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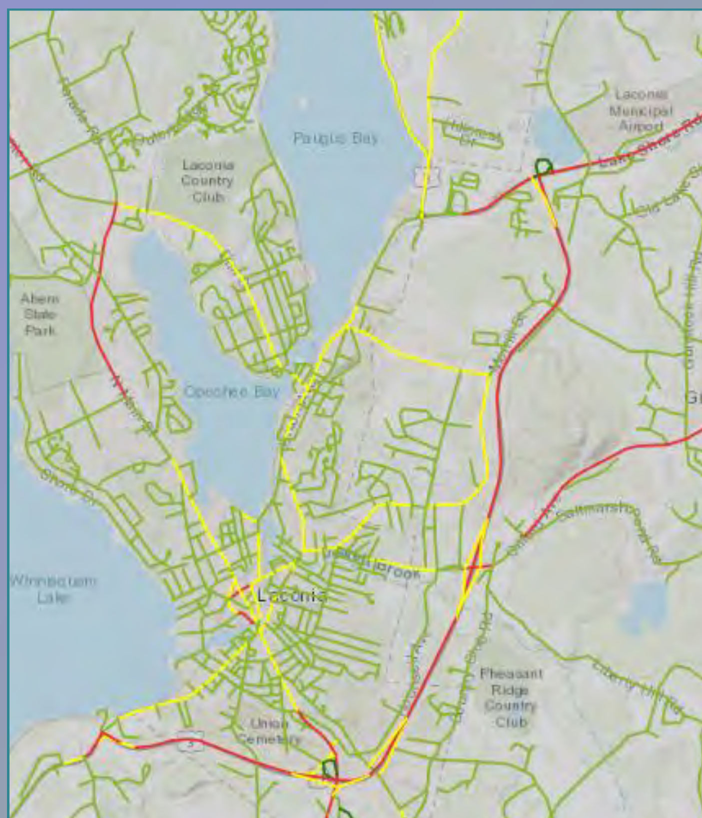

Active Transportation Accounting: Developing Metrics for Project Prioritization

Final Report

Prepared by Plymouth State University Center for the Environment for the
New Hampshire Department of Transportation, in cooperation with the
U.S. Department of Transportation, Federal Highway Administration

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16. Abstract

Despite growing interest and momentum in enhancing active transportation, little weight is currently given to active transportation projects. This is largely due to the lack of sufficient data. In order to identify key areas for active transportation enhancement, to justify investment, and to measure success, it is necessary to understand where and when people are participating in active transportation (e.g. bicycling). This project leveraged a) existing datasets (NHDOT roadways, Strava bicycling data, and crash reports), b) statewide on-the-ground bike counter, c) efforts to develop and apply a Level of Traffic Stress (LTS) model for bicycling and incorporate novel public participatory GIS approaches to assess patterns of current bicycle activity and identify potential barriers to access and participation throughout New Hampshire. More specifically, the project assessed the reliability of Strava data to reflect biking activity in New Hampshire, evaluated the ability of Level of Traffic Stress to predict biking patterns and barriers to active transportation, evaluated perceived barriers to active transportation (e.g. safety concerns) against objective physical barriers as reflected in LTS model, and evaluated the accuracy of current LTS model using public participatory GIS. In addition, the project produced a suite of tools to be used in ArcGIS (10.3 and greater). The report offered recommendations to NHDOT for future data collection and management in order to improve and standardize statewide efforts to monitoring bicycling patterns and to map the level of bicycling traffic stress on all roadways.

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DISCLAIMER

Active Transportation Accounting: Developing Metrics for Project Prioritization

Project ID #26962R October 2016 – June 2019

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Abstract

Despite growing interest and momentum in enhancing active transportation, little weight is currently given to active transportation projects. This is largely due to the lack of sufficient data. In order to identify key areas for active transportation enhancement, to justify investment, and to measure success, it is necessary to understand where and when people are participating in active transportation (e.g. bicycling). This project leveraged a) existing datasets (NHDOT roadways, Strava bicycling data, and crash reports), b) statewide on-the-ground bike counter, c) efforts to develop and apply a Level of Traffic Stress (LTS) model for bicycling and incorporate novel public participatory GIS approaches to assess patterns of current bicycle activity and identify potential barriers to access and participation throughout New Hampshire. More specifically, the project assessed the reliability of Strava data to reflect biking activity in New Hampshire, evaluated the ability of Level of Traffic Stress to predict biking patterns and barriers to active transportation, evaluated perceived barriers to active transportation (e.g. safety concerns) against objective physical barriers as reflected in LTS model, and evaluated the accuracy of current LTS model using public participatory GIS. In addition, the project produced a suite of tools to be used in ArcGIS (10.3 and greater). We offer recommendations to NHDOT for future data collection and management in order to improve and standardize statewide efforts to monitoring bicycling patterns and to map the level of bicycling traffic stress on all roadways.

1. Introduction

Problem Statement

New Hampshire (NH) is on a precipice of change given population growth and distribution shifts across the state; however, we have the opportunity to plan and foster increased connectivity and resilience within and among communities. Significant attention should be paid to equitable investment in active transportation infrastructure to promote safety, sustainability, and protect socially vulnerable areas. Despite growing interest and momentum in enhancing active transportation, little weight is currently given to active transportation projects. This is largely due to the lack of sufficient data. In order to identify key areas for active transportation enhancement, to justify investment, and to measure success, it is necessary to understand where and when people are participating in active transportation (e.g. bicycling). There is an urgent need to change how bicycle-pedestrian (bike-ped) projects are evaluated. This project is relevant and timely in that it was developed with partners from NH Bicycle Pedestrian Transportation Advisory Committee (BPTAC), NH Healthy Eating Active Living program, Bike – Walk Alliance of NH, and representatives from prominent regional planning commissions (Central NHRPC and Nashua RPC) and leverages the momentum of a one-year pilot project (2015-16) led by Project Investigator (PI), Dr. Villamagna, and graduate research assistants housed at Plymouth State University. Likewise, it occurs during the development of NH's Ten-Year Transportation Improvement Plan and this report coincides nicely with the drafting of the Statewide Pedestrian and Bicycle Plan. Moreover, this project reflects priorities at the federal level, including the Federal Highway Administration's (FHWA) Bicycle-Pedestrian Count Technology Pilot Project, Non-motorized Transportation Pilot Program, and the Every Day Counts Round 3 Innovations - Road Diet strategies. Most recently this work will be continued with FHWA funding as a Measuring Multimodal Network Connectivity pilot project in collaboration with NH's Metropolitan Planning Organizations (MPOs) (2018-2019).

Project Outcomes

The project has yielded a suite of data-driven metrics that can be used to assess bicycling patterns and bikeability of NH roads and to evaluate the potential benefits derived from proposed bike-ped projects to support prioritization. It has also generated a wide variety of multi-scaled reference maps using Strava data from 2015-2017, a suite of ArcGIS tools for analyzing Strava data, a Level of Traffic Stress (for bicycling) model and associated ArcGIS tools, as well as subsequent analysis of accessibility within focal regions. ArcGIS is an ESRI geographic information system (GIS) for manipulating, analyzing and presenting geospatial data.

This project has also provided insight into perceived barriers to biking and helped identify roadways that could provide the greatest relative enhancement to bikeability within focal regions. These are listed more specifically below. When considered collectively, this project is expected to improve active transportation accounting during project selection, monitoring, and evaluation which will ultimately lead to a more sustainable NH transportation network. The following is a list of products which have been produced.

- Framework for evaluating bike-ped activity and use of facilities
- Informative bikeability metrics that can be integrated into NH DOT project evaluation to facilitate framework reform and acknowledgement of bike-ped impacts
- Strava-based biking summaries across the state
- ArcGIS tools that will facilitate the use of Strava data to summarize biking trends
- Level of Traffic Stress GIS layers for the entire state
- Summary of Origin-Destination analyses and LTS assessment for focal communities
- Public participation GIS (PPGIS) maps of perceived barriers, conflict areas, and preferred routes

Research Objectives

This project leveraged a) existing datasets (participatory mapping of facility activity through the Strava Application (App)), b) statewide on-the-ground bike counter initiatives (conducted in partnership with the nine (9) regional planning commissions in NH) (Tufts et al. 2015), c) efforts to develop and apply a Level of Traffic Stress (LTS) model for bicycling (Mekuria et al. 2012), and incorporate novel public participatory GIS approaches to assess patterns of current bicycle activity and identify potential barriers to access and participation.

Objective 1: Assess the reliability of Strava data to reflect biking activity in New Hampshire

- Summarize current (2014-2015) patterns of biking in New Hampshire over space and time using Strava data.
- Develop GIS tools (ArcGIS) to calculate summary metrics for future Strava datasets.
- Compare Strava reported bike activity to manual and automated bike counts in focal areas
- Identify future manual count locations that can provide assessment of traffic flow.
- Develop a GIS tool specific to manual counts that evaluates spatial bike flow patterns at the community level for mass manual count events. This will provide a metric against which Strava and LTS analyses can be evaluated.

Objective 2: Evaluate the ability of Level of Traffic Stress to predict biking patterns and barriers to active transportation

- Apply the LTS model adopted by NHDOT and Nashua RPC to Plymouth, Manchester, and Hanover-Lebanon, NH
- Compare biking patterns derived from Strava dataset to expected ridership according to the LTS model.
- Evaluate bike/ped accessibility to key community amenities and services within socially vulnerable communities.
- Evaluate changes in bicycling activity attributed to annual road paving.

Objective 3: Evaluate perceived barriers to active transportation (e.g. safety concerns) against objective physical barriers as reflected in LTS model

- Conduct public participatory GIS surveys to map road conditions and locations of perceived barriers to biking in focal communities: Plymouth and Nashua, NH.

- Compare locations noted by respondents to LTS models and Strava data to validate physical barriers and identify barriers due to perceived threat.
- Develop a framework for assessing community-specific exposure to vehicular conflicts and hazardous conditions using NHDOT vehicle-bicycle reports and PPGIS survey responses.
- Conduct hotspot analysis of the reported barriers to identify potential areas of concern and reform.

Objective 4: Evaluate the accuracy of current LTS model using public participatory GIS

- Conduct public participatory GIS surveys to solicit feedback on current LTS model predictions of LTS across NH.
- Compare the reported LTS scores to modeled scores
- Assess the observed variability in terms of roadway attributes
- Summarize feedback shared by PPGIS respondents

2. Methods and Findings

Objective 1: Assess the reliability of Strava data to reflect biking activity in New Hampshire

Summarize current patterns (2014-2015) of biking in New Hampshire over space and time using Strava

Strava is a social mobile application which allows the user to track bicycle ride information, including the geographic route using GPS. The data available for NH provides information about where regular bicyclists are riding most often and for what purposes. We summarized the bicycling activity using the Strava data between 2014 and 2016. Although more recent Strava data has been made available since the completion of this analysis, project focus steered away from this objective, and no subsequent analysis has been completed.

These summaries were presented in a series of maps to summarize spatially, organized by RPCs, and select graphs to summarize temporally. The results of these analyses can be seen in *Appendix 5.1: Strava Summaries by RPC* and *Appendix 5.2: Temporal assessment of Strava-based bicycling activity in Central NH*. We also evaluated and mapped commuting activity, as noted in Strava App, and the number of unique rides in each RPC. Several summary maps are provided for focal areas within each RPC in *Appendix 5.3: Strava Commuting Patterns* in focal areas within each Regional Planning Commission region. We also summarized the number of 2016 trips recorded in Strava by origin and destination for focal areas: Derry and Londonderry and the greater Manchester Area in *Appendix 5.4: Strava Origin and Destination Analysis.*

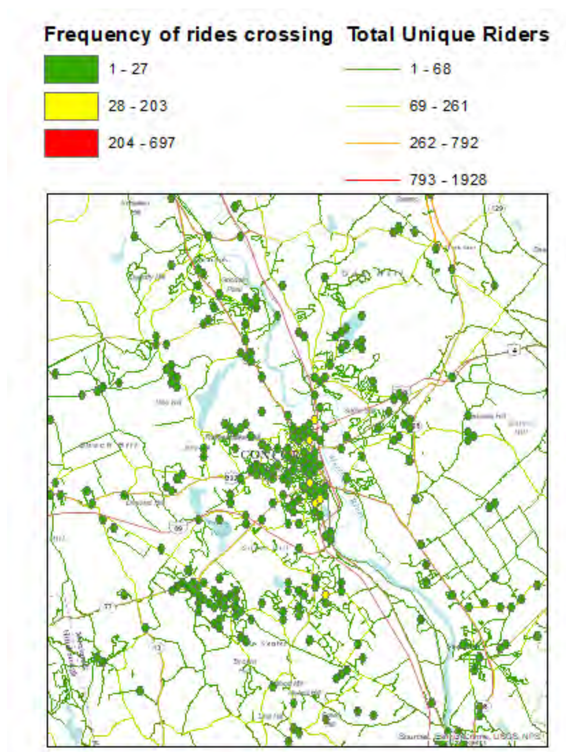


Figure 1: Strava Frequency Summaries. *An example map showing the number of unique riders on each segment and the frequency a specific location (polygon dots) was crossed during a ride recorded in Strava in 2016.*

Finally, we used the rides recorded in Strava to illustrate the frequency of rides starting and ending near "key destinations" as identified by regional planning commissions and generic Google map searches (Figures 1 and 2). *Appendix 5.5: Strava & Key Destination Summaries 2016* provides a series of maps for focal areas within all NH RPCs as well as a detailed summary of observed choke points.

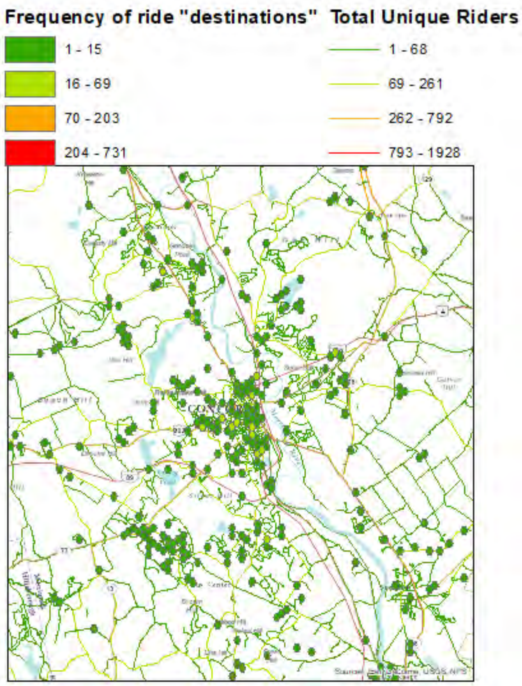


Figure 2: Strava Destination Summaries

An example map showing the number of unique riders per segment and the frequency a specific location (polygon dots) was the destination (terminal point) of a ride recorded in Strava in 2016.

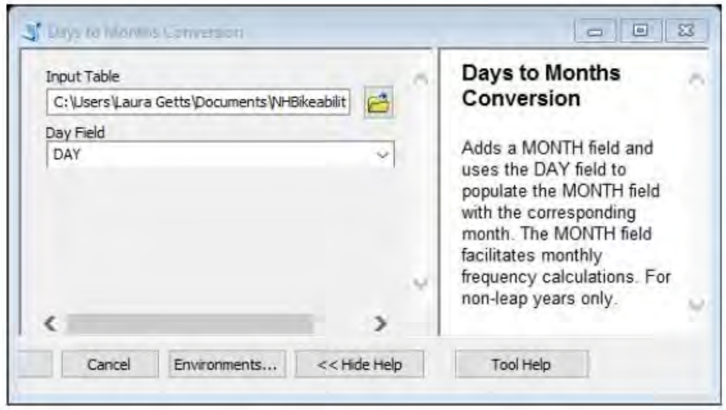
Develop GIS tools (ArcGIS) to calculate summary metrics for future Strava datasets.

We have developed three tools to assist with processing Strava data. These include: "Days to Months Conversion" tool (Figure 3), "Strava Frequencies" tool (Figure 4), "Strava Segment Summary" tool (Figure 5). An example graph from the Strava Frequencies tool is provided in Figure 6. Summarizing the Strava data took a series of analyses outside of ArcGIS, completed using the object-relational database management system PostgreSQL, which made it challenging to fully automate the process. However, we feel these tools can provide support to GIS analysts who want to use Strava for basic analysis. A brief guidebook for the tools can be found in Appendix 5.6 and the ArcGIS toolbox described is available upon request[1].

Figure 3: Days to Months Conversion Tool
This tool adds a MONTH field and uses the DAY field to populate the MONTH field with corresponding month. The tool will only accommodate one year at a time.

[1] Contact Dr. Amy Villamagna amvillamagna@plymouth.edu for up to date ArcGIS toolbox

Figure 4: The Strava Frequencies Tool
This tool calculates and generates a .dbf (database file) and .xls (Excel) file for the total number of Strava rides per Month, Month & Hour, Day, Road Segment, Road Segment and Hour, and Road Segment and Month. Best used for visualizing ridership trends like those seen in Figure 6 below.



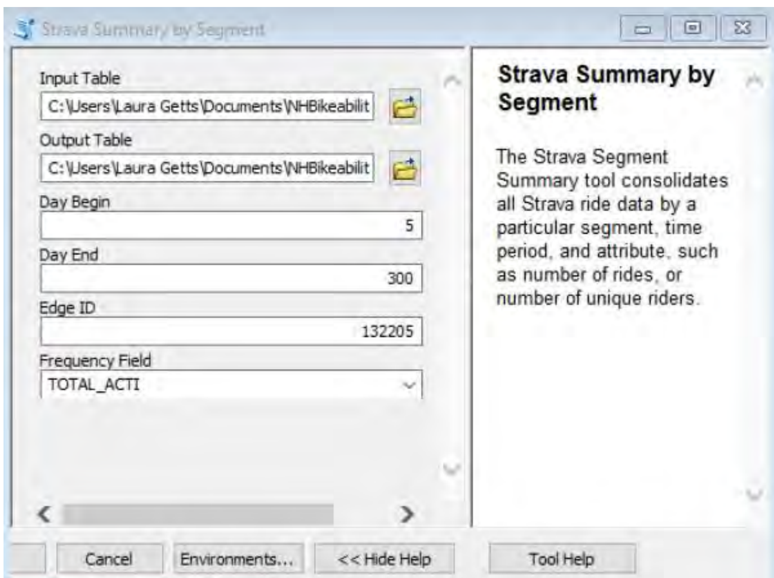


Figure 5: The Strava Segment Summary Tool*. This tool summarizes recorded Strava rides by a specific segment, a timeframe, and number of rides, unique riders or commutes. Best used for comparisons involving specific segments before and after infrastructure changes.*

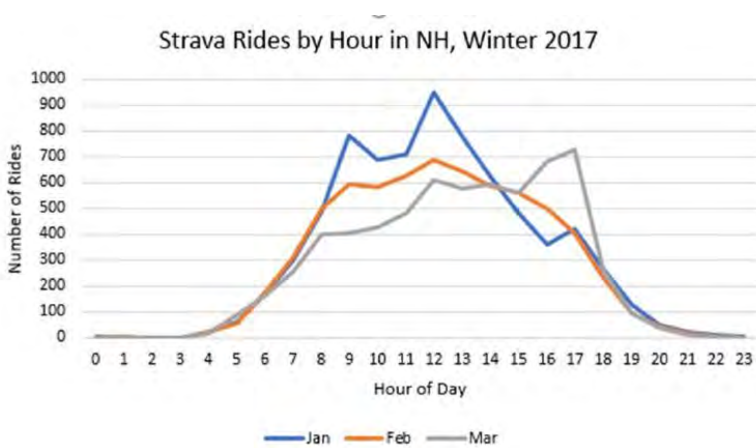


Figure 6: Strava Frequencies Tool
This tool produces data that can be summarized in a time series graph.

Compare Strava reported bike activity to manual and automated bike counts in focal areas

We compared Strava reported bike activity to manual and automated bike counts in focal areas defined by the RPCs. A summary of counts in key locations, mostly trails during specified time periods in 2014 and 2015, is provided in *Appendix 5.7: Strava Ground Count Comparisons*. Significant relationships were found between these two measures of biking at five (5) locations. The Concord I-89 Bike Path, within the Central NHRPC area, reflected the greatest percent representation (proportion of Strava riders to manual count riders) at 25%; the other four locations with significant relationships had less than a 2% representation. We also provide daily summaries of Strava representation of observed bicycling activity at two locations, Commercial Street East of Constitution in Concord, and Nashua River Trail in Nashua to demonstrate the potential utility of a finer-scale spatiotemporal analysis. The finer scale analysis includes the number of trips noted as "commutes" in Strava, which did not exceed two (2) in any observed day.

Identify future manual count locations that can provide assessment of traffic flow

We used the number of unique riders, total commute trips reported in Strava, and a rank for prime bicycling destinations to suggest priority locations for future manual count locations. Recommended locations are described in tabular and map forms in *Appendix 5.8: Recommended Manual Count Locations*. The results of these analyses were shared with each RPC for future planning.

Develop a GIS tool specific to manual counts that evaluates spatial bike flow patterns at the community level for mass manual count events

We pursued this task, but found that the creation of an easy-to-use tool was not feasible. Based on guidance from the Technical Advisory Group (TAG), we pivoted focus to demonstrate the potential analyses of Strava data and to assess its representation of bicycling patterns in NH. As noted above, representation in most regions is very low. Overall, we determined that representation is too low to justify future investment in the development of automated tools. As a result, the additional sub-objectives were added and we have summarized the final outcomes below.

Evaluation of ridership before and after infrastructure change using Strava (*added during project*)

We used Strava data from 2014-2016 to assess changes in bicycling patterns that might be explained by road infrastructure changes. First, we needed to calculate the general growth in Strava reported biking, and it was found that there was a 50% average change in total number of rides (across regions) between 2014-2015, 39% between 2015-2016, and a 106% increase between 2014-16. We ran the same temporal comparisons for the number of unique athletes and found 44%, 31% and 89%, respectively.

We specifically addressed the following infrastructure changes: Piscataquog Trestle Bridge 2015, bike lane installed to S. Mammoth Rd (Manchester) in September 2015, sharrow markings on Chestnut St (Manchester) in December 2015, and an advisory lane to Valley Rd (Hanover) in summer 2014. For each, the number of total rides and unique cyclists were assessed. These are reported in raw number and percent change for each road segment along the network affected. Maps are provided for each location and metric in *Appendix 5.9: Strava-Reported Biking Patterns Before and After Infrastructure Change*.

Objective 2: Evaluate the ability of Level of Traffic Stress to predict biking patterns and barriers to active transportation.

Table 1: Levels of Traffic Stress Descriptions. *The four levels of traffic stress are based on the four types of cyclists, determined by Geller (2009). Each combination of road conditions corresponds to a population class for which the road is suitable. Edmiston (2012) population class terms.*

LTS Rating	LTS Rating Description	Population Class	Population Class Description
LTS 1	Strong separation from all automobiles, except low speed, low volume traffic. Simple-to-use crossings. Suitable for children.	No Way No How	No interest in riding regardless of bicycle accommodations.
LTS 2	Except in low speed / low volume traffic situations, cyclists have their own place to ride that keeps them from having to interact with traffic. Physical separation from higher speed and multi-lane traffic. Crossings that are easy for an adult to negotiate. Limits traffic stress to what the mainstream adult population can tolerate.	Willing but Wary	Uncomfortable negotiating fast, high volume traffic.
LTS 3	Interaction with moderate speed or multi-lane traffic, or close proximity to higher speed traffic.	Comfortably Confident	Willing to ride with minimal bicycle accommodations.
LTS 4	Forced to mix with moderate speed traffic or close proximity to high speed traffic.	Fit and Fearless	Willing to ride under any conditions.

Apply the LTS model adopted by NH DOT and Nashua RPC to Plymouth, Manchester, and Hanover-Lebanon, NH

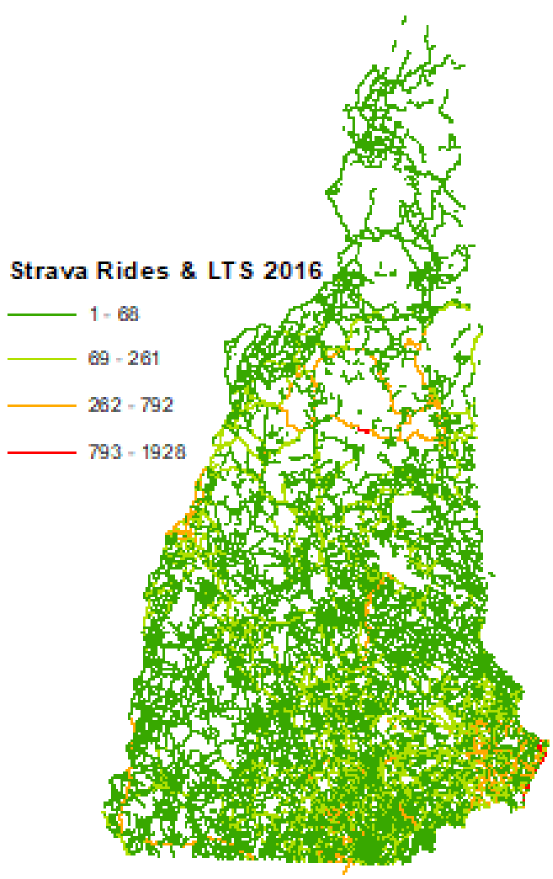
LTS model attributes are critical to a systematic evaluation of roadway bicycle stress. We developed and revised the LTS model several times during the three-year period of this project. The most recent version maps LTS scores for the entire state by means of three sub-models. The sub-model applied to a given roadway is determined based on the data available for that roadway. Table 2 provides an overview of the data inputs to the current NH LTS model and it describes which inputs are needed to run each sub-model. While not all attributes are available in the standard NHDOT roadways GIS layer, every additional attribute that can be provided will add value to the model result. Attributes that are not available in a standard NHDOT GIS dataset are optional inputs in the model. Speed is a required attribute for this model. The NHDOT roadways GIS layer does not include speed data, therefore it is one of the attributes that can be collected and added to the attribute table. For areas where additional data cannot be obtained due to limited resources, the functional class of the roadway can be used as a proxy (Table 3). When no speed is in the final data input layer the “Speed Tool (No Speed Limit)” tool should be used to generate a speed LTS class using FHWA roadway Functional Classification System.

Roadways are functionally grouped according to the levels of mobility (through) and access (destination) that they provide. Table 3 outlines the Speed LTS classes assigned to each functional class. After using the "Speed Tool (No Speed Limit)", a new SHORT integer field is created in the input attribute table named "SPEEDLTS". If speed data is recorded for roadways (i.e. 35mph), then the "Speed Tool (Speed Limit)" should be run to pre-process speed input data and to create the aforementioned "SPEEDLTS" field.

Sub-model 3 (hereafter, V3) is the fullest sub-model algorithm that incorporates additional data beyond the data available in the annual NHDOT roadways GIS layer. The other two sub-models will code roads without additional data for roadways with shoulder widths less than four (4) feet (V1) and greater than four (4) feet (V2). Four feet was deemed the threshold width for a shoulder functioning as a bicycle lane in NH LTS model by the NHDOT TAG and is supported by others working on bikeability in NH within regional planning commissions.

The creation of the LTS model became a large portion of this project between March 2018 and June 2019. We present the most recently adopted results and tools in this report, but want to emphasize that additional model revisions will likely occur during the next year as part of a FHWA-funded pilot project in which the PI Dr. Villamagna is engaged.

We discuss the results of the LTS modeling effort in later sections. A guidebook for using the LTS toolset created for ArcGIS users is provided in *Appendix 5.10: Level of (Bicycle) Traffic Stress Modeling Guide* and LTS tools are available upon request[2].



Compare biking patterns derived from Strava dataset to expected ridership according to the LTS model

Using the 2016 Strava data, we first mapped all recorded rides and symbolized by LTS score (Figure 7) and then graphed the results (Figure 8). A value for each segment traversed was included in the analysis seen below in Figure 7. Based on this analysis, the majority of Strava rides were on LTS 2 roadways, followed by LTS 3. Very few rides recorded used LTS 1 or 4 roads. We suggest this is because most LTS 1 roads do not provide cyclists with connectivity to larger recreational loops or to commuting destinations, and LTS 4 roads are perceived as too stressful for a commute or recreational ride.

Figure 7: Strava Rides & LTS 2016*. Geography of 2016 unique rides recorded by Strava in New Hampshire symbolized by the LTS score (as of April 2018 LTS model).*

[2] Contact Dr. Amy Villamagna amvillamagna@plymouth.edu for up to date ArcGIS toolbox

Table 2: NH LTS Model Data Inputs. *Data inputs for NH Level of Traffic Stress for bicycling models.*

Attribute	Type	Description	Required Formatting	Optional/ Required
Input	*Feature class, shapefile, or table*	*The table containing all road segments and road attributes to be processed. LTS input fields will be copied to the output shapefile.*	*NA*	*Required for all Versions*
Speed (SPEED)* Can choose to replace NHDOT data with prevailing speed where available.*	Field	Either the posted speed limit or prevailing traffic speed of a roadway segment. This must be converted to the LTS speed format using one of the LTS Speed Tools. 20 = speeds ≤ 20 mph 1 = speeds > 20 mph and ≤ 25 mph 2 = speeds > 25 mph and ≤ 30 mph 3 = speeds > 30 mph and ≤ 35 mph 4 = speeds > 35 mph 5 = interstate	20, 1, 2, 3, 4, 5	Required for all Versions
Traffic Directio n (DIRECTION_)	Field	Operational direction of a roadway during non-peak period hours. One way = Roadway that operates with traffic moving in a single direction. Two way = Roadway that operates with traffic moving in both directions.	"One way" "Two way"	Required for all Versions
Number of Lanes (NUM_LANES)	Field	Total number of lanes, which includes both directions of a roadway. Auxiliary lanes, such as truck lanes, turning lanes, and passing lanes are included.	1, 2, 3...	Required for all Versions
AADT (AADT)	Field	Annual Average Daily Traffic (AADT), represented in number of vehicles per day (averaged over the course of a year). This traffic volume approximation can upgrade or downgrade the stress level of a road.	Numeric (e.g. 8200)	Required for all Versions
Road Shoulder Width (SHLDR_WIDT = RIGHT & SHLDR_WI_1 =LEFT)	Field	Width of road shoulder. The shoulder width is measured from the edge of pavement to the center of the white 'fog' line. *Note*: shoulder width fields must be specified for the right and left lanes; widths are not required for every record.	Numeric (e.g. 10)	Required for V2 & V3 (not V1)
Bicycle Lane Width (BikeLWidR = right; BikeLWid_L = left)	Field	The width of a striped bicycle lane or road shoulder ≥ 4 ft. The LTS model automatically labels any road shoulders ≥ 4 ft. in width as a bicycle lane. *Note*: widths are not required for every record.	Numeric (e.g. 4)	Optional for V1 & V2, Required for V3

Attribute	Type	Description	Required Formatting	Optional/ Required
Parking Lane Width (ParkWidthR=right; ParkWidthL= left)	Field	The width of the parking area, measured in feet. When parking is present, prospective road shoulder bicycle lanes are determined by subtracting the parking width lane width from the shoulder lane width. *Note*: widths are not required for every field.	Numeric (e.g. 6)	Optional for V1 & V2, Required for V3
*Prevailing speed data should replace SPEED field data for the SPEED script to work appropriately.				

Table 3: Speed LTS Classifications *The classifications based on posted or prevailing speed or the Functional System field in NHDOT roadways GIS layer. The * notes a noted future revision to the code to increase LTS speed to 3 for Minor Collectors and 4 for Major Collectors as suggested by NHDOT Supervisor of Systems Planning as part of the aforementioned FHWA pilot project.*

Speed Limit or Prevailing Speed	Assigned LTS Speed
≤ 20 mph	20
> 20 mph and ≤ 25 mph	1
> 25 mph and ≤ 30 mph	2
> 30 mph and ≤ 35 mph	3
> 35 mph	4
All Else (Error)	200
Functional System	**Assigned LTS Speed**
Contains "Local"	2
Contains "No Func"	2
Contains "Minor Arterial"	2
Contains "Major Collector"	3
Contains "Principal Arterial"	4
Contains "Interstate" {Also ramps}	5
All Else (Error)	200

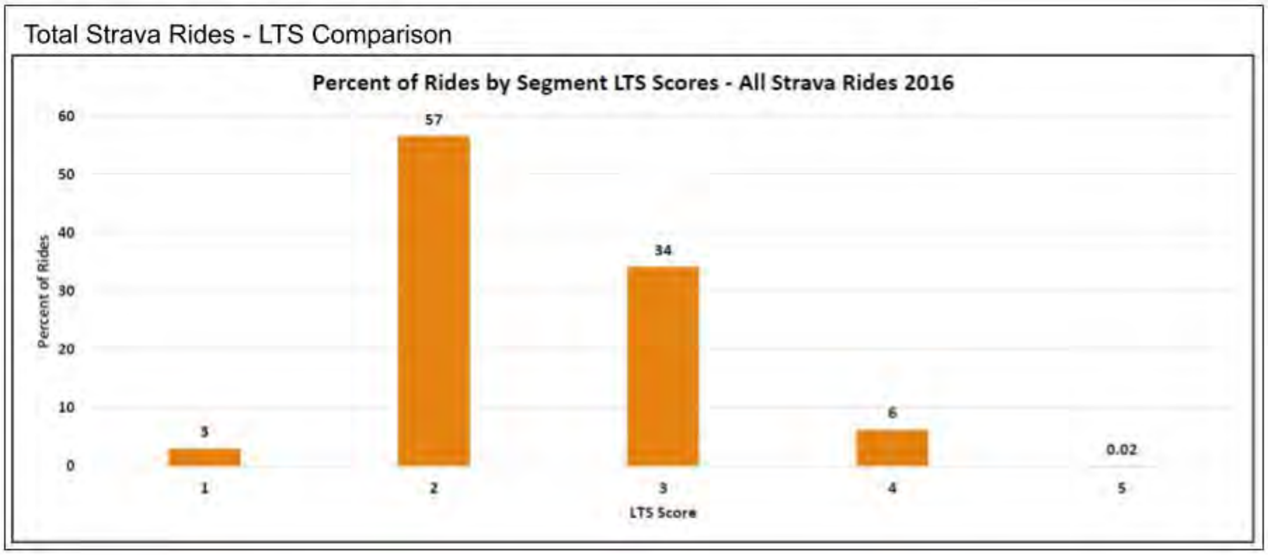


Figure 8: Percent of Rides by Segment LTS Scores *Comparison of Strava recorded rides by Level of Traffic (LTS) score for all of NH in 2016.*

Evaluate bike/ped accessibility to key community amenities and services within socially vulnerable communities

We used both Strava records (Objective 1) and the LTS model to assess bike accessibility. With respect to LTS, the following questions were the focus:

1. What percentage of selected origin-destination routes are accessible along LTS 1 and 2 segments?
2. What percentage of these routes (i.e. network) could become accessible to most of the population with alterations to high stress (LTS 3 and 4) segments?
3. Which road segments are most central to network accessibility?
4. What percentage of the top 10% "most central" segments are high stress links?

The text that follows is adapted from Getts (2017) who completed her master's thesis research at Plymouth State University under this project. More specific detail can be found in Getts, L. 2017. MS Thesis. Plymouth State University. Plymouth, NH, available upon request[3].

We chose to focus this analysis on Manchester and the Lakes Region of NH (Figure 9) to demonstrate bikeability assessments at both the rural-regional and metropolitan scale. The answers to these questions not only paint a picture of the current bikeability of the case study community and region, but also help identify the potential for bicycle network improvements. The use of a NH-specific LTS model establishes a set of bikeability criteria for the state and reflects the immediate infrastructure priorities of the public, regional planning commissions, and NHDOT. Bikeability expectations and tools are constantly evolving, and while NH is currently pursuing more bikeable road shoulders, future LTS criteria may limit low-stress ratings to protected bicycle lanes or separated facilities.

[3] Contact Dr. Amy Villamagna amvillamagna@plymouth.edu for copy of thesis

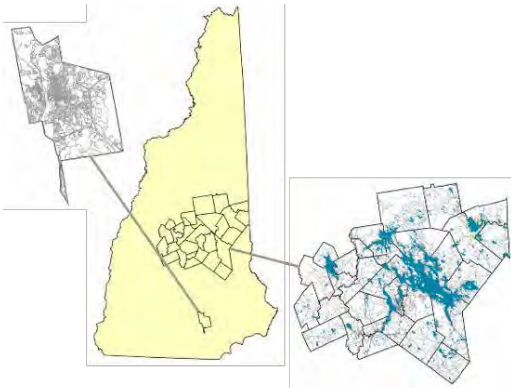


__Figure 9: Accessibility Focal Regions__. Focal regions for biking accessibility analysis: Manchester and the Lakes regions, NH.

Approach: We examined accessibility in the case study regions by generating shortest path routes between selected origins and destinations. We then applied distance and high stress (LTS 3 and 4) cost barriers to understand how these barriers interrupt the road network. Road network segments were prioritized by quantifying the centrality, or relative importance, of each link to all routes in the generated bicycle network. Centrality was determined by calculating the frequency a link in a network was used along the path of all shortest paths between origins and destinations; the more frequently included in a path, the more central the road segment was considered.

Using the ArcGIS Network Analyst extension, a "New Route" analysis was run to generate the shortest trip path between every origin and every possible destination along a road network. Routes were generated under three different scenarios:

1. Complete network with no stress restrictions (baseline);
2. Network limited to LTS 1, 2, and 3 segments (condition 1);
3. Network limited to LTS 1 and LTS 2 segments (condition 2).

This approach allowed us to measure the "percent trips connected", or proportion of trips that are connected of all possible trips without exceeding a given level of traffic stress and without undue detour (Mekuria et al., 2012). "Undue detour" was flagged whenever a low-stress route (LTS 1 and 2) became >25% longer than the original route, which incorporated segments of all stress levels. Interstates and routes where bicycles are not permitted were removed from the road network layer prior to analysis execution as these segments are unsuitable for bicycle travel under all conditions. A distance cost barrier was applied at five (5) miles, which met the criteria for a "short" bicycle trip, as defined by the FHWA's Strategic Agenda (Twaddell et al., 2016). All generated routes exceeding five (5) miles in length were considered "inaccessible".

Additionally, all routes < 0.5 mi. in length were removed, as walking is normally the preferred mode of travel up to this distance. There were no distance cost barriers applied to routes in the Lakes Region as regional accessibility conceptualizes travel at the long-distance scale.

To determine the level of accessibility that each block group or community in the Lakes Region currently experiences, we established a low, medium, and high rating scheme. The Level of Accessibility rating was derived from the number of accessible routes that began or ended in a block group or community (as defined per the Lakes Region). Every route that could be completed along road or trail segments rated < LTS 4 and < LTS 3 were counted twice and four times, respectively. This double and quadruple counting effectively weighted routes to boost associated community's Level of Accessibility rating.

Accessibility scores for each Lakes Region community were classified relative to other communities in the region using Jenks natural breaks. The Jenks classification works by dividing the data into classes which have the most similar mean, and maximizes the difference between class means. Centrality was not assessed for the links contributing to regional accessibility in the Lakes Region, as the regional analysis values each route equally.

Results: The analyses revealed a substantial lack of accessibility throughout Manchester and the Lakes Regions' road and trail networks when segments were limited to LTS 1 and LTS 2. These results signal the importance of many high-stress segments to community-wide accessibility, and highlight specific opportunities for infrastructure-specific bikeability improvement

<u>Manchester</u>. An investigation of Manchester's Level of Accessibility along LTS 1 and 2 roadways reveals a disconnect between downtown Manchester and its surrounding neighborhoods (Figure 10). In contrast, a review of populations lacking access to an automobile indicates that most of Manchester's transportation-vulnerable population resides in the city's denser, more walkable block groups. By combining Level of Accessibility ratings with numbers of residents lacking automobile access, we revealed 17 block groups to be most at risk for restricted accessibility (Figure 11). Although several of these block groups reside in the denser, more walkable portions of downtown Manchester, the analysis penalized them for their inability to access the full extent of destinations scattered throughout the city. Future iterations of the accessibility analysis may restrict specific destinations, such as schools or grocery stores, to a more limited radius from the input origins.

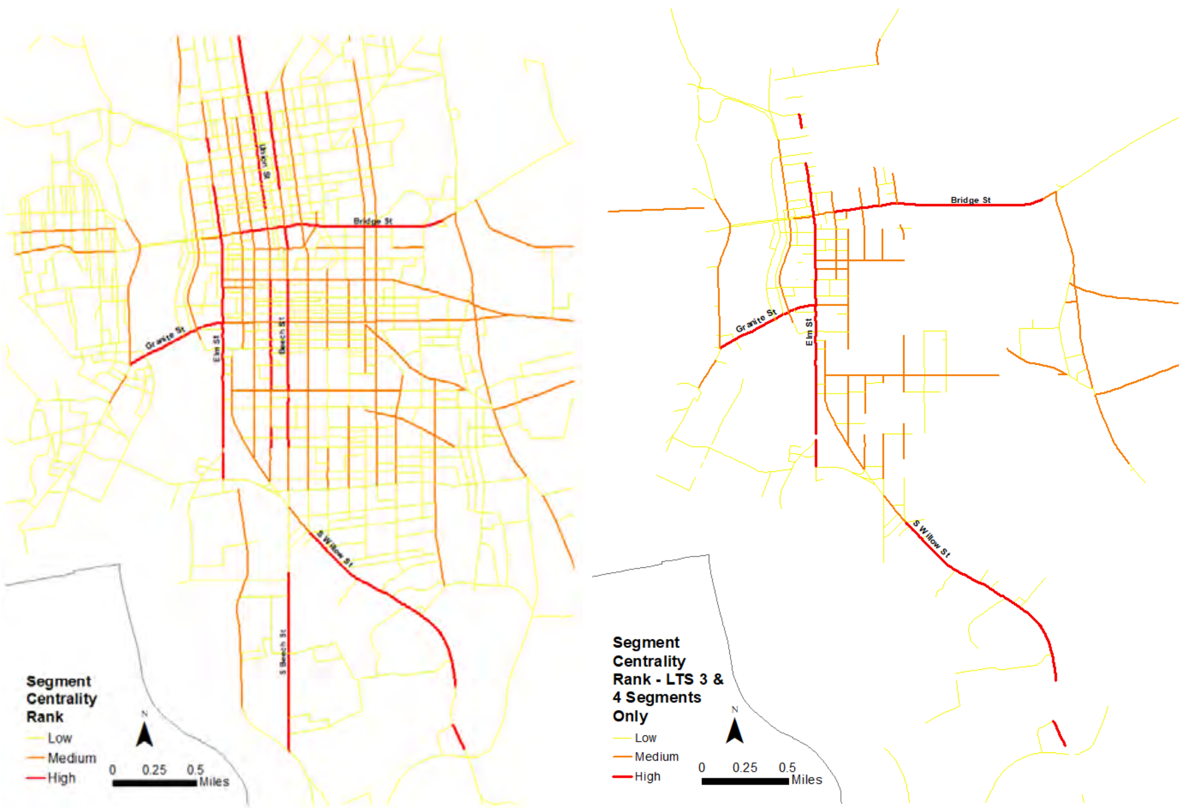


Figure 10. Segment Centrality Ranking. *An example map showing ranking of centrality, or importance, of each road segment to the overall network in Manchester. Left: centrality of all segments, regardless of LTS rating. Right: only LTS 3 & 4 road segments.*

Table 4. Top 10 Priority Segments: Manchester *Top 10 priority road segments for improvement in Manchester, NH, based upon centrality ranking and LTS score > 2.*

PRIORITY	SRI	STREET	LTS SCORE
1	U0000003___	Elm St	3
2	U0000003___	Elm St	4
3	S0000028___	S Willow St	4
4	L2850319___	Granite St	4
5	N2850039___	Bridge St	3
6	L2850558___	Willow St	3
7	N2850051___	S Main St	3
8	S0000028A_	Mammoth Rd	3
9	L2850831___	Pine St	3
10	L2850553___	Union St	3

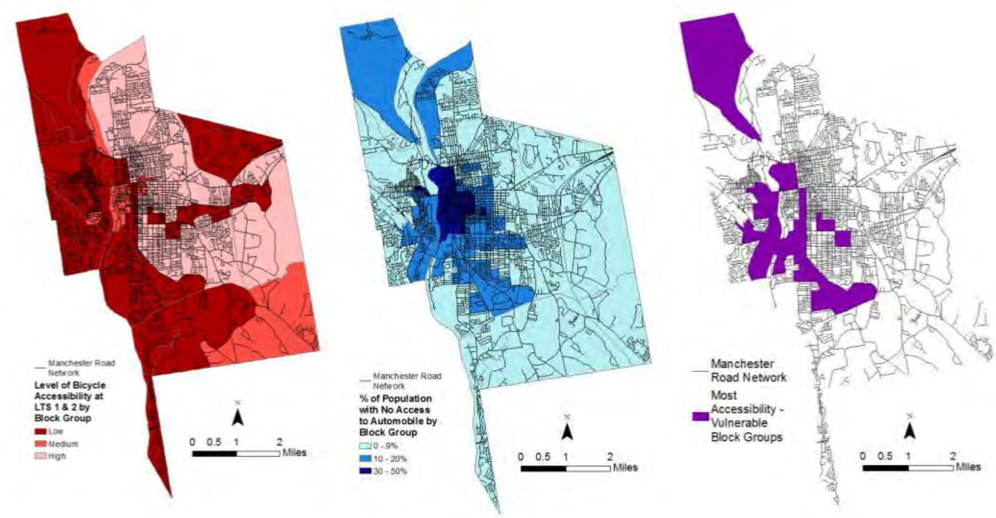


Figure 11. Accessibility Vulnerability by Block Group. *The left map ranks block groups by inaccessibility; the middle map displays block groups by percentage of residents lacking an automobile; the third map indicates the block groups with the highest degree of inaccessibility and percentage of population without access to an automobile. The block groups in purple have low accessibility to destinations along LTS 1 & 2 routes and more than 10% of the census block population does not have access to an automobile. Note: In the accessibility vulnerability analysis, accessibility via walking to destinations was accounted for by considering all destinations located 0.5 miles or less from their origin as accessible.*

Lakes Region. The longest distance between any two communities in the Lakes Region was 30 miles. Total possible origin-destination route combinations from the center of one community to another totaled 350. These routes, generated without restrictions, represent the network's route potential.

Although only 12% of the Lakes Region's road network consisted of LTS 4 segments, the removal of these segments from the network reduces accessibility via LTS 1, 2, or 3 road segments by 89%. When the network is restricted to LTS 1 and 2 segments only, accessibility drops to a mere 3% of the network's route potential.

Unsurprisingly, the further a community is from the region's center, the poorer its level of bicycle accessibility (Figure 12). The 11 communities with low accessibility border the outer edge of the region. Eight Lakes Region communities have high accessibility, which is primarily a factor of proximity to multiple neighboring communities rather than an ability to travel from one community to the next along low-stress roads and trails. The final third of communities, which are situated both centrally and along the outskirts of the region, are primed for inter-community accessibility, but currently suffer from high-stress connection corridors. Many of these communities benefit from immediate lake access and have the potential to develop strong bicycle tourism markets.

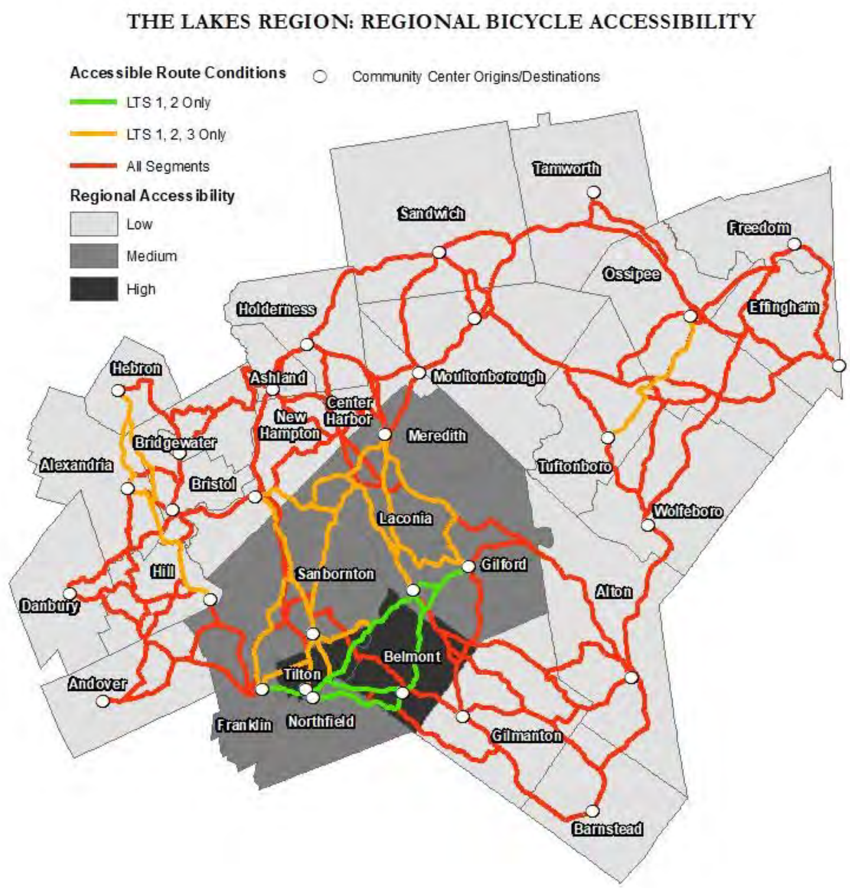


Figure 12. Regional Bicycle Accessibility: The Lakes Region. *Regional accessibility rank and all regional routes accessible under various Level of Traffic Stress (LTS) conditions in Lakes Region, NH. Approximately 97% of regional routes cannot be completed without travelling along an LTS 3 or 4 segment.*

__Table 5__: __Origin- Destination Analysis of Accessible Routes__. Percentage of total origin-destination routes that can be completed given LTS and distance cost barriers.

Focal Region	(Baseline) Total Routes	(Condition 1) % of Total Routes Accessible via LTS 1, 2, or 3-rated Roads or Trails	(Condition 2) % of Total Routes Accessible via LTS 1 or 2-rated Roads or Trails
Lakes Region	350	11%	3%
Manchester	16,274	88%	20%

Note: Routes > 25% longer in distance than baseline route when completed under condition 1 or condition 2 were deemed "inaccessible routes".

The results of the accessibility analyses indicate a substantial lack of low-stress bicycle networks, both regionally throughout the Lakes Region and at the community scale in Manchester (Table 5). More specifically, the analyses reveal the degree of stress impacting the network, and where these higher stress choke points exist. While LTS 4 segments are more crucial to accessibility regionally in the Lakes Region, LTS 3 segments pose the greatest barrier to destination access via bicycle in Manchester.

While centrality identifies specific opportunities for on-road improvement in existing road networks, it does not account for the trails as an alternative, where a complete circumvention of the high stress road network by rail trail or separated bicycle facility may be the preferred and most impactful option. In the Lakes Region, many of the roadways that currently connect communities may not be capable of obtaining low-stress bikeability ratings under any on-road improvement prescription. Given narrow corridors, high traffic speeds, and high traffic volumes, separated bicycle facilities may be the only realistic option for improving portions of the region's bikeability. (Getts, 2017)

Evaluate changes in bicycling activity attributed to annual road paving.

We calculated the average change in total rides and unique riders using Strava data between 2014 and 2016, between 2014 and 2016 for roads repaved in 2015, and between 2014 and 2016 for roads that were not repaved. The results of this analysis are reported in the Table 6 below and maps that illustrate the percent change in number of rides and unique riders between 2014 and 2016 for roads receiving a paving treatment in 2015 are provided in Figure 13 below.

__Table 6__: __Road Paving Impacts on Bicycle Activity__. Average change in bicycling patterns reported using Strava between 2014 and 2016 for roads with and without repaving in 2015.

Years	Avg. Change in Total Rides	Avg. Change in Unique Athletes
2014 to 2016	109%	89%
2014 to 2016 for 2015 Paved Roads	73%	62%
2014 to 2016 Roads without paving treatment	145%	89%

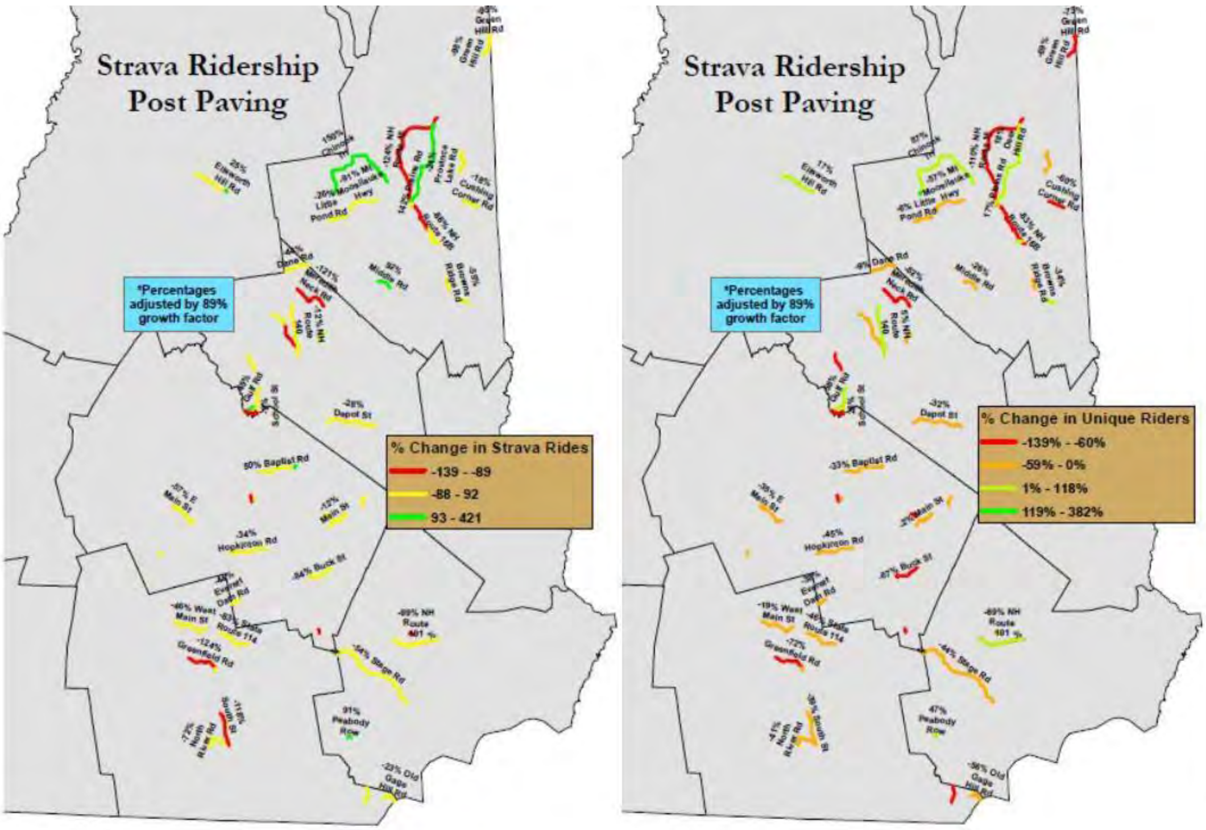


Figure 13: Strava Ridership Post Paving. *Percent change in Strava-reported bicycling between 2014 and 2016 for roads that received paving treatment in 2015.*

Objective 3: Evaluate perceived barriers to active transportation (e.g. safety concerns) against objective physical barriers as reflected in LTS model

Conduct public participatory GIS surveys to map road conditions and locations of perceived barriers to biking in focal communities: Plymouth and Nashua, NH.

The text that follows is adapted from Getts (2017) who completed her master's thesis research at Plymouth State University under this project. More specific detail can be found in Getts, L. 2017. MS Thesis, Plymouth State University. Plymouth, NH[4]

The ultimate question in active transportation research is why an individual chooses to or not to engage with a specific mode of transportation. While bikeability research reveals that higher percentages of active transportation engagement are never attributable to a single factor, significant relationships between active transportation engagement and certain conditions are informative to planners. Although most studies investigate the relationship between bicycling trends and infrastructure (an important consideration in transportation engagement and safety), failure to consider additional factors, such as psychological, social, and economic, may overestimate the role of various infrastructural treatments (Légaré et al., 2009). It is telling that "infrastructure and funding" comprises only one of five categories

[4] Contact Dr. Amy Villamagna amvillamagna@plymouth.edu for copy of thesis

on the League of American Bicyclists' Bicycle Friendly State Report Card that contributes to a state's overall Bicycle-Friendly rating (2015).

Innovative planning approaches to active transportation promotion and development are slowly changing the way communities and their citizens perceive and engage with transportation. One such engagement tool, PPGIS, uses geospatial technology to inform planning processes with public knowledge by inviting participants to provide geospatial information about perceived attributes of place (Sieber, 2006). Roadway models, like the aforementioned NH Level of Traffics Stress model that uses roadway attributes to gauge roadway levels of stress, have long been employed by planners and engineers to systematically characterize bicycling networks. While this technical approach is useful, it fails to account for the subjective experiences of the facility users (Pánek, J., & Benediktsson, 2017). PPGIS methods permit collection of both quantitative and qualitative data that contribute to the subjective void. Individuals at the local level are generally most attuned to their immediate surroundings and are often eager to recognize and report concerns (Goodchild, 2008). Providing outlets for such information, such as PPGIS, can not only generate valuable data, but also increase stakeholder investment in community or statewide planning initiatives.

We conducted a PPGIS intercept survey throughout the two case studies regions over a two-month period. Considering budgetary constraints, the needs of the project partners, and restrictive deadlines, purposive haphazard intercept and snowball sampling was the most appropriate method to use, given the project goal. The intent was to capture diverse responses from NH residents along the attitude spectrum proposed by Geller (2009), as detailed in Table 1.

Using the Finnish PPGIS web platform, Maptionnaire, we issued a questionnaire that addressed bicycling attitudes and habits, motivations for bicycling, barriers to bicycling, access to key destinations, and mapping of hazardous road segments. Survey questions ranged from multiple choice to sliding-bar scale and concluded with a mapping application. In the mapping portion, respondents were asked to place location pins on segments of road or trail that they believed were hazardous and to provide feedback about the perceived hazards for each segment (Figure 6). Point features were selected over lines to minimize confusion with placing features on the map, as was experienced by Pánek and Benediktsson (2017). To facilitate mapping, respondents were given the options of toggling between four different base maps, applying a NH trails layer, and locating specific street addresses using a search bar. Maptionnaire was selected for its user-friendly interface and convenient data delivery packages.

Multiple linear regression was conducted to identify relationships between attitudes towards cycling and selected demographic data and the frequency of cycling and selected demographic data. An analysis of variance (ANOVA) test was conducted on "barriers to bicycling" responses and "motivations for bicycling" responses to determine if variations in response were explained by attitudes toward bicycling or frequency of cycling.

Results:

Among the 529 survey responses, 121 respondents were from the Lakes Region of NH, 88 were from Manchester, and 320 did not claim residency in either focal region. Although the majority of responses were from outside of the case study regions, only data from respondents residing in the Lakes Region and Manchester was analyzed. In the Lakes Region, 45% of respondents were male, while in Manchester, 57% of respondents were male. The greatest frequency of respondents from both regions fell into the 55-64-year age bracket. Additional demographic information collected included: ethnicity, state of employment, income, number of children in household, and seasonality of residence in NH. The average respondent from both communities was likely to be white, employed, hold a college degree, and have no children living at home. Income varied widely among all respondents in both regions. Overall, survey respondents were slightly older and more educated than the NH state average (U.S. Census Bureau, 2016).

Barriers to Bicycling

Among respondents in both regions, the three most frequently stated barriers to bicycling in NH were “Narrow Shoulder”, “Fear of driver awareness of bicycles”, and “Fear of traffic”. A full list of barriers is provided in Figure 14. Interestingly, “Narrow Shoulder” and “Lack of striped bicycle lanes” were, overall, considered greater barriers to bicycle than separated bicycle facilities or bicycle boulevards.

Respondents in both communities expressed a substantial fear of drivers and traffic volumes. Given that previous research has deemed time and/or distance to destination a major barrier to bicycling for many individuals, it is surprising that “Time to destination” was not considered one of the highest-ranked barriers to bicycling among respondents from both the Lakes Region and Manchester. Furthermore, it is interesting to note that “Time to Destination” is considered a greater barrier in Manchester than the Lakes Region, where communities and road densities are far less compact.

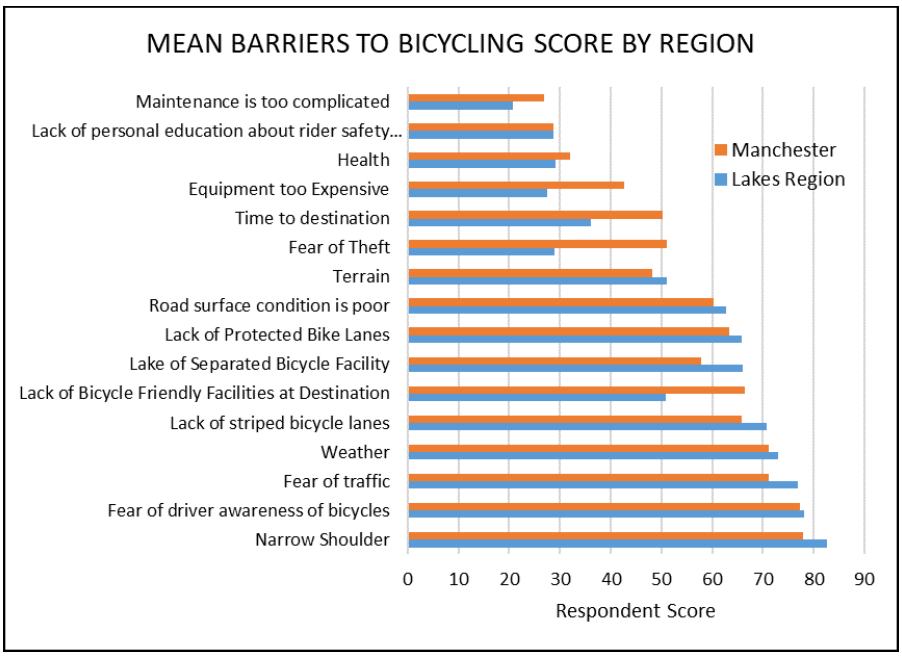


Figure 14. Mean Barriers to Bicycling Score by Region. *Stated barriers to bicycling by intercept survey respondents in two communities in New Hampshire. Respondents scored each variable between 0 and 100 using a sliding scale bar.*

Attitude Towards Bicycling

While both respondents with a confident attitude towards bicycling (Comfortably Confident and Fit and Fearless) and Willing but Wary respondents were almost equally concerned about weather, equipment expense, bicycle facilities at their destination, knowledge of rider safety, bicycle maintenance, and poor road surface conditions, Willing but Wary respondents were significantly more concerned than confident rider respondents about traffic, drivers, and all other infrastructural barriers, as detailed in Table 7. In Manchester, Willing but Wary bicyclists only deviated from confident riders in their concern about terrain and driver awareness of bicyclists. In Manchester, there was no statistically significant difference between Willing but Wary and Confident cyclists’ concerns for all other barriers.

Table 7: Barrier Stress Comparison to Bicycling Attitudes. *Significant ANOVA Tukey Honest Significant Difference (HSD) post-hoc test results for bikeability survey results in the Lakes Region and Manchester. Test compares the differences between attitudes towards bicycling for various barriers to bicycling variables. Willing but Wary respondents consistently scored barriers higher than both Comfortably Confident and Fit and Fearless respondents.*

Dependent Variables	Factor		Std. Error	P-Value	95% Confidence Interval		Region
					Lower Bound	Upper Bound	
Terrain	Willing but Wary	Comfortably Confident	8.63	0.007	6.34	51.71	Lakes Region
		Fit & Fearless	9.94	0.000	24.93	77.21	
	Willing but Wary	Comfortably Confident	9.82	0.000	18.33	70.36	Manchester
		Fit & Fearless	10.82	0.000	36.24	93.58	
Fear of Driver Awareness of Bicyclists	Willing but Wary	Comfortably Confident	6.58	0.014	3.18	37.68	Lakes Region
	Willing but Wary	Fit & Fearless	9.67	0.018	3.88	55.09	Manchester
Fear of Traffic	Willing but Wary	Comfortably Confident	6.57	0.002	7.16	41.57	Lakes Region
		Fit & Fearless	7.36	0.012	3.83	42.36	
The road shoulder is too narrow	Willing but Wary	Fit & Fearless	6.955	0.029	1.47	37.85	Lakes Region
Lack of striped bicycle lanes	Willing but Wary	Fit & Fearless	8.73	0.045	0.35	46.19	Lakes Region
Lack of bicycle lanes separated from traffic by barriers	Willing but Wary	Comfortably Confident	8.32	0.001	10.13	53.81	Lakes Region
		Fit & Fearless	9.65	0.029	2.09	52.79	
Lack of dedicated bicycle paths at least 20ft. from vehicle traffic	Willing but Wary	Comfortably Confident	8.42	0.010	4.97	49.18	Lakes Region
		Fit & Fearless	8.58	0.004	7.70	52.71	
Equipment too expensive	Willing but Wary	Fit & Fearless					Manchester
Inclement Weather	Willing but Wary	Comfortably Confident	11.5	0.011	6.62	68.18	Manchester

Compare locations noted by respondents to LTS models and Strava data to validate physical barriers and identify barriers due to perceived threat

Hazardous Road Flags and Level of Traffic Stress

In the Lakes Region, 59 unique respondents flagged 138 routes. Of the 138 routes flagged, approximately 62% were rated LTS 4, 20% were rated LTS 3, 14% were rated LTS 2, and 4% were rated LTS 1 (Figure 15), with 1 flag along the interstate (removed from total percentage). The large majority of hazards were located on minor arterial and major collector roads in the Lakes Region that ranged from LTS 2 to LTS 4 (Figure 16 top). Streets with more than four hazardous flags included: Lake Shore Rd, NH Rte. 175, US Rte. 3, Central St., Laconia Rd, Main St., NH Rte. 25, and Whittier Hwy. Each of these streets ranged from an LTS 2 to an LTS 4. These hazardous road flags were dispersed throughout Holderness, Moultonborough, Gilford, Belmont, Tilton, Northfield, Sanbornton, and Franklin (North-South through middle of region). In the Lakes Region, the most frequently cited reasons for flagging these roads were narrow road shoulders, followed by a lack of bicycle lane or path and heavy traffic speeds. High traffic volumes were also listed as a concern for approximately 15% of the flagged segments.

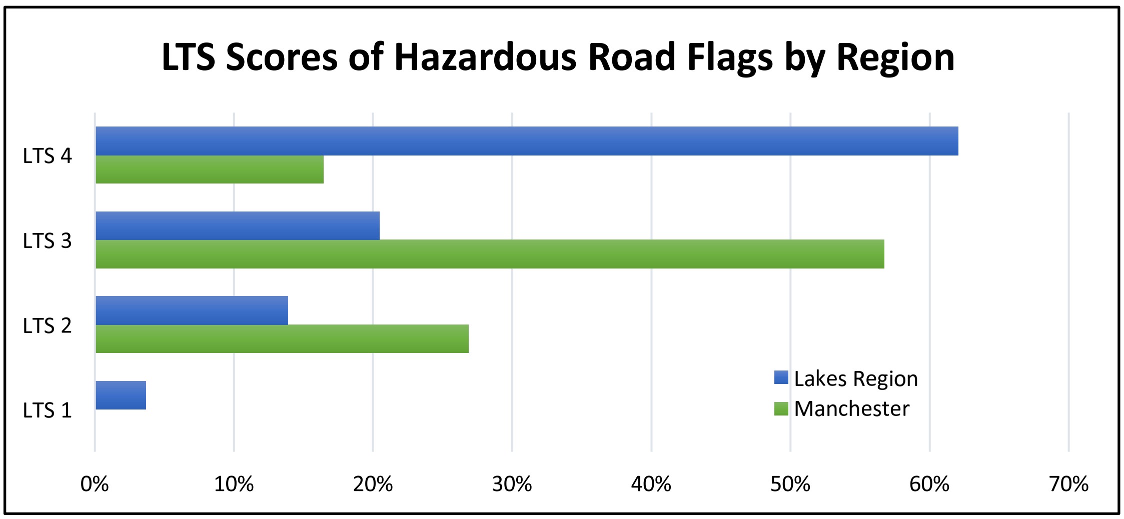
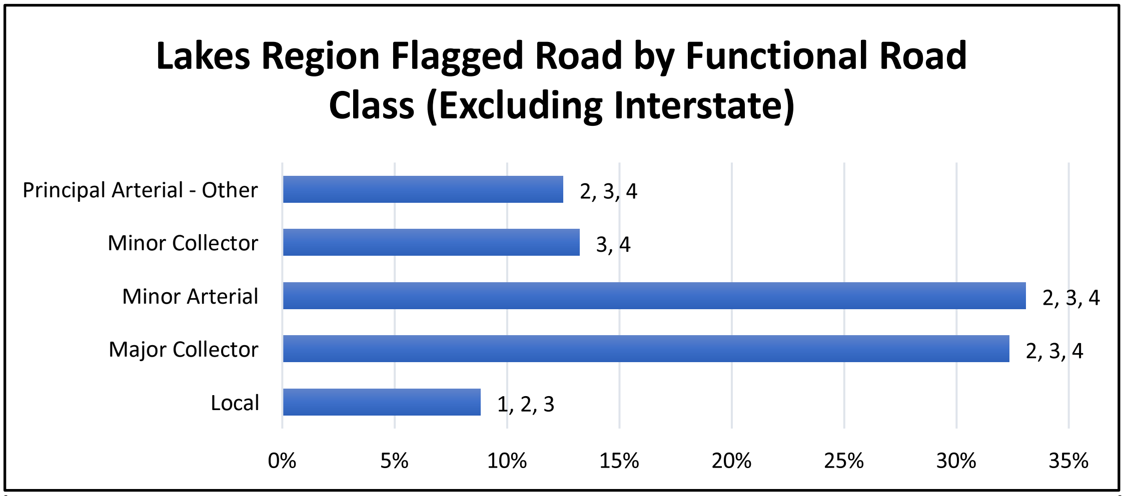


Figure 15: LTS Scores of Hazardous Road Flags by Region. *Percentage of hazardous road flagged segments by Level of Traffic Stress score 1-4 and region.*

In Manchester, 21 different respondents flagged a total of 69 road segments as hazardous. Of these segments, approximately 57% were rated LTS 3, 27% were rated LTS 2, 16% were rated LTS 2 (Figure 16), and 2 flags were placed along the interstate (removed from total percentage). The large majority of hazards were located on principal arterial roads that ranged from LTS 2 to LTS 4 (Figure 16 bottom). Streets with more than three hazardous flags included: Elm St., Union St., Bridge St., Brown Ave., Hanover St., and W Bridge St. Each of these street segments ranged from an LTS 2 to an LTS 4. In Manchester, the top rationales for flagging these roads were a lack of bikeable infrastructure and traffic volumes, followed closely by high traffic speeds (Figure 15 bottom).



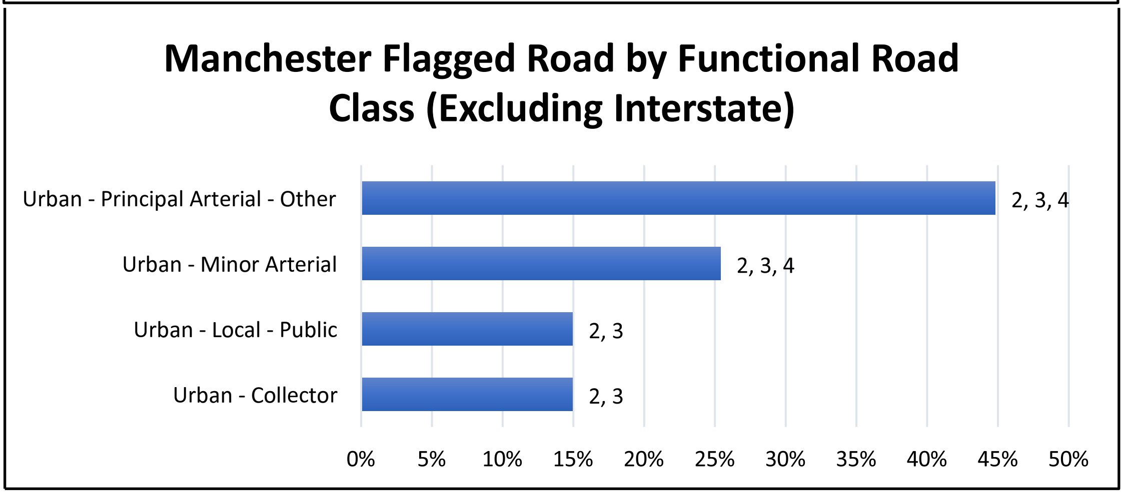


Figure 16: Hazardous Road Flags by Functional Class. *Manchester and Lakes Region roads flagged as hazardous in PPGIS survey by NHDOT- designated functional road class.*

The results of the hazardous road mapping portion of the bikeability survey provide useful feedback for the NH-specific Level of Traffic Stress model. That the majority of flagged segments in Manchester were LTS 3-rated, suggests that respondents view these roadways as unsafe or uncomfortable for bicycling, yet crucial to the network (Getts, 2017: Chapter 2) and potentially improvable. This may reflect adequate, or nearly adequate, scoring criteria by the LTS model in Manchester. In the Lakes Region, most flagged segments had received a score of LTS 4, confirming that respondents view these roadways as unsafe or uncomfortable for bicycling. That the majority of flagged segments were LTS 4 suggests that the LTS model has overestimated the stress of the roadways, or that LTS 4 links are pervasive in the Lakes Region, or perhaps a combination of both. In both regions, enough segments with ratings of LTS 2, and in particular, the LTS 1 flag in the Lakes Region, were flagged as hazardous to prompt additional review of the LTS model. The "reasons for flagging" data provides a useful means of comparison between perceived roadway hazards and modeled roadway stress. While PPGIS model feedback is currently limited to two regions of NH, replications of this feedback process throughout the state may provide a robust and highly useful set of data that can shape the LTS model and facilitate specific planning goals.

The majority of respondents that engaged in the mapping portion of the survey were active cyclists. Their feedback demonstrates that residents (particularly those who know the road from the perspective of a bicyclist) are an excellent source of local knowledge and have an important role to play in the planning process. This PPGIS platform demonstrates the ease with which members of the public can participate in important transportation planning decisions.

Conduct analysis of the reported barriers to identify potential areas of concern and reform.

We analyzed barriers reported through PPGIS efforts and compared them with other focal regions (Figure 17) and, further, between respondents that self-classified as Willing but Wary and Comfortably Confident or Fit and Fearless. For the latter, we conducted inferential statistics (T-test) to compare means of barrier scores between the two groups, Willing but Wary and the combination of responses from Comfortability Confident and Fit and Fearless (Table 8).

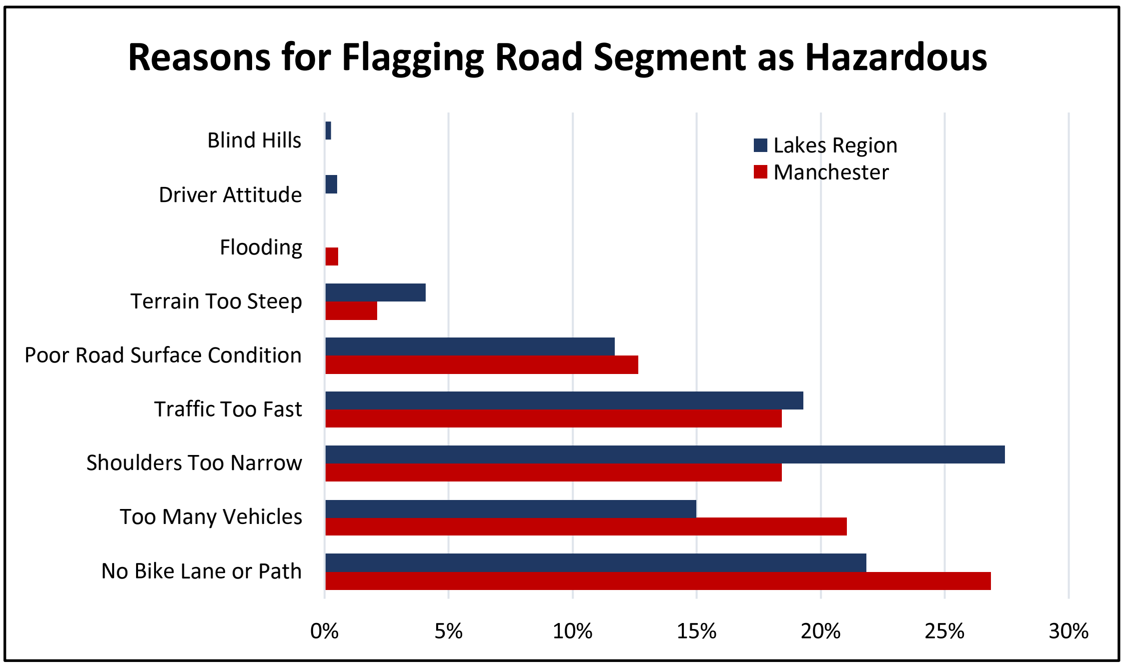


Figure 17. Reasons for Flagging Road Segment as Hazardous. *Rationales for flagging a road segment as hazardous by region and percentage of overall segments flagged*

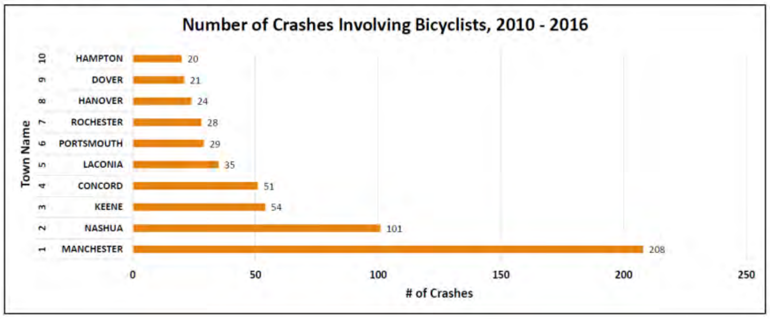
***Table 8**: **Summary of Barrier Significance by Attitude and Region.** Summary of significant and non-significant score means of barriers to bicycling between respondents self-identified as Willing but Wary bicyclists and those identified as Comfortably Confident or Fit and Fearless cyclists in the Lakes Region and Manchester. Willing but Wary respondents consistently scored significant barriers higher than both Comfortably Confident and Fit and Fearless respondents. Barriers were scored on a sliding scale of 0-100.*

Comparing responses between Willing but Wary and Comfortably Confident or Fit and Fearless Respondents			
Lakes Region		**Manchester**	
Significant Difference	**No Significant Difference**	**Significant Difference**	**No Significant Difference**
◦ Terrain ◦ Fear of driver awareness of bicycles ◦ Fear of traffic ◦ The road shoulder is too narrow ◦ Lack of striped bicycle lanes ◦ Lack of bicycle lanes separated from traffic by barriers ◦ Lack of bicycle paths at least 20 feet from vehicle traffic	◦ Time to destination ◦ Lack of bicycle-friendly facilities at destination ◦ Road surface condition is poor ◦ Maintenance is too complicated ◦ Inclement weather ◦ Lack of education about rider safety ◦ Equipment is too expensive ◦ Health ◦ Fear of bicycle theft	◦ Terrain ◦ Fear of driver awareness of bicycles ◦ Equipment is too expensive ◦ Inclement weather	◦ Lack of education about rider safety ◦ Time to destination ◦ Lack of bicycle-friendly facilities at destination ◦ Road surface condition is poor ◦ Maintenance is too complicated ◦ The road shoulder is too narrow ◦ Lack of striped bicycle lanes ◦ Lack of bicycle lanes separated from traffic by barriers ◦ Lack of bicycle paths at least 20 ft. from vehicle traffic ◦ Health ◦ Fear of bicycle theft ◦ Fear of traffic

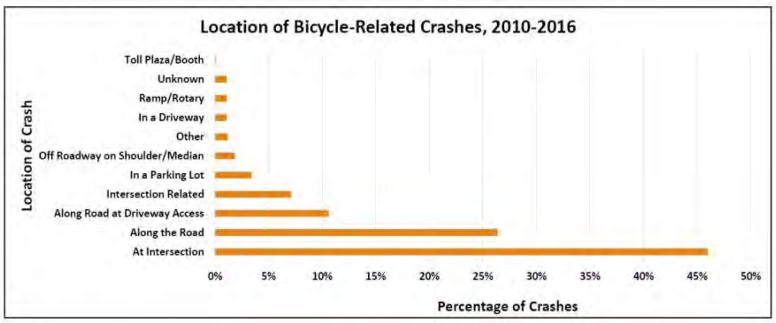
Develop a framework for assessing community-specific exposure to vehicular conflicts and hazardous conditions using NH DOT vehicle-bicycle reports and PPGIS survey responses

We used data from the NHDOT crash database to graph the frequency of crashes by town (Figure 18 upper) and by location of accident over the same time period (Figure 18 upper middle). We also assessed bicycle-related crashes by LTS score of the crash location (Figure 18 lower middle) and by LTS score and town (Figure 18 lower). Manchester far exceeded other towns in terms of the number of crashes reported and that the 67% of the reported bicycle-related crashes were located on LTS 3-5 roadways. Interestingly, a greater percentage of crashes in Concord occurred on LTS 2 roadways than LTS 3 or 4. Figure 19 provides the map overview of recorded crash locations.

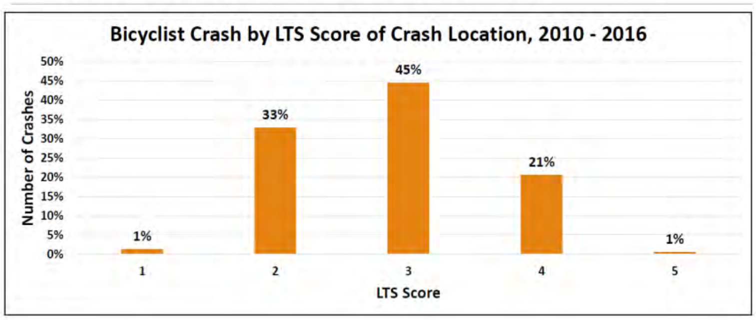
Bicyclist Crash Data – Town



Bicyclist Crash Data – Location



Bicyclist Crash Data – LTS Score



Bicyclist Crash Data – LTS Score & Town

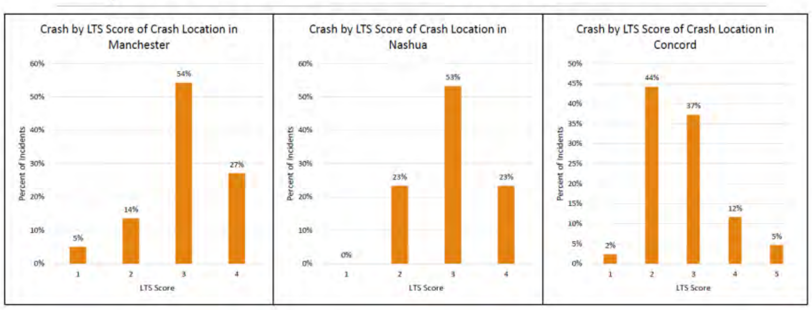


Figure 18**: **Assessment of Bicycle-Related Crashes. *NH crash statistics reported 2010-2016*

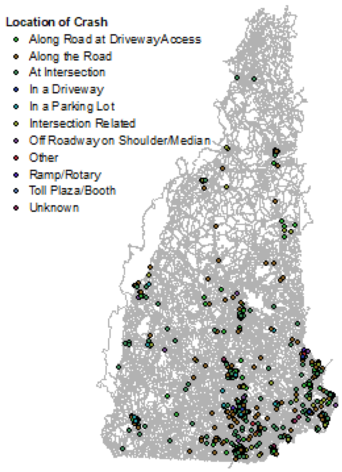


***Figure 19: Location of Bicycle-Related Crashes**. Spatial distribution of bicycle-related crashes recorded by NH DOT 2016 and 2018.*

Objective 4: Evaluate the accuracy of current LTS model using public participatory GIS

Conduct public participatory GIS surveys to solicit feedback on current LTS model predictions of LTS across NH.

We developed an ArcGIS Web Map Application that hosted the current (as of April 2018) Level of Traffic Stress layer for the entire state of NH and was equipped with a tool that enabled users to drop a pin on a road segment to rate the road in terms of bicycle stress. Participants were also encouraged to provide a comment with the rating to defend a score different than the model. The web map application can be accessed online[5].

Promoting the online map survey was done through professional and social networks of this project's TAG. Feedback was collected from the public from April 2018 to October 2018.

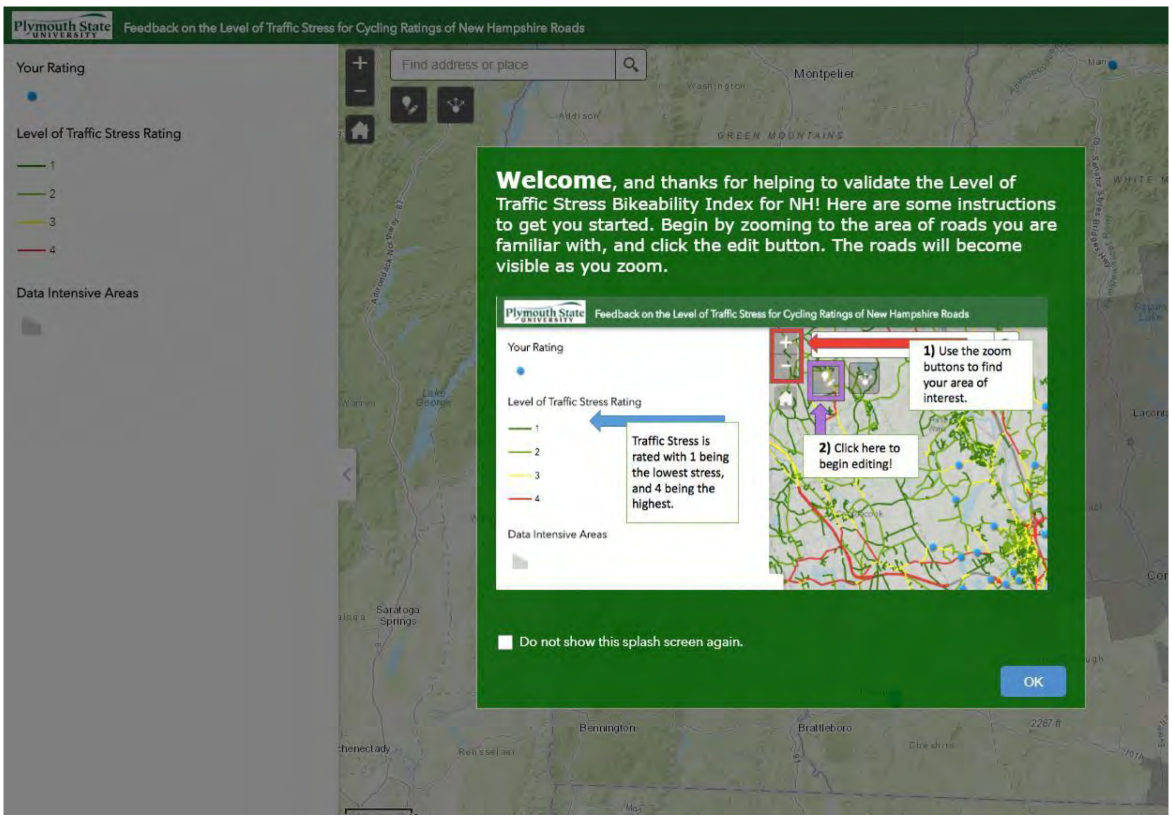


***Figure 20: ArcGIS Participatory Mapping Web Map Application**: **Screen 1.** Opening screen of Web App used to gather public feedback on LTS modeled scores for roadways across New Hampshire.*

[5] ArcGIS Online Web Map application available for viewing online at https://plymouthstate.maps.arcgis.com/apps/webappviewer/index.html?id=633223a8e5b348f09da3873d3c26f62f

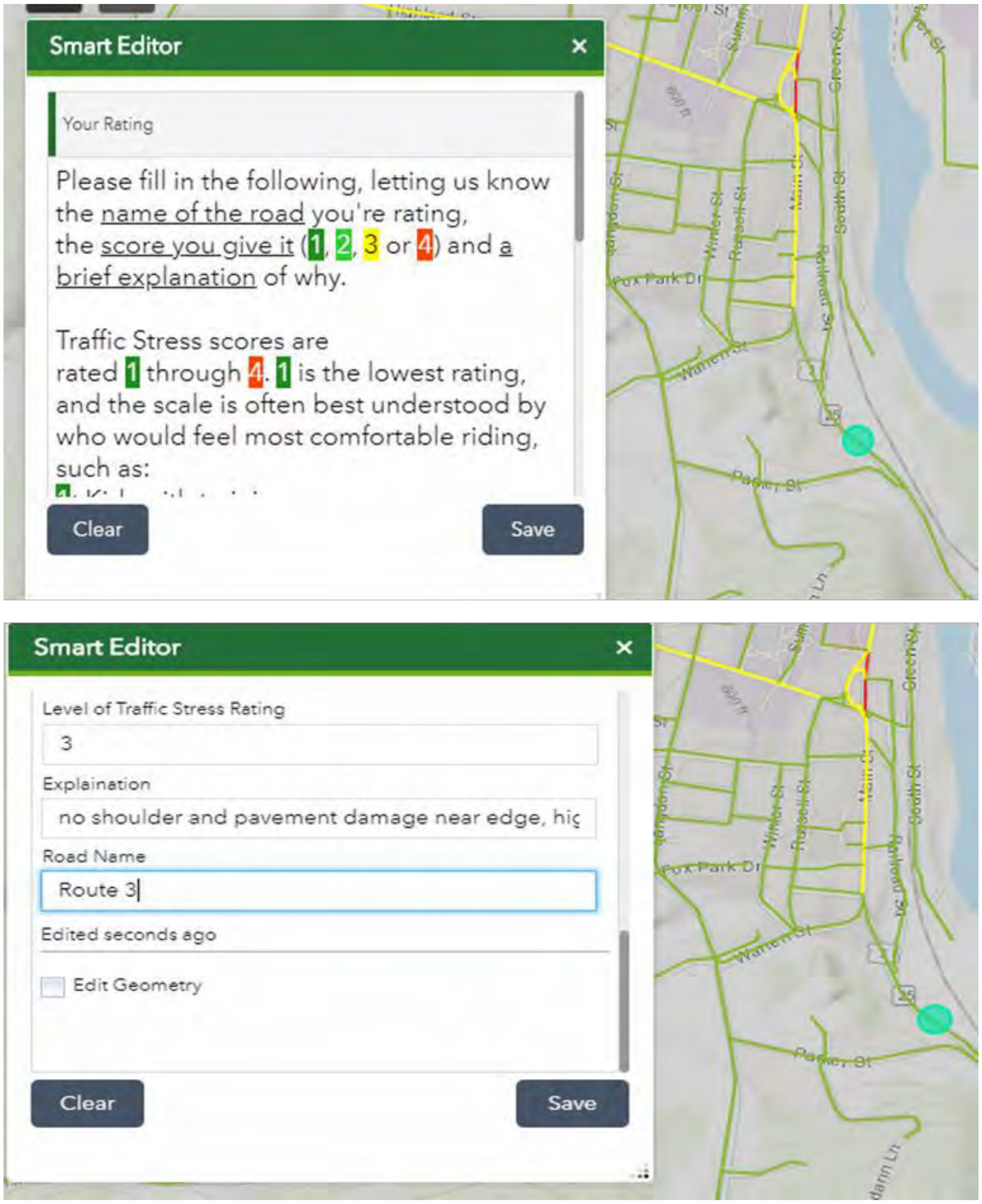


Figure 21: ArcGIS Participatory Mapping Web Map Application: Screens 2 and 3.

Compare the reported LTS scores to modeled scores

We collected eighty-one (81) comment pins during the study time. These responses were analyzed collectively to assess the accuracy of LTS modeled scores. To do so, we calculated the difference between the modeled score and feedback scores such that a positive score suggested the model was rating stress to high and negative too low. We also divided the responses into 2 groups: 1) comments in areas where additional data was collected to support the predictive model (Full model – version 3), and 2) comments in areas where the model relied solely on NHDOT data provided in the roadways layer (Lite model – versions 1 and 2).

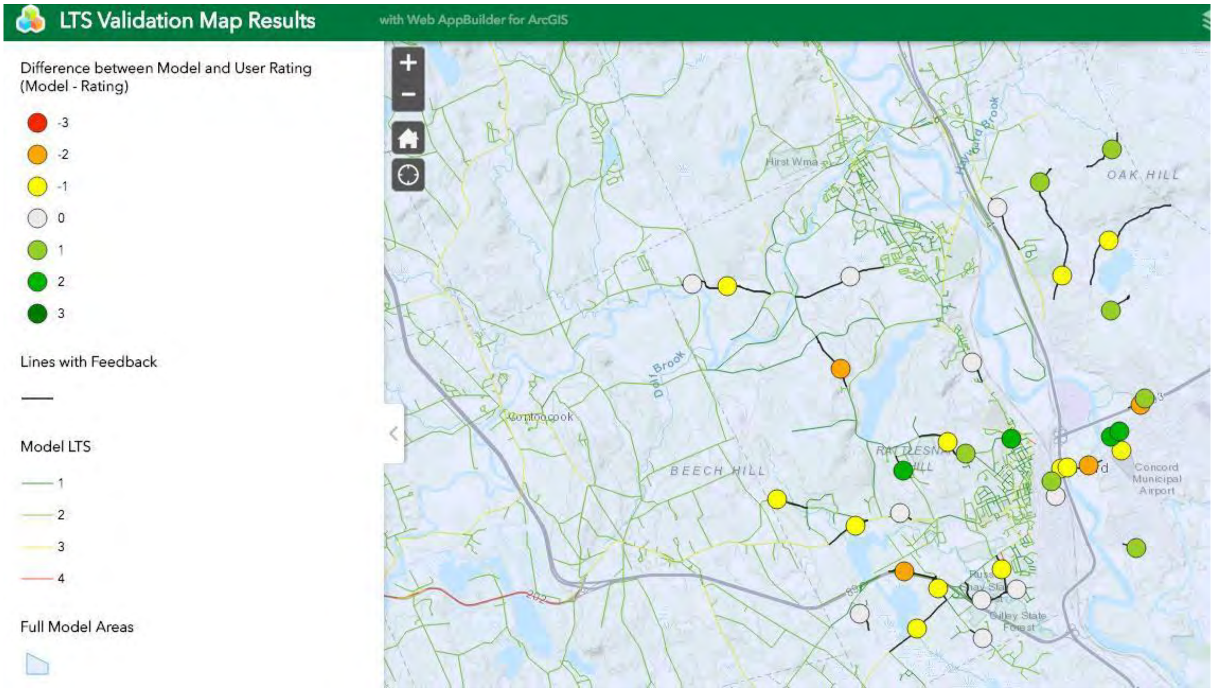


__Figure 22__: __ArcOnline Web Application of Comparison Results__ Comparative analysis results were shared with TAG through an ArcGIS online map.

More than 25% of the responses provided did not rate the roadway any more or less stressful than the LTS model, once it was updated in January 2019 due to some coding errors found during November TAG meeting. Nearly half of the responses suggested that the LTS model was underrating stress (Figure 23); however, when we examined this through the lens of the Lite and Full models, we found that nearly all response pins were snapped to a roadway with a LTS Lite model score (Figure 24)

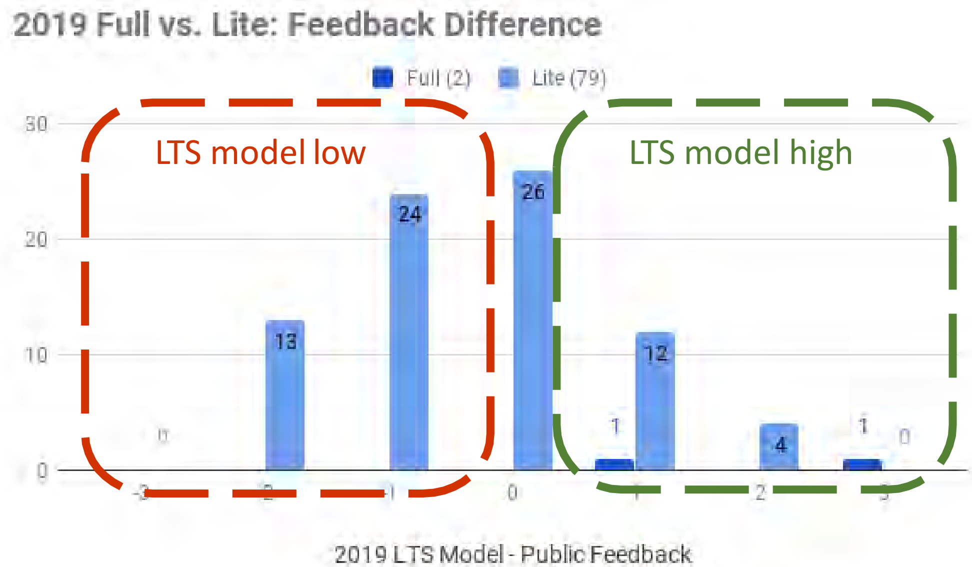


__Figure 23: LTS Feedback Comparison: Total Frequency__ Comparative analysis results suggest that the LTS model underestimated the level of stress for nearly half of the comment pins recorded.

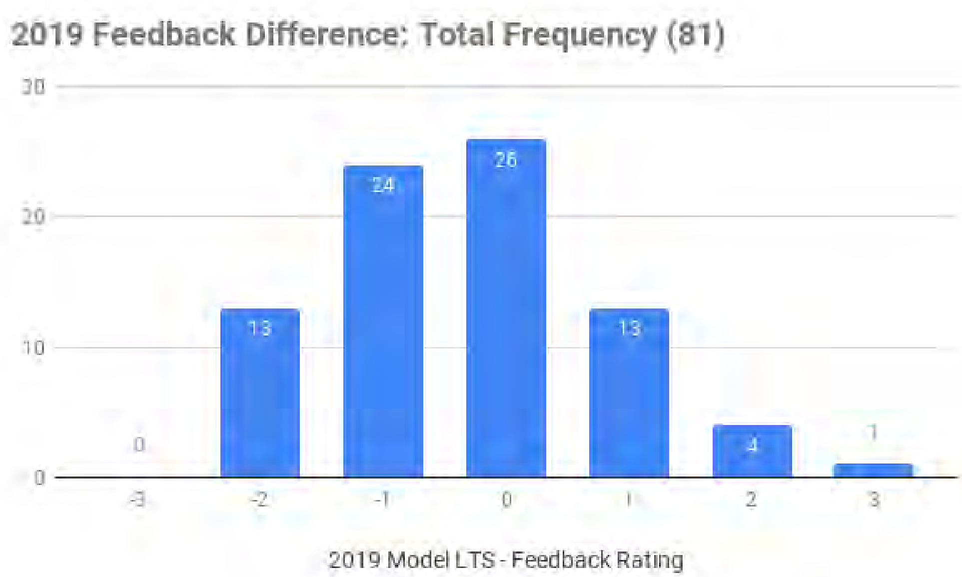


__Figure 24: LTS Feedback Difference: Full vs. Lite__ Comparative analysis of feedback from PPGIS mapping of LTS scores found that the majority of comments were made on roads with LTS scores predicted from V1 or V2 models that use only 2018 NHDOT roadways GIS layer data.

Assess the observed variability in terms of roadway attributes and summarize feedback shared by PPGIS respondents

We reviewed the public feedback with respect to the road tier (Tier 4-5 local roads and Tier 1-3 state and regional corridors) and found that all comments on Tier 4-6 roads were made on Lite model roads, and all but two comments were made on Tier 1-3 roads for which LTS was modeled using the basic NHDOT roadway characteristics (Figures 25 and 26, respectively). We also analyzed comments associated with the pins to evaluate the reason for disparity between modeled score and feedback score. Common comments related to shoulder width, speed, traffic volume, road condition, and bike infrastructure. We summarized the number of comments for each of the above attributes and describe these in the context of the model scores being higher (blue on right) or lower than feedback (red on left; Figure 27 and Table 9). As is noted in Table 9, there were several comments that contradicted the proposed LTS score. For example, there were three comments that stated the shoulder was wide, but also recommended a higher LTS score (i.e. suggesting it was more stressful than the modeled score).

Table 10 provides a summary of comments that corresponded with no proposed change to LTS layer (based on January 2019 update). We further analyzed the data to link roadways attributes, such as shoulder width and traffic volume, to the comments for which the LTS modeled score was lower than feedback. Two of the records that suggest the LTS model underrated stress on a road and cited road shoulder as being narrowed is documented by NHDOT as having an 8-10 feet shoulder (Figure 28), which is well above the LTS threshold of 4 feet being the equivalent of a bike lane. Eleven records based on the Lite model suggested that the shoulder was narrow and that the LTS model was underrating stress level. We suspect these may be on roads where speed and/or AADT suggested a lower LTS value. Interestingly, the majority of the pins cited heavy traffic volume as a rational for increasing the LTS score on Lite modeled roadways. Seven of the eight records that were on roads with 0 to 2000 AADT were actually below the 750 threshold set for minimal stress in LTS model V1 (Table 11).

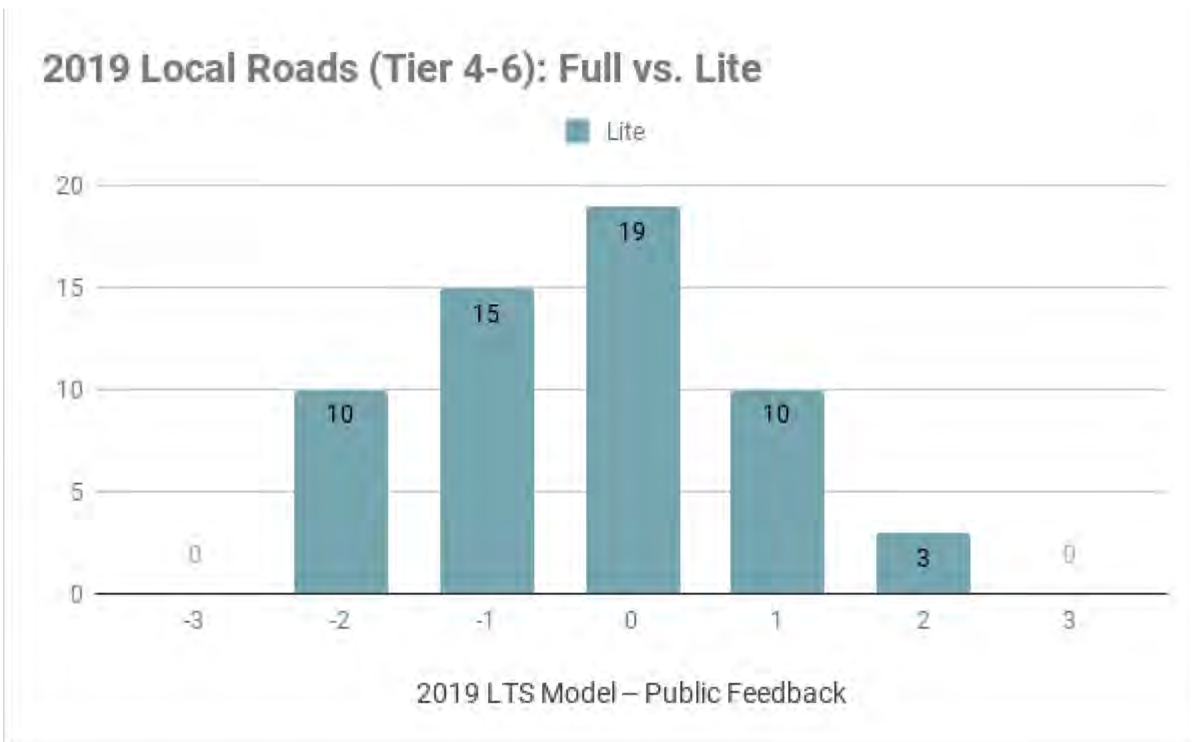


***Figure 25**: **Feedback Comparison of Local Roads by Model** Comparative analysis of feedback pins from PPGIS mapping of LTS scores found that the majority of comments suggested that the LTS model rated stress too high on Tier 4-6 roads.*

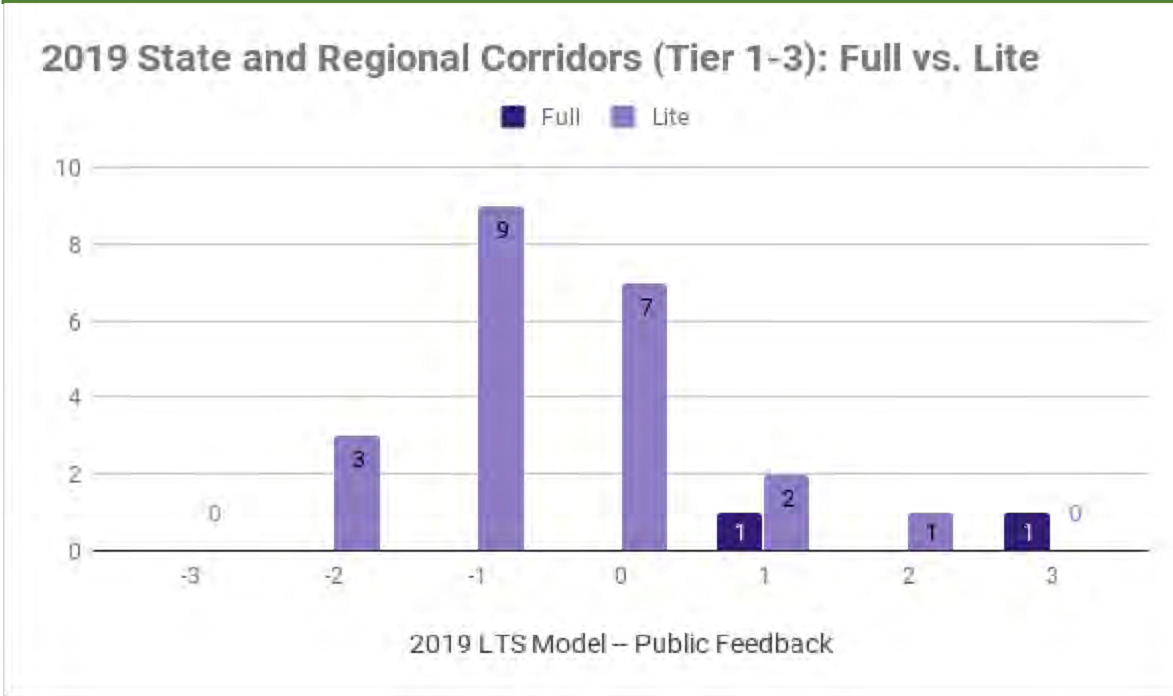


Figure 26: Feedback Comparison of State and Regional Corridors by Model *Comparative analysis of feedback pins from PPGIS mapping of LTS scores found that the majority of comments suggested that the LTS model rated stress too high on Tier 1-3 roads.*

Table 9: LTS Feedback Overview of Comments *Overview of all comments provided during public feedback period. As noted with *, some responses contradicted the proposed change to LTS score. Columns shaded blue refer to those for which the LTS score suggestion was lower than the model (with the exception of those with *). Columns in red refer to those for which the LTS score suggestion was higher than the model (with the exception of those with *).*

Model and Rating Difference	High Speed	Narrow Shldr	High Traffic	Dang. Grade	Road Conditions	Low Speed	Wide Shldr	Low Traf.	BikeInf.
LTS Full- Low (-)	0	0	0	0	0	0	0	0	0
LTS Full- High (+)	1*	1*	1*	0	0	0	0	0	1
LTS Lite - Low (-)	11	11	14	2	4	1*	3*	4*	1*
LTS Lite - High (+)	0	1*	0	0	0	1	2	7	2

Table 10: LTS Feedback Comments with "No Difference". *Frequency of comments that were provided along LTS ratings that did not differ from updated modeled LTS scores.*

"No Difference" Feedback (Model-Rating = 0)									
	High Speed	Narrow Shoulder	High Traffic	Dangerous Grade	Road Conditions	Low Speed	Wide Shoulder	Low Traffic	Bike Infrastructure
LTS Full (15)	1	1	1	2	1	1	1	7	0
LTS Lite (6)	1	0	0	2	1	0	0	0	2

Table 11: AADT of Segments with "High Traffic" Comments. *Summary of actual AADT values of segments with comments noting "High Traffic" with AADT less than 2000.*

"High Traffic" comments with AADT < 2000		
AADT	Full	Lite
0	-	1
499	-	3
523	-	2
563	-	1
1103	-	1

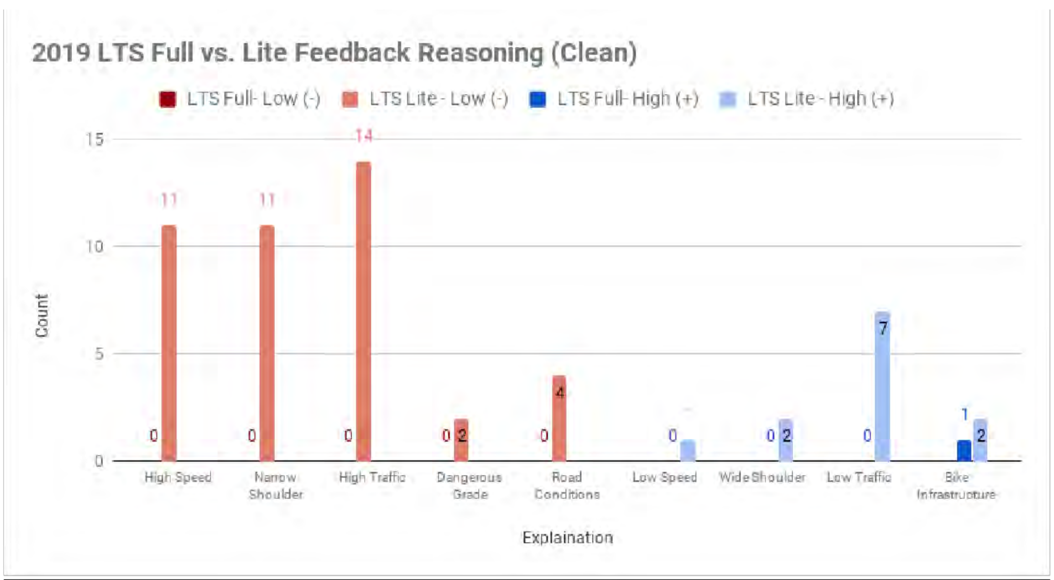


Figure 27: LTS Feedback Comments by LTS Rating Difference and Model. *Comparison of responses summarized by whether the model over or under estimate LTS and by the rationale behind the suggested revision. This excludes records for which there was no difference between the modeled LTS score and the feedback provided, and records where the comment contradicted the LTS rating.*

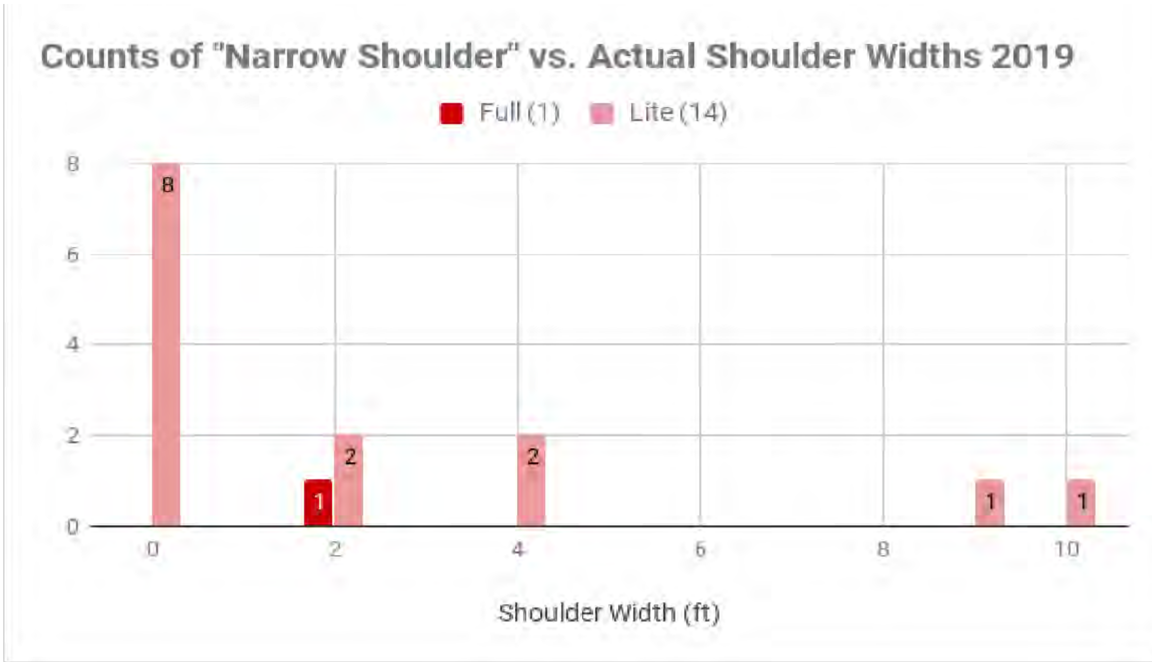


Figure 28: Counts of "Narrow Shoulder" vs. Actual Shoulder Widths. *Summary of "Narrow Shoulder" comments distributed by the NHDOT recorded widths in 2018 roadways GIS layer.*

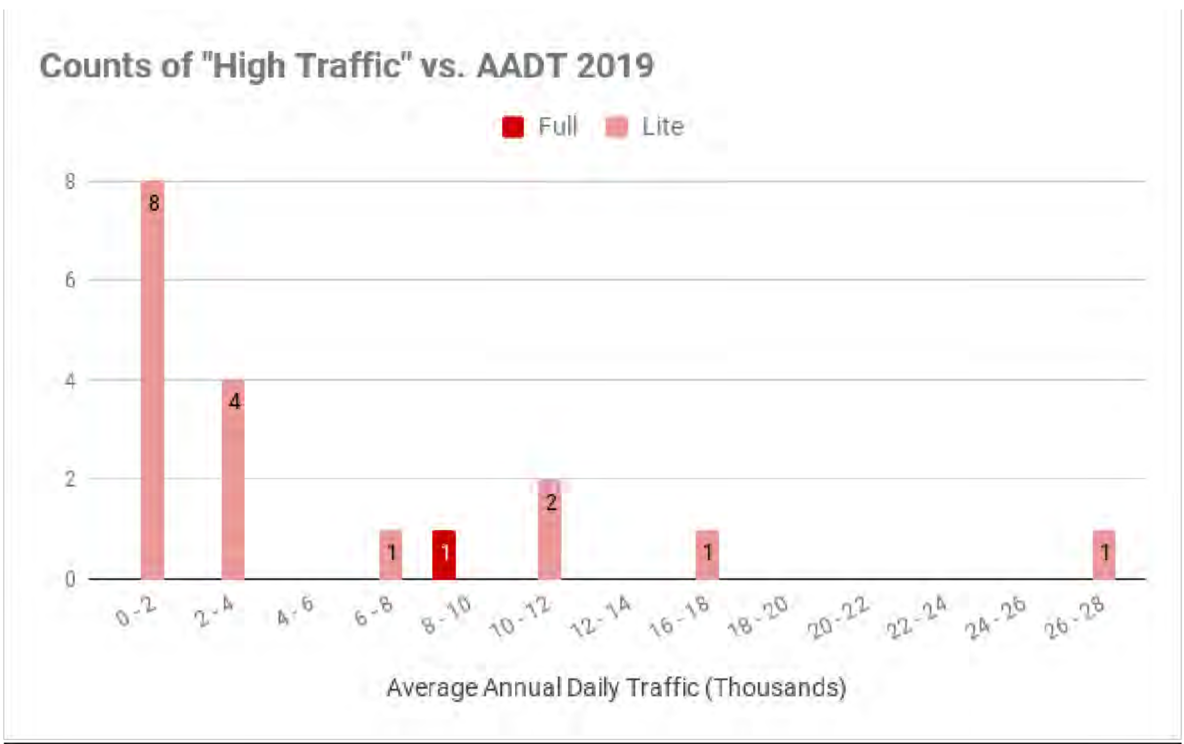


Figure 29: Counts of "High Traffic" vs. AADT *Summary of "High Traffic" comments distributed by the NHDOT recorded widths in 2018 roadways GIS layer.*

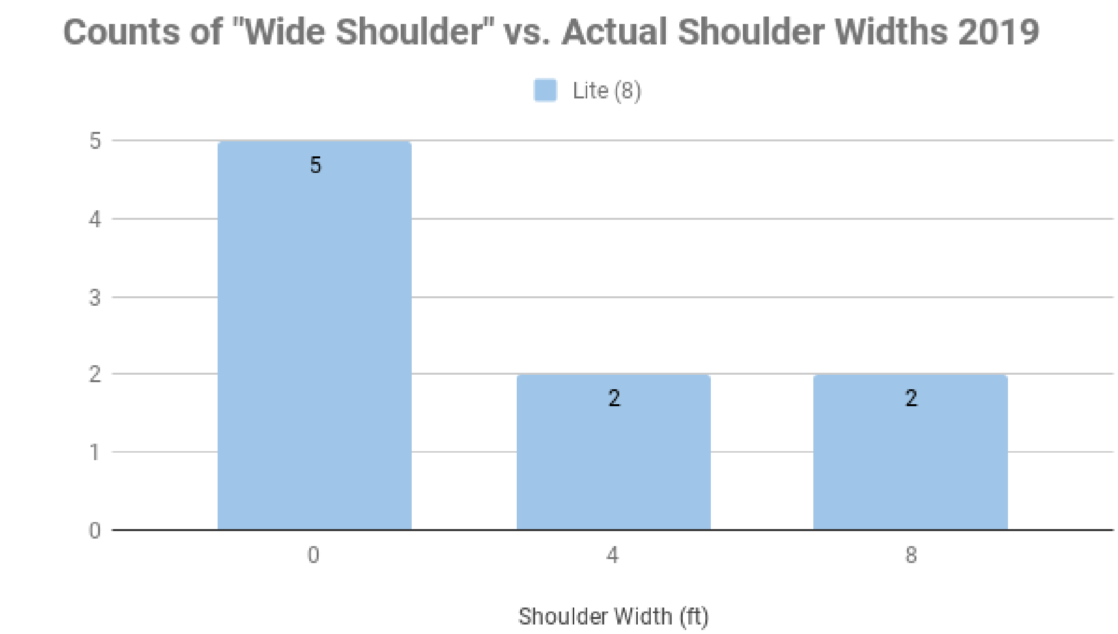


Figure 30: Counts of "Wide Shoulder" vs. Actual Shoulder Widths. *Summary of "Wide Shoulder" comments distributed by the NHDOT recorded 2018 roadways GIS layer.*

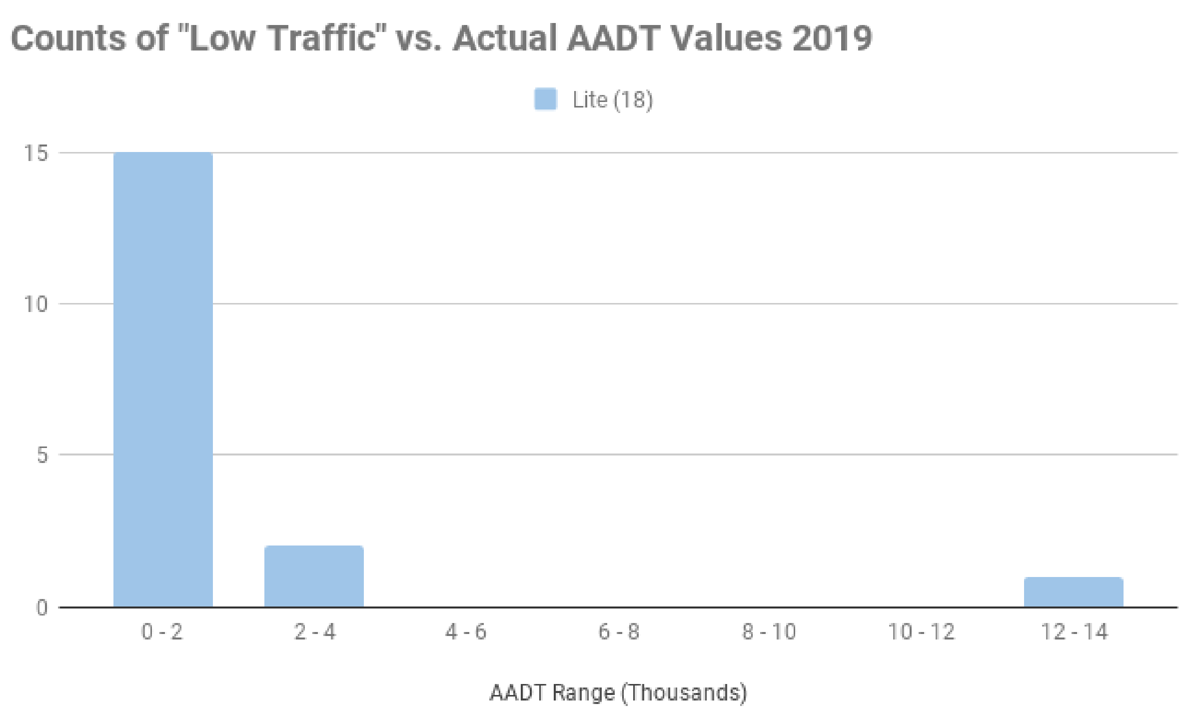


Figure 31: Counts of "Low Traffic" vs. Actual AADT Values. *Summary of "Low Traffic" comments distributed by the NHDOT recorded widths 2018 roadways GIS layer.*

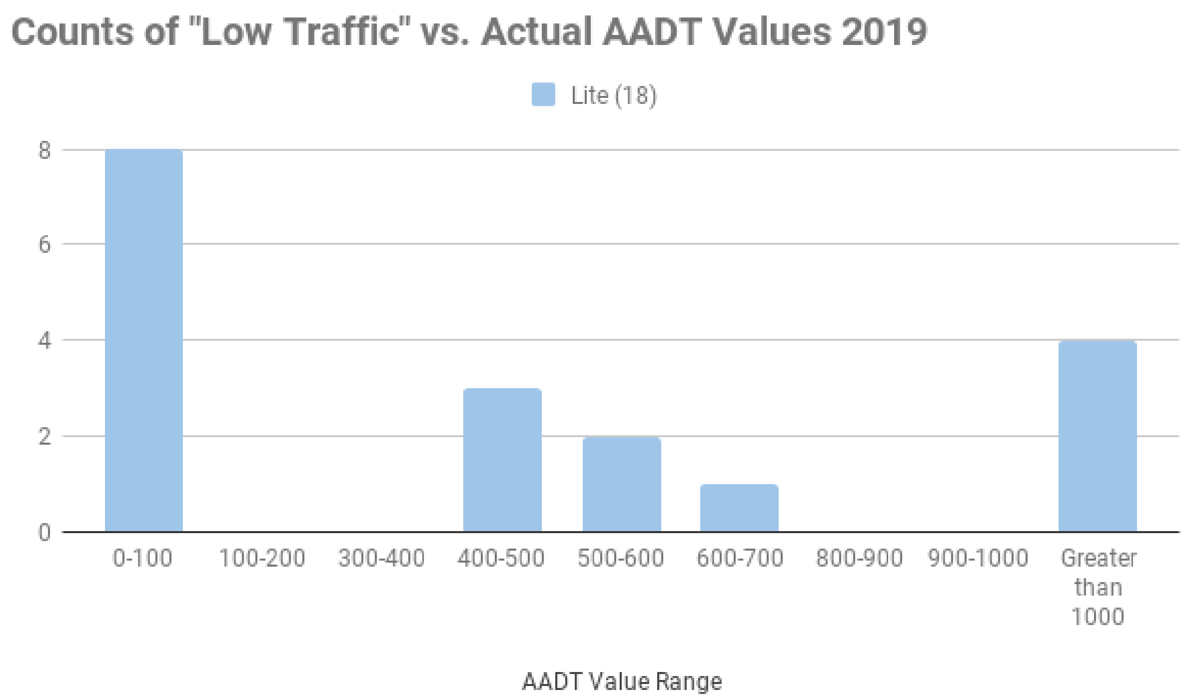


Figure 32: Counts of "Low Traffic" vs. Actual AADT Values. *Summary of "Low Traffic" comments distributed by the NHDOT recorded widths in 2018 roadways GIS layer, with a fine resolution within 0 to 1000 AADT.*

3. Recommendations

This project has yielded a suite of data-driven metrics that can be used assess bicycling patterns and bikeability of NH roads and to evaluate the potential benefits derived from proposed bike-ped projects in order to prioritize. Throughout the process, we have noted recommendations for future study and data collection and sharing. We organize these into two focal areas: assessing bicycling patterns and modeling the level of bicycling stress of roadways. In addition, we emphasize the need for a statewide, standardized approach for assessing bicycling patterns and modeling the level of traffic stress. Throughout the project we have learned of disparate efforts to collect and analyze data to be used as a performance metric. We hope that the products of this three-year project will help standardize the calculation of these metrics to enhance the ability of NHDOT, along with RPCs and municipalities, to make informed decisions regarding project prioritization

Assessing bicycling patterns

This project attempted to use Strava data as an indicator of bicycling activity. Based on limited comparisons to on-the-ground bicycle counts conducted by NH's regional planning commissions, we concluded that Strava reported trips were not a reliable proxy (2014-16). We suspect this is largely attributed to the low frequency of Strava use for day-to-day cycling throughout the state. While we expect the use of this mobile app to increase over time, it will still likely be biased to recreation and training rides (on road and off) unless there are outreach efforts to promote the public use of the app as a means of providing feedback to NHDOT for bike enhancement planning purposes. Such a promotion could be routed through social media, schools, bike shops, cycling clubs, bicycling advocacy groups, etc. throughout the state.

