the remainder of the East side development that would be anticipated as a result of the access provided by Exit 4A (300,000 gsf).

[b] Because it is not possible to predict which type of jobs would result from Derry's industrial rezoning and redevelopment due to the flexible nature of the Industrial District IV zoning that allows retail, commercial, and industrial development, all jobs were assumed to be in the industrial category.

Town of Derry

The Town of Derry has several parcels zoned as Industrial IV, which allows commercial and industrial uses, east of I-93 along Folsom Road, north of North High Street. Redevelopment of the parcels currently zoned as industrial would be encouraged by Alternative A, which provides access to I-93 via Folsom and Madden Roads. The parcels south of Madden and Folsom Roads and west of North High Street were rezoned as Industrial VI in 2004, and construction of the Corporate Park Industrial Park was completed in 2005. Presently, the Town of Derry is undertaking a study to determine whether to rezone several residential properties currently zoned as medium-high density residential to an industrial zoning category (Figure 4). Figure 4 shows these properties and their relationship to Alternative A.

With regard to the properties along Folsom Road north of North High Street, the Build condition includes an estimate of the possible redevelopment that could be induced by Alternative A. To determine the amount of induced development on these parcels, it was necessary to determine the amount of likely existing development or jobs and subtract that from the amount of possible future development or jobs. It was assumed that the industrially zoned properties south of Folsom and Madden Roads would not be redeveloped because the properties have been recently developed (2005). Therefore, only the properties north of Folsom and Madden Roads that are zoned as Industrial District IV were examined for redevelopment.

Of the 10 Industrial District IV properties north of Folsom and Madden Roads that could be developed to higher intensity as a result of Alternative A, only four have existing structures that appear to be places of work rather than residences. Based on Geographic Information System

(GIS) information from the Town of Derry, the footprints of the existing buildings total 43,478 square feet. Based on a windshield survey of the type of businesses, Table 15 outlines the approximate amount of square footage for each use. Using industry-standard employee to gross square foot comparison factors by type of development, Table 15 also provides an estimate of the number of existing employees at the Derry Industrial District IV parcels.

Table 15. Existing Derry Industrial District IV development type and estimated employees

Development Type	Development Size	Conversion to Jobs	Jobs
Retail	8,328 gsf	General Retail: 400 gsf/employee	21
Office	18,322 gsf	Industrial Office: 300 gsf/employee	61
Industrial/Manufacturing	27,191 gsf	Industrial/Manufacturing: 800 gsf/employee	34
		Total	**116**

Source: Town of Derry GIS, RKG Associates (2016); MWCOG (n.d.)
Note: The total amount of development (development size) is greater than the total building footprint size because several buildings appeared to have partial second floors.

Appendix G of the I-93 Widening (Salem to Manchester) Supplemental Environmental Impact Statement (SEIS) includes a memorandum providing revised local future employment estimates to account for the potential indirect land use effects of Exit 4A (NHDOT and FHWA, 2010). The analysis conducted for this memorandum is no longer relevant because the Woodmont PUD was not available at that time (among other changes over time).However, the memorandum included research on employment densities of select industrial properties in Londonderry and Derry that remains applicable and useful for this study. To estimate the potential industrial redevelopment potential of the Industrial District IV properties, the average industrial employment density from the research provided in Appendix G of the I-93 Widening SEIS is used in this report. Table 16 includes the employment densities of three industrial properties in Derry from Appendix G of the SEIS and their average employment density.

Table 16. Employment density of select industrial businesses in Derry

<table>
<tr><th>Name</th><th>Address</th><th>Product/ Service</th><th>Parcel Size (acres)</th><th>Employees</th><th>Employment Density (employees per acre)</th><th>Average Employment Density (employees per acre)</th></tr>
<tr><td>Fireye</td><td>3 Manchester Road</td><td>Fire equipment</td><td>10</td><td>150</td><td>15.0</td><td rowspan="3">12.0</td></tr>
<tr><td>Sammina</td><td>2 Treasure Lane</td><td>Circuit boards</td><td>6</td><td>80</td><td>13.3</td></tr>
<tr><td>Merrimack Valley Wood Products</td><td>1 B Street</td><td>Door and window units</td><td>9</td><td>70</td><td>7.8</td></tr>
</table>

Source: NHDOT and FHWA (2010)

The total area of Industrial District IV properties within the identified redevelopment area that are more than 1 acre (the minimum lot size required by zoning to develop a property in Industrial District IV) is 31.7 acres.[6] Using the average industrial employment density in Table 16 and the amount of Industrial District IV acreage available, the estimated future employment capacity of the Industrial District IV properties is 380 jobs. Although it is not possible to know whether the market could support build out in this area by 2040, these jobs are estimated to be potentially attributable to the interstate access improvements provided to this area of Derry by Alternative A. Additionally, some of the parcels greater than 1 acre adjacent to and north of Folsom and Madden Roads would be transected by Alternative A, which may result in a lower estimated future employment capacity. Subtracting the total number of existing jobs on these industrial properties (see Table 15), the net approximate Build condition employment for these rezoned Industrial District IV properties is 264 jobs.

As previously mentioned, there is the potential for rezoning several residential properties currently zoned as medium-high density residential to an industrial zoning category (Figure 4). If these 10 residential properties were to be rezoned to Industrial Districts IV or VI, only as many as four of the properties could be redeveloped as industrial if properties were not combined because of the minimum lot area requirement in both zoning categories of 1 acre (Town of Derry, 2016). Assuming all four of these properties more than 1 acre were rezoned and redeveloped, a total of 6.8 acres, there would be about 82 jobs produced from the redevelopment based on the aforementioned acre-to-employee conversion factors.

Town of Londonderry

The change in type and amount of development anticipated for Woodmont Commons is based on the modification of the development that would be permitted by the Town of Londonderry (e.g., the "With Exit 4A" scenario from the PUD Master Plan) (see section 4.2). It should be noted that the Woodmont Commons PUD Master Plan includes the maximum possible development that would be permitted by Town of Londonderry for the PUD (east and west of I-93) with the Exit 4A Project. As mentioned in sections 2.4 and 5.1.2, this maximum development has been used as a conservative measure to evaluate potential environmental impacts (i.e., resulting from the development of available land) and should not be construed as a prediction of economic benefit of the Proposed Project. The amount of development for Woodmont Commons was converted into 2040 Build condition population, households, and employment (jobs) using the same methodology discussed in section 5.1.2. Therefore, based on a study area average household size of 2.73 persons and a total of nine Build residential units, the total 2040 Build known development population would be approximately 25 people. Household growth was calculated by multiplying the residential units produced in Woodmont Commons by the 2010 SNHPC weighted average occupancy rate of 95.4 percent, resulting in about nine households.

Employment growth (jobs) from known development projects was calculated based on the size and type of known development project, using the industry standard employee to gross square foot comparison factors by type of development (RKG Associates, 2016; MWCOG, n.d.; U.S. Green Building Council, 2008). Given the assumptions noted in Table 17, approximately 4,335 Build condition jobs are anticipated as a result of the development induced by the Exit 4A Project. This "incremental growth" is added to the No Build condition total population,

[6] Two parcels shared the same parcel number and therefore were considered as one.

households and employment to obtain the total Build condition socioeconomic inputs for the traffic modeling.

The industrial developments in the northwest portion of Londonderry would not be affected by the Project. Access to those parcels is provided by Pettengill Road and Raymond Wieczorek Drive (Manchester Airport Access Road).

Table 17. 2040 Build condition incremental employment growth as a result of known developments in Londonderry

Development Name	Development Size and Type	Conversion to Jobs	Jobs
Woodmont Commons – West of I-93	322,000 gsf of Commercial	½ of gsf at General Retail: 400 gsf / employee ¼ of gsf at Restaurants: 175 gsf/employee ¼ of gsf at Other Services: 400 gsf/employee	403 + 460 + 201
	40,000 gsf of Institutional (Assisted Living)	Lodging: 1,124 gsf/employee	37
Woodmont Commons – East of I-93	200 Hotel Rooms	0.6 employees / room	120
	693,400 gsf of Commercial	½ of gsf at General Retail: 400 gsf / employee ¼ of gsf at Restaurants: 175 gsf/employee ¼ of gsf at Other Services: 400 gsf/employee	867 + 991 + 433
	420,000 gsf of Institutional (Hospital and Assisted Living)	250,000 gsf at Hospital: 429 gsf/employee 170,000 gsf of Lodging: 1,124 gsf/employee	667 + 156
Total			**4,335**

Source: Pillsbury Realty Development (2013), RKG Associates (2016), MWCOG (n.d.), USGBC (2008)

Chester, Sandown, and Auburn

As discussed in the interview summaries, Chester and Sandown are likely to experience additional residential development as a result of Alternative A due to the improved access provided by Exit 4A, which would enable commuters to bypass downtown Derry. Even considering the growth management strategies discussed in section 4.0, the local planners agreed that Alternative A could contribute to Chester and Sandown reaching their 2040 projected population earlier than would otherwise occur in the No Build condition. The potential range of impacts was considered by examining two scenarios:

- Moderate growth impact scenario- Chester and Sandown reach their 2040 population level 5 years early, in 2035. Between 2035 and 2040, the population of both towns continues to grow at the same rate as OEP's projection for 2035-2040.
- High growth impact scenario- Chester and Sandown reach their 2040 population level 10 years early in 2030. Between 2030 and 2040, the population of both towns continues to grow at the same average annual rate as OEP's projection for 2030-2040.

Table 18 presents a comparison of the No Build and both the moderate growth and high-growth impact scenario populations for Chester and Sandown. To present a conservative assessment of potential impacts, the high growth impact scenario was used for impact analysis and incorporated in the travel demand model. The high growth impact scenario yields an additional 1,117 people in Chester and 21 people in Sandown under the 2040 Build condition. Using the 2040 population and household information to determine average household size for each town in 2040, the additional people yield approximately 371 and 9 additional households in 2040 for Chester and Sandown, respectively.

Auburn is not likely to experience a change in growth and development associated with Alternative A because Auburn already has more direct access to I-93 via Exit 5 and NH 101. The local official interviewed as part of this study concurred with this conclusion (see Appendix A).

Table 18. Chester and Sandown 2040 Build condition population growth

Town	Impact Scenario	Population				Population Increase Over No Build in 2040
		2015	2030	2035	2040	
Chester	No Build	4,887	6,101	6,177	**6,253**	NA
	Moderate Growth (Build)	4,887	5,879	**6,253**	6,789	535
	High Growth (Build)	4,887	**6,253**	6,789	7,370	1,117
Sandown	No Build	6,255	7,140	7,229	**7,246**	NA
	Moderate Growth (Build)	6,255	7,061	**7,246**	7,249	3
	High Growth (Build)	6,255	**7,246**	7,257	7,267	21

Source: OEP (2016a)

2040 Build Condition Land Use Forecast Summary

Based on the information presented above, the 2040 Build population for the study area is estimated to be 83,654, as outlined in Table 19, an increase of 1,163 people over the No Build condition. Tables 20 and 21 show the total households and employment (jobs), respectively, for the study area under the 2040 Build condition. The total number of 2040 Build households for the study area is estimated to be 34,190, an increase of 389 households over the No Build condition (Table 20), and the 2040 Build employment for the study area is estimated to be 39,975 jobs, an increase of 4,681 jobs over the No Build condition (Table 21). The large increase in employment under the Build condition is primarily attributable to the additional build out of Woodmont Commons that Londonderry will permit with the completion of Exit 4A.

Table 19. Total 2040 Build condition population for study area

Municipality	2040 No Build Population	2040 Build Incremental Development Project Population	Total 2040 Build Population	Percent Difference between No Build and Build
Derry	33,222	0	33,222	0.00%
Londonderry	30,885	25	30,910	0.08%
Auburn	6,048	0	6,048	0.00%
Chester	6,253	1,117	7,370	16.40%
Sandown	7,246	21	7,267	0.29%
Study Area Total	83,654	1,163	84,818	1.38%

Table 20. Total 2040 Build condition households for study area

Municipality	2040 No Build Households	2040 Build Incremental Development Project Households	Total 2040 Build Households	Percent Difference between No Build and Build
Derry	12,673	0	12,673	0.00%
Londonderry	10,695	9	10,704	0.08%
Auburn	2,187	0	2,187	0.00%
Chester	2,077	371	2,448	16.40%
Sandown	2,914	9	2,923	0.29%
Study Area Total	30,546	389	30,935	1.26%

Table 21. Total 2040 Build condition employment for study area

Municipality	2040 No Build Employment	2040 Build Incremental Development Employment	Total 2040 Build Employment	Percent Difference between No Build and Build
Derry	10,479	346	10,825	3.25%
Londonderry	20,875	4,335	25,210	18.81%
Auburn	2,764	0	2,764	0.00%
Chester	641	0	641	0.00%
Sandown	536	0	536	0.00%
Study Area Total	35,294	4,681	39,975	12.44%

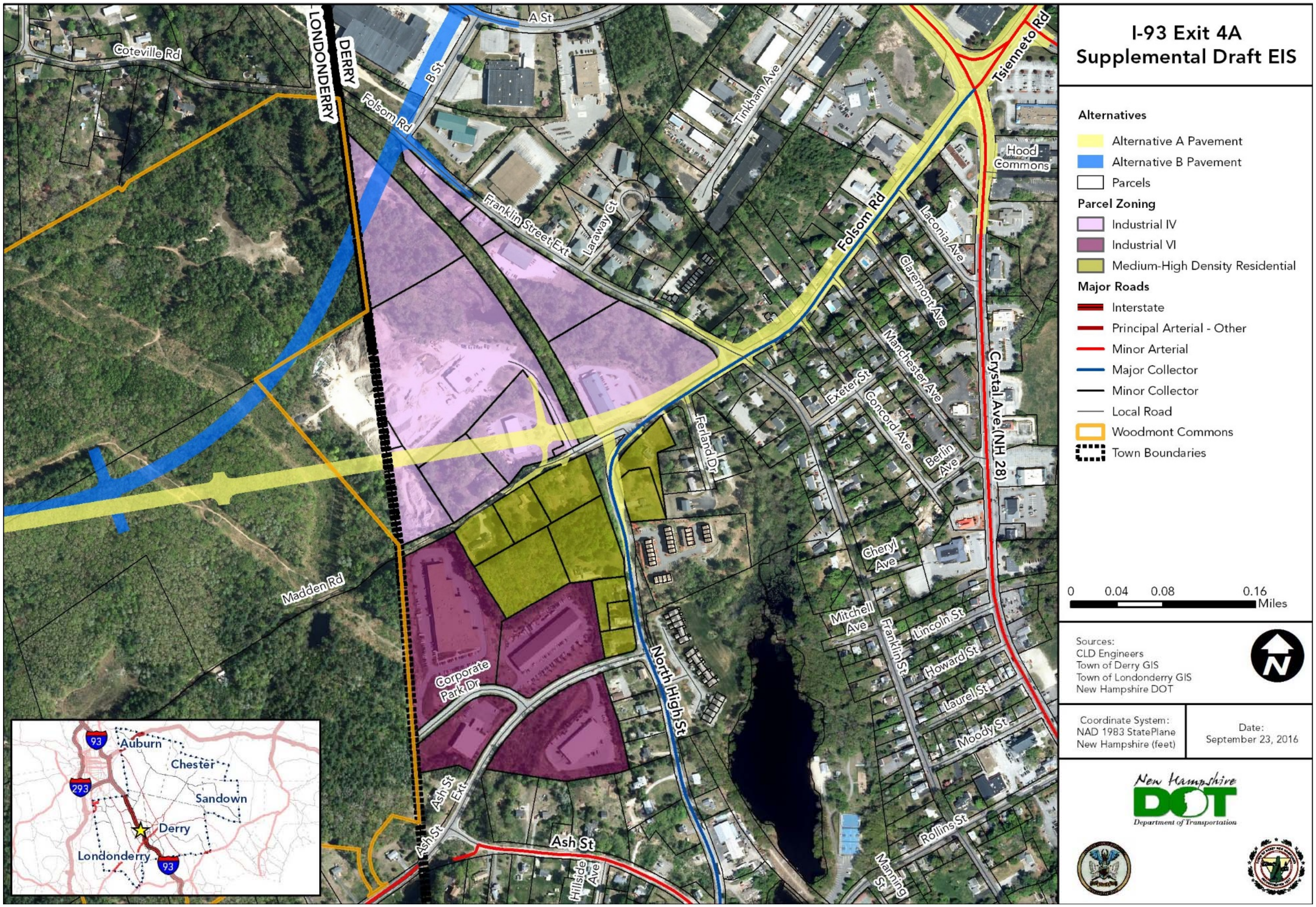

Figure 4. **Location of potential redeveloped and rezoned properties in the Town of Derry**

5.2.2 Alternative B

Compared to Alternative A, Alternative B would be expected to result in similar commercial and industrial growth in Derry. Although the exact location of the connector road would be different from that proposed for Alternative A, Alternative B would provide access to the area zoned as Industrial IV and the area being considered for rezoning. The development associated with Woodmont Commons and Chester are anticipated to be similar under Alternatives A and B. As previously mentioned, the proposed Project is not expected to affect the industrial developments in the northwest portion of Londonderry and residential development in Auburn. Finally, the anticipated increased rate of residential development in Chester and Sandown would be similar under Alternatives A and B.

5.2.3 Alternative C

The commercial and industrial development anticipated in Derry under Alternative A would not be realized under Alternative C because the rezoned parcels along Folsom Road north of North High Street would not have direct access to the interchange. As Figure 3 shows, the alignment of Alternative C would constrain additional commercial/industrial development due to lack of available land adjacent to the right-of-way. As the alignment approaches I-93, a transmission line and conservation areas limit the available land for development. Where the alignment follows Route 28, the adjacent land is largely built out with commercial and industrial uses. Although it is possible that some of the commercial and industrial parcels could be redeveloped, it is unlikely to result in a substantive net gain of commercial or industrial space because of the size of the individual parcels.

Londonderry planning staff and the Woodmont Commons representative indicated that Build Alternative C would limit access to the area available for development near I-93 to an extent that, if this alternative were selected, the Woodmont Commons area on the east side of I-93 would be developed as detailed under the No Build (e.g., primarily residential, 330 households). As previously mentioned, the proposed Project is not expected to affect the industrial developments in the northwest portion of Londonderry and residential development in Auburn. Finally, the anticipated increased rate of residential development in Chester and Sandown would be similar under Alternatives A and B given that the Alternative C interchange/roadway improvements would still provide a bypass of downtown Derry (although with a less direct route than Alternative A).

5.2.4 Alternative D

Development under Alternative D would be the same as that anticipated under Alternative C because the interchange would be located in the same location as Alternative C. Roadway improvements would follow Tsienneto Road to connect with NH 102 (similar to Alternative A).

5.2.5 Alternative F

Alternative F would involve an upgrade of NH Route 102 between Londonderry Road and the NH Route 28 Bypass. Development under Alternative F in the area of Woodmont Commons and the industrial area of Derry would be the same as that anticipated under the No Build condition. The indirect land use impacts on Chester and Sandown are not anticipated. Although the improvements on NH 102 would reduce congestion through downtown Derry, Alternative F does not include improvements that would enable commuters to bypass downtown Derry, thereby encouraging growth in Chester or Sandown.

6.0 ALLOCATION OF GROWTH TO TRAFFIC ANALYSIS ZONES

The purpose of this section is to document how the town-level and development-specific projections for the No Build and Build conditions discussed in prior sections were allocated to geographic unit required by the SNHPC traffic model, the TAZ. The Traffic Technical Report will discuss in detail how the population, household, employment projections from this Report will be used to develop traffic data.The anticipated population, household, and job growth associated with the known No Build developments was assigned to TAZs based on the percentage of the development land area in each TAZ. The detailed formulas for assigning population and households to TAZ are provided in a memorandum in Appendix D. Table 22 shows the 2040 No Build condition growth from known developments, and Table 23 shows the total 2040 No Build condition. Employment data are not available for publication due to confidentiality issues.

Table 22. 2040 No Build condition growth from known developments by TAZ

Municipality	TAZ	2040 No Build Condition Known Development Growth			Associated Growth Notes
		Population	Households	Employment	
Londonderry	277	0	0	148	Market Basket Redevelopment
Londonderry	277	1,392	486	1,113	Woodmont Commons Phase 1 - West
Londonderry	99	813	284	965	Woodmont Commons Remainder - West
Londonderry	277	743	260	882	Woodmont Commons Remainder - West
Londonderry	69	520	182	10	Woodmont Commons - East
Londonderry	375	381	133	7	Woodmont Commons - East
Londonderry	64L	0	0	525	Pettengill Road Industrial Area
Londonderry	274	0	0	569	Pettengill Road Industrial Area
Study Area Total	NA	3,849	1,345	4,219	

Table 23. 2040 No Build condition by TAZ

Municipality	TAZ	2040 Background Growth			2040 No Build Known Developments			2040 Total No Build Condition		
		Population	Households	Employment	Population	Households	Employment	Population	Households	Employment
Derry	132	773	339	CI	0	0	0	773	339	CI
Derry	133	85	29	CI	0	0	0	85	29	CI
Derry	377	13	3	CI	0	0	0	13	3	CI
Londonderry	64L	0	0	CI	0	0	525	0	0	CI
Londonderry	69	74	23	CI	520	182	10	594	205	CI
Londonderry	99	885	304	CI	813	284	965	1,698	588	CI
Londonderry	274	405	118	CI	0	0	569	405	118	CI
Londonderry	277	31	11	CI	2,135	746	2,143	2,166	757	CI
Londonderry	375	0	0	CI	381	133	7	381	133	CI
Auburn[a]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chester	148	796	275	CI	0	0	0	796	275	CI
Chester	149	632	225	CI	0	0	0	632	225	CI
Chester	150	566	220	CI	0	0	0	566	220	CI
Chester	151	624	223	CI	0	0	0	624	223	CI
Chester	152	1,535	448	CI	0	0	0	1,535	448	CI
Chester	153	526	180	CI	0	0	0	526	180	CI
Chester	154	635	229	CI	0	0	0	635	229	CI
Chester	155	938	277	CI	0	0	0	938	277	CI
Sandown[b]	NA	NA	NA	NA	0	0	0	NA	NA	NA
Total	NA	8,519	2,905	CI	3,849	1,345	4,219	12,368	4,250	CI

Notes: TAZs in this table are those that include population, household, and employment growth from known developments under the No Build condition or incremental growth associated with the Build condition (Alternative A). The whole-town TAZ tables for the entire study area are included in Appendix D. SNHPC background employment data by TAZ is confidential and not available for publication. CI = Confidential Information.

[a] Auburn is listed as NA because there are no known developments or induced growth anticipated; therefore, population, households, and employment were not allocated to TAZs.

[b] The anticipated induced population and household growth for Sandown was not assigned to TAZs because Sandown is located in an external zone in the traffic demand model.

The 2040 Build condition incremental growth associated with Derry redevelopment, Woodmont Commons, and induced residential development was assigned to TAZs using the following approach. The anticipated job growth that could result from Derry redevelopment was assigned based on the location of the parcels currently zoned as Industrial IV within each TAZ that would have access to I-93 as a result of Alternative A. The anticipated job growth that could result from the potential Derry rezoning was assigned based on the location of the parcels currently zoned as medium high density residential within each TAZ that would have access to I-93 as a result of Alternative A. The anticipated population, household, and job growth associated with Woodmont Commons was assigned to TAZs based on the percentage of the Woodmont Commons development area in each TAZ. In Chester, the population and household growth anticipated to be induced by Alternative A was allocated to TAZs by overlaying the town and TAZ boundaries and assigning population and households based on the percentage of the town area within each TAZ. The anticipated induced population and household growth for Sandown was not assigned to TAZs because Sandown is located in an external zone in the traffic demand model.[7] Table 24 presents the incremental population, household, and job growth by TAZ that would be induced by Alternative A for the 2040 Build condition. The TAZs shown in Table 24 and Figure 5 (Sheets 1 and 2) are the ones to which growth was assigned. Table 25 shows the total 2040 Build condition anticipated under Alternative A, which includes the 2040 total No Build condition and the incremental growth associated with Alternative A. Appendix D contains detailed tables showing all of the TAZs in the study area and the population, household, and job growth for the 2040 No Build condition and the Build conditions associated with each alternative (A, B, C, D, and F).[8]

Table 24. 2040 Build condition incremental growth associated with Alternative A by TAZ

Municipality	TAZ	2040 Incremental Build Condition Growth (Alternative A)			Associated Growth Notes
		Population	Households	Employment	
Derry	132	0	0	14	Derry Industrial Redevelopment
Derry	133	0	0	106	Derry Industrial Redevelopment
Derry	377	0	0	226	Derry Industrial Redevelopment
Londonderry	99	9	3	575	Woodmont Commons West
Londonderry	277	8	3	526	Woodmont Commons West
Londonderry	69	5	2	6	Woodmont Commons East

[7] Incorporation of Sandown indirect land use impacts in the SNHPC model is not necessary given the minor growth impact estimated.

[8] TAZs for Sandown are not included because of its location outside the SNHPC travel demand model region.

Municipality	TAZ	2040 Incremental Build Condition Growth (Alternative A)			Associated Growth Notes
		Population	Households	Employment	
Londonderry	375	3	1	1,368	Woodmont Commons East
Auburn	NA	0	0	0	No projects or induced growth
Chester	148	121	40	0	Induced growth due to access
Chester	149	126	42	0	Induced growth due to access
Chester	150	204	68	0	Induced growth due to access
Chester	151	144	48	0	Induced growth due to access
Chester	152	241	80	0	Induced growth due to access
Chester	153	103	34	0	Induced growth due to access
Chester	154	93	31	0	Induced growth due to access
Chester	155	85	28	0	Induced growth due to access
Sandown[a]	NA	21	9	0	Not allocated due to location outside of traffic model
Study Area Total	NA	1,163	389	4,681	NA

[a] The anticipated induced population and household growth for Sandown was not assigned to TAZs because Sandown is located in an external zone in the traffic demand model.

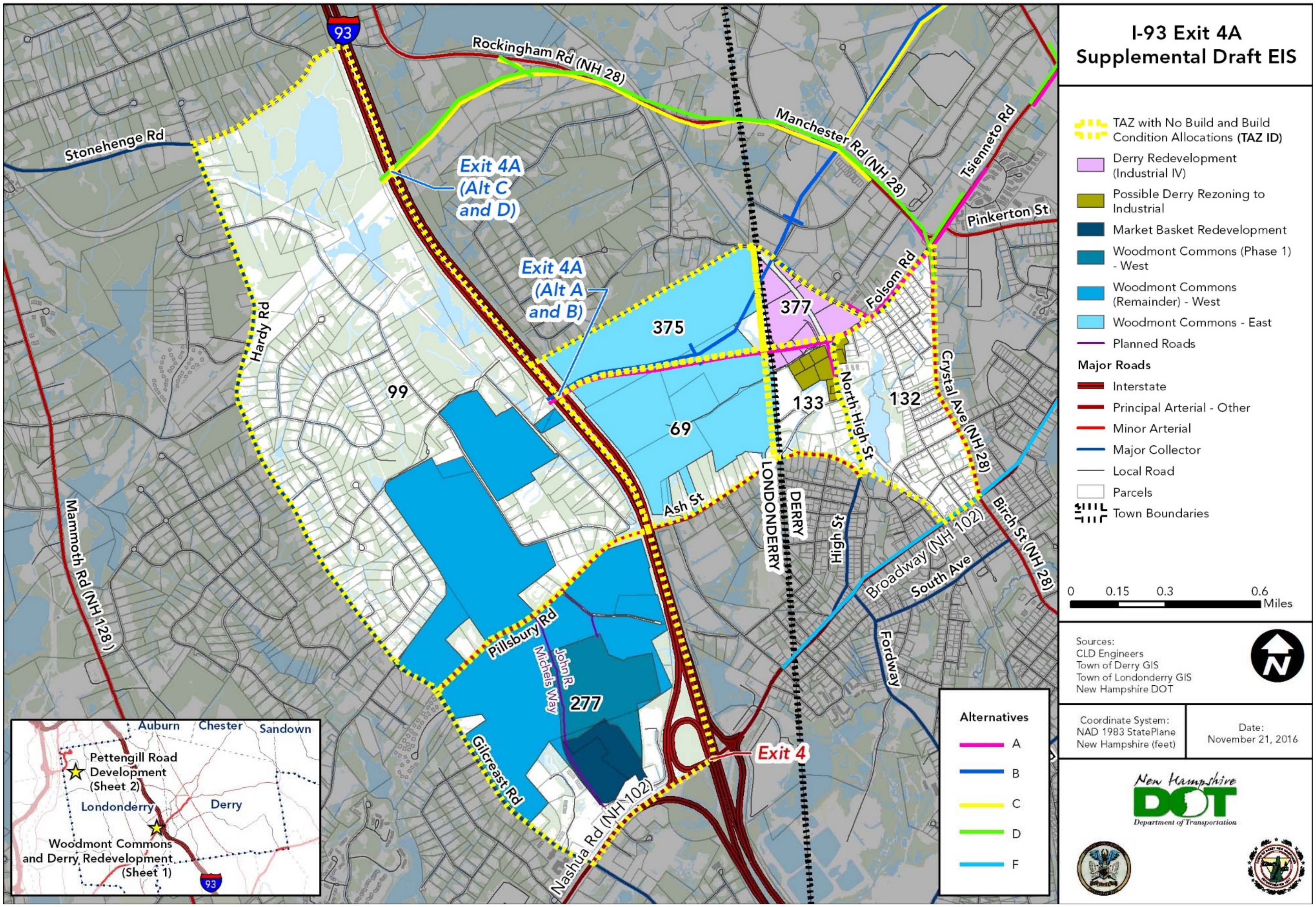

Figure 5 (Sheet 1 of 2). TAZs with No Build and Build allocations

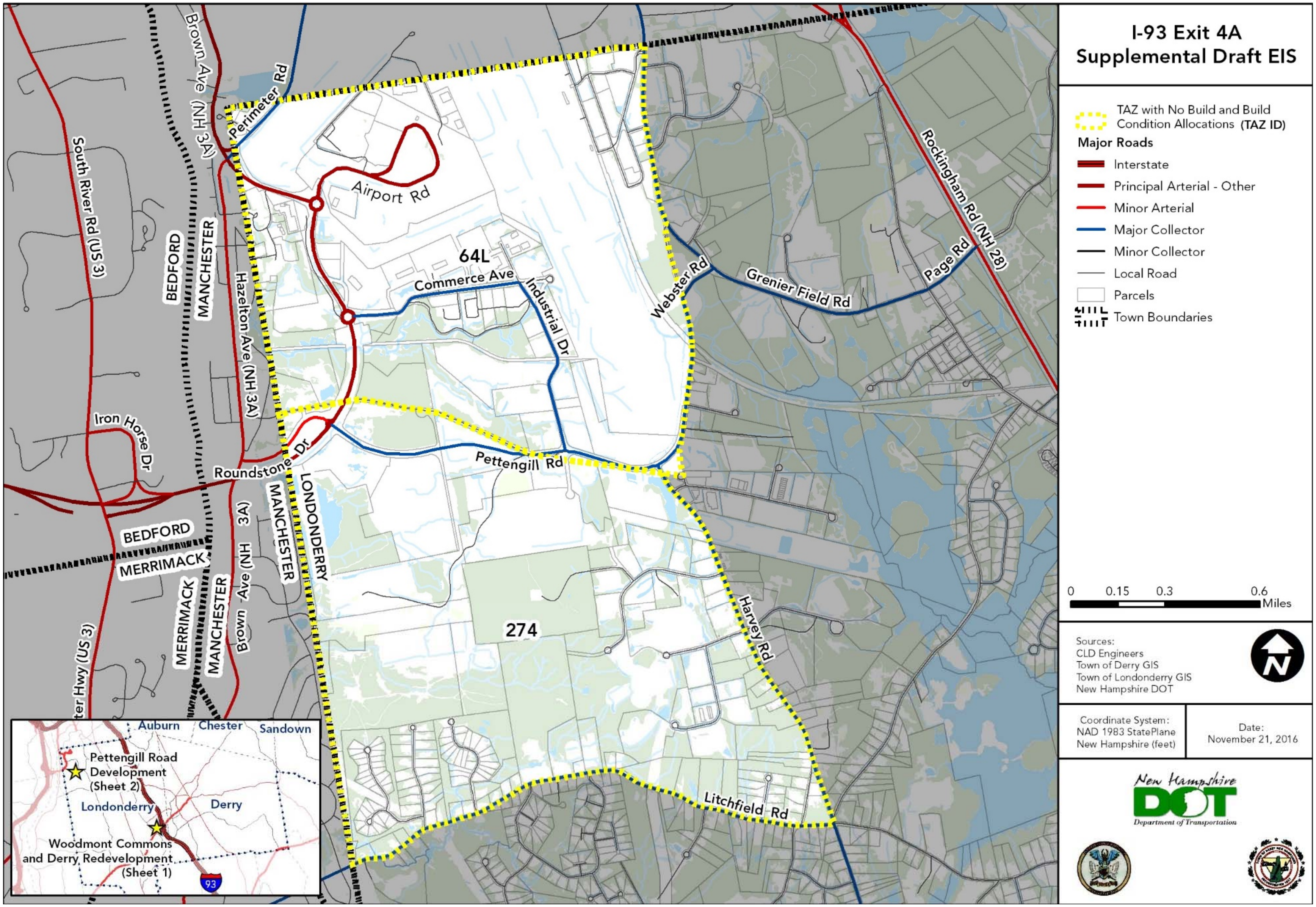

Figure 5 (Sheet 2 of 2). TAZs with No Build and Build allocations

Table 25. 2040 Build condition by TAZ

Municipality	TAZ	2040 Total No Build Condition			2040 Incremental Build Condition Growth (Alternative A)			2040 Total Build Condition		
		Population	Households	Employment	Population	Households	Employment	Population	Households	Employment
Derry	132	773	339	CI	0	0	14	773	339	CI
Derry	133	85	29	CI	0	0	106	85	29	CI
Derry	377	13	3	CI	0	0	226	13	3	CI
Londonderry	64L	0	0	CI	0	0	0	0	0	CI
Londonderry	69	594	205	CI	5	2	1,866	599	207	CI
Londonderry	99	1,698	588	CI	9	3	575	1,707	591	CI
Londonderry	274	405	118	CI	0	0	0	405	118	CI
Londonderry	277	2,166	757	CI	8	3	526	2,174	760	CI
Londonderry	375	381	133	CI	3	1	1,368	384	134	CI
Auburn[a]	NA	NA	NA	NA	0	0	0	NA	NA	NA
Chester	148	796	275	CI	121	40	0	917	315	CI
Chester	149	632	225	CI	126	42	0	758	267	CI
Chester	150	566	220	CI	204	68	0	770	288	CI
Chester	151	624	223	CI	144	48	0	768	271	CI
Chester	152	1,535	448	CI	241	80	0	1,776	528	CI
Chester	153	526	180	CI	103	34	0	629	214	CI
Chester	154	635	229	CI	93	31	0	728	260	CI
Chester	155	938	277	CI	85	28	0	1,023	305	CI
Sandown[b]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total	NA	12,368	4,250	CI	1,142	380	4,681	13,510	4,630	CI

Notes: TAZs in this table are those that include population, household, and employment growth from known developments under the No Build condition or incremental growth associated with the Build condition (Alternative A). The whole-town TAZ tables for the entire study area are included in Appendix D. SNHPC background employment data by TAZ is confidential and not available for publication. CI = Confidential Information

[a] Auburn is listed as NA because there are no known developments or induced growth anticipated; therefore, population, households, and employment were not allocated to TAZs.

[b] The anticipated induced population and household growth for Sandown was not assigned to TAZs because Sandown is located in an external zone in the traffic demand model.

Table 24 shows the incremental population, household, and jobs growth based on the anticipated indirect land use effects of Alternative A. As detailed in Appendix D, the Project would result in the most indirect land use effects under Alternatives A and B, less indirect land use effects under Alternatives C and D, and no anticipated indirect land use effects under Alternative F. The projected indirect land use effects of Alternatives A and B are from the difference in the development approved and expected for Woodmont Commons development with and without the Project, the difference in development on the recently rezoned parcels in the Town of Derry along Folsom Road, and anticipated residential development in the Towns of Chester and Sandown based on improved access to I-93. The projected indirect land use effects of Alternatives C and D are only from the anticipated residential development in the Towns of Chester and Sandown based on improved access to I-93.

The travel demand modeling and traffic impact analyses will utilize the socioeconomic data results of this study as an input, and the details of these analyses will be documented separately in the Traffic and Transportation Technical Report.

7.0 REFERENCES

Applied Economic Research. 2012. Presentation: Pettengill Road Development Opportunities Analysis and Findings. Prepared for Londonderry Housing and Redevelopment Authority. December 2012. Available at: http://www.londonderrynh.org/Pages/LondonderryNH_PlanEcoDev/TigerV/PR_DevelopmentOpportunities.pdf.

Chester Planning Board. 2015. Chester Master Plan 2015. Available at: http://www.chesternh.org/WP2012/wp-content/uploads/2012/08/2015-Chester-Master-Plan-Update.pdf.

FHWA (Federal Highway Administration). 2003. Interim Guidance: Questions and Answers Regarding the Consideration of Indirect and Cumulative Impacts in the NEPA Process. Available at: https://www.environment.fhwa.dot.gov/guidebook/qaimpact.asp

FHWA. 2010. Interim Guidance on the Application of Travel and Land Use Forecasting in NEPA. Available at: https://www.environment.fhwa.dot.gov/projdev/travel_landUse.asp.

Heritage Commission. 2016. Heritage Commission Meeting Minutes, Londonderry, New Hampshire – DRAFT. March 24, 2016. Available at: http://www.londonderrynh.org/pages/LondonderryNH_HistMin/2016/HC%20Minutes%20032416%20(A).pdf.

Jaschik, S. 2012. Chester College will close. Inside Higher Ed, May 21, 2012. Available at: https://www.insidehighered.com/news/2012/05/21/chester-college-will-shut-down. Accessed September 8, 2016.

MWCOG (Metropolitan Washington Council of Governments). No Date. Round 7 Conversion Factors for Employment. Available at: http://www.mwcog.org/file.aspx?A=v0SA9I%2BV005%2F%2Bgsoo02QiYnCTJWpX7sZJJ0CY5cWjyI%3D. Accessed September 20, 2016.

National Historical Geographic Information System. 1990. 1990 Decennial U.S. Census, Household Data. NHGIS data file 'nhgis0001_ds120_1990_cty_sub'. Available at: https://www.nhgis.org/documentation/tabular-data.

NHDOT (New Hampshire Department of Transportation) and FHWA (Federal Highway Administration). 2010. Final Supplemental Environmental Impact Statement and Reevaluation/Section 4(f) Evaluation for Interstate 93 Improvements Salem to Manchester; Appendix G – Indirect Effects Written Reevaluation/Technical Report. May 2010.

NHES (New Hampshire Employment Security). 2015. New Hampshire Community Profiles (individual town pages). Available at: http://www.nhes.nh.gov/elmi/products/cp/index.htm. Accessed September 13, 2016.

OEP (New Hampshire Office of Energy and Planning). 2013. New Hampshire Population Forecast by Municipality: 2013. Available at: https://www.nh.gov/oep/data-center/population-projections.htm.

OEP. 2016a. New Hampshire Population Projections by Municipality: 2016 (projection numbers). Received via email from Ken Gallager (OEP) to Kerri Snyder (Louis Berger) on September 9, 2016.

OEP. 2016b. County Population Projections, By Municipality: August 2016 (memo attached to projection numbers). Received via email from Ken Gallager (OEP) to Kerri Snyder (Louis Berger) on September 9, 2016.

Pillsbury Realty Development, LLC. 2013. Woodmont Commons Planned Unit Development Master Plan. Approved October 2, 2013. Available at: http://www.londonderrynh.org/Pages/LondonderryNH_BComm/Planning/commons.

Pillsbury Realty Development, LLC. 2016. Woodmont Commons - Phase I Development. Available at: http://www.londonderrynh.org/Pages/LondonderryNH_BComm/Planning/projectsunderreview/Woodmont%20Site%20Plan%20-%20Overall%20Site%20Plan%20Sheet.pdf.

Regional Economic Development Center of Southern New Hampshire. 2016. Comprehensive Economic Development Strategy. Available at: http://media.wix.com/ugd/69da16_9e03e77ffacc4e36b3b3e8607fa14491.pdf.

RKG Associates. 2016. Email to Laura Hodgson, Urban/Transportation Planner at Louis Berger, from Lawrence Cranor, Senior Project Manager at RKG Associates, regarding calculating employees per gross square feet of various development types. Received from RKG Associates on September 13, 2016 and September 20, 2016.

Rockingham Planning Commission. 2015. 2015 Regional Master Plan. Available at: http://www.rpc-nh.org/application/files/5414/6168/4994/Complete2015RegionalMasterPlan.pdf. Accessed September 1, 2016.

Sandown Master Plan Steering Committee, Planning Board, and Rockingham Planning Commission. 2013. 2013 Sandown, NH Master Plan. Available at: http://sandown.us/Pages/Sandownnh_Bcomm/PlanningBoard/masterplan/masterplanfinal2013.pdf.

SNHPC (Southern New Hampshire Planning Commission). 2007. Town of Auburn, NH Master Plan. Prepared for the Auburn Planning Board. Available at: http://www.auburnnh.us/sites/auburnnh/files/file/file/masterplanfinalnomaps.pdf.

SNHPC. 2010. Regional Comprehensive Plan 2010 for the Southern New Hampshire Planning Commission Region. Available at: http://www.snhpc.org/pdf/Final_Full_RCP.pdf

SNHPC. 2012a. Letter to Mr. G. Sirois, Director of Derry Planning Department, from Mr. D.J. Preece, Executive Director, SNHPC, regarding population and dwelling unit projections. Received from SNHPC during interview on July 25, 2016.

SNHPC. 2012b. Email to Leo Tidd, Senior Planner at Louis Berger, from Julie Chen, Senior Transportation Planner at SNHPC, regarding population, dwelling unit, and household projections for 2010-2050. Received from SNHPC on August 10, 2016.

SNHPC. 2012c. Email to Leo Tidd, Senior Planner at Louis Berger, from Julie Chen, Senior Transportation Planner at SNHPC, regarding employment projections for 2010-2050. Received from SNHPC on August 22, 2016.

SNHPC. 2014. Moving Southern New Hampshire Forward: 2015–2035. Adopted December 16, 2014. Available at: http://www.snhpc.org/pdf/SNHPCRegionCompPlan2015.pdf.

SNHPC. 2016a. Email to Kerri Snyder, Principal Environmental Planner at Louis Berger, from Julie Chen, Senior Transportation Planner at SNHPC, regarding the allocation of OEP population projections to TAZ and calculation of households by TAZ. Received from SNHPC on October 21, 2016.

SNHPC. 2016b. Email to Leo Tidd, Senior Planner at Louis Berger, from Julie Chen, Senior Transportation Planner at SNHPC, regarding updated 2015 employment projections. Received from SNHPC on August 25, 2016.

SNHPC. 2016c. Email to Kerri Snyder, Principal Environmental Planner at Louis Berger, from Julie Chen, Senior Transportation Planner at SNHPC, regarding the adjusted employment projections for 2020-2040. Received from SNHPC on November 7, 2016.

SNHPC. 2016d. Email to Kerri Snyder, Principal Environmental Planner at Louis Berger, from Julie Chen, Senior Transportation Planner at SNHPC, regarding calculating household size and occupancy rate. Received from SNHPC on August 23, 2016.

SNHPC. 2017. Email to Kerri Snyder, Principal Environmental Planner at Louis Berger, from Julie Chen, Senior Transportation Planner at SNHPC, regarding the revised population and household projections for the Town of Chester. Received from SNHPC on February 14, 2017.

Town of Chester. No Date. Planning Board – Chester Planning Department – Plans for Approved Subdivision Plans. Available at: http://www.chesternh.org/boards-committees/planning-board. Accessed August 23, 2016.

Town of Chester. 2015. Town of Chester Zoning Ordinance. Updated May 12, 2015. Available at: http://www.chesternh.org/WP2012/wp-content/uploads/2012/08/2015-Zoning-Ordinance.pdf.

Town of Derry. 2010. Master Plan. Adopted March 24, 2010. Available at: http://www.derry.nh.us/sites/derrynh/files/uploads/derrymasterplan2010_finaldraft_0.pdf.

Town of Derry. 2016. Zoning Ordinance. Dated July 7, 2016. Available at: http://www.derrynh.org/sites/derrynh/files/uploads/zo_07.07.2016.pdf. Accessed on August 25, 2016.

Town of Londonderry. 2013. Comprehensive Master Plan. Adopted March 2013. Available at: http://www.londonderrynh.org/Pages/LondonderryNH_BComm/Planning/MPSCResources/LondonderryMasterPlan_FINAL_010413-ISSUU.pdf.

Town of Londonderry. 2015. Planning Board 2015 Annual Town Report. Available at: http://www.londonderrynh.org/Pages/LondonderryNH_BComm/SolidWaste/SOLID%20WASTE%20FINAL.pdf

U.S. Census Bureau. 1990. 1990 Census of Population and Housing, Population and Housing Unit Counts, United States. Available at: https://www.census.gov/prod/cen1990/cph2/cph-2-1-1.pdf

U.S. Census Bureau. 2000. Decennial Census, Summary Files 1 and 3 using AmericanFactFinder. Available at: http://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml.

U.S. Census Bureau. 2010. Decennial Census, Summary File 1 using AmericanFactFinder. Available at: http://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml.

U.S. Census Bureau. 2016a. OnTheMap Application. Longitudinal-Employer Household Dynamics Program. Available at: http://onthemap.ces.census.gov/.

U.S. Census Bureau. 2016b. American FactFinder. Available at: http://factfinder.census.gov/).

U.S. Census Bureau. 2016c. City and Town Intercensal Estimates. Available at: https://www.census.gov/popest/data/intercensal/cities/cities2010.htm.

U.S. Green Building Council. 2008. Building Area per Employee by Business Type. Available at: http://www.usgbc.org/Docs/Archive/General/Docs4111.pdf. Accessed on September 20, 2016.

Williams, P. 2015. Chinese international school buys Chester College site. Tri-Town Times, September 30, 2015. Available at: http://tritowntimes.net/2015/09/chinese-international-school-buys-chester-college-site/. Accessed September 8, 2016.

APPENDIX A: LOCAL LAND USE PLANNER INTERVIEW SUMMARIES AND SUPPLEMENTAL INFORMATION

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Local Land Use Planner Interview Summaries and Supplemental Information

I-93 Exit 4A Supplemental Environmental Impact Statement

Land Use Planner Interview Summary – Final 08/05/16

Town of Derry

Following is a summary of the interview held on July 26, 2016 at the Town of Derry offices. Attendees were as follows:

- Town of Derry – George Sioras, Liz Robidoux, and Mike Fowler
- Louis Berger – Leo Tidd and Kerri Snyder
- RKG Associates – Craig Seymour

Population and Employment

The 2010 Comprehensive Plan includes dated population data, and the staff referenced the Granite State Future Project, which resulted in the SNHPC's Moving Southern New Hampshire Forward Regional Comprehensive Plan (2015).[1] This report included a 2015 population for Derry between 31,991 (SNHPC) and 33,991 (OEP) (see Attachment A). The decline from previously projected population numbers is based on school age families migrating away from the area, young adults who leave Derry to attend college or seek employment and settle elsewhere, and an aging population.

There was a general discussion of SNHPC's population projections and the towns input. The SNHPC projections include a straight-line assumption and do not consider individual transportation and land development projects. The Derry staff believe that growth generated by Exit 4A would be in addition to the SNHPC projections. In other words, the SNHPC projections would be representative of a "No Build" condition for Exit 4A in Derry.

The staffs provided additional information on population and growth through a school district facilities committee meeting report (see Attachment B).

Transportation

Regarding the general discussion of how Exit 4A would affect Derry's plan for transportation facilities and services, if Exit 4A were built, it would make improvements on local roads accessing the exit. If Exit 4A were not built, the Town would have to evaluate how to address transportation needs.

Exit 4A would reduce travel times for residents and business travelers during the afternoon rush hour ingress to Derry. The project is not likely to make a difference for the morning rush hour egress from Derry, as travelers already find other routes to take. There is anecdotal evidence of collateral impacts in that residents report too much traffic or traffic traveling too fast on the more rural roadways southeast of downtown Derry. For example, to avoid Exit 4 and the traffic congestion on Route 102 through Downtown, some commuters leave I-93 at Exit 3 instead and

[1] http://www.snhpc.org/pdf/SNHPCRegionCompPlan2015.pdf

take the Route 111 bypass into the southern portion of Derry, followed by navigation northward through Derry on local streets.

The staff discussed the effect of Exit 4A on traffic in downtown Derry. Derry is a “cut-through” town for towns farther to the east (e.g., Chester, Sandown) as drivers access I-93. By providing an alternative route for through-traffic, Exit 4A would alleviate the severe peak hour traffic congestion on Route 102 through downtown Derry, which some believe would be beneficial in terms of economic impacts because it would improve the accessibility to downtown businesses. Others believe that reduced traffic in downtown Derry would result in loss to businesses. The Town of Derry does not have an official position on this issue and has recommended additional study of the benefits and impacts of Exit 4A in the 2010 Comprehensive Plan.

Parts of Derry are primarily built-out, and the staff view the major impacts associated with not building Exit 4A as additional stress on state roads, as there are constraints that preclude expansion of these other roadways to four-lane facilities.

Development and Land Use

Since 1990, the explosive growth experienced since the 1960s slowed. Derry’s growth management ordinance was instituted in the mid-1990s along with changes in zoning to control density of residential development. In addition, the segmented ownership in the central business district and lack of large parcels of available land for development make substantial growth impracticable. Currently, Derry is experiencing a trend of population decline related to an aging population and an outward migration of young adults as they seek employment and educational opportunities.

The area immediately to the east of I-93, along Folsom Road north of High Street, has been rezoned to encourage higher quality industrial and commercial development near the proposed Exit 4A. There are also residential areas south of Folsom Road and North High Street that might be re-zoned to Industrial/Commercial zoning. The Derry staff indicated Exit 4A could have an effect on the timing and intensity of development/redevelopment in this small industrial-zoned area. Effects on commercial/industrial development in other areas of the Town are not anticipated. The commercial zoning district along the southern end of Rockingham Road (Route 28) was revised in 2013, and there has been some commercial development in that area. In addition, water and sewer services are being expanded along Rockingham Road (Route 28) to continue to encourage commercial development along that corridor.

Although there are no large parcels suitable for large-scale developments, there is a 13-apartment building of market rate apartments planned near the central business district. The staff indicated on the maps provided where the areas had been rezoned to encourage commercial and industrial development as well as the limits of municipal water and sewer service (Attachment C). Beyond the eastern limits of water service, there are private water companies that tie into the Town, but there is no sewer service. The limits of water and sewer service, the lack of large parcels, and the topography in the eastern portion of Derry, serve to limit development. Lot size requirements and conserved land are also factors constraining any major single-family home developments in Derry. Due the large number of development constraints, Derry staff suggested that any indirect impacts of Exit 4A on residential development would be more likely to occur in other outlying towns such as Chester, Auburn and Sandown.

The Granite State Future Project is the latest in comprehensive planning for Derry, and the Town's comprehensive plan will most likely be updated in 2020.

Community and Quality of Life

Derry is considered a large town in New Hampshire, yet it still maintains its small town, cohesive character. There is a good sense of community in Derry. The staff cited a recent election to overturn austere budget cuts because the residents want a "full-service" community – for example, they want police and fire service, rather than a volunteer fire department.

The quality of life has improved in Derry over the last 25 years. The growth management ordinance was successful in limiting development, and Derry no longer suffers issues associated with explosive growth (e.g., overcrowded schools). Although some of the retail development Derry used to have is no longer present, the downtown is starting to be revitalized, and the Manchester Road/Crystal Avenue area is beginning to redevelop. There are sufficient plans and policies in place – zoning, capital improvements plan – to maintain Derry's quality of life in the future.

The staff stated that the Exit 4A project would have no effect on the provision, financing, or accessibility of community services. The primary benefit to Derry would be reduced traffic congestion through Downtown, although as noted previously above, some believe that a reduction in traffic downtown has the potential for negative effects on existing businesses.

~~Future~~ future land use

95
Vol II

POPULATION PROJECTIONS

Municipality	2000	2010	2015		2020		2025		2030	-	2035	-
	Census	Census	OEP	SNHPC	OEP	SNHPC	OEP	SNHPC	OEP	SNHPC	OEP	SNHPC
Auburn	4,682	4,953	5,006	5,137	5,117	5,288	5,229	5,519	5,320	5,712	5,366	5,983
Bedford	18,274	21,203	22,449	22,242	23,967	23,243	24,473	24,121	24,859	24,816	25,061	25,409
Candia	3,911	3,909	3,834	4,191	3,799	4,420	3,883	4,601	3,950	4,726	3,985	4,810
Chester	3,792	4,768	5,204	5,097	5,717	5,404	5,842	5,711	5,944	5,982	5,996	6,239
Deerfield	3,678	4,280	4,524	4,571	4,828	4,839	4,935	5,114	5,020	5,344	5,064	5,561
Derry	34,021	33,109	31,991	33,881	31,189	34,400	31,876	34,931	32,429	35,195	32,711	35,416
Goffstown	16,929	17,651	17,774	18,171	18,084	18,663	18,467	19,162	18,757	19,583	18,910	19,942
Hooksett	11,721	13,451	14,028	14,159	14,713	14,809	15,074	15,431	15,381	15,961	15,565	16,432
Londonderry	23,236	24,129	24,154	25,132	24,453	26,082	24,991	27,267	25,425	28,438	25,646	29,925
Manchester	107,006	109,565	109,308	112,395	110,163	114,895	112,493	117,555	114,263	119,351	115,191	120,724
New Boston	4,138	5,321	5,872	5,582	6,502	5,796	6,639	6,120	6,744	6,403	6,799	6,795
Raymond	9,674	10,138	10,197	10,593	10,373	11,424	10,601	11,918	10,785	12,261	10,879	12,705
Weare	7,776	8,785	9,192	9,497	9,708	10,183	9,913	10,857	10,069	11,464	10,151	12,013
Windham	10,709	13,592	14,890	14,502	16,408	15,320	16,769	16,239	17,060	17,061	17,208	17,774
Total	**259,547**	**274,854**	**278,423**	**285,151**	**285,021**	**294,765**	**291,185**	**304,548**	**296,006**	**312,296**	**298,532**	**319,725**

DERRY COOPERATIVE SCHOOL DISTRICT #1
FACILITIES COMMITTEE MEETING

May 27, 2015
6:30 PM

AGENDA

- **Welcome**
- **Population Presentation: George Sioras**
- **Facilities/Space Presentation: Jane Simard and Gary Webster**

NEXT MEETING: June 8th and June 24th at 6:30 PM at West Running Brook Middle School.

As we move forward all requests for information will be made through the facilitator. This will be an important process to observe to ensure the process runs as smoothly as possible. The Facilitator will be Dr. John Moody. Dr. Moody can be reached at jhmschool@comcast.net.

George Sioras

From: George Sioras
Sent: Wednesday, June 24, 2015 10:09 AM
To: Dan McKenna (84mckenna@gmail.com); CHarper@pinkertonacademy.org; debcovino@gmail.com
Cc: jhmschool@comcast.net; Laura Nelson; George Sioras
Subject: Population/Growth-Town of Derry Planning Department summary for subcommittee-Facilities Committee

A component of our subcommittee's work was to review future population growth and demographics in the town. Reviewing the growth patterns from the past 50 years as well the current development in town and a future build-out including the expansion of Interstate 93 and the potential Exit 4A, our subcommittee came to the conclusion the growth rate has peaked for the town and will most likely not peak again and how these changes would impact the school system.

Several factors have and will continue to have an impact on the future school population. The primary change has been in the zoning for the town. Zoning changes that began in the late 1990s now have lowered the density for single family lot sizes throughout town. Where in the past most of the town allowed for one-acre lots the requirement today is for one, two, and three-acre minimum lot size for single-family housing. This change has significantly lowered the number of new homes being built in comparison to the large housing developments of the 1960s, 1970s, and 1980s.

Another more recent zoning change has been in the reduction of the density of multi-family apartments, townhouses, and condominiums. As the town saw large scale multi-family developments beginning in the 1960s through the 1980s the most recent zoning change this past year has significantly reduced the density allowance for this type of housing. This zoning has and will significantly alter future multi-family housing particularly in the older, more compact neighborhoods of West Derry and the Downtown area which is serviced by municipal sewer and water and is a mandatory requirement in the zoning that multi-family housing shall be connected to the town's utility systems.

A third reason for less population in the future is the changing demographics of both the town and state. Our demographics show an aging population which is reflected in both the 2000 and 2010 Census. Both state and regional planning agencies who monitor and project future growth patterns see this aging population trend to continue well into the future over the next three decades as well as a smaller growth rate in the younger population age group from birth up to young adulthood.

A final factor contributing to the lower population growth of the town since the 1990s has been the preservation of open space, purchase of parcels of land and easements which reduces the amount of land that would have been potentially a housing development.

As is highlighted in the Town's 2010 Master Plan which was adopted by the Planning Board the demographic and socio-economic trends that face a community are generally the keystone to the major decisions that need to be made in regards to issues such as economic development, land use, housing and growth and thus in turn impact the school system as well.

January 2014 to present

Apartments/Townhouses Approved

26232	20 townhouses	Floyd School/Highland Avenue
23016	9 townhouses	Brook Street
24037	18 apartments	Magnolia Lane/Kendall Pond
27137	5 townhouses	Barka – South Avenue
(also 30012 & 30013)		
24005	13 Apartments	Keystone Bldrs – Kendall Pond Road

65 Units
34 townhouses
31 apartments

Lots Approved

04094	Sederquist	1 lot	Whitney's Grove Road
05074	Murdoch	1 lot	Lane Road
04038-005	Mark Young	1 lot	Gulf Road
08066 & 08067	Solomini	1 lot	Tsienneto Road
09045	Donahue	8 lots	Beaver Lake Road and Old Chester Road
04075	Cella	2 lots	Cella Drive
04084	BR-10	11 lots	Gulf Road/Bartlett Road

25 lots, single family residential

Completed

10024/10015	Harvest Estates	30 lots	Hampstead Road/Harvest Drive

Single family residential

55+ Housing

02020	Bunker Estates	115 Units	Fordway	almost completed
04003	Indian Hill Estates	26 Units	Kilrea Road	

ZONING

DERRY, NEW HAMPSHIRE

Effective Date 06/06/2014

Zones

IND1-INDUSTRIAL I	MHDR-MEDIUM/HIGH DENSITY RESIDENTIAL
IND II-INDUSTRIAL II	GC-GENERAL COMMERCIAL
IND III-INDUSTRIAL III	GC2-GENERAL COMMERCIAL II
IND IV-INDUSTRIAL IV	GC3-GENERAL COMMERCIAL III
IND V-INDUSTRIAL V	CBD-CENTRAL BUSINESS DISTRICT
IND VI-INDUSTRIAL VI	MFR-MULTI-FAMILY RESIDENTIAL
LDR-LOW DENSITY RESIDENTIAL	MHPD-MANUFACTURED HOUSING PARK DEVELOPMENT
LMDR-LOW/MED DENSITY RESIDENTIAL	OBD-OFFICE BUSINESS DISTRICT
MDR-MEDIUM DENSITY RESIDENTIAL	OMB-OFFICE MEDICAL BUSINESS
MHDR II-MEDIUM HIGH DENSITY RESIDENTIAL	ORD-OFFICE RESEARCH AND DEVELOPMENT

DERRY, NEW-HAMPSHIRE
GEOGRAPHIC INFORMATION SYSTEM

OFFICE ADDRESS
438 Dubuque Street
Manchester, NH 03102
Phone: 603-669-4664
Fax: 603-669-4350
www.snhpc.org
Staff Directory

Please browse the various areas of this web site and give us your feedback on how we can serve you better.

For copies of meeting minutes and other related documentation, please contact SNHPC.

SNHPC

POPULATION

The SNHPC's 2010 population of 261,262 represents an increase of approximately 5 percent since 2000. This compares to New Hampshire's 6.5 percent increase from 2000 to 2010 and a 9.7 percent increase nationally. The SNHPC region had 106,829 total households in 2010. The tables below show the Region's historical and projected population growth.

Historic Population

Municipality	1960	1970	1980	1990	2000	2010
Auburn	1,292	2,035	2,883	4,085	4,682	4,953
Bedford	3,636	5,859	9,481	12,563	18,274	21,203
Candia	1,490	1,997	2,989	3,557	3,911	3,909
Chester	1,053	1,382	2,006	2,691	3,792	4,768
Deerfield	714	1,178	1,979	3,124	3,678	4,280
Derry	6,987	11,712	18,875	29,603	34,021	33,109
Goffstown	7,230	9,284	11,315	14,621	16,929	17,651
Hooksett	3,713	5,564	7,303	9,002	11,721	13,451
Londonderry	2,457	5,346	13,598	19,781	23,236	24,129
Manchester	88,282	87,754	90,936	99,332	107,006	109,565
New Boston	925	1,390	1,928	3,214	4,138	5,321
Raymond	1,867	3,003	5,453	8,713	9,674	10,138
Weare	1,420	1,851	3,232	6,193	7,776	8,785
Total	121,066	138,355	171,978	216,479	248,838	261,262
Sources: 1960-2010 Population from the U.S. Census						

Population Projections

Municipality	2010	2015	2020	2025	2030	2035	2040	2045	2050
Auburn	4,953	5,137	5,288	5,519	5,712	5,983	6,226	6,569	6,937
Bedford	21,203	22,242	23,243	24,121	24,816	25,409	25,886	26,226	26,689
Candia	3,909	4,191	4,420	4,601	4,726	4,810	4,855	4,896	4,949
Chester	4,768	5,097	5,404	5,711	5,982	6,239	6,437	6,613	6,759
Deerfield	4,280	4,571	4,839	5,114	5,344	5,561	5,740	5,888	6,061
Derry	33,109	33,881	34,400	34,931	35,195	35,416	35,215	34,821	34,473
Goffstown	17,651	18,171	18,663	19,162	19,583	19,942	20,142	20,301	20,435
Hooksett	13,451	14,159	14,809	15,431	15,961	16,432	16,790	17,113	17,157
Londonderry	24,129	25,132	26,082	27,267	28,438	29,925	31,477	33,354	35,435
Manchester	109,565	112,395	114,895	117,555	119,351	120,724	121,235	121,960	122,723
New Boston	5,321	5,582	5,796	6,120	6,403	6,795	7,201	7,578	7,990
Raymond	10,138	10,593	11,424	11,918	12,261	12,705	13,000	13,427	13,767
Weare	8,785	9,497	10,183	10,857	11,464	12,013	12,472	12,888	13,275
Total	261,262	270,650	279,446	288,308	295,235	301,951	306,675	311,634	316,650
Sources: 2010 U.S. Census, SNHPC Population Projections									

A PDF file of additional tables and charts related to population growth in the SNHPC region is also available to download.

Additional tables and charts related to population growth in the SNHPC region is also available here.

Back to Top

Chapter 2
DEMOGRAPHIC TRENDS

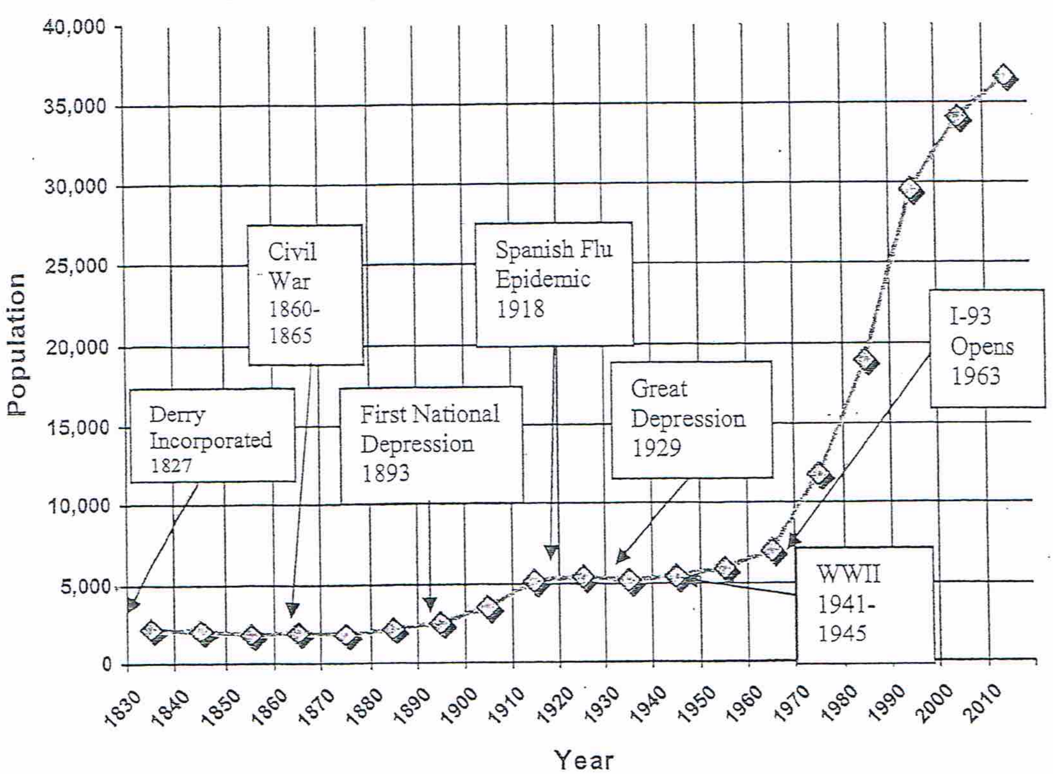
2.0 INTRODUCTION

The demographic and socio-economic trends that face a community are generally the keystone to the major decisions that need to be made in regards to issues such as economic development, land use, housing and growth.

This chapter will focus on all the different aspects of demographic trends, Population, Housing and Economic development. Comparisons between other towns, the county and the state will provide context and understanding of how Derry is doing overall within the region.

2.1 POPULATION GROWTH TRENDS

Figure 2.1: Historical Population, Town of Derry



2.2 POPULATION GROWTH PROJECTIONS

There are an estimated 34,071 people in Derry as of 2008 and with the expansion of I-93, Derry can expect to experience more growth in the coming years, with a projected population of 40,430 in 2030 according to the Office of Energy and Planning. It is important that we plan well for this anticipated growth so that it follows the goals and objectives the town has outlined and so the intensity, patterns, and mix of land uses create a well-balanced, healthy and sustainable community.

Table 2.3 below shows projected populations for Derry, the County, and the State from 2008 through 2030 from the New Hampshire Office of Energy and Planning (NH OEP). These projections are based on the 2000 census and local projections are based on a community's historical share of its respective county's growth.

Table 2.3: Growth Projections 2007-2030

	2008[2]	2010	2015	2020	2025	2030
Derry	34,071	36,560	37,860	38,980	39,730	40,430
Rockingham County	295,525	308,200	320,500	331,200	341,870	351,690
New Hampshire	1,315,000	1,365,140	1,420,000	1,470,010	1,520,310	1,565,040

Source: NH Office of Energy and Planning

Table 2.4 below shows a comparative analysis of the NH OEP projections and those done by the Southern New Hampshire Planning Commission (SNHPC). The Commission methodology includes more localized data and assumptions about the Town and its surrounding area than does the OEP Procedure. The Commission makes its projections based on natural growth and net migration. The differences in projections are different by about 1%, but because the Commission's procedures are more sensitive to local situations the use of these results are recommended.

Table 2.4: Comparative Projections for Derry, 2010 - 2030

	SNHPC	NH OEP	% Difference
2010	37,283	36,560	-1.02%
2015	35,406	37,860	0.94%
2020	36,471	38,980	0.94%
2025	38,101	39,730	0.96%
2030	39,998	40,430	0.99%

Source, NH OEP Projections, SNHPC Projections

[2] NH OEP Estimates

Derry, New Hampshire

The Population by Sex and Age

Females

Age Cohorts	Census 2000	Census 2010	Percent Change
0 to 4	1,164	952	-18%
5 to 9	1,471	986	-33%
10 to 14	1,550	1,150	-26%
15 to 19	1,216	1,285	6%
20 to 24	856	1,035	21%
25 to 29	1,162	1,005	-14%
30 to 34	1,462	986	-33%
35 to 39	1,834	1,219	-34%
40 to 44	1,679	1,418	-16%
45 to 49	1,398	1,640	17%
50 to 54	1,042	1,442	38%
55 to 59	619	1,118	81%
60 to 64	443	833	88%
65 to 69	358	520	45%
70 to 74	334	330	-1%
75 to 79	205	282	38%
80 to 84	111	227	105%
85+	240	246	3%
TOTAL	17,144	16,674	-3%

Males

Age Cohorts	Census 2000	Census 2010	Percent Change
0 to 4	1,268	948	-25%
5 to 9	1,599	1,076	-33%
10 to 14	1,446	1,304	-10%
15 to 19	1,307	1,376	5%
20 to 24	833	1,126	35%
25 to 29	1,160	921	-21%
30 to 34	1,372	957	-30%
35 to 39	1,782	1,128	-37%
40 to 44	1,642	1,300	-21%
45 to 49	1,374	1,564	14%
50 to 54	1,059	1,504	42%
55 to 59	781	1,104	41%
60 to 64	373	851	128%
65 to 69	272	563	107%
70 to 74	285	287	1%
75 to 79	158	177	12%
80 to 84	73	132	81%
85+	93	117	26%
TOTAL	16,877	16,435	-3%

Combined Total Population

Age Cohorts	Census 2000	Census 2010	Percent Change
0 to 4	2,432	1,900	-22%
5 to 9	3,070	2,062	-33%
10 to 14	2,996	2,454	-18%
15 to 19	2,523	2,661	5%
20 to 24	1,689	2,161	28%
25 to 29	2,322	1,926	-17%
30 to 34	2,834	1,943	-31%
35 to 39	3,616	2,347	-35%
40 to 44	3,321	2,718	-18%
45 to 49	2,772	3,204	16%
50 to 54	2,101	2,946	40%
55 to 59	1,400	2,222	59%
60 to 64	816	1,684	106%
65 to 69	630	1,083	72%
70 to 74	619	617	0%
75 to 79	363	459	26%
80 to 84	184	359	95%
85+	333	363	9%
TOTAL	34,021	33,109	-3%

MEDIAN AGE

Both sexes	33.6	38.2	14%

THE POPULATION 18 YEARS AND OVER

Total:	23767	24942	5%
Male	11681	12213	5%
Female	12086	12729	5%

THE POPULATION 21 YEARS AND OVER

Total:	22611	23659	5%

THE POPULATION 62 YEARS AND OVER

Total:	2590	3839	48%
Persentage in Total Population	8%	12%	4%

THE POPULATION 65 YEARS AND OVER

Total:	2103	2881	37%
Male	865	1276	48%
Female	1238	1605	30%
Percentatge in Total Population	6%	9%	3%

RACE

Total:	34021	33109	-3%
Population of one race:	33635	32538	-3%
White	32676	31301	-4%
Black or African American	305	326	7%
American Indian and Alaska Native	71	80	13%
Asian:	362	513	42%
Asian Indian	114	169	48%
Chinese	73	119	63%
Filipino	31	51	65%
Japanese	22	21	-5%
Korean	68	56	-18%
Vietnamese	26	25	
Other Asian	28	72	
Native Hawaiian and Other Pacific Island	16	12	
Native Hawaiian	10	8	
Guamanian or Chamorro	1	4	
Samoan	0	0	
Other Pacific Islander	5	0	
Some Other Race	205	306	49%
Population of Two or More Races	386	571	48%

RACE (TOTAL RACES TALLIED)

White alone or in combination with one or more other races	33032	31846	-4%
Black or African American alone or in combination with one or more other races	399	507	27%
American Indian and Alaska Native alone or in combination with one or more other races	189	261	38%
Asian alone or in combination with one or more other races	460	659	43%
Native Hawaiian and Other Pacific Islander alone or in combination with one or more other races	19	28	47%
Some Other Race alone or in combination with one or more other races	337	403	20%

HISPANIC OR LATINO BY SPECIFIC ORIGIN

Total:	34021	33109	-3%
Hispanic or Latino (of any race):	643	1080	68%
Mexican	94	177	88%
Puerto Rican	223	372	67%
Cuban	29	46	59%
Other Hispanic or Latino	297	485	63%
Not Hispanic or Latino	33378	32029	-4%

RELATIONSHIP

Total:	34021	33109	-3%
In households:	33790	32907	-3%
Householder	12327	12537	2%
Spouse	6948	6569	-5%
Child	11701	10411	-11%
Own child under 18 years	9669	7469	-23%
Other relatives	1049	1446	38%
Under 18 years	363	534	47%
Nonrelatives	1765	1944	10%
Unmarried partner	933	1106	19%
In group quarters:	231	202	-13%
Institutionalized population:	160	150	
Noninstitutionalized population:	71	52	-27%

Derry, New Hampshire

The Population by Sex and Age

Females

Age Cohorts	Census 2000	Census 2010	Percent Change
0 to 4	1,164	952	-18%
5 to 9	1,471	986	-33%
10 to 14	1,550	1,150	-26%
15 to 19	1,216	1,285	6%
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65 to 69	272	563	107%
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Combined Total Population

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THE POPULATION 62 YEARS AND OVER

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THE POPULATION 65 YEARS AND OVER

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Female	1238	1605	30%
Percentatge in Total Population	6%	9%	3%

RACE

Total:	34021	33109	-3%
Population of one race:	33635	32538	-3%
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Asian:	362	513	42%
Asian Indian	114	169	48%
Chinese	73	119	63%
Filipino	31	51	65%
Japanese	22	21	-5%
Korean	68	56	-18%
Vietnamese	26	25	
Other Asian	28	72	
Native Hawaiian and Other Pacific Islande	16	12	
Native Hawaiian	10	8	
Guamanian or Chamorro	1	4	
Samoan	0	0	
Other Pacific Islander	5	0	
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Total:	34021	33109	-3%
Hispanic or Latino (of any race):	643	1080	68%
Mexican	94	177	88%
Puerto Rican	223	372	67%
Cuban	29	46	59%
Other Hispanic or Latino	297	485	63%
Not Hispanic or Latino	33378	32029	-4%

RELATIONSHIP

Total:	34021	33109	-3%
In households:	33790	32907	-3%
Householder	12327	12537	2%
Spouse	6948	6569	-5%
Child	11701	10411	-11%
Own child under 18 years	9669	7469	-23%
Other relatives	1049	1446	38%
Under 18 years	363	534	47%
Nonrelatives	1765	1944	10%
Unmarried partner	933	1106	19%
In group quarters:	231	202	-13%
Institutionalized population:	160	150	
Noninstitutionalized population:	71	52	-27%

George Sioras

From: George Sioras
Sent: Monday, May 16, 2016 9:29 AM
To: Susan Hickey; Barbara Chapman
Cc: Stephen Daly
Subject: RE: Questions for Moody's

Hi Sue,

Here is the information regarding development over the last 18 months. The past two years have been the most busy in the Planning and Building Departments since 2008. I have highlighted various projects and the status of them as well listed the number of new building lots approved by the Planning Board and permits issued by the Building Department. As you will see it has been steady in our departments. In the past we have forwarded this information to the folks at Moody's in advance so when they call in and have asked me questions they have the information in advance which is helpful Just a suggestion.

George

Non-residential development.

1. 72,000 sf self-storage facility-under construction.
2. 45.000 sf self-storage facility-work to begin this summer.
3. Auto custom exhaust garage-work to begin this summer.
4. Cumberland Farms expansion and store façade improvements-completed.
5. 16-bed Assisted Living Facility-under construction.
6. 7,000 sf addition to an Industrial building/summer beach products-work to begin this summer.
7. New landscaping business-under construction.
8. 40,000 sf retail development, Crystal Place, Phase I site work-work to begin this summer.
9. 34,000 sf retail development, Cowbell Corner, Phase I gas station/convenience store-under construction.

Residential development.

1. 65 units of townhouse and apartments which includes 34 townhouses and 31 apartments. All are under construction
2. 40 new single-family house lots approved by the Planning Board. In various stages of permitting.
3. Building-Code Enforcement Office issued 26 residential permits for 2015 and so far to May, 2016, 46 permits will have been issued.

There has been a couple of new economic development initiatives this past year. The Town has extended municipal water and sewer to Route 28 (Rockingham Road) which is a major arterial road which is zoned Commercial with the hope of expanding the town's tax base with future development in this part of town. Also the town has recertified and expanded our existing Economic Revitalization Zones located on Route 28, Manchester Road and Crystal Ave. which incorporate our largest commercial and industrial districts of the town. These zones encourage development and redevelopment opportunities that improve infrastructure and create jobs. New and expanding businesses in these areas are eligible to apply for tax credits against the NH Business Profits Tax and/or the Business Enterprise Tax as administered by the State of New Hampshire Department of Resources and Economic Development.

Lastly, the school enrollment continues to see yearly decreases in the student population and is projected to continue into the next five years. I am a member of the School District's Facilities Study Committee and the Committee has spent the last year and a half looking at the district's need for the future. A final report is expected to be completed in June, 2016, and presented to the School Board. In general the enrollment decline is reflective to many communities in New Hampshire which is an aging state, smaller population growth from past decades and less children being born. Even with the residential development cited above the enrollments numbers will not match previous enrollment numbers from the high residential development rates seen during the 1970, 1980s, and 1990s both in Derry and the State of New Hampshire.

From: Susan Hickey
Sent: Friday, May 13, 2016 9:20 AM
To: Barbara Chapman; George Sioras
Subject: Questions for Moody's

Good morning,

Please have all information ready for our Moody's interview by Tuesday morning.

Thanks,
Sue

Susan A. Hickey
Chief Financial Officer
Town of Derry, NH
14 Manning Street
Derry, NH 03038
(603) 845-5421

DERRY COOPERATIVE SCHOOL DISTRICT ENROLLMENT PROJECTIONS 5 Year Average Method

Grade	15-16 (Actual)	16-17	17-18	18-19	19-20	20-21
K	299	263	253	253	262	258
1	342	320	320	308	308	319
2	357	332	315	315	303	303
3	397	353	340	322	322	310
4	381	390	353	340	322	322
5	381	384	394	356	343	325
6	385	383	392	402	363	350
7	410	393	391	400	410	371
8	433	405	400	398	407	417
Total K-8	3385	3223	3158	3094	3040	2975

Total K-5	2157	2042	1975	1894	1860	1837
Total 6-8	1228	1181	1183	1200	1180	1138

From:	George Sioras
To:	Snyder, Kerri; Elizabeth Robidoux; Mike Fowler
Cc:	Tidd, Leo; Chris Bean; Hodgson (Rydland), Laura; I93-Exit4A-EIS (SM)
Subject:	RE: I-93 Exit 4A: Possible Industrial Development in Derry
Date:	Thursday, September 15, 2016 7:40:37 AM

Good Morning Kerri,

The revisions look great. I will also keep you updated as we move along with the potential zoning amendments with the Planning Board and Town Council. Thanks.

George

From: Snyder, Kerri [mailto:KSnyder@louisberger.com]
Sent: Wednesday, September 14, 2016 6:44 PM
To: George Sioras; Elizabeth Robidoux; Mike Fowler
Cc: Tidd, Leo; Chris Bean; Hodgson (Rydland), Laura; I93-Exit4A-EIS (SM)
Subject: RE: I-93 Exit 4A: Possible Industrial Development in Derry

George,
Based on our conversation on September 13, attached is a revised map showing the parcels in the vicinity of Alternative A that have been recently rezoned as Industrial 4 (north side of Folsom Road), developed parcels zoned as Industrial 6 (south side of Folsom Road), and parcels currently zoned as Medium High Density Residential that will be studied in the coming months to determine if they should be rezoned to Industrial 4 or Industrial 6.

It is my understanding that the Town Council is anticipated to ask the Planning Board to undertake a study of whether or not these parcels should be rezoned. The request is likely to come in late September, and the study would likely take about one year to complete.

I appreciate your review of and comments on the attached map and the information provided in this e-mail regarding the upcoming study.

Regards,
Kerri

From: Snyder, Kerri
Sent: Tuesday, September 06, 2016 2:12 PM
To: 'George Sioras' <georgesioras@derrynh.org>; 'Elizabeth Robidoux' <elizabethrobidoux@derrynh.org>; 'Mike Fowler' <mikefowler@derrynh.org>
Cc: Leo Tidd (ltidd@louisberger.com) <ltidd@louisberger.com>; Chris Bean <ChrisB@cldengineers.com>; Laura Hodgson (Rydland) (lhodgson@louisberger.com) <lhodgson@louisberger.com>; I93-Exit4A-EIS (SM) (I93-Exit4A-EIS@louisberger.com) <I93-Exit4A-EIS@louisberger.com>
Subject: I-93 Exit 4A: Possible Industrial Development in Derry

George, Liz, and Mike,
Based on our interview on July 26, 2016, we understand that the Town of Derry anticipates that

recently rezoned parcels along Folsom Road north of High Street may be redeveloped if Alternative A remains the preferred alternative for Exit 4A.

Attached is a map showing parcels, zoning, and the 2007 DEIS alignments for Alternatives A and B for your review and comment. Would you please comment on or confirm the following?

- The extent of the existing industrial parcels that could experience development or redevelopment as a result of Exit 4A.
- The extent of the existing residential parcels that could be rezoned as industrial to take advantage of the connector road frontage access to Exit 4A.
- List or mark-up the map to let us know of any parcel numbers that should be added or deleted based on what is shown in the attached map.

The results will be used to help identify industrial development that could be induced by the proposed project and will be included in the Land Use Scenarios Technical Report.

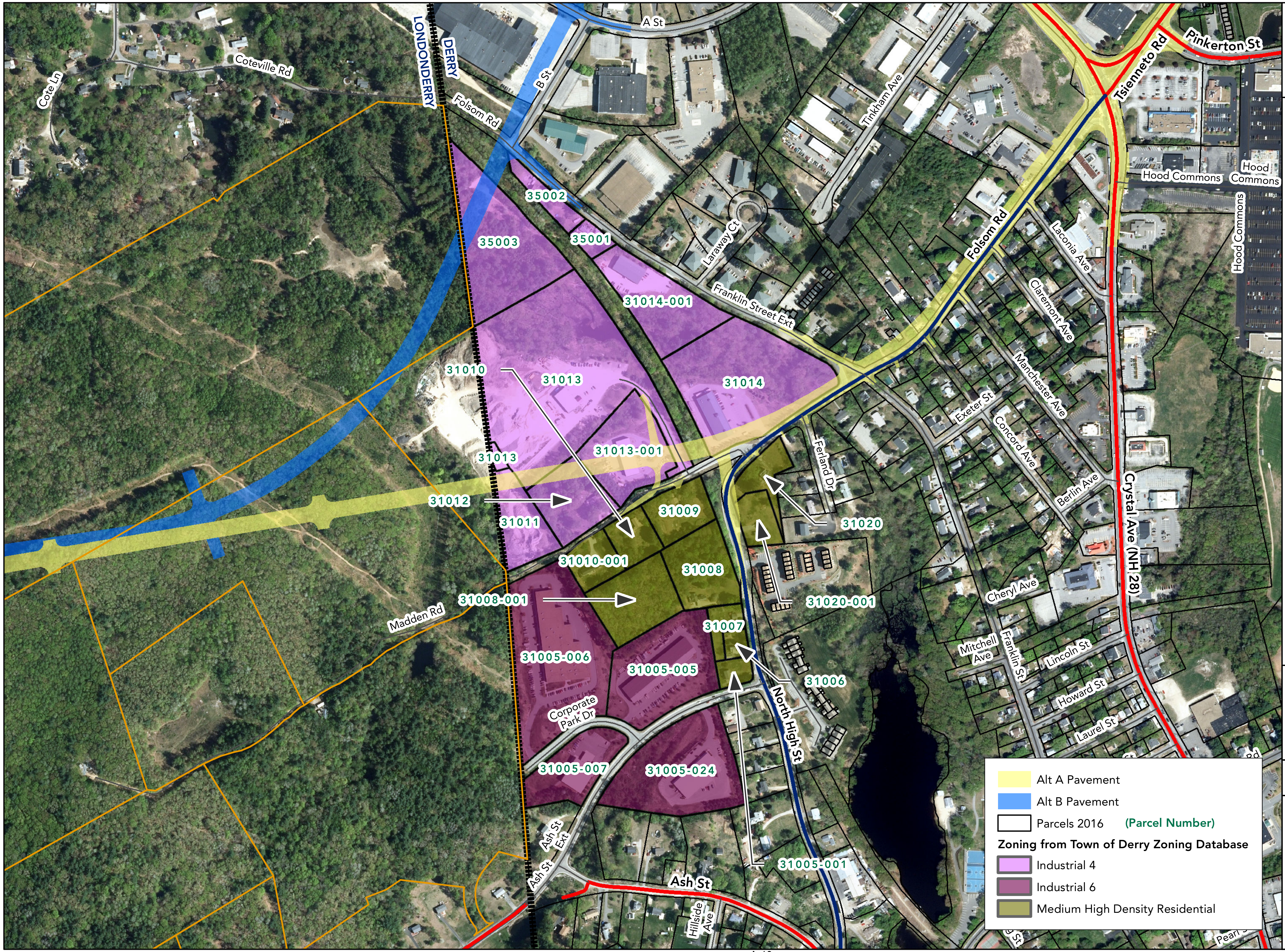
If you think a discussion is in order, please let me know what dates and times work for you, and I can call you to discuss the map and possible redevelopment in more detail. Thank you for your time in reviewing the map and providing input as we develop the Build and No Build Scenarios for the technical report.

Regards,
Kerri

Kerri Snyder, AICP
Principal Environmental Planner | Transportation Planning and Environment
Louis Berger
48 Wall Street, 16th Floor | New York | NY | 10005 | USA
direct +1-212-612-7908
mobile +1-646-584-9490
email ksnyder@louisberger.com
web louisberger.com

I-93 Exit 4A

Zoning Redevelopment Area
Revised Map September 14



Town Boundaries
Parcels 2016
Major Roads
Minor Arterial
Major Collector
Local Road
Woodmont Commons

0 145 290 580 Feet

Sources:
CLD Engineers
Town of Derry GIS
Town of Londonderry GIS
New Hampshire DOT

Coordinate System: NAD 1983 StatePlane New Hampshire (feet)	Date: September 14, 2016

New Hampshire DOT Department of Transportation

I-93 Exit 4A Supplemental Environmental Impact Statement

Land Use Planner Interview Summary Final - 8/8/2016

Town of Londonderry

Following is a summary of the interview held on July 25, 2016 at the Town of Londonderry office. Attendees were as follows:

- Town of Londonderry – Colleen Mailloux and John Vogl
- Louis Berger – Leo Tidd and Kerri Snyder
- RKG Associates – Craig Seymour

Population and Employment

There was a general discussion of SNHPC's population projections and the towns input. The SNHPC projections include a straight-line assumption. Although, Londonderry is currently in a growth phase, the planners believe the 2020 population projection (31,688) included in the Town's 2013 Comprehensive Plan is ambitious.

The Pettengill Road development is industrial and would not contribute to population growth. The Woodmont Commons development has a large residential share and would help push the town toward the 2020 population projection of 31,668. If Woodmont Commons were not built out, the Town's population would likely be lower than projected though it is understood that other projects would likely take its place on the same parcels.

The Town participated in reviewing SNHPC's population projections presented in the 2013 Comprehensive Plan; however, to date, they have not reviewed any subsequent projections. The I-93 Exit 4A project would contribute to growth by providing access to undeveloped land on the east side of I-93. Such growth is understood to be generally non-residential in nature.

Transportation

The Exit 4A project would provide access to the eastern portion of Woodmont Commons. Woodmont Commons will be making some transportation improvements on the west side based on the Development Agreement for Phases I and II. Phase I includes five restaurants, an entertainment venue, and commercial/retail space with residential units on the higher floors. The design plans for Phase I are located on the Town's website.[1] Phase II is planned to expand upon the development built during Phase I and would include additional single-family residential areas and additional commercial uses west of I-93. These phases of Woodmont Commons would proceed regardless of the Exit 4A project. The planners provided the Woodmont Commons traffic study for Phases I and II of the development (Traffic Impact and Access Study – Woodmont Commons PUD Phases I and II, June 2016). As part of the Development Agreement, the agreed upon transportation improvements would be paid for by the developer prior to receiving building permits.

[1] http://www.londonderrynh.org/Pages/LondonderryNH_BComm/Planning/projectsunderreview/

The Town does not have other major transportation projects planned. Based on the planning process for the 2013 Comprehensive Plan, bicycle and pedestrian trail connectivity is a high priority for the community, including the potential regional trail crossing near the eastern extent of the Exit 4A preferred alternative alignment. This is a vital link connecting trail networks in both Londonderry and Derry. At this time, no bicycle trails outside of the PUD study area are in development. However, the Woodmont Commons PUD states that accommodations for bicycles will be provided along or parallel to the Primary Street Network of the development and that shared use of streets will be permitted for all other portions of the development.

Exit 4A would not substantially alter travel times on the west side of I-93; it may improve the travel times on roadways east of I-93, including Pillsbury Road/Ash Street (two-lane facility). The planners do not anticipate major changes in travel patterns or transportation needs for Londonderry associated with the Exit 4A project.

Development and Land Use

Since 2000, the explosive growth experienced in the 1980s and 1990s has slowed, and the current development trends are based on access to undeveloped or underdeveloped land and presence or absence of municipal services (water/sewer), which affects the density of development. For example, the industrial development occurring on Pettengill Road is driven by undeveloped land with access to Raymond Weiczorek Drive (Manchester Airport Access Road). It is not affected by the Exit 4A project. The planners indicated limits of municipal water and sewer access on the maps provided to indicate the limits for higher density development (Attachment B). The planners also indicated on the maps provided the most likely locations in Londonderry for growth outside of the planned Woodmont Commons area. On the east side of I-93, Exit 4A would likely affect the timing and type of growth – the interchange and connector road would provide access and opportunity for commercial, institutional and higher density residential development.

The Woodmont Commons development density with and without Exit 4A was discussed, and the planners indicated that the "without Exit 4A" scenario presented in the approved 2013 PUD was based on design review meetings that included Town staff, project engineers/planners and the Town's review consultant. Thus, the PUD with and without 4A scenarios should not be construed as projections of growth, but rather provide an upper cap on the maximum amount of development that could occur. This explains why less commercial development is allowed on the west side of I-93 without Exit 4A than with Exit 4A, even though Exit 4A would provide no westerly access.

With regard to development associated with Build Alternatives A, B, C, D, and F, the planners stated that growth in Londonderry under Alternatives C and D would be more in line with a No Build Alternative in that they would not provide access to the parcels planned to be developed by Woodmont Commons for commercial and/or institutional use. Given the easterly-only access of Exit 4A, development of the interchange will likely have little effect on the job growth or attraction of industries to the west of I-93. The effects would most likely be experienced east of I-93.

To promote the villages and corridors growth scenario outlined in the 2013 Comprehensive Plan, the planners indicated that higher density development along the transportation corridor is generally acceptable, and the development permitting process allows the villages and corridors growth scenario to happen organically. While the Town is undertaking a zoning update, the planners do not foresee major changes to the way that parcels are currently zoned.

Community and Quality of Life

The Town of Londonderry has retained its rural character as it has grown into more of a suburban rural community with high quality schools and rising property values. The industrial development in the northwestern portion of the Town (near the airport) is distribution-based and has increased in value as technology has improved. Through the master planning process, the Town committed to keep the residential areas as residential. Londonderry aims to improve connectivity of its open space and recreational resources by adding bicycle and pedestrian trails.

Exit 4A would provide the opportunity for commercial development, and as a result, an enhanced tax base. The planners indicated that the Exit 4A project would not result in net negative effects on the quality of life or community character because the development impacts will be mitigated through the requirements of the development agreement and the PUD (e.g. traffic mitigation measures as additional phases go through site plan review). Exit 4A would have no effect on the provision, financing, or accessibility of community services.

From:	Snyder, Kerri
To:	"Colleen Mailloux"
Cc:	Leo Tidd (ltidd@louisberger.com); Chris Bean; Laura Hodgson (Rydland) (lhodgson@louisberger.com); I93-Exit4A-EIS (SM) (I93-Exit4A-EIS@louisberger.com)
Subject:	Market Basket redevelopment area
Date:	Tuesday, September 20, 2016 10:22:00 AM

Colleen,
Thank you for providing information regarding the four additional pad sites in the Market Basket redevelopment area. Based on your voicemail, I understand that the four pad sites have not been approved for development. Although they have currently been put aside, based on previous communications you have had with DeMoulas Supermarkets, Inc., it sounds like they have considered a combination of restaurant uses for three of the pads and bank/office/retail for the remaining pad. Based on this, it is possible that they could get about 20,000-30,000 gsf of commercial development from those four pads.

I appreciate your review of and comments on this information.

Regards,
Kerri

Kerri Snyder, AICP
Principal Environmental Planner | Transportation Planning and Environment
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direct +1-212-612-7908
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web louisberger.com

I-93 Exit 4A Supplemental Environmental Impact Statement

Land Use Planner Interview Summary- *Draft- 8/2/2016*

Southern New Hampshire Planning Commission

Following is a summary of the interview held on July 25, 2016 at the SNHPC office in Manchester. Attendees were as follows:

- SNHPC – Julie Chen, Adam Hlasny, and Jack Munn
- Louis Berger – Leo Tidd and Kerri Snyder
- RKG Associates – Craig Seymour

Population and Employment

SNHPC has provided whole-town and zonal (traffic analysis zone [TAZ]) population projections for Derry and Londonderry through 2050 using the cohort-component method. An overview of the SNHPC methodology is provided in a letter provided to the project team by SNHPC (see Attachment A: Letter to George Sioras dated March 14, 2012, regarding population and dwelling unit projections). To generate population cohort and dwelling unit projections for 5-year increments (e.g., 2015, 2020, 2025) for the TAZs, SNHPC uses the following information:

- Birth and death rates from NH Department of Health and Human Services
- Region survival rates using a life table derived from OEP
- SNHPC's own projection of net migration, four scenarios were analyzed (high, middle, low and historical average).
- available land within the TAZs
- housing information/building permits from the towns and OEP

The SNHPC provides letters to each of the Towns (see Attachment A) to gain their input on the population projections.

SNHPC also makes projections for employment based on quarterly employment averages from the State, compared to building permit data to estimate the number of jobs per square foot of non-residential development.

The methods used for the 2015 employment projections differ from those used for the 2010 population projections. The 2010 projections used an ELMI employer database to identify number of employees per company, which were then assigned to the appropriate TAZs; however, this information is not currently available for 2015.

The Moving Southern New Hampshire Forward Plan (2015) mentions I-93 Exit 4A being constructed by 2024, and the travel demand model includes the Exit 4A project as discussed in the following section. However, the SNHPC population projections do not consider additional growth associated with individual transportation or development projects (e.g., Exit 4A/Woodmont Commons). Rather, these population projections through 2050 are considered background growth.

Transportation

The Moving Southern New Hampshire Forward Plan (2015) considers individual projects that could affect regional transportation (e.g., I-93 widening) in developing the Future Build traffic volumes. As part of a scenario planning effort, the traffic modeling includes a Fast Build Scenario and a Continued Slow Growth Scenario on a regional level, and the individual projects that would contribute to higher traffic volumes (e.g. potential development induced by Exit 4A/Woodmont Commons, and Pettengill Road are considered to be captured in the Future Fast Build Scenario.

There was a general discussion of the proposed splitting of TAZs in Derry and Londonderry based on the proposed Woodmont Commons development. CLD Engineers proposed the splits (see Attachment B) and will provide additional input so that SNHPC can move forward with the 2015 base year updates for the SDEIS. The same TAZ structure will be used for the base year and all future analysis years.

SNHPC provided a technical report that documents the development and calibration of the 2010 travel demand forecast model (Attachment C).

Development and Land Use

Commercial and industrial growth is transportation based. I-93 Exit 4A could improve access for economic development; however, other factors including available land and zoning also play a role in the location of the development.

Expanding the Community Technical Assistance Program (CTAP) through I-93 is listed as a strategic initiative in the SNHPC Regional Plan. Phases I and II of the program were strategic initiatives. Phase III of the CTAP is pending and being coordinated with NHDOT. SNHPC is considering a town survey to gauge needs. For example, SHNPC is currently assisting the Town of Chester with its impact fees program. SNHPC wants to determine needs in the other towns it serves to find out how to make the CTAP most effective.

Regional Planning Activities

SNHPC’s 2015 Regional Comprehensive Plan has been released. Based on State statutes, the next official update of the comprehensive plan would be in 2020. The next SNHPC planning product will be the housing needs assessment.

Other Topics

SNHPC provided suggested contacts with other nearby towns for follow-up questions or information.

March 14, 2012

Mr. George Siroas, AICP, Director
Derry Planning Department
14 Manning Street
Derry, NH 03038

Re: Population and Dwelling Unit Projections

Dear Mr. Sioras:

The Southern New Hampshire Planning Commission (SNHPC) has completed the new population and dwelling unit projections for the region's towns and traffic zones. The projections look at the years 2010 - 2050. At this point, we would like to share our results with you for your review and comments.

The 2010 US Census counted population for Derry was 33,109. According to the SNHPC figures, the number of dwelling units in Derry was 13,277. The SNHPC projected population for 2050 is 34,437, an absolute change of 1,328 persons, and the projected number of dwelling units is 14,926, an absolute change of 1,649 units. These projections represent annual compound growth rates of 0.10 percent and 0.29 percent respectively. Please see the attached tables for details on a five-year basis.

The population projection was conducted using the Cohort Component Method. The actual births and deaths used were obtained from the NH Department of Health and Human Services, Bureau of Vital Records. The regional survival rates were calculated using life table derived from Office of Energy and Planning (OEP). The one variable generated by the SNHPC was the projected net migration. Using the past 40 years of net migration, we projected four possible future net migration outcomes: high, middle, low, and historical average. The most probable of the four was selected to generate the final projection; for Derry we used our low net migration projection.

Dwelling Units were projected based on the annual average of the past 40 years of Building Permits issued (1970 - 2009). The OEP figures from their "Current Estimates and Trends in New Hampshire's Housing Supply, Updates 1989, 1999 and 2009" were used along with "1970-1979 Estimates of Housing Supply for Towns and Counties in New Hampshire." The building permit data was analyzed and any years with atypical net dwelling unit increases were excluded from the calculation of the annual average. For Derry, the annual average of net dwelling unit increase used in the projection was 42.

Using the totals from the population and dwelling unit projections, the net increase expected for each projected five year increment was distributed to the various traffic zones. Please refer to the attached traffic zone map for the location of zone boundaries. General assumptions made in this process were that growth rates would remain constant in each traffic zone and zoning ordinances would not change significantly over the projected time span. More specific assumptions were made in determining the amount of growth each traffic zone would receive based on the existing zoning of vacant land, the quantity of vacant land, the location of wetlands, steep slopes, water bodies or other natural development constraints, the existing land use coverage, the planned development area from SNHPC Comprehensive Plan; and the known proposed developments.

In Derry, the following assumptions were made to distribute the dwelling unit increases to the individual traffic zones:

- Traffic zones 147, 128, 123, and 140 would receive the greatest share of dwelling units given the combination of higher density zoning and quantity of buildable residential land, and the residential construction trend of 1990 - 2010 was to build in these zones.
- Traffic zones 124, 125, 126, 221, 222, and 223 would receive the least amount of dwelling units due in the case of zone 125 to a lack of residential zoned land, and in the other zones there is little vacant land to support growth other than infill development, despite zoning for the highest densities allowed.

Distribution of population increases to the individual traffic zones were in proportion to dwelling unit increase in the individual traffic zones.

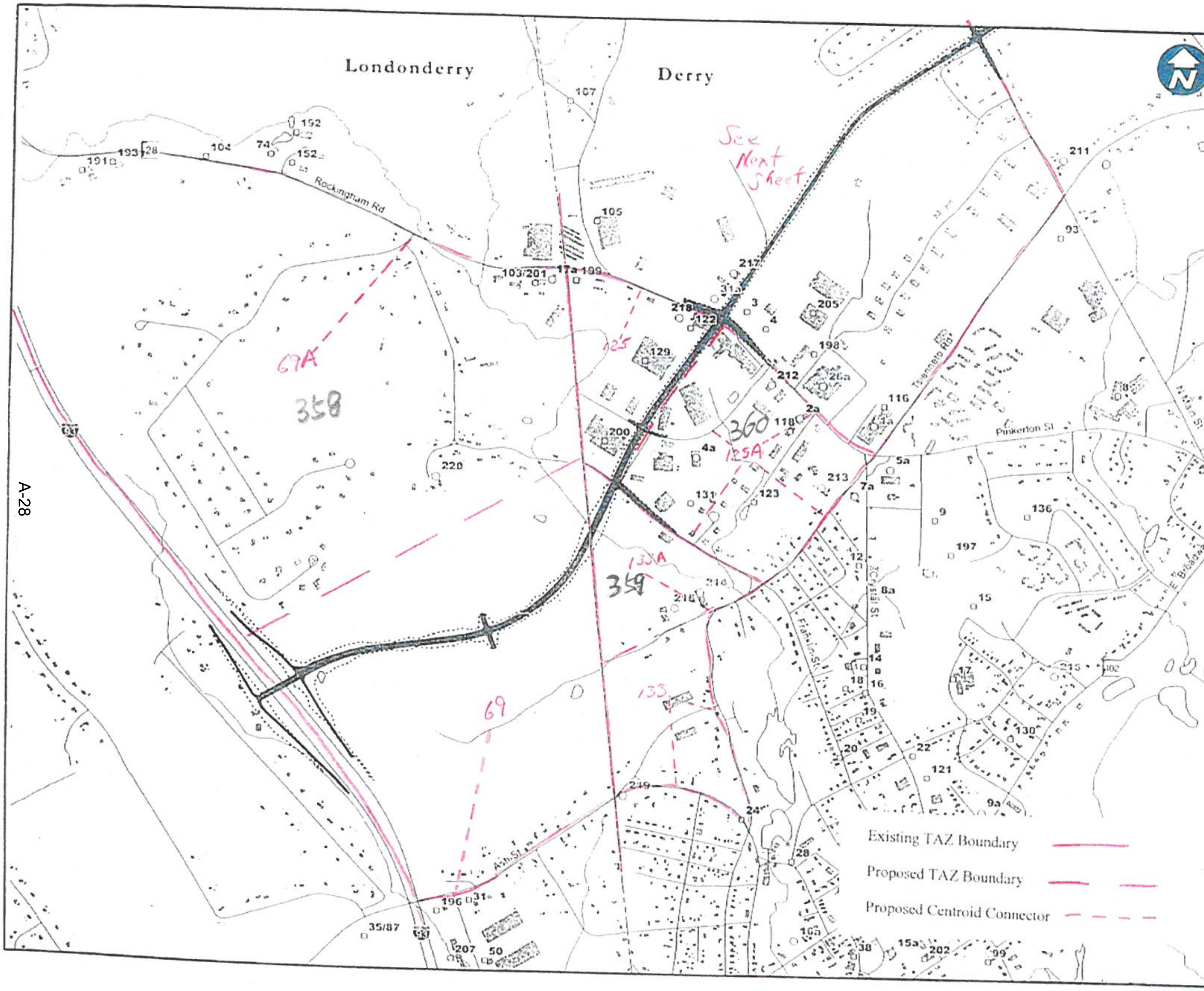
Please review the information in this letter along with the attached supporting tables. We greatly welcome your comments so that our projections will best reflect Derry's future growth. If you have comments or suggested revisions, please contact Julie Chen, Ph.D. within the next two weeks at (603) 669-4664 or jchen@snhpc.org. We would be happy to schedule an appointment to sit down with you and review the data in more detail. If we do not hear from you in the next three weeks, we will assume you are comfortable with our projections.

Sincerely,

SOUTHERN NEW HAMPSHIRE
PLANNING COMMISSION

David J. Preece, AICP
Executive Director/CEO

cc: SNHPC Representatives:
Ann Marie Alogni; Frank Bartkiewitz; Brian Chirichiello; Darrell Park.



I-93 Exit 4A Interchange Study
Draft Environmental Impact Statement

Figure 4.11-3
Potential Petroleum, Hazardous Materials Sites, and Solid Waste Sites for Alternative B

Legend

Hazardous Material Sites
- High
- Moderate/High
- Moderate
- Low
- Not Rated
- Area of Disturbance
- Proposed Pavement Layout
- Study Area
- Building
- Road
- Stream
- Town Boundary

Note

The Not Rated designation is meant to identify those locations that have not been ranked for hazardous materials concerns because the site was deemed (after conducting database research, windshield surveys and coordinating with the NHDOT Hazardous Materials Coordinator) to not warrant further review due to the site condition or physical location/distance from the remaining corridors.

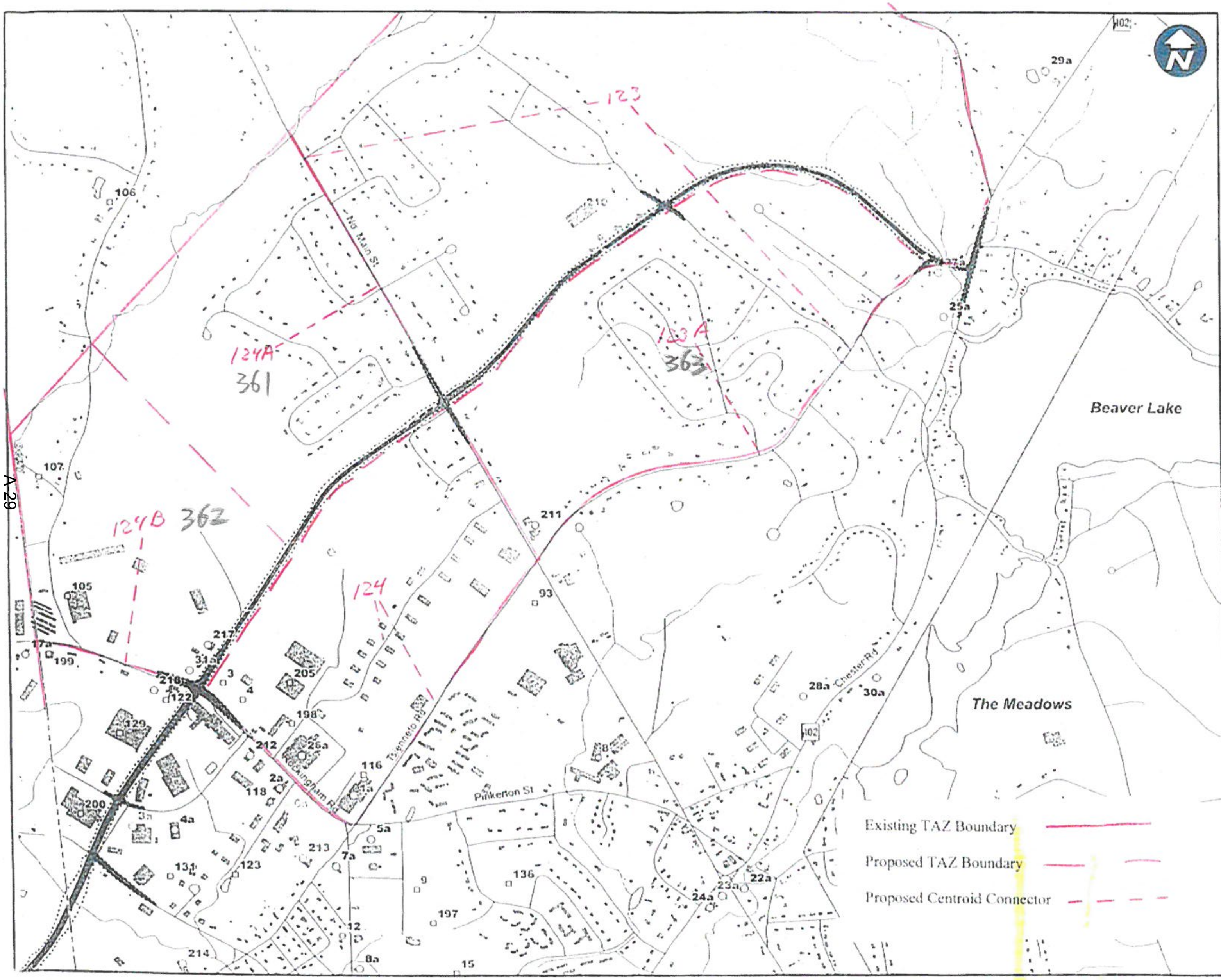
Data Sources

Hazardous material data were compiled by CLD Consulting Engineers, Inc. (CLD) personnel and a professional data search service, Environmental Data Resources, Inc (EDR) of Southport, CT. Searches performed by EDR and CLD personnel include reviews of both the Federal and State Regulatory Agency databases identified by the American Society of Testing and Materials (ASTM). The date of EDR's review is October 26, 2005. CLD completed a windshield survey to re-confirm existing conditions on February 15, 2006.

Existing TAZ Boundary
Proposed TAZ Boundary
Proposed Centroid Connector

0 1,000 2,000 Feet

WOODLOT



I-93 Exit 4A Interchange Study
Draft Environmental Impact Statement

Figure 4.11-4
Potential Petroleum, Hazardous Materials Sites, and Solid Waste Sites for Alternative B

Legend

Hazardous Material Sites
- High
- Moderate/High
- Moderate
- Low
- Not Rated
- Area of Disturbance
- Proposed Pavement Layout
- Study Area
- Building
- Road
- Stream
- Town Boundary

Note
The Not Rated designation is meant to identify those locations that have not been ranked for hazardous materials concerns because the site was deemed (after conducting database research, windshield surveys and coordinating with the NHDOT Hazardous Materials Coordinator) to not warrant further review due to the site condition or physical location/distance from the remaining corridors.

Data Sources
Hazardous material data were compiled by CLD Consulting Engineers, Inc. (CLD) personnel and a professional data search service, Environmental Data Resources, Inc. (EDR) of Southport, CT. Searches performed by EDR and CLD personnel include reviews of both the Federal and State Regulatory Agency databases identified by the American Society of Testing and Materials (ASTM). The date of EDR's review is October 26, 2005. CLD completed a windshield survey to re-confirm existing conditions on February 15, 2006.

0 1,000 2,000 Feet

CLD Consulting Engineers
WOODLOT Alternatives, Inc.

2010 TRAVEL DEMAND FORECAST MODEL DEVELOPMENT AND CALIBRATION REPORT

FOR

THE SOUTHERN NEW HAMPSHIRE PLANNING COMMISSION

July 2012

CHAPTER 1 INTRODUCTION

1.1 Overview

The development and calibration of the 2010 Southern New Hampshire Planning Commission (SNHPC) 24-hour model includes many refinements. This report describes the model and documents the calibration and validation process.

The 2010 model includes all regional roadways of functional class of collectors and higher as well as some local roads. The region was divided into 290 traffic analysis zones and 67 external stations where traffic enters and leaves the region. The model projects average weekday 24-hour traffic volume for roads in the region.

The SNHPC model is used to perform analyses such as:

- Roadway system deficiencies
- Level of service
- Air quality conformity
- Long range transportation planning
- Transportation improvement program
- Special studies

1.2 Household Travel Survey

SNHPC contracted with the University of New Hampshire Survey Center to conduct a household travel survey for the region. The 2007 household travel survey collected travel information for respondents on Tuesday, Wednesday, and Thursday during October and November 2007. In addition to providing basic demographic information about each household and its members, the survey documented specific travel characteristics of trips, including number of vehicle occupants, trip purpose, time of day, and trip mode. The survey included 786 households selected randomly from the region's telephone records. The survey data was analyzed by SNHPC using Microsoft Access. The following products from the analysis were used to develop model factors:

- Average number of vehicles available per household per community

- Vehicle – Person cross-classification tables
- Percentage of internal to external trips expressed as a percentage of total trips
- Auto occupancy rates by trip type
- Trip length (duration) frequency by trip type

1.3 Demographics

Travel survey data and demographic data are essential to developing travel demand models. The demographic data as model inputs includes population, households, number of vehicle available per household, school enrollment by school type and employment.

1.3.1 Base year (2010) model

Population and Households

Population, Dwelling Unit, Households (2010) for each community used U.S. Census data.

Vehicle Ownership

The number of vehicles available in a household influences travel behavior much like the number of persons in a household. The SNHPC model uses number of vehicles per household per TAZ as a demographic input. Average vehicle ownership from the 2007 travel survey for communities is shown in the following table. Average vehicles per household by community were then assigned to TAZs.

Table 1.1 Average Vehicles per Household

Town	Vehicle	Town	Vehicle
Auburn	2.67	Hooksett	2.00
Bedford	2.40	Londonderry	2.14
Candia	2.50	Manchester	2.71
Chester	1.86	New Boston	2.30
Deerfield	2.76	Raymond	2.23
Derry	2.04	Weare	2.65
Goffstown	2.34		

Student Enrollment

Student enrollment influences the number of trips attracted by schools. Data for 2010 student enrolments for all elementary, middle and high schools in the region were obtained from the New Hampshire Department of Education. College enrollments were collected by contacting the colleges in the region. School addresses were used for assigning a TAZ to an individual school.

Employment

Employment data for 2010 was supplied by the New Hampshire Economic and Labor Market Information Bureau (ELMB). The database contained 8,181 records including business name, address, code of North American Industry Classification System (NAICS) and number of employees by month. Average employment for each employer was calculated by averaging monthly employment and excluding months with atypical employment. For some communities, all schools and government employment were located in one address. For such cases, SNHPC contacted those communities and local school district offices to obtain employment data and address for each school and each community department of the community where different physical addresses existed.

SNHPC maintained a roadway database in Microsoft Access in which roads were broken down by TAZs. With the division of TAZ, the database was updated accordingly. The database was used for assigning a TAZ to each employer. While attempting to assign traffic zones for individual employment records, SNHPC found several mistakes in the 2010 employment database which were subsequently corrected after additional research. Because of these corrections, the SNHPC 2010 employment and the ELMB employment did not match. SNHPC's total employment number for the region was approximately 2.3 percent higher.

As a model input, the employment were grouped based on the NAICS code as shown below.

- Retail: 44 and 45
- Service: 22, 48, 49, 51, 52, 53, 54, 55, 56, 61, 62, 71, 72, 81
- Industrial: 21, 23, 31, 32, 33, 42

- Government: 92
- Agriculture: 11

1.3.2 Future Year

Population and Households

Population projections were developed using the Cohort Component Method. Actual births and deaths used were obtained from the OEP and NH Department of Health and Human Services Bureau of Vital Records. The regional survival rates were calculated using life tables derived from OEP. The one variable generated by the SNHPC was the projected net migration. Using the past 40 years of net migration, we projected four possible future net migration outcomes for each community: high, middle, low, and historical average. The most probable of the four was selected to generate the final projection.

Dwelling Units were projected based on the annual average of building permits issued between 1970 and 2009. The OEP's figures from "Current Estimates and Trends in New Hampshire's Housing Supply, Updates 1989, through 2009," were used along with "1970-1979 Estimates of Housing Supply for Towns and Counties in New Hampshire". The building permit data was analyzed and those years with atypical net dwelling unit increases were excluded from the calculation of the annual average. 2010-2014 projections were based on 2008 annual dwelling unit increase to account for slower growth which has been the trend since the economic downturn.

Future number of households was calculated by population divided by occupied housing units.

Vehicle Ownership

The model assumes that the future average number of vehicles available in a household is consistent with 2010.

Student Enrollment

Student enrollments for future years were projected based on the population of the corresponding age cohorts for elementary school, middle school, high school and college.

Employment

Employment data for 1990-2010 by community and NAICS code was downloaded from the website http://www.nh.gov/nhes/elmi/covempwag_arch.htm (New Hampshire Economic and Labor Market Information Bureau) for the projections. Growth rates were assumed based on historic employment data by categories and the State projection for 2008-2018. The growth rates were applied to the projections.

Using the community totals for each category of employment projections, the net increase expected for each projected five-year increment was distributed to the traffic zones. It was generally assumed that zoning ordinances would not change significantly over the projected time span. More specific assumptions were made in determining the amount of growth of each traffic zone would receive based on the existing zoning of vacant land; quantity of vacant land; location of wetlands, steep slopes, water bodies or other natural development constraints; existing land use coverage; and known proposed developments.

CHAPTER 2 TRIP GENERATION

Trip generation step converts the demographic/land use data into productions and attractions. Households are converted into "production" and employment (retail, service, industrial, government and agriculture, school enrollments) is converted into "attractions". Many pieces of data including much of that gathered from the household travel survey goes into the trip generation step.

2.1 Trip Productions

2.1.1 Person Trip Data

SNHPC has expanded trips from four to six trip types by adding school and social trip types. Trip types are as follows.

- Home Based Work (HBW) : Trips with one end at home and one end at work
- Home Based Shop (HBSH) : Trips with one end at home and one end at a shopping establishment
- Home Based Social (HBSO): Trips with one end at home and one end at a social establishment (i.e. movies)
- Home Based School (HBSCH): Trips with one end at home and one end at a school
- Home Based Other (HBO): One end at home and one end anywhere except work, shopping, school or social
- Non-Home Based (NHB): Neither end of the trip at home

Adding two additional trip types will offer more refinement to the model. The 2007 household travel survey collected the "purpose of the trip" which was used to assign a trip type.

2.1.2 Cross-Classification Tables

Household size and number of vehicles in the household influences person trips by a household. Trip rates from the 2007 household travel survey were found to be lower than national average and adjustments were made based on the national average trip rates per household. The following table shows trip rates by number of vehicles and persons in the household (cross-classification) that were used to generate productions in the model.

Table 2.1 Cross-Classification Trip Table

Vehicles (equal to or greater than)	Vehicle (less than)	Home based work	Home based shop	Home based social	Home based School	Home based other	Non-home based
Greater than 1 persons per household but less than 2							
0	1	0.25	0.56	0.23	0.24	1.27	0.79
1	2	0.86	1.12	0.38	0.24	1.58	1.32
2	3	1.12	0.84	0.43	0.24	1.58	0.78
3	4	1.13	0.85	0.40	0.24	1.58	0.92
4	99	1.88	0.85	0.40	0.24	1.58	0.92
Greater than 2 persons per household but less than 3							
0	1	0.63	0.56	0.23	0.16	1.27	0.79
1	2	0.85	0.83	0.51	0.37	1.72	1.39
2	3	1.39	1.04	0.52	0.37	1.83	2.20
3	4	1.59	0.96	0.58	0.37	1.83	1.47
4	99	2.40	0.96	0.58	0.37	2.03	1.47
Greater than 3 persons per household but less than 4							
0	1	1.26	0.56	0.23	0.41	1.53	1.57
1	2	1.62	0.90	0.47	0.50	1.78	1.82
2	3	1.63	0.87	0.51	0.43	2.32	2.55
3	4	1.75	0.96	0.58	0.39	1.40	2.49
4	99	1.73	0.99	0.63	0.51	1.59	3.61
Greater than 4 persons							
0	1	1.26	0.56	0.47	0.65	1.53	1.84
1	2	1.47	0.56	0.58	0.81	2.12	2.10
2	3	1.50	0.87	0.60	0.88	1.65	2.99
3	4	1.49	0.69	0.40	1.01	1.68	2.77
4	99	2.04	1.00	0.65	0.58	1.91	3.33

2.2 Attractions

Establishment of trip attraction rates by type were initially based on data from NCHRP 365 and the NH I-93 Transit Investment Study. Adjustments were made to better reflect the number of trips by trip type estimated from the 2007 household travel survey. The final set of attraction rates is shown in the table below.

2.2 Trip Attraction Rates by Trip Type

Trip Type	Total Employment	Retail	Service	Government	Industrial	Agriculture	Households
Home Based Work	1.35						
Home Based Shop		5.8					
Home Based Social			0.8	0.22			0.28
Home Based Other		3.0	0.9	0.25	0.25	0.25	0.70
Non-Home Based		4.49	1.13	1.13	0.38	0.38	0.59

School trip rates per student per school type were determined by using the ITE Trip Generation Manual 7th Edition. The trip attraction rates used in the model are shown in the table below.

Table 2.3 Trip Generation Rate of school

Trip Type	Elementary	Middle	High School	College
Home Based School	1.00	1.40	1.50	2.10

2.3 Special Generators

Trips created by individuals living in special facilities such as student dormitory, nursing home and jail are generated using special generators. Manchester Airport was maintained as special generator. The following special generators were in the following TAZs.

1. Manchester Airport (TAZ 64)
2. Southern New Hampshire University dormitory (TAZ 18)
3. Drug Treatment Center (TAZ 34)
4. Hillsborough County Jail in Manchester (TAZ)
5. State Prison for Women in Goffstown (TAZ 286)
6. Saint Anselm College dormitory (TAZ 88)
7. Southern New Hampshire University dormitory (TAZ 118)
8. Saint Anselm College dormitory (TAZ 236)
9. Nursing home in Bedford (TAZ 110)
10. Nursing home in Bedford (TAZ 89)
11. Nursing home in Derry (TAZ 131)
12. Nursing home in Goffstown (TAZ 235)
13. Nursing home in Goffstown (TAZ 87)
14. Nursing home in Manchester (TAZ 19)
15. Nursing home in Manchester (TAZ 7)
16. Nursing home in Manchester (TAZ 38)
17. Nursing home in Manchester (TAZ 52)
18. Nursing home in Manchester (TAZ 28)
19. Nursing home in Manchester (TAZ 29)
20. Nursing home in Manchester (TAZ115)
21. Nursing home in Manchester (TAZ 39)
22. Nursing home in Manchester (TAZ 40)

2.4 External trips

Factors for each trip type were used for split trips into internal to internal (I-I) trips, internal to external (I-X) trips and external to internal (X-I) trips. I-X factors by trip type and community were calculated using 2007 household travel survey. For very small samples, the number was adjusted during model calibration. The X-I factors for home based work trips were obtained using work place data from the 2000 Census. The non-work trips X-I factors were generated based on the 2000 model factors, professional judgment, reasonable assumptions concerning the trip characteristic of commuters and the use of an interactive process during calibration. The factors used in the model were shown in the following tables.

Table 2.4 Internal to External Factor

TOWN	HBWIX	HBSHIX	HBSOIX	HBSHCIX	HBOIX	NHBIX
Auburn	0.17	0.05	0.17	0.08	0.12	0.13
Bedford	0.36	0.13	0.10	0.08	0.22	0.13
Candia	0.67	0.33	0.17	0.09	0.44	0.12
Chester	0.69	0.50	0.17	0.09	0.17	0.32
Deerfield	0.34	0.56	0.17	0.50	0.67	0.47
Derry	0.57	0.13	0.35	0.27	0.20	0.30
Goffstown	0.43	0.07	0.13	0.06	0.17	0.17
Hooksett	0.42	0.08	0.13	0.06	0.25	0.24
Londonderry	0.57	0.10	0.30	0.20	0.19	0.27
Manchester	0.26	0.07	0.32	0.12	0.11	0.17
New Boston	0.47	0.44	0.32	0.08	0.24	0.36
Raymond	0.67	0.45	0.40	0.08	0.33	0.50
Weare	0.44	0.56	0.50	0.09	0.35	0.50

Table 2.5 External to Internal Factor

TOWN	XIHBW	XIHBSH	XIHBSO	XIHBSCH	XIHBO	XINHB
Auburn	0.28	0.04	0.05	0.00	0.07	0.09
Bedford	0.35	0.28	0.28	0.00	0.28	0.28
Candia	0.26	0.04	0.04	0.00	0.06	0.07
Chester	0.21	0.03	0.02	0.00	0.02	0.07
Deerfield	0.39	0.04	0.03	0.00	0.04	0.06
Derry	0.25	0.35	0.25	0.10	0.30	0.22
Goffstown	0.19	0.05	0.03	0.02	0.06	0.06
Hooksett	0.37	0.30	0.26	0.03	0.26	0.26
Londonderry	0.29	0.40	0.32	0.00	0.30	0.30
Manchester	0.26	0.27	0.19	0.10	0.25	0.25
New Boston	0.32	0.02	0.04	0.00	0.04	0.04
Raymond	0.46	0.30	0.25	0.00	0.06	0.30
Weare	0.32	0.04	0.04	0.00	0.04	0.08

2.5 Trip Generation Results and Conclusions

The following table summarizes the trip generation results before balancing, which count for a regional population of 261,262. The average motorized trip rate per capital is 3.1 which fall in the range of national average. The table productions and attractions reflect total trips generated by the region.

Table 2.6 Unbalanced Motorized Productions and Attractions

Trip Type	Productions	Attractions
Home Based Work	151,600	162,980
Home Based Shop	94,546	91,396
Home Based Social	51,582	90,615
Home Based School	41,290	100,318
Home Based Other	207,600	193,687
Non-Home Based	236,622	231,053
Total	783,244	870,051

CHAPTER 3 TRIP DISTRIBUTION

Trip distribution involves the roadway networks, travel times, and conversion of productions and attractions from the trip generation step into a TAZ level person trip matrix. The data needed for trip distribution comes from the household travel survey.

3.1 Traffic Analysis Zone (TAZ)

TAZs are geographic areas dividing the planning region into relatively similar areas of land use and land activity. Refinements were made to the 2005 existing TAZs to develop the 2010 TAZs. The 2010 census data boundaries land use type, and major physical and transportation boundaries were all considered in the refinement of TAZs. Total TAZs in each community is shown in the following table. No new TAZs were added to the 2005 model TAZ.

Table 3.1 Number of TAZs

COMMUNITY	**# OF ZONES**	**COMMUNITY**	**# OF ZONES**
Auburn	5	Hooksett	12
Bedford	25	Londonderry	28
Candia	9	Manchester	95
Chester	8	New Boston	10
Deerfield	10	Raymond	17
Derry	35	Weare	19
Goffstown	17	**TOTAL**	**290**

3.2 Network

The model network was adopted from 2005 network. Attributes used in the network includes A node, B node, distance, speed, SPDclass, CAPclass, Lanes, Count, KFAC, Town, CNT93, CNT94, CNT94, CNT95, CNT96, CNT97, ONETWOWAY, Type, CNT98, CNT99, CNT01, Totalest05 and Totalest10. Network roadways are functionally classified, including collectors and higher and some local road. To improve forecasting accuracy and meet needs of planning process, Totalest10 (for validation purpose) were added to the network. Network links were examined and inappropriately coded links were corrected based on local knowledge.

3.2.1Functional Class

Function class as an attribute of links were coded in the network. Functional classes used are shown in the following table.

Table 3.2 Functional Class Classification

Rural	
Code	**Descriptions**
01	Principal Arterial – Interstate
02	Principal Arterial –Other
06	Minor Arterial
07	Major Collector
08	Minor Collector
09	Local
Urban	
Code	**Descriptions**
11	Principal Arterial – Interstate
12	Principal Arterial –Other Freeway and Expressway
14	Minor Arterial
16	Major Collector
17	Minor Collector
19	Local

NHDOT GIS data was used to identify roadway functional class.

3.2.2 Facility type

Facility type plays important roles in model calibration.

Network roadways were classified by 16 facility types based on roadway characteristics such as capacity and speed. Capacities were calculated based on 2000 Highway Capacity Manual (HCM) and adjusted during model calibration. Capacity and speed by facility types are presented in table 3.3.

Table 3.3 Facility Type

Code	Facility Type	Description	Capacity/lane	Speed
1	Rural interstate and its Ramps connect to freeway.	Include functional class 1.	1920	65
2	Rural Other freeway and expressways	Include functional class 2	1790	65
3	**Entrance Ramp**	**Enter to the freeways**	**720**	**35**
4	**Exit Ramp**	**Exit from freeways**	**720**	**30**
5				
6	Rural Minor Arterial	Include functional class 6	1100	50
7	Rural Major Collector	Include functional class 7	800	45
8	Rural Minor Collector	Include functional class 8	800	40

9	Rural Local Road	Include functional class 9	600	30
11	Urban Interstate and its Ramps connect to freeway.	Include functional class 11.	1870	65
12	Urban Other Freeways and Expressway	Include functional class 12	1790	55
13	**One-way Arterial**	**Belongs to the functional class 14 and 16.**	**1380**	**35**
14	Urban Principal Arterial	Functional class 14	1450	35
15	**One-way Collector**	**Belongs to the functional class 17**	**1000**	**30**
16	Urban Minor Arterial	Functional class 16	1200	30
17	Urban Collector	Functional class 17	1100	25
18				
19	Urban Local Road	Functional class 19	500	20

3.2.3 Speed

Average roadway speeds coded into the network were obtained from the SNHPC Congestion Quantity Study if it was included in the study or from the above table.

3.2.4 Model Capacities

Model capacities listed in the above table, calculated based on information in the Highway Capacity Manual 2000 were subjected to change during model calibration.

3.3 Terminal Times

Terminal times added to the beginning and end of a trip (TAZ to TAZ), were inherited from the 2005 model. TAZ terminal times were saved in Terminal.dbf file.

3.4 Turn Restrictions/Penalties

The model includes turn restrictions to reflect actual traffic operations at certain locations. Most delays at intersections derived from the 2005 model. Delays were estimated using Synchro for the intersections with turning movement counts were done since 2005. Delays at toll plazas were modified to reflect the addition of open road tolling. Restrictions at interchange ramps and one way streets were added to the delay file.

3.5 External to External Trip Table

Percentages of external – external trips from the 2005 model were carried over to the 2010 model. Traffic volumes at these external stations were updated by using 2010 traffic estimates.

3.6 Friction Factors

Friction factors for the 2005 model were carried over to the 2010 model.

3.7 Trip Length Frequency Distribution Curves Comparisons

Following figures and tables compare the trip length frequency distribution developed from the household travel survey and the model results for each trip type.

Table 3.5 Trip Length Frequency Distribution

Travel time in minutes	Home Based Work (%)		Home Based Shop (%)		Home Based Social (%)		Home Based School (%)		Home Based Other (%)		Non-Home Based (%)	
	Survey	Model	Survey	Model	Survey	Model	Survey	Model	Survey	Model	Survey	Model
1 to 10	40.85	45.80	62.41	63.10	41.18	50.10	48.98	47.80	43.24	53.00	41.44	42.60
11 to 15	22.81	26.20	17.02	19.50	30.88	32.70	30.61	35.80	19.26	26.20	30.56	29.00
16 to 20	12.73	14.00	7.80	9.30	13.24	9.20	7.14	6.80	22.30	13.50	9.72	13.00
21 to 25	6.90	7.30	6.38	5.10	2.94	4.00	5.10	5.90	6.08	3.70	4.40	7.80
26 to 30	8.22	4.70	4.26	2.30	11.76	2.40	5.10	3.30	6.76	2.20	10.42	5.00
31 to 35	4.24	1.30	2.13	0.40	0.00	1.00	0.00	0.40	1.69	1.00	1.85	2.20
>36	4.24	0.70	0.00	0.30	0.00	0.70	3.06	0.00	0.68	0.60	1.62	0.40

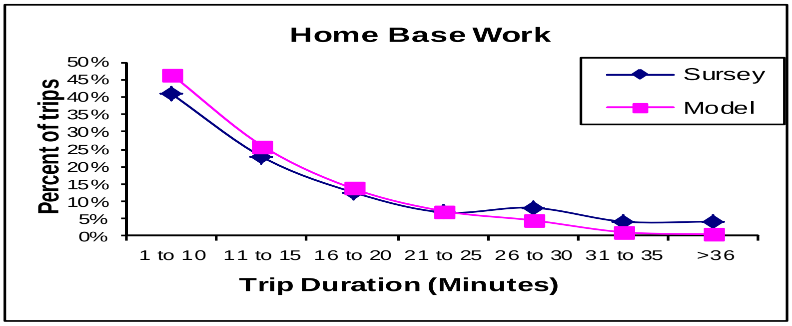
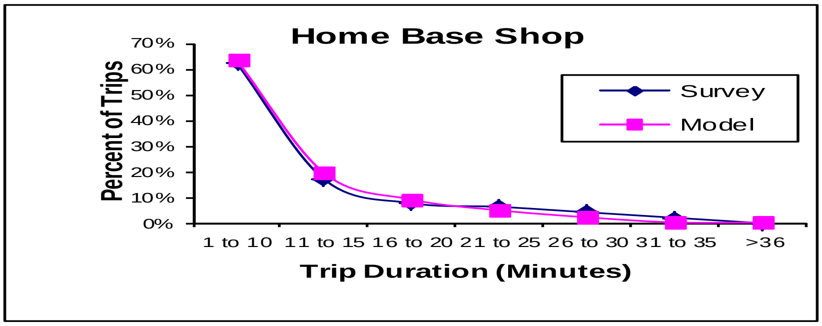


Figure 3.1 Home Based Work Trip Length Frequency



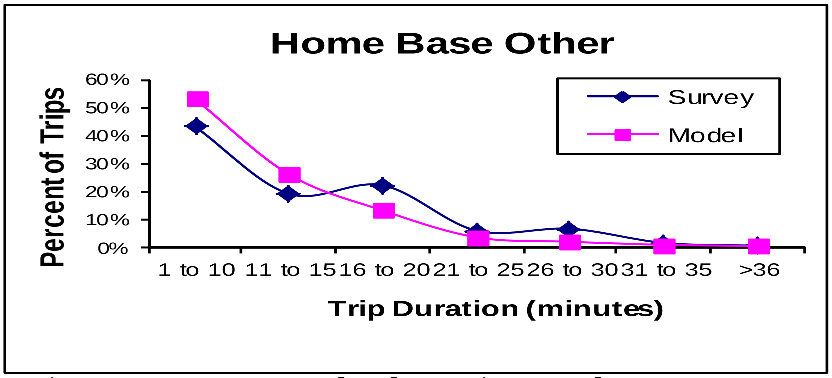


Figure 3.3 Home Based Other Trip Length Frequency

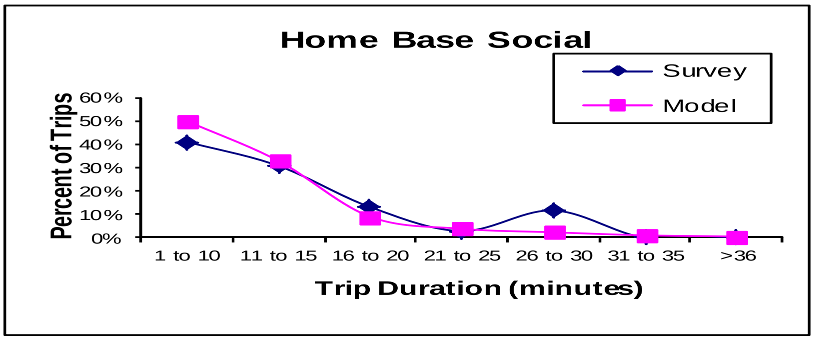


Figure 3.4 Home Based Social Trip Length Frequency

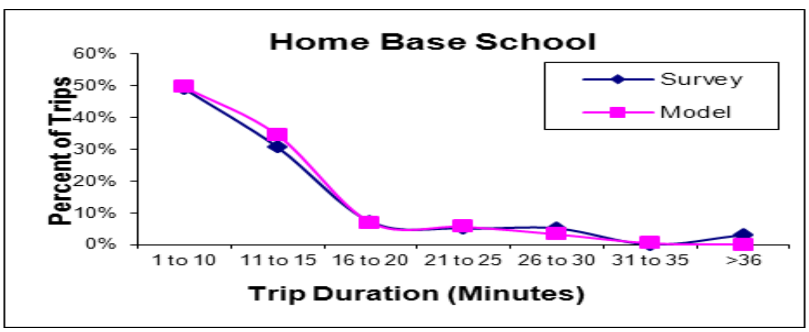


Figure 3.5 Home Based School Trip Length Frequency

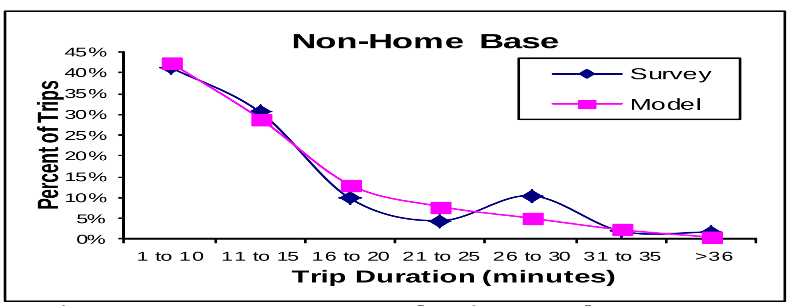


Figure 3.6 Non-Home Based Trip Length Frequency

3.8 Trip Distribution Conclusions

Based on the previous table and figures, similarities of trip length frequency between the 2007 household survey and the model are shown. The results of the trip distribution process were reasonable.

CHAPTER 4 TRUCK TRIP MODELLING

Trip generation step only captures household-based trips rather than commodity-based trips. To generate commodity-based trips, a truck trip table was developed based on Quick Response Freight Manual and NCHRP Synthesis 298, Truck Trip Generation Data.

4.1 Truck Trip Generation

Employment data used as inputs to the model were grouped as follows according to the NAICS codes:

- Agriculture, Mining and Construction (NAICS: 11, 21, 22, 23)
- Manufacturing, Transportation/Communications/Utilities (NAICS Code: 31, 32, 33, 42, 48, 49)
- Retail Trade (NAICS Code: 44, 45, 72)
- Offices and Services (NAICS Code: 51, 52, 53, 54, 55, 56, 61, 62, 71, 81, 92)

Besides the four employment categories, number of household was another variable for truck trip generation.

Because of a lack of local truck trip rate data for industrial categories, trip rates data shown below in table 4.1 from "Quick Response Freight Manual", was used. Truck trip rates were adjusted during calibration.

Table 4.1 Trip Generation Rate

Category	Agriculture, Mining and construction (11,21,22,23)	Manufacturing, transportation/ communications/ Utilities (31,32,33,42,48,49)	Retail Trade (44,45,72)	Offices and Services (51,52,53,54,55,56,61,62,71,81, 92)	Households
Trip Rate	0.865	0.706	0.663	0.283	0.213

The percentage of internal-external and external-internal in total truck trips in each TAZ was assumed to be similar to the 1990 truck trip table. The data was saved in the file IXper.DBF.

4.2 Truck Volumes at External Stations

Vehicle classification counts at external stations were used to estimate truck volume at these stations. For external stations where no data was available, default truck percentage was estimated from FHWA data, Census' Truck Inventory User Survey which can be found in the Quick Response Freight Manual or from adjacent roads with similar functional class. Truck volumes at external stations were stored in the file 10NBTRKEXT.dbf.

Six types of truck trip were generated. They are Productions, Productions of IX, Productions of XI, Attractions, Attractions of IX, and Attractions of XI.

4.3 Truck Trip Distribution

The TP+ software standard gravity model was used for truck trip distribution. A trip table representing the origins and destinations of individual truck trips was produced in the process. Fraction factors for use with the gravity model were based on travel time between analysis areas. Travel time was calculated using model network. The factors for all types of truck trips were calculated using a formula in Quick Response Freight Manual showing as follows.

$$F_{ij} = e^{-0.1*t_{ij}}$$

Where:

$\boldsymbol{F_{ij}}$ **–** Fraction factor.
$\mathbf{t_{ij}}$ **–** Travel time in minutes between analysis areas.

The factors were saved in the file 05NBTRKFRA.dat.

4.4 Input Files and Output File

In this process, following files fed into TP+ script to produce truck trip table.

10NBTRKSCO.DBF
10NBTRKEXT.DBF
IXper.DBF
10NBNETWORK.NET
10NBdelay.prn
10NBTRKFRA.DAT

Output File
10NBTRKOD.MAT

The truck trip table along with the passenger vehicle trip table and the external-external trip table were loaded onto the Viper Network in the trip assignment step.

CHAPTER 5 EXTERNAL TO EXTERNAL TABLE

5.1 Introduction

External stations in travel demand models are locations on the highway network through which trip travel in and out of the region. There are basically three types of movements through these external stations: internal to external (I-X), external to Internal (X-I), and External to External (X-X). The I-X trips have their origin inside the region and destination outside the region; the X-I trips have origin outside the region and destination inside the region; and X-X trips have both origin and destination outside the region. I-X and X-I trips are calculated in the trip generation process in the travel demand model. However, the X-X trips table, as a component of the regional travel demand model, has to be created externally (not using travel demand model) and to be integrated with the regular trips and truck trips for ultimate travel demand forecasting.

Basically, there are two methods to create a XX trip table: (1) Using equations such as those presented in Chapter 5 of the NCHRP report 365; (2) using an Origin-Destination (O-D) survey. An Origin-Destination survey was used to create XX trip table for the region.

5.2 O-D Survey

Generally, there are four O-D survey methods to collect information on the current trip: (1) License plate survey, (2) roadside hand survey, (3) roadside interview survey, and (4) combined roadside interview and handout survey. The roadside hand survey is the most cost efficient method and results in fewer traffic delays. As a result, a roadside hand survey was used to complete the O-D survey in 2007.

In the regional model, 67 external stations exist as 291 to 357. Total Annual Average Daily Traffic (AADT) traveling through these stations is 157,189 vehicles. To survey each station is time, labor, and finance consuming, so to survey all stations is unfeasible. As a result, 1990 XX trip table was examined to select survey locations. In case that percentage of XX trip in total traffic volume per station is unrealisticly high, the station was selected as a potential location for the survey. Nine locations were selected for the O-D survey. For all stations exclusive of these nine, percentage of XX trip in total traffic volume per station was carried over from the order model. A summary of the survey responses for each of the location is shown in Table 5.1 below.

Table 5.1 O-D Survey Locations

LOCATION	LOCID	Card Needed	Card Received
F.E.E.E TPK AT Bedford Toll Plaza, NB	037100	3500	144
I-93 at Hooksett Toll Plaza, SB	225083	3500	349
BEALS RD AT MERRIMACK T/L Over Baboosic Brook	037091	300	28
STOWELL RD AT MERRIMACK T/L	037130	250	10
North Amherst RD at Amherst T/L	037074	380	38
Black Brook Road at Dunbarton T/L	175308	230	22
RESERVOIR DR AT DEERING T/L	471803	390	21
SUGAR HILL RD NORTH AT HOPKINTON T/L	471801	470	21
PINE ST AT BOW T/L	225369	700	49

Number of vehicles requested for the survey based on the 2005 traffic volume per location was calculated using statistical methods. These numbers are also shown in table 5.1. The sample sizes were determined through an assumed confidence level of 95 percent and confidence interval of 4 percent.

5.3 X-X Trip Table

To create the X-X trip table, following steps were taken:

1. The percentage of XX traffic volume in total traffic volume per station was computed using 2007 O-D survey data or 1990 XX trip table data.
2. The percentage of XX traffic volume of each O-D pair in total traffic volume of the origin station was calculated using 2007 O-D survey data or 1990 XX trip table data.
3. Unrealistic percentages were adjusted.
4. XX traffic volumes were distributed to each O-D pair according to the percentage of XX traffic volume from step 2 to get unbalanced XX trip table.
5. The unbalanced excel XX trip table was converted to a format that TP+ can be read by running the excel2TP visual basic script. The results will be saved in XXTPUNB2010 sheet.

6. Copy the sheet to OD2010.txt file.
7. Run TP+ Script to balance the XX trip table and the output XX trip table and vector.
8. Run Matrix Visual Basic script to convert the TP+ format data, the vector to an excel format trip table.

CHAPTER 6 TRIP ASSIGNMENT

In the process of trip assignment, trips in trip table, which are output of the trip distribution step, load onto the highway network to produce estimates of traffic volumes, congested speed, Vehicle Miles Traveled (VMT), and Vehicle Hours Traveled (VHT).
Prior to assigning vehicle trips to the roadway network, the conversion of people trips to vehicles trips is done at the trip generation phase for each trip type.

6.1 Auto Occupancy Rates

The following auto occupancy rates used to convert person trips to vehicle trips were established using the 2007 household travel survey data.

Table 6.1 Auto Occupancy Rates, 2007

Trip Type	Auto Occupancy (Person/vehicle)
Home Based Work	1.31
Home Based Shop	1.36
Home Based Social	1.65
Home Based School	2.37
Home Based Other	1.50
Non-Home Based	1.45

Once trips are converted to vehicle trips they are assigned to the network using a gap parameter of 0.0001 and volume-delay functions.

6.2 Volume – Delay Function

Trip assignment assigns vehicle trips to the roadway network using equilibrium assignment based on the assumptions that people will use the shortest time path and have “perfect” information about the routes available. Trips for each O-D pair are assigned to the links on the minimum path and trips are totaled for each link. The assigned trip volume is then compared to the link capacity to determine congestion. If a link is congested, the travel time is adjusted to result in a longer travel time. Changes in travel time means that the shortest path may change. This process is repeated several times (iterated) until there is an equilibrium between travel demand and travel supply. Trips on congested links will be shifted to uncongested links until this equilibrium condition occurs.

Traffic assignment step is influenced by the relationship between assigned volume and delay caused by congestion. Volume – delay function used to determine this relationship is shown below.

TC [1] = T0 * VDF (Linkclass, VC)

A set of factors were set based on the link class and V/C ratio.

```
 ; V/C   RI,  UI,  UPAO, RMiA, UMi_A,RMC, UC,  U_Exp, R_Exp, RL,   UL,  Centroid
R="0.00, 1.000,1.000,1.000,1.000,1.000,1.000,1.000,1.000, 1.000, 1.000, 1.000,1.000",
 "0.10, 1.002,1.001,1.004,1.018,1.010,1.190,1.190,1.010, 1.020, 1.200, 1.200,1.030",
 "0.30, 1.005,1.001,1.006,1.050,1.022,1.395,1.395,1.040, 1.060, 1.400, 1.400,1.040",
 "0.50, 1.008,1.002,1.010,1.600,1.100,1.550,1.550,1.102, 1.869, 1.550, 1.550,1.060",
 "0.70, 1.009,1.003,1.030,2.330,2.100,1.595,1.595,1.270, 2.000, 1.600, 1.600,1.100",
 "0.80, 1.250,1.050,1.060,2.490,2.200,1.600,1.600,1.440, 2.850, 1.670, 1.670,1.140",
 "0.90, 1.295,1.085,1.340,2.550,2.600,1.650,1.650,1.610, 3.000, 1.700, 1.700,1.180",
 "1.00, 3.750,2.900,1.545,3.190,3.900,1.975,1.975,2.260, 3.890, 1.770, 1.770,1.260",
 "1.10, 4.950,4.300,2.720,3.600,3.950,2.625,2.625,2.900, 4.690, 1.820, 1.820,1.340",
 "1.17, 5.010,4.700,3.994,4.450,4.150,2.670,2.670,3.630, 5.000, 1.889, 1.889,1.453",
 "1.30, 5.000,5.000,4.120,5.487,5.600,2.690,2.690,4.390, 5.890, 1.915, 1.915,1.660",
 "1.50, 5.000,5.000,5.220,6.000,6.600,2.890,2.890,7.790, 7.790, 1.980, 1.980,2.300",
 "99.99,5.000,5.000,5.220,6.000,6.600,3.200,3.200,7.790, 7.790, 2.000, 2.000,2.300"
```

Chapter 7 Model Validation

Highway assignment is crucial for model to produce traffic volume estimates within acceptable ranges of tolerance compared to actual ground counts. Comparisons of VMT estimates between the model, the Highway Performance Monitoring System (HPMS) and SNHPC traffic count program are summarized in this chapter along with assignment statistics. EPA mandates a 3 percent difference of VMT estimates between the model and HPMS as an acceptable tolerance level for regional air quality planning and conformity purposes. A comparison of traffic volumes between model estimates and ground count screen line and cordon line are presented in this chapter as well as validation results of traffic volumes on individual links.

7.1 Vehicle Miles Travelled

Because HPMS VMT estimates of 2010 are unavailable in New Hampshire, model VMT estimates were compared with 2010 VMT of the SNHPC Traffic Count Program. If traffic volume for a link was not available in traffic count program, estimates for the traffic volume on adjacent links were used. Region wide VMT calibration results are shown in the following table by functional class. The results show that region-wide VMT calibration meets the FHWA target percentage for VMT difference between the model and ground counts.

Table 7.1 Model VMT Estimates Verse VMT of Traffic Count Program

Functional Class	2010 VMT Estimates of Traffic Count Program	2010 Model VMT	% Difference
1	389,965	405,956	3.94%
2	401,994	428,680	6.23%
6	80,375	96,125	16.39%
7	381,212	432,241	11.81%
8	85,489	99,278	13.89%
9	258,656	286,314	9.66%
11	1,864,079	1,809,259	-3.03%
12	399,050	415,206	3.89%

14	860,674	791,242	-8.78%
16	1,177,920	1,201,258	1.94%
17	493,457	511,284	3.49%
19	267,790	257,720	-3.91%
Total	**6,660,660**	**6,734,561**	**1.10%**

In New Hampshire, 2008 HPMS VMT estimate was available for model calibration. To produce 2008 model VMT estimates, 2008 social economic data was applied to the 2010 model network. A comparison of VMT between 2008 HPMS and 2008 model generated is made in the following table. The table shows that the model VMT estimates satisfy the EPA requirement.

Table 7.2 2008 Model Estimate Versus 2008 HPMS VMT Estimates

2008 HPMS VMT	2008 Model VMT	% Difference	Target for % Difference (EPA)
6,606,565	6,773,936	2.53	3

7.2 Traffic Volume

7.2.1 Region wide

After validation of the VMT, the next level of validation of the highway assignment involves comparison of observed versus estimated traffic volume on the highway network. Two measures, the Coefficient of Determination (R^2) and Percent Root Mean Square of the Error (%RMSE), to examine performance of the model were calculated using following equations:

$$R^2 = [Correl(Model, Count)]^2$$

Where: Correl=Correlation Coefficient

$$Correl(Model, Count). = \frac{\sum_j (Model - Ave.Model)(Count - Ave.count)}{\sqrt{\sum_j (Model - Ave.Model)^2 (Count - Ave.count)^2}}$$

$$\%RMSE = \frac{(\sum_j (Model_j - Count_j)^2 / (Numberofcounts - 1)^{0.5} * 100}{\sum_j Count_j / NumberofCounts)}$$

R^2 region wide equals 0.90 which is greater than FHWA requirement which is 0.88. %RMSE equals 27.55 for all roadways with functional class collector and higher which is less than the commonly accepted FHWA standard 30.

7.2.2 Screen Line and Cordon line

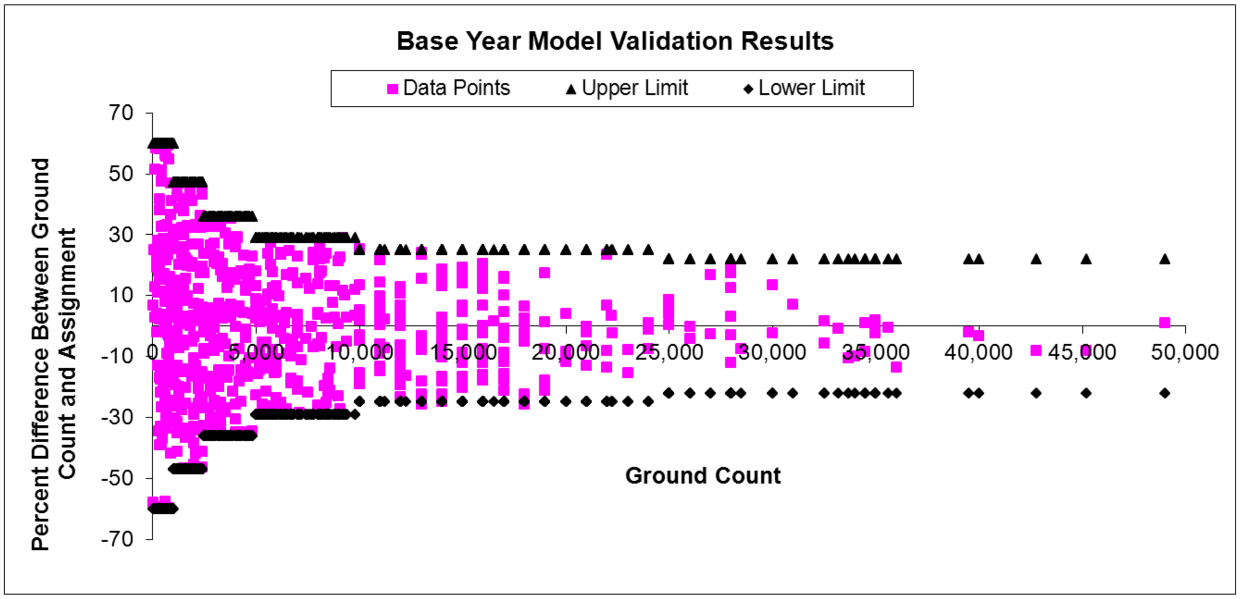
Total observed versus model estimated volumes at a Merrimack River screen line crossing and external stations cordon line crossings were compared in the following table. The table shows both absolute percentage differences are less than 2 percent.

Table 7.3 Total Observed Versus Model Estimates Traffic Volumes

Criteria	2010 Ground Count	2010 Model	% Difference
Daily traffic volume at all external stations	493,818	481,120	2.64%
Merrimack River screen line crossing	247,016	246,000	0.41%

7.2.3 Individual Links

A comparison of the actual ground count to assignment on a link by link basis is one of the more severe tests for a regional model. As can be seen from Figure 7.1, the ground count and model assignment pairs compared fell within the FHWA validation criteria.



From:	Julie Chen
To:	Snyder, Kerri; Adam Hlasny; John Munn
Cc:	Chris Bean; Tidd, Leo; "Craig R Seymour" (crs@rkgassociates.com); I93-Exit4A-EIS (SM); David Preece
Subject:	RE: I-93 Exit 4A: SNHPC Interview Summary
Date:	Thursday, August 04, 2016 10:03:21 AM
Attachments:	Londonderry_2012.doc Final Draft Economic Development Chapter December 26 2014_Copy.docx Final DRAFT Land Use Chapter December 26 2014.docx NHES Economic Impact Final Report of Mixed Use Projects in Region.pdf

Hi Kerri:

My answers to the questions in blue. If you have any questions, please let me know.

Julie Chen

From: Snyder, Kerri [mailto:KSnyder@louisberger.com]
Sent: Wednesday, August 03, 2016 11:14 AM
To: Julie Chen; Adam Hlasny; John Munn
Cc: Chris Bean; Tidd, Leo; 'Craig R Seymour' (crs@rkgassociates.com); I93-Exit4A-EIS (SM)
Subject: I-93 Exit 4A: SNHPC Interview Summary

Julie, Jack, and Adam,
Thank you for taking the time to meet with us on July 25. Attached is a draft summary of our discussion for your review and comment. In addition, we respectfully request the following information.

1. Confirmation of 2050 as the outlook year for the population projections. This is what is stated in the letter to the Town of Derry. Also, is 2012 the date the most recent projections were created (when letter is dated)? Were the projections updated in 2014? If so, is the outlook year still 2050?

Yes. We have projections up to 2050. The projections haven't updated since 2012.

2. Copies of the letters (similar to the copy you provided for the Town of Derry) sent to the towns in the SNHPC area requesting input on the population projections.

   Attached.

3. Results of a search SNHPC files to determine if Derry or Londonderry submitted comments in response to the letters from SNHPC in 2012 explaining the updated population and dwelling unit projections.

Don't have any records showing comments on population and dwelling projection from the two towns. But we did contact Londonderry for employment projection regarding Pettengill Road and Woodmont Common. We adjusted TAZ level employment allocations for Pettengill Road development. At that time, it is too early to tell how many jobs will be created by Woodmont Common.

March 14, 2012

Mr. Andre Garron, AICP, Director
Londonderry Community Development Department
268B Mammoth Road
Londonderry, NH 03053

Re: Population and Dwelling Unit Projections

Dear Mr. Garron:

The Southern New Hampshire Planning Commission (SNHPC) has completed the new population and dwelling unit projections for the region's towns and traffic zones. The projections look at the years 2010 - 2050. At this point, we would like to share our results with you for your review and comments.

The 2010 U.S. Census counted population for Londonderry was 24,129. According to the SNHPC figures, the number of dwelling units in Londonderry was 8,771. The SNHPC projected population for 2050 is 37,623, an absolute change of 13,494 persons, and the projected number of dwelling units is 13,044, an absolute change of 4,273 units. These projections represent annual compound growth rates of 1.12 percent and 1.00 percent respectively. Please see the attached tables for details on a five-year basis.

The population projection was conducted using the Cohort Component Method. The actual births and deaths used were obtained from the NH Department of Health and Human Services, Bureau of Vital Records. The regional survival rates were calculated using life table derived from Office of Energy and Planning (OEP). The one variable generated by the SNHPC was the projected net migration. Using the past 40 years of net migration, we projected four possible future net migration outcomes: high, middle, low, and historical average. The most probable of the four was selected to generate the final projection; for Londonderry we used our low net migration projection.

Dwelling Units were projected based on the annual average of the past 40 years of Building Permits issued (1970 - 2009). The OEP figures from their "Current Estimates and Trends in New Hampshire's Housing Supply, Updates 1989, 1999 and 2009" were used along with "1970-1979 Estimates of Housing Supply for Towns and Counties in New Hampshire." The building permit data was analyzed and any years with atypical net dwelling unit increases were excluded from the calculation of the annual average. For Londonderry, the annual average of net dwelling unit increase used in the projection was 116.

Using the totals from the population and dwelling unit projections, the net increase expected for each projected five year increment was distributed to the various traffic zones. Please refer to the attached traffic zone map for the location of zone boundaries. General assumptions made in this process were that growth rates would remain constant in each traffic zone and zoning ordinances would not change significantly over the projected time span. More specific assumptions were made in determining the amount of growth each traffic zone would receive based on the existing zoning of vacant land, the quantity of vacant land, the location of wetlands, steep slopes, water bodies or other natural development constraints, the existing land use coverage, the planned development area from SNHPC Comprehensive Plan; and the known proposed developments.

In Londonderry, the following assumptions were made to distribute the dwelling unit increases to the individual traffic zones:

- Traffic zones 101, 100, and 102 would receive the greatest share of dwelling units given the quantity of buildable residential land, and residential construction trends of 1990-2010.
- Traffic zones 64L, 284, and 65 would receive the least amount of dwelling units due to less buildable residential land than elsewhere, and the industrial nature of zones 64 and 65.

Distribution of population increases to the individual traffic zones were in proportion to dwelling unit increase in the individual traffic zones.

Please review the information in this letter along with the attached supporting tables. We greatly welcome your comments so that our projections will best reflect Londonderry's future growth. If you have comments or suggested revisions, please contact Julie Chen, Ph.D. within the next two weeks at (603) 669-4664 or jchen@snhpc.org. We would be happy to schedule an appointment to sit down with you and review the data in more detail. If we do not hear from you in the next three weeks, we will assume you are comfortable with our projections.

Sincerely,

SOUTHERN NEW HAMPSHIRE
PLANNING COMMISSION

David J. Preece, AICP
Executive Director/CEO

cc: SNHPC Representatives:
Sharon Carson, Arthur Rugg, Donald Moskowitz, Deborah Lievens, Leitha Reilly, Martin Srugis

4. Confirmation of the source of the employer database used in the 2010 population projections
   NHDOT got employment database form NH Employment Security.

5. The 2015 plan makes reference to a critical document to request from SNHPC in transmittal: "Economic Impact of Mixed Use/Commercial Developments in Rockingham County, March 2014. Would you provide a copy of this document?

You can find how we used the Results of the Economic Impact Final Report in the attached Land Use Chapter of Moving Southern NH Forward Regional Comprehensive Plan 2015-2035 pages 48-55. Also see future employment growth pages 26-28 in attached Economic Development Chapter. The BEA 2014 Report using the REMI model is also attached.

6. We have reviewed the technical report that outlines the methodology for and calibration of the model. Have there been any major updates to the model since this documentation was prepared?

Since then we added Windham and Francestown to the regional model. Right now we have three models: Original model including thirteen communities, Original model + Windham (2013), Original model + Windham + Francestown (2014). The three models used same methodology, social economic data and projections.

7. During the meeting, you mentioned that the next SNHPC planning effort was the housing needs assessment. Is there a timeline for estimated completion of this assessment?

The last full housing needs assessment was in 2010 with an update in 2015. Please refer to Housing Chapter in Moving Southern NH Forward Regional Plan 2015-2035

We look forward to your comments on the draft interview summary as well as the aforementioned information requests.

Regards,
Kerri

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I-93 Exit 4A Supplemental Environmental Impact Statement

Land Use Planner Interview Summary- Draft 8/2/2016

NH Office of Energy and Planning

Following is a summary of the interview held on July 26, 2016 at the OEP office in Concord. Attendees were as follows:

- OEP – Ken Gallager
- Louis Berger – Leo Tidd and Kerri Snyder
- RKG Associates – Craig Seymour

Population

OEP's last release of official state population projections for the state, counties, and municipalities was in 2013 (Attachment A). OEP is currently working on 2016 population projections, which are anticipated to be complete in September 2016. The factors behind the need the update the 2013 projections include OEP's 2015 population estimates and the change in migration of populations within the State. The vital statistics/trends have not changed, but migration to southern New Hampshire is greater than anticipated at the time the 2013 projections were prepared and migration to the northern and western portions of the State is less than anticipated.

The methods used to generate the population projections are outlined in the 2013 report[1], and the 2016 projections are based on the same methods (i.e., cohort projections, IRS data, and migration rates). Differences in net-migration rates are shown in Attachment A. The OEP conducted a meeting with the regional planning commissions to reach consensus on the migration rates to be used in the population projections. The group reached consensus on using 2000-2005 migration rates, reflecting a moderate growth outlook more positive than the late 2000's, but not as robust as the 1990's.

In allocating county-level population projections to towns, OEP based on share of population in each town and how that share has changed between 2000 and 2010. In other words, the projections assume that the current trend in each town will continue, fast growing towns will continue to grow faster than the county average and slower growing towns will experience less growth.

The group discussed the trend of declining populations in Derry due to the aging of the population. Derry experienced a population loss of 1,000 between the 2000 and 2010 Census; however, the population losses in the younger cohorts were greater. Population estimates consider the number of dwelling permits issued, though it was noted that number of dwellings can lead to an overestimate that is adjusted in comparison to Census estimates.

[1] https://www.nh.gov/oep/data-center/documents/2013-projections-municipalities.pdf

The Exit 4A project and related potential for land development was not considered by OEP explicitly or implicitly in making the latest population projections. The group discussed that the situation with Exit 4A is different than the situation with the I-93 Salem to Manchester project where coordination with OEP led NHDOT and FHWA to conclude that the OEP projections represented a “Build” scenario for purposes of the I-93 SEIS. I-93 is of major economic importance to the state, and links New Hampshire to economic activity in Massachusetts and Boston metro area. As a result, the I-93 SEIS concluded growth would be lower along the I-93 corridor without the widening because the level of traffic congestion would rise to level that would adversely impact economic development. Projects such as Exit 4A that not have a large regional effect are not considered in OEP’s projection process, as a result OEP agreed that their projections best represent a “No Build” scenario for purposes of the Exit 4A project. In other words, the OEP projections do not already include growth that would potentially be caused by Exit 4A (such as additional build-out of Woodmont Commons). Large scale planned developments, such as Woodmont Commons, are not included in the population projections; however, these developments would be represented in the population estimates after the development is completed.

State of New Hampshire, Regional Planning Commissions
County Population Projections, 2016
Preliminary Version 2 – Migration Scenarios

At the Regional Planning Commission meeting of April 18, it was decided to use the latest Census and OEP population estimates and reported vital statistics data to establish the 2010 to 2015 population change benchmark. The projection scenarios presented here use fertility, mortality and migration rates calibrated to the known input targets and then explore future migration rate changes to the year 2040.

The data inputs for the projections model include: the 2010 Census population by age and sex, special population distributions by age and sex (college, prison and nursing home populations), fertility patterns by age of mother, survival distributions by age and sex, and migration patterns by age and sex. The model is calibrated to these inputs for the 2010 to 2015 experience as defined by the actual reported data and estimates results. The projection scenarios to 2040 are based on the 2015 targets and future assumptions of possible migration patterns based on historical migration rates. The scenarios presented here illustrate the impact of migration rate changes alone. Fertility and mortality assumptions are held constant in each of the scenarios presented.

Historical Net Migration

Age patterns of migration can remain remarkably stable through fluctuating economic cycles. But the Crude Migration Rate (the total net migrants divided by the beginning period population) is directly impacted by the economy and, in particular, long-term cycles of employment and housing market shifts. The most recent economic recession provides a good example of this impact with some areas showing recovery much more quickly than others.

In establishing future scenarios of net-migration for New Hampshire counties, it is useful to look at historical migration rates as a baseline for future assumptions. Table 1 presents 5-year migration rates by county for each 5-year period from 1990 to 2015. These rates are derived by breaking down the total population change for the period into the components of births, deaths and the residual net-migration. The total county population is obtained from the decennial census results for 1990, 2000 and 2010, adjusted to a July 1 reference date. The Census Bureau's intercensal estimates provide the mid-decade population for 1995 and 2005 and the most current OEP and Census estimates are used for 2015. The birth and death data are based on the New Hampshire Vital Records Information Network web query system and New Hampshire Department of Health and Human Services vital statistics reports.

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2016 Projections (Draft)

RLS Demographics

Table 1: Net-Migration Rates

	1990 to 1995	1995 to 2000	2000 to 2005	2005 to 2010	2010 to 2015
New Hampshire	0.9%	5.3%	3.2%	0.2%	0.8%
Belknap	3.8%	7.9%	6.3%	-0.6%	1.8%
Carroll	8.4%	12.3%	6.1%	2.8%	0.7%
Cheshire	0.0%	2.5%	3.4%	-0.9%	-0.8%
Coos	-3.3%	-1.2%	3.1%	-1.9%	-3.0%
Grafton	3.5%	3.6%	5.5%	3.4%	0.4%
Hillsborough	0.8%	5.5%	1.4%	-0.9%	0.1%
Merrimack	2.0%	6.8%	5.4%	0.1%	0.9%
Rockingham	0.0%	6.3%	2.9%	0.2%	2.4%
Strafford	-1.3%	3.6%	3.0%	2.0%	2.0%
Sullivan	-0.6%	1.6%	3.3%	-0.1%	-1.1%

Rockingham Co. returns to circled rate by 2030

Table 2 presents five different migration scenarios based on the historical experience. The assumptions underlying each scenario run are described below the table. Run 1 very closely approximates the results from the 2013 round of RPC projections with some slight adjustments of fertility and mortality rates to meet the target 2010 to 2015 experience.

Table 2: Preliminary Projections Version 2 Comparison

	2010 Census Estimates Base	2015 Target Population	2040 Projection Scenario 1	2040 Projection Scenario 2	2040 Projection Scenario 3	2040 Projection Scenario 4	2040 Projection Scenario 5
Belknap County	60,088	60,441	64,373	68,687	66,817	69,615	57,118
Carroll County	47,818	47,650	52,446	49,056	47,628	55,493	40,448
Cheshire County	77,117	76,592	76,663	82,717	81,068	81,026	70,203
Coos County	33,055	31,554	27,238	28,566	27,686	27,763	23,414
Grafton County	89,118	89,377	95,877	102,079	99,950	99,999	83,303
Hillsborough County	400,721	404,765	426,157	434,055	428,433	473,686	402,024
Merrimack County	146,445	148,123	156,835	171,554	166,762	172,649	145,824
Rockingham County	295,223	301,095	320,618	325,768	322,111	350,358	307,533
Strafford County	123,143	126,440	137,182	146,848	145,636	147,770	139,630
Sullivan County	43,742	43,152	46,449	43,878	42,601	42,605	36,865
New Hampshire Total	1,316,470	1,329,189	1,403,838	1,453,208	1,428,692	1,520,964	1,306,362

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2016 Projections

RLS Demographics

Assumptions:

Scenario 1:

Target Total Fertility Rate 2010-2015 and held constant for the projections period,
Target Crude Migration Rate 2010-2015 with original 2013 rates for the projections period,
Target Survival Rate distribution 2010-2015 and adjusted for improved survival for the projections period.

Scenario 2:

Target Total Fertility Rate 2010-2015 and held constant for the projections period,
Target Crude Migration Rate 2010-2015, future assumption of return to 2000 to 2005 migration rates by 2030 and held constant to 2040,
Target Survival Rate distribution 2010-2015 and adjusted for improved survival for the projections period.

Scenario 3:

Target Total Fertility Rate 2010-2015 and held constant for the projections period,
Target Crude Migration Rate 2010-2015, future assumption of return to 2000 to 2005 migration rates by 2040,
Target Survival Rate distribution 2010-2015 and adjusted for improved survival for the projections period.

Scenario 4:

Target Total Fertility Rate 2010-2015 and held constant for the projections period,
Target Crude Migration Rate 2010-2015, future assumption of return to historically highest migration rates by 2040,
Target Survival Rate distribution 2010-2015 and adjusted for improved survival for the projections period.

Scenario 5:

Total Fertility Rate 2010-2015 and held constant for the projections period,
Target Crude Migration Rate 2010-2015 held constant throughout 2040,
Target Survival Rate distribution 2010-2015 and adjusted for improved survival for the projections period.

Total non-farm and private sector employment in New Hampshire continue a nearly steady increase from the recessionary low in early 2010. Preliminary March 2015 to March 2016 total non-farm employment increased by 10,500 jobs and represents an increase of nearly 40,000 from March of 2010. Given the increased employment activity and the meeting discussion regarding housing supply and demand, it seems reasonable to assume a more optimistic migration scenario than what was assumed in the 2013 round of projections.

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I-93 Exit 4A Supplemental Environmental Impact Statement

Land Use Planner Interview Summary- Final 8/7/2016

Woodmont Commons

Following is a summary of the interview held on July 25, 2016 at the Gallagher, Callahan, and Gartrell, P.C. office in Concord. Attendees were as follows:

- Woodmont Commons Representative (Developer) – Ari Pollack of Gallagher, Callahan, and Gartrell, P.C.
- CLD Consulting Engineers – Chris Bean
- Louis Berger – Leo Tidd and Kerri Snyder
- RKG Associates – Craig Seymour

Development and Land Use

The discussion centered on the planned development of Woodmont Commons and the Exit 4A project. The Planned Unit Development (PUD) Master Plan for Woodmont Commons approved by the Town of Londonderry in 2013 provides the overall framework for the development of the site, with additional details addressed through site plan review of specific development proposals. Currently, Phase I is currently under a design review by the Town. The Development Agreement with the Town for the entire Woodmont Commons project includes provisions for mitigation of traffic impacts for each phase (discussed below). The Developer's current expectation is a 20-year build out for the entire development (east and west of I-93).

The PUD Master Plan includes caps on the maximum development permitted in specific areas of Woodmont Commons with and without Exit 4A. These caps were developed based on a negotiation between what the Developer and the Town. As part of these negotiations, detailed technical memoranda were produced by consultants to the Developer and the Town that helped shape the final development quantities presented in the PUD. The Exit 4A project team will request this documentation from the Town of Londonderry.

The group discussed what level of development would be likely to occur on the east side of I-93 without Exit 4A. Without Exit 4A, the development on the east side of I-93 would likely go back to a residential development model (up to 330 units as allowed by the PUD). The group agreed that the 400,000 gsf of office development potentially allowed in WC-12 without Exit 4A according to the PUD would not be likely actually occur given the amount of traffic mitigation that would be required. Instead, a more realistic No Build development scenario would be a small number of supporting commercial businesses serving the needs of the 330 residential units (such as a convenience store or pharmacy).

The current programming for the east side, which is also preferred by the Town of Londonderry, is for commercial land use accessed via Exit 4A. In the with- Exit 4A scenario, the Developer expects a mixed use build-out on the east side of I-93 to the level indicated by the caps in 2013 PUD Master Plan by 2040. In other words, the PUD caps represent a reasonable "Build" scenario for the Exit 4A project. In terms of the timing of the east-side development in the Build scenario, no development would be expected to start until after the completion of Exit 4A (currently expected by 2022). Nothing has been pre-sold or pre-leased. If Exit 4A does not move forward, the land would be used for residential development as noted above.

Regardless of the type of development on the east side, the Developer is sensitive to the environmental features (e.g., wetlands and vernal pools) and intends to minimize potential impacts to these features.

For the west side of I-93, the Developer believes the same basic build-out by 2040 will occur with and without Exit 4A; however, as previously noted, the PUD includes slightly lower development caps on the west side without Exit 4A.

Alternative A is the preferred alignment for Woodmont Commons. Alternatives C and D would require creation of a road system to support the easterly development, and the traffic mitigation required would limit commercial development to ancillary development in support of an overall residential land use. With Exit 4A, Alternative A, subarea WC-12 (east of I-93) is desirable for a commercial/institutional campus, which would result in the creation of new jobs for the state rather than shifting jobs from elsewhere within New Hampshire. Woodmont Commons is currently considering opportunities for commercial markets that are not currently present in southern New Hampshire.

Transportation

The Development Agreement with the Town of Londonderry contains provisions for transportation improvements to support Phase I and II of the Woodmont Commons development. The approval process for these phases and future phases includes provisions for traffic studies and requires mitigation based on those studies to support the traffic generated from the development. NHDOT weighs in on improvements of state facilities (e.g., Route 102); however, the primary coordination of transportation mitigation is with the Town. Although NHDOT does not have a site approval mechanism, per se, it does approve driveway access from state facilities.

From: Ari Pollack
To: Snyder, Kerri
Cc: Chris Bean; Tidd, Leo; I93-Exit4A-EIS (SM)
Subject: RE: Market Basket Redevelopment - Summary
Date: Friday, September 16, 2016 11:03:49 AM

Perfect.

Ari B. Pollack, Esq.
603.228.1181
800.528.1181

http://www.gcglaw.com

Gallagher, Callahan & Gartrell, P.C.
A multidisciplinary law firm
214 N. Main Street
Concord, New Hampshire 03301

From: Snyder, Kerri [mailto:KSnyder@louisberger.com]
Sent: Friday, September 16, 2016 11:42 AM
To: Ari Pollack <pollack@gcglaw.com>
Cc: Chris Bean <ChrisB@cldengineers.com>; Tidd, Leo <ltidd@louisberger.com>; I93-Exit4A-EIS (SM) <I93-Exit4A-EIS@louisberger.com>
Subject: Market Basket Redevelopment - Summary

Ari,
Thank you for your time today in talking about the Market Basket Redevelopment Area. Following is a summary of our conversation.

The Market Basket Redevelopment area, owned by DeMoulas Super Markets Inc., is part of the Woodmont Commons Subarea WC-1GL. The new Market Basket was built on the other side of the plaza (in WC-1GL) in 2011. The redevelopment of the original Market Basket and associated retail area included the demolition of approximately 74,000 GSF of commercial space and the construction of approximately 42,000 GSF of commercial space. The construction is complete, and as of May

2016, the area was occupied completely by a state liquor store, card shop, TJMaxx, and Marshalls Home Goods.

In addition, there are four pads available for development within WC-1GL, also owned by DeMoulas. These pads are located along the roadway running through the Woodmont Commons development area connecting Garden Lane and Pillsbury Road.

DeMoulas is currently looking for potential tenants and has received interest from multiple parties. The development of these parcels would occur with or without the Exit 4A project. At this time, it is not possible to determine the GSF associated with these four pads, as the types of tenants and buildings that would be constructed are unknown.

I appreciate your review of the summary. Your comments are appreciated.

Regards,
Kerri

Kerri Snyder, AICP
Principal Environmental Planner | Transportation Planning and Environment
Louis Berger
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Snyder, Kerri

From: Snyder, Kerri
Sent: Thursday, August 11, 2016 1:21 PM
To: 'Bill Herman'
Cc: I93-Exit4A-EIS (SM); Tidd, Leo; Chris Bean
Subject: RE: I-93 Exit 4A: Town of Auburn Land Use and Development Discussion with Bill Herman

Bill,
Thank you for your review. I appreciate your time in talking with me.
Regards,
Kerri

From: Bill Herman [mailto:townadmin@townofauburnnh.com]
Sent: Thursday, August 11, 2016 9:37 AM
To: Snyder, Kerri <KSnyder@louisberger.com>
Cc: I93-Exit4A-EIS (SM) <I93-Exit4A-EIS@louisberger.com>; Tidd, Leo <ltidd@louisberger.com>; Chris Bean <ChrisB@cldengineers.com>
Subject: RE: I-93 Exit 4A: Town of Auburn Land Use and Development Discussion with Bill Herman

Thank you very much for sharing the summery below Kerri.

That is a very good and accurate reflection of our conversation, and I don't find anything to correct or have anything additional I can add.

I appreciate the ability to review the summary.

Bill

Bill Herman, CPM
Town Administrator
Town of Auburn
PO Box 309
Auburn, NH 03032
(603) 483-5052, ext. 111

From: Snyder, Kerri [mailto:KSnyder@louisberger.com]
Sent: Tuesday, August 09, 2016 5:46 PM

To: Bill Herman <townadmin@townofauburnnh.com>
Cc: I93-Exit4A-EIS (SM) <I93-Exit4A-EIS@louisberger.com>; Tidd, Leo <ltidd@louisberger.com>; Chris Bean <ChrisB@cldengineers.com>
Subject: I-93 Exit 4A: Town of Auburn Land Use and Development Discussion with Bill Herman

Bill,
Thank you for your time today. Following is a summary of our discussion regarding I-93 Exit 4A and the Town of Auburn.

In the 2015 Regional Comprehensive Plan, Moving Southern New Hampshire Forward: 2015-2035, the SNHPC projects that Auburn will have a 2020 population of 5,288 and a 2040 population of 6,226. You stated that the current population of Auburn was approximately 5,200, so the 2020 projection may be slightly low.

In discussing the primary drivers for growth in Auburn, you stated that Auburn is largely a bedroom community with limited businesses. The Town is approximately 16,000 acres, with about a quarter of that area (approximately 4,200 acres) being the watershed for Massabesic Lake, which is the water supply for the City of Manchester. This limits the area available for development.

A primary driver of growth over the last five years has been the change in high school from Manchester to Pinkerton Academy. Auburn has a good local elementary school, and the change in high school has been viewed favorably and a selling point for homes in Auburn. The other primary driver of growth is location. Auburn is located near Exits 1 and 2 of Highway 101, and access between the town and I-93 is convenient. The majority of Auburn's population works elsewhere (Manchester and points north and south of Manchester).

Auburn has a growth management policy that has been in place for about 25 years. The growth management policy is based on the number of building permits allowed per year, and it is adjustable each year. Although the threshold to trigger the growth management policy has not been triggered, Auburn's development has been different than most of the surrounding communities. Auburn has issued about 35 new home building permits per year, and that did not change with the economic turndown in 2007-2008. The new home building permits are not for spec housing; rather they are for custom homes. The average housing price in Auburn is between $350,000-$600,000. You mentioned that the steady increase in housing construction has not resulted in a commensurate increase in elementary school enrollment. It appears that many of the homes are built for older couples, with no children living in the home, or for families with older children, for which the Pinkerton Academy is the selling point.

Based on our discussion, the proposed Exit 4A project is not anticipated to affect development and population growth in Auburn. There may be a beneficial effect on travel time if some of the traffic on I-93 is pulled off of the interstate by Exit 4A, but it is likely that this effect would be minor. Auburn residents would not be likely to use Exit 4A to travel from I-93 to Auburn due to the convenience of access provided by Highway 101.

Any comments on the summary of our discussion are appreciated.

Regards,
Kerri

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Snyder, Kerri

From: Snyder, Kerri
Sent: Friday, August 12, 2016 4:36 PM
To: 'Andrew Hadik'
Cc: Chris Bean; Leo Tidd (ltidd@louisberger.com); I93-Exit4A-EIS (SM) (I93-Exit4A-EIS@louisberger.com)
Subject: RE: I-93 Exit 4A: Town of Chester Land Use and Development Discussion with Andrew Hadik

Andrew,
Thank you for reviewing the summary. Following is the updated summary with your changes in red accepted.
Regards,
Kerri

In the 2015 Regional Comprehensive Plan, Moving Southern New Hampshire Forward: 2015-2035, the SNHPC projects that Chester will have a 2020 population of 5,404 and a 2040 population of 6,437. You mentioned of not having enough knowledge to dispute those projections, however, believe those numbers to be relatively conservative and stated that Chester is currently experiencing significant growth pressure in the form of single-family residential development. Many of the subdivisions that have been dormant since the 2007-2008 economic downturn have recently restarted development. This resurgence began in Spring 2016. The primary drivers for additional residential development in Chester are good schools and the desire for rural living.

We discussed schools and population growth. Due to the very recent resurgence of residential/subdivision development, it will likely be a year or two before Chester experiences a significant increase in elementary school enrollment. At this point, it is too early in the boom cycle to say whether or not there would be a commensurate increase in school-age population/shift in demographics of the population. You would, however, expect to see an increase because most new home buyers in Chester have one or more children.

From a transportation perspective, you stated that growth in the surrounding towns (Auburn, Sandown, and Raymond) has resulted in a noticeable traffic impact to Chester roadways, specifically the intersection of NH State Routes 121 and 102. At peak rush hour (am and pm), you see significant traffic congestion on SR 121 in both directions.

We discussed the proposed Exit 4A project and whether it would have an effect on growth in Chester. Based on your experience, you believe that Exit 4A will induce additional residential growth in Chester due to improved access to I-93. However, it seems unlikely that Exit 4A would result in a measurable long-term decrease in travel time for Chester residents due to the induced development associated with the project.

Although Exit 4A would enable additional growth in Chester, the Town has a growth management provision in its zoning ordinance that would go into effect if pressure on school, fire, and police services would outstrip the Town's ability to keep pace with development. There is also an open space subdivision provision to encourage subdivisions to be creatively designed in a way that reduces sprawl and protects natural resources and rural character. The most typical type of residential development seen in Chester is still open space subdivisions, however, recently, 3 small subdivisions have applied for approval with estate size lots that allow enough space to support horses.

From: Andrew Hadik [mailto:chstrpl@gsinet.net]
Sent: Friday, August 12, 2016 3:51 PM
To: Snyder, Kerri <KSnyder@louisberger.com>
Subject: RE: I-93 Exit 4A: Town of Chester Land Use and Development Discussion with Andrew Hadik

Hi Kerri,

Below is my review of your summary with comments in red.

It was nice speaking with you on Wednesday.

Regards,

Andrew

Andrew L. Hadik

Planning Coordinator
Chester Planning Board

Office: 603.887.5629

Town of Chester, 84 Chester Street, Chester, NH 03036

From: Snyder, Kerri [mailto:KSnyder@louisberger.com]
Sent: Tuesday, August 09, 2016 3:46 PM
To: chstrpl@gsinet.net
Cc: I93-Exit4A-EIS (SM) <I93-Exit4A-EIS@louisberger.com>; Chris Bean <ChrisB@cldengineers.com>; Tidd, Leo <ltidd@louisberger.com>
Subject: I-93 Exit 4A: Town of Chester Land Use and Development Discussion with Andrew Hadik

Andrew,
Thank you for your time today. Following is a summary of our discussion regarding I-93 Exit 4A and the Town of Chester.

In the 2015 Regional Comprehensive Plan, Moving Southern New Hampshire Forward: 2015-2035, the SNHPC projects that Chester will have a 2020 population of 5,404 and a 2040 population of 6,437. You mentioned of not having enough knowledge to dispute those projections, however, believe those numbers to be relatively conservative that there is nothing about Chester's development that would dispute those numbers and stated that Chester is currently experiencing significant growth pressure in the form of single-family residential development. Many of the subdivisions that have been dormant since the 2007-2008 economic downturn have recently restarted development. This resurgence began in Spring 2016. The primary drivers for additional residential development in Chester are good schools and the desire for rural living.

We discussed schools and population growth. Due to the very recent resurgence of residential/subdivision development, it will likely be a year or two before Chester experiences a significant possible increase in elementary school enrollment. At this point, it is too early in the boom cycle to say whether or not there would be a commensurate increase in school-age population/shift in demographics of the population. I would, however, expect to see an increase because most new home buyers in Chester have one or more children.

From a transportation perspective, you stated that growth in the surrounding towns (Auburn, Sandown, and Raymond) has resulted in a noticeable an traffic impact to Chester roadways, specifically the intersection of NH State Routes 121 and 102. At peak rush hour (am and pm), you see significant traffic congestion on SR 121 in both directions.

We discussed the proposed Exit 4A project and whether it would have an effect on growth in Chester. Based on your experience, you believe that Exit 4A will induce additional residential growth in Chester due to improved access to I-93. However, it seems unlikely that Exit 4A would result in a measurable long-term decrease in travel time for Chester residents due to the induced development associated with the project.

Although Exit 4A would enable additional growth in Chester, the Town has a growth management provision in its zoning ordinance that would go into effect if pressure on school, fire, and police services would outstrip the Town's ability to keep pace with development. There is also an open space subdivision provision to encourage subdivisions to be creatively designed in a way that reduces sprawl and protects natural resources and rural character. The most typical type of residential development seen in Chester is still open space subdivisions, however, recently 3 small subdivisions have applied for approval with estate size lots that allow enough space to support horses.

Any comments on the summary of our discussion are appreciated.

Regards,
Kerri

Kerri Snyder, AICP
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I-93 Exit 4A Supplemental Environmental Impact Statement

Land Use Planner Interview Summary – Final 02/22/17

Town of Chester

Following is a summary of the discussion held via telephone on January 27, 2017 between Mr. Dick Trask, Vice Chair, Chester Board of Selectmen and Kerri Snyder (Louis Berger). The purpose of the telephone call was to discuss the revision of the population projections for the Town of Chester.

Mr. Trask sent an e-mail to Leo Tidd (Louis Berger) on January 23, 2017 (Attachment A).

Building Permits

Mr. Trask provided the following information on building permits for the Town of Chester.

Chester currently has approved or pending permits to develop about 300 lots, which are anticipated to be developed in the next 5 to 7 years (2022-2024). The 211 lots shown as currently approved and still under construction on the Town Planning Board website is correct, with regard to approved lots.[1] In addition, the Town has two 30-lot and three 5-lot subdivisions that will be approved in the near future. One of the 30-lot subdivisions is a Phase I – there will likely be an additional 90 lots in that 550-acre subdivision. Table 1 shows the building permits issued since 2013.

Table 1. Chester dwelling units approved

Year	Dwellings Approved
2013	30
2014	27
2015	30
2016	43
2017 (January only)	12

The Chester Master Plan 2015 recognizes a trend for residential growth in Chester. The plan notes that SNHPC projects that approximately 96 dwelling units would be constructed every 5 years through 2050 based on the town’s historic growth rate and past building permit trends (Chester Planning Board, 2015). This projection equates to approximately 19 new home permits per year on average over a 35-year period. However, the actual numbers for 2013-2016, as shown above, are higher. Mr. Trask stated that he believes the residential growth trend will continue to mirror the higher rate of development shown in Table 1 over the next 5 to 7 years. There was a general discussion of the previous conversation between Kerri Snyder and Andrew Hadik, Planning Coordinator for the Town of Chester (August 9, 2016). Mr. Hadik stated that many of the previously approved subdivisions had been “dormant” since the 2007-2008

[1] http://www.chesternh.org/boards-committees/planning-board

recession, but that there had been a resurgence (Spring 2016) in development. Mr. Trask agreed with this statement and added that the number of previously approved subdivision plans that were still under construction was a combination of the effects of the recession and the rules regarding impact fees. In Chester, the developer must pay the impact fees at the time the subdivision is approved, which has led to developers applying for subdivision approval with the intention of delaying actual construction until the market is more favorable.

Population Projections

In the August 9, 2016, interview with Mr. Hadik, he indicated that he thought the 2012 Southern New Hampshire Planning Commission (SNHPC) projections were too conservative (i.e. low) but stated that he did not have data at the time to dispute them due to the recent resurgence in growth. Mr. Trask asked that the population projections presented in the draft Land Use Scenarios Technical Report (December 2016) be revisited for Chester in light of the Town's building permit data. The population projections presented in the Land Use Scenarios Technical Report were the 2016 projections developed by NH Office of Energy and Planning (OEP).

Mr. Trask provided information based on a 1:1 dwelling unit to household ratio and estimated household size based on the average number of bedrooms proposed for each of the approved or pending subdivision permits, which yielded a household size of 3. Table 2 includes the population and households for 2014 and 2016 provided in Attachment A and a comparison of the estimated population and households based on the SNHPC occupancy rate (0.96) and OEP household size (3.01). There was an additional adjustment made by SNHPC to increase the revised population number of 4,879 to match the OEP projection of 4,887 to suit the previously run 2015 traffic model – an increase of 8 people. The third-quarter 2016 number was used for the end of 2016. The average annual growth rate of 3.28% is not anticipated to hold as a longer-term trend. For example, the population measured by the U.S. Census Bureau in 2010 was 4,768. The average annual growth rate between 2010 and 2014 (estimate – 5,101) was 1.70%.

Table 2. Chester 2014 and 2016 population and household estimates

	2014		2016		Average Annual Growth Rate 2014-2016
	Households	Population	Households	Population	
Attachment A	1,635	4,905	1,744	5,232	3.28%
Revised	1,570	4,724	1,674	5,039	3.28%

Based on the assumption that the 300 lots are developed by 2023, the Town projects about 2,000 dwelling units (total). Using the SNHPC occupancy rate and OEP household size yields a population projection of 5,779 by 2023 (middle ground in the 5- to 7-year building projection). Based on this projection, the average annual growth rate from 2015 to 2023 is 2.12%.

Table 3 presents the revised population projections for the Town of Chester along with the 2016 OEP projections and 2012 SNHPC projections. Mr. Trask agreed that it was reasonable to apply the average annual growth rate for background population growth from 2015 to 2023 (2.12%)

through the 2025 projection. Looking at 1990-2000 and 2000-2010, the average annual growth rates were 3.49% and 2.32%, respectively for Chester, and these growth rates were higher than the other towns in the study area (see Table 1 in the Land Use Scenarios Technical Report). In addition, the Town of Chester has more available land for development than Derry or Londonderry. Mr. Trask indicated that the Town would like to encourage more senior housing in Chester to alleviate the potential burden on schools and other public services. The Town has growth management and open space provisions in its zoning ordinance. The growth management provision would go into effect if the development pressure on school, fire, and police services exceeds the Town's ability to serve its existing and future populations. The open space provision encourages subdivisions to be designed in a way that reduces sprawl and protects natural resources and rural character. In addition, all of the residential developments in Chester use septic systems, which limits the density of development.

Mr. Trask agreed that under the No Build condition, the Town's rate of development beyond 2025 would likely decrease. As a result, the population projections from 2025 through 2040 used the average annual growth rate projected by OEP. The average annual growth rate for Chester projected by OEP from 2025 to 2040 is 0.25%. The adjusted Town 2040 population projection is 8.9% greater than that projected by OEP in 2016 (and presented in the Draft Land Use Scenarios Technical Report) and 2.9% less than that projected by SNHPC in 2012.

Table 3. Adjusted No Build population projections, Town of Chester

Source	2015[a,b]	2020[c]	2025[d]	2030	2035	2040	Average Annual Growth Rate
2017 Adjusted Town	4,887	5,457	6,027	6,101	6,177	6,253	0.99%
2016 OEP	4,887	5,199	5,536	5,660	5,731	5,744	0.65%
2012 SNHPC	5,096	5,404	5,711	5,982	6,239	6,437	0.94%

Notes:

a. 2015 estimate for adjusted Town is based on the OEP estimate pursuant to a request by SNHPC.
b. 2015 estimate for OEP and SNHPC were generated by the respective agencies.
c. 2020 is based on interpolation between 2015 and 2025.
d. 2025 is based on applying the 2.12% average annual growth rate derived from the 2015-2023 projections. The 2023 projection (5,779) is based on estimated 2,000 dwellings and the SNHPC occupancy rate (0.96) and household size (3.01).

Incremental Impact of the Proposed Project (Exit 4A)

Mr. Trask stated that the primary drivers for residential growth in Chester are access to Pinkerton Academy and the availability of new homes. Mr. Trask agreed that the incremental impact of Exit 4A on residential development would be similar to that described in the draft Land Use Scenarios Technical Report (December 2016) in that the Town of Chester would reach the 2040 population projection earlier under the Build condition than it would under the No Build condition. Mr. Trask stated that the incremental impact of Exit 4A would be similar to what would be anticipated under the high growth impact scenario as outlined in the draft Land Use Scenarios Technical Report. It was agreed that the incremental impact for the Town of Chester would use the high growth scenario with the updated population projections. Table 4 presents a comparison of the No Build and both the moderate growth and high growth impact scenario populations for Chester. These moderate and high impact growth scenarios assume the same average annual growth rate within the 5-year increments of 1.24% and 1.66%, respectively. Based on the assertion that the incremental impact of the proposed Exit 4A project would be similar to the high growth impact scenario, there are projected to be 1,117 additional people in Chester in 2040 as a result of the proposed project. Using the average household size for Chester (3.01), the additional people yield approximately 371 additional households in 2040 for Chester.

Table 4. Chester 2040 Build condition population growth

Town	Impact Scenario	Population				Population Increase Over No Build in 2040
		2015	2030	2035	2040	
Chester	No Build	4,887	6,101	6,177	**6,253**	NA
	Moderate Growth (Build)	4,887	5,879	**6,253**	6,789	535
	High Growth (Build)	4,887	**6,253**	6,789	7,370	1,117

Attachment A – Chester Growth Estimates

TOWN OF CHESTER

84 Chester Street
Chester, NH 03036
Phone- 603.887.5352 Cell- 603.370.0125
Website: www.chesternh.org

Data showing Chester growth:

Building permits issued:	2013	2014	2015	2016
	30	27	30	42
Households:				
		1635		1744 (as of Sept 2016) ~ 3.3%/ year
Population (est.)		4905		5232

~300 lots proposed or approved expected to be built out within 5-7 years, putting Chester at ~2000 households. [This data does not include lots-of-record that are undeveloped]. This would maintain the average of 3% growth per annum, which is roughly 4.5 times the rate of growth projected by DOT.

Projections: Households by 2020 ~1985 or 260 more than projected by DOT
Population by 2020 ~5955 or 756 more than projected by DOT

DOT Projections:	2015	2020
Households:	1621	1725
Population	4887	5199

Table 3. OEP 2016 population projection by municipality for 2015–2040

Municipality	2015[a]	2020	2025	2030	2035	2040	Average Annual Growth Rate 2015–2040
Derry	32,948	32,459	32,018	32,733	33,144	33,222	0.03%
Londonderry	24,891	25,434	26,057	26,639	26,973	27,036	0.33%
Auburn	5,315	5,560	5,828	5,959	6,033	6,048	0.52%
Chester	4,887	5,199	5,536	5,660	5,731	5,744	0.65%
Sandown	6,255	6,604	6,984	7,140	7,229	7,246	0.59%
Study Area Total	74,296	75,256	76,423	78,131	79,110	79,296	0.26%
Rockingham County	300,569	307,013	314,418	321,441	325,474	326,238	0.33%

Source: OEP (2016a)

[a] 2015 data are an estimate.

Table 4. SNHPC and RPC household projections

Municipality	2010[a]	2015[b]	2020	2025	2030	2035	2040	Average Annual Growth Rate 2015–2040
Derry	12,537	12,656	12,436	12,236	12,496	12,645	12,673	0.01%
Londonderry	8,438	8,628	8,812	9,022	9,219	9,332	9,353	0.32%
Auburn	1,765	1,923	2,012	2,108	2,156	2,182	2,188	0.52%
Chester	1,534	1,621	1,725	1,838	1,879	1,903	1,907	0.65%
Sandown[c]	2,072	2,193	2,321	2,457	2,601	2,753	2,914	1.14%
Study Area Total	26,346	27,021	27,306	27,661	28,350	28,814	29,035	0.29%

Source: SNHPC (2016a), RPC (2015)

[a] 2010 households were provided by SNHPC and based on U.S. Census information.

[b] 2015 data are an estimate.

[c] Data are from the RPC 2015 Regional Master Plan, with 2040 projections based on the "strong, dispersed growth" scenario. Household data were not available for 2015-2035; therefore, this table includes straight-line growth between 2010 and 2040.

Snyder, Kerri

From: Snyder, Kerri
Sent: Friday, August 26, 2016 9:33 AM
To: 'Mark Traeger'
Cc: Chris Bean; Leo Tidd (ltidd@louisberger.com); I93-Exit4A-EIS (SM) (I93-Exit4A-EIS@louisberger.com)
Subject: RE: I-93 Exit 4A: Town of Sandown Land Use and Development Discussion with Mark Traeger

Mark,
Thank you for reviewing the summary. Following is the updated summary with your changes in bold accepted.
Regards,
Kerri

The current OEP projections show a 2020 population of 6,754 and a 2040 population of 7,070 for Sandown. We discussed historic development trends, specifically Sandown's rapid growth since the 1980s. The primary driver for growth in Sandown is affordable housing – the bulk of housing in Sandown would be considered starter homes with regard to price and size. In addition, access to I-495 and an increase in people who work from home have led to an increase in residential development in Sandown. There was a major influx of people moving to Sandown during the 1990s until the economic downturn in 2007-2008. Sandown has recently seen a resurgence (2016) in development – a 50-unit apartment building was recently approved, and two developments that were initially planned as 55+ are now being developed as any age.

Although Sandown has had growth management ordinances in the past, they no longer have them due to lawsuits by developers. Sandown is now focused on buying and conserving land to reduce the available developable land in the town.
For example, Sandown purchased 200 acres for conserved Open Space that had been approved for 154 55+ dwellings resulting in a reduction of housing potential in Sandown. The Planning Board is considering applying for another CTAP grant to acquire and conserve more land. Most of the larger tracts have been developed, and Sandown has only a couple of 100 acre tracts left that could be developed as larger subdivisions.

Sandown has a lot of wetlands and rivers, and in addition to purchasing land to conserve, the town has a vernal pool protection provision in its zoning ordinance that includes a 25-foot buffer around vernal pools and a building setback requirement of 50 feet. In addition, the Planning Board has passed variable road width and stormwater regulations to reduce impervious surface and to promote Low Impact Development. The conservation measures improve the quality of natural resources and allow the town to reduce the amount of development and the associated increase in school enrollment.

We discussed the widening of I-93, and you stated that it is having a major effect on growth in Sandown by reducing travel times on I-93, which makes Sandown more attractive for young homebuyers. You stated that the proposed Exit 4A would be anticipated to induce additional residential development in Sandown by providing better access and reduced travel time to I-93.

From: Mark Traeger [mailto:markt@eventide.com]
Sent: Friday, August 26, 2016 8:32 AM
To: Snyder, Kerri <KSnyder@louisberger.com>
Subject: RE: I-93 Exit 4A: Town of Sandown Land Use and Development Discussion with Mark Traeger

Kerri,

See my edits in bold below.

You did a great job at distilling a long conversation.

Mark

Mark Traeger
Eventide, Inc.
1 Alsan Way
Little Ferry, NJ 07643
(603) 887-5589 O
(603) 490-5258 C

From: Snyder, Kerri [mailto:KSnyder@louisberger.com]
Sent: Thursday, August 25, 2016 6:15 PM
To: Mark Traeger <markt@eventide.com>
Cc: Tidd, Leo <ltidd@louisberger.com>; Chris Bean <ChrisB@cldengineers.com>; I93-Exit4A-EIS (SM) <I93-Exit4A-EIS@louisberger.com>
Subject: I-93 Exit 4A: Town of Sandown Land Use and Development Discussion with Mark Traeger

Mark,
Thank you for your time in talking with me today. Following is a summary of our conversation as it relates to Sandown and the proposed I-93 Exit 4A.

The current OEP projections show a 2020 population of 6,754 and a 2040 population of 7,070 for Sandown. We discussed historic development trends, specifically Sandown's rapid growth since the 1980s. The primary driver for growth in Sandown is affordable housing – the bulk of housing in Sandown would be considered starter homes with regard to price and size. In addition, access to I-495 and an increase in people who work from home have led to an increase in residential development in Sandown. There was a major influx of people moving to Sandown during the 1990s until the economic downturn in 2007-2008. Sandown has recently seen a resurgence (2016) in development – a 50-unit apartment building was recently approved, and two developments that were initially planned as 55+ are now being developed as any age.

Although Sandown has had growth management ordinances in the past, they no longer have them due to lawsuits by developers. Sandown is now focused on buying and conserving land to reduce the available developable land in the town.
For example, Sandown purchased **200 acres for conserved Open Space that had been approved for** 154 **55+ dwellings resulting in a reduction of housing potential in Sandown.** The Planning Board is considering applying for another CTAP grant to acquire and conserve more land. Most of the larger tracts have been developed, and Sandown has only a couple of 100 acre tracts left that could be developed as larger subdivisions.

Sandown has a lot of wetlands and rivers, and in addition to purchasing land to conserve, the town has a vernal pool protection provision in its zoning ordinance that includes a 25-foot buffer around vernal pools and a **building setback** requirement of 50 feet. In addition, the Planning Board has **passed variable road width and stormwater regulations to reduce impervious surface and to promote Low Impact Development.** The conservation measures improve the quality of natural resources and allow the town to reduce the amount of development and the associated increase in school enrollment.

We discussed the widening of I-93, and you stated that it is having a major effect on growth in Sandown by reducing travel times on I-93, which makes Sandown more attractive for young homebuyers. You stated that the proposed Exit 4A would be anticipated to induce additional residential development in Sandown by providing better access and reduced travel time to I-93.

Any comments you may have on the summary of our discussion are appreciated.

Regards,
Kerri

Kerri Snyder, AICP
Principal Environmental Planner | Transportation Planning and Environment
Louis Berger
48 Wall Street, 16th Floor | New York | NY | 10005 | USA
direct +1-212-612-7908
mobile +1-646-584-9490
email ksnyder@louisberger.com
web louisberger.com

APPENDIX B: SNHPC DATA AND METHODOLOGY MEMORANDA

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SNHPC DATA AND METHODOLOGY MEMORANDA

From:	Julie Chen
To:	Snyder, Kerri
Cc:	Tidd, Leo; Chris Bean; Paul Konieczka; I93-Exit4A-EIS (SM)
Subject:	RE: I-93 Exit 4A: changes in population projections for Chester
Date:	Tuesday, February 14, 2017 10:50:14 AM
Attachments:	2015-2040 pop HH - Chester.xlsx

Hi Kerri:

Attached please find 2015-2040 population and household distributed based on the number below. If you have any questions, please let me know.

Julie Chen
Southern NH Planning Commission

From: Snyder, Kerri [mailto:KSnyder@louisberger.com]
Sent: Tuesday, February 14, 2017 10:28 AM
To: Julie Chen
Cc: Tidd, Leo; Chris Bean; Paul Konieczka; I93-Exit4A-EIS (SM)
Subject: RE: I-93 Exit 4A: changes in population projections for Chester

Julie,
Following are the revised numbers for Chester based on your preference to use OEP's 2015 projection.

2015	4,887
2020	5,457
2025	6,027
2030	6,101
2035	6,177
2040	6,253

Please send me the TAZ breakdown for the population when you have allocated it.

Regards,
Kerri

		2015		2020		
TAZ	TOWN	Pop	HH	Pop	HH	Pop
148	Chester	646	223	708	245	771
149	Chester	427	152	513	182	598
150	Chester	416	161	479	186	541
151	Chester	447	160	521	186	595
152	Chester	1126	328	1297	378	1468
153	Chester	430	148	470	161	510
154	Chester	567	204	595	215	624
155	Chester	829	244	875	258	920
		4887	1621	5457	1811	6027

2025	2030		2035		2040		
HH	Pop	HH	Pop	HH	Pop	HH	HHS2015
266	779	269	788	272	796	275	2.89
213	610	217	621	221	632	225	2.81
210	550	213	558	216	566	220	2.58
213	604	216	614	220	624	223	2.80
428	1490	435	1513	441	1535	448	3.43
175	515	177	520	179	526	180	2.91
225	627	226	631	228	635	229	2.77
271	926	273	932	275	938	277	3.39
2001	6101	2026	6177	2051	6253	2077	

From:	Julie Chen
To:	Snyder, Kerri
Cc:	Tidd, Leo; Hodgson (Rydland), Laura; I93-Exit4A-EIS (SM); Paul Konieczka (PaulK@cldengineers.com); David Preece
Subject:	Population-Household 2015-2040
Date:	Friday, October 21, 2016 9:44:17 AM
Attachments:	2015-2040 Pop HH.pdf 2015-2040 pop HH.xlsx

As I promised, I have allocated OEP population projections to TAZs and calculated numbers of households for TAZs. Attached please find population and households from 2015 through 2040, household size of 2015, and a memo to document methodology .

If you have any questions, please let me know.

Julie Chen
Southern NH Planning Commission

Southern New Hampshire Planning Commission
438 Dubuque Street, Manchester, NH 03102-3546, Telephone (603) 669-4664 Fax (603) 669-4350
www.snhpc.org
SNHPC

MEMORANDUM

TO: File

FROM: Julie Chen, Ph.D., Sr. Transportation Planner, Southern New Hampshire Planning Commission (SNHPC), 669-4664, jchen@SNHPC.org

DATE: October 20, 2016 JC

RE: 2015-2040 Population Distribution to TAZs and Numbers of Households Calculation

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Population Projections Distribution

The population projections from 2015 through 2040 for each community in the region were downloaded from the New Hampshire Office of Energy and Planning (NHOEP) website: http://www.nh.gov/oep/data-center/documents/2016-subcounty-projections-final-report.pdf.

To distribute population changes in five-year increments to TAZs, SNHPC dwelling unit projections adjusted based on 2015 dwelling unit estimates were used. There are two conditions considered as population projections for each community within the region were allocated to TAZs: 1) population increase in a five-year period; 2) Population decrease in a five-year period.

Condition one

When the population increases during a five-year period, the allocation is calculated using the following formula.

$$\Delta \boldsymbol{P}_{TAZ} = \frac{\Delta \boldsymbol{P}_{com}}{\Delta \boldsymbol{D}_{com}} * \Delta \boldsymbol{D}_{TAZ}$$

Where:

ΔP_{TAZ}= population change in a TAZ during a five-year period
ΔP_{com}=Population change in the community in which the TAZ located during the five-year period
ΔD_{TAZ}=Dwelling units change in a TAZ during the five-year period
ΔD_{com}= Dwelling units change in the community in which the TAZ located during the five-year period

Condition two

When the population decreases during a five-year period, the allocation is calculated using the following formula.

$$\Delta \boldsymbol{P}_{\boldsymbol{TAZ}} = \Delta \boldsymbol{P}_{\boldsymbol{DWTAZ}} + (\Delta \boldsymbol{P}_{\boldsymbol{com}} - \Delta \boldsymbol{P}_{\boldsymbol{DWcom}}) * \frac{\boldsymbol{D}_{\boldsymbol{TAZ}}}{\boldsymbol{D}_{\boldsymbol{com}}}$$

Where:

ΔP_{TAZ}= Population change in a TAZ during a five-year period
$\Delta P_{DWTAZ} = HHS_{2015TAZ} * \Delta D_{TAZ}$ =Assume that population change in a TAZ during a five-year period due to dwelling units change
$HHS_{2015TAZ}$= 2015 household size within the TAZ
ΔP_{com}= Increase of population in the community in which the TAZ located during the 5-year period
$\Delta P_{com} = \sum \Delta P_{TAZ}$= Population change in the community in which the TAZ located during the five-year period due to dwelling units change
D_{TAZ}=Dwelling units in the TAZ at the end of the five-year period
D_{DWcom}
$= \text{Dwelling units in the cummunity in which the TAZ located at end of the five} - \text{year period}$

Population within a TAZ at end of a five-year period was calculated as follows.

$$\boldsymbol{P}_{\boldsymbol{TAZ}} = \boldsymbol{P}_{\boldsymbol{TAZ-1}} + \Delta \boldsymbol{P}_{\boldsymbol{TAZ}}$$

Where:

P_{TAZ} =Population in the TAZ at end of the five-year period
P_{TAZ-1} =Population in the TAZ at end of the prior five-year period

Number of Household Calculation

Numbers of households for TAZs were calculated using the following formula.

$$\boldsymbol{HH}_{\boldsymbol{TAZ}} = (\boldsymbol{P}_{\boldsymbol{TAZ}} - \boldsymbol{P}_{\boldsymbol{specialTAZ}})/\boldsymbol{HHS}_{\boldsymbol{2015}}$$

Where:

HH_{TAZ}= Number of households in a TAZ
$P_{specialTAZ}$= Special population in the TAZ
$HHS_{2015TAZ}$= Household size in the TAZ

		2015		2020		2025	
TAZ	TOWN	Pop	HH	Pop	HH	Pop	HH
71	Auburn	58	30	60	31	62	32
72	Auburn	2159	796	2252	831	2354	868
73	Auburn	998	345	1062	367	1131	391
74	Auburn	932	320	969	332	1009	346
98	Auburn	1167	432	1217	451	1271	471
89	Bedford	1028	350	1052	359	1079	369
90	Bedford	271	95	295	103	322	112
91	Bedford	2100	664	2173	687	2254	712
92	Bedford	1539	475	1624	501	1718	530
93	Bedford	260	87	297	100	337	113
94	Bedford	128	49	126	48	123	47
95	Bedford	1613	791	1796	891	1998	1001
104	Bedford	1622	505	1695	529	1776	556
105	Bedford	1777	550	1825	565	1879	582
106	Bedford	1308	412	1369	431	1436	452
107	Bedford	611	224	623	228	637	233
108	Bedford	548	195	560	199	574	204
109	Bedford	770	308	807	323	847	340
110	Bedford	1405	524	1417	530	1431	536
238	Bedford	514	157	660	202	821	251
239	Bedford	826	266	887	285	954	307
240	Bedford	302	115	314	120	328	125
241	Bedford	49	18	55	21	62	23
242	Bedford	1157	364	1218	383	1285	404
243	Bedford	900	302	961	322	1028	345
244	Bedford	202	64	214	68	228	72
245	Bedford	1783	591	1808	599	1835	608
246	Bedford	292	149	301	153	310	158
289	Bedford	605	174	629	181	656	189
290	Bedford	624	185	746	221	880	261
173	Candia	283	117	275	114	268	111
174	Candia	506	193	495	189	485	185
175	Candia	345	128	355	132	366	136
176	Candia	431	152	444	156	457	161
177	Candia	914	336	891	327	871	320
178	Candia	199	75	194	73	190	72
179	Candia	628	243	629	243	632	244
180	Candia	307	116	305	116	304	115
181	Candia	296	104	302	106	308	108
148	Chester	646	223	680	235	717	248
149	Chester	427	152	474	169	525	187
150	Chester	416	161	450	175	487	189
151	Chester	447	160	487	174	531	190
152	Chester	1126	328	1219	356	1320	385

		2030		2035		2040	
TAZ	TOWN	Pop	HH	Pop	HH	Pop	HH
71	Auburn	63	32	64	33	64	33
72	Auburn	2404	887	2432	897	2438	899
73	Auburn	1165	403	1185	410	1189	411
74	Auburn	1029	353	1040	357	1042	357
98	Auburn	1297	480	1312	486	1315	487
89	Bedford	1089	372	1095	375	1097	376
90	Bedford	332	116	338	118	340	119
91	Bedford	2283	721	2301	727	2307	729
92	Bedford	1752	541	1773	547	1780	549
93	Bedford	351	118	360	121	363	122
94	Bedford	122	47	121	46	121	46
95	Bedford	2069	1041	2114	1065	2130	1074
104	Bedford	1804	566	1822	572	1829	574
105	Bedford	1898	588	1910	592	1914	593
106	Bedford	1460	460	1475	465	1480	466
107	Bedford	642	235	645	236	646	236
108	Bedford	579	205	582	206	583	207
109	Bedford	861	346	870	350	873	351
110	Bedford	1435	538	1438	540	1439	540
238	Bedford	879	268	915	279	927	283
239	Bedford	978	315	993	320	998	321
240	Bedford	332	127	335	128	336	128
241	Bedford	64	24	66	24	66	25
242	Bedford	1309	412	1324	417	1329	418
243	Bedford	1052	353	1067	358	1072	360
244	Bedford	232	73	235	74	237	75
245	Bedford	1844	611	1850	613	1852	613
246	Bedford	313	160	315	161	316	161
289	Bedford	666	191	672	193	674	194
290	Bedford	928	275	958	284	969	287
173	Candia	272	112	275	113	275	114
174	Candia	493	188	497	190	498	190
175	Candia	379	140	386	143	387	144
176	Candia	472	166	480	169	482	170
177	Candia	883	324	889	327	890	327
178	Candia	193	73	194	73	195	73
179	Candia	649	251	659	255	661	256
180	Candia	311	118	315	119	316	120
181	Candia	316	111	321	113	322	113
148	Chester	731	252	739	255	740	256
149	Chester	543	193	554	197	556	198
150	Chester	501	194	509	197	510	198
151	Chester	547	196	556	199	558	200
152	Chester	1357	396	1379	402	1383	403

TAZ	TOWN	HHS2015
71	Auburn	1.96
72	Auburn	2.71
73	Auburn	2.89
74	Auburn	2.92
98	Auburn	2.70
89	Bedford	2.67
90	Bedford	2.87
91	Bedford	3.16
92	Bedford	3.24
93	Bedford	2.97
94	Bedford	2.61
95	Bedford	1.83
104	Bedford	3.02
105	Bedford	3.23
106	Bedford	3.18
107	Bedford	2.73
108	Bedford	2.82
109	Bedford	2.38
110	Bedford	2.13
238	Bedford	3.27
239	Bedford	3.11
240	Bedford	2.63
241	Bedford	2.68
242	Bedford	3.18
243	Bedford	2.98
244	Bedford	3.16
245	Bedford	3.02
246	Bedford	1.96
289	Bedford	3.48
290	Bedford	3.38
173	Candia	2.42
174	Candia	2.62
175	Candia	2.70
176	Candia	2.84
177	Candia	2.72
178	Candia	2.65
179	Candia	2.59
180	Candia	2.64
181	Candia	2.85
148	Chester	2.89
149	Chester	2.81
150	Chester	2.58
151	Chester	2.80
152	Chester	3.43

		2015		2020		2025	
TAZ	TOWN	Pop	HH	Pop	HH	Pop	HH
153	Chester	430	148	452	155	475	163
154	Chester	567	204	582	210	599	216
155	Chester	829	244	854	252	881	260
182	Deerfield	593	198	633	211	675	225
183	Deerfield	481	166	511	177	545	188
184	Deerfield	432	152	460	162	491	173
185	Deerfield	463	186	483	194	504	202
186	Deerfield	362	125	386	133	412	142
187	Deerfield	492	187	507	193	524	200
188	Deerfield	416	141	438	148	462	157
189	Deerfield	504	184	522	191	541	198
190	Deerfield	257	102	268	106	280	111
191	Deerfield	413	140	424	143	436	148
121	Derry	2338	806	2295	791	2256	778
122	Derry	809	276	796	271	783	267
123	Derry	837	260	838	260	839	261
124	Derry	1040	543	996	520	955	499
125	Derry	3	2	3	2	3	2
126	Derry	552	289	528	276	506	265
127	Derry	1088	463	1056	448	1027	435
128	Derry	882	282	917	293	952	304
129	Derry	422	143	416	141	410	139
130	Derry	674	258	661	253	648	248
131	Derry	1352	609	1309	588	1269	568
132	Derry	719	316	716	314	713	313
133	Derry	70	24	73	25	76	26
134	Derry	616	269	605	264	595	260
135	Derry	743	397	714	381	687	367
136	Derry	2418	1089	2342	1055	2272	1023
137	Derry	530	206	529	205	528	205
138	Derry	1411	491	1380	480	1350	470
139	Derry	1162	366	1145	360	1130	355
140	Derry	445	152	475	162	504	172
141	Derry	863	304	861	304	860	303
142	Derry	804	279	810	281	817	284
143	Derry	845	264	843	263	842	262
144	Derry	1519	553	1495	544	1473	537
145	Derry	372	137	382	141	393	145
146	Derry	1477	486	1466	483	1456	479
147	Derry	2091	672	2107	677	2124	683
221	Derry	712	299	685	288	660	277
222	Derry	863	385	830	371	800	357
223	Derry	445	167	432	162	419	157
224	Derry	841	401	812	387	786	375

		2030		2035		2040	
TAZ	TOWN	Pop	HH	Pop	HH	Pop	HH
153	Chester	484	166	489	168	490	168
154	Chester	605	218	609	220	610	220
155	Chester	891	263	897	264	898	265
182	Deerfield	695	232	706	236	708	236
183	Deerfield	560	194	569	197	570	197
184	Deerfield	505	178	514	181	515	181
185	Deerfield	514	206	519	209	521	209
186	Deerfield	424	146	431	149	432	149
187	Deerfield	532	203	536	204	537	205
188	Deerfield	473	160	479	162	480	163
189	Deerfield	549	201	554	203	555	203
190	Deerfield	285	113	288	114	289	115
191	Deerfield	441	149	444	151	445	151
121	Derry	2284	788	2301	793	2304	794
122	Derry	794	271	800	273	801	273
123	Derry	863	268	877	272	879	273
124	Derry	957	500	958	500	958	500
125	Derry	3	2	3	2	3	2
126	Derry	506	265	507	265	507	265
127	Derry	1037	440	1043	442	1045	443
128	Derry	1016	325	1053	336	1060	339
129	Derry	417	142	421	143	422	144
130	Derry	659	252	665	254	666	255
131	Derry	1283	575	1291	579	1293	580
132	Derry	748	329	769	338	773	339
133	Derry	82	28	85	29	85	29
134	Derry	616	269	629	275	631	276
135	Derry	701	375	710	379	711	380
136	Derry	2297	1034	2311	1041	2314	1042
137	Derry	549	213	562	218	564	219
138	Derry	1361	473	1367	476	1368	476
139	Derry	1144	360	1152	363	1154	363
140	Derry	554	189	583	199	588	201
141	Derry	889	314	905	319	908	320
142	Derry	853	296	874	303	877	304
143	Derry	863	269	876	273	878	274
144	Derry	1509	550	1529	557	1533	558
145	Derry	422	156	438	162	441	163
146	Derry	1488	490	1507	496	1510	497
147	Derry	2203	708	2248	722	2257	725
221	Derry	661	277	661	277	661	278
222	Derry	800	357	801	357	801	357
223	Derry	420	157	420	158	420	158
224	Derry	796	380	802	383	804	383

TAZ	TOWN	HHS2015
153	Chester	2.91
154	Chester	2.77
155	Chester	3.39
182	Deerfield	3.00
183	Deerfield	2.89
184	Deerfield	2.84
185	Deerfield	2.49
186	Deerfield	2.90
187	Deerfield	2.47
188	Deerfield	2.95
189	Deerfield	2.73
190	Deerfield	2.52
191	Deerfield	2.87
121	Derry	2.90
122	Derry	2.93
123	Derry	3.22
124	Derry	1.91
125	Derry	1.46
126	Derry	1.91
127	Derry	2.22
128	Derry	3.13
129	Derry	2.94
130	Derry	2.61
131	Derry	2.05
132	Derry	2.28
133	Derry	2.92
134	Derry	2.29
135	Derry	1.87
136	Derry	2.22
137	Derry	2.57
138	Derry	2.87
139	Derry	3.18
140	Derry	2.93
141	Derry	2.83
142	Derry	2.88
143	Derry	3.21
144	Derry	2.75
145	Derry	2.70
146	Derry	3.04
147	Derry	3.11
221	Derry	2.38
222	Derry	2.24
223	Derry	2.67
224	Derry	2.10

		2015		2020		2025	
TAZ	TOWN	Pop	HH	Pop	HH	Pop	HH
225	Derry	414	167	404	163	395	159
226	Derry	1226	406	1206	399	1187	393
227	Derry	645	215	640	213	635	212
228	Derry	689	283	670	275	653	268
83	Goffstown	822	302	845	311	876	322
84	Goffstown	801	278	812	282	826	287
85	Goffstown	1302	494	1310	497	1321	501
86	Goffstown	803	316	807	318	813	320
87	Goffstown	639	129	658	136	683	144
88	Goffstown	3360	1369	3368	1372	3380	1377
111	Goffstown	751	288	763	293	780	299
112	Goffstown	1200	510	1214	516	1234	524
113	Goffstown	692	269	698	271	707	274
114	Goffstown	1295	596	1303	600	1315	605
234	Goffstown	639	207	665	215	702	227
235	Goffstown	1169	377	1199	387	1242	401
236	Goffstown	1736	49	1738	50	1741	51
237	Goffstown	754	262	760	264	769	267
286	Goffstown	1102	489	1111	493	1122	499
287	Goffstown	558	194	575	199	598	207
288	Goffstown	222	77	224	78	227	79
10	Hooksett	2436	1048	2603	1120	2802	1206
18	Hooksett	2364	716	2411	735	2466	759
75	Hooksett	2034	645	2164	687	2319	736
76	Hooksett	843	307	890	324	945	344
77	Hooksett	913	353	941	364	974	377
78	Hooksett	1602	559	1741	608	1907	666
79	Hooksett	615	267	671	291	737	320
80	Hooksett	921	374	972	395	1033	420
81	Hooksett	464	182	575	226	708	278
82	Hooksett	1176	399	1260	428	1360	462
96	Hooksett	985	342	1050	365	1127	392
97	Hooksett	121	50	125	52	131	55
64L	Londonderry	0	0	0	0	0	0
65	Londonderry	137	46	137	46	138	46
66	Londonderry	236	97	241	99	247	102
67	Londonderry	1473	621	1487	626	1502	633
68	Londonderry	1830	678	1841	682	1854	687
69	Londonderry	58	18	62	19	67	21
70	Londonderry	577	183	585	186	595	188
99	Londonderry	842	289	853	293	865	298
100	Londonderry	1620	522	1695	546	1781	574
101	Londonderry	2690	844	2771	869	2865	899
102	Londonderry	2276	736	2341	757	2416	781

		2030		2035		2040	
TAZ	TOWN	Pop	HH	Pop	HH	Pop	HH
225	Derry	402	162	406	164	407	164
226	Derry	1202	398	1210	401	1211	401
227	Derry	650	216	658	219	659	220
228	Derry	660	271	664	273	665	273
83	Goffstown	915	336	939	345	948	349
84	Goffstown	844	293	855	297	859	298
85	Goffstown	1336	507	1345	510	1348	511
86	Goffstown	820	323	824	325	826	325
87	Goffstown	715	155	735	162	742	164
88	Goffstown	3394	1383	3403	1386	3406	1388
111	Goffstown	802	307	815	312	820	314
112	Goffstown	1259	535	1274	542	1280	544
113	Goffstown	717	279	724	281	726	282
114	Goffstown	1329	612	1338	616	1341	617
234	Goffstown	748	242	777	252	787	255
235	Goffstown	1295	419	1328	430	1340	434
236	Goffstown	1745	52	1747	53	1748	53
237	Goffstown	779	271	786	273	788	274
286	Goffstown	1136	506	1145	510	1148	512
287	Goffstown	626	217	644	223	650	225
288	Goffstown	230	80	233	81	233	81
10	Hooksett	2906	1251	2986	1285	3039	1308
18	Hooksett	2495	771	2517	780	2532	786
75	Hooksett	2400	761	2462	781	2503	794
76	Hooksett	974	355	996	363	1011	368
77	Hooksett	992	383	1005	388	1014	392
78	Hooksett	1994	696	2061	719	2104	734
79	Hooksett	772	335	799	347	816	354
80	Hooksett	1064	433	1089	443	1105	449
81	Hooksett	778	306	831	327	866	340
82	Hooksett	1412	479	1452	493	1478	502
96	Hooksett	1168	406	1199	417	1219	424
97	Hooksett	134	56	136	57	137	57
64L	Londonderry	0	0	0	0	0	0
65	Londonderry	139	46	139	47	139	47
66	Londonderry	253	104	257	106	257	106
67	Londonderry	1517	639	1525	642	1527	643
68	Londonderry	1865	691	1872	694	1873	694
69	Londonderry	71	22	73	23	74	23
70	Londonderry	603	191	608	193	609	193
99	Londonderry	877	302	884	304	885	304
100	Londonderry	1861	600	1907	614	1916	617
101	Londonderry	2952	926	3002	942	3012	945
102	Londonderry	2486	804	2526	817	2533	819

TAZ	TOWN	HHS2015
225	Derry	2.48
226	Derry	3.02
227	Derry	3.00
228	Derry	2.44
83	Goffstown	2.72
84	Goffstown	2.82
85	Goffstown	2.61
86	Goffstown	2.54
87	Goffstown	2.95
88	Goffstown	2.41
111	Goffstown	2.61
112	Goffstown	2.35
113	Goffstown	2.58
114	Goffstown	2.17
234	Goffstown	3.09
235	Goffstown	2.99
236	Goffstown	2.86
237	Goffstown	2.88
286	Goffstown	2.00
287	Goffstown	2.88
288	Goffstown	2.88
10	Hooksett	2.32
18	Hooksett	2.37
75	Hooksett	3.15
76	Hooksett	2.74
77	Hooksett	2.59
78	Hooksett	2.87
79	Hooksett	2.30
80	Hooksett	2.46
81	Hooksett	2.54
82	Hooksett	2.95
96	Hooksett	2.88
97	Hooksett	2.40
64L	Londonderry	0.00
65	Londonderry	2.98
66	Londonderry	2.43
67	Londonderry	2.37
68	Londonderry	2.70
69	Londonderry	3.21
70	Londonderry	3.15
99	Londonderry	2.91
100	Londonderry	3.10
101	Londonderry	3.19
102	Londonderry	3.09

TAZ	TOWN	2015 Pop	2015 HH	2020 Pop	2020 HH	2025 Pop	2025 HH
103	Londonderry	1347	434	1358	438	1370	442
229	Londonderry	1186	369	1218	379	1256	390
230	Londonderry	197	79	200	80	203	81
231	Londonderry	155	53	160	54	167	57
232	Londonderry	957	294	968	297	980	301
233	Londonderry	956	296	1004	311	1061	329
274	Londonderry	362	106	373	109	385	113
275	Londonderry	845	309	872	319	903	330
276	Londonderry	1304	531	1342	547	1386	565
277	Londonderry	20	7	23	8	26	9
278	Londonderry	263	98	268	100	275	102
279	Londonderry	551	172	556	174	563	176
280	Londonderry	304	181	309	184	315	188
281	Londonderry	1152	396	1185	407	1222	420
282	Londonderry	578	220	583	222	590	224
283	Londonderry	815	313	818	314	821	315
284	Londonderry	22	11	23	11	23	12
285	Londonderry	1767	600	1783	605	1802	612
1	Manchester	5337	2305	5344	2308	5408	2336
2	Manchester	1617	631	1618	631	1620	632
3	Manchester	427	178	427	178	428	178
4	Manchester	1508	610	1508	610	1511	611
5	Manchester	718	323	718	323	718	323
6	Manchester	2675	1572	2677	1504	2704	1520
7	Manchester	4154	2089	4164	2155	4263	2207
8	Manchester	1385	648	1388	649	1423	665
9	Manchester	3292	1460	3292	1460	3293	1460
11	Manchester	6038	2422	6038	2422	6043	2424
12	Manchester	2335	1038	2336	1038	2338	1039
13	Manchester	1854	767	1855	767	1860	769
14	Manchester	1372	656	1373	656	1378	659
15	Manchester	2168	904	2168	904	2169	905
16	Manchester	209	131	209	131	209	131
17	Manchester	399	191	399	152	399	152
19	Manchester	267	137	267	198	267	198
20	Manchester	262	109	262	109	262	109
21	Manchester	477	191	478	191	479	191
22	Manchester	881	377	881	358	881	358
23	Manchester	442	190	443	211	445	212
24	Manchester	714	389	714	389	714	389
25	Manchester	92	29	92	29	92	29
26	Manchester	401	246	401	222	406	225
27	Manchester	923	467	923	432	923	432
28	Manchester	377	170	377	95	377	95

		2030		2035		2040	
TAZ	TOWN	Pop	HH	Pop	HH	Pop	HH
103	Londonderry	1382	446	1388	448	1390	448
229	Londonderry	1290	401	1311	407	1314	409
230	Londonderry	206	83	207	83	208	83
231	Londonderry	172	59	176	60	176	60
232	Londonderry	992	304	998	306	1000	307
233	Londonderry	1113	345	1143	354	1149	356
274	Londonderry	397	116	404	118	405	118
275	Londonderry	932	341	949	347	952	348
276	Londonderry	1426	581	1450	591	1454	593
277	Londonderry	29	10	30	11	31	11
278	Londonderry	280	104	284	106	284	106
279	Londonderry	568	177	572	178	572	179
280	Londonderry	321	191	324	193	325	193
281	Londonderry	1257	432	1277	439	1281	440
282	Londonderry	595	227	599	228	599	228
283	Londonderry	824	316	826	317	826	317
284	Londonderry	24	12	24	12	24	12
285	Londonderry	1819	618	1829	621	1831	622
1	Manchester	5684	2455	5857	2530	5917	2556
2	Manchester	1631	636	1637	639	1640	640
3	Manchester	430	179	431	180	432	180
4	Manchester	1521	615	1528	618	1530	619
5	Manchester	719	323	720	324	720	324
6	Manchester	2821	1589	2895	1632	2920	1647
7	Manchester	4688	2427	4955	2565	5047	2613
8	Manchester	1572	735	1665	779	1697	794
9	Manchester	3297	1462	3300	1463	3301	1464
11	Manchester	6064	2433	6078	2438	6082	2440
12	Manchester	2349	1044	2355	1047	2358	1048
13	Manchester	1881	778	1894	783	1899	785
14	Manchester	1399	669	1412	675	1417	677
15	Manchester	2173	907	2176	908	2177	908
16	Manchester	209	131	209	131	209	131
17	Manchester	401	153	403	154	403	154
19	Manchester	267	198	267	198	267	198
20	Manchester	262	109	262	109	262	109
21	Manchester	483	193	485	194	486	195
22	Manchester	881	358	881	358	881	358
23	Manchester	456	217	462	221	465	222
24	Manchester	714	389	714	389	714	389
25	Manchester	94	30	96	30	96	30
26	Manchester	428	238	441	247	446	249
27	Manchester	923	432	923	432	923	432
28	Manchester	377	95	377	95	377	95

TAZ	TOWN	HHS2015
103	Londonderry	3.10
229	Londonderry	3.22
230	Londonderry	2.49
231	Londonderry	2.94
232	Londonderry	3.26
233	Londonderry	3.23
274	Londonderry	3.42
275	Londonderry	2.74
276	Londonderry	2.45
277	Londonderry	2.86
278	Londonderry	2.69
279	Londonderry	3.20
280	Londonderry	1.68
281	Londonderry	2.91
282	Londonderry	2.63
283	Londonderry	2.61
284	Londonderry	2.00
285	Londonderry	2.95
1	Manchester	2.32
2	Manchester	2.56
3	Manchester	2.40
4	Manchester	2.47
5	Manchester	2.22
6	Manchester	1.70
7	Manchester	1.93
8	Manchester	2.14
9	Manchester	2.26
11	Manchester	2.49
12	Manchester	2.25
13	Manchester	2.42
14	Manchester	2.09
15	Manchester	2.40
16	Manchester	1.59
17	Manchester	2.09
19	Manchester	1.35
20	Manchester	2.40
21	Manchester	2.50
22	Manchester	2.34
23	Manchester	2.10
24	Manchester	1.83
25	Manchester	3.17
26	Manchester	1.63
27	Manchester	1.89
28	Manchester	1.61

		2015		2020		2025	
TAZ	TOWN	Pop	HH	Pop	HH	Pop	HH
29	Manchester	1835	695	1835	793	1835	793
30	Manchester	2288	989	2288	989	2288	989
31	Manchester	923	478	924	403	926	405
32	Manchester	464	297	465	432	469	437
33	Manchester	442	339	442	250	443	251
34	Manchester	562	251	563	317	563	317
35	Manchester	1170	444	1170	444	1170	444
36	Manchester	1390	557	1390	557	1390	558
37	Manchester	932	392	932	343	932	343
38	Manchester	971	410	971	447	978	450
39	Manchester	1145	435	1145	393	1146	393
40	Manchester	2123	877	2126	943	2156	956
41	Manchester	1406	579	1407	579	1409	580
42	Manchester	784	414	784	415	786	416
43	Manchester	656	238	656	238	657	238
44	Manchester	594	183	594	183	594	183
45	Manchester	606	181	606	181	608	181
46	Manchester	292	110	293	-113	295	-112
47	Manchester	890	123	890	368	890	368
48	Manchester	464	161	464	161	464	161
49	Manchester	1102	415	1103	415	1105	415
50	Manchester	1372	567	1372	567	1373	567
51	Manchester	1588	643	1589	597	1589	597
52	Manchester	2472	990	2473	1038	2475	1039
53	Manchester	701	275	702	276	707	278
54	Manchester	213	46	213	46	214	46
55	Manchester	3040	1201	3044	1202	3078	1216
56	Manchester	638	245	639	245	644	247
57	Manchester	1582	607	1583	607	1585	608
58	Manchester	2702	1118	2702	1093	2702	1093
59	Manchester	625	260	626	288	636	293
60	Manchester	4167	1621	4168	1621	4174	1623
61	Manchester	25	15	25	15	25	15
62	Manchester	5	4	5	4	5	4
63	Manchester	2226	759	2228	760	2245	766
64	Manchester	0	0	0	0	0	0
115	Manchester	297	102	297	120	298	120
116	Manchester	1839	828	1839	829	1842	830
117	Manchester	2075	834	2076	550	2085	554
118	Manchester	1947	507	1948	796	1954	799
119	Manchester	1570	611	1574	612	1608	625
120	Manchester	1186	488	1186	488	1186	488
247	Manchester	38	19	38	19	38	19
248	Manchester	251	125	251	117	252	117

		2030		2035		2040	
TAZ	TOWN	Pop	HH	Pop	HH	Pop	HH
29	Manchester	1835	793	1835	793	1835	793
30	Manchester	2288	989	2288	989	2288	989
31	Manchester	937	410	943	414	946	415
32	Manchester	491	457	504	469	509	474
33	Manchester	445	252	446	253	447	254
34	Manchester	564	317	564	318	565	318
35	Manchester	1170	444	1170	444	1170	444
36	Manchester	1392	559	1394	559	1394	559
37	Manchester	932	343	932	343	932	343
38	Manchester	1004	463	1021	471	1027	474
39	Manchester	1150	395	1153	396	1154	396
40	Manchester	2283	1013	2363	1048	2391	1061
41	Manchester	1420	584	1426	587	1429	588
42	Manchester	796	421	802	424	804	425
43	Manchester	664	241	668	242	669	243
44	Manchester	594	183	594	183	594	183
45	Manchester	615	184	620	185	621	185
46	Manchester	303	-109	308	-107	310	-107
47	Manchester	890	368	890	368	890	368
48	Manchester	464	161	464	161	464	161
49	Manchester	1114	419	1120	421	1122	422
50	Manchester	1375	568	1376	569	1377	569
51	Manchester	1591	598	1593	598	1593	598
52	Manchester	2486	1044	2492	1047	2495	1048
53	Manchester	728	286	741	291	746	293
54	Manchester	219	47	221	48	222	48
55	Manchester	3227	1274	3320	1311	3353	1324
56	Manchester	665	255	678	260	683	262
57	Manchester	1596	612	1602	614	1605	615
58	Manchester	2702	1093	2702	1094	2702	1094
59	Manchester	678	312	705	324	714	329
60	Manchester	4199	1633	4215	1639	4221	1642
61	Manchester	25	15	25	15	25	15
62	Manchester	5	4	5	4	5	4
63	Manchester	2320	791	2366	807	2382	813
64	Manchester	0	0	0	0	0	0
115	Manchester	302	122	305	123	306	123
116	Manchester	1855	836	1863	839	1865	840
117	Manchester	2122	569	2145	578	2154	582
118	Manchester	1982	810	1999	817	2005	819
119	Manchester	1757	683	1850	720	1882	732
120	Manchester	1188	489	1190	490	1190	490
247	Manchester	38	19	38	19	38	19
248	Manchester	254	118	255	119	256	119

TAZ	TOWN	HHS2015
29	Manchester	2.32
30	Manchester	2.31
31	Manchester	1.93
32	Manchester	1.07
33	Manchester	1.30
34	Manchester	1.78
35	Manchester	2.64
36	Manchester	2.49
37	Manchester	2.38
38	Manchester	2.08
39	Manchester	2.55
40	Manchester	2.25
41	Manchester	2.43
42	Manchester	1.89
43	Manchester	2.76
44	Manchester	3.25
45	Manchester	3.35
46	Manchester	2.65
47	Manchester	2.42
48	Manchester	2.88
49	Manchester	2.66
50	Manchester	2.42
51	Manchester	2.47
52	Manchester	2.38
53	Manchester	2.55
54	Manchester	4.64
55	Manchester	2.53
56	Manchester	2.61
57	Manchester	2.61
58	Manchester	2.42
59	Manchester	2.17
60	Manchester	2.57
61	Manchester	1.70
62	Manchester	1.20
63	Manchester	2.93
64	Manchester	0.00
115	Manchester	2.48
116	Manchester	2.22
117	Manchester	2.49
118	Manchester	2.45
119	Manchester	2.57
120	Manchester	2.43
247	Manchester	2.01
248	Manchester	2.01

		2015		2020		2025	
TAZ	TOWN	Pop	HH	Pop	HH	Pop	HH
249	Manchester	368	227	368	237	368	237
250	Manchester	312	251	312	251	312	251
251	Manchester	172	107	172	107	175	109
252	Manchester	254	69	254	69	254	69
253	Manchester	199	132	199	132	199	132
254	Manchester	137	122	137	122	137	122
255	Manchester	408	205	408	205	408	205
256	Manchester	497	277	497	277	497	277
257	Manchester	212	76	212	76	212	76
258	Manchester	1169	331	1169	331	1170	331
259	Manchester	893	316	893	316	894	316
260	Manchester	1254	451	1254	451	1254	451
261	Manchester	1708	687	1708	687	1710	688
262	Manchester	573	255	573	255	574	256
263	Manchester	1410	608	1410	608	1410	608
264	Manchester	665	256	665	256	665	256
265	Manchester	458	198	458	198	459	198
266	Manchester	889	516	889	516	889	516
267	Manchester	2477	990	2477	990	2477	990
268	Manchester	130	57	130	57	130	57
269	Manchester	264	109	264	109	264	109
270	Manchester	1126	533	1129	534	1154	546
271	Manchester	1364	817	1364	817	1367	819
272	Manchester	445	172	445	172	445	172
273	Manchester	112	58	112	58	112	58
192	New Boston	707	268	739	276	775	290
193	New Boston	399	153	413	162	429	169
194	New Boston	458	165	483	174	511	184
195	New Boston	402	153	435	165	471	178
196	New Boston	433	162	447	167	463	173
197	New Boston	581	210	624	226	671	243
198	New Boston	504	182	569	205	641	231
199	New Boston	894	295	966	318	1045	344
200	New Boston	393	140	414	148	438	157
201	New Boston	687	250	726	264	770	280
156	Raymond	530	194	542	198	556	203
157	Raymond	1036	404	1050	410	1068	417
158	Raymond	818	276	828	279	840	284
159	Raymond	1024	349	1037	354	1053	359
160	Raymond	411	146	419	145	427	148
161	Raymond	658	230	664	235	671	238
162	Raymond	510	221	515	223	520	225
163	Raymond	434	201	441	205	450	209
164	Raymond	345	151	346	152	348	152

		2030		2035		2040	
TAZ	TOWN	Pop	HH	Pop	HH	Pop	HH
249	Manchester	368	237	368	237	368	237
250	Manchester	312	251	312	251	312	251
251	Manchester	190	119	200	124	203	126
252	Manchester	256	69	256	70	256	70
253	Manchester	199	132	199	132	199	132
254	Manchester	138	123	139	124	139	124
255	Manchester	409	206	410	206	410	206
256	Manchester	497	277	497	277	497	277
257	Manchester	213	77	214	77	214	77
258	Manchester	1171	331	1171	332	1172	332
259	Manchester	899	318	903	319	904	320
260	Manchester	1256	452	1258	452	1258	452
261	Manchester	1716	690	1720	692	1721	692
262	Manchester	579	258	583	260	584	260
263	Manchester	1413	609	1414	609	1414	610
264	Manchester	665	256	665	256	665	256
265	Manchester	463	200	466	201	467	202
266	Manchester	889	516	889	517	889	517
267	Manchester	2477	990	2477	990	2477	990
268	Manchester	130	57	130	57	130	57
269	Manchester	264	109	264	109	264	109
270	Manchester	1260	596	1326	628	1349	639
271	Manchester	1377	825	1384	829	1386	830
272	Manchester	445	172	445	172	445	172
273	Manchester	112	59	112	59	113	59
192	New Boston	786	294	793	297	795	297
193	New Boston	434	170	437	172	438	172
194	New Boston	519	187	525	188	527	189
195	New Boston	481	182	488	185	490	186
196	New Boston	468	175	471	176	472	176
197	New Boston	686	248	695	251	698	252
198	New Boston	662	239	676	244	680	245
199	New Boston	1069	352	1084	357	1089	359
200	New Boston	445	159	450	161	451	161
201	New Boston	783	285	791	288	794	289
156	Raymond	574	210	585	214	587	215
157	Raymond	1092	426	1105	431	1108	432
158	Raymond	857	289	867	292	868	293
159	Raymond	1074	367	1086	371	1088	371
160	Raymond	439	152	446	154	447	155
161	Raymond	680	241	686	243	687	244
162	Raymond	527	228	531	230	532	230
163	Raymond	461	214	468	217	469	218
164	Raymond	351	153	352	154	352	154

TAZ	TOWN	HHS2015
249	Manchester	1.55
250	Manchester	1.24
251	Manchester	1.60
252	Manchester	3.68
253	Manchester	1.51
254	Manchester	1.12
255	Manchester	1.99
256	Manchester	1.79
257	Manchester	2.77
258	Manchester	3.53
259	Manchester	2.83
260	Manchester	2.78
261	Manchester	2.49
262	Manchester	2.24
263	Manchester	2.32
264	Manchester	2.60
265	Manchester	2.31
266	Manchester	1.72
267	Manchester	2.50
268	Manchester	2.28
269	Manchester	2.43
270	Manchester	2.11
271	Manchester	1.67
272	Manchester	2.59
273	Manchester	1.92
192	New Boston	2.64
193	New Boston	2.55
194	New Boston	2.78
195	New Boston	2.64
196	New Boston	2.67
197	New Boston	2.77
198	New Boston	2.77
199	New Boston	3.03
200	New Boston	2.80
201	New Boston	2.75
156	Raymond	2.73
157	Raymond	2.56
158	Raymond	2.96
159	Raymond	2.93
160	Raymond	2.82
161	Raymond	2.82
162	Raymond	2.31
163	Raymond	2.15
164	Raymond	2.28

		2015		2020		2025	
TAZ	TOWN	Pop	HH	Pop	HH	Pop	HH
165	Raymond	458	188	476	195	496	204
166	Raymond	402	153	403	154	405	154
167	Raymond	522	194	544	202	570	212
168	Raymond	612	224	618	226	625	229
169	Raymond	293	115	293	115	293	115
170	Raymond	969	385	978	388	990	393
171	Raymond	895	347	908	353	924	359
172	Raymond	340	182	340	183	341	183
202	Weare	645	221	657	225	671	230
203	Weare	448	143	452	145	458	146
204	Weare	324	111	329	113	335	115
205	Weare	395	159	408	164	423	170
206	Weare	507	197	522	202	539	209
207	Weare	404	151	416	155	430	160
208	Weare	644	229	664	236	686	244
209	Weare	696	245	712	251	732	257
210	Weare	437	168	449	172	463	178
211	Weare	433	170	445	175	460	181
212	Weare	428	179	457	191	491	205
213	Weare	293	113	305	118	319	123
214	Weare	607	197	626	204	649	211
215	Weare	434	157	441	160	450	163
216	Weare	264	110	268	112	274	114
217	Weare	405	141	415	144	426	148
218	Weare	475	155	492	160	512	167
219	Weare	550	195	562	199	576	204
220	Weare	422	159	430	162	440	166
291	Windham	2736	947	2910	1007	3098	1072
292	Windham	1545	484	1615	487	1690	511
293	Windham	498	189	538	204	581	222
294	Windham	2140	738	2400	853	2680	953
295	Windham	636	266	691	283	750	308
296	Windham	2797	1012	3150	1146	3530	1285
297	Windham	1030	377	1067	391	1108	405
298	Windham	399	162	426	173	455	185
299	Windham	2521	840	2617	871	2720	906
300	Francestown	248	92	249	93	250	93
301	Francestown	250	104	253	105	256	107
302	Francestown	148	62	150	62	152	63
303	Francestown	189	67	190	67	192	68
304	Francestown	471	184	477	186	486	190
305	Francestown	256	104	258	105	260	106
375	Londonderry	0	0	0	0	0	0
376	Londonderry	374	127	378	128	383	130

		2030		2035		2040	
TAZ	TOWN	Pop	HH	Pop	HH	Pop	HH
165	Raymond	525	216	541	222	544	223
166	Raymond	408	155	409	156	409	156
167	Raymond	606	225	626	232	630	234
168	Raymond	634	232	640	234	641	235
169	Raymond	294	115	294	115	294	115
170	Raymond	1005	399	1013	402	1015	403
171	Raymond	945	367	957	372	960	373
172	Raymond	342	184	343	184	343	184
202	Weare	680	233	686	235	688	236
203	Weare	462	148	464	148	465	149
204	Weare	338	116	341	117	341	117
205	Weare	433	174	440	177	442	178
206	Weare	549	213	556	216	559	217
207	Weare	439	164	445	166	447	167
208	Weare	701	249	710	252	713	253
209	Weare	745	262	753	265	756	266
210	Weare	472	181	477	183	479	184
211	Weare	469	184	474	186	476	187
212	Weare	512	214	526	219	531	221
213	Weare	328	127	333	129	335	130
214	Weare	663	216	672	219	676	220
215	Weare	455	165	458	166	460	166
216	Weare	278	116	280	117	281	117
217	Weare	433	151	438	152	439	153
218	Weare	524	171	532	174	535	175
219	Weare	585	207	591	209	593	210
220	Weare	447	168	451	170	452	170
291	Windham	3156	1092	3190	1104	3196	1106
292	Windham	1714	518	1727	523	1730	523
293	Windham	595	228	602	231	604	232
294	Windham	2767	984	2816	1001	2826	1005
295	Windham	768	315	778	320	780	321
296	Windham	3647	1327	3715	1352	3728	1357
297	Windham	1120	410	1128	413	1129	413
298	Windham	464	188	470	190	471	191
299	Windham	2752	916	2770	922	2774	924
300	Francestown	253	94	254	94	255	95
301	Francestown	262	109	265	111	267	111
302	Francestown	156	65	158	66	159	66
303	Francestown	194	69	196	69	196	69
304	Francestown	500	195	508	198	511	199
305	Francestown	263	107	265	108	266	108
375	Londonderry	0	0	0	0	0	0
376	Londonderry	387	131	389	132	390	132

TAZ	TOWN	HHS2015
165	Raymond	2.44
166	Raymond	2.63
167	Raymond	2.69
168	Raymond	2.73
169	Raymond	2.55
170	Raymond	2.52
171	Raymond	2.58
172	Raymond	1.86
202	Weare	2.92
203	Weare	3.13
204	Weare	2.92
205	Weare	2.49
206	Weare	2.58
207	Weare	2.68
208	Weare	2.81
209	Weare	2.84
210	Weare	2.61
211	Weare	2.54
212	Weare	2.40
213	Weare	2.58
214	Weare	3.07
215	Weare	2.76
216	Weare	2.40
217	Weare	2.87
218	Weare	3.06
219	Weare	2.82
220	Weare	2.66
291	Windham	2.89
292	Windham	3.19
293	Windham	2.33
294	Windham	2.81
295	Windham	2.39
296	Windham	2.75
297	Windham	2.73
298	Windham	2.47
299	Windham	3.00
300	Francestown	2.69
301	Francestown	2.40
302	Francestown	2.40
303	Francestown	2.83
304	Francestown	2.56
305	Francestown	2.46
375	Londonderry	0.00
376	Londonderry	2.94

		2015		2020		2025	
TAZ	TOWN	Pop	HH	Pop	HH	Pop	HH
377	Derry	8	2	9	2	11	3
378	Derry	315	154	303	148	292	143
379	Derry	416	134	426	137	436	141
380	Derry	278	103	271	100	264	98
381	Derry	15	5	14	5	14	5

		2030		2035		2040	
TAZ	TOWN	Pop	HH	Pop	HH	Pop	HH
377	Derry	12	3	13	3	13	3
378	Derry	292	143	293	143	293	143
379	Derry	460	148	473	152	476	153
380	Derry	265	98	266	99	266	99
381	Derry	14	5	14	5	14	5

TAZ	TOWN	HHS2015
377	Derry	3.96
378	Derry	2.05
379	Derry	3.10
380	Derry	2.70
381	Derry	2.96

From:	Julie Chen
To:	Snyder, Kerri
Cc:	Tidd, Leo; Chris Bean; I93-Exit4A-EIS (SM); Hodgson (Rydland), Laura; David Preece
Subject:	RE: I-93 Exit 4A: Data for Average Household Size
Date:	Tuesday, August 23, 2016 1:16:57 PM
Attachments:	special population.xlsx

Hi Kerri:

I calculated household size based on population, housing units, and occupancy rate (2010). The equation is as follow.

