HANDICAP ACCESSIBLITY IMPROVEMENTS

CAMP SEWATARO

1 LIBERTY LEDGE, SUDBURY, MA 01776

GEI Project No.: 22148

SHEET INDEX

No.	Title	Issue Date
C001	Cover Sheet	April 10, 2023
C101	Site Plan - Swimming Area	April 10, 2023
C102	Site Plan - Liberty Lodge	April 10, 2023
C501	Site Details - 1	April 10, 2023
C502	Site Details - 2	April 10, 2023

REVISIONS/ISSUES

No.	Note	Date
1	Issued for Permitting	April 10, 2023
2	Add Site Plan Signature Block	April 14, 2023
3	Per Conservation Commission Comments	May 10, 2023
4	Revised per Peer Review Comments	June 23, 2023
5	Revised per Peer Review Comments	July 10, 2023

REFERENCE PLAN INDEX

No.	Title	Issue Date
–	Topographic Plan (Feldman Geospatial) - 2 Sheets	December 20, 2022

LOCUS PLAN - AERIAL

SOURCE: GOOGLE EARTH

SCALE: 1"=1,000'

N

LOCUS PLAN - USGS

SOURCE: MASS GIS

SCALE: 1"=1,000'

N

OWNER

Town of Sudbury

275 Old Lancaster Road

Sudbury, MA 01776

APPLICANT

Town of Sudbury

275 Old Lancaster Road

Sudbury, MA 01776

SURVEYOR

Feldman Geospatial

27 Mechanic Street

Worcester, MA 01608

WETLAND CONSULTANT

EcoTec. Inc.

201 Grove Street

Worcester, MA 01605

GRAVES ENGINEERING, Inc.

100 GROVE STREET | WORCESTER MA 01605

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gravesengineering.com

COMMONWEALTH OF MASSACHUSETTS
MICHAEL R. ANDRADE
CIVIL
No. 45696
REGISTERED PROFESSIONAL ENGINEER

ELECTRONICALLY STAMPED BY MICHAEL ANDRADE, P.E.

SIGNATURE BLOCK	
PLANNING BOARD	APPROVAL DATE:
BUILDING INSPECTOR	
PUBLIC WORKS DIRECTOR	
DIRECTOR OF PLANNING/COMMUNITY DEV.	

C001 - COVER SHEET

LEGEND

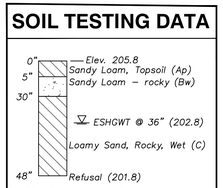
HC	HANDICAP SIGN
WV	WATER SHUT OFF VALVE
W — W	WATER LINE
D — D	DRAIN LINE
X — X	CHAIN LINK FENCE
WOOD FENCE	WOOD FENCE (PRF–POST AND RAIL, WF – WOOD FENCE)
W100 — W100	100–FOOT BUFFER ZONE
HSF — HSF	HAYBALE AND SILTFENCE
CFS — CFS	COMPOST FILTER SOCK
207.4	SPOT ELEVATION
EOP	EDGE OF PAVEMENT
R&D	REMOVE AND DISPOSE (OFF SITE)

STABILIZED CONSTRUCTION ENTRANCE
SAW-CUT LINE
PROPOSED TREELINE
8'X18.5' PAVED HANDICAP PARKING SPACES, AISLES AND SYMBOLS
S-1 SIGN
WHEEL STOP (TYP)
S-1 AND S-2 SIGNS
5' BIT. ASPHALT WALKWAY: 2% LONGITUDINAL SLOPE MAX, 1.5% CROSS-SLOPE MAX
BIT. PAVEMENT
STOCKPILE AREA
CRUSHED STONE FILTER STRIP
COMPOST FILTER SOCK
PROTECT TREE (SURROUND WITH ORANGE CONSTRUCTION FENCE EQUAL TO THE CANOPY DRIP LINE AND REMOVE AS NECESSARY FOR THE PROPOSED WORK)
PAVED PICNIC AREA
H.P. 205.5
FOREBAY
SANDBAG CRESCENT TO PROTECT DRAIN INLET (2' HIGH)
5' BIT. ASPHALT WALKWAY: 4.7% LONGITUDINAL SLOPE MAX, 1.5% CROSS-SLOPE MAX
STORMWATER BIORETENTION AREA
CLEANOUT INV=201.30 (SEE DETAIL)
4' WIDE VEGETATED SPILLWAY, CREST ELEV=204.50 (SEE DETAIL)
HANDICAP ACCESS MAT TO EDGE OF WATER
4' CONCRETE WALK (R&D EXISTING) PITCH TO POND (2% MAX)
HAYBALE AND SILTFENCE
PAVED PICNIC AREA
STORMWATER INFILTRATION AREA: BOTTOM ELEV.=202.0 BOTTOM AREA SHALL BE 6–INCHES DEEP OF A 50–50 BLEND OF SCREENED TOPSOIL AND SAND; SEED INSIDE THE AREA UP TO ELEV. 203.0 WITH A WATER–TOLERANT MIX (ERNST RETENTION BASIN FLOOR MIX, ERNMX–126, OR ENGINEER–APPROVED EQUAL)
6" SCH40 SOLID PVC 62 LF, S=1.0%
INV 15"=200.26 INV 6"=200.63 (USE INSERT–A–TEE OR EQUAL)
6" SCH40 PVC, 5', S=1.0% (CONTRACTOR TO VERIFY EXISTING 15" HDPE PIPE ELEVATION AT CONNECTION PRIOR TO CONSTRUCTION)
4' WIDE VEGETATED SPILLWAY, CREST ELEV=202.80 (SEE DETAIL FOR BIORETENTION AREA)
CLEANOUT (SEE DETAIL)
WYE 200.68
M.E. 207.0
M.E. 207.2
M.E. 207.1
SURFACE DRAINS (TYP) (8.5x11)
DRY WELL
(2) 4'X4'X4' GALLEYS W/1–1/2" STONE AROUND SIDES (8.5x11)
TWO–WAY VALVE
SHUT OFF VALVE
4" CAP @ GATE (8.5x11)
4" PERF PIPE @ 16" (8.5x11)
PERIMETER DRAIN
POOL COVER
WOODED AREA
SWIMMING POND (CONCRETE–LINED)
EDGE OF WATER
GRASS
SAND
CRUSHED STONE AD

SIGNATURE BLOCK

PLANNING BOARD	APPROVAL DATE:
BUILDING INSPECTOR	
PUBLIC WORKS DIRECTOR	
DIRECTOR OF PLANNING/COMMUNITY DEV.	

SOIL TESTING DATA



No Standing GW Observed

NOTE: SOIL TESTING PERFORMED BY GRAVES ENGINEERING ON 02/13/23.

SIGNAGE KEY

GEI ID	FEDERAL ID	SIGN SIZE WIDTH	SIGN SIZE HEIGHT	SIGN LAYOUT	QUANTITY
S–1	R7–8	12"	18"	RESERVED PARKING	2
S–2	R7–8a	12"	6"	VAN ACCESSIBLE	1

SHEET NOTES

1) PAVEMENT MARKINGS SHALL BE PAINTED WITH WHITE TRAFFIC PAINT CONFORMING TO SECTION M7.01.08 OF THE MASSDOT STANDARD SPECIFICATIONS FOR HIGHWAYS AND BRIDGES, LATEST EDITION. LINE WIDTH SHALL BE 4 INCHES. HANDICAP SYMBOL MARKINGS SHALL COMPLY WITH 521 CMR WITH WHITE SYMBOL ON BLUE BACKGROUND.

2) ALL JOINTS OF EXISTING & PROPOSED BITUMINOUS PAVEMENT SHALL BE SEALED WITH HOT RUBBERIZED ASPHALT JOINT SEALANT AND SANDED.

3) GRADING IN HANDICAP PARKING, ISLES. AND WALKWAYS SHALL CONFORM TO MASS AAB (521 CMR) STANDARDS.

GRAPHIC SCALE
10 0 5 10 20 40
(IN FEET)
1 inch = 10 ft.

Know what's below. Call before you dig. 811

GRAVES ENGINEERING, Inc.
100 GROVE STREET | WORCESTER MA 01605
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gravesengineering.com

NO.	DATE	BY	REVISIONS
5	07/10/23	KPM	REVISED PER PEER REVIEW
4	06/23/23	KPM	REVISED PER PEER REVIEW
3	05/10/23	KPM	PER CONS. COM. COMMENTS
2	04/14/23	KPM	ADD SITE PLAN SIGNATURE BLOCK
1	04/10/23	KPM	ISSUED FOR PERMITTING

COMMONWEALTH OF MASSACHUSETTS MICHAEL R. ANDRADE No. 45808 REGISTERED PROFESSIONAL ENGINEER

ELECTRONICALLY CERTIFIED BY: MICHAEL ANDRADE, P.E.

SITE PLAN - SWIMMING AREA
HANDICAP ACCESSIBILITY IMPROVEMENTS
CAMP SEWATARO, 1 LIBERTY LEDGE, SUDBURY, MA 01776

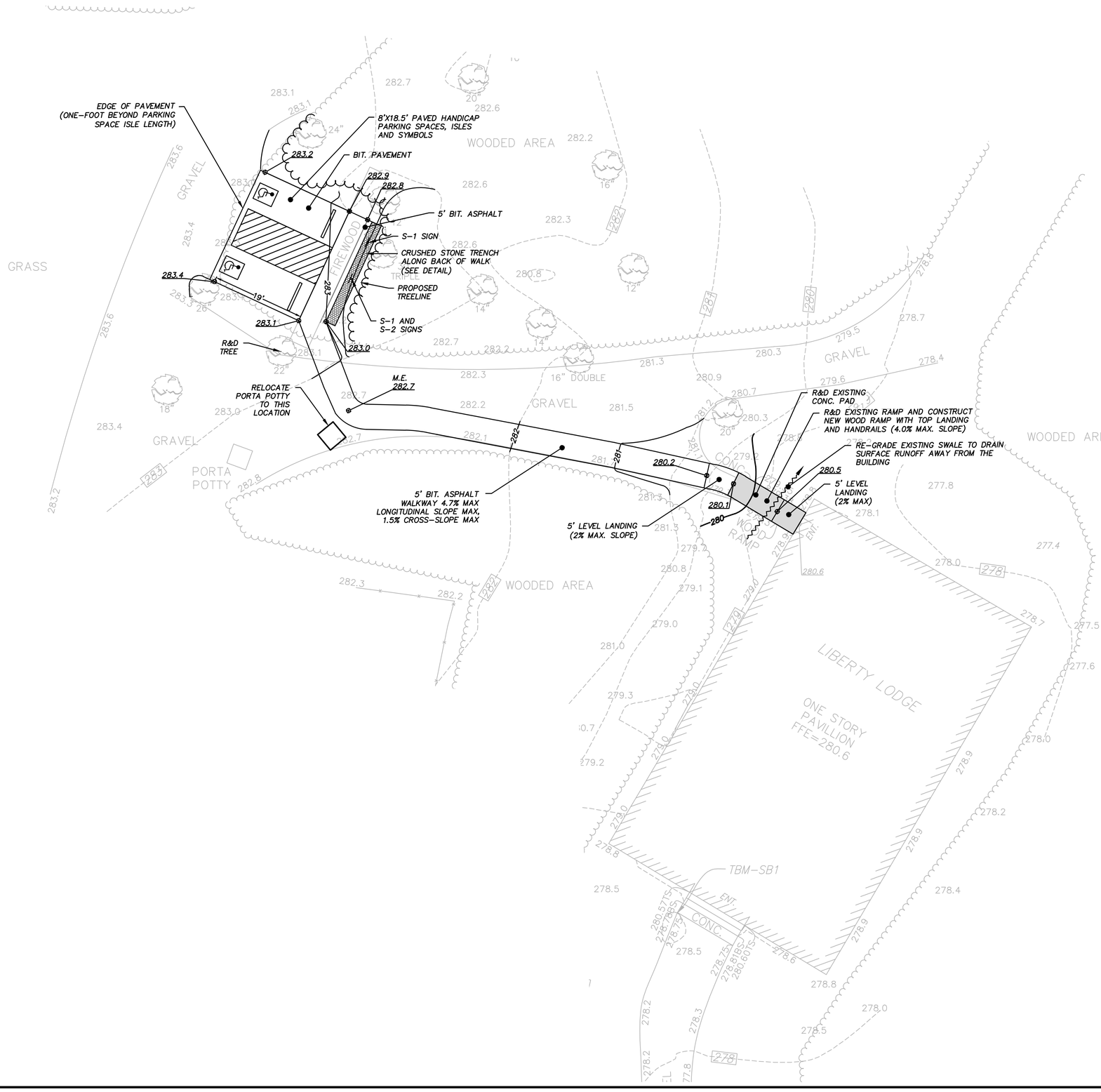
PREPARED FOR:
CAMP SEWATARO, LLC
1 LIBERTY LEDGE, SUDBURY, MA 01776

PRJ. NO.: 22148
CHK. BY: MRA
DRW. BY: KPM
DES. BY: KPM
SCALE: 1"=10'
DATE: 04/10/23

C101

SIGNAGE KEY

GEI ID	FEDERAL ID	SIGN SIZE WIDTH	SIGN SIZE HEIGHT	SIGN LAYOUT	QUANTITY
S-1	R7-8	12"	18"	RESERVED PARKING	2
S-2	R7-8a	12"	6"	VAN ACCESSIBLE	1



GRAPHIC SCALE

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(IN FEET)
1 inch = 10 ft.

SIGNATURE BLOCK

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COMMONWEALTH OF MASSACHUSETTS MICHAEL R. ANDRADE 49598 CIVIL REGISTERED PROFESSIONAL ENGINEER

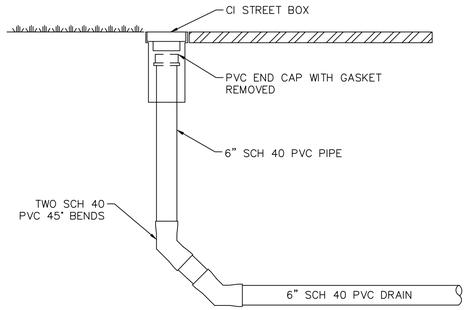
CERTIFICATION STAMPED BY MICHAEL ANDRADE, P.E.

