NH 16 Realignment Project

Dummer, New Hampshire

PREPARED FOR

NH Department of Transportation
PO Box 483, 7 Hazen Drive
Concord, NH 03302-0483

PREPARED BY

VHB
2 Bedford Farms Drive Suite 200
Bedford, NH 03110
603.391.3900

April 2018

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NHDES 401 Water Quality Certificate Application Form

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

APPLICATION FOR WATER QUALITY CERTIFICATION

Water Division

Water Quality Certification Program

RSA: 485-A:12

Date of Request _____

Date Request Received by NHDES _____

I. Applicant Information

Principal Place of Business of the Applicant NH Department of Transportation	
Mailing Address [Street, PO Box, RR, etc.] 7 Hazen Drive, PO Box. 483	
City/Town and Zip Code Concord, NH 03302 -0483	
Telephone No. 603-271-1550	Email Address: Mark.Hemmerlein@dot.nh.us
Name and Title of Signatory Official Responsible for the Activity for which Certification is Sought (e.g., President, Administrator)	

II. Project Information

Name of Project: Route 16 Improvements; NHDOT Project 16304
Name of Town and County that contains the Project: Town of Dummer. Coos County
Name of Receiving Waterbody and Drainage Basin: Androscoggin River
Summary of Activity (e.g., construction, operation, or other practice or action): Reconstruct and realign approximately 1.3 miles (7,200 feet) of roadway (Route 16); Approx. 5,000 ft of new road alignment will be moved approximately 50 to 80 feet west of existing road and farther from the river. Road will be raised to allow enhanced sub-base, improve drainage and existing culverts will be extended. Vegetated roadside buffer will be constructed in existing road footprint to provide water quality treatment.

III. Additional Submittal Information

PLEASE SUBMIT AS MUCH INFORMATION AS POSSIBLE IN ELECTRONIC FORMAT

phone (603) 271-2457
fax (603) 271-7894
PO Box 95, Concord, NH 03302-0095
www.des.nh.gov

Please provide an individual response to each bullet, below. If applicable information is contained in the application materials, please provide a reference to the specific section in the application materials that will represent the response to the individual bullets below.
(See Enclosed Narrative)

- Type of activity (e.g., construction, operation, other action such as water withdrawal) and the start and end dates of the activity.
- The characteristics of the activity: Whether the activity is associated with a discharge and/or water withdrawal and whether the discharge and/or withdrawal is proposed or occurring.
- The characteristics of the discharge and/or withdrawal
    - Flow rate (cfs)
    - Potential chemical, physical, biological constituents
    - Frequency (e.g., daily, hourly,)
    - Duration
    - Temperature (Celsius)
    - Latitude and longitude (dd:mm:ss)

- The existing and designated use(s) that are potentially affected by the proposed activities. (Designated Uses are listed in the NHDES Consolidated Assessment and Listing Methodology).
- The provision(s) of surface water quality standards (Env-Wq 1700) that are applicable to the designated uses affected by the proposed activities.
- A pollutant loading analysis to show the difference between predevelopment and post-development pollutant loads for a typical year. The objective of the loading analysis is to show post-development pollutant loads do not exceed pre-development pollutant loads. Loading analysis guidance and a simple spreadsheet model will be provided by NHDES. The loading analysis will be used to determine appropriate stormwater management measures, which must be effectively designed, installed, and maintained to ensure compliance with surface water quality standards.
- A description of any other aspect of associated with construction and operation of the activity that would affect the chemical composition, temperature, flow, or physical aquatic habitat of the surface water.
- An original or color copy/reproduction of a United States Geological Survey Quadrangle Map that clearly shows the location of the activity and all potential discharge points.
- A copy of the final complete federal permit application or federal license application, including the federal permit, license, or project number.
- A copy of the NHDES wetlands permit (RSA 482-A:3), if necessary.
- A copy of the NHDES alteration of terrain permit (RSA 485-A:17), if necessary.
- The name(s) and address(es) of adjoining riparian or littoral abutters.
- A plan showing the proposed activities to scale including:
    - The location(s) and boundaries of the activities;
    - The location(s), dimension(s), and type(s) of any existing and/or proposed structures; and
    - The location(s), name(s), identification number(s), and extent of all potentially affected surface water bodies, including wetlands.
- For projects that involve a new surface water withdrawal, provide the following:

- a copy of the water conservation plan (WCP) submitted to the NHDES Water Conservation Program and the status of NHDES approval, or
- a copy of a waiver approved by the NHDES Water Conservation Program that waives the requirement to submit a WCP prior to or in conjunction with the application for water quality certification.

[Pursuant to Env-Wq 2101, and unless a waiver is applied for and granted by NHDES, all applicants for water quality certification are required to submit a water conservation plan (WCP) for projects that involve a new withdrawal from a surface water prior to or in conjunction with this application. Contact the NHDES Water Conservation Program for guidance related to drafting a WCP and the review and approval process. Information regarding the WCP, including contact information, may be found at http://des.nh.gov/organization/divisions/water/dwgb/water_conservation/index.htm

- If the project is located within ¼ (one quarter) mile of a designated river, as defined under RSA 483 (the Rivers Management and Protection Act), provide documentation showing that the Local River Management Advisory Committee (LAC) has been provided with a copy of this complete application. A list and map of the designated rivers, as well as contact information, may be found at http://des.nh.gov/organization/divisions/water/wmb/rivers/desigriv.htm

Signature – MUST BE SIGNED AND DATED BY APPLICANT

To the best of my knowledge, the data and information described above, which I have submitted to the New Hampshire Department of Environmental Services, is true and correct. I understand that an approval of the requested water quality certification based upon incorrect data may be subject to revocation of the certification. I have complied with all local regulations or ordinances relative to the proposed activity and have obtained or will obtain, prior to the commencement of any work, all other approvals that may be required.

Signed: _____

Date: 4/4/18

phone (603) 271-2457
fax (603) 271-7894
PO Box 95, Concord, NH 03302-0095
www.des.nh.gov

1.0 Introduction

On behalf of the New Hampshire Department of Transportation ("the Applicant" or NHDOT), VHB has prepared this 401 Water Quality Certificate application pursuant to the New Hampshire Revised Statutes Annotated (RSA) Chapter 485-A:8 and NH Code of Administrative Regulations and surface water quality standards contained in Env-Ws 1700. A 401 Water Quality Certificate ("WQC") is required because the proposed project that involves reconstruction of a portion of NH 16 in Dummer, NH will impact more than 3.0 acres of wetland area, which triggers an individual wetland permit review and approval by the US Army Corps of Engineers ("Corps") under Section 404 of the Clean Water Act.

The following provides a description of the proposed project location, existing and proposed drainage conditions, information pertaining to the proposed stormwater treatment measures and pollutant loading analysis as well as other relevant wetland and water resource information.

2.0 Project Description

The proposed project involves realigning of a portion of NH 16 that is adjacent to the Androscoggin River from Muzzy Hill Road (NH 110A) to Dummer Pond Road. This portion of NH 16 is in poor condition with extensive pavement cracking due to reoccurring frost heaves during the winter months. Erosion of roadway slopes adjacent to the Androscoggin River is also becoming a problem in some locations. Realigning the roadway to the west, away from the Androscoggin River, would minimize the need for ongoing slope stabilization and limit impacts to the river itself.

The total length of the project is approximately 7,200 feet, with approximately 5,000 feet of roadway is proposed to shift approximately 50 feet to the west of the existing road alignment. The roadway will gradually shift to the west after the Robbins Brook crossing and then will merge back on to the existing alignment prior to Dummer Pond Road. This portion of the roadway will be raised approximately 3 feet. The proposed project will require full box reconstruction along the roadway. The new alignment will have two 11-foot wide travel lanes with 4-foot shoulders.

The new roadway alignment will be constructed first, with current vehicle traffic traveling along the existing segment of NH 16. During the merging of the new segment with the existing roadway, one lane of the roadway will be closed during the day while the other will be open to allow through traffic. Daytime flagging operations will be in place throughout the duration of this phase of the project.

Supplemental Application Narrative

The following provides a detailed response for each of the fourteen (14) questions contained on the 401 WQC Application Form. Additional information is also contained in enclosed Appendices.

1. **Type of activity (e.g., construction, operation, other action such as water withdrawal) and the start and end dates of the activity.**

   The proposed project involves relocating and reconstructing a 1.3 mile stretch of Route 16 in the Town of Dummer, NH (See Appendix A - Project Location Map). Approximately 5,000 feet of the roadway will be shifted farther away from the Androscoggin River, which has slowly and incrementally moved closer to the roadway. The Androscoggin River represents the primary water body within or adjacent to the project area. This section of the river is within Assessment Unit (NHRIV400010603-04) and has no listed Category 4 or 5 water quality impairments, aside from mercury, which is as a Category 4A impairment common to all freshwater streams and ponds throughout the state. The mercury impairment relates to fish consumption and is addressed in the Northeast Regional Mercury TMDL study. Rollins Brook is also located within the project area as well as one or two smaller, unnamed tributaries (See Appendix A). These streams are part of Assessment Unit (NHRIV400010603-05) and, also, have no listed Category 4 or 5 water quality impairments, except for mercury. Extensive wetland areas are also located along the toe-of-slope within this roadway section. As noted in Item 9 below – separate state Wetland and Shoreland Permit Applications have been submitted associated with this project.

2. **The characteristics of the activity: Whether the activity is associated with a discharge and/or water withdrawal and whether the discharge and/or withdrawal is proposed or occurring.**

   The activity does not involve any point source discharges or withdrawals. Stormwater runoff during storm events represents the only discharge from the roadway. Under existing conditions, stormwater runoff sheet flows off both sides of the roadway into existing wetland or upland areas that drain to the nearby Androscoggin River. There are no existing stormwater treatment measures. The existing roadway consists of two, 11-foot travel lanes and a 1-foot shoulder. The proposed roadway will also have two, 11-foot travel lanes, but the shoulder will be widened by 3 feet on either side for safety purposes. The shoulder widening will increase the impervious area by approximately 32,920 square feet or 0.76 acres along the 1.3-mile long corridor. As discussed further below, a vegetated, roadside buffer will be constructed along much of the new roadway within the footprint of the existing roadway to provide stormwater treatment and to minimize any potential pollutant load increase as result of the proposed roadway improvement (See Roadway Design Plans in Appendix B).

3. **The characteristics of the discharge and/or withdrawal.**

   During construction, appropriate erosion and sediment control measures will be installed in accordance with the NH Stormwater Manual to avoid and minimize any movement and discharge of

sediment. The project will be subject to EPA's Construction General Permit (CGP) and will require the preparation of Construction Stormwater Pollution Prevention Plan (SWPPP).

A complete drainage analysis has been completed to assess potential changes in pre- and post-construction stormwater flow rates associated with the proposed project (See Appendix C - Drainage Report). The results of the drainage analysis reveal minimal change (i.e., ~ 1 cfs or less) in the estimated overall stormwater flow rates from the project area for the 2, 10 and 50-year storm events. Given the relatively flat roadway profile, runoff will continue to sheet flow off the pavement into extensive wetland areas along either side of the roadway. Existing drainage patterns will be retained.

As discussed in Item 6 below, the realignment of the road allows for a vegetated roadside buffer to be constructed along much of the east side of the relocated roadway within the existing roadway footprint. The vegetated buffer will be constructed in accordance with the design guidance contained in the NH Stormwater Manual to treat roadway runoff and minimize any increase in pollutant loads. The first 20 feet of the buffer will consist of a 4:1 slope or less and the remaining buffer length will have a uniform slope of 15% or less and a minimum length of 50 feet. In some sections, the buffer length will be 10 to 15 feet longer. Approximately 3,900 feet or 59% of the improved roadway will drain toward this vegetated buffer. Approximately 2,540 feet of the roadway draining to the vegetated buffer will consist of one travel lane while the remaining 1,350 feet of road draining to the buffer will consist of two lanes due to curvatures in the road and associated road banking or what is referred to as super-elevations in the curved sections. As mentioned above, the minimum buffer width will be 50 feet for the one travel lane sections and will vary between 50 to 65 feet in length for the two-lane sections. The anticipated pollutant removal efficiencies for the two-lane sections have been prorated based on the available vegetated buffer length relative to the recommended 80-foot buffer length for two-lane roads (See Pollutant Loading Details described in Item 6 below and presented in Appendix D).

For the roadway runoff draining to the west side of the road (away from the buffer), much of this runoff will be collected and conveyed within a grassed roadside swale that will be constructed with a 6:1 side slopes. The runoff within these swales will be conveyed to cross-culverts that flow beneath the road and drain towards the Androscoggin River.

The project will not involve any water withdrawals or transfer of flow between watersheds.

4. The existing and designated use(s) that are potentially affected by the proposed activities. (Designated Uses are listed in the NHDES Consolidated Assessment and Listing Methodology).

The principal water bodies within the project area consists of the Androscoggin River and Rollins Brook (see Appendix A - Project Map).

5. The provision(s) of surface water quality standards (Env-Wq 1700) that are applicable to the designated uses affected by the proposed activities.

Since the proposed project could result in the discharge of additional pollutants or increased flow due to an increase in impervious area, the proposed project is subject to the antidegradation provisions of the surface water quality standards (Env-Wq 1708). Based on pollutant loading and stormwater drainage analyses, discussed below, the project is not anticipated to adversely affect the existing and designated uses of the Androscoggin River.

6. **A pollutant loading analysis should be conducted to show the difference between pre- and post-development pollutant loads for a typical year. The objective of the loading analysis is to show post-development pollutant loads do not exceed pre-development pollutant loads. Loading analysis guidance and a simple spreadsheet model will be provided by NHDES. The loading analysis will be used to determine appropriate stormwater management measures, which must be effectively designed, installed, and maintained to ensure compliance with surface water quality standards.**

As discussed above, a pollutant loading analysis was conducted using NHDES' guidance and simple spreadsheet model to estimate the potential pollutant change and estimate the treatment effects of the proposed vegetated buffer. See Appendix D that contains copies of the relevant pollutant loading model spreadsheets, figures and a summary memo dated December 19, 2017 prepared by VHB for the NH Department of Transportation that presents pollutant loading results and a detailed description of the assumptions and methods used in completing this analysis. Table 1 below presents the results of the pollutant loading analysis.

Table 1. Preliminary Pollutant Loading Results for NH Route 16 Road Project using a Vegetated Buffer.

	TSS (LBS/YR)	TP (LBS/YR)	TN (LBS/YR)
PRE DEVELOPMENT LOADS (NO BMPS)	4141.3	12.6	77.8
PRE DEVELOPMENT LOADS (WITH BMPS)	4141.3	12.6	77.8
PRE DEVELOPMENT LOAD REDUCTION DUE TO BMPS	0.0	0.0	0.0
POST DEVELOPMENT LOADS (NO BMPS)	4964.1	15.1	93.3
POST DEVELOPMENT LOADS (WITH BMPS)	3829.3	13.0	81.7
POST DEVELOPMENT LOAD REDUCTION DUE TO BMPS	1145.7	2.1	11.8
POST DEVELOPMENT - PRE DEVELOPMENT (SHOULD BE 0 OR NEGATIVE)	-312.0	0.4	3.9
% DIFFERENCE FROM PRE DEVELOMENT LOADS (SHOULD BE 0 OR NEGATIVE)	-7.5%	3%	5.0%

The results of this analysis indicate the predicted post-construction total suspended solids (TSS) load would be approximately 7.5% or 312 lbs/year less than the predicted pre-development load due to the proposed treatment with a vegetated buffer. The predicted post-construction TP and TN loads, however, are predicted to increase by approximately 3% and 5% or by 0.4 and 3.9 lbs/year above the estimated pre-development load, respectively. Total phosphorus represents the pollutant of greater concerns since it is the more limited nutrient in freshwater water bodies and, thus, increased loads could potentially stimulate algal growth. Given the size of the Androscoggin River watershed, however, the predicted change of 0.4 lbs/year or 3% above the pre-development load is not likely to cause an observable or measurable change in water quality. The magnitude of this predicted increase is also likely to be well within the margin of error of this modeling procedure. Given limited upland area, extending the buffer length or constructing additional treatment measures would likely result in additional wetland impact or would impact existing vegetation within the protected shoreland zone. Given that the buffer length in Segments B and D (~2,500 ft of road) will be longer than 50 feet by 10 to 15 feet, the additional treatment for this one travel lane, which was not accounted for in this analysis, could partially or fully offset the estimated increase in phosphorus.

7. **A description of any other aspect of associated with construction and operation of the activity that would affect the chemical composition, temperature, flow, or physical aquatic habitat of the surface water.**

   Other than minor culvert extensions and channel realignments to accommodate the culver extensions, no other chemical or physical water quality or habitat changes are expected to occur in surface waters as a result of the proposed project. Since the travel lanes are essentially the same, the proposed roadway improvement will not require additional deicing chemical applications. In fact, the improved roadway substrate and drainage improvements will likely reduce the extent and magnitude of frost heaves within the roadway, which will improve the effectiveness of plowing for snow removal and limit refreezing of moisture on the road surface.

8. **An original or color copy/reproduction of a United States Geological Survey Quadrangle Map that clearly shows the location of the activity and all potential discharge points**

   See attached Project Location Map in Appendix A.

9. **A copy of the final complete federal permit application or federal license application, including the federal permit, license, or project number.**

   See Copy of USACE Wetlands Permit Application in Appendix E.

10. **A copy of the NHDES wetlands permit (RSA 482-A:3), if necessary.**

    A separate Wetlands Permit Application has been submitted (see Copy in Appendix E).

11. **A copy of the NHDES alteration of terrain permit (RSA 485-A:17), if necessary.**

    An Alteration of Terrain permit is not required by the project per the MOU between NHDOT and NHDES.

12. **The name(s) and address(es) of adjoining riparian or littoral abutters.**

    See abutter's list in the Wetland's Permit Application (see Appendix E).

13. **A plan showing the proposed activities to scale including:**
    a. **The location(s) and boundaries of the activities;**
    b. **The location(s), dimension(s), and type(s) of any existing and/or proposed structures; and**
    c. **The location(s), name(s), identification number(s), and extent of all potentially affected surface water bodies, including wetlands.**

    See Project Roadway Design Plans in Appendix B.

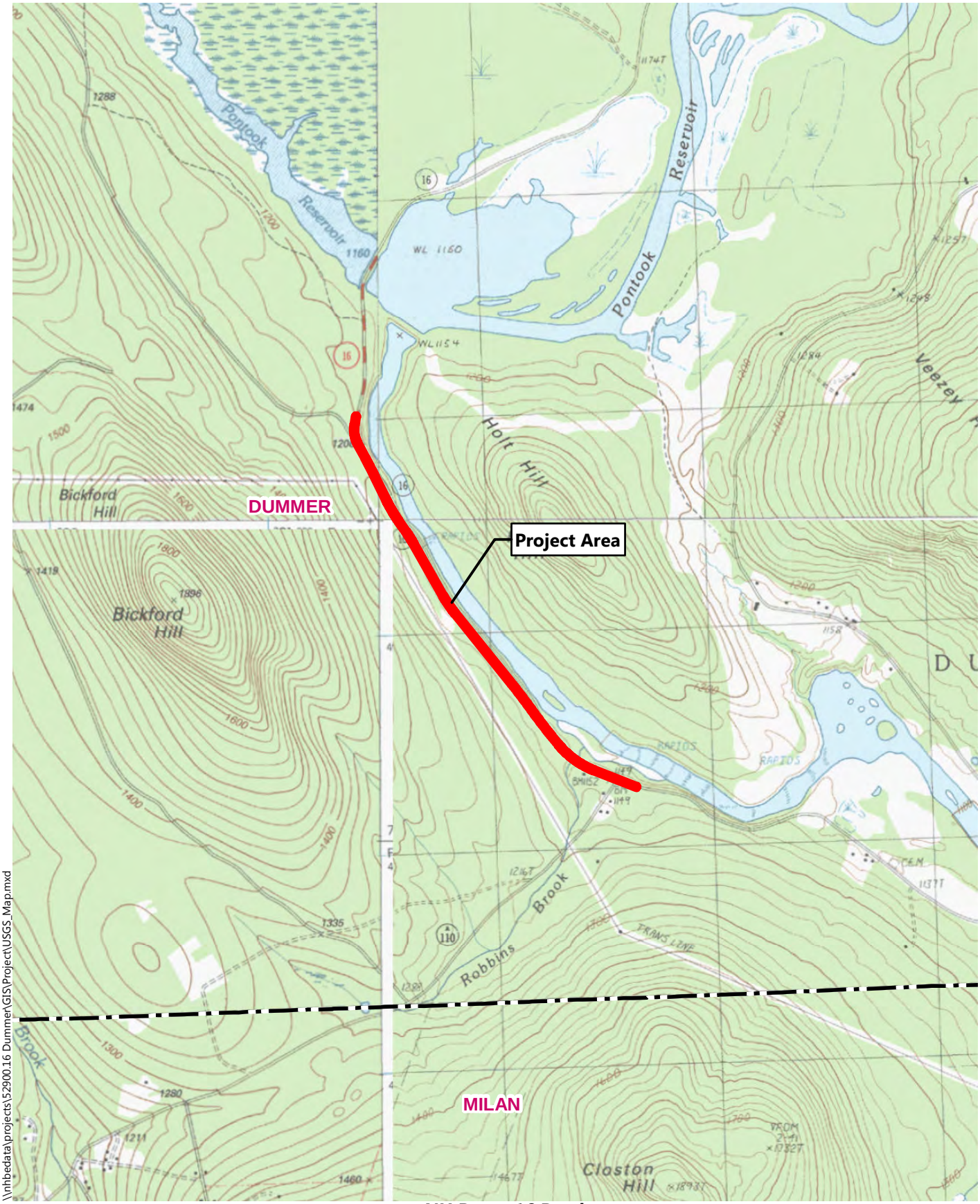
14. **For projects that involve a new surface water withdrawal, provide the following:**

    Not Applicable

Appendices A through E

Appendix A

Project Location and Watershed Map



\\nhbedata\projects\52900.16 Dummer\GIS\Project\USGS_Map.mxd

0 1000 2000 4000 Feet

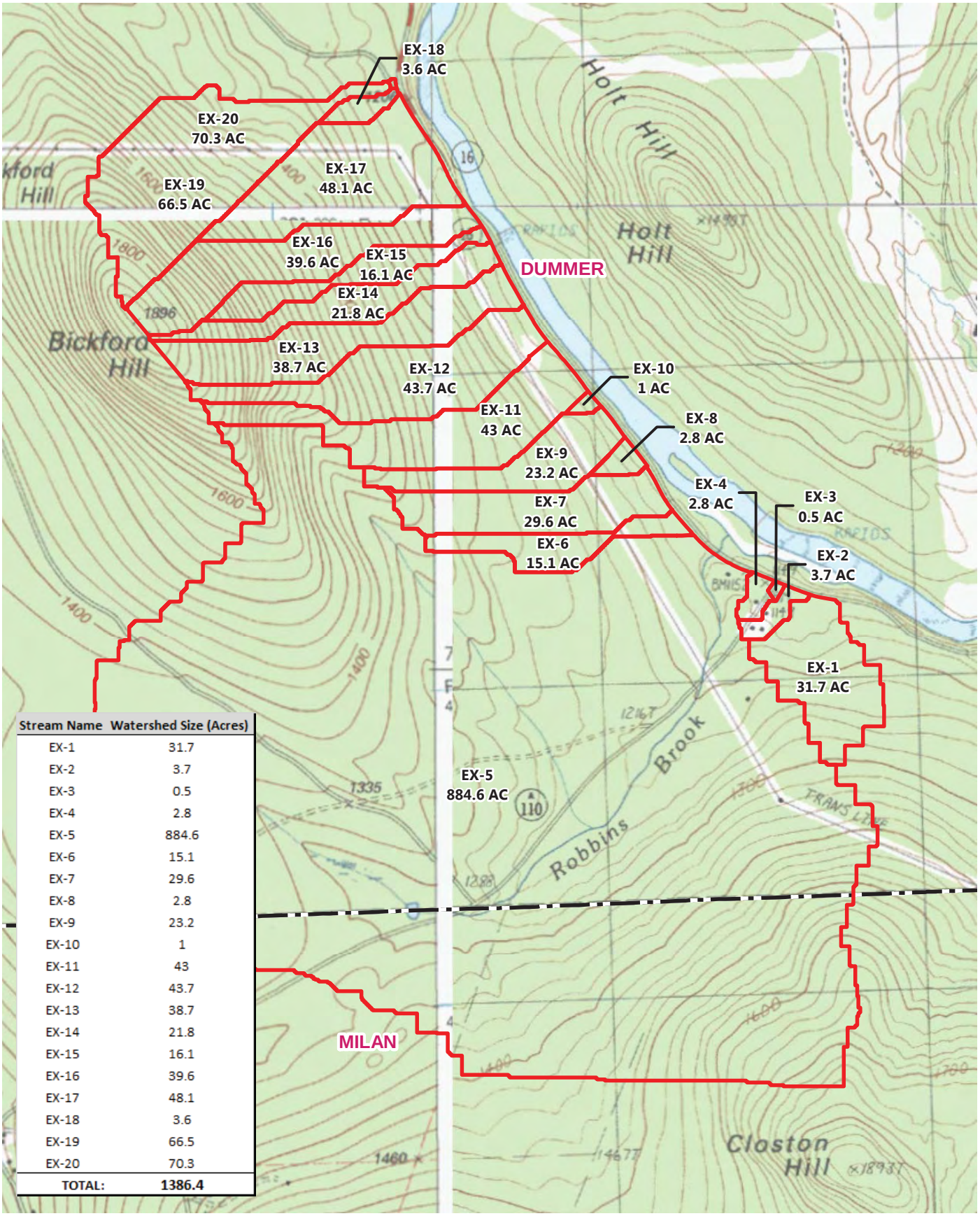
Project Area

Town Boundary

NH Route 16 Roadway Realignment | Dummer, New Hampshire

USGS Site Location Map

Source Info



Stream Name	Watershed Size (Acres)
EX-1	31.7
EX-2	3.7
EX-3	0.5
EX-4	2.8
EX-5	884.6
EX-6	15.1
EX-7	29.6
EX-8	2.8
EX-9	23.2
EX-10	1
EX-11	43
EX-12	43.7
EX-13	38.7
EX-14	21.8
EX-15	16.1
EX-16	39.6
EX-17	48.1
EX-18	3.6
EX-19	66.5
EX-20	70.3
TOTAL:	**1386.4**

0 700 1400 2800 Feet

Watershed Area

Town Boundary

\\NHBEDATA\checkin\52900.16\GIS\Project\Watershed_Areas.mxd

Dummer 16304/X-A001(231) | Dummer, New Hampshire

NH 16 Realignment

Watershed Delineation

Appendix B

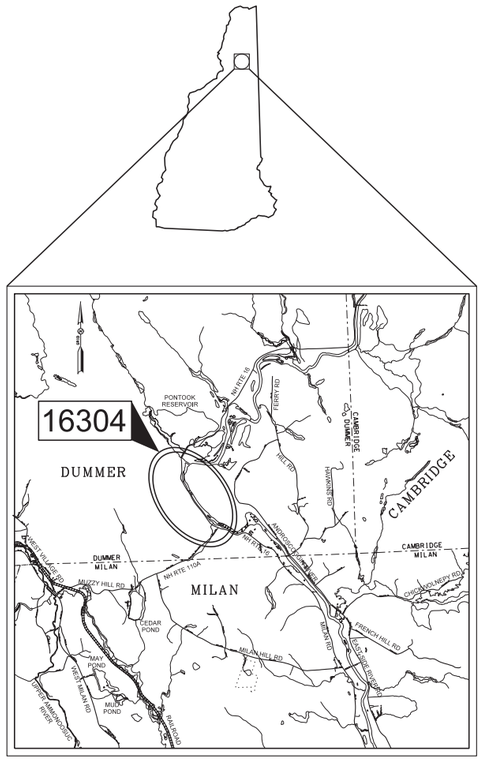
PPSE Submittal: Wetland Impact & Erosion Control Plans

STATE OF NEW HAMPSHIRE
DEPARTMENT OF TRANSPORTATION

WETLANDS PLANS
FEDERAL AID PROJECT

X-A001(231)
N.H. PROJECT NO. 16304
NH ROUTE 16

DESIGN DATA	
AVERAGE DAILY TRAFFIC 20 20	1600
AVERAGE DAILY TRAFFIC 20 40	1900
PERCENT OF TRUCKS	8.8%
DESIGN SPEED	50 MPH
LENGTH OF PROJECT	1.27 MILES



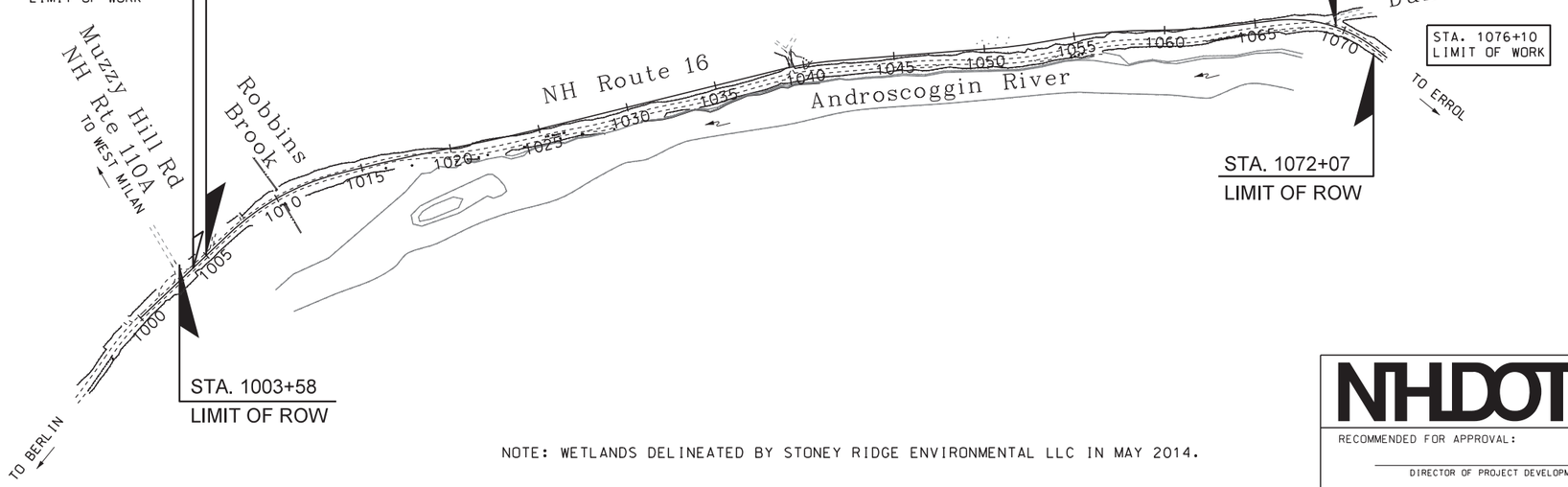
LOCATION MAP

1 ½ 0 1 2 mi.
GRAPHIC SCALE

GRID

STA. 1004+97
BEGIN FULL BOX CONSTRUCTION

STA. 1069+50
END FULL BOX CONSTRUCTION



NOTE: WETLANDS DELINEATED BY STONEY RIDGE ENVIRONMENTAL LLC IN MAY 2014.

INDEX OF SHEETS

DRAWN BY W. DRUDING DATE OCT. 2017
CHECKED BY F. KOCZALKA DATE OCT. 2017

TOWN OF DUMMER

COUNTY OF COOS

SCALE: 1:400

FOR CONSTRUCTION AND ALIGNMENT DETAILS - SEE THE CONSTRUCTION PLANS

NHDOT THE STATE OF NEW HAMPSHIRE DEPARTMENT OF TRANSPORTATION

RECOMMENDED FOR APPROVAL:
DIRECTOR OF PROJECT DEVELOPMENT — DATE

APPROVED:
ASSISTANT COMMISSIONER AND CHIEF ENGINEER — DATE

U. S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

APPROVED:
DIVISION ADMINISTRATOR — DATE

FEDERAL PROJECT NO.	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
X-A001(231)	16304	1	16

GENERAL

EDGE OF PAVEMENT — PROPOSED ROADWAY
TRAVELED WAY — existing roadway — (pavement removed outside slope lines)

DRIVEWAYS — (label surface type)

BUILDINGS — (building to be removed)
(label house or type of building)

FOUNDATION — (label type)

LEACH FIELD — leach field

BRIDGE CROSSINGS — STREAM — OVERPASS

STEPS AND WALK — (label type)

INTERMITTENT WATER COURSE

SHORE LINE — river/stream — pond — (label name of water body)

POTENTIAL WET AREA SYMBOL

BRUSH OR WOODS LINE

TREES (PLANS) — (deciduous) (coniferous) (stump)

TREE OR STUMP (CROSS-SECTIONS) — (show station, circumference in feet & type)

HEDGE — (label type)

MONITORING WELL — mon W

WELL — W

FLAG POLE — fp

ORIGINAL GROUND (TYPICALS)

ROCK OUTCROP

ROCK LINE (TYPICALS & SECTIONS ONLY)

GUARDRAIL (label type) — existing — PROPOSED — bgr — cgr

JERSEY BARRIER

CURB (LABEL TYPE)

STONE WALL

RETAINING WALL (LABEL TYPE) — (points toward retained ground)

FENCE (LABEL TYPE)

SIGNS — (single post) — (double post)

GAS PUMP — gp

FUEL TANK (ABOVE GROUND) — ft (label size & type)

STORAGE TANK FILLER CAP — fc

SEPTIC TANK — S

GRAVE — gr

MAILBOX — mb

VENT PIPE — vp

SATELLITE DISH ANTENNA — da

PHONE — ph

GROUND LIGHT/LAMP POST — gl — lp

BORING LOCATION — B

TEST PIT — TP

INTERSTATE NUMBERED HIGHWAY — 293

UNITED STATES NUMBERED HIGHWAY — 3

STATE NUMBERED HIGHWAY — 102

SHORELAND - WETLAND

WETLAND DESIGNATION AND TYPE — 2 PUB2E

DELINEATED WETLAND — DW
ORDINARY HIGH WATER — OHW
TOP OF BANK — TOB
TOP OF BANK & ORDINARY HIGH WATER — TOBOHW
NORMAL HIGH WATER — NHW
WIDTH AT BANK FULL — WBF
PRIME WETLAND — PWET
PRIME WETLAND 100' BUFFER — PWET100
NON-JURISDICTIONAL DRAINAGE AREA — NJDA
COWARDIN DISTINCTION LINE — CDL
TIDAL BUFFER ZONE — TBZ
DEVELOPED TIDAL BUFFER ZONE — DTBZ
HIGHEST OBSERVABLE TIDE LINE — HOTL
MEAN HIGH WATER — MHW
MEAN LOW WATER — MLW
VERNAL POOL — VP
SPECIAL AQUATIC SITE — SAS
REFERENCE LINE — REF
WATER FRONT BUFFER — WB50
NATURAL WOODLAND BUFFER — NWB150
PROTECTED SHORELAND — PS250
INVASIVE SPECIES LABEL — I.S. I — I.S. II
INVASIVE SPECIES — INV

FLOODPLAIN / FLOODWAY

500 YEAR FLOODPLAIN BOUNDARY — FP500
100 YEAR FLOODPLAIN BOUNDARY — FP100
FLOODWAY — FW

ENGINEERING

CONSTRUCTION BASELINE — 30 31 32

PC, PT, POT (ON CONST BASELINE)

PI (IN CONSTRUCTION BASELINES)

INTERSECTION OR EQUATION OF TWO LINES

ORIGINAL GROUND LINE (PROFILES AND CROSS-SECTIONS)

PROFILE GRADE LINE (PROFILES AND CROSS-SECTIONS)

CLEARING LINE — SLOPE LINE

SLOPE LINE

SLOPE LINE (FILL)

SLOPE LINE (CUT)

PROFILES AND CROSS SECTIONS:
ORIGINAL GROUND ELEVATION (LEFT) — 72.5
FINISHED GRADE ELEVATION (RIGHT) — 79.14

STATE OF NEW HAMPSHIRE
DEPARTMENT OF TRANSPORTATION ◦ BUREAU OF HIGHWAY DESIGN

STANDARD SYMBOLS

REVISION DATE	DGN	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
11-21-2014	stdsymb1_2.dgn	16304	2	16

DRAINAGE

MANHOLE

CATCH BASIN — cb

DROP INLET — di

(existing) (PROPOSED)

DRAINAGE PIPE (existing) (label size & type)

DRAINAGE PIPE (PROPOSED)

UNDERDRAIN (existing) W/ FLUSHING BASIN — fb (label size & type)

UNDERDRAIN (PROPOSED) W/ FLUSHING BASIN

show direction of flow

HEADER (existing & PROPOSED) (with stone outlet protection)

END SECTION (existing & PROPOSED) METAL or PLASTIC; RCP

OPEN DITCH (PROPOSED)

EROSION CONTROL/ STONE SLOPE PROTECTION

BOUNDARIES / RIGHT-OF-WAY

RIGHT-OF-WAY LINE (label type)

RR RIGHT-OF-WAY LINE

PROPERTY LINE

PROPERTY LINE (COMMON OWNER) — Z — Z

TOWN LINE — BOW / CONCORD

COUNTY LINE — COOS / GRAFTON

STATE LINE — MAINE / NEW HAMPSHIRE

NATIONAL FOREST

CONSERVATION LAND — LC

BENCH MARK / SURVEY DISK

BOUND — bnd (PROPOSED)

STATE LINE/ TOWN LINE MONUMENT — S/L T/L

NHDOT PROJECT MARKER

IRON PIPE OR PIN — ip

DRILL HOLE IN ROCK — dh

TAX MAP AND LOT NUMBER — 156 / 14; 1642/341; 6.80 Ac.±

PROPERTY PARCEL NUMBER — 12

HISTORIC PROPERTY — H

UTILITIES

existing PROPOSED

TELEPHONE POLE

POWER POLE

JOINT OCCUPANCY

MISCELLANEOUS/UNKNOWN POLE

GUY POLE OR PUSH BRACE

(plot point at face not center of symbol)

LIGHT POLE

LIGHT ON POWER POLE

LIGHT ON JOINT POLE

POLE STATUS:
REMOVE, LEAVE, PROPOSED, OR TEMPORARY
AS APPLICABLE e.g.:

R L — P+04 25.0' — T+04 25.0'

RAILROAD (label ownership)

RAILROAD SIGN

RAILROAD SIGNAL

UTILITY JUNCTION BOX — jb JB

OVERHEAD WIRE — OW (label type)

UNDERGROUND UTILITIES

WATER (on existing lines label size, type and note if abandoned) — W PW

SEWER — S PS

TELEPHONE — T PT

ELECTRIC — E PE

GAS — G PG

LIGHTING — L PL

INTELLIGENT TRANSPORTATION SYSTEM — ITS PITS

FIBER OPTIC — FO PFO

WATER SHUT OFF — WSO WS

GAS SHUT OFF — GSO GS

HYDRANT — HYD

MANHOLES

SEWER — MHS

TELEPHONE — MHT

ELECTRICAL — MHE

GAS — MHG

UNKNOWN

TRAFFIC SIGNALS / ITS

existing PROPOSED

MAST ARM (existing) — 30' MA (NOTE ANGLE FROM ℄)

OPTICOM RECEIVER

OPTICOM STROBE

TRAFFIC SIGNAL

PEDESTAL WITH PEDESTRIAN SIGNAL HEADS AND PUSH BUTTON UNIT

SIGNAL CONDUIT — C PC

CONTROLLER CABINET — cc CC

METER PEDESTAL — mp MP

PULL BOX — pb PB

LOOP DETECTOR (QUADRUPOLE) (label size)

LOOP DETECTOR (RECTANGULAR) (label size)

CAMERA POLE (CCTV)

FIBER OPTIC DELINEATOR — fod FOD

FIBER OPTIC SPLICE VAULT — SVF

ITS EQUIPMENT CABINET — its ITS

VARIABLE SPEED LIMIT SIGN

DYNAMIC MESSAGE SIGN

ROAD AND WEATHER INFO SYSTEM

CONSTRUCTION NOTES

CURB MARK NUMBER - BITUMINOUS — B-1

CURB MARK NUMBER - GRANITE — G-1

CLEARING AND GRUBBING AREA — A

DRAINAGE NOTE — 1

EROSION CONTROL NOTE — A

FENCING NOTE — A

GUARDRAIL NOTE — 1

ITS NOTE — 1

LIGHTING NOTE — A

TRAFFIC SIGNAL NOTE — 1

STATE OF NEW HAMPSHIRE

DEPARTMENT OF TRANSPORTATION ◦ BUREAU OF HIGHWAY DESIGN

STANDARD SYMBOLS

REVISION DATE	DGN	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
9-1-2016	stdsymb1_2.dgn	16304	3	16

EROSION CONTROL STRATEGIES

1. ENVIRONMENTAL COMMITMENTS:
   1.1. THESE GUIDELINES DO NOT RELIEVE THE CONTRACTOR FROM COMPLIANCE WITH ANY CONTRACT PROVISIONS, OR APPLICABLE FEDERAL, STATE, AND LOCAL REGULATIONS.
   1.2. THIS PROJECT WILL BE SUBJECT TO THE US EPA'S NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) STORM WATER CONSTRUCTION GENERAL PERMIT AS ADMINISTERED BY THE ENVIRONMENTAL PROTECTION AGENCY (EPA). THIS PROJECT IS SUBJECT TO REQUIREMENTS IN THE MOST RECENT CONSTRUCTION GENERAL PERMIT (CGP).
   1.3. THE CONTRACTOR'S ATTENTION IS DIRECTED TO THE NHDES WETLAND PERMIT, THE US ARMY CORPS OF ENGINEERS PERMIT, WATER QUALITY CERTIFICATION AND THE SPECIAL ATTENTION ITEMS INCLUDED IN THE CONTRACT DOCUMENTS.
   1.4. ALL STORM WATER, EROSION AND SEDIMENT CONTROL MEASURES SHALL BE INSTALLED AND MAINTAINED IN ACCORDANCE WITH THE NEW HAMPSHIRE STORMWATER MANUAL, VOLUME 3, EROSION AND SEDIMENT CONTROLS DURING CONSTRUCTION (DECEMBER 2008) (BMP MANUAL) AVAILABLE FROM THE NEW HAMPSHIRE DEPARTMENT OF ENVIRONMENTAL SERVICES (NHDES).
   1.5. THE CONTRACTOR SHALL COMPLY WITH RSA 485-A:17, AND ALL, PUBLISHED NHDES ALTERATION OF TERRAIN ENV-WQ 1500 REQUIREMENTS (HTTP://DES.NH.GOV/ORGANIZATION/COMMISSIONER/LEGAL/RULES/INDEX.HTM)
   1.6. THE CONTRACTOR IS DIRECTED TO REVIEW AND COMPLY WITH SECTION 107.1 OF THE CONTRACT AS IT REFERS TO SPILLAGE, AND ALSO WITH REGARDS TO EROSION, POLLUTION, AND TURBIDITY PRECAUTIONS.

2. STANDARD EROSION CONTROL SEQUENCING APPLICABLE TO ALL CONSTRUCTION PROJECTS:
   2.1. PERIMETER CONTROLS SHALL BE INSTALLED PRIOR TO EARTH DISTURBING ACTIVITIES. PERIMETER CONTROLS AND STABILIZED CONSTRUCTION EXITS SHALL BE INSTALLED AS SHOWN IN THE BMP MANUAL AND AS DIRECTED BY THE STORMWATER POLLUTION PREVENTION PLAN (SWPPP) PREPARER.
   2.2. EROSION, SEDIMENTATION CONTROL MEASURES AND INFILTRATION BASINS SHALL BE CLEANED, REPLACED AND AUGMENTED AS NECESSARY TO PREVENT SEDIMENTATION BEYOND PROJECT LIMITS THROUGHOUT THE PROJECT DURATION.
   2.3. EROSION AND SEDIMENT CONTROL MEASURES SHALL BE INSPECTED IN ACCORDANCE WITH THE CONSTRUCTION GENERAL PERMIT AND SECTION 645 OF THE NHDOT SPECIFICATIONS FOR ROAD AND BRIDGES CONSTRUCTION.
   2.4. AN AREA SHALL BE CONSIDERED STABLE IF ONE OF THE FOLLOWING HAS OCCURRED:
      (A) BASE COURSE GRAVELS HAVE BEEN INSTALLED IN AREAS TO BE PAVED;
      (B) A MINIMUM OF 85% VEGETATED GROWTH HAS BEEN ESTABLISHED;
      (C) A MINIMUM OF 3" OF NON-EROSIVE MATERIAL SUCH AS STONE OR RIP-RAP HAS BEEN INSTALLED;
      (D) TEMPORARY SLOPE STABILIZATION CONFORMING TO TABLE 1 HAS BEEN PROPERLY INSTALLED
   2.5. ALL STOCKPILES SHALL BE CONTAINED WITH A PERIMETER CONTROL. IF THE STOCKPILE IS TO REMAIN UNDISTURBED FOR MORE THAN 14 DAYS, MULCHING WILL BE REQUIRED.
   2.6. A WATER TRUCK SHALL BE AVAILABLE TO CONTROL EXCESSIVE DUST AT THE DIRECTION OF THE CONTRACT ADMINISTRATOR.
   2.7. TEMPORARY EROSION AND SEDIMENTATION CONTROL MEASURES SHALL REMAIN UNTIL THE AREA HAS BEEN PERMANENTLY STABILIZED.
   2.8. CONSTRUCTION PERFORMED ANY TIME BETWEEN NOVEMBER 30" AND MAY 1" OF ANY YEAR SHALL BE CONSIDERED WINTER CONSTRUCTION AND SHALL CONFORM TO THE FOLLOWING REQUIREMENTS.
      (A) ALL PROPOSED VEGETATED AREAS WHICH DO NOT EXHIBIT A MINIMUM OF 85% VEGETATIVE GROWTH BY OCTOBER 15", OR WHICH ARE DISTURBED AFTER OCTOBER 15", SHALL BE STABILIZED IN ACCORDANCE WITH TABLE 1.
      (B) ALL DITCHES OR SWALES WHICH DO NOT EXHIBIT A MINIMUM OF 85% VEGETATIVE GROWTH BY OCTOBER 15", OR WHICH ARE DISTURBED AFTER OCTOBER 15", SHALL BE STABILIZED TEMPORARILY WITH STONE OR IN ACCORDANCE WITH TABLE 1.
      (C) AFTER NOVEMBER 30" INCOMPLETE ROAD SURFACES, WHERE WORK HAS STOPPED FOR THE SEASON, SHALL BE PROTECTED IN ACCORDANCE WITH TABLE 1.
      (D) WINTER EXCAVATION AND EARTHWORK SHALL BE DONE SUCH THAT NO MORE THAN 1 ACRE OF THE PROJECT IS WITHOUT STABILIZATION AT ONE TIME, UNLESS A WINTER CONSTRUCTION PLAN HAS BEEN APPROVED BY NHDOT THAT MEETS THE REQUIREMENTS OF ENV-WQ 1505.02 AND ENV-WQ 1505.05.
      (E) A SWPPP AMENDMENT SHALL BE SUBMITTED TO THE DEPARTMENT, FOR APPROVAL, ADDRESSING COLD WEATHER STABILIZATION (ENV-WQ 1505.05) AND INCLUDING THE REQUIREMENTS OF NO LESS THAN 30 DAYS PRIOR TO THE COMMENCEMENT OF WORK SCHEDULED AFTER NOVEMBER 30".

GENERAL CONSTRUCTION PLANNING AND SELECTION OF STRATEGIES TO CONTROL EROSION AND SEDIMENT ON HIGHWAY CONSTRUCTION PROJECTS

3. PLAN ACTIVITIES TO ACCOUNT FOR SENSITIVE SITE CONDITIONS:
   3.1. CLEARLY FLAG AREAS TO BE PROTECTED IN THE FIELD AND PROVIDE CONSTRUCTION BARRIERS TO PREVENT TRAFFICKING OUTSIDE OF WORK AREAS.
   3.2. CONSTRUCTION SHALL BE SEQUENCED TO LIMIT THE DURATION AND AREA OF EXPOSED SOILS.
   3.3. PROTECT AND MAXIMIZE EXISTING NATIVE VEGETATION AND NATURAL FOREST BUFFERS BETWEEN CONSTRUCTION ACTIVITY AND SENSITIVE AREAS.
   3.4. WHEN WORK IS PERFORMED IN AND NEAR WATER COURSES, STREAM FLOW DIVERSION METHODS SHALL BE IMPLEMENTED PRIOR TO ANY EXCAVATION OR FILLING.
   3.5. WHEN WORK IS PERFORMED WITHIN 50 FEET OF SURFACE WATERS (WETLAND, OPEN WATER OR FLOWING WATER), PERIMETER CONTROL SHALL BE ENHANCED CONSISTENT WITH SECTION 2.1.2.1. OF THE 2012 NPDES CONSTRUCTION GENERAL PERMIT.

4. MINIMIZE THE AMOUNT OF EXPOSED SOIL:
   4.1. CONSTRUCTION SHALL BE SEQUENCED TO LIMIT THE DURATION AND AREA OF EXPOSED SOILS. MINIMIZE THE AREA OF EXPOSED SOIL AT ANY ONE TIME. PHASING SHALL BE USED TO REDUCE THE AMOUNT AND DURATION OF SOIL EXPOSED TO THE ELEMENTS AND VEHICLE TRACKING.
   4.2. UTILIZE TEMPORARY MULCHING OR PROVIDE ALTERNATE TEMPORARY STABILIZATION ON EXPOSED SOILS IN ACCORDANCE WITH TABLE 1.
   4.3. THE MAXIMUM AMOUNT OF DISTURBED EARTH SHALL NOT EXCEED A TOTAL OF 5 ACRES FROM MAY 1" THROUGH NOVEMBER 30", OR EXCEED ONE ACRE DURING WINTER MONTHS, UNLESS THE CONTRACTOR DEMONSTRATES TO THE DEPARTMENT THAT THE ADDITIONAL AREA OF DISTURBANCE IS NECESSARY TO MEET THE CONTRACTORS CRITICAL PATH METHOD SCHEDULE (CPM), AND THE CONTRACTOR HAS ADEQUATE RESOURCES AVAILABLE TO ENSURE THAT ENVIRONMENTAL COMMITMENTS WILL BE MET.

5. CONTROL STORMWATER FLOWING ONTO AND THROUGH THE PROJECT:
   5.1. DIVERT OFF SITE RUNOFF OR CLEAN WATER AWAY FROM THE CONSTRUCTION ACTIVITY TO REDUCE THE VOLUME THAT NEEDS TO BE TREATED ON SITE.
   5.2. DIVERT STORM RUNOFF FROM UPSLOPE DRAINAGE AREAS AWAY FROM DISTURBED AREAS, SLOPES, AND AROUND ACTIVE WORK AREAS AND TO A STABILIZED OUTLET LOCATION.
   5.3. CONSTRUCT IMPERMEABLE BARRIERS AS NECESSARY TO COLLECT OR DIVERT CONCENTRATED FLOWS FROM WORK OR DISTURBED AREAS.
   5.4. STABILIZE, TO APPROPRIATE ANTICIPATED VELOCITIES, CONVEYANCE CHANNELS OR PUMPING SYSTEMS NEEDED TO CONVEY CONSTRUCTION STORMWATER TO BASINS AND DISCHARGE LOCATIONS PRIOR TO USE.
   5.5. DIVERT OFF-SITE WATER THROUGH THE PROJECT IN AN APPROPRIATE MANNER SO NOT TO DISTURB THE UPSTREAM OR DOWNSTREAM SOILS, VEGETATION OR HYDROLOGY BEYOND THE PERMITTED AREA.

6. PROTECT SLOPES:
   6.1. INTERCEPT AND DIVERT STORM RUNOFF FROM UPSLOPE DRAINAGE AREAS AWAY FROM UNPROTECTED AND NEWLY ESTABLISHED AREAS AND SLOPES TO A STABILIZED OUTLET OR CONVEYANCE.
   6.2. CONSIDER HOW GROUNDWATER SEEPAGE ON CUT SLOPES MAY IMPACT SLOPE STABILITY AND INCORPORATE APPROPRIATE MEASURES TO MINIMIZE EROSION.
   6.3. CONVEY STORMWATER DOWN THE SLOPE IN A STABILIZED CHANNEL OR SLOPE DRAIN.
   6.4. THE OUTER FACE OF THE FILL SLOPE SHOULD BE IN A LOOSE RUFFLED CONDITION PRIOR TO TURF ESTABLISHMENT. TOPSOIL OR HUMUS LAYERS SHALL BE TRACKED UP AND DOWN THE SLOPE, DISKED, HARROWED, DRAGGED WITH A CHAIN OR MAT, MACHINE-RAKED, OR HAND-WORKED TO PRODUCE A RUFFLED SURFACE.

7. ESTABLISH STABILIZED CONSTRUCTION EXITS:
   7.1. INSTALL AND MAINTAIN CONSTRUCTION EXITS, ANYWHERE TRAFFIC LEAVES A CONSTRUCTION SITE ONTO A PUBLIC RIGHT-OF-WAY.
   7.2. SWEEP ALL CONSTRUCTION RELATED DEBRIS AND SOIL FROM THE ADJACENT PAVED ROADWAYS AS NECESSARY.

8. PROTECT STORM DRAIN INLETS:
   8.1. DIVERT SEDIMENT LADEN WATER AWAY FROM INLET STRUCTURES TO THE EXTENT POSSIBLE.
   8.2. INSTALL SEDIMENT BARRIERS AND SEDIMENT TRAPS AT INLETS TO PREVENT SEDIMENT FROM ENTERING THE DRAINAGE SYSTEM.
   8.3. CLEAN CATCH BASINS, DRAINAGE PIPES, AND CULVERTS IF SIGNIFICANT SEDIMENT IS DEPOSITED.
   8.4. DROP INLET SEDIMENT BARRIERS SHOULD NEVER BE USED AS THE PRIMARY MEANS OF SEDIMENT CONTROL AND SHOULD ONLY BE USED TO PROVIDE AN ADDITIONAL LEVEL OF PROTECTION TO STRUCTURES AND DOWN-GRADIENT SENSITIVE RECEPTORS.

9. SOIL STABILIZATION:
   9.1. WITHIN THREE DAYS OF THE LAST ACTIVITY IN AN AREA, ALL EXPOSED SOIL AREAS, WHERE CONSTRUCTION ACTIVITIES ARE COMPLETE, SHALL BE STABILIZED.
   9.2. IN ALL AREAS, TEMPORARY SOIL STABILIZATION MEASURES SHALL BE APPLIED IN ACCORDANCE WITH THE STABILIZATION REQUIREMENTS (SECTION 2.2) OF THE 2012 CGP. (SEE TABLE 1 FOR GUIDANCE ON THE SELECTION OF TEMPORARY SOIL STABILIZATION MEASURES.)
   9.3. EROSION CONTROL SEED MIX SHALL BE SOWN IN ALL INACTIVE CONSTRUCTION AREAS THAT WILL NOT BE PERMANENTLY SEEDED WITHIN TWO WEEKS OF DISTURBANCE AND PRIOR TO SEPTEMBER 15, OF ANY GIVEN YEAR, IN ORDER TO ACHIEVE VEGETATIVE STABILIZATION PRIOR TO THE END OF THE GROWING SEASON.
   9.4. SOIL TACKIFIERS MAY BE APPLIED IN ACCORDANCE WITH THE MANUFACTURER'S SPECIFICATIONS AND REAPPLIED AS NECESSARY TO MINIMIZE SOIL AND MULCH LOSS UNTIL PERMANENT VEGETATION IS ESTABLISHED.

10. RETAIN SEDIMENT ON-SITE AND CONTROL DEWATERING PRACTICES:
   10.1. TEMPORARY SEDIMENT BASINS (CGP-SECTION 2.1.3.2) OR SEDIMENT TRAPS (ENV-WQ 1506.10) SHALL BE SIZED TO RETAIN, ON SITE, THE VOLUME OF A 2-YEAR 24-HOUR STORM EVENT FOR ANY AREA OF DISTURBANCE OR 3,600 CUBIC FEET OF STORMWATER RUNOFF PER ACRE OF DISTURBANCE, WHICHEVER IS GREATER. TEMPORARY SEDIMENT BASINS USED TO TREAT STORMWATER RUNOFF FROM AREAS GREATER THAN 5-ACRES OF DISTURBANCE SHALL BE SIZED TO ALSO CONTROL STORMWATER RUNOFF FROM A 10-YEAR 24 HOUR STORM EVENT. ON-SITE RETENTION OF THE 10-YEAR 24-HOUR EVENT IS NOT REQUIRED.
   10.2. CONSTRUCT AND STABILIZE DEWATERING INFILTRATION BASINS PRIOR TO ANY EXCAVATION THAT MAY REQUIRE DEWATERING.
   10.3. TEMPORARY SEDIMENT BASINS OR TRAPS SHALL BE PLACED AND STABILIZED AT LOCATIONS WHERE CONCENTRATED FLOW (CHANNELS AND PIPES) DISCHARGE TO THE SURROUNDING ENVIRONMENT FROM AREAS OF UNSTABILIZED EARTH DISTURBING ACTIVITIES.

11. ADDITIONAL EROSION AND SEDIMENT CONTROL GENERAL PRACTICES:
   11.1. USE TEMPORARY MULCHING, PERMANENT MULCHING, TEMPORARY VEGETATIVE COVER, AND PERMANENT VEGETATIVE COVER TO REDUCE THE NEED FOR DUST CONTROL. USE MECHANICAL SWEEPERS ON PAVED SURFACES WHERE NECESSARY TO PREVENT DUST BUILDUP. APPLY WATER, OR OTHER DUST INHIBITING AGENTS OR TACKIFIERS, AS APPROVED BY THE NHDES.
   11.2. ALL STOCKPILES SHALL BE CONTAINED WITH TEMPORARY PERIMETER CONTROLS. INACTIVE SOIL STOCKPILES SHOULD BE PROTECTED WITH SOIL STABILIZATION MEASURES (TEMPORARY EROSION CONTROL SEED MIX AND MULCH, SOIL BINDER) OR COVERED WITH ANCHORED TARPS.
   11.3. EROSION AND SEDIMENT CONTROL MEASURES WILL BE INSPECTED IN ACCORDANCE WITH SECTION 645 OF NHDOT SPECIFICATIONS, WEEKLY AND WITHIN 24 HOURS AFTER ANY STORM EVENT GREATER THAN 0.25 IN. OF RAIN PER 24-HOUR PERIOD. EROSION AND SEDIMENT CONTROL MEASURES WILL ALSO BE INSPECTED IN ACCORDANCE WITH THE GUIDANCE MEMO FROM THE NHDES CONTAINED WITHIN THE CONTRACT PROPOSAL AND THE EPA CONSTRUCTION GENERAL PERMIT.
   11.4. THE CONTRACTOR SHOULD UTILIZE STORM DRAIN INLET PROTECTION TO PREVENT SEDIMENT FROM ENTERING A STORM DRAINAGE SYSTEM PRIOR TO THE PERMANENT STABILIZATION OF THE CONTRIBUTING DISTURBED AREA.
   11.5. PERMANENT STABILIZATION MEASURES WILL BE CONSTRUCTED AND MAINTAINED IN LOCATIONS AS SHOWN ON THE CONSTRUCTION PLANS TO STABILIZE AREAS. VEGETATIVE STABILIZATION SHALL NOT BE CONSIDERED PERMANENTLY STABILIZED UNTIL VEGETATIVE GROWTH COVERS AT LEAST 85% OF THE DISTURBED AREA. THE CONTRACTOR SHALL BE RESPONSIBLE FOR EROSION AND SEDIMENT CONTROL FOR ONE YEAR AFTER PROJECT COMPLETION.
   11.6. CATCH BASINS: CARE SHALL BE TAKEN TO ENSURE THAT SEDIMENTS DO NOT ENTER ANY EXISTING CATCH BASINS DURING CONSTRUCTION. THE CONTRACTOR SHALL PLACE TEMPORARY STONE INLET PROTECTION OVER INLETS IN AREAS OF SOIL DISTURBANCE THAT ARE SUBJECT TO SEDIMENT CONTAMINATION.
   11.7. TEMPORARY AND PERMANENT DITCHES SHALL BE CONSTRUCTED, STABILIZED AND MAINTAINED IN A MANNER THAT WILL MINIMIZE SCOUR. TEMPORARY AND PERMANENT DITCHES SHALL BE DIRECTED TO DRAIN TO SEDIMENT BASINS OR STORM WATER COLLECTION AREAS.
   11.8. WINTER EXCAVATION AND EARTHWORK ACTIVITIES NEED TO BE LIMITED IN EXTENT AND DURATION, TO MINIMIZE POTENTIAL EROSION AND SEDIMENTATION IMPACTS. THE AREA OF EXPOSED SOIL SHALL BE LIMITED TO ONE ACRE, OR THAT WHICH CAN BE STABILIZED AT THE END OF EACH DAY UNLESS A WINTER CONSTRUCTION PLAN, DEVELOPED BY A QUALIFIED ENGINEER OR A CPESC SPECIALIST, IS REVIEWED AND APPROVED BY THE DEPARTMENT.
   11.9. CHANNEL PROTECTION MEASURES SHALL BE SUPPLEMENTED WITH PERIMETER CONTROL MEASURES WHEN THE DITCH LINES OCCUR AT THE BOTTOM OF LONG FILL SLOPES. THE PERIMETER CONTROLS SHALL BE INSTALLED ON THE FILL SLOPE TO MINIMIZE THE POTENTIAL FOR FILL SLOPE SEDIMENT DEPOSITS IN THE DITCH LINE.

BEST MANAGEMENT PRACTICES (BMP) BASED ON AMOUNT OF OPEN CONSTRUCTION AREA

12. STRATEGIES SPECIFIC TO OPEN AREAS LESS THAN 5 ACRES:
   12.1. THE CONTRACTOR SHALL COMPLY WITH RSA 485:A:17 AND ENV-WQ 1500; ALTERATION OF TERRAIN FOR CONSTRUCTION AND USE ALL CONVENTIONAL BMP STRATEGIES.
   12.2. SLOPES STEEPER THAN 3:1 WILL RECEIVE TURF ESTABLISHMENT WITH MATTING.
   12.3. SLOPES 3:1 OR FLATTER WILL RECEIVE TURF ESTABLISHMENT ALONE.
   12.4. AREAS WHERE HAUL ROADS ARE CONSTRUCTED AND STORMWATER CANNOT BE TREATED THE DEPARTMENT WILL CONSIDER INFILTRATION.
   12.5. FOR HAUL ROADS ADJACENT TO SENSITIVE ENVIRONMENTAL AREAS OR STEEPER THAN 5%, THE DEPARTMENT WILL CONSIDER USING EROSION STONE, CRUSHED GRAVEL, OR CRUSHED STONE BASE TO HELP MINIMIZE EROSION ISSUES.
   12.6. ALL AREAS THAT CAN BE STABILIZED SHALL BE STABILIZED PRIOR TO OPENING UP NEW TERRITORY.
   12.7. DETENTION BASINS SHALL BE DESIGNED AND CONSTRUCTED TO ACCOMMODATE A 2 YEAR STORM EVENT.

13. STRATEGIES SPECIFIC TO OPEN AREAS BETWEEN 5 AND 10 ACRES:
   13.1. THE CONTRACTOR SHALL COMPLY WITH RSA 485:A:17 AND ENV-WQ 1500 ALTERATION OF TERRAIN AND SHALL USE CONVENTIONAL BMP STRATEGIES AND ALL TREATMENT OPTIONS USED FOR UNDER 5 ACRES WILL BE UTILIZED.
   13.2. DETENTION BASINS WILL BE CONSTRUCTED TO ACCOMMODATE THE 2-YEAR 24-HOUR STORM EVENT AND CONTROL A 10-YEAR 24-HOUR STORM EVENT.
   13.3. SLOPES STEEPER THAN A 3:1 WILL RECEIVE TURF ESTABLISHMENT WITH MATTING OR OTHER TEMPORARY SOIL STABILIZATION MEASURES DETAILED IN TABLE 1. THE CONTRACTOR MAY ALSO CONSIDER A SOIL BINDER IN ACCORDANCE WITH THE NHDES APPROVALS OR REGULATIONS. OTHER ALTERNATIVE MEASURES, SUCH AS BONDED FIBER MATRIXES (BFMS) OR FLEXIBLE GROWTH MEDIUMS (FGMS) MAY BE UTILIZED, IF MEETING THE NHDES APPROVALS AND REGULATIONS.
   13.4. SLOPES 3:1 OR FLATTER WILL RECEIVE TURF ESTABLISHMENT OR OTHER TEMPORARY SOIL STABILIZATION MEASURES DETAILED IN TABLE 1. THE CONTRACTOR MAY ALSO CONSIDER A SOIL BINDER IN ACCORDANCE WITH THE NHDES APPROVALS OR REGULATIONS.

14. STRATEGIES SPECIFIC TO OPEN AREAS OVER 10 ACRES:
   14.1. THE CONTRACTOR SHALL COMPLY WITH RSA 485:A:17 AND ENV-WQ 1500 ALTERATION OF TERRAIN AND SHALL USE CONVENTIONAL BMP STRATEGIES AND ALL TREATMENT OPTIONS USED FOR UNDER 5 ACRES AND BETWEEN 5 AND 10 ACRES WILL BE UTILIZED.
   14.2. THE DEPARTMENT ANTICIPATES THAT SOIL BINDERS WILL BE NEEDED ON ALL SLOPES STEEPER THAN 3:1, IN ORDER TO MINIMIZE EROSION AND REDUCE THE AMOUNT OF SEDIMENT IN THE STORMWATER TREATMENT BASINS.
   14.3. THE CONTRACTOR WILL BE REQUIRED TO HAVE AN APPROVED DESIGN IN ACCORDANCE WITH ENV-WQ 1506.12 FOR AN ACTIVE FLOCCULANT TREATMENT SYSTEM TO TREAT AND RELEASE WATER CAPTURED IN STORM WATER BASINS. THE CONTRACTOR SHALL ALSO RETAIN THE SERVICES OF AN ENVIRONMENTAL CONSULTANT WHO HAS DEMONSTRATED EXPERIENCE IN THE DESIGN OF FLOCCULANT TREATMENT SYSTEMS. THE CONSULTANT WILL ALSO BE RESPONSIBLE FOR THE IMPLEMENTATION AND MONITORING OF THE SYSTEM.

TABLE 1
GUIDANCE ON SELECTING TEMPORARY SOIL STABILIZATION MEASURES

APPLICATION AREAS	DRY MULCH METHODS				HYDRAULICALLY APPLIED MULCHES[2]				ROLLED EROSION CONTROL BLANKETS[3]			
	HMT	WC	SG	CB	HM	SMM	BFM	FRM	SNSB	DNSB	DNSCB	DNCB
SLOPES[1]												
STEEPER THAN 2:1	NO	NO	YES	NO	NO	NO	NO	YES	NO	NO	NO	YES
2:1 SLOPE	YES'	YES'	YES	YES	NO	NO	YES	YES	NO	YES	YES	YES
3:1 SLOPE	YES	YES	YES	YES	NO	YES	YES	YES	YES	YES	YES	NO
4:1 SLOPE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	NO	NO
WINTER STABILIZATION	4T/AC	YES	YES	YES	NO	NO	YES	YES	YES	YES	YES	YES
CHANNELS												
LOW FLOW CHANNELS	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	YES	YES
HIGH FLOW CHANNELS	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	YES

ABBREV.	STABILIZATION MEASURE	ABBREV.	STABILIZATION MEASURE	ABBREV.	STABILIZATION MEASURE
HMT	HAY MULCH & TACK	HM	HYDRAULIC MULCH	SNSB	SINGLE NET STRAW BLANKET
WC	WOOD CHIPS	SMM	STABILIZED MULCH MATRIX	DNSB	DOUBLE NET STRAW BLANKET
SG	STUMP GRINDINGS	BFM	BONDED FIBER MATRIX	DNSCB	2 NET STRAW-COCONUT BLANKET
CB	COMPOST BLANKET	FRM	FIBER REINFORCED MEDIUM	DNCB	2 NET COCONUT BLANKET

NOTES:
1. ALL SLOPE STABILIZATION OPTIONS ASSUME A SLOPE LENGTH ≤10 TIMES THE HORIZONTAL DISTANCE COMPONENT OF THE SLOPE, IN FEET.
2. PRODUCTS CONTAINING POLYACRYLAMIDE (PAM) SHALL NOT BE APPLIED DIRECTLY TO OR WITHIN 100 FEET OF ANY SURFACE WATER WITHOUT PRIOR WRITTEN APPROVAL FROM THE NH DEPARTMENT OF ENVIRONMENTAL SERVICES.
3. ALL EROSION CONTROL BLANKETS SHALL BE MADE WITH WILDLIFE FRIENDLY BIODEGRADABLE NETTING.

STATE OF NEW HAMPSHIRE

DEPARTMENT OF TRANSPORTATION ∘ BUREAU OF HIGHWAY DESIGN

WETLAND IMPACT PLANS

REVISION DATE	DGN	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
12-21-2015	16304erosstrat.dgn	16304	4	16

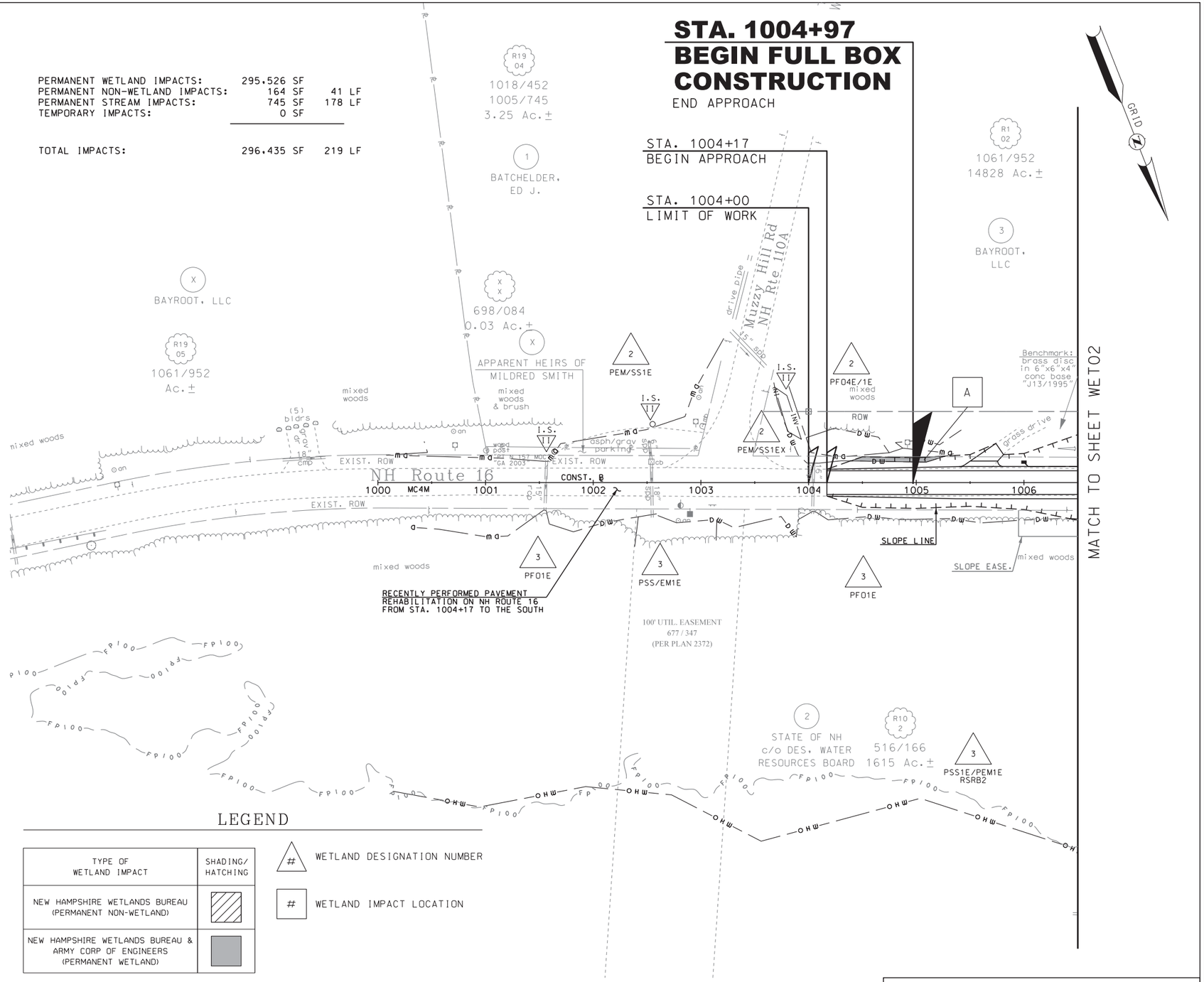
WETLAND IMPACT SUMMARY						
LOCATION	CLASS CODE	WETLAND ID*	AREA IMPACTS PERMANENT			
			N.H.W.B. (NON-WETLAND)		N.H.W.B. & A.C.O.E. (WETLAND)	
			SF	LF	SF	LF
A	PEM/SS1EX	2			302	
B	PFO1E	3			468	
C	PEM1EX	2			2042	
D	PFO4E/1E	2			1004	
E	PSS/EM1E	3			890	
F	PEM/SS1F	3			778	
G	PFO4E/1E	2			375	
H	R3UB1 (BANK)	2	164	41		
I	R3UB1 (BED)	2			173	20
J	PEM1EX	2			4220	
K	PFO4E/1E	2			1396	
L	PFO1E	3			77	
M	PFO4E/1E	1			29358	
N	PEM1EX	1			13760	
O	PSS/EM1E	3			238	
P	PFO4E/1E	1			46578	
Q	PFO4E/1E	1			1273	
R	PEM1EX	1			1686	
S	PSS/EM1E	3			58	
T	PFO4E/1E	1			28139	
U	PEM1EX	1			828	
V	PFO4E/1E	1			121354	
W	R4SB4 INTERMITTENT CHANNEL	1			437	145
X	PEM1EX	1			1003	
Y	PSS/EM1E	3			88	
Z	PEM1EX	1			1945	
AA	PSS/EM1E	3			308	
AB	PEM1EX	1			3728	
AC	PSS/EM1E	3			71	
AD	PSS/EM1E	3			200	
AE	PEM1EX	1			6779	
AF	PSS/EM1E	3			595	
AG	PFO4E/1E	1			25985	
AH	R4SB3 INTERMITTENT CHANNEL	1			135	13

* WETLAND ID FOLLOWS STONEY RIDGE ENVIRONMENTAL, JUNE 2014 (SRE #14-017)

WETLAND CLASSIFICATION CODES	
PEM/SS1E	PALUSTRINE, EMERGENT, PERSISTENT, SEASONALLY FLOODED/SATURATED AND PALUSTRINE, SCRUB-SHRUB, BROAD-LEAVED DECIDUOUS, SEASONALLY FLOODED/SATURATED
PFO1E	PALUSTRINE, FORESTED, BROAD-LEAVED DECIDUOUS, SEASONALLY FLOODED/SATURATED
PFO4E/1E	PALUSTRINE, FORESTED, NEEDLE-LEAVED EVERGREEN, SEASONALLY FLOODED/SATURATED AND PALUSTRINE, FORESTED, BROAD-LEAVED DECIDUOUS, SEASONALLY FLOODED/SATURATED
PEM/SS1F	PALUSTRINE, EMERGENT, PERSISTENT, SEMIPERMANENTLY FLOODED AND PALUSTRINE, SCRUB-SHRUB, BROAD-LEAVED DECIDUOUS, SEMIPERMANENTLY FLOODED
PSS/EM1E	PALUSTRINE, SCRUB-SHRUB, BROAD-LEAVED DECIDUOUS, SEASONALLY FLOODED/SATURATED AND PALUSTRINE, EMERGENT, PERSISTENT, SEASONALLY FLOODED/SATURATED
PEM1Ex	PALUSTRINE, EMERGENT, PERSISTENT, SEASONALLY FLOODED/SATURATED, EXCAVATED
PEM/SS1Ex	PALUSTRINE, EMERGENT, PERSISTENT, SEASONALLY FLOODED/SATURATED, EXCAVATED AND PALUSTRINE, SCRUB-SHRUB, BROAD-LEAVED DECIDUOUS, SEASONALLY FLOODED/SATURATED, EXCAVATED
R3RB2	RIVERINE, UPPER PERENNIAL, ROCK BOTTOM, RUBBLE
R3UB1	RIVERINE, UPPER PERENNIAL, UNCONSOLIDATED BOTTOM, COBBLE-GRAVEL
R3UB3	RIVERINE, UPPER PERENNIAL, UNCONSOLIDATED BOTTOM, MUD
R4SB3	RIVERINE, INTERMITTENT, STREAMBED, COBBLE-GRAVEL
R4SB4	RIVERINE, INTERMITTENT, STREAMBED, SAND

PERMANENT WETLAND IMPACTS: 295,526 SF
PERMANENT NON-WETLAND IMPACTS: 164 SF 41 LF
PERMANENT STREAM IMPACTS: 745 SF 178 LF
TEMPORARY IMPACTS: 0 SF

TOTAL IMPACTS: 296,435 SF 219 LF



LEGEND

TYPE OF WETLAND IMPACT	SHADING/ HATCHING
NEW HAMPSHIRE WETLANDS BUREAU (PERMANENT NON-WETLAND)	
NEW HAMPSHIRE WETLANDS BUREAU & ARMY CORP OF ENGINEERS (PERMANENT WETLAND)	

△ # WETLAND DESIGNATION NUMBER

□ # WETLAND IMPACT LOCATION

50 0 50 100
SCALE IN FEET

REVISIONS AFTER PROPOSAL

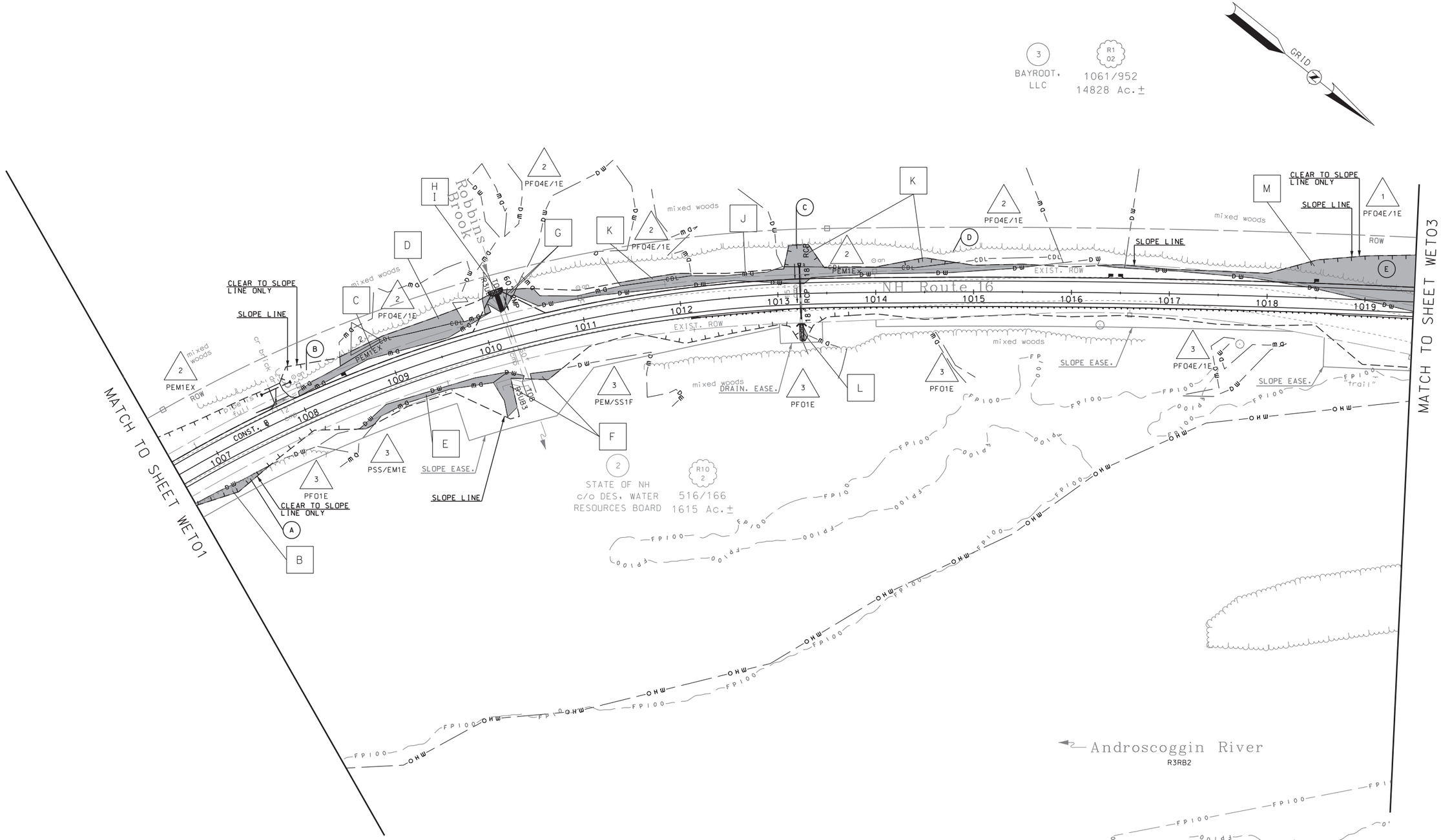
NUMBER	DESCRIPTION	STATION	DATE

SDR PROCESSED VHB TEAM DATE 2/2009
NEW DESIGN lead engineer DATE 1/2017
SHEET CHECKED project manager DATE 1/2017
AS BUILT DETAILS DATE

STATE OF NEW HAMPSHIRE
DEPARTMENT OF TRANSPORTATION ∘ BUREAU OF HIGHWAY DESIGN

WETLAND IMPACT PLANS

DATE PLOTTED	VHB PROJECT NO.	MODEL	DGN	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
4/4/2018	52900.16	Wet01	16304Wet_Plans.dgn	16304	5	16



50 0 50 100
SCALE IN FEET

REVISIONS AFTER PROPOSAL

NUMBER	DESCRIPTION	STATION	STATION	DATE

SDR PROCESSED	VHB TEAM	DATE 2/2009
NEW DESIGN	lead enginerr	DATE 1/2017
SHEET CHECKED	project manager	DATE 1/2017
AS BUILT DETAILS		DATE

STATE OF NEW HAMPSHIRE

DEPARTMENT OF TRANSPORTATION ∘ BUREAU OF HIGHWAY DESIGN

WETLAND IMPACT PLANS

DATE PLOTTED	VHB PROJECT NO.	MODEL	DGN	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
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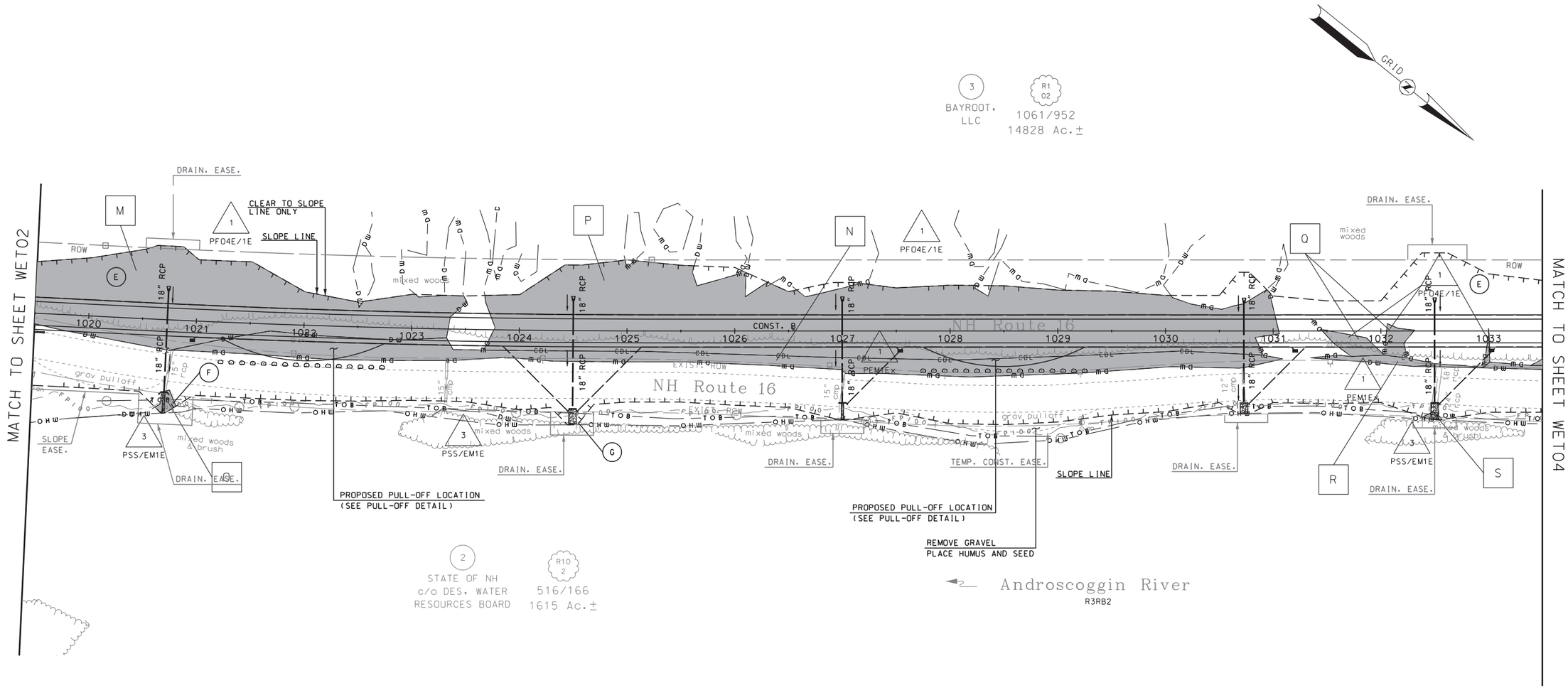