Household size= (Population – special population)/(housing units*occupancy rate)
Occupancy rate(2010)=2010 housing units/2010 household

Attached please find special population data I used.

If you have any questions, please let me know.

Julie Chen

From: Snyder, Kerri [mailto:KSnyder@louisberger.com]
Sent: Tuesday, August 23, 2016 11:48 AM
To: Julie Chen
Cc: Tidd, Leo; Chris Bean; I93-Exit4A-EIS (SM); Hodgson (Rydland), Laura
Subject: I-93 Exit 4A: Data for Average Household Size

Julie,
To follow up on my call/message for you this morning, I wanted to get your input what data you used for average household size in the 2015 population and household updates. The travel demand model methodology appears to have used U.S. Census household size (from 2010). Did you use the U.S. Census household size for your 2015 data? If so, did you use the Town-level or more detailed level (e.g., census block group)? If not, more detailed information on what was used is appreciated. We want to make sure we are consistent with your analysis.

Regards,
Kerri

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Southern New Hampshire Planning Commission
438 Dubuque Street, Manchester, NH 03102-3546, Telephone (603) 669-4664 Fax (603) 669-4350
www.snhpc.org

MEMORANDUM

TO: File

FROM: Julie Chen, Ph.D., Sr. Transportation Planner, Southern New Hampshire Planning Commission, 669-4664, jchen@SNHPC.org JC

DATE: November 4, 2016

RE: 2015-2040 – Employment Projection for I-93 Exit 4A project

---

In order to reflect changes in employment between 2010 and 2015, the original SNHPC employment projection for 2010 through 2040 (completed in 2012) was adjusted for 2020 through 2040 projection. Three steps are followed in calculating 2015-2040 employment projection.

Step 1: Growth rates

The study assumes that employment growth rates by employment category group for 2015-2040 were kept the same as the 2012 Southern NH Planning Commission employment projection for 2010-2040 which were reviewed by corresponding communities in the region. The following formula was used in calculating growth rates over a five-year interval.

$$GR_{Com\ EC\ i} = (E_{2012\ Com\ EC\ i} - E_{2012\ Com\ EC\ i-1})/E_{2012\ Com\ EC\ i-1}$$

Where:

i =projection years 2015, 2020, 2025, 2030, 2035 and 2040

$GR_{Com\ EC\ i}$=Growth rate by employment category group over i to i-1 five-year interval

$E_{2012\ com\ EC\ i}$ = Total employment for an employment category group in a community at projection year i in 2012 projection

$E_{2012\ com\ EC\ i-1}$=Total employment for the employment category group in community at projection year i-1 in 2012 projection

Step 2: Total employment projection for an employment category group in a community 2020 through 2040

The 2015 total employment estimate for an employment category group in a community was considered as base, total employment projections for the employment category group in the community 2020 through 2040 were calculated as follows:

$$E_{2016\ Com\ EC\ i} = E_{2016\ Com\ EC\ i-1} * (1 + GR_{Com\ EC\ i})$$

Where:

i =projection years 2020,2025,2030,2035 and 2040

$E_{2016\,com\,EC\,i}$ = Total employment for an employment category group in the community at projection year i in the 2016 projection

$E_{2016\,com\,EC\,i-1}$=Total employment for the employment category group in the community at projection year i-1 in the 2016 projection

Step 3: Total employment for an employment category group in the community for 2020-2040 projection distributed to TAZs

Two conditions were used as total projected employment for an employment category group in the community was allocated into TAZs.

Condition one

When developable land for a land use category is available and appropriate to use in a community, employment is distributed based on percentage of developable land in a TAZ in total of developable land in the community.

$$E_{2016\,TAZ\,EC\,i} = E_{2016\,TAZ\,EC\,i-1} + (E_{2016\,Com\,EC\,i} - E_{2016\,Com\,EC\,i-1}) * Percentage$$

Where:

$E_{2016\,TAZ\,EC\,i}$=2016 Employment projection in a TAZ for an employment category group at projection year i

$E_{2016\,TAZ\,EC\,i-1}$=2016 Employment projection in a TAZ for the employment category group at projection year i-1 in the 2016 projection

$E_{2016\,com\,EC\,i}$ = Total employment for the employment category group in the community at projection year i in the 2016 projection

$E_{2016\,com\,EC\,i-1}$=Total employment for the employment category group in the community at projection year i-1 in the 2016 projection

Condition two

When developable land for the land use category is not available or not appropriate to use in a community, employment in a TAZ is calculated using same growth rate as that of employment of the employment category.

$$E_{2016\,TAZ\,EC\,i} = E_{2016\,TAZ\,EC\,i-1} * (1 + GR_{2016\,Com\,EC\,i})$$

Where:

$E_{2016\,TAZ\,EC\,i}$=2016 Employment projection in a TAZ for an employment category group at projection year i

$E_{2016\,TAZ\,EC\,i-1}$=2016 Employment projection in a TAZ for the employment category group at projection year i-1 in the 2016 projection

Preparer's note: Employment data were provided on November 7, 2016. Pursuant to an agreement signed with NHDOT and SNHPC, the raw data are not available for public distribution.

APPENDIX C: MEMORANDUM: REVIEW OF EMPLOYMENT PROJECTIONS

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Memorandum

DATE: November 23, 2016

TO: File

FROM: Gabor Debreczeni

SUBJECT: I-93 Exit 4A: Review of Employment Projections

Introduction

This memo is a brief evaluation of employment projections by the Southern New Hampshire Planning Commission for the towns of Auburn, Chester, Derry, Londonderry, and Sandown, all in Rockingham County, through 2040.

SNHPC Projections

The table below shows SNHPC's projection for the annual growth rate of employment from 2015 to 2040 for each of the five towns as well as for the collective study area. These projections were calculated from two inputs: historical growth rates for 1990-2010 (sourced from the New Hampshire Economic and Labor Market Information Bureau, NHELMIB), and a ten-year (2008-2018) employment projection by NHELMIB.

Table 1: Study Area Employment Growth Projection by Town

Area	CAGR, 2015-40
Derry	0.90%
Londonderry	0.84%
Auburn	1.63%
Chester	2.24%
Sandown	0.99%
Total Study Area	0.95%

Review of Historical Trends

Historical data for employment (defined by location of work rather than location of residence) and population growth from the U.S. Census Bureau[1] was reviewed by Louis Berger for 2003-2014, the time range for which data was available at the town level. The table below shows the annual growth rate of employment for this period for the five towns, the study area, Rockingham County, and New Hampshire.

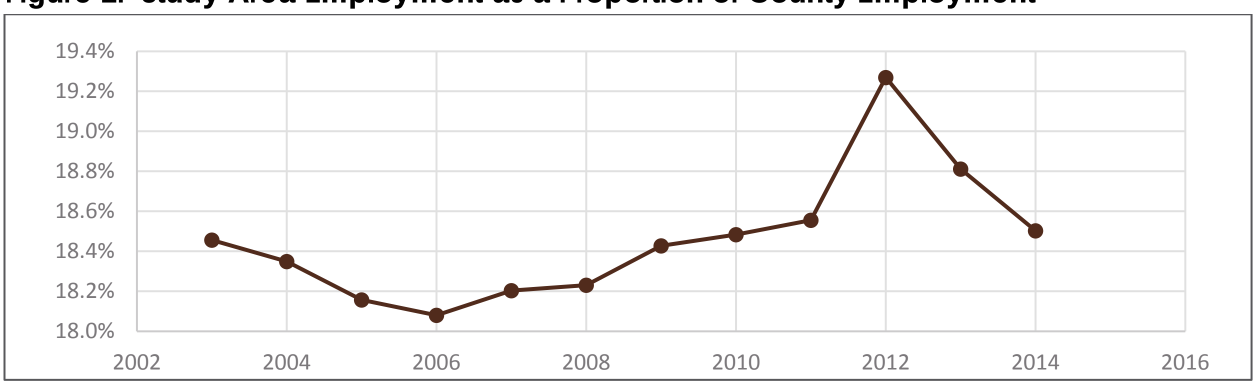
Historical data was also reviewed from Woods & Poole, a firm specializing in county-level economic projections. Employment data from Woods & Poole measures the number of full- and part-time jobs by location of work.

Table 2: Employment Growth History

Area	U.S. Census Bureau CAGR, 2003-14	Woods & Poole CAGR, 2003-14	Woods & Poole CAGR, 1969-2015
Derry	0.53%		
Londonderry	0.61%		
Auburn	1.90%		
Chester	-0.80%		
Sandown	4.09%		
Total Study Area	0.67%		
Rockingham Co.	0.65%	0.96%	3.19%
New Hampshire	0.54%	0.54%	2.08%

The chart below shows the share of Rockingham County employment (place-of-work) that is located within the study area, for the 2003-14 period. As can be seen, the share varies from 18% to just over 19%, but there is no clear trend of rising or declining share over time.

Figure 1: Study Area Employment as a Proportion of County Employment



[1] Specifically, the employment data was collected from the Longitudinal Employer-Household Dynamics section (http://onthemap.ces.census.gov/), while population data was collected from the American FactFinder section (http://factfinder.census.gov/) and the City and Town Intercensal Estimates section (https://www.census.gov/popest/data/intercensal/cities/cities2010.html).

The charts below show the patterns of employment as implied by historical data sourced from the U.S. Census Bureau as well as SNHPC's projected growth rates through 2040, for each of the five towns in the study area. A comparable chart for the entire study area is at the end of this document.

Figure 2: Auburn Employment History and Projection

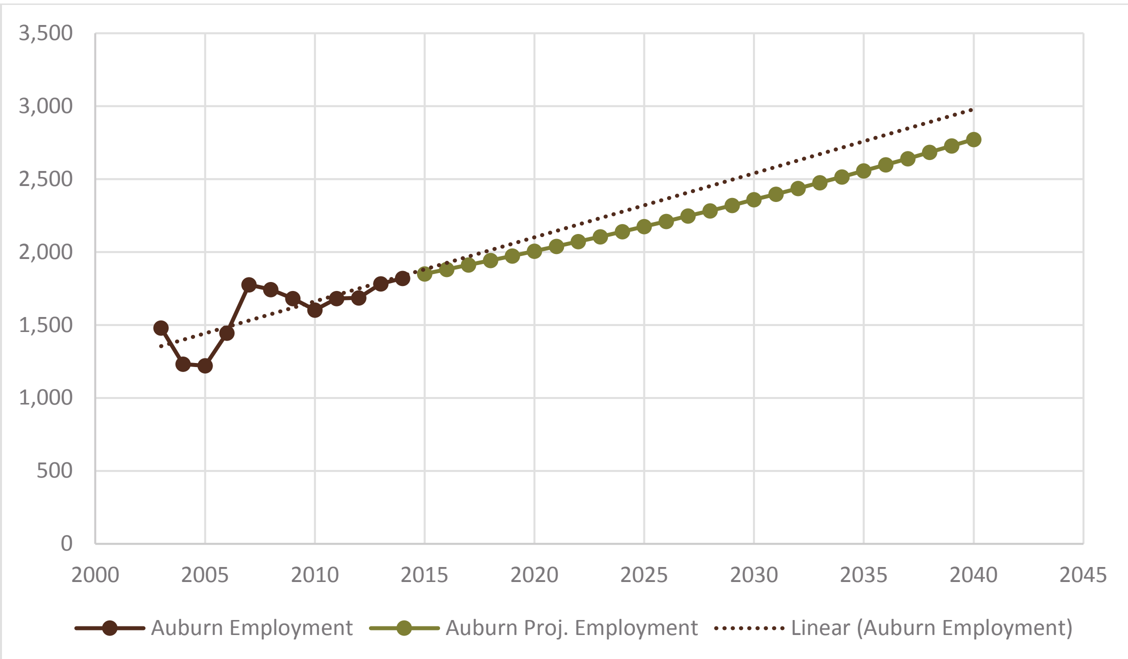


Figure 3: Sandown Employment History and Projection

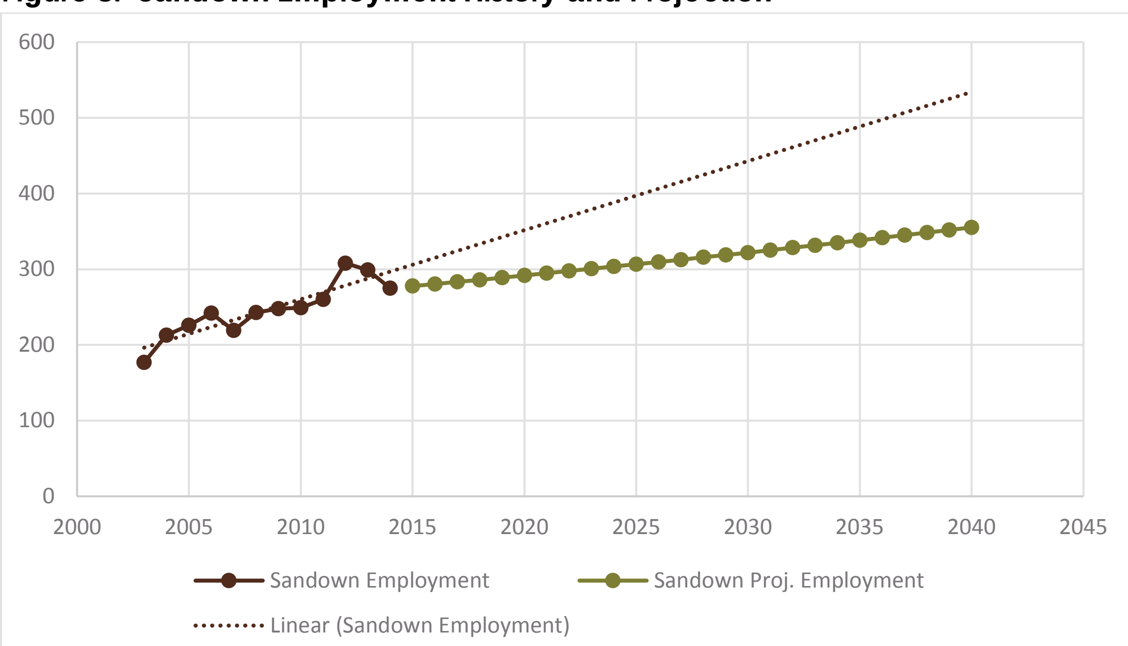


Figure 4: Londonderry Employment History and Projection

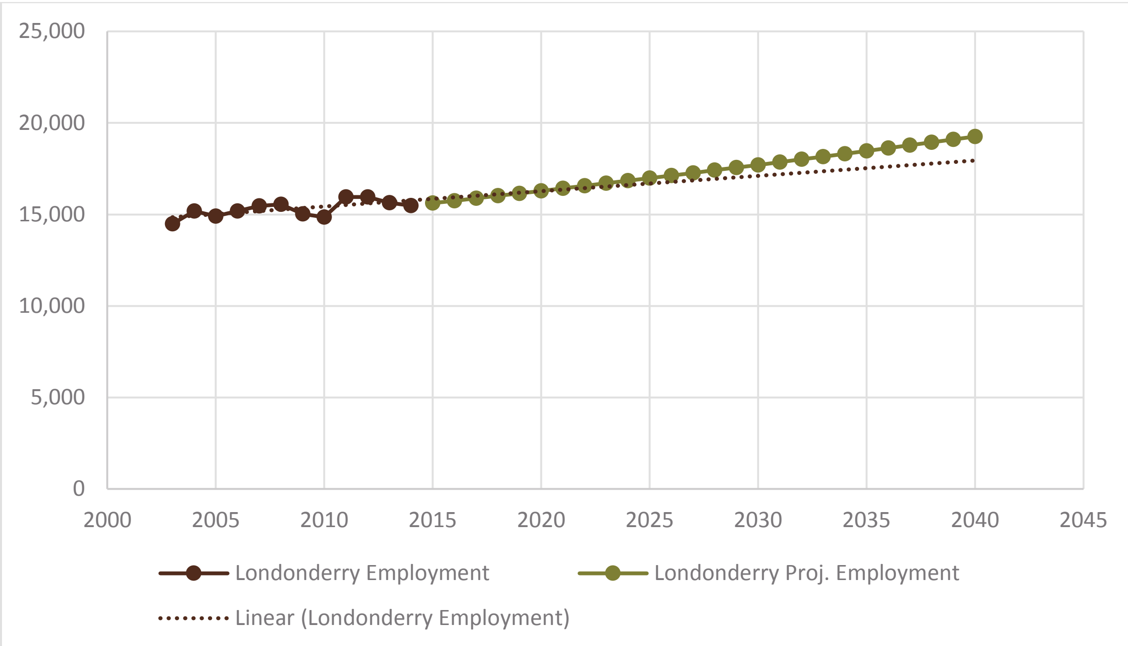


Figure 5: Derry Employment History and Projection

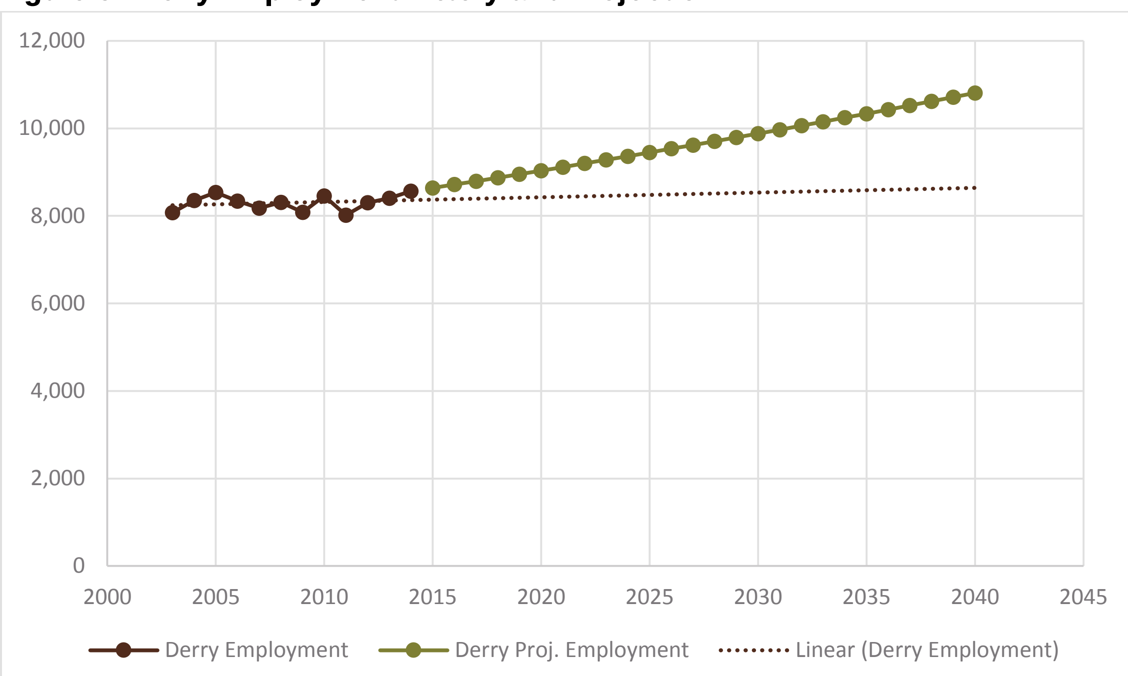
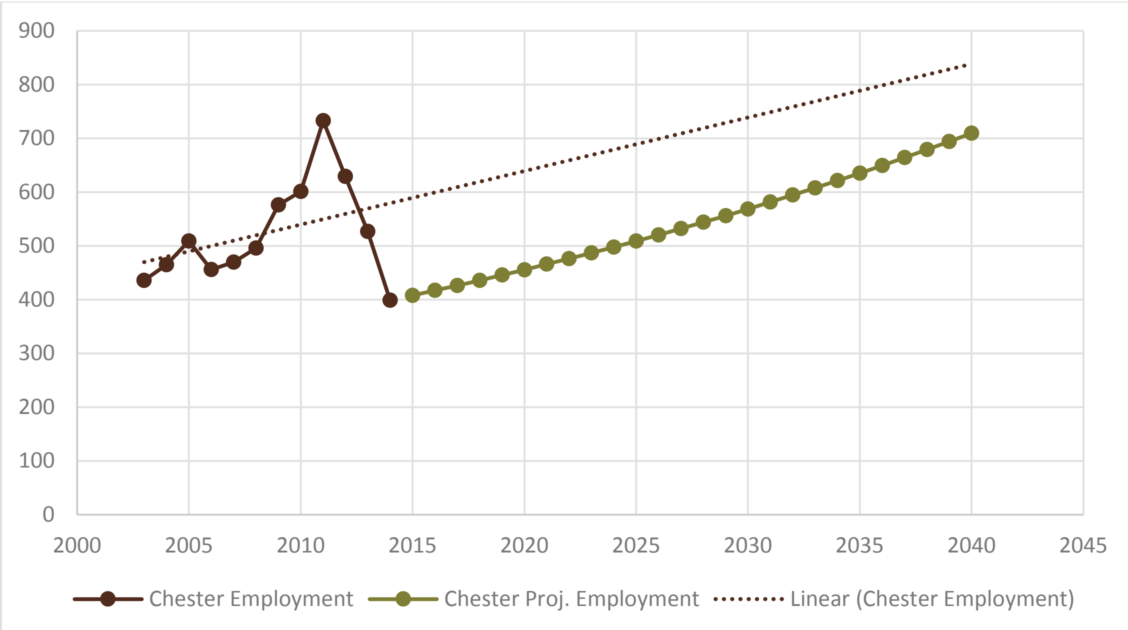


Figure 6: Chester Employment History and Projection



Overall the trajectory of projected employment is generally consistent with past patterns of growth in each town, with future growth rates at or below the linear trend in employment growth from 2003 to 2015.

The downward trend in employment in Chester as of 2012 is ascribed in the Land Use Scenarios Technical Report to the closing of Chester College, which is expected to reopen as a new education institution in 2020.

In Derry, the growth projection is somewhat higher than the linear trend of employment growth since 2003, but consistent with the rate of growth seen in employment following the recovery from the recession in 2011.

Historical Models for Employment within Study Area

To further assess the reasonableness of the regional employment growth projection, we conducted an evaluation of the historical relationship of employment growth in the study area to employment growth in the county and state as a whole. As a benchmark we also obtained an independent projection of county and state level employment through 2040.

Using the 2003-14 U.S. Census Bureau data referenced above, we developed simple regression models to investigate relationships between growth rates in employment in the study area, population in the study area, employment in Rockingham County, and employment in New Hampshire. Two models were found to have the most predictive power – one relating study area employment to county-level employment, and a second relating it to county-level employment and study area population.

The tables below show information about the regression models. The logarithm of both the input and output data were taken for both regression models.

Table 3: Regression Model 1: Regional Employment as a Function of County Employment

```
Call:
lm(formula = Com_Emp ~ Roc_Emp, data = log_added_data)

Residuals:
      Min        1Q    Median        3Q       Max 
-0.019492 -0.009596 -0.004990  0.005649  0.041969 

Coefficients:
            Estimate Std. Error t value Pr(>|t|)   
(Intercept)  -0.1689     2.9563  -0.057  0.95556   
Roc_Emp       0.8717     0.2494   3.496  0.00577 **
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.01802 on 10 degrees of freedom
Multiple R-squared:  0.5499,	Adjusted R-squared:  0.5049 
F-statistic: 12.22 on 1 and 10 DF,  p-value: 0.00577
```

The first regression model indicates that regional employment levels are closely correlated with the overall level of employment in Rockingham County. The model indicates that annual growth in employment at the county level at a rate of 1.00% can be expected to result in regional employment growth at a rate of 0.87%.

Table 4: Regression Model 2: Regional Employment as a Function of County Employment and Regional Population

```
Call:
lm(formula = Com_Emp ~ Roc_Emp + Com_Pop, data = log_added_data)

Residuals:
      Min        1Q    Median        3Q       Max 
-0.020428 -0.009262 -0.001961  0.006356  0.032042 

Coefficients:
            Estimate Std. Error t value Pr(>|t|)  
(Intercept) -17.4068    10.0300  -1.735   0.1167  
Roc_Emp       0.5693     0.2825   2.015   0.0747 .
Com_Pop       1.8589     1.0423   1.783   0.1082  
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.01632 on 9 degrees of freedom
Multiple R-squared:  0.6674,	Adjusted R-squared:  0.5935 
F-statistic: 9.032 on 2 and 9 DF,  p-value: 0.007053
```

The second regression model indicates that regional employment levels are closely correlated with the overall level of employment in Rockingham County along with the level of population in the region. This model indicates that employment in the region can be expected to grow at a rate of 0.57 times the rate of county employment growth and 1.86 times the rate of regional population growth.

Other Benchmark Employment Projections

As shown in the table below, for the 2015-40 period, Woods & Poole projects a yearly growth rate of approximately 1.1% for both New Hampshire and Rockingham County, which is the smallest geographical area relevant to this memo that is projected by Woods & Poole. (As a point of comparison, Woods & Poole projects an annual population growth rate of 0.69% for New Hampshire and 0.85% for Rockingham County during this time period.)

Table 5: Woods & Poole Employment Projection

Area	CAGR, 2015-40
Rockingham Co.	1.07%
New Hampshire	1.06%

Using the Woods & Poole projections as an input, the Regression Model 1 (considering only Rockingham County employment as an input) would suggest an average growth rate of **0.93%** per year through 2040 (1.07% * 0.87 = 0.93%).

Regression Model 2 considers both Rockingham County employment and study area population as inputs. The latter is the Office of Energy and Planning (OEP) population projection, which indicates that Rockingham County is estimated to have an annual growth rate of 0.26% through 2040. As such, this model predicts an employment growth rate of **1.09%** per year through 2040 (0.26% * 1.86 + 1.07% * 0.57).

Conclusion

SNHPC's projection for employment growth in the study area appears to be reasonable. The projected growth rate through 2040 aligns with Woods & Poole's projection for employment growth in Rockingham County, and both regression models suggest study area employment growth rates that are comparable to the rate of growth implied by the SNHPC projection, as shown in Table 6, below.

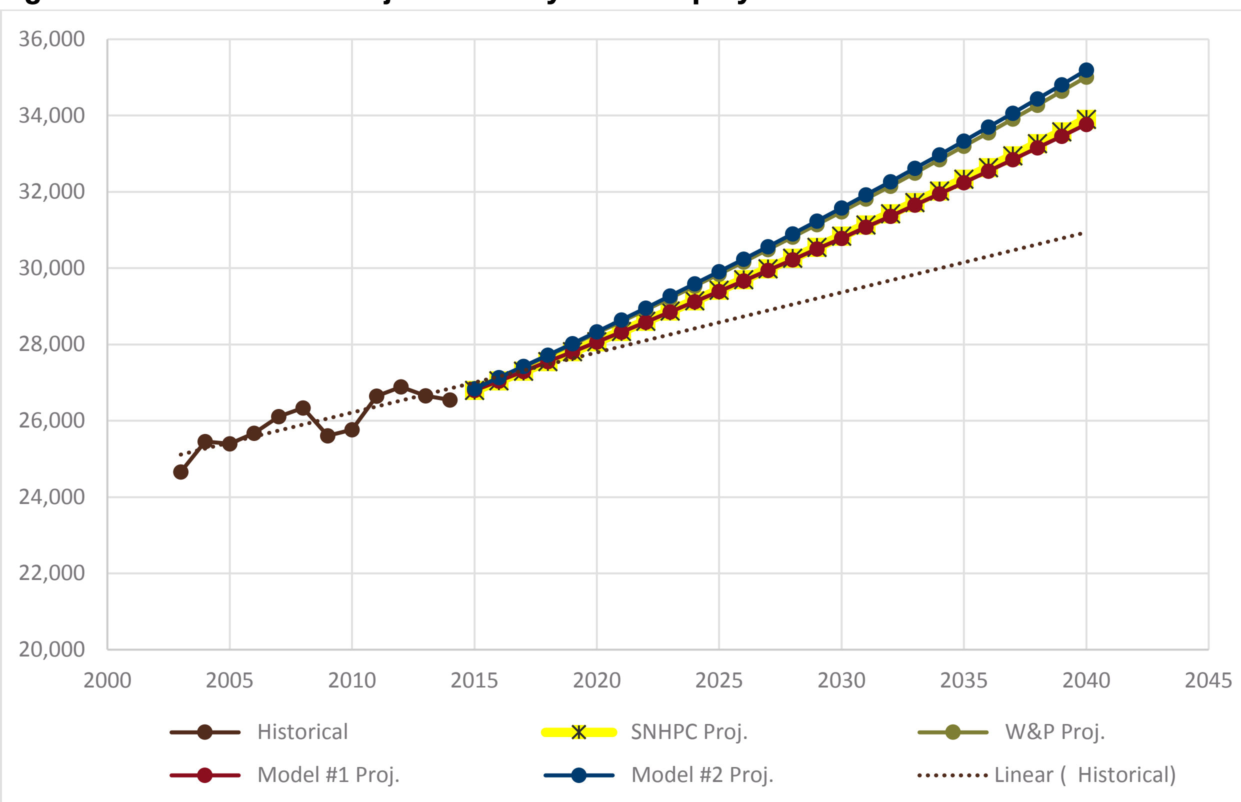
Table 6: Study Area Employment Growth Rate Comparison

	SNHPC	Model #1	Model #2	Woods & Poole (Rockingham Co.)
2015-40 Employment CAGR	0.95%	0.93%	1.09%	1.07%

While it is notable that the study area employment growth rate is forecasted to be substantially greater than the study area population growth rate (which is pegged at a CAGR of 0.26%), a third regression model attempting to predict study area employment by using only study area population as an input showed that for each 1% increase in population, we would expect a 3.1% increase in employment.

The chart below shows the patterns of study area employment based on historical place of work employment as reported by the U.S. Census Bureau; and four projections through 2040 based on growth rates from sources discussed in this memorandum: the SNHPC projection, the two regression models described above, and Woods & Poole projections for Rockingham County.

Figure 7: Historical and Projected Study Area Employment



APPENDIX D: TAZ ALLOCATION UNDER THE NO BUILD AND BUILD CONDITIONS

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TAZ ALLOCATION UNDER THE NO BUILD AND BUILD CONDITIONS

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2040 Total Build Condition for Alternatives A and B

TAZ	TOWN	2040 Pop	2040 HH
71	Auburn	64	33
72	Auburn	2438	899
73	Auburn	1189	411
74	Auburn	1042	357
98	Auburn	1315	487
148	Chester	917	315
149	Chester	758	267
150	Chester	770	288
151	Chester	768	271
152	Chester	1776	528
153	Chester	629	214
154	Chester	728	260
155	Chester	1023	305
121	Derry	2304	794
122	Derry	801	273
123	Derry	879	273
124	Derry	958	500
125	Derry	3	2
126	Derry	507	265
127	Derry	1045	443
128	Derry	1060	339
129	Derry	422	144
130	Derry	666	255
131	Derry	1293	580
132	Derry	773	339
133	Derry	85	29
134	Derry	631	276
135	Derry	711	380
136	Derry	2314	1042
137	Derry	564	219
138	Derry	1368	476
139	Derry	1154	363
140	Derry	588	201
141	Derry	908	320
142	Derry	877	304
143	Derry	878	274
144	Derry	1533	558
145	Derry	441	163
146	Derry	1510	497
147	Derry	2257	725
221	Derry	661	278
222	Derry	801	357
223	Derry	420	158

Town	2040 Pop	2040 HH
Auburn	6048	2188
Chester	7370	2448
Derry	33,222	12,673
Londonderry	30,910	10,707

224	Derry	804	383
225	Derry	407	164
226	Derry	1211	401
227	Derry	659	220
228	Derry	665	273
64L	Londonderry	0	0
65	Londonderry	139	47
66	Londonderry	257	106
67	Londonderry	1527	643
68	Londonderry	1873	694
69	Londonderry	599	207
70	Londonderry	609	193
99	Londonderry	1707	591
100	Londonderry	1916	617
101	Londonderry	3012	945
102	Londonderry	2533	819
103	Londonderry	1390	448
229	Londonderry	1314	409
230	Londonderry	208	83
231	Londonderry	176	60
232	Londonderry	1000	307
233	Londonderry	1149	356
274	Londonderry	405	118
275	Londonderry	952	348
276	Londonderry	1454	593
277	Londonderry	2174	760
278	Londonderry	284	106
279	Londonderry	572	179
280	Londonderry	325	193
281	Londonderry	1281	440
282	Londonderry	599	228
283	Londonderry	826	317
284	Londonderry	24	12
285	Londonderry	1831	622
375	Londonderry	384	134
376	Londonderry	390	132
377	Derry	13	3
378	Derry	293	143
379	Derry	476	153
380	Derry	266	99
381	Derry	14	5

2040 Total Build Condition for Alternatives C and D

TAZ	TOWN	2040 Pop	HH
71	Auburn	64	33
72	Auburn	2438	899
73	Auburn	1189	411
74	Auburn	1042	357
98	Auburn	1315	487
148	Chester	917	315
149	Chester	758	267
150	Chester	770	288
151	Chester	768	271
152	Chester	1776	528
153	Chester	629	214
154	Chester	728	260
155	Chester	1023	305
121	Derry	2304	794
122	Derry	801	273
123	Derry	879	273
124	Derry	958	500
125	Derry	3	2
126	Derry	507	265
127	Derry	1045	443
128	Derry	1060	339
129	Derry	422	144
130	Derry	666	255
131	Derry	1293	580
132	Derry	773	339
133	Derry	85	29
134	Derry	631	276
135	Derry	711	380
136	Derry	2314	1042
137	Derry	564	219
138	Derry	1368	476
139	Derry	1154	363
140	Derry	588	201
141	Derry	908	320
142	Derry	877	304
143	Derry	878	274
144	Derry	1533	558
145	Derry	441	163
146	Derry	1510	497
147	Derry	2257	725
221	Derry	661	278
222	Derry	801	357
223	Derry	420	158

Town	2040 Pop	HH
Auburn	6048	2188
Chester	7370	2448
Derry	33,222	12,673
Londonderry	30,885	10,698

224	Derry	804	383
225	Derry	407	164
226	Derry	1211	401
227	Derry	659	220
228	Derry	665	273
64L	Londonderry	0	0
65	Londonderry	139	47
66	Londonderry	257	106
67	Londonderry	1527	643
68	Londonderry	1873	694
69	Londonderry	594	205
70	Londonderry	609	193
99	Londonderry	1698	588
100	Londonderry	1916	617
101	Londonderry	3012	945
102	Londonderry	2533	819
103	Londonderry	1390	448
229	Londonderry	1314	409
230	Londonderry	208	83
231	Londonderry	176	60
232	Londonderry	1000	307
233	Londonderry	1149	356
274	Londonderry	405	118
275	Londonderry	952	348
276	Londonderry	1454	593
277	Londonderry	2166	757
278	Londonderry	284	106
279	Londonderry	572	179
280	Londonderry	325	193
281	Londonderry	1281	440
282	Londonderry	599	228
283	Londonderry	826	317
284	Londonderry	24	12
285	Londonderry	1831	622
375	Londonderry	381	133
376	Londonderry	390	132
377	Derry	13	3
378	Derry	293	143
379	Derry	476	153
380	Derry	266	99
381	Derry	14	5

2040 Total Under the No Build Condition. Also applies to Build Alternative F.

TAZ	TOWN	2040 Pop	2040 HH
71	Auburn	64	33
72	Auburn	2438	899
73	Auburn	1189	411
74	Auburn	1042	357
98	Auburn	1315	487
148	Chester	796	275
149	Chester	632	225
150	Chester	566	220
151	Chester	624	223
152	Chester	1535	448
153	Chester	526	180
154	Chester	635	229
155	Chester	938	277
121	Derry	2304	794
122	Derry	801	273
123	Derry	879	273
124	Derry	958	500
125	Derry	3	2
126	Derry	507	265
127	Derry	1045	443
128	Derry	1060	339
129	Derry	422	144
130	Derry	666	255
131	Derry	1293	580
132	Derry	773	339
133	Derry	85	29
134	Derry	631	276
135	Derry	711	380
136	Derry	2314	1042
137	Derry	564	219
138	Derry	1368	476
139	Derry	1154	363
140	Derry	588	201
141	Derry	908	320
142	Derry	877	304
143	Derry	878	274
144	Derry	1533	558
145	Derry	441	163
146	Derry	1510	497
147	Derry	2257	725
221	Derry	661	278
222	Derry	801	357
223	Derry	420	158

Town	2040 Pop	2040 HH
Auburn	6048	2188
Chester	6253	2077
Derry	33,222	12,673
Londonderry	30,885	10,698

224	Derry	804	383
225	Derry	407	164
226	Derry	1211	401
227	Derry	659	220
228	Derry	665	273
64L	Londonderry	0	0
65	Londonderry	139	47
66	Londonderry	257	106
67	Londonderry	1527	643
68	Londonderry	1873	694
69	Londonderry	594	205
70	Londonderry	609	193
99	Londonderry	1698	588
100	Londonderry	1916	617
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282	Londonderry	599	228
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284	Londonderry	24	12
285	Londonderry	1831	622
375	Londonderry	381	133
376	Londonderry	390	132
377	Derry	13	3
378	Derry	293	143
379	Derry	476	153
380	Derry	266	99
381	Derry	14	5

Preparer's note: Pursuant to an agreement signed with NHDOT and SNHPC, the employment data are not available for public distribution.

Appendix C: Interchange Justification Report

Interchange Justification Report

I-93 Exit 4A

Prepared for:

Town of Derry
Town of Londonderry
New Hampshire Department of Transportation

Prepared by:

CLD and Louis Berger

Version: 2
April 27, 2018

NHDOT Project Number: 13065
Federal Project Number: IM-0931(201)
CLD/Towns Project Number 05-0244

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

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ABBREVIATIONS AND ACRONYMS

AASHTO	American Association of State Highway Transportation Officials
AAWDT	average annual weekday daily traffic
ADT	average daily traffic
ATR	automatic traffic recorder
CFR	Code of Federal Regulations
DEIS	Draft Environmental Impact Statement
FHWA	Federal Highway Administration
HCM	Highway Capacity Manual
HCS	Highway Capacity Software
I	Interstate
IJR	Interchange Justification Report
LOS	level of service
MEV	million entering vehicles
mph	miles per hour
NEPA	National Environmental Policy Act
NH	New Hampshire
NHDOT	New Hampshire Department of Transportation
PUD	Planned Unit Development
ROW	right-of-way
RPC	Rockingham Planning Commission
SDEIS	Supplemental Draft Environmental Impact Statement
SEIS	I-93 Supplemental EIS
SNHPC	Southern New Hampshire Planning Commission
TAZ	Traffic Analysis Zone
TIA	Traffic Impact Assessment
TIP	Transportation Improvement Plan
TSM	Transportation Systems Management
TWSC	two-way, STOP-controlled (intersection)
U.S.C.	United States Code

1.0 INTRODUCTION

The objective of this Interchange Justification Report (IJR) is to provide the necessary background for justifying the addition of a new interchange along Interstate 93 (I-93) between Exit 4 and Exit 5 in the Town of Londonderry, New Hampshire. The information included within this document will help determine if the proposed interchange improvements satisfy the Federal Highway Administration's (FHWA) two policy requirements that were developed to aid compliance with Title 23, United States Code, Highways Section 111 (23 United States Code [U.S.C.] 111), which requires all interstate construction projects to not add any points of access or exit from the project without prior FHWA approval. The FHWA Division office has been delegated approval authority for new Interstate access points involving freeway to crossroad interchanges. FHWA Headquarters approval is not required.

The two specific requirements that must be met to receive approval for the development of new or revised interstate access points are described in FHWA's May 2017 *Policy on Access to the Interstate System* (FHWA, 2017a). The intent of this policy is to "preserve and enhance the Interstate System to meet the needs of the 21st Century by assuring that it provides the highest level of service in terms of safety and mobility" (FHWA, 2017a).

Section 8, *Policy Analysis*, of this document describes the FHWA interstate access policy requirements and describes how the proposed changes at the new I-93 service interchange would fulfill them.

1.1 Project Description

The proposed Project consists of a new, diamond interchange on I-93 in the Town of Londonderry, New Hampshire, between Exit 4 and Exit 5 (Figure 1-1). A connector roadway would be built on a new alignment from the new interchange to the east toward State Route 28 (NH 28) with a connection to State Route 102 (NH 102) at the east side of Derry following upgraded existing roadways, creating new roadways, or a mixture of both improvement types, depending on the alternative. Section 6.0 describes the four proposed alternatives.

Concurrently with this IJR, FHWA, NHDOT and the Towns of Londonderry and Derry are preparing a Supplemental Draft Environmental Impact Statement (SDEIS) for the Project under the National Environmental Policy Act.

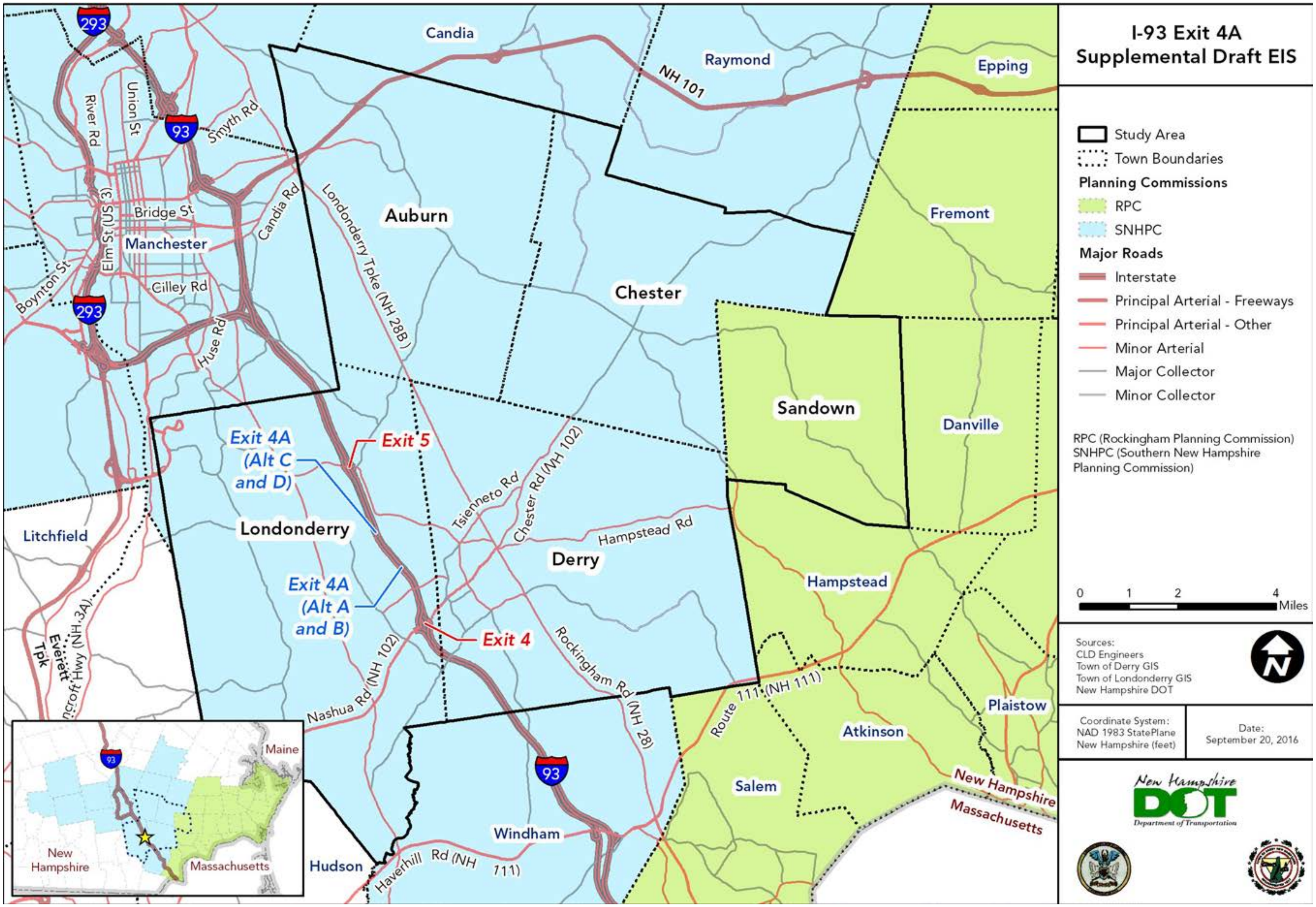


Figure 1-1. Regional map

1.2 Purpose and Need

The purpose and need for the project was identified early in project planning taking into consideration agency and public input. As noted in the SDEIS Appendix A, for purposes of meeting the guidelines of the U.S. Army Corps of Engineers (USACE) Highway Methodology (USACE, 1993), the basic purpose of the project is: to reduce congestion and improve safety along NH 102 from I-93 easterly through downtown Derry, and to promote economic vitality in the Derry-Londonderry area. This project purpose statement was used throughout the planning process for the identification, evaluation, and screening of potential alternatives (CLD, 2000; CLD, 2001).

1.2.1 Purpose

The purpose of this project includes:

- providing for the safe and efficient movement of people, goods, and services between I-93 and the towns served by NH 102, specifically Derry and Londonderry, that are immediately adjacent to I-93 Exit 4;
- providing an alternative route to the Interstate system for traffic using NH 102 to and from the east, thus removing a large volume of through traffic from the heavily congested downtown Derry street network;
- providing improved Interstate access for commercial and industrially-zoned lands near NH 28 in both Derry and Londonderry, thus allowing for the planned and orderly development of such lands to further locally-defined economic development goals and tax base diversification; and
- enhancing and promoting the economic vitality of the downtown Derry area, presently characterized by traffic congestion and decreasing vehicular and pedestrian safety, by separating local, destination-oriented traffic from through traffic destined for the Interstate system.

1.2.2 Need

The Towns of Derry and Londonderry, working with the FHWA, NHDOT, and CATF[1], identified several factors demonstrating the need for transportation improvements within the study area, including traffic congestion in downtown Derry, economic vitality, and safety. Each of these aspects of the need for the project is discussed below taking into account changes in traffic data and economic development opportunities since the 2007 DEIS.

[1] The CATF was formed to offer opportunities for stakeholders to provide input into the project planning process. The CATF included local officials, interested citizens, and Federal and State agency staff. A list of the CATF members, and a summary of the highlights for the project meetings, including the scoping meetings, are provided in Chapter 11.

Traffic congestion in downtown Derry

NH 102, known as Broadway, is the principal east-west roadway through both Derry and Londonderry and serves as the major route for traffic accessing I-93 via Exit 4. The section of NH 102 passing through downtown Derry serves as its “main street.” It is currently a two-lane road from I-93 easterly through the downtown area, with several traffic signals and numerous intersections with side streets, on-street parallel parking, and a steady flow of pedestrian traffic. As a result of these complicating and often conflicting functions, downtown Derry experiences considerable congestion, as locally-oriented traffic intermingles with Interstate-bound through-traffic. Traffic routinely backs up throughout the downtown area in the morning peak periods as the steady flow of westbound traffic from Derry tries to access the Interstate and local highway systems. In the evening peak periods, eastbound traffic on NH 102 backs up through most of the downtown area of Derry, often all the way to the I-93 Exit 4 ramps because the existing two-lane roadway and associated intersections cannot accommodate the existing traffic demands. As such, travelers attempt to find alternative routes to bypass the congestion in the downtown area, placing heavy traffic on local roads, which were not designed to have capacity for it, contributing to safety concerns in neighborhoods, and adding congestion to local roads and intersections.

The 2010 Derry Master Plan notes “The town is also continuing to pursue the I-93 Exit 4A project which is designed to relieve traffic on NH 102 and promote the safe and efficient movement of people, goods and services. Businesses in downtown Derry will benefit from the completion of the I-93 Exit 4A project through the reduction of traffic and related congestion and improved accessibility” (Town of Derry, 2010).

Although operating near capacity, the updated traffic analyses conducted for 2015 existing conditions and the 2040 No Build condition generally show acceptable peak hour Level of Service (LOS) D at the major intersections along NH 102 through downtown Derry, including the NH 102/NH 28 (Crystal Avenue/Birch Street) intersection. Traffic volumes in downtown Derry are projected to increase be approximately 15 percent between 2015 and 2040. Larger traffic increases and higher levels of congestion (LOS E or F) are not projected for Derry because of the availability of alternate routes to disperse traffic. The existing two-lane road is not capable of handling higher volumes without traffic flow breaking down. Therefore, traffic avoids the downtown NH 102 corridor, diverting to other local roads such as Folsom Road and Londonderry Road as alternate access routes to Exit 4. This situation has been observed on Folsom Road where traffic has increased from about 8,700 to 11,768 annual average daily traffic between 1998 and 2015.

The traffic diversions to avoid NH 102 result in congestion issues in additional portions of Derry, such as the intersection of N. High Street and Ash Street Extension, which is projected to operate at LOS F in the AM and PM peak hours in 2040. As traffic diverts around NH 102 to points easterly, it increases traffic on local streets not designed for high through traffic volumes. Table 1-1 provides a summary of existing and 2040 No Build Annual Average Weekday Daily Traffic (AAWDT) along key corridors in the study area.

Table 1-1. Summary of 2015 and 2040 No Build Average Annual Weekday Traffic on NH 102 and Roadways Used to Bypass NH 102

Roadway Segment	Adjusted 2015 AAWDT	2040 No Build AAWDT	2015 to 2040 Increase	Percent Increase
NH 102, East of Griffin Street	16,400	18,958	2,558	13%
NH 102, West of Abbot. Street	14,350	19,217	4,867	25%
NH 102, at Derry/Chester town line	8,200	9,671	1,471	15%
Folsom Road, West of NH 28	11,768	13,839	2,071	15%
Tsienneto Road, West of NH 102	5,394	8,636	3,242	38%
Tsienneto Road, East of Pinkerton Street	14,637	19,457	4,820	25%
Ash Street at Londonderry town line	6,765	15,716	8,951	57%

In addition to congestion in Derry, the Exit 4 interchange is projected to experience congestion issues by 2040, even with the improvements made by the I-93 widening project and intersection spot improvements proposed by Woodmont Commons. Specifically, the following intersections in the I-93 Exit 4 area would operate at LOS E or F in the 2040 No Build:

- NH 102 & Gilcreast Road in AM and PM Peak Hour
- NH 102 & I-93 Exit 4 Southbound Off-Ramp in PM Peak Hour
- NH 102 & I-93 Exit 4 Northbound On and Off-Ramp in AM and PM Peak Hour
- NH 102 & St. Charles Street/Londonderry Road PM Peak Hour

The I-93 Exit 4 southbound off-ramp to NH 102 is also projected to operate at LOS F in the 2040 PM peak hour.

Economic vitality

Economic development issues and opportunities in Derry and Londonderry are discussed in separate sections below. In Derry, constraints related through traffic are a concern to the accessibility of business downtown. In Londonderry, a large tract of undeveloped land on the east side of I-93 currently has poor highway access and is the subject of the Town's Woodmont Commons Planned Unit Development Master Plan to attract regionally significant business opportunities.

Derry

Economic vitality is essential for the Derry downtown area to remain the center of community activity, a clear priority identified in the Derry Master Plan. Results from the community survey conducted as part of the 2010 Master Plan show that residents of Derry support attracting new businesses and industries to Derry. New businesses with the most support were office development, light industrial, an industrial park, and downtown revitalization. One of the recommendations of the Master Plan is to "Continue to research the benefits, challenges and feasibility of Exit 4A." The Master Plan notes the following potential benefits for Derry:

- A direct access route to I-93 for commercial and industrial areas of town
- A bypass for the downtown, which will alleviate some of the current traffic problems and enhance the downtown area
- Create more connections to existing commercial and industrial areas and open them up for more development

The Master Plan acknowledges that the existing heavy traffic on NH 102 influences the quality of the downtown area and the businesses located there. Traffic congestion creates a less pedestrian-friendly downtown and likely results in some drivers seeking alternate shopping opportunities and traffic routes. The Master Plan notes several actions that could be implemented to improve conditions for pedestrians and to promote a business-friendly environment downtown. In order to be implemented, many of the actions recommended in the Derry Master Plan will require that downtown traffic congestion be alleviated. The Master Plan states that "Businesses in downtown Derry will benefit from the completion of the I-93 Exit 4A project through the reduction of traffic and related congestion and improved accessibility." Further economic benefits to both Derry and Londonderry could also be realized by providing access to the existing industrial zoned land adjacent to the east side of I-93 between Exits 4 and 5.

The Exit 4 southbound off-ramp is operating at or near capacity (LOS D) in the AM peak hour and failing (LOS F) in the PM peak hour. The northbound on- and off-ramp is operating at LOS E in the AM peak hour and LOS F in the PM peak hour. This has consequences to the economic well-being of Derry because the Exit 4 Interchange currently provides the only direct access between the Interstate and most of Derry's developed area. Although further improvements to the Exit 4 Interchange were constructed as part of the I-93 widening project, traffic congestion and associated safety issues along NH 102 in downtown Derry will continue, as described later in this IJR.

Londonderry

There are large tracts of undeveloped land adjacent to the east side of I-93 between Exits 4 and 5, the economic value of which would be greatly enhanced by a direct connection to I-93. By providing direct access to the Interstate in this area, land value will increase as it will be better suited for larger scale commercial or industrial development. The proximity of the Manchester-Boston Regional Airport to this area also adds to the value and development potential of this land. As noted in the Land Use Scenarios Technical Report (Louis Berger, 2017), a new exit would provide accessibility to existing undeveloped land, thereby enhancing the development potential. The net effect of these development activities would likely be a number of new, high paying jobs and increased tax revenue for both towns.

Since the 2007 DEIS, additional local planning efforts have further defined the development opportunities near I-93 in Londonderry. In 2013, the Town of Londonderry approved the Woodmont Commons Planned Unit Development Master Plan covering approximately 630 acres bordering the east and west sides of I-93. The Master Plan envisions a mixed-use urban village being developed in several phases over 20 years. Portions of development on the east side of I-93 are under construction, with completion expected in 2020 (Woodmont Commons Phase I). The Master Plan restricts the quantity of development allowed on both the east and west sides of I-93 if Exit 4A is not constructed to limit traffic impacts of development. On the east side of I-93 specifically, coordination conducted during the Exit 4A land use study found that a predominately residential development pattern would occur in a No Build scenario (approx. 330 units). The provision of new interstate access to the east side of I-93 would allow for substantially higher-intensity of development, nearly 700,00 gsf of commercial and 420,00 gsf of institutional uses based on the land use study (Woodmont Planning Team, 2011).

1.2.3 Safety

Although the Exit 4 Interchange has been reconstructed to handle the projected design year traffic flows easterly into Derry as part of the I-93 widening project, the primary design intent is to address the north-south travel demands of the I-93 corridor and not the east-west demands along NH 102 in the study area. The section of NH 102 that runs easterly into downtown Derry from Exit 4 will continue to have an insufficient number of lanes, especially at the intersections, to handle the existing and future peak traffic flows. These peaks are especially high during the heavy evening commuting periods when both through traffic and traffic accessing local businesses are sharing the same roadway. Because the existing road has insufficient lanes to handle the peak traffic volumes, the traffic backs up into the Interchange area, which results in increased safety hazards for the traveling public. Several intersections with high crash rates based on analysis of 2013-2015 crash data are located along NH 102 in the study area, including at Gilcreast Road, Garden Lane/Hampton Drive and the I-93 Exit 4 Northbound Ramps.

Between 2010 and 2014, there were a total of 716 crashes in the DSEIS study area, including 240 crashes along NH 102 between Exit 4A and Tsienneto Road (NHDOT, 2010-2014). Of the total, approximately 24 percent resulted in injury or fatality. If traffic using NH 102 to the east could be moved away from the interchange area more efficiently, traffic congestion at the ramp intersections could be reduced and traffic flow improved, resulting in a more orderly and safer flow of traffic through the intersections, as well as elsewhere along NH 102.

The congestion in downtown Derry results in some vehicles seeking alternative routes, many of which result in additional traffic through residential neighborhoods, representing an additional safety concern. On Broadway itself, the congestion results in increased conflicts between through traffic, turning traffic, parked cars, pedestrians, and bicyclists.

1.2.4 Goals & Objectives

Purpose Statement	Objectives
Provide safety improvements	Provide for the safe and efficient movement of people, goods, and services between I-93 and the towns served by NH 102, specifically Derry and Londonderry, that are immediately adjacent to I-93
Reduce traffic congestion in downtown Derry and discourage traffic from diverting from NH 102 onto local streets to avoid downtown Derry	Provide an alternative route to the Interstate system for traffic using NH 102 to and from the east, thus removing a large volume of through traffic from the heavily congested downtown Derry street network
Improve economic vitality in the Towns of Derry and Londonderry	Enhance and promote the economic vitality of the downtown Derry area, presently characterized by traffic congestion and decreasing vehicular and pedestrian safety, by separating local, destination-oriented traffic from through traffic destined for the Interstate system
Increase Interstate access for commercial and industrial suppliers	Provide improved Interstate access for commercial and industrially-zoned lands near NH 28 in both Derry and Londonderry, thus allowing for the planned and orderly development of such lands to further locally defined economic development goals and tax base diversification

2.0 METHODS AND ASSUMPTIONS

2.1 Documentation

As required by New Hampshire Department of Transportation (NHDOT) and FHWA, the following two specific requirements are addressed in this document:

- Policy Requirement 1 – provides operational and collision analysis by evaluating the operation of existing interchanges in the study area for the base year (2015) and future year (2040) using the U.S. Department of Transportation's Highway Capacity Manual (HCM) analysis and the Southern New Hampshire Planning Commission (SNHPC) to forecast future volumes.
- Policy Requirement 2 – describes access connections and design for all four traffic movements.

2.2 Analysis Period

Operational analysis includes both AM and PM peak hours for the following years:

- Base Year: 2015
- Future Year: 2040

2.3 Study Area

This section defines the traffic study area based on FHWA guidance and describes the data collection methods. The Project study area includes a mixture of Interstate and intersection facilities. According to FHWA guidance, when performing an IJR for a new interchange, the closest existing interchange in each direction of a proposed new interchange must be included. In addition, the first major signalized intersections along the roadway (usually an arterial) serving the closest interchange must be included (FHWA, 2017a). To be conservative, the study includes signalized intersections within 0.5 miles of the interchange. This includes all interchange facilities such as merges, diverges, and weaves and intersections along the arterial. Based on this guidance, the Project study area includes the following:

- I-93 mainline between south of Exit 4 to north of Exit 5
- All merges and diverges at Exit 4 along I-93
- All merges and diverges at Exit 5 along I-93
- All proposed merges and diverges at the new proposed Exit 4A along I-93
- The following NH 102 intersections
  - I-93 Southbound off-ramp (signalized) – ramp terminus at interchange
  - I-93 Northbound off and on-ramp (signalized) – ramp termini at interchange
  - Fordway/ Madden Hill Road (signalized) – approximately 2/3 mile to the east
  - Londonderry Road/St. Charles Street (unsignalized) – approximately 1/3 mile to the east
  - Garden Lane/Hampton Drive (signalized) – approximately 1/3 mile to the west
  - Gilcreast Road (signalized) – approximately 1/2 mile to the west
- The following NH 28 Intersections
  - I-93 Southbound off and on-ramp termini (signalized)
  - I-93 Northbound off and on-ramp termini (signalized)
  - Symmes Drive/Vista Ridge Drive (signalized) – approximately 1/3 mile to the west
  - Liberty Drive (signalized) – approximately 1/3 mile to the east

Figure 2-1 shows the study area intersections.

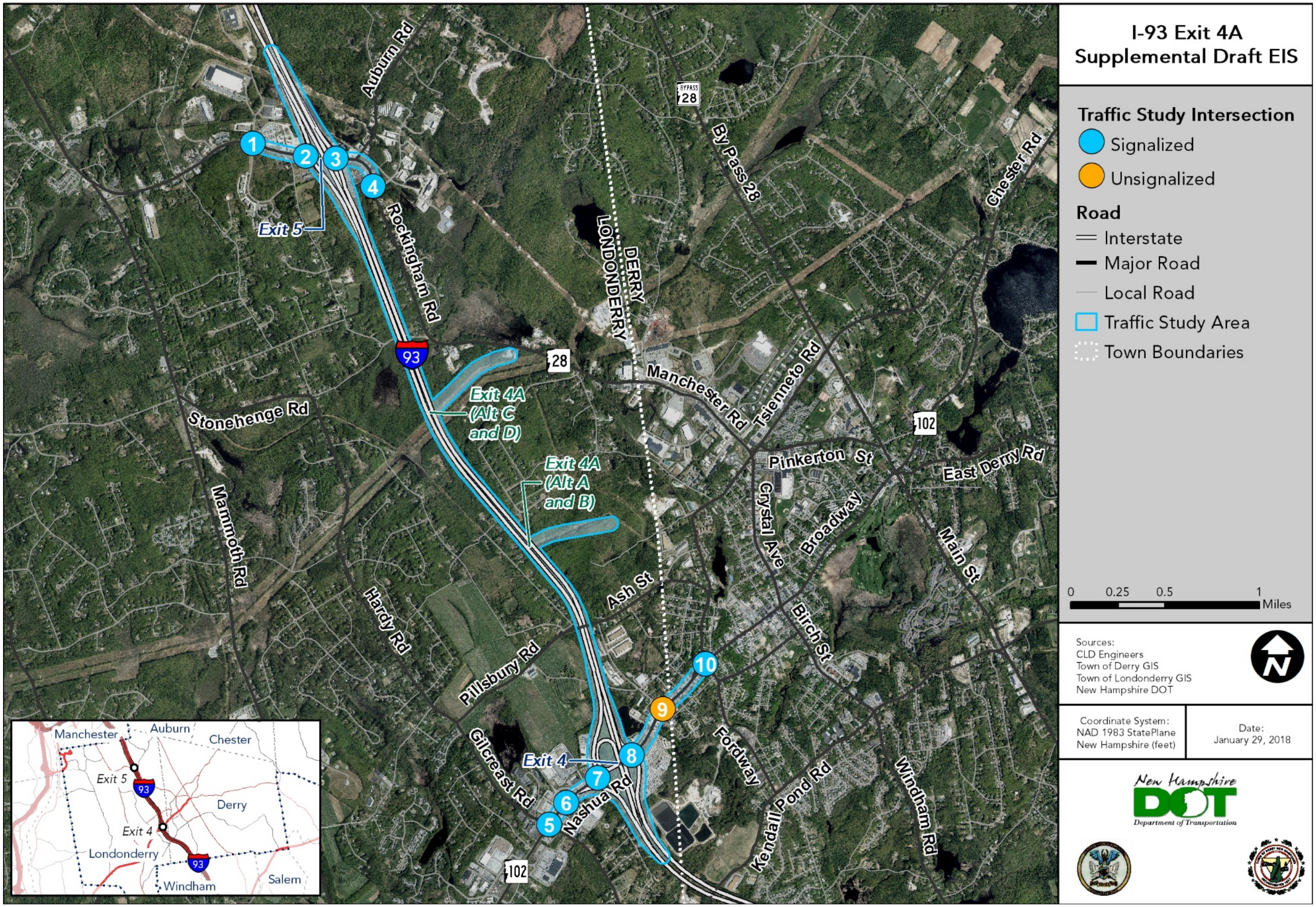


Figure 2-1. IJR Study area intersections

3.0 EXISTING CONDITIONS

The existing conditions describes the existing and future demographic forecasts, existing land use, roadway network, alternative travel modes, interchanges, traffic data sources, operational performance, and safety conditions.

3.1 Demographics

A total of 84 Transportation Analysis Zones (TAZ) covering 143 square miles were used to represent the SNHPC's subarea travel demand model. The demographic values assigned to each TAZ, including population, households, and employment, are based on the report titled Land Use Scenarios Technical Report, a report prepared as part of the current I-93 Exit 4A SDEIS project. These demographic values directly influence the number of trips produced at the residence locations and number of trips attracted to work locations in the travel demand model. The model then converts these production and attraction values into the number of trips assigned from each model origin TAZ to a model destination TAZ to form an origin-destination trip table.

The process to develop the existing and future demographic values included a review of existing federal, state, and regional, and local data sources as well as interviews with planners at the state, regional, and local levels. Primary sources included the following:

- U.S. Census Bureau
- New Hampshire Office of Strategic Initiatives
- SNHPC
- Neighboring Regional Agency, Rockingham Planning Commission (RPC)
- Derry
- Londonderry
- Neighboring Communities of Auburn, Chester, and Sandown

The future demographic forecasts were developed for the No Build Condition and the Build Conditions. They rely on a review of past trends; projections at the state, regional, and local levels; an active list of planned development; and additional demographic trend information learned through the interviews.

3.1.1 2040 No Build Condition

Past trends evaluated demographic changes from 1990 through 2014 and focused on positive and negative patterns by municipality. Population projections have been forecasted in 5-year intervals between 2015 and 2040 by the New Hampshire Office of Energy and Planning and the municipalities; household and employment projections have been forecasted between 2010 and 2040 by SNHPC and RPC. The report synthesized the various data sources and provided future No Build Condition background demographic forecasts.

There are a number of planned developments in Londonderry, including an extensive mixed used development called Woodmont Commons. The Woodmont Commons Planned Unit Development Master Plan includes land on both the west and east sides of I-93, as shown in Figures 3-1 and 3-2. The Woodmont Commons Phase I plan included as part of the No Build comprises 312,574 gross square feet of commercial, 510 units residential, and 135 hotel rooms. There is also a smaller, commercial development of 30,000 gross square feet and 1,094 gross square foot of industrial development. These developments are projected to create over 4,200 jobs and add over 3,800 in population and 1,345 households to the study area (Louis Berger, 2017).

The total 2040 No Build Condition demographic forecasts were developed by adding the existing values to the forecasted background growth and planned development projections. Tables 3-1, 3-2, and 3-3 contain the 2040 No Build Condition population, household, and employment projections for the study area, respectively.

Table 3-1. Total 2040 No Build population for study area

Municipality	Existing Population (2015 Projection)	Background Population Growth from the NH Office of Energy Planning/Chester Projections (2015–2040)	Population Growth from Known Development Proposals	Total 2040 No Build Population
Derry	32,948	274	0	33,222
Londonderry	24,891	2,145	3,849	30,885
Auburn	5,315	733	0	6,048
Chester	4,887	1,366	0	6,253
Sandown	6,255	991	0	7,246
Study Area Total	74,296	5,509	3,849	83,654

Source: Louis Berger (2017)

Table 3-2. Total 2040 No Build households for study area

Municipality	Existing Households (2015 Projection)	Background Household Growth (2015–2040)	Household Growth from Known Development Proposals	Total 2040 No Build Households
Derry	12,656	17	0	12,673
Londonderry	8,625	725	1,345	10,698
Auburn	1,923	264	0	2,187
Chester	1,621	456	0	2,077
Sandown	2,193	721	0	2,914
Study Area Total	27,018	2,183	1,345	30,548

Source: Louis Berger (2017)

Table 3-3. Total 2040 No Build employment for study area

Municipality	Existing Employment (2015 Projection)	Background Employment Growth from SNHPC/ RPC Projections (2015–2040)	Employment Growth From Known Development Proposals	Total 2040 No Build Employment
Derry	8,384	1,938	0	10,322
Londonderry	13,517	4,033	4,219	21,769
Auburn	1,846	914	0	2,760
Chester	368	267	0	635
Sandown	419	117	0	536
Total	24,534	7,269	4,219	36,022

Source: Louis Berger (2017)

3.1.2 2040 Build Condition

Creating a new connection from I-93 to Londonderry and Derry would provide better access to a number of parcels and could influence the type and/or intensity of future development. This development potential is referred to as indirect land use effects. The 2040 Build Condition incorporates indirect land use effects of constructing a new interchange.

In total, 398 new residential units, 200 hotel rooms, 1,015,400 gross square feet commercial, 460,000 gross square feet institutional, and 168 industrial jobs could be added as a result of the indirect land use effects of creating I-93 Exit 4A (Louis Berger, 2017). For Woodmont Commons, the developments on both sides of I-93 (referred to as full build-out) are included containing 9 residential units, 200 hotel rooms, 1,015,400 gross square feet of commercial, and 460,000 gross square feet of institutional.

Each proposed alternative assessed in this study incorporates different levels of demographic growth based on proposed transportation improvements. Each alternative and its demographic components are as follows:

- Alternative A: Woodmont Commons Full Build-out plus growth in Derry, Londonderry, Auburn, Chester, and Sandown
- Alternative B: Similar to Alternative A
- Alternative C: Woodmont Commons Phase I (same as No Build) plus growth in Chester and Sandown
- Alternative D: Similar to Alternative C
- Alternative F: Similar to the No Build Condition

The total 2040 Build Condition demographic forecasts were developed by adding the 2040 No Build values to the forecasted indirect effects of land use. Tables 3-4, 3-5, and 3-6 contain the Alternative A and B 2040 Build Condition population, household, and employment projections for the study area, respectively. Population, households, and employment are not expected to grow under Alternatives C and D in Derry, Londonderry, or Auburn, but would grow in Chester and Sandown in the same manner as Alternatives A and B, as shown in Tables 3-4 through 3-6.

Table 3-4. Alternative A and B 2040 Build condition population

Municipality	2040 No Build Population	2040 Build Incremental Development Project Population	Total 2040 Build Population	Percent Difference between No Build and Build
Derry	33,222	0	33,222	0.00%
Londonderry	30,885	25	30,910	0.08%
Auburn	6,048	0	6,048	0.00%
Chester	6,253	1,117	7,370	16.40%
Sandown	7,246	21	7,267	0.29%
Total	83,654	1,163	84,818	1.38%

Source: Louis Berger (2017)

Table 3-5. Alternative A and B 2040 Build condition households

Municipality	2040 No Build Households	2040 Build Incremental Development Project Households	Total 2040 Build Households	Percent Difference between No Build and Build
Derry	12,673	0	12,673	0.00%
Londonderry	10,698	9	10,707	0.09%
Auburn	2,187	0	2,187	0.00%
Chester	2,077	371	2,448	17.86%
Sandown	2,914	9	2,923	0.31%
Total	30,548	389	30,937	1.27%

Source: Louis Berger (2017)

Table 3-6. Alternative A and B 2040 Build condition employment

Municipality	2040 No Build Employment	2040 Build Incremental Development Employment	Total 2040 Build Employment	Percent Difference between No Build and Build
Derry	10,322	346	10,668	3.25%
Londonderry	21,769	4,335	26,104	18.81%
Auburn	2,760	0	2,760	0.00%
Chester	635	0	635	0.00%
Sandown	536	0	536	0.00%
Total	36,022	4,681	40,703	12.44%

Source: Louis Berger (2017)

Once the 2040 No Build and Build demographic values by municipality were developed, they were allocated to each TAZ representing the municipality. The anticipated population, household, and job growth associated with the known No Build developments was assigned to TAZs based on the percentage of the development land area in each TAZ. Only the TAZ that contained a proposed change in demographic data was updated. Out of the 84 TAZs, 17 TAZs were updated representing the zones in the municipalities where growth would occur based on background growth and planned development, or could occur based on indirect effects of land use. The I-93 Exit 4A SDEIS Land Use Scenarios Technical Report (Louis Berger, 2017) contains the detailed demographic data by TAZ.

3.2 Land Use

In New Hampshire, land use is regulated at the local level by municipalities through zoning and subdivision regulations. Zoning ordinances regulate land uses by area and the type and form of built improvements allowed within each land use. Subdivision ordinances seek to control the density of development on new parcels of land. Land use can also be influenced by other public policy goals expressed as part of land use, transportation, and infrastructure planning processes.

Current land use and zoning conditions were identified using geographic information systems datasets of land use by tax parcel and zoning district boundaries provided by the Towns of Derry and Londonderry. In addition, the data were supplemented with reference to the towns' zoning ordinances (Town of Derry, 2016; Town of Londonderry, 2016). The land use within the study area was defined as the land area within 500 feet of the proposed alternative alignments (Figure 3-1). Field visits and windshield surveys were used to verify land use conditions.

Land use policies and plans for the Project area were identified through a review of the following comprehensive and master plans:

- Master Plan of Derry (Town of Derry, 2010)
- Comprehensive Master Plan of Londonderry (Town of Londonderry, 2013)
- Southern New Hampshire Planning Commission's Moving Southern New Hampshire Forward: 2015-2035 Regional Comprehensive Plan (SNHPC, 2014)

Land use within the study area includes commercial, industrial, single- and multi-family residential, institutional, civic, open space, and recreational (golf course). Figure 3-1 also identifies the proposed Woodmont Commons Planned Unit Development (PUD).

The Woodmont Commons PUD is planned for construction on both the east and west sides of I-93 in Londonderry. Phase I is the only approved plan along the west side of I-93; it includes a Market Basket. Access to these parcels is available from John R. Michels Way and Pillsbury Road. Woodmont Commons East would be located north of Ash Street and directly serviced by a new I-93 Exit 4A under Alternatives A or B (See Section 6.1 for detailed alternative description). Pillsbury Road and Ash Street would provide a direct connection between the east and west sections of Woodmont Commons. Specific uses within the development have not been finalized but would include residential, office, medical, hotel, retail, and civic uses. Figure 3-2 illustrates the proposed Woodmont Commons PUD.

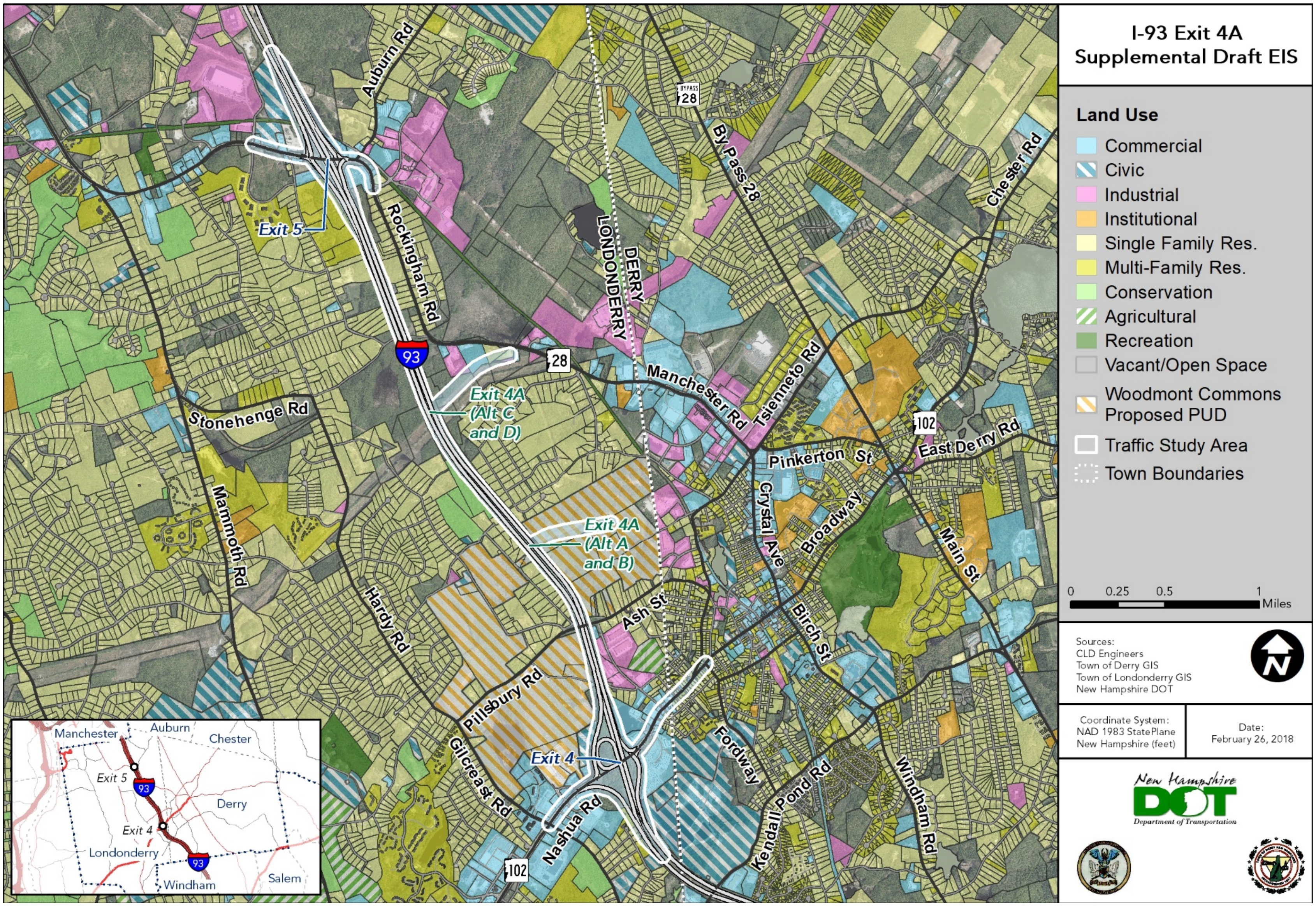


Figure 3-1. Land use in the study area

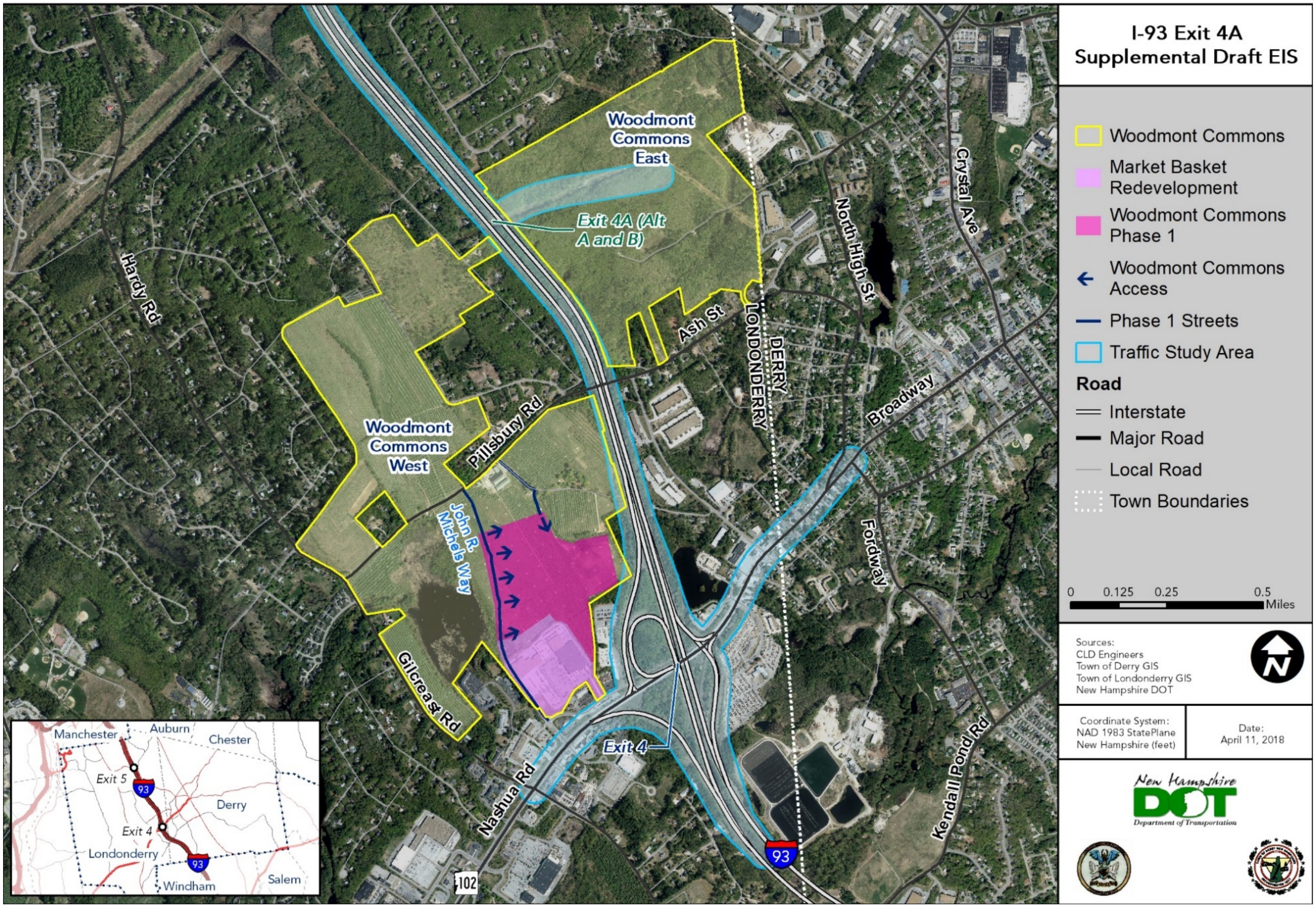


Figure 3-2. Proposed Woodmont Commons Planned Unit Development

3.3 Roadway Network

The roadway network in the study area contains a mix of Interstate, principal arterials, collectors, and local roadways.

Interstate 93 is a north-south oriented, full access control roadway part of the Eisenhower Interstate System connecting Massachusetts to Vermont. It has a posted speed limit of 65 miles per hour (mph) through the study area and four travel lanes, two in each direction. The average daily traffic (ADT) in 2015 was approximately 35,000 vehicles in each direction or 71,000 total vehicles per day and is functionally classified by NHDOT as a principal arterial, Interstate (NHDOT, 2016a; 2017a). Two interchanges exist in the study area serving NH 102 and NH 28.

NHDOT is in the process of upgrading I-93 from four to eight lanes between Salem, New Hampshire, at the Massachusetts border and Manchester, New Hampshire, ending at Exit 6 at the I-293 interchange, more than 3 miles north of Exit 5. Exit 5 reconstruction was completed in 2014. Exit 4 reconstruction is currently ongoing with anticipated completion in fall 2020. Widening the I-93 mainline to six lanes is currently ongoing between Exits 4 and 5 with anticipated completion in fall 2020. Final construction of the fourth lane in each direction (eight lanes total) will be achieved with a separate project in the NHDOT Ten Year Plan with anticipated completion in fall 2020 (NHDOT, 2017b). The No Build and all Build alternatives under study for Exit 4A assume completion of the I-93 widening project.

NH 28 is a north-south oriented roadway with partial access control in the vicinity of the interchange connecting Massachusetts to Manchester, New Hampshire. It has a posted speed limit of 30 mph through the study area and four travel lanes, two in each direction from the I-93 interchange and north. To the south it has two travel lanes, one in each direction. The ADT in 2014 was approximately 16,000 total vehicles per day and is functionally classified by NHDOT as an urban minor arterial (NHDOT, 2016b; 2017a).

NH 102 is a northeast-southwest oriented roadway with partial access control west of I-93 and no access control east of I-93 connecting Nashua to Chester, New Hampshire. It has a posted speed limit of 30 mph through the study area and has four travel lanes, two in each direction from the I-93 interchange and west. To the east it has two travel lanes, one in each direction. The ADT in 2014 was approximately 18,000 total vehicles per day and is functionally classified by NHDOT as an urban principal arterial – other (NHDOT, 2016c; 2017a). The roadway travels through a more urban environment to the east of I-93, entering the outskirts of downtown Derry.

Symmes Drive/Vista Ridge Drive is a north-south oriented local roadway with no access control. It has two travel lanes, one in each direction.

Liberty Drive is a north-south orientated local roadway with no access control. It has two travel lanes, one in each direction.

Gilcreast Drive is a northwest-southeast oriented local roadway with no access control. It has a posted speed limit of 35 mph through the study area and has two travel lanes, one in each direction. It is functionally classified by NHDOT as an urban major collector (NHDOT, 2016c).

Garden Lane/Hampton Drive is a northwest-southeast oriented local roadway with no access control. It has two travel lanes, one in each direction.

Londonderry Road/St. Charles Street is a northwest-southeast oriented local roadway with no access control. It has a posted speed limit of 35 mph along Londonderry Road through the study area and has two travel lanes, one in each direction.

Figure 3-3 shows the functional classification of roadways in the study area.

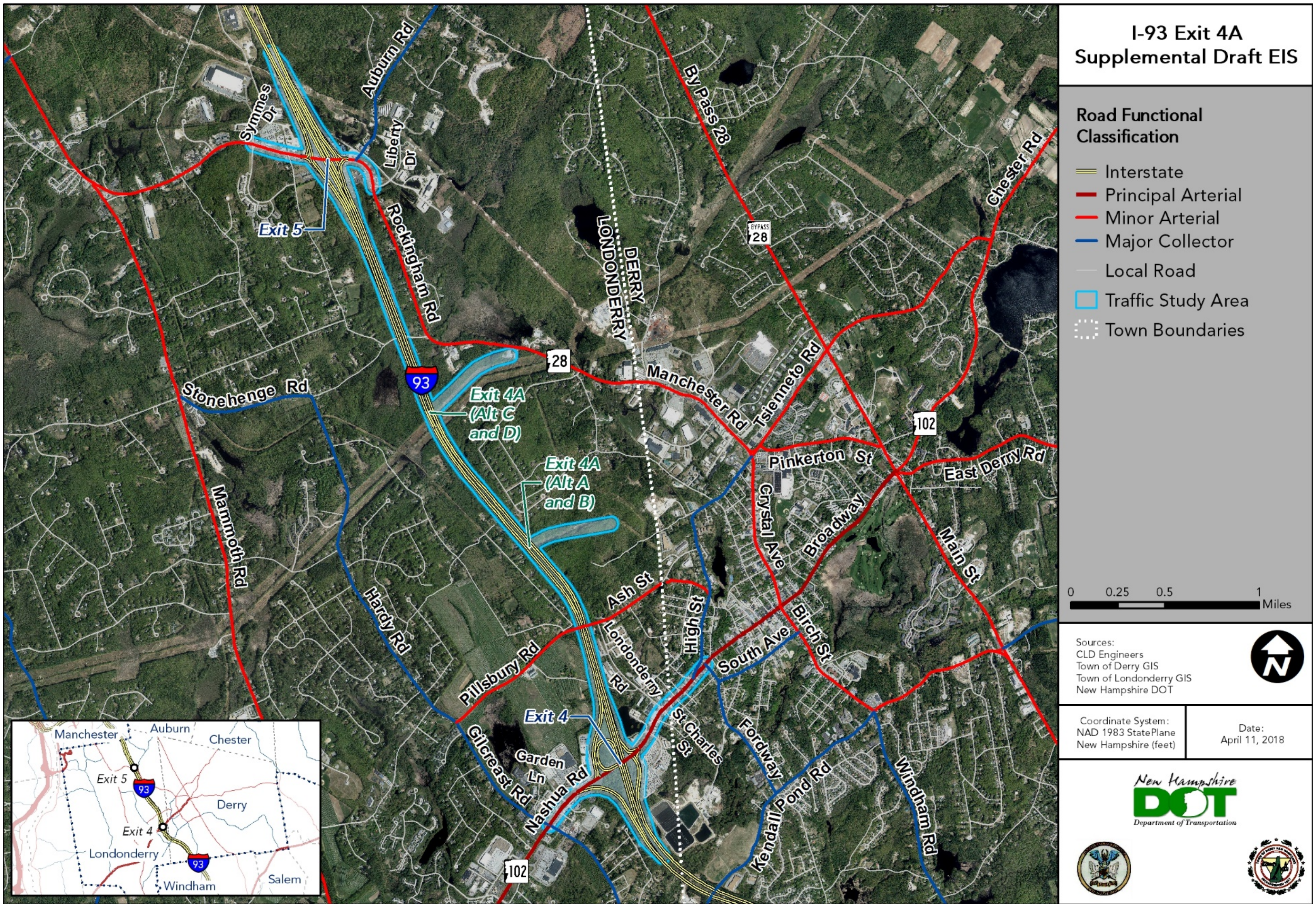


Figure 3-3. Functional classification of roadways in the study area

3.4 Alternative Travel Modes

There are three bus routes, two park and ride lots serviced by the buses, and a bicycle trail in the study area. Figure 3-4 shows the alternative travel modes in the study area. The bus operations include Boston Express, Concord Coach Lines, and Cooperative Alliance for Regional Transportation.

Boston Express operates express bus service between Concord New Hampshire and Boston, Massachusetts. There are two bus stops in the study area composed of North Londonderry at Exit 5 off NH 28 and Londonderry at Exit 4 off NH 102. Buses either service one stop, then express to Boston during the AM peak period, but stop at both Londonderry stops on the return trip. A total of nine inbound buses operate during the AM peak period (6:00 a.m. – 9:00 a.m.) from either stop and 12 buses operate in the return direction during the PM peak period (4:00 p.m. – 7:00 p.m.) (Boston Express, 2016).

Concord Coach Lines operates express bus service between northern New Hampshire and Boston, Massachusetts. There is one bus stop in the study area composed of North Londonderry at Exit 5 off NH 28. A total of six southbound buses operate over the course of the day and five northbound buses operate during the course of the day (Concord Coach Lines, 2017).

Cooperative Alliance for Regional Transportation is a specialty shuttle service that serves the study area by providing on-call rides and scheduled local shuttle routes to shopping and medical services. The routes can include deviations to accommodate patron requests (CART, n.d.).The two park and rides are located near I-93 at Exit 4 in Londonderry and Exit 5 in North Londonderry. Both are served by buses.

Londonderry Exit 4 Park and Ride is operated by Boston Express and Boston Express is the only bus that services the facility. It contains 452 parking spaces and provides a bus shelter and bicycle rack (NHGov, 2017a).

North Londonderry Park and Ride is operated by Boston Express and is served by Boston Express and Concord Coach Lines. It contains 728 parking spaces and provides a bus shelter and bicycle rack (NHGov, 2017b).

There is also a multiuse trail that traverses the study area called the Londonderry Rail Trail along the former Manchester and Lawrence Railroad. This trail is part of a larger trail initiative called the Granite State Rail Trail (Londonderry Trails, 2016).

New Hampshire does not have a high occupancy vehicle lane in the state.

3.5 Interchanges

Two existing interchanges in the study area serve Exits 4 and 5. I-93 at Exit 4 is a combination diamond interchange on the northbound side and partial cloverleaf or Parclo A on the southbound side (FHWA, 2012b). This interchange type provides a higher capacity for NH 102 in the westbound direction by allowing a free-flow move from NH 102 westbound to I-93 southbound. Exit 5 is a compressed diamond interchange, where the spacing between the two intersections at the ramp termini is less than 800 feet (FHWA, 2012b). This interchange was recently upgraded to provide partial access control along NH 28 between Liberty Drive and Symmes Drive. The distance between the two interchanges is approximately 3.6 miles.

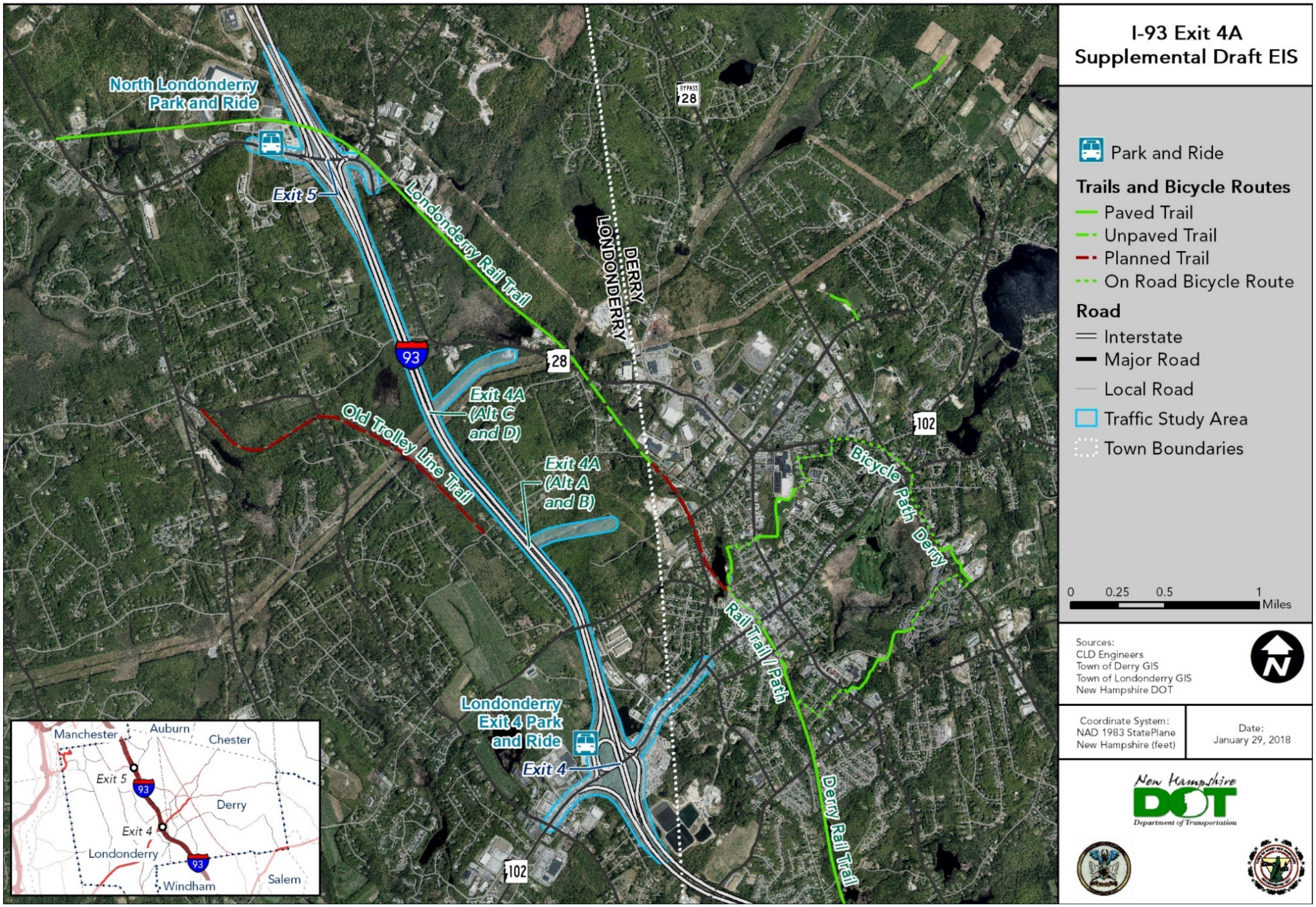


Figure 3-4. Alternative travel modes in the study area

Figure 3-5 shows the I-93 Exit 4 and Exit 5 interchanges.

3.6 Existing Data

3.6.1 Introduction

The primary tool to forecast the future volumes for the proposed I-93 Exit 4A was the SNHPC's travel demand model. The model's most recent base year, 2015, was developed to only forecast daily traffic volumes, not AM or PM peak periods. Therefore, the traffic data collection effort focused on developing both a 2015 balanced AM and PM peak hour network and a daily volume network. The AM and PM peak hour networks provided the percent adjustments between the peak hour volumes and daily volumes while the daily volume network provided the model's 2015 base year data. SNHPC created a 17 TAZ subarea of the model representing Chester, Derry, and Londonderry, the project study area, and calibrated the subarea to the 2015 daily volume balanced network. Once calibrated, the model was ready to test different 2040 future I-93 Exit 4A alternatives and produce the 2040 daily vehicle volumes, based on the land use growth projections. The percent vehicle adjustments between the 2015 AM and PM peak hour volumes and 2015 daily volumes provided the adjustment from the model's forecasted 2040 daily vehicle volume output and forecasted 2040 peak hour volumes. Traffic analysis tools relied on the peak hour volumes to assess the interstate facility and intersection operations.

3.6.2 Traffic Data Collection

Traffic data collection focused on collecting recent data to develop a balanced 2015 network. Data were collected from five sources: (1) Project team, (2) NHDOT permanent count stations, (3) the SNHPC's NH 102 Corridor Update Study Report, (4) the I-93 Supplemental EIS (SEIS), and (5) NHDOT intersection report. The first two sources provided counts in 2016 covering the I-93 mainline and ramp volumes as well as NH 102 and NH 28 turning movement counts for intersections serving I-93 ramp termini and a few intersections east of the interchange along NH 102.

The project team collected daily and hourly ramp volumes at the following intersections in May 2016:

- I-93 northbound off-ramp to NH 102 (Exit 4)
- I-93 northbound on-ramp from NH 102 (Exit 4)
- I-93 southbound off-ramp to NH 102 (Exit 4)
- I-93 southbound on-ramp from NH 102 westbound (Exit 4)
- I-93 southbound on-ramp from NH 102 eastbound (Exit 4)
- I-93 northbound off-ramp to NH 28 (Exit 5)

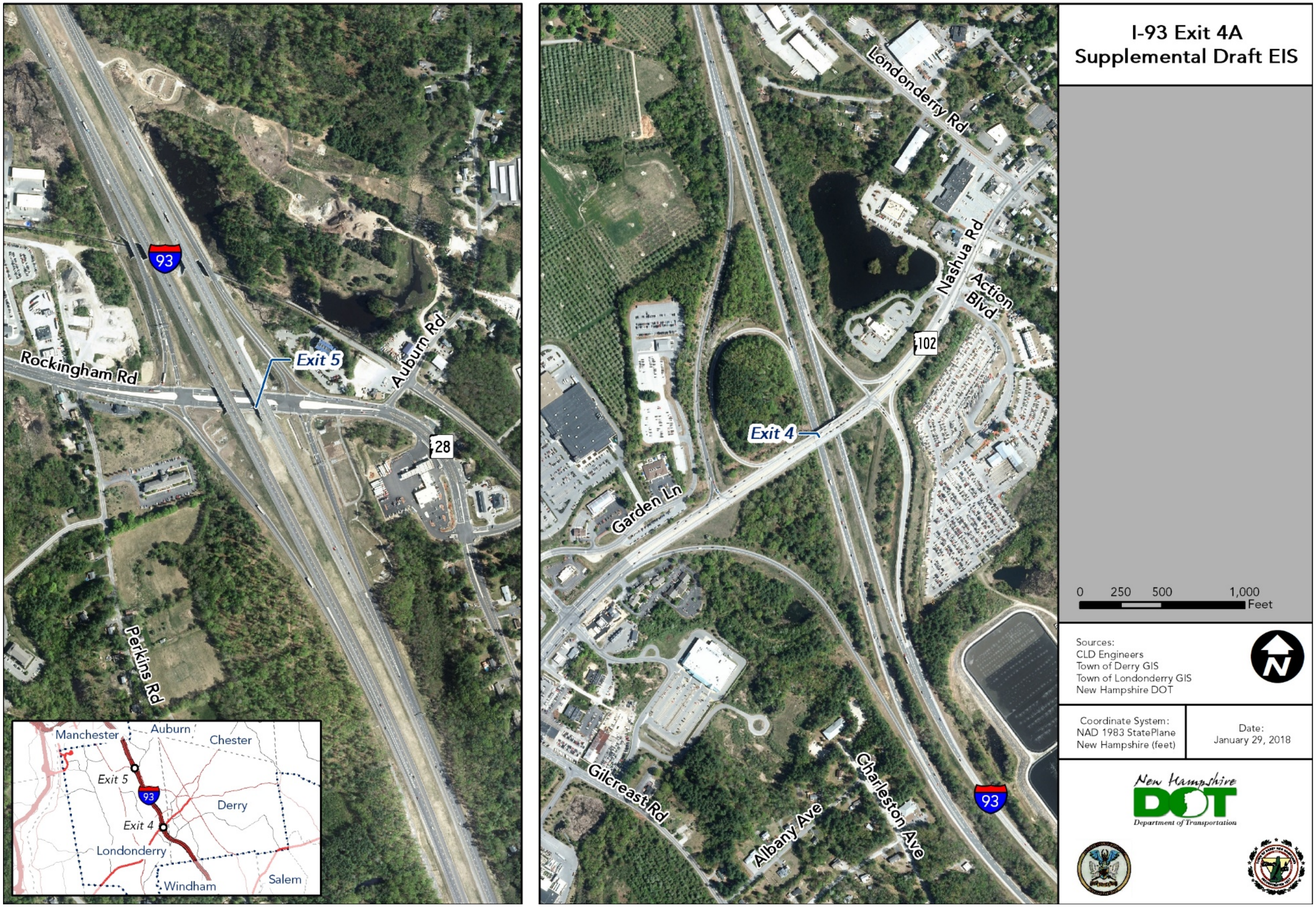


Figure 3-5. I-93 Exit 4 and Exit 5 interchanges

- I-93 northbound on-ramp from NH 28 (Exit 5)
- I-93 southbound off-ramp to NH 28 (Exit 5)
- I-93 southbound on-ramp from NH 28 (Exit 5)

The project team collected AM and PM peak period turning movement counts at the follow intersections in May 2016:

- I-93 northbound on and off-ramps at NH 102 (Exit 4)
- I-93 southbound off-ramp at NH 102 (Exit 4)
- I-93 northbound on and off-ramps at NH 28 (Exit 5)
- I-93 southbound on and off-ramps at NH 28 (Exit 5)
- NH 102 at Londonderry Road/St. Charles Street
- NH 102 at Fordway/Madden Hill Road

The project team obtained hourly and daily vehicle volumes at the follow intersections from April 2014, July 2015, or September 2015:

- NH 102 east of Griffin Street (east of Exit 4)
- NH 102 east of Hampton Drive (west of Exit 4)
- NH 28 east of Perkins Road (west of Exit 5)
- NH 28 north of Liberty Drive (east of Exit 5)

NHDOT provided permanent count station hourly volume data from 2015. The following station data were collected:

- I-93 northbound and southbound, between Exits 3 and 4
- I-93 northbound and southbound mainline, between Exits 4 and 5
- I-93 northbound and southbound mainline, between Exits 5 and 6

The Woodmont Commons Phases I and II Traffic Impact Assessment (TIA) provided turning movement counts for two intersections located west of I-93 at Exit 4 (TEC, 2016). These volumes were obtained in 2016 and used to calculate the vehicle percentage for each tuning movement and applying that percentage to the balanced 2015 traffic network at Exit 4 composed of the project team traffic data. The Woodmont Commons TIA provided data on the following intersections to the study area:

- NH 102 at Gilcreast Road
- NH 102 at Garden Lane/Hampton Drive

The I-93 SEIS provided turning movement counts for one intersection located west of I-93 at Exit 5 (NHDOT, 2009). This volume was obtained in 2005 and used to calculate the vehicle percentage for each tuning movement and applying that percentage to the balanced 2015 traffic network at Exit 5 composed of the project team traffic data. The I-93 SEIS provided data on the following intersection to the study area:

- NH 28 at Symmes Drive/Vista Ridge Drive

NHDOT provided a turning movement count for one intersection located east of I-93 at Exit 5. This volume was obtained in 2005 and used to calculate the vehicle percentage for each tuning movement and applying that percentage to a combination of the balanced 2015 traffic network at Exit 5 composed of the project team traffic data and NHDOT automatic traffic recorder (ATR) data representing NH 28 north of Liberty Drive intersection. NHDOT provided data on the following intersection to the study area:

- NH 28 at Liberty Drive

Figure 3-6 shows the existing condition study area turning movement counts covering the AM and PM peak hours.

As part of the field data collected, a detailed inventory of the lane geometry was conducted through field reconnaissance and a study of aerial imagery. Based on this information, the existing lane geometry and traffic control type (signalized or unsignalized) are shown in Figure 3-7.

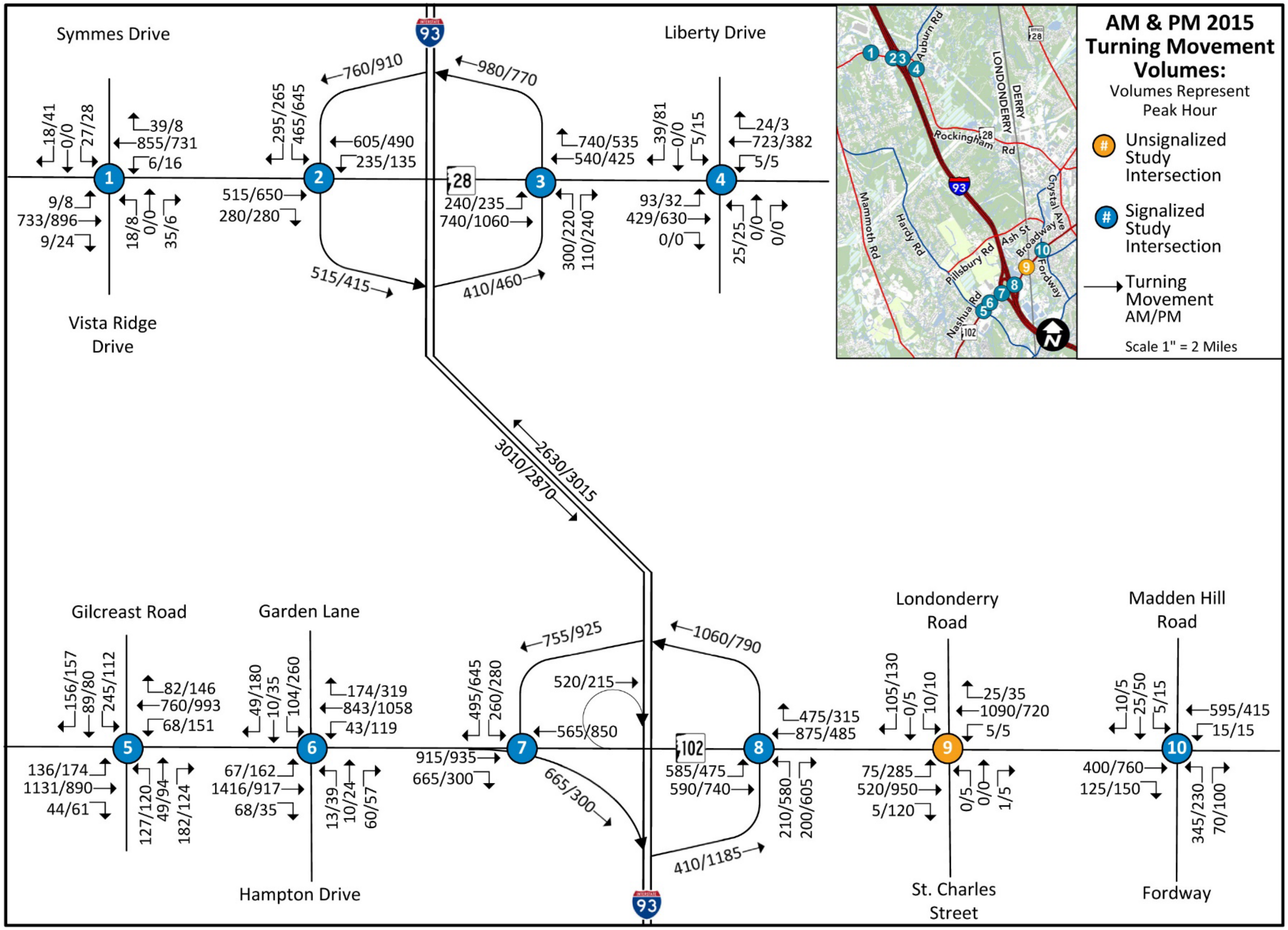


Figure 3-6. AM and PM 2015 existing turning movement volumes

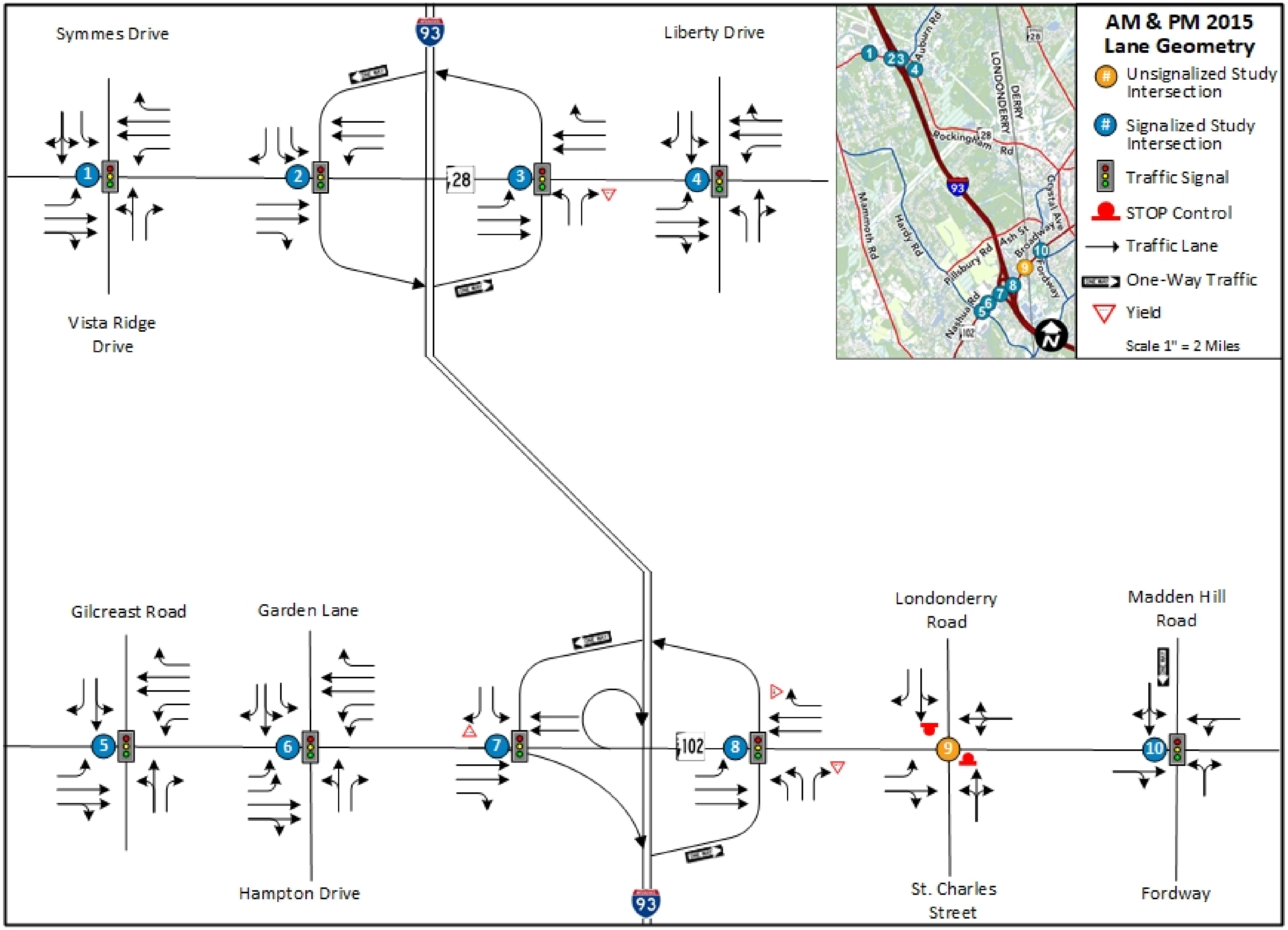


Figure 3-7. AM and PM 2015 existing lane geometry

3.6.3 Traffic Data Adjustments

The raw data from the daily counts were adjusted to create a 2015 base year balanced network using the following three processes. First, they were adjusted based on the count season to allow for seasonal traffic fluctuations and represent a more typical October or April time period. Second, the counts were adjusted to correct for the number of axles that triggered the counter to record a vehicle. Large trucks with more than two axles were counted as two or even three separate vehicles because the counter is programmed to record a vehicle every two axles that cross a sensor or tube. Third, the counts were increased or decreased following a growth factor calculated separately for I-93 mainline and all other roadways (including the I-93 ramps). The I-93 mainline applied a 1.1 percent growth per year based on comparing multiple years of data for a counter on I-93, and all other roadways applied a 2.5 percent growth per year rate based on comparing multiple years of data for a counter on NH 28. Counts were increased or decreased by the appropriate rate depending on whether the counts were before 2015 or after 2015 (no adjustment was applied to 2015 counts).

3.7 Operational Performance

This operational performance explains the concepts and definitions for analyzing the traffic operations, the process used to analyze the study area intersections and freeway facilities along I-93, and the results of the traffic analyses.

3.7.1 Analysis Tools

The study analyzed the study area intersections using Synchro™ Traffic Signal Coordination Software Version 10.0 (Build 1, Revision 26). Two analyses were performed for traffic, including an intersection capacity analysis and an intersection queueing analysis. The intersection capacity analysis used the Synchro™ software tool and various input values as described in the following sections to determine the level of service (LOS) or driver perception of an intersection's operation. The intersection queuing analysis used the Synchro™ tool to determine different levels of queuing or the length that vehicles may back up at an intersection.

The study analyzed the I-93 freeway facilities using Highway Capacity Software (HCS) 2010 (Version 6.90). Analyses were performed for ramp merge and diverge facilities. The HCS relied on various input values to determine the LOS or driver perception of a freeway segment's operation.

3.7.2 Intersection Operations Analysis

LOS is the primary measure of traffic operations for both signalized and unsignalized intersections. LOS is a standard performance measure developed by the transportation profession to quantify driver perception for such elements as travel time, number of stops, total amount of stopped delay, and impediments caused by other vehicles. LOS provides a scale that is intended to match motorists' perception of how a transportation facility operates and to provide a scale to compare different facilities. Detailed LOS descriptions are presented in Figure 3-7.

Signalized Intersection Level of Service

The LOS for signalized intersections is based on the HCM 2000 method and requires the same inputs to determine an accurate LOS (TRB, 2000). HCM 2010 methods were not followed because the signal timings and phasing were not HCM 2010 compliant, for example, signal timings included pedestrian-only phases. Primary inputs include:

- vehicular volumes
- pedestrian volumes
- traffic signal timings
- roadway geometry
- speed limits
- truck percentages
- peak hour factor (measure of vehicle 15-minute flow rate)

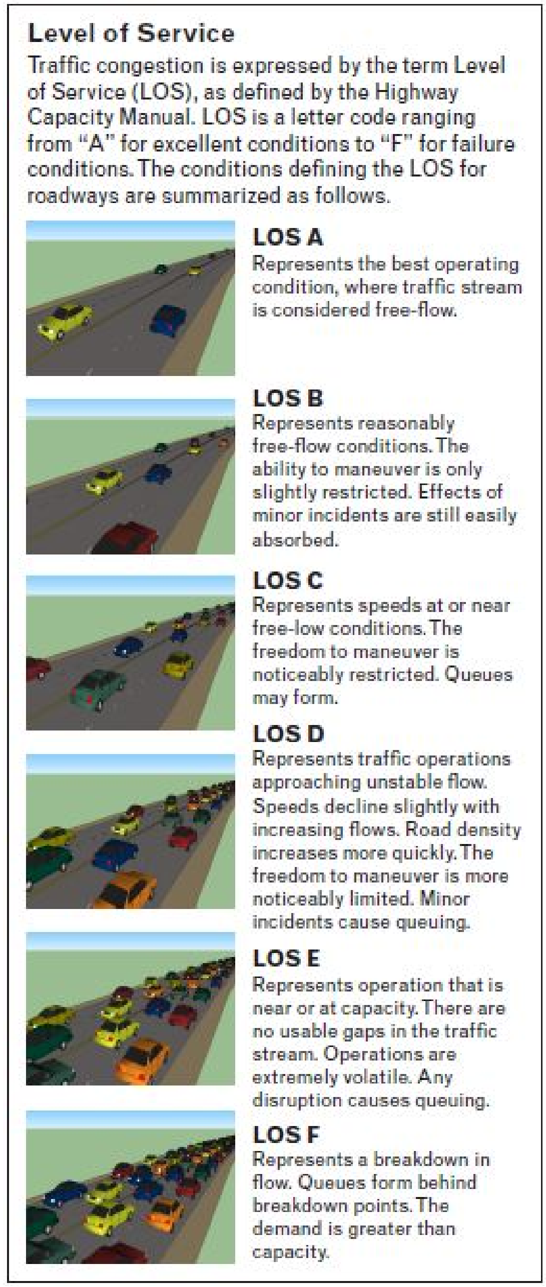


Figure 3-8. Level of service diagram

The average vehicle control delay, measured in seconds per vehicle, is calculated using these parameters with the Synchro™ procedures. This represents the average extra delay in seconds per vehicle caused by the presence of a traffic control device or traffic signal and includes the time required to decelerate, stop, and accelerate. The LOS can be characterized for the entire intersection, each intersection approach, and each lane group. Control delay is used to characterize the LOS for the entire intersection or an approach. The control delay and the volume-to-capacity ratio are used to characterize the LOS for a lane group. Delay quantifies the increase in travel time due to a traffic signal control. It is also a surrogate measure for driver discomfort and fuel consumption (TRB, 2010). Signalized intersections or approaches that exceed a delay of 55 seconds have LOS E and those that exceed a delay of 80 seconds have LOS F. Table 3-7 shows the average control delay and corresponding LOS for signalized intersections.

Table 3-7. Signalized intersection control delay and LOS thresholds – HCM 2000 method

LOS	Average Control Delay (seconds/vehicle)	Description
A	Less than or equal to 10	Stable conditions
B	>10-20	
C	>20-35	
D	>35-55	
E	>55-80	Unstable conditions
F	More than 80	Above capacity and unstable conditions

Source: TRB (2000)

To determine the LOS of an intersection, the critical input values were entered into the analysis software (Synchro™), and the average vehicle delay (seconds per vehicle) was calculated. Based on the average vehicle delay, the LOS was determined for all movements (left, through, and right), approaches, and the intersection as a whole.

Unsignalized Intersection Levels of Service

The LOS for unsignalized intersections (STOP-controlled intersections) is based on the HCM 2000 method to be consistent with the intersections analysis and requires several inputs, including:

- vehicular volumes
- pedestrian volumes
- roadway geometry
- speed limits
- truck percentages
- peak hour factor

The average vehicle control delay, in seconds per vehicle, was calculated using these parameters with the HCM 2000 procedures (TRB, 2010). Average vehicle control delay represents the average delay caused by the presence of a stop sign or roundabout and includes the time required to decelerate, stop, and accelerate.

The LOS for a two-way, STOP-controlled (TWSC) intersection (i.e., unsignalized intersection) is determined for each minor-street movement or shared movement and the major-street left turns. LOS F is assigned to the movement if the volume-to-capacity ratio for the movement exceeds 1.0 or if the movement's control delay exceeds 50 seconds. The criteria used to determine LOS for TWSC intersections are different from the criteria used for signalized intersections primarily because user perceptions differ among transportation facility types. The expectation is that a signalized intersection is designed to carry higher traffic volumes and presents greater delay than an unsignalized intersection. Unsignalized intersections are also associated with more uncertainty for users because delays are less predictable than at signals, which can reduce users' delay tolerance. LOS is not defined for the TWSC intersection as a whole or for major-street approaches for three primary reasons: (1) major-street through vehicles are assumed to experience zero delay; (2) the disproportionate number of major-street through vehicles at a typical TWSC intersection skews the weighted average of all movements, resulting in a very low overall average delay for all vehicles; and (3) the resulting low delay can mask important LOS deficiencies for minor movements (TRB, 2010).

The capacity of the controlled intersection legs is based primarily on three factors: the conflicting volume, the critical gap time (defined as the number of seconds between vehicles passing the same point along the major street approach), and the follow-up time (defined as the number of seconds between the departure of the first and second vehicle in queue along the minor street approach). The HCM-based capacity analysis procedure assumes that drivers are both consistent and homogeneous and assumes consistency for their critical gap time. Critical gap times are based on many factors, including delay experienced by drivers on the approaches controlled by STOP signs. As delay increases, drivers become less patient and accept shorter gaps, resulting in higher capacities for unsignalized intersections that are operating at LOS D or worse. The unsignalized intersection procedure uses fixed critical gap times. Unless the critical gap times are adjusted, the procedure tends to overestimate the delay at unsignalized intersections that are operating at LOS D or worse. Also, poor operations at an unsignalized intersection encourages some drivers to turn right and make a U-turn on the mainline or accept shorter critical gaps (safety issue) rather than attempt a left turn (TRB, 2010).

Table 3-8 shows the average control delay and corresponding LOS for unsignalized intersections. The worst LOS at one-way, STOP-controlled, and TWSC intersections represents the delay for the minor approach only.

Table 3-8. Unsignalized intersection control delay and LOS thresholds – HCM 2000 method

LOS	Average Control Delay (seconds/vehicle)	Description
A	Less than or equal to 10	Stable conditions
B	>10-15	
C	>15-25	
D	>25-35	
E	>35-50	Unstable conditions
F	More than 50	Above capacity and unstable conditions

Source: TRB (2010)

3.7.3 Freeway Operations Analysis

The LOS for freeway facilities is based on the HCM 2010 method and requires inputs to determine an accurate LOS. Primary inputs include:

- vehicular volumes

- roadway geometry
- speed limits
- truck percentages
- peak hour factor

Freeway facilities are evaluated based on the density of vehicles. The higher the density the slower the vehicles travel and the worse the operations. Based on the vehicle density, the HCM provides LOS equivalents to represent the driver's perception of the facility operation. Table 3-9 shows the density and corresponding LOS for signalized intersections.

Table 3-9. HCM freeway facility level of service

LOS	Freeway Merge and Diverge Facilities Density (passenger cars/ mile/ lane)	Description
A	0-10	Passing operation
B	>10-20	
C	>20-28	
D	>28-35	
E	>35	Unstable conditions
F	Demand Exceeds Capacity	Above capacity and unstable conditions

Source: TRB (2010)

3.7.4 Existing Condition Intersection Operations Analysis

Based on the Synchro™ signalized intersection analysis results, one signalized intersection at Gilcreast Road (Intersection #5) operates at unacceptable conditions (LOS E or LOS F) during the AM peak hour. The remaining signalized intersections in the traffic study area operate at acceptable overall conditions (LOS D or better is considered an acceptable operating level) during the peak hours analyzed (weekday AM and PM peak hours).

Based on the Synchro™ signalized intersection analysis results, one study area signalized intersection (Intersection #5) has overall approaches that operate at unacceptable conditions (LOS E or LOS F) during one or two evaluated periods. The following are the individual signalized intersection approaches in the traffic study area that operate under unacceptable conditions during peak hours:

- NH 102 at Gilcreast Road (Intersection #5)
  - Eastbound and Westbound NH 102 during the AM peak hour
  - Northbound Gilcreast Road during the PM peak hour
  - Southbound Gilcreast Road during the AM and PM peak hours

Based on the Synchro™ unsignalized intersection analysis results, the NH 102 at Saint Charles Street/Londonderry Road unsignalized intersection (Intersection #9) operates at acceptable conditions (LOS D or better is considered an acceptable operating level) during the two evaluated periods.

Based on the Synchro™ unsignalized intersection analysis results, the unsignalized Intersection #9 has overall approaches that operate at unacceptable conditions (LOS E or LOS F) during one or two evaluated periods. The following are the individual unsignalized intersection approaches in the traffic study area that operate under unacceptable conditions during peak hours:

- NH 102 at Saint Charles Street/Londonderry Road (Intersection #9)
  - Northbound Saint Charles Street during the PM peak hour
  - Southbound Londonderry Road during the AM and PM peak hours

The overall intersection LOS grades are depicted in Figure 3-9. Table 3-10 contains the results of the LOS capacity analysis and the intersection vehicle delay for the existing condition during the AM and PM peak hours. Appendix A contains the Synchro™ existing conditions intersection analysis reports.

3.7.5 Existing Condition Intersection Queuing Analysis

In addition to analyzing the vehicle delay, the vehicle queue lengths were calculated for each approach. The 95th percentile queue length is the worst-case scenario, calculated as the queue that has a 5% probability of being exceeded. A failing queue length is determined by a queue length exceeding the intersection approach storage capacity. Because the available storage for each intersection approach differs, these values reflect whether the existing storage provides enough space for vehicles waiting to pass through the intersection without blocking another lane or another intersection. The study used Synchro™ to calculate the 95th percentile queue lengths for the nine signalized intersections and one unsignalized intersection.

Based on the Synchro™ signalized intersection analysis results, five signalized intersections listed below experience queuing lengths that exceed the available storage capacity. The remaining signalized intersections in the traffic study area provide sufficient storage for the anticipated demand. The lane group in the approach that is operating under unacceptable conditions is noted in parentheses. Table 3-10 contains the queuing results. Appendix B contains the Synchro™ existing conditions intersection queuing reports.

- NH 28 at Symmes Drive/Vista Ridge Drive (Intersection #1)
  - Northbound Vista Ridge Drive (right turns) during the AM and the PM peak hours
- NH 102 at Gilcreast Road (Intersection #5)
  - Eastbound NH 102 (left turns) during the AM and PM peak hours
  - Eastbound NH 102 (right turns and through movements) during the AM peak hour
  - Westbound (right turns and through movements) during the PM peak hour
  - Southbound Gilcreast Road (left turns and through movements) during the AM peak hour
- NH 102 at Garden Lane (Intersection #6)

    - Northbound Garden Lane (right turns) during the PM peak hour
- NH 102 at I-93 Southbound off-ramp (Exit 4) (Intersection #7)
    - I-93 Southbound off-ramp (all movements) during the PM peak hour
- NH 102 at Fordway/Madden Hill Road (Intersection #10)
    - Eastbound NH 102 (all movements) during the PM peak hour
    - Westbound NH 102 (all movements) during the AM and PM peak hours

Based on the Synchro™ unsignalized intersection analysis results, the unsignalized intersection (Intersection #9) listed below experiences queuing lengths that exceed the available storage capacity.

- NH 102 at Saint Charles/Londonderry Road (Intersection #9)
    - Eastbound NH 102 (left turns) during the PM peak hour

The remaining signalized intersections in the traffic study area provide sufficient storage for the anticipated demand. The lane group in the approach that is operating under unacceptable conditions is highlighted in red In Table 3-10, which contains the queuing results. Note that the percentile values are expressed in feet, and a car occupies about 25 linear feet of roadway, including the space between cars.

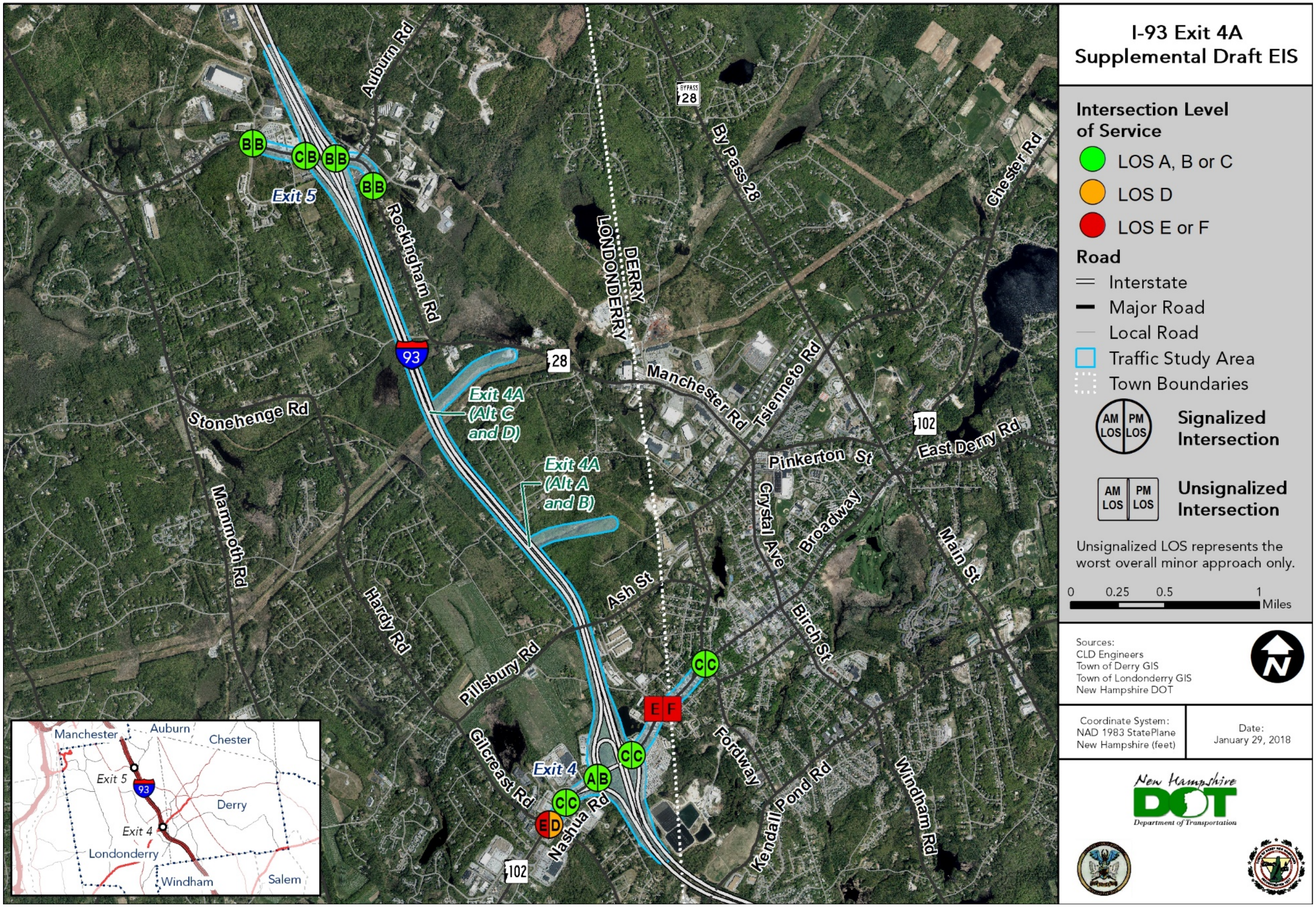


Figure 3-9. 2015 AM and PM peak hour LOS by intersection

Table 3-10. 2015 intersection capacity and queuing analyses

Intersection	Lane Groups	Turning Bay/Link Length (feet)	AM Peak Hour				PM Peak Hour			
			95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS
#1 NH 28 & Symmes Dr/Vista Ridge Dr (Signalized) [a]	EB L	402	24	0.42	46.0	D	24	0.35	46.4	D
	EB TR	726	145	0.47	10.3	B	142	0.54	11.2	B
	EB Overall				10.7	B			11.5	B
	WB L	450	18	0.30	42.1	D	35	0.35	41.4	D
	WB Thru	1,537	291	0.51	10.7	B	189	0.43	9.5	A
	WB R	500	16	0.03	7.7	A	7	0.01	7.0	A
	WB Overall				10.8	B			10.1	B
	NB LT	1,660	40	0.21	33.4	C	30	0.18	39.1	D
	NB R	10	#61	0.02	32.1	C	#26	0.00	37.3	D
	NB Overall				32.5	C			38.3	D
	SB L	270	33	0.28	34.0	C	34	0.22	35.4	D
	SB LTR	270	48	0.02	31.9	C	55	0.03	34.1	C
	SB Overall				33.0	C			34.6	C
	Intersection Overall			**0.47**	**12.0**	**B**		**0.49**	**12.0**	**B**
#2 NH 28 & I-93 SB On and Off-Ramp (Exit 5) (Signalized) [a]	EB Thru	1,537	221	0.73	34.1	C	270	0.59	27.7	C
	EB R	350	55	0.21	0.3	A	55	0.21	0.3	A
	EB Overall				22.2	C			19.5	B
	WB L	592	263	0.91	37.5	D	147	0.65	16.4	B
	WB Thru	592	142	0.47	6.7	A	121	0.29	3.3	A
	WB Overall				15.3	B			6.1	A
	SB L	502	186	0.59	23.4	C	254	0.67	31.3	C
	SB R	502	57	0.64	25.9	C	-	0.21	25.3	C
	SB Overall				24.4	C			29.6	C
	Intersection Overall			**0.74**	**20.3**	**C**		**0.63**	**19.6**	**B**
#3 NH 28 & I-93 NB On and Off-Ramp (Exit 5) (Signalized) [a]	EB L	592	255	0.85	19.8	B	252	0.68	16.0	B
	EB Thru	592	79	0.45	2.4	A	148	0.54	4.1	A
	EB Overall				6.7	A			6.2	A
	WB Thru	481	142	0.57	25.7	C	112	0.40	26.6	C
	WB R	-	-	0.53	1.3	A	-	0.38	0.7	A
	WB Overall				11.6	B			12.2	B
	NB L	798	302	0.86	42.6	D	253	0.71	38.1	D
	NB R	798	-	0.10	21.9	C	98	0.69	37.7	D
	NB Overall				37.0	D			37.9	D
	Intersection Overall			**0.78**	**14.1**	**B**		**0.65**	**15.1**	**B**

Table 3-10. 2015 intersection capacity and queuing analyses (continued)

Intersection	Lane Groups	Turning Bay/Link Length (feet)	AM Peak Hour 95% queue (ft)	AM Peak Hour v/c ratio	AM Peak Hour Average Delay (sec/veh)	AM Peak Hour LOS	PM Peak Hour 95% queue (ft)	PM Peak Hour v/c ratio	PM Peak Hour Average Delay (sec/veh)	PM Peak Hour LOS
#4 NH 28 & Liberty Dr	EB L	225	90	0.53	30.2	C	43	0.41	26.1	C
(Signalized) [a]	EB TR	841	64	0.22	4.6	A	98	0.41	8.1	A
	EB Overall				9.1	A			8.9	A
	WB L	250	21	0.33	42.9	D	19	0.19	27.2	C
	WB TR	332	145	0.45	9.0	A	85	0.27	8.3	A
	WB Overall				9.3	A			8.5	A
	NB L	154	50	0.25	30.7	C	48	0.16	20.0	B
	NB Overall				30.7	C			20.0	B
	SB LT	100	24	0.09	29.8	C	35	0.17	20.0	C
	SB R	502	78	0.05	29.5	C	90	0.09	19.6	B
	SB Overall				29.6	C			19.6	B
	Intersection Overall			**0.45**	**10.4**	**B**		**0.38**	**10.3**	**B**
#5 NH 102 & Gilcreast Rd	EB L	275	#394	0.79	64.1	E	#279	0.80	68.4	E
(Signalized) [a]	EB RT	1,140	#1385	1.04	71.4	E	374	0.79	40.9	D
	EB Overall				**70.7**	**E**			45.1	D
	WB L	250	70	0.29	25.2	C	198	0.31	25.2	C
	WB Thru	666	281	1.06	63.1	E	#769	1.07	62.9	E
	WB R	375	85	0.06	173.6	F	#513	0.10	4.1	A
	WB Overall				**70.2**	**E**			51.8	D
	NB LT	499	185	0.77	55.3	E	240	0.81	64.7	E
	NB R	499	226	0.13	38.1	D	158	0.08	43.4	D
	NB Overall				46.5	D			**56.9**	**E**
	SB LT	303	#339	0.96	73.3	E	247	0.82	68.4	E
	SB R	303	220	0.11	31.9	C	194	0.11	45.3	D
	SB Overall				**60.1**	**E**			**58.0**	**E**
	Intersection Overall			**1.02**	**66.1**	**E**		**0.96**	**50.7**	**D**

Table 3-10. 2015 intersection capacity and queuing analyses (continued)

Intersection	Lane Groups	Turning Bay/Link Length (feet)	AM Peak Hour				PM Peak Hour			
			95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS
#6 NH 102 & Hampton Dr/Garden	EB L	250	118	0.30	56.2	E	118	0.49	68.1	E
Ln (Signalized) [a]	EB TR	666	612	0.97	17.5	B	224	0.60	8.5	A
	EB Overall				19.2	B			17.2	B
	WB L	300	45	0.23	35.5	D	179	0.43	61.4	E
	WB Thru	969	278	0.60	26.5	C	410	0.71	21.4	C
	WB R	364	153	0.13	45.7	D	253	0.28	12.3	B
	WB Overall				30.0	C			22.6	C
	NB LT	630	50	0.11	39.3	D	100	0.48	56.4	E
	NB R	100	74	0.04	38.4	D	#106	0.04	51.3	D
	NB Overall				38.7	D			54.0	D
	SB L	303	85	0.42	46.0	D	191	0.63	53.5	D
	SB LT	303	73	0.42	45.9	D	161	0.64	53.9	D
	SB R	303	57	0.03	41.9	D	192	0.12	44.6	D
	SB Overall				44.7	D			50.3	D
	Intersection Overall			**0.70**	**25.3**	**C**		**0.64**	**26.0**	**C**
#7 NH 102 & I-93 SB Off-Ramp	EB Thru	969	109	0.43	2.0	A	312	0.42	14.4	B
(Exit 4) (Signalized) [a]	EB Overall				2.0	A			14.4	B
	WB Thru	1,033	83	0.29	2.4	A	239	0.39	13.7	B
	WB Overall				2.4	A			13.7	B
	SB L	294	244	0.77	45.8	D	#301	0.79	55.7	E
	SB R	294	138	0.36	0.7	A	#335	0.45	0.9	A
	SB Overall				16.2	B			17.5	B
	Intersection Overall			**0.54**	**7.0**	**A**		**0.57**	**15.2**	**B**
#8 NH 102 & I-93 NB On	EB L	700	629	0.92	38.2	D	494	0.89	60.5	E
and Off-Ramp (Exit 4)	EB Thru	1,033	411	0.25	2.5	A	266	0.33	9.1	A
(Signalized) [a]	EB Overall				20.3	C			29.2	C
	WB Thru	1,095	592	0.97	57.8	E	242	0.54	37.4	D
	WB R	758	294	0.33	0.6	A	-	0.23	0.3	A
	WB Overall				37.7	D			22.8	C
	NB L	1,440	141	0.51	41.3	D	282	0.75	46.8	D
	NB R	1,440	-	0.15	0.2	A	182	0.41	0.8	A
	NB Overall				21.3	C			23.3	C
	Intersection Overall			**0.86**	**28.4**	**C**		**0.73**	**25.3**	**C**

Table 3-10. 2015 intersection capacity and queuing analyses (continued)

Intersection	Lane Groups	Turning Bay/Link Length (feet)	AM Peak Hour 95% queue (ft)	AM Peak Hour v/c ratio	AM Peak Hour Average Delay (sec/veh)	AM Peak Hour LOS	PM Peak Hour 95% queue (ft)	PM Peak Hour v/c ratio	PM Peak Hour Average Delay (sec/veh)	PM Peak Hour LOS
#9 NH 102 & St Charles St/Londonderry Rd (TWSC) [b]	EB L	150	72	0.14	12.3	B	#180	0.35	11.7	B
	EB TR	1,434	-	-	-	-	545	-	-	-
	EB Overall				1.5	-			2.5	-
	WB LTR	463	35	0.01	8.6	A	276	0.01	10.7	B
	WB Overall				0.0	-			0.1	-
	NB LTR	412	10	0.01	11.9	B	88	1.23	*	F
	NB Overall				11.9	B			*****	**F**
	SB LT	780	35	0.25	115.0	F	109	1.13	*	F
	SB R	150	100	0.51	36.1	E	114	0.40	19.9	C
	SB Overall				**43.0**	**E**			**79.8**	**F**
#10 NH 102 & Fordway/Madden Hill Rd (Signalized) [a]	EB TR	455	277	0.72	15.5	B	#1315	0.99	41.5	D
	EB Overall				15.5	B			41.5	D
	WB LT	165	#413	0.85	22.3	C	#693	0.79	18.5	B
	WB Overall				22.3	C			18.5	B
	NB LR	375	248	0.94	47.1	D	196	0.82	33.8	C
	NB Overall				47.1	D			33.8	C
	SB LTR	120	46	0.10	13.8	B	63	0.17	16.5	B
	SB Overall				13.8	B			16.5	B
	Intersection Overall			**0.89**	**25.7**	**C**		**0.93**	**33.0**	**C**

Notes:

95th percentile volume exceeds capacity, queue may be longer.

EB = Eastbound, WB = Westbound, NB= Northbound, SB = Southbound

LOS = Level of Service

LTR = left / through / right lanes

TWSC = Two-way STOP-Controlled unsignalized intersection (TWSC intersections do not have an overall LOS)

V/C = Volume-to-Capacity ratio

Delay is Measured in Seconds Per Vehicle.

Red cells denote intersections or approaches operating at unacceptable conditions or denote approaches and lane groups whose queuing length exceeds capacity

* Calculated delay exceeds 300 seconds

[a] Highway Capacity Manual 2000 results (Signalized intersections)

[b] Highway Capacity Manual 2010 results (Unsignalized intersection)

3.7.6 Existing Condition Freeway Operations Analysis

Based on the analysis performed using HCS, all the freeway facilities operate below capacity, operating with a LOS D or better condition during the AM and PM peak hours. In addition, the demand to capacity ratio did not exceed 0.80 where 1.00 equates to the facility operating at capacity. Table 3-11 contains the Exit 4 existing condition freeway analysis and Table 3-12 contains the Exit 5 existing freeway analysis. Appendix C contains the existing conditions HCS freeway operation reports.

Table 3-11. I-93 Exit 4 existing freeway analysis

Freeway Analysis	Facility Type	Time Period	Demand to Capacity Ratio		Density (pc/mi/ln)	LOS
			Freeway	Ramp		
I-93 Northbound to NH 102	Diverge	AM	0.44	0.29	15.2	B
		PM	0.76	0.68	28.5	D
NH 102 to I-93 Northbound	Merge	AM	0.60	0.57	18.7	B
		PM	0.69	0.44	22.1	C
I-93 Southbound to NH 102	Diverge	AM	0.68	0.43	25.7	C
		PM	0.64	0.54	24.1	C
NH 102 Westbound to I-93 Southbound	Merge	AM	0.64	0.34	19.8	B
		PM	0.49	0.14	14.4	B
NH 102 Eastbound to I-93 Southbound	Merge	AM	0.80	0.42	26.1	C
		PM	0.56	0.19	17.5	B

Notes: LOS = Level of Service; Density = Passenger cars per mile per lane (pc/mi/ln)

Table 3-12. I-93 Exit 5 existing freeway analysis

Freeway Analysis	Facility Type	Time Period	Demand to Capacity Ratio		Density (pc/mi/ln)	LOS
			Freeway	Ramp		
I-93 Northbound to NH 28	Diverge	AM	0.60	0.29	24.6	C
		PM	0.67	0.36	27.6	C
NH 28 to I-93 Northbound	Merge	AM	0.76	0.58	28.6	D
		PM	0.75	0.42	28.5	D
I-93 Southbound to NH 28	Diverge	AM	0.74	0.53	29.9	D
		PM	0.75	0.52	30.7	D
NH 28 to I-93 Southbound	Merge	AM	0.70	0.31	25.8	C
		PM	0.66	0.25	24.4	C

Notes: LOS = Level of Service; Density = Passenger cars per mile per lane (pc/mi/ln)

3.8 Safety Conditions

Crash ratings are used in transportation analyses to help determine where additional attention or examination of safety should be undertaken. Crash ratings are evaluated based on recorded crash information collected by jurisdiction, in this case 3 years of data from NHDOT (2013–2015), and calculated using the crash information and daily volume of vehicles that travel through the intersection. Crash and injury ratings are calculated based on the number of crashes or injuries that would occur per million entering vehicles (MEV) using the following formula:

$$\text{Rate} = \frac{C * 1{,}000{,}000}{n * 365 * V}$$

In this formula, C is the total number of intersection-related crashes or injuries in the study period, n is the number of years of data (i.e., study period), and V is the traffic volumes entering the intersection daily. NHDOT provided the crash information over a 3-year period. Daily traffic volumes were calculated by applying a K factor to the 2015 balanced study area intersection traffic counts (the K factor is defined as the percent of the 24-hour daily vehicle volume that represents the AM or PM peak hour). ATR data covering NH 28 and NH 102 were used to calculate the K factor. Table 3-13 contains the AM and PM K factors for NH 28 and NH 102.

Table 3-13. NH 28 and NH 102 K factors

ATR Location	Average Daily Vehicle Volume	Average AM Peak Hour Volume	Average PM Peak Hour Volume	AM K Factor	PM K Factor
NH 28 North of Liberty Drive	16,852	1,437	1,232	0.085	0.073
NH 102, East of Hampton Drive	36,771	2,531	2,896	0.069	0.079

Table 3-14 presents crash ratings for intersections in the study area using NHDOT crash data (NHDOT 2013–2015). The intersections with the highest crash rating are along NH 102 at the I-93 NB off-ramp, Garden Lane/Hampton Drive, and Gilcreast Road. These locations had crash rates greater than 1.00 crashes per MEV. No intersections had injury rates greater than 1.00.

Table 3-14. Intersection crash summary

	Intersection Name	Number of Crashes	Number of Crashes with Injuries	Crash Rate	Injury Rate
				Crashes per million entering vehicles	
1	NH 28 & Symmes Drive/Vista Ridge Drive	3	0	0.12	0.00
2	NH 28 and I-93 SB ramps	22	10	0.65	0.29
3	NH 28 & I-93 NB Ramps	6	5	0.16	0.13
4	NH 28 and Liberty Drive	9	4	0.52	0.23
5	NH 102 & Gilcreast Road	59	14	1.29	0.31
6	NH 102 & Garden Lane/Hampton Drive	72	16	1.60	0.36
7	NH 102 & I-93 SB off-ramp	23	8	0.52	0.18
8	NH 102 & I-93 NB Ramps	81	34	1.78	0.75
9	NH 102 & Londonderry Road/St. Charles Street	13	5	0.43	0.1
10	NH 102 & Madden Hill Road/Fordway	7	1	0.28	0.04

Locations with crash rates over 1.0 are highlighted in orange.

Intersections that have a crash rating of greater than 1.0 may warrant further examination to determine if one or more particular causes can be gleaned from the detailed intersection crash data, and if mitigation is advisable, what mitigation measures would help to improve the safety of the intersection. Of the intersections for which sufficient data are available for analysis (a minimum of 3 years of data), three of the intersections have a crash rating of greater than 1.0.

All study area intersections are shown in more detail in Table 3-15, which helps to examine whether there is a high percentage of a particular type of crash. True reasons for a high crash rating cannot solely be determined with crash data because each situation has unique circumstances that are not reflected in the crash study. However, general trends can be determined or certain causes can be eliminated by examining the available crash-specific information. Collisions can be caused by the following roadway factors (FHWA, 2011):

- Access control: too many driveways causing potential conflict points
- Speed: drivers speeding through a congested corridor
- Roadway cross section: lane and shoulder widths do not match facility type
- Traffic volumes: high volume of traffic increasing exposure to more vehicles
- Pavement condition: ruts, potholes, and bumps causing drivers to swerve to avoid obstacles

A number of human and vehicle factors can also lead to crashes.

The data indicate that most crashes between motor vehicles involve rear-end crashes. Rear-end collisions are often the result of two vehicles traveling in the same direction in close proximity where the leading vehicle stops to avoid hitting a vehicle entering the same lane, runs a RED light, or stops or slows down to avoid roadway obstruction or a pavement condition issue. If the trailing vehicle is driving in close proximity not enough space may be available to avoid the collision.

Based on the location of the crashes along NH 102 and the crash types, most of the crashes seem to indicate that access control and pavement condition were not factors because the crashes were spaced out and not all clumped together near a specific driveway junction or other spot. The roadway is designed with a standard cross section with 12-foot lanes, a shoulder, and the intersections are located along relatively straight sections of roadway. Therefore, the cause of the crashes could be a result of speeding through an area with high traffic volume or potentially distracted drivers not paying attention. Crash data that may provide clues about crash trends are highlighted in orange.

Table 3-15. Detailed intersection crash analysis

	Intersection Name	Crash Rate	Rear End	Angle	Head On	Side Swipe - Same Direction	Crash Type not Reported	Fixed Object in Road	Fixed Object Off Road	Pedestrian	Other	Total
		crashes/ MEV	Other Vehicle									
1	NH 28 & Symmes Drive/Vista Ridge Drive	0.12	1	0	0	0	2	0	0	0	0	3
2	NH 28 and I-93 SB ramps	0.65	4	1	0	0	14	0	3	0	0	22
3	NH 28 & I-93 NB Ramps	0.16	1	0	0	0	3	1	1	0	0	6
4	NH 28 and Liberty Drive	0.52	4	0	1	1	2	0	1	0	0	9
5	NH 102 & Gilcreast Road	1.29	18	6	2	5	26	0	2	0	0	59
6	NH 102 & Garden Lane/Hampton Drive	1.60	15	5	3	8	37	0	3	1	0	72
7	NH 102 & I-93 SB off-ramp	0.52	12	0	0	1	10	0	0	0	0	23
8	NH 102 & I-93 NB Ramps	1.78	36	1	0	1	34	1	2	0	6	81
9	NH 102 & Londonderry Road/St. Charles Street	0.43	2	2	0	1	7	0	1	0	0	13
10	NH 102 & Madden Hill Road/Fordway	0.28	0	0	0	0	7	0	0	0	0	7

Sources: NHDOT crash data from 2013-2015, received August 30, 2017

Notes: MEV = Million entering vehicles

Crash data that may provide clues about crash trends are highlighted in orange

The freeway crash analysis follows a similar method as the intersection crash analysis to determine the freeway crash rate. A crash rate was calculated for each freeway facility (diverge and merge) and for the I-93 freeway mainline between Exits 4 and 5 by mile. In 2015, Massachusetts calculated an average crash rate for freeways in an urban and rural area of 0.61 and 0.40, respectively (MassDOT, 2018). Following the more conservative rural measure, all freeway facilities and the two mainline I-93 segments between Exits 4 and 5 had crash rates below 0.40. All locations are shown in Table 3-16.

Table 3-16. Freeway crash summary

Intersection Name	Number of Crashes	Number of Crashes with Injuries	Crash Rate	Injury Rate
			Crashes per million entering vehicles	
I-93 NB at Exit 4 Diverge	8	0	0.20	0.00
I-93 NB at Exit 4 Merge	8	0	0.18	0.00
I-93 SB at Exit 4 Diverge	7	3	0.14	0.06
I-93 SB at Exit 4 First Merge	10	3	0.24	0.07
I-93 SB at Exit 4 Second Merge	10	3	0.20	0.06
I-93 NB at Exit 5 Diverge	6	2	0.13	0.04
I-93 NB at Exit 5 Merge	7	2	0.13	0.04
I-93 SB at Exit 5 Diverge	5	1	0.09	0.02
I-93 SB at Exit 5 Merge	5	0	0.10	0.00
I-93 NB between Exit 4 and Exit 5 (2.5 miles)	44	15	0.39	0.13
I-93 SB between Exit 4 and Exit 5 (2.0 miles)	28	8	0.29	0.08

The detailed data identify a high number of crashes with another vehicle and a majority of crashes in the northbound direction occurring during the evening commute period. Most of the crashes occurred on dry pavement on clear days and were scattered along the roadway sections and not clumped in one particular area. Similar to the findings of the intersection analysis, roadway design does not seem to be an issue, rather driver speeding or distracted drivers may be the main reason for the crashes. Another possibility is that heavy rush hour traffic constrained to two lanes could create crashes from aggressive drivers trying to pass slower-moving vehicles by frequently switching lanes. Crash data that may provide clues about crash trends have been highlighted in orange. Table 3-17 provides specific crash types by interstate facility.

Table 3-17. Detailed freeway crash analysis

Intersection Name	Crash Rate	Rear End	Angle	Head On	Side Swipe - Same Direction	Crash Type not Reported	Fixed Object in Road	Fixed Object Off Road	Pedestrian	Other	Total
	crashes/ MEV	Other Vehicle									
I-93 NB at Exit 4 Diverge	0.20	0	0	0	0	5	0	2	0	1	8
I-93 NB at Exit 4 Merge	0.18	0	0	0	0	6	0	2	0	0	8
I-93 SB at Exit 4 Diverge	0.14	0	0	1	0	3	0	2	0	1	7
I-93 SB at Exit 4 First Merge	0.24	1	0	0	0	9	0	0	0	0	10
I-93 SB at Exit 4 Second Merge	0.20	0	0	0	0	5	0	4	0	1	10
I-93 NB at Exit 5 Diverge	0.13	0	0	0	0	5	0	1	0	0	6
I-93 NB at Exit 5 Merge	0.13	0	0	0	0	6	0	1	0	0	7
I-93 SB at Exit 5 Diverge	0.09	0	0	0	0	4	0	0	0	1	5
I-93 SB at Exit 5 Merge	0.10	0	0	0	0	3	0	1	0	1	5
I-93 NB between Exit 4 and Exit 5 (2.5 miles)	0.39	1	0	0	0	23	0	13	0	7	44
I-93 SB between Exit 4 and Exit 5 (2.0 miles)	0.29	0	0	0	0	14	0	8	0	6	28

Sources: NHDOT crash data from 2013-2015, received August 30, 2017

Notes: MEV = Million entering vehicles

Crash data that may provide clues about crash trends are highlighted in orange

4.0 EVALUATION METRICS

The study developed evaluation criteria to provide a comparison between the different alternatives to help assess the pros and cons of each and support the need to construct a new I-93 Exit 4A interchange. Evaluation criteria include traffic and accessibility. The study also evaluates each policy requirement's pros and cons following the detailed assessment section. Traffic focuses on an operational assessment of the study area facilities (12 intersections and 13 freeway facilities). Accessibility reviews changes in the connectivity of the roadway network to improve or prohibit connections between I-93 and the Londonderry/Derry study area. Table 4-1 summarizes the evaluation criteria. Section 7.0 contains the evaluation criteria and policy requirement summary.

Table 4-1. Evaluation criteria summary

Criteria	Definition
Traffic	The intersection and freeway facility LOS
Accessibility	Change in the roadway system to provide connections in the Londonderry/Derry study area

5.0 THE NO BUILD CONDITION

5.1 Introduction

The No Build condition represents the future conditions in the project design year of 2040 if all planned roadway improvements are implemented, Woodmont Commons is partially built out, and other background growth would follow the demographic projections contained in Tables 3-1, 3-2, and 3-3. I-93 Exit 4A would not occur, and downtown Derry would continue to experience traffic issues. This section summarizes the planned roadway improvements, development of the future traffic volumes, traffic operations, and queuing for the No Build Condition.

5.2 No Build Roadway Improvements

The No Build condition planned roadway improvements include six upgrades along I-93 and NH 102. Improvements 1 through 3 are currently under construction. Improvements 4 through 6 are options presented as part of the Woodmont Commons PUD. The six improvements are as follows:

1. Widening of the I-93 mainline from two to four lanes in each direction
2. Construction of a new NH 102 bridge over I-93 at Exit 4
3. Upgrade of NH 102 and I-93 ramp termini intersections at Exit 4 (Intersections #7 and #8) to include additional turning lanes and align with the revised Exit 4 ramp termini

4. Widening of NH 102 from two through lanes to three through lanes in each direction between Hampton Drive/Garden Lane (Intersection #6) and Gilcreast Road (Intersection #5)

5. Additional turning lanes added at NH 102 intersections at Gilcreast Road (Intersection #5) and Hampton Drive/Garden Lane (Intersection #6)

6. Upgrade of NH 102 and Londonderry Road/St. Charles Street (Intersection #9) from unsignalized to a signalized intersections and add additional turning lanes.

Figure 5-1 illustrates improvements 1 through 3, Figure 5-2 illustrates improvements 4 and 5, and Figure 5-3 illustrates improvement 6.

5.3 Development of No Build Volumes

The future No Build condition volumes for the intersections and freeway facilities serving Exits 4 and 5, as well as the two intersections east of Exit 4, NH 102 at Saint Charles/Londonderry Road & NH 102 at Fordway/Madden Hill Road (Intersections #9 and #10), relied on a custom subarea travel demand model built by the SNHPC. The model values represent 24-hour vehicle volumes. The AM and PM peak hour volumes were calculated by applying AM and PM peak hour percentages to the 2040 No Build 24-hour model volume results. These percentages were computed by comparing the existing condition peak hour volumes to the 2015 base year 24-hour travel demand model volumes.

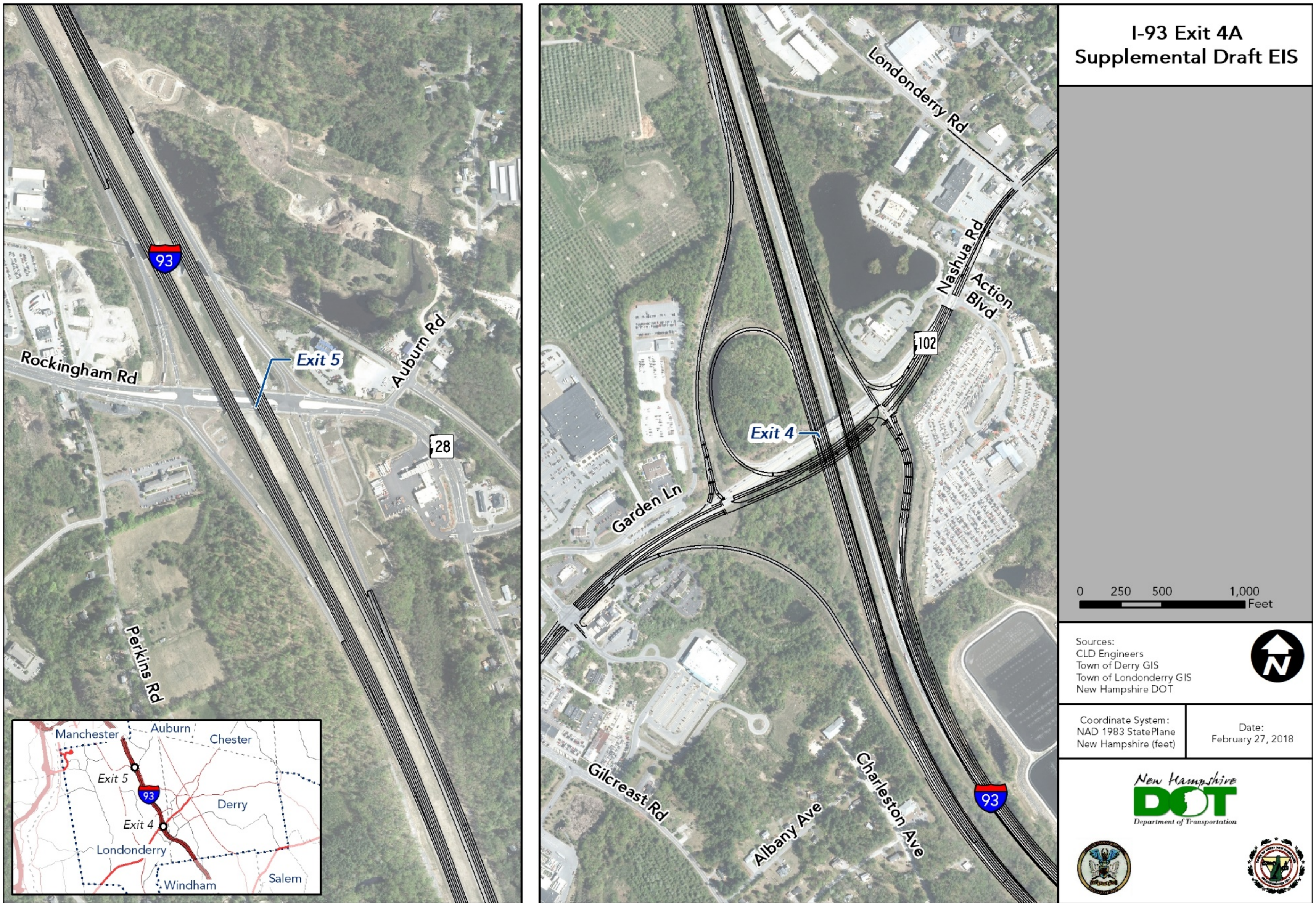
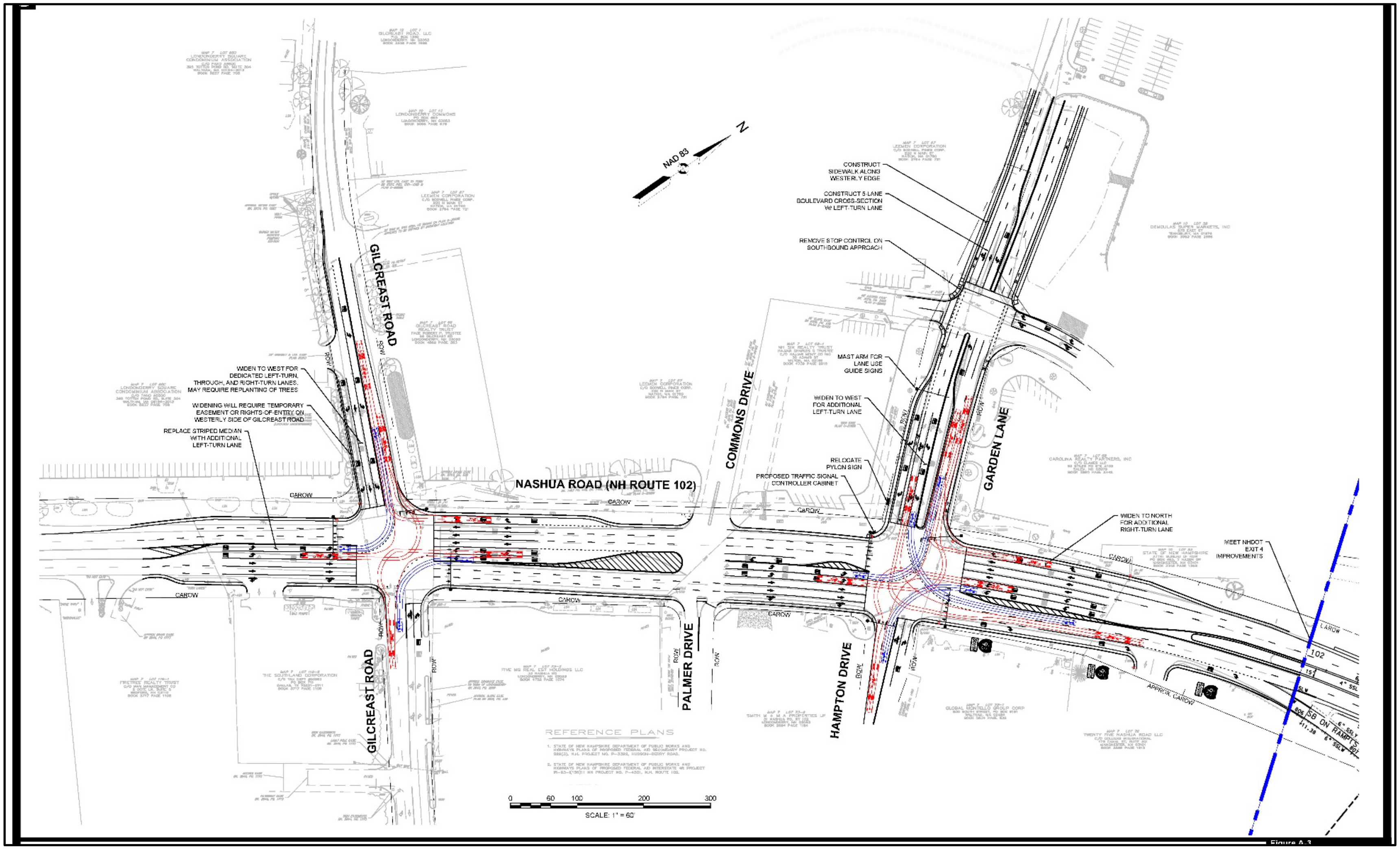
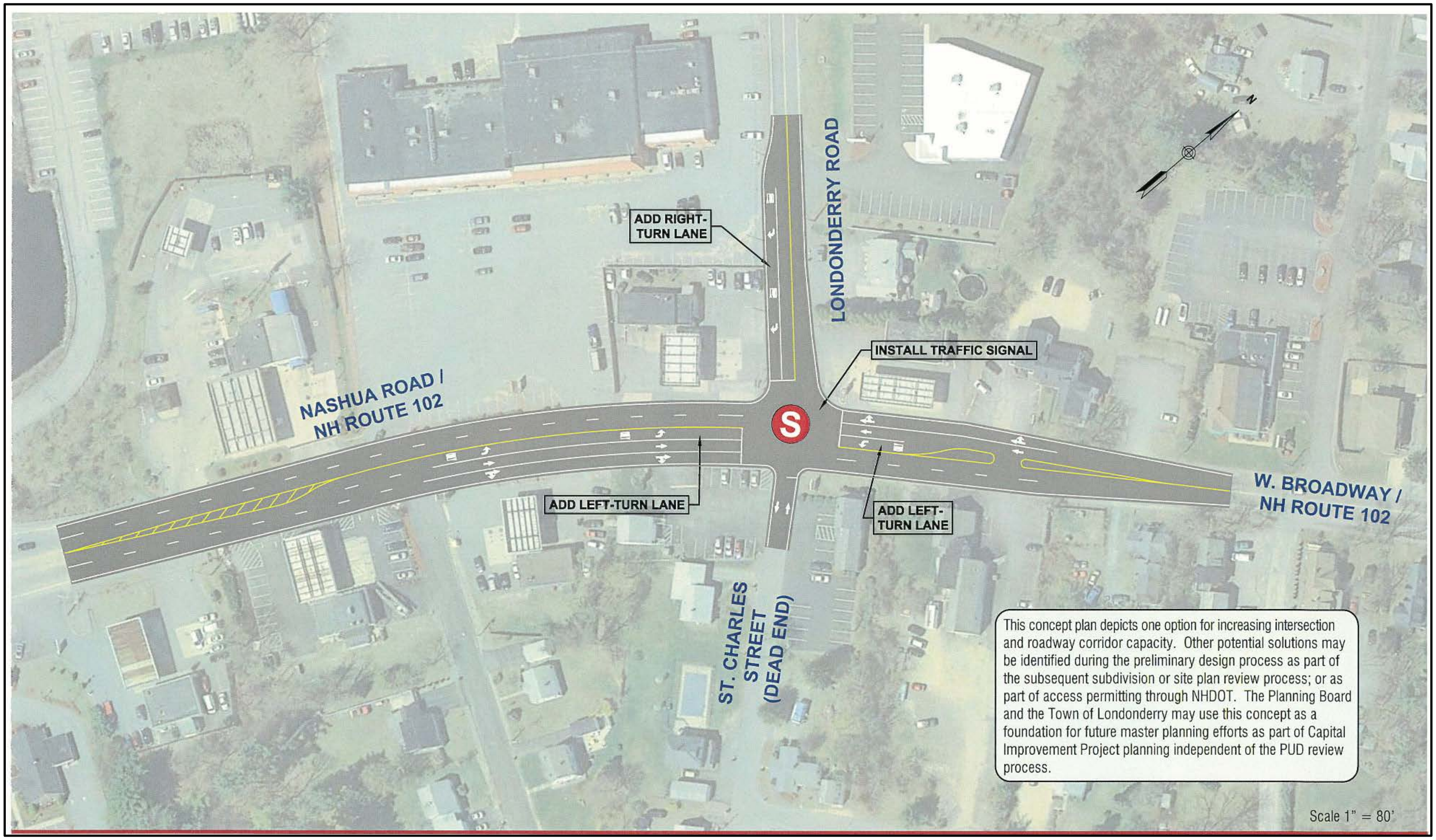


Figure 5-1. Planned improvement at I-93 Exits 4 and 5



Source: TEC, 2016

Figure 5-2. Planned improvement along NH 102 between Gilcreast Road and Hampton Drive/Garden Lane



Source: TEC, 2016

Figure 5-3. Planned improvement at NH 102 and Londonderry Road/St. Charles Street

Following the same procedure as the existing conditions, the Woodmont Commons Phases I and II TIA was used to provide turning movement counts for the two intersections located west of the I-93 at Exit 4: NH 102 at Gilcreast Road & NH 102 at Garden Lane (Intersections #5 and #6). The volumes in the TIA were forecasted for a partial build-out of the development with roadway mitigation in place by 2017 and were used to calculate the vehicle percentage for each tuning movement. These turning movement percentages were applied to the balanced 2040 No Build condition traffic network at Exit 4 determined by the SNHPC travel demand model.

Following the same procedure as the existing conditions, the I-93 SEIS was used to provide turning movement counts for NH 28 at Symmes Drive/Vista Ridge Drive (Intersection #1) located west of I-93 at Exit 5. The No Build condition volume was calculated by applying the vehicle percentage for each tuning movement based on the I-93 SEIS 2030 forecasted vehicle volumes and applying that percentage to the balanced 2040 No Build condition traffic network at Exit 5 determined by the SNHPC travel demand model.

Following the same procedure as the existing conditions, NHDOT provided a turning movement count for NH 28 and Liberty Drive (Intersection #4) located east of I-93 at Exit 5. This volume was obtained in 2005 and used to calculate the vehicle percentage for each tuning movement and applying that percentage to the balanced 2040 No Build condition traffic network at Exit 5 determined by the SNHPC travel demand model.

Figure 5-4 shows the 2040 No Build condition tuning movement volumes. Figure 5-5 shows the 2040 No Build condition lane geometry. The changes in the lane geometry are based on the proposed mitigation as part of the Woodmont Commons development and affect Intersections #5, #6, #7, and #8. This is the Phase I Woodmont Commons build-out scenario and includes 312,574 gross square feet of commercial, 510 units residential, and 135 hotel rooms.

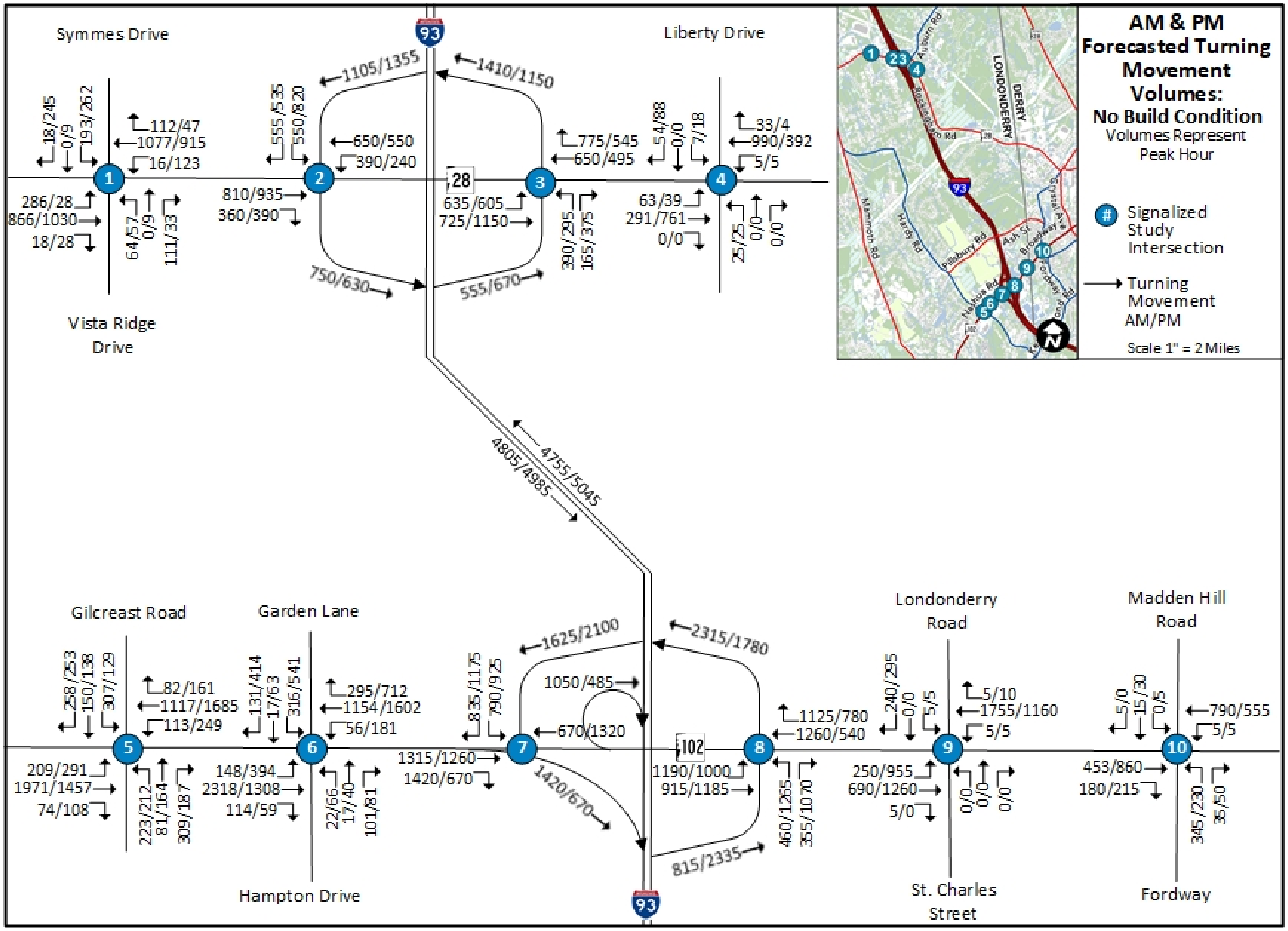


Figure 5-4. AM and PM 2040 No Build condition turning movement volumes

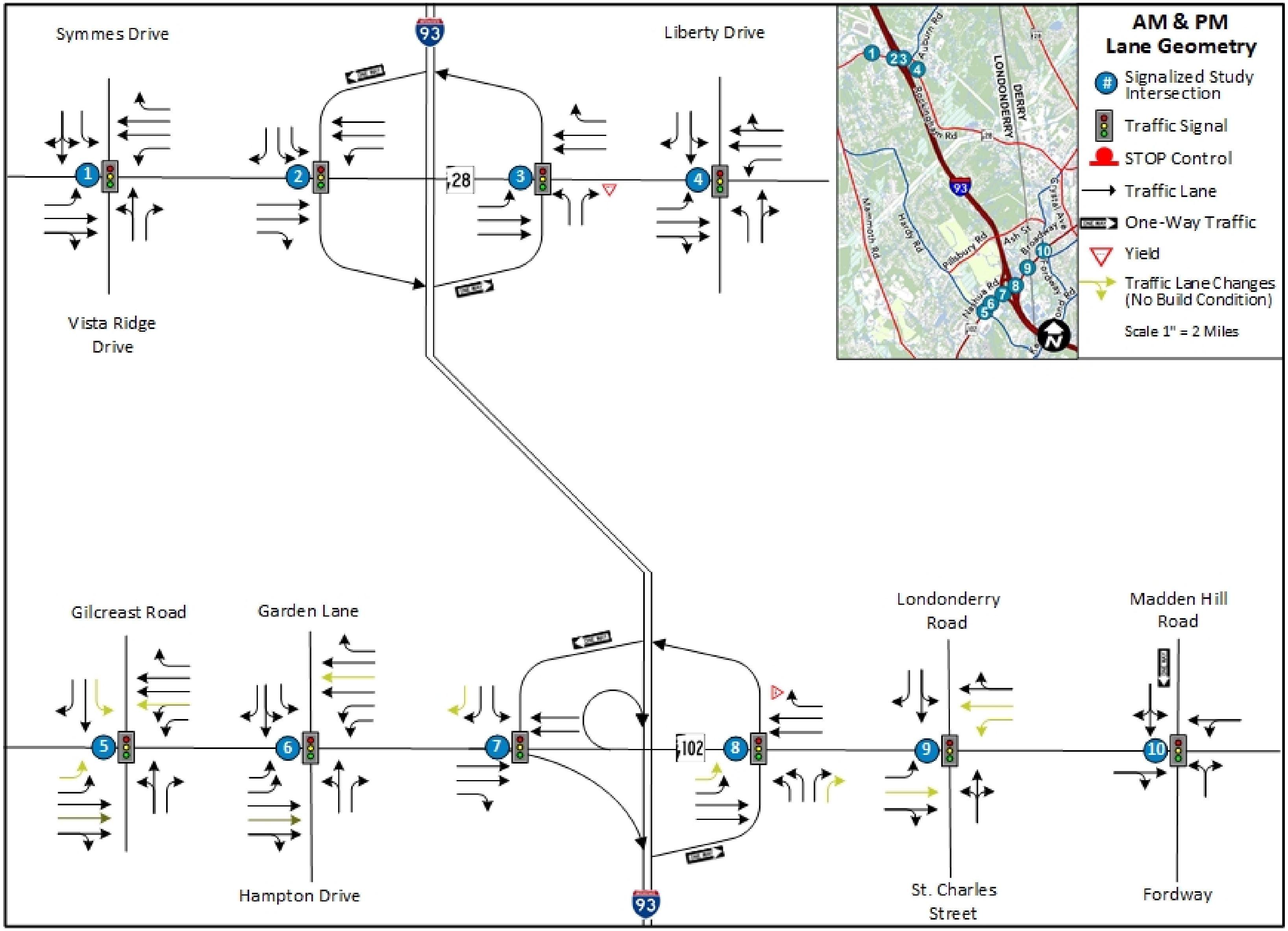


Figure 5-5. AM and PM 2040 No Build condition lane geometry

5.4 2040 No Build Condition Intersection Operations Analysis

Based on the Synchro™ signalized intersection analysis results, five signalized intersections (Intersections #2, #5, #7, #8, and #9) would operate at unacceptable conditions (LOS E or LOS F) during the AM or PM peak hours. The remaining signalized intersections in the traffic study area would operate at acceptable overall conditions (LOS D or better is considered an operating level) during the peak hours analyzed (weekday AM and PM peak hours).

Based on the Synchro™ signalized intersection analysis results, all the study area signalized intersections, with the exception of Intersection #4, have overall approaches that would operate at unacceptable conditions (LOS E or LOS F) during one or two evaluated periods. The following individual signalized intersection approaches in the traffic study area would operate under unacceptable conditions during peak hours:

- NH 28 at Symmes Drive/Vista Ridge Drive (Intersection #1)
  - Southbound Symmes Drive during the AM peak hour
- NH 28 at I-93 Southbound on and off-ramp (Exit 5) (Intersection #2)
  - I-93 Southbound off-ramp during the AM peak hour
- NH 28 at I-93 Northbound on and off-ramp (Exit 5) (Intersection #3)
  - I-93 Northbound off-ramp during the AM and PM peak hours
- NH 102 at Gilcreast Road (Intersection #5)
  - Eastbound NH 102 during the AM and PM peak hours
  - Westbound NH 102 during the PM peak hour
  - Northbound Gilcreast Road during the AM and PM peak hours
  - Southbound NH 102 during the AM and PM peak hours
- NH 102 at Hampton Drive/Garden Lane (Intersection #6)
  - Northbound Hampton Drive during the PM peak hour
  - Southbound Garden Lane during the AM and PM peak hours
- NH 102 at I-93 Southbound off-ramp (Exit 4) (Intersection #7)
  - Eastbound and Westbound NH 102 during the PM peak hour
  - I-93 Southbound off-ramp during the PM peak hour
- NH 102 at I-93 Northbound on and off-ramp (Exit 4) (Intersection #8)
  - Eastbound NH 102 during the PM peak hour
- NH 102 at St Charles Street/Londonderry Road (Intersection #9)
  - Eastbound and Westbound NH 102 during the PM peak hour
- NH 102 at Fordway/Madden Hill Road (Intersection #10)
  - Northbound Fordway during the AM and PM peak hours

The overall intersection LOS grades are depicted in Figure 5-6 for AM and PM peak hours. Table 5-1 shows the results of the LOS capacity analysis and the intersection vehicle delay for the No Build condition during the AM and PM peak hours. Appendix D contains the Synchro™ No Build condition intersection analysis reports.

5.5 2040 No Build Queuing Analysis

Based on the Synchro™ signalized intersection analysis results, all the signalized intersections within the study area, with the exception of NH 28 at Liberty Drive (Intersection #4), would experience queuing lengths that would exceed the available storage capacity. Intersection #4 would provide sufficient storage for the anticipated demand. The lane group in the approach that would operate under unacceptable conditions is noted in parentheses in the following list. Table 5-1 contains the queuing results. Appendix E contains the Synchro™ No Build condition intersection queuing reports.

- NH 28 at Symmes Drive/Vista Ridge Drive (Intersection #1)
  - Northbound Vista Ridge Drive (right turns) during the AM and the PM peak hours
  - Southbound Symmes Drive (left turns, right turns, and through movements) during the PM peak hour
- NH 28 at I-93 Southbound on and off-ramp (Exit 5) (Intersection #2)
  - Eastbound NH 28 (through movements) during the AM peak hour
  - Eastbound NH 28 (right turns) during the AM and PM peak hours
  - Westbound NH 28 (left turns) during the AM peak hour
  - Southbound I-93 off-ramp (right turns) during the AM peak hour
- NH 28 at I-93 Northbound on and off-ramp (Exit 5) (Intersection #3)
  - Eastbound NH 28 (left turns) during the AM and PM peak hours
  - Eastbound NH 28 (through movements) during the AM peak hour
  - Westbound NH 28 (through movements) during the AM peak hour
- NH 102 at Gilcreast Road (Intersection #5)
  - Eastbound NH 102 (left turns) during the PM peak hour
  - Northbound Gilcreast Road (all movements) during the AM and PM peak hours
  - Southbound Gilcreast Road (left turns) during the AM peak hour
  - Southbound Gilcreast Road (right turns and through movements) during the AM and PM peak hours
- NH 102 at Hampton Drive/Garden Lane (Intersection #6)
  - Westbound NH 102 (right turns) during the PM peak hour
  - Northbound Hampton Drive (right turns) during the AM and PM peak hours
  - Southbound Garden Lane (all movements) during the AM and PM peak hours

- NH 102 at I-93 Southbound off-ramp (Exit 4) (Intersection #7)
  - I-93 Southbound off-ramp (all movements) during the AM ad PM peak hours
- NH 102 at I-93 Northbound on and off-ramp (Exit 4) (Intersection #8)
  - Westbound NH 102 (right turns) during the AM peak hour
- NH 102 at St Charles Street/Londonderry Road (Intersection #9)
  - Eastbound NH 102 (left turns) during the PM peak hour
- NH 102 at Fordway/Madden Hill Road (Intersection #10)
  - Eastbound NH 102 (all movements) during the PM peak hour
  - Westbound NH 102 (all movements) during the AM and PM peak hours

Intersection #4 is the only signalized intersection in the traffic study area that would provide sufficient storage for the anticipated demand. The lane group in the approach that would operate under unacceptable conditions is highlighted in red in Table 5-1, which contains the queuing results.

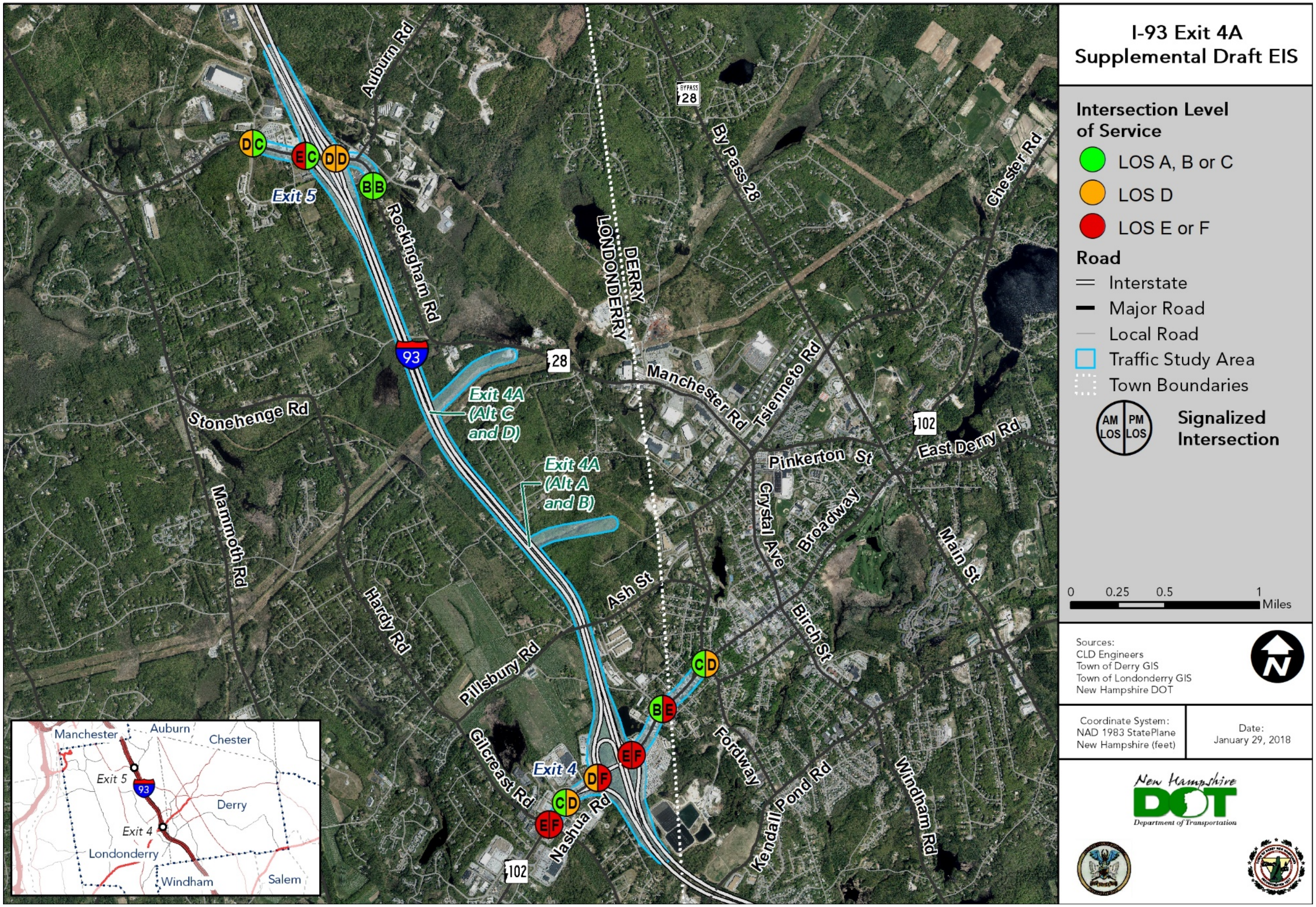


Figure 5-6. 2040 No Build AM and PM peak hour LOS by intersection

Table 5-1. 2040 No Build intersection capacity and queuing analyses

Intersection	Lane Groups	Turning Bay/Link Length (feet)	AM Peak Hour 95% queue (ft)	AM Peak Hour v/c ratio	AM Peak Hour Average Delay (sec/veh)	AM Peak Hour LOS	PM Peak Hour 95% queue (ft)	PM Peak Hour v/c ratio	PM Peak Hour Average Delay (sec/veh)	PM Peak Hour LOS
#1 NH 28 & Symmes Dr/Vista Ridge Dr (Signalized) [a]	EB L	408	353	0.97	85.5	F	50	0.76	111.3	F
	EB TR	729	414	0.51	13.0	B	458	0.81	31.9	C
	EB Overall				30.8	C			33.9	C
	WB L	450	40	0.55	71.3	E	154	0.81	74.0	E
	WB Thru	1,537	409	0.84	33.8	C	298	0.61	20.4	C
	WB R	500	137	0.08	19.5	B	31	0.04	14.0	B
	WB Overall				32.9	C			26.2	C
	NB LT	1,660	330	0.43	48.5	D	120	0.55	55.5	E
	NB R	10	#101	0.08	45.4	D	#79	0.02	49.0	D
	NB Overall				46.5	D			53.3	D
	SB L	270	181	0.93	110.8	F	267	0.84	63.6	E
	SB LTR	270	191	0.07	47.1	D	#368	0.39	42.0	D
	SB Overall				**79.0**	**E**			51.9	D
	Intersection Overall			**0.84**	**36.4**	**D**		**0.79**	**34.7**	**C**
#2 NH 28 & I-93 SB On and Off-Ramp (Exit 5) (Signalized) [a]	EB Thru	1,537	#1904	0.97	73.6	E	1243	0.88	39.4	D
	EB R	350	#546	0.28	0.5	A	#463	0.29	0.5	A
	EB Overall				51.1	D			27.9	C
	WB L	592	#632	1.17	111.5	F	280	0.92	20.7	C
	WB Thru	592	101	0.44	1.8	A	59	0.32	0.2	A
	WB Overall				42.9	D			6.4	A
	SB L	502	492	0.72	44.8	D	406	0.92	48.2	D
	SB R	502	#526	1.35	217.5	F	109	0.89	52.5	D
	SB Overall				**131.6**	**F**			49.9	D
	Intersection Overall			**1.17**	**77.0**	**E**		**0.90**	**31.2**	**C**
#3 NH 28 & I-93 NB On and Off-Ramp (Exit 5) (Signalized) [a]	EB L	592	#729	1.11	67.9	E	#706	1.07	53.5	D
	EB Thru	592	#789	0.39	0.6	A	316	0.62	6.1	A
	EB Overall				32.0	C			22.5	C
	WB Thru	481	#580	1.05	104.5	F	217	0.91	61.7	E
	WB R	481	171	0.56	1.5	A	-	0.38	0.7	A
	WB Overall				48.5	D			29.7	C
	NB L	798	685	1.11	128.2	F	337	0.86	47.1	D
	NB R	798	349	0.23	39.9	D	213	1.08	98.8	F
	NB Overall				**101.9**	**F**			**76.0**	**E**
	Intersection Overall			**1.10**	**51.7**	**D**		**1.04**	**37.7**	**D**

Table 5-1. 2040 No Build intersection capacity and queuing analyses (continued)

Intersection	Lane Groups	Turning Bay/Link Length (feet)	AM Peak Hour 95% queue (ft)	AM Peak Hour v/c ratio	AM Peak Hour Average Delay (sec/veh)	AM Peak Hour LOS	PM Peak Hour 95% queue (ft)	PM Peak Hour v/c ratio	PM Peak Hour Average Delay (sec/veh)	PM Peak Hour LOS
#4 NH 28 & Liberty Dr	EB L	225	79	0.51	42.4	D	50	0.49	30.6	C
(Signalized) [a]	EB TR	841	46	0.13	3.9	A	116	0.47	8.8	A
	EB Overall				10.7	B			9.9	A
	WB L	250	19	0.29	51.2	D	17	0.22	31.7	C
	WB TR	332	178	0.52	8.5	A	88	0.27	8.7	A
	WB Overall				8.7	A			9.0	A
	NB L	154	51	0.29	41.6	D	52	0.14	21.4	C
	NB Overall				41.6	D			21.4	C
	SB LT	100	29	0.15	40.6	D	38	0.17	21.6	C
	SB R	502	96	0.07	39.7	D	97	0.10	21.1	C
	SB Overall				39.8	D			21.2	C
	Intersection Overall			**0.50**	**11.3**	**B**		**0.43**	**11.2**	**B**
#5 - NH 102 & Gilcreast Rd	EB L	275	255	1.00	117.3	F	#345	1.24	193.4	F
(Signalized) [a]	EB RT	852	373	1.10	88.9	F	386	0.81	35.9	D
	EB Overall				**91.5**	**F**			**60.6**	**E**
	WB L	275	86	0.78	53.7	D	135	0.79	32.0	C
	WB Thru	669	150	0.97	33.7	C	266	1.27	134.1	F
	WB R	225	40	0.06	24.2	C	117	0.14	0.2	A
	WB Overall				34.9	C			**111.7**	**F**
	NB LT	488	#610	1.16	155.1	F	#567	1.29	200.5	F
	NB R	488	#598	0.63	47.0	D	#682	0.19	32.8	C
	NB Overall				**100.5**	**F**			**144.8**	**F**
	SB L	356	#442	1.13	142.9	F	314	0.95	114.4	F
	SBT	356	#483	0.53	47.3	D	#433	0.97	116.8	F
	SB R	225	#291	0.35	45.0	D	#303	0.55	49.0	D
	SB Overall				**87.6**	**F**			**83.2**	**F**
	Intersection Overall			**1.14**	**76.3**	**E**		**1.24**	**94.0**	**F**

Table 5-1. 2040 No Build intersection capacity and queuing analyses (continued)

Intersection	Lane Groups	Turning Bay/Link Length (feet)	AM Peak Hour 95% queue (ft)	AM Peak Hour v/c ratio	AM Peak Hour Average Delay (sec/veh)	AM Peak Hour LOS	PM Peak Hour 95% queue (ft)	PM Peak Hour v/c ratio	PM Peak Hour Average Delay (sec/veh)	PM Peak Hour LOS
#6 NH 102 & Hampton Dr/	EB L	275	179	0.58	61.3	E	242	1.08	125.2	F
Garden Ln (Signalized) [a]	EB TR	669	615	1.00	14.9	B	239	0.76	18.9	B
	EB Overall				17.6	B			42.7	D
	WB L	275	62	0.47	62.2	E	182	0.61	51.4	D
	WB Thru	715	221	0.55	16.9	B	367	0.99	44.7	D
	WB R	275	133	0.22	20.4	C	#329	0.81	26.1	C
	WB Overall				19.3	B			39.9	D
	NB LT	630	78	0.28	56.2	E	175	0.77	84.4	F
	NB R	100	#110	0.11	47.0	D	#137	0.06	51.5	D
	NB Overall				49.5	D			**70.1**	**E**
	SB L	175	#258	0.91	92.2	F	#242	1.02	104.3	F
	SB LT	291	#374	0.93	96.9	F	#323	1.00	99.1	F
	SB R	175	#266	0.10	34.2	C	#210	0.79	59.4	E
	SB Overall				**77.5**	**E**			**84.5**	**F**
	Intersection Overall			**0.92**	**24.9**	**C**		**0.99**	**49.9**	**D**
#7 NH 102 & I-93 SB Off-Ramp	EB Thru	895	540	1.06	53.2	D	565	1.12	87.4	F
(Exit 4) (Signalized) [a]	EB Overall				53.2	D			**87.4**	**F**
	WB Thru	1,057	193	0.58	13.4	B	420	1.26	146.7	F
	WB Overall				13.4	B			**146.7**	**F**
	SB L	138	#203	1.10	81.8	F	#205	1.20	116.3	F
	SB R	138	#167	0.84	21.4	C	#192	1.09	72.2	E
	SB Overall				50.8	D			**91.7**	**F**
	Intersection Overall			**1.08**	**44.5**	**D**		**1.22**	**106.4**	**F**
#8 NH 102 & I-93 NB On	EB L	550	529	1.11	85.6	F	475	1.20	127.6	F
and Off-Ramp (Exit 4)	EB Thru	1,057	238	0.37	5.7	A	357	0.69	21.2	C
(Signalized) [a]	EB Overall				50.9	D			**69.9**	**E**
	WB Thru	1,462	767	1.07	82.8	F	266	0.77	51.8	D
	WB R	786	#1006	0.78	3.9	A	230	0.54	1.3	A
	WB Overall				45.6	D			22.0	C
	NB L	1,440	496	1.14	137.6	F	897	1.21	140.7	F
	NB R	1,440	231	1.08	122.3	F	937	1.26	163.5	F
	NB Overall				**130.9**	**F**			**151.2**	**F**
	Intersection Overall			**1.10**	**61.4**	**E**		**1.12**	**92.8**	**F**

Table 5-1. 2040 No Build intersection capacity and queuing analyses (continued)

Intersection	Lane Groups	Turning Bay/Link Length (feet)	AM Peak Hour 95% queue (ft)	AM Peak Hour v/c ratio	AM Peak Hour Average Delay (sec/veh)	AM Peak Hour LOS	PM Peak Hour 95% queue (ft)	PM Peak Hour v/c ratio	PM Peak Hour Average Delay (sec/veh)	PM Peak Hour LOS
#9 NH 102 & St Charles St/Londonderry Rd (Signalized) [a]	EB L	350	202	0.85	58.1	E	#422	1.31	176.0	F
	EB TR	1,462	63	0.27	2.7	A	853	0.49	3.5	A
	EB Overall				17.4	B			**77.9**	**E**
	WBL	100	44	0.31	59.1	E	25	0.31	59.4	E
	WB LTR/TR	410	320	0.87	19.0	B	324	1.01	59.5	E
	WB Overall				19.1	B			**59.5**	**E**
	NB LTR	-	-	-	-	-	-	-	-	-
	NB Overall				0.0	A			0.0	A
	SB LT	780	70	0.23	53.2	D	22	0.21	52.4	D
	SB R	225	194	0.17	7.8	A	141	0.20	22.2	C
	SB Overall				8.7	A			22.6	C
	Intersection Overall			**0.85**	**17.7**	**B**		**1.16**	**67.5**	**E**
#10 NH 102 & Fordway/Madden Hill Rd (Signalized) [a]	EB TR	455	332	0.73	17.0	B	#734	1.05	55.2	E
	EB Overall				17.0	B			**55.2**	**E**
	WB LT	165	#519	0.91	29.2	C	#535	0.71	12.2	B
	WB Overall				29.2	C			12.2	B
	NB LR	375	298	0.94	60.4	E	277	1.02	96.3	F
	NB Overall				**60.4**	**E**			**96.3**	**F**
	SB LTR	120	40	0.05	21.8	C	61	0.16	30.2	C
	SB Overall				21.8	C			30.2	C
	Intersection Overall			**0.92**	**30.8**	**C**		**1.04**	**47.3**	**D**

Notes:

95th percentile volume exceeds capacity, queue may be longer.

EB = Eastbound, WB = Westbound, NB= Northbound, SB = Southbound

LOS = Level of Service

LTR = left / through / right lanes

V/C = Volume-to-Capacity ratio

Delay is Measured in Seconds Per Vehicle.

Red cells denote intersections or approaches operating at unacceptable conditions or denote approaches and lane groups whose queuing length exceeds capacity

[a] Highway Capacity Manual 2000 results (Signalized intersections)

5.6 2040 No Build Condition Freeway Operations Analysis

Based on the analysis performed using HCS, one freeway facility would operate above capacity. This includes the I-93 SB off-ramp to NH 102 that would operate at LOS F. This facility would fail due to the off-ramp operating over capacity, thus queueing onto the I-93 mainline. The NH 102 on-ramp to I-93 NB would operate above capacity potentially creating a queue into the NH 102 mainline. Table 5-2 contains the Exit 4 No Build condition freeway analysis, and Table 5-3 contains the Exit 5 No Build freeway analysis. Appendix F contains the No Build condition HCS freeway operation reports.

Table 5-2. I-93 Exit 4 2040 No Build freeway analysis

Freeway Analysis	Facility Type	Time Period	Demand to Capacity Ratio		Density (pc/mi/ln)	LOS
			Freeway	Ramp		
I-93 Northbound to NH 102	Diverge	AM	0.37	0.26	0.0	A
		PM	0.63	0.61	12.3	B
NH 102 to I-93 Northbound	Merge	AM	0.55	1.25[a]	21.9	C
		PM	0.59	0.99	23.0	C
I-93 Southbound to NH 102	Diverge	AM	0.55	0.84	25.9	C
		PM	0.56	1.10	29.2	F
NH 102 Westbound to I-93 Southbound	Merge	AM	0.50	0.69	16.5	B
		PM	0.39	0.32	10.2	B
NH 102 Eastbound to I-93 Southbound	Merge	AM	0.66	0.85	24.1	C
		PM	0.47	0.40	14.4	B

Notes: LOS = Level of Service; Density = Passenger cars per mile per lane (pc/mi/ln)

Red denotes interstate facilities that would result in failing operations and produce a queue extending to the I-93 mainline.

[a] Because the capacity of the on-ramp exceeds the demand, the ramp could produce a queue extending to NH 102.

Table 5-3. I-93 Exit 5 2040 No build freeway analysis

Freeway Analysis	Facility Type	Time Period	Demand to Capacity Ratio		Density (pc/mi/ln)	LOS
			Freeway	Ramp		
I-93 Northbound to NH 28	Diverge	AM	0.55	0.37	20.7	C
		PM	0.57	0.49	25.4	C
NH 28 to I-93 Northbound	Merge	AM	0.66	0.83	25.3	C
		PM	0.63	0.62	25.1	C
I-93 Southbound to NH 28	Diverge	AM	0.59	0.73	28.2	D
		PM	0.64	0.74	30.3	D
NH 28 to I-93 Southbound	Merge	AM	0.56	0.45	20.7	C
		PM	0.57	0.38	20.2	C

Notes: LOS = Level of Service; Density = Passenger cars per mile per lane (pc/mi/ln)

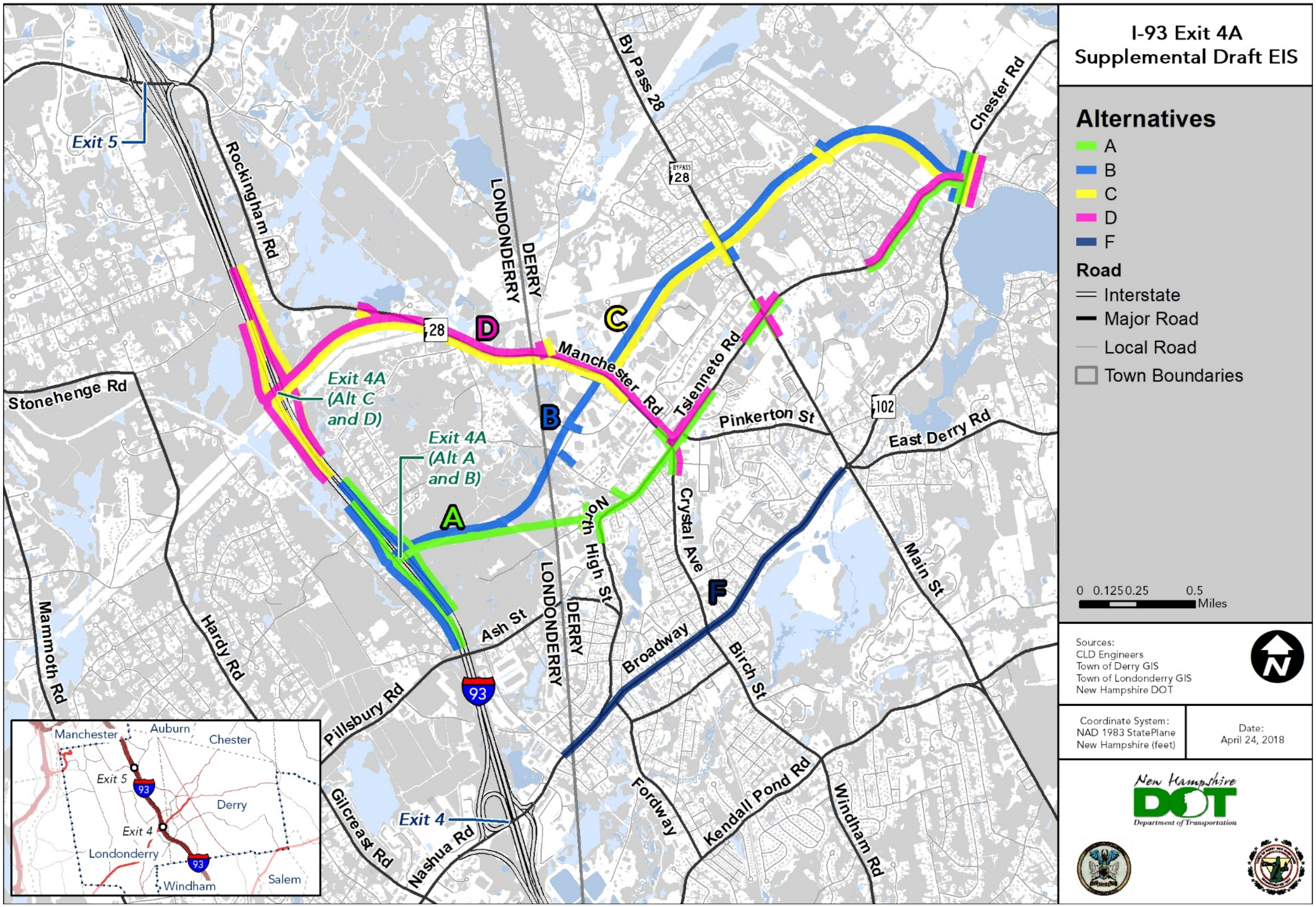
6.0 ALTERNATIVE DESCRIPTION

The proposed Project would entail the construction of a new interchange between I-93 Exit 4 and Exit 5 in Londonderry, New Hampshire. The location of the new interchange has been narrowed to two locations, the first option is located approximately 1.5 miles north of Exit 4 and 2.3 miles south of Exit 5, and the second option is located 2 miles north of Exit 4 and 1.5 miles south of Exit 5. For each option, a diamond interchange would be constructed with two signalized intersections located on either side of I-93 serving the ramp termini. Four proposed alternatives include a new interchange along I-93 as follows:

- **Alternative A**: New I-93 interchange 1.5 miles north of Exit 4, connects to the east to Folsom Road and includes improvements along Folsom Road and Tsienneto Road providing a new direct connection between I-93 and NH 102, east of Beaver Lake. The land use assumptions for the traffic analysis of this alternative assume the Woodmont Commons full build-out.
- **Alternative B**: New I-93 interchange 1.5 miles north of Exit 4, creates a new alignment 0.5 mile north of Folsom Road that runs parallel, then follows a power line ROW before connecting to NH 102 east of Beaver Lake. The land use assumptions for the traffic analysis of this alternative assume the Woodmont Commons full build-out
- **Alternative C**: New I-93 interchange 2 miles north of Exit 4, creates a new alignment along a power line ROW before connecting to NH 28, then follows the same ROW as Alternative B beginning at Ashleigh Drive, connecting to NH 102 east of Beaver Lake. Because Alternative C would not provide access to the undeveloped land on the east side of I-93 within the Woodmont Commons PUD, the Woodmont Commons development under Alternative C would be the same as the No Build Alternative.
- **Alternative D**: New I-93 interchange 2 miles north of Exit 4, creates a new alignment along a power line ROW before connecting to NH 28, then follows the same ROW as Alternative A beginning at Folsom Road, connecting to NH 102 east of Beaver Lake. The Woodmont Commons Phase I scenario is included in this alternative. Similar to Alternative C, this alternative would not provide access to the undeveloped land on the east side of I-93 within the Woodmont Commons PUD; therefore, the Woodmont Commons development under Alternative D would be the same as the No Build Alternative.

There is also **Alternative F** that can be considered the Transportation Systems Management (TSM) alternative composed of intersection improvements along NH 102 between Londonderry Road and Londonderry Turnpike that does not contain a new I-93 interchange. The next section contains detailed descriptions for each alternative.

Figure 6-1 illustrates the five SDEIS alternatives.

1 

2 **Figure 6-1. I-93 Exit 4A SDEIS alternatives**

6.1 Build Alternatives Description

6.1.1 Alternative A

Alternative A was the Preferred Alternative in the 2007 DEIS (FHWA, 2007). This alternative includes a corridor that is approximately 3.2 miles in length between the new proposed I-93 Exit 4A interchange and eastern Derry. There would be approximately one mile of roadway construction on a new alignment and approximately 1.6 miles of existing roadway reconstruction, and approximately 0.6 mile of roadway with no improvements. It would originate from the southern I-93 Exit 4A interchange location and travel northeast along new alignment through a wooded area to Folsom Road, near its intersection with North High Street and Madden Road. This alternative would continue to follow Folsom Road past Ross' Corner (Manchester Road/NH 28) and continue on Tsienneto Road across NH 28 Bypass to its end at NH 102, adjacent to Beaver Lake. Specific improvements are outlined below:

I-93 Exit 4A to Ross' Corner

The section would contain five lanes of mostly new construction.

Ross' Corner Reconstruction

Ross' Corner would require additional eastbound through and left-turn lanes and an additional westbound through-lane to handle the traffic added by Alternative A. The intersection of Tsienneto Road and Pinkerton Street would also require additional through-lanes and would be signalized.

Tsienneto Road from Ross' Corner to NH 28 Bypass

The portion is an existing three-lane roadway (one lane in each direction with a middle turn lane) that would not be altered with this Project.

NH 28 Bypass/Tsienneto Road Intersection Reconstruction

This intersection would also require an additional through-lane in each direction on Tsienneto Road.

Tsienneto Road from NH 28 Bypass to NH 102

This section would require completion of minor safety improvements on the east end of Tsienneto Road.

Tsienneto Road/NH 102 Intersection Reconstruction

This intersection would need to be signalized, with added turning lanes on NH 102 and Tsienneto Road.

6.1.2 Alternative B

The Alternative B corridor is approximately 3.4 miles in length between the new proposed I-93 Exit 4A interchange and eastern Derry. The entire 3.4-mile corridor would consist of roadway construction on new alignment. It would originate from a new southern I-93 Exit 4A interchange and travel northeast along a new alignment through a wooded area to the intersection of Ashleigh Drive and NH 28. From this intersection, this alternative would extend northeast towards the intersection of London Road and NH 28 Bypass and then continue on new alignment to the intersection of Tsienneto Road and NH 102. Specific improvements would be as follows:

I-93 Exit 4A to Ashleigh Drive/NH 28 Intersection

The section leading from the new southern I-93 Exit 4A interchange to the intersection of Ashleigh Drive and NH 28 would contain five lanes of mostly new construction.

Ashleigh Drive/NH 28 Intersection Reconstruction

This intersection would require addition eastbound left-turn lane and a new through lane and westbound through lane and shared through/right-turn lane. The NH 28 northbound approach would include a minor change to the lane geometry with the removal of the exclusive right-turn lane.

Corridor from NH 28 to NH 28 Bypass

The portion would follow a new alignment following Ashleigh Drive to the power line ROW, then following the power line ROW to the NH 28 Bypass. This section would be a three-lane roadway (one lane in each direction with a middle turn lane).

NH 28 Bypass Intersection Construction

There would be a new signalized intersection constructed with all four approaches containing a left-turn lane. The southbound approach would contain a right-turn lane, and the remaining approaches would contain shared through/right-turn lanes.

Corridor from NH 28 Bypass to NH 102

This section would follow the power line ROW, then head southeast through a wooded section to intersect with Tsienneto Road and NH 102. It would contain two lanes.

Tsienneto Road/NH 102 Intersection Reconstruction

This intersection would need to be signalized, with added turning lanes on NH 102 and Tsienneto Road.

6.1.3 Alternative C

The Alternative C corridor is approximately 3.7 miles in length between the new proposed I-93 Exit 4A interchange and eastern Derry. Approximately 2.9 miles of corridor would be on new alignment, while approximately 0.8 mile would reconstruct existing roadways. The alternative would start from a new northern I-93 Exit 4A interchange and travel east approximately 0.7 mile along a power line ROW to NH 28. Following NH 28 south to the intersection of Ashleigh Drive, it would follow the same alignment as Alternative B to the intersection of Tsienneto Road and NH 102. Specific improvements would be as follows:

I-93 Exit 4A to Ashleigh Drive/NH 28 Intersection

The section leading from the northern I-93 Exit 4A interchange option to the intersection of Ashleigh Drive and NH 28 would contain five lanes. Between Exit 4A and Scobie Pond Road, there would be new roadway construction that would tie into NH 28, an existing five-lane roadway.

Ashleigh Drive/NH 28 Intersection Reconstruction

This intersection would require a minor change to the westbound approach lane geometry by changing the left-turn lane into a shared left/through lane and the right lane into a right-turn lane. The NH 28 northbound approach would include a minor change to the lane geometry with the removal of the exclusive right-turn lane.

Corridor from NH 28 to NH 28 Bypass

This portion would be the same as Alternative B.

NH 28 Bypass Intersection Construction

This intersection would be the same as Alternative B.

Corridor from NH 28 Bypass to NH 102

This portion would be the same as Alternative B.

Tsienneto Road/NH Route 102 Intersection Reconstruction

This intersection would need to be signalized, with added turning lanes on NH 102 and Tsienneto Road.

6.1.4 Alternative D

The Alternative D corridor is approximately 3.9 miles in length between the new proposed I-93 Exit 4A interchange and eastern Derry. Within this corridor, approximately 0.8 mile would be on new alignment, 2.5 mile on existing roadways would be reconstructed, and 0.6 mile would have no improvements. The alternative would commence from a new northern I-93 Exit 4A interchange and travel east approximately 0.7 mile along a power line ROW to NH 28. Following NH 28 south to Ross' Corner, the corridor would then follow the same path as Alternative A to the intersection of Tsienneto Road and NH 102. Specific improvements would be as follows:

I-93 Exit 4A to Ross' Corner

Alternative D, originating from the northern I-93 Exit 4A interchange option, would traverse south on NH Route 28 to Ross' Corner. The section leading from the northern I-93 Exit 4A interchange option to the intersection at Ross' Corner would contain five lanes. Between Exit 4A and Scobie Pond Road, there would be new roadway construction that would tie into NH 28, an existing five-lane roadway.

Ross' Corner Reconstruction

Ross' Corner would require an additional eastbound through-lane, and an additional southbound through-lane to handle the traffic. The intersection of Tsienneto Road and Pinkerton Street would also require additional through-lanes on Tsienneto Road, in addition to being signalized.

Tsienneto Road from Ross' Corner to NH 28 Bypass

This portion would be the same as Alternative A.

NH 28 Bypass/Tsienneto Road Intersection Reconstruction

This intersection would be the same as Alternative A.

Tsienneto Road from NH 28 Bypass to NH 102

This portion would be the same as Alternative A.

Tsienneto Road/NH 102 Intersection Reconstruction

This intersection would be the same as Alternative A.

6.1.5 Alternative F

Alternative F focuses all improvements along the existing NH 102 corridor between Exit 4 at I-93 and downtown Derry. A two-way center left-turn lane would be constructed from Londonderry Road to NH Route 28. The majority of existing on-street parking spaces would be lost to accommodate the center turn lane. Additional improvements included in the study area would be as follows:

NH 102/Londonderry Road/St. Charles Street

There would be improvements to three approaches. The eastbound and westbound approaches would include a new left-turn lane and an additional through lane. The southbound approach would include an extension to the existing right-turn lane. The signal would be upgraded to operate the new lane geometry.

NH 102/Fordway/Madden Hill Road

There would be improvements to two approaches. The eastbound approach would include a new right-turn lane, and the northbound approach would include a new left-turn lane. The signal would be upgraded to operate the new lane geometry. There would also be a three-lane cross section along NH 102 between Fordway and Crystal Avenue and additional lanes added to the NH 102 and Crystal Avenue/Birch Street intersection.

7.0 THE 2040 BUILD CONDITION

7.1 Introduction

The Build condition represents the future conditions with one of the five alternatives constructed. This section summarizes development of the future traffic volumes, traffic operations, and queuing for the Build condition.

7.2 Development of 2040 Build Condition Volumes

The 2040 Build conditions represent the future conditions if all planned roadway improvements are implemented, Woodmont Commons is either fully built out or partially built out, and other background growth would follow the demographic projections contained in Tables 3-4, 3-5, and 3-6. I-93 Exit 4A would occur, and, under four of the alternatives, downtown Derry's traffic congestion would be improved. This section summarizes the development of the future traffic volumes, traffic operations, and queuing for the Build conditions.

The study relied on the SNHPC travel demand model, especially for modeling future forecasted traffic volumes generated by the Woodmont Commons PUD. Woodmont Commons is planned to include a variety of land uses such as residential, commercial, and office that could encourage a reduced number of daily work-based vehicle trips. The reduction in work-based trips is called internal capture and refers to a pedestrian or bicycle trip replacing a vehicle trip based on the origin and destination both located at Woodmont Commons. Because the travel demand model was unable to account for internal capture trips, the model likely forecasted more daily vehicle trips than might occur.

The future 2040 Build condition volumes for the intersections and freeway facilities serving Exits 4 and 5, as well as the two intersections east of Exit 4, NH 102 at Saint Charles/Londonderry Road & NH 102 at Fordway/Madden Hill Road (Intersections #9 and #10), relied on a custom travel demand model built by SNHPC to represent each alternative, resulting in five models. The model values represent 24-hour vehicle volumes; therefore, the AM and PM peak hour volumes were calculated by applying AM and PM peak hour percentages to each of the five 2040 Build 24-hour model volume results. These percentages were computed by comparing the existing condition peak hour volumes to the 2015 base year 24-hour travel demand model volumes.

Following a procedure similar to that used for the existing conditions, the Woodmont Commons TIA published Phases I and II traffic counts or Woodmont Commons PUD traffic counts were used to provide turning movement counts for the two intersections located west of I-93 at Exit 4, NH 102 at Gilcreast Road & NH 102 at Garden Lane (Intersections #5 and #6). The volumes in the TIA were used to calculate the vehicle percentage for each tuning movement as follows: (1) Alternatives A and B used the PUD traffic counts representing the full Woodmont Commons build-out; and (2) Alternatives C, D, and F used the Phase I and II traffic counts representing the partial Woodmont Commons build-out. These turning movement percentages were applied to the five balanced 2040 Build condition traffic networks at Exit 4 determined by the five SNHPC travel demand models representing each alternative.

Following the same procedure used for the existing conditions, the I-93 SEIS was used to provide turning movement counts for NH 28 at Symmes Drive/Vista Ridge Drive (Intersection #1) located west of I-93 at Exit 5. The Build condition volumes were calculated by applying the vehicle percentage for each tuning movement based on the I-93 SEIS 2030 forecasted vehicle volumes and applying that percentage to the five (Alternatives A, B, C, D, and F) balanced 2040 Build condition traffic networks at Exit 5 determined by the five SNHPC travel demand models representing each alternative.

Following the same procedure as the existing conditions, NHDOT provided a turning movement count for NH 28 and Liberty Drive (Intersection #4) located east of I-93 at Exit 5. This volume was obtained in 2005 and used to calculate the vehicle percentage for each tuning movement and applying that percentage to the five (Alternatives A, B, C, D, and F) balanced 2040 Build condition traffic networks at Exit 5 determined by the five SNHPC travel demand model representing each alternative.

The proposed new interchange (I-93 Exit 4A) would contain two new intersections with the same lane geometry regardless of the alternative chosen (A, B, C, or D). The Connector Road and I-93 SB on and off-ramp (Intersection # 11) would be signalized and contain two approaches. The other intersection, Connector Road and I-93 NB on and off-ramp (Intersection #12) would be signalized and contain three approaches.

Figures 7-1 through 7-5 show the 2040 Build condition turning movement volumes representing Alternatives A, B, C, D, and F. Figure 7-6 shows the Alternatives A and B lane geometry. Figure 7-7 shows the Alternatives C and D lane geometry. Figure 7-8 shows the Alternative F lane geometry. The location of Exit 4A differs between the alternatives; however, the lane geometry remains the same for Alternatives A through D.