SITE PLAN - LIBERTY LODGE
HANDICAP ACCESSIBILITY IMPROVEMENTS
CAMP SEWATARO, 1 LIBERTY LEDGE, SUDBURY, MA 01776

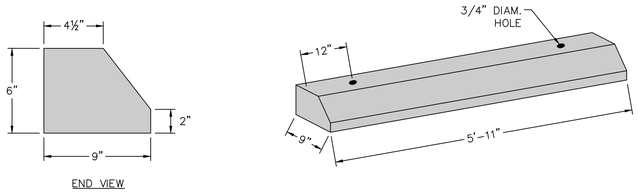
PREPARED FOR:
CAMP SEWATARO, LLC
1 LIBERTY LEDGE, SUDBURY, MA 01776

PRJ. NO.: 22148
CHK. BY: MRA
DRW. BY: KPM
DES. BY: KPM
SCALE: 1"=10'
DATE: 04/10/23

C102

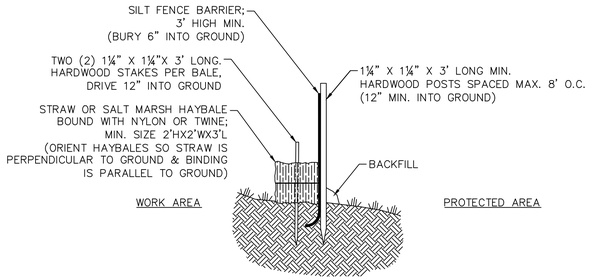


DRAIN CLEANOUT DETAIL NTS



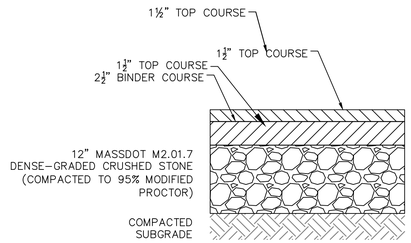
WHEEL STOP NTS

NOTES:
1) WHEEL STOPS SHALL BE CONSTRUCTED OF 4,000 PSI CONCRETE (28 DAYS) AND SECURED TO THE GROUND WITH STEEL PINS.
2) RUBBER OR OTHER MATERIAL WHEEL STOPS MAY BE SUBSTITUTED WITH THE APPROVAL OF THE ENGINEER.



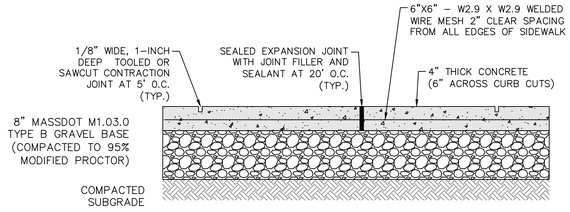
HAYBALE & SILTFENCE NTS

NOTE:
1) PROVIDE A 3' TO 6' LEVEL AREA BETWEEN THE HAYBALE AND THE TOE OF ANY SLOPE TO PROVIDE AREA FOR SEDIMENT ACCUMULATION.



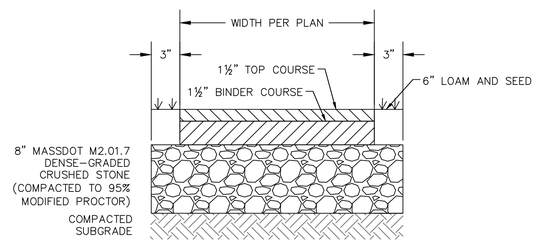
PAVEMENT SECTION NTS

NOTES:
1) TAMP ALL ASPHALT EDGES THAT ABUT LAWN, LANDSCAPED OR OTHER SOFT SURFACE.
2) BINDER COURSE: – MASSDOT M3.11.03, TABLE A, "HMA INTERMEDIATE COURSE DENSE BINDER" OR SUPERPAVE INTERMEDIATE COURSE – 19.0MM (MIXTURE DESIGNATION SIC – 19.0).
3) TOP COURSE: – MASSDOT M3.11.03, TABLE A, "SURFACE COURSE STANDARD TOP" OR SUPERPAVE SURFACE COURSE – 12.5MM (MIXTURE DESIGNATION SSC – 12.5).



CONCRETE SIDEWALK NTS

NOTES:
1) CONCRETE MIX DESIGN SHALL BE FOR EXTERIOR USE; AIR-ENTRAINED, 4,000 PSI MIN. (28-DAY), 3/4" AGGREGATE.
2) WHEN THE WALKWAY ABUTS A STRUCTURE OR EXISTING HARD SURFACE (CONCRETE, ETC.), INSTALL AN EXPANSION JOINT ACROSS THE ENTIRETY OF THE ABUTTING FACE WITH PREFORMED FIBER JOINT FILLER AND FILL WITH 1" DEEP OF POLYURETHANE JOINT SEALANT.
3) WALKWAYS SHALL HAVE A LIGHT BROOM FINISH PERPENDICULAR TO THE DIRECTION OF FOOT TRAFFIC. THERE SHALL BE NO SMOOTHED TOOL JOINTS; BROOM FINISH SHALL EXTEND TO THE EDGES OF THE PAD AND ACROSS ANY JOINTS.



BITUMINOUS WALKWAY SECTION NTS

NOTES:
1) DO NOT EXTEND BASE GRAVEL AS SHOWN WHEN WALKWAYS AREA ABUTTING ROAD, WALKWAY, OR OTHER HARD SURFACE.
2) BINDER COURSE: – MASSDOT M3.11.03, TABLE A, "HMA INTERMEDIATE COURSE DENSE BINDER" OR SUPERPAVE INTERMEDIATE COURSE – 19.0MM (MIXTURE DESIGNATION SIC – 19.0).
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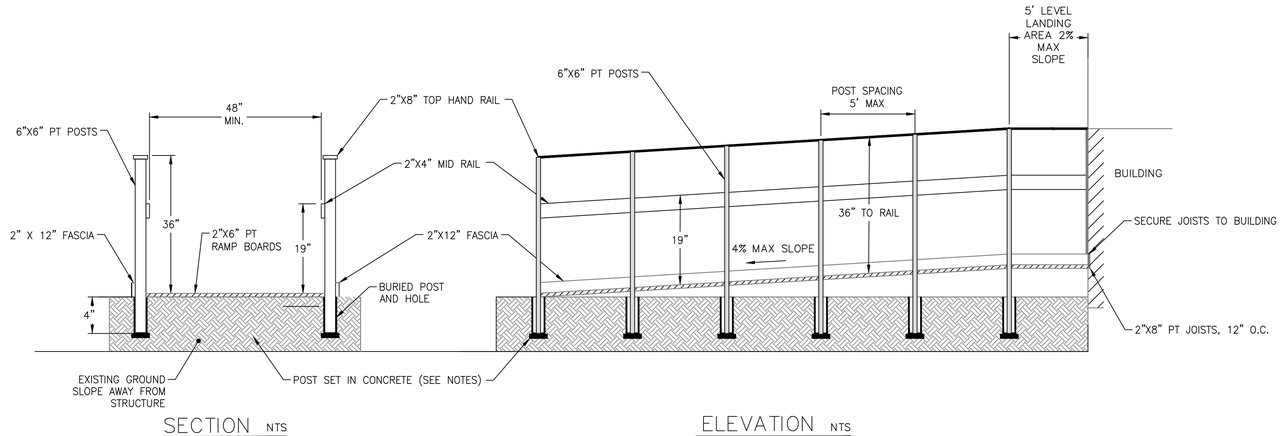
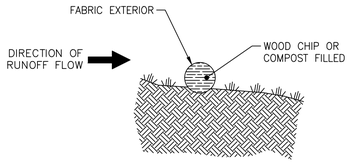


SECTION NTS ELEVATION NTS

HANDICAP ACCESSIBLE RAMP NTS

NOTES:
1) HANDRAILS SHALL COMPLY WITH THE MA ARCHITECTURAL ACCESS BOARD REGULATIONS (MA AAB). IN THE EVENT OF A DISCREPANCY BETWEEN MA AAB AND THESE DRAWINGS, MA AAB SHALL GOVERN.
2) SET POSTS ON 8" DIAMETER CONCRETE FOOTING AT 2' MINIMUM DEPTH.
3) ALL WOOD SHALL BE PRESSURE TREATED PINE SUITABLE FOR GROUND CONTACT.
4) CONTRACTOR MAY MODIFY DESIGN AS NECESSARY TO ENSURE COMPLIANCE WITH APPLICABLE CODES.



COMPOST FILTER SOCK NTS

NOTE:
1) PROVIDE A 3' TO 6' LEVEL AREA BETWEEN THE SILT SOCK AND THE TOE OF ANY SLOPE TO PROVIDE AREA FOR SEDIMENT ACCUMULATION.

SIGNATURE BLOCK	
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ELECTRONICALLY SIGNED BY MICHAEL ANDRADE, P.E.

SITE DETAILS - 1
HANDICAP ACCESSIBILITY IMPROVEMENTS
CAMP SEWATARO, 1 LIBERTY LEDGE, SUDBURY, MA 01776

PREPARED FOR:
CAMP SEWATARO, LLC
1 LIBERTY LEDGE, SUDBURY, MA 01776

PRJ. NO.: 22148
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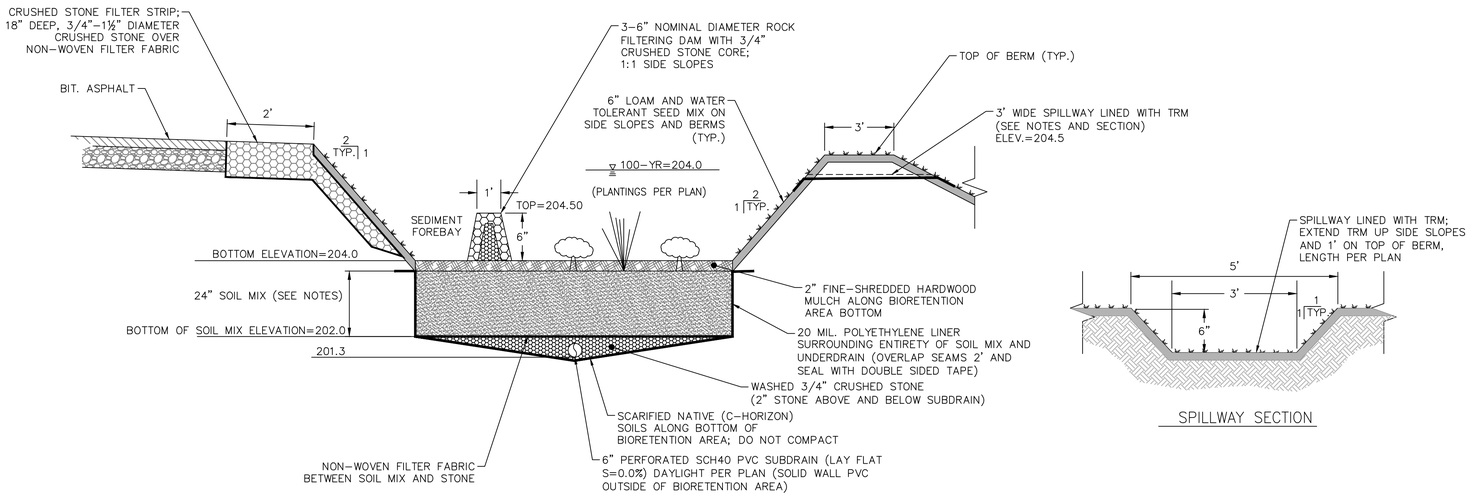
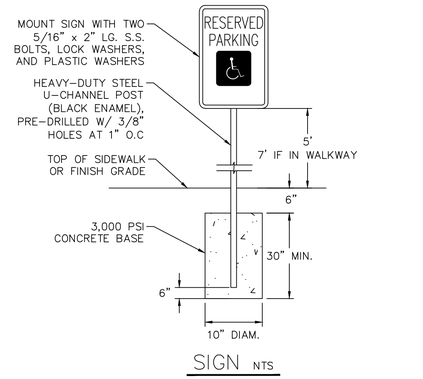
DRW. BY: KPM
DES. BY: KPM
SCALE: 1"=NTS
DATE: 04/10/23

C501



STORMWATER BIORETENTION AREA

SPILLWAY SECTION



SIGN NTS

NOTE:
1) THIS DETAIL APPLIES TO THE CONSTRUCTION OF ALL PROPOSED SIGNS; (SIGN TYPE AND DIMENSIONS MAY VARY FROM THOSE SHOWN). HANDICAP VAN ACCESSIBLE PLACARD SHALL BE MOUNTED DIRECTLY BELOW PRIMARY SIGN.

STORMWATER BIORETENTION AREA NOTES

1) PLANTINGS WITHIN THE BIORETENTION AREA MAY BE SUBSTITUTED WITH MORE READILY AVAILABLE SPECIES APPROVED BY GRAVES ENGINEERING, INC. ALL PLANT SPECIES MUST BE NATIVE TO MASSACHUSETTS AND A NON-INVASIVE SPECIES. PLANTINGS SHALL BE ARRANGED IN A NATURAL MANNER; ENGINEER SHALL APPROVE A PLANTING PLAN PREPARED BY THE CONTRACTOR PRIOR TO PLANTING.

2) BIORETENTION SOIL MIX SHALL BE A MIX OF SAND, COMPOST AND SOIL AS FOLLOWS: 40% SAND, 20-30% TOPSOIL, AND 30-40% COMPOST.

3) SOIL MIX MUST BE UNIFORM, FREE OF STONES, STUMPS, ROOTS OR OTHER SIMILAR OBJECTS LARGER THAN 2 INCHES; CLAY CONTENT LESS THAN 5%, pH BETWEEN 5.5 AND 6.5.

4) SOIL MIX SAND COMPONENT SHALL BE GRAVELLY SAND MEETING ASTM D422 AS FOLLOWS:

SIEVE SIZE	% PASSING
2"	100
3/4"	70-100
1/4"	50-80
#40	15-40
#200	0-3

5) SOIL MIX TOPSOIL COMPONENT SHALL BE SANDY LOAM, LOAMY SAND OR LOAM TEXTURE. COMPOST COMPONENT SHALL BE PROCESSED YARD WASTE IN COMPLIANCE WITH MASSDEP GUIDELINES AND NOT CONTAIN BIOSOLIDS.

6) THE CONTRACTOR SHALL BE RESPONSIBLE FOR SUBMITTING SOIL TESTING TO VERIFY THE SOIL USED FALLS WITHIN THESE LIMITS.

7) SPILLWAY TURF REINFORCEMENT MATTING (TRM) SHALL BE NORTH AMERICAN GREEN MODEL P300, OR ENGINEER APPROVED EQUAL.

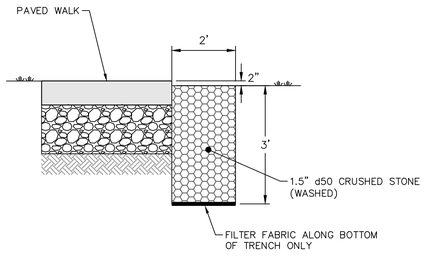
8) INTERIOR SIDE SLOPES SHALL BE SEEDED WITH NEW ENGLAND WETLAND PLANTS "EROSION CONTROL/RESTORATION MIX FOR DETENTION BASINS AND MOIST SITES" OR AN ENGINEER APPROVED EQUAL.

9) THE TERM "BIORETENTION AREA" IS SYNONOMOUS WITH THE TERM "RAIN GARDEN".