Currently, on-the-ground counters are a much better source of data for measuring bicycling patterns, therefore we suggest that the number and frequency of automated bike counters increase via increased NHDOT support to the RPCs and municipalities. While they tend to be placed in high traffic areas, they should also be established in areas of interest. For example, in order to better understand bicycling patterns within underserved populations, counters should be deployed in communities that reflect these demographics. The NH Social Vulnerability index can be used to identify monitoring priorities.

We also recommend Public Participatory GIS or alternative public outreach efforts that enable public to document where they currently ride, where they would like to ride, and what barriers currently exist preventing biking. Unlike like Strava, which only documents those currently riding, these efforts could also be used to prioritize investments in bicycle-friendly facilities. The results from our PPGIS efforts suggest that there are additional roadway attributes that contribute to perceived stress (e.g. pavement condition, slope). We note these in Table 12 below.

Modeling Level of Traffic Stress

We have found that mapping the level of traffic stress that a bicyclist will experience on every roadway in New Hampshire is challenging on multiple fronts. While we have relied heavily on frameworks developed by leaders in the field (e.g. Mecuria and Furth), these frameworks have largely been designed for urbanized areas. We have adapted theses frameworks to better suit all of NH (urban and rural), but have been limited in terms of easy to access and accurate data inputs. The table below provides a list of roadway attributes that would improve the model and its predictive accuracy. Our goal has been to develop a NH specific framework and create tools that can be used annually to update the LTS for all roadways. However, using a single set of inputs, rather than those collected by numerous people over long periods of time, would streamline the process and increase the accuracy and therefore our confidence in the LTS data for planning and measuring performance over time.

Table 12: Data Improvements- Roadway Attributes. *Summary of roadway attributes needed to enhance the predictive accuracy of LTS modeling throughout NH.*

Attribute	Improvement sought	Current source
Posted speed	Integrate speed limit data into NH roads GIS layer for each road segment	A separate GIS point file exists to map the location of speed limit signs, but assumptions need to be made between posted signs
Prevailing speed	Integrate *prevailing* speed limit data into NH roads GIS layer for each road segment	Prevailing speed can be calculated in few areas by RPCs with on-the-ground vehicular monitoring.
Cul-de-Sacs (no outlet)	Integrate a field that can be used to select no outlet roads, including cul-de-sacs. Alternatively, these roadways could be identified if prevailing speed data was available, posted speed was lower than other local roads, or AADT reflected low traffic volume compared to other local roads	Not available. We have manually selected roadway records and created a new field to note these low stress segments that, based solely on default town speed and AADT, are consider low to moderate stress.
Parking lane width	Measure and integrate into NH roads GIS layer for each road segment	Not available. We have conducted visual assessments using ArcGIS aerial imagery basemaps to measure width and created a new field in roads layer

Table 12 Continued

Attribute	Improvement sought	Current source
Biking lane width	Measure and integrate into NH roads GIS layer for each road segment	Not available. We have conducted visual assessments using ArcGIS aerial imagery basemaps to measure width and created a new field in roads layer
Limited access	Integrate a field that clearly identifies roadways with limited access to bicycles	Not available. We have tried to use a combination of keywords in multiple fields, but having a single field would be clearer
Turning lanes	Integrate into NH roads GIS layer for each road segment	Not currently integrated into the analysis and not collected during manual data collection
Road slope	Integrate into NH roads GIS layer for each road segment	Not currently integrated into the analysis due to the data processing needed to note directionality of roadways
Pavement condition or year	Integrate into NH roads GIS layer for each road segment	Not currently integrated into the analysis and not collected during manual data collection
Road Shoulder Width	Increase accuracy and confidence in existing data	NHDOT road GIS layer
Road Shoulder Type	Increase accuracy and confidence in existing data and more detail regarding "combo"	NHDOT road GIS layer

Conclusion

In conclusion, we recommend that NHDOT begin efforts to enhance accessibility to and connectivity across a low-stress bicycling network throughout New Hampshire. This process should focus on identifying high use (or desired use) areas via analyses such as the centrality analysis presented herein. This will require a stronger understanding of from where and to where bicyclists want to bike. This necessitates an in-depth and diversified assessment of key bicycling destinations and identification of populations in the greatest need of access. We recommend using the concepts and analytical techniques of access and centrality demonstrated within this report to prioritize investment throughout the state. While these techniques are effective approaches, they require standardized, consistent, and accurate data inputs. Thus, we recommend that NHDOT make strides to enhance data accuracy and availability while also standardizing the process by which performance metrics are calculated across the state.

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Appendices

APPENDIX A

Priority Destinations
- ATHLETIC/REC FACILITY
- COMMUNITY FACILITY
- ESSENTIAL CITY FACILITY
- GROCERY STORE
- HOSPITAL
- LIBRARY
- PLACE OF WORSHIP
- POST OFFICE
- RETAIL/SHOPPING AREA
- SCHOOL
- SMALLER MARKET
- TRAIL ACCESS POINT

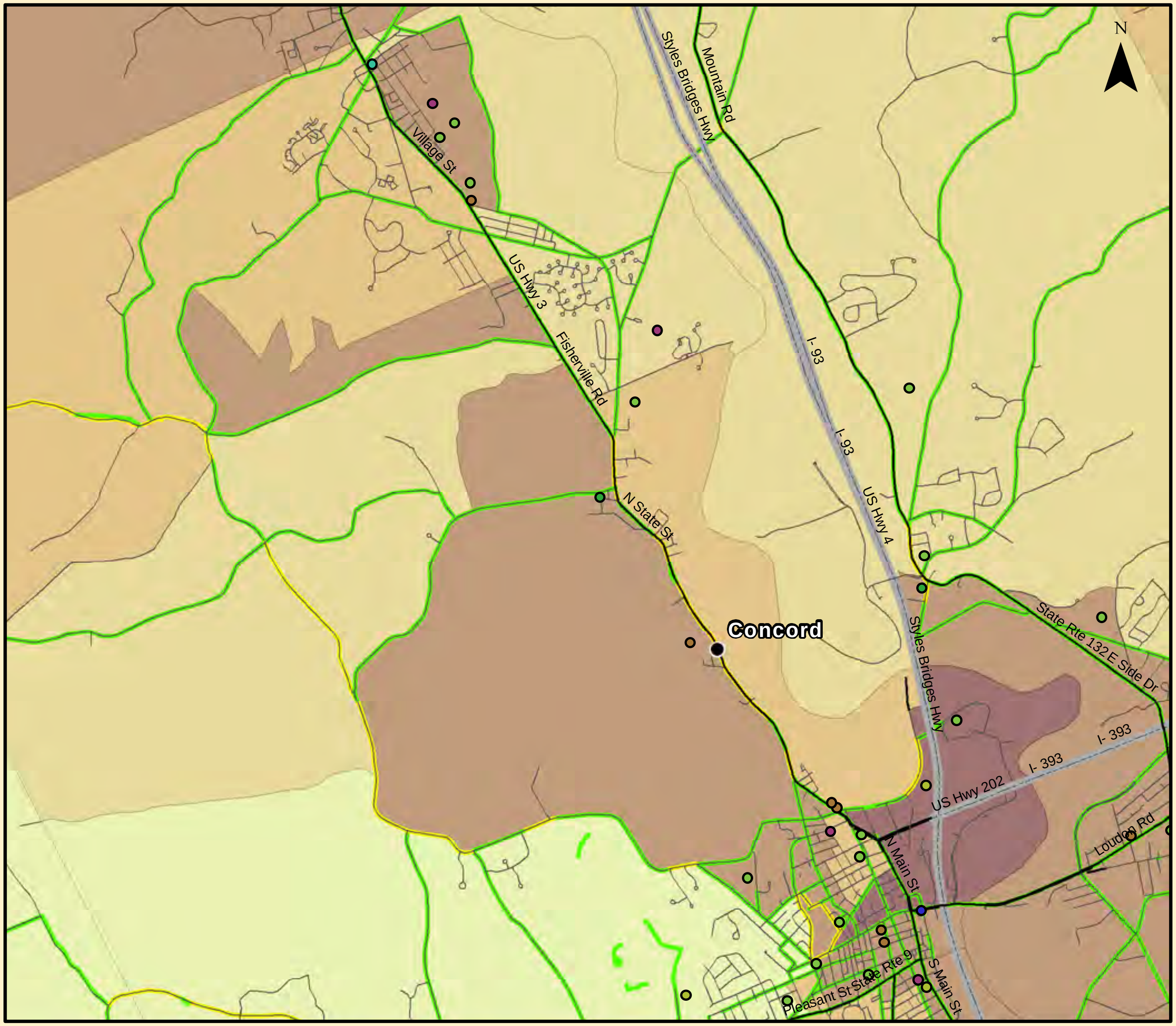
Population
- 100,000 - 499,999
- 50,000 - 99,999
- 10,000 - 49,999
- Under 10,000

Road Class
- Primary Road
- Secondary Road
- Local Road

Total Unique Cyclists Per Segment
- 1 - 30
- 31 - 120
- 121 - 300
- 301 - 500
- 501 - 1185

Central NH RPC
- Boundary

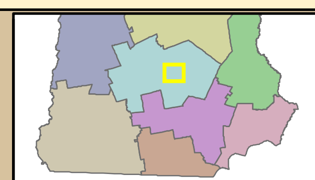
Census Block Groups - Median Income
- $90,000 - 150,000
- $70,000 - $90,000
- $51,932 - 69,999
- Low-Income Community
- Lowest Income Community



Central NH Regional Planning Commission

Fisherville Road, Concord

Complete Streets Road Improvements



0 0.25 0.5 1 1.5 2 Miles

1:62,500

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

Priority Destinations
- ATHLETIC/REC FACILITY
- COMMUNITY FACILITY
- ESSENTIAL CITY FACILITY
- GROCERY STORE
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- LIBRARY
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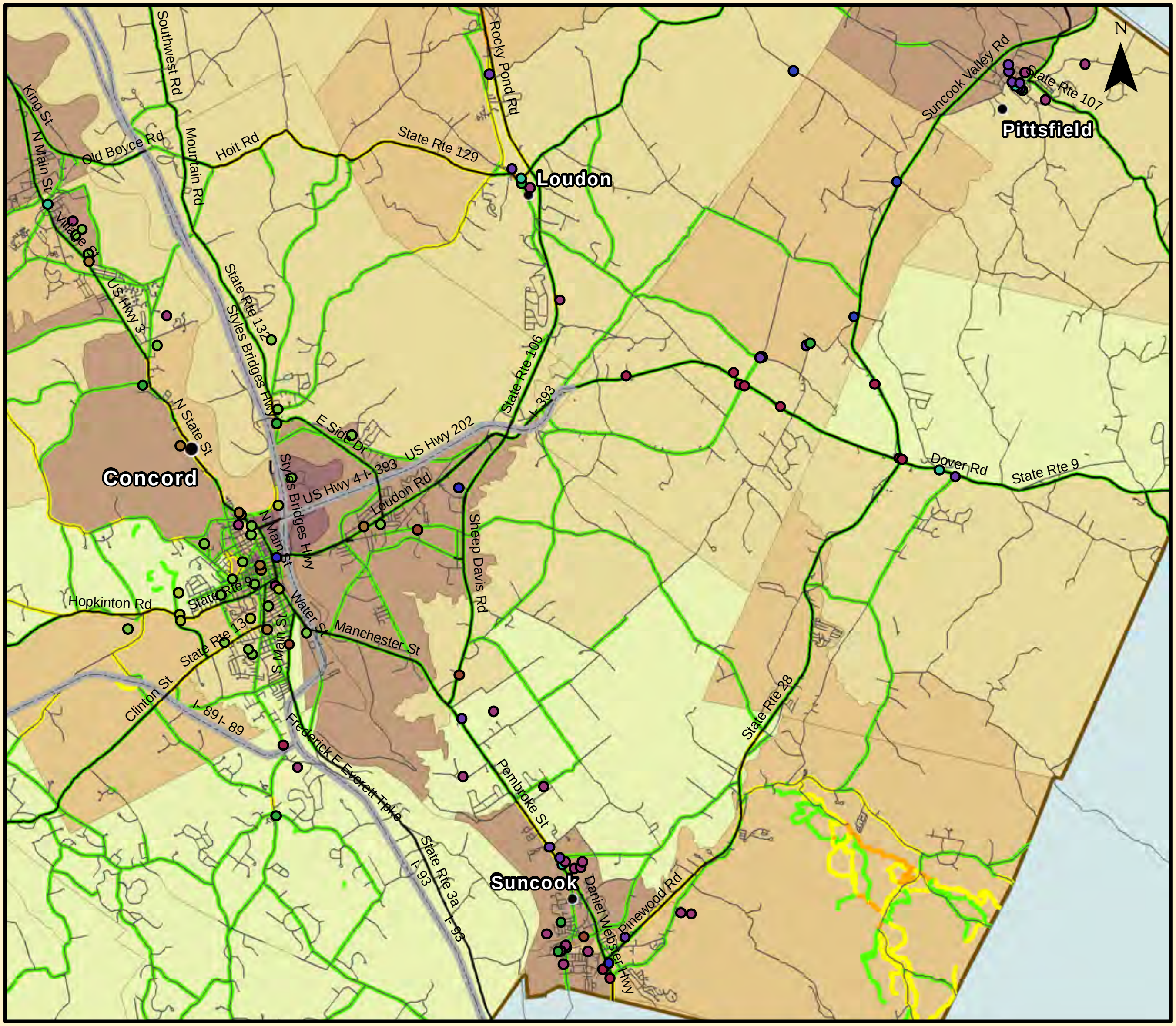
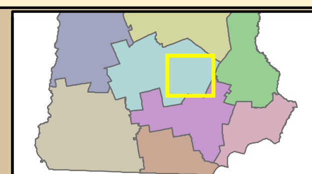


Central NH Regional Planning Commission
Concord, Loudon, Suncook, Pittsfield
Key Destinations



0 0.75 1.5 3 4.5 6 Miles

1:150,000

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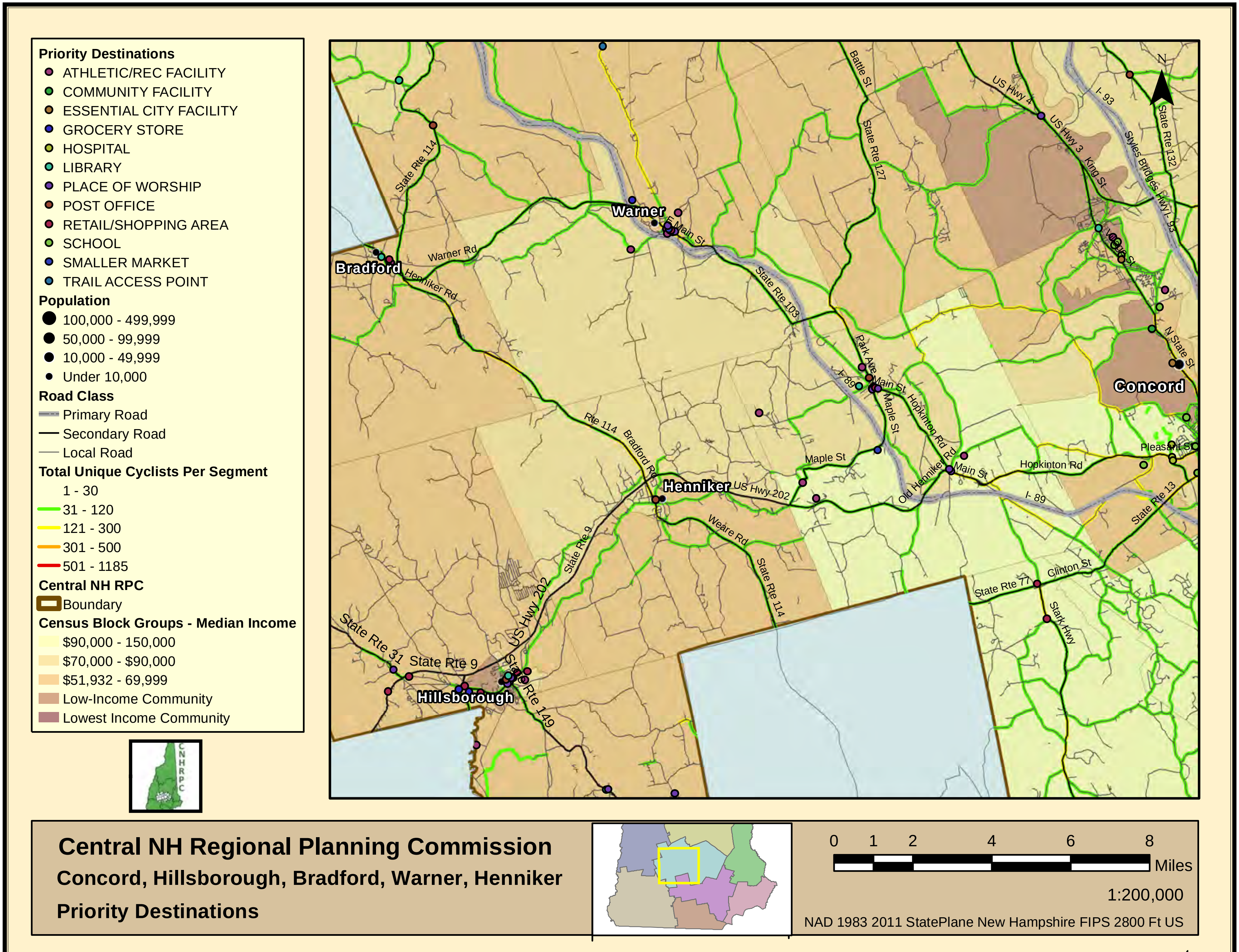
Priority Destinations
ATHLETIC/REC FACILITY
COMMUNITY FACILITY
ESSENTIAL CITY FACILITY
GROCERY STORE
HOSPITAL
LIBRARY
PLACE OF WORSHIP
POST OFFICE
RETAIL/SHOPPING AREA
SCHOOL
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Population
100,000 - 499,999
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Road Class
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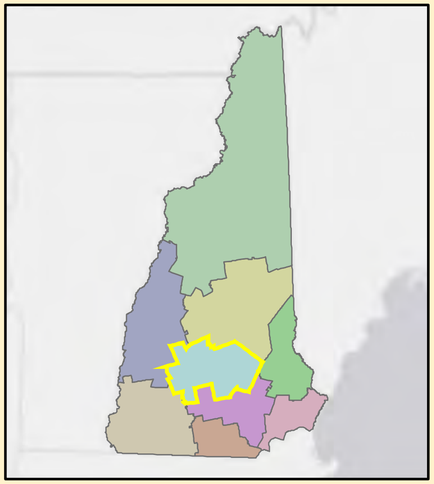
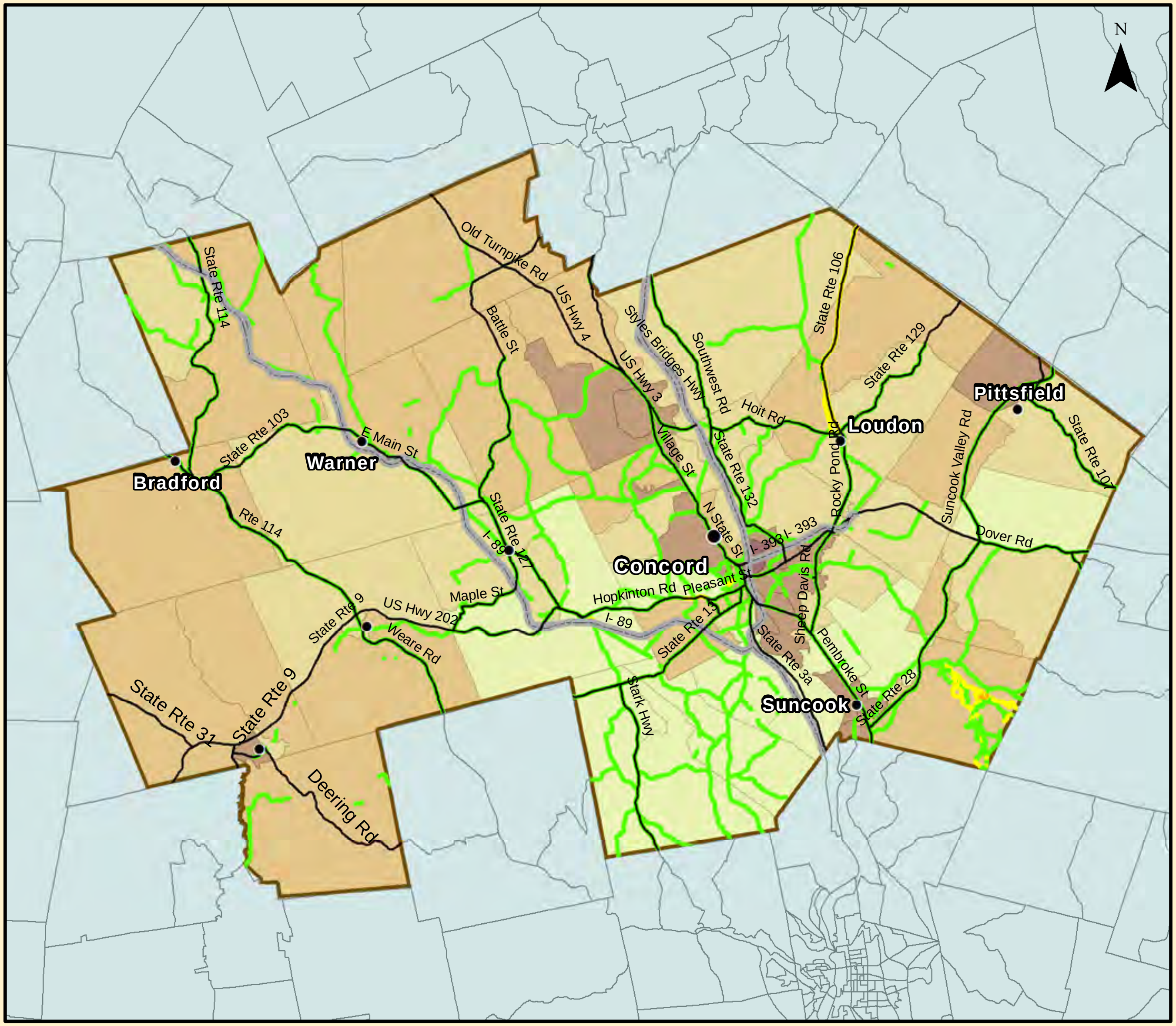
501 - 1185
Central NH RPC
Boundary
Census Block Groups - Median Income
$90,000 - 150,000
$70,000 - $90,000
$51,932 - 69,999
Low-Income Community
Lowest Income Community
CNHRPC
Warner
Bradford
Henniker
Hillsborough
Concord
Warner Rd
Henniker Rd
State Rte 114
E Main St
State Rte 103
Battle St
State Rte 127
US Hwy 4
US Hwy 3
I- 93
King St
Styles Bridges Hwy/I- 93
State Rte 132
N State St
Park Ave
I- 89
Main St
Maple St
Hopkinton Rd
Rte 114
Bradford Rd
US Hwy 202
Weare Rd
Old Henniker Rd
Pleasant St
State Rte 13
State Rte 77
Clinton St
Stark Hwy
State Rte 9
State Rte 31
State Rte 149
N
Central NH Regional Planning Commission
Concord, Hillsborough, Bradford, Warner, Henniker
Priority Destinations
0 1 2 4 6 8
Miles
1:200,000
NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US





Population
- 100,000 - 499,999
- 50,000 - 99,999
- 10,000 - 49,999
- Under 10,000

Road Class
- Primary Road
- Secondary Road

Total Unique Cyclists Per Segment
- 1 - 50
- 51 - 170
- 171 - 350
- 351 - 700
- 701 - 1185

Central NH RPC
- Boundary

Census Block Groups - Median Income
- $90,000 - 150,000
- $70,000 - $90,000
- $51,932 - 69,999
- Low-Income Community
- Lowest Income Community

Central NH Regional Planning Commission

Overview

CNHRPC

0 2.25 4.5 9 13.5 18 Miles

1:400,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

Population
- 100,000 - 499,999
- 50,000 - 99,999
- 10,000 - 49,999
- Under 10,000

Priority Destinations
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- 501 - 1185

Lakes Region Planning Commission
- Boundary

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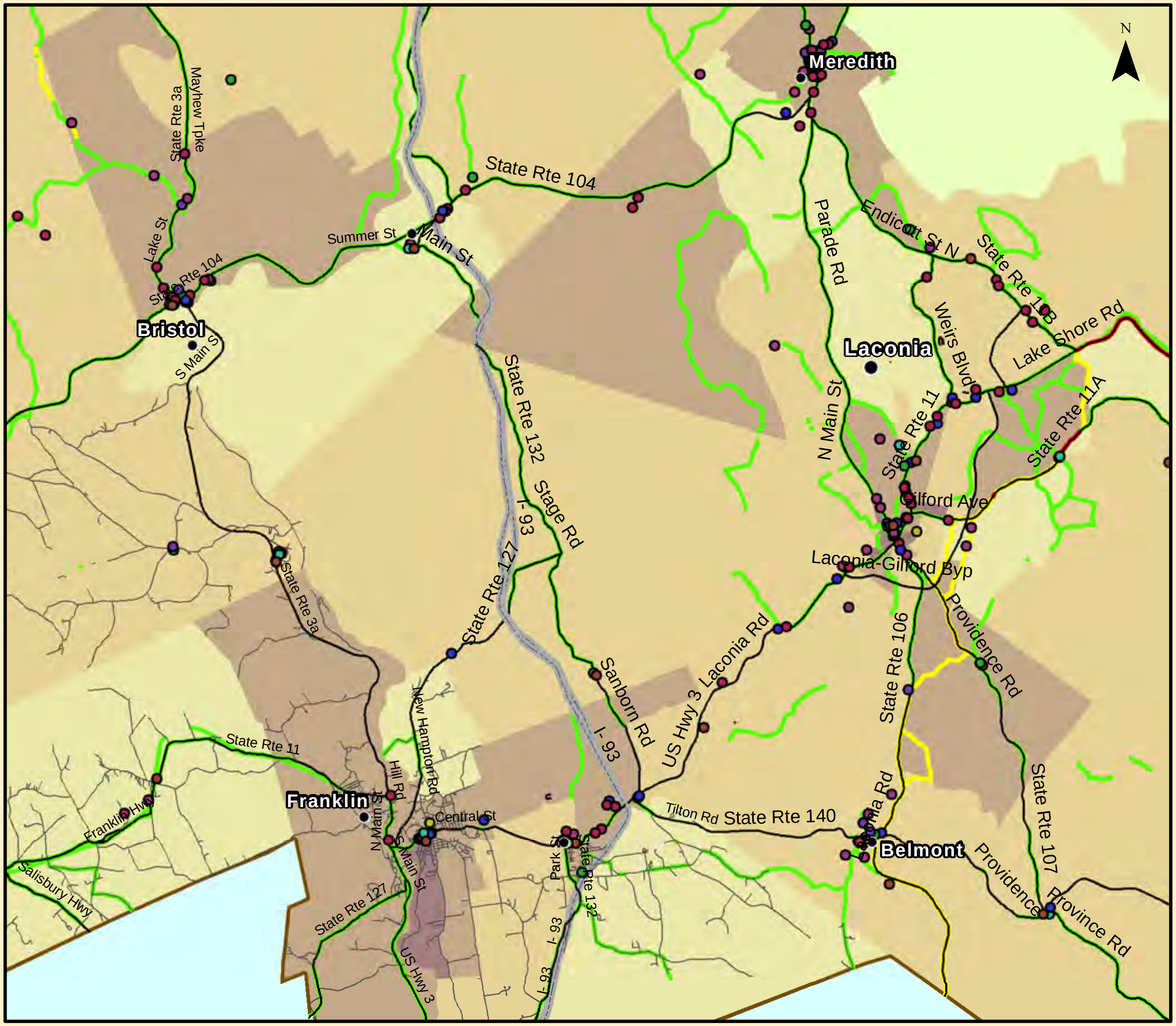
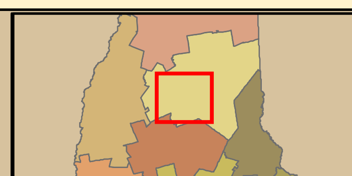
- Lowest Income Community



Lakes Region Planning Commission

Laconia, Meredith,Bristol, Franklin, Belmont

Key Destinations



0 1 2 4 6 8 Miles

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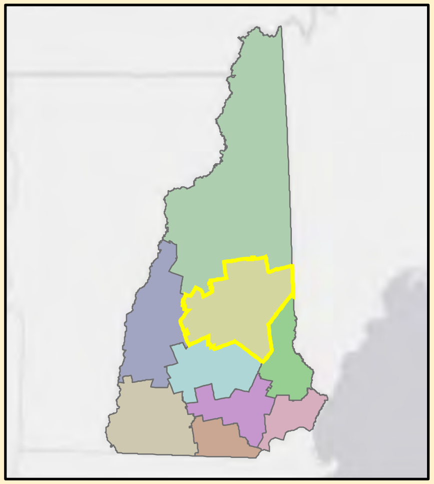
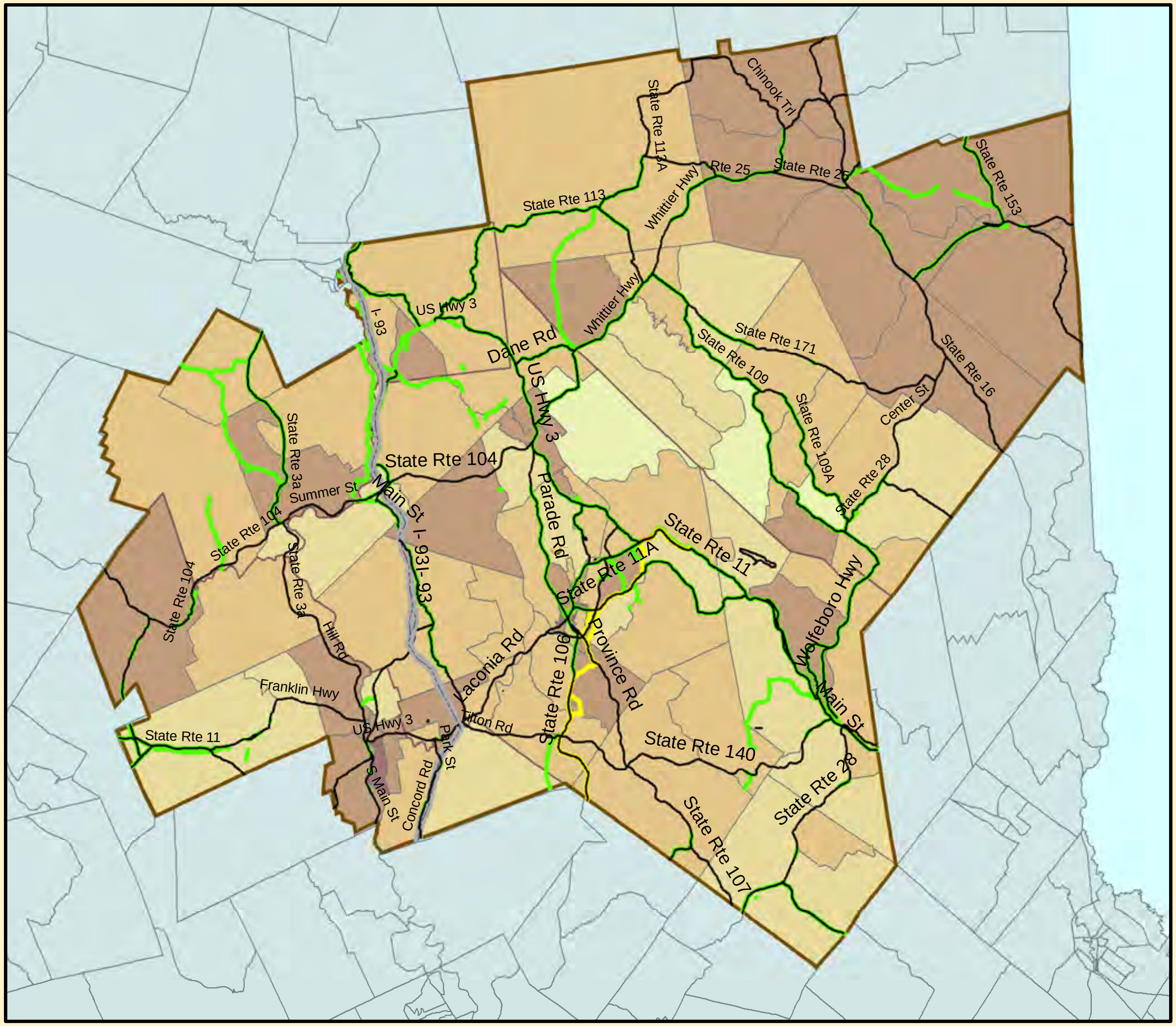
NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US





Population
- 100,000 - 499,999
- 50,000 - 99,999
- 10,000 - 49,999
- Under 10,000

Road Class
- Primary Road
- Secondary Road

Total Unique Cyclists Per Segment
- 1 - 50
- 51 - 170
- 171 - 350
- 351 - 700
- 701 - 1185

Lakes Region Planning Commission
- Boundary

Census Block Groups - Median Income
- $90,000 - 150,000
- $70,000 - $90,000
- $51,932 - 69,999
- Low-Income Community
- Lowest Income Community

Lakes Region Planning Commission

Overview

0 3 6 12 18 24 Miles

1:500,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

N

Population
- 100,000 - 499,999
- 50,000 - 99,999
- 10,000 - 49,999
- Under 10,000

Priority Destinations
- ATHLETIC/REC FACILITY
- COMMUNITY FACILITY
- ESSENTIAL CITY FACILITY
- GROCERY STORE
- HOSPITAL
- LIBRARY
- PLACE OF WORSHIP
- POST OFFICE
- RETAIL/SHOPPING AREA
- SCHOOL
- SMALLER MARKET
- TRAIL ACCESS POINT

Road Class
- Primary Road
- Secondary Road
- Local Road

Total Unique Cyclists Per Segment
- 1 - 30
- 31 - 120
- 121 - 300
- 301 - 500
- 501 - 1185

Lakes Region Planning Commission
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Census Block Groups - Median Income
- $90,000 - 150,000
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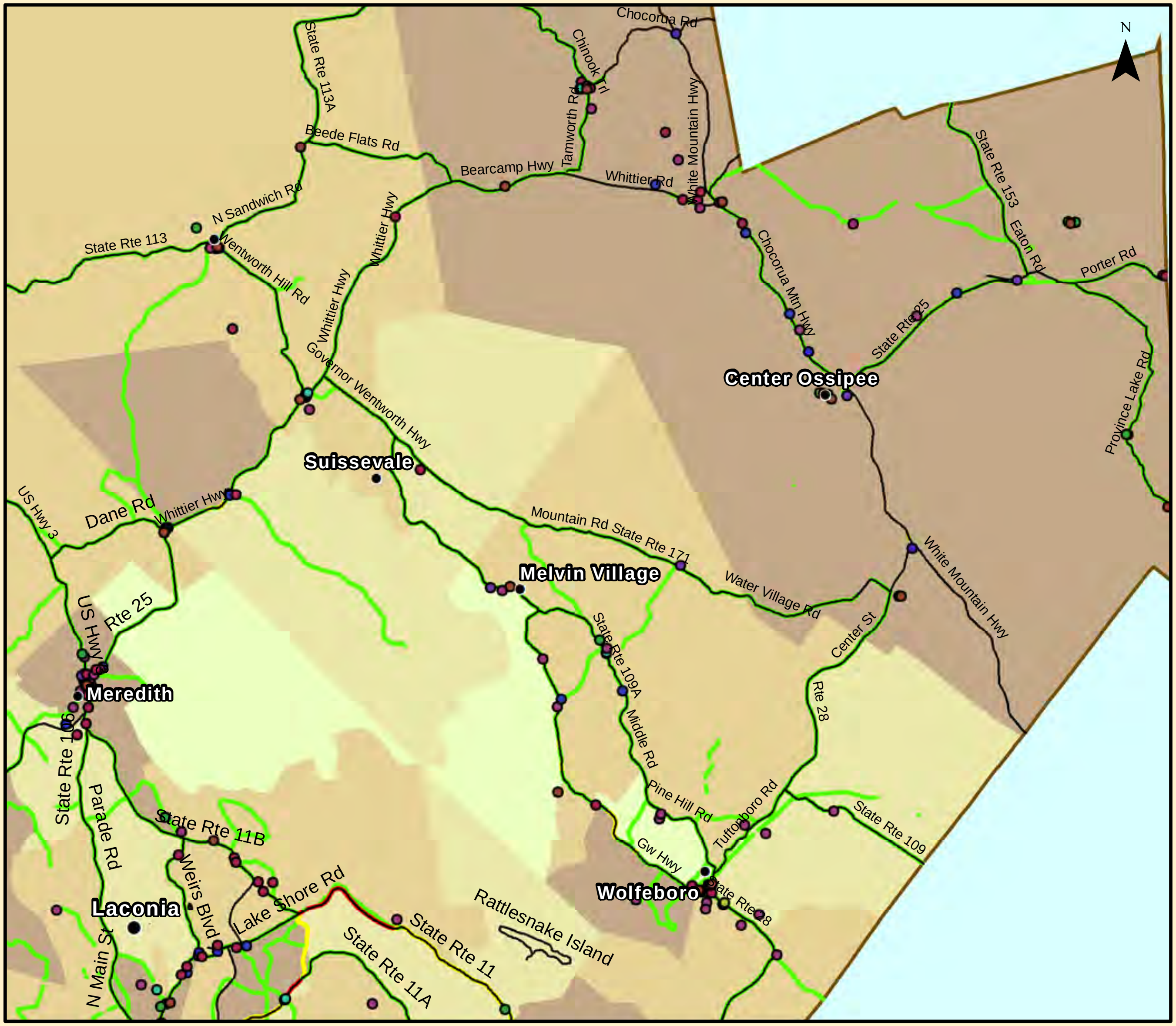
- Lowest Income Community

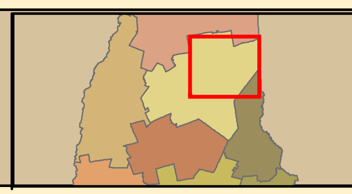
L · R · P · C



Lakes Region Planning Commission

Ossipee, Suissevale, Melvin Village, Wolfeboro

Key Destinations



0 1.5 3 6 9 12 Miles

1:250,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

Priority Destinations
- ATHLETIC/REC FACILITY
- COMMUNITY FACILITY
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- GROCERY STORE
- HOSPITAL
- LIBRARY
- PLACE OF WORSHIP
- POST OFFICE
- RETAIL/SHOPPING AREA
- SCHOOL
- SMALLER MARKET
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- 100,000 - 499,999
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- 10,000 - 49,999
- Under 10,000

Road Class
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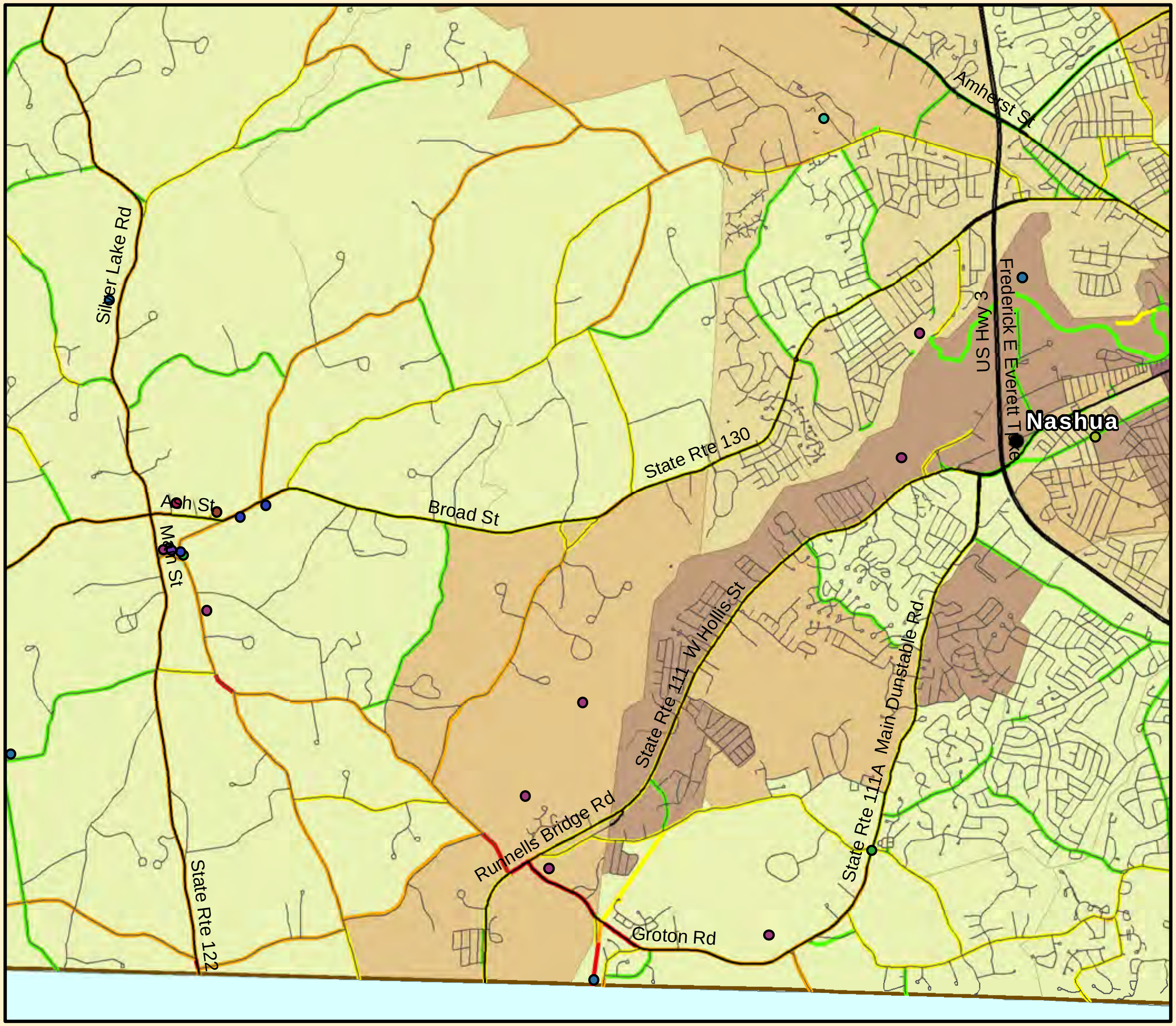
- Secondary Road
- Local Road

Total Unique Cyclists Per Segment
- 1 - 30
- 31 - 80
- 81 - 200
- 201 - 400
- 401 - 1185

Nashua Regional Planning Commission
- Boundary

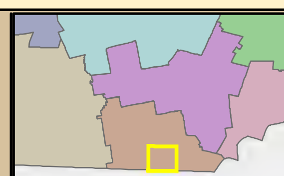
Census Block Groups - Median Income
- $90,000 - 150,000
- $70,000 - $90,000
- $51,932 - 69,999
- Low-Income Community
- Lowest Income Community

NRPC



Nashua Regional Planning Commission

Hollis-Nashua Rt. 130 Connectivity



0 0.375 0.75 1.5 2.25 3 Miles

1:62,500

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

N

Priority Destinations

- ATHLETIC/REC FACILITY
- COMMUNITY FACILITY
- ESSENTIAL CITY FACILITY
- GROCERY STORE
- HOSPITAL
- LIBRARY
- PLACE OF WORSHIP
- POST OFFICE
- RETAIL/SHOPPING AREA
- SCHOOL
- SMALLER MARKET
- TRAIL ACCESS POINT

Population

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Nashua Regional Planning Commission

- Boundary

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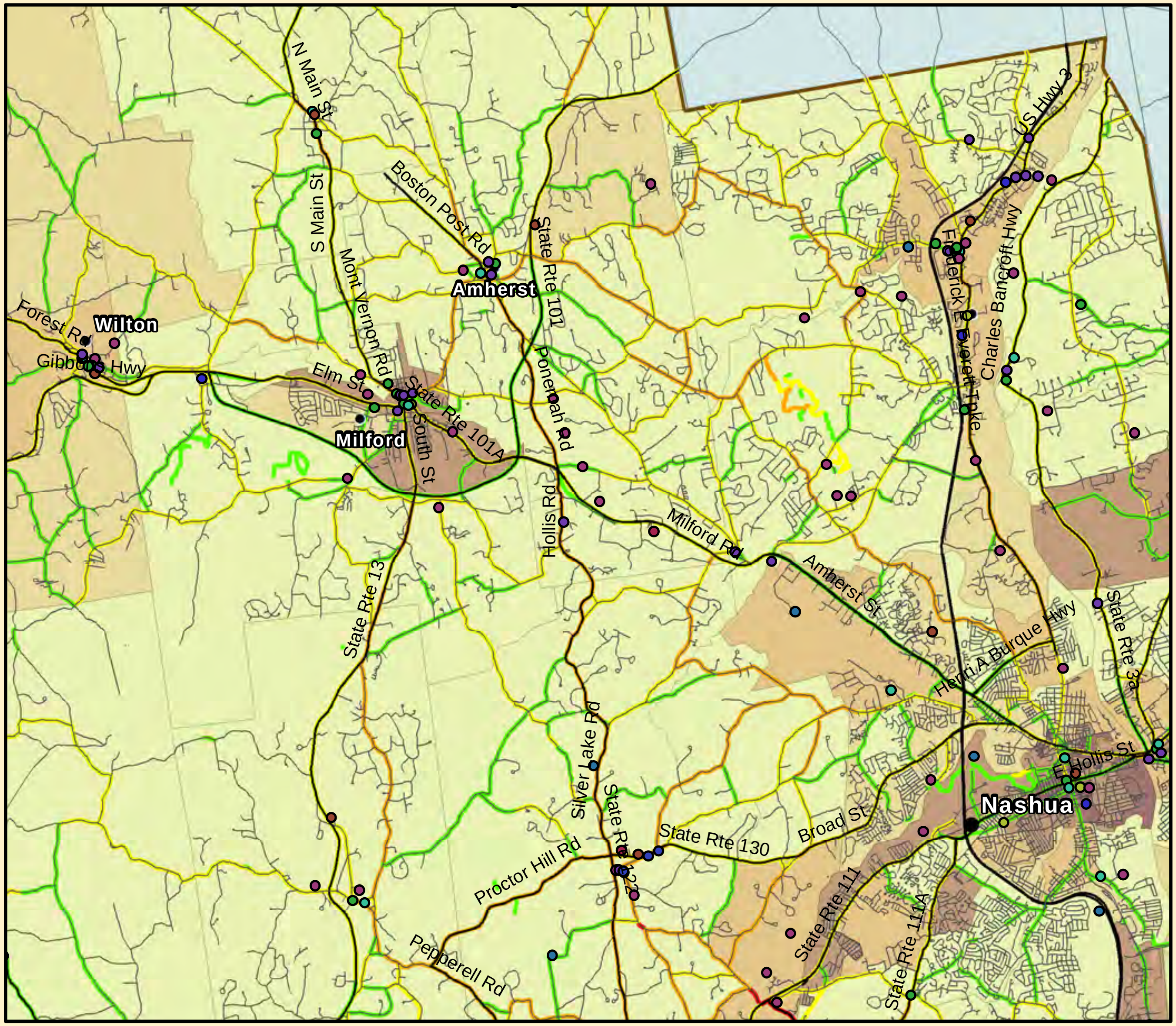
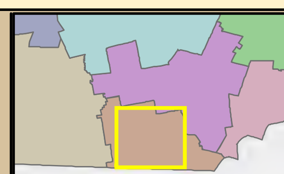
NRPC



Nashua Regional Planning Commission

Wilton, Milford, Amherst, Nashua



0 0.75 1.5 3 4.5 6 Miles

1:150,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

N

Priority Destinations
- ATHLETIC/REC FACILITY
- COMMUNITY FACILITY
- ESSENTIAL CITY FACILITY
- GROCERY STORE
- HOSPITAL
- LIBRARY
- PLACE OF WORSHIP
- POST OFFICE
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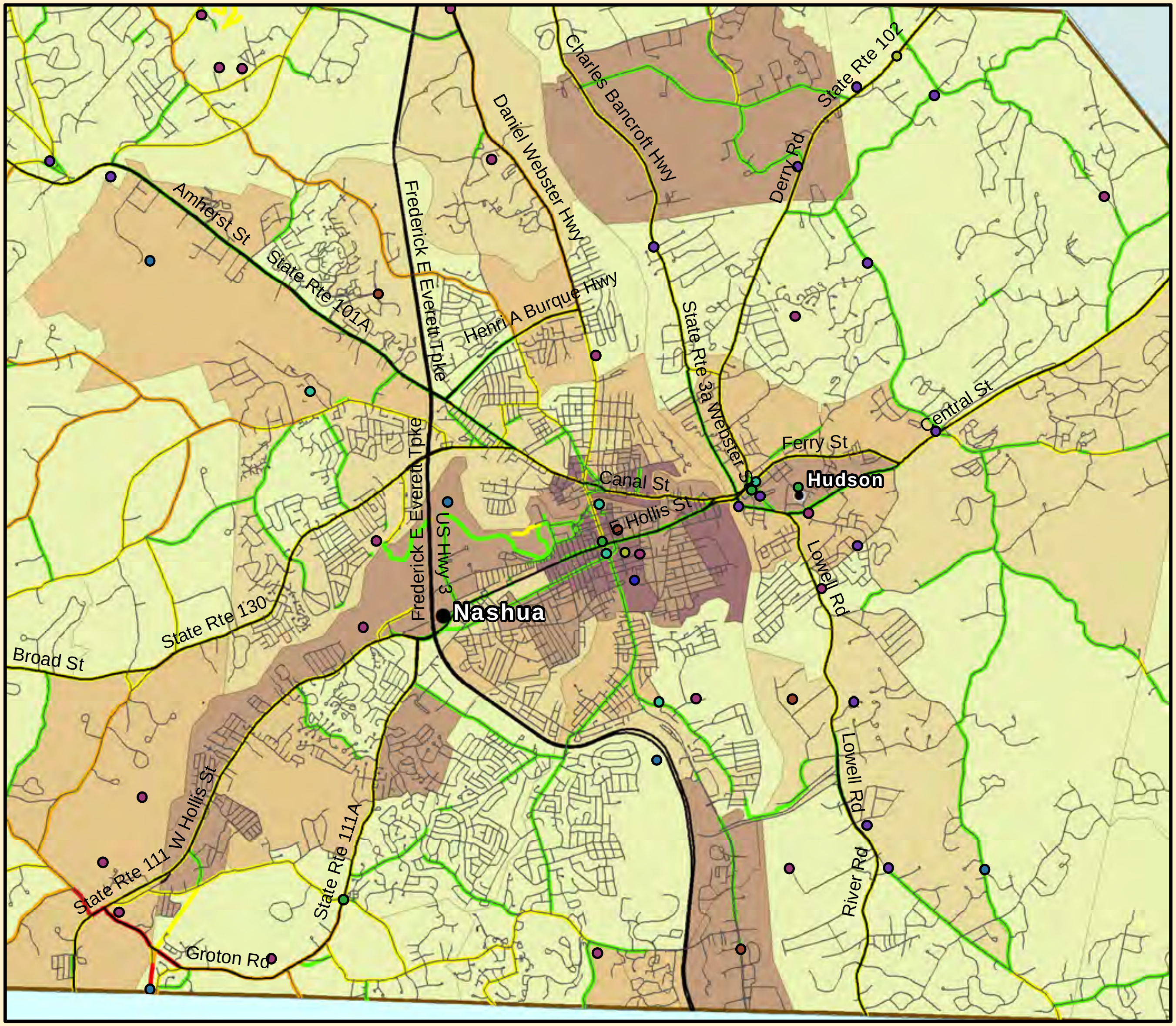
NRPC



Nashua Regional Planning Commission

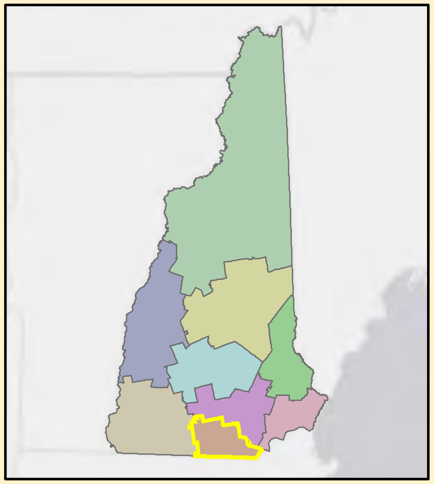
Nashua Connectivity Assessment

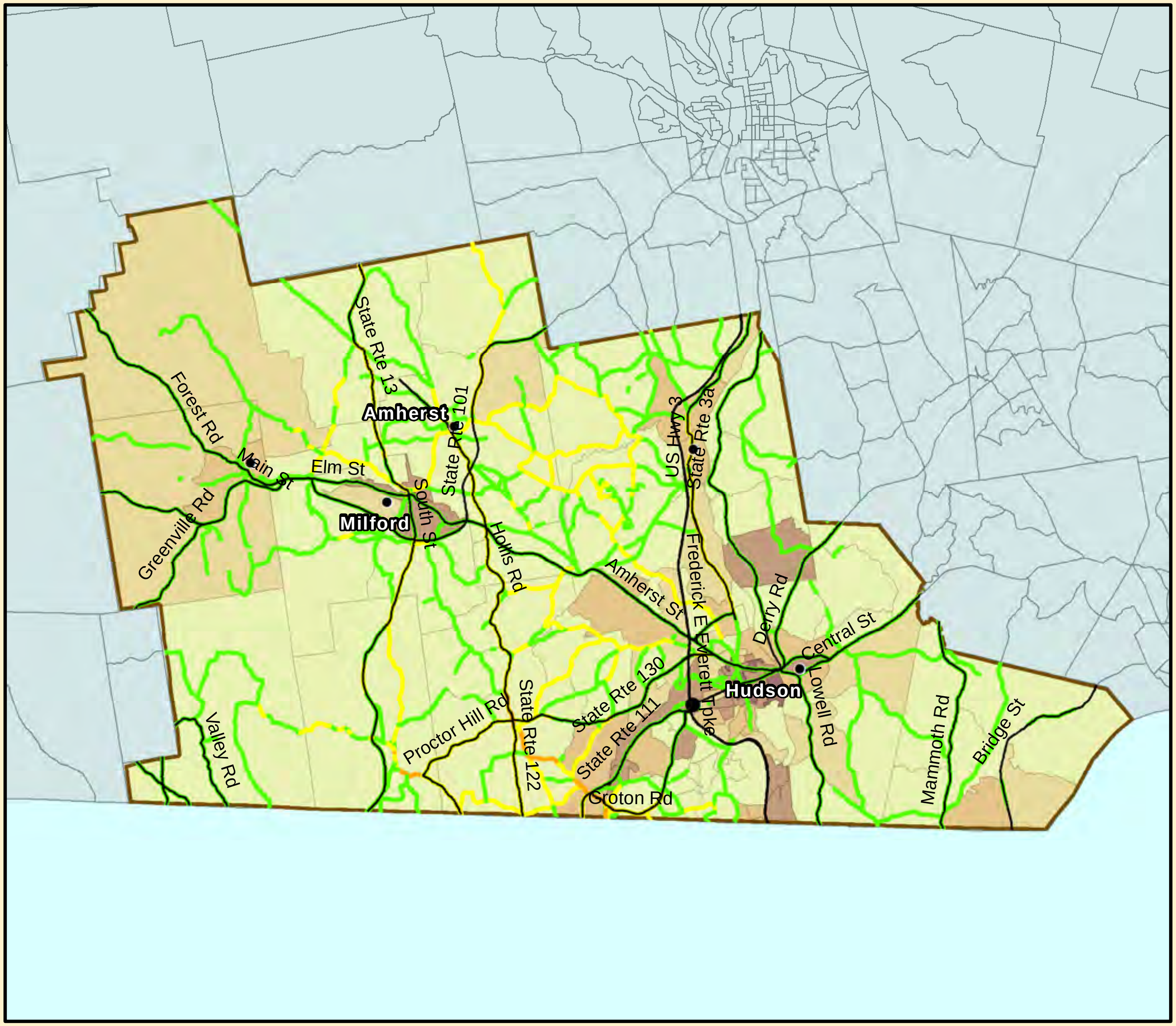
0 0.5 1 2 3 4 Miles

1:90,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

N





Population
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- 10,000 - 49,999
- Under 10,000

Road Class
- Primary Road
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Total Unique Cyclists Per Segment
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Nashua Regional Planning Commission
- Boundary

Census Block Groups - Median Income
- $90,000 - 150,000
- $70,000 - $90,000
- $51,932 - 69,999
- Low-Income Community
- Lowest Income Community

Nashua Regional Planning Commission
Overview

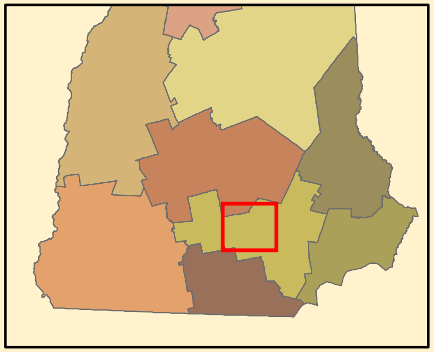
NRPC

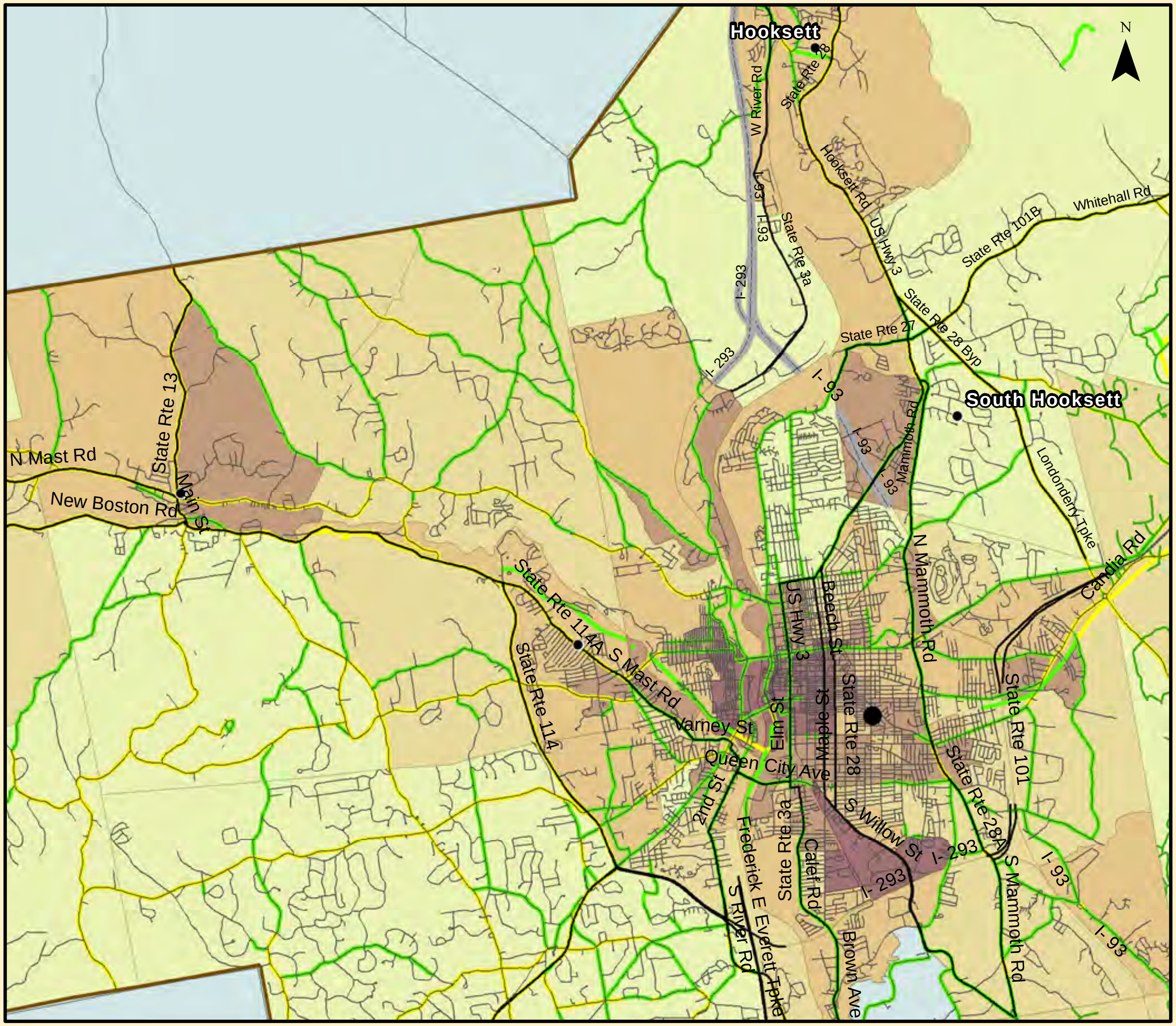
0 1.75 3.5 7 10.5 14 Miles

1:300,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

N





Population
- 100,000 - 499,999
- 50,000 - 99,999
- 10,000 - 49,999
- Under 10,000

Southern NH Planning Commission
- Boundary

Road Class
- Primary Road
- Secondary Road
- Local Road

Total Unique Cyclists Per Segment
- 1 - 30
- 31 - 80
- 81 - 350
- 351 - 700
- 701 - 1185

Census Block Groups - Median Income
- $90,000 - 150,000
- $70,000 - $90,000
- $51,932 - 69,999
- Low-Income Community
- Lowest Income Community

SNHPC

Southern NH Planning Commission

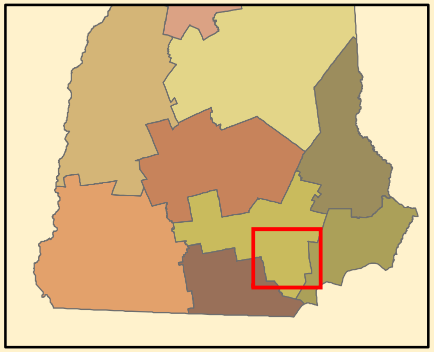
Manchester, Goffstown, Hooksett

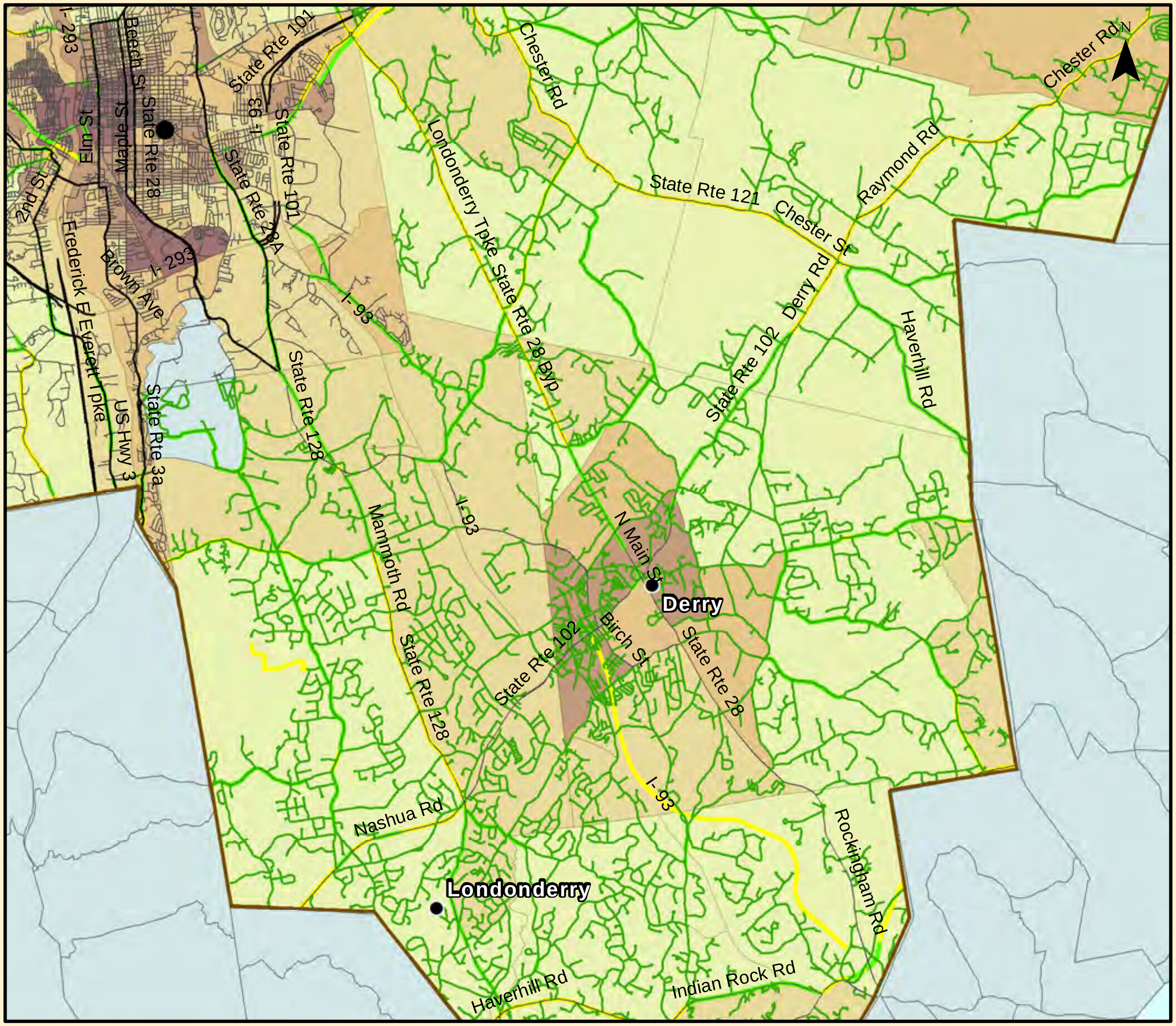
Connectivity Assessment

0 0.5 1 2 3 4 Miles

1:120,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US





Population

- 100,000 - 499,999
- 50,000 - 99,999
- 10,000 - 49,999
- Under 10,000

Southern NH Planning Commission

- Boundary

Road Class

- Primary Road
- Secondary Road
- Local Road

Total Unique Cyclists Per Segment

- 1 - 70
- 71 - 100
- 101 - 350
- 351 - 700
- 701 - 1185

Census Block Groups - Median Income

- $90,000 - 150,000
- $70,000 - $90,000
- $51,932 - 69,999
- Low-Income Community
- Lowest Income Community

Southern NH Planning Commission

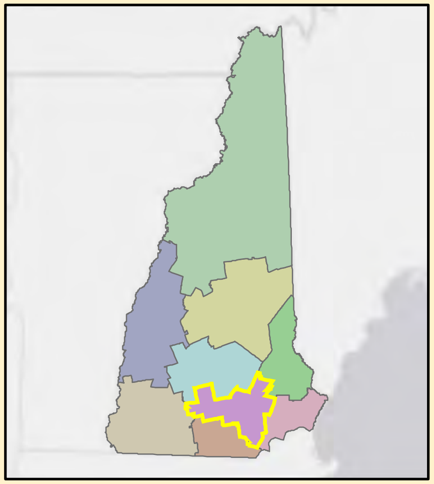
Manchester, Derry, Londonderry

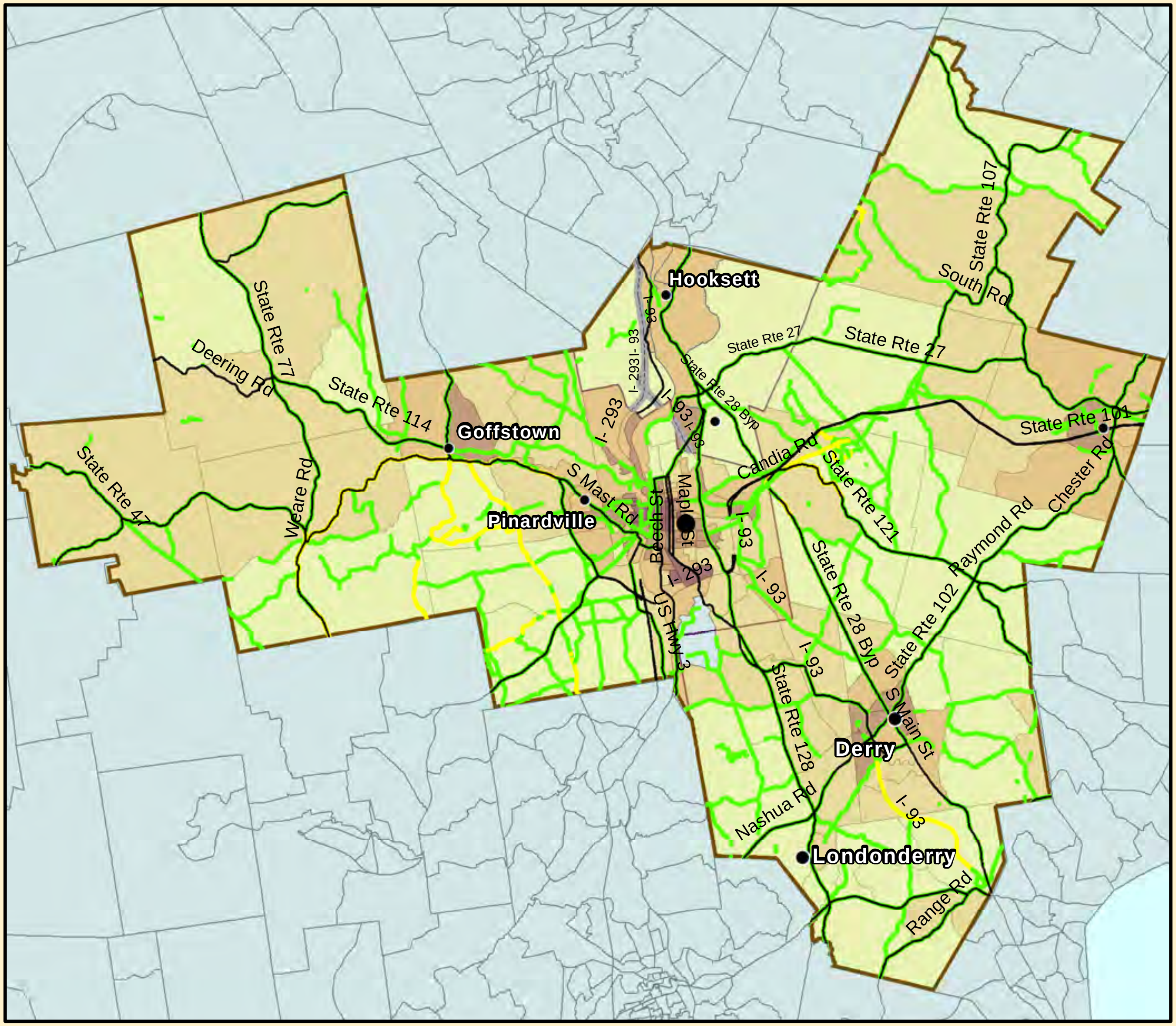
Connectivity Assessment

0 0.75 1.5 3 4.5 6 Miles

1:150,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US





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Southern NH Planning Commission
- Boundary

Census Block Groups - Median Income
- $90,000 - 150,000
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Southern NH Planning Commission
Overview

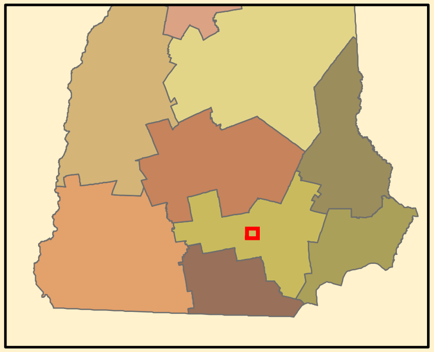
SNHPC

0 2 4 8 12 16 Miles

1:350,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

N



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Southern NH Planning Commission
- Boundary

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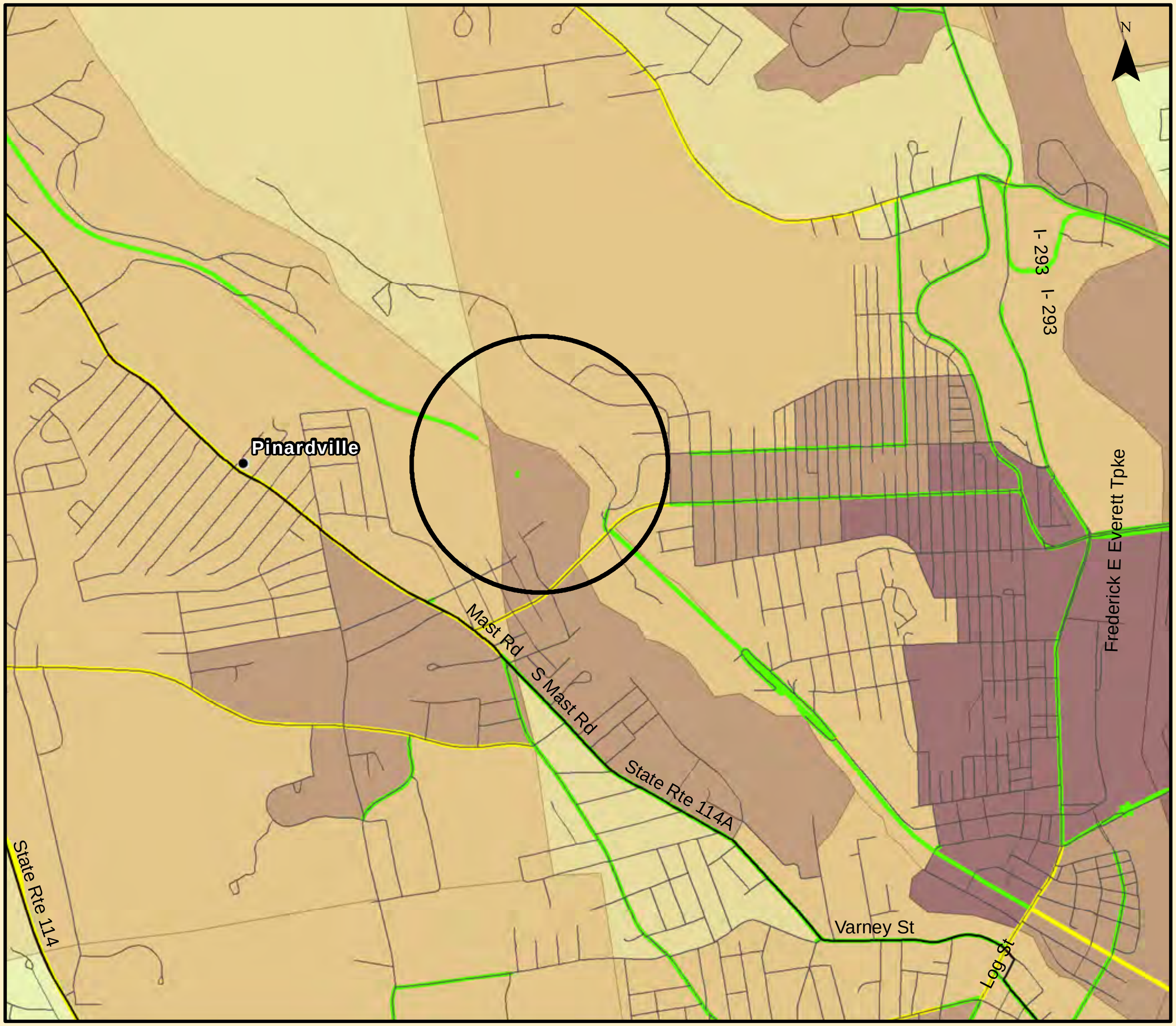
SNHPC



Southern NH Planning Commission

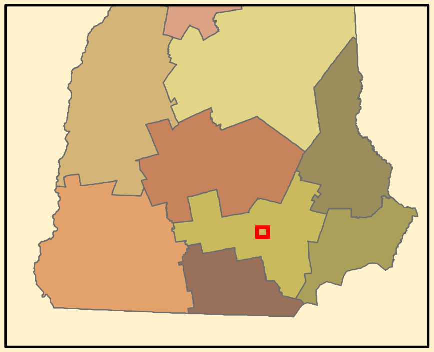
New Piscataquog River Bridge

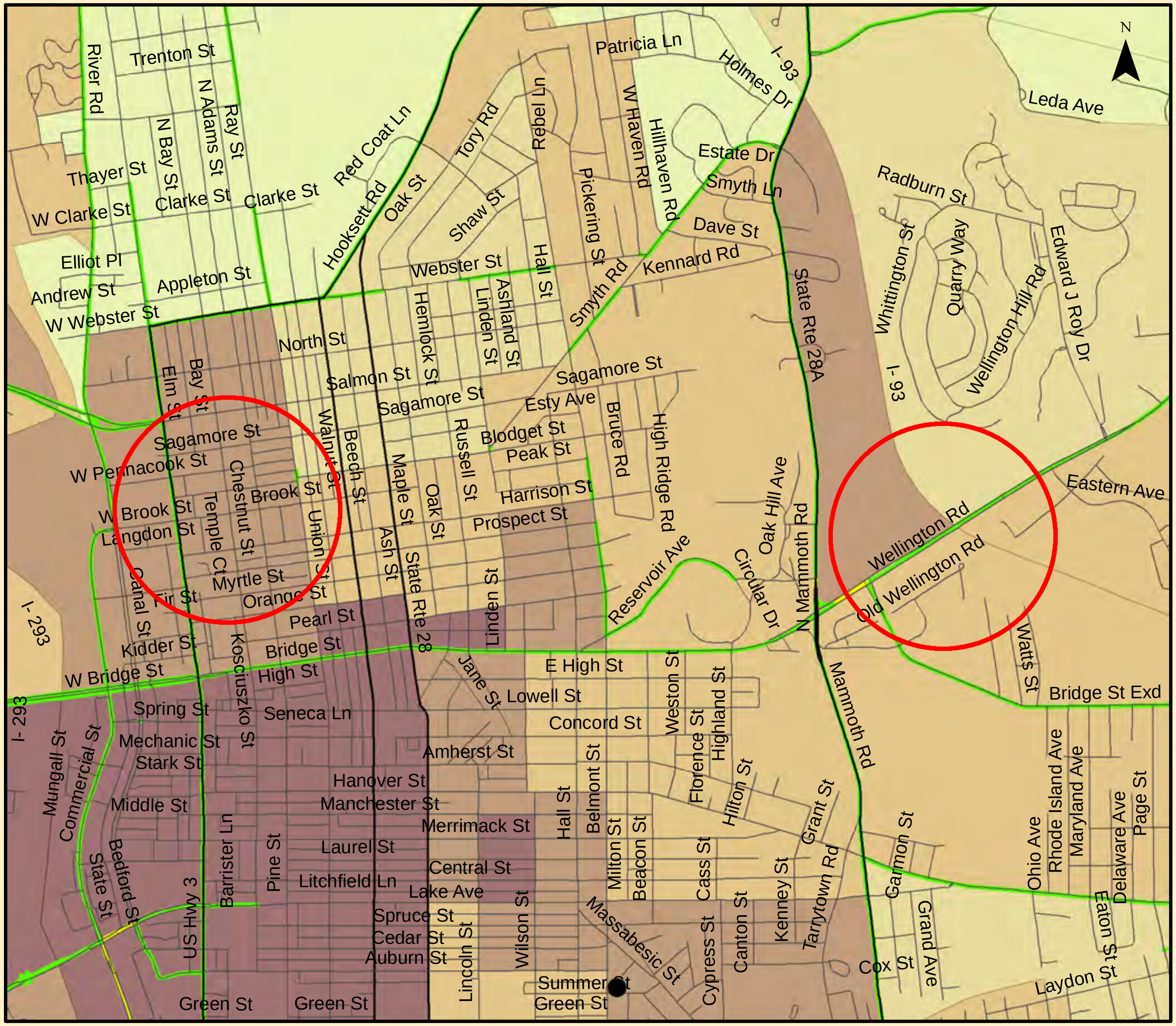
Connectivity Assessment

0 0.125 0.25 0.5 0.75 1 Miles

1:24,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US





Population
- 100,000 - 499,999
- 50,000 - 99,999
- 10,000 - 49,999
- Under 10,000

Southern NH Planning Commission
- Boundary

Road Class
- Primary Road
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Total Unique Cyclists Per Segment
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SNHPC

Southern NH Planning Commission

Planned Striping Chestnut Rd. and Wellington Rd.

Connectivity Assessment

0 0.125 0.25 0.5 0.75 1 Miles

1:24,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

Population

- 100,000 - 499,999
- 50,000 - 99,999
- 10,000 - 49,999
- Under 10,000

Strafford Regional Planning Commission

- Boundary

Priority Destinations

- ATHLETIC/REC FACILITY
- COMMUNITY FACILITY
- ESSENTIAL CITY FACILITY
- GROCERY STORE
- HOSPITAL
- LIBRARY
- PLACE OF WORSHIP
- POST OFFICE
- RETAIL/SHOPPING AREA
- SCHOOL
- SMALLER MARKET
- TRAIL ACCESS POINT

Road Class

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Total Unique Cyclists Per Segment

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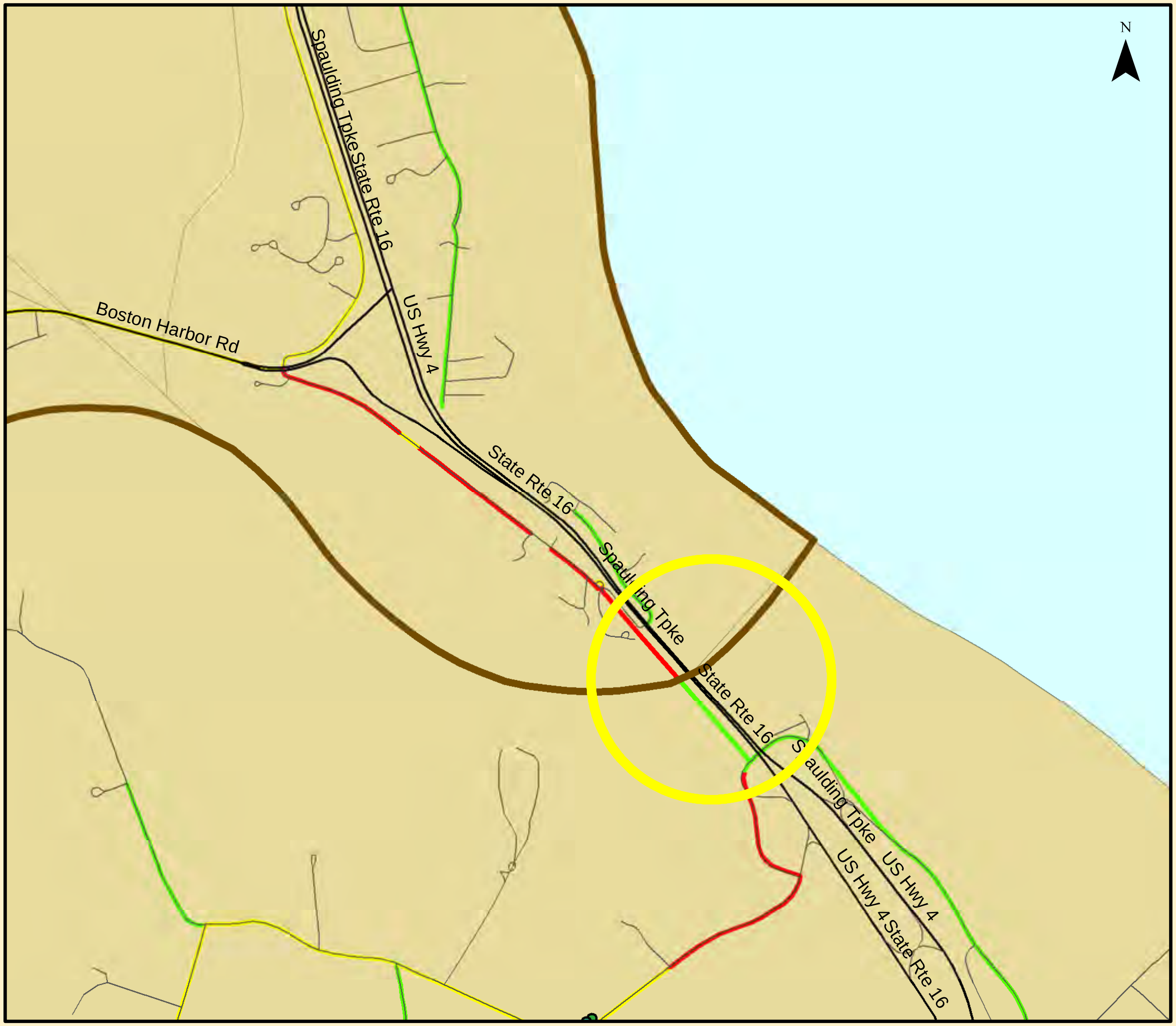
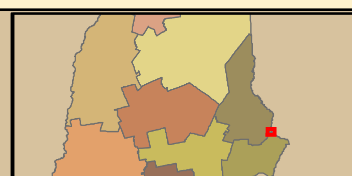


Strafford Regional Planning Commission

Newington-Dover Pedestrian Bridge

Planned Infrastructure Improvements



0 0.125 0.25 0.5 0.75 1 Miles

1:24,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

Population

- 100,000 - 499,999
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Strafford Regional Planning Commission

- Boundary

Priority Destinations

- ATHLETIC/REC FACILITY
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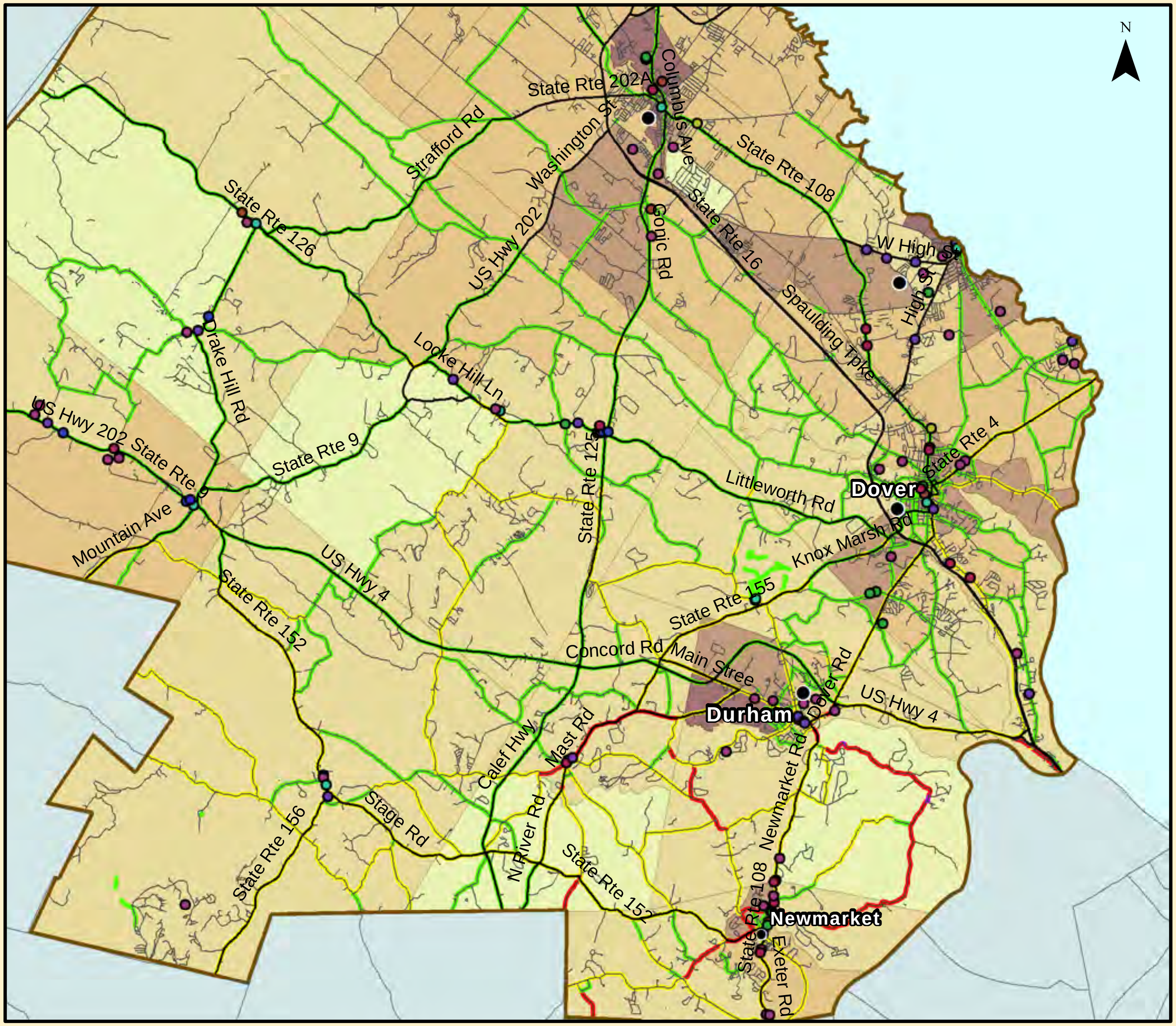
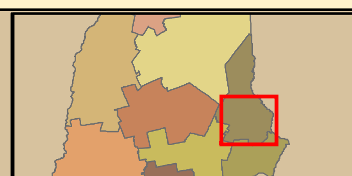


Strafford Regional Planning Commission

Durham, Dover, Rochester, Newmarket

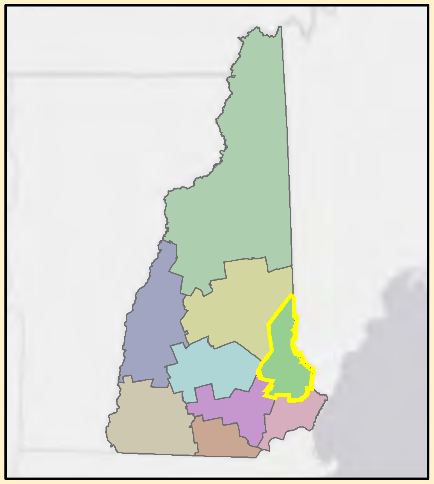
Key Destinations



0 1 2 4 6 8 Miles

1:200,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US



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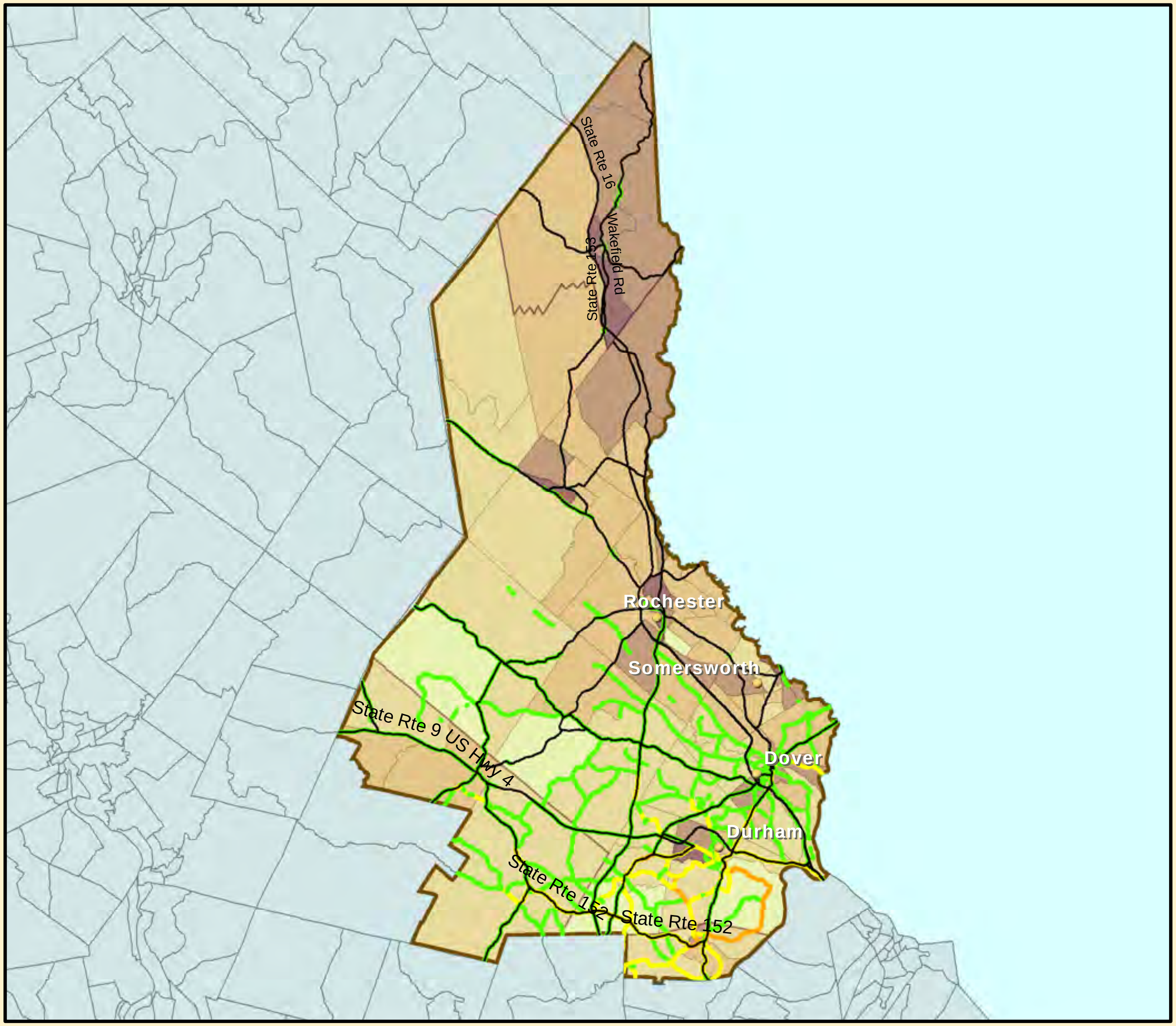

Strafford Regional Planning Commission

Overview

Strafford REGIONAL PLANNING COMMISSION

0 3 6 12 18 24 Miles

1:500,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

N

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Strafford Regional Planning Commission
- Boundary

Priority Destinations
- ATHLETIC/REC FACILITY
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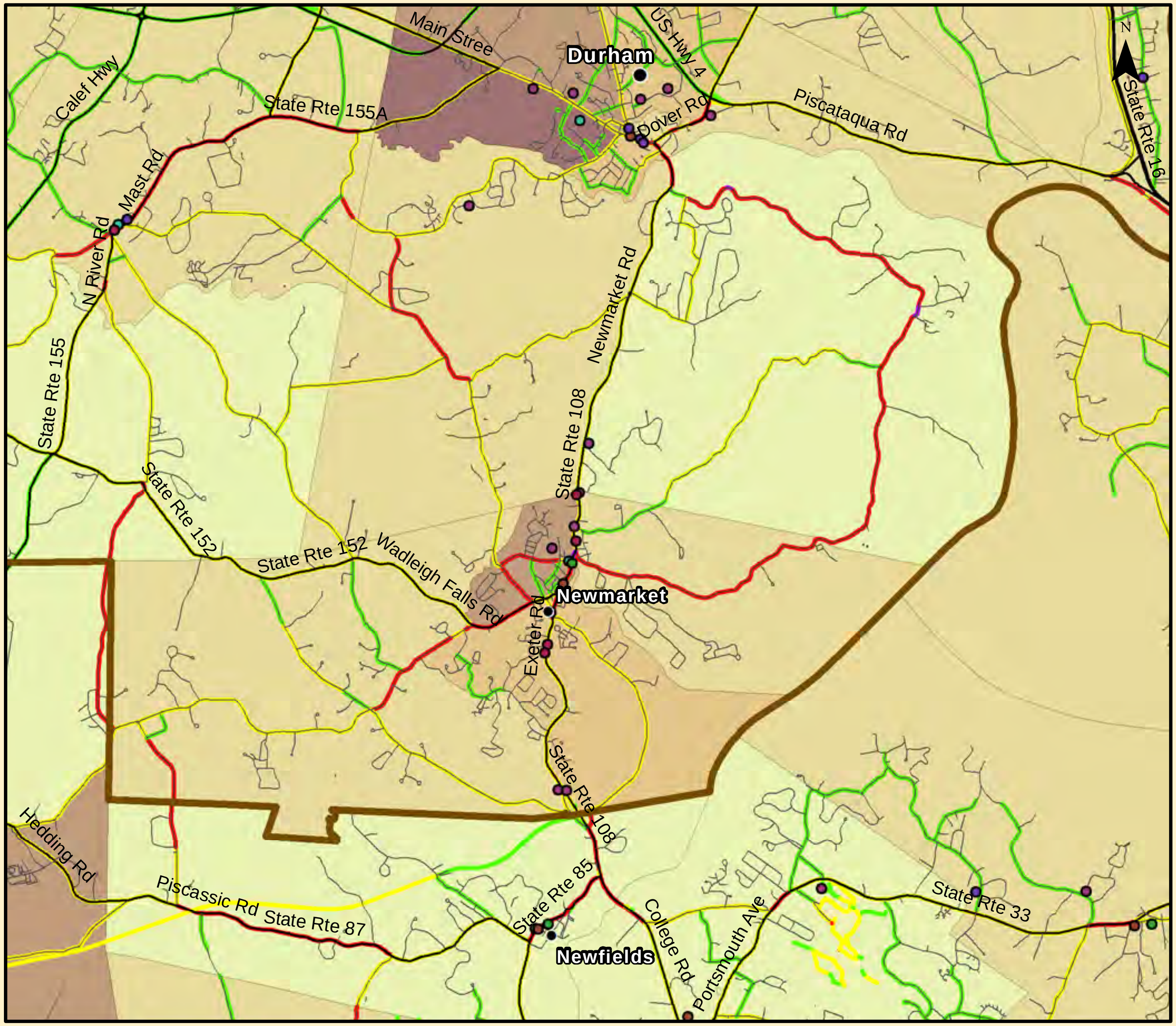
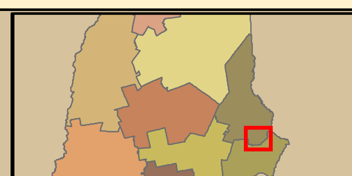


Strafford Regional Planning Commission

Durham, Newmarket, Newfields Project

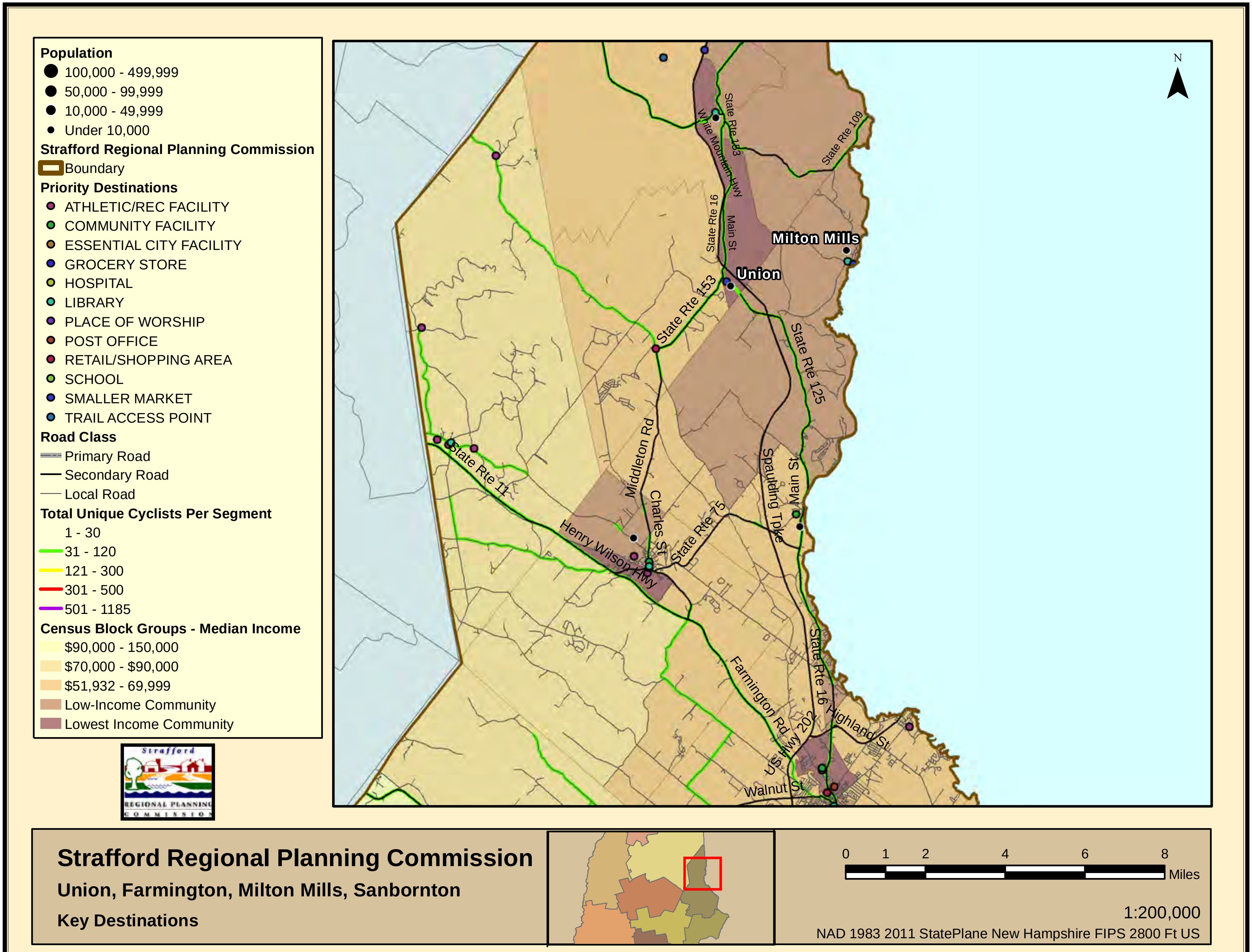
Planned Infrastructure Improvements



0 0.5 1 2 3 4 Miles

1:90,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US



Population
100,000 - 499,999
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Strafford Regional Planning Commission
Boundary
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ATHLETIC/REC FACILITY
COMMUNITY FACILITY
ESSENTIAL CITY FACILITY
GROCERY STORE
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LIBRARY
PLACE OF WORSHIP
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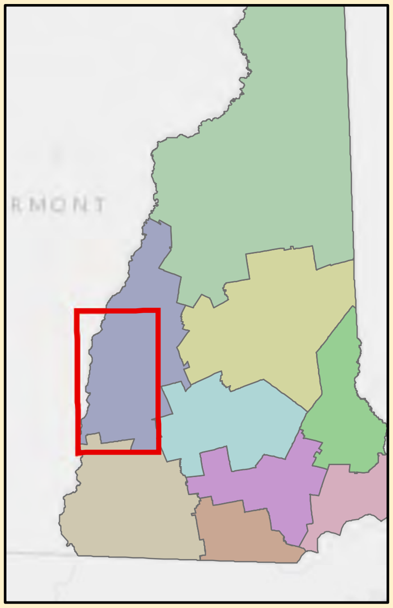
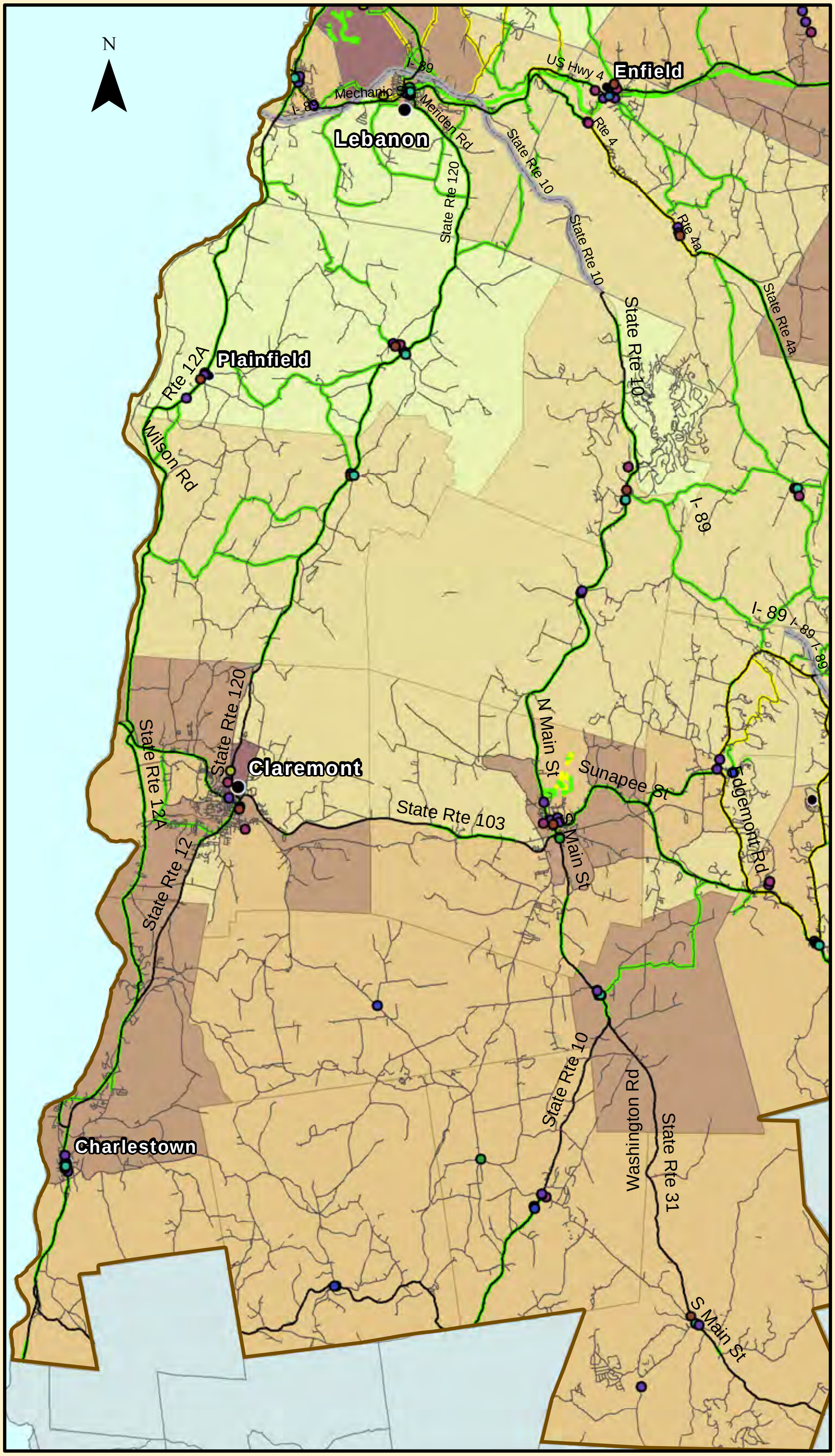
$70,000 - $90,000
$51,932 - 69,999
Low-Income Community
Lowest Income Community
N
Milton Mills
Union
State Rte 153
White Mountain Hwy
State Rte 109
State Rte 16
Main St
State Rte 125
Middleton Rd
Charles St
State Rte 75
Spaulding Tpke
State Rte 11
Henry Wilson Hwy
Farmington Rd
US Hwy 202
Highland St
Walnut St
Strafford Regional Planning Commission
Union, Farmington, Milton Mills, Sanbornton
Key Destinations
0 1 2 4 6 8
Miles
1:200,000
NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US





UVLSRPC

Boundary

Priority Destinations

- ATHLETIC/REC FACILITY
- COMMUNITY FACILITY
- ESSENTIAL CITY FACILITY
- GROCERY STORE
- HOSPITAL
- LIBRARY
- PLACE OF WORSHIP
- POST OFFICE
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- 501 - 1185

Census Block Groups - Median Income

- $90,000 - $200,000
- $70,000 - $89,999
- $51,932 - $69,999
- Low-Income Community
- Lowest Income Community

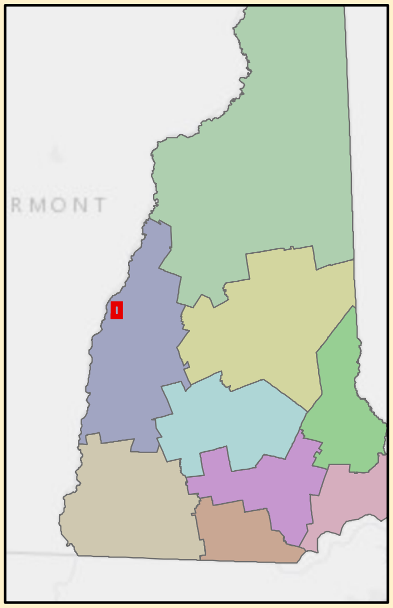
Upper Valley-Lake Sunapee Regional Planning Commission

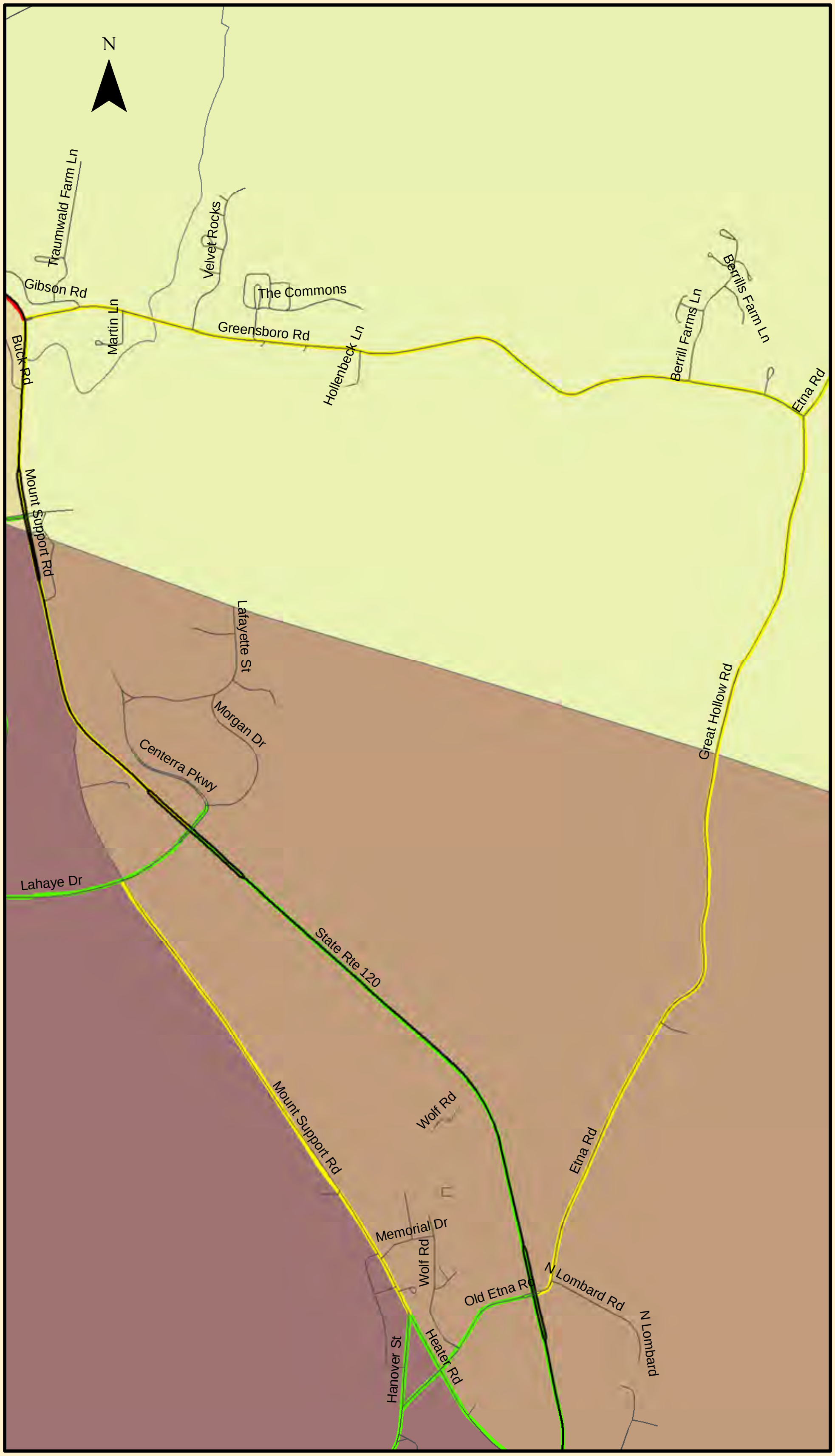
Claremont, Charlestown, Plainfield, Lebanon

0 1.25 2.5 5 7.5 10 Miles

1:270,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US





UVLSRPC

Boundary

Priority Destinations

- ATHLETIC/REC FACILITY
- COMMUNITY FACILITY
- ESSENTIAL CITY FACILITY
- GROCERY STORE
- HOSPITAL
- LIBRARY
- PLACE OF WORSHIP
- POST OFFICE
- RETAIL/SHOPPING AREA
- SCHOOL
- SMALLER MARKET
- TRAIL ACCESS POINT

Population

- 100,000 - 499,999
- 50,000 - 99,999
- 10,000 - 49,999
- Under 10,000

Road Class

- Primary Road
- Secondary Road
- Local Road

Total Unique Cyclists Per Segment

- 1 - 30
- 31 - 120
- 121 - 300
- 301 - 500
- 501 - 1185

Census Block Groups - Median Income

- $90,000 - $200,000
- $70,000 - $89,999
- $51,932 - $69,999
- Low-Income Community
- Lowest Income Community

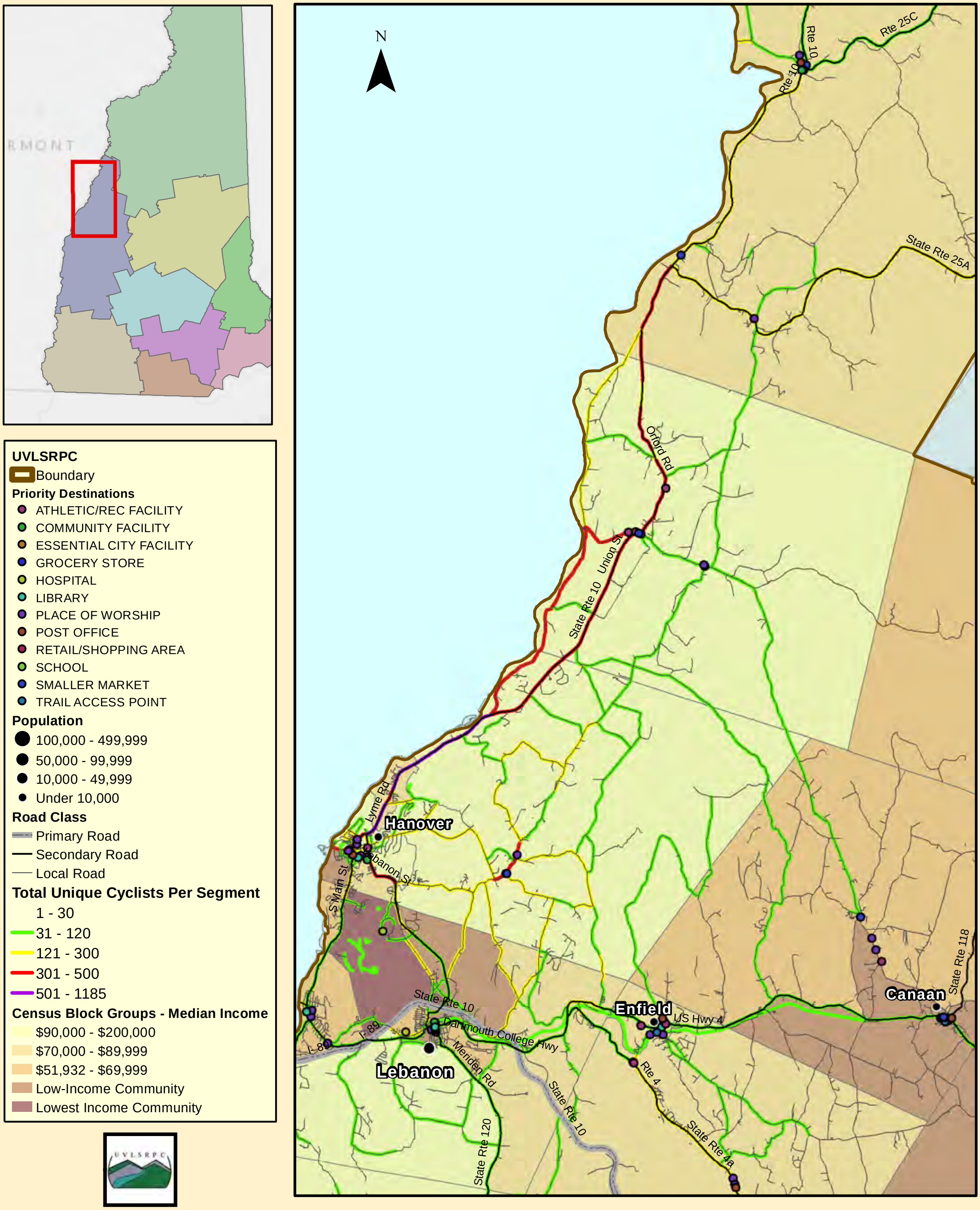
Upper Valley-Lake Sunapee Regional Planning Commission