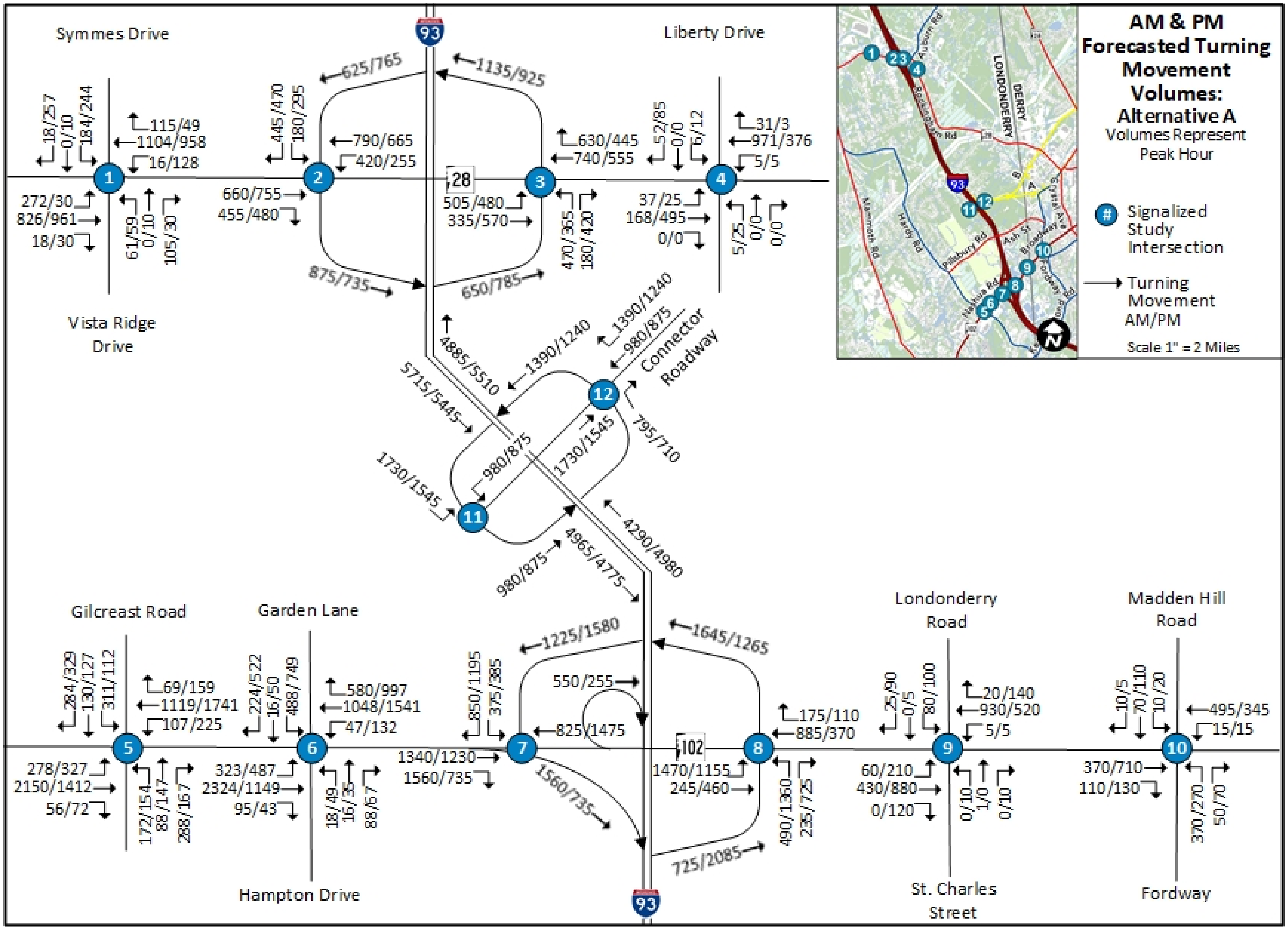


Figure 7-1. Alternative A 2040 Build turning movement volumes

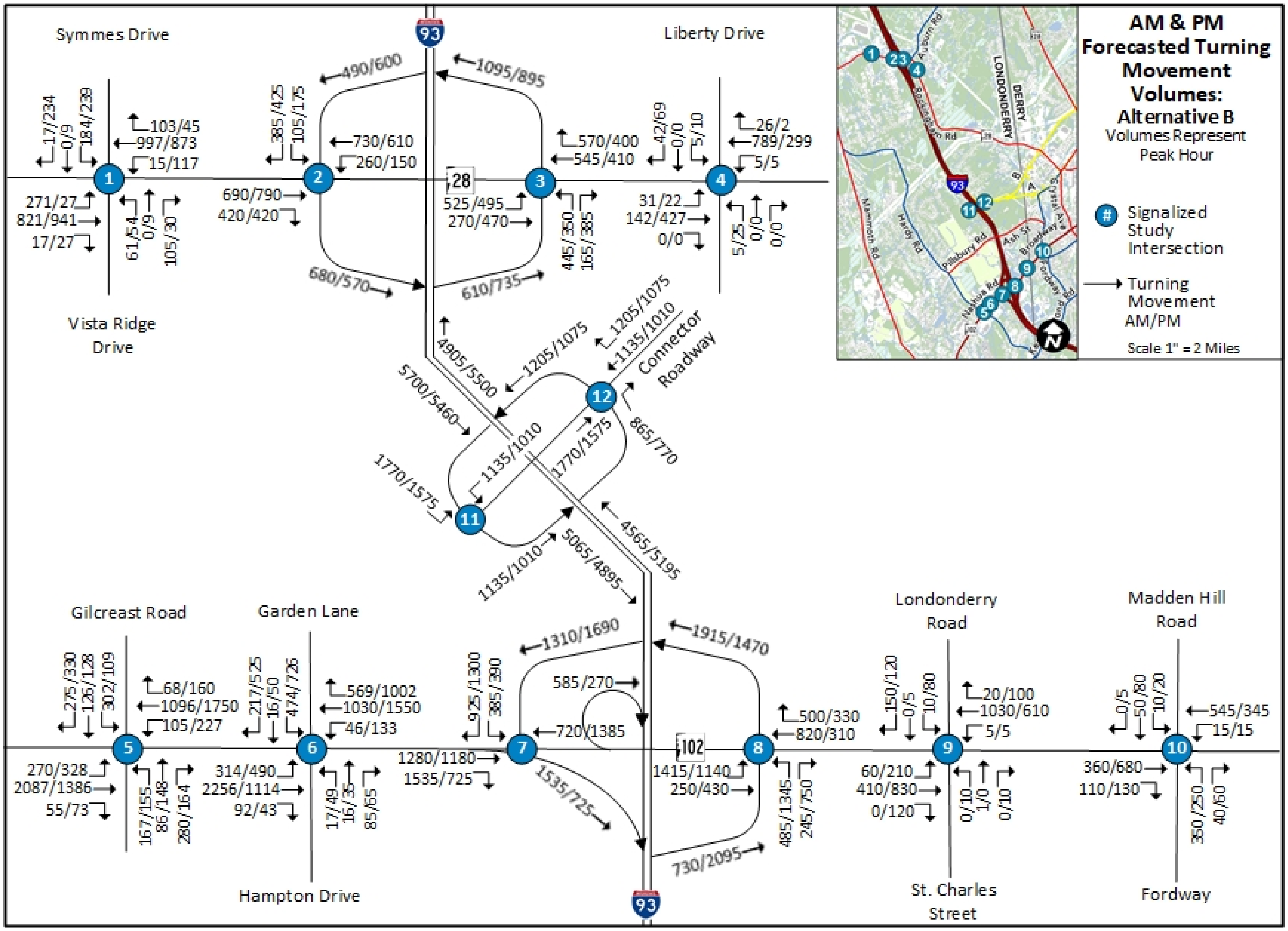
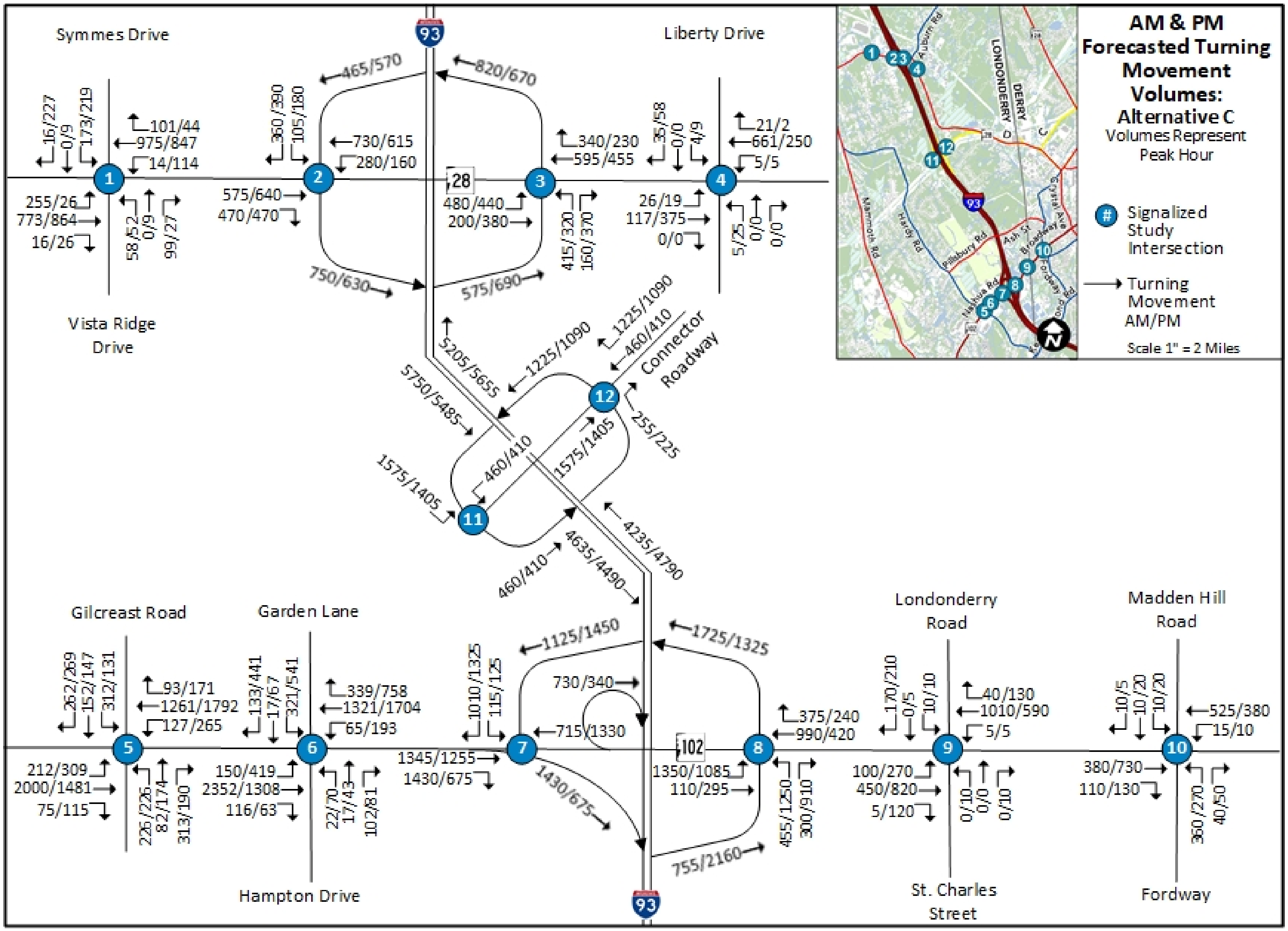


Figure 7-2. Alternative B 2040 Build turning movement volumes



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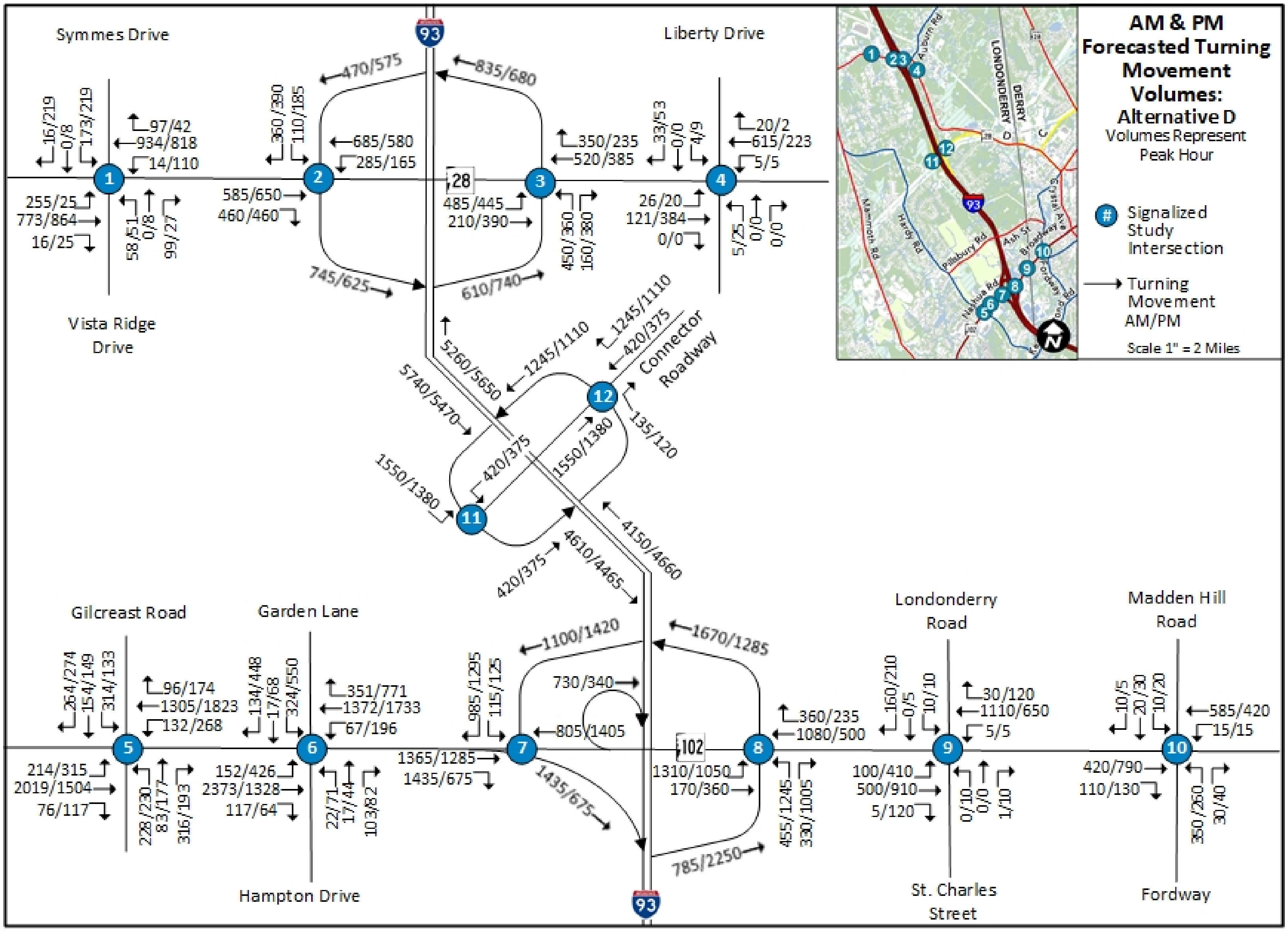
2 **Figure 7-3. Alternative C 2040 Build turning movement volumes**



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2 **Figure 7-4. Alternative D 2040 Build turning movement volumes**

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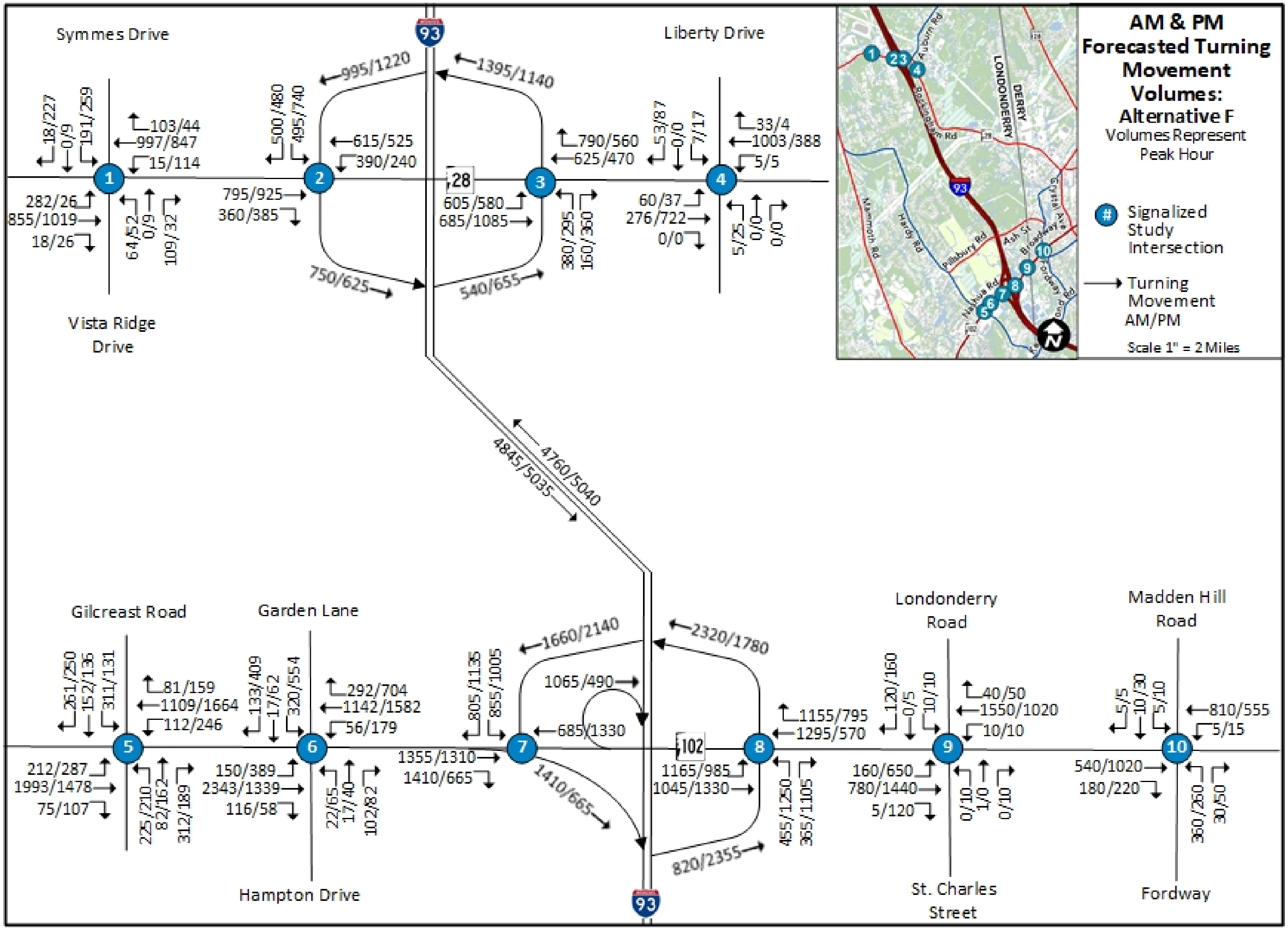

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2 **Figure 7-5. Alternative F 2040 Build turning movement volumes**

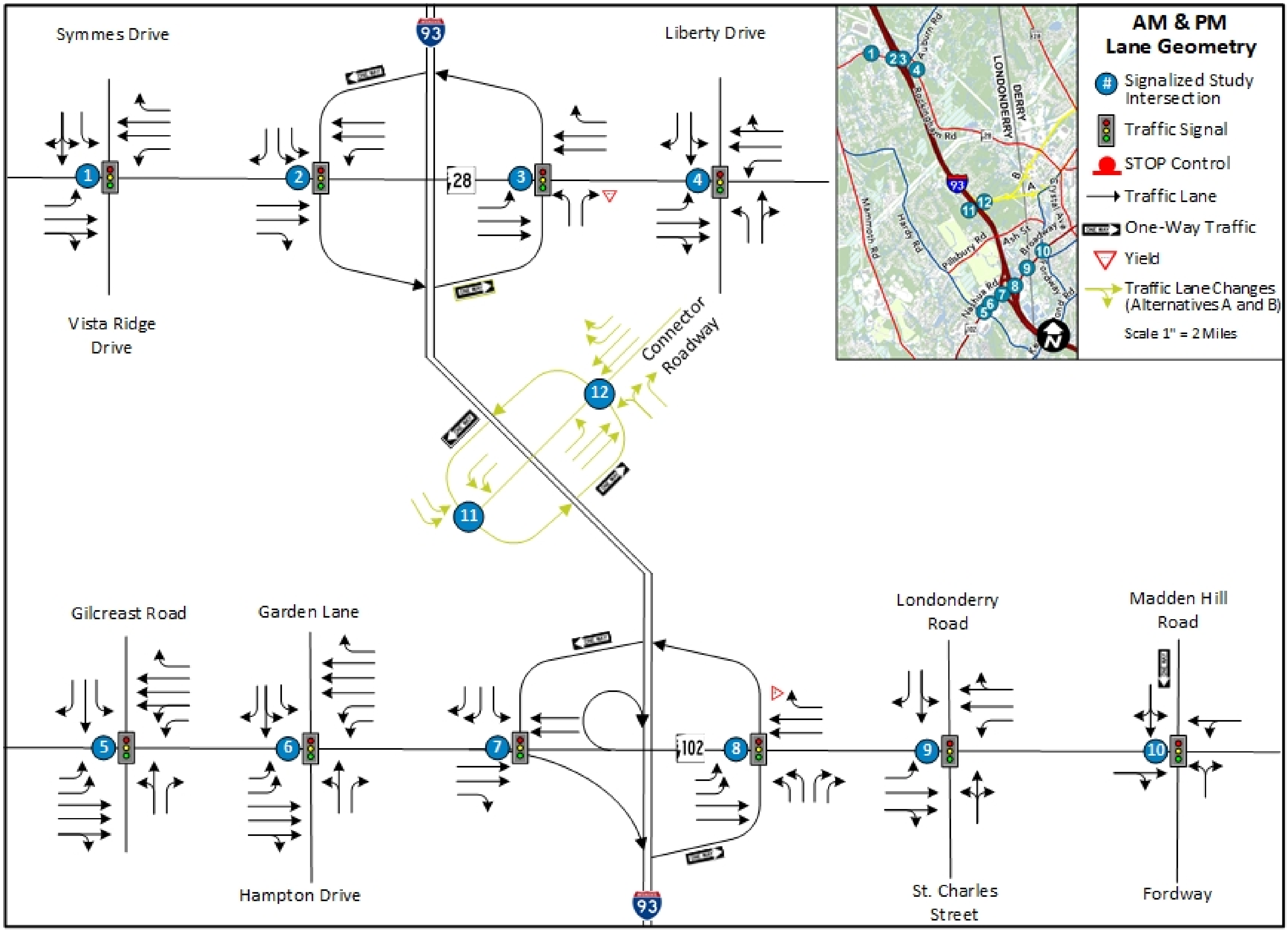


Figure 7-6. Alternatives A & B 2040 Build lane geometry

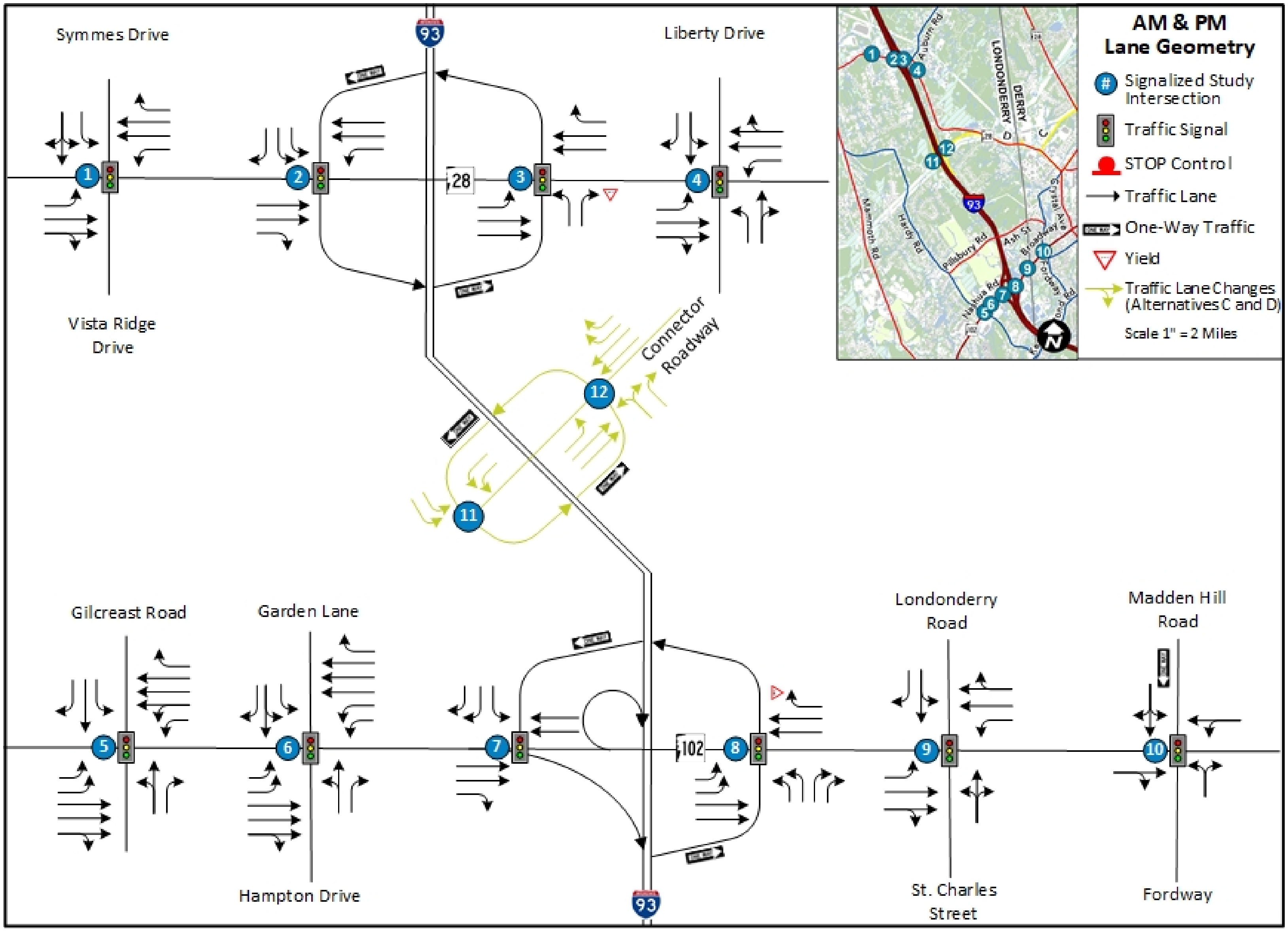


Figure 7-7. Alternatives C & D 2040 Build lane geometry

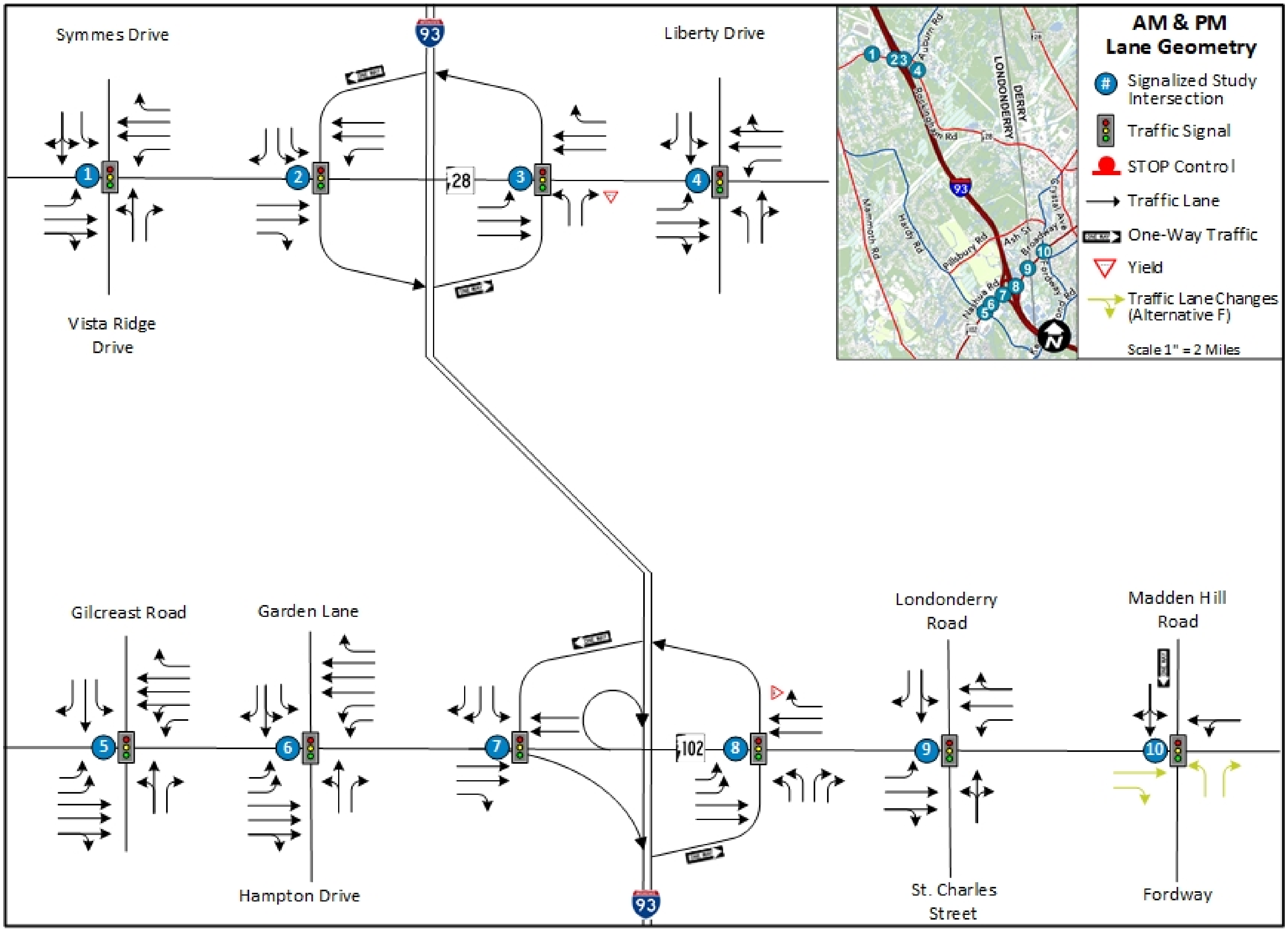


Figure 7-8. Alternative F 2040 Build lane geometry

7.3 2040 Build Alternative A Intersection Operations Analysis

Based on the Synchro™ signalized intersection analysis results, four signalized intersections (Intersections #3, #5, #6, and #8) would operate at unacceptable conditions (LOS E or LOS F) during the AM or PM peak hours. The remaining signalized intersections in the traffic study area would operate at acceptable overall conditions (LOS D or better is considered an operating level) during the peak hours analyzed (weekday AM and PM peak hours).

Based on the Synchro™ signalized intersection analysis results, eight of the study area signalized intersections have overall approaches that would operate at unacceptable conditions (LOS E or LOS F) during one or two evaluated periods. The following individual signalized intersection approaches in the traffic study area would operate under unacceptable conditions during peak hours:

- NH 28 at I-93 Southbound on and off-ramp (Exit 5) (Intersection #2)
  - I-93 Southbound off-ramp during the AM peak hour
- NH 28 at I-93 Northbound on and off-ramp (Exit 5) (Intersection #3)
  - Westbound NH 28 during the AM peak hour.
  - I-93 Northbound off-ramp during the AM and PM peak hours
- NH 102 at Gilcreast Road (Intersection #5)
  - Eastbound NH 102 during the AM and PM peak hours
  - Westbound NH 102 during the PM peak hour
  - Northbound Gilcreast Road during the AM and PM peak hours
  - Southbound Gilcreast Road during the AM and PM peak hours
- NH 102 at Hampton Drive/Garden Lane (Intersection #6)
  - Eastbound NH 102 during the PM peak hour
  - Westbound NH 102 during the PM peak hour
  - Northbound Hampton Drive during the AM and PM peak hours
  - Southbound Garden Lane during the AM and PM peak hours
- NH 102 at I-93 Southbound off-ramp (Exit 4) (Intersection #7)
  - I-93 Southbound off-ramp during the PM peak hour
- NH 102 at I-93 Northbound on and off-ramp (Exit 4) (Intersection #8)
  - Eastbound NH 102 during the AM and PM peak hours
  - Westbound NH 102 during the AM peak hour
  - I-93 Northbound on-ramp during the AM and PM peak hours
- NH 102 at Fordway/Madden Hill Road (Intersection #10)
  - Northbound Fordway during the AM and PM peak hours

- Connector Roadway and I-93 Southbound on and off-ramp (Exit 4A) (Intersection #11)
  - Westbound Connector Roadway during the AM peak hour

The overall Alternative A intersection LOS grades are depicted in Figure 7-9 for AM and PM peak hours. Table 7-1 shows the comparison between Alternative A and No Build condition LOS capacity analysis and the intersection vehicle delay results during the AM and PM peak hours. Appendices G, H, and I contain the Synchro™ Build condition intersection analysis reports.

7.4 2040 Build Alternative A Queuing Analysis

Based on the Synchro™ signalized intersection analysis results, nine of the signalized intersections within the study area would experience queuing lengths that would exceed the available storage capacity. Intersections #4, #8, and #9 would provide sufficient storage for the anticipated demand. The lane group in the approach that would operate under unacceptable conditions is noted in parentheses. Table 7-1 contains the queuing results. Appendices J, K, and L contain the Synchro™ Build condition intersection queuing reports.

- NH 28 at Symmes Drive/Vista Ridge Drive (Intersection #1)
  - Northbound Vista Ridge Drive (right turns) during the AM and the PM peak hours
  - Southbound Symmes Drive (left turns, right turns, and through movements) during the PM peak hour
- NH 28 at I-93 Southbound on and off-ramp (Exit 5) (Intersection #2)
  - Eastbound NH 28 (right turns) during the AM peak hour
  - Westbound NH 28 (left turns) during the AM peak hour
- NH 28 at I-93 Northbound on and off-ramp (Exit 5) (Intersection #3)
  - Eastbound NH 28 (left turns) during the AM peak hour
  - Westbound NH 28 (through movements) during the AM peak hour
- NH 102 at Gilcreast Road (Intersection #5)
  - Eastbound NH 102 (left turns) during the AM and PM peak hours
  - Northbound Gilcreast Road (all movements) during the AM and PM peak hours
  - Southbound Gilcreast Road (left turns) during the AM peak hour
  - Southbound Gilcreast Road (right turns and through movements) during the AM and PM peak hours
- NH 102 at Hampton Drive/Garden Lane (Intersection #6)
  - Eastbound NH 102 (left turns) during the AM and PM peak hours
  - Eastbound NH 102 (right turns and through movements) during the AM peak hour
  - Westbound NH 102 (right turns) during the AM and PM peak hours

    - Northbound Hampton Drive (right turns) during the AM and PM peak hours
    - Southbound Garden Lane (all movements) during the AM and PM peak hours
- NH 102 at I-93 Southbound off-ramp (Exit 4) (Intersection #7)
    - I-93 Southbound off-ramp (all movements) during the AM ad PM peak hours
- NH 102 at Fordway/Madden Hill Road (Intersection #10)
    - Eastbound NH 102 (all movements) during the PM peak hour
    - Westbound NH 102 (all movements) during the AM and PM peak hours
    - Southbound Madden Hill Road during the PM peak hour
- Connector Roadway and I-93 Southbound on and off-ramp (Exit 4A) (Intersection #11)
    - Westbound Connector Roadway (left turns) during the AM peak hour
- Connector Roadway and I-93 Northbound on and off-ramp (Exit 4A) (Intersection #12)
    - Westbound Connector Roadway (right turns) during the AM and PM peak hours

The remaining signalized intersections in the traffic study area would provide sufficient storage for the anticipated demand. The lane group in the approach that would operate under unacceptable conditions is highlighted in red in Table 7-1, which contains a comparison between Alternative A and No Build condition queuing results.

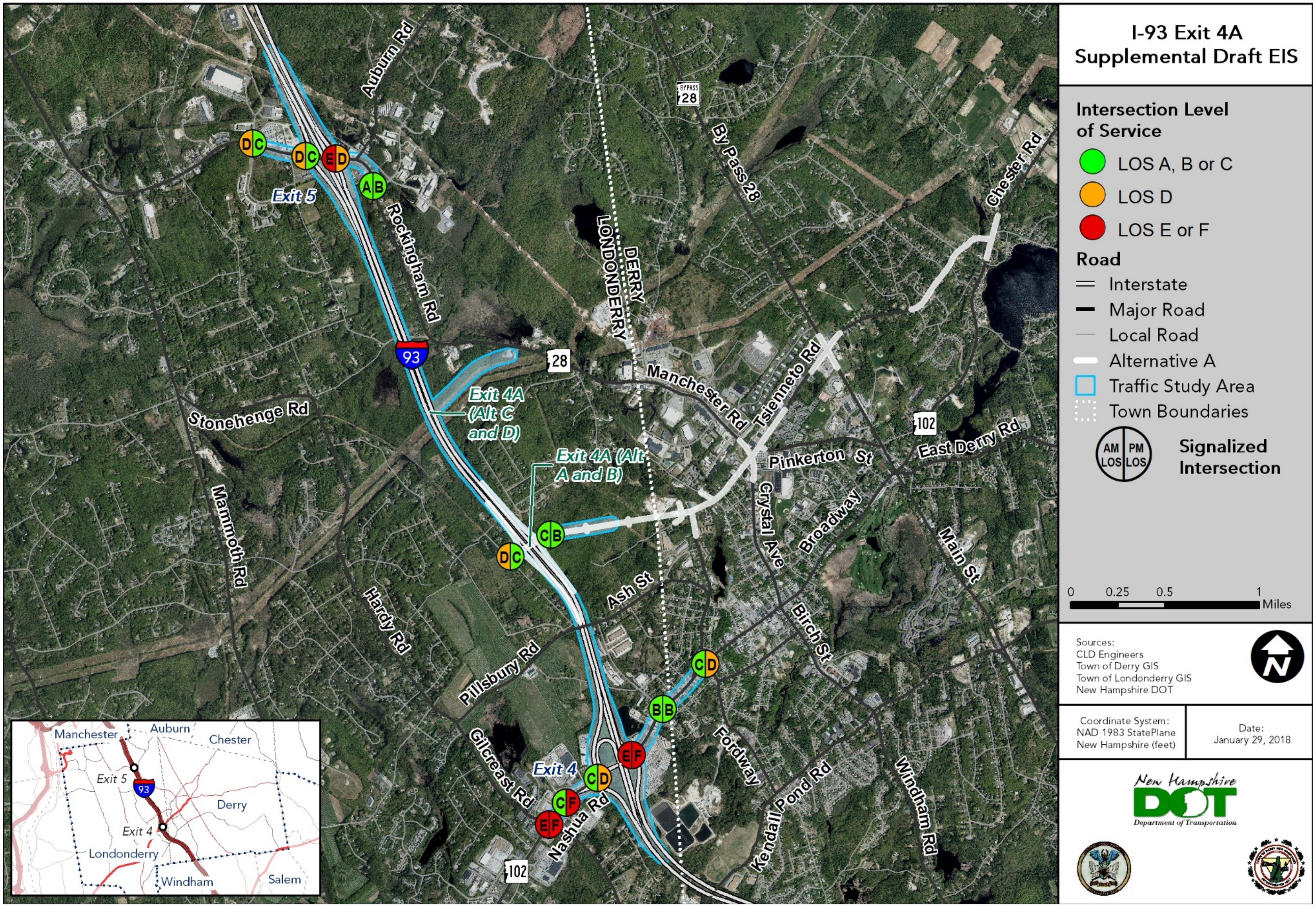


Figure 7-9. 2040 Build Alternative A AM and PM peak hour LOS by intersection

Table 7-1. Comparison between Alternative A and No Build condition intersection capacity and queuing analyses

		No Build Condition									Alternative A								
			AM Peak Hour				PM Peak Hour					AM Peak Hour				PM Peak Hour			
Intersection	Lane Groups	Turning Bay/ Link Length (feet)	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	Turning Bay/ Link Length (feet)	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS
#1 NH 28 & Symmes Dr/ Vista Ridge Dr (Signalized) [a]	EB L	408	353	0.97	85.5	F	50	0.76	111.3	F	408	349	1.07	110.4	F	58	0.59	54.9	D
	EB TR	729	414	0.51	13.0	B	458	0.81	31.9	C	408	233	0.54	13.6	B	313	0.86	29.9	C
	EB Overall				30.8	C			33.9	C				37.2	D			30.6	C
	WB L	450	40	0.55	71.3	E	154	0.81	74.0	E	450	85	0.46	50.6	D	182	0.92	85.6	F
	WB Thru	1,537	409	0.84	33.8	C	298	0.61	20.4	C	755	474	0.93	37.9	D	288	0.73	21.3	C
	WB R	500	137	0.08	19.5	B	31	0.04	14.0	B	500	214	0.08	17.1	B	46	0.04	13.4	B
	WB Overall				32.9	C			26.2	C				36.1	D			28.2	C
	NB LT	1,660	330	0.43	48.5	D	120	0.55	55.5	E	1,660	128	0.44	39.6	D	94	0.48	39.5	D
	NB R	10	#101	0.08	45.4	D	#79	0.02	49.0	D	10	#90	0.07	36.6	D	#70	0.02	35.7	D
	NB Overall				46.5	D			53.3	D				37.7	D			38.3	D
	SB L	270	181	0.93	110.8	F	267	0.84	63.6	E	270	115	0.82	70.6	E	#369	0.93	72.2	E
	SB LTR	270	191	0.07	47.1	D	#368	0.39	42.0	D	270	122	0.07	36.9	D	#631	0.35	33.3	C
	SB Overall				**79.0**	**E**			51.9	D				54.1	D			50.0	D
	Intersection Overall			**0.84**	**36.4**	**D**		**0.79**	**34.7**	**C**			**0.89**	**38.0**	**D**		**0.84**	**33.3**	**C**

Table 7-1. Comparison between Alternative A and No Build condition intersection capacity and queuing analyses (continued)

		No Build Condition									Alternative A								
		Turning Bay/ Link Length (feet)	AM Peak Hour				PM Peak Hour				Turning Bay/ Link Length (feet)	AM Peak Hour				PM Peak Hour			
Intersection	Lane Groups		95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS		95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS
#2 NH 28 & I-93 SB On and Off-Ramp (Exit 5) (Signalized) [a]	EB Thru	1,537	#1904	0.97	73.6	E	1243	0.88	39.4	D	1,537	842	0.95	71.3	E	274	0.77	32.7	C
	EB R	350	#546	0.28	0.5	A	#463	0.29	0.5	A	350	#426	0.35	0.7	A	-	0.36	0.6	A
	EB Overall				51.1	D			27.9	C				42.4	D			20.2	C
	WB L	592	#632	1.17	111.5	F	280	0.92	20.7	C	592	#645	1.06	66.0	E	208	0.86	11.6	B
	WB Thru	592	101	0.44	1.8	A	59	0.32	0.2	A	592	84	0.53	1.8	A	96	0.38	0.2	A
	WB Overall				42.9	D			6.4	A				24.1	C			3.3	A
	SB L	502	492	0.72	44.8	D	406	0.92	48.2	D	502	128	0.25	34.5	C	145	0.35	26.4	C
	SB R	502	#526	1.35	217.5	F	109	0.89	52.5	D	502	332	1.16	138.4	F	43	0.89	50.7	D
	SB Overall				**131.6**	**F**			49.9	D				**108.5**	**F**			41.3	D
	Intersection Overall			**1.17**	**77.0**	**E**		**0.90**	**31.2**	**C**			**1.06**	**49.3**	**D**		**0.83**	**20.1**	**C**
#3 NH 28 & I-93 NB On and Off-Ramp (Exit 5) (Signalized) [a]	EB L	592	#729	1.11	67.9	E	#706	1.07	53.5	D	592	#752	1.12	70.9	E	573	1.03	42.8	D
	EB Thru	592	#789	0.39	0.6	A	316	0.62	6.1	A	592	452	0.20	0.3	A	183	0.32	2.2	A
	EB Overall				32.0	C			22.5	C				42.7	D			20.7	C
	WB Thru	481	#580	1.05	104.5	F	217	0.91	61.7	E	481	#598	1.07	104.4	F	179	0.87	48.8	D
	WB R	481	171	0.56	1.5	A	-	0.38	0.7	A	481	169	0.46	1.0	A	-	0.31	0.5	A
	WB Overall				48.5	D			29.7	C				**56.9**	**E**			27.3	C
	NB L	798	685	1.11	128.2	F	337	0.86	47.1	D	798	746	1.13	122.8	F	533	1.03	78.1	E
	NB R	798	349	0.23	39.9	D	213	1.08	98.8	F	798	273	0.24	32.5	C	286	0.95	59.7	E
	NB Overall				**101.9**	**F**			**76.0**	**E**				**97.8**	**F**			**68.3**	**E**
	Intersection Overall			**1.10**	**51.7**	**D**		**1.04**	**37.7**	**D**			**1.11**	**63.0**	**E**		**0.99**	**39.2**	**D**

Table 7-1. Comparison between Alternative A and No Build condition intersection capacity and queuing analyses (continued)

		No Build Condition									Alternative A								
		Turning Bay/ Link Length	AM Peak Hour				PM Peak Hour				Turning Bay/ Link Length	AM Peak Hour				PM Peak Hour			
Intersection	Lane Groups	(feet)	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	(feet)	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS
#4 NH 28 &	EB L	225	79	0.51	42.4	D	50	0.49	30.6	C	225	53	0.48	41.2	D	35	0.69	62.9	E
Liberty Dr	EB TR	841	46	0.13	3.9	A	116	0.47	8.8	A	841	30	0.08	4.0	A	83	0.37	8.7	A
(Signalized) [a]	EB Overall				10.7	B			9.9	A				10.6	B			11.2	B
	WB L	250	19	0.29	51.2	D	17	0.22	31.7	C	250	22	0.29	46.5	D	19	0.19	23.9	C
	WB TR	332	178	0.52	8.5	A	88	0.27	8.7	A	332	148	0.51	7.3	A	92	0.30	8.4	A
	WB Overall				8.7	A			9.0	A				7.5	A			8.6	A
	NB L	154	51	0.29	41.6	D	52	0.14	21.4	C	154	23	0.05	35.1	D	48	0.14	16.7	B
	NB Overall				41.6	D			21.4	C				35.1	D			16.7	B
	SB LT	100	29	0.15	40.6	D	38	0.17	21.6	C	100	34	0.12	35.8	D	29	0.12	16.6	B
	SB R	502	96	0.07	39.7	D	97	0.10	21.1	C	502	89	0.07	35.3	D	83	0.09	16.4	B
	SB Overall				39.8	D			21.2	C				35.3	D			16.5	B
	Intersection Overall			**0.50**	**11.3**	**B**		**0.43**	**11.2**	**B**			**0.47**	**9.6**	**A**		**0.33**	**11.1**	**B**

Table 7-1. Comparison between Alternative A and No Build condition intersection capacity and queuing analyses (continued)

		No Build Condition									Alternative A								
		Turning Bay/ Link Length (feet)	AM Peak Hour				PM Peak Hour				Turning Bay/ Link Length (feet)	AM Peak Hour				PM Peak Hour			
Intersection	Lane Groups		95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS		95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS
#5 NH 102 & Gilcreast Rd (Signalized) [a]	EB L	275	255	1.00	117.3	F	#345	1.24	193.4	F	275	#280	0.95	105.7	F	#338	1.24	193.6	F
	EB RT	852	373	1.10	88.9	F	386	0.81	35.9	D	852	383	1.05	76.3	E	374	0.71	31.7	C
	EB Overall				**91.5**	**F**			**60.6**	**E**				**79.6**	**E**			**60.9**	**E**
	WB L	275	86	0.78	53.7	D	135	0.79	32.0	C	275	110	0.79	76.5	E	102	0.63	31.9	C
	WB Thru	669	150	0.97	33.7	C	266	1.27	134.1	F	669	200	0.92	37.6	D	212	1.19	99.9	F
	WB R	225	40	0.06	24.2	C	117	0.14	0.2	A	225	64	0.05	29.5	C	83	0.14	0.7	A
	WB Overall				34.9	C			**111.7**	**F**				40.4	D			**85.2**	**F**
	NB LT	488	#610	1.16	155.1	F	#567	1.29	200.5	F	488	#609	1.07	139.8	F	#615	1.23	189.0	F
	NB R	488	#598	0.63	47.0	D	#682	0.19	32.8	C	488	#601	0.68	62.0	E	#661	0.17	36.5	D
	NB Overall				**100.5**	**F**			**144.8**	**F**				**98.9**	**F**			**134.5**	**F**
	SB L	356	#442	1.13	142.9	F	314	0.95	114.4	F	356	#444	1.10	144.5	F	313	0.90	106.6	F
	SBT	356	#483	0.53	47.3	D	#433	0.97	116.8	F	356	#478	0.44	56.4	E	#451	0.97	123.9	F
	SB R	225	#291	0.35	45.0	D	#303	0.55	49.0	D	225	#278	0.43	56.5	E	#277	0.91	86.1	F
	SB Overall				**87.6**	**F**			**83.2**	**F**				**94.2**	**F**			**98.6**	**F**
	Intersection Overall			**1.14**	**76.3**	**E**		**1.24**	**94.0**	**F**			**1.08**	**73.3**	**E**		**1.18**	**82.7**	**F**

Table 7-1. Comparison between Alternative A and No Build condition intersection capacity and queuing analyses (continued)

		No Build Condition									**Alternative A**								
		Turning Bay/ Link Length (feet)	AM Peak Hour				PM Peak Hour				Turning Bay/ Link Length (feet)	AM Peak Hour				PM Peak Hour			
Intersection	Lane Groups		95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS		95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS
#6 NH 102 & Hampton Dr/Garden Ln (Signalized) [a]	EB L	275	179	0.58	61.3	E	242	1.08	125.2	F	275	#277	0.75	84.4	F	#318	1.27	212.8	F
	EB TR	669	615	1.00	14.9	B	239	0.76	18.9	B	669	#785	0.98	13.5	B	577	0.68	16.7	B
	EB Overall				17.6	B			42.7	D				21.8	C			**73.6**	**E**
	WB L	275	62	0.47	62.2	E	182	0.61	51.4	D	275	52	0.48	77.0	E	192	0.60	58.6	E
	WB Thru	715	221	0.55	16.9	B	367	0.99	44.7	D	715	234	0.57	27.5	C	462	1.08	84.3	F
	WB R	275	133	0.22	20.4	C	#329	0.81	26.1	C	275	#277	0.56	10.8	B	#341	1.14	97.0	F
	WB Overall				19.3	B			39.9	D				23.1	C			**87.8**	**F**
	NB LT	630	78	0.28	56.2	E	175	0.77	84.4	F	630	99	0.31	73.3	E	150	0.65	79.9	E
	NB R	100	#110	0.11	47.0	D	#137	0.06	51.5	D	100	#116	0.06	61.3	E	#127	0.05	56.3	E
	NB Overall				49.5	D			**70.1**	**E**				**64.7**	**E**			**69.4**	**E**
	SB L	175	#258	0.91	92.2	F	#242	1.02	104.3	F	175	#244	0.91	91.2	F	#236	1.01	95.1	F
	SB LT	291	#374	0.93	96.9	F	#323	1.00	99.1	F	291	#328	0.89	86.7	F	#320	1.02	96.1	F
	SB R	175	#266	0.10	34.2	C	#210	0.79	59.4	E	175	#276	0.29	34.3	C	#217	0.96	81.8	F
	SB Overall				**77.5**	**E**			**84.5**	**F**				**72.1**	**E**			**90.2**	**F**
	Intersection Overall			**0.92**	**24.9**	**C**		**0.99**	**49.9**	**D**			**0.93**	**30.1**	**C**		**1.11**	**83.9**	**F**

Table 7-1. Comparison between Alternative A and No Build condition intersection capacity and queuing analyses (continued)

		No Build Condition									Alternative A								
			AM Peak Hour				PM Peak Hour					AM Peak Hour				PM Peak Hour			
Intersection	Lane Groups	Turning Bay/ Link Length (feet)	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	Turning Bay/ Link Length (feet)	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS
#7 NH 102 & I-93 SB Off-Ramp (Exit 4) (Signalized) [a]	EB Thru	895	540	1.06	53.2	D	565	1.12	87.4	F	895	765	0.92	24.4	C	387	0.84	23.9	C
	EB Overall				53.2	D			**87.4**	**F**				24.4	C			23.9	C
	WB Thru	1,057	193	0.58	13.4	B	420	1.26	146.7	F	1,057	317	0.61	22.0	C	247	1.08	43.9	D
	WB Overall				13.4	B			**146.7**	**F**				22.0	C			43.9	D
	SB L	138	#203	1.10	81.8	F	#205	1.20	116.3	F	138	#217	0.56	19.0	B	#219	0.49	25.4	C
	SB R	138	#167	0.84	21.4	C	#192	1.09	72.2	E	138	#222	0.92	34.8	C	#244	1.10	94.5	F
	SB Overall				50.8	D			**91.7**	**F**				30.0	C			**77.7**	**E**
	Intersection Overall			**1.08**	**44.5**	**D**		**1.22**	**106.4**	**F**			**0.92**	**25.9**	**C**		**1.09**	**50.9**	**D**
#8 NH 102 & I-93 NB On and Off-Ramp (Exit 4) (Signalized) [a]	EB L	550	529	1.11	85.6	F	475	1.20	127.6	F	550	493	1.05	65.4	E	544	1.26	158.2	F
	EB Thru	1,057	238	0.37	5.7	A	357	0.69	21.2	C	1,057	78	0.10	9.0	A	324	0.26	7.7	A
	EB Overall				50.9	D			**69.9**	**E**				**57.3**	**E**			**115.3**	**F**
	WB Thru	1,462	767	1.07	82.8	F	266	0.77	51.8	D	1,462	815	1.03	92.4	F	234	0.57	50.4	D
	WB R	786	#1006	0.78	3.9	A	230	0.54	1.3	A	786	233	0.12	0.2	A	-	0.08	0.1	A
	WB Overall				45.6	D			22.0	C				**77.2**	**E**			38.8	D
	NB L	1,440	496	1.14	137.6	F	897	1.21	140.7	F	1,440	348	1.03	109.6	F	843	1.29	178.2	F
	NB R	1,440	231	1.08	122.3	F	937	1.26	163.5	F	1,440	173	0.61	60.4	E	894	0.85	44.7	D
	NB Overall				**130.9**	**F**			**151.2**	**F**				**93.6**	**F**			**131.8**	**F**
	Intersection Overall			**1.10**	**61.4**	**E**		**1.12**	**92.8**	**F**			**1.04**	**71.2**	**E**		**1.11**	**115.1**	**F**

Table 7-1. Comparison between Alternative A and No Build condition intersection capacity and queuing analyses (continued)

		No Build Condition										Alternative A								
		Turning Bay/ Link Length	AM Peak Hour				PM Peak Hour				Turning Bay/ Link Length	AM Peak Hour				PM Peak Hour			
Intersection	Lane Groups	(feet)	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	(feet)	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS
#9 NH 102 & St Charles St/ Londonderry Rd (Signalized) [a]	EB L	350	202	0.85	58.1	E	#422	1.31	176.0	F	350	60	0.42	33.0	C	169	0.64	30.3	C
	EB TR	1,462	63	0.27	2.7	A	853	0.49	3.5	A	1,462	78	0.21	5.7	A	181	0.50	8.0	A
	EB Overall				17.4	B			**77.9**	**E**				9.1	A			11.9	B
	WBL	100	44	0.31	59.1	E	25	0.31	59.4	E	100	35	0.26	42.8	D	30	0.26	43.0	D
	WB TR	410	320	0.87	19.0	B	324	1.01	59.5	E	410	171	0.53	10.4	B	194	0.48	15.4	B
	WB Overall				19.1	B			**59.5**	**E**				10.6	B			15.6	B
	NB LTR	-	-	-	-	-	-	-	-	-	400	7	0.02	28.8	C	46	0.06	28.0	C
	NB Overall				0.0	A			0.0	A				28.8	C			28.0	C
	SB LT	780	70	0.23	53.2	D	22	0.21	52.4	D	780	85	0.57	35.4	D	87	0.61	35.9	D
	SB R	225	194	0.17	7.8	A	141	0.20	22.2	C	225	42	0.02	7.3	A	53	0.06	12.5	B
	SB Overall				8.7	A			22.6	C				28.8	C			25.1	C
	Intersection Overall			**0.85**	**17.7**	**B**		**1.16**	**67.5**	**E**			**0.52**	**11.4**	**B**		**0.58**	**14.8**	**B**
#10 NH 102 & Fordway/ Madden Hill Rd (Signalized) [a]	EB TR	455	332	0.73	17.0	B	#734	1.05	55.2	E	455	323	0.70	20.1	C	#562	0.98	43.2	D
	EB Overall				17.0	B			**55.2**	**E**				20.1	C			43.2	D
	WB LT	165	#519	0.91	29.2	C	#535	0.71	12.2	B	165	#430	0.76	22.1	C	#339	0.59	14.6	B
	WB Overall				29.2	C			12.2	B				22.1	C			14.6	B
	NB LR	375	298	0.94	60.4	E	277	1.02	96.3	F	375	323	0.83	32.1	C	336	1.01	84.2	F
	NB Overall				**60.4**	**E**			**96.3**	**F**				32.1	C			**84.2**	**F**
	SB LTR	120	40	0.05	21.8	C	61	0.16	30.2	C	120	83	0.21	15.2	B	#124	0.42	25.1	C
	SB Overall				21.8	C			30.2	C				15.2	B			25.1	C
	Intersection Overall			**0.92**	**30.8**	**C**		**1.04**	**47.3**	**D**			**0.79**	**23.4**	**C**		**0.99**	**42.5**	**D**

Table 7-1. Comparison between Alternative A and No Build condition intersection capacity and queuing analyses (continued)

		No Build Condition									Alternative A								
		Turning Bay/ Link Length	AM Peak Hour				PM Peak Hour				Turning Bay/ Link Length	AM Peak Hour				PM Peak Hour			
Intersection	Lane Groups	(feet)	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	(feet)	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS
#11 Connector Rd & I-93 SB On and Off-Ramp (Exit 4A) (Signalized) [a]	WBL	-	-	-	-	-	-	-	-	-	320	#364	0.98	55.7	E	303	0.83	36.1	D
	WB Overall				-	-			-	-				**55.7**	**E**			36.1	D
	SB L	-	-	-	-	-	-	-	-	-	531	487	0.96	33.0	C	402	0.91	24.8	C
	SB Overall				-	-			-	-				33.0	C			24.8	C
	Intersection Overall			-	-	-		-	-	-			**0.97**	**41.2**	**D**		**0.88**	**28.9**	**C**
#12 Connector Rd & I-93 NB On and Off-Ramp (Exit 4A) (Signalized) [a]	EB T	-	-	-	-	-	-	-	-	-	320	89	0.92	3.0	A	98	0.86	3.5	A
	EB Overall				-	-			-	-				3.0	A			3.5	A
	WB T	-	-	-	-	-	-	-	-	-	3,362	1520	0.52	13.0	B	223	0.49	12.5	B
	WB R	-	-	-	-	-	-	-	-	-	200	#271	0.93	28.5	C	#267	0.86	22.4	C
	WB Overall				-	-			-	-				22.0	C			18.3	B
	NB LR	-	-	-	-	-	-	-	-	-	473	371	0.89	48.8	D	296	0.77	35.6	D
	NB R	-	-	-	-	-	-	-	-	-	473	320	0.94	57.8	E	265	0.80	38.7	D
	NB Overall				-	-			-	-				53.3	D			37.2	D
	Intersection Overall			-	-	-		-	-	-			**0.93**	**20.4**	**C**		**0.84**	**16.1**	**B**

Notes:

95th percentile volume exceeds capacity, queue may be longer.

EB = Eastbound, WB = Westbound, NB= Northbound, SB = Southbound

LOS = Level of Service

LTR = left / through / right lanes

V/C = Volume-to-Capacity ratio

Delay is Measured in Seconds Per Vehicle.

Red cells denote intersections or approaches operating at unacceptable conditions or denote approaches and lane groups whose queuing length exceeds capacity

[a] Highway Capacity Manual 2000 results (Signalized intersections)

7.5 2040 Build Alternative A Freeway Operations Analysis

Analysis performed using HCS shows all freeway facilities would operate below capacity. The one failing freeway facility under the No Build condition (the I-93 SB off-ramp to NH 102) would improve to LOS A. Table 7-2 contains the Exit 4 Alternative A freeway analysis compared to the No Build condition, and Table 7-3 contains the Exit 5 Alternative A freeway analysis compared to the No Build condition. Table 7-4 contains the Exit 4A Alternative A freeway analysis. Appendix M contains the Build condition HCS freeway operation reports.

Table 7-2. I-93 Exit 4 2040 Build Alternative A freeway analysis compared to the No Build condition

Freeway Analysis	Facility Type	Time Period	Demand to Capacity Ratio		Density (pc/mi/ln)	Alt A LOS	No Build LOS
			Freeway	Ramp			
I-93 Northbound to NH 102	Diverge	AM	0.38	0.23	0.0	A	A
		PM	0.66	0.67	14.4	B	B
NH 102 to I-93 Northbound	Merge	AM	0.49	0.89	19.3	B	C
		PM	0.57	0.70	20.1	C	C
I-93 Southbound to NH 102	Diverge	AM	0.57	0.76	25.2	C	C
		PM	0.54	0.46	7.6	A	F
NH 102 Westbound to I-93 Southbound	Merge	AM	0.49	0.36	13.8	B	B
		PM	0.39	0.17	9.2	A	B
NH 102 Eastbound to I-93 Southbound	Merge	AM	0.69	0.93	25.6	C	C
		PM	0.49	0.46	15.1	B	B

Notes: LOS = Level of Service; Density = Passenger cars per mile per lane (pc/mi/ln)

Red denotes interstate facilities that would result in failing operations and would produce a queue extending to the I-93 mainline.

Table 7-3. I-93 Exit 5 2040 Build Alternative A freeway analysis compared to the No Build condition

Freeway Analysis	Facility Type	Time Period	Demand to Capacity Ratio		Density (pc/mi/ln)	Alt A LOS	No Build LOS
			Freeway	Ramp			
I-93 Northbound to NH 28	Diverge	AM	0.56	0.43	24.5	C	C
		PM	0.63	0.58	28.6	D	C
NH 28 to I-93 Northbound	Merge	AM	0.63	0.67	25.7	C	C
		PM	0.65	0.50	24.8	C	C
I-93 Southbound to NH 28	Diverge	AM	0.62	0.41	24.2	C	D
		PM	0.62	0.42	24.0	C	D

Freeway Analysis	Facility Type	Time Period	Demand to Capacity Ratio		Density (pc/mi/ln)	Alt A LOS	No Build LOS
			Freeway	Ramp			
NH 28 to I-93 Southbound	Merge	AM	0.67	0.52	21.2	C	C
		PM	0.63	0.44	19.5	B	C

Notes: LOS = Level of Service; Density = Passenger cars per mile per lane (pc/mi/ln)

Table 7-4. I-93 Exit 4A 2040 Build Alternative A freeway analysis

Freeway Analysis	Facility Type	Time Period	Demand to Capacity Ratio		Density (pc/mi/ln)	LOS
			Freeway	Ramp		
I-93 Northbound to Connector Roadway	Diverge	AM	0.49	0.48	20.2	C
		PM	0.56	0.41	24.3	C
Connector Roadway to I-93 Northbound	Merge	AM	0.59	0.84	24.9	C
		PM	0.63	0.72	25.1	C
I-93 Southbound to Connector Roadway	Diverge	AM	0.65	0.53	16.3	B
		PM	0.61	0.45	13.2	B
Connector Roadway to I-93 Southbound	Merge	AM	0.61	0.60	0.00	C
		PM	0.55	0.51	21.4	C

Notes: LOS = Level of Service; Density = Passenger cars per mile per lane (pc/mi/ln)

7.6 2040 Build Alternative B Intersection Operations Analysis

Based on the Synchro™ signalized intersection analysis results, three signalized intersections (Intersections #5, #6, and #8) would operate at unacceptable conditions (LOS E or LOS F) during the AM or PM peak hours. The remaining signalized intersections in the traffic study area would operate at acceptable overall conditions (LOS D or better is considered an operating level) during the peak hours analyzed (weekday AM and PM peak hours).

Based on the Synchro™ signalized intersection analysis results, eight of the study area signalized intersections have overall approaches that would operate at unacceptable conditions (LOS E or LOS F) during one or two evaluated periods. The following individual signalized intersection approaches in the traffic study area would operate under unacceptable conditions during peak hours:

- NH 28 at I-93 Southbound on and off-ramp (Exit 5) (Intersection #2)
  - I-93 Southbound off-ramp during the AM peak hour
- NH 28 at I-93 Northbound on and off-ramp (Exit 5) (Intersection #3)
  - I-93 Northbound off-ramp during the AM peak hour
- NH 102 at Gilcreast Road (Intersection #5)
  - Eastbound NH 102 during the AM and PM peak hours

    - Westbound NH 102 during the PM peak hour
    - Northbound Gilcreast Road during the AM and PM peak hours
    - Southbound Gilcreast Road during the AM and PM peak hours
- NH 102 at Hampton Drive/Garden Lane (Intersection #6)
    - Eastbound NH 102 during the PM peak hour
    - Westbound NH 102 during the PM peak hour
    - Northbound Hampton Drive during the AM and PM peak hours
    - Southbound Garden Lane during the AM and PM peak hours
- NH 102 at I-93 Southbound off-ramp (Exit 4) (Intersection #7)
    - I-93 Southbound off-ramp during the PM peak hour
- NH 102 at I-93 Northbound on and off-ramp (Exit 4) (Intersection #8)
    - Eastbound NH 102 during the PM peak hour
    - I-93 Northbound off-ramp during the AM and PM peak hours
- Connector Roadway and I-93 Southbound on and off-ramp (Exit 4A) (Intersection #11)
    - I-93 Southbound off-ramp during the AM peak hour
- Connector Roadway and I-93 Northbound on and off-ramp (Exit 4A) (Intersection #12)
    - I-93 Northbound on-ramp during the AM and PM peak hours

The overall Alternative B intersection LOS grades are depicted in Figure 7-10 for AM and PM peak hours. Table 7-5 shows the comparison between Alternative B and No Build condition LOS capacity analysis and the intersection vehicle delay results during the AM and PM peak hours. Appendices G, H, and I contain the Synchro™ Build condition intersection analysis reports.

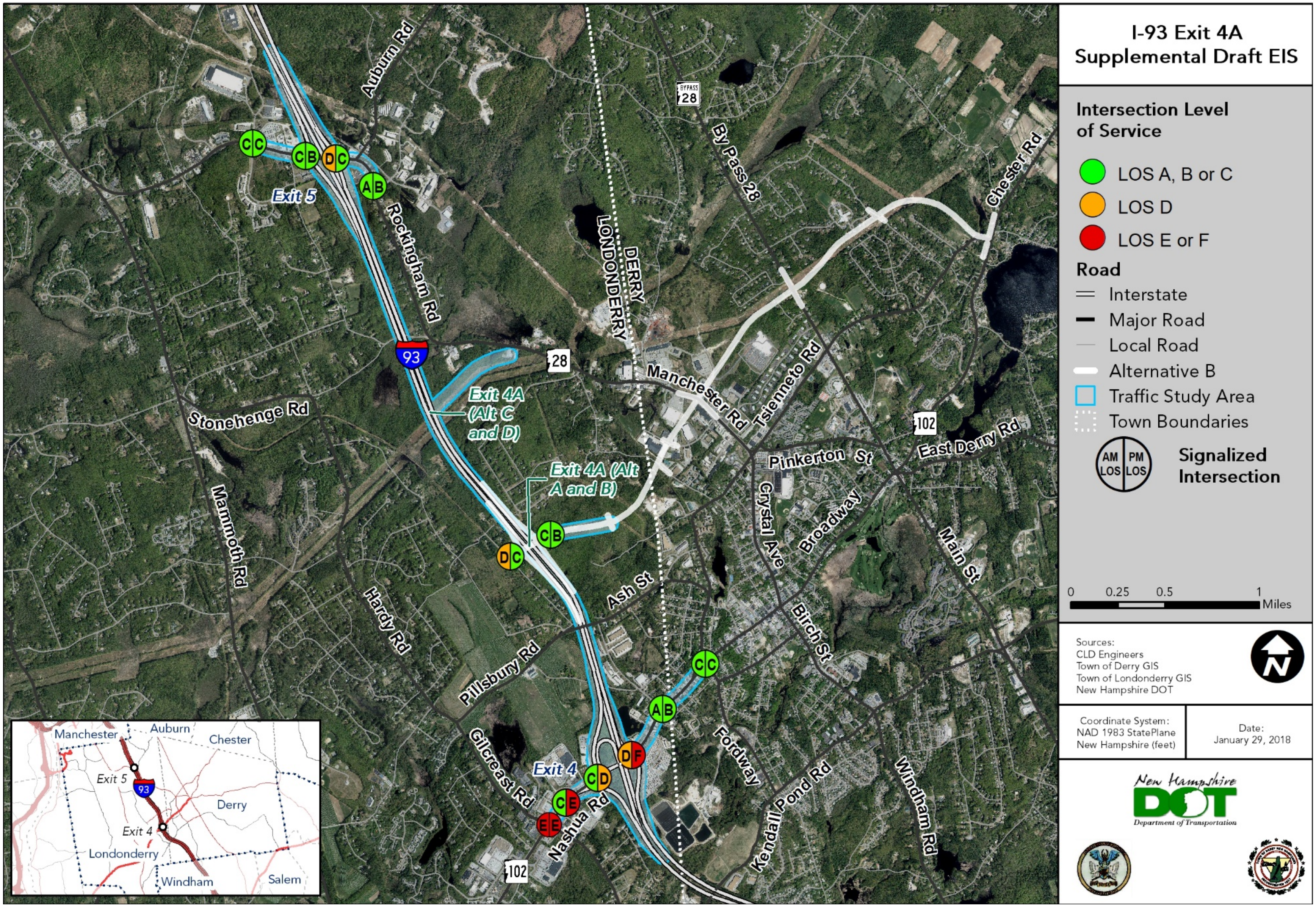
7.7 2040 Build Alternative B Queuing Analysis

Based on the Synchro™ signalized intersection analysis results, eight of the signalized intersections within the study area would experience queuing lengths that would exceed the available storage capacity. Intersections #2, #4, #8, and #9 would provide sufficient storage for the anticipated demand. The lane group in the approach that would operate under unacceptable conditions is noted in parentheses. Table 7-5 contains the queuing results. Appendices J, K, and L contain the Synchro™ Build condition intersection queuing reports.

- NH 28 at Symmes Drive/Vista Ridge Drive (Intersection #1)
    - Northbound Vista Ridge Drive (right turns) during the AM and the PM peak hours
    - Southbound Symmes Drive (left turns, right turns, and through movements) during the PM peak hour
- NH 28 at I-93 Northbound on and off-ramp (Exit 5) (Intersection #3)

    - Eastbound NH 28 (left turns) during the AM and PM peak hours
- NH 102 at Gilcreast Road (Intersection #5)
    - Eastbound NH 102 (left turns) during the AM and PM peak hours
    - Northbound Gilcreast Road (left turns) during the AM and PM peak hours
    - Northbound Gilcreast Road (right turns) during the PM peak hour
    - Southbound Gilcreast Road (left turns) during the AM peak hour
    - Southbound Gilcreast Road (right turns and through movements) during the AM and PM peak hours
- NH 102 at Hampton Drive/Garden Lane (Intersection #6)
    - Eastbound NH 102 (left turns) during the AM and PM peak hours
    - Eastbound NH 102 (right turns and through movements) during the AM peak hour
    - Westbound NH 102 (right turns) during the AM and PM peak hours
    - Northbound Hampton Dr. (right turns) during the AM and PM peak hours
    - Southbound Garden Lane (all movements) during the AM and PM peak hours
- NH 102 at I-93 Southbound off-ramp (Exit 4) (Intersection #7)
    - I-93 Southbound off-ramp (all movements) during the AM and PM peak hours
- NH 102 at Fordway/Madden Hill Road (Intersection #10)
    - Eastbound NH 102 (right turns and through movements) during the PM peak hour
    - Westbound NH 102 (all movements) during the AM and PM peak hours
- Connector Roadway and I-93 Southbound on and off-ramp (Exit 4A) (Intersection #11)
    - Westbound Connector Roadway (left turns) during the AM and PM peak hours
    - I-93 Southbound off-ramp (left turns) during the AM peak hour
- Connector Roadway and I-93 Northbound on and off-ramp (Exit 4A) (Intersection #12)
    - Westbound Connector Roadway (right turns) during the AM and PM peak hours
    - I-93 Northbound on-ramp (all movements) during the AM peak hour

The remaining signalized intersections in the traffic study area would provide sufficient storage for the anticipated demand. The lane group in the approach that would operate under unacceptable conditions is highlighted in red in Table 7-5, which contains a comparison between Alternative B and No Build condition queuing results.

1


2 **Figure 7-10. 2040 Build Alternative B AM and PM peak hour LOS by intersection**

Table 7-5. Comparison between Alternative B and No Build condition intersection capacity and queuing analyses

		No Build Condition									Alternative B								
		Turning Bay/ Link Length	AM Peak Hour				PM Peak Hour				Turning Bay/ Link Length	AM Peak Hour				PM Peak Hour			
Intersection	Lane Groups	(feet)	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	(feet)	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS
#1 NH 28 & Symmes Dr/ Vista Ridge Dr (Signalized) [a]	EB L	408	353	0.97	85.5	F	50	0.76	111.3	F	408	299	1.02	93.1	F	58	0.53	48.7	D
	EB TR	729	414	0.51	13.0	B	458	0.81	31.9	C	729	224	0.52	12.7	B	341	0.84	28.5	C
	EB Overall				30.8	C			33.9	C				32.4	C			29.1	C
	WB L	450	40	0.55	71.3	E	154	0.81	74.0	E	450	34	0.94	231.9	F	136	0.83	67.1	E
	WB Thru	1,537	409	0.84	33.8	C	298	0.61	20.4	C	1,537	428	0.85	30.6	C	239	0.66	19.7	B
	WB R	500	137	0.08	19.5	B	31	0.04	14.0	B	500	96	0.07	17.5	B	36	0.03	13.3	B
	WB Overall				32.9	C			26.2	C				32.1	C			24.8	C
	NB LT	1,660	330	0.43	48.5	D	120	0.55	55.5	E	1,660	131	0.44	40.2	D	95	0.45	39.3	D
	NB R	10	#101	0.08	45.4	D	#79	0.02	49.0	D	10	#89	0.07	37.2	D	#70	0.02	35.8	D
	NB Overall				46.5	D			53.3	D				38.3	D			38.1	D
	SB L	270	181	0.93	110.8	F	267	0.84	63.6	E	270	121	0.82	71.2	E	225	0.91	67.8	E
	SB LTR	270	191	0.07	47.1	D	#368	0.39	42.0	D	270	121	0.07	37.5	D	#325	0.32	32.9	C
	SB Overall				**79.0**	**E**			51.9	D				54.5	D			48.5	D
	Intersection Overall			**0.84**	**36.4**	**D**		**0.79**	**34.7**	**C**			**0.84**	**34.3**	**C**		**0.81**	**31.1**	**C**

Table 7-5. Comparison between Alternative B and No Build condition intersection capacity and queuing analyses (continued)

		No Build Condition									Alternative B								
			AM Peak Hour				PM Peak Hour					AM Peak Hour				PM Peak Hour			
Intersection	Lane Groups	Turning Bay/ Link Length (feet)	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	Turning Bay/ Link Length (feet)	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS
#2 NH 28 & I-93 SB On and Off-Ramp (Exit 5) (Signalized) [a]	EB Thru	1,537	#1904	0.97	73.6	E	1243	0.88	39.4	D	1,537	571	0.76	46.2	D	300	0.65	23.8	C
	EB R	350	#546	0.28	0.5	A	#463	0.29	0.5	A	350	284	0.32	0.6	A	-	0.31	0.5	A
	EB Overall				51.1	D			27.9	C				28.9	C			15.7	B
	WB L	592	#632	1.17	111.5	F	280	0.92	20.7	C	592	390	0.89	36.9	D	164	0.71	17.0	B
	WB Thru	592	101	0.44	1.8	A	59	0.32	0.2	A	592	91	0.50	2.7	A	79	0.34	0.3	A
	WB Overall				42.9	D			6.4	A				11.7	B			3.6	A
	SB L	502	492	0.72	44.8	D	406	0.92	48.2	D	502	91	0.14	31.9	C	93	0.23	26.8	C
	SB R	502	#526	1.35	217.5	F	109	0.89	52.5	D	502	268	0.93	67.0	E	35	0.79	41.4	D
	SB Overall				**131.6**	**F**			49.9	D				**59.4**	**E**			37.2	D
	Intersection Overall			**1.17**	**77.0**	**E**		**0.90**	**31.2**	**C**			**0.86**	**28.0**	**C**		**0.70**	**16.9**	**B**
#3 NH 28 & I-93 NB On and Off-Ramp (Exit 5) (Signalized) [a]	EB L	592	#729	1.11	67.9	E	#706	1.07	53.5	D	592	#756	1.04	52.6	D	#610	1.02	48.7	D
	EB Thru	592	#789	0.39	0.6	A	316	0.62	6.1	A	592	481	0.16	2.7	A	212	0.26	3.3	A
	EB Overall				32.0	C			22.5	C				35.7	D			26.6	C
	WB Thru	481	#580	1.05	104.5	F	217	0.91	61.7	E	481	301	1.00	89.2	F	131	0.66	38.3	D
	WB R	481	171	0.56	1.5	A	-	0.38	0.7	A	-	-	0.41	0.8	A	-	0.28	0.4	A
	WB Overall				48.5	D			29.7	C				44.0	D			19.6	B
	NB L	798	685	1.11	128.2	F	337	0.86	47.1	D	798	624	1.04	93.9	F	387	1.01	72.8	E
	NB R	798	349	0.23	39.9	D	213	1.08	98.8	F	798	86	0.20	31.4	C	27	0.73	33.9	C
	NB Overall				**101.9**	**F**			**76.0**	**E**				**77.0**	**E**			52.4	D
	Intersection Overall			**1.10**	**51.7**	**D**		**1.04**	**37.7**	**D**			**1.03**	**50.2**	**D**		**0.93**	**33.9**	**C**

Table 7-5. Comparison between Alternative B and No Build condition intersection capacity and queuing analyses (continued)

		No Build Condition									Alternative B								
			AM Peak Hour				PM Peak Hour					AM Peak Hour				PM Peak Hour			
Intersection	Lane Groups	Turning Bay/ Link Length (feet)	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	Turning Bay/ Link Length (feet)	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS
#4 NH 28 &	EB L	225	79	0.51	42.4	D	50	0.49	30.6	C	225	46	0.54	40.2	D	32	0.60	42.3	D
Liberty Dr	EB TR	841	46	0.13	3.9	A	116	0.47	8.8	A	841	26	0.07	4.1	A	71	0.33	8.6	A
(Signalized) [a]	EB Overall				10.7	B			9.9	A				10.6	B			10.2	B
	WB L	250	19	0.29	51.2	D	17	0.22	31.7	C	250	18	0.23	37.1	D	15	0.16	22.3	C
	WB TR	332	178	0.52	8.5	A	88	0.27	8.7	A	332	114	0.43	6.2	A	71	0.24	8.3	A
	WB Overall				8.7	A			9.0	A				6.4	A			8.5	A
	NB L	154	51	0.29	41.6	D	52	0.14	21.4	C	154	24	0.05	30.1	C	43	0.14	16.2	B
	NB Overall				41.6	D			21.4	C				30.1	C			16.2	B
	SB LT	100	29	0.15	40.6	D	38	0.17	21.6	C	100	22	0.10	30.6	C	26	0.10	16.0	B
	SB R	502	96	0.07	39.7	D	97	0.10	21.1	C	502	81	0.05	30.3	C	83	0.08	15.9	B
	SB Overall				39.8	D			21.2	C				30.4	C			15.9	B
	Intersection Overall			**0.50**	**11.3**	**B**		**0.43**	**11.2**	**B**			**0.41**	**8.4**	**A**		**0.30**	**10.5**	**B**

Table 7-5. Comparison between Alternative B and No Build condition intersection capacity and queuing analyses (continued)

		No Build Condition									Alternative B								
		Turning Bay/ Link Length (feet)	AM Peak Hour				PM Peak Hour				Turning Bay/ Link Length (feet)	AM Peak Hour				PM Peak Hour			
Intersection	Lane Groups		95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS		95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS
#5 NH 102 & Gilcreast Rd (Signalized) [a]	EB L	275	255	1.00	117.3	F	#345	1.24	193.4	F	275	#276	0.92	99.0	F	#338	1.21	191.8	F
	EB RT	852	373	1.10	88.9	F	386	0.81	35.9	D	852	373	1.04	71.3	E	373	0.65	31.5	C
	EB Overall				**91.5**	**F**			**60.6**	**E**				**74.4**	**E**			**60.9**	**E**
	WB L	275	86	0.78	53.7	D	135	0.79	32.0	C	275	84	0.60	40.9	D	134	0.65	39.8	D
	WB Thru	669	150	0.97	33.7	C	266	1.27	134.1	F	669	142	0.88	21.4	C	201	1.13	73.4	E
	WB R	225	40	0.06	24.2	C	117	0.14	0.2	A	225	26	0.05	6.4	A	60	0.15	1.0	A
	WB Overall				34.9	C			**111.7**	**F**				22.2	C			**64.4**	**E**
	NB LT	488	#610	1.16	155.1	F	#567	1.29	200.5	F	488	#539	1.09	147.7	F	#600	1.18	176.6	F
	NB R	488	#598	0.63	47.0	D	#682	0.19	32.8	C	488	464	0.63	59.0	E	#586	0.19	42.0	D
	NB Overall				**100.5**	**F**			**144.8**	**F**				**101.1**	**F**			**129.3**	**F**
	SB L	356	#442	1.13	142.9	F	314	0.95	114.4	F	356	#431	1.07	133.8	F	273	1.00	152.9	F
	SBT	356	#483	0.53	47.3	D	#433	0.97	116.8	F	356	#478	0.43	56.2	E	#385	1.12	187.0	F
	SB R	225	#291	0.35	45.0	D	#303	0.55	49.0	D	225	#287	0.40	56.0	E	#250	1.03	128.0	F
	SB Overall				**87.6**	**F**			**83.2**	**F**				**89.5**	**F**			**146.1**	**F**
	Intersection Overall			**1.14**	**76.3**	**E**		**1.24**	**94.0**	**F**			**1.06**	**65.4**	**E**		**1.15**	**78.4**	**E**

Table 7-5. Comparison between Alternative B and No Build condition intersection capacity and queuing analyses (continued)

		No Build Condition									Alternative B								
		Turning Bay/ Link Length	AM Peak Hour				PM Peak Hour				Turning Bay/ Link Length	AM Peak Hour				PM Peak Hour			
Intersection	Lane Groups	(feet)	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	(feet)	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS
#6 NH 102 & Hampton Dr/Garden Ln (Signalized) [a]	EB L	275	179	0.58	61.3	E	242	1.08	125.2	F	275	#282	0.74	84.8	F	#325	1.18	192.5	F
	EB TR	669	615	1.00	14.9	B	239	0.76	18.9	B	669	#762	0.97	12.3	B	384	0.64	18.7	B
	EB Overall				17.6	B			42.7	D				20.9	C			**70.4**	**E**
	WB L	275	62	0.47	62.2	E	182	0.61	51.4	D	275	72	0.47	78.8	E	198	0.60	67.7	E
	WB Thru	715	221	0.55	16.9	B	367	0.99	44.7	D	715	326	0.56	35.9	D	450	1.08	86.6	F
	WB R	275	133	0.22	20.4	C	#329	0.81	26.1	C	275	#314	0.55	31.6	C	#340	1.12	86.0	F
	WB Overall				19.3	B			39.9	D				35.6	D			**85.4**	**F**
	NB LT	630	78	0.28	56.2	E	175	0.77	84.4	F	630	95	0.29	72.6	E	196	0.76	104.3	F
	NB R	100	#110	0.11	47.0	D	#137	0.06	51.5	D	100	#115	0.06	61.3	E	#138	0.05	66.3	E
	NB Overall				49.5	D			**70.1**	**E**				**64.4**	**E**			**87.7**	**F**
	SB L	175	#258	0.91	92.2	F	#242	1.02	104.3	F	175	#249	0.86	79.6	E	#234	0.89	70.4	E
	SB LT	291	#374	0.93	96.9	F	#323	1.00	99.1	F	291	#352	0.84	76.9	E	#325	0.90	71.5	E
	SB R	175	#266	0.10	34.2	C	#210	0.79	59.4	E	175	#278	0.27	33.4	C	#215	0.89	70.8	E
	SB Overall				**77.5**	**E**			**84.5**	**F**				**64.5**	**E**			**70.9**	**E**
	Intersection Overall			**0.92**	**24.9**	**C**		**0.99**	**49.9**	**D**			**0.90**	**32.7**	**C**		**1.10**	**78.1**	**E**

Table 7-5. Comparison between Alternative B and No Build condition intersection capacity and queuing analyses (continued)

		No Build Condition										Alternative B									
		Turning Bay/ Link Length	AM Peak Hour				PM Peak Hour				Turning Bay/ Link Length	AM Peak Hour				PM Peak Hour			
Intersection	Lane Groups	(feet)	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	(feet)	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS
#7 NH 102 & I-93 SB Off-Ramp (Exit 4) (Signalized) [a]	EB Thru	895	540	1.06	53.2	D	565	1.12	87.4	F	895	760	0.93	25.8	C	590	0.86	31.0	C
	EB Overall				53.2	D			**87.4**	**F**				25.8	C			31.0	C
	WB Thru	1,057	193	0.58	13.4	B	420	1.26	146.7	F	1,057	256	0.56	22.5	C	287	1.08	40.7	D
	WB Overall				13.4	B			**146.7**	**F**				22.5	C			40.7	D
	SB L	138	#203	1.10	81.8	F	#205	1.20	116.3	F	138	#215	0.54	17.4	B	#219	0.46	25.3	C
	SB R	138	#167	0.84	21.4	C	#192	1.09	72.2	E	138	#238	0.94	35.4	D	#248	1.10	96.5	F
	SB Overall				50.8	D			**91.7**	**F**				30.1	C			**80.1**	**F**
	Intersection Overall			**1.08**	**44.5**	**D**		**1.22**	**106.4**	**F**			**0.93**	**26.8**	**C**		**1.09**	**53.9**	**D**
#8 NH 102 & I-93 NB On and Off-Ramp (Exit 4) (Signalized) [a]	EB L	550	529	1.11	85.6	F	475	1.20	127.6	F	550	468	1.01	50.8	D	486	1.19	124.3	F
	EB Thru	1,057	238	0.37	5.7	A	357	0.69	21.2	C	1,057	112	0.10	8.9	A	257	0.26	8.1	A
	EB Overall				50.9	D			**69.9**	**E**				44.5	D			**92.5**	**F**
	WB Thru	1,462	767	1.07	82.8	F	266	0.77	51.8	D	1,462	612	0.95	74.3	E	201	0.56	60.3	E
	WB R	786	#1006	0.78	3.9	A	230	0.54	1.3	A	786	378	0.35	0.6	A	38	0.23	0.3	A
	WB Overall				45.6	D			22.0	C				46.4	D			29.4	C
	NB L	1,440	496	1.14	137.6	F	897	1.21	140.7	F	1,440	345	1.02	106.5	F	913	1.18	133.8	F
	NB R	1,440	231	1.08	122.3	F	937	1.26	163.5	F	1,440	179	0.63	61.2	E	995	0.81	44.6	D
	NB Overall				**130.9**	**F**			**151.2**	**F**				**91.3**	**F**			**101.9**	**F**
	Intersection Overall			**1.10**	**61.4**	**E**		**1.12**	**92.8**	**F**			**0.99**	**54.8**	**D**		**1.06**	**88.0**	**F**

Table 7-5. Comparison between Alternative B and No Build condition intersection capacity and queuing analyses (continued)

Intersection	Lane Groups	No Build Condition: Turning Bay/ Link Length (feet)	No Build AM Peak Hour: 95% queue (ft)	No Build AM: v/c ratio	No Build AM: Average Delay (sec/veh)	No Build AM: LOS	No Build PM Peak Hour: 95% queue (ft)	No Build PM: v/c ratio	No Build PM: Average Delay (sec/veh)	No Build PM: LOS	Alternative B: Turning Bay/ Link Length (feet)	Alt B AM Peak Hour: 95% queue (ft)	Alt B AM: v/c ratio	Alt B AM: Average Delay (sec/veh)	Alt B AM: LOS	Alt B PM Peak Hour: 95% queue (ft)	Alt B PM: v/c ratio	Alt B PM: Average Delay (sec/veh)	Alt B PM: LOS
#9 NH 102 & St Charles St/ Londonderry Rd (Signalized) [a]	EB L	350	202	0.85	58.1	E	#422	1.31	176.0	F	350	70	0.41	32.3	C	154	0.65	31.3	C
	EB TR	1,462	63	0.27	2.7	A	853	0.49	3.5	A	1,462	56	0.18	3.3	A	165	0.46	7.2	A
	EB Overall				17.4	B			**77.9**	**E**				7.0	A			11.5	B
	WBL	100	44	0.31	59.1	E	25	0.31	59.4	E	100	26	0.26	42.0	D	23	0.26	43.7	D
	WB TR	410	320	0.87	19.0	B	324	1.01	59.5	E	410	180	0.51	7.0	A	205	0.49	14.8	B
	WB Overall				19.1	B			**59.5**	**E**				7.2	A			15.0	B
	NB LTR	-	-	-	-	-	-	-	-	-	400	7	0.12	35.8	D	43	0.06	29.6	C
	NB Overall				0.0	A			0.0	A				35.8	D			29.6	C
	SB LT	780	70	0.23	53.2	D	22	0.21	52.4	D	780	31	0.32	39.8	D	94	0.55	34.8	C
	SB R	225	194	0.17	7.8	A	141	0.20	22.2	C	225	83	0.10	5.0	A	60	0.08	11.9	B
	SB Overall				8.7	A			22.6	C				7.2	A			21.4	C
	Intersection Overall			**0.85**	**17.7**	**B**		**1.16**	**67.5**	**E**			**0.48**	**7.2**	**A**		**0.54**	**14.2**	**B**
#10 NH 102 & Fordway/ Madden Hill Rd (Signalized) [a]	EB TR	455	332	0.73	17.0	B	#734	1.05	55.2	E	455	289	0.64	17.1	B	#529	0.92	29.3	C
	EB Overall				17.0	B			**55.2**	**E**				17.1	B			29.3	C
	WB LT	165	#519	0.91	29.2	C	#535	0.71	12.2	B	165	#418	0.78	21.5	C	#355	0.49	11.3	B
	WB Overall				29.2	C			12.2	B				21.5	C			11.3	B
	NB LR	375	298	0.94	60.4	E	277	1.02	96.3	F	375	266	0.84	34.7	C	254	0.90	54.2	D
	NB Overall				**60.4**	**E**			**96.3**	**F**				34.7	C			54.2	D
	SB LTR	120	40	0.05	21.8	C	61	0.16	30.2	C	120	70	0.16	16.2	B	110	0.36	24.6	C
	SB Overall				21.8	C			30.2	C				16.2	B			24.6	C
	Intersection Overall			**0.92**	**30.8**	**C**		**1.04**	**47.3**	**D**			**0.80**	**23.0**	**C**		**0.91**	**29.1**	**C**

Table 7-5. Comparison between Alternative B and No Build condition intersection capacity and queuing analyses (continued)

		No Build Condition									Alternative B								
		Turning Bay/ Link	AM Peak Hour				PM Peak Hour				Turning Bay/ Link	AM Peak Hour				PM Peak Hour			
Intersection	Lane Groups	Length (feet)	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	Length (feet)	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS
#11 **Connector Rd & I-93 SB On and Off-Ramp (Exit 4A) (Signalized)** [a]	WBL	-	-	-	-	-	-	-	-	-	319	#351	1.02	44.3	D	#344	0.93	40.7	D
	WB Overall				-	-	-	-	-	-				44.3	D			40.7	D
	SB L	-	-	-	-	-	-	-	-	-	525	#578	1.05	57.5	E	505	0.95	30.7	C
	SB Overall				-	-	-	-	-	-				**57.5**	**E**			30.7	C
	Intersection Overall			-	-	-	-	-	-	-			**1.04**	**52.3**	**D**		**0.94**	**34.6**	**C**
#12 **Connector Rd & I-93 NB On and Off-Ramp (Exit 4A) (Signalized)** [a]	EB L	-	-	-	-	-	-	-	-	-	100	-	-	-	-	-	-	-	-
	EB T	-	-	-	-	-	-	-	-	-	319	95	0.96	23.1	C	108	0.90	3.4	A
	EB Overall				-	-			-	-				23.1	C			3.4	A
	WB T	-	-	-	-	-	-	-	-	-	3,359	2873	0.61	14.9	B	251	0.58	14.3	B
	WB R	-	-	-	-	-	-	-	-	-	200	#265	0.82	21.2	C	#257	0.76	18.8	B
	WB Overall				-	-			-	-				18.2	B			16.6	B
	NB LR	-	-	-	-	-	-	-	-	-	467	#568	0.93	55.2	E	370	0.80	36.8	D
	NB R	-	-	-	-	-	-	-	-	-	467	#581	0.99	68.2	E	316	0.84	40.8	D
	NB Overall				-	-			-	-				**61.7**	**E**			38.8	D
	Intersection Overall			-	-	-		-	-	-			**0.97**	**27.5**	**C**		**0.88**	**15.8**	**B**

Notes:

95th percentile volume exceeds capacity, queue may be longer.

EB = Eastbound, WB = Westbound, NB= Northbound, SB = Southbound

LOS = Level of Service

LTR = left / through / right lanes

V/C = Volume-to-Capacity ratio

Delay is Measured in Seconds Per Vehicle.

Red cells denote intersections or approaches operating at unacceptable conditions or denote approaches and lane groups whose queuing length exceeds capacity

[a] Highway Capacity Manual 2000 results (Signalized intersections)

7.8 2040 Build Alternative B Freeway Operations Analysis

Based on the analysis performed using HCS, all freeway facilities would operate below capacity. The one failing freeway facility under the No Build condition would improve to LOS C. This includes the I-93 SB off-ramp to NH 102. The NH 102 on-ramp to I-93 NB would operate above capacity potentially creating a queue into the NH 102 mainline. Table 7-6 contains the Exit 4 Alternative B freeway analysis compared to the No Build condition, and Table 7-7 contains the Exit 5 Alternative B freeway analysis compared to the No Build condition. Table 7-8 contains the Exit 4A Alternative B freeway analysis. Appendix M contains the Build condition HCS freeway operation reports.

Table 7-6. I-93 Exit 4 2040 Build Alternative B freeway analysis compared to the No Build condition

Freeway Analysis	Facility Type	Time Period	Demand to Capacity Ratio		Density (pc/mi/ln)	Alt B LOS	No Build LOS
			Freeway	Ramp			
I-93 Northbound to NH 102	Diverge	AM	0.38	0.23	0.0	A	A
		PM	0.66	0.67	14.5	B	B
NH 102 to I-93 Northbound	Merge	AM	0.53	1.03[a]	20.8	C	C
		PM	0.60	0.81	21.9	C	C
I-93 Southbound to NH 102	Diverge	AM	0.58	0.81	26.1	C	C
		PM	0.55	0.98	27.5	C	F
NH 102 Westbound to I-93 Southbound	Merge	AM	0.50	0.39	14.2	B	B
		PM	0.40	0.18	9.4	A	B
NH 102 Eastbound to I-93 Southbound	Merge	AM	0.69	0.92	25.6	C	C
		PM	0.49	0.45	15.1	B	B

Notes: LOS = Level of Service; Density = Passenger cars per mile per lane (pc/mi/ln)

Red denotes interstate facilities that would result in failing operations and would produce a queue extending to the I-93 mainline.

[a] The capacity of the on-ramp exceeds the demand; therefore, the ramp would produce a queue extending to NH 102.

Table 7-7. I-93 Exit 5 2040 Build Alternative B freeway analysis compared to the No Build condition

Freeway Analysis	Facility Type	Time Period	Demand to Capacity Ratio		Density (pc/mi/ln)	Alt B LOS	No Build LOS
			Freeway	Ramp			
I-93 Northbound to NH 28	Diverge	AM	0.56	0.41	23.6	C	C
		PM	0.63	0.54	28.2	D	C
NH 28 to I-93 Northbound	Merge	AM	0.64	0.65	24.4	C	C
		PM	0.65	0.48	24.6	C	C
I-93 Southbound to NH 28	Diverge	AM	0.63	0.32	23.5	C	D
		PM	0.62	0.33	23.2	C	D
NH 28 to I-93 Southbound	Merge	AM	0.66	0.40	20.0	B	C
		PM	0.63	0.34	18.6	B	C

Notes: LOS = Level of Service; Density = Passenger cars per mile per lane (pc/mi/ln)

Table 7-8. I-93 Exit 4A 2040 Build Alternative B freeway analysis

Freeway Analysis	Facility Type	Time Period	Demand to Capacity Ratio		Density (pc/mi/ln)	LOS
			Freeway	Ramp		
I-93 Northbound to Connector Roadway	Diverge	AM	0.52	0.52	23.2	C
		PM	0.59	0.44	23.2	C
Connector Roadway to I-93 Northbound	Merge	AM	0.59	0.73	22.7	C
		PM	0.63	0.62	24.1	C
I-93 Southbound to Connector Roadway	Diverge	AM	0.65	0.55	16.6	B
		PM	0.62	0.46	13.5	B
Connector Roadway to I-93 Southbound	Merge	AM	0.60	0.70	24.7	C
		PM	0.57	0.58	22.5	C

Notes: LOS = Level of Service; Density = Passenger cars per mile per lane (pc/mi/ln)

7.9 2040 Build Alternative C Intersection Operations Analysis

Based on the Synchro™ signalized intersection analysis results, three signalized intersections (Intersections #5, #7, and #8) would operate at unacceptable conditions (LOS E or LOS F) during the AM or PM peak hours. The remaining signalized intersections in the traffic study area would operate at acceptable overall conditions (LOS D or better is considered an operating level) during the peak hours analyzed (weekday AM and PM peak hours).

Based on the Synchro™ signalized intersection analysis results, six study area signalized intersections have overall approaches that would operate at unacceptable conditions (LOS E or LOS F) during one or two evaluated periods. The following are the individual signalized intersection approaches in the traffic study area that would operate under unacceptable conditions during peak hours:

- NH 28 at I-93 Northbound on and off-ramp (Exit 5) (Intersection #3)
  - I-93 Northbound off-ramp during the AM peak hour
- NH 102 at Gilcreast Road (Intersection #5)
  - Eastbound NH 102 during the AM and PM peak hours
  - Westbound NH 102 during the PM peak hour
  - Northbound Gilcreast Road during the AM and PM peak hours
  - Southbound NH 102 during the AM and PM peak hours
- NH 102 at Hampton Drive/Garden Lane (Intersection #6)
  - Northbound Hampton Drive during the AM and PM peak hours
  - Southbound Garden Lane during the AM and PM peak hours
- NH 102 at I-93 Southbound off-ramp (Exit 4) (Intersection #7)
  - I-93 Southbound off-ramp during the PM peak hour
- NH 102 at I-93 Northbound on and off-ramp (Exit 4) (Intersection #8)
  - Eastbound NH 102 during the PM peak hour
  - Westbound NH 102 during the AM peak hour
  - I-93 Northbound off-ramp during the AM and PM peak hours
- NH 102 at Fordway/Madden Hill Road (Intersection #10)
  - Northbound Fordway during the PM peak hour

The overall Alternative C intersection LOS grades are depicted in Figure 7-11 for AM and PM peak hours. Table 7-9 shows the comparison between Alternative C and No Build condition LOS capacity analysis and the intersection vehicle delay results during the AM and PM peak hours. Appendices G, H, and I contain the Synchro™ Build condition intersection analysis reports.

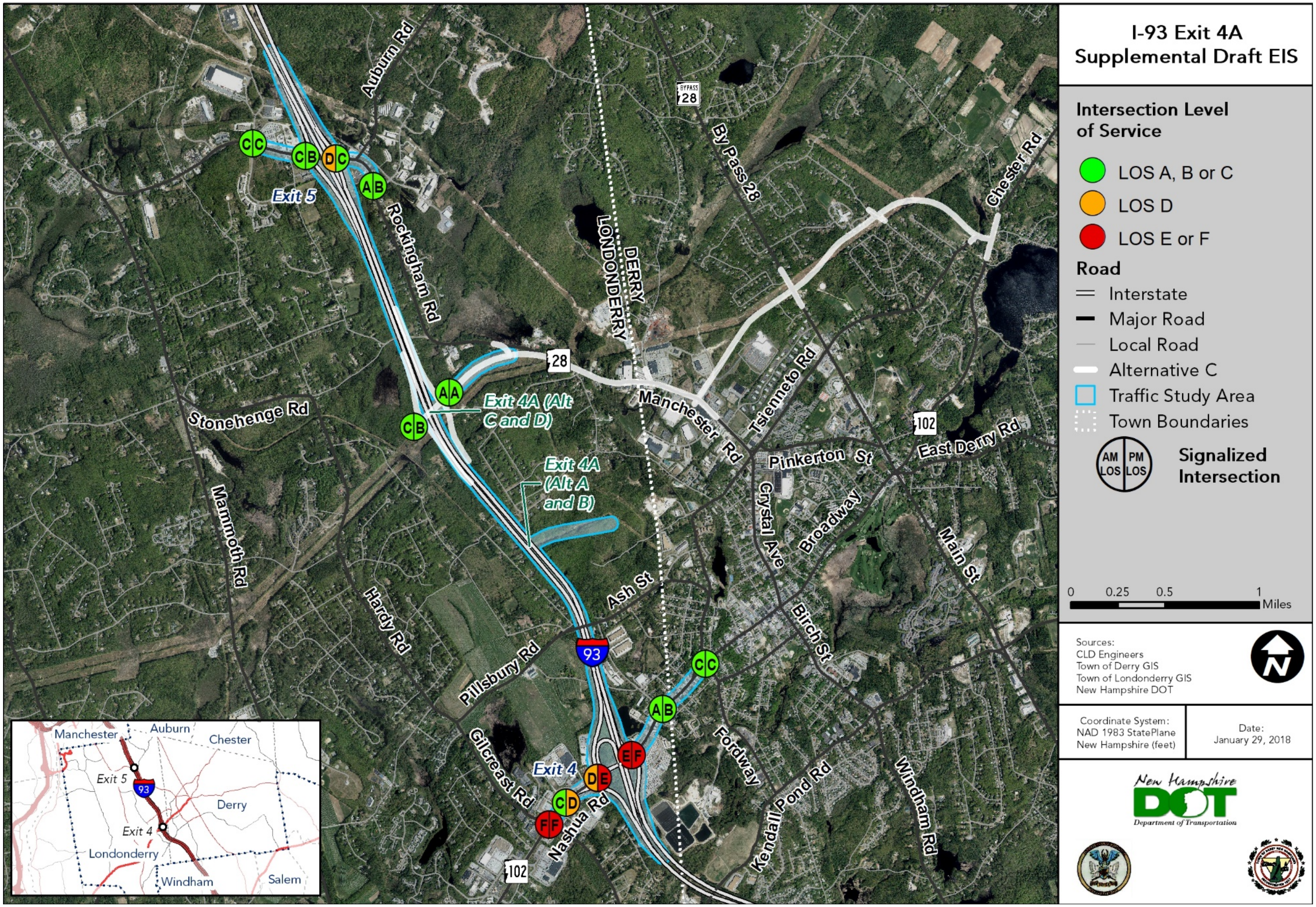
7.10 2040 Build Alternative C Queuing Analysis

Based on the Synchro™ signalized intersection analysis results, seven signalized intersections within the study area, would experience queuing lengths that would exceed the available storage capacity. Intersections #2, #4, #8, #9, and #11 would provide sufficient storage for the anticipated demand. The lane group in the approach that would operate under unacceptable conditions is noted in parentheses. Table 7-9 contains the queuing results. Appendices J, K, and L contain the Synchro™ Build condition intersection queuing reports.

- NH 28 at Symmes Drive/Vista Ridge Drive (Intersection #1)
  - Northbound Vista Ridge Drive (right turns) during the AM and the PM peak hours
- NH 28 at I-93 Northbound on and off-ramp (Exit 5) (Intersection #3)

    - Eastbound NH 28 (left turns) during the AM peak hour
- NH 102 at Gilcreast Road (Intersection #5)
    - Eastbound NH 102 (left turns) during the PM peak hour
    - Northbound Gilcreast Road (all movements) during the AM and PM peak hours
    - Southbound Gilcreast Road (all movements) during the AM and PM peak hours
- NH 102 at Hampton Drive/Garden Lane (Intersection #6)
    - Eastbound NH 102 (left turns) during the PM peak hour
    - Eastbound NH 102 (right turns and through movements) during the AM peak hour
    - Westbound NH 102 (right turns) during the PM peak hour
    - Northbound Hampton Drive (right turns) during the AM and PM peak hours
    - Southbound Garden Lane (all movements) during the AM and PM peak hours
- NH 102 at I-93 Southbound off-ramp (Exit 4) (Intersection #7)
    - I-93 Southbound off-ramp (right turns) during the AM ad PM peak hours
- NH 102 at Fordway/Madden Hill Road (Intersection #10)
    - Eastbound NH 102 (all movements) during the PM peak hour
    - Westbound NH 102 (all movements) during the AM and PM peak hours
- Connector Roadway and I-93 Northbound on and off-ramp (Exit 4A) (Intersection #12)
    - Westbound Connector Roadway (right turns) during the AM and PM peak hours

The remaining signalized intersections in the traffic study area would provide sufficient storage for the anticipated demand. The lane group in the approach that would operate under unacceptable conditions is highlighted in red in Table 7-9, which contains a comparison between Alternative C and No Build condition queuing results.

1


2 **Figure 7-11. 2040 Build Alternative C AM and PM peak hour LOS by intersection**

Table 7-9. Comparison between Alternative C and No Build condition intersection capacity and queuing analyses

		No Build Condition									Alternative C								
		Turning Bay/ Link Length (feet)	AM Peak Hour				PM Peak Hour				Turning Bay/ Link Length (feet)	AM Peak Hour				PM Peak Hour			
Intersection	Lane Groups		95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS		95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS
#1 NH 28 & Symmes Dr/ Vista Ridge Dr (Signalized) [a]	EB L	408	353	0.97	85.5	F	50	0.76	111.3	F	408	270	0.95	75.0	E	48	0.53	48.6	D
	EB TR	729	414	0.51	13.0	B	458	0.81	31.9	C	729	208	0.49	12.3	B	280	0.77	25.6	C
	EB Overall				30.8	C			33.9	C				27.6	C			26.3	C
	WB L	450	40	0.55	71.3	E	154	0.81	74.0	E	450	29	0.88	203.0	F	130	0.81	61.5	E
	WB Thru	1,537	409	0.84	33.8	C	298	0.61	20.4	C	1,537	356	0.83	29.4	C	241	0.64	19.1	B
	WB R	500	137	0.08	19.5	B	31	0.04	14.0	B	500	84	0.07	17.4	B	45	0.03	13.1	B
	WB Overall				32.9	C			26.2	C				30.5	C			23.6	C
	NB LT	1,660	330	0.43	48.5	D	120	0.55	55.5	E	1,660	130	0.43	40.1	D	90	0.45	38.8	D
	NB R	10	#101	0.08	45.4	D	#79	0.02	49.0	D	10	#90	0.07	37.2	D	#63	0.02	35.5	D
	NB Overall				46.5	D			53.3	D				38.3	D			37.8	D
	SB L	270	181	0.93	110.8	F	267	0.84	63.6	E	270	108	0.77	62.3	E	175	0.84	55.6	E
	SB LTR	270	191	0.07	47.1	D	#368	0.39	42.0	D	270	114	0.06	37.4	D	267	0.31	32.6	C
	SB Overall				**79.0**	**E**			51.9	D				49.9	D			42.5	D
	Intersection Overall			**0.84**	**36.4**	**D**		**0.79**	**34.7**	**C**			**0.81**	**31.2**	**C**		**0.76**	**28.4**	**C**

Table 7-9. Comparison between Alternative C and No Build condition intersection capacity and queuing analyses (continued)

		No Build Condition									Alternative C								
		Turning Bay/ Link Length	AM Peak Hour				PM Peak Hour				Turning Bay/ Link Length	AM Peak Hour				PM Peak Hour			
Intersection	Lane Groups	(feet)	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	(feet)	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS
#2 NH 28 & I-93 SB On and Off-Ramp (Exit 5) (Signalized) [a]	EB Thru	1,537	#1904	0.97	73.6	E	1243	0.88	39.4	D	1,537	492	0.69	39.0	D	244	0.53	21.9	C
	EB R	350	#546	0.28	0.5	A	#463	0.29	0.5	A	350	224	0.36	0.7	A	57	0.35	0.6	A
	EB Overall				51.1	D			27.9	C				21.8	C			12.9	B
	WB L	592	#632	1.17	111.5	F	280	0.92	20.7	C	592	327	0.89	32.5	C	167	0.69	17.3	B
	WB Thru	592	101	0.44	1.8	A	59	0.32	0.2	A	592	75	0.50	1.7	A	91	0.33	0.4	A
	WB Overall				42.9	D			6.4	A				10.3	B			3.9	A
	SB L	502	492	0.72	44.8	D	406	0.92	48.2	D	502	75	0.15	28.7	C	108	0.24	27.7	C
	SB R	502	#526	1.35	217.5	F	109	0.89	52.5	D	502	170	0.91	59.9	E	-	0.74	38.8	D
	SB Overall				**131.6**	**F**			49.9	D				52.9	D			35.3	D
	Intersection Overall			**1.17**	**77.0**	**E**		**0.90**	**31.2**	**C**			**0.83**	**22.9**	**C**		**0.62**	**15.0**	**B**
#3 NH 28 & I-93 NB On and Off-Ramp (Exit 5) (Signalized) [a]	EB L	592	#729	1.11	67.9	E	#706	1.07	53.5	D	592	#661	1.03	50.8	D	508	0.91	27.2	C
	EB Thru	592	#789	0.39	0.6	A	316	0.62	6.1	A	592	321	0.12	1.6	A	106	0.21	3.6	A
	EB Overall				32.0	C			22.5	C				36.3	D			16.3	B
	WB Thru	481	#580	1.05	104.5	F	217	0.91	61.7	E	481	302	0.96	69.8	E	140	0.75	41.8	D
	WB R	481	171	0.56	1.5	A	-	0.38	0.7	A	-	-	0.25	0.4	A	-	0.16	0.2	A
	WB Overall				48.5	D			29.7	C				44.6	D			27.8	C
	NB L	798	685	1.11	128.2	F	337	0.86	47.1	D	798	493	1.04	88.9	F	303	0.91	49.0	D
	NB R	798	349	0.23	39.9	D	213	1.08	98.8	F	798	65	0.14	27.6	C	41	0.56	27.3	C
	NB Overall				**101.9**	**F**			**76.0**	**E**				**71.9**	**E**			37.4	D
	Intersection Overall			**1.10**	**51.7**	**D**		**1.04**	**37.7**	**D**			**1.02**	**49.9**	**D**		**0.87**	**27.7**	**C**

Table 7-9. Comparison between Alternative C and No build condition intersection capacity and queuing analyses (continued)

		No Build Condition									**Alternative C**								
		Turning Bay/ Link Length	AM Peak Hour				PM Peak Hour				Turning Bay/ Link Length	AM Peak Hour				PM Peak Hour			
Intersection	Lane Groups	(feet)	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	(feet)	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS
#4 NH 28 & Liberty	EB L	225	79	0.51	42.4	D	50	0.49	30.6	C	225	39	0.42	31.8	C	32	0.51	30.6	C
Dr (Signalized) [a]	EB TR	841	46	0.13	3.9	A	116	0.47	8.8	A	841	20	0.06	4.5	A	58	0.29	8.4	A
	EB Overall				10.7	B			9.9	A				9.4	A			9.5	A
	WB L	250	19	0.29	51.2	D	17	0.22	31.7	C	250	21	0.23	33.1	C	13	0.16	22.2	C
	WB TR	332	178	0.52	8.5	A	88	0.27	8.7	A	332	87	0.38	6.5	A	50	0.20	8.1	A
	WB Overall				8.7	A			9.0	A				6.7	A			8.4	A
	NB L	154	51	0.29	41.6	D	52	0.14	21.4	C	154	17	0.04	26.1	C	42	0.14	16.2	B
	NB Overall				41.6	D			21.4	C				26.1	C			16.2	B
	SB LT	100	29	0.15	40.6	D	38	0.17	21.6	C	100	21	0.07	26.4	C	22	0.09	16.0	B
	SB R	502	96	0.07	39.7	D	97	0.10	21.1	C	502	75	0.05	26.2	C	67	0.06	15.8	B
	SB Overall				39.8	D			21.2	C				26.2	C			15.8	B
	Intersection Overall			**0.50**	**11.3**	**B**		**0.43**	**11.2**	**B**			**0.36**	**8.2**	**A**		**0.27**	**10.1**	**B**

Table 7-9. Comparison between Alternative C and No Build condition intersection capacity and queuing analyses (continued)

		No Build Condition									Alternative C								
			AM Peak Hour				PM Peak Hour					AM Peak Hour				PM Peak Hour			
Intersection	Lane Groups	Turning Bay/ Link Length (feet)	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	Turning Bay/ Link Length (feet)	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS
#5 NH 102 &	EB L	275	255	1.00	117.3	F	#345	1.24	193.4	F	275	262	1.02	134.8	F	#338	1.26	207.4	F
Gilcreast Rd	EB RT	852	373	1.10	88.9	F	386	0.81	35.9	D	852	390	1.08	91.7	F	387	0.78	37.5	D
(Signalized) [a]	EB Overall				**91.5**	**F**			**60.6**	**E**				**95.7**	**F**			**65.0**	**E**
	WB L	275	86	0.78	53.7	D	135	0.79	32.0	C	275	104	0.82	62.3	E	133	0.80	38.2	D
	WB Thru	669	150	0.97	33.7	C	266	1.27	134.1	F	669	156	1.05	51.7	D	261	1.26	131.6	F
	WB R	225	40	0.06	24.2	C	117	0.14	0.2	A	225	63	0.07	1.0	A	138	0.17	0.6	A
	WB Overall				34.9	C			**111.7**	**F**				49.4	D			**110.4**	**F**
	NB LT	488	#610	1.16	155.1	F	#567	1.29	200.5	F	488	#625	1.08	135.1	F	#551	1.29	210.0	F
	NB R	488	#598	0.63	47.0	D	#682	0.19	32.8	C	488	#642	0.67	57.5	E	#681	0.23	37.1	D
	NB Overall				**100.5**	**F**			**144.8**	**F**				**96.0**	**F**			**154.2**	**F**
	SB L	356	#442	1.13	142.9	F	314	0.95	114.4	F	356	#418	1.07	130.5	F	#419	1.13	183.4	F
	SBT	356	#483	0.53	47.3	D	#433	0.97	116.8	F	356	#485	0.49	56.5	E	#440	1.20	207.7	F
	SB R	225	#291	0.35	45.0	D	#303	0.55	49.0	D	225	#309	0.48	56.4	E	#299	0.73	67.5	E
	SB Overall				**87.6**	**F**			**83.2**	**F**				**88.3**	**F**			**133.0**	**F**
	Intersection Overall			**1.14**	**76.3**	**E**		**1.24**	**94.0**	**F**			**1.10**	**80.8**	**F**		**1.26**	**101.6**	**F**

Table 7-9. Comparison between Alternative C and No Build condition intersection capacity and queuing analyses (continued)

		No Build Condition									Alternative C								
			AM Peak Hour				PM Peak Hour					AM Peak Hour				PM Peak Hour			
Intersection	Lane Groups	Turning Bay/ Link Length (feet)	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	Turning Bay/ Link Length (feet)	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS
#6 NH 102 & Hampton Dr/Garden Ln (Signalized) [a]	EB L	275	179	0.58	61.3	E	242	1.08	125.2	F	275	259	0.62	76.0	E	#306	1.04	127.9	F
	EB TR	669	615	1.00	14.9	B	239	0.76	18.9	B	669	#804	0.93	10.7	B	515	0.69	14.1	B
	EB Overall				17.6	B			42.7	D				14.4	B			40.7	D
	WB L	275	62	0.47	62.2	E	182	0.61	51.4	D	275	88	0.66	89.3	F	238	0.66	61.2	E
	WB Thru	715	221	0.55	16.9	B	367	0.99	44.7	D	715	295	0.58	24.9	C	423	0.99	47.0	D
	WB R	275	133	0.22	20.4	C	#329	0.81	26.1	C	275	150	0.25	18.0	B	#344	0.86	26.7	C
	WB Overall				19.3	B			39.9	D				26.0	C			42.3	D
	NB LT	630	78	0.28	56.2	E	175	0.77	84.4	F	630	107	0.35	74.8	E	274	0.95	132.4	F
	NB R	100	#110	0.11	47.0	D	#137	0.06	51.5	D	100	#120	0.25	63.3	E	#155	0.06	61.5	E
	NB Overall				49.5	D			**70.1**	**E**				**66.4**	**E**			**102.8**	**F**
	SB L	175	#258	0.91	92.2	F	#242	1.02	104.3	F	175	#225	0.77	77.7	E	#219	0.98	98.8	F
	SB LT	291	#374	0.93	96.9	F	#323	1.00	99.1	F	291	#333	0.79	79.8	E	#317	0.98	97.9	F
	SB R	175	#266	0.10	34.2	C	#210	0.79	59.4	E	175	#237	0.18	43.0	D	#211	0.92	85.0	F
	SB Overall				**77.5**	**E**			**84.5**	**F**				**68.6**	**E**			**92.7**	**F**
	Intersection Overall			**0.92**	**24.9**	**C**		**0.99**	**49.9**	**D**			**0.87**	**25.1**	**C**		**1.00**	**53.0**	**D**

Table 7-9. Comparison between Alternative C and No Build condition intersection capacity and queuing analyses (continued)

		No Build Condition									Alternative C								
		Turning Bay/ Link Length	AM Peak Hour				PM Peak Hour				Turning Bay/ Link Length	AM Peak Hour				PM Peak Hour			
Intersection	Lane Groups	(feet)	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	(feet)	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS
#7 NH 102 & I-93 SB Off-Ramp (Exit 4) (Signalized) [a]	EB Thru	895	540	1.06	53.2	D	565	1.12	87.4	F	895	742	0.98	32.0	C	841	0.95	39.6	D
	EB Overall				53.2	D			**87.4**	**F**				32.0	C			39.6	D
	WB Thru	1,057	193	0.58	13.4	B	420	1.26	146.7	F	1,057	174	0.56	20.0	B	340	1.09	45.0	D
	WB Overall				13.4	B			**146.7**	**F**				20.0	B			45.0	D
	SB L	138	#203	1.10	81.8	F	#205	1.20	116.3	F	138	117	0.16	13.9	B	118	0.14	18.4	B
	SB R	138	#167	0.84	21.4	C	#192	1.09	72.2	E	138	#215	1.02	55.4	E	#220	1.09	89.1	F
	SB Overall				50.8	D			**91.7**	**F**				51.2	D			**83.0**	**F**
	Intersection Overall			**1.08**	**44.5**	**D**		**1.22**	**106.4**	**F**			**1.00**	**36.1**	**D**		**1.09**	**57.2**	**E**
#8 NH 102 & I-93 NB On and Off-Ramp (Exit 4) (Signalized) [a]	EB L	550	529	1.11	85.6	F	475	1.20	127.6	F	550	404	1.03	48.2	D	286	1.15	96.4	F
	EB Thru	1,057	238	0.37	5.7	A	357	0.69	21.2	C	1,057	41	0.04	8.0	A	54	0.17	2.7	A
	EB Overall				50.9	D			**69.9**	**E**				45.2	D			**76.4**	**E**
	WB Thru	1,462	767	1.07	82.8	F	266	0.77	51.8	D	1,462	717	1.00	79.9	E	253	0.70	59.6	E
	WB R	786	#1006	0.78	3.9	A	230	0.54	1.3	A	786	291	0.26	0.4	A	-	0.17	0.2	A
	WB Overall				45.6	D			22.0	C				**58.1**	**E**			38.0	D
	NB L	1,440	496	1.14	137.6	F	897	1.21	140.7	F	1,440	431	1.04	114.7	F	1008	1.14	114.5	F
	NB R	1,440	231	1.08	122.3	F	937	1.26	163.5	F	1,440	237	0.85	76.8	E	989	1.02	76.0	E
	NB Overall				**130.9**	**F**			**151.2**	**F**				**99.6**	**F**			**98.3**	**F**
	Intersection Overall			**1.10**	**61.4**	**E**		**1.12**	**92.8**	**F**			**1.02**	**62.1**	**E**		**1.05**	**82.0**	**F**

Table 7-9. Comparison between Alternative C and No Build condition intersection capacity and queuing analyses (continued)

		No Build Condition									Alternative C								
		Turning Bay/ Link Length	AM Peak Hour				PM Peak Hour				Turning Bay/ Link Length	AM Peak Hour				PM Peak Hour			
Intersection	Lane Groups	(feet)	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	(feet)	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS
#9 NH 102 & St Charles St/ Londonderry Rd (Signalized) [a]	EB L	350	202	0.85	58.1	E	#422	1.31	176.0	F	350	107	0.57	34.2	C	216	0.71	31.0	C
	EB TR	1,462	63	0.27	2.7	A	853	0.49	3.5	A	1,462	57	0.19	3.3	A	139	0.43	5.6	A
	EB Overall				17.4	B			**77.9**	**E**				8.9	A			11.2	B
	WBL	100	44	0.31	59.1	E	25	0.31	59.4	E	100	28	0.25	41.1	D	18	0.26	42.7	D
	WB TR	410	320	0.87	19.0	B	324	1.01	59.5	E	410	172	0.52	7.7	A	178	0.49	14.3	B
	WB Overall				19.1	B			**59.5**	**E**				7.9	A			14.4	B
	NB LTR	-	-	-	-	-	-	-	-	-	400	-	-	-	-	52	0.05	31.9	C
	NB Overall				0.0	A			0.0	A				0.0	A			31.9	C
	SB LT	780	70	0.23	53.2	D	22	0.21	52.4	D	780	31	0.35	41.2	D	37	0.15	32.5	C
	SB R	225	194	0.17	7.8	A	141	0.20	22.2	C	225	88	0.12	5.5	A	79	0.14	11.8	B
	SB Overall				8.7	A			22.6	C				7.5	A			13.1	B
	Intersection Overall			**0.85**	**17.7**	**B**		**1.16**	**67.5**	**E**			**0.52**	**8.2**	**A**		**0.53**	**13.1**	**B**
#10 NH 102 & Fordway/ Madden Hill Rd (Signalized) [a]	EB TR	455	332	0.73	17.0	B	#734	1.05	55.2	E	455	374	0.68	17.9	B	#550	0.92	28.6	C
	EB Overall				17.0	B			**55.2**	**E**				17.9	B			28.6	C
	WB LT	165	#519	0.91	29.2	C	#535	0.71	12.2	B	165	#415	0.76	20.5	C	#277	0.47	9.8	A
	WB Overall				29.2	C			12.2	B				20.5	C			9.8	A
	NB LR	375	298	0.94	60.4	E	277	1.02	96.3	F	375	266	0.82	31.5	C	244	0.93	62.5	E
	NB Overall				**60.4**	**E**			**96.3**	**F**				31.5	C			**62.5**	**E**
	SB LTR	120	40	0.05	21.8	C	61	0.16	30.2	C	120	49	0.07	15.1	B	72	0.17	25.1	C
	SB Overall				21.8	C			30.2	C				15.1	B			25.1	C
	Intersection Overall			**0.92**	**30.8**	**C**		**1.04**	**47.3**	**D**			**0.78**	**22.3**	**C**		**0.92**	**30.0**	**C**

Table 7-9. Comparison between Alternative C and No Build condition intersection capacity and queuing analyses (continued)

		No Build Condition									Alternative C								
		Turning Bay/ Link	AM Peak Hour				PM Peak Hour				Turning Bay/ Link	AM Peak Hour				PM Peak Hour			
Intersection	Lane Groups	Length (feet)	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	Length (feet)	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS
#11 Connector Rd &	WBL	-	-	-	-	-	-	-	-	-	585	190	0.61	39.3	D	171	0.54	38.1	D
I-93 SB On	WB Overall				-	-	-		-	-				39.3	D			38.1	D
and Off-Ramp	SB L	-	-	-	-	-	-	-	-	-	520	345	0.77	14.5	B	303	0.69	12.5	B
(Exit 4A)	SB Overall				-	-	-	-	-	-				14.5	B			12.5	B
(Signalized) [a]	**Intersection Overall**			-	-	-	-	-	-	-			**0.73**	**20.1**	**C**		**0.65**	**18.3**	**B**
#12 Connector Rd	EB L	-	-	-	-	-	-	-	-	-	100	-	-	-	-	-	-	-	-
& I-93 NB On	EB T	-	-	-	-	-	-	-	-	-	585	172	0.66	3.9	A	146	0.59	3.5	A
and Off-Ramp	EB Overall				-	-			-	-				3.9	A			3.5	A
(Exit 4A)	WB T	-	-	-	-	-	-	-	-	-	1,588	901	0.19	4.4	A	374	0.17	4.2	A
(Signalized) [a]	WB R	-	-	-	-	-	-	-	-	-	200	#268	0.60	7.8	A	#306	0.51	6.6	A
	WB Overall				-	-			-	-				3.9	A			5.9	A
	NB LR	-	-	-	-	-	-	-	-	-	470	176	0.57	38.4	D	159	0.52	37.3	D
	NB R	-	-	-	-	-	-	-	-	-	470	120	0.59	39.6	D	102	0.54	38.0	D
	NB Overall				-	-			-	-				**39.0**	**D**			37.6	D
	Intersection Overall			-	-	-		-	-	-			**0.65**	**7.9**	**A**		**0.58**	**7.1**	**A**

Notes:

95th percentile volume exceeds capacity, queue may be longer.

EB = Eastbound, WB = Westbound, NB= Northbound, SB = Southbound

LOS = Level of Service

LTR = left / through / right lanes

V/C = Volume-to-Capacity ratio

Delay is Measured in Seconds Per Vehicle.

Red cells denote intersections or approaches operating at unacceptable conditions or denote approaches and lane groups whose queuing length exceeds capacity

[a] Highway Capacity Manual 2000 results (Signalized intersections)

7.11 2040 Build 2040 Alternative C Freeway Operations Analysis

Based on the analysis performed using HCS, all freeway facilities would operate below capacity and result in LOS C or better. The one failing freeway facility under the No Build condition would improve to LOS C. This includes the I-93 SB off-ramp to NH 102. Table 7-10 contains the Exit 4 Alternative C freeway analysis compared to the No Build condition and Table 7-11 contains the Exit 5 Alternative C freeway analysis compared to the No Build condition. Table 7-12 contains the Exit 4A Alternative C freeway analysis. Appendix M contains the Build condition HCS freeway operation reports.

Table 7-10. I-93 Exit 4 2040 Build Alternative C freeway analysis compared to the No Build condition

Freeway Analysis	Facility Type	Time Period	Demand to Capacity Ratio		Density (pc/mi/ln)	Alt C LOS	No Build LOS
			Freeway	Ramp			
I-93 Northbound to NH 102	Diverge	AM	0.37	0.24	0.0	A	A
		PM	0.64	0.56	11.1	B	B
NH 102 to I-93 Northbound	Merge	AM	0.49	0.93	19.5	B	C
		PM	0.55	0.73	19.8	B	C
I-93 Southbound to NH 102	Diverge	AM	0.53	0.64	22.5	C	C
		PM	0.51	0.76	23.6	C	F
NH 102 Westbound to I-93 Southbound	Merge	AM	0.49	0.48	15.5	B	B
		PM	0.39	0.22	10.2	B	B
NH 102 Eastbound to I-93 Southbound	Merge	AM	0.67	0.86	24.3	C	C
		PM	0.47	0.40	14.3	B	B

Notes: LOS = Level of Service; Density = Passenger cars per mile per lane (pc/mi/ln)

Red denotes interstate facilities that would result in failing operations and would produce a queue extending to the I-93 mainline.

Table 7-11. I-93 Exit 5 2040 Build Alternative C freeway analysis compared to the No Build condition

Freeway Analysis	Facility Type	Time Period	Demand to Capacity Ratio		Density (pc/mi/ln)	Alt C LOS	No Build LOS
			Freeway	Ramp			
I-93 Northbound to NH 28	Diverge	AM	0.59	0.40	25.1	C	C
		PM	0.64	0.51	28.0	C	C
NH 28 to I-93 Northbound	Merge	AM	0.64	0.48	24.2	C	C
		PM	0.64	0.36	23.1	C	C
I-93 Southbound to NH 28	Diverge	AM	0.62	0.31	25.2	C	D
		PM	0.61	0.31	24.8	C	D
NH 28 to I-93 Southbound	Merge	AM	0.67	0.45	23.9	C	C
		PM	0.63	0.38	22.2	C	C

Notes: LOS = Level of Service; Density = Passenger cars per mile per lane (pc/mi/ln)

Table 7-12. I-93 Exit 4A 2040 Build Alternative C freeway analysis

Freeway Analysis	Facility Type	Time Period	Demand to Capacity Ratio		Density (pc/mi/ln)	LOS
			Freeway	Ramp		
I-93 Northbound to Connector Roadway	Diverge	AM	0.49	0.15	19.0	B
		PM	0.54	0.13	20.6	C
Connector Roadway to I-93 Northbound	Merge	AM	0.62	0.74	21.9	C
		PM	0.65	0.63	21.8	C
I-93 Southbound to Connector Roadway	Diverge	AM	0.66	0.92	32.9	D
		PM	0.62	0.79	30.2	D
Connector Roadway to I-93 Southbound	Merge	AM	0.52	0.27	14.7	B
		PM	0.51	0.23	14.1	B

Notes: LOS = Level of Service; Density = Passenger cars per mile per lane (pc/mi/ln)

7.12 2040 Build Alternative D Intersection Operations Analysis

Based on the Synchro™ signalized intersection analysis results, four signalized intersections (Intersections #5, #6, #7, and #8) would operate at unacceptable conditions (LOS E or LOS F) during the AM or PM peak hours. The remaining signalized intersections in the traffic study area would operate at acceptable overall conditions (LOS D or better is considered an operating level) during the peak hours analyzed (weekday AM and PM peak hours).

Based on the Synchro™ signalized intersection analysis results, six of the study area signalized intersections have overall approaches that would operate at unacceptable conditions (LOS E or LOS F) during one or two evaluated periods. The following are the individual signalized intersection approaches in the traffic study area that would operate under unacceptable conditions during peak hours:

- NH 28 at I-93 Northbound on and off-ramp (Exit 5) (Intersection #3)
  - I-93 Northbound off-ramp during the AM peak hour
- NH 102 at Gilcreast Road (Intersection #5)
  - Eastbound NH 102 during the AM and PM peak hours
  - Westbound NH 102 during the AM and PM peak hours
  - Northbound Gilcreast Road during the AM and PM peak hours
  - Southbound NH 102 during the AM and PM peak hours
- NH 102 at Hampton Drive/Garden Lane (Intersection #6)
  - Northbound Hampton Drive during the AM and PM peak hours
  - Southbound Garden Lane during the AM and PM peak hours
- NH 102 at I-93 Southbound off-ramp (Exit 4) (Intersection #7)
  - I-93 Southbound off-ramp during the PM peak hour
- NH 102 at I-93 Northbound on and off-ramp (Exit 4) (Intersection #8)
  - Eastbound NH 102 during the PM peak hour
  - Westbound NH 102 during the AM peak hour
  - I-93 Northbound off-ramp during the AM and PM peak hours
- NH 102 at Fordway/Madden Hill Road (Intersection #10)
  - Northbound Fordway during the PM peak hour

The overall Alternative D intersection LOS grades are depicted in Figure 7-12 for AM and PM peak hours. Table 7-13 shows the comparison between Alternative D and No Build condition LOS capacity analysis and the intersection vehicle delay results during the AM and PM peak hours. Appendices G, H, and I contain the Synchro™ Build condition intersection analysis reports.

7.13 2040 Build Alternative D Queuing Analysis

Based on the Synchro™ signalized intersection analysis results, seven signalized intersections within the study area would experience queuing lengths that would exceed the available storage capacity. Intersections #2, #4, #8, #9, and #11 would provide sufficient storage for the anticipated demand. The lane group in the approach that would operate under unacceptable conditions is noted in parentheses. Table 7-13 contains the queuing results. Appendices J, K, and L contain the Synchro™ Build condition intersection queuing reports.

- NH 28 at Symmes Drive/Vista Ridge Drive (Intersection #1)
  - Northbound Vista Ridge Drive (right turns) during the AM and the PM peak hours

    - Southbound Symmes Drive (left turns, right turns, and through movements) during the PM peak hour
- NH 28 at I-93 Northbound on and off-ramp (Exit 5) (Intersection #3)
    - Eastbound NH 28 (left turns) during the AM peak hour
- NH 102 at Gilcreast Road (Intersection #5)
    - Eastbound NH 102 (left turns) during the PM peak hour
    - Northbound Gilcreast Road (all movements) during the AM and PM peak hours
    - Southbound Gilcreast Road (all movements) during the AM and PM peak hours
- NH 102 at Hampton Drive/Garden Lane (Intersection #6)
    - Eastbound NH 102 (right turns and through movements) during the AM peak hour
    - Westbound NH 102 (right turns) during the PM peak hour
    - Northbound Hampton Drive (right turns) during the AM and PM peak hours
    - Southbound Garden Lane (all movements) during the AM and PM peak hours
- NH 102 at I-93 Southbound off-ramp (Exit 4) (Intersection #7)
    - I-93 Southbound off-ramp (right turns) during the AM ad PM peak hours
- NH 102 at Fordway/Madden Hill Road (Intersection #10)
    - Eastbound NH 102 (all movements) during the PM peak hour
    - Westbound NH 102 (all movements) during the AM and PM peak hours
- Connector Roadway and I-93 Northbound on and off-ramp (Exit 4A) (Intersection #12)
    - Westbound Connector Roadway (right turns) during the AM and PM peak hours

The remaining signalized intersections in the traffic study area would provide sufficient storage for the anticipated demand. The lane group in the approach that would operate under unacceptable conditions is highlighted in red in Table 7-13, which contains a comparison between Alternative D and No Build condition queuing results.

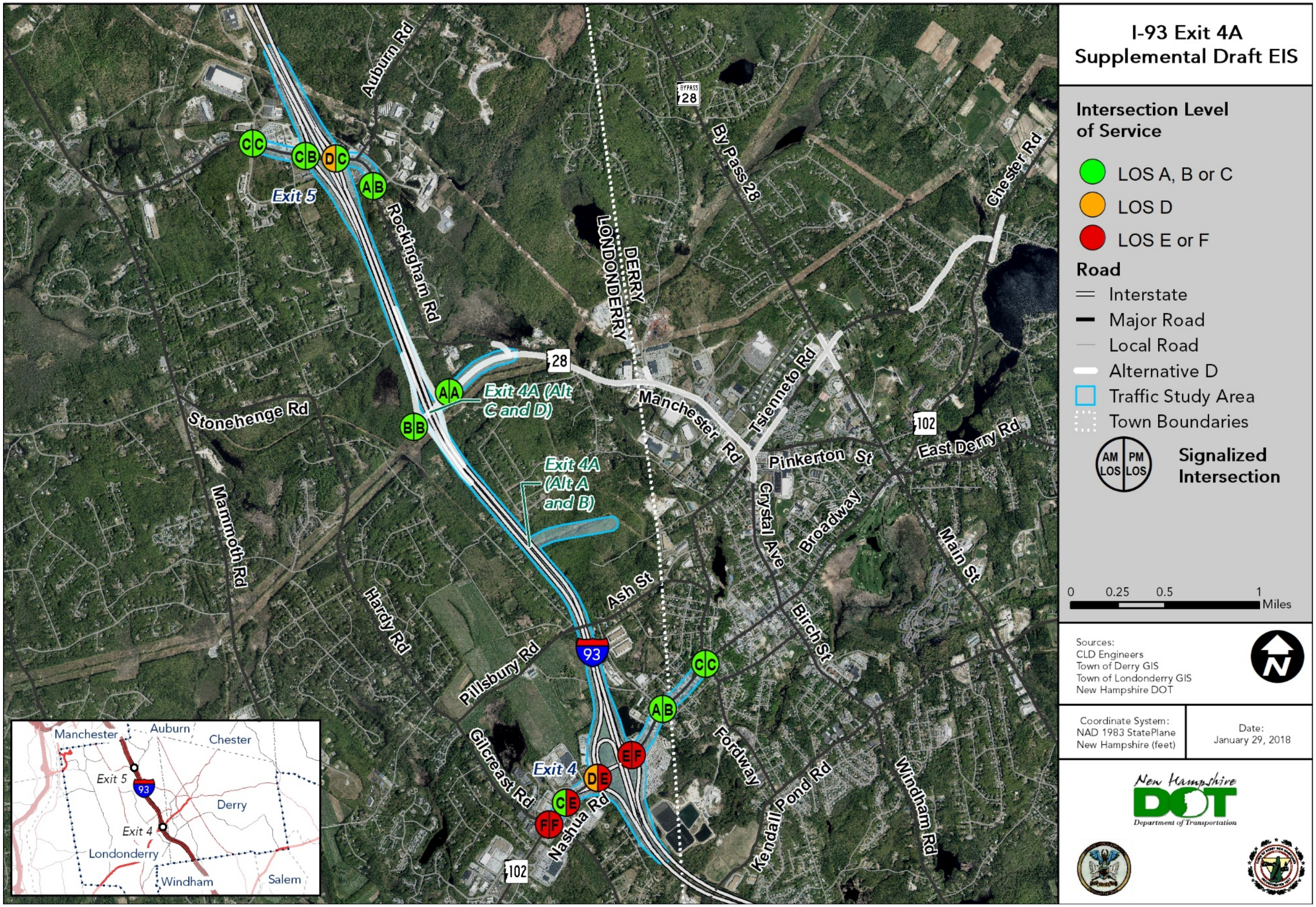


Figure 7-12. 2040 Build Alternative D AM and PM peak hour LOS by intersection

Table 7-13. Comparison between Alternative D and No Build condition intersection capacity and queuing analyses

		No Build Condition									Alternative D								
			AM Peak Hour				PM Peak Hour					AM Peak Hour				PM Peak Hour			
Intersection	Lane Groups	Turning Bay/ Link Length (feet)	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	Turning Bay/ Link Length (feet)	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS
#1 NH 28 & Symmes Dr/ Vista Ridge Dr (Signalized) [a]	EB L	408	353	0.97	85.5	F	50	0.76	111.3	F	408	326	0.95	75.0	E	48	0.76	102.1	F
	EB TR	729	414	0.51	13.0	B	458	0.81	31.9	C	408	217	0.49	12.3	B	266	0.74	23.7	C
	EB Overall				30.8	C			33.9	C				27.6	C			25.8	C
	WB L	450	40	0.55	71.3	E	154	0.81	74.0	E	450	33	0.88	203.0	F	144	0.90	83.8	F
	WB Thru	1,537	409	0.84	33.8	C	298	0.61	20.4	C	755	330	0.80	27.7	C	209	0.60	17.6	B
	WB R	500	137	0.08	19.5	B	31	0.04	14.0	B	500	98	0.07	17.4	B	39	0.03	12.5	B
	WB Overall				32.9	C			26.2	C				29.1	C			24.9	C
	NB LT	1,660	330	0.43	48.5	D	120	0.55	55.5	E	1,660	134	0.43	40.1	D	82	0.44	39.3	D
	NB R	10	#101	0.08	45.4	D	#79	0.02	49.0	D	10	#88	0.07	37.2	D	#56	0.02	35.9	D
	NB Overall				46.5	D			53.3	D				38.3	D			38.2	D
	SB L	270	181	0.93	110.8	F	267	0.84	63.6	E	270	109	0.77	62.3	E	184	0.85	57.7	E
	SB LTR	270	191	0.07	47.1	D	#368	0.39	42.0	D	270	116	0.06	37.4	D	263	0.30	32.9	C
	SB Overall				79.0	E			51.9	D				49.9	D			43.8	D
	Intersection Overall			**0.84**	**36.4**	**D**		**0.79**	**34.7**	**C**			**0.79**	**30.7**	**C**		**0.74**	**29.0**	**C**

Table 7-13. Comparison between Alternative D and No Build condition intersection capacity and queuing analyses (continued)

		No Build Condition									Alternative D								
		Turning Bay/ Link Length	AM Peak Hour				PM Peak Hour				Turning Bay/ Link Length	AM Peak Hour				PM Peak Hour			
Intersection	Lane Groups	(feet)	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	(feet)	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS
#2 NH 28 & I-93	EB Thru	1,537	#1904	0.97	73.6	E	1243	0.88	39.4	D	1,537	349	0.69	38.7	D	233	0.52	21.1	C
SB On and Off-	EB R	350	#546	0.28	0.5	A	#463	0.29	0.5	A	350	123	0.35	0.7	A	-	0.34	0.6	A
Ramp (Exit 5)	EB Overall				51.1	D			27.9	C				22.0	C			12.6	B
(Signalized) [a]	WB L	592	#632	1.17	111.5	F	280	0.92	20.7	C	592	270	0.88	31.4	C	185	0.70	18.0	B
	WB Thru	592	101	0.44	1.8	A	59	0.32	0.2	A	592	73	0.46	1.3	A	97	0.31	0.4	A
	WB Overall				42.9	D			6.4	A				10.1	B			4.3	A
	SB L	502	492	0.72	44.8	D	406	0.92	48.2	D	502	70	0.16	29.7	C	93	0.27	28.8	C
	SB R	502	#526	1.35	217.5	F	109	0.89	52.5	D	502	166	0.91	60.4	E	-	0.71	38.7	D
	SB Overall				**131.6**	**F**			49.9	D				53.2	D			35.5	D
	Intersection Overall			**1.17**	**77.0**	**E**		**0.90**	**31.2**	**C**			**0.82**	**23.3**	**C**		**0.61**	**15.2**	**B**
#3 NH 28 & I-93	EB L	592	#729	1.11	67.9	E	#706	1.07	53.5	D	592	#637	1.04	53.5	D	495	1.00	47.5	D
NB On and Off-	EB Thru	592	#789	0.39	0.6	A	316	0.62	6.1	A	592	301	0.13	2.1	A	118	0.22	3.9	A
Ramp (Exit 5)	EB Overall				32.0	C			22.5	C				38.0	D			27.1	C
(Signalized) [a]	WB Thru	481	#580	1.05	104.5	F	217	0.91	61.7	E	481	315	0.97	76.5	E	115	0.62	37.3	D
	WB R	481	171	0.56	1.5	A	-	0.38	0.7	A	-	-	0.25	0.4	A	-	0.16	0.2	A
	WB Overall				48.5	D			29.7	C				45.9	D			23.2	C
	NB L	798	685	1.11	128.2	F	337	0.86	47.1	D	798	692	1.04	84.2	F	365	0.97	59.2	E
	NB R	798	349	0.23	39.9	D	213	1.08	98.8	F	798	387	0.15	25.7	C	0	0.60	27.4	C
	NB Overall				**101.9**	**F**			**76.0**	**E**				**68.9**	**E**			42.9	D
	Intersection Overall			**1.10**	**51.7**	**D**		**1.04**	**37.7**	**D**			**1.02**	**50.5**	**D**		**0.89**	**32.6**	**C**

Table 7-13. Comparison between Alternative D and No Build condition intersection capacity and queuing analyses (continued)

		No Build Condition									**Alternative D**								
Intersection	Lane Groups	Turning Bay/ Link Length (feet)	AM Peak Hour 95% queue (ft)	AM v/c ratio	AM Average Delay (sec/veh)	AM LOS	PM Peak Hour 95% queue (ft)	PM v/c ratio	PM Average Delay (sec/veh)	PM LOS	Turning Bay/ Link Length (feet)	AM Peak Hour 95% queue (ft)	AM v/c ratio	AM Average Delay (sec/veh)	AM LOS	PM Peak Hour 95% queue (ft)	PM v/c ratio	PM Average Delay (sec/veh)	PM LOS
#4 NH 28 &	EB L	225	79	0.51	42.4	D	50	0.49	30.6	C	225	38	0.41	30.2	C	28	0.50	29.1	C
Liberty Dr	EB TR	841	46	0.13	3.9	A	116	0.47	8.8	A	841	26	0.07	4.7	A	58	0.29	8.3	A
(Signalized) [a]	EB Overall				10.7	B			9.9	A				9.2	A			9.3	A
	WB L	250	19	0.29	51.2	D	17	0.22	31.7	C	250	16	0.22	31.6	C	14	0.16	22.5	C
	WB TR	332	178	0.52	8.5	A	88	0.27	8.7	A	332	89	0.37	6.6	A	54	0.18	7.9	A
	WB Overall				8.7	A			9.0	A				6.8	A			8.3	A
	NB L	154	51	0.29	41.6	D	52	0.14	21.4	C	154	22	0.04	25.0	C	46	0.14	16.6	B
	NB Overall				41.6	D			21.4	C				25.0	C			16.6	B
	SB LT	100	29	0.15	40.6	D	38	0.17	21.6	C	100	19	0.07	25.2	C	22	0.09	16.3	B
	SB R	502	96	0.07	39.7	D	97	0.10	21.1	C	502	67	0.04	25.1	C	55	0.06	16.1	B
	SB Overall				39.8	D			21.2	C				25.1	C			16.2	B
	Intersection Overall			**0.50**	**11.3**	**B**		**0.43**	**11.2**	**B**			**0.34**	**8.3**	**A**		**0.27**	**10.1**	**B**

Table 7-13. Comparison between Alternative D and No Build condition intersection capacity and queuing analyses (continued)

		No Build Condition									Alternative D								
			AM Peak Hour				PM Peak Hour					AM Peak Hour				PM Peak Hour			
Intersection	Lane Groups	Turning Bay/ Link Length (feet)	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	Turning Bay/ Link Length (feet)	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS
#5 NH 102 & Gilcreast Rd (Signalized) [a]	EB L	275	255	1.00	117.3	F	#345	1.24	193.4	F	275	267	1.03	137.3	F	#334	1.28	218.0	F
	EB RT	852	373	1.10	88.9	F	386	0.81	35.9	D	852	380	1.09	95.8	F	387	0.80	38.0	D
	EB Overall				**91.5**	**F**			**60.6**	**E**				**99.7**	**F**			**67.3**	**E**
	WB L	275	86	0.78	53.7	D	135	0.79	32.0	C	275	134	0.85	68.7	E	150	0.81	38.9	D
	WB Thru	669	150	0.97	33.7	C	266	1.27	134.1	F	669	212	1.09	65.7	E	248	1.29	141.9	F
	WB R	225	40	0.06	24.2	C	117	0.14	0.2	A	225	118	0.07	1.9	A	121	0.17	0.7	A
	WB Overall				34.9	C			**111.7**	**F**				**62.0**	**E**			**118.8**	**F**
	NB LT	488	#610	1.16	155.1	F	#567	1.29	200.5	F	488	#602	1.09	138.2	F	#553	1.32	218.6	F
	NB R	488	#598	0.63	47.0	D	#682	0.19	32.8	C	488	#624	0.68	57.9	E	#664	0.24	37.2	D
	NB Overall				**100.5**	**F**			**144.8**	**F**				**97.8**	**F**			**160.2**	**F**
	SB L	356	#442	1.13	142.9	F	314	0.95	114.4	F	356	#431	1.07	132.5	F	#358	1.15	191.4	F
	SBT	356	#483	0.53	47.3	D	#433	0.97	116.8	F	356	#495	0.50	56.6	E	#406	1.22	213.2	F
	SB R	225	#291	0.35	45.0	D	#303	0.55	49.0	D	225	#308	0.49	56.6	E	#266	0.76	69.8	E
	SB Overall				**87.6**	**F**			**83.2**	**F**				**89.1**	**F**			**137.4**	**F**
	Intersection Overall			**1.14**	**76.3**	**E**		**1.24**	**94.0**	**F**			**1.12**	**86.5**	**F**		**1.28**	**107.1**	**F**

Table 7-13. Comparison between Alternative D and No Build condition intersection capacity and queuing analyses (continued)

		No Build Condition									Alternative D								
		Turning Bay/ Link Length (feet)	AM Peak Hour				PM Peak Hour				Turning Bay/ Link Length (feet)	AM Peak Hour				PM Peak Hour			
Intersection	Lane Groups		95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS		95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS
#6 NH 102 & Hampton Dr/Garden Ln (Signalized) [a]	EB L	275	179	0.58	61.3	E	242	1.08	125.2	F	275	258	0.63	76.2	E	270	1.06	131.4	F
	EB TR	669	615	1.00	14.9	B	239	0.76	18.9	B	669	#816	0.94	10.9	B	227	0.69	14.0	B
	EB Overall				17.6	B			42.7	D				14.7	B			41.5	D
	WB L	275	62	0.47	62.2	E	182	0.61	51.4	D	275	101	0.69	92.1	F	227	0.67	61.2	E
	WB Thru	715	221	0.55	16.9	B	367	0.99	44.7	D	715	310	0.60	24.8	C	418	0.99	45.6	D
	WB R	275	133	0.22	20.4	C	#329	0.81	26.1	C	275	199	0.26	14.7	B	#351	0.88	26.4	C
	WB Overall				19.3	B			39.9	D				25.3	C			41.3	D
	NB LT	630	78	0.28	56.2	E	175	0.77	84.4	F	630	133	0.35	74.8	E	303	0.97	136.2	F
	NB R	100	#110	0.11	47.0	D	#137	0.06	51.5	D	100	#125	0.25	63.5	E	#155	0.06	**61.5**	**E**
	NB Overall				49.5	D			**70.1**	**E**				**66.6**	**E**			**105.1**	**F**
	SB L	175	#258	0.91	92.2	F	#242	1.02	104.3	F	175	#235	0.78	78.0	E	#222	1.03	115.6	F
	SB LT	291	#374	0.93	96.9	F	#323	1.00	99.1	F	291	#345	0.79	79.1	E	#317	1.03	113.4	F
	SB R	175	#266	0.10	34.2	C	#210	0.79	59.4	E	175	#239	0.18	43.0	D	#217	0.98	102.3	F
	SB Overall				**77.5**	**E**			**84.5**	**F**				**68.5**	**E**			**109.3**	**F**
	Intersection Overall			**0.92**	**24.9**	**C**		**0.99**	**49.9**	**D**			**0.88**	**25.0**	**C**		**1.02**	**55.8**	**E**

Table 7-13. Comparison between Alternative D and No Build condition intersection capacity and queuing analyses (continued)

		No Build Condition									Alternative D								
		Turning Bay/ Link Length	AM Peak Hour				PM Peak Hour				Turning Bay/ Link Length	AM Peak Hour				PM Peak Hour			
Intersection	Lane Groups	(feet)	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	(feet)	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS
#7 NH 102 & I-93 SB Off-Ramp (Exit 4) (Signalized) [a]	EB Thru	895	540	1.06	53.2	D	565	1.12	87.4	F	895	734	0.99	34.6	C	783	0.93	35.8	D
	EB Overall				53.2	D			**87.4**	**F**				34.6	C			35.8	D
	WB Thru	1,057	193	0.58	13.4	B	420	1.26	146.7	F	1,057	221	0.63	22.4	C	383	1.09	47.1	D
	WB Overall				13.4	B			**146.7**	**F**				22.4	C			47.1	D
	SB L	138	#203	1.10	81.8	F	#205	1.20	116.3	F	138	113	0.16	13.9	B	103	0.15	20.0	C
	SB R	138	#167	0.84	21.4	C	#192	1.09	72.2	E	138	#240	1.00	48.6	D	#214	1.12	99.8	F
	SB Overall				50.8	D			**91.7**	**F**				45.0	D			**92.8**	**F**
	Intersection Overall			**1.08**	**44.5**	**D**		**1.22**	**106.4**	**F**			**0.99**	**35.1**	**D**		**1.11**	**59.6**	**E**
#8 NH 102 & I-93 NB On and Off-Ramp (Exit 4) (Signalized) [a]	EB L	550	529	1.11	85.6	F	475	1.20	127.6	F	550	391	1.04	56.0	E	299	1.12	81.8	F
	EB Thru	1,057	238	0.37	5.7	A	357	0.69	21.2	C	1,057	49	0.07	7.5	A	91	0.21	3.9	A
	EB Overall				50.9	D			**69.9**	**E**				50.5	D			**61.9**	**E**
	WB Thru	1,462	767	1.07	82.8	F	266	0.77	51.8	D	1,462	956	1.03	84.0	F	319	0.87	71.1	E
	WB R	786	#1006	0.78	3.9	A	230	0.54	1.3	A	786	401	0.25	0.4	A	-	0.16	0.2	A
	WB Overall				45.6	D			22.0	C				**63.1**	**E**			48.4	D
	NB L	1,440	496	1.14	137.6	F	897	1.21	140.7	F	1,440	364	1.04	114.7	F	948	1.11	104.2	F
	NB R	1,440	231	1.08	122.3	F	937	1.26	163.5	F	1,440	253	0.93	90.7	F	902	1.10	103.7	F
	NB Overall				**130.9**	**F**			**151.2**	**F**				**104.6**	**F**			**103.9**	**F**
	Intersection Overall			**1.10**	**61.4**	**E**		**1.12**	**92.8**	**F**			**1.04**	**67.3**	**E**		**1.06**	**81.8**	**F**

Table 7-13. Comparison between Alternative D and No Build condition intersection capacity and queuing analyses (continued)

		No Build Condition									Alternative D								
		Turning Bay/ Link Length	AM Peak Hour				PM Peak Hour				Turning Bay/ Link Length	AM Peak Hour				PM Peak Hour			
Intersection	Lane Groups	(feet)	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	(feet)	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS
#9 NH 102 & St Charles St/ Londonderry Rd (Signalized) [a]	EB L	350	202	0.85	58.1	E	#422	1.31	176.0	F	350	105	0.57	34.2	C	274	0.82	34.5	C
	EB TR	1,462	63	0.27	2.7	A	853	0.49	3.5	A	1,462	66	0.21	3.3	A	145	0.46	5.5	A
	EB Overall				17.4	B			**77.9**	**E**				8.5	A			13.8	B
	WBL	100	44	0.31	59.1	E	25	0.31	59.4	E	100	24	0.26	42.5	D	21	0.25	44.2	D
	WB TR	410	320	0.87	19.0	B	324	1.01	59.5	E	410	197	0.56	8.2	A	235	0.60	19.2	B
	WB Overall				19.1	B			**59.5**	**E**				8.3	A			19.3	B
	NB LTR	-	-	-	-	-	-	-	-	-	400	8	0.00	34.7	C	53	0.05	34.1	C
	NB Overall				0.0	A			0.0	A				34.7	C			34.1	C
	SB LT	780	70	0.23	53.2	D	22	0.21	52.4	D	780	32	0.35	41.8	D	38	0.15	34.8	C
	SB R	225	194	0.17	7.8	A	141	0.20	22.2	C	225	94	0.11	5.5	A	83	0.14	15.0	B
	SB Overall				8.7	A			22.6	C				7.7	A			16.3	B
	Intersection Overall			**0.85**	**17.7**	**B**		**1.16**	**67.5**	**E**			**0.56**	**8.3**	**A**		**0.65**	**16.3**	**B**
#10 NH 102 & Fordway/ Madden Hill Rd (Signalized) [a]	EB TR	455	332	0.73	17.0	B	#734	1.05	55.2	E	455	350	0.69	17.6	B	#561	0.94	29.1	C
	EB Overall				17.0	B			**55.2**	**E**				17.6	B			29.1	C
	WB LT	165	#519	0.91	29.2	C	#535	0.71	12.2	B	165	#401	0.79	21.4	C	#428	0.55	9.6	A
	WB Overall				29.2	C			12.2	B				21.4	C			9.6	A
	NB LR	375	298	0.94	60.4	E	277	1.02	96.3	F	375	261	0.84	36.1	D	315	0.94	67.9	E
	NB Overall				**60.4**	**E**			**96.3**	**F**				36.1	D			**67.9**	**E**
	SB LTR	120	40	0.05	21.8	C	61	0.16	30.2	C	120	56	0.10	17.0	B	80	0.24	28.0	C
	SB Overall				21.8	C			30.2	C				17.0	B			28.0	C
	Intersection Overall			**0.92**	**30.8**	**C**		**1.04**	**47.3**	**D**			**0.81**	**23.2**	**C**		**0.94**	**30.2**	**C**

Table 7-13. Comparison between Alternative D and No Build condition intersection capacity and queuing analyses (continued)

		No Build Condition									Alternative D								
		Turning Bay/ Link	AM Peak Hour				PM Peak Hour				Turning Bay/ Link	AM Peak Hour				PM Peak Hour			
Intersection	Lane Groups	Length (feet)	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	Length (feet)	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS
#11 **Connector Rd & I-93 SB On and Off-Ramp (Exit 4A) (Signalized)** [a]	WBL	-	-	-	-	-	-	-	-	-	585	174	0.59	40.9	D	152	0.48	37.2	D
	WB Overall				-	-	-	-	-	-				40.9	D			37.2	D
	SB L	-	-	-	-	-	-	-	-	-	520	317	0.75	13.3	B	297	0.69	13.0	B
	SB Overall				-	-	-	-	-	-				13.3	B			13.0	B
	Intersection Overall			-	-	-	-	-	-	-			**0.70**	**19.2**	**B**		**0.63**	**18.2**	**B**
#12 **Connector Rd & I-93 NB On and Off-Ramp (Exit 4A) (Signalized)** [a]	EB L	-	-	-	-	-	-	-	-	-	100	-	-	-	-	-	-	-	-
	EB T	-	-	-	-	-	-	-	-	-	585	183	0.62	3.4	A	142	0.55	2.9	A
	EB Overall				-	-			-	-				3.4	A			2.9	A
	WB T	-	-	-	-	-	-	-	-	-	1,588	335	0.17	3.4	A	280	0.15	3.2	A
	WB R	-	-	-	-	-	-	-	-	-	200	#290	0.54	5.8	A	#313	0.46	4.9	A
	WB Overall				-	-			-	-				5.2	A			4.5	A
	NB LR	-	-	-	-	-	-	-	-	-	470	127	0.38	37.9	D	109	0.36	38.1	D
	NB R	-	-	-	-	-	-	-	-	-	470	52	0.40	38.2	D	48	0.38	38.4	D
	NB Overall				-	-			-	-				**38.1**	**D**			38.2	D
	Intersection Overall			-	-	-		-	-	-			**0.59**	**5.7**	**A**		**0.53**	**5.1**	**A**

Notes:

95th percentile volume exceeds capacity, queue may be longer.

EB = Eastbound, WB = Westbound, NB= Northbound, SB = Southbound

LOS = Level of Service

LTR = left / through / right lanes

V/C = Volume-to-Capacity ratio

Delay is Measured in Seconds Per Vehicle.

Red cells denote intersections or approaches operating at unacceptable conditions or denote approaches and lane groups whose queuing length exceeds capacity

[a] Highway Capacity Manual 2000 results (Signalized intersections)

7.14 2040 Build Alternative D Freeway Operations Analysis

Based on the analysis performed using HCS, all freeway facilities would operate below capacity and result in LOS C or better. The one failing freeway facility under the No Build condition would improve to LOS C. This includes the I-93 SB off-ramp to NH 102. Table 7-14 contains the Exit 4 Alternative D freeway analysis compared to the No Build condition and Table 7-15 contains the Exit 5 Alternative D freeway analysis compared to the No Build condition. Table 7-16 contains the Exit 4A Alternative D freeway analysis. Appendix M contains the Build condition HCS freeway operation reports.

Table 7-14. I-93 Exit 4 2040 Build Alternative D freeway analysis compared to the No Build condition

Freeway Analysis	Facility Type	Time Period	Demand to Capacity Ratio		Density (pc/mi/ln)	Alt D LOS	No Build LOS
			Freeway	Ramp			
I-93 Northbound to NH 102	Diverge	AM	0.37	0.25	0.0	A	A
		PM	0.64	0.59	11.6	B	B
NH 102 to I-93 Northbound	Merge	AM	0.48	0.90	19.0	B	C
		PM	0.54	0.71	19.1	B	C
I-93 Southbound to NH 102	Diverge	AM	0.53	0.63	22.3	C	C
		PM	0.50	0.75	23.4	C	F
NH 102 Westbound to I-93 Southbound	Merge	AM	0.49	0.48	15.5	B	B
		PM	0.39	0.22	10.3	B	B
NH 102 Eastbound to I-93 Southbound	Merge	AM	0.67	0.85	24.2	C	C
		PM	0.47	0.40	14.3	B	B

Notes: LOS = Level of Service; Density = Passenger cars per mile per lane (pc/mi/ln)

Red denotes interstate facilities that would result in failing operations and would produce a queue extending to the I-93 mainline.

Table 7-15. I-93 Exit 5 2040 Build Alternative D freeway analysis compared to the No Build condition

Freeway Analysis	Facility Type	Time Period	Demand to Capacity Ratio		Density (pc/mi/ln)	Alt D LOS	No Build LOS
			Freeway	Ramp			
I-93 Northbound to NH 28	Diverge	AM	0.60	0.41	25.8	C	C
		PM	0.64	0.55	28.4	D	C
NH 28 to I-93 Northbound	Merge	AM	0.64	0.49	24.4	C	C
		PM	0.64	0.39	23.4	C	C
I-93 Southbound to NH 28	Diverge	AM	0.62	0.31	25.2	C	D
		PM	0.61	0.32	24.8	C	D
NH 28 to I-93 Southbound	Merge	AM	0.67	0.44	23.9	C	C
		PM	0.63	0.38	22.1	C	C

Notes: LOS = Level of Service; Density = Passenger cars per mile per lane (pc/mi/ln)

Table 7-16. I-93 Exit 4A 2040 Build Alternative D freeway analysis

Freeway Analysis	Facility Type	Time Period	Demand to Capacity Ratio		Density (pc/mi/ln)	LOS
			Freeway	Ramp		
I-93 Northbound to Connector Roadway	Diverge	AM	0.48	0.08	17.9	B
		PM	0.52	0.07	19.5	B
Connector Roadway to I-93 Northbound	Merge	AM	0.63	0.76	22.2	C
		PM	0.65	0.64	21.9	C
I-93 Southbound to Connector Roadway	Diverge	AM	0.66	0.91	32.7	D
		PM	0.62	0.78	30.0	D
Connector Roadway to I-93 Southbound	Merge	AM	0.52	0.25	14.4	B
		PM	0.51	0.21	13.8	B

Notes: LOS = Level of Service; Density = Passenger cars per mile per lane (pc/mi/ln)

7.15 2040 Build Alternative F Intersection Operations Analysis

Based on the Synchro™ signalized intersection analysis results, four signalized intersections (Intersections #2, #5, #7, and #8) would operate at unacceptable conditions (LOS E or LOS F) during the AM or PM peak hours. The remaining signalized intersections in the traffic study area would operate at acceptable overall conditions (LOS D or better is considered an operating level) during the peak hours analyzed (weekday AM and PM peak hours).

Based on the Synchro™ signalized intersection analysis results, all the study area signalized intersections, with the exception of Intersection #4, have overall approaches that would operate at unacceptable conditions (LOS E or LOS F) during one or two evaluated periods. The following are the individual signalized intersection approaches in the traffic study area that would operate under unacceptable conditions during peak hours:

- NH 28 at Symmes Drive/Vista Ridge Drive (Intersection #1)

    - Southbound Symmes Drive during the AM peak hour
- NH 28 at I-93 Southbound on and off-ramp (Exit 5) (Intersection #2)
    - Eastbound NH 28 during the AM peak hour
    - I-93 Southbound off-ramp during the AM peak hour
- NH 28 at I-93 Northbound on and off-ramp (Exit 5) (Intersection #3)
    - I-93 Northbound off-ramp during the AM and PM peak hours
- NH 102 at Gilcreast Road (Intersection #5)
    - Eastbound NH 102 during the AM and PM peak hours
    - Westbound NH 102 during the PM peak hour
    - Northbound Gilcreast Road during the AM and PM peak hours
    - Southbound NH 102 during the AM and PM peak hours
- NH 102 at Hampton Drive/Garden Lane (Intersection #6)
    - Northbound Hampton Drive during the AM and PM peak hours
    - Southbound Garden Lane during the AM and PM peak hours
- NH 102 at I-93 Southbound off-ramp (Exit 4) (Intersection #7)
    - Eastbound and Westbound NH 102 during the AM peak hour
    - I-93 Southbound off-ramp during the PM peak hour
- NH 102 at I-93 Northbound on and off-ramp (Exit 4) (Intersection #8)
    - Eastbound NH 102 during the PM peak hour
    - I-93 Northbound off-ramp during the AM and PM peak hours
- NH 102 at St Charles Street/Londonderry Road (Intersection #9)
    - Northbound St Charles Street during the PM peak hour
- NH 102 at Fordway/Madden Hill Road (Intersection #10)
    - Northbound Fordway during the AM and PM peak hours

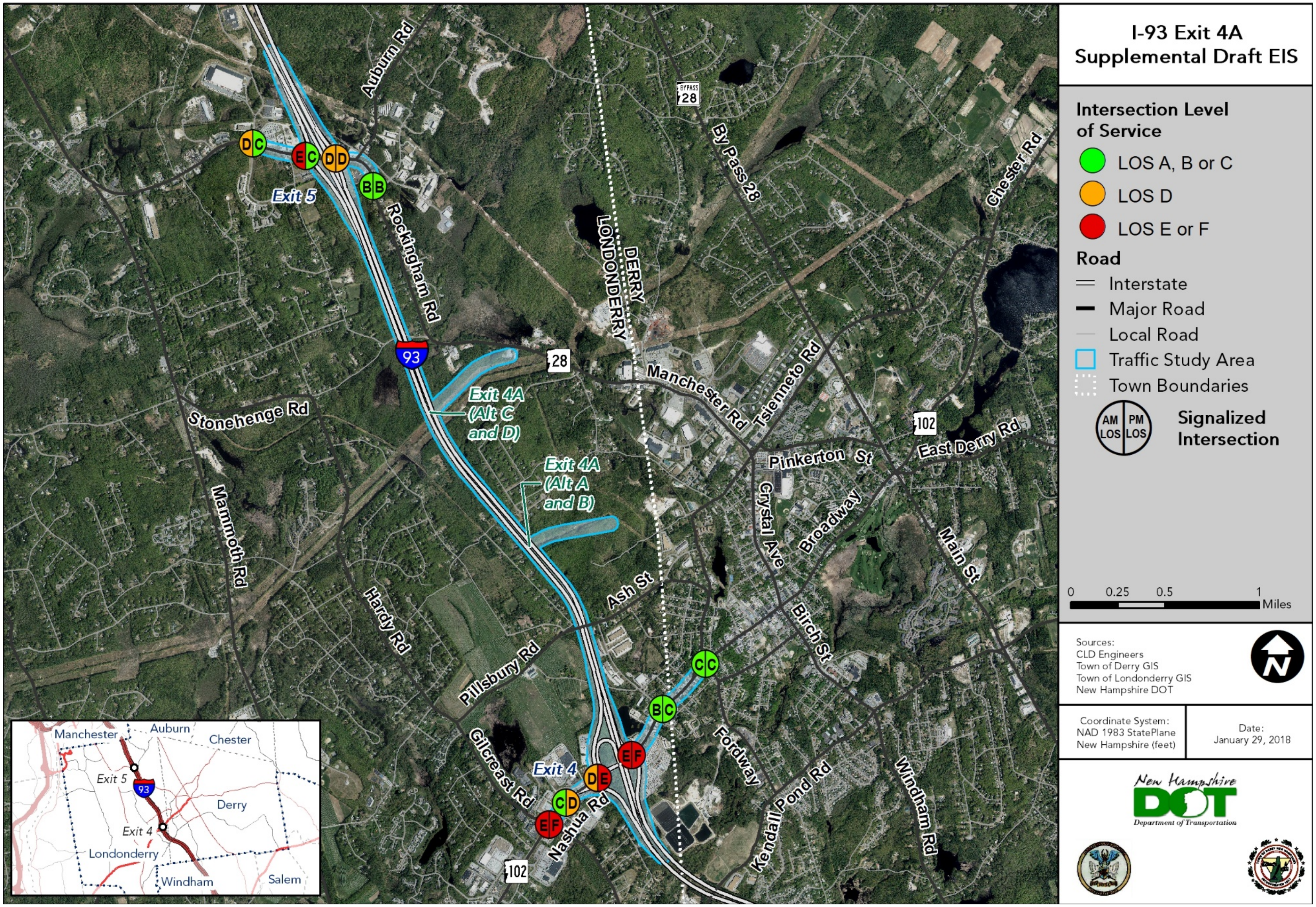
The overall Alternative F intersection LOS grades are depicted in Figure 7-13 for AM and PM peak hours. Table 7-17 shows the comparison between Alternative F and No Build condition LOS capacity analysis and the intersection vehicle delay results during the AM and PM peak hours. Appendices G, H, and I contain the Synchro™ Build condition intersection analysis reports.

7.16 2040 Build Alternative F Queuing Analysis

Based on the Synchro™ signalized intersection analysis results, all the signalized intersections within the study area with the exception of NH 28 at liberty Drive (Intersection #4), would experience queuing lengths that would exceed the available storage capacity. Intersection #4 would provide sufficient storage for the anticipated demand. The lane group in the approach that would operate under unacceptable conditions is noted in parentheses. Table 7-17 contains the queuing results. Appendices J, K, and L contain the Synchro™ Build condition intersection queuing reports.

- NH 28 at Symmes Drive/Vista Ridge Drive (Intersection #1)
  - Northbound Vista Ridge Drive (right turns) during the AM and the PM peak hours
  - Southbound Symmes Drive (left turns, right turns, and through movements) during the PM peak hour
- NH 28 at I-93 Southbound on and off-ramp (Exit 5) (Intersection #2)
  - Eastbound NH 28 (all movements) during the AM peak hour
- NH 28 at I-93 Northbound on and off-ramp (Exit 5) (Intersection #3)
  - Eastbound NH 28 (left turns) during the AM and PM peak hours
  - Eastbound NH 28 (through movements) during the AM peak hour
  - Westbound NH 28 (through movements) during the AM peak hour
- NH 102 at Gilcreast Road (Intersection #5)
  - Eastbound NH 102 (left turns) during the PM peak hour
  - Northbound Gilcreast Road (all movements) during the AM and PM peak hours
  - Southbound Gilcreast Road (left turns) during the AM peak hour
  - Southbound Gilcreast Road (right turns and through movements) during the AM and PM peak hours
- NH 102 at Hampton Drive/Garden Lane (Intersection #6)
  - Westbound NH 102 (right turns) during the PM peak hour
  - Northbound Hampton Drive (right turns) during the AM and PM peak hours
  - Southbound Garden Lane (all movements) during the AM and PM peak hours
- NH 102 at I-93 Southbound off-ramp (Exit 4) (Intersection #7)
  - I-93 Southbound off-ramp (all movements) during the AM ad PM peak hours
- NH 102 at I-93 Northbound on and off-ramp (Exit 4) (Intersection #8)
  - Westbound NH 102 (right turns) during the AM peak hour
- NH 102 at St Charles Street/Londonderry Road (Intersection #9)
  - Eastbound NH 102 (left turns) during the PM peak hour
- NH 102 at Fordway/Madden Hill Road (Intersection #10)
  - Eastbound NH 102 (through movements) during the PM peak hour
  - Eastbound NH 102 (right turns) during the AM and PM peak hours
  - Westbound NH 102 (all movements) during the AM and PM peak hours

Intersection #4 is the only signalized intersection in the traffic study area that would provide sufficient storage for the anticipated demand. The lane group in the approach that would operate under unacceptable conditions is highlighted in red in Table 7-17, which contains a comparison between Alternative F and No Build condition queuing results.

1 

2 **Figure 7-13. 2040 Build Alternative F AM and PM peak hour LOS by intersection**

Table 7-17. Comparison between Alternative F and No Build condition intersection capacity and queuing analyses

		No Build Condition									**Alternative F**								
			AM Peak Hour				PM Peak Hour					AM Peak Hour				PM Peak Hour			
Intersection	Lane Groups	Turning Bay/ Link Length (feet)	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	Turning Bay/ Link Length (feet)	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS
#1 NH 28 & Symmes Dr/ Vista Ridge Dr (Signalized) [a]	EB L	408	353	0.97	85.5	F	50	0.76	111.3	F	408	369	1.07	107.5	F	55	0.51	47.2	D
	EB TR	729	414	0.51	13.0	B	458	0.81	31.9	C	729	364	0.58	14.9	B	380	0.90	32.9	C
	EB Overall				30.8	C			33.9	C				37.5	D			33.2	C
	WB L	450	40	0.55	71.3	E	154	0.81	74.0	E	450	37	0.44	51.0	D	130	0.94	97.3	F
	WB Thru	1,537	409	0.84	33.8	C	298	0.61	20.4	C	1,537	405	0.89	35.0	D	251	0.66	20.2	C
	WB R	500	137	0.08	19.5	B	31	0.04	14.0	B	500	87	0.07	18.5	B	44	0.03	13.9	B
	WB Overall				32.9	C			26.2	C				33.7	C			28.7	C
	NB LT	1,660	330	0.43	48.5	D	120	0.55	55.5	E	1,660	200	0.38	38.0	D	93	0.44	39.2	D
	NB R	10	#101	0.08	45.4	D	#79	0.02	49.0	D	10	#96	0.07	35.7	D	#69	0.02	35.8	D
	NB Overall				46.5	D			53.3	D				36.6	D			38.0	D
	SB L	270	181	0.93	110.8	F	267	0.84	63.6	E	270	129	0.86	78.5	E	214	0.91	67.1	E
	SB LTR	270	191	0.07	47.1	D	#368	0.39	42.0	D	270	139	0.07	37.7	D	#316	0.31	32.0	C
	SB Overall				**79.0**	**E**			51.9	D				**58.1**	**E**			48.5	D
	Intersection Overall			**0.84**	**36.4**	**D**		**0.79**	**34.7**	**C**			**0.86**	**37.5**	**D**		**0.86**	**34.3**	**C**

Table 7-17. Comparison between Alternative F and No Build condition intersection capacity and queuing analyses (continued)

Intersection	Lane Groups	No Build Condition: Turning Bay/ Link Length (feet)	No Build AM Peak Hour: 95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	No Build PM Peak Hour: 95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	Alternative F: Turning Bay/ Link Length (feet)	Alt F AM Peak Hour: 95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	Alt F PM Peak Hour: 95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS
#2 **NH 28 & I-93 SB On and Off-Ramp (Exit 5) (Signalized)** [a]	EB Thru	1,537	#1904	0.97	73.6	E	1243	0.88	39.4	D	1,537	#1764	1.01	81.9	F	492	0.84	35.6	D
	EB R	350	#546	0.28	0.5	A	#463	0.29	0.5	A	350	#536	0.28	0.5	A	239	0.29	0.5	A
	EB Overall				51.1	D			27.9	C				**56.5**	**E**			25.3	C
	WB L	592	#632	1.17	111.5	F	280	0.92	20.7	C	592	535	1.08	74.8	E	304	0.88	24.2	C
	WB Thru	592	101	0.44	1.8	A	59	0.32	0.2	A	592	58	0.41	1.3	A	52	0.29	0.2	A
	WB Overall				42.9	D			6.4	A				29.8	C			7.7	A
	SB L	502	492	0.72	44.8	D	406	0.92	48.2	D	502	445	0.68	41.8	D	325	0.89	46.3	D
	SB R	502	#526	1.35	217.5	F	109	0.89	52.5	D	502	450	1.21	158.2	F	81	0.74	40.0	D
	SB Overall				**131.6**	**F**			49.9	D				**100.3**	**F**			43.8	D
	Intersection Overall			**1.17**	**77.0**	**E**		**0.90**	**31.2**	**C**			**1.10**	**62.1**	**E**		**0.87**	**27.8**	**C**
#3 **NH 28 & I-93 NB On and Off-Ramp (Exit 5) (Signalized)** [a]	EB L	592	#729	1.11	67.9	E	#706	1.07	53.5	D	592	#724	1.08	52.6	D	#687	1.03	40.2	D
	EB Thru	592	#789	0.39	0.6	A	316	0.62	6.1	A	592	#693	0.38	0.3	A	301	0.56	3.2	A
	EB Overall				32.0	C			22.5	C				24.9	C			16.1	B
	WB Thru	481	#580	1.05	104.5	F	217	0.91	61.7	E	481	#504	1.01	88.9	F	168	0.78	47.1	D
	WB R	481	171	0.56	1.5	A	-	0.38	0.7	A	481	98	0.57	1.5	A	-	0.39	0.7	A
	WB Overall				48.5	D			29.7	C				40.1	D			21.9	C
	NB L	798	685	1.11	128.2	F	337	0.86	47.1	D	798	592	1.09	118.2	F	432	0.92	**58.7**	**E**
	NB R	798	349	0.23	39.9	D	213	1.08	98.8	F	798	275	0.19	36.9	D	258	1.09	107.7	F
	NB Overall				**101.9**	**F**			**76.0**	**E**				**94.1**	**F**			**85.7**	**F**
	Intersection Overall			**1.10**	**51.7**	**D**		**1.04**	**37.7**	**D**			**1.07**	**44.0**	**D**		**0.99**	**35.1**	**D**

Table 7-17. Comparison between Alternative F and No Build condition intersection capacity and queuing analyses (continued)

		No Build Condition									Alternative F								
			AM Peak Hour				PM Peak Hour					AM Peak Hour				PM Peak Hour			
Intersection	Lane Groups	Turning Bay/ Link Length (feet)	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	Turning Bay/ Link Length (feet)	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS
#4 NH 28 & Liberty	EB L	225	79	0.51	42.4	D	50	0.49	30.6	C	225	74	0.49	38.7	D	51	0.47	29.4	C
Dr (Signalized) [a]	EB TR	841	46	0.13	3.9	A	116	0.47	8.8	A	841	32	0.13	4.0	A	106	0.45	8.9	A
	EB Overall				10.7	B			9.9	A				10.2	B			9.9	A
	WB L	250	19	0.29	51.2	D	17	0.22	31.7	C	250	13	0.32	49.5	D	17	0.21	30.5	C
	WB TR	332	178	0.52	8.5	A	88	0.27	8.7	A	332	171	0.55	8.7	A	101	0.28	8.9	A
	WB Overall				8.7	A			9.0	A				8.9	A			9.2	A
	NB L	154	51	0.29	41.6	D	52	0.14	21.4	C	154	25	0.05	36.1	D	44	0.13	20.6	C
	NB Overall				41.6	D			21.4	C				36.1	D			20.6	C
	SB LT	100	29	0.15	40.6	D	38	0.17	21.6	C	100	31	0.15	37.1	D	34	0.16	20.8	C
	SB R	502	96	0.07	39.7	D	97	0.10	21.1	C	502	90	0.07	36.3	D	92	0.10	20.4	C
	SB Overall				39.8	D			21.2	C				36.4	D			20.4	C
	Intersection Overall			**0.50**	**11.3**	**B**		**0.43**	**11.2**	**B**			**0.50**	**10.7**	**B**		**0.41**	**11.1**	**B**

Table 7-17. Comparison between Alternative F and No Build condition intersection capacity and queuing analyses (continued)

		No Build Condition									Alternative F								
		Turning Bay/ Link Length (feet)	AM Peak Hour				PM Peak Hour				Turning Bay/ Link Length (feet)	AM Peak Hour				PM Peak Hour			
Intersection	Lane Groups		95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS		95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS
#5 NH 102 &	EB L	275	255	1.00	117.3	F	#345	1.24	193.4	F	275	264	1.02	134.8	F	#329	1.23	187.2	F
Gilcreast Rd	EB RT	852	373	1.10	88.9	F	386	0.81	35.9	D	852	376	1.08	90.2	F	383	0.82	36.3	D
(Signalized) [a]	EB Overall				**91.5**	**F**			**60.6**	**E**				**94.4**	**F**			**59.5**	**E**
	WB L	275	86	0.78	53.7	D	135	0.79	32.0	C	275	95	0.72	57.6	E	122	0.78	32.3	C
	WB Thru	669	150	0.97	33.7	C	266	1.27	134.1	F	669	155	0.92	28.4	C	218	1.26	127.5	F
	WB R	225	40	0.06	24.2	C	117	0.14	0.2	A	225	44	0.06	4.1	A	87	0.13	0.3	A
	WB Overall				34.9	C			**111.7**	**F**				29.4	C			**106.4**	**F**
	NB LT	488	#610	1.16	155.1	F	#567	1.29	200.5	F	488	#569	1.07	134.1	F	#587	1.27	195.3	F
	NB R	488	#598	0.63	47.0	D	#682	0.19	32.8	C	488	#526	0.66	57.4	E	#681	0.20	32.8	C
	NB Overall				**100.5**	**F**			**144.8**	**F**				**95.5**	**F**			**140.6**	**F**
	SB L	356	#442	1.13	142.9	F	314	0.95	114.4	F	356	#440	1.06	129.6	F	354	0.97	118.2	F
	SBT	356	#483	0.53	47.3	D	#433	0.97	116.8	F	356	#485	0.49	56.5	E	#477	0.95	113.1	F
	SB R	225	#291	0.35	45.0	D	#303	0.55	49.0	D	225	#294	0.47	56.4	E	#307	0.54	48.6	D
	SB Overall				**87.6**	**F**			**83.2**	**F**				**87.8**	**F**			**83.2**	**F**
	Intersection Overall			**1.14**	**76.3**	**E**		**1.24**	**94.0**	**F**			**1.08**	**75.7**	**E**		**1.23**	**90.7**	**F**

Table 7-17. Comparison between Alternative F and No Build condition intersection capacity and queuing analyses (continued)

		No Build Condition									Alternative F								
		Turning Bay/ Link Length	AM Peak Hour				PM Peak Hour				Turning Bay/ Link Length	AM Peak Hour				PM Peak Hour			
Intersection	Lane Groups	(feet)	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	(feet)	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS
#6 NH 102 & Hampton Dr/Garden Ln (Signalized) [a]	EB L	275	179	0.58	61.3	E	242	1.08	125.2	F	275	175	0.62	75.9	E	266	1.07	120.3	F
	EB TR	669	615	1.00	14.9	B	239	0.76	18.9	B	669	480	0.93	10.5	B	258	0.77	18.1	B
	EB Overall				17.6	B			42.7	D				14.3	B			40.4	D
	WB L	275	62	0.47	62.2	E	182	0.61	51.4	D	275	54	0.55	86.4	F	201	0.64	51.8	D
	WB Thru	715	221	0.55	16.9	B	367	0.99	44.7	D	715	226	0.50	20.6	C	388	0.98	47.0	D
	WB R	275	133	0.22	20.4	C	#329	0.81	26.1	C	275	102	0.22	11.6	B	#342	0.80	27.0	C
	WB Overall				19.3	B			39.9	D				21.3	C			41.7	D
	NB LT	630	78	0.28	56.2	E	175	0.77	84.4	F	630	116	0.35	74.8	E	213	0.76	83.6	F
	NB R	100	#110	0.11	47.0	D	#137	0.06	51.5	D	100	#121	0.24	63.1	E	#143	0.06	51.5	D
	NB Overall				49.5	D			**70.1**	**E**				**66.3**	**E**			**69.5**	**E**
	SB L	175	#258	0.91	92.2	F	#242	1.02	104.3	F	175	#237	0.78	79.2	E	#240	1.03	106.0	F
	SB LT	291	#374	0.93	96.9	F	#323	1.00	99.1	F	291	#351	0.79	80.2	F	#322	1.04	108.2	F
	SB R	175	#266	0.10	34.2	C	#210	0.79	59.4	E	175	#252	0.15	42.8	D	#205	0.80	61.2	E
	SB Overall				**77.5**	**E**			**84.5**	**F**				**69.2**	**E**			**88.8**	**F**
	Intersection Overall			**0.92**	**24.9**	**C**		**0.99**	**49.9**	**D**			**0.87**	**23.6**	**C**		**0.98**	**50.9**	**D**

Table 7-17. Comparison between Alternative F and No Build condition intersection capacity and queuing analyses (continued)

		No Build Condition									Alternative F								
		Turning Bay/ Link Length (feet)	AM Peak Hour				PM Peak Hour				Turning Bay/ Link Length (feet)	AM Peak Hour				PM Peak Hour			
Intersection	Lane Groups		95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS		95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS
#7 NH 102 &	EB Thru	895	540	1.06	53.2	D	565	1.12	87.4	F	895	560	1.09	68.1	E	408	1.02	43.0	D
I-93 SB Off-	EB Overall				53.2	D			**87.4**	**F**				**68.1**	**E**			43.0	D
Ramp (Exit 4)	WB Thru	1,057	193	0.58	13.4	B	420	1.26	146.7	F	1,057	154	0.59	17.3	B	288	1.11	52.2	D
(Signalized) [a]	WB Overall				13.4	B			**146.7**	**F**				17.3	B			52.2	D
	SB L	138	#203	1.10	81.8	F	#205	1.20	116.3	F	138	#202	1.10	81.9	F	#201	1.17	117.7	F
	SB R	138	#167	0.84	21.4	C	#192	1.09	72.2	E	138	#159	0.74	19.4	B	#194	0.95	43.0	D
	SB Overall				50.8	D			**91.7**	**F**				51.6	D			**78.1**	**E**
	Intersection Overall			**1.08**	**44.5**	**D**		**1.22**	**106.4**	**F**			**1.09**	**51.0**	**D**		**1.14**	**61.5**	**E**
#8 NH 102 &	EB L	550	529	1.11	85.6	F	475	1.20	127.6	F	550	516	1.07	75.5	E	386	1.18	120.1	F
I-93 NB On	EB Thru	1,057	238	0.37	5.7	A	357	0.69	21.2	C	1,057	274	0.42	5.5	A	274	0.77	20.5	C
and Off-Ramp	EB Overall				50.9	D			**69.9**	**E**				42.4	D			**62.9**	**E**
(Exit 4)	WB Thru	1,462	767	1.07	82.8	F	266	0.77	51.8	D	1,124	722	1.04	81.2	F	277	0.82	54.2	D
(Signalized) [a]	WB R	786	#1006	0.78	3.9	A	230	0.54	1.3	A	786	#879	0.80	4.4	A	287	0.55	1.4	A
	WB Overall				45.6	D			22.0	C				45.0	D			23.5	C
	NB L	1,440	496	1.14	137.6	F	897	1.21	140.7	F	1,440	443	1.09	131.3	F	963	1.20	134.3	F
	NB R	1,440	231	1.08	122.3	F	937	1.26	163.5	F	1,440	279	1.08	131.3	F	996	1.30	181.3	F
	NB Overall				**130.9**	**F**			**151.2**	**F**				**131.3**	**F**			**156.4**	**F**
	Intersection Overall			**1.10**	**61.4**	**E**		**1.12**	**92.8**	**F**			**1.06**	**57.5**	**E**		**1.15**	**91.8**	**F**

Table 7-17. Comparison between Alternative F and No Build condition intersection capacity and queuing analyses (continued)

		No Build Condition									Alternative F								
		Turning Bay/ Link Length	AM Peak Hour				PM Peak Hour				Turning Bay/ Link Length	AM Peak Hour				PM Peak Hour			
Intersection	Lane Groups	(feet)	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	(feet)	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS
#9 NH 102 & St Charles St/ Londonderry Rd (Signalized) [a]	EB L	350	202	0.85	58.1	E	#422	1.31	176.0	F	360	147	0.67	41.5	D	#410	0.96	58.7	E
	EB TR	1,462	63	0.27	2.7	A	853	0.49	3.5	A	1,462	71	0.31	3.2	A	437	0.61	5.2	A
	EB Overall				17.4	B			**77.9**	**E**				9.7	A			20.9	C
	WB L	100	44	0.31	59.1	E	25	0.31	59.4	E	65	45	0.69	122.6	F	38	0.79	191.4	F
	WB TR	410	320	0.87	19.0	B	324	1.01	59.5	E	410	210	0.78	13.4	B	201	0.85	39.0	D
	WB Overall				19.1	B			**59.5**	**E**				14.1	B			40.4	D
	NB LTR	-	-	-	-	-	-	-	-	-	400	13	0.1	44.2	D	67	0.05	**56.3**	**E**
	NB Overall				0.0	A			0.0	A				44.2	D			56.3	E
	SB LT	780	70	0.23	53.2	D	22	0.21	52.4	D	780	30	0.39	50.9	D	45	0.25	**58.6**	**E**
	SB R	225	194	0.17	7.8	A	141	0.20	22.2	C	180	92	0.08	6.3	A	99	0.11	23.9	C
	SB Overall				8.7	A			22.6	C				9.7	A			26.8	C
	Intersection Overall			**0.85**	**17.7**	**B**		**1.16**	**67.5**	**E**			**0.75**	**12.3**	**B**		**0.87**	**27.9**	**C**

Table 7-17. Comparison between Alternative F and No Build condition intersection capacity and queuing analyses (continued)

		No Build Condition									Alternative F								
			AM Peak Hour				PM Peak Hour					AM Peak Hour				PM Peak Hour			
Intersection	Lane Groups	Turning Bay/ Link Length (feet)	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	Turning Bay/ Link Length (feet)	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS	95% queue (ft)	v/c ratio	Average Delay (sec/veh)	LOS
#10 NH 102 & Fordway/ Madden Hill Rd (Signalized) [a]	EB TR/T	455	332	0.73	17.0	B	#734	1.05	55.2	E	455	384	0.60	13.3	B	#1545	0.98	34.8	C
	EB R	-	-	-	-	-	-	-	-	-	100	#143	0.16	8.9	B	#155	0.20	5.9	A
	EB Overall				17.0	B			**55.2**	**E**				12.2	B			29.7	C
	WB LT	165	#519	0.91	29.2	C	#535	0.71	12.2	B	165	#627	0.92	29.3	C	#725	0.77	14.3	B
	WB Overall				29.2	C			12.2	B				29.3	C			14.3	B
	NB LR/L	375	298	0.94	60.4	E	277	1.02	96.3	F	375	311	0.95	64.2	E	#523	0.93	69.3	E
	NB R	-	-	-	-	-	-	-	-	-	100	100	0.02	21.3	C	#139	0.04	28.0	C
	NB Overall				**60.4**	**E**			**96.3**	**F**				**60.9**	**E**			**62.7**	**E**
	SB LTR	120	40	0.05	21.8	C	61	0.16	30.2	C	120	40	0.05	22.6	C	66	0.19	30.3	C
	SB Overall				21.8	C			30.2	C				22.6	C			30.3	C
	Intersection Overall			**0.92**	**30.8**	**C**		**1.04**	**47.3**	**D**			**0.93**	**28.7**	**C**		**0.96**	**29.9**	**C**

Notes:

95th percentile volume exceeds capacity, queue may be longer.

EB = Eastbound, WB = Westbound, NB= Northbound, SB = Southbound

LOS = Level of Service

LTR = left / through / right lanes

V/C = Volume-to-Capacity ratio

Delay is Measured in Seconds Per Vehicle.

Red cells denote intersections or approaches operating at unacceptable conditions or denote approaches and lane groups whose queuing length exceeds capacity

[a] Highway Capacity Manual 2000 results (Signalized intersections)

7.17 2040 Build 2040 Alternative F Freeway Operations Analysis

Based on the analysis performed using HCS, one freeway facility would operate above capacity. This includes the I-93 SB off-ramp to NH 102. This facility would fail due to the off-ramp operating over capacity, thus queueing onto the I-93 mainline. The NH 102 on-ramp to I-93 NB would continue to operate above capacity potentially creating a queue into the NH 102 mainline. Table 7-18 contains the Exit 4 Alternative F freeway analysis compared to the No Build condition and Table 7-19 contains the Exit 5 Alternative F freeway analysis compared to the No Build condition. Appendix M contains the Build condition HCS freeway operation reports.

Table 7-18. I-93 Exit 4 2040 Build Alternative F freeway analysis compared to the No Build condition

Freeway Analysis	Facility Type	Time Period	Demand to Capacity Ratio		Density (pc/mi/ln)	Alt F LOS	No Build LOS
			Freeway	Ramp			
I-93 Northbound to NH 102	Diverge	AM	0.37	0.26	0.0	A	A
		PM	0.64	0.62	12.5	B	B
NH 102 to I-93 Northbound	Merge	AM	0.55	1.25[a]	21.9	C	D
		PM	0.58	0.99	23.0	C	C
I-93 Southbound to NH 102	Diverge	AM	0.55	0.85	26.2	C	C
		PM	0.57	1.12	29.6	F	F
NH 102 Westbound to I-93 Southbound	Merge	AM	0.50	0.70	17.5	B	B
		PM	0.41	0.32	11.1	B	B
NH 102 Eastbound to I-93 Southbound	Merge	AM	0.67	0.89	24.2	C	C
		PM	0.47	0.39	14.5	B	B

Notes: LOS = Level of Service; Density = Passenger cars per mile per lane (pc/mi/ln)

Red denotes interstate facilities that would result in failing operations and would produce a queue extending to the I-93 mainline.

[a] The capacity of the on-ramp exceeds the demand; therefore, the ramp would produce a queue extending to NH 102.

Table 7-19. I-93 Exit 5 2040 Build Alternative F freeway analysis compared to the No Build condition

Freeway Analysis	Facility Type	Time Period	Demand to Capacity Ratio		Density (pc/mi/ln)	Alt F LOS	No Build LOS
			Freeway	Ramp			
I-93 Northbound to NH 28	Diverge	AM	0.55	0.36	20.6	C	B
		PM	0.57	0.48	25.3	C	C
NH 28 to I-93 Northbound	Merge	AM	0.67	0.82	25.3	C	C
		PM	0.63	0.62	24.1	C	C
I-93 Southbound to NH 28	Diverge	AM	0.58	0.66	25.1	C	C
		PM	0.64	0.67	27.2	C	C
NH 28 to I-93 Southbound	Merge	AM	0.57	0.45	17.5	B	C
		PM	0.58	0.38	17.0	B	C

Notes: LOS = Level of Service; Density = Passenger cars per mile per lane (pc/mi/ln)

8.0 POLICY ANALYSIS

8.1 Introduction

The need for new access from the Interstate stems from overcrowded traffic conditions through downtown Derry, New Hampshire, as well as traffic diverting to local roads to avoid NH 102 through downtown Derry. These conditions are caused by limited east-west routing options for traffic destined to the NH 28 Bypass and points east along NH 102 from origins along I-93 and points west along NH 102. I-93 Exit 4 along NH 102 provides the straightest path but passes through downtown Derry along an urban-designed roadway with on-street parking, frequent intersections, pedestrian accommodations, and dense development. A new connection from the Interstate would support the study goals to remove the pass-through traffic from downtown Derry, creating a safer and more pedestrian friendly downtown while providing a new direct connection to the Londonderry Turnpike and points east.

The following subsections assess the two FHWA policy requirements. The Project study area is defined in Section 2.3, and the purpose and need is defined in Section 1.2.

8.2 Policy Requirement 1: Operational and Collision Analysis

An operational and safety analysis has concluded that the proposed change in access does not have a significant adverse impact on the safety and operation of the Interstate facility (which includes mainline lanes, existing, new, or modified ramps, and ramp intersections with crossroad) or on the local street network based on both the current and the planned future traffic projections. The analysis should, particularly in urbanized areas, include at least the first adjacent existing or proposed interchange on either side of the proposed change in access (Title 23, Code of Federal Regulations (CFR), paragraphs 625.2(a), 655.603(d) and 771.111(f)). The crossroads and the local street network, to at least the first major intersection on either side of the proposed change in access, should be included in this analysis to the extent necessary to fully evaluate the safety and operational impacts that the proposed change in access and other transportation improvements may have on the local street network (23 CFR 625.2(a) and 655.603(d)). Requests for a proposed change in access should include a description and assessment of the impacts and ability of the proposed changes to safely and efficiently collect, distribute, and accommodate traffic on the Interstate facility, ramps, intersection of ramps with crossroad, and local street network (23 CFR 625.2(a) and 655.603(d)). Each request should also include a conceptual plan of the type and location of the signs proposed to support each design alternative (23 U.S.C. 109(d) and 23 CFR 655.603(d)).

8.2.1 Introduction

The following subsections describe the future traffic and safety conditions based on five alternatives to demonstrate that alternatives that include a new Exit 4A along I-93 would provide equal or more efficient and safe access to the Londonderry/Derry area than the present condition.

8.2.2 Traffic Volume Summary

Traffic volumes were compared between the No Build condition and each alternative at five key locations. These include the following locations:

1. NH 102 eastbound and westbound through movements at Fordway/Madden Hill Road (Intersection #10)
2. NH 28 eastbound through/ northbound right turns and westbound through and right turns at I-93 NB on and off-ramp (Intersection #3)
3. I-93 northbound and southbound between Exit 4 and Exit 4A
4. I-93 northbound and southbound between Exit 5 and Exit 4A
5. Connector Roadway east of I-93 Exit 4A interchange

NH 102 Future Travel Patterns

Based on the comparison of 2040 traffic volume forecasts produced by the SNHPC regional travel demand model, Alternatives A, B, C, and D would reduce traffic along NH 102 and all include a new I-93 Exit 4A interchange. Alternatives A and B would reduce volume by 28 percent along NH 102 when compared to the No Build condition. Alternatives A and B would provide the highest reduction in traffic of the alternatives and would meet the project goal to create a safer pedestrian environment in downtown Derry and reduce diverted traffic off local streets. Alternatives C and D would reduce traffic volume by 24 and 16 percent, respectively, when compared to the No Build condition. These reductions also help reduce traffic along NH 102 through downtown Derry, but not as much as Alternatives A and B. Alternative F would not include a new interchange, but would improvement intersections along NH 102 between I-93 Exit 4 and downtown Derry. These improvements would result in an increase in the vehicle volume by 10 percent which would worsen the traffic levels in downtown Derry.

Table 8-1 presents the NH 102 vehicle volume summary based on the volume of forecasted at location #1.

Table 8-1. NH 102 vehicle volume summary at Location #1

Vehicle Direction	Time Period	No Build	Alt. A	Alt. B	Alt. C	Alt. D	Alt. F
NH 102 Eastbound Volumes	AM	453	370	360	380	420	540
	PM	860	710	680	730	790	1,020
NH 102 Westbound Volumes	AM	790	495	545	525	585	810
	PM	555	345	345	380	420	555
NH 102 Eastbound Average Difference	AM		-18%	-21%	-16%	-7%	19%
	PM		-17%	-21%	-15%	-8%	19%
NH 102 Westbound Average Difference	AM		-37%	-31%	-34%	-26%	3%
	PM		-38%	-38%	-32%	-24%	0%
Overall Average Difference			**-28%**	**-28%**	**-24%**	**-16%**	**10%**

NH 28 Future Travel Patterns

Based on the comparison of 2040 traffic volume forecasts produced by the SNHPC regional travel demand model, Alternatives A, B, C, and D would reduce traffic along NH 28. Alternatives C and D would reduce the volume by more than 44 percent along NH 28 compared to the No Build condition. Of the five alternatives, Alternatives C and D would have the greatest effect on volume, most likely because of the proximity of northern location of the proposed Exit 4A to Exit 5 providing a faster travel time to the same destinations in Londonderry and Derry. Alternatives A and B would reduce traffic volume by 21 and 35 percent, respectively, when compared to the No Build condition. While not as much of a reduction as Alternatives C and D, these reductions would represent a reduction in traffic along NH 28 east of I-93 Exit 5. Alternative F would result in a decrease in the vehicle volume by 3 percent, as a result of improved conditions along NH 102 to access downtown Derry and could represent vehicles shifting to NH 102 rather than remaining on NH 28, which would not achieve the project's goal.

Table 8-2 presents the NH 28 vehicle volume summary forecasted at location #2.

Table 8-2. NH 28 vehicle volume summary at Location #2

Vehicle Direction	Time Period	No Build	Alt. A	Alt. B	Alt. C	Alt. D	Alt. F
NH 28 Eastbound Volumes	AM	890	515	435	360	370	845
	PM	1,525	990	855	750	770	1,445
NH 28 Westbound Volumes	AM	1,425	1,370	1,115	1,050	870	1,415
	PM	1,040	1,000	810	570	620	1,030
NH 28 Eastbound Average Difference	AM		-42%	-51%	-60%	-58%	-5%
	PM		-35%	-44%	-51%	-50%	-5%
NH 28 Westbound Average Difference	AM		-4%	-22%	-26%	-39%	-1%
	PM		-4%	-22%	-45%	-40%	-1%
Overall Average Difference			**-21%**	**-35%**	**-45%**	**-47%**	**-3%**

I-93 between Exit 4 and 5 Future Travel Patterns

Based on the comparison of 2040 traffic volume forecasts produced by the SNHPC regional travel demand model, when compared to the No Build condition, Alternatives A, C, and D would reduce traffic along I-93 between Exit 4 and Exit 4A (southern stretch); however, Alternatives A, B, C, and D would increase traffic along I-93 between Exit 5 and Exit 4A (northern stretch). There would be sufficient capacity along this northern stretch of I-93, resulting in no congestion issue with the completion of the I-93 widening to four lanes in each direction. Alternatives C and D would reduce the volume by more than 7 percent along the southern stretch, but increase the volume by 13 percent along the northern stretch. This would represent a shift of vehicles from Exit 4 to Exit 4A from origins from north of Londonderry. Alternatives A and B would result in a similar volume change, a 3 percent decrease and 1 percent increase, respectively for the southern stretch and 10 percent increase for both alternatives along the northern stretch. Alternative A would result in a similar shift from Exit 4 to Exit 4A in vehicle volume from origins from north of Londonderry. Alternative B would create a new travel pattern by shifting north-south vehicle trips from the NH 28 Bypass to I-93, thereby increasing traffic volumes along I-93 from Exit 4A to points south of Londonderry. Both Alternatives A and B would not shift as many vehicle from Exit 5 to Exit 4A because of the more southern interchange location.

Alternatives A through D resulted in the reduction of vehicle trips forecasted between I-93 Exit 4A and Exit 4 during the PM peak hour. This reduction in vehicle volume eliminates the No Build condition failing I-93 southbound diverge facility serving NH 102. Alternative F does not address this failing facility.

Table 8-3 presents the vehicle summary volume for I-93 between Exit 5 and Exit 4A, and Table 8-4 presents the vehicle volume summary for I-93 between Exit 4 and Exit 4A.

Table 8-3. I-93 between Exit 4 and Exit 4A volume summary at Location #3

Vehicle Direction	Time Period	No Build	Alt. A	Alt. B	Alt. C	Alt. D	Alt. F
I-93 Northbound Volumes	AM	4,755	4,290	4,565	4,235	4,150	4,760
	PM	5,045	4,980	5,195	4,790	4,660	5,040
I-93 Southbound Volumes	AM	4,805	4,965	5,065	4,635	4,610	4,845
	PM	4,985	4,775	4,895	4,490	4,465	5,035
I-93 Northbound Average Difference	AM		-10%	-4%	-11%	-13%	0%
	PM		-1%	3%	-5%	-8%	0%
I-93 Southbound Average Difference	AM		3%	5%	-4%	-4%	1%
	PM		-4%	-2%	-10%	-10%	1%
Overall Average Difference			**-3%**	**1%**	**-7%**	**-9%**	**0%**

Table 8-4. I-93 between Exit 5 and Exit 4A volume summary at Location #4

Vehicle Direction	Time Period	No Build	Alt. A	Alt. B	Alt. C	Alt. D	Alt. F
I-93 Northbound Volumes	AM	4,755	4,885	4,905	5,205	5,260	4,760
	PM	5,045	5,510	5,500	5,650	5,650	5,040
I-93 Southbound Volumes	AM	4,805	5,715	5,700	5,750	5,740	4,845
	PM	4,985	5,445	5,460	5,485	5,470	5,035
I-93 Northbound Average Difference	AM		3%	3%	9%	11%	0%
	PM		9%	9%	12%	12%	0%
I-93 Southbound Average Difference	AM		19%	19%	20%	19%	1%
	PM		9%	10%	10%	10%	1%
Overall Average Difference			**10%**	**10%**	**13%**	**13%**	**0%**

I-93 Exit 4A Connector Roadway Future Travel Patterns

Based on the comparison of 2040 traffic volume forecasts produced by the SNHPC regional travel demand model, Alternatives A and B would generate the most volume along the new roadway serving the I-93 Exit 4A interchange. Alternative D would generate the lowest volume of the four alternatives that include the Exit 4A concept. Compared to Alternative D, Alternatives A and B would generate over 46 percent more vehicle trips. The demographic assumptions supporting Alternatives A and B include a full built-out of Woodmont Commons, thus a number of these vehicle trips generated represent Woodmont Commons-destined traffic that would use Exit 4A to access the development through a new planned connection from the Connector Roadway serving Exit 4A.

Table 8-5 contains the I-93 Exit 4A Connector Road vehicle volume summary.

Table 8-5. I-93 Exit 4A Connector Roadway volume summary at Location #5

Vehicle Direction	Time Period	Alt. A	Alt. B	Alt. C	Alt. D
Connector Rd. Eastbound Volumes	AM	2,525	2,635	1,800	1,685
	PM	2,255	2,345	1,635	1,500
Connector Rd. Westbound Volumes	AM	2,370	2,340	1,685	1,665
	PM	2,115	2,085	1,500	1,485
Connector Rd. Eastbound Average Difference	AM	50%	56%	7%	0%
	PM	50%	56%	9%	0%
Connector Rd. Westbound Average Difference	AM	19%	19%	20%	19%
	PM	9%	10%	10%	10%
Overall Average Difference Compared to Alternative D		**46%**	**48%**	**5%**	**0%**

Alternative A Future Traffic Patterns through Downtown Derry

Select link analysis from the travel demand model was conducted along NH 102 east of Griffin Road (a location at the western end of downtown Derry). The intention of the analysis was to determine how many vehicle trips would be shifted from NH 102 to the new proposed interchange and proposed route to bypass downtown Derry (Table 8-6). Based on the model, under Alternative A there would be a 29 percent decrease in the No Build condition forecasted vehicle volume (2,306 vehicles) that would travel through downtown Derry using NH 102. This decrease represents a shift in travel from NH 102 through downtown Derry to the new parallel route serviced by I-93 Exit 4A. At the same time, there would also be a 15 percent increase in the No Build condition forecasted volume (1,205 vehicles) that would travel through downtown Derry using NH 102. This increase represents a shift in travel from another route to NH 102 through downtown Derry because there would be available capacity through downtown Derry. Combining the two changes in travel patterns, there would be a 14 percent decrease in volume (1,100 vehicles) that would travel through downtown Derry if Alternative A was implemented.

Table 8-6. Downtown Derry travel pattern shifted from Alternative A

Alternative	North Derry	East Derry	Chester	Points north of Derry	Other Destinations	Shifted from NH 102	Shifted To NH 102	TOTAL
	Daily Vehicle Trips							
No Build	2,995	2,521	194	115	2,055			7.880
Build Alternative A	878	2,332	392	259	2,918			6,779
	Change in Volume (Percent/Actual)							
Change in Vehicle Trips	-2,117	-189	198	144	863	2,306	1,205	1,101
Percent Change	-71%	-7.5%	102%	125%	42%	29%	15%	-14%

Source: CLD (2017)

8.2.3 Traffic Operational and Queuing Analysis-Base Conditions

The existing traffic operations and queuing conditions are presented in Sections 3.7.4 and 3.7.5. The critical existing areas that experience operation and queueing issues include the following locations (isolated issues would only affect the specific intersections and would not affect adjacent intersections):

- NH 102 at Gilcreast Road (Intersection #5): operational and queueing issues affecting NH 102 through and turning movements
- NH 102 at Hampton Drive/Garden Lane (Intersection #6): operational issues affecting NH 102 through and turning movements
- NH 102 at I-93 SB off-Ramp (Intersection #7): operational issues affecting I-93 SB off-ramp
- NH 102 at I-93 NB On and Off-Ramps (Intersection #8): operational issues affecting conflicting NH 102 movements (westbound through and eastbound left-turn)
- NH 102 at St. Charles Street/Londonderry Road (Intersection #9): isolated queuing issues affecting NH 102 eastbound left
- NH 102 at Fordway/Madden Hill Road (Intersection #10): isolated queuing issues affecting NH 102

In summary, the majority of issues occur along NH 102 at Gilcreast Road (Intersection #5) where queuing affects Intersection #6. The Exit 4 intersections have some minor issues, but overall operate well. The two NH 102 intersections east of Exit 4 have minor and isolated issues. There were no issues regarding the NH 28 intersections surrounding Exit 5.

8.2.4 Freeway Analysis-Base Conditions

The existing freeway facilities all operate at LOS D or better during the AM and PM peak hours; results are presented in Section 3.7.6.

8.2.5 Forecasting Travel Demand for No Build and Build Alternatives

The future forecasted traffic volumes rely on the SNHPC travel demand model. The development of the No Build condition traffic forecasts is presented in Section 5.3, and the Build alternatives are presented in Section 6.0. Both sets of forecasts rely on changes to the model network at 30 locations and reflect roadway improvements and different demographic forecasts. The demographic forecasts used for the No Build condition were also used for Alternative F. Alternatives C and D have similar projections reflecting some growth beyond the No Build level based on a proposed, more northern location of the I-93 Exit 4 interchange. Alternatives A and B also have similar projections reflecting the maximum induced growth potential based on the location of the proposed, more southern location of the I-93 Exit 4A interchange and its relation to the proposed Woodmont Commons PUD. Section 3.1 provides the detailed demographic descriptions assigned to each future alternative and No Build condition.

8.2.6 Traffic Operational and Queuing Analysis - Future Base Conditions for 2040 (Future Year)

The future No Build condition operations and queuing conditions are presented in Sections 5.4 and 5.5. The critical areas that would experience operation and queueing issues include the following locations (isolated issues would only affect the specific intersections and would not affect adjacent intersections):

- NH 28 at Symmes Drive/Vista Ridge Drive (Intersection #1): isolated operational issues affecting NH 28 turning movements
- NH 28 at I-93 SB On and Off-Ramps (Intersection #2): operational and queueing issues affecting NH 28 through and turning movements and I-93 SB off-ramp
- NH 28 at I-93 NB On and Off-Ramps (Intersection #3): operational and queueing issues affecting NH 28 through and turning movements and I-93 NB off-ramp
- NH 102 at Gilcreast Road (Intersection #5): operational and queueing issues affecting NH 102 through and turning movements
- NH 102 at Hampton Drive/Garden Lane (Intersection #6): operational issues affecting NH 102 through movements
- NH 102 at I-93 SB off-Ramp (Intersection #7): operational issues affecting NH 102 through and turning movements and I-93 SB off-ramp
- NH 102 at I-93 NB On and Off-Ramps (Intersection #8): operational issues affecting NH 102 through and turning movements and I-93 NB off-ramp
- NH 102 at St. Charles Street/Londonderry Road (Intersection #9): isolated operational issues affecting NH 102 through and turning movements
- NH 102 at Fordway/Madden Hill Road (Intersection #10): isolated operational and queuing issues affecting NH 102

In summary, the majority of issues would occur along NH 28 at Exit 5 (Intersections #2 and #3) and NH 102 between Gilcreast Road (Intersection #5) and I-93 NB on- and off-ramps

(Intersection #8) affecting the Exit 4 intersections along NH 102. The two NH 102 intersections east of Exit 4 would have minor, isolated issues.

8.2.7 Freeway Analysis - Future Base Conditions for 2040 (Future Year)

The future No Build condition freeway facilities all operate at LOS D or better during the AM and PM peak hours except for the I-93 SB diverge at Exit 4, which operates at LOS F. In addition, the I-93 NB on-ramp from NH 102 at Exit 4 would operate above its capacity. This would create a queue that might extend back into NH 102 at Intersection #8. These results are presented in Section 5.6.

8.2.8 Traffic Operational and Queuing Analysis – 2040 Build Alternatives

Future Build Traffic Operations

The study analyzed 12 intersections under each alternative covering the study area. For each alternative, including the No Build condition, the traffic signal timings were optimized and the offsets were also optimized to process vehicle platoons as best as possible and reduce queuing as much as possible. Based on the analysis when compared to the No Build condition, the following would occur:

- Intersections east and west of Exit 5 along NH 28 (Intersections #1 and #4) would remain the same or improve for all alternatives.
- Intersections serving Exit 5 along NH 28 (Intersections #2 and #3) for the most part improve; however, Intersection #3 worsens operationally under Alternative A and Intersection #2 remains the same under Alternative F.
- Intersections west of Exit 4 along NH 102 (Intersections #5 and #6) would maintain the same LOS or worse because of the projected increase in vehicle volume attracted to the Woodmont Commons development, accessible from Garden Lane and Gilcreast Road.
- Intersections serving Exit 4 along NH 102 (Intersections #7 and #8) would improve for Alternatives B and F, but remain the same or worsen for the other alternatives. The worsening conditions at these locations result from the generation of vehicle trips from Woodmont Commons to access the I-93 NB on-ramp and from the I-93 NB off-ramp to access Woodmont Commons.
- Intersections east of Exit 4 along Exit 102 (Intersections #9 and #10) would improve because the proposed improvements at Intersections #9 for all alternatives and projected decrease in volumes along NH 102 east of Exit 4 for Alternatives A, B, C, and D.
- Intersections serving the I-93 Exit 4A interchange would operate at LOS D or better for all alternatives that include that component (Alternatives A, B, C, and D).

Table 8-7 provides an operational summary. The cells shown in red highlight LOS E or F operation, and cells shown in orange highlight worsening conditions when compared to the No

Build condition. The vehicle delay has been added to the cells in cases where the alternative LOS would remain the same as the No Build condition to highlight where the vehicle delay worsened, but LOS would remain the same. These values were not added to all cells to reduce the clutter on the table.

Table 8-7. Future intersection operations summary

Intersection		Time Period	No Build	Alt. A	Alt. B	Alt. C	Alt. D	Alt. F
1	NH 28 & Symmes Drive/Vista Ridge Dr.	AM	D	D	C	C	C	D
		PM	C	C	C	C	C	C
2	NH 28 & I-93 SB Off and On-Ramp	AM	E	D	C	C	C	E
		PM	C	C	B	B	B	C
3	NH 28 & I-93 NB Off and On-Ramp	AM	D	E	D	D	D	D
		PM	D	D	C	C	C	D
4	NH 28 & Liberty Drive	AM	B	A	A	A	A	B
		PM	B	B	B	B	B	B
5	NH 102 & Gilcreast Road	AM	E	E	E	F	F	E
		PM	F/94.0	F	E	F/102	F/107	F
6	NH 102 & Hampton Dr./Garden Ln.	AM	C	C	C	C	C	C
		PM	D	F	E	D	E	D
7	NH 102 & I-93 SB Off and On-Ramp	AM	D	C	C	D	D	D
		PM	F	D	D	E	E	E
8	NH 102 & I-93 NB Off and On-Ramp	AM	E/61.4	E/71.2	D	E/62.1	E/67/3	E
		PM	F/92/8	F/115	F	F	F	F
9	NH 102 & St Charles St/Londonderry Rd.	AM	B	B	A	A	A	B
		PM	E	B	B	B	B	C
10	NH 102 & Fordway/ Madden Hill Rd.	AM	C	C	C	C	C	C
		PM	D	D	C	C	C	C
11	Connector Rd. & I-93 SB Off and On-Ramps	AM		D	D	C	B	
		PM		C	C	B	B	
12	Connector Rd. & I-93 NB Off and On-Ramps	AM		C	C	A	A	
		PM		B	B	A	A	

Red denotes overall failing operations (LOS E or F).

Orange denotes cases where the alternative operation would be worse than the No Build condition.

Future Build Traffic and Queuing Assessment

The future Build condition operations and queuing conditions are presented in Sections 7.3 through 7.16. Based on a comparison between the No Build condition and the alternatives, the following can be deduced:

- Alternatives B and C impacted one intersection (Intersection #6 only)
- Alternative D impacted two intersections (Intersections #5 and #6)
- Alternative A impacted two intersections (Intersections #6 and #8)
- Alternative F impacted four intersections (Intersections #2, #3, #7, and #10)
- Alternative A benefited five intersections (Intersections #2, #5, #7, #9, and #10)
- Alternative B benefited seven intersections (Intersections #2, #3, #5, #7, #8, #9, and #10)
- Alternatives C and D benefited six intersections (Intersections #2, #3, #7, #8, #9, and #10)
- Alternative F benefited one intersection (Intersection #9)

Table 8-8 contains a comparison of intersection analysis between Build alternatives.

Based on the Woodmont Commons Memorandum of Understanding, to “unlock” parcels within the PUD Master Plan for the developer to continue construction, the developer must submit a traffic study to the Londonderry Planning Board to ascertain the level of roadway mitigation necessary to handle the new vehicle trips generated (Pillsbury, 2018). The assessment in this study does not include the future mitigation because the future mitigation is not known until the next set of Woodmont Commons traffic studies are completed. Because it is assumed that Alternatives A and B would induce a fully built out Woodmont Commons PUD, two traffic issues occurred as follows:

- The number of vehicle trips generated through the study area was based on a fully built-out Woodmont Commons PUD.
- The appropriate level of traffic mitigation was not in place to address the forecasted vehicle trips generated by the Woodmont Commons PUD.

The resulting issue was traffic impacts along NH 102 at Exit 4 (Intersections #7 and #8), NH 102 at Garden Lane/Hampton Drive (Intersection #6), and NH 102 at Gilcreast Road (Intersection #5). These traffic issues should be assumed to be addressed by the future traffic studies prepared to “unlock” Woodmont Commons PUD parcels.

Table 8-8. Comparison of intersections analysis between Build Alternatives

Intersection		Time Period	No Build		Alt. A		Alt. B		Alt. C		Alt. D		Alt. F	
			Oper.	Queue	Oper.	Queue	Oper.	Queue	Oper.	Queue	Oper.	Queue	Oper.	Queue
1	NH 28 & Symmes Drive/Vista Ridge Dr.	AM												
		PM												
2	NH 28 & I-93 SB Off and On-Ramp	AM												
		PM												
3	NH 28 & I-93 NB Off and On-Ramp	AM												
		PM												
4	NH 28 & Liberty Drive	AM												
		PM												
5	NH 102 & Gilcreast Road	AM												
		PM												
6	NH 102 & Hampton Dr./Garden Ln.	AM												
		PM												
7	NH 102 & I-93 SB Off and On-Ramp	AM												
		PM												
8	NH 102 & I-93 NB Off and On-Ramp	AM												
		PM												
9	NH 102 & St Charles St/Londonderry Rd.	AM												
		PM												
10	NH 102 & Fordway/ Madden Hill Rd.	AM												
		PM												

Oper. = Operations

Red under No Build denotes overall failing operations (LOS E or F) or the vehicle queue is projected to extend beyond available storage space.

Red under all other alternatives denotes worse conditions than the No Build Condition.

Green under No Build denotes overall acceptable conditions.

Green under all other alternatives denotes better condition than the No Build Condition.

The proposed new intersections to serve the I-93 Exit 4A interchange ramp termini would both operate at LOS D or better for all alternatives that include the Exit 4A component. Alternatives A, C, and D would result in minor queuing; however, Alternative B would create the longest queues mainly because this alternative would attract the most vehicle trips.

8.2.9 Freeway Analysis – 2040 Build Alternatives

The study analyzed 13 freeway facilities under each alternative covering the study area (Table 8-9). Based on the analysis, the I-93 southbound off-ramp to NH 102 would continue to operate at LOS F under Alternative F. All other freeway facilities under all alternatives would operate at LOS D or better. The future Build condition freeway facilities including the I-93 Exit 4A interchange would operate as follows:

- All facilities would operate at LOS D or better for Alternative A.
- All facilities would operate at LOS D or better for Alternative B; however, the I-93 NB on-ramp would operate above its capacity, thus creating a queue that might extend back into NH 102 at Intersection #8.
- All facilities would operate at LOS D or better for Alternative C.
- All facilities would operate at LOS D or better for Alternative D.
- The I-93 SB diverge at Exit 4 would continue to operate at LOS F and the I-93 NB on-ramp would operate above its capacity, thus creating a queue that might extend back into NH 102 at Intersection #8.

These results are presented in Sections 7.5, 7.8, 7.11, 7.14, and 7.17.

Table 8-9. Future freeway operations summary

Intersection		Time Period	No Build	Alt. A	Alt. B	Alt. C	Alt. D	Alt. F
I-93 Exit 5								
I-93 Northbound to NH 102	Diverge	AM	A	A	A	A	A	A
		PM	B	B	B	B	B	B
NH 102 to I-93 Northbound	Merge	AM	C	B	C	B	B	C
		PM	C	C	C	B	B	C
I-93 Southbound to NH 102	Diverge	AM	C	C	C	C	C	C
		PM	F	A	C	C	C	F
NH 102 Westbound to I-93 Southbound	Merge	AM	B	B	B	B	B	B
		PM	B	A	A	B	B	B
NH 102 Eastbound to I-93 Southbound	Merge	AM	C	C	C	C	C	C
		PM	B	B	B	B	B	B
I-93 Exit 4								
I-93 Northbound to NH 28	Diverge	AM	C	C	C	C	C	C
		PM	C	D	D	C	D	C
NH 28 to I-93 Northbound	Merge	AM	C	C	C	C	C	C
		PM	C	C	C	C	C	C
I-93 Southbound to NH 28	Diverge	AM	D	C	C	C	C	C
		PM	D	C	C	C	C	C
NH 28 to I-93 Southbound	Merge	AM	C	C	B	C	C	B
		PM	C	B	B	C	C	B
I-93 Exit 4A								
I-93 Northbound to Connector Roadway	Diverge	AM		C	C	B	B	
		PM		C	C	C	B	
Connector Roadway to I-93 Northbound	Merge	AM		C	C	C	C	
		PM		C	C	C	C	
I-93 Southbound to Connector Roadway	Diverge	AM		B	B	D	D	
		PM		B	B	D	D	
Connector Roadway to I-93 Southbound	Merge	AM		C	C	B	B	
		PM		C	C	B	B	

Red denotes overall failing operations (LOS E or F).

8.2.10 Collision Analysis – Base Conditions

A crash analysis was performed covering the study area and included the intersections along NH 28 and NH 102 as well as I-93 between Exits 4 and 5 (see Section 3.8). This section discusses the crash types, speculates regarding the reasons for the crashes, and reviews the crash severity.

Types of Collision Occurring

At the intersections, crash types included rear end, angle, side swipes, head-on, fixed objects in the road, fixed object off the road, pedestrian, and other. The rear end collisions represent one vehicle hitting another directly in front. These are usually caused by a vehicle stopping abruptly and the vehicle directly behind unable to stop fast enough to avoid a collision. These can also occur when both vehicles are traveling above the speed limit and trailing vehicle is driving too close, thus reducing the amount of space necessary to avoid the collision. These types of crashes can also be caused by the driver in the trailer vehicle using their mobile phone and not paying attention to the road.

Angle collisions can be caused by one vehicle not yielding to another when entering a lane on a roadway. In most cases, the vehicle already in the lane has the ROW and another vehicle aggressively enters the lane at an intersection.

Side swipe crashes are similar to angle collisions except these crashes occur when one vehicle changes lanes on the same roadway and does not yield to a vehicle already in that lane. These crashes occur often due to blind spots in a vehicle where the drive cannot see if the adjacent lane is clear.

Head-on crashes can occur in a number of instances such as, if a driver enters a roadway headed in the wrong direction and does not realize their mistake until another vehicle appears. They can also occur when a vehicle enters a reversible lane that is closed.

The other crash types are similar in that they can occur at any time based on the weather, not paying attention to the road, speeding, or failure of the vehicle to operate correctly. These crash types do not involve another vehicle.

Based on the crash data provided by NHDOT, the most prevalent crash type along NH 28 and NH 102 were rear end, followed by angle collisions. There were also a number of side swipes. The intersections with the highest crash rates (all exceeded 1.0 MEV) and highest number of injuries were all along NH 102 and included Gilcreast (Intersection #5), Garden Lane/Hampton Drive (Intersection #6), and I-93 NB Ramps (Intersection #8). Tables 3-14 and 3-15 summarize the intersection crash analysis.

Along the freeway, there were slightly different crash types reported. These included fixed object, other motor vehicle, parked vehicle, overturns, jackknife, other object, and other. A fixed object crash involved a vehicle hitting a sign, guard rail, lamp post, tree, or barrier. Other motor vehicle refers to one moving vehicle crashing into another moving vehicle in a sideswipe manner. A parked vehicle refers to a moving vehicle hitting a vehicle parked along the shoulder. Overturns means a vehicle was traveling much faster than the speed limit and flipped over, which would involve some dangerous driving. Jackknife refers to trucks turning beyond the radius designed by the vehicle and the trailer separating from the cab.

Based on the crash data provided by NHDOT, crashes with other motor vehicles were the most common, followed by crashes with fixed objects. There were a number of overturned vehicles mostly along the I-93 mainline between Exits 4 and 5. The freeway location with the highest crash rate and highest number of injuries was I-93 NB between Exits 4 and 5. The area with the second highest crash rates was the I-93 SB merge at Exit 4. Tables 3-16 and 3-17 summarize the freeway crash analysis.

Reasons for Collisions

Crash data helps to point to possible causes for the crashes, but without reviewing each crash report prepared by the state police, the study can only infer what might be causing the crashes.

Based on the intersection data, most of the crashes occurred during the daylight hours, on clear weather days, and in dry pavement conditions. This would point to driver distraction and speeding and to a lesser extent driver error at NH 102 at Gilcreast, NH 102 at Garden Lane/Hampton Drive, and NH 102 at I-93 NB ramps (Intersections #5, #6, and #8) mainly because the roadway is flat, the signing indicates the lane geometry ahead of intersections, there is a clear view of the intersection on approach, and the traffic signal is visible from all lanes. There are also a number of crashes that fell into the “other” category, which does not help to identify the reason for the crash.

Based on the freeway data, most of the crashes occurred during the daylight hours, on clear weather days, and in dry pavement conditions. There were some crashes (approximately 20 percent) that did occur at night and in winter weather conditions This would point to driver distraction, speeding, and to a lesser extent weather conditions along I-93 NB and SB between Exit 4 and 5 mainly because the road is flat, signing warns of upcoming interchange ramps, and the roadway either is straight or has large radius turns (gentle turns). I-93 SB at Exit 4 does have multiple on-ramps from NH 102, which results in a slightly higher crash rate along the stretch of I-93 between the two merges. Both of these facilities still result in low crash rates with 0.24 and 0.20 MEV, respectively. A few crashes along I-93 resulted in overturned vehicles. Based on the data, these crashes primarily occurred during the day in dry conditions, which further supports speeding as the cause of the crashes.

Severity of Collisions

The severity of collisions can be assessed based on the collision type, number of injuries, and number of fatalities. Based on the intersection data, very few crashes were head-on or involved pedestrians. There was one fatality at NH 102 and I-93 NB ramps (Interchange #8). Based on the freeway data, most crashes were not severe, but there were some overturned vehicles and one jackknifed tractor trailer. None of the crashes resulted in a fatality.

8.2.11 Collision Analysis – 2040 Build Alternatives

The future conditions would include roadway improvements beside the construction of the I-93 Exit 4A interchange. These would include the following five improvements:

1. I-93 Mainline would be widening from two to four lanes in each direction through the study area **(currently under construction)**.
2. The I-93 Exit 4 ramps and NH 102 alignment would be reconstructed to include more turning lanes at the intersections (Intersections #7 and #8) and more through lanes along NH 102 **(currently under construction)**.

3. The intersection of NH 102 and Gilcreast (Intersection #5) would be reconstructed to include more through lanes along NH 102 **(proposed future Woodmont Commons mitigation)**.
4. The intersection of NH 102 and Garden Lane/Hampton Drive (Intersection #6) would be reconstructed to include more through lanes along NH 102 **(proposed future Woodmont Commons mitigation)**.
5. The intersection of NH 102 and Londonderry Road/St. Charles Street (Intersection #9) would be reconstructed to include more turning lanes along NH 102 **(Proposed future Woodmont Commons mitigation)**.

In addition to these five ongoing and future improvements, NHDOT recently improved the I-93 Exit 5 interchange and adjacent intersections along NH 28 at Symmes Drive/Vista Ridge and Liberty Drive (Intersections #1–#4). Together, these future and ongoing improvements would cover all IJR study area intersections with the exception of NH 102 and Fordway/Madden Hill Road (Intersection #10).

These roadway improvement would be based on the latest designs and would follow all applicable American Association of State Highway Transportation Officials (AASHTO), NHDOT, and FHWA guidelines to ensure they address any safety issues and do not create any new ones. The design of I-93 Exit 4A would also follow the latest AASHTO, NHDOT, and FHWA guidelines to ensure the ramps merges and diverges provide adequate distances, the intersections serving the new connector roadway provide proper lane geometry, and traffic signals serving the new intersections can be seen by approaching vehicles.

Any past safety concerns evident from crash data would be assumed to be addressed through the improvement projects. In terms of driver speeding and distracted driver issues, two counter measures could be implemented. NHDOT could install automated speed enforcement cameras to reduce speeding (FHWA, n.d.a). Prior to investing in enforcement cameras, a speed study should be conducted to confirm that the 85th percentile speed is well over the speed limit. For distracted driving, New Hampshire has published is own Net Zero Plan that includes a number of strategies to address distracted drivers. These strategies include (FHWA, n.d.b):

- Education through action plans and local and national campaigns, and exposing young drivers to presentations on the topic
- Enforcement/adjudication through targeted enforcement times and places as well as asking officers to identify the distraction on the crash reports
- Engineering by installing rumble strips
- Legislative policy/programmatic measures to promote strong laws against distracted driving and developing and implementing action plans to focus drivers

8.2.12 Policy Requirement 1 Conclusion

The proposed five alternatives in tandem with the planned roadway improvements each provide a different level of operation, queueing, and safety impacts and benefits. The overall impacts under Alternatives A and B assume Woodmont Commons follows its memorandum of understanding with the Town of Londonderry and implements traffic improvements along NH 102.

Five alternatives and the No Build condition were analyzed to assess if a new interchange is warranted to address the study goals. The No Build condition and Alternative F represent improvements to NH 102 that do not include a new I-93 Exit 4A interchange; therefore, assessment of these alternatives considers using the existing roadway system to address study goals. Based on the forecasted changes in vehicle trip patterns through downtown Derry (see Table 8-1), Alternative F and the No Build condition would not address the goal of reducing pass-through vehicle volumes.

Alternatives A, B, C, and D would each include a new I-93 Exit 4A interchange and a connector roadway to link the interchange to eastern Derry via either a new alignment or improvements to existing alignments. Alternatives A and B would create a new interchange and would serve adjacent developable lane, thus they also include the assumption that induced and background growth would occur in the area. Alternatives C and D would create a new interchange that does not serve adjacent developable land, thus would only include background growth. Therefore, the SNHPC travel demand model created additional vehicle trips in the study area destined to the specific growth areas depending on the alternative. For Alternatives A and B, these growth areas include Woodmont Commons (full build-out) and other smaller developments in Derry, Londonderry, Auburn, Chester, and Sandown. The Woodmont Commons and other background growth vehicle trips were added to freeway facilities and intersections along NH 102 and NH 28. Alternatives C and D only include growth in Chester and Sandown and maintain Woodmont Commons at the same growth level as the No Build condition.

Based on the analysis, the study area freeway facilities would all operate at acceptable levels for Alternatives A, B, C, and D (see Table 8-9). Each alternative would result in a different number of intersections that would operate at worse conditions (operations not queueing) when compared to No Build condition as follows:

- Under Alternative A, four intersections (one along NH 28 and three along NH 102)
- Under Alternative B, one intersection along NH 102
- Under Alternative C, three intersections along NH 102
- Under Alternative D, four intersections along NH 102
- Under Alternative F, none

The proposed trips generated by Woodmont Commons account for most of these intersection issues under Alternatives A and B because these alternatives include the maximum generation of trips under the full build-out scenario. These trips would be added to NH 102 and NH 28 as well as to Exit 4A and the I-93 mainline.

Alternative A Conclusions

Based on the analysis of trip patterns from the SNHPC travel demand model, Alternative A would provide a more parallel route to bypass downtown Derry and connect I-93 and eastern Derry. Alternative A would result in more east-west regional trips using the new I-93 Exit 4A interchange, which would then disperse between Exits 4 and 5 to reach destinations to the west along NH 102 and NH 28. Alternative A would improve I-93 freeway operations at Exit 4, intersection operations at one location along NH 28 and four locations along NH 102, and queueing issues at two locations along NH 28 and three location along NH 102. Therefore, this alternative would resolve the intersection’s operation, queuing, and freeway operation issues and would not significantly affect the safety and operation of the interstate facility. This alternative would also properly collect, distribute, and accommodate traffic between the freeway and proposed new connector roadway as well as Exits 4 and 5. The results do show adverse impacts to three IJR study area intersections, but these will be addressed by the Woodmont Commons traffic mitigation requirements imposed by Londonderry.