50 0 50 100

SCALE IN FEET

REVISIONS AFTER PROPOSAL

NUMBER	DATE	STATION	DESCRIPTION

SDR PROCESSED	VHB TEAM	DATE 2/2009
NEW DESIGN	lead engineer	DATE 1/2017
SHEET CHECKED	project manager	DATE 1/2017
AS BUILT DETAILS		DATE

STATE OF NEW HAMPSHIRE

DEPARTMENT OF TRANSPORTATION ◦ BUREAU OF HIGHWAY DESIGN

WETLAND IMPACT PLANS

DATE PLOTTED	VHB PROJECT NO.	MODEL	DGN	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
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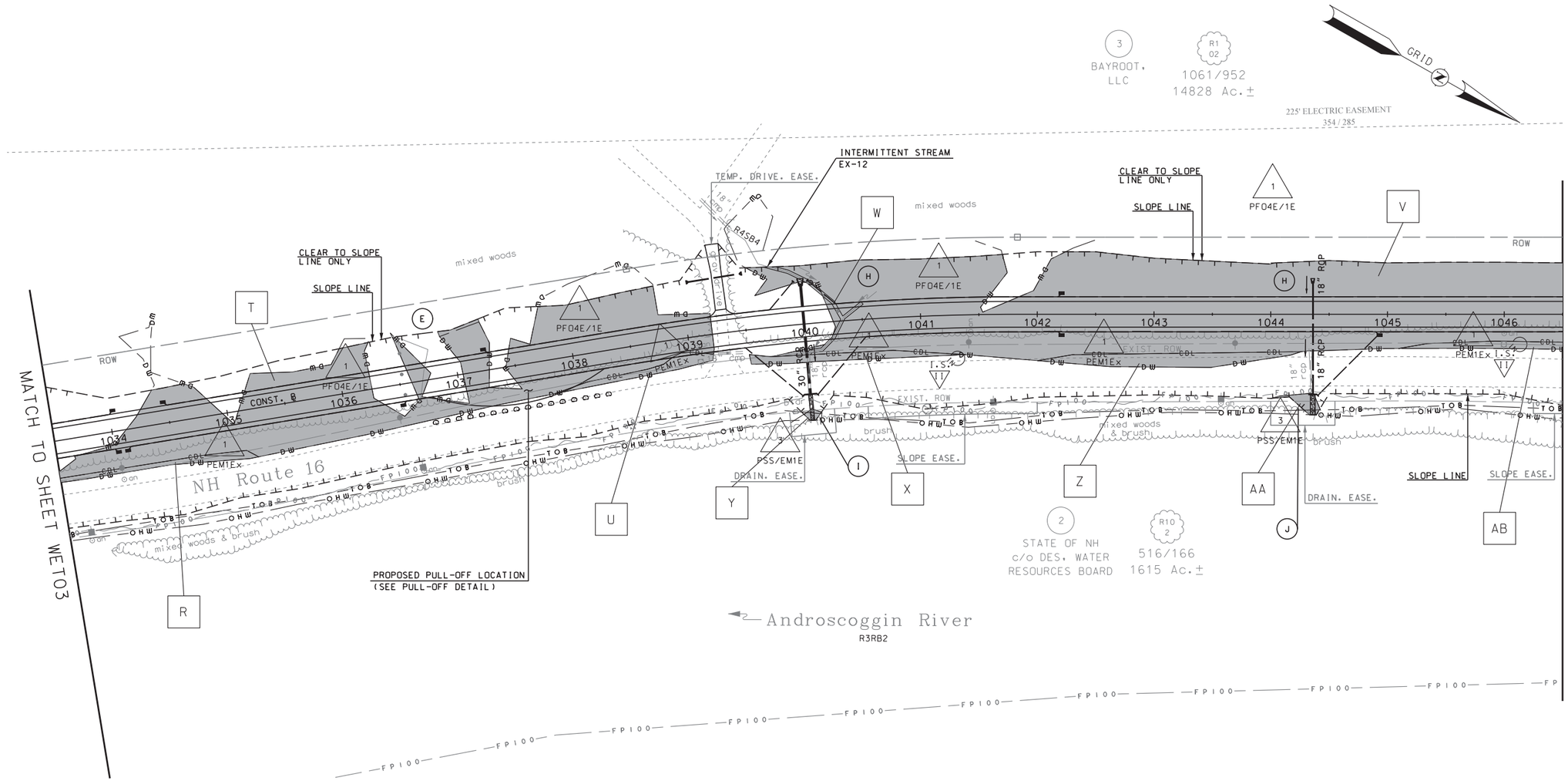

50 0 50 100

SCALE IN FEET

NUMBER	DATE	DESCRIPTION	STATION	STATION
		REVISIONS AFTER PROPOSAL		

SDR PROCESSED	VHB TEAM	DATE 2/2009
NEW DESIGN	lead engineer	DATE 1/2017
SHEET CHECKED	project manager	DATE 1/2017
AS BUILT DETAILS		DATE

STATE OF NEW HAMPSHIRE

DEPARTMENT OF TRANSPORTATION ◦ BUREAU OF HIGHWAY DESIGN

WETLAND IMPACT PLANS

DATE PLOTTED	VHB PROJECT NO.	MODEL	DGN	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
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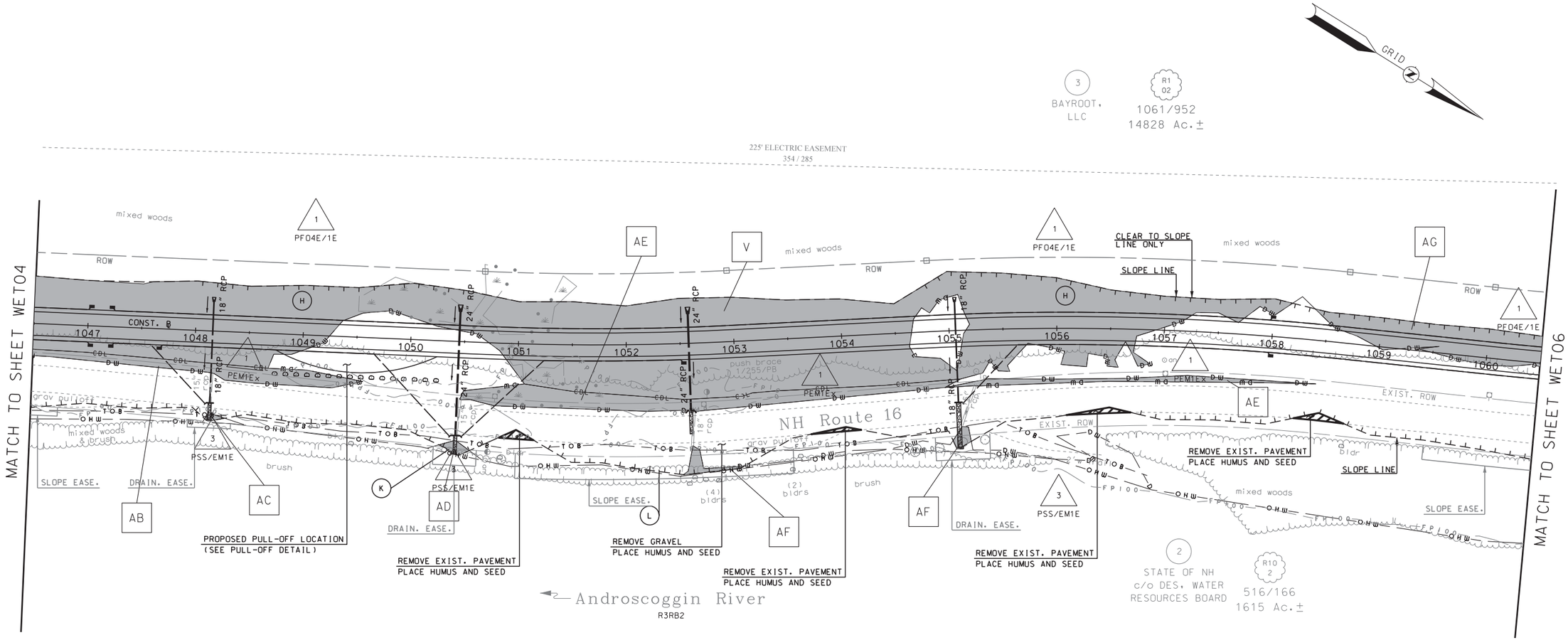

50 0 50 100

SCALE IN FEET

REVISIONS AFTER PROPOSAL	DESCRIPTION	STATION	STATION	NUMBER	DATE

SDR PROCESSED	VHB TEAM	DATE 2/2009
NEW DESIGN	lead engineer	DATE 1/2017
SHEET CHECKED	project manager	DATE 1/2017
AS BUILT DETAILS		DATE

STATE OF NEW HAMPSHIRE

DEPARTMENT OF TRANSPORTATION ◦ BUREAU OF HIGHWAY DESIGN

WETLAND IMPACT PLANS

DATE PLOTTED	VHB PROJECT NO.	MODEL	DGN	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
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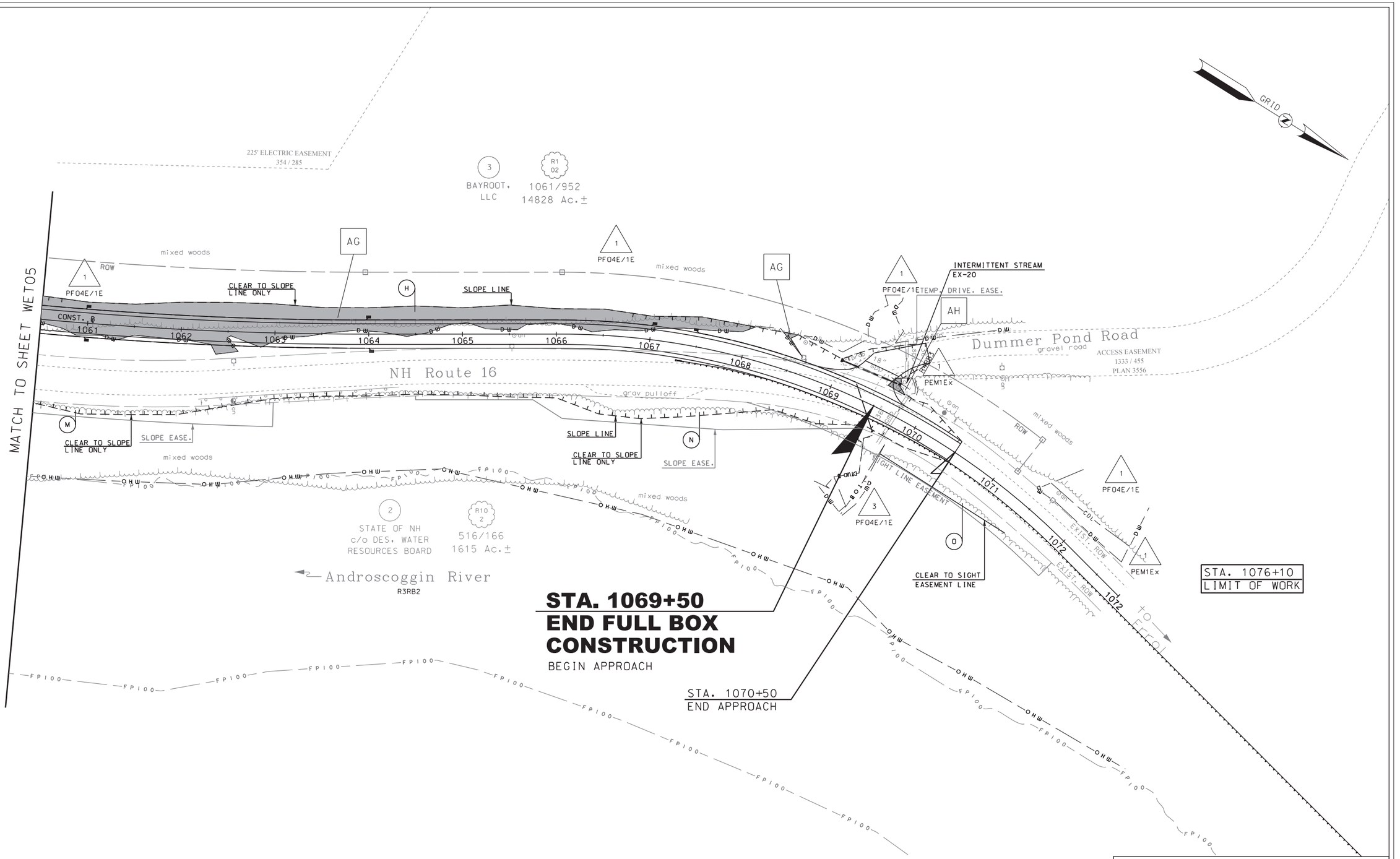

REVISIONS AFTER PROPOSAL

NUMBER	DESCRIPTION	STATION	STATION	DATE

SDR PROCESSED	VHB TEAM	DATE 2/2009
NEW DESIGN	lead engineer	DATE 1/2017
SHEET CHECKED	project manager	DATE 1/2017
AS BUILT DETAILS		DATE

STATE OF NEW HAMPSHIRE

DEPARTMENT OF TRANSPORTATION ◦ BUREAU OF HIGHWAY DESIGN

WETLAND IMPACT PLANS

DATE PLOTTED	VHB PROJECT NO.	MODEL	DGN	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
4/4/2018	52900.16	Wet06	16304Wet_Plans.dgn	16304	10	16

REVISIONS AFTER PROPOSAL

NUMBER	DESCRIPTION	STATION	STATION	DATE

SDR PROCESSED VHB TEAM DATE 2/2009
NEW DESIGN lead engineer DATE 1/2017
SHEET CHECKED project manager DATE 1/2017
AS BUILT DETAILS DATE

GRID

STA. 1004+97
BEGIN FULL BOX CONSTRUCTION
END APPROACH

STA. 1004+17
BEGIN APPROACH

STA. 1004+00
LIMIT OF WORK

1 BATCHELDER, ED J.

X BAYROOT, LLC

X PUBLIC SERVICE OF NEW HAMPSHIRE dba EVERSOURCE

X APPARENT HEIRS OF MILDRED SMITH

3 BAYROOT, LLC

2 PEM/SS1E

2 PEM/SS1EX

2 PFO4E/1E

3 PFO1E

3 PSS/EM1E

3 PFO1E

3 PSS1E/PEM1E RSRB2

2 STATE OF NH c/o DES, WATER RESOURCES BOARD

NH Route 16

N 68°-30'-15.2" W

Muzzy Hill Rd NH Rte 110A

drive pipe

45" spce

ROW

grass drive

asph/gray parking

SLOPE EASE.

100' UTIL. EASEMENT
677 / 347
(PER PLAN 2372)

to Berlin

MATCH TO SHEET ERO02

EROSION CONTROL PLAN LEGEND

PC — PERIMETER CONTROL
- SILT FENCE
- EROSION CONTROL MIX BERM
- EROSION CONTROL MIX SOX
- TURBIDITY CURTAIN
- SHEET PILE
- COFFER DAM

NB/PC — NATURAL BUFFER/PERIMETER CONTROL
- SILT FENCE
- EROSION CONTROL MIX BERM
- EROSION CONTROL MIX SOX
- TURBIDITY CURTAIN
- SHEET PILE
- COFFER DAM

CP — CHANNEL PROTECTION
- STONE CHECK DAMS
- STRAW WATTLES
- CHANNEL MATTING
- CLASS D EROSION STONE
- CLASS C STONE

CWB — CLEAN WATER BYPASS
- PUMP THROUGH PIPE
- DRAIN THROUGH PIPE OR CHANNEL

50 0 50 100
SCALE IN FEET

vhb

STATE OF NEW HAMPSHIRE
DEPARTMENT OF TRANSPORTATION ◦ BUREAU OF HIGHWAY DESIGN

EROSION CONTROL PLANS

DATE PLOTTED	VHB PROJECT NO.	MODEL	DGN	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
4/4/2018	52900.16	Ero01	16304ERO_Plans.dgn	16304	11	16

REVISIONS AFTER PROPOSAL

NUMBER	DESCRIPTION	STATION	STATION	DATE

SDR PROCESSED	VHB TEAM	DATE 2/2009
NEW DESIGN	lead engineer	DATE 1/2017
SHEET CHECKED	project manager	DATE 1/2017
AS BUILT DETAILS		DATE

GRID

3 BAYROOT, LLC

MATCH TO SHEET ERO01

MATCH TO SHEET ERO03

Robbins Brook

NH Route 16

ROW

PEM1EX

PF04E/1E

PF01E

PEM/SS1F

PSS/EM1E

SLOPE EASE.

DRAIN. EASE.

2 STATE OF NH c/o DES. WATER RESOURCES BOARD

Androscoggin River

R3RB2

"trail"

1007 1008 1009 1010 1011 1012 1013 1014 1015 1016 1017 1018 1019

SCALE IN FEET

50 0 50 100

vhb

STATE OF NEW HAMPSHIRE

DEPARTMENT OF TRANSPORTATION ◦ BUREAU OF HIGHWAY DESIGN

EROSION CONTROL PLANS

DATE PLOTTED	VHB PROJECT NO.	MODEL	DGN	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
4/4/2018	52900.16	Ero02	16304ERO_Plans.dgn	16304	12	16

MATCH TO SHEET ER002

MATCH TO SHEET ER004

GRID N

3 BAYROOT, LLC

2 STATE OF NH c/o DES, WATER RESOURCES BOARD

NH Route 16

NH Route 16

Androscoggin River
R3RB2

N 38°-51'-12.4" W

DRAIN. EASE.

SLOPE EASE.

TEMP. CONST. EASE.

PFO4E/1E

PSS/EM1E

PEMIEx

ROW

18" RCP

grav outlet

TOB

OHW

1020 1021 1022 1023 1024 1025 1026 1027 1028 1029 1030 1031 1032 1033

1140 1150 1160

50 0 50 100
SCALE IN FEET

REVISIONS AFTER PROPOSAL

NUMBER	DATE	DESCRIPTION	STATION

SDR PROCESSED VHB TEAM DATE 2/2009
NEW DESIGN lead engineer DATE 1/2017
SHEET CHECKED project manager DATE 1/2017

AS BUILT DETAILS DATE

STATE OF NEW HAMPSHIRE
DEPARTMENT OF TRANSPORTATION ◦ BUREAU OF HIGHWAY DESIGN

EROSION CONTROL PLANS

DATE PLOTTED	VHB PROJECT NO.	MODEL	DGN	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
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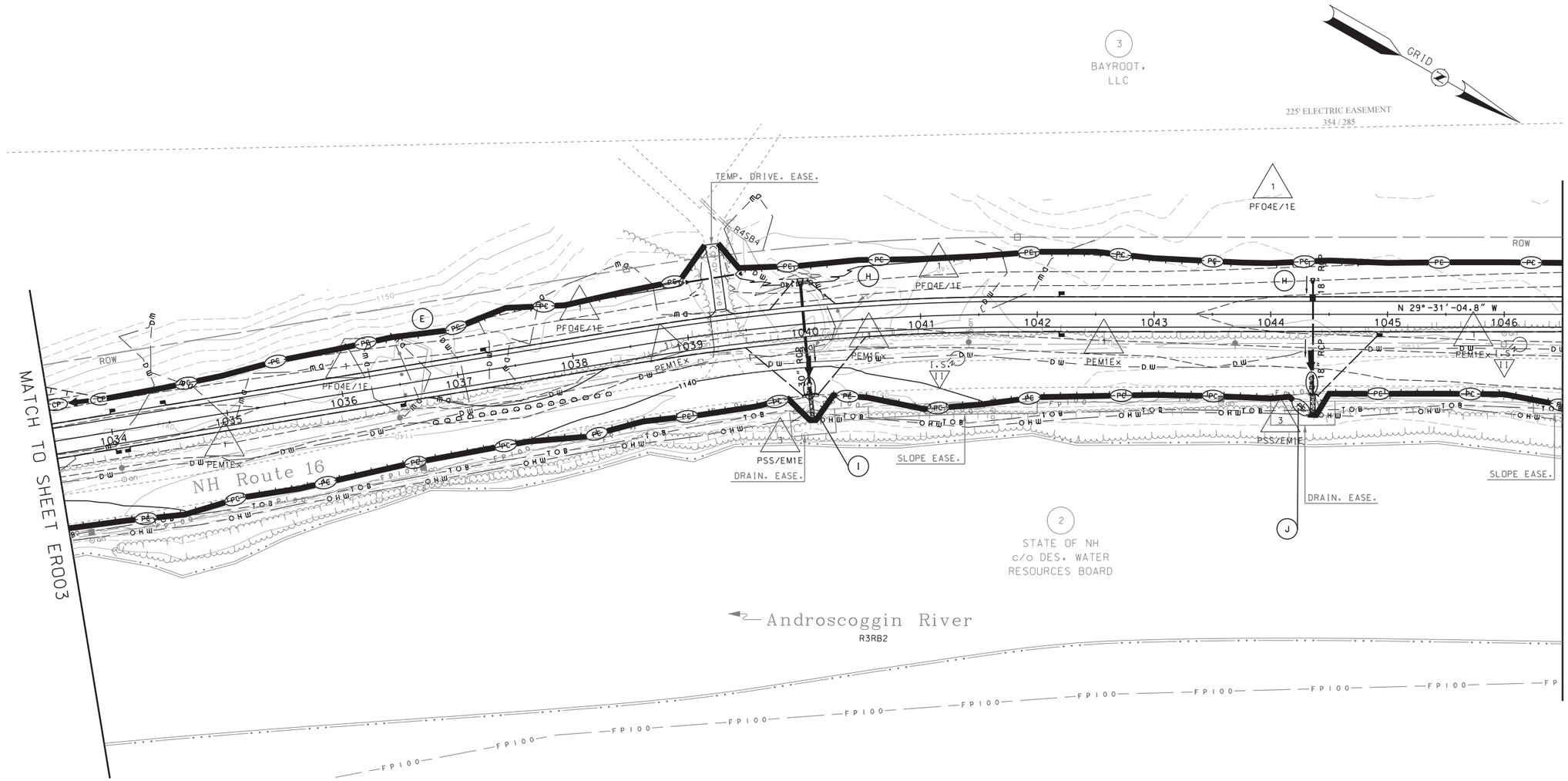

50 0 50 100

SCALE IN FEET

REVISIONS AFTER PROPOSAL

NUMBER	DESCRIPTION	STATION	STATION	DATE

SDR PROCESSED	VHB TEAM	DATE 2/2009
NEW DESIGN	lead enginerr	DATE 1/2017
SHEET CHECKED	project manager	DATE 1/2017
AS BUILT DETAILS		DATE

STATE OF NEW HAMPSHIRE

DEPARTMENT OF TRANSPORTATION ◦ BUREAU OF HIGHWAY DESIGN

EROSION CONTROL PLANS

DATE PLOTTED	VHB PROJECT NO.	MODEL	DGN	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
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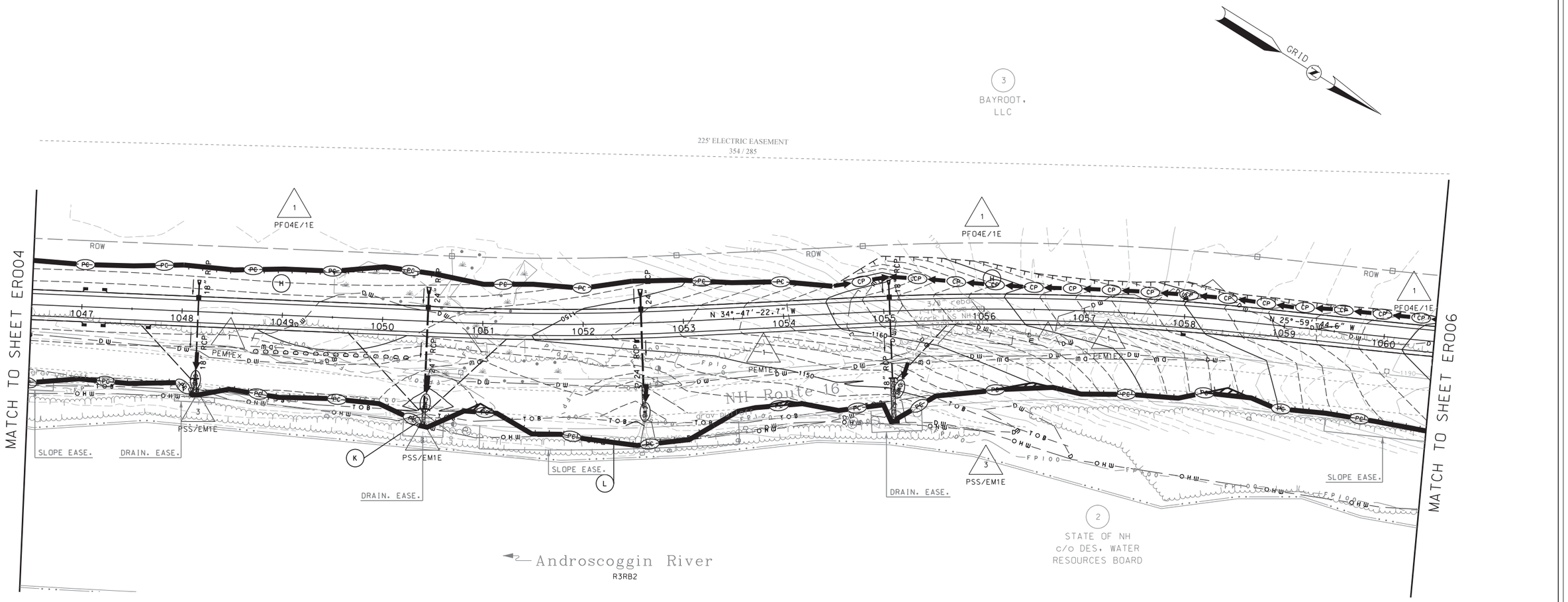


REVISIONS AFTER PROPOSAL

NUMBER	DESCRIPTION	STATION	STATION	DATE

SDR PROCESSED	VHB TEAM	DATE 2/2009
NEW DESIGN	lead engineer	DATE 1/2017
SHEET CHECKED	project manager	DATE 1/2017
AS BUILT DETAILS		DATE

STATE OF NEW HAMPSHIRE

DEPARTMENT OF TRANSPORTATION ◦ BUREAU OF HIGHWAY DESIGN

EROSION CONTROL PLANS

DATE PLOTTED	VHB PROJECT NO.	MODEL	DGN	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
4/4/2018	52900.16	Ero05	16304ERO_Plans.dgn	16304	15	16

MATCH TO SHEET ERO05

225' ELECTRIC EASEMENT
354 / 285

3
BAYROOT, LLC

ROW

1
PF04E/1E

1
PF04E/1E TEMP. DRIVE. EASE.

NH Route 16

Dummer Pond Road
gravel road

ACCESS EASEMENT
1333 / 455
PLAN 3556

PEM1Ex

grav pulloff

SLOPE EASE.

SLOPE EASE.

LIGHT LINE EASEMENT

2
STATE OF NH
c/o DES. WATER
RESOURCES BOARD

Androscoggin River
R3RB2

3
PF04E/1E

PEM1Ex

N 13°-09'-54.8" E

STA. 1069+50
END FULL BOX CONSTRUCTION
BEGIN APPROACH

STA. 1070+50
END APPROACH

STA. 1076+10
LIMIT OF WORK

to Ero1

GRID N

50 0 50 100
SCALE IN FEET

NUMBER	DESCRIPTION	STATION	DATE
	REVISIONS AFTER PROPOSAL		

SDR PROCESSED	VHB TEAM	DATE 2/2009
NEW DESIGN	lead engineer	DATE 1/2017
SHEET CHECKED	project manager	DATE 1/2017
AS BUILT DETAILS		DATE

STATE OF NEW HAMPSHIRE
DEPARTMENT OF TRANSPORTATION ◦ BUREAU OF HIGHWAY DESIGN

EROSION CONTROL PLANS

DATE PLOTTED	VHB PROJECT NO.	MODEL	DGN	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
4/4/2018	52900.16	Ero06	16304ERO_Plans.dgn	16304	16	16

Appendix C

Draft Drainage Report for Preliminary Design Submittal

NH Route 16 Dummer-Cambridge-Errol

Drainage Report

Prepared for **NHDOT**
Hazen Drive
Concord, NH

Prepared by **vhb/Vanasse Hangen Brustlin, Inc.**
Two Bedford Farms
Suite 200
Bedford, NH 03110

April 20, 2018
(PPS&E – 16304)

Table of Contents

Tables

Figures

1
Introduction

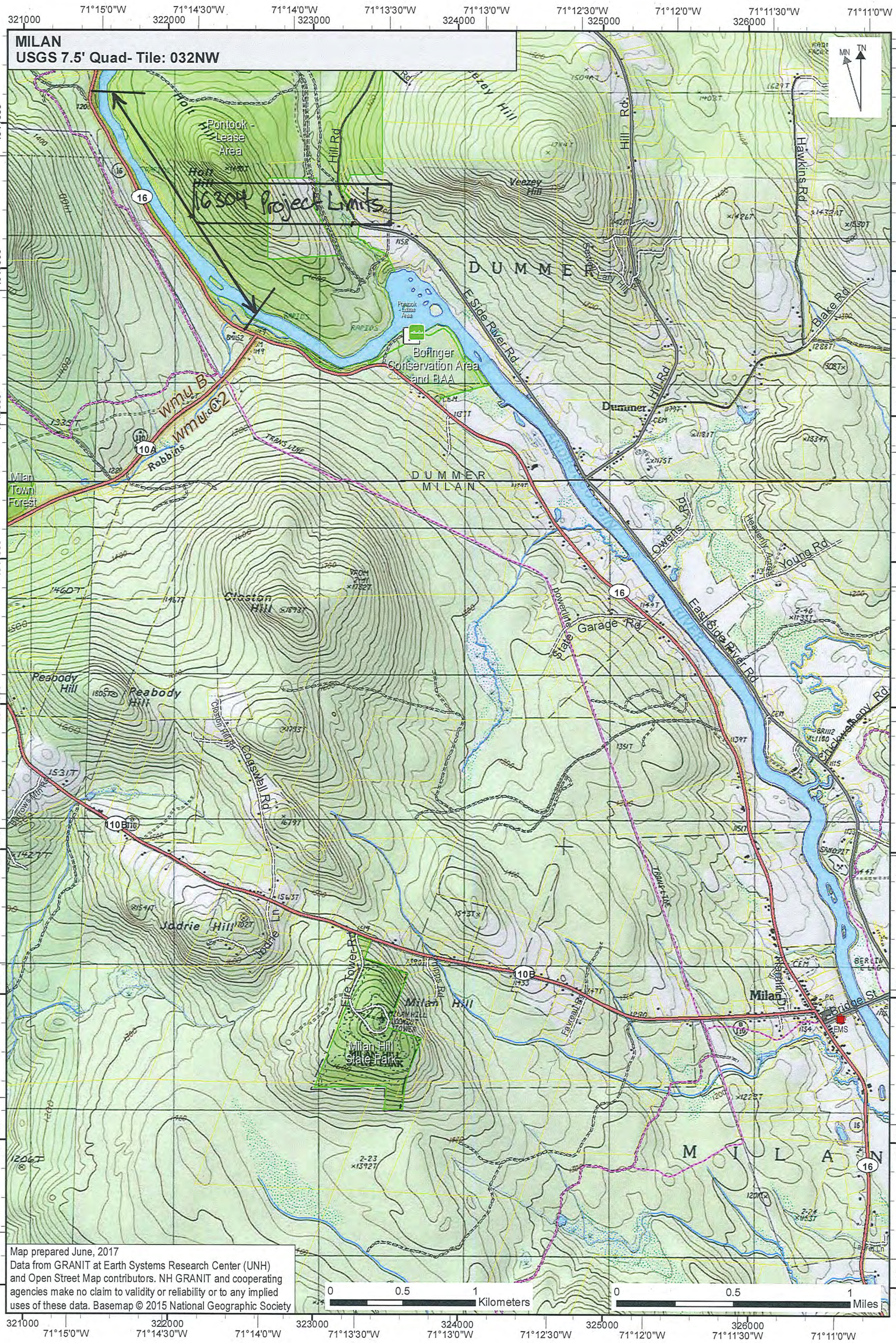
The following report has been prepared by Vanasse Hangen Brustlin, Inc. (VHB) to provide a brief description of existing and proposed drainage areas, design methodology, soil characteristics, and a summary of peak discharge rates for the 16304 Route 16 project. Contract A is the first of 5 contracts that will reconstruct NH 16 along the Androscoggin River. The overall contract begins in Dummer, NH and stretches North, approximately 17.5 miles, to the NH 16/NH 26 intersection.

The project area is located along NH 16 in the town of Dummer, NH (see Figure 1). This report focuses on the portion of the project containing approximately 1.3 miles of NH 16. The corridor extends from 100 feet North of NH Route 110A to 680 feet North of Dummer Pond Road. The project area is located within the surface watershed of the Androscoggin River.

NH 16 currently contains two 11-foot wide lanes with 1-foot wide shoulders. Under existing conditions, untreated stormwater runoff sheet flows in two directions. Runoff flowing West is collected in adjacent open ditches or wetlands prior to discharging into the Androscoggin. This runoff is conveyed to the river via 15 roadway culverts. Runoff flowing East sheet flows directly into the Androscoggin River.

The proposed roadway widening of NH 16 contains 11-foot wide lanes with 4-foot wide shoulders. Approximately 5000 feet of proposed roadway is realigned to the West. This realignment is intended to reduce erosion along the roadway and western bank of the Androscoggin River. Along with the realignment, the roadway profile will be raised so that the roadway subbase is at or above the existing groundwater table which is within 7’ of the existing ground surface.

A HydroCAD model, using TR-20 methodology, Excel spreadsheets utilizing the USGS Regression and Rational method along with FHWA Hy8 were implemented to evaluate the existing and proposed drainage conditions on the project. The results of the analyses indicate that there is a slight increase in peak discharge rates between the pre- and post-development conditions for the 2-, 10-, and 50-year storm events for the overall project as a result of the minor increase in impervious pavement. The pre- and post-development peak discharge values are presented in the Stormwater Management Impacts Section of this report.


MILAN
USGS 7.5' Quad- Tile: 032NW
16304 Project Limits
Pontook Lease Area
Holt Hill
Veezey Hill
Hill Rd
Hawkins Rd
Blake Rd
DUMMER
MILAN
Dummer
E Side River Rd
East Side River Rd
Bofinger Conservation Area and BAA
wmu B
wmu C2
Robbins
Milan Town Forest
Owens Rd
Young Rd
Heavenly Acres
State Garage Rd
powerline
Closton Hill
Peabody Hill
Cogswell Rd
Jodrie Hill
Jodrie Ln
Fire Tower Rd
Milan Hill
Milan Hill State Park
Milan
Bridge St
Chickwolnepy Rd
Fauteaux Rd
Hamlin Dr
Map prepared June, 2017
Data from GRANIT at Earth Systems Research Center (UNH) and Open Street Map contributors. NH GRANIT and cooperating agencies make no claim to validity or reliability or to any implied uses of these data. Basemap © 2015 National Geographic Society
0 0.5 1 Kilometers
0 0.5 1 Miles
TN
MN

2

Existing Conditions

Description of Contributing Areas

The study area for the roadway project is within the Androscoggin River watershed (see Figure 3, Existing Conditions: Drainage Area Map - roll plans 1 and 2). The overall existing drainage area for the project is approximately 1316 acres in size. The area is mountainous, ranging in elevation from 1130 to 1400 feet. The area is currently undeveloped and ground cover consists of a paved highway and adjacent forest with dense vegetation.

The study area has been divided into 20 subcatchment areas. Three of these subcatchments flow to the South of the project and will not be impacted by the proposed widening. The remaining seventeen subcatchments flow toward the Androscoggin River and comprise the remaining 1,281 acres within project study.

Table 1 summarizes the study area and its characteristics.

Table 1
Existing Conditions: Drainage Area Characteristics Summary

Exit Point		Subcatchment Area(s)		Area (Acres)	Tc (Min.)	CN
#	Description	#	Description			
1	Androscoggin River	4	Outlet = 1004+05, 15" CMP	2.85	37.2	52
		5	Robbin's Brook. Outlet = 1010+23 60" CMP	884.55	237.1	70
		6	Outlet = 1013+23, 15" CMP	15.15	86.5	70
		7	Outlet = 1020+73, 15" RCP	29.60	88.1	70
		8	Outlet = 1023+33, 15" CMP	2.85	28.1	69
		9	Outlet = 1027+00, 15" CMP	23.20	75.5	70
		10	Outlet = 1030+73, 12" CMP	1.04	19.5	75
		11	Outlet = 1032+51, 18" RCP to 24" RCP	43.05	82.6	70
		12	Unknown Stream. Outlet 1040+00, 18" RCP	43.70	78.5	69
		13	Outlet = 1044+36, 18" RCP	38.71	74.9	67
		14	Outlet = 1048+16, 15" RCP	21.78	71.7	68
		15	Outlet = 1050+45, 15" RCP	16.09	60.8	68
		16	Outlet = 1052+58, 18" RCP	39.58	70.7	67
		17	Outlet = 1055+05, 15" RCP	48.07	59.6	68
		18	Dummer Pond Road Culvert, 1069+29, 18" SPP. Outlet to Area 20 Culvert	3.58	27.6	71
		19	Dummer Pond Road Culvert, 1069+58, 36" SPP. Outlet to Area 20 Culvert	66.54	72.9	68
		20	Outlet = 1069+69, 36" CMP	0.15	5.0	68
Total				1280.48	n/a	n/a

Soil Conditions

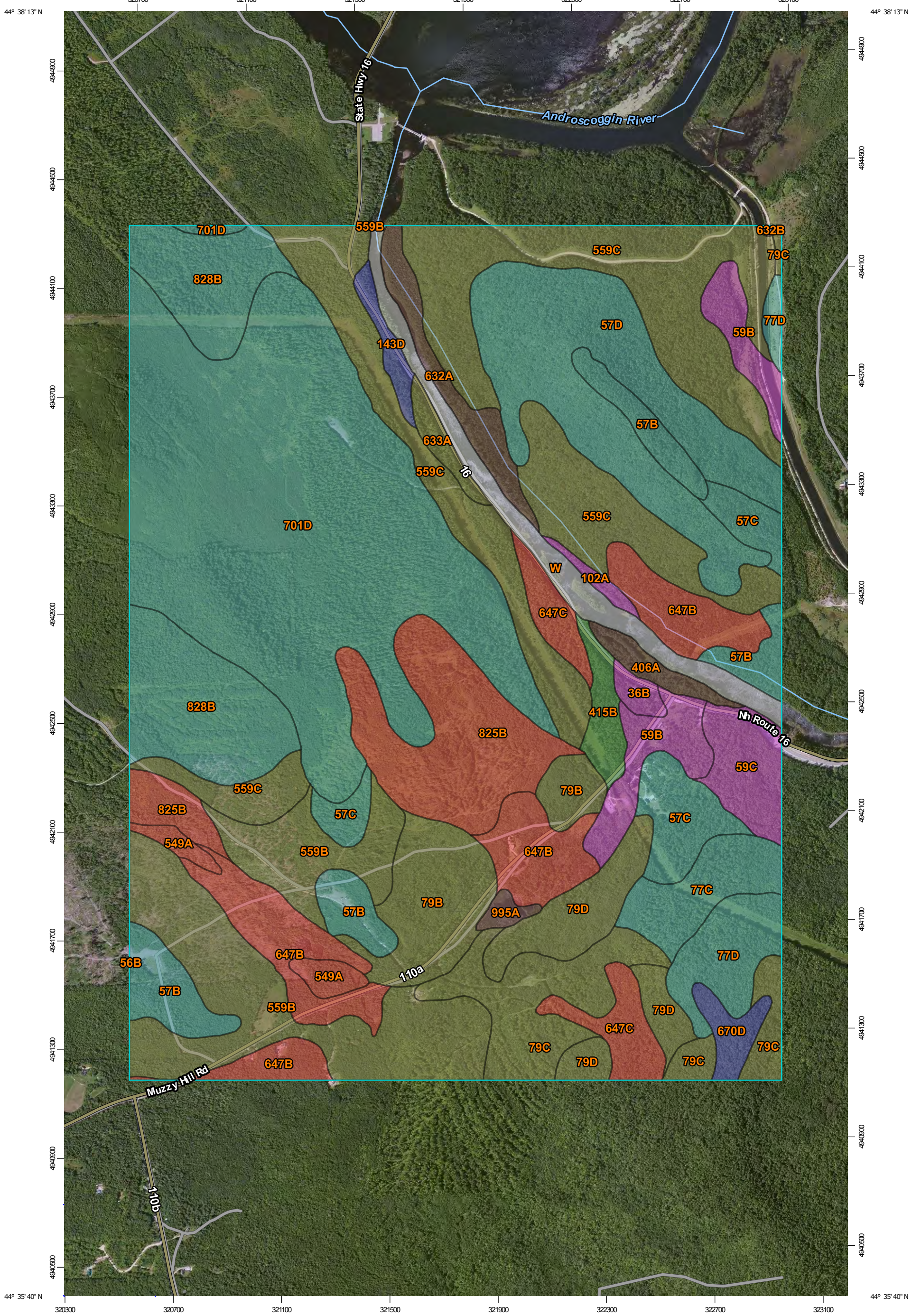
The study area is comprised of several different soil types as defined by the Soil Conservation Service (SCS), Soils Survey of Coos County, New Hampshire. Table 2, Soil Types, lists the designations, names, and groups of the soils located within the study area. Figure 2 depicts the various soil types within the study area.

Table 2
Soil Types

Soil Designation	Soil Name	Soil Group
701D	Becket-Skerry	C
828B	Skerry-Peru	C
143D	Monadnock fine sandy loam	B
633A	Pemi silt loam	C/D
559C	Skerry fine sandy loam, 8 - 15 percent	C/D
647C	Pillbury fine sandy loam 8 - 15 percent	D
415B	Moosilauke loam	A/D
79B	Peru fine sandy loam, 0 - 8 percent	C/D
57C	Becket fine sandy loam, 8 - 15 percent	C
647B	Pillbury fine sandy loam, 0 - 8 percent	D
549A	Peacham mucky peat	D
559B	Skerry fine sandy loam, 0 - 8 percent	C/D
995A	Wonsqueak muck	B/D
825B	Pillsbury-Peacham-Peru	D
36B	Adams loamy sand	A
57B	Becket fine sandy loam, 0 - 8 percent	C
79C	Peru fine sandy loam, 8 - 15 percent	C/D
79D	Peru fine sandy loam, 15 - 25 percent	C/D
59B	Waumbek sandy loam, 3 - 8 percent	A
77C	Marlow fine sandy loam, 8 - 15 percent	C
77D	Marlow fine sandy loam,15 - 25 percent	C
670D	Tunbridge-Berkshire-Lyman	B
59C	Waumbek sandy loam, 8 - 15 percent	A

Source: SCS Soil Survey for Coos County, New Hampshire

Hydrologic Soil Group—Coos County Area, New Hampshire
(16304_Dummer)



Map Scale: 1:13,200 if printed on B portrait (11" x 17") sheet.

N

Meters
0 150 300 600 900

Feet
0 500 1000 2000 3000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 19N WGS84

Existing Hydrologic Flow Patterns

The majority of the stormwater runoff from the existing study area flows from offsite, undeveloped, heavily forested areas to the West of NH 16 through culverts discharging into the Androscoggin River. The remaining portion of the study area sheet flows off NH 16, either directly into the Androscoggin River, or into roadside ditches that convey the stormwater to the Androscoggin River via roadway culverts.

The following describes the existing stormwater flow patterns for each of the subcatchment areas within the project limits.

- Subcatchment EX-4 is an offsite partially developed area that sheet flows over land into roadside ditches. The ditches converge at the intersection of NH 16 and NH 110A. The runoff then flows through a 15" roadway culvert beneath NH 16. From the outlet of the culvert, the runoff flows to the Androscoggin River.

- Subcatchment EX-5 is a large offsite area that consists of undeveloped land. The runoff sheet flows to an existing wetland West of NH 16. From this wetland, Robbin's Brook flows Easterly towards the project site. A 60" roadway culvert conveys the brook beneath NH 16. Once the runoff has exited the culvert, the stormwater then continues down Robbin's Brook where it outlets into the Androscoggin river.

- Subcatchments EX-6 thru EX-11 consist of undeveloped land to the West of the project site. The runoff from these areas begins atop Bickford Hill. From there, the runoff flows over land through dense forest prior to reaching the roadside wetlands. These roadside wetlands divert flow to various roadway culverts, each subcatchment flows through its own respective culvert. Due to the nature of these wetland, runoff may be diverted to an adjacent culvert during peak flow periods. The roadway culvert for subcatchment EX-6 outlets to downstream wetlands which convey runoff to the Androscoggin River. Subcatchments EX-7 thru EX-11 utilize roadway culverts that outlet directly into the Androscoggin River.

- Subcatchment EX-12 is comprised of undeveloped forest similar to other areas, but the runoff forms unknown stream #1. This stream flows through a drive culvert prior to reaching the wetlands adjacent to the roadway. EX-12 runoff then flows through an 18" roadway culvert and outlets directly into the Androscoggin River.

- Subcatchments EX-13 thru EX-16 consist of undeveloped land to the West of the project site. The runoff from these areas begins atop Bickford Hill. From there the runoff flows over land through dense forest prior to reaching the roadside wetlands. These roadside wetlands divert flow to various roadway culverts, each subcatchment flows through its own respective culvert. Subcatchments EX-13 thru EX-16 utilize roadway culverts that outlet directly into the Androscoggin River.

- Subcatchment EX-17 is similar to EX-13 thru EX-16. Undeveloped, heavily forested land flows overland from West of the project site. Once this runoff nears the roadway, a

roadside ditch, likely created by erosion, directs the runoff towards a roadway culvert. Before reaching this culvert, the roadside ditch reaches a 6% grade. During our analysis of the existing condition, this steep grade, coupled with the lack of storage at the culverts inlet, was showing the roadway overtopping during the 50-year storm event. During numerous discussions with maintenance personnel from District 1, this culvert location does not have overtopping issues. With the infield knowledge in hand, VHB calibrated the calculated flows to the culvert to mimic the existing condition. For more information on the calibration, see Methodology and Design Criteria.

- Subcatchments EX-18, EX-19 and EX-20 are all comprised of undeveloped forest. The runoff from these areas converges at the intersection of NH 16 and Dummer Pond Road. EX-18 flows over land into a roadside ditch. The ditch conveys runoff to an 18" roadway culvert under Dummer Pond Road. EX-19 runoff forms unknown stream #2. This stream flows through a 36" roadway culvert under Dummer Pond Road. The roadway culverts from Subcatchments EX-18 and EX-19 both outlet into EX-20. EX-20 is a small area formed by the intersection of NH 16 and Dummer Pond Road. The majority of subcatchment EX-20 consists of a rip-rap lined plunge pool where EX-18 and EX-19 outlet. From there, the combined runoff flows under NH 16 via a 36" roadway culvert. The runoff outlets the roadway culvert onto a steep, forested slope and flows over land prior to discharging into the Androscoggin River.

3

Proposed Conditions

Description of Contributing Areas

The proposed work includes widening NH 16 to allow the construction of 4-foot wide shoulders, realignment to the West of the existing roadway, and raising the roadway profile. The profile modifications will allow the proposed subbase to remain largely above the high-water table. The East side of the proposed roadway will utilize flat side slopes to create a roadway buffer. This roadway buffer will accept runoff via sheet flow from the proposed road. This will allow for a portion of the stormwater to be treated prior to reaching the Androscoggin River. See figure 4, Proposed Conditions: Drainage Area - roll plans 3 and 4.

The proposed conditions Subcatchment areas are approximately 1,274 acres in size. The flow patterns are very similar to the existing and the contributing areas have only changed slightly. The reduction in size is due to the realignment of the proposed roadway. The realignment to the West shifts the proposed roadway into the existing Subcatchment areas, reducing the erosion potential along the river as well as providing area for stormwater treatment.

Table 3 summarizes the proposed Subcatchment areas and their characteristics within the project.

Table 3
Proposed Conditions: Drainage Area Characteristics Summary

Exit Point		Subcatchment Area(s)		Area (Acres)	Tc (Min.)	CN
#	**Description**	**#**	**Description**			
1	Androscoggin River	4	Outlet = 1004+05, 15" CMP	2.84	37.2	52
		5	Robbin's Brook. Outlet = 1010+23 60" CMP	884.53	237.1	70
		6	Outlet = 1013+23, 15" CMP	15.19	86.5	70
		7	Outlet = 1020+73, 15" RCP	28.84	84.3	70
		8	Outlet = 1023+33, 15" CMP	4.93	26.5	69
		9	Outlet = 1027+00, 15" CMP	21.21	73.0	70
		10	Outlet = 1030+73, 12" CMP	1.39	39.9	75
		11	Outlet = 1032+51, 18" RCP to 24" RCP	11.75	64.5	70
		12	Unknown Stream. Outlet 1040+00, 18" RCP	82.44	79.3	69
		13	Outlet = 1044+36, 18" RCP	22.26	76.9	67
		14	Outlet = 1048+16, 15" RCP	11.17	71.5	68
		15	Outlet = 1050+45, 15" RCP	30.39	60.4	68
		16	Outlet = 1052+58, 18" RCP	39.06	71.0	67
		17	Outlet = 1055+05, 15" RCP	45.24	61.2	68
		18	Dummer Pond Road Culvert, 1069+29, 18" SPP. Outlet to Area 20 Culvert	6.21	36.2	71
		19	Dummer Pond Road Culvert, 1069+58, 36" SPP. Outlet to Area 20 Culvert	66.54	72.9	68
		20	Outlet = 1069+69, 36" CMP	0.15	5.0	68
Total				1274.14	n/a	n/a

Proposed Hydrologic Flow Patterns

The proposed drainage system has been designed to maintain the existing flow characteristics. The existing culverts will be replaced in a way that allows the proposed culverts to utilize the existing outlet channels, thereby minimizing impacts to the Androscoggin River.

Subcatchments P-4, P-5, P-19, and P-20 will continue to outlet through the existing culverts in the proposed condition. Subcatchment P-5 will receive an inlet extension of 14 feet. This extension will allow the proposed roadway to be constructed with flat slopes that eliminate the need for guardrail.

Subcatchments P-6 thru P-10, P-16, and P-17 remain largely unchanged in the proposed condition. The slight change in area is due to the shifting of the roadway alignment as well as the proposed roadway superelevation. Each subcatchment will outlet to the Androscoggin River via roadway culverts.

Subcatchments P-11 thru P-15 and P-18 contain the majority of changes in the proposed condition. The flow patterns remain similar to existing, while the amount of runoff directed to each culvert has increased/decreased respectively. The reason for the change in these Subcatchment area sizes and outlet locations is due to the proposed roadway profile modifications. In the proposed condition, better defined high and low point were designed. This will eliminate the lateral flow of runoff from one culvert to another in the adjacent roadside ditch, a condition that was present in the existing conditions.

The proposed condition will increase the amount of impervious area from 3.80 acres to 4.57 acres. The increase is due to the additional shoulder width throughout the project. This increase in stormwater will be mitigated with the use of a vegetated roadway buffer for treatment. The buffer will be along the right side of the proposed roadway from station 1019+50 to station 1067+50. Stormwater runoff will sheet flow off the adjacent roadway and flow across the vegetated buffer prior to discharging into the Androscoggin River.

4

Methodology & Design Criteria

VHB used three separate methodologies to evaluate the hydrologic and hydraulic impacts for the project. During the existing conditions analysis, VHB recognized that one method of analysis didn't make sense for this project. With subcatchment areas ranging in size from less than an acre to almost 900 acres, as well as roadside wetland connectivity, the design methodologies needed to account for this. After discussions with NHDOT staff, the USGS Regression Method, HydroCAD SCS TR-20, and the Rational Method were decided upon.

The existing conditions were analyzed using HydroCAD and the SCS TR-20 method, USGS Regression method, and the Rational Method. Subcatchments EX-6 thru EX-12 and EX-18 thru EX-20 were evaluated using HydroCAD and the SCS TR-20 method due to the connectivity of the roadside wetlands/ditches. Subcatchment EX-5 was evaluated using the USGS Regression method due to its large size, while subcatchments EX-4 and EX-13 thru EX-17 were evaluated using the Rational Method due to their smaller areas. The runoff from these subcatchments was conveyed to the existing culverts in a more direct path. The flows developed from the USGS Regression and the Rational Method were then input into FHWA Hy8 in order to evaluate the existing culverts in relation to the existing roadway layout.

Subcatchment EX-17 was analyzed using HydroCAD as well as the Rational Method for the existing conditions. Both methods produced 50-year storm event flows that the existing 15" culvert could not handle without overtopping the roadway. Utilizing the in-field knowledge of the District 1 maintenance personnel, VHB calibrated the flows for EX-17 to simulate existing conditions. The calibration allowed the runoff to pond to an elevation of 1150.32 feet. This elevation coincides with the elevation of the existing edge of pavement at the centerline of the existing 15" roadway culvert. The existing 15" culvert has an invert elevation of 1146.75, giving a headwater depth of 3.57' relative to the existing edge of pavement. Using this calculated headwater depth and the diameter of the existing culvert, a HW/D ratio, 2.86, to mimic existing conditions was calculated. With this ratio, the Rational Method Excel spreadsheets Culverts tab was used to back calculate a Q50 flow that creates a HW/D of 2.86. This flow was then compared to the Rational Method flow calculated. The flow to replicate the existing condition was 45% of the Rational Method flow. The flows for both the existing and proposed culvert analysis were reduced to 45%. VHB feels this calibration closely replicates the existing conditions. See calibration calculation in Appendix B: Culvert Design.

For the proposed condition, VHB utilized three methodologies to analyze and design the proposed culverts. Subcatchment P-5 was evaluated using the USGS Regression method due to the large size, while the remaining subcatchments were evaluated using the Rational Method. The flows for subcatchments P-4, P-5, P-12, and P-18 were input into FHWA Hy8 to analyze the proposed culverts in relation to the proposed roadway. For the remaining

subcatchments, P-6 thru P-11 and P-13 thru P-17, the Rational Method flows were input into a HydroCAD model, rather than Hy8, in order to analyze the culverts with the addition of the catch basins. This is a changed from the previous submission due to the addition of catch basins at all culvert crossings, excluding stream crossings. VHB input the previous culvert design, from the Rational method and Hy8, into HydroCAD to check the effects of the catch basin.

Design Storms

VHB analyzed the proposed stormwater impacts for the 2, 10 and 50-year design storms. These rainfall events are based on a 24-hour storm duration using a Type II distribution curve. Appendix A-Hydrologic Calculations contains copies of the rainfall data charts used in the calculations.

Curve Number

VHB developed weighted curve numbers for each existing subcatchment area based on the different ground covers and hydrologic soil group types found within each area. Curve numbers were not developed for the proposed subcatchments because HydroCAD was not used during the proposed analysis. The curve numbers were based on the SCS TR-55 methodology and are included in Appendix A: Hydrologic Calculations.

Time of Concentration

VHB calculated the Time of Concentrations (Tc) for each of the individual subcatchment area using the hydraulically most distant point within each area. A minimum time of 5 minutes was used in the calculations. The Tc's were calculated utilizing multiple methodologies and are included in Appendix A: Hydrologic Calculations.

Hydraulic Calculations

Culverts

VHB used both the USGS Regression method as well as the Rational Method to develop the flows used in the design of the proposed roadway culverts. These flows were then input into FHWA Hy8 to analyze the culvert hydraulics. The proposed culverts were sized based on a 50-year design storm. VHB used the following design parameters and criteria to design the system:

Minimum Pipe Size:	18 inches
RCP Pipe Coefficient of Friction:	0.012
CMP Pipe Coefficient of Friction:	0.024
Minimum Time of Concentration (Tc):	5 minutes
Design Software:	FHWA Hy8

The proposed culverts where designed to convey the 50-year design flow without overtopping the roadway. While the existing conditions utilized adjacent wetland/ditch interconnectivity, the proposed culverts were designed to convey the runoff from its respective subcatchment area.

For further information, refer to Appendix B: Culvert Design.

Stone Outlet Protection

VHB sized the riprap outlet protection using Chapter 4, pp. 172 to 174, of the New Hampshire Stormwater Management Manual (December 2008), NHDES. The following design parameters represent the minimum acceptable riprap apron dimensions used for design. See Appendix C: Outlet Protection Calculations for more information.

Apron Width:	≥10 feet
Apron Length:	≥10 feet
Median Stone Diameter:	0.5 feet
Depth of Stone:	6 inches (minimum)

5

Stormwater Management Impacts/Conclusion

Stormwater Quality Mitigation

Under the proposed conditions, the peak flow rates were calculated for the 2, 10, and 50-year storm events. The peak rates of runoff for the proposed conditions are anticipated to have an insignificant increase. While the proposed condition will add 6 feet of impervious width to the roadway, the vegetated roadway buffer will treat 60% of the runoff generated from the additional impervious area. Along with the vegetated buffer, the realignment of the proposed roadway will help reduce the erosion along the Androscoggin River.

The following table summarizes the flow results for the project.

Table 4
Peak Stormwater Runoff Rate Summary

		Peak Flow for Given Storm (cfs)		
Watershed	Condition	2-yr	10-yr	50-yr
Androscoggin River	Existing	140.00	248.52	388.69
	Proposed	140.14	249.16	388.90

Conclusion

This project implements standard stormwater management techniques to mitigate its impacts on peak stormwater runoff rates. Furthermore, stormwater quality issues will be reduced through the proposed implementation of standard practices (i.e. vegetated roadway buffer) that are accepted by the NH Department of Environmental Services Water Supply and Pollution Control Division. For more information concerning the overall pollutant removal efficiencies and their influence on the project, refer to Appendix D.

A

Appendix A
Hydrologic Calculations

- Hydrologic Calculations (Existing Conditions)
- Hydrologic Calculations (Proposed Conditions)
- Rainfall/Support Data

Hydrologic Calculations (Existing Conditions)

Project: Route 16 - Dummer
PIN: 16304.00
Town: Dummer

Prepared by: Seth Hill
Date: 11-Oct-17
Checked by:
Date:
Revised by:

P_2 (in/hr) 2.34

Area ID	Station	Basin Length	Benson Slope	Sheet Flow				T_c by Other Methods (min)			T_c by Kinematic Wave (min)				50-yr Velocity	Concentrated (by Velocity method)						Channel						Basin T_c (min)				Basin
		L (ft)	ft/mi	L (ft)	S (ft/ft)	Rh (in)	n	Velocity Meth	TR-55 KW approx	Kerby-Hath Meth	KW_2	KW_{10}	KW_{50}	KW_{100}	v (ft/s)	L (ft)	S (ft/ft)	Rh (in)	n	T_c	v (ft/s)	L (ft)	S (ft/ft)	Rh (ft)	n	T_c	v (ft/s)	Sum_2	Sum_{10}	Sum_{50}	Sum_{100}	
EX-5		2220.000	0.135	100	0.0256	2.4	0.2	4.1	13.1	14.0	11.0	9.3	8.2	7.9	0.20	1602	0.041	2.4	0.200	52.2	0.5	11021	0.021	2.64	0.400	179.0	1.03	242.2	240.6	239.5	239.1	EX-5
EX-6		580.000	0.393	100	0.0745	2.4	0.2	2.4	8.5	10.9	7.4	6.4	5.7	5.5	0.29	2962	0.075	2.4	0.200	71.2	0.7							78.6	77.6	76.9	76.7	EX-6
EX-7		570.000	0.446	100	0.07	2.4	0.2	70.4	113.9	11.1	7.5	6.6	5.8	5.6	0.29	2942	0.081	2.4	0.200	67.8	0.7	406	0.032	12.00	0.095	0.5	14.68	75.8	89.1	88.3	88.1	EX-7
EX-8		130.000	0.433	100	0.082	2.4	0.2	65.1	106.9	10.7	7.1	6.2	5.5	5.3	0.30	586	0.082	2.4	0.200	13.4	0.7							20.5	19.6	18.9	18.7	EX-8
EX-9		570.000	0.528	100	0.1	2.4	0.2	58.9	98.8	10.2	6.6	5.8	5.2	5.0	0.32	2970	0.100	2.4	0.200	61.6	0.8	160	0.048	12.00	0.095	0.1	17.98	68.4	67.6	66.9	66.8	EX-9
EX-10		70.000	0.516	100	0.0978	2.4	0.2	59.6	99.6	10.2	6.7	5.8	5.2	5.0	0.32	270	0.098	2.4	0.200	5.7	0.8							12.3	11.5	10.9	10.7	EX-10
EX-11		810.000	0.792	100	0.15	2.4	0.2	48.1	84.0	9.3	5.7	5.0	4.5	4.3	0.37	4177	0.150	2.4	0.200	70.8	1.0							76.5	75.8	75.3	75.1	EX-11
EX-12		800.000	0.844	100	0.11	2.4	0.2	56.2	95.1	10.0	6.4	5.6	5.0	4.8	0.33	3971	0.160	2.4	0.200	65.1	1.0	155	0.070	12.00	0.095	0.1	21.71	71.7	70.9	70.3	70.1	EX-12
EX-13		800.000	0.929	100	0.12	2.4	0.2	53.8	91.8	9.8	6.2	5.4	4.9	4.7	0.34	4003	0.180	2.4	0.200	61.9	1.1	115	0.023	12.00	0.095	0.2	12.31	68.3	67.5	66.9	66.8	EX-13
EX-14		750.000	0.996	100	0.11	2.4	0.2	56.2	95.1	10.0	6.4	5.6	5.0	4.8	0.33	3876	0.189	2.4	0.200	58.5	1.1							64.9	64.1	63.5	63.3	EX-14
EX-15		640.000	0.971	100	0.184	2.4	0.2	43.4	77.4	8.8	5.3	4.7	4.2	4.1	0.40	3260	0.184	2.4	0.200	49.9	1.1							55.2	54.6	54.1	53.9	EX-15
EX-16		800.000	0.913	100	0.17	2.4	0.2	45.2	79.9	9.0	5.5	4.8	4.3	4.2	0.39	3891	0.186	2.4	0.200	59.2	1.1	224	0.033	12.0	0.095	0.3	14.91	64.9	64.3	63.8	63.6	EX-16
EX-17		590.000	0.763	100	0.144	2.4	0.2	49.1	85.4	9.3	5.8	5.1	4.6	4.4	0.37	2748	0.144	2.4	0.200	47.5	1.0	267	0.095	6.0	0.040	0.1	37.83	53.4	52.8	52.2	52.0	EX-17
EX-18		150.000	0.549	100	0.104	2.4	0.2	57.8	97.2	10.1	6.5	5.7	5.1	4.9	0.33	692	0.104	2.4	0.200	14.1	0.8							20.6	19.8	19.2	19.0	EX-18
EX-19		750.000	0.891	100	0.169	2.4	0.2	45.3	80.1	9.0	5.5	4.8	4.3	4.2	0.39	3860	0.169	2.4	0.200	61.6	1.0							67.1	66.5	65.9	65.8	EX-19
EX-20		770.000	0.871																0.200													EX-20
EX-4		220.000	0.092	100	0.0348	2.4	0.2	99.9	150.6	13.0	9.8	8.4	7.4	7.1	0.22	481	0.035	2.4	0.200	16.9	0.5							26.7	25.3	24.3	24.0	EX-4

Project: Route 16 - Dummer
PIN: 16304.00
Town: Dummer

Prepared by: Seth Hill
Date: October-17
Checked by:
Date:

Revised by:

Peak Flow Estimates by Rational Method

				T = 2 yrs			T = 10 yrs			T = 50 yrs			T = 100 yrs		
Area ID	Station	Area ac	C	T_c min	i_2 (in/hr)	Q_2 (ft3/s)	T_c min	i_{10} (in/hr)	Q_{10} (ft3/s)	T_c min	i_{50} (in/hr)	Q_{50} (ft3/s)	T_c min	i_{100} (in/hr)	Q_{100} (ft3/s)
EX-6		15.2	0.20	78.6	0.740	**2.24**	77.6	1.080	**3.27**	76.9	1.560	**4.73**	76.7	1.830	**5.54**
EX-7		29.6	0.20	75.8	0.760	**4.50**	89.1	0.960	**5.68**	88.3	1.380	**8.17**	88.1	1.620	**9.59**
EX-8		2.9	0.20	20.5	1.860	**1.06**	19.6	2.560	**1.46**	18.9	3.570	**2.03**	18.7	4.100	**2.34**
EX-9		23.2	0.20	68.4	0.830	**3.85**	67.6	1.190	**5.52**	66.9	1.760	**8.17**	66.8	2.060	**9.56**
EX-10		1.0	0.20	12.3	2.420	**0.50**	11.5	3.380	**0.70**	10.9	4.750	**0.99**	10.7	5.410	**1.13**
EX-11		43.1	0.20	76.5	0.760	**6.54**	75.8	1.100	**9.47**	75.3	1.580	**13.60**	75.1	1.850	**15.93**
EX-12		43.7	0.20	71.7	0.810	**7.08**	70.9	1.150	**10.05**	70.3	1.670	**14.60**	70.1	1.960	**17.13**
EX-13		38.7	0.20	68.3	0.830	**6.43**	67.5	1.210	**9.37**	66.9	1.760	**13.63**	66.8	2.060	**15.95**
EX-14		21.8	0.20	64.9	0.860	**3.75**	64.1	1.250	**5.45**	63.5	1.830	**7.97**	63.3	2.150	**9.37**
EX-15		16.1	0.20	55.2	0.980	**3.15**	54.6	1.400	**4.51**	54.1	2.010	**6.47**	53.9	2.370	**7.63**
EX-16		39.6	0.20	64.9	0.860	**6.81**	64.3	1.250	**9.90**	63.8	1.830	**14.49**	63.6	2.150	**17.02**
EX-17		48.1	0.20	53.4	1.000	**9.61**	52.8	1.430	**13.75**	52.2	2.050	**19.71**	52.0	2.400	**23.07**
EX-18		3.6	0.20	20.6	1.860	**1.33**	19.8	2.560	**1.83**	19.2	3.480	**2.49**	19.0	3.990	**2.86**
EX-19		66.5	0.20	67.1	0.840	**11.18**	66.5	1.220	**16.24**	65.9	1.780	**23.69**	65.8	2.090	**27.81**
EX-20		0.2	0.20	*5.0	3.480	**0.10**	*5.0	4.610	**0.14**	*5.0	6.240	**0.19**	*5.0	7.160	**0.21**
EX-4		2.9	0.20	26.7	1.610	**0.92**	25.3	2.220	**1.27**	24.3	3.110	**1.77**	24.0	3.580	**2.04**

*Time of Concentration is direct entry of 5 minutes (minimum value)

Project: Route 16 - Dummer
Project Number: 16304.00
Town: Dummer

DRAINAGE STUDY
PEAK FLOW Q_{50} SUMMARY & PIPE SIZING

Prepared by: Seth Hill
Date: 11-Oct-17
USGS Quad: Coos County, NH
Checked by:
Revised by:

Note:
Pipe sizing by Manning's equation and Concrete culvert under inlet control (simple orifice)

Entrance	2
H_w/D	1.5
C_d	0.53
c	0.055
Y	0.54
a	0.622

Culvert Entrance Treatment

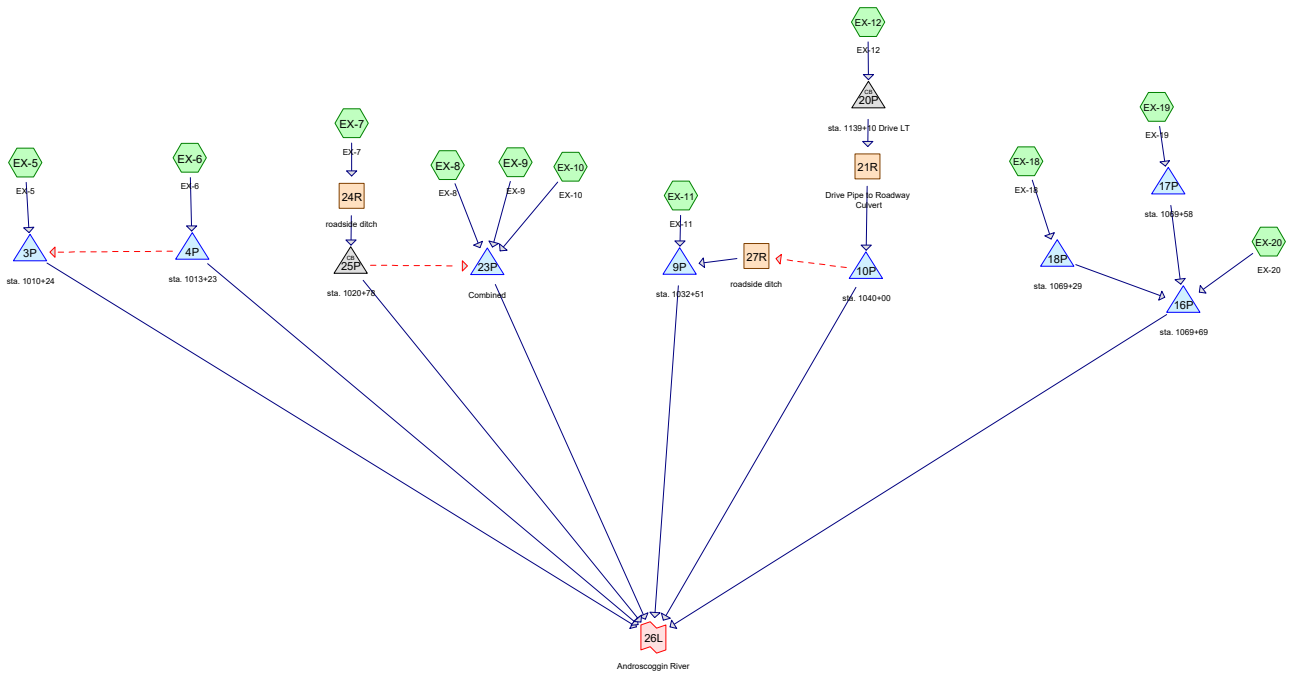
Generic	*Projecting*	*Mitred*	*Headwall*
1	2	3	4
0.6	0.53	0.58	0.64
0.043	0.055	0.046	0.038
0.5	0.54	0.75	0.69

Culvert Orifice Equation
$(H_w/D) = c\{Q/AD^{0.5}\}^2 + Y$
(no slope correction)

Area ID Station	Culvert n	Culvert S	USGS Q50	Pipe Size (in) Manning	Pipe Size (in) Inlet Control	Pipe Size (in) Hw/D	Rational Q50	Pipe Size (in) Manning	Pipe Size (in) Inlet Control	Pipe Size (in) Hw/D	Existing Pipe Size D	Existing Pipe Rational H_w/D	Existing Capacity Manning Q_M	Existing Capacity Orifice Q_O	Notes
EX-6	0.025	0.007	18.54	36	30	0.86	4.73	24	18	0.80	15	1.20	2.75	5.72	15" cmp
EX-7	0.013	0.022	31.26	24	30	1.44	8.17	18	18	1.33	15	2.50	9.56	5.72	15" rcp
EX-8	0.025	0.035	5.04	18	18	0.84	2.03	18	18	0.59	15	0.66	6.32	5.72	15" cmp
EX-9	0.025	0.037	25.85	30	30	1.15	8.17	18	18	1.33	15	2.50	6.42	5.72	15" cmp
EX-10	0.025	0.029	2.29	18	18	0.60	0.99	18	18	0.55	12	0.63	3.15	3.27	12" cmp
EX-11	0.013	0.026	41.87	30	36	1.19	13.60	18	24	1.06	21	1.55	25.44	13.26	18" rcp to 24" rcp
EX-12	0.013	0.017	42.37	30	36	1.20	14.60	24	24	1.14	18	3.05	13.65	9.02	18" rcp
EX-13	0.013	0.035	38.54	24	36	1.09	13.63	18	24	1.06	18	2.73	19.59	9.02	18" rcp
EX-14	0.013	0.036	24.61	24	30	1.10	7.97	18	18	1.29	15	2.41	12.29	5.72	15" rcp
EX-15	0.013	0.006	19.43	30	30	0.89	6.47	18	18	1.03	15	1.77	5.00	5.72	15" rcp
EX-16	0.013	0.016	39.22	30	36	1.11	14.49	24	24	1.13	18	3.02	13.37	9.02	18" rcp
EX-17	0.013	0.057	45.64	24	36	1.31	8.87	18	18	1.47	15	2.85	15.35	5.72	15" rcp. Flows reduced to 45% to mimic existing conditions. See Attached calibration calculation.
EX-18	0.013	0.007	6.02	18	18	0.97	2.49	18	18	0.61	18	0.61	8.66	9.02	18" spp
EX-19	0.013	0.060	58.81	30	42	1.13	23.69	18	30	1.05	36	0.75	163.36	51.02	36" spp
EX-20	0.025	0.040	0.51	18	18	0.54	0.19	18	18	0.54	36	0.54	69.36	51.02	36" cmp
EX-4	0.025	0.033	5.04	18	18	0.84	1.77	18	18	0.58	15	0.63	6.14	5.72	15" cmp

EXISTING CN VALUES

Catchment Name	Catchment Area (Acres)	Hydro Group	Land Cover	CN AC	CN Value	Weight CN (Bold Values)
EX-10	1.0	C	Developed, Low Intensity	0.584546264	46.17915483	44.36
			Developed, Open Space	0.048901504	3.618711307	3.48
			Forest	0.407639007	28.5347305	27.41
EX-10 Total						**75.24**
EX-11	43.0	C	Developed, Low Intensity	0.971095543	76.71654793	1.78
			Developed, Open Space	0.29020523	21.47518704	0.50
			Forest	39.9518646	2796.630522	64.97
			Scrub/Shrub	1.798474773	116.9008603	2.72
		WATER	Developed, Low Intensity	0.012775768	0	0.00
			Developed, Open Space	0.022324953	0	0.00
EX-11 Total						**69.96**
EX-12	43.7	C	Developed, Low Intensity	0.153264909	12.10792778	0.28
			Forest	35.0931286	2456.519002	56.21
			Scrub/Shrub	7.839398364	509.5608937	11.66
			Wetland	0.61632978	43.14308461	0.99
EX-12 Total						**69.13**
EX-18	3.6	C	Developed, Low Intensity	0.176691881	13.95865863	3.90
			Developed, Medium Intensity	0.208455345	16.67642762	4.66
			Forest	2.928269135	204.9788394	57.28
			Grassland/Herbaceous	0.264939897	19.60555239	5.48
EX-18 Total						**71.32**
EX-19	66.5	C	Bare Land	0.089732677	7.986208262	0.12
			Developed, Low Intensity	0.170414526	13.46274753	0.20
			Developed, Medium Intensity	0.975333191	78.02665527	1.17
			Forest	28.57380692	2000.166484	30.06
			Grassland/Herbaceous	4.074997307	301.5498007	4.53
			Scrub/Shrub	32.65930024	2122.854515	31.90
EX-19 Total						**67.99**
EX-20	70.3	C	Bare Land	0.089732677	7.986208262	0.11
			Developed, Low Intensity	0.425920441	33.64771487	0.48
			Developed, Medium Intensity	1.255991457	100.4793165	1.43
			Developed, Open Space	3.60989E-05	0.002671317	0.00
			Forest	31.50207606	2205.145324	31.38
			Grassland/Herbaceous	4.339937204	321.1553531	4.57
			Scrub/Shrub	32.65930024	2122.854515	30.21
EX-20 Total						**68.18**
EX-5	884.6	A	Developed, Low Intensity	0.032316235	1.64812799	0.00
			Forest	2.288626674	68.65880022	0.08
			Scrub/Shrub	0.318426265	9.552787961	0.01
			Wetland	0.614175006	18.42525018	0.02
		B	Bare Land	0.676544263	57.50626239	0.07
			Developed, Low Intensity	0.546841017	37.18518914	0.04
			Forest	8.770636408	482.3850024	0.55
			Scrub/Shrub	2.834377812	136.050135	0.15
			Wetland	0.637578674	35.06682708	0.04
		C	Bare Land	0.907350442	80.75418936	0.09
			Developed, Low Intensity	2.883374218	227.7865632	0.26
			Forest	753.998034	52779.86238	59.67
			Grassland/Herbaceous	16.85812905	1247.501549	1.41
			Scrub/Shrub	48.26884178	3137.474716	3.55
			Unconsolidated Shore	0.100457045	7.031993159	0.01
			Wetland	26.10385756	1827.270029	2.07
		D	Bare Land	0.195194415	17.7626918	0.02
			Forest	9.61449467	740.3160896	0.84
			Grassland/Herbaceous	0.172389923	13.79119383	0.02
			Scrub/Shrub	1.216623583	88.81352156	0.10
			Wetland	7.512987582	578.5000438	0.65
EX-5 Total						**69.63**
EX-6	15.1	C	Developed, Low Intensity	0.297084477	23.46967369	1.55
			Forest	14.5519546	1018.636822	67.24
			Scrub/Shrub	0.270569115	17.58699247	1.16
			Wetland	0.029846449	2.089251458	0.14
EX-6 Total						**70.09**
EX-7	29.6	C	Developed, Low Intensity	0.613889081	48.49723739	1.64
			Developed, Open Space	7.4247E-05	0.005494277	0.00
			Forest	27.41007558	1918.705291	64.83
			Scrub/Shrub	1.569872715	102.0417265	3.45
EX-7 Total						**69.92**
EX-8	2.8	C	Developed, Low Intensity	0.250276757	19.77186384	6.95
			Developed, Open Space	0.080277339	5.940523075	2.09
			Forest	2.325113119	162.7579183	57.18
			Scrub/Shrub	0.02430024	1.579515603	0.55
			Wetland	0.107401021	7.51807147	2.64
		WATER	Developed, Low Intensity	0.010187673	0	0.00
			Developed, Open Space	0.01082486	0	0.00
			Forest	0.001036071	0	0.00
			Wetland	0.034532301	0	0.00
EX-8 Total						**69.41**
EX-9	23.2	C	Developed, Low Intensity	0.820425706	64.81363077	2.79
			Forest	21.58391514	1510.87406	65.12
			Scrub/Shrub	0.796413112	51.76685225	2.23
EX-9 Total						**70.15**



Subcat Reach Pond Link

Routing Diagram for 16304A_Dummer_Existing
Prepared by VHB, Printed 11/14/2017

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.150	89	Gravel roads, HSG C (EX-20)
1.000	75	SEE ATTACHED SPREADSHEET FOR CN VALUES (EX-10)
965.900	70	SEE ATTACHED SPREADSHEET FOR CN VALUES (EX-11, EX-5, EX-6, EX-9)
46.500	69	SEE ATTACHED SPREADSHEET FOR CN VALUES (EX-12, EX-8)
3.600	71	SEE ATTACHED SPREADSHEET FOR CN VALUES (EX-18)
66.500	68	SEE ATTACHED SPREADSHEET FOR CN VALUES (EX-19)
29.600	70	See Notes (EX-7)
1,113.250	**70**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
0.150	HSG C	EX-20
0.000	HSG D	
1,113.100	Other	EX-10, EX-11, EX-12, EX-18, EX-19, EX-5, EX-6, EX-7, EX-8, EX-9
1,113.250		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover
0.000	0.000	0.150	0.000	0.000	0.150	Gravel roads
0.000	0.000	0.000	0.000	1,083.500	1,083.500	SEE ATTACHED SPREADSHEET FOR CN VALUES
0.000	0.000	0.000	0.000	29.600	29.600	See Notes
0.000	**0.000**	**0.150**	**0.000**	**1,113.100**	**1,113.250**	**TOTAL AREA**

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	3P	1,129.96	1,129.26	80.0	0.0088	0.025	60.0	0.0	0.0
2	4P	1,139.25	1,138.90	52.0	0.0067	0.025	15.0	0.0	0.0
3	9P	1,132.63	1,132.05	22.0	0.0264	0.013	24.0	0.0	0.0
4	9P	1,132.05	1,131.47	22.0	0.0264	0.013	18.0	0.0	0.0
5	10P	1,134.76	1,134.00	45.0	0.0169	0.013	18.0	0.0	0.0
6	10P	1,136.12	1,136.54	29.0	-0.0145	0.025	18.0	0.0	0.0
7	16P	1,197.00	1,194.48	63.0	0.0400	0.025	36.0	0.0	0.0
8	17P	1,203.99	1,201.53	41.0	0.0600	0.013	36.0	0.0	0.0
9	18P	1,202.42	1,202.14	41.0	0.0068	0.013	18.0	0.0	0.0
10	20P	1,143.18	1,140.70	37.0	0.0670	0.025	18.0	0.0	0.0
11	23P	1,130.93	1,129.16	50.0	0.0354	0.025	15.0	0.0	0.0
12	23P	1,131.57	1,129.82	48.0	0.0365	0.025	15.0	0.0	0.0
13	23P	1,134.22	1,133.06	40.0	0.0290	0.025	12.0	0.0	0.0
14	25P	1,134.12	1,133.20	42.0	0.0219	0.013	15.0	0.0	0.0

Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment EX-10: EX-10 Runoff Area=1.000 ac 0.00% Impervious Runoff Depth=0.56"
Flow Length=370' Slope=0.0978 '/' Tc=27.0 min CN=75 Runoff=0.44 cfs 0.047 af

Subcatchment EX-11: EX-11 Runoff Area=43.000 ac 0.00% Impervious Runoff Depth=0.38"
Flow Length=4,277' Slope=0.1500 '/' Tc=89.8 min CN=70 Runoff=4.59 cfs 1.366 af

Subcatchment EX-12: EX-12 Runoff Area=43.700 ac 0.00% Impervious Runoff Depth=0.35"
Flow Length=4,226' Tc=87.9 min CN=69 Runoff=4.20 cfs 1.275 af

Subcatchment EX-18: EX-18 Runoff Area=3.600 ac 0.00% Impervious Runoff Depth=0.41"
Flow Length=792' Slope=0.1040 '/' Tc=35.0 min CN=71 Runoff=0.85 cfs 0.124 af

Subcatchment EX-19: EX-19 Runoff Area=66.500 ac 0.00% Impervious Runoff Depth=0.32"
Flow Length=3,960' Slope=0.1690 '/' Tc=79.6 min CN=68 Runoff=6.04 cfs 1.776 af

Subcatchment EX-20: EX-20 Runoff Area=0.150 ac 0.00% Impervious Runoff Depth=1.32"
Tc=5.0 min CN=89 Runoff=0.36 cfs 0.016 af

Subcatchment EX-5: EX-5 Runoff Area=884.600 ac 0.00% Impervious Runoff Depth=0.38"
Tc=242.0 min CN=70 Runoff=49.03 cfs 28.099 af

Subcatchment EX-6: EX-6 Runoff Area=15.100 ac 0.00% Impervious Runoff Depth=0.38"
Flow Length=3,062' Slope=0.0745 '/' Tc=95.9 min CN=70 Runoff=1.54 cfs 0.480 af

Subcatchment EX-7: EX-7 Runoff Area=29.600 ac 0.00% Impervious Runoff Depth=0.38"
Flow Length=3,042' Tc=93.1 min CN=70 Runoff=3.10 cfs 0.940 af

Subcatchment EX-8: EX-8 Runoff Area=2.800 ac 0.00% Impervious Runoff Depth=0.35"
Flow Length=686' Slope=0.0820 '/' Tc=36.3 min CN=69 Runoff=0.50 cfs 0.082 af

Subcatchment EX-9: EX-9 Runoff Area=23.200 ac 0.00% Impervious Runoff Depth=0.38"
Flow Length=3,230' Tc=84.3 min CN=70 Runoff=2.60 cfs 0.737 af

Reach 21R: Drive Pipe to Roadway Avg. Flow Depth=0.36' Max Vel=3.21 fps Inflow=4.20 cfs 1.275 af
n=0.050 L=90.0' S=0.0660 '/' Capacity=30.64 cfs Outflow=4.20 cfs 1.275 af