Planned Improvements to Greensboro Rd., Hanover

0 0.1 0.2 0.4 0.6 0.8 Miles

1:24,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US



Upper Valley-Lake Sunapee Regional Planning Commission

Hanover, Canaan, Lebanon, Enfield

0 1 2 4 6 8 Miles

1:200,000

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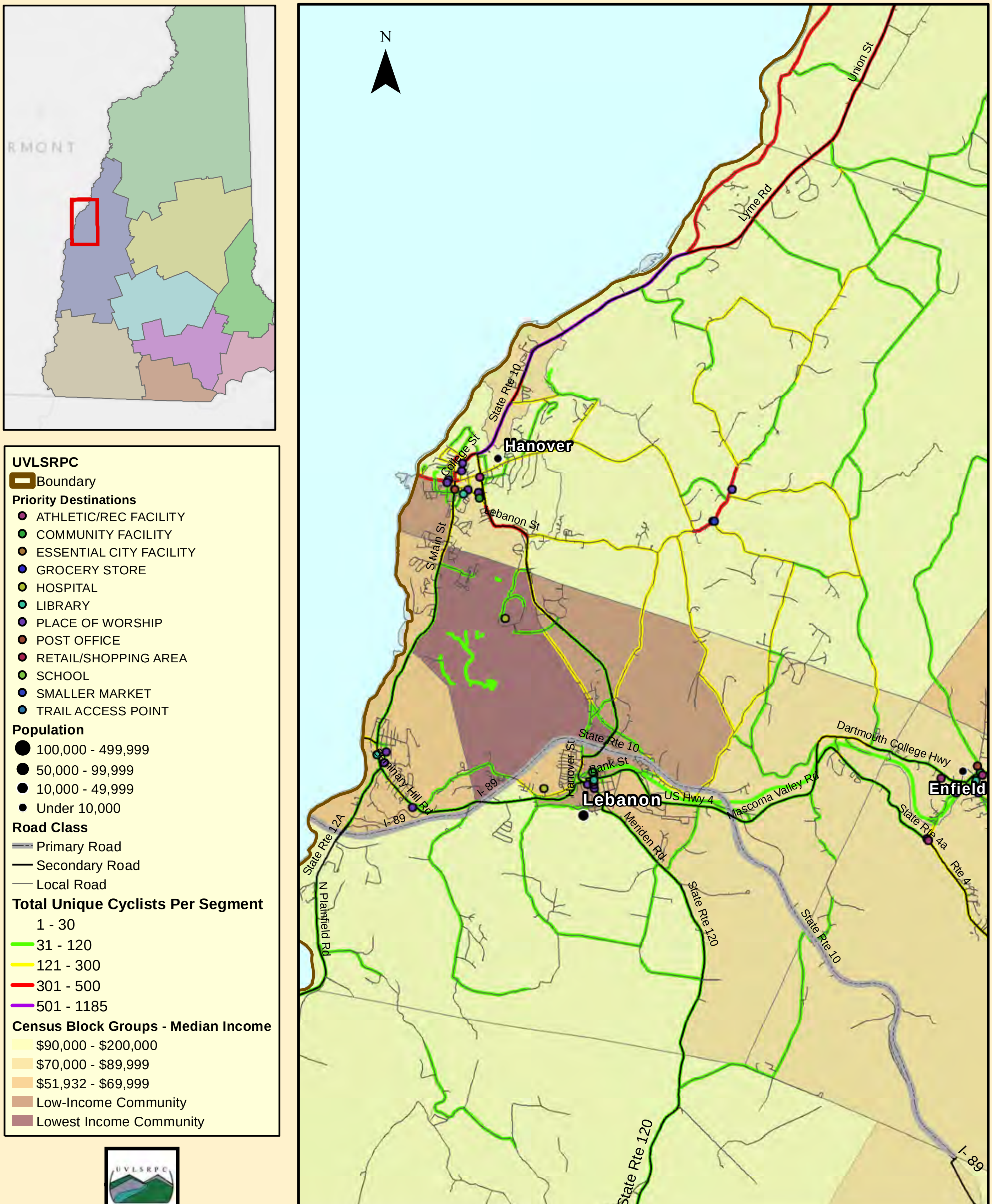
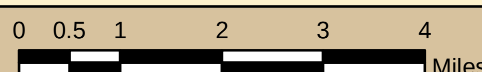


Upper Valley-Lake Sunapee Regional Planning Commission

Hanover, Lebanon, Enfield



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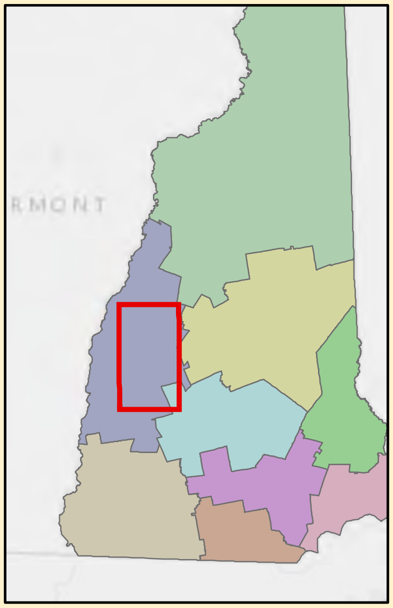

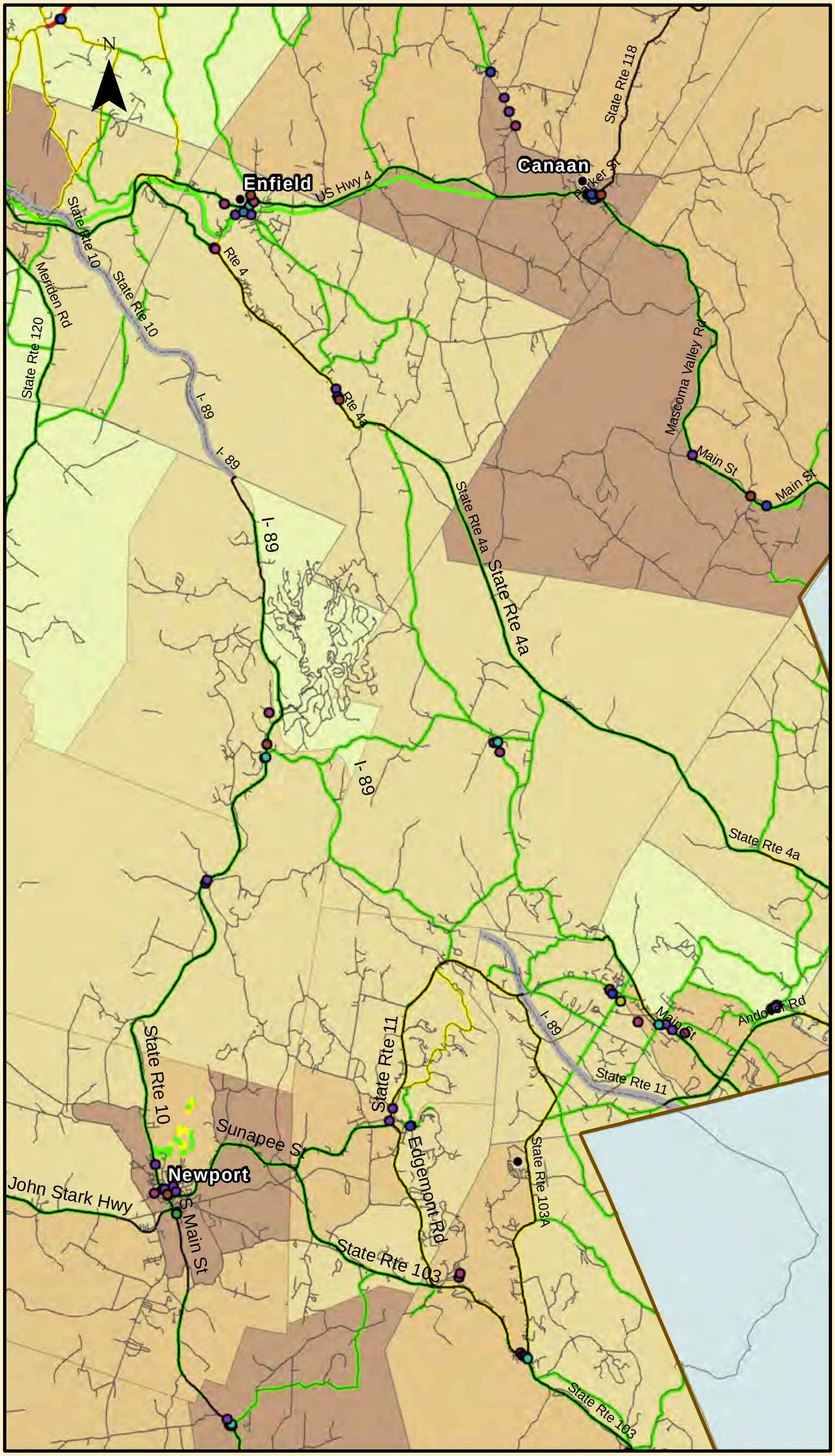

UVLSRPC

Boundary

Priority Destinations

- ATHLETIC/REC FACILITY
- COMMUNITY FACILITY
- ESSENTIAL CITY FACILITY
- GROCERY STORE
- HOSPITAL
- LIBRARY
- PLACE OF WORSHIP
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- SMALLER MARKET
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Population

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Road Class

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- Secondary Road
- Local Road

Total Unique Cyclists Per Segment

- 1 - 30
- 31 - 120
- 121 - 300
- 301 - 500
- 501 - 1185

Census Block Groups - Median Income

- $90,000 - $200,000
- $70,000 - $89,999
- $51,932 - $69,999
- Low-Income Community
- Lowest Income Community

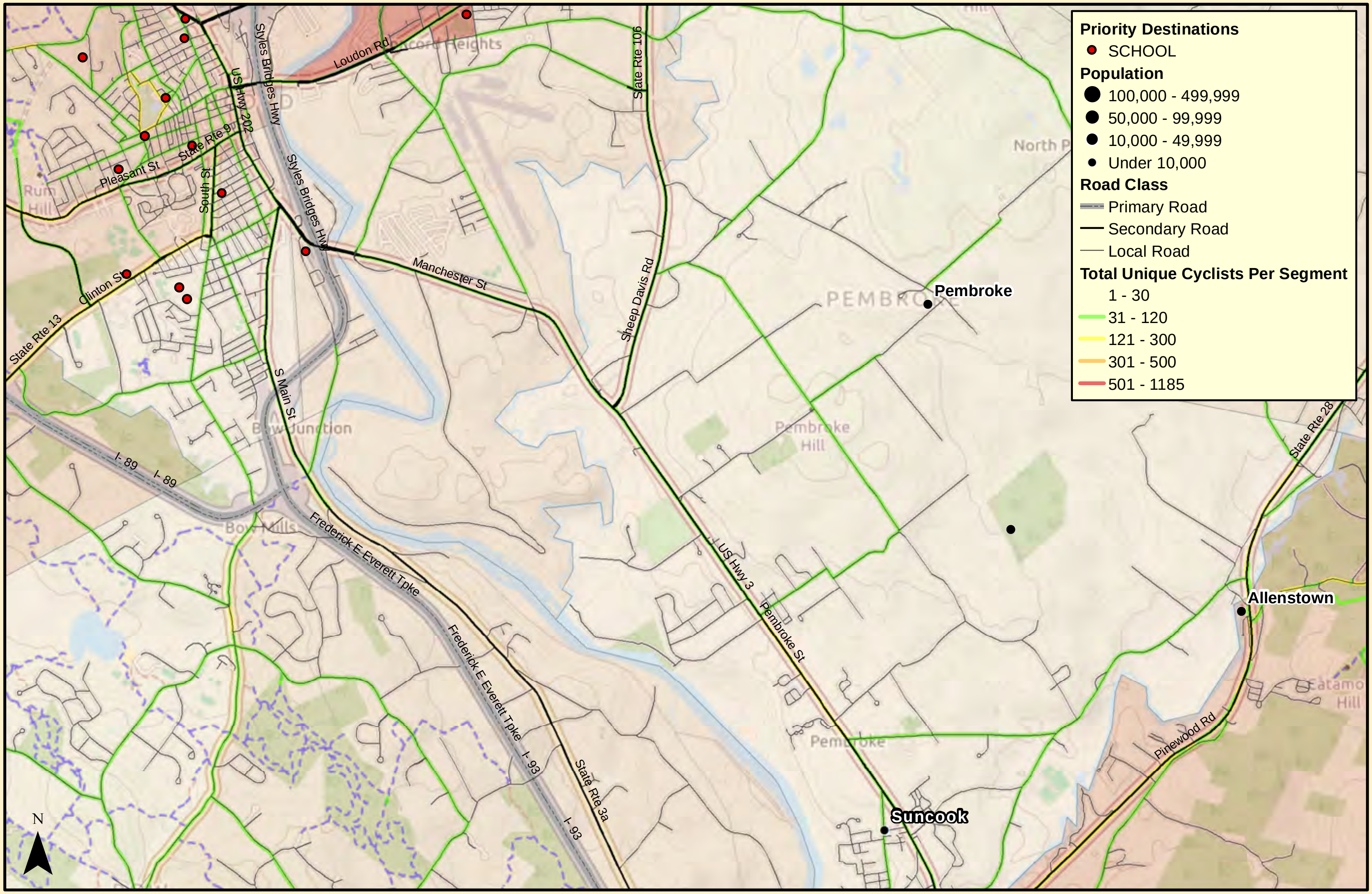
Upper Valley-Lake Sunapee Regional Planning Commission

Newport, Enfield, Canaan

0 1 2 4 6 8 Miles

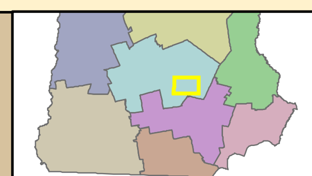
1:200,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US



Central NH Regional Planning Commission

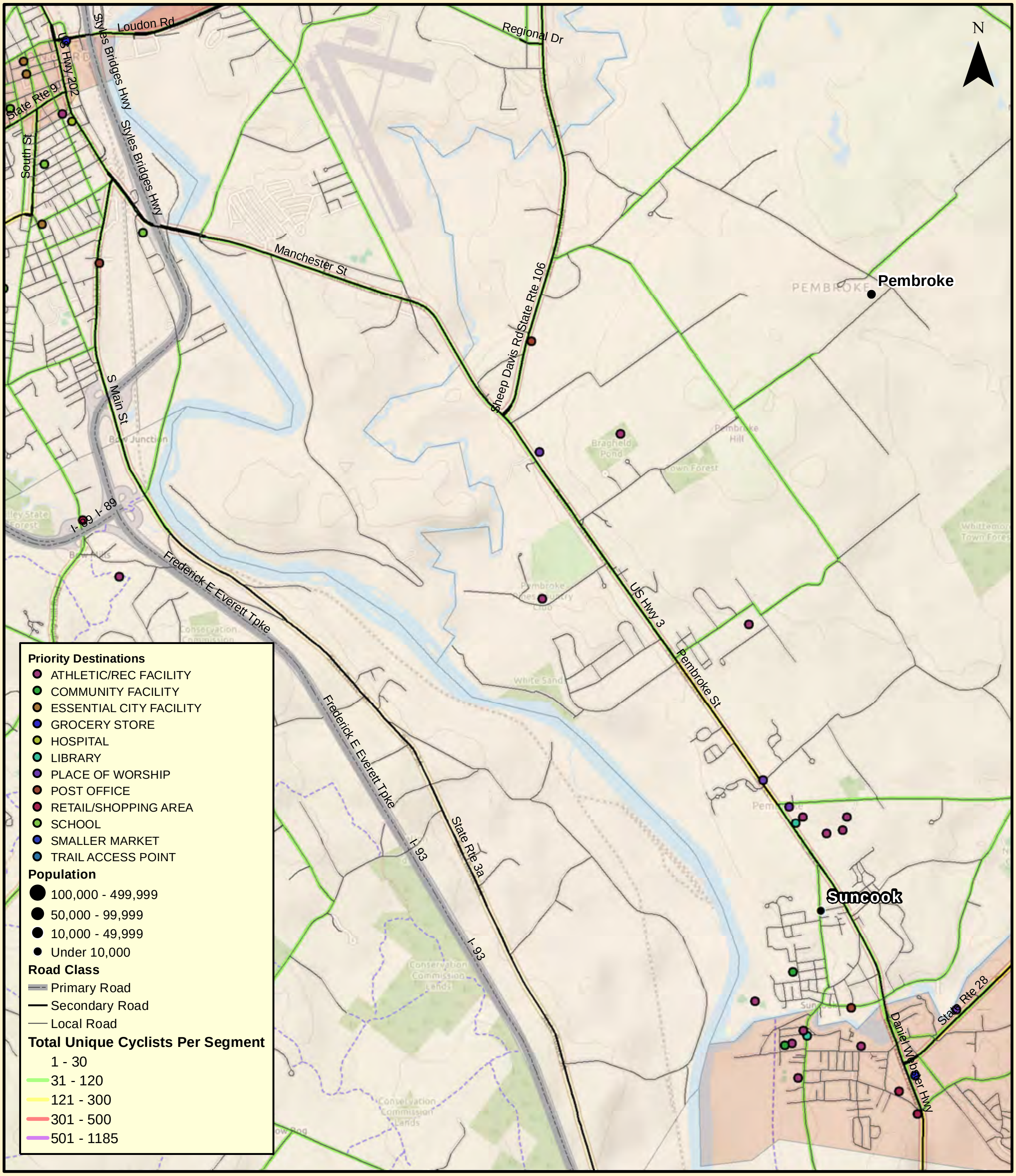
Concord - Suncook, Allenstown & Pembroke Connectivity & Safe Routes to School



0 0.3 0.6 1.2 1.8 2.4 Miles

1:60,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US



Central NH Regional Planning Commission

Concord - Suncook & Pembroke Connectivity

1:50,000

0 0.25 0.5 1 1.5 2 Miles

WGS 1984 Web Mercator Auxiliary Sphere

CNHRPC

Target: Suncook, Allenstown, and Pembroke connectivity to Concord; consider safe routes to school
Contacts: Craig Tufts, Principal Planner/GIS Planner CNHRPC

E-mail: There is a potential trail corridor from Suncook to Concord through Pembroke (abandoned rail trail). We have learned that there are two large potential housing developments along the corridor – approx. 100 homes around the property labeled “riverwood”. Also approx. 110 homes in the properties south of the Littlefield Condos.

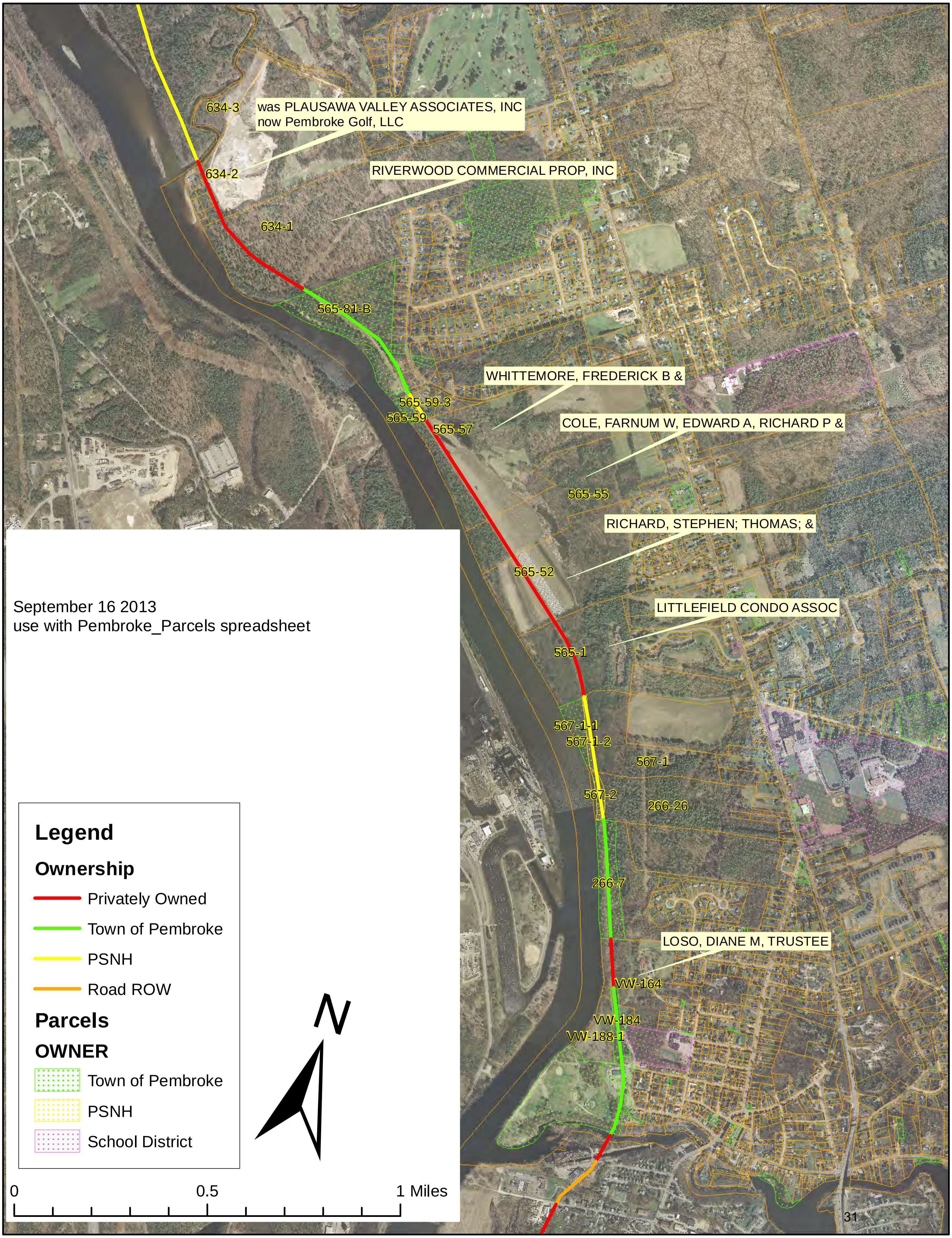
Suncook Village is a lower income area and has a downtown that could be an economic asset.

From article in Concord Monitor (Thursday, May 8, 2014):
The Central New Hampshire Bicycle Coalition has given $17,000 to the city to stripe more than 5 miles of a bike lane on Route 3. As the city continues the fifth phase of its work to rebuild that road this summer, City Engineer Ed Roberge said the coalition’s money will make the bike lanes happen much more quickly. The lanes might not have been painted for years, he said, but this money will be used to mark the bike lane on Route 3 between Borough Road and Penacook Street by this fall.

The bike lane continuing through Penacook village will be painted next summer, Roberge said. The money will also pay for 12 “wrong way, ride with traffic” signs to direct bicycle traffic around the city.

One of Concord's most visible examples of its new 'Complete Streets' policy is the US Route 3 North Improvements Project which will include fully-compliant bike lanes from downtown Concord to Penacook Village.

Social Vulnerability Index
Greater Suncook-Allenstown Tract:
- Overall Vulnerability (0-10): 3
- Themes: for civilian unemployed, the proportion is in the 90th percentile, for mobile homes, the proportion is in the 90th percentile, for crowded housing, the proportion is in the 90th percentile



634-3
was PLAUSAWA VALLEY ASSOCIATES, INC
now Pembroke Golf, LLC
634-2
RIVERWOOD COMMERCIAL PROP, INC
634-1
565-81-B
WHITTEMORE, FREDERICK B &
565-59-3
565-59
565-57
COLE, FARNUM W, EDWARD A, RICHARD P &
565-55
RICHARD, STEPHEN; THOMAS; &
565-52
LITTLEFIELD CONDO ASSOC
565-1
567-1-1
567-1-2
567-1
567-2
266-26
266-7
LOSO, DIANE M, TRUSTEE
VW-164
VW-184
VW-188-1
September 16 2013
use with Pembroke_Parcels spreadsheet
Legend
Ownership
Privately Owned
Town of Pembroke
PSNH
Road ROW
Parcels
OWNER
Town of Pembroke
PSNH
School District
N
0
0.5
1 Miles

Google imagery views of road connecting Rt. 3 and Pembroke, Academy Rd. (connecting Rt. 3 and Allenstown), and Rt. 28 (connecting Rt. 3 and Allenstown).

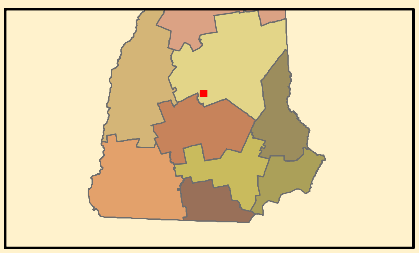
Rt. 3 near Suncook, Rt. 3 at turnoff for Pembroke, Rt. 3 near Concord.

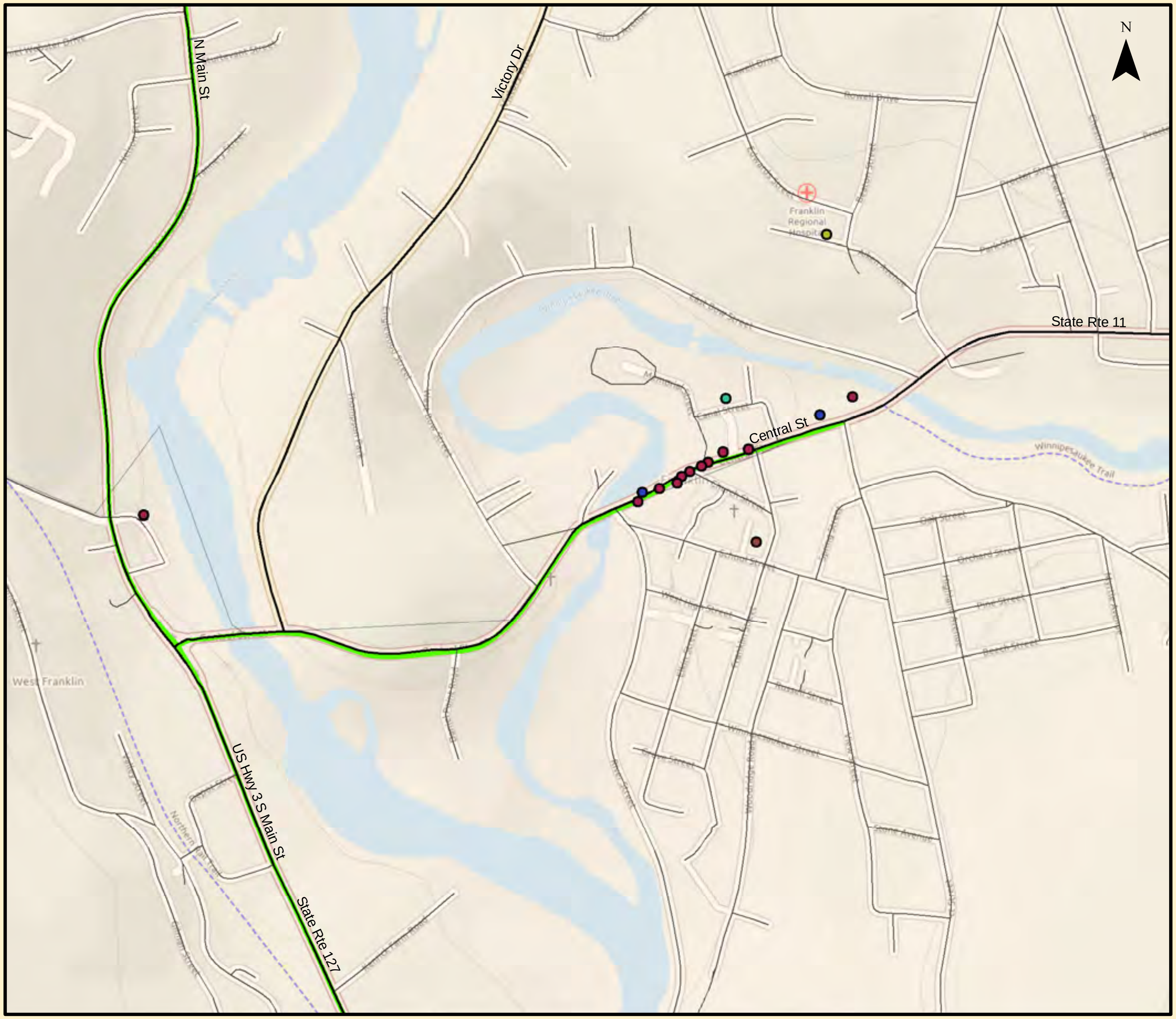
Priority Destinations
- ATHLETIC/REC FACILITY
- COMMUNITY FACILITY
- ESSENTIAL CITY FACILITY
- GROCERY STORE
- HOSPITAL
- LIBRARY
- PLACE OF WORSHIP
- POST OFFICE
- RETAIL/SHOPPING AREA
- SCHOOL
- SMALLER MARKET
- TRAIL ACCESS POINT

Road Class
- Primary Road
- Secondary Road
- Local Road

Total Unique Cyclists Per Segment
- 1 - 30
- 31 - 120
- 121 - 300
- 301 - 500
- 501 - 1185

Social Vulnerability Index
- 0-2
- 3-5
- 6-8
- 9-10





Lakes Region Planning Commission

Franklin Trail Connectivity

L · R · P · C

0 0.05 0.1 0.2 0.3 0.4 Miles

1:12,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

LRPC

Target: Franklin Main St. and Franklin-Tilton disconnected rail trails (goal of WOW trail to have it go out to river)
Contacts: No Response

Winnipesaukee River Trail connects from Central Street in Franklin through to Park St. in Tilton. While the Winnipesaukee River Trail Association is in the process of connecting this trail through central Tilton, this trail does not currently connect to the Northern Rail Trail. According to the LRPC Bicycling and Walking Plan, there is a major focus on connecting the Northern Rail Trail trail in West Franklin to the Winnipesaukee River Trail. While the shortest route would be along the city streets in Franklin, the preferred route would cross the Pemigewasset River somewhere other than the Central Street Bridge, and then go around downtown along a more pedestrian and bicycle friendly route. However, a safe, signed, on-street connection should be prioritized over the preferred route in the near term in order to connect existing trails. Both Central St. and Main St. in Franklin lack bicycle lanes and infrastructure.

Social Vulnerability Index
Franklin Tract:
- Overall Vulnerability (0-10): 2
- Themes: for per capita income, the proportion is in the 90th percentile, the proportion of single parent households is in the 90th percentile

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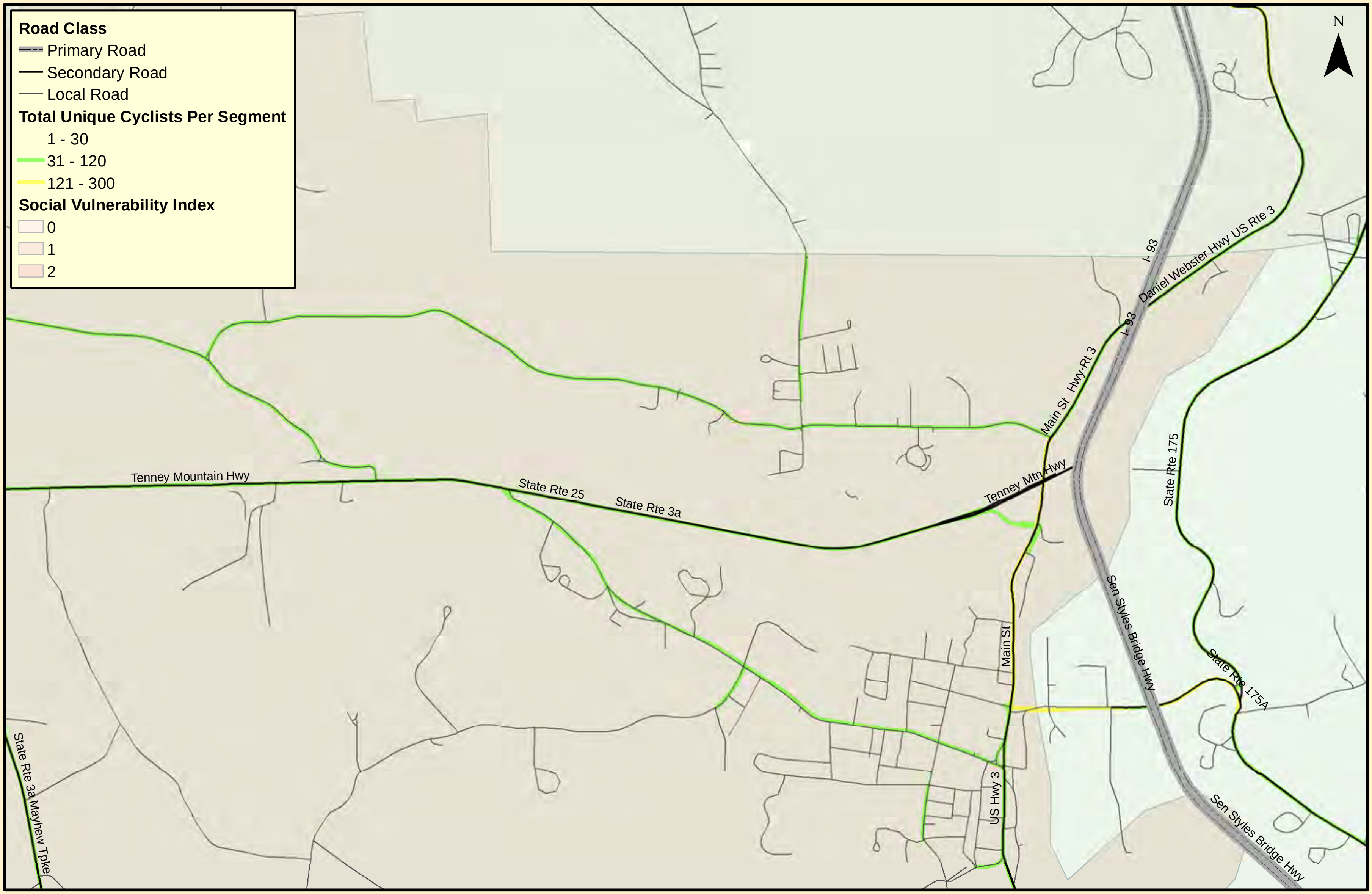
Central St. in Franklin where the Winnipesaukee River Trail connects and S. Main St. in Franklin.



North Country Council
Plymouth, NH

NORTH COUNTRY COUNCIL

1:31,680

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

NCC

Target: Plymouth
Contacts: Mary Poesse, Transportation Planner, NCC

Since most North Country highways are shared roadways, a paved shoulder a minimum width of 4 feet is required for bicycle safety (AASHTO Guide for the Development of Bicycle Facilities). Where gutters and curbs are present, or high traffic volumes, higher speeds, or substantial truck traffic, a minimum paved width of 5 feet is required (AASHTO). Paved shoulders wider than five feet may actually decrease bicycle or pedestrian safety because they encourage faster driving speeds and are often used to pass on the right.

The population of the NCC portion of the Plymouth Labor Market Area travelshed grew by slightly more than 20% from 2000-2010. Plymouth's population is expected to increase by more than 10% between 2010 and 2040.

The I-93 and US 3 corridor forms the backbone of the Plymouth LMA travelshed highway network. Three other regional priorities in the Plymouth LMA travelshed are NH 25, NH 112 and NH 49. NH 25 links two of the region's important job center communities - Plymouth and Woodsville (in Haverhill), and provides some travelers and commerce with a connection between I-91 and I-93. NH 112 is the heart of summer and fall tourism in the region; it becomes the Kancamagus in Lincoln east of I-93.

As shown, the highest traffic volumes in the Plymouth LMA travelshed are associated with NH 25 through Plymouth, on I-93 to the Waterville valley exit, and NH 49 between I-93 and NH 175. In Plymouth, NH 25 & 3A of West of Highland Street, Average Annual Daily Traffic (2004) was 14,000.

Highland Street in Plymouth is a major collector with high traffic volumes and is not presently well suited to safe bicycle travel. Downtown Plymouth on Highland Street near Speare Memorial Hospital is (safety wise) an intersection of concern.

Shoulder widths are less than 4 feet wide on NH 118, NH 112 east of NH 118, all of NH 175, and portions of NH 25. This is a concern given the high level of bicycling seen in this area. Over 100 Strava users alone cycled from Campton and Thornton to Plymouth and to Waterville Valley. NH 112 is a very popular recreational route for groups, clubs, individuals and a growing number of race/organized ride events. The lack of adequate paved shoulders on these routes (between 4-5 feet) poses a danger to the safety of drivers as well as the bicyclists; drivers are forced to cross the center line to pass bicycles when shoulders are not wide enough for the cyclist to safely leave the traveled way. Except for portions of US 3, pavement conditions are fair to good on most of the regional priority highway corridors in the Plymouth LMA travelshed.

In 2014 NCC staff completed an update to the Tenney Mountain Highway Corridor 2003 Access Management Plan. It was recommended that an engineering study to address the feasibility of a system of pedestrian and bicycle pathways. It was also recommended that the town coordinate with Plymouth State and general public in the development of pedestrian and bicycle pathways.

From Town of Plymouth Master Plan with regard to Tenney Mountain Highway:

- Explore the possibility of limited, mixed-use highway commercial development along the southern Route 3 corridor and Route 3A.
- The commercial area along Tenney Mountain Highway generally begins west of the Baker River and extends west for more than two miles. Uses are predominantly retail and service oriented with an occasional residential use.
- Access to businesses in this area is by automobile, with parking provided on the developed property. The majority of individual commercial units is located in plazas, shopping centers or in other clustered methods with several individual uses mixed in-between the centers. The commercial use of the highway becomes much less dense to the west. There has been a corridor development plan prepared by the State, municipal, and business community to guide future development along this highway.
- The most promising area of Plymouth with development potential is the general region bounded by Tenney Mountain Highway to the north, Clay Bog to the east, the junction of Pike Hill Road, Bell Road and Old Hebron Road to the south and Bartlett/Yeaton Road to the west. This area offers the greatest concentration of large undeveloped lots that have the fewest identified limitations to development.

Social Vulnerability Index

Plymouth Tract:

- Overall Vulnerability (0-10): 2

- Themes: for per capita income, the proportion is in the 90th percentile, the proportion of persons in institutionalized group quarters is in the 90th percentile

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Google Street View of Main St., Plymouth, NH and NH-175A near the Plymouth roundabout.

Google Street View of Highland St., Plymouth, and Tenney Mountain Highway in Plymouth.

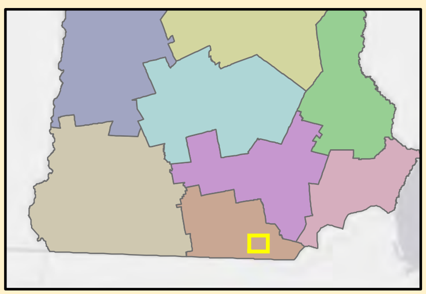
Priority Destinations
- ATHLETIC/REC FACILITY
- COMMUNITY FACILITY
- ESSENTIAL CITY FACILITY
- GROCERY STORE
- HOSPITAL
- LIBRARY
- PLACE OF WORSHIP
- POST OFFICE
- RETAIL/SHOPPING AREA
- SCHOOL
- SMALLER MARKET
- TRAIL ACCESS POINT

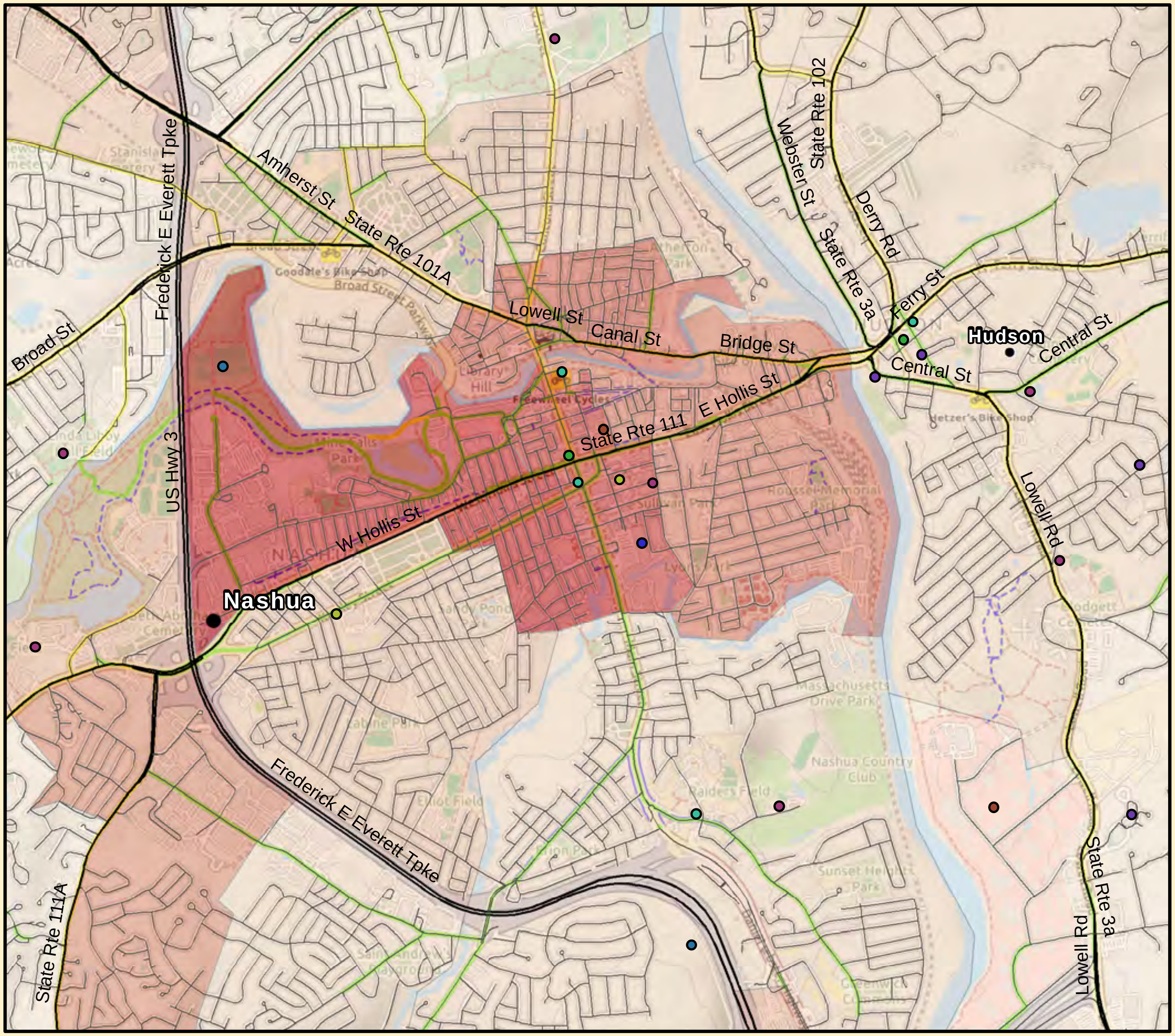
Population
- 100,000 - 499,999
- 50,000 - 99,999
- 10,000 - 49,999
- Under 10,000

Road Class
- Primary Road
- Secondary Road
- Local Road

Total Unique Cyclists Per Segment
- 1 - 30
- 31 - 80
- 81 - 200
- 201 - 400
- 401 - 1185

Nashua Regional Planning Commission
- Boundary





Nashua Regional Planning Commission

Nashua-Hudson Connectivity

NRPC

0 0.25 0.5 1 1.5 2 Miles

1:40,000

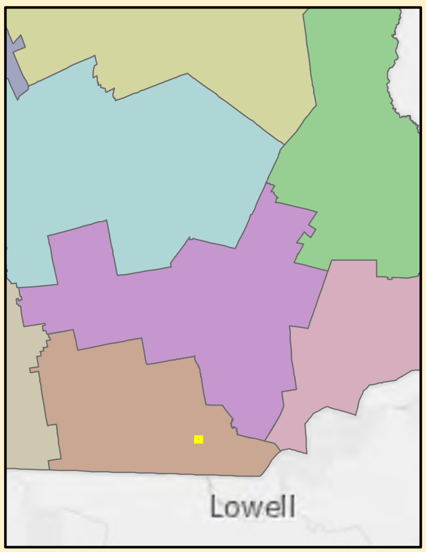
NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

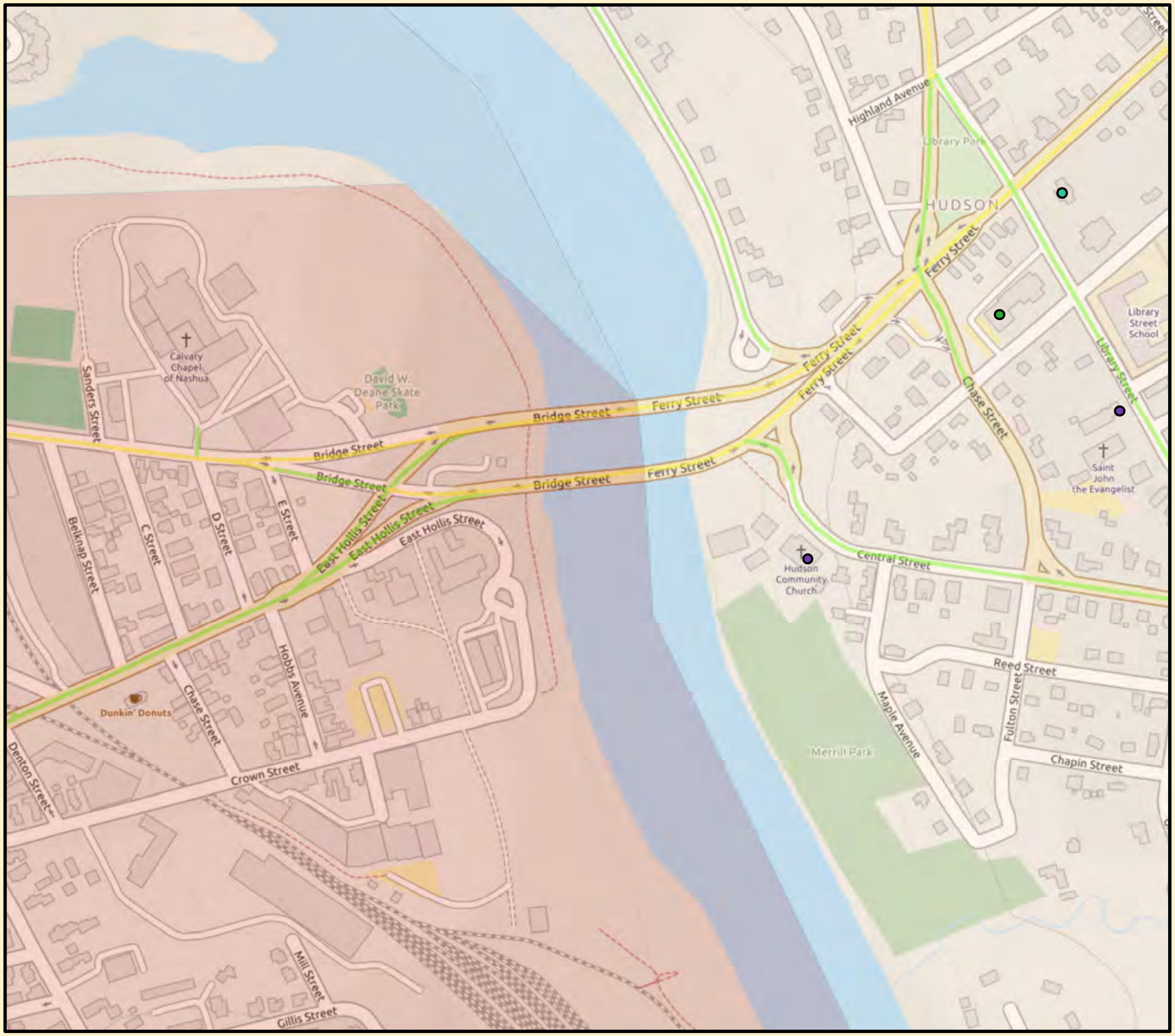
N

Priority Destinations
- ATHLETIC/REC FACILITY
- COMMUNITY FACILITY
- ESSENTIAL CITY FACILITY
- GROCERY STORE
- HOSPITAL
- LIBRARY
- PLACE OF WORSHIP
- POST OFFICE
- RETAIL/SHOPPING AREA
- SCHOOL
- SMALLER MARKET
- TRAIL ACCESS POINT

Total Unique Cyclists Per Segment
- 1 - 30
- 31 - 80
- 81 - 200
- 201 - 400
- 401 - 1185

Nashua Regional Planning Commission
- Boundary





Nashua Regional Planning Commission

Nashua-Hudson Bridges

NRPC

0 0.04 0.08 0.16 0.24 0.32 Miles

1:6,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

N

NRPC

Target: Connectivity between Nashua and Hudson
Contacts: Ryan Friedman, Senior GIS Planner

E-mail: The connections between Nashua and Hudson are definitely a concern. Just getting cars across has been a planning issue for over 50 years here. Right now, there are only 2 bridges across the river and they combine to carry about 80,000 cars every day.

I know that the Sagamore Bridge (the southern one) has a separated path that starts in one of the neighborhoods on the Nashua side, comes up alongside the road as it crosses the river, and then dumps you into an industrial park area in Hudson. The land uses down there are mostly commercial, so I doubt there is much bicycle connectivity demand other than for recreational purposes.

The other bridge, however, connects both downtowns, has been congested with cars forever, and is not very bicycle-friendly with raised sidewalks and practically no shoulder. There is a project on the table that would improve East Hollis Street (Rte 111) which runs from Main St in Nashua all the way out to the bridge. I don't know what's in there for bike-ped improvements, but it's very early in the planning stages. I can look into that when necessary.

Social Vulnerability Index
Hudson Tracts:
- Overall Vulnerability (0-10): 1
- Themes: for crowded housing, the proportion is in the 90th percentile

Tracts in Central Nashua:
- Overall Vulnerability (0-10): 10
- Themes: for poverty, the proportion is in the 90th percentile, for civilian unemployed, the proportion is in the 90th percentile, for per capita income, the proportion is in the 90th percentile, for no high school diploma, the proportion is in the 90th percentile, the proportion of persons aged 17 and younger is in the 90th percentile, the proportion of single parent households is in the 90th percentile, the proportion of minority is in the 90th percentile, for limited English, the proportion is in the 90th percentile, for multi-unit housing, the proportion is in the 90th percentile, for no vehicle access, the proportion is in the 90th percentile

---

Google imagery views of entry to Hudson from Ferry St. bridge, on Ferry St. bridge, and along 111A bridge.

Priority Destinations

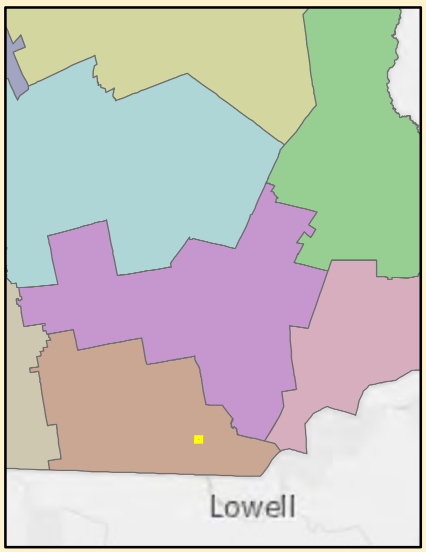
- ATHLETIC/REC FACILITY
- COMMUNITY FACILITY
- ESSENTIAL CITY FACILITY
- GROCERY STORE
- HOSPITAL
- LIBRARY
- PLACE OF WORSHIP
- POST OFFICE
- RETAIL/SHOPPING AREA
- SCHOOL
- SMALLER MARKET
- TRAIL ACCESS POINT

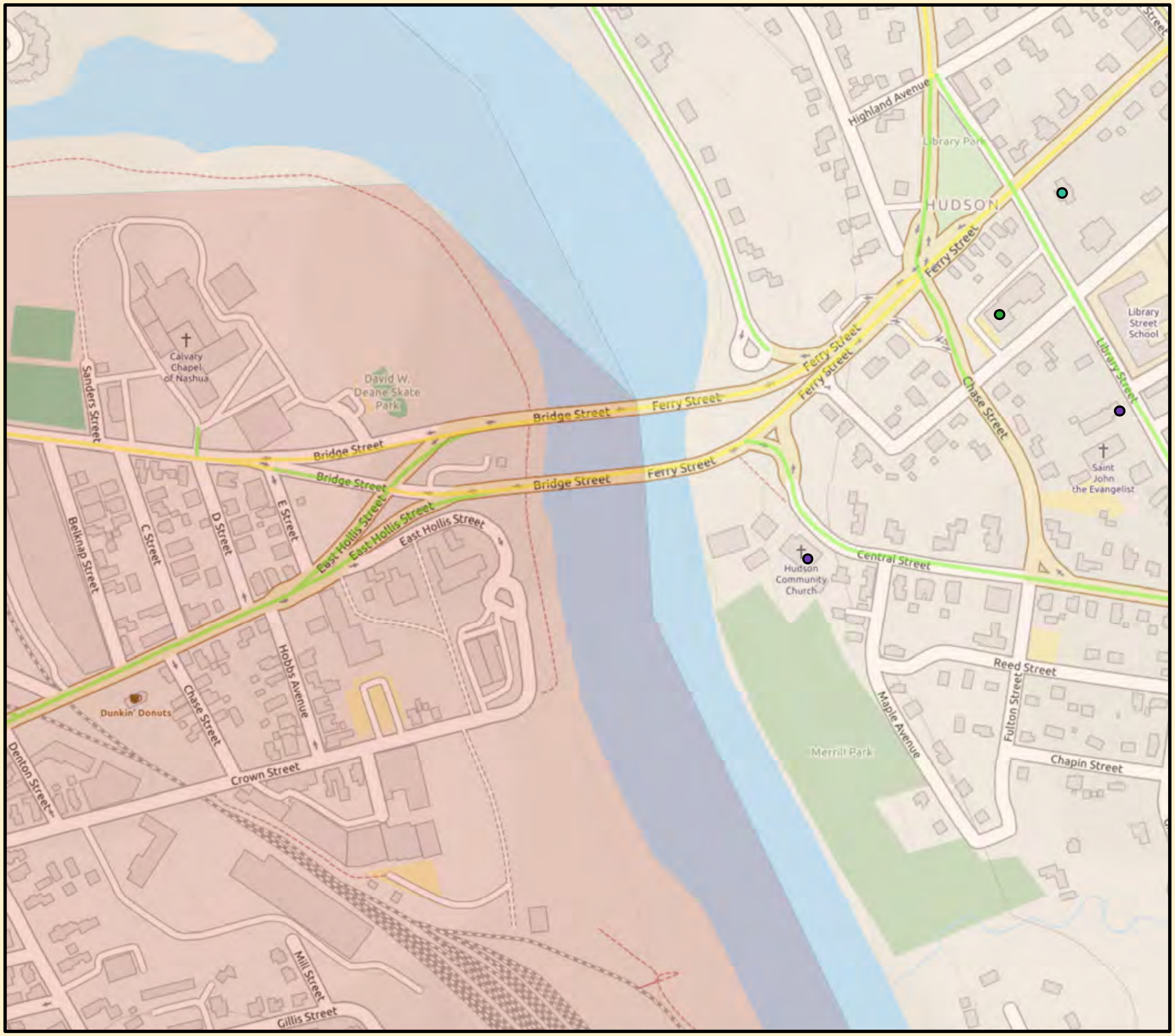
Total Unique Cyclists Per Segment

- 1 - 30
- 31 - 80
- 81 - 200
- 201 - 400
- 401 - 1185

Nashua Regional Planning Commission

- Boundary





Nashua Regional Planning Commission

Nashua-Hudson Bridges

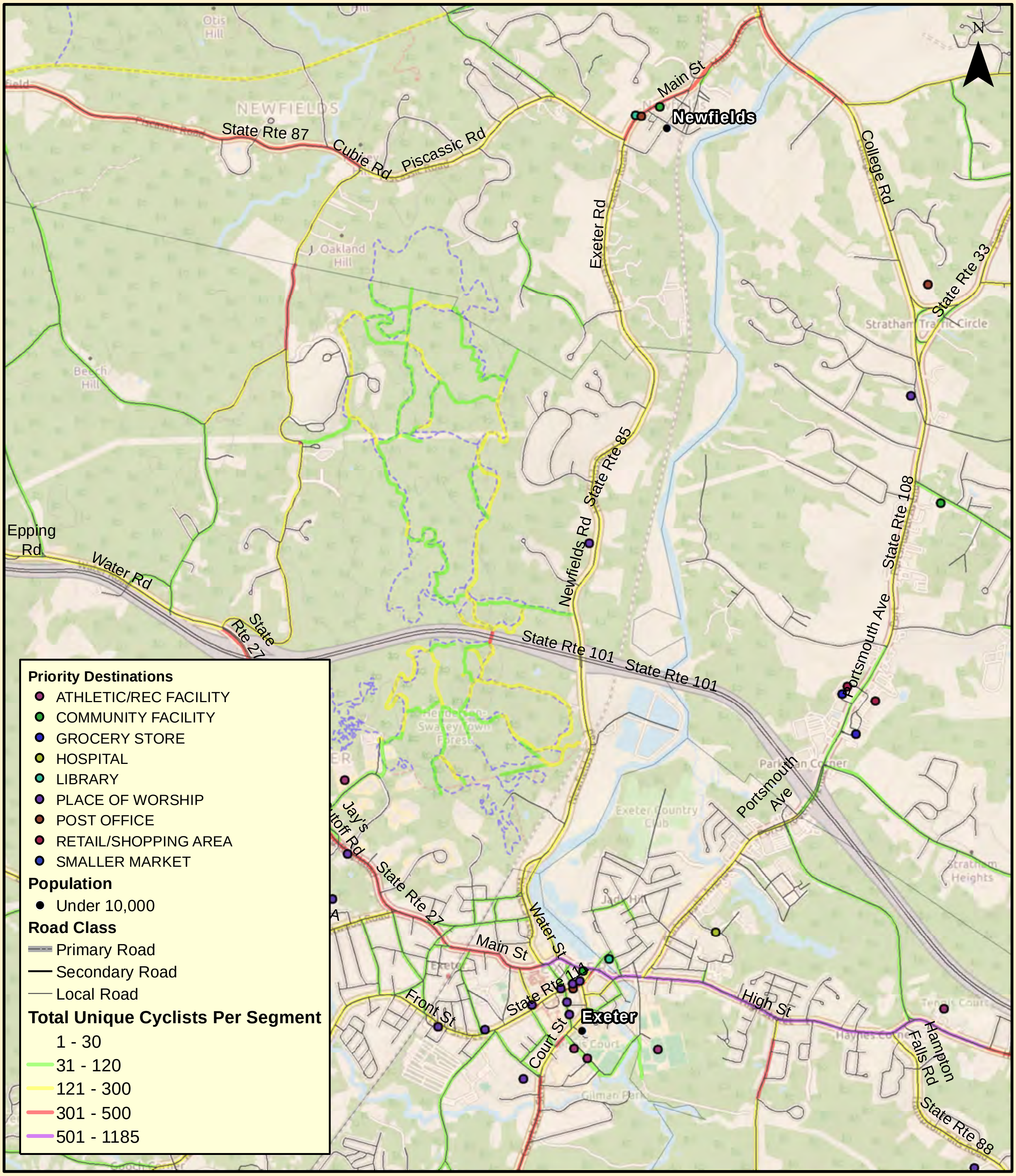
NRPC

0 0.04 0.08 0.16 0.24 0.32 Miles

1:6,000

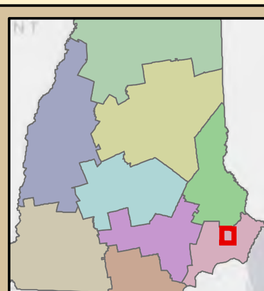
NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

N



Rockingham Planning Commission

Newfields - Exeter Connectivity



1:40,000

0 0.2 0.4 0.8 1.2 1.6 Miles

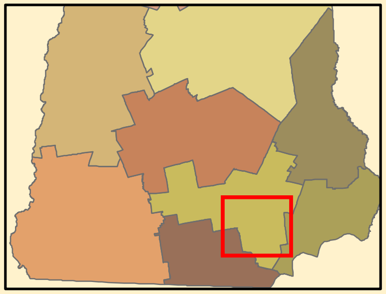
NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

RPC

Target: Rt. 108 to connect Newfields to Exeter
Contacts: No Response

As of 2013, Rt. 108 was delivering 15,000 vehicles per day to Exeter. Regional Master Plan has prioritized NH 87 shoulder widening between Exeter and Newfields. It appears that Rt. 85 is the preferred bicycle corridor between Exeter and Newfields.

Rt. 108 between Newfields and Exeter,
Rt. 85 between Newfields and Exeter



Population
- 100,000 - 499,999
- 50,000 - 99,999
- 10,000 - 49,999
- Under 10,000

Priority Destinations
- ATHLETIC/REC FACILITY
- COMMUNITY FACILITY
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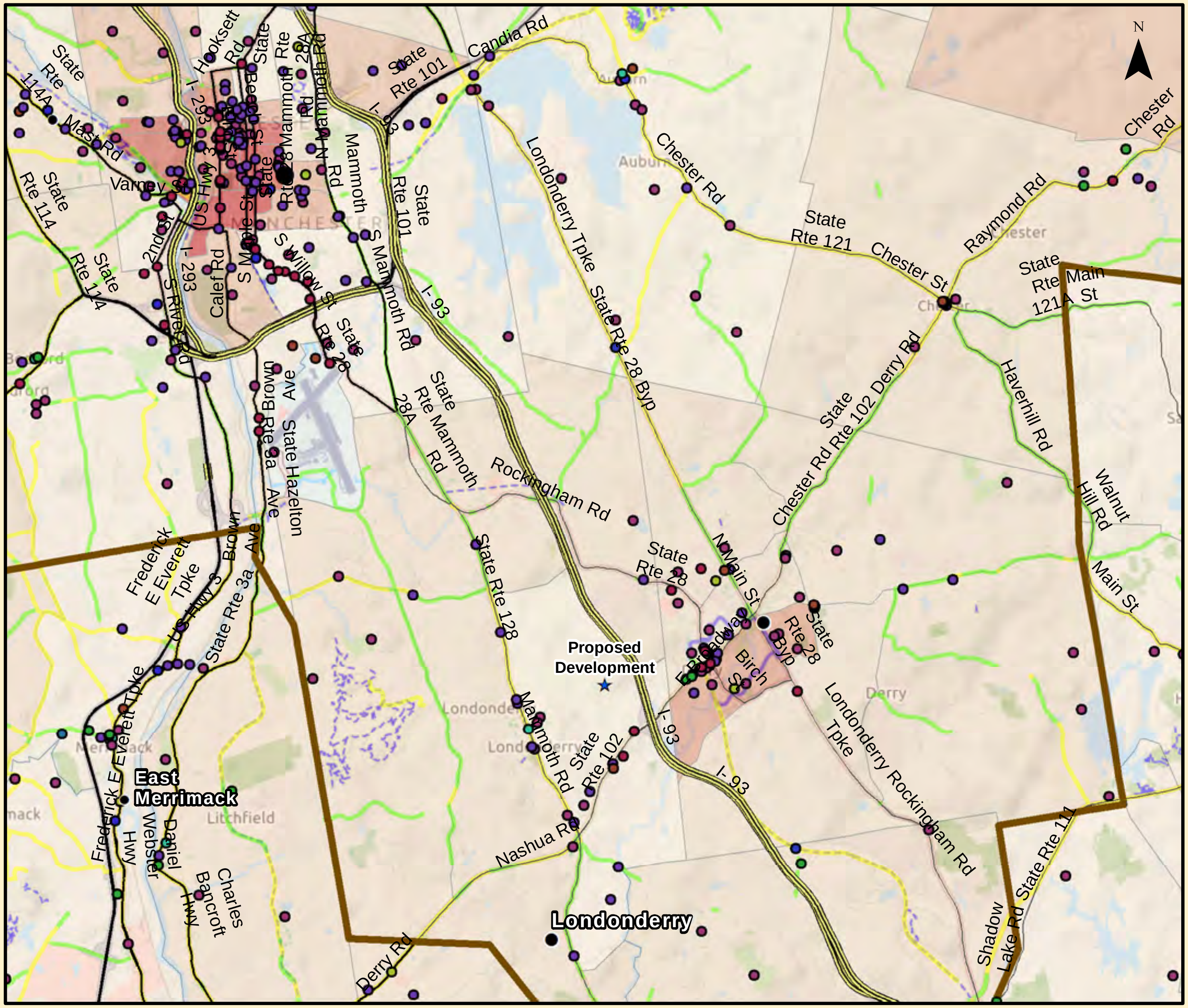
- GROCERY STORE
- HOSPITAL
- LIBRARY
- PLACE OF WORSHIP
- POST OFFICE
- RETAIL/SHOPPING AREA
- SCHOOL
- SMALLER MARKET
- TRAIL ACCESS POINT

Southern NH Planning Commission
- Boundary

Total Unique Cyclists Per Segment
- 1 - 70
- 71 - 100
- 101 - 350
- 351 - 700
- 701 - 1185

Road Class
- Highway
- Primary Road



Southern NH Planning Commission

Manchester, Derry, Londonderry

Connectivity Assessment

0 0.75 1.5 3 4.5 6 Miles

1:150,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

SNHPC

Target:
Derry-Londonderry-Manchester (Rt. 28 & Rt. 128)
Contacts:
Adam Hlasney, Transportation Planner
Bob Rimol, Londonderry Trailways
Will Stewart, Bike Manchester and Derry-Londonderry Chamber of Commerce

Conversation: A new 1.5 mile section of excellent quality rail trail was completed this year due to a large corporate donation. There is very high potential for increased use given better trail connectivity between Derry and Londonderry as well as a northwesterly connection around MHT airport through to the Manchester trail system. These projects are a high priority relative to other trail projects in our region.

As of next spring, the rail trail will run from Salem up through Windham and Derry. The rail trail ends at Hood Park, just south in Derry. It has spurred great economic development, ex. coffee shop and Italian restaurant (Economic development detailed in Visitor's Guide).

The rail trail picks up near Londonderry by exit 5 on hwy 93. This trail has been bolstered by private money and Conservation Commission funds. The largest boost to the Londonderry segment was a $350,000 allocation from Kinder Morgan (Newspaper Article). Additional miles are currently being paved in the direction of the Derry town line but questions remain about financing and land ownership. It is not yet certain how the connection will be made.

There is a 629 acre development called Woodmont Commons (Website) planned along Hwy I-93 off of exit 4A near Londonderry. Ground has already been broken across from exit 5. It is to be a mixed-use neighborhood with homes and businesses. Money has been approved by the DOT and it is included in a 10-yr. plan. The development includes land that is needed to connect the larger Granite State Rail Trail, however it is hoped that including this trail in the development may be in the spirit of the "mini town". At present, no MOU has been signed for the trail to be included in the development.

Challenges exist in routing the rail trail near the Manchester airport. Manchester Regional Airport's runways currently interfere with ideal routes for the rail trail. Trails will either have to be routed around the airport or use a combination of existing streets and bike lanes. Another round of funding will be needed to complete the extension of the S. Manchester trail to connect south Manchester to the Millyard.

There is 1 mile of bike lane striped on Rt. 128 from the Londonderry town line into Manchester.

Biggest concerns: Network connectivity and workable solutions that are cost-effective politically and financially. Liability and insurance where easements are concerned – landowners want to know how they can be protected. Issues are being discussed but need to be discussed more by policymakers at the town and state level. We understand the problems but need to determine how to overcome the challenges. It is difficult to ask the correct questions.

Would love to get hard, economic development data to help convince policymakers that active transportation development is a good investment. We know that people from as far away as CT currently travel to ride the rail trail. Visitor's guide.

Biggest barriers to bicycling in the region is a general lack of infrastructure and perceptions of lack of safety (greatest perceived barrier). Many individuals are not confident riders. The presence of bike racks and bike lanes plants the seed of “oh I could be doing this”. When there is a lack of bicycling infrastructure, it sends the message that the road is not designed for them to be bicycling.

Bicycle counts: Bike Manchester has assisted the planning commission over the past couple of Mays in Manchester and targets areas w/higher traffic volumes and bike crash data (most dangerous intersections and stretches of roads). They participate in National Bicycle Documentation Project. The Windham rail trail group has also been counting along the Derry-Windham section.

Social Vulnerability Index
Tract containing Derry:
- Overall Vulnerability (0-10): 5
- Themes: for poverty, the proportion is in the 90th percentile, for civilian unemployed, the proportion is in the 90th percentile, for no high school diploma, the proportion is in the 90th percentile, the proportion of single parent households is in the 90th percentile, for multi-unit housing, the proportion is in the 90th percentile

Tracts in Greater Derry and Londonderry:
- Overall Vulnerability (0-10): 1
- Themes: the proportion of persons aged 17 and younger is in the 90th percentile

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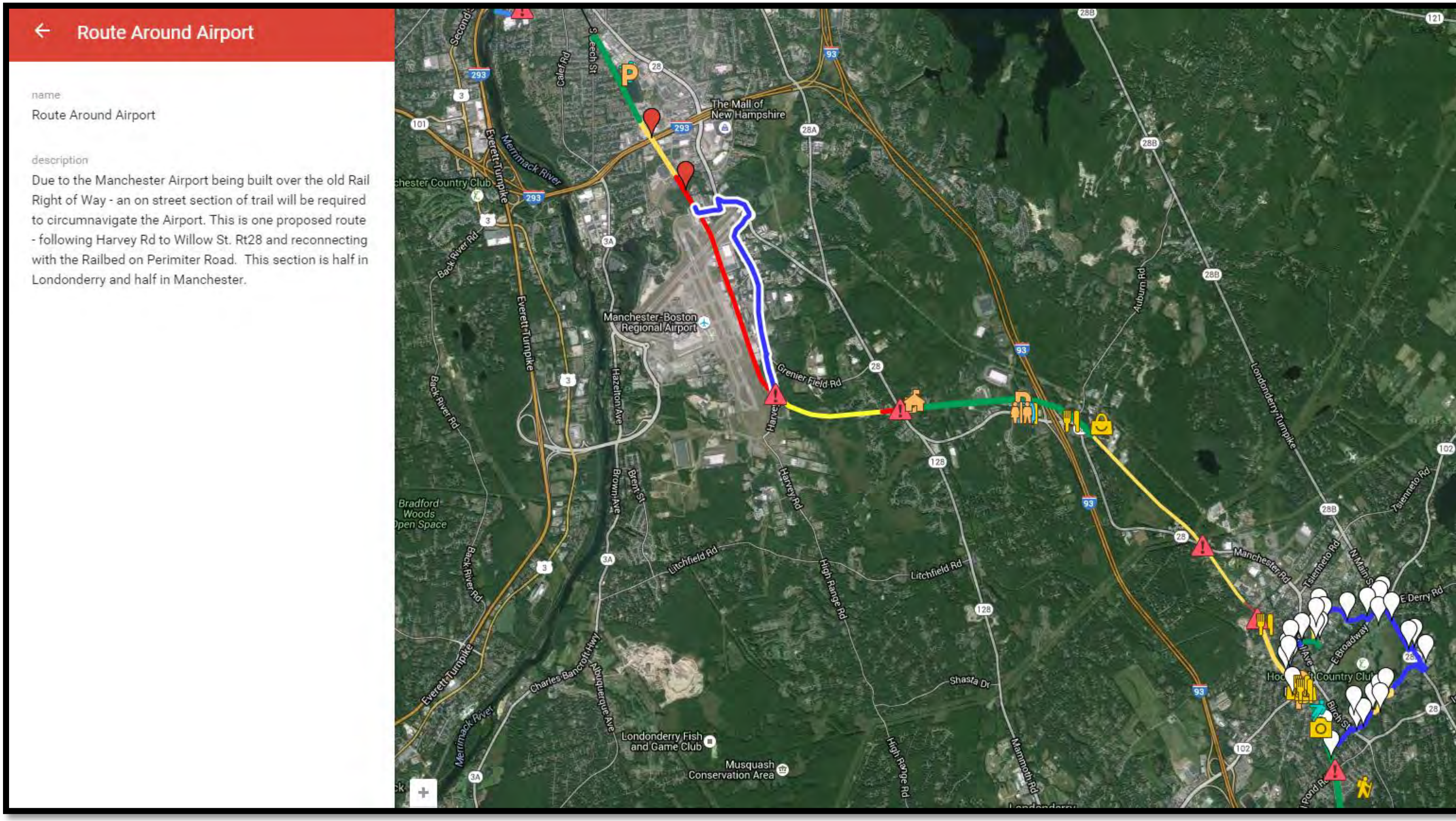


Yellow and Red lines indicate portions of trail that are not yet constructed.

Map Viewer Available [Here]

Population

- 100,000 - 499,999
- 50,000 - 99,999
- 10,000 - 49,999
- Under 10,000

Strafford Regional Planning Commission

- Boundary

Priority Destinations

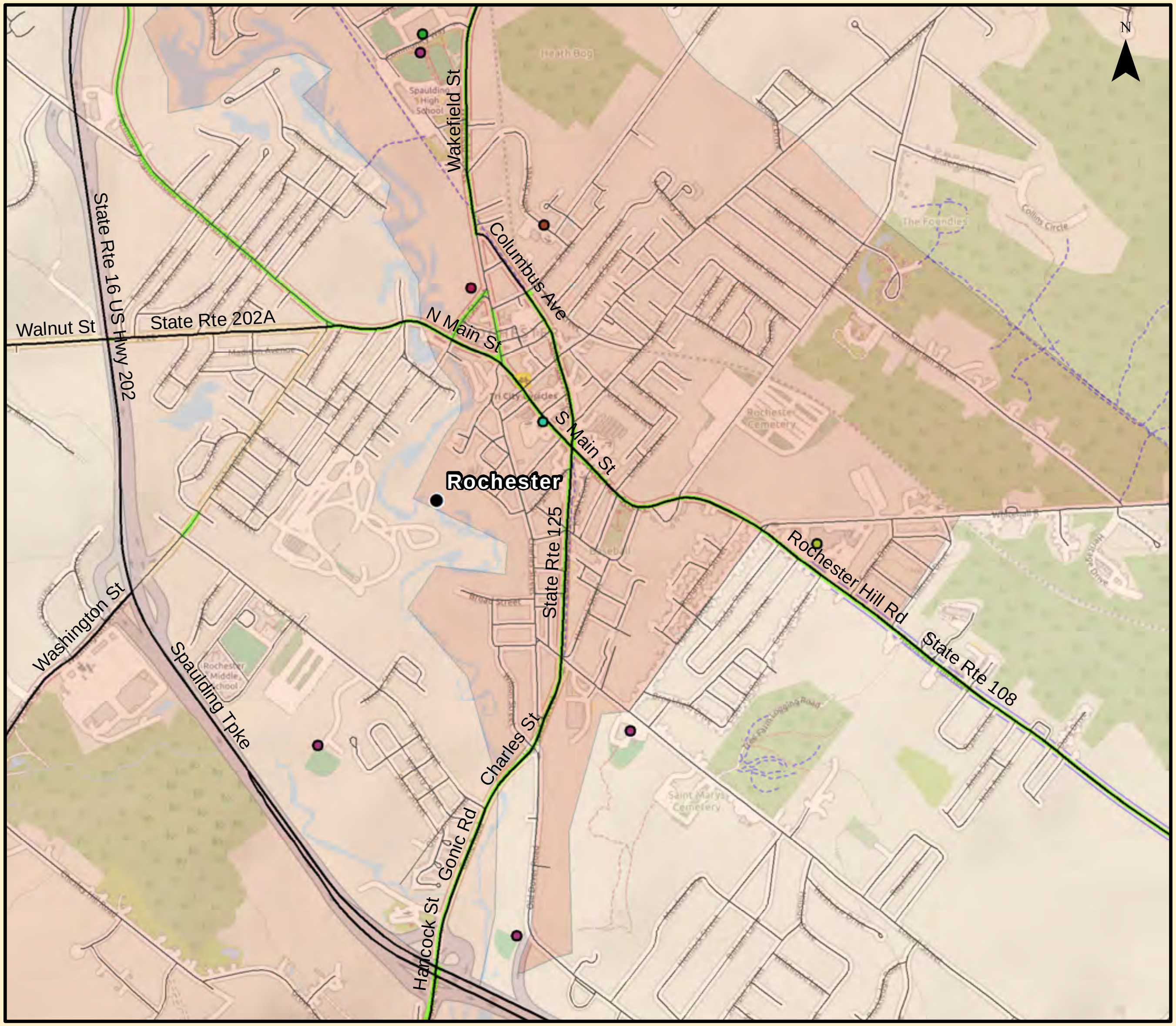
- ATHLETIC/REC FACILITY
- COMMUNITY FACILITY
- ESSENTIAL CITY FACILITY
- GROCERY STORE
- HOSPITAL
- LIBRARY
- PLACE OF WORSHIP
- POST OFFICE
- RETAIL/SHOPPING AREA
- SCHOOL
- SMALLER MARKET
- TRAIL ACCESS POINT

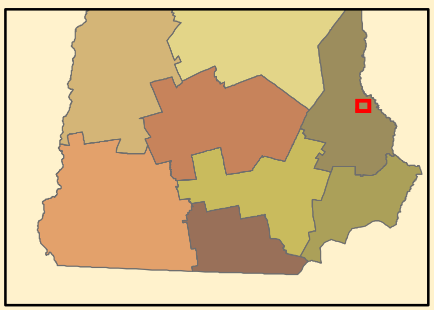
Road Class

- Primary Road
- Secondary Road
- Local Road

Total Unique Cyclists Per Segment

- 1 - 30
- 31 - 120
- 121 - 300
- 301 - 500
- 501 - 1185





Strafford Regional Planning Commission

Rochester North Main Street

Strafford REGIONAL PLANNING COMMISSION

0 0.15 0.3 0.6 0.9 1.2 Miles

1:26,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

SRPC

Target: Rochester - North Main Street from downtown and two intersections: where Congress St. and Wakefield come in on eastern side and Washington St. on west side
Contacts: Colin Lentz, Regional Transportation Planner

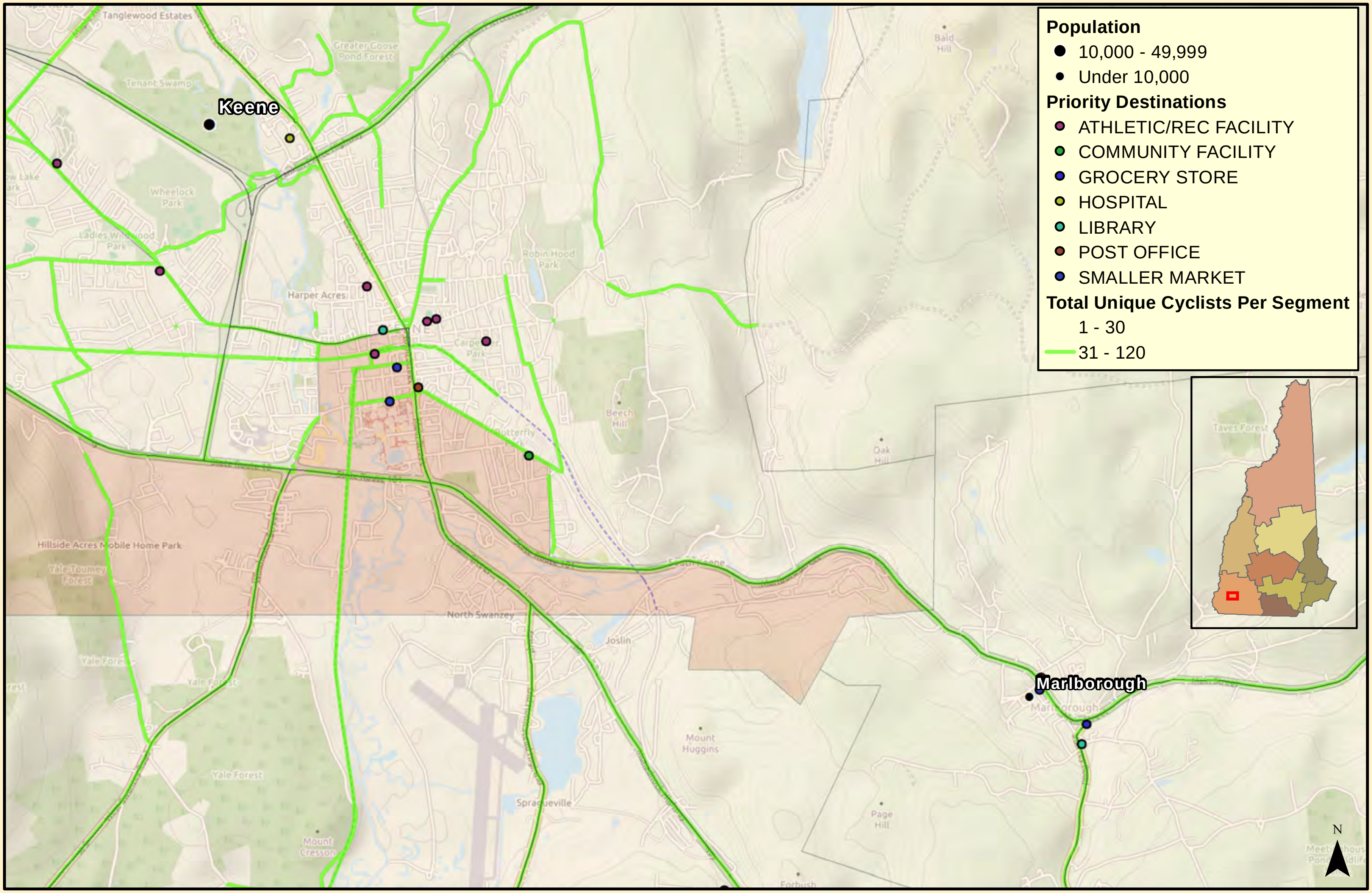
Conversation: The 10 yr. draft Complete Streets plan for this region will run a connection from the Weeks traffic circle in Dover up through Innovation Drive in Rochester. The original scope of this plan talked about bus pullouts, updated bicycle lanes, sidewalks, economic development opportunities, and accessibility. Draft plan crosses both urban and rural communities. The plan has been sent to Governor Hassen's office for consideration. Preliminary engineering on the project should begin in the fall of 2017. The FAST Act was recently signed, which should make additional funding more readily available for the project.

The Avis-Goodwin Community Health Center has excellent bus access but no means for pedestrians.

Additional Info: 2015-2024 DOT Draft Ten Year Plan intends to makes changes to 202A (Walnut Street) in Rochester and intersection improvements to improve safety.

Social Vulnerability Index
Central Rochester Tract:
- Overall Vulnerability (0-10): 4
- Themes: for per capita income, the proportion is in the 90th percentile, the proportion of single parent households is in the 90th percentile, for crowded housing, the proportion is in the 90th percentile, for no vehicle access, the proportion is in the 90th percentile

Google imagery indicates lack of bicycle-friendly infrastructure along Rochester's Main St.



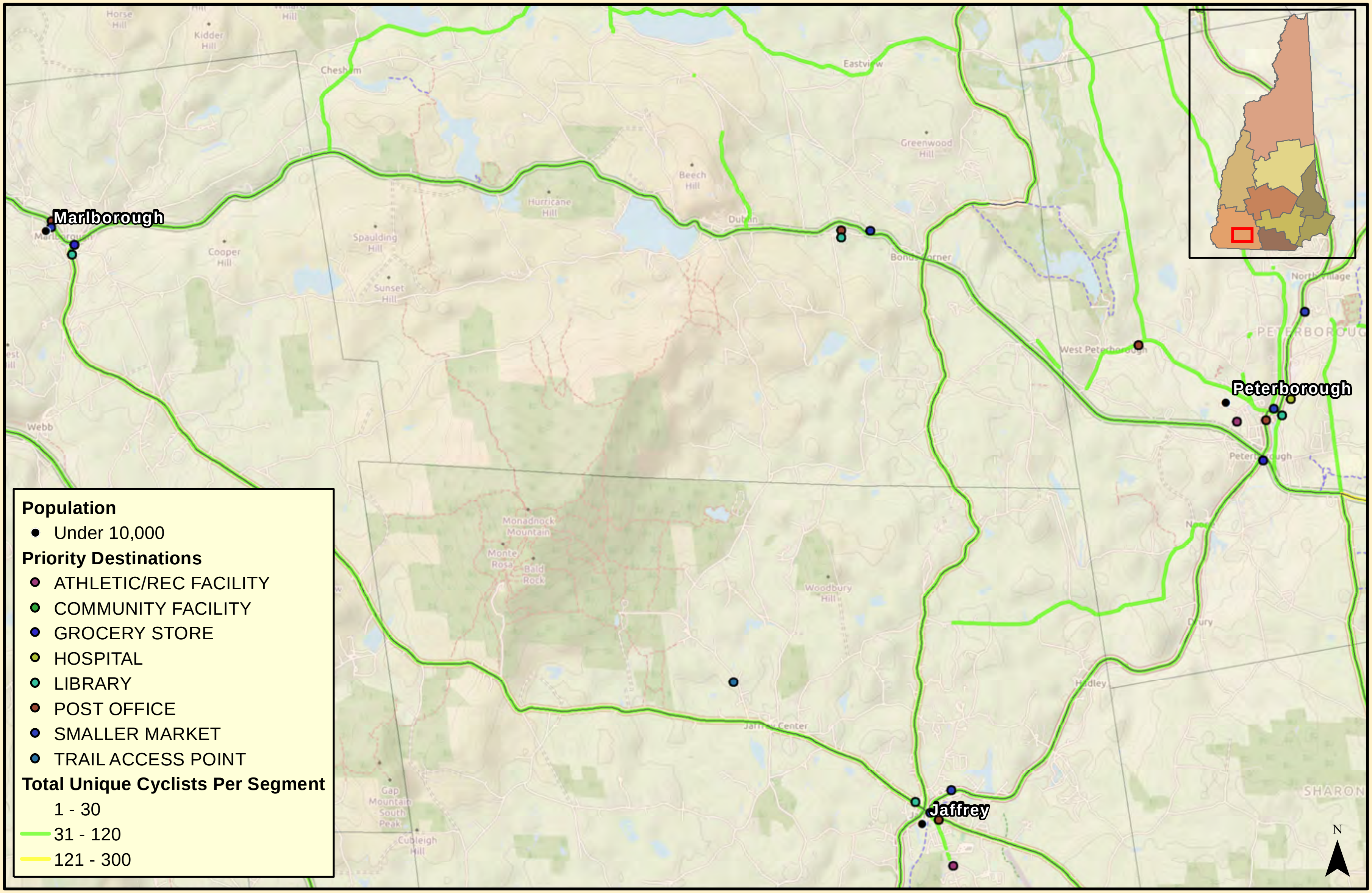
Southwest Region Planning Commission

Keene - Marlborough Connectivity

0 0.3 0.6 1.2 1.8 2.4 Miles

1:50,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US



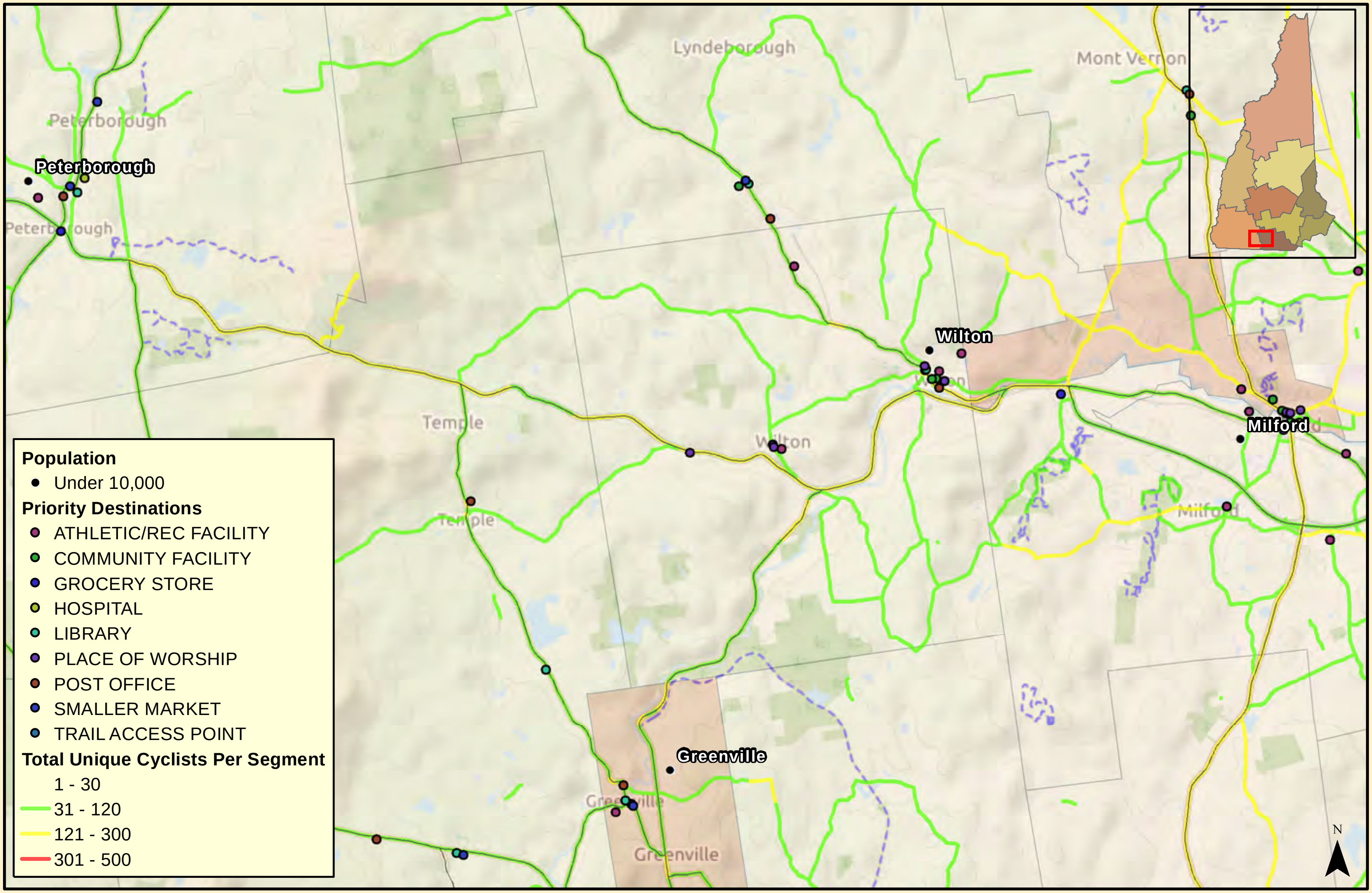
Southwest Region Planning Commission

Marlborough - Peterborough Connectivity

0 0.5 1 2 3 4 Miles

1:100,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US



Southwest Region Planning Commission

Peterborough - Milford Connectivity

0 0.5 1 2 3 4 Miles

1:115,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

SWRPC

Target: Rt. 101 connectivity between Keene, Marlborough, Peterborough, and Milford
Contacts: No Response

There are no existing rail trail that connect these communities. Adding bikeable miles is a stated priority of the Southwest Region Transportation Plan (2014-2035). There appear to be abandoned Rail Trail corridors north of Rt. 101 (See attached).

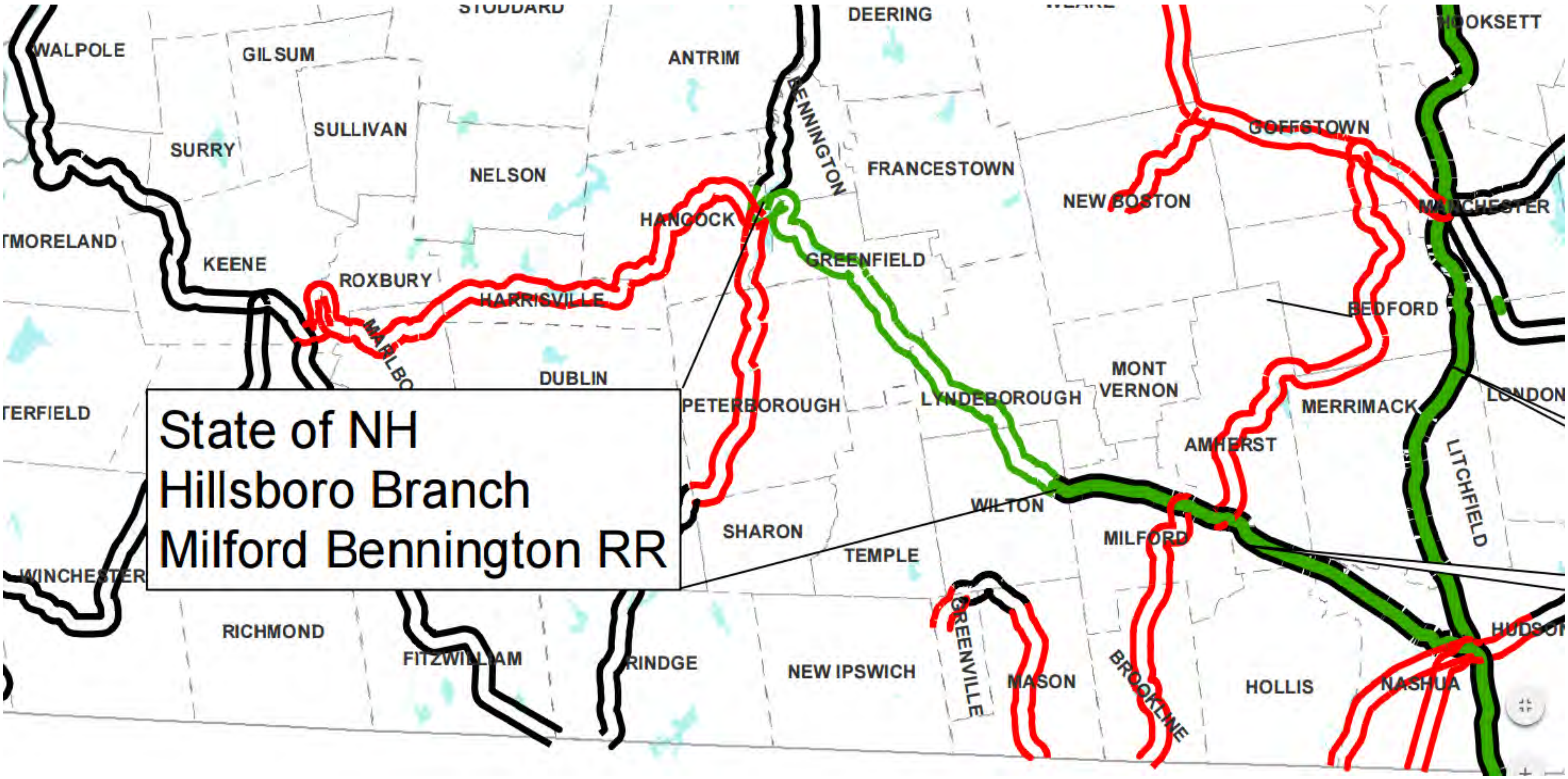
From the Southwest Region Transportation Plan (2014-2035):

- Attention is required towards the crossing of NH 101 from Marlboro Street to Ashuelot Branch Rail Trail as well as the Stone Arch Bridge crossing Branch Brook.
- Keene working on challenge of balancing land use and transportation considerations on Marlboro St., the gateway into Keene from the NH 101 E Corridor.
- Branch and Minnewawa Brooks reduce possibilities for transportation improvements in South Keene and Marlborough including NH 124 bridge at NH 101 intersection.
- Coordination between Marlborough and NHDOT required to balance needs of town village center with regional and state mobility requirements for NH 101.
- Significant incline and curvature in the Hurricane Hill area of NH 101 requiring constant snowplowing attention.
- The NH 101 East, US 202 North and US 202 South Corridors depend on a Contoocook Bridge crossing on NH 101/US 202 in Peterborough.
- A number of Southern NH Region towns use the NH 101 East Corridor to reach Keene, NH and other Southwest Region Planning Commission Towns. For some municipalities, however, even though the distance is shorter using NH 101, it requires a longer travel time than using NH 9.
- There are 4 foot shoulders for bicycling on NH 101 E Backbone Corridor
- Bicycling is accessible for approximately 2.0 mi in Keene, 6.7 mi in Marlborough, and 6.2 mi in Peterborough
- See Attachments

Social Vulnerability Index
Keene Tract:
- Overall Vulnerability (0-10): 4
- Themes: for poverty, the proportion is in the 90th percentile, for civilian unemployed, the proportion is in the 90th percentile, for per capita income, the proportion is in the 90th percentile, the proportion of persons in institutionalized group quarters is in the 90th percentile

Milford Tract:
- Overall Vulnerability (0-10): 3
- Themes: the proportion of persons aged 17 and younger is in the 90th percentile, for limited English, the proportion is in the 90th percentile, for crowded housing, the proportion is in the 90th percentile

Rt. 101 between Keene and Marlborough, Rt. 101 between Peterborough and Marlborough, and Rt. 101 between Peterborough and Milford



Red indicates abandoned railroads. Black indicates State of NH Inactive railroads.

Towns: Dublin, Greenville, Harrisville, Keene, Marlborough, New Ipswich, Peterborough, Sharon, Temple

Nodal Centers: Greenville Village, Keene, Marlborough Village, and Downtown Peterborough

Corridor Backbone: NH 101 from NH 9/10/12/101 in Keene to Temple/Wilton Town Line

Highway Corridor System:
Source: NHDOT

Towns	Principal Arterials	Minor Arterials	Major and Urban Collectors	Minor Collectors
Dublin	NH 101			Chesham Rd
				Beech Hill Rd
				NH 137
Greenville			NH 31	NH 45
			NH 124	NH 123
Harrisville				NH 137
				Chesham Rd
				Breed Rd
				Nelson Rd
				Main St/Dublin Rd
Keene	NH 101	Winchester St East of Main St		
		Optical Ave		
Marlborough	NH 101		NH 124	
New Ipswich			NH 123	NH 45
				NH 123
			NH 124	NH 123A
				Ashby Rd
Peterborough	NH 101		NH 123	
Sharon			NH 123	Nashua Rd
			NH 124	
Temple	NH 101			NH 45
				W Rd

Transportation Infrastructure and Services:
Source: NHDOT and SWRPC

	Examples	Locations Where Accessible
Pedestrian	Sidewalks	Dublin, Greenville Village, Keene, Marlborough Village, Peterborough, Downtown Peterborough, New Ipswich
	Manchester and Keene Branch Rail Trail and Greenville Rail Trail	Harrisville, Greenville Village
Bicycle	4 foot Shoulders on NH 101 E Backbone Corridor	~2.0 mi in Keene, ~ 6.7 mi in Marlborough, ~3.3 mi in Dublin, ~6.2 mi in Peterborough; Temple
Demand Response Bus	Para Express, Friendly Bus	Keene
Volunteer Drivers	American Red Cross, Contoocook Valley Trans. Co. (CVTC)	All Locations
Ridesharing Program	CVTC	
Intercity Bus	Greyhound Bus Lines	Keene

*No Fixed Route Bus, Railroad Services or Airport Available on Corridor.

NH 101 EAST POPULATION

Population Projections:
Source: US Decennial Census & NHOEP

Communities	2010	2040	% Change in Population	Total Population Change
Dublin	1,597	1,724	8.0%	127
Greenville	2,105	2,022	-3.9%	-83
Harrisville	961	834	-13.2%	-127
Keene	23,409	24,260	3.6%	851
Marlborough	2,063	2,116	2.5%	53
New Ipswich	5,099	6,148	20.6%	1,049
Peterborough	6,284	6,898	9.8%	614
Sharon	352	352	0.0%	0
Temple	1,366	1,479	8.3%	113
NH 101 East Corridor	43,236	45,832	6.0%	2,596
SWRPC Region	102,313	108,168	5.40%	5,855

Special Populations:
Sources: US Census, 2010 Decennial Census, (Table QT-P2); ACS 2007-2011 5 Year Estimate (Table S1701); US Census Bureau, 2010 Decennial Census, (Table P39)

	All Corridor Communities	Proportion of Corridor Population	Communities with Above Average proportion of Special Populations
Youth (Age 15 and Under)	7,251	17%	Dublin (18%); Greenville (19%); Greenville Village (20%); Marlborough Village (19%); New Ipswich (25%);, Peterborough (19%); Temple (18%)
Young Adults (Age 16-34)	12,493	29%	Keene (37)
Middle Age (Age 35-64)	16,950	39%	Dublin (48%); Greenville (45%); Greenville Village (43%); Harrisville (54%); Marlborough (45%); Marlborough Village (40%); New Ipswich (43%);, Peterborough (42%); Sharon (51%); Temple (51%)
Seniors (65 and older)	6,542	15%	Dublin (16%); Harrisville (19%); Marlborough (17%); Marlborough Village (17%); Peterborough (22%); Downtown Peterborough (26%); Sharon (16%)
Racial Minorities	1,674	4%	Keene (5%)
Low Income (Population at or under 150% of Poverty Level)	7,522	17%	Greenville (22%); Greenville Village (30%); Keene (22%); Downtown Peterborough (20%); Temple (25%)
Single Parent Households	3,124	31%	Greenville (42%); Greenville Village (46%); Keene (36%); Marlborough Village Center (38%); Peterborough (33%); Downtown Peterborough (40%)

Traffic Volume Change500 AADT or Greater
Source: NHDOT

Facility	Town	Description	AADT	Date Range	AADT Change
NH 101	Dublin	NH 101 WEST OF OLD HARRISVILLE RD	5,300	2006-2012	-700
NH 101	Dublin	NH 101 WEST OF NH 137	6,700	2006-2012	-600
NH 101	Dublin	NH 101 EAST OF CHURCH ST	6,400	2006-2012	-600
NH 31	Greenville	NH 31 AT WILTON TL	3,900	2006-2012	-500
NH 101	Keene	NH 101 EAST OF OPTICAL AVE	14,000	2006-2012	1000
NH 101	Keene	NH 101 EAST OF MAIN ST	12,000	2005-2011	1000
NH 101	Marlborough	NH 101 EAST OF CANADA ST	12,000	2006-2012	-1000
NH 101	Marlborough	NH 101 EAST OF ROXBURY RD	7,400	2005-2011	-500
NH 101	Marlborough	NH 101 EAST OF NH 124	8,200	2005-2011	-1,200
NH 101	Marlborough	NH 101 AT DUBLIN TL	6,700	2006-2012	-600
NH 123	New Ipswich	NH 123 AT GREENVILLE TL	2,500	2005-2011	700
NH 123	New Ipswich	NH 123/NH 124 WEST OF CURRIER RD	4,900	2005-2011	600
NH 123/ NH 124	New Ipswich	NH 123/NH 124 AT SOUHEGAN RIVER	5,200	2006-2011	600
NH 101	Peterborough	NH 101 AT DUBLIN TL	6,500	2007-2010	-600
NH 101	Peterborough	NH 101 AT TEMPLE TL	7,500	2006-2012	700
NH 101	Peterborough	NH 101 WEST OF GROVE ST	9,100	2006-2012	800

Proportion of Daily Traffic by Vehicle Class at NH 101 East Corridor System Locations:
Source: SWRPC

Community	Traffic Count Location Description	Month/Year	Daily Traffic Volume	Motorcycles, Cars, Light Duty Trucks	Buses and Single-Unit Trucks	Trailer Trucks
Peterborough	NH 101 at Temple TL	7/2012	8,684	95.2%	2.7%	2.1%
Dublin	NH 101 E of Church St	6/2012	3,516	95.4%	3.1%	1.5%
Keene	NH 101 E of Optical Ave	9/2014	13,471	95.2%	3.2%	1.6%
Keene	Optical Ave N of NH 101	8/2014	6,716	97.3%	2.1%	0.6%
Keene	NH 101 W of Winchester St	6/2008	26,850	94.2%	3.5%	2.3%

Peak Hour Ridesharing (am & pm peak hours combined) :
Source: SWRPC

Location & $/gallon	Month/ Year	Total Vehicles	Average Vehicle Occupancy	% People Ridesharing	% Vehicles with Ridesharers
NH 101 E of NH 45 $3.660/gallon	7/2014	1,229	1.22	33%	18%
NH 101/US 202 in Peterborough $3.635/gallon	7/2014	2,258	1.27	39%	22%
NH 101 East of Optical Ave $3.604/gallon	9/2013	2,271	1.18	29%	16%

Corridor Communities Registered Vehicles:
Source: NHDES

Total Registered Vehicles	Ratio of Vehicles to Population	Motorcycles and Passenger Vehicles Excluding Electric or Hybrid	Passenger Vehicles Hybrid or Electric	Light Duty Trucks and SUVs	Buses and Single Unit Trucks	Heavy Duty Trucks
34,169	0.79	73.72%	0.11%	23.98%	1.89%	0.30%

Cross Commuting Patterns Among Corridor Communities

		Destination							
		Dublin	Greenville	Keene	Marlborough	New Ipswich	Peterborough	Sharon	Temple
Origin	Dublin	32	0	212	14	0	68	1	0
	Greenville	0	31	0	0	0	2	0	5
	Keene	25	0	4,667	106	12	123	0	2
	Marlborough	0	0	304	35	0	35	0	0
	New Ipswich	0	0	64	0	333	207	9	0
	Peterborough	20	2	207	4	40	800	0	3
	Sharon	0	4	2	0	22	15	1	4
	Temple	0	5	19	1	0	46	1	6

Source: Longitudinal Housing – Employment Dynamics, Primary Jobs, 2011

Communities with Over 50 employees commuting to NH 101 East Communities and Likely Using NH 101 East

Employee Origin	Number	Employee Destination
Marlborough	304	Keene
Dublin	213	Keene
Peterborough	207	Keene
New Ipswich	207	Peterborough
Jaffrey	201	Keene
Nashua	185	Keene
Harrisville	140	Keene
Keene	123	Peterborough
Keene	106	Marlborough
Milford	91	Keene

Employee Origin	Number	Employee Destination
Milford	81	Peterborough
Temple	78	New Ipswich
Dublin	68	Peterborough
Greenville	66	New Ipswich
New Ipswich	64	Keene
Hudson	59	Keene
Jaffrey	59	New Ipswich
Manchester	56	Peterborough
Swanzey	54	Peterborough
Rindge	52	New Ipswich

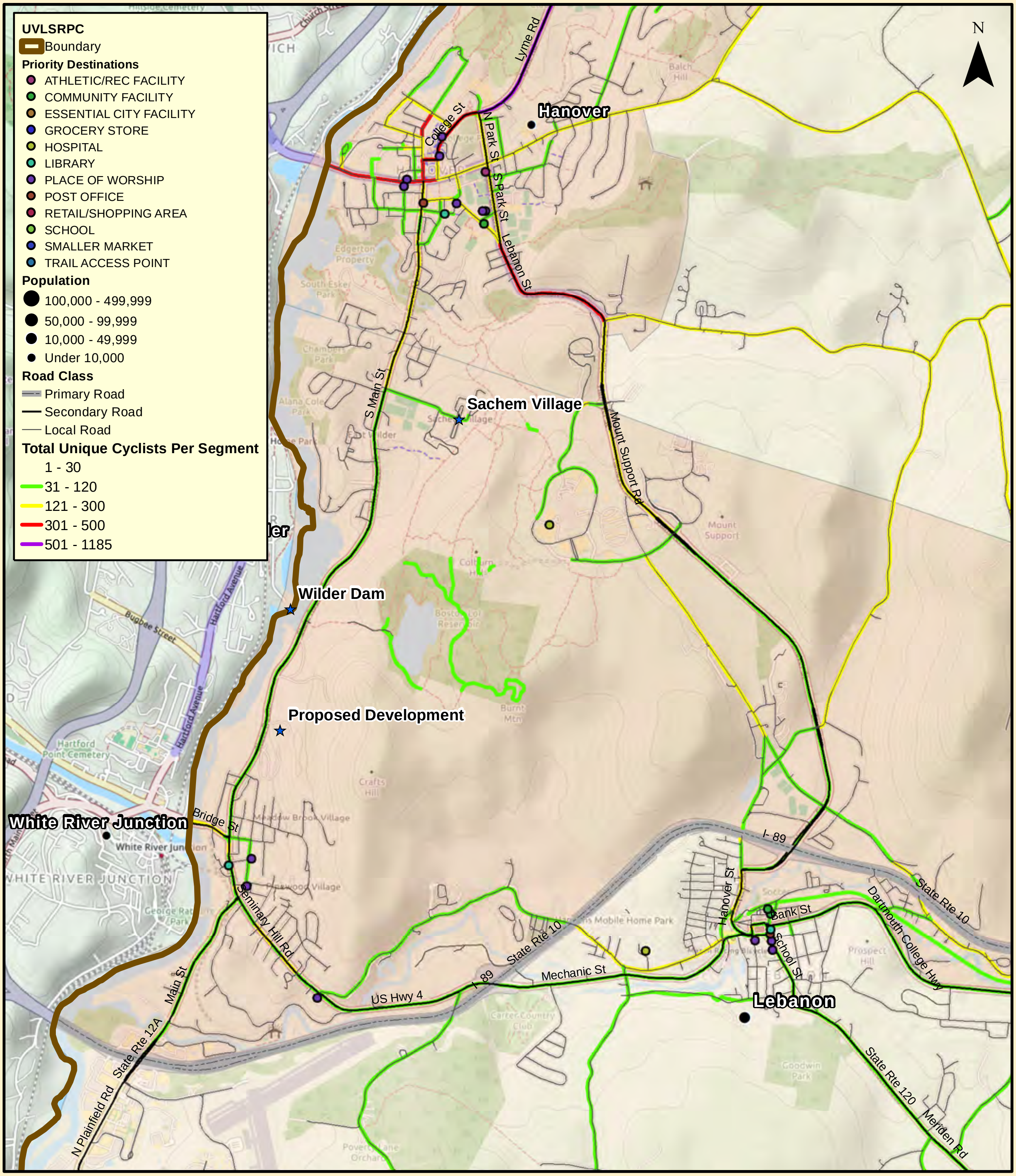
Sources: Longitudinal Housing – Employment Dynamics, Primary Jobs, 2011 and Google Maps

Jobs, Employers, and Unemployment Rates

Sources: [1]Longitudinal Housing -Employment Dynamics, Primary Jobs, 2011; [2]NH Department of Employment Security, 2012; [3]NH Department of Employment Security, August 2013.

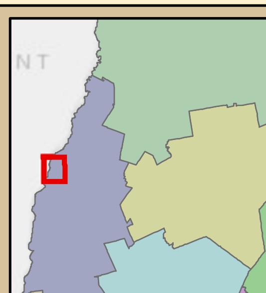
Community	Total Jobs	Total Institutions	Unemployment Rate
Dublin	291	53	4.4%
Greenville	208	35	6.5%
Harrisville	136	19	3.3%
Keene	16,946	864	5.7%
Marlborough	415	54	4.0%
New Ipswich	1,125	110	6.1%
Peterborough	4,368	305	4.7%
Sharon	20	N/A	2.6%
Temple	109	N/A	6.5%

Performance Measure Category	Measure	Units	NH 101 East Only	NH 101 East Corridor System	Target 2017
	Red Listed Bridges	Red list bridge number: total bridges	1 / 16	4 / 40	2
	Rail lines capable of speeds of 40 mph	miles: total miles	N/A	N/A	N/A
	Airport Runway Surface conditions	average condition	N/A	N/A	N/A
	Remaining useful life of transit buses	% of vehicle life remaining	N/A	N/A	N/A
Improve Safety	Crashes Involving Fatalities (5 year moving average 2008-2012)	Number	3	6	0
	Crashes Involving Incapacitating Injuries (5 year moving average 2008-2012)	number	19	39	10
Improve Mobility	PM peak hour volume/capacity ratio range	Volume to capacity	.19-.76	N/A	Under .62
Improve Multimodal Accessibility*	Intermodal Facility	number	0	0	Additional Study Required
	Sidewalks	miles	Inventory in progress	Inventory in progress	
	Bikeways	miles			
	# of park and ride lot spaces	number	0	0	
	Public transportation routes	miles	.5	.5	
	Intercity bus routes	miles	27.2	27.2	



Upper Valley-Lake Sunapee Regional Planning Commission

Hanover - Lebanon Rt. 10 Connectivity



1:50,000

0 0.25 0.5 1 1.5 2 Miles

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

UVLSRPC

Target: Route 10, Lebanon to Hanover
Contacts: Adam Ricker, Assistant Planner
David Brooks, Director of Planning & Zoning for City of Lebanon

Conversation: Hanover to Old West Lebanon on Rt. 10 is a concern, especially the northern portion. In Lebanon, Sachem Village houses many active, bicycle-friendly students. Advanced transit is very active on Rt. 10 at Gould Rd. (Sachem Village) as there are many multi-modal users. There is a section from Sachem Village into West Lebanon where walking along the road can be hairy as there is a high volume of traffic. Along Old West Lebanon (residential area) there are a few apartment villages that are popular with graduate students – produces Rt. 10 traffic up to Hanover. There are a few retirement villages along the corridor, however few bicycles are seen (elderly ridership). South, around Wilder Dam there is Boston Lake access with many recreational bike trails and a conservation area. It appears that many people from northern Rt. 10 travel south to access these areas. There is a large open space along the Connecticut River next to Allard's Furniture known as "River Park". There are plan to develop this into a multi-use complex (already approved). There are specific DOT requirements associated with this development, however only a small portion of the road will likely be updated. There are many bus routes along the road but no known plans for bicycle-friendly improvements along this route.

In general, there is a very narrow shoulder along this section of road (mostly < 2 ft., 3 ft. in best of cases). As the road nears the Connecticut River, it gets funky and narrow. It is recommended that this route be examined .5 - .75 mi. into downtown Old West Lebanon (after Rt. 4) as this area is a large hub for business and transit. This area is tight and dangerous as traffic gets backed up through Main St. The road splits at Rt. 4 and Rt. 10 into Lebanon and there are mostly commercial plazas. Look at the road up to Rt. 12A as this is a natural cutoff point.

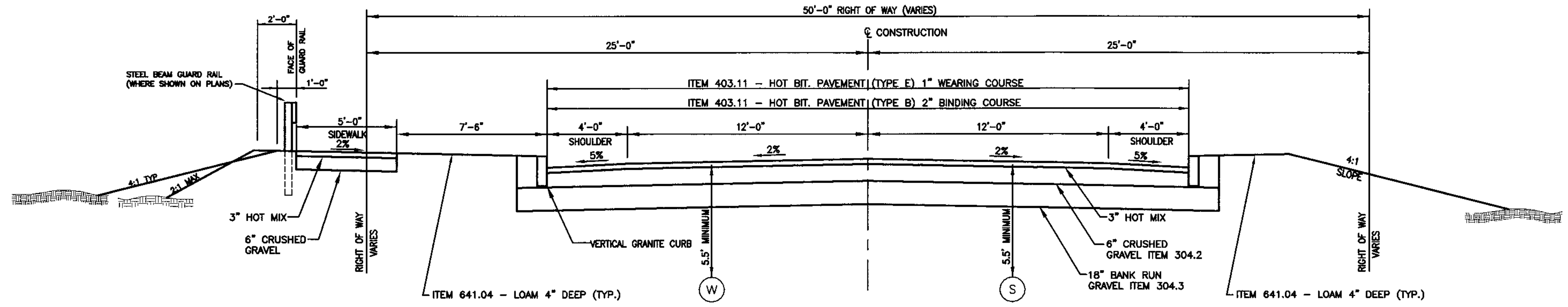
David Brooks: Basically, the proposal was for a 2 lane cross-section between the development entrances widening to 3 lanes with dedicated right and left turn lanes at the intersections. The proposed travel lane widths were 12 feet with a 2-foot shoulder on the westerly side and 4 feet on the east side. The Planning Board, in condition #1b, required the applicant to narrow the vehicle travel lanes (but not the center turn lane) from 12 to 11 feet and to use the extra 2 feet gained to widen the southbound shoulder to 4 feet to improve safety for bicyclists since Route 10 is a designated bike route by the State and RPC. Although there was some question by the State, they have now accepted this plan for the improvements in lieu of other mitigation requirements for the applicant.

Traffic counts were conducted on a stretch of road near Wilder Dam indicating approximately 6,000 vehicles/day. Traffic counts at the Hanover town line indicated approximately 6,300 vehicles/day in 2013, 6,700 vehicles/day in 2010, and 6,900 vehicles/day in 2009.

Social Vulnerability Index
Tract containing Sachem Village:
- Overall Vulnerability (0-10): 2
- Themes: the proportion of minority is in the 90th percentile, the proportion of persons in institutionalized group quarters is in the 90th percentile

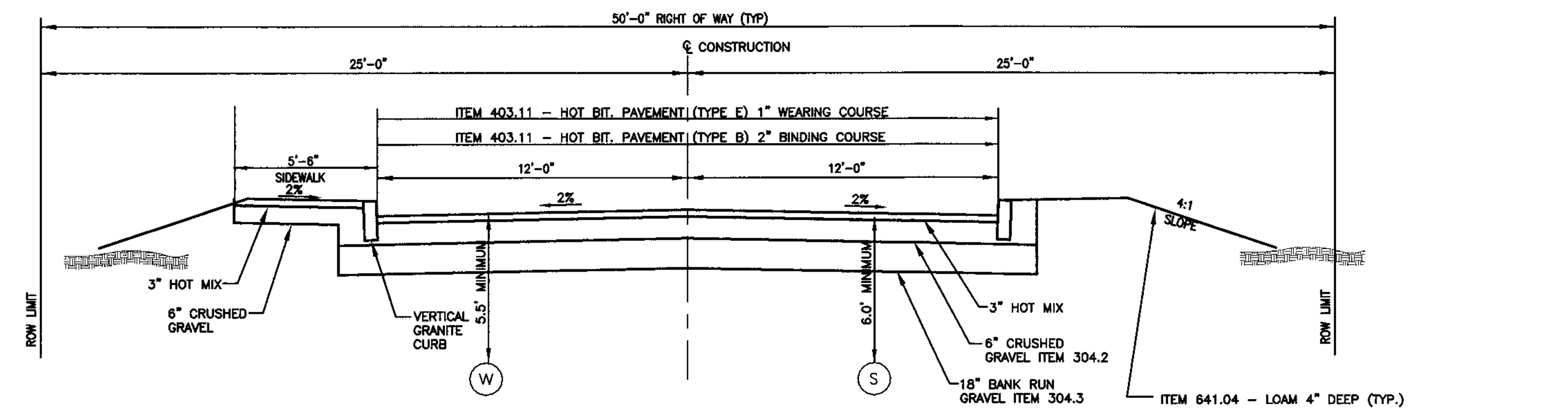
Tract Containing Hanover:
- Overall Vulnerability (0-10): 2
- Themes: the proportion of minority is in the 90th percentile, the proportion of persons in institutionalized group quarters is in the 90th percentile

Google imagery views of the southern portion of Rt. 10 and northern segment of Rt. 10, near Sachem Village.