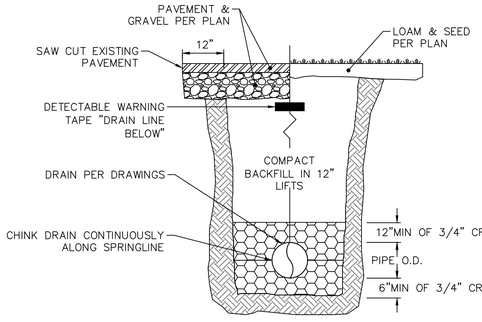
SEEDING NOTES

1) ALL DISTURBED AREAS, UNLESS OTHERWISE NOTED, SHALL BE STABILIZED WITH 6 INCHES OF LOAM AND SEED (LAWN MIX)

2) SEEDING SHALL TAKE PLACE BETWEEN MARCH AND MAY BETWEEN AUGUST AND OCTOBER 15. SHOULD SEEDING NEED TO TAKE PLACE DURING SUMMER MONTHS, ADDITIONAL MULCHING AND WATERING WILL BE REQUIRED.



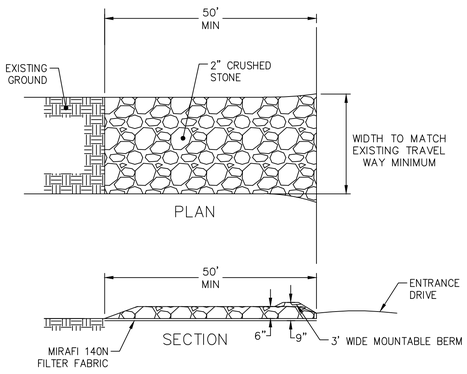
STONE TRENCH ALONG WALK NTS



HDPE/PVC DRAIN TRENCH SECTION NTS

NOTES:
1) BACKFILL SHALL BE AN AASHTO CLASS III SOIL; EITHER TRENCH SPOILS OR AN IMPORTED SAND AND GRAVEL WITH FINES AND COMPACTED TO 90% OF THE PROCTOR DENSITY.

2) BACKFILL OF HDPE PIPE SHALL CONFORM TO ASTM D2321 AND/OR MANUFACTURER'S SPECIFICATIONS.



STORMWATER BIORETENTION AREA PLANTING LIST

QTY.	BOTANICAL NAME	COMMON NAME	SIZE	NOTES
5	PANICUM VIRGATUM	SWITCH GRASS	2 GAL.	18" O.C.
10	ASCLEPIAS TUBEROSA	BUTTERFLY MILKWEED	2 GAL.	24" O.C.
5	HYPERICUM PERFORATUM	ST. JOHN'S WORT	4 OZ.	24" O.C.
10	ARGYRANTHEMUM FRUTESCENS	MARGUERITE DAISY	2 GAL.	30" O.C.
2	CORNUS AMOMUM	SILKY DOGWOOD	8'	8' O.C.
2	ITEA VIRGINICA	VIRGINIA SWEETSPIRE	36" SPREAD	B&B
2	VIBURNUM DENTATUM	ARROWWOOD	3 GAL.	B&B
2	HAMAMELIS VIRGINIANA	WITCH HAZEL	4'	
2	ILEX VERTICILLATE	WINTERBERRY	#2 CONT.	36" O.C.

NOTE: IF ANY SPECIFIED PLANTS LISTED IN THE ABOVE TABLE ARE NOT AVAILABLE, THEY MAY BE SUBSTITUTED WITH OTHER NATIVE SPECIES IN THE MADEP STORMWATER HANDBOOK PLANT SPECIES SUITABLE FOR USE IN BIORETENTION – HERBACEOUS SPECIES.

SIGNATURE BLOCK

PLANNING BOARD	APPROVAL DATE:
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PUBLIC WORKS DIRECTOR	
DIRECTOR OF PLANNING/COMMUNITY DEV	

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COMMONWEALTH OF MASSACHUSETTS — MICHAEL P. ANDRADE — No. 45858 — REGISTERED PROFESSIONAL ENGINEER
CERTIFYING ENGINEER'S SEAL APPLIED BY MICHAEL ANDRADE, P.E.

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1 LIBERTY LEDGE, SUDBURY, MA 01776

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DRW. BY: KPM
DES. BY: KPM
SCALE: 1"=NTS
DATE: 04/10/23

C502

Horsley Witten Group
Sustainable Environmental Solutions
112 Water Street • 6th Floor • Boston, MA 02109
857-263-8193 • horsleywitten.com

July 13, 2023

Mr. Stephen Garvin, Chair
Planning Board
Town of Sudbury
278 Old Sudbury Road
Sudbury, Massachusetts 01776

Re: Third Peer Review of the Stormwater Management for
1 Liberty Ledge (Camp Sewataro)
Sudbury, Massachusetts

Dear Chair Garvin and Board Members:

The Horsley Witten Group, Inc. (HW) is pleased to provide the Sudbury Planning Board with this letter report summarizing our third review of the proposed stormwater management and erosion controls proposed at 1 Liberty Ledge (Camp Sewataro) as part of its handicap accessibility improvements project. The project includes the construction of three handicap parking spaces and handicap access to the swimming pool area, as well as a paved picnic area adjacent to the pool area. The Applicant has proposed a bioretention system to mitigate the stormwater impacts of the proposed improvements. Two additional accessible parking spaces and a paved pathway are also proposed but no stormwater controls have been shown.

Graves Engineering, Inc, has prepared the Application for Stormwater Management Permit (SMP) on behalf of the Town of Sudbury (Applicant). The total area to be disturbed is 10,100± sf, of which an additional 1,823 sf will be impervious.

The following additional documents and plans were received by HW in response to our second peer review dated June 27, 2023:

- Peer Review #2 Response letter, 1 Liberty Ledge - Handicap Accessibility Improvements Project, prepared by Graves Engineering, Inc., dated July 10, 2023, (4 pages);
- Stormwater Report for Handicap Accessibility Improvements Project, Camp Sewataro, 1 Liberty Ledge, Sudbury, MA, prepared by Graves Engineering, Inc., revised July 10, 2023 (81 pages); and
- Site Plans for Handicap Accessibility Improvements, Camp Sewataro, 1 Liberty Ledge, Sudbury, MA, dated April 10, 2023, revised through July 10, 2023, including:
    - Cover Sheet C001
    - Site Plan - Swimming Area C101
    - Site Plan - Liberty Lodge C102
    - Site Details - 1 C501
    - Site Details - 2 C502

Stormwater Review

HW has reviewed the proposed stormwater management design as per the standards listed in the Massachusetts Stormwater Handbook (MSH) dated February 2008 and the Town of Sudbury Stormwater Management Bylaw Regulations (Stormwater Bylaws), revised January 23, 2013.

In accordance with Section 8.0 of the Stormwater Bylaws, this project is required to comply at a minimum with the performance standards of the MSH. Therefore, we have used the MSH as the basis for organizing our comments. However, in instances where the additional criteria established in Section 8 of the Stormwater Bylaws require further recommendations, we have referenced these as well.

The following comments correlate with our second peer review letter dated June 27, 2023, follow up comments are provided in **bold underlined font** where needed.

1. *Standard 1: No new stormwater conveyances (e.g., outfalls) may discharge untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth.*

    a. The Applicant has modeled one design point (DP#1) associated with the proposed project area. DP#1 is the fishing pond located south of the swimming area and southeast of the concrete lined swimming pond. The pre-developed condition is included in one catchment area while the post-development is modeled as two subcatchments.

    - The Project Area is located within an existing catchment area that consists of a landscaped area with trees, a stone walk, ledge outcrops and a sloping lawn. The existing slope directs the runoff down the grassed slope to the fishing pond.

      June 27, 2023: No further comment needed.

    - Under existing conditions, the runoff from a bituminous concrete driveway adjacent to the Project Area flows into a 15-inch HDPE pipe that outlets onto a stone spillway and then flows into the fishing pond via a 36-inch reinforced concrete pipe (RCP). The runoff from the driveway and the 15-inch pipe is not part of the existing catchment area.

      June 27, 2023: No further comment needed.

    - The proposed Project Area includes a bioretention area that divides the existing catchment area and discharges via a proposed 6-inch PVC underdrain into the existing 15-inch HDPE pipe. HW recommends that the Applicant document this outfall to confirm the 15-inch pipe can manage the discharge from the bioretention area and that it will not cause erosion at the outfall.

      June 27, 2023: The Applicant claims that the bioretention area attenuates peak flows to the design point and therefore by extension the 15-inch culvert. However, under existing conditions the subcatchment area does not include runoff that flows into the 15-inch pipe while under post-development conditions the bioretention underdrain connects into it. HW notes that during the 100-year event the peak rate of stormwater exfiltrated is 0.54 cfs. HW further acknowledges that although 0.54 cfs is not excessive the bioretention area is lined so the stormwater will discharge via the underdrain. However, the

Applicant has not included the 6-inch underdrain in its HydroCAD model, and it has not documented that the 15-inch pipe has excess capacity to handle any additional flow coming from the bioretention area.

HW's comment stands, we recommend that the Applicant document that the existing 15-inch pipe can manage the discharge from the bioretention area and that it will not cause erosion at the outfall.

July 13, 2023: The Applicant has revised its HydroCAD model to include the 15-inch pipe and has stated that no erosion is currently occurring at the outfall. The Applicant has also added an infiltration basin to recharge the overflow from the bioretention area. The Applicant has not increased the flow in the 15-inch pipe under proposed conditions. HW has no further comment.

- HW recommends that the Applicant consider the possibility of treating a portion of the existing driveway that flows into the existing 15-inch pipe as part of this proposed project.

  June 27, 2023: The Applicant has stated that it is not required to treat additional areas. HW concurs that it is not a requirement, but it would be beneficial to the water quality flowing into the pond.

As designed it does not appear that precipitation events up to and including the 100-year storm will not cause erosion in the downgradient wetland/fishing pond.

June 27, 2023: It does not appear that the proposed design will cause erosion in the fishing pond.

2. *Standard 2: Stormwater management systems shall be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates.*

   The project area is in an area where the soils have a high infiltration rate. Under existing conditions, the project area is mostly woodland or lawn and has minimal discharge for all storm events analyzed. The proposed stormwater management system includes a bioretention area that captures and manages the stormwater from the proposed bituminous pavement for the swimming pool area.

   a. The Applicant has provided supporting calculations to determine the peak rate attenuation and runoff volume for the 2-year, 10-year, 25-year, and 100-year storm events. HW has confirmed the curve numbers and the surface materials. HW recommends that the Applicant review the time of concentration (Tc) values used in the model, the existing pipe seems to have been left out in both pre- and post-development conditions. HW recommends that the Applicant justify the exclusion of the 15-inch pipe that is managing post development runoff.

      June 27, 2023: The Applicant has restated that the hydrology associated with the 15-inch pipe does not change from pre- to post-conditions. However, as noted above it appears that the bioretention underdrain discharges into the 15-inch pipe therefore changing the outflow of the 15-inch pipe. HW recommends that the Applicant clarify the impact of the proposed bioretention system on the 15-inch pipe under post-development conditions.

July 13, 2023: The Applicant has revised its HydroCAD model to include the 15-inch pipe. The Applicant has also added an infiltration basin to recharge the overflow from the bioretention area. The Applicant has not increased the flow in the 15-inch pipe under proposed conditions. HW has no further comment.

b. HW has confirmed the size of the bioretention area. HW recommends that the Applicant confirm the elevation for the spillway. In the HydroCAD model the elevation is listed as 205.00. The plan set and detail lists the elevation as 204.5. The detail for the bioretention area shows an impermeable liner while the HydroCAD model indicates exfiltration will occur. An impermeable liner is proposed because approximately half of the proposed bioretention soil mix will be located within the estimated seasonal high ground water (ESHGW) table. The 6-inch PVC underdrain is not included in the HydroCAD model. HW recommends that the Applicant revisit the HydroCAD model and confirm it is consistent with the proposed detail.

June 27, 2023: The Applicant has confirmed the outlet elevations and has documented that the capacity of the 6-inch underdrain will adequately manage the flow of stormwater infiltrating into the soil median. No further action required.

c. The Applicant has modeled the bioretention area with an exfiltration rate of 2.41 inches per hour (iph). HW disagrees that this rate is appropriate for a bioretention area and is not applicable when an impermeable liner is proposed. We recommend that the Applicant revisit the HydroCAD model.

June 27, 2023: HW concurs that 2.41 cfs is acceptable for the soil median specified. No further action required.

d. The HydroCAD model indicates a slight increase in peak volume for all the storm events modeled. The Table below summarizes the stormwater discharge as well as the peak volume for the various storm events.

	Existing DP#1		Proposed DP#1	
	Existing Peak Flow (cfs)	Existing Peak Volume (cf)	Prop. Peak Flow (cfs)	Prop. Peak Volume (cf)
2-year (3.25")	0.00 **0.00**	18 **0**	0.00 **0.00**	163 **89**
10-year (4.90")	0.01 **0.00**	303 **97**	0.01 **0.02**	670 **432**
25-year (6.20")	0.09 **0.02**	723 **341**	0.06* **0.03**	1,262 **797**
100-year (8.85")	0.43 **0.21**	1,966 **1,220**	0.26* **0.19**	2,822 **1,646**

*The HydroCAD report differs slightly from the tables provided in the report narrative. The values shown above have been taken from the HydroCAD model.

June 27, 2023: Section 8.0 A.3.i. of the Stormwater Bylaw states that the total volume of discharge as well as peak rate shall be evaluated at each control point. HW has listed the values taken from the Applicant's HydroCAD model. HW defers to the Planning Board on whether further discussion is warranted.

July 13, 2023: The Applicant has added a shallow infiltration basin to further

reduce the peak flow and volume of stormwater reaching the pond. There is still a very slight increase as seen in the table above. The size of the infiltration basin appears to be constrained by ledge and groundwater. HW defers to the Planning Board further discussion, or the granting of a waiver as requested by the Applicant.

e. Applicant has not provided any stormwater management for the additional impervious area created by the proposed picnic area or walkway. HW recommends that the Applicant justify the exclusion of these areas.

June 27, 2023: The Applicant has noted that the areas excluded may be considered *de minimus*. Volume 3, Chapter 1, page 35 of the MSH details the conditions that are required to classify a discharge as *de minimus*. HW recommends that the Applicant provide the appropriate confirmation.

July 13, 2023: The Applicant has added a shallow infiltration basin to capture the proposed impervious area of the walkways. HW has no further comment.

f. The Applicant has not provided any stormwater management for the additional impervious area created by the proposed parking spaces or pathway proposed at Liberty Lodge. It appears that runoff will be directed towards the building. HW recommends that the Applicant address the stormwater management in this area.