Reach 24R: roadside ditch Avg. Flow Depth=0.57' Max Vel=3.17 fps Inflow=3.10 cfs 0.940 af
n=0.035 L=406.0' S=0.0317 '/' Capacity=48.32 cfs Outflow=3.09 cfs 0.940 af

Reach 27R: roadside ditch Avg. Flow Depth=0.00' Max Vel=0.00 fps Inflow=0.00 cfs 0.000 af
n=0.100 L=538.0' S=0.0084 '/' Capacity=12.91 cfs Outflow=0.00 cfs 0.000 af

Pond 3P: sta. 1010+24 Peak Elev=1,132.91' Storage=443 cf Inflow=49.03 cfs 28.099 af
60.0" Round Culvert n=0.025 L=80.0' S=0.0088 '/' Outflow=49.03 cfs 28.099 af

Pond 4P: sta. 1013+23 Peak Elev=1,141.01' Storage=0 cf Inflow=1.54 cfs 0.480 af
Primary=1.54 cfs 0.480 af Secondary=0.00 cfs 0.000 af Outflow=1.54 cfs 0.480 af

Pond 9P: sta. 1032+51 Peak Elev=1,133.03' Storage=1 cf Inflow=4.59 cfs 1.366 af
Outflow=4.59 cfs 1.366 af

Pond 10P: sta. 1040+00 Peak Elev=1,135.75' Storage=51 cf Inflow=4.20 cfs 1.275 af
Primary=4.20 cfs 1.275 af Secondary=0.00 cfs 0.000 af Outflow=4.20 cfs 1.275 af

Pond 16P: sta. 1069+69 Peak Elev=1,198.03' Storage=0 cf Inflow=6.35 cfs 1.917 af
36.0" Round Culvert n=0.025 L=63.0' S=0.0400 '/' Outflow=6.35 cfs 1.917 af

Pond 17P: sta. 1069+58 Peak Elev=1,205.04' Storage=0 cf Inflow=6.04 cfs 1.776 af
36.0" Round Culvert n=0.013 L=41.0' S=0.0600 '/' Outflow=6.04 cfs 1.776 af

Pond 18P: sta. 1069+29 Peak Elev=1,203.01' Storage=0 cf Inflow=0.85 cfs 0.124 af
18.0" Round Culvert n=0.013 L=41.0' S=0.0068 '/' Outflow=0.85 cfs 0.124 af

Pond 20P: sta. 1139+10 Drive LT Peak Elev=1,144.33' Inflow=4.20 cfs 1.275 af
18.0" Round Culvert n=0.025 L=37.0' S=0.0670 '/' Outflow=4.20 cfs 1.275 af

Pond 23P: Combined Peak Elev=1,131.87' Storage=89 cf Inflow=2.89 cfs 0.865 af
Outflow=2.89 cfs 0.865 af

Pond 25P: sta. 1020+78 Peak Elev=1,135.03' Inflow=3.09 cfs 0.940 af
Primary=3.09 cfs 0.940 af Secondary=0.00 cfs 0.000 af Outflow=3.09 cfs 0.940 af

Link 26L: AndroscogginRiver Inflow=56.54 cfs 34.942 af
Primary=56.54 cfs 34.942 af

Total Runoff Area = 1,113.250 ac Runoff Volume = 34.942 af Average Runoff Depth = 0.38"
100.00% Pervious = 1,113.250 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment EX-10: EX-10

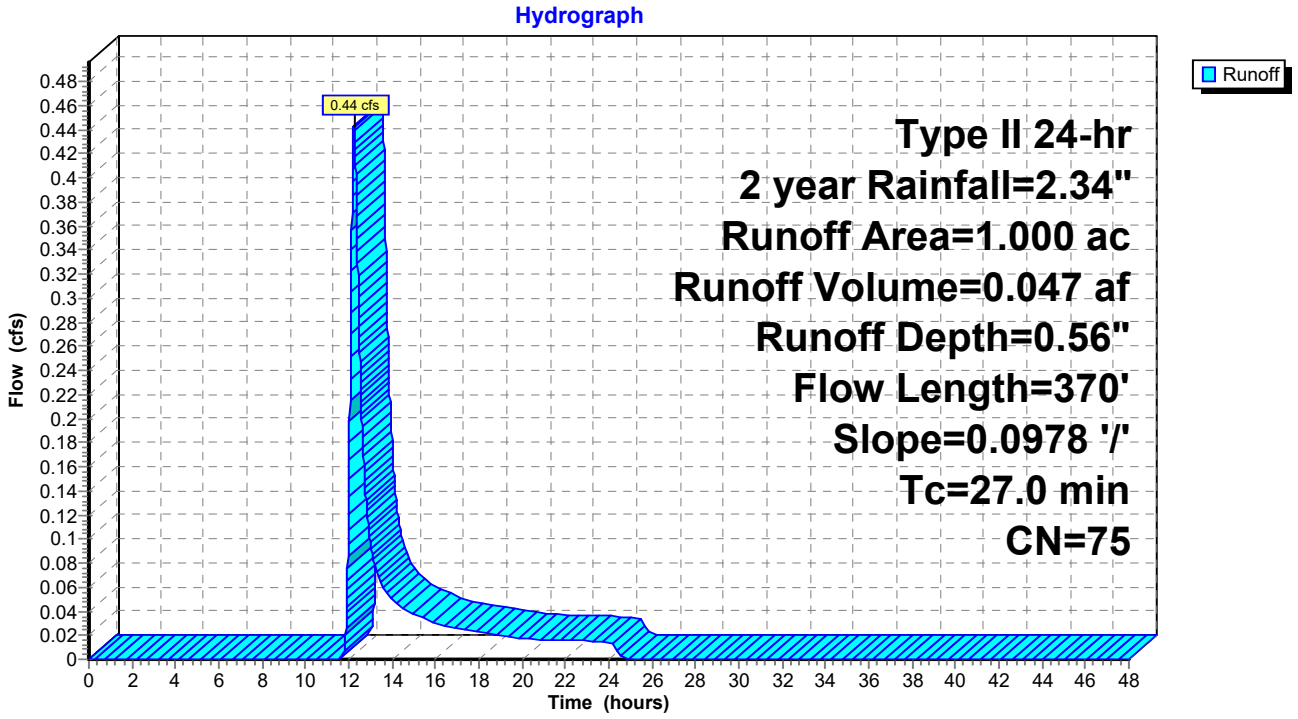
Runoff = 0.44 cfs @ 12.24 hrs, Volume= 0.047 af, Depth= 0.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 2 year Rainfall=2.34"

	Area (ac)	CN	Description
*	1.000	75	SEE ATTACHED SPREADSHEET FOR CN VALUES
	1.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.2	100	0.0978	0.08		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.80"
5.8	270	0.0978	0.78		**Shallow Concentrated Flow,** Forest w/Heavy Litter Kv= 2.5 fps
27.0	370	Total			

Subcatchment EX-10: EX-10



Summary for Subcatchment EX-11: EX-11

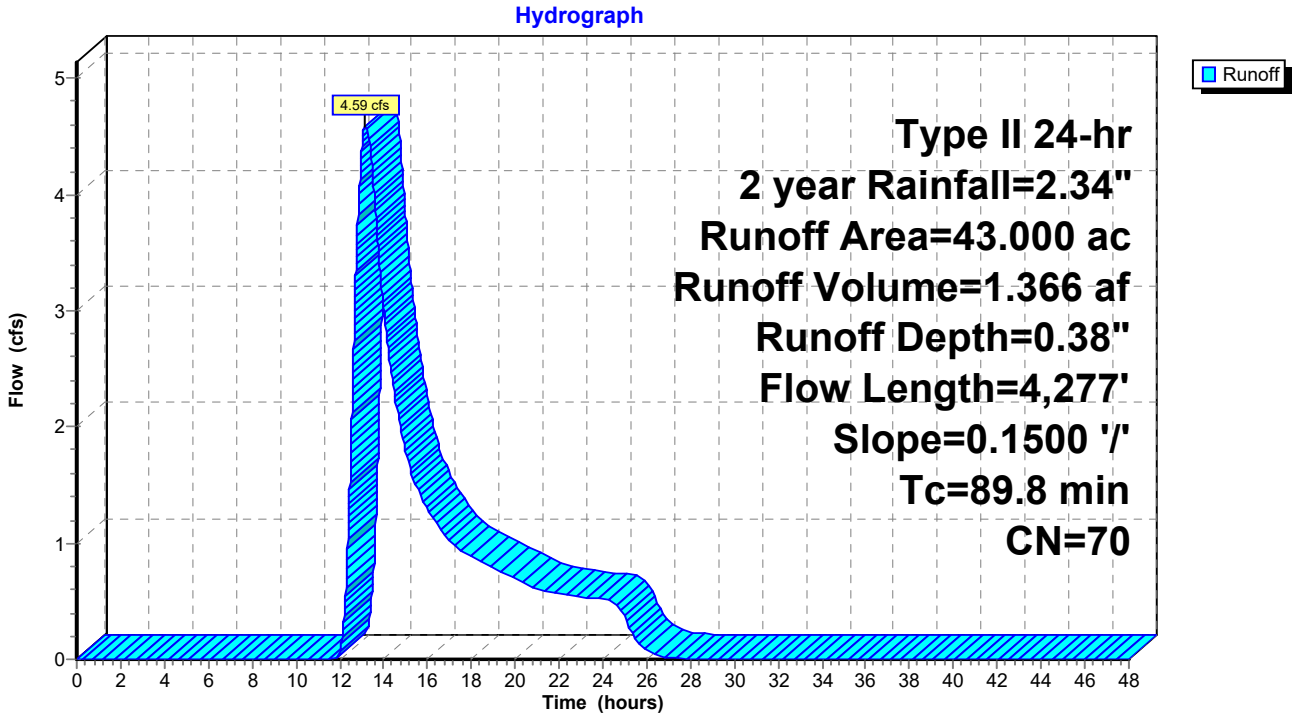
Runoff = 4.59 cfs @ 13.17 hrs, Volume= 1.366 af, Depth= 0.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 2 year Rainfall=2.34"

	Area (ac)	CN	Description
*	43.000	70	SEE ATTACHED SPREADSHEET FOR CN VALUES
	43.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.9	100	0.1500	0.09		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.80"
71.9	4,177	0.1500	0.97		**Shallow Concentrated Flow,** Forest w/Heavy Litter Kv= 2.5 fps
89.8	4,277	Total			

Subcatchment EX-11: EX-11



Summary for Subcatchment EX-12: EX-12

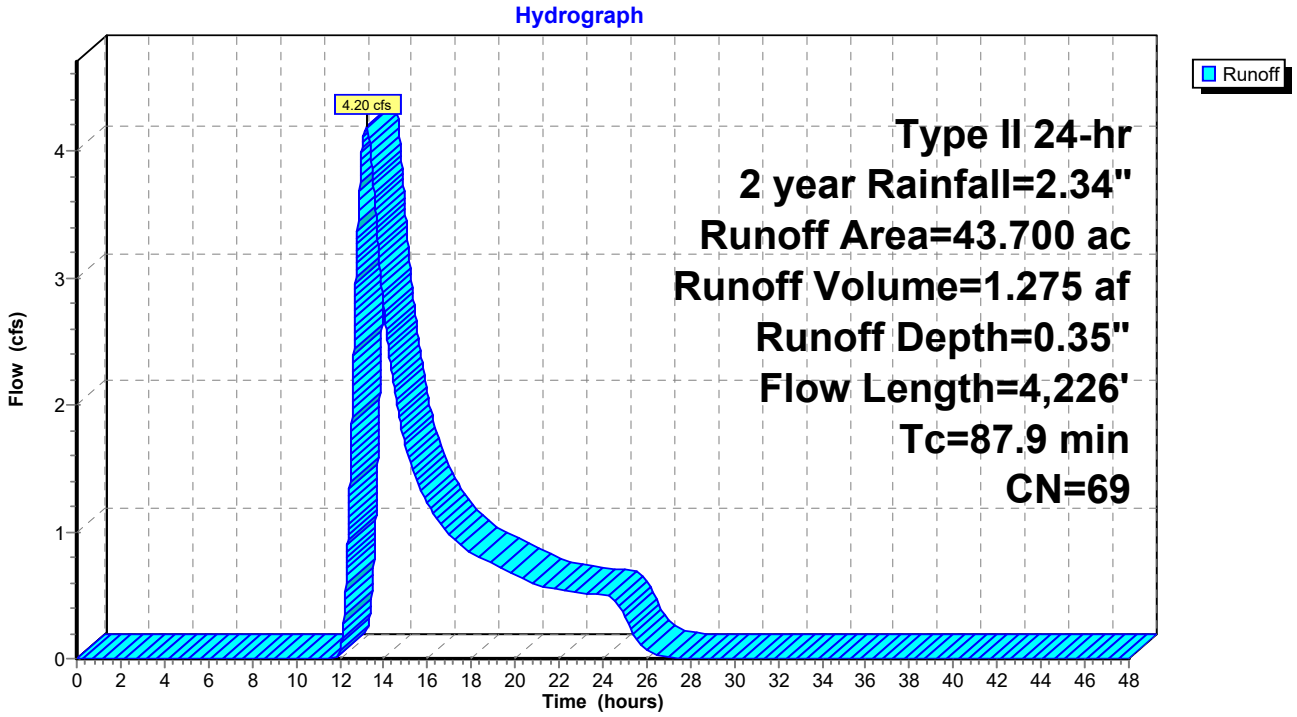
Runoff = 4.20 cfs @ 13.19 hrs, Volume= 1.275 af, Depth= 0.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 2 year Rainfall=2.34"

	Area (ac)	CN	Description
*	43.700	69	SEE ATTACHED SPREADSHEET FOR CN VALUES
	43.700		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.2	100	0.1100	0.08		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.80"
66.2	3,971	0.1600	1.00		**Shallow Concentrated Flow,** Forest w/Heavy Litter Kv= 2.5 fps
1.5	155	0.0700	1.74	0.16	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=0.25' Z= 1.5 '/' Top.W=0.75' n= 0.050 Mountain streams w/large boulders
87.9	4,226	Total			

Subcatchment EX-12: EX-12



Summary for Subcatchment EX-18: EX-18

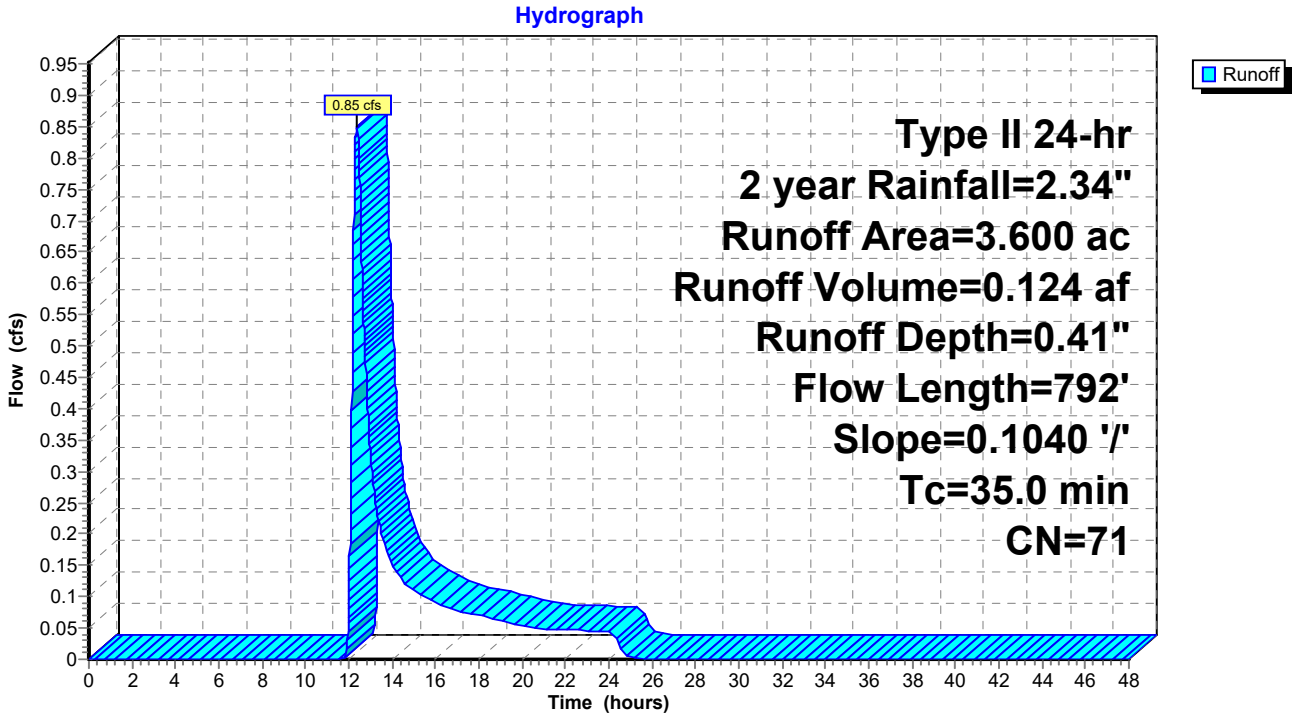
Runoff = 0.85 cfs @ 12.37 hrs, Volume= 0.124 af, Depth= 0.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 2 year Rainfall=2.34"

	Area (ac)	CN	Description
*	3.600	71	SEE ATTACHED SPREADSHEET FOR CN VALUES
	3.600		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.7	100	0.1040	0.08		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.80"
14.3	692	0.1040	0.81		**Shallow Concentrated Flow,** Forest w/Heavy Litter Kv= 2.5 fps
35.0	792	Total			

Subcatchment EX-18: EX-18



Summary for Subcatchment EX-19: EX-19

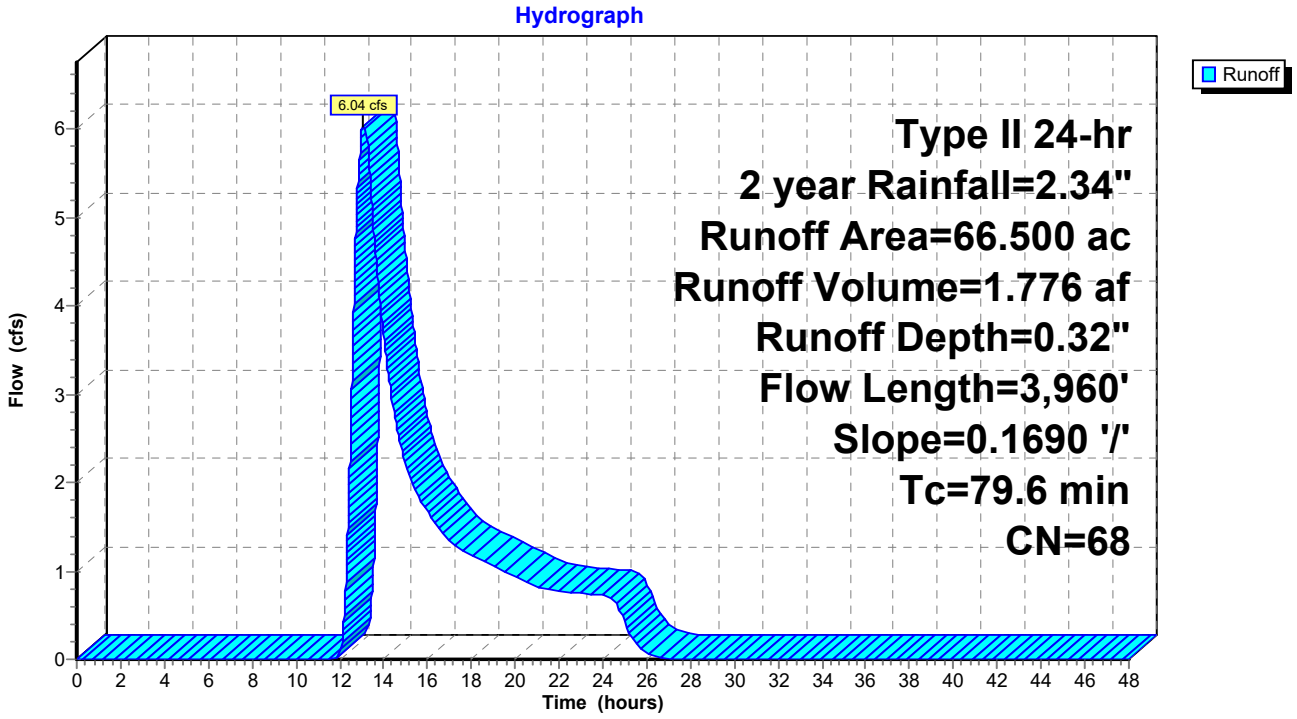
Runoff = 6.04 cfs @ 13.09 hrs, Volume= 1.776 af, Depth= 0.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 2 year Rainfall=2.34"

	Area (ac)	CN	Description
*	66.500	68	SEE ATTACHED SPREADSHEET FOR CN VALUES
	66.500		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.0	100	0.1690	0.10		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.80"
62.6	3,860	0.1690	1.03		**Shallow Concentrated Flow,** Forest w/Heavy Litter Kv= 2.5 fps
79.6	3,960	Total			

Subcatchment EX-19: EX-19



Summary for Subcatchment EX-20: EX-20

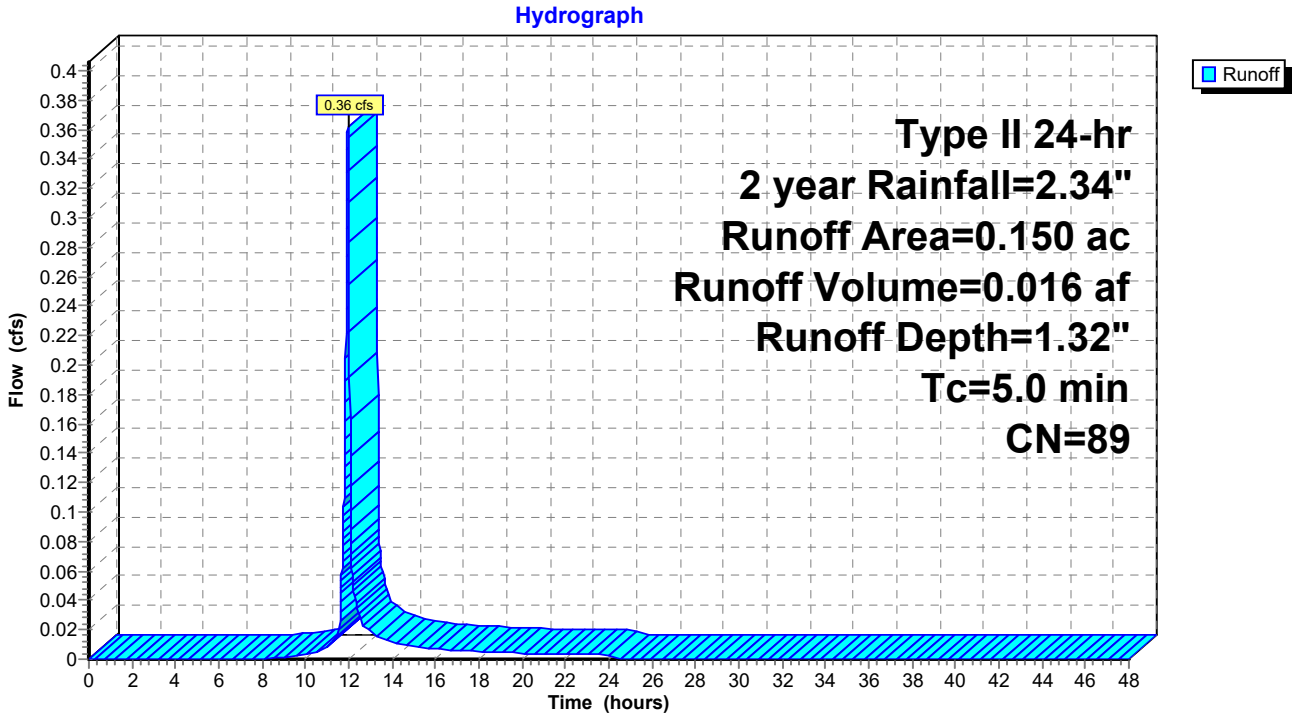
Runoff = 0.36 cfs @ 11.96 hrs, Volume= 0.016 af, Depth= 1.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 2 year Rainfall=2.34"

Area (ac)	CN	Description
0.150	89	Gravel roads, HSG C
0.150		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment EX-20: EX-20



Summary for Subcatchment EX-5: EX-5

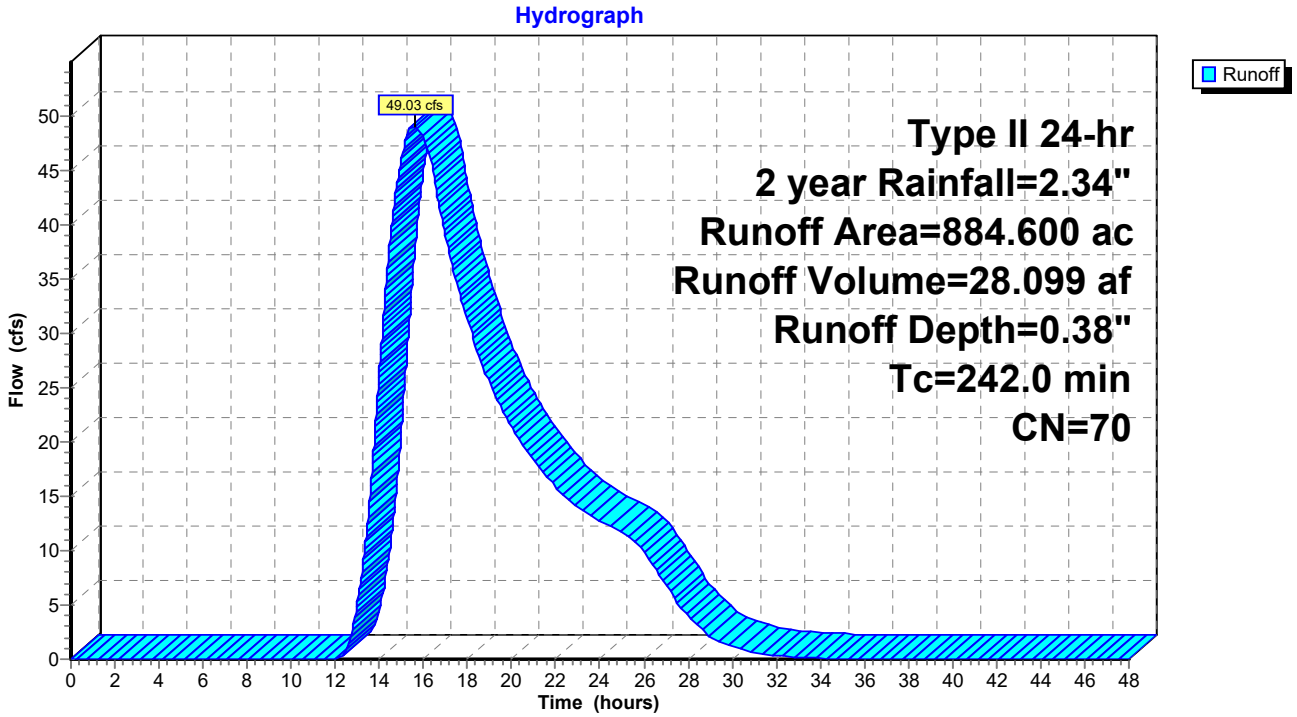
Runoff = 49.03 cfs @ 15.60 hrs, Volume= 28.099 af, Depth= 0.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 2 year Rainfall=2.34"

	Area (ac)	CN	Description
*	884.600	70	SEE ATTACHED SPREADSHEET FOR CN VALUES
	884.600		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
242.0					**Direct Entry,**

Subcatchment EX-5: EX-5



Summary for Subcatchment EX-6: EX-6

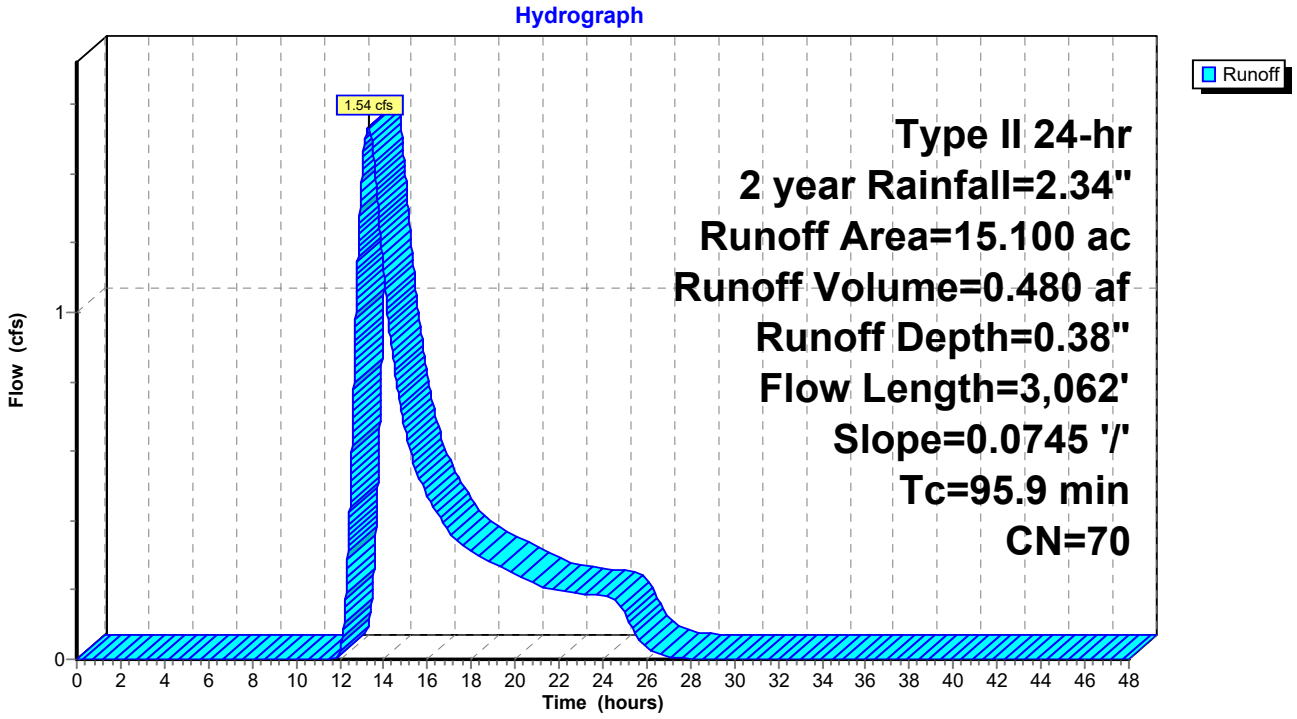
Runoff = 1.54 cfs @ 13.32 hrs, Volume= 0.480 af, Depth= 0.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 2 year Rainfall=2.34"

	Area (ac)	CN	Description
*	15.100	70	SEE ATTACHED SPREADSHEET FOR CN VALUES
	15.100		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
23.6	100	0.0745	0.07		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.80"
72.3	2,962	0.0745	0.68		**Shallow Concentrated Flow,** Forest w/Heavy Litter Kv= 2.5 fps
95.9	3,062	Total			

Subcatchment EX-6: EX-6



Summary for Subcatchment EX-7: EX-7

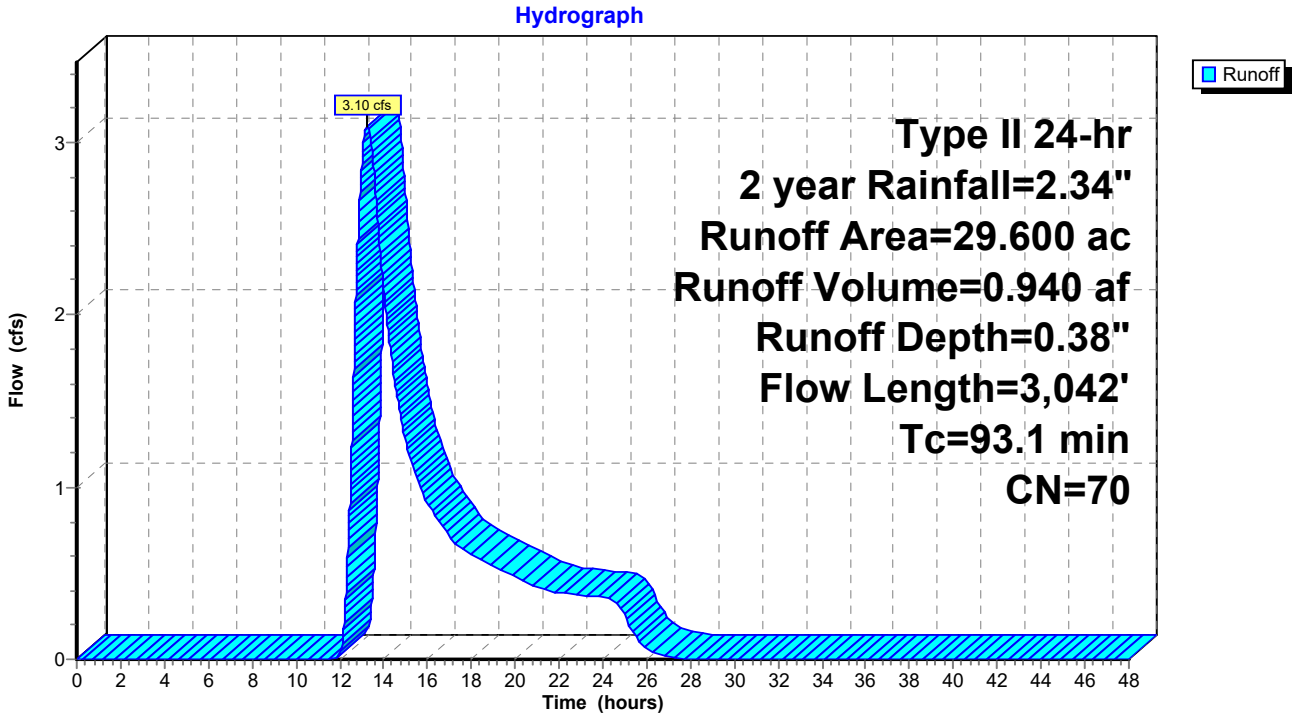
Runoff = 3.10 cfs @ 13.24 hrs, Volume= 0.940 af, Depth= 0.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 2 year Rainfall=2.34"

	Area (ac)	CN	Description
*	29.600	70	See Notes
	29.600		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
24.2	100	0.0700	0.07		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.80"
68.9	2,942	0.0810	0.71		**Shallow Concentrated Flow,** Forest w/Heavy Litter Kv= 2.5 fps
93.1	3,042	Total			

Subcatchment EX-7: EX-7



Summary for Subcatchment EX-8: EX-8

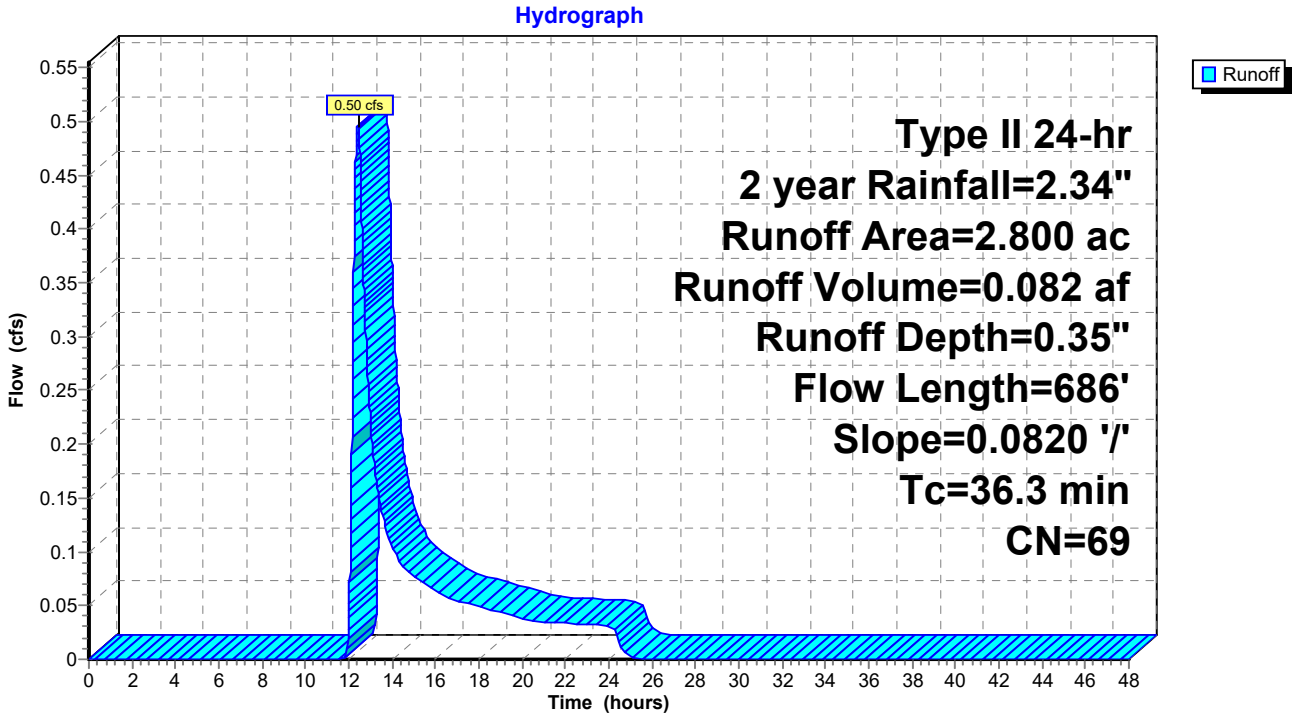
Runoff = 0.50 cfs @ 12.42 hrs, Volume= 0.082 af, Depth= 0.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 2 year Rainfall=2.34"

	Area (ac)	CN	Description
*	2.800	69	SEE ATTACHED SPREADSHEET FOR CN VALUES
	2.800		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.7	100	0.0820	0.07		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.80"
13.6	586	0.0820	0.72		**Shallow Concentrated Flow,** Forest w/Heavy Litter Kv= 2.5 fps
36.3	686	Total			

Subcatchment EX-8: EX-8



Summary for Subcatchment EX-9: EX-9

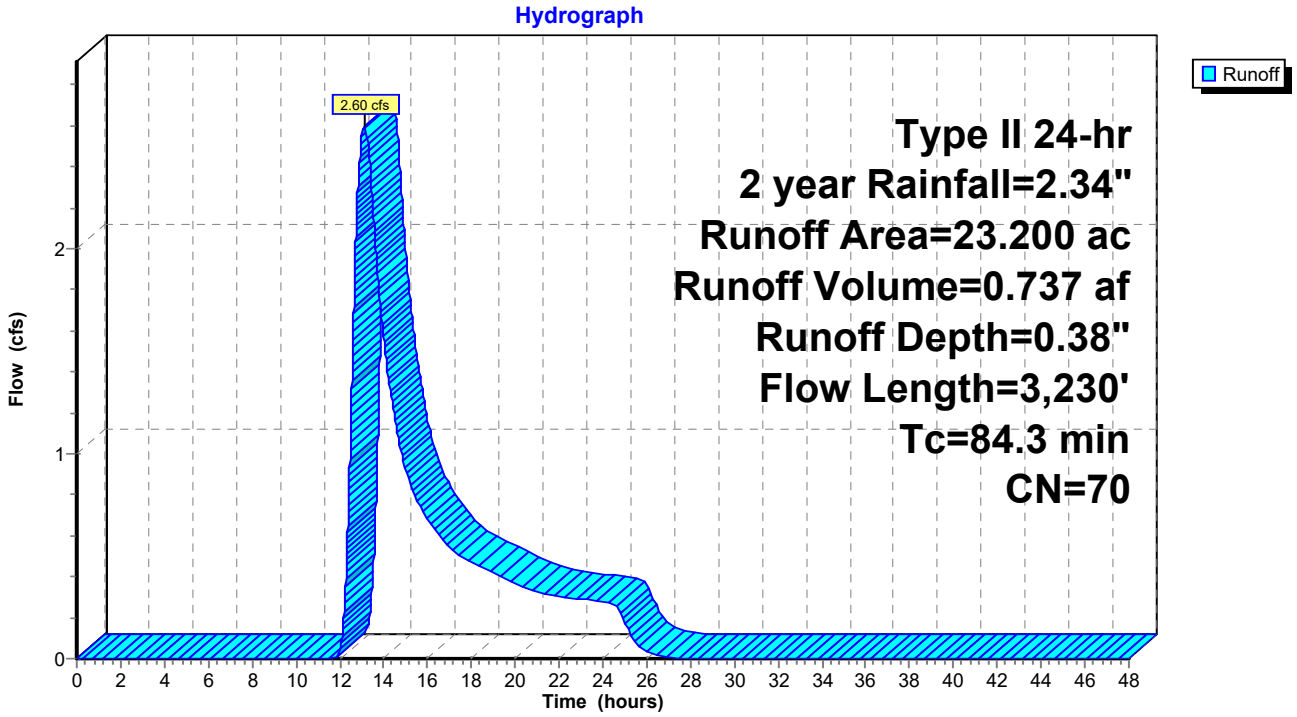
Runoff = 2.60 cfs @ 13.11 hrs, Volume= 0.737 af, Depth= 0.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 2 year Rainfall=2.34"

	Area (ac)	CN	Description
*	23.200	70	SEE ATTACHED SPREADSHEET FOR CN VALUES
	23.200		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.0	100	0.1000	0.08		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.80"
62.6	2,970	0.1000	0.79		**Shallow Concentrated Flow,** Forest w/Heavy Litter Kv= 2.5 fps
0.7	160	0.0480	3.56	2.67	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=0.50' Z= 3.0 '/' Top.W=3.00' n= 0.035 Earth, dense weeds
84.3	3,230	Total			

Subcatchment EX-9: EX-9



Summary for Reach 21R: Drive Pipe to Roadway Culvert

[79] Warning: Submerged Pond 20P Primary device # 1 OUTLET by 0.36'

Inflow Area = 43.700 ac, 0.00% Impervious, Inflow Depth = 0.35" for 2 year event
Inflow = 4.20 cfs @ 13.19 hrs, Volume= 1.275 af
Outflow = 4.20 cfs @ 13.19 hrs, Volume= 1.275 af, Atten= 0%, Lag= 0.3 min

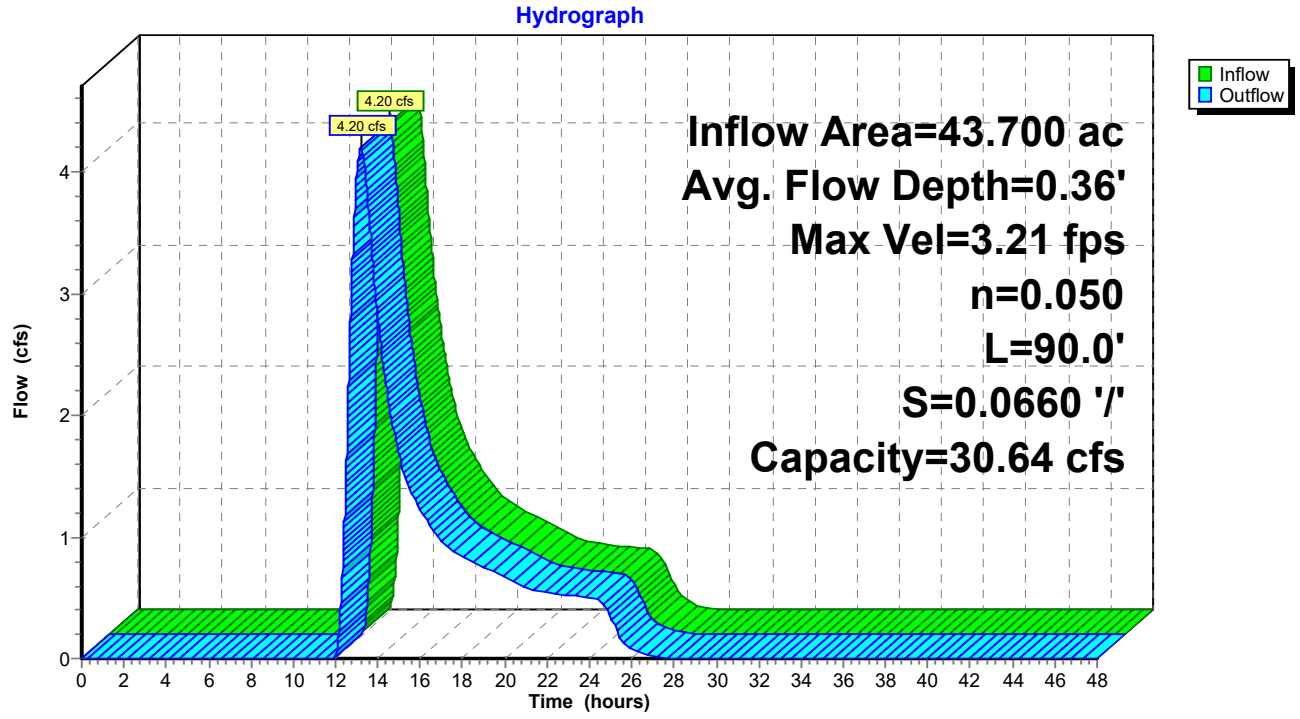
Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 3.21 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 1.68 fps, Avg. Travel Time= 0.9 min

Peak Storage= 118 cf @ 13.19 hrs
Average Depth at Peak Storage= 0.36'
Bank-Full Depth= 1.00' Flow Area= 5.5 sf, Capacity= 30.64 cfs

2.50' x 1.00' deep channel, n= 0.050 Mountain streams w/large boulders
Side Slope Z-value= 3.0 '/' Top Width= 8.50'
Length= 90.0' Slope= 0.0660 '/'
Inlet Invert= 1,140.70', Outlet Invert= 1,134.76'

‡

Reach 21R: Drive Pipe to Roadway Culvert



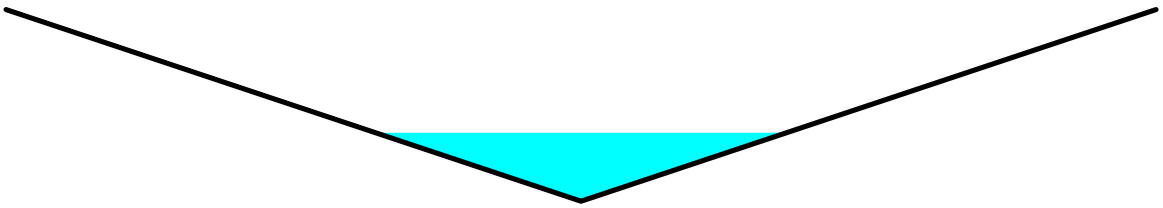
Summary for Reach 24R: roadside ditch

Inflow Area = 29.600 ac, 0.00% Impervious, Inflow Depth = 0.38" for 2 year event
Inflow = 3.10 cfs @ 13.24 hrs, Volume= 0.940 af
Outflow = 3.09 cfs @ 13.26 hrs, Volume= 0.940 af, Atten= 0%, Lag= 1.4 min

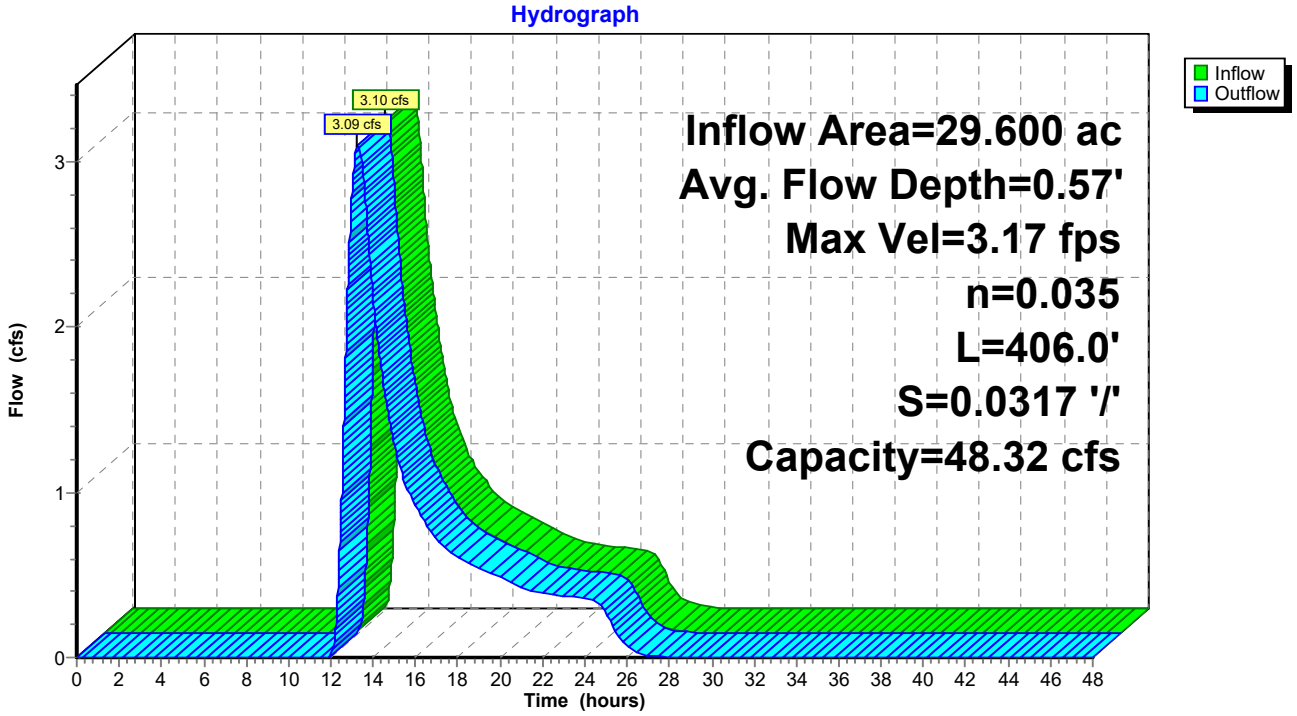
Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.17 fps, Min. Travel Time= 2.1 min
Avg. Velocity = 1.79 fps, Avg. Travel Time= 3.8 min

Peak Storage= 397 cf @ 13.26 hrs
Average Depth at Peak Storage= 0.57'
Bank-Full Depth= 1.60' Flow Area= 7.7 sf, Capacity= 48.32 cfs

0.00' x 1.60' deep channel, n= 0.035 Earth, dense weeds
Side Slope Z-value= 3.0 '/' Top Width= 9.60'
Length= 406.0' Slope= 0.0317 '/'
Inlet Invert= 1,147.00', Outlet Invert= 1,134.12'



Reach 24R: roadside ditch



Summary for Reach 27R: roadside ditch

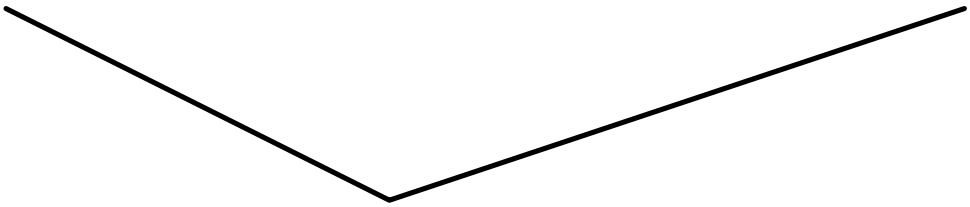
[81] Warning: Exceeded Pond 10P by 2.50' @ 0.00 hrs

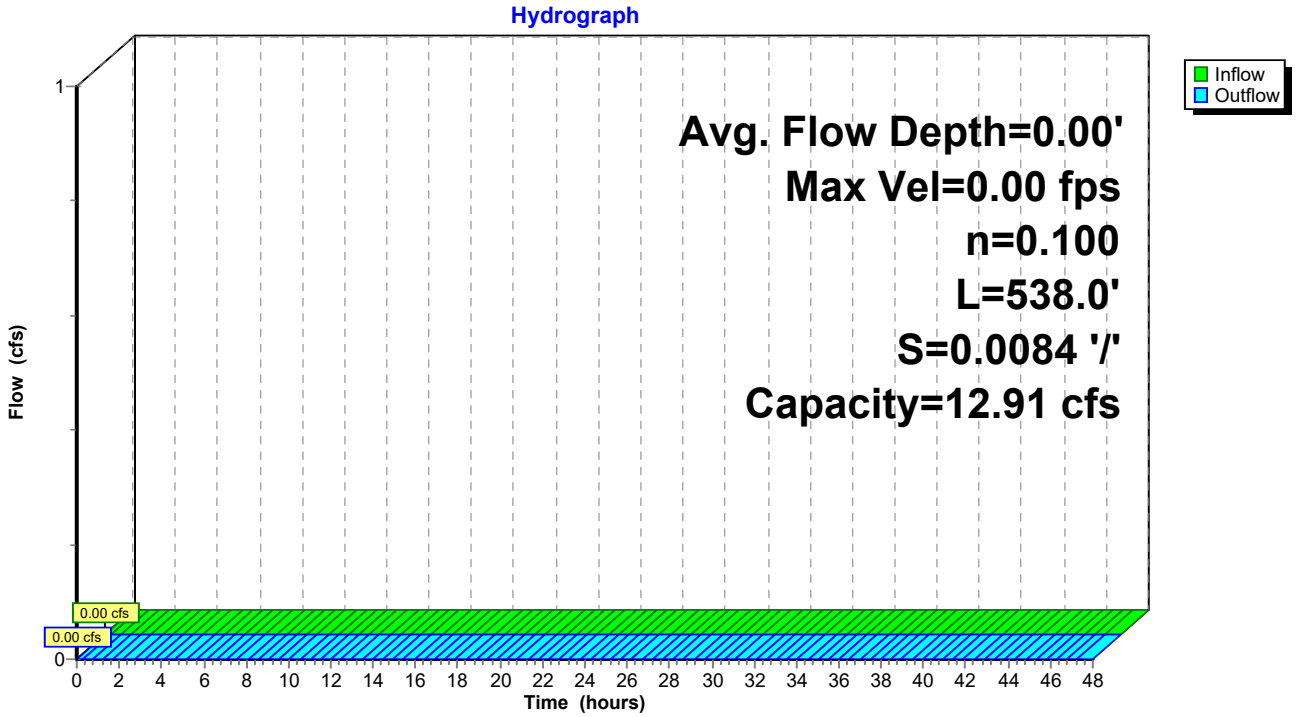
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 0.00 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 0.00 fps, Avg. Travel Time= 0.0 min

Peak Storage= 0 cf @ 0.00 hrs
Average Depth at Peak Storage= 0.00'
Bank-Full Depth= 2.00' Flow Area= 10.0 sf, Capacity= 12.91 cfs

0.00' x 2.00' deep channel, n= 0.100 Earth, dense brush, high stage
Side Slope Z-value= 2.0 3.0 '/' Top Width= 10.00'
Length= 538.0' Slope= 0.0084 '/'
Inlet Invert= 1,137.50', Outlet Invert= 1,133.00'





Summary for Pond 3P: sta. 1010+24

Inflow Area = 884.600 ac, 0.00% Impervious, Inflow Depth = 0.38" for 2 year event
Inflow = 49.03 cfs @ 15.60 hrs, Volume= 28.099 af
Outflow = 49.03 cfs @ 15.60 hrs, Volume= 28.099 af, Atten= 0%, Lag= 0.1 min
Primary = 49.03 cfs @ 15.60 hrs, Volume= 28.099 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 1,132.91' @ 15.60 hrs Surf.Area= 266 sf Storage= 443 cf

Plug-Flow detention time= 0.1 min calculated for 28.093 af (100% of inflow)
Center-of-Mass det. time= 0.1 min (1,123.2 - 1,123.1)

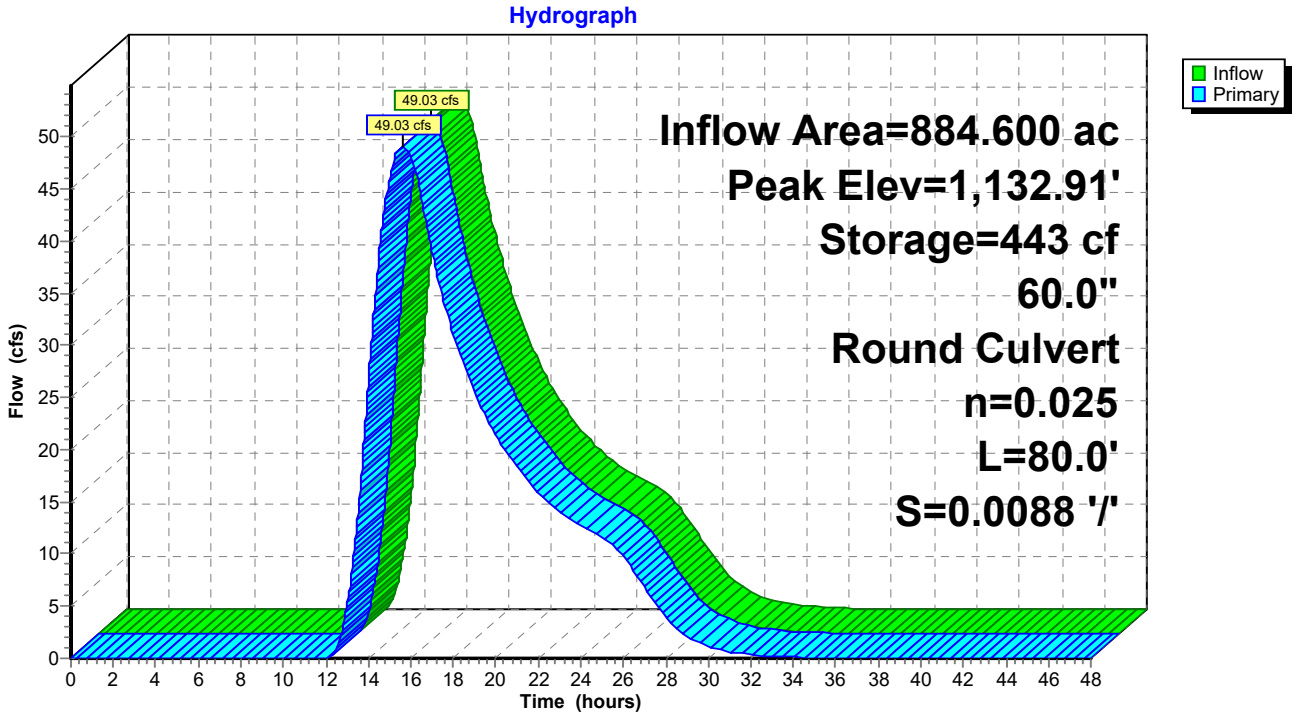
Volume	Invert	Avail.Storage	Storage Description
#1	1,131.00'	17,553 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,131.00	187	0	0
1,132.00	239	213	213
1,133.00	269	254	467
1,134.00	296	283	750
1,135.00	426	361	1,111
1,136.00	764	595	1,706
1,137.00	1,791	1,278	2,983
1,138.00	3,675	2,733	5,716
1,139.00	5,843	4,759	10,475
1,140.00	8,312	7,078	17,553

Device	Routing	Invert	Outlet Devices
#1	Primary	1,129.96'	**60.0" Round CMP_Round 60"** L= 80.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 1,129.96' / 1,129.26' S= 0.0088 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 19.63 sf

Primary OutFlow Max=49.03 cfs @ 15.60 hrs HW=1,132.91' (Free Discharge)
↑—**1=CMP_Round 60"** (Barrel Controls 49.03 cfs @ 5.84 fps)

Pond 3P: sta. 1010+24



Summary for Pond 4P: sta. 1013+23

Secondary flow to EX-5 60" cmp which was analyzed separately using USGS Regression and FHWA Hy8.

Inflow Area = 15.100 ac, 0.00% Impervious, Inflow Depth = 0.38" for 2 year event
Inflow = 1.54 cfs @ 13.32 hrs, Volume= 0.480 af
Outflow = 1.54 cfs @ 13.32 hrs, Volume= 0.480 af, Atten= 0%, Lag= 0.0 min
Primary = 1.54 cfs @ 13.32 hrs, Volume= 0.480 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 1,141.01' @ 13.32 hrs Surf.Area= 6 sf Storage= 0 cf

Plug-Flow detention time= 0.0 min calculated for 0.480 af (100% of inflow)
Center-of-Mass det. time= 0.0 min (985.5 - 985.5)

Volume	Invert	Avail.Storage	Storage Description
#1	1,141.00'	183 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

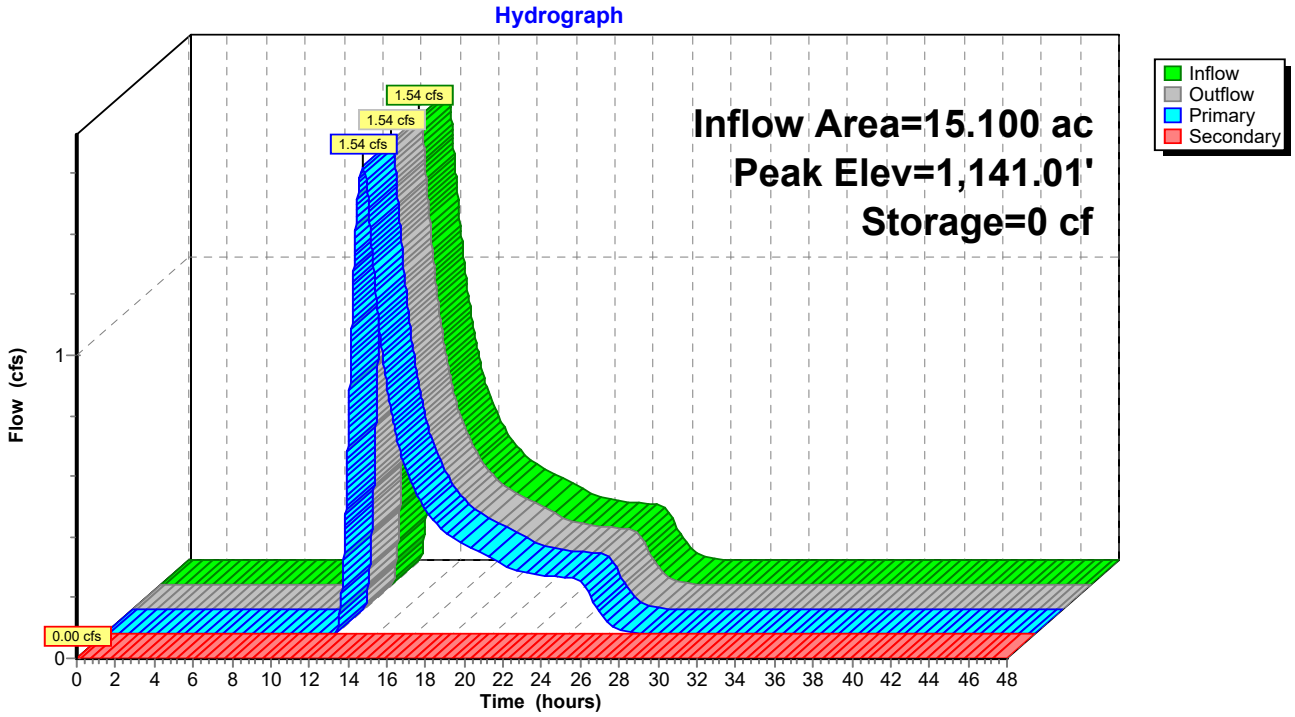
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,141.00	5	0	0
1,142.00	150	78	78
1,142.50	272	106	183

Device	Routing	Invert	Outlet Devices
#1	Primary	1,139.25'	**15.0" Round CMP_Round 15"** L= 52.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,139.25' / 1,138.90' S= 0.0067 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 1.23 sf
#2	Secondary	1,142.50'	**7.0' long (Profile 20) Broad-Crested Rectangular Weir** Head (feet) 0.49 0.98 1.48 1.97 Coef. (English) 2.68 2.63 2.61 2.61

Primary OutFlow Max=3.61 cfs @ 13.32 hrs HW=1,141.01' (Free Discharge)
↑—**1=CMP_Round 15"** (Barrel Controls 3.61 cfs @ 2.94 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=1,141.00' (Free Discharge)
↑—**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 4P: sta. 1013+23



Summary for Pond 9P: sta. 1032+51

[62] Hint: Exceeded Reach 27R OUTLET depth by 0.03' @ 13.17 hrs

Inflow Area = 43.000 ac, 0.00% Impervious, Inflow Depth = 0.38" for 2 year event
Inflow = 4.59 cfs @ 13.17 hrs, Volume= 1.366 af
Outflow = 4.59 cfs @ 13.17 hrs, Volume= 1.366 af, Atten= 0%, Lag= 0.0 min
Primary = 4.59 cfs @ 13.17 hrs, Volume= 1.366 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 1,133.03' @ 13.17 hrs Surf.Area= 21 sf Storage= 1 cf

Plug-Flow detention time= 0.0 min calculated for 1.366 af (100% of inflow)
Center-of-Mass det. time= 0.0 min (979.8 - 979.8)

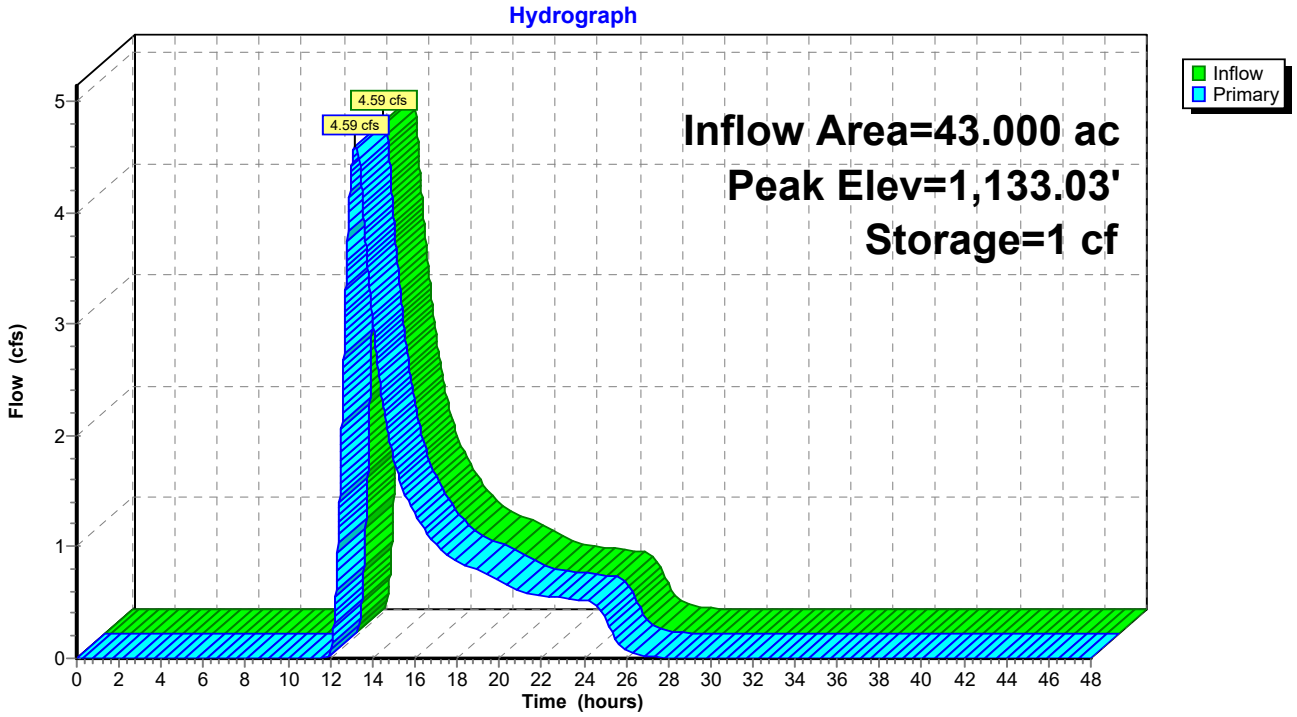
Volume	Invert	Avail.Storage	Storage Description
#1	1,133.00'	1,972 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,133.00	18	0	0
1,134.00	138	78	78
1,135.00	719	429	507
1,136.00	2,211	1,465	1,972

Device	Routing	Invert	Outlet Devices
#1	Primary	1,132.63'	**24.0" Round RCP_Round 24"** L= 22.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 1,132.63' / 1,132.05' S= 0.0264 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 3.14 sf
#2	Primary	1,132.05'	**18.0" Round RCP_Round 18"** L= 22.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 1,132.05' / 1,131.47' S= 0.0264 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 1.77 sf

Primary OutFlow Max=5.05 cfs @ 13.17 hrs HW=1,133.03' (Free Discharge)
↑—**1=RCP_Round 24"** (Inlet Controls 0.95 cfs @ 2.15 fps)
└—**2=RCP_Round 18"** (Inlet Controls 4.10 cfs @ 3.37 fps)

Pond 9P: sta. 1032+51



Summary for Pond 10P: sta. 1040+00

[62] Hint: Exceeded Reach 21R OUTLET depth by 0.63' @ 13.20 hrs

Inflow Area = 43.700 ac, 0.00% Impervious, Inflow Depth = 0.35" for 2 year event
Inflow = 4.20 cfs @ 13.19 hrs, Volume= 1.275 af
Outflow = 4.20 cfs @ 13.20 hrs, Volume= 1.275 af, Atten= 0%, Lag= 0.4 min
Primary = 4.20 cfs @ 13.20 hrs, Volume= 1.275 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 1,135.75' @ 13.20 hrs Surf.Area= 120 sf Storage= 51 cf

Plug-Flow detention time= 0.1 min calculated for 1.275 af (100% of inflow)
Center-of-Mass det. time= 0.1 min (984.8 - 984.7)

Volume	Invert	Avail.Storage	Storage Description
#1	1,135.00'	20,043 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

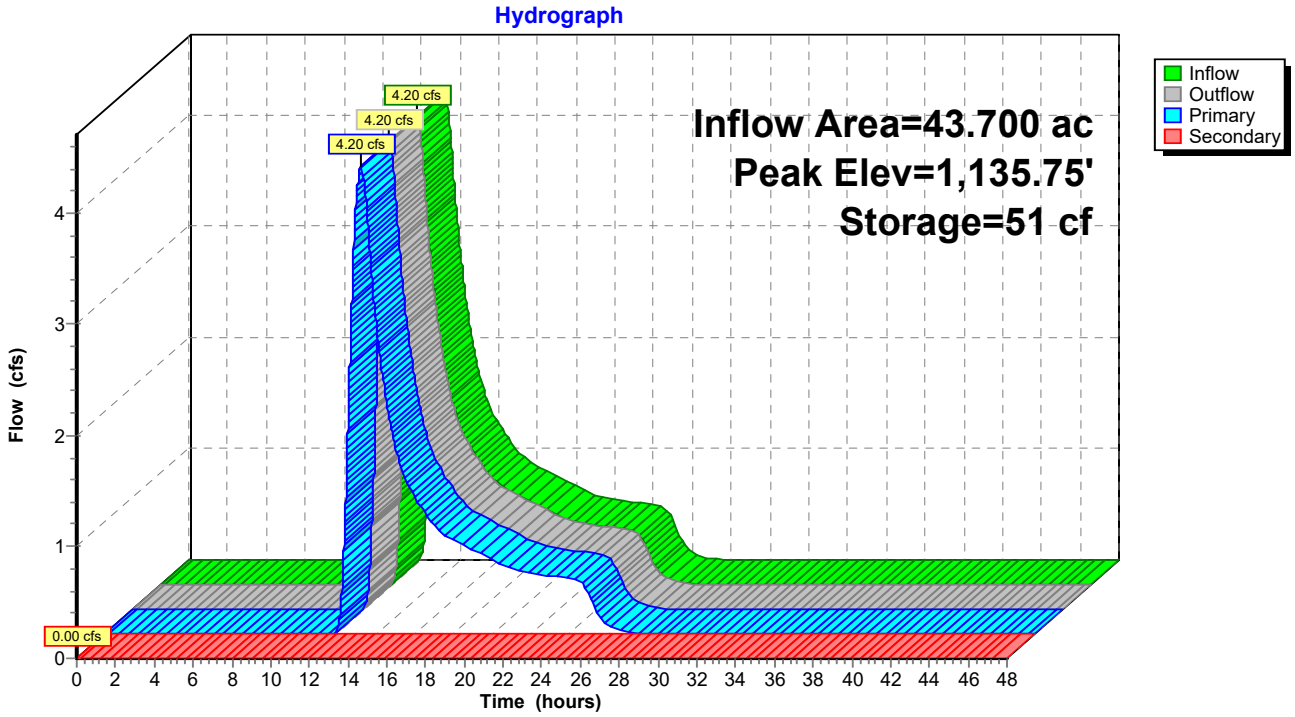
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,135.00	15	0	0
1,136.00	155	85	85
1,137.00	2,548	1,352	1,437
1,138.00	5,844	4,196	5,633
1,139.00	10,620	8,232	13,865
1,139.50	14,092	6,178	20,043

Device	Routing	Invert	Outlet Devices
#1	Primary	1,134.76'	**18.0" Round RCP_Round 18"** L= 45.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 1,134.76' / 1,134.00' S= 0.0169 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 1.77 sf
#2	Secondary	1,136.54'	**18.0" Round CMP_Round 18"** L= 29.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,136.12' / 1,136.54' S= -0.0145 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 1.77 sf

Primary OutFlow Max=4.20 cfs @ 13.20 hrs HW=1,135.75' (Free Discharge)
↑—**1=RCP_Round 18"** (Inlet Controls 4.20 cfs @ 3.39 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=1,135.00' (Free Discharge)
↑—**2=CMP_Round 18"** (Controls 0.00 cfs)

Pond 10P: sta. 1040+00



Summary for Pond 16P: sta. 1069+69

Inflow Area = 70.250 ac, 0.00% Impervious, Inflow Depth = 0.33" for 2 year event
Inflow = 6.35 cfs @ 13.08 hrs, Volume= 1.917 af
Outflow = 6.35 cfs @ 13.08 hrs, Volume= 1.917 af, Atten= 0%, Lag= 0.0 min
Primary = 6.35 cfs @ 13.08 hrs, Volume= 1.917 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 1,198.03' @ 13.08 hrs Surf.Area= 8 sf Storage= 0 cf

Plug-Flow detention time= 0.0 min calculated for 1.917 af (100% of inflow)
Center-of-Mass det. time= 0.0 min (977.4 - 977.4)

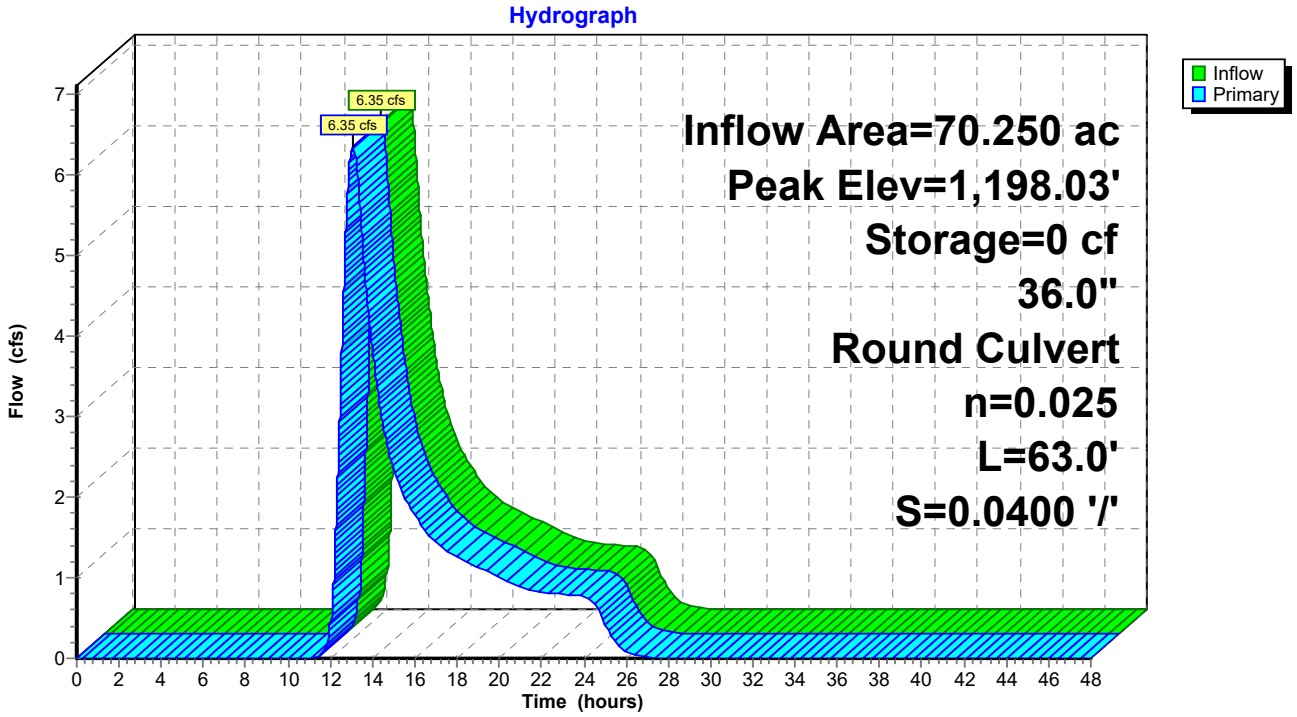
Volume	Invert	Avail.Storage	Storage Description
#1	1,198.00'	372 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,198.00	7	0	0
1,199.00	27	17	17
1,200.00	55	41	58
1,201.00	103	79	137
1,202.00	366	235	372

Device	Routing	Invert	Outlet Devices
#1	Primary	1,197.00'	**36.0" Round CMP_Round 36"** L= 63.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 1,197.00' / 1,194.48' S= 0.0400 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 7.07 sf

Primary OutFlow Max=7.47 cfs @ 13.08 hrs HW=1,198.03' (Free Discharge)
↑**1=CMP_Round 36"** (Inlet Controls 7.47 cfs @ 3.46 fps)

Pond 16P: sta. 1069+69



Summary for Pond 17P: sta. 1069+58

Inflow Area = 66.500 ac, 0.00% Impervious, Inflow Depth = 0.32" for 2 year event
Inflow = 6.04 cfs @ 13.09 hrs, Volume= 1.776 af
Outflow = 6.04 cfs @ 13.09 hrs, Volume= 1.776 af, Atten= 0%, Lag= 0.0 min
Primary = 6.04 cfs @ 13.09 hrs, Volume= 1.776 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 1,205.04' @ 13.09 hrs Surf.Area= 10 sf Storage= 0 cf

Plug-Flow detention time= 0.0 min calculated for 1.776 af (100% of inflow)
Center-of-Mass det. time= 0.0 min (982.6 - 982.6)

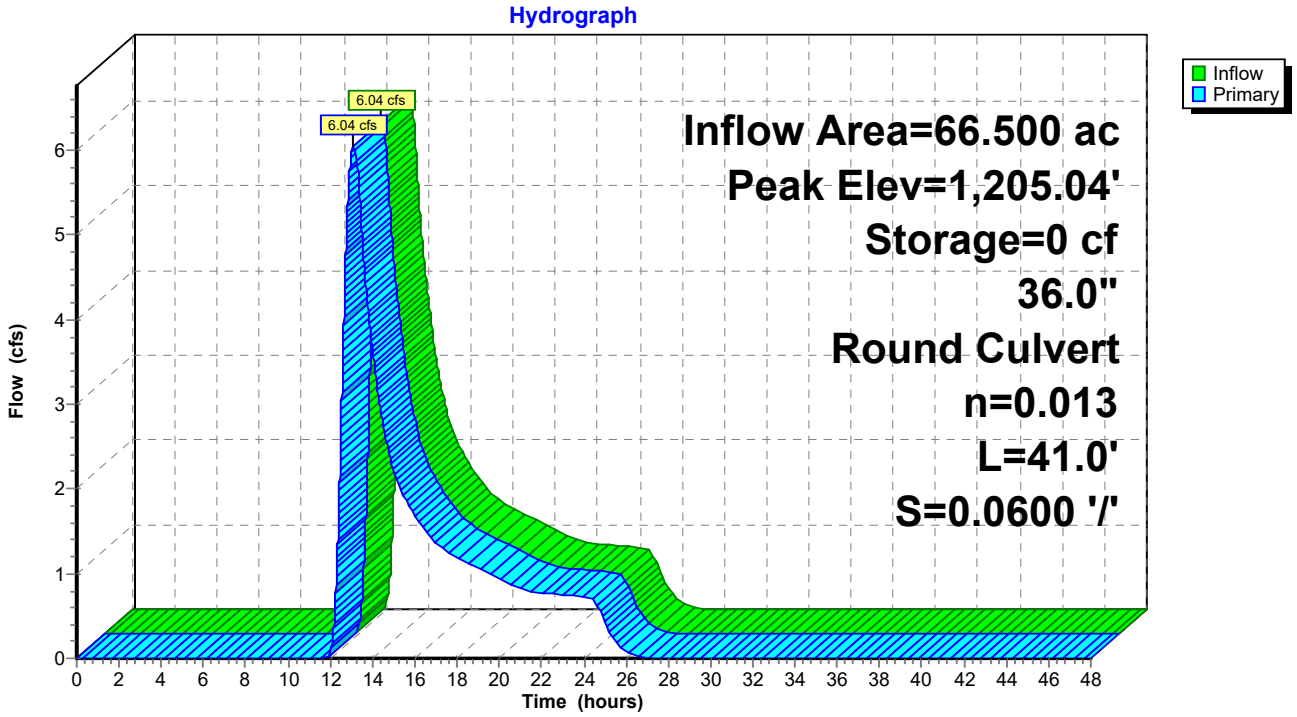
Volume	Invert	Avail.Storage	Storage Description
#1	1,205.00'	225 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,205.00	9	0	0
1,206.00	38	24	24
1,207.00	78	58	82
1,208.00	209	144	225

Device	Routing	Invert	Outlet Devices
#1	Primary	1,203.99'	**36.0" Round 36" spp** L= 41.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,203.99' / 1,201.53' S= 0.0600 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 7.07 sf

Primary OutFlow Max=6.04 cfs @ 13.09 hrs HW=1,205.04' (Free Discharge)
1=36" spp (Inlet Controls 6.04 cfs @ 2.75 fps)

Pond 17P: sta. 1069+58



Summary for Pond 18P: sta. 1069+29

Inflow Area = 3.600 ac, 0.00% Impervious, Inflow Depth = 0.41" for 2 year event
Inflow = 0.85 cfs @ 12.37 hrs, Volume= 0.124 af
Outflow = 0.85 cfs @ 12.37 hrs, Volume= 0.124 af, Atten= 0%, Lag= 0.0 min
Primary = 0.85 cfs @ 12.37 hrs, Volume= 0.124 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 1,203.01' @ 12.37 hrs Surf.Area= 17 sf Storage= 0 cf

Plug-Flow detention time= 0.0 min calculated for 0.124 af (100% of inflow)
Center-of-Mass det. time= 0.0 min (923.8 - 923.7)

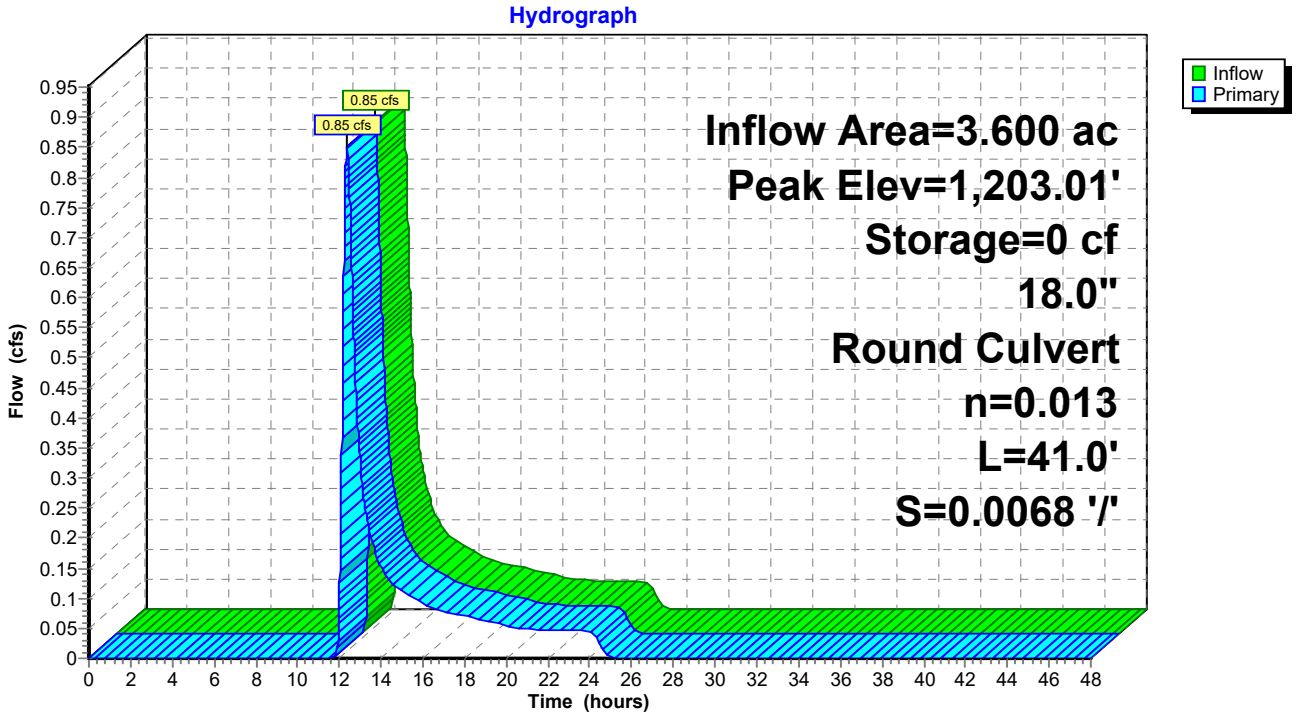
Volume	Invert	Avail.Storage	Storage Description
#1	1,203.00'	428 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,203.00	15	0	0
1,204.00	178	97	97
1,205.00	484	331	428