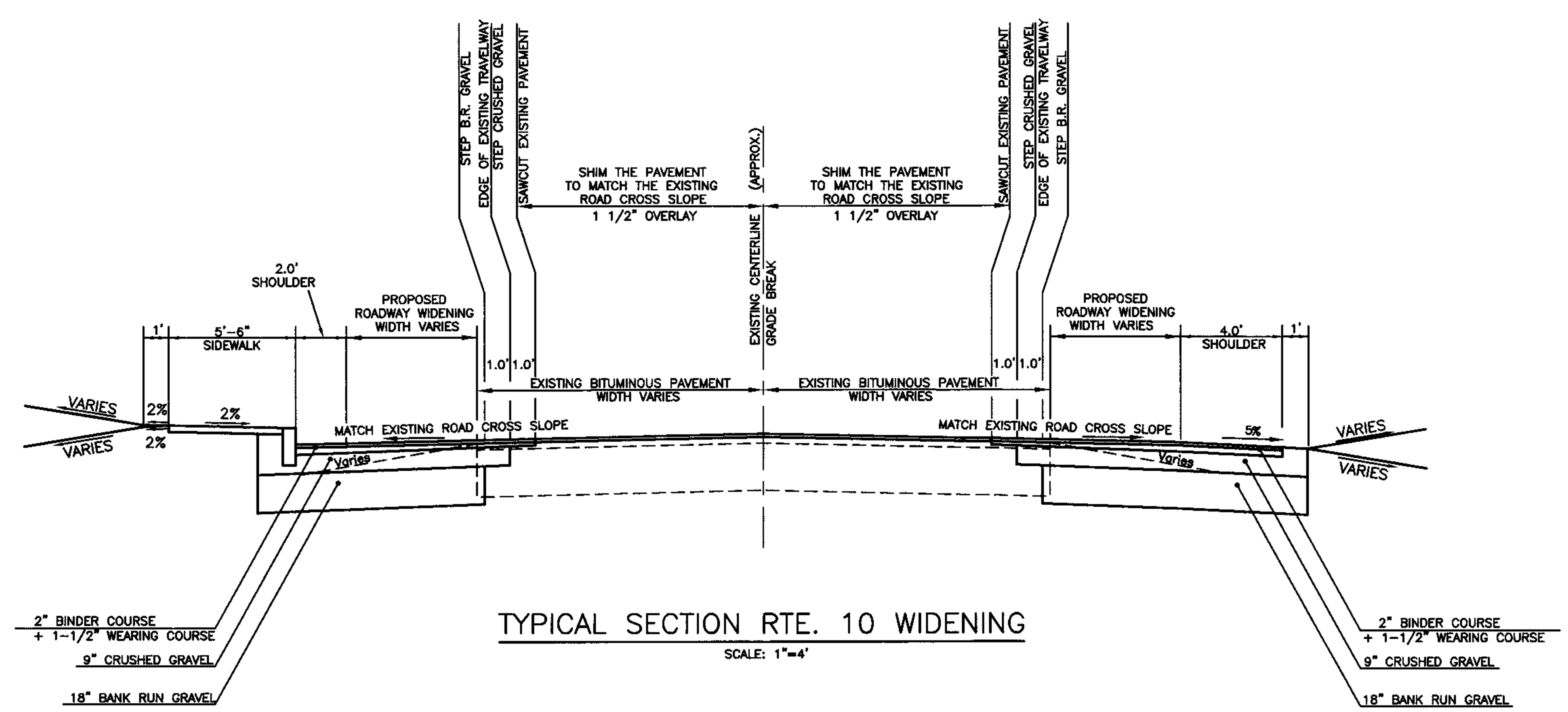
TYPICAL SECTION–RIVER PARK DRIVE

SCALE: 1"=4'



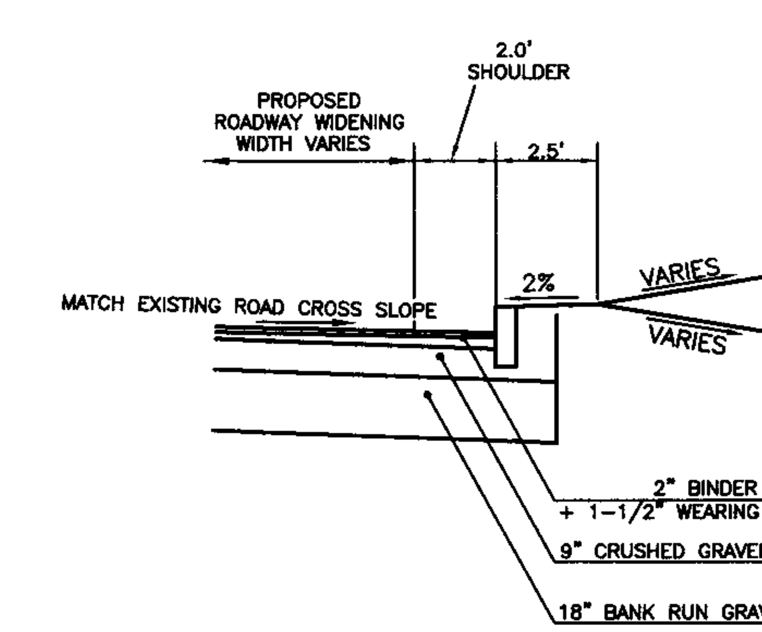
TYPICAL SECTION–CRAFTS AVE. EXTENSION

SCALE: 1"=4'



TYPICAL SECTION RTE. 10 WIDENING

SCALE: 1"=4'



NOTES:

1. ROADWAY MATERIALS AND CONSTRUCTION SHALL MEET THE LATEST EDITION OF STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION BY THE NH DEPARTMENT OF TRANSPORTATION. THE DENSITY OF SELECT MATERIALS AND SUBGRADE PREPARATION SHALL NOT BE LESS THAN 95% OF THE MAXIMUM DENSITY IN ACCORDANCE WITH N.H.D.O.T. SPECIFICATIONS.
2. REMOVE ALL LOAM, CLAY, MUCK, STUMPS, AND OTHER IMPROPER ROAD FOUNDATION MATERIAL WITHIN 3' OF SUBGRADE. REPLACE WITH COMPACTED GRANULAR FILL MATERIAL. COMPACTION TO BE AT LEAST 95% OF THE DRY WEIGHT AS DETERMINED BY MODIFIED TESTING (ASTM 1557)
3. UNDERDRAIN PIPE SHALL BE PROVIDED IN ALL AREAS WHERE THE SEASONAL HIGH WATER TABLE IS WITHIN 5 FEET OF FINISH GRADE, THE PIPE SHALL DISCHARGE THROUGH A MORTARED RUBBLE MASONARY HEADWALL, OR INTO A CATCH BASIN.
4. CONTRACTOR TO OBTAIN AN EXCAVATION PERMIT FROM THE TOWN PRIOR TO ANY CONSTRUCTION WITHIN A TOWN ROW.
5. CONTRACTOR TO COORDINATE WITH TOWN ENGINEERING FOR INSPECTION REQUIREMENTS. A PRECONSTRUCTION MEETING IS REQUIRED PRIOR TO INITIATING CONSTRUCTION.
6. ALL WORK PERFORMED IN THE TOWN RIGHT OF WAY SHALL CONFORM TO THE REQUIREMENTS OF THE LATEST EDITION OF THE CITY OF LEBANON CONSTRUCTION STANDARDS.

HOLDEN ENGINEERING & SURVEYING, Inc.

56 Old Suncook Road – Unit #4
PO Box 480 Concord, N.H. 03302
(603) 225-6449

9 Constitution Drive
Bedford, N.H. 03110
(603) 472-2078

ROADWAY SECTIONS
RIVER PARK
LEBANON, NEW HAMPSHIRE

Date:	Revisions Description	Dr. By	Chk. By
07/27/10	ADDRESS CITY COMMENTS	MK	JH

Book | Page

Date: 05-10-10
Scale: AS SHOWN
Dr. By: MK Ck By: BT
Job No. 1020132
Sheet no 66 of 67

HOLDEN ENGINEERING & SURVEYING, inc.

56 Old Suncook Road - Unit #4
PO Box 480 Concord, N.H. 03302
(603) 225-6449

9 Constitution Drive
Bedford, N.H. 03110
(603) 472-2078

ROUTE 10 IMPROVEMENT PLANS
RIVER PARK
LEBANON, NEW HAMPSHIRE

Date	Revisions Description	Dr. By	Chk. By
07/27/10	ADDRESS CITY COMMENTS	MK	JH
01/04/11	REVISED PER CITY ENGINEER COMMENTS	MK	BT
01/18/11	REVISED PER CITY ENGINEER COMMENTS	MK	BT

Book | Page

Date: 06-10-10
Scale: 1"=50'
Dr. By: MK Ck By: BT
Job No. 1020132
Sheet no 19 of 67

J:\DWG\CADD\SUBDIVISION SET\RTE 10 IMPROVEMENTS.DWG

NOTICE OF ACTION
LEBANON PLANNING BOARD

Notice is here by given that on **May 19, 2011** the following action was taken by a majority of the Lebanon Planning Board in accordance with the City of Lebanon Subdivision Regulations.

Larry LeClair moved that the Lebanon Planning Board finds the application of **XYZ DAIRY, LLC** for Final Review of a Major Subdivision for an 8-lot Industrial Planned Unit Development (IND-PUD) , #PB2011-01-FMAJ is complete enough to accept jurisdiction and commence review..

The motion was seconded by Scott Pauls. The vote on the motion was seven in favor with one abstention.

Notice is here by given that on **October 11, 2011**, the following action was taken by a majority of the Lebanon Planning Board in accordance with the City of Lebanon Subdivision Regulations.

Larry LeClair moved that the Lebanon Planning Board **APPROVES** the Final Major Subdivision application for **XYZ DAIRY, LLC** , in accordance with the Subdivision Regulations for a 22-lot subdivision for a phased development known as River Park, located at North Main Street, Tax Map 44, Lots 3 & 7 and Tax Map 57, Lot 27, West Lebanon, NH, in the CBD, IND-L and R-3 zones, #PB2011-01-FMAJ, as shown on plan set titled "Subdivision Plan – River Park" (67 pages), prepared by Holden Engineering & Surveying, Inc., issued for permitting: June 10, 2010, latest issue: January 18, 2011, including any and all supplemental submissions and testimony provided during the public hearing, with the following conditions:

This Final Major Subdivision approval is for the development of River Park, a 22-lot subdivision, within 3 zoning districts, in accordance with the Lebanon Zoning Ordinance dated last revised July 21, 2010, and the Lebanon Subdivision Regulations dated last revised May 14, 2001.

CONDITIONS-PRECEDENT TO THE SIGNING AND RECORDING OF THE MYLAR:
(These conditions shall be satisfied within 2 years of the date of the Notice of Action.)

1. Prior to the signing and recording of the mylar and prior to the start of any construction activities on the property, which for purposes of this decision shall mean any construction, excavation, or other site work associated with the construction or installation of buildings, roadways, parking, water, sewer, or storm drainage infrastructure (this condition is not intended to preclude temporary construction trailers or site offices), the applicant shall provide two complete sets of revised plans to the Planning Office, depicting the following plan changes:

    a) The five-foot-wide sidewalk and curbing improvements with no grass median, as proposed by the applicant along NH Route 10 and depicted on the approved subdivision plan set, running along the property frontage from a point opposite Fountain Way to Chandler Street, shall be extended further south along NH Route 10 to Beyerle Street to provide a safe and convenient pedestrian connection to the existing sidewalk network on NH Route 10 and Beyerle Street to the satisfaction of the City Engineer. All curbing shall be granite and the sidewalk may be either concrete or asphalt, at the applicant's discretion, to be constructed in accordance with the City's standards.

b) The lane striping layout for all improvements within NH Route 10 shall be revised on all applicable sheets of the approved subdivision plan set to depict 11-foot wide travel lanes, based on painted lines, with no significant changes in grading or paving width, to match the existing lane widths provided on NH Route 10 north of the project site to the satisfaction of the City Engineer, which shall not be unreasonably withheld. The additional pavement width available from narrowing the travel lanes from 12 feet to 11 feet shall be used to widen the proposed shoulder from 2 feet to 4 feet on the southbound side of NH Route 10 as depicted on Sheet 66 (Roadway Sections) of the approved subdivision plan set in order to facilitate safer bicycle use along NH Route 10, which has been designated as a Statewide Bicycle Route by the NHDOT and a Regional Bike Route in the Upper Valley Lake Sunapee Region.

c) The lane striping layout for the development roadway shall be revised on all applicable plan sheets to depict 11-foot wide travel lanes and 5-foot wide shoulders, based on painted lines, with no significant changes in grading or paving width, to the satisfaction of the Planning Office.

d) Sheets 15 & 16 of the approved subdivision plan set shall be revised to indicate that all proposed street trees shall have a minimum caliper of 2.5" – 3", measured 6" above finished grade level, at the time of planting, pursuant to Section 6.2.B(4) of the Site Plan Review Regulations, to the satisfaction of the Planning Office.

e) Sheets 17 & 18 of the approved subdivision plan set shall be revised to include a note that street lights along the development roadway shall be installed to provide full cut-off optics and that the height of such fixtures shall be 20 feet above finished grade to match the height and design of all on-site light fixtures as depicted in the plan sets titled "Site Plan – River Park," prepared by Holden Engineering & Surveying, Inc., issued for permitting: June 10, 2010, latest issue: May 2, 2011, (#PB2010-25-SPR) to the satisfaction of the Planning Office.

f) The subdivision plans shall be revised to reflect the final lot dimensions and metes and bounds, as depicted in the plan set titled "Site Plan – River Park," prepared by Holden Engineering & Surveying, Inc., issued for permitting: June 10, 2010, latest issue: May 2, 2011, (#PB2010-25-SPR), to the satisfaction of the Planning Office.

g) The subdivision plans shall be revised to depict easements for shared access for Lots 1 & 2; Lots 3 & 4; Lots 4 & 5; Lots 8, 9, & 10; and Lots 29 & 30, to the satisfaction of the Planning Office.

2. Prior to the signing and recording of the mylar and prior to the start of any construction activities on the property, the applicant shall submit final designs, including construction drawings, of all infrastructure features, both on- and off-site, including the streets, sidewalks, water and sewer utilities, and storm drainage systems, to the City Engineer for approval, which shall not be unreasonably withheld.

3. Prior to the signing and recording of the mylar and prior to the start of any construction activities on the property, excluding the single-family homes on Lots 29 and 30, the applicant shall prepare final designs and construction details for the two bridges that are part of and integral to the development roadway. Such final designs and construction details shall be submitted to the City for review and approval by the City Engineer and Planning Office to assure that the design is adequate to provide a level of service consistent with the roadway as shown on Sheets 10 & 11 of the approved subdivision plan set.

4. Prior to the signing and recording of the mylar and prior to the start of any construction activities on the property, the applicant shall sign a Subdivision Agreement in accordance with Section 7.4 of the Lebanon Subdivision Regulations.

5. Prior to the signing and recording of the mylar, the applicant shall enter into a Performance Security Agreement pursuant to Section 14.6 of the Subdivision Regulations, for all required improvements intended to serve the entire subdivision, both on- and off-site, including, but not limited to: roadways and sidewalks, sewer and water utilities within the development and the sewer main within Crafts Avenue, storm drainage systems for the development roadways, erosion control, and landscaping and street lights located within the proposed rights-of-way in an amount considered adequate by the Department of Public Works, and in a form satisfactory to the City Attorney. The Performance Security Agreement shall be secured by a surety bond, a letter of credit, or an escrow account for the full anticipated cost of such improvements.

6. Prior to the signing and recording of the mylar and prior to the start of any construction activities on the property, the applicant shall sign a Water & Sewer Extension and Inspection Agreement in accordance with Chapter 181 of the City Code and Section 14 of the Subdivision Regulations for water and sewer mains within the development and for the sewer main within Crafts Avenue serving the entire subdivision.

7. Prior to the signing and recording of the mylar and prior to the start of any construction activities on the property, the applicant shall obtain all required State approvals for the

subdivision including, but not limited to, the following:

- NHDES Alteration of Terrain Permit
- NHDES approval for Sewage Discharge
- NHDOT Driveway Permit for the northerly development entrance and any other improvements within the portion of NH Route 10 under NHDOT jurisdiction

8. Prior to the signing and recording of the mylar and prior to the start of any construction activities on the property, the applicant shall provide to the City for review a Traffic Signal Warrant Analysis for the south development entrance. The applicant shall also provide to the City a copy of a Traffic Signal Warrant Analysis for the north development entrance if such a Warrant Analysis is required by the NH Department of Transportation.

9. [Condition deleted.]

10. Prior to the signing and recording of the mylar, a note shall be added to the mylar noting that access to Lot 7 is limited to NH Route 10 and is subject to the NH Department of Transportation regulations.

11. Covenants and Deeds Restrictions or a conservation easement governing the common open space shall be written and recorded to ensure compliance with Section 12.2 of the Subdivision Regulations to the satisfaction of the City's attorney. As proposed by the applicant, such covenants and deed restrictions or conservation easement shall specifically allow for access to the Open Space parcel (Lot 6) along the Connecticut River frontage via a proposed pathway depicted on Lot 3 and Lot 24 and/or via any other access way that might be proposed and provided by the applicant. The construction or installation of any such pedestrian pathways to the Open Space parcel shall be subject to and in accordance with a NHDES Comprehensive Shoreland Protection permit for the development. It is the applicant's intent and the Planning Board's expectation that the Open Space (Lot 6) will be accessible to the general public.

12. Prior to the signing and recording of the mylar, the street names and numbering within the subdivision shall be approved by the City Engineer and the Lebanon Police Department to ensure compliance with the State's Enhanced 911 system. The Planning Board supports the use of the name "River Park Drive" if deemed acceptable by the City Engineer and the Lebanon Police Department.

13. Prior to the signing and recording of the mylar, the applicant shall provide a digital record drawing of the subdivision plan (CAD .dwg format using NH State Plane Coordinate system) to the Planning Office. The subdivision plan shall be recorded in the Grafton County Registry of Deeds prior to any occupancy of any new buildings within the subdivision.

GENERAL CONDITIONS OF APPROVAL:

14. The applicant acknowledges that the overall build-out of the River Park development will occur in seven (7) phases over an extended period of time in accordance with the application materials submitted to the Planning Board for Site Plan application (#PB2010-25-SPR). The applicant further acknowledges that the subdivision infrastructure, including the development roadway; extension of Crafts Avenue; water and sewer mains, excluding service connections, necessary to serve the subdivision; and storm drainage infrastructure necessary to serve the subdivision roadway will be constructed and/or installed during Phase 1 and Phase 2 as proposed by the applicant and approved by the Planning Board. The applicant shall complete all required Phase 1 subdivision infrastructure, as noted above, within a period of 5 years from the date of the Planning Board's final approval, and shall complete all required Phase 2 subdivision infrastructure, as noted above, within 5 years of commencement of Phase 2, unless, prior to the end of the 5-year period, the applicant shall have submitted an updated phasing schedule to the Planning Board and received approval for additional time to complete the subdivision infrastructure improvements. The applicant shall be required to notify the City of the date of commencement for Phase 2 for purposes of clearly establishing the time period within which required improvements must be completed.

15. Prior to the start of any construction activities within existing public rights-of-way subject to City jurisdiction, including NH Route 10 inside the urban compact area and Crafts Avenue, the applicant shall sign a Performance Security and Inspection Agreement in accordance with Section 14 of the Subdivision Regulations for completion of off-site roadway improvements along NH Route 10 within the urban compact area and for restoration of Crafts Avenue following installation of the required sewer main, to the extent such performance security has not already been provided to the City pursuant to Condition #5 of this decision. Any required agreements or performance security for improvements within NH Route 10 outside of the urban compact area shall be as approved and required by the NH Department of Transportation.

16. The applicant shall request approval from the City of Lebanon Public Safety Committee for the installation of a crosswalk across NH Route 10 at the Maple Street intersection. If such crosswalk is approved and authorized by the Public Safety Committee, the applicant shall be required to install the crosswalk and appropriate signage at the time of construction of other required improvements along NH Route 10, to the satisfaction of the City Engineer, which shall not be unreasonably withheld.

17. Prior to the start of any construction activities for which construction inspection is required pursuant to this decision or any applicable ordinance or code, the City shall retain the services of an independent 3rd party inspector, for which the applicant shall be responsible for all inspection fees related to construction and installation of on- and off-site roadways, sidewalks, water and sewer utilities, storm drainage systems, and erosion control, in accordance with Chapter 181 of the City Code and Section 14 of the Subdivision Regulations. The applicant shall provide funding for inspection services in a form acceptable to the City. Third party engineer inspection reports and as-built drawings provided by the applicant (using NH State Plane Coordinate system), including

tie sheets and Northing and Easting coordinates and elevations of underground utilities, shall be reviewed and approved by the City Engineer, prior to acceptance of any utility improvements by the City, and all such inspection reports shall be made available to the applicant.

18. The applicant shall comply with all other applicable provisions of Chapter 181 of the City Code, to the satisfaction of the Department of Public Works.

19. All proposed streets, sidewalks, water and sewer mains, and service lines shall be constructed pursuant to the City's standards, except as modified by the City Council for Crafts Avenue.

20. The applicant shall implement and maintain NHDES Site Specific Best Management Practices before, during, and after construction.

21. All required street trees and landscape plantings within the proposed rights-of-ways shall meet the minimum size requirements for such plantings set forth in Section 6.2.B of the Site Plan Review Regulations at the time of installation.

22. The applicant shall dedicate the completed water mains and hydrants within the subdivision, excluding service connections beyond the curb shut-off valves, to the City for ownership and maintenance, subject to appropriate easements. Said conveyance and easements shall be approved by the City Attorney and the Department of Public Works and recorded in the Grafton County Registry of Deeds prior to acceptance of any utility improvements by the City.

23. The applicant shall dedicate the completed sewer main within the Crafts Avenue right-of-way, excluding sewer lateral connections, to the City for ownership and maintenance. Said conveyances and easements shall be approved by the City Attorney and the Department of Public Works and recorded in the Grafton County Registry of Deeds prior to acceptance of any utility improvements by the City. All sewer mains within the development upstream of the Crafts Avenue right-of-way shall remain privately owned and maintained by the applicant.

24. The applicant shall comply with all applicable conditions of the Lebanon City Council's approval, dated May 18, 2011, concerning connection of City water and sewer systems for the River Park development.

25. The applicant shall offer to dedicate the extended roadway and cul-de-sac of Crafts Avenue to the City for ownership and maintenance.

26. In accordance with the City's Impact Fee Ordinance fee schedule adopted on September 13, 2010, this application is exempt from impact fees for a period of 5 years from the date of the Planning Board's final approval. Building permits obtained after the 5-year period shall be subject to impact fees in existence at the time of the Building Permit

application submission.

27. The Planning Board hereby grants waivers for Section 11.4.A.23 (Availability of Other Utilities) of the Subdivision Regulations.

28. Effect of Approval. This approval is a final, conditional subdivision approval for a “phased development” under Section 7.5 of the Subdivision Regulations and is a final decision of the Planning Board for purposes of RSA:15(I). Section 7.5 (c) (Review of remaining phases) shall not apply, because the entire subdivision has already been reviewed and approved under the “Review of Final Plat” process of Section 7.4. The deadlines for the construction of improvements within each phase shall be as stated in the approved phasing plan, rather than the 2-year period under Section 7.4(H). It is the intent and effect of this approval, subject to the satisfactory completion of the financial security arrangements in Condition #5 above, that upon completion of the Phase 1 infrastructure improvements within 5 years of this final approval, as set forth in Condition #14 above, the subdivision as a whole, including all phases, shall vest as provided in RSA 674:39,II, and no subsequent changes in subdivision regulations, site plan regulations, or zoning ordinances, except impact fees adopted pursuant to RSA 674:21 and 675:2-4, shall operate to affect this subdivision, provided that the applicant and its successors in interest continue to comply with all conditions of this approval and of the Planning Board’s approval of Site Plan application #PB2010-25-SPR, including the time limits set forth in the phasing plan as outlined in the above-referenced Site Plan approval, unless such a limit is extended for good cause by the Planning Board, acting upon an application submitted prior to the expiration of such limit.

29. If any dispute arises over the interpretation or application of any of the above conditions, such dispute shall be resolved, by the Planning Board itself after notice and public hearing.

The motion was seconded by Earl Jette. The vote on the motion was unanimous in favor

Larry LeClair moved that the Lebanon Planning Board authorizes the Chair to sign the plat for **XYZ DAIRY, LLC**, #PB2011-01-FMAJ, as described above.

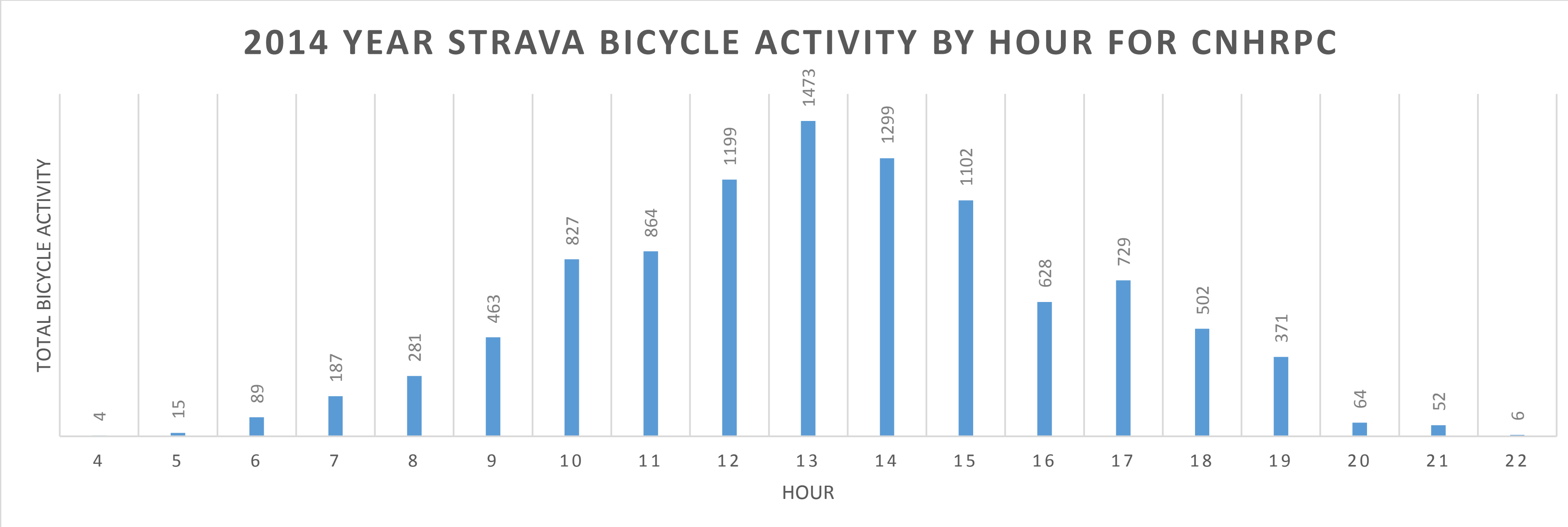
The motion was seconded by Earl Jette. The vote on the motion was unanimous in favor

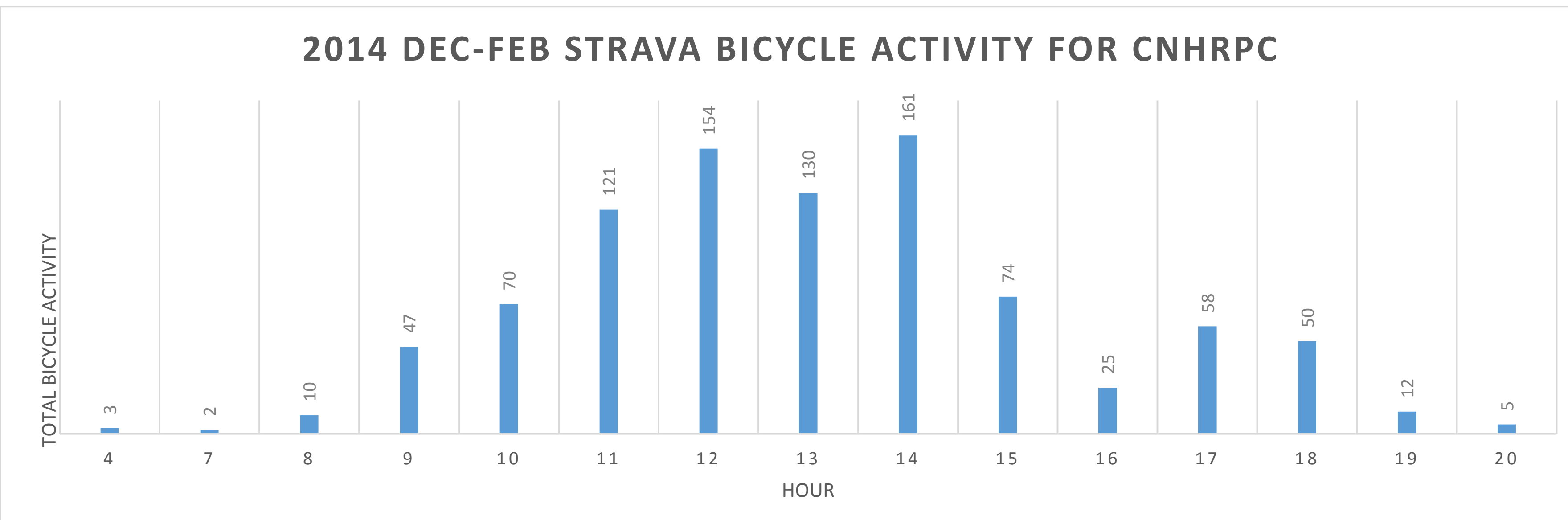
SIGNED:____
The City of Lebanon, Planning Board Chair

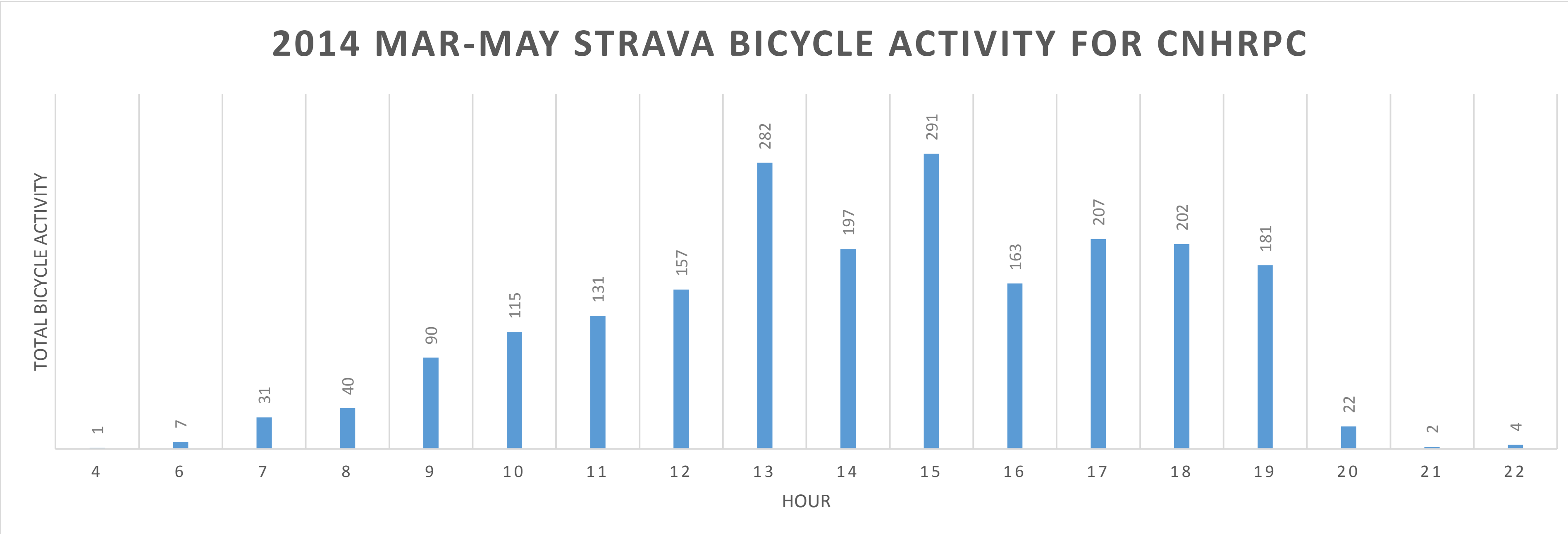
DATE:____

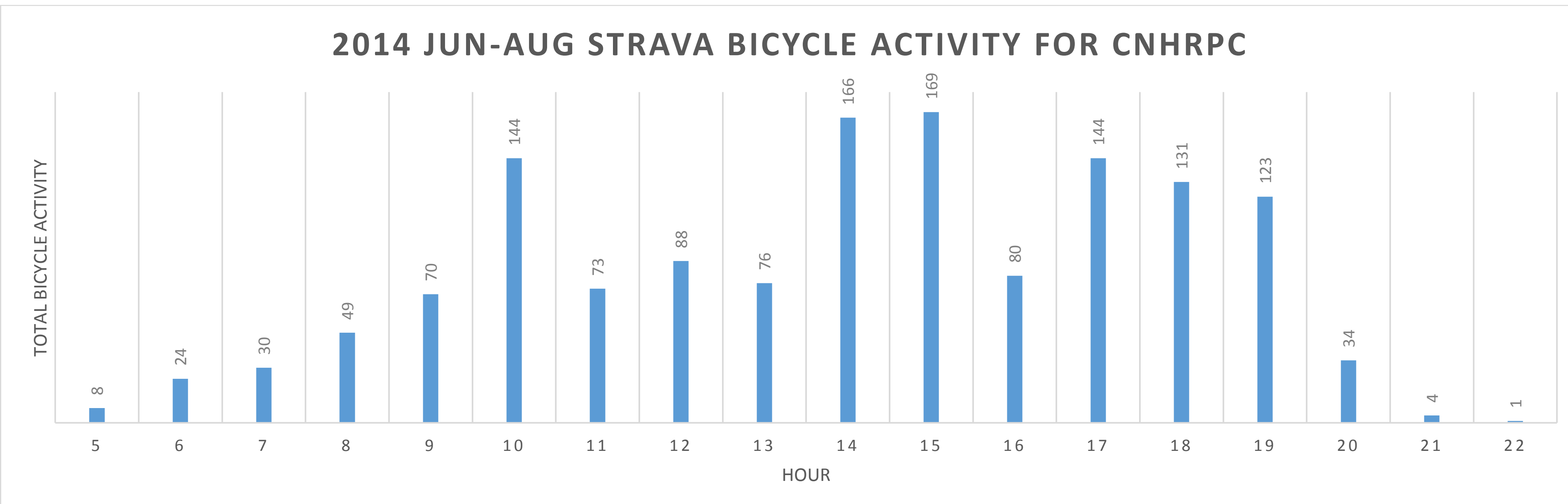
APPENDIX B

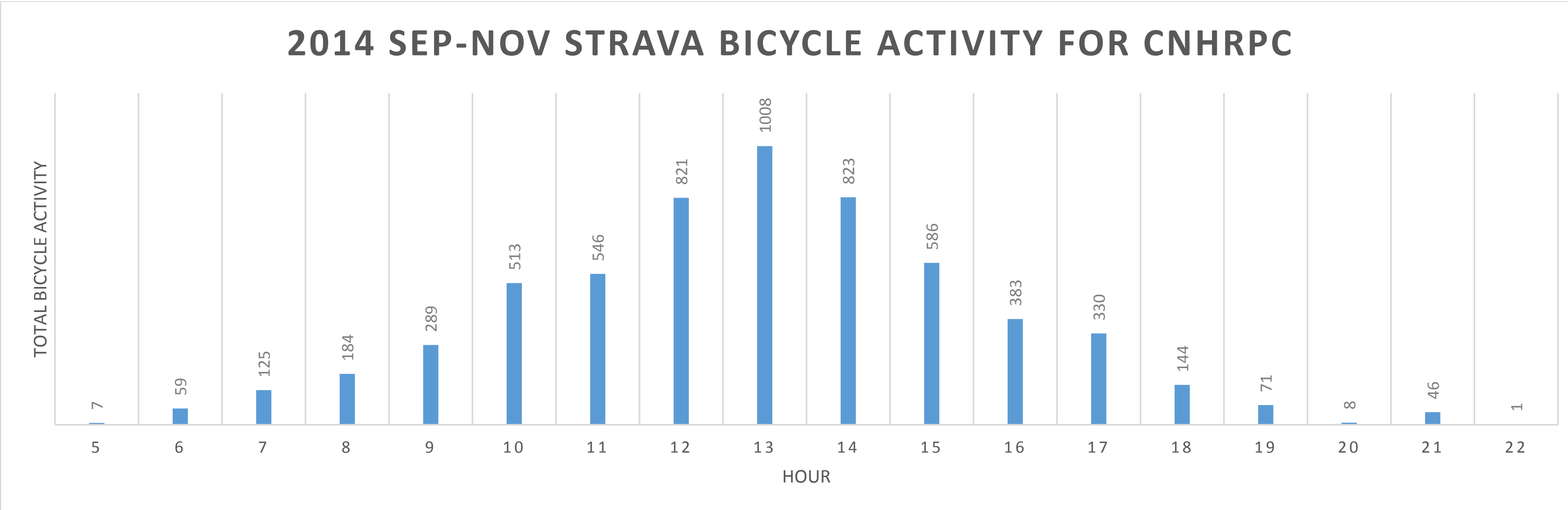
CNHRPC Strava Metro Temporal Use Overview



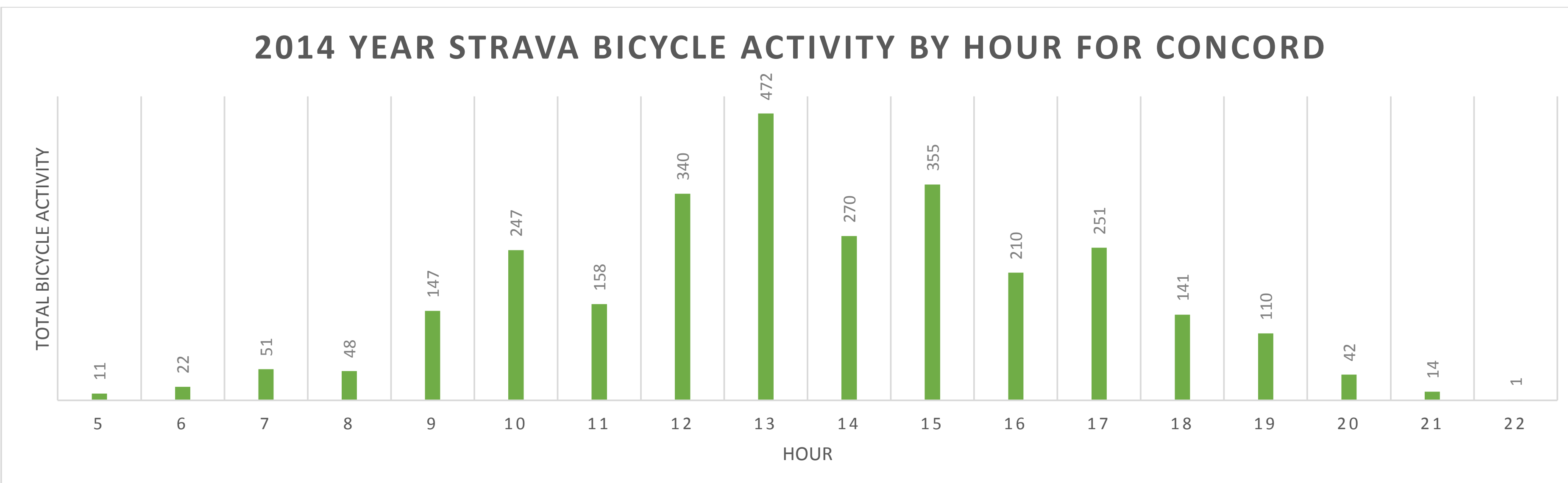



2014 MAR-MAY STRAVA BICYCLE ACTIVITY FOR CNHRPC
TOTAL BICYCLE ACTIVITY
HOUR
4 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22
1 7 31 40 90 115 131 157 282 197 291 163 207 202 181 22 2 4

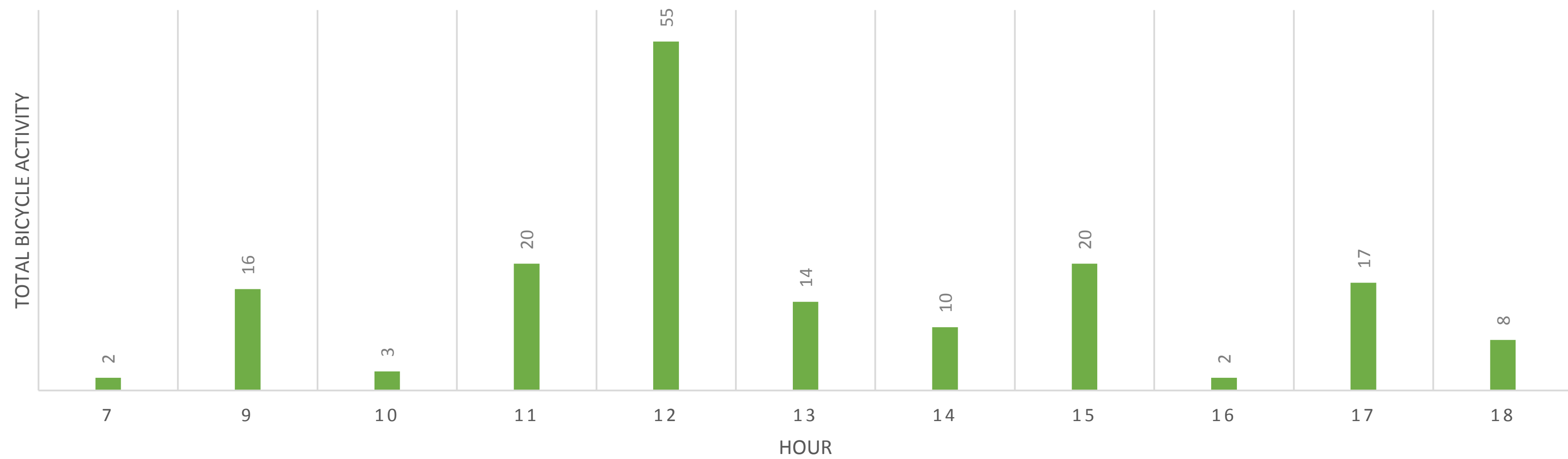

2014 JUN-AUG STRAVA BICYCLE ACTIVITY FOR CNHRPC
TOTAL BICYCLE ACTIVITY
HOUR
5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22
8 24 30 49 70 144 73 88 76 166 169 80 144 131 123 34 4 1


2014 SEP-NOV STRAVA BICYCLE ACTIVITY FOR CNHRPC
TOTAL BICYCLE ACTIVITY
7
59
125
184
289
513
546
821
1008
823
586
383
330
144
71
8
46
1
5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22
HOUR

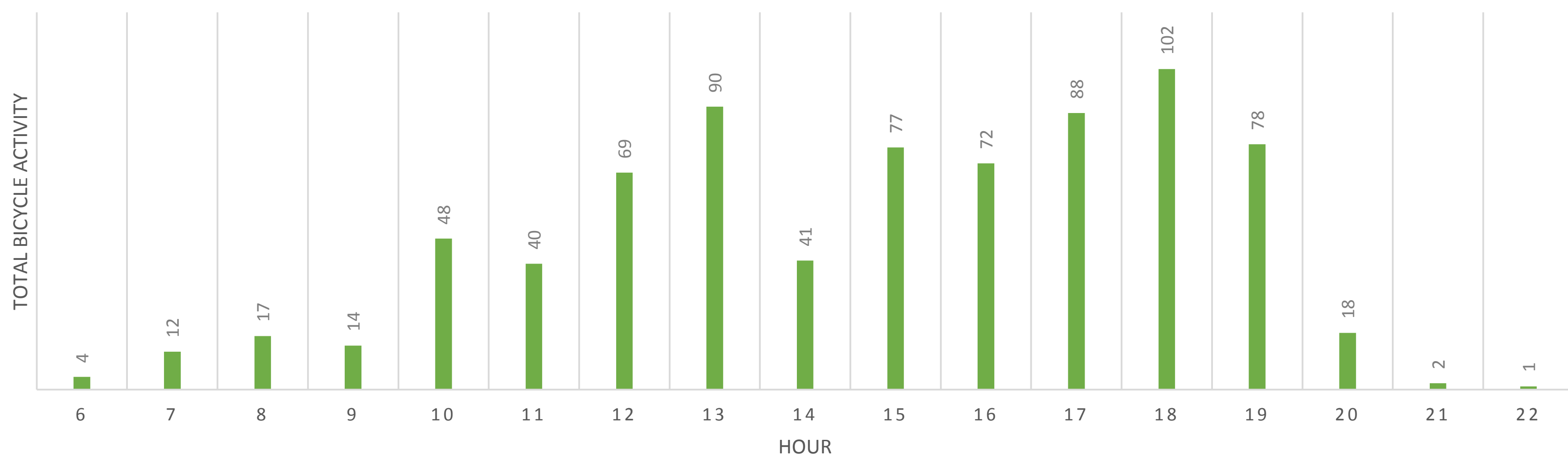
CONCORD

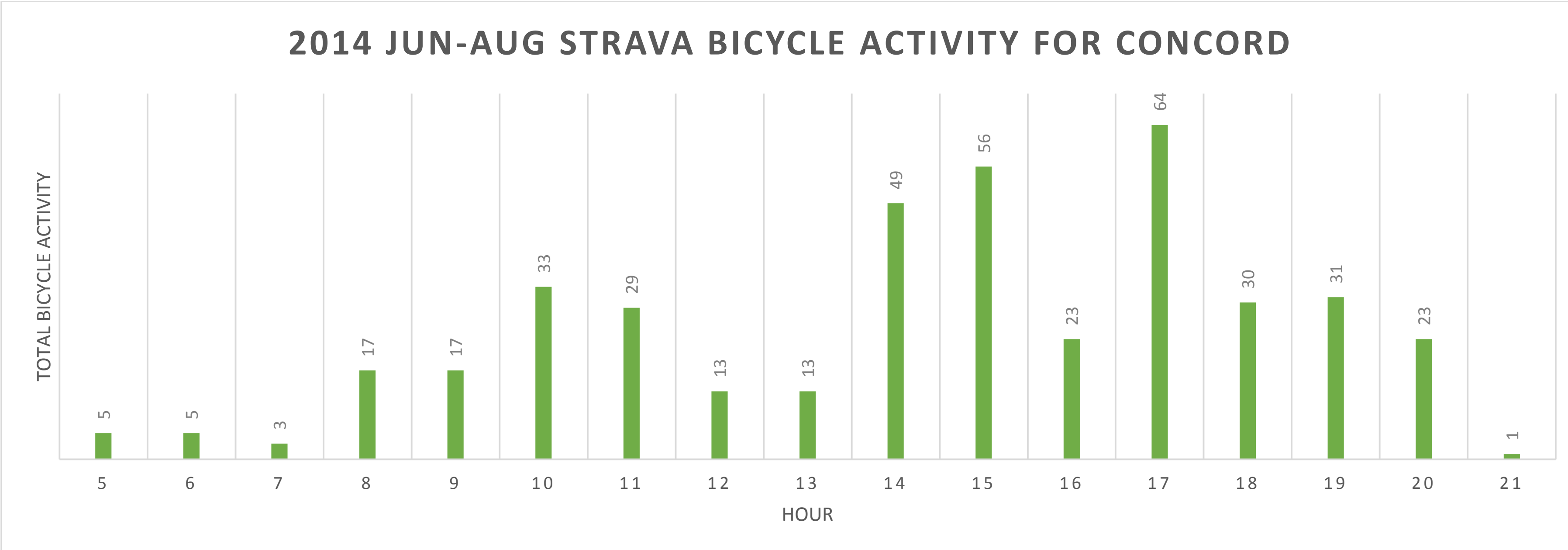

2014 YEAR STRAVA BICYCLE ACTIVITY BY HOUR FOR CONCORD
TOTAL BICYCLE ACTIVITY
11
22
51
48
147
247
158
340
472
270
355
210
251
141
110
42
14
1
5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22
HOUR

2014 DEC-FEB STRAVA BICYCLE ACTIVITY FOR CONCORD

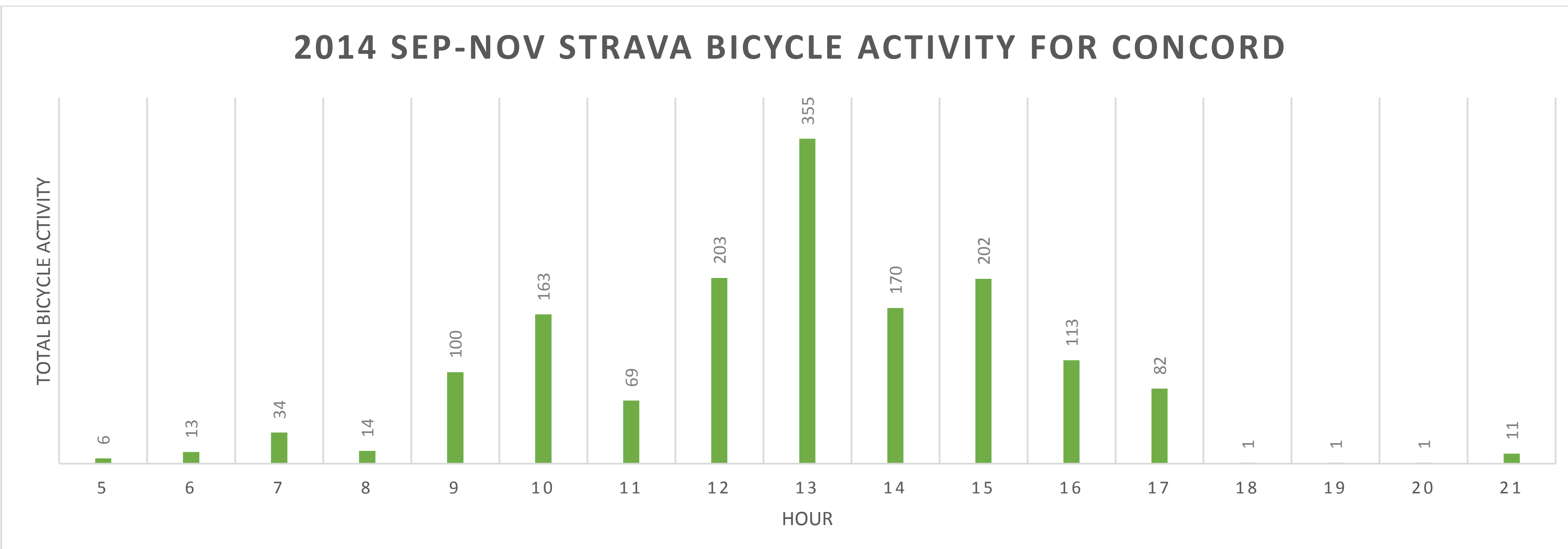


2014 MAR-MAY STRAVA BICYCLE ACTIVITY FOR CONCORD





2014 JUN-AUG STRAVA BICYCLE ACTIVITY FOR CONCORD
TOTAL BICYCLE ACTIVITY
5
5
3
17
17
33
29
13
13
49
56
23
64
30
31
23
1
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
HOUR



2014 SEP-NOV STRAVA BICYCLE ACTIVITY FOR CONCORD
TOTAL BICYCLE ACTIVITY
6
13
34
14
100
163
69
203
355
170
202
113
82
1
1
1
11
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
HOUR

5

Manual Count Recommendations
2014 Manual Count Locations

Preferred Trip Destinations

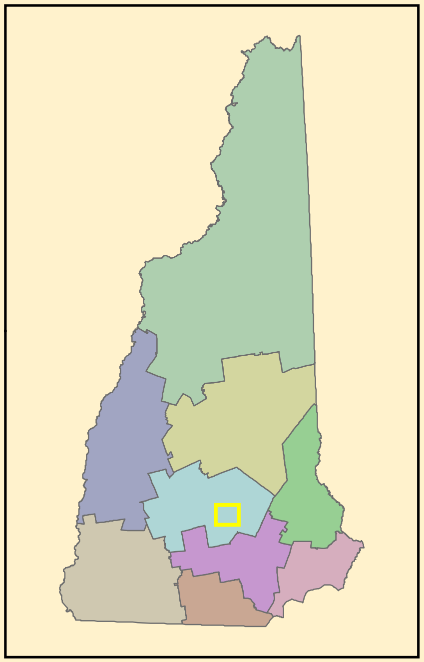
- Destination Priority #4
- Destination Priority #3
- Destination Priority #2
- Destination Priority #1

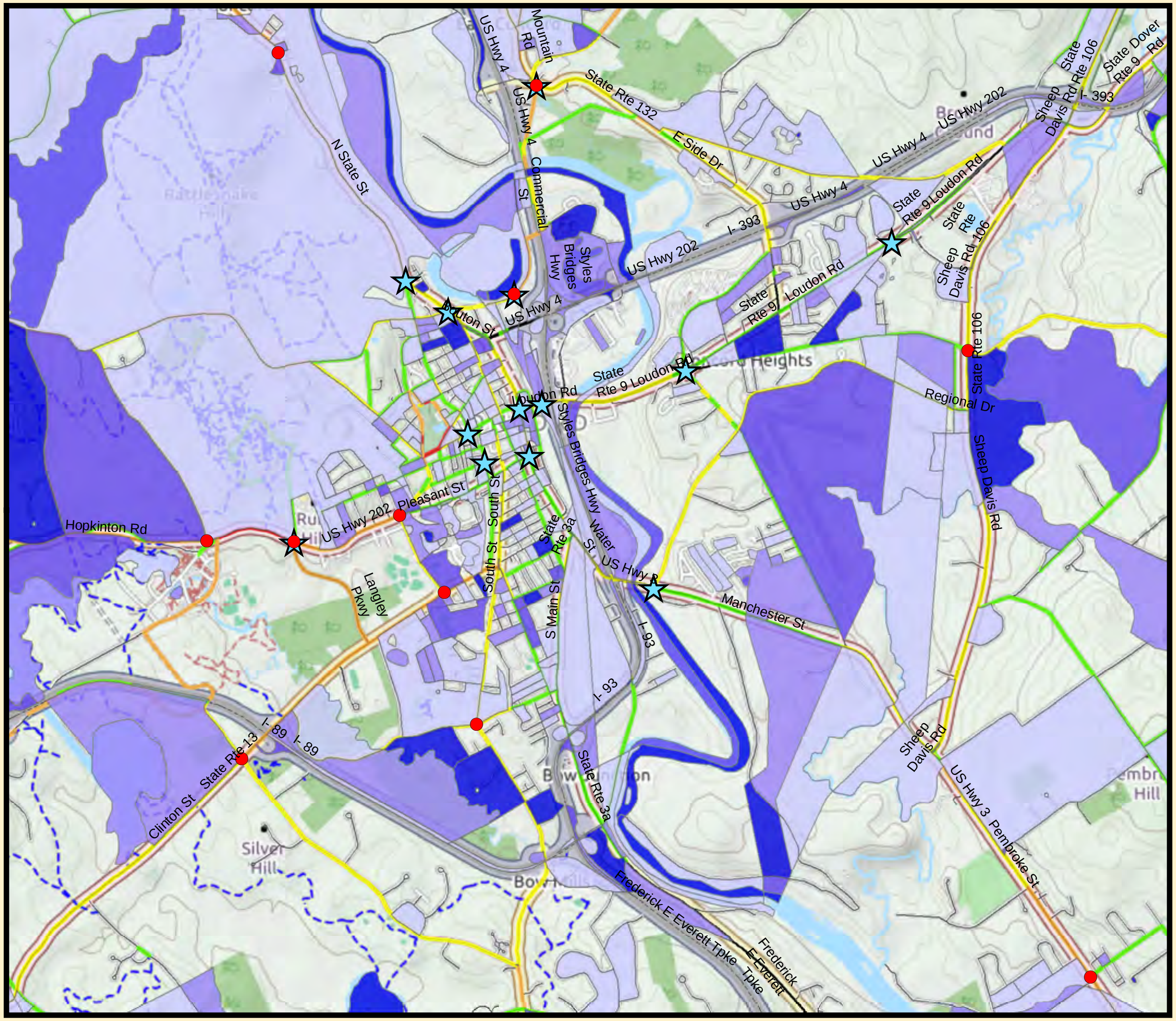
Total Unique Cyclists Per Segment

- 30 - 67
- 68 - 113
- 114 - 178
- 179 - 260

Road Class

- Primary Road
- Secondary Road
- Local Road





Central NH Regional Planning Commission

Greater Concord Metro Area:
Strava-Derived Recommended
Manual Count Locations

0 | 0.375 | 0.75 | 1.5 | 2.25 | 3 Miles

1:62,500

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

N

Concord, NH Recommended Manual Count Locations					
Priority #	**Unique Athlete Count**	**Total Commutes Rank**	**Destination Polygon Rank**	**Designation**	**Intersection**
1	3	3	1	Employment/Residential	Clinton St. & S. Fruit St.
2	3	3	1	Employment/Education	Pleasant St. & Warren St.
3	3	3	1	Commute Route	Sheep Davis Rd. & Pembroke Rd.
4	3	3	2	Education/Residential	Pembroke St. & Pembroke Hill Rd.
5	3	3	2	Employment	Commercial St. & Constitution Ave.
6	3	3	1	Likely Recreational/St. Paul's School	Fisk Rd. & Hopkinton Rd.
7	3	3	1	Residential/Swenson Granite	N. State St. & K St.
8	3	2	4	Employment Destination	Langley Parkway & State Rt. 9
9	3	2	4	Residential/Employment Access	St. Rt. 132 & Eastman St.
10	3	3	2	Likely Recreational	Clinton St. & Silk Farm Rd.
11	3	3	4	Residential/Deli	Rockingham St. & South St.
	*Consider Counting the bike path off of Delta Dr.				

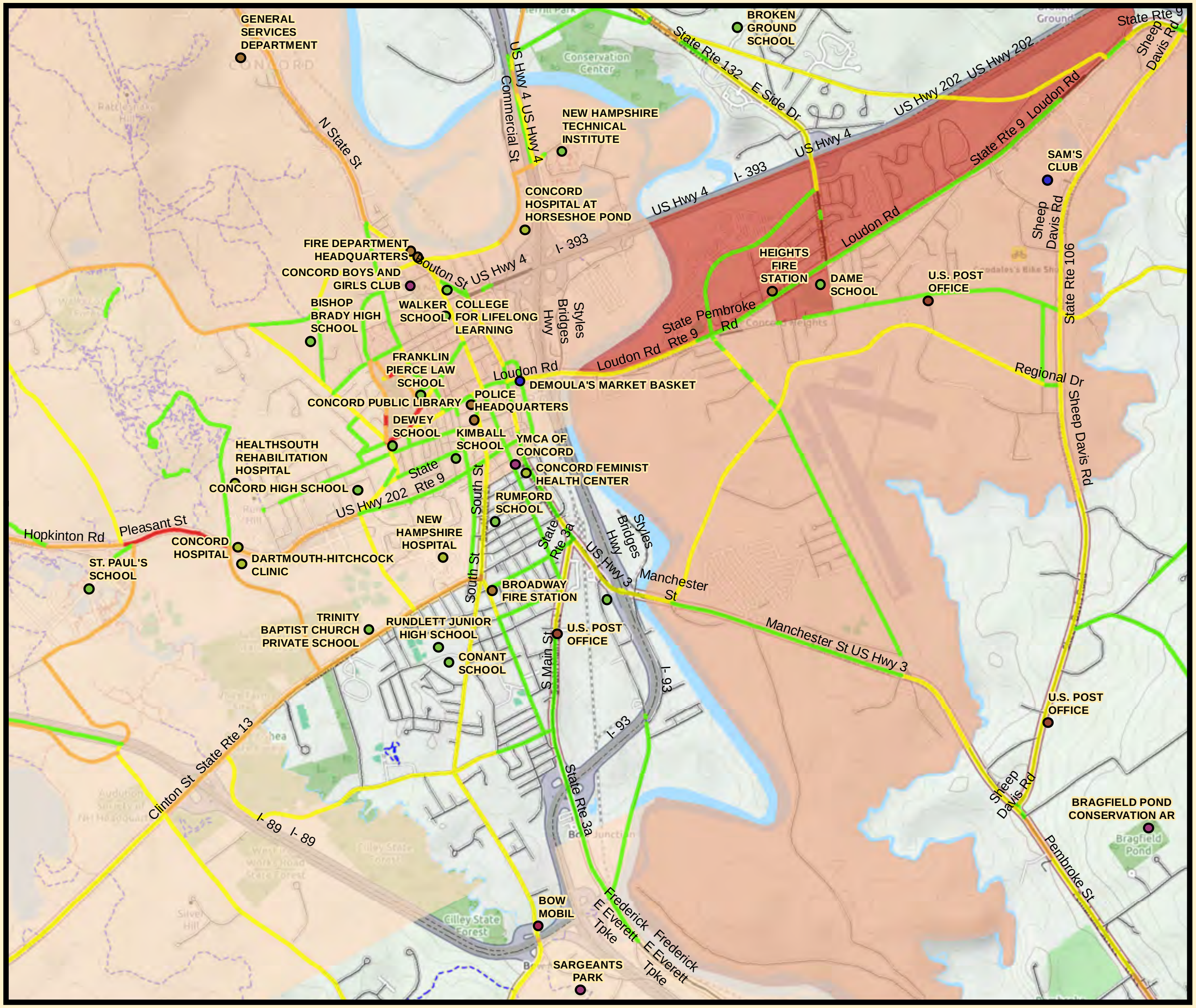
APPENDIX C

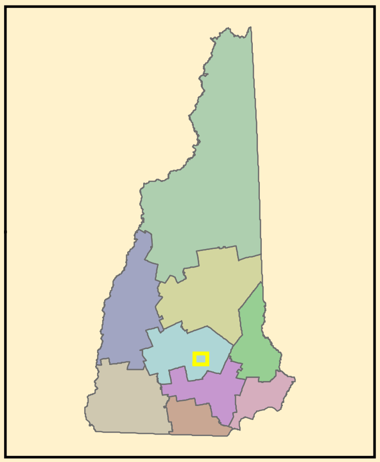
Priority Destinations
- Athletic/Rec Facility
- Essential City Facility
- Grocery Store
- Hospital
- Post Office
- Retail/Shopping Area
- School

Total Unique Cyclists Per Segment
- 30 - 67
- 68 - 113
- 114 - 178
- 179 - 260

NH Social Vulnerability Index
- 1
- 2
- 3
- 4
- 10

Road Class
- Primary Road
- Secondary Road
- Local Road





Central NH Regional Planning Commission

Greater Concord Metro Area: Strava Use & Priority Destinations

0 0.25 0.5 1 1.5 2 Miles

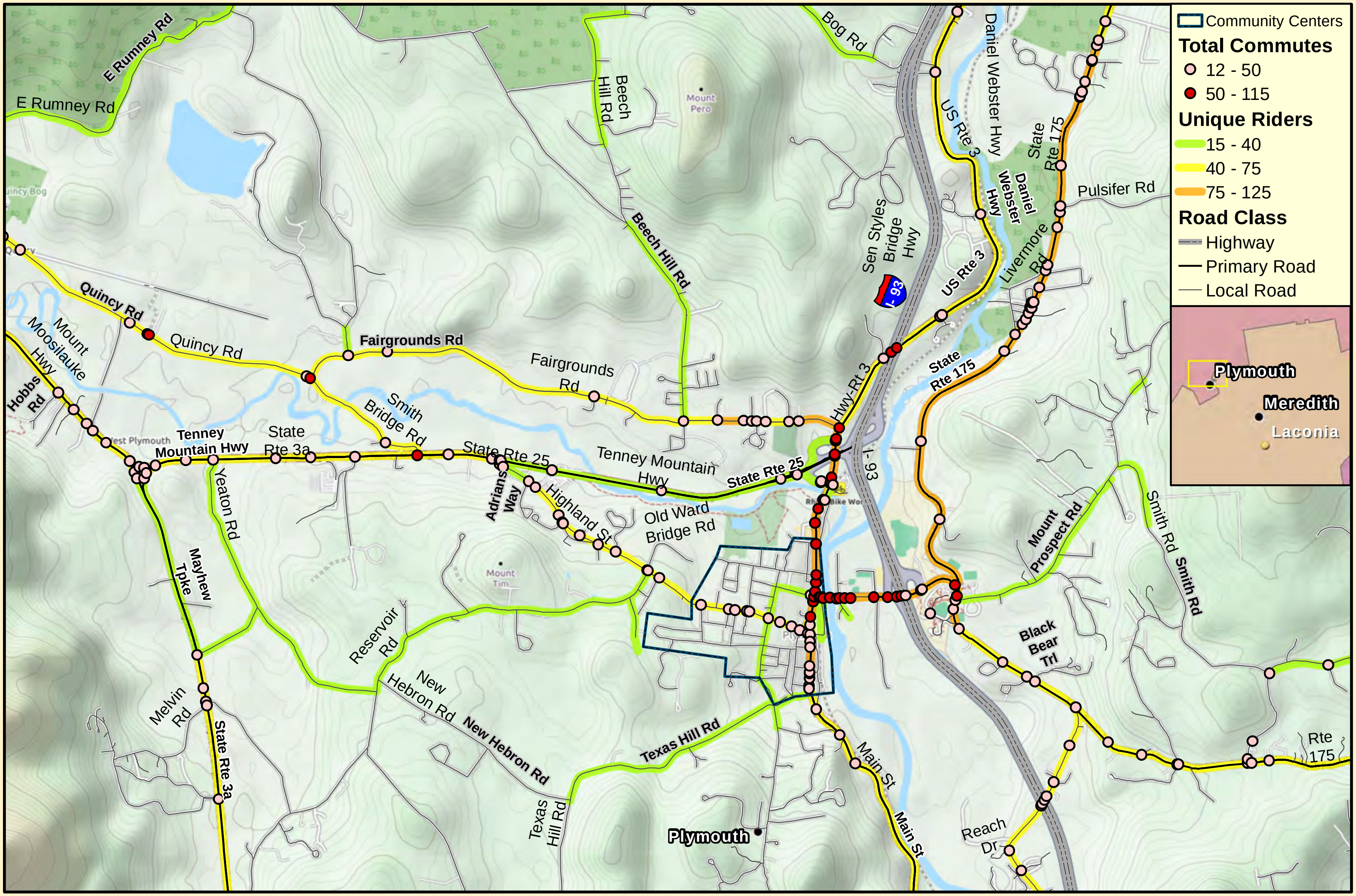
1:50,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

N

Concord Bicycle Counts 2014

1	**BICYCLISTS**									
2										
3										
4	Location	Total 2-4	Strava 2-4	% Rep	Total 4-7	Strava 4-7	% Rep.	Total 2-7	Total Strava 2-7	% Rep.
7	Loudon and Branch Turnpike	0	0		7	0	0.00%	7.00	0.00	0.00%
8	Loudon and Stickney	0	0		16	0	0.00%	16.00	0.00	0.00%
9	Manchester and Old Turnpike	0	0		20	4	20.00%	20.00	4.00	20.00%
10	N Main and Centre May	0	0		38	0	0.00%	38.00	0.00	0.00%
11	July	0	0		71	2	2.82%	71.00	2.00	2.82%
12	N Main and Pleasant May	0	0		36	4	11.11%	36.00	4.00	11.11%
13	July	0	0		27	2	7.41%	27.00	2.00	7.41%
14	N State, Bouton, Horseshoe Pd, Penacook	0	0		56	2	3.57%	56.00	2.00	3.57%
15	N State and Sewalls Falls	0	0		36	2	5.56%	36.00	2.00	5.56%
16	Pleasant and Langley	0	0		33	4	12.12%	33.00	4.00	12.12%
17	Warren and Spring	25	0	0.00%	21	2	9.52%	46.00	2.00	4.35%
18	Warren and N. Spring St	0	0		19	0	0.00%	19.00	0.00	0.00%
19	State and Rumford St	0	0		25	0	0.00%	25.00	0.00	0.00%
20	Centre and Rumford St	0	0		8	0	0.00%	8.00	0.00	0.00%
21	Commerical and Constitution	0	0		12	1	8.33%	12.00	1.00	8.33%
22	Loudon and Hazen	0	0		27	0	0.00%	27.00	0.00	0.00%
23	East Side and Eastman		0		19	0	0.00%	19.00	0.00	0.00%
24	Average Representation			8.75%			5.66%			5.57%
25	Standard Deviation			0.12			0.06			0.06



North Country Council

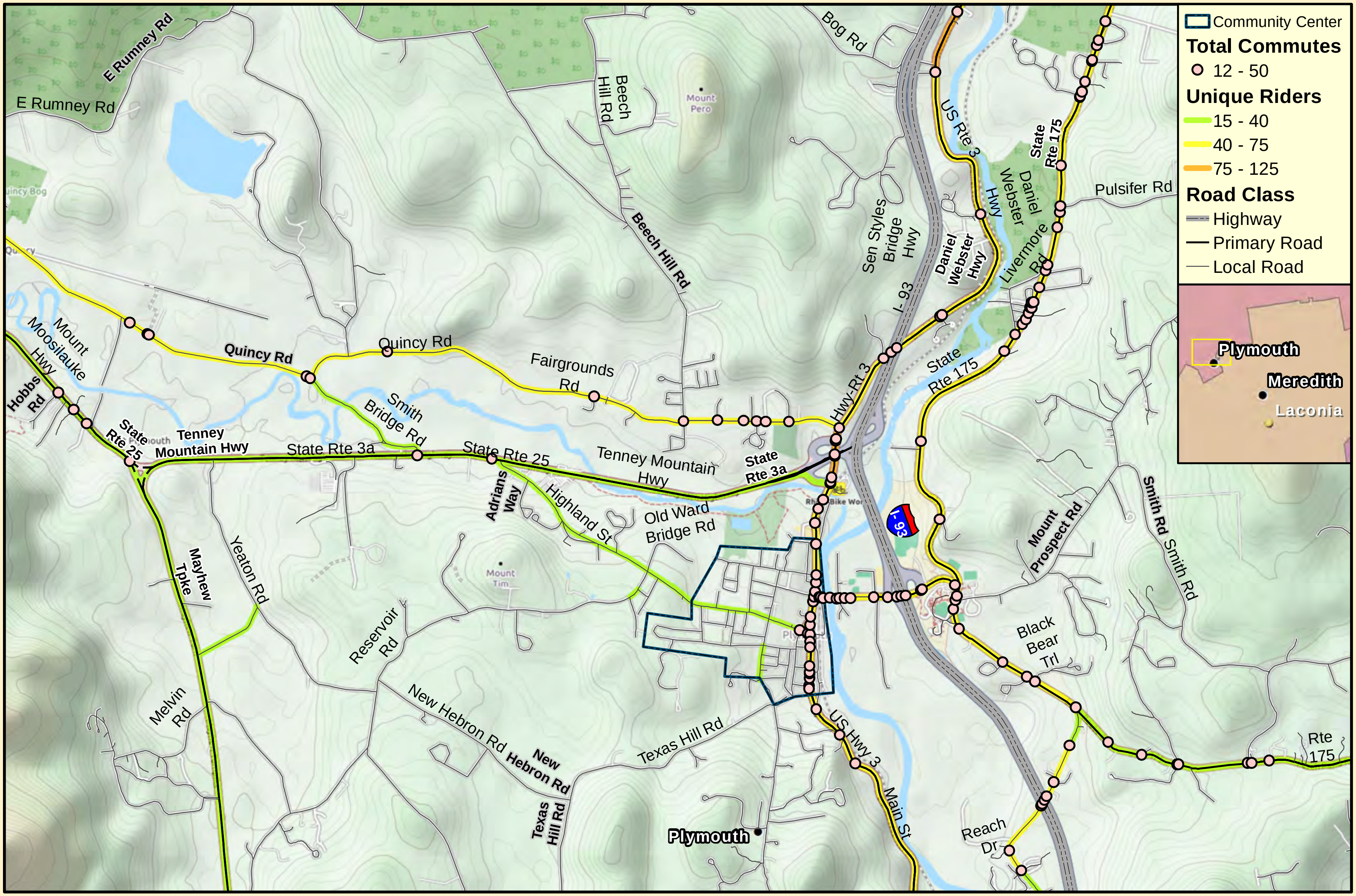
Greater Plymouth, NH Community Weekday Commute Patterns

0 0.25 0.5 1 1.5 2 Miles

1:50,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

N



North Country Council

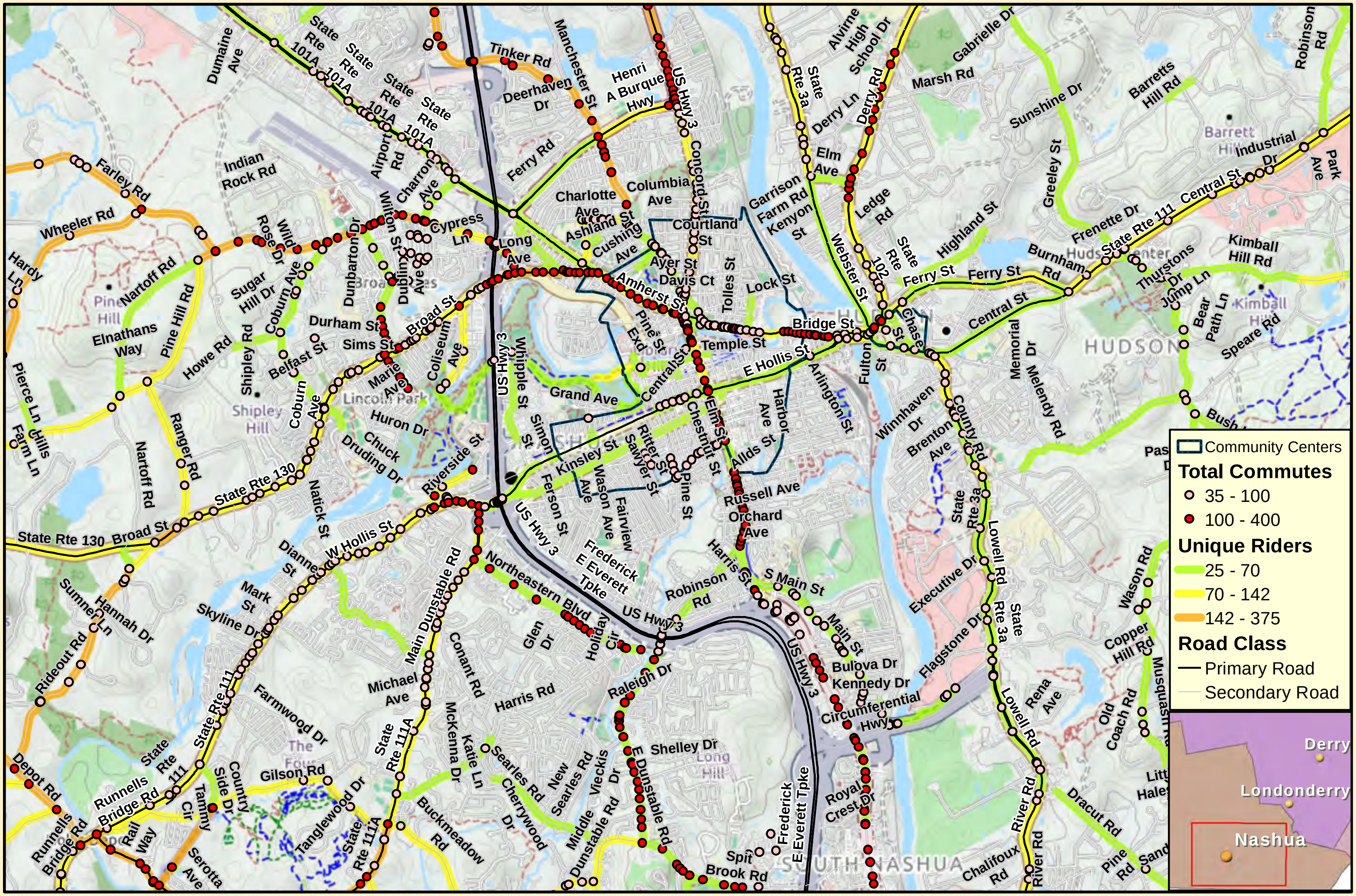
Greater Plymouth, NH Community Weekend Commute Patterns

0 0.25 0.5 1 1.5 2 Miles

1:50,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

N



Nashua Regional Planning Commission

Greater Nashua-Husdon Metro Area

Weekday Commute Patterns

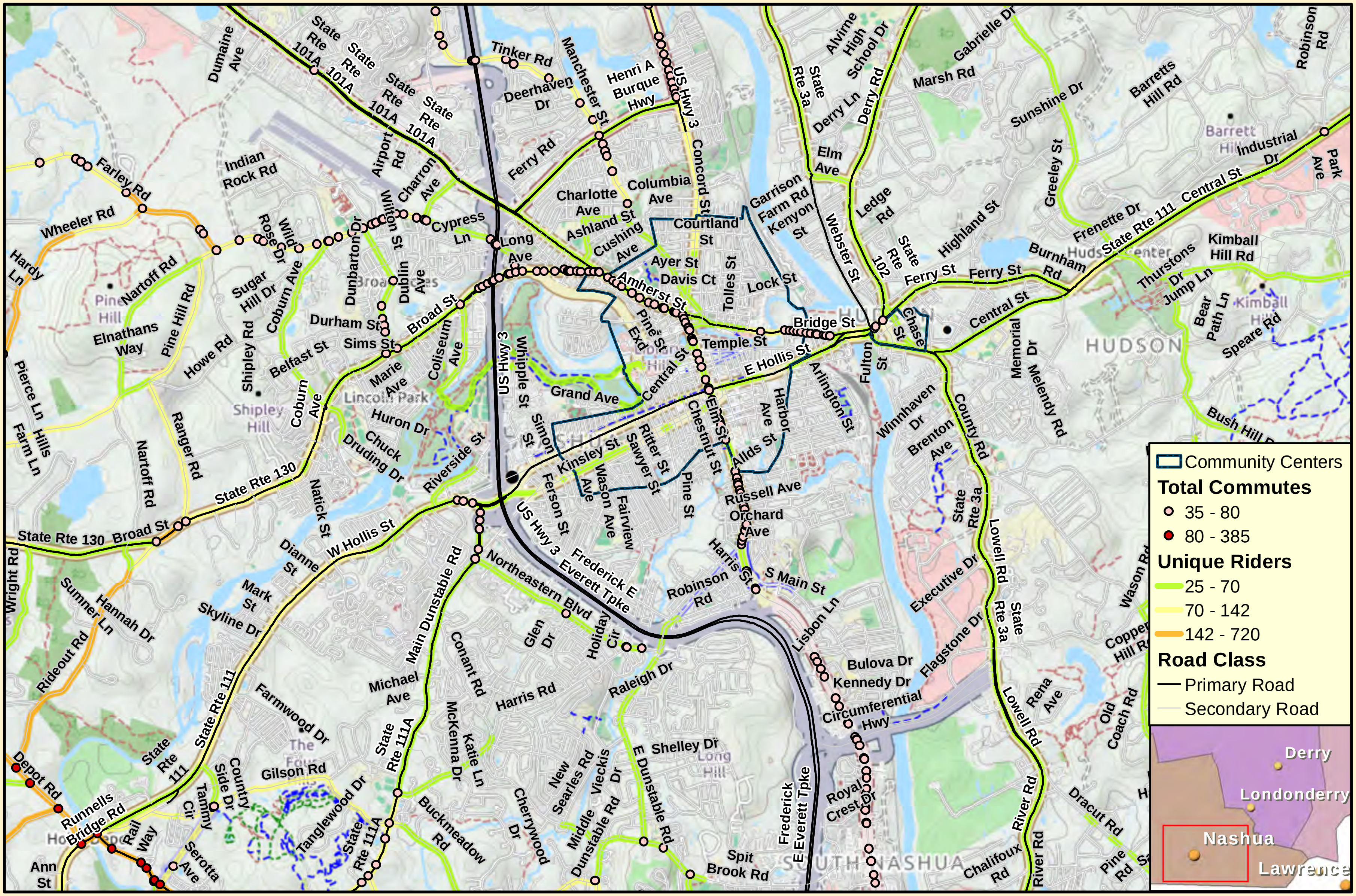
NRPC

0 0.375 0.75 1.5 2.25 3 Miles

1:63,360

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

N



Nashua Regional Planning Commission

Greater Nashua-Hudson Metro Area: Weekend Commute Patterns

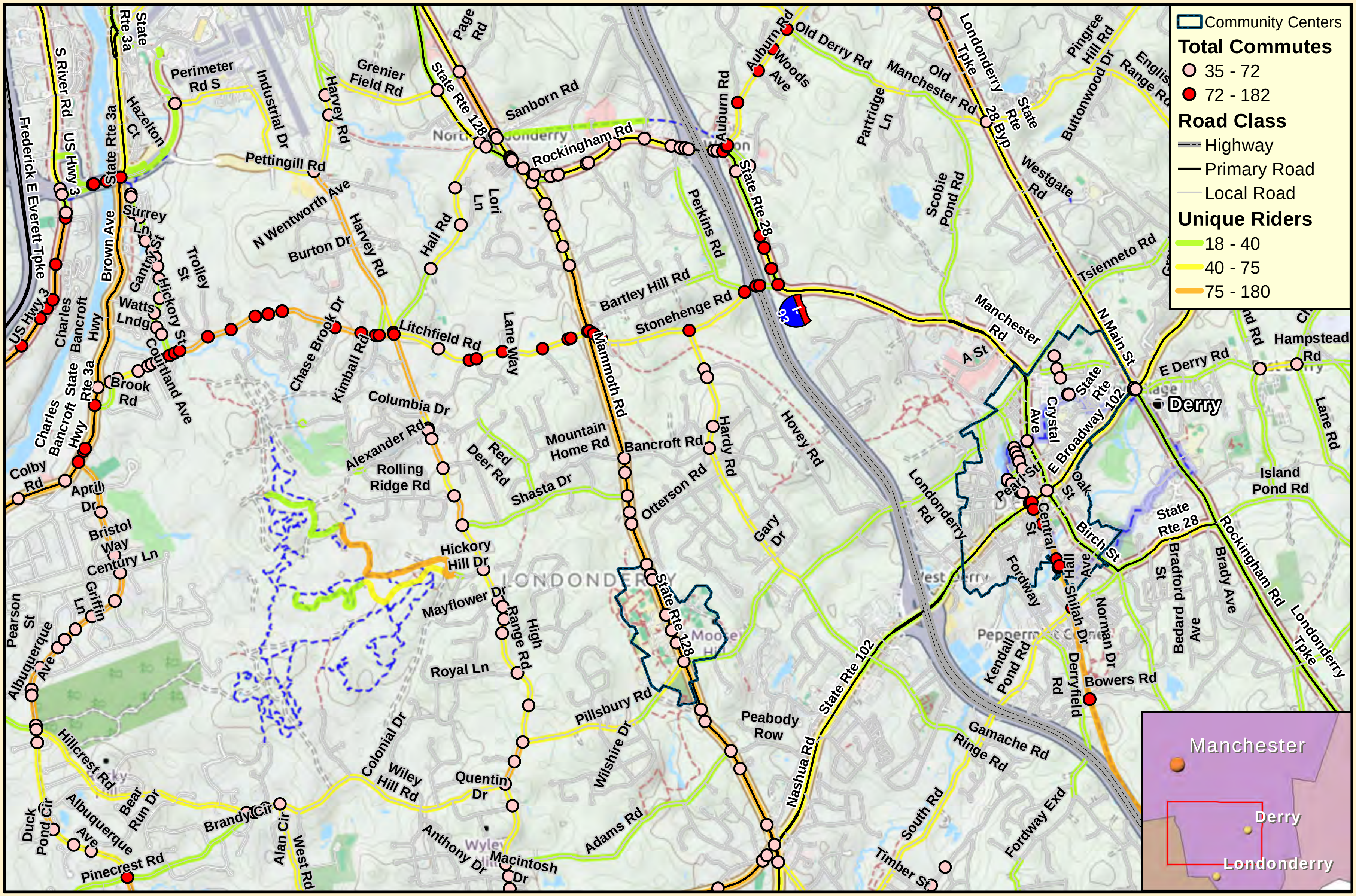
NRPC

0 0.375 0.75 1.5 2.25 3 Miles

1:63,360

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

N



Southern NH Regional Planning Commission

Greater Manchester Metro Area: Derry-Londonderry Weekday Commute Patterns

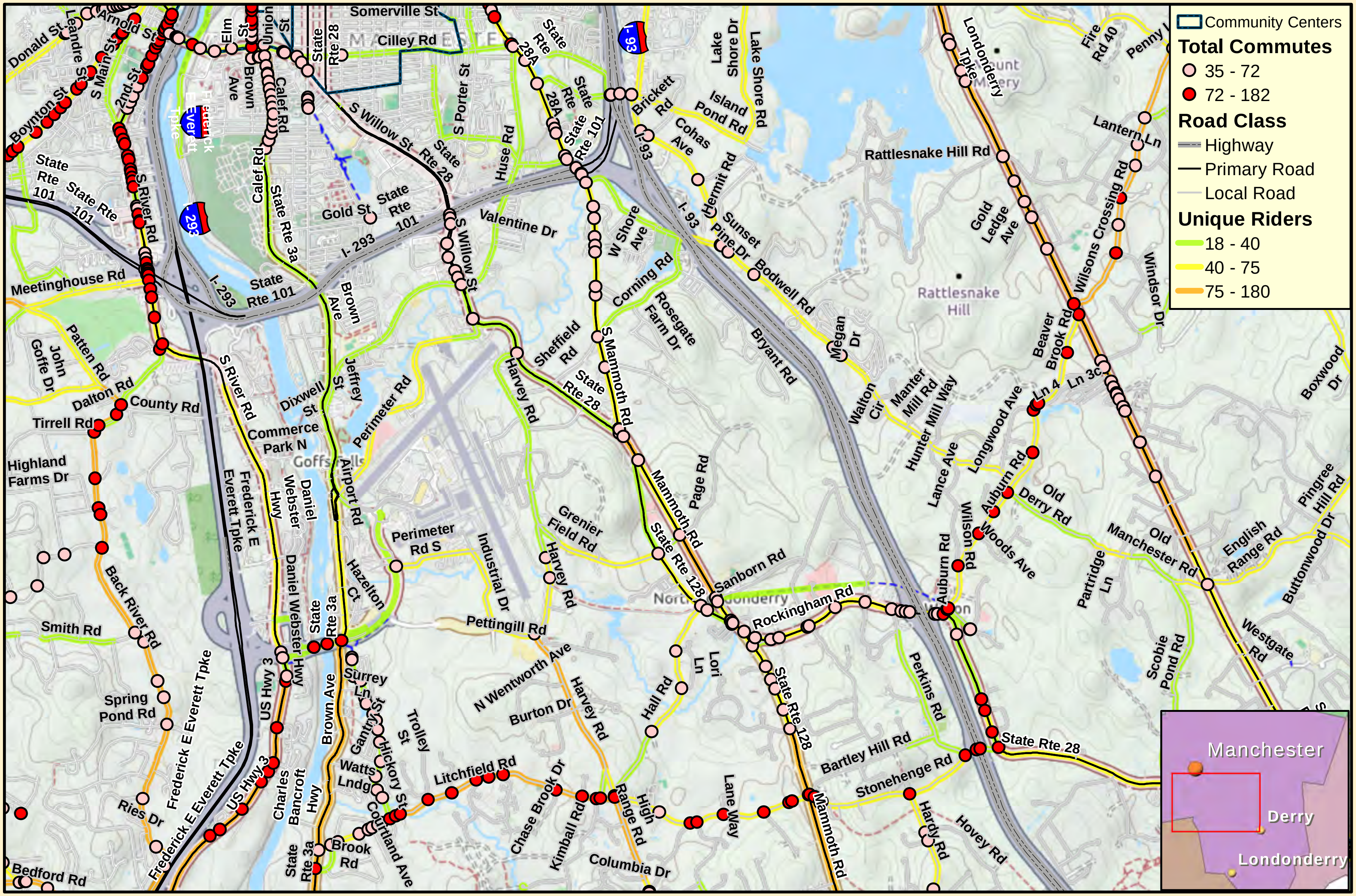
SNHPC

0 0.375 0.75 1.5 2.25 3 Miles

1:63,360

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

N



Southern NH Regional Planning Commission
Greater Manchester Metro Area:
Derry-Londonderry
Weekday Commute Patterns

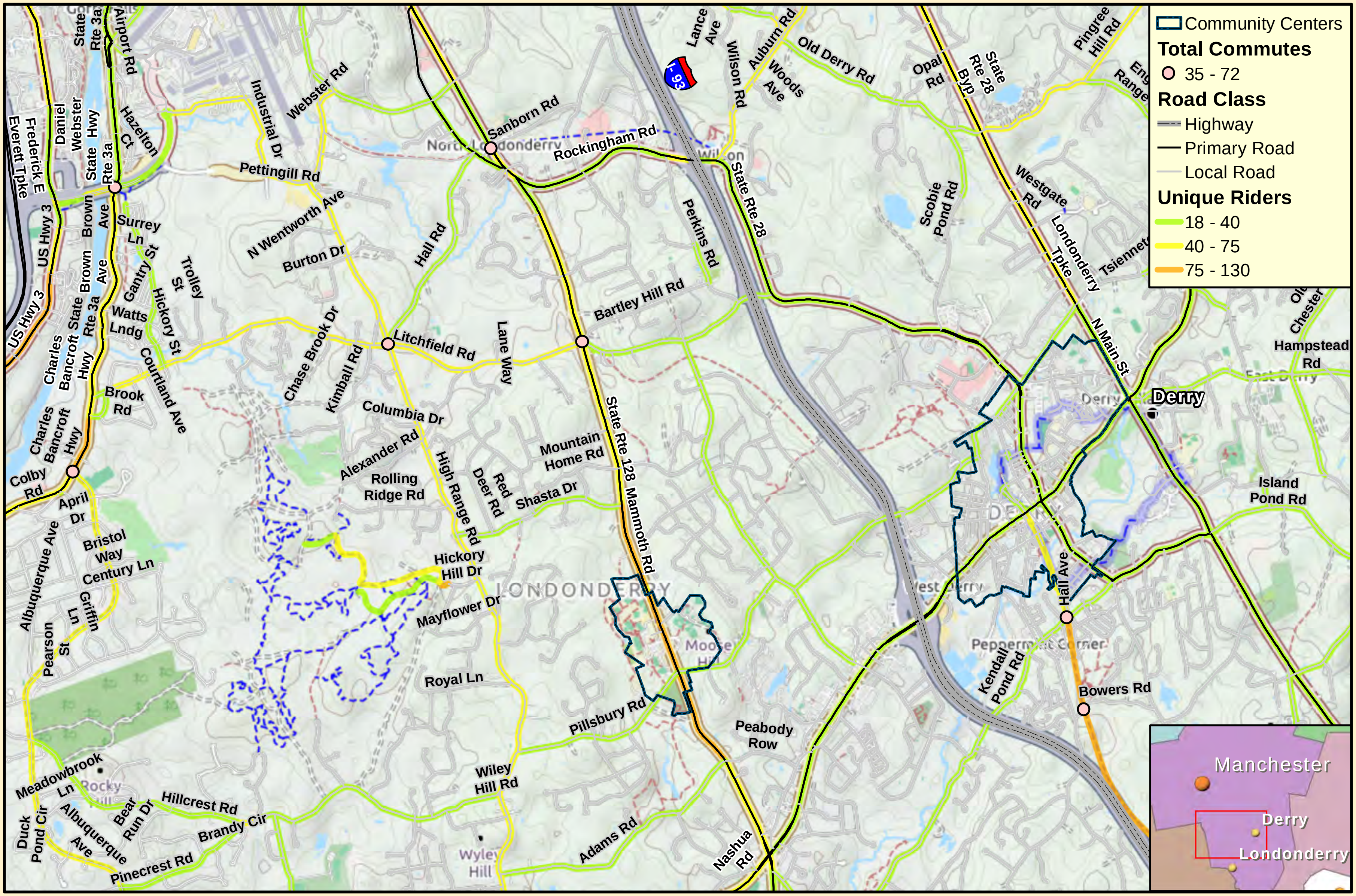
SNHPC

0 0.375 0.75 1.5 2.25 3 Miles

1:63,360

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

N



Southern NH Regional Planning Commission

Greater Manchester Metro Area:
Derry-Londonderry
Weekend Commute Patterns

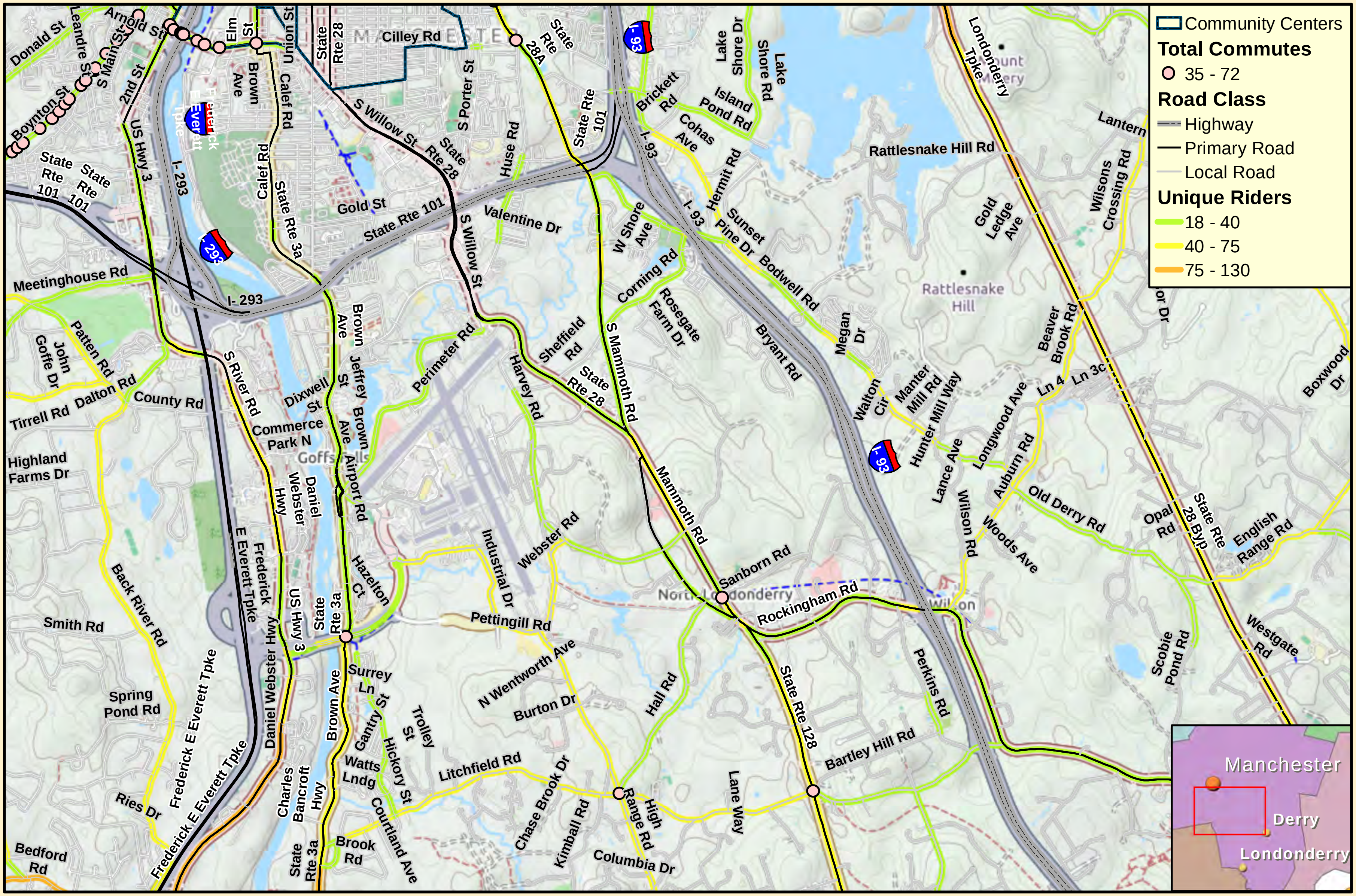
SNHPC

0 0.375 0.75 1.5 2.25 3 Miles

1:63,360

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

N



Southern NH Regional Planning Commission

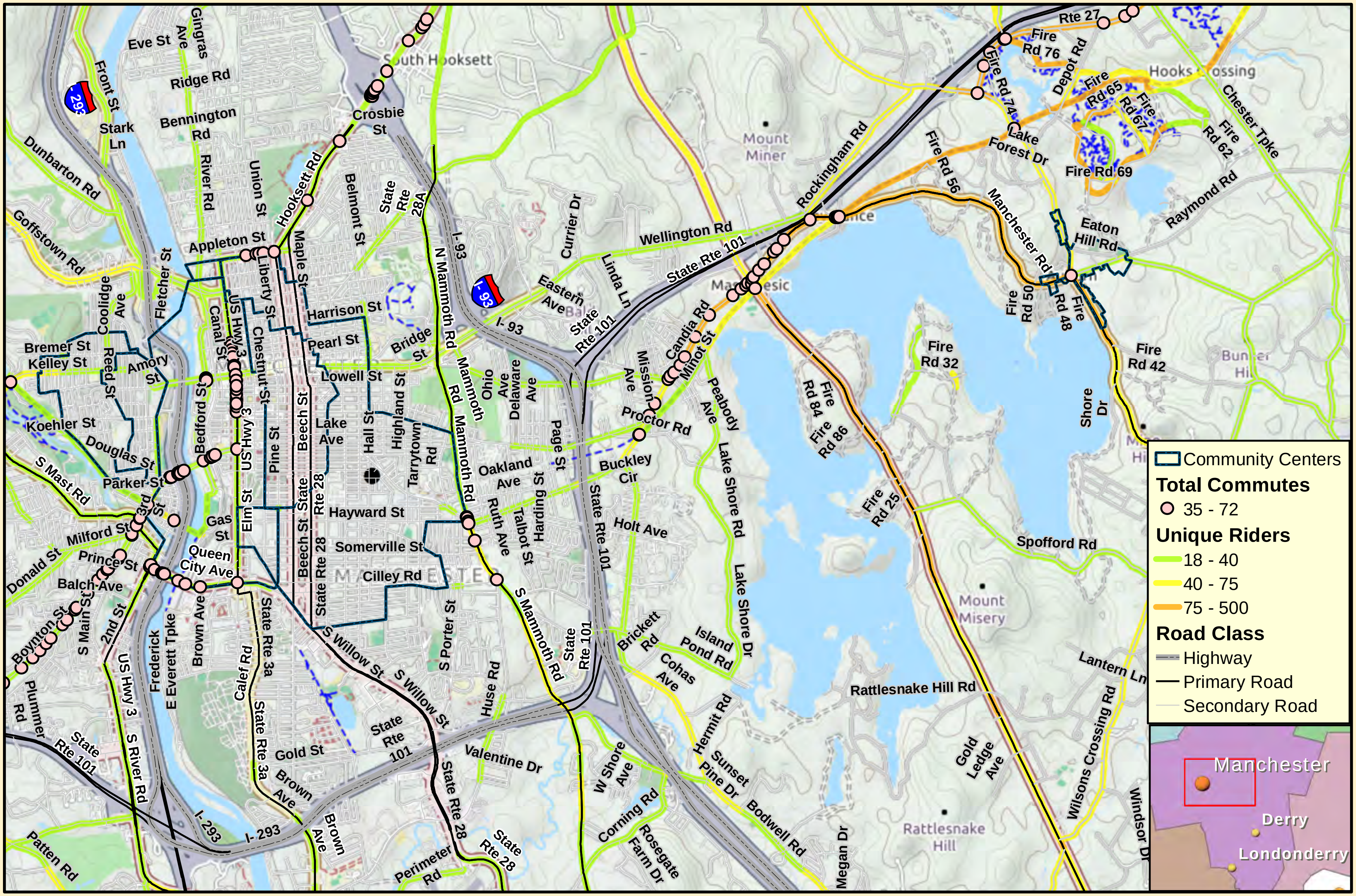
Greater Manchester Metro Area:
Derry-Londonderry
Weekend Commute Patterns

0 0.375 0.75 1.5 2.25 3 Miles

1:63,360

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

N



Southern NH Regional Planning Commission

Greater Manchester Metro Area: Manchester East Weekend Commute Patterns

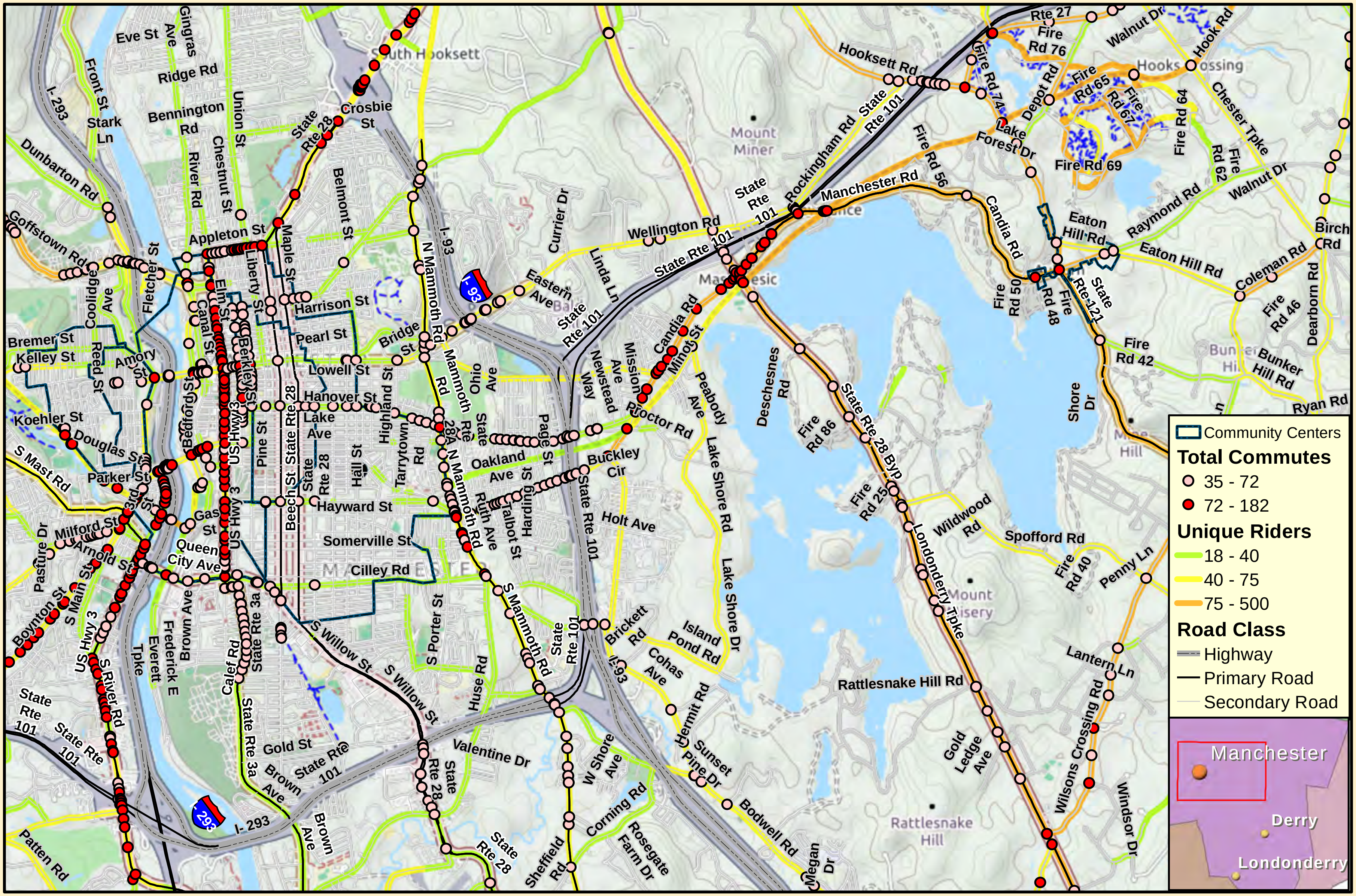
NEW HAMPSHIRE SOUTHERN PLANNING COMMISSION
SNHPC

0 0.375 0.75 1.5 2.25 3 Miles

1:63,360

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

N



Southern NH Regional Planning Commission

Greater Manchester Metro Area: Manchester East Weekday Commute Patterns

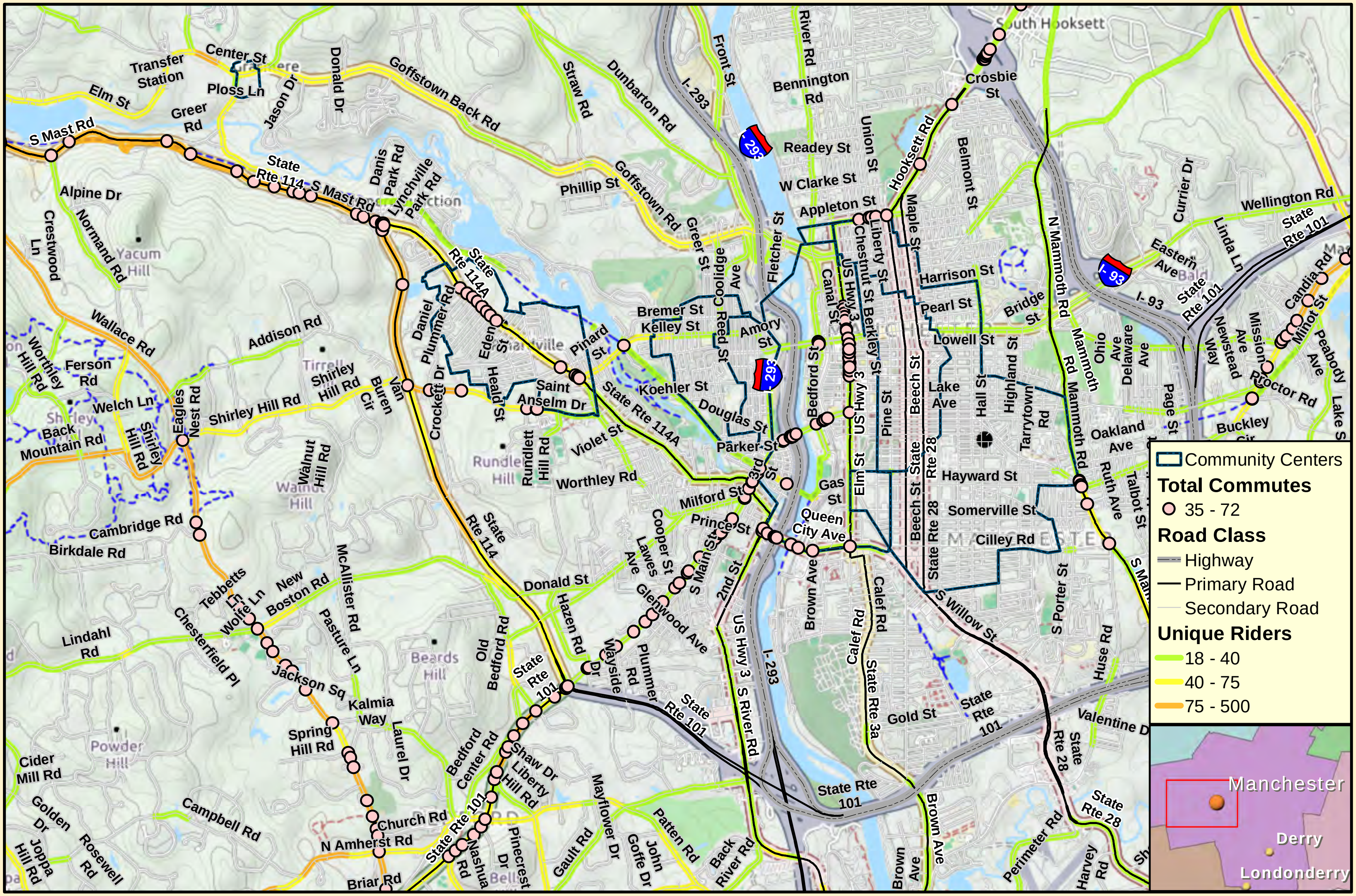
SNHPC

0 0.375 0.75 1.5 2.25 3 Miles

1:63,360

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

N



Southern NH Regional Planning Commission

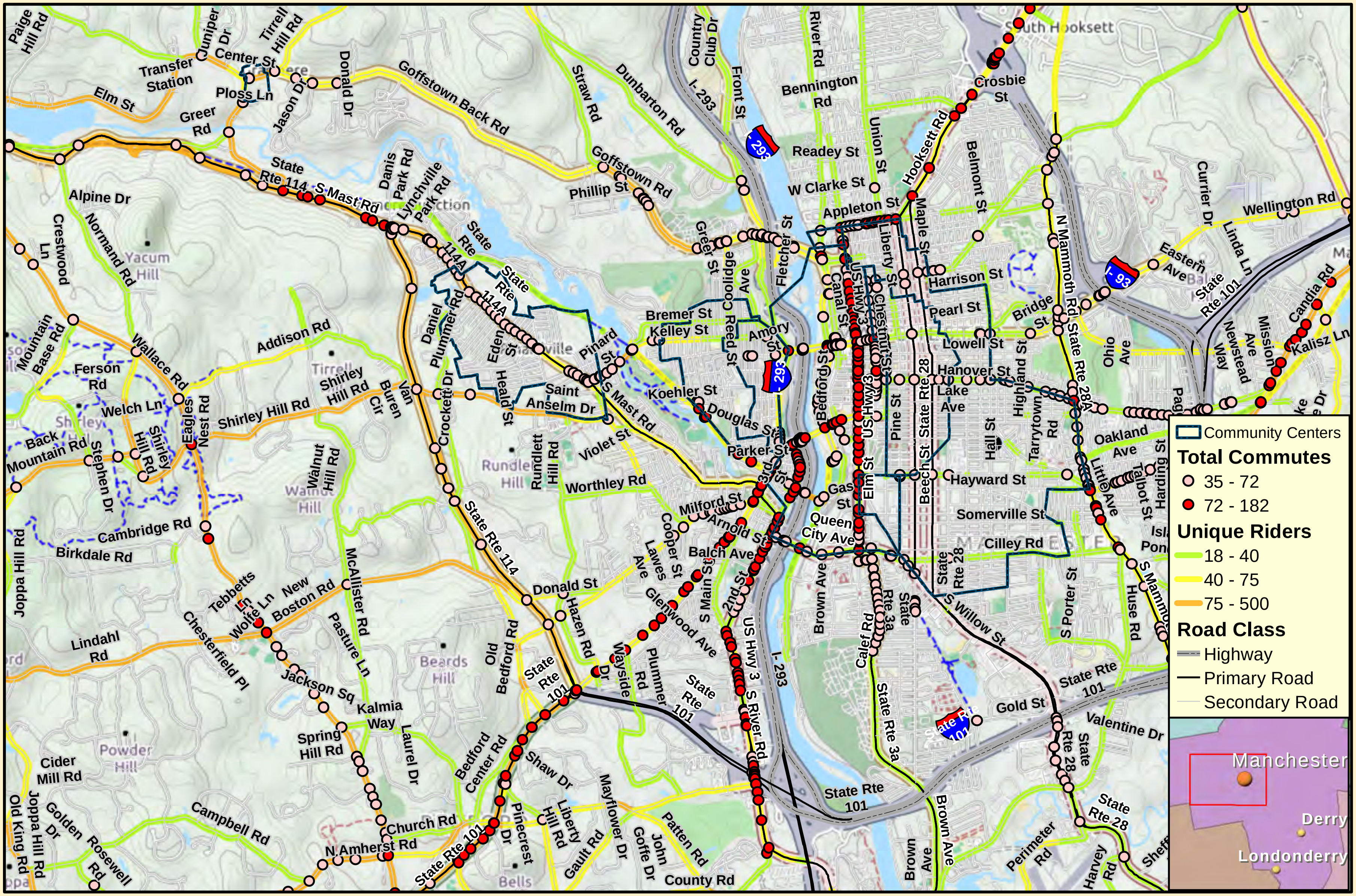
Greater Manchester Metro Area:
Manchester West
Weekend Commute Patterns

0 0.375 0.75 1.5 2.25 3 Miles

1:63,360

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

N



Southern NH Regional Planning Commission

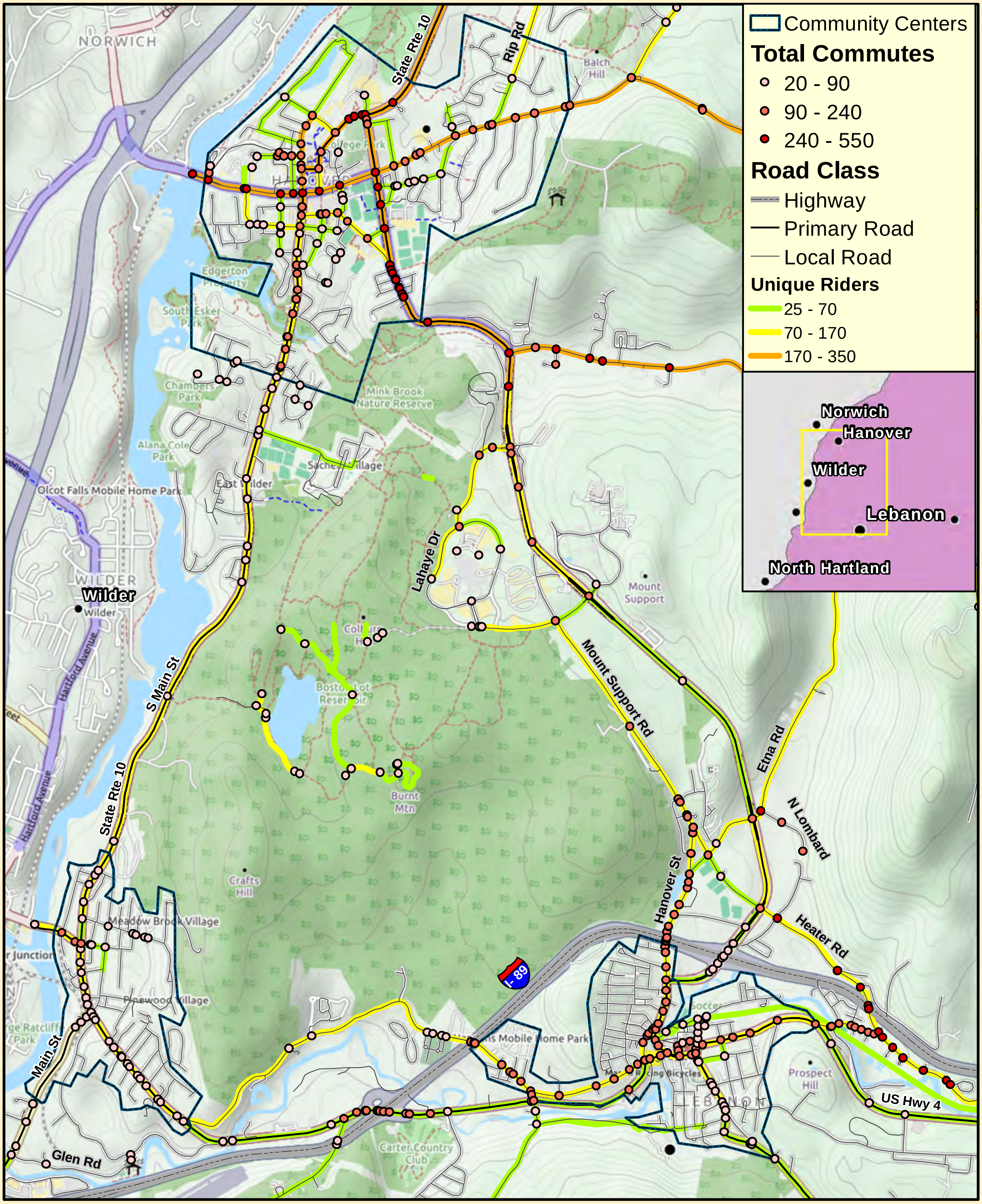
Greater Manchester Metro Area:
Manchester West
Weekday Commute Patterns

0 0.375 0.75 1.5 2.25 3 Miles

1:63,360

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

N



Upper Valley Lake Sunapee Regional Planning Commission

Rt. 10 Hanover - Lebanon, NH

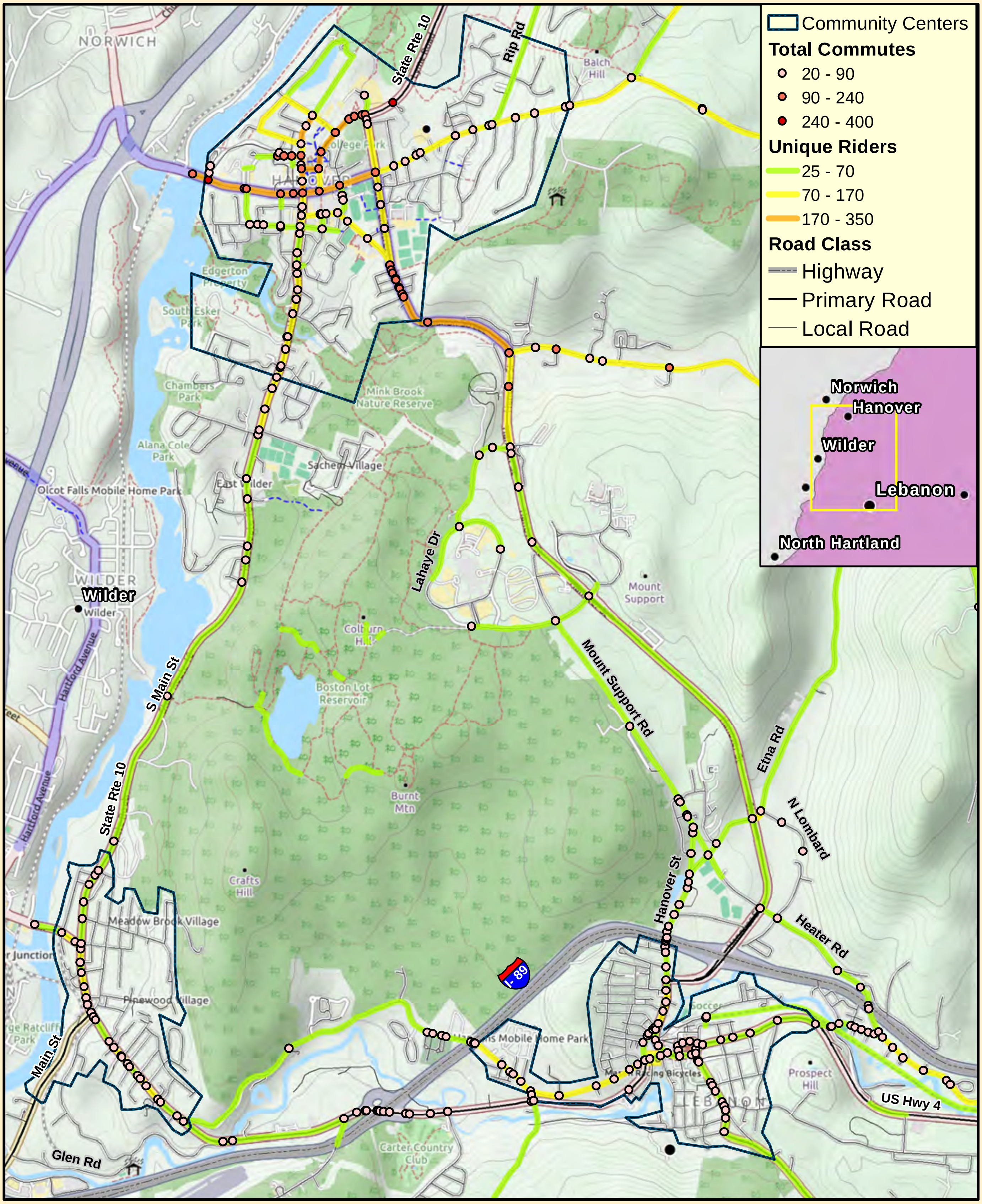
Weekday Commute Patterns

UVLSRPC

0 0.175 0.35 0.7 1.05 1.4 Miles

1:42,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US



Upper Valley Lake Sunapee Regional Planning Commission

Rt. 10 Hanover - Lebanon, NH

Weekend Commute Patterns

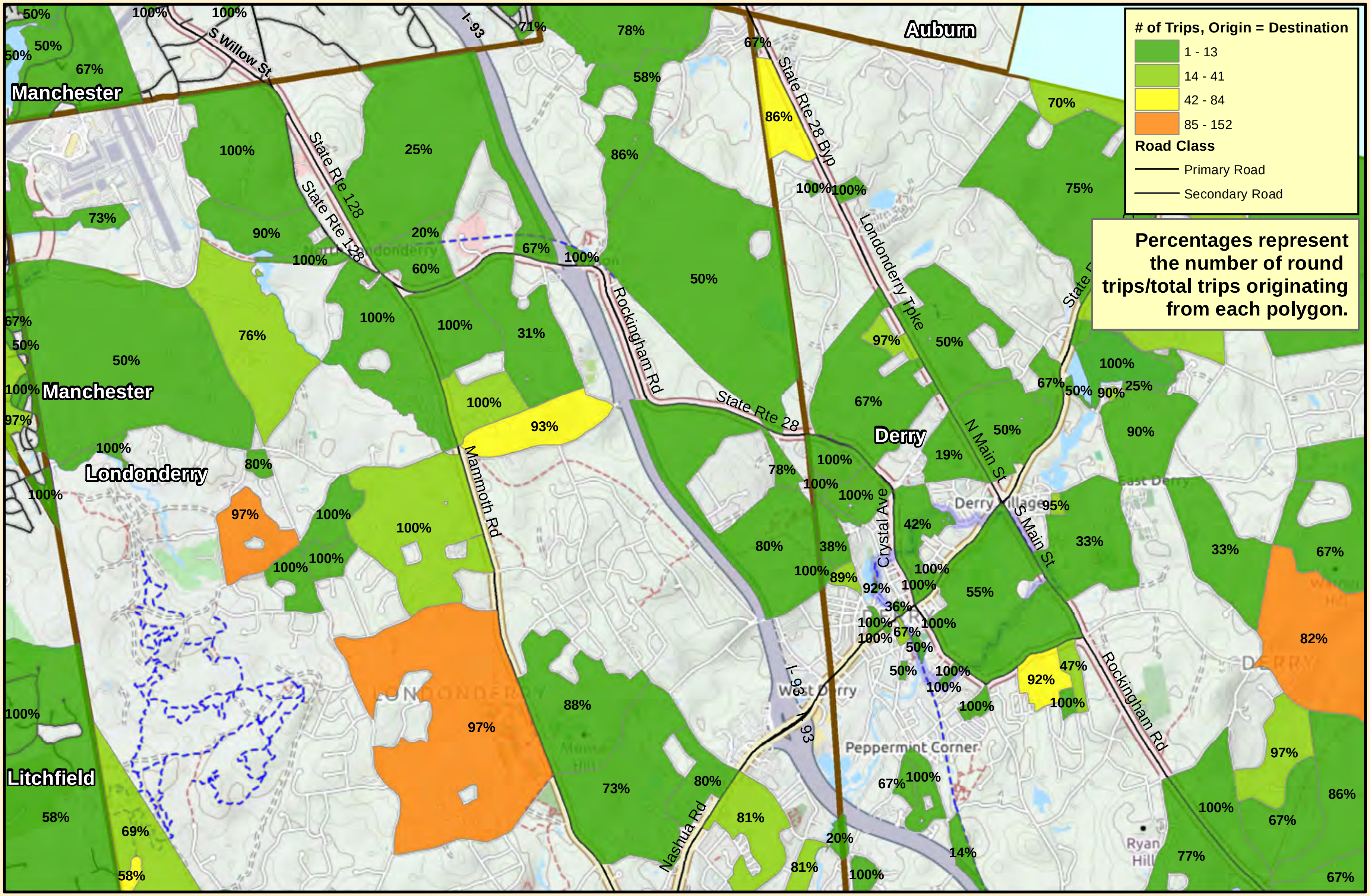
U V L S R P C

0 0.175 0.35 0.7 1.05 1.4 Miles

1:42,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

APPENDIX D



Southern NH Planning Commission

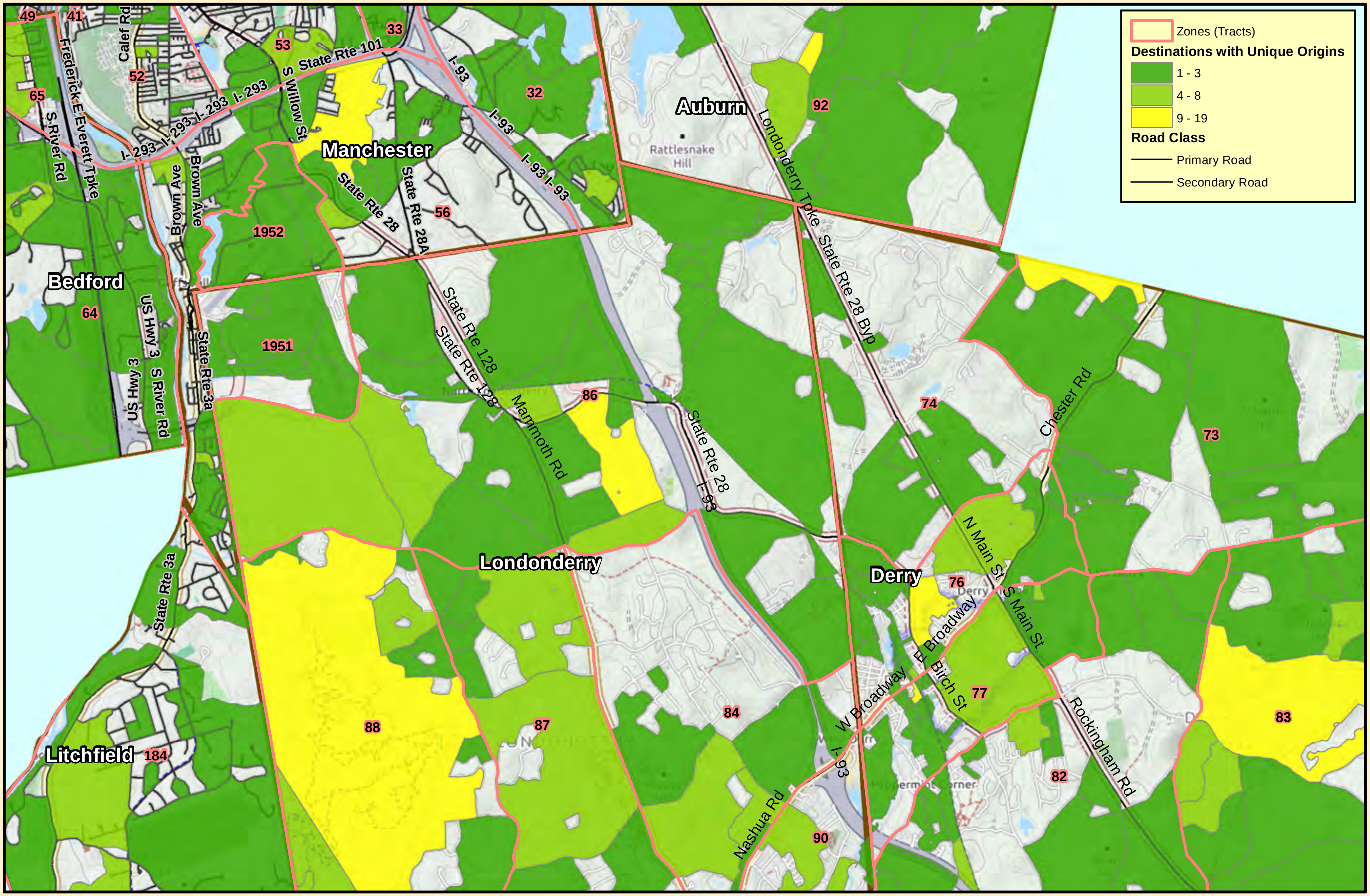
Derry-Londonderry:
Strava Metro Round Trips