June 27, 2023: The Applicant does not believe that stormwater management is needed for the additional parking spaces at Liberty Lodge. It is HW's opinion that a crushed stone trench along the east side of the walkway closest to the parking spaces would be a reasonable means to manage the additional runoff from the parking spaces. HW also recommends that the Applicant review the proposed walkway grading closest to the building as it appears to direct stormwater towards the building. Minor adjustments to the grades would direct the stormwater towards the north and around the building.

July 13, 2023: The Applicant has added a crushed stone trench along the downgradient edge of the parking spaces and clarified the grading closest to the building. HW has no further comment.

3. *Standard 3 requires that the annual recharge from post-development shall approximate annual recharge from pre-development conditions.*

a. The Applicant has provided Recharge Volume calculations. A soil test pit was dug to confirm the ESHGW elevation as well as the soil type within the footprint of the bioretention area. As noted above the bottom of the bioretention area is above the ESHGW elevation. The bioretention area detail calls for an impermeable liner, which will prevent infiltration. HW recommends that the Applicant review the design and calculations and propose a stormwater practice that can provide the required recharge volume.

June 27, 2023: The Applicant notes that due to high groundwater it is not able to provide recharge. However, it has included recharge calculations using the lined bioretention basin. In accordance with Volume 1, Chapter 1, page 6 of the MSH a lined bioretention basin is considered a filtering bioretention basin and does not

receive credit for infiltrating. HW recommends that the Applicant provide clear justification for why it cannot provide adequate recharge for the increased impervious area.

July 13, 2023: The Applicant has added a shallow infiltration basin to capture the overflow from the bioretention area and recharge the stormwater from the larger storm events. The Applicant has also documented that the depth to ledge as well as a high groundwater table limit the recharge options in this area. HW has no further comment.

4. *Standard 4 requires that the stormwater system be designed to remove 80% Total Suspended Solids (TSS) and to treat 1.0-inch of volume from the impervious area for water quality.*

   a. The Applicant has not provided TSS removal worksheet but has stated in the narrative that the bioretention area with sediment forebay is anticipated to have a TSS removal rate of 90%. HW recommends that the Applicant provide the required documentation.

      June 27, 2023: The Applicant has provided the requested documentation. HW concurs that the Applicant has provided adequate water quality for 1 inch of runoff over the additional impervious area. No further action required.

   b. The Applicant has provided water quality calculations based on 0.5 inch of stormwater over the proposed impervious area. Section 8.0 A.3.d. of the Stormwater Bylaws requires that the water quality volume sizing of BMPs be based on 1-inch of runoff from the tributary area. HW recommends that the Applicant provide the applicable calculations.

      June 27, 2023: The Applicant has provided the requested documentation. HW concurs that the Applicant has provided adequate water quality for 1 inch of runoff over the additional impervious area. No further action required.

   c. HW recommends that the Applicant clarify whether a 2:1 slope is appropriate for the forebay given the location adjacent to the parking area.

      June 27, 2023: The Applicant has adjusted the slope from 2:1 to 2 ½:1 for the forebay. If necessary landscaped boulders can be placed to deter foot traffic.

5. *Standard 5 is related to projects with a Land Use of Higher Potential Pollutant Loads (LUHPPL).*

   a. The proposed development is not considered a LUHPPL. Therefore, Standard 5 is not applicable to this project.

      June 27, 2023: No further action required.

6. *Standard 6 is related to projects with stormwater discharging into a critical area, a Zone II, or an Interim Wellhead Protection Area of a public water supply.*

   a. The proposed development is not discharging to a critical area, Zones I or II of the Water Resources Protection District. Therefore, Standard 6 is not applicable to this project.

      June 27, 2023: No further action required.

7. *Standard 7 is related to projects considered Redevelopment.*

   a. The proposed development is not considered a redevelopment.

      June 27, 2023: No further action required.

8. *Standard 8 requires a plan to control construction related impacts including erosion, sedimentation, or other pollutant sources.*

   The Applicant has shown proposed erosion controls consisting of a haybale / silt fence on Sheets C101 and C501 of the plans and has included a Short-Term Drainage System Operation & Maintenance Plan as Attachments F the Stormwater Report. HW offers the following comments pertaining to the erosion and sediment control materials provided:

   a. HW recommends that the Applicant designate a location on the site plans for any soil and materials that may be stockpiled during construction as well as a construction entrance for the Project Area.

      June 27, 2023: The Applicant has added a stockpile area to Sheet C101. No further action needed.

   b. The Applicant has proposed haybale / silt fence as erosion control along the edge of the swimming pond, upgradient from the wetland resource areas. HW recommends that the Applicant install silt sacks in the existing drainage inlet (labeled as “Wood Cover” on the plans) and any existing catch basins within 100 feet of the construction entrance.

      June 27, 2023: The Applicant has provided an inlet protection measure at the 15-inch culvert as suggested. No further action required.

   c. HW recommends that the Applicant provide information on any existing trees within the limit of work. If any trees are proposed to be removed, they should be denoted as such on the plans. Likewise, trees proposed to remain should be surrounded with tree protection fencing.

      June 27, 2026: The Applicant has noted a proposed tree line and has stated that it intends to remove the trees within the proposed limit of clearing except for one 24-inch tree marked to be protected. The Applicant has not stated how many trees will be removed.

      July 13, 2023: The Applicant estimates that less than 12 trees will be removed for the proposed project. The trees were not located by the surveyor and therefore are not shown on the plan.

   d. HW recommends that the Applicant provide a vehicle tracking pad or construction entrance at the access point to the site per the Sudbury Stormwater Bylaws Section 8.B.6.n.

      June 27, 2023: The Applicant has added a stabilized construction entrance to Sheet C101. No further action needed.

   e. HW recommends that the Applicant include seeding requirements on the plan per Stormwater Bylaws Section 8.B.6.o and that areas of loam and seed and/or planting be clearly identified on the plan along with appropriate details.

June 27, 2023: The Applicant has added seeding noted to Sheet C502. No further action required.

f. The Short-Term Drainage System Operation & Maintenance Plan states that the Owners are responsible during construction, HW recommends that the Applicant confirm this reference is accurate or modify it to specify the Owner's contractor.

June 27, 2023: The Applicant has revised the Short Term Construction Operation & Maintenance Plan as suggested. No further action required.

9. *Standard 9 requires a Long-Term Operation and Maintenance (O & M) Plan to be provided.*

a. The Applicant has provided an Operations and Maintenance (O&M) Plan as Attachment G of the Stormwater Management Report. HW recommends that the O&M Plan be provided as a separate standalone document with a maintenance log and simple plan to be provided to the property owner for long term use. Where possible inclusion of other stormwater practices within the property should be included in the long-term O&M Plan.

June 27, 2023: The Applicant has revised the O&M Plan to include a simple sketch and a line for the owner's signature. The Planning Board may choose to require a signed O&M Plan prior to land disturbance as a condition of approval.

b. HW recommends that the area designated for snow storage be shown on the plan.

June 27, 2023: The Applicant has noted that as a summer camp the location of snow storage is not needed. However, the O&M Plan specifically states that snow should be placed in designated areas. HW recommends that the Applicant clarify where the designated areas are on the O&M Sketch.

July 13, 2023: The Applicant has revised the Snow Management Plan section of the O&M Plan to discuss use of de-icing compounds throughout the camp facility. HW has no further comment.

c. HW recommends that the Planning Board consider a condition requiring receipt of a signed O&M Plan prior to earth disturbance.

June 27, 2023: The Applicant has no issue with this suggested condition.

d. HW recommends that additional signage be included near the bioretention area as a reminder to not salt or sand the area.

June 27, 2023: The Applicant has noted that as a summer camp there will not be a need to salt or sand the area. HW notes that the O&M Plan specifically discusses de-icing compounds.

10. *Standard 10 requires an Illicit Discharge Compliance Statement be provided.*

a. The Applicant has prepared an Illicit Discharge Compliance Statement included in Appendix G of the Stormwater Management Report. HW recommends that the Planning Board require receipt of the Illicit Discharge Compliance Statement signed by the property owner prior to earth disturbance.

June 27, 2023: The Applicant has no issue with this suggested condition.

Additional Comments

In addition to the stormwater comments above, HW offers the following general comments:

a. HW recommends that the Applicant review the placement of the filter strip along the edge of the parking spaces to confirm this will not pose any access issues.

   June 27, 2023: The Applicant does not believe the filter strip will cause any access issues.

b. HW recommends that Applicant consider the placement of the striped aisle at the parking spaces for the Liberty Lodge to possibly relocate the 8-foot section of striping to be between the two spaces and eliminate the 5-foot striped area.

   June 27, 2023: The Applicant has revised the parking spaces as suggested. No further action required.

c. HW recommends that the Applicant review the need for tactile warning strips when walkways cross driveways.

   June 27, 2023: The Applicant has reviewed the crosswalks and has made a determination that tactile warning strips are not needed.

Conclusions

HW is satisfied that the Applicant has adequately addressed our comments. Please contact Janet Carter Bernardo at 857-263-8193 or at jbernardo@horsleywitten.com if you have any questions.

Sincerely,

HORSLEY WITTEN GROUP, INC.

Janet Carter Bernardo, P.E.
Associate Principal

STORMWATER REPORT

for

HANDICAP ACCESIBILITY IMPROVEMENTS PROJECT

Camp Sewataro
1 Liberty Ledge
Sudbury, MA 01776

Prepared for:

Camp Sewataro, LLC
1 Liberty Ledge
Sudbury, MA 01776

Date:

April 10, 2023

REVISED July 10, 2023

Prepared By:

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NARRATIVE
REVISED 07/10/23

Project Description

Site Location: Camp Sewataro, 1 Liberty Lane
Sudbury, MA

Development Type: Handicap Accessibility Improvements

Project Summary:

The proposed project is construction of parking area expansion, picnic area, and handicap access to the existing swimming area at Camp Sewataro located at 1 Liberty Lane in Sudbury MA. The project will provide three handicap parking spaces, and handicap access to the swimming pool area and the swimming pond. A paved picnic area will be built adjacent to the swimming pool area as well.

A bioretention system has been designed and will be constructed to treat and attenuate the runoff as a result of 1,847 square feet of additional impervious area from the proposed construction in accordance with Mass DEP Stormwater Management Standards.

Existing Site Conditions

Location: The site is located at Camp Sewataro, 1 Liberty Ledge in Sudbury, MA.

Ground Cover: The ground cover on the property is a combination of woods and grassed areas, a swimming pool area, and a concrete lined swimming pond.

Slopes: The site topography varies in slope from Liberty Lane in a north to south direction towards the ponds.

Soil Types: Site soil types as listed by the USDA-NRCS are Hinkley loamy sand (map unit symbols 245B). This soil is classified as hydrologic group 'A" indicating a high infiltration rate when thoroughly wet. Refer to Appendix D for more detailed USDA-NRCS soil information.

HYDROLOGY CALCULATIONS

Methodology

Peak rate of runoff flows are calculated using SCS TR-20 and TR-55 methodology as implemented by the HydroCAD Stormwater Modeling System computer program. The 2, 10, 25, and 100-year storm events were analyzed with the HydroCAD program using NRCC Worcester County rainfall frequency data as follows:

NRCC Rainfall Amounts (inches) by Frequency			
2 Year	**10 Year**	**25 Year**	**100 Year**
3.25	4.90	6.20	8.85

Design Points

The Design Point for this project is the fishing pond on the southern portion of the project area as indicated on the Drainage Area Plans

Pre-Development

The pre-development drainage area studied is broken into two subcatchments as shown in the calculations.

Refer to Appendix B for the HydroCAD output sheets for each storm event. A summary of the peak rate of runoff for the design point for each storm is as follows:

Pre-Development Peak Rate of Runoff (cfs)				
	2 Year	**10 Year**	**25 Year**	**100 Year**
Design Point #1 (ponds)	0.00	0.00	0.02	0.21

Post-Development

The post-development drainage area studied is broken into three subcatchments. A bioretention area and infiltration area are proposed.

Refer to Appendix C for the HydroCAD output sheets for each storm event. A summary of the peak rate of runoff for the design point for each storm is as follows:

Post-Development Peak Rate of Runoff (cfs)				
	2 Year	**10 Year**	**25 Year**	**100 Year**
Design Point #1 (ponds)	0.00	0.02	0.03	0.19

The total net change in peak rate of runoff from pre-development to post-development at the design point for each storm is as follows:

Comparison of Pre- vs. Post-Development Peak Rate of Runoff (cfs) Net Change				
	2 Year	**10 Year**	**25 Year**	**100 Year**
Design Point #1 (ponds)	0.00	+0.02[(1)]	+0.01[(1)]	-0.02

[(1)] The HydroCAD calculations yield a negligible increase due to routing and rounding assumptions made by the software and are only reported due to GEI's standard of providing runoff flows to two decimal places; if rounded to just one place, these values are zero.

STORMWATER MANAGEMENT

To demonstrate compliance with MassDEP Stormwater Management, we offer the following in response to each of the 10 Standards.

No New Untreated Discharges (Stormwater Management Standard 1)

Stormwater treatment is provided though the Bioretention Area to achieve the required TSS removal. See Appendix H for removal calculations. In summary, the project achieves a 90% TSS Removal rate.

Peak Rate Attenuation (Stormwater Management Standard 2)

Runoff is attenuated through the implementation of a Bioretention Area. Refer to Appendices B and C for pre- and post-development HydroCAD calculations.

Recharge to Groundwater (Stormwater Management Standard 3)

USDA-NRCS soil survey indicates site soils are well drained, sandy loam, hydrologic group A soils. On-site soil testing at the proposed bioretention area confirmed these soils but also indicated a shallow depth to estimated seasonal high groundwater and ledge. As a result, the

bioretention area cannot be designed to provide recharge to groundwater but a separate shallow infiltration area is proposed.

Total pre-development impervious area = 0 ft^2
Total post-development impervious area = 1,833 ft^2
Net increase in impervious area = 1,833 ft^2

Required Recharge Volume (R_v) = F x Net increase in Impervious Area where, F = Target Depth Factor (in.)

(0.6"/12")(1,833)=92 ft^3

The proposed volume in the infiltration area below the outlet is 276 cubic feet, thus providing more than the required volume. (See HydroCAD stage-storage-volume sheet following this Narrative)

Drawdown calculations:

$Time_{drawdown} = R_v / (K \times Bottom\ Area)$ where, R_v= recharge BMP storage volume
K= Saturated Hydraulic Conductivity (Rawls) Rate

$Time_{drawdown}$ = 92 ft^3 / (2.41 in./hr./12" x 195 ft^2) = 2.3 hours < 72 hours.

Water Quality Calculations (Stormwater Management Standard 4)

The proposed runoff flow path to the bioretention area entails runoff directed into a sediment forebay and ultimately into the bioretention area. The proposed treatment train of a sediment forebay and the bioretention area is anticipated to have a TSS removal rate of 90% for a bioretention area per MassDEP Stormwater Handbook. Refer to Appendix H for detailed TSS calculations that demonstrate the TSS removal rates for the site.