Device	Routing	Invert	Outlet Devices
#1	Primary	1,202.42'	**18.0" Round 18" spp** L= 41.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,202.42' / 1,202.14' S= 0.0068 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=1.30 cfs @ 12.37 hrs HW=1,203.01' (Free Discharge)
↑**1=18" spp** (Barrel Controls 1.30 cfs @ 2.95 fps)

Pond 18P: sta. 1069+29



Summary for Pond 20P: sta. 1139+10 Drive LT

[57] Hint: Peaked at 1,144.33' (Flood elevation advised)

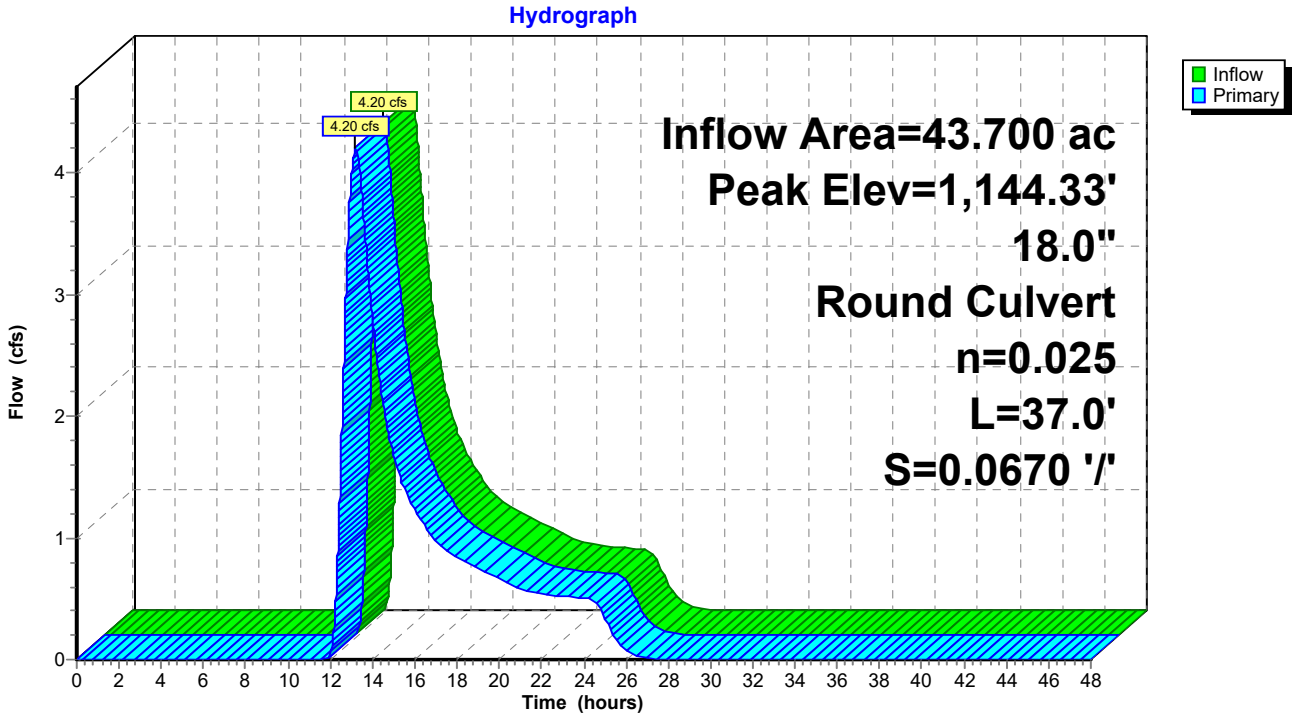
Inflow Area = 43.700 ac, 0.00% Impervious, Inflow Depth = 0.35" for 2 year event
Inflow = 4.20 cfs @ 13.19 hrs, Volume= 1.275 af
Outflow = 4.20 cfs @ 13.19 hrs, Volume= 1.275 af, Atten= 0%, Lag= 0.0 min
Primary = 4.20 cfs @ 13.19 hrs, Volume= 1.275 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 1,144.33' @ 13.19 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	1,143.18'	**18.0" Round CMP_Round 18"** L= 37.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,143.18' / 1,140.70' S= 0.0670 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 1.77 sf

Primary OutFlow Max=4.20 cfs @ 13.19 hrs HW=1,144.33' (Free Discharge)
1=CMP_Round 18" (Inlet Controls 4.20 cfs @ 2.89 fps)

Pond 20P: sta. 1139+10 Drive LT



Summary for Pond 23P: Combined

Inflow Area = 27.000 ac, 0.00% Impervious, Inflow Depth = 0.38" for 2 year event
Inflow = 2.89 cfs @ 13.02 hrs, Volume= 0.865 af
Outflow = 2.89 cfs @ 13.04 hrs, Volume= 0.865 af, Atten= 0%, Lag= 0.8 min
Primary = 2.89 cfs @ 13.04 hrs, Volume= 0.865 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 1,131.87' @ 13.04 hrs Surf.Area= 198 sf Storage= 89 cf

Plug-Flow detention time= 0.4 min calculated for 0.865 af (100% of inflow)
Center-of-Mass det. time= 0.4 min (967.4 - 967.0)

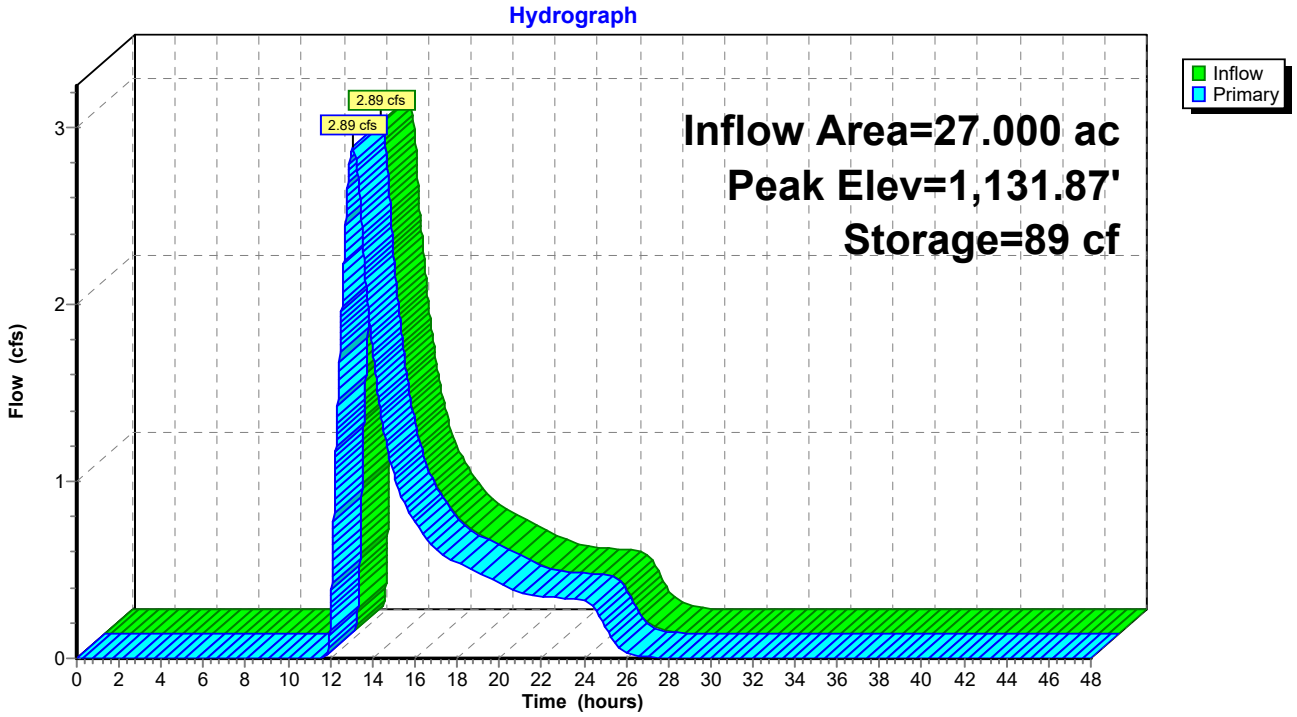
Volume	Invert	Avail.Storage	Storage Description
#1	1,131.00'	26,788 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,131.00	6	0	0
1,132.00	228	117	117
1,133.00	877	553	670
1,134.00	2,625	1,751	2,421
1,135.00	5,643	4,134	6,555
1,136.00	15,193	10,418	16,973
1,136.50	24,069	9,816	26,788

Device	Routing	Invert	Outlet Devices
#1	Primary	1,130.93'	**15.0" Round CMP_Round 15"** L= 50.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,130.93' / 1,129.16' S= 0.0354 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 1.23 sf
#2	Primary	1,131.57'	**15.0" Round CMP_Round 15"** L= 48.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,131.57' / 1,129.82' S= 0.0365 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 1.23 sf
#3	Primary	1,134.22'	**12.0" Round CMP_Round 12"** L= 40.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,134.22' / 1,133.06' S= 0.0290 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 0.79 sf

Primary OutFlow Max=2.89 cfs @ 13.04 hrs HW=1,131.87' (Free Discharge)
- **1=CMP_Round 15"** (Inlet Controls 2.56 cfs @ 2.60 fps)
- **2=CMP_Round 15"** (Inlet Controls 0.33 cfs @ 1.46 fps)
- **3=CMP_Round 12"** (Controls 0.00 cfs)

Pond 23P: Combined



Summary for Pond 25P: sta. 1020+78

[62] Hint: Exceeded Reach 24R OUTLET depth by 0.34' @ 13.26 hrs

Inflow Area = 29.600 ac, 0.00% Impervious, Inflow Depth = 0.38" for 2 year event
Inflow = 3.09 cfs @ 13.26 hrs, Volume= 0.940 af
Outflow = 3.09 cfs @ 13.26 hrs, Volume= 0.940 af, Atten= 0%, Lag= 0.0 min
Primary = 3.09 cfs @ 13.26 hrs, Volume= 0.940 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

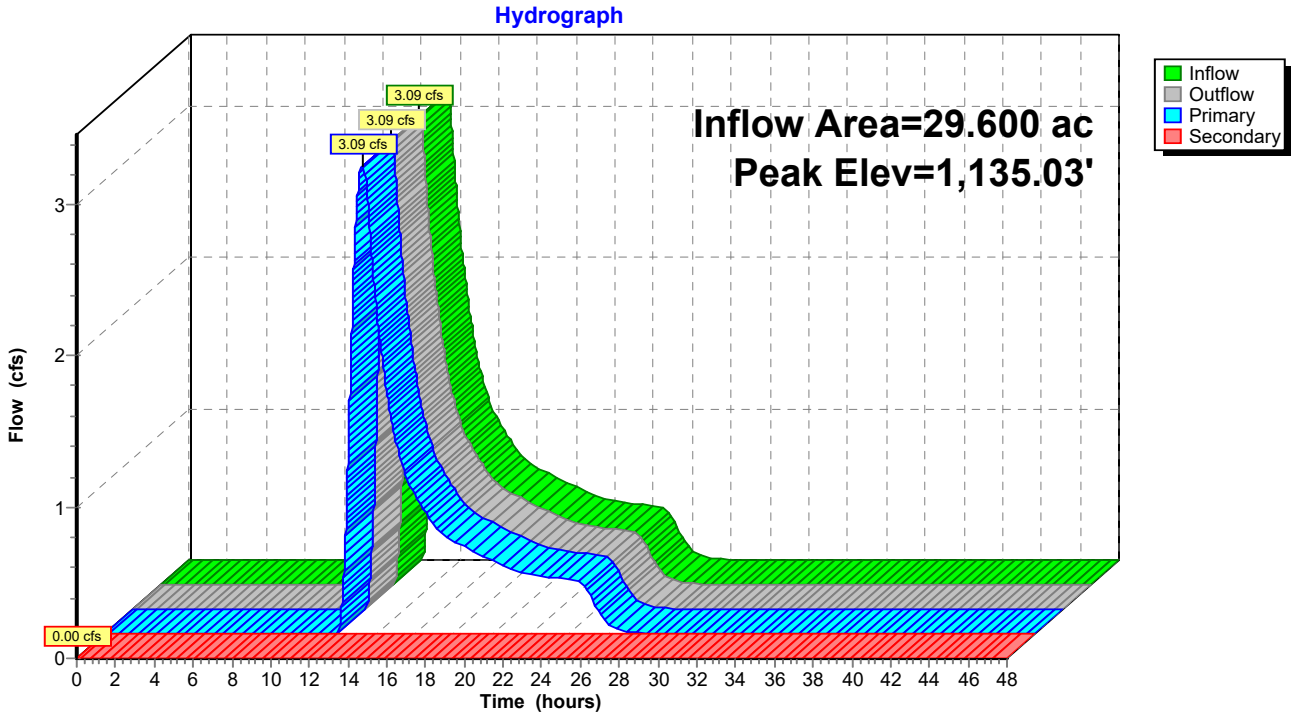
Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 1,135.03' @ 13.26 hrs
Flood Elev= 1,137.71'

Device	Routing	Invert	Outlet Devices
#1	Primary	1,134.12'	**15.0" Round RCP_Round 15"** L= 42.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 1,134.12' / 1,133.20' S= 0.0219 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 1.23 sf
#2	Secondary	1,136.50'	**10.0' long (Profile 14) Broad-Crested Rectangular Weir** Head (feet) 1.97 2.46 2.95 3.94 4.92 Coef. (English) 3.37 3.37 3.37 3.37 3.37

Primary OutFlow Max=3.09 cfs @ 13.26 hrs HW=1,135.03' (Free Discharge)
↑—**1=RCP_Round 15"** (Inlet Controls 3.09 cfs @ 3.24 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=1,134.12' (Free Discharge)
↑—**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 25P: sta. 1020+78

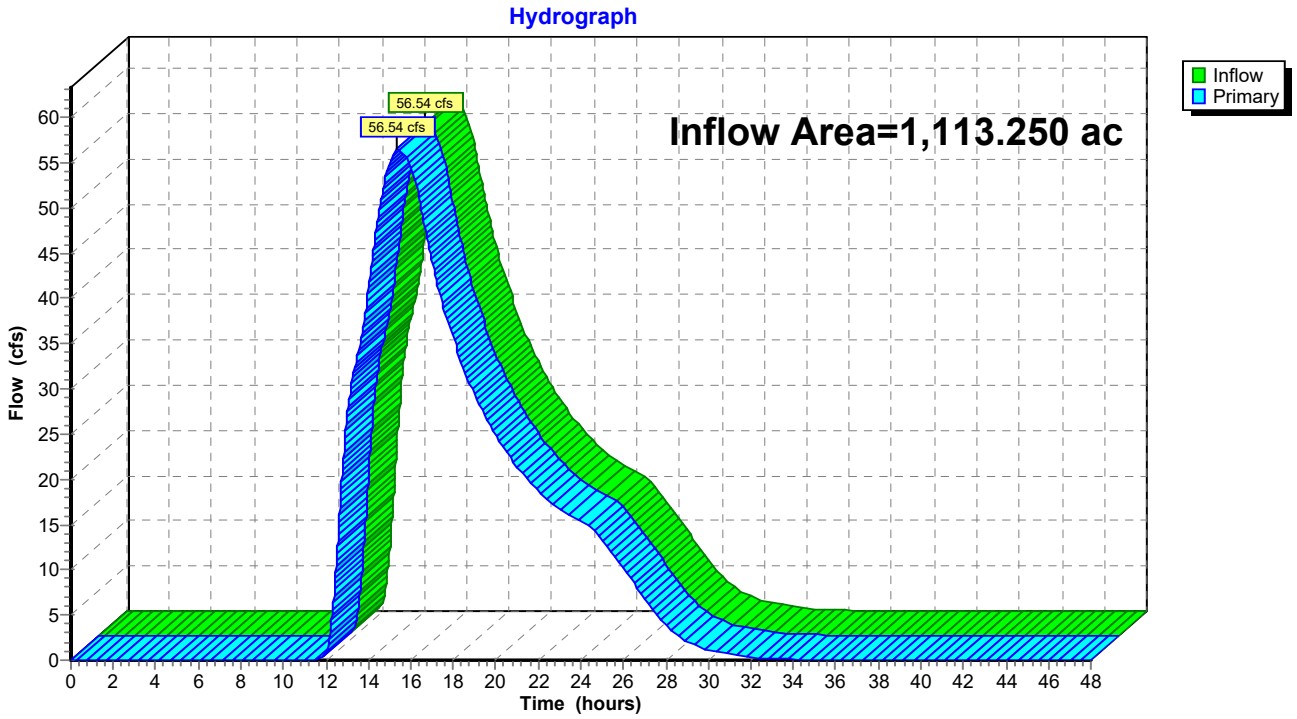


Summary for Link 26L: Androscoggin River

Inflow Area = 1,113.250 ac, 0.00% Impervious, Inflow Depth = 0.38" for 2 year event
Inflow = 56.54 cfs @ 15.33 hrs, Volume= 34.942 af
Primary = 56.54 cfs @ 15.33 hrs, Volume= 34.942 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 26L: Androscoggin River



Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment EX-10: EX-10 Runoff Area=1.000 ac 0.00% Impervious Runoff Depth=1.18"
Flow Length=370' Slope=0.0978 '/' Tc=27.0 min CN=75 Runoff=1.04 cfs 0.098 af

Subcatchment EX-11: EX-11 Runoff Area=43.000 ac 0.00% Impervious Runoff Depth=0.90"
Flow Length=4,277' Slope=0.1500 '/' Tc=89.8 min CN=70 Runoff=13.27 cfs 3.221 af

Subcatchment EX-12: EX-12 Runoff Area=43.700 ac 0.00% Impervious Runoff Depth=0.85"
Flow Length=4,226' Tc=87.9 min CN=69 Runoff=12.58 cfs 3.088 af

Subcatchment EX-18: EX-18 Runoff Area=3.600 ac 0.00% Impervious Runoff Depth=0.95"
Flow Length=792' Slope=0.1040 '/' Tc=35.0 min CN=71 Runoff=2.41 cfs 0.285 af

Subcatchment EX-19: EX-19 Runoff Area=66.500 ac 0.00% Impervious Runoff Depth=0.80"
Flow Length=3,960' Slope=0.1690 '/' Tc=79.6 min CN=68 Runoff=19.26 cfs 4.426 af

Subcatchment EX-20: EX-20 Runoff Area=0.150 ac 0.00% Impervious Runoff Depth=2.19"
Tc=5.0 min CN=89 Runoff=0.59 cfs 0.027 af

Subcatchment EX-5: EX-5 Runoff Area=884.600 ac 0.00% Impervious Runoff Depth=0.90"
Tc=242.0 min CN=70 Runoff=130.41 cfs 66.257 af

Subcatchment EX-6: EX-6 Runoff Area=15.100 ac 0.00% Impervious Runoff Depth=0.90"
Flow Length=3,062' Slope=0.0745 '/' Tc=95.9 min CN=70 Runoff=4.39 cfs 1.131 af

Subcatchment EX-7: EX-7 Runoff Area=29.600 ac 0.00% Impervious Runoff Depth=0.90"
Flow Length=3,042' Tc=93.1 min CN=70 Runoff=8.92 cfs 2.217 af

Subcatchment EX-8: EX-8 Runoff Area=2.800 ac 0.00% Impervious Runoff Depth=0.85"
Flow Length=686' Slope=0.0820 '/' Tc=36.3 min CN=69 Runoff=1.56 cfs 0.198 af

Subcatchment EX-9: EX-9 Runoff Area=23.200 ac 0.00% Impervious Runoff Depth=0.90"
Flow Length=3,230' Tc=84.3 min CN=70 Runoff=7.53 cfs 1.738 af

Reach 21R: Drive Pipe to Roadway Avg. Flow Depth=0.65' Max Vel=4.39 fps Inflow=12.58 cfs 3.088 af
n=0.050 L=90.0' S=0.0660 '/' Capacity=30.64 cfs Outflow=12.58 cfs 3.088 af

Reach 24R: roadside ditch Avg. Flow Depth=0.85' Max Vel=4.12 fps Inflow=8.92 cfs 2.217 af
n=0.035 L=406.0' S=0.0317 '/' Capacity=48.32 cfs Outflow=8.90 cfs 2.217 af

Reach 27R: roadside ditch Avg. Flow Depth=0.84' Max Vel=0.72 fps Inflow=1.47 cfs 0.074 af
n=0.100 L=538.0' S=0.0084 '/' Capacity=12.91 cfs Outflow=1.28 cfs 0.074 af

Pond 3P: sta. 1010+24 Peak Elev=1,135.44' Storage=1,330 cf Inflow=130.41 cfs 66.257 af
60.0" Round Culvert n=0.025 L=80.0' S=0.0088 '/' Outflow=130.38 cfs 66.257 af

Pond 4P: sta. 1013+23 Peak Elev=1,141.42' Storage=15 cf Inflow=4.39 cfs 1.131 af
Primary=4.39 cfs 1.131 af Secondary=0.00 cfs 0.000 af Outflow=4.39 cfs 1.131 af

Pond 9P: sta. 1032+51 Peak Elev=1,133.70' Storage=42 cf Inflow=14.11 cfs 3.295 af
Outflow=14.11 cfs 3.295 af

Pond 10P: sta. 1040+00 Peak Elev=1,137.16' Storage=1,893 cf Inflow=12.58 cfs 3.088 af
Primary=10.94 cfs 3.014 af Secondary=1.47 cfs 0.074 af Outflow=12.41 cfs 3.088 af

Pond 16P: sta. 1069+69 Peak Elev=1,198.79' Storage=12 cf Inflow=20.02 cfs 4.739 af
36.0" Round Culvert n=0.025 L=63.0' S=0.0400 '/' Outflow=20.02 cfs 4.739 af

Pond 17P: sta. 1069+58 Peak Elev=1,206.00' Storage=24 cf Inflow=19.26 cfs 4.426 af
36.0" Round Culvert n=0.013 L=41.0' S=0.0600 '/' Outflow=19.25 cfs 4.426 af

Pond 18P: sta. 1069+29 Peak Elev=1,203.27' Storage=10 cf Inflow=2.41 cfs 0.285 af
18.0" Round Culvert n=0.013 L=41.0' S=0.0068 '/' Outflow=2.41 cfs 0.285 af

Pond 20P: sta. 1139+10 Drive LT Peak Elev=1,147.44' Inflow=12.58 cfs 3.088 af
18.0" Round Culvert n=0.025 L=37.0' S=0.0670 '/' Outflow=12.58 cfs 3.088 af

Pond 23P: Combined Peak Elev=1,132.80' Storage=507 cf Inflow=8.87 cfs 2.063 af
Outflow=8.85 cfs 2.063 af

Pond 25P: sta. 1020+78 Peak Elev=1,136.59' Inflow=8.90 cfs 2.217 af
Primary=8.02 cfs 2.187 af Secondary=0.88 cfs 0.030 af Outflow=8.90 cfs 2.217 af

Link 26L: AndroscogginRiver Inflow=147.14 cfs 82.686 af
Primary=147.14 cfs 82.686 af

Total Runoff Area = 1,113.250 ac Runoff Volume = 82.687 af Average Runoff Depth = 0.89"
100.00% Pervious = 1,113.250 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment EX-10: EX-10

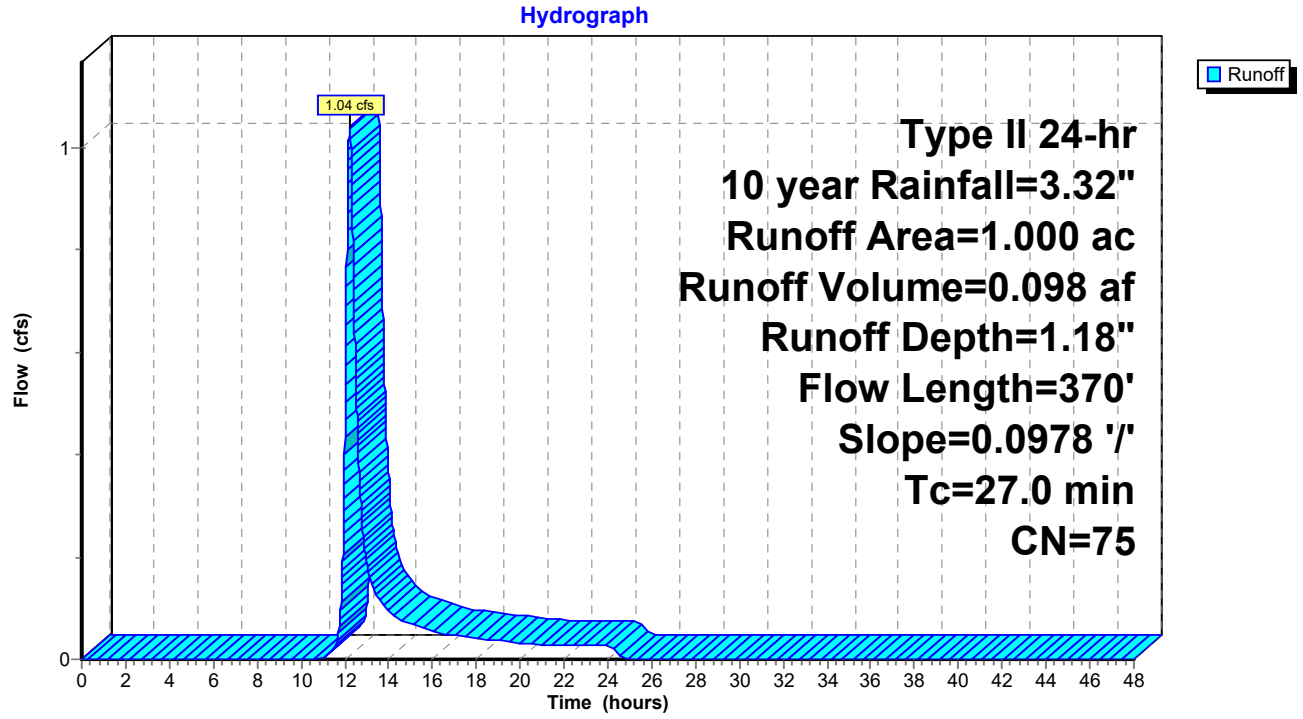
Runoff = 1.04 cfs @ 12.21 hrs, Volume= 0.098 af, Depth= 1.18"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 10 year Rainfall=3.32"

	Area (ac)	CN	Description
*	1.000	75	SEE ATTACHED SPREADSHEET FOR CN VALUES
	1.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.2	100	0.0978	0.08		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.80"
5.8	270	0.0978	0.78		**Shallow Concentrated Flow,** Forest w/Heavy Litter Kv= 2.5 fps
27.0	370	Total			

Subcatchment EX-10: EX-10



Summary for Subcatchment EX-11: EX-11

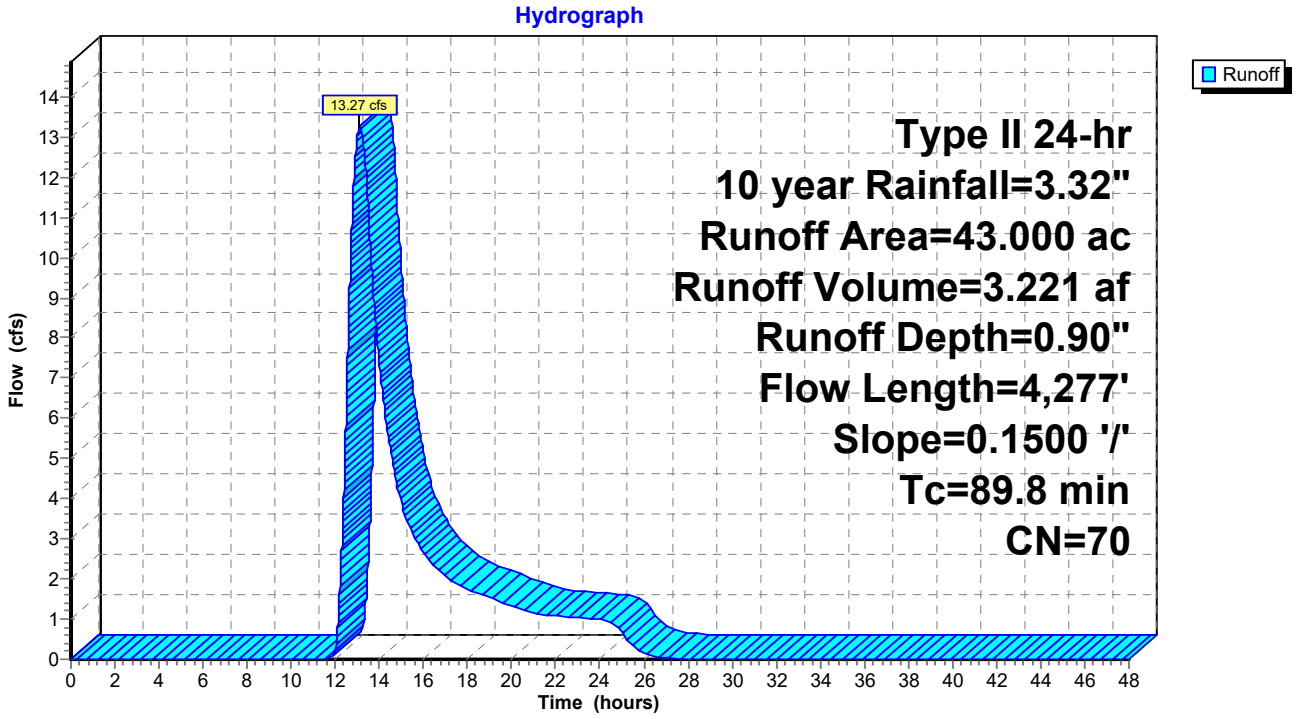
Runoff = 13.27 cfs @ 13.07 hrs, Volume= 3.221 af, Depth= 0.90"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 10 year Rainfall=3.32"

	Area (ac)	CN	Description
*	43.000	70	SEE ATTACHED SPREADSHEET FOR CN VALUES
	43.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.9	100	0.1500	0.09		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.80"
71.9	4,177	0.1500	0.97		**Shallow Concentrated Flow,** Forest w/Heavy Litter Kv= 2.5 fps
89.8	4,277	Total			

Subcatchment EX-11: EX-11



Summary for Subcatchment EX-12: EX-12

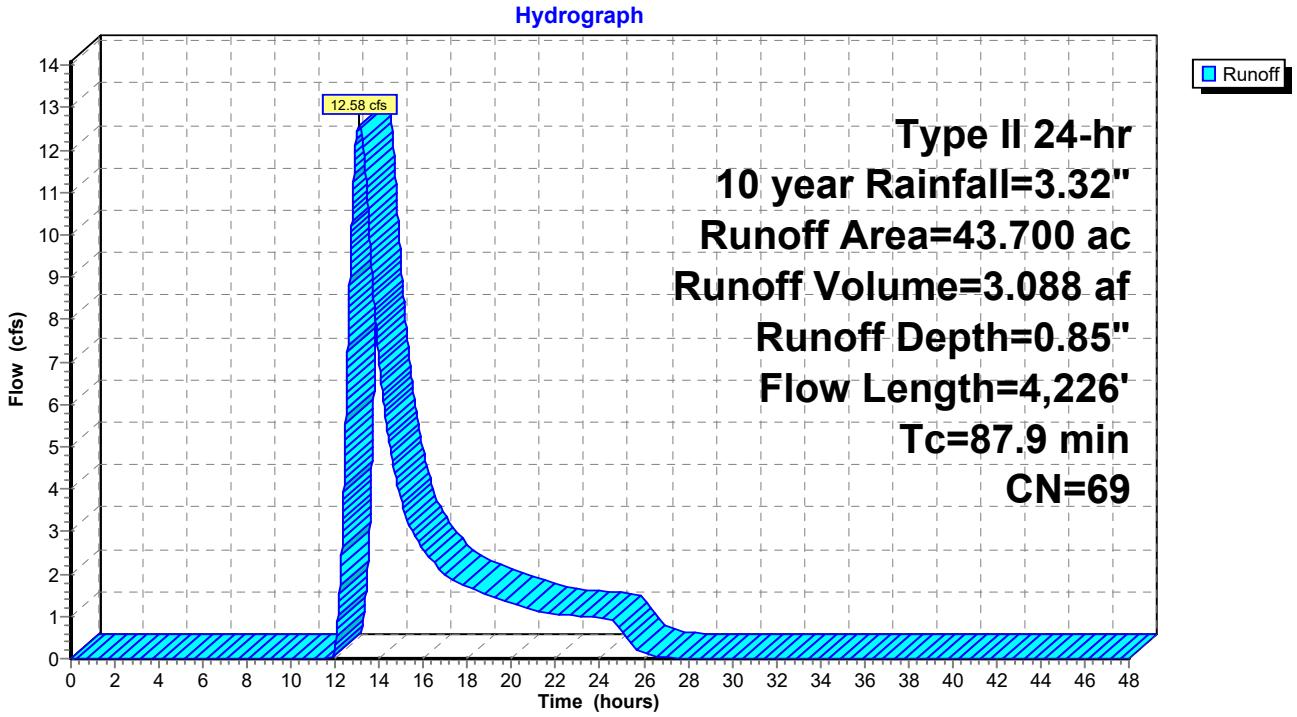
Runoff = 12.58 cfs @ 13.09 hrs, Volume= 3.088 af, Depth= 0.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 10 year Rainfall=3.32"

	Area (ac)	CN	Description
*	43.700	69	SEE ATTACHED SPREADSHEET FOR CN VALUES
	43.700		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.2	100	0.1100	0.08		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.80"
66.2	3,971	0.1600	1.00		**Shallow Concentrated Flow,** Forest w/Heavy Litter Kv= 2.5 fps
1.5	155	0.0700	1.74	0.16	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=0.25' Z= 1.5 '/' Top.W=0.75' n= 0.050 Mountain streams w/large boulders
87.9	4,226	Total			

Subcatchment EX-12: EX-12



Summary for Subcatchment EX-18: EX-18

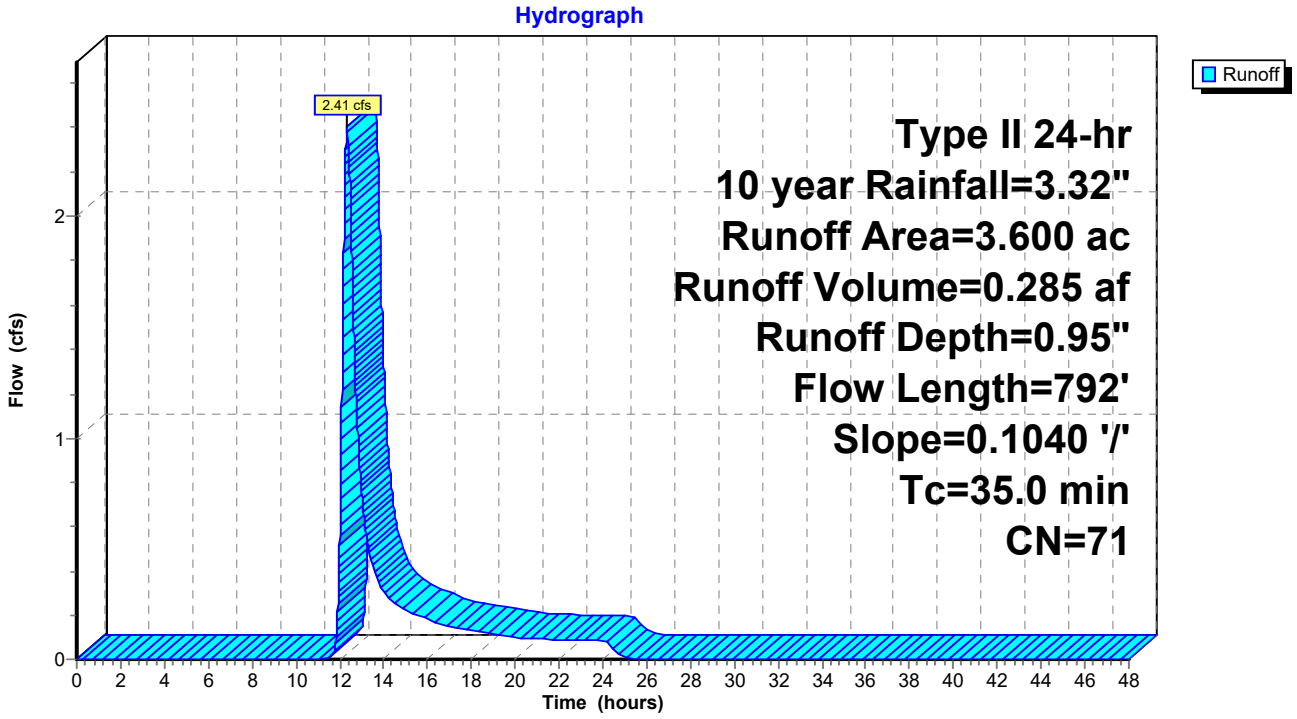
Runoff = 2.41 cfs @ 12.33 hrs, Volume= 0.285 af, Depth= 0.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 10 year Rainfall=3.32"

	Area (ac)	CN	Description
*	3.600	71	SEE ATTACHED SPREADSHEET FOR CN VALUES
	3.600		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.7	100	0.1040	0.08		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.80"
14.3	692	0.1040	0.81		**Shallow Concentrated Flow,** Forest w/Heavy Litter Kv= 2.5 fps
35.0	792	Total			

Subcatchment EX-18: EX-18



Summary for Subcatchment EX-19: EX-19

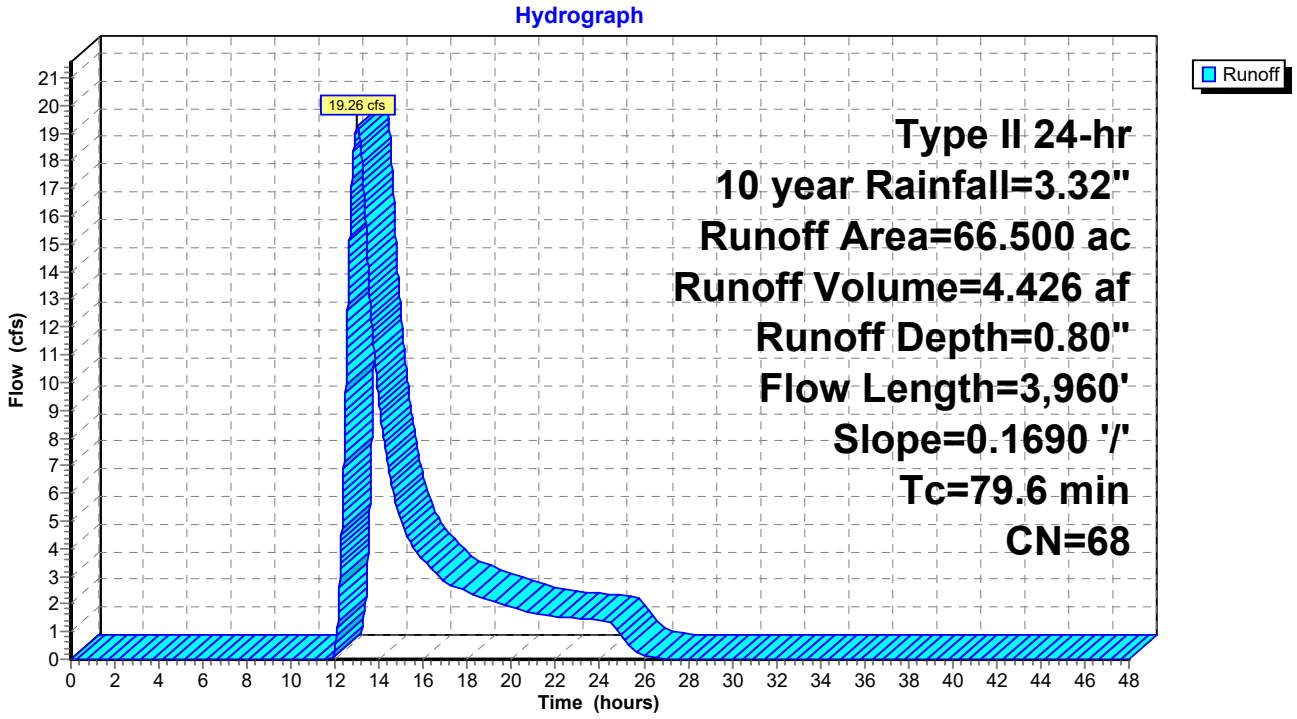
Runoff = 19.26 cfs @ 13.00 hrs, Volume= 4.426 af, Depth= 0.80"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 10 year Rainfall=3.32"

	Area (ac)	CN	Description
*	66.500	68	SEE ATTACHED SPREADSHEET FOR CN VALUES
	66.500		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.0	100	0.1690	0.10		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.80"
62.6	3,860	0.1690	1.03		**Shallow Concentrated Flow,** Forest w/Heavy Litter Kv= 2.5 fps
79.6	3,960	Total			

Subcatchment EX-19: EX-19



Summary for Subcatchment EX-20: EX-20

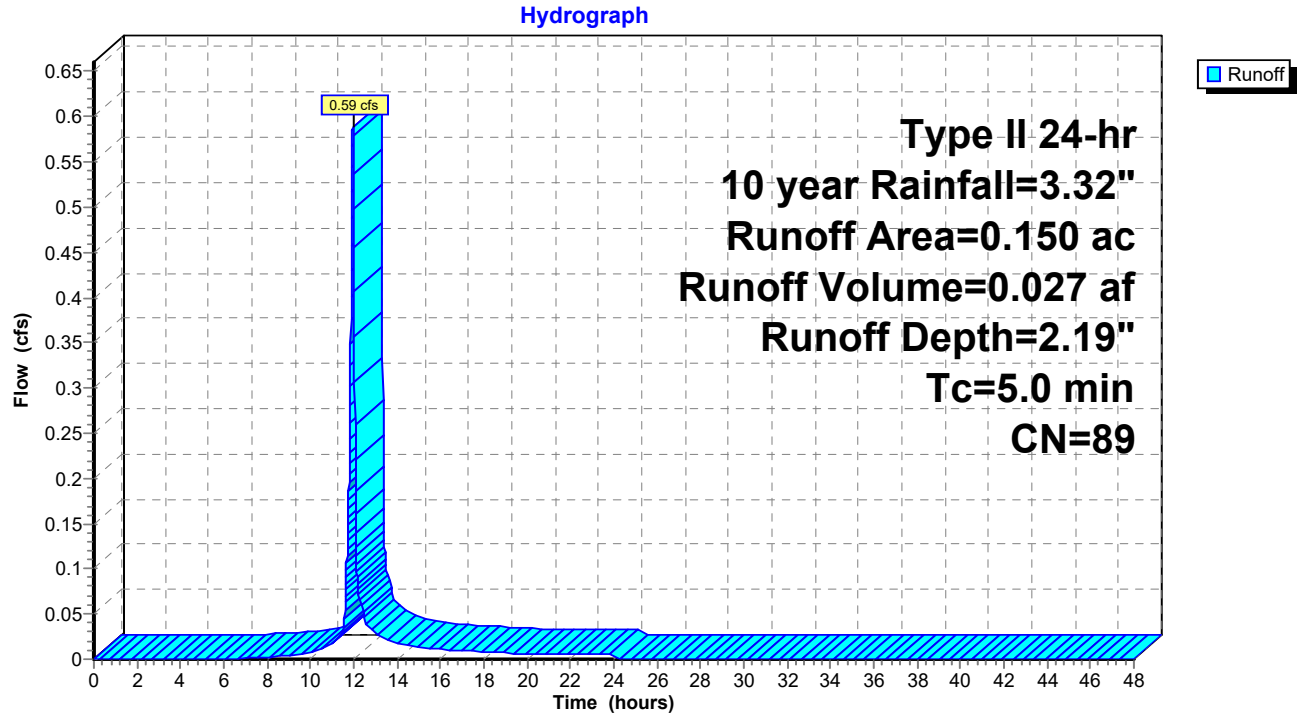
Runoff = 0.59 cfs @ 11.96 hrs, Volume= 0.027 af, Depth= 2.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 10 year Rainfall=3.32"

Area (ac)	CN	Description
0.150	89	Gravel roads, HSG C
0.150		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment EX-20: EX-20



Summary for Subcatchment EX-5: EX-5

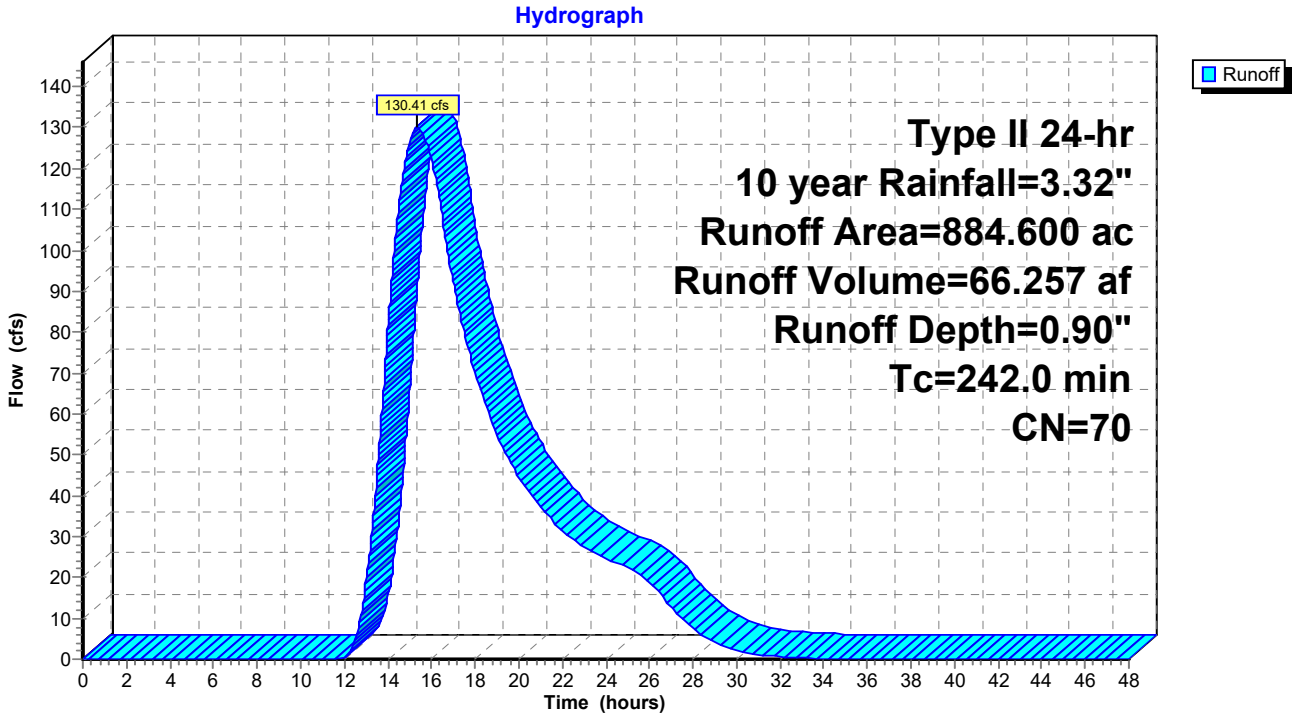
Runoff = 130.41 cfs @ 15.33 hrs, Volume= 66.257 af, Depth= 0.90"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 10 year Rainfall=3.32"

	Area (ac)	CN	Description
*	884.600	70	SEE ATTACHED SPREADSHEET FOR CN VALUES
	884.600		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
242.0					**Direct Entry,**

Subcatchment EX-5: EX-5



Summary for Subcatchment EX-6: EX-6

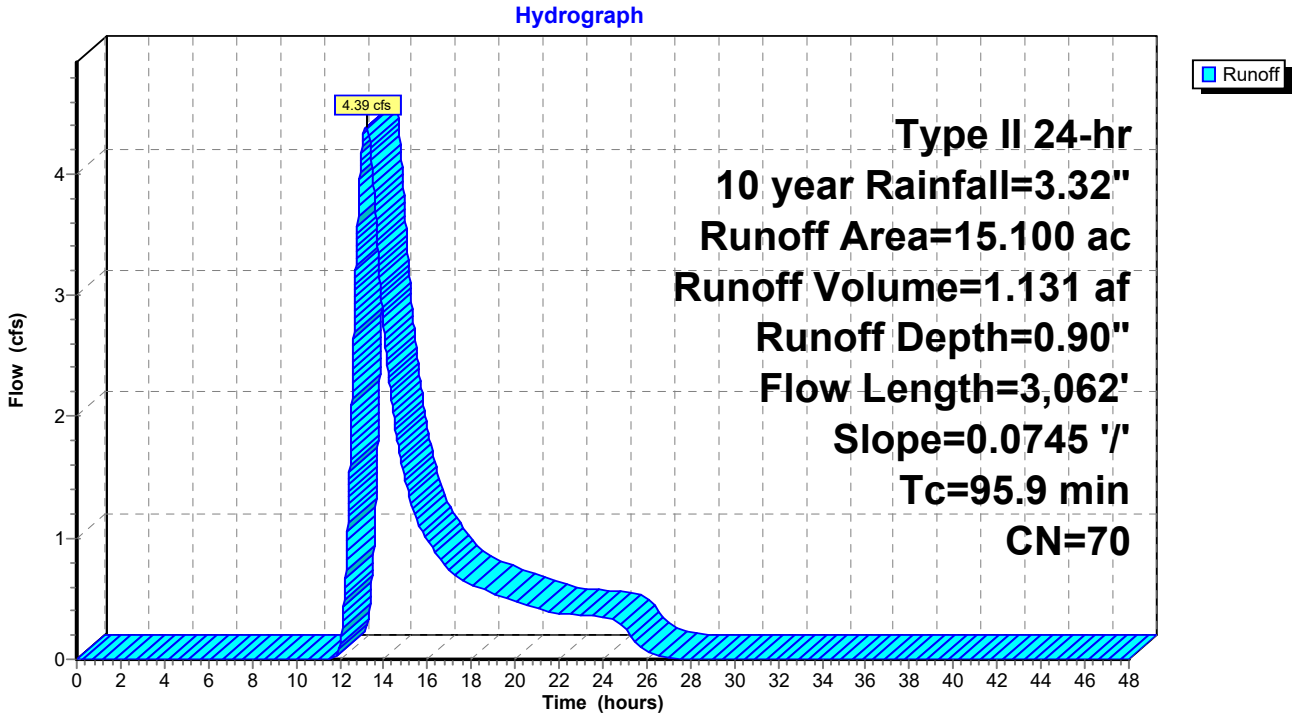
Runoff = 4.39 cfs @ 13.21 hrs, Volume= 1.131 af, Depth= 0.90"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 10 year Rainfall=3.32"

	Area (ac)	CN	Description
*	15.100	70	SEE ATTACHED SPREADSHEET FOR CN VALUES
	15.100		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
23.6	100	0.0745	0.07		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.80"
72.3	2,962	0.0745	0.68		**Shallow Concentrated Flow,** Forest w/Heavy Litter Kv= 2.5 fps
95.9	3,062	Total			

Subcatchment EX-6: EX-6



Summary for Subcatchment EX-7: EX-7

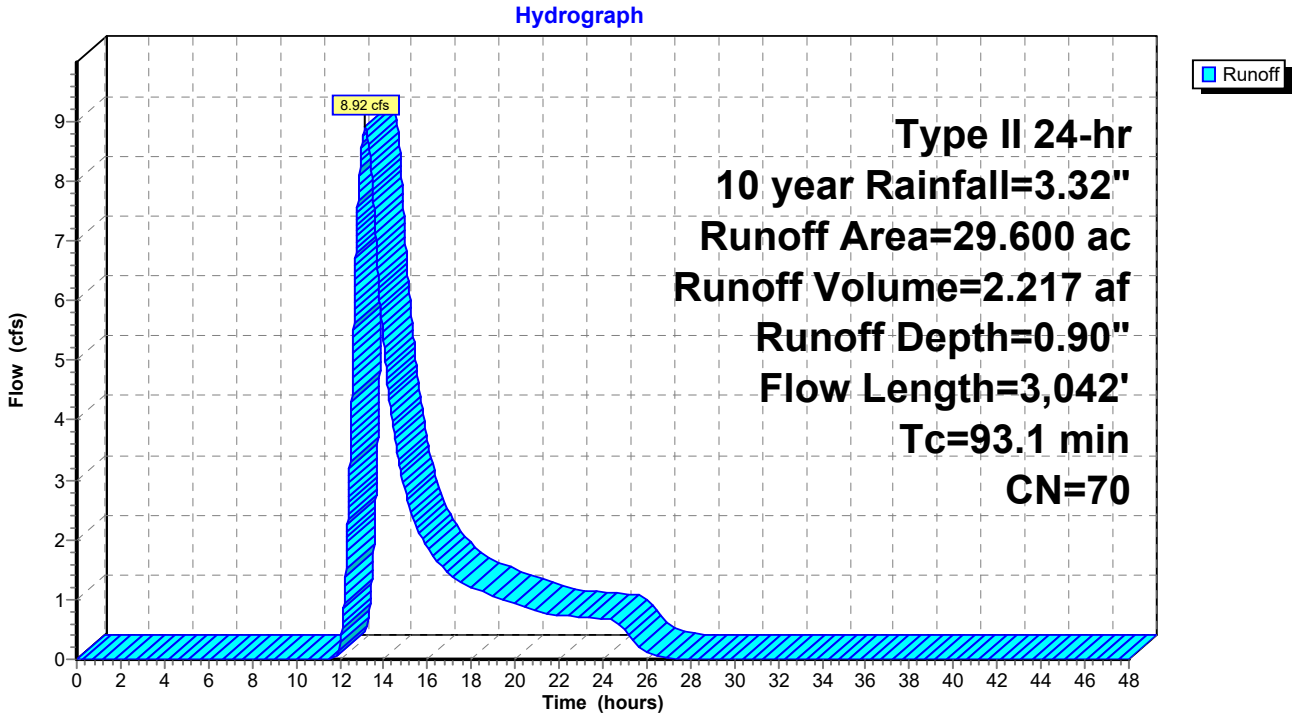
Runoff = 8.92 cfs @ 13.14 hrs, Volume= 2.217 af, Depth= 0.90"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 10 year Rainfall=3.32"

	Area (ac)	CN	Description
*	29.600	70	See Notes
	29.600		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
24.2	100	0.0700	0.07		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.80"
68.9	2,942	0.0810	0.71		**Shallow Concentrated Flow,** Forest w/Heavy Litter Kv= 2.5 fps
93.1	3,042	Total			

Subcatchment EX-7: EX-7



Summary for Subcatchment EX-8: EX-8

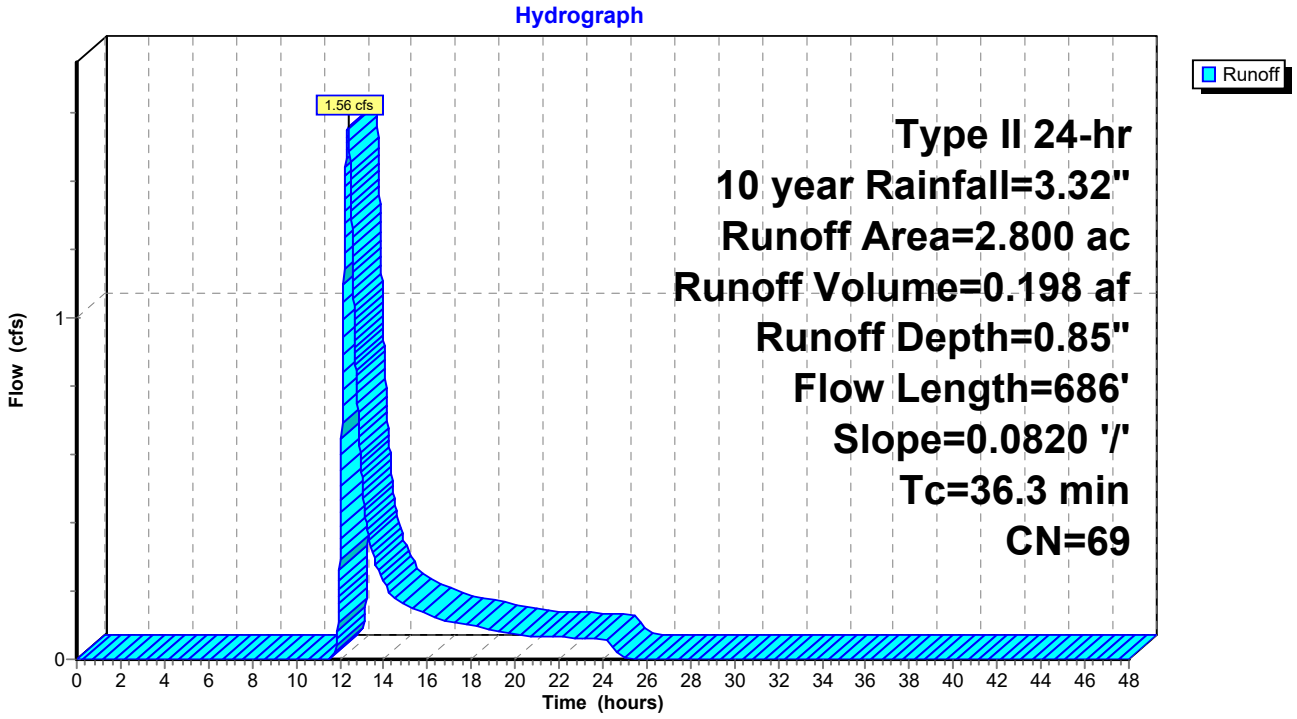
Runoff = 1.56 cfs @ 12.38 hrs, Volume= 0.198 af, Depth= 0.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 10 year Rainfall=3.32"

	Area (ac)	CN	Description
*	2.800	69	SEE ATTACHED SPREADSHEET FOR CN VALUES
	2.800		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.7	100	0.0820	0.07		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.80"
13.6	586	0.0820	0.72		**Shallow Concentrated Flow,** Forest w/Heavy Litter Kv= 2.5 fps
36.3	686	Total			

Subcatchment EX-8: EX-8



Summary for Subcatchment EX-9: EX-9

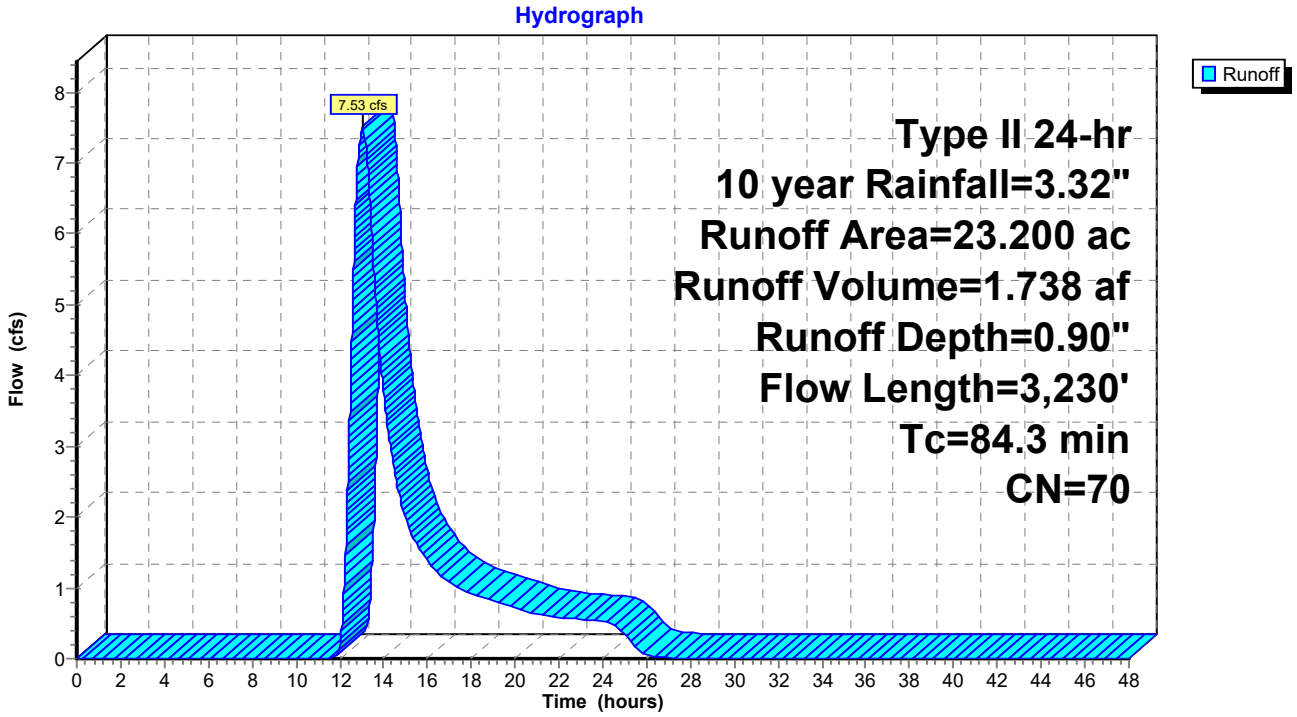
Runoff = 7.53 cfs @ 13.02 hrs, Volume= 1.738 af, Depth= 0.90"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 10 year Rainfall=3.32"

	Area (ac)	CN	Description
*	23.200	70	SEE ATTACHED SPREADSHEET FOR CN VALUES
	23.200		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.0	100	0.1000	0.08		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.80"
62.6	2,970	0.1000	0.79		**Shallow Concentrated Flow,** Forest w/Heavy Litter Kv= 2.5 fps
0.7	160	0.0480	3.56	2.67	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=0.50' Z= 3.0 '/' Top.W=3.00' n= 0.035 Earth, dense weeds
84.3	3,230	Total			

Subcatchment EX-9: EX-9



Summary for Reach 21R: Drive Pipe to Roadway Culvert

[79] Warning: Submerged Pond 20P Primary device # 1 OUTLET by 0.65'

Inflow Area = 43.700 ac, 0.00% Impervious, Inflow Depth = 0.85" for 10 year event
Inflow = 12.58 cfs @ 13.09 hrs, Volume= 3.088 af
Outflow = 12.58 cfs @ 13.09 hrs, Volume= 3.088 af, Atten= 0%, Lag= 0.2 min

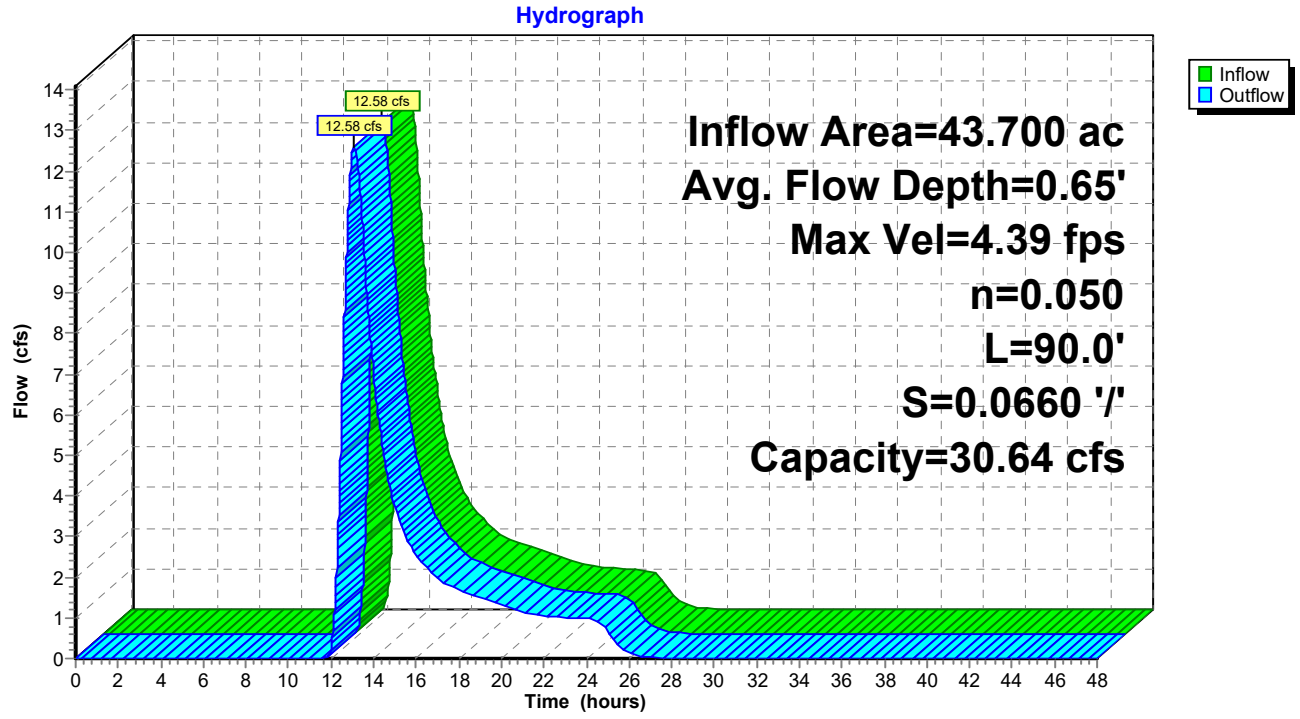
Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 4.39 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 2.12 fps, Avg. Travel Time= 0.7 min

Peak Storage= 258 cf @ 13.09 hrs
Average Depth at Peak Storage= 0.65'
Bank-Full Depth= 1.00' Flow Area= 5.5 sf, Capacity= 30.64 cfs

2.50' x 1.00' deep channel, n= 0.050 Mountain streams w/large boulders
Side Slope Z-value= 3.0 '/' Top Width= 8.50'
Length= 90.0' Slope= 0.0660 '/'
Inlet Invert= 1,140.70', Outlet Invert= 1,134.76'

‡

Reach 21R: Drive Pipe to Roadway Culvert



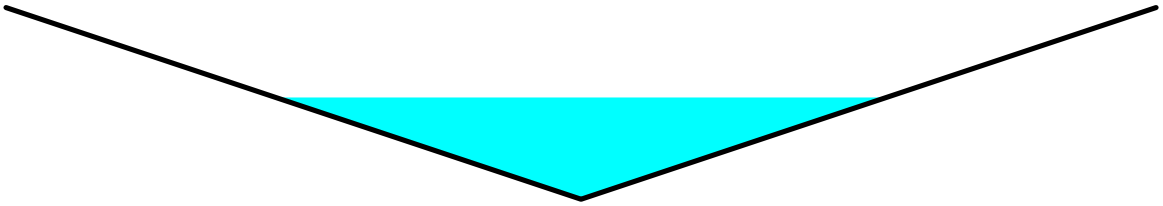
Summary for Reach 24R: roadside ditch

Inflow Area = 29.600 ac, 0.00% Impervious, Inflow Depth = 0.90" for 10 year event
Inflow = 8.92 cfs @ 13.14 hrs, Volume= 2.217 af
Outflow = 8.90 cfs @ 13.16 hrs, Volume= 2.217 af, Atten= 0%, Lag= 1.2 min

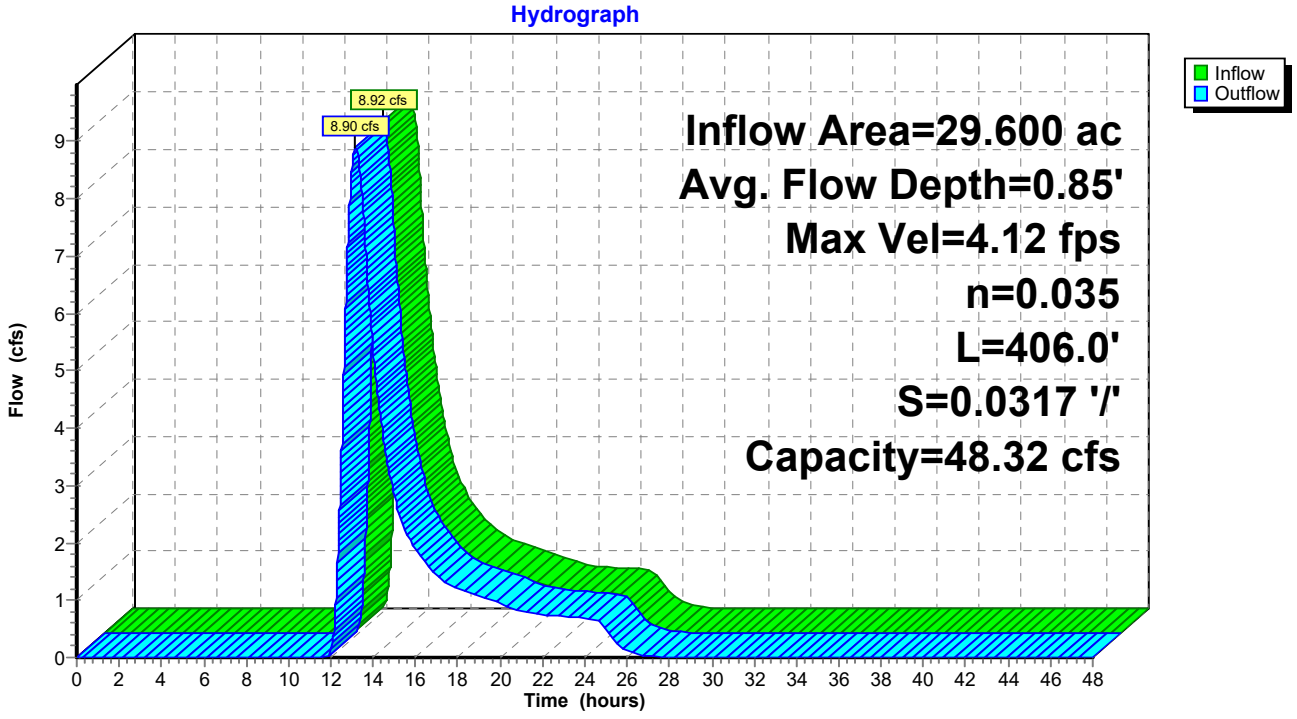
Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.12 fps, Min. Travel Time= 1.6 min
Avg. Velocity = 2.12 fps, Avg. Travel Time= 3.2 min

Peak Storage= 876 cf @ 13.16 hrs
Average Depth at Peak Storage= 0.85'
Bank-Full Depth= 1.60' Flow Area= 7.7 sf, Capacity= 48.32 cfs

0.00' x 1.60' deep channel, n= 0.035 Earth, dense weeds
Side Slope Z-value= 3.0 '/' Top Width= 9.60'
Length= 406.0' Slope= 0.0317 '/'
Inlet Invert= 1,147.00', Outlet Invert= 1,134.12'



Reach 24R: roadside ditch



Summary for Reach 27R: roadside ditch

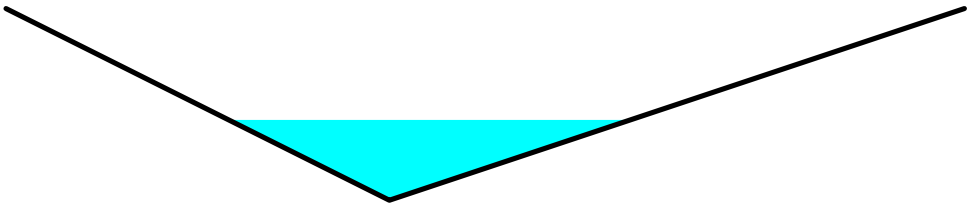
[81] Warning: Exceeded Pond 10P by 2.50' @ 28.73 hrs

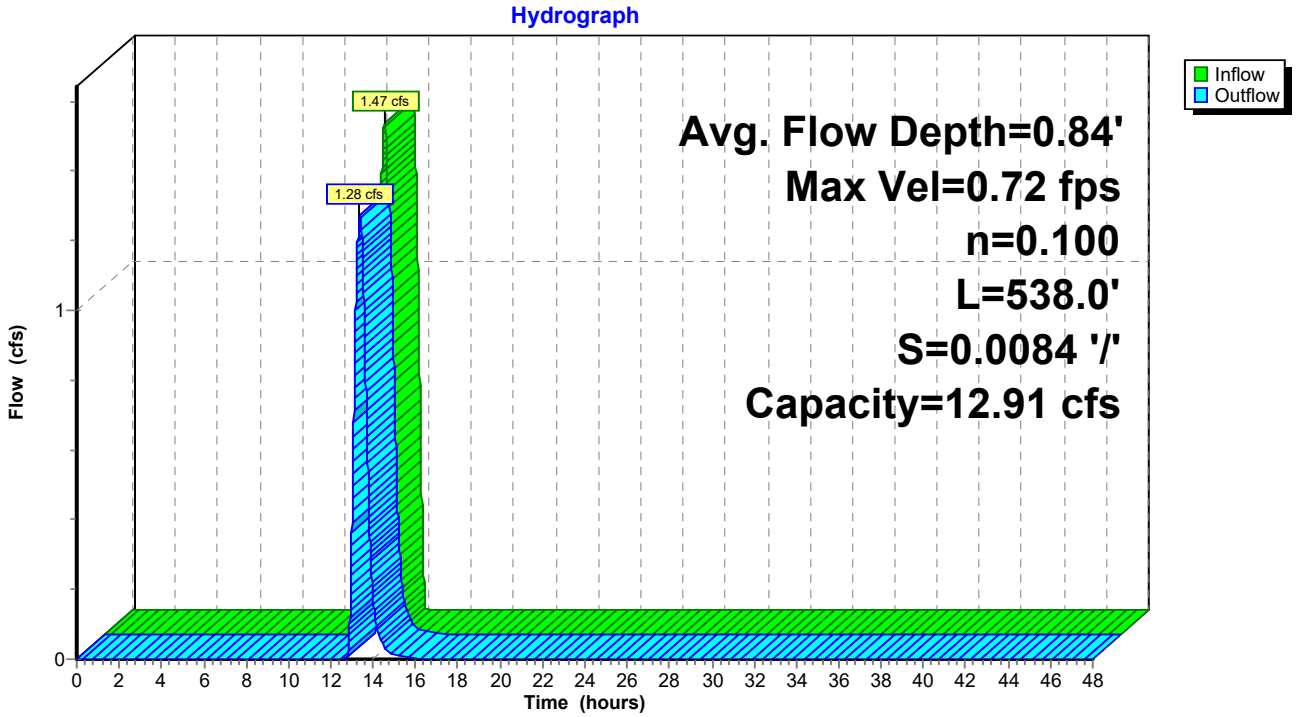
Inflow = 1.47 cfs @ 13.21 hrs, Volume= 0.074 af
Outflow = 1.28 cfs @ 13.37 hrs, Volume= 0.074 af, Atten= 13%, Lag= 9.4 min

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 0.72 fps, Min. Travel Time= 12.4 min
Avg. Velocity = 0.15 fps, Avg. Travel Time= 60.7 min

Peak Storage= 948 cf @ 13.37 hrs
Average Depth at Peak Storage= 0.84'
Bank-Full Depth= 2.00' Flow Area= 10.0 sf, Capacity= 12.91 cfs

0.00' x 2.00' deep channel, n= 0.100 Earth, dense brush, high stage
Side Slope Z-value= 2.0 3.0 '/' Top Width= 10.00'
Length= 538.0' Slope= 0.0084 '/'
Inlet Invert= 1,137.50', Outlet Invert= 1,133.00'





Summary for Pond 3P: sta. 1010+24

Inflow Area = 884.600 ac, 0.00% Impervious, Inflow Depth = 0.90" for 10 year event
Inflow = 130.41 cfs @ 15.33 hrs, Volume= 66.257 af
Outflow = 130.38 cfs @ 15.33 hrs, Volume= 66.257 af, Atten= 0%, Lag= 0.3 min
Primary = 130.38 cfs @ 15.33 hrs, Volume= 66.257 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 1,135.44' @ 15.33 hrs Surf.Area= 574 sf Storage= 1,330 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 0.1 min (1,090.4 - 1,090.3)

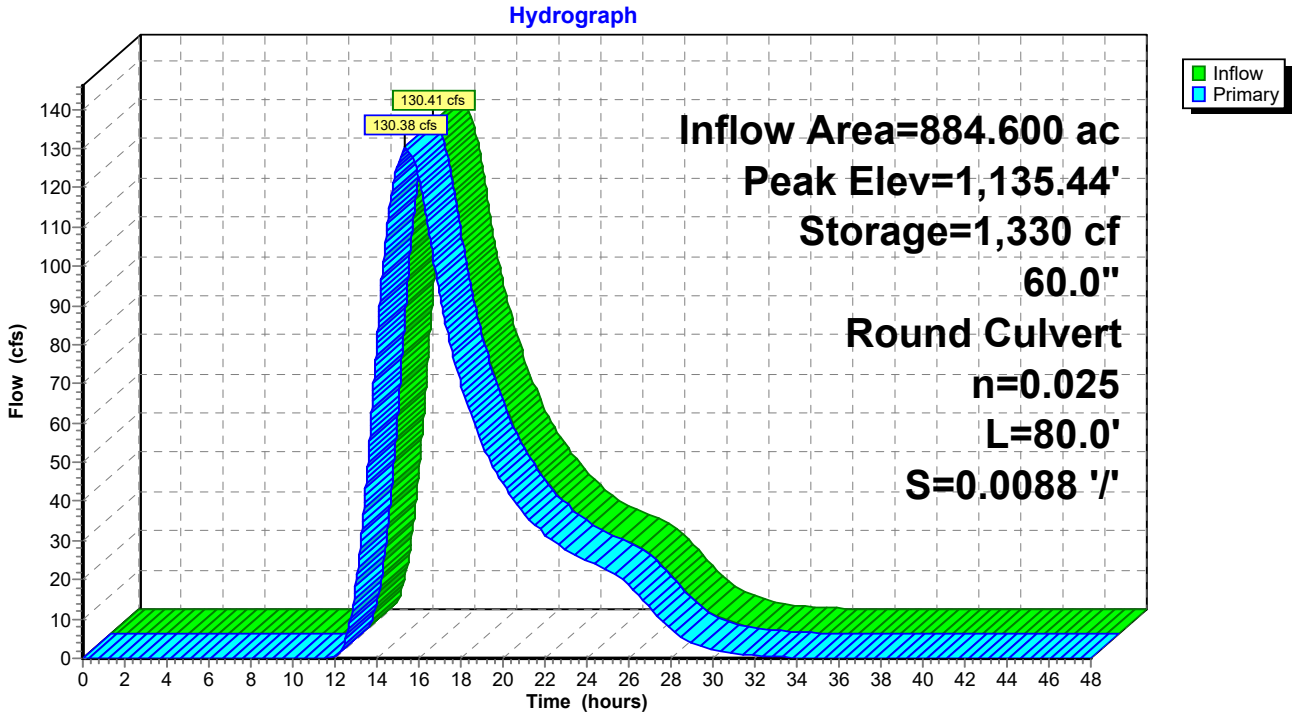
Volume	Invert	Avail.Storage	Storage Description
#1	1,131.00'	17,553 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,131.00	187	0	0
1,132.00	239	213	213
1,133.00	269	254	467
1,134.00	296	283	750
1,135.00	426	361	1,111
1,136.00	764	595	1,706
1,137.00	1,791	1,278	2,983
1,138.00	3,675	2,733	5,716
1,139.00	5,843	4,759	10,475
1,140.00	8,312	7,078	17,553

Device	Routing	Invert	Outlet Devices
#1	Primary	1,129.96'	**60.0" Round CMP_Round 60"** L= 80.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 1,129.96' / 1,129.26' S= 0.0088 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 19.63 sf

Primary OutFlow Max=130.38 cfs @ 15.33 hrs HW=1,135.44' (Free Discharge)
↑—**1=CMP_Round 60"** (Barrel Controls 130.38 cfs @ 7.55 fps)

Pond 3P: sta. 1010+24



Summary for Pond 4P: sta. 1013+23

Secondary flow to EX-5 60" cmp which was analyzed separately using USGS Regression and FHWA Hy8.