0 0.375 0.75 1.5 2.25 3 Miles

1:63,360

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

N



Southern NH Planning Commission

Derry-Londonderry:
Strava Metro Destinations with Unique Origins

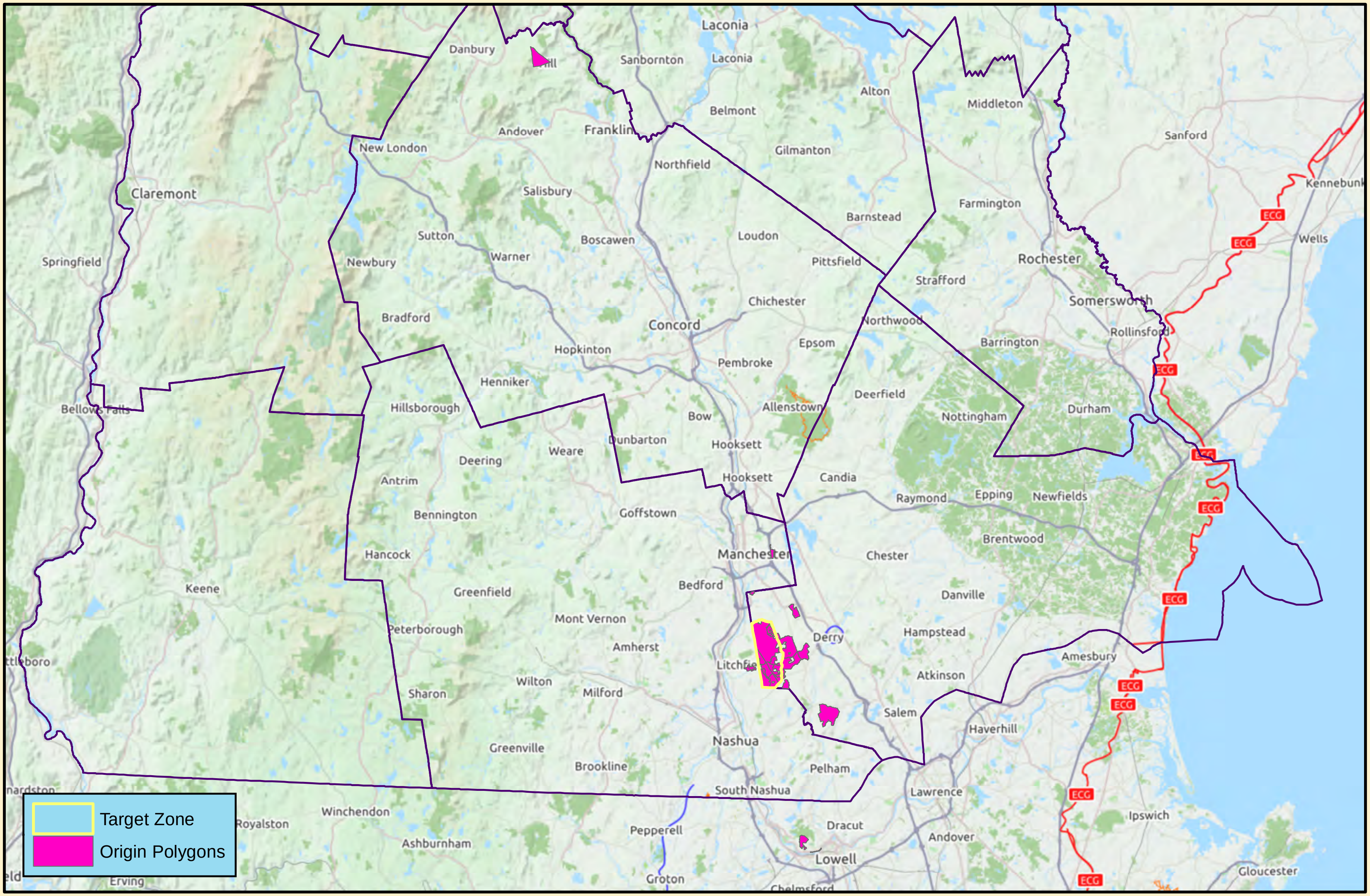
SNHPC

0 0.5 1 2 3 4 Miles

1:80,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

N



Southern NH Planning Commission

Londonderry:
Origin Polygons for Zone 88 (Overview)

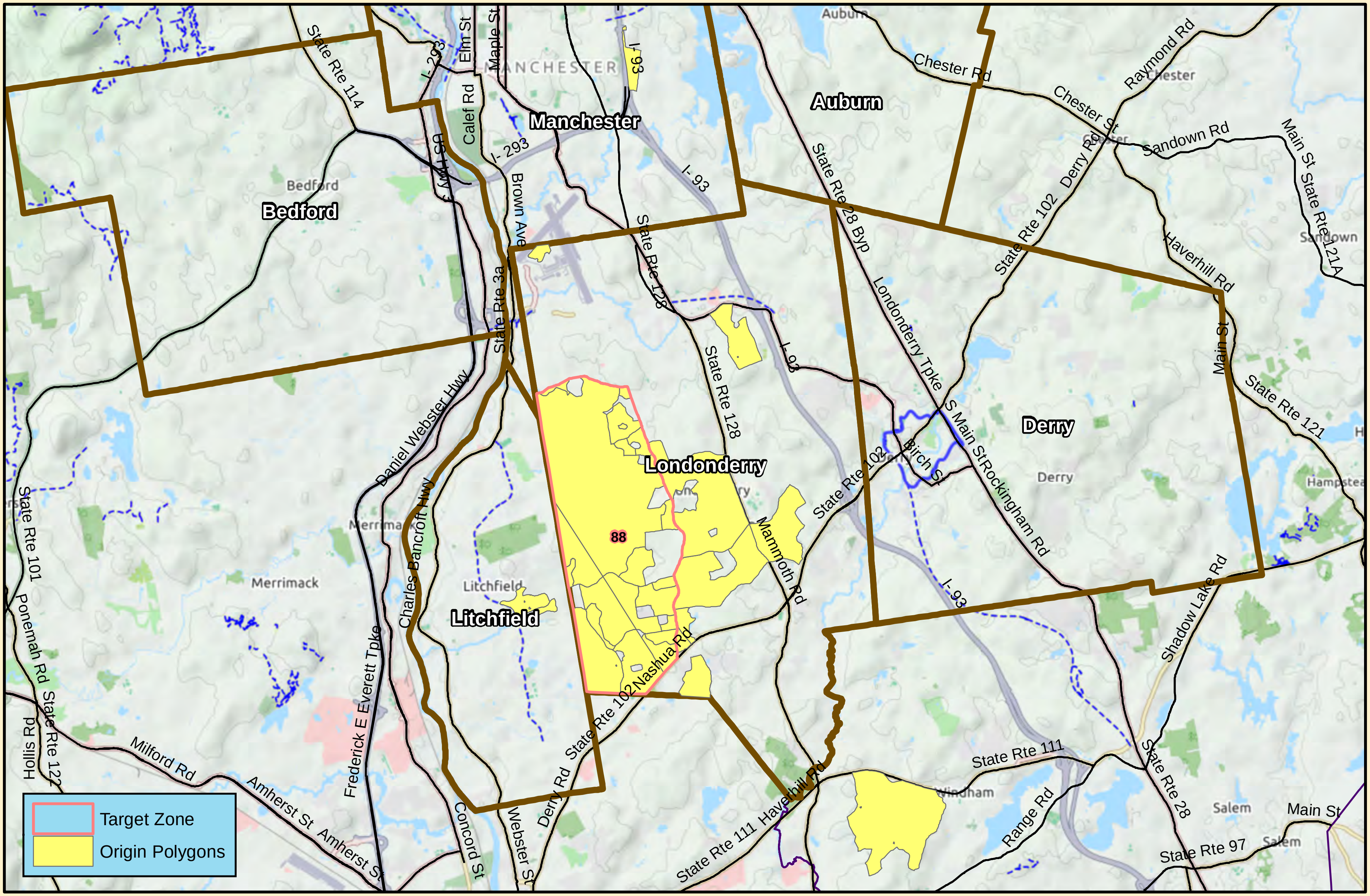
SNHPC

0 4.25 8.5 17 25.5 34 Miles

1:700,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

N



Southern NH Planning Commission

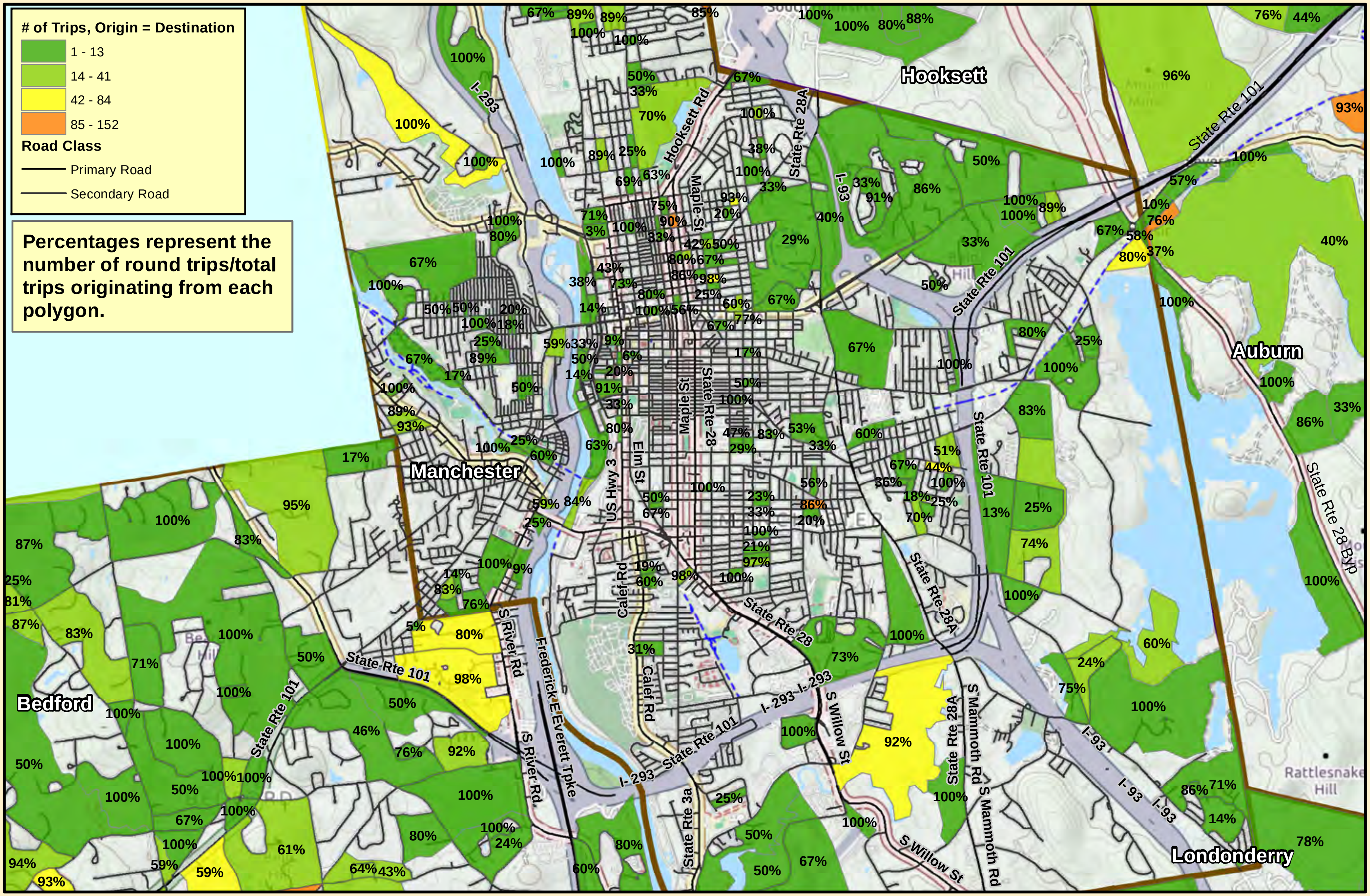
Londonderry:
Origin Polygons for Zone 88

0 0.75 1.5 3 4.5 6
Miles

1:150,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

N



Southern NH Planning Commission

Greater Manchester Area: Strava Metro Round Trips

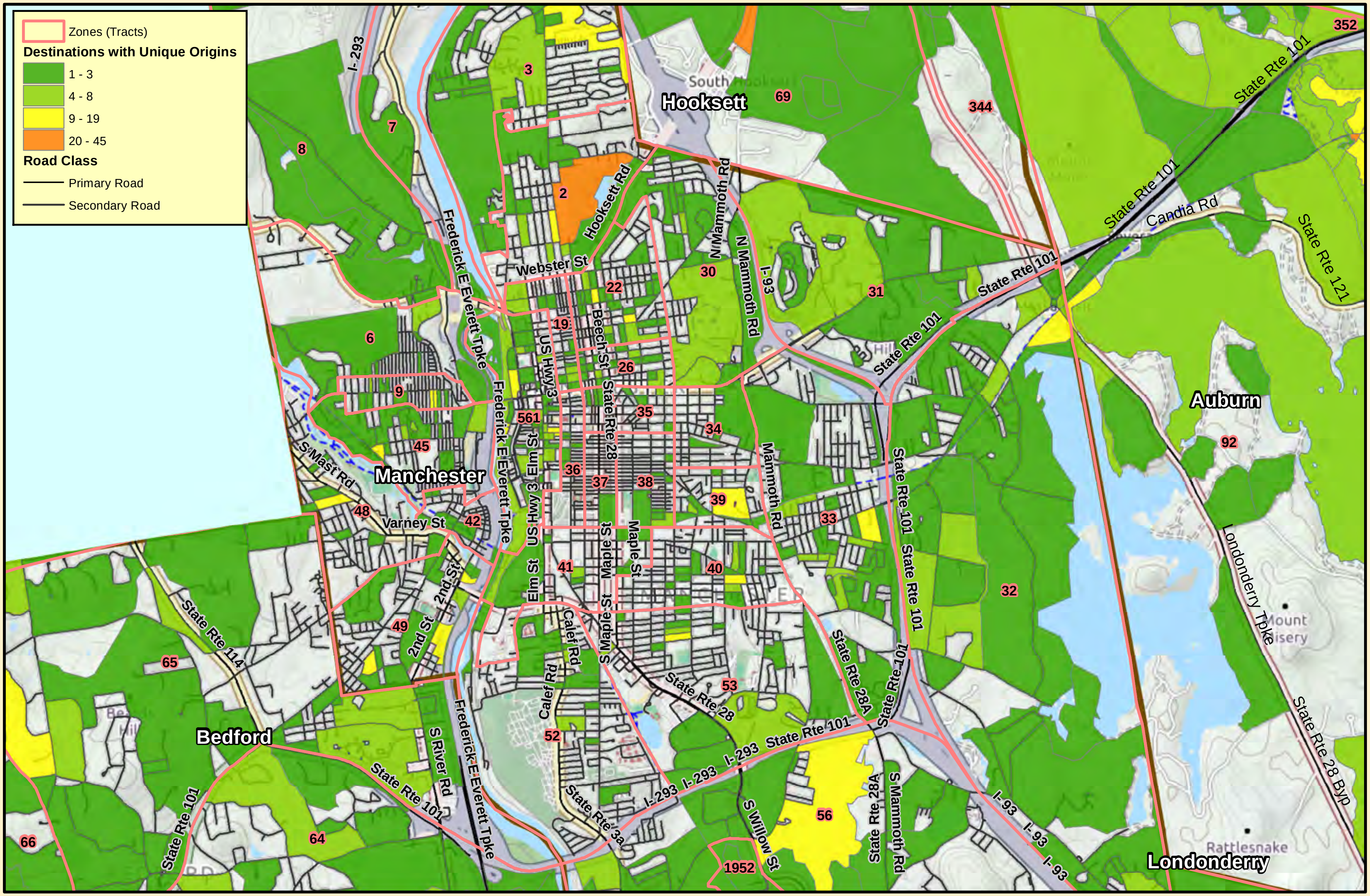
SNHPC

0 0.375 0.75 1.5 2.25 3 Miles

1:63,360

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

N



Southern NH Planning Commission

Manchester:
Strava Metro Destinations with Unique Origins

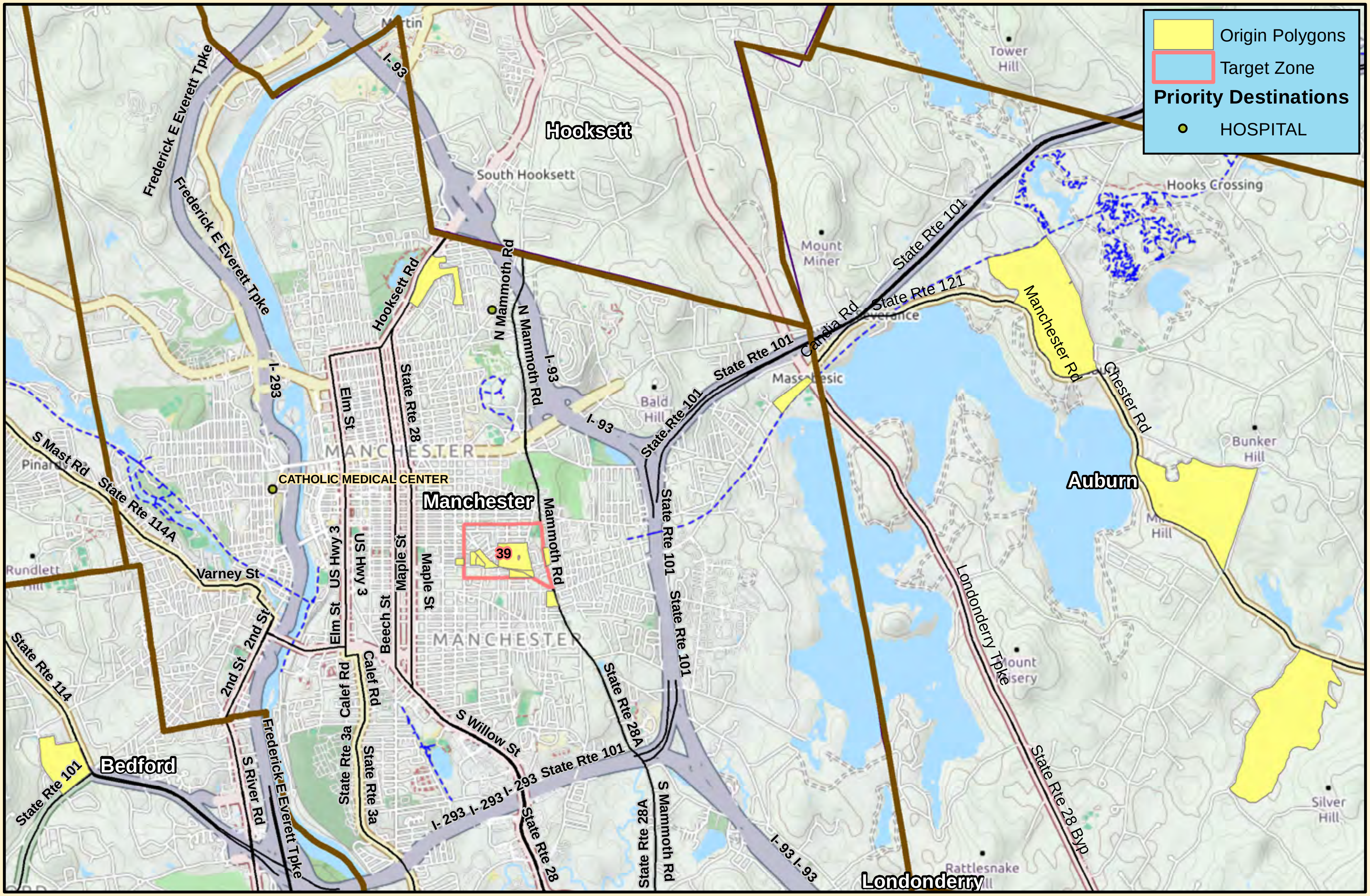
SNHPC

0 0.375 0.75 1.5 2.25 3 Miles

1:63,360

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

N



Southern NH Planning Commission

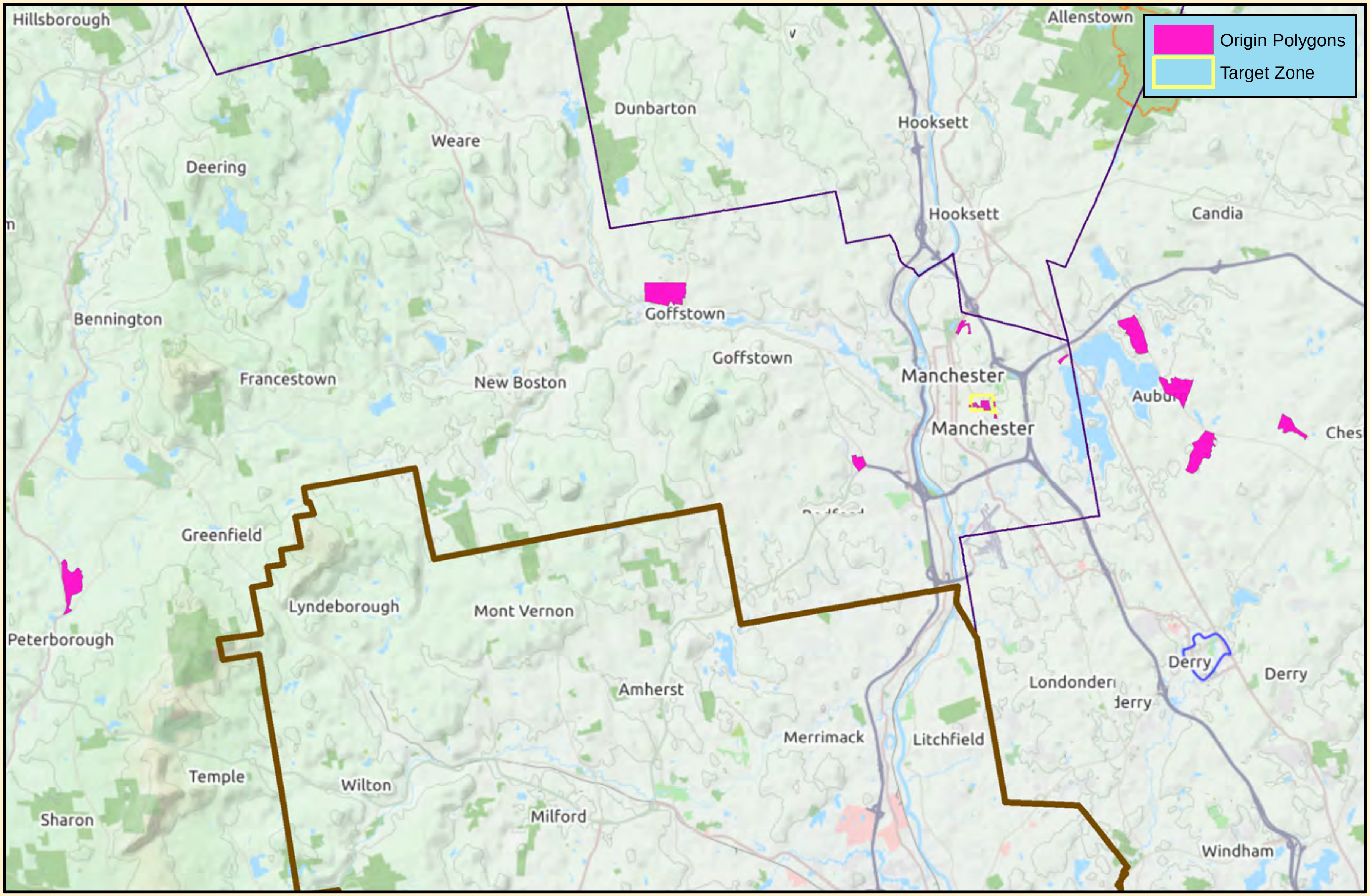
Manchester:
Origin Polygons for Zone 39

0 0.375 0.75 1.5 2.25 3 Miles

1:70,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

N



Southern NH Planning Commission

Manchester:
Origin Polygons for Zone 39 (Overview)

SNHPC

1:250,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

APPENDIX E

Priority Destinations

- ATHLETIC/REC FACILITY
- COMMUNITY FACILITY
- ESSENTIAL CITY FACILITY
- GROCERY STORE
- HOSPITAL
- LIBRARY
- PLACE OF WORSHIP
- POST OFFICE
- RETAIL/SHOPPING AREA
- SCHOOL
- SMALLER MARKET
- TRAIL ACCESS POINT

Population

- 100,000 - 499,999
- 50,000 - 99,999
- 10,000 - 49,999
- Under 10,000

Road Class

- Primary Road
- Secondary Road
- Local Road

Total Unique Cyclists Per Segment

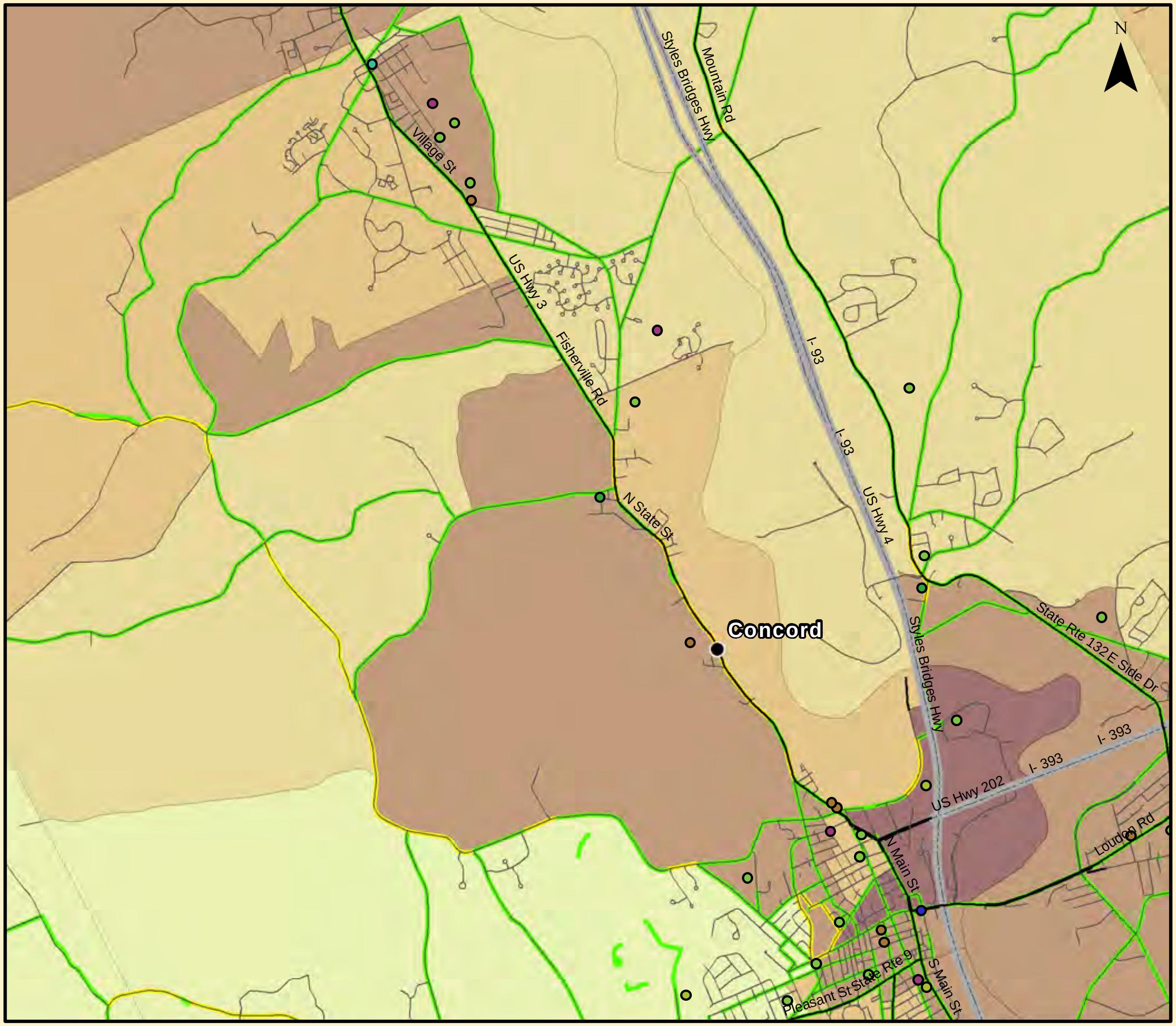
- 1 - 30
- 31 - 120
- 121 - 300
- 301 - 500
- 501 - 1185

Central NH RPC

- Boundary

Census Block Groups - Median Income

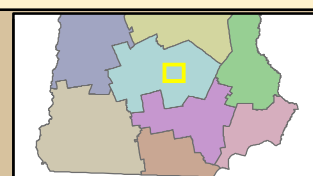
- $90,000 - 150,000
- $70,000 - $90,000
- $51,932 - 69,999
- Low-Income Community
- Lowest Income Community



Central NH Regional Planning Commission

Fisherville Road, Concord

Complete Streets Road Improvements



0 0.25 0.5 1 1.5 2 Miles

1:62,500

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

Priority Destinations
- ATHLETIC/REC FACILITY
- COMMUNITY FACILITY
- ESSENTIAL CITY FACILITY
- GROCERY STORE
- HOSPITAL
- LIBRARY
- PLACE OF WORSHIP
- POST OFFICE
- RETAIL/SHOPPING AREA
- SCHOOL
- SMALLER MARKET
- TRAIL ACCESS POINT

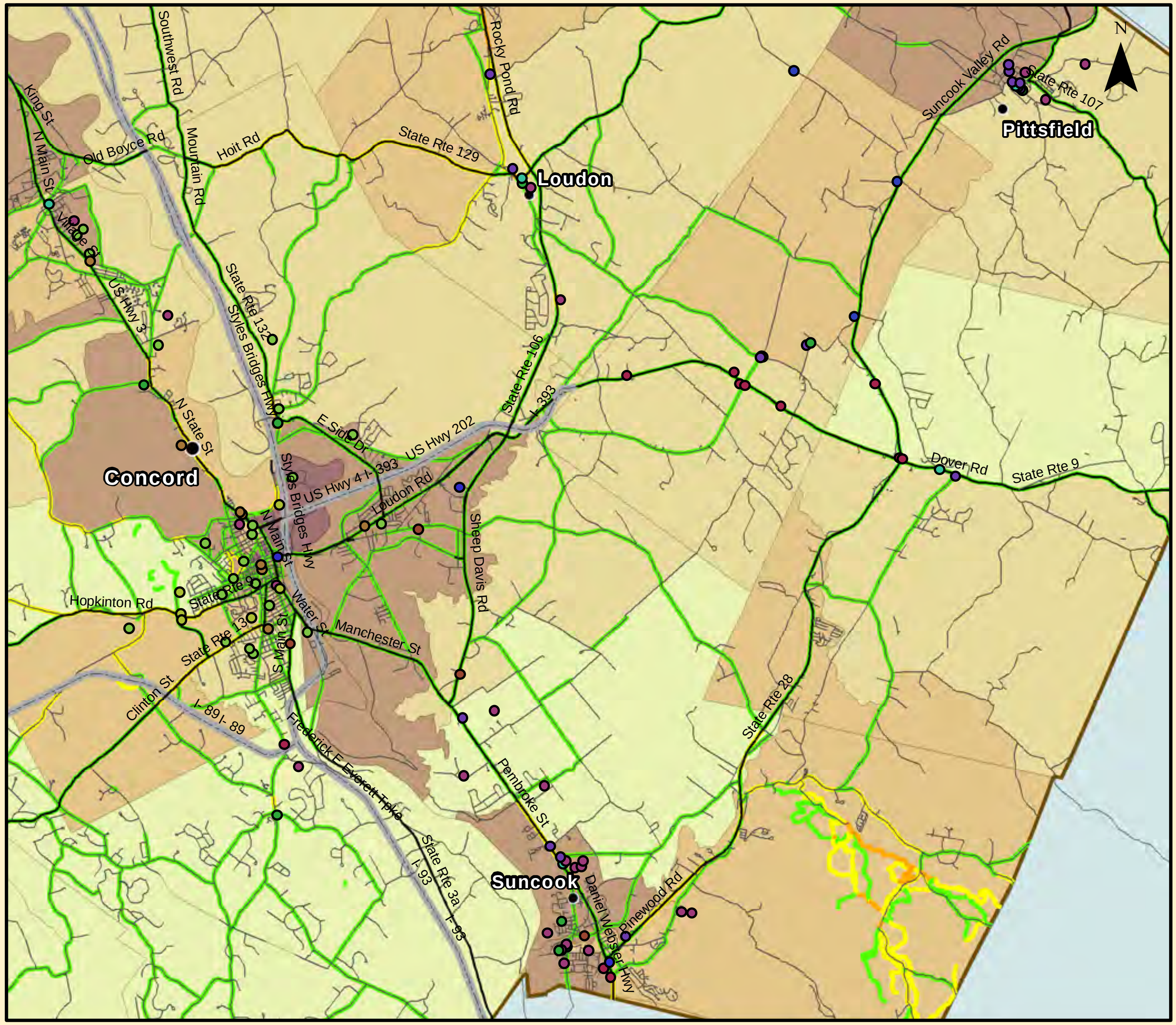
Population
- 100,000 - 499,999
- 50,000 - 99,999
- 10,000 - 49,999
- Under 10,000

Road Class
- Primary Road
- Secondary Road
- Local Road

Total Unique Cyclists Per Segment
- 1 - 30
- 31 - 120
- 121 - 300
- 301 - 500
- 501 - 1185

Central NH RPC
- Boundary

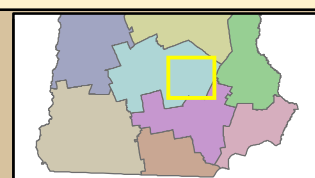
Census Block Groups - Median Income
- $90,000 - 150,000
- $70,000 - $90,000
- $51,932 - 69,999
- Low-Income Community
- Lowest Income Community



Central NH Regional Planning Commission

Concord, Loudon, Suncook, Pittsfield

Key Destinations



0 0.75 1.5 3 4.5 6 Miles

1:150,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

Priority Destinations
- ATHLETIC/REC FACILITY
- COMMUNITY FACILITY
- ESSENTIAL CITY FACILITY
- GROCERY STORE
- HOSPITAL
- LIBRARY
- PLACE OF WORSHIP
- POST OFFICE
- RETAIL/SHOPPING AREA
- SCHOOL
- SMALLER MARKET
- TRAIL ACCESS POINT

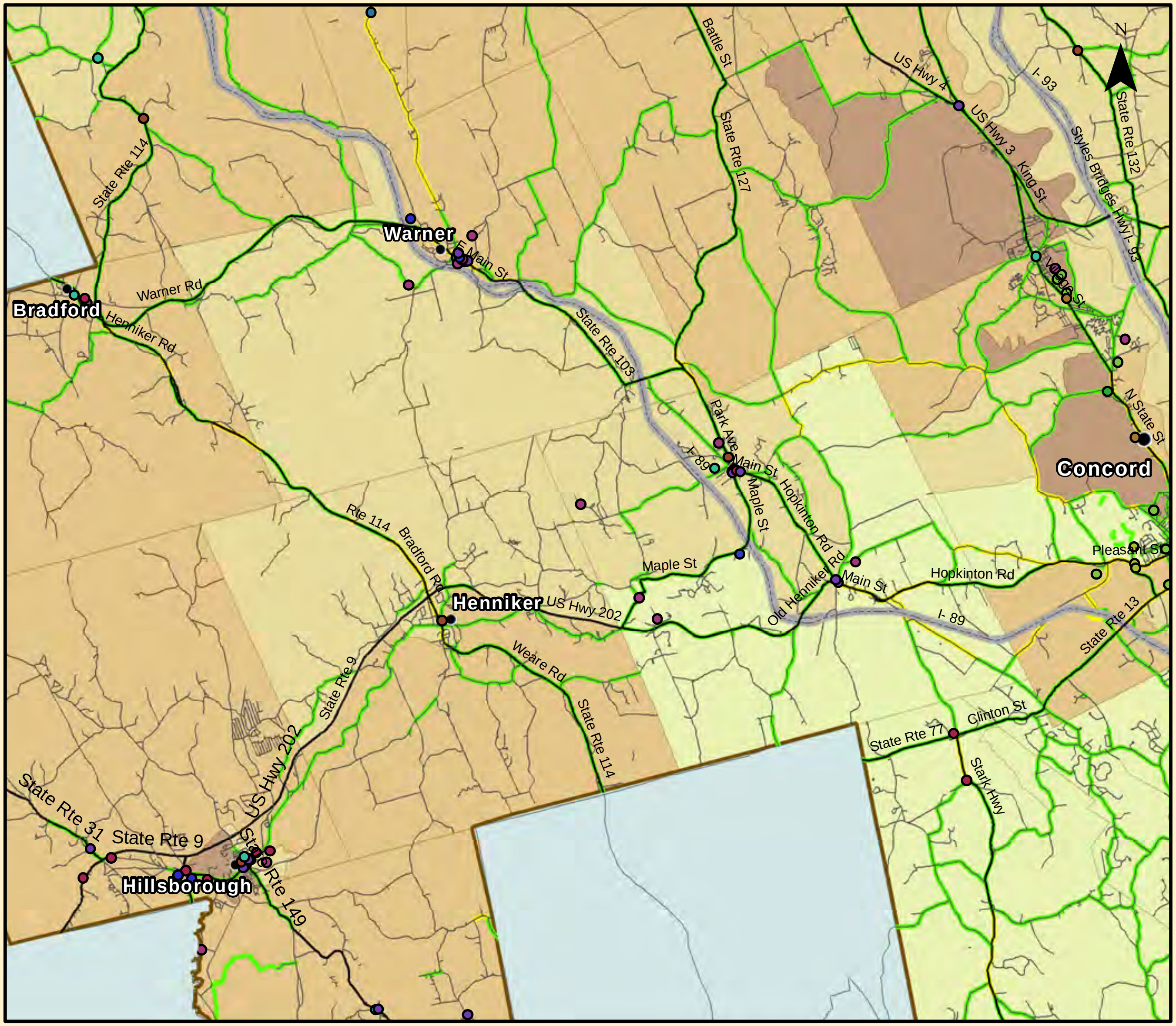
Population
- 100,000 - 499,999
- 50,000 - 99,999
- 10,000 - 49,999
- Under 10,000

Road Class
- Primary Road
- Secondary Road
- Local Road

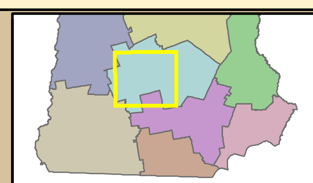
Total Unique Cyclists Per Segment
- 1 - 30
- 31 - 120
- 121 - 300
- 301 - 500
- 501 - 1185

Central NH RPC
- Boundary

Census Block Groups - Median Income
- $90,000 - 150,000
- $70,000 - $90,000
- $51,932 - 69,999
- Low-Income Community
- Lowest Income Community



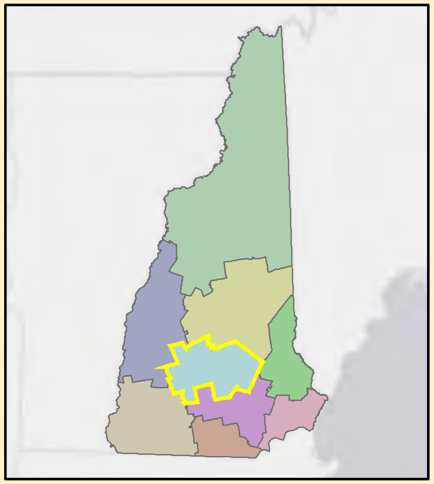
Central NH Regional Planning Commission
Concord, Hillsborough, Bradford, Warner, Henniker
Priority Destinations

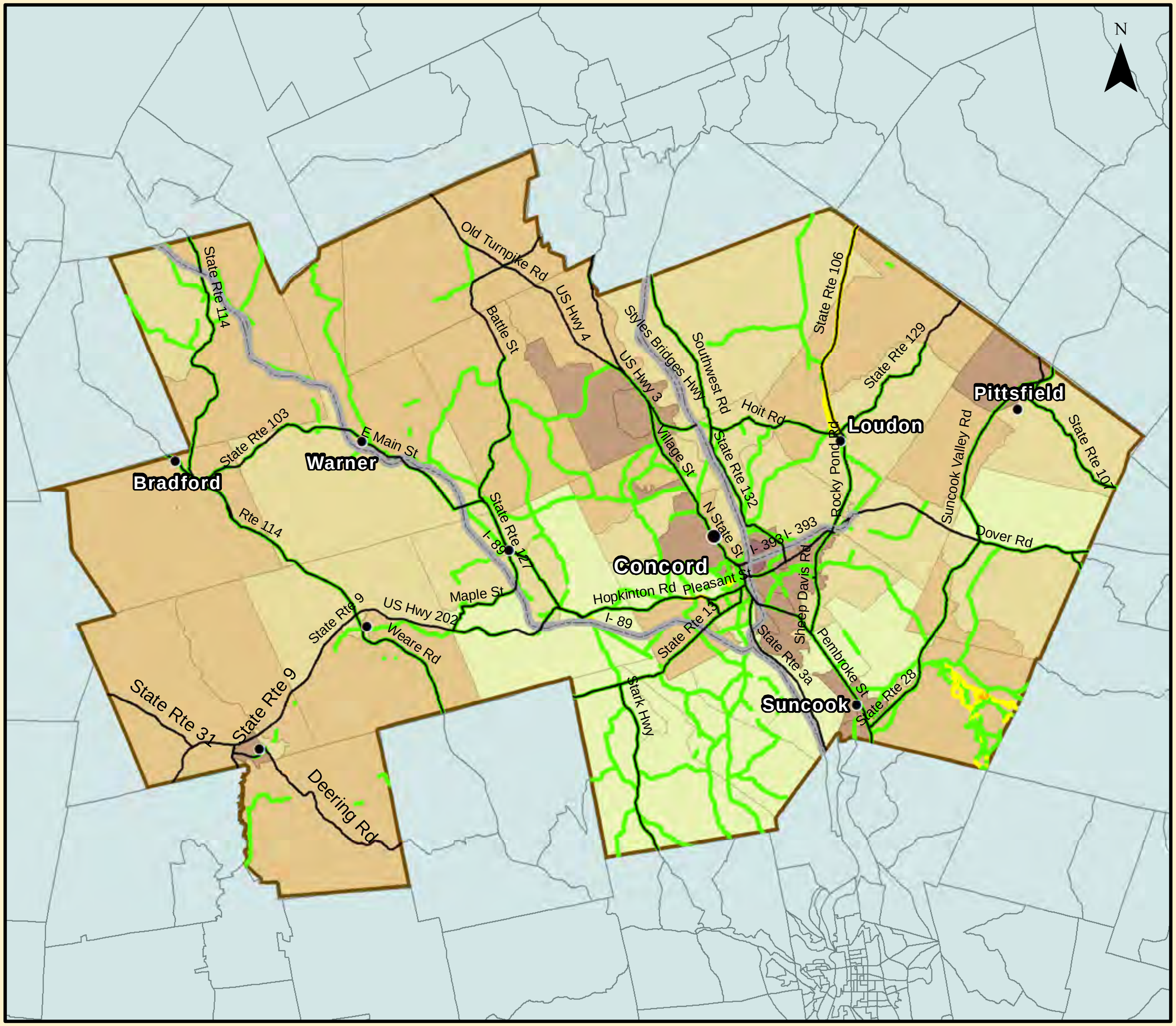


0 1 2 4 6 8 Miles

1:200,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US





Population

- 100,000 - 499,999
- 50,000 - 99,999
- 10,000 - 49,999
- Under 10,000

Road Class

- Primary Road
- Secondary Road

Total Unique Cyclists Per Segment

- 1 - 50
- 51 - 170
- 171 - 350
- 351 - 700
- 701 - 1185

Central NH RPC

- Boundary

Census Block Groups - Median Income

- $90,000 - 150,000
- $70,000 - $90,000
- $51,932 - 69,999
- Low-Income Community
- Lowest Income Community

Central NH Regional Planning Commission

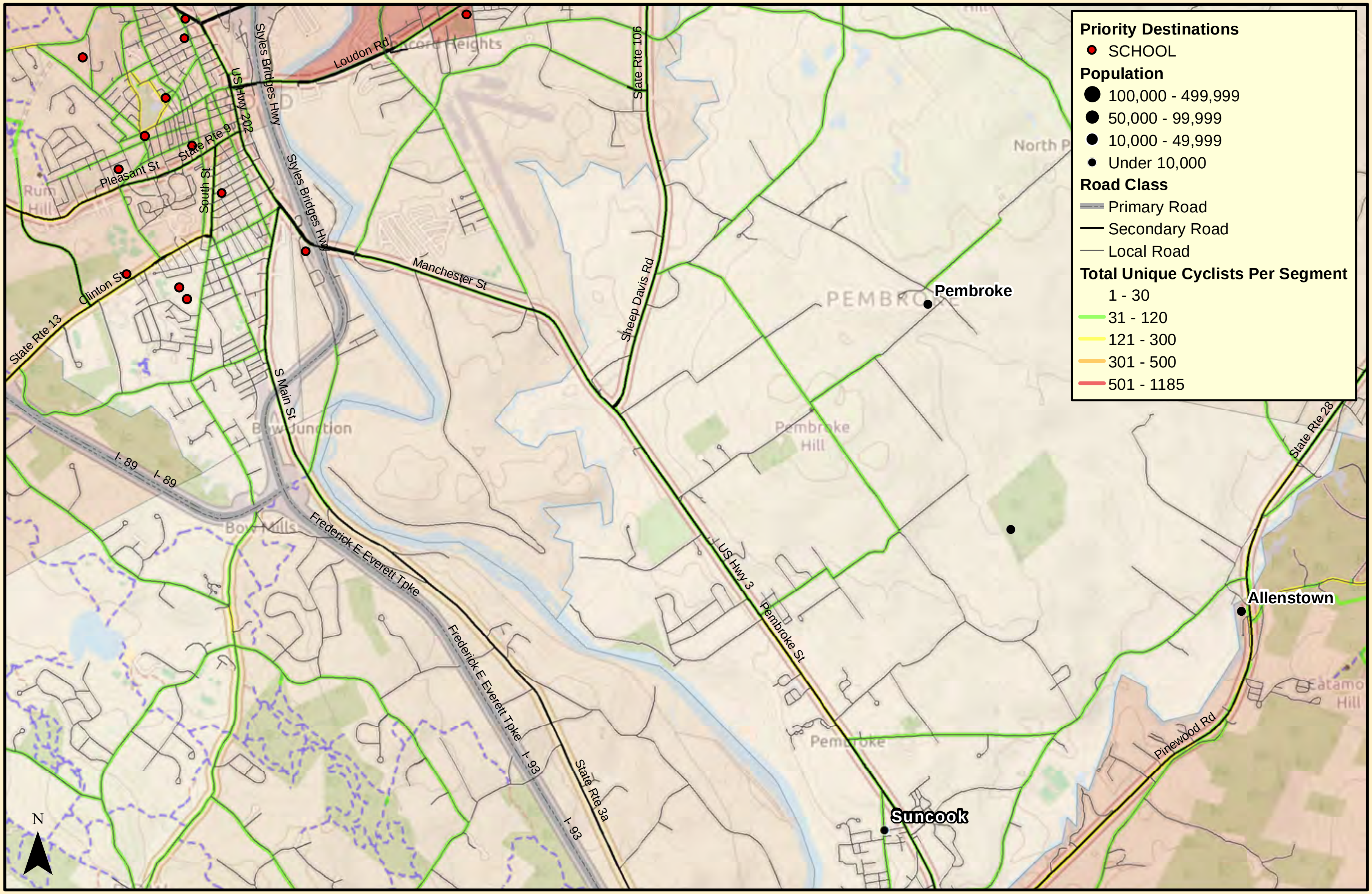
Overview

CNHRPC

0 2.25 4.5 9 13.5 18 Miles

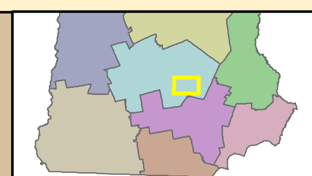
1:400,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US



Central NH Regional Planning Commission

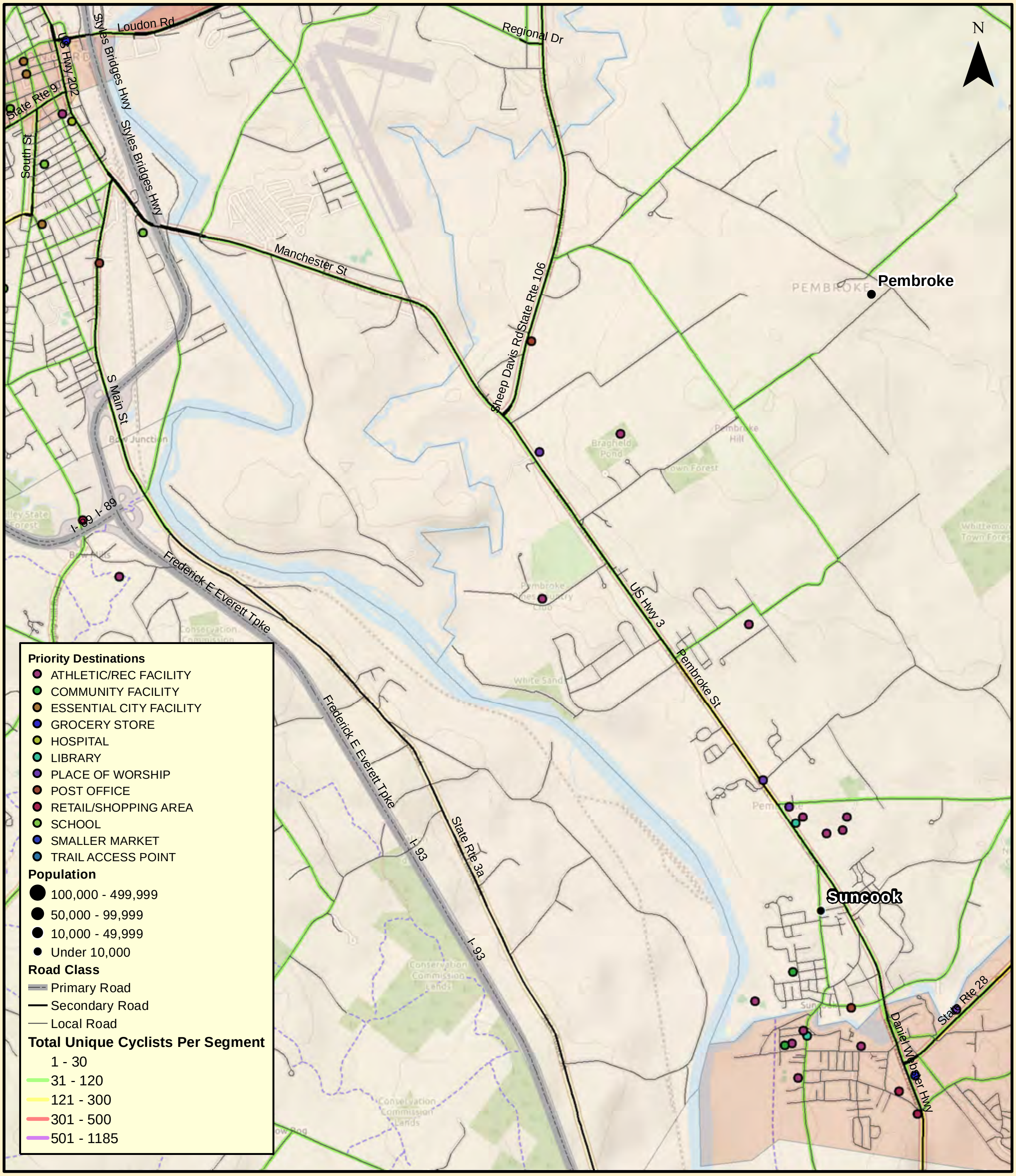
Concord - Suncook, Allenstown & Pembroke Connectivity & Safe Routes to School



0 0.3 0.6 1.2 1.8 2.4 Miles

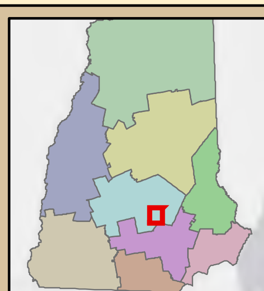
1:60,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US



Central NH Regional Planning Commission

Concord - Suncook & Pembroke Connectivity



1:50,000

0 0.25 0.5 1 1.5 2 Miles

WGS 1984 Web Mercator Auxiliary Sphere

CNHRPC

Target: Suncook, Allenstown, and Pembroke connectivity to Concord; consider safe routes to school
Contacts: Craig Tufts, Principal Planner/GIS Planner CNHRPC

E-mail: There is a potential trail corridor from Suncook to Concord through Pembroke (abandoned rail trail). We have learned that there are two large potential housing developments along the corridor – approx. 100 homes around the property labeled “riverwood”. Also approx. 110 homes in the properties south of the Littlefield Condos.

Suncook Village is a lower income area and has a downtown that could be an economic asset.

From article in Concord Monitor (Thursday, May 8, 2014):
The Central New Hampshire Bicycle Coalition has given $17,000 to the city to stripe more than 5 miles of a bike lane on Route 3. As the city continues the fifth phase of its work to rebuild that road this summer, City Engineer Ed Roberge said the coalition’s money will make the bike lanes happen much more quickly. The lanes might not have been painted for years, he said, but this money will be used to mark the bike lane on Route 3 between Borough Road and Penacook Street by this fall.

The bike lane continuing through Penacook village will be painted next summer, Roberge said. The money will also pay for 12 “wrong way, ride with traffic” signs to direct bicycle traffic around the city.

One of Concord's most visible examples of its new 'Complete Streets' policy is the US Route 3 North Improvements Project which will include fully-compliant bike lanes from downtown Concord to Penacook Village.

Social Vulnerability Index
Greater Suncook-Allenstown Tract:
- Overall Vulnerability (0-10): 3
- Themes: for civilian unemployed, the proportion is in the 90th percentile, for mobile homes, the proportion is in the 90th percentile, for crowded housing, the proportion is in the 90th percentile

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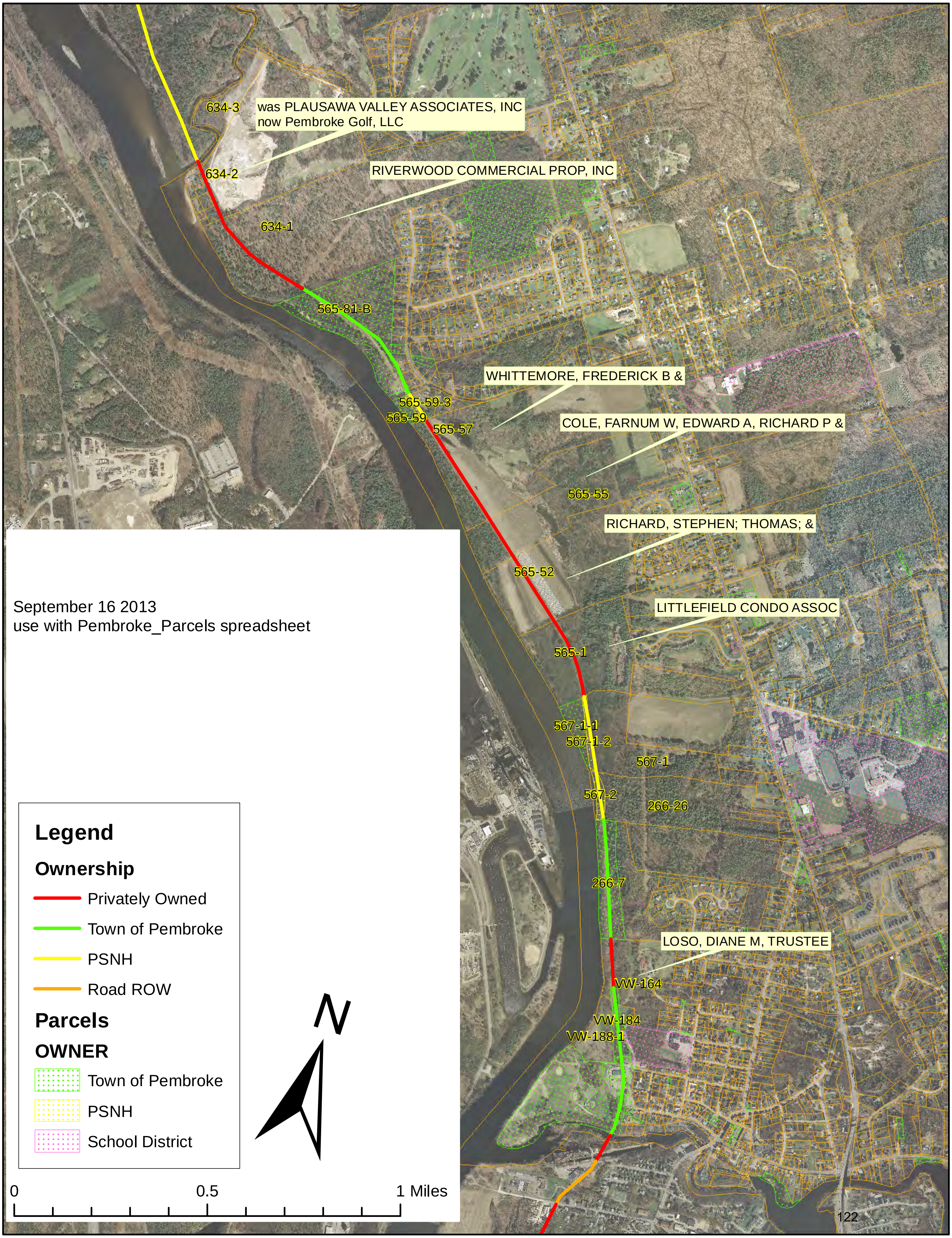


634-3
was PLAUSAWA VALLEY ASSOCIATES, INC
now Pembroke Golf, LLC
634-2
RIVERWOOD COMMERCIAL PROP, INC
634-1
565-81-B
WHITTEMORE, FREDERICK B &
565-59-3
565-59
565-57
COLE, FARNUM W, EDWARD A, RICHARD P &
565-55
RICHARD, STEPHEN; THOMAS; &
565-52
LITTLEFIELD CONDO ASSOC
565-1
567-1-1
567-1-2
567-1
567-2
266-26
266-7
LOSO, DIANE M, TRUSTEE
VW-164
VW-184
VW-188-1
September 16 2013
use with Pembroke_Parcels spreadsheet
Legend
Ownership
Privately Owned
Town of Pembroke
PSNH
Road ROW
Parcels
OWNER
Town of Pembroke
PSNH
School District
N
0
0.5
1 Miles
122

Google imagery views of road connecting Rt. 3 and Pembroke, Academy Rd. (connecting Rt. 3 and Allenstown), and Rt. 28 (connecting Rt. 3 and Allenstown).

Rt. 3 near Suncook, Rt. 3 at turnoff for Pembroke, Rt. 3 near Concord.

Population

- 100,000 - 499,999
- 50,000 - 99,999
- 10,000 - 49,999
- Under 10,000

Priority Destinations

- ATHLETIC/REC FACILITY
- COMMUNITY FACILITY
- ESSENTIAL CITY FACILITY
- GROCERY STORE
- HOSPITAL
- LIBRARY
- PLACE OF WORSHIP
- POST OFFICE
- RETAIL/SHOPPING AREA
- SCHOOL
- SMALLER MARKET
- TRAIL ACCESS POINT

Road Class

- Primary Road
- Secondary Road
- Local Road

Total Unique Cyclists Per Segment

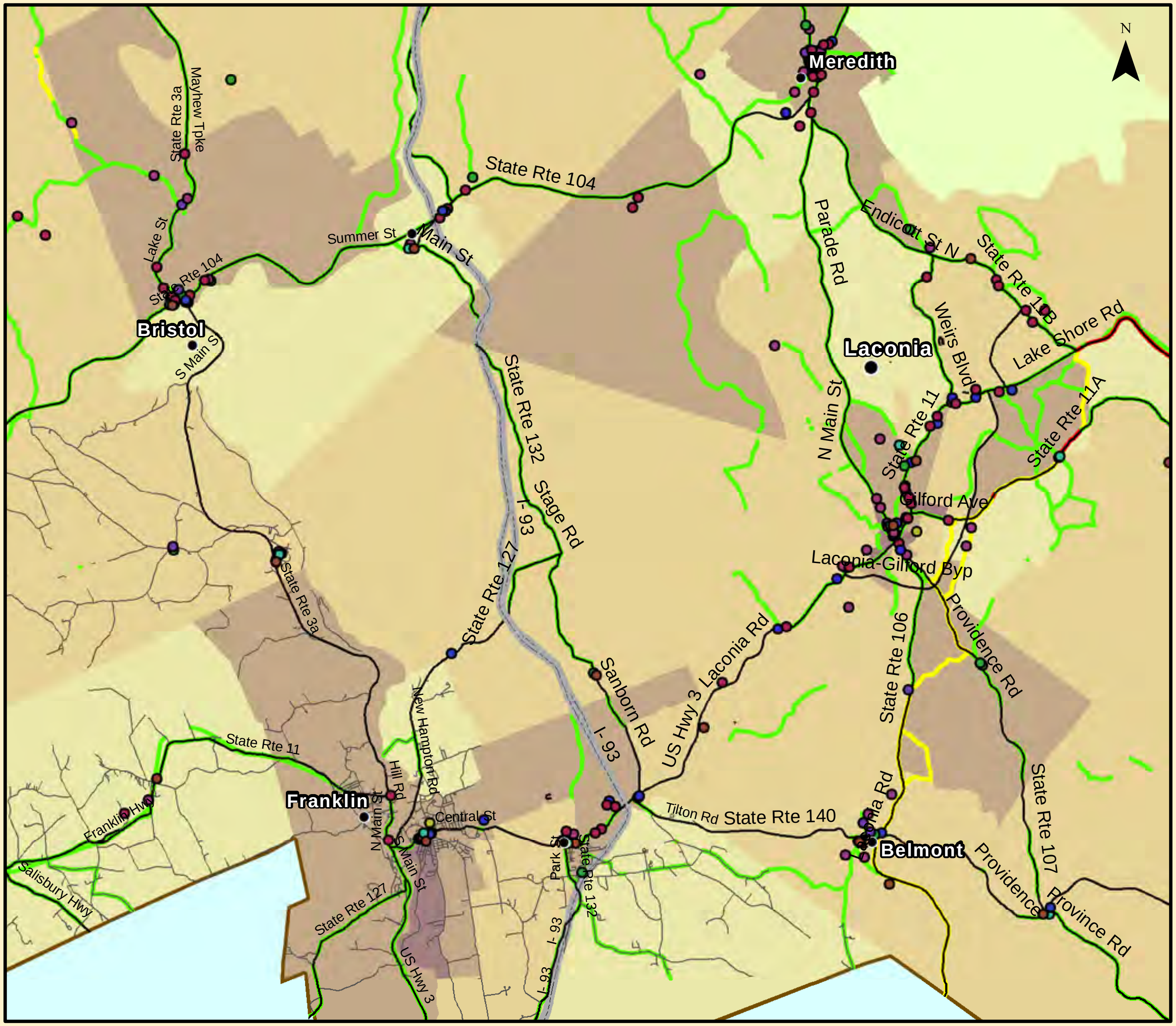
- 1 - 30
- 31 - 120
- 121 - 300
- 301 - 500
- 501 - 1185

Lakes Region Planning Commission

- Boundary

Census Block Groups - Median Income

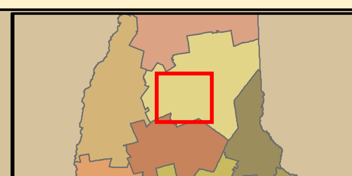
- $90,000 - 150,000
- $70,000 - $90,000
- $51,932 - 69,999
- Low-Income Community
- Lowest Income Community



Lakes Region Planning Commission

Laconia, Meredith,Bristol, Franklin, Belmont

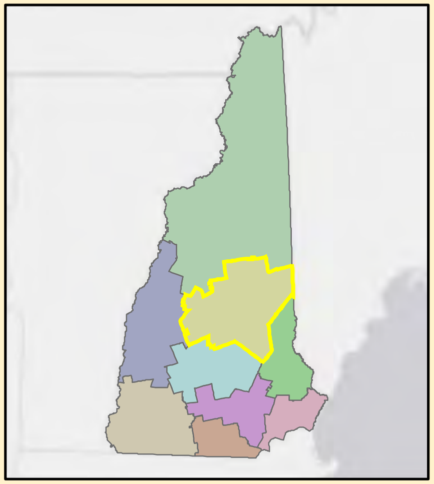
Key Destinations

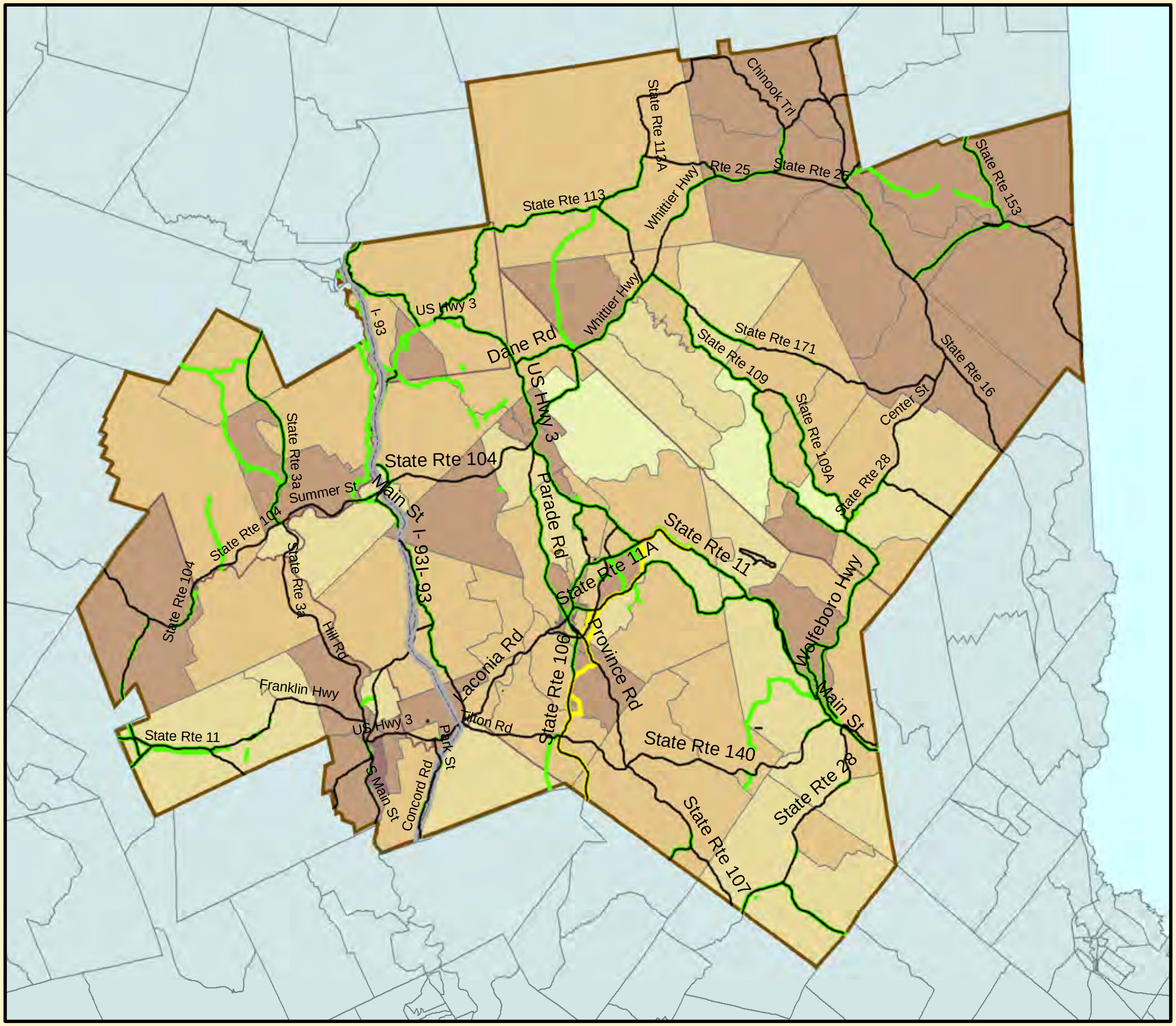


0 1 2 4 6 8 Miles

1:200,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US





Population
- 100,000 - 499,999
- 50,000 - 99,999
- 10,000 - 49,999
- Under 10,000

Road Class
- Primary Road
- Secondary Road

Total Unique Cyclists Per Segment
- 1 - 50
- 51 - 170
- 171 - 350
- 351 - 700
- 701 - 1185

Lakes Region Planning Commission
- Boundary

Census Block Groups - Median Income
- $90,000 - 150,000
- $70,000 - $90,000
- $51,932 - 69,999
- Low-Income Community
- Lowest Income Community

Lakes Region Planning Commission

Overview

L · R · P · C

0 3 6 12 18 24 Miles

1:500,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

N

Population

- 100,000 - 499,999
- 50,000 - 99,999
- 10,000 - 49,999
- Under 10,000

Priority Destinations

- ATHLETIC/REC FACILITY
- COMMUNITY FACILITY
- ESSENTIAL CITY FACILITY
- GROCERY STORE
- HOSPITAL
- LIBRARY
- PLACE OF WORSHIP
- POST OFFICE
- RETAIL/SHOPPING AREA
- SCHOOL
- SMALLER MARKET
- TRAIL ACCESS POINT

Road Class

- Primary Road
- Secondary Road
- Local Road

Total Unique Cyclists Per Segment

- 1 - 30
- 31 - 120
- 121 - 300
- 301 - 500
- 501 - 1185

Lakes Region Planning Commission

- Boundary

Census Block Groups - Median Income

- $90,000 - 150,000
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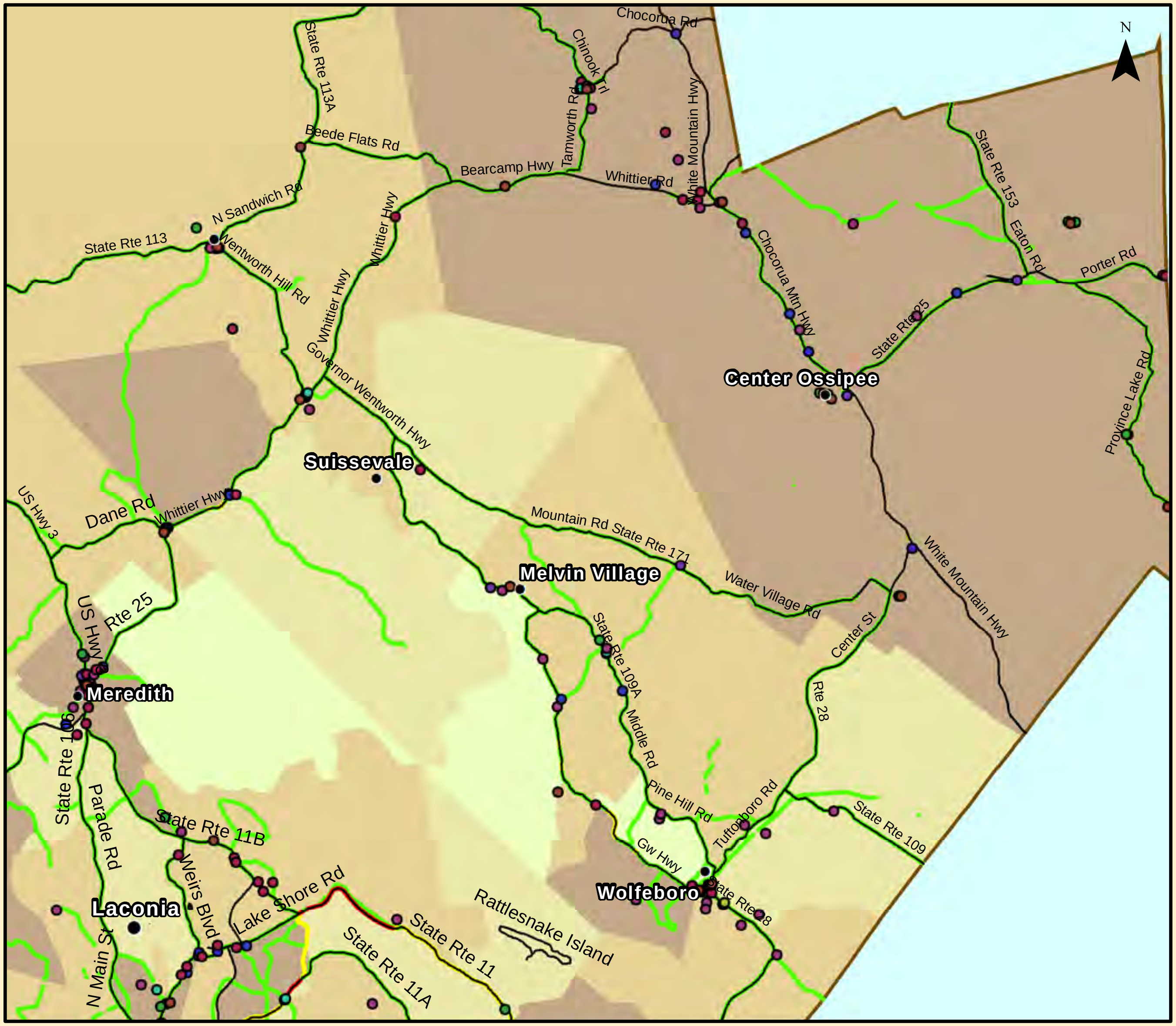
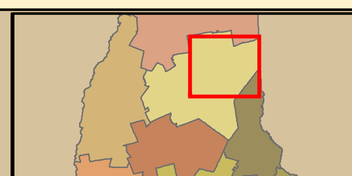


Lakes Region Planning Commission

Ossipee, Suissevale, Melvin Village, Wolfeboro

Key Destinations



0 1.5 3 6 9 12 Miles

1:250,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

Priority Destinations

- ATHLETIC/REC FACILITY
- COMMUNITY FACILITY
- ESSENTIAL CITY FACILITY
- GROCERY STORE
- HOSPITAL
- LIBRARY
- PLACE OF WORSHIP
- POST OFFICE
- RETAIL/SHOPPING AREA
- SCHOOL
- SMALLER MARKET
- TRAIL ACCESS POINT

Road Class

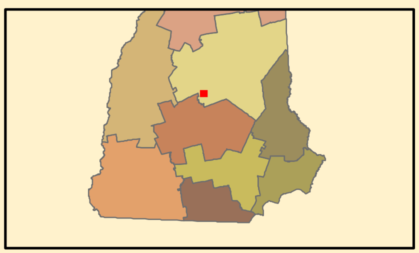
- Primary Road
- Secondary Road
- Local Road

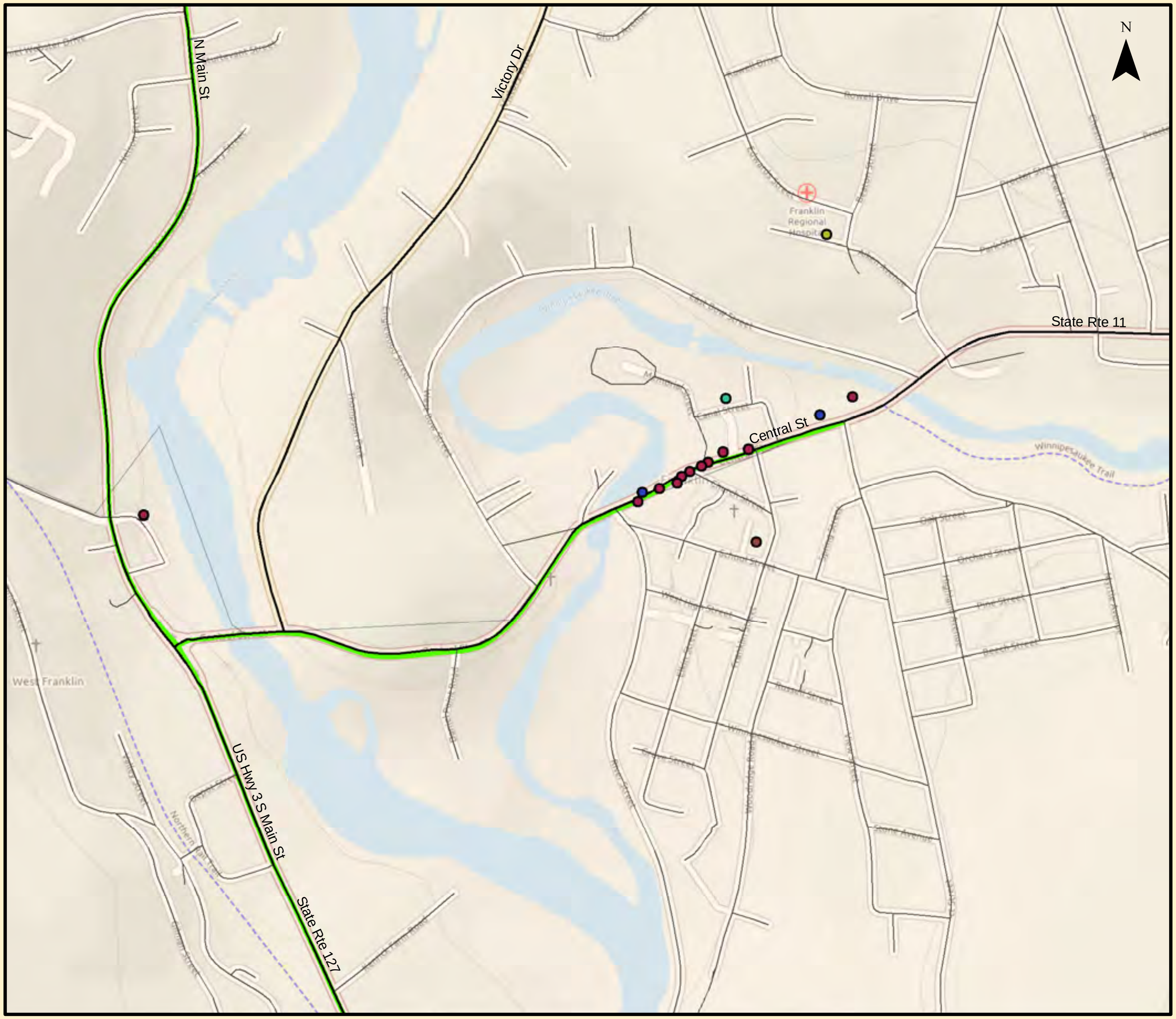
Total Unique Cyclists Per Segment

- 1 - 30
- 31 - 120
- 121 - 300
- 301 - 500
- 501 - 1185

Social Vulnerability Index

- 0-2
- 3-5
- 6-8
- 9-10





Lakes Region Planning Commission

Franklin Trail Connectivity

L · R · P · C

0 0.05 0.1 0.2 0.3 0.4 Miles

1:12,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

LRPC

Target: Franklin Main St. and Franklin-Tilton disconnected rail trails (goal of WOW trail to have it go out to river)
Contacts: No Response

Winnipesaukee River Trail connects from Central Street in Franklin through to Park St. in Tilton. While the Winnipesaukee River Trail Association is in the process of connecting this trail through central Tilton, this trail does not currently connect to the Northern Rail Trail. According to the LRPC Bicycling and Walking Plan, there is a major focus on connecting the Northern Rail Trail trail in West Franklin to the Winnipesaukee River Trail. While the shortest route would be along the city streets in Franklin, the preferred route would cross the Pemigewasset River somewhere other than the Central Street Bridge, and then go around downtown along a more pedestrian and bicycle friendly route. However, a safe, signed, on-street connection should be prioritized over the preferred route in the near term in order to connect existing trails. Both Central St. and Main St. in Franklin lack bicycle lanes and infrastructure.

Social Vulnerability Index

Franklin Tract:
- Overall Vulnerability (0-10): 2
- Themes: for per capita income, the proportion is in the 90th percentile, the proportion of single parent households is in the 90th percentile

Central St. in Franklin where the Winnipesaukee River Trail connects and S. Main St. in Franklin.

Priority Destinations
- ATHLETIC/REC FACILITY
- COMMUNITY FACILITY
- ESSENTIAL CITY FACILITY
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- LIBRARY
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- RETAIL/SHOPPING AREA
- SCHOOL
- SMALLER MARKET
- TRAIL ACCESS POINT

Population
- 100,000 - 499,999
- 50,000 - 99,999
- 10,000 - 49,999
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Road Class
- Primary Road
- Secondary Road
- Local Road

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- 1 - 30
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Nashua Regional Planning Commission
- Boundary

Census Block Groups - Median Income
- $90,000 - 150,000
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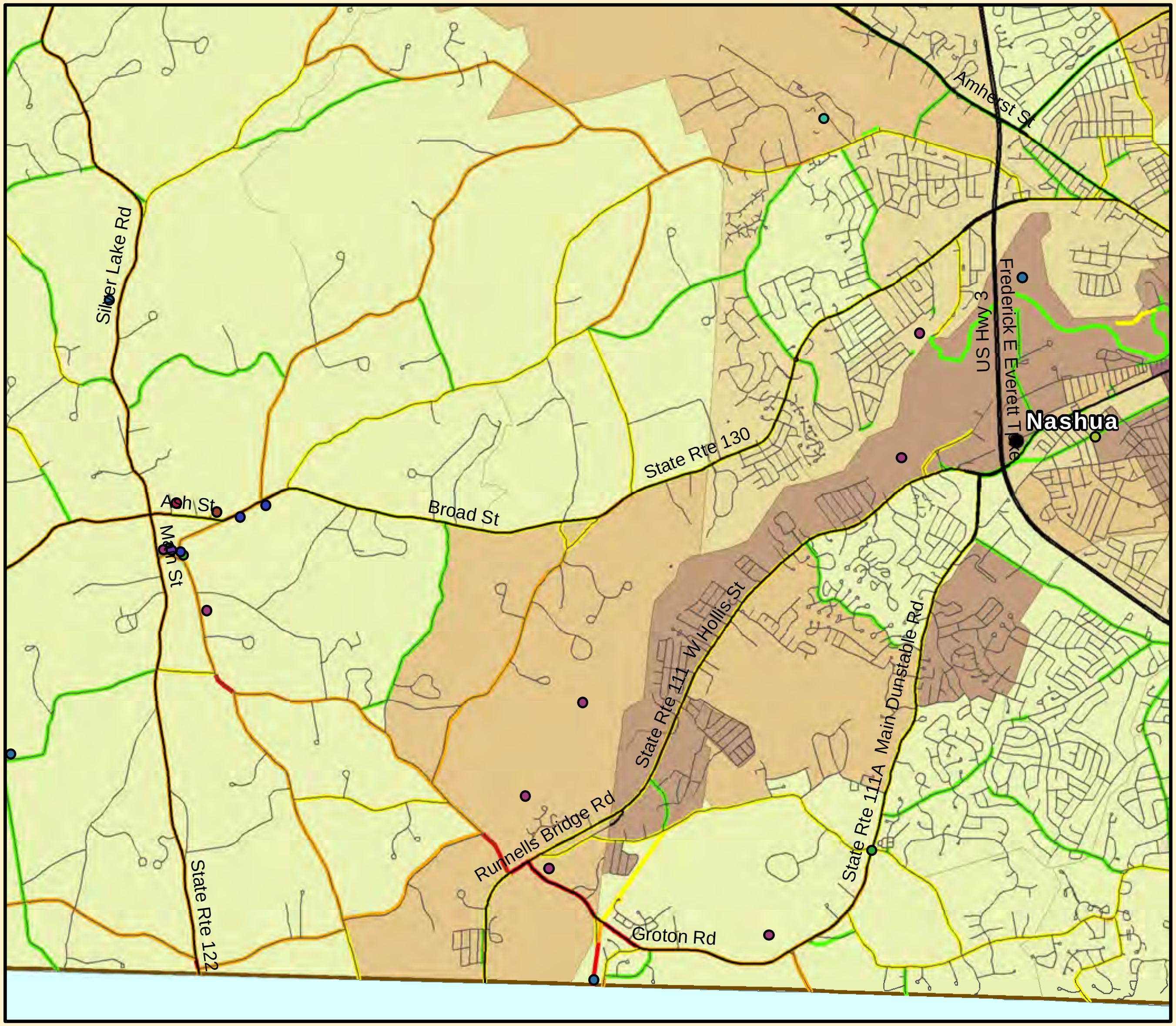
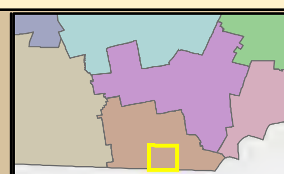
- $51,932 - 69,999
- Low-Income Community
- Lowest Income Community

NRPC



Nashua Regional Planning Commission
Hollis-Nashua Rt. 130 Connectivity



0 0.375 0.75 1.5 2.25 3 Miles

1:62,500

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

N

Priority Destinations

- ATHLETIC/REC FACILITY
- COMMUNITY FACILITY
- ESSENTIAL CITY FACILITY
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Nashua Regional Planning Commission

- Boundary

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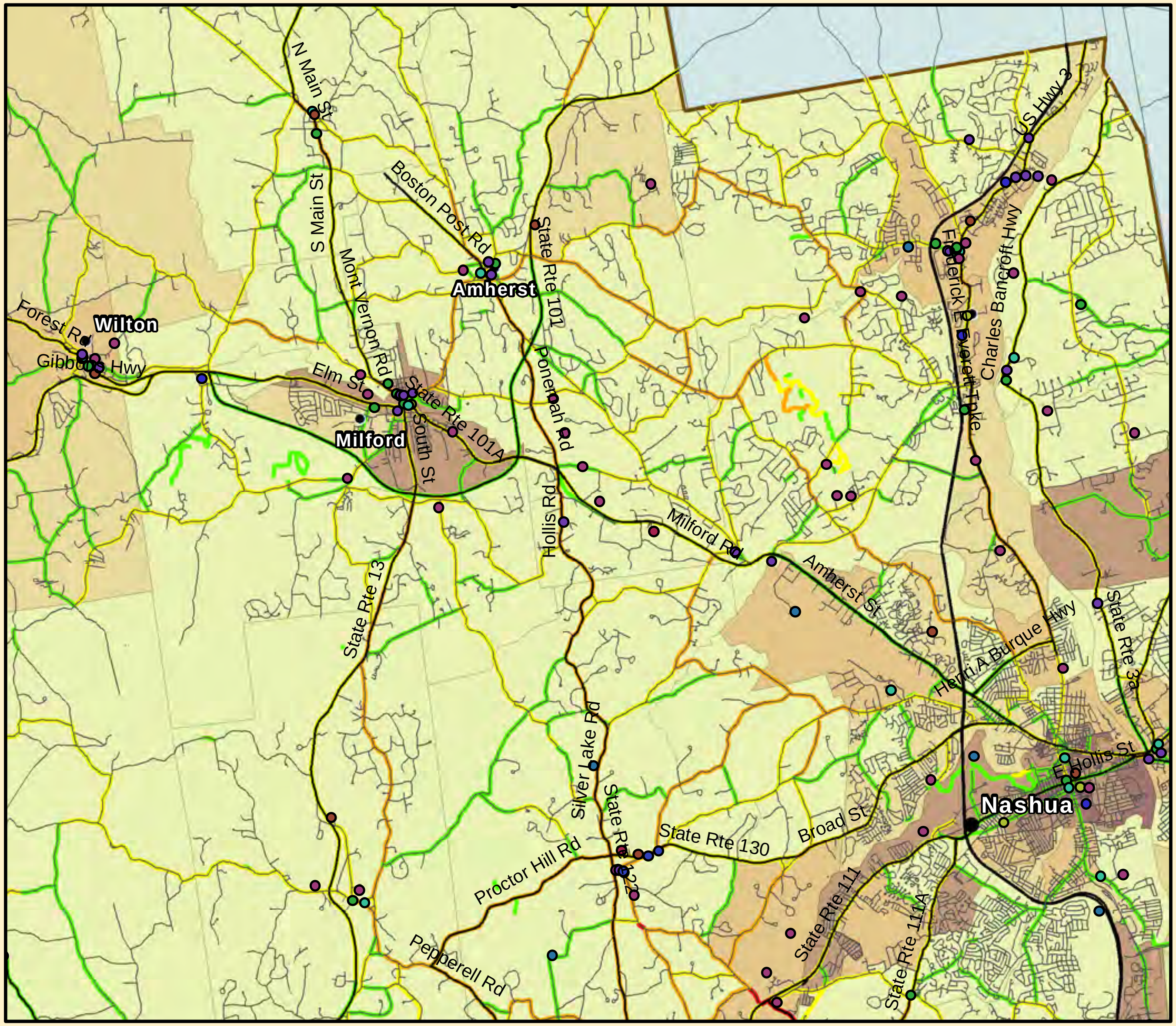
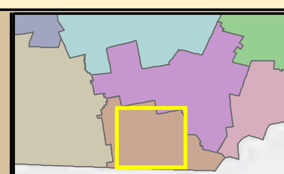
NRPC



Nashua Regional Planning Commission

Wilton, Milford, Amherst, Nashua



0 0.75 1.5 3 4.5 6 Miles

1:150,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

N

Priority Destinations
- ATHLETIC/REC FACILITY
- COMMUNITY FACILITY
- ESSENTIAL CITY FACILITY
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- HOSPITAL
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Nashua Regional Planning Commission
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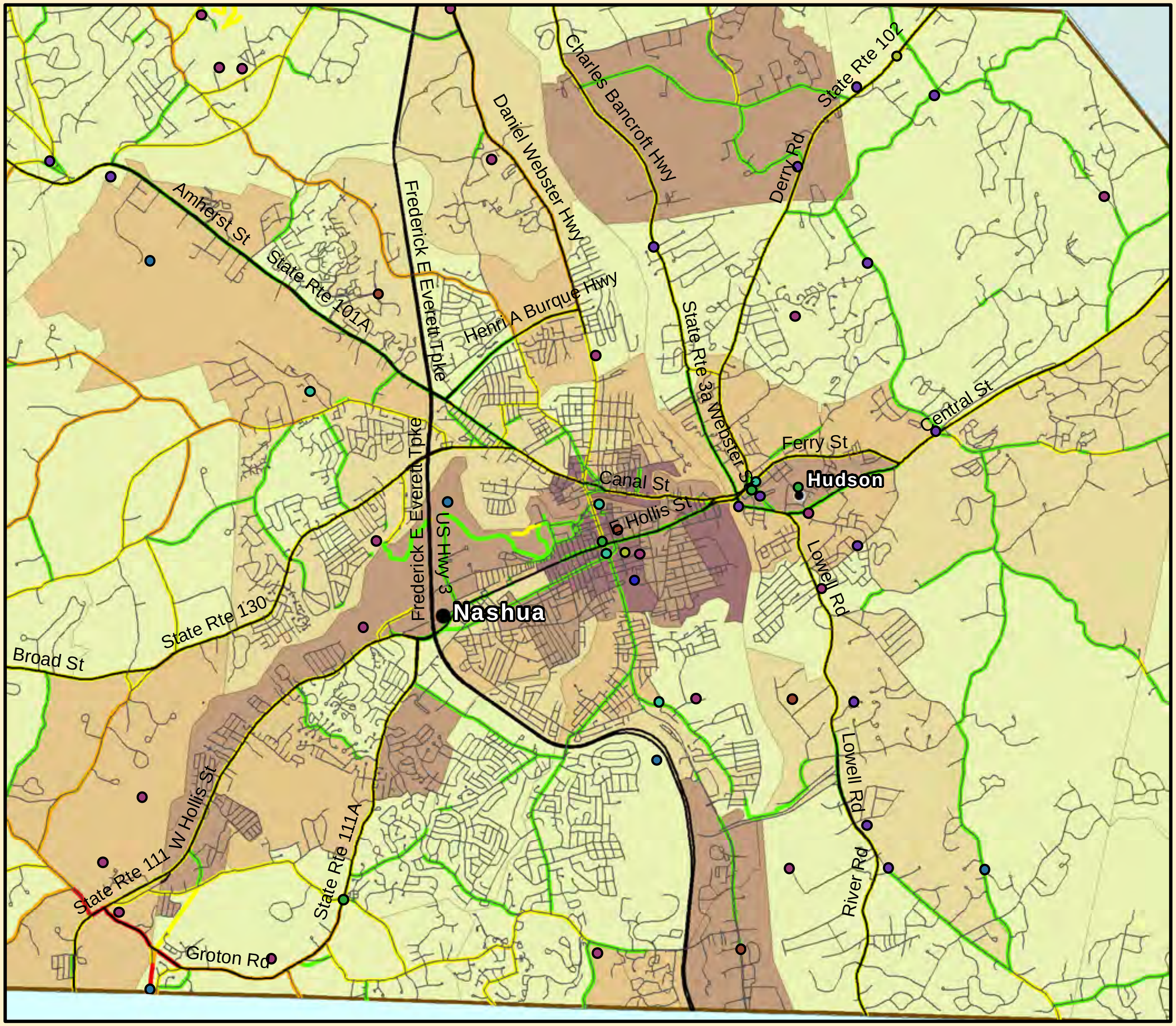
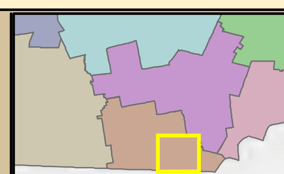
NRPC



Nashua Regional Planning Commission

Nashua Connectivity Assessment

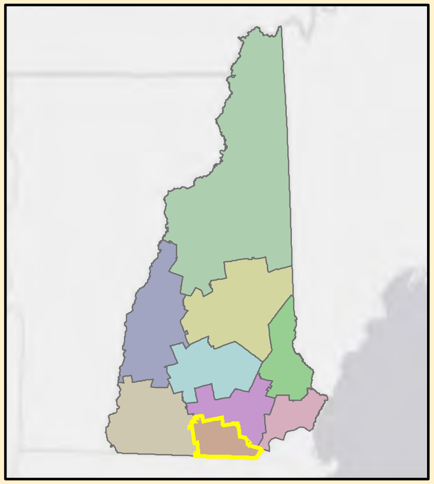


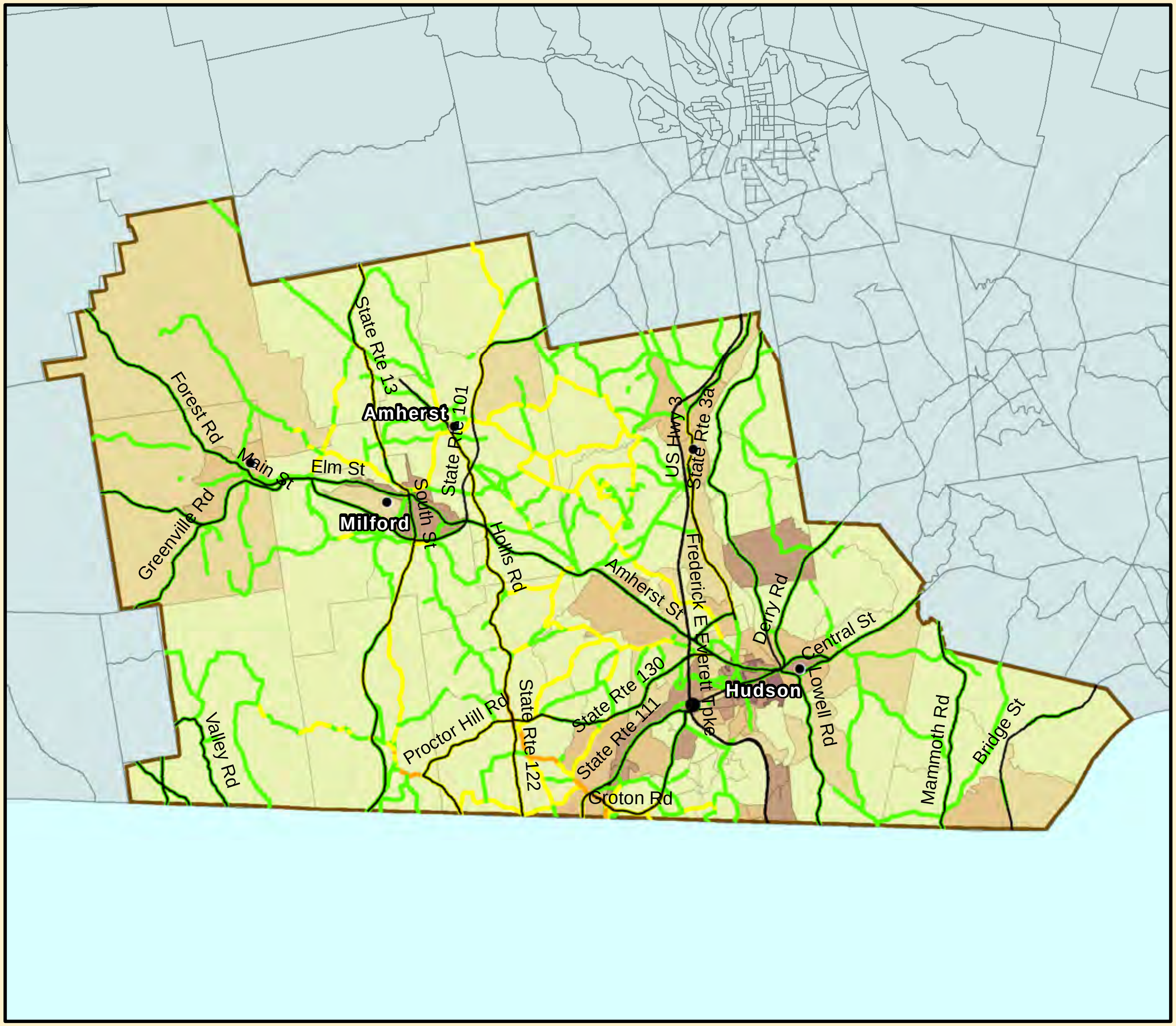
0 0.5 1 2 3 4 Miles

1:90,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

N





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- Secondary Road

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Nashua Regional Planning Commission
- Boundary

Census Block Groups - Median Income
- $90,000 - 150,000
- $70,000 - $90,000
- $51,932 - 69,999
- Low-Income Community
- Lowest Income Community

Nashua Regional Planning Commission

Overview

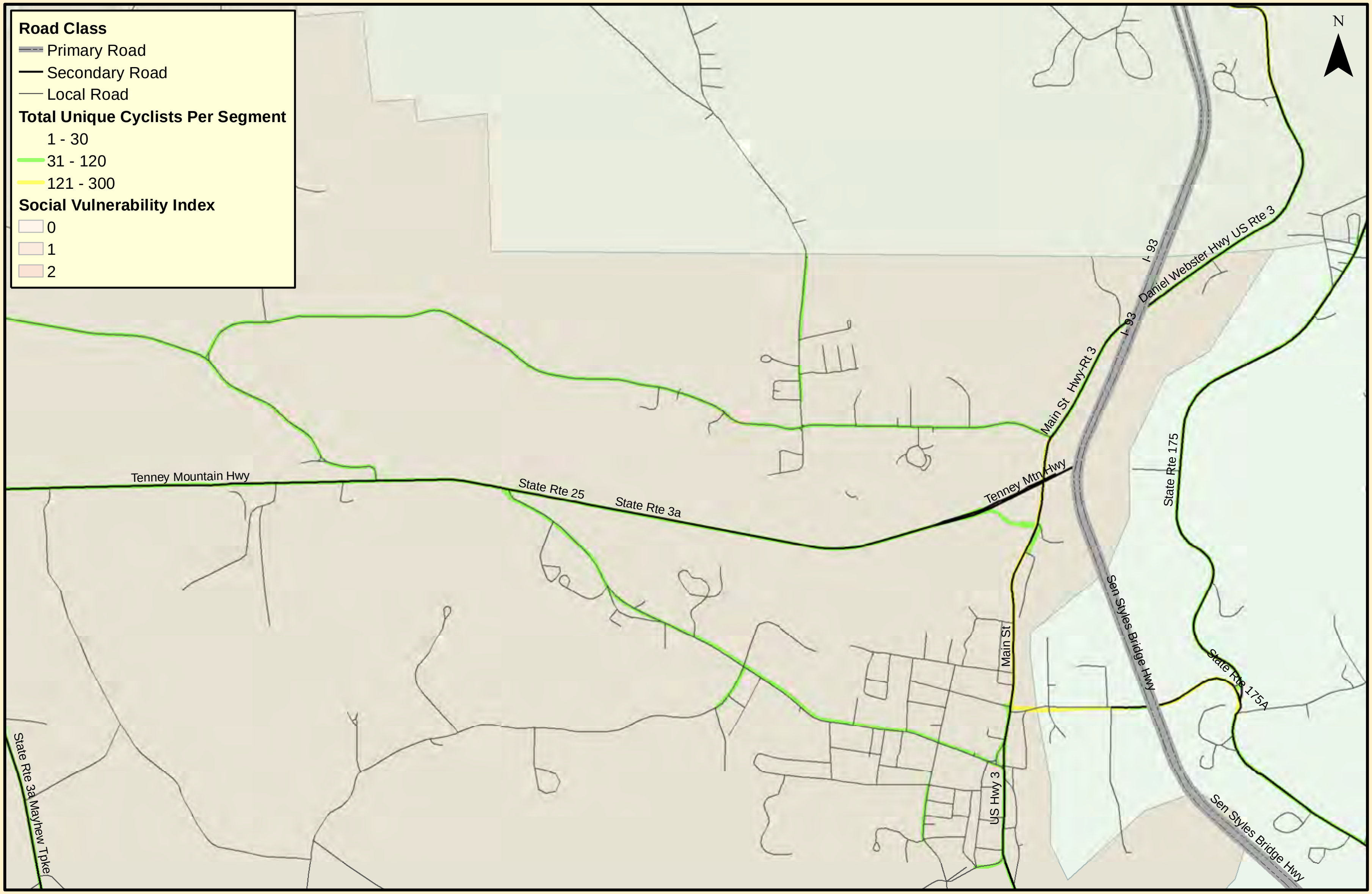
NRPC

0 1.75 3.5 7 10.5 14 Miles

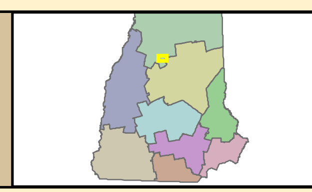
1:300,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

N



North Country Council
Plymouth, NH



0 0.125 0.25 0.5 0.75 1 Miles

1:31,680

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

NCC

Target: Plymouth
Contacts: Mary Poesse, Transportation Planner, NCC

Since most North Country highways are shared roadways, a paved shoulder a minimum width of 4 feet is required for bicycle safety (AASHTO Guide for the Development of Bicycle Facilities). Where gutters and curbs are present, or high traffic volumes, higher speeds, or substantial truck traffic, a minimum paved width of 5 feet is required (AASHTO). Paved shoulders wider than five feet may actually decrease bicycle or pedestrian safety because they encourage faster driving speeds and are often used to pass on the right.

The population of the NCC portion of the Plymouth Labor Market Area travelshed grew by slightly more than 20% from 2000-2010. Plymouth's population is expected to increase by more than 10% between 2010 and 2040.

The I-93 and US 3 corridor forms the backbone of the Plymouth LMA travelshed highway network. Three other regional priorities in the Plymouth LMA travelshed are NH 25, NH 112 and NH 49.
NH 25 links two of the region's important job center communities - Plymouth and Woodsville (in Haverhill), and provides some travelers and commerce with a connection between I-91 and I-93. NH 112 is the heart of summer and fall tourism in the region; it becomes the Kancamagus in Lincoln east of I-93.

As shown, the highest traffic volumes in the Plymouth LMA travelshed are associated with NH 25 through Plymouth, on I-93 to the Waterville valley exit, and NH 49 between I-93 and NH 175. In Plymouth, NH 25 & 3A of West of Highland Street, Average Annual Daily Traffic (2004) was 14,000.

Highland Street in Plymouth is a major collector with high traffic volumes and is not presently well suited to safe bicycle travel. Downtown Plymouth on Highland Street near Speare Memorial Hospital is (safety wise) an intersection of concern.

Shoulder widths are less than 4 feet wide on NH 118, NH 112 east of NH 118, all of NH 175, and portions of NH 25. This is a concern given the high level of bicycling seen in this area. Over 100 Strava users alone cycled from Campton and Thornton to Plymouth and to Waterville Valley. NH 112 is a very popular recreational route for groups, clubs, individuals and a growing number of race/organized ride events. The lack of adequate paved shoulders on these routes (between 4-5 feet) poses a danger to the safety of drivers as well as the bicyclists; drivers are forced to cross the center line to pass bicycles when shoulders are not wide enough for the cyclist to safely leave the traveled way. Except for portions of US 3, pavement conditions are fair to good on most of the regional priority highway corridors in the Plymouth LMA travelshed.

In 2014 NCC staff completed an update to the Tenney Mountain Highway Corridor 2003 Access Management Plan. It was recommended that an engineering study to address the feasibility of a system of pedestrian and bicycle pathways. It was also recommended that the town coordinate with Plymouth State and general public in the development of pedestrian and bicycle pathways.

From Town of Plymouth Master Plan with regard to Tenney Mountain Highway:

- Explore the possibility of limited, mixed-use highway commercial development along the southern Route 3 corridor and Route 3A.
- The commercial area along Tenney Mountain Highway generally begins west of the Baker River and extends west for more than two miles. Uses are predominantly retail and service oriented with an occasional residential use.
- Access to businesses in this area is by automobile, with parking provided on the developed property. The majority of individual commercial units is located in plazas, shopping centers or in other clustered methods with several individual uses mixed in-between the centers. The commercial use of the highway becomes much less dense to the west. There has been a corridor development plan prepared by the State, municipal, and business community to guide future development along this highway.
- The most promising area of Plymouth with development potential is the general region bounded by Tenney Mountain Highway to the north, Clay Bog to the east, the junction of Pike Hill Road, Bell Road and Old Hebron Road to the south and Bartlett/Yeaton Road to the west. This area offers the greatest concentration of large undeveloped lots that have the fewest identified limitations to development.

Social Vulnerability Index

Plymouth Tract:

- Overall Vulnerability (0-10): 2

- Themes: for per capita income, the proportion is in the 90th percentile, the proportion of persons in institutionalized group quarters is in the 90th percentile

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Google Street View of Main St., Plymouth, NH
and NH-175A near the Plymouth roundabout.

Google Street View of Highland St., Plymouth, and Tenney Mountain Highway in Plymouth.

Priority Destinations

- ATHLETIC/REC FACILITY
- COMMUNITY FACILITY
- ESSENTIAL CITY FACILITY
- GROCERY STORE
- HOSPITAL
- LIBRARY
- PLACE OF WORSHIP
- POST OFFICE
- RETAIL/SHOPPING AREA
- SCHOOL
- SMALLER MARKET
- TRAIL ACCESS POINT

Population

- 100,000 - 499,999
- 50,000 - 99,999
- 10,000 - 49,999
- Under 10,000

Road Class

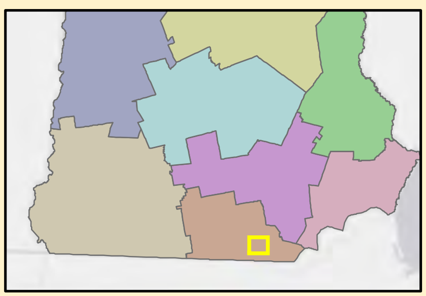
- Primary Road
- Secondary Road
- Local Road

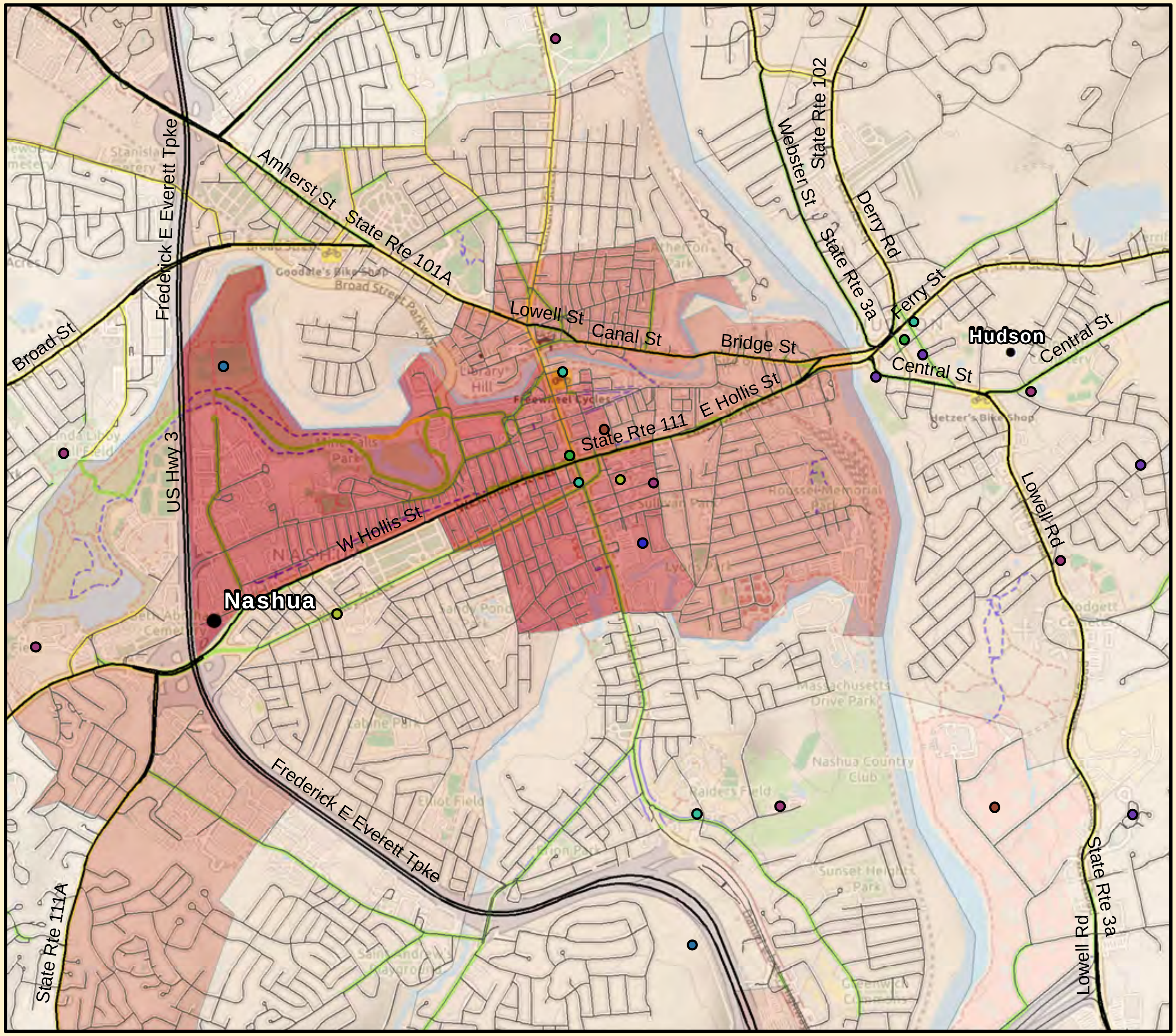
Total Unique Cyclists Per Segment

- 1 - 30
- 31 - 80
- 81 - 200
- 201 - 400
- 401 - 1185

Nashua Regional Planning Commission

- Boundary





Nashua Regional Planning Commission

Nashua-Hudson Connectivity

NRPC

0 0.25 0.5 1 1.5 2 Miles

1:40,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

N

Priority Destinations
- ATHLETIC/REC FACILITY
- COMMUNITY FACILITY
- ESSENTIAL CITY FACILITY
- GROCERY STORE
- HOSPITAL
- LIBRARY
- PLACE OF WORSHIP
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- SMALLER MARKET
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Total Unique Cyclists Per Segment
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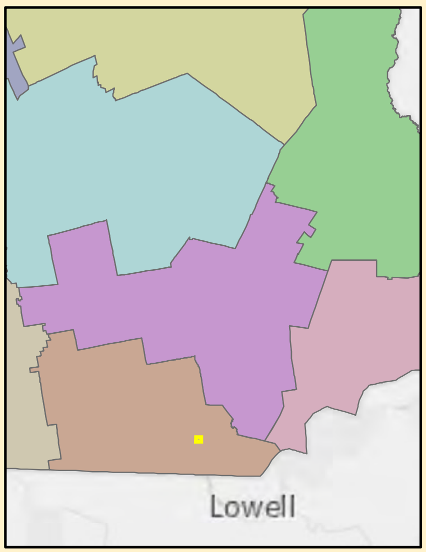
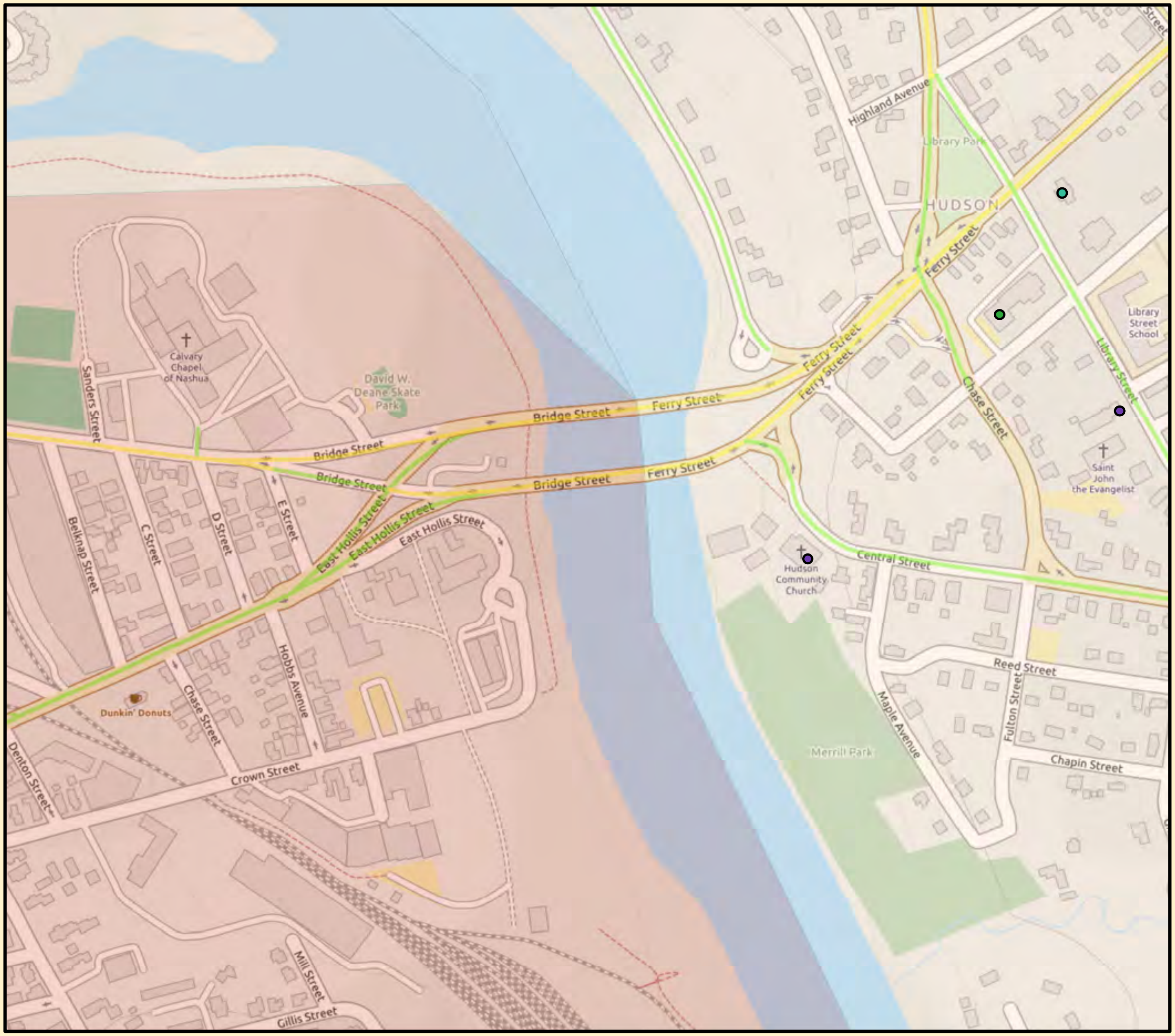
Nashua Regional Planning Commission
- Boundary





Nashua Regional Planning Commission

Nashua-Hudson Bridges

NRPC

0 0.04 0.08 0.16 0.24 0.32 Miles

1:6,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

N

NRPC

Target: Connectivity between Nashua and Hudson
Contacts: Ryan Friedman, Senior GIS Planner

E-mail: The connections between Nashua and Hudson are definitely a concern. Just getting cars across has been a planning issue for over 50 years here. Right now, there are only 2 bridges across the river and they combine to carry about 80,000 cars every day.