Alternative B Conclusions

Alternative B would create a new direct connection to areas northeast of downtown Derry. Based on the travel patterns reported from the model, this new connection would attract more north-south regional trips by shifting vehicles from the NH 28 Bypass to I-93 because the travel time to access I-93 would drop with the Alternative B alignment. The trips destined to locations south of Derry and Londonderry would use I-93 rather than the NH 28 Bypass starting from the new I-93 Exit 4A interchange. The model also indicates that Alternative B would have more downtown Derry pass-through trips than Alternative A. Alternative B would not improve I-93 freeway operations at Exit 4, but would improve intersection operations at one location along NH 28 and five locations along NH 102, and queueing issues at two locations along NH 28 and three location along NH 102. Therefore, this alternative would resolve the intersection operations and queuing issues along NH 102 and NH 28; however, it would also continue to significantly affect the safety and operation of the I-93 NB on-ramp from NH 102. This would cause safety issues with traffic trying to access the freeway from NH 102. Queuing issues at the ramp termini serving Exit 4A would also occur, but these issues could be addressed through the ramp designs. The freeway mainline would not be significantly affected under Alternative B as long as the off-ramps provide enough space to store the forecasted queuing lengths. The results do show an adverse impact to one IJR study area intersection, but this will be addressed by the Woodmont Commons traffic mitigation requirements imposed by Londonderry.

Alternatives C and D Conclusions

Alternative C and D provide variations to Alternatives A and B in terms of the connection route between I-93 and eastern Derry. These alternatives would include a new proposed interchange in a more northern location; therefore they would not create the best parallel route to downtown Derry. They would create more of a bypass to NH 28 between I-93 Exit 5 and where NH 28 intersects the two alignments, would attract more vehicle trips from NH 28 than NH 102, and would attract far fewer trips to Exit 4A than Alternatives A and B. Alternatives C and D would improve I-93 freeway operations at Exit 4, intersection operations at one location along NH 28 and four locations along NH 102, and queueing issues at two locations along NH 28 and three location along NH 102. Therefore, these alternatives would resolve the intersection’s operation, queuing issues along NH 102 and NH 28, and freeway operation issues and would not significantly affect the safety and operation of the interstate facility. These alternatives would also properly collect, distribute, and accommodate traffic between the freeway and proposed new connector roadway as well as Exits 4 and 5.

Alternative F and No Build Conclusions

Alternative F and the No Build would minimally change vehicle trip patterns. Under Alternative F, freeway impacts would continue to occur at the I-93 SB off-ramp to NH 102 and minimal improvement to IJR study area intersection operations and queueing would occur. Therefore, these alternatives would not resolve intersection operation, queuing, and freeway operation issues and would continue to adversely affect the safety and operation of the freeway. Failing freeway facilities would cause queuing onto the I-93 mainline and NH 102 and failing intersections would exist at the ramp termini of Exits 4 and 5.

Overall Conclusions

Based on the goal to reduce through trips traveling through downtown Derry, Alternatives A, B, C, and D would address the policy requirement and Alternatives F would not address the policy requirement. Alternative A would provide the best connection of the five alternatives because it would directly parallel downtown Derry and could handle the design year traffic demands, especially the freeway operations. Some intersections along NH 28 and NH 102 would be affected, but a number of those trips would be directly related to the forecasted trips generated by the Woodmont Commons development. Section 8.2.1 describes the Woodmont Commons PUD process to incrementally perform traffic studies to construct infrastructure improvements, if necessary, to mitigate any future proposed development following the Woodmont Commons PUD Master Plan.

8.2.13 Conceptual Sign Plan

A conceptual sign plan has not been prepared for the proposed alternative designs. It is assumed that once a preferred alternative is identified through the NEPA process and the project moves forward into the design process, a sign plan would be created following the NHDOT and Manual Uniform Traffic Control Devices guidelines to properly alert drivers of the interchange connections, exit locations, entrance locations, ramp speeds, ramp direction (do not enter signs at the end of the ramp), and lane geometry at the ramp termini intersections.

8.3 Policy Requirement 2: Access Connections and Design

The proposed access connects to a public road only and will provide for all traffic movements. Less than "full interchanges" may be considered on a case-by-case basis for applications requiring special access, such as managed lanes (e.g., transit or high occupancy vehicle and high occupancy toll lanes) or park and ride lots. The proposed access will be designed to meet or exceed current standards (23 CFR 625.2(a), 625.4(a)(2), and 655.603(d)). In rare instances where all basic movements are not provided by the proposed design, the report should include a full-interchange option with a comparison of the operational and safety analyses to the partial-interchange option. The report should also include the mitigation proposed to compensate for the missing movements, including wayfinding signage, impacts on local intersections, mitigation of driver expectation leading to wrong-way movements on ramps, etc. The report should describe whether future provision of a full interchange is precluded by the proposed design.

8.3.1 Introduction

The four build alternatives that include a new I-93 Exit 4A interchange have similar designs. The designs follow a standard diamond interchange containing four ramps, two intersections, and a single bridge crossing the Interstate. The spacing for the proposed interchanges places the new interchange over a mile to Exit 4 or Exit 5.

8.3.2 Conceptual Layout

Alternatives A and B include the design of the same interchange approximately 1.25 miles north of Exit 4. The interchange follows a typical diamond interchange design with four ramps, two off-ramps, and two on-ramps, each with adequate space for merging and diverging providing all connections between I-93 and the new connector road. The SB off-ramp would contain two lanes extended to the diverge with I-93 because of the forecasted volume, while the three other ramps would contain one lane. The proposed diamond interchange is the most common interchange configuration and would allow traffic to enter and leave at relatively high speeds (AASHTO, 2011). The ramps would not become new lanes along I-93 but would terminate after providing merging and diverging space. The new connector roadway would contain two intersections, one serving I-93 NB ramps and one serving I-93 SB ramps. A new bridge would be constructed to connect the intersections. The new connector roadway would provide a connection to the Londonderry local roadway network and NH 28 to the east. Figure 8-1 shows the Alternative A and B current interchange design.

Alternatives C and D include a similar diamond interchange design as Alternatives A and B, approximately 1.5 miles south of Exit 5. Figure 8-2 shows the Alternative C and D current interchange design.

These designs both exclude a connection to the west. Alternatives A and B would, therefore, directly connect to the future planned Woodmont Commons PUD development on the eastern side of I-93. Alternatives C and D would not provide a direct connection and instead would connect directly to NH 28. The Woodmont Commons PUD development planned for the western side of I-93 would be accessible from Exit 4A via Ash Street and Pillsbury Road.

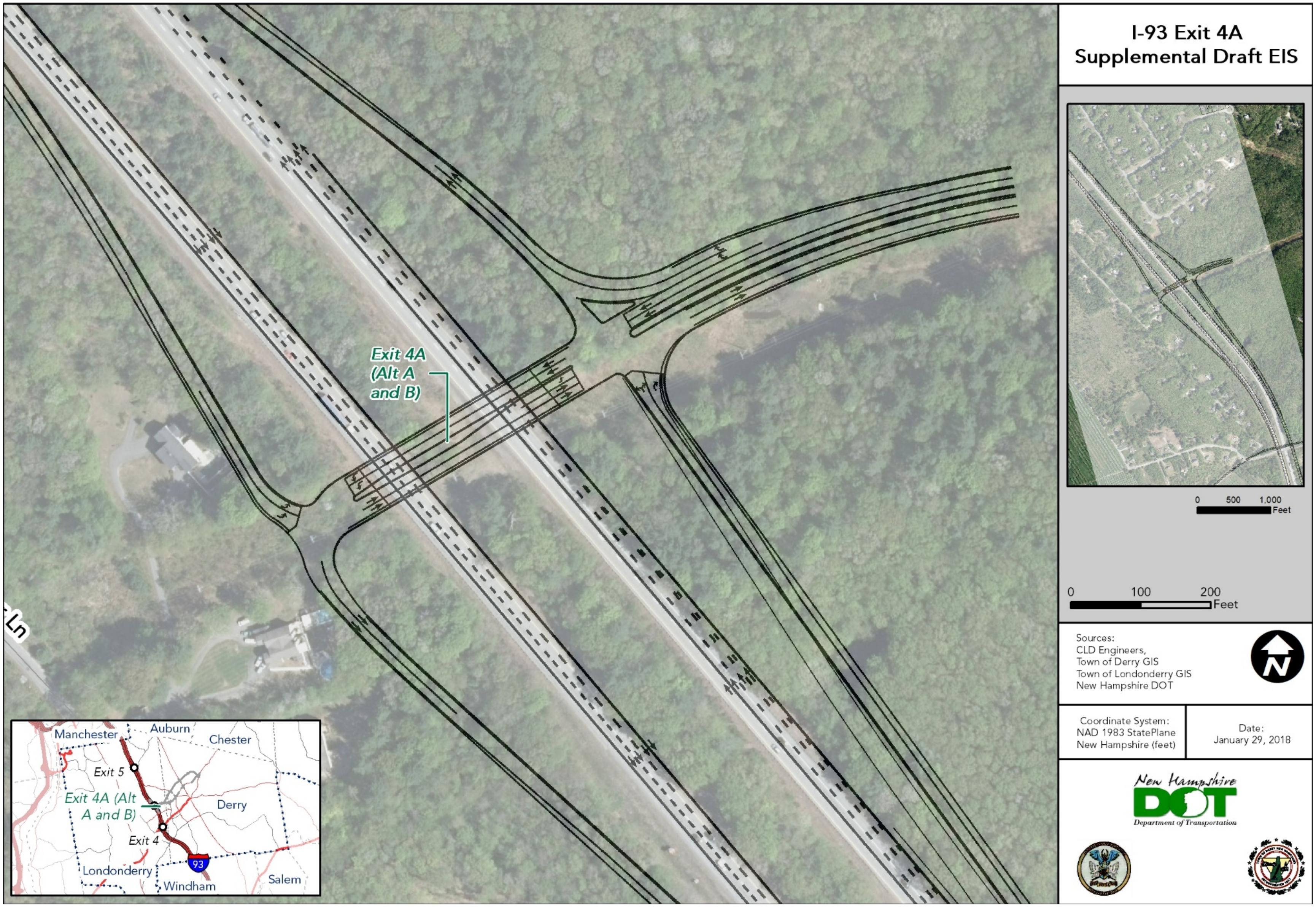


Figure 8-1. Alternatives A and B interchange designs

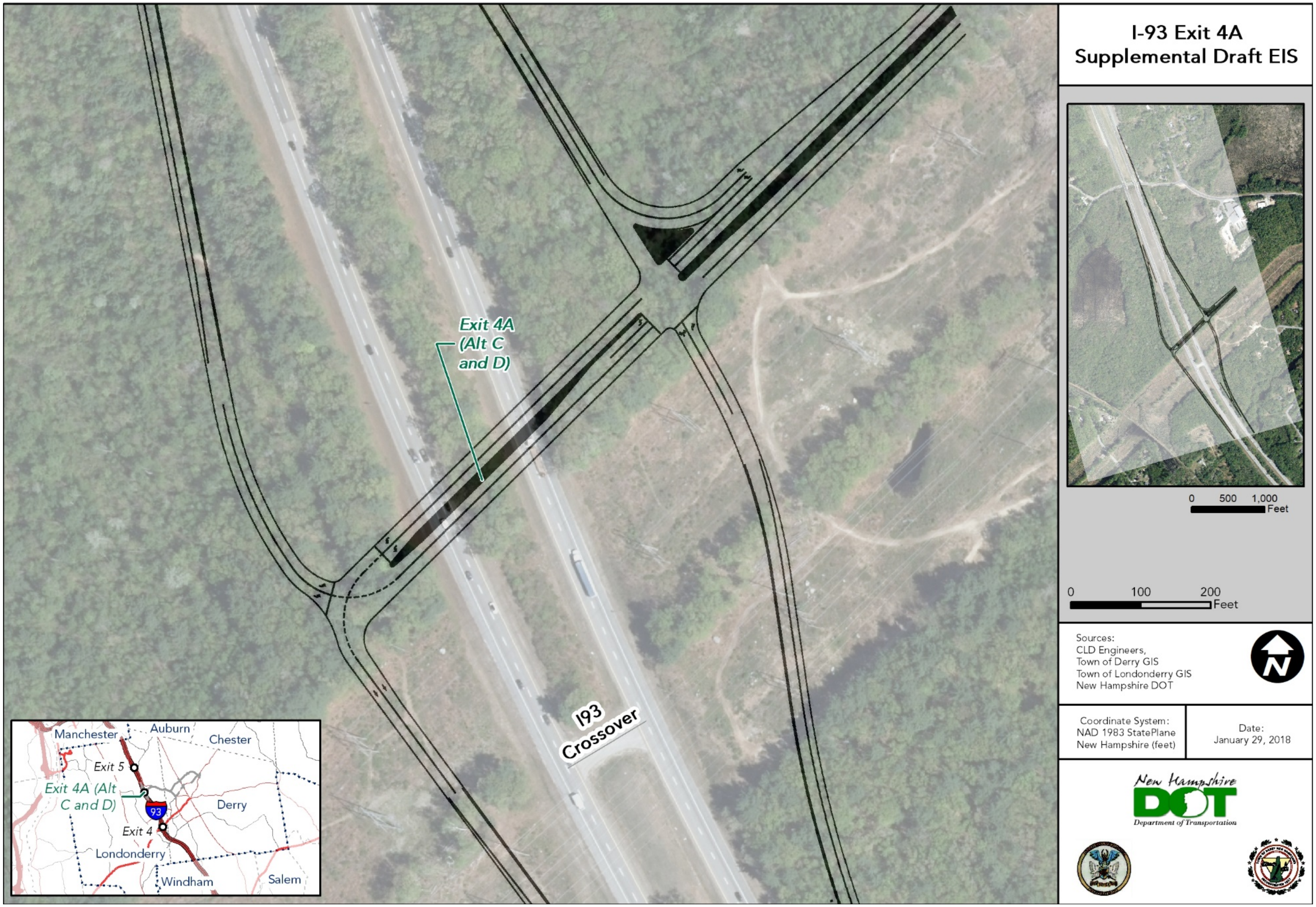


Figure 8-2. Alternatives C and D interchange designs

8.3.3 Present and Future Interchange Spacing

The existing spacing between Exit 4 and Exit 5 is 3.55 miles. Under Alternatives A and B, the proposed interchange spacing between Exit 4 and Exit 4A would be 1.25 miles and between Exit 4A and Exit 5 would be 2.3 miles. Under Alternatives C and D, the proposed interchange spacing between Exit 4 and Exit 4A would be 2.05 miles and between Exit 4A and Exit 5 would be 1.5 miles.

According to the *Policy on Geometric Design of Highways and Streets*, the typical rule of thumb to follow is 1 mile between interchanges in urban areas and 3 miles in rural areas (AASHTO, 2011). In this case, the location is currently suburban in nature and will continue to become more urbanized in the future with additional population and employment growth projected for 2040; therefore, the proposed spacing for either interchange location would exceed the 1-mile minimum threshold.

8.3.4 Policy Requirement 2 Conclusion

The proposed design meets the most common interchange design, and interchange spacing would meet minimum thresholds. The interchange would provide access to parcels to the east of the interchange with connections to NH 28 and points east. Therefore, the proper access would be provided and the interchange design would follow the latest design standards. Before the design is finalized, FHWA would have an opportunity to review.

9.0 SUMMARY

The proposed I-93 Exit 4A interchange would provide an overall benefit to the Londonderry/ Derry area and addresses FHWA's two requirements. Alternative A addresses a number of evaluation factors introduced in Section 4.0, including traffic and accessibility. Table 9-1 summarizes the evaluation criteria presented in Section 4.0 with the preliminary results.

Table 9-1. Preliminary evaluation criteria assessment summary

Criteria	No Build	Alternative A	Alternative B	Alternative C	Alternative D	Alternative F
Traffic	No Change	Improves all freeway and most intersection operations/queuing issues	Improves all freeway and most intersection operations/queuing issues; does not address one on-ramp capacity issue	Improves all freeway and intersection queuing; improves most intersection queuing issues	Improves all freeway and most intersection operations/queuing issues	Minimal Change
Accessibility	No Change	New parallel connection to eastern Derry from I-93 near Exit 4	New connection to northeastern Derry from I-93 near Exit 4	New connection to eastern Derry from I-93 near Exit 5	New connection to northeastern Derry from I-93 near Exit 5	No Change

The IJR study provided an assessment of the existing conditions, future baseline conditions (No Build condition), and future Build based on five alternatives. The future conditions (No Build and Build) were evaluated based on a quantitative traffic operations, queueing, and volume shift assessment as well as a crash data analysis covering the freeway and NH 28/NH 102. The IJR study integrated the various assessments to answer each of the FHWA policy requirements. The following is a summary of the findings for each policy requirement:

1. Operational and Collision Analysis: Alternatives A, B, C and D would not adversely impact the traffic and safety issues along the I-93 freeway as well as NH 102 and NH 28. This includes queuing issues along the ramps serving I-93, the ramp termini intersections at NH 102 and NH 28, and other intersections within the IJR study area. Traffic would also be properly distributed between the different roadway classifications (freeway to ramps to principal arterials to collectors to local roadways).
2. Access Connections and Design: Alternatives A, B, C, and D would all meet minimum interchange spacing thresholds and follow typical interchange design standards established in the AASHTO design manual.

Table 9-2 contains the FHWA policy requirement assessment summary and provides a rating to indicate if the alternative would address the policy requirement. Green indicates the alternative would fully address the policy rating, orange means the alternative would partially address the policy rating, and red means the alternative would minimally address the policy requirements.

Table 9-2. FHWA policy requirement assessment summary

Policy Number		Alternative A	Alternative B	Alternative C	Alternative D	Alternative F
1	Operational and Collision Analysis	Does not adversely impact intersection traffic and safety issues and properly distributes traffic between roadway classes	Does not adversely impact intersection traffic and safety issues and properly distributes traffic between roadway classes	Does not adversely impact intersection traffic and safety issues and properly distributes traffic between roadway classes	Does not adversely impact intersection traffic and safety issues and properly distributes traffic between roadway classes	Adverse impact to traffic operation and safety issues
2	Access Connections and Design	Designs meet minimum thresholds	Designs meet minimum thresholds	Designs meet minimum thresholds	Designs meet minimum thresholds	No Change in freeway network

10.0 REFERENCES

AASHTO (American Association of State Highway Transportation Officials). 2011. Policy on Geometric Design of Highways and Streets. American Association of State Highway Transportation Officials. Washington DC, 2011.

Boston Express. 2016. Boston Express Schedules. Available at: http://www.bostonexpressbus.com/index.php/schedules. Accessed February 21, 2018.

CART (Cooperative Alliance for Transportation). n.d. Services. Available at: http://www.cart-rides.org/html/services.htm. Accessed August 24, 2017.

CLD (CLD Consulting Engineers, Inc.). 2000. Rationale Report, EIS Study: NH Route 102 Improvements, Derry-Londonderry, NH. Prepared for Towns of Derry and Londonderry, New Hampshire. July 2000.

CLD. 2001. Scoping and Rationale Report, EIS Study: NH Route 102 Bypass Study, Derry-Londonderry, NH. Prepared for Towns of Derry and Londonderry, New Hampshire. March 2001.

CLD. 2017. Exit 4a Traffic Technical Memorandum No. 2. May 4, 2017.

Concord Coach Lines. 2017. Schedule. Available at: https://3b28o63pmly8yngc7351s3zs-wpengine.netdna-ssl.com/wp-content/uploads/2017/05/CCL_NH_MAY_2017_FINAL-forWeb.pdf. Accessed August 24, 2017.

Derry Rail Trail Alliance. 2017. Derry Rail Trail. Available at: http://derryrailtrail.org/. Accessed February, 21, 2018.

FHWA (Federal Highway Administration). n.d.a. Crash modification Factors Clearinghouse. Available at: http://www.cmfclearinghouse.org/results.cfm. Accessed April 10, 2018.

FHWA. n.d.b. Roadway Safety Professional Capacity Building. Available at: https://rspcb.safety.fhwa.dot.gov/shspsearch/statesearch.aspx. Accessed April 10, 2018.

FHWA. 2007. I-93 Exit 4A Interchange Study Derry-Londonderry Draft Environmental Impact Statement. July 2007.

FHWA, 2011. Highway Safety Improvement Program Manual. Chapter 3.0. Available at: https://safety.fhwa.dot.gov/hsip/resources/fhwasa09029/sec3.cfm. Accessed April 6, 2018.

FHWA. 2017a. Interstate System Access Information Guide. Dated August 2017. Available at: https://www.fhwa.dot.gov/design/interstate/pubs/access/access.pdf. Accessed August 22, 2017.

FHWA. 2012b. Interchange Design. Available at: https://www.fhwa.dot.gov/modiv/programs/intersta/idp.cfm Accessed April 18, 2018.

Londonderry Trails. 2016. Granite State Rail Trail Connections. Available at: https://londonderrytrails.files.wordpress.com/2015/08/recreation-corridor-region-reduced-3-2016.pdf. Accessed August 25, 2016.

Londonderry Trailways. 2016. Granite State Rail Trail, Londonderry, New Hampshire. Updated March 2016. Prepared by Londonderry Planning and Economic Development Department. Available at: https://londonderrytrails.org/about-the-rail-trail/.

Louis Berger. 2017. Land Use Scenarios Technical Report.

MassDOT (Massachusetts Department of Transportation). 2018. Crash Rates by Roadway Functional Classification. Available at: http://www.massdot.state.ma.us/highway/Departments/TrafficandSafetyEngineering/CrashData/CrashRates/RoadwayFunctionalClassification.aspx. Accessed April 9, 2018.

NHDOT. (New Hampshire Department of Transportation). 2009. Draft Supplemental Environmental Impact Statement and Reevaluation/ Section 4(f) Evaluation, Interstate 93 Improvements Salem to Manchester IM-IR-93-I(174)0, 10418-C. Available at: http://www.rebuildingi93.com/content/environmental/seis/. Accessed April 24, 2018.

NHDOT. 2010-2014. New Hampshire Department of Transportation Crash Data. Available at: ftp://pubftp.nh.gov/DOT/Planning and Community Assistance/Road Data/Public/Crash/. Accessed April, 27, 2018.

NHDOT. 2013-2015. New Hampshire Department of Transportation GIS Planning. Available at: http://gis.dot.nh.gov/nh-roads/. Accessed April, 27, 2018.

NHDOT. 2016a. Bureau of Traffic, Traffic Reports. Available at: https://www.nh.gov/dot/org/operations/traffic/tvr/routes/documents/i-93.pdf. Accessed August 24, 2017.

NHDOT. 2016b. Bureau of Traffic, Traffic Reports. Available at: https://www.nh.gov/dot/org/operations/traffic/tvr/routes/documents/nh-28.pdf. Accessed August 24, 2017.

NHDOT. 2016c. Bureau of Traffic, Traffic Reports. Available at: https://www.nh.gov/dot/org/operations/traffic/tvr/routes/documents/nh-102.pdf. Accessed August 24, 2017.

NHDOT. 2017a. New Hampshire Functional Classification map. Available at: https://www.nh.gov/dot/org/projectdevelopment/planning/gis-data-catalog/documents/FunctionSystem.pdf. Accessed August 24, 2017.

NHDOT. 2017b. Rebuilding I-93 Salem to Manchester. Available at: http://www.rebuildingi93.com/documents/factsheets/June2017/14633B-June-2017.pdf. Accessed August 28, 2017.

NHGov. 2017a. Londonderry Exeter 4 Park and Ride. NH Rideshare Program. Available at: https://www.nh.gov/dot/programs/rideshare/lots/londonderry.htm. Accessed August 24, 2017.

NHGov. 2017b. North Londonderry Park and Ride. NH Rideshare Program. Available at: https://www.nh.gov/dot/programs/rideshare/lots/north-londonderry.htm. Accessed August 24, 2017.

Pillsbury. 2018. Memorandum of Understanding between Woodmont Commons Developer and Town of Londonderry, NH. Available at: http://www.londonderrynh.org/Pages/LondonderryNH_BComm/Planning/commondocs/DevelopmentAgreement82813-FINAL%20DRAFT.pdf. Accessed February 12, 2018.

Rockingham Planning Commission. 2015. 2015 Regional Master Plan: Transportation Chapter. Adopted April 10, 2015. Available at: http://www.rpc-nh.org/application/files/3114/6100/8444/5_RMPTransportation.pdf.

SNHPC (Southern New Hampshire Planning Commission). 2014. Moving Southern NH Forward Regional Comprehensive Plan 2015. Available at: http://www.snhpc.org/pdf/SNHPCRegionCompPlan2015.pdf. Accessed April 18, 2018.

Town of Derry. 2010. Town of Derry New Hampshire Master Plan. March 2010. Available at: https://www.derrynh.org/sites/derrynh/files/uploads/derrymasterplan2010_finaldraft_0.pdf. Accessed February 16, 2018.

Town of Derry. 2016. Zoning Ordinance. Available at: http://www.derrynh.org/sites/derrynh/files/uploads/zo_07.07.2016.pdf. Accessed February 21, 2018.

Town of Londonderry. 2013. Town of Londonderry, New Hampshire Comprehensive Master Plan. Available at: http://londonderrynh.org/Pages/LondonderryNH_BComm/Planning/MPSCResources/LondonderryMasterPlan_FINAL_010413-ISSUU.pdf. Accessed February 16, 2018.

Town of Londonderry. 2016. NH Zoning Ordinance. As amended through August 15, 2016. Available at: http://online.encodeplus.com/regs/londonderry-nh/doclibrary.aspx?id=ada5cd93-15cf-4aca-9273-2a8dc2a7503d. Accessed February 21, 2018.

TEC. 2016. Woodmont Commons Planned Unit Development- Phases I and II, Traffic Impact and Access Study, July 14, 2016.

TRB (Transportation Research Board). 2000. Highway Capacity Manual (HCM). Transportation Research Board for the National Academies of Science, Washington, DC.

TRB. 2010. Highway Capacity Manual (HCM). Transportation Research Board for the National Academies of Science, Washington, DC.

USACE (U.S. Army Corps of Engineers), 1993. The Highway Methodology Workbook: Integrating Corps Section 404 Permit Requirements with Highway Planning and Engineering and the NEPA EIS Process.

Woodmont Planning Team, 2011. Woodmont Commons Master Plan. Available at: http://londonderrynh.org/Pages/LondonderryNH_BComm/Planning/commondocs/Masterplan10.14.FINAL(1)10-14-11.pdf. Accessed April 27, 2018.

Appendix D: Farmland Conversion Impact Rating Form AD 1006

United States Department of Agriculture
NRCS Natural Resources Conservation Service
The Concord Center, 10 Ferry Street, Box 312, Concord, NH 03301-5081 (603) 223-6023 Fax (603) 223-6030 www.nh.nrcs.usda.gov

February 27, 2006

Amanda Farris
Woodlot Alternatives
30 Park Drive
Topsham, ME 04086

Re: Farmland Conversion Impact Rating for the I-93 Exit 4a Interchange Study in Derry and Londonderry, NH

Dear Ms. Farris,

The Farmland Conversion Impact rating has been completed based on your correspondence of February 17, 2006. I am forwarding a completed Form NRCS-CPA-106, Farmland Conversion Impact Rating for Corridor Type Projects. All areas impacted by the project are either designated as urbanized areas by the U.S. Census Bureau or soils that are not prime, statewide or locally important. Therefore, this project is not subject to FPPA and no further action is required.

If you have any questions, please do not hesitate to contact me.

Katherine Swain

Katherine Swain
MLRA Soil Survey Leader
USDA, NRCS
10 Ferry St., Box 312
Concord, NH 03301
Ph: (603)223-6025

Enc.

U.S. DEPARTMENT OF AGRICULTURE
Natural Resources Conservation Service

NRCS-CPA-106
(Rev. 1-91)

FARMLAND CONVERSION IMPACT RATING FOR CORRIDOR TYPE PROJECTS

PART I *(To be completed by Federal Agency)*	3. Date of Land Evaluation Request 2/17/06	4. Sheet 1 of 1	
1. Name of Project **I-93 Exit 4a Interchange Study**	5. Federal Agency Involved		
2. Type of Project **Adding exit to existing highway**	6. County and State **Rockingham County, NH**		
PART II *(To be completed by NRCS)*	1. Date Request Received by NRCS 2/17/06	2. Person Completing Form **Katherine Swain**	
3. Does the corridor contain prime, unique statewide or local important farmland? (If no, the FPPA does not apply - Do not complete additional parts of this form). YES ☐ NO ☑		4. Acres Irrigated 0	Average Farm Size 125 Ac.
5. Major Crop(s) **corn silage, grass legume hay**	6. Farmable Land in Government Jurisdiction Acres: 349,686 % 27	7. Amount of Farmland As Defined in FPPA Acres: 126,772 % 27	
8. Name Of Land Evaluation System Used **Rockingham County**	9. Name of Local Site Assessment System **NA**	10. Date Land Evaluation Returned by NRCS 2/27/06	

PART III *(To be completed by Federal Agency)*	Maximum Points	Alternative Corridor For Segment ______ Corridor A	Corridor B	Corridor C	Corridor D
A. Total Acres To Be Converted Directly					
B. Total Acres To Be Converted Indirectly, Or To Receive Services					
C. Total Acres In Corridor		0	0	0	0
PART IV *(To be completed by NRCS) Land Evaluation Information*					
A. Total Acres Prime And Unique Farmland					
B. Total Acres Statewide And Local Important Farmland					
C. Percentage Of Farmland in County Or Local Govt. Unit To Be Converted					
D. Percentage Of Farmland in Govt. Jurisdiction With Same Or Higher Relative Value					
PART V *(To be completed by NRCS) Land Evaluation Information Criterion Relative value of Farmland to Be Serviced or Converted (Scale of 0 - 100 Points)*					
PART VI *(To be completed by Federal Agency) Corridor Assessment Criteria (These criteria are explained in 7 CFR 658.5(c))*	Maximum Points				
1. Area in Nonurban Use	15				
2. Perimeter in Nonurban Use	10				
3. Percent Of Corridor Being Farmed	20				
4. Protection Provided By State And Local Government	20				
5. Size of Present Farm Unit Compared To Average	10				
6. Creation Of Nonfarmable Farmland	25				
7. Availability Of Farm Support Services	5				
8. On-Farm Investments	20				
9. Effects Of Conversion On Farm Support Services	25				
10. Compatibility With Existing Agricultural Use	10				
TOTAL CORRIDOR ASSESSMENT POINTS	160	0	0	0	0
PART VII *(To be completed by Federal Agency)*					
Relative Value Of Farmland (From Part V)	100				
Total Corridor Assessment (From Part VI above or a local site assessment)	160	0	0	0	0
TOTAL POINTS *(Total of above 2 lines)*	260	0	0	0	0

1. Corridor Selected:	2. Total Acres of Farmlands to be Converted by Project:	3. Date Of Selection:	4. Was A Local Site Assessment Used? YES ☐ NO ☐

5. Reason For Selection:

Signature of Person Completing this Part: DATE

NOTE: Complete a form for each segment with more than one Alternate Corridor

From:	Laurin, Marc
To:	"Whitcomb, Peter - NRCS, Concord, NH"
Cc:	Jamie Sikora; Cota, Keith; Christopher Bean (CBean@fando.com); Snyder, Kerri; Tidd, Leo
Subject:	RE: Derry-Londonderry, 13065 - Farmland Conversion Impact Rating Form
Date:	Wednesday, July 18, 2018 2:59:10 PM
Attachments:	AD 1006_Exit 4A_2018_Alts A-F Signed.pdf

External

Peter,

Attached is the completed and signed Farmland Conversion Impact Rating Form for the project. The total point score for the Selected Corridor (Alternative A) is less than 160, as such the project is in full compliance with the FPPA.

Thank you for your assistance.

If you have any questions or comments, please contact me.

Marc

From: Whitcomb, Peter - NRCS, Concord, NH [mailto:peter.whitcomb@nh.usda.gov]
Sent: Thursday, July 05, 2018 11:26 AM
To: Laurin, Marc
Subject: RE: Derry-Londonderry, 13065 - Farmland Conversion Impact Rating Form

Marc,

Parts II, IV, and V of form CPA-106, the Farmland Conversion Impact Rating For Corridor Type Projects (attached) have been completed. The Relative Value of each alternative corridor is 34 or less. Please note that Alternative A does not include any land that is Prime, Statewide or Locally Important Farmland, and therefore is not subject to the Farmland Protection Policy Act. Also attached is the soil map of the area and a Farmland Classification map.

Please fill out Parts VI and VII. If the total point score is 160 or less, then the project is in full compliance with FPPA and no further action is required. If the total point score is above 160 points, then alternative design or location should be considered that might reduce the total point score. If this is not possible, then an explanation should be provided in Block 5 at the bottom of the form. Additional information about completing the form and the Farmland Protection Policy Act can be found at the following web site: http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/landuse/fppa/.

Please provide a final copy of the completed CPA-106 to me for NRCS records and retain a copy for your records, regardless of the total point score.

If you have any questions, please feel free to contact me.

Peter

From: Laurin, Marc [mailto:Marc.Laurin@dot.nh.gov]
Sent: Friday, June 22, 2018 1:15 PM
To: Whitcomb, Peter - NRCS, Concord, NH <peter.whitcomb@nh.usda.gov>
Cc: Jamie Sikora <jamie.sikora@dot.gov>; Cota, Keith <Keith.Cota@dot.nh.gov>; Butler, John (DOT) <John.Butler@dot.nh.gov>; Chris Bean <ChrisB@cldengineers.com>; Leo Tidd <ltidd@louisberger.com>; Snyder, Kerri <KSnyder@louisberger.com>
Subject: Derry-Londonderry, 13065 - Farmland Conversion Impact Rating Form

Mr. Whitcomb,

Enclosed for your evaluation are Farmland Conversion Forms for the Alternatives being evaluated for the I-93 Exit 4A Project SDEIS.

Please contact me if you have any questions.

Thank you.

Marc Laurin
Senior Environmental Manager
Bureau of Environment
NH Department of Transportation
(603) 271-4044

U.S. DEPARTMENT OF AGRICULTURE
Natural Resources Conservation Service

NRCS-CPA-106
(Rev. 1-91)

FARMLAND CONVERSION IMPACT RATING FOR CORRIDOR TYPE PROJECTS

PART I *(To be completed by Federal Agency)*	3. Date of Land Evaluation Request 6/22/18	4. Sheet 1 of 1
1. Name of Project I-93 Exit 4A	5. Federal Agency Involved FHWA	
2. Type of Project highway interchange	6. County and State Rockingham County, NH	
PART II *(To be completed by NRCS)*	1. Date Request Received by NRCS 6/22/18	2. Person Completing Form Peter Whitcomb
3. Does the corridor contain prime, unique statewide or local important farmland? (If no, the FPPA does not apply - Do not complete additional parts of this form). YES ☑ NO ☐		4. Acres Irrigated 0 / Average Farm Size 125
5. Major Crop(s) corn silage, grass legume hay	6. Farmable Land in Government Jurisdiction Acres: 349,686 % 75.2	7. Amount of Farmland As Defined in FPPA Acres: 126,772 % 27
8. Name Of Land Evaluation System Used Rockingham County	9. Name of Local Site Assessment System N/A	10. Date Land Evaluation Returned by NRCS 7/5/18

PART III *(To be completed by Federal Agency)*	Maximum Points	Alternative Corridor For Segment Alternatives A-D			
		Corridor A	Corridor B	Corridor C	Corridor D
A. Total Acres To Be Converted Directly		69.50	78.69	89.91	87.42
B. Total Acres To Be Converted Indirectly, Or To Receive Services		0	0	0	0
C. Total Acres In Corridor					
PART IV *(To be completed by NRCS) Land Evaluation Information*					
A. Total Acres Prime And Unique Farmland		0	0	0	0
B. Total Acres Statewide And Local Important Farmland		0	2	2	1
C. Percentage Of Farmland in County Or Local Govt. Unit To Be Converted		0	0.001	0.001	0.001
D. Percentage Of Farmland in Govt. Jurisdiction With Same Or Higher Relative Value		74	72	70	75
PART V *(To be completed by NRCS) Land Evaluation Information Criterion Relative value of Farmland to Be Serviced or Converted (Scale of 0 - 100 Points)*		18	28	34	19
PART VI *(To be completed by Federal Agency) Corridor Assessment Criteria (These criteria are explained in 7 CFR 658.5(c))*	Maximum Points				
1. Area in Nonurban Use	15	5	5	5	5
2. Perimeter in Nonurban Use	10	0	0	0	0
3. Percent Of Corridor Being Farmed	20	0	0	0	0
4. Protection Provided By State And Local Government	20	0	0	0	0
5. Size of Present Farm Unit Compared To Average	10	0	0	0	0
6. Creation Of Nonfarmable Farmland	25	0	0	0	0
7. Availablility Of Farm Support Services	5	0	0	0	0
8. On-Farm Investments	20	0	0	0	0
9. Effects Of Conversion On Farm Support Services	25	0	0	0	0
10. Compatibility With Existing Agricultural Use	10	10	10	10	10
TOTAL CORRIDOR ASSESSMENT POINTS	160	15	15	15	15
PART VII *(To be completed by Federal Agency)*					
Relative Value Of Farmland (From Part V)	100	18	28	34	19
Total Corridor Assessment (From Part VI above or a local site assessment)	160	15	15	15	15
TOTAL POINTS *(Total of above 2 lines)*	260	33	43	49	34

1. Corridor Selected:	2. Total Acres of Farmlands to be Converted by Project:	3. Date Of Selection:	4. Was A Local Site Assessment Used?
Alternative A	0	7/1/18	YES ☐ NO ☑

5. Reason For Selection:

Alternative A was selected as the Preferred Alternative based on the results of engineering, environmental, and socioeconomic studies (see SDEIS). Advantages of Alternative A compared to the other Build Alternatives include lowest cost, including utilities; least acreage for ROW acquisitions; least area of stream impacts; lowest wetland impacts of the alternatives that meet the purpose and need; and no impact on Wildlife Action Plan (WAP) highest ranked habitat.

Signature of Person Completing this Part: Marc G. Laurin Marc G. Laurin

DATE 7/18/18

NOTE: Complete a form for each segment with more than one Alternate Corridor

U.S. DEPARTMENT OF AGRICULTURE
Natural Resources Conservation Service

NRCS-CPA-106
(Rev. 1-91)

FARMLAND CONVERSION IMPACT RATING FOR CORRIDOR TYPE PROJECTS

PART I *(To be completed by Federal Agency)*	3. Date of Land Evaluation Request: 6/22/18 — 4. Sheet 1 of 1
1. Name of Project: I-93 Exit 4A	5. Federal Agency Involved: FHWA
2. Type of Project: highway interchange	6. County and State: Rockingham County, NH
PART II *(To be completed by NRCS)*	1. Date Request Received by NRCS: 6/22/18 — 2. Person Completing Form: Peter Whitcomb
3. Does the corridor contain prime, unique statewide or local important farmland? (If no, the FPPA does not apply - Do not complete additional parts of this form). YES ☐ NO ☐	4. Acres Irrigated: 0 — Average Farm Size: 125

5. Major Crop(s): corn silage, grass legume hay	6. Farmable Land in Government Jurisdiction — Acres: 349,686 % 75.2	7. Amount of Farmland As Defined in FPPA — Acres: 126,772 % 27
8. Name Of Land Evaluation System Used: Rockingham County	9. Name of Local Site Assessment System: N/A	10. Date Land Evaluation Returned by NRCS: 7/5/18

	Maximum Points	Alternative Corridor For Segment Alternative F (Corridor A): Corridor A	Corridor B	Corridor C	Corridor D
PART III *(To be completed by Federal Agency)*					
A. Total Acres To Be Converted Directly		21.51			
B. Total Acres To Be Converted Indirectly, Or To Receive Services		0			
C. Total Acres In Corridor		21.51			
PART IV *(To be completed by NRCS) Land Evaluation Information*					
A. Total Acres Prime And Unique Farmland		0			
B. Total Acres Statewide And Local Important Farmland		1			
C. Percentage Of Farmland in County Or Local Govt. Unit To Be Converted		0.001			
D. Percentage Of Farmland in Govt. Jurisdiction With Same Or Higher Relative Value		78			
PART V *(To be completed by NRCS) Land Evaluation Information Criterion Relative value of Farmland to Be Serviced or Converted (Scale of 0 - 100 Points)*		3			
PART VI *(To be completed by Federal Agency) Corridor Assessment Criteria (These criteria are explained in 7 CFR 658.5(c))*	Maximum Points				
1. Area in Nonurban Use	15	0			
2. Perimeter in Nonurban Use	10	0			
3. Percent Of Corridor Being Farmed	20	0			
4. Protection Provided By State And Local Government	20	0			
5. Size of Present Farm Unit Compared To Average	10	0			
6. Creation Of Nonfarmable Farmland	25	0			
7. Availablility Of Farm Support Services	5	0			
8. On-Farm Investments	20	0			
9. Effects Of Conversion On Farm Support Services	25	0			
10. Compatibility With Existing Agricultural Use	10	5			
TOTAL CORRIDOR ASSESSMENT POINTS	160	5	0	0	0
PART VII *(To be completed by Federal Agency)*					
Relative Value Of Farmland (From Part V)	100	3	0	0	0
Total Corridor Assessment (From Part VI above or a local site assessment)	160	5	0	0	0
TOTAL POINTS *(Total of above 2 lines)*	260	8	0	0	0

1. Corridor Selected:	2. Total Acres of Farmlands to be Converted by Project:	3. Date Of Selection:	4. Was A Local Site Assessment Used?
Alternative A	0	7/1/18	YES ☐ NO ☑

5. Reason For Selection:

Alternative A was selected as the Preferred Alternative based on the results of engineering, environmental, and socioeconomic studies (see SDEIS). Advantages of Alternative A compared to the other Build Alternatives include lowest cost, including utilities; least acreage for ROW acquisitions; least area of stream impacts; lowest wetland impacts of the alternatives that meet the purpose and need; and no impact on Wildlife Action Plan (WAP) highest ranked habitat.

Signature of Person Completing this Part:	DATE
Marc G. Laurin	7/18/18

NOTE: Complete a form for each segment with more than one Alternate Corridor

Appendix E: Noise Technical Report

Noise Technical Report

I-93 Exit 4A
Technical Report

Prepared for:

Town of Derry
Town of Londonderry
New Hampshire Department of Transportation

Prepared by:

CLD / Fuss & O'Neill and Louis Berger

Version: 3
September 7, 2018

NHDOT Project Number: 13065
Federal Project Number: IM-0931(201)
CLD/Towns Project Number 05-0244

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

ABBREVIATIONS AND ACRONYMS

CFR	Code of Federal Regulations
dBA	Adjusted Decibels
DEIS	Draft Environmental Impact Statement
EIS	Environmental Impact Statement
FHWA	Federal Highway Administration
FEIS	Final Environmental Impact Statement
L_{eq}	Equivalent Sound Level
NAC	Noise Abatement Criteria
NEPA	National Environmental Policy Act
NHDES	New Hampshire Department of Environmental Services
NHDOT	New Hampshire Department of Transportation
NSA	Noise Sensitive Area
Project	Exit 4A Project
SDEIS	Supplemental Draft Environmental Impact Statement

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1.0 INTRODUCTION

The I-93 Exit 4A Project (Project) is proposed by the Towns of Derry and Londonderry and the New Hampshire Department of Transportation (NHDOT), in cooperation with the Federal Highway Administration (FHWA). A Supplemental Draft Environmental Impact Statement (SDEIS) is being prepared for the project. The proposed project meets the definition of a Type I project under FHWA's noise regulation (23 CFR 772) because it involves a new interchange and connector roadway. Therefore, a traffic noise study is required to identify noise-sensitive land uses, model traffic noise impacts, and evaluate noise abatement measures for impacted receptors.

As part of this study, the need for and design of noise barriers along the I-93 mainline within the project area has been reevaluated in light of the Exit 4A, specifically for receptors along Trolley Car Lane on the west side of I-93, and along Seasons Lane on the east side of I-93. Noise barriers were designed for these locations as part of the I-93 widening, but these barrier designs do not take into account the location of the Exit 4A ramps and associated fill.

1.1 Project Alternatives

The purpose of the Project is to reduce congestion and improve safety along NH 102, from I-93 east through downtown Derry and to promote economic vitality in the Derry/Londonderry area. Five build alternatives are under consideration as summarized below. Alternative A is the preferred alternative identified in the SDEIS. As shown in Figure 1-1, Alternatives A and B share a common new interchange location approximately 1.5 miles north of Exit 4 (referred to as the southern interchange location), as do Alternatives C and D approximately 2 miles north of Exit 4 (northern interchange location). All the new interchange alternatives (A, B, C and D) involve construction the new connector roadway on a bridge over I-93. For detailed mapping of the alternatives, refer to Chapter 3 of the SDEIS.

Alternative A

Alternative A (the preferred alternative) includes a corridor that is approximately 3.2 miles in length between the new proposed I-93 Exit 4A interchange and eastern Derry. There would be approximately 1 mile of roadway construction on a new alignment, 1.6 miles of existing roadway reconstruction, and 0.6 miles of roadway with no improvements. It would originate from the southern I-93 Exit 4A interchange location and travel northeast along new alignment through a wooded area to Folsom Road, near its intersection with North High Street and Madden Road. This alternative would continue to follow Folsom Road past Ross' Corner (Manchester Road/NH 28) and continue on Tsienneto Road across NH 28 Bypass to its end at NH 102, adjacent to Beaver Lake.

Alternative B

The Alternative B corridor is approximately 3.4 miles in length between the new proposed I-93 Exit 4A interchange and eastern Derry. The entire 3.4-mile corridor would consist of roadway construction on new alignment. It would originate from a new southern I-93 Exit 4A interchange and travel northeast along a new alignment through a wooded area to the intersection of Ashleigh Drive and NH 28. From this intersection, this alternative would extend northeast towards the intersection of London Road and NH 28 Bypass and then continue on new alignment to the intersection of Tsienneto Road and NH 102.

Alternative C

The Alternative C corridor is approximately 3.7 miles in length between the new proposed I-93 Exit 4A interchange and eastern Derry. Approximately 2.9 miles of corridor would be on new alignment, while approximately 0.8 miles would reconstruct existing roadways. The alternative would start from a new northern I-93 Exit 4A interchange and travel east approximately 0.7 miles along a powerline ROW to NH 28. Following NH 28 south to the intersection of Ashleigh Drive, it would follow the same alignment as Alternative B to the intersection of Tsienneto Road and NH 102.

Alternative D

The Alternative D corridor is approximately 3.9 miles in length between the new proposed I-93 Exit 4A interchange and eastern Derry. Within this corridor, approximately 0.8 miles would be on new alignment, 2.5 miles on existing roadways would be reconstructed, and 0.6 miles would have no improvements. The alternative would commence from a new northern I-93 Exit 4A interchange and travel east approximately 0.7 miles along a powerline ROW to NH 28. Following NH 28 south to Ross' Corner, the corridor would then follow the same path as Alternative A to the intersection of Tsienneto Road and NH 102.

Alternative F

Alternative F focuses all improvements along the existing NH 102 corridor between Exit 4 at I-93 and downtown Derry. A two-way, center, left-turn lane would be constructed from Londonderry Road to NH Route 28, and improvements would be made to existing intersections. The majority of existing on-street parking spaces would be lost to accommodate the center turn lane. The corridor would be 1.7 miles long, with the entire corridor consisting of roadway reconstruction (i.e., there is no portion on new alignment).

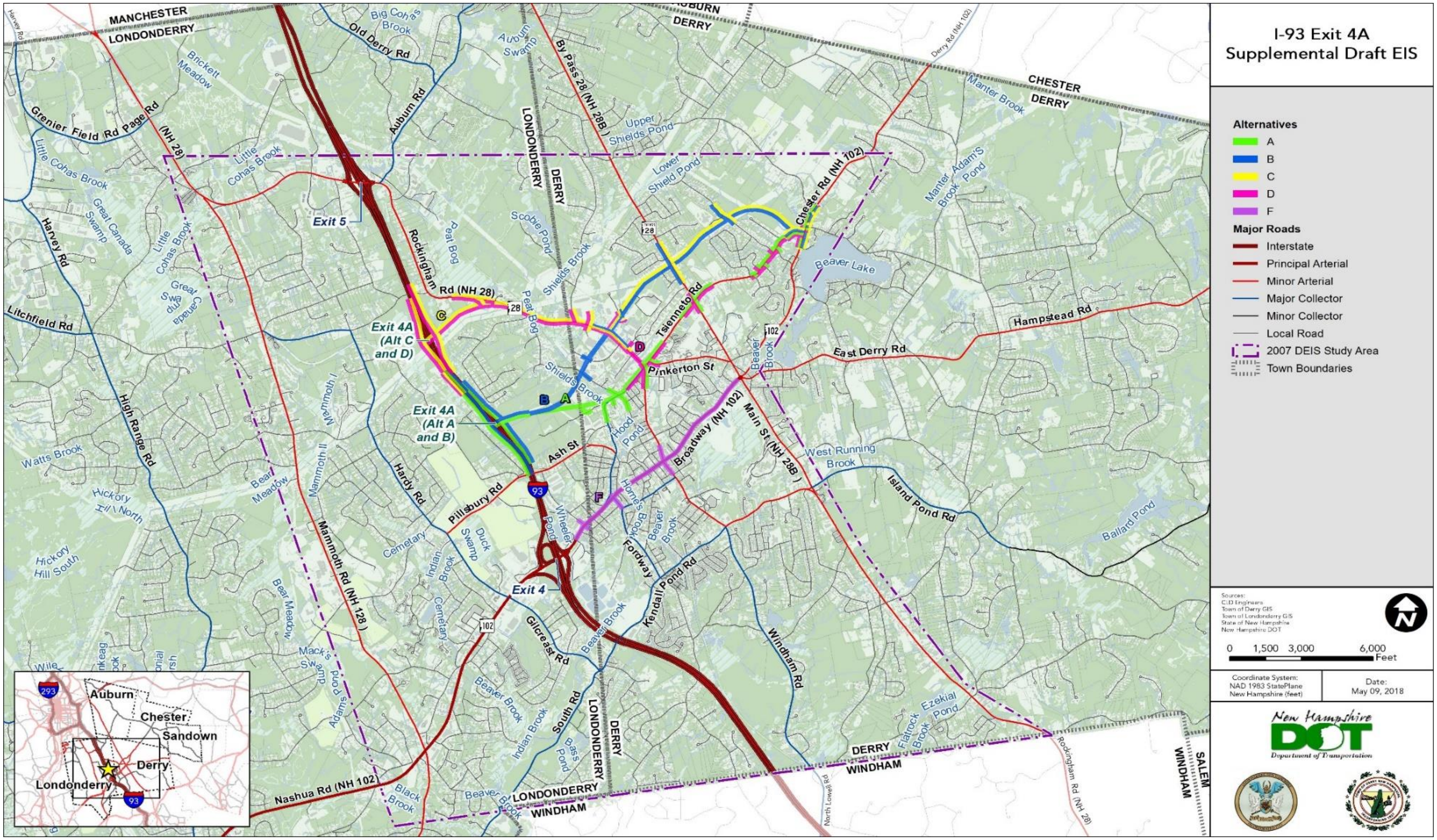


Figure 1-1. Project Location

2.0 BACKGROUND

2.1 Characteristics of Noise

Noise is defined as undesired and disruptive sound. It can be emitted from many sources, including airplanes, factories, railroads, power generation plants, and highway vehicles. Highway noise, or traffic noise, is usually a composite of noises from engine exhaust and tire-roadway interaction.

The magnitude of noise is usually described by its sound pressure. Because the range of sound pressure varies greatly, a logarithmic scale is used to relate sound pressures to some common reference level, usually the decibel.

The A-weighted decibel scale is used almost exclusively in vehicular noise measurements because it reflects the frequency range to which the human ear is most sensitive (1,000–6,000 Hertz). Sound levels measured using an A-weighted decibel scale is generally expressed as adjusted decibels (dBA). For this report, all noise levels are expressed in dBAs. Several examples of noise pressure levels in dBA scale are listed in Figure 2-1, *Comparative Noise Levels*.

Figure 2-1 indicates that most individuals in urbanized areas are exposed to fairly high noise levels from many sources as they go about their daily activities. The degree of disturbance from undesired sound depends essentially on three factors:

- The amount and nature of the intruding noise;
- The relationship between background noise and the intruding noise; and
- The type of activity occurring where the noise is heard.

In considering the first of these factors (i.e., amount and nature of the intruding noise), it is important to note that individuals have different sensitivity to noise. Loud noises bother some individuals more than others, and some patterns of noise also enter into an individual's judgment of whether or not a noise is offensive. For example, noises occurring during sleeping hours are usually considered to be more of a nuisance than the same noises in the daytime.

With regard to the second factor (i.e., the relationship between background noise and the intruding noise), individuals tend to judge the annoyance of an unwanted noise in terms of its relationship to noise from other sources (background noise). For instance, the blowing of a car horn at night when background noise levels are typically about 45 dBA would generally be more objectionable than the blowing of a car horn in the afternoon when background noises are likely to be 60 dBA or higher.

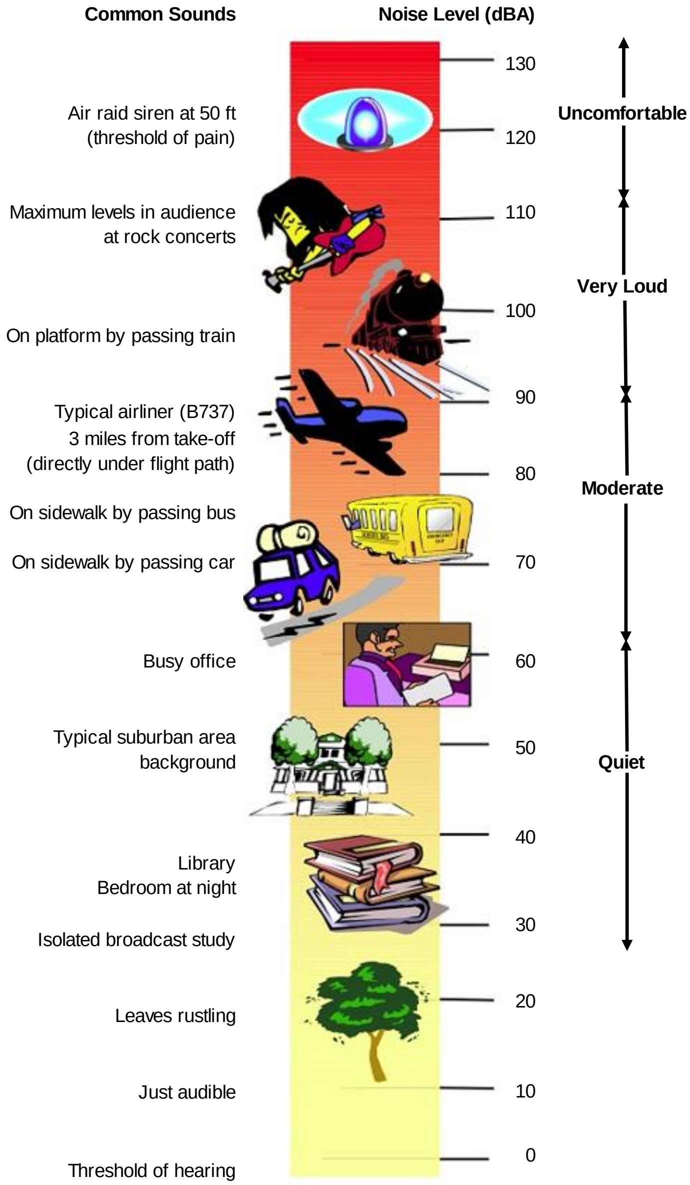


Figure 2-1. Comparative Noise Levels (Source: Cowan, 1994)

The third factor (i.e., the type of activity occurring where the noise is heard) is related to the interference of noises with activities of individuals. In a 60-dBA environment, normal work activities requiring high levels of concentration may be interrupted by loud noises, while activities requiring manual effort may not be interrupted to the same degree.

Since sound is described in logarithmic scale (i.e., dBA), sound levels cannot be added by ordinary arithmetic means. In fact, a doubling of the noise source produces only a 3 dBA increase in the sound pressure (noise) level. Studies have shown that this increase is barely perceptible to the human ear, whereas a change of 5 dBA is readily perceptible. As a general rule, an increase or decrease of 10 dBA in noise level is perceived by an observer to be a doubling or halving of the sound, respectively.

Because the sound pressure level unit of dBA describes a noise level at just one moment and very few noises are constant, other ways of describing noise over more extended periods have been developed. One way of describing fluctuating sound is to describe the fluctuating noise heard over specific periods as if it had been a steady, unchanging sound. For this condition, a descriptor called the equivalent sound level (L_{eq}) can be computed. L_{eq} is the constant sound level that, in a given situation and period (e.g., 1 hour, denoted by $L_{eq(1)}$, or 24 hours, denoted as $L_{eq(24)}$), conveys the same sound energy as the actual time-varying sound.

2.2 Regulatory Framework

2.2.1 FHWA Regulations and NHDOT Policy

Traffic noise impact and abatement analyses were conducted in accordance with the procedures as set forth in the following regulations and policies: FHWA's *Procedures for Abatement of Highway Traffic Noise and Construction Noise*, 23 Code of Federal Regulations (CFR) Part 772; FHWA Highway Traffic Noise: Analysis and Abatement Guidance document issued December 2011; and NHDOT's *Policy and Procedural Guidelines for the Assessment and Abatement of Highway Traffic Noise for Type I & II Highway Projects*, as approved by FHWA on November 30, 2016. The FHWA Noise Abatement Criteria (NAC) in 23 CFR Part 772 and the Noise Abatement Guidelines in the NHDOT policy were used to identify and evaluate noise impacts. The traffic noise level predictions and noise mitigation analyses were performed using FHWA's *Highway Traffic Noise Model 2.5*. The FHWA NAC are presented in Table 2-1.

A traffic noise impact is identified, and consideration of noise abatement is required, when:

- Leq (h) noise levels approach or exceed the FHWA NAC given in Table 2-1, where "approach" means within 1 dBA of the NAC.
- There is a substantial increase in the predicted noise levels over the existing noise levels, regardless of whether or not the NAC level is exceeded. NHDOT's policy defines a substantial increase as future build noise level 15 dBA Leq or higher than existing conditions.

Noise abatement measures must meet the criteria for *feasibility* and *reasonableness*, as presented in NHDOT's Policy.

The *feasibility* of noise abatement primarily relates to engineering and safety considerations for providing mitigation. A minimum of a 5-dBA noise reduction for at least one impacted receiver is required for a proposed noise barrier to be feasible, the design goal is to obtain a 10-dBA or greater insertion loss at the first row receptors. Safety considerations in designing noise barriers could include such factors as maintaining a clear recovery zone, redirection of errant vehicles, adequate sight distance, and fire/emergency vehicle access.

The factors considered when evaluating the *reasonableness* of a noise barrier are as follows:

- **Effectiveness**. The NHDOT's base effectiveness criterion is 1,500 square feet per benefited receptor (defined as all receptors receiving 5 dBA or greater insertion loss from the proposed barrier). For Type I projects, the effectiveness criterion is reduced depending on the percentage of benefited properties permitted for development after November 30, 2017. The effectiveness criterion is increased by 200 square feet (e.g., to a total of 1,700 square feet) for municipalities that have enacted noise compatible planning requirements to mitigate noise impacts associated with new development near state highways.

- **Noise Reduction Design Goal.** The design goal is to provide 10-dBA insertion loss to the first row of benefited receptors. At a minimum, it must provide 7-dBA noise reduction for one benefited receptor.
- **Views of the Benefited Receptors.** Viewpoints of the affected community are considered through the NEPA public outreach process. If there are objections to a proposed barrier, a voting process is used to make the final reasonableness determination.

Table 2-1. FHWA Noise Abatement Criteria: Hourly A-weighted Sound Level in Decibels (dBA)

Activity Category	NAC Leq (h)	Activity Description
A (Exterior)	57	Lands on which serenity and quiet are of extraordinary significance and serve an important public need, and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B (Exterior)	67	Residential.
C (Exterior)	72	Active sport areas, amphitheaters, auditoriums, campgrounds, cemeteries, day care centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings.
D (Interior)	52	Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios.
E (Exterior)	52	Hotels, motels, offices, restaurants/bars, and other developed lands, properties or activities not included in A-D or F.
F	-	Agriculture, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical), and warehousing.
G	-	Undeveloped lands that are not permitted.

Source: Title 23 Code of Federal Regulations, Part 772.

2.2.2 Local Noise Regulations

The Town of Londonderry adopted a local noise control ordinance on June 7, 2016, as an amendment to their municipal code, Title IV, Chapter XIV, Noise Regulations. Ordinance #2016-03 is intended to control unnecessary and excessively loud noises between the hours of 10 p.m. and 7 a.m. in order to protect the public's health, safety, and comfort. During these specific hours, noises which are prolonged, unusual, and unnatural in their time and place are prohibited unless an exemption has been obtained. Ordinance #2002-12, relative to municipal code, Title III, Land Use Codes, states that devices to muffle equipment noise, landscape earth berms, screen planting, decorative screen walls, or other barriers or devices shall be installed as necessary to achieve compliance with the Town of Londonderry noise control standards. Noise is expected to not exceed a maximum level of 75 decibels at property lines. Ordinance 97-6, An Amendment to the Zoning Ordinance related to Section VII-Commercial Performance Standards, also states that noise should not exceed 75 decibels at property lines and that all noise, except that generated by normal automobile, truck, or railroad service shall be muffled so as not to be objectionable due to intermittence, beat frequency, or shrillness.

The Town of Derry does not currently possess any local ordinances or regulations specifically pertaining to noise/construction noise.

3.0 EXISTING CONDITIONS NOISE MONITORING

3.1 2007 DEIS Noise Monitoring

Noise monitoring was conducted for the 2007 DEIS at 10 receptor locations in May and July 2006. The 10 monitoring sites are shown on Figure 3-1 as Sites 1 through 10. Table 3-1 presents noise levels from the 2007 DEIS monitoring effort.

Table 3-1. 2007 DEIS Monitoring Locations and Noise Levels

Site Number	Address	Leq (dBA)
1	1 Tsienneto Road	61
2	75 Tsienneto Road	69
3	4 Seasons Lane	63
4	12 Trolley Car Lane	64
5	5 Coteville Road	63
6	1 London Road	61
7	29 Scenic Drive	51
8	112 Franklin Ext	57
9	120 East Broadway[a]	65
10	70 West Broadway[a]	66

[a] In the 2007 DEIS, 120 East Broadway was incorrectly identified as 70 East Broadway, and 70 West Broadway was incorrectly identified as 120 West Broadway.

3.2 2016 Noise Monitoring Update

Given the passage of time since the 2007 DEIS, updated noise monitoring was conducted in five locations along the Alternative A corridor in September 2016. The monitoring sites are:

- Site A: 25 Trolley Car Ln
- Site B: 52 Trolley Car Ln
- Site C: 60 Seasons Ln
- Site D: 4 Folsom Rd
- Site E: 71 Tsienneto Rd

Two of these sites, A and D, were chosen because they were monitored in the 2007 DEIS and determined to be impacted receptors. The other three sites, B, C, and E, were selected because they were shown as impacted receptors under Alternative A and were not monitored in the 2007 DEIS. Sites A, B, and C are located in an area where barriers are proposed as part of the I-93 widening, but would need to be modified as a result of the Exit 4A Project.

Figure 3-1 shows the monitoring locations, and monitoring results are summarized in Table 3-2. Short-term noise levels were measured during the AM peak hours (7:00-8:00 AM) and PM peak hours (5:00-6:00 PM) at each location. Traffic counts with vehicle classification were conducted simultaneously with the noise monitoring locations.

A Rion NL-42 Sound Level Meter (SLM) was utilized for field measurements. The SLM meets the requirements set forth in the ANSI S1.4-1983 Standards for Type 2 quality and accuracy. An acoustical calibrator (Norsonic 1251) was used to calibrate the SLM for each measurement interval. Calibration certificates for the equipment are provided in Appendix A.

The SLMs were operated on the A-weighting network and slow-meter response, as FHWA recommends. Measurements were not collected if roadway pavement was wet, or if wind speed exceeded 12 miles per hour. A porous windscreen was used on each SLM during all measurement periods, and measurements were taken by mounting the SLMs about 5 feet above the ground surface at each receptor. This height represents ear level of an average person. Wherever possible, measurement sites were located in open areas away from buildings or other potentially reflective surfaces, but which represented the outdoor use area of a given receptor.

During measurements, important events and site conditions were noted and a sketch was drawn for each receptor location. If an extraneous noise source interrupted the monitoring session, the measurement was then temporarily paused until the noise source was out of range. Noises of this nature, occurring at the time of measurement, included a swimming pool water pump and a lawn mower. No other unusual noises occurred during the morning or evening study hours. Appendix A provides photos of each monitoring location, field monitoring diagrams and traffic counts.

Table 3-2. 2016 Existing Conditions Noise Monitoring Results

Site	Address	Date	Time	L_{eq} (dBA)
A	25 Trolley Car Lane	9/20/2016	7:00 AM	**63.8**
			5:30 PM	**63.0**
		9/21/2016	7:00 AM	**66.0**
			5:08 PM	**64.2**
B	52 Trolley Car Lane	9/20/2016	7:03 AM	**70.5**
			5:35 PM	**69.1**
		9/21/2016	7:00 AM	**70.9**
			5:08 PM	**70.3**
C	60 Seasons Lane	9/20/2016	7:45 AM	**60.5**
			5:00 PM	**60.8**
		9/22/2016	7:15 AM	**62.2**
			4:30 PM	**60.7**
D	4 Folsom Road	9/20/2016	7:43 AM	**74.2**
			5:03 PM	**74.4**
		9/21/2016	7:36 AM	**73.5**
			4:30 PM	**75.2**
E	71 Tsienneto Road	9/21/2016	7:33 AM	**65.1**
			4:30 PM	**63.5**
		9/22/2016	7:16 AM	**63.9**
			4:30 PM	**64.1**

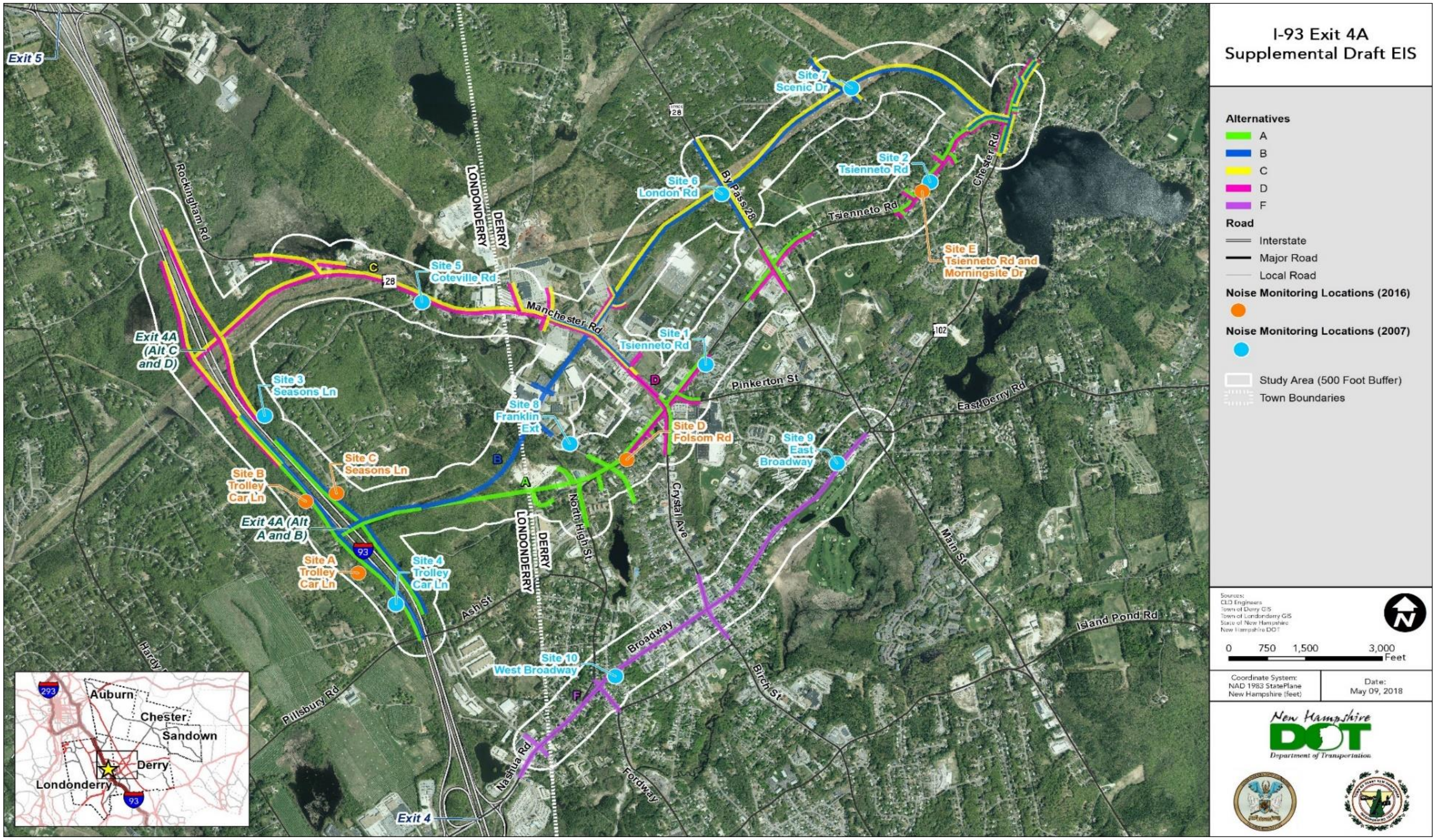


Figure 3-1. 2007 and 2016 Noise Monitoring Locations

4.0 IMPACTS AND MITIGATION

4.1 Traffic Noise Modeling Methodology

Design year 2040 predicted noise levels were determined using Version 2.5 of the FHWA Traffic Noise Model (FHWA TNM). All FHWA TNM computer files are included electronically with this report (Appendix B).

4.1.1 Noise Sensitive Areas and Receptors

The alternatives were divided into 11 noise sensitive areas (NSAs) for traffic noise modeling purposes as shown in Figure 4-1. Within each NSA, sensitive receptors were delineated within approximately 500 feet of the alternative corridors based on detailed land use and building data provided by Derry and Londonderry, with actual building use and location confirmed by aerial imagery.

For multifamily homes, apartments and townhomes, one receptor location was used to represent the multiple units in each building or building section. Multiple receivers were placed for non-residential uses such as parks, cemeteries and schools based on the typical frontage length of nearby residential lots. The placement of residential and community facility receptors was based on a visual assessment of where outdoor use usually takes place on the side of the building closest to the roadway, for example the backyard of a house adjacent to I-93. If no outdoor use on that side of the building was reasonable (no back yard, for example), than the nearest possible outdoor activity area on the property to the roadway was used. Commercial business with outdoor uses received receptors based on the location of the outdoor use, for example, an outdoor seating area at a restaurant. Receiver height was set at the default height of 4.92 feet, to represent a person at ground level.

4.1.2 Roadways and Traffic Data

The No Build Alternative and each Build alternative noise models include the widening of I-93 to four lanes in each direction. The I-93 final design plans were used to reflect the future edge of pavement of this roadway. The updated preliminary engineering plans for each Exit 4A project alternative were used for the proposed roadways. For major roadways (arterials, interstate and select major collectors), each individual traffic lane was modeled as a separate TNM roadway. For minor roadways, a single TNM roadway was used to represent both directions of traffic.

Traffic data for existing conditions (2015) and 2040 was obtained from the Exit 4A Traffic Technical Report. Separate methods to determine the appropriate percentage of traffic in each TNM vehicle class (auto, medium truck, heavy truck, motorcycle and bus) were used for the I-93 mainline vs other roadways. The I-93 vehicle class percentages were based on data from the permanent traffic recorder south of Exit 4, taken in May of 2015. The recorder provided a breakdown of traffic into 13 vehicle classes and included data on lane use of heavy vehicles, allowing the noise model traffic to reflect the actual lane usage by heavy trucks. For arterials and major collectors, the vehicle class percentages were based on a combination of field traffic counts taken during the 2016 noise monitoring along Folsom Rd and Tsienneto Rd, NH DOT vehicle counts, and Synchro data used to create the Exit 4A Traffic Technical Report. The noise monitoring traffic counts were used to determine the breakdown of vehicles into the six TNM model categories for a typical road type, while the Synchro data was used to modify vehicles within those categories to reflect heavy vehicle percentages for each roadway segment.

4.1.3 Elevation Data Sources

Within the footprint of the Exit 4A project, roadway vertical profiles and proposed contours were available from the SDEIS preliminary engineering effort. Outside the Exit 4A alternatives footprint, the I-93 widening final design plans were used to define elevations near the I-93 corridor. Existing ground elevation data beyond the immediate roadway construction area was obtained from high resolution LIDAR data, which was part of the LiDAR for the North East Project, 2011 Coastal LiDAR Acquisition by the USGS.

4.1.4 Terrain Lines

Terrain lines were placed to define topographic features not already covered by another TNM feature that potentially block line of sight or influence ground cover noise attenuation.

4.1.5 Building Rows

Rather than using the TNM building row function (which assumes a simplified percent building cover to estimate shielding rather than considering the actual geometry of specific buildings and gaps between buildings), buildings providing shielding to other receivers were modeled in greater detail as fixed height barriers. The location and dimensions of each building were based on detailed building GIS data provided by Derry and Londonderry. The height of each building was estimated using Google Street View and classified as either 15 or 25 feet.

4.1.6 Tree Zones and Ground Zones

No tree zones were used given that thick year-round vegetation is required to appreciably reduce noise levels (areas of deciduous trees would not block line of sight in the winter). The default ground zone of lawn was used, no additional special ground zones were used.

4.1.7 I-93 Widening Noise Barriers

Consistent with the inclusion of the I-93 widening in the 2040 No Build condition for the Exit 4A project, the I-93 widening noise barriers were digitized in TNM based on the I-93 final design plans. CAD files were used to determine the location of each barrier post and the height and finished grade elevation were taken from the soundwall post location tables.

Construction of the I-93 noise barriers was assumed as part of the modeling of noise impacts under the No Build Alternative. The barriers were also included in the Build Alternatives, with the exception of the areas where the barriers would conflict with the new interchange ramps. In these cases, the conflicting portion of the barrier was removed from the noise model, but the remaining portions were assumed to be left in place. Figure 4-2 illustrates the location of the I-93 widening barriers for NSA 4 and NSA 5, and the portions of the barriers assumed to be removed under the initial modeling of Alternatives A and B. The purpose of this initial modeling was to determine the total number of noise impacts in each NSA for comparing between alternatives. Determination of potential barrier modifications to account for the new interchange was conducted separately as part of the noise barrier evaluation.

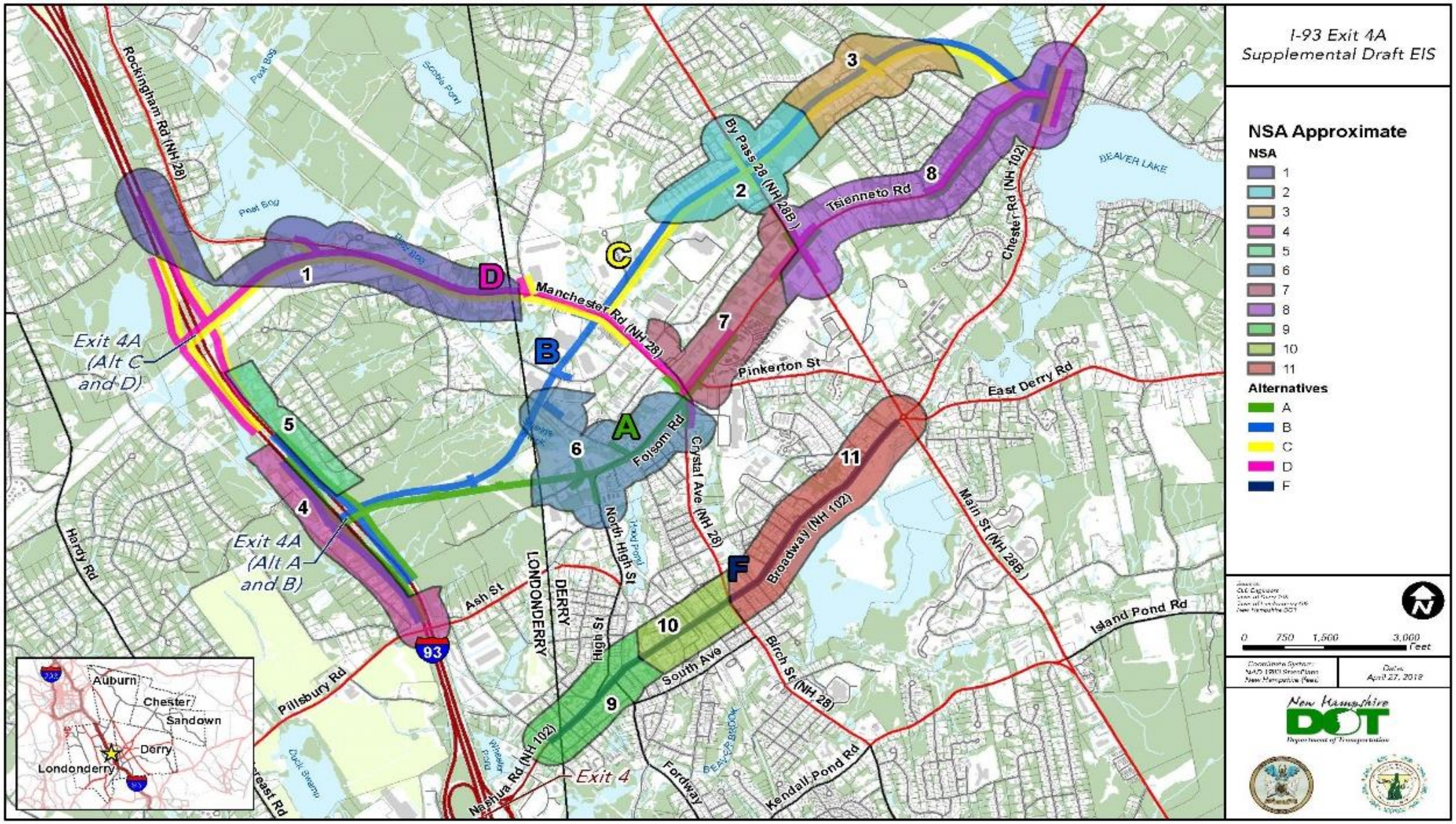


Figure 4-1. Noise Sensitive Areas Overview

Figure 4-2. I-93 Widening Final Design Noise Barriers in NSA 4 and 5

4.1.8 Noise Model Validation

Noise model validation refers to the FHWA requirement that traffic noise analyses demonstrate that the model is capable of predicting the field measured noise levels within 3 dBA. This is accomplished by modeling the same traffic volumes and vehicle mix counted simultaneously with the noise monitoring. Table 4-1 summarizes noise model validation results, showing that the modeled noise levels differ from the measured values by less than the required 3 dBA threshold.

Table 4-1. Traffic Noise Model Validation Summary

Monitoring Location	Date/Time Period	Measured Leq, dBA	Modeled Leq, dBA	Difference
A	Sept. 20- AM	63.8	66.2	2.4
	Sept. 20- PM	63.0	64.9	1.9
	Sept. 21- AM	66.0	66.0	0.0
	Sept. 21- PM	64.2	65.6	1.4
B	Sept. 20- AM	70.5	68.8	-1.7
	Sept. 20- PM	69.1	67.5	-1.6
	Sept. 21- AM	70.9	68.5	-2.4
	Sept. 21- PM	70.3	68.2	-2.1
C	Sept. 20- AM	60.5	62.3	1.8
	Sept. 20- PM	60.8	61.8	1.0
	Sept. 22- AM	62.2	63.1	0.9
	Sept. 22- PM	60.7	62.0	1.3
D	Sept. 20- AM	74.2	71.8	-2.4
	Sept. 20- PM	74.4	73.8	-0.6
	Sept. 21- PM[a]	75.2	73.3	-1.9
E	Sept. 21- PM[a]	63.5	62.9	-0.6
	Sept. 22- AM	63.9	61.5	-2.4
	Sept. 22-PM	64.1	63.7	-0.4

[a] AM Time period not validated due to lack of traffic count data during the noise monitoring for that particular location/time period. Additional monitoring was not necessary since AM peak bi-directional traffic counts with classification were available from the second day of monitoring at each site

4.2 Impacts

4.2.1 Noise Impact Summary

Table 4-2 summarizes the initial noise modeling results for existing conditions, the No Build Alternative, and Build Alternatives A, B, C, D, and F in terms of impacted receptor points. The approximate boundaries of the NSAs shown in the table are mapped in Figure 4-1. Noise impacts were identified considering both the absolute predicted hourly Leq in comparison to the NAC. The incremental increase in noise relative to existing conditions was also evaluated to identify receptors potentially experiencing a substantial increase (defined by NHDOT policy as an increase of 15 dBA or greater over existing conditions). AM and PM peak hour traffic was modeled separately for each Alternative, and the worst result for each receptor was used for purposes of the impact summary shown in Table 4-2.

It is important to note that the results in Table 4-2 include construction of noise barriers as part of the I-93 widening project under the No Build Alternative (and the Build alternatives, where the barrier is not in conflict with the particular alternative). As a result, the number of impacted receptors in each NSA is different from the detailed noise barrier evaluations presented in Section 4.3 where a true “no barrier” condition is evaluated for purposes of determining cost reasonableness of modified barrier configurations.

The single family residential and multi-family residential receptors correspond to FHWA Noise Abatement Criteria Activity Category B. The community facility and parkland receptors identified in the study area are all considered Activity Category C for purposes of the corridor-wide comparison of alternatives (further detailed investigation of receptors impacted by Alternative A was conducted as part of the mitigation analysis). The Commercial with outdoor use land use type corresponds to Activity Category E. Category G (undeveloped lands that are not permitted) is addressed in Section 4.4.

Table 4-2. Traffic Noise Impacts Summary

Noise Sensitive Area	Land Use	Existing	No Build Alt. (2040)	Alt. A	Alt. B	Alt. C	Alt. D	Alt. F
1 (NH 28 Corridor, I-93 to Scobie Pond Rd.)	Single-Family	3	5	4	3	7	7	6
	Multi-Family/Apartment	1	1	1	0	1	1	1
	Community Facility/Park	0	0	0	0	1	0	0
	NSA Subtotal	*4*	*6*	*5*	*3*	*9*	*8*	*7*
2 (Alts. B and C connector near Olde Coach Rd, and Bypass 28)	Single-Family	9	5	5	2 exceed NAC + 1 substantial increase	2	5	4
	NSA Subtotal	*9*	*5*	*5*	*3*	*2*	*5*	*4*
3 (Alts. B and C connector near Barkland Dr., and Scenic Dr.)	Single-Family	0	0	0	2 exceed NAC + 8 substantial increase	2 exceed NAC + 7 substantial increase	0	0
	NSA Subtotal	*0*	*0*	*0*	*10*	*9*	*0*	*0*
4 (I-93 at Alts. A and B interchange, Trolley Car Lane)	Single-Family	14	1	10	11	1	1	2
	NSA Subtotal	*14*	*1*	*10*	*11*	*1*	*1*	*2*
5 I-93 at Alts. A and B interchange, Seasons Lane	Single-Family	*8*	*1*	*3*	*3*	*1*	*1*	*1*
	NSA Subtotal	*8*	*1*	*3*	*3*	*1*	*1*	*1*
6 (Alts. A and B Connector from Derry Town Line to NH 28, Folsom Rd.)	Single-Family	11	11	13 (includes one recep. impacted due to both NAC and substantial increase)	6	12	11	11
	Multi-Family/Apartment	0	2	2	0	0	0	2
	NSA Subtotal	*12*	*13*	*15*	*6*	*12*	*11*	*13*
7 (Tsienneto Rd from NH 28 to Bypass 28)	Single-Family	0	0	0	0	0	0	0
	Multi-Family/ Apartment	3	4	4	0	1	2	4

Noise Sensitive Area	Land Use	Existing	No Build Alt. (2040)	Alt. A	Alt. B	Alt. C	Alt. D	Alt. F
	Community Facility/Park	0	0	1	0	0	0	0
	NSA Subtotal	*3*	*4*	*5*	*0*	*1*	*2*	*4*
8 (Tsienneto Rd. from Bypass 28 to NH 102)	Single-Family	5	9	13	4	4	13	9
	Multi-Family/Apartment	0	2	1	1	0	0	0
	NSA Subtotal	*5*	*11*	*14*	*5*	*4*	*13*	*9*
9 (NH 102, Exit 4 to Griffin St.)	Single-Family	20	20	19	15	13	15	17
	Multi-Family/Apartment	12	12	12	11	11	11	12
	Community Facility/Park	1	1	1	1	1	1	1
	Commercial w/outdoor use	0	0	0	0	0	0	1
	NSA Subtotal	*33*	*33*	*32*	*27*	*25*	*27*	*31*
10 (NH 102, Griffin St. to NH 28)	Single-Family	1	1	1	1	1	1	1
	Multi-Family/Apartment	11	9	11	11	11	11	11
	Community Facility/Park	5	5	5	5	5	5	6
	NSA Subtotal	*17*	*15*	*17*	*17*	*17*	*17*	*18*
11 (NH 102, NH 28 to Bypass 28)	Single-Family	12	13	15	4	6	13	15
	Multi-Family/Apartment	13	11	13	10	10	13	12
	Community Facility/Park	4	4	4	2	2	4	4
	NSA Subtotal	*29*	*28*	*32*	*16*	*18*	*30*	*31*
Total Impacts	Single-Family	83	66	83	60	56	67	66
	Multi-Family/Apartment	40	41	44	33	34	38	42
	Community Facility/Park	10	10	11	8	9	10	11
	Commercial w/outdoor use	0	0	0	0	0	0	1
	Grand Total	*133*	*117*	*138*	*101*	*99*	*115*	*120*

Note: Results account for I-93 widening barriers, except sections of barriers in conflict with the alternatives (see Figure 4-2)

No Build

In the majority of NSAs, noise impacts under the No Build Alternative would be similar to those predicted under existing conditions. In some cases, the number of No Build impacts would increase relative to existing conditions as a result of future growth in traffic volumes, such as along Tsienneto Road where the No Build Alternative would result in five additional impacted single-family homes and three additional multi-family/apartment receptor impacts (NSAs 7 and 8). The No Build Alternative noise levels at these Tsienneto Road receptors would be in the 66–68 dBA range.

In the vicinity of the proposed Exit 4A under Alternative A and B interchange (Trolley Car Lane and Seasons Lane, NSA 4 and 5), the number of impacted receptors would decrease substantially relative to existing conditions because the No Build Alternative model includes the noise barriers proposed as part of the I-93 widening project. Overall, the total study area noise impacts under the No Build Alternative would decrease to 117, compared to 133 under existing conditions.

Alternative A

Alternative A would conflict with portions of the I-93 widening noise walls in the new interchange area, resulting in 10 single family receptors impacted at NSA 4 and three impacted in NSA 5. The conflicting noise walls were assumed to be not constructed for the initial impact analysis. I-93 improvements proposed noise walls not in conflict with the new ramps were assumed to be in place. The majority of the impacted receptors at the interchange area would be in the 66 to 69 Leq, dBA range. Alternative A would also increase noise impacts on portions of Folsom Road (NSA 6) and Tsienneto Road (NSA 8) due to increased traffic volumes on these roadways. Overall, the number of impacted receptors would increase from 117 under the No Build Alternative to 138 under Alternative A (before considering mitigation).

Alternative B

Similar to Alternative A, Alternative B would conflict with portions of noise walls planned for the I-93 widening project, increasing the number of impacted receptors at NSA 4 and 5 (Trolley Car Lane and Seasons Lane). Alternative B would cause traffic diversions that would reduce the number of noise impacts on portions of Tsienneto Road relative to the No Build Alternative (see for example NSA 8). Alternative B related traffic reductions on NH 102 in Derry would reduce the number of impacted receptors in NSA 11 (NH 28 to Bypass 28) relative to the No Build Alternative. However, Alternative B would impact residential areas along the new connector road alignment through Derry, including neighborhoods at Old Coach Road and Bypass 28 (NSA 2) and Barkland Drive and Scenic Drive (NSA 3). Overall, the total number of impacted receptors in the study area (101) would be less than the No Build Alternative. This result is consistent with Alternative B being located more on new alignment (in areas with fewer sensitive receptors) relative to the existing roadway corridor used by much of Alternative A (e.g., Folsom Rd. and Tsienneto Rd).

Alternative C

Alternative C would result in nine impacted receptors in the vicinity of the new interchange location and along NH 28 (NSA 1). Impacts along the new alignment portion of the connector road through Derry would be similar to Alternative B (NSA 2 and 3). Also similar to Alternative

B, noise impacts would be reduced on portions of Tsienneto Road (NSA 8 and 11 most notably). Overall, the total number of impacted receptors in the study area would decrease relative to the No Build Alternative to 99.

Alternative D

Alternative D would result in eight impacted receptors in the vicinity the new interchange location and along NH 28 (NSA 1). Impacts along Tsienneto Road from increased traffic volumes would similar to Alternative A (NSA 8 and 9). Overall, the total number of impacted receptors in the study area (115) would be similar to the No Build Alternative.

Alternative F

Noise impacts under Alternative F (120) would be similar to the No Build Alternative. Although traffic in downtown Derry would increase, it would not increase to an extent that would result in a substantial increase in newly impacted receptors. Noise levels would increase at receptors already considered affected in the No Build Alternative.

4.2.2 NSA Receptor Locations and Modeling Results

The following section presents the figures and tables for each NSA receptor. The tables with the modeling results (Tables 4-3 through 4-12) are presented first followed by the figures for each NSA (Figures 4-3 through 4-17). Shading on the tables is used to indicate the receptors considered impacted under each alternative (whether due to approach or exceedance of the NAC or a substantial increase over existing conditions). Both the AM and PM peak hour traffic were modeled and the maximum hourly Leq for each receptor based on this data is reported in the tables.

Table 4-3. Noise Modeling Results for NSA 1 (Worst-Case Peak Hour, Leq, dBA)

Receiver ID	Land Use Type	Existing	2040 No Build	Alt. A	Alt. B	Alt. C	Alt. D	Alt. F
Rockingham 28 12 CF	Community Facility	62.6	61.7	59.3	58	66.1	65.3	62.3
Rockingham 28 11 MF	Multi-Family	69.2	68.2	65.7	64.5	71.8	71.7	68.8
Rockingham 28 9	SFR	68.1	67.6	64.6	63.6	71.3	71.2	67.9
Rockingham 28 9 CF	Community Facility	59.9	59	56.6	55.4	64	63.4	59.4
Coteville 1	SFR	64.2	63.3	60.9	59.6	67.6	67.2	63.9
Coteville 2	SFR	56.2	55.2	53	51.7	59.3	59	55.7
Seasons 18	SFR	56.8	55.8	53.7	52.5	59.7	59.7	56.3
Seasons 13	SFR	66.4	65.5	63.1	61.8	68.7	69.3	66
Seasons 14	SFR	55.2	54	52.5	51.1	57.6	57.9	54.4
Seasons 15	SFR	51.5	50.6	49.6	48.7	54	54.6	51
Seasons 16	SFR	48.6	47.8	45.6	44.8	50.7	51.2	48.1
Seasons 17	SFR	51.6	50.7	49.5	48.6	54.1	54.2	51.2
Rockingham 28 8A COD	Commercial w/Outdoor Use	58	56.9	54.8	53.5	61.7	61.1	57.4
Rockingham 28 8	SFR	65.3	64.7	61.9	60.7	68.6	68.2	65
Rockingham 28 7	SFR	53.5	54	53.8	53.5	63	63.3	54.5
Rockingham 28 6	SFR	64.3	66.3	66.8	66.7	66.6	66.6	66.6
Rockingham 28 4	SFR	61.1	62.1	62.1	61.9	61.8	61.7	62.4
Rockingham 28 3	SFR	63	63.9	64.1	63.9	63.9	63.8	64.1
Rockingham 28 5	SFR	63.6	65.3	65.6	65.4	65.3	65.3	65.6
Rockingham 28 1	SFR	64.4	65.8	66.1	65.9	65.8	65.8	66.1
Rockingham 28 2	SFR	66.1	67.8	68.3	68.3	68.4	68.3	68.1
Rockingham 28 13 CF	Community Facility	52.2	51.3	49.6	49.3	55.7	54.8	51.8

Note: Shading indicates impacted receptors based on NAC or substantial increase over existing conditions. For purposes of determining impacts, results were rounded to the nearest whole number (e.g., 65.6 dBA rounds to 66 and is considered an impact for a residential land use).
SFR - Single-Family Residence

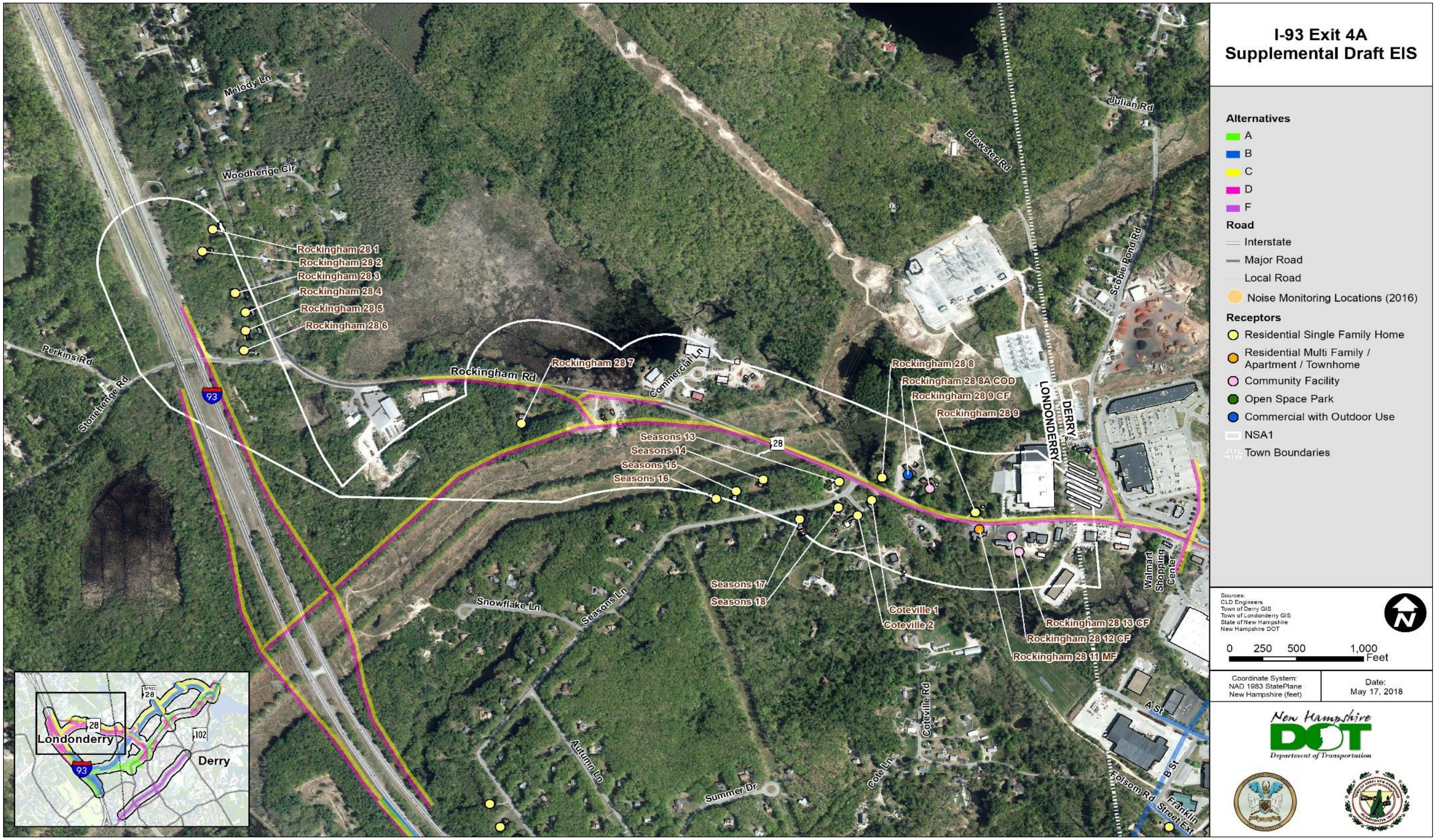


Figure 4-3. NSA 1 Receptors

Table 4-4. Noise Modeling Results for NSA 2 (Worst-Case Peak Hour, Leq, dBA)

Receiver ID	Land Use Type	Existing	2040 No Build	Alt. A	Alt. B	Alt. C	Alt. D	Alt. F
By Pass 28 1	SFR	66.5	63.6	63.8	60.8	60.1	62.5	63.1
By Pass 28 10"	SFR	68.6	66.1	65.9	64.2	64.2	65.5	65.3
By Pass 28 11"	SFR	70.6	68	67.9	66.5	66.5	67.3	67.3
By Pass 28 12"	SFR	67.2	64.6	64.5	63	63	64	63.9
By Pass 28 13"	SFR	57.9	55	55.1	55.3	55.3	53.9	54.5
By Pass 28 14"	SFR	58	55.1	55.3	55.5	55.5	54.1	54.6
By Pass 28 15"	SFR	56	53.1	53.2	53.4	53.4	52.1	52.6
By Pass 28 16"	SFR	57.4	54.5	54.6	54.5	54.8	53.5	54
By Pass 28 17"	SFR	58.5	55.7	55.7	56.9	56.9	54.7	55.1
By Pass 28 2"	SFR	71.2	68.3	68.4	64.1	63.3	67.2	67.8
By Pass 28 3"	SFR	51.9	48.8	49	46.8	46	48.1	48.4
By Pass 28 4"	SFR	57.1	54.3	54.3	50.9	50.2	53.7	53.7
By Pass 28 6"	SFR	66	63.4	63.3	61	60.1	62.7	62.7
By Pass 28 7"	SFR	66.3	63.7	63.5	61.4	60.5	63	63
By Pass 28 8"	SFR	69.1	66.5	66.4	65.8	66.6	65.8	65.8
By Pass 28 9"	SFR	69.1	66.5	66.3	65.1	65.3	65.8	65.7
Driftwood 1"	SFR	52.1	49.4	49.3	48.7	48.8	48.6	48.7
Driftwood 2"	SFR	51.3	48.5	48.5	48.5	48.6	47.8	47.9
Driftwood 3"	SFR	48.2	45.3	45.3	46.4	46.2	44.5	44.7
Driftwood 4"	SFR	47	44.3	44	47.9	47.3	43.8	43.5
London Rd 1"	SFR	60.8	58.3	58	**N/A**	**N/A**	57.7	57.5
London Rd 2"	SFR	52.9	50.4	50.1	**N/A**	**N/A**	49.8	49.5
London Rd 3"	SFR	47.7	45	44.7	**N/A**	**N/A**	44.5	44.2
London Rd 4"	SFR	46.7	43.8	43.6	**N/A**	**N/A**	43.4	43.1
London Rd 5"	SFR	43.7	40.4	40.1	**N/A**	**N/A**	40.2	39.7
London Rd 6"	SFR	60.5	57.8	57.7	62.8	62.2	57.2	57.1
London Rd 7"	SFR	49.8	47	46.9	62.1	61.6	46.3	46.4
London Rd 8"	SFR	45.7	42.7	42.5	60.7	59.9	42.3	42
Olde Coach 1"	SFR	45.7	42.9	42.6	50.9	50.2	42.4	42.1
Olde Coach 10"	SFR	39.6	33.3	32.4	49.6	49	35.7	33

Receiver ID	Land Use Type	Existing	2040 No Build	Alt. A	Alt. B	Alt. C	Alt. D	Alt. F
Olde Coach 11"	SFR	40.8	37.2	37	46.3	45.9	37	36.7
Olde Coach 12"	SFR	54	51.6	51.3	51.2	50.9	51	50.7
Olde Coach 2"	SFR	45.2	42.2	42	50.8	50.1	41.8	41.5
Olde Coach 3"	SFR	44.9	41.7	41.5	51.6	51	41.5	41.1
Olde Coach 4"	SFR	43.5	40.1	39.8	51.3	50.7	40.1	39.5
Olde Coach 5"	SFR	42.8	39.2	38.8	51.7	51.1	39.2	38.6
Olde Coach 6"	SFR	41	36.6	36.1	52	51.5	37.1	36.1
Olde Coach 7"	SFR	40.3	35.4	34.8	51.3	50.7	36.3	34.9
Olde Coach 8"	SFR	40.1	34.8	34.2	52.4	51.8	35.9	34.4
Olde Coach 9"	SFR	39.7	33.3	32.5	50.4	49.8	36.6	32.9
Oxford 1"	SFR	49.1	44.9	45.3	45.7	45.9	46.3	45.5
Oxford 2"	SFR	51.1	47.6	47.7	47	46.8	48.1	47.7
Oxford 3"	SFR	57.9	55.2	55.1	53.5	52.7	54.5	54.5
Oxford 4"	SFR	57.9	55.3	55.1	54.3	53.4	54.7	54.6
Oxford 5"	SFR	49.2	46.3	46.2	48.5	48.1	45.8	45.7
Rider 1"	SFR	47.8	44.6	44.7	52.7	52.2	43.7	44.2
Rider 2"	SFR	44.1	40.8	40.7	54.5	54.1	41.2	40.3
Thames 1"	SFR	43.7	39.6	39.4	48	47.6	40.6	39.2
Thames 2"	SFR	42.7	39.5	39.2	50.8	50.2	39.1	38.8
Thames 3"	SFR	45.5	42.7	42.3	59.5	58.7	42.1	41.9
Thames 4"	SFR	47.4	44.6	44.5	52.2	51.7	44.2	44
Thames 5"	SFR	47.7	44.6	44.6	49.8	49.2	44.3	44.1

Note: Shading indicates impacted receptors based on NAC or substantial increase over existing conditions. For purposes of determining impacts, results were rounded to the nearest whole number (e.g., 65.6 dBA rounds to 66 and is considered an impact for a residential land use).
N/A - Not applicable, property is full acquisition
SFR - Single-Family Residence

Figure 4-4. NSA 2 Receptors

Table 4-5. Noise Modeling Results for NSA 3 (Worst-Case Peak Hour, Leq, dBA)

Receiver ID	Land Use Type	Existing	2040 No Build	Alt. A	Alt. B	Alt. C	Alt. D	Alt. F
Barka Elementary School 1 CF	Community Facility	34	33.4	33.6	46.9	46.5	33.1	33
Barka Elementary School 2 CF	Community Facility	34.1	34.1	34.4	48.3	47.9	33.9	33.8
Barka Elementary School 3 CF	Community Facility	35	34.7	35	48.9	48.5	34.5	34.4
Barka Elementary School 4 CF	Community Facility	33.7	32.7	32.8	47.4	47	32.3	32.4
Barka Elementary School 5 CF	Community Facility	37.9	37.7	37.7	51.6	51.2	37.5	37.5
Barka Elementary School 6 CF	Community Facility	36.5	36.7	36.8	48.1	47.7	36.6	36.6
Barka Elementary School 7 CF	Community Facility	37.5	37.8	37.9	46.7	46.4	37.8	37.7
Barkland 1	SFR	35.6	35.8	35.9	52.9**	52.5**	35.8	35.7
Barkland 10	SFR	36.9	37.7	38.1	46.2	45.9	37.7	37.5
Barkland 11	SFR	36.8	37.6	38.1	45.7	45.4	37.6	37.4
Barkland 12	SFR	34.2	33.9	34	49.4**	49**	33.9	33.9
Barkland 2	SFR	34.8	35.6	35.9	51.9**	51.5**	35.6	35.4
Barkland 3	SFR	32	31.5	31.5	52.1**	51.7**	31.4	31.3
Barkland 4	SFR	30.5	30.1	30.2	51.3**	50.9**	30	30
Barkland 5	SFR	33.9	34.2	34.4	51.5**	51.1**	33.9	34
Barkland 6	SFR	34.2	34.5	34.8	52.8**	52.4**	34.4	34.2
Barkland 7	SFR	35.4	36	36.4	49.5	49.1	35.9	35.7
Barkland 8	SFR	36.1	36.7	37	43	42.8	36.5	36.4
Barkland 9	SFR	36.2	37.1	37.6	46.8	46.4	37.1	36.9
Birchwood 1	SFR	40.7	41.3	41.5	46.2	45.8	41.4	41.2
Birchwood 2	SFR	39.5	39.7	39.8	46.9	46.5	39.6	39.6
Birchwood 3	SFR	39.9	40.3	40.5	51.1	50.7	40.4	40.2
Birchwood 4	SFR	38.8	39.8	40.2	47	46.7	39.9	39.6
Brookview 1	SFR	37	37.8	38.3	46	45.7	37.8	37.6
Eastgate 1	SFR	35.8	35.1	35.2	47.4	47	34.8	34.7

Receiver ID	Land Use Type	Existing	2040 No Build	Alt. A	Alt. B	Alt. C	Alt. D	Alt. F
Eastgate 2	SFR	33.1	33.2	33.6	47.6**	47.2	33.2	32.9
Hummingbird 1	SFR	39.3	39.7	39.9	N/A	N/A	39.7	39.6
Hummingbird 2	SFR	37.4	38	38.4	N/A	N/A	38.1	37.9
Hummingbird 3	SFR	36.1	36.9	37.4	N/A	N/A	37	36.7
Hummingbird 4	SFR	36	36.4	36.8	N/A	N/A	36.4	36.2
Hummingbird 5	SFR	35.6	35.5	35.7	N/A	N/A	35.2	35.2
Jeff 1 MF	Multi-Family	40.5	40.9	41.1	47.8	47.5	41	40.9
Jeff 2	SFR	37.3	38.3	38.7	48.6	48.2	38.4	38.2
Jeff 3	SFR	37.6	38.9	39.4	46.7	46.4	39	38.7
Scenic 1	SFR	51.7	51.8	51.8	N/A	N/A	51.8	51.8
Scenic 10	SFR	57	57	57	57.2	57.2	57	57
Scenic 11	SFR	58.3	58.3	58.4	58.4	58.4	58.3	58.3
Scenic 12	SFR	57	57	57	57.2	57.2	57	57
Scenic 13	SFR	44.9	45.1	45.2	48	47.8	45.1	45.1
Scenic 14	SFR	48.5	48.6	48.7	51.6	51.4	48.6	48.6
Scenic 15	SFR	43.6	43.6	43.7	52.7	52.3	43.6	43.6
Scenic 2	SFR	52.3	52.3	52.4	56.3	56	52.3	52.3
Scenic 3	SFR	39.3	39.5	39.6	48.9	48.6	39.5	39.4
Scenic 4	SFR	46.9	46.9	46.9	48.9	48.8	46.9	46.9
Scenic 5	SFR	57.9	57.9	57.9	58.1	58	57.9	57.9
Scenic 6	SFR	54.8	54.8	54.8	55.6	55.5	54.8	54.8
Scenic 7	SFR	56.9	56.9	56.9	60.6	60.3	56.9	56.9
Scenic 8	SFR	41.8	41.9	41.9	N/A	N/A	41.9	41.9
Scenic 9	SFR	56.2	56.2	56.2	56.8	56.7	56.2	56.2

Note: Shading indicates impacted receptors based on NAC or substantial increase over existing conditions. For purposes of determining impacts, results were rounded to the nearest whole number (e.g., 65.6 dBA rounds to 66 and is considered an impact for a residential land use).
N/A: Not applicable, property is full acquisition
** Substantial increase over existing conditions
SFR: Single-family residence

Figure 4-5. NSA 3 Receptors

Table 4-6. Noise Modeling Results for NSA 4 (Worst-Case Peak Hour, Leq, dBA)

Receiver ID	Land Use Type	Existing	2040 No Build	Alt. A	Alt. B	Alt. C	Alt. D	Alt. F
Hovey 1	SFR	66.9	66.2	67.1	67.3	65.9	65.8	66.5
Trolley Car 1	SFR	65.7	65.3	65.4	65.6	64.8	64.7	65.5
Trolley Car 10	SFR	64.5	60.4	62.6	62.7	60.3	60.2	60.8
Trolley Car 11	SFR	66.6	60.8	61.9	62	60.7	60.6	61.2
Trolley Car 12	SFR	67.2	60.4	N/A	N/A	60.3	60.2	60.7
Trolley Car 13	SFR	67.8	60.4	N/A	N/A	60.4	60.2	60.8
Trolley Car 14	SFR	69	59.6	N/A	N/A	59.5	59.5	60
Trolley Car 15	SFR	60.1	56.2	61.5	61.6	56.3	56.2	56.7
Trolley Car 16	SFR	61.3	58.1	62.7	62.7	58	58	58.5
Trolley Car 17	SFR	69.6	60.2	68.2	68.2	60.1	60	60.6
Trolley Car 18	SFR	73.1	63.2	74.1	74	63	63	63.5
Trolley Car 19	SFR	62.5	58.5	62.5	62.4	58.5	58.4	58.9
Trolley Car 2	SFR	63.5	61.7	65.5	65.6	61.5	61.4	62
Trolley Car 3	SFR	69.7	64.6	67.8	68	64.3	64.2	64.8
Trolley Car 4	SFR	69.4	64	69.2	69.3	63.7	63.8	64.3
Trolley Car 5	SFR	67.7	62.7	68.3	68.4	62.5	62.5	63
Trolley Car 6	SFR	67.9	62.4	68.1	68.2	62.2	62.2	62.7
Trolley Car 7	SFR	66.3	61.1	66.5	66.6	61	60.9	61.5
Trolley Car 8	SFR	66.8	61.6	66.7	66.8	61.5	61.4	61.9
Trolley Car 9	SFR	64.9	60.6	64.1	64.1	60.5	60.4	61

Note: Shading indicates impacted receptors based on NAC or substantial increase over existing conditions. For purposes of determining impacts, results were rounded to the nearest whole number (e.g., 65.6 dBA rounds to 66 and is considered an impact for a residential land use).
N/A: Not applicable, property is full acquisition
** Substantial increase over existing conditions
SFR: Single-family residence

Table 4-7. Noise Modeling Results for NSA 5 (Worst-Case Peak Hour, Leq, dBA)

Receiver ID	Land Use Type	Existing	2040 No Build	Alt. A	Alt. B	Alt. C	Alt. D	Alt. F
Seasons 1	SFR	58.3	62.3	62.3	62.3	62.3	62.1	62.5
Seasons 10	SFR	65.8	60.6	61.2	61.2	61.1	61	60.9
Seasons 11	SFR	66.1	61.1	61.7	61.7	61.8	61.7	61.4
Seasons 12	SFR	64.7	59.7	60.3	60.3	61.3	61.3	60.1
Seasons 2	SFR	67.7	63.6	74.1	74.1	63.6	63.5	63.9
Seasons 3	SFR	59.4	60	62.8	62.8	60	59.8	60.2
Seasons 4	SFR	68.1	59.6	67.2	67.3	59.7	59.6	60
Seasons 5	SFR	58.8	57.2	59.3	59.3	57.1	57.1	57.5
Seasons 6	SFR	67.1	60	63.2	63.2	60	59.9	60.3
Seasons 7	SFR	66.9	60.7	62.4	62.4	60.7	60.7	61.1
Seasons 8	SFR	66.7	60.8	61.5	61.5	60.9	60.9	61.1
Seasons 9	SFR	66.5	60.9	61.5	61.5	61.1	61.1	61.2
Buyck 1	SFR	64.9	68.4	68.4	68.6	68.2	68.1	68.6
Seasons_E" (SFR)		58.2	58.4	58.8	58.9	Not analyzed- receptors included for purposes of evaluating benefits of the Seasons Lane barrier only.		
Seasons_D" (SFR)		58.7	58.8	59.2	59.4			
Seasons_C" (SFR)		55.8	57	57.4	57.6			
Seasons_B" (SFR)		54	55.2	55.6	55.8			
Seasons_F" (SFR)		62.3	60.8	61.2	61.2			
Seasons_G" (SFR)		61.8	60.7	61.1	61.1			
Seaons_H" (SFR)		61.2	60.1	60.5	60.5			
Seasons_I" (SFR)		61.1	59.4	59.9	59.9			
Seasons_J" (SFR)		60.3	58.5	59.2	59.2			
Seasons_K" (SFR)		62	59.6	60.8	60.9			
Seasons_L" (SFR)		57.9	57.3	59.7	59.7			

Receiver ID	Land Use Type	Existing	2040 No Build	Alt. A	Alt. B	Alt. C	Alt. D	Alt. F
Seasons_N" (SFR)		55.3	58.8	59	59.1			
Seaons_M" (SFR)		54.6	56.9	57.5	57.6			
Seasons_A" (SFR)		52.8	55.5	56.6	56.7			

Note: Shading indicates impacted receptors based on NAC or substantial increase over existing conditions. For purposes of determining impacts, results were rounded to the nearest whole number (e.g., 65.6 dBA rounds to 66 and is considered an impact for a residential land use).
N/A: Not applicable, property is full acquisition
** Substantial increase over existing conditions
SFR: Single-family residence

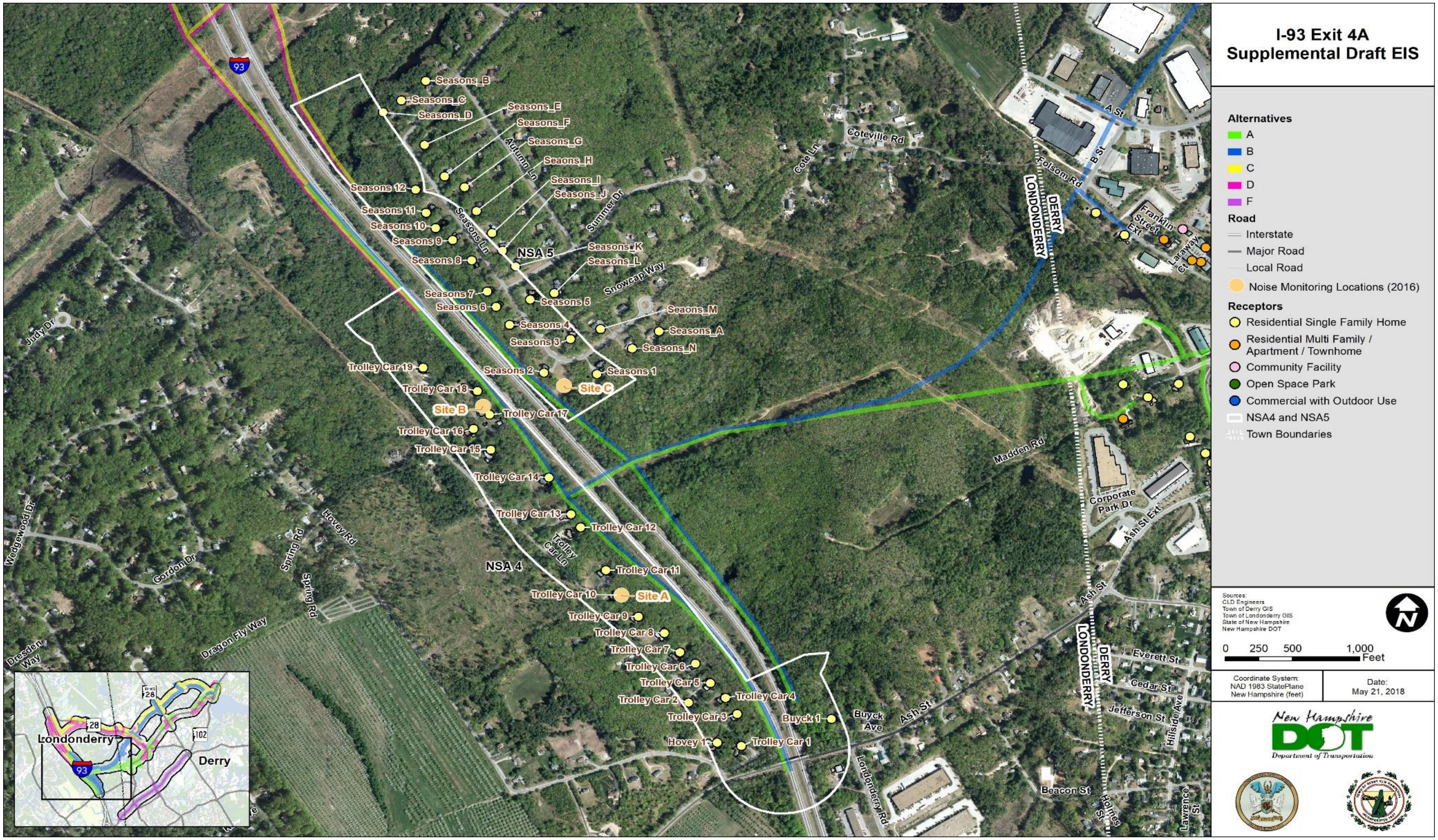


Figure 4-6. NSA 4 and NSA 5 Receptors

Table 4-8. Noise Modeling Results for NSA 6 (Worst-Case Peak Hour, Leq, dBA)

Receiver ID	Land Use Type	Existing	2040 No Build	Alt. A	Alt. B	Alt. C	Alt. D	Alt. F
Claremont 1	SFR	66.5	66.1	68.3	64.7	67.3	67.3	66.6
Claremont 2"	SFR	55.2	54.8	58.8	53.3	55.5	54.2	55.2
Claremont 3"	SFR	48.8	48.7	53.4	48.6	50.3	49.7	49.2
Claremont 4"	SFR	48.5	48.3	52.2	48.7	49.7	50.2	48.9
Claremont 5"	SFR	47.9	47.8	51.5	48.7	49.4	50.8	48.7
Claremont 6"	SFR	50.9	50.7	53.2	51.4	53.5	53.1	51.6
Claremont 7"	SFR	49.8	49.7	53.4	49.5	51.4	51.2	50.2
Claremont 8"	SFR	52	51.7	56.5	50.7	52.7	52.6	52.1
Concord 1"	SFR	49.1	48.7	55.2	50	50.4	50.1	49.4
Concord 2"	SFR	53.2	53	57.9	51.3	53.5	52.9	53.3
Concord 4"	SFR	48	48.1	52.2	47.2	47.5	46.8	48.4
Concord 3"	SFR	49.5	49.4	54.5	48.4	49.4	49.3	49.7
Covey Run 1 APT TH"	Apartment/Townhome	54.2	56.2	55.9	53.8	54.8	54.7	55.3
Covey Run 10 APT TH"	Apartment/Townhome	44.4	45.8	49.7	44.6	44.9	45	45.1
Covey Run 11 APT TH"	Apartment/Townhome	44.7	46.4	49.9	44.9	45.2	45.4	45.6
Covey Run 12 APT TH"	Apartment/Townhome	46.1	47.8	51.9	46.4	46.6	46.8	47
Covey Run 2 APT TH"	Apartment/Townhome	57.7	59.7	59.3	57.2	58.2	58.2	58.7
Covey Run 3 APT TH"	Apartment/Townhome	62.6	64.8	64.7	61.8	62.7	63.4	63.6
Covey Run 4 APT TH"	Apartment/Townhome	62.8	65.1	65	62.1	63	63.7	63.9
Covey Run 5 APT TH"	Apartment/Townhome	63.1	65.4	65.2	62.3	63.2	63.9	64.1
Covey Run 6 APT TH"	Apartment/Townhome	42.5	43.7	48.2	42.7	43.1	43.2	43.1
Covey Run 7 APT TH"	Apartment/Townhome	43	44.4	48.6	43.1	43.7	43.8	43.8
Covey Run 8 APT TH"	Apartment/Townhome	49.7	51.5	54.3	49.4	50.1	50.2	50.6
Covey Run 9 APT TH"	Apartment/Townhome	42.5	43.8	48.1	42.6	43	43.2	43.2
Exeter 1"	SFR	51.1	50.1	58.1	53.5	53.9	51.3	51.5
Exeter 2"	SFR	47.7	47.6	54.4	48.9	48.9	47.8	48.1

Receiver ID	Land Use Type	Existing	2040 No Build	Alt. A	Alt. B	Alt. C	Alt. D	Alt. F
Exeter 3"	SFR	47.3	47.3	53	48	48.2	47.1	47.7
Exeter 4"	SFR	47.8	47.8	52.2	47.1	48	47.7	48.1
Exeter 5"	SFR	47.4	47.4	52.5	47.7	48.4	48.5	47.8
Exeter 6"	SFR	47.2	47.3	51.6	47.2	47.6	47.5	47.7
Ferland 1"	SFR	58.5	60.2	0	57.9	58.8	59.2	59.5
Ferland 2"	SFR	50.9	52.6	58.2	50.7	51.5	51.6	51.9
Ferland 3 MF"	Multi-Family	47.3	48.9	54.1	47.4	48	47.9	48.2
Ferland 4"	SFR	49.3	51.3	54	49.1	49.8	50	50.3
Ferland 5 MF"	Multi-Family	47.5	49.2	52.9	47.4	47.9	48.1	48.4
Ferland 6 MF"	Multi-Family	47.4	48.7	54.4	47	48.2	48.1	48.2
Folsom 1"	SFR	68	67.8	68.5	66.4	68.9	68.6	68.1
Folsom 10"	SFR	67.2	66.7	N/A	65.1	67.7	67.5	67.2
Folsom 11 CF"	Community Facility	59.4	59	N/A	57.4	60	60.1	59.4
Folsom 2"	SFR	67.6	67.4	67	65.9	68.6	68.3	67.8
Folsom 3"	SFR	62.5	63.2	N/A	62.5	63.6	63.2	63.2
Folsom 4"	SFR	62.1	62.1	N/A	60.4	62.7	62.4	62.3
Folsom 5"	SFR	68.5	68.2	67.1	66.8	69.5	69.2	68.6
Folsom 5A"	SFR	52.9	53.2	N/A	52.1	53.8	53.5	53.3
Folsom 6"	SFR	66.7	66.3	N/A	64.7	67.2	66.9	66.7
Folsom 7"	SFR	67.8	67.4	N/A	65.7	68.3	68.1	67.8
Folsom 8"	SFR	66.1	65.7	N/A	64.1	66.6	66.1	66.1
Folsom 9"	SFR	66.5	66.2	70.4	64.7	67.4	67.9	66.6
Franklin 1"	SFR	62.3	62.8	67.3	62.3	64.1	62.8	62.9
Franklin 10 APT TH"	Apartment/Townhome	46.3	46.1	53.4	48.5	48.5	46.4	46.8
Franklin 11 APT TH"	Apartment/Townhome	46.1	45.9	53.1	48.2	48.2	46.2	46.6
Franklin 12"	SFR	67.9	67.9	70.4	66.6	68.9	68.6	68.2
Franklin 13 MF"	Multi-Family	51.2	50.8	57.1	50.8	52.3	51.3	51.4
Franklin 14"	SFR	50.6	48.9	57.5	53.5	53.5	50.4	50.9
Franklin 15"	SFR	47.3	46.5	54.1	49.9	50.3	47.4	47.8
Franklin 2 APT TH"	Apartment/Townhome	64.5	66.3	69.6	63.8	64.7	65.3	65.5
Franklin 3 APT TH"	Apartment/Townhome	64.6	66.3	70	63.9	64.8	65.4	65.5
Franklin 4 APT TH"	Apartment/Townhome	55	54.7	61.4	56.3	57.5	55	55.4
Franklin Ext 4 CF"	Community Facility	43.2	43.5	48.1	48.4	42.7	44.5	44
Franklin 5 APT TH"	Apartment/Townhome	52.9	51.9	59.5	54.9	55.8	52.9	53.3
Franklin 6 APT TH"	Apartment/Townhome	50.8	49.6	57.9	53.3	53.7	50.6	51.2
Franklin 7 APT TH"	Apartment/Townhome	49.5	48.4	56.7	51.9	52.2	49.3	49.8
Franklin 8 APT TH"	Apartment/Townhome	47.4	47.4	54.7	49.3	49.4	47.6	48
Franklin 9 APT TH"	Apartment/Townhome	47	47.3	54	48.4	48.6	47.3	47.6
Franklin Ext 1"	SFR	57.5	57.9	59	62.8	40.7	59.8	59.5

Receiver ID	Land Use Type	Existing	2040 No Build	Alt. A	Alt. B	Alt. C	Alt. D	Alt. F
Franklin Ext 10 APT TH"	Apartment/Townhome	48	49	57.3	48.8	49.4	49.2	49
Franklin Ext 11 APT TH"	Apartment/Townhome	48	48.9	57.1	48.5	49.2	49.1	48.8
Franklin Ext 12 APT TH"	Apartment/Townhome	47.9	48.8	57.1	48.3	49.1	48.9	48.7
Franklin Ext 13 APT TH"	Apartment/Townhome	45.8	46.1	55.1	47.2	46.7	46.5	46.1
Franklin Ext 14 APT TH"	Apartment/Townhome	45.5	45.8	54.8	47.9	46.7	46.4	45.9
Franklin Ext 15 APT TH"	Apartment/Townhome	45	45	54.3	47.5	46.2	46	45.3
Franklin Ext 17"	SFR	59.9	60.9	66.6	61.5	61.7	61.2	61.1
Franklin Ext 2"	SFR	57.6	58.1	59.3	62.9	43.2	59.9	59.7
Franklin Ext 3 MF"	Multi-Family	50.8	51.2	53.3	55.9	39.6	53.1	52.8
Franklin Ext 4 APT TH"	Apartment/Townhome	58.4	58.9	60.8	62.7	61.9	60.5	60.3
Franklin Ext 5 APT TH"	Apartment/Townhome	57.9	58.4	61	62.1	61.4	60	59.8
Franklin Ext 6 APT TH"	Apartment/Townhome	50.8	51.8	58.8	53.3	53.1	52.5	52.3
Franklin Ext 7 APT TH"	Apartment/Townhome	49.7	50.7	58.3	51.9	51.8	51.4	51.1
Franklin Ext 8 APT TH"	Apartment/Townhome	48.9	49.9	57.9	50.6	50.7	50.4	50.1
Franklin Ext 9 APT TH"	Apartment/Townhome	48.4	49.4	57.5	49.6	50	49.7	49.5
Franklin Ext 16"	SFR	57.1	57.9	62.7	60.4	59.9	58.8	58.7
Laconia 1"	SFR	51.2	50.9	54.4	51.1	52.7	53.2	51.5
Laconia 1A COD"	Commercial w/Outdoor Use	65.4	64.9	66.1	65.4	66.6	66.8	65.8
Laconia 2"	SFR	51.2	50.9	56.6	50.1	52.2	52	51.4
Laconia 3"	SFR	60.8	60.4	65.9	59	61.6	62	60.9
Madden 1"	SFR	44.1	45.4	67.9	48	44.7	45	44.7
Madden 2 MF"	Multi-Family	44.6	49.5	57	47.3	47.2	47.3	47.1
Madden 3"	SFR	49.3	57.2	61	50.3	54.1	54.4	54.2
Madden 4"	SFR	56.1	58.3	65.8	55.6	56.6	57.1	57.3
Manchester 1"	SFR	64.8	64.5	65.4	63	65.7	65.2	64.9
Manchester 10"	SFR	48.1	48	51.8	48.7	49.4	49.4	48.7
Manchester 2"	SFR	52.4	52.1	57.3	50.9	52.9	52.5	52.4
Manchester 3"	SFR	47.6	47.5	53.9	47.2	48.5	48.2	47.9
Manchester 4"	SFR	47.1	47	51.3	47.6	48.4	48.1	47.5

Receiver ID	Land Use Type	Existing	2040 No Build	Alt. A	Alt. B	Alt. C	Alt. D	Alt. F
Manchester 5"	SFR	63.9	63.6	66.8	62.1	64.7	64.3	64
Manchester 6"	SFR	53.5	53.1	57.3	51.7	53.9	53.1	53.5
Manchester 7"	SFR	48.6	48.3	53.3	47.8	49.4	49.1	48.8
Manchester 8 MF"	Multi-Family	48.1	48	53.6	47.9	49.1	49.1	48.5
Manchester 9 MF"	Multi-Family	47.6	47.5	52.4	48	48.8	49	48
North High 1"	SFR	54.5	56.8	58	53.8	54.6	55.4	55.5
North High 2"	SFR	55.8	58.1	57.9	55.1	55.9	56.7	56.9
North High 3"	SFR	62.2	64.3	64.2	61.5	62.6	62.9	63.3
North High 4"	SFR	57.6	59.6	60.3	57.2	58.2	58.2	58.7
North High 5"	SFR	60.3	62.2	62.2	59.8	60.8	61	61.4
North High 6"	SFR	68.2	70	71.7	67.4	68.3	68.9	69.2
Laraway_1"	SFR	50.5	51	53.4	55.3	52.1	53	52.5
Laraway_2"	SFR	45.4	46.4	53.1	48.2	47.4	47	46.8
Laraway_3"	SFR	42.3	42.3	46.7	46.9	43.1	43.7	42.4
Laraway_4"	SFR	43.5	44	49.5	46.9	44.9	45.3	44.7
Laraway_4"	SFR	53.6	54.1	56.6	58	54.6	55.8	55.6

Note: Shading indicates impacted receptors based on NAC or substantial increase over existing conditions. For purposes of determining impacts, results were rounded to the nearest whole number (e.g., 65.6 dBA rounds to 66 and is considered an impact for a residential land use).
N/A: Not applicable, property is full acquisition
** Substantial increase over existing conditions
SFR: Single-family residence

Figure 4-7. NSA 6 Receptors

Table 4-9. Noise Modeling Results for NSA 7 (Worst-Case Peak Hour, Leq, dBA)

Receiver ID	Land Use Type	Existing	2040 No Build	Alt. A	Alt. B	Alt. C	Alt. D	Alt. F
Bittersweet 1 APT TH	Apartment/Townhome	45.5	45.7	46.2	43.3	44.4	45.8	45.2
Bittersweet 10 APT TH	Apartment/Townhome	45.2	45.1	45.7	43.4	44.1	45.2	44.6
Bittersweet 11 APT TH	Apartment/Townhome	45	44.9	45.8	43.2	44.1	45.3	44.4
Bittersweet 12 APT TH	Apartment/Townhome	44.9	44.8	45.9	43.1	44	45.3	44.4
Bittersweet 2 APT TH	Apartment/Townhome	44.3	44.3	45.1	42.2	43	44.8	43.8
Bittersweet 3 APT TH	Apartment/Townhome	42.9	42.7	43.4	40.9	41.8	43	42.2
Bittersweet 4 APT TH	Apartment/Townhome	41.3	40.8	41.6	39.6	40.3	41.1	40.4
Bittersweet 5 APT TH	Apartment/Townhome	41.9	41.6	42	40	40.9	41.4	41.1
Bittersweet 6 APT TH	Apartment/Townhome	41.2	40.6	41.5	39.4	40.2	41	40.2
Bittersweet 7 APT TH	Apartment/Townhome	40.8	40.1	41	39	39.8	40.5	39.7
Bittersweet 8 APT TH	Apartment/Townhome	42.9	43	42.8	41	41.9	42.3	42.5
Bittersweet 9 APT TH	Apartment/Townhome	43.6	43.5	43.5	41.6	42.3	43.1	43.1
Energy 1 APT TH	Apartment/Townhome	56.6	55.9	57.8	56.9	57.5	57.7	55.6
Energy 10 APT TH	Apartment/Townhome	45.4	45.1	46.2	44.8	45.5	46.2	44.7
Energy 11 APT TH	Apartment/Townhome	45.5	45.2	46.2	44.9	45.6	46.2	44.7
Energy 12 APT TH	Apartment/Townhome	45.4	45.1	46.1	44.9	45.5	46.2	44.7
Energy 13 APT TH	Apartment/Townhome	45.8	45.5	46.6	45	45.6	46.2	45.1
Energy 14 APT TH	Apartment/Townhome	46.2	46	47	45.5	46.1	46.7	45.6
Energy 15 APT TH	Apartment/Townhome	49.6	49.3	50.5	48.9	49.4	50.5	48.8
Energy 16 APT TH	Apartment/Townhome	50	49.4	51	49.6	50.2	50.8	49
Energy 17 APT TH	Apartment/Townhome	50.2	49.6	51.4	50	50.6	51.2	49.2
Energy 18 APT TH	Apartment/Townhome	50.6	50	51.9	50.7	51.3	51.7	49.7
Energy 19 APT TH	Apartment/Townhome	51	50.4	52.3	51.1	51.7	52.1	50.1
Energy 2 APT TH	Apartment/Townhome	51.4	50.7	52.8	51.6	52.2	52.5	50.5
Energy 20 APT TH	Apartment/Townhome	51.7	51.1	53.1	51.9	52.5	52.9	50.8
Energy 3 APT TH	Apartment/Townhome	48.5	47.8	49.1	48.1	48.6	49	47.4
Energy 4 APT TH	Apartment/Townhome	48.6	47.8	49.3	48.2	48.8	49.2	47.4
Energy 5 APT TH	Apartment/Townhome	48.2	47.7	49.2	48	48.6	49.1	47.3
Energy 6 APT TH	Apartment/Townhome	46.7	46.7	47.5	45.6	46.3	47.5	46.2

Receiver ID	Land Use Type	Existing	2040 No Build	Alt. A	Alt. B	Alt. C	Alt. D	Alt. F
Energy 7 APT TH	Apartment/Townhome	46.3	46.2	46.9	45.3	46.1	47	45.8
Energy 8 APT TH	Apartment/Townhome	46	45.9	46.8	45.2	45.9	46.8	45.4
Energy 9 APT TH	Apartment/Townhome	45.6	45.3	46.4	45	45.6	46.4	44.9
Linlew 1 APT TH	Apartment/Townhome	49.5	49.6	49.8	48.4	48.5	50.4	48.4
Linlew 2 APT TH	Apartment/Townhome	47.7	46.3	46.3	44.6	44.8	45.8	45.8
Linlew 3 APT TH	Apartment/Townhome	53.9	51.5	52.2	47.9	47.5	50.6	51
Linlew 4 APT TH	Apartment/Townhome	63	60.2	61.4	53.7	53.1	59	59.7
Linlew 5 APT TH	Apartment/Townhome	54	51.5	52.5	47.4	47	50.5	51
Pinkerton 1 APT TH	Apartment/Townhome	57.8	57.4	60	58.5	59.2	59.8	57
Pinkerton 2 APT TH	Apartment/Townhome	56.6	56.4	58.9	57	57.5	58.4	56.1
Pinkerton 3 APT TH	Apartment/Townhome	55.9	55.8	58.2	55.7	56.5	57.4	55.6
Solar 1 APT TH	Apartment/Townhome	66.9	67.7	67.8	64.5	65.9	67.2	67.1
Solar 10 APT TH	Apartment/Townhome	51.8	52.2	52.2	49.3	50.2	51.8	51.6
Solar 11 APT TH	Apartment/Townhome	51.6	51.9	52	49.3	50	51.6	51.4
Solar 12 APT TH	Apartment/Townhome	51.1	51.4	51.2	49.1	49.4	50.9	50.8
Solar 13 APT TH	Apartment/Townhome	53.2	53.5	54.5	51.4	51.4	54.7	52.9
Solar 14 APT TH	Apartment/Townhome	51.7	51.9	53.2	49.7	49.9	53.5	51.3
Solar 15 APT TH	Apartment/Townhome	50.1	50.3	51.5	48.1	48.2	51.7	49.7
Solar 16 APT TH	Apartment/Townhome	49.3	49.4	50.4	47.2	47.3	50.5	48.8
Solar 17 APT TH	Apartment/Townhome	48.3	48.4	49.3	46.3	46.5	49.4	47.9
Solar 18 APT TH	Apartment/Townhome	47.6	47.6	48.4	45.5	45.7	48.4	47.1
Solar 2 APT TH	Apartment/Townhome	65.7	66.5	66.2	63.4	64.7	65.6	65.9
Solar 3 APT TH	Apartment/Townhome	64.5	65.2	64.8	62.2	63.4	64.3	64.7
Solar 4 APT TH	Apartment/Townhome	63.1	63.8	63.4	60.8	61.9	63	63.2
Solar 5 APT TH	Apartment/Townhome	61.4	62	61.8	59.2	60	61.5	61.4
Solar 6 APT TH	Apartment/Townhome	59.9	60.4	60.4	57.9	58.4	60.2	59.9
Solar 7 APT TH	Apartment/Townhome	55.7	56.2	56.2	53.7	54.2	55.9	55.6
Solar 8 APT TH	Apartment/Townhome	54	54.5	54.5	51.7	52.4	54.2	53.9
Solar 9 APT TH	Apartment/Townhome	52.9	53.4	53.5	50.6	51.4	53.2	52.8
Squire 1 APT TH	Apartment/Townhome	44.9	45	44.8	43.1	43.2	44.3	44.4
Squire 10 APT TH	Apartment/Townhome	45.7	45.7	45.9	43.6	43.7	45.7	45.1
Squire 11 APT TH	Apartment/Townhome	46.7	47.1	47.3	44.3	45.3	46.9	46.5

Receiver ID	Land Use Type	Existing	2040 No Build	Alt. A	Alt. B	Alt. C	Alt. D	Alt. F
Squire 12 APT TH	Apartment/Townhome	46.1	46.5	46.6	43.7	44.8	46.2	46
Squire 13 APT TH	Apartment/Townhome	49.2	49.7	49.5	46.8	47.8	49.2	49.1
Squire 14 APT TH	Apartment/Townhome	51.2	51.7	51	48.4	49.7	50.6	51.1
Squire 15 APT TH	Apartment/Townhome	53.1	53.6	52.4	51	51.5	52	53
Squire 16 APT TH	Apartment/Townhome	56.1	56.5	55.2	53.4	54.5	54.9	56
Squire 17 APT TH	Apartment/Townhome	58.6	59.2	57.9	56	57.2	57.4	58.6
Squire 18 APT TH	Apartment/Townhome	62.9	63.6	62.1	60.4	61.7	61.3	63.1
Squire 19 APT TH	Apartment/Townhome	65.7	66.5	65.3	63.4	64.7	64.7	65.9
Squire 2 APT TH	Apartment/Townhome	42.4	42.6	43	40.1	40.9	42.7	42
Squire 20 APT TH	Apartment/Townhome	64.5	65.3	63.7	62.3	63.5	63	64.7
Squire 21 APT TH	Apartment/Townhome	63.5	64.3	62.7	61.2	62.5	62	63.7
Squire 22 APT TH	Apartment/Townhome	62.3	63.1	61.8	60.1	61.3	61.1	62.5
Squire 23 APT TH	Apartment/Townhome	60.8	61.6	60.7	58.6	59.9	60	61
Squire 24 APT TH	Apartment/Townhome	52.6	53.2	52.9	50.3	51.3	52.4	52.6
Squire 25 APT TH	Apartment/Townhome	49.1	49.6	49.6	46.7	47.7	49.2	49
Squire 26 APT TH	Apartment/Townhome	46.6	47	47.2	44.2	45.2	46.9	46.4
Squire 27 APT TH	Apartment/Townhome	47.4	47.9	47.8	44.8	46	47.4	47.3
Squire 28 APT TH	Apartment/Townhome	48.8	49.3	49.5	46.2	47.5	49	48.8
Squire 29 APT TH	Apartment/Townhome	51.9	52.5	52.4	49.2	50.6	51.9	51.9
Squire 3 APT TH	Apartment/Townhome	41.6	41.7	42.1	39.3	40	41.8	41.1
Squire 30 APT TH	Apartment/Townhome	54.7	55.3	55.1	52.1	53.5	54.5	54.8
Squire 31 APT TH	Apartment/Townhome	58.6	59.2	58.7	56.1	57.3	58.1	58.6
Squire 32 APT TH	Apartment/Townhome	61.7	62.4	61.6	59.3	60.5	61	61.8
Squire 33 APT TH	Apartment/Townhome	62.1	62.8	62.4	59.9	60.9	62	62.2
Squire 34 APT TH	Apartment/Townhome	58.9	59.5	59.5	56.7	57.5	59.2	58.9
Squire 35 APT TH	Apartment/Townhome	56.9	57.3	57.3	54.9	55.3	57	56.8
Squire 36 APT TH	Apartment/Townhome	53.2	53.7	54.4	50.7	51.8	54.1	53.1
Squire 37 APT TH	Apartment/Townhome	51.5	51.9	52.6	48.9	50	52.4	51.4
Squire 38 APT TH	Apartment/Townhome	49.6	50	50.7	47.1	48.1	50.4	49.4
Squire 4 APT TH	Apartment/Townhome	40.5	40.5	41.8	38.1	39	41.5	39.9
Squire 5 APT TH	Apartment/Townhome	43.1	43.3	43.3	40.8	41.5	43	42.7
Squire 6 APT TH	Apartment/Townhome	42.6	42.7	42.7	40.2	40.9	42.3	42.1

Receiver ID	Land Use Type	Existing	2040 No Build	Alt. A	Alt. B	Alt. C	Alt. D	Alt. F
Squire 7 APT TH	Apartment/Townhome	43.1	43.3	43.1	40.6	41.4	42.8	42.7
Squire 8 APT TH	Apartment/Townhome	44.4	44.3	43.8	41.8	42.3	43.5	43.8
Squire 9 APT TH	Apartment/Townhome	45.1	45.1	45.1	42.8	43.2	44.8	44.5
Sunview 1 APT TH	Apartment/Townhome	62.5	63.2	63.8	60.3	61.4	63.4	62.7
Sunview 10 APT TH	Apartment/Townhome	48.6	48.7	49.6	47	47.5	49.1	48.1
Sunview 11 APT TH	Apartment/Townhome	48.2	48.2	49.2	46.7	47.3	48.9	47.6
Sunview 12 APT TH	Apartment/Townhome	45.8	45.6	46.6	45	45.6	46.2	45.2
Sunview 13 APT TH	Apartment/Townhome	46	45.8	46.7	45.2	45.8	46.4	45.4
Sunview 14 APT TH	Apartment/Townhome	44.1	43.8	45	42.8	43.6	44.6	43.4
Sunview 15 APT TH	Apartment/Townhome	44.3	44.1	45.2	43	43.8	44.8	43.6
Sunview 16 APT TH	Apartment/Townhome	44.7	44.5	45.6	43.5	44.3	45.1	44.1
Sunview 17 APT TH	Apartment/Townhome	43.9	43.6	44.7	42.6	43.4	44.3	43.2
Sunview 18 APT TH	Apartment/Townhome	44.4	44.1	45.2	43.1	43.9	44.7	43.7
Sunview 19 APT TH	Apartment/Townhome	45.1	44.9	46	43.9	44.6	45.5	44.5
Sunview 2 APT TH	Apartment/Townhome	62	62.8	63.5	59.8	60.9	63	62.2
Sunview 20 APT TH	Apartment/Townhome	44.7	44.7	45	42.9	43.8	44.6	44.2
Sunview 21 APT TH	Apartment/Townhome	44.6	44.5	45.2	42.8	43.6	44.8	44
Sunview 22 APT TH	Apartment/Townhome	45	44.9	45.5	43.3	44.1	45.1	44.4
Sunview 23 APT TH	Apartment/Townhome	44.9	44.8	45.5	43.2	44	45	44.3
Sunview 24 APT TH	Apartment/Townhome	65.3	66.1	65.9	63.1	64.3	64.8	65.5
Sunview 25 APT TH	Apartment/Townhome	64.2	64.9	63.5	61.9	63	62.7	64.3
Sunview 26 APT TH	Apartment/Townhome	53.6	54.3	54.4	51.2	52.5	53.8	53.7
Sunview 27 APT TH	Apartment/Townhome	52.8	53.1	53.6	51.3	51.4	53.1	52.6
Sunview 28 APT TH	Apartment/Townhome	48.7	49	49.3	46.3	47.3	49.2	48.4
Sunview 29 CF	Community Facility	44.7	45	45.1	42.4	43.3	44.6	44.4
Sunview 3 APT TH	Apartment/Townhome	63.5	64.3	65.6	61.6	62.9	64.9	63.8
Sunview 4 APT TH	Apartment/Townhome	50.9	51	52.5	49.7	50.2	51.4	50.6
Sunview 5 APT TH	Apartment/Townhome	50.6	51	52	49.2	49.7	50.9	50.5
Sunview 6 APT TH	Apartment/Townhome	50.9	51.2	52.3	49.5	49.9	51.4	50.7
Sunview 7 APT TH	Apartment/Townhome	50.7	51	52.3	49.1	49.7	51.6	50.5
Sunview 8 APT TH	Apartment/Townhome	49.8	50	51	48.3	48.8	50.4	49.5
Sunview 9 APT TH	Apartment/Townhome	49.3	49.5	50.6	47.7	48.3	50	48.9

Receiver ID	Land Use Type	Existing	2040 No Build	Alt. A	Alt. B	Alt. C	Alt. D	Alt. F
Tsienneto 10 CF	Community Facility	61.3	61.6	61.8	58.6	59.3	61.5	61.1
Tsienneto 11 CF	Community Facility	60.1	60.5	61.1	57.1	58.3	60.7	59.9
Tsienneto 12 CF	Community Facility	48.9	49.1	49.1	46.5	47.6	48.5	48.5
Tsienneto 8 CF	Community Facility	62.2	62.9	62.7	59.9	61	62.2	62.3
Tsienneto 9 CF	Community Facility	64.7	65	65.6	62.9	62.8	65.4	64.5

Note: Shading indicates impacted receptors based on NAC or substantial increase over existing conditions. For purposes of determining impacts, results were rounded to the nearest whole number (e.g., 65.6 dBA rounds to 66 and is considered an impact for a residential land use).
N/A: Not applicable, property is full acquisition
** Substantial increase over existing conditions
SFR: Single-family residence

Figure 4-8. NSA 7 Receptors South

Figure 4-9. NSA 7 Receptors North

Table 4-10. Noise Modeling Results for NSA 8 (Worst-Case Peak Hour, Leq, dBA)

Receiver ID	Land Use Type	Existing	2040 No Build	Alt. A	Alt. B	Alt. C	Alt. D	Alt. F
Barkland 1	SFR		49.8	50	46.5	47	49.4	49.5
Barkland 2"	SFR	45.5	48.1	48.6	45.3	45.7	48.1	47.8
Barkland 3"	SFR	45.2	47.8	48.3	45	45.5	47.8	47.5
Barkland 4"	SFR	45.8	48.4	48.9	45.4	45.9	48.3	48
Barkland 5"	SFR	45.3	47.7	48	45	45.4	47.4	47.4
Barkland 6"	SFR	44	46.3	47	43.9	44.4	46.4	45.9
Beaver 1"	SFR	59.1	61.9	62.6	58.6	59	62.1	61.7
Beaver 2"	SFR	49	51.2	51.8	49.2	49.4	51.3	51.1
Beaver 3"	SFR	48.5	50.5	51	48.9	48.9	50.6	50.4
Beaver 4"	SFR	45.1	46.8	47.2	45.1	45.2	46.7	46.6
Beaver 5"	SFR	47.5	49.4	50	47.8	47.7	49.6	49.3
Beaver 6"	SFR	55.1	57.4	57.5	55	55.1	57	57.5
Beaver 7"	SFR	45.4	47.5	48.1	45.7	45.8	47.6	47.3
By Pass 28 5"	SFR	61.9	59.3	59.2	56	54.7	58.6	58.6
Chester 1"	SFR	67.6	68.5	68.2	68.5	69	68.3	68.5
Chester 10"	SFR	67.8	66.9	66.3	64.5	65.1	66.5	66.8
Chester 2"	SFR	50.6	52	52.6	52.9	52.9	52.2	51.5
Chester 3"	SFR	54.3	55.5	57.1	56.8	56.8	56.2	55
Chester 4 MF"	Multi-Family	63.2	63.7	66.1	65.8	65.4	65.2	64
Chester 5"	SFR	66.8	67.5	68.3	67.9	68.3	67.5	67.3
Chester 6"	SFR	59	60	62.3	62.3	62.7	61.8	59.9
Chester 7"	SFR	58.5	57.6	58.4	56.5	57.8	58.3	57.5
Chester 8"	SFR	57	56	55.7	53.8	54.8	55.8	55.9
Chester 9"	SFR	66.2	65.3	57.6	55.6	56.8	57.4	65.3
Country 1"	SFR	45.8	46.8	46.6	44.9	45.2	46.1	46.5
English Range 1"	SFR	60	59.9	59.6	62.9	59.6	59.4	59.7
English Range 2"	SFR	57.3	55.5	55.3	56.4	55.1	55.1	55.1
Fieldston 2 MF"	Multi-Family	42.7	45	45.9	42.3	42.8	45.4	44.8
Fieldston 4"	SFR	42.7	45	45.9	42.2	42.5	45.4	44.7
Fieldstone 1 MF"	Multi-Family	45.4	47.8	48.5	45.1	45.5	48	47.6

Receiver ID	Land Use Type	Existing	2040 No Build	Alt. A	Alt. B	Alt. C	Alt. D	Alt. F
Fieldstone 3 MF"	Multi-Family	42.8	45.2	46	42.4	42.9	45.5	44.9
Horseshoe 1"	SFR	59.2	62	61.3	58.7	59	60.8	61.8
Horseshoe 2"	SFR	46.7	49.7	49.7	46.2	46.7	49.1	49.3
Horseshoe 3"	SFR	45.7	48.1	48.5	46	46.1	48	47.9
Horseshoe 4"	SFR	47.5	50.1	50.3	47.4	47.8	49.7	49.8
Horseshoe 5"	SFR	46.7	49.3	49.7	46.9	47.2	49.1	49
Horseshoe 6"	SFR	47.5	49.9	50.9	47.8	48	50.4	49.6
Horseshoe 7"	SFR	46.8	49.1	50.1	47.4	47.4	49.5	48.8
Lake Shore 1"	SFR	43.4	44.1	45	45.5	45.8	44.5	43.8
Main 28B 1 CF"	Community Facility	56.9	54.1	55.3	53.2	53.6	53.3	53.8
Main 28B 2 CF"	Community Facility	51.6	49.5	50.3	48.3	48.3	48.6	48.6
Main 28B 3 CF"	Community Facility	62.4	63.4	64.8	60	60.6	64.3	63
Main 28B 4 CF"	Community Facility	54	52.2	53.2	50.8	51.2	52	51.8
Main 28B 5 CF"	Community Facility	55.7	53.8	54.6	52.3	52.7	53.5	53.4
McKinley 1"	SFR	50.4	51.8	52.9	53.1	53.3	52.6	51.2
McKinley 2"	SFR	50	51.7	53.3	51.8	52.2	52.9	51.1
McKinley 3"	SFR	46.7	47.7	49.2	50.4	50.9	48.9	47.2
McKinley 4"	SFR	45.6	46.5	47.7	48.9	49.3	47.3	46.1
McKinley 5"	SFR	46	46.9	48.3	49.6	50	47.8	46.5
McKinley 6"	SFR	44.7	45.4	46.4	47.2	47.6	45.9	45.1
McKinley 7"	SFR	45.3	46	47.3	48.1	48.5	46.8	45.7
McKinley 8"	SFR	44.8	45.7	45.9	47.4	47.9	45.5	45.4
Morningside 1 MF"	Multi-Family	61	64	64.3	60.1	60.7	63.7	63.7
Morningside 2 MF"	Multi-Family	47.3	50.1	50.8	46.9	47.5	50.2	49.8
Morningside 3 MF"	Multi-Family	43.7	46.2	47.4	43.5	44.1	46.8	45.9
Morningside 4 MF"	Multi-Family	44.5	47	47.7	44.3	44.7	47.2	46.8
N Shore 1"	SFR	61.4	62.4	64.2	64.1	64	63.5	62
N Shore 2"	SFR	51.9	53.5	53.4	53.5	53.3	53	52.3

Receiver ID	Land Use Type	Existing	2040 No Build	Alt. A	Alt. B	Alt. C	Alt. D	Alt. F
N Shore 3"	SFR	53	54.7	53.4	53.7	53.3	53.2	53.1
N Shore 4"	SFR	51.9	53.5	52.6	53	52.6	52.3	52
N Shore 5"	SFR	59.1	60.9	59.5	59.9	59.5	59.4	59.2
Private near Lake Shore 1"	SFR	51.1	51.1	52.6	52.3	53.3	52.6	50.8
Private near Lake Shore 2"	SFR	56.4	56.2	58.4	57.7	58.7	58	56.1
Scenic 17"	SFR	50.2	52.3	53.1	50.8	50.2	52.7	52
Scenic 18"	SFR	49.9	50.7	52.1	51.5	49.8	51.9	50.6
Scenic 19"	SFR	53.8	54	55.8	55.6	53.5	55.8	54
Scenic 20"	SFR	52	52.4	54.1	53.8	51.8	54	52.4
Scenic 21"	SFR	50.4	51.5	52.7	51.8	50.1	52.5	51.3
Tsienneto 1"	SFR	63.1	65.3	66.2	67.1	68.1	65.8	65.1
Tsienneto 12A"	SFR	58.1	60.6	62.3	57.2	57.8	61.5	60.3
Tsienneto 13"	SFR	50.4	50.6	51.8	48.1	48	51.1	50.4
Tsienneto 14"	SFR	60.6	63.1	65.1	60.1	60.3	64.7	63
Tsienneto 15 MF"	Multi-Family	62.7	65.7	64.9	61.8	62.5	64.3	65.4
Tsienneto 16"	SFR	62.5	65	65.9	62.2	62.3	65.7	64.9
Tsienneto 17"	SFR	54.3	56.8	57.3	53.4	54.1	56.7	56.5
Tsienneto 18 MF"	Multi-Family	61.4	64.4	63.6	60.5	61.3	63	64.1
Tsienneto 19"	SFR	58.5	61.2	62.8	58	58.4	62.2	61
Tsienneto 2"	SFR	60.9	63.5	64	0	0	63.5	63.4
Tsienneto 20 MF"	Multi-Family	62.6	65.6	65	61.6	62.4	64.3	65.3
Tsienneto 21 MF"	Multi-Family	50.6	53.3	54	49.6	50.3	53.4	52.9
Tsienneto 22 CF"	Community Facility	62	64.6	65.1	61.7	61.8	64.6	64.5
Tsienneto 23"	SFR	59.6	62.3	63.4	59.1	59.9	62.9	62.1
Tsienneto 24"	SFR	57.8	60.4	60	57.3	57.9	59.4	60.2
Tsienneto 25"	SFR	56.1	58.1	58	55.8	56.2	57.6	58.5
Tsienneto 25A"	SFR	45.2	46.2	46.8	43.7	44	46.3	45.9
Tsienneto 26"	SFR	53.5	56.4	56.3	52.5	53.3	55.7	56.1
Tsienneto 27"	SFR	50.9	53.7	53.7	50.1	50.9	53.2	53.4

Receiver ID	Land Use Type	Existing	2040 No Build	Alt. A	Alt. B	Alt. C	Alt. D	Alt. F
Tsienneto 28 MF"	Multi-Family	57	59.1	59.4	56.7	56.9	59.2	59.4
Tsienneto 29 MF"	Multi-Family	57.6	59.9	60.3	57.4	57.6	59.9	60
Tsienneto 3"	SFR	63.4	66	66.6	63	63.1	66.1	65.9
Tsienneto 30"	SFR	58.9	61.9	62.7	58	58.7	62.1	61.6
Tsienneto 31"	SFR	62.8	65.3	66.6	62.5	62.6	66.1	65.2
Tsienneto 32"	SFR	58	60.5	60.7	57.8	58	60.2	60.4
Tsienneto 33"	SFR	64.3	67.3	67.9	63.4	64.1	67.3	67
Tsienneto 34 MF"	Multi-Family	54.6	57.8	58	53.6	54.4	57.5	57.4
Tsienneto 35"	SFR	59.4	62.3	63.2	58.8	59.1	62.6	62.1
Tsienneto 36"	SFR	51.1	53.2	53.3	50.9	51	52.8	53.5
Tsienneto 37 MF"	Multi-Family	58.5	61.3	61.7	57.9	58.3	61.2	61.1
Tsienneto 38 CF"	Community Facility	46	47.3	48.5	44.8	45.2	47.9	46.9
Tsienneto 38 MF"	Multi-Family	60.4	63.3	64	59.7	60.1	63.5	63.1
Tsienneto 39 CF"	Community Facility	46.2	47.2	48.4	44.7	44.9	47.7	46.7
Tsienneto 39 MF"	Multi-Family	57	60.4	61.4	55.7	56.9	60.8	60
Tsienneto 4"	SFR	49.1	52	51.7	49.7	50.1	51.2	51.6
Tsienneto 40 CF"	Community Facility	46.8	47.6	48.9	45	45.2	48.2	47.1
Tsienneto 40 MF"	Multi-Family	54.3	57.5	58.6	53.2	54.2	58.1	57.1
Tsienneto 41"	SFR	62.7	65.3	66.5	62.4	62.4	66	65.2
Tsienneto 42 MF"	Multi-Family	53.6	56.7	58.3	52.6	53.6	57.8	56.3
Tsienneto 43 MF"	Multi-Family	54	57	58.7	53	53.9	58.1	56.7
Tsienneto 44"	SFR	58.7	61.7	62.2	57.9	58.3	61.6	61.4
Tsienneto 45"	SFR	59.4	62.4	63.5	58.7	59.2	63	62.1
Tsienneto 47"	SFR	60	62.9	64	59.3	59.7	63.5	62.6
Tsienneto 48"	SFR	61.3	64.2	64	60.6	61.2	63.4	64
Tsienneto 49"	SFR	59.5	62.4	63.5	58.9	59.3	62.9	62.2
Tsienneto 5"	SFR	59.9	62.8	63.1	59.4	59.8	62.6	62.5
Tsienneto 50"	SFR	59.9	62.8	63	59.3	59.8	62.4	62.5
Tsienneto 51"	SFR	61.2	63.8	64.4	60.9	60.9	63.9	63.6

Receiver ID	Land Use Type	Existing	2040 No Build	Alt. A	Alt. B	Alt. C	Alt. D	Alt. F
Tsienneto 52"	SFR	64.9	67.5	68.2	64.6	64.9	67.7	67.4
Tsienneto 53"	SFR	57.1	60	60.8	56.4	57.2	60.3	59.7
Tsienneto 54"	SFR	65.8	68.3	69.5	65.5	65.8	69	68.2
Tsienneto 55 MF"	Multi-Family	54.9	57.2	57.1	54.8	55.2	56.6	57.2
Tsienneto 6"	SFR	64.3	67.4	68.4	64.3	64.9	67.9	67.1
Tsienneto 7"	SFR	63.7	66.8	67.2	62	63	66.6	66.4

Note: Shading indicates impacted receptors based on NAC or substantial increase over existing conditions. For purposes of determining impacts, results were rounded to the nearest whole number (e.g., 65.6 dBA rounds to 66 and is considered an impact for a residential land use).
N/A: Not applicable, property is full acquisition
** Substantial increase over existing conditions
SFR: Single-family residence

Figure 4-10. NSA 8 South

Figure 4-11. NSA 8 Receptors North

Table 4-11. Noise Modeling Results for NSA 9 (Worst-Case Peak Hour, Leq, dBA)

Receiver ID	Land Use Type	Existing	2040 No Build	Alt. A	Alt. B	Alt. C	Alt. D	Alt. F
Aiken 1	SFR	59.6	56	61.1	60	60	60.1	60.8
Aiken 10	SFR	45.3	45.1	44.3	43.9	43.9	44.3	44.8
Aiken 11	SFR	46	45.8	45.2	44.8	44.7	45.1	45.2
Aiken 12	SFR	50.9	50.6	50.8	50.1	50	50.3	47.9
Aiken 13	SFR	55.3	55	55.3	54.6	54.5	54.7	53
Aiken 14	SFR	61.6	61.3	61.7	61.1	61	61.1	59.1
Aiken 15	SFR	42.6	42.5	41.9	41.2	41.5	41.9	42
Aiken 16	SFR	44.3	44.1	43.5	43	43	43.4	43.5
Aiken 17	SFR	45.2	45.1	44.7	44	44.2	44.6	44.1
Aiken 18	SFR	46.1	45.9	45.8	45.2	45.1	45.5	44.6
Aiken 19	SFR	46.9	46.7	46.9	46.1	46.1	46.4	44.7
Aiken 2	SFR	51.9	51.9	53	52.4	52.3	52.7	54.1
Aiken 20	SFR	52.7	52.4	52.6	52	51.9	52.1	51.4
Aiken 21	SFR	60.1	59.8	60.2	59.6	59.5	59.6	58.4
Aiken 3	SFR	51.6	51.9	50.4	50.3	50.1	50.5	52.6
Aiken 4	SFR	48.1	48.8	46.8	46.8	46.7	47.1	49.7
Aiken 5	SFR	49.2	49.7	48.2	48.1	47.8	48.3	48.5
Aiken 6	SFR	48.8	49.2	47.6	47.6	47.3	47.7	48.3
Aiken 7	SFR	48	48.3	46.4	46.3	46.3	46.7	48.2
Aiken 8	SFR	48.1	48.3	46.5	46.4	46.3	46.7	48.5
Aiken 9 MF	Multi-Family	44.7	44.4	43.3	42.9	43	43.4	44.3
Broadway 102 1	SFR	70.4	71.2	69.6	69.6	69.3	69.7	72.6
Broadway 102 10 APT TH	Apartment/Townhome	62.6	63.1	61.3	61.3	61	61.4	61.9
Broadway 102 11 APT TH	Apartment/Townhome	70	70.7	69.2	69.1	68.8	69.2	72
Broadway 102 12 MF	Multi-Family	71.3	72	70.5	70.5	70.1	70.6	74
Broadway 102 13 APT TH	Apartment/Townhome	66	66.7	65.2	65.1	64.8	65.3	67.2
Broadway 102 14	SFR	68.4	68.7	69	67.6	67.4	67.8	69.1
Broadway 102 15 MF	Multi-Family	67.6	68.1	67.8	66.8	66.7	67.4	68.7
Broadway 102 16	SFR	66.5	67	66.8	65.7	65.7	65.8	67.6

Receiver ID	Land Use Type	Existing	2040 No Build	Alt. A	Alt. B	Alt. C	Alt. D	Alt. F
Broadway 102 17	SFR	68.2	68.5	68.8	67.4	67.2	67.6	68.7
Broadway 102 2 COD	Commercial w/Outdoor Use	69.4	70.3	68	68.1	68.1	68.5	70.5
Broadway 102 3	SFR	69.9	70.8	68.4	68.5	68.6	69	70.8
Broadway 102 4 MF	Multi-Family	67.8	68.6	67	67	66.7	67.1	68.6
Broadway 102 5	SFR	69.5	70.3	68.8	68.7	68.4	68.8	70.3
Broadway 102 6	SFR	69.2	70.1	67.7	67.9	67.9	68.3	70.1
Broadway 102 7	SFR	69.4	70.2	67.9	68	68.1	68.5	70.3
Broadway 102 8	SFR	69.3	70.1	68.5	68.4	68.1	68.6	70.1
Broadway 102 9 CF	Community Facility	68.9	69.5	68	67.9	67.6	68	69.6
Clark 1 MF	Multi-Family	68.1	69	67.4	67.3	67	67.5	68.7
Clark 2 MF	Multi-Family	53.6	53.8	52.2	52.2	51.9	52.3	54
Clark 3	SFR	48.3	48.4	47	46.9	46.6	47.1	48.6
Clark 4 MF	Multi-Family	52.1	52.4	50.4	50.4	50.4	50.8	52.3
Clark 5	SFR	51.8	51.8	49.8	49.8	49.9	50.3	51.2
Clark 6	SFR	47.2	46.7	45.2	45.1	45.1	45.5	46.7
Clark 7	SFR	49	49.1	47.7	47.6	47.3	47.7	49.3
Clark 8	SFR	46.5	46.8	45.4	45.3	45	45.5	46.3
Desmarais 1	SFR	47.4	47.3	47.7	46.6	46.9	47.5	47.8
Desmarais 2	SFR	48.6	48.8	49.1	47.9	47.9	48.8	49.4
Desmarais 3	SFR	46.2	46.6	47	45.5	45.9	46.6	47.4
Dickey 1	SFR	57	57.8	56.3	56.2	55.8	56.3	56.3
Dickey 2	SFR	51.3	51.4	49.2	49.4	49	49.7	51.5
Dickey 3	SFR	49.4	49.1	46.7	47	46.5	47.4	48.5
Dickey 4	SFR	48.4	48.3	46.2	46.3	45.9	46.7	48.3
Dickey 5	SFR	48.9	48.9	46.8	46.9	46.5	47.2	49.3
Dickey 6	SFR	51	51.3	49.4	49.4	49.1	49.7	51.6
Ela 1	SFR	54.6	56.6	53.5	53.8	54	54.4	57.3
Ela 2	SFR	52	54	51.1	51.3	51.4	51.9	54.6
Ela 3	SFR	50.4	52.1	50.3	50.3	50.4	50.8	53.5
Ela 4	SFR	51.7	53.4	51.5	51.5	51.6	52.1	55.1
Ela 5	SFR	55.4	57.5	54.3	54.6	54.8	55.3	58.4

Receiver ID	Land Use Type	Existing	2040 No Build	Alt. A	Alt. B	Alt. C	Alt. D	Alt. F
Elm 1	SFR	67.7	68.2	67.9	66.9	66.8	67.4	68.9
Elm 10 MF	Multi-Family	49.6	49.8	50.1	48.7	48.4	49.2	50.6
Elm 11	SFR	49.1	49.4	49.7	48.2	48.2	49.1	50.3
Elm 12 APT TH	Apartment/Townhome	47.7	48.4	49.9	47.4	47.3	47.9	48.9
Elm 13 MF	Multi-Family	43.7	44.7	46.3	43.5	43.6	44	45.1
Elm 2 MF	Multi-Family	57	57.3	57.5	56.2	56.1	55.9	57
Elm 3 MF	Multi-Family	48.2	49.5	52.6	49	48.7	48.7	49.1
Elm 4 MF	Multi-Family	48.2	49.7	52.8	49.1	48.8	48.8	49.3
Elm 5 MF	Multi-Family	47.1	48.7	51.8	48	47.9	47.9	48.3
Elm 6 MF	Multi-Family	45.1	47.8	51.8	47.3	47.1	47	47.4
Elm 7 MF	Multi-Family	44.6	46.8	50	45.9	45.9	46.1	46.7
Elm 8	SFR	56.6	56.8	57.1	55.7	54.7	55.7	56.1
Elm 9 MF	Multi-Family	52.5	52.7	53.1	51.6	51.2	51.8	52.8
Fordway 1 MF	Multi-Family	68.7	69.4	68.1	67.9	67.6	68	70
Fordway 2 MF	Multi-Family	62.5	62.1	62.5	61.9	61.8	61.9	61.3
Fordway 3	SFR	66.2	65.9	66.2	65.7	65.6	65.7	67.1
Fordway 4	SFR	65.8	65.5	65.9	65.3	65.2	65.3	66.7
Fordway 5	SFR	66	65.7	66.1	65.5	65.4	65.5	67
Fordway 6	SFR	65.7	65.4	65.8	65.3	65.1	65.2	66.6
Fordway 7	SFR	60.1	59.8	60.2	59.6	59.5	59.6	59.1
Fordway 8 MF	Multi-Family	63.8	63.5	64	63.4	63.3	63.3	61
Griffin 1 APT TH	Apartment/Townhome	69.2	69.5	69.8	68.4	68.2	68.8	70.2
Griffin 10	SFR	49.9	50	50.1	49.1	49.2	50.2	50.7
Griffin 11	SFR	49.1	49.1	49.3	48.3	48.5	49.2	49.7
Griffin 12	SFR	48	47.9	48.3	47.3	47.5	48.1	48.6
Griffin 13	SFR	47.8	47.4	48	47.1	47.2	47.8	48.1
Griffin 2	SFR	56	56.5	56.3	55.2	54.6	56.2	55.6
Griffin 3 MF	Multi-Family	52.5	52.6	52.5	51.7	51.2	52.3	52.8
Griffin 4	SFR	51	50.8	51.1	50.3	50	50.8	51.6
Griffin 5 MF	Multi-Family	50.7	50.1	50.9	50	49.8	50.3	50.4
Griffin 6	SFR	50.1	49.5	50.3	49.4	49.2	49.8	49.9
Griffin 7 MF	Multi-Family	49.1	48.6	49.2	48.4	48.3	48.9	49.1

Receiver ID	Land Use Type	Existing	2040 No Build	Alt. A	Alt. B	Alt. C	Alt. D	Alt. F
Griffin 8 MF	Multi-Family	48.5	48.1	48.6	47.7	47.7	48.3	48.5
Griffin 9	SFR	51.3	51.4	51.4	50.4	50.5	51.6	51.9
High 1	SFR	68.4	69.3	67.2	67.5	67.2	67.4	68.8
High 10	SFR	65.4	65.8	65	64.4	64.4	64.6	65.2
High 11	SFR	56.3	61.4	66.3	61.4	60.4	60.2	59.7
High 12	SFR	55.3	61.1	66.4	61.1	60.2	60	59.3
High 13 MF	Multi-Family	55.2	61.6	66.9	61.5	60.6	60.4	59.6
High 14	SFR	54.5	60.9	66.2	60.9	59.9	59.7	58.9
High 15	SFR	52.4	58.8	64.1	58.8	57.8	57.7	56.8
High 16	SFR	59	59.1	59.7	58.2	58.1	58.1	58.4
High 17	SFR	55.4	57	60.1	56.5	56.1	55.8	55.9
High 18 MF	Multi-Family	53.7	56.7	60.9	56.6	55.9	55.5	55.7
High 19 MF	Multi-Family	51.5	53.9	57.7	53.6	53	52.8	53.2
High 2	SFR	60.5	61.7	60.6	61	59.7	59.7	60.8
High 20	SFR	50.5	55.1	59.9	55	54.2	54	53.7
High 21	SFR	49.6	54.7	59.8	54.7	53.8	53.6	53.1
High 22	SFR	49	54.3	59.4	54.3	53.4	53.2	52.7
High 23 MF	Multi-Family	49.2	54.8	59.9	54.7	53.8	53.6	53
High 24 MF	Multi-Family	45.4	50.1	55.1	49.9	49.4	49.2	48.9
High 3 MF	Multi-Family	56.5	58.4	57.8	58.7	56.5	56.1	57.7
High 4	SFR	56.1	57.5	57.6	58.1	56.2	55.7	57.1
High 5	SFR	58.3	60.4	63.3	61.2	59.5	58.8	59.6
High 6 MF	Multi-Family	72.1	72.9	70.6	70.8	70.8	71.1	72.9
High 7 MF	Multi-Family	68.3	69.1	66.7	66.9	67	67.3	68.7
High 8	SFR	65.7	66.4	64.4	64.5	64.5	64.8	65.5
High 9 MF	Multi-Family	69	69.8	67.7	67.7	67.8	68.2	69.6
Lawrence_10	SFR	50.4	51.4	53	50.7	50.2	50.2	51
Linden 1	SFR	47.9	48.1	47.1	46.4	46.2	46.7	48.5
Linden 2	SFR	49.5	50.1	49.5	48.4	48.3	48.7	49.9
Linden 3	SFR	49.3	49.9	49.9	48.4	48.4	48.6	49.9
Linwood 1	SFR	56.8	57.7	56.2	56.1	55.8	56.2	55.6
Linwood 2	SFR	47.9	47.9	46	45.9	45.6	46.2	48.1

Receiver ID	Land Use Type	Existing	2040 No Build	Alt. A	Alt. B	Alt. C	Alt. D	Alt. F
Linwood 3 APT TH	Apartment/Townhome	48.7	48.9	47.2	46.9	46.8	47.3	49.4
Linwood 4	SFR	50.7	50.9	49.4	49.3	48.9	49.4	50.9
Linwood 5	SFR	62.6	63.3	61.7	61.7	61.4	61.8	61.7
Londonderry 1	SFR	66.4	65.8	59.9	63.4	60.8	63.5	60.1
Londonderry 2	SFR	66.9	66.3	60.4	63.9	61.3	64	60.5
Londonderry 3	SFR	69.2	68.5	62.7	66.1	63.5	66.3	62.8
Londonderry 4	SFR	57.4	58.2	55.2	56	55.3	56.3	57.4
South 1 MF	Multi-Family	54.3	53.9	54.4	53.7	53.6	53.8	52.7
St Charles 1	SFR	61.5	60.7	62.7	62	61.9	62.2	63.3
St Charles 2	SFR	57.9	55.9	59.3	58.2	58.2	58.4	59.5
St Charles 3	SFR	55.4	51.9	57	55.9	55.9	56	56.8
St Charles 4	SFR	57.4	50.4	59.2	57.9	57.9	57.9	58.3
St Charles 5	SFR	57.4	51.9	59.2	57.9	57.9	58	58.4
Valley 1 MF	Multi-Family	70	70.9	69.3	69.3	69	69.4	72
Valley 2	SFR	52.4	52.5	50.6	50.7	50.4	50.8	52.3
Valley 3	SFR	51.9	52	50.3	50.3	50	50.4	51.9
Valley 4	SFR	47.6	48.4	46.7	46.6	46.5	47	49.4
Valley 5	SFR	47.6	48	46	46	45.9	46.3	48.5
West Everett 1	SFR	68.9	69.2	69.4	68.1	67.9	68.4	69.7
West Everett 2	SFR	53.6	54.1	53.9	52.8	52.7	53.1	53.2
West Everett 3	SFR	54	53.6	54.1	53.4	53.3	53.6	54.3
West Everett 4	SFR	56.1	55.8	56.2	55.6	55.5	55.7	56.2
Wyman 1 APT TH	Apartment/Townhome	52.5	52.9	51.3	51.2	50.9	51.4	52.4
Wyman 2	SFR	47.8	48	46.4	46.1	45.9	46.4	48.1
Wyman 3	SFR	47.3	47.4	46.1	45.6	45.4	45.9	48
Wyman 4 MF	Multi-Family	51.1	51.5	50	49.9	49.5	50	50.6

Note: Shading indicates impacted receptors based on NAC or substantial increase over existing conditions. For purposes of determining impacts, results were rounded to the nearest whole number (e.g., 65.6 dBA rounds to 66 and is considered an impact for a residential land use).
N/A: Not applicable, property is full acquisition
** Substantial increase over existing conditions
SFR: Single-family residence

Figure 4-12. NSA 9 Receptors South

Figure 4-13. NSA 9 Receptors North

Table 4-12. Noise Modeling Results for NSA 10 (Worst-Case Peak Hour, Leq, dBA)

Receiver ID	Land Use Type	Existing	2040 No Build	Alt. A	Alt. B	Alt. C	Alt. D	Alt. F
Birch 1 CF	Community Facility	66	64.9	66.2	65.8	66.2	66.3	66.7
Birch 2 MF	Multi-Family	66.1	65	66.2	65.8	66.2	66.4	66.4
Birch 3 MF	Multi-Family	66.1	65.1	66.3	66	66.4	66.5	66.3
Birch 4	SFR	66.5	65.5	66.7	66.4	66.8	66.9	66.4
Broadway 102 18 APT TH	Apartment/Townhome	67.1	67.5	67.4	66.3	66.2	66.7	68.1
Broadway 102 19 APT TH	Apartment/Townhome	69.5	69.6	70.1	68.6	68.4	69	69.8
Broadway 102 20 CF	Community Facility	61.7	61.9	62.2	60.8	60.6	61.1	61.1
Broadway 102 21 APT TH	Apartment/Townhome	66.7	67.2	67	65.9	65.8	66.4	67.6
Broadway 102 22 APT TH	Apartment/Townhome	67.5	67.9	67.8	66.7	66.6	67.3	68.4
Broadway 102 23 APT TH	Apartment/Townhome	69.4	69.5	70	68.5	68.3	68.9	70.5
Broadway 102 24 COD	Commercial w/Outdoor Use	68.4	68.5	69	67.5	67.3	67.9	69.4
Broadway 102 25 COD	Commercial w/Outdoor Use	69.2	69.3	69.8	68.3	68.1	69	70.3
Broadway 102 26 CF	Community Facility	66.4	66.8	66.6	65.6	65.5	66.2	67
Broadway 102 27 COD	Commercial w/Outdoor Use	62.9	63.1	63.5	62	61.9	62.4	61.7
Broadway 102 28 APT TH	Apartment/Townhome	69.7	70.3	69.9	69	68.9	69.7	71.1
Broadway 102 29 APT TH	Apartment/Townhome	68	68.1	68.5	67.1	66.9	67.5	68.6
Broadway 102 30 APT TH	Apartment/Townhome	69.6	70.1	69.8	68.8	68.7	69.7	71.4
Broadway 102 31 APT TH	Apartment/Townhome	68.3	68.4	68.8	67.4	67.2	67.9	68.9
Broadway 102 34 CF	Community Facility	67.6	67.5	68.2	66.7	66.5	66.9	68.6
Broadway 102 35 CF	Community Facility	68.2	67.6	68.3	67.2	67.3	68	70.3
Broadway 32 PARK	Park	65.3	65.8	65.4	64.5	64.4	64.2	66
Broadway 33 COD	Commercial w/Outdoor Use	63.9	64.1	64.5	63	62.8	62.9	63.5
Central 1 APT TH	Apartment/Townhome	54.6	54.8	55	53.7	53.5	54.4	52.1
Central 2 CF	Community Facility	47.5	47.6	47.8	46.5	46.4	47.4	47.5
Central 3 APT TH	Apartment/Townhome	44.6	44.8	44.9	43.6	43.6	44.3	45.4
Central 4 MF	Multi-Family	51.8	52.2	52	51	50.9	51.6	51.3
Central 5 APT TH	Apartment/Townhome	45.4	45.7	45.6	44.5	44.5	44.9	45.6
Crystal 1 CF	Community Facility	66.7	65.7	65.9	66	67.3	67.3	66.7
Franklin 1 MF	Multi-Family	50.9	49.8	51.5	49.9	50.4	50.7	50.6

Receiver ID	Land Use Type	Existing	2040 No Build	Alt. A	Alt. B	Alt. C	Alt. D	Alt. F
Franklin 2 MF	Multi-Family	51.4	50.4	52.1	50.6	51.2	51.5	51.1
Franklin 3	SFR	48.9	47.9	49	48.1	48.8	49	48.6
Franklin 4 APT TH	Apartment/Townhome	54.7	53.6	55.3	53.7	54	54.3	53.7
Franklin 5	SFR	55.4	54.3	56.1	54.7	55.1	55.4	54.8
Franklin 6 MF	Multi-Family	52.6	51.6	53.3	51.8	52.3	52.7	52.5
Manning 1 APT TH	Apartment/Townhome	54.1	54.2	54.7	53.2	53	52.9	53.6
Maple 1 APT TH	Apartment/Townhome	52	52.3	52.4	51.1	51	51.2	51.4
Maple 2	SFR	47.4	47.7	47.7	46.3	46.4	46.9	48.1
Maple 3	SFR	45.7	45.9	46.3	44.7	44.8	45.3	46.4
Maple 4 APT TH	Apartment/Townhome	51.5	51.8	51.9	50.6	50.5	50.8	50.7
Maple 5 MF	Multi-Family	51.1	51.4	51.5	50.2	50.1	50.5	50.8
Maple 6 MF	Multi-Family	49.7	49.8	50.3	48.8	48.7	49.1	49.4
Maple 7 APT TH	Apartment/Townhome	48.6	48.8	49.2	47.7	47.6	48	48.2
Maple 8	SFR	45	45.1	45.5	43.9	44	44.4	45.3
Merchants 1 PARK	Park	48.3	48.4	48.3	47.4	47.3	47.8	48.6
Pearl 1	SFR	52.5	51.5	53.1	51.7	52.3	52.6	52.3
Pearl 2 MF	Multi-Family	51.3	50.4	51.8	50.5	51	51.3	51.1
Pillsbury 1 MF	Multi-Family	49	49.2	49.4	48	47.9	48.2	48.6
Pillsbury 2 MF	Multi-Family	48.4	48.6	48.8	47.4	47.3	47.8	48.1
Pillsbury 3 MF	Multi-Family	48	48.1	48.5	47	47	47.6	48.3
Pillsbury 4	SFR	49	49.1	49.6	48.1	48	48.5	48.5
Pillsbury 5	SFR	49.7	49.8	50.2	48.8	48.6	49.1	49
Railroad 1 APT TH	Apartment/Townhome	47.4	47.3	47.5	46.7	46.6	47.1	47.3
Railroad 2 CF	Community Facility	50.9	51.1	51.1	49.9	49.8	50.4	51.3
Railroad 3 APT TH	Apartment/Townhome	48.9	48.9	49.1	48.1	48	48.6	49.4
Railroad 4 CF	Community Facility	46.5	46.3	46.5	45.7	45.6	46.1	46.8
Sawyer 1 MF	Multi-Family	47	47	47.4	46.1	45.9	46.9	46.8
Sawyer 2 APT TH	Apartment/Townhome	47.3	47.3	47.7	46.3	46.2	47.2	47.3
Storer 1 MF	Multi-Family	50.4	50.6	50.8	49.5	49.4	50.3	49.6
Storer 2 MF	Multi-Family	47.6	47.7	48.1	46.7	46.6	47.4	47.6
Storer 3 APT TH	Apartment/Townhome	47.1	47.3	47.4	46.2	46.1	46.8	47.6
Walker 1	SFR	46.9	47.4	47.2	45.9	46	46.4	47.4

Receiver ID	Land Use Type	Existing	2040 No Build	Alt. A	Alt. B	Alt. C	Alt. D	Alt. F
Walker 2 MF	Multi-Family	46.2	46.6	46.8	45.2	45.4	45.7	47
Wall 1 MF	Multi-Family	54.4	53.5	54.5	54.1	54.5	54.3	55.5
Wall 2 MF	Multi-Family	51.6	50.6	51.7	51.1	51.3	51.4	52.8
Wall 3 MF	Multi-Family	54.2	53.1	54.4	53.9	54.4	54.2	54.9
Wall 4 MF	Multi-Family	51.5	50.4	51.7	51	51.3	51.4	52.2

Note: Shading indicates impacted receptors based on NAC or substantial increase over existing conditions. For purposes of determining impacts, results were rounded to the nearest whole number (e.g., 65.6 dBA rounds to 66 and is considered an impact for a residential land use).
N/A: Not applicable, property is full acquisition
** Substantial increase over existing conditions
SFR: Single-family residence

Figure 4-14. NSA 10 Receptors

Table 4-13. Noise Modeling Results for NSA 3 (Worst-Case Peak Hour, Leq, dBA)

Receiver ID	Land Use Type	Existing	2040 No Build	Alt. A	Alt. B	Alt. C	Alt. D	Alt. F
Abbott 1 APT TH	Apartment/Townhome	43.6	43.3	43.8	41.8	41.9	43.5	43.8
Abbott 10 MF	Multi-Family	45.3	44.9	45.4	43.5	43.6	45.1	45.5
Abbott 2 MF	Multi-Family	54.4	54.7	54.9	53.1	52.9	54	55
Abbott 3 MF	Multi-Family	49.2	49	49.6	47.6	47.6	49	49.6
Abbott 4 MF	Multi-Family	47.9	47.5	48.1	46.3	46.3	47.7	48.1
Abbott 5 MF	Multi-Family	47.2	46.8	47.3	45.6	45.6	47	47.4
Abbott 6	SFR	45.4	44.9	45.3	43.7	43.8	45.1	45.6
Abbott 7 APT TH	Apartment/Townhome	55.6	55.8	56.1	54.2	54.1	55.3	56.2
Abbott 8	SFR	48.4	48.2	48.8	46.8	46.8	48.3	48.8
Abbott 9 MF	Multi-Family	47.1	46.8	47.3	45.5	45.5	46.9	47.4
Birch 5 MF	Multi-Family	66.4	65.4	66.6	66.4	66.7	66.8	66.4
Broadway 102 75G	Community Facility	60.2	60.2	60.8	58.8	58.6	60.4	60.8
Boyd 1 CF	Community Facility	51.8	51.6	52.1	50.2	50.1	51.6	52.2
Boyd 2	SFR	50.1	49.8	50.4	48.5	48.5	50	50.4
Boyd 3	SFR	48.9	48.4	48.8	47.2	47.6	48.7	48.9
Boyd 4	SFR	47.1	46.4	46.9	45.5	45.8	46.7	46.8
Brandywine 1	SFR	44.9	44.7	45.3	43	43.2	45.1	45.2
Brandywine 2	SFR	45.1	44.7	45.3	43.4	43.3	45	45.3
Brandywine 3	SFR	44.1	43.8	44.4	42.2	42.3	44.2	44.4
Broadway 102 36 CF	Community Facility	67.7	68	68.3	66.3	66.3	68	69.4
Broadway 102 37 CF	Community Facility	67.7	68	68.3	66.4	66.4	68.1	69.3
Broadway 102 38 CF	Community Facility	66.5	66.5	67.1	64.7	65.2	67.3	67.5
Broadway 102 39 CF	Community Facility	66.2	66.2	66.8	64.4	64.7	66.4	66.7
Broadway 102 40	SFR	66.7	66.8	67.2	65.2	65.2	66.8	67.2
Broadway 102 41	SFR	53.4	53.2	53.8	51.5	51.6	54	53.7
Broadway 102 42 APT TH	Apartment/Townhome	67.6	67.7	68.1	66.1	66	67.7	68.1
Broadway 102 43 APT TH	Apartment/Townhome	60.6	60.6	61.2	59	59	59.7	61.2
Broadway 102 44 Park	Park	63.9	63.8	64.4	62.1	62.2	63.9	64.3
Broadway 102 45 Park	Park	63.9	63.9	64.5	62.1	62.3	64	64.4

Receiver ID	Land Use Type	Existing	2040 No Build	Alt. A	Alt. B	Alt. C	Alt. D	Alt. F
Broadway 102 46 MF	Multi-Family	68.5	68.8	69.1	67.2	67.1	68.6	69.1
Broadway 102 47	SFR	64.8	64.8	65.4	63.1	63.2	64.8	65.4
Broadway 102 48	SFR	67.6	67.9	68.3	66.3	66.2	67.7	68.3
Broadway 102 49 MF	Multi-Family	62.7	62.7	63.3	61.1	61.1	62.8	63.3
Broadway 102 50	SFR	68.1	68.4	68.7	66.8	66.7	68.2	68.7
Broadway 102 51 APT TH	Apartment/Townhome	67.2	67.5	67.8	65.9	65.8	67.3	67.8
Broadway 102 52 MF	Multi-Family	65.8	66.1	66.4	64.5	64.4	65.5	66.4
Broadway 102 53 APT TH	Apartment/Townhome	67	67.3	67.6	65.7	65.6	67.1	67.6
Broadway 102 54	SFR	67.3	67.6	67.9	65.9	65.9	67.4	67.9
Broadway 102 55 MF	Multi-Family	61.9	62	62.4	60.4	60.3	61.7	62.4
Broadway 102 56 MF	Multi-Family	62.2	62.1	62.7	60.5	60.5	62	62.7
Broadway 102 57 MF	Multi-Family	62.2	62.1	62.7	60.5	60.5	62.1	62.7
Broadway 102 58 MF	Multi-Family	63.8	63.9	64.4	62.2	62.2	63.1	64.4
Broadway 102 59 MF	Multi-Family	66.6	66.5	67.2	64.8	64.9	66.6	67.1
Broadway 102 60 APT TH	Apartment/Townhome	68.5	68.5	69.1	66.7	66.9	68.9	69.1
Broadway 102 61 MF	Multi-Family	64.8	64.8	65.5	63.2	63.3	64.8	65.4
Broadway 102 62	SFR	65.8	65.8	66.4	64.1	64.2	65.8	66.4
Broadway 102 63	SFR	66.7	66.7	67.4	65	65.1	66.9	67.3
Broadway 102 64	SFR	62.7	62.8	63.4	61.2	61.2	62.7	63.3
Broadway 102 65	SFR	64.7	64.8	65.4	63	63.1	64.8	65.3
Broadway 102 66	SFR	68.3	68.3	68.9	66.5	66.7	68.6	68.9
Broadway 102 67	SFR	66.1	66.1	66.8	64.4	64.5	66.1	66.7
Broadway 102 68	SFR	64.6	64.6	65.2	62.9	63	64.7	65.2
Broadway 102 69	SFR	62.2	62.3	62.9	60.6	60.7	62.4	62.8
Broadway 102 70 MF	Multi-Family	65.8	65.8	66.4	64.1	64.2	65.8	66.4
Broadway 102 71 MF	Multi-Family	49.3	49	49.7	47.6	47.6	49.7	49.7
Broadway 102 72 MF	Multi-Family	64.4	64.4	65	62.6	62.7	64.6	64.9
Broadway 102 73	SFR	64.9	64.9	65.5	63.2	63.3	65	65.5
Broadway 102 74	SFR	63.9	63.9	64.5	62.2	62.3	64	64.5
Broadway 102 75	SFR	65.3	65.3	65.9	63.6	63.7	65.3	65.9
Broadway 102 75 CF	Community Facility	57	57	57.6	55.2	55.4	57.6	57.6
Broadway 102 75A	Community Facility	60.3	60.6	60.8	59	58.8	60.2	60.9

Receiver ID	Land Use Type	Existing	2040 No Build	Alt. A	Alt. B	Alt. C	Alt. D	Alt. F
Broadway 102 75B	Community Facility	60.9	61.3	61.4	59.7	59.4	60.8	61.5
Broadway 102 75C	Community Facility	61.8	62.4	62.4	60.8	60.5	61.5	62.5
Broadway 102 75D	Community Facility	62.9	63.1	63.6	61.4	61.4	62.7	63.5
Broadway 102 75E	Community Facility	60.8	61.1	61.4	59.5	59.3	60.9	61.4
Broadway 102 75F	Community Facility	60.6	60.7	61.1	59.1	59	60.6	61.2
Broadway 102 76	SFR	65.9	65.9	66.5	64.1	64.2	65.8	66.4
Broadway 102 77	SFR	66.3	66.3	66.9	64.6	64.7	66.3	66.9
Broadway 102 78	SFR	63	62.9	63.4	61.3	61.4	62.8	63.4
Broadway 102 79 CF	Community Facility	64.2	64	64.5	62.5	62.7	63.9	64.5
Bypass 28 1A PARK	Park	52.9	51.9	51.9	51.2	51.3	52	52
Bypass 28 1B PARK	Park	55.9	54.9	54.9	54.5	54.7	55	55
Bypass 28 3 MF	Multi-Family	68.9	67.7	67.7	67.8	67.9	68.2	67.8
Bypass 28 4 MF	Multi-Family	58.4	57.3	57.3	57.3	57.3	57.6	57.1
Bypass 28 5 MF	Multi-Family	68.6	67.4	67.4	67.5	67.6	67.9	67.4
Bypass 28 6 MF	Multi-Family	66.6	65.3	65.3	65.5	65.6	65.9	65.4
Bypass 28 7 CF	Community Facility	50	48.6	48.6	48.5	48.5	48.9	48.6
Bypass 28 8 COD	Commercial w/Outdoor Use	61.2	59.4	59.9	59.7	59.8	59.7	59.7
Bypass 28 9	SFR	58.5	56.7	57.3	57.1	57.2	57.1	57.1
Chester 1 COD	Commercial w/Outdoor Use	67.5	65.1	65.2	63.4	64.4	65.3	65
Crescent 1	SFR	48.6	48.5	48.9	47.1	47	48.3	49
Crescent 2	SFR	47.7	47.3	47.7	46.1	46	47.2	47.7
Crescent 3	SFR	48.7	47.7	47.9	46.8	46.9	47.8	47.9
Crescent 4	SFR	48.3	47.4	47.5	46.5	46.8	47.5	47.5
Crescent 5 APT TH	Apartment/Townhome	46.9	45.9	46.1	45.2	45.5	46.1	46.1
Crescent 6 MF	Multi-Family	52.4	51.7	51.8	50.6	50.5	51.6	51.9
Crescent 7	SFR	49.6	48.5	48.5	47.7	47.9	48.5	48.5
Crescent 8	SFR	49.2	48.8	48.8	48	48.5	48.6	48.9
Crescent 9	SFR	48.5	48	48	47.3	47.8	48	48.1
Fenway 1 MF	Multi-Family	60	60	60.6	58.4	58.4	59.5	60.6
Fenway 10	SFR	44.8	44.4	45.1	43	43.1	44.7	45
Fenway 2 MF	Multi-Family	52.4	52.3	52.9	50.5	50.7	52.2	52.9
Fenway 3	SFR	48.1	47.8	48.5	46.2	46.4	47.4	48.3

Receiver ID	Land Use Type	Existing	2040 No Build	Alt. A	Alt. B	Alt. C	Alt. D	Alt. F
Fenway 4	SFR	47.5	47.1	47.7	45.7	45.7	47	47.7
Fenway 5	SFR	47.5	47.1	47.8	45.8	45.9	47.3	47.8
Fenway 6	SFR	46.4	46	46.6	44.7	44.9	46.2	46.6
Fenway 7	SFR	48.1	47.9	48.5	46.2	46.4	47.8	48.4
Fenway 8	SFR	46.7	46.4	47.1	44.8	45	46.4	46.9
Fenway 9	SFR	45.5	45.1	45.8	43.7	43.8	45.4	45.7
Hardy 1 MF	Multi-Family	47.8	47.4	47.8	46.3	46.5	47.6	47.9
Hood 1	SFR	51.2	51.4	51.7	49.8	49.6	50.9	51.7
Hood 2	SFR	45.1	44.8	45.4	43.4	43.4	45	45.5
Hood 3CF	Community Facility	47.7	47.5	48.1	46.2	46.1	47.6	48.2
Hood 4 CF	Community Facility	44.8	44.5	45.1	43.2	43.1	44.6	45.2
Hoodcroft 1 MF	Multi-Family	48.6	48.4	49	46.9	46.9	48.9	49
Hoodcroft 2	SFR	49.4	49.2	49.7	47.9	47.7	49.1	49.7
Hoodcroft 3	SFR	45.1	44.4	45	43.4	43.3	44.7	45
Hoodcroft 4	SFR	48.8	48.5	49	47.3	47.2	48.5	48.9
Hoodcroft 5	SFR	46.9	46.2	46.8	45.3	45.3	46.4	46.7
Lenox 1	SFR	43.8	43.5	44.1	42.1	42.1	43.6	44.1
Marlboro 1 MF	Multi-Family	51.2	51	51.4	49.8	50.2	51.4	51.4
Marlboro 10	SFR	47.7	46.7	47.5	46.3	46.9	47.3	47.2
Marlboro 2 MF	Multi-Family	50.7	50.1	50.6	49.2	49.6	50.7	51
Marlboro 3 MF	Multi-Family	49.9	49.1	49.6	48.3	48.9	49.7	49.9
Marlboro 4	SFR	50.2	49.2	50.1	49.2	49.9	50.2	50.3
Marlboro 5	SFR	50.9	49.9	51	50.1	50.9	51.1	50.8
Marlboro 6	SFR	50.7	49.7	50.8	49.9	50.7	50.9	50.6
Marlboro 7 MF	Multi-Family	49.2	48.6	49	47.6	48.1	48.7	48.9
Marlboro 8	SFR	49.2	48.5	49	47.7	48.3	48.7	48.9
Marlboro 9 MF	Multi-Family	48.7	47.8	48.5	47.2	47.9	48.3	48.1
Mt Pleasant 1	SFR	54	53.8	54.4	52.3	52.3	54.2	54.4
Mt Pleasant 2 MF	Multi-Family	45.5	45.2	45.8	43.8	43.8	45.7	45.8
Mt Pleasant 3 MF	Multi-Family	45.4	45	45.6	43.5	43.6	45.4	45.6
Mt Pleasant 4	SFR	43.7	43.3	43.9	42	42	43.6	44
Mt Pleasant 5	SFR	39.8	39.3	39.9	38	38	39.6	40

Receiver ID	Land Use Type	Existing	2040 No Build	Alt. A	Alt. B	Alt. C	Alt. D	Alt. F
Mt Pleasant 6	SFR	42.6	42.3	42.9	41	40.9	42.6	43
Mt Pleasant 7 MF	Multi-Family	44.3	43.9	44.5	42.6	42.5	44.1	44.6
Mt Pleasant 8	SFR	43.2	42.8	43.4	41.5	41.5	42.9	43.5
Mt Washington 1	SFR	65.9	65.9	66.6	64.2	64.3	65.9	66.5
Mt Washington 2	SFR	53.3	53.6	53.8	52	51.8	53	53.9
Mt Washington 3	SFR	49.8	49.6	50.2	48.3	48.2	49.7	50.3
Mt Washington 4	SFR	46.4	46.1	46.6	44.7	44.7	46.2	46.7
Mt Washington 5	SFR	44.1	43.7	44.2	42.4	42.4	43.9	44.3
Mt Washington 6 MF	Multi-Family	62.5	62.6	63.1	61	61	62.4	63.1
Mt Washington 7 MF	Multi-Family	51.4	51.6	51.9	50	49.8	51.2	51.9
Mt Washington 8	SFR	45.8	45.5	46.1	44.1	44.1	45.6	46.2
Mt Washington 9	SFR	44.2	43.9	44.4	42.4	42.5	44.2	44.5
Oak 1 MF	Multi-Family	52	51.6	52.2	50.9	51	52.1	52.8
Oak 2 MF	Multi-Family	50.7	50	50.6	49.9	50	50.6	52.5
Oak 3 APT TH	Apartment/Townhome	53.2	52.2	53.3	52.8	53	53.1	55.4
Oak 4 MF	Multi-Family	52.5	51.5	52.6	52.1	52.3	52.4	54
Oak 5 MF	Multi-Family	48.4	48.1	48.7	46.6	45.8	48.6	47.3
Oak 6 MF	Multi-Family	46.9	46.4	47.1	45.9	45.4	46.9	47.4
Oak 7	SFR	46.2	45.5	46.2	45.2	45.6	46	47.3
Oak 8	SFR	47	46.4	47	46.1	45.8	46.6	47.8
Park 1 CF	Community Facility	50.4	50.2	50.8	48.5	48.9	50.8	50.4
Park 10	SFR	45	44.6	45.3	43.4	43.5	44.7	46
Park 2 MF	Multi-Family	45.2	44.7	45.2	44	43.7	45	45.6
Park 3 MF	Multi-Family	45.7	45.1	45.7	44.6	44.2	45.5	46.4
Park 4	SFR	44.8	44.2	44.9	43.7	43.6	44.9	46.2
Park 5	SFR	45.2	44.6	45.2	44	44	45.1	46.3
Park 6 MF	Multi-Family	66.9	67.1	67.5	65.5	65.5	67.1	67.5
Park 7	SFR	49	48.8	49.4	47.1	47.2	49	49.1
Park 8	SFR	45.6	45.1	45.7	43.8	43.9	45.1	45.9
Park 9	SFR	45.3	44.9	45.5	43.6	43.7	44.8	46
Perley 1	SFR	44.2	43.8	44.4	42.5	42.4	44.2	44.4
Perley 2	SFR	45.2	44.8	45.4	43.5	43.5	45.3	45.4

Receiver ID	Land Use Type	Existing	2040 No Build	Alt. A	Alt. B	Alt. C	Alt. D	Alt. F
Perley 3	SFR	45.7	45.3	46	44	43.9	45.9	46
Perley 4	SFR	45.8	45.5	46.1	44.1	44.1	46.1	46.1
Perley 5	SFR	45.8	45.4	46	44.2	44.1	45.8	46
Thornton 1 MF	Multi-Family	63	60.5	60.5	58.6	59.8	60.5	60.4
Thornton 2	SFR	69.6	67	67	65.1	66.1	67.1	66.8
Thornton 3	SFR	55	53.5	53.6	52.9	53.3	53.6	53.4
Thornton 4	SFR	54.7	53.4	53.4	52.9	53.2	53.5	53.2
Thornton 5	SFR	54.6	53.1	53.1	52.9	53.3	53.5	53
Thornton 6	SFR	58	56.8	56.8	55.6	56.8	56.9	56.8
Thornton 7	SFR	65.1	65.5	65.5	65	65.7	65.7	65.9
Thornton 8 MF	Multi-Family	57.5	57.5	57.5	57.1	57.8	57.7	57.8

Note: Shading indicates impacted receptors based on NAC or substantial increase over existing conditions. For purposes of determining impacts, results were rounded to the nearest whole number (e.g., 65.6 dBA rounds to 66 and is considered an impact for a residential land use).
N/A: Not applicable, property is full acquisition
** Substantial increase over existing conditions
SFR: Single-family residence

Figure 4-15. NSA 11 Receptors—South

Figure 4-16. NSA 11 Receptors—Central

Figure 4-17. NSA 11 Receptors—North

4.3 Mitigation

This section evaluates noise mitigation options for two locations where barriers were proposed as part of the I-93 widening project, as well as additional barriers along the proposed connector road where traffic noise impacts are predicted.

4.3.1 NSA 4 Trolley Car Lane

Previous Analysis

The 2004 I-93 widening FEIS presented the Trolley Car Lane neighborhood (“Location 23”) as having 23 impacted receptors. A 12-foot barrier (6-foot wall and 6-foot berm) of 5,000 feet in length was proposed for an estimated cost of $900,000. The analysis estimated 28 receptors would be benefited, resulting in a cost of $32,100 per benefited receptor. Although the cost effectiveness criterion was slightly exceeded, the barrier was still recommended.

In 2008, the I-93 widening final design noise analysis recommended a 12–18 foot barrier (with 10 feet of the height on berm) 4,450 feet long. The barrier was estimated to benefit 28 receptors, cost $1,068,000, and have a cost per benefited receptor of $38,000. Although this exceeded the $30,000 threshold, the barrier continued to be recommended. The final barrier design did not anticipate the Exit 4A interchange ramps.

For purposes of comparing the benefit of new barrier options with the benefits provided by the I-93 widening barrier, the I-93 widening barriers were evaluated for the 2040 No Build condition. Table 4-14 summarizes the I-93 barrier performance results for each receptor based on the updated TNM models. This analysis excluded the I-93 widening barrier berms from the terrain data to evaluate the full benefit of the noise barriers.

Table 4-14. Trolley Car Lane: I-93 Widening Barrier Benefits, 2040 No Build

Receptor Unit ID- Shading Indicates Impacted Receptor Units	Number of Receptor Units	2016 Noise Levels	2040 (No Barrier and no berm)- shading indicates impact		I-93 Southbound Widening Barrier	
			Noise Levels	Increase Over Existing	Noise Levels	I.L.
Buyck 1	1	65	68	4	68	0
Hovey 1"	1	67	69	2	66	3
Trolley Car 1"	1	66	67	2	65	2
Trolley Car 10"	1	64	65	0	61	4
Trolley Car 11"	1	67	67	0	61	6
Trolley Car 12"	2	67	67	0	61	7
Trolley Car 13"	2	68	68	1	61	8
Trolley Car 14"	2	69	68	0	60	8
Trolley Car 15"	1	60	60	0	57	4
Trolley Car 16"	1	61	63	2	59	5
Trolley Car 17"	1	69	71	2	60	11
Trolley Car 18"	1	73	75	2	63	12
Trolley Car 19"	1	62	65	3	59	6

Receptor Unit ID- Shading Indicates Impacted Receptor Units	Number of Receptor Units	2016 Noise Levels	2040 (No Barrier and no berm)- shading indicates impact		I-93 Southbound Widening Barrier	
			Noise Levels	Increase Over Existing	Noise Levels	I.L.
Trolley Car 2"	1	64	66	3	62	5
Trolley Car 3"	1	70	70	0	65	5
Trolley Car 4"	1	69	70	1	64	6
Trolley Car 5"	1	68	67	0	63	5
Trolley Car 6"	1	68	67	-1	62	5
Trolley Car 7"	1	66	65	-1	61	4
Trolley Car 8"	1	67	66	-1	62	4
Trolley Car 9"	2	65	64	-1	61	4
Hovey 2"	1	64	66	3	66	1
Hovey 3"	2	65	68	3	66	2
Trolley Car 20"	1	61	64	2	59	4
Trolley Car 21"	1	62	65	3	62	3
Trolley Car 22"	1	59	62	3	59	3
Trolley Car 23"	2	58	60	2	57	3
Trolley Car 24"	2	57	60	3	57	3
Trolley Car 26"	1	60	63	3	58	6
Trolley Car 27"	1	61	63	3	58	6
Trolley Car 28"	1	58	61	3	57	4
Noise Abatement Details and Evaluation Criteria						
Barrier Area (square feet)					65,527	
Effectiveness Criterion					1,500	
Total Number of Impacted Receptor Units					21	
Number of Impacted Receptor Units Receiving ≥ 10 dBA I.L.					2	
Percent of Impacted Receptor Units Receiving ≥ 10 dBA I.L.					10%	
Number of Impacted Receptor Units Receiving I.L.≥ 5 dBA but < 10 dBA					12	
Total Number of Impacted Receptor Units Benefited					14	
Percent of Impacted Receptor Units Benefited					67%	
Number of Non-Impacted Receptor Units Benefited (I.L.≥ 5 dBA)					4	
Total Number of Benefited Receptor Units					18	
Square Feet per Receptor Unit Benefited					3,640	
Barrier Reasonable from a Square Foot/Receptor Unit Standpoint?					**No**	
Total Barrier Length (feet)					4,360	
Barrier Height Range (feet)					7.35 to 26.09	
Average Barrier Height (feet)					15.03	

Notes:

All values represent hourly Leq in dBA
dBA = Decibels on the A-weighted scale

Impacted Receptor Units (Build noise levels > 66 dBA)

Impacted Receptor Units Receiving I.L. ≥ 10 dBA

Receptor Unit ID- Shading Indicates Impacted Receptor Units	Number of Receptor Units	2016 Noise Levels	2040 (No Barrier and no berm)- shading indicates impact		I-93 Southbound Widening Barrier	
			Noise Levels	Increase Over Existing	Noise Levels	I.L.

Leq = Equivalent noise level
I.L. = Insertion Loss

Impacted Receptor Units Receiving I.L.≥ 5 dBA but <10 dBA

Non-Impacted Receptor Units Receiving ≥ 5 dBA

Updated Analysis

Trolley Car Lane was divided into two separate areas for purposes of the Exit 4A noise barrier evaluation (Trolley Car Lane and Trolley Car Lane south), separated by three single-family homes that would be total acquisitions under Alternative A (receptors Trolley Car 12, 13 and 14). As a result of these acquisitions and the placement of fill for the Exit 4A ramps shielding certain receivers in the center of the neighborhood from I-93 mainline traffic noise, a continuous noise barrier is no longer logical for this location.

Trolley Car Lane North

Trolley Car Lane north consists of the remaining residences near the proposed southbound off-ramp. Based on the 2040 Build traffic projections, two receptors would experience traffic noise impacts with no barrier in place (Trolley Car 17 and Trolley Car 18).

Two barrier options were evaluated for Trolley Car Lane North as shown in Figures 4-18 and 4-19. The horizontal barrier alignment for the Trolley Car Lane north area was kept the same as the I-93 widening final design barrier alignment, from station 3701+10 at the northern end to station 3696. From station 3696 to 3685+50, the barrier alignment was modified to follow near the off-ramp edge of pavement, which allows the barrier to take advantage of being on fill required for the ramps.

The Trolley Car Lane North Barrier analysis (Table 4-15) shows there are insufficient receptors in the area for a barrier to be cost effective. The barrier design option closest to meeting the criterion (Option 2) would focus on protecting the two affected receptors only and would be about 10 feet high and 586 feet long. The square feet per receptor unit benefited would be 2,890, which exceeds NHDOT’s criterion. A barrier option attempting to benefit more receptors would similarly not be cost reasonable.

Trolley Car Lane South

Trolley Car Lane south consists of the residences near the proposed southbound on-ramp and south to Pillsbury Rd. Based on the 2040 Build traffic projections, nine receptors would experience traffic noise impacts with no barrier in place (Trolley Car 1, 2, 3, 4, 6, Hovey 1, Hovey 2, and Hovey 3). Hovey 3 is a duplex that counts as two receptor units. It is important to note that the five northernmost receptors in this area are not considered impacted under Alternative A (Trolley Car 7, 8, 9, 10, 11). These receptors are below the elevation of the on-ramp, which serves to shield them from the full I-93 mainline traffic. This effect is illustrated by the “increase over existing” column in Table 4-16, which shows Alternative A would *reduce* noise at a majority of the receptors in this area by 3 to 5 dBA.

Figures 4-20 through 4-22 show the three Trolley Car Lane South barriers considered. The barrier was extended further south than the I-93 widening proposed barrier (to approx. station 3656+50), to study if this segment would provide any benefit to barrier performance. The horizontal barrier alignment for the Trolley Car Lane south area was kept the same as the I-93 widening final design barrier alignment from station 3657+50 to station 3661. From station 3661 to 3668+50, the barrier alignment was shifted west by 5 feet or less to remain on the berm proposed in the I-93 final design plans. The northern end of the barrier near station 3671+75 would begin to follow the on ramp embankment. The barrier was not extended farther north because the receptors north of Trolley Car 6 are not impacted.

As shown in Table 4-16, the Trolley Car Lane South barrier analysis results demonstrate there are insufficient receptors in the area for a barrier to be cost effective. The option closest to meeting the criterion (Option 2) would focus on protecting the central portion of the NSA and would be have an average height of 11.6 feet and would be 1,080 feet in length. The square feet per receptor unit benefited would be 2,089, which exceeds NHDOT's criterion.

Conclusion

Table 4-17 provides an overall summary of the Trolley Car Lane barrier analyses in comparison to the I-93 widening barrier analyses, including cost information based on recent NHDOT bid prices ($38 per square foot).

The selection of a preferred option by NHDOT and FHWA was based on consideration of which option would provide a benefit to impacted receptors comparable to the benefit that would be provided if the I-93 widening barriers were built without Exit 4A. NHDOT and FHWA are committed to providing noise barriers in these locations by the I-93 widening 2005 ROD and 2010 Supplemental ROD, regardless of whether the options meet the current noise policy effectiveness criterion. For both Trolley Car Lane North and South, the recommended barrier option for further evaluation during final design is Option 1.

Based on the studies so far completed, NHDOT is committed to the construction of feasible and reasonable noise abatement measures at Trolley Car Lane (North and South). These preliminary indications of likely abatement measures are based upon preliminary design for two discontinuous barriers with a combined length of approximately 2,700 feet and an average height of approximately 13.5 feet, that would reduce the noise level by at least 5dB(A) for 13 residents. If it is subsequently found during final design that these conditions have substantially changed, the abatement measure(s) might not be provided. A final decision on the installation of the abatement measure(s) would be made during the final design process following the completion of public involvement.

Table 4-15. NSA 4 Barrier Analysis, Trolley Car Lane North, 2040 PM Peak Hour Traffic

Receptor Unit ID- Shading Indicates Impacted Receptor Units	Number of Receptor Units	2016 Noise Levels	2040 (No Barrier)- shading indicates impact		Barrier Option 1		Barrier Option 2	
			Noise Levels	Increase Over Existing	Noise Levels	I.L.	Noise Levels	I.L.
Trolley Car 15	1	60	62	1	60	2	61	1
Trolley Car 16"	1	61	63	2	60	3	61	2
Trolley Car 17"	1	69	68	-1	63	6	63	5
Trolley Car 18"	1	73	74	1	65	9	67	8
Trolley Car 19"	1	62	63	1	59	5	61	2
Trolley Car 26"	1	60	62	2	61	2	62	1
Trolley Car 27"	1	61	63	2	60	3	62	1
Trolley Car 28"	1	58	61	3	59	2	59	1

Noise Abatement Details and Evaluation Criteria	Barrier Option 1	Barrier Option 2
Barrier Area (square feet)	12,513	5,779
Effectiveness Criterion	1,500	1,500
Total Number of Impacted Receptor Units	2	2
Number of Impacted Receptor Units Receiving ≥ 10 dBA I.L.	0	0
Percent of Impacted Receptor Units Receiving ≥ 10 dBA I.L.	0%	0%
Number of Impacted Receptor Units Receiving I.L.≥ 5 dBA but < 10 dBA	2	2
Total Number of Impacted Receptor Units Benefited	2	2
Percent of Impacted Receptor Units Benefited	100%	100%
Number of Non-Impacted Receptor Units Benefited (I.L.≥ 5 dBA)	1	0
Total Number of Benefited Receptor Units	3	2
Square Feet per Receptor Unit Benefited	4,171	2,890
Barrier Reasonable from a Square Foot/Receptor Unit Standpoint?	**No**	**No**
Total Barrier Length (feet)	1,161	586

Barrier Height Range (feet)	4 to 16	8 to 10
Average Barrier Height (feet)	10.78	9.86

Notes:

All values represent hourly Leq in dBA		Impacted Receptor Units (Build noise levels > 66 dBA)
dBA = Decibels on the A-weighted scale		Impacted Receptor Units Receiving I.L. ≥ 10 dBA
Leq = Equivalent noise level		Impacted Receptor Units Receiving I.L.≥ 5 dBA but <10 dBA
I.L. = Insertion Loss		Non-Impacted Receptor Units Receiving ≥ 5 dBA

Note: The “2040 No Barrier” results include the Exit 4A project infrastructure and grading, and the constructed I-93 widening berms.

Table 4-16. NSA 4 Barrier Analysis, Trolley Car Lane South, 2040 PM Peak Hour Traffic

Receptor Unit ID-Shading Indicates Impacted Receptor Units	Number of Receptor Units	2016 Noise Levels	2040 (No Barrier)- shading indicates impact		Barrier Option 1		Barrier Option 2		Barrier Option 3	
			Noise Levels	Increase Over Existing	Noise Levels	I.L.	Noise Levels	I.L.	Noise Levels	I.L.
Hovey 1	1	67	69	2	64	5	66	2	63.8	5
Trolley Car 1"	1	66	66	1	62	5	65	2	61.8	5
Trolley Car 10"	1	64	62	-3	61	1	61	1	61.3	1
Trolley Car 11"	1	67	61	-5	61	1	61	0	61	0
Trolley Car 2"	1	64	66	2	59	6	61	5	60	6
Trolley Car 3"	1	70	68	-2	62	6	63	5	61.5	7
Trolley Car 4"	1	69	68	-1	61	7	62	7	61.1	7
Trolley Car 5"	1	68	65	-3	60	5	61	5	60	5
Trolley Car 6"	1	68	66	-2	60	6	61	5	60.2	6
Trolley Car 7"	1	66	64	-2	59	5	61	3	59.8	4
Trolley Car 8"	1	67	65	-2	60	5	62	2	61.9	3
Trolley Car 9"	2	65	63	-2	61	2	62	1	61.7	1
Hovey 2"	1	64	66	2	64	2	65	1	63.7	2
Hovey 3"	2	65	67	2	64	3	65	2	63.8	3
Trolley Car 20"	1	61	63	2	57	6	59	5	57.6	6
Trolley Car 21"	1	62	65	2	61	4	63	2	61.9	3
Trolley Car 22"	1	59	62	2	58	3	60	2	59.4	2
Trolley Car 23"	2	58	59	2	57	2	58	1	58.2	1
Trolley Car 24"	2	57	59	2	58	2	58	1	58.2	1
Noise Abatement Details and Evaluation Criteria										
Barrier Area (square feet)					23,948		12,536		19,680	
Effectiveness Criterion					1,500		1,500		1,500	
Total Number of Impacted Receptor Units					9		9		9	

Number of Impacted Receptor Units Receiving ≥ 10 dBA I.L.	0	0	0
Percent of Impacted Receptor Units Receiving ≥ 10 dBA I.L.	0%	0%	0%
Number of Impacted Receptor Units Receiving I.L.≥ 5 dBA but < 10 dBA	6	4	6
Total Number of Impacted Receptor Units Benefited	6	4	6
Percent of Impacted Receptor Units Benefited	67%	44%	67%
Number of Non-Impacted Receptor Units Benefited (I.L.≥ 5 dBA)	4	2	2
Total Number of Benefited Receptor Units	10	6	8
Square Feet per Receptor Unit Benefited	2,395	2,089	2,460
Barrier Reasonable from a Square Foot/Receptor Unit Standpoint?	**No**	**No**	**No**
Total Barrier Length (feet)	1,535	1,080	1,260
Barrier Height Range (feet)	12 to 20	6 to 16	12 to 20
Average Barrier Height (feet)	15.6	11.61	15.61

Notes:

All values represent hourly Leq in dBA
dBA = Decibels on the A-weighted scale
Leq = Equivalent noise level
I.L. = Insertion Loss

Impacted Receptor Units (Build noise levels > 66 dBA)
Impacted Receptor Units Receiving I.L. ≥ 10 dBA
Impacted Receptor Units Receiving I.L.≥ 5 dBA but <10 dBA
Non-Impacted Receptor Units Receiving ≥ 5 dBA

Note: The "2040 No Barrier" results include the Exit 4A project infrastructure and grading, and the constructed I-93 widening berms.

Table 4-17. NSA 4 Barrier Analysis Summary

	I-93 Improvements Salem to Manchester		**Exit 4A SDEIS**					
	2004 FEIS	**2008 Final Design Noise Analysis**	***North Option 1 + South Option 1 Combined***	**Trolley Car North Option 1**	**Trolley Car North Option 2**	**Trolley Car South Option 1**	**Trolley Car South Option 2**	**Trolley Car South Option 3**
Barrier Square Feet	60,000	75,250	25,049	12,513	5,779	23,948	12,536	19,680
Barrier Height (feet)	12 (6 feet wall, 6 feet berm)	12-18 (10 feet as berm)	4-20	4-16 (11 ave)	8-10 (10 ave)	12-20 (16 ave)	6-16 (12 ave)	12 -20 (16 ave)
Length (feet)	5,000	4,450	2,696	1,161	586	1,535	1,080	2,460
No. of Impacted Receptors	23	Not reported	11	2	2	9	9	9
No. of Benefited Receptors	28	28	13	3	2	10	6	8
Square Feet Per Benefited Receptor	2,143	2,688	1,927	4,171	2,890	2,395	2,089	2,460
Cost (at time of original analysis)	$900,000	$1,068,000	NA	NA	NA	NA	NA	NA
Cost Per Benefited Receptor (at time of original analysis)	$32,143	$38,143	NA	NA	NA	NA	NA	NA
Implied Cost Per Square Foot (at time of original analysis)	$15.00	$14.19	NA	NA	NA	NA	NA	NA
Current Cost Per SF	$38.00	$38.00	$38.00	$38.00	$38.00	$38.00	$38.00	$38.00
Current Cost Barrier Cost (no berm discount)	$2,280,000	$2,859,500	$951,862	$475,494	$219,602	$910,024	$476,368	$747,840
Current Cost Per Benefited Receptor	$81,428.57	$102,125.00	$73,220.15	$158,498.00	$109,801.00	$91,002.40	$79,394.67	$93,480.00

Figure 4-18. Trolley Car Lane North- Option 1 Barrier

Figure 4-19. Trolley Car Lane North- Option 2 Barrier

Figure 4-20. Trolley Car Lane South- Option 1 Barrier

Figure 4-21. Trolley Car Lane South- Option 2 Barrier

Figure 4-22. Trolley Car Lane South- Option 3 Barrier

4.3.2 NSA 5 Seasons Lane

Previous Analysis

The 2004 I-93 widening FEIS presented the Seasons Lane neighborhood ("Location 24") as having 10 impacted receptors. A 14-foot barrier (8-foot wall and 6-foot berm) of 2,500 feet in length was proposed for an estimated cost of $550,000. The analysis estimated 19 receptors would be benefited, resulting in a cost of $29,000 per benefited receptor. The cost criterion at that time (1996 policy) was $30,000 per benefited receptor, so based on this information a barrier was recommended.

In 2008, the I-93 widening final design noise analysis recommended a 14–18 foot barrier (with 10 feet of the height on berm) of 3,050 feet in length. The barrier was estimated to benefit 21 receptors, cost $738,000 and have a cost per benefited receptor of $35,000. Although this exceeded the $30,000 threshold, the barrier continued to be recommended.

For purposes of comparing the benefit of new barrier options with the benefits provided by the I-93 widening barrier, the I-93 widening barriers were evaluated for the No Build condition. Table 4-18 summarizes the I-93 barrier performance results for each receptor based on the updated TNM models. This analysis excluded the I-93 widening barrier berms from the terrain data to evaluate the full benefit of the noise barriers. The "barrier height" was calculated based on the top of barrier profile from the final design plans in comparison to pre-I-93 widening construction topography.

Table 4-18. Seasons Lane: I-93 Widening Barrier Benefits, 2040 No Build

Receptor Unit ID-Shading Indicates Impacted Receptor Units	Number of Receptor Units	2016 Noise Levels	2040 (No Barrier and no berm)- shading indicates impact		I-93 Widening Barrier Northbound	
			Noise Levels	Increase Over Existing		
					Noise Levels	I.L.
Seasons 1"	1	58	63	5	62	1
Seasons 10"	1	66	71	5	61	10
Seasons 11"	1	66	71	5	61	10
Seasons 12"	1	65	69	4	60	9
Seasons 2"	1	68	72	4	64	8
Seasons 3"	1	59	64	4	60	4
Seasons 4"	1	68	71	3	60	11
Seasons 5"	1	59	63	5	57	6
Seasons 6"	1	67	70	3	60	10
Seasons 7"	1	67	71	4	61	10
Seasons 8"	1	67	71	4	61	10
Seasons 9"	1	67	71	4	61	10
Seasons_E"	1	58	63	5	59	5

Receptor Unit ID-Shading Indicates Impacted Receptor Units	Number of Receptor Units	2016 Noise Levels	2040 (No Barrier and no berm)- shading indicates impact		I-93 Widening Barrier Northbound	
			Noise Levels	Increase Over Existing		
Seasons_D"	1	59	63	4	59	4
Seasons_C"	1	56	60	4	57	3
Seasons_B"	1	54	57	3	56	2
Seasons_F"	1	62	66	4	61	5
Seasons_G"	1	62	66	4	61	5
Seaons_H"	1	61	65	4	60	5
Seasons_I"	1	61	65	4	60	6
Seasons_J"	1	60	65	4	59	6
Seasons_K"	1	62	66	4	60	6
Seasons_L"	1	58	62	4	57	5
Seasons_N"	1	55	59	4	59	0
Seaons_M"	1	55	58	3	57	1
Seasons_A"	1	53	56	3	56	1
Seasons_back_1"	1	52	55	3	55	1
Seasons_back_2"	1	54	56	3	56	1
Summer_back_1"	1	57	61	4	57	4
Autumn_back_1"	1	59	63	4	59	4
Autumn_back_2"	1	58	62	4	59	4
Autumn_back_3"	1	59	62	4	59	3
Autumn_back_4"	1	59	63	4	59	3
Autumn_back_5"	1	59	63	4	60	3
Autumn_back_6"	1	61	65	4	61	4
Autumn_back_7"	1	61	64	4	61	3
Seasons_back_3"	1	53	57	3	55	2

Noise Abatement Details and Evaluation Criteria	
Barrier Area (square feet)	75,237
Effectiveness Criterion	1,500
Total Number of Impacted Receptor Units	12
Number of Impacted Receptor Units Receiving ≥ 10 dBA I.L.	7
Percent of Impacted Receptor Units Receiving ≥ 10 dBA I.L.	58%
Number of Impacted Receptor Units Receiving I.L.≥ 5 dBA but < 10 dBA	5
Total Number of Impacted Receptor Units Benefited	12
Percent of Impacted Receptor Units Benefited	100%
Number of Non-Impacted Receptor Units Benefited (I.L.≥ 5 dBA)	6
Total Number of Benefited Receptor Units	18

Receptor Unit ID- Shading Indicates Impacted Receptor Units	Number of Receptor Units	2016 Noise Levels	2040 (No Barrier and no berm)- shading indicates impact		I-93 Widening Barrier Northbound
			Noise Levels	Increase Over Existing	
Square Feet per Receptor Unit Benefited					4,180
Barrier Reasonable from a Square Foot/Receptor Unit Standpoint?					**No**
Total Barrier Length (feet)					3,136
Barrier Height Range (feet)					7.11 to 35.94
Average Barrier Height (feet)					23.99

Notes:

All values represent hourly Leq in dBA
dBA = Decibels on the A-weighted scale
Leq = Equivalent noise level
I.L. = Insertion Loss

- (Yellow) Impacted Receptor Units (Build noise levels > 66 dBA)
- (Green) Impacted Receptor Units Receiving I.L. ≥ 10 dBA
- (Blue) Impacted Receptor Units Receiving I.L.≥ 5 dBA but <10 dBA
- (Orange) Non-Impacted Receptor Units Receiving ≥ 5 dBA

Updated Analysis

The updated analysis for Exit 4A shows substantially fewer Seasons Lane receptors would be impacted than was predicted previously (12 receptors based on 2040 traffic and no barriers). The receptors are located on hill above the elevation of I-93.

Four barrier options were considered for Seasons Lane as shown in Figures 4-23 through 4-26. The horizontal barrier alignment for the Seasons Lane area was kept the same as the I-93 widening final design barrier alignment, from station 1717+50 at the northern end to station 1694. From station 1694 to 1687+25, the barrier alignment was shifted east to follow the right-of-way line in order to avoid conflict with the Alternative A northbound on-ramp and to take advantage of the terrain.

As shown in Table 4-19, Option 1 evaluated the barrier necessary to achieve 10 dB insertion loss at the majority of the first-row impacted receptors (the design goal per the November 2016 NHDOT Traffic Noise Policy). The option 1 barrier would be similar in total dimensions to the barrier recommended in the I-93 widening final design, totaling 2,983 feet in length and with an average height of 18 feet. In total, 16 receptor units would be benefited by the option 1 barrier, resulting in 3,367 square feet per receptor unit benefited, which exceeds the effectiveness criterion of 1,500 square feet per benefited receptor.

Barrier options that would provide less insertion loss or only protect a portion of the NSA were also considered, but similarly would not be able to meet the effectiveness criterion. Option 2 would be closest to meeting the criterion at 2,706 square feet per benefited receptor for a barrier with an average height 16.2 feet.

Conclusion

Table 4-20 provides an overall summary of the Seasons Lane barrier analyses in comparison to the I-93 widening barrier analyses, including cost information based on recent NHDOT bid prices ($38 per square foot).

The selection of a preferred option by NHDOT and FHWA was based on consideration of which option would provide a benefit to impacted receptors comparable to the benefit that would be provided if the I-93 widening barriers were built without Exit 4A. NHDOT and FHWA are committed to providing noise barriers in these locations by the I-93 widening 2005 ROD and 2010 Supplemental ROD, regardless of whether the options meet the current noise policy effectiveness criterion. The recommended barrier option for further evaluation during final design is Option 1.

Based on the studies so far completed, NHDOT is committed to the construction of feasible and reasonable noise abatement measures at Seasons Lane. These preliminary indications of likely abatement measures are based upon preliminary design for a barrier with a length of about 3,000 feet and an average height of approximately 18.1 feet, that will reduce the noise level by at least 5dB(A) for 16 residents. If it is subsequently found during final design that these conditions have substantially changed, the abatement measure(s) might not be provided. A final decision on the installation of the abatement measure(s) will be made during the final design process following the completion of public involvement.

Table 4-19. NSA 5 Barrier Analysis, Seasons Lane, 2040 PM Peak Hour Traffic

Receptor Unit ID- Shading Indicates Impacted Receptor Units	Number of Receptor Units	2016 Noise Levels	2040 (No Barrier)- shading indicates impact		Barrier Option 1		Barrier Option 2		Barrier Option 3		Barrier Option 4	
			Noise Levels	Increase Over Existing	Noise Levels	I.L.	Noise Levels	I.L.	Noise Levels	I.L.	Noise Levels	I.L.
Seasons 1"	1	58	62.3	4	62	0	62.1	0	62.1	0	62.1	0
Seasons 10" (first row)	1	66	70.6	5	60.5	10	61.2	9	63.5	7	61.8	9
Seasons 11 (first row)	1	66	70.9	5	60.9	10	61.4	10	63.8	7	62.4	9
Seasons 12" (first row)	1	65	67	2	59.7	7	59.9	7	62.5	5	61.8	5
Seasons 2" (first row)	1	68	74.1	6	63.8	10	68.4	6	68.5	6	68.4	6
Seasons 3"	1	59	63.8	4	60.6	3	61.6	2	62.1	2	61.6	2
Seasons 4" (first row)	1	68	69.4	1	60.2	9	61.3	8	62.8	7	61.4	8
Seasons 5"	1	59	63.3	5	57.5	6	58.4	5	59.8	4	58.5	5
Seasons 6" (first row)	1	67	70.1	3	60.2	10	61.8	8	63.6	6	61.8	8
Seasons 7" (first row)	1	67	70.5	4	61	10	62.6	8	65	6	62.7	8
Seasons 8" (first row)	1	67	70.4	4	60.8	10	62.1	8	65	5	62.4	8
Seasons 9" (first row)	1	67	70.8	4	60.8	10	61.7	9	64.3	7	62.1	9
Seasons_E"	1	58	63.1	5	58.9	4	58.6	5	61.1	2	60.9	2
Seasons_D"	1	59	61.7	3	59.5	2	59.3	2	60.4	1	60.3	1
Seasons_C"	1	56	59.3	4	57.6	2	57.5	2	58.4	1	58.3	1
Seasons_B"	1	54	57.8	4	55.8	2	55.8	2	56.4	1	56.3	2
Seasons_F"	1	62	66.4	4	61.1	5	60.7	6	63	3	62.1	4
Seasons_G"	1	62	65.8	4	60.7	5	60.8	5	62.9	3	61.6	4
Seaons_H"	1	61	65.2	4	60	5	60.4	5	62.4	3	60.9	4
Seasons_I"	1	61	65	4	59.5	6	60.3	5	62.5	3	60.8	4
Seasons_J"	1	60	64.6	4	58.8	6	59.7	5	61.9	3	60	5
Seasons_K"	1	62	65.7	4	59.8	6	61.1	5	63.5	2	61.3	4
Seasons_L"	1	58	62.4	5	58	4	58.6	4	59.7	3	58.8	4
Seasons_N"	1	55	59.2	4	59	0	59.1	0	59.1	0	59.1	0

Receptor Unit ID- Shading Indicates Impacted Receptor Units	Number of Receptor Units	2016 Noise Levels	2040 (No Barrier)- shading indicates impact		Barrier Option 1		Barrier Option 2		Barrier Option 3		Barrier Option 4	
			Noise Levels	Increase Over Existing	Noise Levels	I.L.	Noise Levels	I.L.	Noise Levels	I.L.	Noise Levels	I.L.
Seaons_M"	1	55	58.1	4	57.3	1	57.6	1	57.8	0	57.6	1
Seasons_A"	1	53	56.8	4	56.5	0	56.6	0	56.6	0	56.6	0
Seasons_back_1"	1	52	55.8	4	55.5	0	55.5	0	55.6	0	55.6	0
Seasons_back_2"	1	54	56.4	3	55.9	1	56.1	0	56.2	0	56.1	0
Summer_back_1"	1	57	61.3	4	57.9	3	58.5	3	59.7	2	58.7	3
Autumn_back_1"	1	59	62.7	4	58.9	4	59.6	3	61.2	2	60	3
Autumn_back_2"	1	58	62.4	4	58.9	4	59.5	3	61.1	1	59.9	3
Autumn_back_3"	1	59	62.3	4	59.1	3	59.5	3	60.8	2	60	2
Autumn_back_4"	1	59	62.7	4	59.4	3	59.7	3	61.1	2	60.2	3
Autumn_back_5"	1	59	63.3	4	59.9	3	59.9	3	61.5	2	60.7	3
Autumn_back_6"	1	61	64.9	4	61.1	4	61	4	63	2	62.1	3
Autumn_back_7"	1	61	64.4	4	61.1	3	60.6	4	62.7	2	62.1	2
Seasons_back_3"	1	53	56.4	3	55	1	54.9	2	55.6	1	55.5	1

Noise Abatement Details and Evaluation Criteria				
Barrier Area (square feet)	53,871	45,994	27,903	36,890
Effectiveness Criterion	1,500	1,500	1,500	1,500
Total Number of Impacted Receptor Units	12	12	12	12
Number of Impacted Receptor Units Receiving ≥ 10 dBA I.L.	7	1	0	0
Percent of Impacted Receptor Units Receiving ≥ 10 dBA I.L.	58%	8%	0%	0%
Number of Impacted Receptor Units Receiving I.L.≥ 5 dBA but < 10 dBA	5	11	9	9
Total Number of Impacted Receptor Units Benefited	12	12	9	9
Percent of Impacted Receptor Units Benefited	100%	100%	75%	75%
Number of Non-Impacted Receptor Units Benefited (I.L.≥ 5 dBA)	4	5	0	2
Total Number of Benefited Receptor Units	16	17	9	11
Square Feet per Receptor Unit Benefited	3,367	2,706	3,100	3,354

Receptor Unit ID- Shading Indicates Impacted Receptor Units	Number of Receptor Units	2016 Noise Levels	2040 (No Barrier)- shading indicates impact		Barrier Option 1		Barrier Option 2		Barrier Option 3		Barrier Option 4	
			Noise Levels	Increase Over Existing	Noise Levels	I.L.	Noise Levels	I.L.	Noise Levels	I.L.	Noise Levels	I.L.
Barrier Reasonable from a Square Foot/Receptor Unit Standpoint?					**No**		**No**		**No**		**No**	
Total Barrier Length (feet)					2,983		2,833		2,221		2,221	
Barrier Height Range (feet)					10 to 22		12 to 18		10 to 14		12 to 18	
Average Barrier Height (feet)					18.06		16.23		12.56		16.61	

Notes:

All values represent hourly Leq in dBA

dBA = Decibels on the A-weighted scale

Leq = Equivalent noise level

I.L. = Insertion Loss

Impacted Receptor Units (Build noise levels > 66 dBA)

Impacted Receptor Units Receiving I.L. ≥ 10 dBA

Impacted Receptor Units Receiving I.L.≥ 5 dBA but <10 dBA

Non-Impacted Receptor Units Receiving ≥ 5 dBA

Note: The “2040 No Barrier” results include the Exit 4A project infrastructure and grading, and the constructed I-93 widening berms.