Inflow Area = 15.100 ac, 0.00% Impervious, Inflow Depth = 0.90" for 10 year event
Inflow = 4.39 cfs @ 13.21 hrs, Volume= 1.131 af
Outflow = 4.39 cfs @ 13.21 hrs, Volume= 1.131 af, Atten= 0%, Lag= 0.1 min
Primary = 4.39 cfs @ 13.21 hrs, Volume= 1.131 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 1,141.42' @ 13.21 hrs Surf.Area= 66 sf Storage= 15 cf

Plug-Flow detention time= 0.1 min calculated for 1.131 af (100% of inflow)
Center-of-Mass det. time= 0.0 min (953.0 - 953.0)

Volume	Invert	Avail.Storage	Storage Description
#1	1,141.00'	183 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

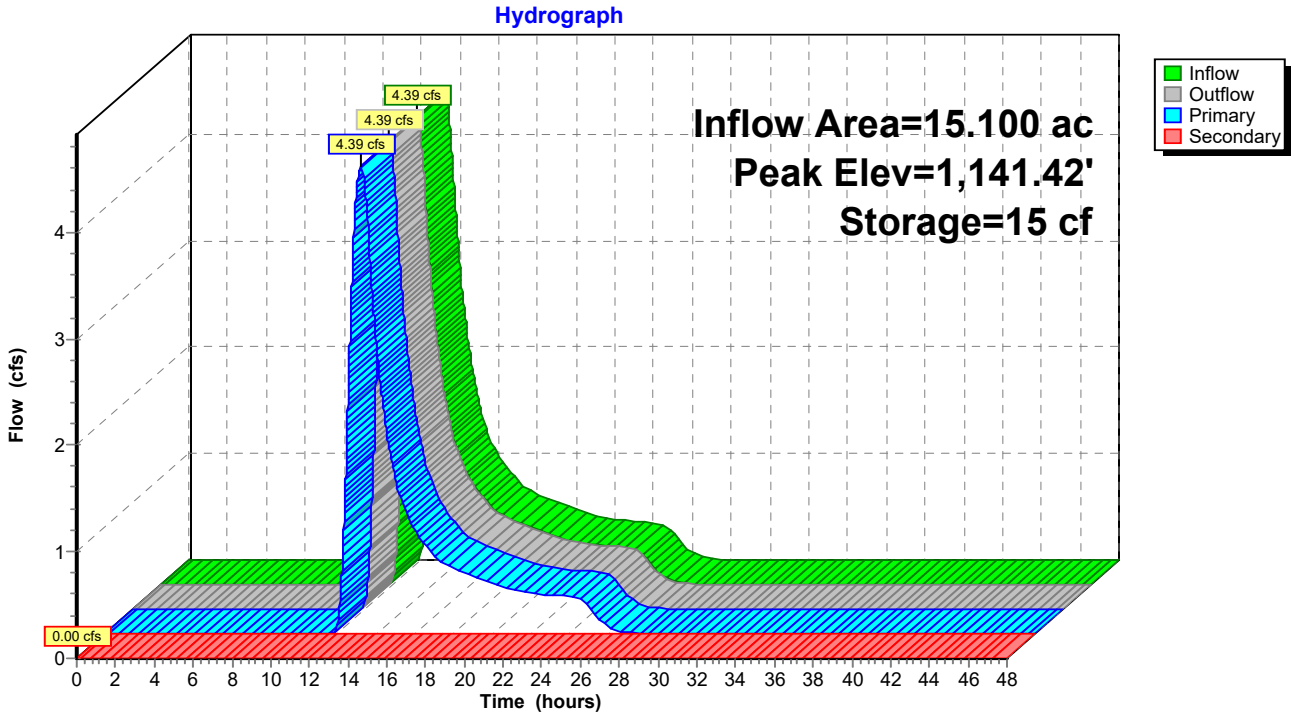
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,141.00	5	0	0
1,142.00	150	78	78
1,142.50	272	106	183

Device	Routing	Invert	Outlet Devices
#1	Primary	1,139.25'	**15.0" Round CMP_Round 15"** L= 52.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,139.25' / 1,138.90' S= 0.0067 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 1.23 sf
#2	Secondary	1,142.50'	**7.0' long (Profile 20) Broad-Crested Rectangular Weir** Head (feet) 0.49 0.98 1.48 1.97 Coef. (English) 2.68 2.63 2.61 2.61

Primary OutFlow Max=4.39 cfs @ 13.21 hrs HW=1,141.42' (Free Discharge)
↑—**1=CMP_Round 15"** (Barrel Controls 4.39 cfs @ 3.58 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=1,141.00' (Free Discharge)
↑—**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 4P: sta. 1013+23



Summary for Pond 9P: sta. 1032+51

[62] Hint: Exceeded Reach 27R OUTLET depth by 0.42' @ 12.72 hrs

Inflow Area = 43.000 ac, 0.00% Impervious, Inflow Depth = 0.92" for 10 year event
Inflow = 14.11 cfs @ 13.17 hrs, Volume= 3.295 af
Outflow = 14.11 cfs @ 13.18 hrs, Volume= 3.295 af, Atten= 0%, Lag= 0.2 min
Primary = 14.11 cfs @ 13.18 hrs, Volume= 3.295 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 1,133.70' @ 13.18 hrs Surf.Area= 102 sf Storage= 42 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 0.0 min (944.3 - 944.2)

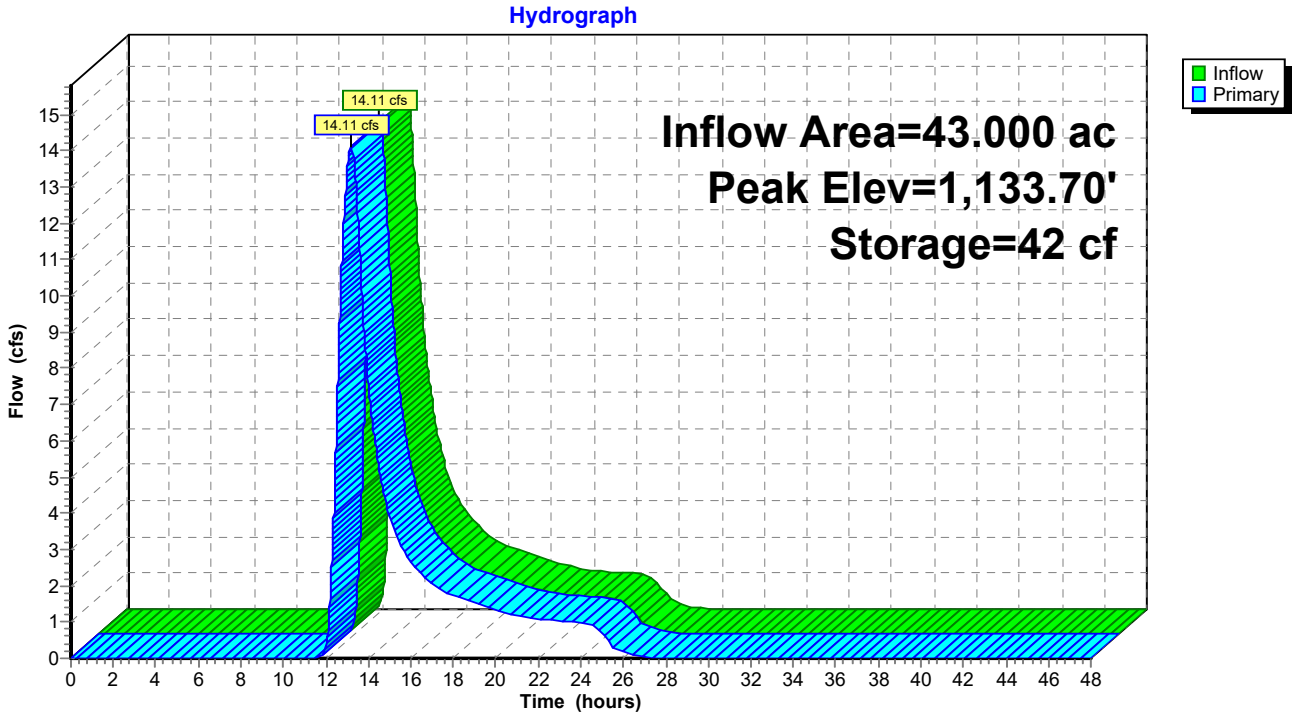
Volume	Invert	Avail.Storage	Storage Description
#1	1,133.00'	1,972 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,133.00	18	0	0
1,134.00	138	78	78
1,135.00	719	429	507
1,136.00	2,211	1,465	1,972

Device	Routing	Invert	Outlet Devices
#1	Primary	1,132.63'	**24.0" Round RCP_Round 24"** L= 22.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 1,132.63' / 1,132.05' S= 0.0264 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 3.14 sf
#2	Primary	1,132.05'	**18.0" Round RCP_Round 18"** L= 22.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 1,132.05' / 1,131.47' S= 0.0264 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 1.77 sf

Primary OutFlow Max=14.11 cfs @ 13.18 hrs HW=1,133.70' (Free Discharge)
↑—**1=RCP_Round 24"** (Inlet Controls 6.03 cfs @ 3.52 fps)
└—**2=RCP_Round 18"** (Inlet Controls 8.07 cfs @ 4.57 fps)

Pond 9P: sta. 1032+51



Summary for Pond 10P: sta. 1040+00

[62] Hint: Exceeded Reach 21R OUTLET depth by 1.76' @ 13.24 hrs

Inflow Area = 43.700 ac, 0.00% Impervious, Inflow Depth = 0.85" for 10 year event
Inflow = 12.58 cfs @ 13.09 hrs, Volume= 3.088 af
Outflow = 12.41 cfs @ 13.21 hrs, Volume= 3.088 af, Atten= 1%, Lag= 7.3 min
Primary = 10.94 cfs @ 13.21 hrs, Volume= 3.014 af
Secondary = 1.47 cfs @ 13.21 hrs, Volume= 0.074 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 1,137.16' @ 13.21 hrs Surf.Area= 3,082 sf Storage= 1,893 cf

Plug-Flow detention time= 0.8 min calculated for 3.088 af (100% of inflow)
Center-of-Mass det. time= 0.8 min (950.6 - 949.8)

Volume	Invert	Avail.Storage	Storage Description
#1	1,135.00'	20,043 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

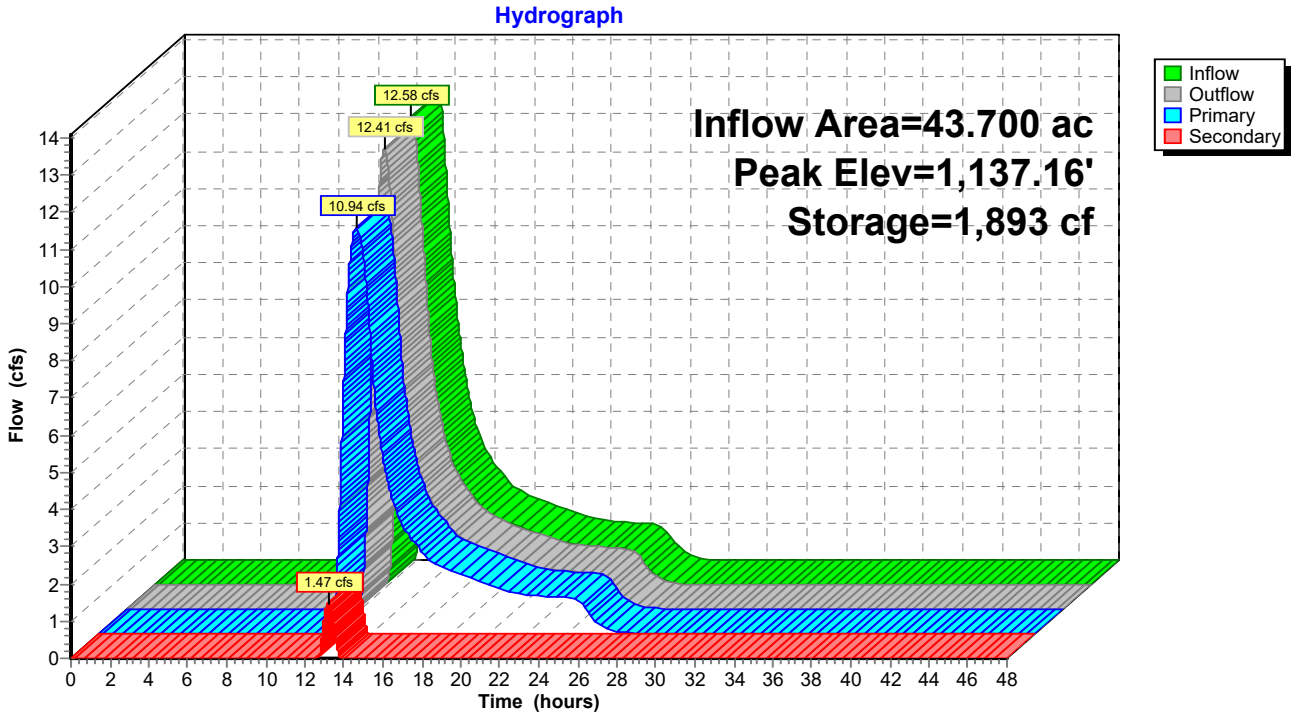
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,135.00	15	0	0
1,136.00	155	85	85
1,137.00	2,548	1,352	1,437
1,138.00	5,844	4,196	5,633
1,139.00	10,620	8,232	13,865
1,139.50	14,092	6,178	20,043

Device	Routing	Invert	Outlet Devices
#1	Primary	1,134.76'	**18.0" Round RCP_Round 18"** L= 45.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 1,134.76' / 1,134.00' S= 0.0169 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 1.77 sf
#2	Secondary	1,136.54'	**18.0" Round CMP_Round 18"** L= 29.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,136.12' / 1,136.54' S= -0.0145 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 1.77 sf

Primary OutFlow Max=10.94 cfs @ 13.21 hrs HW=1,137.16' (Free Discharge)
↑—**1=RCP_Round 18"** (Inlet Controls 10.94 cfs @ 6.19 fps)

Secondary OutFlow Max=1.47 cfs @ 13.21 hrs HW=1,137.16' (Free Discharge)
↑—**2=CMP_Round 18"** (Inlet Controls 1.47 cfs @ 2.12 fps)

Pond 10P: sta. 1040+00



Summary for Pond 16P: sta. 1069+69

Inflow Area = 70.250 ac, 0.00% Impervious, Inflow Depth = 0.81" for 10 year event
Inflow = 20.02 cfs @ 13.00 hrs, Volume= 4.739 af
Outflow = 20.02 cfs @ 13.00 hrs, Volume= 4.739 af, Atten= 0%, Lag= 0.0 min
Primary = 20.02 cfs @ 13.00 hrs, Volume= 4.739 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 1,198.79' @ 13.00 hrs Surf.Area= 23 sf Storage= 12 cf

Plug-Flow detention time= 0.0 min calculated for 4.738 af (100% of inflow)
Center-of-Mass det. time= 0.0 min (941.6 - 941.6)

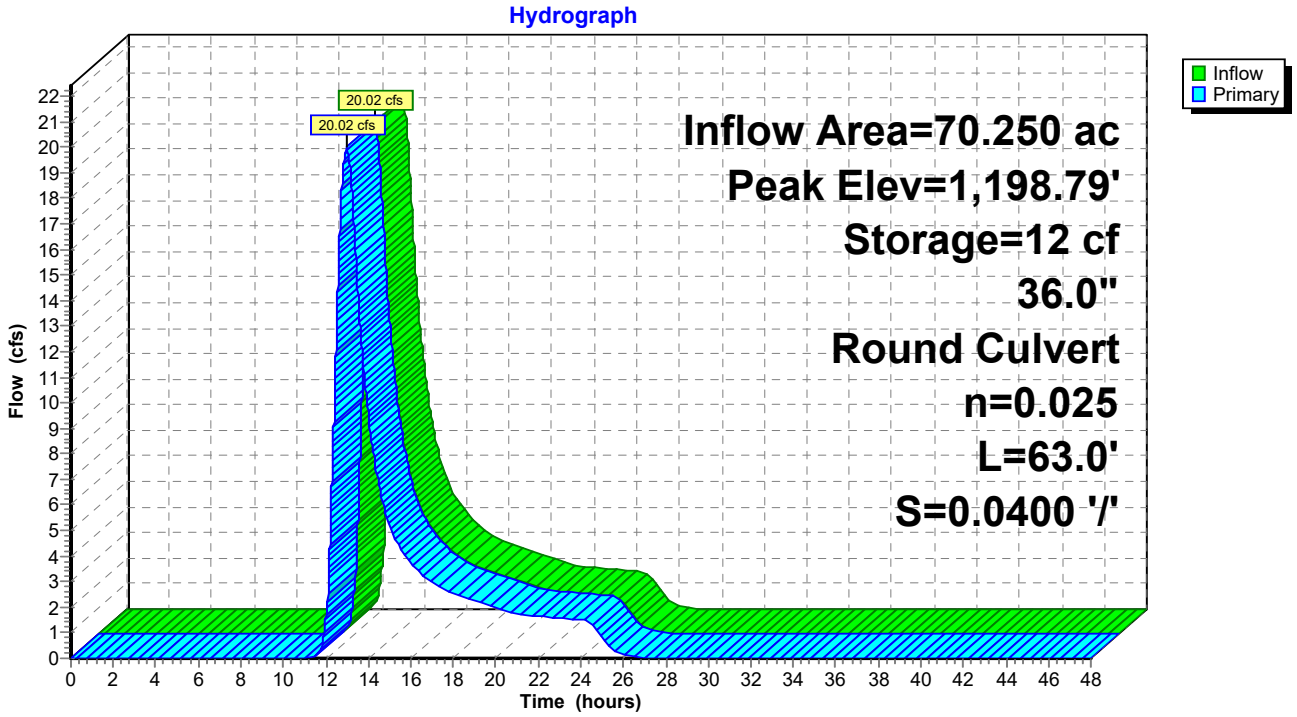
Volume	Invert	Avail.Storage	Storage Description
#1	1,198.00'	372 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,198.00	7	0	0
1,199.00	27	17	17
1,200.00	55	41	58
1,201.00	103	79	137
1,202.00	366	235	372

Device	Routing	Invert	Outlet Devices
#1	Primary	1,197.00'	**36.0" Round CMP_Round 36"** L= 63.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 1,197.00' / 1,194.48' S= 0.0400 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 7.07 sf

Primary OutFlow Max=20.02 cfs @ 13.00 hrs HW=1,198.79' (Free Discharge)
↑**1=CMP_Round 36"** (Inlet Controls 20.02 cfs @ 4.55 fps)

Pond 16P: sta. 1069+69



Summary for Pond 17P: sta. 1069+58

Inflow Area = 66.500 ac, 0.00% Impervious, Inflow Depth = 0.80" for 10 year event
Inflow = 19.26 cfs @ 13.00 hrs, Volume= 4.426 af
Outflow = 19.25 cfs @ 13.00 hrs, Volume= 4.426 af, Atten= 0%, Lag= 0.0 min
Primary = 19.25 cfs @ 13.00 hrs, Volume= 4.426 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 1,206.00' @ 13.00 hrs Surf.Area= 38 sf Storage= 24 cf

Plug-Flow detention time= 0.0 min calculated for 4.425 af (100% of inflow)
Center-of-Mass det. time= 0.0 min (945.5 - 945.5)

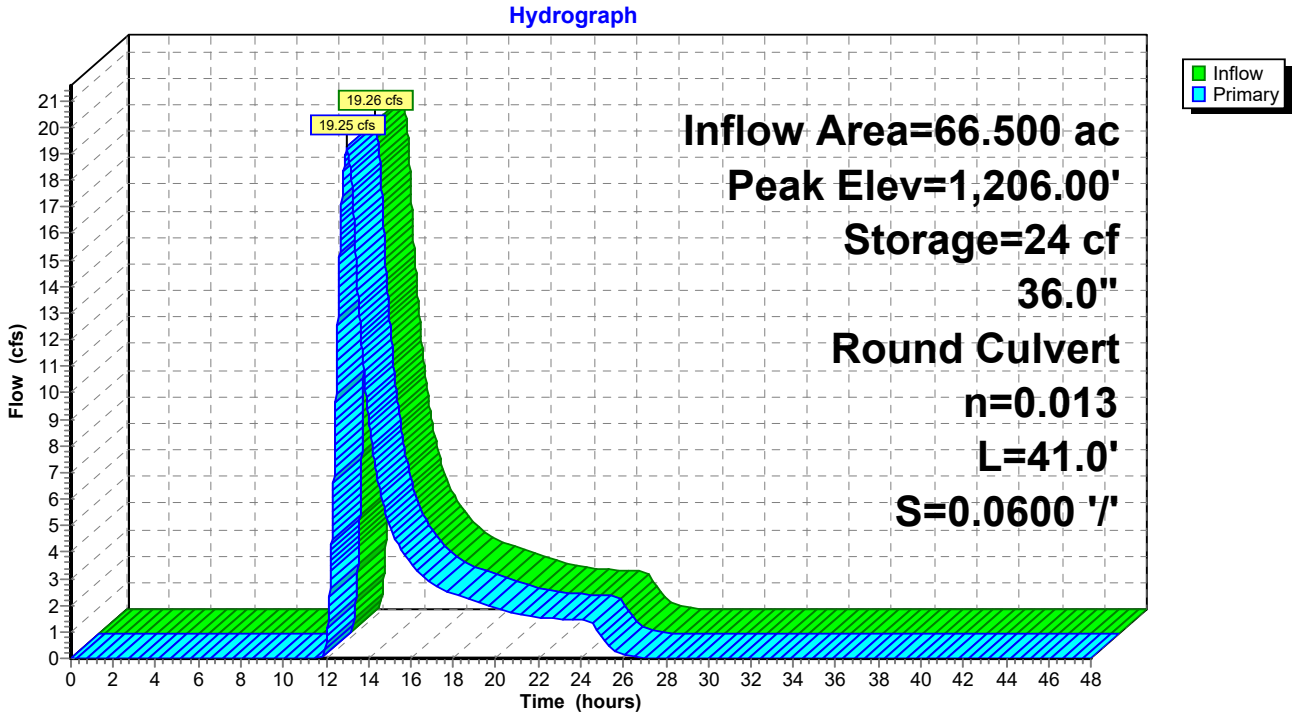
Volume	Invert	Avail.Storage	Storage Description
#1	1,205.00'	225 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,205.00	9	0	0
1,206.00	38	24	24
1,207.00	78	58	82
1,208.00	209	144	225

Device	Routing	Invert	Outlet Devices
#1	Primary	1,203.99'	**36.0" Round 36" spp** L= 41.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,203.99' / 1,201.53' S= 0.0600 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 7.07 sf

Primary OutFlow Max=19.25 cfs @ 13.00 hrs HW=1,206.00' (Free Discharge)
1=36" spp (Inlet Controls 19.25 cfs @ 3.81 fps)

Pond 17P: sta. 1069+58



Summary for Pond 18P: sta. 1069+29

Inflow Area = 3.600 ac, 0.00% Impervious, Inflow Depth = 0.95" for 10 year event
Inflow = 2.41 cfs @ 12.33 hrs, Volume= 0.285 af
Outflow = 2.41 cfs @ 12.33 hrs, Volume= 0.285 af, Atten= 0%, Lag= 0.2 min
Primary = 2.41 cfs @ 12.33 hrs, Volume= 0.285 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 1,203.27' @ 12.33 hrs Surf.Area= 58 sf Storage= 10 cf

Plug-Flow detention time= 0.0 min calculated for 0.285 af (100% of inflow)
Center-of-Mass det. time= 0.0 min (893.3 - 893.2)

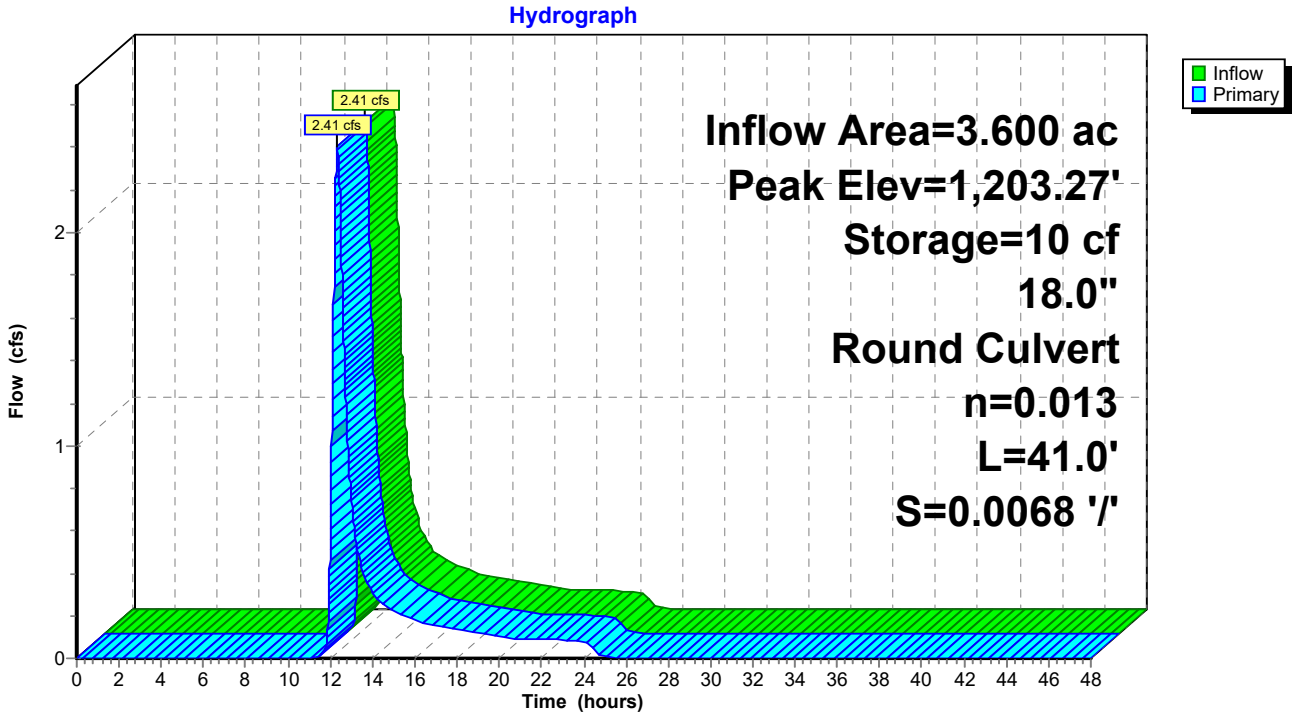
Volume	Invert	Avail.Storage	Storage Description
#1	1,203.00'	428 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,203.00	15	0	0
1,204.00	178	97	97
1,205.00	484	331	428

Device	Routing	Invert	Outlet Devices
#1	Primary	1,202.42'	**18.0" Round 18" spp** L= 41.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,202.42' / 1,202.14' S= 0.0068 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=2.40 cfs @ 12.33 hrs HW=1,203.27' (Free Discharge)
↑**1=18" spp** (Barrel Controls 2.40 cfs @ 3.38 fps)

Pond 18P: sta. 1069+29



Summary for Pond 20P: sta. 1139+10 Drive LT

[57] Hint: Peaked at 1,147.44' (Flood elevation advised)

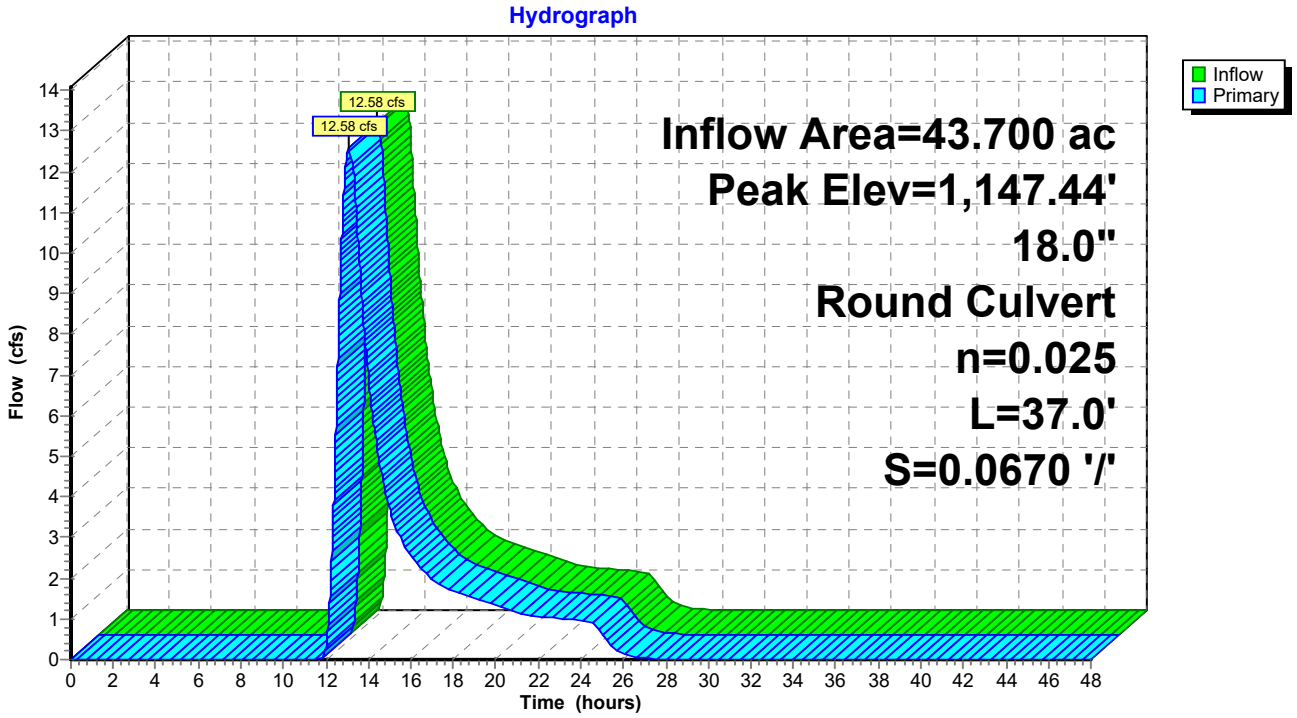
Inflow Area = 43.700 ac, 0.00% Impervious, Inflow Depth = 0.85" for 10 year event
Inflow = 12.58 cfs @ 13.09 hrs, Volume= 3.088 af
Outflow = 12.58 cfs @ 13.09 hrs, Volume= 3.088 af, Atten= 0%, Lag= 0.0 min
Primary = 12.58 cfs @ 13.09 hrs, Volume= 3.088 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 1,147.44' @ 13.09 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	1,143.18'	**18.0" Round CMP_Round 18"** L= 37.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,143.18' / 1,140.70' S= 0.0670 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 1.77 sf

Primary OutFlow Max=12.58 cfs @ 13.09 hrs HW=1,147.44' (Free Discharge)
1=CMP_Round 18" (Inlet Controls 12.58 cfs @ 7.12 fps)

Pond 20P: sta. 1139+10 Drive LT



Summary for Pond 23P: Combined

Inflow Area = 27.000 ac, 0.00% Impervious, Inflow Depth = 0.92" for 10 year event
Inflow = 8.87 cfs @ 13.06 hrs, Volume= 2.063 af
Outflow = 8.85 cfs @ 13.13 hrs, Volume= 2.063 af, Atten= 0%, Lag= 3.8 min
Primary = 8.85 cfs @ 13.13 hrs, Volume= 2.063 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 1,132.80' @ 13.13 hrs Surf.Area= 747 sf Storage= 507 cf

Plug-Flow detention time= 0.6 min calculated for 2.063 af (100% of inflow)
Center-of-Mass det. time= 0.6 min (933.6 - 933.0)

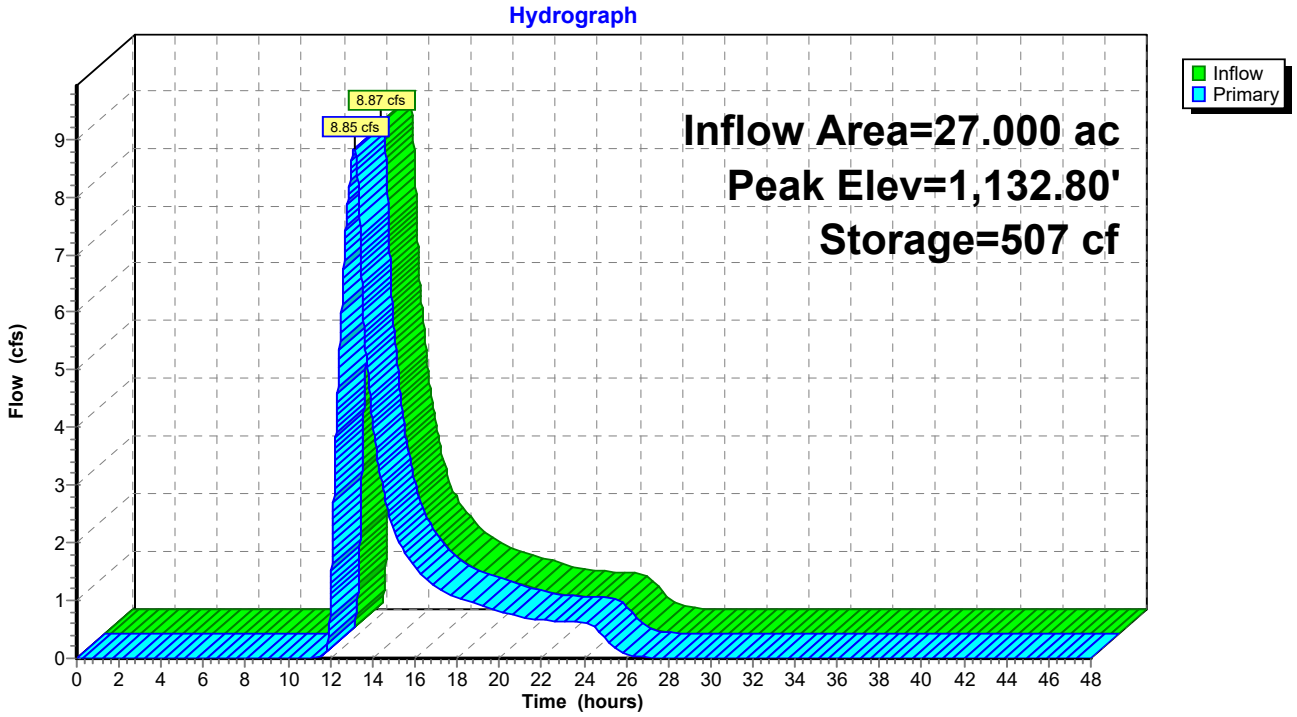
Volume	Invert	Avail.Storage	Storage Description
#1	1,131.00'	26,788 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,131.00	6	0	0
1,132.00	228	117	117
1,133.00	877	553	670
1,134.00	2,625	1,751	2,421
1,135.00	5,643	4,134	6,555
1,136.00	15,193	10,418	16,973
1,136.50	24,069	9,816	26,788

Device	Routing	Invert	Outlet Devices
#1	Primary	1,130.93'	**15.0" Round CMP_Round 15"** L= 50.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,130.93' / 1,129.16' S= 0.0354 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 1.23 sf
#2	Primary	1,131.57'	**15.0" Round CMP_Round 15"** L= 48.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,131.57' / 1,129.82' S= 0.0365 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 1.23 sf
#3	Primary	1,134.22'	**12.0" Round CMP_Round 12"** L= 40.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,134.22' / 1,133.06' S= 0.0290 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 0.79 sf

Primary OutFlow Max=8.85 cfs @ 13.13 hrs HW=1,132.80' (Free Discharge)
- **1=CMP_Round 15"** (Inlet Controls 5.21 cfs @ 4.24 fps)
- **2=CMP_Round 15"** (Inlet Controls 3.65 cfs @ 2.98 fps)
- **3=CMP_Round 12"** (Controls 0.00 cfs)

Pond 23P: Combined



Summary for Pond 25P: sta. 1020+78

[62] Hint: Exceeded Reach 24R OUTLET depth by 1.62' @ 13.16 hrs

Inflow Area = 29.600 ac, 0.00% Impervious, Inflow Depth = 0.90" for 10 year event
Inflow = 8.90 cfs @ 13.16 hrs, Volume= 2.217 af
Outflow = 8.90 cfs @ 13.16 hrs, Volume= 2.217 af, Atten= 0%, Lag= 0.0 min
Primary = 8.02 cfs @ 13.16 hrs, Volume= 2.187 af
Secondary = 0.88 cfs @ 13.16 hrs, Volume= 0.030 af

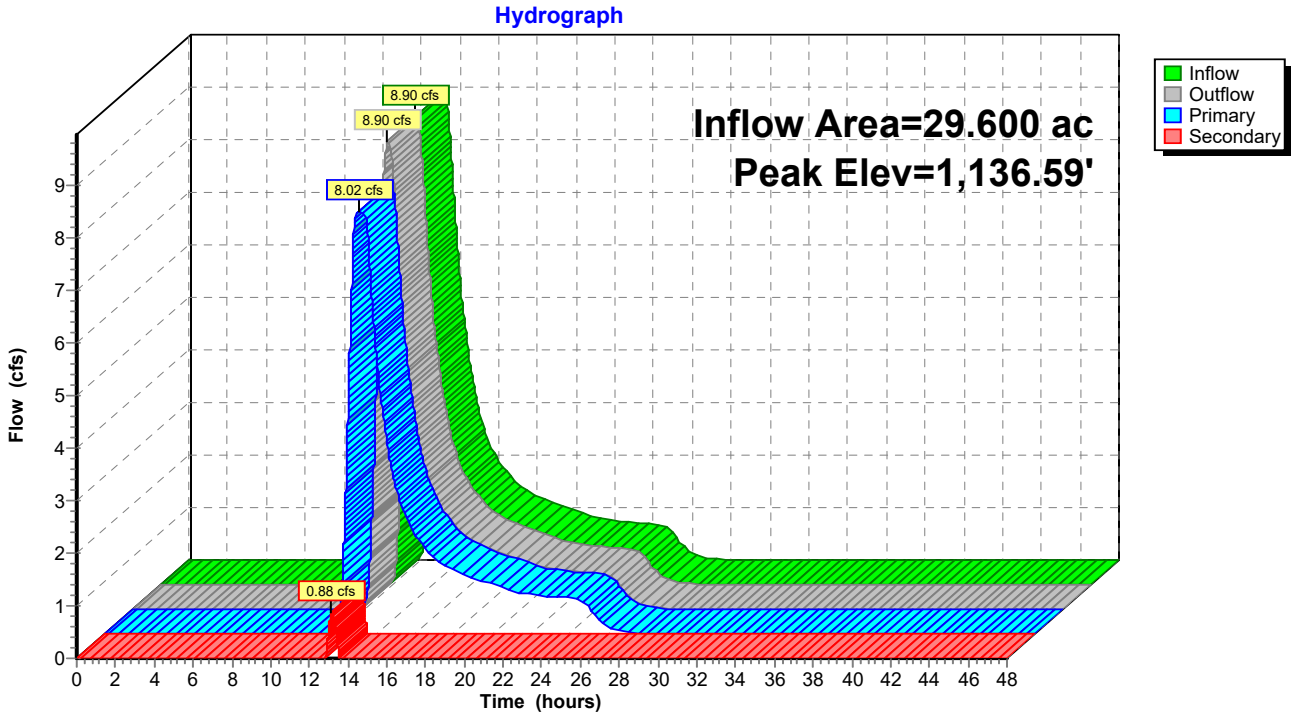
Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 1,136.59' @ 13.16 hrs
Flood Elev= 1,137.71'

Device	Routing	Invert	Outlet Devices
#1	Primary	1,134.12'	**15.0" Round RCP_Round 15"** L= 42.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 1,134.12' / 1,133.20' S= 0.0219 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 1.23 sf
#2	Secondary	1,136.50'	**10.0' long (Profile 14) Broad-Crested Rectangular Weir** Head (feet) 1.97 2.46 2.95 3.94 4.92 Coef. (English) 3.37 3.37 3.37 3.37 3.37

Primary OutFlow Max=8.02 cfs @ 13.16 hrs HW=1,136.59' (Free Discharge)
└**1=RCP_Round 15"** (Inlet Controls 8.02 cfs @ 6.54 fps)

Secondary OutFlow Max=0.87 cfs @ 13.16 hrs HW=1,136.59' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Weir Controls 0.87 cfs @ 0.99 fps)

Pond 25P: sta. 1020+78

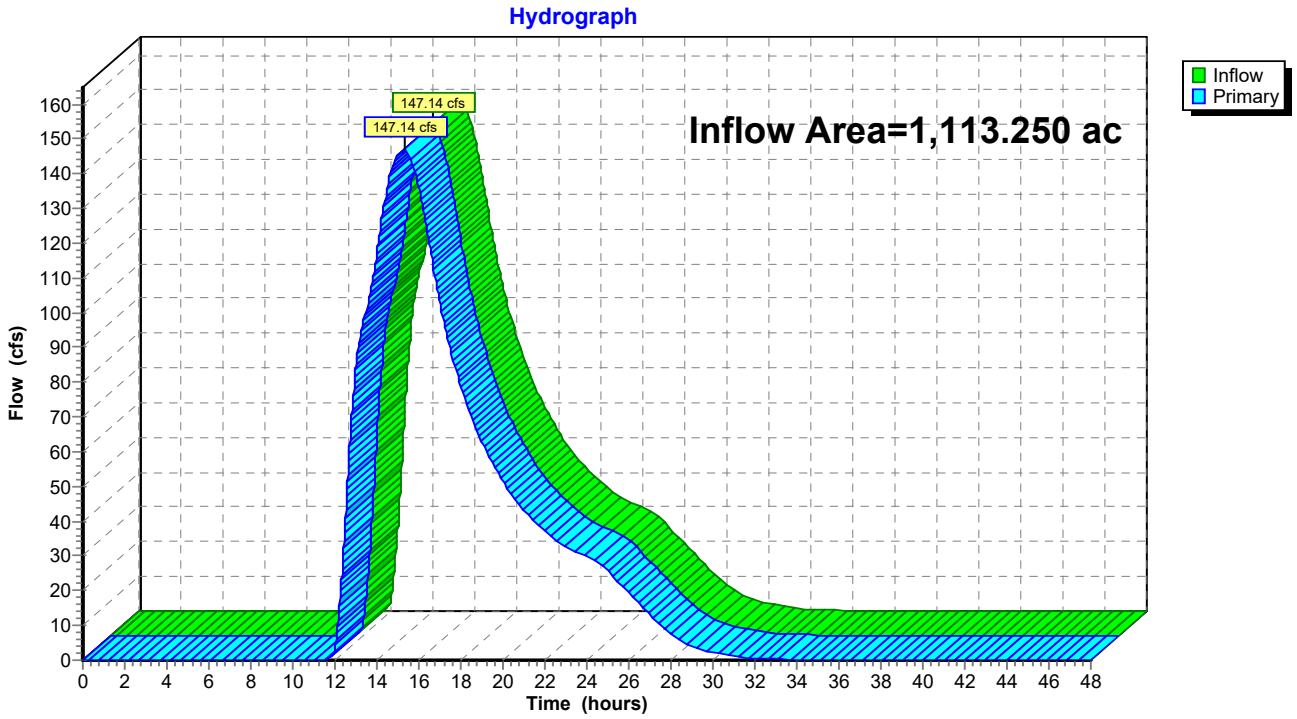


Summary for Link 26L: Androscoggin River

Inflow Area = 1,113.250 ac, 0.00% Impervious, Inflow Depth = 0.89" for 10 year event
Inflow = 147.14 cfs @ 15.33 hrs, Volume= 82.686 af
Primary = 147.14 cfs @ 15.33 hrs, Volume= 82.686 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 26L: Androscoggin River



Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment EX-10: EX-10 Runoff Area=1.000 ac 0.00% Impervious Runoff Depth=2.24"
Flow Length=370' Slope=0.0978 '/' Tc=27.0 min CN=75 Runoff=2.07 cfs 0.187 af

Subcatchment EX-11: EX-11 Runoff Area=43.000 ac 0.00% Impervious Runoff Depth=1.85"
Flow Length=4,277' Slope=0.1500 '/' Tc=89.8 min CN=70 Runoff=29.98 cfs 6.614 af

Subcatchment EX-12: EX-12 Runoff Area=43.700 ac 0.00% Impervious Runoff Depth=1.77"
Flow Length=4,226' Tc=87.9 min CN=69 Runoff=29.28 cfs 6.448 af

Subcatchment EX-18: EX-18 Runoff Area=3.600 ac 0.00% Impervious Runoff Depth=1.92"
Flow Length=792' Slope=0.1040 '/' Tc=35.0 min CN=71 Runoff=5.26 cfs 0.577 af

Subcatchment EX-19: EX-19 Runoff Area=66.500 ac 0.00% Impervious Runoff Depth=1.70"
Flow Length=3,960' Slope=0.1690 '/' Tc=79.6 min CN=68 Runoff=45.66 cfs 9.403 af

Subcatchment EX-20: EX-20 Runoff Area=0.150 ac 0.00% Impervious Runoff Depth=3.52"
Tc=5.0 min CN=89 Runoff=0.92 cfs 0.044 af

Subcatchment EX-5: EX-5 Runoff Area=884.600 ac 0.00% Impervious Runoff Depth=1.85"
Tc=242.0 min CN=70 Runoff=286.01 cfs 136.057 af

Subcatchment EX-6: EX-6 Runoff Area=15.100 ac 0.00% Impervious Runoff Depth=1.85"
Flow Length=3,062' Slope=0.0745 '/' Tc=95.9 min CN=70 Runoff=9.97 cfs 2.322 af

Subcatchment EX-7: EX-7 Runoff Area=29.600 ac 0.00% Impervious Runoff Depth=1.85"
Flow Length=3,042' Tc=93.1 min CN=70 Runoff=20.08 cfs 4.553 af

Subcatchment EX-8: EX-8 Runoff Area=2.800 ac 0.00% Impervious Runoff Depth=1.77"
Flow Length=686' Slope=0.0820 '/' Tc=36.3 min CN=69 Runoff=3.61 cfs 0.413 af

Subcatchment EX-9: EX-9 Runoff Area=23.200 ac 0.00% Impervious Runoff Depth=1.85"
Flow Length=3,230' Tc=84.3 min CN=70 Runoff=16.96 cfs 3.568 af

Reach 21R: Drive Pipe to Roadway Avg. Flow Depth=0.98' Max Vel=5.50 fps Inflow=29.28 cfs 6.448 af
n=0.050 L=90.0' S=0.0660 '/' Capacity=30.64 cfs Outflow=29.27 cfs 6.448 af

Reach 24R: roadside ditch Avg. Flow Depth=1.15' Max Vel=5.05 fps Inflow=20.08 cfs 4.553 af
n=0.035 L=406.0' S=0.0317 '/' Capacity=48.32 cfs Outflow=20.06 cfs 4.553 af

Reach 27R: roadside ditch Avg. Flow Depth=1.75' Max Vel=1.18 fps Inflow=9.15 cfs 1.045 af
n=0.100 L=538.0' S=0.0084 '/' Capacity=12.91 cfs Outflow=9.07 cfs 1.045 af

Pond 3P: sta. 1010+24 Peak Elev=1,143.36' Storage=17,553 cf Inflow=286.01 cfs 136.299 af
60.0" Round Culvert n=0.025 L=80.0' S=0.0088 '/' Outflow=295.45 cfs 137.776 af

Pond 4P: sta. 1013+23 Peak Elev=1,142.83' Storage=183 cf Inflow=9.97 cfs 2.322 af
Primary=6.38 cfs 2.081 af Secondary=3.59 cfs 0.241 af Outflow=9.97 cfs 2.322 af

Pond 9P: sta. 1032+51 Peak Elev=1,135.85' Storage=1,652 cf Inflow=37.57 cfs 7.659 af
Outflow=37.38 cfs 7.659 af

Pond 10P: sta. 1040+00 Peak Elev=1,139.23' Storage=16,455 cf Inflow=29.27 cfs 6.448 af
Primary=16.40 cfs 5.403 af Secondary=9.15 cfs 1.045 af Outflow=25.55 cfs 6.448 af

Pond 16P: sta. 1069+69 Peak Elev=1,200.45' Storage=87 cf Inflow=47.49 cfs 10.028 af
36.0" Round Culvert n=0.025 L=63.0' S=0.0400 '/' Outflow=47.48 cfs 10.028 af

Pond 17P: sta. 1069+58 Peak Elev=1,208.39' Storage=225 cf Inflow=45.66 cfs 9.403 af
36.0" Round Culvert n=0.013 L=41.0' S=0.0600 '/' Outflow=45.78 cfs 9.407 af

Pond 18P: sta. 1069+29 Peak Elev=1,203.81' Storage=65 cf Inflow=5.26 cfs 0.577 af
18.0" Round Culvert n=0.013 L=41.0' S=0.0068 '/' Outflow=5.25 cfs 0.577 af

Pond 20P: sta. 1139+10 Drive LT Peak Elev=1,162.93' Inflow=29.28 cfs 6.448 af
18.0" Round Culvert n=0.025 L=37.0' S=0.0670 '/' Outflow=29.28 cfs 6.448 af

Pond 23P: Combined Peak Elev=1,136.30' Storage=22,281 cf Inflow=29.24 cfs 5.162 af
Outflow=22.44 cfs 5.162 af

Pond 25P: sta. 1020+78 Peak Elev=1,136.98' Inflow=20.06 cfs 4.553 af
Primary=8.83 cfs 3.559 af Secondary=11.22 cfs 0.993 af Outflow=20.06 cfs 4.553 af

Link 26L: AndroscogginRiver Inflow=329.18 cfs 171.668 af
Primary=329.18 cfs 171.668 af

Total Runoff Area = 1,113.250 ac Runoff Volume = 170.186 af Average Runoff Depth = 1.83"
100.00% Pervious = 1,113.250 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment EX-10: EX-10

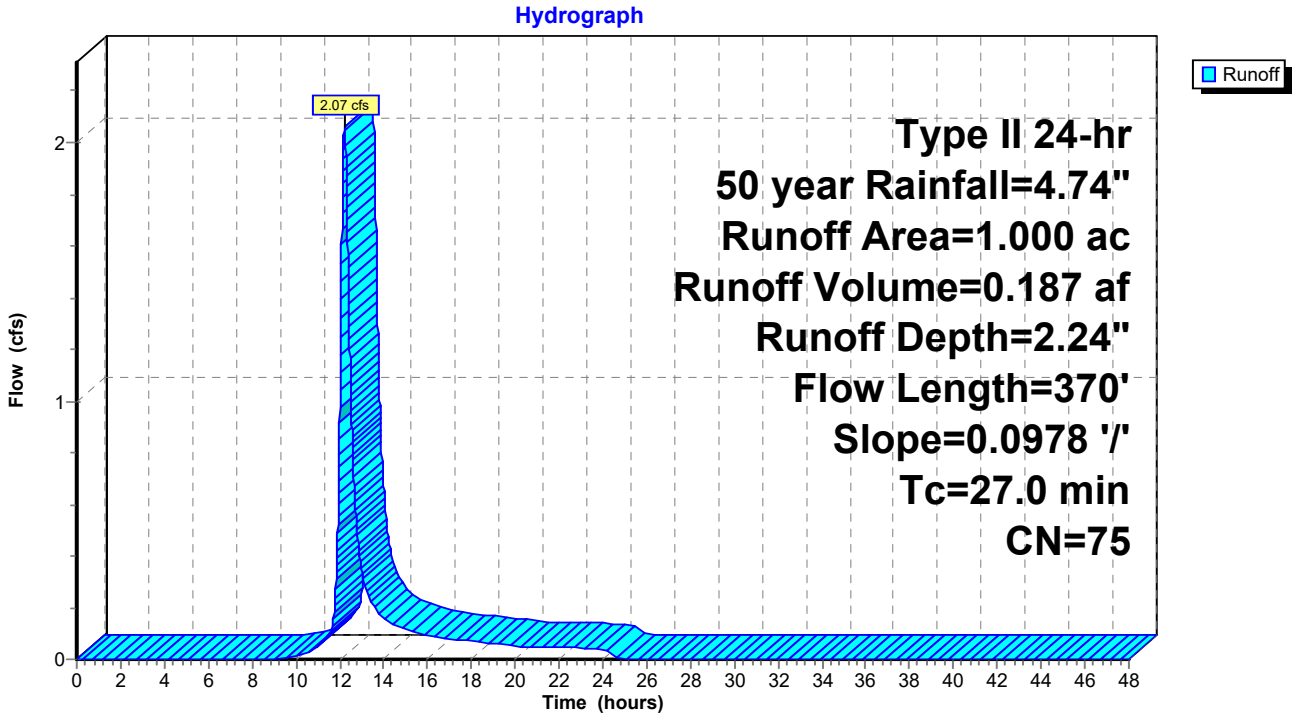
Runoff = 2.07 cfs @ 12.21 hrs, Volume= 0.187 af, Depth= 2.24"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 50 year Rainfall=4.74"

	Area (ac)	CN	Description
*	1.000	75	SEE ATTACHED SPREADSHEET FOR CN VALUES
	1.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.2	100	0.0978	0.08		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.80"
5.8	270	0.0978	0.78		**Shallow Concentrated Flow,** Forest w/Heavy Litter Kv= 2.5 fps
27.0	370	Total			

Subcatchment EX-10: EX-10



Summary for Subcatchment EX-11: EX-11

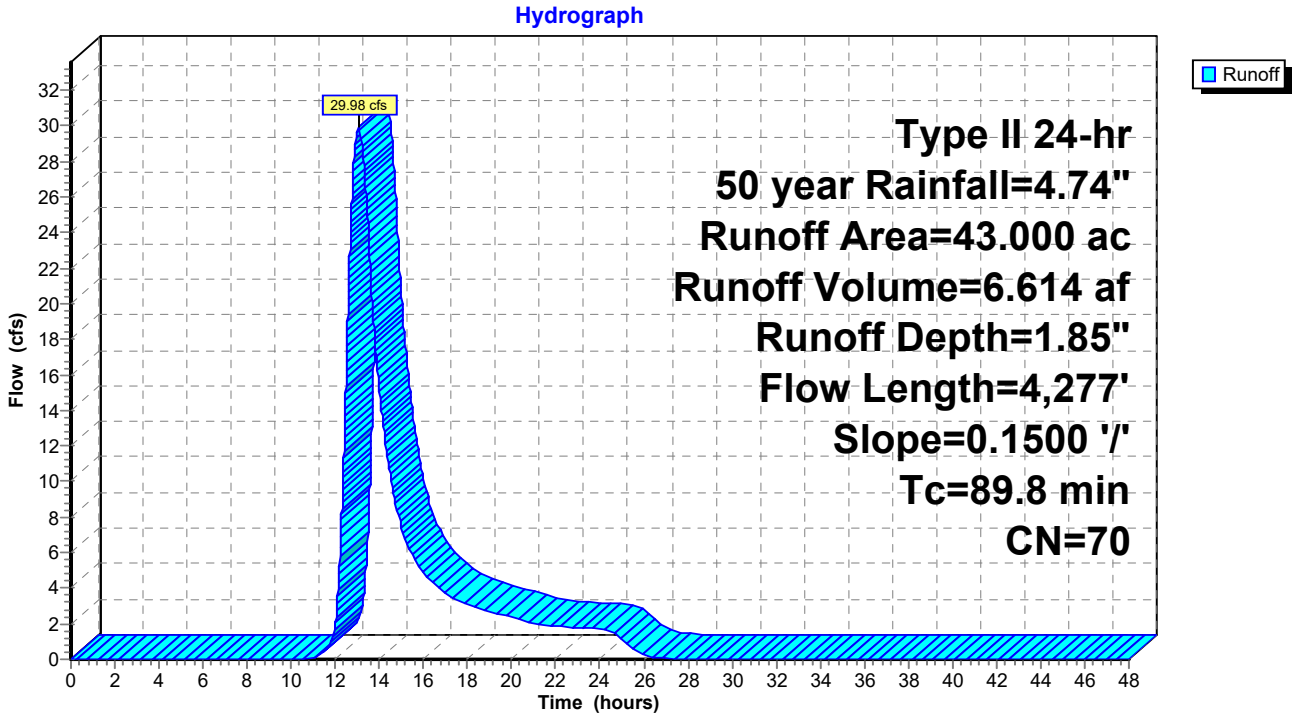
Runoff = 29.98 cfs @ 13.07 hrs, Volume= 6.614 af, Depth= 1.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 50 year Rainfall=4.74"

	Area (ac)	CN	Description
*	43.000	70	SEE ATTACHED SPREADSHEET FOR CN VALUES
	43.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.9	100	0.1500	0.09		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.80"
71.9	4,177	0.1500	0.97		**Shallow Concentrated Flow,** Forest w/Heavy Litter Kv= 2.5 fps
89.8	4,277	Total			

Subcatchment EX-11: EX-11



Summary for Subcatchment EX-12: EX-12

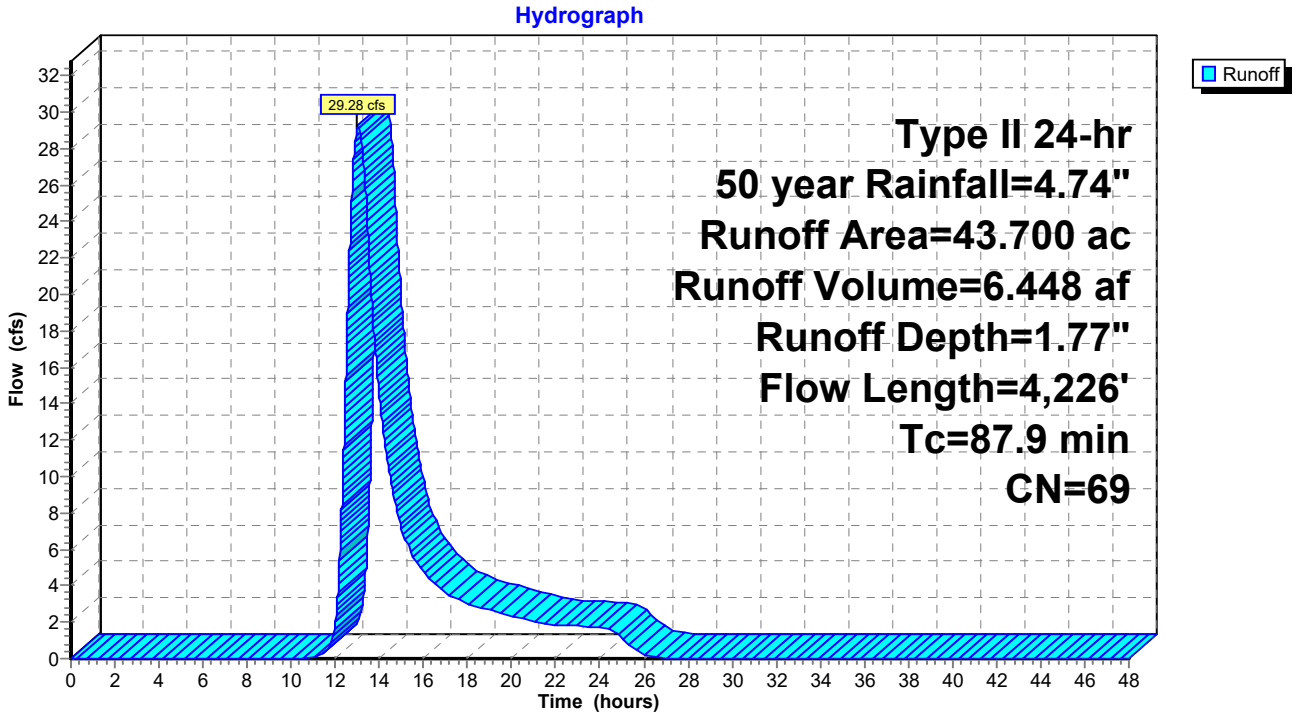
Runoff = 29.28 cfs @ 12.99 hrs, Volume= 6.448 af, Depth= 1.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 50 year Rainfall=4.74"

	Area (ac)	CN	Description
*	43.700	69	SEE ATTACHED SPREADSHEET FOR CN VALUES
	43.700		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.2	100	0.1100	0.08		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.80"
66.2	3,971	0.1600	1.00		**Shallow Concentrated Flow,** Forest w/Heavy Litter Kv= 2.5 fps
1.5	155	0.0700	1.74	0.16	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=0.25' Z= 1.5 '/' Top.W=0.75' n= 0.050 Mountain streams w/large boulders
87.9	4,226	Total			

Subcatchment EX-12: EX-12



Summary for Subcatchment EX-18: EX-18

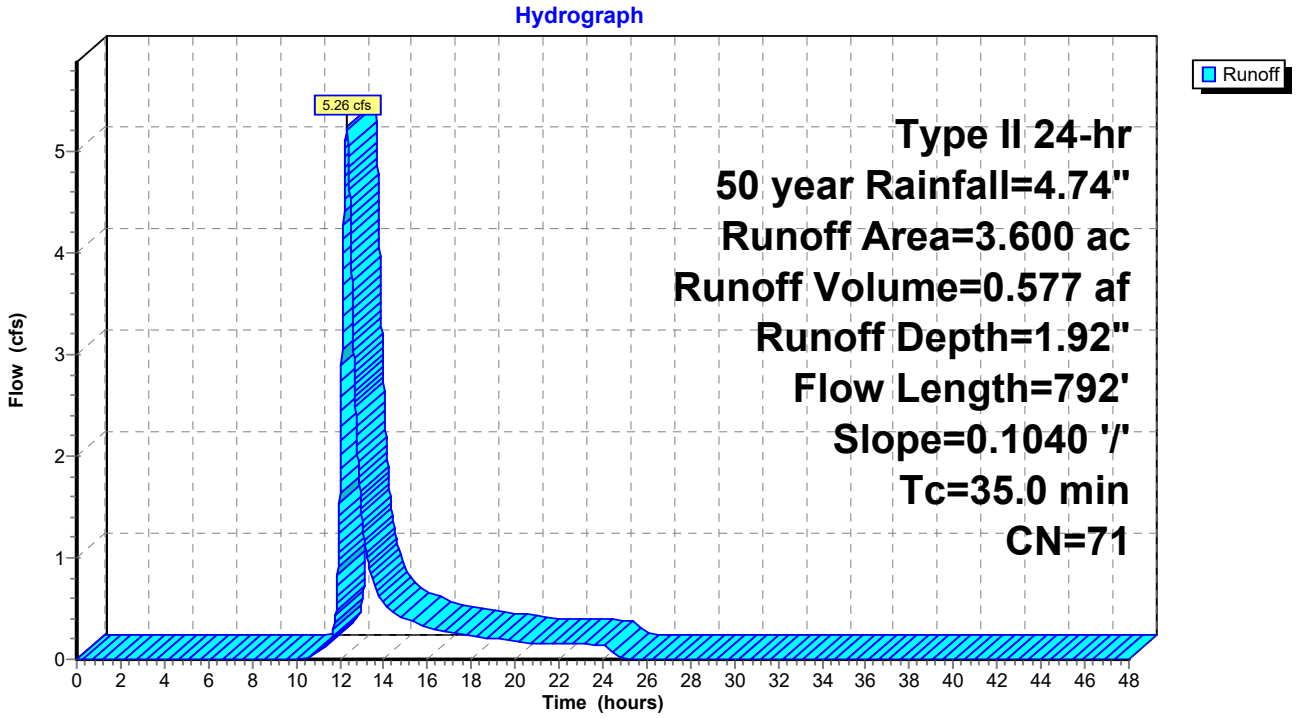
Runoff = 5.26 cfs @ 12.33 hrs, Volume= 0.577 af, Depth= 1.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 50 year Rainfall=4.74"

	Area (ac)	CN	Description
*	3.600	71	SEE ATTACHED SPREADSHEET FOR CN VALUES
	3.600		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.7	100	0.1040	0.08		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.80"
14.3	692	0.1040	0.81		**Shallow Concentrated Flow,** Forest w/Heavy Litter Kv= 2.5 fps
35.0	792	Total			

Subcatchment EX-18: EX-18



Summary for Subcatchment EX-19: EX-19

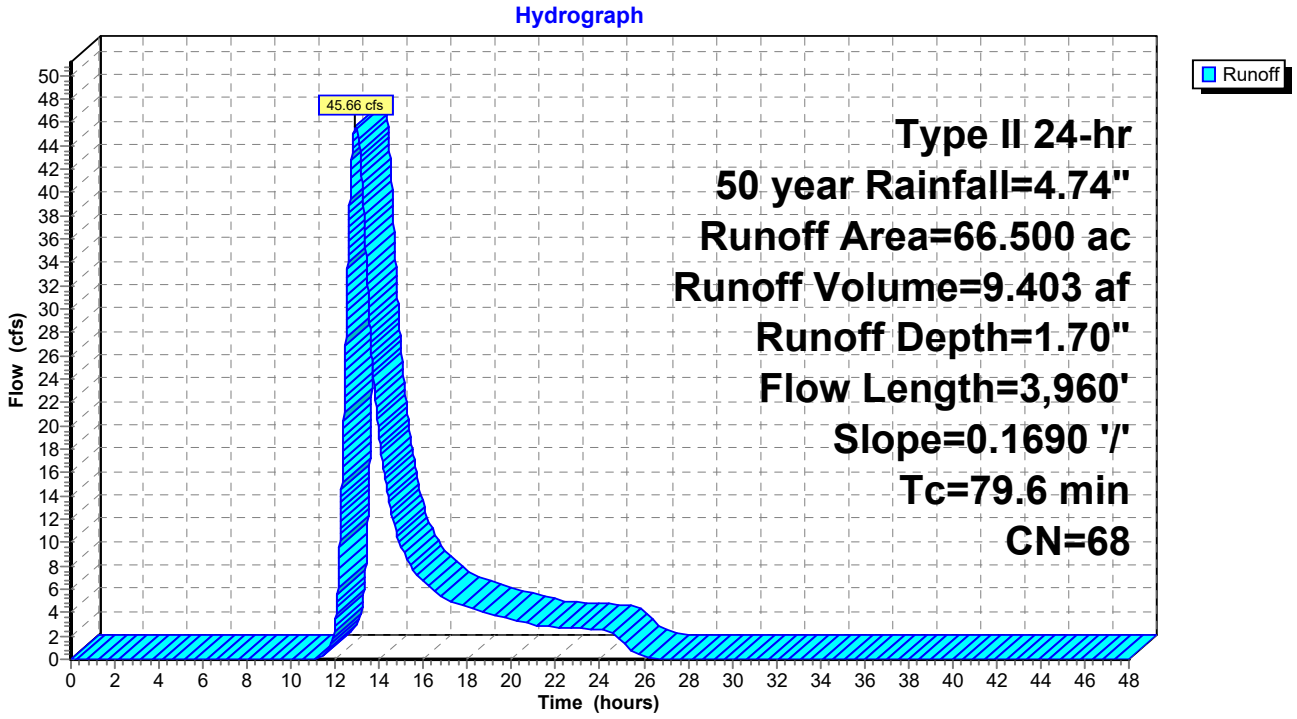
Runoff = 45.66 cfs @ 12.92 hrs, Volume= 9.403 af, Depth= 1.70"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 50 year Rainfall=4.74"

	Area (ac)	CN	Description
*	66.500	68	SEE ATTACHED SPREADSHEET FOR CN VALUES
	66.500		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.0	100	0.1690	0.10		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.80"
62.6	3,860	0.1690	1.03		**Shallow Concentrated Flow,** Forest w/Heavy Litter Kv= 2.5 fps
79.6	3,960	Total			

Subcatchment EX-19: EX-19



Summary for Subcatchment EX-20: EX-20

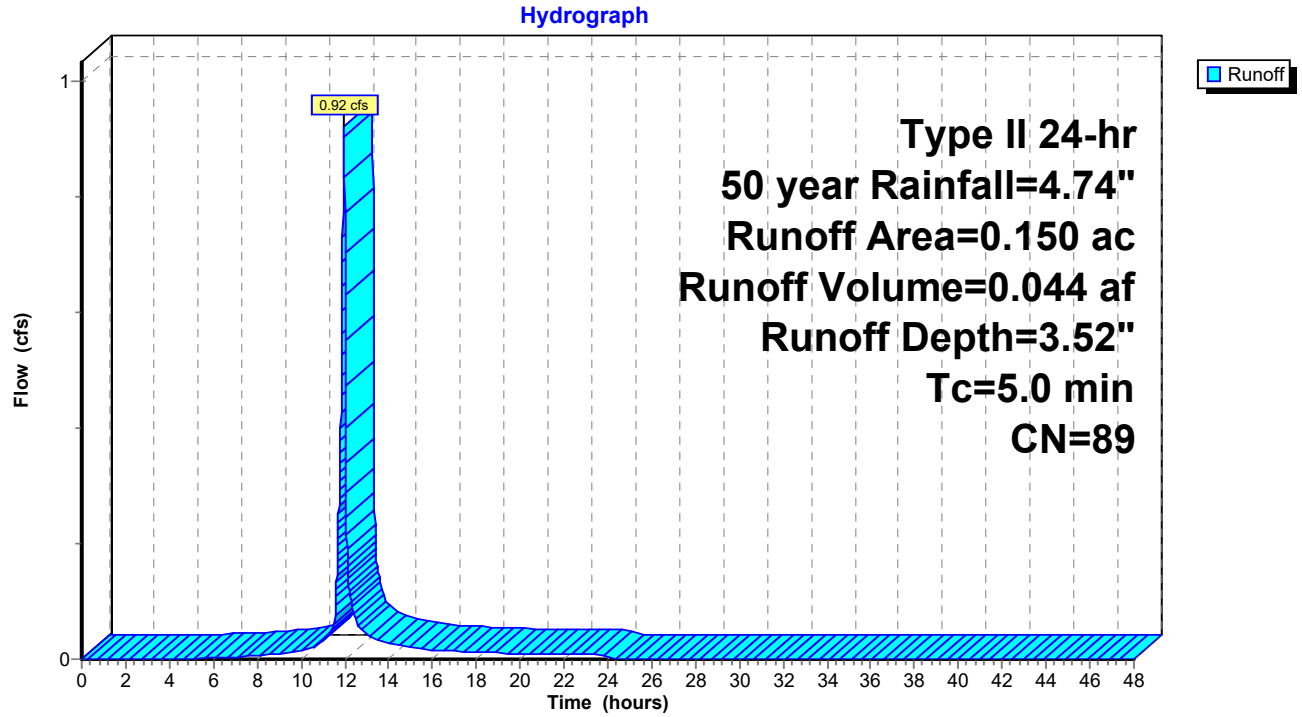
Runoff = 0.92 cfs @ 11.96 hrs, Volume= 0.044 af, Depth= 3.52"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 50 year Rainfall=4.74"

Area (ac)	CN	Description
0.150	89	Gravel roads, HSG C
0.150		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment EX-20: EX-20



Summary for Subcatchment EX-5: EX-5

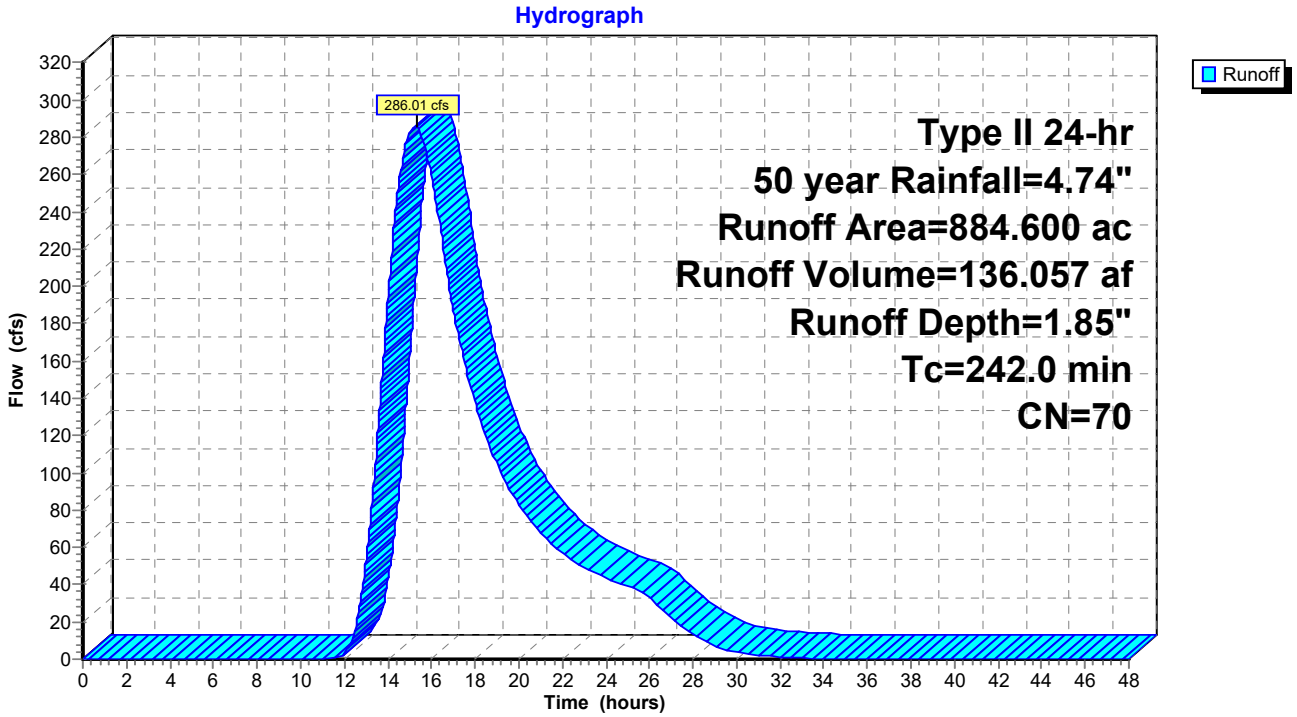
Runoff = 286.01 cfs @ 15.32 hrs, Volume= 136.057 af, Depth= 1.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 50 year Rainfall=4.74"

	Area (ac)	CN	Description
*	884.600	70	SEE ATTACHED SPREADSHEET FOR CN VALUES
	884.600		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
242.0					**Direct Entry,**

Subcatchment EX-5: EX-5



Summary for Subcatchment EX-6: EX-6

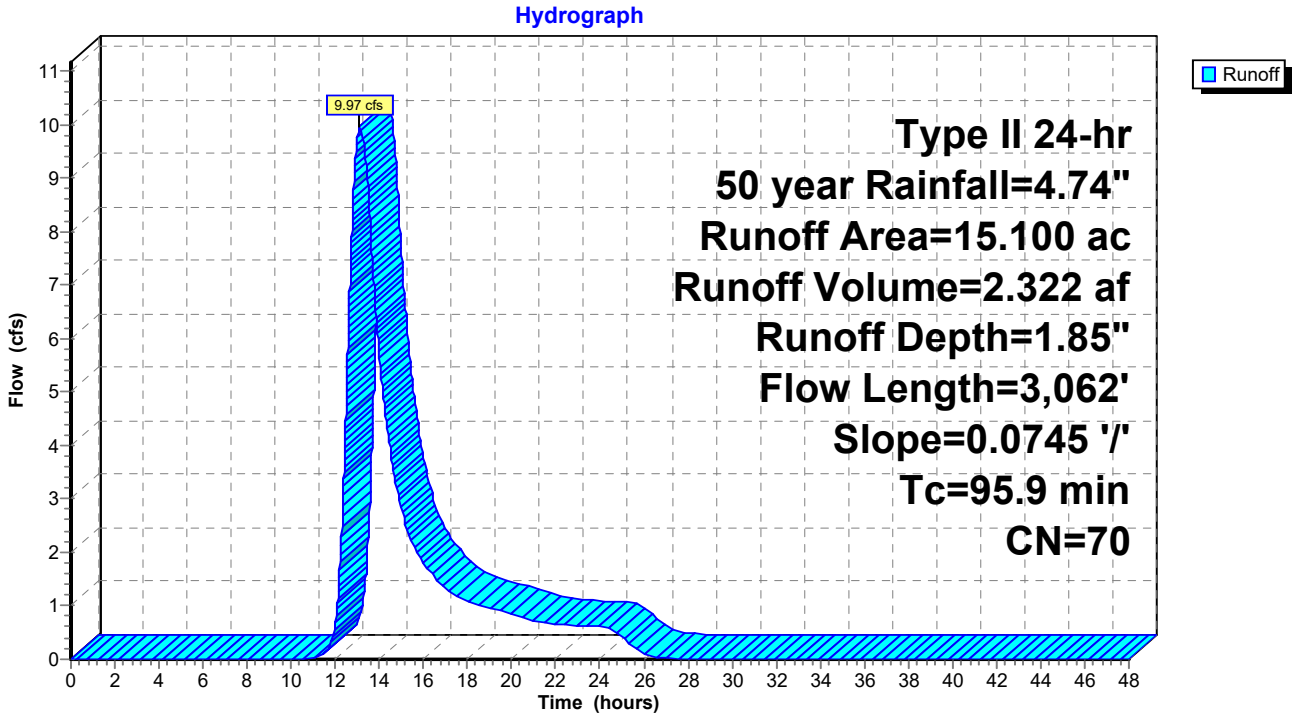
Runoff = 9.97 cfs @ 13.11 hrs, Volume= 2.322 af, Depth= 1.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 50 year Rainfall=4.74"

	Area (ac)	CN	Description
*	15.100	70	SEE ATTACHED SPREADSHEET FOR CN VALUES
	15.100		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
23.6	100	0.0745	0.07		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.80"
72.3	2,962	0.0745	0.68		**Shallow Concentrated Flow,** Forest w/Heavy Litter Kv= 2.5 fps
95.9	3,062	Total			

Subcatchment EX-6: EX-6



Summary for Subcatchment EX-7: EX-7

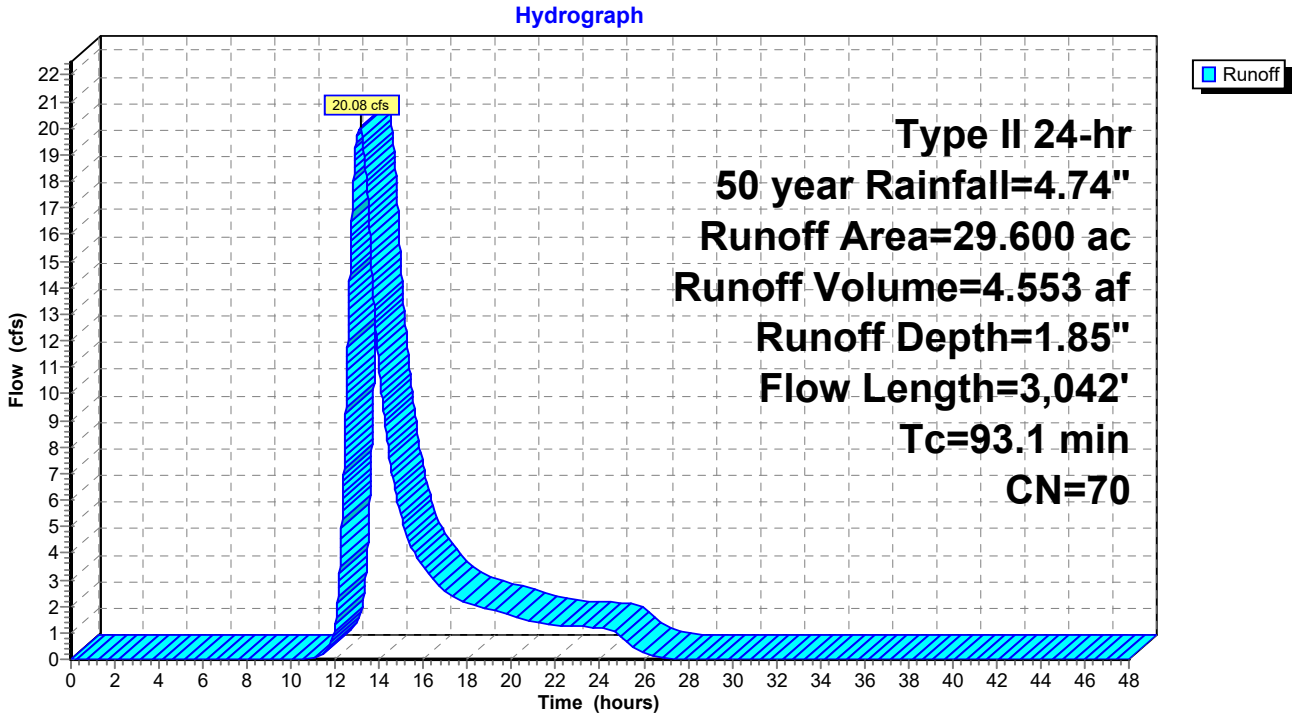
Runoff = 20.08 cfs @ 13.13 hrs, Volume= 4.553 af, Depth= 1.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 50 year Rainfall=4.74"

	Area (ac)	CN	Description
*	29.600	70	See Notes
	29.600		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
24.2	100	0.0700	0.07		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.80"
68.9	2,942	0.0810	0.71		**Shallow Concentrated Flow,** Forest w/Heavy Litter Kv= 2.5 fps
93.1	3,042	Total			

Subcatchment EX-7: EX-7



Summary for Subcatchment EX-8: EX-8

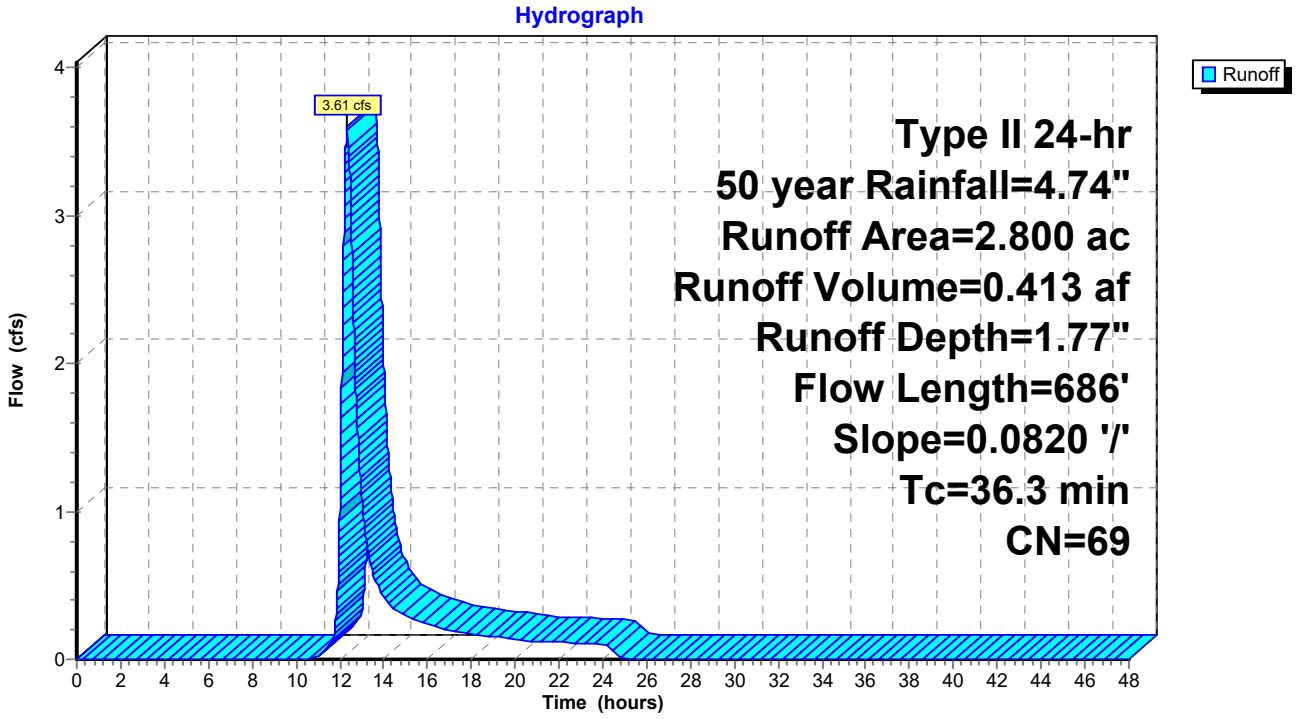
Runoff = 3.61 cfs @ 12.34 hrs, Volume= 0.413 af, Depth= 1.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 50 year Rainfall=4.74"

	Area (ac)	CN	Description
*	2.800	69	SEE ATTACHED SPREADSHEET FOR CN VALUES
	2.800		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.7	100	0.0820	0.07		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.80"
13.6	586	0.0820	0.72		**Shallow Concentrated Flow,** Forest w/Heavy Litter Kv= 2.5 fps
36.3	686	Total			

Subcatchment EX-8: EX-8



Summary for Subcatchment EX-9: EX-9

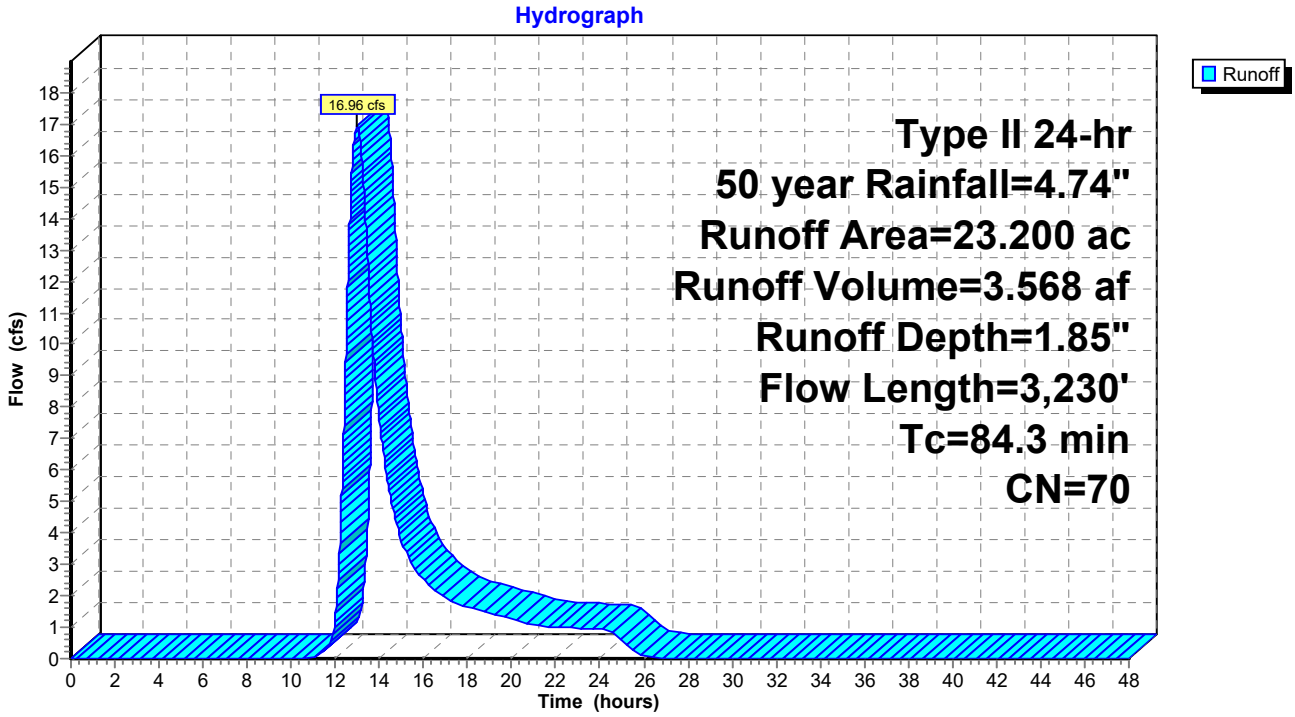
Runoff = 16.96 cfs @ 13.02 hrs, Volume= 3.568 af, Depth= 1.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 50 year Rainfall=4.74"

	Area (ac)	CN	Description
*	23.200	70	SEE ATTACHED SPREADSHEET FOR CN VALUES
	23.200		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.0	100	0.1000	0.08		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.80"
62.6	2,970	0.1000	0.79		**Shallow Concentrated Flow,** Forest w/Heavy Litter Kv= 2.5 fps
0.7	160	0.0480	3.56	2.67	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=0.50' Z= 3.0 '/' Top.W=3.00' n= 0.035 Earth, dense weeds
84.3	3,230	Total			

Subcatchment EX-9: EX-9



Summary for Reach 21R: Drive Pipe to Roadway Culvert

[79] Warning: Submerged Pond 20P Primary device # 1 OUTLET by 0.98'

Inflow Area = 43.700 ac, 0.00% Impervious, Inflow Depth = 1.77" for 50 year event
Inflow = 29.28 cfs @ 12.99 hrs, Volume= 6.448 af
Outflow = 29.27 cfs @ 13.00 hrs, Volume= 6.448 af, Atten= 0%, Lag= 0.4 min