Water Quality Volume: $V = 1.0"/12 \times A_{IMP}$

1.0" depth required per Sudbury Stormwater Management Bylaw Regulations)
A_{IMP}=Impervious area to BMP requiring treatment (excluding walkways)

Bioretention Area:

V= 1.0"/12 x 1,105 ft^2 = 92 ft^3 required volume
Provided volume (below lowest outlet)= 142 ft^3
(See HydroCAD stage-storage-volume sheet following this Narrative)

Forebay Sizing:

$V = 0.1"/12 \times A_{IMP}$

V= 0.1"/12 x 1,105 ft^2 = 10 ft^3 required volume
Provided volume (below lowest outlet)= 46 ft^3
(See HydroCAD stage-storage-volume sheet following this Narrative)

Additionally, a Long-Term Pollution Prevention Plan has been developed for the site (refer to Appendix G).

Higher Potential Pollutant Loads (Stormwater Management Standard 5)

The site is not a land use with a higher potential pollutant load.

Protection of Critical Areas (Stormwater Management Standard 6)

The site does not discharge to a critical area.

Redevelopment Projects (Stormwater Management Standard 7)

The site is not considered redevelopment as there is an increase in impervious area.

Erosion/Sediment Control (Stormwater Management Standard 8)

See the Site development plans for erosion and sediment control during construction.

Operation/Maintenance Plan (Stormwater Management Standard 9)

Refer to Appendix F for the site Long-Term Drainage System Operation & Maintenance Plan.

Illicit Discharge Compliance Statement (Stormwater Management Standard 10)

There are no existing illicit discharges to GEI's or the owner's knowledge and there are no proposed illicit discharges. There are no cross-connections between the stormwater system and the wastewater system and discharges to each will remain separate; these systems are shown on the project drawings. An owner-signed Compliance Statement will be provided to the Town prior to commencement of construction.

APPENDIX A

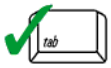
MASSDEP STORMWATER REPORT CHECKLIST

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands Program

Checklist for Stormwater Report

A. Introduction

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.



A Stormwater Report must be submitted with the Notice of Intent permit application to document compliance with the Stormwater Management Standards. The following checklist is NOT a substitute for the Stormwater Report (which should provide more substantive and detailed information) but is offered here as a tool to help the applicant organize their Stormwater Management documentation for their Report and for the reviewer to assess this information in a consistent format. As noted in the Checklist, the Stormwater Report must contain the engineering computations and supporting information set forth in Volume 3 of the Massachusetts Stormwater Handbook. The Stormwater Report must be prepared and certified by a Registered Professional Engineer (RPE) licensed in the Commonwealth.

The Stormwater Report must include:

- The Stormwater Checklist completed and stamped by a Registered Professional Engineer (see page 2) that certifies that the Stormwater Report contains all required submittals.[1] This Checklist is to be used as the cover for the completed Stormwater Report.
- Applicant/Project Name
- Project Address
- Name of Firm and Registered Professional Engineer that prepared the Report
- Long-Term Pollution Prevention Plan required by Standards 4-6
- Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan required by Standard 8[2]
- Operation and Maintenance Plan required by Standard 9

In addition to all plans and supporting information, the Stormwater Report must include a brief narrative describing stormwater management practices, including environmentally sensitive site design and LID techniques, along with a diagram depicting runoff through the proposed BMP treatment train. Plans are required to show existing and proposed conditions, identify all wetland resource areas, NRCS soil types, critical areas, Land Uses with Higher Potential Pollutant Loads (LUHPPL), and any areas on the site where infiltration rate is greater than 2.4 inches per hour. The Plans shall identify the drainage areas for both existing and proposed conditions at a scale that enables verification of supporting calculations.

As noted in the Checklist, the Stormwater Management Report shall document compliance with each of the Stormwater Management Standards as provided in the Massachusetts Stormwater Handbook. The soils evaluation and calculations shall be done using the methodologies set forth in Volume 3 of the Massachusetts Stormwater Handbook.

To ensure that the Stormwater Report is complete, applicants are required to fill in the Stormwater Report Checklist by checking the box to indicate that the specified information has been included in the Stormwater Report. If any of the information specified in the checklist has not been submitted, the applicant must provide an explanation. The completed Stormwater Report Checklist and Certification must be submitted with the Stormwater Report.

[1] The Stormwater Report may also include the Illicit Discharge Compliance Statement required by Standard 10. If not included in the Stormwater Report, the Illicit Discharge Compliance Statement must be submitted prior to the discharge of stormwater runoff to the post-construction best management practices.

[2] For some complex projects, it may not be possible to include the Construction Period Erosion and Sedimentation Control Plan in the Stormwater Report. In that event, the issuing authority has the discretion to issue an Order of Conditions that approves the project and includes a condition requiring the proponent to submit the Construction Period Erosion and Sedimentation Control Plan before commencing any land disturbance activity on the site.

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands Program

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

The following checklist is intended to serve as a guide for applicants as to the elements that ordinarily need to be addressed in a complete Stormwater Report. The checklist is also intended to provide conservation commissions and other reviewing authorities with a summary of the components necessary for a comprehensive Stormwater Report that addresses the ten Stormwater Standards.

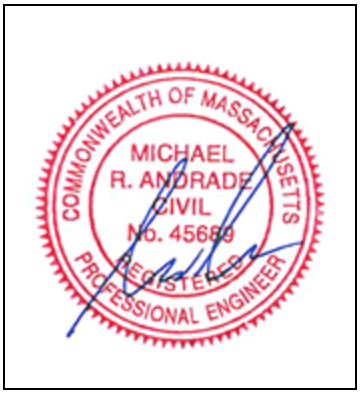
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the item is not applicable (N.A.) and provide the reasons for that determination.

A complete checklist must include the Certification set forth below signed by the Registered Professional Engineer who prepared the Stormwater Report.

Registered Professional Engineer's Certification

I have reviewed the Stormwater Report, including the soil evaluation, computations, Long-term Pollution Prevention Plan, the Construction Period Erosion and Sedimentation Control Plan (if included), the Long-term Post-Construction Operation and Maintenance Plan, the Illicit Discharge Compliance Statement (if included) and the plans showing the stormwater management system, and have determined that they have been prepared in accordance with the requirements of the Stormwater Management Standards as further elaborated by the Massachusetts Stormwater Handbook. I have also determined that the information presented in the Stormwater Checklist is accurate and that the information presented in the Stormwater Report accurately reflects conditions at the site as of the date of this permit application.

Registered Professional Engineer Block and Signature



Electronically stamped by Michael Andrade, PE: 07/10/23

Signature and Date

Checklist

Project Type: Is the application for new development, redevelopment, or a mix of new and redevelopment?

☒ New development

☐ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

LID Measures: Stormwater Standards require LID measures to be considered. Document what environmentally sensitive design and LID Techniques were considered during the planning and design of the project:

- ☒ No disturbance to any Wetland Resource Areas
- ☐ Site Design Practices (e.g. clustered development, reduced frontage setbacks)
- ☐ Reduced Impervious Area (Redevelopment Only)
- ☐ Minimizing disturbance to existing trees and shrubs
- ☐ LID Site Design Credit Requested:
  - ☐ Credit 1
  - ☐ Credit 2
  - ☐ Credit 3
- ☐ Use of "country drainage" versus curb and gutter conveyance and pipe
- ☒ Bioretention Cells (includes Rain Gardens)
- ☐ Constructed Stormwater Wetlands (includes Gravel Wetlands designs)
- ☐ Treebox Filter
- ☐ Water Quality Swale
- ☐ Grass Channel
- ☐ Green Roof
- ☐ Other (describe): _____

Standard 1: No New Untreated Discharges

- ☒ No new untreated discharges
- ☐ Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth
- ☐ Supporting calculations specified in Volume 3 of the Massachusetts Stormwater Handbook included.

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

☐ Standard 2 waiver requested because the project is located in land subject to coastal storm flowage and stormwater discharge is to a wetland subject to coastal flooding.

☐ Evaluation provided to determine whether off-site flooding increases during the 100-year 24-hour storm.

☒ Calculations provided to show that post-development peak discharge rates do not exceed pre-development rates for the 2-year and 10-year 24-hour storms. If evaluation shows that off-site flooding increases during the 100-year 24-hour storm, calculations are also provided to show that post-development peak discharge rates do not exceed pre-development rates for the 100-year 24-hour storm.

Standard 3: Recharge

☒ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

☐ Required Recharge volume reduced through use of the LID site Design Credits.

☒ Sizing the infiltration, BMPs is based on the following method: Check the method used.

☒ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

☐ Runoff from all impervious areas at the site discharging to the infiltration BMP.

☒ Runoff from all impervious areas at the site is *not* discharging to the infiltration BMP and calculations are provided showing that the drainage area contributing runoff to the infiltration BMPs is sufficient to generate the required recharge volume.

☒ Recharge BMPs have been sized to infiltrate the Required Recharge Volume.

☐ Recharge BMPs have been sized to infiltrate the Required Recharge Volume *only* to the maximum extent practicable for the following reason:

- ☐ Site is comprised solely of C and D soils and/or bedrock at the land surface
- ☐ M.G.L. c. 21E sites pursuant to 310 CMR 40.0000
- ☐ Solid Waste Landfill pursuant to 310 CMR 19.000
- ☐ Project is otherwise subject to Stormwater Management Standards only to the maximum extent practicable.

☒ Calculations showing that the infiltration BMPs will drain in 72 hours are provided.

☐ Property includes a M.G.L. c. 21E site or a solid waste landfill and a mounding analysis is included.

[1] 80% TSS removal is required prior to discharge to infiltration BMP if Dynamic Field method is used.

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

☐ The infiltration BMP is used to attenuate peak flows during storms greater than or equal to the 10-year 24-hour storm and separation to seasonal high groundwater is less than 4 feet and a mounding analysis is provided.

☐ Documentation is provided showing that infiltration BMPs do not adversely impact nearby wetland resource areas.

Standard 4: Water Quality

The Long-Term Pollution Prevention Plan typically includes the following:

- Good housekeeping practices;
- Provisions for storing materials and waste products inside or under cover;
- Vehicle washing controls;
- Requirements for routine inspections and maintenance of stormwater BMPs;
- Spill prevention and response plans;
- Provisions for maintenance of lawns, gardens, and other landscaped areas;
- Requirements for storage and use of fertilizers, herbicides, and pesticides;
- Pet waste management provisions;
- Provisions for operation and management of septic systems;
- Provisions for solid waste management;
- Snow disposal and plowing plans relative to Wetland Resource Areas;
- Winter Road Salt and/or Sand Use and Storage restrictions;
- Street sweeping schedules;
- Provisions for prevention of illicit discharges to the stormwater management system;
- Documentation that Stormwater BMPs are designed to provide for shutdown and containment in the event of a spill or discharges to or near critical areas or from LUHPPL;
- Training for staff or personnel involved with implementing Long-Term Pollution Prevention Plan;
- List of Emergency contacts for implementing Long-Term Pollution Prevention Plan.

☒ A Long-Term Pollution Prevention Plan is attached to Stormwater Report and is included as an attachment to the Wetlands Notice of Intent.

☐ Treatment BMPs subject to the 44% TSS removal pretreatment requirement and the one inch rule for calculating the water quality volume are included, and discharge:

- ☐ is within the Zone II or Interim Wellhead Protection Area
- ☐ is near or to other critical areas
- ☐ is within soils with a rapid infiltration rate (greater than 2.4 inches per hour)
- ☐ involves runoff from land uses with higher potential pollutant loads.

☐ The Required Water Quality Volume is reduced through use of the LID site Design Credits.

☒ Calculations documenting that the treatment train meets the 80% TSS removal requirement and, if applicable, the 44% TSS removal pretreatment requirement, are provided.

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

☒ The BMP is sized (and calculations provided) based on:

- ☒ The ½" or 1" Water Quality Volume or
- ☐ The equivalent flow rate associated with the Water Quality Volume and documentation is provided showing that the BMP treats the required water quality volume.

☐ The applicant proposes to use proprietary BMPs, and documentation supporting use of proprietary BMP and proposed TSS removal rate is provided. This documentation may be in the form of the propriety BMP checklist found in Volume 2, Chapter 4 of the Massachusetts Stormwater Handbook and submitting copies of the TARP Report, STEP Report, and/or other third party studies verifying performance of the proprietary BMPs.

☐ A TMDL exists that indicates a need to reduce pollutants other than TSS and documentation showing that the BMPs selected are consistent with the TMDL is provided.

Standard 5: Land Uses With Higher Potential Pollutant Loads (LUHPPLs)

☐ The NPDES Multi-Sector General Permit covers the land use and the Stormwater Pollution Prevention Plan (SWPPP) has been included with the Stormwater Report.

☐ The NPDES Multi-Sector General Permit covers the land use and the SWPPP will be submitted ***prior to*** the discharge of stormwater to the post-construction stormwater BMPs.

☐ The NPDES Multi-Sector General Permit does ***not*** cover the land use.

☐ LUHPPLs are located at the site and industry specific source control and pollution prevention measures have been proposed to reduce or eliminate the exposure of LUHPPLs to rain, snow, snow melt and runoff, and been included in the long term Pollution Prevention Plan.

☐ All exposure has been eliminated.

☐ All exposure has ***not*** been eliminated and all BMPs selected are on MassDEP LUHPPL list.

☐ The LUHPPL has the potential to generate runoff with moderate to higher concentrations of oil and grease (e.g. all parking lots with >1000 vehicle trips per day) and the treatment train includes an oil grit separator, a filtering bioretention area, a sand filter or equivalent.

Standard 6: Critical Areas

☐ The discharge is near or to a critical area and the treatment train includes only BMPs that MassDEP has approved for stormwater discharges to or near that particular class of critical area.

☐ Critical areas and BMPs are identified in the Stormwater Report.

Checklist for Stormwater Report

Checklist (continued)

Standard 7: Redevelopments and Other Projects Subject to the Standards only to the maximum extent practicable

☐ The project is subject to the Stormwater Management Standards only to the maximum Extent Practicable as a:

- ☐ Limited Project
- ☐ Small Residential Projects: 5-9 single family houses or 5-9 units in a multi-family development provided there is no discharge that may potentially affect a critical area.
- ☐ Small Residential Projects: 2-4 single family houses or 2-4 units in a multi-family development with a discharge to a critical area
- ☐ Marina and/or boatyard provided the hull painting, service and maintenance areas are protected from exposure to rain, snow, snow melt and runoff
- ☐ Bike Path and/or Foot Path
- ☐ Redevelopment Project
- ☐ Redevelopment portion of mix of new and redevelopment.

☐ Certain standards are not fully met (Standard No. 1, 8, 9, and 10 must always be fully met) and an explanation of why these standards are not met is contained in the Stormwater Report.