Table 4-20. NSA 5 Barrier Analysis Summary

	I-93 Improvements Salem to Manchester		Exit 4A SDEIS			
	2004 FEIS	**2008 Final Design Noise Analysis**	**Option 1**	**Option 2**	**Option 3**	**Option 4**
Barrier Square Feet	35,000	52,100	53,871	45,994	27,903	36,890
Average Barrier Height (feet)	14 (8 feet wall, 6 feet berm)	14- 18 (10 feet as berm)	10-22 (18 feet ave)	12-18 (16 feet ave.)	10-14 (13 feet ave.)	12-18 (17 ave.)
Length (feet)	2,500	3,050	2,983	2,833	2,221	2,211
No. of Impacted Receptors	10	Not reported	12	12	12	12
No. of Benefited Receptors	19	21	16	17	9	11
Square Feet Per Benefited Receptor	1,842	2,481	3,367	2,706	3,100	3,354
Cost (at time of original analysis)	$550,000	$738,000	NA	NA	NA	NA
Cost Per Benefited Receptor (at time of original analysis)	$28,947	$35,143	NA	NA	NA	NA
Implied Cost Per Square Foot (at time of original analysis)	$15.71	$14.17	NA	NA	NA	NA
Current Cost Per SF	$38.00	$38.00	$38.00	$38.00	$38.00	$38.00
Current Cost Barrier Cost (no berm discount)	$1,330,000	$1,979,800	$2,047,098	$1,747,772	$1,060,314	$1,401,820
Current Cost Per Benefited Receptor	$70,000.00	$94,276.19	$127,943.63	$102,810.12	$117,812.67	$127,438.18

Figure 4-23. Seasons Lane- Option 1 Barrier

Figure 4-24. Seasons Lane- Option 2 Barrier

Figure 4-25. Seasons Lane- Option 3 Barrier

Figure 4-26. Seasons Lane- Option 4 Barrier

4.3.3 Folsom Rd./ Tsienneto Rd. Barrier Analyses

Noise barriers were evaluated in 13 locations along Folsom/Tsienneto Road where noise impacts were predicted to occur under Alternative A. Each potential barrier was developed to include breaks as necessary to not directly conflict with driveways (see Figures 4-27 through 4-34). Multiple heights were modeled (10, 12, 14, and 16 feet) for each barrier and the best performing option identified as shown in Table 4-21. The barriers were compared to NHDOT's minimum acoustic criteria (7 dBA insertion loss for at least one benefited receptor, and 5 dBA insertion loss for at least one impacted receptor).

Barriers that met these acoustic criteria were then evaluated in comparison to the NHDOT effectiveness criterion of 1,500 square feet per benefited receptor. Three potential barriers met the effectiveness criterion:

- Barrier 3, located on the south side of the connector road between Ferland Drive and Franklin Street
- Barrier 5, located on the south side of Tsienneto Road east of Pinkerton Street
- Barrier 10, located on the north side of Tsienneto Road between Jeff Lane and Scenic Drive

The three barriers that were potentially reasonable and feasible based on acoustic performance and the effectiveness criterion were advanced for further evaluation of engineering, environmental, and safety issues. The engineering/environmental feasibility evaluations are as follows:

- **Barrier 3:** To provide adequate clear zones, the barrier would need to be located 6 feet offset from the sidewalk (or 4 feet behind a guardrail), which would result in an unacceptable slope limit encroachment into the entrance of the apartment building at 99 North High Street. In addition, this barrier could require extending the Shields Brook Bridge and additional costs of constructing the barrier on the structure.
- **Barrier 5:** There is insufficient space for construction of a sidewalk and barrier in several sections of this area without resulting in additional property acquisitions or construction of retaining walls that would make the barrier not feasible in terms of cost effectiveness. Existing retaining walls would also be impacted, as well as existing driveways. The eastern end of this proposed barrier would increase wetland impacts.
- **Barrier 10**: Construction of the noise barrier would necessitate the removal of mature trees in the front yard of two historic properties, which would likely constitute an adverse effect to the setting of these historic resources. There is also a sight distance issue at the intersection of Tsienneto Road and Scenic Drive that would necessitate locating the barrier almost to the front of the historic home at 72 Tsienneto Road to provide clear sight lines for the 35 mph design speed.

In conclusion, barriers 3, 5, and 10 would not be feasible from an engineering/environmental perspective and are not recommended for further consideration. The other 10 barriers evaluated for Tsienneto Road/Folsom Road are either not feasible based on acoustic considerations or not reasonable because they would not meet the NHDOT effectiveness criterion.

Table 4-21. Folosom Rd./ Tsienneto Rd. Barrier Analysis- Initial Evaluation of Acoustic Performance and Effectiveness Criterion

Barrier No.	Approx. Location	Number of Noise Impacted Receptors in Vicinity	Total Length (feet, accounting for breaks due to driveways)	7 dBA I.L. for at least one benefited receptor?	5 dBA I.L. for at least one impacted receptor?	Option with lowest SF/benefited receptor and meeting I.L. criteria	SF of option	No. Benefited Receptors	SF/benefited receptor	Conclusion
1	Connector Road South Side, Madden Rd.	2	571	Yes	Yes	16 feet	9,138	1	9,138	Barrier is not reasonable based on effectiveness criterion
2	Connector Road South Side, North High St. to Ferland Dr.	1	519	No	Yes	N/A	N/A	N/A	N/A	Not feasible because no option can provide at least 7 dBA I.L.
3	Connector Road South Side, Ferland Dr. to Franklin St.	5	247	Yes	Yes	10 feet	2,473	4	618	Barrier is feasible and reasonable based on acoustic and effectiveness criterion. Advanced for evaluation of engineering/ environmental issues
4	Folsom Rd. South Side, Franklin St. to NH 28	9	911	Yes	Yes	14 feet	12,759	6	2,127	Barrier is not reasonable based on effectiveness criterion

Barrier No.	Approx. Location	Number of Noise Impacted Receptors in Vicinity	Total Length (feet, accounting for breaks due to driveways)	7 dBA I.L. for at least one benefited receptor?	5 dBA I.L. for at least one impacted receptor?	Option with lowest SF/benefited receptor and meeting I.L. criteria	SF of option	No. Benefited Receptors	SF/benefited receptor	Conclusion
5	Tsienneto Rd South Side, East of Pinkerton St.	10	1,478	Yes	Yes	12 feet	17,732	80	222	Barrier is feasible and reasonable based on acoustic and effectiveness criterion. Advanced for evaluation of engineering/ environmental issues
6	Bypass 28, East Side, Liniew Dr. to London Rd	1	521	No	No	N/A	N/A	N/A	N/A	Not feasible because no option can provide at least 7 dBA I.L, and impacted receiver does not receive at least 5 dBA I.L.
7	Tsienneto Rd, North Side, East of Bypass 28	1	943	Yes	Yes	14 feet	13,186	5	2,637	Barrier is not reasonable based on effectiveness criterion
8	Tsienneto Rd, north side, west of Barkland Dr.	1	753	Yes	Yes	10 feet	7,530	3	2,510	Barrier is not reasonable based on effectiveness criterion
9	Tsienneto Rd, South Side, west of Fieldstone Dr.	2	970	Yes	Yes	16 feet	15,518	6	2,586	Barrier is not reasonable based on effectiveness criterion

Barrier No.	Approx. Location	Number of Noise Impacted Receptors in Vicinity	Total Length (feet, accounting for breaks due to driveways)	7 dBA I.L. for at least one benefited receptor?	5 dBA I.L. for at least one impacted receptor?	Option with lowest SF/benefited receptor and meeting I.L. criteria	SF of option	No. Benefited Receptors	SF/benefited receptor	Conclusion
10	Tsienneto Rd, north side, Jeff Ln to Scenic Dr.	2	384	Yes	Yes	10 feet	3,841	3	1,280	Barrier is feasible and reasonable based on acoustic and effectiveness criterion. Advanced for evaluation of engineering/ environmental issues
11	Tsienneto Rd, north side, East of Jeff Ln	2	685	Yes	Yes	10 feet	6,844	2	3,422	Barrier is not reasonable based on effectiveness criterion
12	NH 102, Tsienneto Rd. to English Range Rd	2	859	No	Yes	N/A	N/A	N/A	N/A	Not feasible because no option can provide at least 7 dBA I.L.
13	NH 102, north of North Shore Rd.	3	468	Yes	Yes	10 feet	4,682	3	1,561	Barrier is not reasonable based on effectiveness criterion

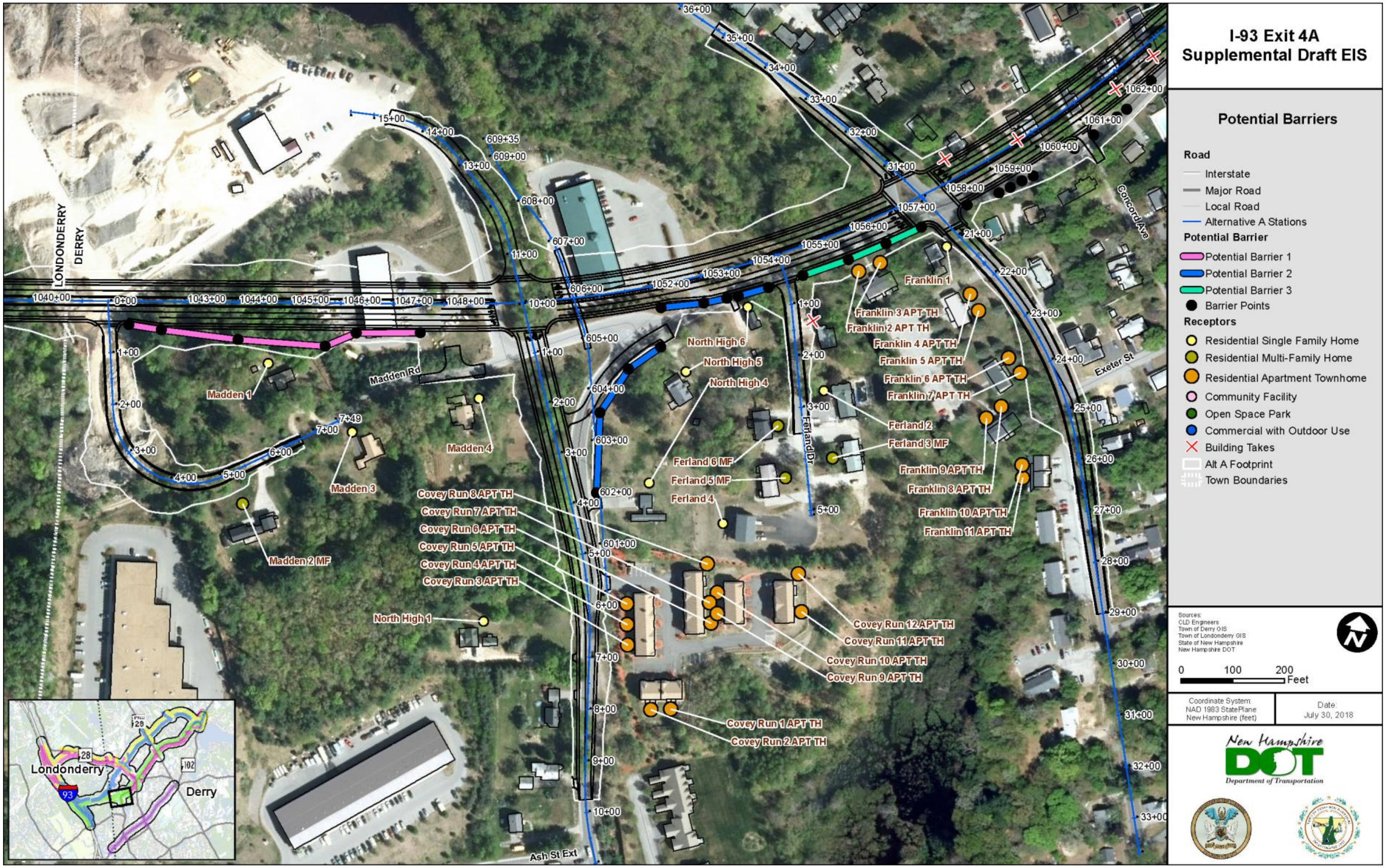


Figure 4-27. Potential Barriers 1, 2 and 3

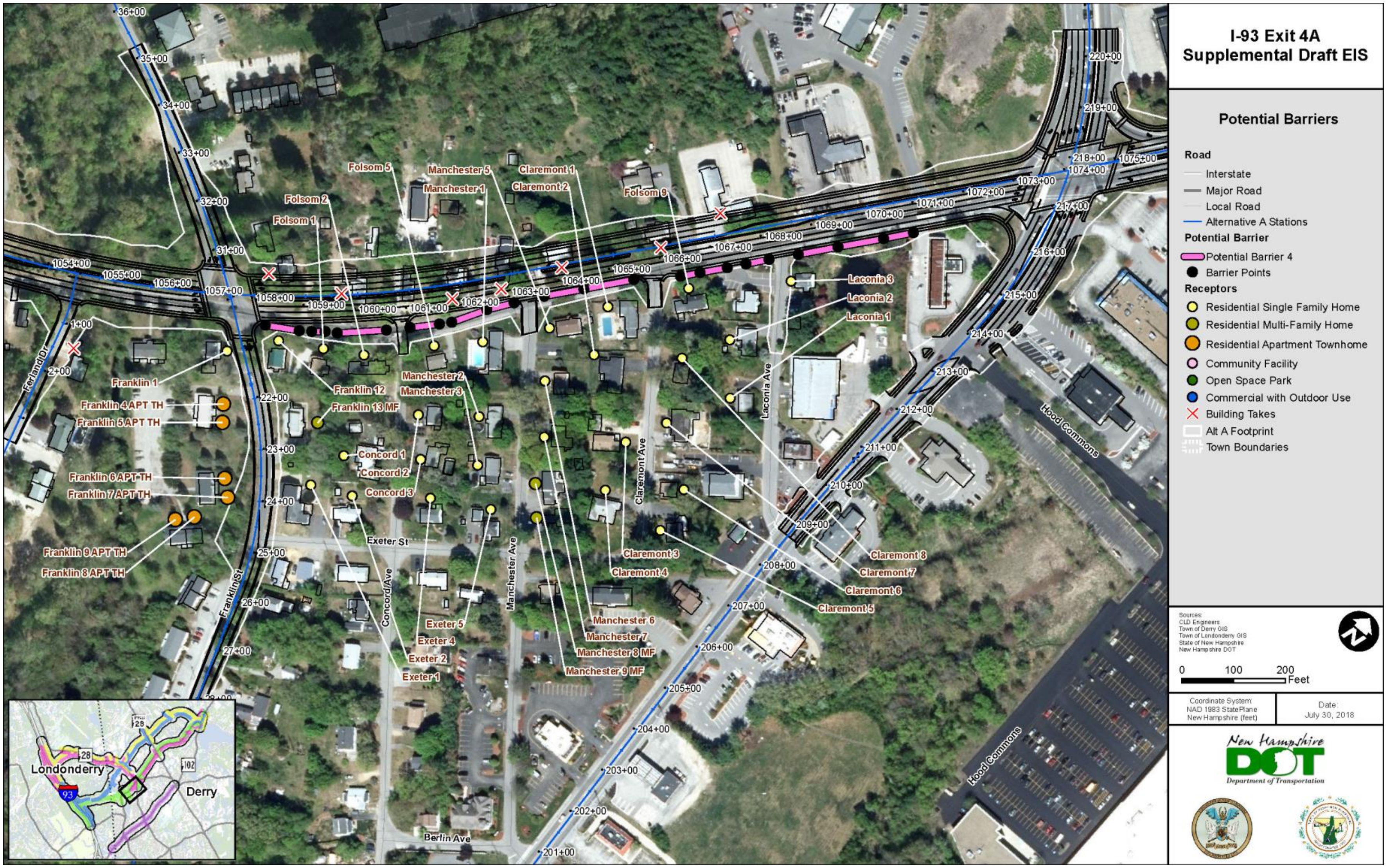


Figure 4-28. Potential Barrier 4

Figure 4-29. Potential Barrier 5

Figure 4-30. Potential Barrier 6

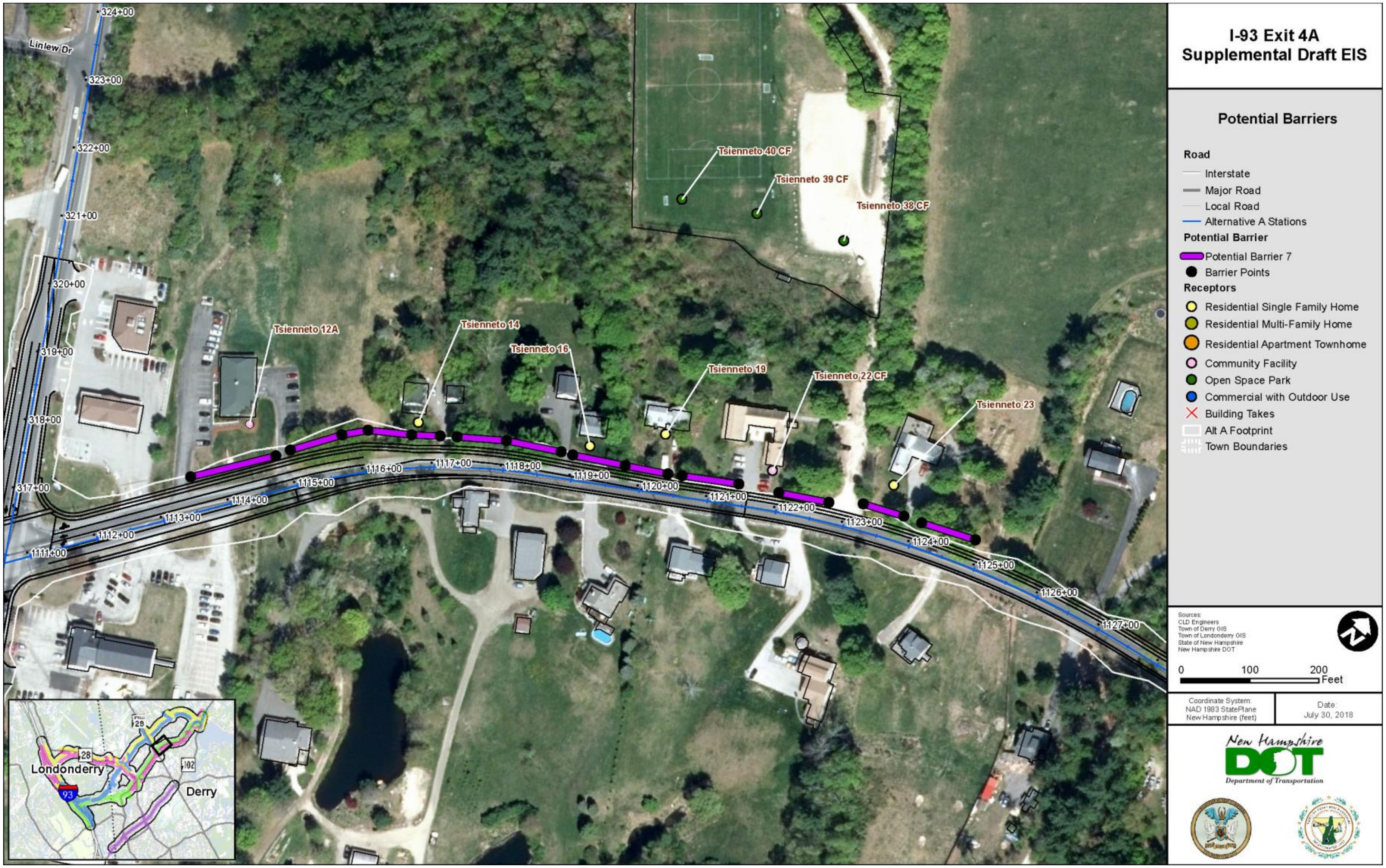


Figure 4-31. Potential Barrier 7

Figure 4-32. Potential Barriers 8 and 9

Figure 4-33. Potential Barriers 10 and 11

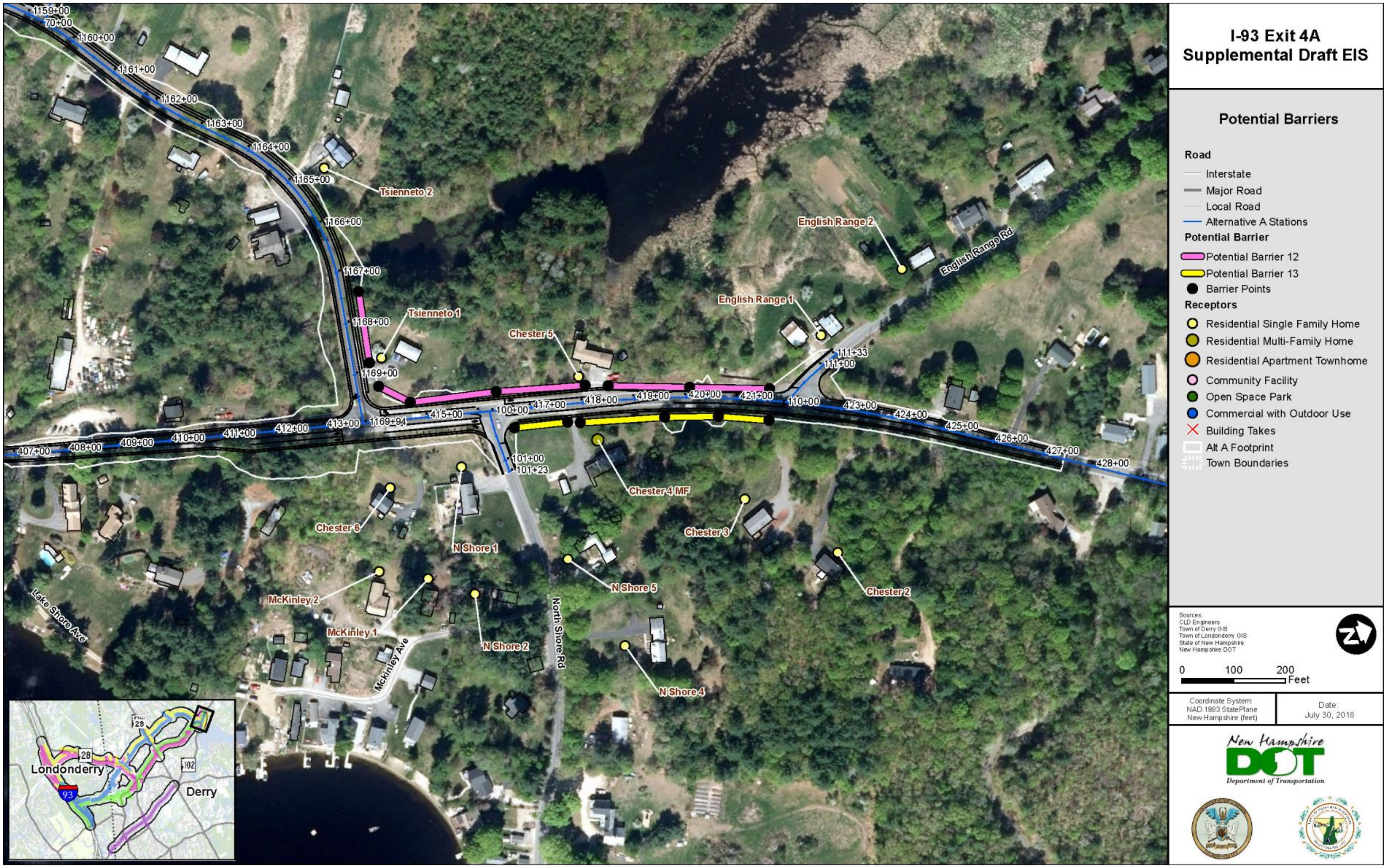
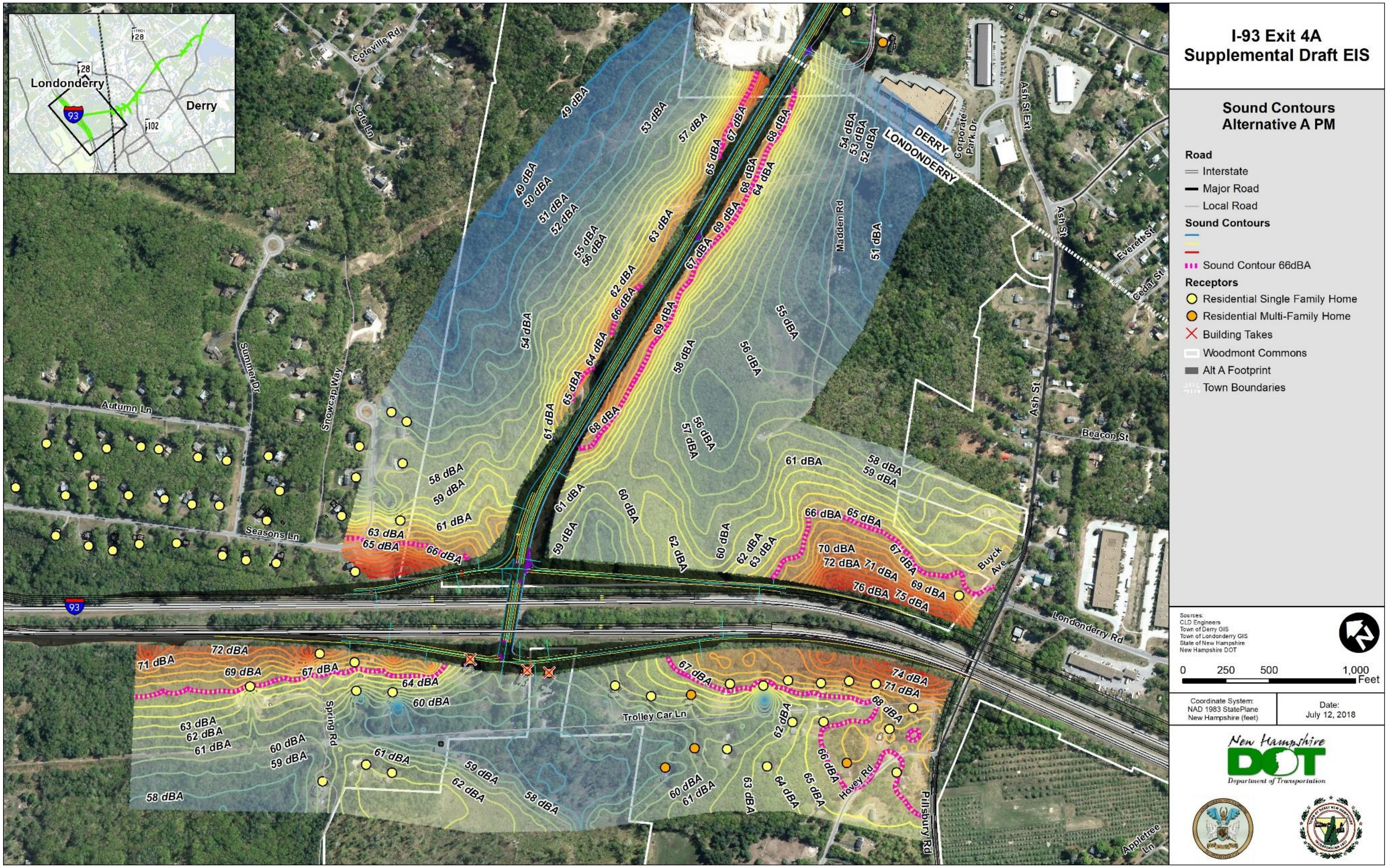


Figure 4-34. Potential Barriers 12 and 13

4.4 Undeveloped Lands Noise Analysis for Future Land Use Planning

In addition to identifying impacts to existing land uses, FHWA's traffic noise regulations require consideration of "undeveloped lands for which development is planned, designed and programmed, which may be affected by noise from the highway." For this project, the primary undeveloped lands are the site of Woodmont Commons on the east and west side of I-93. Woodmont Commons is Planned Unit Development approved by the Town of Londonderry in 2013. Additional site plan review and local approvals are required for each portion of the plan to advance to construction—as of July 2018 no specific development proposal has been submitted for the portions of Woodmont Commons East and West closest to the interchange area (the areas of Woodmont East under construction are closer to Exit 4 and outside the study area). Although no building permit has been issued that would require detailed analysis of impacts and mitigation, noise contours were developed to aid the Town of Londonderry in future land use planning decisions in this area. The contours were developed by analyzing a dense receptor grid and TNM and interpolating contours using ArcGIS. The receptors were assigned elevations based on LIDAR data so that the noise contours accurately reflect existing terrain. Figure 4-27 shows the Alternative A 2040 PM peak hour noise contours for the immediate interchange area. The contours show the effects of terrain shielding provided by portions of the connector road ramps and that the size of the 66 dBA contour zone along the connector road is much smaller than the 66 dBA contour zone along the I-93 mainline, which is consistent with the I-93 volumes being substantially higher than the connector road.

Figure 4-35. Undeveloped Lands Noise Contours



4.5 Construction Noise Impacts and Mitigation

Construction noise differs from traffic noise in length, type, and duration of noise events. Construction noise is of a fixed duration and ceases at the completion of the construction phase. Construction noise, usually limited to daylight hours, differs from normal vehicular traffic noise, which continues throughout the day- and night-time hours. Additionally, construction-related noise is responsible for a variety of impulsive, discontinuous noise sources, such as jack-hammer and/or vibratory rollers. Traffic noise, although varying in level, is more continuous as a noise source. Temporary increase in noise levels will occur during the time period that construction takes place. Noise levels due to construction, although temporary, can impact areas adjacent to the proposed project.

Impacts due to construction noise are dependent upon the following criteria:

- Time and duration of construction activities;
- Equipment types; and
- Equipment usage cycle.

Typical construction phases for the proposed project may involve the following construction activities:

- **Demolition:** Removal of structures within the right-of-way.
- **Clearing and Grubbing:** Existing landscaping, along with unwanted earth and rock.
- **General Earthwork:** Site topography will be altered in order to prepare the area for the roadway design. Earth moving operations will be required to prepare the roadbed. Trenches will be excavated for drainage materials.
- **Foundations:** Preparation for, and construction of, foundation support systems for both bridge and other primary foundation structures.
- **Paving Operations:** Preparation of the base layer, such as roadbed compaction and the laying of substrata material as well as surface paving operations.
- **Finishing:** Cleanup and landscaping.

Equipment such as bulldozers, scrapers, pavers, backhoe, graders, loaders, cranes, trucks, compressors, vibratory compactors, generators, and pile driving operations are typically utilized during construction.

Mitigation measures will be incorporated into the contract documents to lessen potential construction noise impacts. The following mitigation strategies will be employed to the extent practicable to limit the potential impact of noise:

- Source Control
  - All exhaust systems in good working order, also using properly designed engine enclosures, and intake silencers.
  - Regular equipment maintenance.
- Site Control

  - Placement of stationary equipment as far away from sensitive receptors as possible (i.e., pumps, compressors, aggregate crushers, AC plants, operators, etc.).
  - Choice of disposal sites and haul routes thereto.
  - Employing shielding where possible.

- Time and Activity Constraints

  - Schedule of operations to coincide with periods when people would least likely be affected.
  - Limiting working hours and work days to least noise sensitive times.

- Community Awareness

  - Public notification of construction operations.
  - Methods to handle complaints.

5.0 REFERENCES

Cowan, James. 1994. Handbook of Environmental Acoustics. New York: Van Nostrand Reinhold.

FHWA. 2016. Traffic Noise Model Version 2.5. May 19, 2016. Available at: https://www.fhwa.dot.gov/environment/noise/traffic_noise_model/tnm_v25/.

FHWA. 2011. Highway Traffic Noise: Analysis and Abatement Guidance. Original document dated June 2010, revised December 2010, and re-issued 2011. Available at: http://www.fhwa.dot.gov/Environment/noise/regulations_and_guidance/analysis_and_abatement_guidance/revguidance.pdf.

FHWA. 2010. Procedures for Abatement of Highway Traffic Noise and Construction Noise: FAPG 23 CFR 772. July 13, 2010. Available at: https://www.gpo.gov/fdsys/pkg/FR-2010-07-13/pdf/2010-15848.pdf.

FHWA. 1996. Measurement of Highway-Related Noise: Final Report (FHWA-PD-96-046). May, 1996. Available at: http://www.fhwa.dot.gov/environment/noise/measurement/measure.cfm.

NHDOT (New Hampshire Department of Transportation). 2016. Ten Year Transportation Improvement Plan 2017–2026. Available at: https://www.nh.gov/dot/org/projectdevelopment/planning/typ/documents/ApprovalTYP-CompleteBook6.24.16.pdf.

NHDOT. 2016. Policy and Procedural Guidelines for the Assessment and Abatement of Highway Traffic Noise for Type I & II Highway Projects. November 30, 2016. Available at: https://www.nh.gov/dot/org/projectdevelopment/environment/units/program-management/documents/2016NHDOTTypeIandIINoisePolicy.pdf.

NHDOT and The Towns (New Hampshire Department of Transportation and the Towns of Derry and Londonderry). 2015. State/Local Project Agreement for Derry-Londonderry, I-93 Exit 4A. Dated December 23, 2015.

Town of Londonderry, New Hampshire. 2016. Municipal Code Title IV, Chapter XIV, Noise Regulations. Ordinance #2016-03. Signed June 2, 2016. Available at: http://www.londonderrynh.org/Pages/LondonderryNH_Manager/Official%20Town%20Documents/Ordinances/14-01%20to%20Present/16/16-03.

Town of Londonderry, New Hampshire. 2002. Municipal Code Title III, Land Use Codes. Ordinance #2002-12. Adopted August 26, 2002. Available at: http://www.londonderrynh.org/Pages/LondonderryNH_Manager/Official%20Town%20Documents/Ordinances/00-01%20to%2004-16/02/02-12.

Town of Londonderry, New Hampshire. 1997. Zoning Ordinance Section VII, Commercial Performance Standards. Adopted June 16, 1997. Available at: http://www.londonderrynh.org/Pages/LondonderryNH_Manager/Official%20Town%20Documents/Ordinances/97-01%20to%2099-18/97/97-06.

Appendix A: Noise Measurement Field Data Sheets, Photos, and Noise Meter Calibration Certificates

MONITORING LOCATIONS – SKETCHES AND FIELD DATA

Noise Monitoring Fieldwork - Site Diagram
The Louis Berger Group, Inc.

Receptor / Site #	Date	Site Address / Location	Observer
Site A		24 Trolley Car Ln	DP

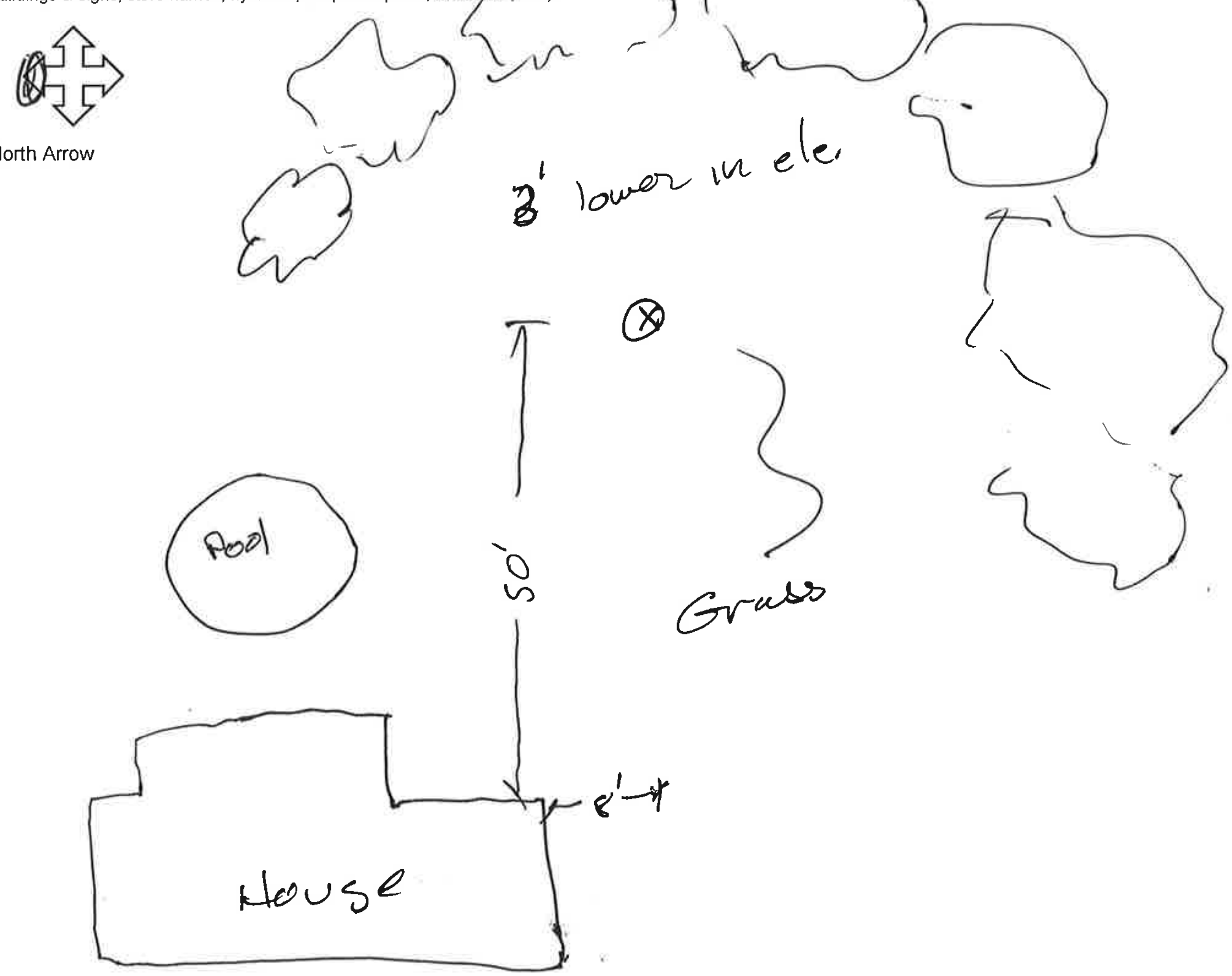
Lane / Traffic Direction	Receptor / Site Surface (Grass, Lawn, Sidewalk, etc.)	Nearby Landmark
	Grass Trees	

Grade (At, Level, Below, Slope)	Roadway Pavement Type (Dirt Road, Asphalt, Concrete, Wet, etc.)	Distance to Landmark

Meterological Condition (Clear, Sunny, Overcast, etc.)	Temperature (degrees)	Wind Condition/Speed (Mild, Breezy, Gusty, etc.)	Equipment Check List	Noise Meter Model
			Noise Meter, Calibrator, Windscreen, Tripod	

Plan View (Bird's Eye View - Indicate: site -location, meter- location, distance (ft) to landmarks, roadway & travel lane direction, geographical objects - trees, water, buildings & signs, store names, hydrants, telephone poles, manholes, etc.)

North Arrow



Elevation View (Ground Plane/Cross-section view - Indicate terrain, roadway, height and location of receptor, meter, walls/barriers, buildings, etc.)

** Not to scale!*

SHORT TERM NOISE MEASUREMENT RESULTS (20 MINUTES)

SITE **A** Address 25 Trolley Car Ln

Time Periods		Date	Starting Time	Duration	PARAMETERS (dBA)						Rec #
					Leq	L10	L50	L90	MaxL	MinL	
AM Peak	7:00 Am - 8:00 AM	9/20	7:00	20	63.8	65.7	63.5	60.7	68.9	54	30
PM Peak	5:00 PM - 6:00 PM	9/20	5:30	20	630	64.9	62.8	60.0	67.3	54.7	33
Photo					Diagram			Meter			

Note Ambient and Unusual Noises (e.g. helicopter, airplane, ambulance, motorcycle, police, ambulance, fire truck, garbage truck, people yelling/shouting, barking dog, etc.)

Calm, overcast

		M	Car	PU	MT	HT	B
AM	NB	2	774	164	28	44	0
	SB	2	794	209	32	41	1
	NB	2	870	163	13	19	4
	SB	13	791	112	12	10	4

SHORT TERM NOISE MEASUREMENT RESULTS (20 MINUTES)

SITE **A** Address 25 Trolley Car Ln

Time Periods		Date	Starting Time	Duration	Leq	L10	L50	L90	MaxL	MinL	Rec #
					PARAMETERS (dBA)						
AM Peak	7:00 Am - 8:00 AM	9/21	7:00	20	66.0	67.7	65.8	63.4	71.7	59.3	34
PM Peak	5:00 PM - 6:00 PM	9/21	5:08	20	64.2	65.6	64.2	62.0	67.9	58.8	37
Photo					Diagram			Meter			

Note Ambient and Unusual Noises (e.g. helicopter, airplane, ambulance, motorcycle, police, ambulance, fire truck, garbage truck, people yelling/shouting, barking dog, etc.)

Calm Clear

		m	Car	PU	MT	HT	B
AM	NB	1	728	141	38	36	0
	SB	6	844	176	30	31	1
PM	NB	8	969	164	21	15	2
Calm Clear	SB	5	880	157	20	22	3

PM Small water pump for swiming pool supply running: may add to overall levels
pump stopped @ ~ 7:50 into 20:00 min run

Noise Monitoring Fieldwork - Site Diagram

The Louis Berger Group, Inc.

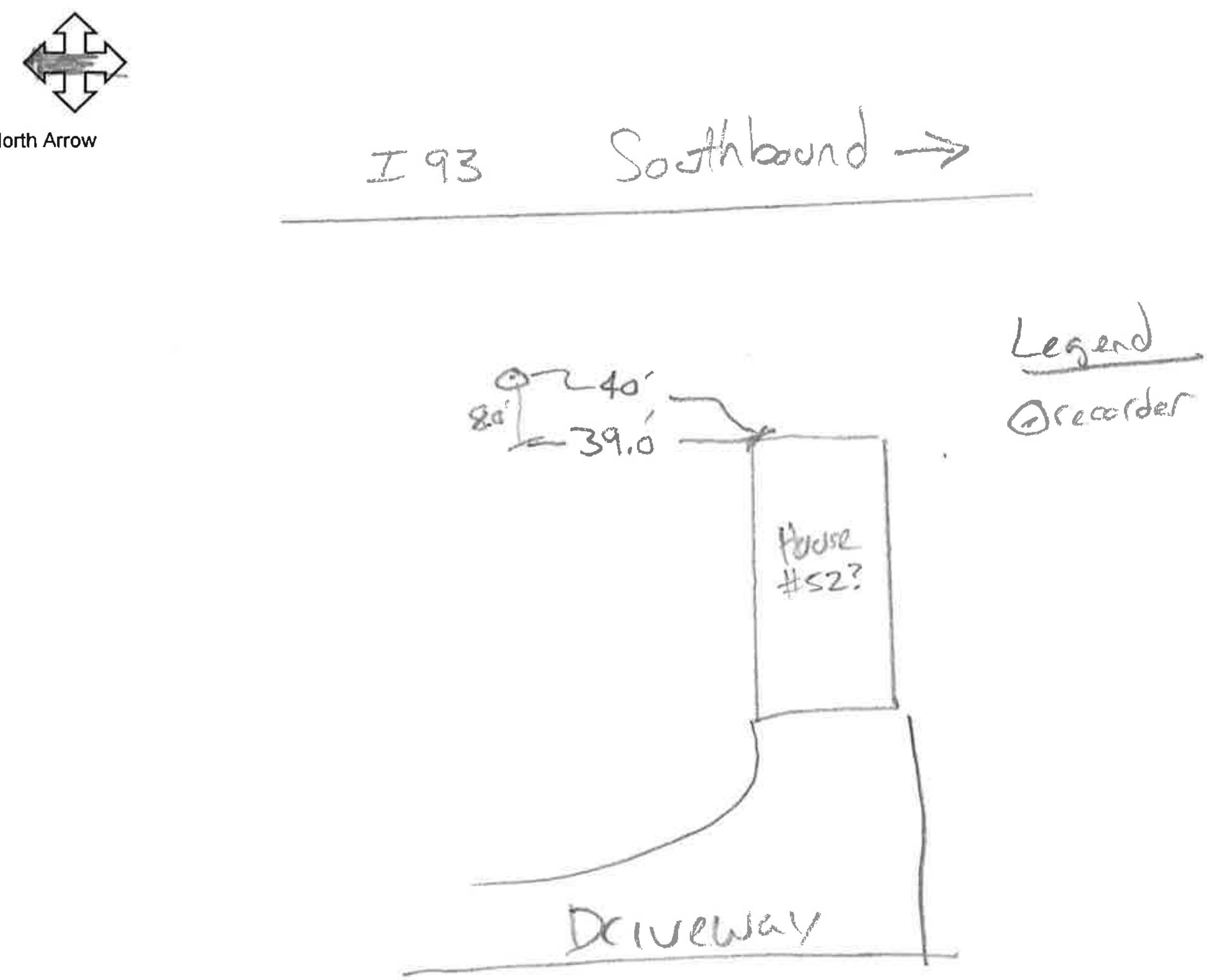
Receptor / Site #,	Date	Site Address / Location	Observer
B/am	9/20/16	52 Trolley Car Lane	MEF

Lane / Traffic Direction	Receptor / Site Surface (Grass, Lawn, Sidewalk, etc.)	Nearby Landmark
South	Grass	House

Grade (At, Level, Below, Slope)	Roadway Pavement Type (Dirt Road, Asphalt, Concrete, Wet, etc.)	Distance to Landmark
Level	Asphalt	40'

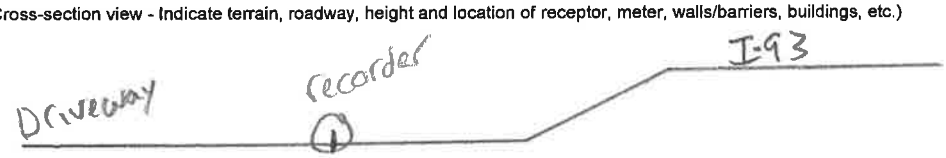
Meterological Condition (Clear, Sunny, Overcast, etc.)	Temperature (degrees)	Wind Condition/Speed (Mild, Breezy, Gusty, etc.)	Equipment Check List	Noise Meter Model
overcast	70°	Mild	Noise Meter, Calibrator, Windscreen, Tripod	Rion NL-42

Plan View (Bird's Eye View - Indicate: site -location, meter- location, distance (ft) to landmarks, roadway & travel lane direction, geographical objects - trees, water, buildings & signs, store names, hydrants, telephone poles, manholes, etc.)



Elevation View (Ground Plane/Cross-section view - Indicate terrain, roadway, height and location of receptor, meter, walls/barriers, buildings, etc.)

** Not to scale!*



SHORT TERM NOISE MEASUREMENT RESULTS (20 MINUTES)

Start pt. 1000

SITE **B** Address 52 Trolley Car Ln

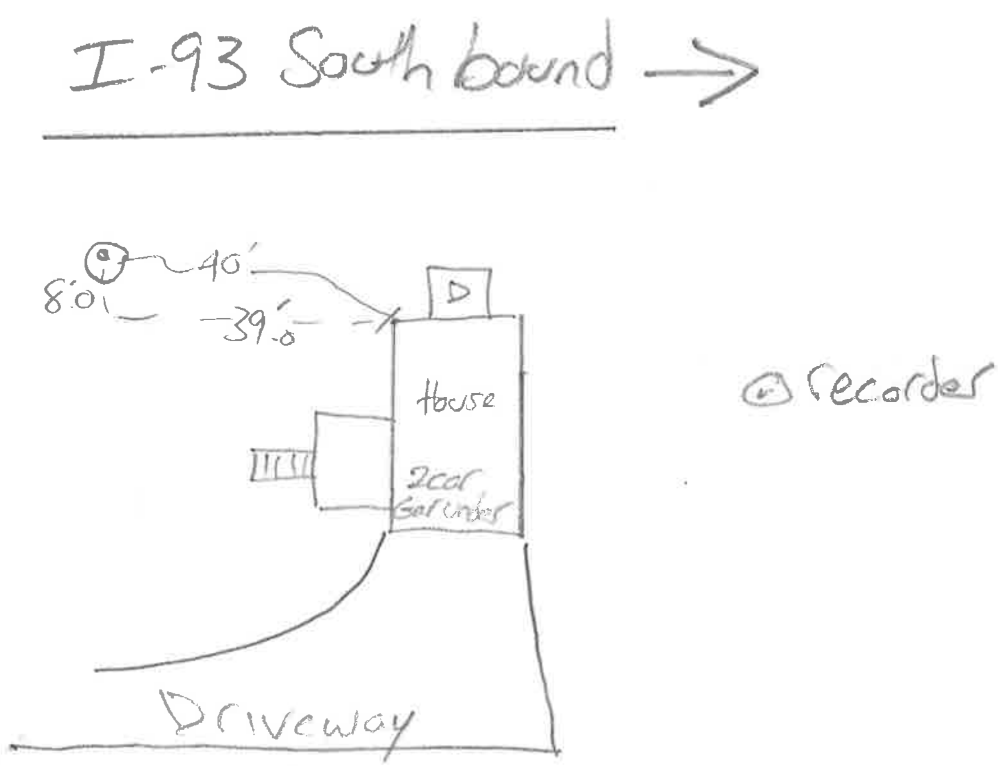
	Time Periods	Date	Starting Time	Duration	PARAMETERS (dBA)						Rec #
					Leq	L10	L50	L90	MaxL	MinL	
AM Peak	7:00 Am - 8:00 AM	9/20/16	7:03am	20min	70.5	72.9	70.0	65.4	77.9	60.2	0001
PM Peak	5:00 PM - 6:00 PM	9/20/16	5:35pm	20min	69.1	71.3	68.7	64.6	75.1	56.7	0005
Photo					Diagram			Meter			

Note Ambient and Unusual Noises (e.g. helicopter, airplane, ambulance, motorcycle, police, ambulance, fire truck, garbage truck, people yelling/shouting, barking dog, etc.)

AM Peak: no unusual noises to report

PM Peak: Lawn mower in neighboring lot at start to 2 min elapsed.

* Traffic counts on back of sheet



Morning B

	NB	SB
Motorcycle	2	2
passenger	774	794
pick up	164	209
med truck	28	32
heavy truck	44	41
Buses	Ø	1

Afternoon B

	NB	SB
Mcycle	2	13
passenger	870	791
pickup	163	112
med truck	13	12
heavy	19	10
Buses	4	4

Stor pt. 1003

SHORT TERM NOISE MEASUREMENT RESULTS (20 MINUTES)

SITE B **Address 52 Trolley Car Ln**

Time Periods		Date	Starting Time	Duration	PARAMETERS (dBA)						Rec #
					Leq	L10	L50	L90	MaxL	MinL	
AM Peak	7:00 Am - 8:00 AM	9/21/16	7:00am	20min	70.9	73.2	70.4	66.3	77.0	59.9	0006
PM Peak	5:00 PM - 6:00 PM	9/21/16	5:08pm	20min	70.3	72.1	70.2	66.6	77.1	60.0	0015
Photo					Diagram			Meter			

Note Ambient and Unusual Noises (e.g. helicopter, airplane, ambulance, motorcycle, police, ambulance, fire truck, garbage truck, people yelling/shouting, barking dog, etc.)

car counts

	AM SB	AM NB	PM SB	PM NB
Motorcycle	6	1	5	8
passenger	844	728	880	969
pickup	176	141	157	164
med truck 4 axle	30	38	20	21
Tractor trailer 5 axle	31	36	22	15
Bus	1	Ø	3	2

Noise Monitoring Fieldwork - Site Diagram
The Louis Berger Group, Inc.

Receptor / Site #	Date	Site Address / Location	Observer
Site C		60 Seasons Ln	AF

Lane / Traffic Direction	Receptor / Site Surface (Grass, Lawn, Sidewalk, etc.)	Nearby Landmark
	Grass / Trees	Ras / I-93

Grade (At, Level, Below, Slope)	Roadway Pavement Type (Dirt Road, Asphalt, Concrete, Wet, etc.)	Distance to Landmark

Meterological Condition (Clear, Sunny, Overcast, etc.)	Temperature (degrees)	Wind Condition/Speed (Mild, Breezy, Gusty, etc.)	Equipment Check List	Noise Meter Model
			Noise Meter, Calibrator, Windscreen, Tripod	

Plan View (Bird's Eye View - Indicate: site -location, meter- location, distance (ft) to landmarks, roadway & travel lane direction, geographical objects - trees, water, buildings & signs, store names, hydrants, telephone poles, manholes, etc.)

Elevation View (Ground Plane/Cross-section view - Indicate terrain, roadway, height and location of receptor, meter, walls/barriers, buildings, etc.)

** Not to scale!*

SHORT TERM NOISE MEASUREMENT RESULTS (20 MINUTES)

SITE **C** Address 60 Seasons Ln

Time Periods		Date	Starting Time	Duration	PARAMETERS (dBA) Leq	L10	L50	L90	MaxL	MinL	Rec #
AM Peak	7:00 Am - 8:00 AM	9/20	7:45	20	60.5	62.1	60.3	58.3	65.8	51.9	31
PM Peak	5:00 PM - 6:00 PM	9/20	5:00	20	60.8	62.1	60.6	59.1	65.7	56.2	32
Photo					Diagram			Meter			

Note Ambient and Unusual Noises (e.g. helicopter, airplane, ambulance, motorcycle, police, ambulance, fire truck, garbage truck, people yelling/shouting, barking dog, etc.)

Calm, overcast

		M	Car	PU	MT	HT	B
AM	NB	0	746	120	24	27	2
	SB	1	806	164	36	32	1

PM Calm - Clear

	NB	4	921	220	23	18	4
	SB	6	836	153	22	10	2

SHORT TERM NOISE MEASUREMENT RESULTS (20 MINUTES)

SITE **C** Address 60 Seasons Ln

Time Periods		Date	Starting Time	Duration	PARAMETERS (dBA)						Rec #
					Leq	L10	L50	L90	MaxL	MinL	
AM Peak	7:00 Am - 8:00 AM	9/22	7:15	20	62.2	63.4	62.2	60.2	65.9	58.0	38
PM Peak	5:00 PM - 6:00 PM	9/22	4:30	20	60.7	61.9	60.7	58.9	83.1	55.9	39
Photo					Diagram			Meter			

Note Ambient and Unusual Noises (e.g. helicopter, airplane, ambulance, motorcycle, police, ambulance, fire truck, garbage truck, people yelling/shouting, barking dog, etc.)

Calm Clear	M	Car	PU	MT	HT	B
NB	7	890	174	34	42	2
SB	9	854	196	45	26	2

Calm, Clear

NB	5	887	223	21	13	2
SB	9	778	139	35	21	4

Noise Monitoring Fieldwork - Site Diagram

The Louis Berger Group, Inc.

Receptor / Site #	Date	Site Address / Location	Observer
D / am	9/20/16	6 Folson Rd / at Concord Ave	MEF

Lane / Traffic Direction	Receptor / Site Surface (Grass, Lawn, Sidewalk, etc.)	Nearby Landmark
East & West	Sidewalk	Utility Pole

Grade (At, Level, Below, Slope)	Roadway Pavement Type (Dirt Road, Asphalt, Concrete, Wet, etc.)	Distance to Landmark
Level	Asphalt	5'

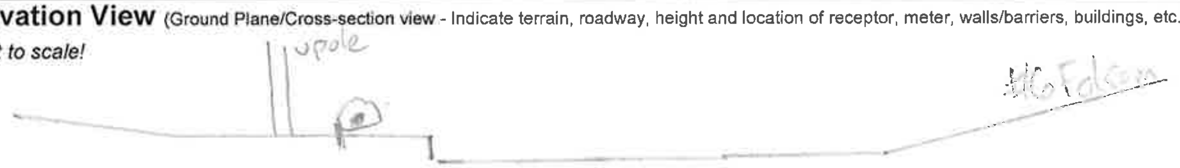
Meterological Condition (Clear, Sunny, Overcast, etc.)	Temperature (degrees)	Wind Condition/Speed (Mild, Breezy, Gusty, etc.)	Equipment Check List	Noise Meter Model
Overcast	70°	Mild	Noise Meter, Calibrator, Windscreen, Tripod	Rion NL-42

Plan View (Bird's Eye View - Indicate: site -location, meter- location, distance (ft) to landmarks, roadway & travel lane direction, geographical objects - trees, water, buildings & signs, store names, hydrants, telephone poles, manholes, etc.)

North Arrow

Elevation View (Ground Plane/Cross-section view - Indicate terrain, roadway, height and location of receptor, meter, walls/barriers, buildings, etc.)

** Not to scale!*



SHORT TERM NOISE MEASUREMENT RESULTS (20 MINUTES)

State pt. 1000

SITE D **Address 4 Folsom Rd**

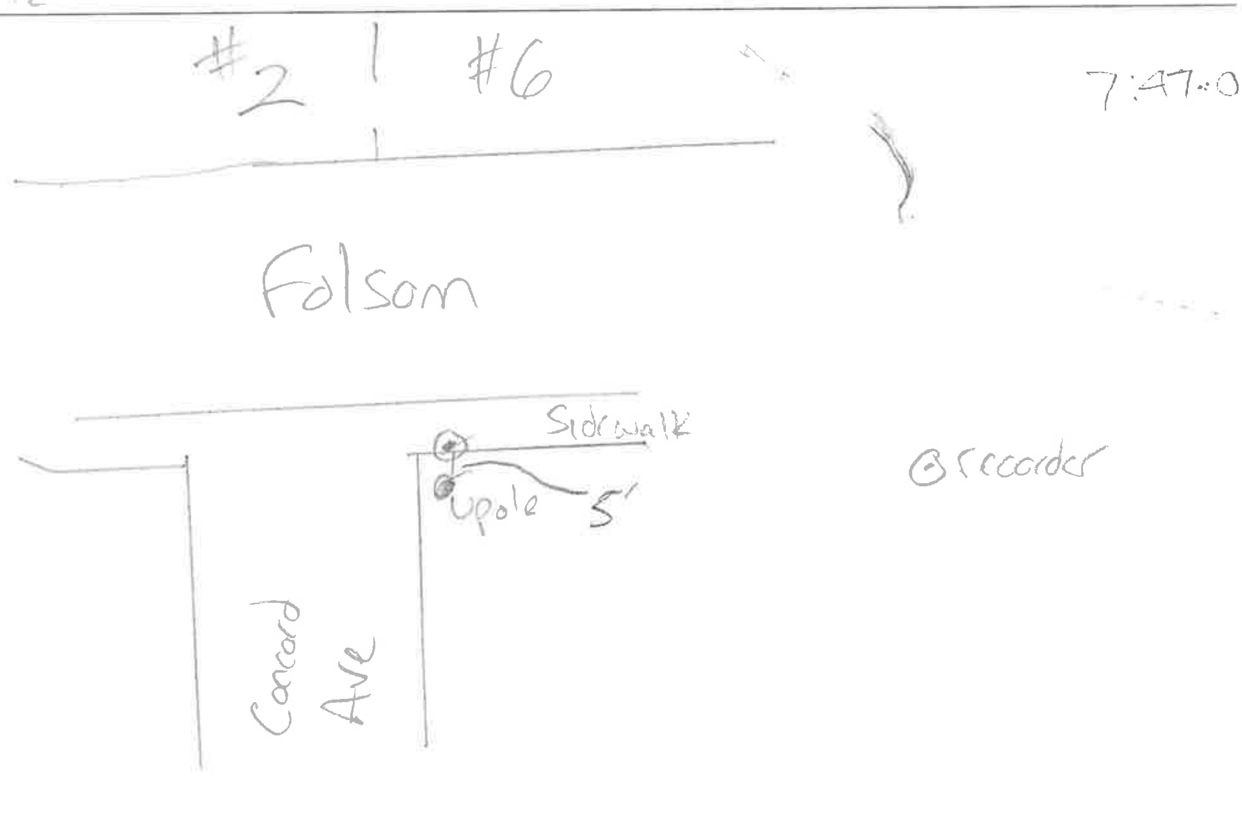
Time Periods		Date	Starting Time	Duration	PARAMETERS (dBA) Leq	L10	L50	L90	MaxL	MinL	Rec #
AM Peak	7:15 Am - 8:15 AM	9/20/16	7:43am	20min	74.2	77.5	71.6	63.3	88.2	52.6	0003
PM Peak	4:30 PM - 5:30 PM	9/20/16	5:03pm	20min	74.4	77.8	72.7	65.0	85.3	53.4	0004
Photo					Diagram			Meter			

Note Ambient and Unusual Noises (e.g. helicopter, airplane, ambulance, motorcycle, police, ambulance, fire truck, garbage truck, people yelling/shouting, barking dog, etc.)

Morning Traffic	West	East
Motorcycle	1	Ø
Passenger car	131	102
Pick up	29	20
Med truck 4 axle	4	4
Tractor Trailer 6 axle	Ø	1

AM Peak: No unusual noises to report

*See back of sheet for pm traffic count



PM Traffic - D 9/20/16 SITE

	East	West
motorcycle	1	3
passenger cars	174	131
pickup	65	45
Med truck	8	Ø
Large	Ø	Ø

SHORT TERM NOISE MEASUREMENT RESULTS (20 MINUTES)

Stare pt 1000

SITE **D** Address 4 Folsom Rd

Time Periods		Date	Starting Time	Duration	PARAMETERS (dBA)						Rec #
					Leq	L10	L50	L90	MaxL	MinL	
AM Peak	7:15 Am - 8:15 AM	9/21/16	7:36am	20min	73.5	77.1	70.3	61.5	89.6	51.7	0007
PM Peak	4:30 PM - 5:30 PM	9/21/16	4:30pm	20min	75.2	78.4	73.1	64.9	88.3	57.3	0010
Photo					Diagram			Meter			

Note Ambient and Unusual Noises (e.g. helicopter, airplane, ambulance, motorcycle, police, ambulance, fire truck, garbage truck, people yelling/shouting, barking dog, etc.)

Traffic count

	AM	PM	
	~~E W~~ Totals	E	W
Motorcyle	2	4	Ø
passenger	207	185	125
		33	22
pickup	49	1	6
Med truck	7	1	Ø
tractor trailer	Ø	Ø	Ø
Bus	1		

Noise Monitoring Fieldwork - Site Diagram
The Louis Berger Group, Inc.

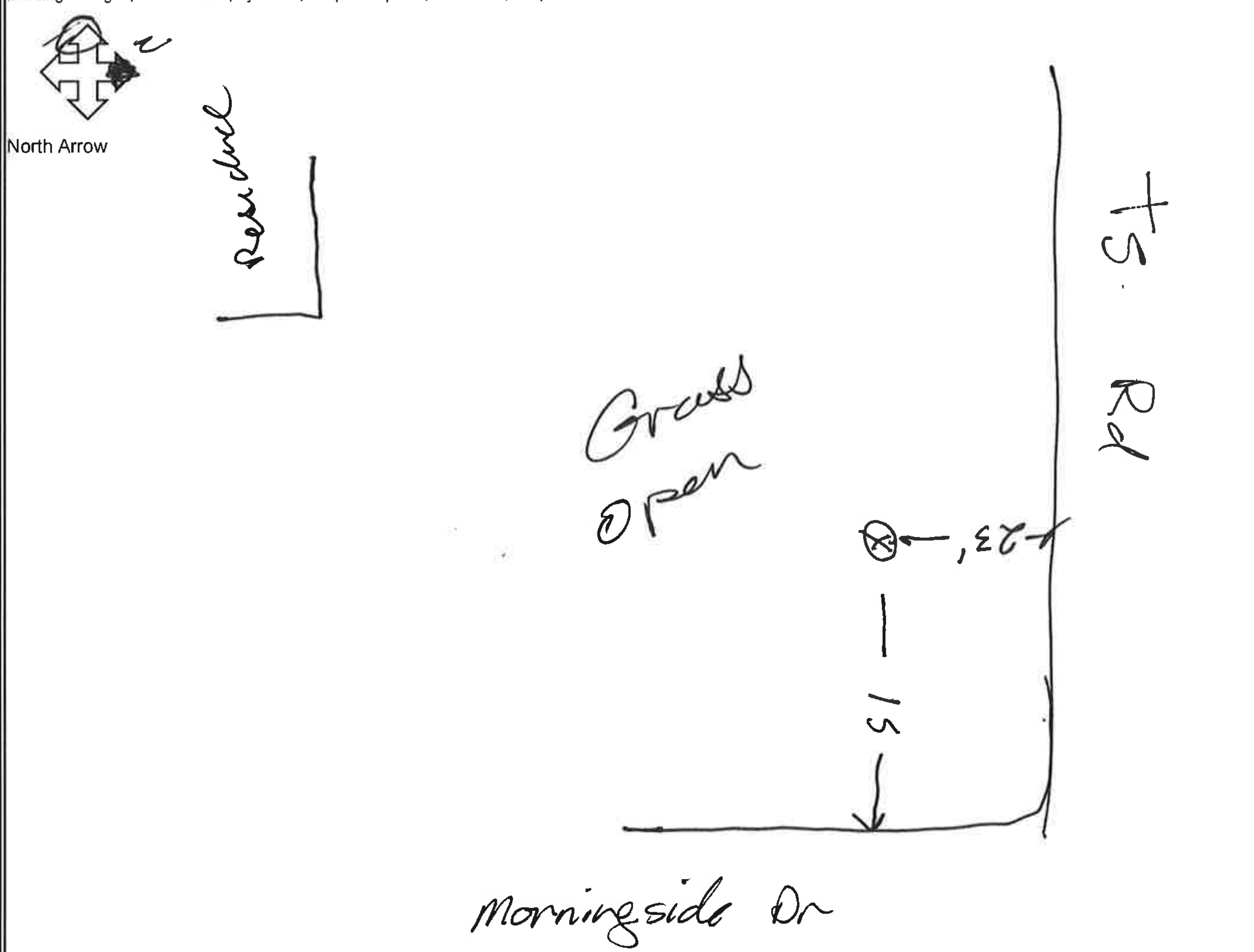
Receptor / Site #	Date	Site Address / Location	Observer
Site F		71 Tsienneto Rd	DP

Lane / Traffic Direction	Receptor / Site Surface (Grass, Lawn, Sidewalk, etc.)	Nearby Landmark
	Grass	Rd

Grade (At, Level, Below, Slope)	Roadway Pavement Type (Dirt Road, Asphalt, Concrete, Wet, etc.)	Distance to Landmark

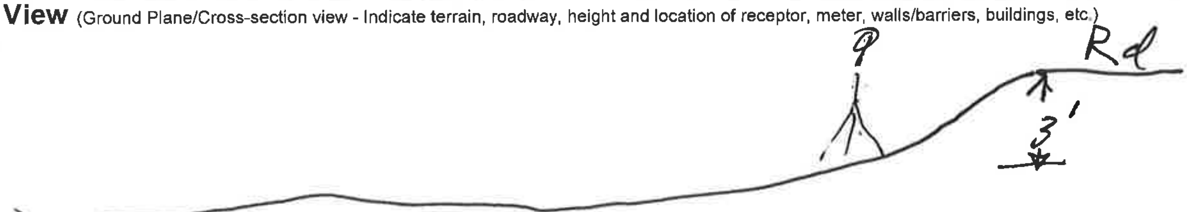
Meterological Condition (Clear, Sunny, Overcast, etc.)	Temperature (degrees)	Wind Condition/Speed (Mild, Breezy, Gusty, etc.)	Equipment Check List	Noise Meter Model
			Noise Meter, Calibrator, Windscreen, Tripod	

Plan View (Bird's Eye View - Indicate: site -location, meter- location, distance (ft) to landmarks, roadway & travel lane direction, geographical objects - trees, water, buildings & signs, store names, hydrants, telephone poles, manholes, etc.)



Elevation View (Ground Plane/Cross-section view - Indicate terrain, roadway, height and location of receptor, meter, walls/barriers, buildings, etc.)

** Not to scale!*



SHORT TERM NOISE MEASUREMENT RESULTS (20 MINUTES)

SITE E

Address 71 Tsienneto Rd

	Time Periods	Date	Starting Time	Duration	PARAMETERS (dBA) Leq	L10	L50	L90	MaxL	MinL	Rec #
AM Peak	7:15 Am - 8:15 AM	9/21	7:33	20	65.1	68.3	60.7	48.8	82.3	40.8	35
PM Peak	4:30 PM - 5:30 PM	9/21	4:30	20	63.5	67.6	59.9	46.2	79.1	39.4	36
Photo					Diagram			Meter			

Note Ambient and Unusual Noises (e.g. helicopter, airplane, ambulance, motorcycle, police, ambulance, fire truck, garbage truck, people yelling/shouting, barking dog, etc.)

		m	Car	PU	MT	HT	B
Calm Clear							
	AM (EB WB)	1	147	31	5	0	3
Calm Clear	PM EB	1	95	31	0	0	0
	WB	3	57	18	1	0	0

SHORT TERM NOISE MEASUREMENT RESULTS (20 MINUTES)

Store pt 1000

SITE **E** Address 71 Tsienneto Rd

Time Periods		Date	Starting Time	Duration	PARAMETERS (dBA) Leq	L10	L50	L90	MaxL	MinL	Rec #
AM Peak	7:15 Am - 8:15 AM	9/22/16	7:16am	20min	63.9	67.5	58.2	48.0	82.8	44.3	0016
PM Peak	4:30 PM - 5:30 PM	9/22/16	4:30pm	20min	64.1	68.1	60.1	48.2	78.4	44.4	0017
Photo					Diagram			Meter			

Note Ambient and Unusual Noises (e.g. helicopter, airplane, ambulance, motorcycle, police, ambulance, fire truck, garbage truck, people yelling/shouting, barking dog, etc.)

	AM E	AM W	PM E	PM W
motorcycle	1	2	1	Ø
passenger Car	28	87	107	86
pickup	12	37	17	16
med truck	1	2	3	3
Heavy truck	Ø	Ø	1	Ø
Bus	Ø	Ø	Ø	Ø

MONITORING LOCATIONS – TRAFFIC CLASSIFICATION DATA

Tue. 20 Sep. AM

Site/Record	A/30		B/01		C/38		D/03	
Time	7:00 - 7:20		7:00 - 7:20		7:40 - 8:00		7:40 - 8:00	
Direction/Road	NB I-93	SB I-93	NB I-93	SB I-93	NB I-93	SB I-93	WB Fol. Rd	EB Fol. Rd
Motorcycles	2	2	2	2	7	9	1	0
Cars	774	794	774	794	890	854	131	102
Pick-Up	164	209	164	209	174	196	29	20
Med. Truck	28	32	28	32	34	45	4	4
Heavy Trk.	44	41	44	41	42	26	0	1
Bus	0	1	0	1	2	2	0	0

Tue. 20 Sep. PM

Site/Record	A/33		B/05		C/32		D/04	
Time	17:30 - 17:50		17:30 - 17:50		16:30 - 16: 50		7:40 - 8:00	
Direction/Road	NB I-93	SB I-93	NB I-93	SB I-93	NB I-93	SB I-93	WB Fol. Rd	EB Fol. Rd
Motorcycles	2	13	3	13	4	6	3	1
Cars	870	791	870	791	921	936	131	174
Pick-Up	163	112	163	112	220	153	45	65
Med. Truck	13	12	13	12	23	22	0	8
Heavy Trk.	19	10	19	10	18	10	0	0
Bus	4	4	4	4	4	2	0	0

Wed. 21 Sep. AM

Site/Record	A/34		B/06		D/07		E/35	
Time	7:00 - 7:20		7:00 - 7:20		7:30 - 7:50		7:30 - 7:50	
Direction/Road	NB I-93	SB I-93	NB I-93	SB I-93	WB Fol. Rd	EB Fol. Rd	WB Tsi Rd	EB Tsi Rd
Motorcycles	1	6	1	6		2		1
Cars	728	844	728	844		207		147
Pick-Up	141	176	141	176		49		31
Med. Truck	38	30	38	30		7		5
Heavy Trk.	36	31	36	31		0		0
Bus	0	1	0	1		1		3

Wed. 21 Sep. PM

Site/Record	A/37		B/15		D/10		E/36	
Time	17:00 - 17:20		17:00 - 17:20		16:30 - 16:50		16:30 - 16:50	
Direction/Road	NB I-93	SB I-93	NB I-93	SB I-93	WB Fol. Rd	EB Fol. Rd	WB Tsi Rd	EB Tsi Rd
Motorcycles	8	5	8	5	4	0	1	3
Cars	969	880	969	880	185	125	147	57
Pick-Up	164	157	164	157	33	22	31	18
Med. Truck	21	20	21	20	1	6	5	1
Heavy Trk.	15	22	15	22	1	0	0	0
Bus	2	3	2	3	0	0	3	0

Thu. 22 Sep. AM

Site/Record	C/38		E/16	
Time	7:15 - 7:35		7:15 - 7:35	
Direction/Road	NB I-93	SB I-93	WB Tsi Rd	EB Tsi Rd
Motorcycles	7	9	2	1
Cars	890	854	87	28
Pick-Up	174	196	73	12
Med. Truck	34	45	2	1
Heavy Trk.	42	26	0	0
Bus	2	2	0	0

Thu. 22 Sep. PM

Site/Record	C/39		E/17	
Time	16:30 - 16:50		16:30 - 16:50	
Direction/Road	NB I-93	SB I-93	WB Tsi Rd	EB Tsi Rd
Motorcycles	5	9	0	1
Cars	887	778	86	107
Pick-Up	223	139	16	17
Med. Truck	21	35	3	3
Heavy Trk.	13	21	0	1
Bus	2	4	0	0

MONITORING LOCATIONS – PHOTOGRAPHS

Location A: 24 Trolley Car Lane, Looking East

Location A: 24 Trolley Car Lane, Looking North

Location B: 52 Trolley Car Lane, Looking Southeast

Location B: 52 Trolley Car Lane, Looking North

Location C: 60 Seasons Lane, Looking South

Location C: 60 Seasons Lane, Looking Northeast

Location D:6 Folsom Road, Looking East

Location D:6 Folsom Road, Looking Southwest

Location E: 71 Tsienneto Road, Looking North

Location E: 71 Tsienneto Road, Looking West

Calibration Certificates

Scantek, Inc.
CALIBRATION LABORATORY

ISO 17025: 2005, ANSI/NCSL Z540:1994 Part 1
ACCREDITED by NVLAP (an ILAC MRA signatory)

NVLAP®

NVLAP Lab Code: 200625-0

Calibration Certificate No.36572

Instrument:	**Sound Level Meter**	*Date Calibrated:* **7/7/2016**	*Cal Due:* **7/7/2017**
Model:	**NL42**		
Manufacturer:	**Rion**		
Serial number:	**00133002**		
Tested with:	**Microphone UC52 s/n 144581** **Preamplifier NH24 s/n 23049**		
Type (class):	**2**		
Customer:	**Scantek, Inc.**		
Tel/Fax:	**410-290-7726 / -9167**		

Status:	**Received**	**Sent**
In tolerance:	X	X
Out of tolerance:		
See comments:		

Contains non-accredited tests: __Yes _X_ No
Calibration service: __ Basic _X_ Standard
Address: **6430 Dobbin Road, Suite C**
Columbia, MD 21045

Tested in accordance with the following procedures and standards:
Calibration of Sound Level Meters, Scantek Inc., Rev. 6/26/2015
SLM & Dosimeters – Acoustical Tests, Scantek Inc., Rev. 7/6/2011

Instrumentation used for calibration: Nor-1504 Norsonic Test System:

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence Cal. Lab / Accreditation	Cal. Due
483B-Norsonic	SME Cal Unit	25747	Jul 6, 2016	Scantek, Inc./ NVLAP	Jul 6, 2017
DS-360-SRS	Function Generator	61646	Aug 12, 2015	ACR Env./ A2LA	Aug 12, 2017
34401A-Agilent Technologies	Digital Voltmeter	MY41022043	Aug 13, 2015	ACR Env. / A2LA	Aug 13, 2016
DPI 141-Druck	Pressure Indicator	790/00-04	Nov 18, 2014	ACR Env./ A2LA	Nov 18, 2016
HMP233-Vaisala Oyj	Humidity & Temp. Transmitter	V3820001	Oct 1, 2015	ACR Env./ A2LA	Apr 1, 2017
PC Program 1019 Norsonic	Calibration software	v.6.1T	Validated Nov 2014	Scantek, Inc.	-
1251-Norsonic	Calibrator	30878	Nov 10, 2015	Scantek, Inc./ NVLAP	Nov 10, 2016
4226-Brüel&Kjær	Multifunction calibrator	2305103	Jul 24, 2015	Scantek, Inc./ NVLAP	Jul 24, 2016

Instrumentation and test results are traceable to SI (International System of Units) through standards maintained by NIST (USA) and NPL (UK).

Environmental conditions:

Temperature (°C)	Barometric pressure (kPa)	Relative Humidity (%)
22.6	99.65	44.0

Calibrated by:	Jeremy Gotwalt	**Authorized signatory:**	Valentin Buzduga
Signature		Signature	
Date	7/7/16	Date	7/07/2016

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Scantek, Inc.
CALIBRATION LABORATORY

ISO 17025: 2005, ANSI/NCSL Z540:1994 Part 1
ACCREDITED by NVLAP (an ILAC MRA signatory)

NVLAP®

NVLAP Lab Code: 200625-0

Calibration Certificate No.35807

Instrument:	**Acoustical Calibrator**	*Date Calibrated:* **3/16/2016** *Cal Due:* **3/16/2017**			
Model:	**1251**	*Status:*	**Received**	**Sent**	
Manufacturer:	**Norsonic**	*In tolerance:*	X	X	
Serial number:	**22770**	*Out of tolerance:*			
Class (IEC 60942):	**1**	*See comments:*			
Barometer type:		*Contains non-accredited tests:* __**Yes** _X_ **No**			
Barometer s/n:					

Customer:	**Scantek, Inc.**	*Address:*	**6430 Dobbin Rd., Suite C,**
Tel/Fax:	**410-290-7726 / 410-290-9167**		**Columbia MD, 21045**

Tested in accordance with the following procedures and standards:
Calibration of Acoustical Calibrators, Scantek Inc., Rev. 1/16/2015

Instrumentation used for calibration: Nor-1504 Norsonic Test System:

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence Cal. Lab / Accreditation	Cal. Due
483B-Norsonic	SME Cal Unit	31061	Jul 20, 2015	Scantek, Inc./ NVLAP	Jul 20, 2016
DS-360-SRS	Function Generator	88077	Sep 9, 2014	ACR Env./ A2LA	Sep 9, 2016
34401A-Agilent Technologies	Digital Voltmeter	MY47011118	Sep 24, 2015	ACR Env./ A2LA	Sep 24, 2016
HM30-Thommen	Meteo Station	1040170/39633	Oct 23, 2015	ACR Env./ A2LA	Oct 23, 2016
140 Norsonic	Real Time Analyzer	1403978	Mar 19, 2015	Scantek, Inc. / NVLAP	Mar 19, 2016
PC Program 1018 Norsonic	Calibration software	v.6.1T	Validated Nov 2014	Scantek, Inc.	-
4192-Brüel&Kjær	Microphone	2854675	Nov 11, 2015	Scantek, Inc. / NVLAP	Nov 11, 2016
1203-Norsonic	Preamplifier	92268	Oct 14, 2015	Scantek, Inc./ NVLAP	Oct 14, 2016

Instrumentation and test results are traceable to SI (International System of Units) through standards maintained by NIST (USA) and NPL (UK)

Calibrated by:	Jeremy Gotwalt	Authorized signatory:	Valentin Buzduga
Signature		Signature	
Date	3/16/16	Date	3/16/2016

Document stored as: Z:\Calibration Lab\Cal 2016\NOR1251_22770_M1.doc

Scantek, Inc.
CALIBRATION LABORATORY

ISO 17025: 2005, ANSI/NCSL Z540:1994 Part 1
ACCREDITED by NVLAP (an ILAC MRA signatory)

NVLAP®

NVLAP Lab Code: 200625-0

Calibration Certificate No.36955

Instrument:	**Sound Level Meter**	*Date Calibrated:* **9/8/2016**	*Cal Due:* **9/8/2017**
Model:	**NL42**	*Status:*	**Received** / **Sent**
Manufacturer:	**Rion**	*In tolerance:*	X / X
Serial number:	**00321503**	*Out of tolerance:*	
Tested with:	**Microphone UC52 s/n 139853** **Preamplifier NH24 s/n 11523**	*See comments:*	
		Contains non-accredited tests:	__ Yes X No
Type (class):	**2**	*Calibration service:*	__ Basic X Standard
Customer:	**Scantek, Inc.**	*Address:*	**6430 Dobbin Road, Suite C** **Columbia, MD 21045**
Tel/Fax:	**410-290-7726 / 410-290-9167**		

Tested in accordance with the following procedures and standards:
Calibration of Sound Level Meters, Scantek Inc., Rev. 6/22/2012
SLM & Dosimeters – Acoustical Tests, Scantek Inc., Rev. 7/6/2011

Instrumentation used for calibration: Nor-1504 Norsonic Test System:

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence Cal. Lab / Accreditation	Cal. Due
483B-Norsonic	SME Cal Unit	31061	Jul 27, 2016	Scantek, Inc./ NVLAP	Jul 27, 2017
DS-360-SRS	Function Generator	88077	Sep 9, 2014	ACR Env./ A2LA	Sep 9, 2016
34401A-Agilent Technologies	Digital Voltmeter	MY47011118	Sep 24, 2015	ACR Env./ A2LA	Sep 24, 2016
HM30-Thommen	Meteo Station	1040170/39633	Oct 23, 2015	ACR Env./ A2LA	Oct 23, 2016
PC Program 1019 Norsonic	Calibration software	v.6.1T	Validated Nov 2014	Scantek, Inc.	-
1251-Norsonic	Calibrator	30878	Nov 10, 2015	Scantek, Inc./ NVLAP	Nov 10, 2016
4226-Brüel&Kjær	Multifunction calibrator	2305103	Jul 25, 2016	Scantek, Inc./ NVLAP	Jul 25, 2017

Instrumentation and test results are traceable to SI (International System of Units) through standards maintained by NIST (USA) and NPL (UK).

Environmental conditions:

Temperature (°C)	Barometric pressure (kPa)	Relative Humidity (%)
22.0	99.95	58.8

Calibrated by:	Jeremy Gotwalt	**Authorized signatory:**	Valentin Buzduga
Signature		Signature	
Date	9/8/16	Date	9/09/2016

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Appendix F: NHDOT Environmental Justice Analysis

STATE OF NEW HAMPSHIRE
DEPARTMENT OF TRANSPORTATION
INTER-OFFICE COMMUNICATION

DATE: June 4, 2018

JA **FROM:** Jay Ankenbrock, Chief of Labor Compliance

TO: John Butler, Geometrics Engineer, Highway Design

RE: Environmental Justice Population Analysis, Project: **Derry - Londonderry 13065**

The attached analysis and recommendations are provided pursuant to Title VI of the Civil Rights Act of 1964 and Executive Orders 12898 & 13166. The intent of these statutes is to ensure fair and full participation and the equal receipt of benefits under Federally-assisted programs. Your efforts to accommodate and encourage participation by traditionally underserved groups, where significant, will ensure program access and minimize the potential for disproportionate project impacts on protected groups.

The table entitled "EJ Population Analysis" shows the presence of protected groups that might be impacted by the project. Personnel responsible for project planning/design and the coordination of public meetings/hearings should use this analysis to guide their outreach efforts under Title VI and in support of developing a context sensitive solution. Based on the availability of information and where appropriate, we have included specific outreach recommendations to facilitate public comment from underrepresented groups.

Please note that US Census Bureau, American Community Survey (ACS) 2011-2015 data is used to provide to an EJ Population analysis for the project. If you have questions regarding this analysis, please contact me at 271-2467.

Encls: EJ Population Analysis, Derry - Londonderry 13065

cc: Keith Cota, Bureau of Highway Design
Michael O'Donnell, Bureau of Traffic
Kevin Nyhan, Administrator, Bureau of Environment
Paul Coddington, Bureau of Right-of-Way

EJ Population Analysis for Derry - Londonderry 13065

STUDY AREA	AVG% Elderly Population	AVG % Minority Population	AVG % Low-income Household Population**	AVG% LEP
Impacted Area – Rockingham County, 1 mile radius of project area.	**13.5%***	3.9%	**21.6%***	0.63%
Surrounding Area – Rockingham County, 3 mile radius of project area.	**10.9%***	4.43%	9.4%	0.63%

REMARKS:

* The population percentage identified is meaningfully greater than the surrounding area and constitutes an EJ population. Characteristics of this particular study area indicate that targeted outreach efforts to solicit public participation should be taken.

** Low-income population for this analysis is defined as household income of less than $25,000.

LEP Definition: Where there is a population of people who speak English as a second language less than well (as indicated by the U.S. Census data). When a particular LEP language group constitutes 5% of the impacted population, the Department is required to translate public information meeting notices and take appropriate measures to ensure language access. If this requirement exists, the Project Manager should contact the Title VI Coordinator for further assistance.

Impacted Area: The impacted area was defined by the project limits and a 1 mile radius the immediate vicinity.

Surrounding Area: The surrounding area was defined by a 3 mile radius (excluding the impact area) of the project area

Special Considerations: Special consideration should be given to any project features that affect pedestrian accessibility. This project constitutes an alteration in accordance with Title II of the Americans with Disabilities Act. As such, minimum ADAAG accessibility requirements apply, unless deemed technically infeasible.

ADAAG was adopted as the 2010 Standards for Accessible Design on July 23, 2010 by the DOJ. Additional information is located at http://www.ada.gov/reg3a.html#Anchor-Appendix-52467

For more information, I have also provided a link to the Draft Public Rights-of-Way Guidelines:

http://www.access-board.gov/guidelines-and-standards/streets-sidewalks/public-rights-of-way/background/revised-draft-guidelines

The Draft PROWAG (Revised Draft Guidelines for Accessible Public Rights-of-Way) was released in November 2005 and has not been adopted by DOJ or FHWA. In 2006, FHWA issued a statement that the Draft PROWAG is to be considered best practice for making public rights-of-way accessible.

The Draft PROWAG includes specifications for detectable warnings and gives detailed information regarding their installation on curb ramps and on blended curbs, including at street corners, at cut-through islands and medians, and in front of buildings. It also has sections on accessible pedestrian signals (APS), roundabouts, channelized turn lanes, protruding objects, channelizing devices and barriers, and tactile and print signs.

Outreach Recommendations: In consideration of the populations above, we are providing contact information for all known agencies the project area. The Study area shows high rates for Low-Income and Elderly populations. These contacts should be included in your notification list for public information meetings and hearings related to this project

Resident/Agency Address	Organization/Housing Type	Contact Information
Beaver Lake Lodge 38 North Shore Road Derry, NH 03038	Seniors	Karen Massahos, Owner (603)434-5683 Cell: 479-4742
Holiday Retirement at Birch Heights 7 Kendall Pond Road Derry NH 03038	Seniors	Renee McCallister (603)425-7755
Derry Healthcare & Rehabilitation 20 Chester Road Derry, NH 03038	Seniors	(603)432-3801
Tender Care Homes Nursing Service 4 Birch Street Derry, NH 03038	Seniors	(603)434-2535
Greater Derry Londonderry Chamber of Commerce 29 West Broadway Derry, NH 03038	Community (Business)	Ashley Haseltine, President (603)432-8205

Derry Public Library 64 East Broadway Derry, NH 03038-6410	Community	Susan Brown (603)432-6140
Derry Community Television 14 Manning St Derry, NH 03038	Community Television	Owen Provencher (603)845-5514
Derry Parks & Recreation Veterans Hall 31 West Broadway Derry, NH 03038	Community	Eric Bodenrader (603)432-6136
Town of Derry Municipal Center 14 Manning St Derry, NH 03038	Municipal	David Caron, Town Admin. (603)432-6100
Derry USPS Post Office 24 Tsienneto Road Derry, NH 03038	Federal Government	(603)432-7835
Town of Londonderry 268-B Mammoth Road Londonderry, NH 03053	Municipal	Kevin Smith, Town Manager (603)432-1100 x120
Leach Library 276 Mammoth Road Londonderry, NH 03053	Community	Barbara Ostertag-Holtkamp (603)432-1132
Londonderry Senior Affairs 535 Mammoth Road Londonderry, NH 03053	Seniors	Catherine Blash, Director (603)432-8554
Londonderry Access Center 281 Mammoth Road Londonderry, NH 03053	Community Television	Drew Caron (603)432-1147 x179
Londonderry USPS Post Office 86 Nashua Road Londonderry, NH 03053	Federal Government	(603)432-7194

Appendix G: Known and Potential Petroleum and Hazardous Materials Sites

The following databases were researched as part of this report and were noted to have documented sites within the Project area. Potential petroleum and hazardous materials sites are listed in the table following the database descriptions.

ALLSITES: Provides information on sites in NH, with activities that either have resulted in groundwater contamination or pose a potential hazard to groundwater supplies. The regulated activities and groundwater hazards include: confirmed releases of oil or hazardous materials to the soil and/or groundwater as a result of discharges, spills, and removal of underground storage tanks; underground injection wells such as floor drains, leaching galleries, and septic systems anything other than domestic wastewater; large discharges of wastewater such as domestic wastewater septic systems which are designed to discharge more than 20,000 gallons per day (gpd), land application of wastewater treatment facility effluent (spray irrigation, rapid infiltration rapid infiltration basins, etc.) and unlined septage and wastewater lagoons; unpermitted hazardous waste storage facilities; landfills and other waste repositories in which groundwater quality is at risk.

AST Database: This database contains registered ASTs. The data came from the NHDES AST Registration Data List.

CERCLIS: Comprehensive Environmental Response, Compensation, and Liability Information System. This database contains information on potentially hazardous material sites that have been reported to EPA by states, municipalities, private companies, and persons, pursuant to Section 103 of CERCLA. CERCLIS contains sites, which are either on, or proposed to be on, the NPL, and sites that are in the screening and assessment phase for possible inclusion on the NPL.

CONSENT: Major legal settlements that establish responsibility and standards for cleanup at NPL (Superfund) sites. Released periodically by U.S. District Courts after settlement by parties to litigation.

ERNS: The Emergency Response Notification System. This system records and stores information on reported releases of oil and hazardous substances. The source of this database is EPA.

ECHO: Enforcement & Compliance History Information database. EPA's ECHO provides integrated compliance and enforcement information for about 800,000 regulated facilities nationwide.

FINDS: Facility Index System/Facility Registry System. This database is maintained by EPA and contains both facility information and "pointers" to other sources of information that contain more detail. Databases under FINDS include PCS (Permit Compliance System), AIRS (Aerometric Information Retrieval System), DOCKET (Enforcement Docket used to manage and track information on civil judicial enforcement cases for all environmental statutes), FURS (Federal Underground Injection Control), C-DOCKET (Criminal Docket System used to track criminal enforcement actions for all environmental statutes), FFIS (Federal Facilities Information System), STATE (State Environmental Laws and Statutes), and PADS (PCB Activity Data System).

FTTS: FIFRA/ TSCA Tracking System. FIFRA (Federal Insecticide, Fungicide, & Rodenticide Act)/TSCA (Toxic Substances Control Act). FTTS tracks administrative cases and pesticide enforcement actions and compliance activities related to FIFRA, TSCA and EPCRA (Emergency Planning and Community Right-to-Know Act).

HIST FTTS: FIFRA/TSCA Tracking System Administrative Case Listing. A complete administrative case listing from the FIFRA/TSCA Tracking System (FTTS) for all 10 EPA regions. The information was obtained from the National Compliance Database (NCDB). NCDB supports the implementation of FIFRA and TSCA. Some EPA regions are now closing out records. Because of that, and the fact that some EPA regions are not providing EPA Headquarters with updated records, it was decided to create a HIST FTTS database. It included records that may not be included in the newer FTTS database updates. This database is no longer updated.

LUST Database: This incident report contains an inventory of reported LUST incidents. The data came from the NHDES LUST Sites Summary Report.

MANIFEST is a document that lists and tracks hazardous waste from the generator through transporters to a Treatment, Storage and Disposal (TSD) facility. States maintain databases of manifested hazardous waste.

NH BROWNFIELDS: Sites that have benefited from one or more brownfields initiative.

NH DRYCLEANERS: A listing of drycleaner locations in NH.

NPL: Also known as Superfund, this database is a subset of the CERCLIS and identifies over 1,200 sites for priority cleanup under the Superfund program. The source of this database is EPA.

RCRA-CESQG: RCRAInfo is EPA's comprehensive information system, providing access to data supporting RCRA of 1976 and the Hazardous and Solid Waste Amendments of 1984. The database includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by RCRA. Conditionally exempt small quantity generators generate less than 100 kg of hazardous waste, or less than 1 kg of acutely hazardous waste per month.

RCRA NonGen / NLR: is also from the RCRAInfo database. Non-Generators do not presently generate hazardous waste.

RCRIS: The Resource Conservation and Recovery Information System: This database includes selected information on sites that generate, store, treat, or dispose of hazardous material as defined by RCRA. The source of this database is EPA.

ROD: Record of Decision: These documents mandate a permanent remedy at an NPL (Superfund) site, and contain technical and health information to aid the cleanup.

SEMS-ARCHIVE: Superfund Enterprise Management System Archive. This database tracks sites that have no further interest under the federal Superfund Program based on available information. The list was formerly known as the CERCLIS-NFRAP, renamed to SEMS ARCHIVE by the EPA in 2015. EPA may perform a minimal level of assessment work at a site while it is archived if site conditions change and/or new information becomes available. Archived sites have been removed and archived from the inventory of SEMS sites. Archived status indicates that, to the best of EPA's knowledge, assessment at a site has been completed and that EPA has determined no further steps will be taken to list the site on the NPL, unless information indicates this decision was not appropriate or other considerations require a recommendation for listing at a later time. The decision does not necessarily mean that there is no hazard associated with a given site; it only means that based upon available information, the location is not judged to be potential NPL site.

SHWS: State Hazardous Wastes Sites. These records are the states' equivalent to CERCLIS. These sites may or may not already be listed on the federal CERCLIS list. Priority sites planned for cleanup using State funds (i.e., state equivalent of Superfund) are identified along with sites where cleanup will be paid for by potentially responsible parties. The data came from the NHDES Hazardous Material Inventory List.

SPILLS: This contains the state spills database and denotes an oil spill or release record from the NHDES Hazardous Waste Remediation Site database.

SWF/LF: Solid Waste Facility Information. Solid Waste Facilities/Landfill Sites. SWF/LF type records contain an inventory of solid waste disposal facilities or landfills in NH, maintained by NHDES.

SWRCY: Recycling Centers. A listing of recycling center locations in NH maintained by NHDES.

US BROWNFIELDS: EPA's listing of Brownfields properties from the Cleanups in My Community program, which provides information on Brownfields properties for which information is reported back to EPA, as well as areas served by Brownfields grant programs.

US ENG CONTROLS: Engineering Controls Sites List. A listing of sites maintained by EPA with engineering controls in place. Engineering controls include various forms of caps, building foundations, liners, and treatment methods to create pathway elimination for regulated substances to enter environmental media or effect human health.

US INST CONTROL: Sites with Institutional Controls. A listing of sites maintained by EPA with institutional controls in place. Institutional controls include administrative measures, such as groundwater use restrictions, construction restrictions, property use restrictions, and post remediation care requirements intended to prevent exposure to contaminants remaining on site. Deed restrictions are generally required as part of the institutional controls.

US MINES: Mines Master Index File. Contains all mine identification numbers issued for mines active or opened since 1971. The data also include violation information. Maintained by the Department of Labor.

UST Database: This database contains registered USTs, which are regulated under Subtitle I of RCRA. The source of the data is the NHDES UST Registration Data List.

KNOWN PETROLEUM AND HAZARDOUS MATERIALS SITES WITHIN 1,000 FEET OF THE PROPOSED ALIGNMENTS

Site #	Site Activity	Site Address	Database Source	Existing or New
DERRY				
1	RESIDENCE	OLD COACH ROAD	SHWS	NEW
2	A STREET	A STREET	ALLSITES, SHWS, UST	EXISTING
3	CRYSTAL AVENUE PROPERTY	CRYSTAL AVENUE	ALLSITES	EXISTING
4	REAL ESTATE PROPERTY	WEST BROADWAY	RCRA NonGen / NLR, UST	EXISTING
5	DEPARTMENT STORE	ROUTE 28	ALLSITES, UST	EXISTING
6	RESIDENCE	WEST BROADWAY	ALLSITES	EXISTING
7	CONVENIENCE STORE	EAST BROADWAY	LUST, UST	EXISTING
8	AUTO REPAIR	WEST BROADWAY	RCRA NonGen / NLR, ALLSITES, LUST	EXISTING
9	GAS STATION/CONVENIENCE STORE	ROUTE 28 BYPASS	ALLSITES, UST	EXISTING
10	TOWN OF DERRY	WEST BROADWAY	ECHO, FINDS, US BROWNFIELDS, ALLSITES, NH BROWNFIELDS	NEW
11	FIRE DEPARTMENT	MANNING STREET	ALLSITES	EXISTING
12	FIRE DEPARTMENT	EAST BROADWAY	LUST, UST	EXISTING
13	TOWN OF DERRY	EAST BROADWAY	ALLSITES, UST	EXISTING
14	SPILL	BROADWAY & RAILROAD AVENUE	ALLSITES	EXISTING
15	SALON	WEST BROADWAY	ALLSITES	EXISTING
16	SERVICE STATION	CRYSTAL AVENUE	RCRA NonGen / NLR, LUST, UST	EXISTING
17	REAL ESTATE PROPERTY	GRIFFIN STREET	ALLSITES	EXISTING
18	MANUFACTURING FACILITY	MANCHESTER ROAD	ALLSITES, ECHO, MANIFEST, RCRA-CESQG, TRIS, UST	EXISTING
19	FORMER SERVICE STATION	BIRCH & E BROADWAY STREET	LUST, UST	EXISTING
20	COMMERCIAL BUSINESS	MANCHESTER ROAD	LUST, UST, MANIFEST, RCRA NonGen / NLR	EXISTING

Site #	Site Activity	Site Address	Database Source	Existing or New
21	SERVICE STATION	ASHLEIGH DRIVE	ALLSITES, LUST, UST	EXISTING
22	APARTMENT COMPLEX	LARAWAY COURT	RCRA NonGen / NLR, ALLSITES	EXISTING
23	RESIDENCE	WEST BROADWAY	ALLSITES	EXISTING
24	FORMER OIL SITE	CRYSTAL AVENUE	LUST, UST	EXISTING
25	COMMERCIAL PROPERTY	EAST BROADWAY	ALLSITES, LUST, UST	EXISTING
26	MANUFACTURING FACILITY	MANCHESTER ROAD	ALLSITES, SHWS	EXISTING
27	SHOPPING CENTER	ROUTE 28/CRYSTAL AVENUE	LUST, UST	EXISTING
28	RESIDENCE	CHESTER ROAD	ALLSITES	NEW
29	MARKET	MANCHESTER ROAD	LUST, UST	EXISTING
30	EXCAVATION COMPANY	MADDEN ROAD	ALLSITES, US MINES	EXISTING
31	SERVICE STATION	SOUTH MAIN STREET	LUST, UST, ECHO, FINDS, RCRA NonGen / NLR	EXISTING
32	MEDICAL CENTER	TSIENNETO ROAD	ALLSITES	NEW
33	SCHOOL	PINKERTON STREET	ALLSITES, LUST	EXISTING
34	UTILITY COMPANY	CRYSTAL AVENUE	RCRA NonGen / NLR, ALLSITES, LUST, UST	EXISTING
35	MANUFACTURING FACILITY	MANCHESTER STREET	SWF/LF, SWRCY	NEW
36	RESIDENCE	EAST BROADWAY	ALLSITES	EXISTING
37	ROADSIDE	ENGLISH RANGE ROAD	ALLSITES	NEW
38	RESIDENCE	EVERETT STREET	ALLSITES	EXISTING
39	RESIDENCE	HIGH STREET	ALLSITES	EXISTING
40	DRY CLEANERS	RAILROAD AVENUE	BROWNFIELDS, DRYCLEANERS, SHWS, UST, LIENS 2, MANIFEST, PRP, RCRA NonGen / NLR, SEMS-ARCHIVE, US BROWNFIELDS, ECHO, FINDS	EXISTING
41	AUTO SALES	WEST BROADWAY	LUST, MANIFEST, RCRA NonGen / NLR, UST	EXISTING
42	RESIDENCE	WEST BROADWAY	ALLSITES	NEW

Site #	Site Activity	Site Address	Database Source	Existing or New
43	RESIDENCE	GROVE STREET	ALLSITES	EXISTING
44	COMMERCIAL BUSINESS	SOUTH AVENUE	RCRA NonGen / NLR, ALLSITES, SHWS, UST	EXISTING
45	PRINTING BUSINESS	TINKHAM AVENUE	ALLSITES, MANIFEST, RCRA-CESQG, SHWS, SPILLS	EXISTING
46	MACHINE SHOP	NUTFIELD COURT	LUST, UST	EXISTING
47	PRESSURE WASHING BUSINESS	NORTH HIGH STREET	ALLSITES	NEW
48	OIL FACILITY	CENTRAL COURT	ALLSITES, AST, LAST	EXISTING
49	RESIDENCE	GROVE STREET	ALLSITES	EXISTING
50	FUEL DISTRIBUTOR	SOUTH AVENUE	AST, LAST	EXISTING
51	OIL STORAGE PLANT	FRANKLIN STREET	ALLSITES, AST	EXISTING
52	OIL COMPANY	CRYSTAL AVENUE	UST, LUST	NEW
53	SCHOOL	GRINNEL ROAD	ALLSITES, UST	EXISTING
54	ACCIDENT	CHESTER ROAD	ALLSITES	EXISTING
55	COUNTERTOP STORE	ELM STREET	SEMS	NEW
56	OIL DELIVERY COMPANY	CENTRAL COURT	ALLSITES, AST, LUST, UST	EXISTING
57	MANUFACTURING FACILITY	LINLEW DRIVE	2020 COR ACTION, CORRACTS, ECHO, FINDS, MANIFEST, RCRA NonGen / NLR	NEW
58	COMMERCIAL PROPERTY	MAPLE STREET	ALLSITES	NEW
59	RESIDENCE	LENNOX ROAD	ALLSITES	EXISTING
LONDONDERRY				
60	RESIDENCE	TROLLEY CAR LANE	ALLSITES	EXISTING
61	TOWING COMPANY	ROCKINGHAM ROAD	ALLSITES	EXISTING
62	SERVICE STATION	NASHUA ROAD	LUST, UST	EXISTING
63	HYDRAULIC RELEASE	TROLLEY CAR LANE	ALLSITES	NEW
64	COMMERCIAL BUSINESS	LONDONDERRY ROAD	ALLSITES, RCRA NonGen / NLR	EXISTING
65	COMMERCIAL BUSINESS	LONDONDERRY ROAD	AST, ALLSITES	EXISTING

Site #	Site Activity	Site Address	Database Source	Existing or New
66	RESIDENCE	ROCKINGHAM ROAD	ALLSITES	NEW
67	SERVICE STATION	NASHUA ROAD	ALLSITES, LUST, UST	EXISTING
68	RESIDENCE	COTEVILLE ROAD	ALLSITES	EXISTING
69	ELECTRIC SUBSTATION	SEASONS LANE	ALLSITES	NEW
70	SERVICE STATION	NASHUA ROAD	ALLSITES, LUST, SPILLS, UST	EXISTING
71	METAL FINISHING BUSINESS	HILLSIDE AVENUE	AIRS, SWF/LF, RCRA NonGen / NLR	EXISTING
72	MTBE SITE	WOODHENGE CIRCLE	ALLSITES	EXISTING

Source: Environmental Data Resources, Inc. (2010, 2016)

POTENTIAL PETROLEUM AND HAZARDOUS MATERIAL SITES WITHIN 500 FEET OF THE PROPOSED ALIGNMENTS

Site #	Site Activity	Site Address	Database Source	Existing or New
		DERRY		
73	CONVENIENCE STORE	MANCHESTER ROAD	RCRA NonGen / NLR, UST	EXISTING
74	MANUFACTURING FACILITY	TINKHAM AVENUE	RCRA NonGen / NLR	NEW
75	COMMERCIAL PROPERTY	WEST BROADWAY	UST	EXISTING
76	AUTO SALES	MANCHESTER ROAD	RCRA NonGen / NLR, UST, MANIFEST	EXISTING
77	AUTO PARTS STORE	CRYSTAL AVENUE	RCRA-CESQG	EXISTING
78	MECHANIC	COMMERCIAL LANE	RCRA NonGen / NLR	EXISTING
79	DENTIST	BIRCH STREET	RCRA-CESQG	EXISTING
80	CONSTRUCTION COMPANY	ASHLEIGH DRIVE	RCRA NonGen / NLR	NEW
81	BANK	EAST BROADWAY	UST	EXISTING
82	PAVING BUSINESS	TSIENNETO ROAD	RCRA NonGen / NLR	EXISTING
83	HARDWARE STORE	MARTIN ROAD	RCRA NonGen / NLR	EXISTING
84	DENTIST	BIRCH STREET	RCRA NonGen / NLR	EXISTING
85	AUTO DEALERSHIP	NORTH MAIN STREET	MANIFEST, RCRA-CESQG	EXISTING
86	FEED SUPPLY BUSINESS	CRYSTAL AVENUE	RCRA NonGen / NLR	EXISTING
87	AUTO BODY SHOP	STORER COURT	RCRA NonGen / NLR	EXISTING

Site #	Site Activity	Site Address	Database Source	Existing or New
88	PRINTING BUSINESS	MANCHESTER ROAD	RCRA NonGen / NLR	EXISTING
89	RESIDENCE	WEST BROADWAY	RCRA NonGen / NLR	EXISTING
90	CHURCH	HOOD ROAD	UST	EXISTING
91	MEDICAL OFFICE	TSIENNETO ROAD	RCRA NonGen / NLR	EXISTING
92	CONVENIENCE STORE	EAST BROADWAY	RCRA NonGen / NLR	EXISTING
93	PHARMACY/CONVENIENCE STORE	EAST BROADWAY	RCRA-LQG, RCRA NonGen / NLR	EXISTING
94	AUTO SALES	WEST BROADWAY	RCRA NonGen / NLR	EXISTING
95	SALES BUSINESS	MANCHESTER ROAD	RCRA NonGen / NLR	EXISTING
96	ANIMAL HOSPITAL	TSIENNETO ROAD	RCRA NonGen / NLR	EXISTING
97	FEED SUPPLY BUSINESS	MARTIN STREET	UST	EXISTING
98	FIRE DEPARTMENT	WEST BROADWAY	UST	EXISTING
99	FIRE DEPARTMENT	MUNICIPAL DRIVE	RCRA NonGen / NLR	EXISTING
100	MEDICAL CENTER	TSIENNETO ROAD	RCRA NonGen / NLR	EXISTING
101	NEWSPAPER PUBLISHER	BROADWAY	RCRA NonGen / NLR	NEW
102	POLICE	MUNICIPAL WAY	RCRA NonGen / NLR	EXISTING
103	LIBRARY	EAST BROADWAY	UST	EXISTING
104	TOWN OF DERRY	WEST BROADWAY	RCRA NonGen / NLR	EXISTING
105	TOWN OF DERRY	MANNING STREET	RCRA NonGen / NLR, MANIFEST	EXISTING
106	FIRE DEPARTMENT	EAST BROADWAY	RCRA NonGen / NLR	EXISTING
107	RESIDENCE	BIRCH STREET	RCRA NonGen / NLR	EXISTING
108	COMMERCIAL BUSINESS	SCOBIE POND ROAD	RCRA NonGen / NLR	EXISTING
109	SERVICE STATION	CRYSTAL AVENUE	UST	EXISTING
110	UTILITY COMPANY	A STREET	ECHO, RCRA-CESQG	NEW
111	AUTO BODY SHOP	CENTRAL STREET	RCRA NonGen / NLR	NEW
112	TELECOMMUNICATIONS SERVICE PROVIDER	EAST BROADWAY	AST, SPILLS, UST	EXISTING
113	DRY CLEANERS	EAST BROADWAY	MANIFEST, RCRA-CESQG, DRYCLEANERS	EXISTING
114	HARDWARE STORE	WEST BROADWAY	UST	EXISTING
115	SERVICE STATION	WEST BROADWAY	RCRA NonGen / NLR	EXISTING

Site #	Site Activity	Site Address	Database Source	Existing or New
116	PHOTO SHOP	MANCHESTER ROAD	RCRA NonGen / NLR	EXISTING
117	MEDICAL OFFICE	TSIENNETO ROAD	RCRA-CESQG	NEW
118	SERVICE STATION	DANFORTH CIRCLE	MANIFEST, RCRA NonGen / NLR	EXISTING
119	SERVICE STATION	CRYSTAL AVENUE	MANIFEST, RCRA-CESQG	EXISTING
120	LABORATORY	MANCHESTER ROAD	MANIFEST, RCRA-CESQG	EXISTING
121	MACHINE SHOP	TINKHAM AVENUE	RCRA NonGen / NLR	EXISTING
122	RESTAURANT	CENTRAL STREET	RCRA NonGen / NLR	NEW
123	SUPERMARKET w/PHARMACY	MANCHESTER ROAD	RCRA-CESQG	NEW
124	MANUFACTURING FACILITY	WEST BROADWAY	RCRA NonGen / NLR	EXISTING
125	COUNTRY CLUB	EAST BROADWAY	RCRA NonGen / NLR	EXISTING
126	INSURANCE AGENCY	BROADWAY	RCRA NonGen / NLR	NEW
127	TECH EDUCATION BUSINESS	TSIENNETO ROAD	RCRA NonGen / NLR	NEW
128	AUTO BODY SHOP	CHESTER ROAD	RCRA-CESQG	EXISTING
129	MANUFACTURING FACILITY	MANCHESTER ROAD	UST, RCRA NonGen / NLR	EXISTING
130	MEDICAL CENTER	TSIENNETO ROAD	MANIFEST, RCRA-CESQG	NEW
131	RESIDENCE	EAST BROADWAY	RCRA NonGen / NLR	EXISTING
132	OIL DELIVERY COMPANY	LARAWAY RD	RCRA NonGen / NLR	EXISTING
133	MEDIA PLACEMENT BUSINESS	TSIENNETO ROAD	RCRA NonGen / NLR	EXISTING
134	SERVICE STATION	CRYSTAL AVENUE	RCRA NonGen / NLR	EXISTING
135	INDUSTRIAL COMPANY	B STREET	RCRA NonGen / NLR	EXISTING
136	RETAILER	EAST BROADWAY	UST	EXISTING
137	AUTO REPAIR	AIKEN STREET	RCRA NonGen / NLR	EXISTING
138	AUTO REPAIR	TINKHAM AVENUE	RCRA NonGen / NLR	EXISTING
139	TELEPHONE COMPANY	EAST BROADWAY	RCRA NonGen / NLR	EXISTING
140	MEDICAL CENTER	TSIENNETO ROAD	RCRA-CESQG	NEW
141	AUTO PARTS STORE	MANCHESTER ROAD	RCRA-CESQG	NEW
142	RESIDENCE	WEST BROADWAY	RCRA NonGen / NLR	EXISTING

Site #	Site Activity	Site Address	Database Source	Existing or New
143	RESIDENCE	LYNNWOOD AVENUE	RCRA NonGen / NLR	EXISTING
144	SCHOOL	PINKERTON STREET	FTTS, HIST FTTS, MANIFEST, RCRA NonGen / NLR, UST	EXISTING
145	MEDICAL OFFICE	BIRCH STREET	RCRA NonGen / NLR	EXISTING
146	MANUFACTURING FACILITY	MANCHESTER ROAD	RCRA-CESQG	EXISTING
147	DRY CLEANERS	MANCHESTER ROAD	MANIFEST, RCRA-CESQG, RCRA NonGen / NLR, DRYCLEANERS	EXISTING
148	UTILITY COMPANY	A STREET	UST	EXISTING
149	PROPERTY MANAGEMENT COMPANY	WEST BROADWAY	UST	EXISTING
150	PROPERTY MANAGEMENT COMPANY	MARTIN STREET	UST	EXISTING
151	RETAIL STORE	WEST BROADWAY	RCRA NonGen / NLR	EXISTING
152	RECYCLING COMPANY	FRANKLIN STREET EXTENSION	RCRA NonGen / NLR	EXISTING
153	SUPERMARKET	CRYSTAL AVENUE	RCRA-CESQG	NEW
154	PAINT STORE	WEST BROADWAY	MANIFEST, RCRA-CESQG	EXISTING
155	PAINT STORE	CRYSTAL AVENUE	RCRA NonGen / NLR	EXISTING
156	BANK	EAST BROADWAY	UST	EXISTING
157	MARKET	MANCHESTER ROAD	RCRA NonGen / NLR	EXISTING
158	SERVICE STATION	ROUTE 28 & FOLSOM ROAD	RCRA NonGen / NLR	EXISTING
159	COMMERCIAL BUSINESS	TREASURE LANE	RCRA NonGen / NLR	EXISTING
160	EQUIPMENT RENTAL	MANCHESTER ROAD	RCRA NonGen / NLR	EXISTING
161	INDUSTRIAL COMPANY	MANCHESTER ROAD	RCRA NonGen / NLR	EXISTING
162	AUTO SALES	A STREET	MANIFEST, RCRA NonGen / NLR	NEW
163	INSURANCE AGENCY	EAST BROADWAY	UST	EXISTING
164	SERVICE STATION	ASHLEIGH DRIVE	RCRA-SQG	EXISTING
165	TOWN OF DERRY	WEST BROADWAY	UST	EXISTING

Site #	Site Activity	Site Address	Database Source	Existing or New
166	TOWN OF DERRY	MANNING & BROADWAY	UST	EXISTING
167	LAWN AND GARDEN STORE	CRYSTAL AVENUE	ECHO, FINDS, RCRA-CESQG	NEW
168	COMMERCIAL PROPERTY	DERRY INDUSTRIAL PK	MANIFEST, RAATS, RCRA NonGen / NLR	EXISTING
169	AUTO PARTS STORE	ROUTE 28	UST, MANIFEST, RCRA NonGen / NLR	EXISTING
170	REAL ESTATE AGENCY	CRYSTAL AVENUE	ECHO, FINDS, RCRA NonGen / NLR	NEW
171	RETAIL STORE	MANCHESTER ROAD	MANIFEST, RCRA NonGen / NLR	EXISTING
172	RETAIL STORE	ASHLEIGH DRIVE	RCRA-SQG	NEW
173	COMMUNITY CENTER	WEST BROADWAY	UST	EXISTING
174	DENTIST	PINKERTON STREET	RCRA NonGen / NLR	EXISTING
175	AUTO REPAIR	NORTH AVENUE	RCRA NonGen / NLR	EXISTING
176	LABORATORY	TINKHAM AVENUE	MANIFEST, RCRA NonGen / NLR	EXISTING
177	PAVING BUSINESS	MAPLE & ROLLIN STREET JUNCTION	RCRA NonGen / NLR	EXISTING
178	PAINTING BUSINESS	NUTFIELD COURT	ECHO, FINDS, RCRA-CESQG	NEW
179	RESIDENCE	BIRCH STREET	RCRA NonGen / NLR	EXISTING
180	REAL ESTATE AGENCY	CENTRAL STREET	RCRA NonGen / NLR	EXISTING
181	FOOD STORE	CRYSTAL AVENUE	RCRA NonGen / NLR	EXISTING
182	MANUFACTURING FACILITY	TINKHAM AVENUE	RCRA NonGen / NLR	EXISTING
183	AUTO PARTS STORE	SOUTH AVENUE	RCRA NonGen / NLR	EXISTING
184	COUNTRY CLUB	LINLEW DRIVE	RCRA NonGen / NLR	EXISTING
185	DENTIST	PEABODY ROAD	RCRA NonGen / NLR	EXISTING
186	MEDICAL OFFICE	PEABODY ROAD ANNEX	RCRA NonGen / NLR	EXISTING
187	OIL DELIVERY COMPANY	CENTRAL COURT	RCRA NonGen / NLR	EXISTING
188	EDR	TINKHAM AVENUE	RCRA NonGen / NLR	EXISTING
189	OIL DELIVERY COMPANY	CENTRAL COURT	RCRA NonGen / NLR	EXISTING
190	OIL DELIVERY COMPANY	FRANKLIN STREET	RCRA NonGen / NLR	EXISTING

Site #	Site Activity	Site Address	Database Source	Existing or New
191	WOODWORKING BUSINESS	CHESTER ROAD	RCRA NonGen / NLR	EXISTING
192	MANUFACTURING FACILITY	TINKHAM AVENUE	RCRA NonGen / NLR	EXISTING
193	LANDSCAPE DESIGNER	NORTH HIGH STREET	RCRA NonGen / NLR	NEW
194	FARM	CHESTER ROAD	UST	EXISTING
195	RESIDENCE	TINKHAM AVENUE	RCRA NonGen / NLR, UST	EXISTING
196	RESIDENCE	BIRCH STREET	UST	EXISTING
197	RESIDENCE	PINKERTON STREET	RCRA NonGen / NLR	EXISTING
198	AUTO BODY SHOP	MAPLE STREET	ECHO, FINDS, RCRA-CESQG	NEW
199	COMMERCIAL BUSINESS	TINKHAM AVENUE	RCRA NonGen / NLR	EXISTING
200	SERVICE STATION	HILLSIDE AVENUE	RCRA NonGen / NLR	EXISTING
201	MANUFACTURING FACILITY	CORPORATE DRIVE	RCRA NonGen / NLR, ECHO, FINDS	NEW
202	MANUFACTURING FACILITY	TINKHAM AVENUE	RCRA NonGen / NLR	EXISTING
203	COMMERCIAL PROPERTY	CENTRAL COURT	MANIFEST, RCRA NonGen / NLR	EXISTING
204	METAL FINISHING BUSINESS	MAPLE STREET	ECHO, US AIRS, FINDS, RCRA NonGen / NLR	EXISTING
205	LABORATORY	ASH STREET EXTENSION	ECHO, FINDS, RCRA NonGen / NLR	NEW
206	COMMERCIAL BUSINESS	NORTH AVENUE	RCRA NonGen / NLR	EXISTING
207	FUNERAL HOME	BIRCH STREET	UST	EXISTING
208	TOOL BUSINESS	MAPLE STREET	RCRA NonGen / NLR	EXISTING
209	DRY CLEANERS	LINLEW DRIVE	DRYCLEANERS	EXISTING
210	COMMERCIAL BUSINESS	HILLSIDE AVENUE	RCRA NonGen / NLR	EXISTING
211	PHARMACY/CONVENIENCE STORE	CRYSTAL AVENUE	MANIFEST, RCRA-CESQG	EXISTING
212	AUTO PARTS STORE	CRYSTAL AVENUE	UST	EXISTING
213	SCHOOL	HOOD ROAD	ECHO, FINDS, RCRA NonGen / NLR, US AIRS, UST	EXISTING
214	REAL ESTATE AGENCY	SOUTH AVENUE	RCRA NonGen / NLR	EXISTING

Site #	Site Activity	Site Address	Database Source	Existing or New
215	DENTIST	PINKERTON STREET	RCRA NonGen / NLR	EXISTING
216	DENTIST	MANCHESTER AVENUE	RCRA NonGen / NLR	EXISTING
217	RESIDENCE	SOUTH AVENUE	RCRA NonGen / NLR	EXISTING
218	AUTO REPAIR	LONDONDERRY ROAD	RCRA NonGen / NLR	NEW
219	MAINTENANCE COMPANY	LONDONDERRY ROAD	RCRA NonGen / NLR	EXISTING
220	MACHINE SHOP	COMMERCIAL LANE	RCRA NonGen / NLR	EXISTING
221	MANUFACTURING FACILITY	LONDONDERRY ROAD	RCRA NonGen / NLR	EXISTING
222	SERVICE STATION	WEST BROADWAY	RCRA NonGen / NLR	EXISTING
223	WHOLESALER	LONDONDERRY ROAD	RCRA NonGen / NLR, RCRA-CESQG	EXISTING
224	SERVICE STATION	WEST BROADWAY	RCRA NonGen / NLR	EXISTING
225	TRACTOR RETAILER	ROCKINGHAM ROAD	RCRA NonGen / NLR	EXISTING
226	AUTO REPAIR	LONDONDERRY ROAD	RCRA NonGen / NLR, RCRA NonGen / NLR	EXISTING
227	COMMERCIAL BUSINESS	LONDONDERRY ROAD	RCRA NonGen / NLR	EXISTING
228	COMMERCIAL BUSINESS	LONDONDERRY ROAD	RCRA NonGen / NLR	EXISTING
229	SERVICE STATION	NASHUA ROAD	UST	EXISTING
230	MACHINE SHOP	COMMERICAL LANE	RCRA NonGen / NLR	EXISTING
231	SERVICE STATION	NASHUA ROAD	RCRA NonGen / NLR	EXISTING
232	EQUIPMENT RENTAL	ROUTE 28	RCRA NonGen / NLR	NEW
233	STATE OF NH	ROCKINGHAM ROAD	RCRA NonGen / NLR	EXISTING
234	COMMERCIAL BUSINESS	LONDONDERRY ROAD	RCRA NonGen / NLR	EXISTING
235	WATERPROOFING CONTRACTOR	LONDONDERRY ROAD	RCRA NonGen / NLR	EXISTING
236	AUTO FINISHING	COTEVILLE ROAD	RCRA NonGen / NLR	EXISTING
237	AUTO REPAIR	LONDONDERRY ROAD	RCRA NonGen / NLR	EXISTING

Site #	Site Activity	Site Address	Database Source	Existing or New
238	COMMERCIAL BUSINESS	LONDONDERRY ROAD	RCRA NonGen / NLR	EXISTING
239	AUTO REPAIR	COMMERICAL LANE	RCRA NonGen / NLR	EXISTING
240	AUTO REPAIR	LONDONDERRY ROAD	RCRA-CESQG	NEW
241	AUTO RECYCLING BUSINESS	LONDONDERRY ROAD	RCRA NonGen / NLR	EXISTING
242	AUTO REPAIR	LONDONDERRY ROAD	RCRA NonGen / NLR	EXISTING
243	AUTO REPAIR	COMMERCIAL LANE	MANIFEST, RCRA NonGen / NLR	EXISTING
244	MANUFACTURING FACILITY	LONDONDERRY ROAD	RCRA NonGen / NLR	EXISTING
245	GENERAL CONTRACTOR	ROUTE 28/ROCKINGHAM ROAD	US MINES	NEW
246	AUTO REPAIR	ASH STREET EXTENSION	RCRA NonGen / NLR	EXISTING
247	AUTO AUCTION HOUSE	ACTION BOULEVARD	RCRA NonGen / NLR, UST	EXISTING
248	DEVELOPMENT COMPANY	HILLSIDE AVENUE	UST	EXISTING
249	AUTO BODY SHOP	ROCKINGHAM ROAD	RCRA-CESQG	EXISTING
250	AUTO BODY SHOP	HILLSIDE AVENUE	RCRA-CESQG	EXISTING
251	SERVICE STATION	NASHUA ROAD	UST	EXISTING
252	SERVICE STATION	NASHUA ROAD	RCRA NonGen / NLR	EXISTING
253	MANUFACTURING FACILITY	ROCKINGHAM ROAD	RCRA NonGen / NLR	EXISTING
254	BUSINESS PARK	HILLSIDE AVENUE	RCRA NonGen / NLR	EXISTING
255	RESIDENCE	ROCKINGHAM ROAD	MANIFEST, RCRA NonGen / NLR	EXISTING
256	RECYCLING COMPANY	HILLSIDE AVENUE	RCRA NonGen / NLR	EXISTING
257	EQUIPMENT RENTAL	ROCKINGHAM ROAD	RCRA NonGen / NLR	EXISTING
258	TIRE STORE	HILLSIDE AVENUE	RCRA NonGen / NLR	EXISTING
259	AUTO REPAIR	ASH STREET EXTENSION	RCRA NonGen / NLR	EXISTING
260	RESIDENCE	HILLSIDE AVENUE	RCRA NonGen / NLR	EXISTING

POTENTIAL PETROLEUM AND HAZARDOUS MATERIAL SITES – LOCATION UNCERTAIN

Site #	Site Activity	Site Address	Database Source
DERRY			
1	DRY CLEANERS	CRYSTAL AVENUE	NH DRYCLEANERS
2	MUNICIPAL LANDFILL	KENDALL POND ROAD	NH SWF/LF, NH ALLSITES, NH FINANCIAL ASSURANCE, SEMS-ARCHIVE
LONDONDERRY			
3	DRY CLEANERS	ROUTE 102	NH DRYCLEANERS
4	IMPACTED WATER WELLS	BOSTON AND CHARLESTON AVENUE	NH SHWS
5	AUTO REPAIR SHOP	PILLSBURY ROAD	SEMS-ARCHIVE, NH SHWS

Appendix H: Chloride Technical Report

Chloride Loading in the Upper Beaver Brook Watershed – Current and Future Conditions

I-93 Exit 4A Supplemental Draft Environmental Impact Statement

Prepared for:

Town of Derry
Town of Londonderry
New Hampshire Department of Transportation

Prepared by:

Normandeau Associates, Fuss & O'Neill, Inc. and Louis Berger Group

August 27, 2018

NHDOT Project Number: 13065
Federal Project Number: IM-0931(201)
Fuss & O'Neill, Inc. /Towns Project Number 05-0244

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABBREVIATIONS AND ACRONYMS

AoT	NHDES Alteration of Terrain permit program
AU	Assessment Unit for water quality assessment – collection of stream reaches within a watershed
Beaver Brook	Assessment Unit (AU) NHRIV700061203-16 within the Upper Beaver Brook Watershed (Level 12 Hydrologic Unit 010700061025)
BMP	Best Management Practice
CLD	CLD Consulting Engineers (As of August 7, 2017; Fuss & O'Neill, Inc.)
CWA	Clean Water Act
FY	State Fiscal Year
LBG	Louis Berger Group
NHDES	New Hampshire Department of Environmental Services
NHDOT	New Hampshire Department of Transportation
Normandeau	Normandeau Associates, Inc.
The Towns	The Towns of Derry and Londonderry
TMDL	Total Maximum Daily Load
USEPA	United States Environmental Protection Agency
WQC	Clean Water Act Section 401 Water Quality Certification

1.0 INTRODUCTION

The Towns of Derry and Londonderry, New Hampshire (the Towns) and the New Hampshire Department of Transportation (NHDOT), in cooperation with the Federal Highway Administration (FHWA), are preparing a Supplemental Draft Environmental Impact Statement (SDEIS) for the Interstate 93 (I-93) Exit 4A Project (Project). The Project is located in the Towns and includes construction of a new interchange with I-93 (known as Exit 4A) and other transportation improvements to reduce congestion and improve safety along State Route 102 (NH 102), from I-93 easterly through downtown Derry, and to promote economic vitality in the Derry/Londonderry area.

The SDEIS presents the affected environment and the direct and indirect effects (environmental consequences) anticipated from the proposed Project in accordance with the requirements of the National Environmental Policy Act (NEPA; Public Law 91-190, 42 United States Code [USC] 4321–4347 as amended) and the regulations of the Council on Environmental Quality (CEQ; 40 Code of Federal Regulations [CFR] 1500–1508), as well as applicable FHWA regulations (23 CFR Part 771; 23 USC 138) and guidance (FHWA, 1987). Environmental consequences studied include impacts to water quality from each alternative assessed in the SDEIS. The Preferred Alternative in the SDEIS is Alternative A and that alternative is the focus of this report. Impacts from the proposed Project will include an increase in impervious area from additional roadway and a proportional increase in associated pollutants. Chloride, primarily from road salt used for winter road maintenance, is a pollutant of concern associated with increased impervious area.

This report provides:

- A review of the water quality regulatory environment for the proposed Project,
- An update on the status of chloride loading from NHDOT maintained roadways and municipally maintained roadways in the Towns of Derry and Londonderry in the Project area within Upper Beaver Brook watershed,
- A summary of expected chloride loading from the proposed Project and other reasonably foreseeable actions by others within the watershed, and
- A discussion of best management practices for the proposed Project and other reasonably foreseeable actions by others within the watershed that would be implemented to minimize chloride loading.

1.1 Existing Conditions

The proposed Project lies within the Upper Beaver Brook watershed (Level 12 Hydrologic Unit 010700061025) as mapped in the US Geological Survey's Watershed Boundary Dataset (NHDES, 2017a). Beaver Brook, south of the proposed Project, flows west under I-93 and then south into Massachusetts where it joins the Merrimack River in Lowell. Upper Beaver Brook has been subject to water quality investigations since 2003 in response to proposed development in the watershed, including widening and improvements to I-93 (NHDES, 2008).

1.2 Proposed Action

The preferred alternative (Alternative A) for the proposed Project passes through Londonderry and Derry, with 3.2 miles of new alignment between the proposed I-93 Exit 4A interchange and eastern Derry. There would be approximately 1 mile of roadway construction on a new alignment, 1.6 miles of existing roadway reconstruction, and 0.6 mile of roadway with no improvements. It would originate from the proposed I-93 Exit 4A interchange location and travel southeast along new alignment through a wooded area to Folsom Road, near its intersection with North High Street and Madden Road. This alternative would continue to follow Folsom Road past Ross' Corner (Manchester Road/NH 28) and continue on Tsienneto Road across NH 28 Bypass to its end at NH 102, adjacent to Beaver Lake. Alternative A would cross Shields Brook, a perennial stream with a 3,767 acre watershed, as well as one other perennial stream on Tsienneto Road and several intermittent streams.

1.3 Indirect/Foreseeable Actions

A Land Use Scenarios Technical Report (Louis Berger Group, 2017) prepared in conjunction with the SDEIS documents the development anticipated to occur if the proposed project were constructed. The Land Use Scenarios Technical Report predicts increased industrial development in Derry, increased residential development in Chester, and increased development in currently undeveloped land south and east of Exit 4A. Woodmont Commons, shown in Figure 1, is a planned, mixed-use, urban village in the Town of Londonderry. The developer, Pillsbury Realty Development, LLC, owns approximately 630 acres bordering the east and west sides of I-93. Alternative A would bisect the Woodmont East property.

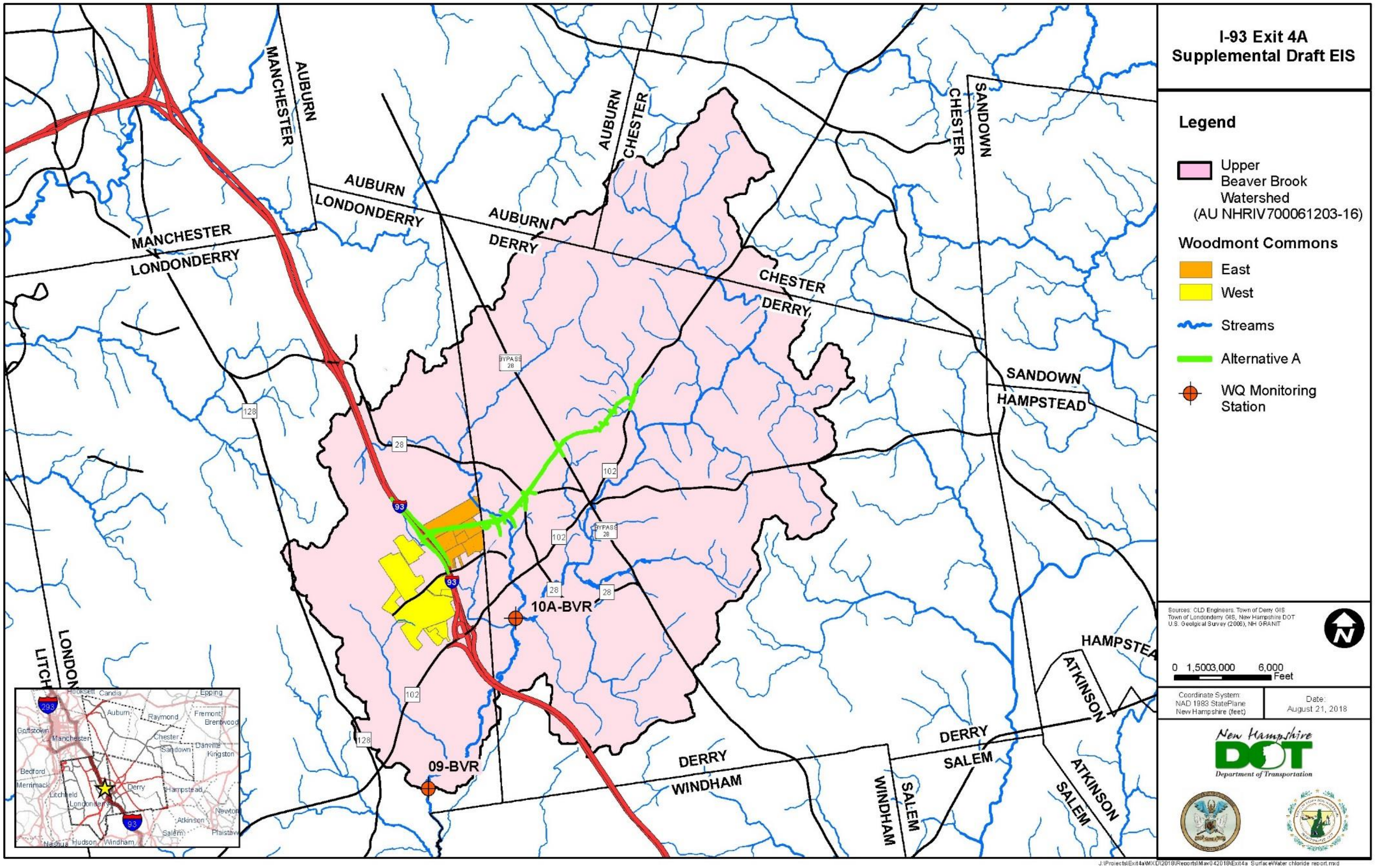

Figure 1. Upper Beaver Brook Watershed – Project Alternative A and Woodmont Commons East and West

2.0 REGULATORY FRAMEWORK

The Exit 4A project is subject to a variety of state and federal regulations and associated programs that ensure surface water quality is preserved or restored in all waters of the U.S. Impacts to waterbodies near the Alternative A alignment would necessitate involvement with these regulations as the Project proceeds through final design to construction.

2.1 Clean Water Act 303(d) and 305(b)

The Clean Water Act (CWA), as amended in 1972, established the structure by which the federal government regulates discharges into the waters of the United States. Sections 303(d) and 305(b) of the CWA requires each state to submit two reports (CWA 303(d) report and CWA 305(b) report) to the U.S. Environmental Protection Agency (USEPA) every two years, documenting the water quality status of surface waters within the state. The New Hampshire Department of Environmental Services (NHDES) Watershed Management Bureau administers the monitoring and reporting of surface water quality to the USEPA. One of the required reports is New Hampshire's "305(b) Report" which describes the quality of New Hampshire's surface waters and analyzes the extent to which all such waters provide for the protection and propagation of a balanced population of shellfish, fish, and wildlife and allow recreational activities in and on the water.

The second report, required by Section 303(d) of the CWA requires submittal of a list of waters that:

- are impaired or threatened by a pollutant or pollutant(s);
- are not expected to meet water quality standards within a reasonable time even after application of best available technology standards for point sources or best management practices for nonpoint sources; and
- require development and implementation of a comprehensive water quality study (i.e., a Total Maximum Daily Load or TMDL study) that assesses pollutant loads consistent with water quality standards.

2.1.1 New Hampshire Surface Water Assessment

The NHDES process for assessing surface water quality is detailed in the "Consolidated Assessment and Listing Methodology" (CALM) that interprets New Hampshire's Surface Water Quality Regulations (Env-Wq 1702.17) and identifies "designated uses" for New Hampshire surface waters, defined as "the uses that a waterbody should support" (NHDES, 2017b). Designated uses are listed in Table 1.

Table 1. Designated Uses for New Hampshire Non-Tidal Surface Waters[a]

Designated Use	NHDES Definition
Aquatic Life	Waters that provide suitable chemical and physical conditions for supporting a balanced, integrated and adaptive community of aquatic organisms.
Fish Consumption	Waters that support fish free from contamination at levels that pose a human health risk to consumers.
Shellfish Consumption	Waters that support a population of shellfish free from toxicants and pathogens that could pose a human health risk to consumers
Drinking Water Supply After Adequate Treatment	Waters that with adequate treatment will be suitable for human intake and meet state/federal drinking water regulations.
Primary Contact Recreation (i.e. swimming)	Waters that support recreational uses that involve minor contact with the water.
Secondary Contact Recreation	Waters that support recreational uses that involve minor contact with the water.
Wildlife	Waters that provide suitable physical and chemical conditions in the water and the riparian corridor to support wildlife as well as aquatic life[b]

Notes: a - NHDES (2017e)

b - Parameters for assessing wildlife are under development, so no assessments for this designated use have been made to date.

New Hampshire's Administrative Rules Env-Wq 1703 et seq. provide the thresholds for pollutants, dissolved oxygen (DO), color, temperature, and other criteria that must be met for surface waters to be in compliance. Designated uses are assessed in the CALM using a 1–5 scale, with 1 indicating that all designated uses are attained, and 4 or 5 indicating that the Assessment Unit (AU, the waterbody or stream segment used for recording assessments) is impaired for one or more designated uses, as defined in the CALM:

- **AU Category 4A**: Impaired or threatened for one or more designated uses but does not require the development of a TMDL because a TMDL has been completed.
- **AU Category 4B**: Impaired or threatened for one or more designated uses but does not require the development of a TMDL because other pollution control requirements are reasonably expected to result in attainment of the water quality standard in the near future.
- **AU Category 4C**: Impaired or threatened for one or more designated uses but does not require the development of a TMDL because the impairment is not caused by a pollutant.
- **AU Category 5**: Impaired or threatened for one or more designated uses by a pollutant(s), and requires a TMDL (this is the 303(d) List) (NHDES, 2017b).

For impaired waterbodies on the 303(d) list, a TMDL is calculated that establishes the maximum amount of a pollutant that can be allowed in a waterbody to achieve water quality standards for all designated uses (NHDES, 2008). A TMDL report also identifies the sources of the pollutant(s) of concern and the quantity of pollutant that could be discharged by each source while achieving water quality standards. All TMDLs are subject to public review and comment and review and approval by EPA (NHDES, 2008). A TMDL is determined as:

$$\text{TMDL} = \text{WLA} + \text{LA} + \text{MOS}$$

Where "WLA" is the waste load allocation for point sources of a pollutant; "LA" is the load allocation for nonpoint sources of a pollutant; and "MOS" is the margin of safety to account for uncertainty and unknowns (NHDES, 2008).

2.2 Beaver Brook Chloride TMDL

In 2008, the NHDES prepared TMDL studies for four waterbodies in southern New Hampshire that were adjacent to I-93 (NHDES, 2008). One of those was Beaver Brook, AU NHRIV700061203-16 in Derry and Londonderry (Figure 1), which includes the surface waters within the Upper Beaver Brook Watershed[1]. According to the TMDL, the majority (~95%) of chloride loading in the watershed is associated with de-icing activities for public and private roadways and parking lots. The TMDL was set as a load duration curve based on the chronic water quality standard (230 mg/L Cl) reduced by 10%, to include a 10% margin of safety, (=207 mg/L Cl) multiplied by each streamflow value in a four day average flow duration curve determined by NHDES (NHDES, 2008). The load duration curve expresses the TMDL in tons of chloride per day that can be imported to the watershed at a given flow and meet the chronic water quality standard (NHDES, 2008). Of the daily salt import total expressed by the TMDL, 66% is reserved for the WLA (MS4 permittees) and 34% is reserved for the LA (nonpoint sources) (NHDES, 2008). NHDES has also expressed the TMDL for Beaver Brook as an alternative form, the percent reduction goal, which establishes an annual salt load allocation in tons of salt per year (NHDES, 2008). The annual salt load allocation is not the TMDL (the TMDL is the load duration curve), but is used for implementing the TMDL by establishing a longer term goal (i.e. versus daily criteria) for watershed salt imports that can be expected to meet water quality standards. Based on empirical water quality data and annual salt imports from all salt sources in the watershed and including a 10% margin of safety, NHDES set the annual Upper Beaver Brook watershed salt load allocation at 9,069 tons of salt per year (NHDES, 2008). The TMDL report also sets forth the process by which each sector would be allocated an annual quantity of salt to be applied (the "salt load"). The recommended salt loads were negotiated via a Salt Reduction Workgroup, with representatives from each sector of salt applicators. Recommended salt loads per sector were established in the "*Chloride Reduction Implementation Plan for Beaver Brook – Derry, Londonderry, Auburn, Chester, NH*" (NHDES, 2011a).

2.3 NHDES TMDL Implementation Plan

A TMDL study establishes a target for reducing a pollutant(s) in order to achieve water quality standards in an impaired waterbody. A TMDL implementation plan may identify a framework for achieving load reductions through existing or necessary controls that address the identified source(s) of pollutant(s).

[1] "Beaver Brook" as used in this document refers to the NHDES Assessment Unit NHRIV700061203-16, consistent with documents referenced in this report.

The *Chloride Reduction Implementation Plan for Beaver Brook* (NHDES, 2011a) specifies a number of best management practices (BMPs) to optimize salt use efficiency and identifies activities and target dates for achieving compliance with the TMDL (see Table 2). The BMPs were identified consistent with the implementation plan goals to reduce salt loads and attain chloride water quality standards in the Upper Beaver Brook watershed while preserving winter road maintenance standards and traffic safety.

Table 2. Chloride Reduction Implementation Plan Matrix (from NHDES, 2011a)

	Action	Target Completion Date of Responsible Agencies							
		NH DES	UNH	NH DOT	Towns[a]	LER[b]	RPC[c]	PS[d]	NH DOS[e]
	Objective: Creation of Educational Manuals, Training Programs and Procedural/Operational Strategies								
1	State Snow and Ice BMP Manual for Roadways	2012		2012					
2	State Snow and Ice BMP Manual for Parking Lots	2012		2012				2012	
3	Develop DOT Winter Maintenance Training Program for Salt Reduction			2012					
4	Certification Training Program for Private Sector		2011						
5	Training and Certification Program for Municipal Staff		2011		2011				
6	Legislative approval of salt applicators license program	DLA[f]							
7	Legislative approval of mandatory use of snow tires								DLA
8	Develop Join Incident Protocols			2011					2011
9	Complete Driver Behavior Study	2012							
10	Adopt traffic violation procedure to address reckless driving during inclement road conditions								DLA
11	Develop winter driving training and require attendance for repeat traffic violation offenders								DLA
12	Develop training for inexperienced drivers, such as high school students				2012				2012
13	Reduce driving speed limits during inclement weather conditions			2010	2010				
14	Hold prewinter meetings to review Level of Service				2011	2011			
15	Develop call-back ranking system				2012	2012			
16	Develop and adopt a formal snow and ice removal policy				2011				
17	Revise site plan review process to include designs and/or management strategies that may decrease chloride use				2012		2012		
18	Revise permit review process to include designs and/or management strategies that may decrease chloride use	2012							
19	Creation of a salt reduction ordinance				2015				
20	Require mandatory training for employees and contracted staff that deal with winter maintenance			2012	2012			2012	
21	Review and update Salt Management Plans every 5 years				2015				
22	Development of company operational procedure manual for snow and ice removal							2015	

Action		Target Completion Date of Responsible Agencies							
		NH DES	UNH	NH DOT	Towns[a]	LER[b]	RPC[c]	PS[d]	NH DOS[e]
23	Develop record keeping strategy for salt application			2012	2012			2012	
24	Properly store salt under cover and on an impervious surface and away from surface water			2011	2011			2011	
Objective: Snow and Ice Removal BMP Applications									
1	Modify existing equipment for pre-wetting				2012			2012	
2	Implement pre-wetting watershed wide			2014	2014			2014	
3	Implement anti-icing watershed wide			2016	2016			2016	
4	Use handheld or truck mounted spreaders			2011	2011			2011	
5	Install ground speed oriented spreaders to trucks			2014	2014			2014	
6	Use alternative snow fighting methods such as snow fences where applicable			2011	2011			2011	
7	Manage overflow parking areas based on level of use			2013				2013	
8	Properly maintain and calibrate equipment			2011	2011			2011	
9	Complete periodic inspections of parking lots and walk ways for over application of deicer. Follow up with staff/contractor on findings.							2012	
10	Adopt BMP's at all salt storage and handling facilities			2012	2012			2012	
11	Track salt use utilizing salt accounting system developed by UNH T2[g]							2012	
12	Install AVL systems to collect real time data			2015	2015				

Notes: a – Derry and Londonderry
b – LER - Local Emergency Responders
c – RPC - Rockingham Planning Commission
d – PS - Private Sector
e – NHDOS - NH Department of Safety
f – DLA - Dependent on Legislative Approval
g – UNH T2 - University of New Hampshire Technology Transfer Center

2.3.1 NHDOT Implementation Plan

A 19.8-mile section of Interstate I-93 from Salem, NH to Manchester, NH is undergoing reconstruction and widening to four lanes to improve transportation efficiency and safety with an expected completion date in October 2019[2]. The I-93 project includes a 5.2 mile segment located within the Upper Beaver Brook watershed. In 2009, prior to NHDES' publication of the *Chloride Reduction Implementation Plan for Beaver Brook* (NHDES, 2011a) the NHDOT prepared the *Implementation Plan to Increase the Efficiency and Effectiveness of Road Salt Use to Meet Total Maximum Daily Load for Chloride in Water Bodies along the I-93 Corridor from Salem to Manchester, NH: Beaver Brook; Dinsmore Brook; North Tributary to Canobie Lake; Porcupine-Policy Brook* which demonstrated to NHDES how NHDOT could meet the Beaver Brook chloride TMDL (NHDOT, 2009).

[2] http://www.rebuildingi93.com/content/news/ Accessed 4/18/2018.

The I-93 improvement project required a 401 Water Quality Certification (WQC) and preparation of an Environmental Impact Statement with a Record of Decision (ROD) from the FHWA that describes measures that would be taken to minimize harm to the environment, including water quality. To date, relevant BMPs identified in the *Chloride Reduction Implementation Plan for Beaver Brook* have been implemented including actions taken by NHDOT in executing the conditions of the I-93 project 401 WQC (NHDES, 2006) and consistent with the FHWA 2005 ROD for the I-93 project EIS (FHWA, 2005). NHDOT submitted a letter dated March 13, 2018 to Fuss & O'Neill (Appendix A) that identifies all salt reduction BMPs that have been implemented to date consistent with the NHDOT Implementation Plan (NHDOT, 2009) and the NHDES Implementation Plan (NHDES, 2011a), as presented below (from Appendix A, pages 3-4). The NHDOT letter asserts, through implementation of salt reduction BMPs, compliance with all current permits (see Appendix A).

- Salt accounting - DOT meticulously monitors its salt stock in each patrol shed and reports that information annually to DES
- Pre-wetting - DOT applies liquid deicer to dry salt at time of application
- Anti-Icing - DOT applies brine directly to the pavement in advance of an oncoming storm when conditions allow
- Underbelly Plows - DOT utilizes these plows that enhance snow scraping / removal capabilities
- Ground-speed Spreader Controllers - All DOT trucks utilized out of Shed 528 have ground-speed, closed loop controllers
- Mobile Pavement Temperature Sensors - All DOT trucks located in Shed 528 have mobile pavement temperature sensors. Several road weather stations have also been established along I-93 corridor
- Equipment Calibration - DOT annually calibrates their spreader equipment prior to each season
- Enhanced Training - DOT provides enhanced training tracks participation via an online accounting system. Hired equipment operators are encouraged to attend
- Improved Storage Practices - DOT has just completed upgrading a depot shed in Salem which has increased indoor storage capacity
- Snow and Ice Forecasting - DOT utilizes computer software that provides forecast for plowing and salting with information feed from it Roadside Weather Information System
- Enhanced Plow Blade Technology - DOT utilizes flexible plow blades that provide better road contact and enhance snow scraping / removal capabilities
- GPS/AVL technology - All DOT spreader trucks located in Shed 528 are equipped with GPS/AVL which helps track salt usage by specific trucks and areas or interest.
- Variable Messaging Signs - VMS have been installed to warn drivers of impending or current weather and traffic conditions and set lower speed limits

- Enhanced Material Reporting Relative to Winter Severity - DOT has been reporting post-implementation salt usage relative to pre-implementation usage while adjusting for winter weather severity.

2.3.2 Town of Derry Implementation Plan

The Town of Derry developed the document *Salt Reduction Plan for: Beaver Brook* with subsequent updates (Derry, 2011a; Derry, 2016) in response to the TMDL and the *2011 Chloride Reduction Implementation Plan for Beaver Brook* (NHDES, 2011a). The 2016 Salt Reduction Plan, included as Appendix B, details several measures that have been implemented to reduce salt loading in Beaver Brook (Derry, 2016):

- Purchased five salt reducing plow trucks
- Salt pre-wetting sprayers on new trucks
- Groundspeed controls on new trucks
- Pavement temperature sensors on new trucks
- Salt spreader calibration program developed and implemented to ensure accurate application rates.
- All Derry municipal operators have been trained in the Green Snow Pro Program offered by the UNH Technology Transfer Center
- Derry regularly hosts the Green Snow Pro Program training in its municipal center on Manning Street.
- Derry officials supported the passage of the Voluntary Certified Salt Applicator law each time it was presented to the legislature.
- Derry has filmed and broadcasted plow truck ride-alongs on its public access television station.
- Derry has provided ride-alongs for the DES Salt Reduction Coordinator.
- Derry public television interviewed DES and UNH salt reduction experts during a segment about the chloride contamination issues in Beaver Brook.

The town committed in 2016 to equipping nine plow trucks with Automatic Vehicle Location (AVL) technology which will allow the town to track the amount of salt applied on each salt route and will log salt applied in a central database. This system also helps avoid duplicating salting efforts by displaying a trail of where other salt applicators have been.

2.3.3 Town of Londonderry Implementation Plan

The Town of Londonderry developed a salt reduction plan (Londonderry, 2011) in response to the TMDL and the *2011 Chloride Reduction Implementation Plan for Beaver Brook* (NHDES, 2011a). The Londonderry salt reduction plan, included as Appendix C identified a number of BMPs and implementation goals for reducing salt loads including equipment upgrades, improved equipment calibration procedures, private sector outreach, and improved weather monitoring. Londonderry reports in the document *Town of Londonderry, NH Salt Reduction Best*

Management Practices for the Beaver Brook Watershed Within the Boundaries of the Town of Londonderry (Londonderry, 2018a) that as of March 2018, they have completed the following:

- Purchased five dump trucks with underbody discharge spreaders
- Salt pre-wetting and ground speed control on new trucks
- Pavement temperature sensors on new trucks
- Spreader control units on new trucks to allow adaptive road treatment
- Developed and implemented spreader calibration policies
- Developed and implemented salt use tracking policies
- Salt reduction training program is required for town staff and road maintenance contractors
- Upgraded local weather forecast service to aid road maintenance decision making process

2.3.4 NHDES Private Sector Implementation Plan

The 2011 Chloride Reduction Plan for Beaver Brook provides recommendations for salt reduction by the private sector including reporting of salt usage to the University of New Hampshire Technical Transfer Center. Specific elements of the implementation plan applicable to the private sector are itemized in Table 2. NHDES has also published "*Best Management Practices and Salt-Use Minimization Efforts in Chloride-Impaired Watersheds of New Hampshire – A Guidance Document for Private Developers and Contractors*" (NHDES, 2016 – see Appendix D) which reiterates elements of the 2011 Chloride Reduction Plan and provides specific guidance on how to develop an individual Salt Minimization Plan. Individual salt minimization plans identify and describe the development being maintained, and provide the following:

- Operational Guidelines
    - Winter Operator Certification Requirements – such as Green SnowPro[3] Training, which is administered by NHDES
    - Weather Monitoring – How weather information is gathered and communicated
    - Equipment Calibration Requirements
    - Mechanical Removal – information such as snow storage and plowing frequency
- Salt Usage Evaluation and Monitoring – Description of salt usage monitoring and reporting
- Analysis of Alternative De-icing Materials, Site Design Considerations and Watershed Offsets

[3] Voluntary Certified Salt Applicator Program, authorized in Env-Wq 2200

2.4 Water Quality Permits Required for the Proposed Action

2.4.1 National Pollutant Discharge Elimination System (NPDES)

The National Pollutant Discharge Elimination System (NPDES) permit program, under the authority of the CWA, addresses water pollution by regulating point sources that discharge pollutants to waters of the United States. Two permitting programs under NPDES are relevant to highway construction projects in the Project study area: the Construction General Permit (CGP) and the Municipal Separate Storm Sewer System (MS4) general permit. While a Construction General Permit will be required for the Project, only the MS4 permit has a chloride nexus and is discussed in this section.

Municipal Separate Storm Sewer System (MS4) Permit

The NPDES program requires that operators of Municipal Separate Storm Sewer Systems (MS4s) file a notice of intent to obtain coverage under the MS4 permit for stormwater discharge from these systems. MS4s are defined by the EPA as a stormwater conveyance or system of conveyances that is owned by a state, city, town, village, or public entity that discharges to waters of the U.S. Owners and operators of MS4s in 61 New Hampshire municipalities, including Derry and Londonderry, are required to apply for coverage under the MS4 permit program. In January 2017, EPA released the General Permits (GPs) for New Hampshire MS4s, which took effect on July 1, 2018 (USEPA, 2017). The MS4 general permit has special requirements for operators of MS4s that discharge to Beaver Brook, Dinsmore Brook, North Tributary to Canobie Lake, and Policy-Porcupine Brook. These requirements are detailed in Appendix F “Requirements of Approved Total Maximum Daily Loads” of the 2017 MS4 General Permits (USEPA, 2017).

NHDOT and Municipally Maintained Surfaces

Under Appendix F Part I.1 of the 2017 MS4 permit, municipalities (which includes NHDOT under this permit) must develop a Chloride Reduction Plan by July 1, 2019, which must be fully implemented by July 1, 2023. Elements of the municipal Chloride Reduction Plan, briefly, are:

- Tracking of salt applied (starting July 1, 2020)
- Planned activities for salt reduction such as:
    - Operational changes (pre-wetting, pre-treating salt stockpile, increased plowing prior to de-icing, monitoring of road surface temperature) – implemented by July 1, 2019
    - New or modified equipment
    - Staff training - implemented by July 1, 2019
    - Adoption of guidelines for application rates
    - Equipment calibration
    - Designation of no-salt and low salt zones
- Estimate of total tonnage of salt reduction expected
- Implementation schedule – full implementation by July 1, 2023.

Privately Maintained Surfaces

Private facilities that drain to an MS4 in the Upper Beaver Brook watershed also have chloride reduction requirements as specified in Appendix F Part I.1 of the 2017 NH MS4 permit and must be included within a permittee's Chloride Reduction Plan. These requirements include:

- Private parking lots with 10 or more parking spaces draining to the MS4 must be identified
- Private parking lot owners and operators and private street owners and operators are required to utilize salt applicators trained and certified in accordance with Env-Wq 2203
- Private parking lot owners and operators and private street owners and operators have to report annual salt usage within the municipal boundaries to the UNH Technology Transfer Center or directly to the permittee
- Private new development and redevelopment projects are required to minimize salt usage, and track and report amounts used using the UNH Technology Transfer Center online tool (http://www.roadsalt.unh.edu/Salt/)

2.4.2 401 Water Quality Certificate

Proponents of federal actions that propose discharges to waters of the U.S. that require a federal permit or license, such as a permit under Section 404 or Section 402 (e.g. MS4 GP) of the Clean Water Act, are required to obtain a Water Quality Certification (WQC) through Section 401 of the Clean Water Act. In New Hampshire, the NHDES Watershed Management Bureau administers this program. For projects that require a Section 404 permit from the Army Corps of Engineers and that fall under the NH Programmatic General Permit (USACE, 2017) the 401 WQC is programmatic under state WQC #2017-404P-001, and no separate application is needed. Projects that require an individual Section 404 permit from the Army Corps of Engineers must apply for a WQC from the NHDES Watershed Management Bureau.

The NHDES Watershed Management Bureau commonly requires applicants for individual WQCs to develop and adopt a BMP-based Chloride Management Plan, as discussed in "*Best Management Practices and Salt-Use Minimization Efforts in Chloride-Impaired Watersheds of New Hampshire – A Guidance Document for Private Developers and Contractors*" (NHDES, 2016). The proposed Exit 4A project would be located entirely within the Upper Beaver Brook watershed and would require an individual WQC. Accordingly, the WQC will likely require a condition that NHDOT and the Towns prepare and adopt BMP-based Chloride Management Plans similar to the Chloride Reduction Plan (Appendix F of the 2017 MS4 permit) required for the MS4 permit.

2.4.3 Alteration of Terrain Permit

The NHDES Alteration of Terrain (AoT) Bureau is also charged with oversight of the NH Water Quality Standards. The AoT Bureau issues permits for projects that disturb:

- 100,000 square feet or more,
- 50,000 square feet or more for projects within 250 feet of surface waters under the jurisdiction of RSA 483, the New Hampshire Water Quality Protection Act, or

- Projects of any size that disturb areas with a grade of 25 percent or greater within 50 feet of any surface water.

NHDOT has been granted an exemption from the requirement to obtain an individual Alteration of Terrain Permit by NHDES as detailed in an agreement signed by NHDOT and NHDES titled “Department of Transportation Terrain Alteration Permit Exemption” (NHDES, 2011b). The agreement recognizes that NHDOT projects are designed, constructed and maintained to comply with all provisions of state water quality standards under a number of state and federal regulations, standards, guidance documents, and contract provisions. These standards are listed in the agreement and are updated by NHDOT as needed:

- DOT Standard Specifications for Road and Bridge Construction, specifically Sections 107 and 645 (approved August 17, 2010)
- AASHTO “Highway Drainage Guidelines,” 4th Edition, 2007
- EPA's “Developing Your Stormwater Pollution Prevention Plan-A Guide for Construction Sites,” May 2007
- US Department of Transportation, “Best Management Practices for Erosion and Sediment Control,” June 1995
- New Hampshire Department of Environmental Services “New Hampshire Stormwater Management Manual” Volumes 1, 2 & 3, December 2008
- NHDOT “Guidelines for Temporary Erosion Control and Stormwater Management,” 2002
- NHDOT “Best Management Practices for Routine Roadway Maintenance Activities in New Hampshire,” August 2001
- NHDOT “Construction Manual”; June 1, 2006
- FHWA's “Guidance Manual for Monitoring Highway Runoff Water Quality" March 2001
- FHWA's “Urban Drainage Design Manual,” September 2009
- FHWA's “Hydraulic Design of Highway Culverts,” April 2012
- All applicable Federal Aviation Administration Advisory Circulars and Orders
- The American Railway Engineering and Maintenance-of-Way (AREMA) “Manual for American Railway Engineering and Maintenance-of Way Association,” April 2015

The construction of the proposed Project will be in compliance with all requirements imposed under the 2011 agreement.

3.0 CURRENT CONDITIONS

3.1 Impairment Status

The 2008 chloride TMDL remains in effect for Beaver Brook (AU NHRIV700061203-16). Other reaches of Beaver Brook, NHRIV700061203-11 and NHRIV70061203-09, are listed in the most recent 303 (d) list (NHDES, 2017c) as impaired for aquatic life by chloride.

3.2 Regulated Discharges

Discharges to Beaver Brook are currently regulated by the MS4 General Permit and by existing Alteration of Terrain permits for private development and municipal infrastructure, and under the 2011 agreement between NHDOT and the NHDES Alteration of Terrain program (NHDES, 2011b).

3.3 State and Municipal Chloride Loading in Upper Beaver Brook Watershed

Annual salt use within Upper Beaver Brook watershed for NHDOT and the Towns (FY01 through FY10) was summarized in the NHDES Chloride Reduction Implementation Plan (NHDES, 2011a). Table 3 presents the annual chloride loading estimates for NHDOT Patrol Shed 528 and the municipally maintained assets for the Towns of Derry and Londonderry within the Upper Beaver Brook watershed for FY01-FY16 (NHDES, 2011a; Derry, 2018; Londonderry, 2018; NHDOT, 2018). NHDOT Patrol Sheds 508, 512, 513, and 514 are also responsible for state roadway maintenance in Upper Beaver Brook watershed but are not discussed in this report as only Patrol Shed 528 maintains state roadway within the Exit 4A project area. Other sources, including other NHDOT maintained assets, private roads and private parking lots, contribute significantly to chloride loads in the watershed, and therefore the ability of the watershed to meet the established TMDL, but are not within the scope of this report and are not presented (for a comprehensive presentation of chloride loads in Upper Beaver Brook watershed see NHDES, 2011a). Table 3 includes all reported tonnage for the Beaver Brook watershed from the Town of Derry which includes 14.4 acres of municipal parking lots, as Derry does not track municipal parking lot salt application separately, and no separate tally of salt application on municipal roadways has been published by NHDES since 2011 (NHDES, 2011a). Review of the table reveals the relatively high degree of variability in annual salt loading for Patrol Shed 528, Derry, and Londonderry. As may be expected, salt loading in Upper Beaver Brook watershed is strongly correlated with winter weather (NHDES, 2011a). A weather severity index (WSI) has been used by NHDES to evaluate seasonal salt application totals relative to overall winter severity (e.g. total snowfall, total storm hours, etc.) and a positive correlation was found ($r^2 = 0.884$) over a ten year period from 2001 through 2010 (Section 4.2, NHDES, 2011a). As of 2011, NHDES reported chloride reductions were still needed in Upper Beaver Brook watershed to meet the TMDL target total annual salt imports, even with WSI adjustments to annual salt imports (NHDES, 2011a).

Table 4 presents estimates of salt loading rates for NHDOT Shed 528 and the towns of Londonderry and Derry’s municipally maintained roads. Because Derry does not track municipally maintained roads separately from their 14.4 acres of municipally maintained parking lots, all of which fall within the Beaver Brook watershed, the average salt application outside of the Beaver Brook watershed was used to calculate an estimate of the loading rate per lane mile, because it represents roadway salt use only.

Table 3. Salt Loading in the Upper Beaver Brook Watershed from NHDOT Patrol Shed 528 Maintained Roads and Municipal Sources for Derry and Londonderry: FY01 - FY16 (tons/year) (NHDOT, 2018; Derry, 2018; Londonderry, 2018)

Source	Treatment Area	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	FY11	FY12	FY13	FY14	FY15	FY16
NHDOT Patrol Shed 528	21.70 lane-miles - salt tonnage used	642	364	611	466	622	371	304	667	495	361	384	212	329	518	590	723
Derry	Beaver Brook watershed 212 lane-miles + 14.4 acres parking lots - salt tonnage used[a]	3,241	2,209	3,621	2,312	2,947	3,404	1,354	3,795	2,909	2,310	2,178	1,254	2,520	3,432	2,772	1,650
London-derry	Beaver Brook Watershed municipal roads[b]	1,229	616	1,185	638	1,212	678	535	1,170	828	607	809	353	718	1,090	879	578
	TOTAL (tons)	**5,112**	**3,189**	**5,417**	**3,416**	**4,781**	**4,453**	**2,193**	**5,633**	**4,232**	**3,278**	**3,370**	**1,819**	**3,567**	**5,040**	**4,241**	**2,951**

Notes: a – Derry tracks salt usage within the Beaver Brook watershed but does not track municipal road salt application separately from municipal parking lot salt application. As such, municipal parking lots are included in this total.

b – Londonderry does not track salt loading within the Beaver Brook watershed separately from other municipal roadways. The Londonderry Salt Reduction Plan reports that there are 77.9 municipally maintained roadway lane-miles within the Beaver Brook watershed (Londonderry, 2011). Londonderry reports that there are 368.8 total municipally maintained lane-miles in Londonderry (Londonderry, 2018). Beaver Brook Watershed municipal road salt application was calculated by multiplying Londonderry's reported salt tonnage totals by 77.9/368.8.

Table 4. NHDOT and Municipal Salt Application Rate Estimates

Source	Treatment Area and Rate	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	FY11	FY12	FY13	FY14	FY15	FY16	*AVG FY08-FY16*
NHDOT Patrol Shed 528	21.70 lane-miles - salt tonnage used	642	364	611	466	622	371	304	667	495	361	384	212	329	518	590	723	*475*
	tons/lane-mile/year	29.6	16.8	28.2	21.5	28.7	17.1	14.0	30.7	22.8	16.7	17.7	9.8	15.2	23.9	27.2	33.3	*21.9*
Derry	Non-Beaver Brook Watershed (roads only) - 118 lane-miles[a]	1,669	1,138	1,865	1,191	1,518	1,754	697	1,955	1,498	1,190	1,122	646	1,298	1,768	1,428	850	*1,306*
	tons/lane-mile/year	14.1	9.6	15.8	10.1	12.9	14.9	5.9	16.6	12.7	10.1	9.5	5.5	11.0	15.0	12.1	7.2	*11.1*
London-derry	Town-wide municipal roads only – 368.8 lane-miles	5,818	2,916	5,610	3,019	5,736	3,208	2,533	5,541	3,918	2,873	3,828	1,669	3,398	5,160	4,161	2,738	*3,698*
	tons/lane-mile/year	15.8	7.9	15.2	8.2	15.6	8.7	6.9	15.0	10.6	7.8	10.4	4.5	9.2	14.0	11.3	7.4	*10.0*

Notes: a – Salt application tonnages for Derry municipal roads outside of the Beaver Brook watershed was used to estimate lane-mile application rates. Derry reports that total lane miles maintained by the town = 329.8. Total lane miles within the Beaver Brook watershed = 212.

3.4 Beaver Brook Chloride TMDL Monitoring

A component of the 2008 Beaver Brook chloride TMDL is the requirement for in-stream monitoring to evaluate changes in water quality following approval of the TMDL (EPA, 2008). The TMDL specifies near-continuous (15 minute readings) specific conductance monitoring over a nine-year period from 2007-2016 at two water quality monitoring stations in the Upper Beaver Brook watershed to determine achievement of the TMDL. The two identified water quality stations are 10A-BVR (located on Beaver Brook at Fordway Ext. bridge) and 09-BVR (located on Beaver Brook at the outlet of Kendall Pond) as shown in Figure 1. Periodic chloride and specific conductance data exist for station 10A-BVR for the period 2002 through 2006. Nearly continuous monitoring data has since been collected at station 10A-BVR from July 2006 through June 2017 (NHDES, 2018) as presented in NHDES' annual TMDL Data Report and Quality Assurance Audit (NHDES, 2007, NHDES, 2008b, NHDES, 2009, NHDES, 2010, NHDES, 2011c, NHDES, 2012, NHDES, 2014, NHDES, 2015, NHDES, 2016b, NHDES, 2017d, NHDES, 2018). A nearly continuous data record also exists for station 09-BVR from July 2006 through June 2009 as presented in the NHDES' annual TMDL Data Report and Quality Assurance Audit (NHDES, 2007, NHDES, 2008b, NHDES, 2009).

A summary of water quality violations at the TMDL monitoring stations 10A-BVR and 09-BVR is presented in Table 5 as summarized from all available published data for the continuous specific conductance monitoring conducted in support of the Beaver Brook chloride TMDL study. The data presented were collected, quality controlled, and published by NHDES in their annual Data Report and Quality Assurance Audit. Numerous other water quality stations have been periodically monitored for chloride in the Upper Beaver Brook Watershed (see NHDES, 2007; NHDES, 2008a); however, the Beaver Brook chloride TMDL identifies attainment of chloride water quality standards at stations 10A-BVR and 09-BVR, determined by a period of continuous specific conductance monitoring, as one of the primary means for determining achievement of the TMDL (NHDES, 2008a) and is therefore presented here.

In the three years of continuous specific conductance and chloride monitoring at station 09-BVR, from July 2006 through June 2009, no acute or chronic chloride water quality violations were documented. Published data are not available beyond June 2009 at station 09-BVR. At station 10A-BVR, there are eleven years of continuous specific conductance monitoring data available and in that period there were no documented violations of the acute chloride water quality standard and there were two documented violations of the chronic chloride water quality standard as presented in Table 5. Both documented chronic chloride water quality standards violations were short in duration (5.28 days from November 29 – December 4, 2007; and 5.06 days from February 5 – February 10, 2011), as presented in Table 6. There have been no further documented chloride water quality standards violations at station 10A-BVR between February, 2011 and June, 2017 (i.e. the most recent published TMDL Data Report [NHDES, 2018]). Therefore, the TMDL monitoring data have demonstrated that the number and duration of chloride water quality standards violations have decreased since approval of the Beaver Brook chloride TMDL in 2008, with no violations documented in the past six years of published TMDL Data Reports.

Table 5. Water Quality Violations Summary at NHDES TMDL Water Quality Monitoring Station 09-BVR - Beaver Brook at Kendall Pond Outlet (42° 50' 23.04", 71° 20' 58.26")

Date Range	Number of valid specific conductance data points	Percent of reporting period with valid conductance data	Number of violations of accute chloride water quality standard (1 hr rolling average)	Number of violations of chronic chloride water quality standard (4 day rolling average)	Duration of chronic exceedance(s)
7/1/06 - 6/30/07	35,001	99.89	0	0	-
7/1/07 - 6/30/08	35,108	99.92	0	0	-
7/1/08 - 6/30/09	27,583	78.72	0	0	-
7/1/09 - 6/30/10	0	0	-	-	-
7/1/10 - 6/30/11	0	0	-	-	-
7/1/11 - 6/30/12	0	0	-	-	-
7/1/12 - 6/30/13	0	0	-	-	-
7/1/13 - 6/30/14	0	0	-	-	-
7/1/14 - 6/30/15	0	0	-	-	-
7/1/15 - 6/30/16	0	0	-	-	-
7/1/16 - 6/30/17	0	0	-	-	-

Table 6. Water Quality Violations Summary at NHDES TMDL Water Quality Monitoring Station 10A-BVR - Beaver Brook at Fordway Ext. Bridge (42° 52' 21.14", 71° 19' 46.06")

Date Range	Number of valid specific conductance data points	Percent of reporting period with valid conductance data	Number of violations of accute chloride water quality standard (1 hr rolling average)	Number of violations of chronic chloride water quality standard (4 day rolling average)	Duration of chronic exceedance (days)
7/1/06 - 6/30/07	35,001	99.89	0	0	-
7/1/07 - 6/30/08	24,253	69.03	0	1	5.28
7/1/08 - 6/30/09	34,961	99.77	0	0	-
7/1/09 - 6/30/10	35,023	99.95	0	0	-
7/1/10 - 6/30/11	27,853	79.49	0	1	5.06
7/1/11 - 6/30/12	34,637	98.58	0	0	-
7/1/12 - 6/30/13	34,357	98.05	0	0	-
7/1/13 - 6/30/14	35,018	99.94	0	0	-
7/1/14 - 6/30/15	33,260	94.92	0	0	-
7/1/15 - 6/30/16	35,118	99.95	0	0	-
7/1/16 - 6/30/17	34,587	98.71	0	0	-

Table 7. Water Quality Violation Periods at NHDES TMDL Water Quality Monitoring Stations 10A-BVR and 09-BVR

NHDES TMDL WQ Monitoring Station	Time of Start of Violation	Time of End of Violation	Duration (days)	Number of Violations
10A-BVR	11/29/2007 6:00	12/4/2007 12:45	5.28	1
10A-BVR	2/5/2011 3:45	2/10/2011 5:15	5.06	1

4.0 DIRECT IMPACTS OF THE PROPOSED ACTION

4.1 Methods

The proposed Project falls entirely within the Upper Beaver Brook Watershed. Methods used to estimate chloride loading from each potential source are as follows:

Additional chloride loading for Exit 4A was estimated by identifying which of the proposed new lane-miles, as determined by CLD Consulting Engineers (CLD)[4] would be maintained by NHDOT and the Towns. The on-off ramps and the bridge over I-93 (1.51 lane-miles or ln-mi) would be maintained by NHDOT-Patrol Shed 528. Londonderry would maintain the 2.50 ln-mi that would be located within its town boundaries while 3.59 ln-mi would be the responsibility of the Town of Derry. Salt loading for each roadway section was assumed to equal the FY01 - FY10 historic average annual salt loading rates for each entity shown in Table 3. Thus, salt loading for Exit 4A was calculated as: Average Salt Usage (tons/lane-mile/year) as calculated in Table 4 (by Entity) x Lane-Miles Maintained by Each Entity for Alternative A = Estimated Salt Loading (tons/year) for the proposed Project. The total estimated salt loading on public roadways is the sum of estimated salt loading by NHDOT plus the salt loading from the Town of Derry and Town of Londonderry.

4.2 Results and Table

The total additional annual chloride loading estimated for the proposed Project is 99.4 tons per year.

Table 8. Estimated Future Chloride Loading on Public Roadways (per Source)

Source	Average annual salt usage FY08-FY16 (Tons/Lane-Mile/Year)[a]	Lane-Miles Maintained by Each Entity for Alternative A	Estimated salt loading for Alternative A (Tons/Year)
NHDOT Patrol Shed 528	21.9	1.51	33.1
Town of Londonderry[a]	10.6	2.5	26.5
Town of Derry[b]	11.1	3.59	39.8
		Total	**99.4**

[4] CLD was purchased on August 7, 2017 and became Fuss & O'Neill, Inc. (Fuss & O'Neill).

Table Notes – a. This estimate assumes that salt application rates on all municipal lane miles within Londonderry are consistent.

b. This estimate assumes that salt application rates on all municipal lane miles within Derry are the consistent.

4.3 Chloride Mitigation

Chloride mitigation in the Upper Beaver Brook watershed is addressed for current salt users in the 2017 NH MS4 permit (USEPA, 2017), which became effective on July 1, 2018 and is discussed in Section 2.4.1. A requirement of the 2017 MS4 Permit is for permittees to develop a Chloride Reduction Plan by July 2019, as detailed in Appendix F of the permit. One of the key components to developing a successful Chloride Reduction Plan will be identifying actions (BMPs) that will be used to reduce chlorides in the watershed and achieve the waste load allocation specified in the Beaver Brook chloride TMDL. The TMDL chloride reduction implementation plan (NHDES, 2011a), developed in support of the Beaver Brook chloride TMDL, outlines a number of BMPs that can be used to achieve significant reductions in salt use by the various salt users in the watershed as discussed in Section 2.3. Many of the same salt reduction activities identified in the TMDL implementation plan are also identified in Appendix F of the MS4 permit as recommended components of a permittees required Chloride Reduction Plan. The salt reduction BMPs identified in the TMDL chloride reduction implementation plan (NHDES, 2011a) are summarized in Table 9 including the associated % chloride reduction potential for each BMP and the implementation status to date by the NHDOT and the Towns. As demonstrated in Table 9, many salt applicator BMPs which are planned or already implemented in the watershed have the potential to reduce salt use, during the specified operation, by as much as 30-50%. These actions also satisfy the salt reduction activities listed in Appendix F of the MS4 and therefore will likely be included as core components of the required Chloride Reduction Plans for NHDOT and the Towns and will likely be extended to any future actions requiring chloride mitigation, including the proposed Exit 4A Project.

The use of BMPs outlined in the TMDL chloride reduction implementation plan (NHDES, 2011) and summarized in Table 9, will likely result in significantly less salt load than could be achieved under the minimum requirements of the 2017 NH MS4 Permit, which does not require use of BMPs but rather recommends BMPs be included in a permittee's Chloride Reduction Plan (See Part I.1 of 2017 NH MS4 Appendix F). Given the current level of adoption of salt reducing BMPs in the watershed by NHDOT and the Towns, it is likely that the watershed salt load, required to be reported in 2020 per the MS4 permit, will demonstrate compliance with the TMDL waste load allocation.

Table 9. Chloride BMPs (from Table 9, NHDES, 2011a)

Chloride Reduction BMPs	Definition	Potential % Chloride Reduction[a]	Implementation Status
Pre-Wetting	Application of salt brine or proprietary chemical to dry salt as it is being applied to the roadway	20% - 30%	NHDOT – Implemented Derry – Implemented Londonderry - Implemented

Chloride Reduction BMPs	Definition	Potential % Chloride Reduction[a]	Implementation Status
Pre-Treating	Application of salt brine or proprietary chemical to dry salt either before, during, or after it has been loaded into the truck.	10% - 30%	NHDOT – Planned Derry – Planned Londonderry - Planned
Anti-Icing	Application of salt brine or proprietary chemical up to 48 hours in advance of onset of storm.	10% - 30%	NHDOT – Implemented Derry – Planned Londonderry -Planned
Zero-Velocity Spreaders	Spreader ejects salt particles at the same velocity of the forward motion of the truck's traveling speed; allowing salt to drop as if the spreading vehicle was standing still.	10% - 50%	NHDOT – Not planned Derry – Not planned Londonderry – Not planned
Groundspeed Oriented Spreader Controls	Allows accurate dispensation of prescribed salt application rates irrespective of vehicle speed. Controls can be integrated to automatically vary application rate with ground temperature. Controller units can integrate GIS and wirelessly download application rate data for review	10% - 30%[b]	NHDOT – Implemented Derry – Implemented Londonderry - Planned
Equipment Calibration	Ensures equipment application of chlorides is accurate	5 - 20%	NHDOT – Implemented Derry – Implemented Londonderry -Implemented
In-Cab Air/Ground Temp. Sensor	Installation of pavement and air temperature sensors with in-cab readout.	1% - 10%[b]	NHDOT – Implemented Derry – Implemented Londonderry - Implemented
Training, improved storage and handling practices	Training staff about various best management practices, improving storage and handling practices for loading and unloading salt	10%-25%[b]	NHDOT – Implemented Derry – Implemented Londonderry - Implemented

Notes: a. Reductions assumed do not take into account existing practices.

b. Highly dependent on existing procedures and level of adoption.

Chloride Mitigation for the Proposed Action

The Beaver Brook chloride TMDL study (NHDES, 2008) developed a daily chloride load as a function of streamflow determined to attain water quality standards. The daily load/streamflow target is problematic for managing salt applicators, given the inherent variability of daily streamflow; therefore, the TMDL study also provides an alternative expression of the maximum daily load, presented as an annual salt load (9,069 tons/year), to allow for a more realistic salt management goal and aid with implementing the TMDL. The Salt Reduction Workgroup, an interagency advisory group with representatives from NHDES, NHDOT, and other stakeholders (NHDES, 2008), is responsible for distributing the total allocation among various sectors of the Upper Beaver Brook watershed as presented in the most recent sector load allocations in the TMDL chloride reduction implementation plan (NHDES, 2011a). However, assigning sector allocations has proven to be difficult, due to the highly variable data inputs to the original TMDL, and sector allocations remain contentious. The total watershed salt allocation of 9,069 tons/year is the executable articulation of the TMDL percent reduction goal, regardless of current or future sector allocations, and is a basis for determining achievement of the TMDL.

Within the Upper Beaver Brook watershed, MS4 permittees are subject to the requirements of Appendix F of the 2017 NH MS4 permit including the requirement to "*reduce chloride discharges to support achievement of the WLA included in the applicable approved TMDL*." The Beaver Brook chloride TMDL study provides an alternative expression of the TMDL waste load allocation as an annual salt loading allowance (commonly called the "salt load allocation" of 9,069 tons salt/year (NHDES, 2008). The Beaver Brook chloride TMDL also does not "*include an allowance for future growth, so any future construction of additional roads or parking lots in the Beaver Brook watershed would necessitate additional load reductions elsewhere in the watershed*" (NHDES, 2008). Therefore, any future development in the Upper Beaver Brook watershed would be subject to the MS4 requirement for permittees to support achievement of the waste load allocation and it would be necessary to offset any exceedance of the salt load allocation that would result from future development through salt load reductions elsewhere in the watershed.

The Proposed Action will contribute an additional salt load to the watershed estimated to be 99.4 tons/year as presented in Section 4.2. This load represents 1% of the 9,069 tons/year Upper Beaver Brook watershed salt load allocation, which is a minor increase. This additional salt load is expected to be offset by NHDOT and the Towns through development and execution of Chloride Reduction Plans as required in the 2017 NH MS4. In addition, NHDOT, Derry and Londonderry plan to implement salt reducing BMPs not specified in the MS4 permit (as presented in Section 2.3) which will provide additional assurances that the Project salt load will be offset and the Beaver Brook chloride TMDL can be achieved.

5.0 INDIRECT IMPACTS OF THE PROPOSED ACTION

The proposed Project will improve access to areas currently inaccessible and will facilitate development of these areas. As such, development that will follow its completion is an indirect impact of the project. The proposed Project will likely result in additional industrial development in Derry if areas currently zoned as residential are rezoned as industrial, and if existing lower density industrial development are redeveloped. The project is also anticipated to facilitate more residential development in several towns, but particularly in Chester where 371 additional residential units are anticipated. Woodmont Commons, shown in Figure 1, is a planned, mixed-use, urban village in the Town of Londonderry. The developer, Pillsbury Realty Development, LLC, owns approximately 630 acres bordering the east and west sides of I-93. Alternative A would bisect the property. The Town of Londonderry recently granted approval of the Woodmont Commons West Phase I plan.

5.1 Methods

This analysis assumes a range of build-outs of Woodmont Commons with separate accountings for Woodmont Commons East and Woodmont Commons West (including Market Basket expansion) to clearly account for the two related but separate actions. A separate estimate for additional Derry industrial development is also provided. New private road lane-miles and parking acreage were determined by Louis Berger Group (LBG) based on the documentation provided in the Land Use Scenarios Technical Document (Louis Berger Group, 2017). Determinations for parking were made by assuming a 300 sq. ft. requirement for each expected parking space, including travel aisles associated with the parking spaces. For new private roadways, each divided roadway length was assumed to equal a single lane length while each non-divided roadway length was assumed to equal two lane lengths. Thus, the total mileage of divided streets was multiplied by one and non-divided street mileage was multiplied by two to yield total lane-miles. Existing roadways within Woodmont Commons were assumed to receive no additional salt loading, even if those roadways were to be upgraded, except when additional lane-miles were proposed.

Residential development has not been included in this calculation because the nature of residential development, including lot size and road layout, is not foreseeable. Chester is anticipated to have the largest proportion of increase in residential development, where approximately 11% of the town (1,784 acres) falls into the Upper Beaver Brook Watershed.

5.2 Results and Table

The foreseeable new parking and private roadways are summarized in Table 10. Development scenarios for the No-Build, Build (with Exit 4A) and incremental (development attributable to the project, or the difference between the Build and No-Build)

Table 10. Indirect Impacts New Parking and Roadways Summary

Develop-ment Activity	Development Scenarios with No-Build			Development Scenarios with Exit 4A			Incremental Development Attributable to Exit 4A		
	Parking (acres)	Min Build-Out Lane Miles	Max Build-Out Lane Miles	Parking (acres)	Min Build-Out Lane Miles	Max Build-Out Lane Miles	Parking (acres)	Min Build-Out Lane Miles	Max Build-Out Lane Miles
Woodmont Commons East	4.70	4.43	6.18	26.38	6.14	7.53	21.69	1.71	1.35
Woodmont Commons West	19.17	6.14	8.32	27.20	7.11	19.93	8.02	0.97	11.60
Additional Derry Industrial	0	0	0	2.38	0	0	2.38	0	0

The foreseeable new actions associated with the Woodmont Commons development will contribute to future chloride loading in the Beaver Brook watershed. Chloride loading for parking was determined using the application rate used in the "Data Report for the Total Maximum Daily Loads for Chloride For Waterbodies in the Vicinity of the I-93 Corridor From Massachusetts to Manchester, NH: Policy-Porcupine Brook Beaver Brook Dinsmore Brook North Tributary to Canobie Lake" (NHDES, 2007) of 6.4 tons/acre/year. This rate is in turn based on an analysis of salt use by maintainers of private roads and parking lots that was specifically prepared for the Beaver Brook TMDL titled "Salt Loading Due to Private Winter Maintenance Practices" (Sassan and Kahl, 2007). Sassan and Kahl established a range of 5.7 – 6.4 tons/acre/year, with 6.4 tons/acre/year being the average rate for educational institutions which had the best records of salt purchases and areas serviced. Sassan and Kahl acknowledge that there is a high degree of variability in salt application rate reporting from private applicators.

Chloride loading for new streets was determined from new lane-miles provided by LBG. Each divided roadway length was assumed to equal a single lane length while each non-divided roadway length was assumed to equal two lane lengths. Thus, the total mileage of divided streets was multiplied by one and non-divided street mileage was multiplied by two to yield total lane-miles. Existing roadways within Woodmont Commons were assumed to receive no additional salt loading, even if those roadways were to be upgraded, except when additional lane-miles were proposed. When additional lanes miles were added to existing roadways, the new lane-miles were added to the new lane-miles calculation. New chloride loading was determined using the average FY08-FY16 municipal rates, per methods described in Section 3.3.

Table 11. Salt Loading Attributable to Indirect Impacts (Tons / Year)

Develop-ment Activity	Development Scenarios with No-Build			Development Scenarios with Exit 4A			Incremental Development Attributable to Exit 4A		
	Parking	Min Build-Out	Max Build-Out	Parking	Min Build-Out	Max Build-Out	Parking	Min Build-Out	Max Build-Out
Woodmont Commons East	30.1	47.0	65.5	168.9	65.1	79.8	138.8	18.2	14.3
Woodmont Commons West	122.7	65.1	88.2	174.1	75.4	211.2	51.3	10.3	123.0
Additional Derry Industrial	0.0	0.0	0.0	15.3	0.0	0.0	15.3	0.0	0.0
Total	**152.8**	**112.1**	**153.7**	**358.2**	**140.6**	**291.0**	**205.4**	**28.5**	**137.3**
Potential Additional Salt Load Range	***264.8 – 306.5 tons / year***			***498.7 - 649.2 tons / year***			***233.9 – 342.7 tons / year***		

Under these scenarios, the salt loading from incremental development attributable to the construction of Exit 4A could range from 233.9 tons/year to 342.7 tons/year.

5.3 Chloride Mitigation

The Beaver Brook chloride TMDL establishes an annual salt load allocation as an alternative expression of the maximum daily load requirement and is used as a planning and management target for various sectors in the watershed as discussed in Sections 2.2 and 4.3. Private parking lots are designated the largest sector salt allocation, approximately 35% of the Beaver Brook watershed total salt load allocation in the most recent TMDL Implementation Plan (NHDES, 2011a). Development attributable to the construction of Exit 4A would potentially contribute 233.9– 342.7 tons of salt/year, which would comprise 2.5% - 3.8% of the total watershed allocation of 9,069 tons of salt/year.

All future development (including additional development induced by construction of Exit 4A) will require implementation of reasonable and practical BMPs to reduce chloride loading, consistent with the Chloride Reduction Plans required in the MS4 permit and/or AoT permitting (as was required for Woodmont Commons Phase I, included herein as Appendix D). The 2017 MS4 permit has additional requirements for private sector salt applicators including requiring all existing and future private parking lot and private roadway owners to only utilize salt applicators who are trained and certified according to Env-Wq-2203 Certification of Commercial Applicators, report annual salt usage to the UNH T2 Center or to the MS4 permittee, and include the private sector in a MS4 permittee’s Chloride Reduction Plan. These measures will assure reduction of salt loads in the private sector including indirect impacts as well as watershed-wide.

It is reasonable to expect the annual salt load from private roads and parking lots will decrease with adoption of the 2017 NH MS4 permit due to the salt reduction measures included in the permit. While the Beaver Brook chloride TMDL does not allow for additional future salt loads, development can occur as long as sector annual salt load allocations are met. Indirect impacts could potentially contribute a future additional salt load equivalent to 2.5% – 3.8% of the total watershed allocation and while this is not explicitly accounted for in the TMDL, it is possible for the private sector allocation, including Project indirect impacts, to still meet the allocation through adoption of BMPs. Studies have shown that salt application rates on private roads and parking lots can be reduced with BMPs (e.g. Hossein and Fu, 2015) well below the 6.4 tons/acre/year assumed for this study and as used by NHDES to develop their salt load estimates for private roads and parking lots (NHDES, 2007). Because salt application has historically not been required to be tracked in private parking lots, it is unknown whether the current salt load has been reduced to the allocation goal and if not whether the salt load increase attributable to indirect impacts will need to be further mitigated beyond the current permitting requirements. As private sector salt use data becomes available as part of the 2017 NH MS4 requirements, better assessments of the Beaver Brook salt imports compared to sector allocations will be possible and will serve to further guide management of chlorides in the private sector.

6.0 CONCLUSION

NHDOT and the Towns have been implementing salt reduction BMPs in the Upper Beaver Brook Watershed since the 2008 Beaver Brook chloride TMDL was published. NHDOT reports that they are in compliance with their Permits through execution of their respective Implementation Plans for chloride (Appendix A, page 1). Londonderry and Derry report that they are continuing with implementation of their salt reduction plans (Appendix B, Appendix C). Reasonably foreseeable actions are expected to contribute additional salt loads to the Upper Beaver Brook watershed as demonstrated in Sections 4 and 5 of this document. However, additional salt loads to the Upper Beaver Brook watershed are expected to be mitigated through the BMPs already in place and additional planned BMPs outlined in various implementation plans (NHDOT, 2009; Derry, 2011; Derry, 2016; Londonderry, 2011). The 2017 MS4 permit includes requirements for salt reduction implementation and reporting by the private sector, which contributes nearly half the total salt load to Beaver Brook (NHDES, 2011a), in Derry and Londonderry. When fully implemented, the 2017 MS4 will require all existing and future private parking lot and private roadway owners to only utilize salt applicators trained and certified according to Env-Wq-2203 Certification of Commercial Applicators and report annual salt usage to the UNH T2 Center or to the MS4 permittee.

It is anticipated that development and execution of a BMP based chloride reduction implementation plan (or plans) will be required as permit conditions to satisfy all applicable state and federal permitting requirements. BMPs required to be implemented will likely be comparable the BMPs currently implemented as part of the I-93 improvement project, with which the NHDOT reports they are in compliance, and comparable to the current BMPs implemented by the Towns. As such, the Towns and NHDOT would meet anticipated permitting requirements through extension of planned and currently utilized salt reduction BMPs.

7.0 REFERENCES

Federal Highway Administration (FHWA). 2005. Record of Decision FHWA-NH-EIS-02-01-F. I-93, Salem to Manchester IM-IR-93-1(174)0, 10418-C; Salem, Windham, Derry, Londonderry, Manchester Rockingham and Hillsborough Counties, New Hampshire. Concord, NH, June 2005.

Derry. 2011. Salt Reduction Plan for Beaver Brook. Derry, New Hampshire. 22 pp.

Derry. 2016. Salt Reduction Plan for Beaver Brook, Revision 2. Derry, New Hampshire. 11pp.

Derry. 2018. Mike Fowler, Director of Public Works. Town of Derry. Personal communication June 1, 2018.

Hossain, K. and L. Fu. 2015. Optimal Snow and Ice Control of Parking Lots and Sidewalks. A Summary Final Report. Department of Civil & Environmental Engineering. Univ. of Waterloo, Waterloo, Ontario, Canada. 27pp.

Londonderry. 2011. Salt Reduction Plan for: Beaver Brook Watershed Within the Boundaries of Londonderry. Londonderry, New Hampshire. 38 pp.

Londonderry. 2018a. Salt Reduction Best Management Practices for the Beaver Brook Watershed Within the Boundaries of the Town of Londonderry. 3 pp.

Londonderry. 2018b. Janusz Czyzowski, Director of Public Works and Engineering. Town of Londonderry. Personal Communication, June 5-6, 2018.

Louis Berger Group. 2017. Land Use Scenarios Technical Report, I-93 Exit 4A Supplemental Draft Environmental Impact Statement, 195 pp.

NHDES (New Hampshire Department of Environmental Services). 2006. Water Quality Certification in fulfillment of Section 401 of the United States Clean Water Act (33 U.S.C 1341) WQC #2002-007. NHDES, Water Division, Concord, NH. May 2, 2006.

NHDES. 2007. Data Report for the Total Maximum Daily Loads for Waterbodies in the Vicinity of the I-93 Corridor from Massachusetts to Manchester, NH: Policy-Porcupine Brook Beaver Brook Dinsmore Brook North Tributary to Canobie Lake. NHDES, Watershed Management Bureau, Concord, NH. December, 2007.

NHDES. 2008a. Total Maximum Daily Load (TMDL) Study for Waterbodies in the Vicinity of the I-93 Corridor from Massachusetts to Manchester, NH: Beaver Brook in Derry and Londonderry, NH. NHDES, Watershed Management Bureau, Concord, NH. April, 2008.

NHDES. 2008b. FY08 TMDL Implementation Monitoring Data Report and Quality Assurance Audit for the Total Maximum Daily Loads for Waterbodies in the Vicinity of the I-93 Corridor from Massachusetts to Manchester, NH: Policy-Porcupine Brook Beaver Brook Dinsmore Brook North Tributary to Canobie Lake. NHDES, Watershed Management Bureau, Concord, NH. August, 2008.

NHDES. 2009. SFY09 TMDL Implementation Monitoring Data Report and Quality Assurance Audit for the Total Maximum Daily Loads for Waterbodies in the Vicinity of the I-93 Corridor from Massachusetts to Manchester, NH: Policy-Porcupine Brook Beaver Brook Dinsmore Brook North Tributary to Canobie Lake. NHDES, Watershed Management Bureau, Concord, NH. October, 2009.

NHDES. 2010. SFY10 TMDL Implementation Monitoring Data Report and Quality Assurance Audit for the Total Maximum Daily Loads for Waterbodies in the Vicinity of the I-93 Corridor from Massachusetts to Manchester, NH: Policy-Porcupine Brook Beaver Brook Dinsmore Brook North Tributary to Canobie Lake. NHDES, Watershed Management Bureau, Concord, NH. August, 2010.

NHDES. 2011a. Chloride Reduction Implementation Plan for Beaver Brook, Derry, Londonderry, Auburn, Chester, NH. NHDES, Watershed Management Bureau, Concord, NH. August, 2011.

NHDES. 2011b. Department of Transportation Terrain Alteration Permit Exemption. NHDES, Alteration of Terrain Bureau, Concord, NH. July, 2011.

NHDES. 2011c. SFY11 TMDL Implementation Monitoring Data Report and Quality Assurance Audit for the Total Maximum Daily Loads for Waterbodies in the Vicinity of the I-93 Corridor from Massachusetts to Manchester, NH: Policy-Porcupine Brook Beaver Brook Dinsmore Brook North Tributary to Canobie Lake. NHDES, Watershed Management Bureau, Concord, NH. December, 2011.

NHDES. 2012. SFY12 TMDL Implementation Monitoring Data Report and Quality Assurance Audit for the Total Maximum Daily Loads for Waterbodies in the Vicinity of the I-93 Corridor from Massachusetts to Manchester, NH: Policy-Porcupine Brook Beaver Brook Dinsmore Brook North Tributary to Canobie Lake. NHDES, Watershed Management Bureau, Concord, NH. December, 2012.

NHDES. 2014. SFY13 TMDL Implementation Monitoring Data Report and Quality Assurance Audit for the Total Maximum Daily Loads for Waterbodies in the Vicinity of the I-93 Corridor from Massachusetts to Manchester, NH: Policy-Porcupine Brook Beaver Brook Dinsmore Brook North Tributary to Canobie Lake. NHDES, Watershed Management Bureau, Concord, NH. February, 2014.

NHDES. 2015. SFY14 TMDL Implementation Monitoring Draft Data Report and Quality Assurance Audit for the Total Maximum Daily Loads for Waterbodies in the Vicinity of the I-93 Corridor from Massachusetts to Manchester, NH: Policy-Porcupine Brook Beaver Brook Dinsmore Brook North Tributary to Canobie Lake. NHDES, Watershed Management Bureau, Concord, NH. January, 2015.

NHDES. 2016a. Best Management Practices and Salt-Use Minimization Efforts in Chloride-Impaired Watersheds of New Hampshire – A Guidance Document for Private Developers and Contractors. NHDES, Watershed Management Bureau, Concord, NH. December, 2016.

NHDES. 2016b. SFY15 TMDL Implementation Monitoring Data Report and Quality Assurance Audit for the Total Maximum Daily Loads for Waterbodies in the Vicinity of the I-93 Corridor from Massachusetts to Manchester, NH: Policy-Porcupine Brook Beaver Brook Dinsmore Brook North Tributary to Canobie Lake. NHDES, Watershed Management Bureau, Concord, NH. March, 2016.

NHDES. Onestop Datamapper. 2017a Available at: http://nhdesonestop.sr.unh.edu/html5viewer/. Accessed July 17, 2017.

NHDES. 2017b. 2016 Section 305(b) and 303(d) Consolidated Assessment and Listing Methodology. New Hampshire Department of Environmental Services. Concord, NH. November, 2017. Available at: https://www.des.nh.gov/organization/divisions/water/wmb/swqa/2016/documents/r-wd-17-08.pdf.

NHDES. 2017c. Draft 2016 List of Threatened or Impaired Waters that Require a TMDL. New Hampshire Department of Environmental Services. Concord, NH. May, 2017. Available at: https://www.des.nh.gov/organization/divisions/water/wmb/swqa/2016/documents/r-wd-17-09-app-a1.pdf.

NHDES. 2017d. SFY16 TMDL Implementation Monitoring Data Report and Quality Assurance Audit for the Total Maximum Daily Loads for Waterbodies in the Vicinity of the I-93 Corridor from Massachusetts to Manchester, NH: Policy-Porcupine Brook Beaver Brook Dinsmore Brook North Tributary to Canobie Lake. NHDES, Watershed Management Bureau, Concord, NH. June, 2017.

NHDES. 2018. SFY17 TMDL Implementation Monitoring Data Report and Quality Assurance Audit for the Total Maximum Daily Loads for Waterbodies in the Vicinity of the I-93 Corridor from Massachusetts to Manchester, NH: Policy-Porcupine Brook Beaver Brook Dinsmore Brook North Tributary to Canobie Lake. NHDES, Watershed Management Bureau, Concord, NH. April, 2018.

NHDOT (New Hampshire Department of Transportation). 2009. Implementation Plan to Increase the Efficiency and Effectiveness of Road Salt Use to Meet Total Maximum Daily Load for Chloride in Water Bodies along the I-93 Corridor from Salem to Manchester, NH: Beaver Brook; Dinsmore Brook; North Tributary to Canobie Lake; Porcupine-Policy Brook. NHDOT, Bureau of Environment, Concord, NH. September, 2009.

NHDOT. 2018. Mark Hemmerlein, Water Quality Program Manager, New Hampshire Department of Transportation. Personal communication June 1, 2018.

United States Army Corps of Engineers (USACE). 2017. General Permit No: NAE-2016-02415. USACE, Regulatory Division, Concord, MA. August, 2017. Available at: http://www.nae.usace.army.mil/portals/74/docs/regulatory/StateGeneralPermits/NH/NH%20General%20Permit%2018August2017.pdf

United States Environmental Protection Agency (USEPA). 2017. General Permits for Stormwater Discharges from Small Municipal Separate Storm Sewer Systems. Available at: https://www3.epa.gov/region1/npdes/stormwater/nh/2017-small-ms4-general-permit-nh.pdf

APPENDIX A: NHDOT BMP IMPLEMENTATION SUMMARY

New Hampshire
DOT
Department of Transportation

THE STATE OF NEW HAMPSHIRE
DEPARTMENT OF TRANSPORTATION

Victoria F. Sheehan
Commissioner

William Cass, P.E.
Assistant Commissioner

March 13, 2018

Derry-Londonderry, 13065
I-93, Exit 4A Study
[Water Quality BMP-Based Approach]

Christopher R. Bean, PE
Executive Vice President/Division Leader
CLD/Fuss & O'Neill, Inc.
540 Commercial St (South Entry)
Manchester, NH 03101

Dear Chris;

As the Exit 4A team works toward the draft Exit 4A NEPA document this spring of 2018, the Department's recommendation for our project's approach in addressing chlorides is to be consistent with TMDL Implementation plans for affected waterbodies in the Project Area (i.e.: Beaver Brook). In doing so, the qualitative analysis will need to take the following into account for the Exit 4A NEPA documentation:

1. Calculate a proposed increase in salt load for the activity, list the BMPs that can be used to mitigate the increase in salt usage, and provide project commitment to the continued employment of the BMPs in the TMDL Implementation Plans, as published, for the watershed;
2. Identify the BMPs to be included in the design and operation of the project, explain how these measures meet the requirements of the current TMDL Implementation Plans for the watershed (recommend using the narratives provided in the Implementation Plans for removal efficiencies);
3. Under Exit 4A existing conditions will need to include the operation of the I-93 fourth lane. The Department remains in compliance with the Beaver Brook TMDL Implementation Plan for chloride through the use of the following updated BMP-based approach;
    a. Consistent with the adaptive management strategy in the I-93 ROD to the EIS, the Department has continuously and diligently worked with DES to identify and adopt various chloride reduction measures to reduce salt use in the project corridor from both DOT operations, and others. DOT has met the terms and conditions of the I-93 Water Quality Certificate (WQC) and, subsequently, the Implementation Plan developed by DES following completion of the TMDL studies;
    b. Consistent with the I-93 WQC, Department has met all conditions, including specific chloride-related stipulations;
        i. Condition E-6 (chloride monitoring) – performed the requested monitoring in six non-TMDL watersheds with data reports submitted to DES through FY 2012;

ii. Condition E-7 (TMDL studies) – assisted in the development of the TMDL studies by providing funding to cover DES costs, among other efforts;
iii. Condition E-8 (implementation plan development) – assisted in testing chloride reduction measures that were later included in the Implementation Plans (see table below);
iv. Condition E-9 (implement chloride reductions in the Implementation Plans) - upgraded the Division of Operation's winter maintenance equipment for the I-93 corridor and other State-operated roads, and implemented all the various chloride reduction measures as outlined in DES' Chloride Reduction Implementation Plans (see table below).
v. Condition E-10 (DOT to implement adaptive management outlined in the I-93 ROD) - The Department contribution to additional chloride loads beyond those based on existing management practices is actually lower with anticipated reductions in the average annual road salt usage in excessive of 20% on a per lane-mile basis. This is due directly to the implementation of the suite of BMPs described in the I-93 ROD and outlined in Table 1 below.

4. With respect to the I-93 MOA, the DOT has met all the conditions specified. Consistent with the I-93 ROD and WQC, the MOA included a mechanism to fund the TMDL studies, DOT agreed to comply with the Implementation Plans, and to assist the municipalities and private sectors in complying with the Implementation Plans.

In summary, it is the Department's recommended approach for the Exit 4A NEPA document to take a qualitative approach versus quantifying the specific salt reductions (i.e.: "counting grains of salt"). As you can see from the process noted above, our maintenance commitments and activities is best addressed through the expanded use of the BMPs identified in the DES Implementation Plan for the Beaver Brook watershed. By following these DES accepted practices, the chloride reduction goals will be achieved for the Exit 4A project.

Should you have any questions, please feel free to contact me. Thanks.

Keith A. Cota, P.E.
Chief Project Manager

KAC/kac

cc: Peter Stamnas, Director of Project Development
Kevin Nyhan, Administrator, Bureau of Environment

Table 1. Chloride Reduction BMPs Implemented by NHDOT along the I-93 Roadway

Chloride Reduction BMP	Description	Elements of the Record of Decision	Included in DES Implementation Plans
Salt Accounting	DOT meticulously monitors is salt stock in each patrol shed and reports that information annually to DES	X	X
Pre-wetting	DOT applies liquid deicer to dry salt at time of application		X
Anti-Icing	DOT applies brine directly to the pavement in advance of an oncoming storm when conditions allow	X	X
Underbelly Plows	DOT utilizes these plows that enhance snow scraping / removal capabilities	X	X
Ground-speed Spreader Controllers	All DOT trucks utilized out of Shed 528[1] have ground-speed, closed loop controllers		X
Mobile Pavement Temperature Sensors	All DOT trucks located in Shed 528[1] have mobile pavement temperature sensors. Several road weather stations have also been established along I-93 corridor	X	X
Equipment Calibration	DOT annually calibrates their spreader equipment prior to each season		X
Enhanced Training	DOT provides enhanced training tracks participation via an online accounting system. Hired equipment operators are encouraged to attend	X	X
Improved Storage Practices	DOT has just completed upgrading a depot shed in Salem which has increased indoor storage capacity		X
Snow and Ice Forecasting	DOT utilizes computer software that provides forecast for plowing and salting with information feed from it Roadside Weather Information System	X	X
Enhanced Plow Blade Technology	DOT utilizes flexible plow blades that provide better road contact and enhance snow scraping / removal capabilities		X

GPS/AVL technology	All DOT spreader trucks located in Shed 528 are equipped with GPS/AVL which helps track salt usage by specific trucks and areas or interest.		X
Variable Messaging Signs	VMS have been installed to warn drivers of impending or current weather and traffic conditions and set lower speed limits		X
Enhanced Material Reporting Relative to Winter Severity	DOT has been reporting post-implementation salt usage relative to pre-implementation usage while adjusting for winter weather severity.		X

Notes: [1] Shed 528 in Derry performs winter maintenance activities along the southern I-93 corridor.

APPENDIX B: TOWN OF DERRY, NH SALT REDUCTION PLAN FOR: BEAVER BROOK REVISION 2

Town of Derry, NH

Salt Reduction Plan For:

Beaver Brook

Original Approved by Council:
Revision 1: *8/11/2011*
Revision 2: *3/9/2016*

Legal Notices:

These are General guidelines used by the Derry, NH Public Works Dept. Each decision to mobilize crews, extend operation hours, and to apply de-icing, anti-icing, and pre-treatment materials is made based on particular weather conditions, past experience, and the availability of resources and therefore may not adhere strictly to this policy.

Table of Contents

List of Tables

List of Figures

List of Appendices

1.0 Introduction

Beaver Brook has been identified as impaired by the New Hampshire Department of Environmental Services (DES) and the US Environmental Protection Agency (EPA) for chloride concentrations that exceed state and federal water quality standards. NH DES has completed a Total Maximum Daily Load (TMDL) analysis (April 2008) to quantify pollutant reductions needed to meet the state water quality standards for chlorides. The goal of the TMDL is to reduce chloride loads from all sources (municipal, state and private/commercial sources) so that water quality standards for all the designated uses affected by chloride pollution are met in all areas of the Beaver Brook watershed.

The TMDL is expressed as a load duration curve and is based on a 4-day average concentration. The units for the TMDL are expressed as tons of chloride per day. The TMDL was set at the level necessary to achieve the EPA and DES standard of 230 mg Cl/L standard which includes a 10% margin of safety in order to address impacts associated with chlorides on the instream, benthic, and riparian communities. In order to meet water quality standards, significant reductions from current chloride loading from all sources are required. The Town of Derry has agreed to implement reduction measures and improve storage, handling and application operations in order to reduce the amount of chlorides applied during snow and ice removal operations while maintaining an acceptable level of service (LOS) on roadways. See Appendix A for a copy of the approved Municipal Resolution stating same.

This salt reduction plan will serve as a general scope of work for implementation of salt reduction efforts. The Federal Highway Administration has allocated funds to assist municipalities with salt source reductions to implement the chloride TMDL in the I-93 corridor. Preparation of this Salt Reduction Plan is a prerequisite to eligibility for these funds.

For purposes of this plan, salt or chloride reduction efforts not only include simply applying less de-icing materials that contain chloride, but a series of actions that include operational changes and improvements, mechanical upgrades, outreach and awareness activities, and monitoring, all of which are designed and implemented with the result being a net decrease in chloride loading to the watershed.

It is important to note that since the development of the TMDL and prior to development of this plan, the Town of Derry has already started taking chloride reduction measures including construction of a new salt/sand storage facility and loading procedures, calibration of spreaders, preparation of a draft outreach brochure targeted at the private/commercial sectors, and periodic conductivity monitoring of select tributaries to Beaver Brook that is separate from monitoring conducted by NHDES.

<u>Beaver Brook</u> is a 4.86 mile stream segment located in Auburn, Derry, Chester, and Londonderry, NH. The associated watershed is 30.33 square miles (NHDES, Total Maximum Daily Load (TMDL) Study for Waterbodies in the Vicinity of the I-93 Corridor from Massachusetts to Manchester, NH: Beaver Brook in Auburn, Chester, Derry, and Londonderry 2008) (see figure 3).

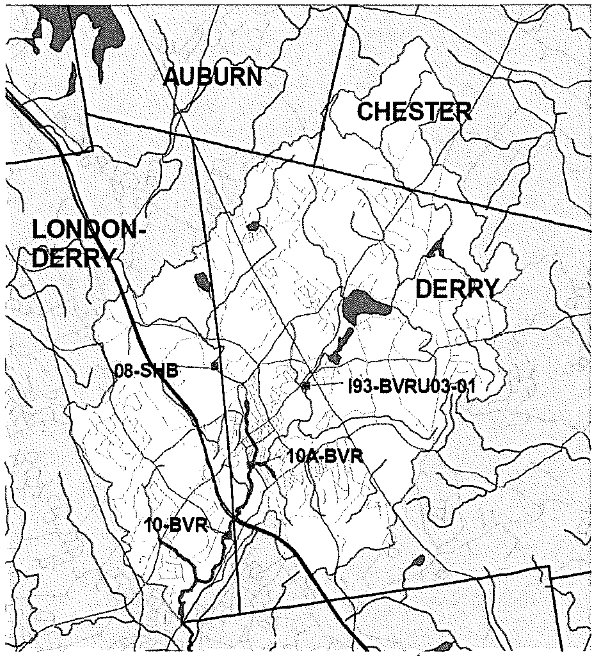

Figure 1: Beaver Brook[1]

Derry is responsible for winter maintenance on 212.78[2] lane miles (106.39 road miles) of road within the watershed. Derry maintains 29[4] parking lots (14.4 Acres – 627,483 Sq. Ft.) within the watershed. These parking lots include paved (impervious) lots associated with municipal operations (employee lots, highway and waste water facilities, fire and police stations, etc), general public use parking (town parks, municipal lots, library, cemetery, etc.) and the associated parking lot driveways

NHDOT is responsible for winter maintenance operations on approximately 53[2] lane miles within the entire Beaver Brook Watershed. Within the municipal boundaries of Derry (within the watershed) NHDOT maintains approximately 4.4 lane miles of Interstate I-93 and approximately 17.6 miles of other state routes.

Roadways and parking lots which are not maintained by Derry or DOT are classified as private. These paved surfaces are maintained each winter season by a private snow and ice removal company hired by the respective land owner. Within the watershed and within the municipal boundaries of Derry there are approximately 31.5[2] lane miles (15.75 road miles) of private roads, 270.5[3] acres of parking lots, and 9.18[3] miles of parking lot driveways as of the date of this plan. The area of parking lots and parking lot driveways is expected to increase as additional development occurs in areas approved as commercial and industrial.

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[1] Photo Credit: NHDES TMDL 2008
[2] NHDOT 2010 GIS Road Centerline File
[3] PSU Parking Lot Study
[4] Derry GIS 2010

2.0 Plan Development

The goal for the Salt Reduction Plan (SRP) is to set a policy and procedural framework to demonstrate how the Town of Derry will continuously work to improve winter maintenance operations while effectively and efficiently using road salt during snow and ice removal operations. New practices contained within this plan are intended to reduce the amount of road salt applied by the Town thus working towards meeting the Town's allocation of the required TMDL load reductions while continuing to meet town level of service (LOS).

Derry will provide winter maintenance to ensure the designated LOS to roadways, parking lots and sidewalks is maintained according to applicable state and local legislation while striving to minimize adverse impacts to the environment. These commitments will be met by:

- Adhering to the procedures contained within this Salt Reduction Plan;
- Committing to ongoing winter maintenance staff training and education;
- Reporting fiscal year salt use data to the NH DES
- Re-evaluating the effectiveness of the Salt Reduction Plan as needed to incorporate new cost-effective technologies or changes in procedures.

The SRP is meant to be dynamic to allow the municipality to evaluate and phase-in any changes, new approaches and technologies in winter maintenance activities in a fiscally sound manner.

To reduce the financial burden on municipal tax payers the town will participate in the I-93 Watersheds municipal salt reduction program developed in 2008 by the NH Department of Transportation in cooperation with the Federal Highway Administration. The program will administer a reimbursement process to assist towns with implementing TMDL load reductions. This SRP has been prepared in partial fulfillment of program requirements to address TMDL chloride load reductions.

3.0 Winter Maintenance Overview

Derry is responsible for winter maintenance on various roads and parking lots within the watershed and winter maintenance involves numerous activities, not all of which involve snow clearing or deicing. The summary below provides detail on paved surface maintained, material usage, application rates, and level of service policy. The major activities related to winter maintenance are:

Table 1: Winter Maintenance Activities

Snow Plowing	Snow Storage
Salt/Sand Spreading	Sidewalk Plowing & De-icing
Salt & Sand Storage	Install Hydrant Flags, Hydrant Clearing
Snow & Ice Removal	Drainage Clearing

The Town of Derry currently maintains 160.81[4] miles of public roads town-wide, and 14.4 acres of parking lots. Town-maintained parking lots include: town municipal offices, Derry Library, Derry Fire Dept., Derry Police Dept. Derry Transfer Station, Derry recreational parks, and a few public lots. All of the parking lots are located within the watershed, however approximately 66% of roads are within the watershed.

Table 2: Town-Wide Road Mileage Summary

Road Classification	Average Daily Traffic	Typical Road Width	Number of Lane Miles
Arterial	3,000 +	24' – 36'	56.6
Collector	1,000 – 3,000	22' – 24'	63.2
Access Street	< 500	18' – 20'	210

Note: Road classifications per NHOEP (http://www.nh.gov/oep/resourcelibrary/documents/12-roads.pdf)

Derry roads have been classified based on the average daily traffic and maintainer in order that LOS can be set for each classification of road. It should be noted that the LOS policy has remained consistent throughout the TMDL process. During snow and ice events, the LOS and operating procedures constantly change depending on numerous factors, all of which change depending on forecasts, projected road conditions, and the actual conditions observed. Some of the factors that affect the Town's LOS and OP include but are not limited to observed and anticipated precipitation rates, regular forecasts of snowfall and temperature changes throughout the storm, projected post-storm forecast (warm-up or deep freeze), time of day (solar assistance), and locality (hills or high traffic intersections). Derry also does not apply salt each time that plows are out and does not apply salt on unpaved roads. The Town's Snow and Ice Control Policy is included in Appendix B. Also included are select pages to the Town of Derry Winter Operations Booklet which is updated annually. Some pages are omitted as they include operators personal information (names and home phone numbers) which are subject to frequent changes.

Table 3: Summarized Level of Service Policy

Arterial Roads	Full width bare pavement as soon as practical after storm event terminates.
Collector Streets	Full width bare pavement as soon as practical after storm event terminates.
Access Streets	Full width bare pavement as soon as practical after storm event terminates.

Materials used in winter maintenance vary annually and are a function of winter weather severity. The table below provides an overview of average material usage. A detailed 10 year average is provided within Appendix C. The 10 year average is used to evaluate salt usage to normalize the effects of more and less severe winters. NHDOT analysis has found that a 10 year average is approximately equal to the Weather Severity Index (WSI) normalized average.

Table 4: Annual Town Wide Material Usage Summary (last 2 fiscal years)

Material	**2014/2015**	**2015/2016**	**10 Year Average**
Solids			
Rock Salt (NaCl)	5200 Tons	4200 Tons	3977 Tons

Table 5: Beaver Brook Watershed Usage

Material	**2014/2015**	**2015/2016**	**10 Year Average**
Solids			
Rock Salt (NaCl)	3772 Tons	3432 Tons	2625 Tons

Current application rates town wide are set at approximately 300 lb/lane mile (±50lb). The material applied varies from a 100% salt application to a 20-25% Salt/Sand Mix. Town-wide plow route maps are included in Appendix D.

4.0 Proposed Best Management Practices (BMPs)

4.1 Previous (Rounds 1-3) Best Management Practices Summary

Derry has demonstrated an ongoing commitment to salt reduction in several key areas

Equipment: Derry has participated in each round of federal funding for salt reduction. It has purchased a total of five (5) salt reducing plow trucks with pre-wetting sprayers, groundspeed controls, pavement temperature sensors, and instituted a calibration program to ensure accurate application.

Training: All Derry municipal operators have been trained in the Green Snow Pro Program offered by the UNH Technology Transfer Center, and the municipality regularly hosts the training in its municipal center on Manning Street. Derry Officials also supported the passage of the Voluntary Certified Salt Applicator law each time it was presented to the legislature.

Public Outreach: The town has filmed and broadcasted plow truck ride-alongs on its public access television station. It has also provided ride-alongs for the DES Salt Reduction Coordinator. Additionally Derry public television also interviewed DES and UNH salt reduction experts during a segment about the chloride contamination issues in Beaver Brook.

Total Estimated Planned reductions from rounds 1-3 are summarized below:

Table 6: Summarized Estimated Reductions from rounds 1-3

Watershed	Existing Imports[5]	Estimated Reduction	Estimated Reduction	Estimated Reduced Imports	TMDL Allocation
	Tons/Year	*Percent*	*Tons/Year*	*Tons/Year*	*Tons/Year*
Beaver Brook	2705.05	18%	486.91	2,218.14	2,264.4

4.2 Equipment Upgrade Automatic Vehicle Location

The town proposes to equip the nine (9) vehicles that operate within Beaver Brook with Automatic Vehicle Location (AVL) technology. This technology will allow the town to track the amount of salt applied on each of the salt routes dynamically. It will also log the amount of salt applied in a central database so that town staff can analyze application rates per route and storm for further optimization.

The system will also feature an in cab display where operators can view a 90 minute trail of the position of other plow vehicles. By viewing this trail operators will be able to stop spreading de-icing chemical in areas where they overlap with other plow trucks. Studies

[5] per 10 year average from Round 1

have shown greater than thirty percent reduction (30%) from overlap along in urban areas. Because Derry is somewhat rural the town is estimating a 4% reduction due to implementation of this technology.

Table 7: AVL Estimated Reductions for Round 4

Watershed	Existing Imports[6]	Estimated Reduction	Estimated Reduction	Estimated Reduced Imports	TMDL Allocation
	Tons/Year	*Percent*	*Tons/Year*	*Tons/Year*	*Tons/Year*
Beaver Brook	2,625	4%	105	2,520	2264.4

5.0 Implementation Cost & Timeline

Equipment costs reflect Derry's best estimate at this time. Costs may change due to factors beyond the town's control. The table below summarizes BMP and the associated estimated costs. It should be noted that matching funds will be compliant with 49 CFR18.24 and 49 CFR19.23.

Table 8: Estimated Cost Table – Round 4

BMP	Equipment	Estimated Cost
4.1 Equipment AVL Upgrade	Nine AVL systems including required data plan and support	$47,500
	Total Project Cost:	**$47,500.00**
	Total Federal:	**$38,000.00**
	Total Municipal Match (20%):	**$9,500.00**
	Municipal Match Due:	**$9,500.00**

Table 9: Round 4 Project Timeline

Time Period	Action
March-April 2016	Steering Committee Approval
May 2016	Budget Approval
June 2016-October 2016	Procurement
November 2016	Implementation
Notes: The town anticipates implementation for winter 2016-17. In the event that procurement is delayed the system will be implemented for winter 2017-2018.	

[6] Using Current 10 year average

6.0 Salt Usage Evaluation & Monitoring

Derry continues to monitor its salt usage with respect to TMDL compliance. Derry is committed to a multi-year program of efforts and operational modifications that would result in salt reduction with the goal of meeting TMDL load allocation requirements. It is anticipated that salt usage data will be compiled throughout the winter and be summarized and analyzed during the spring. Data will be provided to state agencies on an annual basis, and will be used in future salt reduction plans. Salt usage data will be substantiated with documentation such as invoices, cancelled checks, purchase orders, and or delivery receipts and be provided in total annual usage format based on fiscal/seasonal year on town letterhead.

DES proposes TMDL compliance will be measured using a 10 year average and confidence intervals as currently described in a DRAFT document titled "TMDL IMPLEMENTATION PLAN CONSIDERATIONS" dated April 15, 2010 prepared by NHDES and is included in Appendix E. This document is subject to change following additional Salt Reduction Workgroup discussions.

It is noted that determination of TMDL compliance hinges upon 1) monitoring conducted by DES at the compliance points and 2) DES providing Derry with compliance point monitoring data in a timely manner as it becomes available.

7.0 Summary

The town commits to providing a written report and oral presentation to the salt reduction workgroup. The town is committing to reducing is chloride imports into the Beaver Brook Watershed by implementing the BMP's contained herein.

APPENDIX A
Derry Town-Wide Municipal Salt Usage Summary
FY1991 through FY2015

Fiscal Year	Town-Wide Salt Use (tons)	10-yr aver.	5-yr aver.	Watershed Salt Use (tons)	10-yr aver.	5-yr aver.
FY15	4200	3977	3653	2772	2625	2411
FY14	5200	3914	3688	3432	2583	2434
FY13	3818	3940	3779	2520	2600	2494
FY12	1900	3952	3771	1254	2608	2489
FY11	3300	4097	3802	2178	2704	2509
FY10	3500	4258	4173	2310	2810	2754
FY09	4407	4211	4366	2909	2779	2882
FY08	5750	4041	4185	3795	2667	2762
FY07	2051	3825	4133	1354	2525	2728
FY 06	5158	4000	4392	3404	2640	2899
FY05	4465	4195	4342	2947	2769	2866
FY04	3503	3965	4056	2312	2617	2677
FY03	5486	3931	3897	3621	2595	2572
FY 02	3347	3745	3518	2209	2472	2322
FY 01	4910	3747	3608	3241	2473	2381
FY 00	3035	3516	4048	2003	2321	2672
FY 99	2708		3873	1787		2556
FY 98	3590		3965	2369		2617
FY 97	3796		3972	2505		2622
FY 96	7110		3886	4693		2565
FY 95	2160		2984	1426		1970
FY 94	3171			2093		
FY 93	3625			2393		
FY 92	3365			2221		
FY 91	2600			1716		

Note: Fiscal Year runs July 1 through June 30
i.e., FY10 is July 1, 2009 through June 30, 2010

APPENDIX C: TOWN OF LONDONDERRY, NH SALT REDUCTION BEST MANAGEMENT PRACTICES FOR THE BEAVER BROOK WATERSHED WITHIN THE BOUNDARIES OF THE TOWN OF LONDONDERRY

Town of Londonderry, NH

Salt Reduction Best Management Practices

For

The Beaver Brook Watershed
Within the Boundaries of the Town of Londonderry

The Town of Londonderry currently maintains a total of 186 miles of public roads and 26 acres of parking lots throughout the town. Londonderry is responsible for winter maintenance of 78 lane miles (39 road miles) of town owned roads within the Beaver Brook watershed. Londonderry also maintains 2 municipal parking lots (2.4 Acres) within the Beaver Brook watershed.

Londonderry provides winter maintenance to town roadways and parking lots in accordance with Londonderry's "Winter Maintenance Snow and Ice Control Policy" while striving to minimize adverse impacts to the environment. These efforts are met by:

- Adhering to the procedures contained within the Town's Salt Reduction Plan (SRP)
- Committing to ongoing winter maintenance staff training and education
- Reporting fiscal year salt use data to the NH DES
- Re-evaluating the effectiveness of the SRP as needed to incorporate new technologies or changes in procedures.

The goal of the Salt Reduction Plan (SRP) is to provide procedural framework for the Town of Londonderry to continuously strive to improve winter maintenance operations while effectively and efficiently using road salt during snow and ice removal operations. New practices, mechanical upgrades, outreach and awareness activities contained within the SRP plan are intended to reduce the amount of road salt applied therefore working towards decreasing chloride loading to the watershed and meeting the required TMDL.

The SRP is meant to be dynamic to allow the municipality to evaluate and phase-in any changes, new approaches and technologies in winter maintenance activities in a fiscally sound manner.

The town purchased five 6-wheel dump trucks with underbelly (dump/spreader combination) discharge spreaders also equipped with sprayers to prewet salt and a ground speed oriented spreaders. The trucks primarily are used in four plow routes of municipally maintained roads within the Beaver Brook watershed. In addition to the prewetting equipment the trucks are equipped with a pavement temperature sensor with in cab readout.

Spreader Control Units are used to calibrate and accurately dispense material regardless of vehicle speed. The controllers are capable of controlling pre-wetting equipment, ground speed oriented spreaders, and temperature sensor data. The units allow management to set application rates which will automatically change with vehicle speed and ground temperature. Prescribed application rates may only be changed with an administrative password.

Londonderry calibrates each spreader unit prior to the winter season using manufacturer information. Calibrated settings are logged in a master sheet, and stored inside the vehicle. Prior to each storm each truck is checked to verify that settings are calibrated to dispense the proper amount of chemical. Each unit is re-calibrated at least once during the season, and hydraulically controlled units are re-calibrated whenever the hydraulic system is altered or maintained.

Properly calibrated equipment ensures that each spreader is dispensing the appropriate amount of material for each storm. This practice reduces waste and improves efficiency of chemical dispensation

In-Cab Air/Pavement Temperature Sensor Unit provides air and pavement temperature readings on an in-cab display and integrate into the spreader control unit.

Electronically Controllable Hydraulic Valves allows the controller to adjust auger and spinner speeds.

In addition the town maintains a log of salt usage for snow plow routes to tabulate salt usage.

Londonderry takes advantage of NHDOT's knowledge based on the States application rates and best practices to aid in the success of the Salt Use Reduction.

Londonderry requires that all town staff and private contractors hired by the town attend salt reduction trainings. Londonderry is planning to engage in a public outreach program including sending mailers to local business owners encouraging them to require their winter maintenance contractors to attend salt reduction training. A website and local Access TV program will be created to educate homeowners and homeowner associations town-wide about proper salt use. The town will post informational brochures and best management practices information on town websites and in town hall. The town may also investigate other avenues such as posting winter driving tips in the town high school, and speaking to new drivers about safe winter driving. The town will also communicate with the local bus company. In addition the town will communicate with the private contractors who the town is aware of and encourage them to attend training. Londonderry strongly supports a program requiring the certification of private sector salt applicators.

The goal of the outreach program is to increase awareness and encourage private sector applicators to become trained and implement best practices. Outreach to new drivers and local bus companies is the first step in changing driver expectation within town and could result in less salt use in the long term.

Londonderry upgraded a contract with a meteorological service Precision Weather Forecasting to obtain custom storm forecasts for the community, with the capability of viewing and printing weather reports for use during winter storm events. This more accurate information results in more efficient salt use and applications at key points during the storm.

The town is committed to the efforts of reducing its chloride imports into the Beaver Brook Watershed by implementing the BMP's as described above.

Z:\Salt Reduction\Salt Reduction BMP - Beaver Brook Watershed\Salt Reduction BMP - Beaver Brook Watershed - March 2018.doc

APPENDIX D: WOODMONT COMMONS PHASE I CHLORIDE MANAGEMENT PLAN

NHDES

The State of New Hampshire
Department of Environmental Services

Clark B. Freise, Assistant Commissioner

February 15, 2017

Pillsbury Realty Development, LLC
Attn: Ari Pollack
214 North Main Street
Concord, New Hampshire 03301

RE: Woodmont Commons, Planned Unit Development
Garden Lane and Pillsbury Road
Tax Map 10, Block 41, 52, 54-1, Londonderry, NH

Permit: AoT-1213

Dear Applicant:

Based upon the plans and application, approved on February 15, 2017, we are hereby issuing RSA 485-A:17 Alteration of Terrain Permit AoT-1213. As part of the processing of this application, DES grants approval to waiving specific requirements of Rule Env-Wq 1507.04, *Groundwater Recharge Requirements*, finding that generally elevated groundwater elevations at the site preclude reasonable opportunities to recharge groundwater, and finding that some recharge will be achieved at proposed filtration basins. It was further determined that granting the waiver would not have an adverse impact on the environment, public health, public safety, or abutting properties, and that granting the request is consistent with the intent and purpose of the rule waived. Additional documentation relative to the waiver requested is contained within the file. This permit is subject to the following conditions

1. Activities shall not cause or contribute to any violations of the surface water quality standards established in Administrative Rule Env-Wq 1700.

2. You must submit revised plans for permit amendment prior to any changes in construction details or sequences. You must notify the Department in writing within ten days of a change in ownership.

3. You must notify the Department in writing prior to the start of construction and upon completion of construction. Forms are available at: http://des.nh.gov/organization/divisions/water/aot/categories/forms.htm. **If any underground detention systems, infiltration systems, or filtering systems are installed, a letter must be provided, signed by a qualified engineer, stating that the individual observed such system(s) prior to such system(s) being backfilled, and that in his or her professional opinion, such system(s) conform to the approved plans and specifications.**

4. The plans, latest revision dated February 13, 2017, and supporting documentation in the permit file are a part of this approval.

5. **This permit expires on February 15, 2022.** No earth moving activities shall occur on the project after this expiration date unless the permit has been extended by the Department. If requesting an extension, the request must be received by the department before the permit expires. The Amendment Request form is available at: http://des.nh.gov/organization/divisions/water/aot/categories/forms.htm

6. This permit does not relieve the applicant from the obligation to obtain other local, state or federal permits that may be required (e.g., from US EPA, US Army Corps of Engineers, etc.). Projects disturbing over 1 acre may require a federal stormwater permit from EPA. Information regarding this

permitting process can be obtained at: http://des.nh.gov/organization/divisions/water/stormwater/construction.htm.

7. **All stormwater practices shall be inspected and maintained in accordance with Env-Wq 1507.08 and the project Inspection and Maintenance (I&M) Manual.** All record keeping required by the I&M Manual shall be maintained by the identified responsible party, and be made available to the department upon request.

8. Winter snow and ice management activities shall be in accordance with the Chloride Management Plan, Woodmont Commons – Planned Unit Development, Londonderry, New Hampshire, received by the Department on October 18, 2016.

9. If applicable, no activity shall occur in wetland areas until a Wetlands Permit is obtained from the Department. Issuance of this permit does not obligate the Department to approve a Wetlands Permit for this project.

Sincerely,

Ridgely Mauck

Ridgely Mauck, P.E.
Alteration of Terrain Bureau

cc: Londonderry Planning Board

ec: TFMoran, Inc.

WOODMONT COMMONS – PLANNED UNIT DEVELOPMENT
LONDONDERRY, NEW HAMPSHIRE

Chloride Management Plan

Winter Operational Guidelines

The following Chloride Management Plan is for the Woodmont Commons Planned Unit Development in Londonderry, New Hampshire. The Plan includes road salt source reduction methodologies in the categories of: road salt equipment specifications, certification requirements, stormwater management efforts, public awareness efforts, and road salt usage and monitoring requirements. Due to the evolving nature of chloride management efforts, the Chlorides Management Plan will be periodically reviewed to reflect the current management standards.

1.0 Background Information

The Woodmont Commons live-work-play development is mostly located within the Beaver Brook Watershed in Londonderry and Derry, New Hampshire. In 2006, the New Hampshire Department of Environmental Services (NHDES) and the US Environmental Protection Agency (EPA) designated the Beaver Brook Watershed, and three additional watersheds along the I-93 corridor, as impaired watersheds due to locational chloride concentrations that exceed the Total Maximum Daily Load (TMDL) in portions of each watershed. Further studies within these watersheds identified the sources of chloride loading as winter operational use of de-icing, anti-icing and pretreatment materials applied for the removal of snow and surface maintenance. These studies further attributed the primary sources of chloride loading to three major user groups. Within the I-93 corridor, approximately 10-15% of the overall chloride load was attributed to winter operational activities on State roads. Public and private sector user groups, the additional two groups identified, equally accounted for the remaining portion of the chloride load.

In an attempt to reduce chloride loading derived from the use of de-icing, anti-icing and pretreatment materials applied for the removal of snow and surface maintenance within the Beaver Brook Watershed, the Towns of Londonderry, Auburn, Chester, and Derry, in conjunction with the New Hampshire Department of Transportation, have developed salt reduction plans for each of the four towns within the Beaver Brook Watershed. According to the Salt Reduction Plan for the Town of Londonderry, and the additional supporting documents used to develop the plan, source reduction is identified as the most effective method for reducing chloride loading in the Beaver Brook Watershed. The primary source reduction methodologies outlined in the Salt Reduction Plan focus on increased education opportunities for municipal employees and private contractors involved with winter operational activities, more accurately calibrated application methods, enhanced forecasting, improved surface monitoring technologies, and public outreach efforts that include measures to ensure that the private sector entities located within the Beaver Brook Watershed continually adhere to the current standards.

Included in the Salt Reduction Plan for the Town of Londonderry is the NHDES Watershed Management Bureau, 2010 Draft TMDL Implementation Plan Considerations document. In this document is a table for how the TMDL allocations are broken down in each of the four impaired watersheds. For the Beaver Brook Watershed, the ten year rolling average TMDL of 5,863.4 tons/year is distributed between NHDOT I-93, NHDOT other roads, Londonderry Municipal, Derry Municipal, Chester & Auburn, Londonderry Private, Derry Private, Londonderry Future, and Derry Future. The Plan further identifies that within the Beaver Brook Watershed the Town's objective is to reduce chloride imports by 5% annually to achieve the ten year rolling average TMDL allocation.