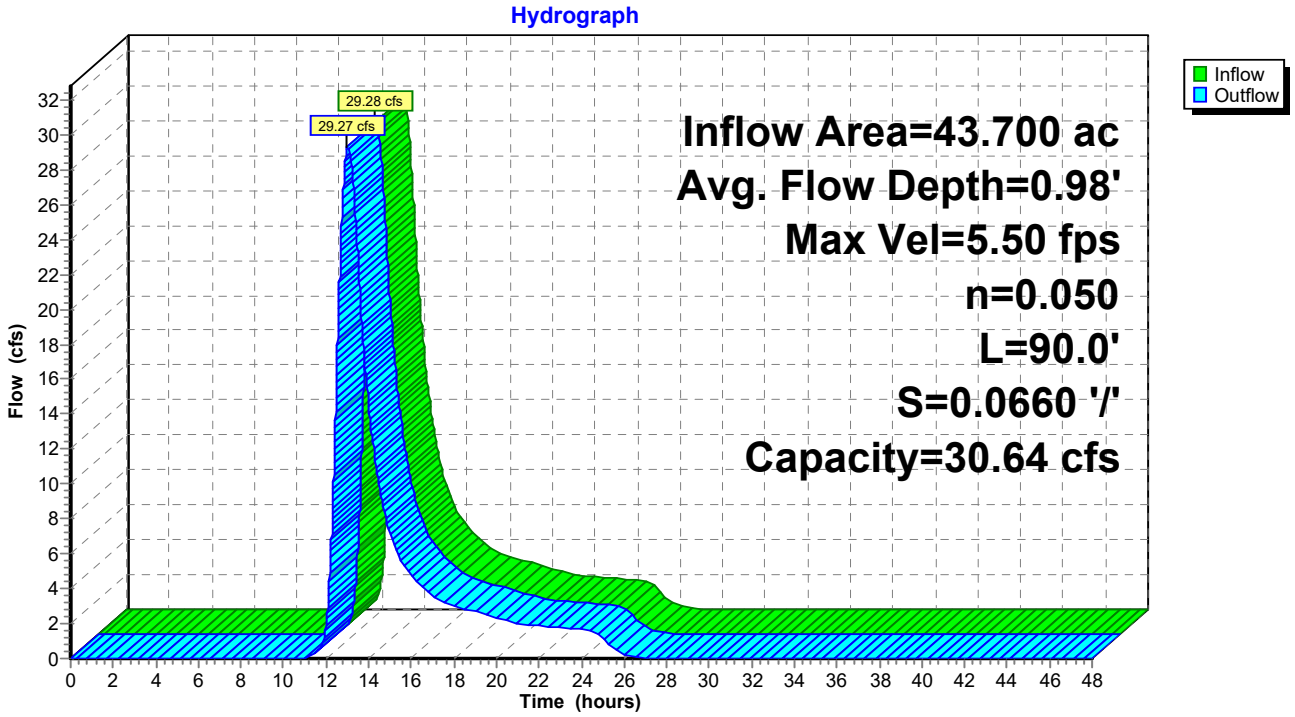
Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 5.50 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 2.50 fps, Avg. Travel Time= 0.6 min

Peak Storage= 479 cf @ 13.00 hrs
Average Depth at Peak Storage= 0.98'
Bank-Full Depth= 1.00' Flow Area= 5.5 sf, Capacity= 30.64 cfs

2.50' x 1.00' deep channel, n= 0.050 Mountain streams w/large boulders
Side Slope Z-value= 3.0 '/' Top Width= 8.50'
Length= 90.0' Slope= 0.0660 '/'
Inlet Invert= 1,140.70', Outlet Invert= 1,134.76'

‡

Reach 21R: Drive Pipe to Roadway Culvert



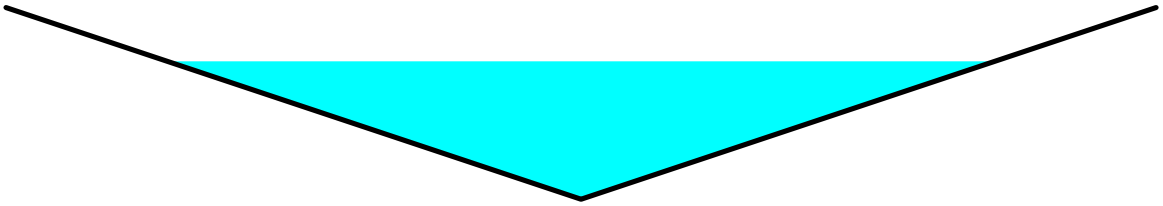
Summary for Reach 24R: roadside ditch

Inflow Area = 29.600 ac, 0.00% Impervious, Inflow Depth = 1.85" for 50 year event
Inflow = 20.08 cfs @ 13.13 hrs, Volume= 4.553 af
Outflow = 20.06 cfs @ 13.14 hrs, Volume= 4.553 af, Atten= 0%, Lag= 0.5 min

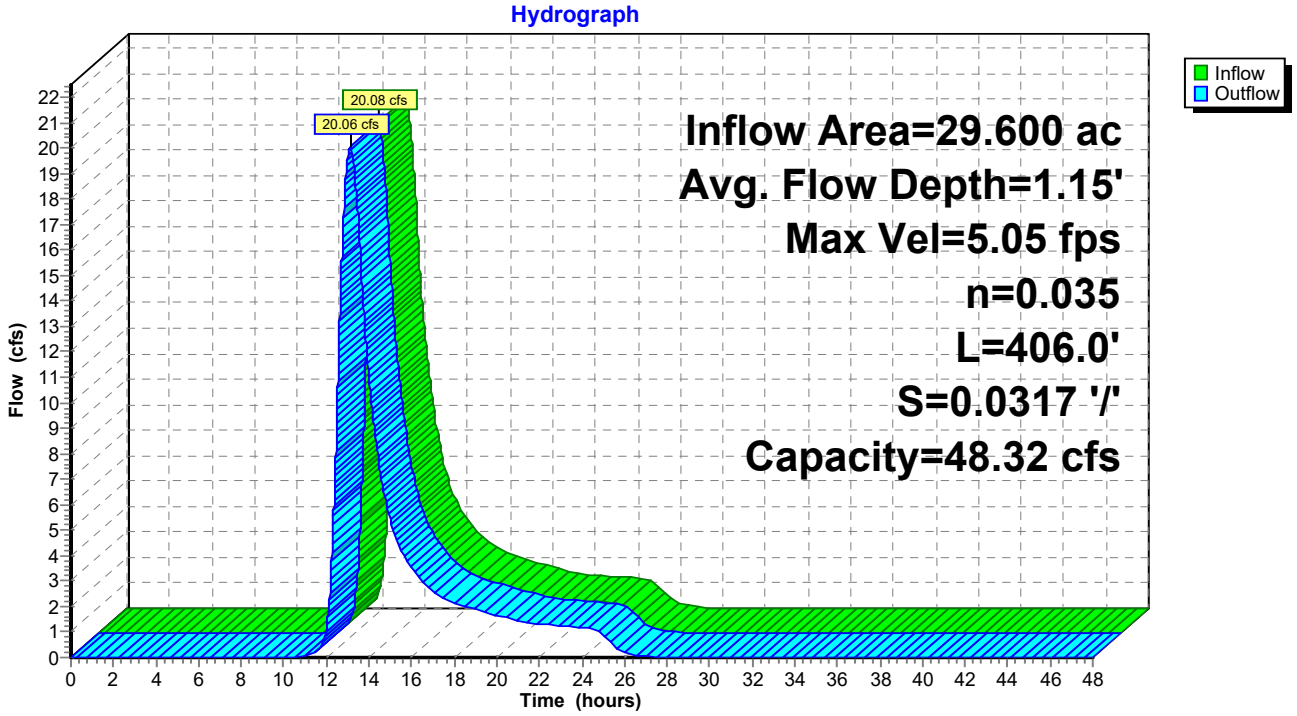
Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 5.05 fps, Min. Travel Time= 1.3 min
Avg. Velocity = 2.41 fps, Avg. Travel Time= 2.8 min

Peak Storage= 1,612 cf @ 13.14 hrs
Average Depth at Peak Storage= 1.15'
Bank-Full Depth= 1.60' Flow Area= 7.7 sf, Capacity= 48.32 cfs

0.00' x 1.60' deep channel, n= 0.035 Earth, dense weeds
Side Slope Z-value= 3.0 '/' Top Width= 9.60'
Length= 406.0' Slope= 0.0317 '/'
Inlet Invert= 1,147.00', Outlet Invert= 1,134.12'



Reach 24R: roadside ditch



Summary for Reach 27R: roadside ditch

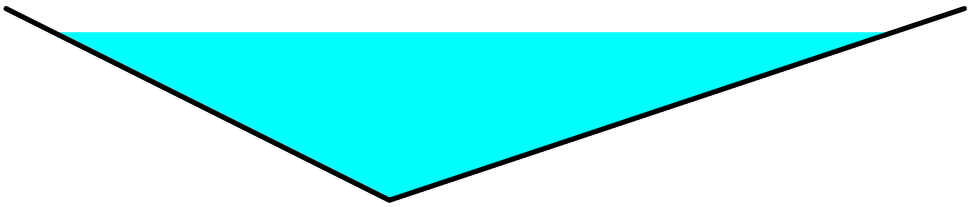
[81] Warning: Exceeded Pond 10P by 2.50' @ 28.75 hrs

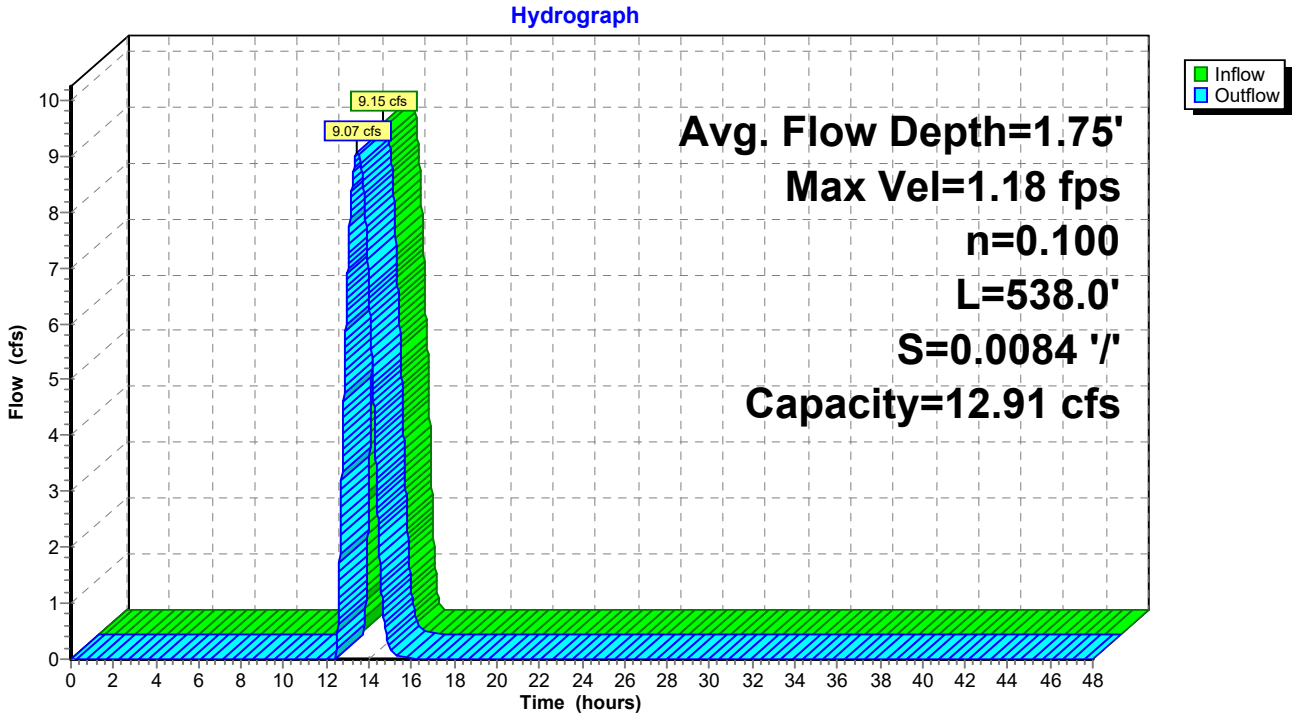
Inflow = 9.15 cfs @ 13.38 hrs, Volume= 1.045 af
Outflow = 9.07 cfs @ 13.47 hrs, Volume= 1.045 af, Atten= 1%, Lag= 5.7 min

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 1.18 fps, Min. Travel Time= 7.6 min
Avg. Velocity = 0.25 fps, Avg. Travel Time= 35.8 min

Peak Storage= 4,128 cf @ 13.47 hrs
Average Depth at Peak Storage= 1.75'
Bank-Full Depth= 2.00' Flow Area= 10.0 sf, Capacity= 12.91 cfs

0.00' x 2.00' deep channel, n= 0.100 Earth, dense brush, high stage
Side Slope Z-value= 2.0 3.0 '/' Top Width= 10.00'
Length= 538.0' Slope= 0.0084 '/'
Inlet Invert= 1,137.50', Outlet Invert= 1,133.00'





Summary for Pond 3P: sta. 1010+24

[93] Warning: Storage range exceeded by 3.36'
[88] Warning: Qout>Qin may require smaller dt or Finer Routing
[81] Warning: Exceeded Pond 4P by 2.35' @ 15.32 hrs

Inflow Area = 884.600 ac, 0.00% Impervious, Inflow Depth = 1.85" for 50 year event
Inflow = 286.01 cfs @ 15.32 hrs, Volume= 136.299 af
Outflow = 295.45 cfs @ 15.32 hrs, Volume= 137.776 af, Atten= 0%, Lag= 0.0 min
Primary = 295.45 cfs @ 15.32 hrs, Volume= 137.776 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 1,143.36' @ 15.32 hrs Surf.Area= 8,312 sf Storage= 17,553 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= (not calculated: outflow precedes inflow)

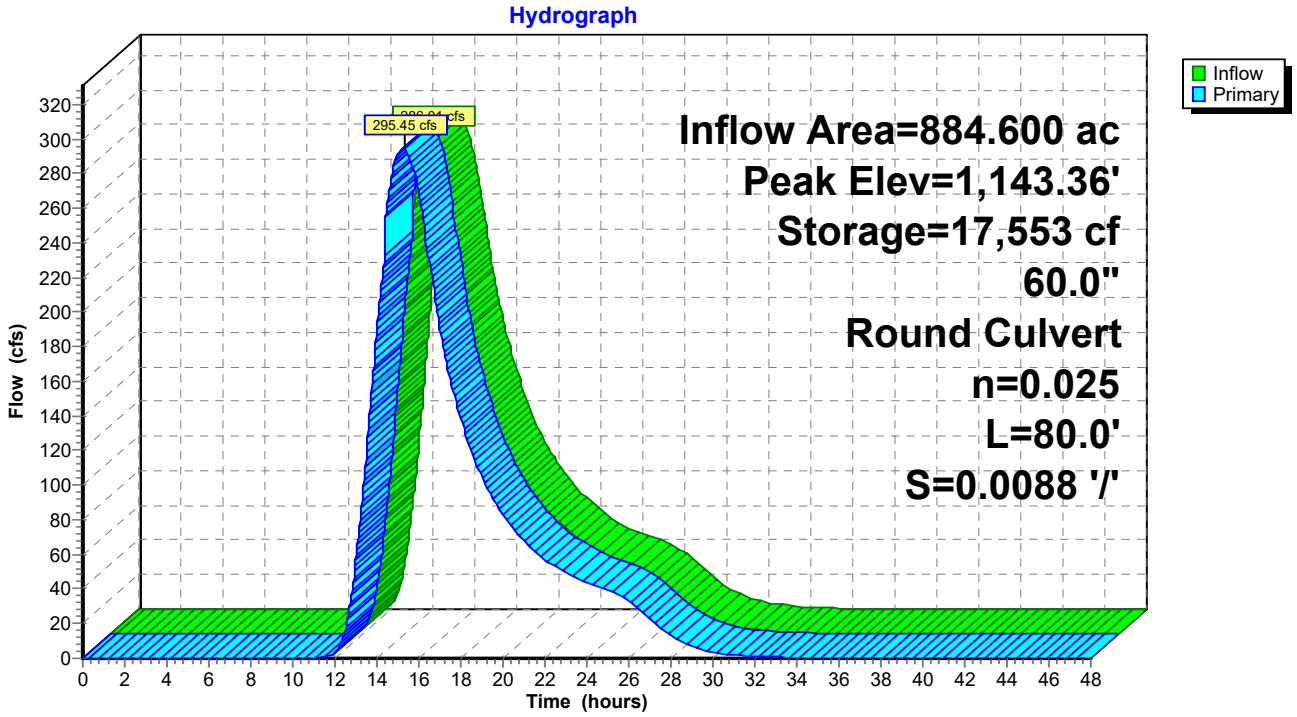
Volume	Invert	Avail.Storage	Storage Description
#1	1,131.00'	17,553 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,131.00	187	0	0
1,132.00	239	213	213
1,133.00	269	254	467
1,134.00	296	283	750
1,135.00	426	361	1,111
1,136.00	764	595	1,706
1,137.00	1,791	1,278	2,983
1,138.00	3,675	2,733	5,716
1,139.00	5,843	4,759	10,475
1,140.00	8,312	7,078	17,553

Device	Routing	Invert	Outlet Devices
#1	Primary	1,129.96'	**60.0" Round CMP_Round 60"** L= 80.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 1,129.96' / 1,129.26' S= 0.0088 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 19.63 sf

Primary OutFlow Max=295.44 cfs @ 15.32 hrs HW=1,143.36' (Free Discharge)
1=CMP_Round 60" (Barrel Controls 295.44 cfs @ 15.05 fps)

Pond 3P: sta. 1010+24



Summary for Pond 4P: sta. 1013+23

Secondary flow to EX-5 60" cmp which was analyzed separately using USGS Regression and FHWA Hy8.

[93] Warning: Storage range exceeded by 0.33'

Inflow Area = 15.100 ac, 0.00% Impervious, Inflow Depth = 1.85" for 50 year event
Inflow = 9.97 cfs @ 13.11 hrs, Volume= 2.322 af
Outflow = 9.97 cfs @ 13.11 hrs, Volume= 2.322 af, Atten= 0%, Lag= 0.0 min
Primary = 6.38 cfs @ 13.11 hrs, Volume= 2.081 af
Secondary = 3.59 cfs @ 13.11 hrs, Volume= 0.241 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 1,142.83' @ 13.11 hrs Surf.Area= 272 sf Storage= 183 cf

Plug-Flow detention time= 0.3 min calculated for 2.322 af (100% of inflow)
Center-of-Mass det. time= 0.2 min (930.6 - 930.4)

Volume	Invert	Avail.Storage	Storage Description
#1	1,141.00'	183 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

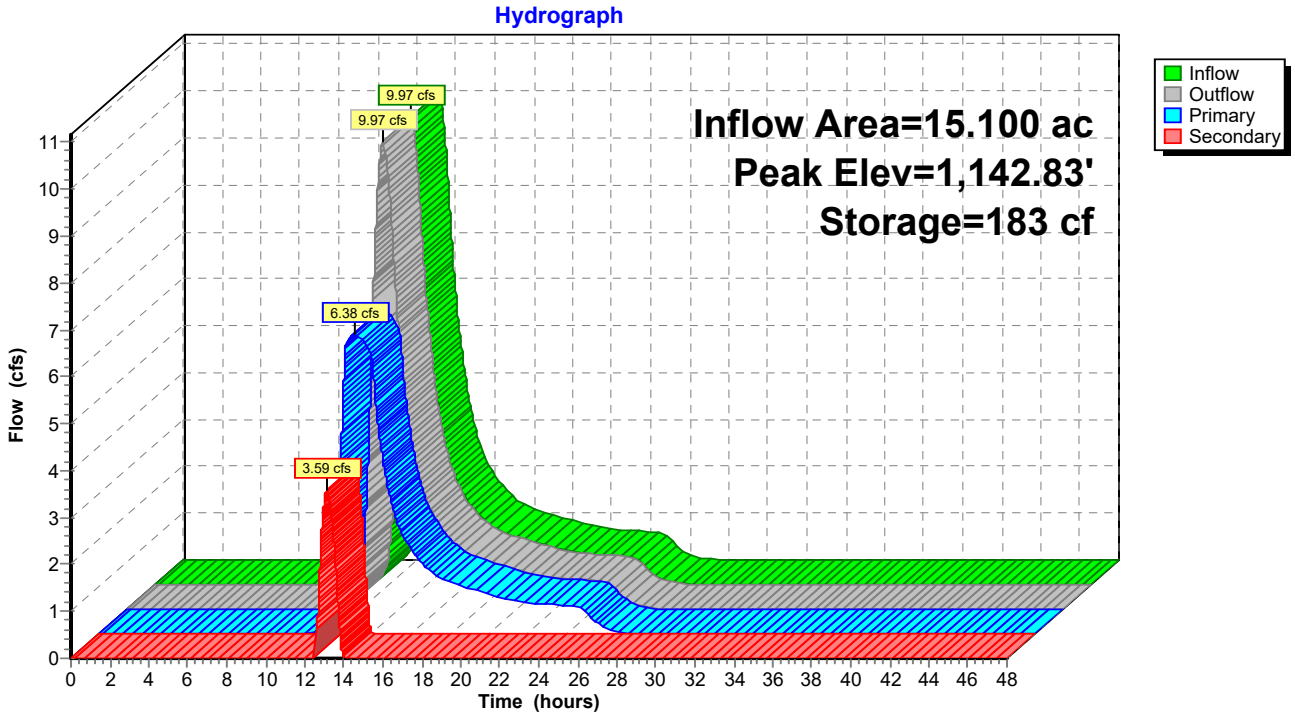
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,141.00	5	0	0
1,142.00	150	78	78
1,142.50	272	106	183

Device	Routing	Invert	Outlet Devices
#1	Primary	1,139.25'	**15.0" Round CMP_Round 15"** L= 52.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,139.25' / 1,138.90' S= 0.0067 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 1.23 sf
#2	Secondary	1,142.50'	**7.0' long (Profile 20) Broad-Crested Rectangular Weir** Head (feet) 0.49 0.98 1.48 1.97 Coef. (English) 2.68 2.63 2.61 2.61

Primary OutFlow Max=6.38 cfs @ 13.11 hrs HW=1,142.83' (Free Discharge)
↑—**1=CMP_Round 15"** (Barrel Controls 6.38 cfs @ 5.20 fps)

Secondary OutFlow Max=3.59 cfs @ 13.11 hrs HW=1,142.83' (Free Discharge)
↑—**2=Broad-Crested Rectangular Weir** (Weir Controls 3.59 cfs @ 1.54 fps)

Pond 4P: sta. 1013+23



Summary for Pond 9P: sta. 1032+51

[62] Hint: Exceeded Reach 27R OUTLET depth by 1.15' @ 13.16 hrs

Inflow Area = 43.000 ac, 0.00% Impervious, Inflow Depth = 2.14" for 50 year event
Inflow = 37.57 cfs @ 13.12 hrs, Volume= 7.659 af
Outflow = 37.38 cfs @ 13.20 hrs, Volume= 7.659 af, Atten= 1%, Lag= 4.8 min
Primary = 37.38 cfs @ 13.20 hrs, Volume= 7.659 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 1,135.85' @ 13.20 hrs Surf.Area= 1,984 sf Storage= 1,652 cf

Plug-Flow detention time= 0.3 min calculated for 7.659 af (100% of inflow)
Center-of-Mass det. time= 0.2 min (909.9 - 909.6)

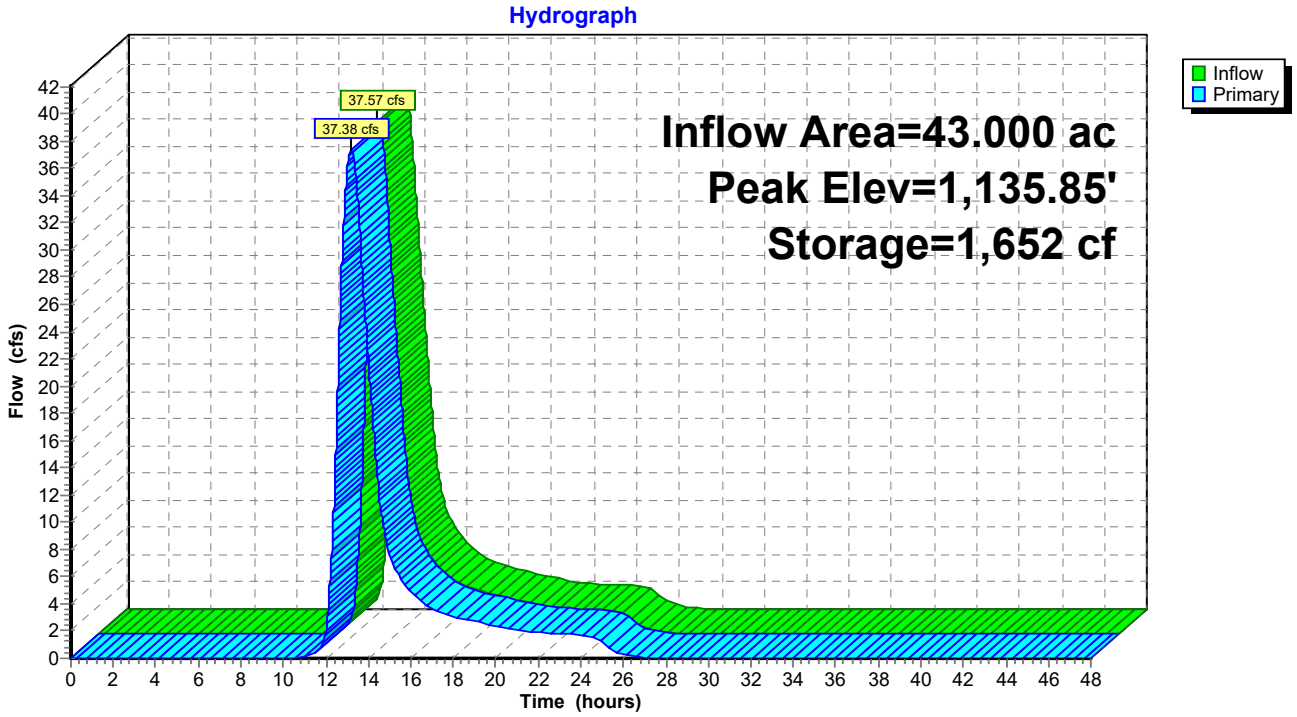
Volume	Invert	Avail.Storage	Storage Description
#1	1,133.00'	1,972 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,133.00	18	0	0
1,134.00	138	78	78
1,135.00	719	429	507
1,136.00	2,211	1,465	1,972

Device	Routing	Invert	Outlet Devices
#1	Primary	1,132.63'	**24.0" Round RCP_Round 24"** L= 22.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 1,132.63' / 1,132.05' S= 0.0264 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 3.14 sf
#2	Primary	1,132.05'	**18.0" Round RCP_Round 18"** L= 22.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 1,132.05' / 1,131.47' S= 0.0264 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 1.77 sf

Primary OutFlow Max=37.38 cfs @ 13.20 hrs HW=1,135.85' (Free Discharge)
↑—**1=RCP_Round 24"** (Inlet Controls 22.53 cfs @ 7.17 fps)
└—**2=RCP_Round 18"** (Inlet Controls 14.85 cfs @ 8.41 fps)

Pond 9P: sta. 1032+51



Summary for Pond 10P: sta. 1040+00

[62] Hint: Exceeded Reach 21R OUTLET depth by 3.56' @ 13.44 hrs

Inflow Area = 43.700 ac, 0.00% Impervious, Inflow Depth = 1.77" for 50 year event
Inflow = 29.27 cfs @ 13.00 hrs, Volume= 6.448 af
Outflow = 25.55 cfs @ 13.38 hrs, Volume= 6.448 af, Atten= 13%, Lag= 22.7 min
Primary = 16.40 cfs @ 13.38 hrs, Volume= 5.403 af
Secondary = 9.15 cfs @ 13.38 hrs, Volume= 1.045 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 1,139.23' @ 13.38 hrs Surf.Area= 12,197 sf Storage= 16,455 cf

Plug-Flow detention time= 4.2 min calculated for 6.447 af (100% of inflow)
Center-of-Mass det. time= 4.2 min (930.3 - 926.1)

Volume	Invert	Avail.Storage	Storage Description
#1	1,135.00'	20,043 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

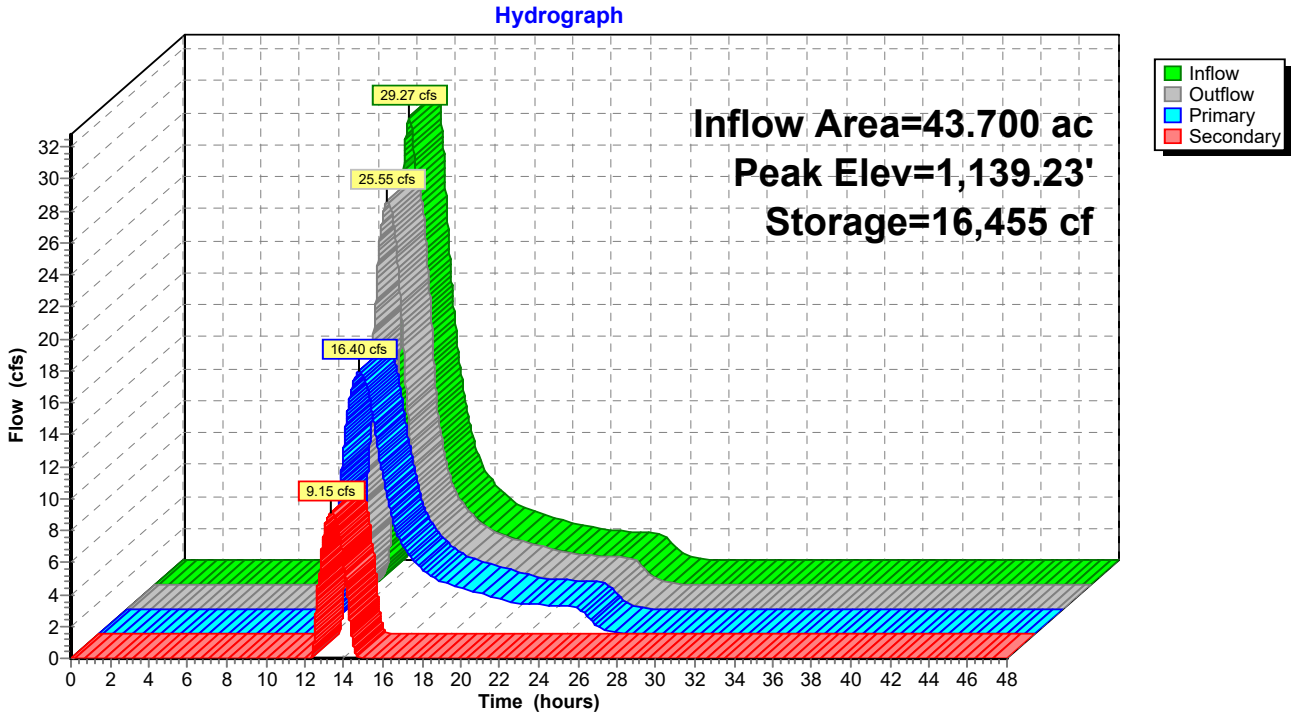
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,135.00	15	0	0
1,136.00	155	85	85
1,137.00	2,548	1,352	1,437
1,138.00	5,844	4,196	5,633
1,139.00	10,620	8,232	13,865
1,139.50	14,092	6,178	20,043

Device	Routing	Invert	Outlet Devices
#1	Primary	1,134.76'	**18.0" Round RCP_Round 18"** L= 45.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 1,134.76' / 1,134.00' S= 0.0169 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 1.77 sf
#2	Secondary	1,136.54'	**18.0" Round CMP_Round 18"** L= 29.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,136.12' / 1,136.54' S= -0.0145 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 1.77 sf

Primary OutFlow Max=16.40 cfs @ 13.38 hrs HW=1,139.23' (Free Discharge)
↑—**1=RCP_Round 18"** (Inlet Controls 16.40 cfs @ 9.28 fps)

Secondary OutFlow Max=9.15 cfs @ 13.38 hrs HW=1,139.23' (Free Discharge)
↑—**2=CMP_Round 18"** (Barrel Controls 9.15 cfs @ 5.18 fps)

Pond 10P: sta. 1040+00



Summary for Pond 16P: sta. 1069+69

Inflow Area = 70.250 ac, 0.00% Impervious, Inflow Depth = 1.71" for 50 year event
Inflow = 47.49 cfs @ 12.91 hrs, Volume= 10.028 af
Outflow = 47.48 cfs @ 12.91 hrs, Volume= 10.028 af, Atten= 0%, Lag= 0.1 min
Primary = 47.48 cfs @ 12.91 hrs, Volume= 10.028 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 1,200.45' @ 12.91 hrs Surf.Area= 76 sf Storage= 87 cf

Plug-Flow detention time= 0.0 min calculated for 10.026 af (100% of inflow)
Center-of-Mass det. time= 0.0 min (917.5 - 917.5)

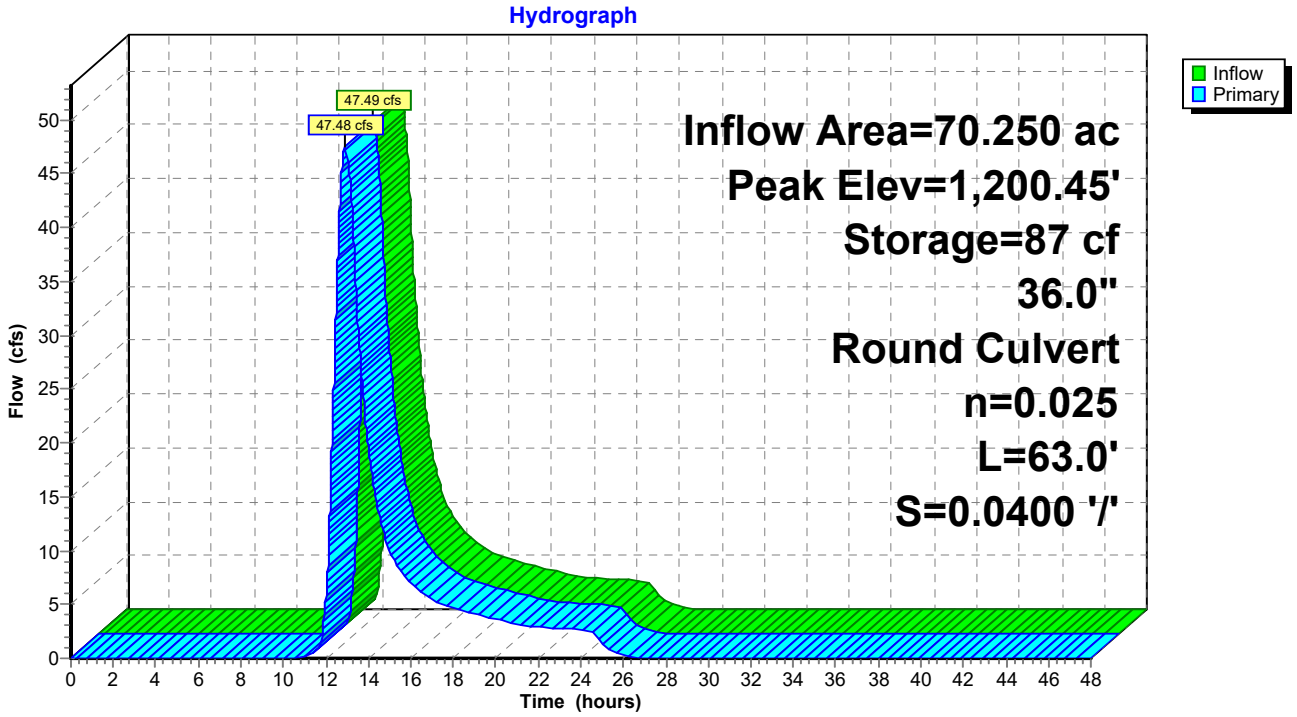
Volume	Invert	Avail.Storage	Storage Description
#1	1,198.00'	372 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,198.00	7	0	0
1,199.00	27	17	17
1,200.00	55	41	58
1,201.00	103	79	137
1,202.00	366	235	372

Device	Routing	Invert	Outlet Devices
#1	Primary	1,197.00'	**36.0" Round CMP_Round 36"** L= 63.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 1,197.00' / 1,194.48' S= 0.0400 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 7.07 sf

Primary OutFlow Max=47.48 cfs @ 12.91 hrs HW=1,200.45' (Free Discharge)
↑**1=CMP_Round 36"** (Inlet Controls 47.48 cfs @ 6.72 fps)

Pond 16P: sta. 1069+69



Summary for Pond 17P: sta. 1069+58

[93] Warning: Storage range exceeded by 0.39'
[88] Warning: Qout>Qin may require smaller dt or Finer Routing

Inflow Area = 66.500 ac, 0.00% Impervious, Inflow Depth = 1.70" for 50 year event
Inflow = 45.66 cfs @ 12.92 hrs, Volume= 9.403 af
Outflow = 45.78 cfs @ 12.92 hrs, Volume= 9.407 af, Atten= 0%, Lag= 0.0 min
Primary = 45.78 cfs @ 12.92 hrs, Volume= 9.407 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 1,208.39' @ 12.92 hrs Surf.Area= 209 sf Storage= 225 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= (not calculated: outflow precedes inflow)

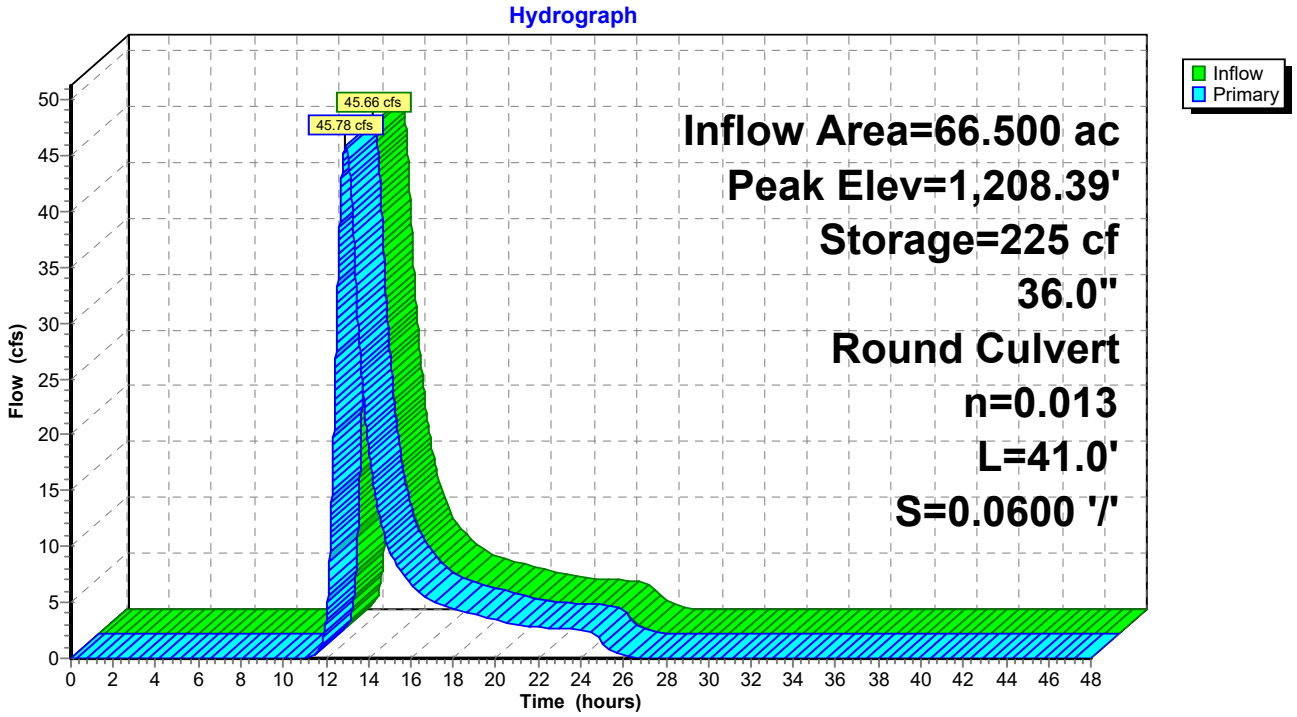
Volume	Invert	Avail.Storage	Storage Description
#1	1,205.00'	225 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,205.00	9	0	0
1,206.00	38	24	24
1,207.00	78	58	82
1,208.00	209	144	225

Device	Routing	Invert	Outlet Devices
#1	Primary	1,203.99'	**36.0" Round 36" spp** L= 41.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,203.99' / 1,201.53' S= 0.0600 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 7.07 sf

Primary OutFlow Max=45.78 cfs @ 12.92 hrs HW=1,208.39' (Free Discharge)
1=36" spp (Inlet Controls 45.78 cfs @ 6.48 fps)

Pond 17P: sta. 1069+58



Summary for Pond 18P: sta. 1069+29

Inflow Area = 3.600 ac, 0.00% Impervious, Inflow Depth = 1.92" for 50 year event
Inflow = 5.26 cfs @ 12.33 hrs, Volume= 0.577 af
Outflow = 5.25 cfs @ 12.33 hrs, Volume= 0.577 af, Atten= 0%, Lag= 0.3 min
Primary = 5.25 cfs @ 12.33 hrs, Volume= 0.577 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 1,203.81' @ 12.33 hrs Surf.Area= 146 sf Storage= 65 cf

Plug-Flow detention time= 0.1 min calculated for 0.576 af (100% of inflow)
Center-of-Mass det. time= 0.1 min (871.6 - 871.5)

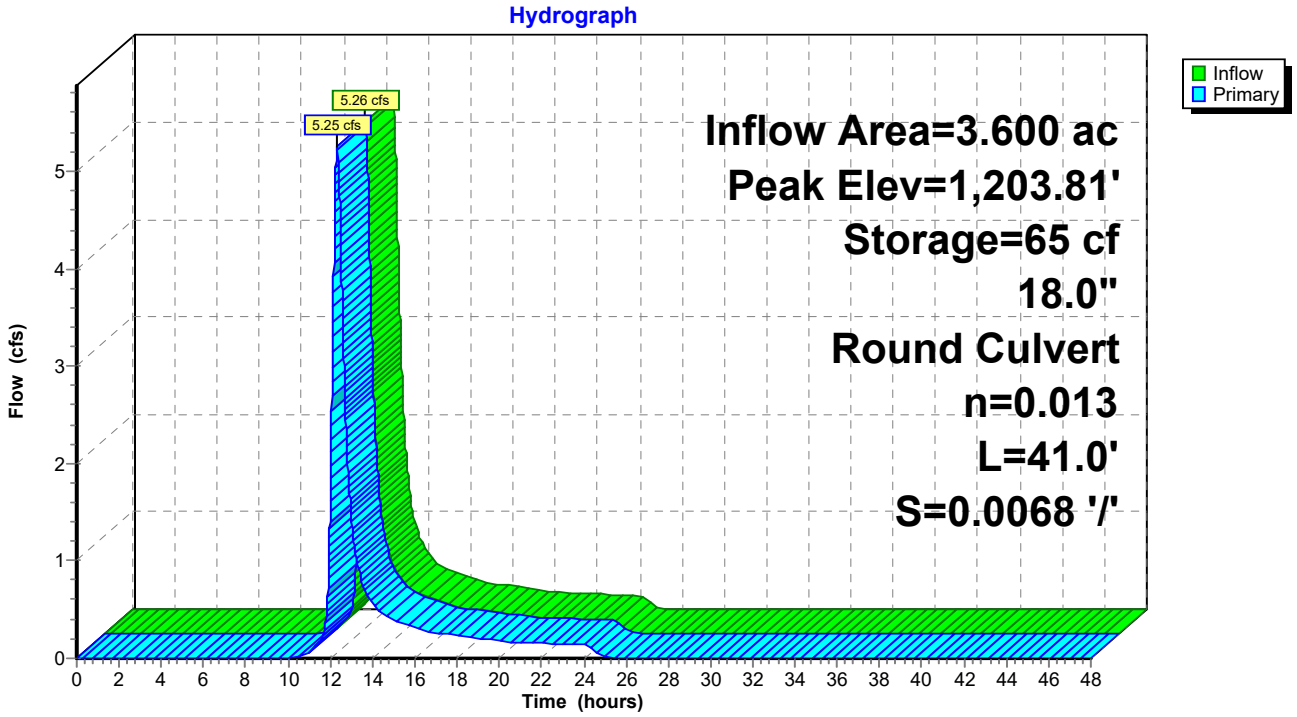
Volume	Invert	Avail.Storage	Storage Description
#1	1,203.00'	428 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,203.00	15	0	0
1,204.00	178	97	97
1,205.00	484	331	428

Device	Routing	Invert	Outlet Devices
#1	Primary	1,202.42'	**18.0" Round 18" spp** L= 41.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,202.42' / 1,202.14' S= 0.0068 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=5.25 cfs @ 12.33 hrs HW=1,203.81' (Free Discharge)
↑**1=18" spp** (Barrel Controls 5.25 cfs @ 4.02 fps)

Pond 18P: sta. 1069+29



Summary for Pond 20P: sta. 1139+10 Drive LT

[57] Hint: Peaked at 1,162.93' (Flood elevation advised)

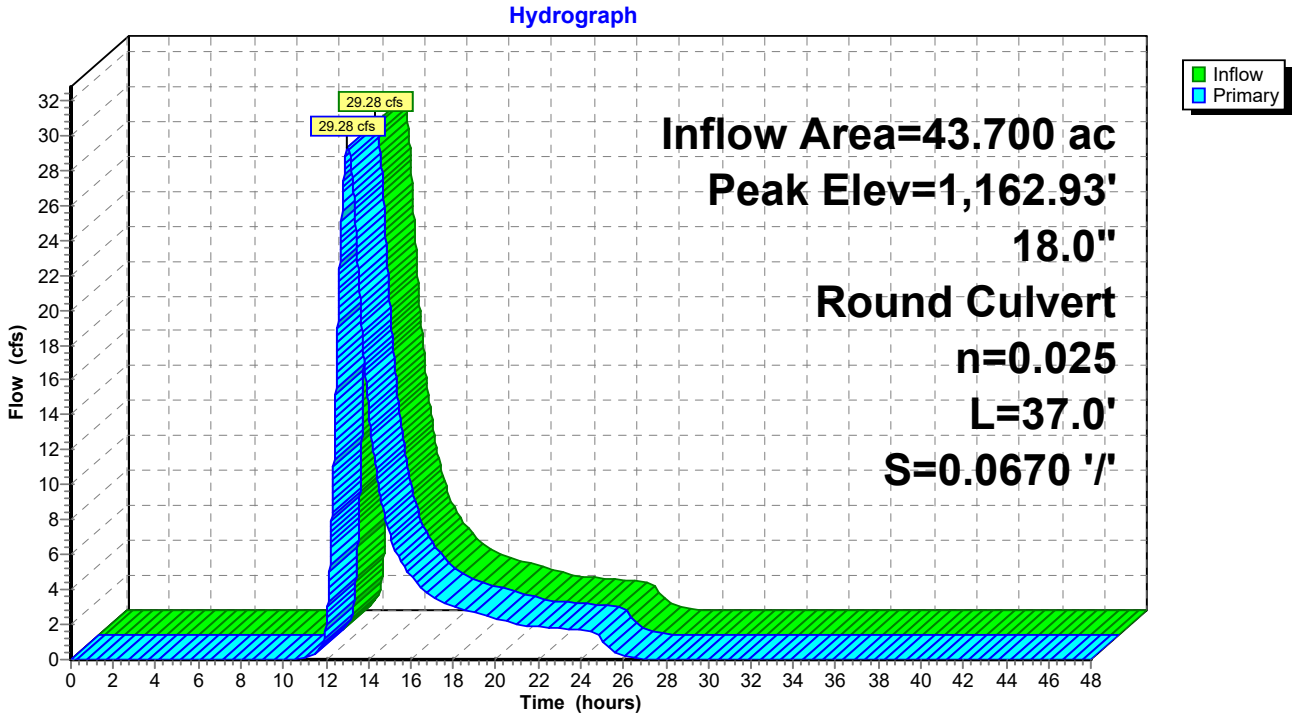
Inflow Area = 43.700 ac, 0.00% Impervious, Inflow Depth = 1.77" for 50 year event
Inflow = 29.28 cfs @ 12.99 hrs, Volume= 6.448 af
Outflow = 29.28 cfs @ 12.99 hrs, Volume= 6.448 af, Atten= 0%, Lag= 0.0 min
Primary = 29.28 cfs @ 12.99 hrs, Volume= 6.448 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 1,162.93' @ 12.99 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	1,143.18'	**18.0" Round CMP_Round 18"** L= 37.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,143.18' / 1,140.70' S= 0.0670 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 1.77 sf

Primary OutFlow Max=29.27 cfs @ 12.99 hrs HW=1,162.92' (Free Discharge)
1=CMP_Round 18" (Inlet Controls 29.27 cfs @ 16.57 fps)

Pond 20P: sta. 1139+10 Drive LT



Summary for Pond 23P: Combined

Inflow Area = 27.000 ac, 0.00% Impervious, Inflow Depth = 2.29" for 50 year event
Inflow = 29.24 cfs @ 13.02 hrs, Volume= 5.162 af
Outflow = 22.44 cfs @ 13.46 hrs, Volume= 5.162 af, Atten= 23%, Lag= 26.6 min
Primary = 22.44 cfs @ 13.46 hrs, Volume= 5.162 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 1,136.30' @ 13.46 hrs Surf.Area= 20,477 sf Storage= 22,281 cf

Plug-Flow detention time= 6.8 min calculated for 5.160 af (100% of inflow)
Center-of-Mass det. time= 6.8 min (896.9 - 890.1)

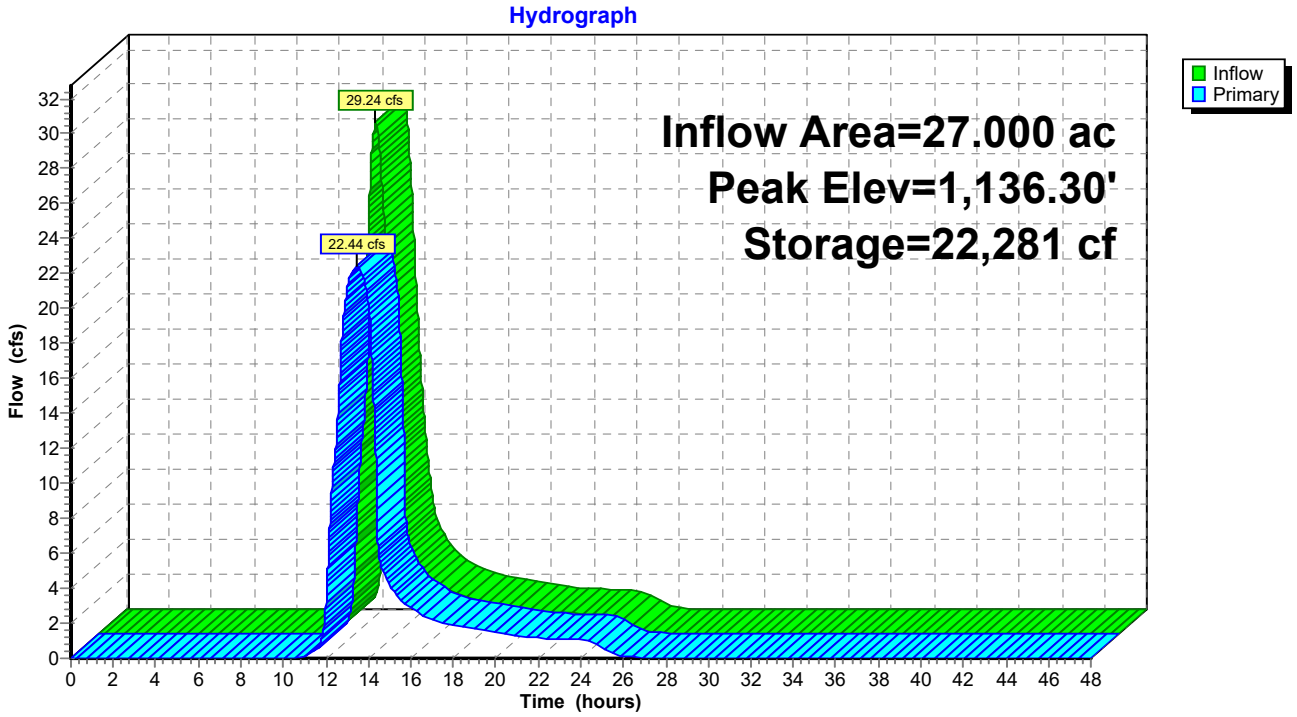
Volume	Invert	Avail.Storage	Storage Description
#1	1,131.00'	26,788 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,131.00	6	0	0
1,132.00	228	117	117
1,133.00	877	553	670
1,134.00	2,625	1,751	2,421
1,135.00	5,643	4,134	6,555
1,136.00	15,193	10,418	16,973
1,136.50	24,069	9,816	26,788

Device	Routing	Invert	Outlet Devices
#1	Primary	1,130.93'	**15.0" Round CMP_Round 15"** L= 50.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,130.93' / 1,129.16' S= 0.0354 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 1.23 sf
#2	Primary	1,131.57'	**15.0" Round CMP_Round 15"** L= 48.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,131.57' / 1,129.82' S= 0.0365 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 1.23 sf
#3	Primary	1,134.22'	**12.0" Round CMP_Round 12"** L= 40.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 1,134.22' / 1,133.06' S= 0.0290 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 0.79 sf

Primary OutFlow Max=22.44 cfs @ 13.46 hrs HW=1,136.30' (Free Discharge)
- **1=CMP_Round 15"** (Barrel Controls 9.59 cfs @ 7.81 fps)
- **2=CMP_Round 15"** (Barrel Controls 9.16 cfs @ 7.47 fps)
- **3=CMP_Round 12"** (Barrel Controls 3.69 cfs @ 4.69 fps)

Pond 23P: Combined



Summary for Pond 25P: sta. 1020+78

[62] Hint: Exceeded Reach 24R OUTLET depth by 1.71' @ 13.14 hrs

Inflow Area = 29.600 ac, 0.00% Impervious, Inflow Depth = 1.85" for 50 year event
Inflow = 20.06 cfs @ 13.14 hrs, Volume= 4.553 af
Outflow = 20.06 cfs @ 13.14 hrs, Volume= 4.553 af, Atten= 0%, Lag= 0.0 min
Primary = 8.83 cfs @ 13.14 hrs, Volume= 3.559 af
Secondary = 11.22 cfs @ 13.14 hrs, Volume= 0.993 af

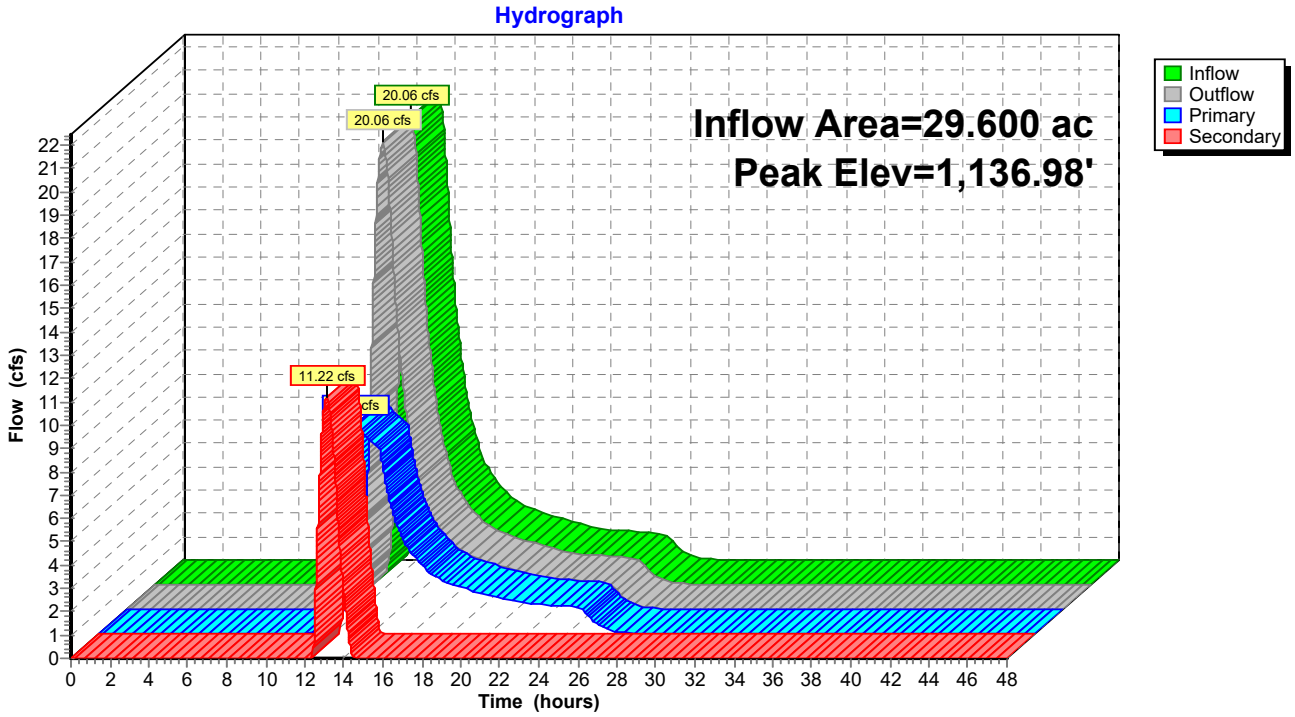
Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 1,136.98' @ 13.14 hrs
Flood Elev= 1,137.71'

Device	Routing	Invert	Outlet Devices
#1	Primary	1,134.12'	**15.0" Round RCP_Round 15"** L= 42.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 1,134.12' / 1,133.20' S= 0.0219 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 1.23 sf
#2	Secondary	1,136.50'	**10.0' long (Profile 14) Broad-Crested Rectangular Weir** Head (feet) 1.97 2.46 2.95 3.94 4.92 Coef. (English) 3.37 3.37 3.37 3.37 3.37

Primary OutFlow Max=8.83 cfs @ 13.14 hrs HW=1,136.98' (Free Discharge)
↑—**1=RCP_Round 15"** (Inlet Controls 8.83 cfs @ 7.20 fps)

Secondary OutFlow Max=11.22 cfs @ 13.14 hrs HW=1,136.98' (Free Discharge)
↑—**2=Broad-Crested Rectangular Weir** (Weir Controls 11.22 cfs @ 2.34 fps)

Pond 25P: sta. 1020+78

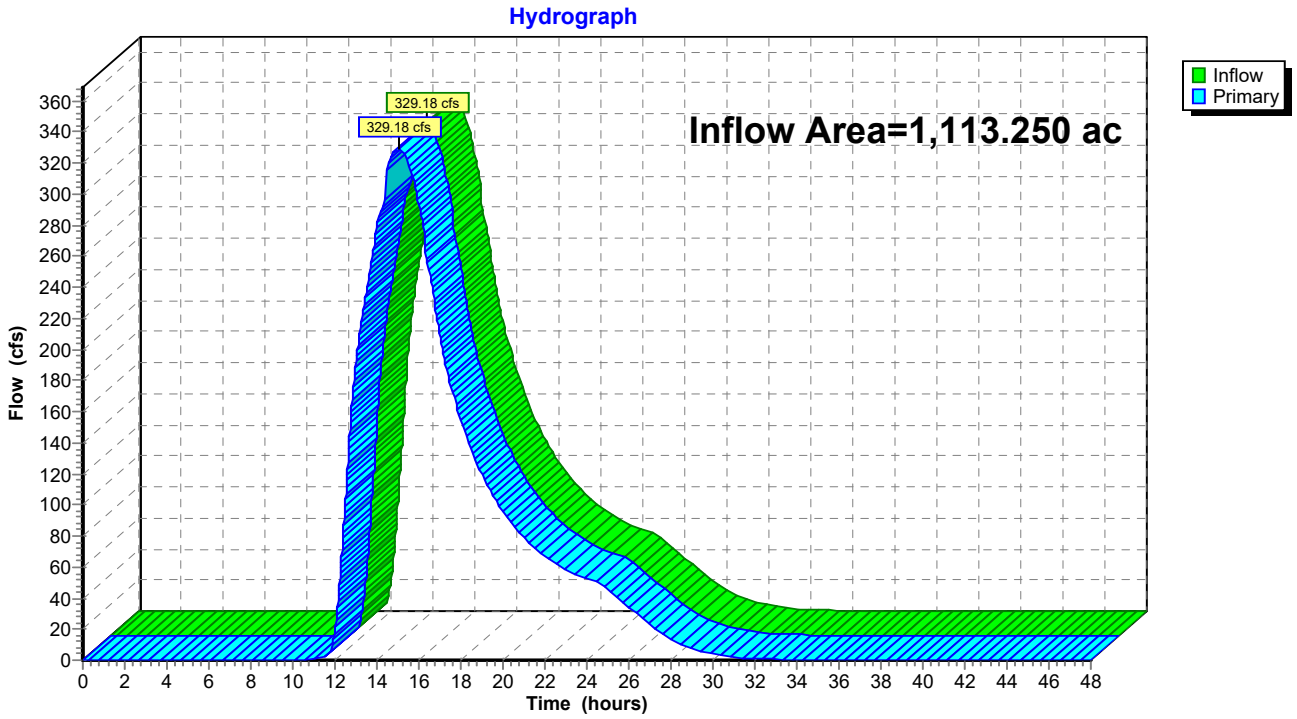


Summary for Link 26L: Androscoggin River

Inflow Area = 1,113.250 ac, 0.00% Impervious, Inflow Depth = 1.85" for 50 year event
Inflow = 329.18 cfs @ 15.06 hrs, Volume= 171.668 af
Primary = 329.18 cfs @ 15.06 hrs, Volume= 171.668 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 26L: Androscoggin River



EX-4 - STA. 1004+05-15" CMP											
Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
2 year	0.9	0.9	1142.13	0.54	-1.48	0.31	0.37	0.31	0.11	3.7	1.31
10 year	1.24	1.24	1142.23	0.64	-1.04	0.36	0.44	0.36	0.14	4.07	1.48
50 year	1.74	1.74	1142.37	0.78	-0.87	0.43	0.52	0.43	0.17	4.46	1.69
100 year	2	2	1142.44	0.85	-0.78	0.47	0.56	0.47	0.19	4.62	1.79

HY-8 Analysis Results

Crossing Summary Table

Culvert Crossing: EX-4

Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	Existing 15 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
1142.13	2 year	0.90	0.90	0.00	1
1142.23	10 year	1.24	1.24	0.00	1
1142.37	50 year	1.74	1.74	0.00	1
1142.44	100 year	2.00	2.00	0.00	1
1147.10	Overtopping	10.07	0.00	1.00	

Project	16304 Route 16	By	SPH
Location	Dummer, NH	Date	10/13/2017

FHWA Regression Equations (Report No. RD-77-159)

Data Input	
1.380	A = drainage area (sq miles)
76.00	R = Precipitation factor
9	Z = Zone
300	DH = Elevation difference of main channel (feet)
2.220	L = Hydraulic length (length of conventional TC Path) (miles)
0.84%	S = Storage factor (area of pond/swamp/total area x 100) *** Apply Storage Correction to q if S>4%
1.00	*** Storage Correction (from Nomograph) [5%=0.97, 10%=0.92, 15%=0.89, 20%=0.85)
1.52	P60 = 10 year, 60 min. rainfall (inches)
4.40	P10 = 10 year, 10 min. rainfall intensity (inches/hour)
3.000	LL = Cumulative length of all streams shown as blue lines on USGS Quad Map (miles)
239	q'10 - General [3 Parameter] All Zone Equation (cfs) q10 = 1.28015 x A^0.56172 x R^0.94356 x DH^0.16887
181	q'10 - Equation corrected for Zone 9 q10 = 0.17280 x q'10 ^ 1.26937
150	q'10 - Zone 9 [3 Parameter] Equation (cfs) q10 = 0.50051 x A^0.69229 x R^0.74166 x DH^0.39729
163	q'10 - Zone 9 [5 parameter] Equation (cfs) q10 = 7.7165 x A^0.5814 x R^0.0547 x DH^0.3865 x L^0.0990 x P60^0.8217
166	q'10 - Zone 9 [7 parameter] Equation (cfs) q10 = 50.808 x A^0.3799 x R^-0.1432 x DH^0.3401 x L^0.0917 x LL^0.2879 x P10^-0.9655 x P60^1.8748
150	Enter selected q'10
150	Q10 (***corrected for storage)
71	Q2.33 = 0.46921 x Q10 ^1.00243
246	Q50 = 1.45962 x Q10 ^1.02342
285	Q100 = 1.64380 x Q10 ^1.02918

EX-5 - STA. 1010+23-60" CMP											
Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
10 year	150	150	1135.54	5.27	5.58	5	3.51	3.51	1.45	10.2	6.07
50 year	249.6	249.6	1139.5	8.14	9.54	5	4.42	4.42	2.02	13.59	7.28
100 year	285	268.41	1140.44	8.81	10.48	5	4.53	4.53	2.2	14.36	7.62

HY-8 Analysis Results

Crossing Summary Table

Culvert Crossing: EX-5_Existing 60

Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	Existing 60 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
1135.54	10 year	150.00	150.00	0.00	1
1139.50	50 year	249.60	249.60	0.00	1
1140.44	100 year	285.00	268.41	16.54	5
1140.18	Overtopping	263.51	0.00	1.00	

EX-13 - STA. 1044+36-18" RCP											
Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
2 year	6.42	6.42	1138.78	1.42	-0.04	0.55	0.98	0.61	0.86	9.25	1.87
10 year	9.37	9.37	1139.26	1.9	0.74	0.68	1.18	0.77	1.11	9.95	2.1
50 year	13.62	13.62	1140.25	2.89	1.72	0.85	1.37	0.97	1.45	10.95	2.34
100 year	15.94	15.94	1140.96	3.6	2.37	0.94	1.42	1.07	1.63	11.45	2.45

HY-8 Analysis Results

Crossing Summary Table

Culvert Crossing: EX-13

Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	Existing 18 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
1138.78	2 year	6.42	6.42	0.00	1
1139.26	10 year	9.37	9.37	0.00	1
1140.25	50 year	13.62	13.62	0.00	1
1140.96	100 year	15.94	15.94	0.00	1
1141.50	Overtopping	17.51	0.00	1.00	

EX-14 - STA. 1048+16-15" RCP											
Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
2 year	3.75	3.75	1139.44	1.12	-0.38	0.44	0.78	0.48	0.6	8.46	1.57
10 year	5.45	5.45	1139.79	1.47	0.26	0.54	0.94	0.59	0.77	9.2	1.77
50 year	7.98	7.98	1140.5	2.18	1.04	0.68	1.11	0.75	1	10.02	2
100 year	9.37	9.37	1141.01	2.69	1.56	0.75	1.16	0.84	1.11	10.43	2.1

HY-8 Analysis Results

Crossing Summary Table

Culvert Crossing: EX-14

Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	Existing 15 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
1139.44	2 year	3.75	3.75	0.00	1
1139.79	10 year	5.45	5.45	0.00	1
1140.50	50 year	7.98	7.98	0.00	1
1141.01	100 year	9.37	9.37	0.00	1
1142.30	Overtopping	12.14	0.00	1.00	

EX-15 - STA. 1050+45-15" RCP											
Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
2 year	3.61	3.61	1138.32	1.12	0.78	0.72	0.76	0.72	0.5	4.75	2.4
10 year	4.51	4.51	1138.49	1.29	1.03	0.84	0.86	0.84	0.58	4.96	2.58
50 year	6.47	6.47	1138.94	1.74	1.74	1.25	1.02	1.02	0.75	6.03	2.89
100 year	7.63	7.63	1139.34	2.08	2.14	1.25	1.1	1.1	0.84	6.69	3.04

HY-8 Analysis Results

Crossing Summary Table

Culvert Crossing: EX-15

Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	Existing 15 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
1138.32	2 year	3.61	3.61	0.00	1
1138.49	10 year	4.51	4.51	0.00	1
1138.94	50 year	6.47	6.47	0.00	1
1139.34	100 year	7.63	7.63	0.00	1
1141.80	Overtopping	13.08	0.00	1.00	

EX-16 - STA. 1052+58-18" RCP											
Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
2 year	6.81	6.81	1140.57	1.49	-0.34	0.7	1.01	0.75	0.74	7.47	2.29
10 year	9.9	9.9	1141.1	2.02	1.54	0.88	1.21	0.95	0.96	8.18	2.58
50 year	14.49	14.49	1142.24	3.16	2.68	1.18	1.39	1.25	1.25	9.01	2.9
100 year	17.03	16.85	1143	3.92	3.4	1.5	1.4	1.4	1.4	9.82	3.03

HY-8 Analysis Results

Crossing Summary Table

Culvert Crossing: EX-16

Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	Existing 18 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
1140.57	2 year	6.81	6.81	0.00	1
1141.10	10 year	9.90	9.90	0.00	1
1142.24	50 year	14.49	14.49	0.00	1
1143.00	100 year	17.03	16.85	0.01	79
1143.00	Overtopping	16.85	0.00	1.00	

EX-17 - STA. 1055+06-15" RCP											
Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
2 year	4.33	4.33	1147.97	1.22	-1.35	0.42	0.84	0.45	0.52	10.42	2.09
10 year	6.19	6.19	1148.38	1.63	-0.64	0.51	1	0.56	0.65	11.15	2.36
50 year	8.87	8.87	1149.23	2.48	0.31	0.63	1.15	0.7	0.83	12.14	2.66
100 year	10.39	10.39	1149.86	3.11	0.96	0.7	1.19	0.78	0.93	12.51	2.8

HY-8 Analysis Results

Crossing Summary Table

Culvert Crossing: EX-17

Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	Existing 15 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
1147.97	2 year	4.33	4.33	0.00	1
1148.38	10 year	6.19	6.19	0.00	1
1149.23	50 year	8.87	8.87	0.00	1
1149.86	100 year	10.39	10.39	0.00	1
1152.36	Overtopping	14.84	0.00	1.00	

Project NH Route 16 Project # 16304A

Location Dummer, NH Sheet 1 of 1

Calculated by SPH Date 10/16/17.

Checked by _____ Date _____

Title EX-17 Calibration

Computations

Rational Method 50 yr flow = 19.72 cfs

15" RCP Inv. h = 1146.75

E.P. @ 4 Pipe = 1150.32 H_w = 3.57' $\frac{H_w}{D}$ = 2.86

Flow to Match $\frac{H_w}{D}$ => $\frac{8.9\ cfs.}{19.72\ cfs}$ = 45%

Hydrologic Calculations (Proposed Conditions)

Project: Route 16 - Dummer
PIN: 16304.00
Town: Dummer

Prepared by: Seth Hill
Date: 17-Oct-17
Checked by:
Date:
Revised by:

P_2 (in/h) 2.34

Area ID	Station	Basin Length	Benson Slope	Sheet Flow				T_c by Other Methods (min)			T_c by Kinematic Wave (min)				50-yr Velocity	Concentrated (by Velocity method)						Channel						Basin T_c (min)				
		L (ft)	ft/mi	L (ft)	S (ft/ft)	Rh (in)	n	Velocity Meth	TR-55 KW approx	Kerby-Hath Meth	KW_2	KW_{10}	KW_{50}	KW_{100}	v (ft/s)	L (ft)	S (ft/ft)	Rh (in)	n	T_c	v (ft/s)	L (ft)	S (ft/ft)	Rh (ft)	n	T_c	v (ft/s)	Sum_2	Sum_{10}	Sum_{50}	Sum_{100}	Basin
P-4		110.000	0.184	100	0.0348	1.2	0.8	22.3	35.0	25.0	28.7	23.3	20.3	19.1	0.08	481	0.035	2.4	0.200	16.9	0.5							45.6	40.3	37.2	36.0	P-4
P-5		2200.000	0.136	100	0.0256	1.2	0.8	26.0	39.6	26.9	32.5	26.3	22.8	21.4	0.07	1602	0.041	2.4	0.200	52.2	0.5	9981.0	0.021	2.64	0.400	162.1	1.03	246.8	240.6	237.1	235.8	P-5
P-6		580.000	0.403	100	0.0745	1.2	0.8	433.6	336.8	20.9	21.2	17.5	15.2	14.4	0.11	2962	0.075	2.4	0.200	71.2	0.7							92.4	88.7	86.5	85.6	P-6
P-7		560.000	0.455	100	0.07	1.2	0.8	447.3	345.3	21.2	21.8	17.9	15.6	14.7	0.11	2950	0.081	2.4	0.200	68.0	0.7	420	0.017	12.00	0.095	0.7	10.54	90.4	86.6	84.3	83.4	P-7
P-8		150.000	0.693	100	0.1	1.2	0.8	374.2	299.4	19.5	18.9	15.6	13.7	12.9	0.12	703	0.130	2.4	0.200	12.8	0.9							31.7	28.4	26.5	25.7	P-8
P-9		560.000	0.543	100	0.1	1.2	0.8	374.2	299.4	19.5	18.9	15.6	13.7	12.9	0.12	2860	0.100	2.4	0.200	59.4	0.8							78.3	75.0	73.0	72.3	P-9
P-10		240.000	0.592	100	0.06	1.2	0.8	483.1	367.3	22.0	23.1	18.9	16.5	15.6	0.10	1049	0.120	2.4	0.200	19.9	0.9	116	0.005	1.44	0.240	3.5	0.56	46.5	42.3	39.9	38.9	P-10
P-11		520.000	0.612	100	0.1	1.2	0.8	374.2	299.4	19.5	18.9	15.6	13.7	12.9	0.12	2650	0.117	2.4	0.200	50.8	0.9							69.7	66.5	64.5	63.8	P-11
P-12		780.000	0.868	100	0.11	1.2	0.8	356.8	288.2	19.1	18.2	15.1	13.2	12.5	0.13	4027	0.160	2.4	0.200	66.1	1.0							84.3	81.1	79.3	78.6	P-12
P-13		790.000	0.933	100	0.12	1.2	0.8	341.6	278.3	18.7	17.6	14.6	12.8	12.1	0.13	3968	0.180	2.4	0.200	61.4	1.1	90	0.005	1.44	0.240	2.7	0.56	81.7	78.7	76.9	76.2	P-13
P-14		730.000	1.019	100	0.14	1.2	0.8	316.3	261.7	18.1	16.6	13.8	12.1	11.5	0.14	3770	0.190	2.4	0.200	56.8	1.1	90	0.005	1.44	0.240	2.7	0.56	76.0	73.2	71.5	70.9	P-14
P-15		660.000	1.059	100	0.2	1.2	0.8	264.6	226.9	16.6	14.4	12.1	10.6	10.1	0.16	3392	0.200	2.4	0.200	49.8	1.1							64.2	61.9	60.4	59.9	P-15
P-16		780.000	0.949	100	0.17	1.2	0.8	287.0	242.1	17.2	15.4	12.8	11.3	10.7	0.15	3798	0.186	2.4	0.200	57.8	1.1	217	0.055	1.44	0.240	2.0	1.85	75.1	72.6	71.0	70.4	P-16
P-17		590.000	0.783	100	0.144	1.2	0.8	311.8	258.8	17.9	16.4	13.6	12.0	11.3	0.14	2687	0.144	2.4	0.200	46.5	1.0	304	0.055	1.44	0.240	2.7	1.85	65.6	62.8	61.2	60.6	P-17
P-18		220.000	0.573	100	0.18	1.2	0.8	278.9	236.7	17.0	15.0	12.6	11.0	10.5	0.15	1004	0.110	2.4	0.200	19.9	0.8	177	0.005	1.44	0.240	5.3	0.56	40.2	37.7	36.2	35.6	P-18
EX-19		750.000	0.891	100	0.169	1.2	0.8	287.9	242.7	17.3	15.4	12.9	11.3	10.7	0.15	3860	0.169	2.4	0.200	61.6	1.0							77.0	74.5	72.9	72.3	EX-19
P-20																												5.0	5.0	5.0	5.0	P-20

Project: Route 16 - Dummer
PIN: 16304.00
Town: Dummer

Prepared by: Seth Hill
Date: October-17
Checked by:
Date:

Revised by:

Peak Flow Estimates by Rational Method

				T = 2 yrs			T = 10 yrs			T = 50 yrs			T = 100 yrs		
Area ID	Station	Area ac	C	T_c min	i_2 (in/hr)	Q_2 (ft3/s)	T_c min	i_{10} (in/hr)	Q_{10} (ft3/s)	T_c min	i_{50} (in/hr)	Q_{50} (ft3/s)	T_c min	i_{100} (in/hr)	Q_{100} (ft3/s)
P-4		2.8	0.20	45.6	1.610	**0.91**	40.3	2.220	**1.26**	37.2	3.110	**1.77**	36.0	3.580	**2.03**
P-5		884.5	0.20	246.8		**0.00**	240.6		**0.00**	237.1		**0.00**	235.8		**0.00**
P-6		15.2	0.20	92.4	0.750	**2.28**	88.7	1.070	**3.25**	86.5	1.540	**4.68**	85.6	1.830	**5.56**
P-7		28.8	0.20	90.4	0.770	**4.44**	86.6	0.960	**5.54**	84.3	1.380	**7.96**	83.4	1.620	**9.34**
P-8		4.9	0.20	31.7	1.910	**1.88**	28.4	2.630	**2.59**	26.5	3.570	**3.52**	25.7	4.220	**4.16**
P-9		21.2	0.20	78.3	0.850	**3.61**	75.0	1.240	**5.26**	73.0	1.800	**7.64**	72.3	2.120	**8.99**
P-10		1.4	0.20	46.5	1.460	**0.41**	42.3	2.140	**0.59**	39.9	3.000	**0.83**	38.9	3.460	**0.96**
P-11		11.8	0.20	69.7	0.950	**2.23**	66.5	1.370	**3.22**	64.5	1.970	**4.63**	63.8	2.330	**5.48**
P-12		82.4	0.20	84.3	0.800	**13.19**	81.1	1.150	**18.96**	79.3	1.650	**27.21**	78.6	1.960	**32.32**
P-13		22.3	0.20	81.7	0.810	**3.61**	78.7	1.210	**5.39**	76.9	1.760	**7.84**	76.2	2.060	**9.17**
P-14		11.2	0.20	76.0	0.860	**1.92**	73.2	1.290	**2.88**	71.5	1.880	**4.20**	70.9	2.210	**4.94**
P-15		30.4	0.20	64.2	0.980	**5.96**	61.9	1.400	**8.51**	60.4	2.030	**12.34**	59.9	2.370	**14.40**
P-16		39.1	0.20	75.1	0.860	**6.72**	72.6	1.250	**9.77**	71.0	1.800	**14.06**	70.4	2.150	**16.80**
P-17		45.2	0.20	65.6	0.980	**8.87**	62.8	1.420	**12.85**	61.2	2.050	**18.55**	60.6	2.400	**21.72**
P-18		6.2	0.20	40.2	1.500	**1.86**	37.7	2.220	**2.76**	36.2	3.110	**3.86**	35.6	3.580	**4.45**
EX-19		66.5	0.20	77.0	0.840	**11.18**	74.5	1.220	**16.24**	72.9	1.780	**23.69**	72.3	2.090	**27.81**
P-20		0.2	0.20	*5.0	3.480	**0.10**	*5.0	4.610	**0.14**	*5.0	6.240	**0.19**	*5.0	7.160	**0.21**

*Time of Concentration is direct entry of 5 minutes (minimum value)

Project: Route 16 - Dummer
Project Number: 16304.00
Town: Dummer

DRAINAGE STUDY
PEAK FLOW Q_{50} SUMMARY & PIPE SIZING

Prepared by: Seth Hill
Date: 17-Oct-17
USGS Quad: Coos County, NH
Checked by:
Revised by:

Note:
Pipe sizing by Manning's equation and Concrete culvert under inlet control (simple orifice)

Entrance	2
H_w/D	1.5
C_d	0.53
c	0.055
Y	0.54
a	0.622

Culvert Entrance Treatment

Generic	*Projecting*	*Mitred*	*Headwall*
1	2	3	4
0.6	0.53	0.58	0.64
0.043	0.055	0.046	0.038
0.5	0.54	0.75	0.69

Culvert Orifice Equation
$(H_w/D) = c\{Q/AD^{0.5}\}^2 + Y$
(no slope correction)

Area ID	Station	Culvert n	Culvert S	USGS Q50	Pipe Size (in) Manning	Pipe Size (in) Inlet Control	Pipe Size (in) Hw/D	Rational Q50	Pipe Size (in) Manning	Pipe Size (in) Inlet Control	Pipe Size (in) Hw/D	Proposed Pipe Size D	Proposed Pipe USGS H_w/D	Rational H_w/D	Proposed Capacity Manning Q_M	Proposed Capacity Orifice Q_O	Notes
P-5		0.025	0.009	442.47	96	90	1.28	0.00	18	18	0.54	60	6.15	0.54	127.05	182.97	Existing 60". Proposed inlet extension
P-6		0.013	0.037	18.58	18	30	0.86	4.68	18	18	0.80	18	4.61	0.80	20.28	9.02	Proposed 18" RCP
P-7		0.013	0.044	30.64	24	30	1.40	7.96	18	18	1.29	18	11.62	1.29	21.98	9.02	Proposed 18" RCP
P-8		0.013	0.010	7.72	18	18	1.24	3.52	18	18	0.69	18	1.24	0.69	10.71	9.02	Proposed 18" RCP
P-9		0.013	0.021	24.11	24	30	1.07	7.64	18	18	1.23	18	7.40	1.23	15.22	9.02	Proposed 18" RCP
P-10		0.013	0.026	2.88	18	18	0.64	0.83	18	18	0.55	18	0.64	0.55	16.77	9.02	Proposed 18" RCP
P-11		0.013	0.030	15.21	18	24	1.19	4.63	18	18	0.79	18	3.27	0.79	18.19	9.02	Proposed 18" RCP
P-12		0.013	0.006	69.51	42	42	1.36	27.21	30	30	1.22	30	4.97	1.22	32.42	32.34	Proposed 30" RCP
P-13		0.013	0.023	25.03	24	30	1.12	7.84	18	18	1.26	18	7.94	1.26	16.06	9.02	Proposed 18" RCP
P-14		0.013	0.011	14.62	24	24	1.14	4.20	18	18	0.75	18	3.06	0.75	11.11	9.02	Proposed 18" RCP
P-15		0.013	0.008	31.91	30	30	1.47	12.34	24	24	0.97	24	3.39	0.97	19.97	18.51	Proposed 24" RCP
P-16		0.013	0.049	38.81	24	36	1.10	14.06	18	24	1.09	24	4.76	1.09	50.01	18.51	Proposed 24" RCP
P-17		0.013	0.080	43.53	24	36	1.24	8.35	18	18	1.36	18	22.90	1.36	29.70	9.02	Flows reduced to 45% to mimic existing conditions. See Attached calibration calculation.
P-18		0.025	0.007	9.25	24	24	0.78	3.86	18	18	0.72	18	1.55	0.72	4.57	9.02	Proposed 18" CMP
EX-19		0.013	0.060	58.81	30	42	1.13	23.69	18	30	1.05	36	1.82	0.75	163.36	51.02	Existing 36" CMP
P-20		0.025	0.040	0.51	18	18	0.54	0.19	18	18	0.54	18	0.54	0.54	10.92	9.02	Existing 36" SPP

VHB

EXISTING CONDITIONS

Project: Route 16 - Dummer
Project Number: 16304.00
Town: Dummer

DRAINAGE STUDY
PEAK FLOW Q_{50} SUMMARY & PIPE SIZING

Prepared by: Seth Hill
Date: 17-Oct-17
USGS Quad: Coos County, NH
Checked by:
Revised by:

Note:
Pipe sizing by Manning's equation and Concrete culvert under inlet control (simple orifice)

Entrance	2
H_w/D	1.5
C_d	0.53
c	0.055
Y	0.54
a	0.622

Culvert Entrance Treatment

Generic	*Projecting*	*Mitred*	*Headwall*
1	2	3	4
0.6	0.53	0.58	0.64
0.043	0.055	0.046	0.038
0.5	0.54	0.75	0.69

Culvert Orifice Equation
$(H_w/D) = c\{Q/AD^{0.5}\}^2 + Y$
(no slope correction)

Area ID Station	Culvert n	Culvert S	USGS Q50	Pipe Size (in) Manning	Pipe Size (in) Inlet Control	Pipe Size (in) Hw/D	Rational Q50	Pipe Size (in) Manning	Pipe Size (in) Inlet Control	Pipe Size (in) Hw/D	Existing Pipe Size D	Existing Pipe USGS H_w/D	Existing Pipe Rational H_w/D	Existing Capacity Manning Q_M	Existing Capacity Orifice Q_O	Notes
P-5	0.025	0.007	442.466	102	90	1.28	0.000	18	18	0.54	15	5749.55	0.54	2.748	5.718	Existing 15" cmp
P-6	0.013	0.022	18.581	24	30	0.86	4.679	18	18	0.80	15	10.68	1.18	9.556	5.718	Existing 15" rcp
P-7	0.025	0.035	30.637	30	30	1.40	7.960	18	18	1.29	15	28.10	2.40	6.318	5.718	Existing 15" cmp
P-8	0.025	0.037	7.724	18	18	1.24	3.520	18	18	0.69	15	2.29	0.90	6.415	5.718	Existing 15" cmp
P-9	0.025	0.029	24.107	30	30	1.07	7.636	18	18	1.23	12	52.62	5.76	3.154	3.273	Existing 12" cmp
P-10	0.013	0.026	2.877	18	18	0.64	0.834	18	18	0.55	21	0.59	0.54	25.444	13.260	Existing 18" rcp to 24" rcp
P-11	0.013	0.017	15.208	24	24	1.19	4.630	18	18	0.79	18	3.27	0.79	13.651	9.019	Existing 18" rcp
P-12	0.013	0.035	69.508	30	42	1.36	27.205	24	30	1.22	18	57.56	9.27	19.589	9.019	Existing 18" rcp
P-13	0.013	0.036	25.033	24	30	1.12	7.836	18	18	1.26	15	18.94	2.34	12.286	5.718	Existing 15" rcp
P-14	0.013	0.006	14.619	24	24	1.14	4.200	18	18	0.75	15	6.82	1.06	5.002	5.718	Existing 15" rcp
P-15	0.013	0.016	31.913	30	30	1.47	12.338	18	24	0.97	18	12.56	2.34	13.365	9.019	Existing 18" rcp
P-16	0.013	0.057	38.815	24	36	1.10	8.900	18	18	1.47	15	44.78	2.87	15.349	5.718	Existing 15" rcp
P-17	0.013	0.007	43.526	36	36	1.24	18.548	24	30	0.86	18	22.90	4.60	8.659	9.019	Existing 18" spp
P-18	0.013	0.060	9.248	18	24	0.78	3.863	18	18	0.72	36	0.57	0.55	163.361	51.021	Existing 36" spp
EX-19	0.025	0.040	58.810	36	42	1.13	23.688	30	30	1.05	36	1.82	0.75	69.360	51.021	Existing 36" cmp

Project	16304 Route 16	By	SPH
Location	Dummer, NH	Date	10/13/2017

FHWA Regression Equations (Report No. RD-77-159)

Data Input	
1.380	A = drainage area (sq miles)
76.00	R = Precipitation factor
9	Z = Zone
300	DH = Elevation difference of main channel (feet)
2.200	L = Hydraulic length (length of conventional TC Path) (miles)
0.84%	S = Storage factor (area of pond/swamp/total area x 100) *** Apply Storage Correction to q if S>4%
1.00	*** Storage Correction (from Nomograph) [5%=0.97, 10%=0.92, 15%=0.89, 20%=0.85)
1.52	P60 = 10 year, 60 min. rainfall (inches)
4.40	P10 = 10 year, 10 min. rainfall intensity (inches/hour)
3.000	LL = Cumulative length of all streams shown as blue lines on USGS Quad Map (miles)
239	q'10 - General [3 Parameter] All Zone Equation (cfs) q10 = 1.28015 x A^0.56172 x R^0.94356 x DH^0.16887
181	q'10 - Equation corrected for Zone 9 q10 = 0.17280 x q'10 ^ 1.26937
150	q'10 - Zone 9 [3 Parameter] Equation (cfs) q10 = 0.50051 x A^0.69229 x R^0.74166 x DH^0.39729
163	q'10 - Zone 9 [5 parameter] Equation (cfs) q10 = 7.7165 x A^0.5814 x R^0.0547 x DH^0.3865 x L^0.0990 x P60^0.8217
166	q'10 - Zone 9 [7 parameter] Equation (cfs) q10 = 50.808 x A^0.3799 x R^-0.1432 x DH^0.3401 x L^0.0917 x LL^0.2879 x P10^-0.9655 x P60^1.8748
150	Enter selected q'10
150	Q10 (***corrected for storage)
71	Q2.33 = 0.46921 x Q10 ^1.00243
246	Q50 = 1.45962 x Q10 ^1.02342
285	Q100 = 1.64380 x Q10 ^1.02918

Rainfall/Support Data

Extreme Precipitation Tables

Northeast Regional Climate Center

Data represents point estimates calculated from partial duration series. All precipitation amounts are displayed in inches.