☐ The project involves redevelopment and a description of all measures that have been taken to improve existing conditions is provided in the Stormwater Report. The redevelopment checklist found in Volume 2 Chapter 3 of the Massachusetts Stormwater Handbook may be used to document that the proposed stormwater management system (a) complies with Standards 2, 3 and the pretreatment and structural BMP requirements of Standards 4-6 to the maximum extent practicable and (b) improves existing conditions.

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control

A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan must include the following information:

- Narrative;
- Construction Period Operation and Maintenance Plan;
- Names of Persons or Entity Responsible for Plan Compliance;
- Construction Period Pollution Prevention Measures;
- Erosion and Sedimentation Control Plan Drawings;
- Detail drawings and specifications for erosion control BMPs, including sizing calculations;
- Vegetation Planning;
- Site Development Plan;
- Construction Sequencing Plan;
- Sequencing of Erosion and Sedimentation Controls;
- Operation and Maintenance of Erosion and Sedimentation Controls;
- Inspection Schedule;
- Maintenance Schedule;
- Inspection and Maintenance Log Form.

☐ A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan containing the information set forth above has been included in the Stormwater Report.

Checklist for Stormwater Report

Checklist (continued)

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control (continued)

☐ The project is highly complex and information is included in the Stormwater Report that explains why it is not possible to submit the Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan with the application. A Construction Period Pollution Prevention and Erosion and Sedimentation Control has ***not*** been included in the Stormwater Report but will be submitted ***before*** land disturbance begins.

☒ The project is ***not*** covered by a NPDES Construction General Permit.

☐ The project is covered by a NPDES Construction General Permit and a copy of the SWPPP is in the Stormwater Report.

☐ The project is covered by a NPDES Construction General Permit but no SWPPP been submitted. The SWPPP will be submitted BEFORE land disturbance begins.

Standard 9: Operation and Maintenance Plan

☒ The Post Construction Operation and Maintenance Plan is included in the Stormwater Report and includes the following information:

- ☒ Name of the stormwater management system owners;
- ☒ Party responsible for operation and maintenance;
- ☒ Schedule for implementation of routine and non-routine maintenance tasks;
- ☒ Plan showing the location of all stormwater BMPs maintenance access areas;
- ☐ Description and delineation of public safety features;
- ☒ Estimated operation and maintenance budget; and
- ☒ Operation and Maintenance Log Form.

☐ The responsible party is ***not*** the owner of the parcel where the BMP is located and the Stormwater Report includes the following submissions:

- ☐ A copy of the legal instrument (deed, homeowner's association, utility trust or other legal entity) that establishes the terms of and legal responsibility for the operation and maintenance of the project site stormwater BMPs;
- ☐ A plan and easement deed that allows site access for the legal entity to operate and maintain BMP functions.

Standard 10: Prohibition of Illicit Discharges

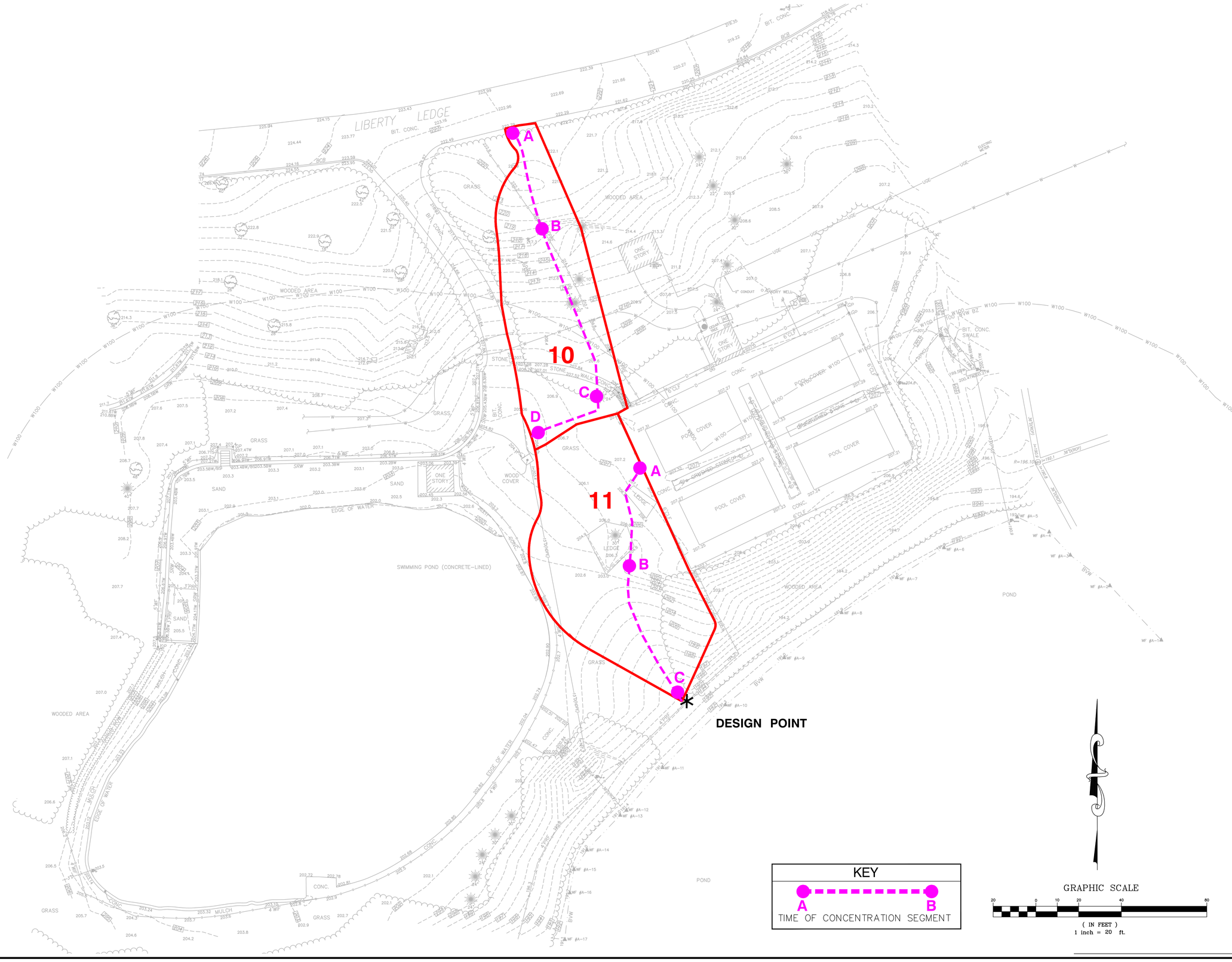
☒ The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;

☒ An Illicit Discharge Compliance Statement is attached;

☐ NO Illicit Discharge Compliance Statement is attached but will be submitted ***prior to*** the discharge of any stormwater to post-construction BMPs.

APPENDIX B

HYDROCAD REPORTS
PRE-DEVELOPMENT



KEY

A — B

TIME OF CONCENTRATION SEGMENT

GRAPHIC SCALE

20 0 10 20 40 80

(IN FEET)
1 inch = 20 ft.

GRAVES ENGINEERING, Inc.
100 GROVE STREET | WORCESTER MA 01605
T 508-856-0321 | F 508-856-0357
gravesengineering.com

NO.	DATE	DESCRIPTION
5	07/10/23	KPM REVISED PER PEER REVIEW
2	07/10/23	KPM REVISED PER PEER REVIEW
1	04/10/23	KPM ISSUED FOR PERMITTING

REVISIONS

COMMONWEALTH OF MASSACHUSETTS — MICHAEL R. ANDRADE — No. 45634 — REGISTERED PROFESSIONAL ENGINEER

CERTIFYING ENGINEER
BY: MICHAEL ANDRADE, P.E.

PRE-DEVELOPMENT DRAINAGE AREA PLAN

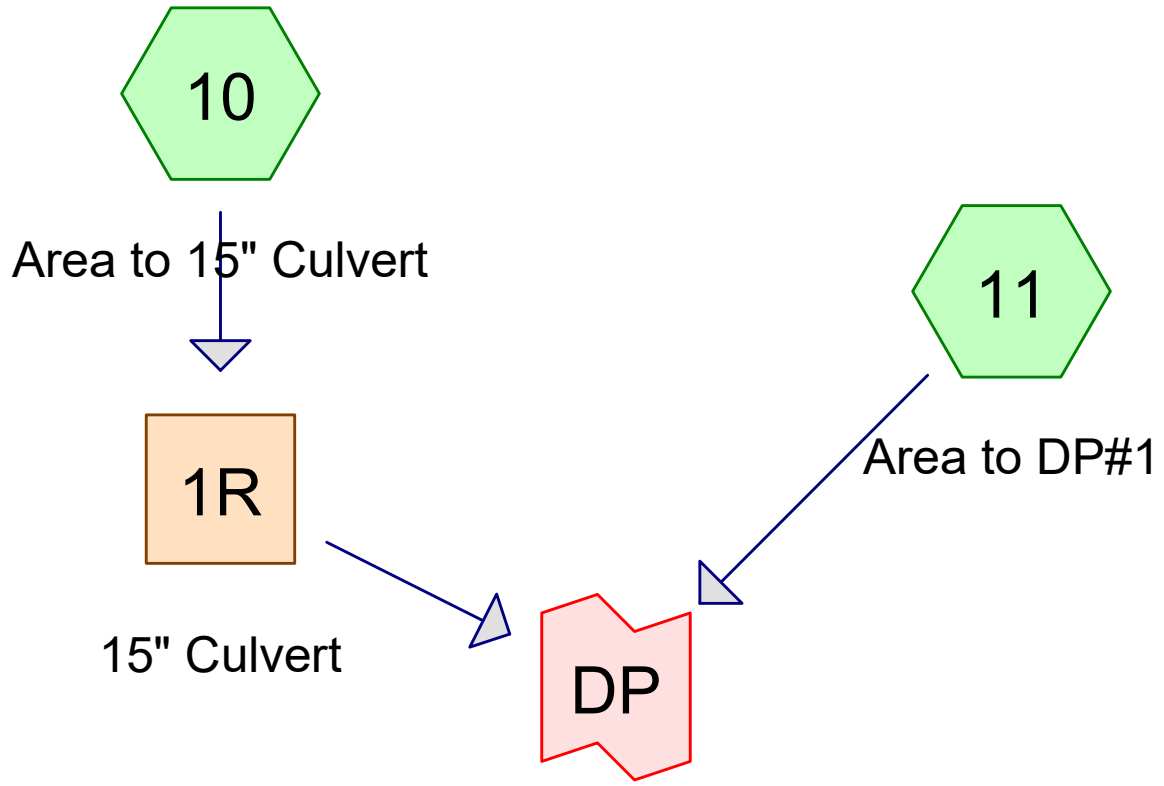
HANDICAP ACCESSIBILITY IMPROVEMENTS

CAMP SEWATARO, 1 LIBERTY LEDGE, SUDBURY, MA 01776

PREPARED FOR:
CAMP SEWATARO, LLC
1 LIBERTY LEDGE, SUDBURY, MA 01776

DATE: 04/10/23 | SCALE: 1"=20' | DES. BY: KPM | DRW. BY: KPM | CHK. BY: MRA | PRJ. NO.: 22148

PRE



Design Point #1- Ponds

Subcat Reach Pond Link

Routing Diagram for 22148_Pre-Development_Rev071023
Prepared by Graves Engineering, Inc, Printed 7/10/2023

Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-yr	NRCC 24-hr	D	Default	24.00	1	3.25	2

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
7,409	39	>75% Grass cover, Good, HSG A (10, 11)
5,192	30	Woods, Good, HSG A (10, 11)
12,601	**35**	**TOTAL AREA**

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
12,601	HSG A	10, 11
0	HSG B	
0	HSG C	
0	HSG D	
0	Other	
12,601		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Subcatchment Numbers
7,409	0	0	0	0	7,409	>75% Grass cover, Good	10, 11
5,192	0	0	0	0	5,192	Woods, Good	10, 11
12,601	**0**	**0**	**0**	**0**	**12,601**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)	Node Name
1	1R	0.00	-6.10	137.0	0.0445	0.012	0.0	15.0	0.0	15" Culvert

Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 10: Area to 15" Culvert Runoff Area=5,477 sf 0.00% Impervious Runoff Depth=0.00"
Flow Length=174' Tc=8.0 min CN=32 Runoff=0.00 cfs 0 cf

Subcatchment 11: Area to DP#1 Runoff Area=7,124 sf 0.00% Impervious Runoff Depth=0.00"
Tc=6.0 min CN=38 Runoff=0.00 cfs 0 cf

Reach 1R: 15" Culvert Avg. Flow Depth=0.00' Max Vel=0.00 fps Inflow=0.00 cfs 0 cf
15.0" Round Pipe n=0.012 L=137.0' S=0.0445 '/' Capacity=14.77 cfs Outflow=0.00 cfs 0 cf

Link DP: Design Point #1- Ponds Inflow=0.00 cfs 0 cf
Primary=0.00 cfs 0 cf

Total Runoff Area = 12,601 sf Runoff Volume = 0 cf Average Runoff Depth = 0.00"
100.00% Pervious = 12,601 sf 0.00% Impervious = 0 sf

Summary for Subcatchment 10: Area to 15" Culvert

Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Depth= 0.00"
Routed to Reach 1R : 15" Culvert

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 2-yr Rainfall=3.25"

Area (sf)	CN	Description
4,297	30	Woods, Good, HSG A
1,180	39	>75% Grass cover, Good, HSG A
5,477	32	Weighted Average
5,477		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.9	50	0.0860	0.12		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.18"
0.8	84	0.1310	1.81		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
0.3	40	0.0750	1.92		**Shallow Concentrated Flow, C-D** Short Grass Pasture Kv= 7.0 fps
8.0	174	Total			

Summary for Subcatchment 11: Area to DP#1

Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Depth= 0.00"
Routed to Link DP : Design Point #1- Ponds

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 2-yr Rainfall=3.25"

Area (sf)	CN	Description
895	30	Woods, Good, HSG A
6,229	39	>75% Grass cover, Good, HSG A
7,124	38	Weighted Average
7,124		100.00% Pervious Area

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

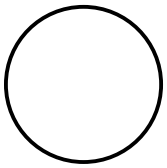
Summary for Reach 1R: 15" Culvert

Inflow Area = 5,477 sf, 0.00% Impervious, Inflow Depth = 0.00" for 2-yr event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min
Routed to Link DP : Design Point #1- Ponds

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
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= 1.25' Flow Area= 1.2 sf, Capacity= 14.77 cfs

15.0" Round Pipe
n= 0.012
Length= 137.0' Slope= 0.0445 '/'
Inlet Invert= 0.00', Outlet Invert= -6.10'



Summary for Link DP: Design Point #1- Ponds

Inflow Area = 12,601 sf, 0.00% Impervious, Inflow Depth = 0.00" for 2-yr event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 10: Area to 15" Culvert Runoff Area=5,477 sf 0.00% Impervious Runoff Depth=0.02"
Flow Length=174' Tc=8.0 min CN=32 Runoff=0.00 cfs 9 cf