In keeping with these expectations, the Town of Londonderry worked closely with the Woodmont Commons Management Team to ensure that the Master Plan reflected the objectives outlined in the Salt Reduction Plan for the Town of Londonderry.

2.0 Operational Guidelines – Chloride Management

All Woodmont Commons Team Managers are responsible for assisting in meeting compliance for the following protocols. It is important to note that portions of the Woodmont Commons Property is NOT located in the portion of the Beaver Brook Watershed that is impaired, runoff water leaving the property does pass through the impaired portion of the watershed. Woodmont Commons Team Managers are expected to minimize the effects of the use of de-icing, anti-icing and pretreatment materials by adhering to the strict guidelines outlined below.

The Woodmont Commons winter operational de-icing, anti-icing and pretreatment materials will adhere to the following protocols:

2.1 Private Maintenance Contracting Equipment Requirements and Training

Woodmont Commons serves as a model for private sector participation by committing to contract with snow removal maintenance providers who have been trained and are knowledgeable of the Best Management Practices (BMPs) for snow removal under reduced salt applications. Each Woodmont Commons Team Manager is responsible to know and be up to date on the current standards for snow removal under reduced salt applications. These practices are published and updated by the UNH Technology Transfer (T2) program.

All Woodmont Commons Team Managers directly involved with winter operational activities, and all private contractors engaged at the Woodmont Commons premises for the purposes of winter operational snow removal and surface maintenance, must be current UNHT2 Green SnowPro Certified operators or equivalent, and will use only pre-approved methods for spreading abrasives on private roadways and parking lots. When a salt aggregate or brining solution is applied for the purposes of snow removal or surface maintenance, it will adhere to the current BMP standard, including pre- treatment and ground speed-controlled spreaders as outlined in the NHDES August 2011 Salt Reduction Implementation Plan for the Beaver Brook Watershed.

2.1.1 Minimum Specification Requirements for De-icing, Anti-icing and Pretreatment Equipment

All private contractors engaged at the Woodmont Commons premises for the purposes of winter operational snow removal and surface maintenance, must be current UNHT2 Green SnowPro Certified operators or equivalent. All equipment utilized on the Woodmont Commons premises for the purpose of winter operational snow removal and surface maintenance will conform to the following specifications.

2.1.1.1 Material Spreader Control Unit

All equipment utilized for the application of road salt aggregate shall be equipped with a spreader control unit with the ability to calibrate and accurately dispense aggregate materials at a uniform density and frequency based on the forward rate of the vehicle or equivalent spreader carrier unit. At a minimum, acceptable spreader control units will include the capacity to control salt aggregates, pre-wetting equipment, ground speed orientation, and air/ground surface temperature data. The unit will also allow Woodmont Commons Operational Management password access to confirm and set calibration limits which will automatically adjust to the vehicle/carrier speed and ground surface temperature.

2.1.1.2 Brining Equipment Control Unit

All equipment utilized for the application of brining and pre-wetting solution shall be equipped with a spreader control unit with the ability to calibrate and accurately dispense brining and pre-wetting solution at a uniform density and frequency based on the forward rate of the vehicle or equivalent carrier unit. At a minimum, acceptable spreader control units will include the capacity to directly interface with salt aggregate equipment, pre-wetting equipment, ground speed orientation, and air/ground surface temperature data. The unit will also allow Woodmont Commons Operational Management password access to confirm and set calibration limits which will automatically adjust to the vehicle/carrier speed and ground surface temperature.

2.1.1.3 Air/Ground Surface Temperature Monitors

All vehicle/carriers utilized for the application of road salt aggregate or brining and pre-wetting solution shall be equipped with an annually calibrated and operational air/ground surface temperature monitor capable of providing in-cab operator displays and automatic interface with a compatible spreader control unit. At a minimum, acceptable air/ground surface temperature monitor units will include the capacity to interface with spreader control units and be compatible with salt aggregate equipment, pre-wetting equipment, and air/ground speed orientation data. The unit will also allow Woodmont Commons Operational Management access to confirm and/or calibrate limits to ensure accurate interface with the vehicle/carrier speed and ground surface temperature function.

2.1.1.4 Electronically Controlled Hydraulic Valve Unit

All equipment utilized for the application of road salt aggregate or brining and pre-wetting solution shall be equipped with an electronically controlled hydraulic valve unit capable of providing in-cab operator displays and automatic interface with a functional spreader control unit. At a minimum, an acceptable electronically controlled hydraulic valve unit will include the capacity to interface with a vehicle/carrier spreader control unit that automatically adjusts salt aggregates, pre-wetting equipment, ground speed orientation, and ground surface temperature data. The unit will also allow Woodmont Commons Operational Management access to confirm and/or calibrate limits to ensure accurate interface with the vehicle/carrier spreader control interface.

2.1.2 Equipment Calibration Requirements

All equipment utilized on the Woodmont Commons premises for the purpose of winter operational snow removal and surface maintenance will conform to the following calibration requirements.

2.1.2.1 Annual Calibration Requirements

All private contractors engaged at the Woodmont Commons premises for the purpose of winter operational snow removal and surface maintenance shall provide two copies of the annual calibration report for each piece of equipment utilized on the Woodmont Commons premises. Each calibration report shall include the vehicle/carrier VIN number and the serial numbers for each component including, but not limited to, spreader control units, salt aggregate spreader equipment, brining/pre-wetting equipment, ground speed orientation unit, and air/ground surface temperature monitor. Annual calibration reports will be available on file in the Woodmont Commons Property Management Building and be present in the vehicle/carrier at all times. Prior to each use, each vehicle/carrier operator will perform a systems check to verify that unit settings remain within the guidelines established by the Woodmont Commons Management Team in order to accurately dispense material. All private contractors engaged at the Woodmont Commons premises for the purpose of winter operational snow removal and surface maintenance will be subject to spot inspections by members of the Woodmont Commons Management Team to ensure that each vehicle/carrier is operating in a manner consistent with the guidelines set herein or State and Municipal regulations. All units will be recalibrated and the updated calibration reports will be provided each time repairs or maintenance procedures affect the hydraulic system of the vehicle/carrier.

2.1.3 Winter Operator Certification Requirements

All private contractors engaged at the Woodmont Commons premises for the purpose of winter operational snow removal and surface maintenance must be current UNHT2 Green SnowPro Certified operators or equivalent, and will use only pre-approved methods for spreading abrasives on private roadways and parking lots. All private contractors engaged at the Woodmont Commons premises for the purpose of winter operational snow removal and surface maintenance shall provide to Woodmont Commons management two copies of the annual UNHT2 Green SnowPro certificate or equivalent for each operator utilized on the Woodmont Commons premises. The annual UNHT2 Green SnowPro certificate or equivalent for each operator will be available on file in the Woodmont Commons Property Management Building and be present in the vehicle/carrier at all times.

2.2 Improved Weather Monitoring

Woodmont Commons will coordinate weather information for use by winter maintenance contractors. This information in conjunction with site specific air/ground surface temperature monitoring will ensure that private contractors engaged at the Woodmont Commons premises for the purpose of winter operational snow removal and surface maintenance will make more informed decisions as to when and to what extent de-icing, anti-icing and pretreatment materials are applied to private roadways, sidewalks, and parking lots.

2.3 Increased Mechanical Removal Capabilities

Woodmont Commons will endeavor to use mechanical removal means on a more frequent basis for roadways, parking lots and sidewalks. Dedicating more manpower and equipment to increase snow removal frequencies prevents the buildup of snow and the corresponding need for de-icing, anti-icing and pretreatment materials. Shortened maintenance routes, with shorter service intervals, will be used to stay ahead of snowfall. Minimized snow and ice packing will reduce the need for abrasives, salt aggregates, and/or brining solution to restore surfaces back to bare surface states after winter precipitation events.

After storm events the Woodmont Commons management team will be responsible for having the streets swept to recapture unmelting de-icing materials, when practical.

2.4 Public Awareness Campaign

Woodmont Commons will inform all future developers, grantees, and tenants at the Woodmont Commons development of the need to reduce the use of de-icing, anti-icing and pretreatment materials on roadways, parking lots, and sidewalks.

2.5 Summary

The above-described methodologies are incorporated into the Woodmont Commons Operational Manual and are to be used to qualify and retain all private contractors engaged at the Woodmont Commons premises for the purpose of winter operational snow removal and surface maintenance. This section of the Manual, as with the Town of Londonderry's Salt Reduction Plan, is intended to be an adaptive management document that is modified as required based on experience gained from past practices and technological advancements that reflect chloride BMP standards. Each member of the Woodmont Common Management Team is required to review this document and the current standard Best Management Practices published by the UNH Technology Transfer (T2) program annually. Each member of the Woodmont Commons Management Team directly involved with winter operational guidelines is required to be certified as a UNHT2 Green SnowPro or equivalent and undergo the necessary requirements to maintain this certification annually.

3.0 Stormwater Management

Wherever applicable, stormwater in locations subject to winter operational de-icing, anti-icing and pretreatment materials will be directed to the Woodmont Commons Tiered Stormwater Management System. The Woodmont Commons Stormwater Management System is designed using a comprehensive stormwater management philosophy designed to retain and treat stormwater based on land use. Stormwater volumes and pollutant signatures vary based on land use. By identifying the potential stormwater characteristics based on the land use, stormwater management efforts may be designed to remediate stormwater pollutants at the source level prior to conveying the stormwater down gradient for additional treatment.

3.1 Woodmont Commons Tiered Stormwater Management System Overview

The Tiered Stormwater Management Plan for the Woodmont Commons Planned Unit Development (PUD) is a multifaceted proposal composed of stormwater systems at the **Site Level** and **Area Level.** These stormwater land-use goals can layer with additional land-use goals such as landscaping requirements, greenspace, greenway, active recreational, and passive open space components as defined in sections 2.4.6 PUD Site Plan Landscape Requirements and 2.3.6 Conserved Green Space and Shared Open Space Standards of the Woodmont Commons PUD Master Plan accepted by the Town of Londonderry on September 11, 2013.

Site Level stormwater management systems will focus on removal of total suspended solids (TSS), and if/where soil conditions are suitable, bio-remediation will be implemented to capture excess nutrient loads and other contaminants typically found in residential stormwater runoff.

Area Level systems will be spaced and sized to receive the stormwater from the Site Level systems, while extending the treatment processes and resonance period of the stormwater treatment.

The **Area Level** systems will detain and release the treated stormwater outside of the PUD area consistent with the rates of discharge prior to the project. The **Area Level** systems will provide additional filtration and macro nutrient removal as the base rate of flow is slowed. The plants and microbial species selected will promote long-term nutrients entrainment and incorporate elements of vegetation to maintain optimum wildlife values, and bacterial and mycoremediation rates.

Much of the stormwater from the PUD on the west side of I-93 will discharge to Duck Pond in the southwest corner of the Woodmont Common's property. The Duck Pond impoundment will be enhanced consistent with the Master Plan to promote recreational opportunities for the surrounding communities in a successional trajectory that is best suited to sustain the resource into the future.

4.0 Salt Usage Evaluation and Monitoring

The Woodmont Commons Management Team is committed to an ongoing Chloride Management Plan to aid the Town of Londonderry in its efforts towards reducing chloride imports into the Beaver Brook Watershed. All private contractors engaged at the Woodmont Commons premises for the purpose of winter operational snow removal and surface maintenance shall provide two copies of the standardized Storm Report, which includes detailed information regarding treatment areas and the use of de-icing, anti-icing and pretreatment materials applied for the removal of snow and surface maintenance on the Woodmont Commons premises. Each spring, Woodmont Commons will submit a Summary Document, including copies of the Storm Reports, operator certifications, equipment used for roadway and sidewalk winter maintenance, calibration reports and amount of de-icing materials used, to the Town of Londonderry Department of Public Works for their use in documenting the chloride usage in the Beaver Brook Watershed.

5.0 Chloride Management Plan Summary

The Woodmont Commons Management Team is committed to maintaining written documentation and adaptive management solutions for the Town of Londonderry to supplement in its efforts towards reducing chloride imports into the Beaver Brook Watershed. These efforts include minimizing chloride imports into unimpaired portions of the watershed by the implementation and enforcement of the BMP standards outlined above in section 2.0 Operational Guidelines – Chloride Management; implementation and maintenance of the efforts outlined above in section 3.0 Stormwater Management; and the adherence and adaptive management efforts outlined above in section 4.0 Salt Usage Evaluation and Monitoring.

Appendix I: 2014-2015 Vernal Pool Assessment Report

<u>2014-2015 Vernal Pool Assessment Report for NHDOT</u>

March 2016

Hyrax-Pillsbury Property
East of I-93, Londonderry, NH

A vernal pool assessment was conducted from May 2014 through June 2015 on the 200-plus acre parcel of land owned by Hyrax Derry Partners LLC and Pillsbury Realty Development LLC (Hyrax-Pillsbury) located to the east of Interstate 93 in Londonderry, New Hampshire (the Property). This was a joint effort between Stable Growth Environmental LLC (SGE), Northeast Wetland Restoration (NWR) and Stoney Ridge Environmental LLC (SRE), with field work completed by Michael Parsont (NH Certified Wetland Scientist), Gerard Thomas (Wildlife Biologist), Richard Bolton (Wildlife Biologist) and Geoffrey Wilson (Urban Forester).

This assessment was performed five years after a prior study was conducted by Normandeau Associates (Normandeau) in April-May 2009. Locations of the pools identified on or immediately adjacent to the Property by Normandeau were documented in their Hyrax Wetland Delineation Report, dated September 2011, which utilized the data collected by Normandeau staff from the 2009 vernal pool survey. In June-July 2013, SGE/NWR initially visited the 2009 pool sites, as reported in 2011. These sites were further assessed in the field by SGE/SRE during the vernal pool amphibian breeding season in May 2014; by SGE towards the end of the two-month required hydroperiod in early June 2014 and to assess pool permanency in September 2014; by SGE/SRE during the vernal pool amphibian breeding season in May 2015; and by SGE in early-mid June 2015.

By definition, vernal pools are required to hold water for at least two continuous months in the spring and/or summer, and are intended to be seasonal not permanent (see enclosed State and Federal vernal pool definitions). Therefore, to designate a pool site as a “vernal pool”, a minimum of two field observations in the same year are necessary to document the wet/dry cycle, one of which must be during the vernal pool amphibian breeding season to identify the presence of indicator species and the other should occur later within two months following spring ice-out.

Enclosed with this report is a figure prepared by CLD Consulting Engineers, Inc. (CLD) that shows the locations of the 2009 vernal pools (identified by Normandeau in the September 2011 report as on or immediately adjacent to the Property) that are within the limits CLD defined for this report. A table is enclosed that identifies these 2009 vernal pools. Subsequent columns in this table include: (1) relevant information taken from Normandeau’s 2011 chart; (2) indicators present as identified on Normandeau’s 2009 data forms; (3) indicators present in May 2014; (4) if water was present in June 2014; (5) if water was present in September 2014; (6) indicators present in May 2015; (7) if water was present in June 2015; and (8) comments. The comments include: 2006 indicators data from a Woodlot Alternatives Inc. study (for ten of the 2009 vernal pools), distinctions between the Normandeau 2011 report and the 2009 data forms, additional 2014-2015 considerations and pool quality determination. The Woodlot Alternatives information was obtained from the 2006 Draft Environmental Impact Statement, which states the study was comprised of one visit to each pool in late April 2006 with no follow-up visits.

Precipitation records for Concord, New Hampshire, from 1868 to present, show that 2005 (57 inches) and 2006 (55 inches) were the second and third highest precipitation years on record to date, respectively. Additionally, 2008 (58 inches) was the highest precipitation year to date, while 2009 had 47 inches total, which was well above the average of 41 inches. Meanwhile, 2012 and 2013 were average (40 and 41 inches respectively), 2014 was above average (46 inches) and 2015 had been well below average at the time of the final pool assessments (10 inches to May 31, 2015, with the average being 16 inches through that date).

There are a total of eleven pool locations identified on the enclosed table. An SGE NH Vernal Pool Determination/Assessment Data Form is enclosed for each of these locations. Based on the information obtained during the 2014-2015 field assessments, two of these 2009 pool locations did not meet the State criteria or the Federal criteria to be considered vernal pools in 2014-15 (VP 41B and VP 43). They either had insufficient indicators present and/or an insufficient hydroperiod. Also, one of these pools (VP 41B) appeared to be isolated and not part of a wetland. The remaining nine vernal pools are identified as VP 2, 3, 4, 5, 6, 7, 8, 42 and 46.

Finally, a table is included showing all of the vernal pools in the study area.

Env-Wt 101.105 "Upland buffer" means an area of land that is contiguous to a jurisdictional resource and that contributes to the functions and values of that resource.

Source. (See Revision Notes #2 and #3 at chapter heading for Env-Wt 100) *#8340, eff 4-25-05;* renumbered by #9094 (from Env-Wt 101.96 to Env-Wt 101.97); renumbered by #9131 (from Env-Wt 101.97 to Env-Wt 101.100); renumbered by #9713 (from Env-Wt 101.100 to Env-Wt 101.106)

Env- Wt 101.106 "Vernal pool" means a surface water or wetland, including an area intentionally created for purposes of compensatory mitigation, which provides breeding habitat for amphibians and invertebrates that have adapted to the unique environments provided by such pools and which:

(a) Is not the result of on-going anthropogenic activities that are not intended to provide compensatory mitigation, including but not limited to:

(1) Gravel pit operations in a pit that has been mined at least every other year; and

(2) Logging and agricultural operations conducted in accordance with all applicable New Hampshire statutes and rules; and

(b) Typically has the following characteristics:

(1) Cycles annually from flooded to dry conditions, although the hydroperiod, size, and shape of the pool might vary from year to year;

(2) Forms in a shallow depression or basin;

(3) Has no permanently flowing outlet;

(4) Holds water for at least 2 continuous months following spring ice-out;

(5) Lacks a viable fish population; and

(6) Supports one or more primary vernal pool indicators, or 3 or more secondary vernal pool indicators.

Source. *#9131, eff 4-19-08*; renumbered by #9713 (from Env-Wt 101.99 to Env-Wt 101.105)

Env-Wt 101.107 "Watercourse" means any surface water that:

(a) Develops and maintains a defined scoured channel, with evidence of sediment transport, that:

(1) Is greater than 75 feet in length; or

(2) Is of any length and connected to another jurisdictional area at either end; and

(b) Is not a drainage swale.

Source. *#9713, eff 5-12-10*

Env-Wt 101.108 "Watershed" means a geographical area in which all water drains to a given stream, lake, wetland, estuary, or ocean.

Source. (See Revision Notes #2 and #3 at chapter heading for Env-Wt 100) *#8340, eff 4-25-05;* renumbered by #9094 (from Env-Wt 101.97 to Env-Wt 101.98); renumbered by #9131 (from Env-Wt 101.98 to Env-Wt 101.101);

	facilitate moorage of vessels where such areas have been established for that purpose by the U.S. Coast Guard, provided: • Placement in the area is away from vegetated shallows • If the above isn't possible, proper/eco-friendly moorings are used so chains or other connections don't rest on the bottom in veg. shallows15. • Float stops, chains, or other devices must be used to provide ≥2.5-foot clearance between the bottom of the float and the substrate during all tides Scientific measurement devices, and small weirs and flumes constructed primarily to record water quantity and velocity provided the discharge of fill is limited to 10 cubic yards. No work may restrict movement of aquatic species or potentially threaten to impact or entangle sea turtles or marine mammals in near-coastal waters. Survey activities including core sampling, seismic exploratory operations, plugging of seismic shot holes, other exploratory-type bore holes and oil and gas test wells, soil survey and sampling, and historic resources surveys. Discharges and structures associated with the recovery of historic resources are not authorized. Drilling and the discharge of excavated material from test wells for oil and gas exploration are not authorized. Fill placed for roads, pads and other similar activities is not authorized, nor is any permanent structure.		

End Notes/Definitions

[1] **Bordering and Contiguous Wetlands:** A bordering wetland is immediately next to its adjacent waterbody and may lie at, or below, the OHW mark (MHW in navigable waters) of that waterbody and is directly influenced by its hydrologic regime. Contiguous wetlands extend landward from their adjacent waterbody to a point where a natural or manmade discontinuity exists. Contiguous wetlands include bordering wetlands as well as wetlands that are situated immediately above the ordinary high water mark and above the normal hydrologic influence of their adjacent waterbody. Note, with respect to the Federally designated navigable rivers, the wetlands bordering and contiguous to the tidally influenced portions of those rivers are reviewed under "II. Navigable Waters."

[2] **Regulation**: Either DES or NHCP must regulate an activity for it to be eligible for authorization as a Minimum Impact Project of this NH PGP. The Minimum Impact Project category does not apply to activities exempt from State regulation. These activities must report to the Corps.

[3] **Direct, Secondary (Indirect), and Cumulative Impacts:**

Direct Impacts: The immediate loss of aquatic ecosystem within the footprint of the fill.

Secondary (Indirect) impacts: These are effects on an aquatic ecosystem that are associated with a discharge of dredged or fill materials, but do not result from the actual placement of the dredged or fill material. (40 CFR 230.11 (h)). Secondary impacts are those impacts outside the footprint of the fill (e.g., beyond the bounds of the disposal site) that arise from and are associated with the direct discharge of dredged or fill material. Some examples are: I) Habitat Fragmentation. This occurs when a relatively undisturbed habitat block is interrupted or broken apart by roads, ditches, disturbance of vegetation, or development of structures. II) Interruption of Travel Corridors. Travel corridors are routes that many species travel on to find food, mates, shelter, and cover. Many aquatic species follow stream channels and wetlands, and follow established routes season after season. III) Vernal Pools. These are critically important breeding habitats for amphibians. Many amphibians disperse several hundred feet from their breeding ponds into the adjacent upland habitat after the breeding season has ended. IV) Hydrology, hydrological functions and non-point source impacts: A) Interference with the migration or movement of fish and shellfish from one area to another, such as placement of a dam eliminating access to spawning grounds for anadromous fish. B) Greater amounts of sediment, nutrients, and other pollutants such as lead, oil, gas, and salt that could impact wetlands and streams. Sediment causes turbidity, which reduces aquatic life and usually transports pesticides, heavy metals and other toxins into streams. This is especially a concern in watersheds where the streams are already listed as impaired by NHDES. C) Submerged aquatic vegetation is very dependent on light transmission and small changes in ambient turbidity can preclude it from growing in certain areas. D) Trout spawning areas are selected in areas that are well flushed and aerated, and new amounts of deposition may result in a spawning area being eliminated due to siltation of fish eggs. E) Physical effects such as erosion, accretion, entrenchment, sedimentation, embedment, channel or shoreline migration and failure to pass bedload material, organic matter and large woody debris.

Cumulative Impacts: The extent of past, present, and foreseeable developments in the area may be an important consideration in evaluating the significance of a particular project's impacts. Although the impacts associated with a particular discharge may be minor, the cumulative effect of numerous similar discharges can result in a large impact. Cumulative impacts should be estimated only to the extent that they are reasonable and practical.

[4] **Incidental Fallback:** The term "discharge of dredged or fill material" also includes certain discharges resulting from excavation.

[5] **Water Diversions:** Water diversions are activities such as bypass pumping or water withdrawals. Temporary flume pipes, culverts or cofferdams where normal flows are maintained within the stream boundary's confines aren't water diversions. "Normal flows" are defined as no change in flow from pre-project conditions. See GC 21.

[6] **Special Aquatic Sites:** These include both inland & salt marsh wetlands, mud flats, vegetated shallows[15], coral reefs, and riffle & pool complexes. (40 CFR 230).

[7] **Special Wetlands:** These include 1. enriched/calcareous seepage swamps, estuarine wetlands, floodplains, peatlands, unique basin swamps/marshes, and vernal pools, 2. all wetlands that provide habitat for threatened or endangered species, and 3. all exemplary wetland natural community occurrences as designated by the NH Natural Heritage Bureau (NHNHB). The wetland types provided in 1 above are expanded below and fully described in Natural Community Systems of New Hampshire and Natural Communities of New Hampshire, which are available at www.nhnaturalheritage.org. Note: The Corps will use the definition of vernal pools that is listed below, not the definition in the referenced Natural Heritage documents. The applicant is required to have NHNHB check the wetland types listed in 2 and 3 above by either requesting a hard copy review or using the DataCheck Tool at www.nhnaturalheritage.org.

Vernal Pool (VP) and Habitat: VPs are confined basin depressions with water for two or more continuous months in the spring and/or summer, for which evidence of one or more of the following indicator vernal pools species: wood frogs (*Rana sylvatica)*, mole salamanders (*Ambystoma* spp), and fairy shrimp (*Eubranchipus* spp) has been documented **OR** for which evidence of two or more of the following facultative organisms: caddisfly (*Trichoptera*) larvae casings, fingernail clams (*Sphaeriidae*), or amphibious snails (*Basammatophora*) and evidence that the pool does not contain an established reproducing fish population has been documented. Vernal pool habitat is the seasonal pool depression, seasonal pool envelope (100 FT radius from the VP edge) and seasonal pool terrestrial habitat (750 FT radius from the VP edge). The Corps will determine on a case-by-case basis which vernal pools are within their jurisdiction.

Enriched/Calcareous seepage swamps: Wetlands characterized by the discharge of enriched groundwater. Floristic composition is an indicator of these conditions.

- Calcareous sloping fen system
- Circumneutral seepage swamp (natural community)
- Circumneutral hardwood forest seep (natural community)
- Calcareous riverside seep (natural community)
- Red maple-black ash-swamp saxifrage swamp (natural community)
- Northern hardwood-black ash-conifer swamp (natural community)

Estuarine wetlands: Wetland communities occurring in subtidal and intertidal coastal habitats connected to the ocean but semi-enclosed by land and protected from high-energy wave action. These wetlands are periodically exposed and flooded by tides.

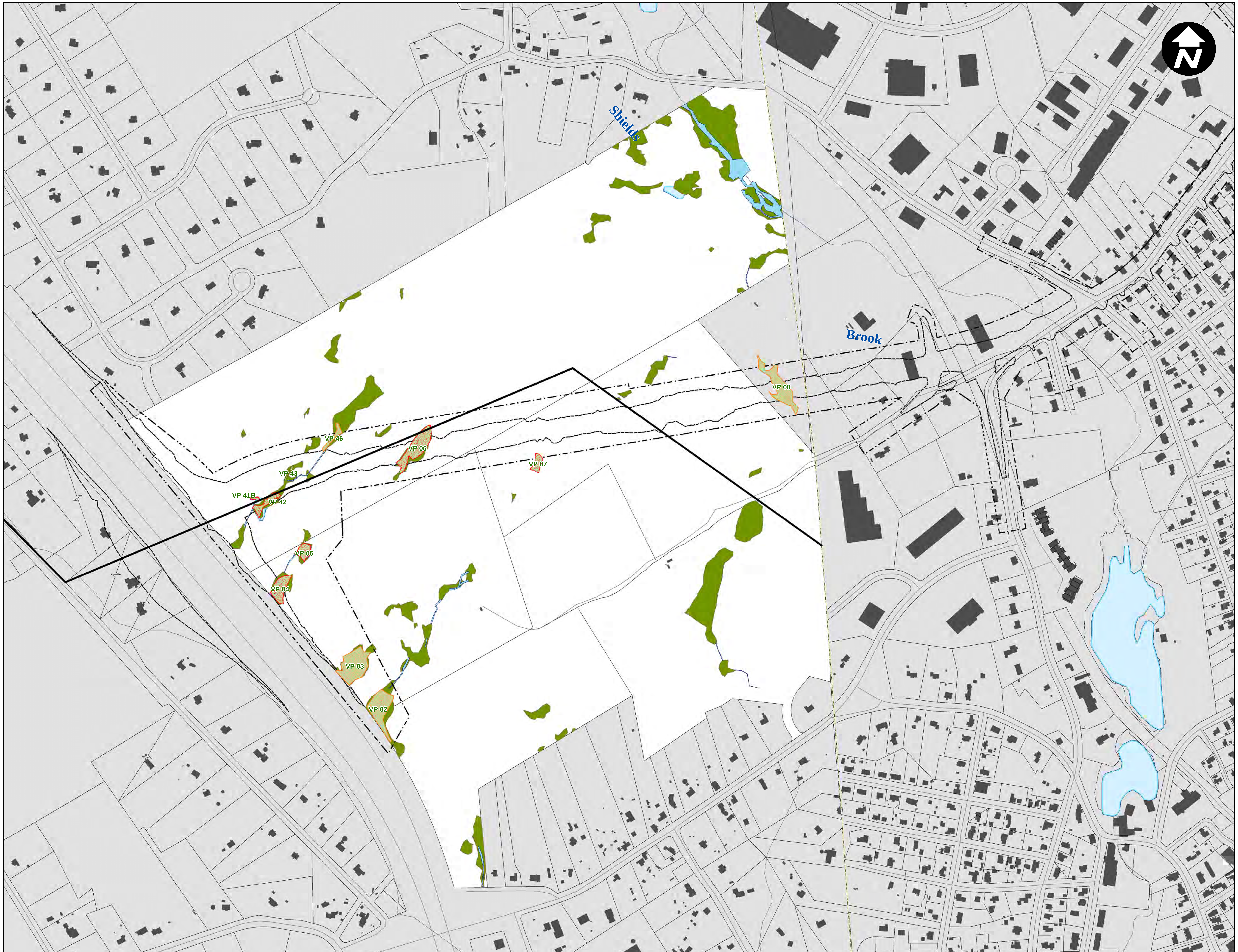
- Salt marsh system
- Brackish tidal riverbank marsh system
- Sparsely vegetated intertidal system
- Subtidal system

Floodplains: Areas of low land along a watercourse that are subject to periodic flooding and sediment deposition.

- Montane/near boreal floodplain system
- Major river silver maple floodplain system
- Temperate minor river floodplain system
- Swamp white oak floodplain forest (natural community)

Peatlands: Peat-accumulating wetlands, including bogs, fens, cedar swamps, which are often dominated with sphagnum moss, heath family plants and sedges.

- Alpine/subalpine bog system
- Kettle hole bog system



Woodmont Commons

Exit 4A EIS Alternative A
Vernal Pools

Legend

- Building
- Open Water
- Stream
- Road
- Town Boundary
- Alt A
- Approximate Transmission Line
- Delineated Stream
- Field Delineated Parcel
- Wetland
- Exit 4A Alt A Data Limit

Vernal Pools

- High
- Medium
- Low

0 500 1,000 Feet

CLD CONSULTING ENGINEERS

NORMANDEAU ASSOCIATES ENVIRONMENTAL CONSULTANTS

VPDataLimits.mxd

March 23, 2016

VPool ID# (2009)	April-May 2009 (2011 chart)	Normandeau (2009 data forms)	May 2014 SGE w/SRE⁺	June 2014 Hydroperiod	Sept 2014 Hydroperiod	May 2015 SGE w/SRE⁺	June 2015 Hydroperiod	Comments
46	Semi-perm pool, linked to VP42 & 47, "med"	SS egg masses	WF egg masses (12), WF larvae (1000s), caddisfly larvae	Yes	No water present	SS egg mass (1), juv/adult WFs, caddisfly/aquatic beetle larvae	Yes	Moderate quality
***43**	Linked to intermittent stream, green frog present, "low"	caddisfly larvae, fingernail clams, flat spire snails	**caddisfly larvae**	Yes	No water present	**aquatic beetle larvae**	**No water present**	Not vernal pool
42	Perm pool, mostly in powerline ROW, bullfrog larvae, "modified", NHDES vpool??, "high"	WF/SS egg masses, caddisfly larvae, spire/flat spire snails, dragonfly larvae	WF larvae, caddisfly larvae, flat spire snails	Yes	No water present	WF larvae, aquatic beetle larvae	Yes	Semi-perm pool on 2009 data form, unclear why "question mark" regarding NHDES vpool; moderate quality
***41B**	Not natural, "not fishless", in utility ROW, linked to VP42, NHDES vpool??, "high"	WF larvae	**No indicators present**	Yes	No water present	**aquatic beetle larvae**	Yes	Only tadpoles present, no fish noted on 2009 data form, unclear why "question mark" re: NHDES vpool; large rut w/mud bottom, no veg; not vernal pool; **isolated?**
8 offsite	"modified", semi-perm pool, "med"	WF/SS egg masses, caddisfly larvae, spire snails, flat spire snails	WF larvae (1000s), caddisfly larvae	Yes	No water present	WF larvae, caddisfly larvae, aquatic beetle larvae, damselfly larvae	Yes	WF egg masses in 2006; active gravel pit/beaver flowage on 2009 data form; green frogs present (2014); impacted by adj. land use, low quality
7	Perm pool, very deep, "high"	WF/SS egg masses, WF larvae	WF egg masses (4), WF larvae, f.shrimp, caddisfly larvae	Yes	No water present	BSS/SS egg masses (2/13), WF larvae, juv WFs	Yes	SS egg masses, WF larvae in 2006; bullfrog larvae present (2014); semi-perm pool; high quality
6	Perm pool, "high"	WF/SS egg masses, caddisfly larvae, fingernail clams, spire snails, dragonfly larvae	WF egg masses (3), WF larvae, f.shrimp, caddisfly/aquatic beetle larvae, flat spire snails	Yes	No open water present (mucky soil under veg)	SS egg masses (3), WF larvae, juv/adult WFs, caddisfly/aquatic beetle larvae, fingernail clams	Yes	SS egg masses, WF larvae in 2006; only 0.17 ac on 2009 data form; semi-perm pool; portion in utility ROW w/no canopy, other portion w/buttonbush; moderate quality

VPool ID# (2009)	April-May 2009 Normandeau (2011 chart)	(2009 data forms)	May 2014 SGE w/SRE⁺	June 2014 Hydroperiod	Sept 2014 Hydroperiod	May 2015 SGE w/SRE⁺	June 2015 Hydroperiod	Comments
5	Assoc w/stream, maybe perm in/outlet/fish present, "high"	WF/SS egg masses, WF larvae, caddisfly larvae	WF egg masses (6), caddisfly larvae	Yes	No water present	SS egg masses (9), WF larvae, f.shrimp, caddisfly larvae, spire snails	Yes	SS/WF egg masses in 2006; "assoc w/stream" not on 2009 data form; linked to VP4; moderate quality
4	Perm pool, assoc w/stream, maybe perm in/outlet, "modified", maybe fish present	SS egg masses, caddisfly larvae, fingernail clams, aquatic beetle larvae, spire/flat spire snails	WF egg mass (1), WF larvae, f.shrimp, caddisfly larvae, flat spire snails	Yes	No water present	SS egg masses (3), WF larvae (1000s), f.shrimp, aquatic beetle larvae, fingernail clams, spire snails	Yes	SS/WF egg masses in 2006; semi-perm, "maybe" perm, "deep", hydrology poss. modified by I-93 on 2009 data form; assoc w/stream not on 2009 data form; affected by I-93 drainage, linked to VP5; high quality
3	Bullfrog larvae present, may be fish, semi-perm pool, assoc w/stream link to VP4, maybe perm in/outlet, "med"	SS egg masses, caddisfly larvae, spire snails, flat spire snails	WF larvae, f.shrimp, caddisfly larvae, aquatic beetle larvae	Yes	No water present	WF larvae (1000s), f.shrimp, caddisfly larvae, fingernail clams	Yes	SS egg mass in 2006; "at least portion" is perm pool and "modified" on 2009 data form; assoc w/stream and link to VP4 not on 2009 data form; bullfrogs present (2014); affected by I-93 drainage; moderate quality
2	"Modified", semi-perm pool, assoc w/stream, maybe perm in/outlet, may be fish, "med"	WF egg masses, caddisfly larvae, fingernail clams, spire snails, flat spire snails	f.shrimp, caddisfly larvae, flat spire snails	Yes	No water present	SS egg masses (3), WF larvae, f.shrimp, caddisfly/aquatic beetle larvae, fingernail clams	Yes (water present in localized areas, otherwise wet muck)	SS/WF egg masses in 2006; on 2009 data form hydrology possibly modified by I-93, connect to VP3; assoc w/stream not on 2009 data form; is affected by I-93 drainage, link to VP3?; moderate quality

⁺SRE = Stoney Ridge Environmental LLC, Professional Wildlife Biologist (G.Thomas in 2014, R.Bolton in 2015)

*Designated vernal pool in 2009 that does not meet the State or Federal criteria to be considered a vernal pool in 2014-15

NH Vernal Pool Determination/Assessment Data Form

Pool ID #: 46 Survey Date(s): 7/12/13, 5/8/14, 5/22/14, 6/6/14, 5/19/15, 6/12/15

Project Name: I93-Exit 4A Location: Londonderry, NH

Observer's Name: M. Parsons Credentials: NH CWS

Observer's Name: G. Thomas (5/2014) Credentials: Prof. Wildlife Biologist
R. Bolton (5/2015) " "

POOL CHARACTERISTICS

(1) LANDSCAPE SETTING (check all that apply):

__ Isolated Upland Depression ✓ Within Larger Wetland System __ Within Floodplain

✓ Part of a Pool Complex (within 1000 ft of one/more vernal pools) __ Other:

(2) WETLAND TYPE (choose dominant):

✓ Forested Wetland __ Shrub Wetland __ Herbaceous Wetland __ Open Water

__ Floodplain __ Peatland (fen or bog) __ Other:

(3) POOL ORIGIN:

✓ Natural __ Natural-Modified __ Manmade __ Manmade for Mitigation

__ Unknown If not natural, describe:

(4) POOL SIZE (approximate dimensions): 30' x 120' = 3,600 sq ft (0.08 ac)

(5) MAX POOL DEPTH (at time of survey): __ 0-12" (0-1 ft) ✓ 12-36" (1-3 ft) __ 36-60" (3-5 ft) __ >60" (>5 ft)

(6) PREDOMINANT SUBSTRATE: __ Mineral Soil __ Leaf Litter ✓ Organic (peat/muck) __ Other:

(7) ESTIMATED HYDROPERIOD (provide rationale):

__ Ephemeral (drying out completely in most years) ✓ Semi-Permanent (drying partially in all yrs & completely in drought yrs) __ Permanent Explain: No water present in 9/2014 though deep water present in May/June 2014. Water present June 2015.

(8) INLET/OUTLET FLOW:

Inlet: __ None ✓ Intermittent __ Permanent (channel with well-defined banks, permanent flow)

Outlet: __ None ✓ Intermittent (seasonal) __ Permanent

(9) SURROUNDING HABITAT (check all that apply and provide percentages/descriptions as applicable):

✓ Forested: Mixed uplands/wetlands

__ Shrub:

__ Open (e.g. meadow, agriculture, golf course):

✓ Developed: residential to northwest

✓ Other: powerline ROW

NH Vernal Pool Determination/Assessment Data Form

Pool ID #: 46   Survey Date(s): 7/12/13, 5/8/14, 5/22/14, 6/6/14, 5/19/15, 6/12/15

Project Name: I93 - Exit 4A   Location: Londonderry, NH

POOL INDICATOR SPECIES

PRIMARY INDICATORS	SURVEY DATE(S)	EGG MASSES (#)	TADPOLES/LARVAE
Wood Frog (*Lithobates sylvatica*)	1: 2: 5/22/14	1: 2: twelve	Few / Common / Many Few / Common / Many
Spotted Salamander (*Ambystoma maculatum*)	1: 5/19/15 2:	1: One 2:	Few / Common / Many Few / Common / Many
Blue-spotted Salamander (*Ambystoma laterale*)	1: 2:	1: 2:	Few / Common / Many Few / Common / Many
Fairy Shrimp (*Eubranchipus* spp.)	1: 2:	Present? Y N Present? Y N	Few / Common / Many Few / Common / Many

SECONDARY INDICATORS (check all observed):

State & Federal:
- ✓ Caddisfly Larvae/Casings
- ___ Fingernail Clams/Shells
- ___ Spire-Shaped Snails/Shells
- ___ Flat-Spire Snails/Shells

State Only:
- ___ Aquatic Beetle Larvae
- ___ Damselfly Larvae/Exuviae
- ___ True Fly Larvae/Pupae
- ___ Dragonfly Larvae/Exuviae
- ___ Clam Shrimp/Shells

OTHER SPECIES/RARITY:

5/19/15: SS egg mass (1)
adult/juv. WFs
caddisfly larvae
aq beetle larvae

6/12/15: water present

POOL STATUS

Primary Indicators Present? Y N

2 or more Federal Secondary Indicators? Y N

3 or more State Secondary Indicators? Y N

Water Present for 2 or more Continuous Months in Spring/Summer? Y N

Seasonal Pool? Y N   Lacks a Viable Fish Population? Y N

✓ FEDERAL VERNAL POOL? Y N

STATE OF NH VERNAL POOL? Y N

COMMENTS Numerous WF egg masses/tadpoles present in late May 2014.
SS egg mass present in May 2015.

NH Vernal Pool Determination/Assessment Data Form

Pool ID #: 43 Survey Date(s): 7/12/13, 5/8/14, 5/22/14, 6/6/14, 9/3/14, 5/19/15, 6/12/15

Project Name: I93-Exit 4A Location: Londonderry, NH

Observer's Name: M Parsont Credentials: NH CWS

Observer's Name: G. Thomas (5/2014) Credentials: Prof. Wildlife Biologist
R. Bolton (5/2015) " "

POOL CHARACTERISTICS

(1) LANDSCAPE SETTING (check all that apply):

__ Isolated Upland Depression ✓ Within Larger Wetland System __ Within Floodplain

✓ Part of a Pool Complex (within 1000 ft of one/more vernal pools) __ Other:

(2) WETLAND TYPE (choose dominant):

✓ Forested Wetland __ Shrub Wetland __ Herbaceous Wetland __ Open Water

__ Floodplain __ Peatland (fen or bog) __ Other:

(3) POOL ORIGIN:

✓ Natural __ Natural-Modified __ Manmade __ Manmade for Mitigation

__ Unknown If not natural, describe:

(4) POOL SIZE (approximate dimensions): 15' x 40' = 600 sq ft. (0.01 ac)

(5) MAX POOL DEPTH (at time of survey): ✓ 0-12" (0-1 ft) __ 12-36" (1-3 ft) __ 36-60" (3-5 ft) __ >60" (>5 ft)

(6) PREDOMINANT SUBSTRATE: ✓ Mineral Soil __ Leaf Litter __ Organic (peat/muck) __ Other:

(7) ESTIMATED HYDROPERIOD (provide rationale):

✓ Ephemeral (drying out completely in most years) __ Semi-Permanent (drying partially in all yrs & completely in drought yrs) __ Permanent Explain: Shallow, no water present Sept. 2014. No water present June 2015.

(8) INLET/OUTLET FLOW:

Inlet: __ None ✓ Intermittent __ Permanent (channel with well-defined banks, permanent flow)

Outlet: __ None ✓ Intermittent (seasonal) __ Permanent

(9) SURROUNDING HABITAT (check all that apply and provide percentages/descriptions as applicable):

✓ Forested: mixed uplands/wetlands

__ Shrub:

__ Open (e.g. meadow, agriculture, golf course):

__ Developed:

✓ Other: cleared ROW immed. adjacent (southeast), ATV usage, highway to southwest

NH Vernal Pool Determination/Assessment Data Form

Pool ID #: 43 Survey Date(s): 7/12/13, 5/8/14, 5/22/14, 6/6/14, 9/3/14, 5/19/15, 6/12/15

Project Name: I93 - Exit 4A Location: Londonderry, NH

POOL INDICATOR SPECIES

PRIMARY INDICATORS	SURVEY DATE(S)	EGG MASSES (#)	TADPOLES/LARVAE
Wood Frog (*Lithobates sylvatica*)	1: 2:	1: 2:	Few / Common / Many Few / Common / Many
Spotted Salamander (*Ambystoma maculatum*)	1: 2:	1: 2:	Few / Common / Many Few / Common / Many
Blue-spotted Salamander (*Ambystoma laterale*)	1: 2:	1: 2:	Few / Common / Many Few / Common / Many
Fairy Shrimp (*Eubranchipus* spp.)	1: 2:	Present? Y N Present? Y N	Few / Common / Many Few / Common / Many

SECONDARY INDICATORS (check all observed):

State & Federal:
- ✓ Caddisfly Larvae/Casings
- ___ Fingernail Clams/Shells
- ___ Spire-Shaped Snails/Shells
- ___ Flat-Spire Snails/Shells

State Only:
- ___ Aquatic Beetle Larvae
- ___ Damselfly Larvae/Exuviae
- ___ True Fly Larvae/Pupae
- ___ Dragonfly Larvae/Exuviae
- ___ Clam Shrimp/Shells

OTHER SPECIES/RARITY:

5/19/15: aquatic beetle larvae
6/12/15: no water present

POOL STATUS

Primary Indicators Present? Y N

2 or more Federal Secondary Indicators? Y N

3 or more State Secondary Indicators? Y N

Water Present for 2 or more Continuous Months in Spring/Summer? Y N

Seasonal Pool? Y N Lacks a Viable Fish Population? Y N

✓ FEDERAL VERNAL POOL? Y N

STATE OF NH VERNAL POOL? Y N

COMMENTS

✓ Not sufficient indicators present.

NH Vernal Pool Determination/Assessment Data Form

Pool ID #: 42 Survey Date(s): 7/12/13, 5/9/14, 5/23/14, 6/6/14, 9/3/14, 5/19/15, 6/12/15

Project Name: I93 - Exit 4A Location: Londonderry, NH

Observer's Name: M. Parsont Credentials: NH CWS

Observer's Name: G. Thomas (5/2014) Credentials: Prof. Wildlife Biologist
R. Bolton (5/2015) " "

POOL CHARACTERISTICS

(1) LANDSCAPE SETTING (check all that apply):

_ Isolated Upland Depression ✓ Within Larger Wetland System _ Within Floodplain

✓ Part of a Pool Complex (within 1000 ft of one/more vernal pools) _ Other:

(2) WETLAND TYPE (choose dominant):

_ Forested Wetland _ Shrub Wetland ✓ Herbaceous Wetland _ Open Water

_ Floodplain _ Peatland (fen or bog) _ Other:

(3) POOL ORIGIN:

_ Natural ✓ Natural-Modified ✓ Manmade _ Manmade for Mitigation

_ Unknown If not natural, describe: within powerline ROW clearing

(4) POOL SIZE (approximate dimensions): 40' x 120' = 4,800 sq ft. (0.11 ac.)

(5) MAX POOL DEPTH (at time of survey): _ 0-12" (0-1 ft) ✓ 12-36" (1-3 ft) _ 36-60" (3-5 ft) _ >60" (>5 ft)

(6) PREDOMINANT SUBSTRATE: ✓ Mineral Soil _ Leaf Litter _ Organic (peat/muck) _ Other:

(7) ESTIMATED HYDROPERIOD (provide rationale):

✓ Ephemeral (drying out completely in most years) ? Semi-Permanent (drying partially in all yrs & completely in drought yrs) _ Permanent Explain: No water present Sept. 2014, though water present June 2014 and deep in May 2014. Water present in June 2015.

(8) INLET/OUTLET FLOW:

Inlet: _ None ✓ Intermittent _ Permanent (channel with well-defined banks, permanent flow)

Outlet: _ None ✓ Intermittent (seasonal) _ Permanent

(9) SURROUNDING HABITAT (check all that apply and provide percentages/descriptions as applicable):

✓ Forested: mixed wetlands/uplands

_ Shrub:

_ Open (e.g. meadow, agriculture, golf course):

_ Developed:

✓ Other: powerline ROW, highway to southwest

NH Vernal Pool Determination/Assessment Data Form

Pool ID #: 42 Survey Date(s): 7/12/13, 5/9/14, 5/23/14, 6/6/14, 9/3/14, 5/19/15, 6/12/15

Project Name: I93 - Exit 4A Location: Londonderry, NH

POOL INDICATOR SPECIES

PRIMARY INDICATORS	SURVEY DATE(S)	EGG MASSES (#)	TADPOLES/LARVAE
Wood Frog (*Lithobates sylvatica*)	1: 5/9/14 2: 5/23/14	1: None 2: None	Few / Common / Many Few / Common / Many
Spotted Salamander (*Ambystoma maculatum*)	1: 2:	1: 2:	Few / Common / Many Few / Common / Many
Blue-spotted Salamander (*Ambystoma laterale*)	1: 2:	1: 2:	Few / Common / Many Few / Common / Many
Fairy Shrimp (*Eubranchipus* spp.)	1: 2:	Present? Y N Present? Y N	Few / Common / Many Few / Common / Many

SECONDARY INDICATORS (check all observed):

State & Federal:
- ✓ Caddisfly Larvae/Casings
- ___ Fingernail Clams/Shells
- ___ Spire-Shaped Snails/Shells
- ✓ Flat-Spire Snails/Shells

State Only:
- ___ Aquatic Beetle Larvae
- ___ Damselfly Larvae/Exuviae
- ___ True Fly Larvae/Pupae
- ___ Dragonfly Larvae/Exuviae
- ___ Clam Shrimp/Shells

OTHER SPECIES/RARITY:

5/19/15: WF larvae (few)
aq beetle larvae
6/12/15: water present

POOL STATUS

Primary Indicators Present? Y N

2 or more Federal Secondary Indicators? Y N 2014 2015

3 or more State Secondary Indicators? Y N

Water Present for 2 or more Continuous Months in Spring/Summer? Y N

Seasonal Pool? Y N Lacks a Viable Fish Population? Y N

✓ FEDERAL VERNAL POOL? Y N

STATE OF NH VERNAL POOL? Y N

COMMENTS WF tadpoles present May 2014, no egg masses observed. {same in May 2015}

NH Vernal Pool Determination/Assessment Data Form

Pool ID #: 41B   Survey Date(s): 7/12/13, 5/8/14, 5/22/14, 6/6/14, 9/3/14, 5/19/15, 6/12/15

Project Name: I93 - Exit 4A   Location: Londonderry, NH

Observer's Name: M. Parsont   Credentials: NH CWS

Observer's Name: G. Thomas (5/2014)   Credentials: Prof. Wildlife Biologist
R. Bolton (5/2015)   " "

POOL CHARACTERISTICS

(1) LANDSCAPE SETTING (check all that apply):

√ Isolated Upland Depression   __ Within Larger Wetland System   __ Within Floodplain

√ Part of a Pool Complex (within 1000 ft of one/more vernal pools)   __ Other:

(2) WETLAND TYPE (choose dominant):

__ Forested Wetland   __ Shrub Wetland   __ Herbaceous Wetland   __ Open Water

__ Floodplain   __ Peatland (fen or bog)   √ Other: skidder rut, no vegetation

(3) POOL ORIGIN:

__ Natural   __ Natural-Modified   √ Manmade   __ Manmade for Mitigation

__ Unknown   If not natural, describe: within a powerline ROW road

(4) POOL SIZE (approximate dimensions): 10' x 30' = 300 sq ft.

(5) MAX POOL DEPTH (at time of survey): √ 0-12" (0-1 ft) __ 12-36" (1-3 ft) __ 36-60" (3-5 ft) __ >60" (>5 ft)

(6) PREDOMINANT SUBSTRATE: √ Mineral Soil __ Leaf Litter __ Organic (peat/muck) __ Other:

(7) ESTIMATED HYDROPERIOD (provide rationale):

√ Ephemeral (drying out completely in most years)   __ Semi-Permanent (drying partially in all yrs & completely in drought yrs)   __ Permanent   Explain: shallow; no water present Sept. 2014. Water present June 2015.

(8) INLET/OUTLET FLOW:

Inlet: √ None   __ Intermittent   __ Permanent (channel with well-defined banks, permanent flow)

Outlet: __ None   √ Intermittent (seasonal)   __ Permanent

(9) SURROUNDING HABITAT (check all that apply and provide percentages/descriptions as applicable):

√ Forested: mixed uplands/wetlands

__ Shrub:

__ Open (e.g. meadow, agriculture, golf course):

__ Developed:

√ Other: within powerline ROW (totally cleared of vegetation), highway to west + south

NH Vernal Pool Determination/Assessment Data Form

Pool ID #: 41B   Survey Date(s): 7/12/13, 5/8/14, 5/22/14, 6/6/14, 9/3/14, 5/19/15, 6/12/15

Project Name: I93 - Exit 4A   Location: Londonderry, NH

POOL INDICATOR SPECIES

PRIMARY INDICATORS	SURVEY DATE(S)	EGG MASSES (#)	TADPOLES/LARVAE
Wood Frog (*Lithobates sylvatica*)	1: 2:	1: 2:	Few / Common / Many Few / Common / Many
Spotted Salamander (*Ambystoma maculatum*)	1: 2:	1: 2:	Few / Common / Many Few / Common / Many
Blue-spotted Salamander (*Ambystoma laterale*)	1: 2:	1: 2:	Few / Common / Many Few / Common / Many
Fairy Shrimp (*Eubranchipus* spp.)	1: 2:	Present? Y N Present? Y N	Few / Common / Many Few / Common / Many

SECONDARY INDICATORS (check all observed):

State & Federal:
- ___ Caddisfly Larvae/Casings
- ___ Fingernail Clams/Shells
- ___ Spire-Shaped Snails/Shells
- ___ Flat-Spire Snails/Shells

State Only:
- ___ Aquatic Beetle Larvae
- ___ Damselfly Larvae/Exuviae
- ___ True Fly Larvae/Pupae
- ___ Dragonfly Larvae/Exuviae
- ___ Clam Shrimp/Shells

OTHER SPECIES/RARITY:

5/19/15: aquatic beetle larvae
6/12/15: water present

POOL STATUS

Primary Indicators Present? Y N

2 or more Federal Secondary Indicators? Y N

3 or more State Secondary Indicators? Y N

Water Present for 2 or more Continuous Months in Spring/Summer? Y N

Seasonal Pool? Y N   Lacks a Viable Fish Population? Y N

✓ FEDERAL VERNAL POOL? Y N

STATE OF NH VERNAL POOL? Y N

COMMENTS No indicators present 2014; one State secondary indicator present May 2015.

→ [Also, isolated pool that is not part of wetland (no federal jurisdiction?)?]

NH Vernal Pool Determination/Assessment Data Form

Pool ID #: 8 (offsite) Survey Date(s): 5/8/14, 5/22/14, 6/6/14, 9/3/14, 5/21/15, 6/12/15

Project Name: I93-Exit 4A Location: Londonderry, NH

Observer's Name: M. Parsont Credentials: NHCWS

Observer's Name: G. Thomas (2014) Credentials: Prof. Wildlife Biologist
R. Bolton (2015) " "

POOL CHARACTERISTICS

(1) LANDSCAPE SETTING (check all that apply):

__ Isolated Upland Depression ✓ Within Larger Wetland System __ Within Floodplain

✓ Part of a Pool Complex (within 1000 ft of one/more vernal pools) __ Other:

(2) WETLAND TYPE (choose dominant):

✓ Forested Wetland __ Shrub Wetland __ Herbaceous Wetland __ Open Water

__ Floodplain __ Peatland (fen or bog) __ Other:

(3) POOL ORIGIN:

✓ Natural __ Natural-Modified __ Manmade __ Manmade for Mitigation

__ Unknown If not natural, describe: may have been impacted by adj. gravel pit operation

(4) POOL SIZE (approximate dimensions): 75' x 250' = 18,750 sq ft. (0.43 ac.)

(5) MAX POOL DEPTH (at time of survey): __ 0-12" (0-1 ft) ✓ 12-36" (1-3 ft) __ 36-60" (3-5 ft) __ >60" (>5 ft)

(6) PREDOMINANT SUBSTRATE: __ Mineral Soil __ Leaf Litter ✓ Organic (peat/muck) __ Other:

(7) ESTIMATED HYDROPERIOD (provide rationale):

__ Ephemeral (drying out completely in most years) ✓ Semi-Permanent (drying partially in all yrs & completely in drought yrs) __ Permanent Explain: No water present 9/2014, but deep water present 5-6/2014. Water present June 2015.

(8) INLET/OUTLET FLOW:

Inlet: ✓ None __ Intermittent __ Permanent (channel with well-defined banks, permanent flow)

Outlet: ✓ None __ Intermittent (seasonal) __ Permanent

(9) SURROUNDING HABITAT (check all that apply and provide percentages/descriptions as applicable):

✓ Forested: mostly uplands (west)

__ Shrub:

__ Open (e.g. meadow, agriculture, golf course):

__ Developed:

✓ Other: active gravel pit operation adjacent to northeast.

NH Vernal Pool Determination/Assessment Data Form

Pool ID #: 8 (offsite)   Survey Date(s): 5/8/14, 5/22/14, 6/6/14, 9/3/14, 5/21/15, 6/12/15

Project Name: I93-Exit 4A   Location: Londonderry, NH

POOL INDICATOR SPECIES

PRIMARY INDICATORS	SURVEY DATE(S)	EGG MASSES (#)	TADPOLES/LARVAE
Wood Frog (*Lithobates sylvatica*)	1: 2: 5/22/14	1: 2: None	Few / Common / Many Few / Common / Many
Spotted Salamander (*Ambystoma maculatum*)	1: 2:	1: 2:	Few / Common / Many Few / Common / Many
Blue-spotted Salamander (*Ambystoma laterale*)	1: 2:	1: 2:	Few / Common / Many Few / Common / Many
Fairy Shrimp (*Eubranchipus* spp.)	1: 2:	Present? Y N Present? Y N	Few / Common / Many Few / Common / Many

SECONDARY INDICATORS (check all observed):

State & Federal:
- ✓ Caddisfly Larvae/Casings
- ___ Fingernail Clams/Shells
- ___ Spire-Shaped Snails/Shells
- ___ Flat-Spire Snails/Shells

State Only:
- ✓ Aquatic Beetle Larvae
- ___ Damselfly Larvae/Exuviae
- ___ True Fly Larvae/Pupae
- ___ Dragonfly Larvae/Exuviae
- ___ Clam Shrimp/Shells

OTHER SPECIES/RARITY: green frogs

5/21/15: WF larvae
caddisfly larvae
aquatic beetle larvae
damselfly larvae
6/12/15: water present

POOL STATUS

Primary Indicators Present? Y N

2 or more Federal Secondary Indicators? Y N

3 or more State Secondary Indicators? Y N → 2014 → 2015

Water Present for 2 or more Continuous Months in Spring/Summer? Y N

Seasonal Pool? Y N   Lacks a Viable Fish Population? Y N

✓ FEDERAL VERNAL POOL? Y N

STATE OF NH VERNAL POOL? Y N

✓ COMMENTS WF larvae present late May. 2014 + 2015.

[* very limited populations present - believed to be polluted by adjacent activities]

NH Vernal Pool Determination/Assessment Data Form

Pool ID #: 7 Survey Date(s): 7/12/13, 5/9/14, 5/23/14, 6/6/14, 9/3/14, 5/19/15, 6/12/15

Project Name: I93 - Exit 4A Location: Londonderry, NH

Observer's Name: M. Parsons Credentials: NH CWS

Observer's Name: G. Thomas (5/2014) Credentials: Prof. Wildlife Biologist
R. Bolton (5/2015) " "

POOL CHARACTERISTICS

(1) LANDSCAPE SETTING (check all that apply):

✓ Isolated Upland Depression __ Within Larger Wetland System __ Within Floodplain

✓ Part of a Pool Complex (within 1000 ft of one/more vernal pools) __ Other:

(2) WETLAND TYPE (choose dominant):

✓ Forested Wetland __ Shrub Wetland __ Herbaceous Wetland __ Open Water

__ Floodplain __ Peatland (fen or bog) __ Other:

(3) POOL ORIGIN:

✓ Natural __ Natural-Modified __ Manmade __ Manmade for Mitigation

__ Unknown If not natural, describe:

(4) POOL SIZE (approximate dimensions): 40' x 100' = 4,000 sqft. (0.09 ac.)

(5) MAX POOL DEPTH (at time of survey): __ 0-12" (0-1 ft) ✓ 12-36" (1-3 ft) ✓ 36-60" (3-5 ft) __ >60" (>5 ft)

(6) PREDOMINANT SUBSTRATE: __ Mineral Soil __ Leaf Litter ✓ Organic (peat/muck) __ Other:

(7) ESTIMATED HYDROPERIOD (provide rationale):

__ Ephemeral (drying out completely in most years) ✓ Semi-Permanent (drying partially in all yrs & completely in drought yrs) __ Permanent

Explain: No water present Sept. 2014, though water present June 2014 and deep in May + June 2014. Water present in ~~Ap~~ June 2015.

(8) INLET/OUTLET FLOW:

Inlet: ✓ None __ Intermittent __ Permanent (channel with well-defined banks, permanent flow)

Outlet: ✓ None __ Intermittent (seasonal) __ Permanent

(9) SURROUNDING HABITAT (check all that apply and provide percentages/descriptions as applicable):

✓ Forested: mostly uplands

__ Shrub:

__ Open (e.g. meadow, agriculture, golf course):

__ Developed:

✓ Other: powerline ROW

NH Vernal Pool Determination/Assessment Data Form

Pool ID #: 7 Survey Date(s): 7/12/13, 5/9/14, 5/23/14, 6/6/14, 9/3/14, 5/19/15, 6/12/15

Project Name: I93 - Exit 4A Location: Londonderry, NH

POOL INDICATOR SPECIES

PRIMARY INDICATORS	SURVEY DATE(S)	EGG MASSES (#)	TADPOLES/LARVAE
Wood Frog (*Lithobates sylvatica*)	1: 2: 5/23/14	1: 2: four	Few / Common / Many Few / Common / Many (Common circled)
Spotted Salamander (*Ambystoma maculatum*)	1: 5/19/15 2:	1: 13 2:	Few / Common / Many Few / Common / Many
Blue-spotted Salamander (*Ambystoma laterale*)	1: 5/19/15 2:	1: two 2:	Few / Common / Many Few / Common / Many
Fairy Shrimp (*Eubranchipus* spp.)	1: 5/9/14 2: 5/23/14	Present? Y N (Y circled) Present? Y N (Y circled)	Few / Common / Many (Few circled) Few / Common / Many (Common circled)

SECONDARY INDICATORS (check all observed):

State & Federal:
- ✓ Caddisfly Larvae/Casings
- ___ Fingernail Clams/Shells
- ___ Spire-Shaped Snails/Shells
- ___ Flat-Spire Snails/Shells

State Only:
- ___ Aquatic Beetle Larvae
- ___ Damselfly Larvae/Exuviae
- ___ True Fly Larvae/Pupae
- ___ Dragonfly Larvae/Exuviae
- ___ Clam Shrimp/Shells

OTHER SPECIES/RARITY: bullfrog larvae (2014)

5/19/15: BSS/SS egg masses (2/13)
WF larvae
juv. WFs

6/12/15: Water present

POOL STATUS

Primary Indicators Present? Y N (Y circled)

2 or more Federal Secondary Indicators? Y N (N circled)

3 or more State Secondary Indicators? Y N (N circled)

Water Present for 2 or more Continuous Months in Spring/Summer? Y N (Y circled)

Seasonal Pool? Y N (Y circled) Lacks a Viable Fish Population? Y N (Y circled)

✓ FEDERAL VERNAL POOL? Y N (Y circled)

STATE OF NH VERNAL POOL? Y N (Y circled)

COMMENTS Some WF egg masses + tadpoles present in late May 2014, fairy shrimp present in 2014. BSS/SS egg masses + WF larvae present in May 2015.

NH Vernal Pool Determination/Assessment Data Form

Pool ID #: 6 Survey Date(s): 7/12/13, 5/9/14, 5/23/14, 6/6/14, 9/3/14, 5/19/15, 6/12/15

Project Name: I93-Exit 4A Location: Londonderry, NH

Observer's Name: M Parsons Credentials: NH CWS

Observer's Name: G. Thomas (5/2014) Credentials: Prof. Wildlife Biologist
R. Bolton (5/2015) " "

POOL CHARACTERISTICS

(1) LANDSCAPE SETTING (check all that apply):

✓ Isolated Upland Depression __ Within Larger Wetland System __ Within Floodplain

✓ Part of a Pool Complex (within 1000 ft of one/more vernal pools) __ Other:

(2) WETLAND TYPE (choose dominant):

__ Forested Wetland ✓ Shrub Wetland __ Herbaceous Wetland __ Open Water

__ Floodplain __ Peatland (fen or bog) __ Other:

(3) POOL ORIGIN:

✓ Natural __ Natural-Modified __ Manmade __ Manmade for Mitigation

__ Unknown If not natural, describe:

(4) POOL SIZE (approximate dimensions): ~ 50' x 200' = 10,000 sq ft (0.23 ac.)

(5) MAX POOL DEPTH (at time of survey): __ 0-12" (0-1 ft) ✓ 12-36" (1-3 ft) __ 36-60" (3-5 ft) __ >60" (>5 ft)

(6) PREDOMINANT SUBSTRATE: __ Mineral Soil __ Leaf Litter ✓ Organic (peat/muck) __ Other:

(7) ESTIMATED HYDROPERIOD (provide rationale):

__ Ephemeral (drying out completely in most years)
✓ Semi-Permanent (drying partially in all yrs & completely in drought yrs)
? Permanent

Explain: No open water present in Sept. 2014, though ~~[illegible]~~ saturated soils present under dense vegetation; significant water present May-June 2014. Water present June 2015.

(8) INLET/OUTLET FLOW:

Inlet: ✓ None __ Intermittent __ Permanent (channel with well-defined banks, permanent flow)

Outlet: ✓ None __ Intermittent (seasonal) __ Permanent

(9) SURROUNDING HABITAT (check all that apply and provide percentages/descriptions as applicable):

✓ Forested: mostly uplands

__ Shrub:

__ Open (e.g. meadow, agriculture, golf course):

__ Developed:

✓ Other: Half of wetland is within cleared powerline ROW (dense herbaceous/shrub vegetation is present in the wetland portion).

NH Vernal Pool Determination/Assessment Data Form

Pool ID #: 6 Survey Date(s): 7/12/13, 5/9/14, 5/23/14, 6/6/14, 9/3/14, 5/19/15, 6/12/15

Project Name: I93-Exit 4A Location: Londonderry, NH

POOL INDICATOR SPECIES

PRIMARY INDICATORS	SURVEY DATE(S)	EGG MASSES (#)	TADPOLES/LARVAE
Wood Frog (*Lithobates sylvatica*)	1: 2: 5/23/14	1: 2: three	Few / Common / Many Few / Common / Many
Spotted Salamander (*Ambystoma maculatum*)	1: 5/19/15 2:	1: three 2:	Few / Common / Many Few / Common / Many
Blue-spotted Salamander (*Ambystoma laterale*)	1: 2:	1: 2:	Few / Common / Many Few / Common / Many
Fairy Shrimp (*Eubranchipus* spp.)	1: 5/9/14 2: 5/23/14	Present? Y N Present? Y N	Few / Common / Many Few / Common / Many

SECONDARY INDICATORS (check all observed):

State & Federal:
- ✓ Caddisfly Larvae/Casings
- __ Fingernail Clams/Shells
- __ Spire-Shaped Snails/Shells
- ✓ Flat-Spire Snails/Shells

State Only:
- ✓ Aquatic Beetle Larvae
- __ Damselfly Larvae/Exuviae
- __ True Fly Larvae/Pupae
- __ Dragonfly Larvae/Exuviae
- __ Clam Shrimp/Shells

OTHER SPECIES/RARITY:

5/19/15: SS egg masses (3)
WF larvae/juv./adults
caddisfly/aq beetle larvae
fingernail clams
6/12/15: water present

POOL STATUS

Primary Indicators Present? Y N

2 or more Federal Secondary Indicators? Y N

3 or more State Secondary Indicators? Y N

Water Present for 2 or more Continuous Months in Spring/Summer? Y N

Seasonal Pool? Y N Lacks a Viable Fish Population? Y N

✓ FEDERAL VERNAL POOL? Y N

STATE OF NH VERNAL POOL? Y N

COMMENTS Fairy shrimp, WF egg masses and WF tadpoles present late May 2014. SS egg masses. + WF larvae present in May 2015.

NH Vernal Pool Determination/Assessment Data Form

Pool ID #: 5 Survey Date(s): 6/24/13, 5/8/14, 5/22/14, 6/6/14, 9/3/14, 5/19/15, 6/12/15

Project Name: I93 - Exit 4A Location: Londonderry, NH

Observer's Name: M. Parsons Credentials: NH CWS

Observer's Name: G. Thomas (5/2014) Credentials: Prof. Wildlife Biologist
R. Bolton (5/2015) " "

POOL CHARACTERISTICS

(1) LANDSCAPE SETTING (check all that apply):

_ Isolated Upland Depression ✓ Within Larger Wetland System _ Within Floodplain

✓ Part of a Pool Complex (within 1000 ft of one/more vernal pools) _ Other:

(2) WETLAND TYPE (choose dominant):

✓ Forested Wetland _ Shrub Wetland _ Herbaceous Wetland _ Open Water

_ Floodplain _ Peatland (fen or bog) _ Other:

(3) POOL ORIGIN:

✓ Natural _ Natural-Modified _ Manmade _ Manmade for Mitigation

_ Unknown If not natural, describe:

(4) POOL SIZE (approximate dimensions): 50' × 80' = 4,000 sq ft. (0.09 ac.)

(5) MAX POOL DEPTH (at time of survey): _ 0-12" (0-1 ft) ✓ 12-36" (1-3 ft) _ 36-60" (3-5 ft) _ >60" (>5 ft)

(6) PREDOMINANT SUBSTRATE: _ Mineral Soil _ Leaf Litter ✓ Organic (peat/muck) _ Other:

(7) ESTIMATED HYDROPERIOD (provide rationale):

✓ Ephemeral (drying out completely in most years) ? Semi-Permanent (drying partially in all yrs & completely in drought yrs) _ Permanent

Explain: No water present Sept. 2014, though water present June 2014 and fairly deep in May 2014. Water present June 2015.

(8) INLET/OUTLET FLOW:

Inlet: _ None ✓ Intermittent _ Permanent (channel with well-defined banks, permanent flow)

Outlet: _ None ✓ Intermittent (seasonal) _ Permanent

(9) SURROUNDING HABITAT (check all that apply and provide percentages/descriptions as applicable):

✓ Forested: mostly uplands

_ Shrub:

_ Open (e.g. meadow, agriculture, golf course):

_ Developed:

✓ Other: I93 highway located to southwest

NH Vernal Pool Determination/Assessment Data Form

Pool ID #: 5

Survey Date(s): 6/24/13, 5/8/14, 5/22/14, 6/6/14, 9/3/14, 5/19/15, 6/12/15

Project Name: I93-Exit 4A

Location: Londonderry, NH

POOL INDICATOR SPECIES

PRIMARY INDICATORS	SURVEY DATE(S)	EGG MASSES (#)	TADPOLES/LARVAE
Wood Frog (*Lithobates sylvatica*)	1: 5/8/14 2:	1: six 2:	Few / Common / Many Few / Common / Many
Spotted Salamander (*Ambystoma maculatum*)	1: 5/19/15 2:	1: nine 2:	Few / Common / Many Few / Common / Many
Blue-spotted Salamander (*Ambystoma laterale*)	1: 2:	1: 2:	Few / Common / Many Few / Common / Many
Fairy Shrimp (*Eubranchipus* spp.)	1: 2:	Present? Y N Present? Y N	Few / Common / Many Few / Common / Many

SECONDARY INDICATORS (check all observed):

State & Federal:
- ✓ Caddisfly Larvae/Casings
- ___ Fingernail Clams/Shells
- ___ Spire-Shaped Snails/Shells
- ___ Flat-Spire Snails/Shells

State Only:
- ___ Aquatic Beetle Larvae
- ___ Damselfly Larvae/Exuviae
- ___ True Fly Larvae/Pupae
- ___ Dragonfly Larvae/Exuviae
- ___ Clam Shrimp/Shells

OTHER SPECIES/RARITY:

5/19/15: SS egg masses (9)
WF larvae
fi shrimp
caddisfly larvae
spire snails
6/12/15: water present

POOL STATUS

Primary Indicators Present? Y N

2 or more Federal Secondary Indicators? Y N (2015 Y, 2014 N)

3 or more State Secondary Indicators? Y N

Water Present for 2 or more Continuous Months in Spring/Summer? Y N

Seasonal Pool? Y N   Lacks a Viable Fish Population? Y N

✓ FEDERAL VERNAL POOL? Y N

STATE OF NH VERNAL POOL? Y N

COMMENTS WF egg masses present early May 2014.
SS egg masses + WF larvae + fi shrimp present in May 2015.

NH Vernal Pool Determination/Assessment Data Form

Pool ID #: 4 Survey Date(s): 6/24/13, 5/9/14, 5/23/14, 6/6/14, 9/3/14, 5/19/15, 6/12/15

Project Name: I93-Exit 4A Location: Londonderry, NH

Observer's Name: M Parsont Credentials: NH CWS

Observer's Name: G. Thomas (5/2014) Credentials: Prof. Wildlife Biologist
R. Bolton (5/2015) " "

POOL CHARACTERISTICS

(1) LANDSCAPE SETTING (check all that apply):

__ Isolated Upland Depression ✓ Within Larger Wetland System __ Within Floodplain

✓ Part of a Pool Complex (within 1000 ft of one/more vernal pools) __ Other:

(2) WETLAND TYPE (choose dominant):

✓ Forested Wetland __ Shrub Wetland __ Herbaceous Wetland ✓ Open Water

__ Floodplain __ Peatland (fen or bog) __ Other:

(3) POOL ORIGIN:

✓ Natural __ Natural-Modified __ Manmade __ Manmade for Mitigation

__ Unknown If not natural, describe: pool extends to toe of slope of I93

(4) POOL SIZE (approximate dimensions): 100'x150' = 15,000 sq ft. (0.34 ac.)

(5) MAX POOL DEPTH (at time of survey): __ 0-12" (0-1 ft) __ 12-36" (1-3 ft) ✓ 36-60" (3-5 ft) __ >60" (>5 ft)

(6) PREDOMINANT SUBSTRATE: __ Mineral Soil __ Leaf Litter ✓ Organic (peat/muck) __ Other:

(7) ESTIMATED HYDROPERIOD (provide rationale):

__ Ephemeral (drying out completely in most years) ✓ Semi-Permanent (drying partially in all yrs & completely in drought yrs) ? Permanent Explain: No water present Sept. 2014, though deep water present May-June 2014. Water present June 2015.

(8) INLET/OUTLET FLOW:

Inlet: __ None ✓ Intermittent __ Permanent (channel with well-defined banks, permanent flow)

Outlet: __ None ✓ Intermittent (seasonal) __ Permanent

(9) SURROUNDING HABITAT (check all that apply and provide percentages/descriptions as applicable):

✓ Forested: mostly uplands

__ Shrub:

__ Open (e.g. meadow, agriculture, golf course):

__ Developed:

✓ Other: I93 highway immediately adjacent (southwest)

NH Vernal Pool Determination/Assessment Data Form

Pool ID #: 4   Survey Date(s): 6/24/13, 5/9/14, 5/23/14, 6/6/14, 9/3/14, 5/19/15, 6/12/15

Project Name: I93 - Exit 4A   Location: Londonderry, NH

POOL INDICATOR SPECIES

PRIMARY INDICATORS	SURVEY DATE(S)	EGG MASSES (#)	TADPOLES/LARVAE
Wood Frog (*Lithobates sylvatica*)	1: 2: 5/23/14	1: 2: one	Few / Common / Many Few / Common / Many
Spotted Salamander (*Ambystoma maculatum*)	1: 5/19/15 2:	1: three 2:	Few / Common / Many Few / Common / Many
Blue-spotted Salamander (*Ambystoma laterale*)	1: 2:	1: 2:	Few / Common / Many Few / Common / Many
Fairy Shrimp (*Eubranchipus* spp.)	1: 5/9/14 2: 5/23/14	Present? Y N Present? Y N	Few / Common / Many Few / Common / Many

SECONDARY INDICATORS (check all observed):

State & Federal:
- ✓ Caddisfly Larvae/Casings
- ___ Fingernail Clams/Shells
- ___ Spire-Shaped Snails/Shells
- ✓ Flat-Spire Snails/Shells

State Only:
- ___ Aquatic Beetle Larvae
- ___ Damselfly Larvae/Exuviae
- ___ True Fly Larvae/Pupae
- ___ Dragonfly Larvae/Exuviae
- ___ Clam Shrimp/Shells

OTHER SPECIES/RARITY:

5/19/15: SS egg masses (3)
WF larvae (1000s)
f. shrimp
aq. beetle larvae
fingernail clams, spire snails
6/12/15: Water present

POOL STATUS

Primary Indicators Present? Y N

2 or more Federal Secondary Indicators? Y N

3 or more State Secondary Indicators? Y N → 2014 → 2015

Water Present for 2 or more Continuous Months in Spring/Summer? Y N

Seasonal Pool? Y N   Lacks a Viable Fish Population? Y N

✓ FEDERAL VERNAL POOL? Y N

STATE OF NH VERNAL POOL? Y N

COMMENTS Fairy shrimp present early May 2014, WF egg mass/larvae present late May 2014. SS egg masses + WF larvae + f. shrimp present in May 2015.

NH Vernal Pool Determination/Assessment Data Form

Pool ID #: 3 Survey Date(s): 6/24/13, 5/9/14, 5/23/14, 6/6/14, 9/3/14, 5/19/15, 6/12/15

Project Name: I93 - Exit 4A Location: Londonderry, NH

Observer's Name: M. Parsont Credentials: NH CWS

Observer's Name: G. Thomas (5/2014) Credentials: Prof. Wildlife Biologist
R. Bolton (5/2015) " "

POOL CHARACTERISTICS

(1) LANDSCAPE SETTING (check all that apply):

✓ Isolated Upland Depression __ Within Larger Wetland System __ Within Floodplain

✓ Part of a Pool Complex (within 1000 ft of one/more vernal pools) __ Other:

(2) WETLAND TYPE (choose dominant):

__ Forested Wetland ✓ Shrub Wetland __ Herbaceous Wetland __ Open Water

__ Floodplain __ Peatland (fen or bog) __ Other:

(3) POOL ORIGIN:

✓ Natural __ Natural-Modified __ Manmade __ Manmade for Mitigation

__ Unknown If not natural, describe: pool extends to toe of slope of I-93

(4) POOL SIZE (approximate dimensions): 150' x 200' = 30,000 sq ft (0.69 ac.)

(5) MAX POOL DEPTH (at time of survey): __ 0-12" (0-1 ft) ✓ 12-36" (1-3 ft) __ 36-60" (3-5 ft) __ >60" (>5 ft)

(6) PREDOMINANT SUBSTRATE: __ Mineral Soil __ Leaf Litter ✓ Organic (peat/muck) __ Other:

(7) ESTIMATED HYDROPERIOD (provide rationale):

__ Ephemeral (drying out completely in most years) ✓ Semi-Permanent (drying partially in all yrs & completely in drought yrs) ? Permanent Explain: No water present Sept. 2014, very deep water present May-June 2014. Water present June 2015.

(8) INLET/OUTLET FLOW:

Inlet: __ None ✓ Intermittent __ Permanent (channel with well-defined banks, permanent flow)

Outlet: __ None ✓ Intermittent (seasonal) ? Permanent

(9) SURROUNDING HABITAT (check all that apply and provide percentages/descriptions as applicable):

✓ Forested: mixed uplands + wetlands

__ Shrub:

__ Open (e.g. meadow, agriculture, golf course):

__ Developed:

✓ Other: I93 highway immediately adjacent (southwest)

NH Vernal Pool Determination/Assessment Data Form

Pool ID #: 3   Survey Date(s): 6/24/13, 5/9/14, 5/23/14, 6/6/14, 9/3/14, 5/19/15, 6/12/15

Project Name: I93 - Exit 4A   Location: Londonderry, NH

POOL INDICATOR SPECIES

PRIMARY INDICATORS	SURVEY DATE(S)	EGG MASSES (#)	TADPOLES/LARVAE
Wood Frog (*Lithobates sylvatica*)	1: 2: 5/23/14	1: 2: None	Few / Common / Many Few / Common / Many
Spotted Salamander (*Ambystoma maculatum*)	1: 2:	1: 2:	Few / Common / Many Few / Common / Many
Blue-spotted Salamander (*Ambystoma laterale*)	1: 2:	1: 2:	Few / Common / Many Few / Common / Many
Fairy Shrimp (*Eubranchipus* spp.)	1: 5/9/14 2: 5/23/14	Present? Y N Present? Y N	Few / Common / Many Few / Common / Many

SECONDARY INDICATORS (check all observed):

State & Federal:
- ✓ Caddisfly Larvae/Casings
- ___ Fingernail Clams/Shells
- ___ Spire-Shaped Snails/Shells
- ___ Flat-Spire Snails/Shells

State Only:
- ✓ Aquatic Beetle Larvae
- ___ Damselfly Larvae/Exuviae
- ___ True Fly Larvae/Pupae
- ___ Dragonfly Larvae/Exuviae
- ___ Clam Shrimp/Shells

OTHER SPECIES/RARITY: bullfrogs

5/19/15: F. shrimp
WF larvae (1000s)
caddisfly larvae
fingernail clams
6/12/15: water present.

POOL STATUS

Primary Indicators Present? Y N

2 or more Federal Secondary Indicators? Y N   2015   2014

3 or more State Secondary Indicators? Y N

Water Present for 2 or more Continuous Months in Spring/Summer? Y N

Seasonal Pool? Y N   Lacks a Viable Fish Population? Y N

✓ FEDERAL VERNAL POOL? Y N

STATE OF NH VERNAL POOL? Y N

COMMENTS Fairy shrimp present early May 2014, WF larvae present late May 2014.
Fairy shrimp + WF larvae present May 2015.

NH Vernal Pool Determination/Assessment Data Form

Pool ID #: 2

Survey Date(s): 6/24/13, 5/9/14, 5/23/14, 6/6/14, 9/3/14, 5/19/15, 6/12/15

Project Name: I93 - Exit 4A

Location: Londonderry, NH

Observer's Name: M. Parsont

Credentials: NH CWS

Observer's Name: G. Thomas (5/2014)
R. Bolton (5/2015)

Credentials: Prof. Wildlife Biologist
" "

POOL CHARACTERISTICS

(1) LANDSCAPE SETTING (check all that apply):

__ Isolated Upland Depression ✓ Within Larger Wetland System __ Within Floodplain

✓ Part of a Pool Complex (within 1000 ft of one/more vernal pools) __ Other:

(2) WETLAND TYPE (choose dominant):

✓ Forested Wetland __ Shrub Wetland __ Herbaceous Wetland __ Open Water

__ Floodplain __ Peatland (fen or bog) __ Other:

(3) POOL ORIGIN:

✓ Natural __ Natural-Modified __ Manmade __ Manmade for Mitigation

__ Unknown If not natural, describe: pool extends to toe of slope of I93

(4) POOL SIZE (approximate dimensions): 100' x 150' = 15,000 sqft (0.34 ac.)

(5) MAX POOL DEPTH (at time of survey): ✓ 0-12" (0-1 ft) __ 12-36" (1-3 ft) __ 36-60" (3-5 ft) __ >60" (>5 ft)

(6) PREDOMINANT SUBSTRATE: __ Mineral Soil __ Leaf Litter ✓ Organic (peat/muck) __ Other:

(7) ESTIMATED HYDROPERIOD (provide rationale):

__ Ephemeral (drying out completely in most years)

✓ Semi-Permanent (drying partially in all yrs & completely in drought yrs)

__ Permanent

Explain: No water present Sept. 2014; though shallow, significant water present May-June 2014. Water present in localized areas June 2015.

(8) INLET/OUTLET FLOW:

Inlet: __ None ✓ Intermittent __ Permanent (channel with well-defined banks, permanent flow)

Outlet: __ None ✓ Intermittent (seasonal) __ Permanent

(9) SURROUNDING HABITAT (check all that apply and provide percentages/descriptions as applicable):

✓ Forested: mostly wetlands, uplands to east

__ Shrub:

__ Open (e.g. meadow, agriculture, golf course):

__ Developed:

✓ Other: I93 highway immediately adjacent to southwest

NH Vernal Pool Determination/Assessment Data Form

Pool ID #: 2 Survey Date(s): 6/24/13, 5/9/14, 5/23/14, 6/6/14, 9/3/14, 5/19/15, 6/12/15

Project Name: I93 - Exit 4A Location: Londonderry, NH

POOL INDICATOR SPECIES

PRIMARY INDICATORS	SURVEY DATE(S)	EGG MASSES (#)	TADPOLES/LARVAE
Wood Frog (*Lithobates sylvatica*)	1: 2:	1: 2:	Few / Common / Many Few / Common / Many
Spotted Salamander (*Ambystoma maculatum*)	1: 5/19/15 2:	1: three 2:	Few / Common / Many Few / Common / Many
Blue-spotted Salamander (*Ambystoma laterale*)	1: 2:	1: 2:	Few / Common / Many Few / Common / Many
Fairy Shrimp (*Eubranchipus* spp.)	1: 5/9/14 2: 5/23/14	Present? Y N Present? Y N	Few / Common / Many Few / Common / Many

SECONDARY INDICATORS (check all observed):

State & Federal:
- ✓ Caddisfly Larvae/Casings
- ___ Fingernail Clams/Shells
- ___ Spire-Shaped Snails/Shells
- ✓ Flat-Spire Snails/Shells

State Only:
- ___ Aquatic Beetle Larvae
- ___ Damselfly Larvae/Exuviae
- ___ True Fly Larvae/Pupae
- ___ Dragonfly Larvae/Exuviae
- ___ Clam Shrimp/Shells

OTHER SPECIES/RARITY:

5/19/15: SS egg masses (3)
WF larvae, f. shrimp
caddisfly/aq beetle larvae
fingernail clams
6/12/15: water present in localized areas

POOL STATUS

Primary Indicators Present? Y N

2 or more Federal Secondary Indicators? Y N

3 or more State Secondary Indicators? Y N → 2014 → 2015

Water Present for 2 or more Continuous Months in Spring/Summer? Y N

Seasonal Pool? Y N Lacks a Viable Fish Population? Y N

FEDERAL VERNAL POOL? Y N

✓ STATE OF NH VERNAL POOL? Y N

COMMENTS Fairy shrimp present early and late May 2014.
SS egg masses + WF larvae + f. shrimp present in May 2015.

Exit 4A Project Vernal Pool Survey Summary

				April 2006 Survey - Primary Indicator[b]		2009 Survey - 1st visit / 2nd visit [a]												Additional information - Rows in *bold italics* indicate pools surveyed in 2014-2015.							
						Primary Indicator[b]					Secondary Indicator[b]														
Pool ID[g]	Relative Value	Pool Attri-butes	Size (acres)	SS egg masses	WF egg masses	WF egg mass-es	WF larvae	SS egg masses	Blue ss egg mass-es	Fairy Shrimp	Caddis-fly Larvae[c]	Finger-nail Clams[c]	Aqua-tic beetle larvae	Spire Shap-ed snails[c]	Flat spire snails[c]	True Fly larvae	Drag-onfly larvae	Pool fishless	Perm. Inlet/ Outlet	Perm. pool	Natural[3]	Phys-ical set-ting[d]	Notes	NHDES Vernal Pool[e]	USACE Vernal Pool[f]
2	***m***		***0.42***	***15***	***8***	***18***					***y***	***y***		***y***	***y***			***maybe***	***maybe***	***semi***	***modified***	***2***	***2009 - I93 may impact hydrology; assoc. with stream May 2014 - f. shrimp, caddisfly, flat spire snails May 2015 - SS egg masses, WF larvae, f. shrimp, caddisfly & aquatic beetle larvae, fingernail clams***	***y***	***y***
3	***m***		***0.52***	***1***	***0***			***13***			***y***			***y***	***y***			***maybe***	***maybe***	***semi***	***y***	***2***	***2009 - bull frog larvae present, linked to 17; associated with a stream May 2104 - WF larvae, fairy shrimp, caddisfly larvae, aquatic beetle larvae May 2015 - WF larvae (1000s), fairy shrimp, caddisfly larvae, fingernail clams***	***y***	***y***
4	***h***	****#***	***0.21***	***50***	***50***			***88***			***y***	***y***	***y***	***y***	***y***			***maybe***	***maybe***	***perm***	***modified***	***2***	***2009 - I93 may impact hydrology; assoc. with a stream May 2014 - WF egg mass (1), WF larvae, f. shrimp, caddisfly larvae, flat spire snails May 2015 - SS egg masses (3), WF larvae (1000s), f. shrimp, aquatic beetle larvae, fingernail clams, spire snails***	***y***	***y***

				April 2006 Survey - Primary Indicator[b]		2009 Survey - 1st visit / 2nd visit [a]												Additional information - Rows in *bold italics* indicate pools surveyed in 2014-2015.							
						Primary Indicator[b]					Secondary Indicator[b]														
Pool ID[g]	Relative Value	Pool Attri-butes	Size (acres)	SS egg masses	WF egg masses	WF egg mass-es	WF larvae	SS egg masses	Blue ss egg mass-es	Fairy Shrimp	Caddis-fly Larvae[c]	Finger-nail Clams[c]	Aqua-tic beetle larvae	Spire Shap-ed snails[c]	Flat spire snails[c]	True Fly larvae	Drag-onfly larvae	Pool fishless	Perm. Inlet/ Outlet	Perm. pool	Natural[3]	Phys-ical set-ting[d]	Notes	NHDES Vernal Pool[e]	USACE Vernal Pool[f]
5	***h (2009) m (2016)***	****#***	***0.12***	***32***	***20***	***11***	***0/y***	***27/21***			***y***							***maybe***	***maybe***	***n***	***y***	***2***	***2009 - associated with a stream May 2014 - WF egg masses (6), caddisfly larvae May 2015 - SS egg masses (9), WF larvae, f. shrimp, caddisfly larvae, spire snails***	***y***	***y***
6	***h (2009) m (2016)***	****#***	***0.41***	***39***	***>100 tp's***	***33***		***29***			***y***	***0/y***		***0/y***			***0/y***	***y***	***n***	***y***	***y***	***1***	***May 2014 - WF egg masses (3), WF larvae, f.shrimp, caddisfly/aquatic beetle larvae, flat spire snails May 2015 - SS egg masses (3), WF larvae, juv/adult WFs, caddisfly/aquatic beetle larvae, fingernail clams***	***y***	***y***
7	***h***	****#***	***0.09***	***63***	***>1000 tp's***	***35/1***	***0/y***	***6/29***			***y***							***y***	***n***	***y***	***y***	***1***	***2009 - very deep May 2014 - WF egg masses (4), WF larvae, f.shrimp, caddisfly larvae May 2015- BSS/SS egg masses (2/13), WF larvae, juv WFs***	***y***	***y***
8	***m (2009) l (2016)***		***0.44***	***0***	***3***	***1***		***10/13***			***y***			***0/y***				***y***	***n***	***semi***	***modified***	***2***	***May 2014 - WF larvae (1000s), caddisfly larvae May 2015 - WF larvae, caddisfly larvae, aquatic beetle larvae, damselfly larvae***	***y***	***y***
9	m		0.08	0	34	15					y/y							y	n	semi	y	1		y	y
11	l		NR	5	0													y	n	n	NR	2		y	y
12	l		0.15	0	5	0	0											y	n	ephem	n	2		y	y
13	h	*#	0.13	10	12	28/0	5/7	50/6			y/y	0/y		0/y				y	n	n	y	2	within intermittent stream corridor	y	y
14	l		0.08	6	0													y	NR	n	NR	2		y	y
15	l		0.07	0	3													y	NR	n	NR	2		y	y
16	l		0.15	1	2													y	NR	n	NR	2		y	y

				April 2006 Survey - Primary Indicator[b]		2009 Survey - 1st visit / 2nd visit [a]												Additional information - Rows in *bold italics* indicate pools surveyed in 2014-2015.							
						Primary Indicator[b]					Secondary Indicator[b]														
Pool ID[g]	Relative Value	Pool Attri-butes	Size (acres)	SS egg masses	WF egg masses	WF egg mass-es	WF larvae	SS egg masses	Blue ss egg mass-es	Fairy Shrimp	Caddis-fly Larvae[c]	Finger-nail Clams[c]	Aqua-tic beetle larvae	Spire Shap-ed snails[c]	Flat spire snails[c]	True Fly larvae	Drag-onfly larvae	Pool fishless	Perm. Inlet/ Outlet	Perm. pool	Natural[3]	Phys-ical set-ting[d]	Notes	NHDES Vernal Pool[e]	USACE Vernal Pool[f]
17	h	#	0.26	3	42													y	NR	n	NR	2		y	y
18	l		0.13	0	7													y	NR	n	NR	2	Many tadpoles present in 2006.	y	y
19	l		0.16	5	0													y	NR	n	NR	2		y	y
20	h	*#	0.12	71	20													y	NR	n	NR	2		y	y
21	m		0.05	14	7													y	NR	n	NR	2		y	y
22	h	#	0.78	NS	NS			42/21			y	y						y	n	y	y	1	painted turtle in pool	y	y
23	h	#	0.05	NS	NS			23/19										y	n	maybe	y	2	ephemeral link to 22	y	y
25	l		0.02	NS	NS			2			y					y		y	n	n	y	1	ephemeral link to 26	y	y
26	h	+	0.09	NS	NS			5		4/y				0/y		y		y	n	n	y	1		y	y
27	h	#	0.01	NS	NS			30/2			y	y		y	y	y		y	n	y	y	2	bullfrog larvae present	y	y
28	h	#	0.45	NS	NS			6/9	>50		y	y			y			y	n	semi	y	1		y	y
29	l		0.04	NS	NS						y	y		y	y			y	n	n	modified	2		y	y
31	l		0.04	NS	NS			5			y			y				y	n	semi	gp	2	ephemeral outlet to 32	n	y
32	l		0.04	NS	NS	8		5			y			y		y		y	n	semi	modified	1	old gravel pit or beaver flowage, green frog present	y	y
35	h	+	0.07	NS	NS					>10						y		y	n	n	y	2	ephemeral outlet to 36	y	y
36	l		0.02								y				y			y	n	n	y	2	ephemeral link to 22	n	y
38	l		0.02				0/y				y/y							y	n	n	y	2	Green frog present, ephemeral link to 37	y	y
41A	h	+	0.003	NS	NS					y						y		y	n	n	y	1		y	y
42	***h (2009) m (2016)***	*******	***0.12***	***NS***	***NS***	***>50***		***1/1***			***y***			***y***	***y***		***y***	***y***	***n***	***y***	***modified***	***2***	***2009 - Portion of pool within powerline ROW, bullfrog larvae May 2014 - WF larvae, caddisfly larvae, flat spire snails May 2015 - WF larvae, aquatic beetle larvae***	***?***	***y***
44	h	+	0.01	NS	NS	1	y			y	y					y		y	n	semi	y	1		y	y

				April 2006 Survey - Primary Indicator[b]		2009 Survey - 1st visit / 2nd visit [a]												Additional information - Rows in ***bold italics*** indicate pools surveyed in 2014-2015.							
						Primary Indicator[b]					Secondary Indicator[b]														
Pool ID[g]	Relative Value	Pool Attri-butes	Size (acres)	SS egg masses	WF egg masses	WF egg mass-es	WF larvae	SS egg masses	Blue ss egg mass-es	Fairy Shrimp	Caddis-fly Larvae[c]	Finger-nail Clams[c]	Aqua-tic beetle larvae	Spire Shap-ed snails[c]	Flat spire snails[c]	True Fly larvae	Drag-onfly larvae	Pool fishless	Perm. Inlet/ Outlet	Perm. pool	Natural[3]	Phys-ical set-ting[d]	Notes	NHDES Vernal Pool[e]	USACE Vernal Pool[f]
46	***m***		***0.07***	***NS***	***NS***			***11/8***										***y***	***n***	***semi***	***y***	***2***	***2009 - linked to 42 & 47 May 2014 - WF egg masses (12), WF larvae (1000s), caddisfly larvae May 2015- SS egg mass (1), juv/adult WFs, caddisfly/aquatic beetle larvae***	***y***	***y***
47	l		0.03	NS	NS		y											y	n	n	y	2	linked to 46	y	y
48	h	*	0.08	NS	NS	4	y	32/19			y/y				y	y		y	n	semi	y	2	adult wood frog observed, linked to 47	y	y
49	h	+	0.15	NS	NS	0/y	y/y			y/y	y					y		y	n	y	y	2	hundreds of wood frog larvae, linked to 50	y	y
50	h	*	0.11	NS	NS			90/79			y	y						y	n	y	y	2		y	y
51	l		0.13	NS	NS		0/y											y	n	n	n	2	pool in woods road	y	y
54	h	*#	0.57	NS	NS	50		92/42			y					y		y	n	y	y	1	lots of bull frog larvae, deep pool	y	y
56	h	#	0.08	NS	NS	1		0/20			y/y	y		y				y	n	n	y	2		y	y
57	h	*#	0.08	NS	NS	38	0/y	40/13			y	y			y			y	n	semi	y	2	outlets to 61	y	y
58	h	#	0.03	NS	NS	8		23/18			y/y	y						y	n	semi	y	1	linked to 2	y	y
59	h	* # +	0.18	NS	NS	23	0/y		50-100	1/y				0/y				y	n	n	y	1	trash in pool	y	y
60	l		0.01	NS	NS						y/y	y/-			y/y			y	n	n	n	2		n	y
63	h	+	0.01	NS	NS					>10/y						y		y	n	n	y	1	Possible ribbon snake sighted	y	y
64	h		0.01	NS	NS				>20		0/y			0/y				y	n	n	y	1	GP within 100'	n	y

[a] First survey April 22 to 28; second visit May 7 and 8, 2009.

[b] NH Env-Wt. 101.86 and 101.87.

[c] USACE, NH PGP vernal pool facultative indicators.

[d] 1- Isolated depression 2- associated with wetland complex.

[e] Supports one or more primary vernal pool indicators, or 3 or more secondary vernal pool indicators (Env-Wt. 101.108).

[f] Evidence of one or more indicator vernal pool species (primary) or evidence of two or more facultative species (footnote b), (USACE, 2012).

[g] Gaps in vernal pool IDs indicate pools eliminated from consideration as vernal pools under both USACE and NHDES criteria.

Qualitative Values:

h=high productivity (20 or more WF, SS or BS egg masses; or fairy shrimp present

m=medium productivity (10 to 19 WF, SS, or BS egg masses)

l=low productivity (<10 WF, BS, or SS egg masses)

Pool Attributes:

+ = fairy shrimp present

BS=blue-spotted salamander

SS=spotted salamander

WF=wood frog

NR=Not Recorded

= 20 or more wood frog egg masses present

* = 20 or more spotted salamander or blue-spotted salamander egg masses present

tp = tadpole

Appendix J: Wetlands and Vernal Pools Functions and Values

Wetlands proposed to be impacted by each alternative were reviewed to determine what functions and values the wetland currently provides that may be affected by construction of each alternative. *The Highway Methodology Workbook Supplement* (USACE, 1999) recognizes up to 13 different functions and values, including:

- Groundwater recharge/discharge; GW
- Floodflow Alteration; FA
- Fish and Shellfish habitat; FS
- Sediment/toxicant retention; SR
- Nutrient removal/retention/transformation; NR
- Production Export; PE
- Sediment/shoreline stabilization; SS
- Wildlife habitat; WH
- Recreation; RE
- Education/scientific value; ED
- Uniqueness/Heritage; UH
- Visual Quality/aesthetics; VQ and
- Endangered Species; ES

Results of the impact review follow. In accordance with Highway Methodology practices, functions are either assigned a P, for Primary Function provided by the wetland, an X for function provided by the wetland, or left blank to indicate that the function is not provided by the wetland.

Table 1 Impacts to Wetland Functions and Values for 4A Alternatives

Alternative A Impacts to Wetland Functions and Values																
Wetland ID	**Total Wetland Acres**	**Square Feet Impact**	**Cowardin Class**	**GW**	**FA**	**FS**	**SR**	**NR**	**PE**	**SS**	**WH**	**RE**	**ED**	**UH**	**VQ**	**ES**
11	3.38	3,350	PFO	X	X	-	X	X	X	-	X	-	-	-	-	-
13	0.06	958	PFO	X	-	-	-	-	-	-	-	-	-	-	-	-
14	3.46	51,317	PFO	X	P	X	P	X	X	X	P	-	-	-	X	-
15	0.27	5,344	PFO	X	X	-	X	X	X	-	P	-	-	-	-	-
16	0.46	8,115	PFO	X	X	-	X	X	X	-	P	-	-	-	-	-
17	0.30	5,530	PFO	X	X	-	X	X	X	-	P	-	-	-	-	-
18	0.02	659	PEM	X	-	-	-	-	-	-	X	-	-	-	-	-
19	0.22	8,745	PFO	X	X	-	X	X	X	-	P	-	-	-	-	-
20	0.03	1,504	PFO	X	X	-	X	X	X	-	P	-	-	-	-	-
22	0.61	12	PFO	X	X	-	X	X	X	-	P	-	-	-	-	-
24	0.11	3,388	PFO	X	X	-	P	X	X	-	X	-	-	-	-	-
35	0.10	1,882	PFO	X	-	-	-	-	-	-	P	-	-	-	-	-
39	0.19	4,172	PEM	X	-	-	X	-	-	-	X	-	-	-	-	-
40	0.02	852	PSS	X	-	-	X	-	-	-	-	-	-	-	-	-
41	0.95	756	PFO	X	P	X	P	X	P	X	P	-	-	-	-	-
46	0.18	57	PFO	X	P	X	P	X	P	X	P	-	-	-	X	-
49	1.15	2,020	PFO	X	-	X	X	X	-	-	P	-	-	-	-	-
54	0.12	251	PEM	X	-	-	-	-	X	-	P	-	-	-	-	-
55	0.07	2	PEM	X	-	-	-	-	X	-	P	-	-	-	-	-
56	0.31	33	PEM	X	X	-	P	-	X	-	X	-	-	-	-	-
59	2.91	1,479	PFO	X	P	X	X	X	P	X	P	X	-	-	X	-

Alternative B - Impacts to Wetland Functions and Values																	
Wetland ID	Total Wetland Acres	Square Feet Impact	Cowardin Class	GW	FA	FS	SR	NR	PE	SS	WH	RE	ED	UH	VQ	ES
11	3.38	3,350	PFO	X	X	-	X	X	X	-	X	-	-	-	-	-
13	0.06	958	PFO	X	-	-	-	-	-	-	-	-	-	-	-	-
14	3.46	51,317	PFO	X	P	X	P	X	X	X	P	-	-	-	X	-
15	0.27	5,344	PFO	X	X	-	X	X	X	-	P	-	-	-	-	-
16	0.46	8,115	PFO	X	X	-	X	X	X	-	P	-	-	-	-	-
17	0.30	5,530	PFO	X	X	-	X	X	X	-	P	-	-	-	-	-
18	0.02	659	PEM	X	-	-	-	-	-	-	X	-	-	-	-	-
19	0.22	7,610	PFO	X	X	-	X	X	X	-	P	-	-	-	-	-
20	0.03	1,504	PFO	X	X	-	X	X	X	-	P	-	-	-	-	-
21	0.06	871	PFO	X	-	-	-	-	-	-	X	-	-	-	-	-
22	0.61	758	PFO	X	X	-	X	X	X	-	P	-	-	-	-	-
23	0.05	978	PFO	X	X	-	X	X	X	-	P	-	-	-	-	-
24	0.11	1,252	PFO	X	X	-	P	X	X	-	X	-	-	-	-	-
32	0.01	256	PFO	X	-	-	X	-	-	-	-	-	-	-	-	-
33	0.03	1,482	PFO	X	-	-	-	-	-	-	-	-	-	-	-	-
34	0.07	2,916	PFO	X	-	-	-	-	-	-	-	-	-	-	-	-
36	0.01	416	PFO	X	-	-	-	-	-	-	P	-	-	-	-	-
37	0.06	2,153	PFO	X	-	-	-	-	-	-	-	-	-	-	-	-
38	0.93	15,325	PFO	X	P	X	P	X	P	X	P	-	-	-	X	-
42	2.26	55,700	PUB	X	P	X	P	X	X	X	X	-	-	-	X	-

Alternative B - Impacts to Wetland Functions and Values

Wetland ID	Total Wetland Acres	Square Feet Impact	Cowardin Class	GW	FA	FS	SR	NR	PE	SS	WH	RE	ED	UH	VQ	ES
43	2.38	347	PSS/PEM	X	P	-	P	X	X	-	P	X	-	-	X	-
44	0.12	4,748	PEM	P	-	-	P	X	-	-	-	-	-	-	-	-
47	2.27	18,453	PFO	P	P	-	X	X	X	X	P	-	-	-	-	-
48	8.58	90,956	PFO	P	P	-	X	X	X	X	P	-	-	-	-	-
50	0.20	5,037	PEM	-	-	-	X	-	-	-	X	-	-	-	-	-
51	0.16	3,576	PEM	-	-	-	X	-	-	-	X	-	-	-	-	-
52	2.17	19,976	PFO	-	-	-	X	-	-	-	X	-	X	-	-	-
53	7.42	79,714	PSS	P	P	X	X	X	X	X	P	-	-	-	-	-
56	0.31	13	PEM	X	X	-	P	-	X	-	X	-	-	-	-	-
57	0.12	614	PSS	-	-	-	-	-	-	-	X	-	-	-	-	-
59	1.72	2,806	PFO	X	P	X	X	X	P	X	P	X	-	-	X	-
47	2.27	18,453	PFO	P	P	-	X	X	X	X	P	-	-	-	-	-
48	8.58	90,956	PFO	P	P	-	X	X	X	X	P	-	-	-	-	-
50	0.20	5,037	PEM	-	-	-	X	-	-	-	X	-	-	-	-	-
51	0.16	3,576	PEM	-	-	-	X	-	-	-	X	-	-	-	-	-
52	2.17	19,976	PFO	-	-	-	X	-	-	-	X	-	X	-	-	-
53	7.42	79,714	PSS	P	P	X	X	X	X	X	P	-	-	-	-	-
56	0.31	13	PEM	X	X	-	P	-	X	-	X	-	-	-	-	-
57	0.12	614	PSS	-	-	-	-	-	-	-	X	-	-	-	-	-
59	1.72	2,806	PFO	X	P	X	X	X	P	X	P	X	-	-	X	-

Alternative C - Impacts to Wetland Functions and Values																
Wetland ID	**Total Wetland Acres**	**Square Feet Impact**	**Cowardin Class**	**GW**	**FA**	**FS**	**SR**	**NR**	**PE**	**SS**	**WH**	**RE**	**ED**	**UH**	**VQ**	**ES**
1	5.41	26,288	PFO	P	P	X	P	P	P	X	P	-	-	-	X	-
2	0.01	16	PFO	X	-	-	-	-	X	-	P	-	-	-	-	-
3	0.06	2,185	PFO	X	-	-	X	-	-	-	P	-	-	-	-	-
4	6.40	54,416	PFO	P	P	X	P	P	P	X	P	-	-	-	X	-
5	0.19	8,125	PFO	X	-	-	X	-	-	-	X	-	-	-	-	-
6	0.20	1,305	PFO	X	-	-	X	-	-	-	X	-	-	-	-	-
7	0.05	925	PFO	X	-	-	X	-	-	-	X	-	-	-	-	-
8	0.93	17,270	PEM	X	X	-	X	X	X	-	P	-	-	-	-	-
9	3.63	1,025	PFO	X	X	-	X	X	P	X	P	-	-	-	-	-
10	0.10	735	PFO	X	-	-	X	-	-	-	X	-	-	-	-	-
11	3.38	1,693	PFO	X	X	-	X	X	X	-	X	-	-	-	-	-
25	0.13	4,194	PFO	-	-	-	-	-	-	-	P	-	-	-	-	-
26	0.22	8,332	PSS	-	-	-	X	-	-	-	-	-	-	-	-	-
27	0.04	1,152	PSS	-	-	-	X	-	-	-	-	-	-	-	-	-
28	0.42	12,758	PFO	-	-	-	P	-	-	-	X	-	-	-	-	-
29	0.35	5,616	PSS	-	-	-	X	-	-	-	-	-	-	-	-	-
30	0.08	732	PEM	-	-	-	X	-	-	-	-	-	-	-	-	-
31	0.04	534	PEM	-	-	-	X	-	-	-	-	-	-	-	-	-
47	2.27	18,453	PFO	P	P	-	X	X	X	X	P	-	-	-	-	-
48	8.58	90,956	PFO	P	P	-	X	X	X	X	P	-	-	-	-	-
50	0.20	5,037	PEM	-	-	-	X	-	-	-	X	-	-	-	-	-
51	0.16	3,576	PEM	-	-	-	X	-	-	-	X	-	-	-	-	-

Alternative C - Impacts to Wetland Functions and Values																
Wetland ID	Total Wetland Acres	Square Feet Impact	Cowardin Class	GW	FA	FS	SR	NR	PE	SS	WH	RE	ED	UH	VQ	ES
52	2.17	19,976	PFO	-	-	-	X	-	-	-	X	-	X	-	-	-
53	7.42	79,714	PSS	P	P	X	X	X	X	X	P	-	-	-	-	-
57	0.12	614	PSS	-	-	-	-	-	-	-	X	-	-	-	-	-
59	1.72	2,788	PFO	X	P	X	X	X	P	X	P	X	-	-	X	-

Alternative D - Impacts to Wetland Functions and Values																
Wetland ID	Total Wetland Acres	Square Feet Impact	Cowardin Class	GW	FA	FS	SR	NR	PE	SS	WH	RE	ED	UH	VQ	ES
1	5.41	26,288	PFO	P	P	X	P	P	P	X	P	-	-	-	X	-
2	0.01	16	PFO	X	-	-	-	-	X	-	P	-	-	-	-	-
3	0.06	2,185	PFO	X	-	-	X	-	-	-	P	-	-	-	-	-
4	6.40	54,379	PFO	P	P	X	P	P	P	X	P	-	-	-	X	-
5	0.19	8,125	PFO	X	-	-	X	-	-	-	X	-	-	-	-	-
6	0.20	1,305	PFO	X	-	-	X	-	-	-	X	-	-	-	-	-
7	0.05	925	PFO	X	-	-	X	-	-	-	X	-	-	-	-	-
8	0.93	17,270	PEM	X	X	-	X	X	X	-	P	-	-	-	-	-
9	3.63	1,025	PFO	X	X	-	X	X	P	X	P	-	-	-	-	-
10	0.10	735	PFO	X	-	-	X	-	-	-	X	-	-	-	-	-
11	3.38	1,841	PFO	X	X	-	X	X	X	-	X	-	-	-	-	-
25	0.13	4,194	PFO	-	-	-	-	-	-	-	P	-	-	-	-	-

Alternative D - Impacts to Wetland Functions and Values																
Wetland ID	Total Wetland Acres	Square Feet Impact	Cowardin Class	GW	FA	FS	SR	NR	PE	SS	WH	RE	ED	UH	VQ	ES
26	0.22	8,332	PSS	-	-	-	X	-	-	-	-	-	-	-	-	-
27	0.04	1,152	PSS	-	-	-	X	-	-	-	-	-	-	-	-	-
28	0.42	12,758	PFO	-	-	-	P	-	-	-	X	-	-	-	-	-
29	0.35	5,616	PSS	-	-	-	X	-	-	-	-	-	-	-	-	-
30	0.08	732	PEM	-	-	-	X	-	-	-	-	-	-	-	-	-
31	0.04	534	PEM	-	-	-	X	-	-	-	-	-	-	-	-	-
45	1.57	5,009	PSS/PEM	P	X	-	P	X	-	-	-	-	-	-	-	-
46	0.18	789	PFO	X	P	X	P	X	P	X	P	-	-	-	X	-
49	1.15	2,020	PFO	X	-	X	X	X	-	-	P	-	-	-	-	-
54	0.12	203	PEM	X	-	-	-	-	X	-	P	-	-	-	-	-
55	0.07	2	PEM	X	-	-	-	-	X	-	P	-	-	-	-	-
56	0.31	33	PEM	X	X	-	P	-	X	-	X	-	-	-	-	-
59	2.91	1,479	PFO	X	P	X	X	X	P	X	P	X	-	-	X	-

**Photo 1. Facing west-northwest from Wetland 14,
south of Project boundary crossing with Stream Crossing 1 (5/21/2018)**

Photo 2. Facing southwest from northern boundary of Wetland 14 (5/21/2018).

Riprap from recent construction on I-93.

Photo 3. Facing northwest from Stream Crossing 1 crossing with western Project boundary, within Wetland 14 (5/21/2018)

Photo 4. Facing east-southeast from western Project boundary crossing with Wetland 14 (5/21/2018)

Photo 5. Facing north near southern end of Wetland 15 towards Vernal Pool 2 (5/21/2018). Erosion controls from recent construction for I-93.

Photo 6. Facing southeast from northwest boundary of Wetland 15, towards Vernal Pool 2 (5/21/2018)
Sideslopes of recently widened I-93 to right in photo.

Photo 7. Facing north-northwest from southern boundary of Wetland 16, towards Vernal Pool 03 (5/21/2018).
Erosion controls from recent I-93 construction.

Photo 8. Facing north-northeast from northern boundary of Wetland 16, towards Vernal Pool 4 (5/21/2018)

Photo 9. Facing east-northeast to Wetland 16, near southern boundary of Vernal Pool 4 (5/21/2018). Erosion controls from recent I-93 construction.

Photo 10. Facing north-northeast of Wetland 17 and Stream Crossing 7 (5/21/2018)

Photo 11. Facing southwest from northeastern boundary of Wetland 17 and Stream 7 (5/21/2018)

Photo 12. Facing east-southeast from eastern boundary of Wetland 19, towards Vernal Pool 42, south of Wetland 18 (5/21/2018)

Photo 13. Facing northeast from western boundary of Wetland 19, towards Vernal Pool 42 (5/21/2018)

Photo 14. Facing northwest from eastern boundary of Wetland 20 (5/21/2018)

Photo 15. Facing east-northeast between wetlands 20 and 22 along Stream 8 (5/21/2018)

Photo 16. Facing northeast from junction of Stream 8 and Wetland 22 at Project boundary crossing/southern boundary of Vernal Pool 46 (5/21/2018)

Photo 17. Facing north-northeast from southern boundary of Wetland 24, toward Vernal Pool 06 (5/21/2018)

Photo 18. Facing west from eastern boundary of Wetland 24, toward Vernal Pool 06 (5/21/2018)

Photo 19. Facing north from Wetland 35 to Vernal Pool 08 from southwest Project boundary crossing (5/21/2018)

Photo 20. Facing southwest from Wetland 35 to Vernal Pool 08 from eastern pool/wetland boundary (5/21/2018)

Photo 21. Facing south-southwest from northeast boundary of Wetland 39 (5/24/2018)

Photo 22. Facing northeast from southwest boundary of Wetland 40, near Stream 11 (5/24/2018)

Photo 23. Facing northwest to Wetland 41 and Stream 2, north of North High Street (5/15/2018)

Photo 24. Facing southeast toward Stream 2 at road crossing, south of North High Street (5/15/2018)

Photo 25. Facing south to Wetland 41 from Franklin Street Extension (5/21/2018)

Photo 26. Facing southeast towards Wetland 46 from Folsom Road (5/15/2018)

Photo 27. Facing northwest from Tsienneto Road toward Wetland 49 (5/15/2018)

Photo 28. Facing northwest from Tsienneto Road toward Wetland 54/Vernal Pool 11 (5/15/2018)

Photo 29. Facing southeast from Tsienneto Road toward Stream Crossing 4 (5/15/2018)

Photo 30. Facing northwest from Tsienneto Road toward Wetland 56 (5/15/2018)

Photo 31. Facing southeast from Tsienneto Road toward Wetland 59 (5/15/2018)

Photo 32. Facing north from Tsienneto Road toward Wetland 59 (prime wetland) and Stream Crossing 5 (5/15/2018)

Photo 33. Facing south from Tsienneto Road toward Wetland 59 and Stream Crossing 5 (5/15/2018)

Photo 34. Facing southeast from Chester Road (NH Route 102) towards Wetland 59 and Stream Crossing 6 into Beaver Lake (5/15/2018)

Photo 35. Facing northwest from Chester Road (NH Route 102) towards Stream Crossing 6 (5/15/2018)

Photo 36 Wetland 60, north of Tsienneto Road, view north (7/27/2018)

Photo 37 Wetland 61, south of Tsienneto Road, view south (7/27/2018)

Appendix K: Agency Correspondence

Memo

NH Natural Heritage Bureau
NHB Datacheck Results Letter

To: Sarah Barnum, Normandeau Associates
25 Nashua Rd
Bedford, NH 03110

From: Amy Lamb, NH Natural Heritage Bureau
Date: 4/4/2016 (valid for one year from this date)
Re: Review by NH Natural Heritage Bureau
NHB File ID: NHB16-0960 Town: Derry, Londonderry Location: North End of project area
Description: I-93 Exit 4A Project: This is a re-evaluation request from previous submittals in 2010, 2005 and 1999. This review is intended to ensure data presented in the project's Final Environmental Impact Statement (FEIS) is up to date. Project proposes to construct a new interchange one mile north of Exit 4 on Interstate 93 in Londonderry and Derry, NH. New interchange would consist of an easterly-only new construction access road that would connect with Folsom Road and then traverse east along Folsom and Tsienneto Roads. Work along Tsienneto Road would typically result in slight adjustments to easterly end of roadway and intersection improvements with Rt 28, Bypass Route 28, and Rt 102. We request that the five remaining alternatives within this study be evaluated to ensure they are each provided the most recent NHNHB review for sensitive plants and animals (Alternatives A through D and F).
cc: Kim Tuttle

As requested, I have searched our database for records of rare species and exemplary natural communities, with the following results.

Comments: Please coordinate with NH Fish & Game and the NHB to avoid and minimize impacts to the species and exemplary natural systems below.

Natural Community	State[1]	Federal	Notes
Medium level fen system*	--	--	Level fens are stagnant, and as such are characterized by low nutrient levels, relatively high acidity levels, and accumulations of peat. The primary threats to this community are changes to its hydrology (especially that which causes pooling), increased nutrient input from stormwater runoff, and sedimentation from nearby disturbance.
Poor level fen/bog system*	--	--	Level fens are stagnant, and as such are characterized by low nutrient levels, relatively high acidity levels, and accumulations of peat. The primary threats to this community are changes to its hydrology (especially that which causes pooling), increased nutrient input from stormwater runoff, and sedimentation from nearby disturbance.

Plant species	State[1]	Federal	Notes
Dwarf Huckleberry (*Gaylussacia bigeloviana*)*	T	--	The primary threats are changes to this species' peatland habitat, including changes to

			local hydrology, increased nutrient input from stormwater runoff, and sedimentation from nearby disturbance.
red threeawn (*Aristida longespica var. geniculata*)*	E	--	The pond or lake shore natural communities where this species occurs are extremely vulnerable to trampling, and tend to disappear from areas that experience even moderate recreational use. They are also vulnerable to changes to the lake's hydrology. Additional habitats include sandplains and disturbed openings.

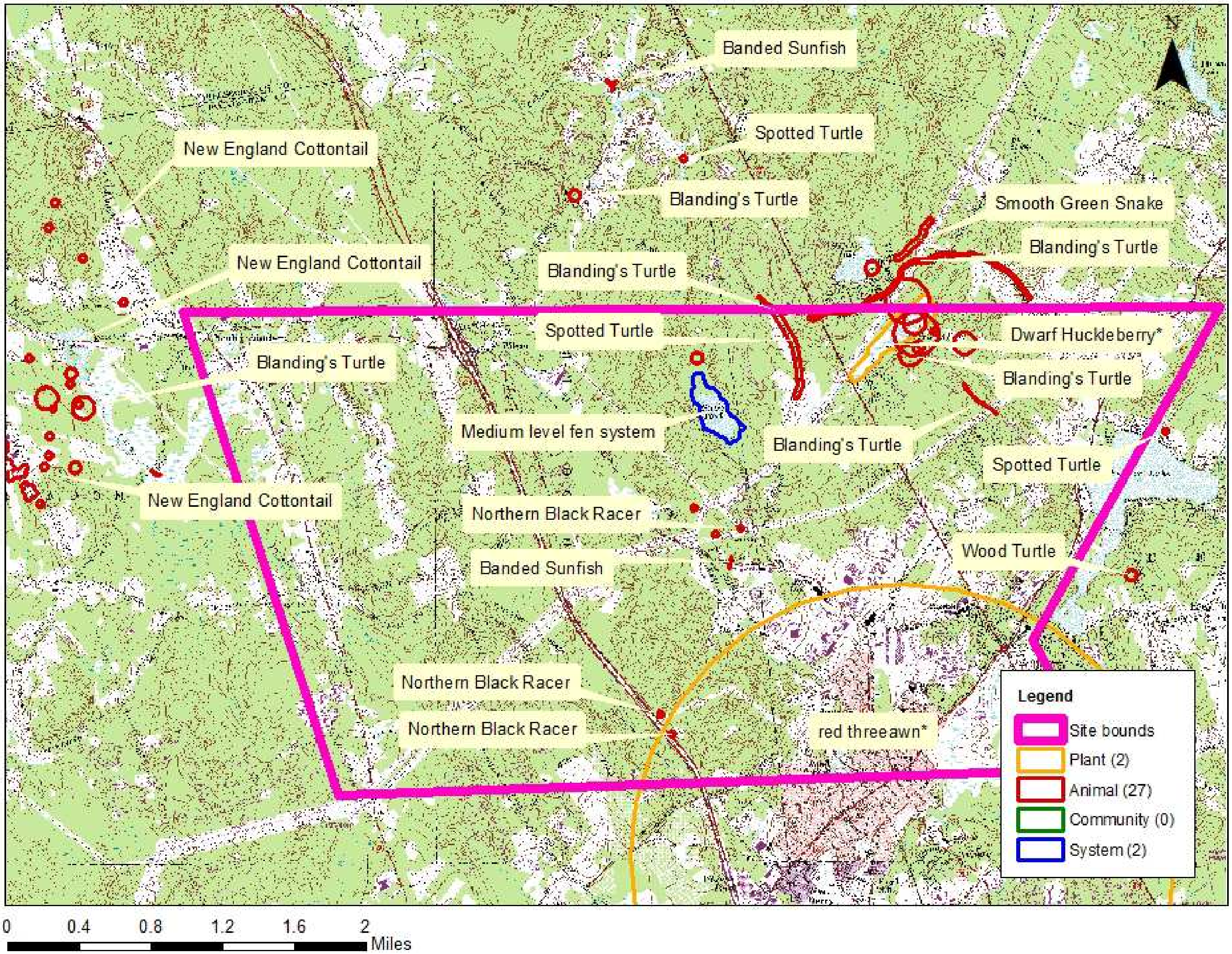
Vertebrate species	**State[1]**	**Federal**	**Notes**
Banded Sunfish (*Enneacanthus obesus*)	SC	--	Contact the NH Fish & Game Dept (see below).
Blanding's Turtle (*Emydoidea blandingii*)	E	--	Contact the NH Fish & Game Dept (see below).
New England Cottontail (*Sylvilagus transitionalis*)	E	--	Contact the NH Fish & Game Dept (see below).
Northern Black Racer (*Coluber constrictor constrictor*)	T	--	Contact the NH Fish & Game Dept (see below).
Smooth Green Snake (*Opheodrys vernalis*)	SC	--	Contact the NH Fish & Game Dept (see below).
Spotted Turtle (*Clemmys guttata*)	T	--	Contact the NH Fish & Game Dept (see below).
Wood Turtle (*Glyptemys insculpta*)	SC	--	Contact the NH Fish & Game Dept (see below).

[1]Codes: "E" = Endangered, "T" = Threatened, "SC" = Special Concern, "--" = an exemplary natural community, or a rare species tracked by NH Natural Heritage that has not yet been added to the official state list. An asterisk (*) indicates that the most recent report for that occurrence was more than 20 years ago.

Contact for all animal reviews: Kim Tuttle, NH F&G, (603) 271-6544.

A negative result (no record in our database) does not mean that a sensitive species is not present. Our data can only tell you of known occurrences, based on information gathered by qualified biologists and reported to our office. However, many areas have never been surveyed, or have only been surveyed for certain species. An on-site survey would provide better information on what species and communities are indeed present.

NHB16-0960



Banded Sunfish
Spotted Turtle
New England Cottontail
Blanding's Turtle
Smooth Green Snake
Blanding's Turtle
New England Cottontail
Blanding's Turtle
Spotted Turtle
Dwarf Huckleberry*
Blanding's Turtle
Blanding's Turtle
Medium level fen system
Blanding's Turtle
Spotted Turtle
New England Cottontail
Northern Black Racer
Banded Sunfish
Wood Turtle
Northern Black Racer
Northern Black Racer
red threeawn*
Legend
Site bounds
Plant (2)
Animal (27)
Community (0)
System (2)
0
0.4
0.8
1.2
1.6
2
Miles

New Hampshire Natural Heritage Bureau - System Record

Medium level fen system

Legal Status		**Conservation Status**	
Federal:	Not listed	Global:	Not ranked (need more information)
State:	Not listed	State:	Rare or uncommon

Description at this Location

Conservation Rank: Historical records only - current condition unknown.
Comments on Rank:

Detailed Description: 1992: Closer to the pond edge, the heath shrubs are shorter or dwarfed and dominated by *Chamaedaphne calyculata* (leatherleaf) and *Myrica gale* (sweet gale), with *Rhododendron canadense* (rhodora) most common along the high-shrub border. Small pockets of open sphagnum moss and sedges are found near the inlet stream and pond edge, with a greater diversity of species apparent. Species found in these areas include *Carex trisperma* (three-seeded sedge), *Andromeda polifolia* var. *glaucophylla* (bog rosemary), *Eriophorum virginicum* (tawny cotton-grass), *Vaccinium macrocarpon* (large cranberry), *Drosera intermedia* (spatulate-leaved sundew), and *Peltandra virginica* (arrow arum). *Nuphar variegata* (variegated yellow pondlily), *Nymphaea odorata* (white waterlily), and *Brasenia schreberi* (water shield) are found along the edges of the floating mat.

General Area: 1992: The northwest side of Scobie Pond has an approximate 8-acre basin with several associations including hardwood-conifer basin swamp, high shrub bog, dwarf heath-shrub bog and acidic fen communities represented. Collectively, they form a level bog ecosystem. The rare *gaylussacia dumosa* var bigeloviana was sought but not found, although the habitat appeared appropriate for it. A vernal pond is found about 100 yards SSW from the Cardinal Road cul de sac.

General Comments:

Management Comments: 1992: Housing expansion to north/northeast of the pond could present threats to the ecosystem water quality. Houses on the pond appear to be relatively benign in terms of direct threats, but water quality impacts are uncertain.

Location

Survey Site Name: Scobie Pond
Managed By:

County: Rockingham
Town(s): Londonderry
Size: 34.2 acres Elevation: 360 feet

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 1992: Site was accessed from end of Cardinal Road off of Partridge Road. (junction at Derry/Londonderry line) off of Old Derry Road. May be better access from elsewhere.

Dates documented

First reported: 1992-06-09 Last reported: 1992-06-09

New Hampshire Natural Heritage Bureau - System Record

Poor level fen/bog system

Legal Status		**Conservation Status**	
Federal:	Not listed	Global:	Not ranked (need more information)
State:	Not listed	State:	Rare or uncommon

Description at this Location

Conservation Rank: Historical records only - current condition unknown.
Comments on Rank:

Detailed Description: 1992: Population of *Gaylussacia dumosa* var bigeloviana was found in the fen community.
General Area: he classic fen sequence of floating mat, open peat, low heath, tall heath, dwarf spruce and larch, and shrub swamp is found in this wetland complex. The lag varies from 20 to over 200 feet wide, although the low and high heath zones are not always well developed. The dominant plant in the low heath where the dwarf huckleberry was found was leatherleaf. Dwarf black spruce and larch are scattered throughout this zone. The shrub swamp further back from the pond is dominated by mountain holly, winterberry holly, and high bush blueberry.
General Comments:
Management Comments:

Location

Survey Site Name: Lower Shields Pond
Managed By:

County: Rockingham
Town(s): Derry
Size: 41.8 acres Elevation: 380 feet

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: Take Rte 28BYP north from Derry Village traffic circle ca 2 miles to Shields Pond Road on the right. Go ca. 0.5 mile to culverted creek. There is a path beyond the powerlines that you hike to from the west side of the stream.

Dates documented

First reported: 1992-09-11 Last reported: 1992-09-11

New Hampshire Natural Heritage Bureau - Plant Record

Dwarf Huckleberry (*Gaylussacia bigeloviana*)

Legal Status
Federal: Not listed
State: Listed Threatened

Conservation Status
Global: Apparently secure but with cause for concern
State: Imperiled due to rarity or vulnerability

Description at this Location

Conservation Rank: Historical records only - current condition unknown.
Comments on Rank:

Detailed Description: 1992: Ca. 200 plants seen, 60 percent with mature fruit and dispersing seed, 30 percent in leaf. Growing at the bottom of a slope in wet-mesic condition. May be more plants scattered through the leatherleaf.

General Area: 1992: The huckleberry was found on a low heath mat that rings a portion of the shallow water pond. The classic fen sequence of floating mat, open peat, low heath, tall heath, dwarf spruce and larch, and shrub swamp, is found in this wetland complex. The dominant plant in the low heath where the the dwarf huckleberry was found was *Chamaedaphne calyculata*. Dwarf *Picea mariana*, and *Larix larcina* are scattered throughout this zone. The shrub swamp further back from the pond is dominated by *Nemopanthus mucronata*, *Ilex verticillata*, and *Vaccininium corymbosum*.

General Comments:
Management Comments:

Location

Survey Site Name: Lower Shields Pond
Managed By:

County: Rockingham
Town(s): Derry
Size: 41.8 acres
Elevation: 370 feet

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: Take Rte 28BYP north from Derry Village traffic circle ca. 2 miles to Shields Pond Road on the right. Go ca. 0.5 mile to culverted creek. There is a path beyond the powerlines that you hike to from the west side of the stream.

Dates documented

First reported: 1992-09-11
Last reported: 1992-09-11

New Hampshire Natural Heritage Bureau - Plant Record

red threeawn (*Aristida longespica var. geniculata*)

Legal Status
Federal: Not listed
State: Listed Endangered

Conservation Status
Global: Demonstrably widespread, abundant, and secure
State: Critically imperiled due to rarity or vulnerability

Description at this Location

Conservation Rank: Historical records only - current condition unknown.
Comments on Rank:

Detailed Description: 1977: Specimen collected.
General Area: 1977: Disturbed area, railroad right-of-way.
General Comments: 1993: AT&e put through in 1993.
Management Comments:

Location

Survey Site Name: Derry
Managed By: Tuckernuck Development LLC

County: Rockingham
Town(s): Derry
Size: 4592.3 acres
Elevation: 235 feet

Precision: Within 1.5 miles of the area indicated on the map (location information is vague or uncertain).

Directions: Derry. Railroad right-of-way.

Dates documented

First reported: 1977-10-15
Last reported: 1977-10-15

New Hampshire Natural Heritage Bureau - Animal Record

Banded Sunfish (*Enneacanthus obesus*)

Legal Status		**Conservation Status**	
Federal:	Not listed	Global:	Demonstrably widespread, abundant, and secure
State:	Special Concern	State:	Rare or uncommon

Description at this Location

Conservation Rank: Not ranked
Comments on Rank:

Detailed Description: 2005: Area 8978: 2 observed, age and sex unknown. Area 8972: 1 observed, age and sex unknown. 2000: Area 260: 1 observed, age and sex unknown (Obs_id 368). 1938: Cohas Brook: Specimen collected.

General Area: 2005: Area 8978: Freshwater - stream or river. Area 8972: Freshwater - stream or river. Wide channel with a lot of pickerel weed and submerged vegetation. Marsh and pond-like area. 2000: Area 260: Freshwater - stream or river (Obs_id 368). 1938: Cohas Brook: Vegetation moderate, rushes and *Potamogeton* (pondweed). Partly wooded shore, moderate current.

General Comments: 2000: Area 260: Sampled by DES electrofishing 150 meter index site (Obs_id 368).

Management Comments:

Location

Survey Site Name: Cohas Brook
Managed By: NHDOT Mitigation

County: Hillsborough
Town(s): Manchester
Size: 84.8 acres Elevation: 195 feet

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 1938: Cohas Brook: Cohas Brook from I93 W to Little Island Pond. 2000: Area 260: Cohas Brook at DES Station 00m-50. 2005: Area 8978: Little Cohas Brook on Hall Rd. Area 8972: Cohas Brook on Auburn Rd. at sand and gravel pit.

Dates documented

First reported: 1938 Last reported: 2005-10-03

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

New Hampshire Natural Heritage Bureau - Animal Record

Banded Sunfish (*Enneacanthus obesus*)

Legal Status		**Conservation Status**	
Federal:	Not listed	Global:	Demonstrably widespread, abundant, and secure
State:	Special Concern	State:	Rare or uncommon

Description at this Location

Conservation Rank: Not ranked
Comments on Rank:

Detailed Description: 2005: Area 9005: 8 observed, sex and age unknown.
General Area: 2005: Area 9005: Freshwater - stream or river. Large open area with submergent vegetation at perimeter.
General Comments:
Management Comments:

Location

Survey Site Name: Shields Brook
Managed By:

County: Rockingham
Town(s): Londonderry
Size: .0 acres
Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2005: Area 9005: From the junction of Broadway and Rockingham Rd take Rockingham Rd (also Rte. 28) N for ca.1.75 miles until it crosses Shield Brook.

Dates documented

First reported: 2005-08-22 Last reported: 2005-08-22

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

New Hampshire Natural Heritage Bureau - Animal Record

Blanding's Turtle (*Emydoidea blandingii*)

Legal Status		**Conservation Status**	
Federal:	Not listed	Global:	Apparently secure but with cause for concern
State:	Listed Endangered	State:	Critically imperiled due to rarity or vulnerability

Description at this Location

Conservation Rank: Good quality, condition and landscape context ('B' on a scale of A-D).
Comments on Rank:

Detailed Description: 1997: Area 11910: 1 turtle. Plastron length 8.25 inches.
General Area: 1997: Area 11910: Wetlands and woods nearby. Two small ponds within 0.25 miles (Shields and Rainbow Ponds).
General Comments: 1997: Area 11910: Observed by Joel and Ron Miller.
Management Comments:

Location

Survey Site Name: Lower Shields Pond
Managed By: Rugh - Private Owner

County: Rockingham
Town(s): Derry
Size: 17.7 acres Elevation: 400 feet

Precision: Within 1.5 miles of the area indicated on the map (location information is vague or uncertain).

Directions: 1997: Area 11910: [From Derry Village rotary, take Rte. 102 about 1.5 miles north. Turn left on English Range Road. Follow for ca. 1 mile to vicinity of Rainbow Lake and Lower Shields Pond.]

Dates documented

First reported: 1997-05-20 Last reported: 1997-05-20

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

New Hampshire Natural Heritage Bureau - Animal Record

Blanding's Turtle (*Emydoidea blandingii*)

Legal Status		**Conservation Status**	
Federal:	Not listed	Global:	Apparently secure but with cause for concern
State:	Listed Endangered	State:	Critically imperiled due to rarity or vulnerability

Description at this Location

Conservation Rank: Fair quality, condition and/or landscape context ('C' on a scale of A-D).
Comments on Rank:

Detailed Description: 2004: Area 9278: 1 turtle.
General Area:
General Comments:
Management Comments:

Location

Survey Site Name: Little Cohas Brook
Managed By: NHDOT Mitigation

County: Rockingham
Town(s): Londonderry
Size: 7.7 acres
Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2004: Area 9278: End of Delta Road off of Harvey Road behind the Londonderry Armed Forces Reserve Center.

Dates documented

First reported: 2004-05-15
Last reported: 2004-05-15

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

New Hampshire Natural Heritage Bureau - Animal Record

Blanding's Turtle (*Emydoidea blandingii*)

Legal Status		**Conservation Status**	
Federal:	Not listed	Global:	Apparently secure but with cause for concern
State:	Listed Endangered	State:	Critically imperiled due to rarity or vulnerability

Description at this Location

Conservation Rank: Good quality, condition and landscape context ('B' on a scale of A-D).
Comments on Rank:

Detailed Description: 2005: Area 9329: 1 adult turtle, road kill with 8" x 5.5" shell.
General Area:
General Comments:
Management Comments:

Location

Survey Site Name: Scobie Pond
Managed By:

County: Rockingham
Town(s): Derry
Size: .2 acres Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2005: Area 9329: Scoby Pond Road ca 0.25 miles from Rte 28. The vicinity of M &ycling.

Dates documented

First reported: 2005-06-01 Last reported: 2005-06-01

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

New Hampshire Natural Heritage Bureau - Animal Record

Blanding's Turtle (*Emydoidea blandingii*)

Legal Status		**Conservation Status**	
Federal:	Not listed	Global:	Apparently secure but with cause for concern
State:	Listed Endangered	State:	Critically imperiled due to rarity or vulnerability

Description at this Location

Conservation Rank: Not ranked
Comments on Rank:

Detailed Description: 2006: Area 11743: 1 adult female seen.
General Area:
General Comments:
Management Comments:

Location

Survey Site Name: Nesenkeag Brook
Managed By:

County: Rockingham
Town(s): Londonderry
Size: .4 acres Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2006: Area 11743: Crossed Mayflower Drive approximately 150' from High Range Road.

Dates documented

First reported: 2006-06-15 Last reported: 2006-06-15

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

New Hampshire Natural Heritage Bureau - Animal Record

Blanding's Turtle (*Emydoidea blandingii*)

Legal Status		**Conservation Status**	
Federal:	Not listed	Global:	Apparently secure but with cause for concern
State:	Listed Endangered	State:	Critically imperiled due to rarity or vulnerability

Description at this Location

Conservation Rank: Not ranked
Comments on Rank:

Detailed Description: 2005: Area 11511: 1 adult turtle observed 30 yards from a medium to large vernal pool.
General Area: 2005: Area 11511: Near medium to large vernal pool. Meadows and little woods.
General Comments:
Management Comments:

Location

Survey Site Name: Lower Shields Pond
Managed By:

County: Rockingham
Town(s): Derry
Size: 7.7 acres   Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2005: Area 11511: About 200 yards from powerline off Paul Avenue.

Dates documented

First reported: 2005-04-18   Last reported: 2005-04-18

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

New Hampshire Natural Heritage Bureau - Animal Record

Blanding's Turtle (*Emydoidea blandingii*)

Legal Status

Federal: Not listed
State: Listed Endangered

Conservation Status

Global: Apparently secure but with cause for concern
State: Critically imperiled due to rarity or vulnerability

Description at this Location

Conservation Rank: Not ranked
Comments on Rank:

Detailed Description: 2008: Area 11543M: 2 adults seen.
General Area: 2008: Area 11543M: Beaver pond. On a log in the water.
General Comments:
Management Comments:

Location

Survey Site Name: Lower Shields Pond
Managed By:

County: Rockingham
Town(s): Derry
Size: 30.8 acres
Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2008: Area 11543M: Intersection of powerlines off Scenic Drive and Paul Avenue.

Dates documented

First reported: 2008-05-14
Last reported: 2008-05-14

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

New Hampshire Natural Heritage Bureau - Animal Record

Blanding's Turtle (*Emydoidea blandingii*)

Legal Status		**Conservation Status**	
Federal:	Not listed	Global:	Apparently secure but with cause for concern
State:	Listed Endangered	State:	Critically imperiled due to rarity or vulnerability

Description at this Location

Conservation Rank: Not ranked
Comments on Rank:

Detailed Description: 2006: Area 11689M: 1 young individual female seen on 2006-05-18. 1 adult seen on 2006-05-20.
General Area: 2006: Area 11689M: Near vernal pool.
General Comments:
Management Comments:

Location

Survey Site Name: Lower Shields Pond
Managed By:

County: Rockingham
Town(s): Derry
Size: 30.8 acres Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2006: Area 11689M: Vernal pool near beaver pond at powerline between Paul Avenue &c Drive.

Dates documented

First reported: 2006-05-18 Last reported: 2006-05-20

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

New Hampshire Natural Heritage Bureau - Animal Record

Blanding's Turtle (*Emydoidea blandingii*)

Legal Status		**Conservation Status**	
Federal:	Not listed	Global:	Apparently secure but with cause for concern
State:	Listed Endangered	State:	Critically imperiled due to rarity or vulnerability

Description at this Location

Conservation Rank: Not ranked
Comments on Rank:

Detailed Description: 2006: Area 11854: 1 adult male turtle observed.
General Area:
General Comments:
Management Comments:

Location

Survey Site Name: Lower Shields Pond
Managed By:

County: Rockingham
Town(s): Derry
Size: .2 acres
Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2006: Area 11854: 36R Scenic Drive.

Dates documented

First reported: 2006-06-23 Last reported: 2006-06-23

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

New Hampshire Natural Heritage Bureau - Animal Record

Blanding's Turtle (*Emydoidea blandingii*)

Legal Status		**Conservation Status**	
Federal:	Not listed	Global:	Apparently secure but with cause for concern
State:	Listed Endangered	State:	Critically imperiled due to rarity or vulnerability

Description at this Location

Conservation Rank: Not ranked
Comments on Rank:

Detailed Description: 2009: Area 12308: 1 observed.
General Area: 2009: Area 12308: In residential building.
General Comments:
Management Comments:

Location

Survey Site Name: Little Cohas Brook
Managed By:

County: Rockingham
Town(s): Londonderry
Size: 7.7 acres Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2009: Area 12308: 13 Delta Drive, Suite 7, Londonderry.

Dates documented

First reported: 2009-09-23 Last reported: 2009-09-23

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

New Hampshire Natural Heritage Bureau - Animal Record

Blanding's Turtle (*Emydoidea blandingii*)

Legal Status		**Conservation Status**	
Federal:	Not listed	Global:	Apparently secure but with cause for concern
State:	Listed Endangered	State:	Critically imperiled due to rarity or vulnerability

Description at this Location

Conservation Rank: Not ranked
Comments on Rank:

Detailed Description: 2006: Area 11746: 3 adult females seen.
General Area: 2006: Area 11746: Stream adjacent to open tussock, sedge, meadow with seeps.
General Comments:
Management Comments:

Location

Survey Site Name: Scobie Pond
Managed By:

County: Rockingham
Town(s): Londonderry
Size: .4 acres
Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2006: Area 11746: A superfund site (the Auburn Road landfill).

Dates documented

First reported: 2006-04-02
Last reported: 2006-04-02

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

New Hampshire Natural Heritage Bureau - Animal Record

Blanding's Turtle (*Emydoidea blandingii*)

Legal Status		**Conservation Status**	
Federal:	Not listed	Global:	Apparently secure but with cause for concern
State:	Listed Endangered	State:	Critically imperiled due to rarity or vulnerability

Description at this Location

Conservation Rank: Not ranked
Comments on Rank:

Detailed Description: 2010: Area 12821: 1 adult female nesting.
General Area: 2010: Area 12821: Digging nest in residential yard within mixed forest.
General Comments:
Management Comments:

Location

Survey Site Name: Lower Shields Pond
Managed By:

County: Rockingham
Town(s): Derry
Size: 1.9 acres

Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2010: Area 12821: 24 Paul Avenue, Derry.

Dates documented

First reported: 2010-07-10

Last reported: 2010-07-10

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

New Hampshire Natural Heritage Bureau - Animal Record

Blanding's Turtle (*Emydoidea blandingii*)

Legal Status		**Conservation Status**	
Federal:	Not listed	Global:	Apparently secure but with cause for concern
State:	Listed Endangered	State:	Critically imperiled due to rarity or vulnerability

Description at this Location

Conservation Rank: Not ranked
Comments on Rank:

Detailed Description: 2012: Area 12991M: 1 female observed, laying eggs.
General Area: 2012: Area 12991M: Residential yard. Laying eggs in mulched garden area near retaining wall.
General Comments:
Management Comments:

Location

Survey Site Name: Scobie Pond
Managed By:

County: Rockingham
Town(s): Londonderry
Size: 1.9 acres
Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2012: Area 12991M: 27 Partridge Lane, Derry.

Dates documented

First reported: 2012-05-31
Last reported: 2012-05-31

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

New Hampshire Natural Heritage Bureau - Animal Record

Blanding's Turtle (*Emydoidea blandingii*)

Legal Status		**Conservation Status**	
Federal:	Not listed	Global:	Apparently secure but with cause for concern
State:	Listed Endangered	State:	Critically imperiled due to rarity or vulnerability

Description at this Location

Conservation Rank: Not ranked
Comments on Rank:

Detailed Description: 2012: Area 13045: 1 adult observed.
General Area: 2012: Area 13045: Gravel road shoulder near wetland forest.
General Comments:
Management Comments:

Location

Survey Site Name: Little Cohas Brook
Managed By:

County: Rockingham
Town(s): Londonderry
Size: 1.9 acres
Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2012: Area 13045: Aviation Park Drive, Londonderry, just before cul-de-sac at end of road.

Dates documented

First reported: 2012-06-07
Last reported: 2012-06-07

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

New Hampshire Natural Heritage Bureau - Animal Record

Blanding's Turtle (*Emydoidea blandingii*)

Legal Status		**Conservation Status**	
Federal:	Not listed	Global:	Apparently secure but with cause for concern
State:	Listed Endangered	State:	Critically imperiled due to rarity or vulnerability

Description at this Location

Conservation Rank: Not ranked
Comments on Rank:

Detailed Description: 2013: Area 13547: 1 juvenile observed, sex unknown.
General Area: 2013: Area 13547: Roadside, suburban area near wood and wetland.
General Comments:
Management Comments:

Location

Survey Site Name: Scobie Pond
Managed By:

County: Rockingham
Town(s): Londonderry
Size: 1.9 acres Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2013: Area 13547: Auburn Road, Derry, approximately 200 feet north of Old Derry Road.

Dates documented

First reported: 2013-05-22 Last reported: 2013-05-22

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

New Hampshire Natural Heritage Bureau - Animal Record

Blanding's Turtle (*Emydoidea blandingii*)

Legal Status		**Conservation Status**	
Federal:	Not listed	Global:	Apparently secure but with cause for concern
State:	Listed Endangered	State:	Critically imperiled due to rarity or vulnerability

Description at this Location

Conservation Rank: Not ranked
Comments on Rank:

Detailed Description: 2013: Area 13428: 1 adult observed, sex unknown.
General Area: 2013: Area 13428: Roadside in residential area, coniferous forest.
General Comments:
Management Comments:

Location

Survey Site Name: Nesenkeag Brook
Managed By:

County: Rockingham
Town(s): Londonderry
Size: 1.9 acres Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2013: Area 13428: High Range Road, Londonderry. Crossing Road at intersection of High Range Road and Davis Drive.

Dates documented

First reported: 2013-06-10 Last reported: 2013-06-10

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

New Hampshire Natural Heritage Bureau - Animal Record

Blanding's Turtle (*Emydoidea blandingii*)

Legal Status		**Conservation Status**	
Federal:	Not listed	Global:	Apparently secure but with cause for concern
State:	Listed Endangered	State:	Critically imperiled due to rarity or vulnerability

Description at this Location

Conservation Rank: Not ranked
Comments on Rank:

Detailed Description: 2014: Area 13919: 1 adult observed, sex unknown.
General Area: 2014: Area 13919: Office park just west of Little Cohas Brook
General Comments:
Management Comments:

Location

Survey Site Name: Little Cohas Brook
Managed By:

County: Rockingham
Town(s): Londonderry
Size: .4 acres Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2014: Area 13919: Outside of office building on Delta Drive, Londonderry (42.91197, -71.41648).

Dates documented

First reported: 2014-06-12 Last reported: 2014-06-12

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

New Hampshire Natural Heritage Bureau - Animal Record

New England Cottontail (*Sylvilagus transitionalis*)

Legal Status		**Conservation Status**	
Federal:	Not listed	Global:	Rare or uncommon
State:	Listed Endangered	State:	Critically imperiled due to rarity or vulnerability

Description at this Location

Conservation Rank: Not ranked
Comments on Rank:

Detailed Description: 2002: Capture, seen (Obs_id 446).
General Area:
General Comments: 2002: Results of J. Litvaitis (UNH) Regional NEC survey (Obs_id 446). 2002: Rte. 102, 1000 (Obs_id 446).
Management Comments:

Location

Survey Site Name: Beaver Lake, north of
Managed By:

County: Rockingham
Town(s): Derry
Size: .0 acres Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2002: Rte. 102 (Obs_id 446).

Dates documented

First reported: 2002-01-01 Last reported: 2002-01-01

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

New Hampshire Natural Heritage Bureau - Animal Record

New England Cottontail (*Sylvilagus transitionalis*)

Legal Status		**Conservation Status**	
Federal:	Not listed	Global:	Rare or uncommon
State:	Listed Endangered	State:	Critically imperiled due to rarity or vulnerability

Description at this Location

Conservation Rank: Not ranked
Comments on Rank:

Detailed Description: 2013: Winter observations at 13 points.2011: Winter observations at 32 points.2002: 1+ age and sex unknowns (Obs_id 744).
General Area: 2002: Terrestrial: grassland / field (Obs_id 744).
General Comments: 2002: Results of J. Litvaitis Regional NEC Survey - 2003 (Obs_id 744).
Management Comments:

Location

Survey Site Name: Little Cohas Brook, south of
Managed By: NHDOT Mitigation

County: Rockingham
Town(s): Londonderry
Size: 27.6 acres Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2002: Stonyfield Farm (Obs_id 744).

Dates documented

First reported: 2002-02-02 Last reported: 2013

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

New Hampshire Natural Heritage Bureau - Animal Record

Northern Black Racer (*Coluber constrictor constrictor*)

Legal Status		**Conservation Status**	
Federal:	Not listed	Global:	Demonstrably widespread, abundant, and secure
State:	Listed Threatened	State:	Imperiled due to rarity or vulnerability

Description at this Location

Conservation Rank: Not ranked
Comments on Rank:

Detailed Description: 2013: Area 13552: 1 adult observed, sex unknown.
General Area: 2013: Area 13552: Scrub-shrub wetland under powerline adjacent to substation.
General Comments:
Management Comments:

Location

Survey Site Name: Scobie Pond, south of
Managed By:

County: Rockingham
Town(s): Londonderry
Size: .4 acres
Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2013: Area 13552: Electric substation at Scobie Pond Road, Londonderry.

Dates documented

First reported: 2013-05-28
Last reported: 2013-05-28

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

New Hampshire Natural Heritage Bureau - Animal Record

Northern Black Racer (*Coluber constrictor constrictor*)

Legal Status		**Conservation Status**	
Federal:	Not listed	Global:	Demonstrably widespread, abundant, and secure
State:	Listed Threatened	State:	Imperiled due to rarity or vulnerability

Description at this Location

Conservation Rank: Not ranked
Comments on Rank:

Detailed Description: 2014: Area 13599: 1 adult observed, sex unknown. Area 13607: 1 adult observed, sex unknown.
General Area: 2014: Area 13599: Roadside.
General Comments:
Management Comments:

Location

Survey Site Name: I-93, Londonderry
Managed By:

County: Rockingham
Town(s): Londonderry
Size: .9 acres
Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2014: Area 13599: Side of I-93, Londonderry (42.88717, -71.34987). Area 13607: Side of I-93, Londonderry (42.88556, -71.34861).

Dates documented

First reported: 2014-07-30 Last reported: 2014-07-30

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

New Hampshire Natural Heritage Bureau - Animal Record

Smooth Green Snake (*Opheodrys vernalis*)

Legal Status		**Conservation Status**	
Federal:	Not listed	Global:	Demonstrably widespread, abundant, and secure
State:	Special Concern	State:	Rare or uncommon

Description at this Location

Conservation Rank: Not ranked
Comments on Rank:

Detailed Description: 2008: Area 11542: 1 adult seen. 2004: Area 11663: 1 adult seen.
General Area: 2008: Area 11542: On side of Vista Avenue. 2004: Area 11663: Residential yard.
General Comments:
Management Comments:

Location

Survey Site Name: Vista Avenue
Managed By:

County: Rockingham
Town(s): Derry
Size: 13.8 acres
Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2008: Area 11542: On the side of Vista Avenue, Derry.2004: Area 11663: 16 Paul Avenue, Derry.

Dates documented

First reported: 2004-07-01 Last reported: 2008-08-01

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

New Hampshire Natural Heritage Bureau - Animal Record

Smooth Green Snake (*Opheodrys vernalis*)

Legal Status		**Conservation Status**	
Federal:	Not listed	Global:	Demonstrably widespread, abundant, and secure
State:	Special Concern	State:	Rare or uncommon

Description at this Location

Conservation Rank: Not ranked
Comments on Rank:

Detailed Description: 2003: Area 1044: 1 observed.
General Area: 2003: Area 1044: Marsh.
General Comments:
Management Comments:

Location

Survey Site Name: Little Cohas Marsh
Managed By: NHDOT Mitigation

County: Rockingham
Town(s): Londonderry
Size: 1.9 acres
Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2003: Area 1044: West shore of marsh, 1/4 mile south of the dam, on the perimeter of the Army National Guard detention pond

Dates documented

First reported: 2003-09-17
Last reported: 2003-09-17

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

New Hampshire Natural Heritage Bureau - Animal Record

Spotted Turtle (*Clemmys guttata*)

Legal Status		**Conservation Status**	
Federal:	Not listed	Global:	Demonstrably widespread, abundant, and secure
State:	Listed Threatened	State:	Imperiled due to rarity or vulnerability

Description at this Location

Conservation Rank: Good quality, condition and landscape context ('B' on a scale of A-D).
Comments on Rank:

Detailed Description: 2006: Area 11884: 1 gravid (2 eggs) female killed on road. Area 11687M: 1 young individual seen on 04-28. 1 4" long young individual seen on 04-30. 1 adult seen on 05-19. 1997: 1 adult observed.
General Area: 2006: Area 11687M: Powerline near beaver pond. 1997: Small brook, outflow of Rainbow Pond.
General Comments: 1997: Observed by Joel and Ron Miller.
Management Comments:

Location

Survey Site Name: Rainbow Pond
Managed By:

County: Rockingham
Town(s): Derry
Size: 11.0 acres Elevation: 395 feet

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2006: Area 11884: Cul-de-sac on Paul Avenue. Area 11687M: Off Paul Avenue &c Drive powerline intersection. 1996:[From Derry Village rotary, take Rte. 28 Bypass north about 2 miles. Turn right onto Shields Pond Road. Access outlet stream by taking the 5th left.]

Dates documented

First reported: 1997-06-21 Last reported: 2006-07-13

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

New Hampshire Natural Heritage Bureau - Animal Record

Spotted Turtle (*Clemmys guttata*)

Legal Status		**Conservation Status**	
Federal:	Not listed	Global:	Demonstrably widespread, abundant, and secure
State:	Listed Threatened	State:	Imperiled due to rarity or vulnerability

Description at this Location

Conservation Rank: Fair quality, condition and/or landscape context ('C' on a scale of A-D).

Comments on Rank:

Detailed Description: 2014: Area 13573: 1 adult female observed.2013: Area 13553: 1 adult observed, sex unknown.2006: Area 11710: 1 seen.

General Area: 2014: Area 13573: Forested wetland, connects to shrub wetland.2013: Area 13553: Forested wetland.

General Comments:

Management Comments:

Location

Survey Site Name: Scobie Pond vicinity

Managed By: Scobie Pond Recreation Area

County: Rockingham

Town(s): Derry

Size: 11.4 acres Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2014: Area 13573: Forested wetland between powerlines [west of electric substation].2013: Area 13553: Electric substation at Scobie Pond Road, Londonderry.2006: Area 11710: Scobie Pond Road.

Dates documented

First reported: 2006-07-13 Last reported: 2014-05-02

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

New Hampshire Natural Heritage Bureau - Animal Record

Spotted Turtle (*Clemmys guttata*)

Legal Status		**Conservation Status**	
Federal:	Not listed	Global:	Demonstrably widespread, abundant, and secure
State:	Listed Threatened	State:	Imperiled due to rarity or vulnerability

Description at this Location

Conservation Rank: Fair quality, condition and/or landscape context ('C' on a scale of A-D).
Comments on Rank:

Detailed Description: 2006: Area 11745: 1 adult seen.
General Area:
General Comments:
Management Comments:

Location

Survey Site Name: Old Derry Road, north of
Managed By:

County: Rockingham
Town(s): Londonderry
Size: .4 acres Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2006: Area 11745: [Wetlands along unnamed tributary of Cohas Brook near Derry town line, approximately 1km north of Old Derry Road].

Dates documented

First reported: 2006-04-02 Last reported: 2006-04-02

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

New Hampshire Natural Heritage Bureau - Animal Record

Spotted Turtle (*Clemmys guttata*)

Legal Status		**Conservation Status**	
Federal:	Not listed	Global:	Demonstrably widespread, abundant, and secure
State:	Listed Threatened	State:	Imperiled due to rarity or vulnerability

Description at this Location

Conservation Rank: Not ranked
Comments on Rank:

Detailed Description: 2014: Area 13678: 1 adult female observed.
General Area: 2014: Area 13678: Spotted turtle found in residential driveway. Nearby habitats are small pond and Beaver Lake to the west, wetlands to the east.
General Comments:
Management Comments:

Location

Survey Site Name: Beaver Lake
Managed By:

County: Rockingham
Town(s): Derry
Size: .4 acres Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2014: Area 13678: 1 Orchard Drive, Derry.

Dates documented

First reported: 2014-06-12 Last reported: 2014-06-12

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

New Hampshire Natural Heritage Bureau - Animal Record

Wood Turtle (*Glyptemys insculpta*)

Legal Status		**Conservation Status**	
Federal:	Not listed	Global:	Apparently secure but with cause for concern
State:	Special Concern	State:	Rare or uncommon

Description at this Location

Conservation Rank: Not ranked
Comments on Rank:

Detailed Description: 2011: Area 13154: 1 adult observed.
General Area: 2011: Area 13154: Forest adjacent to residential yard.
General Comments:
Management Comments:

Location

Survey Site Name: Beaver Lake, south of
Managed By: Shepard

County: Rockingham
Town(s): Derry
Size: 1.9 acres Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2011: Area 13154: 26 Pond Road, Derry.

Dates documented

First reported: 2011-08-27 Last reported: 2011-08-27

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

Memo

NH Natural Heritage Bureau
NHB Datacheck Results Letter

To: Sarah Barnum, Normandeau Associates
25 Nashua Rd
Bedford, NH 03110

From: Amy Lamb, NH Natural Heritage Bureau
Date: 4/4/2016 (valid for one year from this date)
Re: Review by NH Natural Heritage Bureau

NHB File ID: NHB16-0961 Town: Derry, Londonderry Location: South end of project area

Description: I-93 Exit 4A Project: This is a re-evaluation request from previous submittals in 2010, 2005 and 1999. This review is intended to ensure data presented in the project's Final Environmental Impact Statement (FEIS) is up to date. Project proposes to construct a new interchange one mile north of Exit 4 on Interstate 93 in Londonderry and Derry, NH. New interchange would consist of an easterly-only new construction access road that would connect with Folsom Road and then traverse east along Folsom and Tsienneto Roads. Work along Tsienneto Road would typically result in slight adjustments to easterly end of roadway and intersection improvements with Rt 28, Bypass Route 28, and Rt 102. We request that the five remaining alternatives within this study be evaluated to ensure they are each provided the most recent NHNHB review for sensitive plants and animals (Alternatives A through D and F).

cc: Kim Tuttle

As requested, I have searched our database for records of rare species and exemplary natural communities, with the following results.

Comments: This site is within an area flagged for possible impacts on the state-listed *Alasmidonta varicosa* (brook floater) in Beaver Brook. Please coordinate with NH Fish & Game and the NHB to avoid and minimize impacts to the species below.

Invertebrate Species	**State[1]**	**Federal**	**Notes**
Brook Floater (*Alasmidonta varicosa*)	E	--	Contact the NH Fish & Game Dept (see below).

Plant species	**State[1]**	**Federal**	**Notes**
bird-foot violet (*Viola pedata*)	T	--	This species occurs in sandplains, disturbed openings, dry forests, and thin woods. Threats would include direct destruction of the plants or major alterations in their habitat.
butterfly milkweed (*Asclepias tuberosa*)*	E	--	Threats to this species include direct destruction of its habitat.
common star-grass (*Hypoxis hirsuta*)	T	--	This species occurs in sandplains, disturbed openings, dry forests, and thin woods. Threats would include direct destruction of the plants or major alterations in their habitat.
Downy Arrowwood (*Viburnum rafinesquianum*)*	E	--	Threats to this understory species would be activities that impacted its habitat (dry

			forests and thin woods), such as logging and development.
dragon's-mouth (*Arethusa bulbosa*)*	E	--	Alteration of the hydrologic regime is likely the worst threat to this species. Also damaging are over-collection of flowers, succession and overshading by woody species, invasion of wetlands by exotic plant species, and human trampling of loose moss.
greater fringed-gentian (*Gentianopsis crinita*)	T	--	Vulnerable to shading by invading trees and to disturbances that destroy plants or impede their ability to reproduce (such as mowing in the mid-summer while the plants are in bloom).
northern tubercled bog-orchid (*Platanthera flava var. herbiola*)	E	--	This species occurs in forested swamps, low floodplain forest, riparian thickets, bogs, fens, seeps, and wet meadows. Threats to the plants include direct destruction of the plants, e.g., by ATV traffic, destruction (draining) of its habitat, and excessive shade when succession leads to dense shrub or tree growth.
red threeawn (*Aristida longespica var. geniculata*)*	E	--	The pond or lake shore natural communities where this species occurs are extremely vulnerable to trampling, and tend to disappear from areas that experience even moderate recreational use. They are also vulnerable to changes to the lake's hydrology. Additional habitats include sandplains and disturbed openings.

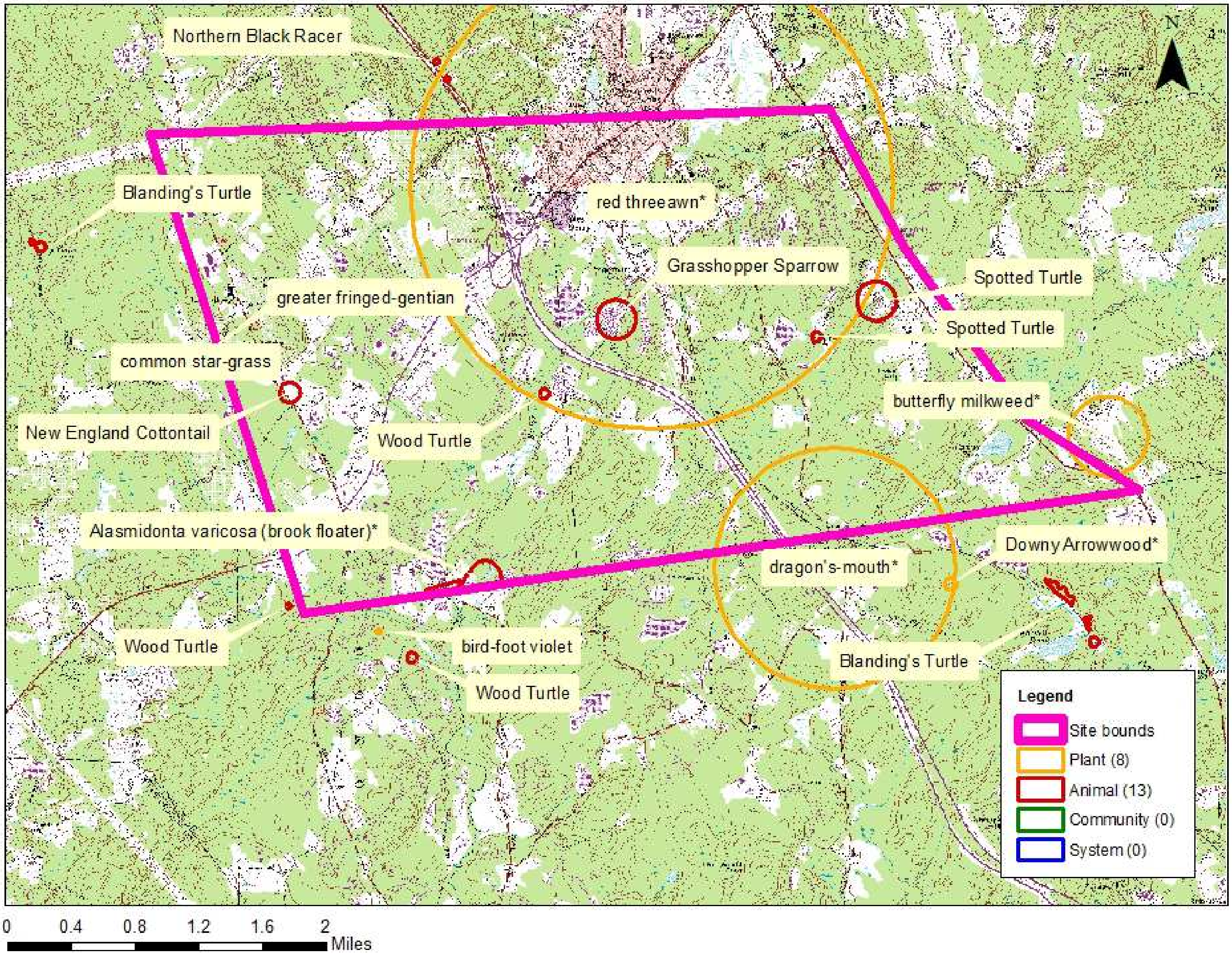
Vertebrate species	**State[1]**	**Federal**	**Notes**
Blanding's Turtle (*Emydoidea blandingii*)	E	--	Contact the NH Fish & Game Dept (see below).
Grasshopper Sparrow (*Ammodramus savannarum*)	T	--	Contact the NH Fish & Game Dept (see below).
New England Cottontail (*Sylvilagus transitionalis*)	E	--	Contact the NH Fish & Game Dept (see below).
Northern Black Racer (*Coluber constrictor constrictor*)	T	--	Contact the NH Fish & Game Dept (see below).
Spotted Turtle (*Clemmys guttata*)	T	--	Contact the NH Fish & Game Dept (see below).
Wood Turtle (*Glyptemys insculpta*)	SC	--	Contact the NH Fish & Game Dept (see below).

[1]Codes: "E" = Endangered, "T" = Threatened, "SC" = Special Concern, "--" = an exemplary natural community, or a rare species tracked by NH Natural Heritage that has not yet been added to the official state list. An asterisk (*) indicates that the most recent report for that occurrence was more than 20 years ago.

Contact for all animal reviews: Kim Tuttle, NH F&G, (603) 271-6544.

A negative result (no record in our database) does not mean that a sensitive species is not present. Our data can only tell you of known occurrences, based on information gathered by qualified biologists and reported to our office. However, many areas have never been surveyed, or have only been surveyed for certain species. An on-site survey would provide better information on what species and communities are indeed present.

NHB16-0961



Northern Black Racer
Blanding's Turtle
red threeawn*
Grasshopper Sparrow
Spotted Turtle
greater fringed-gentian
Spotted Turtle
common star-grass
butterfly milkweed*
New England Cottontail
Wood Turtle
Alasmidonta varicosa (brook floater)*
Downy Arrowwood*
dragon's-mouth*
Wood Turtle
bird-foot violet
Blanding's Turtle
Wood Turtle
N
Legend
Site bounds
Plant (8)
Animal (13)
Community (0)
System (0)
0
0.4
0.8
1.2
1.6
2
Miles

New Hampshire Natural Heritage Bureau - Plant Record

bird-foot violet (*Viola pedata*)

Legal Status		**Conservation Status**	
Federal:	Not listed	Global:	Demonstrably widespread, abundant, and secure
State:	Listed Threatened	State:	Imperiled due to rarity or vulnerability

Description at this Location

Conservation Rank: Fair quality, condition and/or landscape context ('C' on a scale of A-D).
Comments on Rank: Large population but site highly disturbed and likely to be developed.

Detailed Description: 2010: Area 1: A house has been built on lot and area loamed and seeded. Several clumps observed on roadsides of lot.Area 2: 630 clumps, 60% in fruit. Seed collection for NEWFS undertaken (6/7 and 6/9). Very healthy population.2006: Area 1: About 300 clumps estimated - as abundant as in 2005. Quite vigorous, and carpeted some areas (5/22). Observed and photographed (7/25).2005: Area 1: 250-300 clumps (often 5-7 in. diameter) estimated, clumped and scattered in a 0.5 acre area.

General Area: 2006: Area 1: In vacant lot. Other species in the vicinity include: *Ionactis linariifolius* (stiff-leaved aster), *Viola sagittata* (arrow-leaved violet), *Euthamia graminifolia* (flat-topped goldenrod), *Erigeron canadensis* (horseweed), *Schizachyrium scoparium* (little bluestem), *Potentilla canadensis* (running field cinquefoil), *Juncus greenei* (Greene's rush), *Helianthemum canadense* (Canadian frostweed), *Deschampsia flexuosa* (common hairgrass), *Betula populifolia* (gray birch), *Oenothera biennis* (biennial evening primrose), *Pinus strobus* (white pine), *Erigeron annuus* (daisy fleabane), *Nuttallanthus canadensis* (blue toadflax), *Solidago nemoralis* (northern gray goldenrod), *Dichanthelium linearifolium* (linear-leaved panic grass), *Solidago juncea* (early goldenrod), *Asclepias syriaca* (common milkweed), and *Hypericum gentianoides* (orange grass).2005: Area 1: Vacant lot in the vicinity of *Pinus strobus* (white pine) and *Pinus resinosa* (red pine) woods. Associated species include *Potentilla simplex* (old-field cinquefoil), *Potentilla canadensis* (running field cinquefoil), *Houstonia caerulea* (bluets), *Solidago* spp. (goldenrod), *Ionactis linariifolius* (stiff-leaved aster), and *Rumex acetosella* (red sorrel). Lot is heavily disturbed: all trees removed, soil disturbed as stumps dragged around, slash dumped at one side.

General Comments:

Management Comments: 2006: At one lot after some trees were taken down (year unknown) the numbers of violets increased.

Location

Survey Site Name: Pine Street
Managed By:

County: Rockingham
Town(s): Londonderry
Size: .4 acres Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2010: Area 2: From Route 128 (Mammoth Rd.) in Londonderry, head east onto Valley Street to residence at 8 Valley St.2006: Areas 1 and 2: [From Rte. 128 in Londonderry, head east onto Valley Street. Take a left onto Loop Rd. and then merge onto Pine Street. Park at vacant lot at 17 Pine Street]. Driving around neighborhood, clumps of violets observed growing on the roadsides.2005: Area 1: Take Rte. 102 to Mammoth Rd. south. Turn left on Valley St. Bear left on Loop Rd. which turns into Pine St.

Dates documented

First reported: 2005-06-08 Last reported: 2006-07-25

New Hampshire Natural Heritage Bureau - Plant Record

butterfly milkweed (*Asclepias tuberosa*)

Legal Status		**Conservation Status**	
Federal:	Not listed	Global:	Demonstrably widespread, abundant, and secure
State:	Listed Endangered	State:	Critically imperiled due to rarity or vulnerability

Description at this Location

Conservation Rank: Historical records only - current condition unknown.
Comments on Rank:

Detailed Description: 2008, 2004, 2002, 2001: Searched for but not found.No date: Specimen collected.
General Area:
General Comments:
Management Comments: 2008: Open fields in the area had been mowed with the last month or so (7/14). One landowner unable to delay haying, second landowner not spoken to.2001: Area appeared to be regularly mowed as well as disturbed in front field.

Location

Survey Site Name: Ezekiel Pond
Managed By:

County: Rockingham
Town(s): Derry
Size: 123.5 acres Elevation: 460 feet

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: No Date: 0.75 mile east of Ezekiel Pond. South of Kilrea Road.

Dates documented

First reported: No Date Last reported: No date

New Hampshire Natural Heritage Bureau - Plant Record

common star-grass (*Hypoxis hirsuta*)

Legal Status		**Conservation Status**	
Federal:	Not listed	Global:	Demonstrably widespread, abundant, and secure
State:	Listed Threatened	State:	Imperiled due to rarity or vulnerability

Description at this Location

Conservation Rank: Good quality, condition and landscape context ('B' on a scale of A-D).
Comments on Rank: Moderate population in an artificially maintained habitat.

Detailed Description: 2010: 84 flowering stems marked and counted, scattered in a 25 x 50-foot area.
General Area: 2010: Rich, wet meadow, artificially maintained by annual mowing.
General Comments:
Management Comments: 2010: Purple loosestrife is a problem. Plants have been pulled for a number of years and beatles were released in 2009. The area has to be mowed in the fall. Also managed for pale green orchid (*Platanthera flava* var. *herbiola*) and fringed gentian (*Gentianopsis crinita*).

Location

Survey Site Name: Flax Field
Managed By: Flax Field (Phase II)

County: Rockingham
Town(s): Londonderry
Size: .4 acres Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2010: From the intersection of I-93 and NH Rte. 102 in Londonderry travel west on 102 to right turn on Mammoth Road at a light. Travel north to intersection with Pillsbury Road at a light. Turn left onto Pillsbury Road. Flax Field is on the right just past the driveway to Moose Hill Kindergarten. Most of the plants are in the SW portion of the field (42.85990N, 71.37965W).

Dates documented

First reported: 2010-07-08 Last reported: 2010-07-17

New Hampshire Natural Heritage Bureau - Plant Record

Downy Arrowwood (*Viburnum rafinesquianum*)

Legal Status		**Conservation Status**	
Federal:	Not listed	Global:	Demonstrably widespread, abundant, and secure
State:	Listed Endangered	State:	Critically imperiled due to rarity or vulnerability

Description at this Location

Conservation Rank: Historical records only - current condition unknown.
Comments on Rank: Very small population compared to Howe Hill in Derry and Hampstead.

Detailed Description: 1991: 11-50 plants, 5% with mature fruit. Some of these shrubs were up to 6 feet tall.
General Area: 1991: Growing alongside a narrow seepage swamp. Appears to be some ecological differences in this relatively small area of the forest as indicated by different species found here.
General Comments: 1991: 1 small population found. No more in vicinity, but possibly a "mother" population somewhere in surrounding woods.
Management Comments: 1991: Evidence of human disturbance nearby - some cutting and dirt roads.

Location

Survey Site Name: Morrison Road Seepage Swamp
Managed By:

County: Rockingham
Town(s): Windham
Size: 2.8 acres Elevation: 330 feet

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 1991: Take Morrison Road just south of Windham Depot off Bridge Street.

Dates documented

First reported: 1991-10-18 Last reported: 1991-10-18

New Hampshire Natural Heritage Bureau - Plant Record

dragon's-mouth (*Arethusa bulbosa*)

Legal Status		**Conservation Status**	
Federal:	Not listed	Global:	Apparently secure but with cause for concern
State:	Listed Endangered	State:	Critically imperiled due to rarity or vulnerability

Description at this Location

Conservation Rank: Historical records only - current condition unknown.
Comments on Rank:

Detailed Description: 1909: Specimen collected.
General Area: 1909: No details.
General Comments:
Management Comments:

Location

Survey Site Name: Windham Depot
Managed By: Windham Rd Holdings

County: Rockingham
Town(s): Windham
Size: 1148.0 acres Elevation: 320 feet

Precision: Within 1.5 miles of the area indicated on the map (location information is vague or uncertain).

Directions: Windham Depot.

Dates documented

First reported: 1909-06-09 Last reported: 1909-06-09

New Hampshire Natural Heritage Bureau - Plant Record

greater fringed-gentian (*Gentianopsis crinita*)

Legal Status		**Conservation Status**	
Federal:	Not listed	Global:	Demonstrably widespread, abundant, and secure
State:	Listed Threatened	State:	Imperiled due to rarity or vulnerability

Description at this Location

Conservation Rank: Not ranked
Comments on Rank:

Detailed Description: 1997: 20-30 plants.
General Area: 1997: Meadow with surrounding wetlands.
General Comments:
Management Comments: Meadow is mowed in August for town event.

Location

Survey Site Name: Moose Hill Orchards
Managed By: Flax Field (Phase II)

County: Rockingham
Town(s): Londonderry
Size: 2.8 acres Elevation: 325 feet

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: From Rte. 93, exit 4 onto Mammoth. Take a left on W. Pillsbury Rd. and go 0.75 mile to apple orchard on right. Walk about 15 feet North from road, proceed west into meadow. Plants are scattered throughout.

Dates documented

First reported: 1997-10 Last reported: 1997-10

New Hampshire Natural Heritage Bureau - Plant Record

northern tubercled bog-orchid (*Platanthera flava var. herbiola*)

Legal Status		Conservation Status	
Federal:	Not listed	Global:	Apparently secure but with cause for concern
State:	Listed Endangered	State:	Critically imperiled due to rarity or vulnerability

Description at this Location

Conservation Rank: Fair quality, condition and/or landscape context ('C' on a scale of A-D).

Comments on Rank: Moderate population size on conservation land being managed for multiple rare plants. 2003: (D) Single plant.

Detailed Description: 2010: 33 flowering stems, scattered in groups. Smaller stature due to droughty conditions.2009: 44 flowering stems, normal vigor.2003: One plant, in flower.

General Area: 2010: Rich, wet meadow artificially maintained by annual mowing. Associated species include old-field cinquefoil (*Potentilla simplex*), purple avens (*Geum rivale*), large cranberry (*Vaccinium macrocarpon*), asters (*Symphyotrichum* sp.), goldenrods (*Solidago* sp.), and various garminoids.2003: Wet meadow, inundated in spring. Associated plants include *Scirpus cyperinus* (woolly bulrush), *Lythrum salicaria* (purple loosestrife), *Salix* sp. (willow), *Sanguisorba canadensis* (Canadian burnet), and *Hypoxis hirsuta* (hairy star-grass).

General Comments: 2010: American copper butterflies were pollinating the flowers.2003: Meadow mowed by accident 7-10 days after the survey. Status of the orchid unknown.

Management Comments: 2010: Area being managed by the Londonderry Conservation Commission in co-operation with the NEWFS Plant Conservation Volunteer program. There is a purple loosestrife problem. We have been pulling for a number of years and released beetles in 2009. The pale green orchid area has been kept as clear as possible, but mowing probably offers a vector for continued seed dispersal. Area has to be mowed in the fall as it is also home to hairy stargrass (*Hypoxis hirsuta*) and fringed gentian (*Gentianopsis crinita*).

Location

Survey Site Name: Londonderry, west of
Managed By: Flax Field (Phase II)

County: Rockingham
Town(s): Londonderry
Size: 1.9 acres Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2010: From the intersection of I-93 and Rte. 102 in Londonderry travel west on Rte. 102 to Mammoth Road. There is a light. Travel north to first light, turning left on Pillsbury Road. Flax Field is on the right just past the driveway to Moose Hill Kindergarten. Plants are in the lower portions of the SW part of the field.2003: From Rte. 128 (Mammoth Rd) in Londonderry, take Pillsbury Road west. Go ca. 0.5 miles on Pillsbury Road. Plant is on the north side of the road, just past the [driveway] to Moose Hill School. (N 42.85990 W 71.37965)

Dates documented

First reported: 2003-07-01 Last reported: 2010-07-17

New Hampshire Natural Heritage Bureau - Plant Record

red threeawn (*Aristida longespica var. geniculata*)

Legal Status		**Conservation Status**	
Federal:	Not listed	Global:	Demonstrably widespread, abundant, and secure
State:	Listed Endangered	State:	Critically imperiled due to rarity or vulnerability

Description at this Location

Conservation Rank: Historical records only - current condition unknown.
Comments on Rank:

Detailed Description: 1977: Specimen collected.
General Area: 1977: Disturbed area, railroad right-of-way.
General Comments: 1993: AT&e put through in 1993.
Management Comments:

Location

Survey Site Name: Derry
Managed By: Tuckernuck Development LLC

County: Rockingham
Town(s): Derry
Size: 4592.3 acres Elevation: 235 feet

Precision: Within 1.5 miles of the area indicated on the map (location information is vague or uncertain).

Directions: Derry. Railroad right-of-way.

Dates documented

First reported: 1977-10-15 Last reported: 1977-10-15

New Hampshire Natural Heritage Bureau - Animal Record

Blanding's Turtle (*Emydoidea blandingii*)

Legal Status		**Conservation Status**	
Federal:	Not listed	Global:	Apparently secure but with cause for concern
State:	Listed Endangered	State:	Critically imperiled due to rarity or vulnerability

Description at this Location

Conservation Rank: Good quality, condition and landscape context ('B' on a scale of A-D).
Comments on Rank:

Detailed Description: 2007: Area 11768M: Observed on May 3 and May 22.
General Area: 2007: Area 11768M: May 3: On log with several painted turtles in wetland near Mitchell Pond. May 22: Less than 100 feet from bike trail on logs.
General Comments:
Management Comments:

Location

Survey Site Name: Mitchell Pond
Managed By: Manchester-Lawrence RR Bed

County: Rockingham
Town(s): Windham
Size: 1.9 acres Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions:

Dates documented

First reported: 2007-05-03 Last reported: 2007-05-22

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

New Hampshire Natural Heritage Bureau - Animal Record

Blanding's Turtle (*Emydoidea blandingii*)

Legal Status		**Conservation Status**	
Federal:	Not listed	Global:	Apparently secure but with cause for concern
State:	Listed Endangered	State:	Critically imperiled due to rarity or vulnerability

Description at this Location

Conservation Rank: Not ranked
Comments on Rank:

Detailed Description: 2006: Area 11743: 1 adult female seen.
General Area:
General Comments:
Management Comments:

Location

Survey Site Name: Nesenkeag Brook
Managed By:

County: Rockingham
Town(s): Londonderry
Size: .4 acres Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2006: Area 11743: Crossed Mayflower Drive approximately 150' from High Range Road.

Dates documented

First reported: 2006-06-15 Last reported: 2006-06-15

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

New Hampshire Natural Heritage Bureau - Animal Record

Blanding's Turtle (*Emydoidea blandingii*)

Legal Status

Federal: Not listed
State: Listed Endangered

Conservation Status

Global: Apparently secure but with cause for concern
State: Critically imperiled due to rarity or vulnerability

Description at this Location

Conservation Rank: Not ranked
Comments on Rank:

Detailed Description: 2013: Area 13428: 1 adult observed, sex unknown.
General Area: 2013: Area 13428: Roadside in residential area, coniferous forest.
General Comments:
Management Comments:

Location

Survey Site Name: Nesenkeag Brook
Managed By:

County: Rockingham
Town(s): Londonderry
Size: 1.9 acres
Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2013: Area 13428: High Range Road, Londonderry. Crossing Road at intersection of High Range Road and Davis Drive.

Dates documented

First reported: 2013-06-10
Last reported: 2013-06-10

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

New Hampshire Natural Heritage Bureau - Animal Record

Blanding's Turtle (*Emydoidea blandingii*)

Legal Status		**Conservation Status**	
Federal:	Not listed	Global:	Apparently secure but with cause for concern
State:	Listed Endangered	State:	Critically imperiled due to rarity or vulnerability

Description at this Location

Conservation Rank: Not ranked
Comments on Rank:

Detailed Description: 2013: 2 individuals observed on 4/19. 2 individuals observed on 4/27.
General Area:
General Comments:
Management Comments:

Location

Survey Site Name: Mitchell Pond
Managed By: Manchester-Lawrence RR Bed

County: Rockingham
Town(s): Windham
Size: 5.3 acres Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions:

Dates documented

First reported: 2013-04-19 Last reported: 2013-04-27

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

New Hampshire Natural Heritage Bureau - Animal Record

Blanding's Turtle (*Emydoidea blandingii*)

Legal Status		**Conservation Status**	
Federal:	Not listed	Global:	Apparently secure but with cause for concern
State:	Listed Endangered	State:	Critically imperiled due to rarity or vulnerability

Description at this Location

Conservation Rank: Not ranked
Comments on Rank:

Detailed Description: 2013: 6 individuals observed on 4/19. 6 individuals observed on 4/27.
General Area:
General Comments:
Management Comments:

Location

Survey Site Name: Mitchell Pond
Managed By: Manchester-Lawrence RR Bed

County: Rockingham
Town(s): Windham
Size: 1.1 acres Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions:

Dates documented

First reported: 2013-04-19 Last reported: 2013-04-27

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

New Hampshire Natural Heritage Bureau - Animal Record

Grasshopper Sparrow (*Ammodramus savannarum*)

Legal Status		**Conservation Status**	
Federal:	Not listed	Global:	Demonstrably widespread, abundant, and secure
State:	Listed Threatened	State:	Not ranked (need more information)

Description at this Location

Conservation Rank: Not ranked
Comments on Rank:

Detailed Description: 2003: 1 singing male, not present on next visit in early July. 1999: 1 adult male heard (Obs_id 261).
General Area: 1999: Terrestrial - Grassland / Field
General Comments:
Management Comments:

Location

Survey Site Name: Peppermint Corner, SW of
Managed By:

County: Rockingham
Town(s): Derry
Size: 30.8 acres Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: In grasses on old Derry landfill, just east of I-93.

Dates documented

First reported: 1999-07-16 Last reported: 2003-06-20

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

New Hampshire Natural Heritage Bureau - Animal Record

New England Cottontail (*Sylvilagus transitionalis*)

Legal Status		**Conservation Status**	
Federal:	Not listed	Global:	Rare or uncommon
State:	Listed Endangered	State:	Critically imperiled due to rarity or vulnerability

Description at this Location

Conservation Rank: Not ranked
Comments on Rank:

Detailed Description: 2002: Seen (Obs_id 451).
General Area:
General Comments: 2002: Results of J. Litvaitis (UNH) Regional NEC survey; small patch (Obs_id 451). 2002: Rte. 128; 540 (Obs_id 451).
Management Comments:

Location

Survey Site Name: Moose Hill, south of
Managed By: Moose Hill Orchards Phase I

County: Rockingham
Town(s): Londonderry
Size: 7.7 acres Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2002: Rte. 128 (Obs_id 451).

Dates documented

First reported: 2002-01-01 Last reported: 2002-01-01

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

New Hampshire Natural Heritage Bureau - Animal Record

Northern Black Racer (*Coluber constrictor constrictor*)

Legal Status		**Conservation Status**	
Federal:	Not listed	Global:	Demonstrably widespread, abundant, and secure
State:	Listed Threatened	State:	Imperiled due to rarity or vulnerability

Description at this Location

Conservation Rank: Not ranked
Comments on Rank:

Detailed Description: 2014: Area 13599: 1 adult observed, sex unknown. Area 13607: 1 adult observed, sex unknown.
General Area: 2014: Area 13599: Roadside.
General Comments:
Management Comments:

Location

Survey Site Name: I-93, Londonderry
Managed By:

County: Rockingham
Town(s): Londonderry
Size: .9 acres
Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2014: Area 13599: Side of I-93, Londonderry (42.88717, -71.34987). Area 13607: Side of I-93, Londonderry (42.88556, -71.34861).

Dates documented

First reported: 2014-07-30 Last reported: 2014-07-30

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

New Hampshire Natural Heritage Bureau - Animal Record

Spotted Turtle (*Clemmys guttata*)

Legal Status		**Conservation Status**	
Federal:	Not listed	Global:	Demonstrably widespread, abundant, and secure
State:	Listed Threatened	State:	Imperiled due to rarity or vulnerability

Description at this Location

Conservation Rank: Fair quality, condition and/or landscape context ('C' on a scale of A-D).
Comments on Rank:

Detailed Description: 2012: Area 13018: 1 adult observed.2005: Area 9299: 1 turtle observed.
General Area: 2012: Area 13018: Crossing road between wetland areas.2005: Area 9299: Old farm pond, wet areas, stream.
General Comments:
Management Comments:

Location

Survey Site Name: Robert Frost Farm, South of
Managed By:

County: Rockingham
Town(s): Derry
Size: 32.8 acres Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2012: Area 13018: Culvert under road at 44 Berry Road, Derry.2005: Area 9299: Broadview Farm [From the junction of Rte. 28 and Rte. 102 take Rte. 28 southeast ca. 1.67 miles and turn right onto Gregg Road and travel ca. 0.35 miles to South Range Road. Follow South Range Road for 0.15 miles.].

Dates documented

First reported: 2005-05-09 Last reported: 2012-08-18

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

New Hampshire Natural Heritage Bureau - Animal Record

Wood Turtle (*Glyptemys insculpta*)

Legal Status		**Conservation Status**	
Federal:	Not listed	Global:	Apparently secure but with cause for concern
State:	Special Concern	State:	Rare or uncommon

Description at this Location

Conservation Rank: Fair quality, condition and/or landscape context ('C' on a scale of A-D).
Comments on Rank:

Detailed Description: 2006: Area 11655: 1 adult male seen.
General Area:
General Comments:
Management Comments:

Location

Survey Site Name: Old Nashua Road, south of
Managed By:

County: Rockingham
Town(s): Londonderry
Size: .4 acres Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: South of Old Nashua Road.

Dates documented

First reported: 2006-09-08 Last reported: 2006-09-08

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

New Hampshire Natural Heritage Bureau - Animal Record

Wood Turtle (*Glyptemys insculpta*)

Legal Status		**Conservation Status**	
Federal:	Not listed	Global:	Apparently secure but with cause for concern
State:	Special Concern	State:	Rare or uncommon

Description at this Location

Conservation Rank: Not ranked
Comments on Rank:

Detailed Description: 2010: Area 12813: 1 adult female observed laying eggs.
General Area: 2010: Area 12813: Laying eggs in sandy soil near Beaver Brook.
General Comments:
Management Comments:

Location

Survey Site Name: Beaver Brook, Londonderry
Managed By:

County: Rockingham
Town(s): Londonderry
Size: 1.9 acres
Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2010: Area 12813: 5 Gilcrest Road, Londonderry.

Dates documented

First reported: 2010-05-25
Last reported: 2010-05-25

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

New Hampshire Natural Heritage Bureau - Animal Record

Wood Turtle (*Glyptemys insculpta*)

Legal Status		**Conservation Status**	
Federal:	Not listed	Global:	Apparently secure but with cause for concern
State:	Special Concern	State:	Rare or uncommon

Description at this Location

Conservation Rank: Not ranked
Comments on Rank:

Detailed Description: 2014: Area 13636: 1 adult male and 1 adult female observed.
General Area: 2014: Area 13636: Slow moving stream surrounded by woods and some populated areas.
General Comments:
Management Comments:

Location

Survey Site Name: Beaver Brook Tributary, Londonderry
Managed By:

County: Rockingham
Town(s): Londonderry
Size: 1.9 acres Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 2014: Area 13636: Tributary of Beaver Brook behind houses on Pleasant Drive, Londonderry.

Dates documented

First reported: 2014-05-03 Last reported: 2014-05-03

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 11 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
New England Ecological Services Field Office
70 Commercial Street, Suite 300
Concord, NH 03301-5094
Phone: (603) 223-2541 Fax: (603) 223-0104
http://www.fws.gov/newengland

In Reply Refer To: June 20, 2018
Consultation Code: 05E1NE00-2017-SLI-0288
Event Code: 05E1NE00-2018-E-04980
Project Name: I-93 Exit 4A

Subject: Updated list of threatened and endangered species that may occur in your proposed project location, and/or may be affected by your proposed project

To Whom It May Concern:

The enclosed species list identifies threatened, endangered, proposed and candidate species, as well as proposed and final designated critical habitat, that may occur within the boundary of your proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*).

New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. Please feel free to contact us if you need more current information or assistance regarding the potential impacts to federally proposed, listed, and candidate species and federally designated and proposed critical habitat. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally as desired. The Service recommends that verification be completed by visiting the ECOS-IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through the ECOS-IPaC system by completing the same process used to receive the enclosed list.

The purpose of the Act is to provide a means whereby threatened and endangered species and the ecosystems upon which they depend may be conserved. Under sections 7(a)(1) and 7(a)(2) of the Act and its implementing regulations (50 CFR 402 *et seq.*), Federal agencies are required to utilize their authorities to carry out programs for the conservation of threatened and endangered species and to determine whether projects may affect threatened and endangered species and/or designated critical habitat.

A Biological Assessment is required for construction projects (or other undertakings having similar physical impacts) that are major Federal actions significantly affecting the quality of the human environment as defined in the National Environmental Policy Act (42 U.S.C. 4332(2)(c)). For projects other than major construction activities, the Service suggests that a biological evaluation similar to a Biological Assessment be prepared to determine whether the project may affect listed or proposed species and/or designated or proposed critical habitat. Recommended contents of a Biological Assessment are described at 50 CFR 402.12.

If a Federal agency determines, based on the Biological Assessment or biological evaluation, that listed species and/or designated critical habitat may be affected by the proposed project, the agency is required to consult with the Service pursuant to 50 CFR 402. In addition, the Service recommends that candidate species, proposed species and proposed critical habitat be addressed within the consultation. More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found in the "Endangered Species Consultation Handbook" at:

http://www.fws.gov/endangered/esa-library/pdf/TOC-GLOS.PDF

Please be aware that bald and golden eagles are protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668 *et seq.*), and projects affecting these species may require development of an eagle conservation plan (http://www.fws.gov/windenergy/eagle_guidance.html). Additionally, wind energy projects should follow the wind energy guidelines (http://www.fws.gov/windenergy/) for minimizing impacts to migratory birds and bats.

Guidance for minimizing impacts to migratory birds for projects including communications towers (e.g., cellular, digital television, radio, and emergency broadcast) can be found at: http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/towers.htm; http://www.towerkill.com; and http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/comtow.html.

We appreciate your concern for threatened and endangered species. The Service encourages Federal agencies to include conservation of threatened and endangered species into their project planning to further the purposes of the Act. Please include the Consultation Tracking Number in the header of this letter with any request for consultation or correspondence about your project that you submit to our office.

Attachment(s):

- Official Species List

Official Species List

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

New England Ecological Services Field Office
70 Commercial Street, Suite 300
Concord, NH 03301-5094
(603) 223-2541

Project Summary

Consultation Code: 05E1NE00-2017-SLI-0288

Event Code: 05E1NE00-2018-E-04980

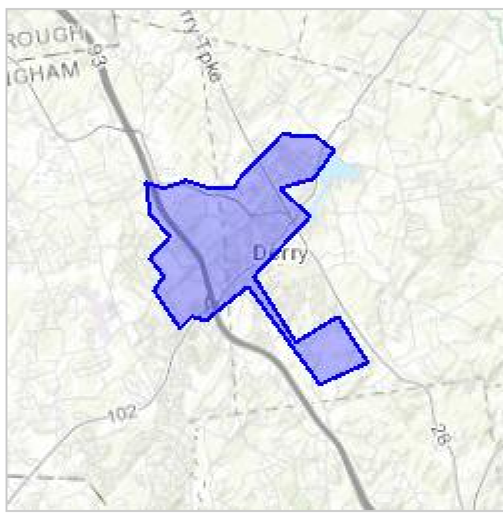
Project Name: I-93 Exit 4A

Project Type: TRANSPORTATION

Project Description: The Towns of Derry and Londonderry, New Hampshire (NH), and the Federal Highway Administration (FHWA) are studying the construction of a new Interstate 93 (I-93) Interchange, known as Exit 4A, that would provide access to only areas east of I-93 along with a new roadway connecting the proposed Exit 4A with the existing roadway network.

Project Location:

Approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/place/42.8821615762781N71.34204636632049W



Counties: Rockingham, NH

Endangered Species Act Species

There is a total of 1 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries[1], as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

---

1. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

Mammals

NAME	STATUS
Northern Long-eared Bat *Myotis septentrionalis* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9045	Threatened

Critical habitats

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
GREATER ATLANTIC REGIONAL FISHERIES OFFICE
55 Great Republic Drive
Gloucester, MA 01930-2276

NOV 18 2016

Patrick Bauer
Division Administrator
Federal Highway Administration
New Hampshire Division
53 Pleasant Street, Suite 2200
Concord, NH 03301

Re: SDEIS for the I-93 Exit 4A Project

Dear Mr. Bauer:

On November 9, 2016, we received your letter asking if we have an interest in becoming a participating agency with FHWA for the development of your Supplemental Draft Environmental Impact Statement (SDEIS).

Endangered Species Act (ESA)
We do not expect any federally listed or proposed threatened or endangered species nor critical habitat under our jurisdiction to occur in the vicinity of the proposed project; therefore, no direct or indirect effects are expected. The Protected Resources Division does not intend to offer additional comments on this project. For the future, if you are looking for information relevant to ESA-listed species and critical habitat, please visit our website at:
https://www.greateratlantic.fisheries.noaa.gov/protected/section7/
If you wish to discuss this further, please contact Zachary Jylkka (978-282-8467; Zachary.Jylkka@noaa.gov).

Magnuson-Stevens Fishery Conservation and Management Act
The proposed project area does not contain areas identified as Essential Fish Habitat (EFH) under the Magnuson-Stevens Fishery Conservation and Management Act. Therefore, we do not intend to provide EFH conservation recommendations to you for this action. For a listing of EFH and further information, please go to our website at:
http://www.greateratlantic.fisheries.noaa.gov/habitat. If you wish to discuss this further, please contact Mike Johnson (978-281-9130; Mike.R.Johnson@noaa.gov) of our Habitat Conservation Division.

Sincerely,

Mark Murray-Brown
Section 7 Coordinator for
Protected Resources

EC: Sikora, FHWA; Johnson, NMFS-HCD
File path: H:\Section 7 Team\Section 7\Non-Fisheries\FHWA_State DOTs\TA Letters\NH DOT\FWHA NH-DOT I-93 Exit 4A Project

From:	Tidd, Leo
To:	Vicki Chase (vchase@normandeau.com); Snyder, Kerri
Cc:	"Christopher Bean"; I93-Exit4A-EIS (SM)
Subject:	FW: Derry-Londonderry 13065 - NH DOT I-93 Exit 4A Project Comments
Date:	Tuesday, July 24, 2018 8:23:55 AM
Attachments:	image001.png image002.png

Leo Tidd AICP
Manager

Louis Berger | +1.607.280.9438 | louisberger.com

From: Cota, Keith <Keith.Cota@dot.nh.gov>
Sent: Tuesday, July 24, 2018 9:17 AM
To: 'Edith Carson - NOAA Federal' <edith.carson@noaa.gov>
Cc: Mike R Johnson - NOAA Federal <mike.r.johnson@noaa.gov>; Laurin, Marc <Marc.Laurin@dot.nh.gov>; Tidd, Leo <ltidd@louisberger.com>; Christopher Bean, CLD <chrisb@cldengineers.com>
Subject: RE:Derry-Londonderry 13065 - NH DOT I-93 Exit 4A Project Comments

External

Ms. Carson,

Thank you for your feedback on the I-93, Exit 4A project and the upcoming Public Informational Meeting. I will pass along your information to our environmental staff as to no endangered species within the corridor and no essential fish habitat as well.

Thank you for your corridor overview.

Keith A. Cota, PE
Chief Project Manager
Bureau of Highway Design
7 Hazen Drive, PO Box 483
Room 200
Concord, NH 03302-0483
TEL (603) 271-1615
FAX (603) 271-7025
Email: Keith.Cota@dot.nh.gov

From: Edith Carson - NOAA Federal [mailto:edith.carson@noaa.gov]
Sent: Friday, July 20, 2018 9:32 AM
To: Cota, Keith
Cc: Mike R Johnson - NOAA Federal
Subject: NH DOT I-93 Exit 4A Project Comments

Mr. Cota,

We received your letter on July 13, 2018, regarding the I-93, exit 4A project in Derry, NH. Here are our comments.

Endangered Species Act

No federally listed or proposed threatened or endangered species under our jurisdiction are known to exist in the site of your proposed project. Based on this, we do not believe a consultation in accordance with section 7 of the Endangered Species Act is necessary. As such, no further coordination on this activity with the NMFS Protected Resources Division is necessary at this time. Should project plans change or new information become available that changes the basis for this determination, further coordination should be pursued. Please contact me (978) 282-8490 or Edith.Carson@noaa.gov), should you have any questions regarding these comments.

Magnuson-Stevens Fishery Conservation and Management Act

The proposed project area does not contain areas identified as Essential Fish Habitat (EFH) under the Magnuson-Stevens Fishery Conservation and Management Act. Therefore, we do not intend to provide EFH conservation recommendations to you for this action. For a listing of EFH and further information, please go to our website at: http://www.greateratlantic.fisheries.noaa.gov/habitat. If you wish to discuss this further, please contact Mike Johnson (978-281-9130; Mike.R.Johnson@noaa.gov) of our Habitat Conservation Division.

Thank you,

Edith

Edith Carson-Supino, M.Sc.
Section 7/Shortnose Sturgeon Fish Biologist
NOAA Fisheries
U.S. Department of Commerce
Greater Atlantic Regional Fisheries Office
Phone: 978-282-8490
edith.carson@noaa.gov

For ESA Section 7 guidance please see:

https://www.greateratlantic.fisheries.noaa.gov/section7

From:	Gegas, Vasilios (Bill)
To:	Snyder, Kerri
Cc:	ericbodenrader@derrynh.org; sheilabodenrader@derrynh.org
Subject:	RE: LWCF Properties in Derry, NH
Date:	Tuesday, August 7, 2018 12:42:03 PM
Attachments:	Exit4A_doc_Parks_Conservation_Rec_bw_noborders_v4_080318 (LWCF SITES).pdf

External

Hi Kerri,
Based on our records, there are three separate sites within this area that were funded under LWCF project #33-00166 "Derry Three Parks". Please see the attached and let me know if you anticipate any impacts to these sites.
Thanks!
Bill

Bill Gegas
LWCF Program Specialist
NH Department of Natural and Cultural Resources
Division of Parks and Recreation
172 Pembroke Road
Concord, NH 03301-5767
(603) 271-3556 p
(603) 271-3553 f
bill.gegas@dncr.nh.gov
www.nhstateparks.org

From: Snyder, Kerri [mailto:KSnyder@louisberger.com]
Sent: Tuesday, August 7, 2018 11:48 AM
To: Gegas, Vasilios (Bill)
Cc: I93-Exit4A-EIS (SM); Tidd, Leo
Subject: LWCF Properties in Derry, NH

Mr. Gegas,
As we discussed, Louis Berger is conducting the Supplemental Draft EIS for the proposed I-93 Exit 4A project. As part of the evaluation, we are identifying properties near the alternative alignments that have received money from the Land and Water Conservation Fund. Attached is a map showing parks and recreation resources near the alternative alignments. From our research, we have noted that the Veteran's & O'Hara Ball Fields appear to have received LWCF money (Parcel ID 2). Are there any other properties in the following table that have received LWCF money? Are there any other properties in proximity to the alignments that we may have missed?

Parcel ID	Name	Location	LWCF Recipient?
1	Hoodkroft Golf Course	NH 102 (Chester Road)	
2	Veteran's & O'Hara Ball Fields	Wilson Avenue	Yes
3	MacGregor Park	Birch Street	
4	Buckley Field	Hood Road	
5	Pinkerton Academy Athletic Field	Crescent Street	

6	Pinkerton Academy Fields	Pinkerton Street	
7	Pinkerton Academy Fields East	Pinkerton Street	
8	Rider Fields	Tsienneto Road	
9	Hovey Road Viewshed Easement	Pillsbury Road	
10	Dumont	North and east of Trolley Car Lane, bisected by Old Trolley Line Trail	
11	Rockingham Rd	Rockingham Rd	
12	Woodhenge Cir	Rockingham Rd	
-	Old Trolley Line Trail	Various west of I-93	
-	Londonderry Rail Trail	Various east of I-93	
-	Rail Trail Path	Various east of I-93	
-	Derry Rail Trail	Various east of I-93	
-	Derry Bicycle Path	Downtown Derry	
-	Rider Field Trail	Near Rider Field	

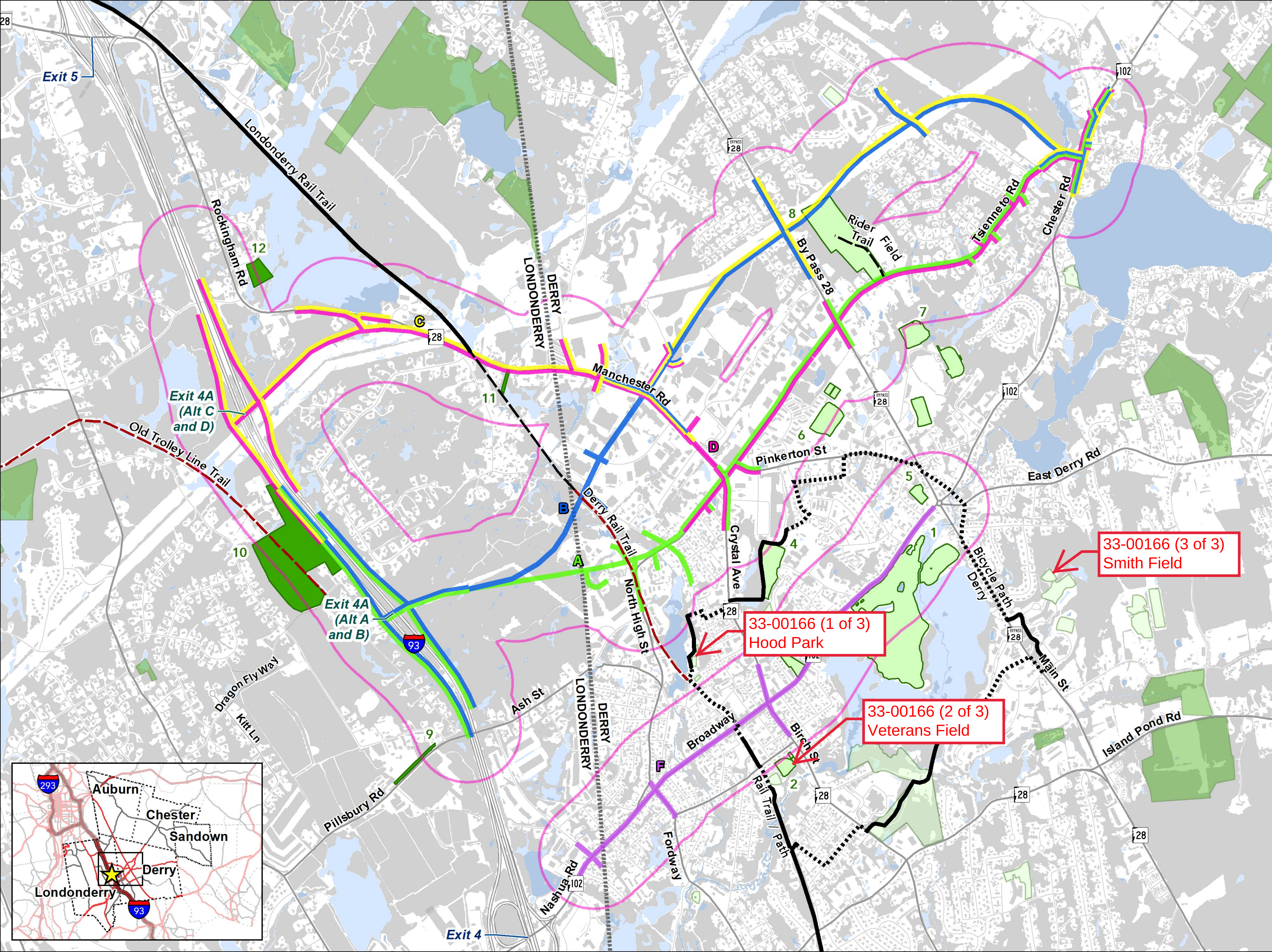
Thank you for your time and review of the enclosed materials.

Regards,
Kerri

Kerri Snyder AICP
Principal Environmental Planner
Louis Berger

mobile +1.646.584.9490
direct +1.212.612.7908
email ksnyder@louisberger.com

I-93 Exit 4A Supplemental Draft EIS



Alternatives
- A
- B
- C
- D
- F

Road
- Interstate
- Major Road
- Local Road

Trails and Bicycle Routes
- Paved Trail
- Unpaved Trail
- Planned Trail
- On Road Bicycle Route

Park and Conservation Land
- Conservation Land
- Park
- Study Area (1000 Foot Buffer)
- Town Boundaries

Sources:
CLD Engineers
Town of Derry GIS
Town of Londonderry GIS
State of New Hampshire
New Hampshire DOT

N

0 800 1,600 3,200 Feet

Coordinate System: NAD 1983 StatePlane New Hampshire (feet)

Date: August 03, 2018

New Hampshire DOT Department of Transportation

From:	Gegas, Vasilios (Bill)
To:	Snyder, Kerri
Cc:	ericbodenrader@derrynh.org; sheilabodenrader@derrynh.org; Christopher Bean; Tidd, Leo; I93-Exit4A-EIS (SM)
Subject:	RE: LWCF Properties in Derry, NH
Date:	Tuesday, August 7, 2018 12:54:47 PM

External

Based on the information provided we do not expect any impacts to any properties encumbered under the LWCF State and Local Assistance Program.
Thanks!

Bill Gegas
LWCF Program Specialist
NH Department of Natural and Cultural Resources
Division of Parks and Recreation
172 Pembroke Road
Concord, NH 03301-5767
(603) 271-3556 p
(603) 271-3553 f
bill.gegas@dncr.nh.gov
www.nhstateparks.org

From: Snyder, Kerri [mailto:KSnyder@louisberger.com]
Sent: Tuesday, August 7, 2018 1:50 PM
To: Gegas, Vasilios (Bill)
Cc: ericbodenrader@derrynh.org; sheilabodenrader@derrynh.org; Christopher Bean; Tidd, Leo; I93-Exit4A-EIS (SM)
Subject: RE: LWCF Properties in Derry, NH

Bill,
Thank you for your review and for the additional information. We will include this in the Supplemental Draft EIS. None of those parks is anticipated to be impacted. The preferred alternative has been identified as Alternative A (bright green alignment).
Regards,
Kerri

From: Gegas, Vasilios (Bill) [mailto:Bill.Gegas@dncr.nh.gov]
Sent: Tuesday, August 7, 2018 12:39 PM
To: Snyder, Kerri <KSnyder@louisberger.com>
Cc: ericbodenrader@derrynh.org; sheilabodenrader@derrynh.org
Subject: RE: LWCF Properties in Derry, NH

External

Hi Kerri,
Based on our records, there are three separate sites within this area that were funded under LWCF project #33-00166 “Derry Three Parks”. Please see the attached and let me know if you anticipate any impacts to these sites.
Thanks!

Bill

Bill Gegas
LWCF Program Specialist
NH Department of Natural and Cultural Resources
Division of Parks and Recreation
172 Pembroke Road
Concord, NH 03301-5767
(603) 271-3556 p
(603) 271-3553 f
bill.gegas@dncr.nh.gov
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From: Snyder, Kerri [mailto:KSnyder@louisberger.com]
Sent: Tuesday, August 7, 2018 11:48 AM
To: Gegas, Vasilios (Bill)
Cc: I93-Exit4A-EIS (SM); Tidd, Leo
Subject: LWCF Properties in Derry, NH

Mr. Gegas,
As we discussed, Louis Berger is conducting the Supplemental Draft EIS for the proposed I-93 Exit 4A project. As part of the evaluation, we are identifying properties near the alternative alignments that have received money from the Land and Water Conservation Fund. Attached is a map showing parks and recreation resources near the alternative alignments. From our research, we have noted that the Veteran's & O'Hara Ball Fields appear to have received LWCF money (Parcel ID 2). Are there any other properties in the following table that have received LWCF money? Are there any other properties in proximity to the alignments that we may have missed?

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10	Dumont	North and east of Trolley Car Lane, bisected by Old Trolley Line Trail	
11	Rockingham Rd	Rockingham Rd	
12	Woodhenge Cir	Rockingham Rd	

-	Old Trolley Line Trail	Various west of I-93	
-	Londonderry Rail Trail	Various east of I-93	
-	Rail Trail Path	Various east of I-93	
-	Derry Rail Trail	Various east of I-93	
-	Derry Bicycle Path	Downtown Derry	
-	Rider Field Trail	Near Rider Field	

Thank you for your time and review of the enclosed materials.

Regards,
Kerri

Kerri Snyder AICP
Principal Environmental Planner
Louis Berger

mobile +1.646.584.9490
direct +1.212.612.7908
email ksnyder@louisberger.com

New Hampshire
DOT
Department of Transportation

THE STATE OF NEW HAMPSHIRE
DEPARTMENT OF TRANSPORTATION

Victoria F. Sheehan
Commissioner

William Cass, P.E.
Assistant Commissioner

September 4, 2018

Mr. Eric Bodenrader
Parks and Recreation Director
Veterans Hall
31 West Broadway
Derry, NH 03038

Re: Derry-Londonderry 13065
I-93 Exit 4A Environmental Impact Statement
FHWA Intent to Make a Section 4(f) *de minimis* determination

Dear Mr. Bodenrader:

This letter is in regard to Section 4(f) coordination for the I-93 Exit 4A project. Per 23 CFR 774.5, we are coordinating with you as the official with jurisdiction responsible for Section 4(f) recreational resources in the Town of Derry.

The Towns of Derry and Londonderry, the New Hampshire Department of Transportation (NHDOT) and Federal Highway Administration (FHWA) are preparing a Supplemental Draft Environmental Impact Statement (SDEIS) under the National Environmental Policy Act (NEPA) for the proposed I-93 Exit 4A (Project). The Project includes construction of a new interchange with I-93 (known as Exit 4A) and other transportation improvements to reduce congestion and improve safety along State Route 102 (NH 102), from I-93 easterly through downtown Derry, and to promote economic vitality in the Derry/Londonderry area. The Preferred Alternative for the Project is Alternative A (Figure 1).

Parks and Recreational Resources – Rider Fields

The Project involves the improvement of Tsienneto Road, which would require permanent acquisition of 920 square feet (0.02 acre) of the Rider Fields property adjacent to the existing roadway. The Project would result in slope and driveway impacts beyond the proposed right of way (ROW) that would require additional, temporary easements of 2,500 square feet (0.06 acre) on the Rider Field property (Figure 2).

Within the permanent acquisition area, the following items will be disturbed:

- Stone wall spanning between the parcel to the west (34 Tsienneto Rd) and this parcel
- The tree west of the driveway to the Upper Room
- The mailbox

- The sign for the Upper Room Family Resource Center
- The landscaping blocks around a landscaped area
- Stone wall between the Upper Room Family Resource Center driveway and the Rider Fields driveway
- The end of the culvert under Tsienneto Road between the driveways
- The ditch between the driveways (approximately 15 linear feet)

The impacts associated with the temporary easement are limited to the vegetation between the Upper Room driveway and the Rider Fields driveway. This vegetated area near Tsienneto Rd. is not typically used for recreational purposes by the public and is approximately 346 feet from the sports fields to the north that constitute the primary recreational area of the park.

NHDOT will coordinate with the Town of Derry to move the mailbox and sign for the Upper Room Family Resource Center and to replace the stone walls and vegetation that would be impacted by the Project. The temporary easement would not impact the usability of park and access to the park would be maintained throughout the construction period. Neither the Upper Room Family Resource Center nor the activities, features, and attributes of the Rider Fields would be adversely impacted on a permanent or temporary basis.

De Minimis Finding

As a part of the environmental review process, the FHWA has responsibilities to comply with Section 4(f) of the Department of Transportation Act of 1966 (which has been later revised and recodified but still referred to as Section 4(f)). The intent of the Section 4(f) Statute, 49 U.S.C. Section 303, and the policy of the FHWA is to avoid transportation use of historic sites and publicly owned recreational areas, parks, and wildlife and waterfowl refuges. If the FHWA determines that a transportation use of these types of properties, also known as Section 4(f) properties, results in a *de minimis* impact on that property, an analysis of avoidance alternatives is not required, and the Section 4(f) evaluation process is complete. *De minimis* impacts on publicly owned parks, recreation areas, and wildlife and waterfowl refuges are defined as those that do not "adversely affect the activities, features and attributes" of the Section 4(f) resource.

The finding of a *de minimis* impact on recreational and wildlife resources can be made when:

1. The transportation use of the Section 4(f) resource, together with any impact avoidance, minimization, and mitigation or enhancement measures incorporated into the project, does not adversely affect the activities, features, and attributes that qualify the resource for protection under Section 4(f);
2. The public has been afforded an opportunity to review and comment on the effects of the project on the protected activities, features, and attributes of the Section 4(f) resource; and

3. The official(s) with jurisdiction over the property are informed of FHWA's intent to make the *de minimis* impact finding based on their written concurrence that the project will not adversely affect the activities, features, and attributes that qualify the property for protection under Section 4(f).

NHDOT respectfully requests concurrence that the Project will not "adversely affect the activities, features and attributes" that qualify the Rider Fields for protection, in order that FHWA can make a determination that the impacts to Rider Fields are *de minimis*. Per requirements of 23 CFR 774.5(a)(2)(ii), the public will receive notice and an opportunity for public review and comment concerning the effects on park lands during the SDEIS public comment period.

Please contact me if you have any questions regarding this matter.

Sincerely,

Keith A Cota

Keith Cota
NHDOT Project Manager

cc: Mike Fowler, Town of Derry, Director of Public Works
Jamie Sikora, FHWA
Chris Bean, Fuss & O'Neil
Marc Laurin, NHDOT

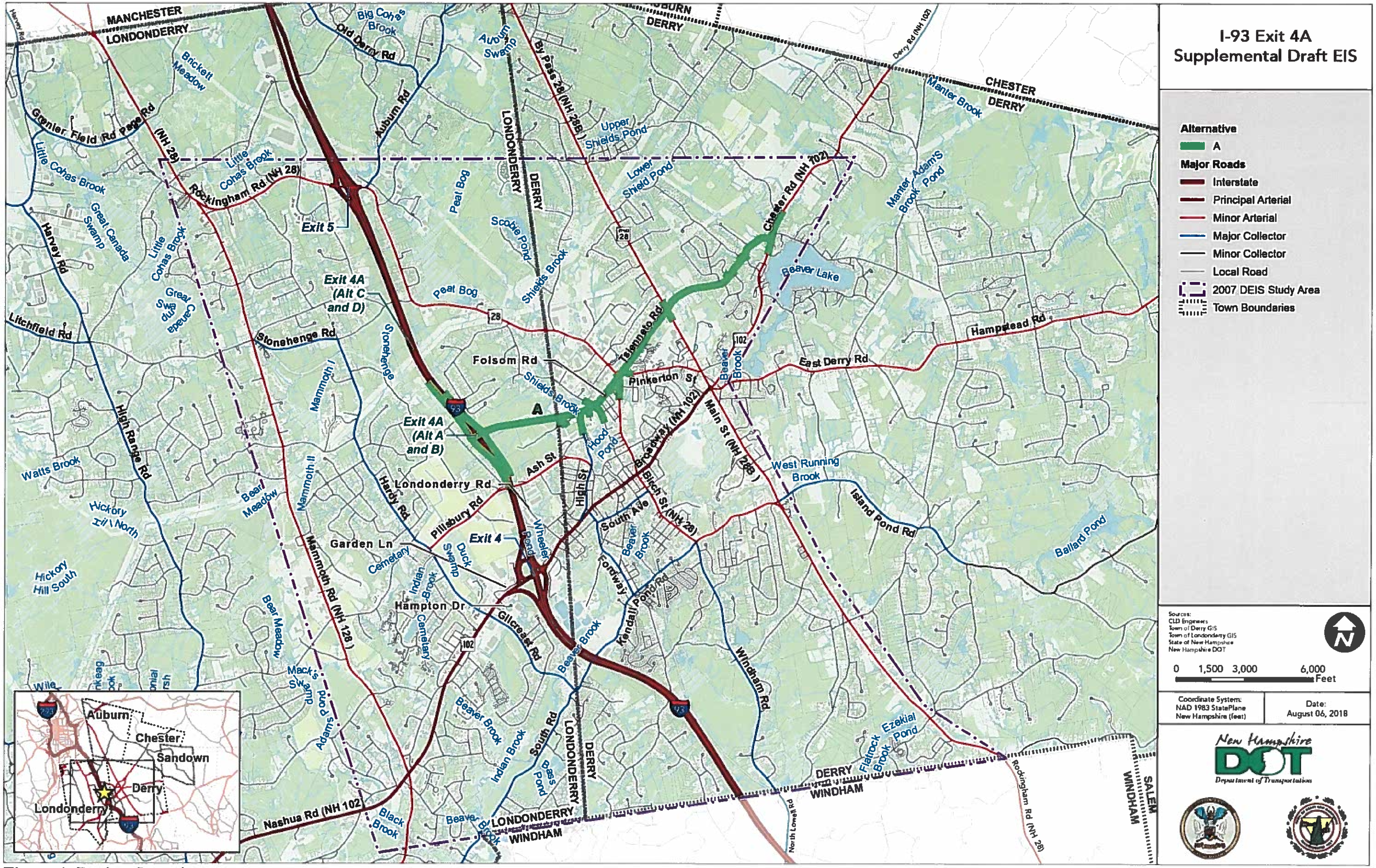


Figure 1. Project Location

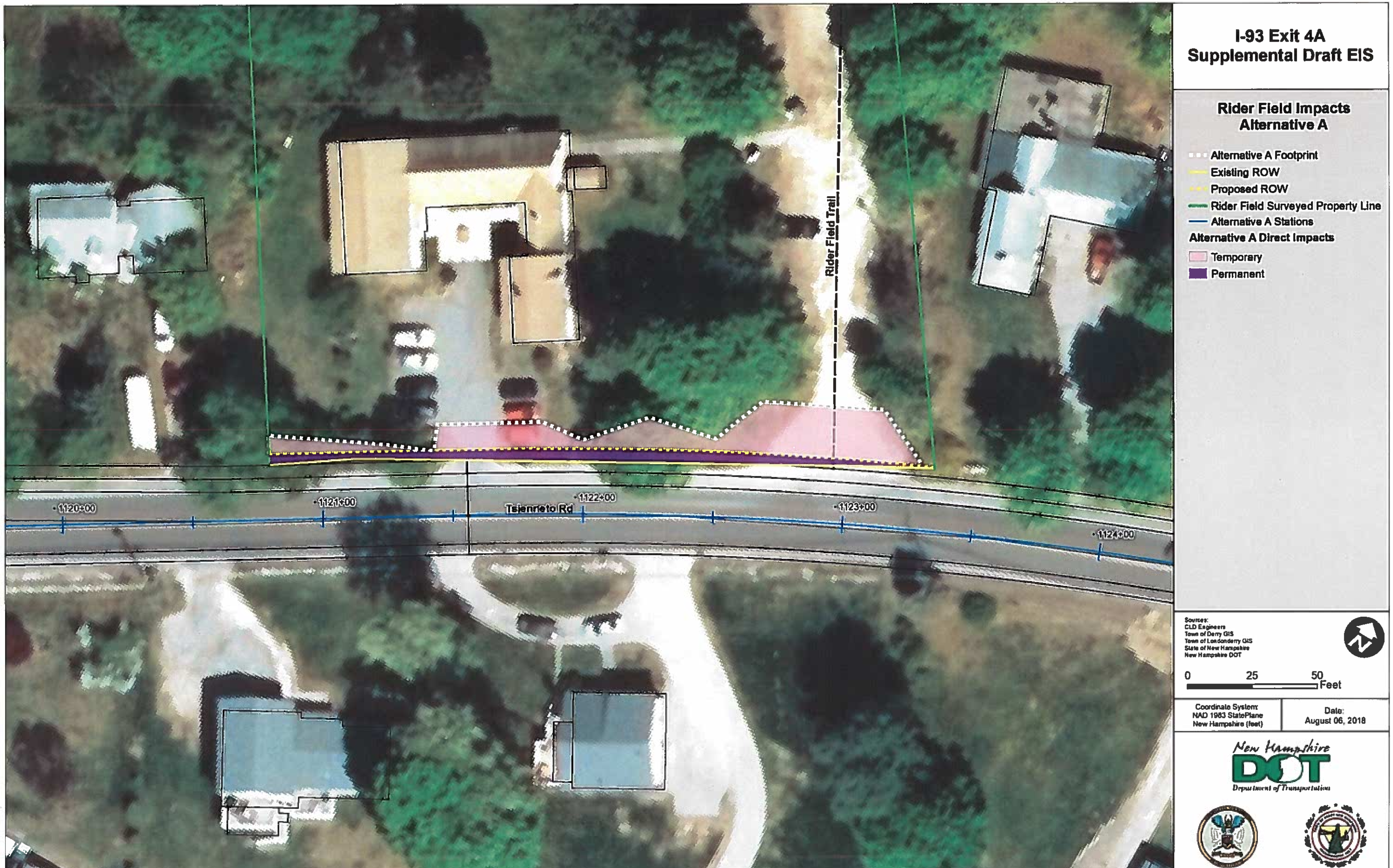


Figure 2. Impacts to Rider Fields

Appendix L: Wildlife Species List

United States Department of the Interior

FISH AND WILDLIFE SERVICE
New England Ecological Services Field Office
70 Commercial Street, Suite 300
Concord, NH 03301-5094
Phone: (603) 223-2541 Fax: (603) 223-0104
http://www.fws.gov/newengland

In Reply Refer To: June 20, 2018
Consultation Code: 05E1NE00-2017-SLI-0288
Event Code: 05E1NE00-2018-E-04980
Project Name: I-93 Exit 4A

Subject: Updated list of threatened and endangered species that may occur in your proposed project location, and/or may be affected by your proposed project

To Whom It May Concern:

The enclosed species list identifies threatened, endangered, proposed and candidate species, as well as proposed and final designated critical habitat, that may occur within the boundary of your proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*).

New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. Please feel free to contact us if you need more current information or assistance regarding the potential impacts to federally proposed, listed, and candidate species and federally designated and proposed critical habitat. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally as desired. The Service recommends that verification be completed by visiting the ECOS-IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through the ECOS-IPaC system by completing the same process used to receive the enclosed list.

The purpose of the Act is to provide a means whereby threatened and endangered species and the ecosystems upon which they depend may be conserved. Under sections 7(a)(1) and 7(a)(2) of the Act and its implementing regulations (50 CFR 402 *et seq.*), Federal agencies are required to utilize their authorities to carry out programs for the conservation of threatened and endangered species and to determine whether projects may affect threatened and endangered species and/or designated critical habitat.

A Biological Assessment is required for construction projects (or other undertakings having similar physical impacts) that are major Federal actions significantly affecting the quality of the human environment as defined in the National Environmental Policy Act (42 U.S.C. 4332(2)(c)). For projects other than major construction activities, the Service suggests that a biological evaluation similar to a Biological Assessment be prepared to determine whether the project may affect listed or proposed species and/or designated or proposed critical habitat. Recommended contents of a Biological Assessment are described at 50 CFR 402.12.

If a Federal agency determines, based on the Biological Assessment or biological evaluation, that listed species and/or designated critical habitat may be affected by the proposed project, the agency is required to consult with the Service pursuant to 50 CFR 402. In addition, the Service recommends that candidate species, proposed species and proposed critical habitat be addressed within the consultation. More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found in the "Endangered Species Consultation Handbook" at:

http://www.fws.gov/endangered/esa-library/pdf/TOC-GLOS.PDF

Please be aware that bald and golden eagles are protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668 *et seq.*), and projects affecting these species may require development of an eagle conservation plan (http://www.fws.gov/windenergy/eagle_guidance.html). Additionally, wind energy projects should follow the wind energy guidelines (http://www.fws.gov/windenergy/) for minimizing impacts to migratory birds and bats.

Guidance for minimizing impacts to migratory birds for projects including communications towers (e.g., cellular, digital television, radio, and emergency broadcast) can be found at: http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/towers.htm; http://www.towerkill.com; and http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/comtow.html.

We appreciate your concern for threatened and endangered species. The Service encourages Federal agencies to include conservation of threatened and endangered species into their project planning to further the purposes of the Act. Please include the Consultation Tracking Number in the header of this letter with any request for consultation or correspondence about your project that you submit to our office.

Attachment(s):

- Official Species List

Official Species List

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

New England Ecological Services Field Office
70 Commercial Street, Suite 300
Concord, NH 03301-5094
(603) 223-2541

Project Summary

Consultation Code: 05E1NE00-2017-SLI-0288

Event Code: 05E1NE00-2018-E-04980

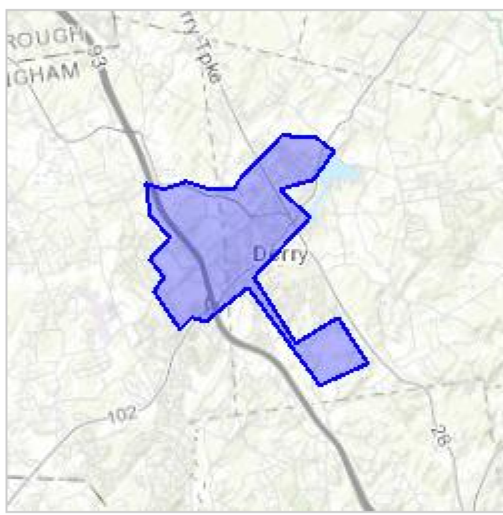
Project Name: I-93 Exit 4A

Project Type: TRANSPORTATION

Project Description: The Towns of Derry and Londonderry, New Hampshire (NH), and the Federal Highway Administration (FHWA) are studying the construction of a new Interstate 93 (I-93) Interchange, known as Exit 4A, that would provide access to only areas east of I-93 along with a new roadway connecting the proposed Exit 4A with the existing roadway network.

Project Location:

Approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/place/42.8821615762781N71.34204636632049W



Counties: Rockingham, NH

Endangered Species Act Species

There is a total of 1 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries[1], as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

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1. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

Mammals

NAME	STATUS
Northern Long-eared Bat *Myotis septentrionalis* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9045	Threatened

Critical habitats

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

Table D-1. Reptile Species with Ranges Likely to Overlap the Study Area[1]

Scientific Name	Common Name	Special Habitat Requirements	Species of Greatest Conservation Need[a]	State Status[b]	Federal Status
Chelydra serpentina	Snapping turtle	Aquatic habitat; sandy, gravely soil			
Chrysemys picta	Painted turtle	Ponds with projecting or floating logs			
Clemmys guttata	Spotted turtle+	Unpolluted shallow water	√	T	
Coluber constrictor	Northern black racer+	Wooded areas, fields, swamps, marshes	√	T	
Diadophis punctatus	Northern ring-necked snake	Mesic areas with abundant cover			
Emydoidea blandingii	Blanding's turtle+	Wetlands with shallow water adjacent to upland fields or forests	√	E	
Glyptemys insculpta	Wood turtle+	Wooded river or stream banks	√	SC	
Heterodon platirhinos	Eastern hognose snake+	Sandy soils, open woodlands	√	E	
Lampropeltis triangulum	Eastern milk snake	Slash, woodpiles, debris, lose soil for laying eggs			
Nerodia sipedon	Northern water snake	Branches or logs overhanging water			
Opheodrys vernalis	Smooth green snake+	Upland grassy openings	√	SC	
Sternotherus odoratus	Common musk turtle	Permanent water bodies			
Storeria dekayi	Northern brown snake	Damp woods, swamps, bogs, open fields			
Storeria occipitomaculata	Northern red-bellied snake	Moist woods, hillsides with surface debris			
Terrapene carolina	Eastern box turtle+	Old fields, clearings, sandy soil	√	SC	
Thamnophis sauritus	Ribbon snake+	Mesic woods with aquatic habitat	√		
Thamnophis sirtalis	Common garter snake	Moist areas, forest edges, stream edges, swamps			

Source: DeGraaf and Yamasaki (2001) and NHFGD (2016).

* Indicates that species distribution (known, potential, or historic) does not include Derry or Londonderry as depicted on species distribution map in NH Wildlife Action Plan

+ Indicates that species distribution (known, potential, or historic) does not include Derry or Londonderry as depicted on species distribution map in NH Wildlife Action Plan

[a] Species of Greatest Conservation Need are identified in the NH Wildlife Action Plan. These include all Federal and State-listed threatened and endangered species; state species with Natural Heritage Rank of S1 or S2; species of concern as identified by the Northeast Wildlife Diversity Technical Committee; and recommendations from expert panels, groups and individuals.

[b] E = Endangered; T = Threatened; SC = Special Concern

Table D-2. Amphibian Species with Ranges Likely to Overlap the Study Area[1]

Scientific Name	Common Name	Special Habitat Requirements	Species of Greatest Conservation Need[a]	State Status[b]	Federal Status
Ambystoma jeffersonianum	Jefferson salamander*		√	SC	
Ambystoma laterale	Blue-spotted salamander*	Ponds or semi-permanent water for breeding	√	SC	
Ambystoma maculatum	Spotted salamander	Mesic woods, semi-permanent water for breeding			
Ambystoma opacum	Marbled salamander*	Woodland ponds or swamps for breeding	√	E	
Anaxyrus americanus	American toad	Moist upland woods			
Anaxyrus fowleri	Fowler's toad*	Sandy soils, shallow water for breeding	√	SC	
Desmognathus fuscus	Northern dusky salamander	Permanent woodland streams or seeps			
Eurycea bislineata	Northern two-lined salamander	Streams for breeding			
Gyrinophilus porphyriticus	Northern spring salamander	Streams, seeps, springs			
Hemidactylium scutatum	Four-toed salamander	Wet woodlands			
Hyla versicolor	Gray tree frog	Seeps, aquatic sites for breeding			
Notophthalmus viridescens	Red-spotted newt	Water with aquatic vegetation for adults			
Plethodon cinereus	Red-backed salamander	Logs, stumps, rocks, etc.			
Pseudacris crucifer	Northern spring peeper	Pools for breeding			
Lithobates catesbeiana	Bullfrog	Deep water, floating and emergent vegetation			
Lithobates clamitans melanota	Green frog	Riparian habitat			

Scientific Name	Common Name	Special Habitat Requirements	Species of Greatest Conservation Need[a]	State Status[b]	Federal Status
Lithobates palustris	Pickerel frog	Shallow, clear water of bogs or woodland streams			
Lithobates pipiens	Northern leopard frog*	Wet meadows	√	SC	

Source: DeGraaf and Yamasaki (2001) and NHFGD (2016).