Smoothing	Yes
State	New Hampshire
Location	
Longitude	71.247 degrees West
Latitude	44.622 degrees North
Elevation	0 feet
Date/Time	Tue, 14 Nov 2017 13:31:07 -0500

Extreme Precipitation Estimates

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.26	0.40	0.50	0.65	0.82	1.01	**1yr**	0.70	0.94	1.14	1.38	1.65	1.96	2.30	**1yr**	1.74	2.21	2.64	3.28	3.83	**1yr**
2yr	0.29	0.45	0.56	0.73	0.92	1.15	**2yr**	0.80	1.07	1.31	1.60	1.94	2.34	2.68	**2yr**	2.07	2.58	3.08	3.76	4.35	**2yr**
5yr	0.34	0.53	0.66	0.89	1.13	1.42	**5yr**	0.98	1.29	1.63	1.98	2.39	2.85	3.32	**5yr**	2.53	3.19	3.73	4.50	5.14	**5yr**
10yr	0.37	0.59	0.75	1.02	1.32	1.67	**10yr**	1.14	1.50	1.92	2.33	2.80	3.32	3.90	**10yr**	2.94	3.75	4.31	5.17	5.84	**10yr**
25yr	0.44	0.70	0.89	1.22	1.63	2.07	**25yr**	1.41	1.83	2.38	2.89	3.45	4.06	4.83	**25yr**	3.60	4.65	5.24	6.21	6.91	**25yr**
50yr	0.49	0.79	1.01	1.41	1.91	2.44	**50yr**	1.65	2.12	2.80	3.40	4.05	4.74	5.68	**50yr**	4.19	5.47	6.07	7.13	7.86	**50yr**
100yr	0.56	0.90	1.16	1.65	2.24	2.87	**100yr**	1.93	2.47	3.31	4.00	4.73	5.52	6.69	**100yr**	4.88	6.43	7.04	8.19	8.94	**100yr**
200yr	0.63	1.03	1.34	1.91	2.63	3.38	**200yr**	2.27	2.88	3.90	4.71	5.55	6.44	7.87	**200yr**	5.70	7.57	8.16	9.42	10.18	**200yr**
500yr	0.74	1.23	1.60	2.32	3.26	4.22	**500yr**	2.81	3.54	4.86	5.85	6.86	7.89	9.78	**500yr**	6.98	9.40	9.95	11.35	12.10	**500yr**

Lower Confidence Limits

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.21	0.32	0.39	0.52	0.64	0.83	**1yr**	0.55	0.82	0.93	1.18	1.58	1.76	2.02	**1yr**	1.56	1.95	2.33	2.86	3.43	**1yr**
2yr	0.28	0.43	0.53	0.72	0.89	1.06	**2yr**	0.77	1.04	1.20	1.53	1.91	2.28	2.63	**2yr**	2.02	2.53	3.00	3.68	4.27	**2yr**
5yr	0.31	0.48	0.59	0.82	1.04	1.22	**5yr**	0.90	1.19	1.36	1.76	2.32	2.68	3.13	**5yr**	2.37	3.01	3.54	4.27	4.93	**5yr**
10yr	0.35	0.54	0.66	0.93	1.20	1.36	**10yr**	1.03	1.33	1.51	1.97	2.44	3.03	3.57	**10yr**	2.68	3.44	3.99	4.76	5.49	**10yr**
25yr	0.40	0.60	0.75	1.07	1.41	1.57	**25yr**	1.22	1.54	1.74	2.24	2.78	3.56	4.23	**25yr**	3.15	4.07	4.67	5.52	6.35	**25yr**
50yr	0.43	0.66	0.82	1.18	1.59	1.77	**50yr**	1.37	1.73	1.92	2.46	3.05	4.03	4.82	**50yr**	3.56	4.63	5.26	6.16	7.10	**50yr**
100yr	0.48	0.73	0.91	1.32	1.81	2.05	**100yr**	1.56	2.01	2.30	2.69	3.34	4.57	5.48	**100yr**	4.04	5.27	5.94	6.89	7.95	**100yr**
200yr	0.53	0.80	1.02	1.47	2.05	2.32	**200yr**	1.77	2.27	2.58	2.93	3.63	5.17	6.24	**200yr**	4.58	6.00	6.72	7.67	8.91	**200yr**
500yr	0.62	0.92	1.18	1.72	2.45	2.75	**500yr**	2.11	2.68	3.02	3.27	4.00	6.11	7.39	**500yr**	5.41	7.11	7.94	8.90	10.41	**500yr**

Upper Confidence Limits

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.28	0.44	0.53	0.72	0.88	1.04	**1yr**	0.76	1.02	1.21	1.57	1.92	2.11	2.61	**1yr**	1.87	2.51	2.85	3.50	4.05	**1yr**
2yr	0.30	0.46	0.57	0.77	0.95	1.14	**2yr**	0.82	1.11	1.29	1.67	2.07	2.40	2.76	**2yr**	2.13	2.66	3.17	3.87	4.44	**2yr**
5yr	0.36	0.55	0.68	0.94	1.19	1.40	**5yr**	1.03	1.37	1.60	2.09	2.54	3.04	3.53	**5yr**	2.69	3.39	3.94	4.72	5.36	**5yr**
10yr	0.42	0.65	0.80	1.12	1.45	1.68	**10yr**	1.25	1.64	1.93	2.52	3.13	3.63	4.26	**10yr**	3.21	4.09	4.66	5.52	6.19	**10yr**
25yr	0.52	0.79	0.99	1.41	1.85	2.15	**25yr**	1.60	2.10	2.48	3.24	4.05	4.60	5.46	**25yr**	4.07	5.25	5.84	6.80	7.48	**25yr**
50yr	0.61	0.93	1.16	1.66	2.24	2.58	**50yr**	1.93	2.52	2.99	3.94	4.92	5.50	6.61	**50yr**	4.86	6.36	6.92	7.96	8.64	**50yr**
100yr	0.72	1.09	1.36	1.97	2.70	3.00	**100yr**	2.33	2.94	3.48	4.80	6.01	6.57	7.99	**100yr**	5.81	7.68	8.24	9.31	9.98	**100yr**
200yr	0.85	1.28	1.62	2.34	3.27	3.59	**200yr**	2.82	3.51	4.17	5.85	7.35	7.85	9.68	**200yr**	6.95	9.31	9.78	10.90	11.53	**200yr**
500yr	1.06	1.58	2.04	2.96	4.21	4.54	**500yr**	3.63	4.44	5.31	7.60	9.63	9.95	12.48	**500yr**	8.81	12.00	12.28	13.44	13.95	**500yr**

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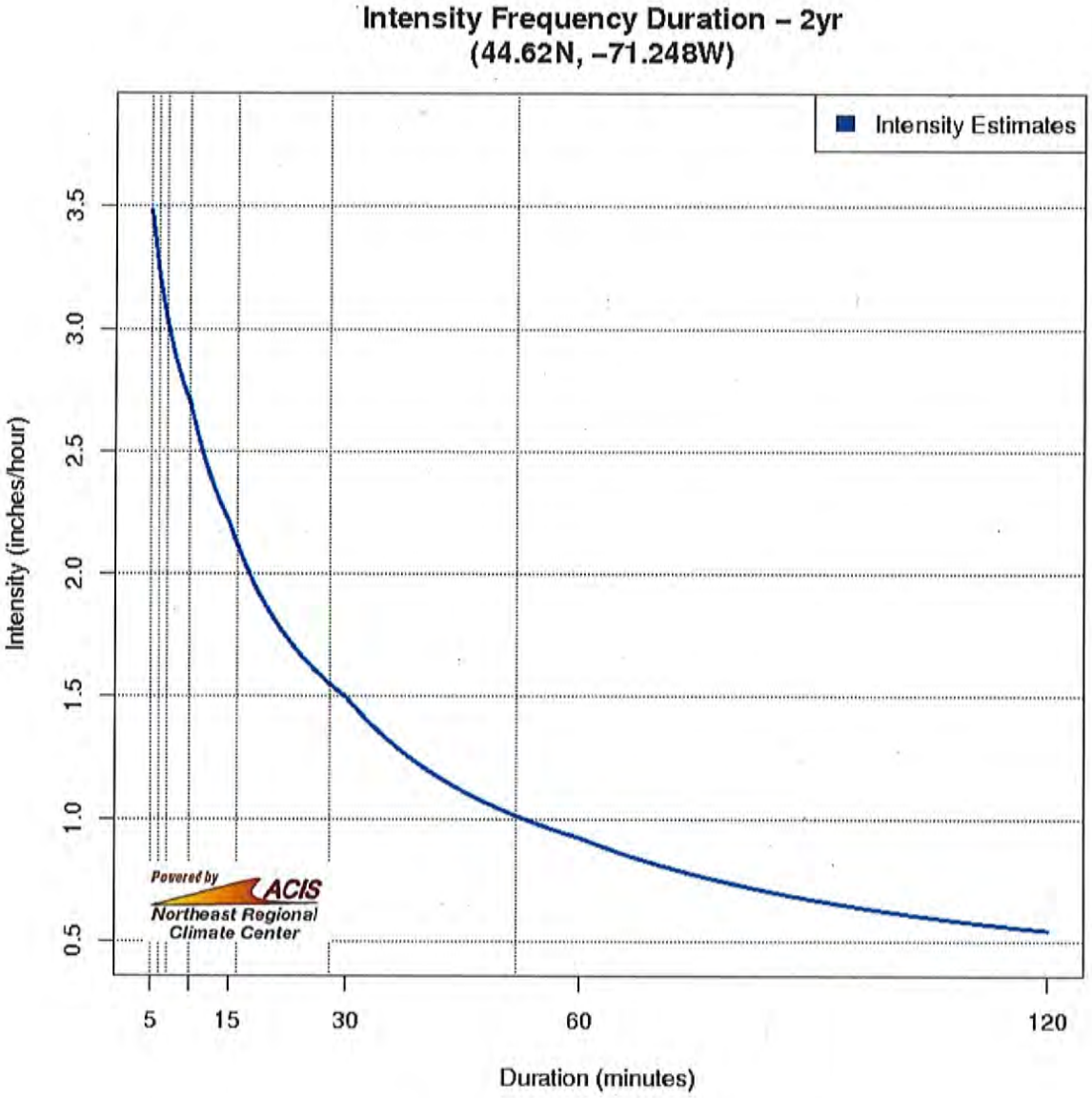
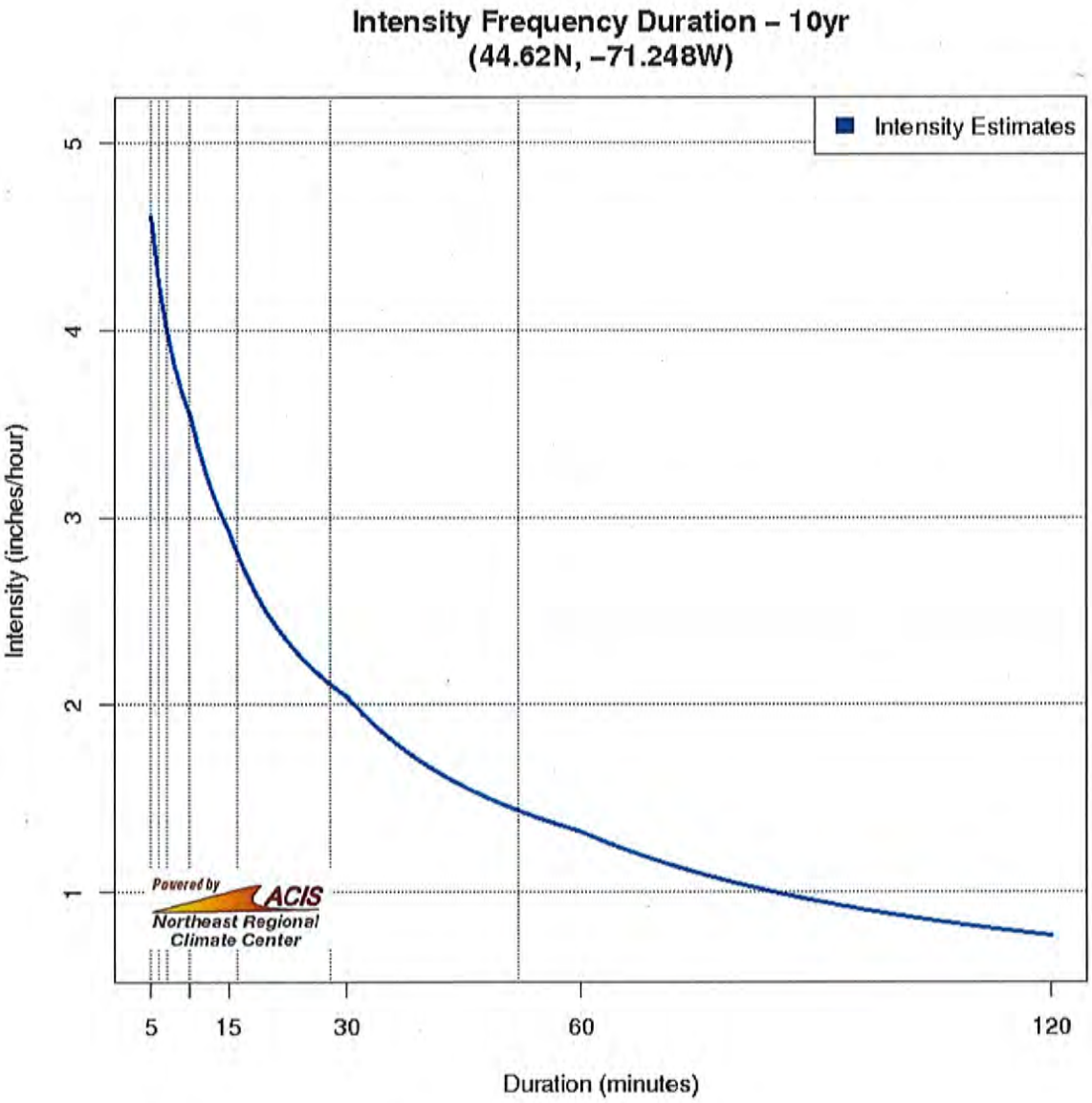


Time (mins)	Intensity (in/hr)
5	3.48
6*	3.22
7*	3.03
8*	2.89
9*	2.78
10	2.69
11*	2.56
12*	2.45
13*	2.36
14*	2.28
15	2.21
16*	2.12
17*	2.04
18*	1.97
19*	1.91
20*	1.86

21*	1.80
22*	1.76
23*	1.72
24*	1.68
25*	1.64
26*	1.61
27*	1.58
28*	1.55
29*	1.52
30	1.50
31*	1.46
32*	1.43
33*	1.39
34*	1.36
35*	1.33
36*	1.31
37*	1.28
38*	1.26
39*	1.23
40*	1.21
41*	1.19
42*	1.17
43*	1.15
44*	1.13
45*	1.11
46*	1.10
47*	1.08
48*	1.07
49*	1.05
50*	1.04
51*	1.02
52*	1.01
53*	1.00
54*	0.99
55*	0.98
56*	0.96
57*	0.95
58*	0.94
59*	0.93
60	0.92
61*	0.91
62*	0.90
63*	0.89
64*	0.88
65*	0.86
66*	0.85
67*	0.84
68*	0.83
69*	0.82
70*	0.81
71*	0.81
72*	0.80
73*	0.79
74*	0.78
75*	0.77
76*	0.76
77*	0.76
78*	0.75
79*	0.74
80*	0.73

81*	0.73
82*	0.72
83*	0.71
84*	0.71
85*	0.70
86*	0.69
87*	0.69
88*	0.68
89*	0.68
90*	0.67
91*	0.67
92*	0.66
93*	0.65
94*	0.65
95*	0.64
96*	0.64
97*	0.63
98*	0.63
99*	0.62
100*	0.62
101*	0.62
102*	0.61
103*	0.61
104*	0.60
105*	0.60
106*	0.59
107*	0.59
108*	0.59
109*	0.58
110*	0.58
111*	0.58
112*	0.57
113*	0.57
114*	0.56
115*	0.56
116*	0.56
117*	0.55
118*	0.55
119*	0.55
120	0.54

*values for noted rows are calculated estimates

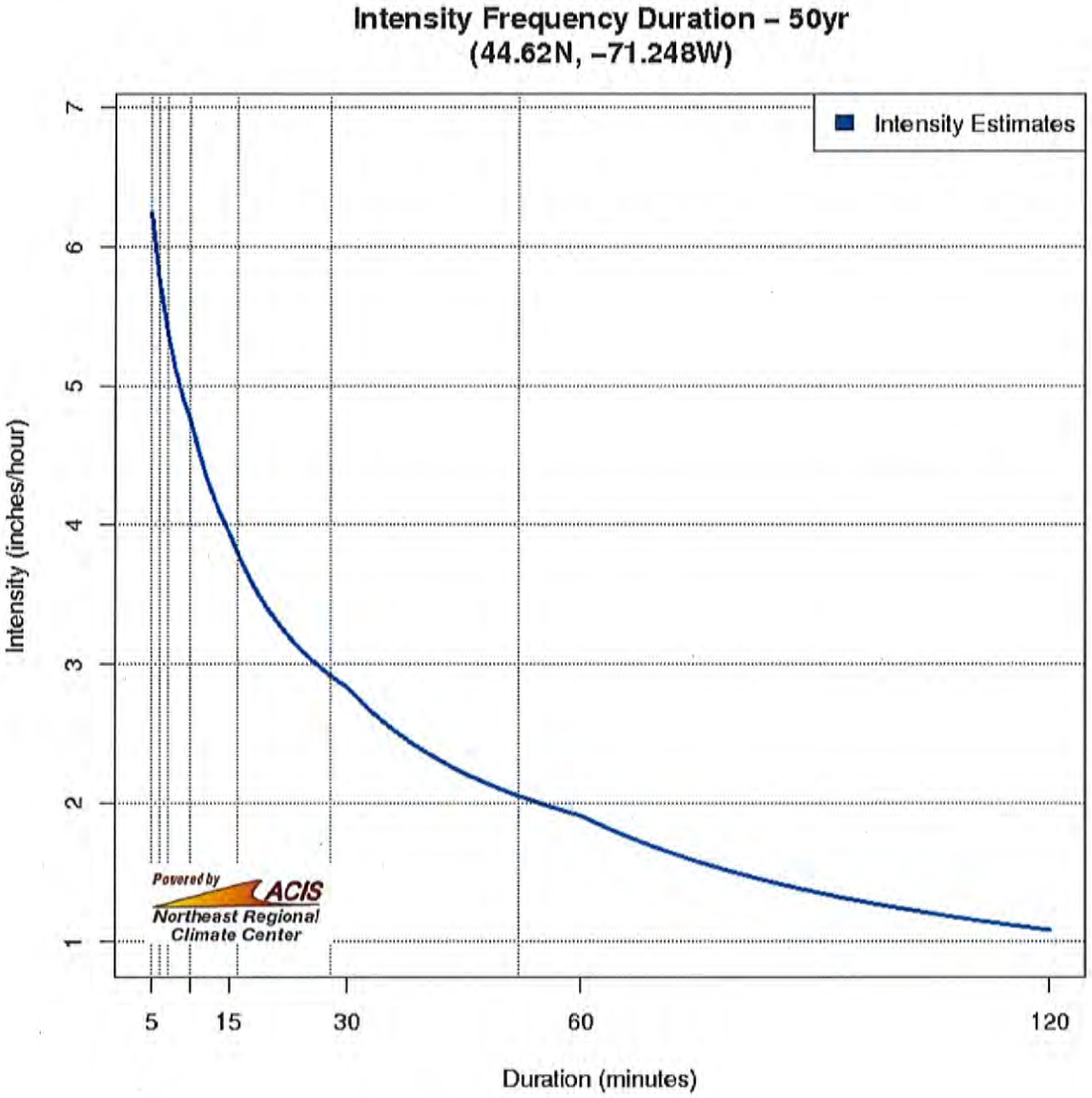


Time (mins)	Intensity (in/hr)
5	4.61
6*	4.25
7*	4.00
8*	3.81
9*	3.66
10	3.55
11*	3.38
12*	3.24
13*	3.12
14*	3.02
15	2.93
16*	2.82
17*	2.72
18*	2.63
19*	2.56
20*	2.49

21*	2.42
22*	2.37
23*	2.31
24*	2.27
25*	2.22
26*	2.18
27*	2.14
28*	2.11
29*	2.08
30	2.05
31*	2.00
32*	1.96
33*	1.91
34*	1.88
35*	1.84
36*	1.80
37*	1.77
38*	1.74
39*	1.71
40*	1.68
41*	1.66
42*	1.63
43*	1.61
44*	1.59
45*	1.56
46*	1.54
47*	1.52
48*	1.50
49*	1.48
50*	1.47
51*	1.45
52*	1.43
53*	1.42
54*	1.40
55*	1.39
56*	1.37
57*	1.36
58*	1.35
59*	1.33
60	1.32
61*	1.30
62*	1.29
63*	1.27
64*	1.25
65*	1.24
66*	1.22
67*	1.21
68*	1.19
69*	1.18
70*	1.16
71*	1.15
72*	1.14
73*	1.12
74*	1.11
75*	1.10
76*	1.09
77*	1.08
78*	1.07
79*	1.05
80*	1.04

81*	1.03
82*	1.02
83*	1.01
84*	1.00
85*	1.00
86*	0.99
87*	0.98
88*	0.97
89*	0.96
90*	0.95
91*	0.94
92*	0.94
93*	0.93
94*	0.92
95*	0.91
96*	0.91
97*	0.90
98*	0.89
99*	0.88
100*	0.88
101*	0.87
102*	0.86
103*	0.86
104*	0.85
105*	0.85
106*	0.84
107*	0.83
108*	0.83
109*	0.82
110*	0.82
111*	0.81
112*	0.81
113*	0.80
114*	0.80
115*	0.79
116*	0.79
117*	0.78
118*	0.78
119*	0.77
120	0.77

*values for noted rows are calculated estimates

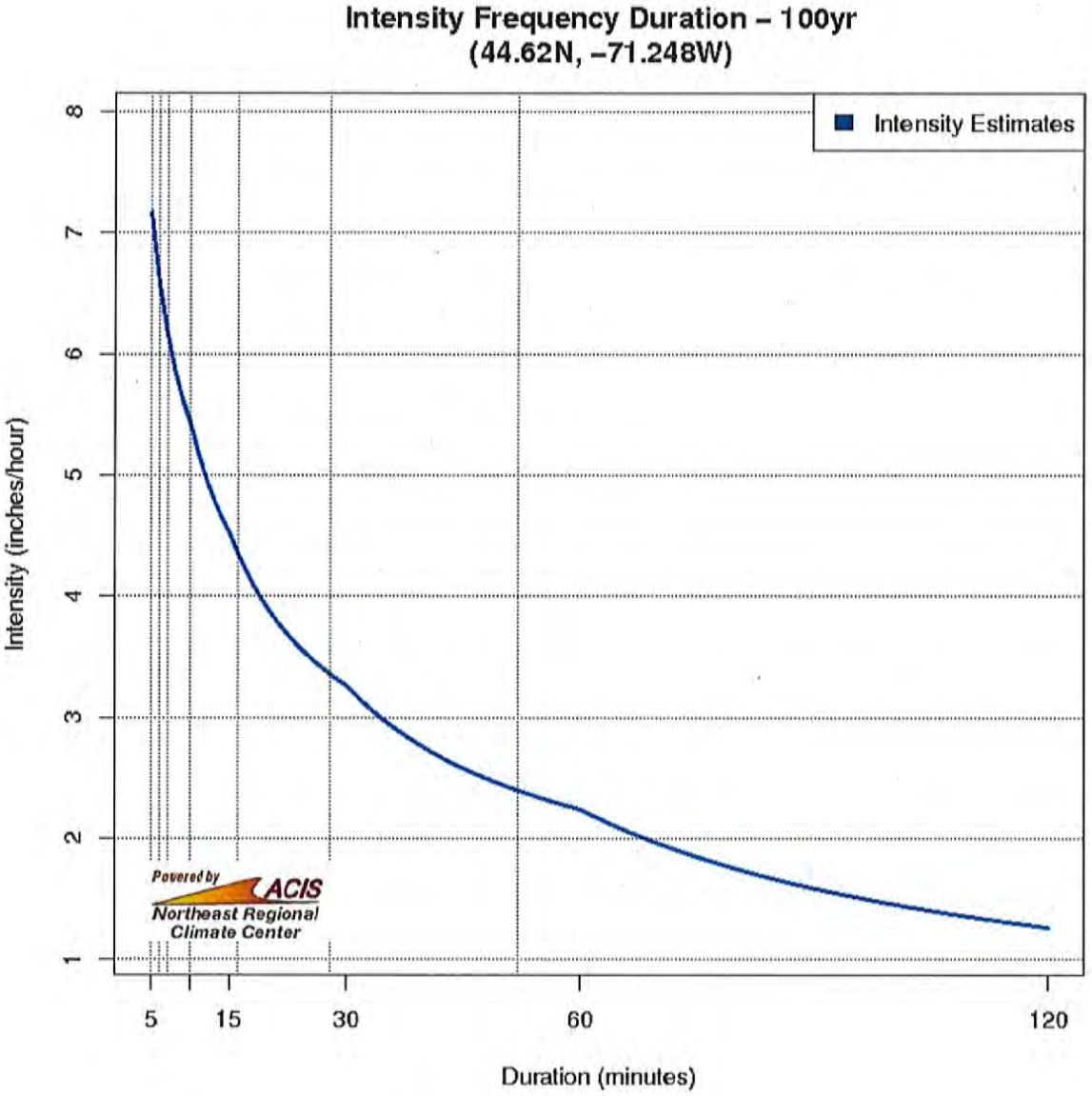


Time (mins)	Intensity (in/hr)
5	6.24
6*	5.74
7*	5.39
8*	5.12
9*	4.91
10	4.75
11*	4.53
12*	4.35
13*	4.19
14*	4.06
15	3.94
16*	3.81
17*	3.68
18*	3.57
19*	3.48
20*	3.39

21*	3.31
22*	3.24
23*	3.17
24*	3.11
25*	3.06
26*	3.00
27*	2.96
28*	2.91
29*	2.87
30	2.83
31*	2.77
32*	2.72
33*	2.67
34*	2.62
35*	2.57
36*	2.53
37*	2.48
38*	2.44
39*	2.41
40*	2.37
41*	2.34
42*	2.30
43*	2.27
44*	2.24
45*	2.22
46*	2.19
47*	2.16
48*	2.14
49*	2.12
50*	2.09
51*	2.07
52*	2.05
53*	2.03
54*	2.01
55*	1.99
56*	1.97
57*	1.96
58*	1.94
59*	1.92
60	1.91
61*	1.88
62*	1.85
63*	1.83
64*	1.80
65*	1.78
66*	1.76
67*	1.74
68*	1.71
69*	1.69
70*	1.67
71*	1.65
72*	1.63
73*	1.61
74*	1.60
75*	1.58
76*	1.56
77*	1.54
78*	1.53
79*	1.51
80*	1.50

81*	1.48
82*	1.47
83*	1.45
84*	1.44
85*	1.42
86*	1.41
87*	1.40
88*	1.38
89*	1.37
90*	1.36
91*	1.35
92*	1.34
93*	1.32
94*	1.31
95*	1.30
96*	1.29
97*	1.28
98*	1.27
99*	1.26
100*	1.25
101*	1.24
102*	1.23
103*	1.22
104*	1.21
105*	1.20
106*	1.19
107*	1.19
108*	1.18
109*	1.17
110*	1.16
111*	1.15
112*	1.14
113*	1.14
114*	1.13
115*	1.12
116*	1.11
117*	1.11
118*	1.10
119*	1.09
120	1.09

*values for noted rows are calculated estimates



Time (mins)	Intensity (in/hr)
5	7.16
6*	6.58
7*	6.16
8*	5.85
9*	5.61
10	5.41
11*	5.17
12*	4.97
13*	4.79
14*	4.65
15	4.52
16*	4.36
17*	4.22
18*	4.10
19*	3.99
20*	3.89

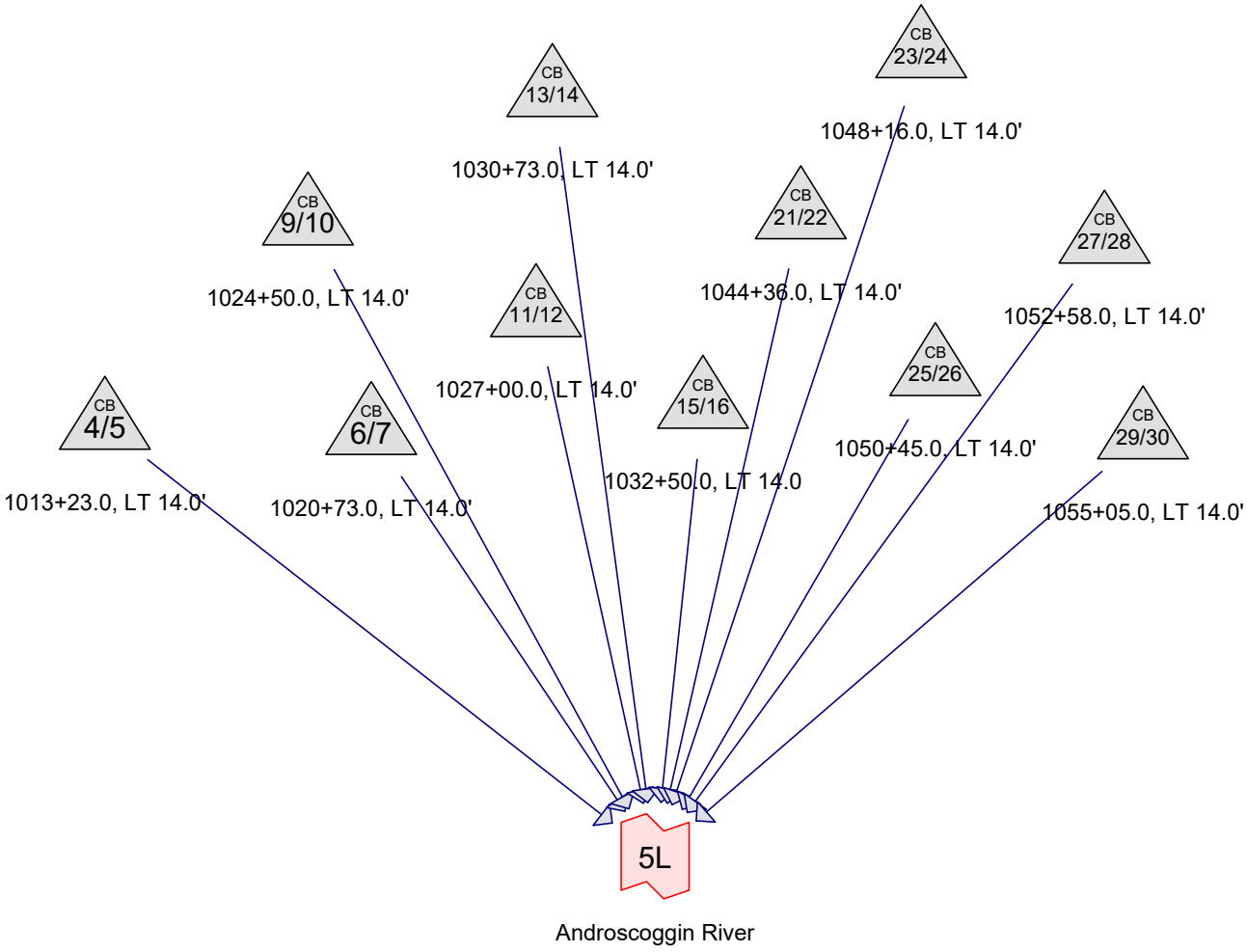
21*	3.80
22*	3.72
23*	3.65
24*	3.58
25*	3.52
26*	3.46
27*	3.40
28*	3.35
29*	3.31
30	3.26
31*	3.20
32*	3.14
33*	3.08
34*	3.02
35*	2.97
36*	2.92
37*	2.88
38*	2.83
39*	2.79
40*	2.75
41*	2.71
42*	2.68
43*	2.64
44*	2.61
45*	2.58
46*	2.55
47*	2.52
48*	2.50
49*	2.47
50*	2.44
51*	2.42
52*	2.40
53*	2.37
54*	2.35
55*	2.33
56*	2.31
57*	2.29
58*	2.27
59*	2.26
60	2.24
61*	2.21
62*	2.18
63*	2.15
64*	2.12
65*	2.09
66*	2.06
67*	2.04
68*	2.01
69*	1.98
70*	1.96
71*	1.94
72*	1.91
73*	1.89
74*	1.87
75*	1.85
76*	1.83
77*	1.81
78*	1.79
79*	1.77
80*	1.75

81*	1.73
82*	1.72
83*	1.70
84*	1.68
85*	1.67
86*	1.65
87*	1.63
88*	1.62
89*	1.60
90*	1.59
91*	1.58
92*	1.56
93*	1.55
94*	1.53
95*	1.52
96*	1.51
97*	1.50
98*	1.48
99*	1.47
100*	1.46
101*	1.45
102*	1.44
103*	1.43
104*	1.41
105*	1.40
106*	1.39
107*	1.38
108*	1.37
109*	1.36
110*	1.35
111*	1.34
112*	1.33
113*	1.32
114*	1.32
115*	1.31
116*	1.30
117*	1.29
118*	1.28
119*	1.27
120	1.26

*values for noted rows are calculated estimates

B

Appendix B
Culvert Design



Subcat Reach Pond Link

Routing Diagram for 16304_Dummer_Culverts_w_CBs
Prepared by VHB, Printed 4/2/2018

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.000	**0**	**TOTAL AREA**

Soil Listing (selected nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.000	Other	
0.000		**TOTAL AREA**

Ground Covers (selected nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**TOTAL AREA**	

Pipe Listing (selected nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	4/5	1,140.00	1,136.43	59.0	0.0605	0.013	18.0	0.0	0.0
2	6/7	1,137.30	1,132.52	80.0	0.0597	0.013	18.0	0.0	0.0
3	9/10	1,135.33	1,133.56	85.0	0.0208	0.013	18.0	0.0	0.0
4	11/12	1,135.97	1,133.49	80.0	0.0310	0.013	18.0	0.0	0.0
5	13/14	1,138.03	1,135.12	80.0	0.0364	0.013	18.0	0.0	0.0
6	15/16	1,139.03	1,135.05	80.0	0.0498	0.013	18.0	0.0	0.0
7	21/22	1,139.84	1,137.03	81.0	0.0347	0.013	18.0	0.0	0.0
8	23/24	1,140.85	1,139.23	80.0	0.0202	0.013	18.0	0.0	0.0
9	25/26	1,140.55	1,137.95	100.0	0.0260	0.013	24.0	0.0	0.0
10	27/28	1,144.82	1,140.67	75.0	0.0553	0.013	24.0	0.0	0.0
11	29/30	1,154.91	1,150.16	80.0	0.0594	0.013	18.0	0.0	0.0

Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Pond 4/5: 1013+23.0, LT 14.0' Peak Elev=1,141.06' Inflow=4.68 cfs 18.569 af
18.0" Round Culvert n=0.013 L=59.0' S=0.0605 '/' Outflow=4.68 cfs 18.569 af

Pond 6/7: 1020+73.0, LT 14.0' Peak Elev=1,138.61' Inflow=7.96 cfs 31.583 af
18.0" Round Culvert n=0.013 L=80.0' S=0.0597 '/' Outflow=7.96 cfs 31.583 af

Pond 9/10: 1024+50.0, LT 14.0' Peak Elev=1,136.22' Inflow=3.52 cfs 13.967 af
18.0" Round Culvert n=0.013 L=85.0' S=0.0208 '/' Outflow=3.52 cfs 13.967 af

Pond 11/12: 1027+00.0, LT 14.0' Peak Elev=1,137.53' Inflow=7.64 cfs 30.314 af
18.0" Round Culvert n=0.013 L=80.0' S=0.0310 '/' Outflow=7.64 cfs 30.314 af

Pond 13/14: 1030+73.0, LT 14.0' Peak Elev=1,138.43' Inflow=0.83 cfs 3.293 af
18.0" Round Culvert n=0.013 L=80.0' S=0.0364 '/' Outflow=0.83 cfs 3.293 af

Pond 15/16: 1032+50.0, LT 14.0 Peak Elev=1,140.08' Inflow=4.63 cfs 18.371 af
18.0" Round Culvert n=0.013 L=80.0' S=0.0498 '/' Outflow=4.63 cfs 18.371 af

Pond 21/22: 1044+36.0, LT 14.0' Peak Elev=1,141.44' Inflow=7.84 cfs 31.107 af
18.0" Round Culvert n=0.013 L=81.0' S=0.0347 '/' Outflow=7.84 cfs 31.107 af

Pond 23/24: 1048+16.0, LT 14.0' Peak Elev=1,141.84' Inflow=4.20 cfs 16.665 af
18.0" Round Culvert n=0.013 L=80.0' S=0.0202 '/' Outflow=4.20 cfs 16.665 af

Pond 25/26: 1050+45.0, LT 14.0' Peak Elev=1,142.22' Inflow=12.34 cfs 48.962 af
24.0" Round Culvert n=0.013 L=100.0' S=0.0260 '/' Outflow=12.34 cfs 48.962 af

Pond 27/28: 1052+58.0, LT 14.0' Peak Elev=1,146.67' Inflow=14.06 cfs 55.787 af
24.0" Round Culvert n=0.013 L=75.0' S=0.0553 '/' Outflow=14.06 cfs 55.787 af

Pond 29/30: 1055+05.0, LT 14.0' Peak Elev=1,160.41' Inflow=18.55 cfs 73.602 af
18.0" Round Culvert n=0.013 L=80.0' S=0.0594 '/' Outflow=18.55 cfs 73.602 af

Link 5L: AndroscogginRiver Inflow=86.25 cfs 342.220 af
Primary=86.25 cfs 342.220 af

Summary for Pond 4/5: 1013+23.0, LT 14.0'

50 Year Rational Method flows used. See proposed condition excel spreadsheet.Flood elevations reflect 1' freeboard to shoulder break.

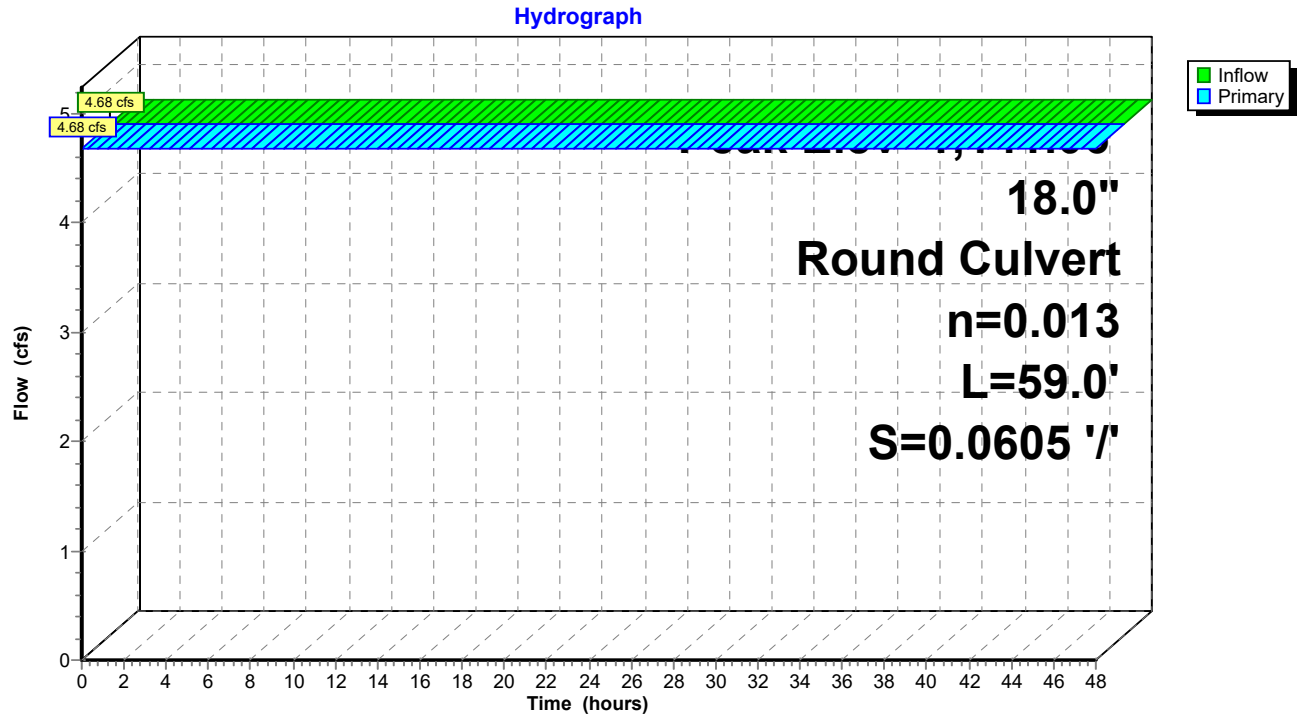
Inflow	=	4.68 cfs @	0.00 hrs, Volume=	18.569 af,	Incl. 4.68 cfs Base Flow
Outflow	=	4.68 cfs @	0.00 hrs, Volume=	18.569 af,	Atten= 0%, Lag= 0.0 min
Primary	=	4.68 cfs @	0.00 hrs, Volume=	18.569 af	

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 1,141.06' @ 0.00 hrs
Flood Elev= 1,144.30'

Device	Routing	Invert	Outlet Devices
#1	Primary	1,140.00'	**18.0" Round RCP_Round 18"** L= 59.0' RCP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 1,140.00' / 1,136.43' S= 0.0605 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 1.77 sf

Primary OutFlow Max=4.68 cfs @ 0.00 hrs HW=1,141.06' (Free Discharge)
└**1=RCP_Round 18"** (Inlet Controls 4.68 cfs @ 3.51 fps)

Pond 4/5: 1013+23.0, LT 14.0'



Summary for Pond 6/7: 1020+73.0, LT 14.0'

50 Year Rational Method flows used. See proposed condition excel spreadsheet.Flood elevations reflect 1' freeboard to shoulder break.

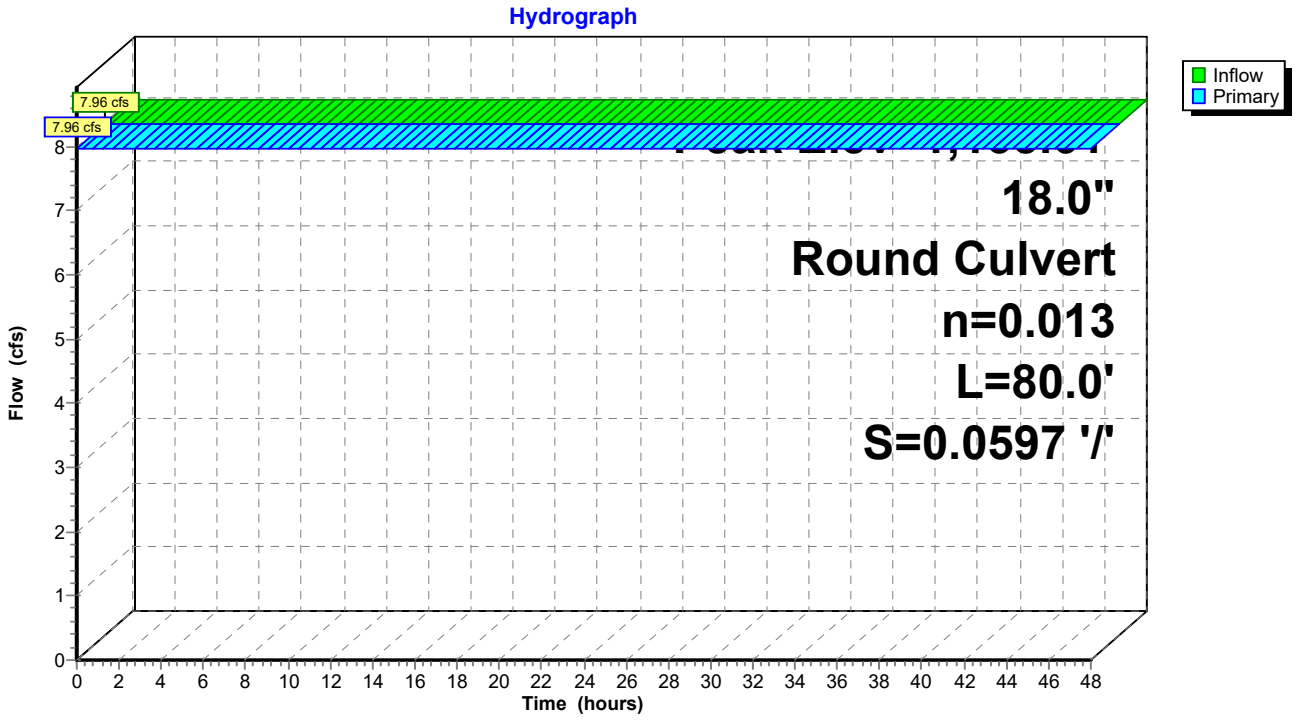
Inflow	=	7.96 cfs @	0.00 hrs,	Volume=	31.583 af, Incl. 7.96 cfs Base Flow
Outflow	=	7.96 cfs @	0.00 hrs,	Volume=	31.583 af, Atten= 0%, Lag= 0.0 min
Primary	=	7.96 cfs @	0.00 hrs,	Volume=	31.583 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 1,138.61' @ 0.00 hrs
Flood Elev= 1,142.58'

Device	Routing	Invert	Outlet Devices
#1	Primary	1,137.30'	**18.0" Round RCP_Round 18"** L= 80.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 1,137.30' / 1,132.52' S= 0.0597 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 1.77 sf

Primary OutFlow Max=7.96 cfs @ 0.00 hrs HW=1,138.61' (Free Discharge)
└**1=RCP_Round 18"** (Inlet Controls 7.96 cfs @ 4.87 fps)

Pond 6/7: 1020+73.0, LT 14.0'



Summary for Pond 9/10: 1024+50.0, LT 14.0'

50 Year Rational Method flows used. See proposed condition excel spreadsheet.Flood elevations reflect 1' freeboard to shoulder break.

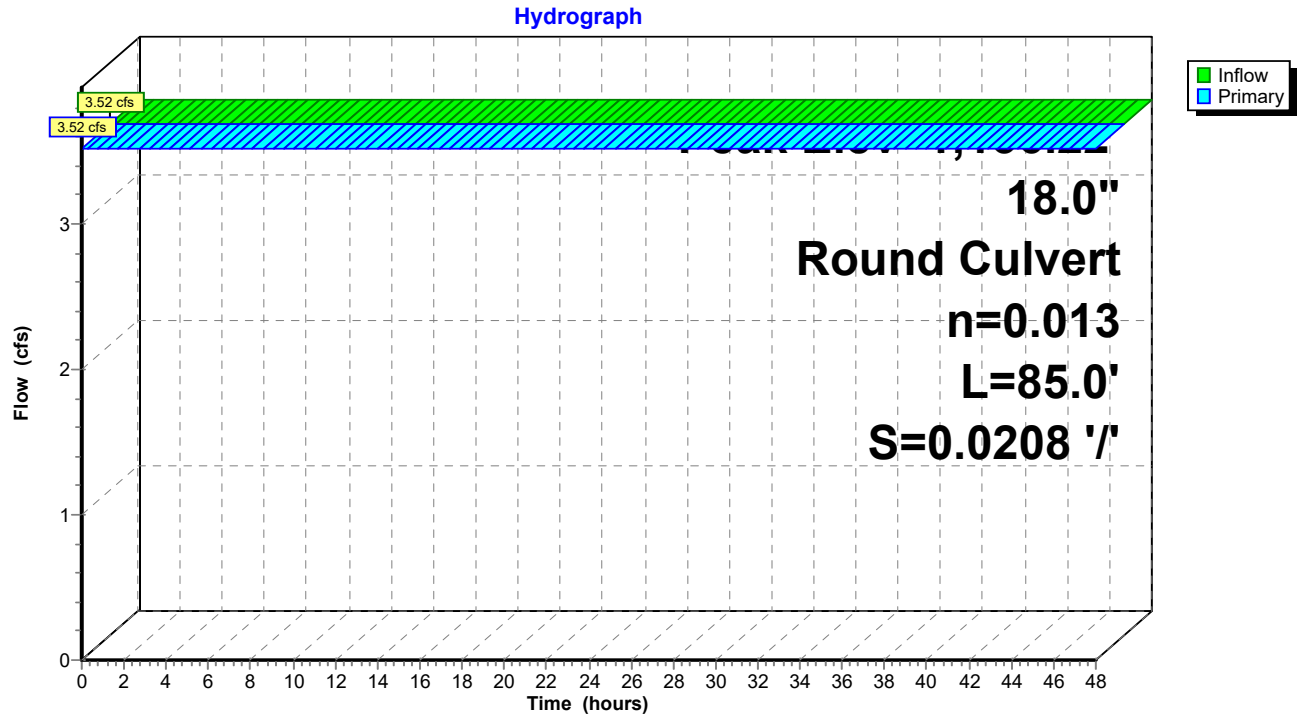
Inflow	=	3.52 cfs @	0.00 hrs, Volume=	13.967 af,	Incl. 3.52 cfs Base Flow
Outflow	=	3.52 cfs @	0.00 hrs, Volume=	13.967 af,	Atten= 0%, Lag= 0.0 min
Primary	=	3.52 cfs @	0.00 hrs, Volume=	13.967 af	

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 1,136.22' @ 0.00 hrs
Flood Elev= 1,140.60'

Device	Routing	Invert	Outlet Devices
#1	Primary	1,135.33'	**18.0" Round RCP_Round 18"** L= 85.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 1,135.33' / 1,133.56' S= 0.0208 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 1.77 sf

Primary OutFlow Max=3.52 cfs @ 0.00 hrs HW=1,136.22' (Free Discharge)
└**1=RCP_Round 18"** (Inlet Controls 3.52 cfs @ 3.21 fps)

Pond 9/10: 1024+50.0, LT 14.0'



Summary for Pond 11/12: 1027+00.0, LT 14.0'

50 Year Rational Method flows used. See proposed condition excel spreadsheet.Flood elevations reflect 1' freeboard to shoulder break.

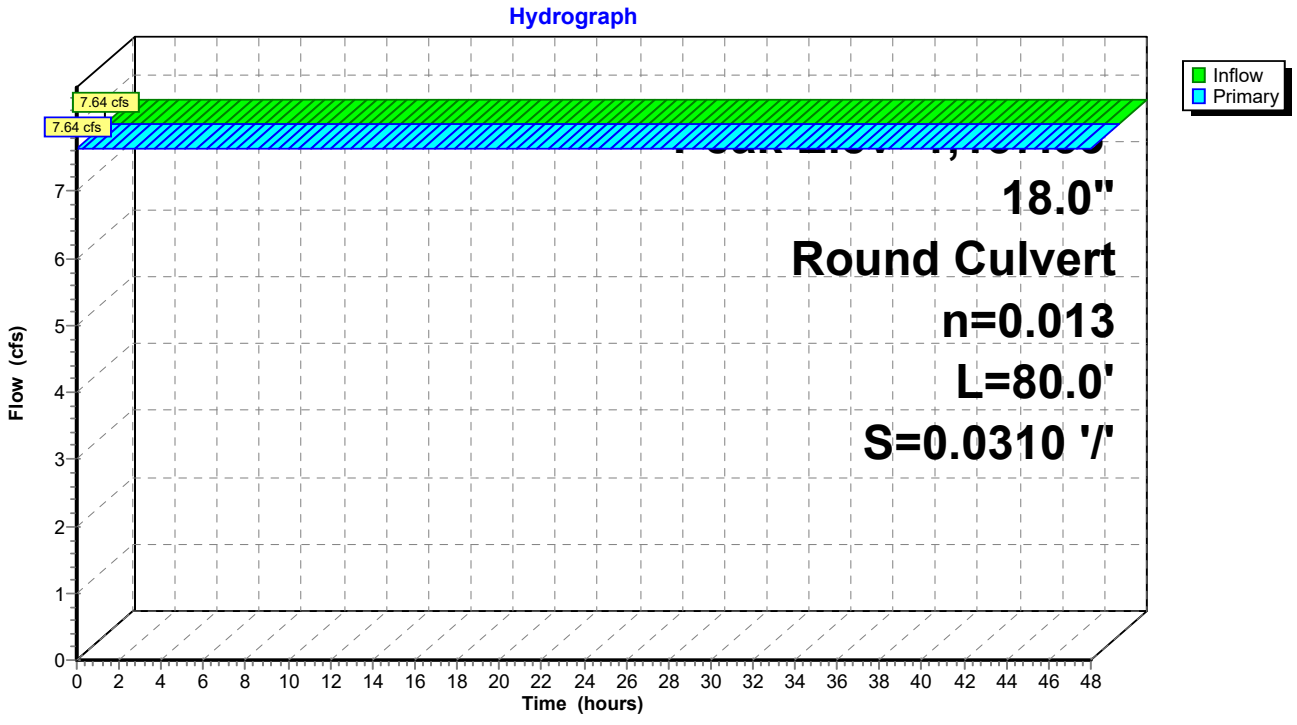
Inflow	=	7.64 cfs @	0.00 hrs,	Volume=	30.314 af, Incl. 7.64 cfs Base Flow
Outflow	=	7.64 cfs @	0.01 hrs,	Volume=	30.314 af, Atten= 0%, Lag= 0.6 min
Primary	=	7.64 cfs @	0.01 hrs,	Volume=	30.314 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 1,137.53' @ 0.00 hrs
Flood Elev= 1,141.20'

Device	Routing	Invert	Outlet Devices
#1	Primary	1,135.97'	**18.0" Round RCP_Round 18"** L= 80.0' RCP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 1,135.97' / 1,133.49' S= 0.0310 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 1.77 sf

Primary OutFlow Max=7.64 cfs @ 0.01 hrs HW=1,137.53' (Free Discharge)
└**1=RCP_Round 18"** (Inlet Controls 7.64 cfs @ 4.32 fps)

Pond 11/12: 1027+00.0, LT 14.0'



Summary for Pond 13/14: 1030+73.0, LT 14.0'

50 Year Rational Method flows used. See proposed condition excel spreadsheet.Flood elevations reflect 1' freeboard to shoulder break.

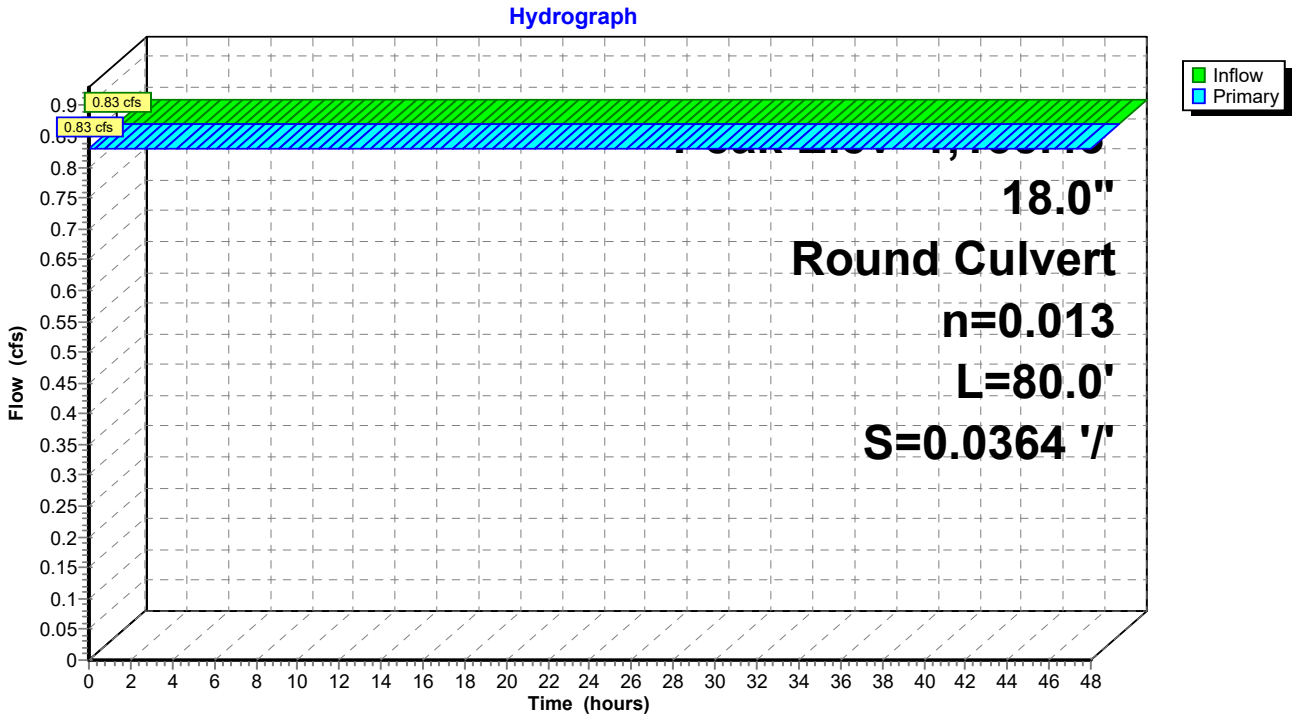
Inflow	=	0.83 cfs @	0.00 hrs, Volume=	3.293 af, Incl. 0.83 cfs Base Flow
Outflow	=	0.83 cfs @	0.00 hrs, Volume=	3.293 af, Atten= 0%, Lag= 0.0 min
Primary	=	0.83 cfs @	0.00 hrs, Volume=	3.293 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 1,138.43' @ 0.00 hrs
Flood Elev= 1,143.30'

Device	Routing	Invert	Outlet Devices
#1	Primary	1,138.03'	**18.0" Round RCP_Round 18"** L= 80.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 1,138.03' / 1,135.12' S= 0.0364 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 1.77 sf

Primary OutFlow Max=0.83 cfs @ 0.00 hrs HW=1,138.43' (Free Discharge)
1=RCP_Round 18" (Inlet Controls 0.83 cfs @ 2.16 fps)

Pond 13/14: 1030+73.0, LT 14.0'



Summary for Pond 15/16: 1032+50.0, LT 14.0

50 Year Rational Method flows used. See proposed condition excel spreadsheet.Flood elevations reflect 1' freeboard to shoulder break.

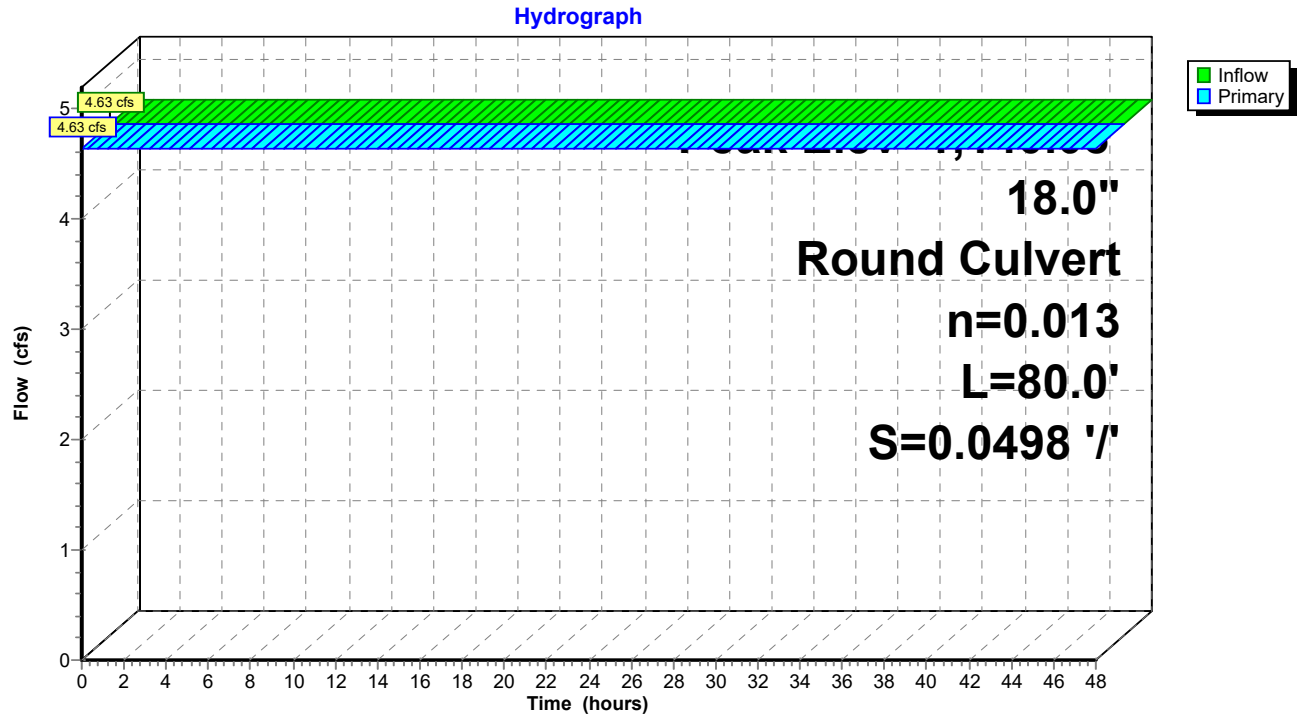
Inflow	=	4.63 cfs @	0.00 hrs, Volume=	18.371 af,	Incl. 4.63 cfs Base Flow
Outflow	=	4.63 cfs @	0.00 hrs, Volume=	18.371 af,	Atten= 0%, Lag= 0.0 min
Primary	=	4.63 cfs @	0.00 hrs, Volume=	18.371 af	

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 1,140.08' @ 0.00 hrs
Flood Elev= 1,144.30'

Device	Routing	Invert	Outlet Devices
#1	Primary	1,139.03'	**18.0" Round RCP_Round 18"** L= 80.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 1,139.03' / 1,135.05' S= 0.0498 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 1.77 sf

Primary OutFlow Max=4.63 cfs @ 0.00 hrs HW=1,140.08' (Free Discharge)
└**1=RCP_Round 18"** (Inlet Controls 4.63 cfs @ 3.49 fps)

Pond 15/16: 1032+50.0, LT 14.0



Summary for Pond 21/22: 1044+36.0, LT 14.0'

50 Year Rational Method flows used. See proposed condition excel spreadsheet.Flood elevations reflect 1' freeboard to shoulder break.

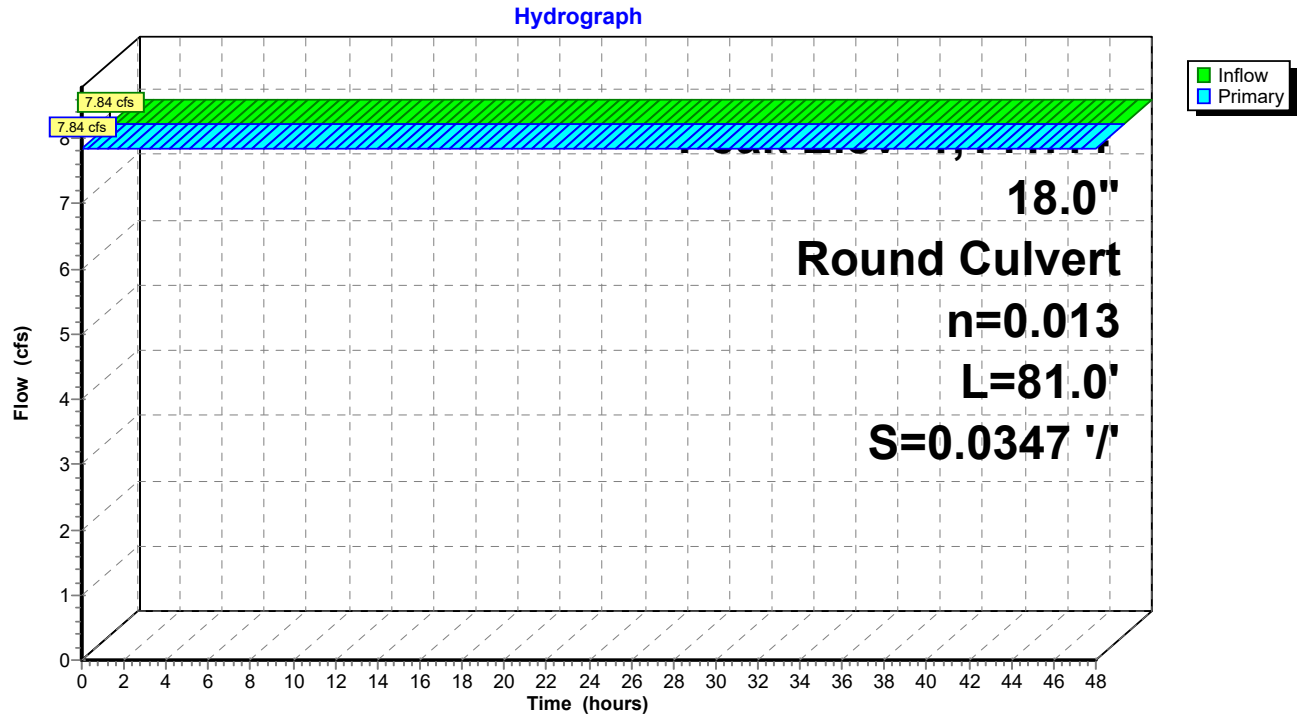
Inflow	=	7.84 cfs @	0.00 hrs,	Volume=	31.107 af, Incl. 7.84 cfs Base Flow
Outflow	=	7.84 cfs @	0.00 hrs,	Volume=	31.107 af, Atten= 0%, Lag= 0.0 min
Primary	=	7.84 cfs @	0.00 hrs,	Volume=	31.107 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 1,141.44' @ 0.00 hrs
Flood Elev= 1,145.10'

Device	Routing	Invert	Outlet Devices
#1	Primary	1,139.84'	**18.0" Round RCP_Round 18"** L= 81.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 1,139.84' / 1,137.03' S= 0.0347 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 1.77 sf

Primary OutFlow Max=7.84 cfs @ 0.00 hrs HW=1,141.44' (Free Discharge)
└**1=RCP_Round 18"** (Inlet Controls 7.84 cfs @ 4.44 fps)

Pond 21/22: 1044+36.0, LT 14.0'



Summary for Pond 23/24: 1048+16.0, LT 14.0'

50 Year Rational Method flows used. See proposed condition excel spreadsheet.Flood elevations reflect 1' freeboard to shoulder break.

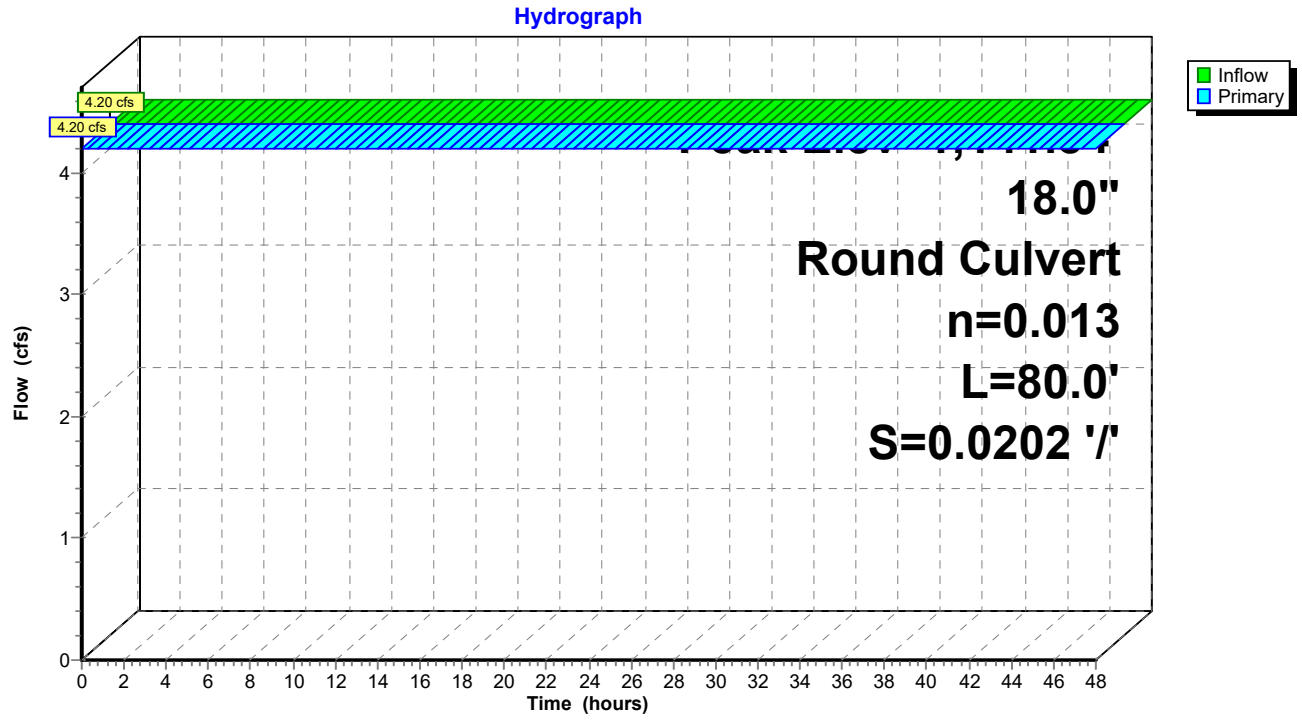
Inflow	=	4.20 cfs @	0.00 hrs,	Volume=	16.665 af, Incl. 4.20 cfs Base Flow
Outflow	=	4.20 cfs @	0.00 hrs,	Volume=	16.665 af, Atten= 0%, Lag= 0.0 min
Primary	=	4.20 cfs @	0.00 hrs,	Volume=	16.665 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 1,141.84' @ 0.00 hrs
Flood Elev= 1,146.15'

Device	Routing	Invert	Outlet Devices
#1	Primary	1,140.85'	**18.0" Round RCP_Round 18"** L= 80.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 1,140.85' / 1,139.23' S= 0.0202 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 1.77 sf

Primary OutFlow Max=4.20 cfs @ 0.00 hrs HW=1,141.84' (Free Discharge)
└**1=RCP_Round 18"** (Inlet Controls 4.20 cfs @ 3.39 fps)

Pond 23/24: 1048+16.0, LT 14.0'



Summary for Pond 25/26: 1050+45.0, LT 14.0'

50 Year Rational Method flows used. See proposed condition excel spreadsheet.Flood elevations reflect 1' freeboard to shoulder break.

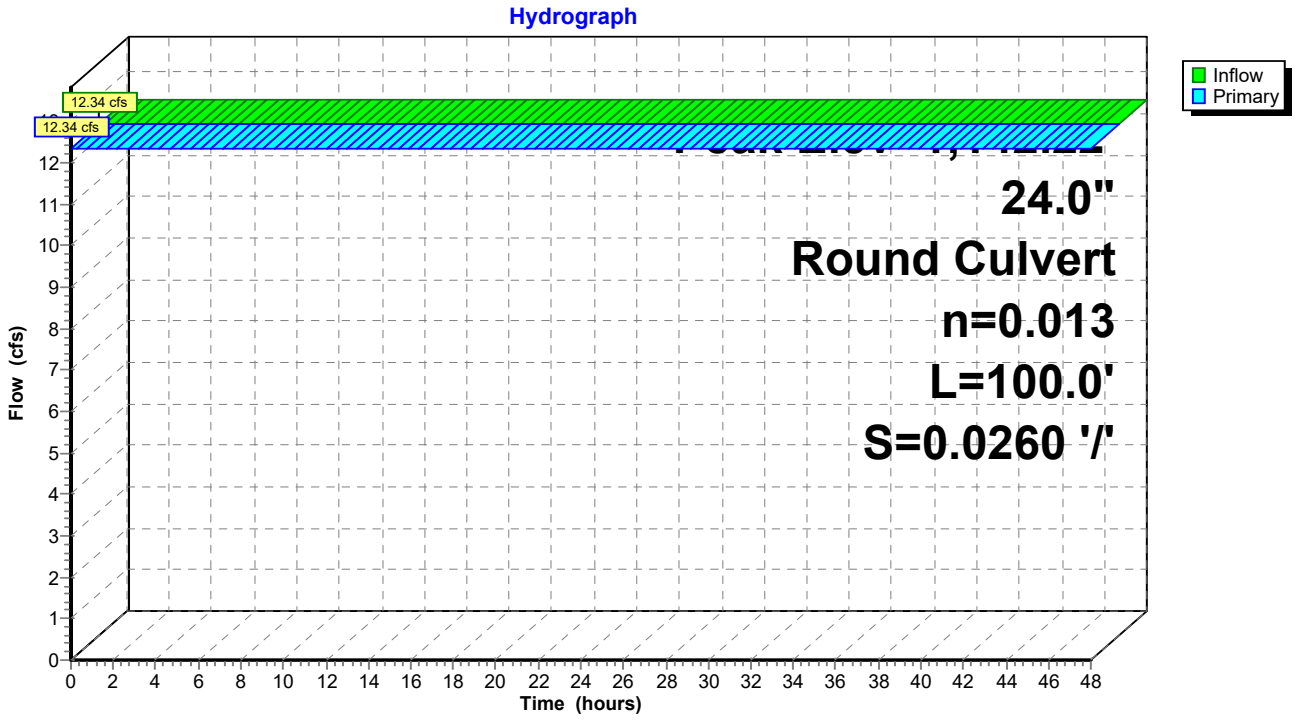
Inflow	=	12.34 cfs @	0.00 hrs, Volume=	48.962 af,	Incl. 12.34 cfs Base Flow
Outflow	=	12.34 cfs @	0.00 hrs, Volume=	48.962 af,	Atten= 0%, Lag= 0.0 min
Primary	=	12.34 cfs @	0.00 hrs, Volume=	48.962 af	

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 1,142.22' @ 0.00 hrs
Flood Elev= 1,146.30'

Device	Routing	Invert	Outlet Devices
#1	Primary	1,140.55'	**24.0" Round RCP_Round 24"** L= 100.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 1,140.55' / 1,137.95' S= 0.0260 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 3.14 sf

Primary OutFlow Max=12.34 cfs @ 0.00 hrs HW=1,142.22' (Free Discharge)
└**1=RCP_Round 24"** (Inlet Controls 12.34 cfs @ 4.40 fps)

Pond 25/26: 1050+45.0, LT 14.0'



Summary for Pond 27/28: 1052+58.0, LT 14.0'

50 Year Rational Method flows used. See proposed condition excel spreadsheet.Flood elevations reflect 1' freeboard to shoulder break.

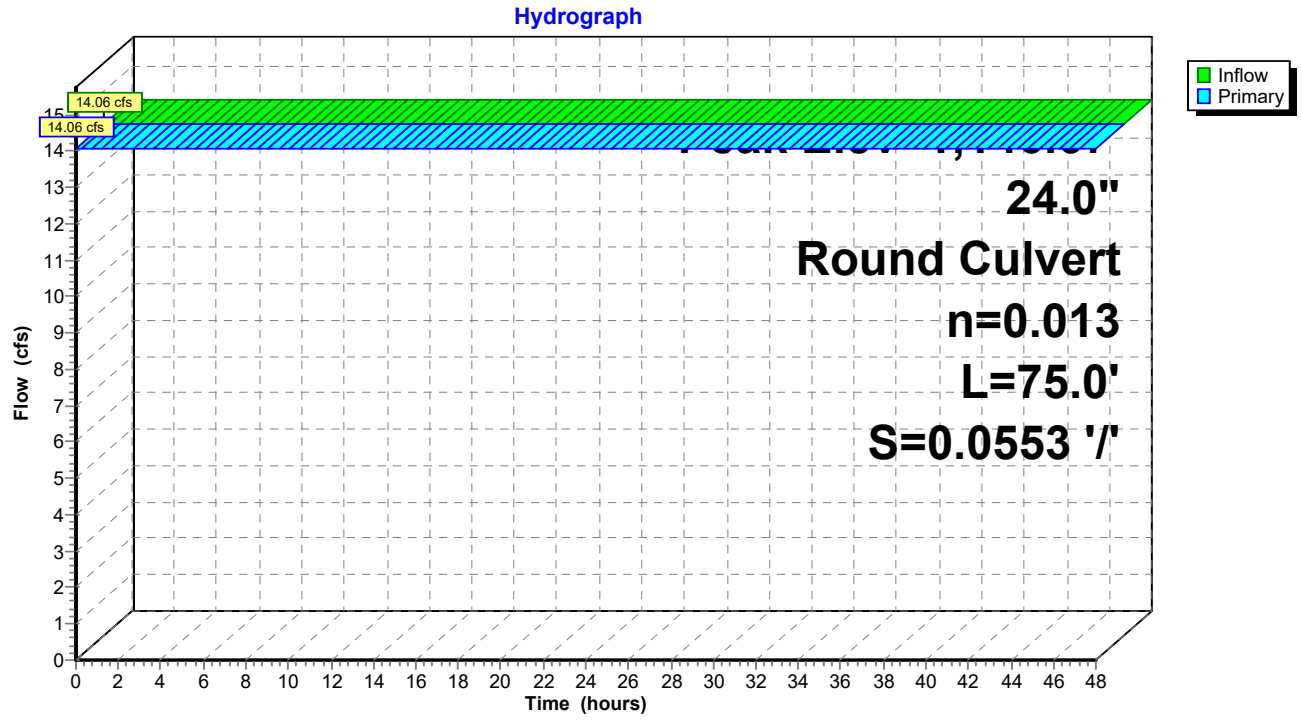
Inflow	=	14.06 cfs @	0.00 hrs,	Volume=	55.787 af, Incl. 14.06 cfs Base Flow
Outflow	=	14.06 cfs @	0.00 hrs,	Volume=	55.787 af, Atten= 0%, Lag= 0.0 min
Primary	=	14.06 cfs @	0.00 hrs,	Volume=	55.787 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 1,146.67' @ 0.00 hrs
Flood Elev= 1,150.66'

Device	Routing	Invert	Outlet Devices
#1	Primary	1,144.82'	**24.0" Round RCP_Round 24"** L= 75.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 1,144.82' / 1,140.67' S= 0.0553 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 3.14 sf

Primary OutFlow Max=14.06 cfs @ 0.00 hrs HW=1,146.67' (Free Discharge)
└**1=RCP_Round 24"** (Inlet Controls 14.06 cfs @ 4.63 fps)

Pond 27/28: 1052+58.0, LT 14.0'



Summary for Pond 29/30: 1055+05.0, LT 14.0'

50 Year Rational Method flows used. See proposed condition excel spreadsheet.Flood elevations reflect 1' freeboard to shoulder break.