I know that the Sagamore Bridge (the southern one) has a separated path that starts in one of the neighborhoods on the Nashua side, comes up alongside the road as it crosses the river, and then dumps you into an industrial park area in Hudson. The land uses down there are mostly commercial, so I doubt there is much bicycle connectivity demand other than for recreational purposes.

The other bridge, however, connects both downtowns, has been congested with cars forever, and is not very bicycle-friendly with raised sidewalks and practically no shoulder. There is a project on the table that would improve East Hollis Street (Rte 111) which runs from Main St in Nashua all the way out to the bridge. I don't know what's in there for bike-ped improvements, but it's very early in the planning stages. I can look into that when necessary.

Social Vulnerability Index
Hudson Tracts:
- Overall Vulnerability (0-10): 1
- Themes: for crowded housing, the proportion is in the 90th percentile

Tracts in Central Nashua:
- Overall Vulnerability (0-10): 10
- Themes: for poverty, the proportion is in the 90th percentile, for civilian unemployed, the proportion is in the 90th percentile, for per capita income, the proportion is in the 90th percentile, for no high school diploma, the proportion is in the 90th percentile, the proportion of persons aged 17 and younger is in the 90th percentile, the proportion of single parent households is in the 90th percentile, the proportion of minority is in the 90th percentile, for limited English, the proportion is in the 90th percentile, for multi-unit housing, the proportion is in the 90th percentile, for no vehicle access, the proportion is in the 90th percentile

---

Google imagery views of entry to Hudson from Ferry St. bridge, on Ferry St. bridge, and along 111A bridge.

Priority Destinations
- ATHLETIC/REC FACILITY
- COMMUNITY FACILITY
- ESSENTIAL CITY FACILITY
- GROCERY STORE
- HOSPITAL
- LIBRARY
- PLACE OF WORSHIP
- POST OFFICE
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Total Unique Cyclists Per Segment
- 1 - 30
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- 81 - 200
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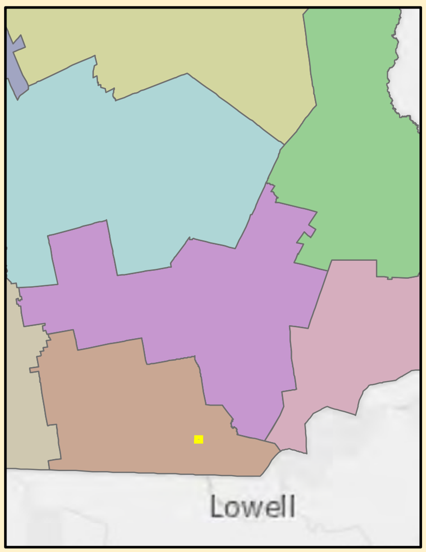
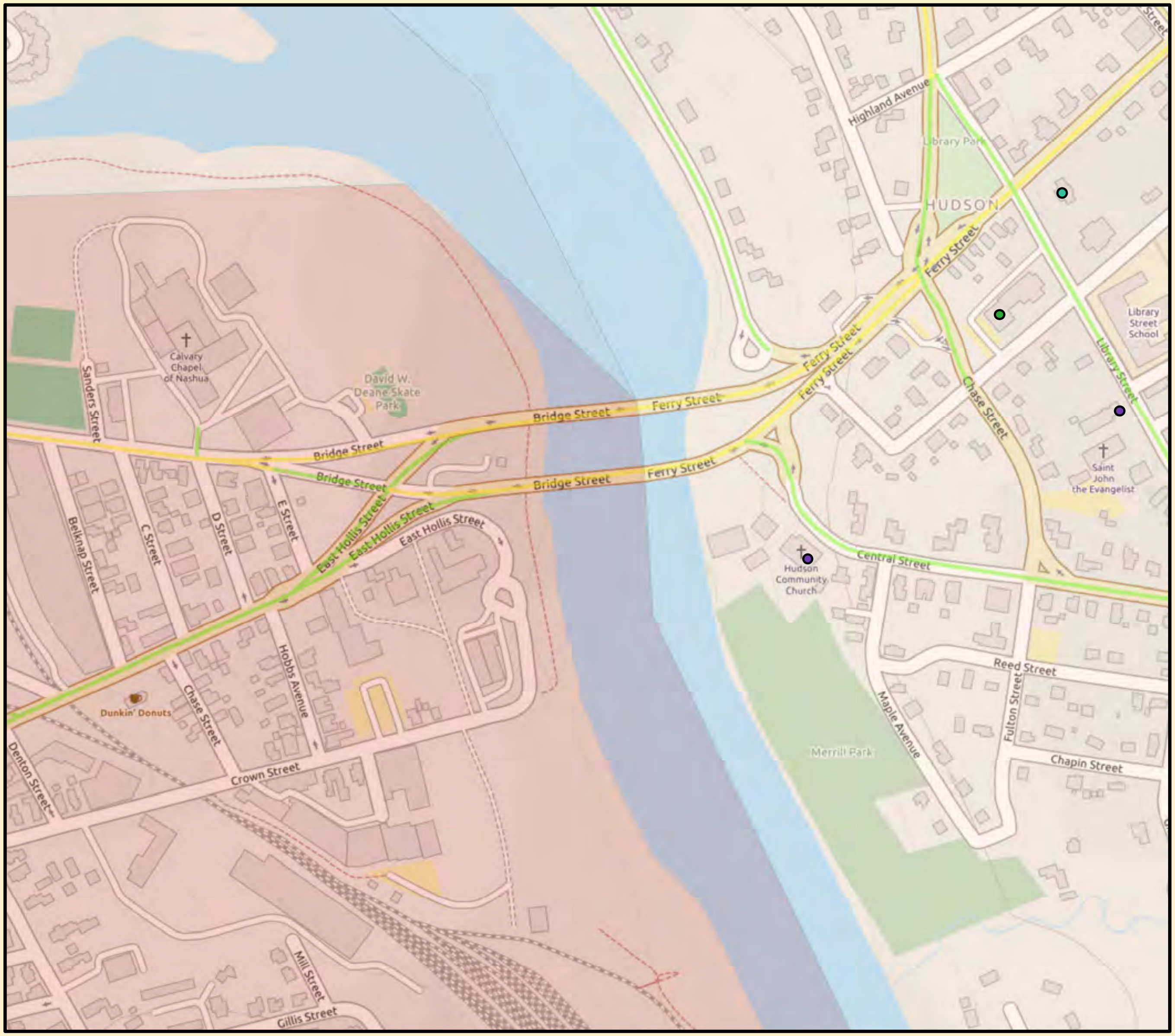
Nashua Regional Planning Commission
- Boundary





Nashua Regional Planning Commission

Nashua-Hudson Bridges

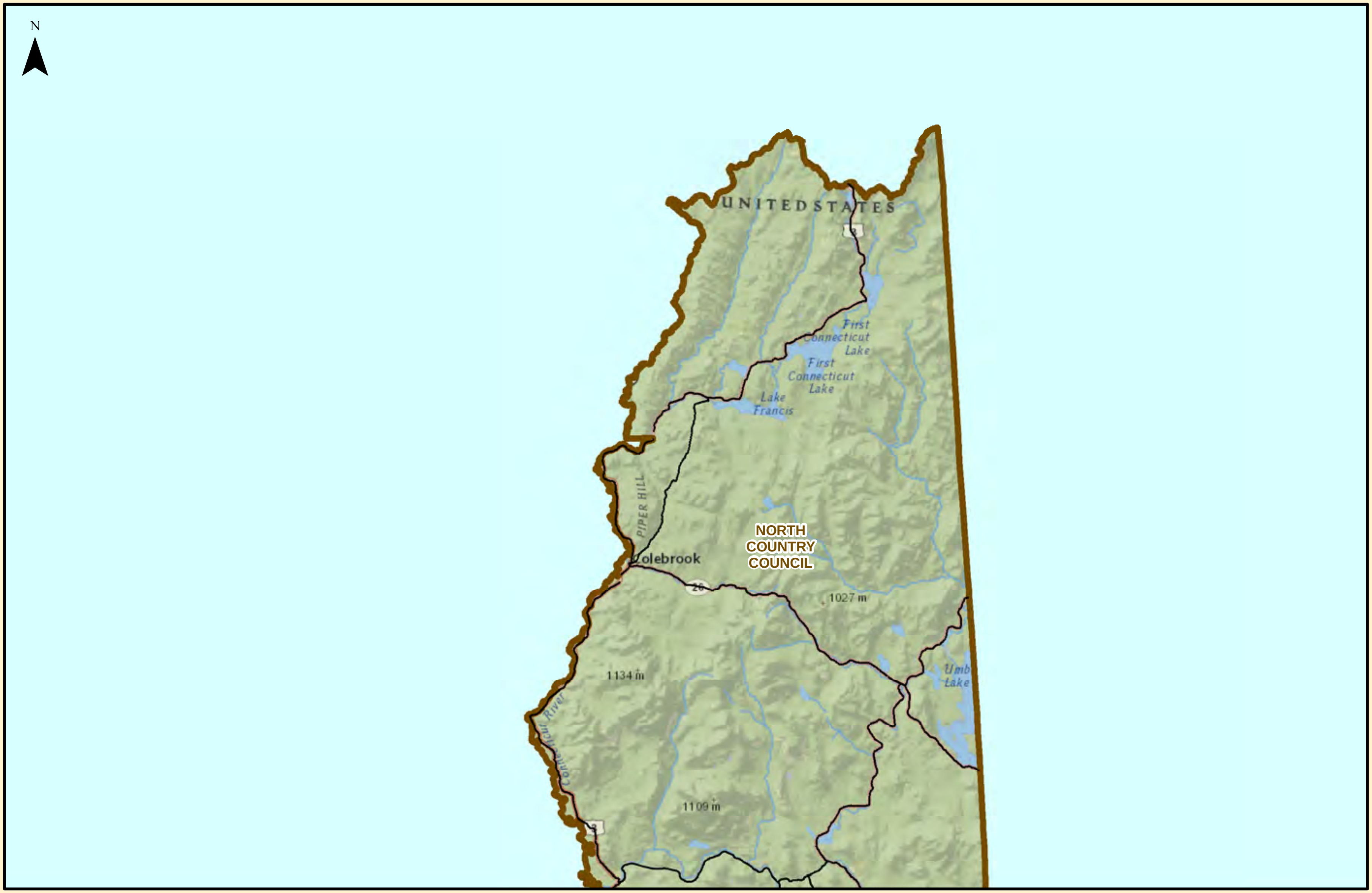
NRPC

0 0.04 0.08 0.16 0.24 0.32 Miles

1:6,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

N



Regional Connectivity Analysis Mapbook

Population
- 100,000 - 499,999
- 50,000 - 99,999
- 10,000 - 49,999

Road Class
- Primary Road
- Secondary Road
- Bicycle Trail

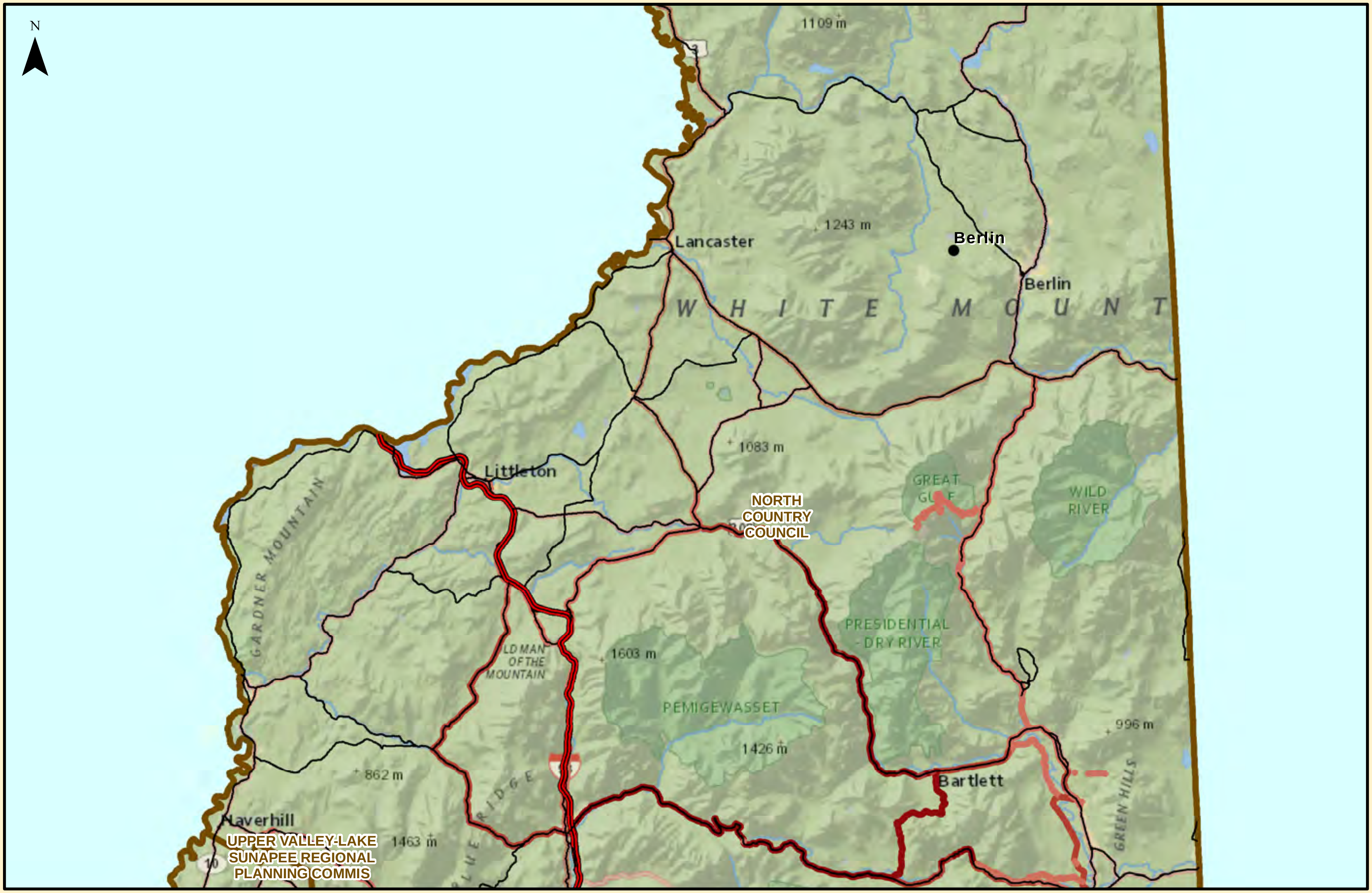
Total Unique Cyclists Per Segment
- 1.000000 - 25.000000
- 25.000001 - 66.000000
- 66.000001 - 113.000000
- 113.000001 - 211.000000
- 211.000001 - 456.000000

Pg. 1 of 5

0 2.75 5.5 11 16.5 22 Miles

1:600,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US



Regional Connectivity Analysis Mapbook

Population
- 100,000 - 499,999
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- 10,000 - 49,999
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Road Class
- Primary Road
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- Bicycle Trail

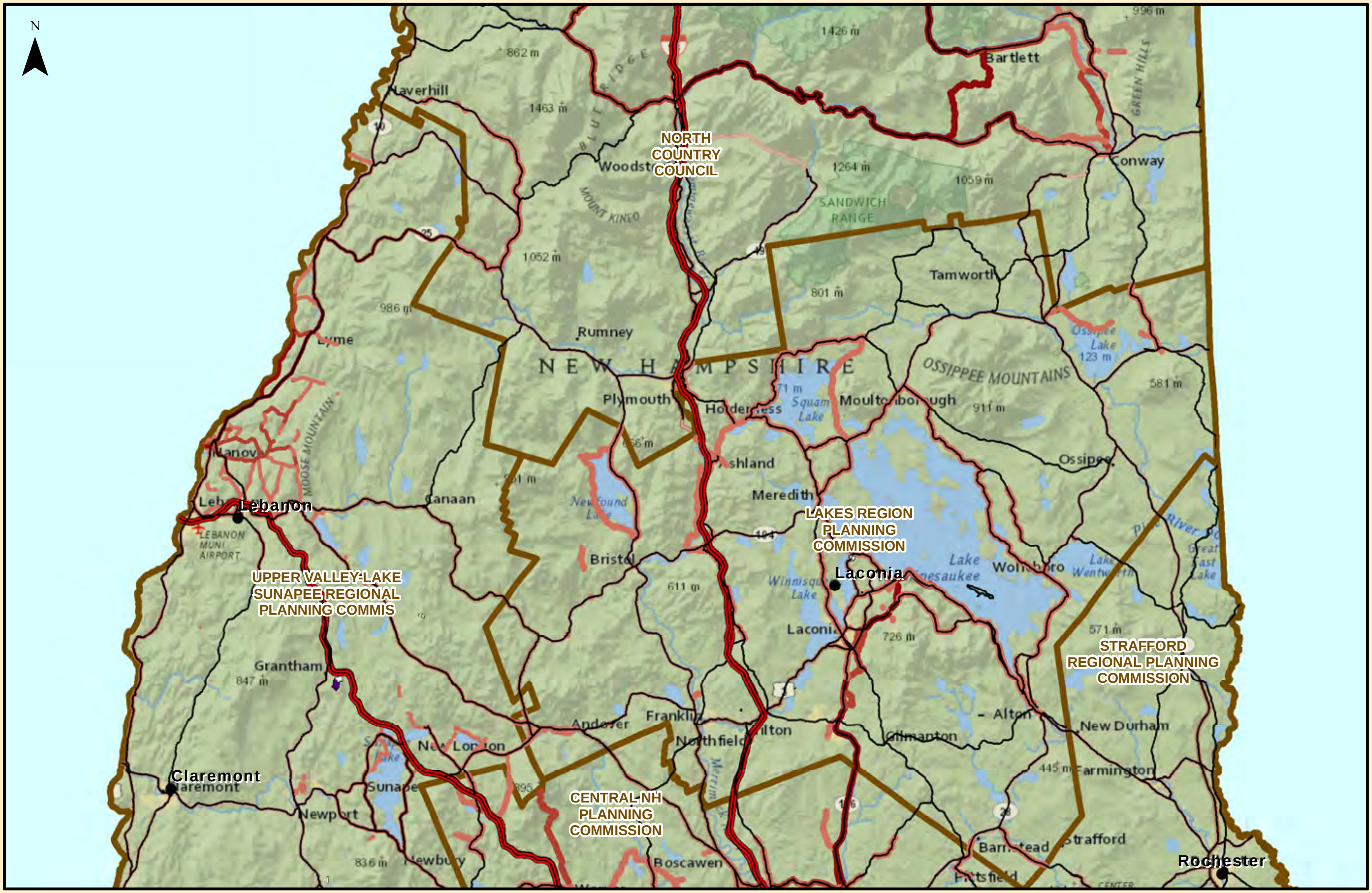
Total Unique Cyclists Per Segment
- 1.000000 - 25.000000
- 25.000001 - 66.000000
- 66.000001 - 113.000000
- 113.000001 - 211.000000
- 211.000001 - 456.000000

Pg. 2 of 5

0 2.25 4.5 9 13.5 18 Miles

1:500,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US



Regional Connectivity Analysis Mapbook

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Road Class
- Primary Road
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Total Unique Cyclists Per Segment
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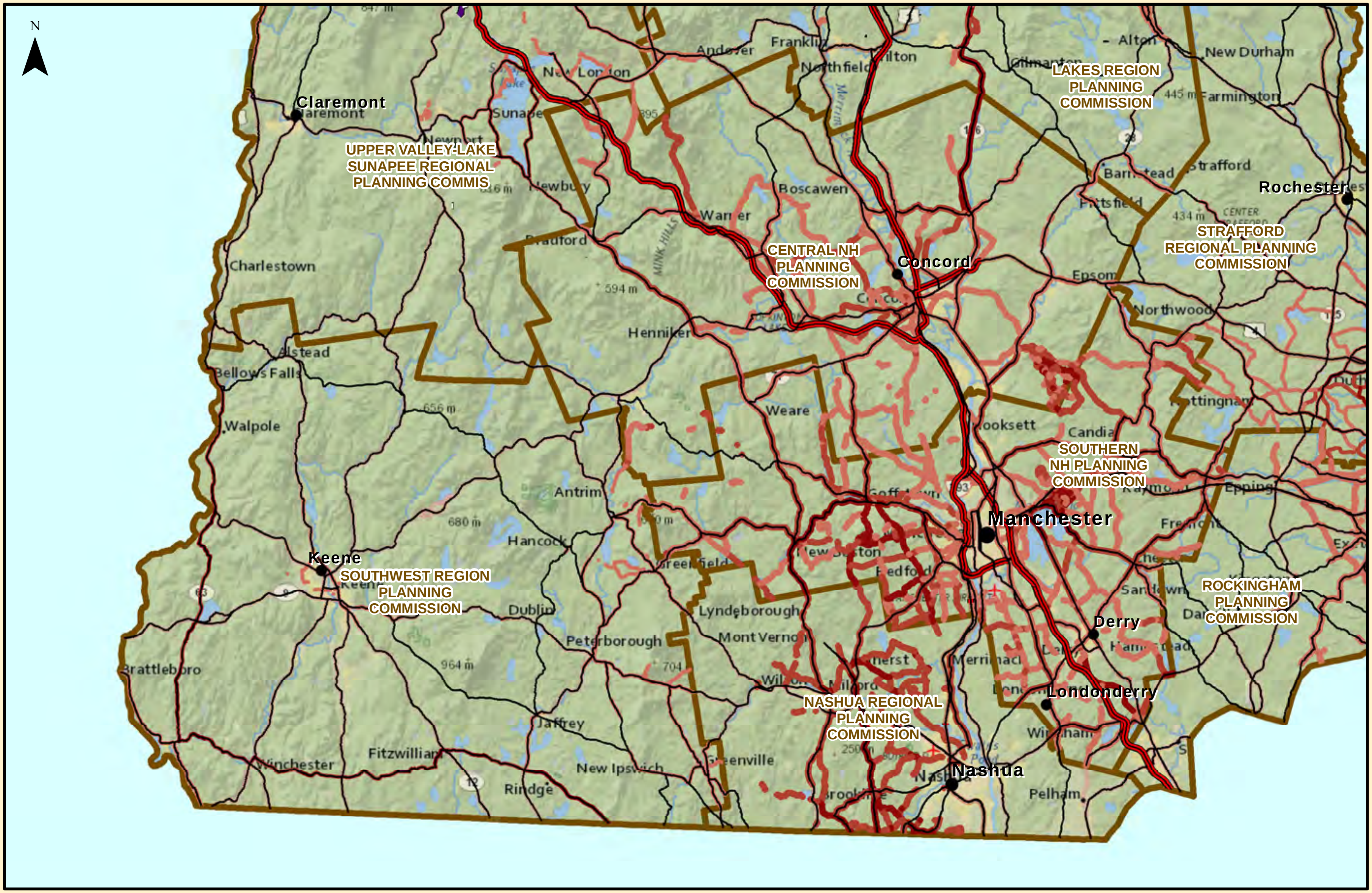
Pg. 3 of 5

0 2.75 5.5 11 16.5 22 Miles

1:600,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US



Regional Connectivity Analysis Mapbook

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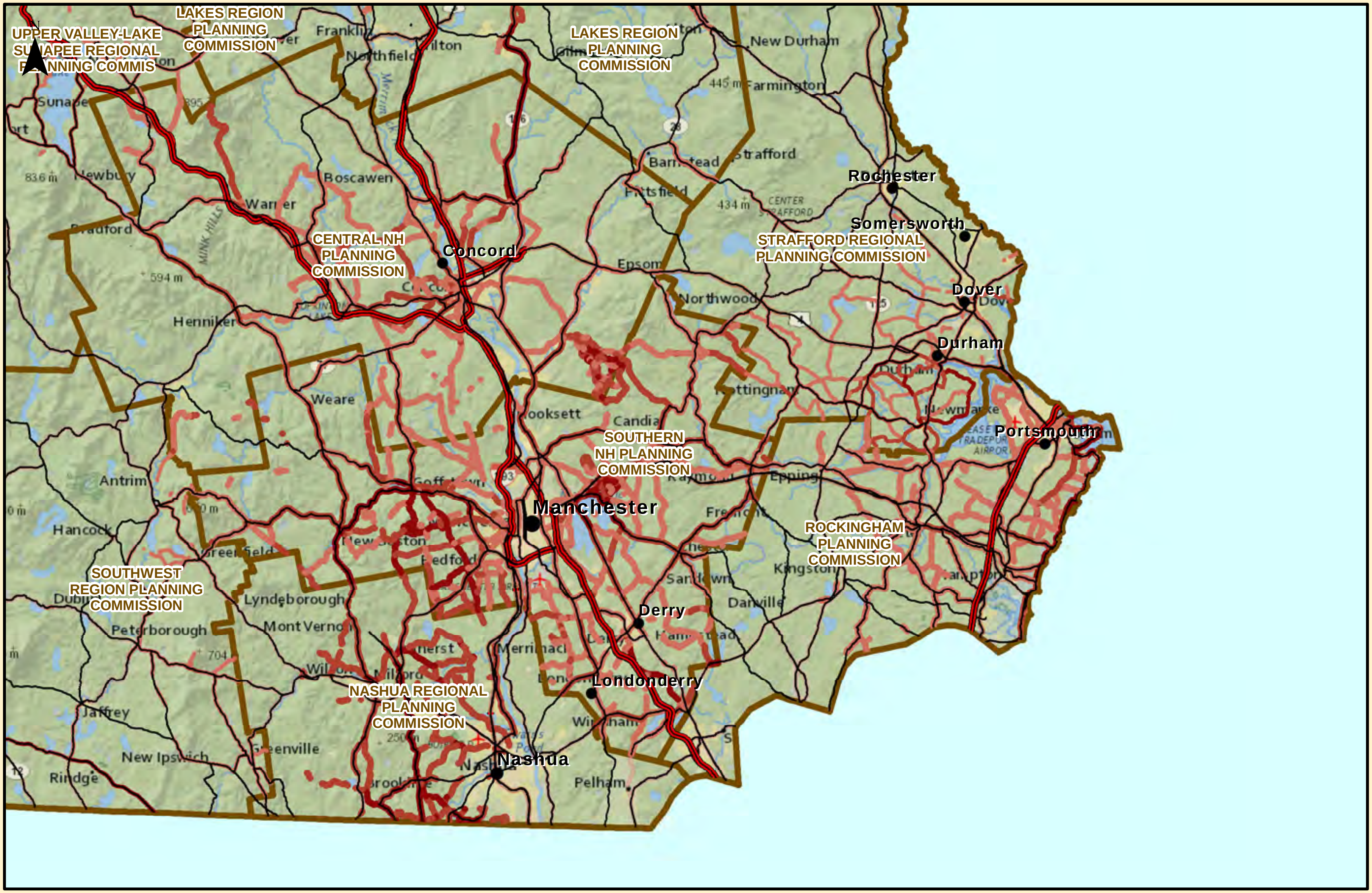
Pg. 4 of 5

1:600,000

0 2.75 5.5 11 16.5 22 Miles

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US



Regional Connectivity Analysis Mapbook

Population
- 100,000 - 499,999
- 50,000 - 99,999
- 10,000 - 49,999

Road Class
- Primary Road
- Secondary Road
- Bicycle Trail

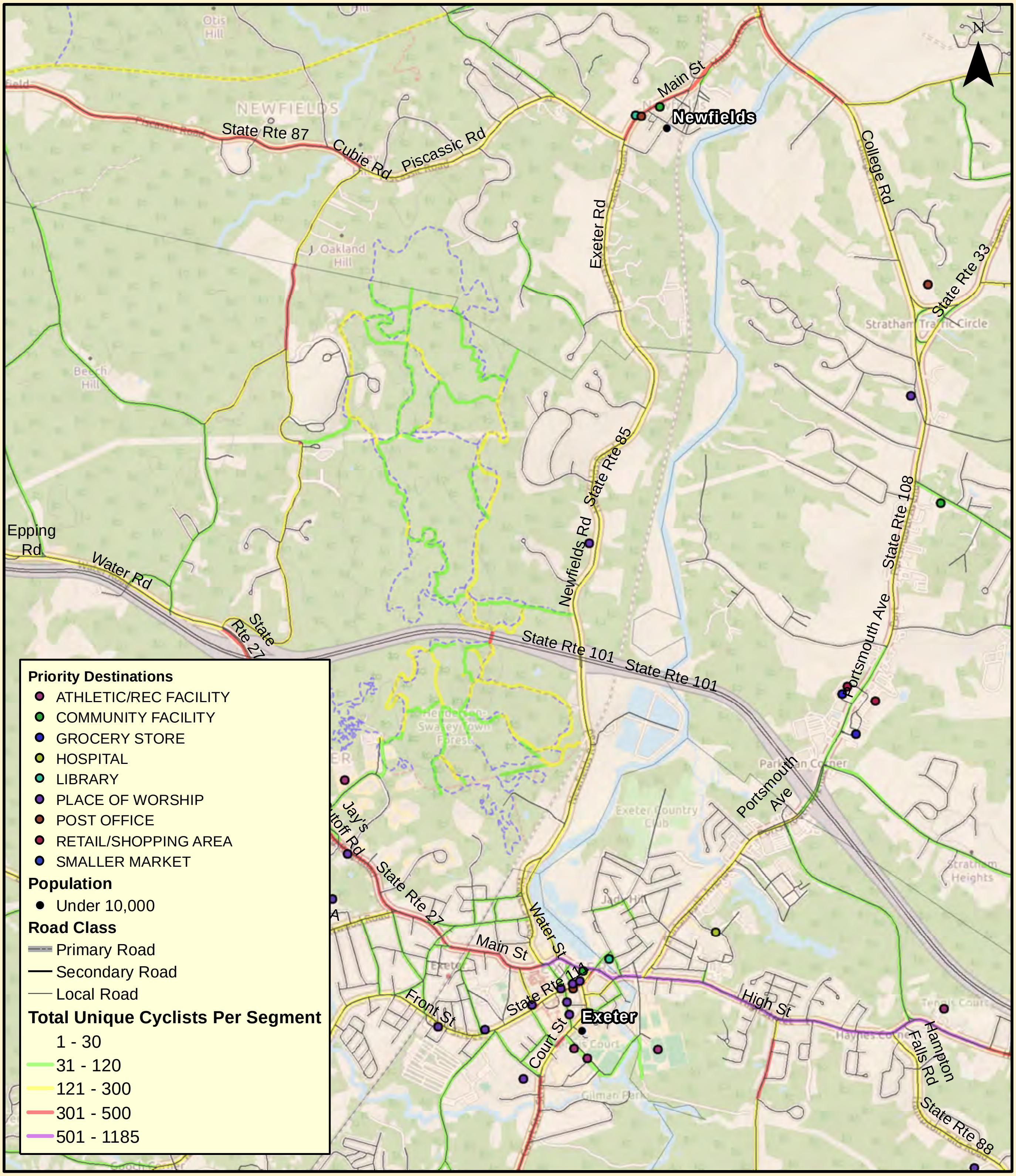
Total Unique Cyclists Per Segment
- 1.000000 - 25.000000
- 25.000001 - 66.000000
- 66.000001 - 113.000000
- 113.000001 - 211.000000
- 211.000001 - 456.000000

Pg. 5 of 5

0 2.75 5.5 11 16.5 22 Miles

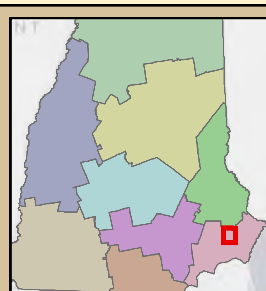
1:600,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US



Rockingham Planning Commission

Newfields - Exeter Connectivity



1:40,000

0 0.2 0.4 0.8 1.2 1.6 Miles

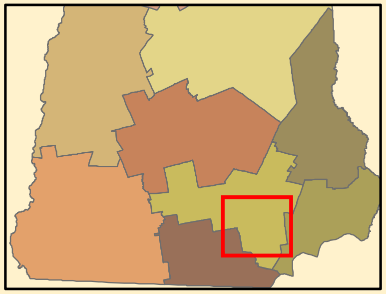
NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

RPC

Target: Rt. 108 to connect Newfields to Exeter
Contacts: No Response

As of 2013, Rt. 108 was delivering 15,000 vehicles per day to Exeter. Regional Master Plan has prioritized NH 87 shoulder widening between Exeter and Newfields. It appears that Rt. 85 is the preferred bicycle corridor between Exeter and Newfields.

Rt. 108 between Newfields and Exeter,
Rt. 85 between Newfields and Exeter



Population

- 100,000 - 499,999
- 50,000 - 99,999
- 10,000 - 49,999
- Under 10,000

Priority Destinations

- ATHLETIC/REC FACILITY
- COMMUNITY FACILITY
- ESSENTIAL CITY FACILITY
- GROCERY STORE
- HOSPITAL
- LIBRARY
- PLACE OF WORSHIP
- POST OFFICE
- RETAIL/SHOPPING AREA
- SCHOOL
- SMALLER MARKET
- TRAIL ACCESS POINT

Southern NH Planning Commission

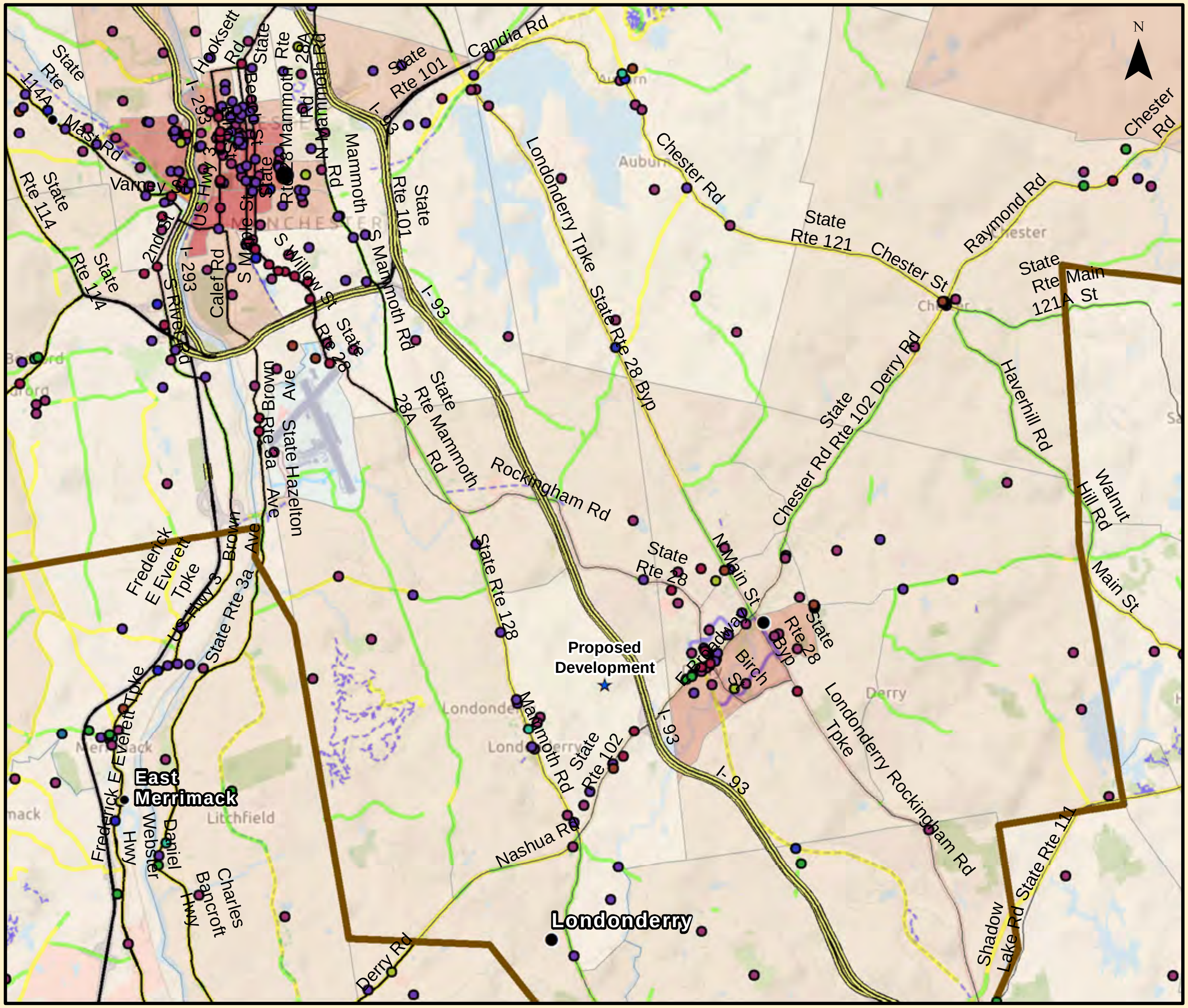
- Boundary

Total Unique Cyclists Per Segment

- 1 - 70
- 71 - 100
- 101 - 350
- 351 - 700
- 701 - 1185

Road Class

- Highway
- Primary Road



Southern NH Planning Commission

Manchester, Derry, Londonderry

Connectivity Assessment

SNHPC

0 0.75 1.5 3 4.5 6 Miles

1:150,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

SNHPC

Target:
Derry-Londonderry-Manchester (Rt. 28 & Rt. 128)
Contacts:
Adam Hlasney, Transportation Planner
Bob Rimol, Londonderry Trailways
Will Stewart, Bike Manchester and Derry-Londonderry Chamber of Commerce

Conversation: A new 1.5 mile section of excellent quality rail trail was completed this year due to a large corporate donation. There is very high potential for increased use given better trail connectivity between Derry and Londonderry as well as a northwesterly connection around MHT airport through to the Manchester trail system. These projects are a high priority relative to other trail projects in our region.

As of next spring, the rail trail will run from Salem up through Windham and Derry. The rail trail ends at Hood Park, just south in Derry. It has spurred great economic development, ex. coffee shop and Italian restaurant (Economic development detailed in Visitor's Guide).

The rail trail picks up near Londonderry by exit 5 on hwy 93. This trail has been bolstered by private money and Conservation Commission funds. The largest boost to the Londonderry segment was a $350,000 allocation from Kinder Morgan (Newspaper Article). Additional miles are currently being paved in the direction of the Derry town line but questions remain about financing and land ownership. It is not yet certain how the connection will be made.

There is a 629 acre development called Woodmont Commons (Website) planned along Hwy I-93 off of exit 4A near Londonderry. Ground has already been broken across from exit 5. It is to be a mixed-use neighborhood with homes and businesses. Money has been approved by the DOT and it is included in a 10-yr. plan. The development includes land that is needed to connect the larger Granite State Rail Trail, however it is hoped that including this trail in the development may be in the spirit of the "mini town". At present, no MOU has been signed for the trail to be included in the development.

Challenges exist in routing the rail trail near the Manchester airport. Manchester Regional Airport's runways currently interfere with ideal routes for the rail trail. Trails will either have to be routed around the airport or use a combination of existing streets and bike lanes. Another round of funding will be needed to complete the extension of the S. Manchester trail to connect south Manchester to the Millyard.

There is 1 mile of bike lane striped on Rt. 128 from the Londonderry town line into Manchester.

Biggest concerns: Network connectivity and workable solutions that are cost-effective politically and financially. Liability and insurance where easements are concerned – landowners want to know how they can be protected. Issues are being discussed but need to be discussed more by policymakers at the town and state level. We understand the problems but need to determine how to overcome the challenges. It is difficult to ask the correct questions.

Would love to get hard, economic development data to help convince policymakers that active transportation development is a good investment. We know that people from as far away as CT currently travel to ride the rail trail. Visitor's guide.

Biggest barriers to bicycling in the region is a general lack of infrastructure and perceptions of lack of safety (greatest perceived barrier). Many individuals are not confident riders. The presence of bike racks and bike lanes plants the seed of “oh I could be doing this”. When there is a lack of bicycling infrastructure, it sends the message that the road is not designed for them to be bicycling.

Bicycle counts: Bike Manchester has assisted the planning commission over the past couple of Mays in Manchester and targets areas w/higher traffic volumes and bike crash data (most dangerous intersections and stretches of roads). They participate in National Bicycle Documentation Project. The Windham rail trail group has also been counting along the Derry-Windham section.

Social Vulnerability Index

Tract containing Derry:

- Overall Vulnerability (0-10): 5
- Themes: for poverty, the proportion is in the 90th percentile, for civilian unemployed, the proportion is in the 90th percentile, for no high school diploma, the proportion is in the 90th percentile, the proportion of single parent households is in the 90th percentile, for multi-unit housing, the proportion is in the 90th percentile

Tracts in Greater Derry and Londonderry:

- Overall Vulnerability (0-10): 1
- Themes: the proportion of persons aged 17 and younger is in the 90th percentile

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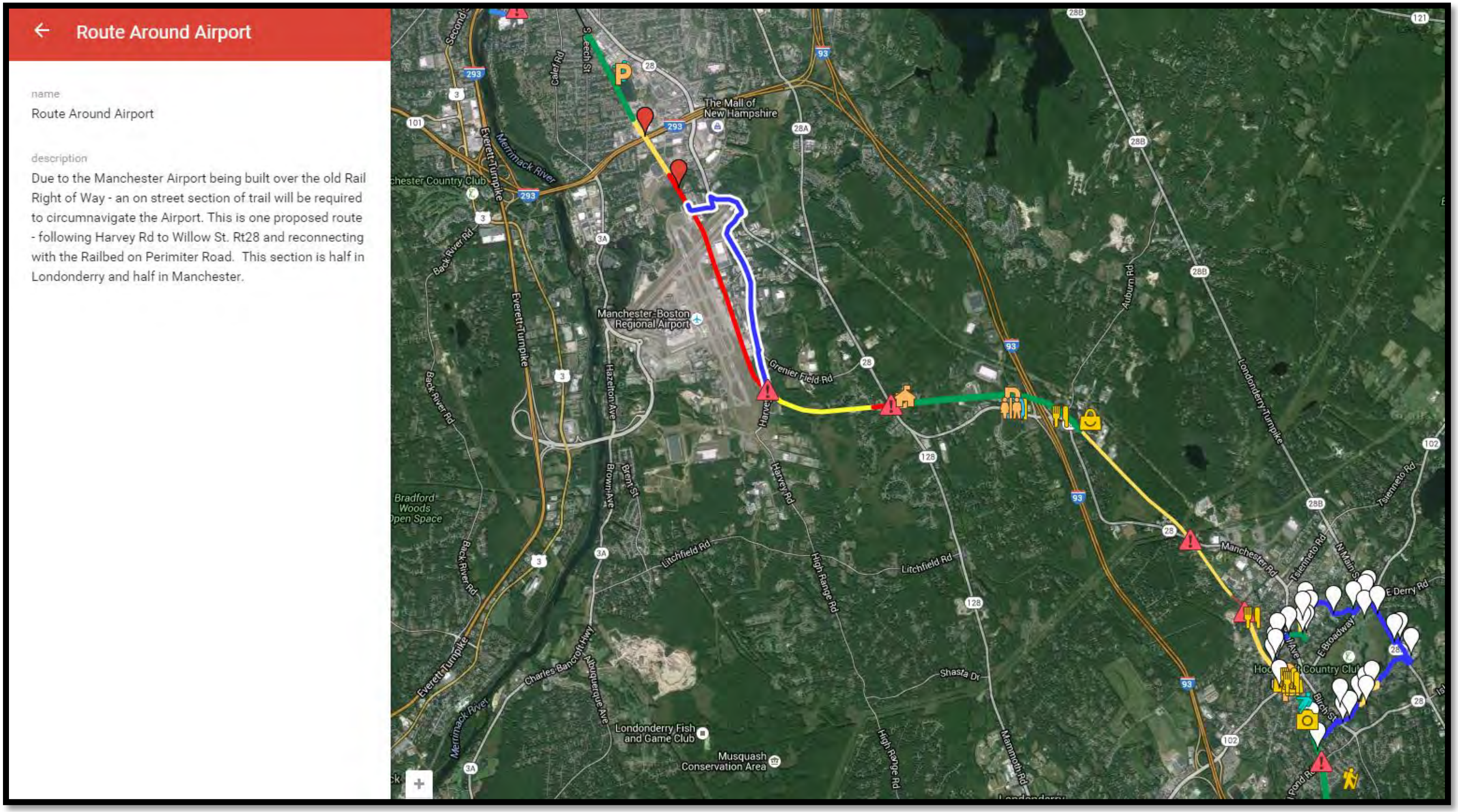
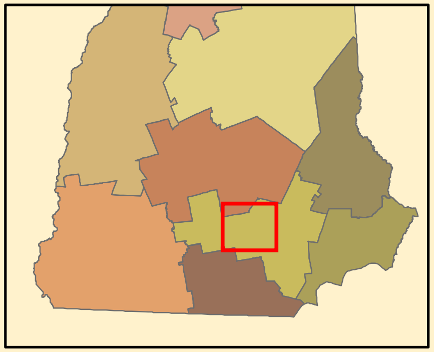
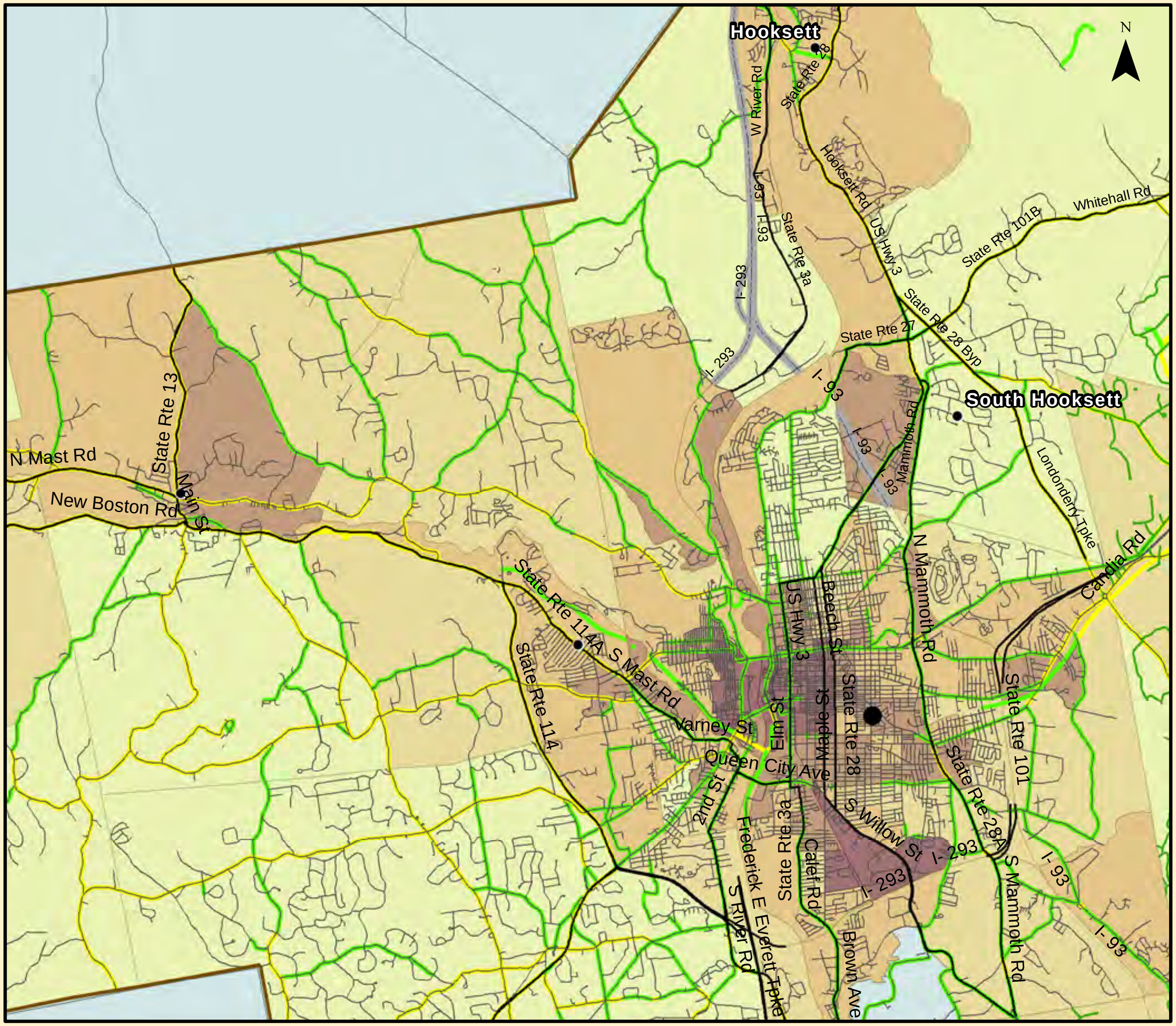


Yellow and Red lines indicate portions of trail that are not yet constructed.

Map Viewer Available Here





Population

- 100,000 - 499,999
- 50,000 - 99,999
- 10,000 - 49,999
- Under 10,000

Southern NH Planning Commission

- Boundary

Road Class

- Primary Road
- Secondary Road
- Local Road

Total Unique Cyclists Per Segment

- 1 - 30
- 31 - 80
- 81 - 350
- 351 - 700
- 701 - 1185

Census Block Groups - Median Income

- $90,000 - 150,000
- $70,000 - $90,000
- $51,932 - 69,999
- Low-Income Community
- Lowest Income Community

SNHPC

Southern NH Planning Commission

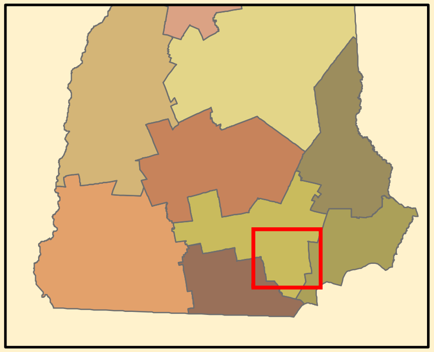
Manchester, Goffstown, Hooksett

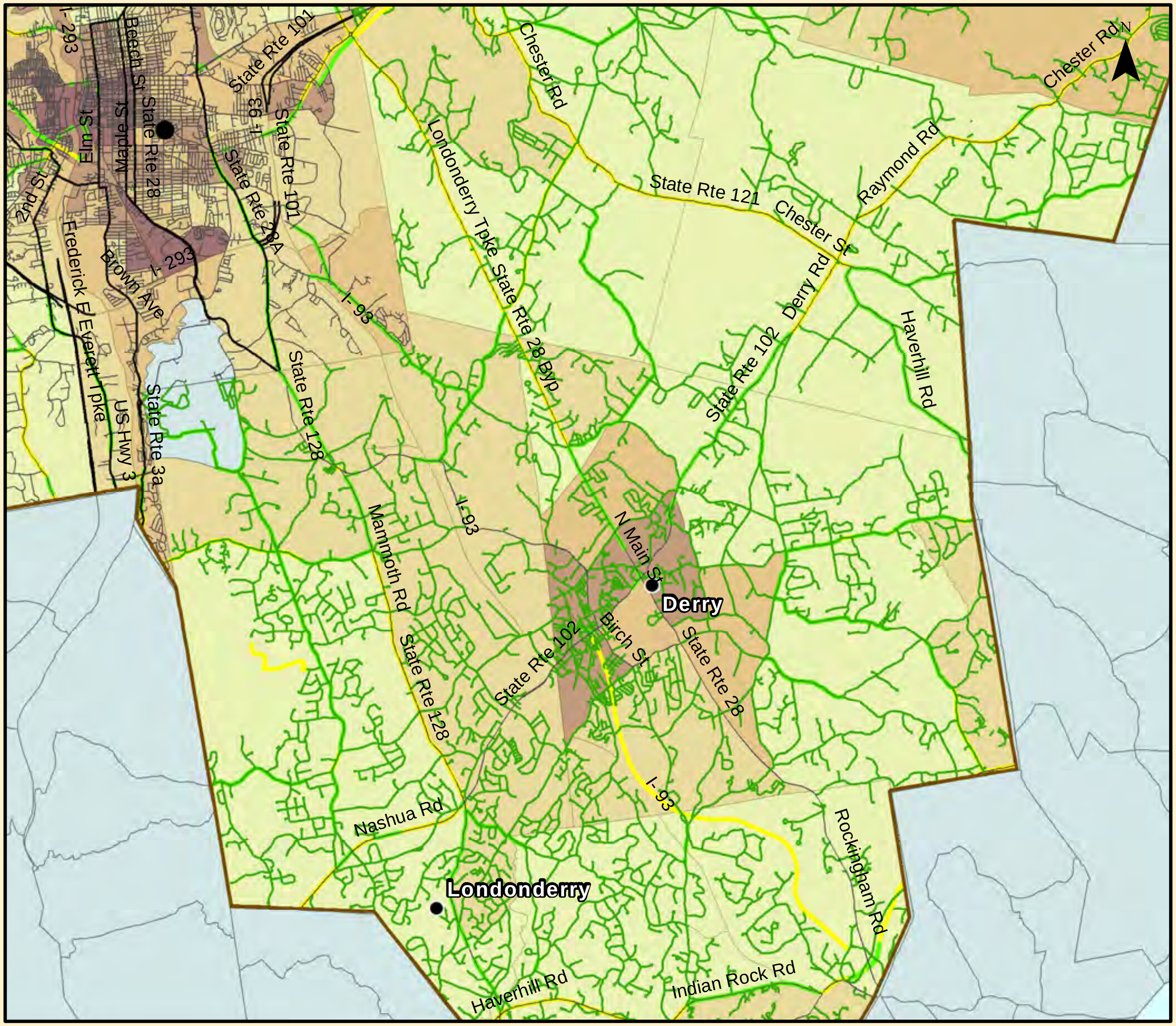
Connectivity Assessment

0 0.5 1 2 3 4 Miles

1:120,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US





Population

- 100,000 - 499,999
- 50,000 - 99,999
- 10,000 - 49,999
- Under 10,000

Southern NH Planning Commission

- Boundary

Road Class

- Primary Road
- Secondary Road
- Local Road

Total Unique Cyclists Per Segment

- 1 - 70
- 71 - 100
- 101 - 350
- 351 - 700
- 701 - 1185

Census Block Groups - Median Income

- $90,000 - 150,000
- $70,000 - $90,000
- $51,932 - 69,999
- Low-Income Community
- Lowest Income Community

SNHPC

Southern NH Planning Commission

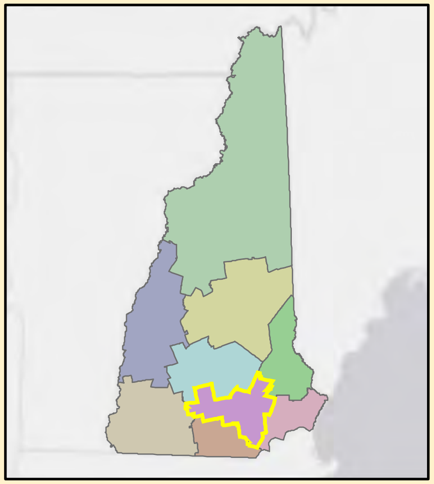
Manchester, Derry, Londonderry

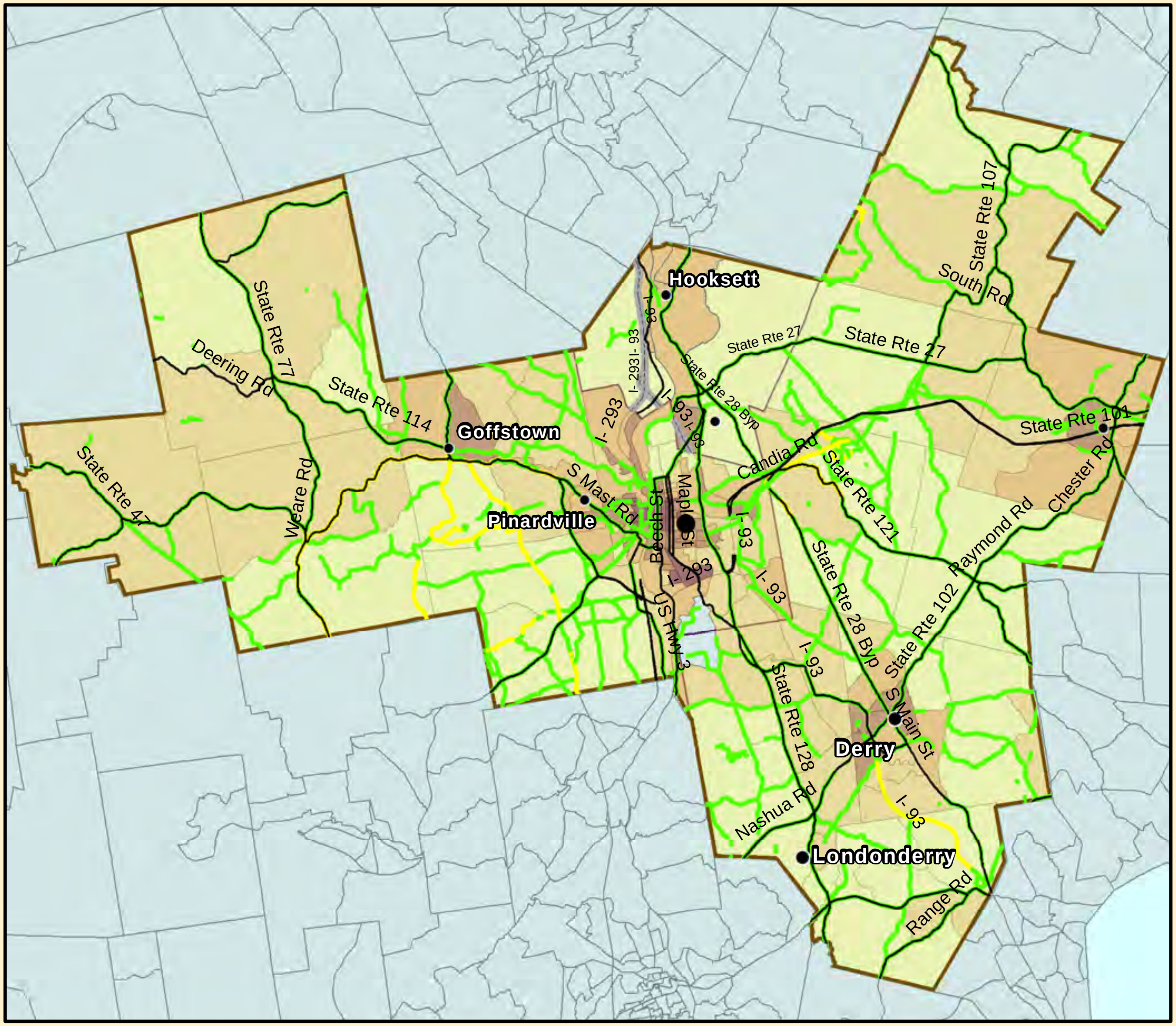
Connectivity Assessment

0 0.75 1.5 3 4.5 6 Miles

1:150,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US





Population
- 100,000 - 499,999
- 50,000 - 99,999
- 10,000 - 49,999
- Under 10,000

Road Class
- Primary Road
- Secondary Road

Total Unique Cyclists Per Segment
- 1 - 50
- 51 - 170
- 171 - 350
- 351 - 700
- 701 - 1185

Southern NH Planning Commission
- Boundary

Census Block Groups - Median Income
- $90,000 - 150,000
- $70,000 - $90,000
- $51,932 - 69,999
- Low-Income Community
- Lowest Income Community

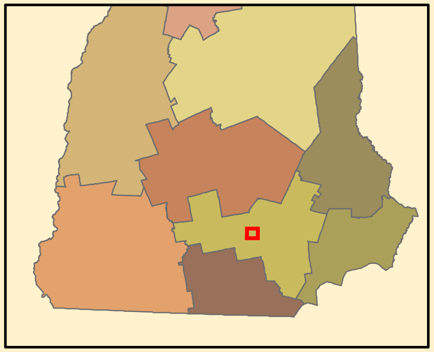
Southern NH Planning Commission
Overview

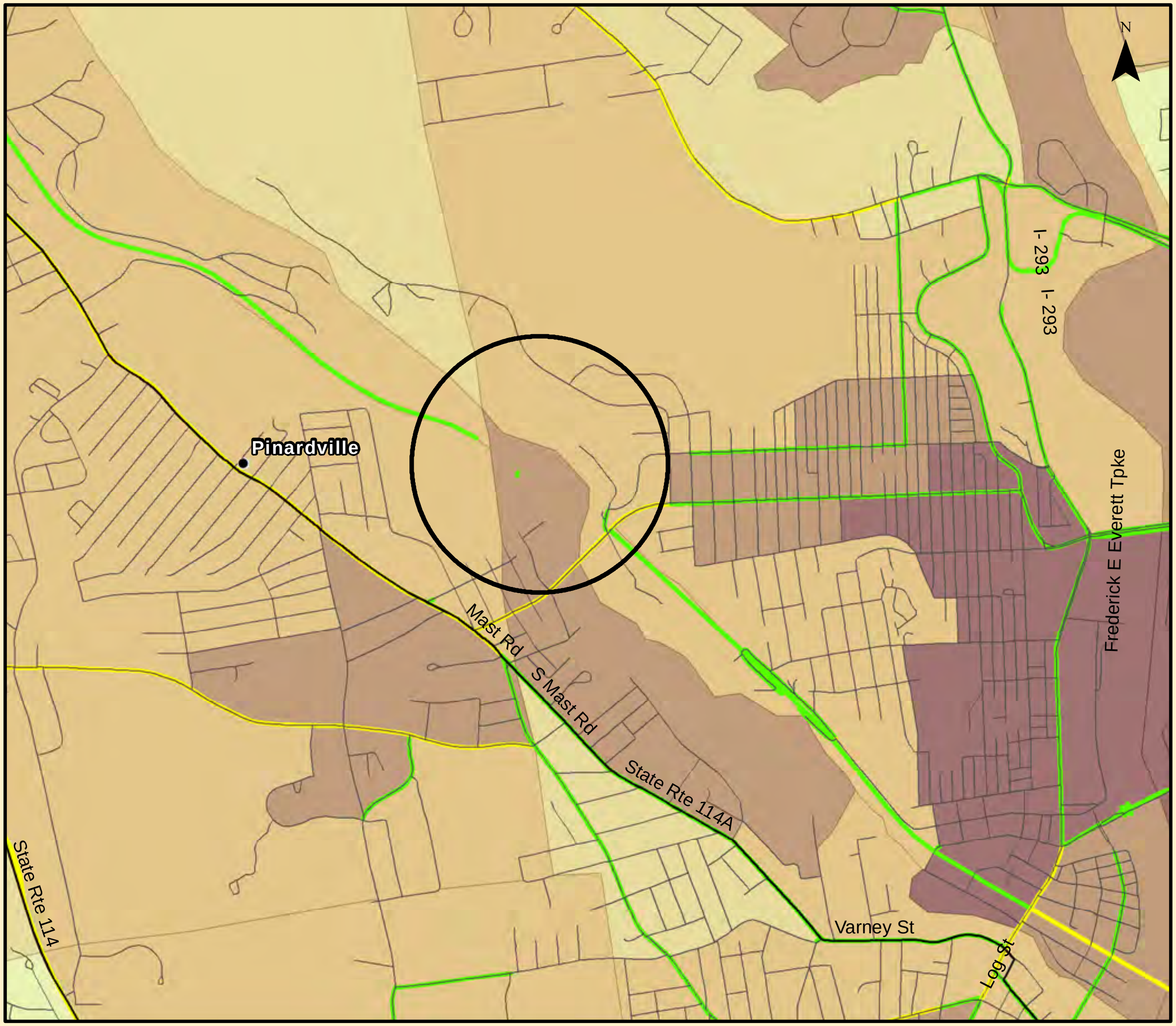
0 2 4 8 12 16 Miles

1:350,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

N





Population
- 100,000 - 499,999
- 50,000 - 99,999
- 10,000 - 49,999
- Under 10,000

Southern NH Planning Commission
- Boundary

Road Class
- Primary Road
- Secondary Road
- Local Road

Total Unique Cyclists Per Segment
- 1 - 30
- 31 - 80
- 81 - 350
- 351 - 700
- 701 - 1185

Census Block Groups - Median Income
- $90,000 - 150,000
- $70,000 - $90,000
- $51,932 - 69,999
- Low-Income Community
- Lowest Income Community

SNHPC

Southern NH Planning Commission

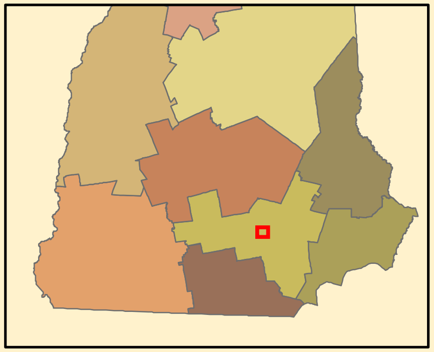
New Piscataquog River Bridge

Connectivity Assessment

0 0.125 0.25 0.5 0.75 1 Miles

1:24,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US



Population

- 100,000 - 499,999
- 50,000 - 99,999
- 10,000 - 49,999
- Under 10,000

Southern NH Planning Commission

Boundary

Road Class

- Primary Road
- Secondary Road
- Local Road

Total Unique Cyclists Per Segment

- 1 - 30
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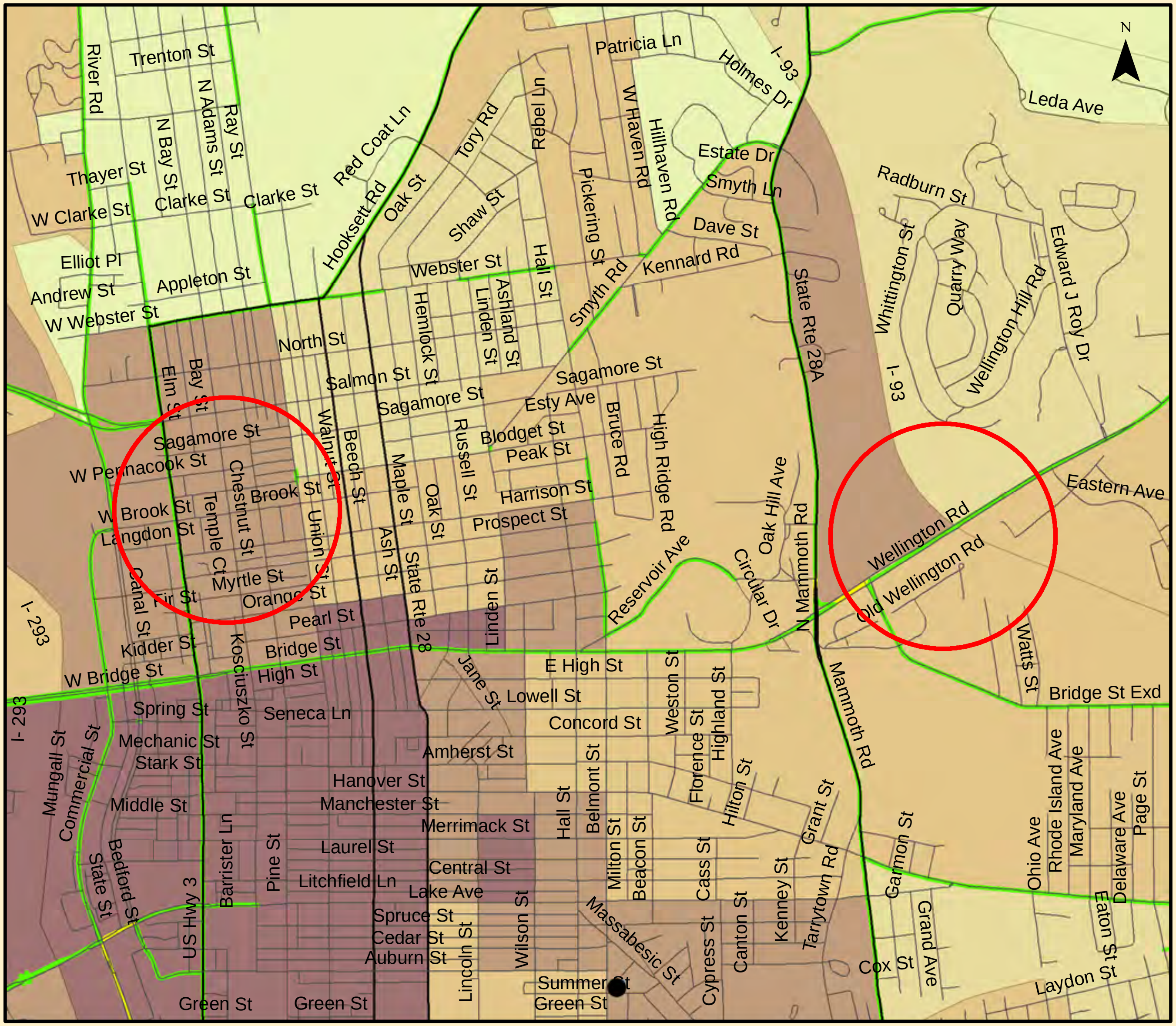
Census Block Groups - Median Income

- $90,000 - 150,000
- $70,000 - $90,000
- $51,932 - 69,999
- Low-Income Community
- Lowest Income Community

SNHPC



Southern NH Planning Commission

Planned Striping Chestnut Rd. and Wellington Rd.

Connectivity Assessment

0 0.125 0.25 0.5 0.75 1 Miles

1:24,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

Population

- 100,000 - 499,999
- 50,000 - 99,999
- 10,000 - 49,999
- Under 10,000

Strafford Regional Planning Commission

- Boundary

Priority Destinations

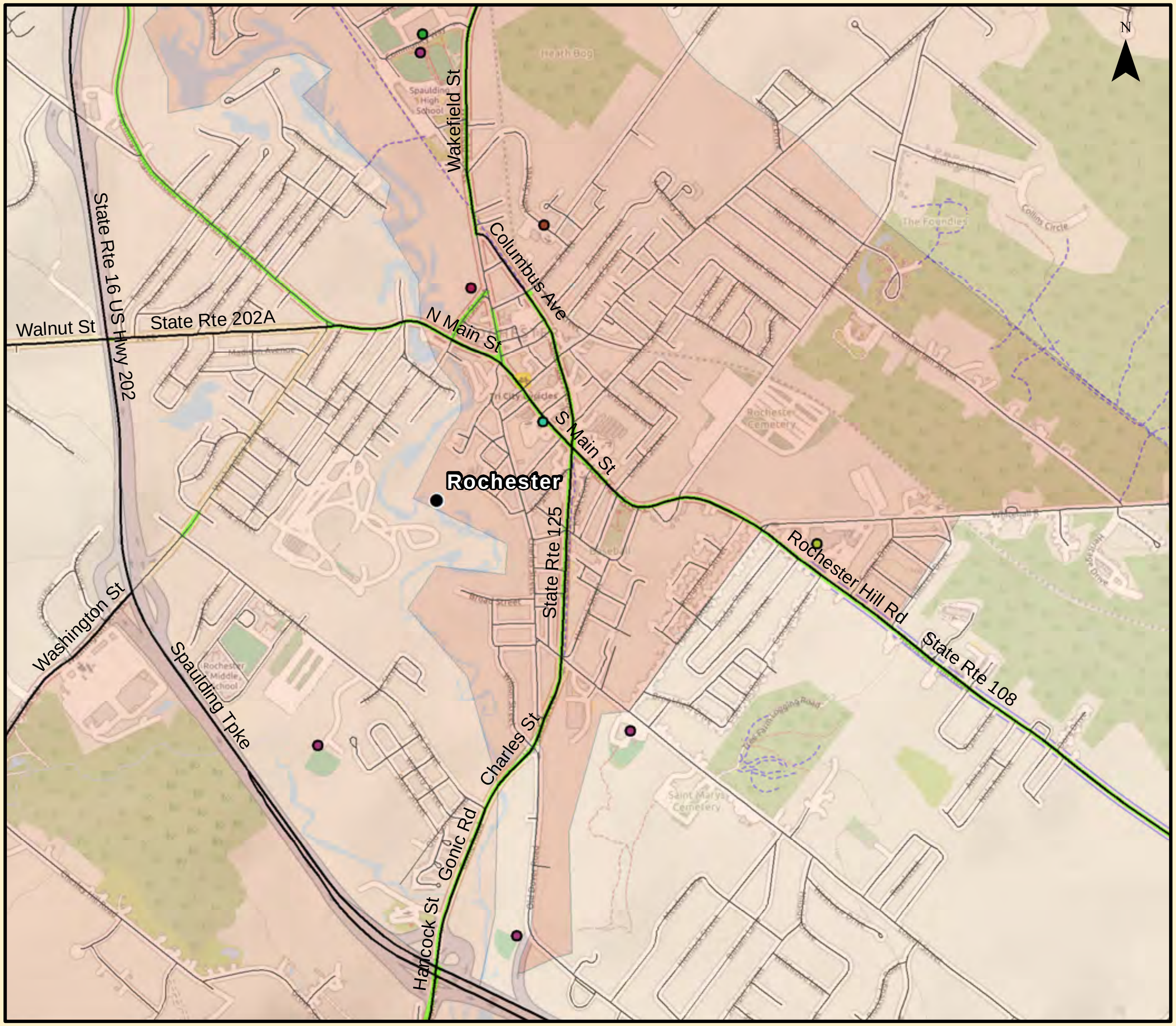
- ATHLETIC/REC FACILITY
- COMMUNITY FACILITY
- ESSENTIAL CITY FACILITY
- GROCERY STORE
- HOSPITAL
- LIBRARY
- PLACE OF WORSHIP
- POST OFFICE
- RETAIL/SHOPPING AREA
- SCHOOL
- SMALLER MARKET
- TRAIL ACCESS POINT

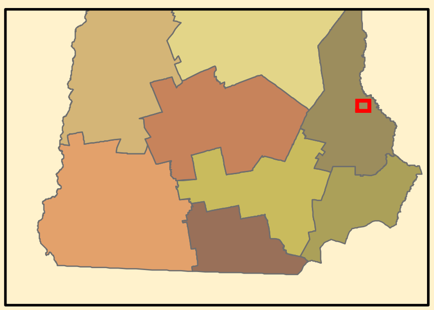
Road Class

- Primary Road
- Secondary Road
- Local Road

Total Unique Cyclists Per Segment

- 1 - 30
- 31 - 120
- 121 - 300
- 301 - 500
- 501 - 1185





Strafford Regional Planning Commission

Rochester North Main Street

0 0.15 0.3 0.6 0.9 1.2 Miles

1:26,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

SRPC

Target: Rochester - North Main Street from downtown and two intersections: where Congress St. and Wakefield come in on eastern side and Washington St. on west side
Contacts: Colin Lentz, Regional Transportation Planner

Conversation: The 10 yr. draft Complete Streets plan for this region will run a connection from the Weeks traffic circle in Dover up through Innovation Drive in Rochester. The original scope of this plan talked about bus pullouts, updated bicycle lanes, sidewalks, economic development opportunities, and accessibility. Draft plan crosses both urban and rural communities. The plan has been sent to Governor Hassen's office for consideration. Preliminary engineering on the project should begin in the fall of 2017. The FAST Act was recently signed, which should make additional funding more readily available for the project.

The Avis-Goodwin Community Health Center has excellent bus access but no means for pedestrians.

Additional Info: 2015-2024 DOT Draft Ten Year Plan intends to makes changes to 202A (Walnut Street) in Rochester and intersection improvements to improve safety.

Social Vulnerability Index
Central Rochester Tract:
- Overall Vulnerability (0-10): 4
- Themes: for per capita income, the proportion is in the 90th percentile, the proportion of single parent households is in the 90th percentile, for crowded housing, the proportion is in the 90th percentile, for no vehicle access, the proportion is in the 90th percentile

Google imagery indicates lack of bicycle-friendly infrastructure along Rochester's Main St.

Population
- 100,000 - 499,999
- 50,000 - 99,999
- 10,000 - 49,999
- Under 10,000

Strafford Regional Planning Commission
- Boundary

Priority Destinations
- ATHLETIC/REC FACILITY
- COMMUNITY FACILITY
- ESSENTIAL CITY FACILITY
- GROCERY STORE
- HOSPITAL
- LIBRARY
- PLACE OF WORSHIP
- POST OFFICE
- RETAIL/SHOPPING AREA
- SCHOOL
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Census Block Groups - Median Income
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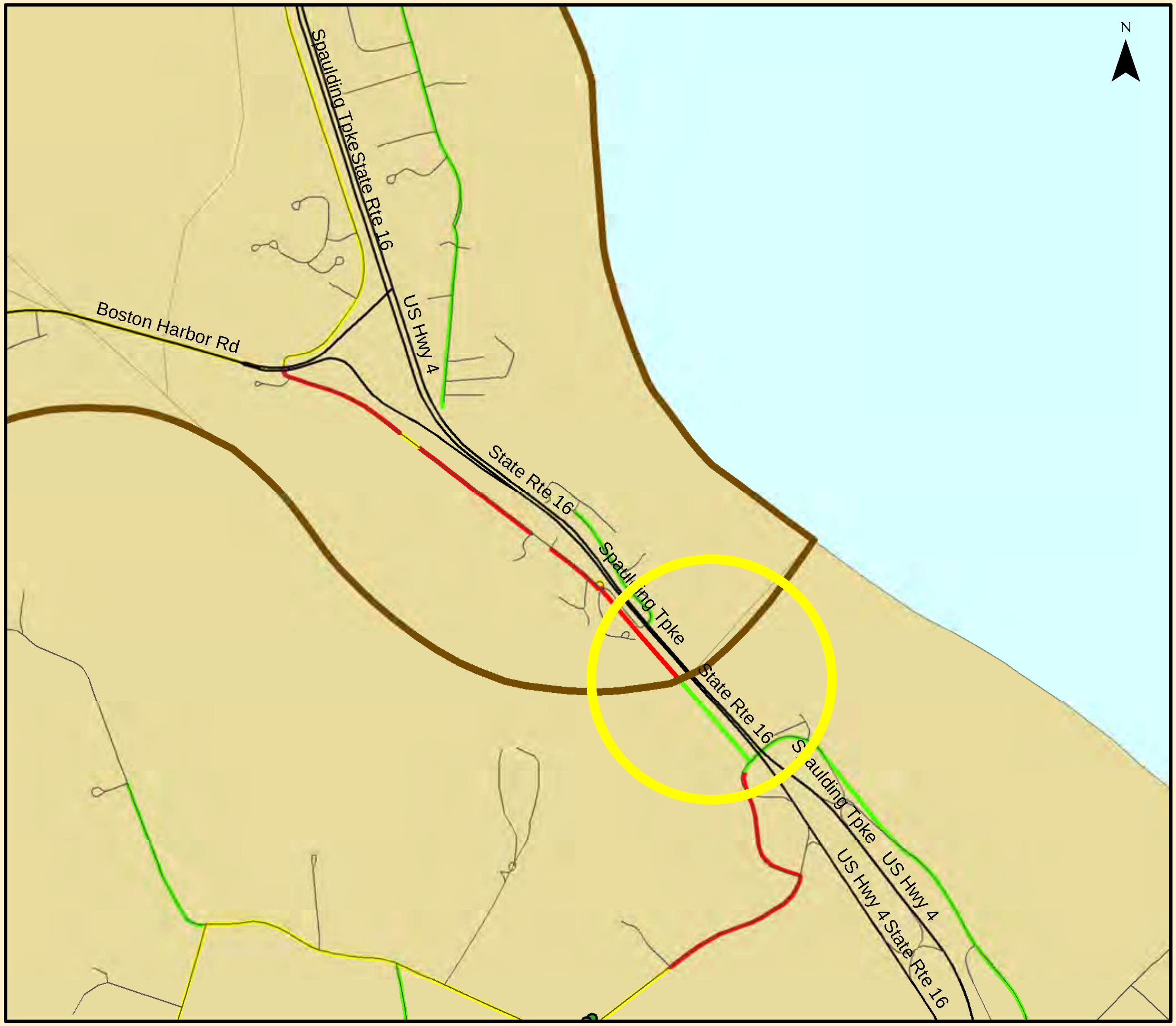
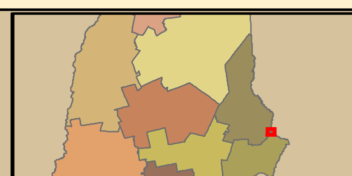


Strafford Regional Planning Commission

Newington-Dover Pedestrian Bridge

Planned Infrastructure Improvements



0 0.125 0.25 0.5 0.75 1 Miles

1:24,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

Population

- 100,000 - 499,999
- 50,000 - 99,999
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Strafford Regional Planning Commission

- Boundary

Priority Destinations

- ATHLETIC/REC FACILITY
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- ESSENTIAL CITY FACILITY
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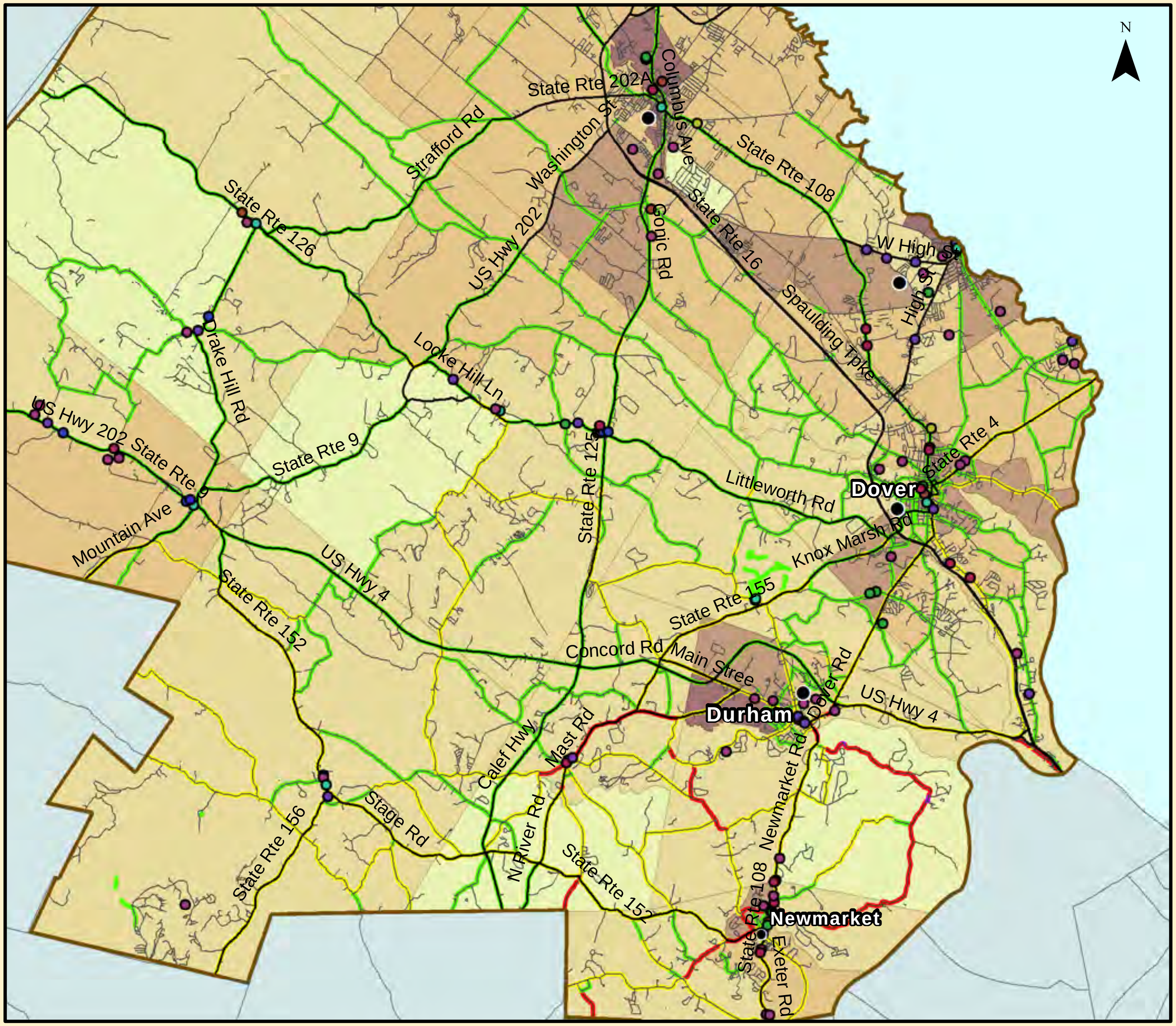
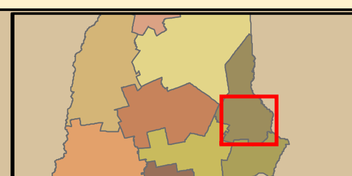


Strafford Regional Planning Commission

Durham, Dover, Rochester, Newmarket

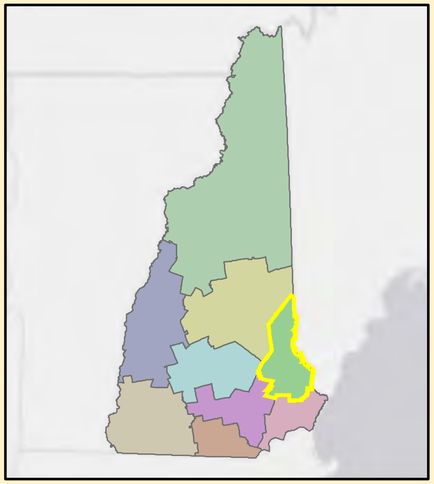
Key Destinations



0 1 2 4 6 8 Miles

1:200,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US



Population
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- Secondary Road

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- 171 - 350
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Strafford Regional Planning Commission
- Boundary

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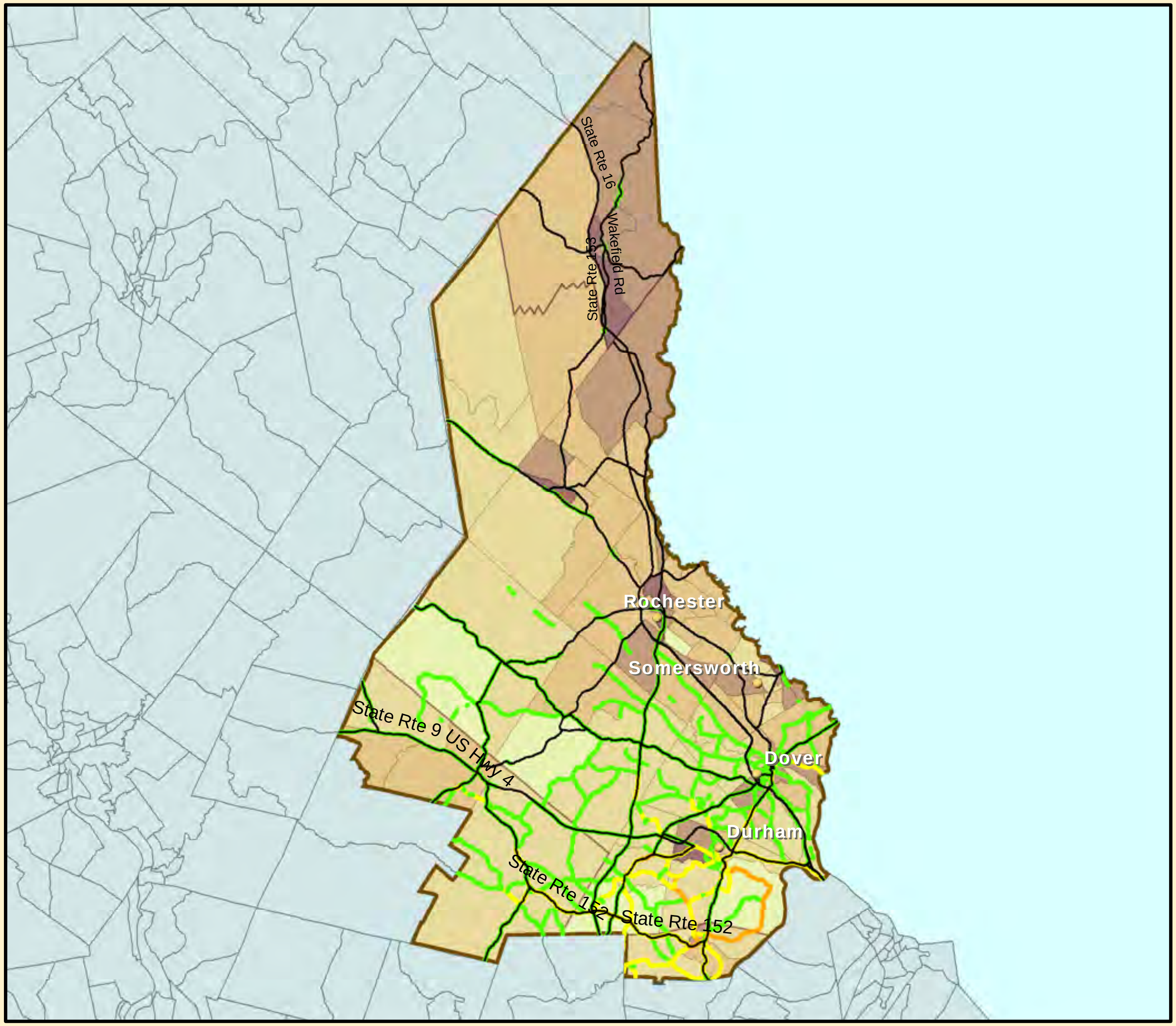

Strafford Regional Planning Commission

Overview

0 3 6 12 18 24 Miles

1:500,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

N

Population

- 100,000 - 499,999
- 50,000 - 99,999
- 10,000 - 49,999
- Under 10,000

Strafford Regional Planning Commission

- Boundary

Priority Destinations

- ATHLETIC/REC FACILITY
- COMMUNITY FACILITY
- ESSENTIAL CITY FACILITY
- GROCERY STORE
- HOSPITAL
- LIBRARY
- PLACE OF WORSHIP
- POST OFFICE
- RETAIL/SHOPPING AREA
- SCHOOL
- SMALLER MARKET
- TRAIL ACCESS POINT

Road Class

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- Secondary Road
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Total Unique Cyclists Per Segment

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- 501 - 1185

Census Block Groups - Median Income

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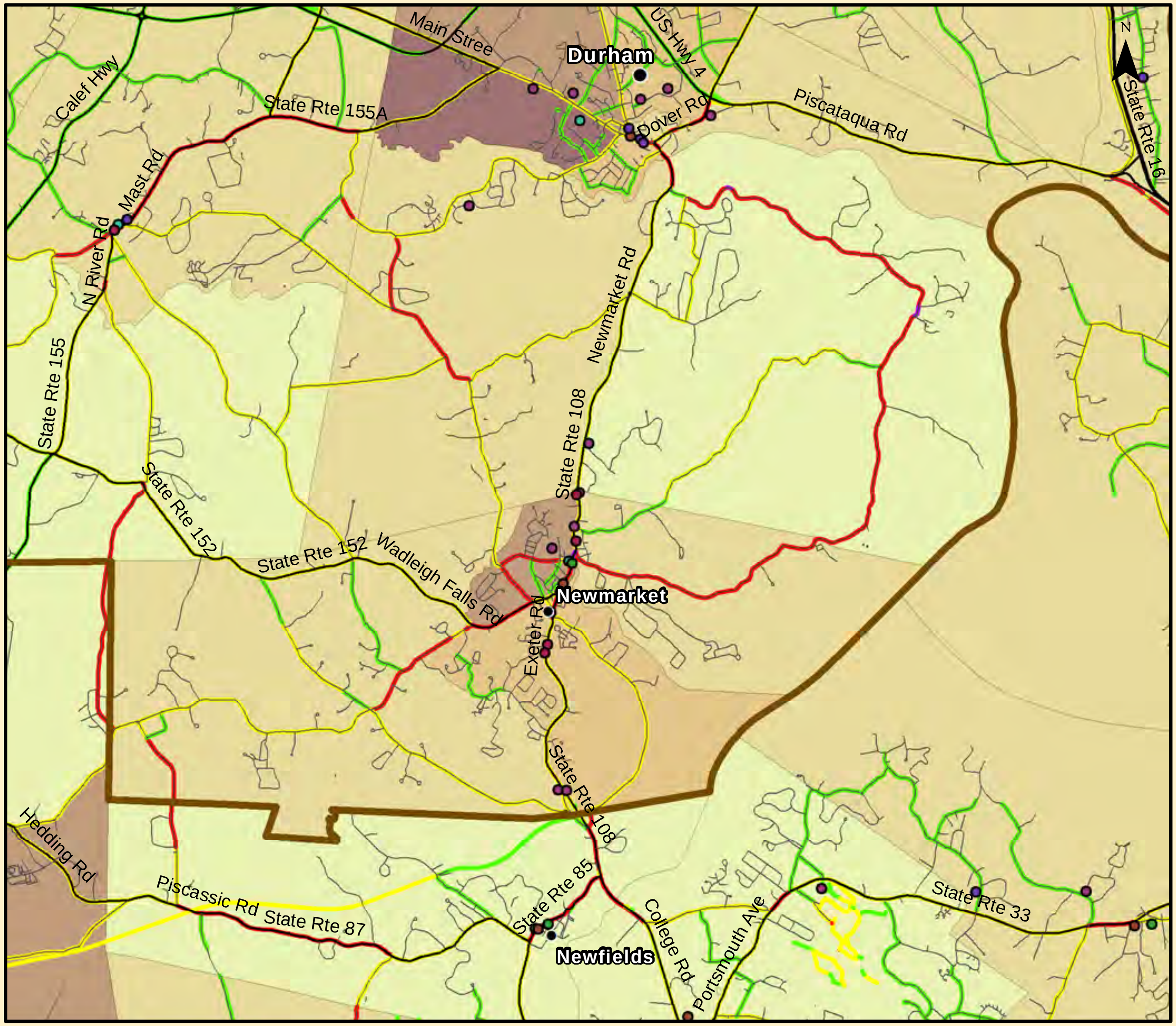
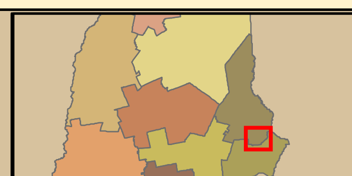
- Lowest Income Community



Strafford Regional Planning Commission

Durham, Newmarket, Newfields Project

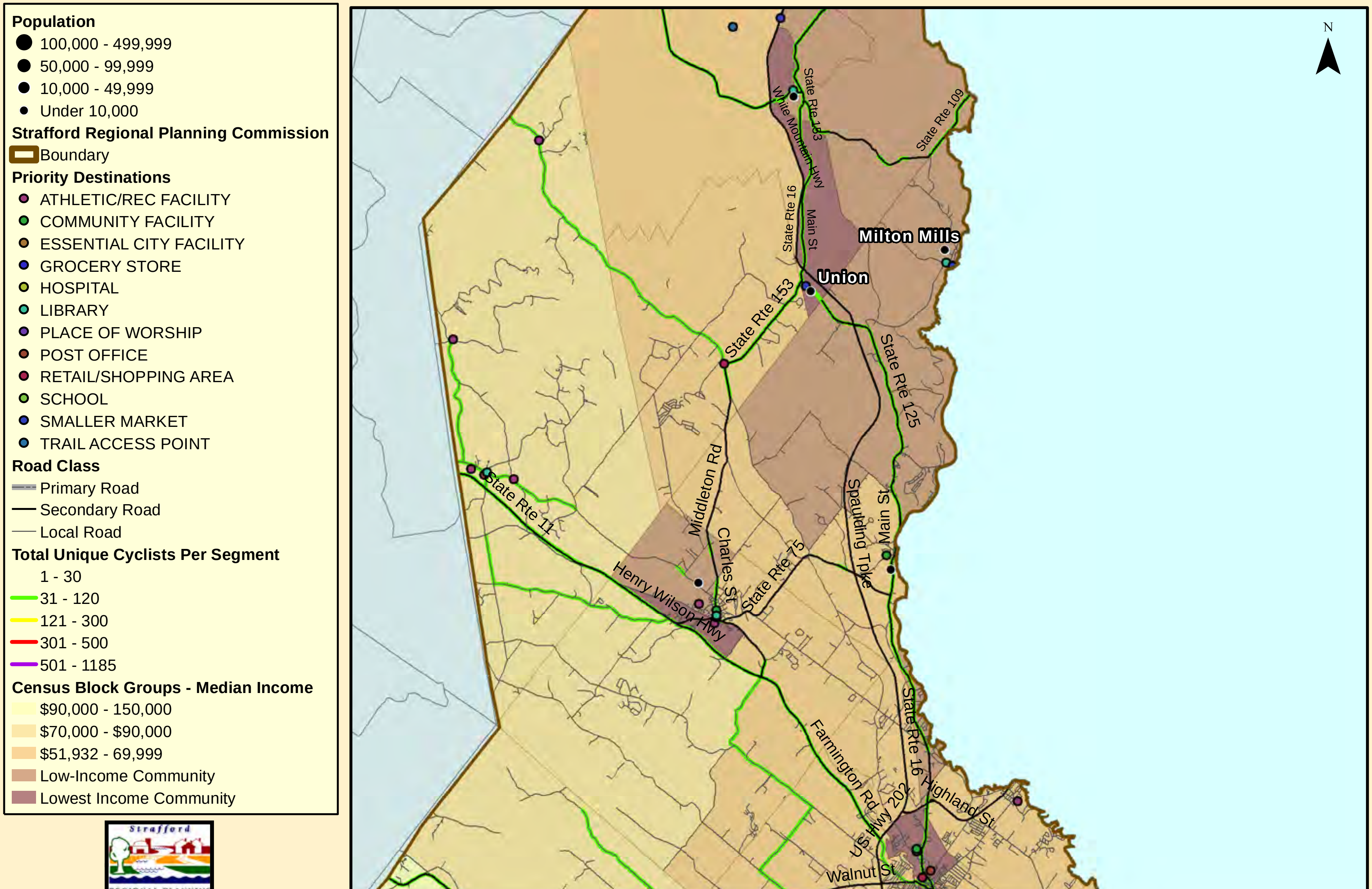
Planned Infrastructure Improvements



0 0.5 1 2 3 4 Miles

1:90,000

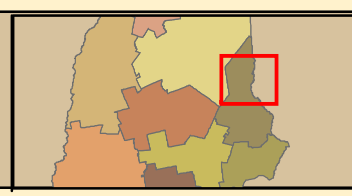
NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US



Strafford Regional Planning Commission

Union, Farmington, Milton Mills, Sanbornton

Key Destinations



1:200,000

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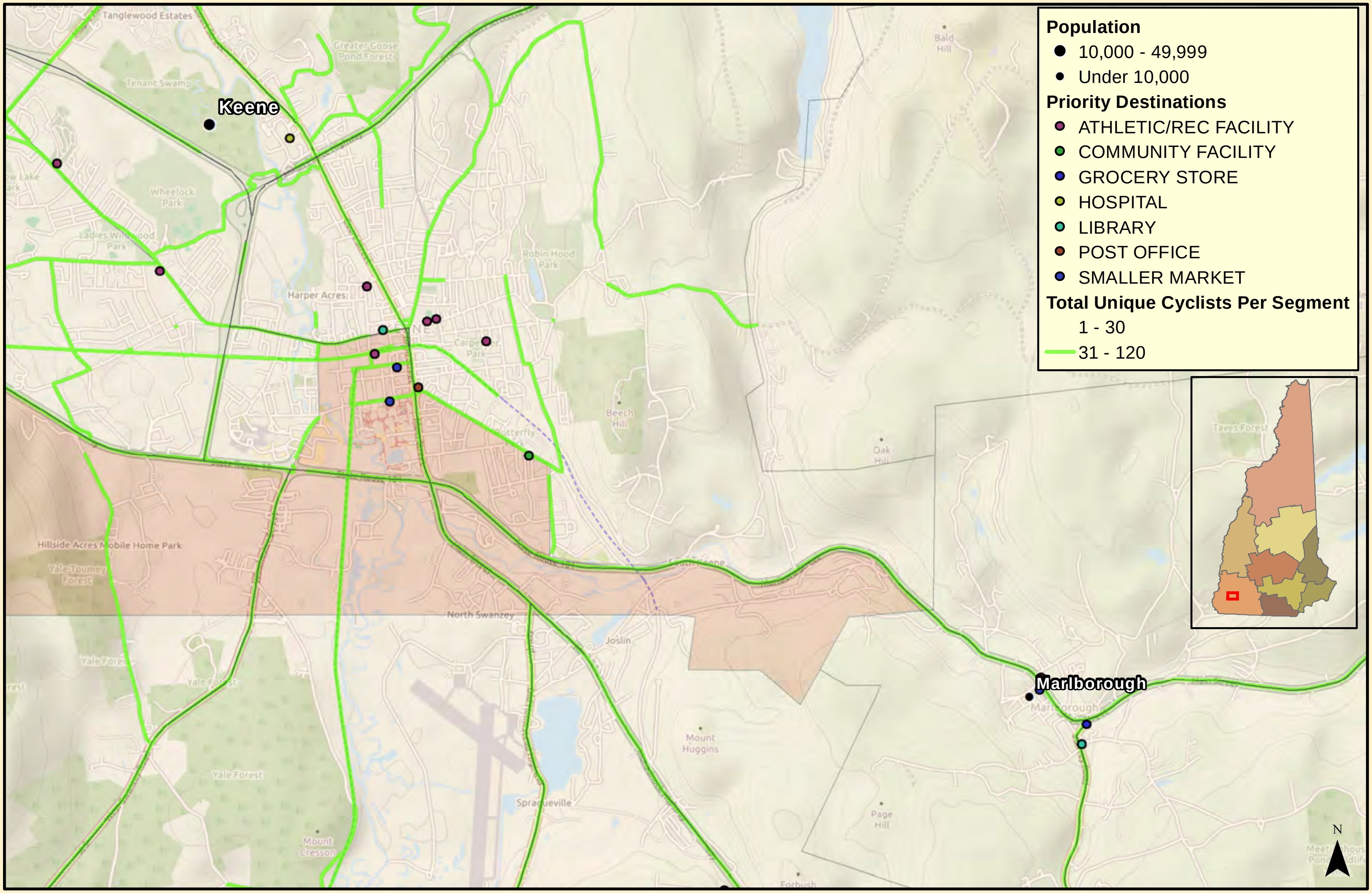


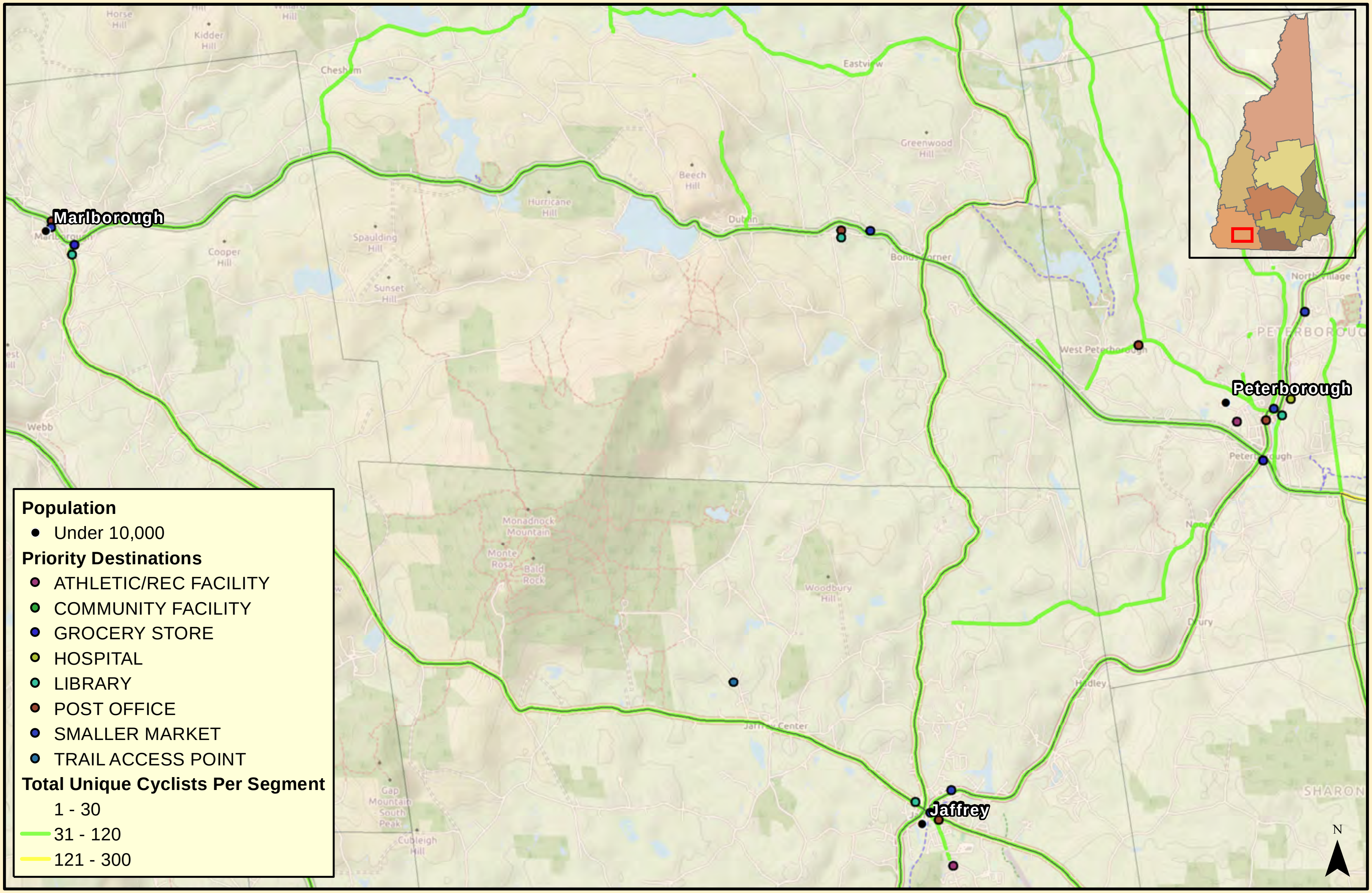
Southwest Region Planning Commission

Keene - Marlborough Connectivity

0 0.3 0.6 1.2 1.8 2.4 Miles

1:50,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US



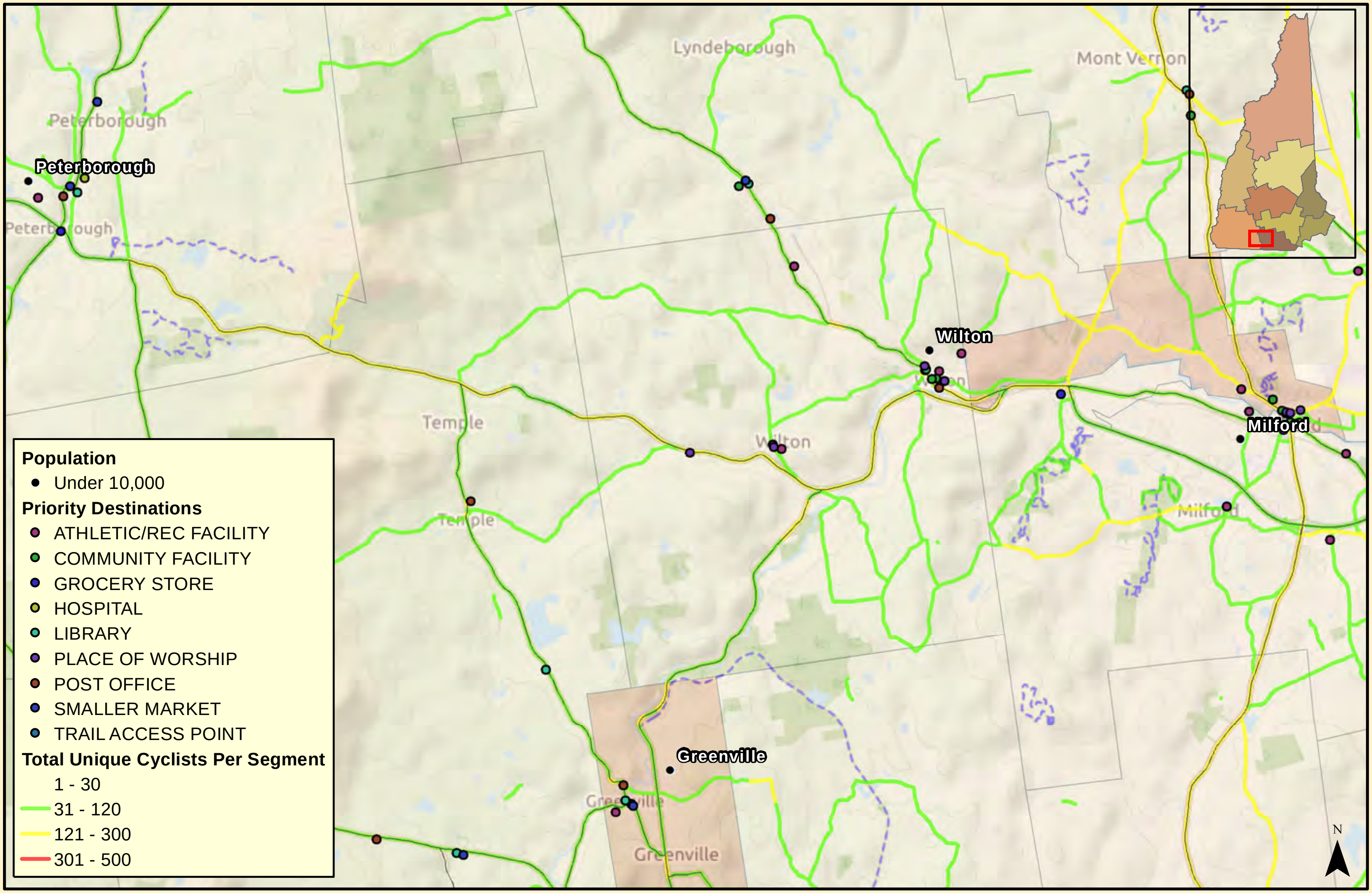
Southwest Region Planning Commission

Marlborough - Peterborough Connectivity

0 0.5 1 2 3 4 Miles

1:100,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US



Southwest Region Planning Commission

Peterborough - Milford Connectivity

0 0.5 1 2 3 4 Miles

1:115,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

SWRPC

Target: Rt. 101 connectivity between Keene, Marlborough, Peterborough, and Milford
Contacts: No Response

There are no existing rail trail that connect these communities. Adding bikeable miles is a stated priority of the Southwest Region Transportation Plan (2014-2035). There appear to be abandoned Rail Trail corridors north of Rt. 101 (See attached).

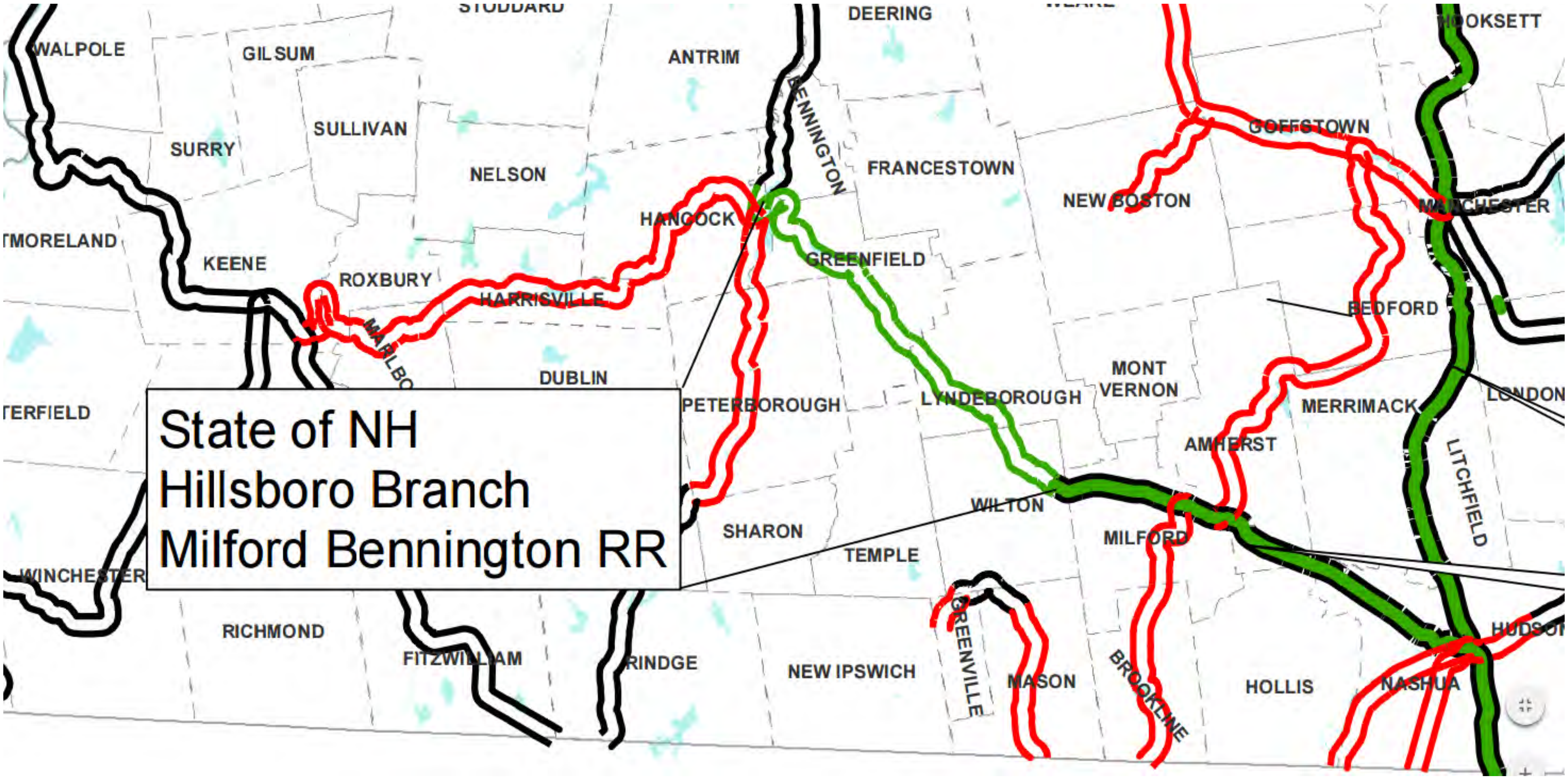
From the Southwest Region Transportation Plan (2014-2035):

- Attention is required towards the crossing of NH 101 from Marlboro Street to Ashuelot Branch Rail Trail as well as the Stone Arch Bridge crossing Branch Brook.
- Keene working on challenge of balancing land use and transportation considerations on Marlboro St., the gateway into Keene from the NH 101 E Corridor.
- Branch and Minnewawa Brooks reduce possibilities for transportation improvements in South Keene and Marlborough including NH 124 bridge at NH 101 intersection.
- Coordination between Marlborough and NHDOT required to balance needs of town village center with regional and state mobility requirements for NH 101.
- Significant incline and curvature in the Hurricane Hill area of NH 101 requiring constant snowplowing attention.
- The NH 101 East, US 202 North and US 202 South Corridors depend on a Contoocook Bridge crossing on NH 101/US 202 in Peterborough.
- A number of Southern NH Region towns use the NH 101 East Corridor to reach Keene, NH and other Southwest Region Planning Commission Towns. For some municipalities, however, even though the distance is shorter using NH 101, it requires a longer travel time than using NH 9.
- There are 4 foot shoulders for bicycling on NH 101 E Backbone Corridor
- Bicycling is accessible for approximately 2.0 mi in Keene, 6.7 mi in Marlborough, and 6.2 mi in Peterborough
- See Attachments

Social Vulnerability Index
Keene Tract:
- Overall Vulnerability (0-10): 4
- Themes: for poverty, the proportion is in the 90th percentile, for civilian unemployed, the proportion is in the 90th percentile, for per capita income, the proportion is in the 90th percentile, the proportion of persons in institutionalized group quarters is in the 90th percentile

Milford Tract:
- Overall Vulnerability (0-10): 3
- Themes: the proportion of persons aged 17 and younger is in the 90th percentile, for limited English, the proportion is in the 90th percentile, for crowded housing, the proportion is in the 90th percentile

Rt. 101 between Keene and Marlborough, Rt. 101 between Peterborough and Marlborough, and Rt. 101 between Peterborough and Milford



Red indicates abandoned railroads. Black indicates State of NH Inactive railroads.

Towns: Dublin, Greenville, Harrisville, Keene, Marlborough, New Ipswich, Peterborough, Sharon, Temple

Nodal Centers: Greenville Village, Keene, Marlborough Village, and Downtown Peterborough

Corridor Backbone: NH 101 from NH 9/10/12/101 in Keene to Temple/Wilton Town Line

Highway Corridor System:
Source: NHDOT

Towns	Principal Arterials	Minor Arterials	Major and Urban Collectors	Minor Collectors
Dublin	NH 101			Chesham Rd Beech Hill Rd NH 137
Greenville			NH 31 NH 124	NH 45 NH 123
Harrisville				NH 137 Chesham Rd Breed Rd Nelson Rd Main St/Dublin Rd
Keene	NH 101	Winchester St East of Main St Optical Ave		
Marlborough	NH 101		NH 124	
New Ipswich			NH 123 NH 124	NH 45 NH 123 NH 123A Ashby Rd
Peterborough	NH 101		NH 123	
Sharon			NH 123 NH 124	Nashua Rd
Temple	NH 101			NH 45 W Rd

Transportation Infrastructure and Services:
Source: NHDOT and SWRPC

	Examples	Locations Where Accessible
Pedestrian	Sidewalks	Dublin, Greenville Village, Keene, Marlborough Village, Peterborough, Downtown Peterborough, New Ipswich
Bicycle	Manchester and Keene Branch Rail Trail and Greenville Rail Trail	Harrisville, Greenville Village
	4 foot Shoulders on NH 101 E Backbone Corridor	~2.0 mi in Keene, ~ 6.7 mi in Marlborough, ~3.3 mi in Dublin, ~6.2 mi in Peterborough; Temple
Demand Response Bus	Para Express, Friendly Bus	Keene
Volunteer Drivers	American Red Cross, Contoocook Valley Trans. Co. (CVTC)	All Locations
Ridesharing Program	CVTC	
Intercity Bus	Greyhound Bus Lines	Keene

*No Fixed Route Bus, Railroad Services or Airport Available on Corridor.