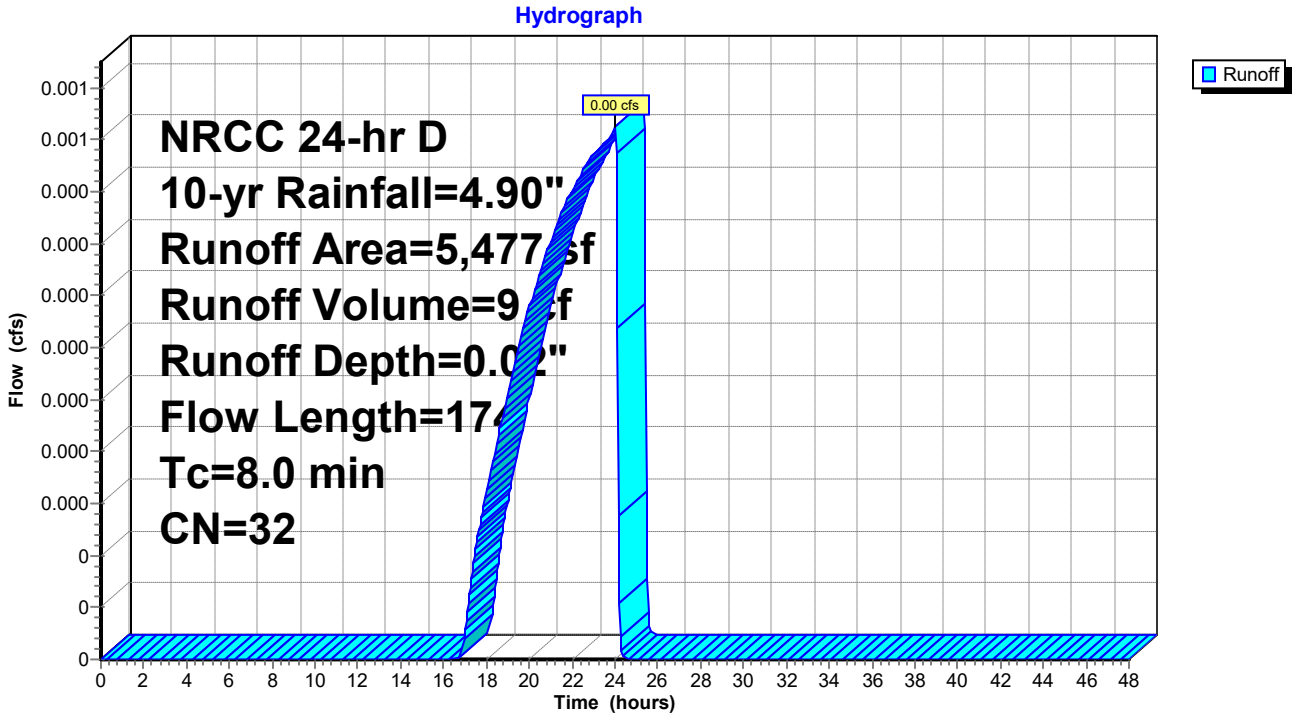
Subcatchment 11: Area to DP#1 Runoff Area=7,124 sf 0.00% Impervious Runoff Depth=0.15"
Tc=6.0 min CN=38 Runoff=0.00 cfs 89 cf

Reach 1R: 15" Culvert Avg. Flow Depth=0.00' Max Vel=1.07 fps Inflow=0.00 cfs 9 cf
15.0" Round Pipe n=0.012 L=137.0' S=0.0445 '/' Capacity=14.77 cfs Outflow=0.00 cfs 9 cf

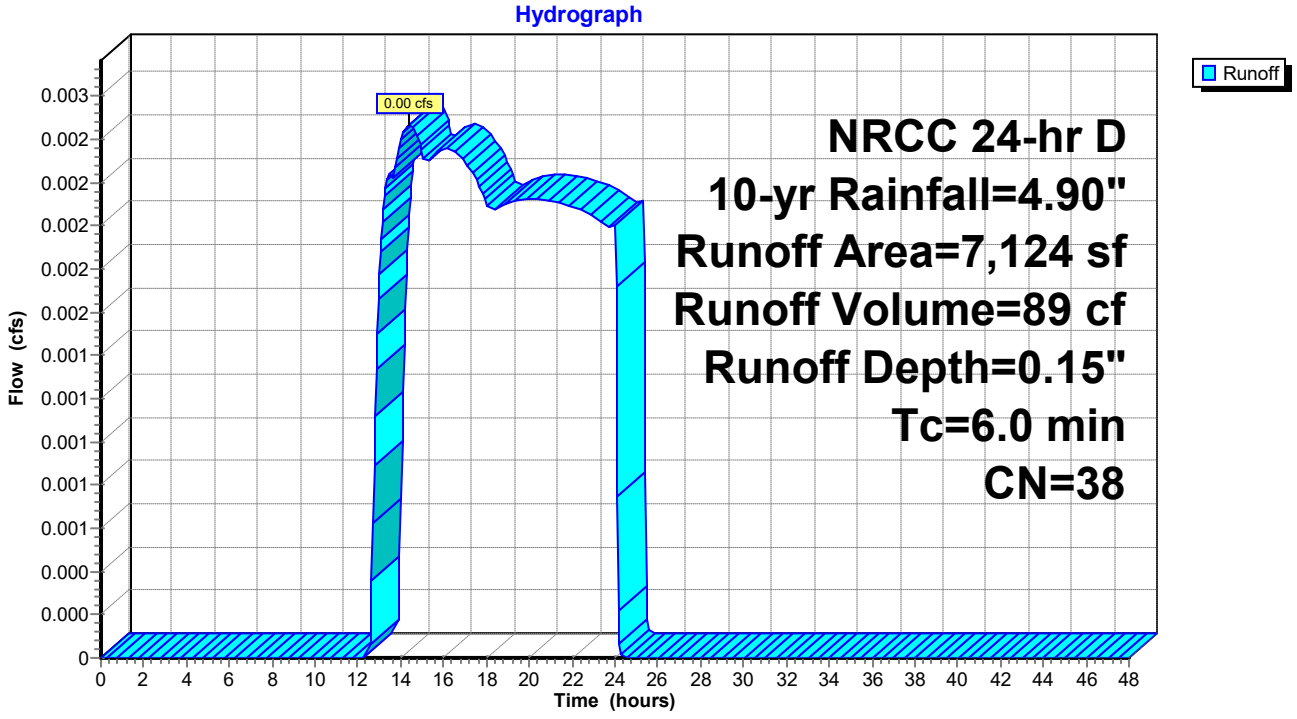
Link DP: Design Point #1- Ponds Inflow=0.00 cfs 97 cf
Primary=0.00 cfs 97 cf

Total Runoff Area = 12,601 sf Runoff Volume = 97 cf Average Runoff Depth = 0.09"
100.00% Pervious = 12,601 sf 0.00% Impervious = 0 sf

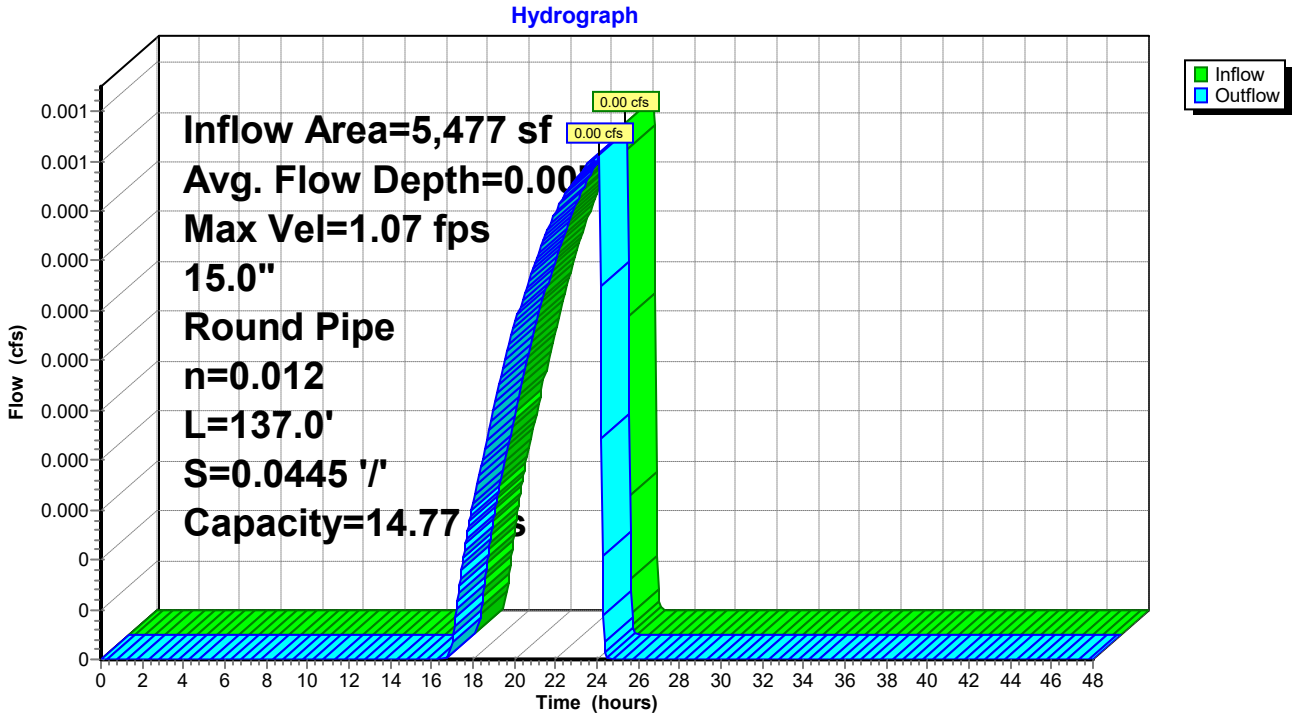
Subcatchment 10: Area to 15" Culvert



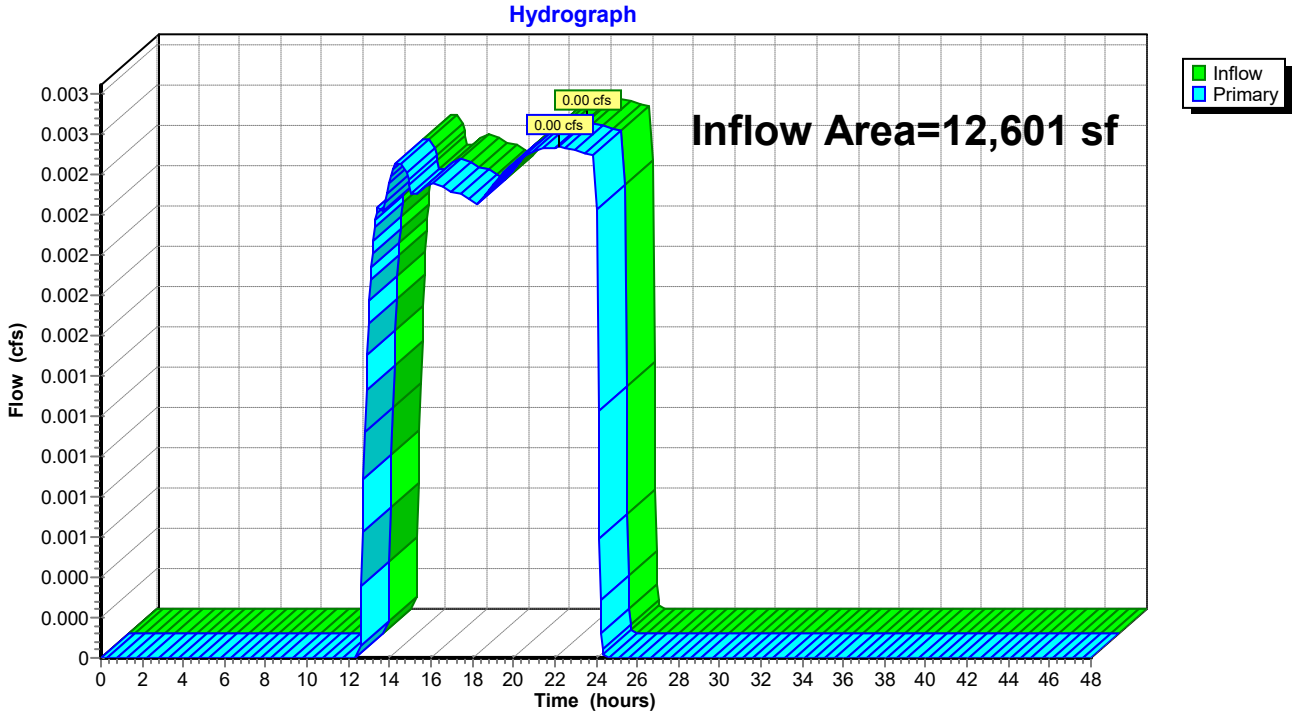
Subcatchment 11: Area to DP#1



Reach 1R: 15" Culvert



Link DP: Design Point #1- Ponds



Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 10: Area to 15" Culvert Runoff Area=5,477 sf 0.00% Impervious Runoff Depth=0.16"
Flow Length=174' Tc=8.0 min CN=32 Runoff=0.00 cfs 75 cf

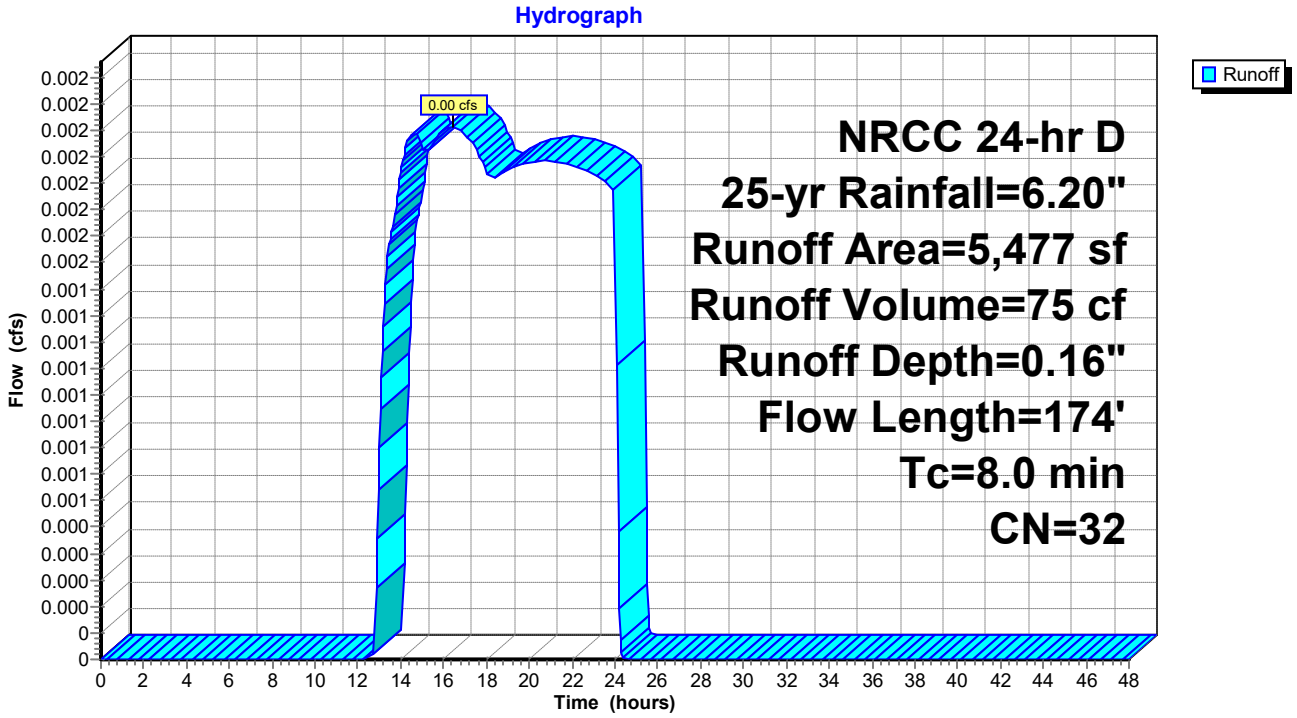
Subcatchment 11: Area to DP#1 Runoff Area=7,124 sf 0.00% Impervious Runoff Depth=0.45"
Tc=6.0 min CN=38 Runoff=0.02 cfs 266 cf