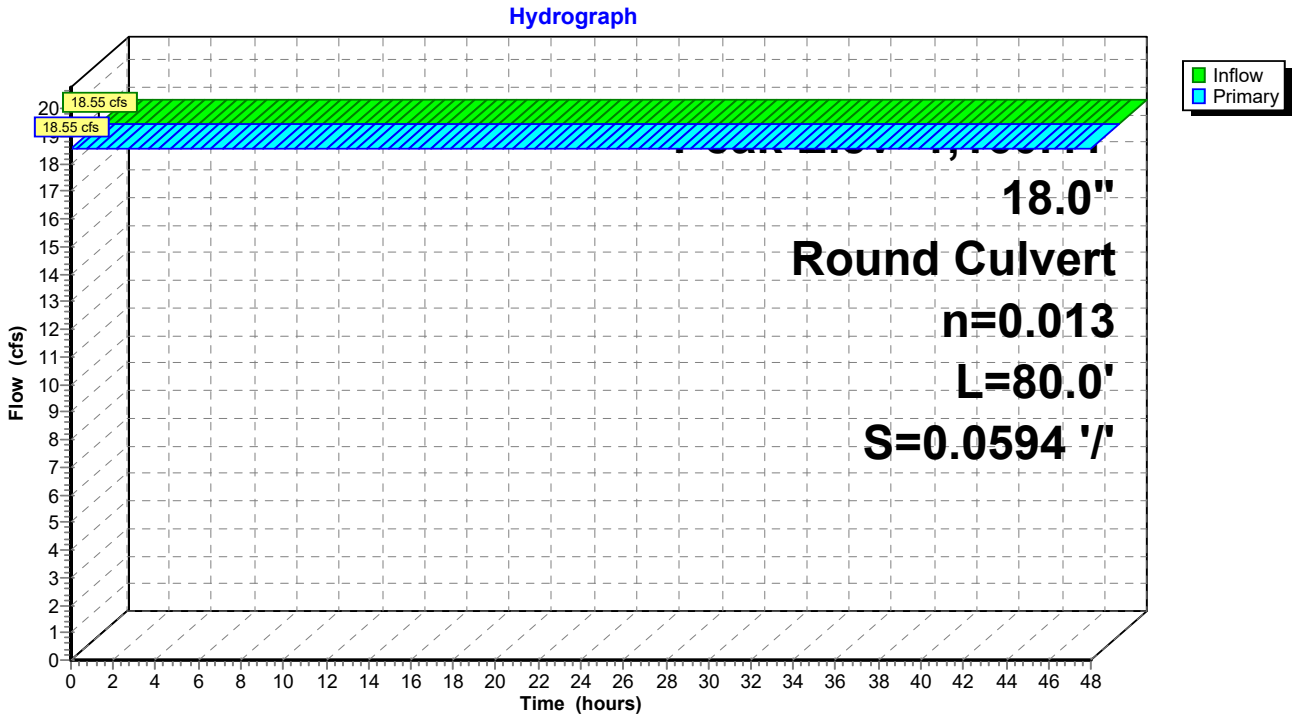
Inflow	=	18.55 cfs @	0.00 hrs,	Volume=	73.602 af, Incl. 18.55 cfs Base Flow
Outflow	=	18.55 cfs @	0.00 hrs,	Volume=	73.602 af, Atten= 0%, Lag= 0.0 min
Primary	=	18.55 cfs @	0.00 hrs,	Volume=	73.602 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 1,160.41' @ 0.00 hrs
Flood Elev= 1,162.36'

Device	Routing	Invert	Outlet Devices
#1	Primary	1,154.91'	**18.0" Round RCP_Round 18"** L= 80.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 1,154.91' / 1,150.16' S= 0.0594 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 1.77 sf

Primary OutFlow Max=18.55 cfs @ 0.00 hrs HW=1,160.41' (Free Discharge)
└**1=RCP_Round 18"** (Inlet Controls 18.55 cfs @ 10.50 fps)

Pond 29/30: 1055+05.0, LT 14.0'

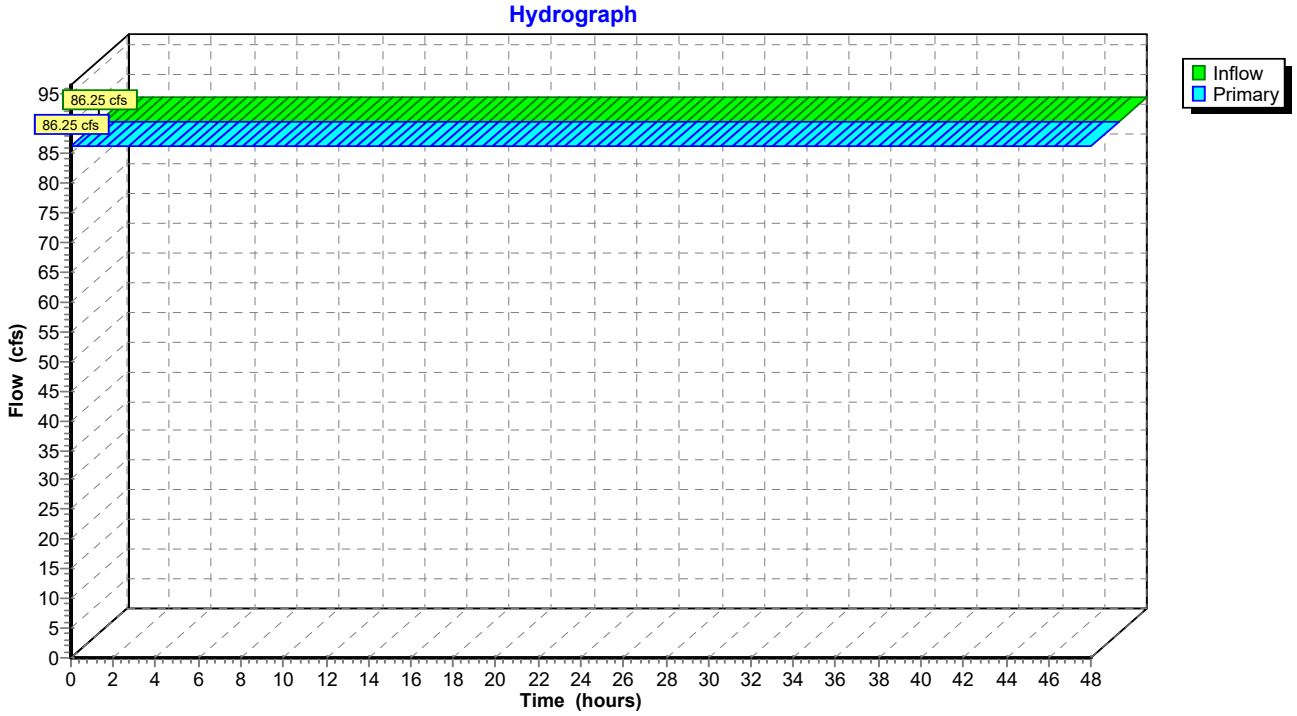


Summary for Link 5L: Androscoggin River

Inflow = 86.25 cfs @ 0.00 hrs, Volume= 342.220 af
Primary = 86.25 cfs @ 0.00 hrs, Volume= 342.220 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 5L: Androscoggin River



P-4 - STA. 1010+20-15" CMP (EXISTING CULVERT)											
Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
2 year	0.91	0.91	1142.13	0.54	-1.49	0.31	0.37	0.31	0.1	3.71	2.31
10 year	1.26	1.26	1142.23	0.64	-1.04	0.37	0.44	0.37	0.12	4.09	2.61
50 year	1.77	1.77	1142.38	0.79	-0.86	0.44	0.53	0.44	0.15	4.47	2.98
100 year	2.03	2.03	1142.44	0.85	-0.76	0.47	0.57	0.47	0.16	4.64	3.14

HY-8 Analysis Results

Crossing Summary Table

Culvert Crossing: P-4

Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	Existing 15 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
1142.13	2 year	0.91	0.91	0.00	1
1142.23	10 year	1.26	1.26	0.00	1
1142.38	50 year	1.77	1.77	0.00	1
1142.44	100 year	2.03	2.03	0.00	1
1147.24	Overtopping	10.18	0.00	1.00	

P-5 - STA. 1010+23-60" CMP EXTENSION											
Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
10 year	150	150	1135.67	5.27	5.59	5	3.51	3.51	1.45	10.2	6.07
50 year	246	246	1139.73	8.02	9.65	5	4.4	4.4	2	13.45	7.24
100 year	285	285	1141.8	9.44	11.72	5	4.61	4.61	2.2	15.06	7.62

P-12 - STA. 1040+00-30" RCP											
Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
2 year	13.19	13.19	1138.22	1.84	-0.97	0.71	1.22	0.76	0.62	10	7.04
10 year	18.96	18.96	1138.68	2.3	-0.42	0.86	1.47	0.92	0.8	11.14	7.88
50 year	27.21	27.21	1139.49	3.11	0.49	1.05	1.78	1.14	1.04	12.01	8.76
100 year	32.32	32.32	1140.14	3.76	1.41	1.16	1.93	1.27	1.17	12.48	9.19

HY-8 Analysis Results

Crossing Summary Table

Culvert Crossing: P-12

Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	Proposed 30 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
1138.22	2 year	13.19	13.19	0.00	1
1138.68	10 year	18.96	18.96	0.00	1
1139.49	50 year	27.21	27.21	0.00	1
1140.14	100 year	32.32	32.32	0.00	1
1144.75	Overtopping	57.37	0.00	1.00	

HY-8 Analysis Results

Crossing Summary Table

Culvert Crossing: P-5

Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	Existing 60 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
1135.67	10 year	150.00	150.00	0.00	1
1139.73	50 year	246.00	246.00	0.00	1
1141.80	100 year	285.00	285.00	0.00	1
1142.76	Overtopping	301.67	0.00	1.00	

P-18 - STA. 1069+50-18" CMP											
Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
2 year	1.86	1.86	1202.78	0.78	-1.66	0.39	0.51	0.39	0.13	4.92	6.5
10 year	2.76	2.76	1202.96	0.96	-1.43	0.48	0.63	0.48	0.16	5.48	7.45
50 year	3.86	3.86	1203.16	1.16	-1.13	0.57	0.75	0.57	0.19	6.01	8.33
100 year	4.45	4.45	1203.26	1.26	-0.96	0.62	0.81	0.64	0.21	6.03	8.73

HY-8 Analysis Results

Crossing Summary Table

Culvert Crossing: P-18

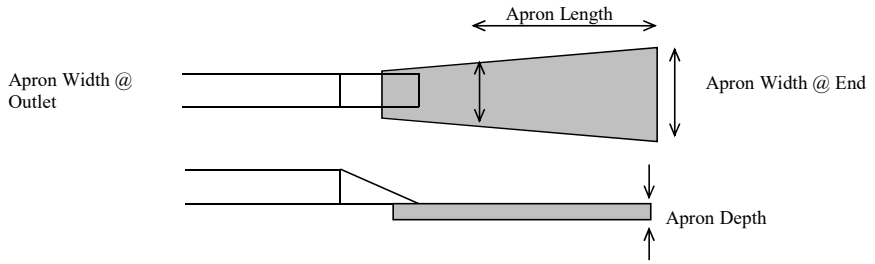
Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	Proposed 18 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
1202.78	2 year	1.86	1.86	0.00	1
1202.96	10 year	2.76	2.76	0.00	1
1203.16	50 year	3.86	3.86	0.00	1
1203.26	100 year	4.45	4.45	0.00	1
1205.00	Overtopping	11.21	0.00	1.00	

C

Appendix C
Outlet Protection Calculations

RIPRAP OUTLET PROTECTION SIZING

Source: NH Stormwater Manual: Volume 2
NHDES, December 2008, Outlet Protection, pp. 172 to 174



Apron Width at Outlet:	Width = 3 * pipe dia. (or width of channel)	
Apron Length:	Length = (1.8 * Q) / (dia.^3/2) + 7 * dia.	if Tw depth is < 1/2 dia.
	Length = (3.0 * Q) / (dia^3/2) + 7 * dia.	if Tw depth is >= 1/2 dia.
Apron Width at End:	Width = 3*dia. + apron length	if Tw depth is < 1/2 dia.
	Width = 3dia. + 0.4*apron length	if Tw depth is >= 1/2 dia.
	or apron width = channel width if a well defined channel exists	
Rock Riprap:	Median Diameter = (0.02 * Q^4/3) / (Tw * dia)	
	Largest Stone Diameter = 1.5 * d50)	
	Largest Stone Diameter = 1.5 * d50	

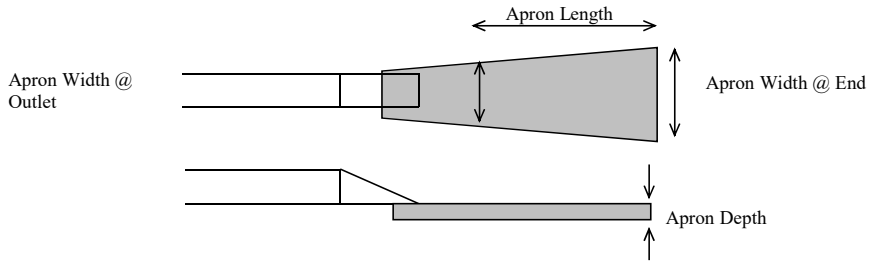
	Outlet Description						
Drainage Note	4	5	7	8*	9*	10*	
	1013+23	1020+73	1024+50	1027+00	1030+73	1032+50	
Drainage Note:							
Design Storm (yr):	50	50	50	50	50	50	
Def. Channel (yes/no)	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	
Channel Width, ft	4	2	7	2	7	7	
Pipe Dia (D), in	18	18	18	18	18	18	
Tail Water (Tw), ft	0.1	0.4	0.1	0.4	0.0	0.1	
Pipe Slope (ft/ft)	0.037	0.044	0.010	0.021	0.026	0.030	
	Tw<0.5D	Tw<0.5D	Tw<0.5D	Tw<0.5D	Tw<0.5D	Tw<0.5D	
Flow (Q), cfs	4.7	8.0	3.5	7.6	0.8	4.6	(from Appendix J)
Apron Width (outlet), ft	4.0	2.0	7.0	2.0	7.0	7.0	
Apron Length, ft	16	19	14	18	12	16	(10' min)
Apron Width (end), ft	21	24	19	23	17	21	(10' min)
Median Stone Dia., ft	0.80	0.54	1.01	0.54	0.35	1.28	
Median Stone Dia., in	10	7	13	7	6	16	(6" min)
Largest Stone Dia., ft	1.25	0.88	1.63	0.88	0.75	2.00	
Largest Stone Dia., in	15	11	20	11	9	24	
Apron Depth, ft	1.9	1.3	2.4	1.3	1.1	3.0	
Apron Depth, in	23.0	17.0	30.0	17.0	14.0	36.0	
NHDOT Stone Class	B	C	B	C	C	B	
Proposed Constructed dimensions:							
La(ft)	16	19	14	18	12	16	
Ws or Wb (ft)	4	2	7	2	7	7	
We or Wc (ft)	4	2	7	2	7	7	
de (ft)	2.25	1.5	2.25	1.5	1.5	2.25	(1.5' min.)

Note: Tw depths determined using FHWA Hy8.

* Stone Outlet modified to eliminate impacts to O.H.W

RIPRAP OUTLET PROTECTION SIZING

Source: NH Stormwater Manual: Volume 2
NHDES, December 2008, Outlet Protection, pp. 172 to 174



Apron Width at Outlet:	Width = 3 * pipe dia. (or width of channel)	
Apron Length:	Length = (1.8 * Q) / (dia.^3/2) + 7 * dia.	if Tw depth is < 1/2 dia.
	Length = (3.0 * Q) / (dia^3/2) + 7 * dia.	if Tw depth is >= 1/2 dia.
Apron Width at End:	Width = 3*dia. + apron length	if Tw depth is < 1/2 dia.
	Width = 3dia. + 0.4*apron length	if Tw depth is >= 1/2 dia.
	or apron width = channel width if a well defined channel exists	
Rock Riprap:	Median Diameter = (0.02 * Q^4/3) / (Tw * dia)	
	Largest Stone Diameter = 1.5 * d50)	
	Largest Stone Diameter = 1.5 * d50	

	Outlet Description						
Drainage Note	13*	14*	15	16*	17*	18	
	1040+00	1044+36	1048+16	1050+45	1052+58	1055+06	
Drainage Note:							
Design Storm (yr):	50	50	50	50	50	50	
Def. Channel (yes/no)	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	
Channel Width, ft	3	4	3	3	3	4	
Pipe Dia (D), in	30	18	18	24	24	18	
Tail Water (Tw), ft	0.6	0.2	0.2	0.3	0.4	0.4	
Pipe Slope (ft/ft)	0.006	0.023	0.011	0.008	0.049	0.080	
	Tw<0.5D	Tw<0.5D	Tw<0.5D	Tw<0.5D	Tw<0.5D	Tw<0.5D	
Flow (Q), cfs	27.2	7.9	4.2	12.3	14.1	8.3	(from Appendix J)
Apron Width (outlet), ft	3.0	4.0	3.0	3.0	3.0	4.0	
Apron Length, ft	30	19	15	22	23	19	(10' min)
Apron Width (end), ft	38	24	20	28	29	24	(10' min)
Median Stone Dia., ft	1.05	1.04	0.38	0.86	0.77	0.58	
Median Stone Dia., in	13	13	6	11	10	7	(6" min)
Largest Stone Dia., ft	1.63	1.63	0.75	1.38	1.25	0.88	
Largest Stone Dia., in	20	20	9	17	15	11	
Apron Depth, ft	2.4	2.4	1.1	2.1	1.9	1.3	
Apron Depth, in	30.0	30.0	14.0	26.0	23.0	17.0	
NHDOT Stone Class	B	B	C	B	B	C	
Proposed Constructed dimensions:							
La(ft)	30	19	15	22	23	19	
Ws or Wb (ft)	3	4	3	3	3	4	
We or Wc (ft)	3	4	3	3	3	4	
de (ft)	2.25	2.25	1.5	2.25	2.25	1.5	(1.5' min.)

Note: Tw depths determined using FHWA Hy8.

* Stone Outlet modified to eliminate impacts to O.H.W

D

Appendix D
Pollutant Loading Calculations

BUFFER DESIGN CRITERIA
(Env-Wq 1508.09)

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

Type **16304 Route 16 Roadway Buffer**

Enter the type of buffer (e.g., residential buffer) and the node name in the drainage analysis, if applicable

yes	Yes/No	Is the buffer adjacent to the area that you are treating?	← **yes**
yes	Yes/No	Does the runoff enter the buffer as sheet flow (naturally or with a level spreader?)	
no	Yes/No	Has a level spreader been provided?	
-	%F	% Forest (F) cover in the buffer (remaining assumed to be meadow (M)).	
100.0	%M	% Meadow cover in the buffer	
-	%A	Hydrologic soil group (HSG) in buffer (%A, %B, %C). Remaining assumed to be D soil	
25.0	%B		
25.0	%C		
50.0	%D		
15.0	%	Buffer Slope	← **≤ 15%**

If a Residential or Small Pervious Area buffer is proposed:

	Yes/No	Is the runoff from a single family or duplex residential lot?	← **yes**
		L_{FP} = maximum flow path to the buffer	
	ac	A = area draining to the buffer	
	ac	A_{IMP} = impervious area draining to the buffer	
-	%	I = percent impervious area draining to the buffer	← **≤ 10%**
FALSE		Option A check: $A_{IMP} \leq 1$ ac & $L_{FP} \leq 100'$	← **yes for**
FALSE		Option B check: $I \leq 10\%$ & $L_{FP} \leq 150'$	**A or B**
no		Level Spreader proposed? (Sheet flow without the aid of a LS)	← **no**
Good		Slope check	← **≤ 15%**
97	feet	Buffer base length due to soil type (weighted based on HSG)	
30	feet	Buffer length adjustment due to steepness of buffer	
30	feet	Buffer length adjustment due to percent of meadow in buffer	
157	feet	Minimum buffer length required [1]	

If a Developed Area Buffer with a Level Spreader is proposed:

no		Level Spreader proposed?	← **yes**
	ac	A = Area draining to the buffer [2]	
	ac	A_I = impervious area draining to the buffer [2]	
-	%	Percent impervious of the area that is draining to the buffer	
Good		Slope check	← **≤ 15%**
-	sf	Buffer base area due to soil type in the buffer (weighted based on HSG)	
-	sf	Buffer area adjustment due to impervious cover draining to buffer	
-	sf	Buffer area adjustment due to steepness of buffer	
-	sf	Buffer area adjustment due to percent of meadow in buffer	
-	sf	A_{MIN} = Minimum buffer area required	
	ft	L_{LS} = total length of level spreader(s) provided [3]	
	ft	L_B = buffer length [4]	
	sf	A_B = buffer area provided	← **≥ A_{MIN}**

If a Roadway Buffer is proposed:

no	Yes/No	LS proposed? Roadway/shoulder must sheet directly to the buffer.	← **no**
no	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
yes	Yes/No	Is the road parallel to the contours of the buffer slope?	← **yes**
Good		Natural slope check [5]	← **≤ 20%**
20.0	feet	How much embankment slope counts toward the buffer? [6]	← **0 - 20 feet**
1.0	Lane(s)	Number of travel lanes draining to the buffer	
50.0		Minimum buffer flow path (L_{MIN})	
60.0	feet	Buffer flow path	← **≥ L_{MIN}**

If a Ditch Turn Out Buffer is proposed:

no		Level Spreader proposed?	← **yes**
	feet	Level Spreader Length [7]	
	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
	sf	Drainage Area to the ditch	← **≤ 6000 sf**
Good		Slope check	← **≤ 15%**
-	feet	Buffer base length due to soil type (weighted based on HSG)	
30	feet	Buffer length adjustment due to steepness of buffer	
30	feet	Buffer length adjustment due to percent of meadow in buffer	
60	feet	Minimum buffer length required [8]	

1. Minimum buffer length is the total of the above three cells OR 45', whichever is greater.
2. If a detention structure is used upstream of the level spreader, the drainage area draining to the buffer shall considered equal to 1 acre of impervious area for every 1 cfs of peak 2-year, 24-hr outflow from the detention structure.
3. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them.

Example: A_{MIN} = 6,000 sf with a 100' buffer available. Therefore the LS lengths must total 60 feet (6,000 sf/ 100'); however LS lengths must be between 20' and 50' so one 60' long level spreader is not permitted. The design would have two LS, each 30'. As long as a collection basin is provided to evenly distribute the flow to the two level spreaders.

4. Minimum buffer length 50 feet.
5. If the slope is man-made, it must be 15% or flatter.
6. 20' (max) of the roadway embankment slope may count towards the buffer length if it is 3:1 or flatter.
7. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them. For example, you may have a total length of 100 feet for the level spreaders as long as you have two 50' level spreaders.
8. Minimum buffer length is the total of the above three cells OR 50', whichever is greater.

Designer's Notes:

Appendix D

Pollutant Loading Analysis and Supporting Information

Memorandum

To: Mark Hemmerlein, NHDOT

Date: December 19, 2017

Project #: 52900.16

From: Bill Arcieri, VHB

Re: Route 16 Improvement Project: NHDOT #16304: Town of Dummer: Preliminary Proposal of Stormwater Treatment Measures

Project Background

The New Hampshire Department of Transportation ("Department") is proposing to improve 1.26 miles (~6,640 feet) section of NH Route 16 located in Dummer, New Hampshire. The purpose of the project is to realign or shift the road away from the Androscoggin River, which runs directly parallel to this road section. The river has incrementally migrated closer to the road. The proposed improvement will shift the road farther away from the river. The amount of upland area available for stormwater treatment is extremely limited due to existing wetland areas that border nearly the entire length of right-of way or toe-of-slope on both sides of the road and especially along the west side of road. These wetland areas are supported by shallow groundwater and surface flow as it drains to the river from the adjacent western hillside. For safety reasons, the paved roadway shoulders will be widened from 1 to 4 feet adding +/-3 feet to either side and increasing the road width by 6 feet, on average. The pavement width of the new road will be 30 feet. The following presents the estimated change in impervious area between existing and proposed conditions:

Impervious Area;

- Existing Impervious Area = 165,546 sf (3.80 Ac)
- Proposed Impervious Area = 198,465 sf (4.56 Ac)
- Difference (Increase) = 32,919 sf (0.76 Ac)

Proposed Stormwater Treatment:

Table 1 below provides a summary of the various roadway segments in the project corridor (see separate plan sheet) that will be treated with a vegetated filter strip that will be designed in accordance with the roadway buffer design guidelines contained in the NHDES Stormwater Manual. The vegetated buffer will be constructed along the east side of the roadway within the existing road footprint once road is shifted to the west. The first 20 feet of the buffer will consist of a 4:1 slope or less and the remaining 30 feet of buffer length will have a uniform slope of 15% or less for an overall minimum length of 50 feet. Runoff will leave the roadway edge of pavement as sheet flow. As noted below, in certain road sections where the vegetated buffer will treat two travel lanes instead of one, the removal efficiencies are prorated based on the anticipated buffer length versus recommended length. Given the extent of wetland area on both sides of the road, particularly on the west side, there is limited opportunity to construct additional buffer area or other structural stormwater BMPs without resulting in additional wetland impact.

The realignment will enable a vegetated buffer with a minimum length of 50-feet to be constructed along 3,895 feet or 59% of the improved road section (Segments B, C, D, F & H on plan sheet). Segments A and I, at the southern and northern ends of the project, respectively, will not have sufficient space to construct a 50-foot treatment buffer as the improved roadway will taper back into the existing road. Segments E and G consist of curved or super-elevated road sections that will direct runoff from both lanes to the west and away from the vegetated buffer.

Of the roadway length that will be directed to the vegetated buffer, approximately 2,540 feet will consist of one travel lane plus shoulder (Segments B & D). These sections have a normal crown along the centerline, the west side travel lane and shoulder will drain to the west away from the vegetated buffer. The buffer length in Segments B and D will be 10 to 15 feet longer than 50 feet for approximately 900 and 400 feet of roadway, respectively, or roughly half of the road length treating one travel lane.

Approximately 1,355 feet of roadway draining to the vegetated buffer will consist of two-lanes or full roadway width within three curved sections (Segments C, F & H). Due to the extent of wetland area, the recommended 80 feet of vegetated buffer length for two travel lanes per NHDES design guidance cannot be accommodated. However, the buffer length will range from 60 to 80 feet or have an average length of approximately 65 feet for approximately 555 feet in Segment F. Approximately 150 feet or half of Segment H will have approximately 10 feet of additional buffer for a total length of 60 feet.

For this analysis, stormwater runoff from Segments A and I at the southern and northern ends of the project as well as Segments E and G will be considered untreated. In reality, stormwater in Segments A and I will at least receive partial treatment as runoff flows down the grassed road embankments to wooded areas outside the right-of-way.

The pollutant removal efficiencies for Segments B & D which will direct one travel-lane to a 50-foot vegetated buffer were assumed to be 73%, 45% and 40% for TSS, TP and TN respectively, consistent with the NHDES Stormwater Manual. This accounts for approximately 0.9 acres of pavement. As mentioned above, the buffer length in these two segments will actually be 10 feet or more longer for more than a half of the road length. However, no additional treatment credit was assumed for these areas with longer flow paths beyond 50 feet.

In Segments C, F and H that will direct two (2) travel lanes to the vegetated buffer, the assumed removal efficiencies were prorated based on the estimated buffer length relative to the specified 80 feet. For Segments C and H, the total buffer length was conservatively assumed to be 50-feet and the assumed removal efficiencies were reduced by half to 37%, 23% and 20% for TSS, TP and TN, respectively. For Segment F, where the buffer length will be 60 to 80-feet, the assumed removal efficiencies were reduced by 25% to 55%, 34% and 30% for TSS, TP and TN, respectively.

Table 1. Summary of Roadway Areas and Road Segments Proposed to be Treated and Remain Untreated

				Untreated		Treated		
Segment	Stations	Length (feet)	Road Crown	# lanes	Area (sq. ft)	# lanes	Area (sq. ft)	Anticipated Treatment
A	1004+17 to 1019+50	1533	normal	2	45,990			Sheet flow drains to mixed woods
B	1019+50 to 1037+70	1820	normal	1	27,300	1	27,300	1 lane to 50' buffer; ~900 ft. w/ add'l 10- 15 feet of buffer length[1]
C	1037+70 to 1042+70	500	Super. curve			2	15,000	2 lanes to 50 feet of buffer[2]
D	1042+70 to 1049+90	720	normal	1	10,800	1	10,800	1 lane to >50 ft. buffer; approx. half of road with ~10 ft. of added buffer[1]
E	1049+90 to 1053+90	400	Super. curve	2	12,000			2 lanes drain to west away from buffer
F	1053+90 to 1059+45	555	Super. curve			2	16,650	2 lanes to >50' buffer: 550 ft w/ 10-20 feet of added buffer[3]
G	1059+45 to 1064+55	510	Super curve	2	15,300			2 lanes drain to the west away from buffer
H	1064+55 to 1067+55	300	Super Curve			2	9,000	2 lanes to 50 feet buffer; approx. 50% drains to 60 feet buffer[2]
I	1067+50 1070+50	300	Super Curve	2	9,000			Sheet flow drains to mixed woods
	Totals	6,638	Sq ft (acres)		120,300 (2.76 ac)	1	78,750 (1.81 ac)	Approx. 50% of treated road length has 10-20 ft of added buffer length

Notes: [1]For Segments B and D treating one lane, the assumed pollutant removal efficiencies for TSS, TP and TN were 73%, 45% and 40%, respectively, consistent with the NHDES Stormwater Manual.
[2]For Segment C and H, 2-lane road that will be treated by a 50-foot buffer the normal removal efficiencies were reduced by 50% to 37%, 23% and 20% for TSS, TP and TN, respectively.
[3]For Segment F, 2-lane road that will be treated by a vegetated buffer of 60 to 80-feet in length, and the normal removal efficiencies were reduced by approximately 25% to 55%, 34% and 30% for TSS, TP and TN, respectively.

Pollutant Loading Results:
Table 2 provides a summary of the preliminary pollutant loading results using DES' Simple Method spreadsheet based on the design parameters and assumptions described above.

Table 2. Preliminary Pollutant Loading Results for NH Route 16 Road Project using a vegetated buffer.

	TSS (LBS/YR)	TP (LBS/YR)	TN (LBS/YR)
PRE DEVELOPMENT LOADS (NO BMPS)	4141.3	12.6	77.8
PRE DEVELOPMENT LOADS (WITH BMPS)	4141.3	12.6	77.8
PRE DEVELOPMENT LOAD REDUCTION DUE TO BMPS	0.0	0.0	0.0
PROPOSED PERCENT REDUCTION IN FERTILIZER APPLICATION RATE	NA	0.0%	0.0%
POST DEVELOPMENT LOADS (NO BMPS)	4964.1	15.1	93.3
POST DEVELOPMENT LOADS (WITH BMPS)	3829.3	13.0	81.7
POST DEVELOPMENT LOAD REDUCTION DUE TO BMPS	1145.7	2.1	11.8
POST DEVELOPMENT - PRE DEVELOPMENT (SHOULD BE 0 OR NEGATIVE)	-312.0	0.4	3.9
% DIFFERENCE FROM PRE DEVELOMENT LOADS (SHOULD BE 0 OR NEGATIVE)	-7.5%	3%	5.0%

Based on the results of this analysis, the predicted total suspended solids (TSS) load under future conditions is less than the predicted existing load due to the proposed treatment with a vegetated buffer. The predicted TSS load would be reduced by approximately 7.5% or 312 lbs/year compared to the predicted existing load while the TP and TN loads under future conditions are predicted to increase slightly by approximately 3% and 5% or by 0.4 and 3.9 lbs/year, respectively. Since phosphorus is the more limited nutrient in freshwater water bodies, it represents the pollutant of greater concern for potentially stimulating algal growth. Given the size of the Androscoggin River and its watershed, the predicted change of 0.4 lbs/year or 3% above the existing load is not likely to cause an observable or measurable change in water quality. The magnitude of this predicted increase is likely to be well within the margin of error of this modeling procedure. It is possible that the additional potential treatment associated with the longer buffer length in Segments B and D that will treat one travel lane would offset this potential increase. In the curved section of Segment H, more than half of the road segment will have more than 50-feet of buffer length, which is also not accounted for in this analysis. Based on the inherent assumptions and results of this analysis, no additional stormwater treatment is considered necessary.

Date (MM/DD/YYYY):	**12/18/2017**
Project Name:	**NHDOT Route 16 Dummer Road Improvement**
Town/City:	**Dummer**
Impacted Surface Waters:	**Androscoggin River**
Applicant:	**NHDOT**
DES File #:	

Average Annual Precipitation P	**40.00**	**inches**
Fraction of Annual Runoff events that produce runoff	**0.90**	**(usually 0.9)**

ONLY INPUT VALUES IN BLUE SHADED CELLS

Credit for Using Low Nutrient Fertilizer: If there are managed turf areas under post development conditions that are to be fertilized annually, reductions in post development nutrient (TP and TN) loadings can be realized by by providing enforceable documents (i.e., deed restrictions) requiring land owners to use low nutrient fertilizer. To get low nutrient fertilizer pollutant reductions input the proposed reduced fertilizer application rates for post development development for TP and TN in the table below. Low nutrient fertilizers must have application rates less than the standard fertilizer application rate shown in the table. Then input the percent of each land use in each post development sub-area that is managed turf that is fertilzed annually.

	Fertilizer Reduction Calculator	
	TP	**TN**
STANDARD FERTILIZER APPLICATION RATE (lbs/acre/year)	15.0	150.0
PROPOSED REDUCED FERTILIZER APPLICATION RATES FOR POST-DEVELOPMENT (lbs/acre/year)	**15.0**	**150.0**
INITIAL PERCENT REDUCTION	0.0%	0.0%
PERCENT OF CITIZENS THAT WILL COMPLY WITH REDUCED APPLICATION RATES	50%	50%
PERCENT OF APPLIED FERTILIZER THAT IS LOST TO RUNOFF OR PERCOLATION	10%	10%
FINAL PERCENT FERTILIZER REDUCTION WITH COMPLIANCE AND RUNOFF RATES APPLIED (%FR)	**0.0%**	**0.0%**
MINIMUM ASSUMED EMC = EMC_{MIN} (mg/L)	0.11	1.74

← **Used to reduce EMCs for Post TP and Post TN for each land use in each Sub Area depending on perce of area that is managed turf that is fertilized annually**

PRE-DEVELOPMENT CONDITIONS

	Area	**Impervious Area**
Total Area (All Sub-Areas) (acres)	**3.80**	**3.80**

Insert information for 1st sub-area below

Sub_Area_ID	**1- PRE**	
Point of Analysis (PoA) Number		
Total Area for Sub-Area (acres)	**3.80**	**3.80**

Land Use	**Area**	**Ia**
	(acres)	(% Impervious)
From HWG		
Residential Roof	0.00	0.00%
Commercial Roof	0.00	0.00%
Commercial/Res Parking	0.00	0.00%
Residential Street	0.00	0.00%
Urban Highway	0.00	0.00%
Lawns	0.00	0.00%
Driveway	0.00	0.00%
Residential (general)	0.00	0.00%
Commercial (general)	0.00	0.00%
Industrial (general)	0.00	0.00%
From CDM		
Agriculture and Pasture	0.00	0.00%
Commercial	0.00	0.00%
Forest/Rural Open	0.00	0.00%
Highway	3.80	100.00%
Industrial	0.00	0.00%
Medium Density Residential	0.00	0.00%
Urban Open	0.00	0.00%
Water/Wetland	0.00	0.00%

Insert information for 2nd sub-area below

Sub_Area_ID	**2-PRE**

POST-DEVELOPMENT CONDITIONS

	Area	**Impervious Area**	**Area Fertilized Annually**
Total Area (All Sub-Areas) (acres)	**4.57**	**4.57**	**0.00**

Sub_Area_ID	**1-POST**		
Point of Analysis (PoA) Number	**no treatment**		
Total Area in Sub-Area (acres)	**2.76**	**2.76**	**0.00**

Land Use	**Total Area for each Land Use**	**Ia**	**Percent of Area that is managed turf (i.e., fertilized annually)**	**Post-TP EMC**	**Post-TN EMC**
	(acres)	(% Impervious)	%	mg/L	mg/L
From HWG					
Residential Roof	0.00	0.00%	0.0%	0.11	1.50
Commercial Roof	0.00	0.00%	0.0%	0.14	2.10
Commercial/Res Parking	0.00	0.00%	0.0%	0.15	1.90
Residential Street	0.00	0.00%	0.0%	0.55	1.40
Urban Highway	0.00	0.00%	0.0%	0.32	3.00
Lawns	0.00	0.00%	0.0%	2.10	9.10
Driveway	0.00	0.00%	0.0%	0.56	2.10
Residential (general)	0.00	0.00%	0.0%	0.40	2.20
Commercial (general)	0.00	0.00%	0.0%	0.20	2.00
Industrial (general)	0.00	0.00%	0.0%	0.40	2.50
From CDM					
Agriculture and Pasture	0.00	0.00%	0.0%	0.37	5.98
Commercial	0.00	0.00%	0.0%	0.33	2.97
Forest/Rural Open	0.00	0.00%	0.0%	0.11	1.74
Highway	2.76	100.00%	0.0%	0.43	2.65
Industrial	0.00	0.00%	0.0%	0.32	3.97
Medium Density Residential	0.00	0.00%	0.0%	0.52	5.15
Urban Open	0.00	0.00%	0.0%	0.11	1.74
Water/Wetland	0.00	0.00%	0.0%	0.08	1.38

Sub_Area_ID	**2-POST**

Point of Analysis (PoA) Number		
Total Area for Sub-Area (acres)	0.00	0.00

Land Use	Area (acres)	Ia (% Impervious)
From HWG		
Residential Roof	0.00	0.00%
Commercial Roof	0.00	0.00%
Commercial/Res Parking	0.00	0.00%
Residential Street	0.00	0.00%
Urban Highway	0.00	0.00%
Lawns	0.00	0.00%
Driveway	0.00	0.00%
Residential (general)	0.00	0.00%
Commercial (general)	0.00	0.00%
Industrial (general)	0.00	0.00%
From CDM		
Agriculture and Pasture	0.00	0.00%
Commercial	0.00	0.00%
Forest/Rural Open	0.00	0.00%
Highway	0.00	0.00%
Industrial	0.00	0.00%
Medium Density Residential	0.00	0.00%
Urban Open	0.00	0.00%
Water/Wetland	0.00	0.00%

Point of Analysis (PoA) Number	B&D: 1-lane to veg filter strip		
Total Area in Sub-Area (acres)	0.88	0.88	0.00

Land Use	Area (acres)	Ia (% Impervious)	Percent of Area that is managed turf (i.e., fertilized annually) %	Post-TP EMC mg/L	Post-TN EMC mg/L
From HWG					
Residential Roof	0.00	0.00%	0.0%	0.11	1.50
Commercial Roof	0.00	0.00%	0.0%	0.14	2.10
Commercial/Res Parking	0.00	0.00%	0.0%	0.15	1.90
Residential Street	0.00	0.00%	0.0%	0.55	1.40
Urban Highway	0.00	0.00%	0.0%	0.32	3.00
Lawns	0.00	0.00%	0.0%	2.10	9.10
Driveway	0.00	0.00%	0.0%	0.56	2.10
Residential (general)	0.00	0.00%	0.0%	0.40	2.20
Commercial (general)	0.00	0.00%	0.0%	0.20	2.00
Industrial (general)	0.00	0.00%	0.0%	0.40	2.50
From CDM					
Agriculture and Pasture	0.00	0.00%	0.0%	0.37	5.98
Commercial	0.00	0.00%	0.0%	0.33	2.97
Forest/Rural Open	0.00	0.00%	0.0%	0.11	1.74
Highway	0.88	100.00%	0.0%	0.43	2.65
Industrial	0.00	0.00%	0.0%	0.32	3.97
Medium Density Residential	0.00	0.00%	0.0%	0.52	5.15
Urban Open	0.00	0.00%	0.0%	0.11	1.74
Water/Wetland	0.00	0.00%	0.0%	0.08	1.38

Insert information for 3rd sub-area below

Sub_Area_ID	3-PRE	
Point of Analysis (PoA) Number		
Total Area for Sub-Area (acres)	0.00	0.00

Land Use	Area (acres)	Ia (% Impervious)
From HWG		
Residential Roof	0.00	0.00%
Commercial Roof	0.00	0.00%
Commercial/Res Parking	0.00	0.00%
Residential Street	0.00	0.00%
Urban Highway	0.00	0.00%
Lawns	0.00	0.00%
Driveway	0.00	0.00%
Residential (general)	0.00	0.00%
Commercial (general)	0.00	0.00%
Industrial (general)	0.00	0.00%
From CDM		
Agriculture and Pasture	0.00	0.00%
Commercial	0.00	0.00%
Forest/Rural Open	0.00	0.00%
Highway	0.00	0.00%
Industrial	0.00	0.00%
Medium Density Residential	0.00	0.00%
Urban Open	0.00	0.00%
Water/Wetland	0.00	0.00%

Sub_Area_ID	3-POST		
Point of Analysis (PoA) Number	eg C&H: 2 Lns- 50' buffer		
Total Area in Sub-Area (acres)	0.55	0.55	0.00

Land Use	Area (acres)	Ia (% Impervious)	Percent of Area that is managed turf (i.e., fertilized annually) %	Post-TP EMC mg/L	Post-TN EMC mg/L
From HWG					
Residential Roof	0.00	0.00%	0.0%	0.11	1.50
Commercial Roof	0.00	0.00%	0.0%	0.14	2.10
Commercial/Res Parking	0.00	0.00%	0.0%	0.15	1.90
Residential Street	0.00	0.00%	0.0%	0.55	1.40
Urban Highway	0.00	0.00%	0.0%	0.32	3.00
Lawns	0.00	0.00%	0.0%	2.10	9.10
Driveway	0.00	0.00%	0.0%	0.56	2.10
Residential (general)	0.00	0.00%	0.0%	0.40	2.20
Commercial (general)	0.00	0.00%	0.0%	0.20	2.00
Industrial (general)	0.00	0.00%	0.0%	0.40	2.50
From CDM					
Agriculture and Pasture	0.00	0.00%	0.0%	0.37	5.98
Commercial	0.00	0.00%	0.0%	0.33	2.97
Forest/Rural Open	0.00	0.00%	0.0%	0.11	1.74
Highway	0.55	100.00%	0.0%	0.43	2.65
Industrial	0.00	0.00%	0.0%	0.32	3.97
Medium Density Residential	0.00	0.00%	0.0%	0.52	5.15
Urban Open	0.00	0.00%	0.0%	0.11	1.74
Water/Wetland	0.00	0.00%	0.0%	0.08	1.38

Insert information for 4th sub-area below

Sub_Area_ID	4-PRE	
Point of Analysis (PoA) Number		
Total Area for Sub-Area (acres)	0.00	0.00

Land Use	Area (acres)	Ia (% Impervious)
From HWG		
Residential Roof	0.00	0.00%

Sub_Area_ID	4-POST		
Point of Analysis (PoA) Number	Seg F: 2 Lns 60-80' buffer		
Total Area in Sub-Area (acres)	0.38	0.38	0.00

Land Use	Area (acres)	Ia (% Impervious)	Percent of Area that is managed turf (i.e., fertilized annually) %	Post-TP EMC mg/L	Post-TN EMC mg/L
From HWG					
Residential Roof	0.00	0.00%	0.0%	0.11	1.50

Date (MM/DD/YYYY): 12/18/2017
Project Name: NHDOT Route 16 Dummer Road Improvement
Town/City: Dummer
Impacted Surface Waters: Androscoggin River
Applicant: NHDOT
DES File #:

ONLY CHANGE VALUES SHADED IN BLUE

PRE DEVELOPMENT Sub-Area	INPUT BMP DESCRIPTIONS		INPUT OVERALL REMOVAL EFFICIENCIES (%) FOR POLLUTANTS OF CONCERN TSS	TP	TN
1- PRE	No Structural Treatment		0%	0%	0%
2-PRE			0%	0%	0%
3-PRE			0%	0%	0%
4-PRE			0%	0%	0%
5-PRE			0%	0%	0%
6-PRE			0%	0%	0%
7-PRE			0%	0%	0%
8-PRE			0%	0%	0%
9-PRE			0%	0%	0%
10-PRE			0%	0%	0%
11-PRE			0%	0%	0%
12-PRE			0%	0%	0%
13-PRE			0%	0%	0%
14-PRE			0%	0%	0%
15-PRE			0%	0%	0%
16-PRE			0%	0%	0%
17-PRE			0%	0%	0%
18-PRE			0%	0%	0%
19-PRE			0%	0%	0%
20-PRE			0%	0%	0%
21-PRE			0%	0%	0%
22-PRE			0%	0%	0%
23-PRE			0%	0%	0%
24-PRE			0%	0%	0%
25-PRE			0%	0%	0%

POST DEVELOPMENT Sub-Area	INPUT BMP DESCRIPTIONS		INPUT OVERALL REMOVAL EFFICIENCIES (%) FOR POLLUTANTS OF CONCERN TSS	TP	TN
1-POST	No Engineered Treatment		0%	0%	0%
2-POST	Vegetated Filter Strip -one lane section		73%	45%	40%
3-POST	Segment C & H -Partial Treatment to 50 ft Vegetated Buffer Strip -two lanes		37%	22%	20%
4-POST	Segment F -Partial Treatment to 60-80 ft Vegetated Buffer Strip-two lanes		55%	34%	30%
5-POST			0%	0%	0%
6-POST			0%	0%	0%
7-POST			0%	0%	0%
8-POST			0%	0%	0%
9-POST			0%	0%	0%
10-POST			0%	0%	0%
11-POST			0%	0%	0%
12-POST			0%	0%	0%
13-POST			0%	0%	0%
14-POST			0%	0%	0%
15-POST			0%	0%	0%
16-POST			0%	0%	0%
17-POST			0%	0%	0%
18-POST			0%	0%	0%
19-POST			0%	0%	0%
20-POST			0%	0%	0%
21-POST			0%	0%	0%
22-POST			0%	0%	0%
23-POST			0%	0%	0%
24-POST			0%	0%	0%
25-POST			0%	0%	0%

NHDES Pollutant load-Dummer-12-18-2017
OVERALL SUMMARY

Date (MM/DD/YYYY):	**12/18/2017**
Project Name:	**NHDOT Route 16 Dummer Road Improvement**
Town/City:	**Dummer**
Impacted Surface Waters:	**Androscoggin River**
Applicant:	**NHDOT**
DES File #:	

TOTAL PRE -DEVELOPMENT (PRE-DEV) AREA (ACRES) =	**3.80**
TOTAL PRE-DEV EFFECTIVE IMPERVIOUS AREA (ACRES) =	**3.80**
TOTAL PRE-DEV PERCENT EFFECTIVE IMPERVIOUS (%) =	**100.0%**
TOTAL POST DEVELOPMENT (POST-DEV) AREA (ACRES) =	**4.57**
TOTAL POST-DEV EFFECTIVE IMPERVIOUS AREA (ACRES) =	**4.57**
TOTAL POST-DEV PERCENT EFFECTIVE IMPERVIOUS (%) =	**100.0%**
TOTAL POST-DEV AREA THAT IS FERTILIZED ANNUALLY (ACRES) =	**0.00**
TOTAL POST-DEV PERCENT OF AREA THAT IS FERTILIZED ANNUALLY (%) =	**0.0%**

	TSS (LBS/YR)	**TP (LBS/YR)**	**TN (LBS/YR)**
PRE DEVELOPMENT LOADS (NO BMPS)	**4141.3**	**12.6**	**77.8**
PRE DEVELOPMENT LOADS (WITH BMPS)	**4141.3**	**12.6**	**77.8**
PRE DEVELOPMENT LOAD REDUCTION DUE TO BMPS	**0.0**	**0.0**	**0.0**
PROPOSED PERCENT REDUCTION IN FERTILIZER APPLICATION RATE	**NA**	**0.0%**	**0.0%**
POST DEVELOPMENT LOADS (NO BMPS)	**4975.0**	**15.2**	**93.5**
POST DEVELOPMENT LOADS (WITH BMPS)	**3829.3**	**13.0**	**81.7**
POST DEVELOPMENT LOAD REDUCTION DUE TO BMPS	**1145.7**	**2.1**	**11.8**
POST DEVELOPMENT - PRE DEVELOPMENT (SHOULD BE 0 OR NEGATIVE)	**-312.0**	**0.4**	**3.9**
% DIFFERENCE FROM PRE DEVELOMENT LOADS (SHOULD BE 0 OR NEGATIVE)	**-7.5%**	**3.2%**	**5.0%**
TOTAL REMOVAL EFFICIENCY NEEDED TO MEET PRE-DEVELOPMENT LOAD	**16.8%**	**16.8%**	**16.8%**

Date (MM/DD/YYYY): 12/18/2017
Project Name: NHDOT Route 16 Dummer Road Improvement
Town/City: Dummer
Impacted Surface Waters: Androscoggin River
Applicant: NHDOT
DES File #:

TOTAL POST DEVELOPMENT - PRE DEVELOPMENT (SHOULD BE 0 OR NEGATIVE) (lbs/yr)	-312.0
% DIFFERENCE FROM PRE DEVELOMENT LOADS (SHOULD BE 0 OR NEGATIVE)	-7.5%
TOTAL REMOVAL EFFICIENCY NEEDED TO MEET PRE-DEVELOPMENT LOAD	16.8%
CURRENTLY PROPOSED REMOVAL EFFICIENCY	23.0%
REMAINING REMOVAL EFFICIENCY NECESSARY TO MEET PRE-DEVELOPMENT LOAD	-6.3%

PRE-DEVELOPMENT

PRE OR POST - DEV	SUB-AREA	POINT OF ANALYSIS NUMBER	AREA (acres)	Effective Impervious Area (acres)	Area Fertilized Annually (acres)	POLLUTANT	PERCENT REDUCTION IN FERTILIZER APPLICATION RATE	BMPS	LOAD (NO BMPS) (lbs/yr)	LOAD (WITH BMPS) (lbs/yr)	LOAD REDUCTION DUE TO BMPS (lbs/yr)	PERCENT REMOVAL
PRE	1- PRE		3.80	3.80	NA	TSS	NA	No Structural Treatment	4141.3	4141.3	0.0	0.0%
PRE	2-PRE		0.00	0.00	NA	TSS	NA		0.0	0.0	0.0	0.0%
PRE	3-PRE		0.00	0.00	NA	TSS	NA		0.0	0.0	0.0	0.0%
PRE	4-PRE		0.00	0.00	NA	TSS	NA		0.0	0.0	0.0	0.0%
PRE	5-PRE		0.00	0.00	NA	TSS	NA		0.0	0.0	0.0	0.0%
PRE	6-PRE		0.00	0.00	NA	TSS	NA		0.0	0.0	0.0	0.0%
PRE	7-PRE		0.00	0.00	NA	TSS	NA		0.0	0.0	0.0	0.0%
PRE	8-PRE		0.00	0.00	NA	TSS	NA		0.0	0.0	0.0	0.0%
PRE	9-PRE		0.00	0.00	NA	TSS	NA		0.0	0.0	0.0	0.0%
PRE	10-PRE		0.00	0.00	NA	TSS	NA		0.0	0.0	0.0	0.0%
PRE	11-PRE		0.00	0.00	NA	TSS	NA		0.0	0.0	0.0	0.0%
PRE	12-PRE		0.00	0.00	NA	TSS	NA		0.0	0.0	0.0	0.0%
PRE	13-PRE		0.00	0.00	NA	TSS	NA		0.0	0.0	0.0	0.0%
PRE	14-PRE		0.00	0.00	NA	TSS	NA		0.0	0.0	0.0	0.0%
PRE	15-PRE		0.00	0.00	NA	TSS	NA		0.0	0.0	0.0	0.0%
PRE	16-PRE		0.00	0.00	NA	TSS	NA		0.0	0.0	0.0	0.0%
PRE	17-PRE		0.00	0.00	NA	TSS	NA		0.0	0.0	0.0	0.0%
PRE	18-PRE		0.00	0.00	NA	TSS	NA		0.0	0.0	0.0	0.0%
PRE	19-PRE		0.00	0.00	NA	TSS	NA		0.0	0.0	0.0	0.0%
PRE	20-PRE		0.00	0.00	NA	TSS	NA		0.0	0.0	0.0	0.0%
PRE	21-PRE		0.00	0.00	NA	TSS	NA		0.0	0.0	0.0	0.0%
PRE	22-PRE		0.00	0.00	NA	TSS	NA		0.0	0.0	0.0	0.0%
PRE	23-PRE		0.00	0.00	NA	TSS	NA		0.0	0.0	0.0	0.0%
PRE	24-PRE		0.00	0.00	NA	TSS	NA		0.0	0.0	0.0	0.0%
PRE	25-PRE		0.00	0.00	NA	TSS	NA		0.0	0.0	0.0	0.0%
		TOTAL	3.80	3.80				TOTAL	4141.3	4141.3	0.0	0.0%

Date (MM/DD/YYYY): 12/18/2017
Project Name: NHDOT Route 16 Dummer Road Improvement
Town/City: Dummer
Impacted Surface Waters: Androscoggin River
Applicant: NHDOT
DES File #:

TOTAL POST DEVELOPMENT - PRE DEVELOPMENT (SHOULD BE 0 OR NEGATIVE) (lbs/yr)	-312.0
% DIFFERENCE FROM PRE DEVELOMENT LOADS (SHOULD BE 0 OR NEGATIVE)	-7.5%
TOTAL REMOVAL EFFICIENCY NEEDED TO MEET PRE-DEVELOPMENT LOAD	16.8%
CURRENTLY PROPOSED REMOVAL EFFICIENCY	23.0%
REMAINING REMOVAL EFFICIENCY NECESSARY TO MEET PRE-DEVELOPMENT LOAD	-6.3%

POST-DEVELOPMENT

PRE OR POST - DEV	SUB-AREA	POINT OF ANALYSIS NUMBER	AREA (acres)	Effective Impervious Area (acres)	Area Fertilized Annually (acres)	POLLUTANT	PERCENT REDUCTION IN FERTILIZER APPLICATION RATE	BMPS	LOAD (NO BMPS) (lbs/yr)	LOAD (WITH BMPS) (lbs/yr)	LOAD REDUCTION DUE TO BMPS (lbs/yr)	PERCENT REMOVAL
POST	1-POST	no treatment	2.76	2.76	0.00	TSS	NA	No Engineered Treatment	3007.9	3007.9	0.0	0.0%
POST	2-POST	&D: 1-lane to veg filt	0.88	0.88	0.00	TSS	NA	Vegetated Filter Strip -one lane section	953.6	257.5	696.1	73.0%
POST	3-POST	g C&H: 2 Lns- 50' bu	0.55	0.55	0.00	TSS	NA	Segment C & H -Partial Treatment to 50 ft Vegetated Buffer Strip -two lanes	599.4	377.6	221.8	37.0%
POST	4-POST	g F: 2 Lns 60-80' but	0.38	0.38	0.00	TSS	NA	Segment F -Partial Treatment to 60-80 ft Vegetated Buffer Strip-two lanes	414.1	186.4	227.8	55.0%
POST	5-POST		0.00	0.00	0.00	TSS	NA		0.0	0.0	0.0	0.0%
POST	6-POST		0.00	0.00	0.00	TSS	NA		0.0	0.0	0.0	0.0%
POST	7-POST		0.00	0.00	0.00	TSS	NA		0.0	0.0	0.0	0.0%
POST	8-POST		0.00	0.00	0.00	TSS	NA		0.0	0.0	0.0	0.0%
POST	9-POST		0.00	0.00	0.00	TSS	NA		0.0	0.0	0.0	0.0%
POST	10-POST		0.00	0.00	0.00	TSS	NA		0.0	0.0	0.0	0.0%
POST	11-POST		0.00	0.00	0.00	TSS	NA		0.0	0.0	0.0	0.0%
POST	12-POST		0.00	0.00	0.00	TSS	NA		0.0	0.0	0.0	0.0%
POST	13-POST		0.00	0.00	0.00	TSS	NA		0.0	0.0	0.0	0.0%
POST	14-POST		0.00	0.00	0.00	TSS	NA		0.0	0.0	0.0	0.0%
POST	15-POST		0.00	0.00	0.00	TSS	NA		0.0	0.0	0.0	0.0%
POST	16-POST		0.00	0.00	0.00	TSS	NA		0.0	0.0	0.0	0.0%
POST	17-POST		0.00	0.00	0.00	TSS	NA		0.0	0.0	0.0	0.0%
POST	18-POST		0.00	0.00	0.00	TSS	NA		0.0	0.0	0.0	0.0%
POST	19-POST		0.00	0.00	0.00	TSS	NA		0.0	0.0	0.0	0.0%
POST	20-POST		0.00	0.00	0.00	TSS	NA		0.0	0.0	0.0	0.0%
POST	21-POST		0.00	0.00	0.00	TSS	NA		0.0	0.0	0.0	0.0%
POST	22-POST		0.00	0.00	0.00	TSS	NA		0.0	0.0	0.0	0.0%
POST	23-POST		0.00	0.00	0.00	TSS	NA		0.0	0.0	0.0	0.0%
POST	24-POST		0.00	0.00	0.00	TSS	NA		0.0	0.0	0.0	0.0%
POST	25-POST		0.00	0.00	0.00	TSS	NA		0.0	0.0	0.0	0.0%
		TOTAL	4.57	4.57	0.00			TOTAL	4975.0	3829.3	1145.7	23.0%

Date (MM/DD/YYYY): 12/18/2017
Project Name: NHDOT Route 16 Dummer Road Improvement
Town/City: Dummer
Impacted Surface Waters: Androscoggin River
Applicant: NHDOT
DES File #:

TOTAL POST DEVELOPMENT - PRE DEVELOPMENT (SHOULD BE 0 OR NEGATIVE) (lbs/yr)	0.4
% DIFFERENCE FROM PRE DEVELOMENT LOADS (SHOULD BE 0 OR NEGATIVE)	3.2%
TOTAL REMOVAL EFFICIENCY NEEDED TO MEET PRE-DEVELOPMENT LOAD	16.8%
CURRENTLY PROPOSED REMOVAL EFFICIENCY	14.1%
REMAINING REMOVAL EFFICIENCY NECESSARY TO MEET PRE-DEVELOPMENT LOAD	2.7%

PRE-DEVELOPMENT

PRE OR POST - DEV	SUB-AREA	POINT OF ANALYSIS NUMBER	AREA (acres)	Effective Impervious Area (acres)	Area Fertilized Annually (acres)	POLLUTANT	PERCENT REDUCTION IN FERTILIZER APPLICATION RATE	BMPS	LOAD (NO BMPS) (lbs/yr)	LOAD (WITH BMPS) (lbs/yr)	LOAD REDUCTION DUE TO BMPS (lbs/yr)	PERCENT REMOVAL
PRE	1- PRE		3.80	3.80	NA	TP	NA	No Structural Treatment	12.6	12.6	0.0	0.0%
PRE	2-PRE		0.00	0.00	NA	TP	NA		0.0	0.0	0.0	0.0%
PRE	3-PRE		0.00	0.00	NA	TP	NA		0.0	0.0	0.0	0.0%
PRE	4-PRE		0.00	0.00	NA	TP	NA		0.0	0.0	0.0	0.0%
PRE	5-PRE		0.00	0.00	NA	TP	NA		0.0	0.0	0.0	0.0%
PRE	6-PRE		0.00	0.00	NA	TP	NA		0.0	0.0	0.0	0.0%
PRE	7-PRE		0.00	0.00	NA	TP	NA		0.0	0.0	0.0	0.0%
PRE	8-PRE		0.00	0.00	NA	TP	NA		0.0	0.0	0.0	0.0%
PRE	9-PRE		0.00	0.00	NA	TP	NA		0.0	0.0	0.0	0.0%
PRE	10-PRE		0.00	0.00	NA	TP	NA		0.0	0.0	0.0	0.0%
PRE	11-PRE		0.00	0.00	NA	TP	NA		0.0	0.0	0.0	0.0%
PRE	12-PRE		0.00	0.00	NA	TP	NA		0.0	0.0	0.0	0.0%
PRE	13-PRE		0.00	0.00	NA	TP	NA		0.0	0.0	0.0	0.0%
PRE	14-PRE		0.00	0.00	NA	TP	NA		0.0	0.0	0.0	0.0%
PRE	15-PRE		0.00	0.00	NA	TP	NA		0.0	0.0	0.0	0.0%
PRE	16-PRE		0.00	0.00	NA	TP	NA		0.0	0.0	0.0	0.0%
PRE	17-PRE		0.00	0.00	NA	TP	NA		0.0	0.0	0.0	0.0%
PRE	18-PRE		0.00	0.00	NA	TP	NA		0.0	0.0	0.0	0.0%
PRE	19-PRE		0.00	0.00	NA	TP	NA		0.0	0.0	0.0	0.0%
PRE	20-PRE		0.00	0.00	NA	TP	NA		0.0	0.0	0.0	0.0%
PRE	21-PRE		0.00	0.00	NA	TP	NA		0.0	0.0	0.0	0.0%
PRE	22-PRE		0.00	0.00	NA	TP	NA		0.0	0.0	0.0	0.0%
PRE	23-PRE		0.00	0.00	NA	TP	NA		0.0	0.0	0.0	0.0%
PRE	24-PRE		0.00	0.00	NA	TP	NA		0.0	0.0	0.0	0.0%
PRE	25-PRE		0.00	0.00	NA	TP	NA		0.0	0.0	0.0	0.0%
		TOTAL	3.80	3.80				TOTAL	12.6	12.6	0.0	0.0%

Date (MM/DD/YYYY): 12/18/2017
Project Name: NHDOT Route 16 Dummer Road Improvement
Town/City: Dummer
Impacted Surface Waters: Androscoggin River
Applicant: NHDOT
DES File #:

POST-DEVELOPMENT

PRE OR POST - DEV	SUB-AREA	POINT OF ANALYSIS NUMBER	AREA (acres)	Effective Impervious Area (acres)	Area Fertilized Annually (acres)	POLLUTANT	PERCENT REDUCTION IN FERTILIZER APPLICATION RATE	BMPS	LOAD (NO BMPS) (lbs/yr)	LOAD (WITH BMPS) (lbs/yr)	LOAD REDUCTION DUE TO BMPS (lbs/yr)	PERCENT REMOVAL
POST	1-POST	no treatment	2.76	2.76	0.00	TP	0.0%	No Engineered Treatment	9.2	9.2	0.0	0.0%
POST	2-POST	D: 1-lane to veg filt	0.88	0.88	0.00	TP	0.0%	Vegetated Filter Strip -one lane section	2.9	1.6	1.3	45.0%
POST	3-POST	C&H: 2 Lns- 50' bu	0.55	0.55	0.00	TP	0.0%	Segment C & H -Partial Treatment to 50 ft Vegetated Buffer Strip -two lanes	1.8	1.4	0.4	22.0%
POST	4-POST	F: 2 Lns 60-80' bu	0.38	0.38	0.00	TP	0.0%	Segment F -Partial Treatment to 60-80 ft Vegetated Buffer Strip-two lanes	1.3	0.8	0.4	34.0%
POST	5-POST		0.00	0.00	0.00	TP	0.0%		0.0	0.0	0.0	0.0%
POST	6-POST		0.00	0.00	0.00	TP	0.0%		0.0	0.0	0.0	0.0%
POST	7-POST		0.00	0.00	0.00	TP	0.0%		0.0	0.0	0.0	0.0%
POST	8-POST		0.00	0.00	0.00	TP	0.0%		0.0	0.0	0.0	0.0%
POST	9-POST		0.00	0.00	0.00	TP	0.0%		0.0	0.0	0.0	0.0%
POST	10-POST		0.00	0.00	0.00	TP	0.0%		0.0	0.0	0.0	0.0%
POST	11-POST		0.00	0.00	0.00	TP	0.0%		0.0	0.0	0.0	0.0%
POST	12-POST		0.00	0.00	0.00	TP	0.0%		0.0	0.0	0.0	0.0%
POST	13-POST		0.00	0.00	0.00	TP	0.0%		0.0	0.0	0.0	0.0%
POST	14-POST		0.00	0.00	0.00	TP	0.0%		0.0	0.0	0.0	0.0%
POST	15-POST		0.00	0.00	0.00	TP	0.0%		0.0	0.0	0.0	0.0%
POST	16-POST		0.00	0.00	0.00	TP	0.0%		0.0	0.0	0.0	0.0%
POST	17-POST		0.00	0.00	0.00	TP	0.0%		0.0	0.0	0.0	0.0%
POST	18-POST		0.00	0.00	0.00	TP	0.0%		0.0	0.0	0.0	0.0%
POST	19-POST		0.00	0.00	0.00	TP	0.0%		0.0	0.0	0.0	0.0%
POST	20-POST		0.00	0.00	0.00	TP	0.0%		0.0	0.0	0.0	0.0%
POST	21-POST		0.00	0.00	0.00	TP	0.0%		0.0	0.0	0.0	0.0%
POST	22-POST		0.00	0.00	0.00	TP	0.0%		0.0	0.0	0.0	0.0%
POST	23-POST		0.00	0.00	0.00	TP	0.0%		0.0	0.0	0.0	0.0%
POST	24-POST		0.00	0.00	0.00	TP	0.0%		0.0	0.0	0.0	0.0%
POST	25-POST		0.00	0.00	0.00	TP	0.0%		0.0	0.0	0.0	0.0%
		TOTAL	4.57	4.57	0.00			TOTAL	15.2	13.0	2.1	14.1%

Date (MM/DD/YYYY): 12/18/2017
Project Name: NHDOT Route 16 Dummer Road Improvement
Town/City: Dummer
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Applicant: NHDOT
DES File #:

TOTAL POST DEVELOPMENT - PRE DEVELOPMENT (SHOULD BE 0 OR NEGATIVE) (lbs/yr)	3.9
% DIFFERENCE FROM PRE DEVELOMENT LOADS (SHOULD BE 0 OR NEGATIVE)	5.0%
TOTAL REMOVAL EFFICIENCY NEEDED TO MEET PRE-DEVELOPMENT LOAD	16.8%
CURRENTLY PROPOSED REMOVAL EFFICIENCY	12.6%
REMAINING REMOVAL EFFICIENCY NECESSARY TO MEET PRE-DEVELOPMENT LOAD	4.2%

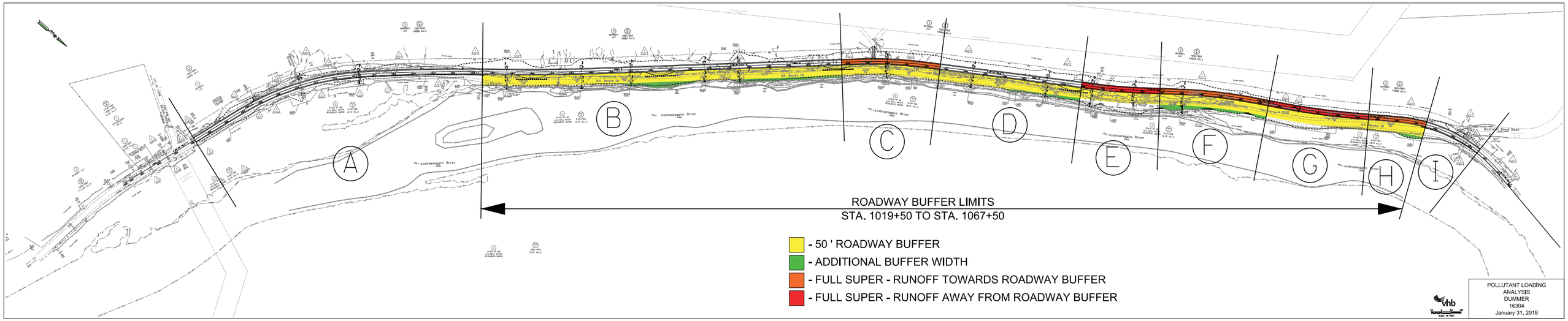
PRE-DEVELOPMENT

PRE OR POST - DEV	SUB-AREA	POINT OF ANALYSIS NUMBER	AREA (acres)	Effective Impervious Area (acres)	Area Fertilized Annually (acres)	POLLUTANT	PERCENT REDUCTION IN FERTILIZER APPLICATION RATE	BMPS	LOAD (NO BMPS) (lbs/yr)	LOAD (WITH BMPS) (lbs/yr)	LOAD REDUCTION DUE TO BMPS (lbs/yr)	PERCENT REMOVAL
PRE	1- PRE		3.80	3.80	NA	TN	NA	No Structural Treatment	77.8	77.8	0.0	0.0%
PRE	2-PRE		0.00	0.00	NA	TN	NA		0.0	0.0	0.0	0.0%
PRE	3-PRE		0.00	0.00	NA	TN	NA		0.0	0.0	0.0	0.0%
PRE	4-PRE		0.00	0.00	NA	TN	NA		0.0	0.0	0.0	0.0%
PRE	5-PRE		0.00	0.00	NA	TN	NA		0.0	0.0	0.0	0.0%
PRE	6-PRE		0.00	0.00	NA	TN	NA		0.0	0.0	0.0	0.0%
PRE	7-PRE		0.00	0.00	NA	TN	NA		0.0	0.0	0.0	0.0%
PRE	8-PRE		0.00	0.00	NA	TN	NA		0.0	0.0	0.0	0.0%
PRE	9-PRE		0.00	0.00	NA	TN	NA		0.0	0.0	0.0	0.0%
PRE	10-PRE		0.00	0.00	NA	TN	NA		0.0	0.0	0.0	0.0%
PRE	11-PRE		0.00	0.00	NA	TN	NA		0.0	0.0	0.0	0.0%
PRE	12-PRE		0.00	0.00	NA	TN	NA		0.0	0.0	0.0	0.0%
PRE	13-PRE		0.00	0.00	NA	TN	NA		0.0	0.0	0.0	0.0%
PRE	14-PRE		0.00	0.00	NA	TN	NA		0.0	0.0	0.0	0.0%
PRE	15-PRE		0.00	0.00	NA	TN	NA		0.0	0.0	0.0	0.0%
PRE	16-PRE		0.00	0.00	NA	TN	NA		0.0	0.0	0.0	0.0%
PRE	17-PRE		0.00	0.00	NA	TN	NA		0.0	0.0	0.0	0.0%
PRE	18-PRE		0.00	0.00	NA	TN	NA		0.0	0.0	0.0	0.0%
PRE	19-PRE		0.00	0.00	NA	TN	NA		0.0	0.0	0.0	0.0%
PRE	20-PRE		0.00	0.00	NA	TN	NA		0.0	0.0	0.0	0.0%
PRE	21-PRE		0.00	0.00	NA	TN	NA		0.0	0.0	0.0	0.0%
PRE	22-PRE		0.00	0.00	NA	TN	NA		0.0	0.0	0.0	0.0%
PRE	23-PRE		0.00	0.00	NA	TN	NA		0.0	0.0	0.0	0.0%
PRE	24-PRE		0.00	0.00	NA	TN	NA		0.0	0.0	0.0	0.0%
PRE	25-PRE		0.00	0.00	NA	TN	NA		0.0	0.0	0.0	0.0%
		TOTAL	3.80	3.80				TOTAL	77.8	77.8	0.0	0.0%

Date (MM/DD/YYYY): 12/18/2017
Project Name: NHDOT Route 16 Dummer Road Improvement
Town/City: Dummer
Impacted Surface Waters: Androscoggin River
Applicant: NHDOT
DES File #:

POST-DEVELOPMENT

PRE OR POST - DEV	SUB-AREA	POINT OF ANALYSIS NUMBER	AREA (acres)	Effective Impervious Area (acres)	Area Fertilized Annually (acres)	POLLUTANT	PERCENT REDUCTION IN FERTILIZER APPLICATION RATE	BMPS	LOAD (NO BMPS) (lbs/yr)	LOAD (WITH BMPS) (lbs/yr)	LOAD REDUCTION DUE TO BMPS (lbs/yr)	PERCENT REMOVAL
POST	1-POST	no treatment	2.76	2.76	0.00	TN	0.0%	No Engineered Treatment	56.5	56.5	0.0	0.0%
POST	2-POST	D: 1-lane to veg filt	0.88	0.88	0.00	TN	0.0%	Vegetated Filter Strip -one lane section	17.9	10.8	7.2	40.0%
POST	3-POST	C&H: 2 Lns- 50' bu	0.55	0.55	0.00	TN	0.0%	Segment C & H -Partial Treatment to 50 ft Vegetated Buffer Strip -two lanes	11.3	9.0	2.3	20.0%
POST	4-POST	F: 2 Lns 60-80' bu	0.38	0.38	0.00	TN	0.0%	Segment F -Partial Treatment to 60-80 ft Vegetated Buffer Strip-two lanes	7.8	5.4	2.3	30.0%
POST	5-POST		0.00	0.00	0.00	TN	0.0%		0.0	0.0	0.0	0.0%
POST	6-POST		0.00	0.00	0.00	TN	0.0%		0.0	0.0	0.0	0.0%
POST	7-POST		0.00	0.00	0.00	TN	0.0%		0.0	0.0	0.0	0.0%
POST	8-POST		0.00	0.00	0.00	TN	0.0%		0.0	0.0	0.0	0.0%
POST	9-POST		0.00	0.00	0.00	TN	0.0%		0.0	0.0	0.0	0.0%
POST	10-POST		0.00	0.00	0.00	TN	0.0%		0.0	0.0	0.0	0.0%
POST	11-POST		0.00	0.00	0.00	TN	0.0%		0.0	0.0	0.0	0.0%
POST	12-POST		0.00	0.00	0.00	TN	0.0%		0.0	0.0	0.0	0.0%
POST	13-POST		0.00	0.00	0.00	TN	0.0%		0.0	0.0	0.0	0.0%
POST	14-POST		0.00	0.00	0.00	TN	0.0%		0.0	0.0	0.0	0.0%
POST	15-POST		0.00	0.00	0.00	TN	0.0%		0.0	0.0	0.0	0.0%
POST	16-POST		0.00	0.00	0.00	TN	0.0%		0.0	0.0	0.0	0.0%
POST	17-POST		0.00	0.00	0.00	TN	0.0%		0.0	0.0	0.0	0.0%
POST	18-POST		0.00	0.00	0.00	TN	0.0%		0.0	0.0	0.0	0.0%
POST	19-POST		0.00	0.00	0.00	TN	0.0%		0.0	0.0	0.0	0.0%
POST	20-POST		0.00	0.00	0.00	TN	0.0%		0.0	0.0	0.0	0.0%
POST	21-POST		0.00	0.00	0.00	TN	0.0%		0.0	0.0	0.0	0.0%
POST	22-POST		0.00	0.00	0.00	TN	0.0%		0.0	0.0	0.0	0.0%
POST	23-POST		0.00	0.00	0.00	TN	0.0%		0.0	0.0	0.0	0.0%
POST	24-POST		0.00	0.00	0.00	TN	0.0%		0.0	0.0	0.0	0.0%
POST	25-POST		0.00	0.00	0.00	TN	0.0%		0.0	0.0	0.0	0.0%
		TOTAL	4.57	4.57	0.00			TOTAL	93.5	81.7	11.8	12.6%


A
B
C
D
E
F
G
H
I
Androscoggin River
ROADWAY BUFFER LIMITS
STA. 1019+50 TO STA. 1067+50
- 50 ' ROADWAY BUFFER
- ADDITIONAL BUFFER WIDTH
- FULL SUPER - RUNOFF TOWARDS ROADWAY BUFFER
- FULL SUPER - RUNOFF AWAY FROM ROADWAY BUFFER
POLLUTANT LOADING
ANALYSIS
DUMMER
16304
January 31, 2018

BUFFER DESIGN CRITERIA
(Env-Wq 1508.09)

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

Type **16304 Route 16 Roadway Buffer**

Enter the type of buffer (e.g., residential buffer) and the node name in the drainage analysis, if applicable

yes	Yes/No	Is the buffer adjacent to the area that you are treating?	← **yes**
yes	Yes/No	Does the runoff enter the buffer as sheet flow (naturally or with a level spreader?)	
no	Yes/No	Has a level spreader been provided?	
-	%F	% Forest (F) cover in the buffer (remaining assumed to be meadow (M)).	
100.0	%M	% Meadow cover in the buffer	
-	%A	Hydrologic soil group (HSG) in buffer (%A, %B, %C). Remaining assumed to be D soil	
25.0	%B		
25.0	%C		
50.0	%D		
15.0	%	Buffer Slope	← **≤ 15%**

If a Residential or Small Pervious Area buffer is proposed:

	Yes/No	Is the runoff from a single family or duplex residential lot?	← **yes**
		L_{FP} = maximum flow path to the buffer	
	ac	A = area draining to the buffer	
	ac	A_{IMP} = impervious area draining to the buffer	
-	%	I = percent impervious area draining to the buffer	← **≤ 10%**
FALSE		Option A check: $A_{IMP} \leq 1$ ac & $L_{FP} \leq 100'$	← **yes for**
FALSE		Option B check: $I \leq 10\%$ & $L_{FP} \leq 150'$	**A or B**
no		Level Spreader proposed? (Sheet flow without the aid of a LS)	← **no**
Good		Slope check	← **≤ 15%**
97	feet	Buffer base length due to soil type (weighted based on HSG)	
30	feet	Buffer length adjustment due to steepness of buffer	
30	feet	Buffer length adjustment due to percent of meadow in buffer	
157	feet	Minimum buffer length required [1]	

If a Developed Area Buffer with a Level Spreader is proposed:

no		Level Spreader proposed?	← **yes**
	ac	A = Area draining to the buffer [2]	
	ac	A_I = impervious area draining to the buffer [2]	
-	%	Percent impervious of the area that is draining to the buffer	
Good		Slope check	← **≤ 15%**
-	sf	Buffer base area due to soil type in the buffer (weighted based on HSG)	
-	sf	Buffer area adjustment due to impervious cover draining to buffer	
-	sf	Buffer area adjustment due to steepness of buffer	
-	sf	Buffer area adjustment due to percent of meadow in buffer	
-	sf	A_{MIN} = Minimum buffer area required	
	ft	L_{LS} = total length of level spreader(s) provided [3]	
	ft	L_B = buffer length [4]	
	sf	A_B = buffer area provided	← **≥ A_{MIN}**

If a Roadway Buffer is proposed:

no	Yes/No	LS proposed? Roadway/shoulder must sheet directly to the buffer.	← **no**
no	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
yes	Yes/No	Is the road parallel to the contours of the buffer slope?	← **yes**
Good		Natural slope check [5]	← **≤ 20%**
20.0	feet	How much embankment slope counts toward the buffer? [6]	← **0 - 20 feet**
1.0	Lane(s)	Number of travel lanes draining to the buffer	
50.0		Minimum buffer flow path (L_{MIN})	
60.0	feet	Buffer flow path	← **≥ L_{MIN}**

If a Ditch Turn Out Buffer is proposed:

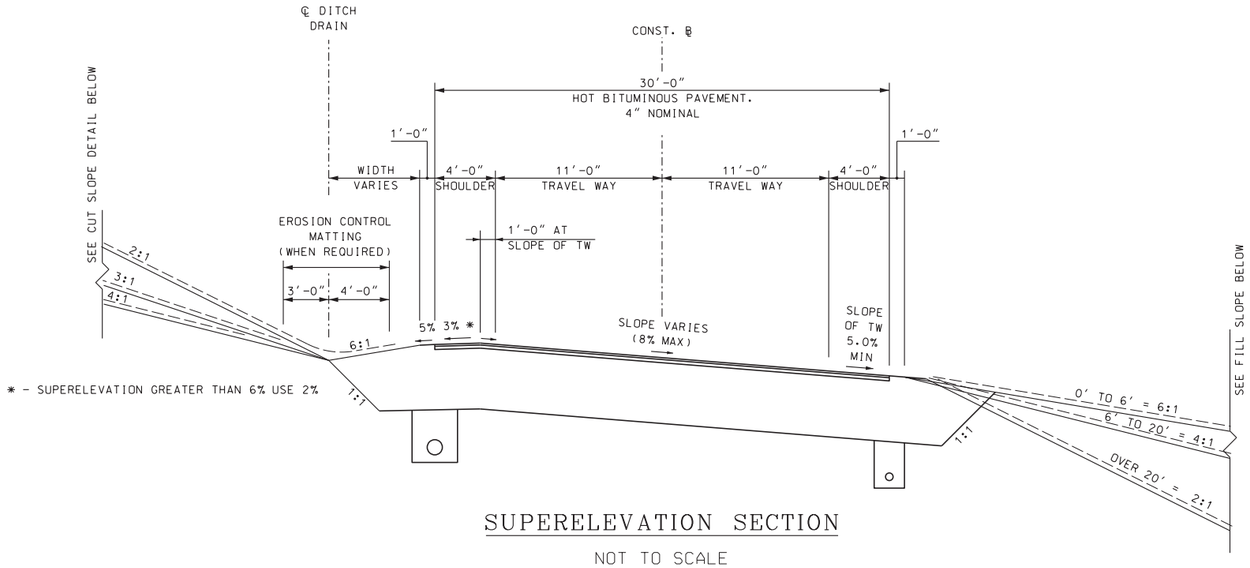
no		Level Spreader proposed?	← **yes**
	feet	Level Spreader Length [7]	
	Yes/No	Do any other areas drain to the buffer (other than roadway & shoulder)?	← **no**
	sf	Drainage Area to the ditch	← **≤ 6000 sf**
Good		Slope check	← **≤ 15%**
-	feet	Buffer base length due to soil type (weighted based on HSG)	
30	feet	Buffer length adjustment due to steepness of buffer	
30	feet	Buffer length adjustment due to percent of meadow in buffer	
60	feet	Minimum buffer length required [8]	

1. Minimum buffer length is the total of the above three cells OR 45', whichever is greater.
2. If a detention structure is used upstream of the level spreader, the drainage area draining to the buffer shall considered equal to 1 acre of impervious area for every 1 cfs of peak 2-year, 24-hr outflow from the detention structure.
3. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them.

Example: A_{MIN} = 6,000 sf with a 100' buffer available. Therefore the LS lengths must total 60 feet (6,000 sf/ 100'); however LS lengths must be between 20' and 50' so one 60' long level spreader is not permitted. The design would have two LS, each 30'. As long as a collection basin is provided to evenly distribute the flow to the two level spreaders.

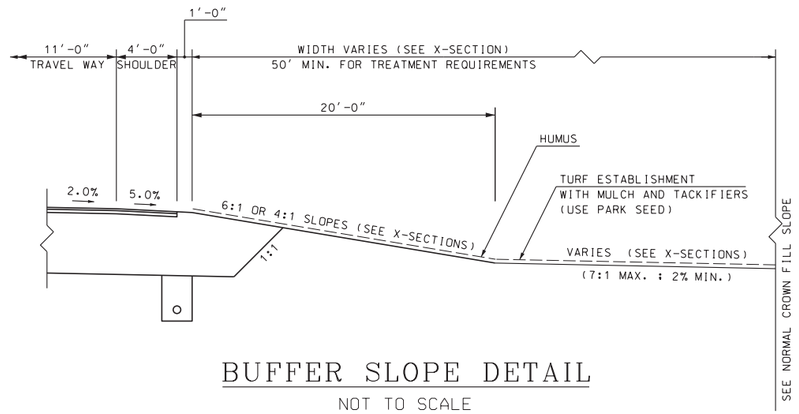
4. Minimum buffer length 50 feet.
5. If the slope is man-made, it must be 15% or flatter.
6. 20' (max) of the roadway embankment slope may count towards the buffer length if it is 3:1 or flatter.
7. Minimum level spreader length is 20 feet and maximum is 50 feet. You may use multiple level spreaders if the stormwater is evenly distributed to them. For example, you may have a total length of 100 feet for the level spreaders as long as you have two 50' level spreaders.
8. Minimum buffer length is the total of the above three cells OR 50', whichever is greater.

Designer's Notes:



SUPERELEVATION SECTION

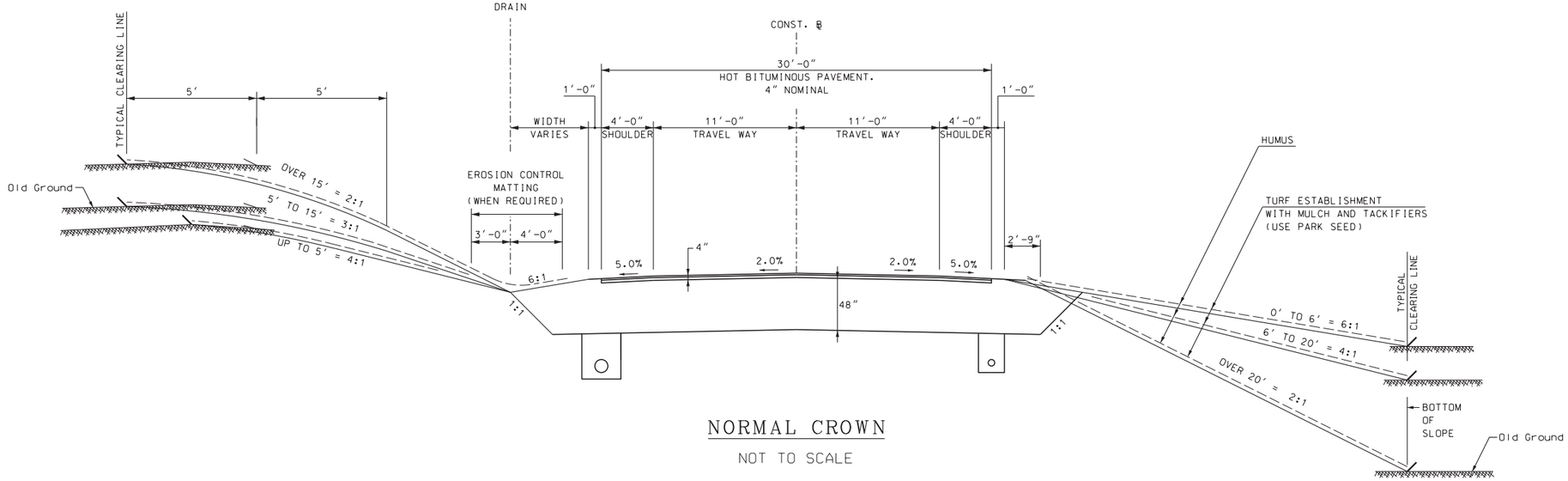
NOT TO SCALE



BUFFER SLOPE DETAIL

NOT TO SCALE

STA. 1019+50 - STA. 1067+50, RT



NORMAL CROWN

NOT TO SCALE

NUMBER	DATE	STATION

REVISIONS AFTER PROPOSAL DESCRIPTION

SDR PROCESSED	VHB TEAM	DATE 7/2017
NEW DESIGN	S. HILL	DATE 11/2017
SHEET CHECKED	F. KOCZALKA	DATE 11/2017
AS BUILT DETAILS		DATE

PPS&E SUBMISSION
PLANS
SUBJECT TO CHANGE
DATE 3/30/2018

vhb

STATE OF NEW HAMPSHIRE
DEPARTMENT OF TRANSPORTATION ◦ BUREAU OF HIGHWAY DESIGN

NH ROUTE 16
TYPICAL SECTIONS

DATE PLOTTED	VHB PROJECT NO.	MODEL	DGN	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
3/30/2018	52900.16	-	16304TYP_Wet_Cert.dgn	16304	2	66

Appendix E

Copies of Wetland and Shoreland Permit Applications

■

Separate Wetland and Shoreland Permit Applications have been submitted for the Project on April 4, 2018, however, to minimize file size and use of paper, these applications were not attached as it was assumed that copies of these permit applications can be retrieved from the Wetlands Bureau and Shoreland Permit groups.