NH 101 EAST POPULATION

Population Projections:
Source: US Decennial Census & NHOEP

Communities	2010	2040	% Change in Population	Total Population Change
Dublin	1,597	1,724	8.0%	127
Greenville	2,105	2,022	-3.9%	-83
Harrisville	961	834	-13.2%	-127
Keene	23,409	24,260	3.6%	851
Marlborough	2,063	2,116	2.5%	53
New Ipswich	5,099	6,148	20.6%	1,049
Peterborough	6,284	6,898	9.8%	614
Sharon	352	352	0.0%	0
Temple	1,366	1,479	8.3%	113
NH 101 East Corridor	43,236	45,832	6.0%	2,596
SWRPC Region	102,313	108,168	5.40%	5,855

Special Populations:
Sources: US Census, 2010 Decennial Census, (Table QT-P2); ACS 2007-2011 5 Year Estimate (Table S1701); US Census Bureau, 2010 Decennial Census, (Table P39)

	All Corridor Communities	Proportion of Corridor Population	Communities with Above Average proportion of Special Populations
Youth (Age 15 and Under)	7,251	17%	Dublin (18%); Greenville (19%); Greenville Village (20%); Marlborough Village (19%); New Ipswich (25%);, Peterborough (19%); Temple (18%)
Young Adults (Age 16-34)	12,493	29%	Keene (37)
Middle Age (Age 35-64)	16,950	39%	Dublin (48%); Greenville (45%); Greenville Village (43%); Harrisville (54%); Marlborough (45%); Marlborough Village (40%); New Ipswich (43%);, Peterborough (42%); Sharon (51%); Temple (51%)
Seniors (65 and older)	6,542	15%	Dublin (16%); Harrisville (19%); Marlborough (17%); Marlborough Village (17%); Peterborough (22%); Downtown Peterborough (26%); Sharon (16%)
Racial Minorities	1,674	4%	Keene (5%)
Low Income (Population at or under 150% of Poverty Level)	7,522	17%	Greenville (22%); Greenville Village (30%); Keene (22%); Downtown Peterborough (20%); Temple (25%)
Single Parent Households	3,124	31%	Greenville (42%); Greenville Village (46%); Keene (36%); Marlborough Village Center (38%); Peterborough (33%); Downtown Peterborough (40%)

Traffic Volume Change500 AADT or Greater
Source: NHDOT

Facility	Town	Description	AADT	Date Range	AADT Change
NH 101	Dublin	NH 101 WEST OF OLD HARRISVILLE RD	5,300	2006-2012	-700
NH 101	Dublin	NH 101 WEST OF NH 137	6,700	2006-2012	-600
NH 101	Dublin	NH 101 EAST OF CHURCH ST	6,400	2006-2012	-600
NH 31	Greenville	NH 31 AT WILTON TL	3,900	2006-2012	-500
NH 101	Keene	NH 101 EAST OF OPTICAL AVE	14,000	2006-2012	1000
NH 101	Keene	NH 101 EAST OF MAIN ST	12,000	2005-2011	1000
NH 101	Marlborough	NH 101 EAST OF CANADA ST	12,000	2006-2012	-1000
NH 101	Marlborough	NH 101 EAST OF ROXBURY RD	7,400	2005-2011	-500
NH 101	Marlborough	NH 101 EAST OF NH 124	8,200	2005-2011	-1,200
NH 101	Marlborough	NH 101 AT DUBLIN TL	6,700	2006-2012	-600
NH 123	New Ipswich	NH 123 AT GREENVILLE TL	2,500	2005-2011	700
NH 123	New Ipswich	NH 123/NH 124 WEST OF CURRIER RD	4,900	2005-2011	600
NH 123/ NH 124	New Ipswich	NH 123/NH 124 AT SOUHEGAN RIVER	5,200	2006-2011	600
NH 101	Peterborough	NH 101 AT DUBLIN TL	6,500	2007-2010	-600
NH 101	Peterborough	NH 101 AT TEMPLE TL	7,500	2006-2012	700
NH 101	Peterborough	NH 101 WEST OF GROVE ST	9,100	2006-2012	800

Proportion of Daily Traffic by Vehicle Class at NH 101 East Corridor System Locations:
Source: SWRPC

Community	Traffic Count Location Description	Month/Year	Daily Traffic Volume	Motorcycles, Cars, Light Duty Trucks	Buses and Single-Unit Trucks	Trailer Trucks
Peterborough	NH 101 at Temple TL	7/2012	8,684	95.2%	2.7%	2.1%
Dublin	NH 101 E of Church St	6/2012	3,516	95.4%	3.1%	1.5%
Keene	NH 101 E of Optical Ave	9/2014	13,471	95.2%	3.2%	1.6%
Keene	Optical Ave N of NH 101	8/2014	6,716	97.3%	2.1%	0.6%
Keene	NH 101 W of Winchester St	6/2008	26,850	94.2%	3.5%	2.3%

Peak Hour Ridesharing (am & pm peak hours combined) :
Source: SWRPC

Location & $/gallon	Month/ Year	Total Vehicles	Average Vehicle Occupancy	% People Ridesharing	% Vehicles with Ridesharers
NH 101 E of NH 45 $3.660/gallon	7/2014	1,229	1.22	33%	18%
NH 101/US 202 in Peterborough $3.635/gallon	7/2014	2,258	1.27	39%	22%
NH 101 East of Optical Ave $3.604/gallon	9/2013	2,271	1.18	29%	16%

Corridor Communities Registered Vehicles:
Source: NHDES

Total Registered Vehicles	Ratio of Vehicles to Population	Motorcycles and Passenger Vehicles Excluding Electric or Hybrid	Passenger Vehicles Hybrid or Electric	Light Duty Trucks and SUVs	Buses and Single Unit Trucks	Heavy Duty Trucks
34,169	0.79	73.72%	0.11%	23.98%	1.89%	0.30%

Cross Commuting Patterns Among Corridor Communities

		Destination							
		Dublin	Greenville	Keene	Marlborough	New Ipswich	Peterborough	Sharon	Temple
Origin	Dublin	32	0	212	14	0	68	1	0
	Greenville	0	31	0	0	0	2	0	5
	Keene	25	0	4,667	106	12	123	0	2
	Marlborough	0	0	304	35	0	35	0	0
	New Ipswich	0	0	64	0	333	207	9	0
	Peterborough	20	2	207	4	40	800	0	3
	Sharon	0	4	2	0	22	15	1	4
	Temple	0	5	19	1	0	46	1	6

Source: Longitudinal Housing – Employment Dynamics, Primary Jobs, 2011

Communities with Over 50 employees commuting to NH 101 East Communities and Likely Using NH 101 East

Sources: Longitudinal Housing – Employment Dynamics, Primary Jobs, 2011 and Google Maps

Employee Origin	Number	Employee Destination
Marlborough	304	Keene
Dublin	213	Keene
Peterborough	207	Keene
New Ipswich	207	Peterborough
Jaffrey	201	Keene
Nashua	185	Keene
Harrisville	140	Keene
Keene	123	Peterborough
Keene	106	Marlborough
Milford	91	Keene

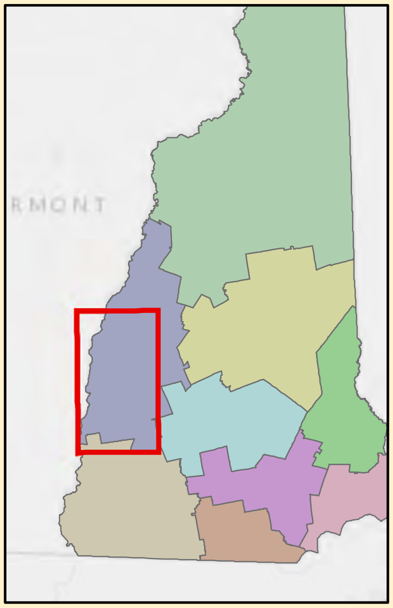
Employee Origin	Number	Employee Destination
Milford	81	Peterborough
Temple	78	New Ipswich
Dublin	68	Peterborough
Greenville	66	New Ipswich
New Ipswich	64	Keene
Hudson	59	Keene
Jaffrey	59	New Ipswich
Manchester	56	Peterborough
Swanzey	54	Peterborough
Rindge	52	New Ipswich

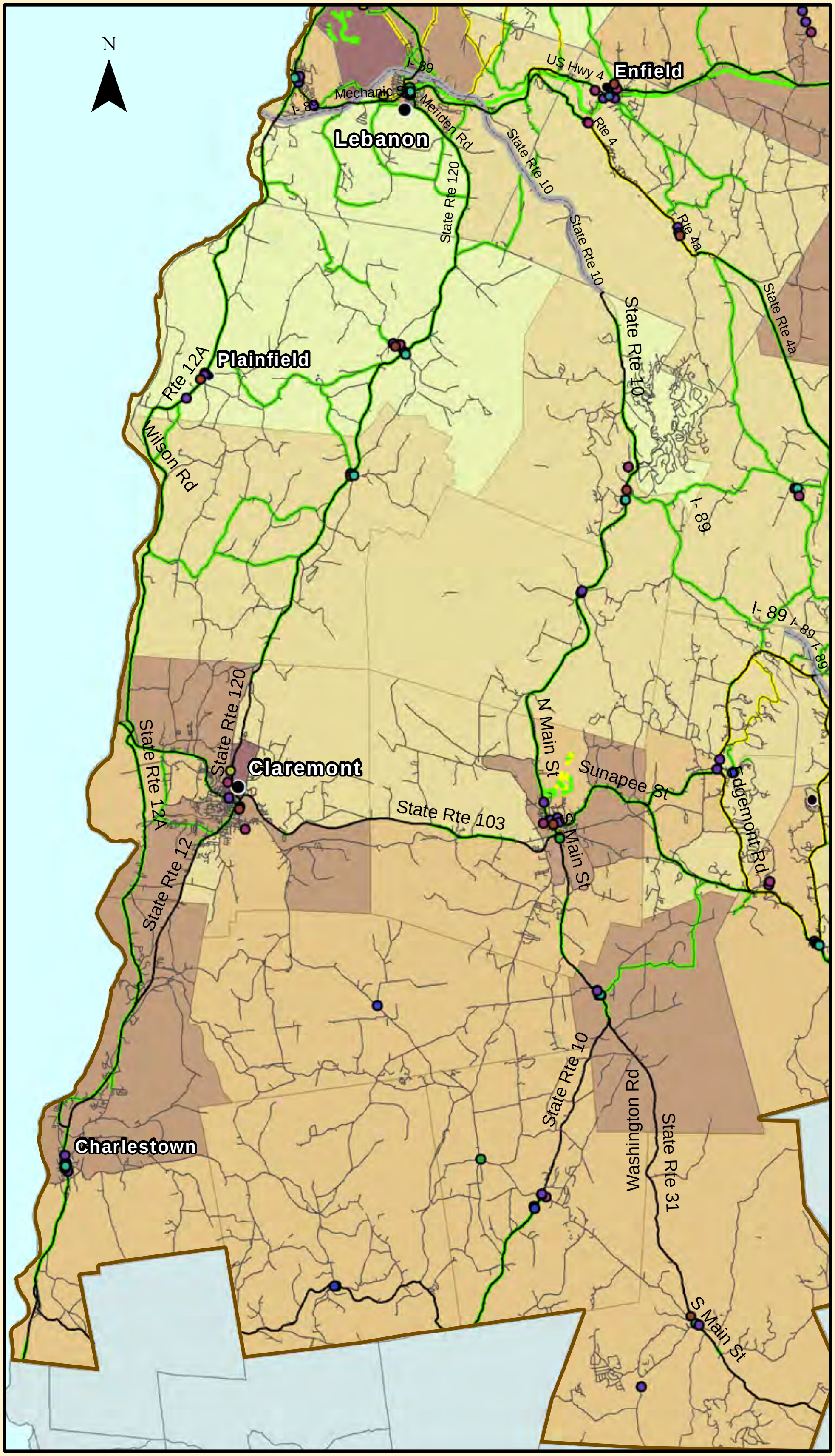
Jobs, Employers, and Unemployment Rates

Sources: [1]Longitudinal Housing -Employment Dynamics, Primary Jobs, 2011; [2]NH Department of Employment Security, 2012; [3]NH Department of Employment Security, August 2013.

Community	Total Jobs	Total Institutions	Unemploy-ment Rate
Dublin	291	53	4.4%
Greenville	208	35	6.5%
Harrisville	136	19	3.3%
Keene	16,946	864	5.7%
Marlborough	415	54	4.0%
New Ipswich	1,125	110	6.1%
Peterborough	4,368	305	4.7%
Sharon	20	N/A	2.6%
Temple	109	N/A	6.5%

Performance Measure Category	Measure	Units	NH 101 East Only	NH 101 East Corridor System	Target 2017
	Red Listed Bridges	Red list bridge number: total bridges	1 / 16	4 / 40	2
	Rail lines capable of speeds of 40 mph	miles: total miles	N/A	N/A	N/A
	Airport Runway Surface conditions	average condition	N/A	N/A	N/A
	Remaining useful life of transit buses	% of vehicle life remaining	N/A	N/A	N/A
Improve Safety	Crashes Involving Fatalities (5 year moving average 2008-2012)	Number	3	6	0
	Crashes Involving Incapacitating Injuries (5 year moving average 2008-2012)	number	19	39	10
Improve Mobility	PM peak hour volume/capacity ratio range	Volume to capacity	.19-.76	N/A	Under .62
Improve Multimodal Accessibility*	Intermodal Facility	number	0	0	Additional Study Required
	Sidewalks	miles	Inventory in progress	Inventory in progress	
	Bikeways	miles			
	# of park and ride lot spaces	number	0	0	
	Public transportation routes	miles	.5	.5	
	Intercity bus routes	miles	27.2	27.2	





UVLSRPC

Boundary

Priority Destinations

- ATHLETIC/REC FACILITY
- COMMUNITY FACILITY
- ESSENTIAL CITY FACILITY
- GROCERY STORE
- HOSPITAL
- LIBRARY
- PLACE OF WORSHIP
- POST OFFICE
- RETAIL/SHOPPING AREA
- SCHOOL
- SMALLER MARKET
- TRAIL ACCESS POINT

Population

- 100,000 - 499,999
- 50,000 - 99,999
- 10,000 - 49,999
- Under 10,000

Road Class

- Primary Road
- Secondary Road
- Local Road

Total Unique Cyclists Per Segment

- 1 - 30
- 31 - 120
- 121 - 300
- 301 - 500
- 501 - 1185

Census Block Groups - Median Income

- $90,000 - $200,000
- $70,000 - $89,999
- $51,932 - $69,999
- Low-Income Community
- Lowest Income Community

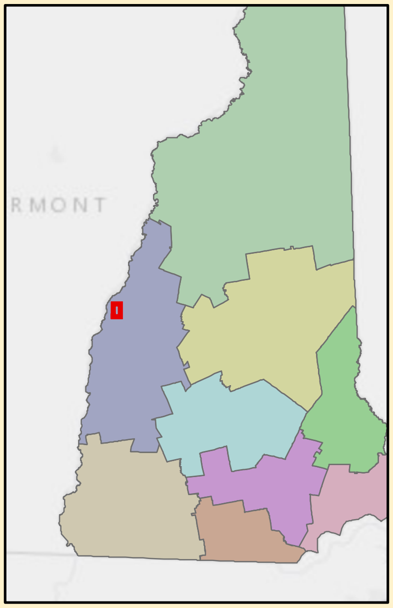
Upper Valley-Lake Sunapee Regional Planning Commission

Claremont, Charlestown, Plainfield, Lebanon

0 1.25 2.5 5 7.5 10 Miles

1:270,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US



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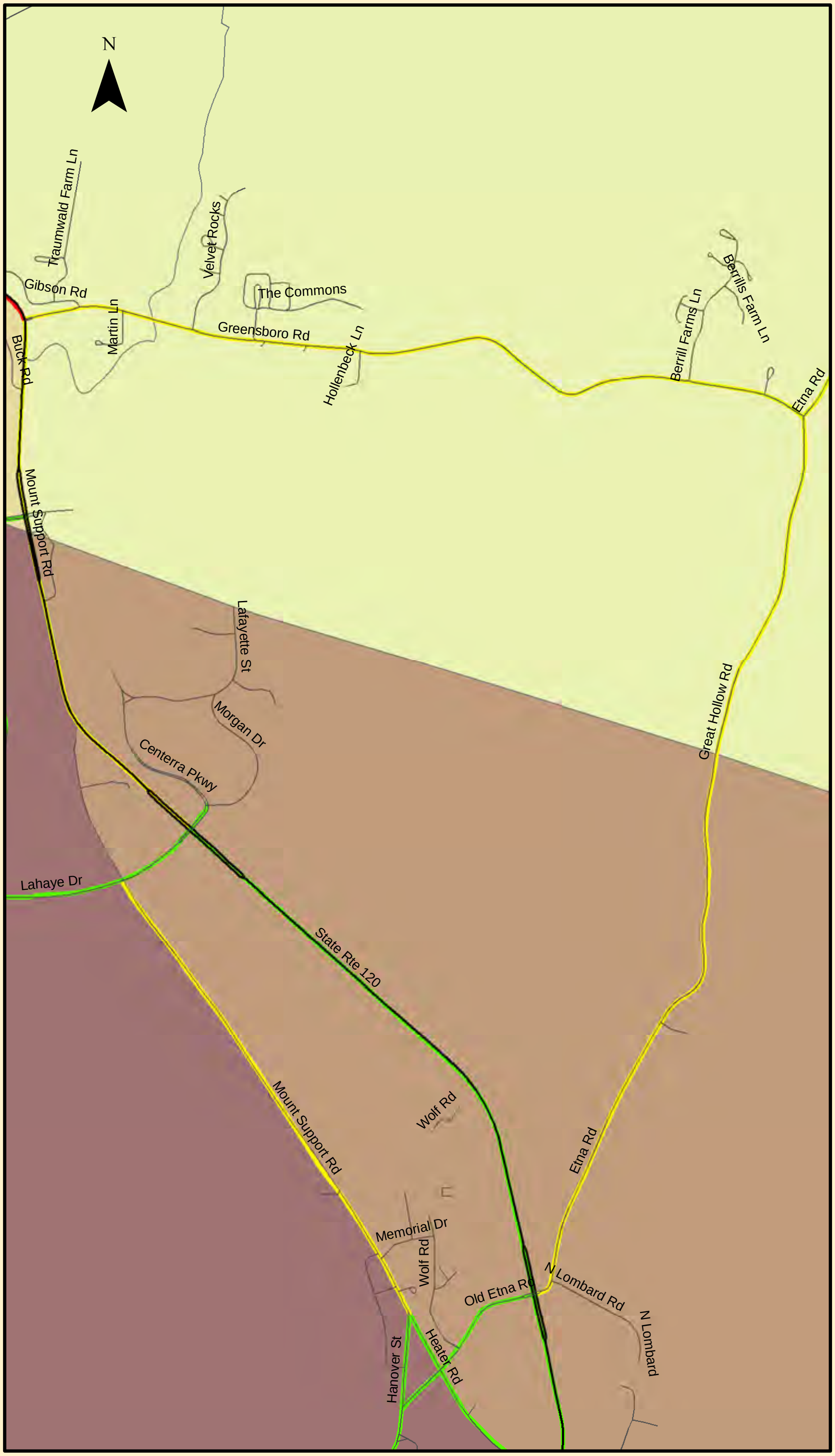


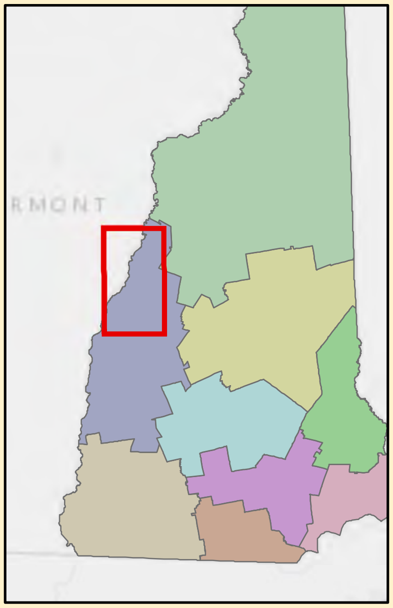
Upper Valley-Lake Sunapee Regional Planning Commission

Planned Improvements to Greensboro Rd., Hanover

0 0.1 0.2 0.4 0.6 0.8 Miles

1:24,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US



UVLSRPC

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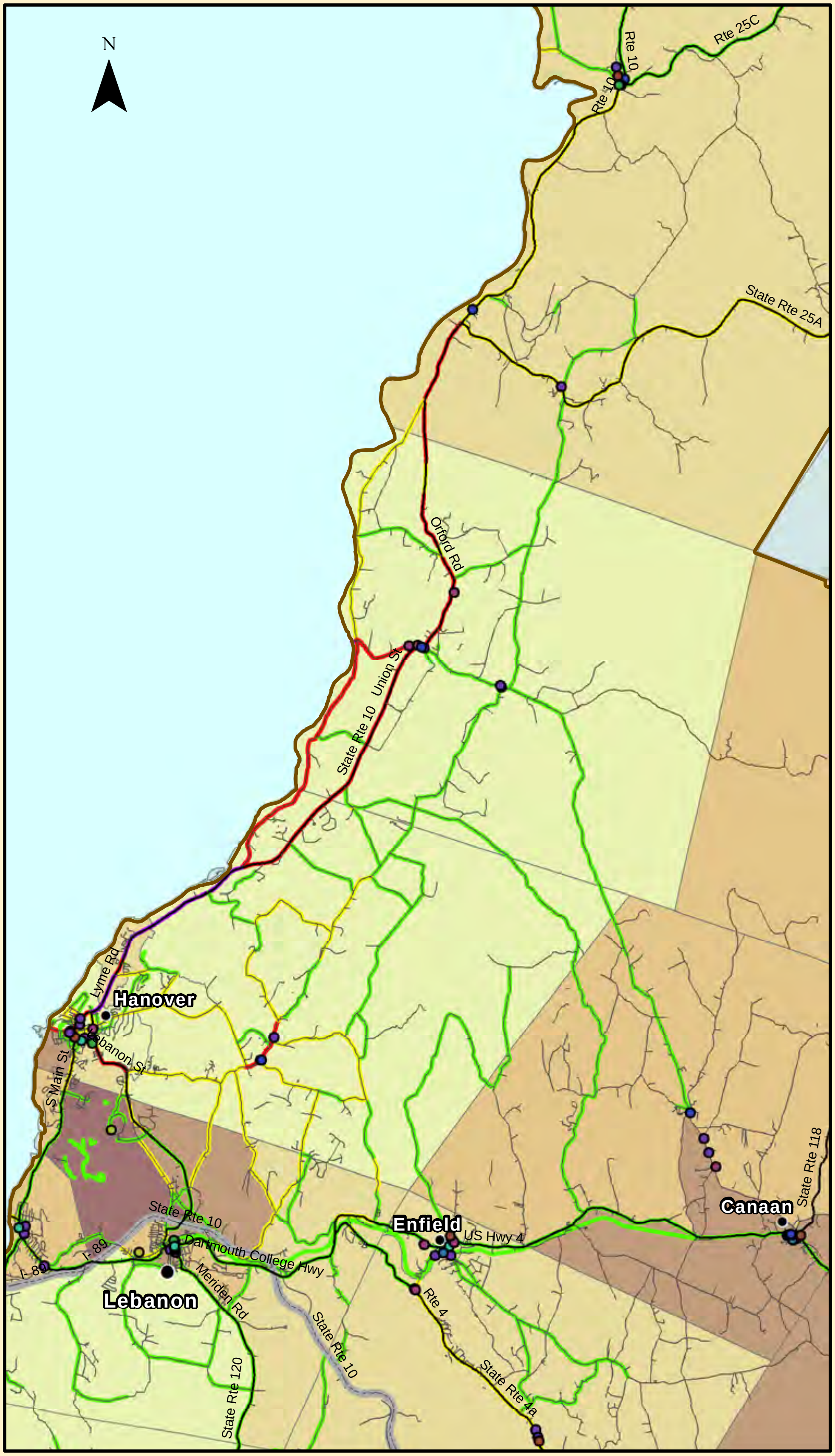

Upper Valley-Lake Sunapee Regional Planning Commission

Hanover, Canaan, Lebanon, Enfield

0 1 2 4 6 8 Miles

1:200,000

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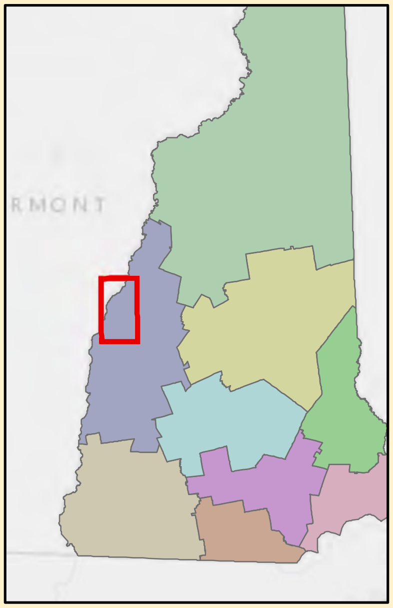

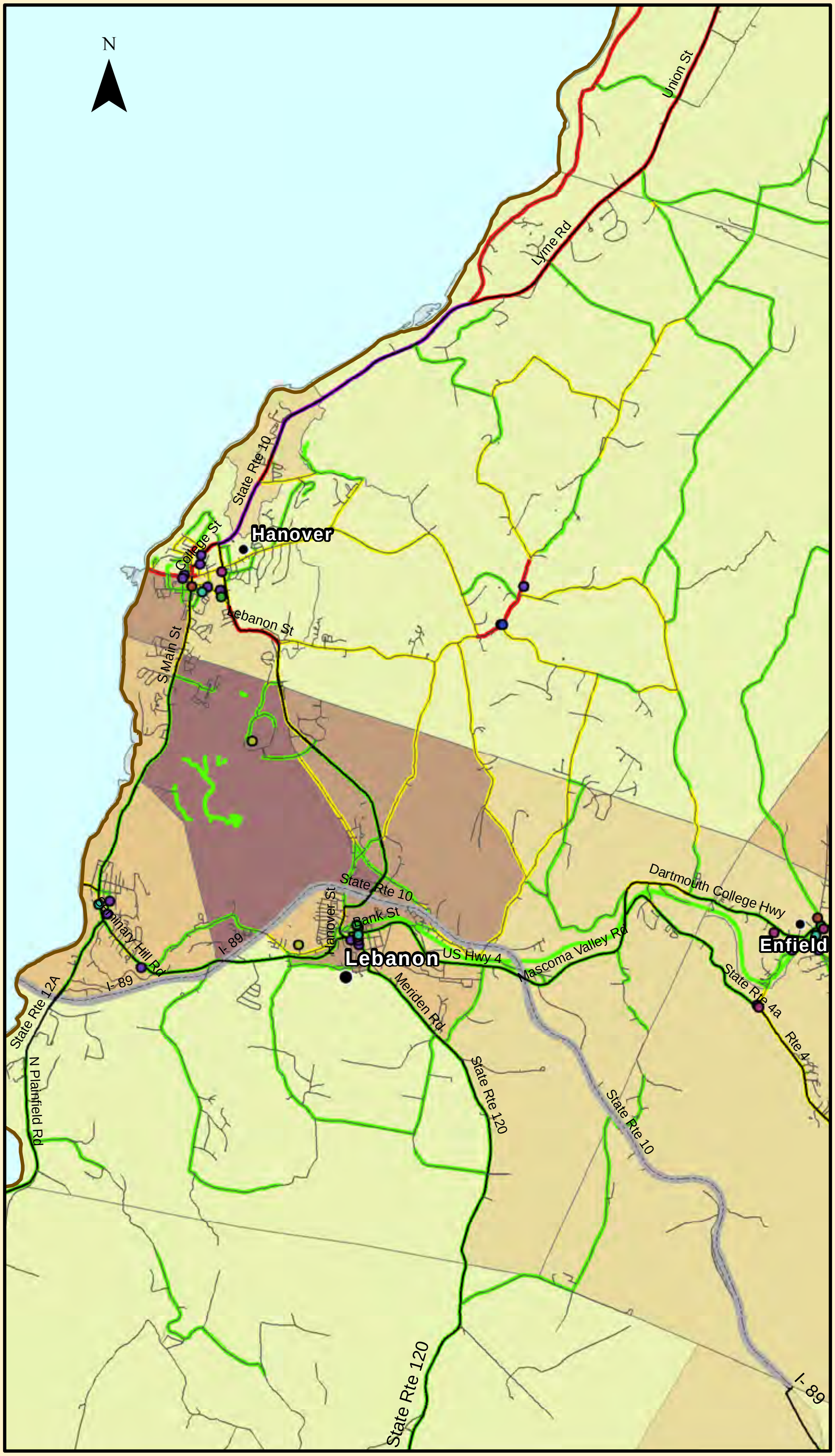

UVLSRPC

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Upper Valley-Lake Sunapee Regional Planning Commission

Hanover, Lebanon, Enfield

0 0.5 1 2 3 4 Miles

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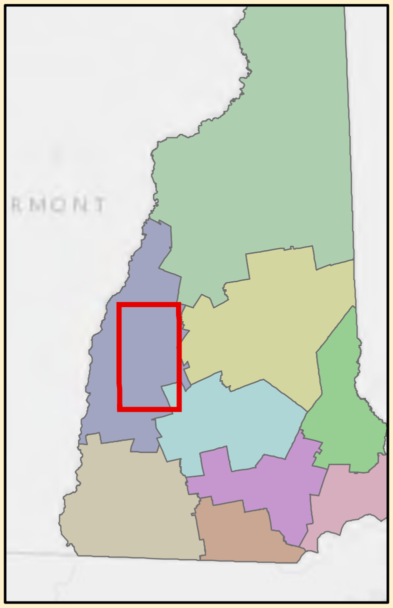

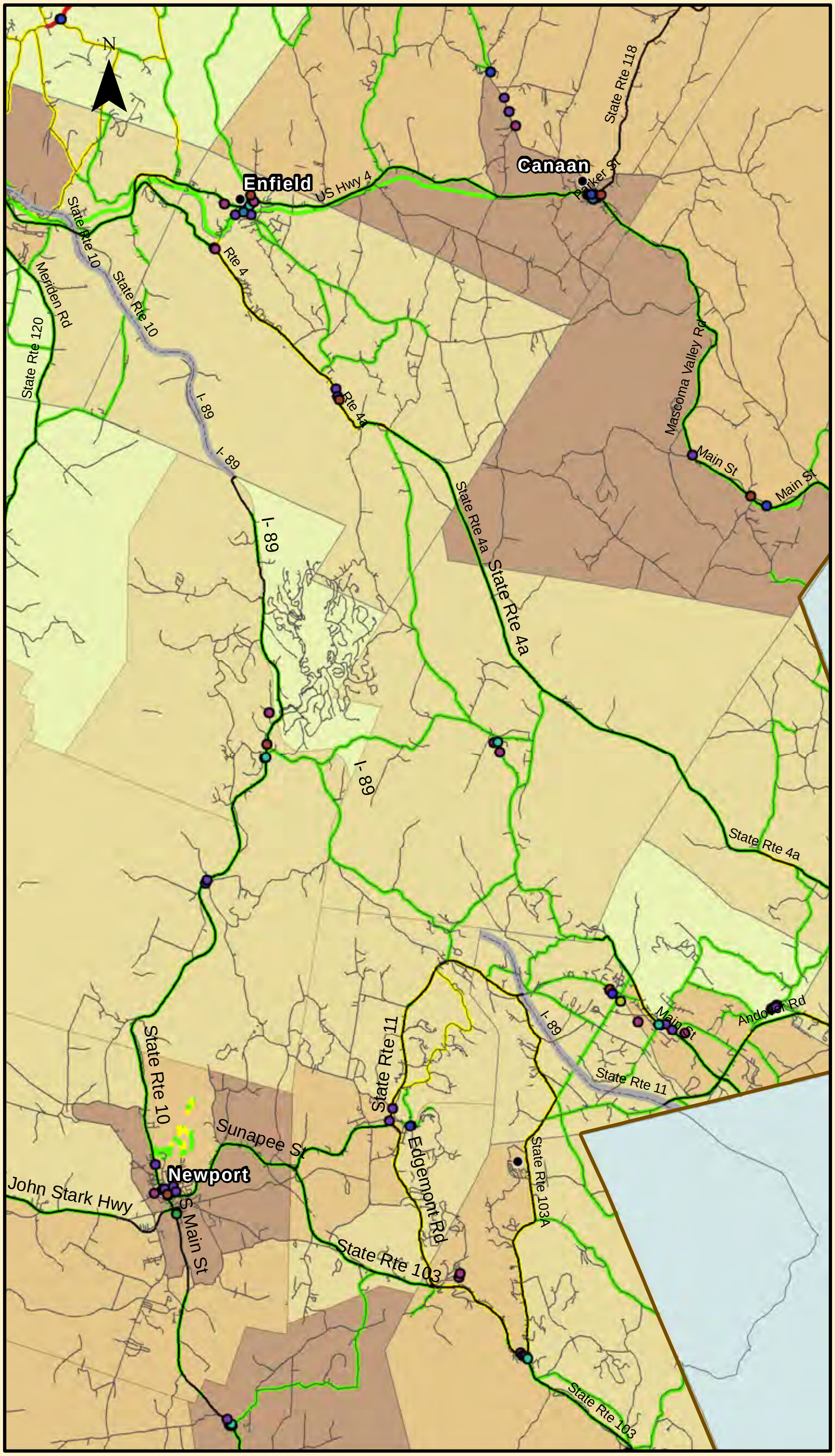

UVLSRPC

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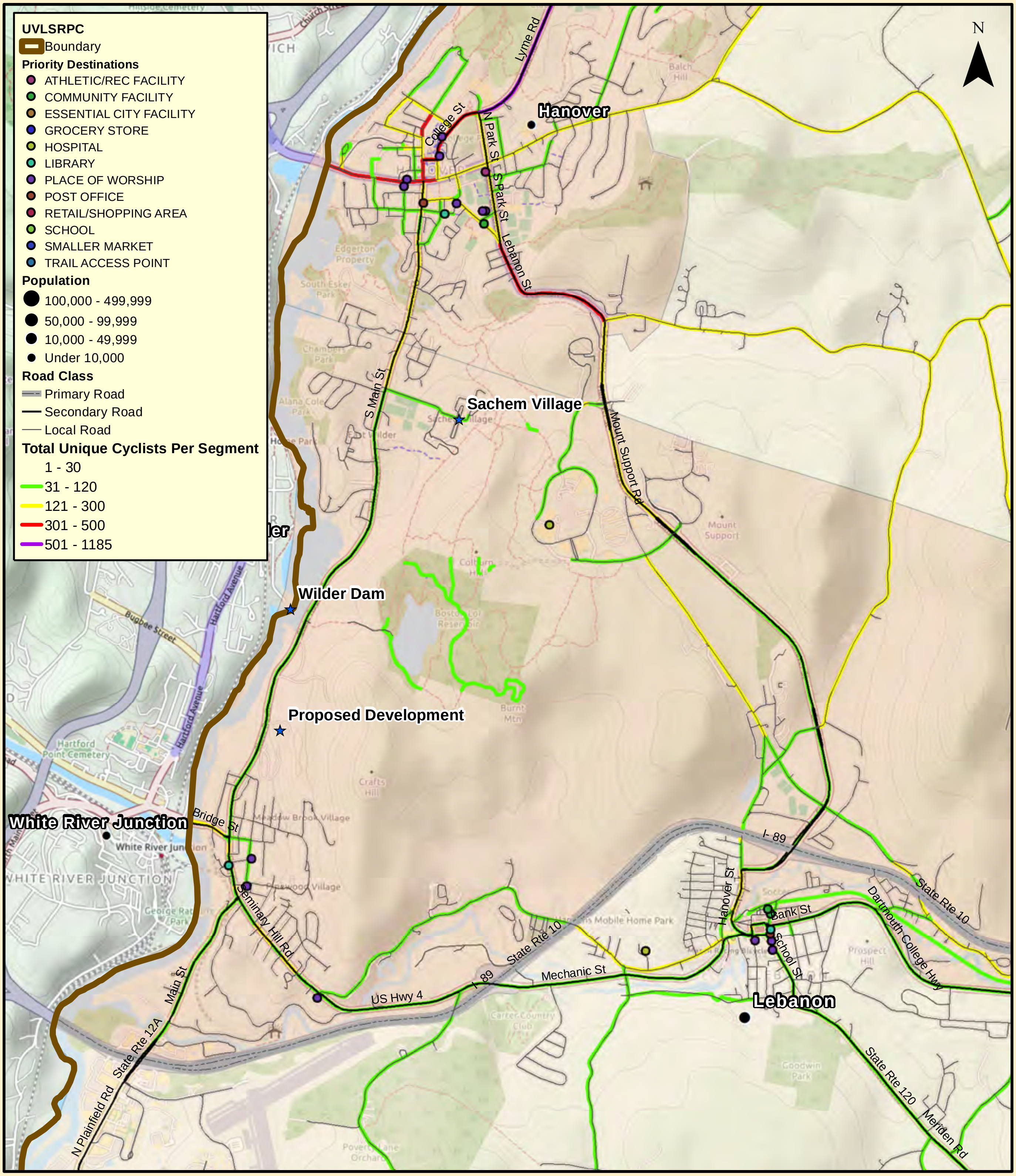
Upper Valley-Lake Sunapee Regional Planning Commission

Newport, Enfield, Canaan

0 1 2 4 6 8 Miles

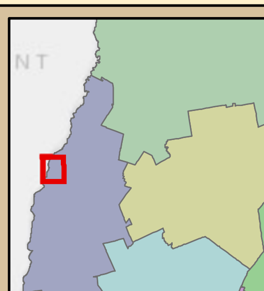
1:200,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US



Upper Valley-Lake Sunapee Regional Planning Commission

Hanover - Lebanon Rt. 10 Connectivity



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0 0.25 0.5 1 1.5 2 Miles

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

UVLSRPC

Target: Route 10, Lebanon to Hanover
Contacts: Adam Ricker, Assistant Planner
David Brooks, Director of Planning & Zoning for City of Lebanon

Conversation: Hanover to Old West Lebanon on Rt. 10 is a concern, especially the northern portion. In Lebanon, Sachem Village houses many active, bicycle-friendly students. Advanced transit is very active on Rt. 10 at Gould Rd. (Sachem Village) as there are many multi-modal users. There is a section from Sachem Village into West Lebanon where walking along the road can be hairy as there is a high volume of traffic. Along Old West Lebanon (residential area) there are a few apartment villages that are popular with graduate students – produces Rt. 10 traffic up to Hanover. There are a few retirement villages along the corridor, however few bicycles are seen (elderly ridership). South, around Wilder Dam there is Boston Lake access with many recreational bike trails and a conservation area. It appears that many people from northern Rt. 10 travel south to access these areas. There is a large open space along the Connecticut River next to Allard's Furniture known as "River Park". There are plan to develop this into a multi-use complex (already approved). There are specific DOT requirements associated with this development, however only a small portion of the road will likely be updated. There are many bus routes along the road but no known plans for bicycle-friendly improvements along this route.

In general, there is a very narrow shoulder along this section of road (mostly < 2 ft., 3 ft. in best of cases). As the road nears the Connecticut River, it gets funky and narrow. It is recommended that this route be examined .5 - .75 mi. into downtown Old West Lebanon (after Rt. 4) as this area is a large hub for business and transit. This area is tight and dangerous as traffic gets backed up through Main St. The road splits at Rt. 4 and Rt. 10 into Lebanon and there are mostly commercial plazas. Look at the road up to Rt. 12A as this is a natural cutoff point.

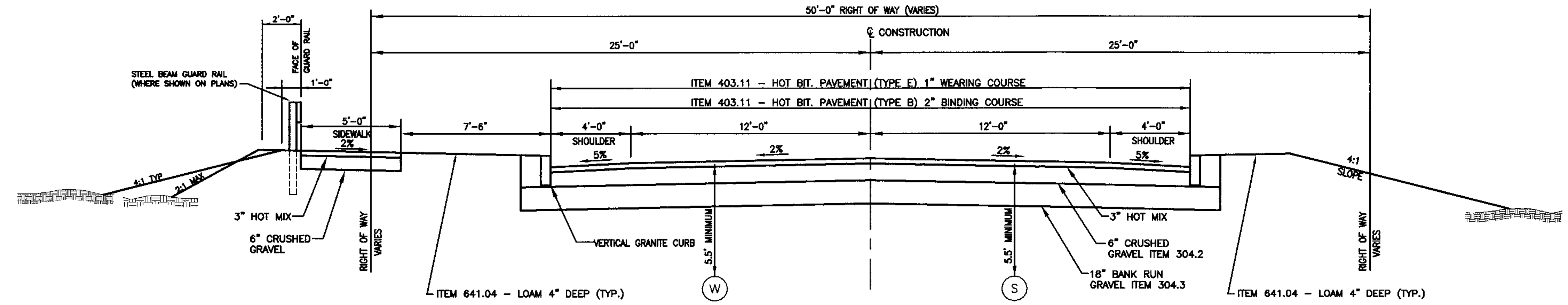
David Brooks: Basically, the proposal was for a 2 lane cross-section between the development entrances widening to 3 lanes with dedicated right and left turn lanes at the intersections. The proposed travel lane widths were 12 feet with a 2-foot shoulder on the westerly side and 4 feet on the east side. The Planning Board, in condition #1b, required the applicant to narrow the vehicle travel lanes (but not the center turn lane) from 12 to 11 feet and to use the extra 2 feet gained to widen the southbound shoulder to 4 feet to improve safety for bicyclists since Route 10 is a designated bike route by the State and RPC. Although there was some question by the State, they have now accepted this plan for the improvements in lieu of other mitigation requirements for the applicant.

Traffic counts were conducted on a stretch of road near Wilder Dam indicating approximately 6,000 vehicles/day. Traffic counts at the Hanover town line indicated approximately 6,300 vehicles/day in 2013, 6,700 vehicles/day in 2010, and 6,900 vehicles/day in 2009.

Social Vulnerability Index
Tract containing Sachem Village:
- Overall Vulnerability (0-10): 2
- Themes: the proportion of minority is in the 90th percentile, the proportion of persons in institutionalized group quarters is in the 90th percentile

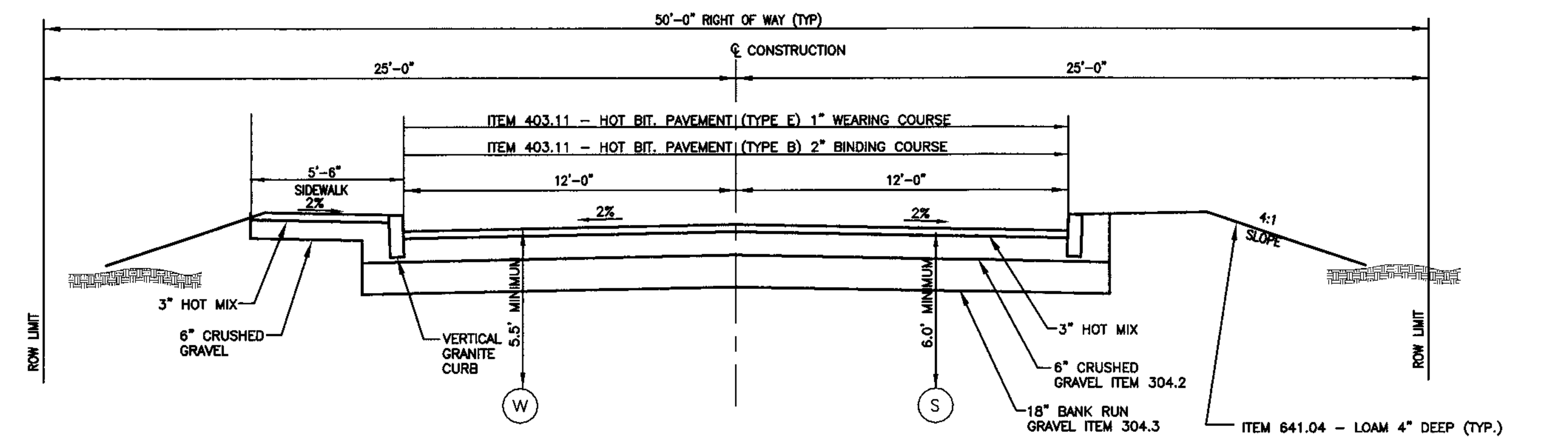
Tract Containing Hanover:
- Overall Vulnerability (0-10): 2
- Themes: the proportion of minority is in the 90th percentile, the proportion of persons in institutionalized group quarters is in the 90th percentile

Google imagery views of the southern portion of Rt. 10 and northern segment of Rt. 10, near Sachem Village.



TYPICAL SECTION–RIVER PARK DRIVE

SCALE: 1"=4'

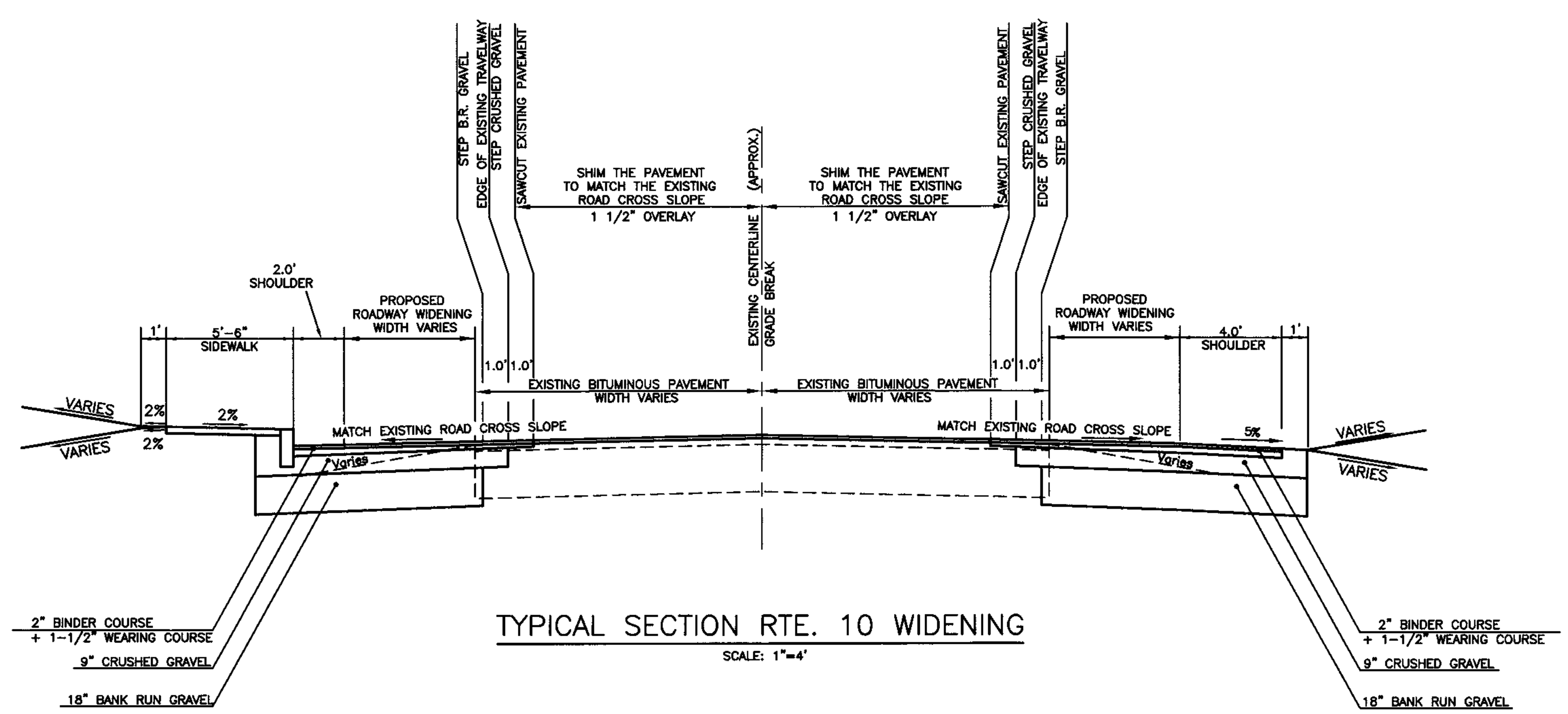


TYPICAL SECTION–CRAFTS AVE. EXTENSION

SCALE: 1"=4'

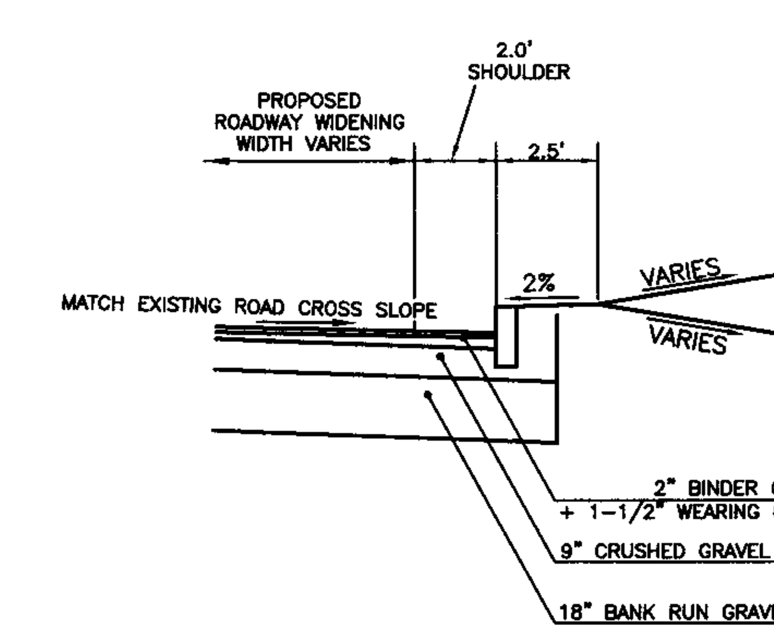
NOTES:

1. ROADWAY MATERIALS AND CONSTRUCTION SHALL MEET THE LATEST EDITION OF STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION BY THE NH DEPARTMENT OF TRANSPORTATION. THE DENSITY OF SELECT MATERIALS AND SUBGRADE PREPARATION SHALL NOT BE LESS THAN 95% OF THE MAXIMUM DENSITY IN ACCORDANCE WITH N.H.D.O.T. SPECIFICATIONS.
2. REMOVE ALL LOAM, CLAY, MUCK, STUMPS, AND OTHER IMPROPER ROAD FOUNDATION MATERIAL WITHIN 3' OF SUBGRADE. REPLACE WITH COMPACTED GRANULAR FILL MATERIAL. COMPACTION TO BE AT LEAST 95% OF THE DRY WEIGHT AS DETERMINED BY MODIFIED TESTING (ASTM 1557)
3. UNDERDRAIN PIPE SHALL BE PROVIDED IN ALL AREAS WHERE THE SEASONAL HIGH WATER TABLE IS WITHIN 5 FEET OF FINISH GRADE, THE PIPE SHALL DISCHARGE THROUGH A MORTARED RUBBLE MASONARY HEADWALL, OR INTO A CATCH BASIN.
4. CONTRACTOR TO OBTAIN AN EXCAVATION PERMIT FROM THE TOWN PRIOR TO ANY CONSTRUCTION WITHIN A TOWN ROW.
5. CONTRACTOR TO COORDINATE WITH TOWN ENGINEERING FOR INSPECTION REQUIREMENTS. A PRECONSTRUCTION MEETING IS REQUIRED PRIOR TO INITIATING CONSTRUCTION.
6. ALL WORK PERFORMED IN THE TOWN RIGHT OF WAY SHALL CONFORM TO THE REQUIREMENTS OF THE LATEST EDITION OF THE CITY OF LEBANON CONSTRUCTION STANDARDS.



TYPICAL SECTION RTE. 10 WIDENING

SCALE: 1"=4'



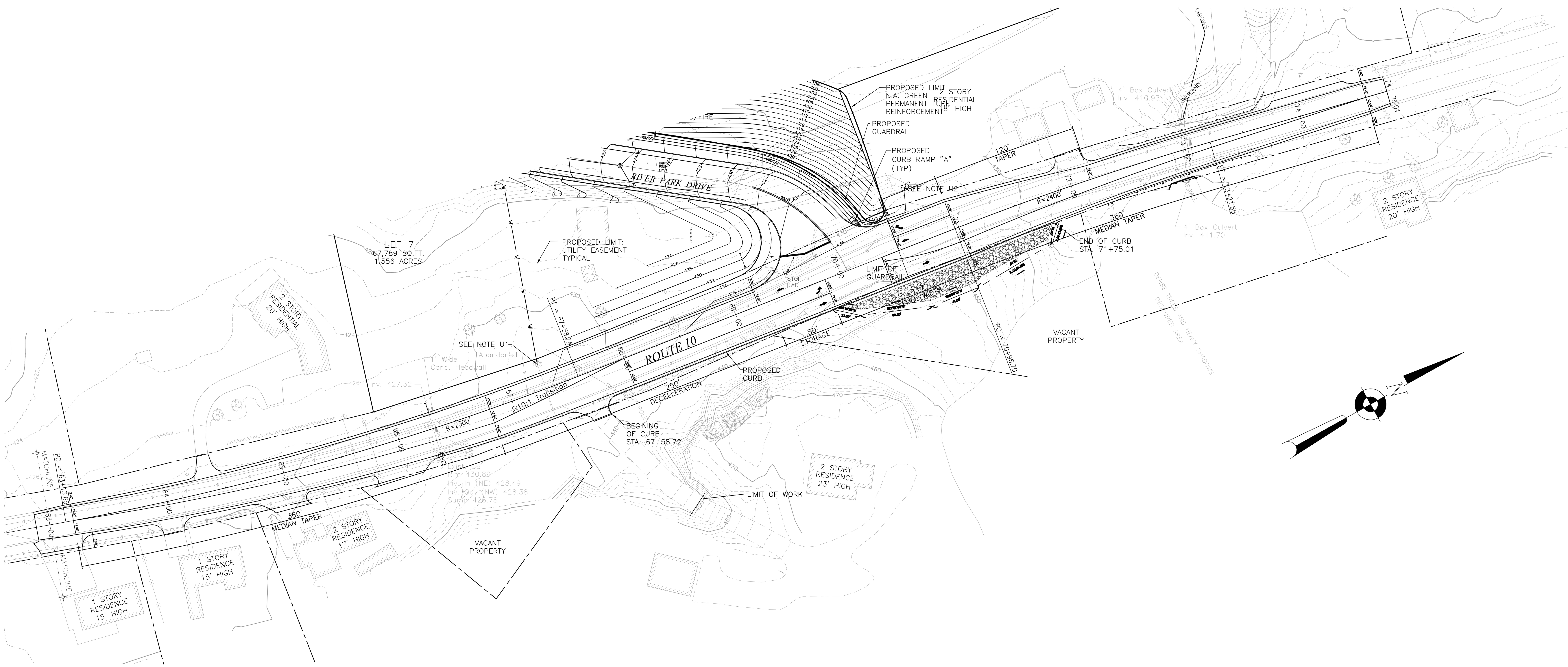
HOLDEN ENGINEERING & SURVEYING, Inc.
56 Old Suncook Road – Unit #4
PO Box 480 Concord, N.H. 03302
(603) 225-6449
9 Constitution Drive
Bedford, N.H. 03110
(603) 472-2078

ROADWAY SECTIONS
RIVER PARK
LEBANON, NEW HAMPSHIRE

Date:	Revisions Description	Dr. By	Chk. By
07/27/10	ADDRESS CITY COMMENTS	MK	JH

Book | Page

Date: 05-10-10
Scale: AS SHOWN
Dr. By: MK Ck By: BT
Job No. 1020132
Sheet no 66 of 67



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9 Constitution Drive
Bedford, N.H. 03110
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ROUTE 10 IMPROVEMENT PLANS
RIVER PARK
LEBANON, NEW HAMPSHIRE

Revisions

Date:	Description	Dr. By	Chk. By
07/27/10	ADDRESS CITY COMMENTS	MK	JH
01/04/11	REVISED PER CITY ENGINEER COMMENTS	MK	BT
01/18/11	REVISED PER CITY ENGINEER COMMENTS	MK	BT

Book | Page

Date: 06-10-10
Scale: 1"=50'
Dr. By: MK Ck By: BT
Job No. 1020132
Sheet no 19 of 67

J:\DWG\CADD\SUBDIVISION SET\RTE 10 IMPROVEMENTS.DWG

NOTICE OF ACTION
LEBANON PLANNING BOARD

Notice is here by given that on **May 19, 2011** the following action was taken by a majority of the Lebanon Planning Board in accordance with the City of Lebanon Subdivision Regulations.

Larry LeClair moved that the Lebanon Planning Board finds the application of **XYZ DAIRY, LLC** for Final Review of a Major Subdivision for an 8-lot Industrial Planned Unit Development (IND-PUD) , #PB2011-01-FMAJ is complete enough to accept jurisdiction and commence review..

The motion was seconded by Scott Pauls. The vote on the motion was seven in favor with one abstention.

Notice is here by given that on **October 11, 2011**, the following action was taken by a majority of the Lebanon Planning Board in accordance with the City of Lebanon Subdivision Regulations.

Larry LeClair moved that the Lebanon Planning Board **APPROVES** the Final Major Subdivision application for **XYZ DAIRY, LLC** , in accordance with the Subdivision Regulations for a 22-lot subdivision for a phased development known as River Park, located at North Main Street, Tax Map 44, Lots 3 & 7 and Tax Map 57, Lot 27, West Lebanon, NH, in the CBD, IND-L and R-3 zones, #PB2011-01-FMAJ, as shown on plan set titled “Subdivision Plan – River Park” (67 pages), prepared by Holden Engineering & Surveying, Inc., issued for permitting: June 10, 2010, latest issue: January 18, 2011, including any and all supplemental submissions and testimony provided during the public hearing, with the following conditions:

This Final Major Subdivision approval is for the development of River Park, a 22-lot subdivision, within 3 zoning districts, in accordance with the Lebanon Zoning Ordinance dated last revised July 21, 2010, and the Lebanon Subdivision Regulations dated last revised May 14, 2001.

CONDITIONS-PRECEDENT TO THE SIGNING AND RECORDING OF THE MYLAR:
(These conditions shall be satisfied within 2 years of the date of the Notice of Action.)

1. Prior to the signing and recording of the mylar and prior to the start of any construction activities on the property, which for purposes of this decision shall mean any construction, excavation, or other site work associated with the construction or installation of buildings, roadways, parking, water, sewer, or storm drainage infrastructure (this condition is not intended to preclude temporary construction trailers or site offices), the applicant shall provide two complete sets of revised plans to the Planning Office, depicting the following plan changes:

    a) The five-foot-wide sidewalk and curbing improvements with no grass median, as proposed by the applicant along NH Route 10 and depicted on the approved subdivision plan set, running along the property frontage from a point opposite Fountain Way to Chandler Street, shall be extended further south along NH Route 10 to Beyerle Street to provide a safe and convenient pedestrian connection to the existing sidewalk network on NH Route 10 and Beyerle Street to the satisfaction of the City Engineer. All curbing shall be granite and the sidewalk may be either concrete or asphalt, at the applicant's discretion, to be constructed in accordance with the City's standards.

b) The lane striping layout for all improvements within NH Route 10 shall be revised on all applicable sheets of the approved subdivision plan set to depict 11-foot wide travel lanes, based on painted lines, with no significant changes in grading or paving width, to match the existing lane widths provided on NH Route 10 north of the project site to the satisfaction of the City Engineer, which shall not be unreasonably withheld. The additional pavement width available from narrowing the travel lanes from 12 feet to 11 feet shall be used to widen the proposed shoulder from 2 feet to 4 feet on the southbound side of NH Route 10 as depicted on Sheet 66 (Roadway Sections) of the approved subdivision plan set in order to facilitate safer bicycle use along NH Route 10, which has been designated as a Statewide Bicycle Route by the NHDOT and a Regional Bike Route in the Upper Valley Lake Sunapee Region.

c) The lane striping layout for the development roadway shall be revised on all applicable plan sheets to depict 11-foot wide travel lanes and 5-foot wide shoulders, based on painted lines, with no significant changes in grading or paving width, to the satisfaction of the Planning Office.

d) Sheets 15 & 16 of the approved subdivision plan set shall be revised to indicate that all proposed street trees shall have a minimum caliper of 2.5" – 3", measured 6" above finished grade level, at the time of planting, pursuant to Section 6.2.B(4) of the Site Plan Review Regulations, to the satisfaction of the Planning Office.

e) Sheets 17 & 18 of the approved subdivision plan set shall be revised to include a note that street lights along the development roadway shall be installed to provide full cut-off optics and that the height of such fixtures shall be 20 feet above finished grade to match the height and design of all on-site light fixtures as depicted in the plan sets titled "Site Plan – River Park," prepared by Holden Engineering & Surveying, Inc., issued for permitting: June 10, 2010, latest issue: May 2, 2011, (#PB2010-25-SPR) to the satisfaction of the Planning Office.

f) The subdivision plans shall be revised to reflect the final lot dimensions and metes and bounds, as depicted in the plan set titled "Site Plan – River Park," prepared by Holden Engineering & Surveying, Inc., issued for permitting: June 10, 2010, latest issue: May 2, 2011, (#PB2010-25-SPR), to the satisfaction of the Planning Office.

g) The subdivision plans shall be revised to depict easements for shared access for Lots 1 & 2; Lots 3 & 4; Lots 4 & 5; Lots 8, 9, & 10; and Lots 29 & 30, to the satisfaction of the Planning Office.

2. Prior to the signing and recording of the mylar and prior to the start of any construction activities on the property, the applicant shall submit final designs, including construction drawings, of all infrastructure features, both on- and off-site, including the streets, sidewalks, water and sewer utilities, and storm drainage systems, to the City Engineer for approval, which shall not be unreasonably withheld.

3. Prior to the signing and recording of the mylar and prior to the start of any construction activities on the property, excluding the single-family homes on Lots 29 and 30, the applicant shall prepare final designs and construction details for the two bridges that are part of and integral to the development roadway. Such final designs and construction details shall be submitted to the City for review and approval by the City Engineer and Planning Office to assure that the design is adequate to provide a level of service consistent with the roadway as shown on Sheets 10 & 11 of the approved subdivision plan set.

4. Prior to the signing and recording of the mylar and prior to the start of any construction activities on the property, the applicant shall sign a Subdivision Agreement in accordance with Section 7.4 of the Lebanon Subdivision Regulations.

5. Prior to the signing and recording of the mylar, the applicant shall enter into a Performance Security Agreement pursuant to Section 14.6 of the Subdivision Regulations, for all required improvements intended to serve the entire subdivision, both on- and off-site, including, but not limited to: roadways and sidewalks, sewer and water utilities within the development and the sewer main within Crafts Avenue, storm drainage systems for the development roadways, erosion control, and landscaping and street lights located within the proposed rights-of-way in an amount considered adequate by the Department of Public Works, and in a form satisfactory to the City Attorney. The Performance Security Agreement shall be secured by a surety bond, a letter of credit, or an escrow account for the full anticipated cost of such improvements.

6. Prior to the signing and recording of the mylar and prior to the start of any construction activities on the property, the applicant shall sign a Water & Sewer Extension and Inspection Agreement in accordance with Chapter 181 of the City Code and Section 14 of the Subdivision Regulations for water and sewer mains within the development and for the sewer main within Crafts Avenue serving the entire subdivision.

7. Prior to the signing and recording of the mylar and prior to the start of any construction activities on the property, the applicant shall obtain all required State approvals for the

subdivision including, but not limited to, the following:

- NHDES Alteration of Terrain Permit
- NHDES approval for Sewage Discharge
- NHDOT Driveway Permit for the northerly development entrance and any other improvements within the portion of NH Route 10 under NHDOT jurisdiction

8. Prior to the signing and recording of the mylar and prior to the start of any construction activities on the property, the applicant shall provide to the City for review a Traffic Signal Warrant Analysis for the south development entrance. The applicant shall also provide to the City a copy of a Traffic Signal Warrant Analysis for the north development entrance if such a Warrant Analysis is required by the NH Department of Transportation.

9. [Condition deleted.]

10. Prior to the signing and recording of the mylar, a note shall be added to the mylar noting that access to Lot 7 is limited to NH Route 10 and is subject to the NH Department of Transportation regulations.

11. Covenants and Deeds Restrictions or a conservation easement governing the common open space shall be written and recorded to ensure compliance with Section 12.2 of the Subdivision Regulations to the satisfaction of the City's attorney. As proposed by the applicant, such covenants and deed restrictions or conservation easement shall specifically allow for access to the Open Space parcel (Lot 6) along the Connecticut River frontage via a proposed pathway depicted on Lot 3 and Lot 24 and/or via any other access way that might be proposed and provided by the applicant. The construction or installation of any such pedestrian pathways to the Open Space parcel shall be subject to and in accordance with a NHDES Comprehensive Shoreland Protection permit for the development. It is the applicant's intent and the Planning Board's expectation that the Open Space (Lot 6) will be accessible to the general public.

12. Prior to the signing and recording of the mylar, the street names and numbering within the subdivision shall be approved by the City Engineer and the Lebanon Police Department to ensure compliance with the State's Enhanced 911 system. The Planning Board supports the use of the name "River Park Drive" if deemed acceptable by the City Engineer and the Lebanon Police Department.

13. Prior to the signing and recording of the mylar, the applicant shall provide a digital record drawing of the subdivision plan (CAD .dwg format using NH State Plane Coordinate system) to the Planning Office. The subdivision plan shall be recorded in the Grafton County Registry of Deeds prior to any occupancy of any new buildings within the subdivision.

GENERAL CONDITIONS OF APPROVAL:

14. The applicant acknowledges that the overall build-out of the River Park development will occur in seven (7) phases over an extended period of time in accordance with the application materials submitted to the Planning Board for Site Plan application (#PB2010-25-SPR). The applicant further acknowledges that the subdivision infrastructure, including the development roadway; extension of Crafts Avenue; water and sewer mains, excluding service connections, necessary to serve the subdivision; and storm drainage infrastructure necessary to serve the subdivision roadway will be constructed and/or installed during Phase 1 and Phase 2 as proposed by the applicant and approved by the Planning Board. The applicant shall complete all required Phase 1 subdivision infrastructure, as noted above, within a period of 5 years from the date of the Planning Board's final approval, and shall complete all required Phase 2 subdivision infrastructure, as noted above, within 5 years of commencement of Phase 2, unless, prior to the end of the 5-year period, the applicant shall have submitted an updated phasing schedule to the Planning Board and received approval for additional time to complete the subdivision infrastructure improvements. The applicant shall be required to notify the City of the date of commencement for Phase 2 for purposes of clearly establishing the time period within which required improvements must be completed.

15. Prior to the start of any construction activities within existing public rights-of-way subject to City jurisdiction, including NH Route 10 inside the urban compact area and Crafts Avenue, the applicant shall sign a Performance Security and Inspection Agreement in accordance with Section 14 of the Subdivision Regulations for completion of off-site roadway improvements along NH Route 10 within the urban compact area and for restoration of Crafts Avenue following installation of the required sewer main, to the extent such performance security has not already been provided to the City pursuant to Condition #5 of this decision. Any required agreements or performance security for improvements within NH Route 10 outside of the urban compact area shall be as approved and required by the NH Department of Transportation.

16. The applicant shall request approval from the City of Lebanon Public Safety Committee for the installation of a crosswalk across NH Route 10 at the Maple Street intersection. If such crosswalk is approved and authorized by the Public Safety Committee, the applicant shall be required to install the crosswalk and appropriate signage at the time of construction of other required improvements along NH Route 10, to the satisfaction of the City Engineer, which shall not be unreasonably withheld.

17. Prior to the start of any construction activities for which construction inspection is required pursuant to this decision or any applicable ordinance or code, the City shall retain the services of an independent 3rd party inspector, for which the applicant shall be responsible for all inspection fees related to construction and installation of on- and off-site roadways, sidewalks, water and sewer utilities, storm drainage systems, and erosion control, in accordance with Chapter 181 of the City Code and Section 14 of the Subdivision Regulations. The applicant shall provide funding for inspection services in a form acceptable to the City. Third party engineer inspection reports and as-built drawings provided by the applicant (using NH State Plane Coordinate system), including

tie sheets and Northing and Easting coordinates and elevations of underground utilities, shall be reviewed and approved by the City Engineer, prior to acceptance of any utility improvements by the City, and all such inspection reports shall be made available to the applicant.

18. The applicant shall comply with all other applicable provisions of Chapter 181 of the City Code, to the satisfaction of the Department of Public Works.

19. All proposed streets, sidewalks, water and sewer mains, and service lines shall be constructed pursuant to the City's standards, except as modified by the City Council for Crafts Avenue.

20. The applicant shall implement and maintain NHDES Site Specific Best Management Practices before, during, and after construction.

21. All required street trees and landscape plantings within the proposed rights-of-ways shall meet the minimum size requirements for such plantings set forth in Section 6.2.B of the Site Plan Review Regulations at the time of installation.

22. The applicant shall dedicate the completed water mains and hydrants within the subdivision, excluding service connections beyond the curb shut-off valves, to the City for ownership and maintenance, subject to appropriate easements. Said conveyance and easements shall be approved by the City Attorney and the Department of Public Works and recorded in the Grafton County Registry of Deeds prior to acceptance of any utility improvements by the City.

23. The applicant shall dedicate the completed sewer main within the Crafts Avenue right-of-way, excluding sewer lateral connections, to the City for ownership and maintenance. Said conveyances and easements shall be approved by the City Attorney and the Department of Public Works and recorded in the Grafton County Registry of Deeds prior to acceptance of any utility improvements by the City. All sewer mains within the development upstream of the Crafts Avenue right-of-way shall remain privately owned and maintained by the applicant.

24. The applicant shall comply with all applicable conditions of the Lebanon City Council's approval, dated May 18, 2011, concerning connection of City water and sewer systems for the River Park development.

25. The applicant shall offer to dedicate the extended roadway and cul-de-sac of Crafts Avenue to the City for ownership and maintenance.

26. In accordance with the City's Impact Fee Ordinance fee schedule adopted on September 13, 2010, this application is exempt from impact fees for a period of 5 years from the date of the Planning Board's final approval. Building permits obtained after the 5-year period shall be subject to impact fees in existence at the time of the Building Permit

application submission.

27. The Planning Board hereby grants waivers for Section 11.4.A.23 (Availability of Other Utilities) of the Subdivision Regulations.

28. Effect of Approval. This approval is a final, conditional subdivision approval for a “phased development” under Section 7.5 of the Subdivision Regulations and is a final decision of the Planning Board for purposes of RSA:15(I). Section 7.5 (c) (Review of remaining phases) shall not apply, because the entire subdivision has already been reviewed and approved under the “Review of Final Plat” process of Section 7.4. The deadlines for the construction of improvements within each phase shall be as stated in the approved phasing plan, rather than the 2-year period under Section 7.4(H). It is the intent and effect of this approval, subject to the satisfactory completion of the financial security arrangements in Condition #5 above, that upon completion of the Phase 1 infrastructure improvements within 5 years of this final approval, as set forth in Condition #14 above, the subdivision as a whole, including all phases, shall vest as provided in RSA 674:39,II, and no subsequent changes in subdivision regulations, site plan regulations, or zoning ordinances, except impact fees adopted pursuant to RSA 674:21 and 675:2-4, shall operate to affect this subdivision, provided that the applicant and its successors in interest continue to comply with all conditions of this approval and of the Planning Board’s approval of Site Plan application #PB2010-25-SPR, including the time limits set forth in the phasing plan as outlined in the above-referenced Site Plan approval, unless such a limit is extended for good cause by the Planning Board, acting upon an application submitted prior to the expiration of such limit.

29. If any dispute arises over the interpretation or application of any of the above conditions, such dispute shall be resolved, by the Planning Board itself after notice and public hearing.

The motion was seconded by Earl Jette. The vote on the motion was unanimous in favor

Larry LeClair moved that the Lebanon Planning Board authorizes the Chair to sign the plat for **XYZ DAIRY, LLC**, #PB2011-01-FMAJ, as described above.

The motion was seconded by Earl Jette. The vote on the motion was unanimous in favor

SIGNED:____
The City of Lebanon, Planning Board Chair

DATE:____

APPENDIX F

DAYS TO MONTHS CONVERSION TOOL

Adds a MONTH field and uses the DAY field to populate the MONTH field with the corresponding month. The tool will only accommodate one year at a time, A version has been generated for both leap years and non-leap years.

Best Used For:

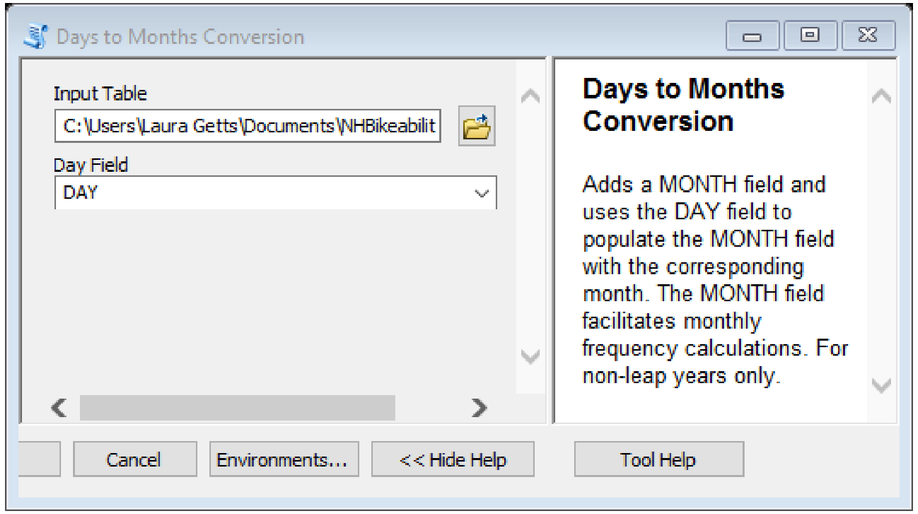
- Monthly frequency calculations

od_data

ON_ID	YEAR	MONTH	DAY	HOUR
402470	2017	Feb	54	13
395317	2017	Feb	44	12
272098	2017	Feb	52	10
97082	2017	Feb	49	7
102869	2017	Feb	51	13

Input Requirements:

- Input table must contain an "EDGE_ID" field, a "DAY" field, and a rides, riders, or commute field, such as "TOTAL_ACTI" or "COMMUTE_CO"
- Look for the table named "metro_edges"



3

STRAVA FREQUENCIES TOOL (POLYGON)

Calculates and generates a .dbf table and .xls (Excel) file for the total number of Strava rides per:

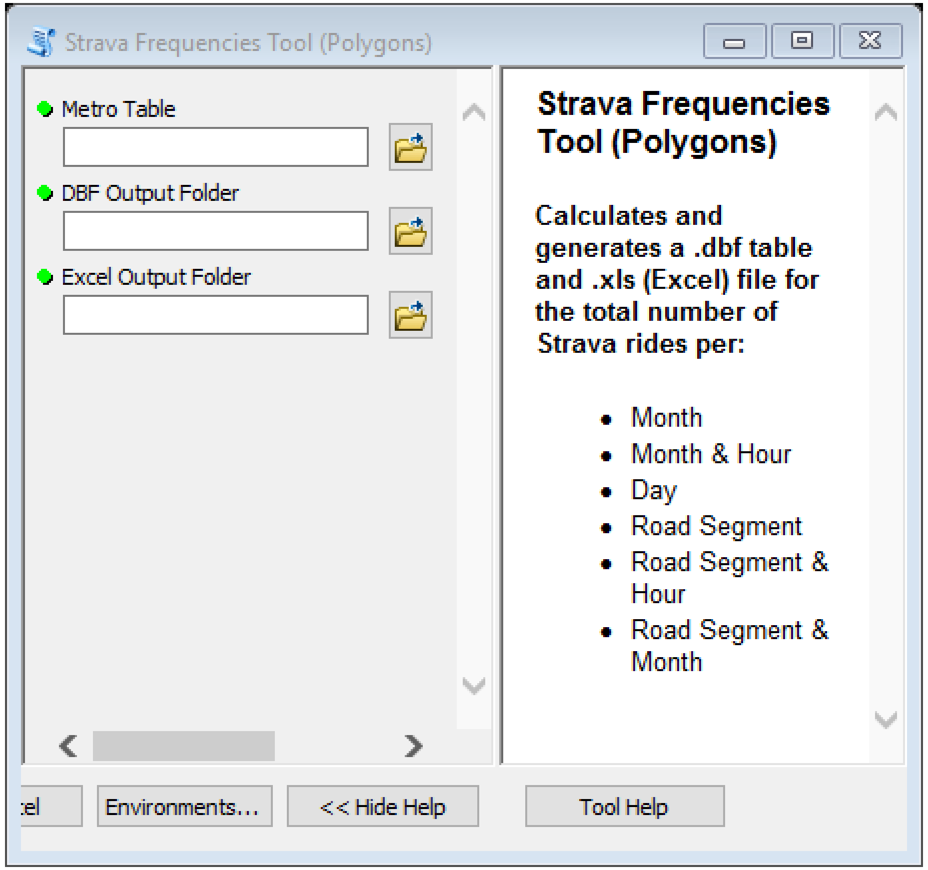
1. Month
2. Month & Hour
3. Day
4. Road Segment
5. Road Segment & Hour
6. Road Segment & Month

Input Requirements:

- Formatted for Strava 2017 Ride_Hex files
- Input table must contain an "EDGE_ID", "DAY", and "HOUR" field
- Look for the table named "edges_metro_od_data"

Best Used For:

- Visualizing ridership trends

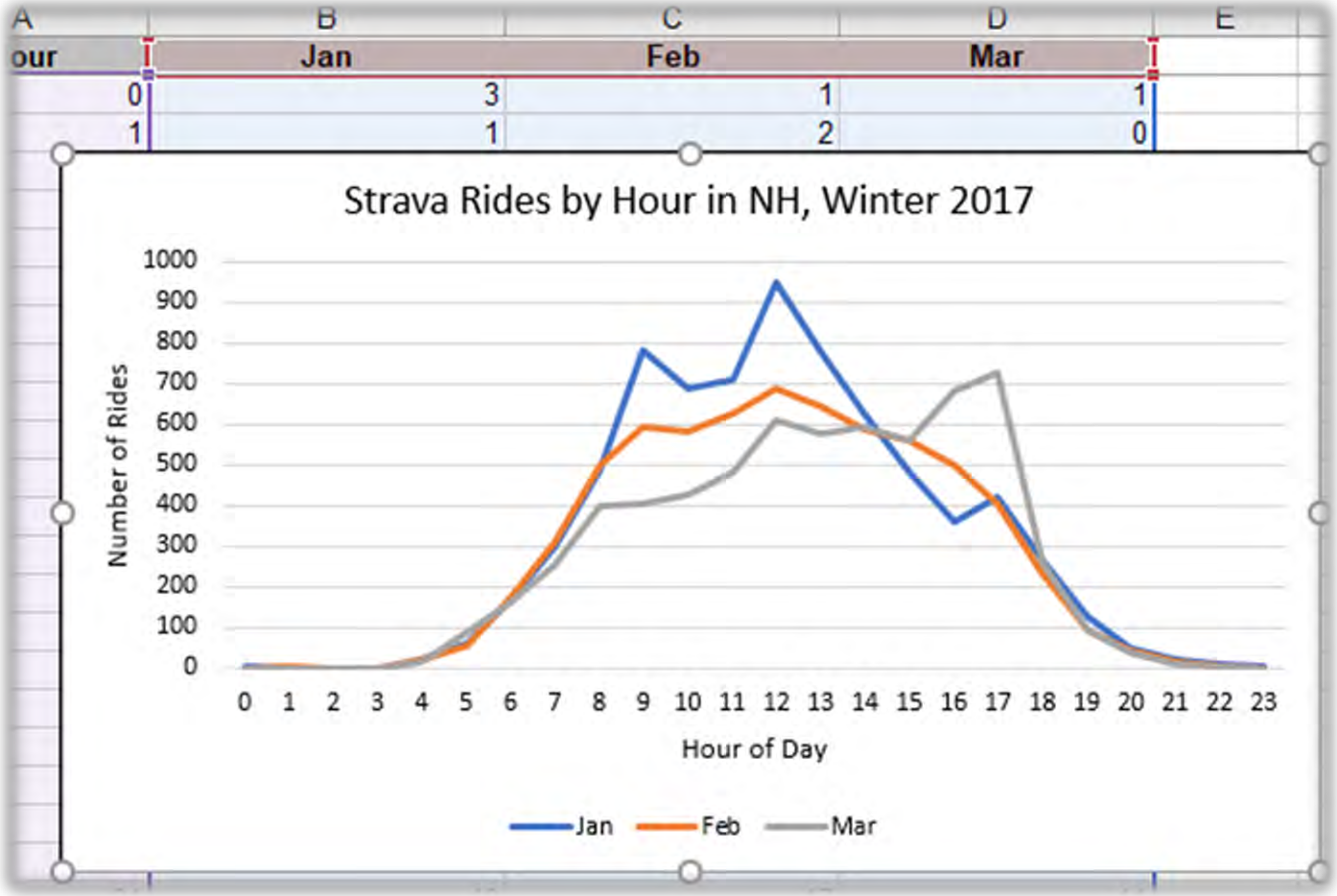


STRAVA FREQUENCIES TOOL (POLYGON)

nh_edges_metro_od_data

OID	POLYGON_ID	YEAR	MONTH	DAY	HOUR	MINUTE
1	402470	2017	Feb	54	13	3
2	395317	2017	Feb	44	12	5
3	272098	2017	Feb	52	10	3
18	97082	2017	Feb	49	7	2
19	102869	2017	Feb	51	13	4
26	445296	2017	Feb	53	17	5
27	445296	2017	Feb	53	17	5
29	560622	2017	Feb	51	18	1
36	521047	2017	Feb	54	18	[illegible]
37	318139	2017	Feb	56	10	[illegible]

- StravaFrequencies2017_day.dbf
- StravaFrequencies2017_Excel_day.xls
- StravaFrequencies2017_Excel_hour_month.xls
- StravaFrequencies2017_Excel_road_hour.xls
- StravaFrequencies2017_Excel_road_month.xls
- StravaFrequencies2017_Excel_roadsegment.xls
- StravaFrequencies2017_Excelmonth.xls
- StravaFrequencies2017_hour_month.dbf
- StravaFrequencies2017_road_hour.dbf
- StravaFrequencies2017_road_month.dbf
- StravaFrequencies2017_roadsegment.dbf
- StravaFrequencies2017month.dbf



STRAVA SEGMENT SUMMARY TOOL

Summarizes recorded Strava rides by:

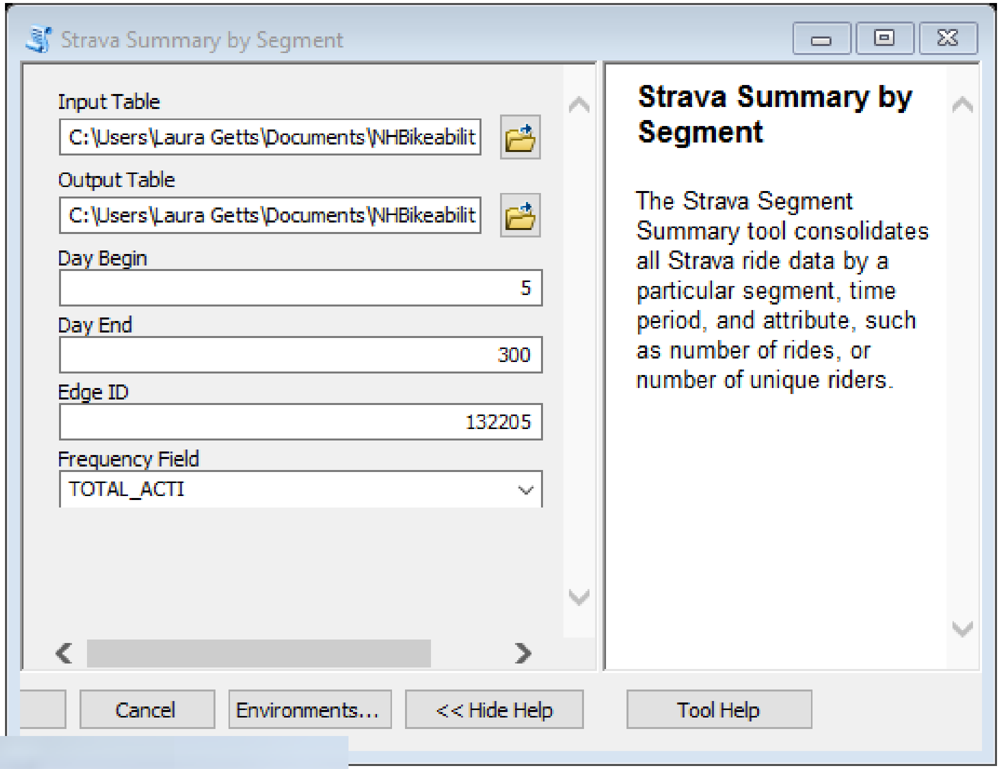
1. A specific segment,
2. A timeframe, and
3. Number of rides, unique riders, or commutes

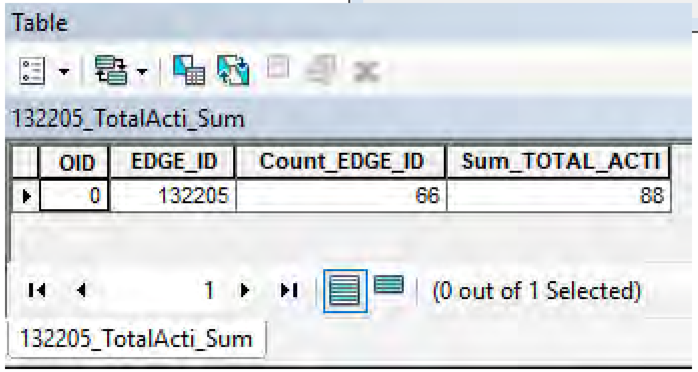
Best Used For:

- Before/After infrastructure comparisons involving specific segments

Input Requirements:

- Input table must contain an "EDGE_ID" field, a "DAY" field, and a rides, riders, or commute field, such as "TOTAL_ACTI" or "COMMUTE_CO"
- Look for the table named "metro_edges_data"





APPENDIX G

STRAVA GROUND COUNT COMPARISONS (DAILY OBS)

Location	Type/ RPC	Dates	Year	# of Obs.	Std. Error	Adj. R Square	Sig.	% Rep.
Nashua River Trail	Trail NRPC	Aug. 6 - Sep. 2	2014	28	1.817	0.431	.000	0.48
Nashua River Trail (Southbound)	Trail NRPC	Aug. 6 - Sep. 3	2014	28	1.048	0.284	0.002	0.3
Nashua River Trail (Northbound)	Trail NRPC	Aug. 6 - Sep. 4	2014	28	1.605	0.238	.005	0.65
Concord Commercial St., E of Constitution	Street CNHRPC	May 22 - May 30	2014	9	2.159	0.102	.209	4.4
Concord Commercial St., Eastbound	Street CNHRPC	May 22 - May 31	2014	9	0.607	0.641	.006	2.06
Concord Commercial St., Westbound	Street CNHRPC	May 22 - May 32	2014	9	1.976	-0.116	.694	5.97
Pleasant St. Chichester	Street CNHRPC	Aug 24 - Sep 1	2015	9	1.294	0.139	.174	5.17
Northern Rail Trail Boscawen	Trail CNHRPC	Jul 30 - Aug 6	2015	8	-	-	-	0
Concord 189 Bike Path	Trail CNHRPC	Jun 10 - Jun 25	2015	16	3.602	0.355	.009	25.23
Henniker 114N of Main	Street CNHRPC	Sep 28 - Oct 2	2015	5	-	-	-	0
Cheshire Rail Trail (North Bridge)	Trail SWRPC	July 31- Aug 15	2015	18	1.433	0.044	.201	0.83
Cheshire Rail Trail (Downtown)	SWRPC	July 30 - Aug 16	2015	18	0.333	-0.059	.834	0.04
Durham 155A Path to Campus	Trail SRPC	Apr 24 - May 4	2015	11	2.352	-0.091	.692	134.24
Windham Trail at Depot Jamar	Trail SNHPC	Aug 26 - Sep 10	2015	16	-	-	-	0
Windham Railtrail at Depot	Trail SNHPC	Sep 2 - Nov. 16	2015	76	0.162	-0.012	.737	0.01
Derry Rail Trail at Windham	Trail SNHPC	May 21 - Jun 10	2015	21	1.348	-0.04	.638	0.56
WOW Trail	Trail LRPC	Jul 15 - Jul 29	2015	15	1.028	-0.077	.975	1.16

Table 1: STRAVA to traffic counter comparison for Commercial Street East of Constitution, Concord

Date	Concord, Commercial St E of Constitution	Eastbound	Westbound	Strava Eastbound	Strava Westbound	Strava Eastbound Accuracy	Strava Westbound Accuracy	Strava Overall Accuracy	Commute Trips
Thu, May 22, 2014	45	23	22	0	1	0.00%	4.55%	2.22%	1
Fri, May 23, 2014	44	12	32	0	0	0.00%	0.00%	0	0
Sat, May 24, 2014	38	15	23	1	3	6.67%	13.04%	10.53%	0
Sun, May 25, 2014	45	19	26	0	0	0.00%	0.00%	0.00%	0
Mon, May 26, 2014	53	22	31	1	5	4.55%	16.13%	11.32%	2
Tue, May 27, 2014	47	19	28	0	1	0.00%	3.57%	2.13%	0
Wed, May 28, 2014	45	17	28	0	4	0.00%	14.29%	8.89%	0
Thu, May 29, 2014	88	41	47	3	1	7.32%	2.13%	4.55%	2
Fri, May 30, 2014	18	9	9	0	0	0.00%	0.00%	0.00%	0
Total Trips Recorded:	423	177	246	5	15			4.73%	5
						StDev: 3.17	StDev: 6.63	**StDev: 4.66**	

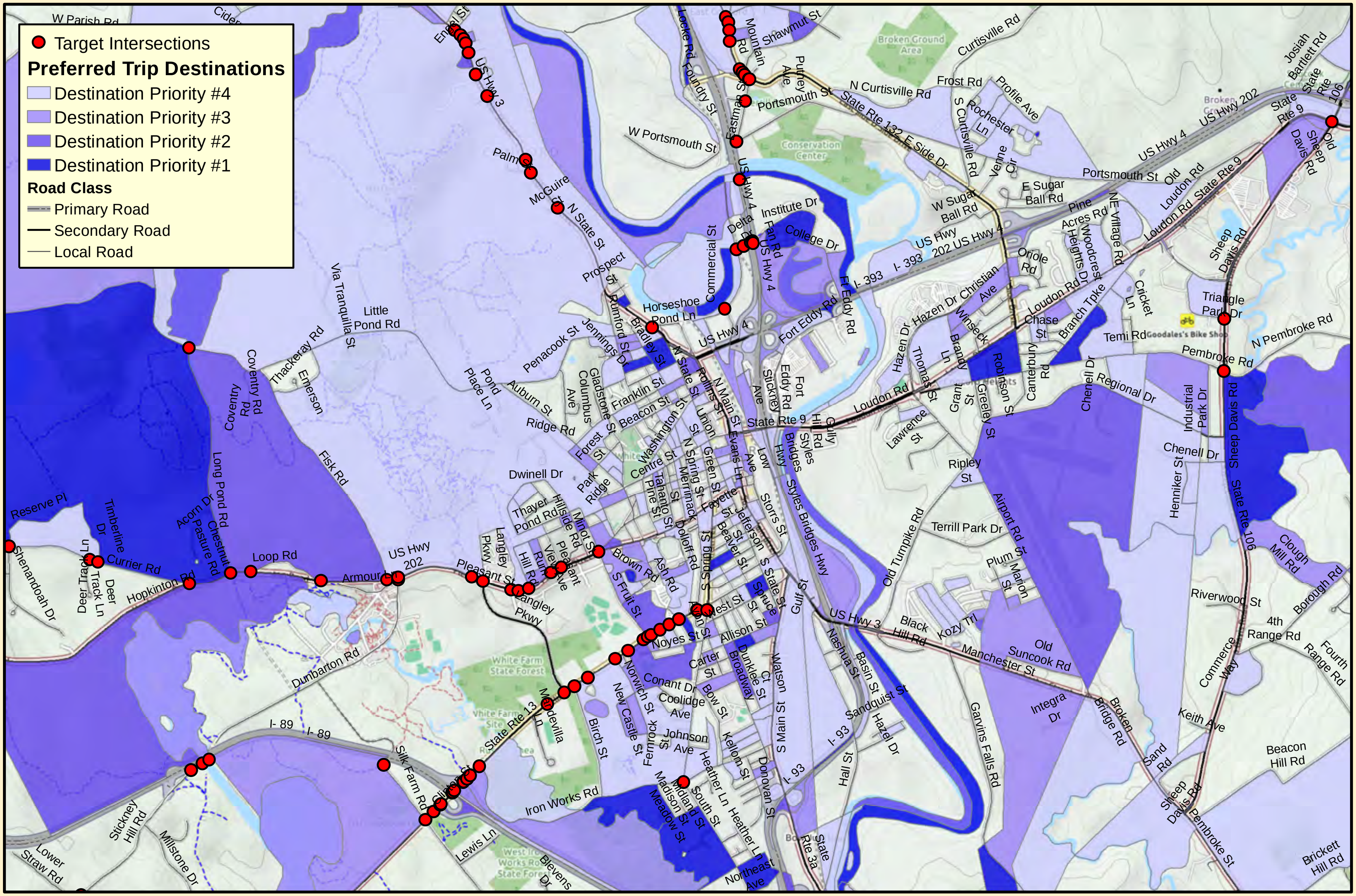
Table 2: Nashua River Trail

Date	Nashua River Trail	Southbound Nashua River Trail	Northbound Nashua River Trail	Strava Eastbound	Strava Westbound	Strava Eastbound Accuracy	Strava Westbound Accuracy	Strava Overall Accuracy	Commute Trips
Wed, Aug 6, 2014	318	166	152	1	0	0.60%	0.00%	0.31%	0
Thu, Aug 7, 2014	320	152	168	0	1	0.00%	0.60%	0.31%	0
Fri, Aug 8, 2014	552	272	280	1	0	0.37%	0.00%	0.18%	0
Sat, Aug 9, 2014	891	421	470	0	3	0.00%	0.64%	0.34%	0
Sun, Aug 10, 2014	934	459	475	3	4	0.65%	0.84%	0.75%	0
Mon, Aug 11, 2014	344	168	176	0	2	0.00%	1.14%	0.58%	1
Tue, Aug 12, 2014	371	171	200	1	2	0.58%	1.00%	0.81%	0
Wed, Aug 13, 2014	9	5	4	0	0	0.00%	0.00%	0.00%	0

Thu, Aug 14, 2014	456	225	231	0	2	0.00%	0.87%	0.44%	1
Fri, Aug 15, 2014	326	162	164	0	1	0.00%	0.61%	0.31%	0
Sat, Aug 16, 2014	868	409	459	1	7	0.24%	1.53%	0.92%	1
Sun, Aug 17, 2014	823	385	438	1	1	0.26%	0.23%	0.24%	0
Mon, Aug 18, 2014	428	204	224	1	0	0.49%	0.00%	0.23%	0
Tue, Aug 19, 2014	457	213	244	1	1	0.47%	0.41%	0.44%	1
Wed, Aug 20, 2014	456	212	244	0	2	0.00%	0.82%	0.44%	0
Thu, Aug 21, 2014	269	128	141	0	0	0.00%	0.00%	0.00%	0
Fri, Aug 22, 2014	160	80	80	0	1	0.00%	1.25%	0.63%	0
Sat, Aug 23, 2014	772	358	414	1	1	0.28%	0.24%	0.26%	0
Sun, Aug 24, 2014	1124	523	601	1	6	0.19%	1.00%	0.62%	0
Mon, Aug 25, 2014	360	173	187	0	4	0.00%	2.14%	1.11%	2
Tue, Aug 26, 2014	326	159	167	1	3	0.63%	1.80%	1.23%	0
Wed, Aug 27, 2014	228	109	119	1	0	0.92%	0.00%	0.44%	1
Thu, Aug 28, 2014	330	156	174	0	3	0.00%	1.72%	0.91%	0
Fri, Aug 29, 2014	423	201	222	1	1	0.50%	0.45%	0.47%	0
Sat, Aug 30, 2014	966	438	528	1	0	0.23%	0.00%	0.10%	0
Sun, Aug 31, 2014	750	356	394	2	1	0.56%	0.25%	0.40%	0
Mon, Sep 1, 2014	933	455	478	6	3	1.32%	0.63%	0.96%	0
Tue, Sep 2, 2014	110	61	49	0	0	0.00%	0.00%	0.00%	0.00%
Total Trips Recorded:	14304	6821	7483	24	49	SD: 0.339	SD: 0.620	0.51% **StDev: 0.334**	7

APPENDIX H

Concord, NH Recommended Manual Count Locations					
Priority #	**Unique Athlete Count**	**Total Commutes Rank**	**Destination Polygon Rank**	**Designation**	**Intersection**
1	3	3	1	Employment/Residential	Clinton St. & S. Fruit St.
2	3	3	1	Employment/Education	Pleasant St. & Warren St.
3	3	3	1	Commute Route	Sheep Davis Rd. & Pembroke Rd.
4	3	3	2	Education/Residential	Pembroke St. & Pembroke Hill Rd.
5	3	3	2	Employment	Commercial St. & Constitution Ave.
6	3	3	1	Likely Recreational/St. Paul's School	Fisk Rd. & Hopkinton Rd.
7	3	3	1	Residential/Swenson Granite	N. State St. & K St.
8	3	2	4	Employment Destination	Langley Parkway & State Rt. 9
9	3	2	4	Residential/Employment Access	St. Rt. 132 & Eastman St.
10	3	3	2	Likely Recreational	Clinton St. & Silk Farm Rd.
11	3	3	4	Residential/Deli	Rockingham St. & South St.
	*Consider Counting the bike path off of Delta Dr.				



Central NH Regional Planning Commission

Greater Concord Metro Area:
Recommended Manual Count Locations

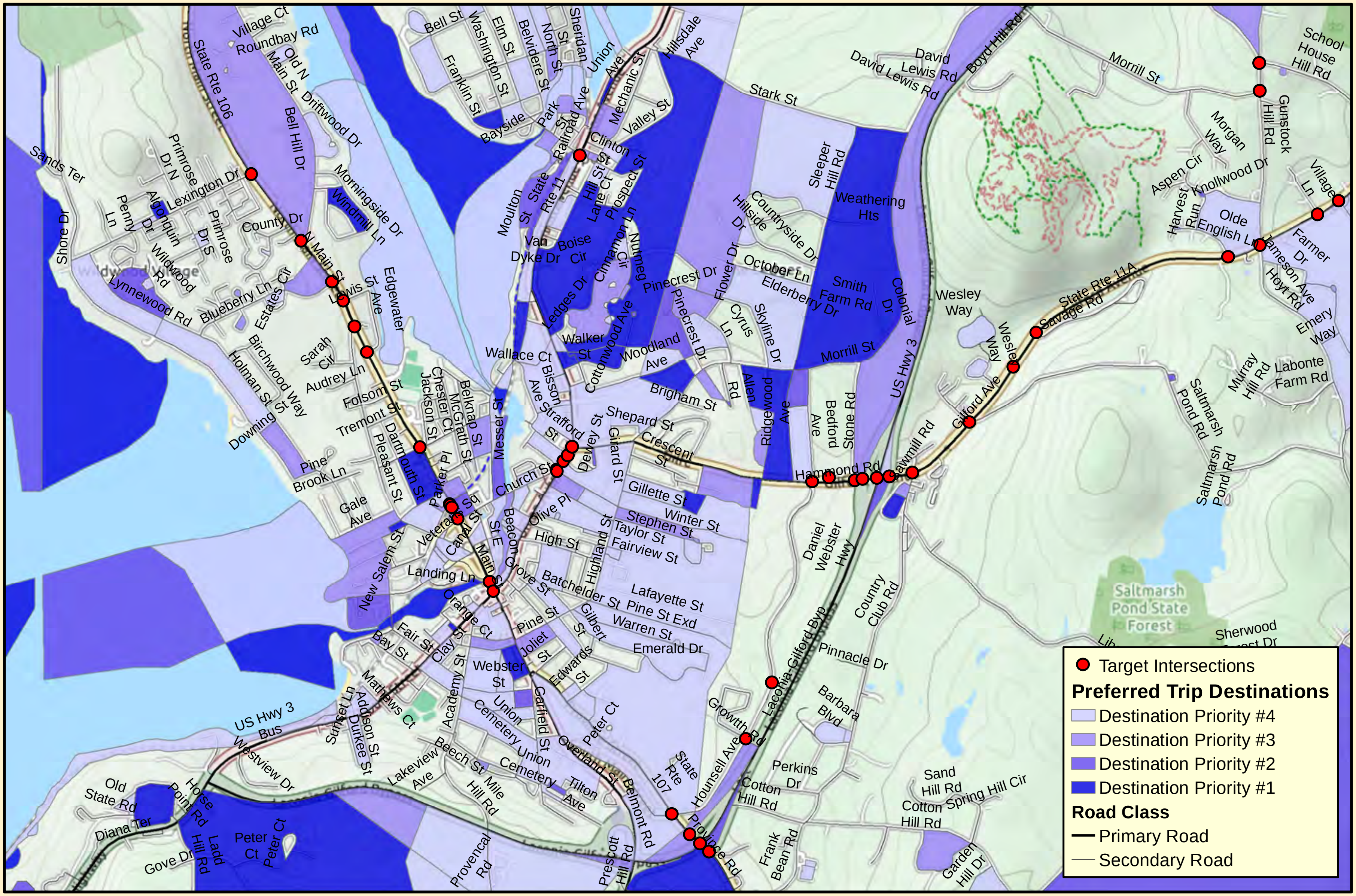
0 0.25 0.5 1 1.5 2 Miles

1:50,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

N

Lakes Region Planning Commission Recommended Manual Count Locations					
Priority #	**Unique Athlete Count**	**Total Commutes Rank**	**Destination Polygon Rank**	**Designation**	**Intersection**
1	2	3	1	Commercial	Old Lake Shore Rd & Weirs Rd (Laconia)
2	2	3	1	Church/Commercial	Laconia Rd & Leavitt Rd (Belmont)
3	2	3	3	Residential	Province St & Hounsell Ave (Laconia)
4	2	3	4	Commercial/Residential	Gilford Ave & Bedford Ave (Gilford)
5	4	3	1	Downtown/Bikeway	Messer St & Winnisquam Trail
6	4	4	1	Commercial	Mechanic St & Union Ave (Laconia)
7	4	4	1	Residential	Meredith Center Rd & State Rte 106 (Laconia)
8	3	3	1	Downtown/Commercial	Depot St. & North Main St. (Wolfeboro)
9	4	3	3	Church/Commercial	Center St. & Wolfeboro Rail Trail (Wolfeboro)



Lakes Region Planning Commission

Laconia

Recommended Manual Count Locations

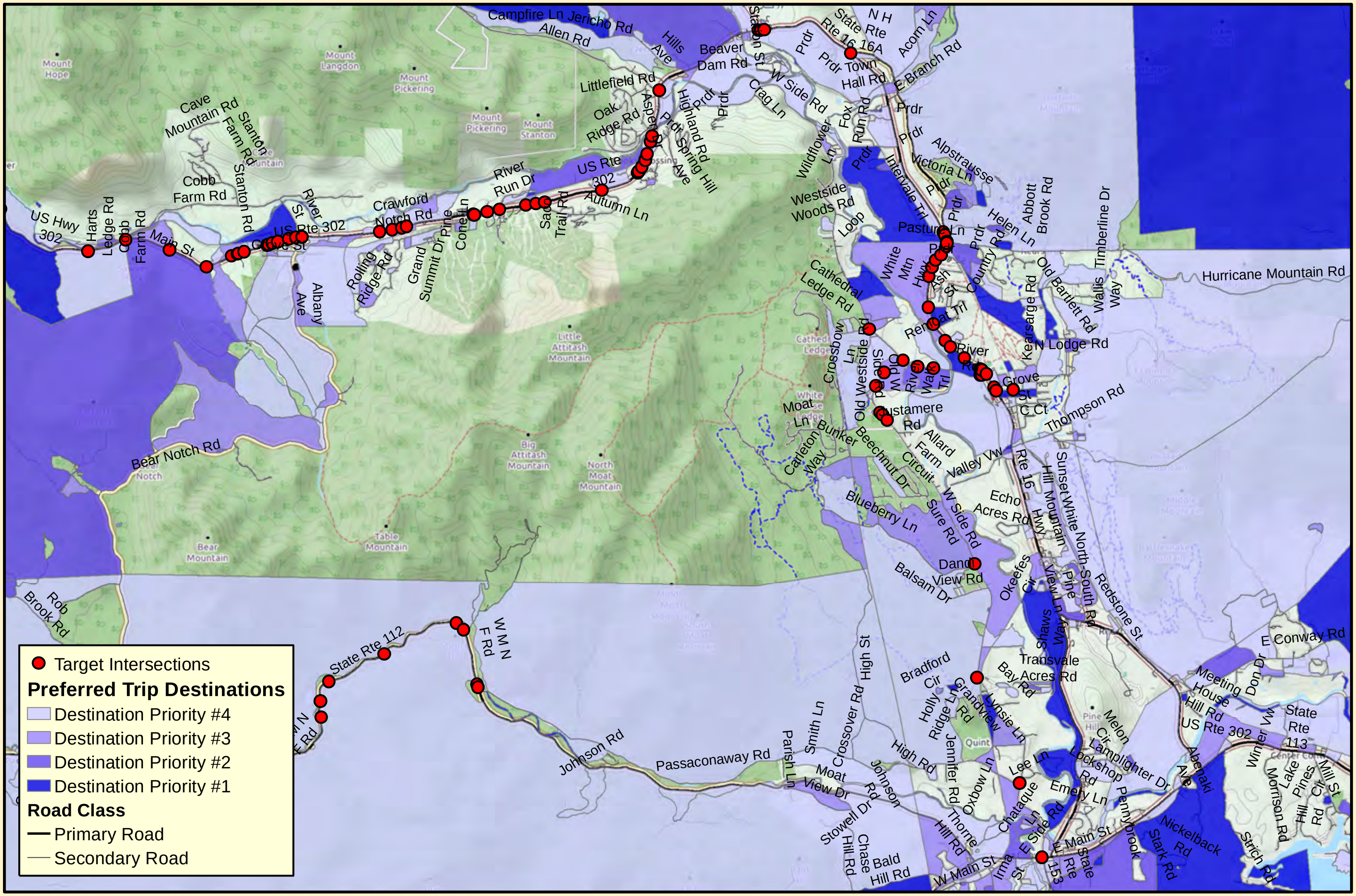
0 0.2 0.4 0.8 1.2 1.6 Miles

1:31,360

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

N

North Country Council Recommended Manual Count Locations					
Priority #	**Unique Athlete Count**	**Total Commutes Rank**	**Destination Polygon Rank**	**Designation**	**Intersection**
1	3	3	4	Downtown Traffic Circle	High Street & Holderness Rd & Main St. (Plymouth)
2	4	3	1	Services/Residential	Highland St & Reservoir Rd (Plymouth)
3	4	3	1	Commercial	Highland St & Tenney Mountain Hwy (Plymouth)
4	3	3	5	Services	Main St. & Fairgrounds Rd. (Plymouth)
5	2	3	1	Downtown/Services	Main St. & Church St. (Lincoln)
6	2	3	4	Downtown/Loon Mountain	Kancamangus Hwy & Bike Path near West Branch Rd (Lincoln)
7	2	3	1	Residential	West Side Rd & Allens Siding Rd (Conway)
8	2	3	4	Downtown/Services	White Mountain Rd & Washington St (Conway)
9	2	3	4	Downtown/Services	White Mountain Hwy & River Rd (North Conway)
10	2	3	2	Condos/Services	State Rte 16 & Hurricane Mountain Rd (North Conway)



North Country Council

Conway & North Conway

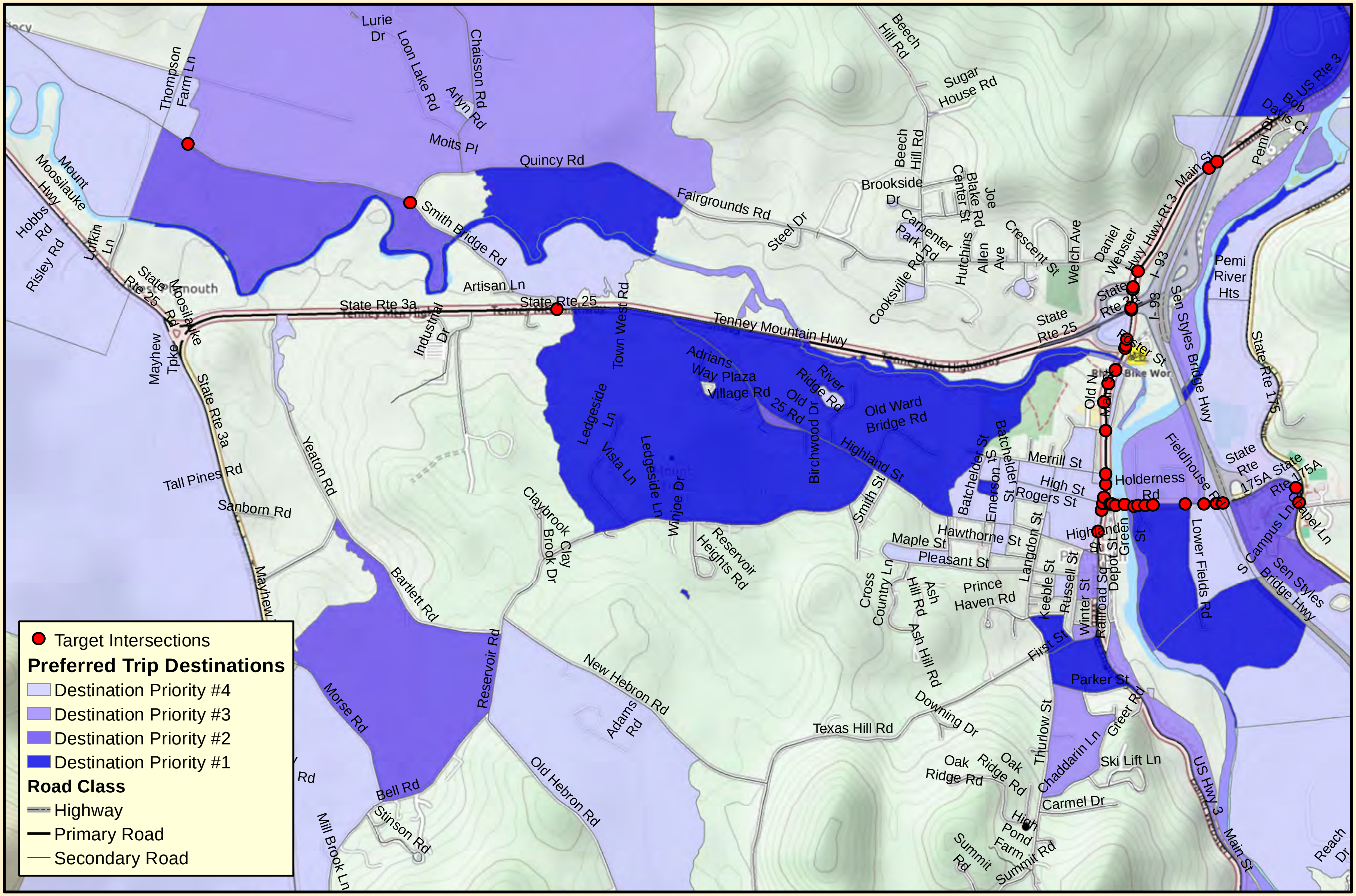
Recommended Manual Count Locations

0 0.5 1 2 3 4 Miles

1:100,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

N



North Country Council

Plymouth

Recommended Manual Count Locations

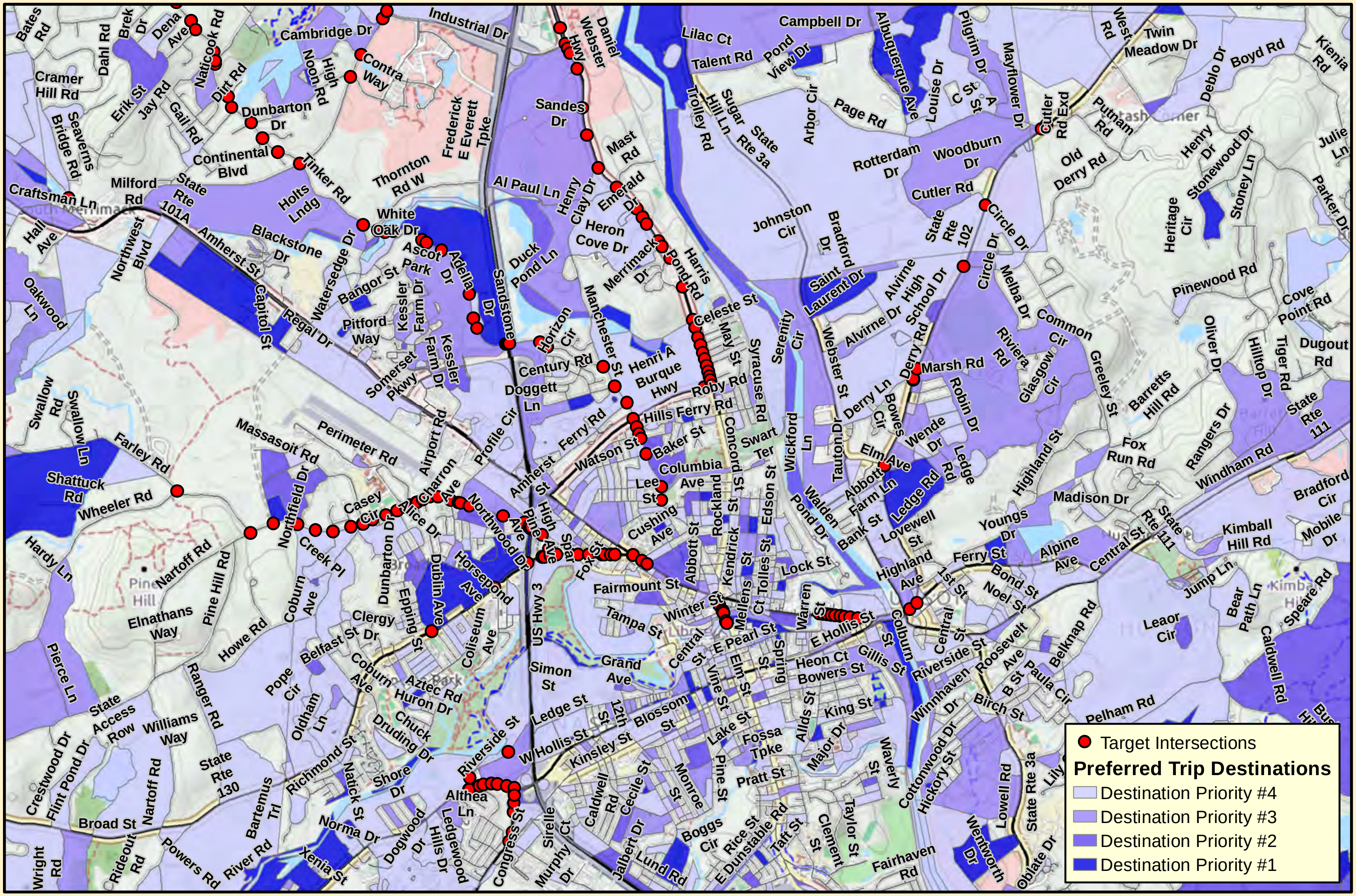
0 0.25 0.5 1 1.5 2 Miles

1:36,360

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

N

Nashua, NH Recommended Manual Count Locations					
Priority #	**Unique Athlete Count**	**Total Commutes Rank**	**Destination Polygon Rank**	**Designation**	**Intersection**
1	3	2	1	Commercial	Broad St. & Amherst St.
2	3	2	1	Commercial	Main St. & Pearson Ave.
3	3	2	2	Commute	Hollis St. & Dunstable Rd.
4	3	3	3	Commercial/Commute	Ferry St. & State Rte. 102 & Chase St. (Hudson)
5	3	2	3	Commercial	Main St. & State Rte. 101A & Lowell St.
6	3	2	4	Commercial	State Rte 111 & Riverside St.
7	3	2	4	Commercial	Broad St. & Blue Hill Ave.
8	3	3	3	Bridge	Webster St. & Derry Rd. (Hudson)
9	3	3	3	Commercial	Bridge St & Amory St
10	3	3	4	Residential/Commute	Concord St & US Hwy 3
11	3	2	4	Residential	Manchester St. & Charlotte Ave.
12	2	2	3	Residential	Continental Blvd & Tinker Rd
13	2	2	2	Commercial/Residential/Undeveloped	Groton Rd & State Rte. 111 (Hollis)



Nashua Regional Planning Commission

Greater Nashua Metro Area

Recommended Manual Count Locations

NRPC

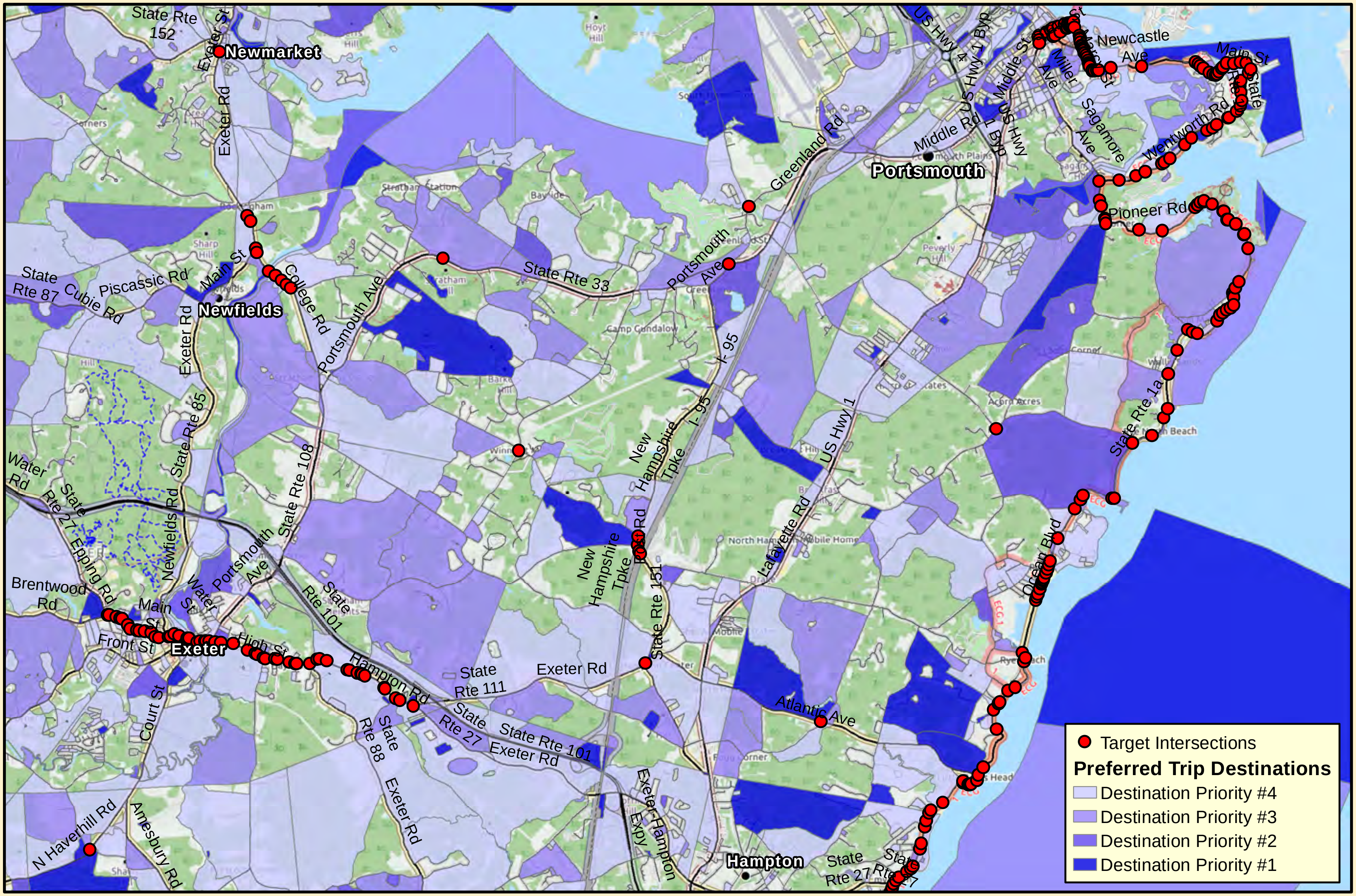
0 0.375 0.75 1.5 2.25 3 Miles

1:63,360

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

N

Rockingham Planning Commission Recommended Manual Count Locations					
Priority #	**Unique Athlete Count**	**Total Commutes Rank**	**Destination Polygon Rank**	**Designation**	**Intersection**
1	1	1	1	Commercial/Beach	Ocean Blvd &Washington Rd. (Rye)
2	1	1	1	Commercial	State Rte 1a & Elwyn Rd. & Pioneer Rd. & Sagamore Rd. (Rye)
3	1	1	2	Commercial/Beach	Ocean Blvd & Atlantic Ave. (North Hampton)
4	1	1	3	Commercial/Beach	High St. & Ocean Blvd (Hampton)
5	1	1	1	Downtown/Commercial	State St. & Pleasant St. (Portsmouth)
6	2	1	1	Commercial	Pease Blvd & Arboretum Dr (Newington)
7	1	1	5	Bridge	Badger Island Bridge (Portsmouth)
8	2	1	1	Commercial	Woodbury Ave & Franklin Dr. (Portsmouth)
9	1	1	4	Commercial	State Rte 108 & Front St (Exeter)
10	2	2	1	Phillips Exeter Academy	State Rte 108 & Pine St (Exeter)
11	2	1	1	Commercial/Residential	Epping Rd & Brentwood Rd (Exeter)
12	2	1	4	Commercial	State St & Middle St (Portsmouth)



Rockingham Planning Commission
Hampton, Rye, Portsmouth, Exeter
Recommended Manual Count Locations