* Indicates that species distribution (known, potential, or historic) does not include Derry or Londonderry as depicted on species distribution map in NH Wildlife Action Plan

+ Indicates that species distribution (known, potential, or historic) does not include Derry or Londonderry as depicted on species distribution map in NH Wildlife Action Plan

[a] Species of Greatest Conservation Need are identified in the NH Wildlife Action Plan. These include all Federal and State-listed threatened and endangered species; state species with Natural Heritage Rank of S1 or S2; species of concern as identified by the Northeast Wildlife Diversity Technical Committee; and recommendations from expert panels, groups and individuals.

[b] E = Endangered; T = Threatened; SC = Special Concern

Table D-3. Bird Species with Ranges Likely to Overlap the Study Area[1]

Scientific Name	Common Name	Special Habitat Requirements	Species of Greatest Conservation Need[a]	State Status[b]	Federal Status
Acanthis flammea	Common redpoll				
Accipiter cooperii	Cooper's hawk	Undisturbed forests			
Accipiter gentilis	Northern goshawk+	Extensive, mature mixed woods	√		
Accipiter striatus	Sharp-shinned hawk	Extensive, undisturbed open mixed woodlands			
Actitis macularia	Spotted sandpiper	Shorelines			
Aegolius acadicus	Northern saw-whet owl	Cavity trees >12" diameter at breast height			
Agelaius phoeniceus	Red-winged blackbird				
Aix sponsa	Wood duck	Trees >16" diameter at breast height with large cavities			
Ammodramus savannarum	Grasshopper sparrow+	Dry grassy areas with perches.	√	T	
Anas platyrhynchos	Mallard				
Anas rubripes	American black duck+		√		
Antrostomus vociferus	Eastern Whip-poor-will+	Dry, open woods, early successional forest adjacent to large clearings or brushy field edges	√	SC	
Aquila chrysaetos	Golden eagle	Cliffs for nesting; large open areas for hunting.	√	E	
Archilochus colubris	Ruby-throated hummingbird	Flowers, preferably red			
Ardea herodias	Great blue heron	Tall trees for nesting			
Asio otus	Long-eared owl	Dense conifer thickets in open country			

Scientific Name	Common Name	Special Habitat Requirements	Species of Greatest Conservation Need[a]	State Status[b]	Federal Status
Baeolophus bicolor	Tufted titmouse	Cavity trees >8" diameter at breast height			
Bartramia longicauda	Upland sandpiper*	Open habitats with low vegetation	√	E	
Bombycilla cedrorum	Cedar waxwing				
Bonasa umbellus	Ruffed grouse+	Fallen logs amidst dense saplings	√		
Botaurus lentiginosus	American bittern	Undisturbed tall marsh vegetation			
Branta canadensis	Canada goose				
Bubo virginianus	Great horned owl	Large abandoned hawk nests, large tree cavities			
Buteo jamaicensis	Red-tailed hawk	Mature forest-field ecotone			
Buteo lagopus	Rough-legged hawk	Open country			
Buteo lineatus	Red-shouldered hawk	Cool, moist, mature forests			
Buteo platypterus	Broad-winged hawk	Extensive woodlands with roads or clearings			
Butorides virescens	Green heron	Shrub and forested wetlands			
Calcarius lapponicus	Lapland longspur				
Cardellina canadensis	Canada warbler+		√		
Cardinalis cardinalis	Northern cardinal	Thickets, vines			
Cathartes aura	Turkey vulture	Forest openings, fields, large dead tree trunks			
Catharus fuscescens	Veery+	Moist woodlands with understory	√		
Catharus guttatus	Hermit thrush	Coniferous woodlands with dense understory			
Certhia americana	Brown creeper	Woodland trees with sloughing or loose bark			

Scientific Name	Common Name	Special Habitat Requirements	Species of Greatest Conservation Need[a]	State Status[b]	Federal Status
Chaetura pelagica	Chimney swift+	Chimneys, Feeds over water	√		
Charadrius vociferus	Killdeer	Bare ground, sparse vegetation			
Chordeiles minor	Common nighthawk*	Feeds over water	√	E	
Cistothorus palustris	Marsh wren*	Marshes	√		
Cistothorus platensis	Sedge wren+	Sedge meadows	√	E	
Coccothraustes vespertinus	Evening grosbeak	Spruce and fir forest			
Coccyzus americanus	Yellow-billed cuckoo	Low, dense thickets			
Coccyzus erythropthalmus	Black-billed cuckoo+	Low, dense thickets	√		
Colaptes auratus	Northern flicker	Open areas, trees with heartrot			
Columba livia	Rock pigeon				
Contopus cooperi	Olive-sided flycatcher*	Tall perches adjacent to low, wet thickets	√	SC	
Contopus virens	Eastern wood-pewee				
Corvus brachyrhynchos	American crow				
Corvus corax	Common raven				
Cyanocitta cristata	Blue jay				
Dolichonyx oryzivorus	Bobolink+	Wide expanses of grasslands	√		
Dryocopus pileatus	Pileated woodpecker	Mature trees >20" dbh with decay			
Dumetella carolinensis	Gray catbird	Shrubs, thickets in open country			
Empidonax alnorum	Alder flycatcher	Thickets, low shrubs, clearings			
Empidonax minimus	Least flycatcher	Open deciduous or mixed forest, edges			
Empidonax traillii	Willow flycatcher	Low deciduous trees and shrubs with clearings			

Scientific Name	Common Name	Special Habitat Requirements	Species of Greatest Conservation Need[a]	State Status[b]	Federal Status
Eremophila alpestris	Horned lark+	Bare, exposed soil	√	SC	
Falco peregrinus	Peregrine falcon*	Open country, nests on cliffs	√	T	
Falco sparverius	American kestrel+	Tall trees with cavities, open country	√	SC	
Gallinago delicata	Wilson's snipe	Moist, organic soils, large open spaces			
Gallinula galeata	Common gallinule*	Emergent vegetation in water 1-3 feet deep	√	SC	
Gavia immer	Common loon+	Surface water bodies with stable water levels and limited human disturbance	√	T	
Geothlypis philadelphia	Mourning warbler	Hardwood regeneration			
Geothlypis trichas	Common yellowthroat				
Haemorhous mexicanus	House finch	Open ground with low seed-producing plants			
Haemorhous purpureus	Purple finch+	Coniferous forest	√		
Haliaeetus leucocephalus	Bald eagle*	Large bodies of water with fish	√	T	
Hirundo rustica	Barn swallow	Abandoned or little used buildings			
Hylocichla mustelina	Wood thrush+	Cool, moist, mature deciduous or mixed forests	√		
Icteria virens	Yellow-breasted chat	Dense thickets with young trees, often near water			
Icterus galbula	Baltimore oriole	Tall scattered deciduous trees			
Ixobrychus exilis	Least bittern*	Deep marshes with emergent vegetation	√	SC	
Junco hyemalis	Dark-eyed junco				

Scientific Name	Common Name	Special Habitat Requirements	Species of Greatest Conservation Need[a]	State Status[b]	Federal Status
Lanius excubitor	Northern shrike	Scattered trees or shrubs in open country			
Larus argentatus	Herring gull				
Lophodytes cucullatus	Hooded merganser	Wooded areas with cavity trees, clear fresh water			
Megaceryle alcyon	Belted kingfisher	Perches over streams, ponds, banks for nests			
Megascops asio	Eastern screech owl	Cavity trees >12" diameter at breast height			
Melanerpes erythrocephalus	Red-headed woodpecker	Cavity trees in open country			
Meleagris gallopavo	Wild turkey	Open, mast-producing woodlands			
Melospiza georgiana	Swamp sparrow				
Melospiza melodia	Song sparrow				
Mimus polyglottos	Northern mockingbird	Low thickets, high perches, persistent fruits			
Mniotilta varia	Black-and-white warbler				
Molothrus ater	Brown-headed cowbird				
Myiarchus crinitus	Great crested flycatcher	Mature cavity trees, deciduous forests, edges			
Oreothlypis ruficapilla	Nashville warbler	Scattered trees interspersed with brush			
Pandion haliaetus	Osprey	Clear lakes and rivers with fish			
Parkesia motacilla	Louisiana waterthrush	Woodlands with flowing water			
Parkesia noveboracensis	Northern waterthrush	Cool, shaded, wet ground with shallow pools			

Scientific Name	Common Name	Special Habitat Requirements	Species of Greatest Conservation Need[a]	State Status[b]	Federal Status
Passer domesticus	House sparrow				
Passerculus sandwichensis	Savannah sparrow	Herbaceous cover of moderate height			
Passerina cyanea	Indigo bunting	Forest-field ecotones			
Petrochelidon pyrrhonota	Cliff swallow*	Open areas, mud, vertical wall with an overhang	√	SC	
Pheucticus ludovicianus	Rose-breasted grosbeak	Forest-field ecotones, thickets, sapling stands			
Picoides pubescens	Downy woodpecker	Trees, limbs with decay column >6" diameter at breast height			
Picoides villosus	Hairy woodpecker	Trees, limbs with decay column >10" diameter at breast height			
Pinicola enucleator	Pine grosbeak	Northern coniferous forest			
Pipilo erythrophthalmus	Eastern towhee+	Dense brushy understory, well-drained soils	√		
Piranga olivacea	Scarlet tanager+		√		
Plectrophenax nivalis	Snow bunting				
Podilymbus podiceps	Pied-billed grebe+	Marshes with water and emergent vegetation	√	T	
Poecile atricapillus	Black-capped chickadee	Cavity trees in small woodlands or clearings			
Polioptila caerulea	Blue-gray gnatcatcher				
Pooecetes gramineus	Vesper sparrow*	Dry open uplands with perches	√	SC	
Porzana carolina	Sora*		√	SC	
Progne subis	Purple martin*		√	SC	
Quiscalus quiscula	Common grackle				

Scientific Name	Common Name	Special Habitat Requirements	Species of Greatest Conservation Need[a]	State Status[b]	Federal Status
Rallus limicola	Virginia rail	Wetlands with sedge and cattails			
Regulus satrapa	Golden-crowned kinglet				
Riparia riparia	Bank swallow+	Stabilized sandy or clay banks	√	SC	
Sayornis phoebe	Eastern phoebe	Exposed perches in streamside clearings			
Scolopax minor	American woodcock+	Moist soils, small clearings and dense swales	√		
Seiurus aurocapillus	Ovenbird				
Setophaga caerulescens	Black-throated blue warbler	Hardwoods with well-developed understory			
Setophaga coronata	Yellow-rumped warbler	Coniferous trees, bayberry thickets			
Setophaga discolor	Prairie warbler+	Coniferous cover in old fields	√		
Setophaga fusca	Blackburnian warbler	Coniferous forests, mixed woodlands			
Setophaga magnolia	Magnolia warbler	Young stands of spruce or fir			
Setophaga pensylvanica	Chestnut-sided warbler	Brush at wood margins, hardwood seedling stands			
Setophaga petechia	Yellow warbler	Scattered small trees or dense brush			
Setophaga pinus	Pine warbler	Pine forests			
Setophaga ruticilla	American redstart				
Setophaga virens	Black-throated green warbler	Coniferous or mixed woodlands			
Sialia sialis	Eastern bluebird	Low cavities, open country			
Sitta canadensis	Red-breasted nuthatch	Cavity trees in mixed or coniferous woods			
Sitta carolinensis	White-breasted nuthatch	Cavity trees in hardwoods or mixed woods			

Scientific Name	Common Name	Special Habitat Requirements	Species of Greatest Conservation Need[a]	State Status[b]	Federal Status
Sphyrapicus varius	Yellow-bellied sapsucker	Trees with >10" diameter at breast height			
Spinus pinus	Pine siskin	Conifers			
Spinus tristis	American goldfinch	Open, weedy fields with scattered small trees			
Spizella passerina	Chipping sparrow				
Spizella pusilla	Field sparrow+	Old fields	√		
Spizelloides arborea	American tree sparrow				
Stelgidopteryx serripennis	Northern rough-winged swallow	Cut banks for nesting			
Strix varia	Barred owl	Cool, damp lowlands, cavity trees >20" diameter at breast height			
Sturnella magna	Eastern meadowlark+		√	SC	
Sturnus vulgaris	European starling	Cavity trees >10" diameter at breast height			
Tachycineta bicolor	Tree swallow	Cavity trees >10" diameter at breast height, open areas			
Toxostoma rufum	Brown thrasher+	Hardwood forest-field ecotone	√		
Troglodytes aedon	House wren	Cavity trees, shrubs			
Troglodytes hiemalis	Winter wren				
Turdus migratorius	American robin				
Tyrannus tyrannus	Eastern kingbird	Clearings, fields, edges. Fallen shoreline trees			
Vermivora chrysoptera	Golden-winged warbler*	Open areas with saplings in deciduous woodlands	√	SC	SOC

Scientific Name	Common Name	Special Habitat Requirements	Species of Greatest Conservation Need[a]	State Status[b]	Federal Status
Vermivora cyanoptera	Blue-winged warbler+	Old fields with scatted shrubs and small trees	√		
Vireo flavifrons	Yellow-throated vireo	Mature deciduous forest			
Vireo gilvus	Warbling vireo	Scattered deciduous trees			
Vireo olivaceus	Red-eyed vireo				
Vireo solitarius	Blue-headed vireo	Mixed or predominantly coniferous forests			
Zenaida macroura	Mourning dove	Open land with bare ground			
Zonotrichia albicollis	White-throated sparrow				

Source: DeGraaf and Yamasaki (2001) and NHFGD (2016).

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[b] E = Endangered; T = Threatened; SC = Special Concern

Table D-4. Bird Species with Ranges Likely to Overlap the Study Area[1]

Scientific Name	Common Name	Special Habitat Requirements	Species of Greatest Conservation Need[a]	State Status[b]	Federal Status
Alces alces	Moose+	Wetlands in summer	√		
Blarina brevicauda	Northern short-tailed shrew	Low vegetation, damp, loose leaf litter			
Canis latrans	Coyote				
Castor canadensis	North American beaver	Woodland streams, lack of disturbance			
Myodes gapperi	Southern red-backed vole	Springs, brooks, seeps, debris or slash cover			
Condylura cristata	Star-nosed mole	Wet muck, humus			
Didelphis virginiana	Virginia opossum	Hollow logs or tree cavities			
Eptesicus fuscus	Big brown bat+	Cold, dry areas of caves	√		
Erethizon dorsatum	North American porcupine	Rock ledges or tree dens			
Glaucomys sabrinus	Northern flying squirrel	Mature trees with cavities, arboreal lichens			
Glaucomys volans	Southern flying squirrel	Mature woodlands with cavity trees			
Lasionycteris noctivagans	Silver-haired bat+	Dead trees with loose bark; streams	√	SC	
Lasiurus borealis	(Eastern) Red bat+	Deciduous trees on forest edges for roosting	√	SC	
Lasiurus cinereus	Hoary bat+	Edges of coniferous forests	√	SC	
Lepus americanus	Snowshoe hare	Dense brushy or softwood cover			
Lontra canadensis	River otter	Bodies of water, such as streams, ponds, lakes, rivers			
Lynx rufus	Bobcat	Rock ledges, under windfalls, hollow logs			

Scientific Name	Common Name	Special Habitat Requirements	Species of Greatest Conservation Need[a]	State Status[b]	Federal Status
Marmota monax	Woodchuck	Open land			
Martes pennanti	Fisher				
Mephitis mephitis	Striped skunk				
Microtis pennsylvanicus	Meadow vole	Herbaceous vegetation, loose organic soils			
Microtis pinetorum	Woodland vole	Ground cover; moist well-drained soils			
Mus musculus	House mouse	Buildings in winter			
Mustela erminea	Short-tailed weasel (Ermine)	Dense brushy cover			
Mustela frenata	Long-tailed weasel				
Mustela vison	Mink	Hollow logs, natural crevices, riparian habitat			
Myotis leibii	Eastern small-footed myotis*	Cold, dry hibernacula in winter	√	E	
Myotis lucifugus	Little brown bat+	Dark, warm sites for maternity colonies	√		
Myotis septentrionalis	Northern long-eared bat*	Caves with high humidity and calm air	√	T	T
Napaeozapus insignis	Woodland jumping mouse	Moist, cool woodland, loose soils			
Odocoileus virginianus	White-tailed deer	Softwood yarding cover in winter			
Ondatra zibethicus	Muskrat	Wetlands with dense emergent vegetation			
Parascalops breweri	Hairy-tailed mole	Loose, moist, well-drained soil			
Peromyscus leucopus	White-footed mouse				
Peromyscus maniculatus	Deer mouse	Northern hardwoods or coniferous forests			

Scientific Name	Common Name	Special Habitat Requirements	Species of Greatest Conservation Need[a]	State Status[b]	Federal Status
Perimyotis subflavus	Tricolored bat+	Warm, draft-free, damp sites for hibernation	√	SC	
Procyon lotor	Raccoon	Hollow trees			
Rattus norvegicus	Norway rat	Buildings, dumps, loose soil for burrows			
Scalopus aquaticus	Eastern mole	Soft moist soil with earthworms			
Sciurus carolinensis	Gray squirrel	Tall trees for dens or leafnests			
Sorex cinereus	Masked shrew	Damp woodlands, ground cover			
Sorex fumeus	Smokey shrew	Loose damp leaf litter			
Sorex palustris	American water shrew	Herbaceous cover, cold water, wetlands	√		
Sylvilagus floridanus	Eastern cottontail	Brush piles, herbaceous and shrubby cover			
Sylvilagus transitionalis	New England cottontail+	Young woodlands with thick cover	√	T	
Synaptomys cooperi	Southern bog lemming	Moist soils	√		
Tamias striatus	Eastern chipmunk	Forest edge or shrub cover			
Tamiasciurus hudsonicus	Red squirrel	Woodlands with mature trees			
Urocyon cinereoargenteus	Gray fox	Hollow logs, tree cavities, rock crevices			
Ursus americanus	Black bear	Fallen trees, hollow logs, rock ledges, slash piles			
Vulpes vulpes	Red fox				
Zapus hudsonius	Meadow jumping mouse	Herbaceous groundcover, loose soils			

Source: DeGraaf and Yamasaki (2001) and NHFGD (2016).

* Indicates that species distribution (known, potential, or historic) does not include Derry or Londonderry as depicted on species distribution map in NH Wildlife Action Plan

+ Indicates that species distribution (known, potential, or historic) does not include Derry or Londonderry as depicted on species distribution map in NH Wildlife Action Plan

[a] Species of Greatest Conservation Need are identified in the NH Wildlife Action Plan. These include all Federal and State-listed threatened and endangered species; state species with Natural Heritage Rank of S1 or S2; species of concern as identified by the Northeast Wildlife Diversity Technical Committee; and recommendations from expert panels, groups and individuals.

[b] E = Endangered; T = Threatened; SC = Special Concern

Appendix M: 2016 Northern Long-eared Bat Acoustic Survey

Northern Long-eared Bat Acoustic Survey
I-93 Exit 4A Interchange Project,
Derry and Londonderry, NH

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August 22 2016

NORMANDEAU ASSOCIATES
Environmental Consultants

TABLE OF CONTENTS

Summary

Ultrasonic acoustic surveys were conducted to inventory the federally threatened northern long-eared bat (NLEB; *Myotis septentrionalis*) within the I-93 Exit 4A interchange project area, located in the towns of Derry and Londonderry, New Hampshire (NH). The project route and route alternatives primarily follow existing ROW and road networks, spanning roughly 13 kilometers in length. Twelve of these kilometers were determined to potentially provide habitat for NLEB based on on-site visual assessments. Surveys were conducted from August 8 through August 15, 2016 within 12 pre-determined 1 kilometer segments. All segments were required to be surveyed a minimum of two detector nights, achieved with one detector per kilometer for two nights. Six of the segments were surveyed from Aug 8 to Aug 10, and six were surveyed from August 10 to August 12. The detector from Segment 3 (surveyed Aug 8-Aug 10) malfunctioned, and an additional two survey nights were needed. Bat calls were recorded at eleven of the twelve Segments, none of which returned positive results for NLEB. Other species likely to be present include big brown bat, eastern red bat, hoary bat, silver-haired bat, little brown bat, and tricolored bat.

1.0 Project Overview

The Project consists of constructing the on and off ramps to I-93 and a connector road, and improvements to the existing roadway that the connector will join into. Five alternatives are under consideration, four of which would require varying amounts of tree clearing. Surveys assessed potentially suitable habitat for all four tree-clearing alternatives.

The project is within the range of the federally threatened and state threatened NLEB. This tree-roosting bat uses forested habitats during its active season, from April 15 – October 31. The project has the potential to affect this species via tree clearing, which could reduce roosting habitat or potentially cause direct mortality if an occupied roost tree is felled when bats are present. Therefore, a survey compliant with the USFWS' 2016 *Range-wide Indiana Bat Summer Survey Guidelines* (Guidelines), which are also applicable to summer survey for NLEB, was conducted to determine if NLEB are present. Results of the survey are summarized below, and these results include all the elements requested in Appendix C of the 2016 Guidelines.

2.0 Methods

The survey was conducted in conformance with the methods and approach outlined in the Guidelines. The field survey and the data analysis were conducted by personnel trained and qualified to conduct their respective tasks. Staff resumes are attached at the end of this document.

Habitat Assessment

The general suitability of the habitat on this site was assessed by examining recent aerial photography of the site (Google Earth™) prior to deploying the detectors. In the field, the characteristics of the habitat were examined in all locations where acoustic detectors were placed, to confirm that suitable habitat was present. The desktop assessment was conducted by Sarah Barnum, Ph.D., CWB®, and the on-site observations of the surrounding vegetation within the project area were conducted by acoustic survey technician Jamie O'Brien. Their resumes are attached to the end of this document, and results of the assessment are presented in Section 3.1.

Detector Deployment

Normandeau conducted the survey using full-spectrum ultrasonic acoustic detectors. As defined by the Guidelines, this project was categorized as linear; therefore it was surveyed as 12 1-kilometer segments, requiring a minimum of two survey nights each. Detectors placed for Segments 1, 2, 4 through 7, and 9 were placed along existing power line right-of-ways. Detectors surveying Segments 3, 10, and 12 were placed along roadsides, and detectors for segments 8 and 11 were placed along a small bike/foot path and the edge of town-owned recreation fields, respectively. All acoustic detectors were left in place to collect data on sequential nights with suitable weather conditions described in the Guidelines, yielding two detector nights of data for each segment.

The sampling locations were selected based on a combination of factors including access, best site conditions to deploy the equipment so that it would not be disturbed, an open cone of detection for the microphones to sample, and apparent bat habitat quality (e.g., mature trees, snags, hollows and crevices, and wetland habitat). The detector set-up adhered to specifications detailed in the Guidelines.

To ensure that the detectors were functioning correctly during every survey period, settings were checked upon retrieval of the detectors in a similar fashion as to when they are deployed: 1) the microphones were checked for proper recording of sounds and archival of data onto the internal drive/USB; and 2) the program recording times, detector limits, and acoustic range were verified.

Call Analysis

The entire call analysis process was managed via Normandeau's ReBAT® data management system, which tracks each acoustic recording file after upload throughout the call analysis process and stores all results in a MySQL database. Each acoustic file was processed as required by the 2016 Guidelines using Kaleidoscope Pro v 3.1.4, zero crossing, which is one of the USFWS-approved automated bat call classification software packages. The software analyzes bat calls and determines the probability (or "likelihood of presence p (probability) value") that they were made by a certain bat species. Any probability less than 0.05 is statistically interpreted to mean that the call belongs to that species. Probabilities <1 but >0.05 indicate that calls of certain species were identified but the probabilities were not low enough to confirm presence, or that no calls of that specie were detected. If bat call files were identified by the software package as belonging or potentially belonging to the NLEB, they were manually examined for final determination by Stephen Lindsay, a trained bat acoustic expert and call analyst. His resume is attached at the end of this document.

3.0 Results

3.1 Overall Habitat Assessment

The general location of the survey site is depicted in Figure A-1, Appendix A. Overall, the Project area consists of developed roads bordered by commercial and residential lots, as well as existing right-of-ways and undeveloped forest in the southwestern corner of the project area (Segments 7 and 8). A mix of forest cover types are present, but predominantly were composed of a hardwood/softwood tree mixture. Varying wetland cover types were also present, including emergent marshes and vernal pools close to some of the detector locations. Snags were present at many of the chosen survey locations, and structures such as an old bridge, residential houses, and commercial buildings provided potential roost alternatives. The on-site trees consisted primarily of northern red oak (*Quercus rubra*), Eastern white pine (*Pinus strobus*), red maple (*Acer rubrum*), sugar maple (*Acer saccharum*), and white oak (*Quercus alba*).

3.2 Deployment Details

The survey was conducted from August 8 through August 15, 2016 and the detectors were programed to run from 19:32 UTC (coordinated universal time) until 6:01 UTC the following morning. One acoustic detector was placed in each of the 12 1-kilometer segments for two nights to capture a total of two detector nights per segment (Figure A-1, Appendix A). Detectors are placed at least 200 m apart, as per USFWS guidelines. Photos of the detector set-ups are presented in Appendix C. Details of the survey for each of the recording nights are summarized in Table 1 and specifications of the detectors and microphones used are summarized in Table 2.

Hourly weather conditions from Manchester Airport (KMHT), the NOAA weather reporting station nearest to Derry and Londonderry, are presented in Appendix B for each of the survey nights. Although weather was acceptable for each of the first four survey nights (Aug 8-Aug 12), malfunctions with the IFR unit at Segment 3 (i.e. recording device) added an additional three survey nights, as one of the additional nights failed due to weather.

Table 1. Deployment Details

Detector	Date	Lat	Long	Begin	End	Sunset	Hi Temp*	Low Temp*	Max Wind*	Weather
Segment 1	10-Aug-16	42.897556	-71.359398	19:32	6:01	19:55	80	75	S 8	A Few Clouds
	11-Aug-16	42.897556	-71.359398	19:32	6:01	19:54	93	80	W 7	Mostly Cloudy
Segment 2	8-Aug-16	42.901321	-71.350533	19:32	6:01	19:58	84	68	W 10	Fair
	9-Aug-16	42.901321	-71.350533	19:32	6:01	19:57	86	72	SW 8	Mostly Cloudy
Segment 3	8-Aug-16	42.898766	-71.336708	19:32	6:01	19:58	84	68	W 10	Fair
	9-Aug-16	42.898766	-71.336708	19:32	6:01	19:57	86	72	SW 8	Mostly Cloudy
	12-Aug-16	42.898766	-71.336708	19:32	6:01	19:53	90	80	W 12	Mostly Cloudy
	13-Aug-16	42.898766	-71.336708	19:32	6:01	19:51	71	67	E 9	Light Rain
	14-Aug-16	42.898766	-71.336708	19:32	6:01	19:50	88	79	W 7	Mostly Cloudy
Segment 4	10-Aug-16	42.903927	-71.327835	19:32	6:01	19:55	80	75	S 8	A Few Clouds
	11-Aug-16	42.903927	-71.327835	19:32	6:01	19:54	93	80	W 7	Mostly Cloudy
Segment 5	10-Aug-16	42.909554	-71.318184	19:32	6:01	19:55	80	75	S 8	A Few Clouds
	11-Aug-16	42.909554	-71.318184	19:32	6:01	19:54	93	80	W 7	Mostly Cloudy
Segment 6	10-Aug-16	42.912567	-71.311035	19:32	6:01	19:55	80	75	S 8	A Few Clouds
	11-Aug-16	42.912567	-71.311035	19:32	6:01	19:54	93	80	W 7	Mostly Cloudy
Segment 7	8-Aug-16	42.887005	-71.348640	19:32	6:01	19:58	84	68	W 10	Fair
	9-Aug-16	42.887005	-71.348640	19:32	6:01	19:57	86	72	SW 8	Mostly Cloudy
Segment 8	8-Aug-16	42.892834	-71.337456	19:32	6:01	19:58	84	68	W 10	Fair
	9-Aug-16	42.892834	-71.337456	19:32	6:01	19:57	86	72	SW 8	Mostly Cloudy
Segment 9	8-Aug-16	42.888718	-71.338760	19:32	6:01	19:58	84	68	W 10	Fair
	9-Aug-16	42.888718	-71.338760	19:32	6:01	19:57	86	72	SW 8	Mostly Cloudy
Segment 10	8-Aug-16	42.898724	-71.321800	19:32	6:01	19:58	84	68	W 10	Fair
	9-Aug-16	42.898724	-71.321800	19:32	6:01	19:57	86	72	SW 8	Mostly Cloudy
Segment 11	10-Aug-16	42.904358	-71.317345	19:32	6:01	19:55	80	75	S 8	A Few Clouds
	11-Aug-16	42.904358	-71.317345	19:32	6:01	19:54	93	80	W 7	Mostly Cloudy
Segment 12	10-Aug-16	42.904816	-71.310257	19:32	6:01	19:55	80	75	S 8	A Few Clouds
	11-Aug-16	42.904816	-71.310257	19:32	6:01	19:54	93	80	W 7	Mostly Cloudy

*High temp, low temp, and max wind within the first five hours after sunset.
Gray rows indicate detector nights from which data was unacceptable due to weather or detector malfunctions.

Table 2. Acoustic Monitoring Equipment Settings

Detector Setting	Specification	Microphone Setting	Specification
Threshold	21	Frequency range	1 to 125 KHz
TE	1	Dynamic range	> 90 dB (Full BW); > 96 dB (Audio BW)
Dur	1.7	Range limits	(SPL +/- 3 dB); Max: 90 dB
Idle	1.7	Min	0 dB (Full) / -6 dB (audio) Interface: USB 2.0
Delay	0	Output format	16-bit offset binary, 250Ksps
Low F	15		
High F	125		
PopFilt	On		
PwrSave	On		

Individual descriptions of the habitat in the locations where each detector was placed follow below, and pictures of the habitat are presented in Appendix C.

- **Segment 1** – The detector at Segment 1 was deployed in an existing power line right-of-way facing northeast. The right-of-way had a well-established maintenance road throughout, and woody vegetation was generally less than five feet tall. Interstate 93 runs almost perpendicular to the right-of-way, approximately 330 feet west of the unit. Adjacent tree cover was a mix of hardwood and softwood trees. Species include eastern white pine (dominant), red maple, paper birch, northern red oak, and white oak. Average DBH was about 4-12" with larger trees scattered throughout.

- **Segment 2** – The unit at Segment 2 was deployed in a forest patch approximately 15 feet from an existing power line right-of-way and roughly 150 feet from Rockingham Road. Along the forest edge, adjacent to the right-of-way, there was considerable slash, which prevented the detector being placed along this forest edge. The understory in the forest patch interior was mostly open with a 60-80 percent closed canopy. The detector, facing northwest, pointed toward a dry vernal pool. Tree species in the surrounding area included northern red oak (dominant), eastern white pine, white oak, red maple, and paper birch. Average DBH was about 3-10".

- **Segment 3 –** The unit was deployed in a small woodland patch between two commercial lots, off of Manchester Road. This forest patch was the best available survey location in this highly commercialized segment. The detector faced west away from the road and towards a more forested area approximately 200 feet from the unit. Trees were almost exclusively sugar maple, with a few eastern white pine, white ash, and northern red oak in the surrounding area. Average DBH was roughly 8-18", with an open understory.

- **Segment 4 –** The unit at Segment 4 was placed along the edge of an existing power line right-of-way facing northeast over an emergent marsh, which was dry at the time of survey. Surrounding forests were a mix of hardwood and softwood trees, with an average DBH of 6-12”. Tree species included eastern white pine (dominant), red maple, yellow birch, and northern red oak. Snags were present at this location.

- **Segment 5 –** The unit at Segment 5 was placed facing northeast along an existing power line right-of-way. The adjacent forest cover was a mix of hardwood and softwood trees. A stand of snags was located approximately 100 feet southwest of the unit. Dominant tree species within the area included northern red oak, followed by eastern white pine, sugar maple, and white birch. Average DBH was approximately 8-16”.

- **Segment 6 –** The unit was placed along an existing power line right-of-way facing east towards an emergent marsh. Roughly one half-dozen snags were located within 50 feet of the detector. Surrounding forest area was a mix of hardwood and softwood trees, with an average DBH of 6-12”. Tree species included eastern white pine (dominant), ash, yellow birch, eastern hemlock, red maple, and northern red oak.

- **Segment 7 –** The detector at Segment 7 was placed along an existing power line right-of-way facing east in a large emergent marsh and connecting (dry) vernal pool. This location was approximately 350 feet from Interstate 93. Adjacent forest cover included a mix of hardwood and softwood trees, including eastern hemlock (dominant), yellow birch, eastern white pine, red maple, northern red oak, and paper birch. Snags were scattered throughout and average DBH was about 5-12”.

- **Segment 8 –** The unit was deployed along a small foot/bike path facing northwest. In this direction was a wooden bridge approximately 500 feet from the detector. Habitat surrounding the unit was a mix of hardwood and softwood trees, with hardwoods being more abundant. Dominant tree species were northern red oak, followed by quaking aspen, American elm, eastern hemlock, sugar maple, and eastern white pine. Average DBH was about 8-14”, with a 60-80 percent closed canopy.

- **Segment 9 –** The detector was placed along the west side of an existing power line right-of-way, facing southeast. Forest cover toward the south was predominantly hardwood trees with a closed canopy and moderately dense understory. Some snags were present, and a vernal pool was across the right-of-way, about 300 feet east of the detector. Tree species included northern red oak (dominant), sugar maple, eastern white pine, hickory, and sweet birch. Average DBH was roughly 8-14”.

- **Segment 10 –** The unit was deployed off of Tsienneto Road in a small clearing surrounded by shrubs and saplings, facing south toward a stand of eastern white pine trees. The area adjacent to these softwoods was shrubby and overgrown with lots of clutter, making deployment closer to these trees unsuitable. Snags were also present near the pines. Dominant species included quaking aspen, mostly 3” DBH or less, eastern white pine (10-24” DBH), and red maple (3”DBH or less).

- **Segment 11 –** The habitat along Segment 11 was primarily residential, which limited available locations for deployment. The unit was placed on town property near recreational fields along Tsienneto Road, facing west towards mature forest. The surrounding trees were a mix of hardwoods and softwoods, including White ash (dominant), quaking aspen, northern red oak, eastern white pine, and red maple. Average DBH was 3-10".

- **Segment 12 –** The detector was deployed along Tsienneto Road facing north over an emergent marsh/dry storm water retention pond. The surrounding forest was a mix of hardwood and softwood trees, with snags present throughout. The dominant tree species were red maple, followed by eastern white pine, American elm, northern red oak, white oak, ash, and black birch. The average DBH was 8-12".

3.3 Survey Results

The number of calls recorded by species and location are presented in Table 3. Table 4 contains corresponding likelihood values. Blue cells are those with likelihood of presence values <0.05 and correspond to species considered by Kaleidoscope Pro to be present. Bat calls were recorded at all Segments except for Segment 2. Calls from six species, big brown bat (*Eptesicus fuscus*), eastern red bat (*Lasiurus borealis*), hoary bat (*Lasiurus cinereus*), silver-haired bat (*Lasionycteris noctivagans*), little brown bat (*Myotis lucifugus*), and tricolored bat (*Perimyotis subflavus*) were recorded with p-values of less than 0.05. **Although Kaleidoscope Pro software identified four NLEB calls (one each at Segments 9 and 12, and both nights at Segment 7) the P-values for these calls are not below the required threshold to confirm this identification.**

Table 3. Number of Calls by Date, Segement, and Species

	Date	EPFU	LABO	LACI	LANO	MYLE	MYLU	MYSE	PESU
Segment 1	10-Aug-16	148	11	2	32	0	2	0	2
	11-Aug-16	192	23	1	51	0	6	0	0
Segment 2	8-Aug-16	0	0	0	0	0	0	0	0
	9-Aug-16	0	0	0	0	0	0	0	0
Segment 3	12-Aug-16	3	0	0	0	0	1	0	0
	14-Aug-16	0	0	0	0	0	0	0	0
Segment 4	10-Aug-16	451	25	11	60	0	1	0	2
	11-Aug-16	939	26	6	73	0	3	0	0
Segment 5	10-Aug-16	226	10	5	41	0	1	0	0
	11-Aug-16	223	8	1	31	0	4	0	0
Segment 6	10-Aug-16	225	35	5	115	0	2	0	0
	11-Aug-16	687	54	5	204	1	4	0	0
Segment 7	8-Aug-16	28	13	3	13	0	2	1	0
	9-Aug-16	119	6	8	57	0	4	1	0

	Date	EPFU	LABO	LACI	LANO	MYLE	MYLU	MYSE	PESU
Segment 8	8-Aug-16	4	0	0	0	0	0	0	0
	9-Aug-16	1	0	0	0	0	0	0	0
Segment 9	8-Aug-16	1734	52	56	881	1	7	0	1
	9-Aug-16	1410	22	46	750	0	3	1	0
Segment 10	8-Aug-16	10	6	2	7	0	0	0	0
	9-Aug-16	25	5	1	9	0	1	0	0
Segment 11	10-Aug-16	203	28	58	109	0	3	0	1
	11-Aug-16	227	19	25	122	0	2	0	1
Segment 12	10-Aug-16	172	91	2	57	0	0	1	4
	11-Aug-16	256	16	8	62	0	0	0	3

Table 4. Likelihood Values by Date, Segment and Species

	Date	EPFU	LABO	LACI	LANO	MYLE	MYLU	MYSE	PESU
Segment 1	10-Aug-16	0	0	0.99916	0.951099	1	0.723559	1	0.134804
	11-Aug-16	0	0	1	0.244045	1	0.083411	1	1
Segment 2	8-Aug-16	1	1	1	1	1	1	1	1
	9-Aug-16	1	1	1	1	1	1	1	1
Segment 3	12-Aug-16	0.004672	1	1	1	1	0.081101	1	1
	14-Aug-16	1	1	1	1	1	1	1	1
Segment 4	10-Aug-16	0	0	0.181832	1	1	1	1	0.420288
	11-Aug-16	0	0	1	1	1	0.939572	1	1
Segment 5	10-Aug-16	0	0	0.559256	1	1	0.993353	1	1
	11-Aug-16	0	1.56E-05	1	1	1	0.044483	1	1
Segment 6	10-Aug-16	0	0	0.741076	0	1	1	1	1
	11-Aug-16	0	0	1	8.3E-06	1	1	1	1
Segment 7	8-Aug-16	0	0	0.0412	0.112729	1	0.731274	0.146266	1
	9-Aug-16	0	0.000709	0.003519	1.53E-05	1	0.018856	0.274476	1
Segment 8	8-Aug-16	1	1	1	1	1	1	1	1
	9-Aug-16	1	1	1	1	1	1	1	1
Segment 9	8-Aug-16	0	0	3.4E-06	0	1	0.999271	1	1
	9-Aug-16	0	0	3.32E-05	0	1	0.990892	0.11788	1
Segment 10	8-Aug-16	0.000154	6E-07	0.049901	0.116874	1	1	1	1
	9-Aug-16	0	3.53E-05	0.683937	0.406323	1	0.759838	1	1
Segment 11	10-Aug-16	0	0	0	1E-07	1	0.969507	1	1
	11-Aug-16	0	0	0	0	1	0.992172	1	1
Segment 12	10-Aug-16	0	0	1	0.004223	1	1	1	0.818781
	11-Aug-16	0	0	0.109827	0.554516	1	1	1	0.040982

EPFU= *Eptesicus fuscus*, LABO = *Lasiurus borealis*, LACI = *Lasiurus cinereus*, LANO = *Lasionycteris noctivagans*, MYLE= *Myotis leibii*, MYLU= *Myotis lucifugus*, MYSE = *Myotis septentrionalis*, PESU= *Perimyotis subflavus*.

Appendix A Figures

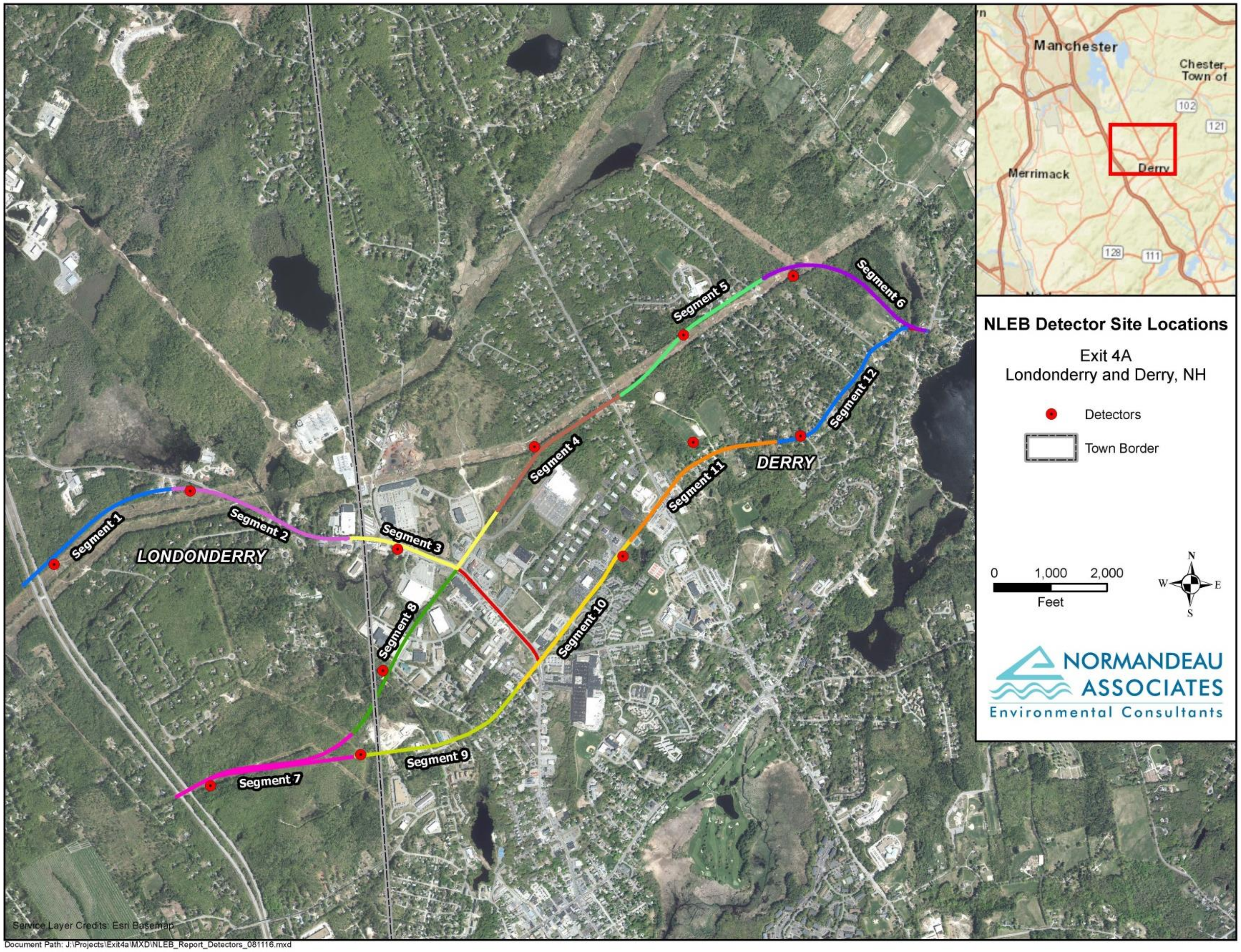


Figure A-1. Locations of detector deployment sites within the project area.

Table A-1. Geographical coordinates of bat detector survey locations

Segments	Coordinates	
	Latitude	*Longitude*
Segment 1	42.897556	-71.359398
Segment 2	42.901321	-71.350533
Segment 3	42.898766	-71.336708
Segment 4	42.903927	-71.327835
Segment 5	42.909554	-71.318184
Segment 6	42.912567	-71.311035
Segment 7	42.887005	-71.348640
Segment 8	42.892834	-71.337456
Segment 9	42.888718	-71.338760
Segment 10	42.898724	-71.321800
Segment 11	42.904358	-71.317345
Segment 12	42.904816	-71.310257

Appendix B Weather

Table B-1. Hourly weather conditions during the survey period, as reported by the NOAA weather station in nearby Manchester, NH: Manchester Airport (KMHT).

Date	Time (edt)	Wind (mph)	Vis. (mi.)	Weather	Sky Cond.	Temperature (ºF)				Relative Humidity	Wind Chill (°F)	Heat Index (°F)	Pressure		Precipitation (in.)		
						Air	Dwpt	6 hour Max.	6 hour Min.				altimeter (in)	sea level (mb)	1 hr	3 hr	6 hr
15	6:53	NW 5	10	Mostly Cloudy	SCT180 BKN250	73	64			74%	NA	NA	30.07	1019.2			
15	5:53	NW 6	10	Mostly Cloudy	SCT180 BKN250	73	64			74%	NA	NA	30.06	1018.7			
15	4:53	NW 9	10	Partly Cloudy	SCT180	74	64			71%	NA	NA	30.03	1017.6			
15	3:53	NW 7	10	Partly Cloudy	SCT180	76	65			69%	NA	78	29.99	1016.3			
15	2:53	W 9	10	A Few Clouds	FEW250	76	66			72%	NA	78	29.98	1015.9			
15	1:53	W 3	10	A Few Clouds	FEW250	77	67	86	77	71%	NA	79	29.98	1016			
15	0:53	W 3	10	Partly Cloudy	FEW080 SCT250	79	67			67%	NA	81	29.97	1015.6			
14	23:53	Calm	10	Mostly Cloudy	FEW080 BKN250	80	67			64%	NA	82	29.96	1015.3			
14	22:53	Vrbl 3	10	Mostly Cloudy	BKN085 BKN250	82	67			60%	NA	84	29.95	1014.9			
14	21:53	W 6	10	Overcast	BKN085 OVC250	83	67			59%	NA	86	29.96	1015.2			
14	20:53	W 7	10	Mostly Cloudy	SCT080 BKN100 BKN250	84	66			55%	NA	86	29.93	1014.4			
14	19:53	W 5	10	Mostly Cloudy	BKN085 BKN220	86	67	94	86	53%	NA	89	29.9	1013.5			
14	18:53	W 5	10	Mostly Cloudy	FEW060 SCT085 SCT200 BKN250	88	67			50%	NA	91	29.89	1013			
14-August																	
14	6:53	S 6	10	Mostly Cloudy	FEW003 SCT120	71	68			90%	NA	NA	29.85	1011.8			

Date	Time (edt)	Wind (mph)	Vis. (mi.)	Weather	Sky Cond.	Temperature (ºF)				Relative Humidity	Wind Chill (°F)	Heat Index (°F)	Pressure		Precipitation (in.)		
						Air	Dwpt	6 hour Max.	6 hour Min.				altimeter (in)	sea level (mb)	1 hr	3 hr	6 hr
					BKN250												
14	5:53	S 8	10	Mostly Cloudy	FEW003 SCT080 BKN200	70	67			90%	NA	NA	29.85	1011.7			
14	4:53	S 3	8	Overcast	OVC003	69	67			93%	NA	NA	29.83	1011			
14	3:53	S 5	9	Overcast	OVC004	69	67			93%	NA	NA	29.84	1011.5			
14	2:53	Calm	10	Overcast	OVC004	69	66			90%	NA	NA	29.82	1010.6			
14	1:53	SW 5	10	Mostly Cloudy	BKN003	69	66	70	66	90%	NA	NA	29.86	1011.9	0.01		
14	0:53	SW 5	7	Light Rain	SCT007 SCT080 BKN110	68	66			93%	NA	NA	29.89	1012.9	0.07		
13	23:53	Vrbl 5	6	Thunderstorm Light Rain Fog/Mist	SCT004 BKN090CB OVC120	67	65			93%	NA	NA	29.9	1013.5			
13	22:53	S 8	4	Thunderstorm Light Rain Fog/Mist	SCT006 BKN045CB OVC110	67	64			91%	NA	NA	29.96	1015.5	0.05	0.33	
13	21:53	SE 3	3	Thunderstorm Heavy Rain Fog/Mist	FEW007 BKN020CB OVC035	67	64			91%	NA	NA	29.94	1014.7	0.28		
13	20:53	E 9	10	Thunderstorm Light Rain	BKN020 BKN035CB OVC050	69	62			78%	NA	NA	29.93	1014.5			
13	19:53	E 6	10	Overcast	OVC023	70	60	82	70	71%	NA	NA	29.92	1014.1			
13	18:53	E 9	10	Overcast	OVC025	71	61			71%	NA	NA	29.91	1013.8			
13-August																	
13	6:53	E 9	10	Mostly Cloudy	BKN015 BKN070	68	61			78%	NA	NA	29.93	1014.3			
13	5:53	E 8	10	Mostly Cloudy	BKN015 BKN065	69	62			78%	NA	NA	29.9	1013.4			

Date	Time (edt)	Wind (mph)	Vis. (mi.)	Weather	Sky Cond.	Temperature (ºF)				Relative Humidity	Wind Chill (°F)	Heat Index (°F)	Pressure		Precipitation (in.)		
						Air	Dwpt	6 hour Max.	6 hour Min.				altimeter (in)	sea level (mb)	1 hr	3 hr	6 hr
13	4:53	E 7	10	Mostly Cloudy	BKN012	70	63			79%	NA	NA	29.88	1012.8			
13	3:53	E 6	10	Partly Cloudy	SCT006	72	66			82%	NA	NA	29.87	1012.2			
13	2:53	E 8	10	Mostly Cloudy	SCT120 BKN200	74	69			85%	NA	NA	29.85	1011.6			
13	1:53	Calm	10	Mostly Cloudy	SCT120 BKN200	77	70	88	77	79%	NA	79	29.84	1011.1			
13	0:53	Vrbl 3	10	Overcast	BKN100 OVC200	80	71			74%	NA	83	29.84	1011.3			
12	23:53	Calm	10	Overcast	BKN070 OVC200	81	71			72%	NA	85	29.83	1010.9			
12	22:53	S 6	10	Overcast	BKN080 OVC200	82	71			69%	NA	86	29.82	1010.3			
12	21:53	S 6	10	Mostly Cloudy	BKN110	83	70			65%	NA	87	29.82	1010.6			
12	20:53	SW 6	10	Mostly Cloudy	BKN250	85	70			61%	NA	90	29.8	1009.7			
12	19:53	SW 9	10	Overcast	FEW045 BKN110 OVC250	88	72	96	88	59%	NA	95	29.78	1009.2			
12	18:53	W 12	10	Mostly Cloudy	FEW045 BKN140 BKN250	90	72			56%	NA	98	29.77	1008.7			
12-August																	
12	6:53	S 7	10	Mostly Cloudy	SCT090 BKN180 BKN250	77	71			82%	NA	79	29.84	1011.3			
12	5:53	S 3	10	Mostly Cloudy	SCT090 BKN180 BKN250	78	71			79%	NA	80	29.84	1011.2			
12	4:53	S 5	10	Mostly Cloudy	FEW060 BKN100 BKN200	78	71			79%	NA	80	29.85	1011.4			

Date	Time (edt)	Wind (mph)	Vis. (mi.)	Weather	Sky Cond.	Temperature (ºF)				Relative Humidity	Wind Chill (°F)	Heat Index (°F)	Pressure		Precipitation (in.)		
						Air	Dwpt	6 hour Max.	6 hour Min.				altimeter (in)	sea level (mb)	1 hr	3 hr	6 hr
12	3:53	Calm	10	Mostly Cloudy	SCT180 BKN200	78	71			79%	NA	80	29.85	1011.5			
12	2:53	S 6	10	Partly Cloudy	SCT250	79	71			77%	NA	82	29.86	1011.9			
12	1:53	S 5	10	Partly Cloudy	FEW080 SCT250	79	71	90	79	77%	NA	82	29.87	1012.1			
12	0:53	Vrbl 3	10	Mostly Cloudy	BKN080 BKN250	80	71			74%	NA	83	29.9	1013.1			
11	23:53	S 6	10	Partly Cloudy	SCT250	81	71			72%	NA	85	29.91	1013.5			
11	22:53	S 6	10	A Few Clouds	FEW250	83	71			67%	NA	88	29.92	1014			
11	21:53	S 6	10	A Few Clouds	FEW250	84	70			63%	NA	88	29.92	1014.1			
11	20:53	SW 5	10	Partly Cloudy	SCT250	87	69			55%	NA	91	29.92	1014.1			
11	19:53	SW 6	10	Mostly Cloudy	BKN250	90	68	97	90	48%	NA	94	29.91	1013.7			
11	18:53	W 7	10	Mostly Cloudy	FEW065 BKN250	93	67			42%	NA	96	29.93	1014.2			
11-August																	
11	6:53	Calm	0.5	Fog	VV002	71	69			94%	NA	NA	30.05	1018.6			
11	5:53	Calm	0.06	Fog	VV002	71	69			94%	NA	NA	30.05	1018.5			
11	4:53	S 3	0.06	Fog	VV002	72	70			94%	NA	NA	30.04	1018.1			
11	3:53	N 5	0	Fog	VV002	72	71			97%	NA	NA	30.04	1018.1			
11	2:53	Calm	0.5	Fog	BKN001	73	71			94%	NA	NA	30.03	1018			
11	1:53	Calm	3	Fog/Mist	FEW002	75	72	79	75	90%	NA	NA	30.04	1018.1			
11	0:53	S 3	3	Fog/Mist	FEW002 SCT015	75	72			90%	NA	NA	30.05	1018.4			
10	23:53	S 3	10	Fair	CLR	76	73			91%	NA	76	30.05	1018.7			
10	22:53	S 5	10	Fair	CLR	76	73			91%	NA	76	30.06	1018.9			
10	21:53	S 5	10	A Few Clouds	FEW020	77	73			88%	NA	78	30.07	1019.2			
10	20:53	S 5	10	A Few Clouds	FEW070 FEW250	78	73			85%	NA	80	30.06	1019			

Date	Time (edt)	Wind (mph)	Vis. (mi.)	Weather	Sky Cond.	Temperature (ºF)				Relative Humidity	Wind Chill (°F)	Heat Index (°F)	Pressure		Precipitation (in.)		
						Air	Dwpt	6 hour Max.	6 hour Min.				altimeter (in)	sea level (mb)	1 hr	3 hr	6 hr
10	19:53	S 5	10	Mostly Cloudy	FEW020 FEW055 BKN070 BKN250	79	73	81	76	82%	NA	82	30.05	1018.6			
10	18:53	S 8	10	Mostly Cloudy	FEW015 FEW035 BKN070 BKN250	80	73			79%	NA	84	30.05	1018.6			
10-August																	
10	6:53	S 7	10	Overcast	BKN070 OVC090	72	57			59%	NA	NA	30.16	1022.2			
10	5:53	S 7	10	Mostly Cloudy	BKN050 BKN080	72	55			55%	NA	NA	30.16	1022.2			
10	4:53	S 6	10	Mostly Cloudy	BKN080	72	54			53%	NA	NA	30.17	1022.3			
10	3:53	S 3	10	Mostly Cloudy	BKN065 BKN250	71	54			55%	NA	NA	30.17	1022.6			
10	2:53	S 3	10	A Few Clouds	FEW270	71	56			59%	NA	NA	30.18	1022.7			
10	1:53	S 3	10	Partly Cloudy	SCT270	71	56	84	70	59%	NA	NA	30.18	1023			
10	0:53	SW 3	10	Partly Cloudy	SCT270	72	56			57%	NA	NA	30.19	1023			
9	23:53	S 6	10	Mostly Cloudy	BKN270	72	55			55%	NA	NA	30.18	1022.8			
9	22:53	S 6	10	Partly Cloudy	SCT270	75	55			50%	NA	NA	30.17	1022.6			
9	21:53	SE 6	10	Mostly Cloudy	BKN250	75	57			54%	NA	NA	30.16	1022.3			
9	20:53	Calm	10	Partly Cloudy	SCT250	77	57			50%	NA	79	30.15	1022			
9	19:53	Calm	10	Mostly Cloudy	BKN250	84	47	91	84	27%	NA	82	30.13	1021.3			
9	18:53	SW 8	10	Mostly Cloudy	BKN250	86	49			28%	NA	84	30.13	1021.3			
9-August																	
9	6:53	N 3	10	Fair	CLR	64	54			70%	NA	NA	30.19	1023.2			
9	5:53	Calm	10	Fair	CLR	61	54			78%	NA	NA	30.16	1022.4			

Date	Time (edt)	Wind (mph)	Vis. (mi.)	Weather	Sky Cond.	Temperature (ºF)				Relative Humidity	Wind Chill (°F)	Heat Index (°F)	Pressure		Precipitation (in.)		
						Air	Dwpt	6 hour Max.	6 hour Min.				altimeter (in)	sea level (mb)	1 hr	3 hr	6 hr
9	4:53	Calm	10	Fair	CLR	62	54			75%	NA	NA	30.15	1021.8			
9	3:53	Calm	10	Fair	CLR	63	52			68%	NA	NA	30.13	1021.2			
9	2:53	Calm	10	Fair	CLR	64	52			65%	NA	NA	30.12	1020.7			
9	1:53	SE 3	10	Fair	CLR	66	52	80	65	61%	NA	NA	30.09	1019.9			
9	0:53	SE 3	10	Fair	CLR	68	52			57%	NA	NA	30.08	1019.5			
8	23:53	S 3	10	Fair	CLR	71	51			49%	NA	NA	30.07	1019.2			
8	22:53	Calm	10	Fair	CLR	73	51			46%	NA	NA	30.06	1018.8			
8	21:53	Calm	10	Fair	CLR	75	50			42%	NA	NA	30.05	1018.5			
8	20:53	Calm	10	Fair	CLR	78	49			36%	NA	78	30.03	1017.7			
8	19:53	W 5	10	Fair	CLR	80	48	86	80	33%	NA	79	30.01	1017			
8	18:53	W 10	10	A Few Clouds	FEW090 FEW250	84	46			27%	NA	82	29.99	1016.6			
8-August																	

Appendix C Photos of Detector Set-up & Habitat

Figure C-1. Segment 1 – overview of set-up.

Figure C-2. Segment 1 – cone of detection.

Figure C-3. Segment 1 – facing north.

Figure C-4. Segment 1 – facing east.

Figure C-5. Segment 1 – facing south.

Figure C-6. Segment 1 – facing west.

Figure C-7. Segment 2 – overview of set-up.

Figure C-8. Segment 2 – cone of detection.

Figure C-5. Segment 9 – facing north.

Figure C-10. Segment 2 – facing east.

Figure C-11. Segment 2 – facing south.

Figure C-12. Segment 2 – facing west.

Figure C-63. Segment 3 – overview of set-up.

Figure C-14. Segment 3 – cone of detection.

Figure C-15. Segment 3 – facing north.

Figure C-16. Segment 3 – facing east.

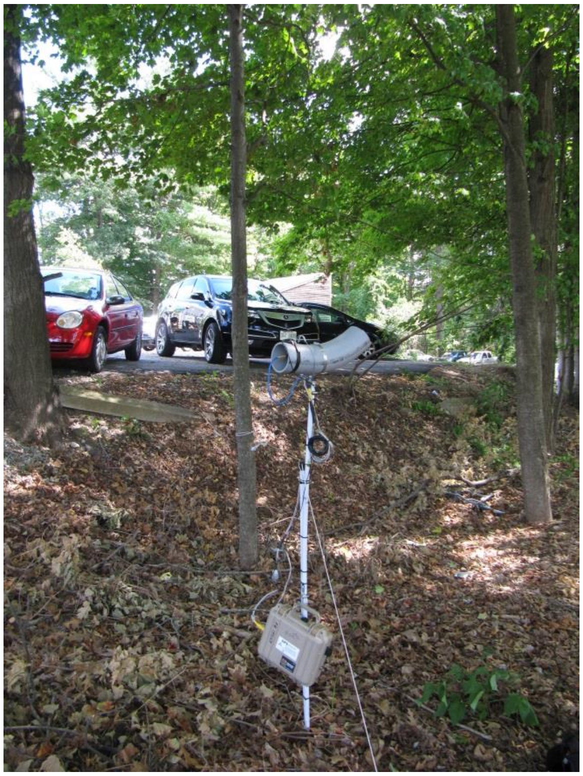


Figure C-17. Segment 3 – facing south.

Figure C-18. Segment 3 – facing west.

Figure C-79. Segment 4 – overview of set-up.

Figure C-80. Segment 4 – cone of detection.

Figure C-21. Segment 4 – facing north.

Figure C-22. Segment 4 – facing east.

Figure C-23. Segment 4 – facing south.

Figure C-24. Segment 4 – facing west.

Figure C-25. Segment 5 – overview of set-up.

Figure C-96. Segment 5 – cone of detection.

Figure C-27. Segment 5 – facing north.

Figure C-28. Segment 5 – facing east.

Figure C-29. Segment 5 – facing south.

Figure C-30. Segment 5 – facing west.

Figure C-310. Segment 6 – overview of set-up.

Figure C-311. Segment 6 – cone of detection.

Figure C-123. Segment 6 – facing north.

Figure C-313. Segment 6 – facing east.

Figure C-35. Segment 6 – facing south.

Figure C-36. Segment 6 – facing west.


Figure C-37. Segment 7 – overview of set-up.


Figure C-38. Segment 7 – cone of detection.


Figure C-149. Segment 7 – facing north.


Figure C-150. Segment 7 – facing east.

Figure C-41. Segment 7 – facing south.

Figure C-42. Segment 7 – facing west.

Figure C-43. Segment 8 – overview of set-up.

Figure C-44. Segment 8 – cone of detection.


Figure C-45. Segment 8 – facing north.


Figure C-166. Segment 8 – facing east.


Figure C-47. Segment 8 – facing south.


Figure C-48. Segment 8 – facing west.

Figure C-49. Segment 9 – overview of set-up.

Figure C-50. Segment 9 – cone of detection.

Figure C-51. Segment 9 – facing north.

Figure C-52. Segment 9 – facing east.

Figure C-53. Segment 9 – facing south.

Figure C-54. Segment 9 – facing west.

Figure C-55. Segment 10 – overview of set-up.

Figure C-56. Segment 10 – cone of detection.

Figure C-57. Segment 10 – facing north.

Figure C-58. Segment 10 – facing east.

Figure C-59. Segment 10 – facing south.

Figure C-60. Segment 10 – facing west.

Figure C-617. Segment 11 – overview of set-up.

Figure C-618. Segment 11 – cone of detection.

Figure C-619. Segment 11 – facing north.

Figure C-620. Segment 11 – facing east.

Figure C-65. Segment 11 – facing south.

Figure C-66. Segment 11 – facing west.

Figure C-67. Segment 12 – overview of set-up.

Figure C-68. Segment 12 – cone of detection.

Figure C-69. Segment 12 – facing north.

Figure C-70. Segment 12 – facing east.

Figure C-71. Segment 12 – facing south.

Figure C-72. Segment 12 – facing west.

Resumes

SARAH A. BARNUM, CWB®

Senior Wildlife Ecologist

Dr. Barnum is a Senior Wildlife Ecologist at Normandeau with over 20 years of professional experience. Her background includes providing expertise to the transportation and energy sectors, as well as a variety of general development projects. She has hands-on experience with a wide range of species including forest birds, waterfowl, raptors, small mammals, large mammals, amphibians, and reptiles. Dr. Barnum's projects have emphasized examining habitat relationships, impact assessment for threatened and endangered species, mitigation planning, and Federal Endangered Species Act (ESA) compliance. Dr. Barnum also has extensive experience in project planning, project management, experimental design, and data analysis.

EDUCATION

Ph.D., Conservation Planning, University of Colorado
M.S., Wildlife Biology, Utah State University
B.S., (cum laude) Wildlife Biology, University of Vermont

PROFESSIONAL EXPERIENCE

2007-Present	Normandeau Associates
2005-2007	New Hampshire Audubon
2004-2005	Baystate Environmental Consultants
2001-2003	Environmental Planning and Policy Unit, Colorado DOT
1998-2000	Office of Environmental Services, Colorado DOT
1996-1998	Dames & Moore1993-1994 Bio-Resources, Inc.

PROFESSIONAL CERTIFICATIONS

- Certified Wildlife Biologist
- AAE's Airport Wildlife Manager's Course and Wildlife Management Techniques Course
- Cyber Tracker Level III Tracking Certification

PROFESSIONAL AFFILIATIONS

- The Wildlife Society
- New Hampshire Association of Natural Resource Scientists
- Epsom, NH Conservation Commission
- Bear-Paw Regional Greenways Land Conservation Committee

REPRESENTATIVE PROJECT EXPERIENCE

Northeast Energy Direct Pipeline, Kinder Morgan, New Hampshire, Massachusetts, Connecticut, New York (2015-Present). Planning and coordination of surveys and reporting for state and federally listed wildlife to support state and federal permitting for installation of a new, 400-mile long natural gas pipeline. Focal species include New England cottontail, songbirds, marsh birds, raptors, turtles, snakes, and lepidopterans. All tasks conducted to meet the Federal Energy Regulatory Commission (FERC) permitting requirements. Wildlife Task Manager.

Northern Pass Transmission Project, Eversource Energy, Canadian Border to Deerfield, New Hampshire (2010-Present). Conducting wildlife assessments, impact analysis, and mitigation planning in support of state and federal permitting for installation of a new, 200-mile long HVDC line in New Hampshire. Tasks include consultation with state and federal agencies (ESA, NEPA), desktop analysis, design and coordination of field surveys, writing the wildlife section of the SEC Natural Resources Report, and providing expert testimony. Focal species include Canada lynx, American marten, bats, raptors, song birds, turtles, snakes, and Karner blue butterfly. Wildlife Task Manager.

The Balsams Grand Resort, Dixville LLC, New Hampshire (2014 - Present). Planned and coordinated surveys and reporting for general wildlife issues and northern long-eared bat acoustic surveys. Wildlife Task Manager.

Boston Convention and Events Center Gull Dissuasion Study, Massachusetts Convention Center Authority, Boston, Massachusetts (2014-2016). Designed and oversaw field surveys of gull activities on the BCEC roof, and assisted in identification and evaluation of dissuasion strategies. Project Manager and Avian Biologist.

Post-Construction Mortality Monitoring, Pheasant Run Wind LLC, Huron County, Michigan (2014-2015). Conducted bird and bat post-construction fatality monitoring, coordinated data analysis and report writing. Project Manager.

Loon Pond Dam Reconstruction, Town of Lincoln, Lincoln, New Hampshire (2015-2016). Conducted habitat suitability assessment for Canada lynx and forest roosting bats for project located on Forest Service Land; coordinated rare plant surveys and wrote the Biological Evaluation. Project Manager and Wildlife Biologist.

Acoustic Northern Long-eared Bat Surveys, MassDOT, Massachusetts (2015). Planned and coordinated USFWS-compliant surveys and reporting for 20 separate MassDOT projects across MA. Project Manager.

Habitat Assessment and Acoustic Northern Long-eared Bat Surveys, Various, New Hampshire (2015). Planned and coordinated USFWS compliant surveys and reporting for four separate development projects in southern NH. Project Manager.

Northern Long-eared Bat Habitat Assessment, Horizons Engineering, Loudon, New Hampshire (2015). Conducted USFWS compliant habitat assessment and reporting for the proposed Liberty Pipeline. Project Manager and Bat Biologist

Fowler's Toad Study for Hydro Dam Relicensing, TransCanada, Connecticut River, New Hampshire and Vermont (2013-2014). Designed and conducted habitat suitability evaluation and toad survey; reporting. All tasks conducted to meet the FERC permitting requirements. Task Manager and Amphibian Biologist.

Loon Mountain Ski Area Expansion Biological Evaluation, US Forest Service, White Mountain National Forest, New Hampshire (2013-2014). Conducted habitat suitability assessment for Canada lynx, forest roosting bats, and black bear and wrote the Biological Evaluation. Wildlife Task Manager and Mammal Biologist.

New England Cottontail Permitting, Tidewater Landing, LLC, Wells, Maine (2013). Wrote the New England cottontail related permitting documents for the Tidewater Landing sub-division. Assessed habitat suitability and negotiated with MDIFW. Wrote the Habitat Management Plan and Incidental Take Plan required for the project permit. Project Manager and NEC Biologist.

Waterville Valley Ski Area Expansion Biological Evaluation, US Forest Service, White Mountain National Forest, New Hampshire (2012-2013). Conducted habitat suitability assessment for Canada lynx, forest roosting bats, and black bear, and wrote the Biological Evaluation. Wildlife Task Manager and Mammal Biologist.

Rare Species Surveys, Tennessee Gas Pipeline Co., various locations in Massachusetts and Connecticut (2012 - 2013). Rare species surveys in support of pipeline repair activities. Various surveys for rare turtles and rare plants prior to pipeline repair projects. Project Manager and Turtle Biologist.

Winthrop Beach Piping Plover Management Plan, MA Department of Conservation and Recreation, Winthrop, Massachusetts (2012). Designed and wrote the piping plover management plan required as part of the permitting effort for the Winthrop Beach re-nourishment project. Project Manager and Avian Biologist.

Roseate Tern Expert Testimony, Entergy Nuclear Generation Company, Plymouth, Massachusetts (2012). Provided expert testimony summarizing potential impacts of relicensing of Pilgrim Nuclear Power Station in Plymouth, MA on roseate terns. Avian Biologist.

The Effect of Roadside Mowing Practices on Deer-Vehicle Collision Rates, Federal Highway Administration (2009-2012) Nationwide. Conducted literature review and interviews with State DOT personnel to summarize any known effects of roadside mowing regimes on DVC rates, followed by a quantitative analysis of DVC rates as a function of mowing regime. Project responsibilities include acquiring data from State DOTs, data management and analysis, and report writing. Data Analysis Task Manager.

Madaket Wind Permitting Assessment, Town of Nantucket, Nantucket, Massachusetts (2010-2011). Assessed avian and T&E resources in the proposed project area to determine potential impacts and permitting requirements for 1-3 utility scale wind turbines on Nantucket DPW lands. Focal species included long-tailed duck, northern harrier, and night migrants (birds and bats). Work includes both desktop and field assessment. Project Manager, Wildlife Biologist.

Post-Construction Mortality Monitoring, First Wind, Stetson Wind Power Facility, Washington County, Maine (2010-2011). Managed personnel to search turbines for bird and bat fatalities, spring through fall and estimate fatality rates. Coordinated searcher efficiency trials and scavenger trials to estimate true number of fatalities; supervised and quality-checked fatality estimation and report writing. Project Manager.

Analysis of Methods to Identify Deer-Vehicle Collision Hotspot, Federal Highway Administration (2009-2011) Nationwide. Compared qualitative and quantitative methods to identify DVC hotspots, based on data needs, ease of implementation, expertise required, and relevancy to solving safety and ecological issues. Project responsibilities included review of methods through literature review and interviews with DOT staff, creating and implementing comparison protocols, staff management and report writing. Principle Investigator and Project Manager.

Brimfield Wind Avian and Bat Surveys, First Wind, Brimfield, Massachusetts (2009-2010). Avian and acoustic bat surveys to support environmental permitting for a proposed 20 MW project in southwestern MA. Avian surveys include raptor surveys and breeding bird surveys. Project Manager and Avian Biologist.

Avian Impact Assessment, Town of Saugus, Saugus, Massachusetts (2009-2010). Desktop analysis of biological and permitting issues associated with a proposed municipal, utility-scale wind development on the abandoned I-95 road bed Saugus, MA. Species of interest include neotropical migrants, wintering ducks, terns, and other shore birds. Project Manager and Avian Biologist.

Mitigation Wetland Functional Assessment, Federal Highway Administration, various nationwide locations (2008-2010). Wetlands constructed to mitigate for highway project-related impacts and reference wetlands were surveyed, and levels of invasive cover and wildlife functions compared. Project responsibilities included interviewing state DOT staff to identify and select study sites, conducting surveys, semi-quantitative analysis, report writing, and managing staff. Project Manager.

Seabrook Nuclear Facility Relicensing, Florida Power and Light, Seabrook, New Hampshire (2008-2010). Reviewed and summarized all terrestrial ecology issues associates with facility construction and operations with a focus on threatened and endangered species, and impact assessment; results presented in a NRC compliant Environmental Report format to support relicensing. Task Manager.

Nine Mile Point Nuclear Facility Expansion, Constellation Energy, Scriba, New York (2007-2010). Wildlife studies to support expansion of an energy facility in Oswego NY. Tasks included field review of the site, evaluation of the habitat's ability to support potential threatened and endangered species, and impact assessment; results presented in a NRC compliant Environmental Report format to support licensing. Wildlife Task Manager.

Mount Snow Resort Snow Making Upgrade Biological Evaluation, US Forest Service, Green Mountain National Forest, Vermont (2008). Review all threatened and endangered species issues associated with a snow making upgrade; analyzed impacts and summarize results in a Forest Service Biological Assessment and a NEPA Environmental Assessment. Senior Wildlife Ecologist.

Casco Bay Fuel Line Removal, U.S. Navy, in Brunswick and Harpswell, Maine (2008). Wildlife studies to support Corps 404 and Maine NRPA permitting. Conducted habitat survey of project area, mapped wildlife habitat, and assessed impacts, with a focus suitable habitat for and presence of species listed by the State of Maine and /or USFWS. Compiled results in a report to support all local and federal permitting efforts. Senior Wildlife Ecologist.

Canada Lynx and American Marten Habitat Assessment, Mount Washington Resort, Bretton Woods, New Hampshire (2007-2008). Provided expert opinion regarding the suitability of the resort's property for Canada lynx and American marten. Tasks included field assessment of the property, review of current literature, producing a written report detailing analysis approach and findings, and ongoing consultation with regulating agencies. Senior Wildlife Ecologist.

NH Route 2 Wildlife Crossing Investigation, New Hampshire Audubon, Jefferson and Randolph, New Hampshire (2005-2007). Designed, implement and managed a tracking study to identify the locations where wildlife crossed the highway, and to determine the characteristics of preferred crossing locations. Tasks included extensive quantitative and qualitative analysis of GIS based data sets. Principle Investigator and Project Manager.

Runway Expansion Feasibility Study, Town of Montague Airport Commission, Montague, Massachusetts (2004-2005). Analyses of potential impacts to birds, sensitive habitats, and special status species including grasshopper sparrows, box turtles, rare plants, and pine-barrens associated insects present in the project area Tasks included field surveys, literature reviews, report writing and general project management. Project Manager.

Runway Expansion Feasibility Study, Martha's Vineyard Airport Commission, West Tisbury, Massachusetts (2004-2005). Conducted analyses and mitigation planning for potential impacts to birds, sensitive habitats, and special status species, including grasshopper sparrows, rare plants, and pine-barrens associated insects. Tasks included consultations with the MA Natural heritage and Endangered Species Program, field surveys, impact assessments, mitigation planning, literature reviews, report writing and general project management. Project Manager.

Programmatic Section 7 Consultation Regarding Impacts to Canada Lynx, Colorado Department of Transportation (2001-2002). Researched and wrote the document that served as the basis for a programmatic agreement between the USFWS and CDOT. Tasks included analysis of habitat and highway conflicts, analysis of likely impacts to lynx resulting from highway projects, development of a formalized impact assessment procedure, and literature review. Environmental Planner.

US 40 Rabbit Ears Pass Upgrade, Colorado Department of Transportation, Grand and Jackson Counties, Colorado (2001). Assessed project area for wildlife corridors and use by Canada lynx and large ungulates. Worked with project engineers and USFS to develop design recommendations, including locations for potential under passes, to improve motorist safety, reduce wildlife mortality and provides habitat connectivity. Environmental Planner.

US 9 Upgrade, Colorado Department of Transportation, Silverthorne, Colorado (1999-2000). Assessed project area for wildlife corridors and use by Canada lynx and large ungulates. Developed recommendation to improve motorist safety, reduce wildlife mortality and provides habitat connectivity. Worked with project engineers and designers to design and locate two wildlife underpasses. Endangered Species Specialist.

US 40 Berthoud Pass Upgrade, Colorado Department of Transportation, Clear Creek and Grand Counties, Colorado (1997-1998). Habitat assessment at the local and landscape scale to determine the best locations for wildlife underpasses to benefit mule deer, elk, Canada lynx and other species. Coordinated with project planners and designers to design underpasses that were appropriate for the target species and that provided engineering feasibility. Endangered Species Specialist.

REPRESENTATIVE PRESENTATIONS

Barnum, S. A., Alt, G. 2013. The effect of reduced mowing on rate of deer-vehicle collisions. 2013 Transportation Research Board Annual Meeting. Washington, D.C.

Barnum, S. A., Gray, M. 2011. A comparison of methods to identify deer-vehicle crash hotspots. 2011 Transportation Research Board Annual Meeting. Washington, D.C.

Barnum, S. A. 2008. Habitat, highway features, and animal-vehicle collision locations as indicators of wildlife crossing hotspots *in* Proceedings of the 2007 International Conference on Ecology and Transportation. Center for Transportation and the Environment, North Carolina State University.

Barnum, S. A. 2007. Habitat, highway features, and animal-vehicle collision locations as indicators of wildlife crossing hotspots. 2007 International Conference on Ecology and Transportation. Little Rock, AR.

Barnum, S. A. 2003. Identifying the best locations to provide safe highway crossing opportunities for wildlife. Society for Conservation Biology 17th Annual Meeting. Duluth, MN.

Barnum, S. A. 2001. Preliminary analysis of locations where wildlife crosses highways in the Southern Rocky Mountains 2001 International Conference on Ecology and Transportation. Keystone, CO.

Barnum, S. A. 2001. Preliminary analysis of locations where wildlife crosses highways in the Southern Rocky Mountains *in* Proceedings of the 2001 International Conference on Ecology and Transportation. Center for Transportation and the Environment, North Carolina State University.

Barnum, S. A. 1999. A programmatic approach to minimize highway project impacts on Canada Lynx (Lynx canadensis) in Colorado. Third International Conference on Wildlife Ecology and Transportation. Missoula, MT.

PEER-REVIEWED ARTICLES AND PUBLICATIONS

Barnum, S. A. 2003. Identifying the best locations along highways for wildlife under- and overpasses: a handbook for highway planners and designers. Colorado Department of Transportation Research Report 2003-9.

Barnum, S. A., C. J. Mannville, J. R. Tester, and W. J. Carmen. 1992. Path selection by *Peromyscus leucopus novaboracensis* in the presence and absence of vegetative cover. J. Mammal. 74:797-801.

JAMIE L. O'BRIEN
Biologist/Data Analyst

Ms. O'Brien is a biologist with six years of professional experience in wildlife research, conservation, and natural resource management throughout New England. Her projects have emphasized protecting and managing threatened and endangered species, assessing environmental impacts, regulating and managing natural resources and wildlife, and ensuring Federal Endangered Species Act compliance. Her diverse wildlife background includes experience with forest, wetlands, and marsh birds, shorebirds, waterfowl, songbirds, raptors, amphibians, and small mammals, including bats. In addition to her field skills, Ms. O'Brien possesses a strong foundation in project planning and implementation, project management and organization, and data analysis and quality control.

Additionally, Ms. O'Brien is a SAS programmer in the Technical Data Processing group. In this capacity she is responsible for the integrity and quality of data and for the generation of final data deliverables.

EDUCATION

M.S.E.S., Applied Ecology, Indiana University, Bloomington

M.P.A., Environmental Policy and Natural Resource Management, Indiana University, Bloomington

B.A., (cum laude) Biology, Saint Anselm College

PROFESSIONAL EXPERIENCE

2013-Present	Normandeau Associates
2011-2013	U.S. Fish & Wildlife Service, Umbagog National Wildlife Refuge
2012	Ducks Unlimited, Inc. U.S. Great Lakes Region
2009-2011	Office of Sustainability, Indiana University, Bloomington
2008	Dickinson College Biodiesel Shop

PROFESSIONAL AFFILIATIONS

- New Hampshire Audubon
- Loon Preservation Committee
- New Hampshire Association of Natural Resource Scientists

REPRESENTATIVE PROJECT EXPERIENCE

Balsams Ski Resort Expansion, Northern Long-eared Bat Surveys Dixville LLC, Dixville, NH (2015-Present). Dixville LLC is proposing to revive and expand the deteriorated Balsams Grand Resort and Wilderness Ski Area into a year-round resort. The project includes restoring the original resort and facilities, constructing new facilities, and increasing the ski terrain from approximately 100 acres to 1200 acres. Normandeau was retained to undertake natural resources data collection efforts and to assist with environmental State and Federal permitting. Ms. O'Brien played a large role in the 2015 Northern long-eared bat surveys, where, in addition to deployment and retrieval of detectors, she coordinated site access and field crew schedules, and was responsible for data reporting, and habitat assessments. Biologist.

Pike Industries Northern Long-eared Bat Surveys, Hooksett, New Hampshire (2015). Normandeau is conducting Northern long-eared bat survey work for a proposed quarry expansion. Ms. O'Brien conducted the Northern long-eared bat surveys, which involved deployment and retrieval of acoustic detectors and habitat analysis of detector sites. Biologist.

Socha Companies Northern Long-eared Bat Surveys, Hooksett, New Hampshire (2015). Normandeau is providing delineation and natural resource survey work for a proposed apartment complex. Ms. O'Brien participated in Northern long-eared bat surveys, which involved the deployment and retrieval of acoustic detectors. Biologist.

Northern Pass Transmission Line Project Northern Long-eared Bat Surveys, Northeast Utilities, NH (2014-present). Northeast Utilities is proposing the Northern Pass Transmission Line, a 180-mile HVDC and AC Transmission project to bring hydropower from Quebec into New Hampshire and the New England region. Ms. O'Brien is involved with various aspects of this project, including wetland mitigation research and permit preparation for NH Department of Environmental Services Shorelands, Wetlands, and Alteration of Terrain Permits. Ms. O'Brien is also providing GPS support for delineated wetland boundaries, and participating in natural resource surveys including rare plants, vernal pools, and bats. Ms. O'Brien was especially involved with Northern Long-eared Bat surveys, where she managed scheduling for up to five people, conducted habitat analysis, deployed and retrieved detectors, and wrote code to filter call data for target species identification. Biologist.

Confidential Client, (2014-2015). This is a confidential energy project. Ms. O'Brien was involved with various aspects of this project, including wetlands and mitigation in a fatal flaw analysis, map revisions in ArcGIS for presentation at state and local meetings, wetland compensatory mitigation research and ARM fund numbers. Ms. O'Brien is also providing GPS support for delineated wetland boundaries, and participating in natural resource surveys including vernal pools, turtles, snakes, Northern Harriers, and bat hibernacula. Additionally, Ms. O'Brien helped with the creation of public outreach documents involving tourism in associated project areas. Biologist.

Bat Monitoring, U.S. Fish & Wildlife Service, Umbagog National Wildlife Refuge, NH/ME (2011-2013). Ms. O'Brien evaluated resident bat populations adjacent to Lake Umbagog. Monitoring activities included conducting maternity roost emergence surveys and acoustic driving transect surveys. Coordinating volunteer efforts, completing required documentation following each survey, maintaining and preserving accurate records, and updating database records was also practiced. Biological Technician.

SPECIAL TRAINING

Motor Boat Operator Certification (Department of the Interior), valid through 06/2016
Defensive Driving (Department of the Interior), valid through 06/2016
CPR/AED (American Red Cross), valid through 02/2017
SAS System programming
ArcGIS 9.2-10.3
Normandeau's 1 week Bat Acoustic Training course

NORMANDEAU ASSOCIATES
Environmental Consultants

Stephen R. Lindsay

Wildlife Biologist, Bat Specialist

Stephen Lindsay is a wildlife biologist with special expertise in bats, raptors, grassland birds, and endangered species, particularly in the northeastern United States. His experience working with and studying bats includes mist netting, harp trapping, affixing transmitters and pit tags, banding and handling, performing hibernacula surveys, using acoustic monitoring devises, and analyzing acoustic results. He is also experienced in radio telemetry and GIS.

While working for the New York State Department of Environmental Conservation (NYSDEC), Stephen handled hundreds of bats, identifying them to species, assessing reproductive status, determining sex and age, and banding and attaching pit tags. He also monitored Indiana and northern long-eared bats, deploying acoustic devices and analyzing results to identify species using full spectrum programs.

EDUCATION

B.S.	2011, Wildlife Management, Paul Smith's College
A.S	2007, Individual Studies

PROFESSIONAL EXPERIENCE

2015–Present	Normandeau Associates
2013–2015	New York State Department of Environmental Conservation
2014	Vesper Environmental
2012	New Jersey Audubon
2011	Penn State University

SELECTED PROJECT EXPERIENCE

Reassessing Summer Range of Indiana Bats (*Myotis sodalis*) in the Hudson Valley, New York, NYSDEC (2013–2015)—Assess previous summer range use of Indiana bats using previously collected data. Used GIS and areal mapping to determine detector location and gain access to private and public location for detector deployment. Deployed acoustic detectors at sites throughout the Hudson Valley to detect Indiana bats. Collected, sorted, and filter collected data. Ran data through call analysis software and verified that the species determinations were correct for *Myotis* species. Set and monitored triple high mist nets at high priority sites. Determined species, sex, and age of captured bats and attached radio transmitters to captured Indiana bats. Perform exit counts at discovered maternity colonies. Wildlife Technician.

Monitor Cave Ecosystems and White-Nose Fungus Presence in Bat Hibernacula, New York, NYSDEC (2013–2015)—Accessed known hibernacula of Indiana bats and determined the number present. Used caving gear, including caving suits and ropes/harnesses, to enter natural cave formations and abandoned mining sites. Took swabs from the ceiling of the cave at various locations using climbing and ladders. Took soil samples from the floor at various locations. Retrieved temperature and humidity monitoring buttons and collected data from them. Replaced and reported missing detectors. Wildlife Technician.

Bi-yearly Winter Survey of Indiana Bat (*Myotis sodalis*) Hibernacula, New York, NYSDEC (2013–2015)—Accessed known hibernacula of Indiana bats and determined the number present. Used caving gear, including caving suits and ropes/harnesses, to enter natural cave formations and abandoned mining sites. Navigated through complex tunnel systems and used caving maps. Photographed and visually counted the number of Indiana bats and other species present. Wildlife Technician.

Determining Range of Wintering Raptors Throughout the Hudson Valley, New York, NYSDEC (2013–2015)—Performed wintering raptor surveys in areas of the Hudson Valley known and suspected to be occupied to determine roost locations and sites used by wintering raptors. Used bi-weekly surveys to determine presence of winter raptors with special interest in Short-eared Owl (*Asio flammeus*) and Northern Harriers (*Circus cyaneus*). Used bow nets and live bait to lure and capture both species near roost locations. Handled, banded, collected biological data, and affixed tail-mount radio transmitters to captured birds. Performed radio telemetry on birds to determine roost locations and foraging data. Wildlife Technician.

Aeolas Cave Winter Mortality Survey, Vermont, Vesper Environmental (Summer 2014)—Helped determine the survival rate of hibernating bats at Aeolas cave using pit tags and mark and capture. Deployed harp traps at cave mouth and nearby. Assessed species, age, sex, and reproductive status of captured bats. Affixed pit tags and wing bands. Bat Technician.

Assessment of Grassland Bird Nesting Success and Survival at PAX Naval Air Station, Maryland, New Jersey Audubon (Summer 2012)—Located and monitored grassland birds, with emphasis on eastern meadowlarks and grasshopper sparrows, on grassland plots at air bases to determine effects of mowing on productivity and survival. Performed nest searches using roping and sticking, nest monitoring, band resighting, nestling banding, and vegetation surveys. Maintained a professional working relationship with Patuxent Air Naval Station base officials. Field Technician.

Assessment of Grassland Bird Community response to Habitat Manipulation at Reclaimed Strip Mine Mountains, Pennsylvania State University (Summer 2011)—Assisted with PhD research on grassland bird community response to habitat manipulation on reclaimed surface mine grasslands in west-central Pennsylvania. Assessedchanges in survival, apparent return rates, and population sizes for these areas following vegetation removal. Assisted with capturing (via playback) and banding adult and nestling Grasshopper, Henslows, Savannah, and Vesper Sparrows. Performed nest searches and monitoring, and re-sighted color-banded birds to estimate population sizes. Research Assistant.

SPECIAL TRAINING

- Chemical Immobilization Training, Safe Capture International

Appendix N: Cultural Resources

Cultural Resource Memorandum of Effect

(Municipally Managed Projects)

Project Name: Derry-Londonderry Exit 4A – Alternative A Date: June 7, 2007
State No.: 13065 Federal No.(as applicable): IM-93-1(201)12

Pursuant to meetings on 8/20/1998, 8/4/2005, 3/2/2006, 3/9/2006, 6/8/2006, 10/5/2006, 4/5/2007, and for the purpose of compliance with the regulations of the National Historic Preservation Act and the Advisory Council on Historic Preservation's *Procedures for the Protection of Historic Properties* (36 CFR 800), the NH Division of Historical Resources and, when applicable, the NH Division of the Federal Highway Administration or the US Army Corps of Engineers have coordinated on the identification and evaluation of cultural resources relative to providing transportation improvements, including construction of a new interchange with Interstate 93 (I-93) (known as Exit 4A), to address existing traffic congestion and safety issues on NH Route 102 and to promote economic vitality in the Derry/Londonderry area. The project extensively reviewed different alternatives through the preparation of an environmental impact statement (EIS).

Alternative A would construct a new interchange on I-93 located approximately one mile north of the existing Exit 4. The interchange would have north and southbound on- and off-ramps, with access only to the east. An access road would connect the interchange with Folsom Road. The Alternative would require land and building acquisitions along the north side of Folsom Road then continue along Tsienneto Road to its intersection with NH Route 102.

HISTORIC RESOURCES

Along the corridor, two residential properties were determined to be eligible for the National Register of Historic Places (NRHP). These properties are located in Derry and identified as:

Number	Address	Description	Eligibility/Criteria
DER0134	76 Tsienneto Road	Palmer Homestead	Eligible (C)
DER0135	72 Tsienneto Road	E.F. Adams House	Eligible (C)

It was determined that Alternative A would have no effect on these NRHP-eligible properties.

ARCHAEOLOGICAL RESOURCES

There are no known archaeological sites that will be affected by Alternative A. However, there is one area of pre-contact Native American archaeological sensitivity along this Alternative corridor. This sensitive area is located across the eastern extent of Tsienneto Road, in the vicinity of Jeff Lane. The expected impacts on this potentially sensitive area associated with the roadway improvements could reach 0.7 acre. FHWA and NHDHR agree that the preliminary Phase I-A archaeological review and report preparation provided an acceptable level of data for determining potential impacts to archaeological resources and proceeding to a public hearing. However, additional studies and identification of mitigation will be required as the project progresses.

MITIGATION

Historic Resources

As no historic resources will be effected by this Alternative, no mitigation is proposed.

Archaeological Resources

Once an alternative has been chosen and the public hearing has been held, a Phase IB field verification and report preparation by a professional archaeologist will be completed for the Selected Alternative. Based on the findings in the Phase IB report, additional, more intense field work may be required under a Phase II site survey.

A Phase II survey would be completed once the final design stage of the project has been reached. The Phase II work would include additional field investigation and research to help determine site integrity, establish a period of occupation, function, cultural affiliation, and associated context, and to more closely define site boundaries within the project area. Field examination would involve a combined strategy of excavation using 0.5-meter by 0.5-meter tests with 1-meter by 1-meter units and trenches, as well as mapping visible features. A report would be completed to help explain the site(s) and how it compares to similar sites in the region, if they exist.

Any resources found will be reviewed by NHDHR and FHWA to determine if they are eligible for the NRHP. If the resource is found to be eligible, the project's effect on the resource will be determined. If the project is found to adversely affect an eligible resource, then a determination will be made as to whether the resource should be preserved in-place or recovered.

If after reviewing the reports and data provided in the Phase II level study, and considering the footprint of the proposed design plans, it is determined by NHDHR and FHWA that recovery of a resource is required, then a Phase III data recovery plan will be implemented.

Although excavation of resources will need to be accomplished before construction of the project is complete, monitoring may be required during construction. Depending on the sensitivity of any findings, information or actual artifacts collected within the project area may be either displayed or presented to the public via numerous public outlets, such as museums, schools, informational brochures, internet websites, and other readily available and appropriate means.

Based on a review of the project, as presented on this date, it has been determined that:

☒ **No Historic or Archaeological Properties will be Effected**

☐ **There will be No Adverse Effect on Historic or Archaeological Properties**
Describe any outstanding commitments: Not applicable.

☐ **There will be an Adverse Effect on Historic or Archaeological Properties or Resources**
Describe the effect, measures to minimize harm and proposed mitigation: Not applicable.

In accordance with the Advisory council's regulations, we will continue to consult, as appropriate, as this project proceeds.

Linda Ray Wilson DSHPO
NH Division of Historical Resources

for Federal Highway Administration

Project Manager

Not Applicable
US Army Corps of Engineers

CC: FHWA, NHDHR, FHWA, ACOE (⇦ as applicable ⇧)

Cultural Resource Memorandum of Effect

(Municipally Managed Projects)

Project Name: Derry-Londonderry Exit 4A – Alternative B Date: June 7, 2007

State No.: 13065 Federal No.(as applicable): IM-93-1(201)12

Pursuant to meetings on 8/20/1998, 8/4/2005, 3/2/2006, 3/9/2006, 6/8/2006, 10/5/2006, 4/5/2007, and for the purpose of compliance with the regulations of the National Historic Preservation Act and the Advisory Council on Historic Preservation's *Procedures for the Protection of Historic Properties* (36 CFR 800), the NH Division of Historical Resources and, when applicable, the NH Division of the Federal Highway Administration or the US Army Corps of Engineers have coordinated on the identification and evaluation of cultural resources relative to providing transportation improvements, including construction of a new interchange with Interstate 93 (I-93) (known as Exit 4A), to address existing traffic congestion and safety issues on NH Route 102 and to promote economic vitality in the Derry/Londonderry area. The project extensively reviewed different alternatives through the preparation of an environmental impact statement (EIS).

Alternative B would construct a new interchange on I-93 located approximately one mile north of the existing Exit 4. The interchange would have north and southbound on- and off-ramps, with access only to the east. An access road would travel from the interchange cross country through the Derry Business Park located near A and B Streets, cross over NH Route 28 and connect with Ashleigh Drive. The Alternative would then continue traversing cross country, requiring land and building acquisitions along the north side of London Court, cross over NH Route 28 Bypass, acquiring several residences near Scenic Drive, then continue towards Tsienneto Road to its intersection with NH Route 102.

HISTORIC RESOURCES

Along the Alternative B corridor, there are no National Register of Historic Places (NRHP)-eligible properties. Therefore, it was determined that Alternative B would have no effect on any historic properties.

ARCHAEOLOGICAL RESOURCES

Alternative B will affect no known archaeological sites. However, it could impact 1.2 acres of potentially sensitive pre-contact Native American sensitive area. This sensitive area is located across the eastern extent of Tsienneto Road, in the vicinity of Jeff Lane. FHWA and NHDHR agree that the preliminary Phase I-A archaeological review and report preparation provided an acceptable level of data for determining potential impacts to archaeological resources and proceeding to a public hearing. However, additional studies and identification of mitigation will be required as the project progresses.

MITIGATION

Historic Resources

As no historic resources will be effected by this Alternative, no mitigation is proposed.

Archaeological Resources

Once an alternative has been chosen and the public hearing has been held, a Phase IB field verification and report preparation by a professional archaeologist will be completed for the Selected Alternative. Based on the findings in the Phase IB report, additional, more intense field work may be required under a Phase II site survey.

A Phase II survey would be completed once the final design stage of the project has been reached. The Phase II work would include additional field investigation and research to help determine site integrity, establish a period of occupation, function, cultural affiliation, and associated context, and to more closely define site boundaries within the project area. Field examination would involve a combined strategy of excavation using 0.5-meter by 0.5-meter tests with 1-meter by 1-meter units and trenches, as well as mapping visible features. A report would be completed to help explain the site(s) and how it compares to similar sites in the region, if they exist.

Any resources found will be reviewed by NHDHR and FHWA to determine if they are eligible for the NRHP. If the resource is found to be eligible, the project's effect on the resource will be determined. If the project is found to adversely affect an eligible resource, then a determination will be made as to whether the resource should be preserved in-place or recovered.

If after reviewing the reports and data provided in the Phase II level study, and considering the footprint of the proposed design plans, it is determined by NHDHR and FHWA that recovery of a resource is required, then a Phase III data recovery plan will be implemented.

Although excavation of resources will need to be accomplished before construction of the project is complete, monitoring may be required during construction. Depending on the sensitivity of any findings, information or actual artifacts collected within the project area may be either displayed or presented to the public via numerous public outlets, such as museums, schools, informational brochures, internet websites, and other readily available and appropriate means.

Based on a review of the project, as presented on this date, it has been determined that:

☒ **No Historic or Archaeological Properties will be Effected**

☐ **There will be No Adverse Effect on Historic or Archaeological Properties**
Describe any outstanding commitments: Not applicable.

☐ **There will be an Adverse Effect on Historic or Archaeological Properties or Resources**
Describe the effect, measures to minimize harm and proposed mitigation: Not applicable.

In accordance with the Advisory council's regulations, we will continue to consult, as appropriate, as this project proceeds.

Linda Ray Wilson DSHPO
NH Division of Historical Resources

Federal Highway Administration

Project Manager

Not Applicable
US Army Corps of Engineers

CC: FHWA, NHDHR, FHWA, ACOE (⇦ as applicable ⇧)

Cultural Resource Memorandum of Effect

(Municipally Managed Projects)

Project Name: Derry-Londonderry Exit 4A – Alternative C Date: June 7, 2007
State No.: 13065 Federal No.(as applicable): IM-93-1(201)12

Pursuant to meetings on 8/20/1998, 8/4/2005, 3/2/2006, 3/9/2006, 6/8/2006, 10/5/2006, 4/5/2007, and for the purpose of compliance with the regulations of the National Historic Preservation Act and the Advisory Council on Historic Preservation's *Procedures for the Protection of Historic Properties* (36 CFR 800), the NH Division of Historical Resources and, when applicable, the NH Division of the Federal Highway Administration or the US Army Corps of Engineers have coordinated on the identification and evaluation of cultural resources relative to providing transportation improvements, including construction of a new interchange with Interstate 93 (I-93) (known as Exit 4A), to address existing traffic congestion and safety issues on NH Route 102 and to promote economic vitality in the Derry/Londonderry area. The project extensively reviewed different alternatives through the preparation of an environmental impact statement (EIS).

Alternative C would construct a new interchange on I-93 located approximately one mile south of the existing Exit 5. The interchange would have north and southbound on- and off-ramps, with access only to the east. An access road would travel from the interchange cross country to NH Route 28. The Alternative would continue south on NH Route 28 and connect with Ashleigh Drive. The Alternative would then traverse cross country, requiring land and building acquisitions along the north side of London Court, cross over NH Route 28 Bypass, acquiring several residences near Scenic Drive, then continue towards Tsienneto Road to its intersection with NH Route 102.

HISTORIC RESOURCES

There is one National Register of Historic Places (NRHP)-eligible property located along the Alternative C corridor. This property is located in Londonderry and identified as:

Number	Address	Description	Eligibility/Criteria
LON0114	79 Stonehenge Road	Reed Paige Clark Homestead	Eligible (A&C)

It was determined that Alternative C would have an adverse effect on this NRHP-eligible property. There would be negative visual impacts on the farmstead complex and its historic rural agricultural setting. In addition, land takings would be required on the property to accommodate the proposed interchange.

ARCHAEOLOGICAL RESOURCES

Alternative C will not affect any known archaeological resources. However, this alternative has the potential to impact two acres of pre-contact Native American sensitive areas in two separate locations. These locations include NH Route 28 at the Shields Brook crossing, and along Tsienneto Road in the vicinity of Jeff Lane. FHWA and NHDHR agree that the preliminary Phase I-A archaeological review and report preparation provided an acceptable level of data for determining potential impacts to archaeological resources and proceeding to a public hearing. However, additional studies and identification of mitigation will be required as the project progresses.

MITIGATION

Historic Resources

Avoid using Alternative C and select one of the other alternatives that would not have impacts on the Reed Paige Clark Homestead.

Archaeological Resources

Once an alternative has been chosen and the public hearing has been held, a Phase IB field verification and report preparation by a professional archaeologist will be completed for the Selected Alternative. Based on the findings in the Phase IB report, additional, more intense field work may be required under a Phase II site survey.

A Phase II survey would be completed once the final design stage of the project has been reached. The Phase II work would include additional field investigation and research to help determine site integrity, establish a period of occupation, function, cultural affiliation, and associated context, and to more closely define site boundaries within the project area. Field examination would involve a combined strategy of excavation using 0.5-meter by 0.5-meter tests with 1-meter by 1-meter units and trenches, as well as mapping visible features. A report would be completed to help explain the site(s) and how it compares to similar sites in the region, if they exist.

Any resources found will be reviewed by NHDHR and FHWA to determine if they are eligible for the NRHP. If the resource is found to be eligible, the project's effect on the resource will be determined. If the project is found to adversely affect an eligible resource, then a determination will be made as to whether the resource should be preserved in-place or recovered.

If after reviewing the reports and data provided in the Phase II level study, and considering the footprint of the proposed design plans, it is determined by NHDHR and FHWA that recovery of a resource is required, then a Phase III data recovery plan will be implemented.

Although excavation of resources will need to be accomplished before construction of the project is complete, monitoring may be required during construction. Depending on the sensitivity of any findings, information or actual artifacts collected within the project area may be either displayed or presented to the public via numerous public outlets, such as museums, schools, informational brochures, internet websites, and other readily available and appropriate means.

Based on a review of the project, as presented on this date, it has been determined that:

☐ **No Historic or Archaeological Properties will be Effected**

☐ **There will be No Adverse Effect on Historic or Archaeological Properties**
Describe any outstanding commitments: Not applicable.

☒ **There will be an Adverse Effect on Historic or Archaeological Properties or Resources**
Describe the effect, measures to minimize harm and proposed mitigation: See items listed above under Mitigation.

In accordance with the Advisory council's regulations, we will continue to consult, as appropriate, as this project proceeds.

Linda Ray Wilson DSHPO
NH Division of Historical Resources

For Federal Highway Administration

Project Manager

Not Applicable
US Army Corps of Engineers

CC: FHWA, NHDHR, FHWA, ACOE (⇦ as applicable ⇧)

Cultural Resource Memorandum of Effect

(Municipally Managed Projects)

Project Name: Derry-Londonderry Exit 4A – Alternative D Date: June 7, 2007
State No.: 13065 Federal No.(as applicable): IM-93-1(201)12

Pursuant to meetings on 8/20/1998, 8/4/2005, 3/2/2006, 3/9/2006, 6/8/2006, 10/5/2006, 4/5/2007, and for the purpose of compliance with the regulations of the National Historic Preservation Act and the Advisory Council on Historic Preservation's *Procedures for the Protection of Historic Properties* (36 CFR 800), the NH Division of Historical Resources and, when applicable, the NH Division of the Federal Highway Administration or the US Army Corps of Engineers have coordinated on the identification and evaluation of cultural resources relative to providing transportation improvements, including construction of a new interchange with Interstate 93 (I-93) (known as Exit 4A), to address existing traffic congestion and safety issues on NH Route 102 and to promote economic vitality in the Derry/Londonderry area. The project extensively reviewed different alternatives through the preparation of an environmental impact statement (EIS).

Alternative D would construct a new interchange on I-93 located approximately one mile south of the existing Exit 5. The interchange would have north and southbound on- and off-ramps, with access only to the east. An access road would travel from the interchange cross country to NH Route 28. The Alternative would continue south on NH Route 28 and connect with Tsienneto Road. The Alternative would then continue along Tsienneto Road to its intersection with NH Route 102.

HISTORIC RESOURCES

There are three National Register of Historic Places (NRHP)-eligible properties located along the Alternative D corridor. These properties are located in both Londonderry and Derry and identified as:

Number	Address	Description	Eligibility/Criteria
LON0114	79 Stonehenge Road	Reed Paige Clark Homestead	Eligible (A&C)
DER0134	76 Tsienneto Road	Palmer Homestead	Eligible (C)
DER0135	72 Tsienneto Road	E.F. Adams House	Eligible (C)

Reed Paige Clark Homestead: It was determined that Alternative D would have an adverse effect on the Reed Paige Clark Homestead. There would be negative visual impacts on the farmstead complex and its historic rural agricultural setting. In addition, land takings would be required on the property to accommodate the proposed interchange.

Palmer Homestead: It was determined that Alternative D would have no effect on the Palmer Homestead.

E.F. Adams House: It was also determined that Alternative D would have no effect on the E.F. Adams House.

ARCHAEOLOGICAL RESOURCES

Alternative D will not affect any known archaeological resources. However, this alternative has the potential to impact 1.5 acres of pre-contact Native American sensitive areas in two separate locations. These locations include NH Route 28 at the Shields Brook crossing, and along Tsienneto Road in the vicinity of Jeff Lane. FHWA and NHDHR agree that the preliminary Phase I-A archaeological review and report preparation provided an acceptable level of data for determining potential impacts to archaeological resources and proceeding to a public hearing. However, additional studies and identification of mitigation will be required as the project progresses.

MITIGATION

<u>Historic Resources</u>

Avoid using Alternative D and select one of the other alternatives that would not have impacts on the Reed Paige Clark Homestead.

<u>Archaeological Resources</u>

Once an alternative has been chosen and the public hearing has been held, a Phase IB field verification and report preparation by a professional archaeologist will be completed for the Selected Alternative. Based on the findings in the Phase IB report, additional, more intense field work may be required under a Phase II site survey.

A Phase II survey would be completed once the final design stage of the project has been reached. The Phase II work would include additional field investigation and research to help determine site integrity, establish a period of occupation, function, cultural affiliation, and associated context, and to more closely define site boundaries within the project area. Field examination would involve a combined strategy of excavation using 0.5-meter by 0.5-meter tests with 1-meter by 1-meter units and trenches, as well as mapping visible features. A report would be completed to help explain the site(s) and how it compares to similar sites in the region, if they exist.

Any resources found will be reviewed by NHDHR and FHWA to determine if they are eligible for the NRHP. If the resource is found to be eligible, the project's effect on the resource will be determined. If the project is found to adversely affect an eligible resource, then a determination will be made as to whether the resource should be preserved in-place or recovered.

If after reviewing the reports and data provided in the Phase II level study, and considering the footprint of the proposed design plans, it is determined by NHDHR and FHWA that recovery of a resource is required, then a Phase III data recovery plan will be implemented.

Although excavation of resources will need to be accomplished before construction of the project is complete, monitoring may be required during construction. Depending on the sensitivity of any findings, information or actual artifacts collected within the project area may be either displayed or presented to the public via numerous public outlets, such as museums, schools, informational brochures, internet websites, and other readily available and appropriate means.

Based on a review of the project, as presented on this date, it has been determined that:

☐ No Historic or Archaeological Properties will be Effected

☐ There will be No Adverse Effect on Historic or Archaeological Properties
Describe any outstanding commitments: Not applicable.

☒ There will be an Adverse Effect on Historic or Archaeological Properties or Resources
Describe the effect, measures to minimize harm and proposed mitigation: See items listed above under Mitigation.

In accordance with the Advisory council's regulations, we will continue to consult, as appropriate, as this project proceeds.

Linda Ray Wilson DSHPO
NH Division of Historical Resources

Federal Highway Administration

Project Manager

Not Applicable
US Army Corps of Engineers

CC: FHWA, NHDHR, FHWA, ACOE (⇦ as applicable ⇧)

Cultural Resource Memorandum of Effect

(Municipally Managed Projects)

Project Name: Derry-Londonderry Exit 4A – Alternative F Date: June 7, 2007
State No.: 13065 Federal No.(as applicable): IM-93-1(201)12

Pursuant to meetings on 8/20/1998, 8/4/2005, 3/2/2006, 3/9/2006, 6/8/2006, 10/5/2006, 4/5/2007, and for the purpose of compliance with the regulations of the National Historic Preservation Act and the Advisory Council on Historic Preservation's *Procedures for the Protection of Historic Properties* (36 CFR 800), the NH Division of Historical Resources and, when applicable, the NH Division of the Federal Highway Administration or the US Army Corps of Engineers have coordinated on the identification and evaluation of cultural resources relative to providing transportation improvements, including construction of a new interchange with Interstate 93 (I-93) (known as Exit 4A), to address existing traffic congestion and safety issues on NH Route 102 and to promote economic vitality in the Derry/Londonderry area. The project extensively reviewed different alternatives through the preparation of an environmental impact statement (EIS).

Alternative F involves a minor upgrade of NH Route 102 between Londonderry Road and NH Route 28 Bypass to include a two-way center left-turn lane between Londonderry Road and NH Route 28, as well as sidewalk and roadway improvements between NH Route 28 and NH Route 28 Bypass. The entire corridor consists of roadway reconstruction (i.e., there is no portion on new alignment). This Alternative would require the removal of a majority of on-street parking from the downtown area along NH Route 102.

HISTORIC RESOURCES

There are three National Register of Historic Places (NRHP)-eligible districts and one individually-eligible property located along the Alternative F corridor. These properties are located in Derry and identified as:

Number	Address	Description	Eligibility/Criteria
Area B	NH Route 102/ Broadway	Broadway Historic District	Eligible (A)*
Area BI	Birch Street	Birch Street Historic District	Eligible (C)*
Area DV	NH Route 28 Bypass, NH Route 102, and associated side roads	Derry Village Historic District	Eligible (A)
DER0102	116 East Broadway	Gilbert and Helen Hood House	Eligible (A&B)

* This is a preliminary determination, if the districts were to be impacted, further investigations would be needed.

Broadway Historic District: It was determined that Alternative F would have an adverse effect on the Broadway Historic District. Intensifying east-west through traffic in the historic district could damage its historical and architectural character. It would disrupt its traditional functions and values as a downtown business center, which requires convenient on-street short-term parking, low traffic speeds and a pedestrian-friendly environment, to continue its role as a focal point for economic development and heritage tourism.

Derry Village Historic District: Alternative F was determined to have no adverse effect upon the Derry Village Historic District. Potential adverse effects have been mitigated by design through the planning process.

Birch Street Historic District: The Alternative was determined to have no adverse effect upon the Birch Street Historic District. Alternative F is unlikely to introduce more intense uses or heavier traffic into the district, nor to interfere significantly with its traditional functions and values as a pedestrian mixed use neighborhood in the town center.

Gilbert and Helen Hood House: It was also determined that Alternative F would have no effect on the Hood House.

ARCHAEOLOGICAL RESOURCES

Alternative F will not affect any known archaeological resources. However, this alternative crosses an area of pre-contact Native American sensitivity along the south side of NH Route 102 between Hood Road and the limits of the corridor at the Derry Village traffic circle. It is estimated that a potential impact of 2.2 acres could occur to this sensitive area. FHWA and NHDHR agree that the preliminary Phase I-A archaeological review and report preparation provided an acceptable level of data for determining potential impacts to archaeological resources and proceeding to a public hearing. However, additional studies and identification of mitigation will be required as the project progresses.

MITIGATION

Historic Resources

Avoid using Alternative F and select one of the other alternatives that would not have impacts on historic properties.

Archaeological Resources

Once an alternative has been chosen and the public hearing has been held, a Phase IB field verification and report preparation by a professional archaeologist will be completed for the Selected Alternative. Based on the findings in the Phase IB report, additional, more intense field work may be required under a Phase II site survey.

A Phase II survey would be completed once the final design stage of the project has been reached. The Phase II work would include additional field investigation and research to help determine site integrity, establish a period of occupation, function, cultural affiliation, and associated context, and to more closely define site boundaries within the project area. Field examination would involve a combined strategy of excavation using 0.5-meter by 0.5-meter tests with 1-meter by 1-meter units and trenches, as well as mapping visible features. A report would be completed to help explain the site(s) and how it compares to similar sites in the region, if they exist.

Any resources found will be reviewed by NHDHR and FHWA to determine if they are eligible for the NRHP. If the resource is found to be eligible, the project's effect on the resource will be determined. If the project is found to adversely affect an eligible resource, then a determination will be made as to whether the resource should be preserved in-place or recovered.

If after reviewing the reports and data provided in the Phase II level study, and considering the footprint of the proposed design plans, it is determined by NHDHR and FHWA that recovery of a resource is required, then a Phase III data recovery plan will be implemented.

Although excavation of resources will need to be accomplished before construction of the project is complete, monitoring may be required during construction. Depending on the sensitivity of any findings, information or actual artifacts collected within the project area may be either displayed or presented to the public via numerous public outlets, such as museums, schools, informational brochures, internet websites, and other readily available and appropriate means.

Based on a review of the project, as presented on this date, it has been determined that:

☐ No Historic or Archaeological Properties will be Effected

☐ There will be No Adverse Effect on Historic or Archaeological Properties
Describe any outstanding commitments: Not applicable.

☒ There will be an Adverse Effect on Historic or Archaeological Properties or Resources
Describe the effect, measures to minimize harm and proposed mitigation: See items listed above under Mitigation.

In accordance with the Advisory council's regulations, we will continue to consult, as appropriate, as this project proceeds.

Linda Ray Wilson DSHPO
NH Division of Historical Resources

for Federal Highway Administration

Project Manager

Not Applicable
US Army Corps of Engineers

CC: FHWA, NHDHR, FHWA, ACOE (⇦ as applicable ⇧)

BUREAU OF ENVIRONMENT, NHDOT
REVIEW REQUEST TO THE NH DIVISION OF HISTORICAL RESOURCES

RECEIVED JAN 06 2017

Date: January 3, 2017 **Return Prior to:**

Project: Derry-Londonderry 13065 – NHDHR Bibliography Form & Short Report. Summary of Phase IA Archaeological Survey Caras Parcels Exit 4A Environmental Impact Statement Update, Derry, New Hampshire. By VBI, January 3, 2017. RPR 2772

Other Parties

COMMENTS: Concur with consultant findings.

This request is forwarded to the **NH DIVISION OF HISTORICAL RESOURCES** for review and comment. NEPA and Sec. 106 of the NHPA require consultation with the SHPO to ensure the review of all actions covered by these acts relative to historical and cultural properties. The review should focus on the project's impacts pertinent to this act.

FOR MORE INFORMATION CONTACT: Sheila Charles

Sheila Charles, Cultural Resources Program Specialist
scharles@dot.state.nh.us 603-271-4049

COMMENTS: Please check one. Additional comments should be included below or on a separate sheet.

✓ **CONCUR** with recommendations - if sensitive area cannot be avoided, then Phase IB is recommended

___ **CONCUR WITH CONDITION** *(Indicate major reservations about the project and the specific substantive changes or modifications desired.)*

___ **TECHNICAL COMMENTS** *(No formal position, technical comments may be attached.)*

___ **NO COMMENTS**

** **NON-RECEIPT OF THIS REVIEW IMPLIES CONSENT**

PLEASE COPY AND RETURN THIS SHEET

Date: 1/12/17

Reviewer's signature: Edna Feighner **(Please Type or Print)** **Title:** R & C

RECEIVED
05 2017

BUREAU OF ENVIRONMENT, NHDOT
REVIEW REQUEST TO THE NH DIVISION OF HISTORICAL RESOURCES

Date: January 3, 2017 **Return Prior to:** ______

Project: Derry-Londonderry 13065 – NHDHR Bibliography Form and Short Report, Phase IA Archaeological Survey (update), I-93 Supplemental Draft EIS, Alternatives A through F, Londonderry and Derry, New Hampshire. By VBI, December 19, 2016. RPR 2772

Other Parties ______

COMMENTS: Concur with consultant findings.

This request is forwarded to the **NH DIVISION OF HISTORICAL RESOURCES** for review and comment. NEPA and Sec. 106 of the NHPA require consultation with the SHPO to ensure the review of all actions covered by these acts relative to historical and cultural properties. The review should focus on the project's impacts pertinent to this act.

FOR MORE INFORMATION CONTACT: Sheila Charles

Sheila Charles, Cultural Resources Program Specialist
scharles@dot.state.nh.us 603-271-4049

COMMENTS: Please check one. Additional comments should be included below or on a separate sheet.

✓ **CONCUR** no further review.

___ **CONCUR WITH CONDITION** *(Indicate major reservations about the project and the specific substantive changes or modifications desired.)*

___ **TECHNICAL COMMENTS** *(No formal position, technical comments may be attached.)*

___ **NO COMMENTS**

** **NON-RECEIPT OF THIS REVIEW IMPLIES CONSENT**

PLEASE COPY AND RETURN THIS SHEET

Date: 1/12/17

Reviewer's signature: Edna Feighner **Title:** R&C
(Please Type or Print)

BUREAU OF ENVIRONMENT, NHDOT
REVIEW REQUEST TO THE NH DIVISION OF HISTORICAL RESOURCES

RECEIVED
JAN 05 2017

Date: January 3, 2017 **Return Prior to:** ______

Project: Derry-Londonderry 13065 – Summary of Phase IA Archaeological Survey Caras Parcels Exit 4A Environmental Impact Statement Update, Derry, New Hampshire. By VBI, December 19, 2016. RPR2772

Other Parties ______

COMMENTS: Concur with consultant findings.

This request is forwarded to the **NH DIVISION OF HISTORICAL RESOURCES** for review and comment. NEPA and Sec. 106 of the NHPA require consultation with the SHPO to ensure the review of all actions covered by these acts relative to historical and cultural properties. The review should focus on the project's impacts pertinent to this act.

FOR MORE INFORMATION CONTACT: Sheila Charles

Sheila Charles, Cultural Resources Program Specialist
scharles@dot.state.nh.us 603-271-4049

COMMENTS: Please check one. Additional comments should be included below or on a separate sheet.

✓ **CONCUR** no further review

___ **CONCUR WITH CONDITION** *(Indicate major reservations about the project and the specific substantive changes or modifications desired.)*

___ **TECHNICAL COMMENTS** *(No formal position, technical comments may be attached.)*

___ **NO COMMENTS**

** **NON-RECEIPT OF THIS REVIEW IMPLIES CONSENT**

PLEASE COPY AND RETURN THIS SHEET

Date: 1/12/17

Reviewer's signature: Edna Feighner **Title:** R & C
(Please Type or Print)

J:\FORMS\trDHR Archaeology.doc

1. Type of Area Form

Town-wide: ☐
Historic District: ☐
Project Area: ☒

2. Name of area: Derry, I-93 Exit 4A Interchange Study

3. Location: West Derry, Derry Village, Beaver Lake, Folsam Road, Tsienneto Road, Chester Road

4. City or town: Derry

5. County: Rockingham

6. USGS quadrangle name(s): Derry, NH; Windham, NH

7. Dataset: SP Feet, NAD83

8. SP Feet: X: 1,084,828.40 Y: 153,656.91; X: 1,086,007.29 Y: 148,706.42; X: 1,079,437.18 Y: 133,957.72; X: 1,072,944.73 Y: 136,545.44; X: 1,072,065.45 Y: 144,382.69

9. Inventory numbers in this area: DER0004-DER0165, Area DV

10. Setting: rural, built-up village centers

11. Acreage: 24.5 acres

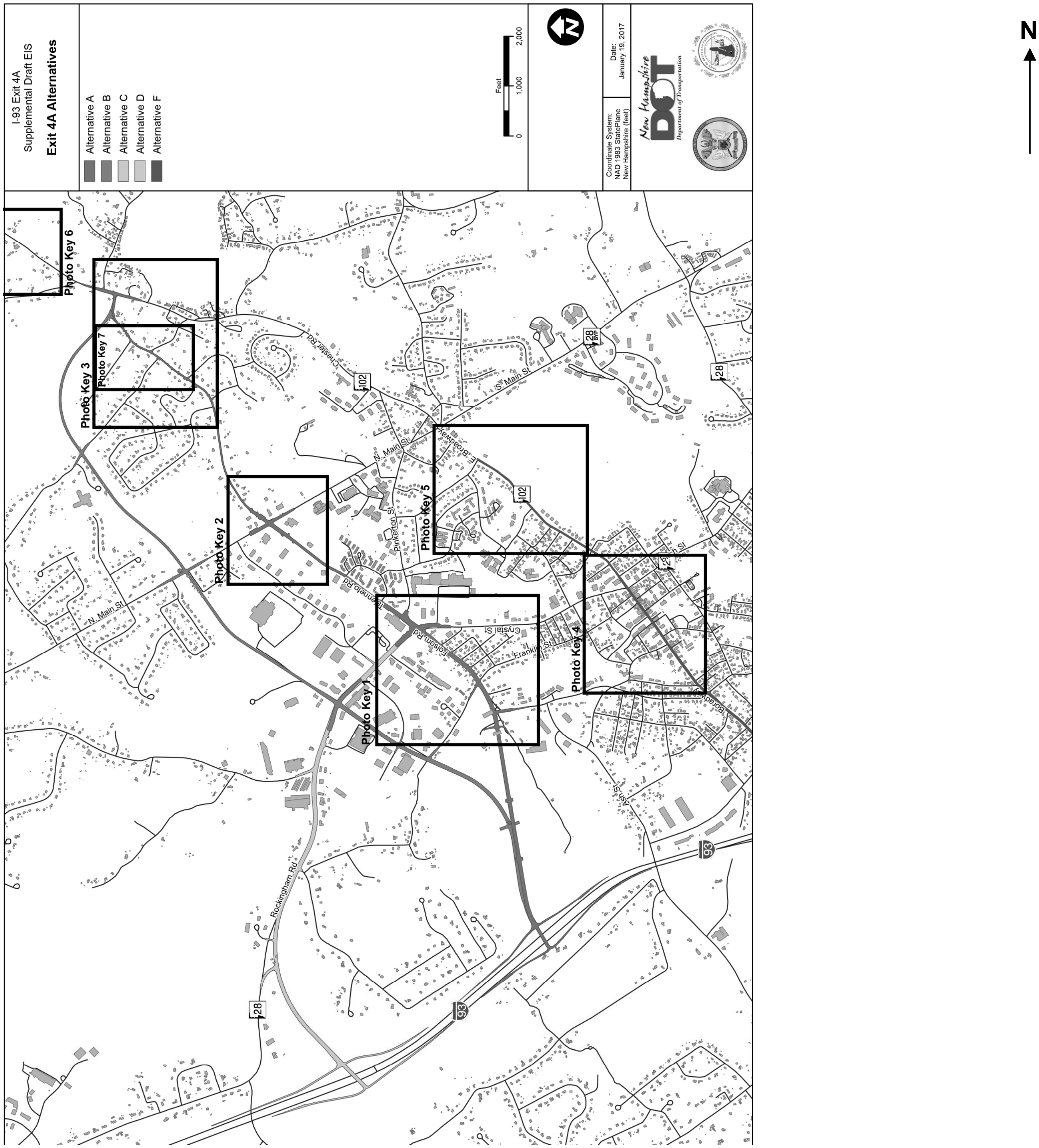
12. Preparer(s): Lynne Monroe, Reagan Ruedig

13. Organization: Preservation Company

14. Date(s) of field survey: August 2016

15: Location Map:

Photo Key Areas 1-3 are Properties Dating 1958-1968 in Preferred Alternative (Photos D01-D23)
Photo Key Areas 4-7 are Previously Determined Eligible Properties in Impact Area (Photos U01-U30)



Location Map showing areas revisited for this update/addenda.
Street addresses of resources are listed in the Tables on pages:

C7 (Properties Dating 1958-1968 in Preferred Alternative)

C25-C26 (Previously Determined Eligible Properties in Impact Area)

Detail Maps/Photo Keys 1-3 begin on page C10, Detail Maps/Photo Keys 4-7 on page C27.

17. Methods and Purpose (Continuation)

The scope of work for this current phase of the project was specified at a joint meeting of FHWA, NHDOT and NHDHR on March 1, 2016.

This update was completed for the I-93 Exit 4A Interchange Study, Derry-Londonderry, NHDOT Project Number: 13065. The initial historic resources survey for the project took place from 1999-2002. Five alternative routes (see Project Map) were studied. Identification of Historic Resources included field survey of individual properties and historic districts that were done in 1999-2000. Products of that effort included 155 Individual Forms, one District Form, and a Derry Townwide Area Form. These were evaluated by the NHDHR DOE Committee in 2001 and 2002. These efforts focused on the areas potentially affected by all five alternatives. Note that no overall Project Area Form was prepared since the entire Project Area was included in, and therefore addressed fully by, the Townwide Area Form for Derry.

The project was put on hold from 2003 to 2005, after which the survey of historic properties needed to be updated to reflect current conditions. This effort was completed in 2005. The 2005 effort was intended to update the integrity and eligibility of all of the individuals and districts in Derry that had been determined eligible for the National Register in 2002 that were along the impact areas. All of these resources were field checked and assessed for integrity changes. The Derry Townwide Form was only updated relative to areas within the project area. The update to the Townwide Form was presented on Area continuation sheets and titled "Project Area Form" and included a table and updated photographs (Preservation Company 2005).

After the 2005 re-evaluation, NHDHR concluded that four of the 26 eligible properties in Derry were found to have changed to such a degree that they were no longer eligible for the National Register (see Table 1).

In 2006, Alternative A (see Project Map) was chosen as the preferred route. In 2007 a Draft EIS (DEIS) was submitted. The Final EIS (FEIS) was begun in 2009, and after funding delays the review process resumed in 2015. This necessitated yet another re-evaluation of the historic resources.

Current Work

The 2016 survey update focused on the area of Alternative A, the Preferred Alternative. The Preferred Alternative impacts Madden Road, Folsom Road, Tsienneto Road, and the intersections of Manchester and Tsienneto Roads, North Main Street and Tsienneto Road, and Chester and Tsienneto Roads (see Project Map).

Preservation Company again reviewed the survey work done in 1999-2002 and 2005 in Derry to update and complete the Section 106 evaluation for Historic Resources and complete the FEIS. The individual resources and historic districts that were determined eligible in 2002 and 2005 were reviewed in 2016 with fieldwork and research to determine if any changes had been made to compromise eligibility.

Preservation Company conducted a windshield survey to assess these eligible properties, shown in Table 1, and noted any changes in integrity. Digital photographs were taken of all of the eligible properties, and a photographic record was created and presented on the appended photo pages (U01-U30). The photographs are keyed to base maps provided by CLD Consulting Engineers.

Based on this work, NHDHR concluded that three properties in Derry (DER0036, DER0073, DER0083) were found to no longer retain sufficient integrity to meet the standards of eligibility for the National Register. For the Individual Survey Forms for these resources, black-and-white prints were made and attached to continuation sheets with scans of the 1999 or 2005 photographs provided for comparison. A narrative re-assessment of the integrity and significance comparison was also given on the continuation sheets.

The current study of historic resources also required an evaluation of any previously unevaluated resources that had reached sufficient age to be considered for National Register eligibility (now 50 years or older, i.e., constructed between 1955 and 1968). The results of this effort are shown in Table 2. Seventeen properties in this area were found to now be of sufficient age to be considered for further study. Photographs were taken of these resources (D1-D23) and are keyed to a series of Photo Keys on base maps provided by CLD Consulting Engineers. A narrative updating the Derry Townwide Area Form (presented on Area Form continuation sheets) follows.

As per the scope outlined in a joint meeting between NHDOT and NHDHR in March 2016, attention was also given to the Wetland Mitigation Site (the "Caras Parcels" between Windham Road and Frost Road, see Caras Parcels Map) in Derry for any possible impact to historic resources. These parcels are surrounded by late twentieth century development along Berry Road to the north, Willow Street and Lilac Court to the west, Frost Street to the southeast, and Craven Terrace to the northeast. South Range Road to the east contains three parcels that were once part of a historic farm and still retain the outlines of some of the open areas that were once farmed. This land has been subdivided, and the earlier farmhouse is located at 7 South Range Road, whose parcel abuts the "Northern Caras Parcel." Historic stone walls that were used as historic property boundaries (no longer in use) can been seen in current satellite aerial photographs within the Caras Parcels.

19. Historical Background (Continuation)

1950-present Highways, Commuting, Residential Development

Residential development along Folsom Road and Tsienneto Road followed a general pattern of infill amongst earlier farmhouses and lightly populated intersections. The population growth of Derry following the construction of Interstate 93 in 1963 and the demand for housing increased dramatically as Derry became a "bedroom community" for Boston. This, along with the decline of farming in the area, led to the redevelopment of the rural farmland in this area.

Already lightly populated by the early twentieth century with a mix of farms and worker housing for nearby shoe factories, construction in the Hood's Pond area to the west of Crystal Avenue increased as neighborhoods were cut into former open land starting in the early twentieth century. "Franklin Terrace" was the name of a proposed development by Edmund M. Warren in the area bounded by Franklin Street, Folsom Road, and Crystal Avenue, and was laid out in a plan dated to 1908 (Rockingham County Registry of Deeds, Plan #251). This proposed a dense development of approximately 156 lots and the construction of 6 streets in a grid parallel to Franklin Street. The first roads constructed were Exeter Street, Concord Avenue and Manchester Avenue, with Claremont Avenue and Laconia Avenue added in the 1950s. The lots were developed gradually over time from the 1920s through the 1980s.

The development of Barkland Acres, on the north side of Tsienneto Road, was proposed in 1965 (Plans #546, 761, 689, and 744) and accepted by the town of Derry in 1966 (Deed 1836: 67). The designed subdivision initially consisted of approximately 170 lots and included the construction of Barkland Drive, Horseshoe Drive, Birchwood Drive, and Brookview Drive. By the early 1969, lots along Scenic Road had been laid out (Plan #1537). The neighborhood developed quickly between 1965 and 1975, when most of the lots were purchased and new homes were constructed in similar sizes and styles.

Commercial development along Tsiennetto Road during the mid-twentieth century was tied to the creation of the Hood Shopping Plaza and several residential areas out of the former H.P. Hood Company farmland in the late 1960s. Previously mostly rural farmland and scattered residences, Tsienneto Road between the intersections of Manchester Road and Main Street saw gradual development in the second half of the twentieth century beginning with the construction of the Knapp Brothers shoe factory at the north corner of Manchester Road and Tsienneto Road (3 Manchester Road, photos 12, 13) in 1960, near the Klev-Bro Shoe company's new building at 22 Manchester Road constructed at the same time. Only a couple of years later, a car dealership was constructed on the southern corner of Tsienneto Road and North Main Street. By the 1970s an apartment complex to the north (Derry Country Club Estates) and the Hood Shopping Plaza commercial development to the south had been constructed; by the 1980s Sunview Condominiums had been developed next to Hood Plaza. By this time commercial development had fully encompassed the routes between Tsienneto Road and Derry Village: Crystal Avenue, Pinkerton Road, and North Main Street. The significant amount of development during this period reflects the more than tripling of the population of Derry from 1950 to 1980 (census.gov).

The area around Beaver Lake saw an increase in cabin and summer home construction during the mid-twentieth century, as well as a rise in year-round residency. The northwest corner of the lake, along Chester Road, small homes and cabins were placed on small parcels fitting in between and behind earlier lakefront properties. This area and others around the shoreline continue to be more densely developed through the early twenty-first century with the addition of more homes on subdivided parcels or new homes replacing older structures.

21. Architectural Description and Comparative Evaluation (Continuation)

1950-present Ranches and Split Levels, Modern Commercial Development

The area along Folsom Road west of Crystal Avenue and east of Franklin Street was where a dense development of farmland was proposed in 1908. However, the development was not all constructed at once, and lots were independently developed slowly over time, often on the combination of two or more of the small lots originally drawn in the 1908 plan, allowing for a variety of forms, density, and styles (photos 3,4, 8-11). Several houses were added on the north side of Folsom Road, independent of "Franklin Terrace," infilling open land near earlier houses. The houses in this area were generally modest homes constructed in contemporary vernacular styles, such as Ranch houses, Raised Ranches, and Cape-style homes (photos 2, 5-7).

The development of Barkland Acres, on the north side of the eastern end of Tsienneto Road, was proposed in 1965 and built out quickly in the following ten years. The neighborhood consists of mostly two-story houses with attached garages in styles and forms typical of this time period: Raised Ranches, Split Levels, and Garrisons, all on lots of approximately one-half to one acre in size. Roads cut for the development are slightly curved and take advantage of the natural topography, and most areas between the houses and lawns are naturally landscaped with trees and shrubs (photos 15-18).

Modern commercial development began in this area with the construction of two shoe factories on Manchester Road. Both constructed around 1960, they represent the more modern, low-rise industrial structures common in the mid-twentieth century and reflecting the downsizing of the shoe manufacturing industry. The former Knapp Brothers Shoe Corporation manufacturing building at 3 Manchester Road (photos 12, 13) is now the home to a fire safety and control firm, but still retains the same general design and building footprint.

An early car dealership constructed ca. 1962 at the corner of Tsienneto and North Main Street (50 North Main Street, photo 14) was one of the earliest commercial additions to the area north of Derry Village along Tsienneto Road. Aerial photographs show a substantial expansion of the building ca. 1990 and the building was again fully renovated in the early 2000s.

Commercial and residential development continues along the main thoroughfares in Derry. Both major commercial construction and large housing developments have filled in all the former open farmland along Tsienneto Road. Large commercial development continues into the early 21st century especially along Manchester Road, near the town boundary with Londonderry, where a shopping mall, movie theater, and Wal-Mart have been recently constructed.

22. Statement of Significance (Continuation)

No additions to the National Register of Historic Places have been made in Derry since the 2002 Area Form for Derry was completed.

The areas of Derry under consideration dating from 1958 to 1968 include residential subdivisions and planned neighborhoods, commercial development along main routes, and residential infill that is consistent with the trends of the growth of the suburbs in the mid-twentieth century. The residential area south of Folsom Road, "Franklin Terrace," is a vernacular neighborhood that evolved over a significant amount of time and is not cohesive enough of a development to be recommended for a district survey. However, Barkland Acres, the residential development on the north side of Tsienneto Road, was seemingly laid out with a particular design intent for the plan of the roads and lots, and the properties were developed in a condensed time period and share a fairly consistent style of house and lot. Many of the homes may have been designed by the same architectural firm or firms, though more research is necessary. This is an area that might be surveyed as a potentially eligible district once the period of significance, likely 1965-1975, reaches the 50-year mark to be considered for the National Register.

The former shoe factory at 3 Manchester Road, constructed ca. 1960, seems to have retained integrity, though more research is necessary to confirm the original design. It was one of the last remaining shoe manufacturing companies in Derry, and is therefore potentially of historic interest at the local level. An individual survey is recommended for this property, as it may be eligible under Criterion A as having significance tied to the shoe manufacturing industry in Derry. It may also be eligible under Criterion C for architectural style.

24. Statement of Integrity (Continuation)

Mid-twentieth century development in the areas along Folsom Road and Tsienneto Road has added to the loss of integrity in Derry as an overall historic community, as the resources added were part of infill and subdivisions covering old farm land and within earlier neighborhoods. The early and mid-twentieth century designed developments in the area retain varying degrees of integrity, as many houses have been renovated over time and have synthetic exterior materials or additions and alterations to the original structure.

48. Bibliography and/or References

Preservation Company
2002 "Project Area Form (Area DER), Derry, NH" filed at New Hampshire Department of Historical Resources, Concord, NH

2005 "Continuation Sheets for Project Area Form (Area DER), Derry, NH" filed at New Hampshire Department of Historical Resources, Concord, NH

U.S. Census Bureau

"Census of Population and Housing". *www.census.gov.*

Rockingham County Registry of Deeds
Deeds and Plans available through *www.nhdeeds.com*.

Table 1: List of Properties Dating 1958-1968

Street Address	Map-Lot	Est. Construction Date	Description/ Notes on Integrity	Photo Nos.
11 Madden Road	31/12	1958	Ranch, vinyl siding and shutters	D1
2.5 Folsom Road	35/08/A	1967	Mobile home in rear of 4 Folsom Rd	D2
7 Folsom Road	35/49	1959	Ranch, vinyl siding and shutters	D3
9 Folsom Road	35/41	1957	Ranch, front portico a later addition, vinyl siding and shutters	D4
12 Folsom Road	35/12	1959	Raised Ranch with underground garage, vinyl siding and shutters	D5
16 Folsom Road	35/13	1961	Garrison (2nd story recently added) with cabin/bathhouse, recent freestanding garage in rear, vinyl siding and shutters	D6, D7
20 Manchester Avenue	35/48	1966	Midcentury Cape with attached garage, vinyl siding and shutters	D8
3 Manchester Road	08/269	1960	Large industrial building, former shoe factory, currently Fireye, Inc.	D12, D13
50 No. Main Street	08/73/1	ca. 1962	Car dealership, dramatically renovated and enlarged ca. 1990 and 2000.	D14
1 Horseshoe Drive	54/94	1965	Raised Ranch with underground garage, vinyl siding and windows	D15
60 Tsienneto Road	54/95	1966	Ranch with full dormer on façade, underground garage	D16
64 Tsienneto Road	54/97	1966	Raised Ranch with underground garage	D17
66 Tsienneto Road	54/98	1965	Raised Ranch with underground garage, vinyl siding and shutters	D18
83 Tsienneto Road	55/13	1960	Ranch, vinyl siding, pool added ca. 1970	D19, D20
84 Tsienneto Road	08/42/1	1960	Ranch, garage added ca. 1980, vinyl siding	D21
91 Chester Road	55/44	1959	Mobile home	D22
80 Chester Road	55/11/1	ca. 1968	Garage/auto repair shop	D23

Survey #	Street Address	Map-Lot	Acreage	2002 Determined Eligible	2005 Retained Integrity/ Eligibility?	2016 Retained Integrity/ Eligibility?	2016 Changes Noted in Windshield Survey	2016 Photo Nos.
DER0025	80 West Broadway	26-042	0.44	Eligible Individually (C)	No	--	Synthetic siding, replacement windows and doors, change to commercial use (2005)	--
DER0029	49 West Broadway	26-114	0.50	Eligible Individually (C)	Yes	Yes	No changes	U01
DER0036	60-62 West Broadway	26-146	1.64	Eligible Individually (C)	Yes	No	Vinyl siding has been added to the exterior, windows have been replaced with vinyl replacement windows in a different configuration (3/1 instead of 2/1). No other changes.	U02
DER0038	52-54 West Broadway	26-145	0.25	Eligible Individually (C)	No	--	Synthetic siding, replacement windows and doors (2005)	--
DER0044	31 West Broadway	29-141	0.26	Eligible Individually (A, C)	Yes	Yes	Windows have been replaced with combination of fixed and awning, changing the earlier double-hung style. No other changes.	U03
DER0047	32 West Broadway	29-195	0.26	Eligible Individually (A)	Yes	Yes	Use has changed to a restaurant, windows and garage doors have been replaced, awning installed. Retains sufficient form and integrity to remain eligible.	U04, U05
DER0048	29 West Broadway	29-189	0.47	NR listed (A)	Yes	Yes	No changes	U06
DER0052	Manning Street	30-051	0.72	More Information Requested	--	--	Out of impact area; more information needed if it is to be impacted.	
DER0054	1 East Broadway	30-022	0.19	Eligible Individually (A)	Yes	Yes	No changes	U07
DER0055	8 East Broadway	30-053	0.06	Eligible Individually (C)	Yes	Yes	No changes	U08
DER0062	20 East Broadway	30-059	1.26	Eligible Individually (A, C)	Yes	Yes	No changes; more information needed if the area is impacted.	U09
DER0070	44 East Broadway	30-075	0.69	Eligible Individually (C)	Yes	Yes	Vinyl siding added to the exterior, accessibility ramp added to front entrance. No other changes.	U10
DER0073	48 East Broadway	30-101	1.18	Eligible Individually (A, C)	Yes	No	Building was demolished 2005, replaced by a pharmacy.	U11
DER0075	52 East Broadway	30-103	0.59	More Information Requested	--	--	Out of impact area; more information needed if it is to be impacted.	
DER0078	58 East Broadway	30-105	0.31	Eligible Individually (A, C)	Yes	Yes	Entry doors and sidelights have been replaced. No other changes.	U12
DER0080	63 East Broadway	30-206	0.55	Eligible Individually (A, C)	Yes	Yes	No changes	U13
DER0083	69 East Broadway	30-210	0.39	Eligible Individually (C)	Yes	No	Vinyl siding added to the exterior, wood brackets and details removed, new vinyl replacement windows, new front porch constructed.	U14
DER0084	71 East Broadway	30-209	0.47	More Information Requested	--	--	Out of impact area; more information needed if it is to be impacted.	
DER0085	72 East Broadway	32-105	0.88	Eligible Individually (C)	Yes	Yes	No changes	U15
DER0089	80 East Broadway	32-099	0.43	More Information Requested	--	--	Out of impact area; more information needed if it is to be impacted.	
DER0090	81 East Broadway	32-079	0.40	Eligible Individually (C)	Yes	Yes	Vinyl replacement windows have been added. No other changes.	U16
DER0099	98 East Broadway	32-065	0.38	Eligible Individually (C)	Yes	Yes	New metal picket fence with granite posts has replaced wood fence. No other changes.	U17

Survey #	Street Address	Map-Lot	Acreage	2002 Determined Eligible	2005 Retained Integrity/ Eligibility?	2016 Retained Integrity/ Eligibility?	2016 Changes Noted in Windshield Survey	2016 Photo Nos.
DER0100	102 East Broadway	32-063	0.53	Eligible Individually (C)	Yes	Yes	Upper story windows replaced. No other changes.	U18, U19
DER0102	116 East Broadway	33-014	1.16	Eligible Individually (B)	Yes	Yes	Attached garage in rear has been redesigned, new construction Carriage House style building added in rear. No longer single family use. No other changes.	U20
DER0114	70 Chester Road	55-018	0.42	Eligible Individually (C)	No	--	Synthetic siding, change in windows and exterior details (2005)	--
DER0121	101 English Range Road	08-045	2.0	More Information Requested	--	--	Fieldwork needed to obtain information requested.	--
DER0129	102 Chester Road	12-014	3.0	More Information Requested	--	--	Out of impact area; more information needed if it is to be impacted.	
DER0132	120 Chester Road	12-023	13.77	Eligible Individually (A)	Yes	Yes	No changes	U21
DER0134	76 Tsienneto Road	08-041-001	1.52	Eligible Individually (C)	Yes	Yes	Metal roof added to main house. No other changes.	U22, U23
DER0135	72 Tsienneto Road	55-008	1.05	Eligible Individually (C)	Yes	Yes	No changes	U24
DER0141	104 East Broadway	32-064	0.42	Eligible Individually (C)	Yes	Yes	Bay window has been modified and replaced. No other changes.	U25
DER0150	55 Route 28 Bypass	08-096	2.2	Eligible Individually (C)	No	--	Building demolished (2005)	--
DER0161	North High Street and Franklin Street Ext.	31-014	12.5	More Information Requested	--	--	Building Demolished (ca. 2002)	--
DER0164	131 Chester Road	12-022	4.62	More Information Requested	--	--	Out of impact area; more information needed if it is to be impacted.	--
DER0165	124 Chester Road	12-024	19.0	More Information Requested	--	--	Out of impact area; more information needed if it is to be impacted.	--
Area DV	126 East Broadway	37-009	0.96	Contributing to NR-eligible district	Yes	Yes	Vinyl siding has been added, vinyl replacement windows on upper floor, gutters added.	U26
Area DV	128 East Broadway	37-010	0.49	Contributing to NR-eligible district	Yes	Yes	New driveway in front, new front porch with accessibility ramp, gutter added to first floor roofline.	U27
Area DV	130 East Broadway	37-030	0.24	Contributing to NR-eligible district	Yes	Yes	Vinyl replacement windows have been added to the second floor. No other changes.	U28
Area DV	130½ East Broadway	37-031	0.21	Contributing to NR-eligible district	Yes	Yes	No changes	U29
Area DV	132 East Broadway	37-032	0.55	Contributing to NR-eligible district	Yes	Yes	Synthetic shutters added to more of the windows.	U30
Area B	NH Route 102/Broadway	--	--	More Information Requested	--	--	District may be eligible; more information needed if it is to be impacted.	
Area BI	Birch Street	--	--	No determination made	--	--	District may be eligible; more information needed if it is to be impacted.	
None yet	7 South Range Road	02-146	16.16	Survey to be completed	--	--	Surveyed may be required for Wetland Mitigation Site	

Digital Photography Statement

I, the undersigned, confirm that the photos in this inventory form have not been digitally manipulated and that they conform to the standards set forth in the NHDHR Photo Policy. My camera was set to the following specifications: "fine" image quality (compression ratio 1:4) and "large" image size (3008 x 2000 pixels). These photos were printed using the following: Epson SureColor P600 photo printer on Epson Ultra Premium Photo Paper, glossy. The digital files are housed with Preservation Company in Kensington, NH.

Lynne Emerson Monroe, Preservation Company

Digital Photo Log

The photography files for this project are named: Derry2016_D01- Derry2016_D23 and Derry2016_U01- Derry2016_U30 where the photos are numbers D01-D23 (Properties Dating 1958-1968) and U01-U30 (updates to Previously Determined Eligible Properties).

Index to Photo Keys

Photo Keys 1-3 are 2016 Photos of Properties Dating 1958-1968 in Preferred Alternative (Photos D01-D23)

Photo Keys 4-7 are 2016 Photos of Previously Determined Eligible Properties in Impact Area (Photos U01-U30)

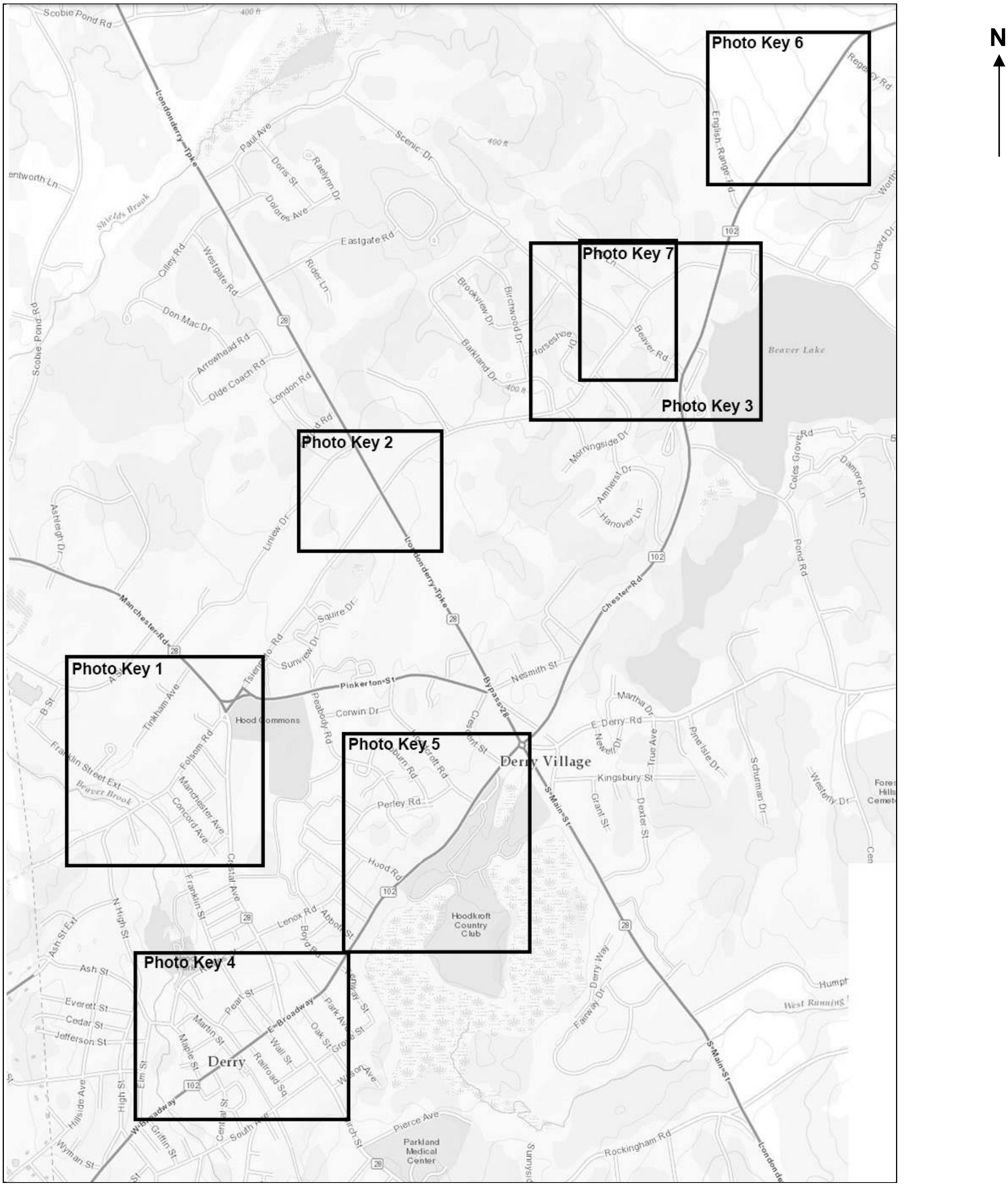


Photo Keys – Properties Dating 1958-1968 in Preferred Alternative (Photos D01-D23)

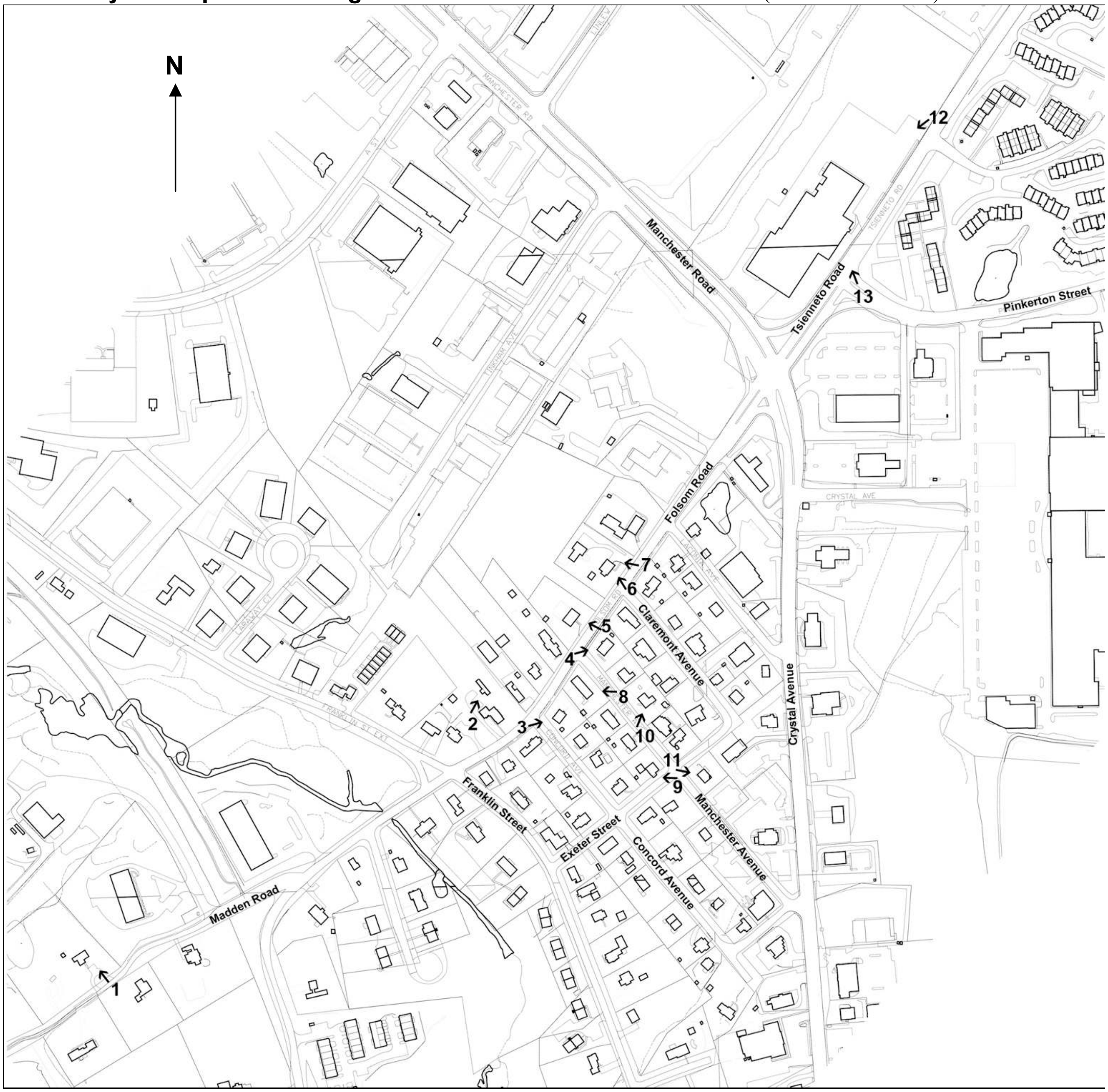


Photo Key 1 – Photos D01-D13

Photo Key 2 – Photo D14

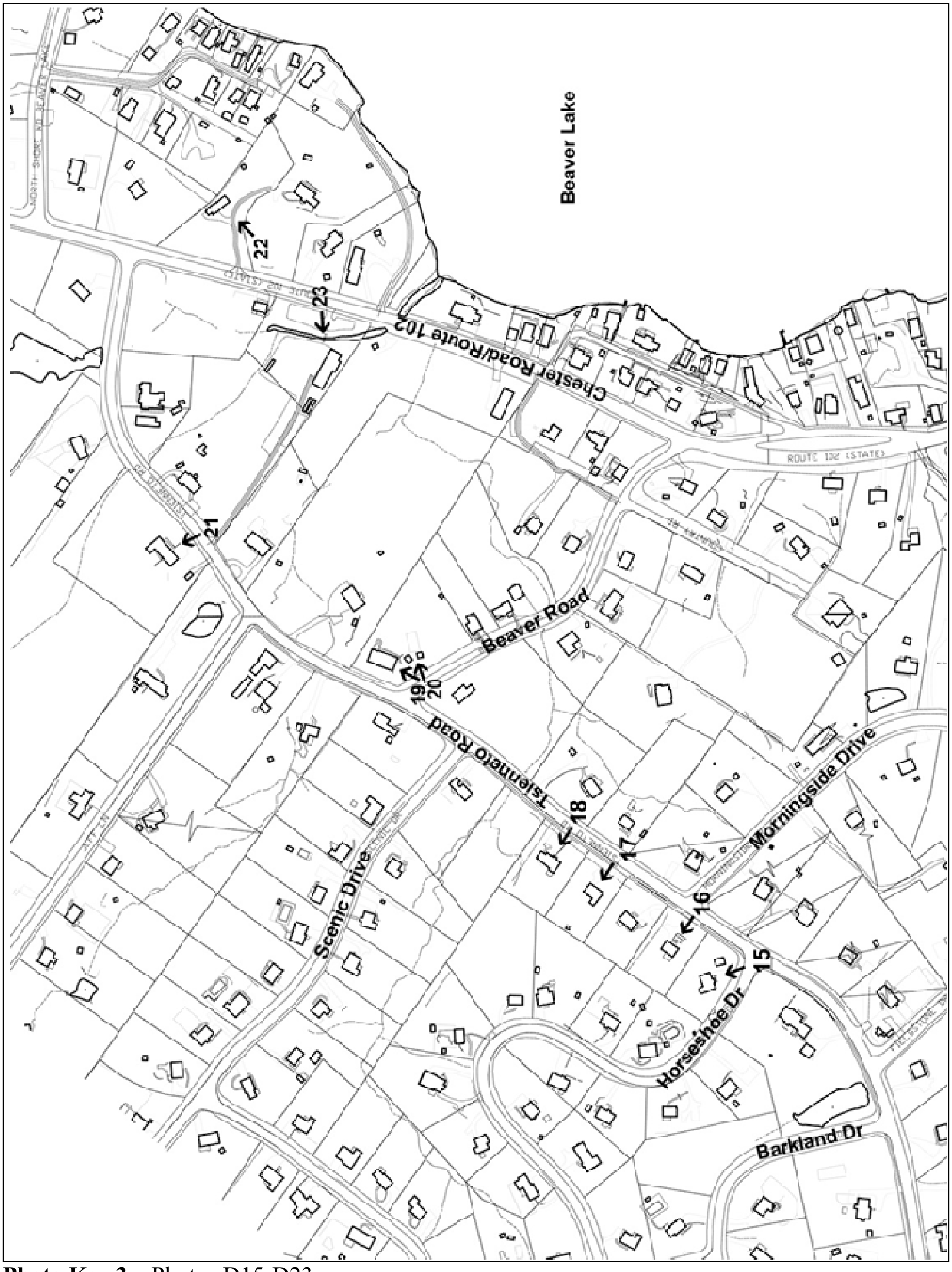


Photo Key 3 – Photos D15-D23

Photographs of Properties Dating 1958-1968 in Preferred Alternative (Photos D01-D23)

Date of Photography: August 2016

Photo D01: 11 Madden Road, facade
File Name: Derry2016_01 Direction: NW

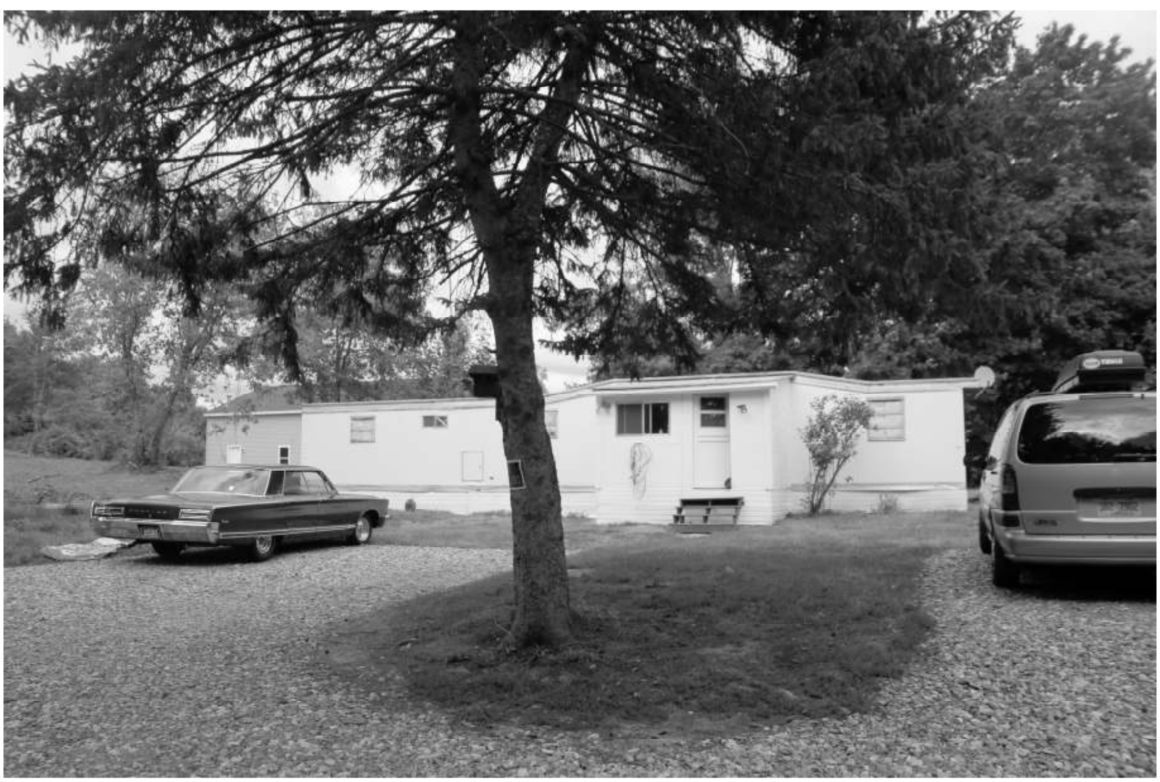


Photo D02: 2.5 Folsom Road, mobile home in rear of 4 Folsom Road.
File Name: Derry2016_D02 Direction: NE

Photo D03: 7 Folsom Road, façade and side elevation.
File Name: Derry2016_D03 Direction: E

Photo D04: 9 Folsom Road, façade and southwest elevation.
File Name: Derry2016_D04 Direction: E

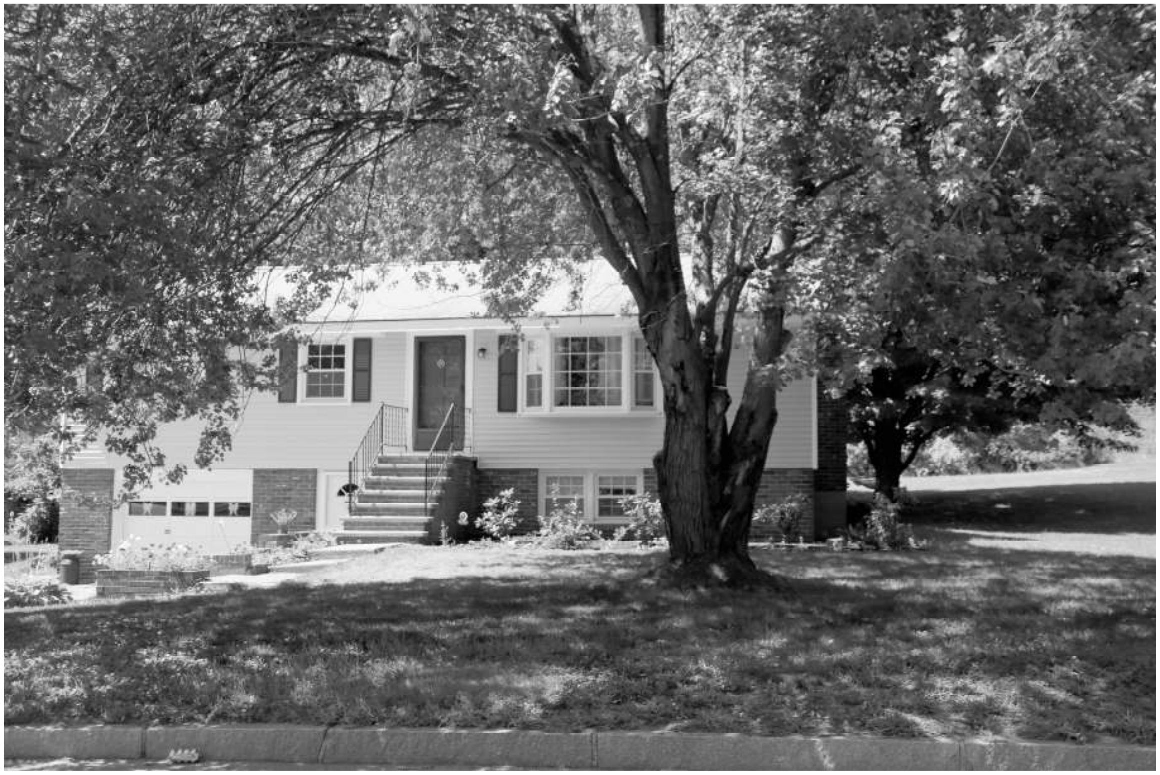


Photo D05: 12 Folsom Road, facade
File Name: Derry2016_D05 Direction: NW

Photo D06: 16 Folsom Road, façade
File Name: Derry2016_D06 Direction: NW

Photo D07: 16 Folsom Road, façade and northeast elevation
File Name: Derry2016_D07 Direction: NW

Photo D08: 20 Manchester Avenue, façade
File Name: Derry2016_D08 Direction: W

Photo D09: (Left to right) 4 Exeter Street (ca. 1975) and 6 Exeter Street (ca. 1929), representative examples of the "Franklin Terrace" neighborhood
File Name: Derry2016_D09 Direction: W

Photo D10: 17 Manchester Avenue (ca. 1976), representative example of the "Franklin Terrace" neighborhood
File Name: Derry2016_D10 Direction: NE

Photo D11: 11 Manchester Avenue (ca. 1960), representative example of the “Franklin Terrace” neighborhood
File Name: Derry2016_D11 Direction: E

Photo D12: 3 Manchester Road at the corner of Tsienneto Road, façade and northeast elevation and parking lot
File Name: Derry2016_D12 Direction: SW

Photo D13: 3 Manchester Road at the corner of Tsienneto Road, façade on Tsienneto Road
File Name: Derry2016_D13 Direction: N

Photo D14: 50 North Main Street at the corner of Tsienneto Road, façade
File Name: Derry2016_D14 Direction: S

Photo D15: 1 Horseshoe Drive, façade
File Name: Derry2016_D15 Direction: NW

Photo D16: 60 Tsienneto Road, façade
File Name: Derry2016_D16 Direction: NW

Photo D17: 64 Tsienneto Road, façade
File Name: Derry2016_D17 Direction: NW

Photo D18: 66 Tsienneto Road, façade
File Name: Derry2016_D18 Direction: NW

Photo D19: 83 Tsienneto Road, southwest elevation (façade not accessible)
File Name: Derry2016_D19 Direction: NE

Photo D20: 83 Tsienneto Road, storage shed, pool and screen house
File Name: Derry2016_D20 Direction: NE

Photo D21: 84 Tsienneto Road, façade
File Name: Derry2016_D21 Direction: NW

Photo D22: 91 Chester Road, façade
File Name: Derry2016_22 Direction: NE

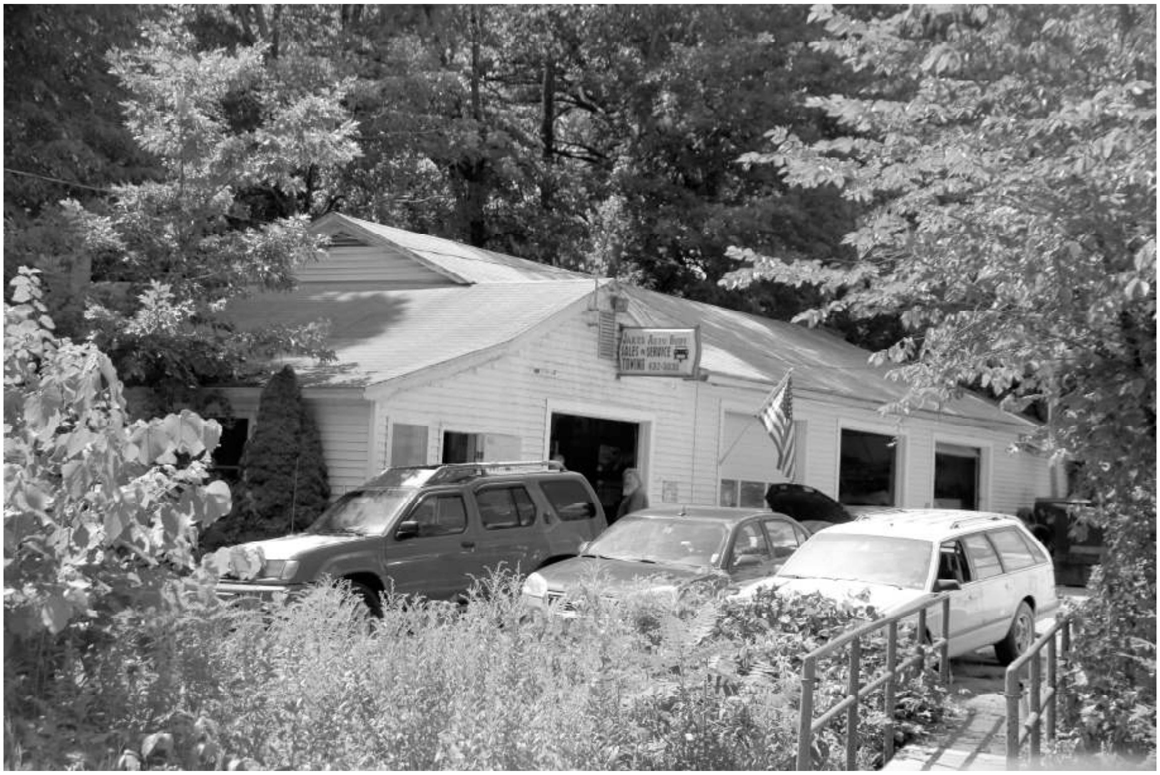


Photo D23: 80 Chester Road
File Name: Derry2016_D23 Direction: W

Table 2: Previously Determined Eligible Properties In Impacted Areas

Survey #	Street Address	Map-Lot	Acreage	2016 Photo Nos.	2002 DOE	Retained Integrity/ Eligibility 2016	Notes on Integrity
DER0029	49 West Broadway	26-114	0.50	U01	Eligible Individually (C)	Yes	No changes
DER0036	60-62 West Broadway	26-146	1.64	U02	Eligible Individually (C)	No	Vinyl siding has been added to the exterior, windows have been replaced with vinyl replacement windows in a different configuration (3/1 instead of 2/1). No other changes.
DER0044	31 West Broadway	29-141	0.26	U03	Eligible Individually (A, C)	Yes	Windows have been replaced with combination of fixed and awning, changing the earlier double-hung style. No other changes.
DER0047	32 West Broadway	29-195	0.26	U04, U05	Eligible Individually (A)	No	Use has changed to a restaurant, windows and garage doors have been replaced, awning installed.
DER0048	29 West Broadway	29-189	0.47	U06	NR listed (A)	Yes	No changes
DER0054	1 East Broadway	30-022	0.19	U07	Eligible Individually (A)	Yes	No changes
DER0055	8 East Broadway	30-053	0.06	U08	Eligible Individually (C)	Yes	No changes
DER0062	20 East Broadway	30-059	1.26	U09	Eligible Individually (A, C)	Yes	No changes
DER0070	44 East Broadway	30-075	0.69	U10	Eligible Individually (C)	Yes	Vinyl siding added to the exterior, accessibility ramp added to front entrance. No other changes.
DER0073	48 East Broadway	30-101	1.18	U11	Eligible Individually (A, C)	No	Building was demolished 2005, replaced by a pharmacy.
DER0078	58 East Broadway	30-105	0.31	U12	Eligible Individually (A, C)	Yes	Entry doors and sidelights have been replaced. No other changes.
DER0080	63 East Broadway	30-206	0.55	U13	Eligible Individually (A, C)	Yes	No changes
DER0083	69 East Broadway	30-210	0.39	U14	Eligible Individually (C)	No	Vinyl siding added to the exterior, wood brackets and details removed, new vinyl replacement windows, new front porch constructed.
DER0085	72 East Broadway	32-105	0.88	U15	Eligible Individually (C)	Yes	No changes
DER0090	81 East Broadway	32-079	0.40	U16	Eligible Individually (C)	Yes	Vinyl replacement windows have been added. No other changes.
DER0099	98 East Broadway	32-065	0.38	U17	Eligible Individually (C)	Yes	New metal picket fence with granite posts has replaced wood fence. No other changes.
DER0100	102 East Broadway	32-063	0.53	U18, U19	Eligible Individually (C)	Yes	Upper story windows replaced. No other changes.
DER0102	116 East Broadway	33-014	1.16	U20	Eligible Individually (B)	Yes	Attached garage in rear has been redesigned, new construction Carriage House style building added in rear. No longer single family use. No other changes.
DER0132	120 Chester Road	12-023	13.77	U21	Eligible Individually (A)	Yes	No changes
DER0134	76 Tsienneto Road	08-041-001	1.52	U22, U23	Eligible Individually (C)	Yes	Metal roof added to main house. No other changes.
DER0135	72 Tsienneto Road	55-008	1.05	U24	Eligible Individually (C)	Yes	No changes

Survey #	Street Address	Map-Lot	Acreage	2016 Photo Nos.	2002 DOE	Retained Integrity/ Eligibility 2016	Notes on Integrity
DER0141	104 East Broadway	32-064	0.42	U25	Eligible Individually (C)	Yes	Bay window has been modified and replaced. No other changes.
Area DV	126 East Broadway	37-009	0.96	U26	Contributing to NR-eligible district	Yes	Vinyl siding has been added, vinyl replacement windows on upper floor, gutters added.
Area DV	128 East Broadway	37-010	0.49	U27	Contributing to NR-eligible district	Yes	New driveway in front, new front porch with accessibility ramp, gutter added to first floor roofline.
Area DV	130 East Broadway	37-030	0.24	U28	Contributing to NR-eligible district	Yes	Vinyl replacement windows have been added to the second floor. No other changes.
Area DV	130½ East Broadway	37-031	0.21	U29	Contributing to NR-eligible district	Yes	No changes
Area DV	132 East Broadway	37-032	0.55	U30	Contributing to NR-eligible district	Yes	Synthetic shutters added to more of the windows.

Photo Keys – Previously Determined Eligible Properties, 2016 (Photos U01-U30)

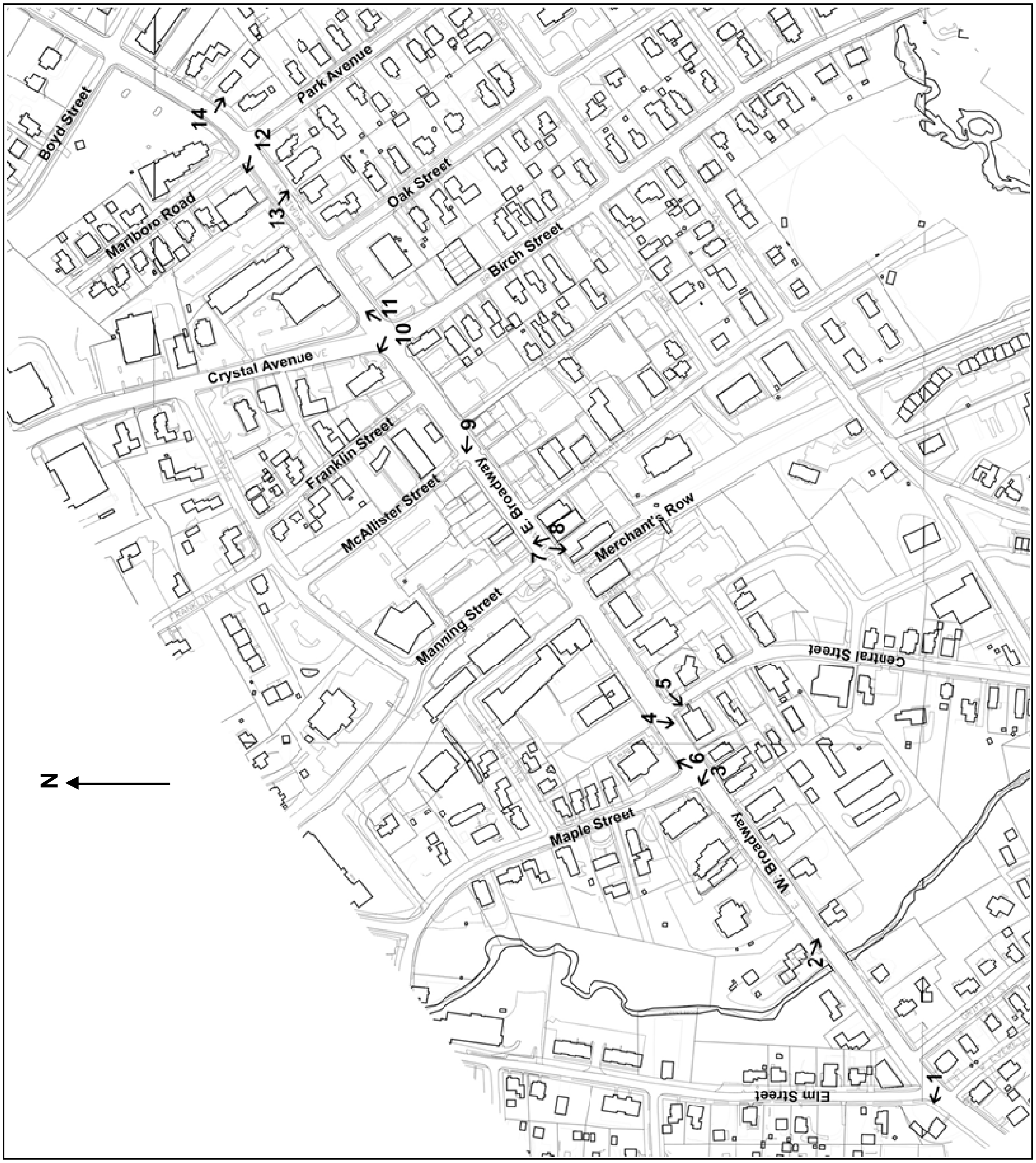


Photo Key 4 – Photos U01-U14

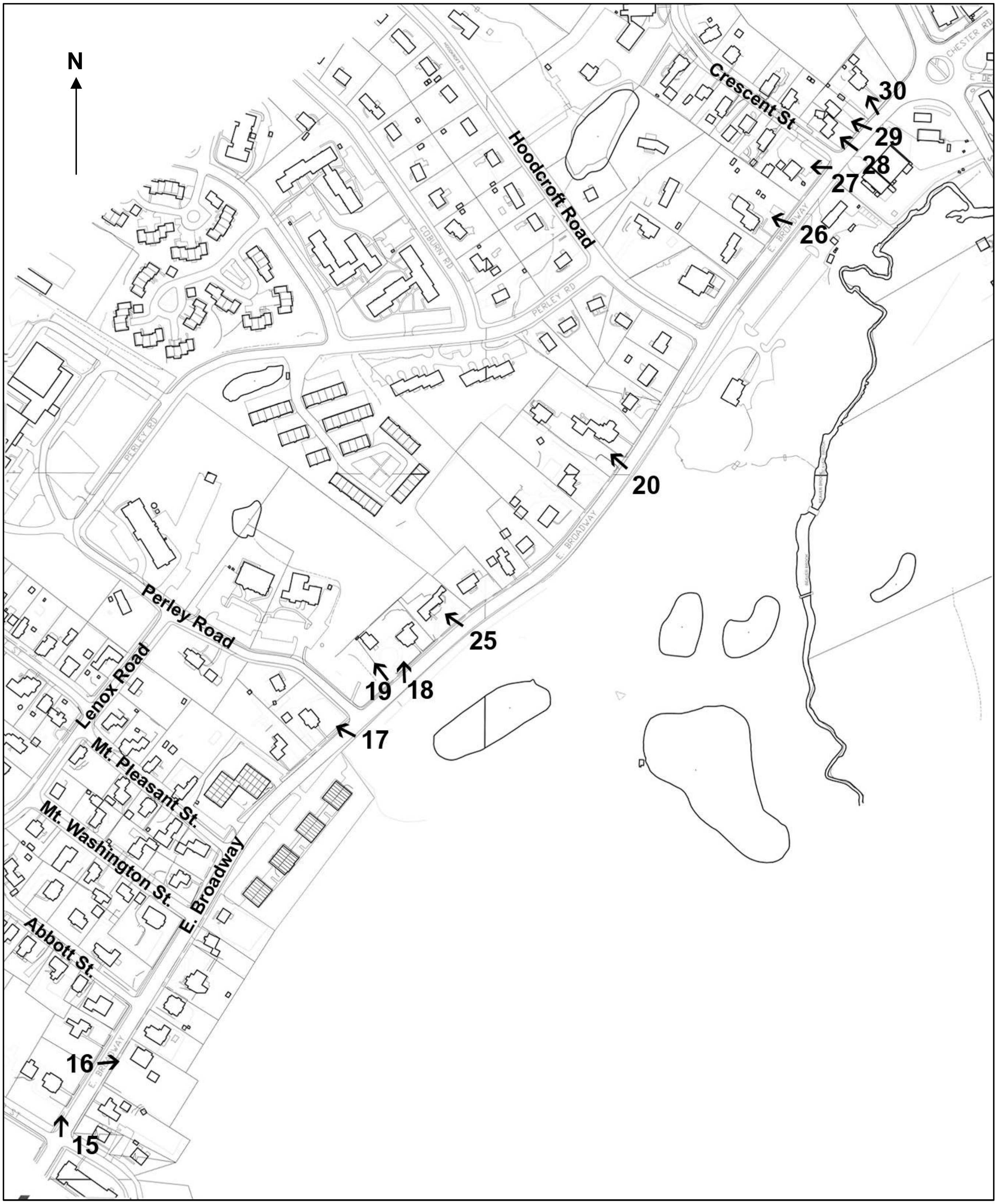


Photo Key 5 – Photos U15- U20, U25- U30

Photo Key 6 – Photo U21

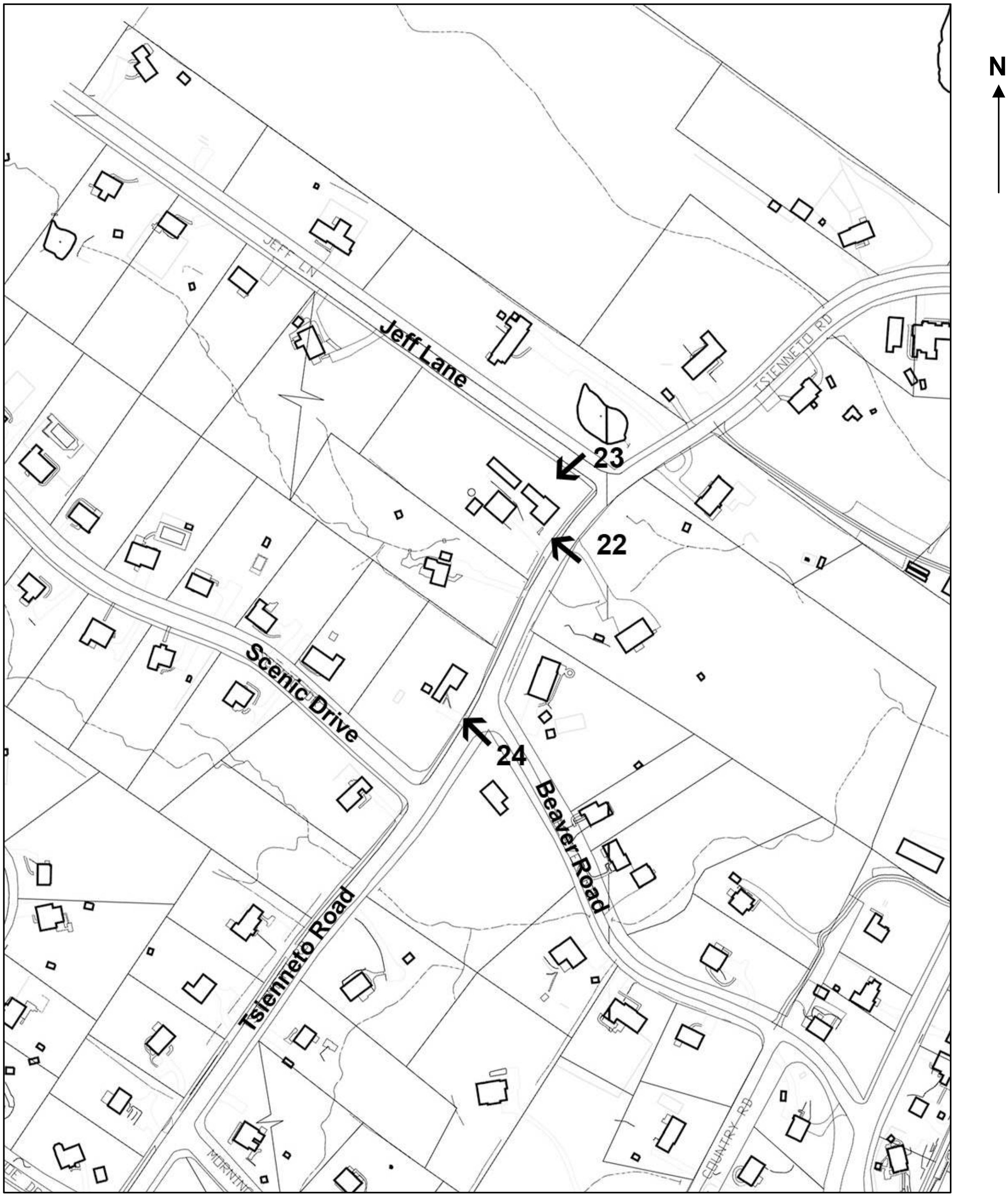


Photo Key 7 – Photos U22-U24

Photographs of Properties Previously Determined Eligible (Photos U01-U30)

Date of Photography: August 2016

Photo U01: 49 West Broadway (**DER0029**). Façade and east elevations of the Benson/Warren House and garage. Windows and door of garage are boarded up, no other changes noted.
File Name: Derry2016_U01 Direction: NW

Photo U02: 60-62 West Broadway (**DER0036**). Façade and west elevation. Vinyl siding and replacement windows.
File Name: Derry2016_U02 Direction: SW

Photo U03: 31 West Broadway (**DER0044**). Façade and east elevation of the Veterans Memorial Building. Windows have been replaced, no other changes noted.
File Name: Derry2016_U03 Direction: W

Photo U04: 32West Broadway (**DER0047**). Façade of the Central Fire Station. Building use changed to a restaurant, windows and garage doors have been replaced and/or infilled.
File Name: Derry2016_U04 Direction: SW

Photo U05: 32West Broadway (**DER0047**). East elevation of the Central Fire Station. Building use changed to a restaurant, windows have been replaced and new awning installed.
File Name: Derry2016_U05 Direction: SW

Photo U06: 29 West Broadway (**DER0048**). Façade and west elevation of the Adams Memorial Building. No changes noted.
File Name: Derry2016_U06 Direction: NE

Photo U07: 1 East Broadway (**DER0054**). Façade and northwest elevation. No changes noted.
File Name: Derry2016_U07 Direction: S

Photo U08: 8 East Broadway (**DER0055**). Façade of the 8 East Broadway commercial blcok. No changes noted.
File Name: Derry2016_U08 Direction: N

Photo U09: 20 East Broadway (**DER0062**). Façade and east elevation of the First National Bank. No changes noted.
File Name: Derry2016_U09 Direction: W

Photo U10: 44 East Broadway (**DER0070**). Façade and east elevation of the First Baptist Church. Vinyl siding has been installed, accessibility ramp added to the front door.
File Name: Derry2016_U10 Direction: NW

Photo U11: 48 East Broadway (**DER0073**). Site of former Derry Town Hall, demolished in 2005, now a pharmacy.
File Name: Derry2016_U11 Direction: NE

Photo U12: 58 East Broadway (**DER0078**). Façade and east elevation of the Mason Temple (former Newell House). Front door and sidelights have been replaced, no other changes noted.
File Name: Derry2016_U12 Direction: W

Photo U13: 63 East Broadway (**DER0080**). Façade and west elevation of St. Luke's Methodist Episcopal Church. No changes noted.
File Name: Derry2016_U13 Direction: NE

Photo U14: 69 East Broadway (**DER0083**). Façade and west elevation the Wheeler House. Vinyl siding and replacement windows have been added, wood trim details and brackets have been removed, new front porch constructed.
File Name: Derry2016_U14 Direction: E

Photo U15: 72 East Broadway (**DER0085**). Façade of the Greenough House and granite block fencing. No changes noted.
File Name: Derry2016_U15 Direction: NE

Photo U16: 81 East Broadway (**DER0090**). Façade and southwest elevation of the Abbott/Cutlip House. Vinyl replacement windows have been added, no other changes noted.
File Name: Derry2016_U16 Direction: E

Photo U17: 98 East Broadway (**DER0099**). Façade and east elevation of the Arthur Green House. New metal fence with granite posts installed, no other changes noted.
File Name: Derry2016_U17 Direction: W

Photo U18: 102 East Broadway (**DER0100**). Façade and west elevation of the Proctor House. Upper story windows have been replaced, no other changes noted.
File Name: Derry2016_U18 Direction: N

Photo U19: 102 East Broadway (**DER0100**). Façade and southeast elevation of the Proctor House carriage barn. No changes noted.
File Name: Derry2016_U19 Direction: W

Photo U20: 116 East Broadway (**DER0102**). Façade and additions of the Gilbert and Helen Hood House. Attached garage has been renovated, new construction house added in 2006 to rear of property.
File Name: Derry2016_U20 Direction: NW

Photo U21: 120 Chester Road (**DER0132**). Façade and southwest elevation of J & F Farms building with ell additions. Vinyl siding installed and several replacement windows noted. No other changes.
File Name: Derry2016_U21 Direction: N

Photo U22: 76 Tsienneto Road (**DER0134**). Façade and barn of the Palmer Homestead. Metal standing-seam roof installed on the house. No other changes noted.
File Name: Derry2016_U22 Direction: NW

Photo U23: 76 Tsienneto Road (**DER0134**). Northeast elevation of the Palmer Homestead and carriage barn. Metal standing-seam roof installed on the house. No other changes noted.
File Name: Derry2016_U23 Direction: SW

Photo U24: 72 Tsienneto Road (**DER0135**). Façade of E. F. Adams House. Row of Hemlock trees removed in front, no other changes noted.
File Name: Derry2016_U24 Direction: N

Photo U25: 104 East Broadway (**DER0141**). Façade of the Amadee Cote House. Bay window has been replaced, no other changes noted.
File Name: Derry2016_U25 Direction: NW

Photo U26: 126 East Broadway (**Area DV**). Façade and northeast elevation of the Wilson House. Vinyl siding and gutters added, vinyl replacement windows on upper floor. No other changes noted.
File Name: Derry2016_U26 Direction: NW

Photo U27: 128 East Broadway (**Area DV**). Façade and northeast elevation of the Doctor Thomas Wallace House. Parking lot to the northeast enlarged, accessibility ramp added to front entry, gutter added to first floor roofline. No other changes noted.
File Name: Derry2016_U27 Direction: NW

Photo U28: 130 East Broadway (**Area DV**). Façade of the B. F. Kincaid House. Vinyl replacement windows have been added to the second floor. No other changes noted.
File Name: Derry2016_U28 Direction: NW

Photo U29: 130½ East Broadway (**Area DV**). Façade and northeast elevation of the 130½ East Broadway. No changes noted.
File Name: Derry2016_U29 Direction: NW

Photo U30: 132 East Broadway (**Area DV**). Façade and southwest elevation of the Joseph Bradbury Bartlett House. Vinyl shutters added to façade windows. No other changes noted.
File Name: Derry2016_U30 Direction: N

1. Type of Area Form

Town-wide: ☒
Historic District: ☐
Project Area: ☐

2. Name of area: Londonderry, I-93 Exit 4A Interchange Study

3. Location: Pillsbury Road, Appletree Lane, Route 28/Rockingham Road (from town line to Perkins Road), Perkins Road, Stonehenge Road (abutting I-93)

4. City or town: Londonderry

5. County: Rockingham

6. USGS quadrangle name(s): Derry, NH; Manchester South, NH

7. Dataset: SP Feet, NAD83

8. SP Feet: X: 1,064,044.92 Y: 154,879.72; X: 1,072,020.91 Y: 145,919.59; X: 1,072,978.32 Y: 137,814.10; X: 1,068,20.41 Y: 137,814.10; X: 1,068,207.41 Y: 134,374.51; X: 1,060,464.32 Y: 153,561.35

9. Inventory numbers in this area: Area LON-WO, Area PS, LON0094-LON0100, LON0103-LON0109, LON0114, LON0116, LON0117

10. Setting: Rural

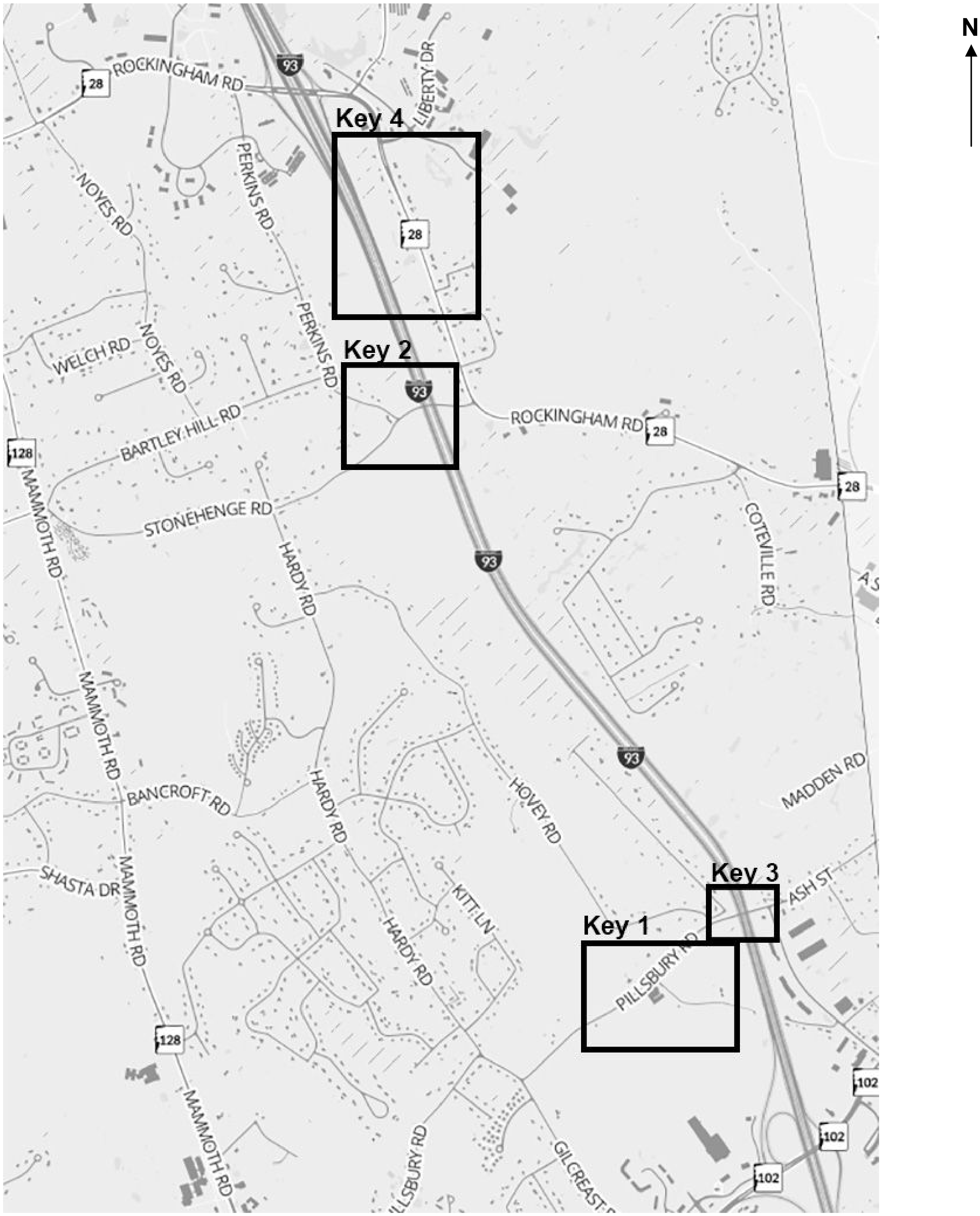
11. Acreage: approximately 400 acres

12. Preparer(s): Lynne Monroe, Reagan Ruedig

13. Organization: Preservation Company

14. Date(s) of field survey: August 2016

15. Location Map



Location Map showing areas revisited for this update.
Street addresses of resources are listed in the Table on page A4.
Detail Maps/Photo Keys 1-4 begin on page A7.

17. Methods and Purpose (Continuation)

The scope of work for this current phase of the project was specified at a joint meeting of FHWA, NHDOT and NHDHR on March 1, 2016. This update was completed for the I-93 Exit 4A Interchange Study, Derry-Londonderry, NHDOT Project Number: 13065. The objective is to review the work done in 1999-2002, and make it current to complete the Section 106 evaluation for Historic Resources. A Townwide Area Form for Londonderry was completed in 1995 for the Bedford-Manchester-Londonderry Project DPR-F-0047-(001), 11512. Six Individual Survey Forms were completed in 1999-2000 for this project (LON0094-LON0099). Survey was completed in 2001 for the I-93 Improvement Project: Salem-Manchester 10418c that included areas and individual properties that fall within the Exit 4A Project's Area of Potential Effects (as stated in the 2007 Draft Environmental Impact Statement, Section 3.8.4.2).

In August 2016, Preservation Company conducted a windshield survey of the project area to assess the changes to the properties that had retained eligibility as of 2002. The survey focused on the eligible properties in potential impact areas located on Rockingham Road, Stonehenge Road, and Pillsbury Road; this included the Woodmont Orchard Historic District. The Ash Street Bridge (Prowse Memorial Bridge) over Interstate 93 was also surveyed. Changes in integrity are noted in the following table. Of these resources, only one property (99 Rockingham Road) was found to no longer be individually eligible for the National Register. Continuation sheets were made for this property to be appended to form #LON0103. They include current black-and-white prints with scans of the 2002 photographs provided for comparison as well as a narrative re-assessment of the integrity and significance comparison.

Digital photographs were taken of all of the eligible properties, and a photographic record was created for properties that were unchanged. This effort is presented on continuation sheets to the original Townwide Area Form and photographs are keyed to a base map taken from the Town of Londonderry MapGeo website (https://londonderrynh.mapgeo.io).

A table of eligible properties was prepared that shows the following information: Survey Number, Address, Map/parcel #, Acreage, 2002 DOE, 2016 Integrity/Eligibility, Notes on Integrity, and 2016 photo number.

List of Eligible Properties In Impacted Areas

Survey #	Street Address	Map-Lot	Acreage	2002 Determined Eligible	2016 Retained Integrity/ Eligibility?	2016 Changes Noted in Windshield Survey	2016 Photo Nos.
Area LON-WO	Pillsbury Road	Map 10	196.003	Eligible as a District (A,B)	Yes	Buildings have been mostly abandoned and are dilapidated, the sites are overgrown, but none had been demolished as of August 2016.	1-10
LON0100	15 Appletree Lane	10/41-1	5.0	Contributing to NR-eligible district (A)	Yes	Building uninhabited and overgrown, no changes.	5
LON0103	99 Rockingham Road	13/43	8.26	Eligible Individually (C)	No	Queen Anne style turned posts added to overhanging eave on façade, changing feeling and design.	15
LON0105	117 Rockingham Road	16/88	1.50	Eligible Individually (C as of 2005)	Yes	No changes noted.	16
LON0107	118 Rockingham Road	16/82	1.84	Not Eligible (Age)	Yes	No changes noted, should be re-evaluated if there are potential impacts now that the age threshold has been reached.	17
LON0114	79 Stonehenge Road (corner of Perkins Rd)	13/21, 22	114.39	Eligible Individually (A,C)	Yes	New storm doors added, no other changes.	11-13
LON0116	Ash Street over I-93	10/00	Bridge footprint/ approaches	Eligible Individually (2003) (C,E)	Yes	No changes.	14
LON0117	113 Rockingham Road	16/93	1.40	Eligible Individually (C)	Yes	No changes noted.	18

Digital Photo Log
The photo reference (file name) for this project is named LON_2016_01 through LON_2016_18 where the last two digits are the photo number.

Digital Photography Statement
I, the undersigned, confirm that the photos in this inventory form have not been digitally manipulated and that they conform to the standards set forth in the NHDHR Photo Policy. These photos were printed using the following: Epson SureColor P600 printer on Epson Ultra Premium Photo Paper, glossy. The digital files are housed with Preservation Company in Kensington, NH.

Lynne Emerson Monroe, Preservation Company

Photo Keys

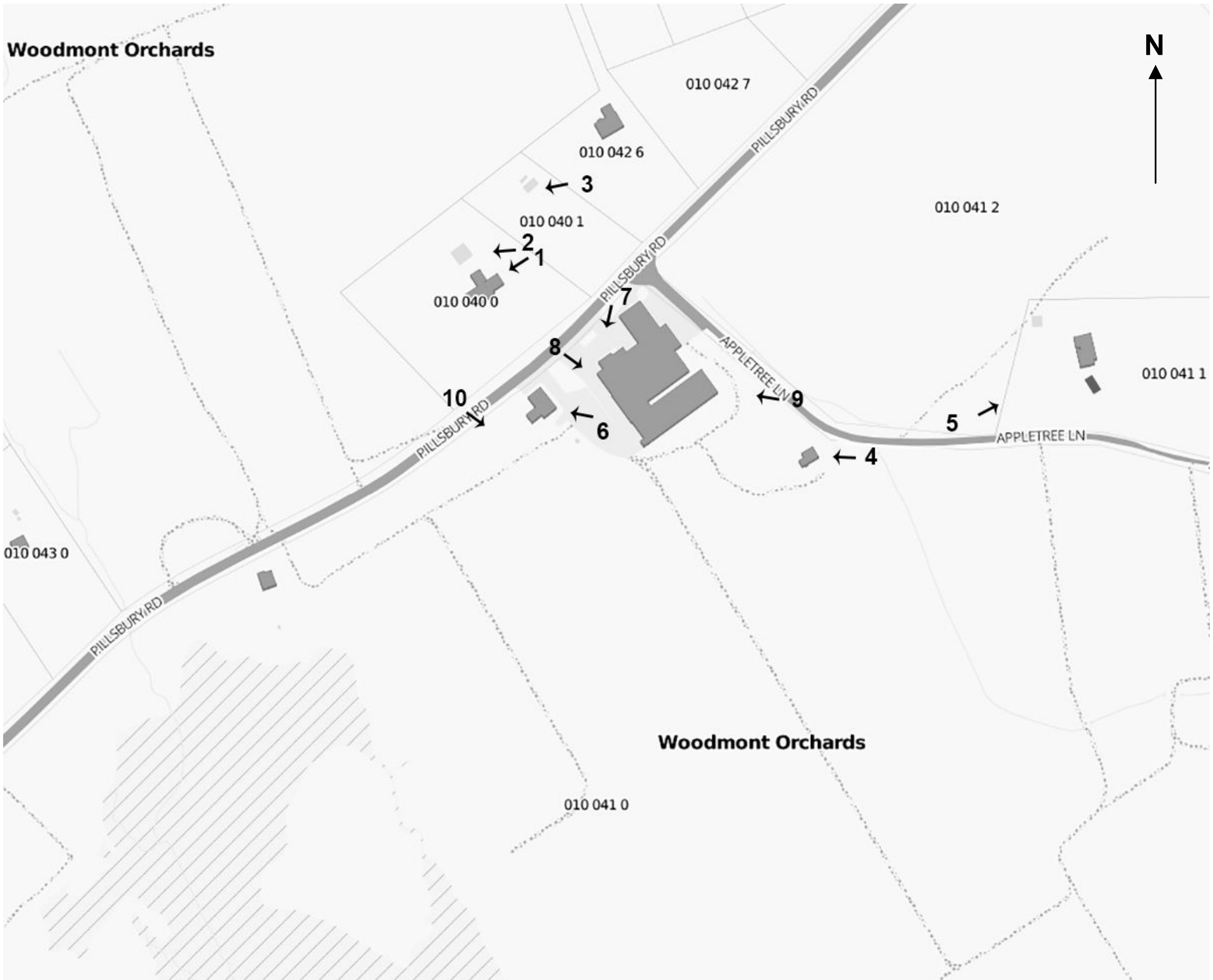


Photo Key 1 – Photos 1-10

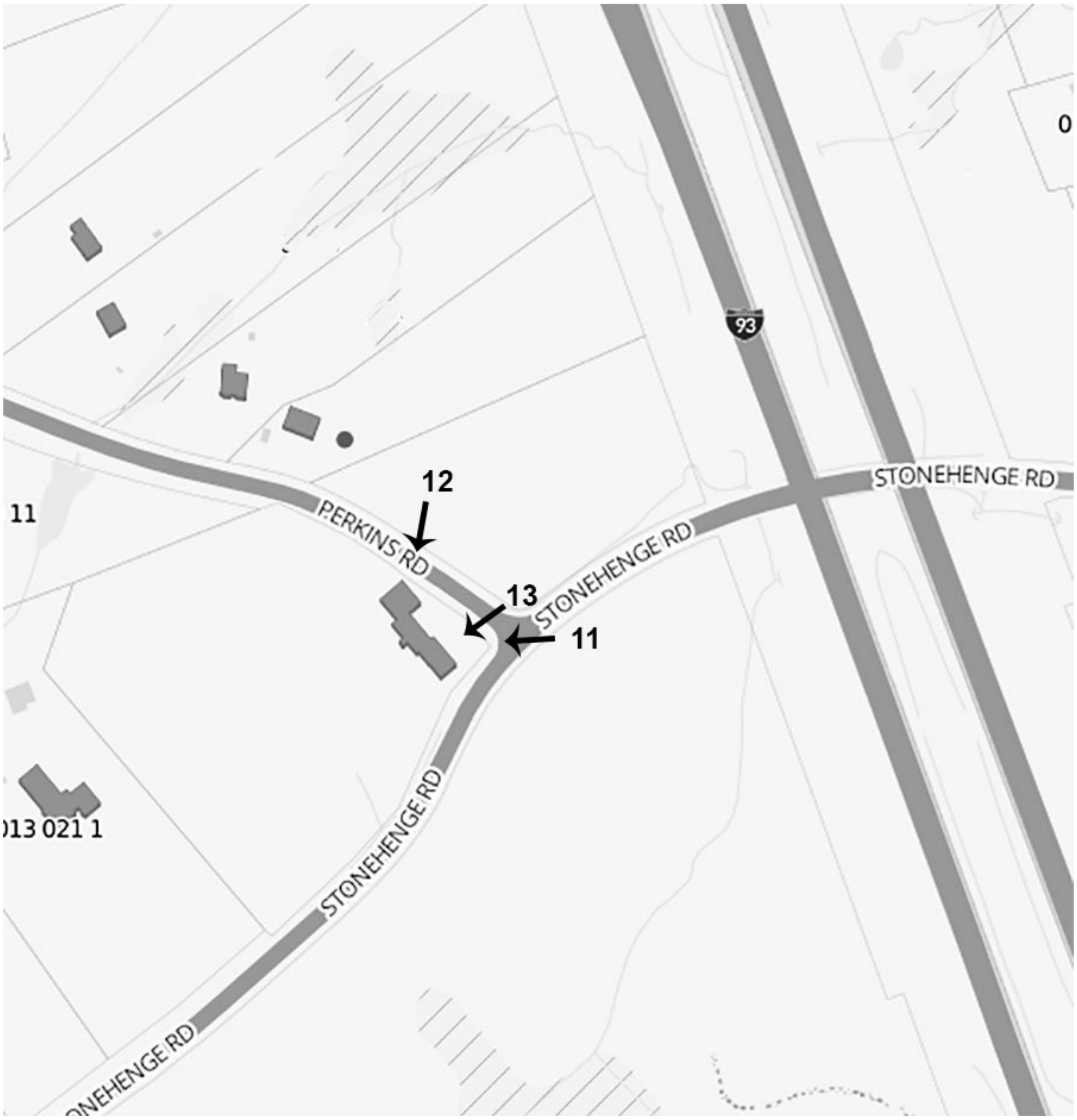


Photo Key 2 – Photos 11-13

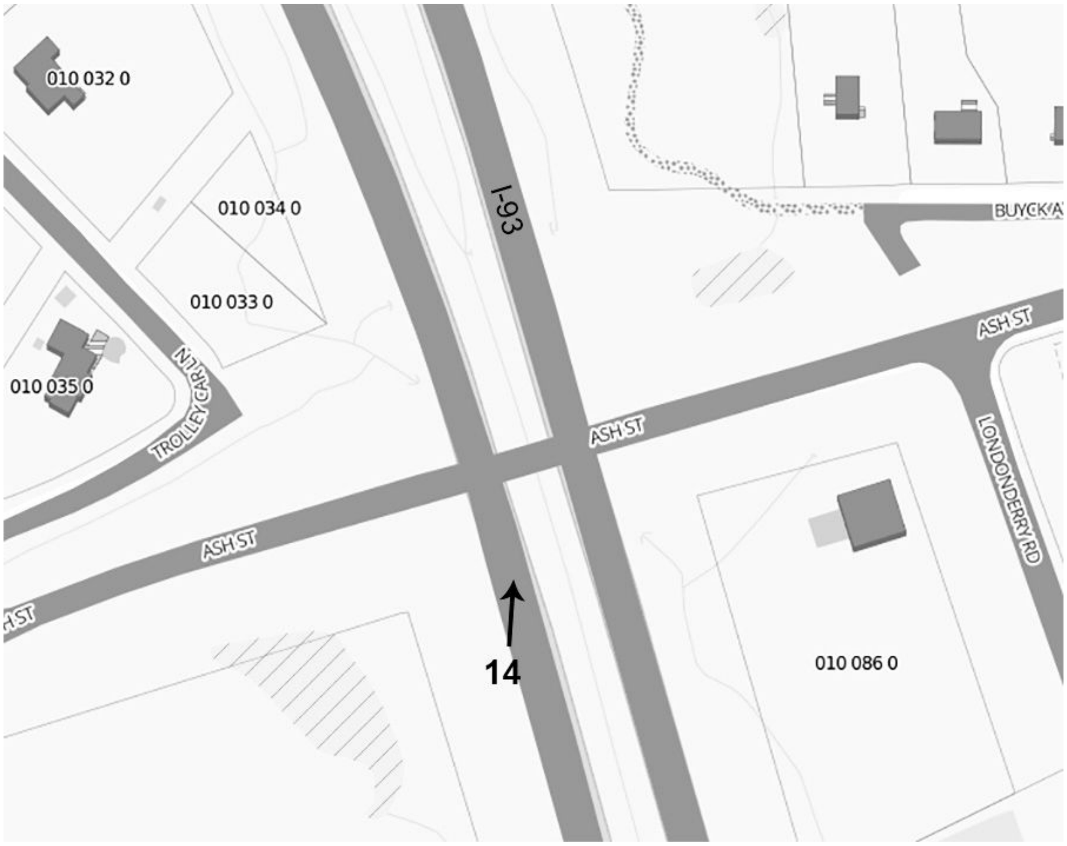


Photo Key 3 – Photo 14

Photo Key 4 – Photos 15-18

Date of Photography: August 2016

Photo 01: Rosencrans Pillsbury House, 22 Pillsbury Rd., abandoned and overgrown (**LON-WO**, Woodmont Orchard Historic District)
File Name: LON_2016_01 Direction: SW

Photo 02: Garage, 22 Pillsbury Rd., abandoned and overgrown (**LON-WO**, Woodmont Orchard Historic District)
File Name: LON_2016_02 Direction: NW

Photo 03: Equipment Shed, 22 Pillsbury Rd., roof collapsed (**LON-WO**, Woodmont Orchard Historic District)
File Name: LON_2016_03 Direction: WSW

Photo 04: Woodmont House #1, 1 Pillsbury Rd., abandoned and overgrown (**LON-WO**, Woodmont Orchard Historic District)
File Name: LON_2016_04 Direction: W

Photo 05: Hawkes-Lievens House, 15 Appletree Ln., abandoned and overgrown (**LON-WO**, Woodmont Orchard Historic District and **LON0100**)
File Name: LON_2016_05 Direction: NE

Photo 06: Woodmont House #3, 1 Pillsbury Rd., no changes (**LON-WO**, Woodmont Orchard Historic District)
File Name: LON_2016_06 Direction: NW

Photo 07: Woodmont Packing/Equipment Shed, 1 Pillsbury Rd., no changes (**LON-WO**, Woodmont Orchard Historic District)
File Name: LON_2016_07 Direction: S

Photo 08: Woodmont Packing/Equipment Shed, 1 Pillsbury Rd., no changes (**LON-WO**, Woodmont Orchard Historic District)
File Name: LON_2016_08 Direction: SE

Photo 09: Woodmont Packing/Equipment Shed, 1 Pillsbury Rd., no changes (**LON-WO**, Woodmont Orchard Historic District)
File Name: LON_2016_09 Direction: NW

Photo 10: Landscape, off Pillsbury Rd., no changes (**LON-WO**, Woodmont Orchard Historic District)
File Name: LON_2016_10 Direction: SE

Photo: 11: Reed Paige Clark Homestead, Stonehenge House, 79 Stonehenge Road (**LON0114**)
File Name: LON_2016_11 Direction: NW

Photo 12: Reed Paige Clark Homestead, Stonehenge House, 79 Stonehenge Road (**LON0114**)
File Name: LON_2016_12 Direction: SSE

Photo: 13: Reed Paige Clark Homestead, Stonehenge House, 79 Stonehenge Road (**LON0114**)
File Name: LON_2016_13 Direction: SW

Photo 14: Ash Street Bridge (Robert J. Prowse Memorial Bridge) over Interstate 93 (**LON0116**)
File Name: LON_2016_14 Direction: N

Photo 15: 99 Rockingham Road, turned columns and frieze added to overhanging eave on façade, no other changes noted (**LON0103**)
File Name: LON_2016_19 Direction: SW

Photo 16: 117 Rockingham Road, no changes (**LON0105**)
File Name: LON_2016_21 Direction: NW

Photo 17: 118 Rockingham Road, landscaping has been removed, no other changes (**LON0107**)
File Name: LON_2016_23 Direction: E

Photo 18: 113 Rockingham Road, no changes (**LON0117**)
File Name: LON_2016_26 Direction: W

THE STATE OF NEW HAMPSHIRE
DEPARTMENT OF TRANSPORTATION

New Hampshire DOT Department of Transportation

Victoria F. Sheehan
Commissioner

William Cass, P.E.
Assistant Commissioner

LETTER OF TRANSMITTAL

Date: July 2, 2018
Bureau: Environment
Project: Derry-Londonderry
Project No: 13065
IM-0931(201)
RPR 2772

TO: Megan Rupnik
NH Division of Historical Resources
19 Pillsbury Street
Concord, NH 03301

WE ARE SENDING YOU ☒Attached ☐Under separate cover via the following items:

COPIES	DATE	DESCRIPTION
		Individual Inventory Forms:
1	2018	DER0193 – 11 Madden Road, Derry
1	2018	DER0194 – 2 Ferland Drive, Derry
1	2018	DER0195 – 12 Folsom Road, Derry
1	2018	DER0196 – 3 Manchester Road, Derry
1	2018	DER0197 – 80 Chester Road, Derry
1	2018	Franklin Terrace Historic Area Form, Derry

THESE ARE TRANSMITTED as checked below:

☐ For approval
☐ For your use
☐ As requested
☒ For review

☐ Approved as submitted
☐ Approved as noted
☐ Returned for corrections
☐

REMARKS: Megan, please find enclosed the above area form updates for review at the next DOE meeting.

Please let me know if you have any questions.

Jill Edelmann
Cultural Resources Manager
Bureau of Environment
Room 160 – Tel. 271-7968

cc. Jamie Sikora, FHWA

S:\Environment\PROJECTS\DERRY\13065\Cultural\Architectural\2018 Updates\trDHR NewInventories 7.3.2018.docx

INDIVIDUAL INVENTORY FORM **NHDHR INVENTORY DER0193**

Name, Location, Ownership

1. Historic name: None
2. District or area: None
3. Street and number: 11 Madden Road
4. City or town: Derry
5. County: Rockingham
6. Current owner: Marcia Abbott

Function or Use

7. Current use(s): Single dwelling
8. Historic use(s): Single dwelling

Architectural Information

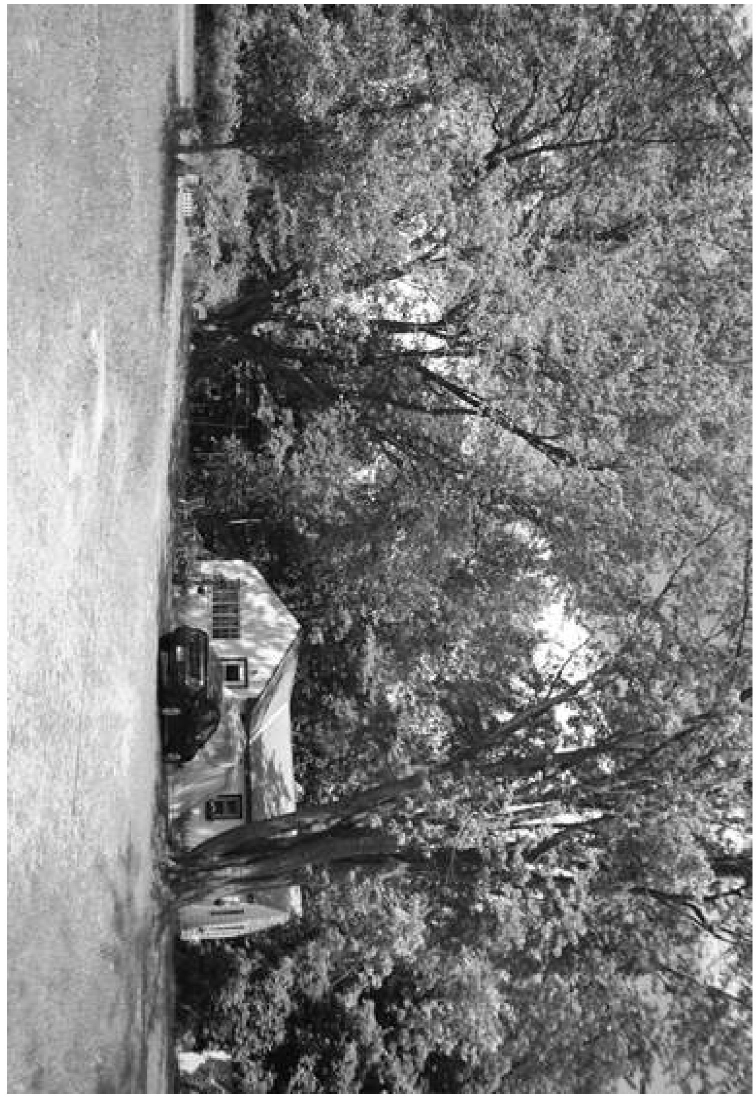
9. Style: Ranch style
10. Architect/builder: Unknown
11. Source: None
12. Construction date: ca. 1955
13. Source: Research, Inspection
14. Alterations, with dates: Vinyl siding, date unknown
15. Moved? no ☒ yes ☐ date: N/A

Exterior Features

16. Foundation: concrete
17. Cladding: vinyl
18. Roof material: asphalt shingles
19. Chimney material: concrete block
20. Type of roof: cross gable
21. Chimney location: rear wall
22. Number of stories: 1
23. Entry location: Façade, off-center
24. Windows: Casement, 1/1 double-hung, 2/2 double-hung
    Replacement? no ☒ yes ☐ date: N/A

Site Features

25. Setting: Mixed use neighborhood
26. Outbuildings: Shed, storage
27. Landscape features: Garden, flower; mature trees
28. Acreage: 2.01 acres
29. Tax map/parcel: 31/12



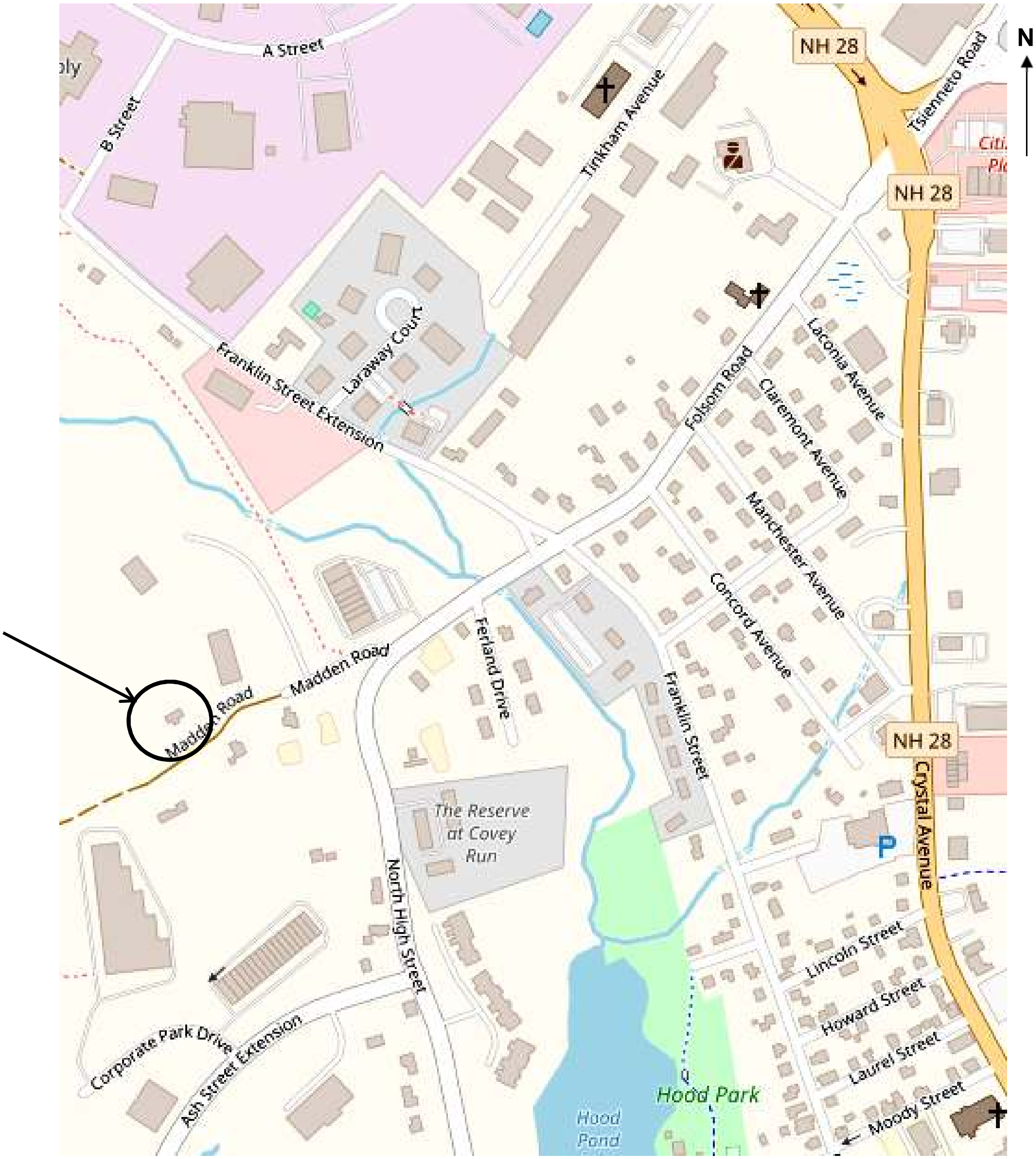
35. Photo 1: Façade and gravel drive Direction: WNW
36. Date: June 2018
37. Reference (file name): Photo_June2018_164

30 State Plane Feet (NAD83): X: 1072995.949621; Y: 141803.708127
31. USGS quadrangle and scale: Derry, NH, 1:24000

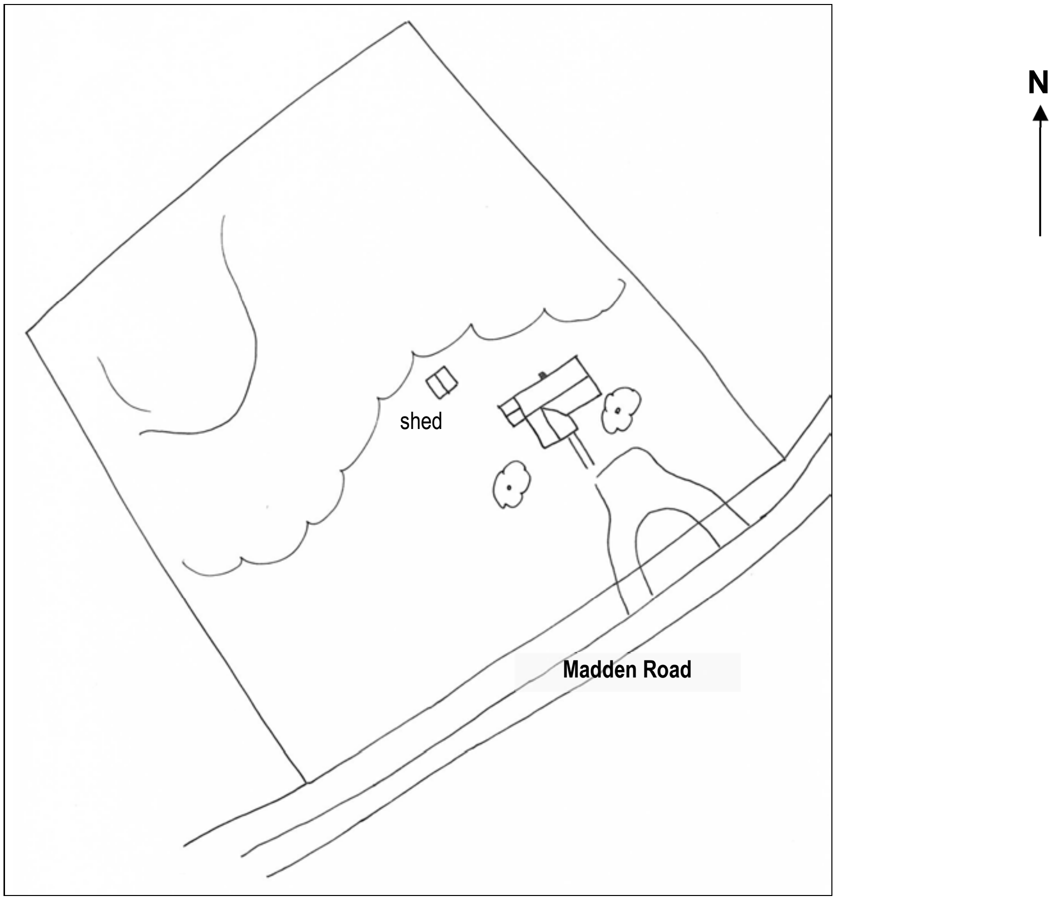
Form prepared by

32. Name: Reagan Ruedig, Lynne Monroe
33. Organization: Preservation Company, Kensington, NH
34. Date of survey: June 2018

39. Location Map



40. Property Map



Property map showing all buildings and surveyed area (tax map parcel)

41. Historical Background and Role in the Town or City's Development

The house at 11 Madden Road was constructed in 1955 behind the older Madden farmhouse that was demolished at about the same time. The 1892 Hurd Atlas shows "J. Madden" at this location, and USGS maps and historic aerial photographs show a house fronting Madden Road until at least 1952 (see below). James Madden (ca. 1819-1896), a farmer from Ireland, lived in the old house from 1854 on land that straddled the Derry/Londonderry border (Deed 359: 356). The road known as Old Folsom Road had become Madden Road by the early twentieth century.

James Madden's son, William F. Madden (1871-1959), began to subdivide the Madden property in the 1950s. The first lot subdivided was his father's house on a lot of approximately two acres, which he sold to Nellie B. Kimball in 1952 (Deed 1241: 297). Two years later, in 1954, the Tinkham family purchased that lot (Deed 1331: 163). Wendell W. and Sylvia I. Tinkham were from Derry. Wendell was in the U.S. Navy during World War II. According to the current owner, Marcia Abbott, the Tinkhams demolished the old Madden farmhouse and constructed the smaller, 1-story house being surveyed.

In 1961, the Tinkhams sold the house to William E. and Kathleen L. Mahoney of Everett, MA (Deed 1602: 491). Their ownership was brief, as they sold it to Millard C. and Marcia E. Abbott in 1963 (Deed 1695: 86). Millard Abbott died in 1981, and Marcia Abbott is the current owner and resident.

This area of Derry lies between the tracks of the Manchester and Lawrence railroad and the Londonderry town line; it was remote farmland for much of the nineteenth and early twentieth centuries. A couple of small houses were constructed on the south side of the road in the mid-twentieth century. Development along North High Street and Folsom Road increased in the second half of the twentieth century, and by 2000 large areas of woods had been cleared for industrial warehouses located on the north and east sides of the house, though dense trees and vegetation help to screen Madden Road and maintain the earlier rural feel of the area.

42. Applicable NHDHR Historic Contexts (please list names from appendix C)

131. Suburban/bedroom community growth in New Hampshire, c. 1850-present

43. Architectural Description and Comparative Evaluation

The house at 11 Madden Road is a minimal Ranch style house with a cross-gabled roof, set back approximately 90 feet from the road. The house is clad in yellow vinyl siding, with brown asphalt shingles on the roof, and rests on a concrete foundation. The main entrance is in the front gable, set on the west side of the house, with a secondary entrance in a smaller wing addition on the west side. Adjacent to the main entry door is a row of five, six-light wooden casement windows. Elsewhere the house has 1/1 (on the façade) and 2/2 horizontal-light (on the rear) wooden double-hung windows covered with aluminum storm windows. Both doorways have modern, steel storm doors. A concrete block flue was added to the rear wall on the east end.

What trim detail might have existed originally has been thoroughly covered or removed by the addition of vinyl siding, likely installed in the 1990s. The eaves and fascia boards are squared and simple, and the doors and windows are framed with flat-stock trim. Simple window boxes are hung beneath the four double-hung windows to the east of the door on the façade. A pathway of modern brick pavers leads from the semicircular gravel driveway to the front door, and there is a concrete patio area in front of the secondary doorway on the west side of the front gable.

Two large silver maples, which were planted in the early 1960s, are sited at the front corners of the house. There are flower gardens in the front of the house, and a small vegetable garden to the west. There is a small wood, gabled storage shed (likely constructed at the same time as the house) northwest of the house and a modern, plastic shed to the east. The rear of the parcel is thickly wooded, and there are trees along the east edge of the property that provide a buffer from the surrounding industrial buildings.

This minimal Ranch is not typical or exemplary of the Ranch style and is not similar to any buildings in the immediate area. Derry experienced a period of major growth in the mid-twentieth century, and there are many other examples of buildings that better represent the Ranch style, such as the houses along Newell Drive and Kingsbury Road in Derry Village.

44. National or State Register Criteria Statement of Significance

Criterion A: This property is not eligible under Criterion A because it is not associated with any event that has made a significant contribution to broad patterns in history. This house was constructed during a major building boom in Derry, but it is not part of a planned development or part of that trend in the mid-twentieth century.

Criterion B: This property is not associated with a historically significant person. It is the site of the farm of James Madden, an Irish immigrant who became a local farmer in Derry in 1854, but the buildings associated with his residency are gone. It is not eligible under Criterion B.

Criterion C: This house does not represent a distinctive type of architecture or work of a master. The Ranch house is a common house type in Derry, and this house neither exhibits a fully articulated expression of the Ranch style nor does it retain sufficient integrity to communicate its original design. Therefore it is not eligible for the National Register under Criterion C.

45. Period of Significance

None

46. Statement of Integrity

The property at 11 Madden Road retains its integrity of location and setting. However, the house has lost its integrity of design, materials, and workmanship due to the addition of vinyl siding, which covers any trim details that might have existed originally. The footprint of the building has not changed and there are some original windows. Even though development has encroached on the area in the north and east, the thick buffer of trees and vegetation maintains the character of the setting of the small house on a grassy lot with mature trees surrounded by woods.

47. Boundary Discussion

The tax parcel (Map 31, lot 12) was used as the boundary of the area surveyed for this form. This property is not eligible for the National Register, so an eligible boundary discussion is not necessary.

48. Bibliography and/or References

Pettis, Emily et al.
2012 *NCHRP Report 723: A Model for Identifying and Evaluating the Historic Significance of Post-World War II Housing*. Transportation Research Board: Washington, D.C.

<u>Deeds</u>
Rockingham County Registry of Deeds

Book 359, page 356	5/31/1854
Book 1241, page 297	3/24/1952
Book 1331, page 163	7/30/1954
Book 1602, page 491	10/11/1961
Book 1695, page 86	10/24/1963
Book 2932, page 2232	7/2/1992

<u>Historic Maps</u>
Hurd, D. H. & Co.
1892 Town and City Atlas of the State of New Hampshire. Boston: Hurd & Co.

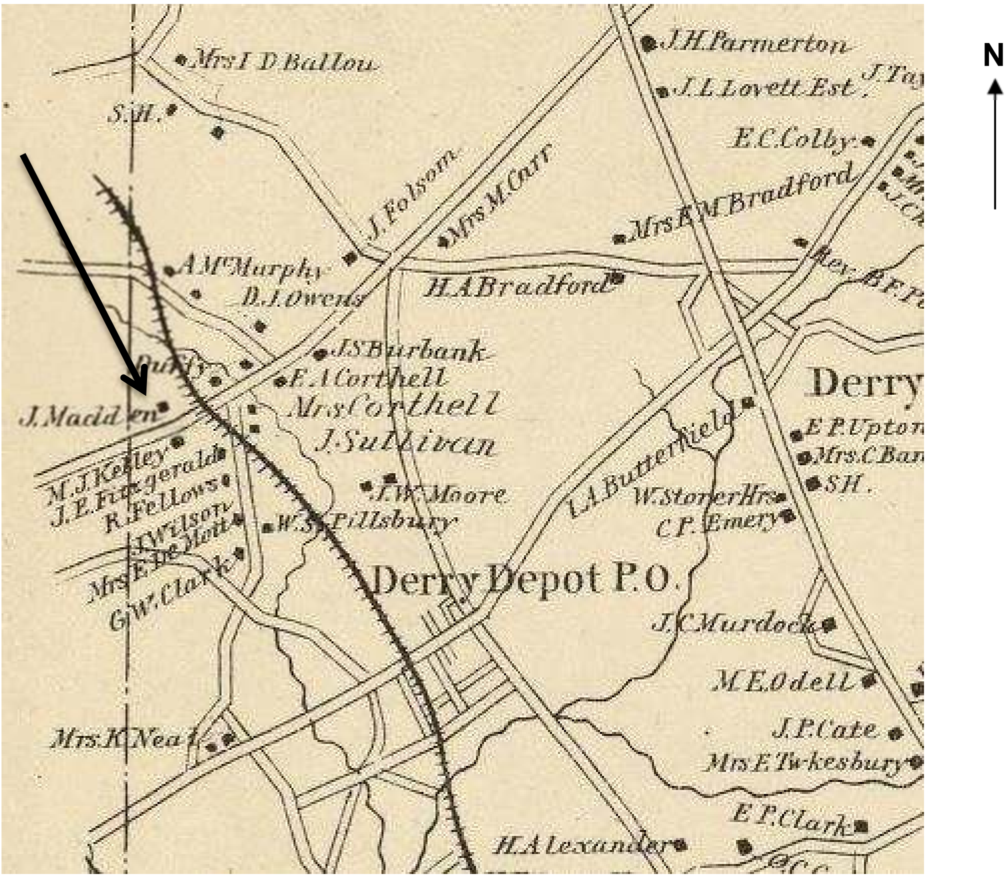
United States Geological Service
1968 Derry, NH quadrangle (www.usgs.com)

<u>Electronic Resources</u>
Ancestry.com: www.Ancestry.com
NETRonline: www.historicaerials.com

Surveyor's Evaluation

NR listed:	individual	☐	NR eligible:			NR Criteria:	A	☐
	within district	☐		individual	☐		B	☐
				within district	☐		C	☐
Integrity:	yes	☐		not eligible	☒		D	☐
	no	☒		more info needed	☐		E	☐

Historic Maps



Detail of 1892 D.H. Hurd Atlas of Derry, arrow showing the location of J. Madden on what is now Madden Road

Historic aerial photograph from 1952 showing Madden Road (the earlier James Madden farmhouse circled)

Historic aerial photograph from 1965 showing Madden Road (11 Madden Road circled)

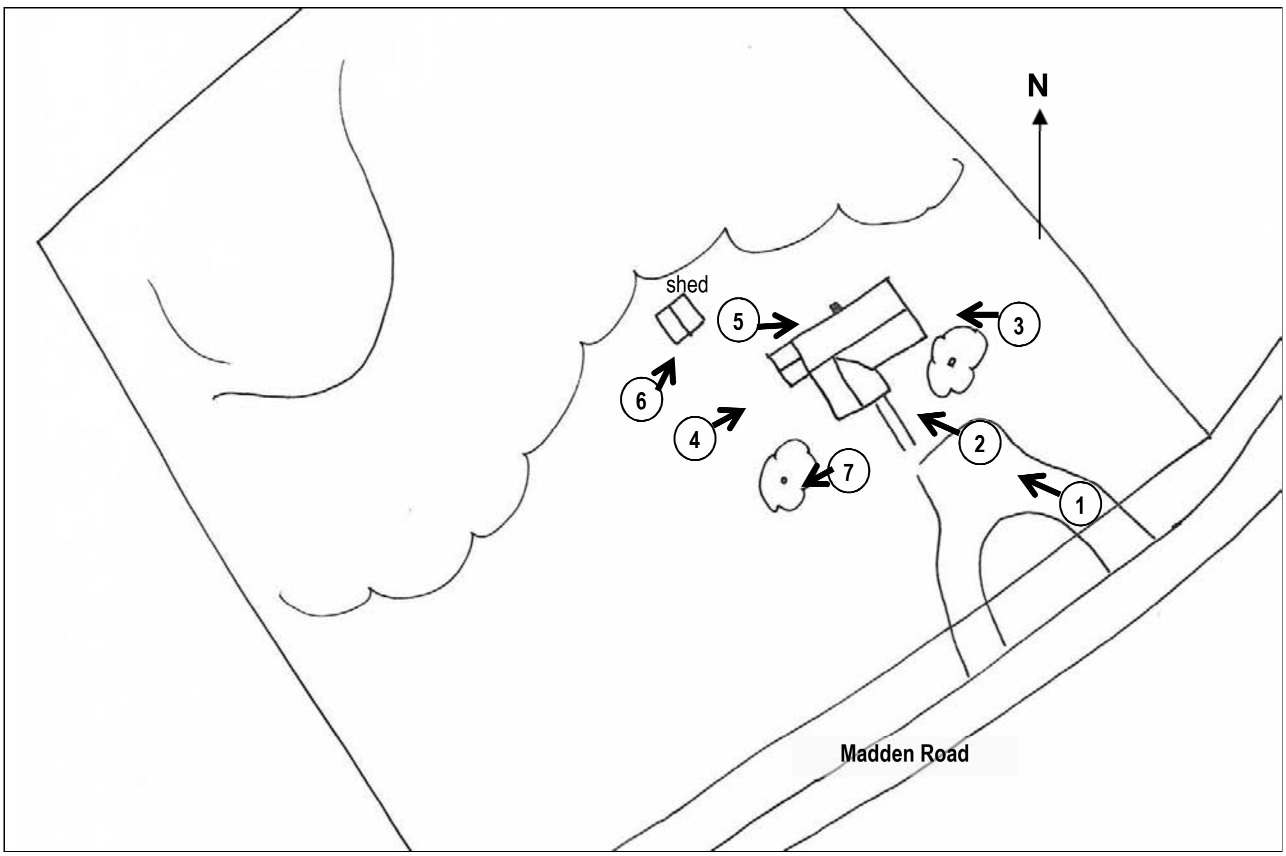
Detail of 1968 USGS map of Derry, NH quadrangle, arrow showing location of 11 Madden Road

Digital Photography Statement

I, the undersigned, confirm that the photos in this inventory form have not been digitally manipulated and that they conform to the standards set forth in the NHDHR Photo Policy. These photos were printed using the following: Epson SureColor P600 printer on Epson Ultra Premium Photo Paper, glossy. The digital files are housed with Preservation Company in Kensington, NH.

Lynne Emerson Monroe, Preservation Company

Photo Key



Current Photographs

Date taken: June 2018

Photo 2) Front door on façade Direction: WNW
Reference (file name): Photo_June2018_175

Photo 3) Façade and east elevation Direction: W
Reference (file name): Photo_June2018_173

Photo 4) West elevation Direction: NE
Reference (file name): Photo_June2018_168

Photo 5) North (rear) and west elevations Direction: ESE
Reference (file name): Photo_June2018_169

Photo 6) Shed in rear of house Direction: N
Reference (file name): Photo_June2018_167

Photo 7) Side yard looking west Direction: W
Reference (file name): Photo_June2018_165

INDIVIDUAL INVENTORY FORM NHDHR INVENTORY DER0194

Name, Location, Ownership

1. Historic name: None
2. District or area: N/A
3. Street and number: 2 Ferland Drive
4. City or town: Derry
5. County: Rockingham
6. Current owner: Ronald S. and Christine M. Randall

Function or Use

7. Current use(s): Single dwelling
8. Historic use(s): Single dwelling

Architectural Information

9. Style: Ranch style
10. Architect/builder: Unknown
11. Source: N/A
12. Construction date: 1967
13. Source: Research, Inspection
14. Alterations, with dates: Vinyl siding and replacement windows, dates unknown
15. Moved? no ☒ yes ☐ date: N/A

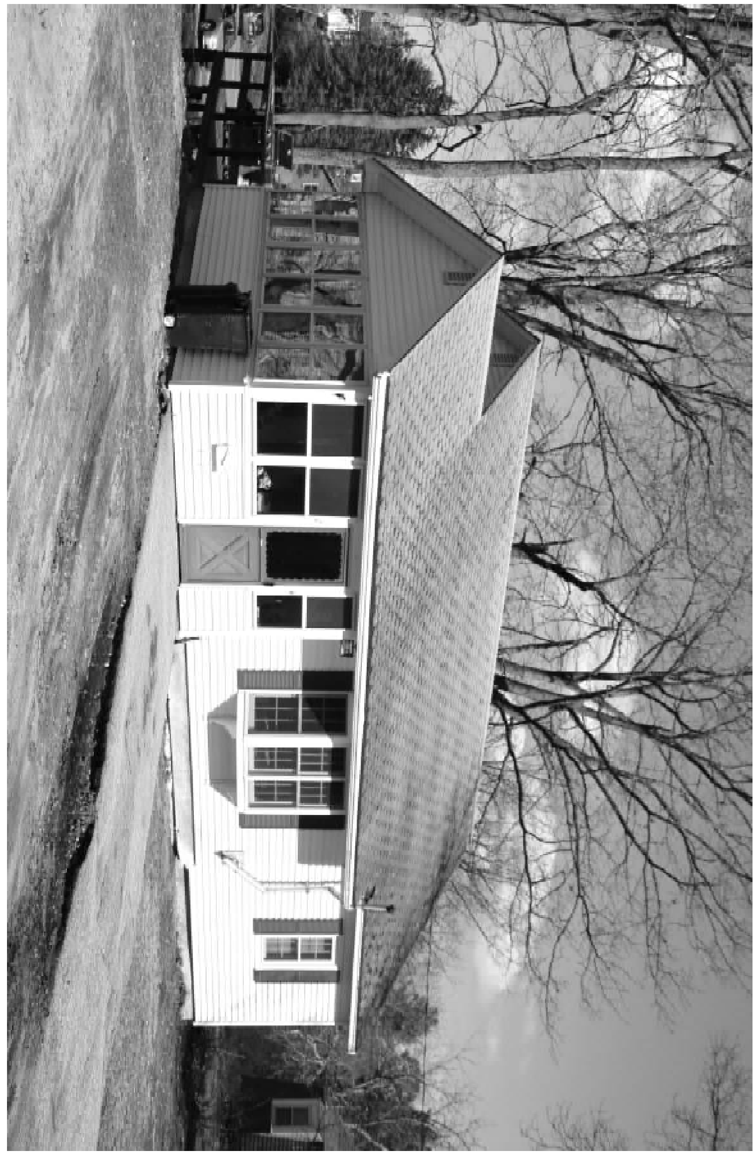
Exterior Features

16. Foundation: concrete, poured
17. Cladding: vinyl
18. Roof material: asphalt shingles
19. Chimney material: brick
20. Type of roof: gable
21. Chimney location: rear wall
22. Number of stories: 1½
23. Entry location: façade, off-center
24. Windows: 6/6 double-hung, 2/2 double-hung, casement, picture

    Replacement? no ☒ yes ☒ date: unknown

Site Features

25. Setting: City/town neighborhood
26. Outbuildings: Shed, storage
27. Landscape features: Stream
28. Acreage: 0.56 acres
29. Tax map/parcel: 31/15



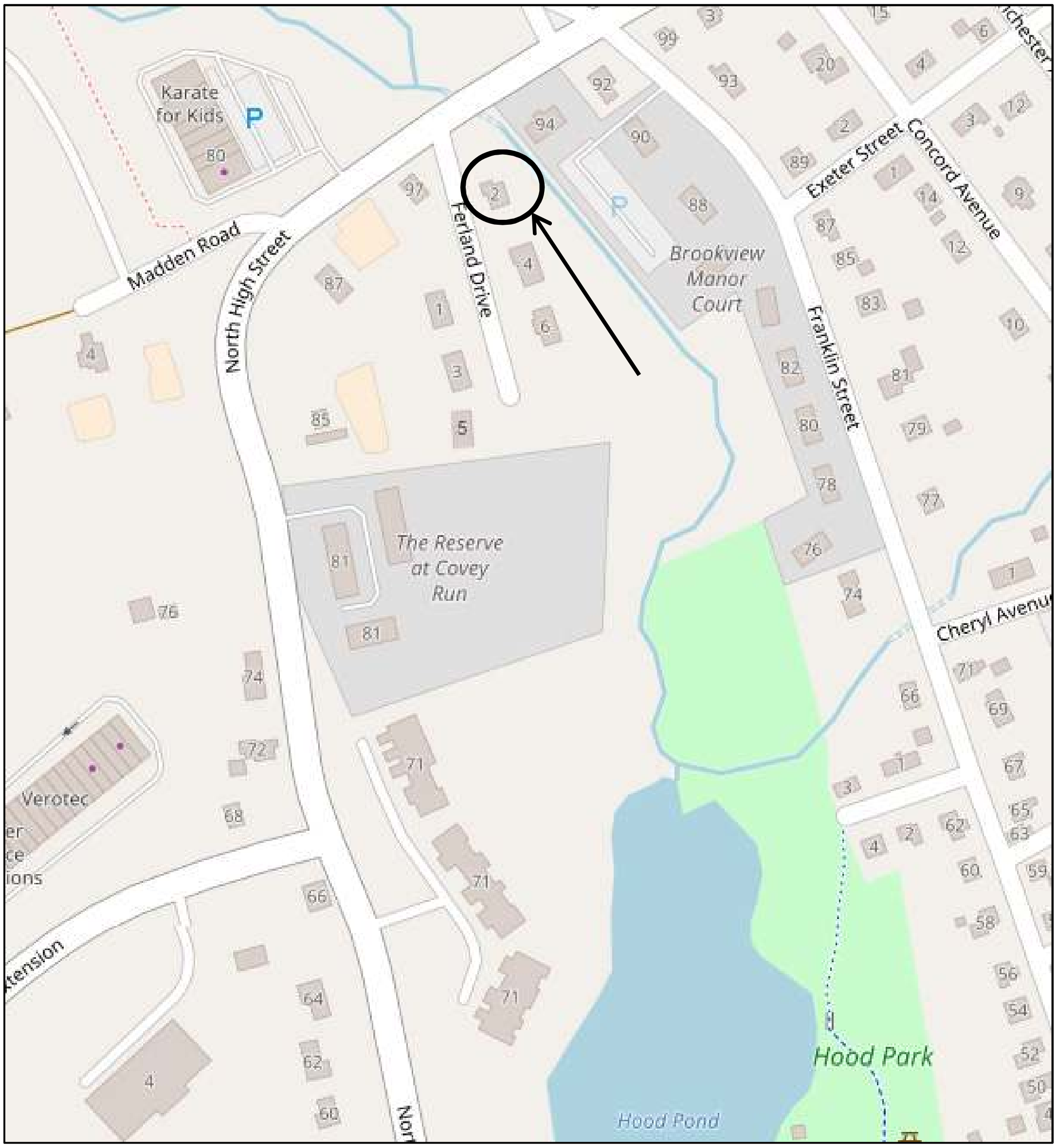
35. Photo 1: Façade and north elevation Direction: SE
36. Date: April 2018
37. Reference (file name): Photo_April2018_717

30. State Plane Feet (NAD83): X: 1073982.172922; Y: 142095.274250
31. USGS quadrangle and scale: Derry, NH, 1:24000

Form prepared by

32. Name: Reagan Ruedig, Lynne Monroe
33. Organization: Preservation Company, Kensington, NH
34. Date of survey: June 2018

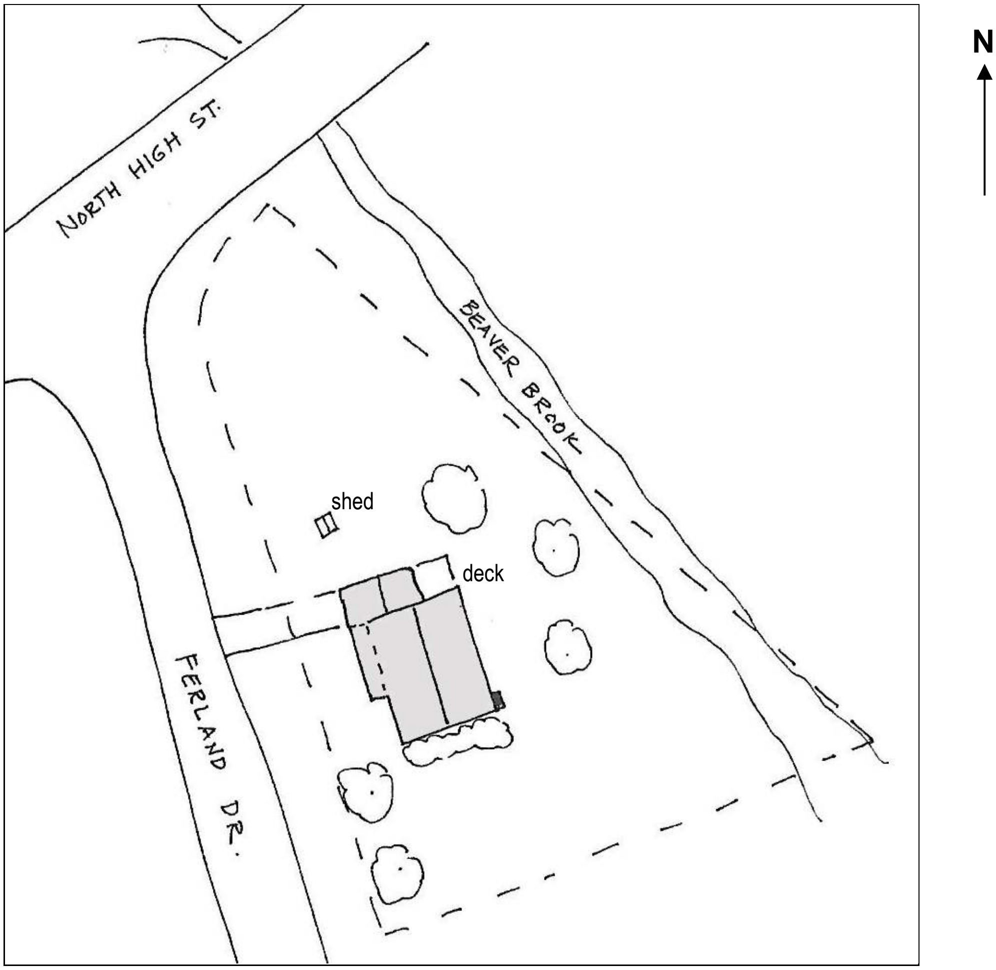
39. Location Map



N

© OpenStreetMap contributors

40. Property Map



Property map showing all buildings, setting and tax map/parcel (dashed line)

41. Historical Background and Role in the Town or City's Development

The house at 2 Ferland Drive was constructed in 1967 by a local builder, Roland Ferland, who subdivided and developed Ferland Drive.

Roland J. Ferland (1929-2004) and his wife, Pauline, moved to Derry from Sanford, Maine, in 1955 and purchased 97 North High Street (Deed 1353: 224, Photo 13).[1] Ferland became a builder in the region, his company was called the Roland Ferland Construction Company. In the mid-twentieth century, Derry experienced a rapid rise in population, and Ferland took advantage of the associated building boom. His company built utilitarian homes, duplexes, and multifamily units primarily in Derry but also in Windham and Hudson (David J. Ferland interview, 2018). Research indicates that he was most active in the 1970's building primarily individual homes and duplexes or clusters of two or three as infill, rather than full neighborhoods. Although he was not a prominent builder, he served as president of the New Hampshire Home Builders Association in 1976 (Lambert Funeral Home Obituary 2004).

In 1962 Ferland purchased the three-acre lot adjoining his property at 97 North High Street and shortly thereafter filed plans for a road and four lots (Deed 1621: 302, Plan 852, see below). The subdivision plan includes the old house where he lived at 97 North High Street as Lot 1, lots 2 and 3 on Ferland Drive, and a fourth lot (not numbered) south of Lot 1. Over time, his family and business located on Ferland Drive.

In 1967-68 Ferland built houses at 1 Ferland Drive, (on the fourth, unnumbered lot, Photo 7) and 2 Ferland Drive (on Lot 2, Photos 1-6). The Ferland family, including three young children, moved into the new house at 1 Ferland Drive, and Roland Ferland's mother in law, Elise Barrieau, lived in 2 Ferland Drive. Roland and Pauline maintained ownership of this house until his daughter and son-in-law, Jacqueline and Paul Kramer, bought it in 1996 (Deed 3152: 1505; David J. Ferland interview, 2018). Eventually the family moved across the street into the larger house at 4 Ferland Drive (Photos 8, 9). In 1974, the lots further south on Ferland Drive were subdivided and developed (Plan 4523), creating 3 and 6 Ferland Drive (Photos 10, 11), which were constructed as apartment buildings. In 2004, the Kramers sold the house at 2 Ferland Drive to Ronald and Christine Randall, the current owners (Deed 4351: 2662). 5 Ferland Drive was constructed much later, in 2014, after the Ferland family had left the area (Photo 12).

In the late 1970s and early 1980s, Roland Ferland also purchased and developed lots nearby on Franklin Street, where there is now a row of multi-unit buildings named "Brookview Manor Court" (76-90 Franklin Street, 99 North High Street, see plan D-9948). These are split/bi-level buildings, a common type of the era seen throughout Derry and southern New Hampshire (Photos 14, 15). In 2001 Roland Ferland and his son, David, developed "Water View Estates" at 71 North High Street along Hood Pond (Plan 29779). Deeds indicate that Ferland had developed or renovated single or double lots in various other places in Derry, but most of his development was concentrated in the area near Ferland Drive. He built similar buildings in the nearby towns of Windham and Hudson (David J. Ferland interview, 2018).

42. Applicable NHDHR Historic Contexts (please list names from appendix C)

131. Suburban/bedroom community growth in New Hampshire, c. 1850-present

[1] The Ferlands lived at 97 North High Street for thirteen years. It is a 1½ story sidehall, ca. 1888, that was surveyed in 1999 and found not eligible in 2002, DER0160.

43. Architectural Description and Comparative Evaluation

The house at 2 Ferland Drive is a Ranch in the minimal Traditional style. It is sited facing west, with the façade on the long side facing Ferland Drive; the land drops to the rear allowing a full story facing Beaver Brook. The house rests on a poured concrete foundation and is clad in white vinyl siding with a gabled, asphalt shingle roof. Green vinyl shutters flank the windows on three elevations excepting the rear, and there is a wide brick chimney on the south end of the east, (rear) wall. There is a smaller wing enclosing a porch on the north elevation; with a low gabled roof that shares the western slope of the main roof. The eave line on the façade projects over the porch and bay window and recesses over the remaining bay.

The windows display a combination of vinyl double-hung windows (date unknown) on the first floor level and original 2/2 horizontal-light double-hung sash protected by storm windows on the rear, basement level. The façade has a central bay window with 6/6 windows supported by two brackets and a single 6/6 window to the south. The north elevation contains a large, vinyl picture window with simulated divided lights. There is single casement window on the rear, first floor level. The porch has a series of 1/1 storm windows on three sides.

The main entrance is through the enclosed porch on the north side, with a second door into the living space and another accessing a wood deck. The basement door on the rear elevation is located at ground level.

The paved driveway runs directly from the street to the face of the enclosed porch with a gravel parking area just to the north. A modern storage shed, added ca. 2010, is located to the north of the house, facing the gravel parking area.

<u>Other Houses on Ferland Drive</u>

The other houses on Ferland Drive that were built by Roland Ferland are different types, forms, and styles. They are now all multi-unit residences, though 1 and 4 Ferland Drive were originally single-family houses.

- 1 Ferland Drive, built in 1967, (Photo 7) is a simple, Twentieth-century Cape with no Colonial Revival detail. It has vinyl siding and shutters and the eaves extend. The attached garage now has a basement apartment.
- 4 Ferland Drive, built in 1968 (Photos 8, 9) has the form of a ranch but with a cross-gable and integrated two-car garage but an above ground level under the rear pile. The gambrel roof of the cross-gable section on the north end extends to the ground, like a barn. The integral two-bay garage on the south end has applied cross-battens mimicking barn doors. It is sided with a combination of vertical wood siding and wood shingles.[2] There are two driveway areas: an asphalt drive at street level connecting directly to the garage doors, and another concrete driveway on the south side that is sloped steeply to the lower ground level at the rear of the house, a full story in height. The concrete area extends to 6 Ferland Drive, and substantial concrete retaining walls were built to support the yards at each side. This wide drive was for the purpose of parking the trucks and machinery associated with Roland Ferland Construction Company.

[2] According to Roland Ferland's son, 4 Ferland Drive was named the "Home of the Year", year unknown, by the Nashua Local Group of the NH Homebuilders Association. The NHHA didn't become a statewide organization until 1973 (Sharon Wayman interview, 2018). The unusual design was created by Roland Ferland (David J. Ferland interview, 2018).

- 3 and 6 Ferland Drive added after 1973 were constructed as apartment buildings. 6 Ferland Drive, built in 1974 (Photo 10), is a cross-gabled Ranch clad in green aluminum siding, white shutters and replacement windows. The driveways on each side slope to the above grade basement level, and there are concrete retaining walls lining the edges to support the front yard.
- 3 Ferland Drive (Photo 11) built in ca. 1975 combines a number of forms common to housing of the period: bi-level split-level ranch with a "wounded dove" shallow cross-gable, garrison overhang between the stories. It is clad in red aluminum siding with white shutters and replacement windows. Both 3 and 6 Ferland Drive are under ownership and management of Brookview Manor Court, Inc., which also owns the apartment buildings developed by Ferland at 76-90 Franklin Street.
- 5 Ferland Drive (Photo 12) is a two-story, two-family building with a lower garage level constructed in 2014. It sits on a large, irregular parcel that contains wetlands behind the apartment buildings along Franklin Street. There was previously a circular turnaround at the end of Ferland Drive on this lot as well as a mobile home or storage containers (see 2008 satellite photograph).

Ferland's development of apartment buildings along Franklin Street, Brookview Manor Court, is a series of split-level or two-story, multi-family buildings with brick lower and a vinyl-sided upper stories. Each has a central entrance in a shallow projection on the façade (Photos 14, 15).

44. National or State Register Criteria Statement of Significance

2 Ferland Drive is not eligible for the National Register because it does not retain integrity necessary for eligibility status, nor does it individually meet any of the Criteria. Because it was constructed on a lot that was originally a family subdivision, the surrounding properties were also identified and considered as a possible district. However, the development of the Ferland land does not demonstrate a particular aspect of the historic context or theme for Derry, nor does the group as a whole represent a cohesive neighborhood that exemplifies local patterns or architectural distinction.

Criterion A: The house at 2 Ferland Drive was built by a local homebuilder and was one of the first houses he constructed as part of his own land development. This house was built for his family, not as part of his later subdivisions. He developed several lots in the immediate area between 1967 and 1975, and while they are of local interest, they are not collectively of sufficient age to interpret the trend in Derry. There are several more notable subdivisions and neighborhoods in Derry from this era that more clearly exemplify the post-World War II building boom. Therefore, 2 Ferland Drive is not eligible for the National Register under this Criterion as an example of this trend of home construction at the end of the twentieth century in Derry, New Hampshire.

Criterion B: The house at 2 Ferland Drive is not eligible under this Criterion as it is not associated with a historically significant person. Roland J. Ferland was a local homebuilder who developed a number of lots on the area between North High Street and Franklin Street. He also built a number of houses and multi-family dwellings in the region that are not significant architecturally. Although he served as president of the New Hampshire Home Builders Association for one year, his work is not distinctive as a whole.

Criterion C: The house at 2 Ferland Drive does not represent a distinctive style of architecture or work of a master. The Ranch form house is a common house type in Derry, and this house neither exhibits a fully articulated expression of the Ranch style nor does it retain sufficient integrity to communicate its original design. Therefore, this property is not eligible for the National Register under Criterion C.

45. Period of Significance

None

46. Statement of Integrity

The house at 2 Ferland Drive retains integrity of location and setting. However, its integrity of materials and workmanship has been lost by the installation of vinyl siding, shutters, and replacement windows as well as the enclosure of the porch. Any original design details have been removed or covered, and only four original windows remain on the rear. The integrity of design remains in that the footprint and general massing of the building has not changed. The property retains integrity of feeling as it remains residential, but the association with the Ferlands is now gone as the property was sold out of the family in 2004.

47. Boundary Discussion

The tax parcel (Map 31, lot 15) was used as the boundary of the area surveyed for this form (see Property Map). This property is not eligible for the National Register, so an eligible boundary discussion is not necessary.

48. Bibliography and/or References

Ferland, David J.
2018 Telephone interview, June 28

Lambert Funeral Home
2004 Obituary of Roland J. Ferland (http://lambertfuneralhome.tributes.com/obituary/show/Roland-J.-Ferland-570612)

Pettis, Emily et al.
2012 *NCHRP Report 723: A Model for Identifying and Evaluating the Historic Significance of Post-World War II Housing*. Transportation Research Board: Washington, D.C.

Sharon Wayman, New Hampshire Builders Association
2018 Telephone interview, July 2

<u>Deeds</u>
Rockingham County Registry of Deeds
Book 1075, page 337 4/18/1947
Book 1353, page 224 5/7/1955
Book 1621, page 302 3/26/1962
Plan 852 11/1965
Book 1850, page 132 12/20/1967

Book 2212, page 1869	10/25/1973
Plan D-4523	12/1973
Plan D-9948	10/1980
Book 3152, page 1505	04/30/1996
Plan 29779	09/2001
Book 4351, page 2662	08/25/2004

<u>Historic Maps</u>
United States Geological Service
1968, 1985 Derry, NH quadrangle (www.usgs.com)

<u>Electronic Resources</u>
Ancestry.com: www.Ancestry.com
NETRonline: www.historicaerials.com
Google Earth: www.google.com/earth

Surveyor's Evaluation

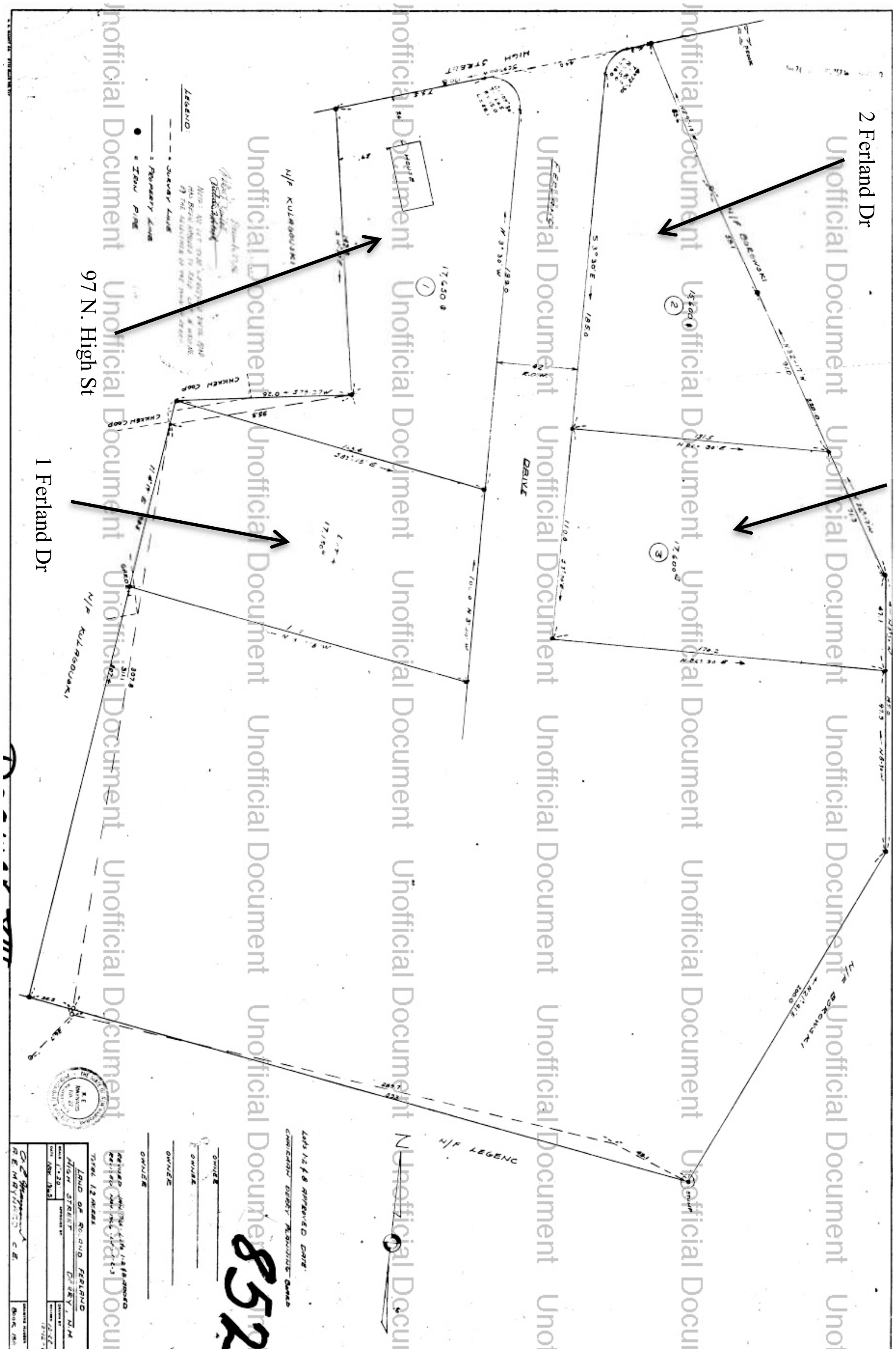
NR listed: individual ☐
within district ☐

Integrity: yes ☐
no ☒

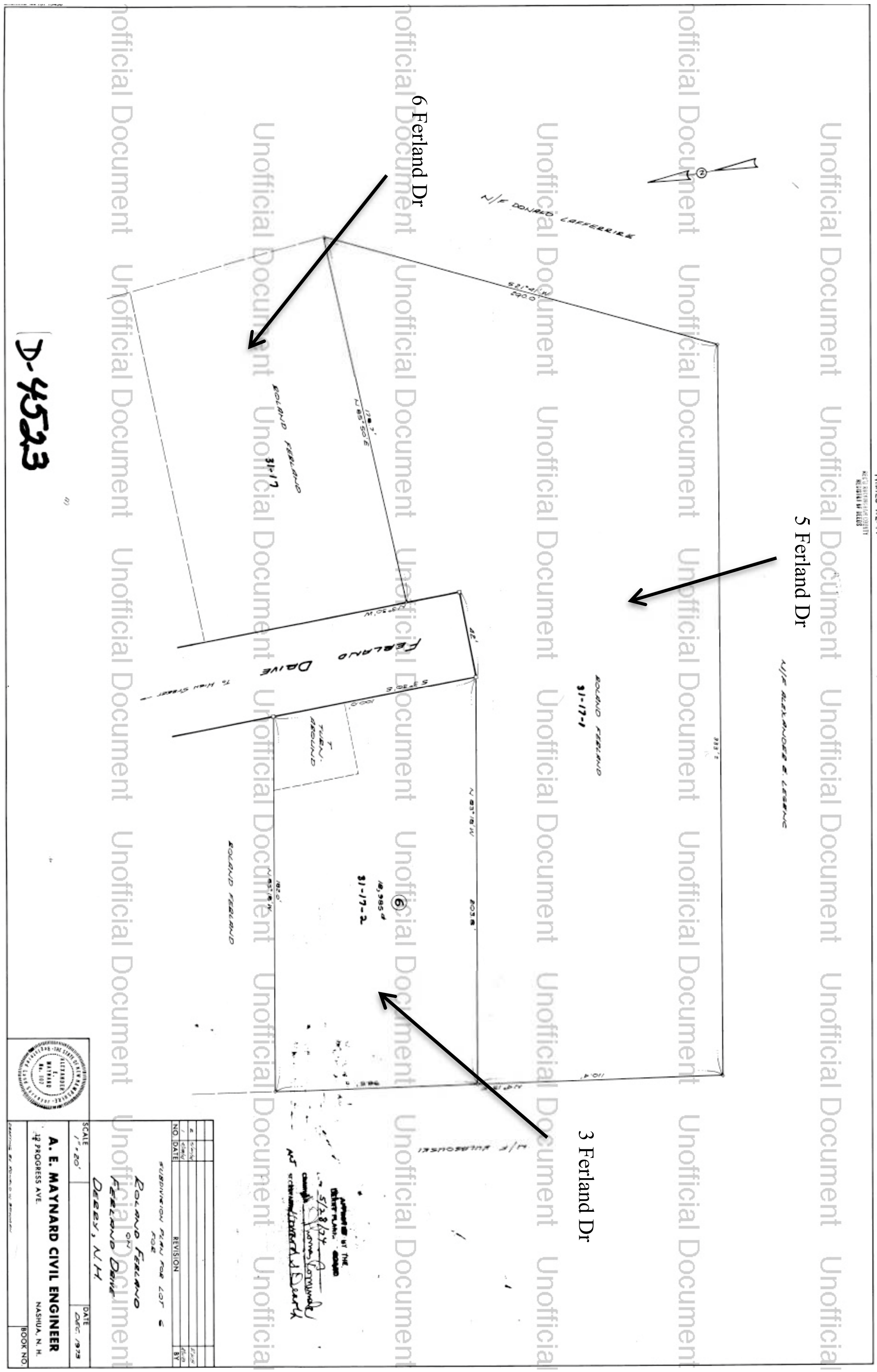
NR eligible:
individual ☐
within district ☐
not eligible ☒
more info needed ☐

NR Criteria: A ☐
B ☐
C ☐
D ☐
E ☐

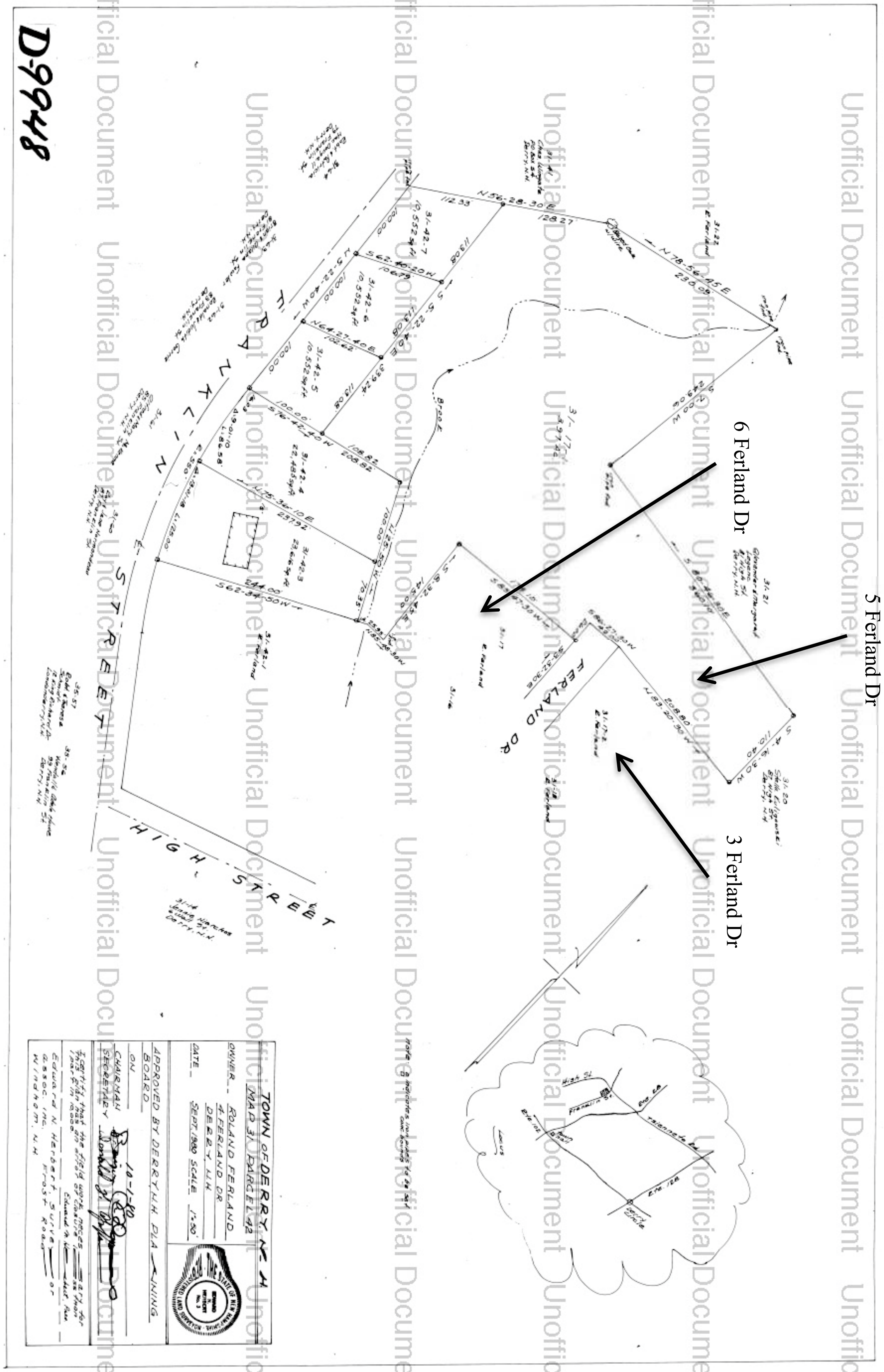
Plans



Rockingham County Registry of Deeds, Plan 852 (1966) showing the subdivision of lots and the creation of Ferland Drive. Lot 1 is 97 North High Street, Lot 2 is 2 Ferland Drive, Lot 3 is 4 Ferland Drive, and the fourth unnumbered lot is 1 Ferland Drive.

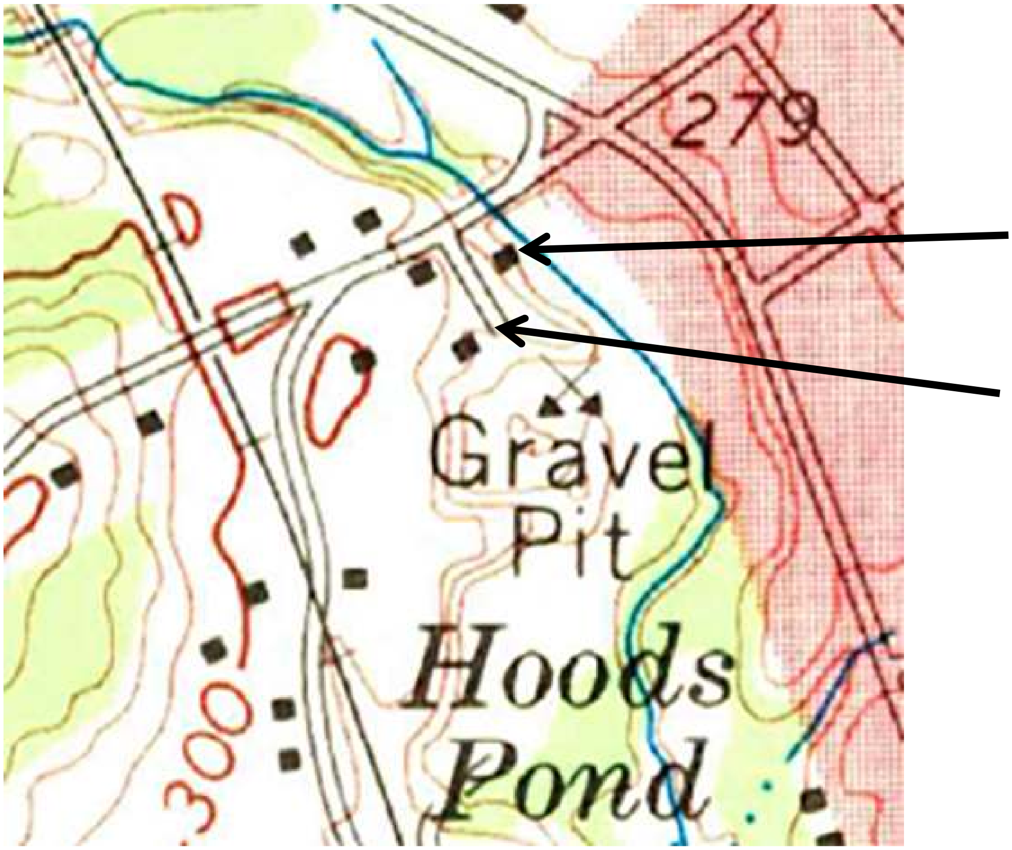


Rockingham County Registry of Deeds, Plan 4523 (1973) showing the subdivision of lots on the southern end of Ferland Drive.

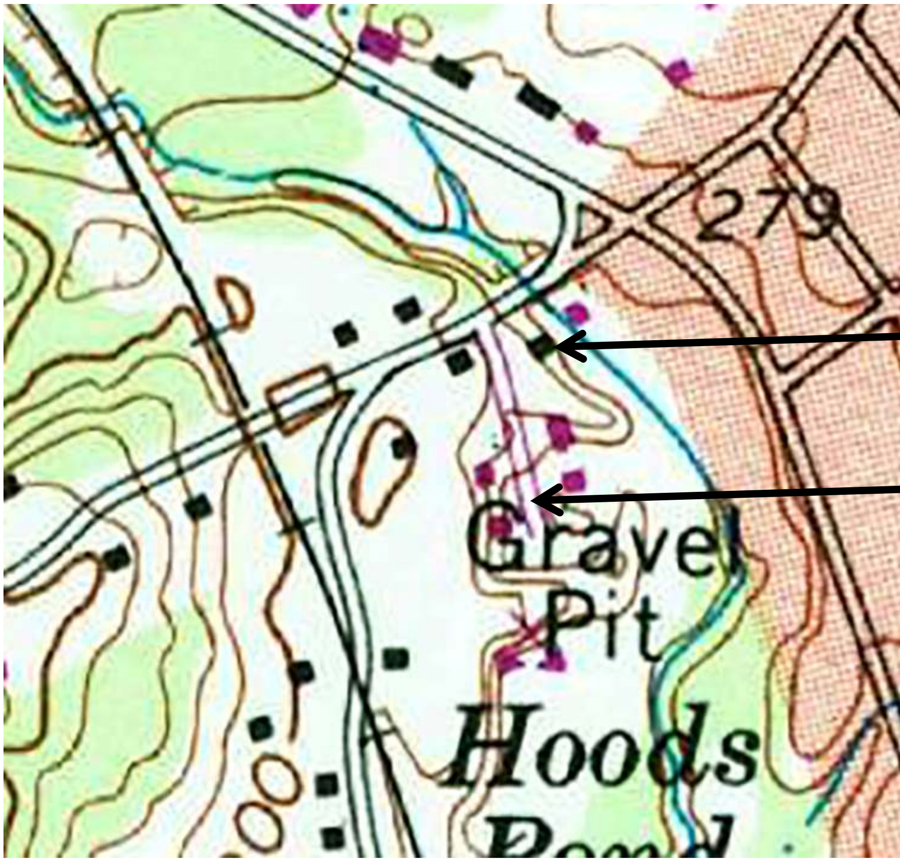


Rockingham County Registry of Deeds, Plan 9948 (1980) showing subdivision of lots along Franklin Street that are now part of Brookview Manor Court.

Historic Maps

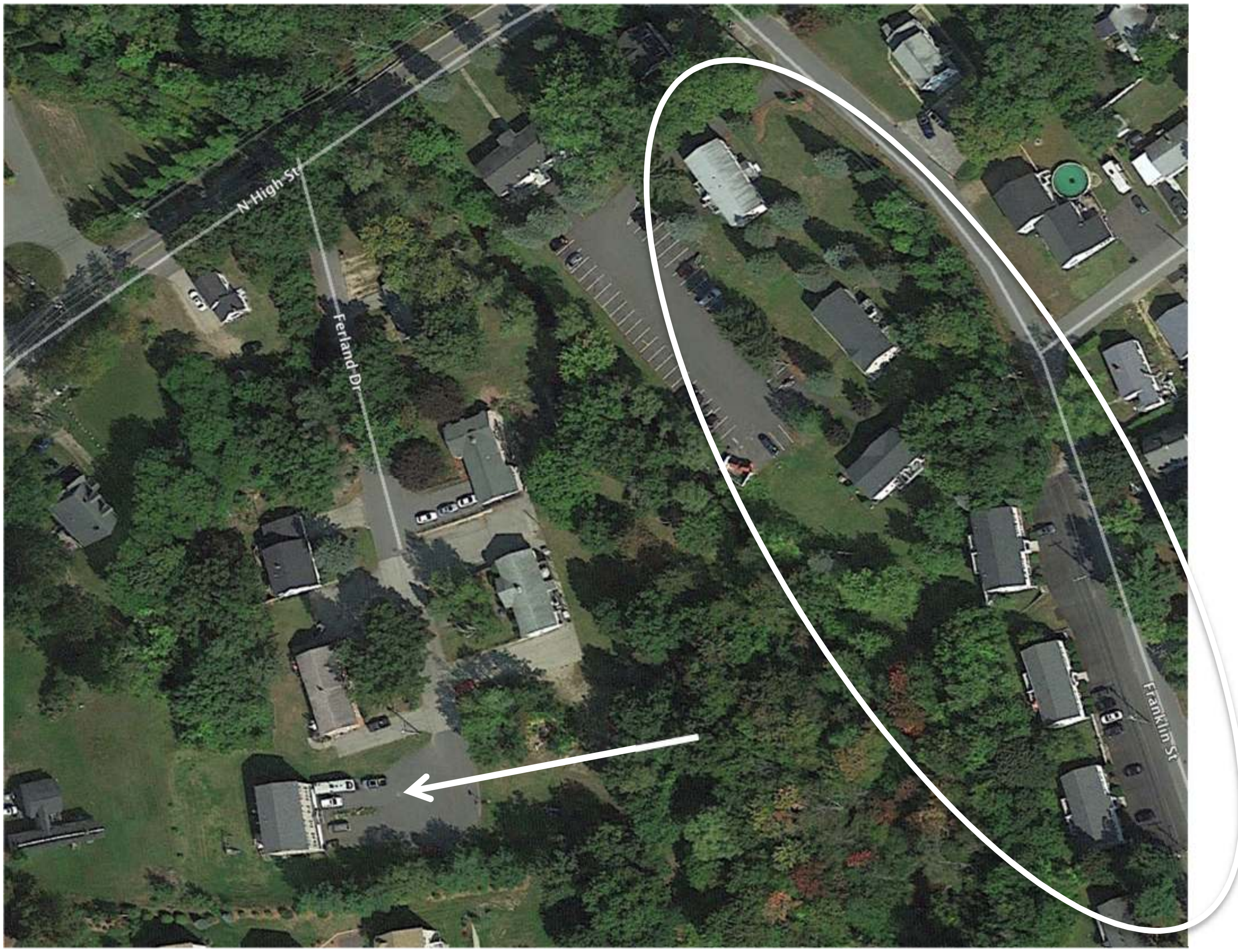


1968 USGS map, Derry NH quadrangle



1985 USGS map, Derry NH quadrangle

Google Earth satellite photograph dated 2008, showing houses along Ferland Drive, the circular turnaround at the south end (arrow), and apartment buildings along Franklin Street (circled).



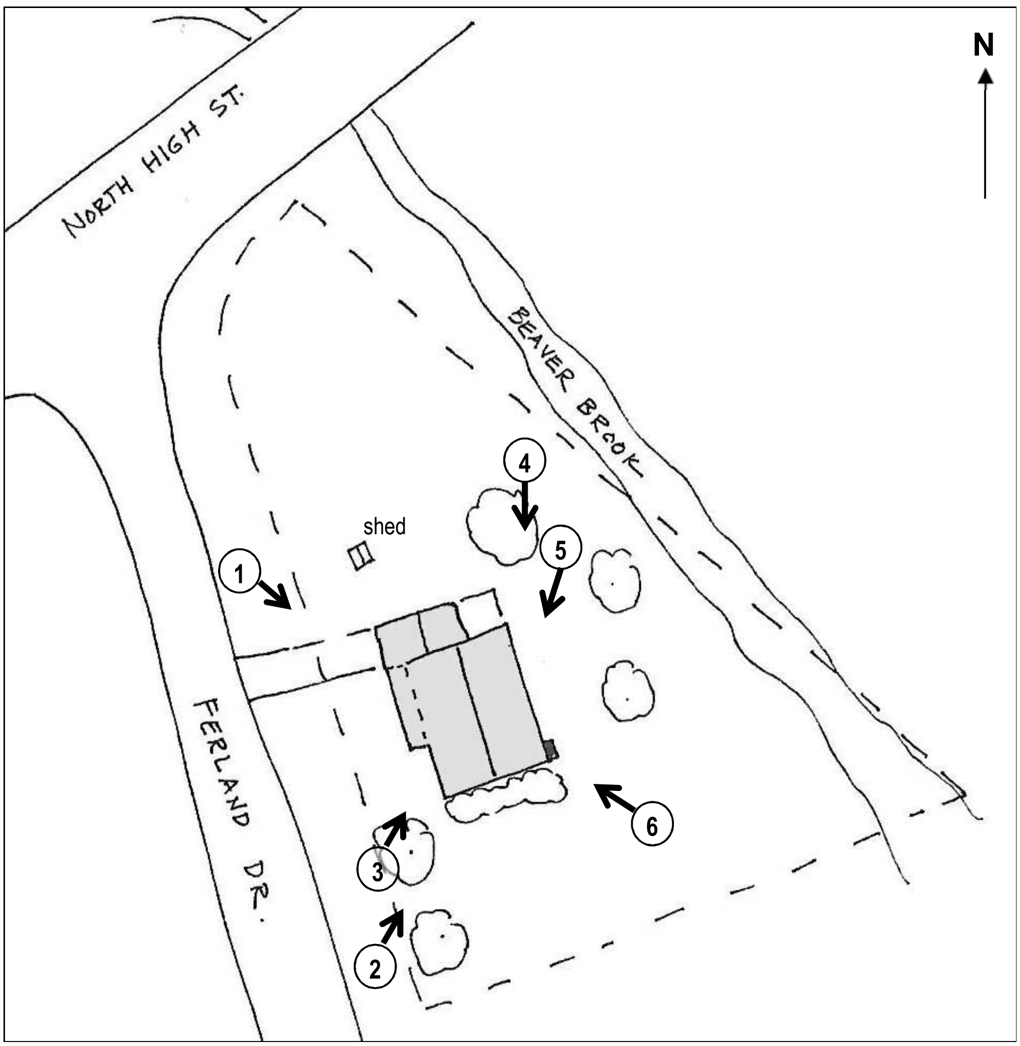
Google Earth satellite photograph dated 9/2017, showing houses along Ferland Drive, the 2014 duplex building at 5 Ferland Drive (arrow), and apartment buildings along Franklin Street (circled).

Digital Photography Statement

I, the undersigned, confirm that the photos in this inventory form have not been digitally manipulated and that they conform to the standards set forth in the NHDHR Photo Policy. These photos were printed using the following: Epson SureColor P600 printer on Epson Ultra Premium Photo Paper, glossy. The digital files are housed with Preservation Company in Kensington, NH.

Lynne Emerson Monroe, Preservation Company

Photo Key – 2 Ferland Drive



Photos 1-6 of 2 Ferland Drive

Photo Key – Neighboring Properties

Photos 7-13 of neighboring properties

Current Photographs – 2 Ferland Drive

Date taken: June 2018

Photo 2) Façade and south elevation with street frontage; shed in background Direction: NE
Reference (file name): Photo_June2018_176

Photo 3) Façade and south elevation Direction: NE
Reference (file name): Photo_June2018_182

Photo 4) North elevation Direction: S
Reference (file name): Photo_June2018_179

Photo 5) West (rear) elevation Direction: SSW
Reference (file name): Photo_June2018_180

Photo 6) North and west elevation Direction: NW
Reference (file name): Photo_June2018_181

Current Photographs – Neighboring Properties

Date taken: June 2018

Photo 7) 1 Ferland Drive, façade Direction: SW
Reference (file name): Photo_June2018_394

Photo 8) 4 Ferland Drive, facade Direction: SE
Reference (file name): Photo_June2018_384

Photo 9) 4 Ferland Drive, garage and driveway Direction: NE
Reference (file name): Photo_June2018_386

Photo 10) 6 Ferland Drive, façade and driveway Direction: NE
Reference (file name): Photo_June2018_387

Photo 11) 3 Ferland Drive, façade and north elevation Direction: NW
Reference (file name): Photo_June2018_393

Photo 12) 5 Ferland Drive, façade Direction: WSW
Reference (file name): Photo_June2018_391

Photo 13) 97 North High Street, façade and west elevation Direction: SW
Reference (file name): Photo_June2018_397

Photo 14) 90 Franklin Street, façade Direction: SW
Reference (file name): Photo_June2018_406

Photo 15) 80-84 Franklin Street Direction: S
Reference (file name): Photo_June2018_405

INDIVIDUAL INVENTORY FORM **NHDHR INVENTORY** DER0195

Name, Location, Ownership

1. Historic name: Donald Ross House
2. District or area: N/A
3. Street and number: 12 Folsom Road
4. City or town: Derry
5. County: Rockingham
6. Current owner: Charles J Goddard, Jr.

Function or Use

7. Current use(s): Single dwelling
8. Historic use(s): Single dwelling

Architectural Information

9. Style: Raised Ranch
10. Architect/builder: Unknown
11. Source: N/A
12. Construction date: ca. 1964
13. Source: Research, Inspection
14. Alterations, with dates: Exterior renovation 2013
15. Moved? no ☒ yes ☐ date: N/A

Exterior Features

16. Foundation: concrete block, plain
17. Cladding: vinyl
18. Roof material: asphalt shingles
19. Chimney material: brick
20. Type of roof: gable
21. Chimney location: one end, single exterior
22. Number of stories: 1½
23. Entry location: Façade, center
24. Windows: 6/6 double-hung, bay
    Replacement? no ☐ yes ☒ date: 2013

Site Features

25. Setting: Developing mixed-use road
26. Outbuildings: None
27. Landscape features: Garden, flower; Pool
28. Acreage: 0.63 acres
29. Tax map/parcel: 35/12

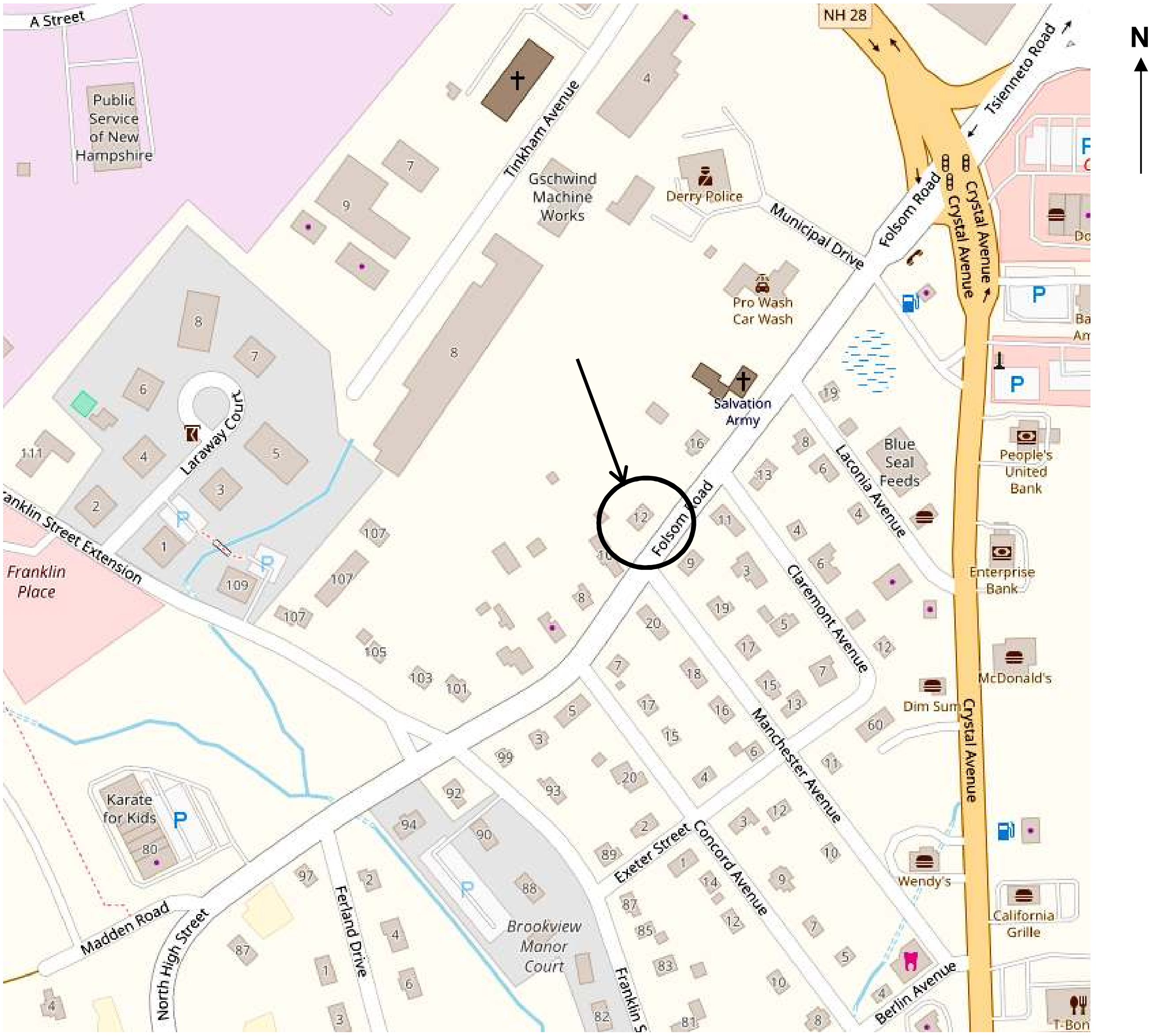
35. Photo 1 Façade and west elevation Direction: N
36. Date: June 2018
37. Reference (file name): Photo_June2018_185

30. State Plane Feet (NAD83): X: 1074585.702306; Y: 142842.979311
31. USGS quadrangle and scale: Derry, NH, 1:24000

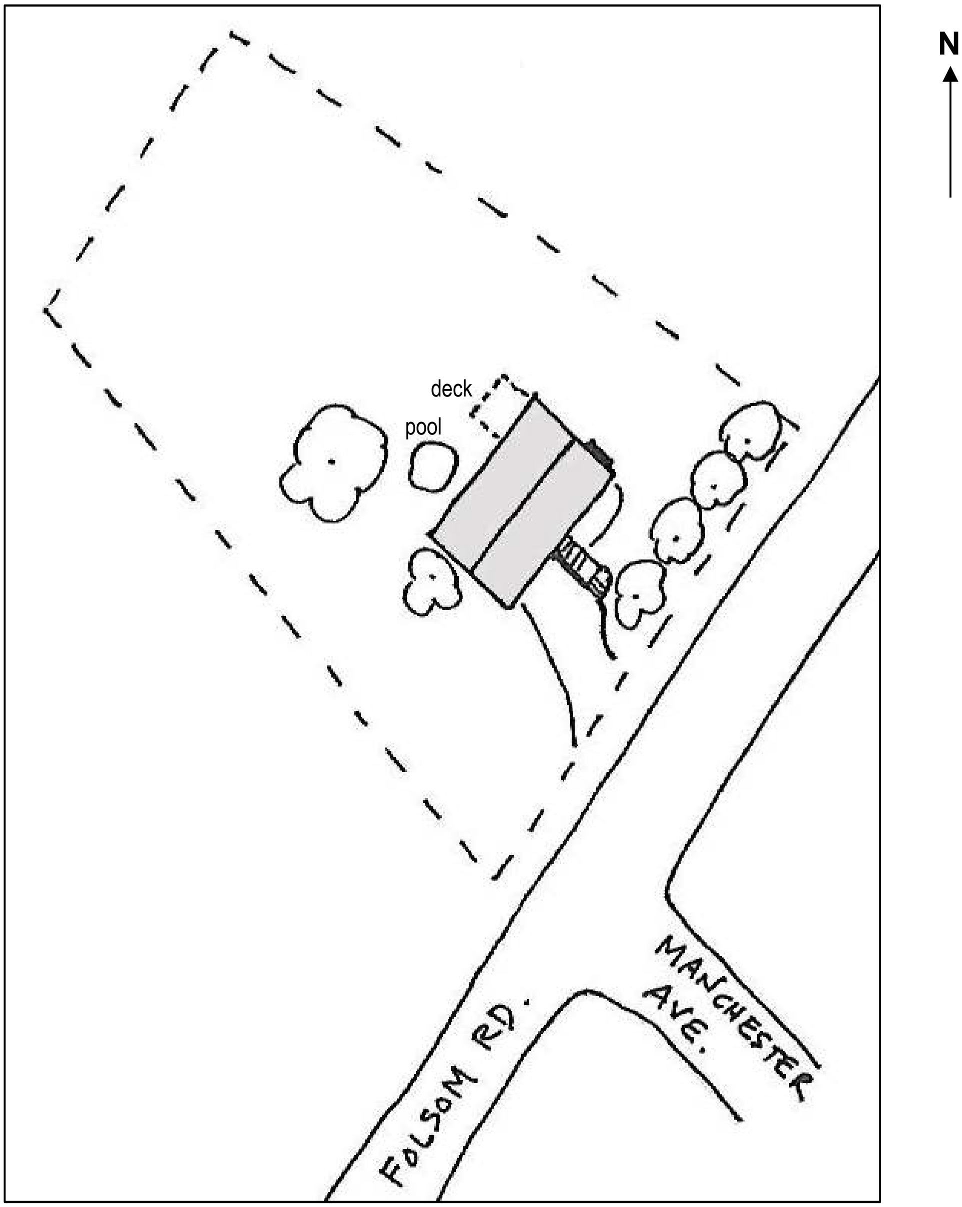
Form prepared by

32. Name: Reagan Ruedig, Lynne Monroe
33. Organization: Preservation Company, Kensington, NH
34. Date of survey: June 2018

39. Location Map



40. Property Map



Sketch map showing all buildings, landscape features, and tax map/parcel (dashed line)

41. Historical Background and Role in the Town or City's Development

The house at 12 Folsom Road was constructed in 1964 on land that was developed by the Ross family. Eugene W. Ross (1860-1943) and his son, Bert E. Ross (1882-1957) moved to Derry from Cambridge, MA in 1907 to work in the dairy business. They had been employed by the H.P. Hood Dairy Co. in Boston, and moved to Derry, (the home of H.P. Hood), to start their own dairy business. In 1909 they rented (and purchased ten years later) the John Folsom farm at the corner of Folsom and Manchester Roads, and established the E.W. Ross & Son dairy business, bottling and delivering milk (Holmes 2012).

The five-point intersection of Folsom Road, Manchester Road, Crystal Avenue, Tsienneto Road, and Pinkerton Street became known as Ross's Corner. The Ross family dairy business was very successful in the early twentieth century and was one of six commercial dairy farms in Derry. By the time Eugene Ross died in 1943, however, local dairy businesses were beginning to decline due to competition from larger regional and national companies (Holmes 2012). Bert died in 1957, and his son Herbert W. Ross (1911-1993) took on the family business, then known as Ross Corner Dairy.

Herbert took the land and farms that the family owned and subdivided part of the former Folsom farm field on the north side of Folsom Road. The first lot, now 16 Folsom Road, was sold to Earl and Viola Pelletier, Herbert's daughter, in 1962 (Deed 1637: 370). In 1963 Herbert's son, Donald W. Ross (1936-2015), purchased a subdivided lot on the western edge of the property (Deed 1669: 116, see Plan 1656). Donald and his wife, Joanne, had their house, 12 Folsom Road, constructed the following year. The house at 18 Folsom Road was the residence of Herbert Ross and his wife, Katherine and was constructed in 1970.

Herbert Ross attempted to streamline the operations of the dairy business, but it continued to decline. Ross Corner Dairy Company auctioned off the farm buildings, land, and operation equipment in 1970 (Nashua Telegraph, 18 June 1970). Reduced production continued with packaging by Turner Dairy in Salem. Products were still distributed at a warehouse on Folsom Road (Holmes 2012). Donald Ross took over the business in 1973 but could not keep up with commercial competition. Ross Corner Dairy went out of business in 1981.

The land formerly associated with the Ross dairy farm (and the Folsom farm before that) was fully subdivided and sold off in the 1970s and 1980s. The town of Derry owns the lot that once had the farm buildings on the northwest corner of Folsom and Manchester Roads (Map/lot 35/14-2), and the police station was constructed there in 1985. The car wash at 20 Folsom Road (Map/lot 35/14-5) was constructed in ca. 1975. The three Ross family houses along Folsom Road have sold out of the family. Herbert's house at 18 Folsom was sold in 1997 (Deed 3199: 891) after Herbert's death in 1993 and is now home to an office for the Salvation Army. 16 Folsom was sold by the Pelletier family in 2002 (Deed 3768: 2729) and has been renovated with the addition of a full second floor. 12 Folsom Road, the property being surveyed, was recently sold in 2015 following Donald Ross's death (Deed 5602: 1757).

42. Applicable NHDHR Historic Contexts (please list names from appendix C)

56. Local-scale dairy farming, 1800-present

131. Suburban/bedroom community growth in New Hampshire, c. 1850-present

43. Architectural Description and Comparative Evaluation

The house at 12 Folsom Road, constructed ca.1964, is a Raised Ranch with one and a half stories above grade and an integrated garage at the lower level. The lower level is constructed of brick-faced concrete block, while the upper level is clad in vinyl siding, installed in 2013. The low-pitched gable roof has asphalt shingles, and a wide exterior chimney is placed on the east end gable wall. The main entry door is centered on the façade at the upper level, reached by a flight of brick stairs with cast-concrete treads and black iron handrails. A secondary entry at the basement level is located just to the west of the brick stairs, and the single garage door is adjacent on the west side. The front door, as well as the overhead garage door, are original to the house. The lower-level entry door is a vinyl replacement with a fan light.

The windows were replaced with vinyl 6/6 replacement windows in 2013-2014 (see Google Streetview image below). Red vinyl shutters were added to the facade at the same time. The façade has a paired set of double-hung windows and a single double-hung window on the western half, and a bay picture window with paired double-hung windows below at ground level on the eastern half. The west elevation has two double-hung windows symmetrically placed with two awning windows below at the top of the concrete block basement wall. The rear, north elevation has a sliding glass door at the east end and two double-hung windows in the center of the elevation, with two awning windows at the lower level. The east elevation has no openings other than a small vent window just underneath the peak of the gable, same on the west elevation.

The house is sited approximately 40 feet from the road, with a row of four maple trees at the edge of the front yard. The wide, paved driveway is angled from the road to the garage door, with a gravel parking area off of it on the west side. A low, cast concrete block retaining wall edges the curve of the driveway on the east edge of the drive, leading to low brick steps and a taller brick-faced concrete block retaining wall attached to the house by the door at the lower level. A small flower garden bed is planted along the front of the house on the eastern half. The back yard has two large maple trees and an above-ground swimming pool.

Previous to the exterior renovations, the house had wide wood clapboards, original wood 6/6 double-hung windows, and white shutters. The front stairs had no handrails, and the lower-level door was a 9-light wood door.

This house is fairly typical of Ranch style homes built in the mid-twentieth century in the area, but it is not a distinctive example and has lost integrity of original materials. Derry experienced a period of major growth in the mid-twentieth century, and there are many other examples of buildings that better represent the Ranch style, such as the houses along Newell Drive and Kingsbury Road in Derry Village.

44. National or State Register Criteria Statement of Significance

Criterion A: This house was constructed during a major building boom in postwar Derry, but it is not part of a planned development, nor does it singularly represent a significant aspect of the broad pattern of history in Derry or the greater region. There are many other developments in the town of Derry that more are more representative of population growth starting in the mid-twentieth century. Therefore, it is not eligible under Criterion A.

Criterion B: This property is associated with the Ross family, which owned and operated a successful dairy operation at nearby Ross's Corner. It was built by Donald Ross, a great-grandson, who was head of family dairy business in its final days. His significance to the family business does not rise to a level to grant individual eligibility to this house for its association with him.

Criterion C: This house does not represent a distinctive type of architecture or work of a master. The Raised Ranch house is a common house type in Derry, and this house neither exhibits a fully articulated expression of the Ranch style nor does it retain sufficient integrity to be eligible for the National Register under Criterion C.

45. Period of Significance

None

46. Statement of Integrity

This property retains integrity of location and setting, as it has not been moved and the setting of Folsom Road and the surrounding neighborhood has not substantially changed since 1964. However, the house has lost integrity of workmanship and materials with the loss of the original wide-lap clapboard and its replacement with narrow vinyl siding and trim boards, as well as the loss of original windows and their replacement with vinyl windows. Because of this, it has diminished integrity of design, though there have been no major additions or changes to the form of the house itself or the property. The property retains integrity of feeling as a residence, but its association has been diminished as it and the neighboring properties have been sold out of the family.

47. Boundary Discussion

The tax parcel (Map 35, lot 12) was used as the boundary of the area surveyed for this form. This property is not eligible for the National Register, so an eligible boundary discussion is not necessary.

48. Bibliography and/or References

Holmes, Rick
2012 "Gone are the days when milk came right to your door," *Derry News,* Derry, NH: 6 December 2012. [www.derrynews.com, accessed 28 June 2018]

Obituary: Donald Ross
2015 "Donald's Story," *Derry News*, Derry, NH: 20 August 2015. [www.derrynews.com, accessed 28 June 2018]

Pettis, Emily et al.
2012 *NCHRP Report 723: A Model for Identifying and Evaluating the Historic Significance of Post-World War II Housing*. Transportation Research Board: Washington, D.C.

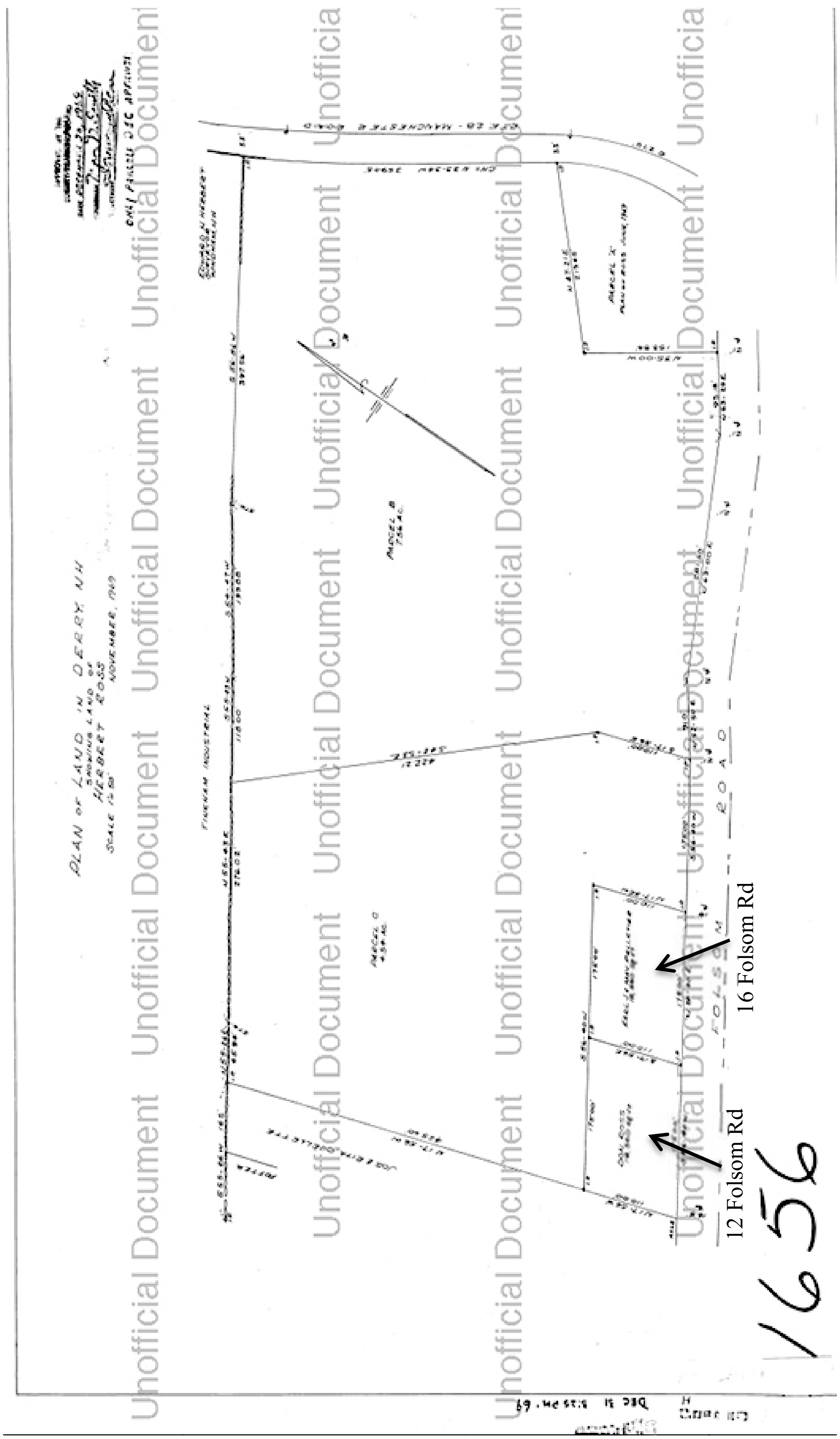
<u>Deeds</u>
Rockingham County Registry of Deeds
Book 739, page 54 6/26/1919
Book 1448, page 62 10/11/1957
Book 1637, page 370 8/14/1962

Book 1669, page 116	5/6/1963
Book 1961, page 18	3/19/1968
Plan 1656	11/1969
Plan 1931	08/1970
Plan 9524	04/1980
Book 2710, page 2604	10/28/1987
Book 2384, page 1133	12/9/1987
Book 4184, page 456	09/22/1993
Book 3199, page 891	2/12/1997
Book 3768, page 2729	5/7/2002
Book 5602, page 1757	03/19/2015
Book 5607, page 1489	04/07/2015
Book 5642, page 1074	08/03/2015

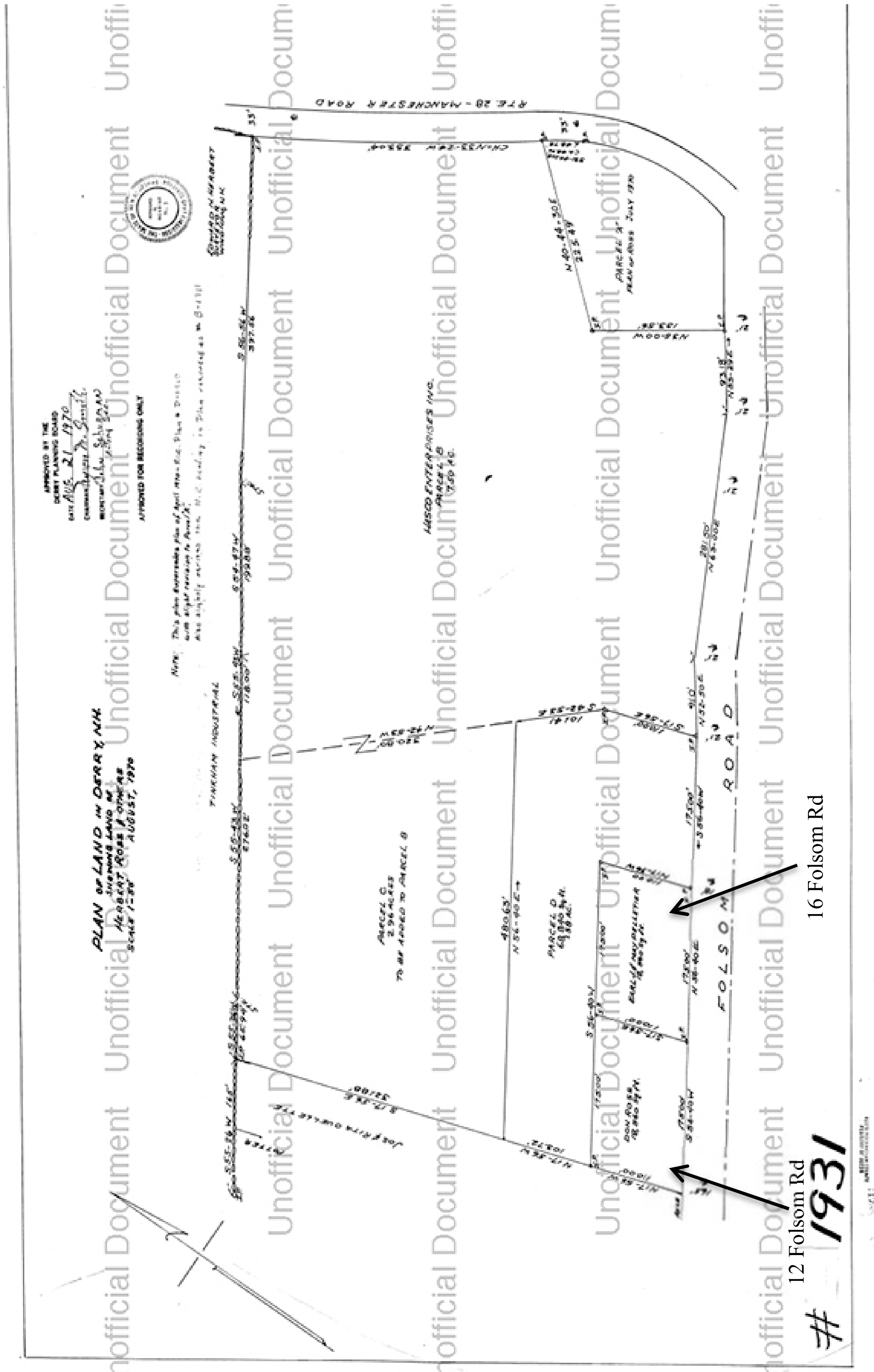
Surveyor's Evaluation

NR listed:	individual	☐	NR eligible:		NR Criteria:	A	☐
	within district	☐	individual	☐		B	☐
			within district	☐		C	☐
Integrity:	yes	☐	not eligible	☒		D	☐
	no	☒	more info needed	☐		E	☐

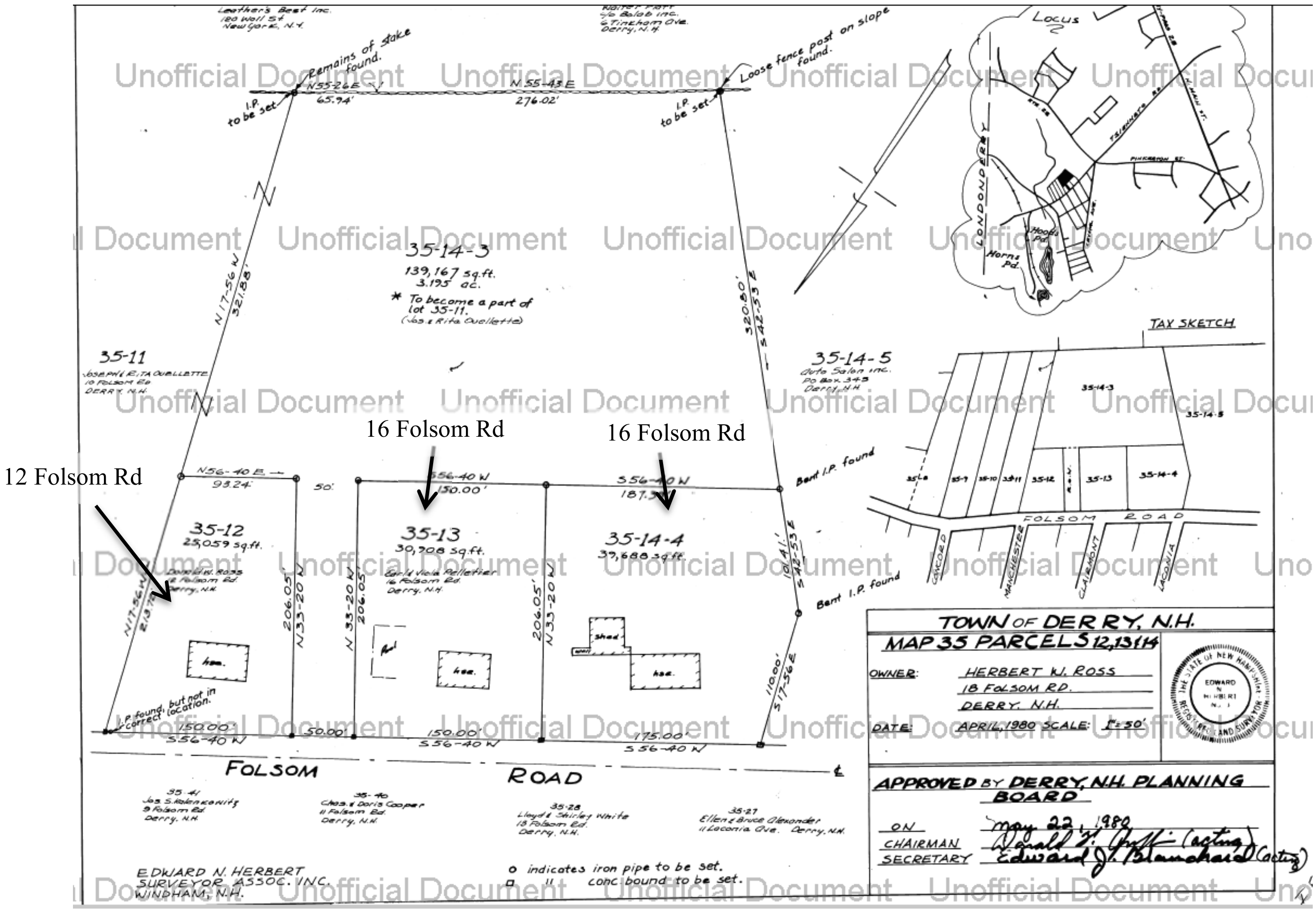
Plans



Plan 1656 (11/1969)



Plan 1931 (8/1970)

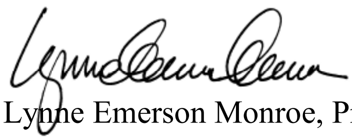


Plan 9524 (04/1980)

Google Streetview image dated September 2013, showing original siding on the façade and vinyl replacement siding on the west elevation.

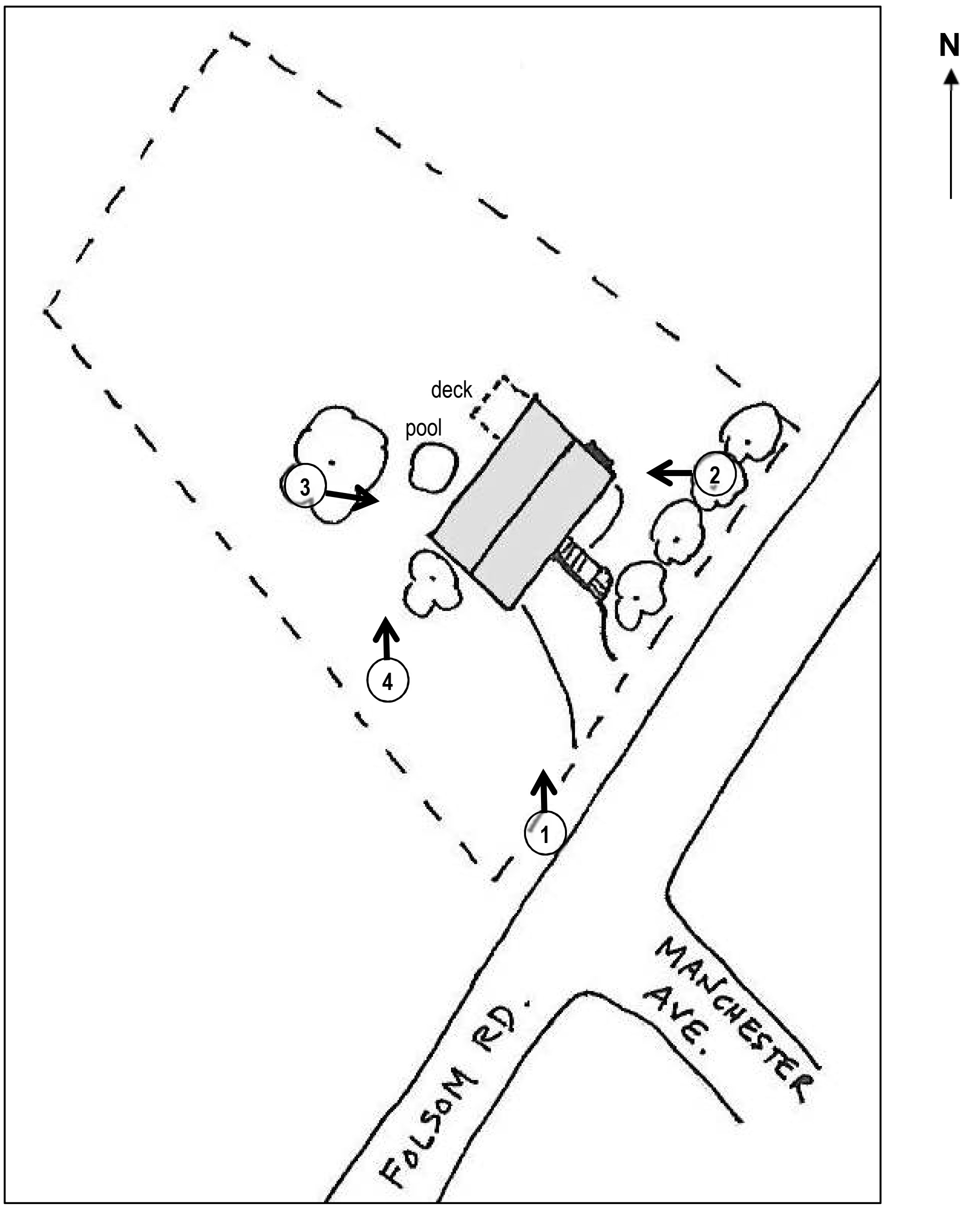
Digital Photography Statement

I, the undersigned, confirm that the photos in this inventory form have not been digitally manipulated and that they conform to the standards set forth in the NHDHR Photo Policy. These photos were printed using the following: Epson SureColor P600 printer on Epson Ultra Premium Photo Paper, glossy. The digital files are housed with Preservation Company in Kensington, NH.



Lynne Emerson Monroe, Preservation Company

Photo Key



Current Photographs

Date taken: June 2018

Photo 2) Façade and east elevation Direction: W
Reference (file name): Photo_June2018_190

Photo 3) West and north (rear) elevations Direction: ESE
Reference (file name): Photo_June2018_187

Photo 4) Rear yard Direction: N
Reference (file name): Photo_June2018_186

INDIVIDUAL INVENTORY FORM **NHDHR INVENTORY** DER0196

Name, Location, Ownership

1. Historic name: Knapp Brothers Shoe Manufacturing
2. District or area: None
3. Street and number: 3 Manchester Road
4. City or town: Derry
5. County: Rockingham
6. Current owner: Fireye Inc.

Function or Use

7. Current use(s): Office, manufacturing facility
8. Historic use(s): Office, Manufacturing facility

Architectural Information

9. Style: Modern Movement
10. Architect/builder: Fletcher-Thompson, Inc.
11. Source: newspaper article 5 May 1960
12. Construction date: 1960
13. Source: newspaper article 5 May 1960
14. Alterations, with dates: enclose loading/ garage bays, NE elevation ca. 2000
15. Moved? no ☒ yes ☐ date: N/A

Exterior Features

16. Foundation: concrete, poured
17. Cladding: Other-pre-cast concrete
18. Roof material: unknown
19. Chimney material: does not apply
20. Type of roof: flat
21. Chimney location: does not apply
22. Number of stories: 1
23. Entry location: facade, off-center
24. Windows: other
    Replacement? no ☒ yes ☐ date: N/A

Site Features

25. Setting: Other
26. Outbuildings: does not apply
27. Landscape features: mature trees, other
28. Acreage: 8.97 acres

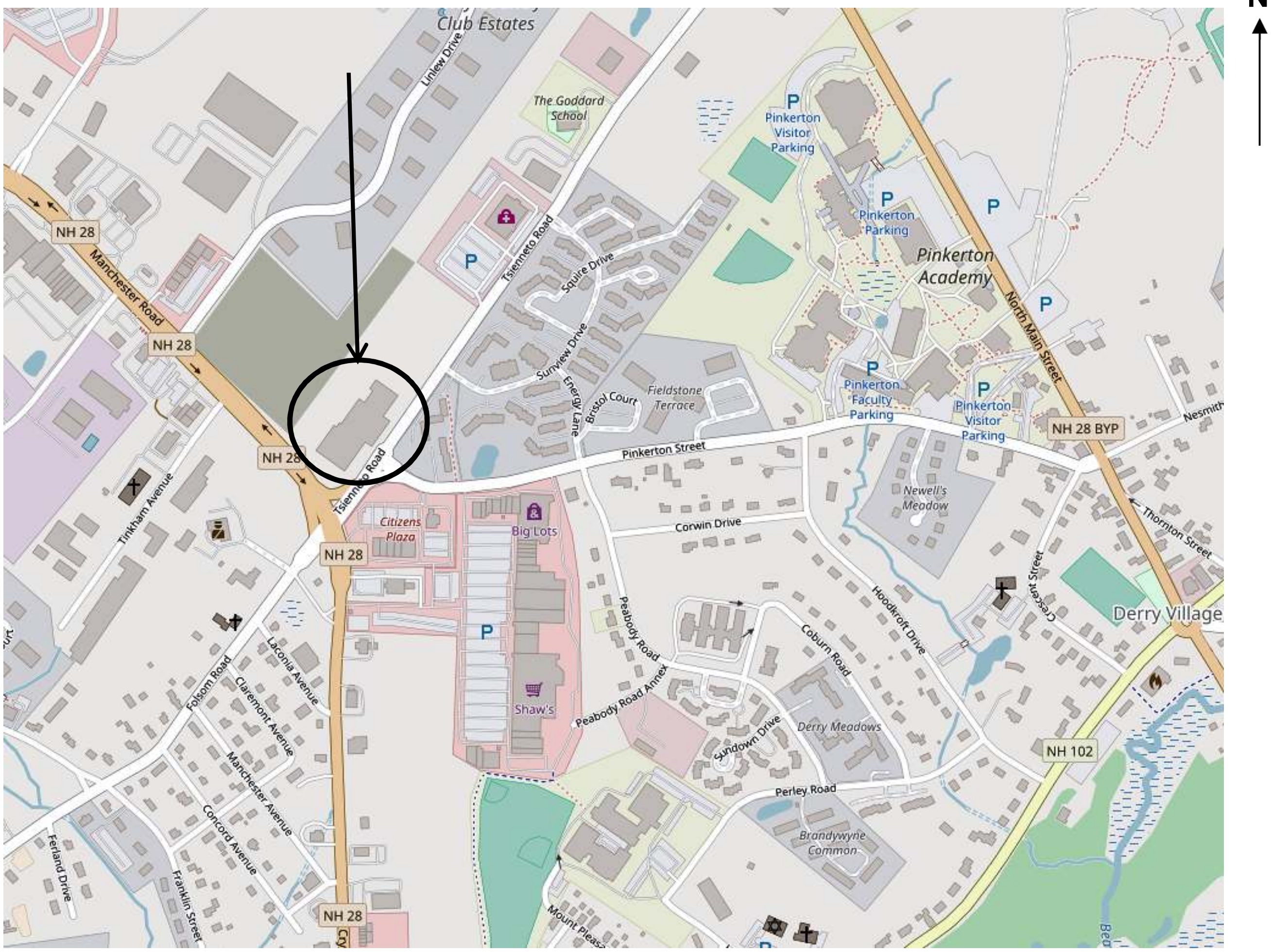
35. Photo 1 Direction: W
36. Date: June 2018
37. Reference (file name): Photo_June2018_287

29. Tax map/parcel: 08/269
30. State Plane Feet (NAD83): X: 1075490.394874; Y: 144051.444189
31. USGS quadrangle and scale: Derry, NH, 1:24000

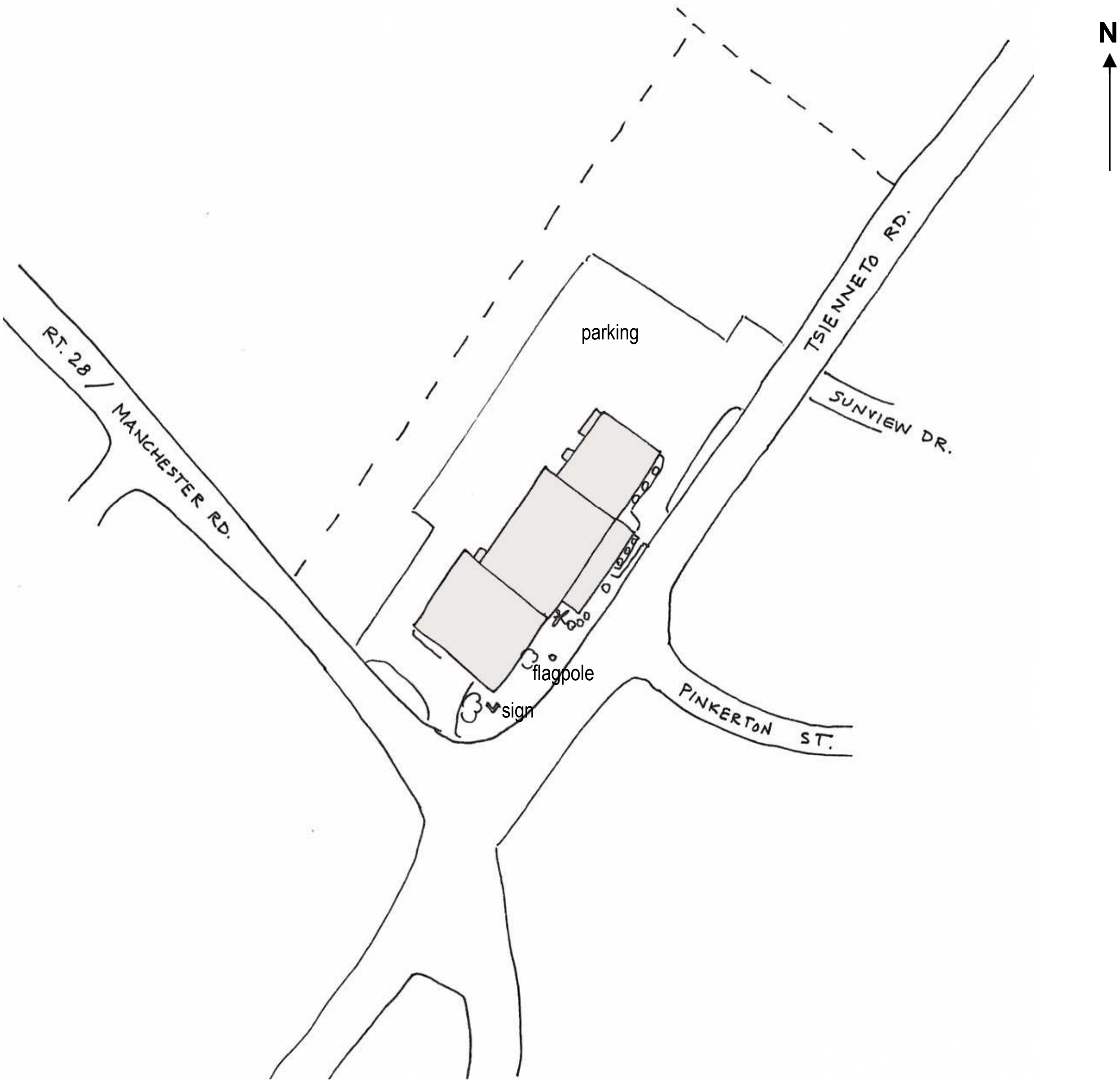
Form prepared by

32. Name: Laura B. Driemeyer
33. Organization: Preservation Company, Kensington, NH
34. Date of survey: June 2018

39. Location Map



40. Property Map



41. Historical Background and Role in the Town or City's Development

3 Manchester Road was built in 1960 by the Derry Realty Corporation on land they had acquired the previous year (Deed 1959; *Nashua Telegraph* 5 May 1960). The new building with a "clean modernistic appearance" was constructed as a new shoe factory that would be occupied by the Knapp Brothers Shoe Manufacturing Corporation, manufacturers and sellers of men's shoes. The building consisted of a one-story front office wing roughly centered on a large rectangular manufacturing section, all erected using tilt-up construction. The building remained in use as a shoe factory until 1983, under several different entities, who continued to manufacture Knapp shoes. In 1983 the building was acquired by the Electronics Corporation of America (ECA), a Cambridge, Massachusetts, manufacturers of products that managed power systems in an industrial setting (Deed 1983; Cambridge Historical Commission). In 1988 Fireye Inc., originally a part of ECA, and a manufacturer of flame safeguard controls and burner management systems, acquired the property and continues to occupy it largely as first designed with office and manufacturing uses (Deed 1988).

Derry, New Hampshire, had a long association of shoe manufacturing, dating back to the mid-nineteenth century when the railroad came through the town. Shoe manufacturing remained a major part of the local economy into the 1980s though the method of manufacture changed significantly over that period. In the second half of the nineteenth century shoe manufacturing transitioned from predominantly outwork from factories (in nearby Massachusetts cities in the case of Derry), with much of the work done by Derry residents in their homes throughout the village. By 1850 the town had a large number of small shoe shops, with twenty-nine employing just one man. By the end of the nineteenth century, shoe manufacturing was centralized in large manufacturing facilities with steam power. In Derry, several shoe factories were erected or existing buildings were converted to that use. Several more were erected in the first quarter of the twentieth century, during the height of Derry's shoe industry. They were occupied by a series of companies whose financial successes appear to have been short lived (Preservation Company 2002, 36). As of 1915, however, the five big shops employed a total of 1,800 people, making more than 20,000 pairs of shoes a day (Preservation Company 2002, 37; Hazlett 1915, 283). The shoe industry in Derry recovered partially in the post-World War II period, but was limited due to competition from southern mills that had access to cheaper labor and power (Preservation Company 2002, 43).

In 1959, the Derry Realty Corporation acquired a parcel on Route 28 at what was then known as Ross' Corner, upon which they erected the new office and manufacturing facility that would be occupied by the Knapp Brothers Shoe Manufacturing Company.[1] The Bridgeport, Connecticut, architectural firm Fletcher-Thompson, Inc. designed the building. William C. Pahl Construction Company of Syracuse, New York, was the builder (*Nashua Telegraph* 5 May 1960). A 1960 *Nashua Telegraph* article indicated the building would be of "a clean modernistic appearance." Shoe making machinery was to be installed beginning in September 1960 with manufacturing to begin the following month (*Nashua Telegraph* 5 May 1960).

The Knapp Brothers Shoe Manufacturing Corporation had been established in Brockton, Massachusetts, by two Knapp brothers, Clarence E. (ca. 1892-1972) and Elwin D. (died 1969). Clarence E. had founded a shoe business in 1920 in the Pacific Northwest, with the then novel idea of selling directly to the consumer. In 1939, he and his brother moved east to establish a shoe manufacturing company, the Knapp Brothers Shoe Manufacturing Company. In the initial years, they occupied a former factory in Brockton, Massachusetts. During World War II they acquired the Barker

[1] The Realty Company had acquired the land from Herbert W. Ross at which time the land included a barn where he housed his cattle, likely dairy cows (Deed 1959).

Shoe Company of Lewiston, Maine, and also operated a large factory there, manufacturing civilian and military shoes. They subsequently added the Derry factory and an additional one in Brockton (*Boston Globe* 4 October 1972). According to Clarence E. Knapp's obituary, the company became one of the ten largest shoe manufacturers and largest direct shoe sales companies in the world (*Boston Globe* 4 October 1972).[2] In Derry it remained an important employer through the 1970s.

In 1970, two shoe manufacturing businesses owned by New York University (Knapp Brothers Shoe Manufacturing Corp. of Brockton and the King-Size Co.) were sold to a management group which established a new corporation, known as Knapp King-Size Corp. As of 1970, Knapp was the "world's largest direct selling shoe firm." It distributed its shoes through 12,000 salesmen and thirty-eight retail shoe stores. It was a major manufacturer of safety footwear of industrial locations. King-Size, a major mail-order firm, specialized in footwear and apparel for tall and big men (*Boston Globe* 6 June 1970). It remained in operation in Derry at the Manchester Road facility until the end of 1981 (www.upi.com/Archives/1981/12/01/The-Derry-Shoe-Co-will-gradually-shut-down-this/4339376030800/).

The construction of the Knapp facility coincided with the construction of at least one other new factory, just to the northwest, the new Klev-Bro Shoe Factory (built ca. 1958) also on Manchester Road. Like the Knapp factory, that facility closed in the 1980s, essentially ending the long history of shoe manufacturing in Derry. But in the case of the Knapp factory, a new type of business moved into the building, one that became a part of the local economy but on a much smaller scale than shoe manufacturing.

Since 1983 the building has been the site of the manufacture of burner management systems. In that year, Electronics Corporation of American (ECA) acquired the property. The company, which originated in Waltham, Massachusetts, subsequently established new research headquarters in Cambridge, Massachusetts, in 1955 where they remained for many years. As of 1986, Electronics Corp of America was the third largest local employer in Derry with 110 employees (Preservation Company 2002). In 1991, the property was sold to a new entity, Fireye Inc. (originally a part of ECA) and they continue to manufacture the same type of burner management system products that had been produced in the building since its acquisition by ECA. Since that time some alterations have been made to the northeast end of the manufacturing space, most notably the enclosure of four loading bays/garages and the addition of an employee's entrance. Other electronics manufacturing facilities in Derry in this period included Hadco Printed Circuit (built 1969, demolished early 2000s), on the property just north of 3 Manchester Road.

Fletcher-Thompson, Inc. of Bridgeport, Connecticut, the architectural firm that designed the building, was established in 1907 by E. Leslie Fletcher. Two years later, Charles L. Thompson joined the practice and in early 1910 it was incorporated as the Fletcher Thompson Engineering Company, changing its name to Fletcher Thompson Inc. four years later. For many decades the practice specialized in industrial engineering. Beginning in 1916 two generations of the Phelan family played instrumental roles in guiding the expansion of the firm, up to the present day, that also included the acquisition of several other firms. The firm has increased its breadth of services for a range of mostly large private and public clients such as major commercial developers, colleges and universities, healthcare institutions, leading corporations, and local, county, and state governments.

[2] The brothers had actually sold the company to New York University in the late 1940s though they had a ten-year employment contract as part of the sale and remained secured creditors. The ownership transfer was intended to benefit New York University ("Knapp Brothers Shoe Mfg. Corp. v. United States," Case No. 321-52, United States Court of Claims, 12 July 1956 (www.leagle.com/decision/19561041142fsupp8991873).

(www.fletcherthompson.com/about_history.aspx). Engineering remains an important component of their design work. They are known to have used tilt-up construction in other buildings contemporary with 3 Manchester Road, such as a 50,000 square-foot plant in Glens Falls, New York, for the Union Bag-Camp Paper Corporation in 1958-1959 and a warehouse addition in Montville, Connecticut, in 1961 (*New York Times* 15 September 1958; 5 February 1961).

The William C. Pahl Construction Company of Syracuse, New York, is known mostly for their large concrete construction projects in western New York. Other known work contemporary with 3 Manchester Road includes the Imperial Gardens Apartments in Syracuse (a twelve-story high-rise apartment building, built 1960), and Sadler Hall at Syracuse University (a brick-faced multistory student housing with dining hall, completed 1960).

42. Applicable NHDHR Historic Contexts (please list names from appendix C)

Mid-twentieth-century shoe manufacturing

Late twentieth-century electronics manufacturing

43. Architectural Description and Comparative Evaluation

3 Manchester Road is a large, rectangular, one-story building located on a flat 8.97-acre parcel. The flat-roofed building consists of two parts, the front office section and a larger, higher height manufacturing section to the rear (**Photos 1-3**). The six-bay office section is the more decorative of the two sections and includes four bays with curtain walls, a bay with the modified glass entry screened by an original concrete canopy, and a multi-colored masonry-faced bay with the name of the company. The masonry continues along the easterly elevation of the office section to either side of some additional curtain wall sections.

The construction method of multiple tilt-up concrete panels separated by concrete piers is particularly evident on the large industrial space to the northwest of the office section (**Photos 5-7**). Pedestrian and loading openings are in scattered locations on the southwesterly and northwesterly elevations and include a raised delivery doorway, large ground level garage door, and pedestrian doors including one accessed by concrete steps. The greatest number of alterations have occurred on the northeast elevation. At present an added pedestrian entrance is located in the second bay, providing access to the employee parking lot (**Photo 1**). The double-leaf metal doors are screened by a metal canopy. Historically this elevation included loading dock/garage door openings in four of the five bays. Evidence of them can be seen on the panels. The exterior of all the concrete panels is now covered with a painted cementitious material.

The building is notable for its tilt-up construction, a method that consists of large pre-cast concrete wall sections. The wall components were cast on site and then lifted into place with a crane. After placement of the walls they were then braced and tied in with the roof structure (www.tilt-up.org/construction).

Though this building method was first “conceptualized” in the early 1900s, its use did not become common place until the development of the mobile crane in the late 1940s (Concrete Contractor).

Since that time the method has seen some innovations and refinements and remains in use for a variety of building types (Concrete Contractor; www.tilt-up.org/construction).[3]

On the interior, the office space has been updated with the addition of new three-quarter height cubicle walls and drop ceilings with integrated overhead lighting.[4] Original features include the regularly spaced piers and banks of full-height interior glass windows along the wall of individual offices that span the northwesterly wall of the office space (**Photo 8**). The large, open manufacturing space has been updated with new lighting and flooring but retains its historic interior steel framing comprised of posts, I-beams supporting the roof, in addition to exposed piping (**Photo 9**).

A possibly original square masonry signage base is located just south of the southerly corner of the building (**Photo 4**). Modern signage sits atop it with the name of the company. It is located within a landscaped, slightly elevated piece of ground that includes some mature shrubs and a smaller shade tree. Additional landscaping along much of the front side of the building includes large expanses of lawn and some mature shrubs and conifers. The other three sides of the building are flanked by asphalt paving used for parking and access to the loading and garage bays. Beyond the paved areas to the northwest and northeast are areas of a mix of shrubs and trees with some cut grass in places.

The property is located on the northeast corner of Tsienneto and Manchester roads, a heavily trafficked intersection. In the vicinity is a mix of commercial and small-scale industrial development, mostly dating to the last quarter of the twentieth century, along with a variety attached multifamily housing of the same period.

Comparative Evaluation

The most direct comparable in Derry is the former Klev-Bro shoe factory built just before the Knapp factory, located just to the northwest at 22 Manchester Road (see comparable photograph on page 17). Like the Knapp factory, this modern, low-rise building is one story with office space on the front (though not nearly centered but rather located towards the southerly end) and the former manufacturing space to the rear. Though the building is no longer in manufacturing use as it has been subdivided for occupancy by multiple small business it retains its historic footprint, exterior materials, and much of its historic fenestration that distinguishes the two sections: large window openings for the former industrial space and regular three-part windows on the office section.

44. National or State Register Criteria Statement of Significance

The Knapp Brothers Shoe Factory, 3 Manchester Road (constructed 1960), is eligible for listing in the National Register of Historic Places under Criterion A for its associations with shoe manufacturing in Derry and under Criterion C for its Architecture.

Criterion A: The Knapp Brothers Shoe Factory, 3 Manchester Road (constructed 1960), is eligible for listing in the National Register of Historic Places under Criterion A for its associations with shoe manufacturing in Derry. Its construction in 1960 represents the final stage of shoe manufacturing in Derry and its importance in the local economy. Shoe manufacturing in Derry dates to at least the mid-nineteenth century and it evolved over time as the manufacture moved from small one-person shops or outwork in people's

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[3] Well-known early examples are the houses constructed by Thomas Edison in 1908 in the newly created village of Union, New Jersey (Concrete Contractor).

[4] According to the Assessor Records, the industrial area totals approximately 57, 630 square feet while the office area totals nearly 9,000 square feet.

homes to large factories powered by steam and/or water. 3 Manchester Road illustrates the final phase, incorporating manufacturing and office space within a single building as the company not only manufactured shoes but also sold the shoes directly to customers. The facility is representative of the scale and method of shoe manufacturing in New England in the mid-twentieth century.

Though not of sufficient age at this time for its association with electronics manufacturing once it becomes of sufficient age, that association would likely contribute to its significance as that became an important component of the local economy in Derry beginning in the 1980s, though at a considerably small scale. The property remains in use for manufacturing purposes with associated office space up to the present. Its transition to an electronics manufacturing space is representative of changes in the local economy beginning in the late twentieth century.

Criterion B: The Knapp Brothers Shoe Factory, 3 Manchester Road (constructed 1960), is not eligible for listing in the National Register of Historic Places under this criterion as it does not convey associations with individual persons that make it eligible under this criterion.

Criterion C: The Knapp Brothers Shoe Factory, 3 Manchester Road (constructed 1960), is eligible for listing in the National Register of Historic Places under Criterion C for its Architecture as a representative example of a mid-twentieth century manufacturing and office building in the modernist style that employs tilt-up construction, a common construction method of the period for industrial buildings. Stylistically, the building embodies a number of characteristic modernistic elements particular on the office section such as a low profile and contrasting building materials such as the curtain walls and masonry facing.

The building also embodies a distinctive method of construction, tilt-up construction. Though developed in the early twentieth-century, this construction method was first popularized in the post-war period with the development of mobile cranes. This method entails casting large concrete panels on site that are then lifted into place on the existing foundation and tied in with the roof framing and other structural members. This method of construction remains readily visible on the exterior and interior of the building.

45. Period of Significance

1960-1968: The Period of Significance under Criterion A extends from the building's construction in 1960 to the fifty-year cutoff date for eligibility. The building was in continuous use as a shoe factory until 1983 and since that time has remained in continuous industrial and office use up to the present time.

1960: The Period of Significance under Criterion C is 1960 for its construction method and design.

46. Statement of Integrity

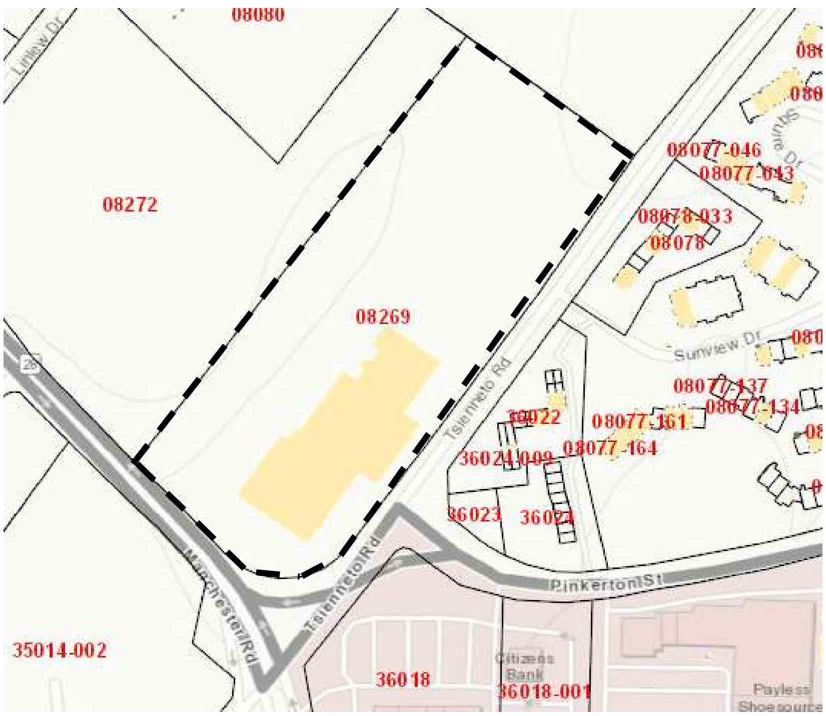
3 Manchester Road retains integrity of design, materials, and workmanship. With the exception of the northeast elevation where the loading/garage bays were enclosed ca. 2000, the fenestration pattern, including the curtain wall windows on the office section is otherwise intact, as is the historic footprint. The main entrance appears to have been modified but this does not significantly alter the integrity of design and materials. The original tilt-up construction method is readily apparent and intact on the

manufacturing section. The building retains integrity of feeling and association as a mid-twentieth-century manufacturing space with attached office space. The building retains integrity of location. The immediate setting of the building of the building has evolved considerably since its initial construction but this does not diminish the building's significance. At the time of its completion in 1960 only one other similar industrial and office building was present, located to the northwest on Manchester Road (see comparable). Otherwise the setting was rural, with a few scattered farmsteads. Though the Hoods Commons was developed on the former Hood Dairy Farm on the just southeast of 3 Manchester Road in 1969, the most extensive amount of commercial, residential, and small-scale industrial occurred by 1974 and 1992.

47. Boundary Discussion

Part A

The boundary of the area surveyed for this form was the tax parcel Map 8, Lot 269 as shown on the map below (dashed line).



Part B

The property's eligible boundary would include the entire tax parcel as it is the remaining portion of the original approximately 9.38-acre parcel acquired by the Derry Realty Corporation in 1959 and developed with the current building, occupied initially by the Knapp Brothers Shoe Manufacturing Corporation. The entire parcel contributes to the property's significance as a shoe factory and office. A small portion of the original parcel was acquired by the NHDOT in 1982 in connection with road expansion along the easterly side of NH Route 28 and northerly side of Tsienneto (Plan of Derry MG-M-5119(001)-C-2422-A on file with NH Dept of Public Works and Highways).

48. Bibliography and/or References

Preservation Company
2002 "Townwide Area Form (Area DER), Derry, NH" filed at New Hampshire Division of Historical Resources, Concord, NH

2005 "Continuation Sheets for Project Area Form (Area DER), Derry, NH" filed at New Hampshire Division of Historical Resources, Concord, NH

Newspapers
"New Plant Going Up," *New York Times,* 15 September 1958
Nashua Telegraph 5 May 1960, p. 28
"Building Cost Cut by Not Using Fill," *New York Times*, 5 February 1961
"N.Y.U. sells Knapp, King-Size," *Boston Globe*, 6 June 1970, p. 11
Clarence E. Knapp, obituary, *Boston Globe*, 4 October 1972, p. 42

Websites
Cambridge Historical Commission, "The Electronics Corporation of America Collection," (CHC006) [https://www.cambridgema.gov/~/media/Files/historicalcommission/pdf/findingaids/fa_eca.pdf?la=en] Accessed June 2018.

Concrete Contractor, "Tilt-up Construction: History and Uses" [http://www.concretecontractor.com/tilt-up-concrete/construction-history/]. Accessed June 2018.

"Knapp Brothers Shoe Mfg. Corp. v. United States," Case No. 321-52, United States Court of Claims, 12 July 1956 [www.leagle.com/decision/19561041142fsupp8991873]. Accessed June 2018.

Tilt-Up Concrete Association [http://www.tilt-up.org/]. Accessed June 2018.

Rockingham County Registry of Deeds (online)
Deeds
1959 Book 1532, Page 57
1970 Book 2018, Page 72
1970 Book 2018, Page 78
1983 Book 2451, Page 1502
1991 Book 2896, Page 600

Plans
1959 "Plan of Land in Derry, N.H. Showing Land of Herbert W Ross", Plan No. 02818
1983 "Improvements, Plan of Land, Knapp King-Size Corp., Derry, N.N. Prepared for Electronics Corporation of America", Plan No. D-11754

Surveyor's Evaluation

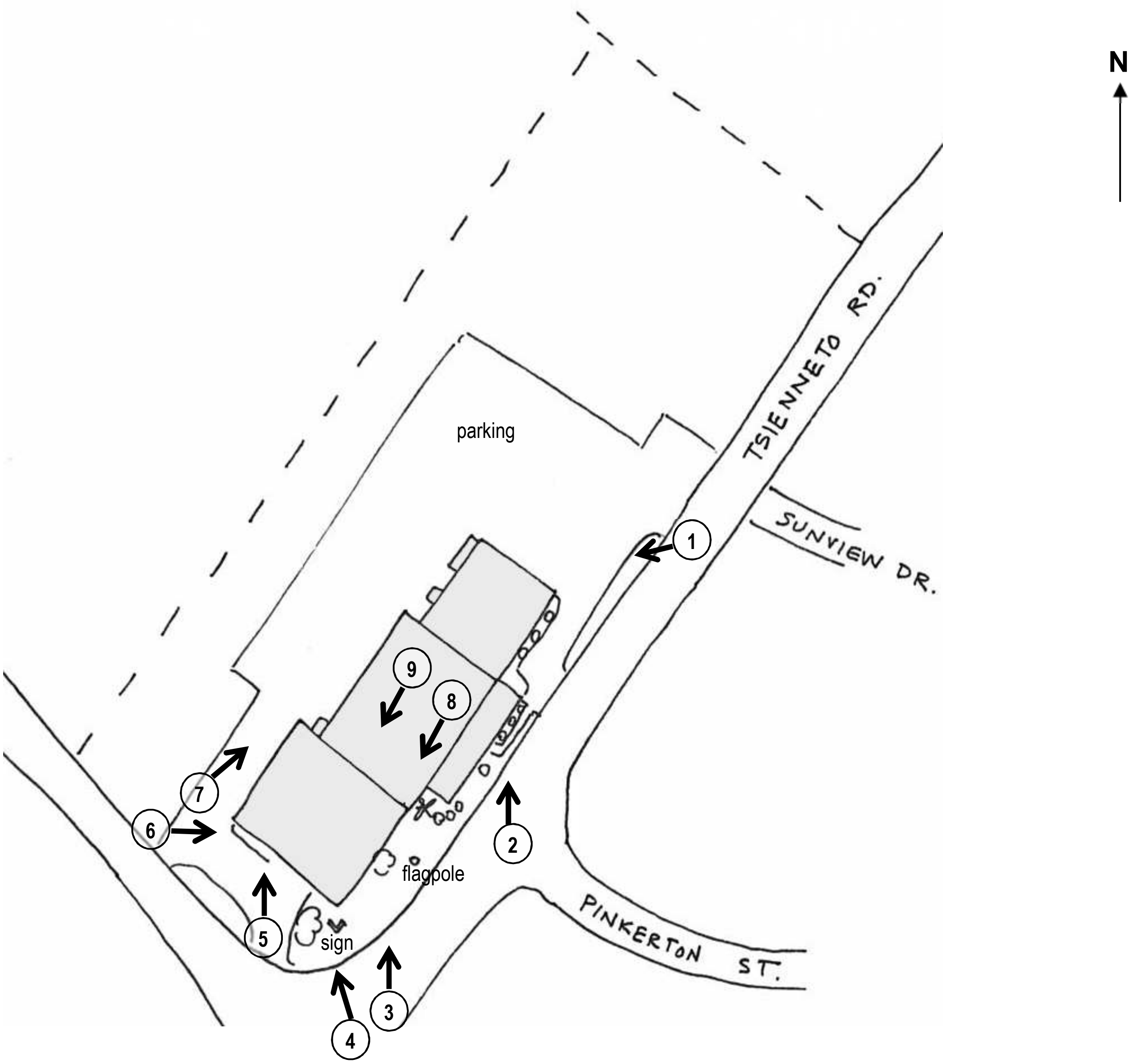
NR listed:	individual	☐	NR eligible:			NR Criteria:	A	☒
	within district	☐		individual	☒		B	☐
				within district	☐		C	☒
Integrity:	yes	☒		not eligible	☐		D	☐
	no	☐		more info needed	☐		E	☐

Digital Photography Statement

I, the undersigned, confirm that the photos in this inventory form have not been digitally manipulated and that they conform to the standards set forth in the NHDHR Photo Policy. These photos were printed using the following: Epson SureColor P600 printer on Epson Ultra Premium Photo Paper, glossy. The digital files are housed with Preservation Company in Kensington, NH.

Lynne Emerson Monroe, Preservation Company

Photo Key



Current Photographs

Date taken: June 2018

Photo 2) Façade, office section Direction: N
Reference (file name): Photo_June2018_285

Photo 3) Façade (south east elevation) of manufacturing and office sections Direction: N
Reference (file name): Photo_June2018_284

Photo 4) Sign Direction: NNW
Reference (file name): Photo_June2018_280

Photo 5) Southwest elevation of manufacturing section Direction: NNE
Reference (file name): Photo_June2018_281

Photo 6) Northwest and southwest elevations of southwesterly part of manufacturing section
Direction: E
Reference (file name): Photo_June2018_282

Photo 7) Northwesterly elevation of manufacturing section Direction: NE
Reference (file name): Photo_June2018_283

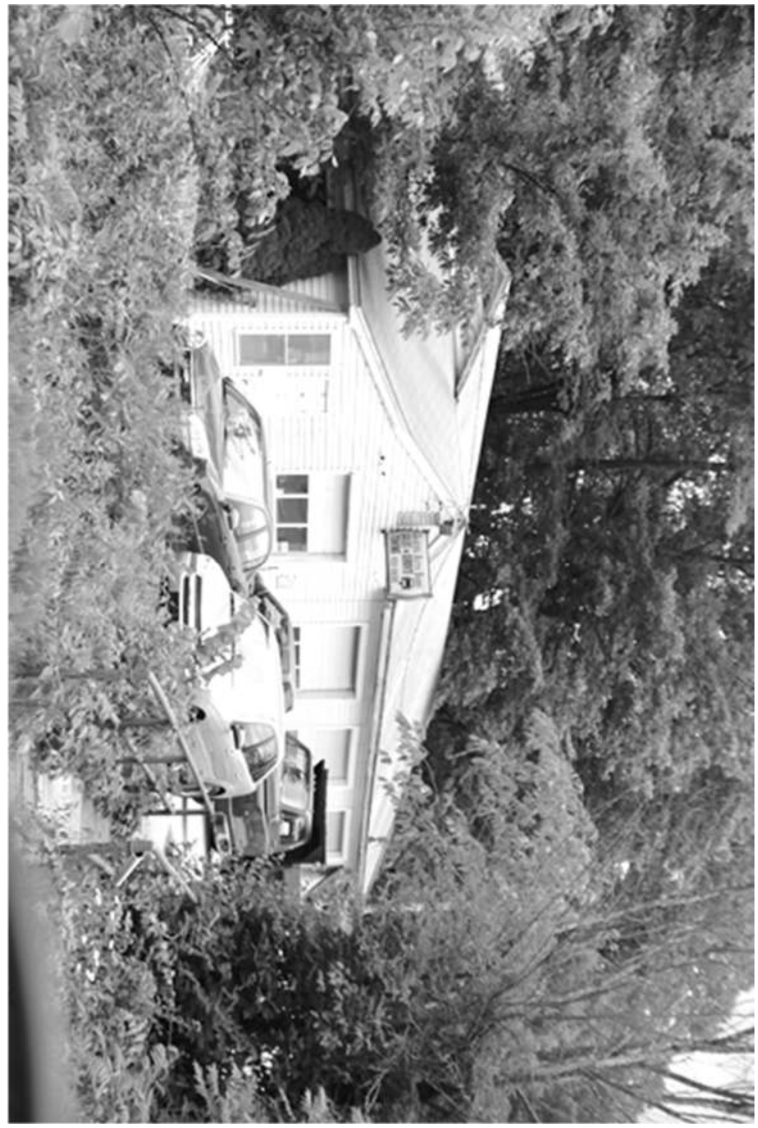
Photo 8) Interior, office section Direction: SW
Reference (file name): Photo_June2018_274

Photo 9) Interior, industrial section Direction: SW
Reference (file name): Photo_June2018_276

Comparable Property

Klev Bros. shoe factory at 22 Manchester Road, built ca. 1958

INDIVIDUAL INVENTORY FORM **NHDHR INVENTORY** DER0197



35. Photo 1: Façade and footbridge Direction: W
36. Date: June 2018
37. Reference (file name): Photo_June2018_342

Name, Location, Ownership

1. Historic name: Jake's Auto Body
2. District or area: None
3. Street and number: 80 Chester Road (Route 102)
4. City or town: Derry
5. County: Rockingham
6. Current owner: John G. DeGroot

Function or Use

7. Current use(s): Other: auto repair
8. Historic use(s): Other: auto repair

Architectural Information

9. Style: Other
10. Architect/builder: Jacob DeGroot (builder)
11. Source: DeGroot 2018
12. Construction date: 1961
13. Source: Research, Inspection
14. Alterations, with dates: 1968/9,1981,1989
15. Moved? no ☒ yes ☐ date: N/A

Exterior Features

16. Foundation: concrete, poured & block
17. Cladding: vinyl
18. Roof material: asphalt shingles
19. Chimney material: block
20. Type of roof: gable
21. Chimney location: exterior
22. Number of stories: 1
23. Entry location: façade, off-center
24. Windows: 1/1 double-hung
    Replacement? no ☒ yes ☐ date: N/A

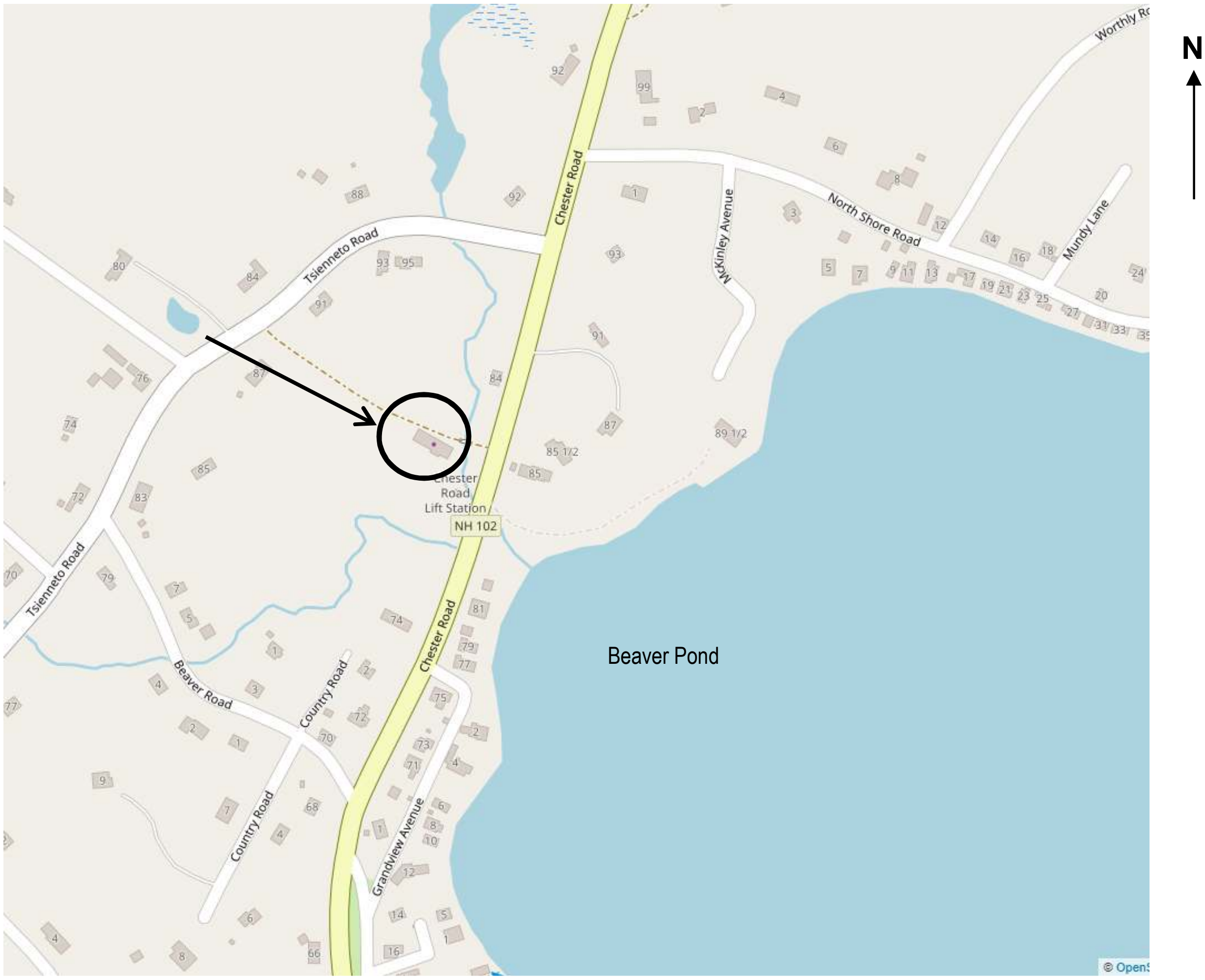
Site Features

25. Setting: Developing mixed use road
26. Outbuildings: None
27. Landscape features: Stream with bridge
28. Acreage: 1.15 acres
29. Tax map/parcel: 55/011/001
30. State Plane Feet (NAD83): X: 1081670.291262; Y: 149153.456948
31. USGS quadrangle and scale: Derry, NH, 1:24000

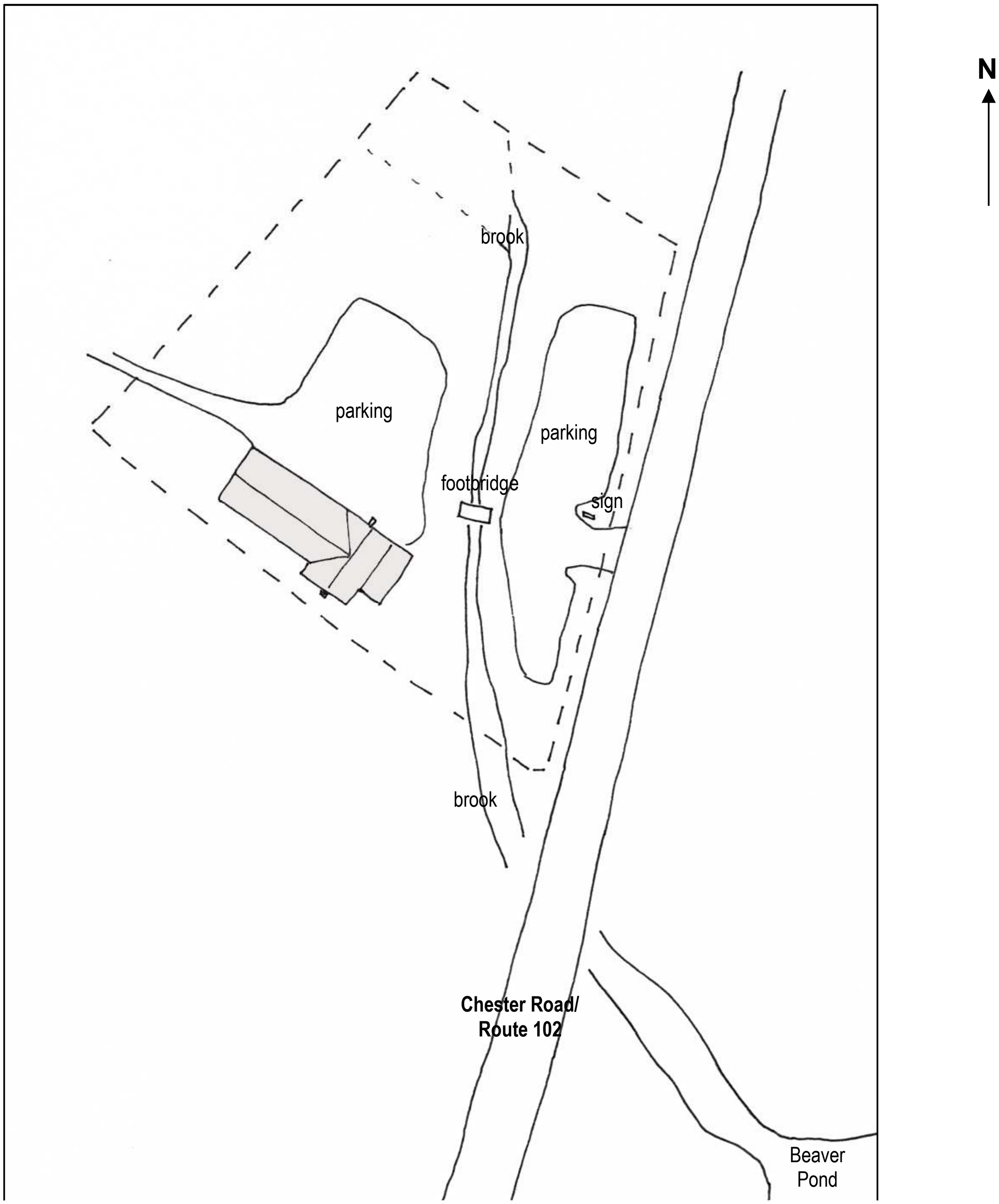
Form prepared by

32. Name: Carol Hooper, Reagan Ruedig, Lynne Monroe
33. Organization: Preservation Company, Kensington, NH
34. Date of survey: June 2018

39. Location Map



40. Property Map



Sketch map showing buildings, landscape features and tax map/parcel (dashed line)

41. Historical Background and Role in the Town or City's Development

Jake's Auto Body (80 Chester Road), is located in central Derry on the west side of Chester Road (NH Route 102) just west of Beaver Lake. A small part of the existing building was constructed ca. 1961 by Jacob (Jake) DeGroot Sr. (1919-2010)[1], and the building with its subsequent (1968-1989) additions has been in continuous use as an auto repair shop run by the DeGroot family (DeGroot 2018; *Nashua Telegraph* 1967).

The 1.15-acre lot upon which the garage is located was part of a larger lot purchased by Jacob DeGroot's father, Garrit DeGroot (1889-1976) in 1946.[2] That lot ran from Route 102 north to Tsienneto Road. According to family sources Jacob sent the money to buy at least a portion of the property to his father while he was still in the service in Germany (DeGroot 2018). Garrit transferred part of the land he had acquired in 1946 (the part on Tsienneto Road) to Jacob in 1947 after he returned from Germany and soon thereafter Jacob constructed the house at 91 Tsienneto Road. (It remains in the family today.)

Jacob DeGroot had been a wrecker driver during World War II and did similar work when he returned for a variety of automobile dealers in the Derry area (DeGroot 2018). In 1953, Jacob purchased the remaining eastern part of the lot his father had acquired in 1946 and in 1961 he received a permit to build on what was to become the site of the garage (*Nashua Telegraph* 1967). The first part of Jake's Auto Body was small – a roughly 32' x 20' building with a single vehicle bay. During the early years of the business, Jacob continued to work for automobile dealers during nights and weekends to supplement his income (DeGroot 2018). As the business grew, in 1968/9 DeGroot added on the long, three-vehicle-bay center section of the building, which roughly tripled its size.[3] The concrete block foundations of this part of the building were salvaged from the garage on the Robert Frost Farm, which DeGroot demolished before the property was sold to the state in 1965 (DeGroot 2018). The end section of the garage toward Tsienneto Road was added in 1981, and an office addition was added onto the front (*i.e.*, toward Chester Road/Route 102) in 1989 (DeGroot 2018).

Since 1987 the property has been owned by Jacob DeGroot's son, John G. DeGroot, who took over the business when his father retired. The use of the building, however, has remained unchanged over the years (DeGroot 2018). The business continues to do car repair/mechanical services, auto body repair and paint, and also sells used cars as it did in the 1960s (DeGroot 2018; *Nashua Telegraph*). Jake's Auto Body prospered in Derry's growth period after the completion of Interstate 93 in 1963, generally benefiting from the increase in population and vehicles/commuters in the town. However, for the most part, over time the garage remained a smaller local operation with nearby Derry clients. Because of its location in a residential neighborhood, it generally did not attract passing traffic.

42. Applicable NHDHR Historic Contexts (please list names from appendix C)

88. Automobile highways and culture, 1900-present

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[1] According to his obituary, Jacob Degroot was involved with veteran's issues and helped found the Boys Club of Greater Derry. He was also a fire warden with the East Derry fire department.

[2] Garrit DeGroot, as well as his wife Teuntje (1891-1975), were natives of the Netherlands. Garrit immigrated to the U.S. in 1915 and worked as an engineer and later fireman for the railroad in Massachusetts. The family moved to Derry in the late 1930s or early 1940s when they purchased property on Tsienneto. Garrit apparently farmed his land (DeGroot 2018).

[3] The building permit for the addition dates to August 1968, so it is possible the construction continued into the next year.

43. Architectural Description and Comparative Evaluation

Jake's Auto Body, is located in central Derry on the west side of Chester Road (NH Route 102) just west of Beaver Lake. The building is set back roughly 100' from the road to accommodate a stream that runs diagonally through the lot; at the southern lot line the stream crosses the road and empties into Beaver Lake. The small part of the lot on the east side of the stream along Chester Road is used for parking. Although there is a footbridge over the stream from Chester Road, vehicle access to the garage is from Tsienneto Road, over an access easement on the 91 Tsienneto Road lot to the west. The garage lot is partially wooded with much of the open space used for parked cars. The area on the south side of the garage is heavily vegetated with a mixture of trees and bushes and is largely inaccessible.

Jake's Auto Body is a single story rectangular wood frame building. Roughly 100' long by 30' wide, the building has a generally east/west orientation, with entrances on the north side of the building. Garage doors – all replacements of a recent vintage – are rolling metal overhead doors with three fixed rectangular windows in the center of the door. The building has vinyl siding which replaced T-111 siding on the earlier portions of the building. Foundations are a combination of poured concrete and concrete block.

As mentioned above, the building has four sections (three additions date from between 1968/9 and 1989). Going from east to west, the easternmost (*i.e.*, closest to Route 102) section of the building is a shed-roofed office that was a 1989 addition to the original section of the building. The office addition has two double-hung 1/1 vinyl windows on the east (road) elevation and one on the north elevation. A concrete block exterior chimney is located in this section. The main entrance to the building is in this section on the north elevation; it has a vinyl single door of recent vintage. The small gabled roof original (1961) section of the building (second section in from the east/Chester Road side) consists of a single garage bay. This section of the building has a north/south orientation with the gabled entrance to the north. A sign ("Jake's Auto Body Sales & Service Towing") is located on the gable. The next section, the long 1968/9 three-vehicle-bay extension, also has a gabled roof, however with an east/west orientation. Vehicle bays on this section are higher than that on the original section. The westernmost (1981) section of the building is roughly square and continues the roof orientation of the center section (although slightly lower). There are no vehicle bays on this section.

Comparative Property

A comparable property to Jake's Auto Body in Derry is the Space Town Auto Body at 66 Scobie Pond Road which was built ca. 1958 (photo). This large (approximately 70' by 80') gable roofed garage has pre-fabricated wood walls, a metal roof and three early or original overhead bay doors. The building's one minor addition for handicapped access does not detract significantly from integrity. Overall the building displays a significantly higher level of integrity than Jake's Auto Body.

44. National or State Register Criteria Statement of Significance

Criterion A: Jake's Auto Body did generally benefit from mid-twentieth century changes in Derry tied to suburban growth and improvements in transportation, such as nearby I-93. However it remained largely a local operation and it does not in particular exemplify these themes. There are other Derry garages/auto body businesses that better illustrate the contexts. It is of some interest as a long-standing business in the community but does not rise to the level of significance required for the National Register under this Criterion.

Criterion B: Jake's Auto Body is not eligible under this Criterion as it is not associated with a person of historical significance.

Criterion C: Jake's Auto Body does not embody the distinctive characteristics of a type, period, or method of construction, nor is it the work of a master. In a general sense, with a series of automotive bays the building does conform to the service garage or automotive repair building type, but due to its later additions and alterations it does not clearly demonstrate the type and it does not retain sufficient integrity to communicate its original design. There are other Derry garages/auto body businesses that retain integrity and better illustrate the type. Therefore, this property is not eligible for the National Register under Criterion C.

45. Period of Significance

1961-1989

46. Statement of Integrity

The property retains integrity of location, setting, and association. However, the building was constructed in four stages over the period from 1961 to 1989 so the majority of the fabric of the building actually dates from after 1968/9, as does the massing. Thus significant elements of the building's integrity have been compromised. In particular, the replacement of original siding with vinyl siding and the newer vinyl replacement garage/bay doors compromise the building's integrity of materials.

47. Boundary Discussion

The boundary of the area surveyed corresponds to Derry lot 55/011/001 shown on the Property Map on page 3.

48. Bibliography and/or References

DeGroot, John
2018 Interviews with Lynne Monroe and Carol Hooper 6/2018.

Nashua Telegraph
1967 "Derry News from Town Hall" 12/21/1967 p.6.
1968 "Derry Zoning Board Grants Requests." 8/12/1968 p.12

Peabody Funeral Homes Website
Accessed 2018 Obituary for Jacob "Jake" De Groot Sr.
http://www.currentobituary.com/member/obit/87395

Deeds

Rockingham County Registry of Deeds

4/29/1987	2675/2602
5/2/1953	1280/206
5/15/1946	1053/380

Surveyor's Evaluation

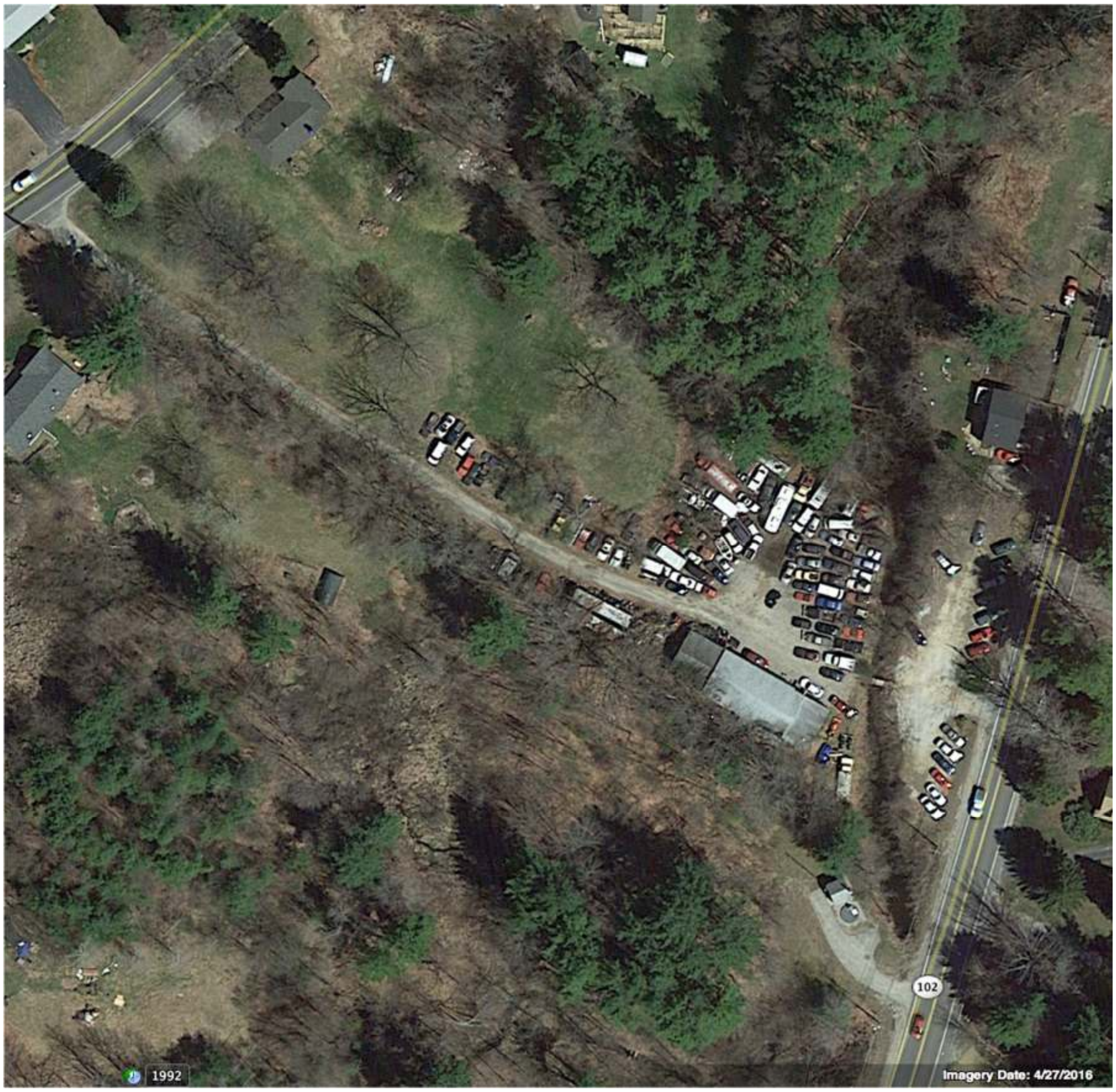
NR listed: individual ☐
within district ☐

Integrity: yes ☐
no ☒

NR eligible:
individual ☐
within district ☐
not eligible ☒
more info needed ☐

NR Criteria: A ☐
B ☐
C ☐
D ☐
E ☐

Other Images



Google Earth satellite photograph, dated April 2016, showing access road from Tsienneto Road and parked cars on property

Comparative Property

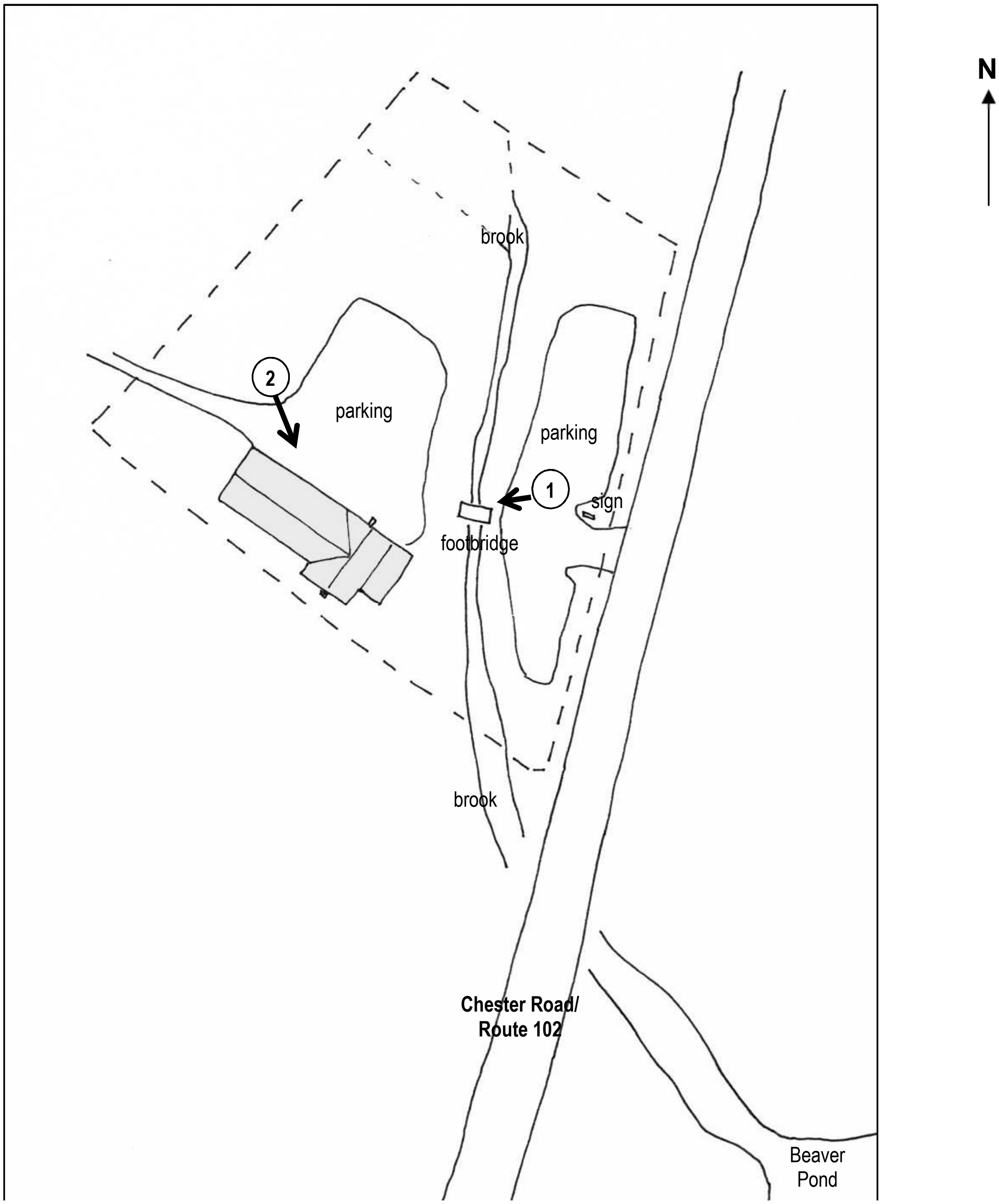
Space Town Auto Body, 66 Scobie Pond Road, Derry (1958)
Town of Derry tax card/GIS photo
http://gis.vgsi.com/derrynh/Parcel.aspx?Pid=10323

Digital Photography Statement

I, the undersigned, confirm that the photos in this inventory form have not been digitally manipulated and that they conform to the standards set forth in the NHDHR Photo Policy. These photos were printed using the following: Epson SureColor P600 printer on Epson Ultra Premium Photo Paper, glossy. The digital files are housed with Preservation Company in Kensington, NH.

Lynne Emerson Monroe, Preservation Company

Photo Key


N
brook
2
parking
parking
1
sign
footbridge
brook
Chester Road/
Route 102
Beaver
Pond

Current Photographs

Date taken: June 2018

Photo 2) Garage bays on façade. Original section of building (with sign) and office addition to left, 1968/69 addition to right. (1981 addition not in view.) Direction: SE
Reference (file name): Photo_June2018_327

1. Type of Area Form

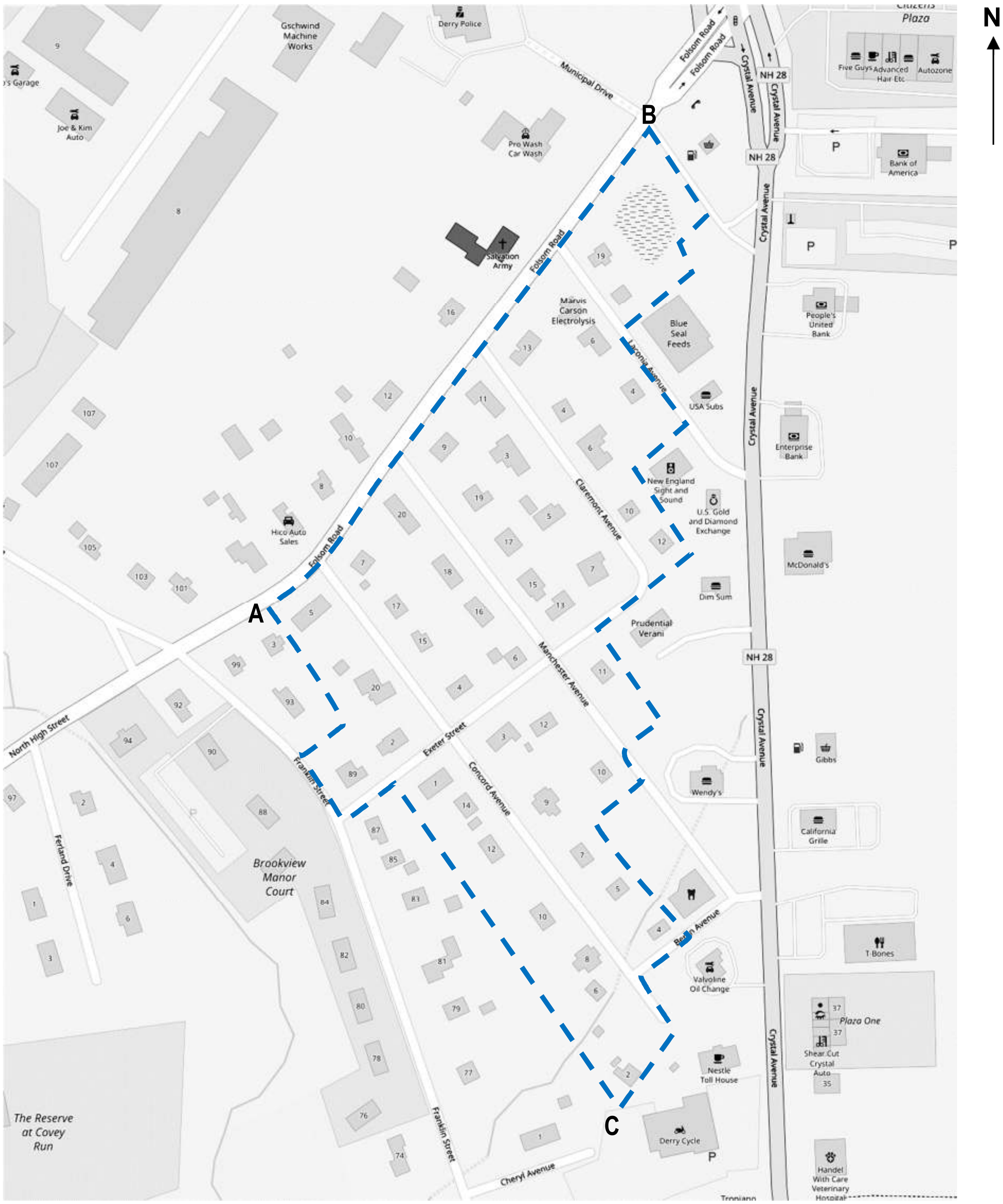
   Town-wide: ☐
   Historic District: ☒
   Project Area: ☐
2. Name of area: Franklin Terrace Historic Area
3. Location: Between Folsom Road, Franklin Street and Crystal Avenue
4. City or town: Derry
5. County: Rockingham
6. USGS quadrangle name(s): Manchester, NH
7. Dataset: SP Feet, NAD83
8. SP Feet: (shown on location map)

A: X: 1074370.309378; Y: 142440.614174
B: X: 1075082.602857; Y: 143345.893529
C: X: 1075074.425043; Y: 141504.987565

9. Inventory numbers in this area:

   DER0152 – 19 Folsom Road
10. Setting: Densely settled residential area of four blocks adjacent to modern commercial strip
11. Acreage: approximately 15 acres
12. Preparer(s): Kari Laprey, Reagan Ruedig
13. Organization: Preservation Company
14. Date(s) of field survey: June 2018

15. Location Map



16. Sketch Map

See large-format Sketch Map included

17. Methods and Purpose

This area form was prepared for the Exit 4A Project, 2018, for which properties built prior to ca. 1968 were inventoried. Franklin Terrace is a residential neighborhood built over nearly a century on a subdivision platted in 1908. Properties at the northern end of the area are potentially impacted by the proposed project (specifically 19 Folsom Road, 11 Folsom Road and 8 Laconia Avenue). A single house in the area, 19 Folsom Road, was previously documented for the New Hampshire Division of Historic Resources (NHDHR) as DER0152. The Franklin Terrace subdivision is a definable area, identified as a possible historic district. However, the neighborhood does not have integrity for a specific historic period, because it developed gradually, with nearly a third of the construction taking place in the past fifty years and most of the older homes substantially remodeled. The area contains a total of forty-five residential properties. Twenty-six of the properties that are more than fifty years old retain some integrity, i.e. the original form and type is evident. All but one or two of those have been remodeled with new siding, windows, doors, etc. Six other pre-1968 houses have large additions obscuring their original form and thirteen houses were built in the past fifty years.

All residential buildings within the Franklin Terrace subdivision plan were photographed with photo locations keyed to the sketch map. The district maps are based on Town of Derry GIS mapping. Estimated construction dates are based on Derry tax assessments, adjusted in some cases based on research. Properties are identified by street address, with tax parcel numbers cross referenced in the text and property table. Properties are arranged roughly geographically. Streets are presented from west to east, with addresses in order from south to north. All the residential buildings in the area platted in 1908 are included. Lots on the eastern edge of the subdivision, fronting on Crystal Avenue/NH 28, developed separately from the neighborhood with commercial buildings on larger parcels. The adjacent residential streets bordering Franklin Terrace on the west and south were subdivided independently, though they were built up during the same time frame. The mid-twentieth century houses on the northwest side of the Folsom Road were not part of the Franklin Terrace subdivision plan and those in the project area are surveyed individually. Only one property fronting on Franklin Street was part of the subdivision. Other homes on either side of Franklin Street date from the early 1900s through the 1980s.

Historic background research sources were historic maps, local histories, population, census and birth and death records. Limited deed research was carried out for a few properties to determine construction dates of the earliest homes and identify basic patterns of ownership and development. The deed references are given in the text to aid future researchers. Due to the limited potential for eligibility and for effects by the current project, the architectural descriptions of each resource are presented in a table of properties, with detailed discussion only of those few impacted resources.

18. Geographical Context

Franklin Terrace is in western Derry, about a half-mile north of the village of West Derry and three-quarters of a mile west of Derry Village. Interstate-93 is a mile to the west, just over the Londonderry line. The neighborhood is about 1.5 miles from Exit 4, the I-93/NH 102 interchange, and under three miles from Exit 5. Downtown Manchester is roughly a twelve-mile drive.

The grid of streets occupies relatively flat land on the eastern side of Shields Brook, which flows north-south towards Beaver Brook. Shields Brook is dammed to create Hood’s Pond, which has a small public park on the north edge of West Derry village. Derry’s topography is uneven but gently rolling at an overall low elevation of only about 200-300 feet above sea level.

The Franklin Terrace subdivision fills a triangular area between converging main roads. Crystal Avenue/NH 28, which borders the neighborhood on the east, runs north—south on the direct route between Manchester and West Derry. Franklin Street runs north-northwest to south-southeast parallel to Shields Brook, about 0.1 to 0.2 of a mile west of Crystal Avenue. Folsom Road across the northwest edge of the historic area runs southwest from the junction of Crystal/NH 28, Rockingham Road/NH 28 and Tsienneto Road. Folsom Road connects to the upper end of High Street on the far side of Shields Brook and continues as Madden Road in Londonderry where it dead-ends at I-93. Four parallel residential streets, called Concord, Manchester Claremont and Laconia avenues, run southeast from Folsom Road toward Crystal Ave, roughly parallel to Franklin Street. A cross street, Exeter Street, connects Franklin Street, Concord Manchester and Claremont. A shorter cross street, Berlin Avenue, bounds the area on the southeast.

19. Historical Background

The Franklin Terrace subdivision was laid out in 1908 with streets named for New Hampshire cities and towns. The sale of lots to investors began immediately, but construction took place very slowly from the 1920s through the 1960s and beyond. The development of the neighborhood relates to the growth of West Derry, formerly Derry Depot, in the early 1900s and the population boom of the 1950s-60s period. During the same periods, adjacent lots along the older roads, Franklin Street and Folsom Road, were developed and Crystal Avenue/NH 28 became a commercial strip.

1720-1908 Farmland on Folsom Road, Crystal Avenue and Franklin Street
Until the early twentieth century this was a rural area with scattered farmhouses and large tracts of open land. The overall pattern of property lines and roads in the vicinity relates to the original land divisions. The roads developed as part of the local and regional transportation routes. Folsom Road/Madden Road dates from the 1720's when Londonderry, including Derry was settled and it was the road to the first meetinghouse. The four-way intersection with Tsienneto Road, the early route to Chester, and Pinkerton Street and Manchester Road, which formed the main route through Londonderry to Manchester, was known as Folsom's Corner and then Ross' Corner for the owners of the farmhouse that stood in the western quadrant of the junction until the 1980s. A district schoolhouse was located on the southeast corner of the intersection (Chace 1857). The primary north-south road through town was the Londonderry Turnpike (now Bypass 28 and NH 28) established in the early 1800s through the small mill hamlet of Derry Village.

After the Manchester and Lawrence Railroad was built through the southwest corner of town in 1849, Derry Depot or West Derry grew up around the station to become the primary town center. A commercial downtown developed along East and West Broadway and large shoe factories were built near the railroad. Industry resulted in population growth and Derry became the third largest community in Rockingham County in the late nineteenth century. Between 1890 and 1900 the town saw an increase of nearly a thousand people to over 3,500. New residential streets were laid out. Crystal Avenue was built as a more direct route between West Derry and the road to Manchester (Norris 1887). It became the location of St. Thomas Aquinas Roman Catholic Church completed in 1888. A parallel north-south road, Franklin Street, connected Folsom Road and West Broadway in the 1890s (Hurd 1892; USGS 1903). At the end of the century, a few isolated homes were located in the area, with open land surrounding them (Bailey 1898). Around 1900, a series of short residential cross streets were platted between the lower ends of Franklin Street and Crystal Avenue. Lincoln, Howard and Laurel streets were developed during a relatively short time with over a dozen 1½-story gable fronts and other small houses (USGS 1905; Sanborn 1921).

Derry experienced a population boom of over forty percent in the first decade of the 1900s. A prophetic statement in a 1902 article about the town declared, "The topography of Derry is such that it can and does grow in all directions, with practically its whole surface available for building purposes" (Cheney 1902:3 73). As street railways brought the first suburban development to the region, West Derry was connected to Manchester via the electric railway completed in 1907.

1908 Edmund M. Warren Subdivision
In 1908, a 21.2-acre tract of land between Crystal Avenue and a highway (Folsom Road) was acquired by George Barnes of Providence, RI, who mortgaged some of it to George Knowles (1850-1933) of Boxford, MA (Deed 630:447). It was sold in the spring of 1908 to real estate developer Edmund M. Warren of Providence, RI, who laid out a subdivision of 156 lots in April 1908 (Plan 521). This was one of two Derry subdivisions in which he was involved that year; plans for Hillside Park were drawn up in May. Edmund M. Warren (1869-1936) was a farmer's son from Island Falls, Aroostook County, Maine. He and his wife Mary A. White lived in East Providence, RI, until they divorced in 1911 and he moved to West Springfield, MA, according to censuses and directories. The Edmund M. Warren Realty Company, owners, developers and managers of real estate, did business in the New England states and New York.

The individual lots in the subdivision were roughly 0.1 acre. Most were combined in twos or threes for about 0.23 or 0.34 acre house lots. Deeds included restrictions including a ten-foot setback, no dwelling less than 1½ stories or costing less than $1,000. Warren sold the first lots in 1908, but deed research of selected properties suggests that the first construction did not take more than a dozen years after the lots were platted and, in many cases, they were not developed for decades. The value and return on these investments is unknown because these and subsequent deeds were recorded for $1 and "other valuable considerations." Examples of the first lot owners included Mrs. Stella Madden, a stitcher in the shoe factory who lived on Central and purchased four lots on Crystal Avenue in 1908, which she owned until 1946, then there were still no buildings on them (Deed 638:438; Deed 1060:294). Another shoe stitcher, Elisabeth Tanner, bought two lots on Concord that were not developed until 1998 (Deed 637:243). Thomas Cote, a machinist who lived on East Broadway, acquired lots on Concord Street where no house was built until after his estate sold the lots in 1957 (Deed 638:427).

1909- 1944 New England Land Company (Otis Perry)
In 1909, Warren transferred all his real estate holdings to New England Land Company, including land in Derry, Goffstown, Manchester and elsewhere (Deed 641:172). New England Land Company was based in Portland, ME. The main shareholder was real estate agent Otis Perry (1872-1944) who was from the same town as Warren in Aroostook County, ME. Perry lived on Commonwealth Avenue in Boston during the 1910s and later in Lexington, MA, according to directories and census. Otis Perry also became the assignee of the mortgage held by George Knowles (Deed 679:424).

Lots were sold off gradually in the 1910s and 20s. The first few houses were built at the southern end of the area closest to the downtown and existing residential streets. Development remained slow, as Derry's population growth came to an end. North of Exeter Street, there was no construction through the 1940s. However, increased mobility soon brought potential builders to outlying areas as automobiles superseded the railroad and streetcar. The street railway ceased to operate in 1926. NH Route 28 was established as a state road ca.1915 following a series of older roads including Birch

Street, Crystal Avenue and Manchester Road through West Derry. Crystal Ave. north of the Catholic Church had several filling stations and shops, none of which are extant (Preservation Company 2002).

The 1931 Sanborn map shows five houses in this area. The recently remodeled one-story house at 2 Concord is said to date from 1920. 4 Berlin Ave. was a one-story house built after 1928 when lot 46 was purchased by Myer Miller (1880-1946) a cigar maker from New York City. A house on the site of 6 Concord Ave. was built in the 1920s on lots (6-7) purchased by Ida Chase from New England Land Company in 1920 (Deed 794:193). Her husband Asa Chase was a laborer and her son worked in the shoe factory (Census 1930). A one-story house also stood on the site of 5 Concord Street in the 1930s-50s (Sanborn 1950). 9 Concord (lots 38-39) was originally built ca. 1920. From 1935, a house on the site of 6 Concord was owned by widow Mary Joyce who worked in the shoe factory, as did her eldest children (Deed 906:246; Census 1940). Truck driver Earl Geer was the owner of a bungalow at 8 Concord (lots 8-9 and 10) built ca. 1939.

Many parcels were purchased but remained undeveloped. Lots on Claremont Ave. and Folsom Road were bought from New England Land Company by Agnes Dors in 1912 (Deed 668:336). She and her husband were Polish immigrants who lived in Manchester where he was a machinist in a shoe factory. It wasn't until 1947 that she sold the lots to her son who built a house at 19 Folsom Road (Deed 1080:231). John A. Wall (1855-1922) who worked in the shoe factory purchased lots in 1912, which he owned until 1921 while renting elsewhere in town (Deed 668:168). Louis P. Laronde who lived elsewhere on Franklin Street acquired multiple lots in the area in 1940 that he owned for nearly a decade (Deed 1144:291).

The whole area was listed as Franklin Terrace in the 1940 census and there were nine houses. Nearly all were owner-occupied, single-family homes. Several residents worked in shoe factories. Men were employed at the time in road construction, probably in WPA projects and as truck driver, sign painter and bookkeeper (Census 1940).

1944-1969 New England Land Company (Albert and Margaret Perry)
The New England Land Company holdings passed to Albert O. Perry (1900-1952) who lived in Exeter. During the 1940s, more lots were sold, mainly in pairs. All deeds were recorded for $1 and other valuable considerations. Margaret Perry (1903-2007), became president of New England Land Company in the 1950s and continued to sell off several groups of two or three lots each year as Derry's population grew again. By 1957, all lots had been sold. Margaret Perry, the sole surviving stockholder, president and director, dissolved the New England Land Company, which had no remaining liabilities or assets. Subsequent deeds of 1979 and 1986 confirmed transfer of any remaining right she might have (Deed 2346:566; Deed 2649:1141).

Robert Fortier (1897-1972) and his wife Catherine, who lived on Crystal Avenue where he had an automobile business, acquired multiple lots from New England Land Company and other interim owners in the 1940s-50s and sold them again in subsequent years. Automobile ownership allowed some residents to commute farther for work. A small ranch was built at 11 Folsom ca. 1947 for Oscar Warren who worked on a Londonderry poultry farm according to the census (Deed 1060:94). The altered house at 8 Laconia dates from ca. 1948, built for Alden and Dorothy Whitney on two lots bought in 1947 (Deed 1153:188). They owned it for nearly ten years. 19 Folsom Road (DER0152) was built ca. 1950 and was the home of George and Celia Dors for many years (Chase 1965). He worked for the telephone company as an installer according to city directories. Area residents continued to work in the shoe factories, such as Raymond Sweezy (1913-1972) who lived at 2 Concord Ave from 1957. The original part of 89 Franklin was built ca. 1951 for George and Anne Devine (Deed 1231:303). He was employed at the shoe factory and rented a house in West Derry previously (Census

1940). The historic shoe factories closed and burned, but in 1960, a new modern shoe factory was built on Manchester Road just north of this neighborhood.

Growth in the region was influenced by the construction of Interstate-93 between Massachusetts, Manchester, Concord and points north in the early 1960s. The interstate passes through the southwestern-most corner of Derry with an interchange at Route 102 just over the Londonderry line at edge of West Derry village. Between 1960 and 1970, Derry's population boomed by sixty-seven percent. Ten new homes were built in the neighborhood during that period.

1969-present *Construction on Remaining Lots in Last Fifty Years*,
By the end of the 20th century, much of the land that had once been pasture and field, which had reforested during the first half of the 20th century, was the location of tracts of houses. According to the master plan, there were over 9,000 dwelling units in town in 1985. Some 3,251 units had been built between 1970 and 1980, many in multi-family buildings (Preservation Company 2002).

The last undeveloped farmland was east and north of this neighborhood where there is recent large-scale commercial and industrial activity. Hood Plaza was built on the corner of Crystal Ave. and Pinkerton Street at the end of the 1960s. Multiple free-standing stores and restaurants were constructed on Crystal Avenue beginning in the 1980s, filling in vacant land and replacing older business. Only a couple of mid-twentieth century buildings remain extant.

New home construction in Derry took place primarily in new subdivisions, but infill of older neighborhoods continued until maximum density was reached. In Franklin Terrace over a dozen houses were built in the 1970s-90s period. A few houses were converted to two-family use. Most properties have changed hands multiple times in the last fifty years. Tax records indicate the area is now a mix of owner-occupied and rental properties.

20. Applicable NHDHR Historic Context(s)

131. Suburban/bedroom community growth in New Hampshire, c.1850-present.

21. Architectural Description and Comparative Evaluation

The Franklin Terrace subdivision is a grid of short parallel streets with forty-five residential properties on small lots. Homes date from the 1920s to the 1990s and are a mix of small capes, cottages and bungalow-type houses, many small, minimal ranch houses and more recent raised ranches and two-story houses. All have been updated in the past few decades with new siding and windows. Of the thirty-two homes in the area that are greater than fifty years old, five houses date from the 1910s-30s, three were built in the 1940s, fourteen in the 1950s and ten in the 1960s. Thirteen houses were built within the past fifty years.

The four parallel streets of varying lengths fill a roughly triangular area. Franklin Terrace was laid out in a total of 156 lots, which were typically about 0.1 acre. When sold, most lots were grouped in twos or threes, so when the area reached its fully-built state, the forty-five homes were about evenly spaced along the streets, with three to five properties in each block. Fronting on Crystal Avenue at the east edge of the subdivision, lots were irregularly shaped and when developed in the late twentieth century, were combined into triangular parcels creating a jagged edge along the border between the residential neighborhood and backs of the commercial properties.

This is predominantly a single-family area, with small houses of two or three bedrooms. Three of the houses were built as duplex/two families and two or more of the older homes have been converted for two family use. Nearly all of the buildings are one or 1½ stories except for some of the newest ones. Roofs are gable or hip. All buildings are wood frame construction, on concrete block and poured concrete foundations. Vinyl siding and 1/1 windows are nearly ubiquitous, and roofs are asphalt shingled. The homes have few stylistic architectural details. Three-part picture windows are the only common feature, but most have been replaced. The front entries are unadorned. Most have new doors and new small wooden decks or concrete steps. There are few outbuildings including new sheds and detached garages, only one of which appears to be original. The rectangular, flat lots include front lawns, back yards, short paved driveways and some mature trees. Foundation plantings are popular. Some houses have modern retaining walls of concrete or stone or new fencing.

The five oldest houses in the neighborhood date from the 1920s-30s, but all have been remodeled. Three have large additions that obscure the appearance of the original building. The Bungalow was a common local house type from the 1910s. 6 Exeter (Photos 26-27) is an example of a small Bungalow with hip roof and dormers, though it lacks the characteristic front porch. 8 Concord (Photo 7) has a clipped gable roof and front porch, so the original Bungalow form is evident despite additions on both sides. 9 Concord (Photo 8) began as a one-story house, enlarged into a two-family home with a two-story addition in the mid-twentieth century. The original form of the 1930s house at 2 Concord Ave. (Photo3) is not evident due to expansion and remodeling. The small house at 4 Berlin Ave. (Photo 2) was enlarged by the addition of a second story. Other early twentieth century, one-story houses stood on the sites of 6 Concord and 5 Concord (Sanborn 1950).

There was construction of only about three more homes during the 1940s according to the tax card dates. The post-WWII, a population boom began and about fourteen houses were built in this area in the 1950s and ten in the 1960s. All were small one and 1½-story houses with little architectural detailing or ornament.

Several 1½-story capes characterized by a center entry and a three or five-bay façade include 5 Folsom (Photos 20-21) and 12 Claremont (Photo 48), as well as 20 Manchester Ave. (Photo 35) which has brand new siding. A more altered version is at 8 Laconia, which has added dormers, oriel windows and new front entry (Photos 51-52). The least altered house in Franklin Terrace is a 1½-story cottage, with a gable front and side entry at 19 Folsom (Photos 53-54). It retains wooden clapboards and the original 6/1 windows. One house has a gambrel roof suggesting the Dutch Colonial style, but no other features (Photo 11).

About twenty of the houses in the area are classified as ranches due to their one-story rectangular form. The most common small ranch type in the area is the side-gabled form with low-pitched gable roof. Three or four-bay facades are asymmetrical with a three-part picture window but no other details or ornament. Examples of this type are 1, 2, 3 and 4 Exeter Street (Photos 12-15), 7, 9, 11 and 13 Folsom Road (Photos 22, 36-37, 38-39 and 41-42), 12, 13 and 18 Manchester Ave. (Photos 25, 28-29,33) and 4 Laconia Ave. (Photo 49). Two slightly larger ranches have hip roofs. 3 Claremont (Photo 42) has all new siding and windows, while 7 Claremont (Photo 46) retains “form stone” siding, which was popular in Derry during the 1950s-60s, a stone chimney and picture windows. 6 Claremont (Photo 45) and 10 Manchester (Photo 23) are ranches with low shed roofs and overhanging eaves. Other ranch houses have been altered by large additions, including 16 Manchester Ave. (Photo 31) and 89 Franklin Street (Photo 1). Garages were fairly common in the mid-twentieth century; six of the ranches have attached garages, three have car ports.

Late twentieth century houses are a mix of types, all on small parcels like the earlier homes. The raised ranch form with entry at ground level, living space above and finished basement below was popular in Derry and this area has four raised ranches built in the 1970s (12 and 15 Concord, 17 and 19 Manchester, Photos 10, 16, 32, 34). Other houses built in recent decades are a duplex with Mansard roof (Photo 6), two-story houses at 5 and 6 Concord Ave. (Photo 4, 7) and capes at 4 Claremont and 17 Concord (Photos 17 and 43).

Property Descriptions

Three properties with potential effects under the Exit 4A Project are described below.

11 Folsom Road (35-40) ca. 1947 ranch with ell, Photos 38-39
A small ranch is located on the corner of Folsom Road and Claremont Ave. The house faces Folsom with ell and driveway on Claremont. The one-story house has low-pitched gable roofs. The windows are 1/1 replacements and the walls, trim and shutters are vinyl. The four-bay façade has new casement windows. A concrete block chimney is inset in the gable end wall. The ell may be an addition. It has board and batten siding. The windows and doors of the back entry and garage are modern. Added to the end of the ell is a smaller one-story section with overhanging roofs on both sides. The side and back yard is enclosed by palisade fence. There is an inground pool. The small front yard is flat lawn with a mature tree near the corner.

8 Laconia Avenue (35-27) ca. 1948 remodeled cape, Photos 51-52
This house is oriented toward Laconia Ave. with driveway and parking along Folsom Road and a small home business in the back ell. The 1½-story cape has a center entry and 3-bay façade. There are large shed dormers on the front roof slopes that appear to be a modern addition. The entry is sheltered by a gable hood. The entry trim and oriel windows on the façade are new. All other windows have 1/1 replacement sashes. The siding, trim and shutters are vinyl. The foundation is concrete. An asphalt walk leads to the front door, which has new concrete steps. A side entry is through a gabled portico. The one-story ell has sliding glass doors and a new deck. A modern shed stands beside the parking lot near Folsom Road. There is a sign for the home business on the corner and front lawn along Laconia Ave.

19 Folsom Road, DER0152, (32-20) ca. 1950 cottage, Photos 53-54
The Dors House, inventoried in 2000, is a small Colonial Revival cottage, built c.1950 on the southeast side of Folsom Road. The 1½-story house is oriented laterally to the street, with a gable wall dormer and central entry pavilion on the facade. The wood frame structure is supported by a concrete block foundation. The walls are sheathed in clapboards and the roof in asphalt shingles. The eaves are close cropped with a molded raking cornice. Windows have flat trim and contain double-hung 6/1 sash. The entry, into the small enclosed pavilion, is framed by channeled boards with corner blocks. The front of the house is blocked from view by large cedars. Open lawn surrounds the house, shaded by tall pines in the rear. The 0.8 acre parcel is located on the comer of Folsom and Laconia Street. The driveway and a two car garage with novelty siding and overhead doors on its front gable, are located on Laconia Street. The property is located at the upper end of Folsom Road at the edge of the commercial area around the intersection of Crystal Avenue.

List of Properties

All properties in the area are listed with descriptions in the following table. Address, photo and tax numbers are cross-referenced. The integrity assessment is based on whether the house retains its original form and massing. Nearly all properties have been remodeled to some degree.

Street Address	Tax Map-Lot	Estimated Date	Description	50+ years with some Integrity Yes/No		Photo Nos.
89 Franklin St	35-58	1951	Ranch, 3 bays, with large addition of equal size, with basement garage bays, new siding and windows, new front deck		X	1
4 Berlin Ave	31-51	1930	Small two-story house with porch, saltbox roof, second story added (per Sanborn map), new siding and windows		X	2
2 Concord Ave	31-53	1920/ 2017	One-story house with large new brand-new addition, original form unknown, new siding, windows, doors		X	3
5 Concord Ave	31-50	2000	Two-story gable front with porch. Site of earlier house		X	4
6 Concord Ave	31-55	1992	Two-story, side gable. Site of ca. 1920s house, shed		X	5
7 Concord Ave	31-49	1973	Duplex with mansard roof, brick veneer, carports		X	6
8 Concord Ave	31-56	1939	Bungalow with clipped gable, enclosed front porch - original form still evident despite side additions, new siding and windows	X		7
9 Concord Ave	31-48	1920	1½-story gable front Bungalow/cottage, now a two-family. Large mid-20th c. two-story addition envelops back of house. Asbestos siding, new windows. Attached garage has original windows.		X	8
10 Concord Ave	31-56-1	1986	Duplex, two-story garrison form		X	9
12 Concord Ave	31-57	1979	Raised ranch, new siding and windows		X	10
14 Concord Ave	31-58	1953	1½-story gambrel, shed dormers, enclosed porch, new siding and windows, detached garage (modern)	X		11

Street Address	Tax Map-Lot	Estimated Date	Description	50+ years with some Integrity Yes/No		Photo Nos.
1 Exeter St	31-59	1958	Ranch, 4 bays and carport, new siding, windows, doors	X		12
2 Exeter St	35-52	1967	Ranch 3 bays, and basement garage, sun room, new siding, windows	X		13
3 Exeter St	31-47	1964	Ranch, 4 bays plus attached garage, new siding and windows, "form stone"	X		14
4 Exeter St	35-45-1	1975	Ranch, 4 bays, new siding and windows		X	15
15 Concord Ave	35-51	1976	Raised Ranch, new siding, windows and doors		X	16
17 Concord Ave	35-50	1998	Cape, 3 bays, dormers		X	17
20 Concord Ave	35-53	1964	Ranch with cross gable, brick chimneys, new siding, windows, detached garage	X		18-19
5 Folsom Rd	35-54	1949	Cape with breezeway and garage, aluminum siding, picture window, old windows	X		20-21
7 Folsom Rd	35-49	1959	Ranch, 4 bays, new vinyl siding and windows, new bay window, small modern shed	X		22
10 Manchester Ave	31-45	1961	Ranch, two units, flat roof, stone chimney, new siding and windows, setting includes parking, access to business to southeast	X		23
11 Manchester Ave	35-43	1960	Small Ranch, one story, 4 bays, picture window, new door and windows	X		24
12 Manchester Ave	31-46	1945	Ranch, 4 bays with extension, new windows	X		25
6 Exeter St	35-45	1929	Bungalow, hip roof and dormers, stone foundation, detached garage	X		26-27
13 Manchester Ave	35-42-1	1955	Cabin/ranch, 1 story, wood clapboards, picture window, side addition, new shed	X		28-29
15 Manchester Ave	35-42	1955	Two family, two-stories with two-story porch, carport	X		29-30
16 Manchester Ave	35-46	1959	Ranch, 4 bays, attached garage converted/enclosed, new siding, windows and doors		X	31

Street Address	Tax Map-Lot	Estimated Date	Description	50+ years with some Integrity Yes/No		Photo Nos.
17 Manchester Ave	35-38-1	1976	Raised ranch with basement garage, new siding, windows and front entry		X	32
18 Manchester Ave	35-47	1954	Ranch, 4 bays, with carport, concrete block foundation, new siding, windows, doors	X		33
19 Manchester Ave	35-41-1	1976	Raised ranch, basement garage new siding, windows, front entry		X	34
20 Manchester Ave	35-48	1966	Cape with attached garage, added bay window, new vinyl siding, windows, shed, pool, split-rail fence		X	35
9 Folsom Rd	35-41	1957	Ranch, 4+ bays, brick chimneys, new front entry, new siding and windows, new retaining wall	X		36-37
11 Folsom Rd	35-40	1947	Project impacts. Ranch, 4 bays, new siding, windows and doors, attached garage in added ell, in-ground pool	X		38-39
13 Folsom Rd	35-28	1955	Ranch, 3 bays with breezeway and attached converted garage, new siding and windows, older front steps with wrought iron railing, metal awning, small shed	X		40-41
3 Claremont Ave	35-39	1965	Ranch, hip roof, 4 bays plus garage, new siding and windows, new front deck	X		42
4 Claremont Ave	35-29	1987	Cape, 5 bays, new siding, windows and door		X	43
5 Claremont Ave	35-38	1964	Ranch, gable front, mixed siding and windows, new front door and deck, detached 2-car garage	X		44
6 Claremont Ave	35-30	1970	Ranch/Modern with shed roof, chimney, attached garage plus carport, new siding, windows front entry and deck		X	45
7 Claremont Ave	35-37	1965	Ranch, hip roof, stone chimney, original picture windows, “form stone” siding	X		46

Street Address	Tax Map-Lot	Estimated Date	Description	50+ years with some Integrity Yes/No		Photo Nos.
10 Claremont Ave	35-31-1	1954	Small one-story cottage with front porch, new siding, windows and doors	X		47
12 Claremont Ave	35-31	1965	Cape with rear shed dormer, 3 bays, picture window, new siding, windows and doors, new decks	X		48
4 Laconia Ave	35-25	1956	Ranch, 3 bay, new siding, windows and door	X		49
6 Laconia Ave	35-26	1969	Ranch, 4 bays plus carport, brick chimney - top removed, new siding, windows and doors	X		50
8 Laconia Ave	35-27	1948	Project impacts. Cape remodeled with full shed dormers, new siding, windows, new front entry, added oriel windows, business in ell, modern outbuilding		X	51-52
19 Folsom Rd	35-20	1950	Project impacts. Previously surveyed - DER0152 Cape/cottage, Colonial Revival, retains integrity - original clapboards, 6/1 windows, detached 2-car garage with novelty siding	X		53-54

Comparative Evaluation

Derry has extensive areas of residential subdivisions on all sides of the village of West Derry. There are grids of short side streets for several blocks north and south of Broadway with a mix of late nineteenth and early twentieth century homes. The outer edges of the village were divided in the early 1900s. Residential streets immediately south of Franklin Terrace between Franklin Street and Crystal Avenue, Lincoln, Howard and Laurel streets, date from around 1900 and have a more consistent collection of small early 1900s homes, including 1½-story side halls and bungalows and houses with clipped gable and gambrel roofs. The Highlands, laid out in 1902 off Hillside Ave. on the western edge of West Derry, developed over a long period like Franklin Terrace. Another 1908 subdivision by the same developer as Franklin Terrace, Hillside Park, is located on both sides of Hillside Avenue near the Londonderry line. It too has a mix of old and new homes and lacks integrity for the early twentieth century period.

22. Statement of Significance

In 2000, a single house in Franklin Terrace, DER0152 at 19 Folsom Road, was determined not to be individually eligible for the National Register of Historic Places. There has been no other historic resources survey in the area.

The Franklin Terrace Historic Area does not meet the criteria for listing in the National Register or NH State Register as a historic district, because it is not a significant and distinguishable entity. The subdivision plan is the unifying element that defines the area. The neighborhood does not retain integrity for a specific historic trend or period due to the ongoing development. The houses were built over time, with substantial new construction within the last fifty years. The neighborhood is not significant as a collection of small homes for representing the evolution of building types or construction techniques, due to the universal remodeling of all but the newest buildings with modern siding, windows and doors. Forty-five percent of the forty-five houses in the Franklin Terrace subdivision are less than fifty years old or lack integrity due to additions altering their form and massing. While twenty-five houses retain some degree of integrity, the cumulative changes have resulted in a loss of nearly all character-defining features.

23. Periods(s) of Significance

N/A

24. Statement of Integrity

The 1908 subdivision retains integrity of location and the design of the parallel streets and grid of small house lots. However, the area does not have the spatial organization it acquired during the historic period due to subsequent construction. The area did not achieve its current density until the 1980s-90s. The buildings do not represent a specific period and the feeling is that of a mixed age neighborhood. Nearly a third of the houses are less than fifty years old.

Most houses retain their basic original form and overall design, but half a dozen houses, including several of the oldest ones, have large-scale additions that alter the overall massing. A very small percentage retain any visible historic materials or features. The materials and workmanship of nearly all of the houses over fifty years old have been lost to vinyl siding and trim and replacement of windows and doors. Even the buildings of the 1970s have replacement siding and windows. Front entries have been reconfigured and picture windows replaced. The cumulative changes result in an overall lack of integrity of design.

The setting within the neighborhood changed gradually as more homes were built and the relationship between the older buildings was changed by recent infill. Several of the earlier homes were replaced. The surrounding setting was altered in the late twentieth century by the large-scale commercial development of Crystal Avenue on one edge of the area. The streets themselves are the only historic landscape characteristics. All built features such as walls and fencing are modern. There are some mature trees, but most of the foundation plantings, gardens and outbuildings are not old.

25. Boundary Justification

N/A

26. Boundary Description

The surveyed area is defined by the residential neighborhood within the subdivision known as Franklin Terrace. The area is shown on the 1908 plat plan. The northwest bound of the subdivision is Folsom Road. On the southwest, the boundary is the back of properties on the east side of Franklin Street, except for 89 Franklin located on lots platted in the 1908 subdivision. The neighborhood includes residential streets, Concord, Manchester, Claremont and Laconia avenues Commercial properties at the end of those streets and fronting on Crystal Avenue/NH 28 are not included. Although part of the subdivision plan, they developed as part of a growing commercial strip on Route 28, with larger groups of lots and larger commercial buildings, most from the late twentieth century. See boundary on both Location Map and Sketch Map.

27. Bibliography and/or References

Cheney. G.A.
1902 "Derry: Its Interesting Past and Prosperous Present," *The Granite Monthly*, vol. XXXIII, December, 1902.

Derry Historical Research Committee
1977 *From Turnpike to Interstate*. Canaan. NH: Phoenix Publishing.

Newell, Harriett Chase
1965 *Outlying Districts of Derry, New Hampshire*. Littleton, N.H.: The Courier Printing Company, Inc.

Preservation Company (Lynne Monroe, T. Kirker Hill, Kari Laprey)
2000 DER0152 Individual Inventory Form on file at New Hampshire Division of Historical Resources, Concord, NH.

Preservation Company
2002 "Townwide Area Form (Area DER), Derry, NH" filed at New Hampshire Division of Historical Resources, Concord, NH.

Preservation Company
2005 "Continuation Sheets for Project Area Form (Area DER), Derry, NH" filed at New Hampshire Division of Historical Resources, Concord, NH.

Public Member Trees, Ancestry.com (http://search.ancestry.com/search/db.aspx?dbid=1030).

U.S. City Directories, Ancestry.com (http://search.ancestry.com/search/db.aspx?dbid=2469).

U.S. Federal Census Collection, Ancestry.com (http://search.ancestry.com/search/group/usfedcen).

Historic Maps

Bailey, O.H.
1898 *Derry, New Hampshire*. Derry, NH: Charles Bartlett (https://collections.leventhalmap.org/search/commonwealth:4m90f426h).

Chace, J. Jr.
1857 *Rockingham County, New Hampshire*. Philadelphia: Smith and Coffin (https://www.loc.gov/item/2012593011/).

Hurd, D. H. & Co.
1892 *Town and City Atlas of the State of New Hampshire*. Boston: Hurd & Co. (http://www.davidrumsey.com).

Norris, George E.
1887 *Derry Depot, N.H: Rockingham County*. Brockton, MA: G.E. Norris (https://collections.leventhalmap.org/search/commonwealth:cj82m044r).

Sanborn maps
1931, 1950 Derry, NH (http://sanborn.umi.com/)

USGS
1903? Manchester, NH Quadrangle (http://docs.unh.edu/NH/mnch05se.jpg)
1953 Manchester, NH Quadrangle (http://docs.unh.edu/NH/mnch53ne.jpg)

Rockingham County Registry of Deeds
(http://www.nhdeeds.com/rockingham/RoHome.html)

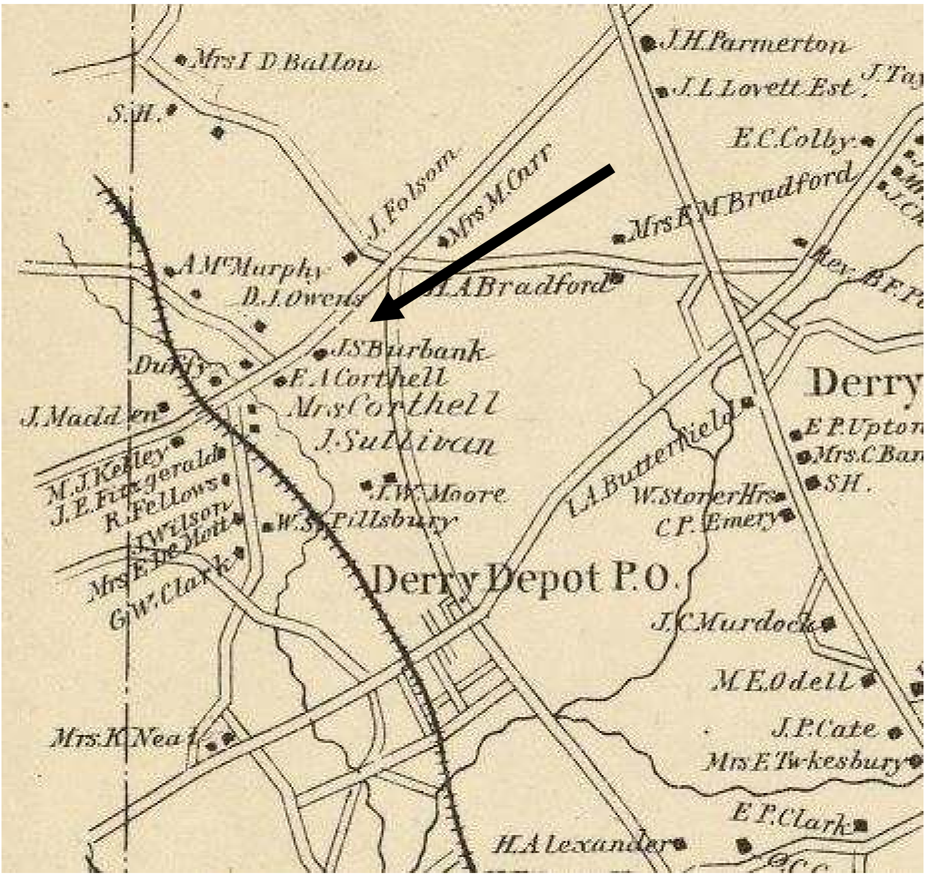
1908	Book 630, Page 447
1908	Plan 251
1908	Book 637, Page 243
1908	Book 638, Page 427
1908	Book 638, Page 438
1909	Book 641, Page 172
1909	Book 641, Page 322
1910	Book 652, Page 10
1912	Book 668, Page 131
1912	Book 668, Page 168
1912	Book 669, Page 45
1914	Book 679, Page 424
1920	Book 794, Page 193
1925	Book 794, Page 192
1927	Book 822, Page 245
1929	Book 480, Page 279
1929	Book 851, Page 78
1932	Book 873, Page 307
1932	Book 883, Page 65
1935	Book 906, Page 246
1939	Book 952, Page 207
1939	Book 956, Page 18
1940	Book 963, Page 371
1943	Book 1004, Page 403
1946	Book 1060, Page 94
1946	Book 1060, Page 294
1947	Book 1080, Page 231
1947	Book 1153, Page 188
1948	Book 1096, Page 424
1949	Book 1144, Page 291
1949	Book 1152, Page 483
1951	Book 1221, Page 142
1951	Book 1231, Page 303
1955	Book 1357, Page 341
1957	Book 1432, Page 442
1961	Book 1589, Page 387
1972	Book 2157, Page 297
1979	Book 2344, Page 1085
1983	Book 2446, Page 1713
1986	Book 2649, Page 1141
1998	Book 3351, Page 199.

28. Surveyor's Evaluation

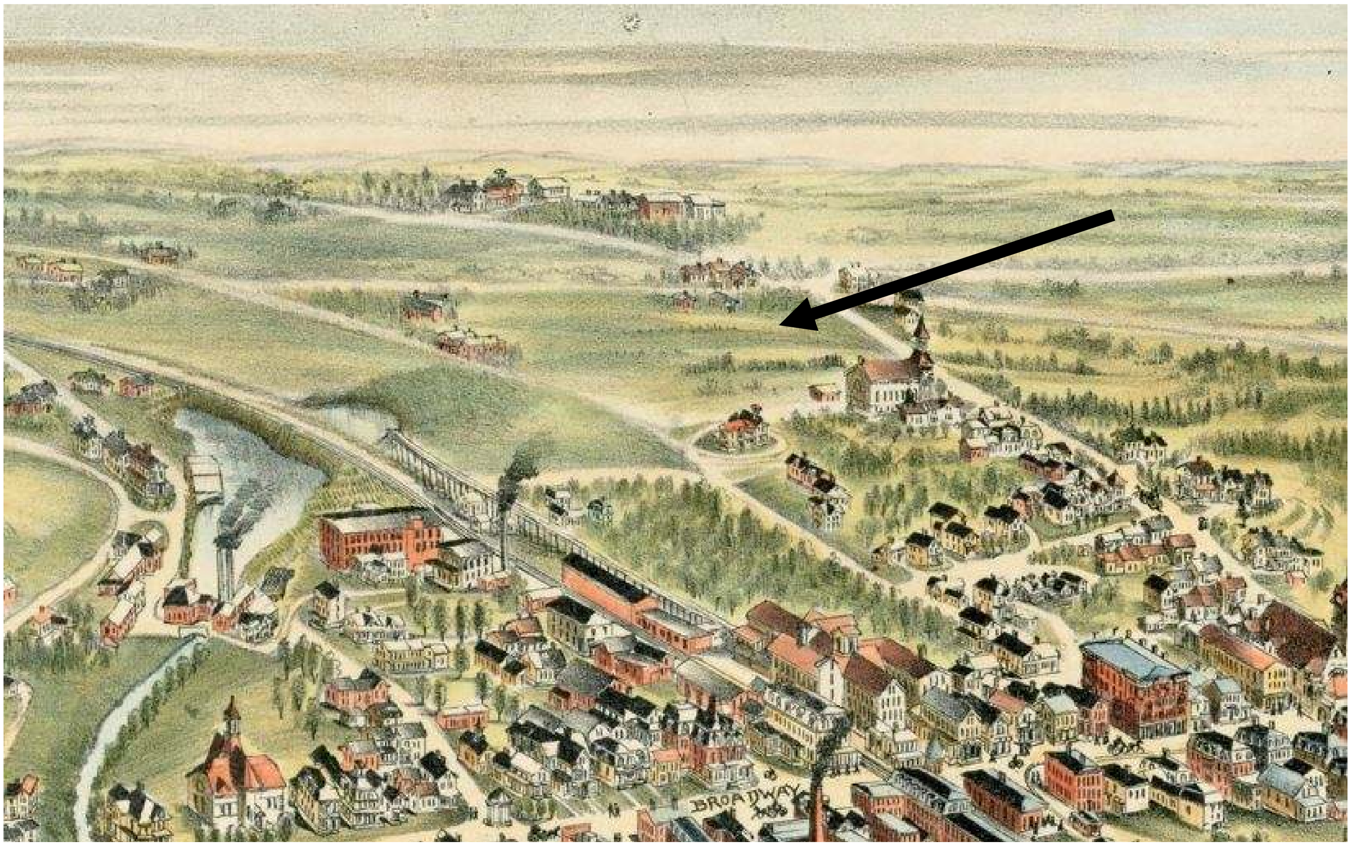
NR listed:	district	☐	NR eligible:		NR Criteria:	A	☐
	individuals		district	☐		B	☐
	within district	☐	not eligible	☒		C	☐
Integrity:	yes	☐				D	☐
	no	☒	more info needed	☐		E	☐

If this Area Form is for a Historic District: # of contributing resources: ______
# of noncontributing resources: ______

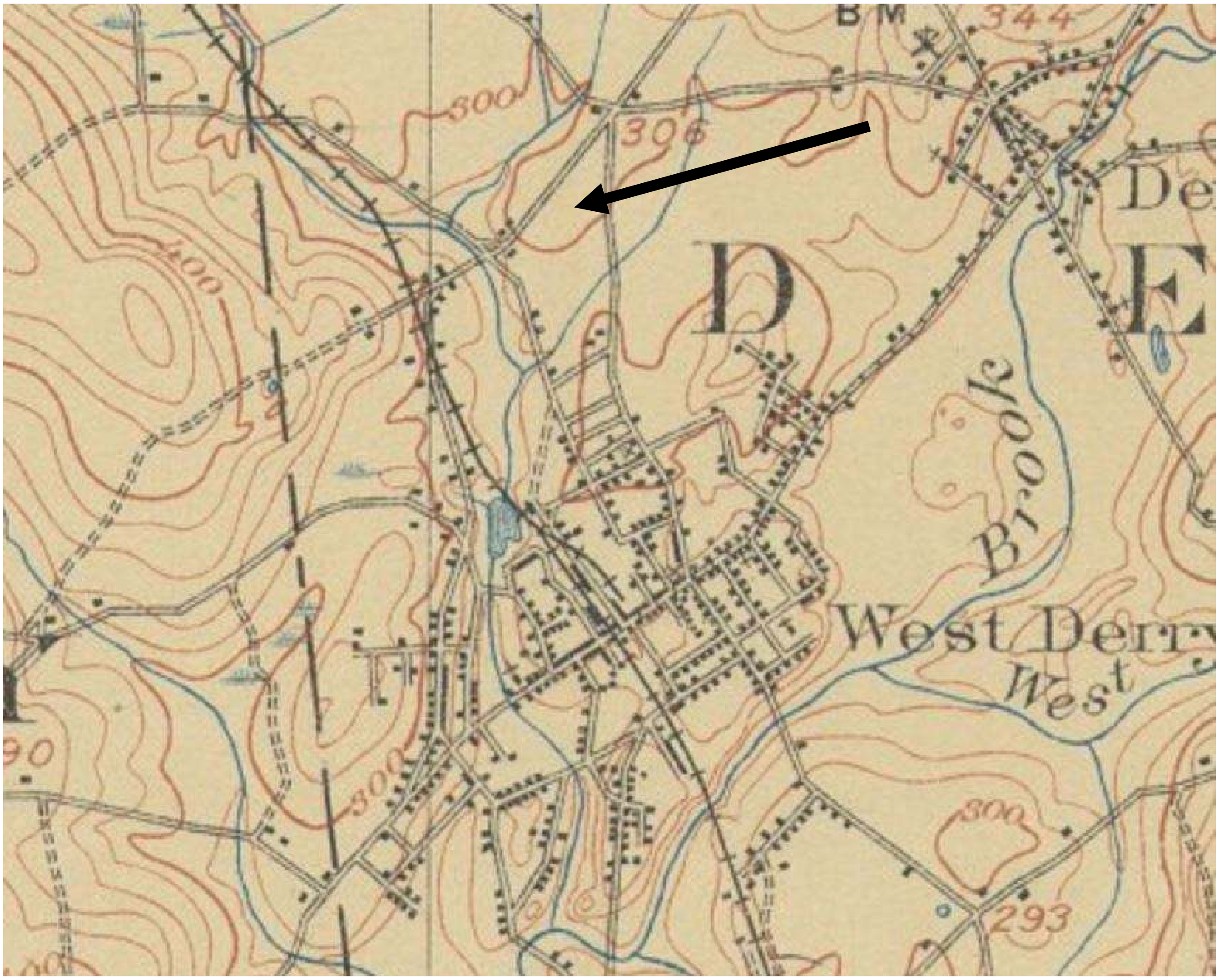
Historic Maps and Images



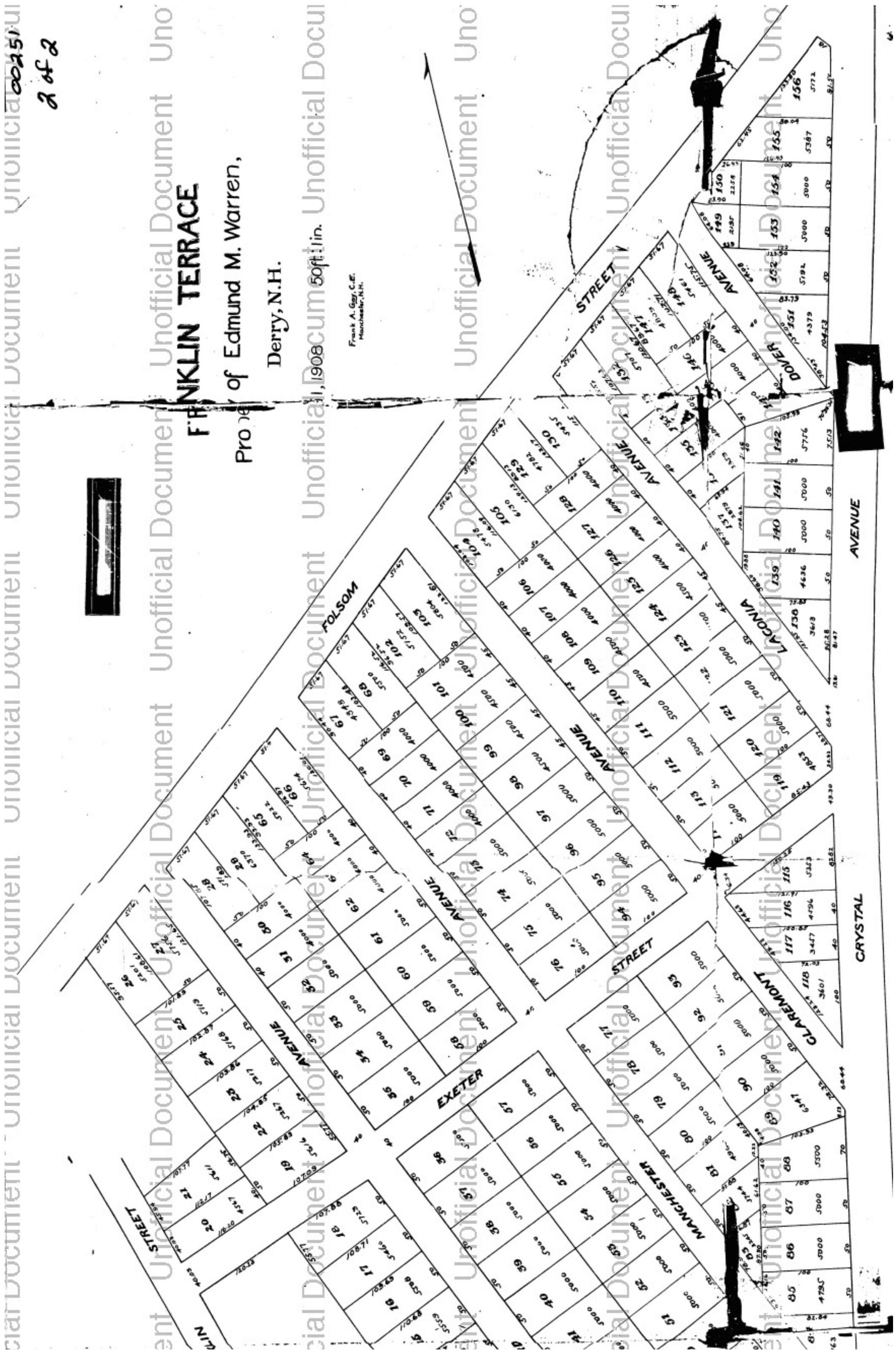
Detail of 1892 D.H. Hurd atlas of Derry shows Folsom Road and Crystal Ave. in vicinity of future subdivision



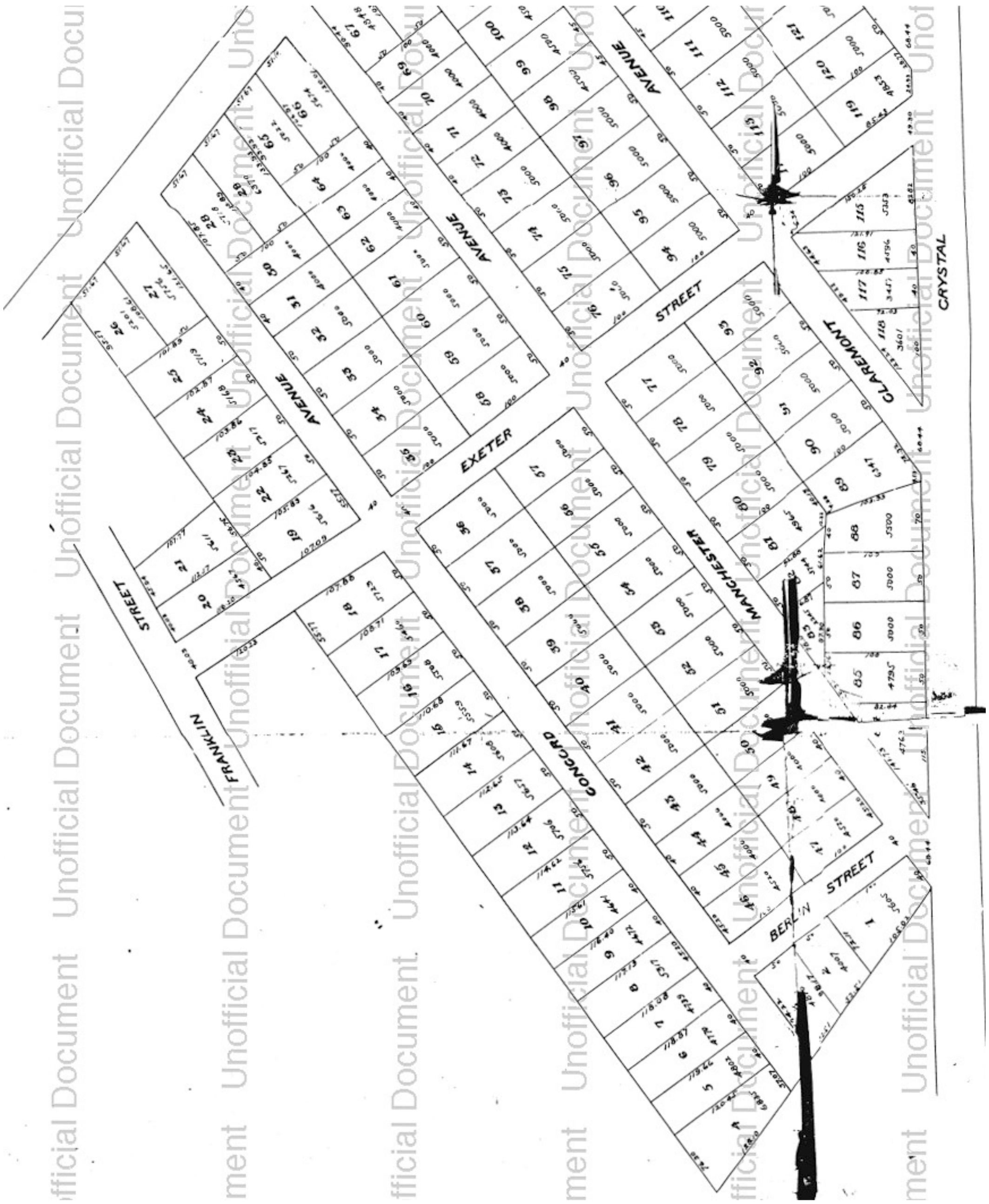
Detail of Birdseye View of Derry, 1898 inn vicinity of future subdivision shows Franklin Street, Folsom Road and Crystal Ave.



1905 USGS map shows West Derry shows streets between Franklin Street and Crystal Avenue south of future site of Franklin Terrace subdivision



Franklin Terrace subdivision of northern streets and lots, Rockingham County Registry of Deeds, Plan 251, page 2



Franklin Terrace subdivision plan of southern streets and lots - Rockingham County Registry of Deeds, Plan 251, page 1

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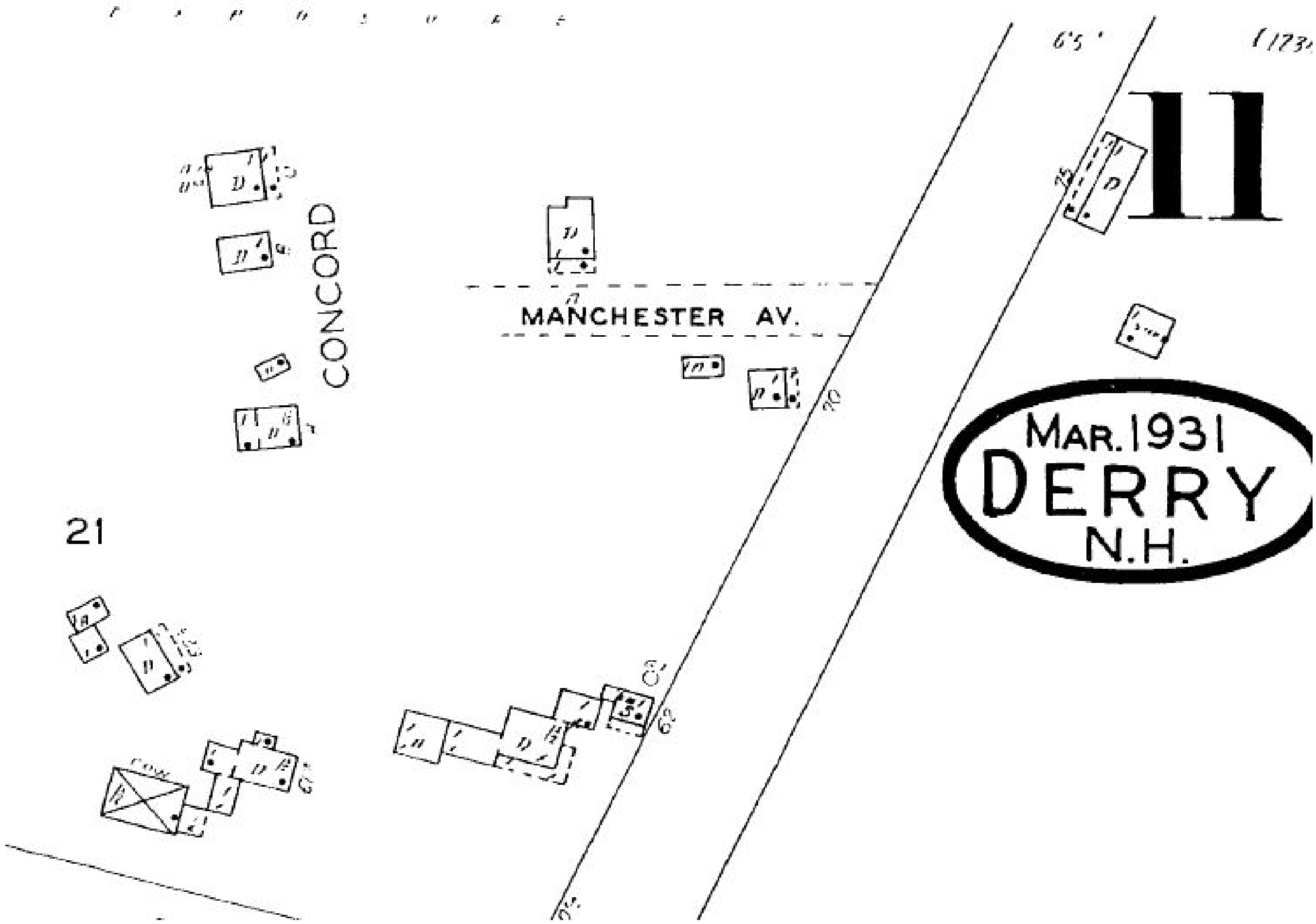
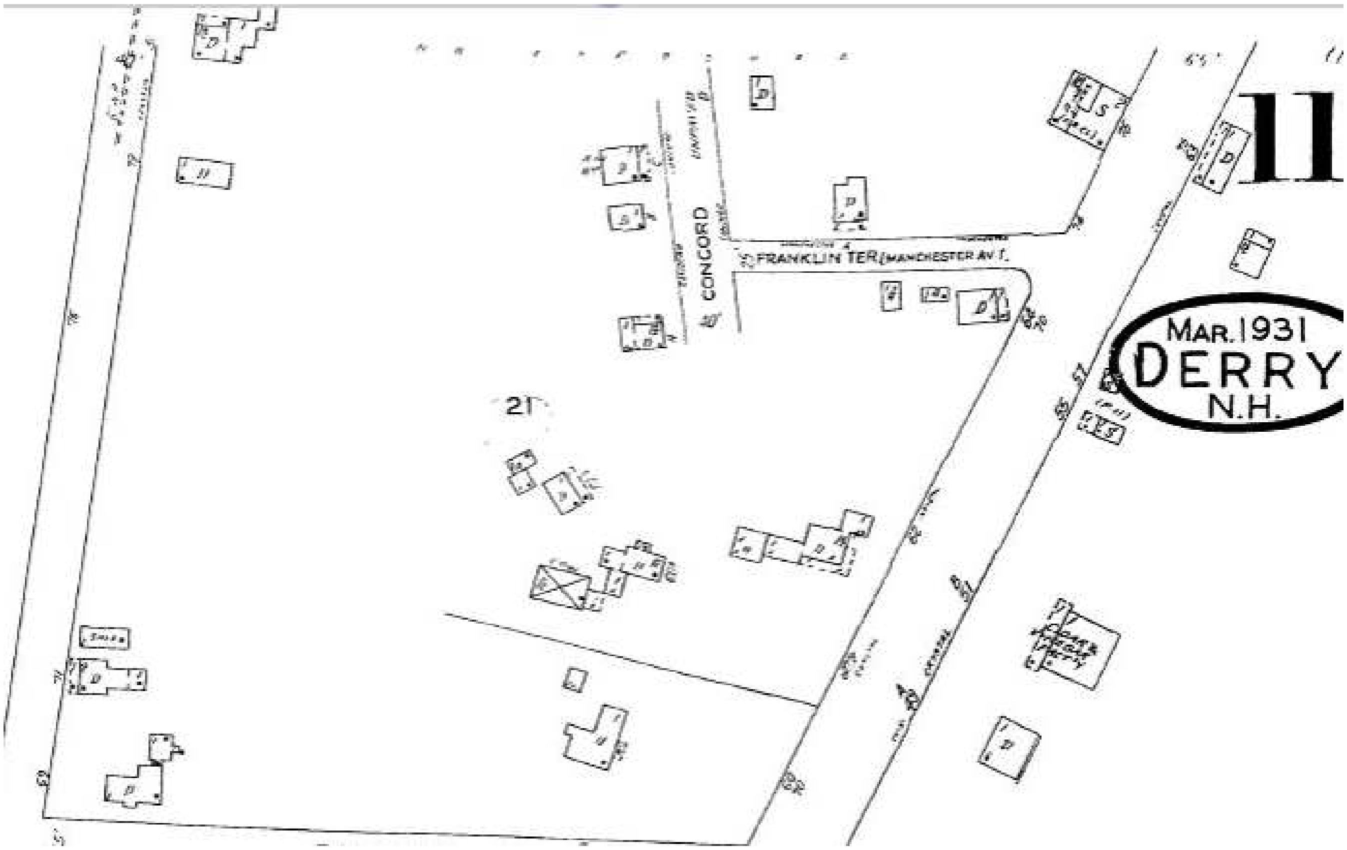
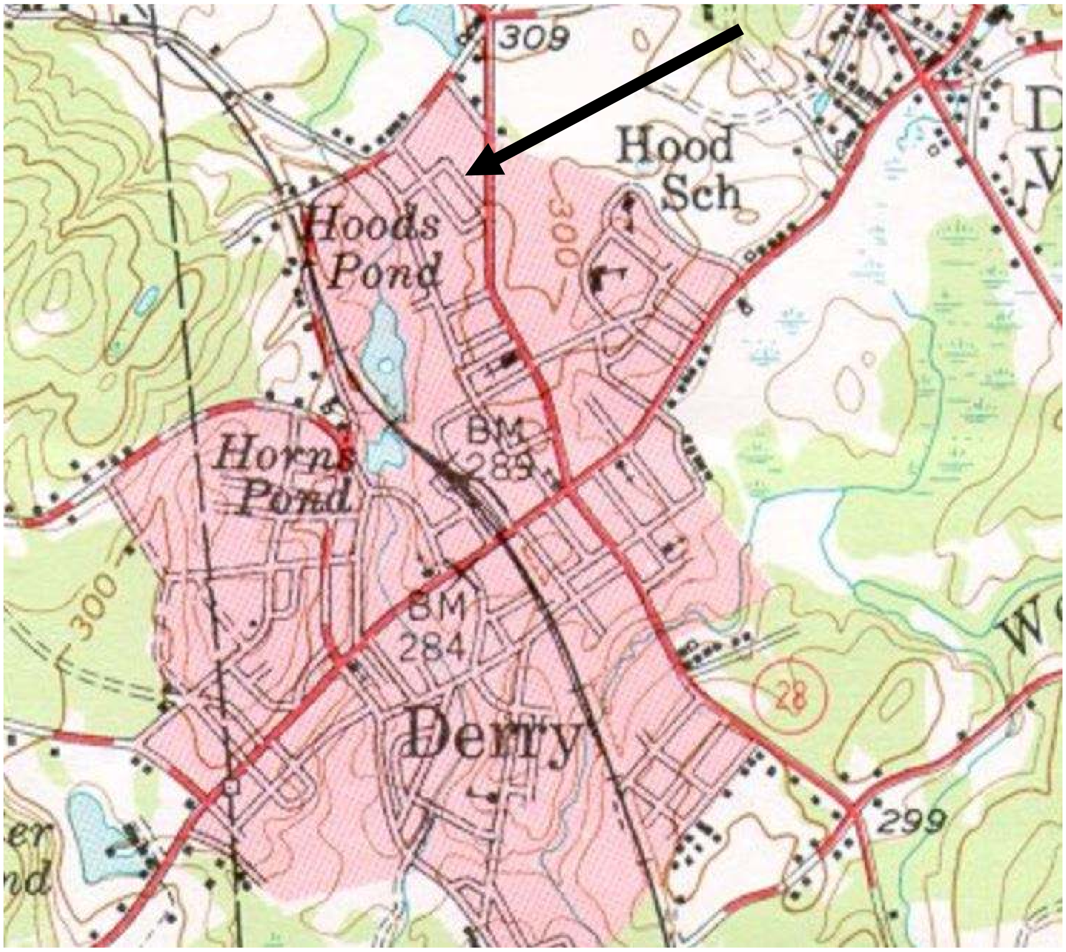


Detail of 1931 Sanborn Fire Insurance Company Map, Derry shows first homes in subdivision, south end of Concord Avenue at Crystal Avenue



Detail of 1931, revised 1950 Sanborn Fire Insurance Company Map, Derry showing southern end of Concord Avenue between Franklin and Crystal



1953 USGS map shows Concord Ave., the lower end of Manchester Ave. and Laconia Ave.

1965 aerial photograph of Franklin Terrace and surrounding area (NETRonline)

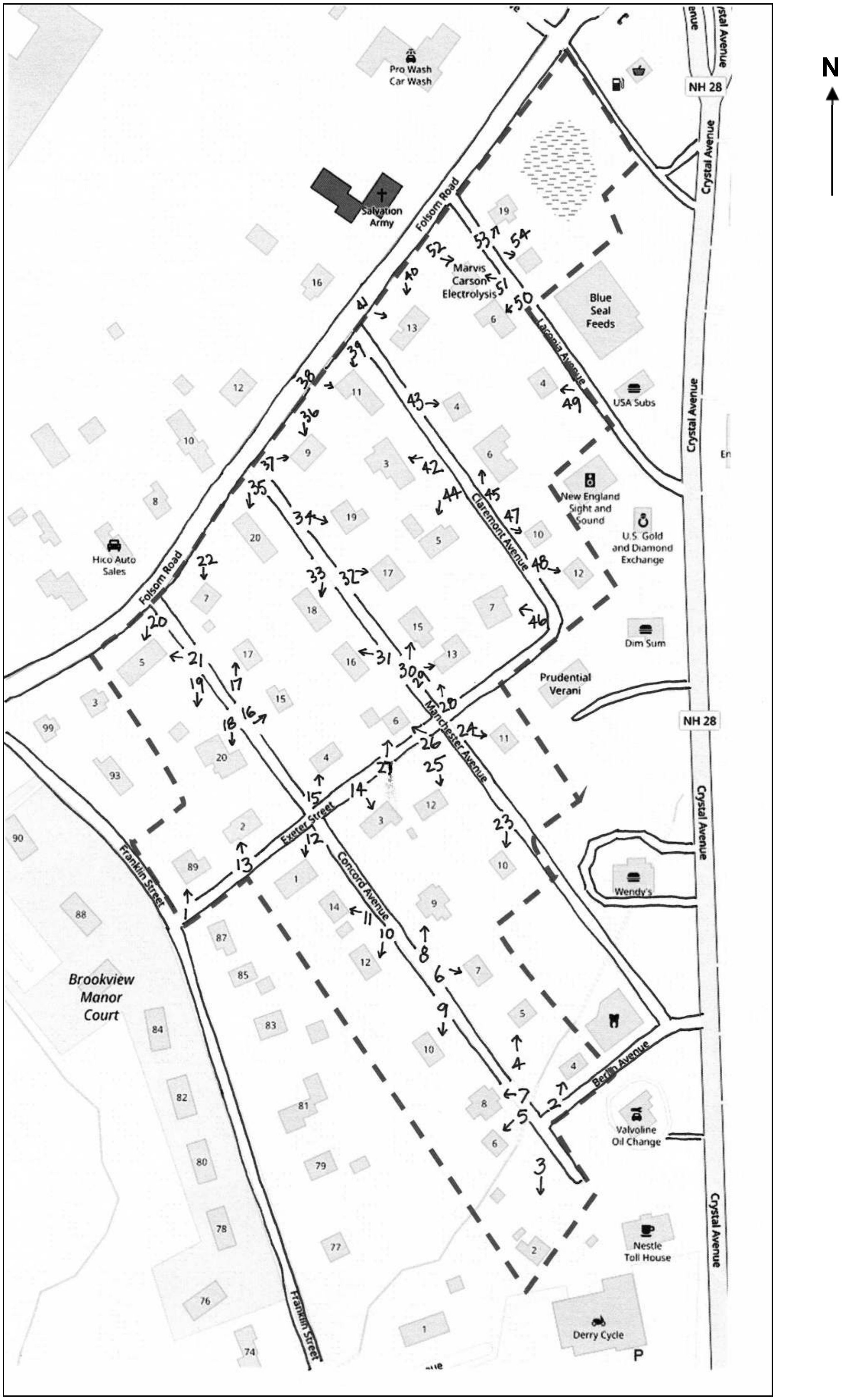
Digital Photography Statement

I, the undersigned, confirm that the photos in this inventory form have not been digitally manipulated and that they conform to the standards set forth in the NHDHR Photo Policy. My camera was set to the following specifications: “fine” image quality (compression ratio 1:4) and “large” image size (3008 x 2000 pixels). These photos were printed using the following: Epson SureColor P600 photo printer on Epson Ultra Premium Photo Paper, glossy. The digital files are housed with Preservation Company in Kensington, NH.

Lynne Emerson Monroe

Lynne Emerson Monroe, Preservation Company

Photo Key


Pro Wash
Car Wash
Salvation Army
Folsom Road
Marvis Carson Electrolysis
Blue Seal Feeds
Laconia Avenue
USA Subs
Crystal Avenue
NH 28
New England Sight and Sound
U.S. Gold and Diamond Exchange
Claremont Avenue
Hico Auto Sales
Dim Sum
Prudential Verani
Manchester Avenue
Exeter Street
Concord Avenue
Franklin Street
Wendy's
Brookview Manor Court
Berlin Avenue
Valvoline Oil Change
Nestle Toll House
Derry Cycle
N

Current Photographs

Date taken: June 2018

Photo 1) 89 Franklin Street (map-lot 35-58) Direction: N
Reference (file name): Photo_June2018_214

Photo 2) 4 Berlin Avenue (map-lot 31-51) Direction: N
Reference (file name): Photo_June2018_236

Photo 3) 2 Concord Avenue (map-lot 31-53) Direction: S
Reference (file name): Photo_June2018_237


Photo 4) 5 Concord Avenue (map-lot 31-50) Direction: N
Reference (file name): Photo_June2018_235

Photo 5) 6 Concord Avenue (map-lot 31-55) Direction: SW
Reference (file name): Photo_June2018_238

Photo 6) 7 Concord Avenue (map-lot 31-49) Direction: E
Reference (file name): Photo_June2018_234

Photo 7) 8 Concord Avenue (map-lot 31-56) Direction: W
Reference (file name): Photo_June2018_239

Photo 8) 9 Concord Avenue (map-lot 31-48) Direction: N
Reference (file name): Photo_June2018_233

Photo 9) 10 Concord Avenue (map-lot 31-56-1) Direction: S
Reference (file name): Photo_June2018_241

Photo 10) 12 Concord Avenue (map-lot 31-57) Direction: S
Reference (file name): Photo_June2018_242

Photo 11) 14 Concord Avenue (map-lot 31-58) Direction: W
Reference (file name): Photo_June2018_243

Photo 12) 1 Exeter Street (map-lot 31-59) Direction: S
Reference (file name): Photo_June2018_229

Photo 13) 2 Exeter Street (map-lot 35-52) Direction: N
Reference (file name): Photo_June2018_223

Photo 14) 3 Exeter Street (map-lot 31-47) Direction: SE
Reference (file name): Photo_June2018_228

Photo 15) 4 Exeter Street (map-lot 35-45-1) Direction: N
Reference (file name): Photo_June2018_224

Photo 16) 15 Concord Avenue (map-lot 35-51) Direction: NE
Reference (file name): Photo_June2018_232

Photo 17) 17 Concord Avenue (map-lot 35-50) Direction: N
Reference (file name): Photo_June2018_231

Photo 18) 20 Concord Avenue (map-lot 35-53) Direction: S
Reference (file name): Photo_June2018_244

Photo 19) 20 Concord Avenue, outbuildings Direction: S
Reference (file name): Photo_June2018_245

Photo 20) 5 Folsom Road (map-lot 35-54) Direction: S
Reference (file name): Photo_June2018_210

Photo 21) 5 Folsom Road, rear Direction: W
Reference (file name): Photo_June2018_246

Photo 22) 7 Folsom Road (map-lot 35-49) Direction: S
Reference (file name): Photo_June2018_209

Photo 23) 10 Manchester Avenue (map-lot 31-45) Direction: S
Reference (file name): Photo_June2018_256

Photo 24) 11 Manchester Avenue (map-lot 35-43) Direction: E
Reference (file name): Photo_June2018_255

Photo 25) 12 Manchester Avenue (map-lot 31-46) Direction: S
Reference (file name): Photo_June2018_227

Photo 26) 6 Exeter Street (map-lot 35-45) Direction: W
Reference (file name): Photo_June2018_226

Photo 27) 6 Exeter Street Direction: N
Reference (file name): Photo_June2018_225

Photo 28) 13 Manchester Avenue (map-lot 35-42-1) Direction: E
Reference (file name): Photo_June2018_253

Photo 29) 13-15 Manchester Avenue (map-lots 35-42-1 and 35-42) Direction: N
Reference (file name): Photo_June2018_254

Photo 30) 15 Manchester Avenue (map-lot 35-42) Direction: N
Reference (file name): Photo_June2018_252

Photo 31) 16 Manchester Avenue (map-lot 35-46) Direction: W
Reference (file name): Photo_June2018_257

Photo 32) 17 Manchester Avenue (map-lot 35-38-1) Direction: E
Reference (file name): Photo_June2018_250

Photo 33) 18 Manchester Avenue (map-lot 35-47) Direction: S
Reference (file name): Photo_June2018_258

Photo 34) 19 Manchester Avenue (map-lot 35-41-1) Direction: E
Reference (file name): Photo_June2018_249

Photo 35) 20 Manchester Avenue (map-lot 35-48) Direction: S
Reference (file name): Photo_June2018_191

Photo 36) 9 Folsom Road (map-lot 35-41) Direction: S
Reference (file name): Photo_June2018_208

Photo 37) 9 Folsom Road Direction: E
Reference (file name): Photo_June2018_193

Photo 38) 11 Folsom Road (map-lot 35-40) Direction: E
Reference (file name): Photo_June2018_206

Photo 39) 11 Folsom Road Direction: S
Reference (file name): Photo_June2018_204

Photo 40) 13 Folsom Road (map-lot 35-28) Direction: S
Reference (file name): Photo_June2018_203

Photo 41) 13 Folsom Road Direction: E
Reference (file name): Photo_June2018_205

Photo 42) 3 Claremont Avenue (map-lot 35-39) Direction: W
Reference (file name): Photo_June2018_266

Photo 43) 4 Claremont Avenue (map-lot 35-29) Direction: E
Reference (file name): Photo_June2018_259

Photo 44) 5 Claremont Avenue (map-lot 35-38) Direction: S
Reference (file name): Photo_June2018_265

Photo 45) 6 Claremont Avenue (map-lot 35-30) Direction: N
Reference (file name): Photo_June2018_260

Photo 46) 7 Claremont Avenue (map-lot 35-37) Direction: W
Reference (file name): Photo_June2018_264

Photo 47) 10 Claremont Avenue (map-lot 35-31-1) Direction: E
Reference (file name): Photo_June2018_262

Photo 48) 12 Claremont Avenue (map-lot 35-31) Direction: E
Reference (file name): Photo_June2018_263

Photo 49) 4 Laconia Avenue (map-lot 35-25) Direction: W
Reference (file name): Photo_June2018_269

Photo 50) 6 Laconia Avenue (map-lot 35-26) Direction: SW
Reference (file name): Photo_June2018_271

Photo 51) 8 Laconia Avenue, façade (map-lot 35-27) Direction: W
Reference (file name): Photo_June2018_272

Photo 52) 8 Laconia Avenue, side elevation facing Folsom Road Direction: SE
Reference (file name): Photo_June2018_202

Photo 53) 19 Folsom Road, side elevation (map-lot 35-20) Direction: NE
Reference (file name): Photo_June2018_267

Photo 54) 19 Folsom Road, garage Direction: ESE
Reference (file name): Photo_June2018_268

FRANKLIN TERRACE HISTORIC AREA

16. Sketch Map

3 Street Address

- - - Tax Map/Parcel boundaries