ROCKINGHAM PLANNING COMMISSION

0 0.5 1 2 3 4 Miles

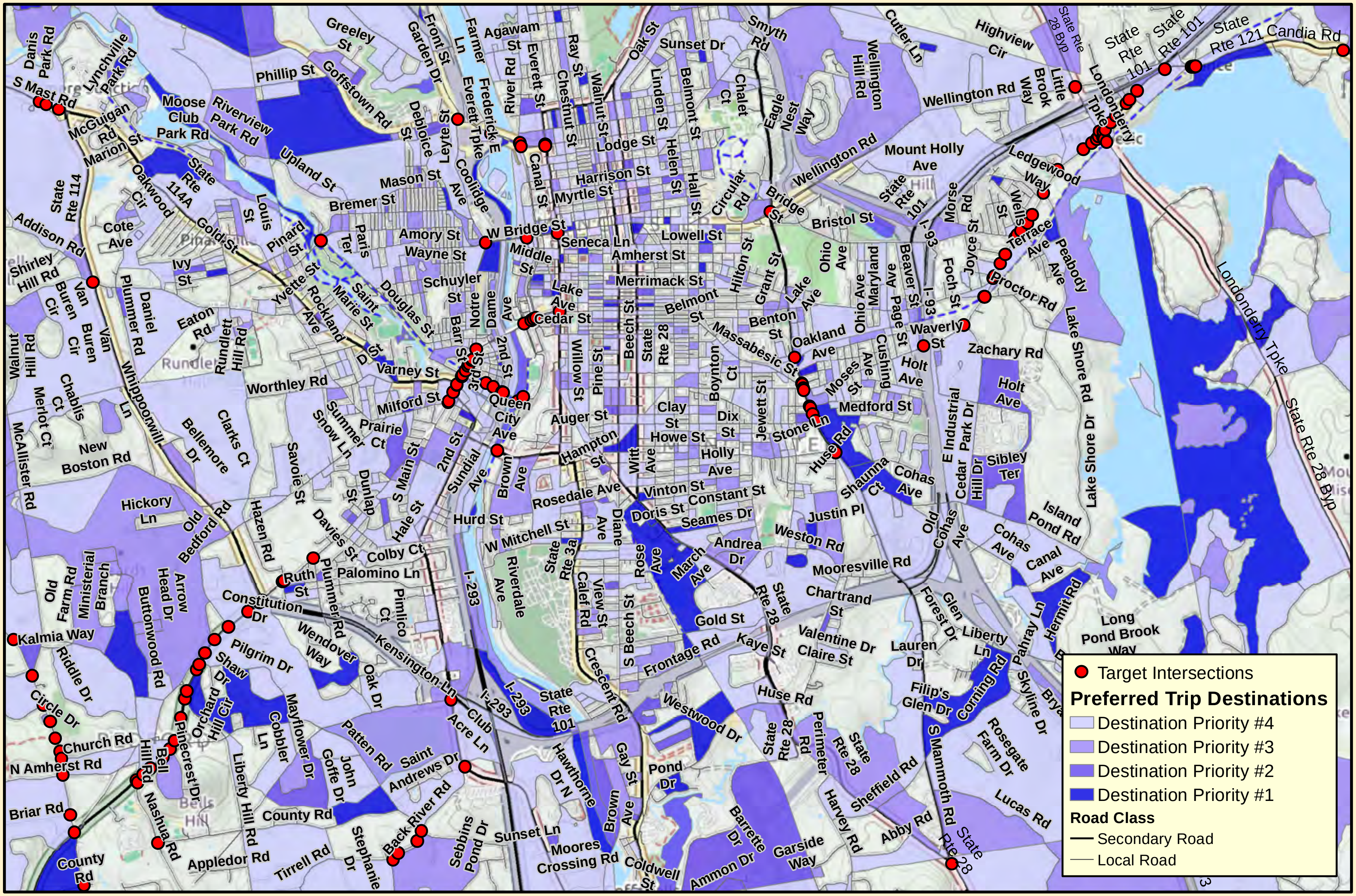
1:100,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

N

Manchester, NH Recommended Manual Count Locations					
Priority #	**Unique Athlete Count**	**Total Commutes Rank**	**Destination Polygon Rank**	**Designation**	**Intersection**
1	2	2	1	Commuter Route/Lake	Manchester Ave & Cottage Ave & Rockingham Recreational Trail
2	4	2	1	Downtown/Commercial	W Bridge St & US Hwy 3
3	3	3	1	Downtown/Commercial	Granite St. & Commercial St.
4	3	3	1	Residential	State Rte. 3a & Corning Rd.
5	4	3	1	Downtown/School	Cilley Rd. & State Rte 28A
6	3	2	4	Downtown/Commercial	State Rte. 114 & S. Main St.
7	3	2	4	Commercial/Commute	Londonderry Turnpike & Beaver Brook Rd.
8	2	3	4	Commuter Route/Food/Lake	Massabesic Traffic Circle & Rockingham Recreational Trail
9	4	3	2	Downtown	Elm St & W Salmon St
10	4	3	2	Downtown/School/Recreation/Residenti al	Mammouth Rd & Bridge St
11	3	3	3	Commute/Commercial	State Rte 128 & Litchfield Rd.
12	4	2	4	Downtown/Commercial/Verizon Arena	Granite St & Elm St.
13	3	2	5	Downtown/Bikeway/Commerical	S. Main St. & Piscataquog Bike Trail
14	4	3	3	Downtown/Commercial/Residential	Mammouth Rd & Candia Rd
15	3	3	4	Goffstown Rail Trail Access/Nursing Home	Rte. 114 & Danis Park Rd.
16	3	3	4	Commercial/Bikeway	Candia Rd. & Rockingham Recreational Trail
17	3	3	4	Bikeway/River/Residential/Commercial	Electric St. & Piscataquog Bike Trail
18	3	3	5	Bikeway/Commute	State Rte 3a & Raymond Weczorek Dr & Bike Path

External to Manchester					
1	3	3	1	Residential	State Rte 101 & Liberty Hill Road (Bedford)
2	2	3	2	Goffstown Downtown/Piscataquog River	Main St. and State Rt. 114 (Goffstown)
3	3	3	2	Rail Trail/Commercial	Depot Rd. & Windham Rail Trail (Derry/Windham)
4	2	3	3	School/Rec. Fields/Residential	New Boston Rd. & Wallace Rd. (Bedford)
5	3	2	4	Downtown Bedford/Residential	Rte. 101 & Meetinghouse Rd. (Bedford)
6	3	3	3	Commute/Light Commercial/Residential	State Rte. 114 & Saint Anselm Dr. (Bedford)
7	3	3	3	Rail Trail/Residential	Kendall Pond Rd. & Derry Rail Trail (Derry)
8	3	3	4	Commercial/Central Londonderry	State Rte 102 & State Rte 128 (Londonderry)
9	3	3	5	Commercial/Bikeway/Downtown Derry	State Rte 102 & Derry Rail Trail (Derry)



Southern NH Regional Planning Commission

Greater Manchester Metro Area: Recommended Manual Count Locations

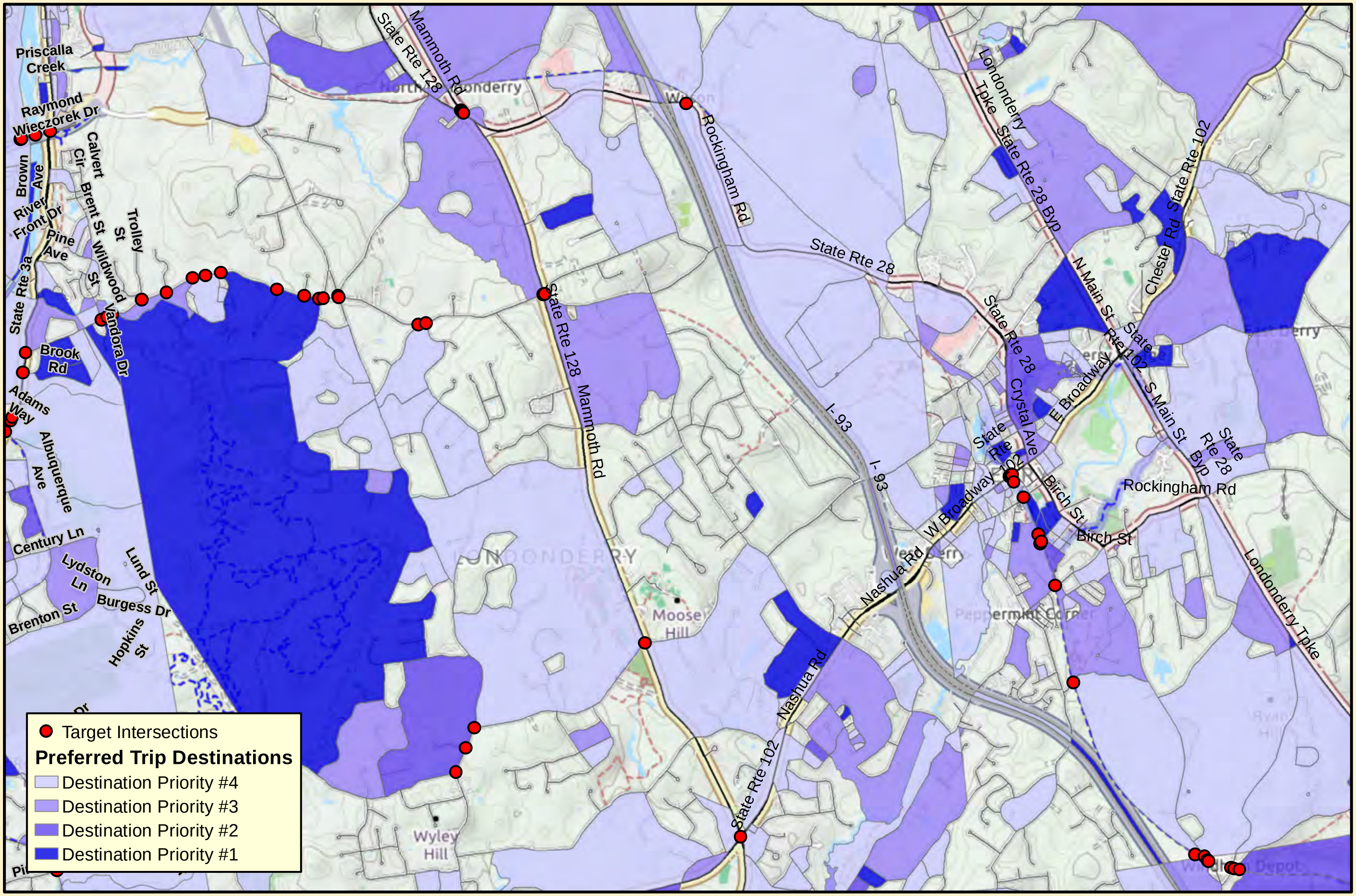
SNHPC

0 0.375 0.75 1.5 2.25 3 Miles

1:60,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

N



Southern NH Regional Planning Commission

Greater Manchester Metro Area

Derry-Londonderry

Recommended Manual Count Locations

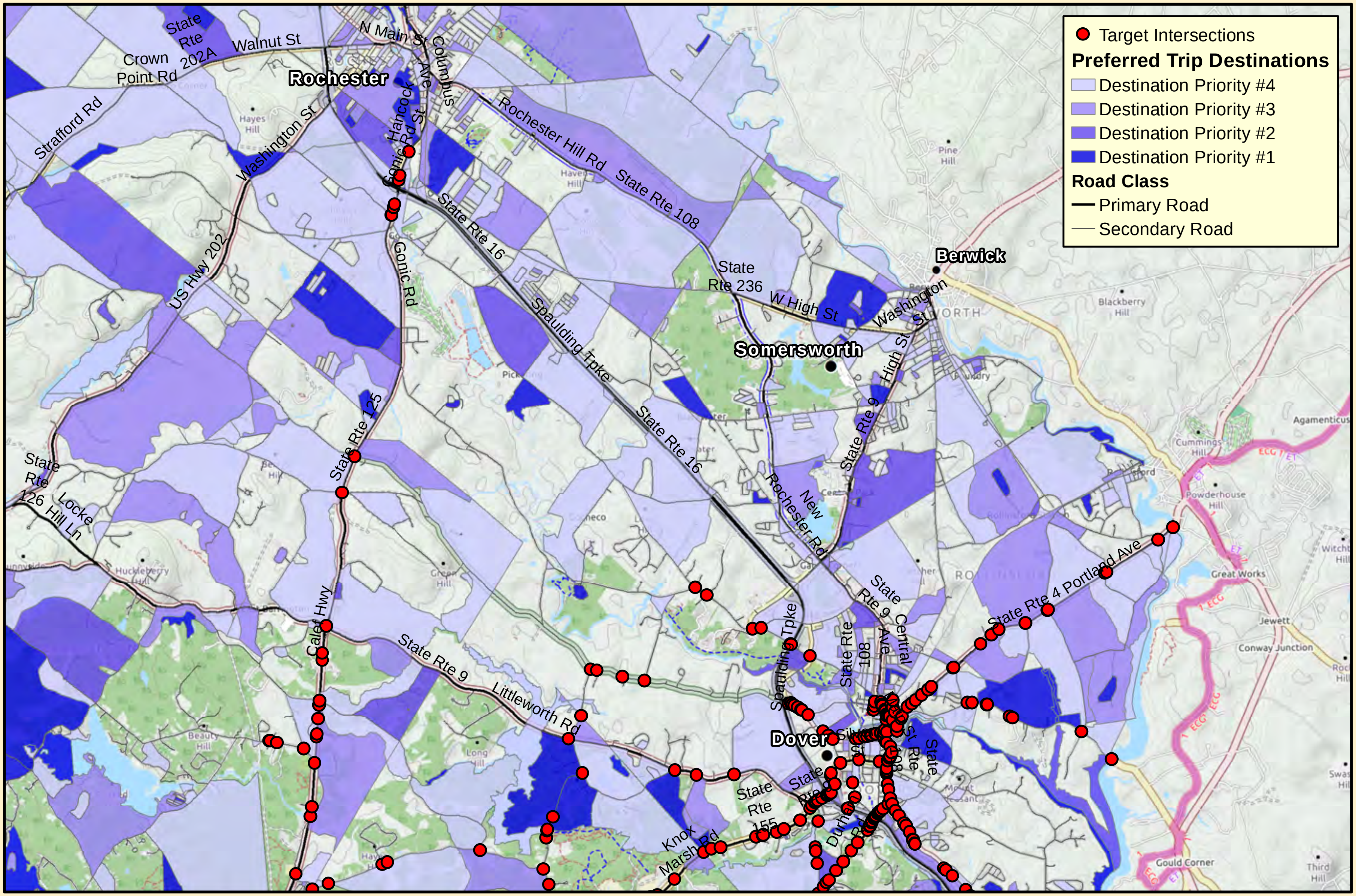
0 0.375 0.75 1.5 2.25 3 Miles

1:60,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

N

Strafford Regional Planning Commission Recommended Manual Count Locations					
Priority #	**Unique Athlete Count**	**Total Commutes Rank**	**Destination Polygon Rank**	**Designation**	**Intersection**
1	2	2	4	Downtown/Commercial/Services	State Rte 108 & Newmarket Rd. & Main St. (Durham)
2	2	2	3	Downtown/Commercial/Services	Madbury Rd & Pettee Brook Lane (Durham)
3	2	2	4	UNH Campus	Main St. & State Rte 155A (Durham)
4	2	1	1	Commute/Recreation	Boston Harbor Rd & Spur Rd (Dover)
5	3	1	2	Downtown/Commercial/Services	Central Ave & Washington Street (Dover)
6	3	1	3	Commercial	Central Ave & Silver St (Dover)
7	3	2	3	Commercial	Central Ave & Broadway (Dover)
8	4	4	3	Commercial/Residential	Market St. & Prospect St. (Somersworth)
9	4	4	4	Commercial/Services	Main St. & Washington St. (Somersworth)
10	4	4	3	Commercial	Rte 108 & Blackwater Rd (Somersworth)
11	4	3	1	Services	State Rte 125 & Old Dover Rd (Rochester)
12	4	3	3	Downtown/Services	S. Main St. & Columbus Ave. (Rochester)
13	4	4	4	Services	N. Main ST. & Ten Rod Rd. (Rochester)



Strafford Regional Planning Commission
Dover, Somersworth, Rochester
Recommended Manual Count Locations

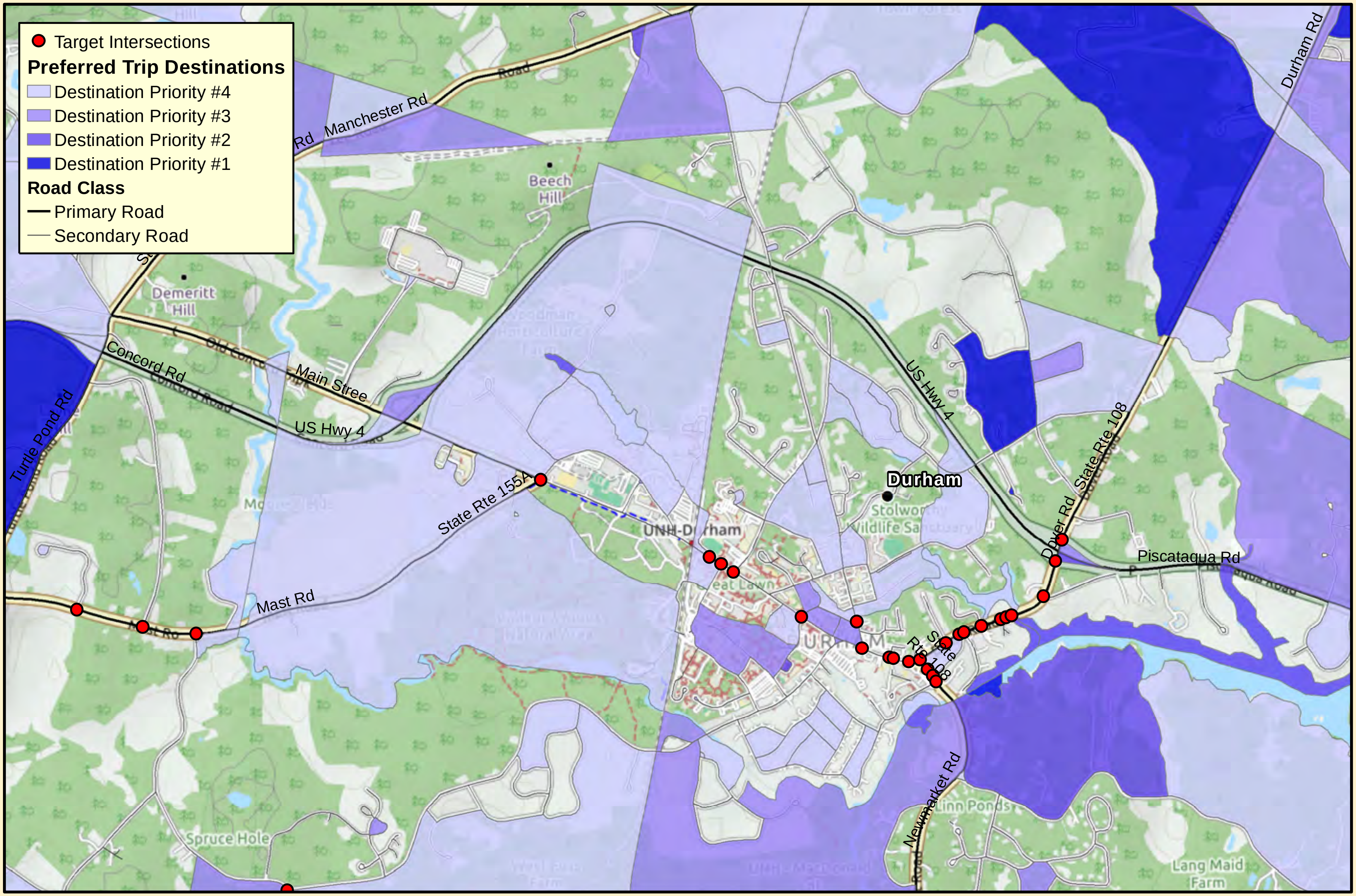
Strafford REGIONAL PLANNING COMMISSION

0 0.5 1 2 3 4 Miles

1:100,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

N



Strafford Regional Planning Commission
Durham
Recommended Manual Count Locations

Strafford REGIONAL PLANNING COMMISSION

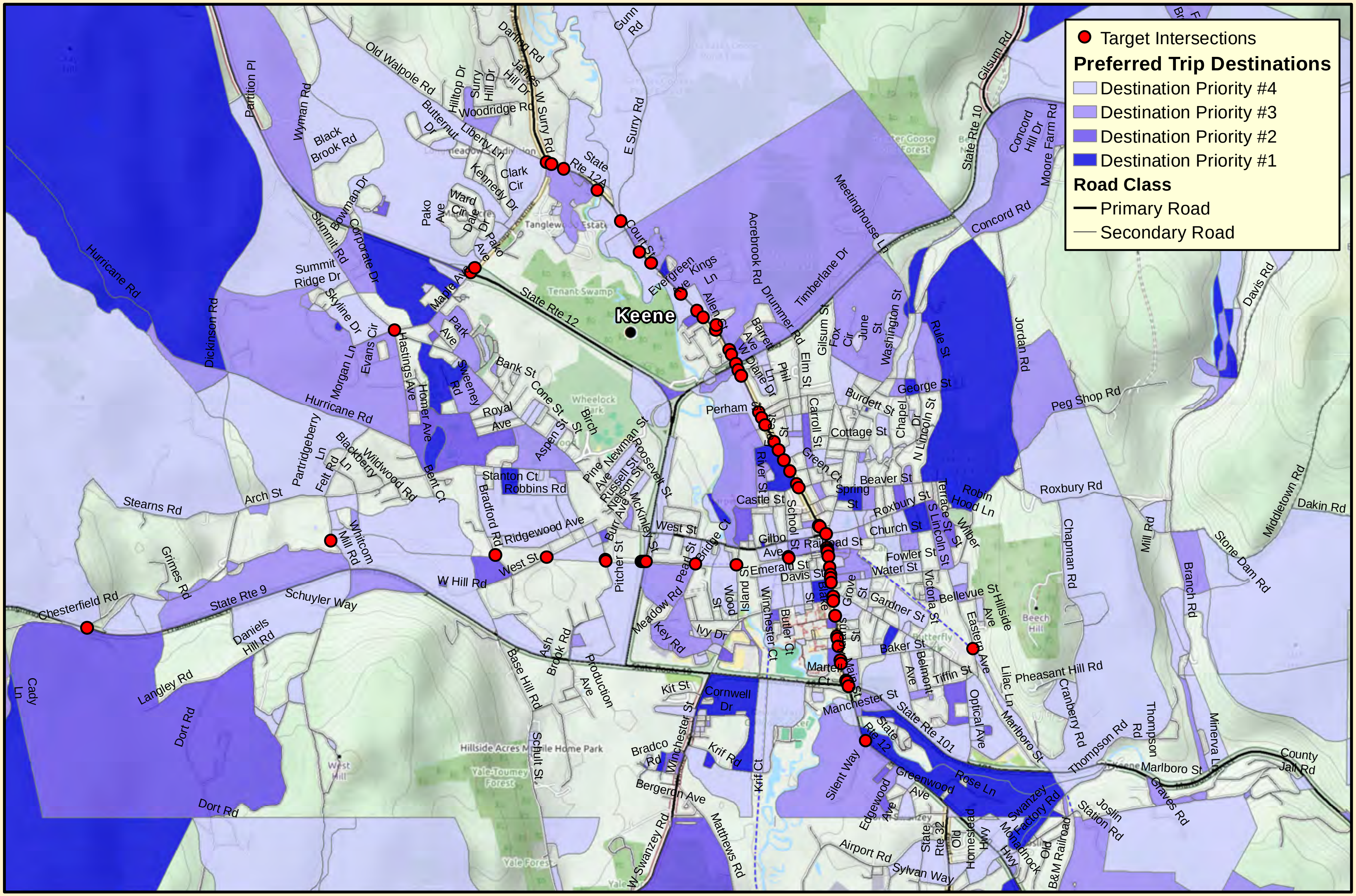
0 0.2 0.4 0.8 1.2 1.6 Miles

1:31,680

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

N

Southwest Regional Planning Commission (Keene) Recommended Manual Count Locations					
Priority #	**Unique Athlete Count**	**Total Commutes Rank**	**Destination Polygon Rank**	**Designation**	**Intersection**
1	4	3	1	School/Residential	School St. & Court St.
2	4	3	1	Church/Services/Commercial	Main St & Water St
3	4	3	2	Services/Employment/Residential	Ingalls St & Court St.
4	4	3	3	Downtown/Services	Gilbo Ave & School St
5	4	3	3	Antioch University	Pearl St. & Cheshire Rail Trail
6	4	3	4	Rail Trail/Services	Eastern Ave. & Cheshire Rail Trail



Southwest Regional Planning Commission
Keene, NH
Recommended Manual Count Locations

SWRPC

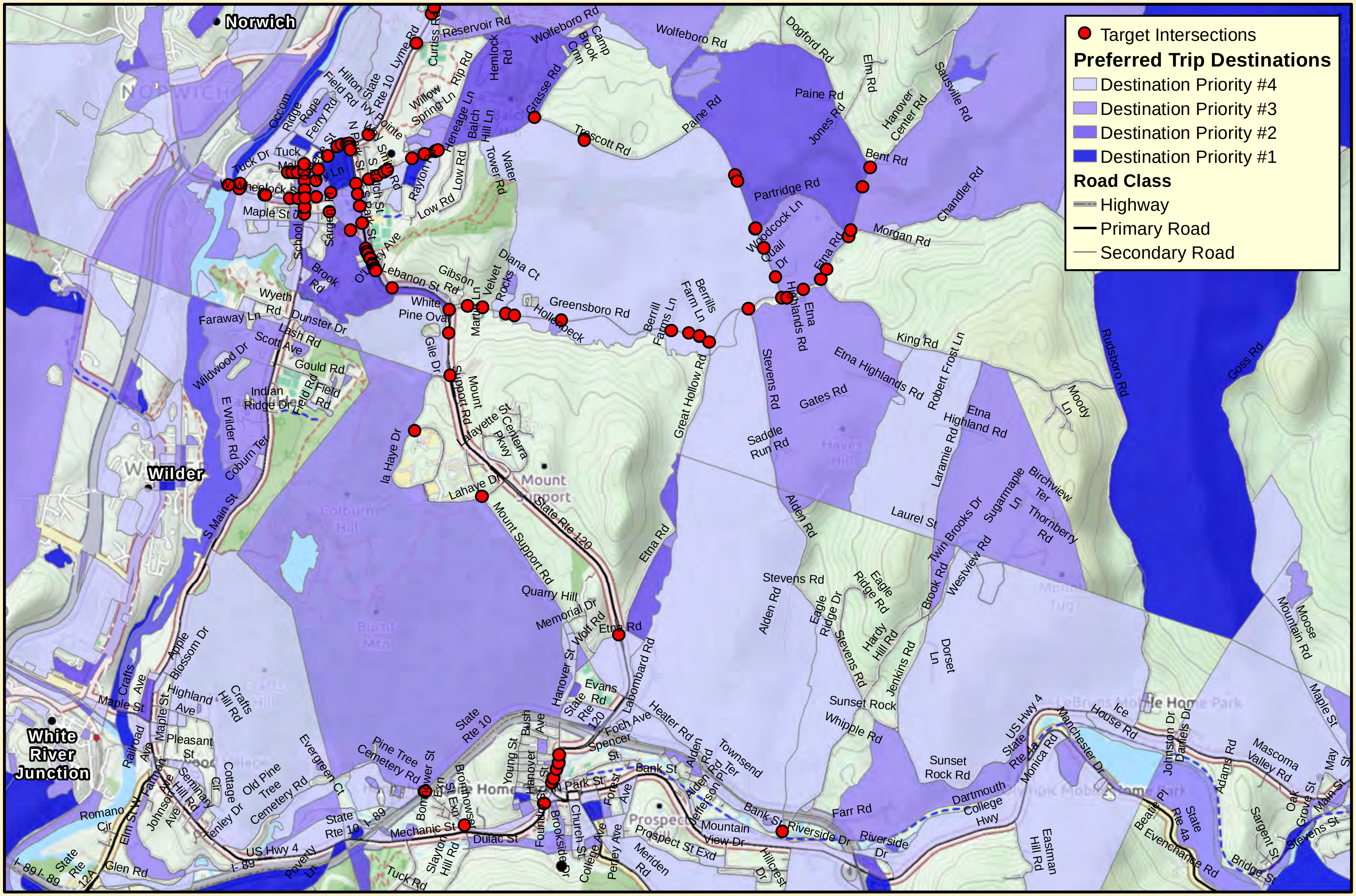
0 0.25 0.5 1 1.5 2 Miles

1:50,000

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

N

Upper Valley Lake Sunapee Regional Planning Commission Recommended Manual Count Locations					
Priority #	**Unique Athlete Count**	**Total Commutes Rank**	**Destination Polygon Rank**	**Designation**	**Intersection**
1	2	1	1	Dartmouth College Campus	East Wheelock St. & N. Park St. (Hanover)
2	2	1	1	Dartmouth College Campus	N. Park & Lyme Rd & Dewey Field Rd & College St. (Hanover)
3	2	1	2	School of Business/Bridge	East Wheelock & Tuck Drive (Hanover)
4	2	1	2	Commute/Residential	Greensboro Rd & Lebanon St. (Hanover)
5	2	1	2	Recreation/Residential	Etna Rd & Rudsboro Rd (Hanover)
6	2	1	4	Residential	Greensboro Rd & Great Hollow Rd (Hanover)
7	3	2	2	Residential/Commute	State Rte 10 & Brook Rd (Hanover)
8	3	1	2	Commercial	State Rte 120 & Etna Rd (Lebanon)
9	3	1	4	Residential	Bank St & Riverside Dr (Lebanon)
10	3	1	4	Rail Trail/Residential	Riverside Dr & Northern Rail Trail (Lebanon)
11	3	3	3	Downtown	Parkhurst & N Park & Bank St (Lebanon)



Upper Valley Lake Sunapee Regional Planning Commission

Hanover & Lebanon

Recommended Manual Count Locations

0 0.375 0.75 1.5 2.25 3 Miles

1:63,360

NAD 1983 2011 StatePlane New Hampshire FIPS 2800 Ft US

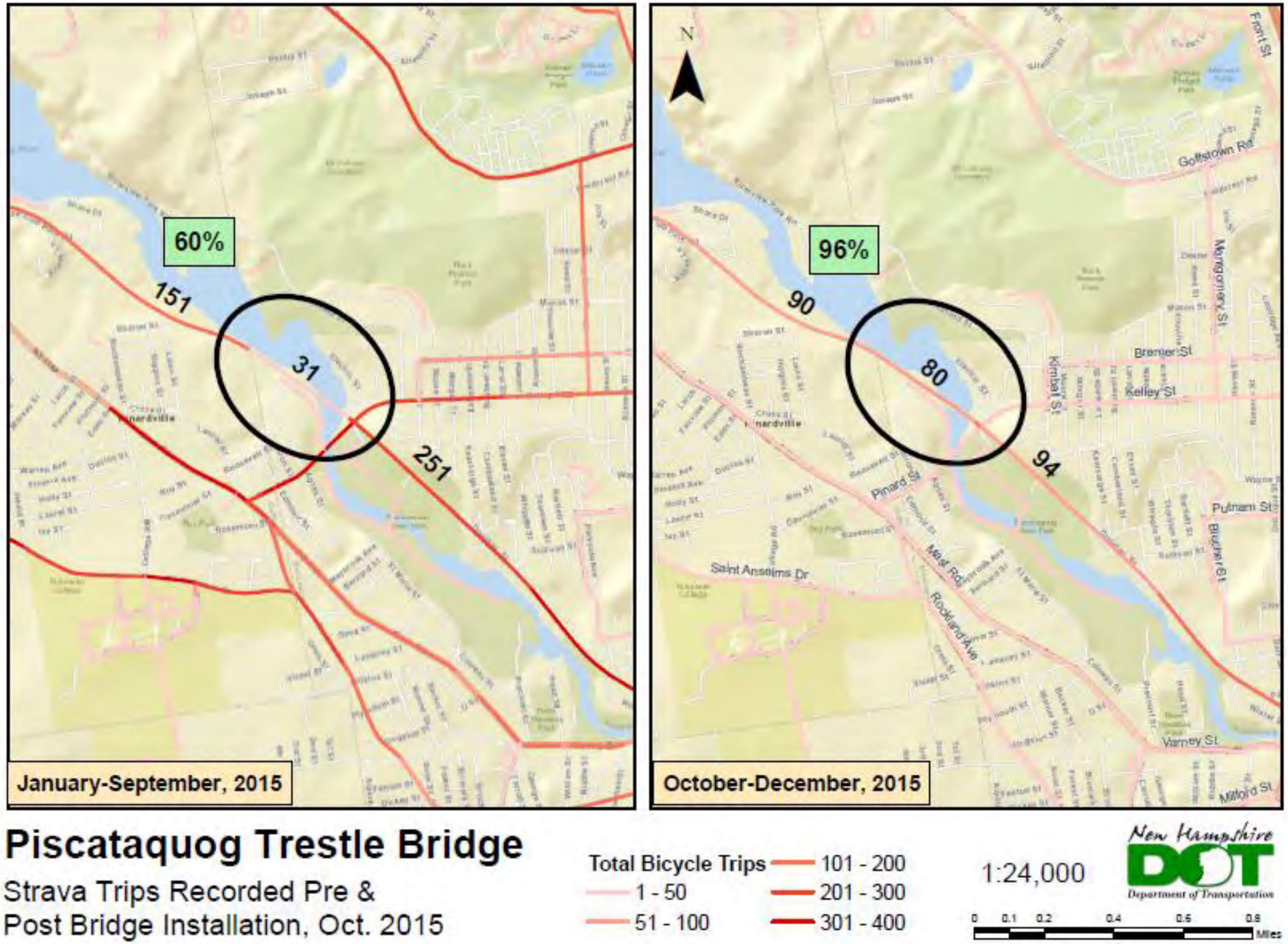
N

APPENDIX I

Before/After:

Piscataquog Trestle Bridge 2015

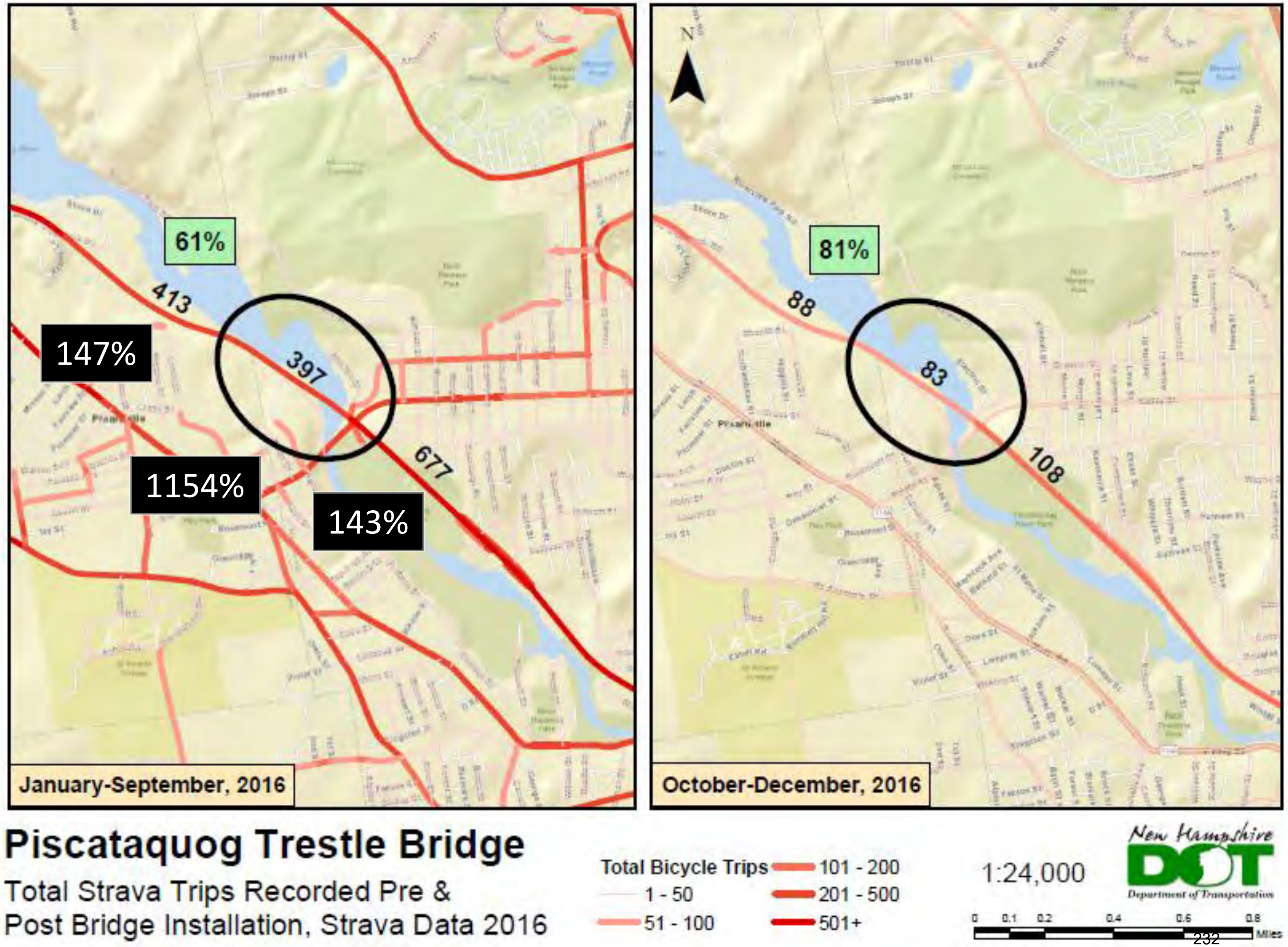
Total Trips



Before/After:

Piscataquog Trestle Bridge 2016

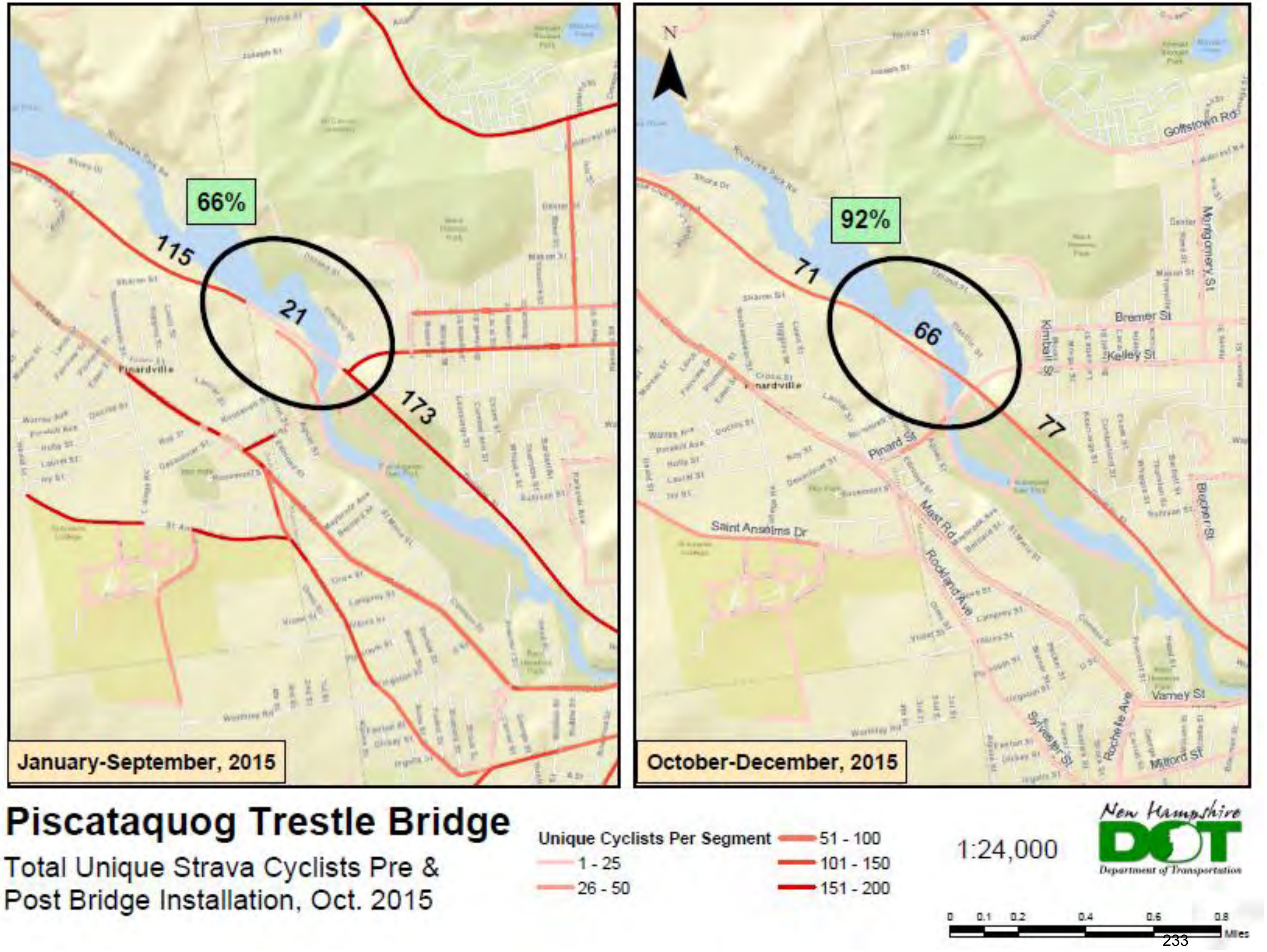
Total Trips



Before/After:

Piscataquog Trestle Bridge 2015

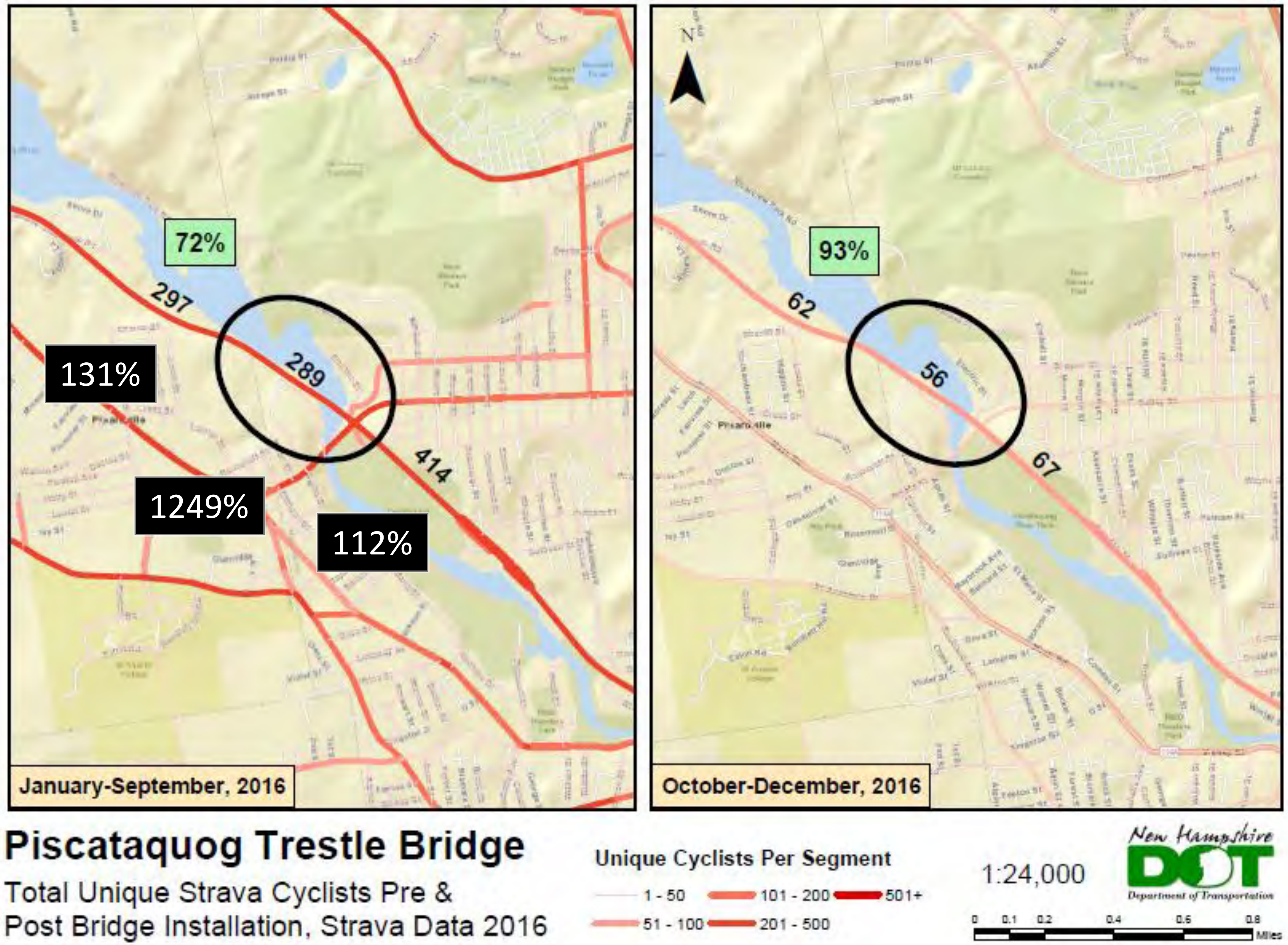
Unique Cyclists



Before/After:

Piscataquog Trestle Bridge 2016

Unique Cyclists

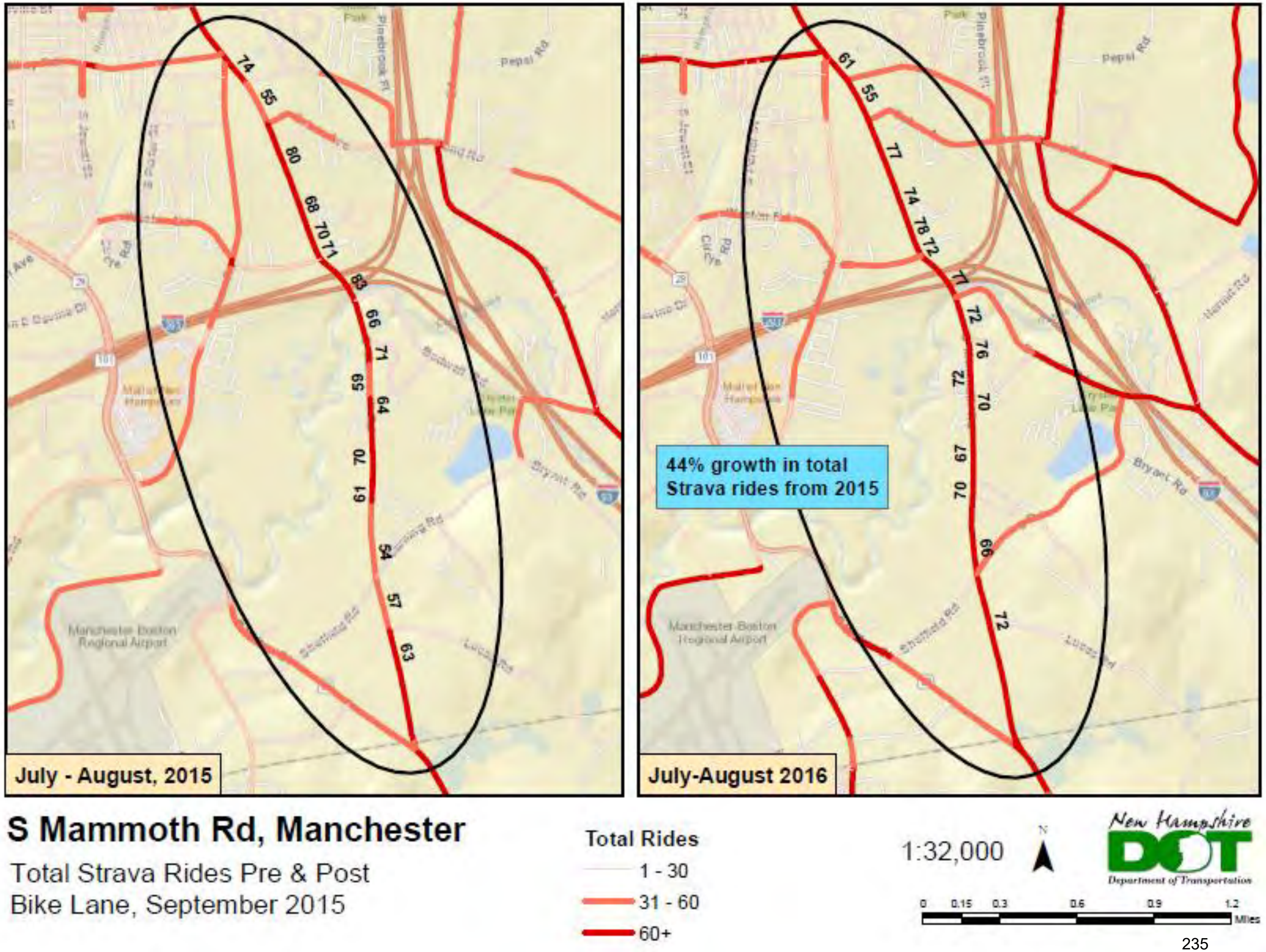


Before/After:

S Mammoth Rd.

Bike Lane,
September 2015

Total Rides

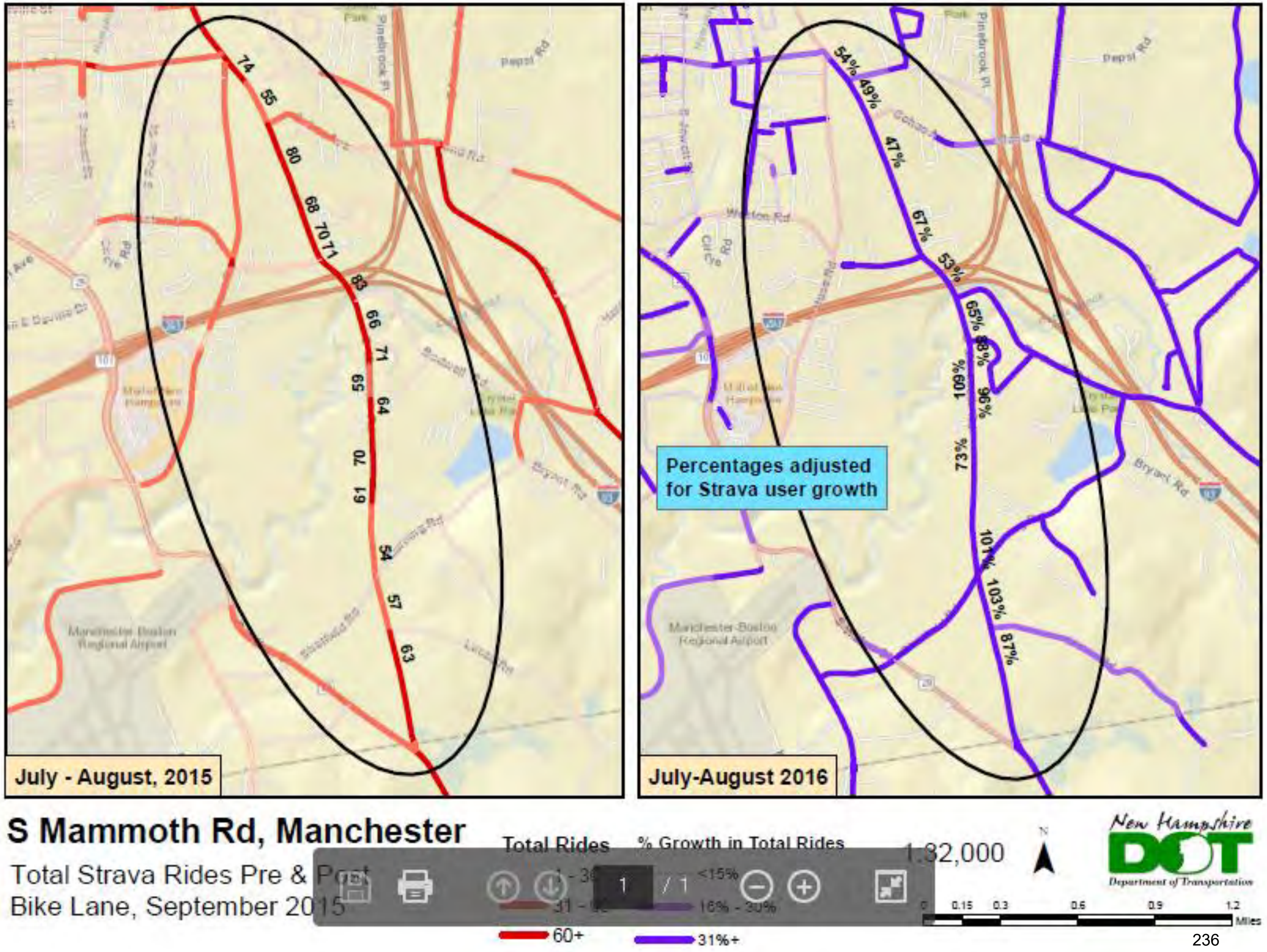


Before/After:

S Mammoth Rd.

Bike Lane,
September 2015

% Increase Total Rides

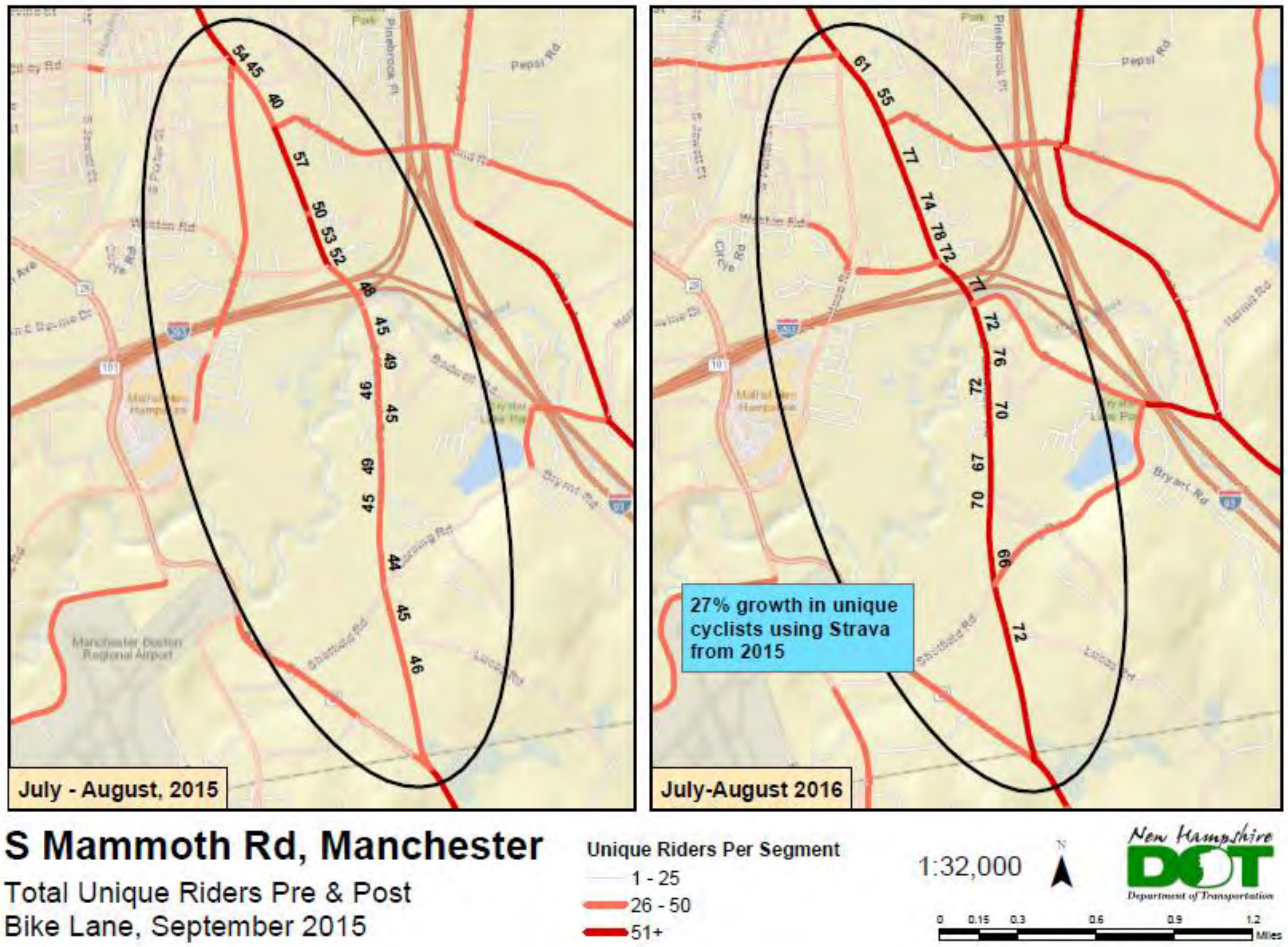


Before/After:

S Mammoth Rd.

Bike Lane, September 2015

Unique Cyclists

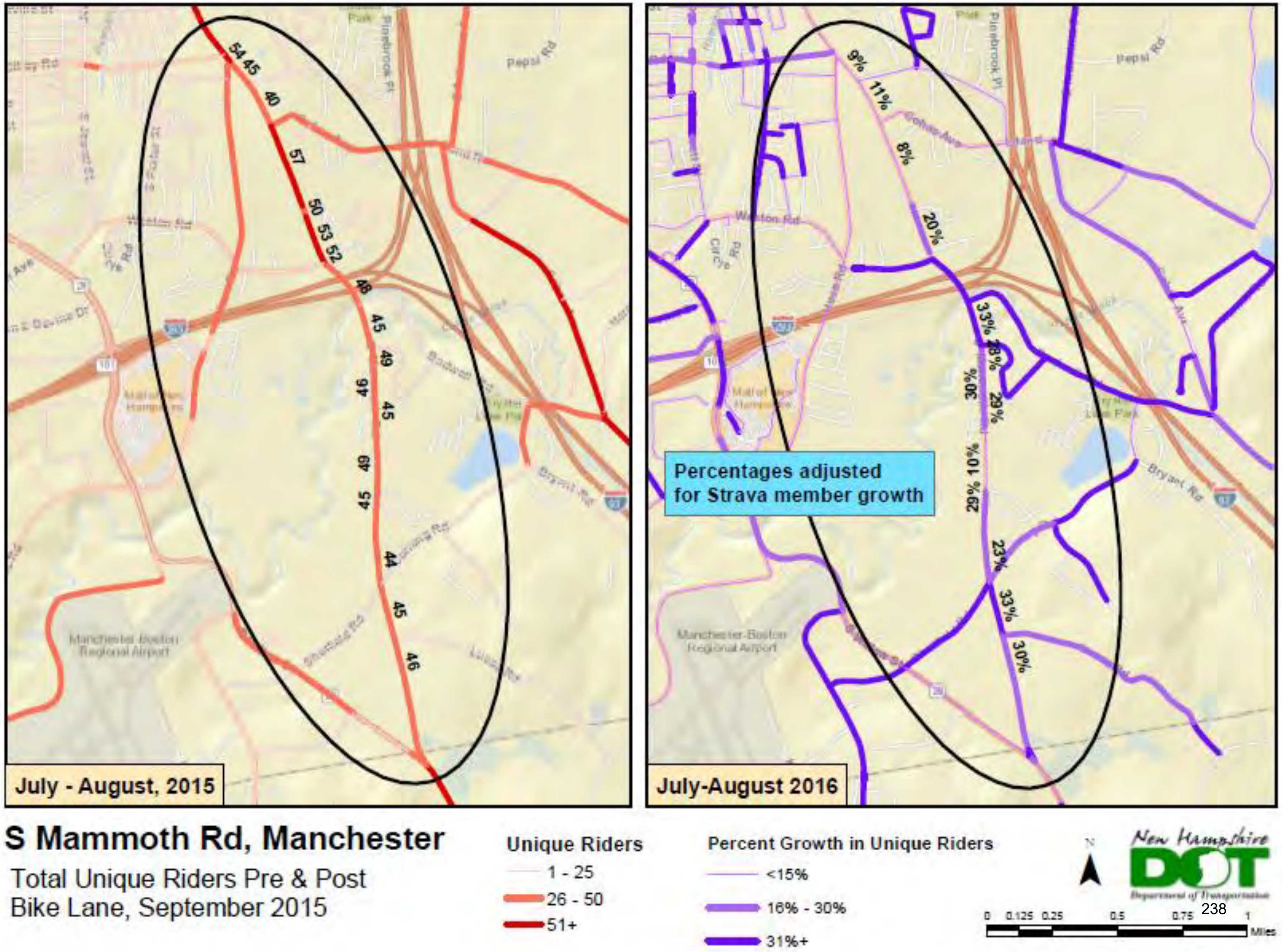


Before/After:

S Mammoth Rd.

Bike Lane, September 2015

% Increase in Unique Cyclists

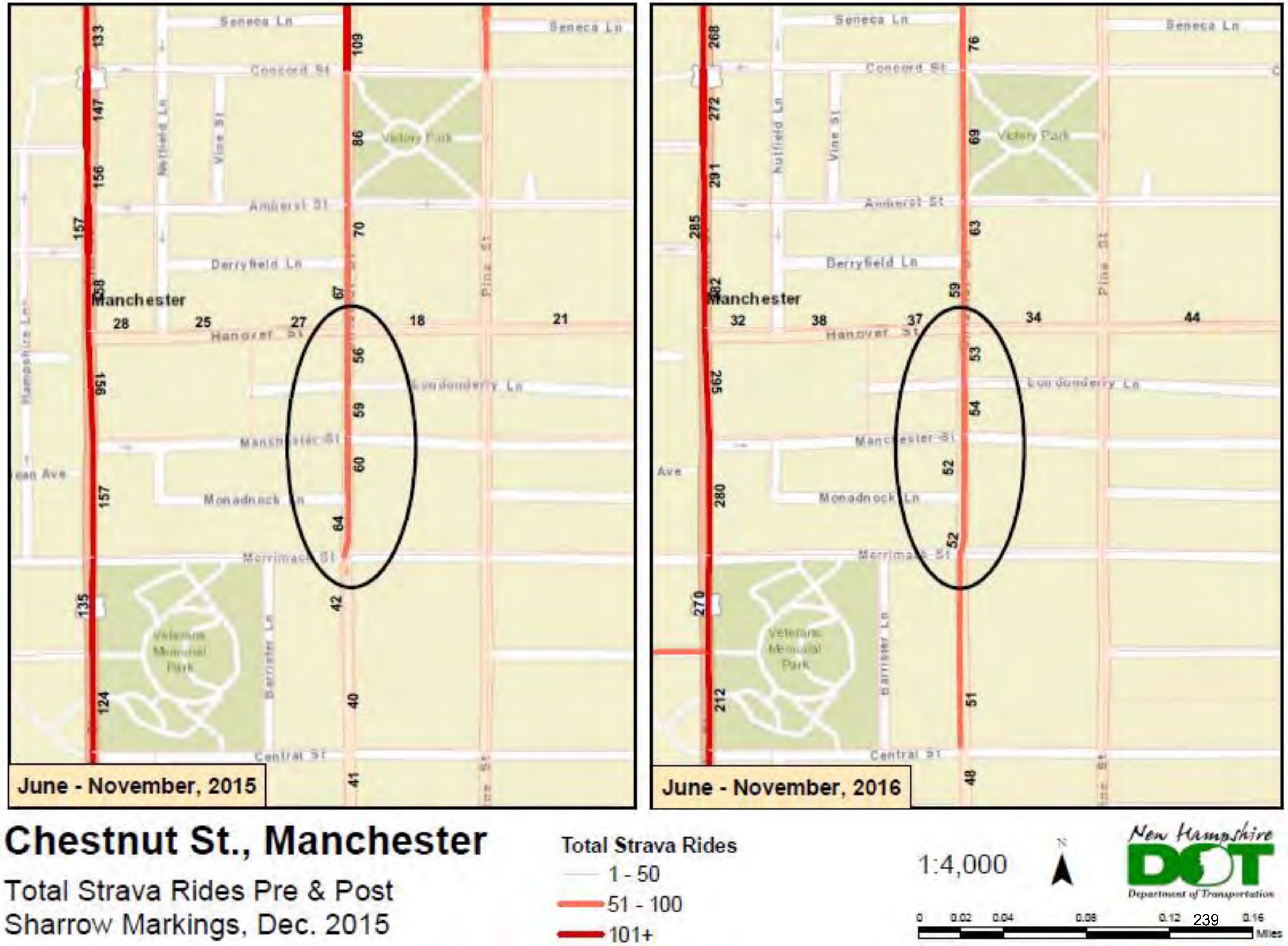


Before/After:

Chestnut Rd.

Sharrow Markings, December 2015

Total Rides

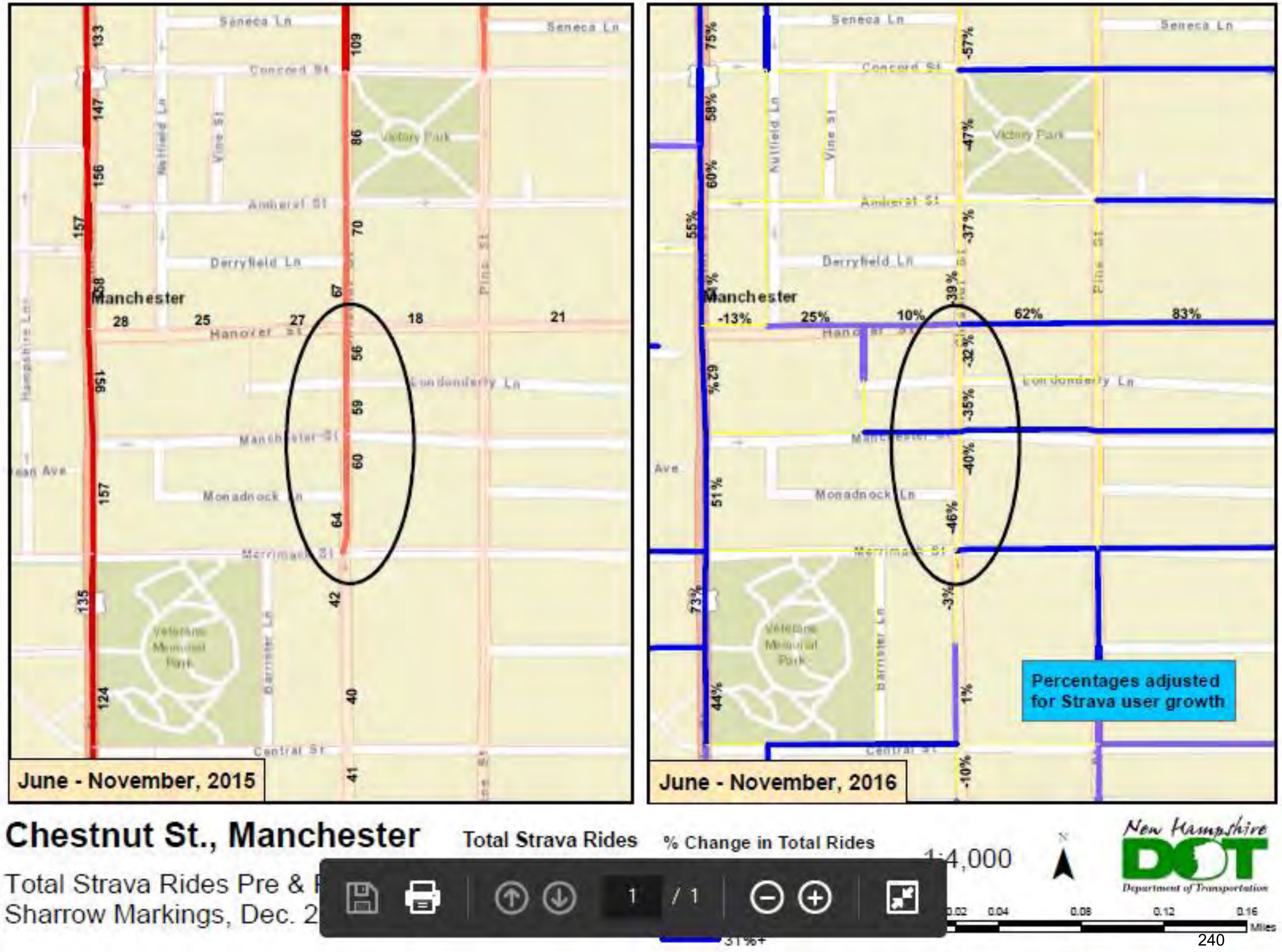


Before/After:

Chestnut Rd.

Sharrow Markings, December 2015

% Increase in Total Rides

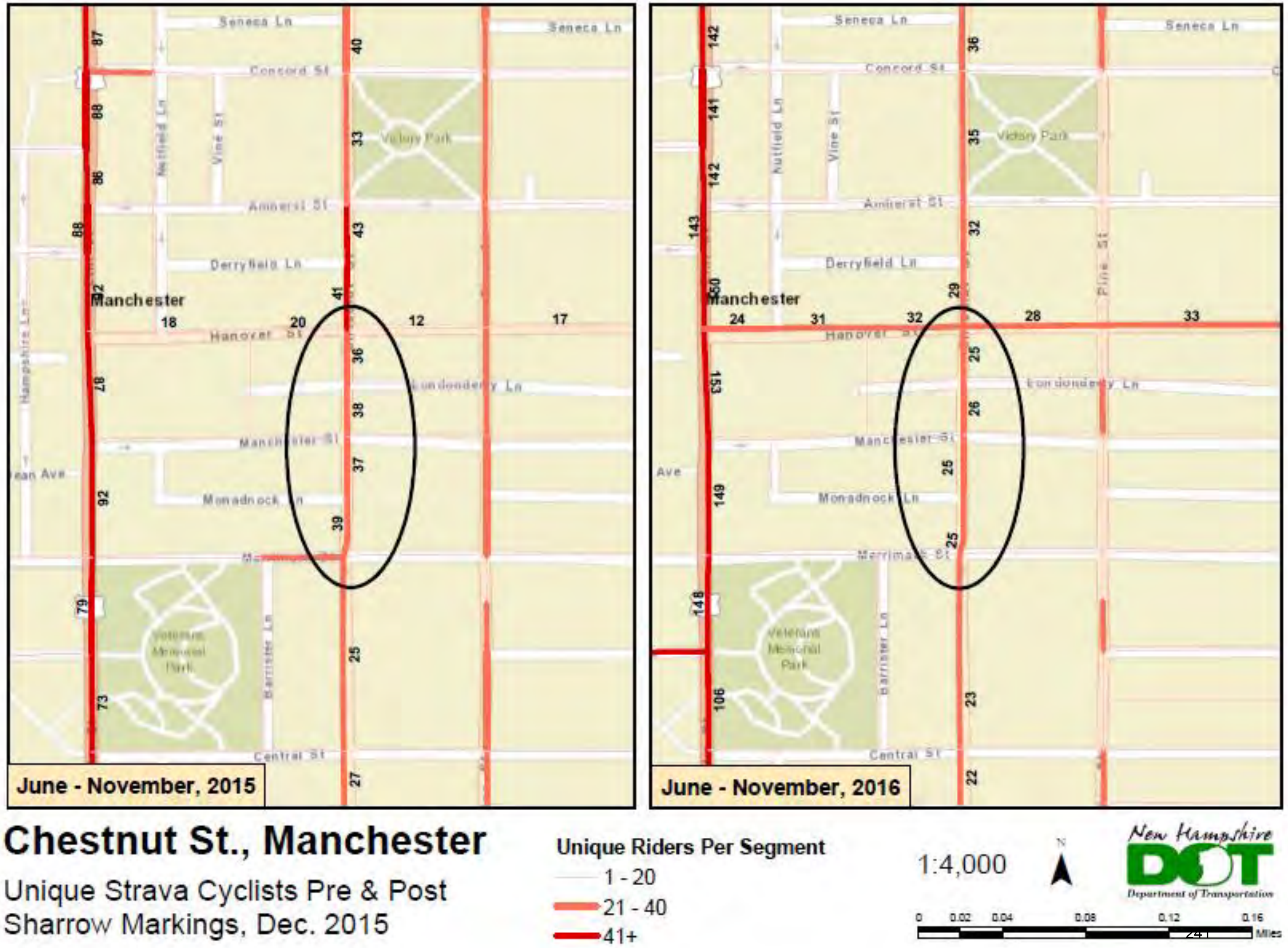


Before/After:

Chestnut Rd.

Sharrow Markings, December 2015

Unique Cyclists

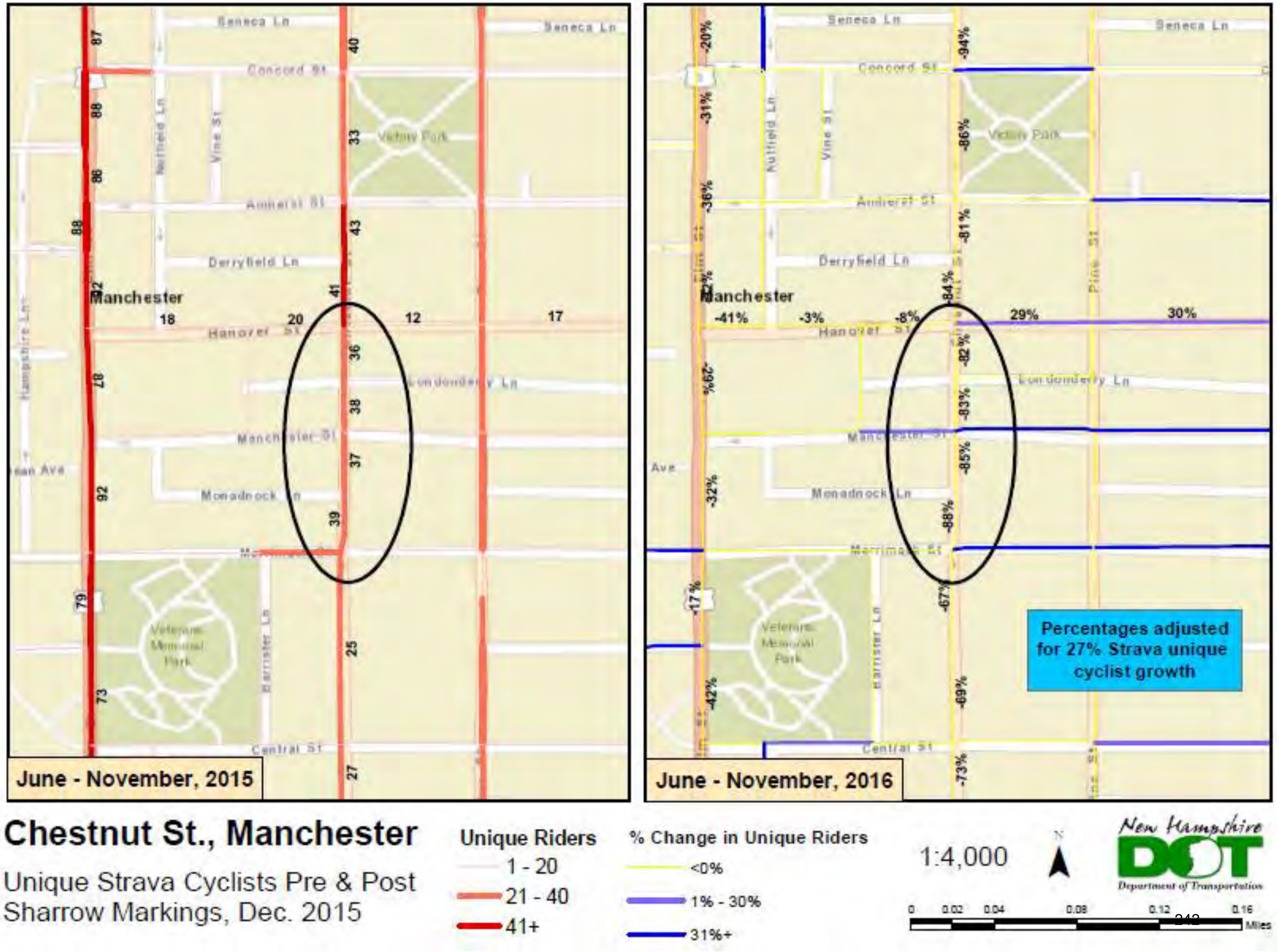


Before/After:

Chestnut Rd.

Sharrow Markings, December 2015

% Increase in Unique Cyclists

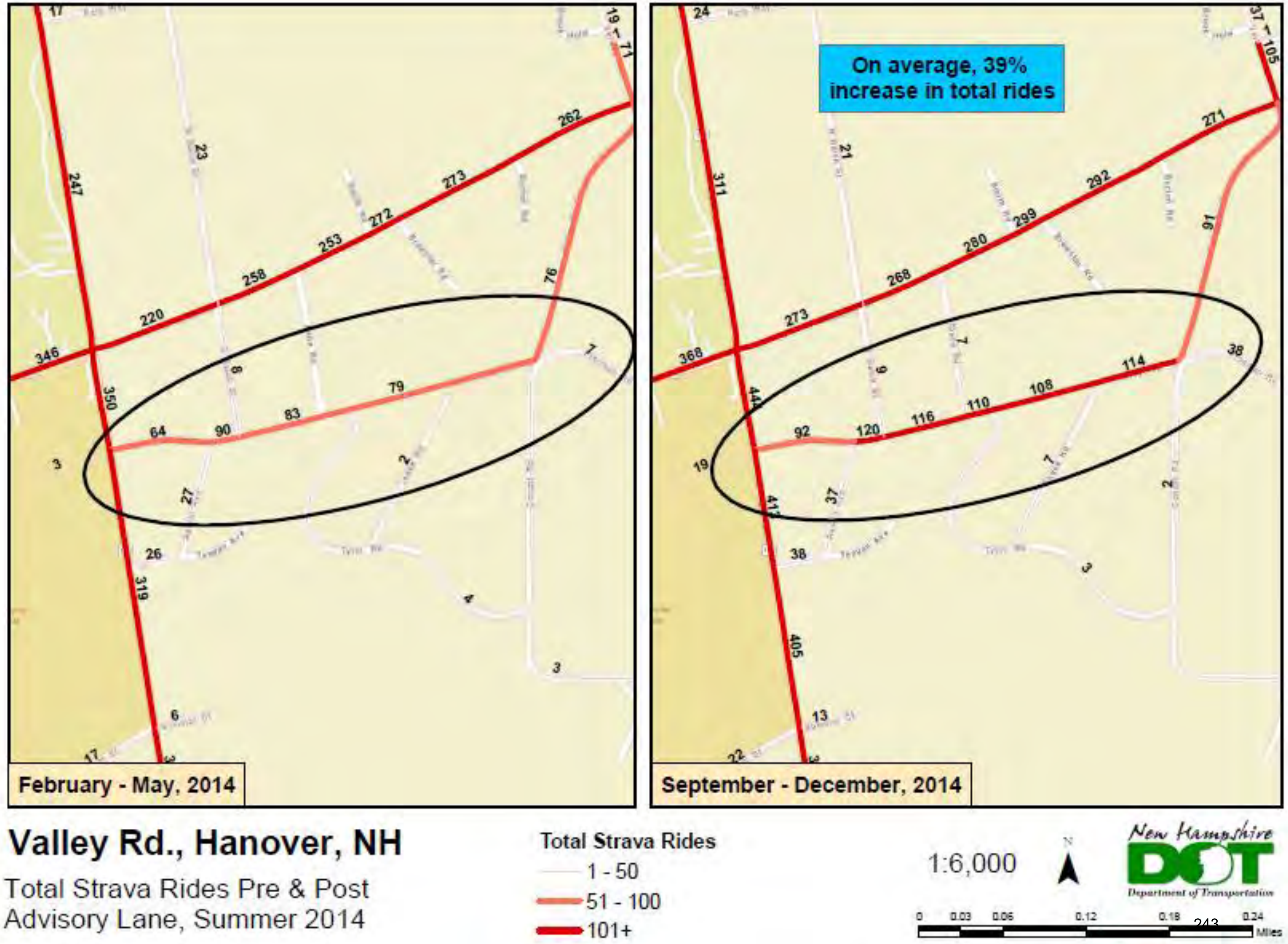


Before/After:

Valley Rd.

Advisory Lane, Summer 2014

Total Rides

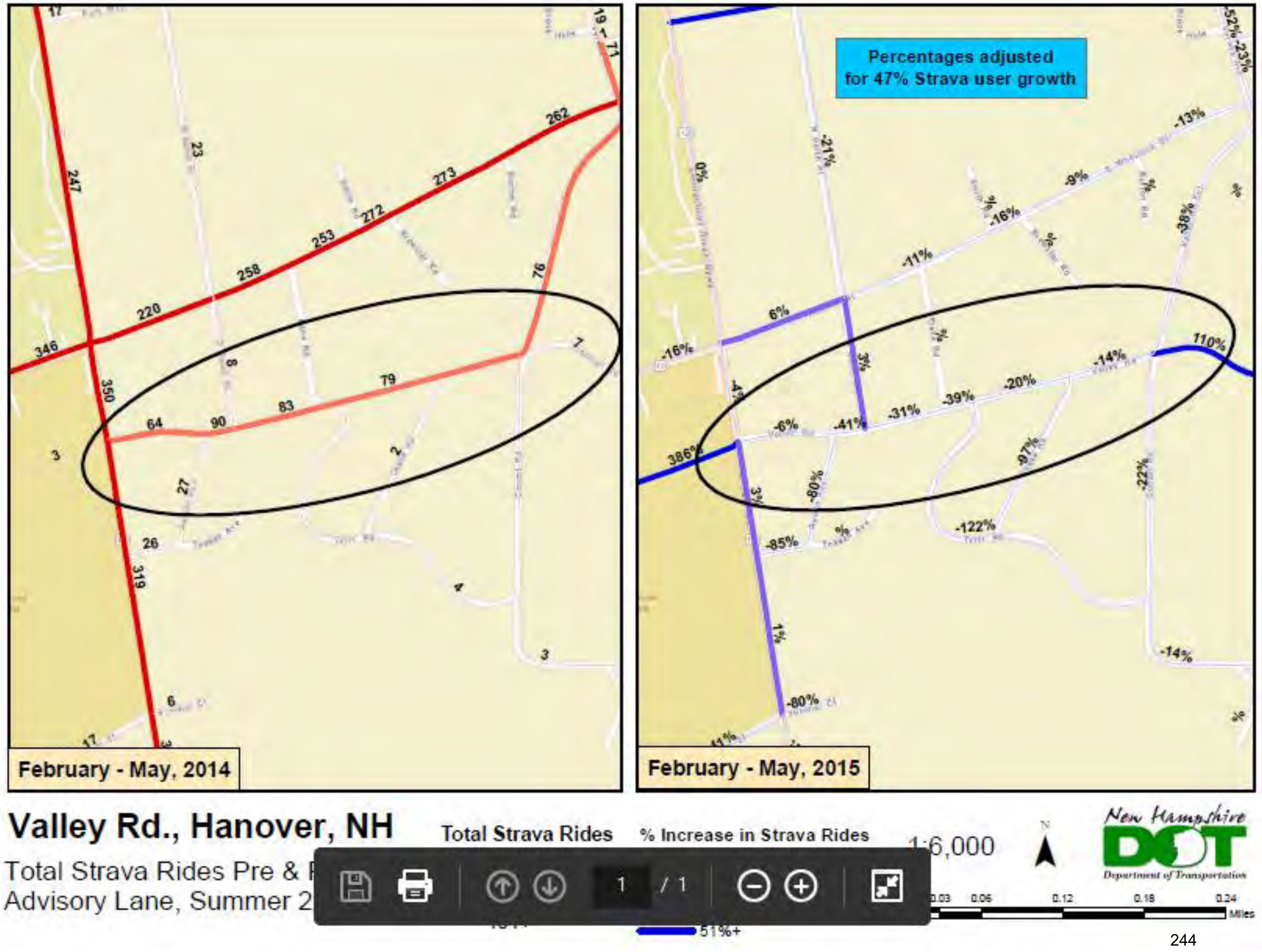


Before/After:

Valley Rd.

Advisory Lane, Summer 2014

% Increase in Total Rides

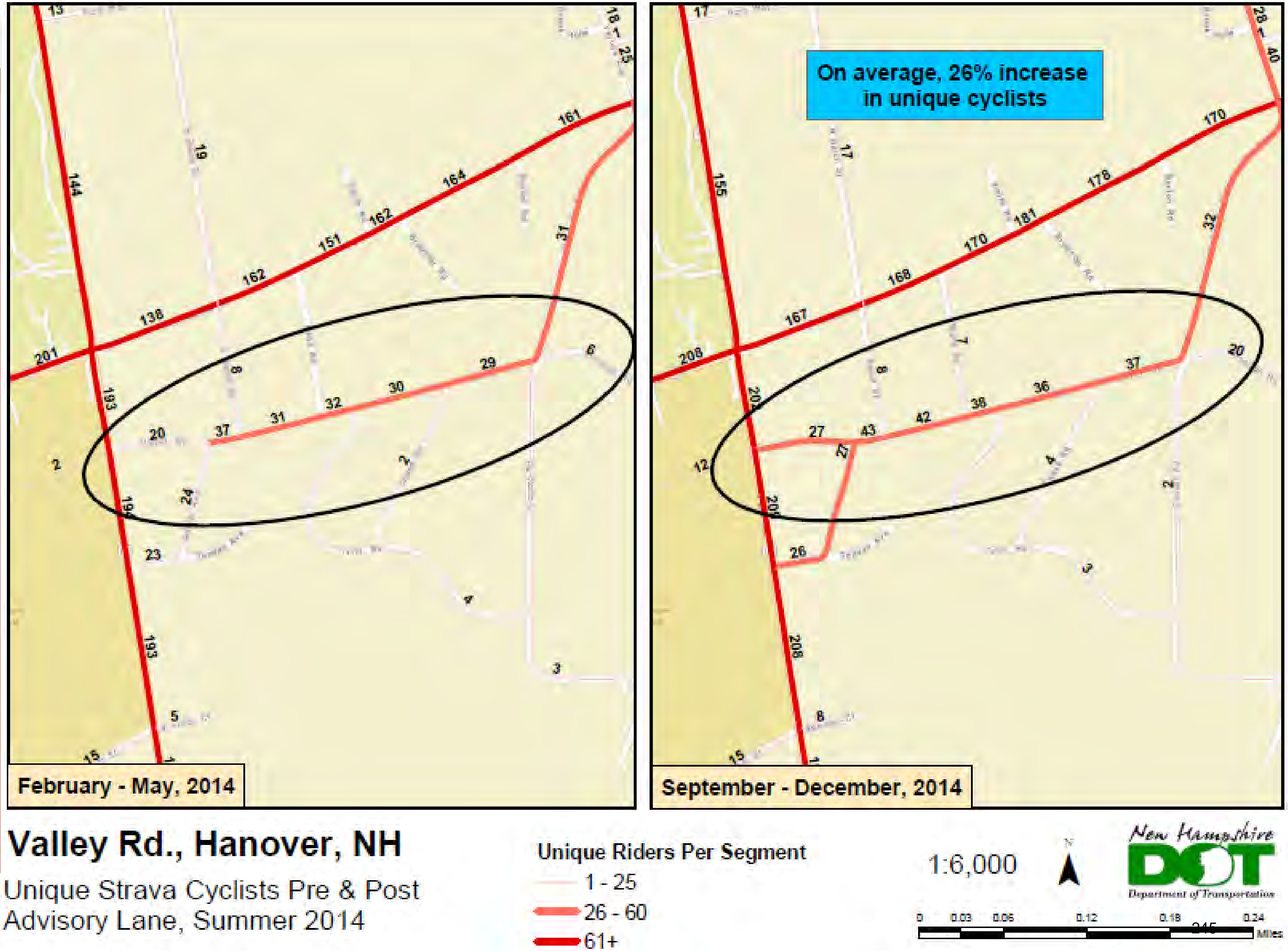


Before/After:

Valley Rd.

Advisory Lane, Summer 2014

Unique Cyclists

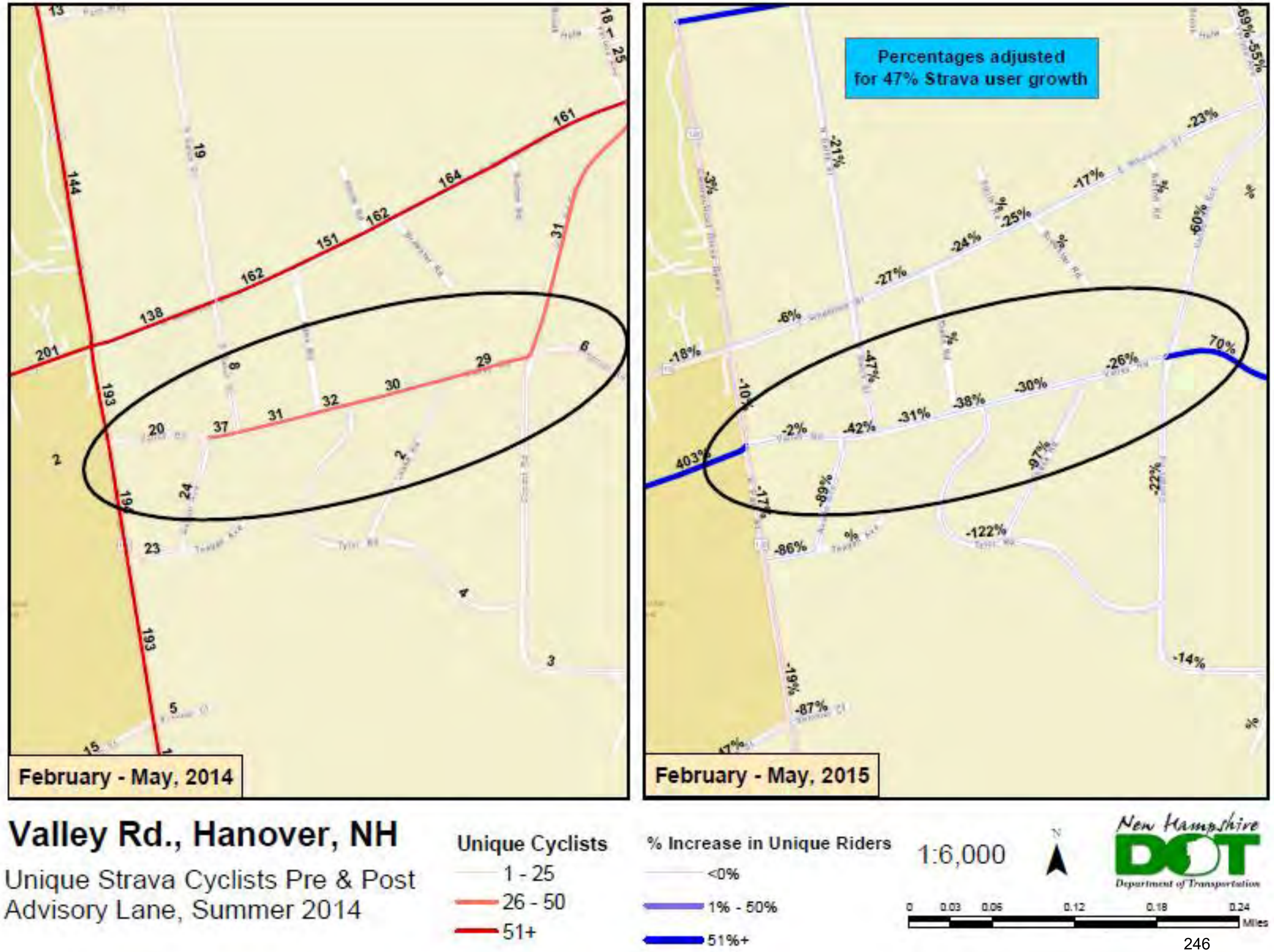


Before/After:

Valley Rd.

Advisory Lane, Summer 2014

% Increase in Unique Cyclists



APPENDIX J

Level of Traffic Stress Modeling Guide

03.11.2019

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Table of Contents

Overview

The Level of Traffic Stress (LTS) Model is a rating given to a road segment or crossing, indicating the traffic stress it imposes on bicyclists.

Mekuria et al. (2012) pioneered the Level of Traffic Stress (LTS) roadway rating system, which considers roadway attributes, such as: number of vehicle lanes, speed limit, bike lane width, and parking. Increases in the number of lanes and/or traffic speeds and traffic volumes generate progressively higher LTS scores (i.e., less suitable). An LTS network map enables users to identify and prioritize areas for investment that may increase bicycle network connectivity while decreasing traffic stress encountered by bicyclists.

Mekuria et al.'s (2012) 1-4 roadway stress rating scheme corresponds to four distinct classes of the population, as first suggested by Geller in 2006 (Dill and McNeil, 2013). This four-tiered LTS classification scheme gives planners and engineers a better description of whom a roadway serves.

The following table details the LTS rating system in relation to Geller's (2006) population classifications:

LTS Rating	LTS Rating Description	Population Class	Population Class Description
LTS 1	Strong separation from all automobiles, except low speed, low volume traffic. Simple-to-use crossings. Suitable for children.	No Way No How	No interest in riding regardless of bicycle accommodations.
LTS 2	Except in low speed / low volume traffic situations, cyclists have their own place to ride that keeps them from having to interact with traffic. Physical separation from higher speed and multilane traffic. Crossings that are easy for an adult to negotiate. Limits traffic stress to what the mainstream adult population can tolerate.	Interested but Concerned	Uncomfortable negotiating fast, high volume traffic.
LTS 3	Interaction with moderate speed or multilane traffic, or close proximity to higher speed traffic.	Enthused and Confident	Willing to ride with minimal bicycle accommodations.
LTS 4	Forced to mix with moderate speed traffic or close proximity to high speed traffic.	Strong and Fearless	Willing to ride under any condition.

Inputs: Roadway Attributes

LTS model attributes are critical to a systematic evaluation of roadway bicycle stress. While not all attributes are available in the standard New Hampshire Department of Transportation (NHDOT) Geographic Information System (GIS) road database, every additional attribute that can be provided will add value to the model result. Attributes that are not available in a standard NHDOT GIS dataset are optional inputs in the model.

Speed is a required attribute for this model, however speed must be formatted as an LTS speed (1, 2, 3, or 4). If a speed attribute is not in LTS format (i.e. 65 mph), or if the speed attribute is non-existent, it must be converted to or generated in an LTS format by using one of the LTS Speed Tools (see "Speed LTS Scripts").

The following roadway attributes inform the LTS model:

Attribute	Type	Description	Required Formatting	Optional/ Required
Input	*Feature class, shapefile, or table*	*The table containing all road segments and road attributes to be processed. LTS input fields will be copied to the output shapefile.*	*NA*	*Required for all Versions*
Speed (SPEED)* Can choose to replace NHDOT data with prevailing speed where available.*	Field	Either the posted speed limit or prevailing traffic speed of a roadway segment. This must be converted to the LTS speed format using one of the LTS Speed Tools. 20 = speeds ≤ 20 mph 1 = speeds > 20 mph and ≤ 25 mph 2 = speeds > 25 mph and ≤ 30 mph 3 = speeds > 30 mph and ≤ 35 mph 4 = speeds > 35 mph 5 = interstate	20, 1, 2, 3, 4, 5	Required for all Versions
Traffic Direction (DIRECTION_)	Field	Operational direction of a roadway during non-peak period hours. One way = Roadway that operates with traffic moving in a single direction. Two way = Roadway that operates with traffic moving in both directions.	"One way" "Two way"	Required for all Versions
Number of Lanes (NUM_LANES)	Field	Total number of lanes, which includes both directions of a roadway. Auxiliary lanes, such as truck lanes, turning lanes, and passing lanes are included.	1, 2, 3…	Required for all Versions
AADT (AADT)	Field	Annual Average Daily Traffic (AADT), represented in number of vehicles per day (averaged over the course of a year). This traffic volume approximation can upgrade or downgrade the stress level of a road.	Numeric (e.g. 8200)	Required for all Versions
Road Shoulder Width (SHLDR_WIDT = RIGHT & SHLDR_WI_1 =LEFT)	Field	Width of road shoulder. The shoulder width is measured from the edge of pavement to the center of the white 'fog' line. The shoulder is the same material as the roadway surface. *Note*: shoulder width fields must be specified for the right and left lanes; widths are not required for every record.	Numeric (e.g. 10)	No Required for Versions 2 & 3 (not included in Version 1)
Attribute	**Type**	**Description**	**Required**	**Optional/**

			Formatting	Required
Bicycle Lane Width (BikeLWidR = right; BikeLWid_L = left)	Field	The width of a striped bicycle lane or road shoulder ≥ 4 ft. The LTS model automatically labels road shoulders ≥ 4 ft. in width as a bicycle lane. *Note*: widths are not required for every record.	Numeric (e.g. 4)	Optional for Versions 1 & 2, Required for Version 3
Parking Lane Width (ParkWidthR =right; ParkWidthL= left)	Field	The width of the parking area, measured in feet. When parking is present, prospective road shoulder bicycle lanes are determined by subtracting the parking width lane width from the shoulder lane width. *Note*: widths are not required for every field.	Numeric (e.g. 6)	Optional for Versions 1 & 2, Required for Version 3
*Prevailing speed data should replace SPEED field data for the SPEED script to work appropriately.				

For additional attribute descriptions, consult the NHDOT Roadway Data Inventory User Guide: https://www.nh.gov/dot/org/projectdevelopment/planning/gis-data-catalog/documents/RDIUserGuide20185Mar.pdf

Level of Traffic Stress Tools

To simplify the processing of posted or prevailing speed information, we have created two Speed LTS Tools (described below) that categorize a roadway as LTS 1-4, 5, 20, and 200 using the following decision criteria.

Speed Tool (No Speed Limit): No speed is provided

When no speed is provided, Speed Tool (No Speed Limit) will generate a speed using the Federal Highway Administration (FHWA) roadway Functional Classification System. Roadways are functionally grouped according to the levels of Mobility (through) and access (destination) that they provide. This tool requires a functional class field input. The result appears in the input table as a SHORT field named, "SPEEDLTS".

The LTS speeds are assigned to functional groups as follows:

Functional System	Assigned LTS Speed
Contains "Local"	2
Contains "No Func"	2
Contains "Minor Arterial"	2
Contains "Minor Collector"	2
Contains "Major Collector"	3
Contains "Principal Arterial"	4
Contains "Interstate"	5
All Else (Error)	200

Speed Tool (Speed Limit): Given speed limit or prevailing speed

When the speed limit or prevailing speed field is provided, Speed Tool 2 will convert all available speeds into an LTS speed limit number, 1-4. For all other fields, the Functional System (FUNCT_SY_1) is used to assign an LTS speed. This tool requires a speed field input and a functional class field input. The result appears in the input table as a SHORT field named, "SPEEDLTS". Note: The speed input field must not contain text.

The LTS speeds are assigned as follows:

Speed Limit or Prevailing Speed	Assigned LTS Speed
≤ 20 mph	20
> 20 mph and ≤ 25 mph	1
> 25 mph and ≤ 30 mph	2
> 30 mph and ≤ 35 mph	3
> 35 mph	4
All Else (Error)	200
Functional Group	**Assigned LTS Speed**
Contains "Local"	2
Contains "No Func"	2
Contains "Minor Arterial"	2
Contains "Minor Collector"	2
Contains "Major Collector"	3
Contains "Principal Arterial"	4
Contains "Interstate" {Also ramps}	5
All Else (Error)	200

LTS Model Versions

The matrix for each LTS model version is an adaptation of Dr. Peter Furth's Level of Traffic Stress Criteria for Road Segments, version 2.0, June, 2017. This LTS framework has been adapted to best accommodate New Hampshire roadway datasets and constraints.

The user must first decide which "Version" of the LTS model they should run. Version 1 is the fastest and simplest algorithm, computing LTS scores based on a minimal set of data that is available for all NHDOT roadways. The model parameters include: number of lanes, traffic direction, Annual Average Daily Traffic (AADT), and SpeedLTS (created using one of two SpeedLTS tools: *Speed Tool (Speed Limit)* and *Speed Tool (No Speed Limit)*.

Speed LTS (No Speed Limit) and then LTS Version 1 should be pursued when no data has been collected outside of the NHDOT roads GIS layer and road shoulder widths are all less than 4ft wide)

Speed LTS (Speed Limit) and then LTS Version 1 should be pursued when speed data is the only additional data added to NHDOT roads GIS layer and road shoulder widths are all less than 4ft wide).

Speed LTS (Speed Limit or No Speed Limit) and then LTS Version 2 should be pursued if some road shoulder widths are greater than 4ft wide. *Note*: LTS version 2 will run code on records with shoulder widths ≥ 4ft, for all other records the script will pursue code of Version 1.

Speed LTS (Speed Limit or No Speed Limit) and then LTS Version 3 should be pursued if some road should widths are greater than 4ft wide, if parking area width for some records is greater than 0 , and/or biking lane width is greater than 0. *Note*: LTS Version 3 will run code seeking additional parameter data, for those records lacking bike lane and/or parking lane widths the script will pursue code of Version 2. For those records lacking shoulder widths < 4ft, the script will pursue code of Version 1. For example, if bicycle and parking lane data was only provided for 2000 out of 10,000 road segments, but shoulder lane data was included for all 10,000, 2000 segments would be scored with the Version 3 model results, and the other 8,000 would be scored using model Version 2.

Output fields can be found to the far right of the resulting shapefile's attribute table. Scores and the model version used to calculate are provided for the left and right sides of the roadway individually (**LTSLEFT** and **LTSRIGHT**), and then the combined LTS score (**LTSCOMB**) is provided that reflect the higher score of the two sides as the final segment LTS score. The **LTS** field is the final LTS rating and the **VERSION** field provides recap of the model version used for that road segment.

The following charts detail model version inputs and matrices:

LTS Model (Version 1): Speed, Traffic Direction, Number of Lanes, AADT

Number of lanes	Effective AADT*	Speed (Speed LTS score) ≤ 20 mph (20)	21-25 mph (1)	26-30 mph (2)	31-35 mph (3)	≥36 mph (4)	Interstate (5)
Unlaned 2-way street (no centerline)	0-750	LTS 1	LTS 1	LTS 2	LTS 2	LTS 3	LTS 5
	751-1500	LTS 1	LTS 1	LTS 2	LTS 3	LTS 3	LTS 5
	1501-3000	LTS 2	LTS 2	LTS 2	LTS 3	LTS 4	LTS 5
	3000+	LTS 2	LTS 3	LTS 3	LTS 3	LTS 4	LTS 5
1 thru lane per direction (1-way, 1-lane street or 2-way street with centerline)	0-750	LTS 1	LTS 1	LTS 2	LTS 2	LTS 3	LTS 5
	751-1500	LTS 2	LTS 2	LTS 2	LTS 3	LTS 3	LTS 5
	1501-3000	LTS 2	LTS 3	LTS 3	LTS 3	LTS 4	LTS 5
	3000+	LTS 3	LTS 3	LTS 3	LTS 3	LTS 4	LTS 5
2 thru lanes per direction	0-8000	LTS 3	LTS 3	LTS 3	LTS 3	LTS 4	LTS 5
	8001+	LTS 3	LTS 3	LTS 4	LTS 4	LTS 4	LTS 5
3+ thru lanes per direction	Any AADT	LTS 3	LTS 3	LTS 4	LTS 4	LTS 4	LTS 5

Effective AADT = AADT for two-way roads; Effective AADT=1.5 AADT for one-way roads

LTS Model (Version 2): Speed, Traffic Direction, Number of Lanes, Shoulder Width

Attempt Version 2 code below. If above criteria not met, attempt Version 1 on remaining records.

Number of lanes	Bike lane width*	Speed (Speed LTS score)				
		≤ 25 mph (20 & 1)	26-30 mph (2)	31-35 mph (3)	≥ 36 mph (4)	Interstate (5)
1 thru lane per direction, or unlaned	6 ft. +	LTS 1	LTS 2	LTS 2	LTS 3	LTS 5
	4 or 5 ft.	LTS 2	LTS 2	LTS 2	LTS 4	LTS 5
2 thru lanes per direction	6 ft. +	LTS 2	LTS 2	LTS 2	LTS 3	LTS 5
	4 or 5 ft.	LTS 2	LTS 2	LTS 2	LTS 4	LTS 5
3+ lanes per direction	Any width	LTS 3	LTS 3	LTS 3	LTS 4	LTS 5

Notes: 1) If bike lane / shoulder is frequently blocked, use model Version 1. 2) Qualifying bike lane / shoulder should extend at least 4 ft from a curb and at least 3.5 ft from a pavement edge or discontinuous gutter pan seam 3) Bike lane width includes any marked buffer next to the bike lane. 4) AADT will in place of bike lane with if shoulder width <4ft.

LTS Model (Version 3): Speed, Traffic Direction, Number of Lanes, Shoulder Width, Bicycle Lane Width, Parking Lane Width

Number of lanes	Bike lane reach = Bike + Pkg lane width*	Speed (Speed LTS score)				
		≤ 25 mph (20 & 1)	26-30 mph (2)	30-35 mph (3)	≥ 36 mph (4)	Interstate (5)
1 thru lane, or unlaned, one way	4 or 5 ft.	LTS 2	LTS 2	LTS 2	LTS 4	LTS 5
	6+ ft.	LTS 1	LTS 2	LTS 2	LTS 3	LTS 5
1 lane per direction	15+ ft.	LTS 1	LTS 2	LTS 3	LTS 3	LTS 5
	12-14 ft.	LTS 2	LTS 2	LTS 3	LTS 3	LTS 5
2 lanes per direction (2-way)	15+ ft.	LTS 2	LTS 3	LTS 3	LTS 4	LTS 5
2-3 lanes per direction (1-way)		LTS 2	LTS 3	LTS 3	LTS 4	LTS 5
other multilane		LTS 3	LTS 3	LTS 3	LTS 4	LTS 5

Coding for bike lane reach ≤6ft is within Version 2 decision matrix

*Bike lane width is either actual bike lane width or shoulder lanes >4 ft. in width.
Notes: 1) If bike lane is frequently blocked, use model Version 1, 2) Qualifying bike lane must have reach (bike lane width + parking lane width) > 12 ft, 3) Bike lane width includes any marked buffer next to the bike lane, 4) AADT will in place of bike lane with if shoulder width <4ft.

Outputs

The LTS model generates a copy of the original input feature class and adds several new output fields to the output table. The output fields are as follows:

Field Name	Description	Type
AADT_NEW	Uses the AADT field and Traffic Direction field inputs to generate an "Effective AADT". Effective AADT = AADT for two-way roads; 1.5 * AADT for one-way roads	Double
BikeWiL & BikeWiR	Uses the Road Shoulder Width field input (left and right) to generate a bicycle lane if the road shoulder is ≥ 4 ft. In such cases, the bicycle lane width is equivalent to the shoulder lane width. When both a Road Shoulder Width field and Bicycle Lane Width field are input into model, this field will contain both input bicycle lane widths and road shoulder-derived widths. If the model runs Version 1 only, these fields will contain all zeros.	Long
ReachL & ReachR	Contains the calculation for the Bike Lane Reach (left and right lanes). Bike Lane Reach = Bike + Parking lane width. This calculation is necessary for model Version 3. If the model runs Version 1 or 2 only, these fields will contain all zeros.	Long
LTSLEFT	Results of LTS model or the left lane and the Version of code run to produce score (e.g., 3 V1). The numbers represent an LTS score 1 through 4, 5 (interstate), or 200 (error). Version 3 results are prioritized over Version 1 and 2 results, and Version 2 results are prioritized over Version 1 results.	Long
LTSRIGHT	Same as above, but for right lane	Long
LTSCOMB	A combination of LTSLEFT and LTSRIGHT scores in which the highest score is assumed. This is the final LTS score and model version for all road segments in the input table.	Long
LTS	Final LTS score for a road segment, without the model version.	
VERSION	Reports the version from which the LTS score was derived. The score will either read, "V1", "V2", or "V3".	

Troubleshooting

Whenever the model encounters input combinations that it is unable to recognize and process, it will return the value, “200”.

If the model fails to complete processing, or if you see 200 in fields other than LTSLEFT, LTSRIGHT, LTSCOMB, or LTS, try the following:

I. Check the Field Type

Double check that your input fields are the correct Type and do not contain additional text characters, etc.

II. Double Check the Phrasing

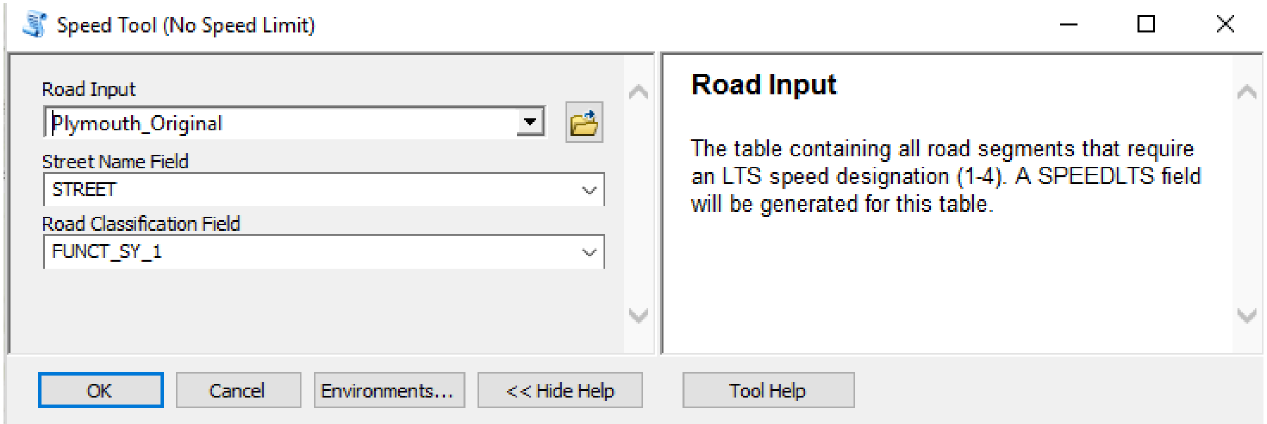
If text field inputs, such as Traffic Direction, do not match the required formatting exactly, the model will not process correctly. See the “Inputs: Roadway Attributes” table for format requirements.

III. Try Adding a New Field

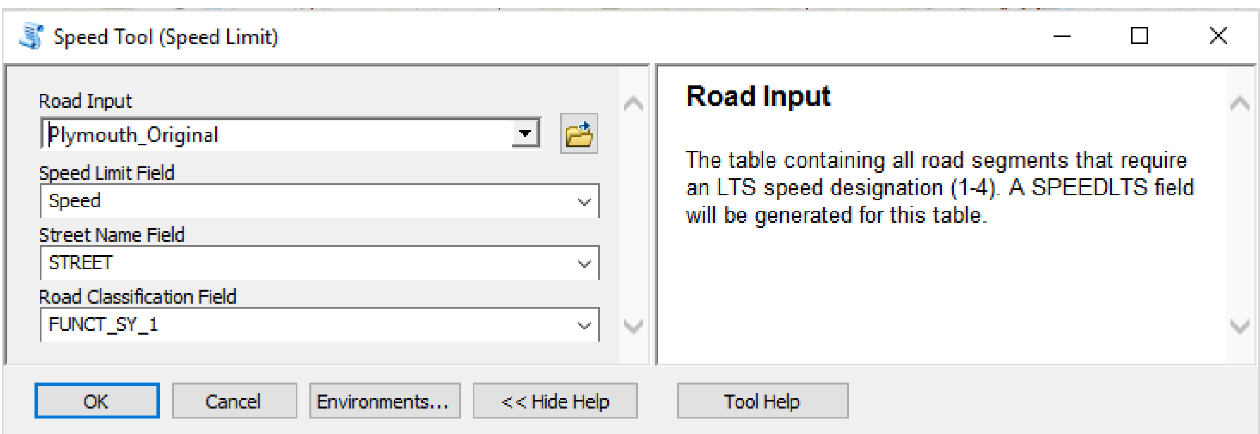
Try creating a new field for one or more of your original input fields. Copy the data over into the new field. In certain cases, this will fix an error.

Examples

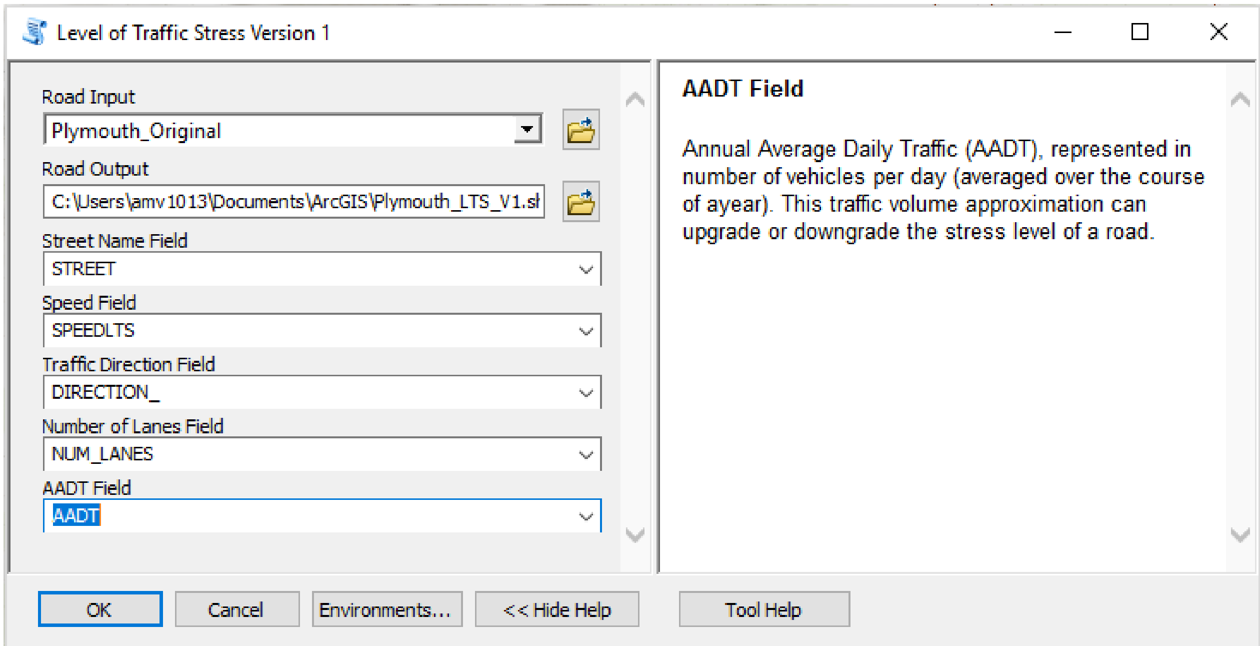
Speed Tool (No Speed Limit):



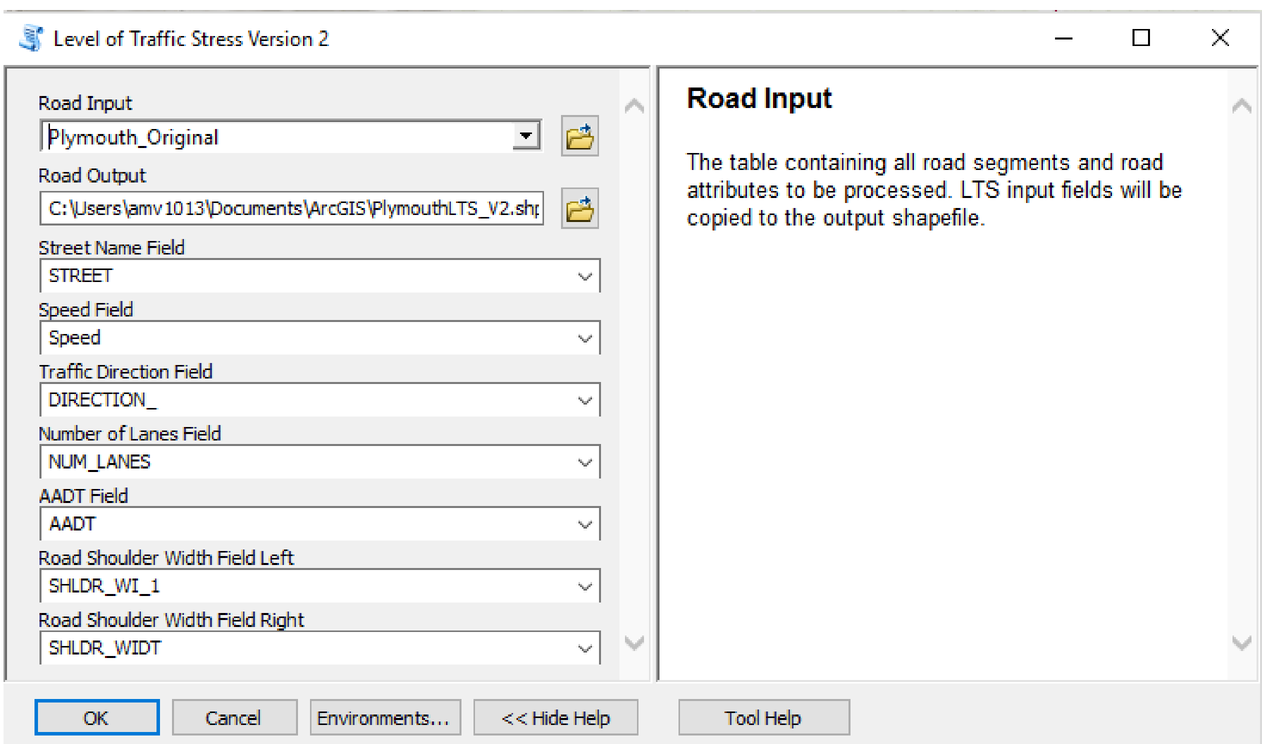
Speed Tool (Speed Limit):



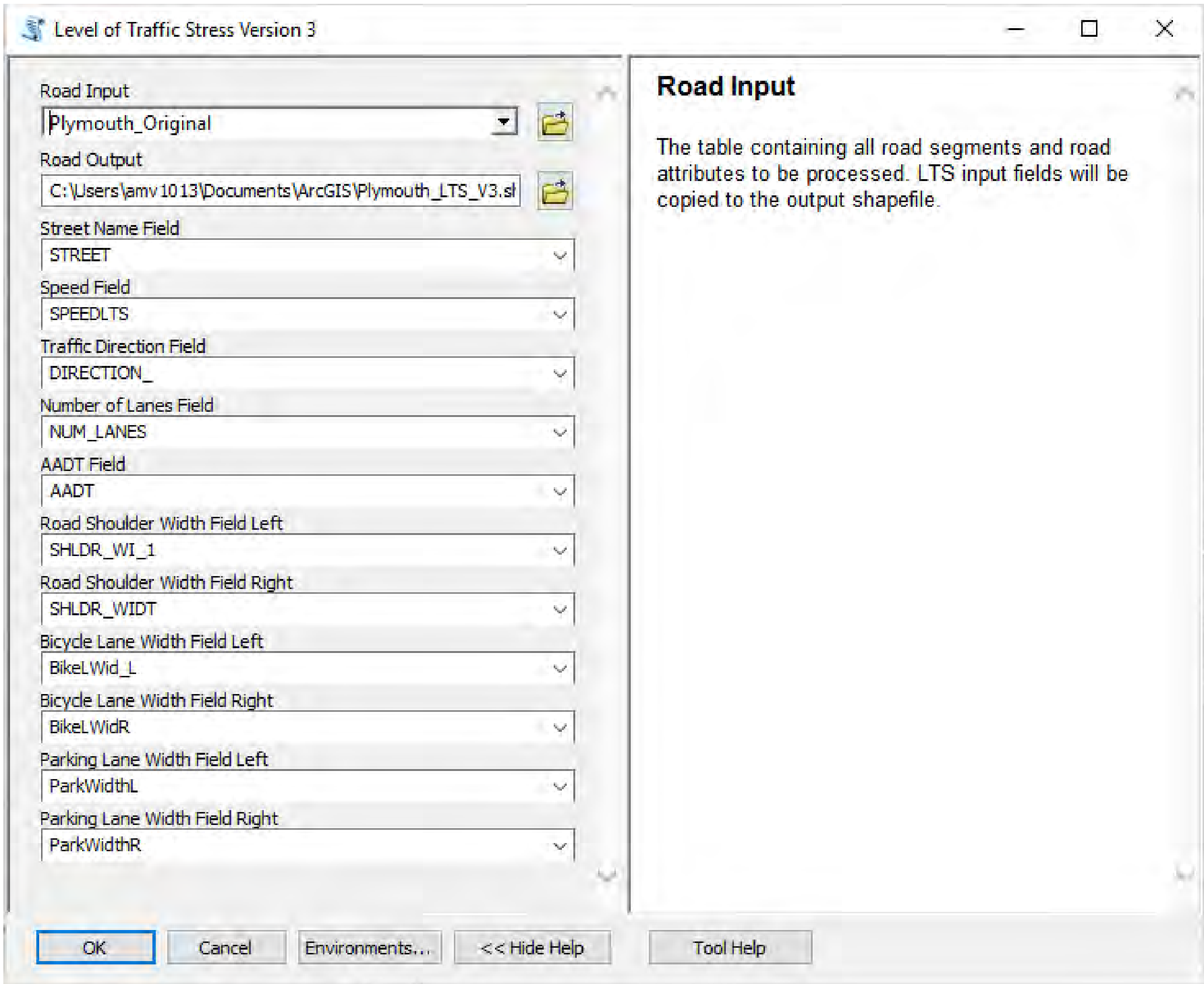
Level of Traffic Stress Version 1 Model with Inputs:



Level of Traffic Stress Version 2 Model with Inputs:



Level of Traffic Stress Version 3 Model with Inputs:



Speed Tool and Level of Traffic Stress Model Output Fields:

SPEEDLTS	BikeWiL	BikeWiR	ReachL	ReachR	AADT_NEW	LTSLEFT	LTSRIGHT	LTSCOMB	LTS	VERSION
3	8	4	8	4	0	2 V2	2 V2	2 V2	2	V2
2	0	0	0	0	0	2 V1	2 V1	2 V1	2	V1
2	0	0	0	0	0	2 V1	2 V1	2 V1	2	V1
2	0	0	0	0	0	2 V1	2 V1	2 V1	2	V1
2	6	5	6	5	2100	2 V2	2 V2	2 V2	2	V2
2	0	0	0	0	0	2 V1	2 V1	2 V1	2	V1
2	0	0	0	0	0	2 V1	2 V1	2 V1	2	V1
2	0	0	0	0	0	2 V1	2 V1	2 V1	2	V1
3	0	0	0	0	14526	3 V1	3 V1	3 V1	3	V1
2	0	0	0	0	0	2 V1	2 V1	2 V1	2	V1
2	0	0	0	0	0	2 V1	2 V1	2 V1	2	V1

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Furth, P. (2017). Level of Traffic Stress Criteria for Road Segments, version 2.0, June, 2017. [http://www.northeastern.edu/peter.furth/wp-content/uploads/2014/05/LTS-Tables-v2-June-1.pdf]

End of Guide

Updated *Monday, March 11, 2019*

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