Reach 1R: 15" Culvert Avg. Flow Depth=0.01' Max Vel=1.07 fps Inflow=0.00 cfs 75 cf
15.0" Round Pipe n=0.012 L=137.0' S=0.0445 '/' Capacity=14.77 cfs Outflow=0.00 cfs 75 cf

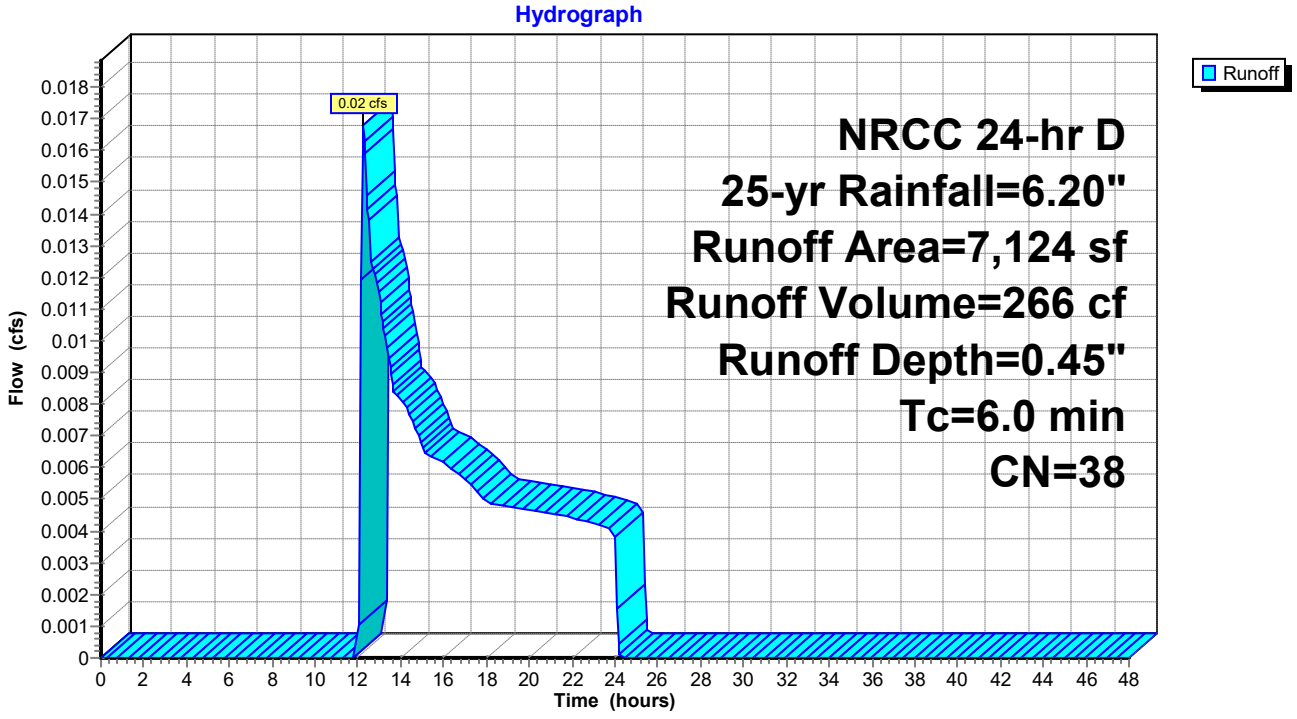
Link DP: Design Point #1- Ponds Inflow=0.02 cfs 341 cf
Primary=0.02 cfs 341 cf

Total Runoff Area = 12,601 sf Runoff Volume = 341 cf Average Runoff Depth = 0.32"
100.00% Pervious = 12,601 sf 0.00% Impervious = 0 sf

Subcatchment 10: Area to 15" Culvert

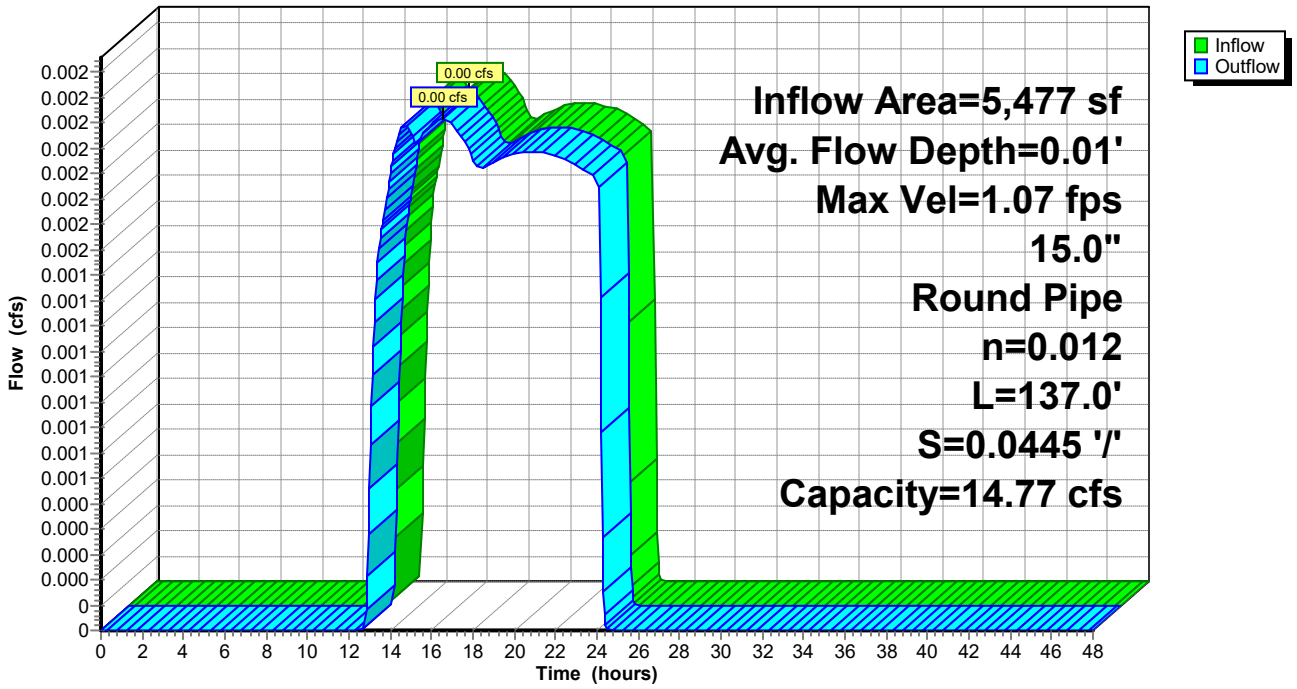


Subcatchment 11: Area to DP#1



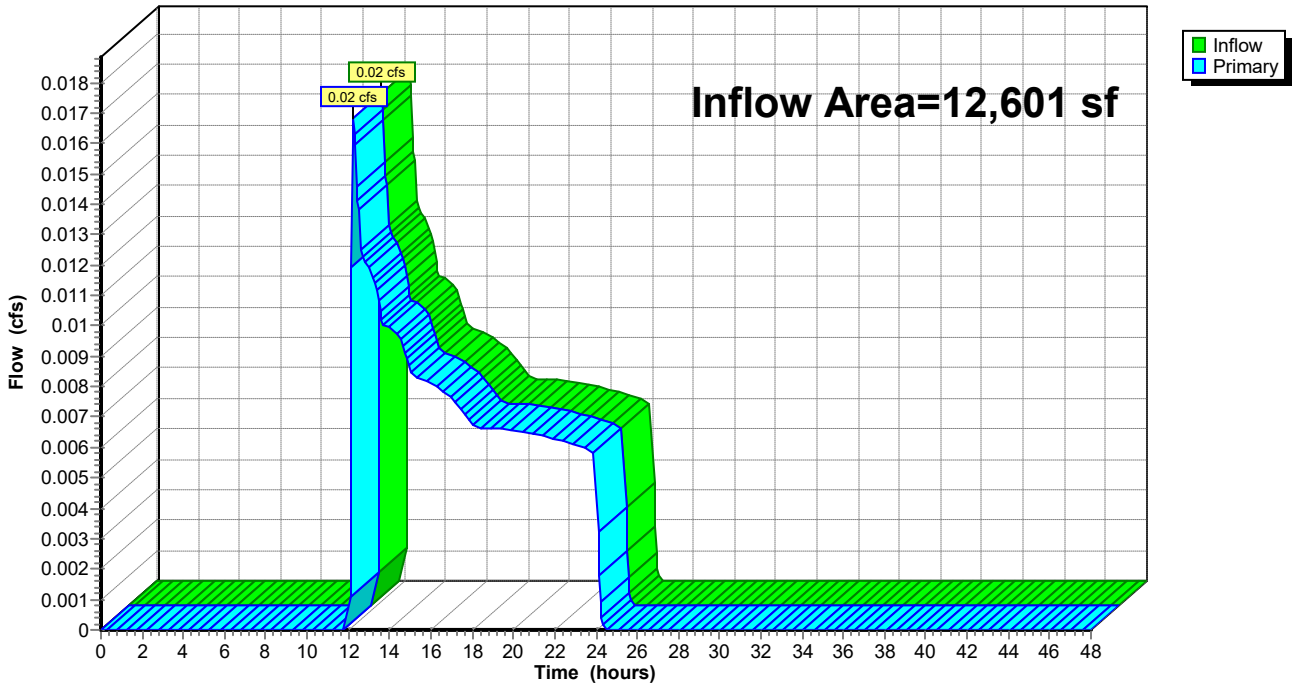
Reach 1R: 15" Culvert

Hydrograph



Link DP: Design Point #1- Ponds

Hydrograph



Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 10: Area to 15" Culvert Runoff Area=5,477 sf 0.00% Impervious Runoff Depth=0.82"
Flow Length=174' Tc=8.0 min CN=32 Runoff=0.04 cfs 374 cf

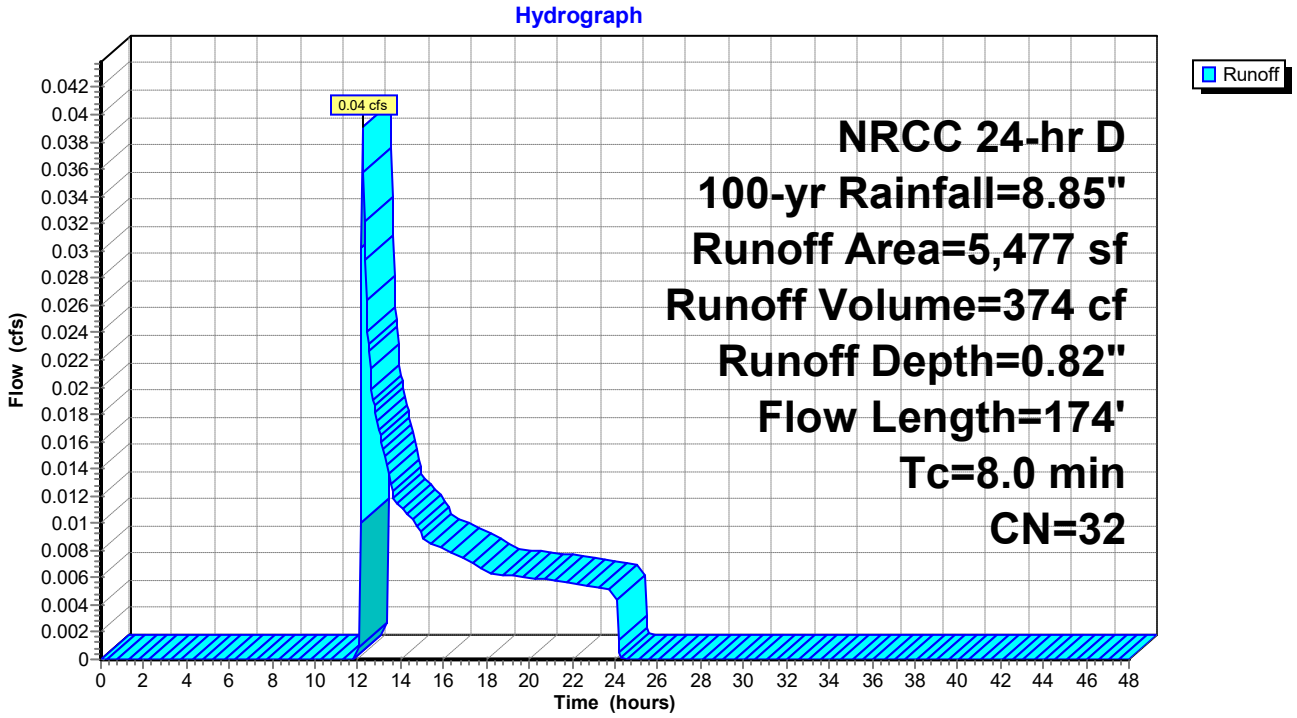
Subcatchment 11: Area to DP#1 Runoff Area=7,124 sf 0.00% Impervious Runoff Depth=1.43"
Tc=6.0 min CN=38 Runoff=0.19 cfs 846 cf

Reach 1R: 15" Culvert Avg. Flow Depth=0.05' Max Vel=2.59 fps Inflow=0.04 cfs 374 cf
15.0" Round Pipe n=0.012 L=137.0' S=0.0445 '/' Capacity=14.77 cfs Outflow=0.04 cfs 374 cf

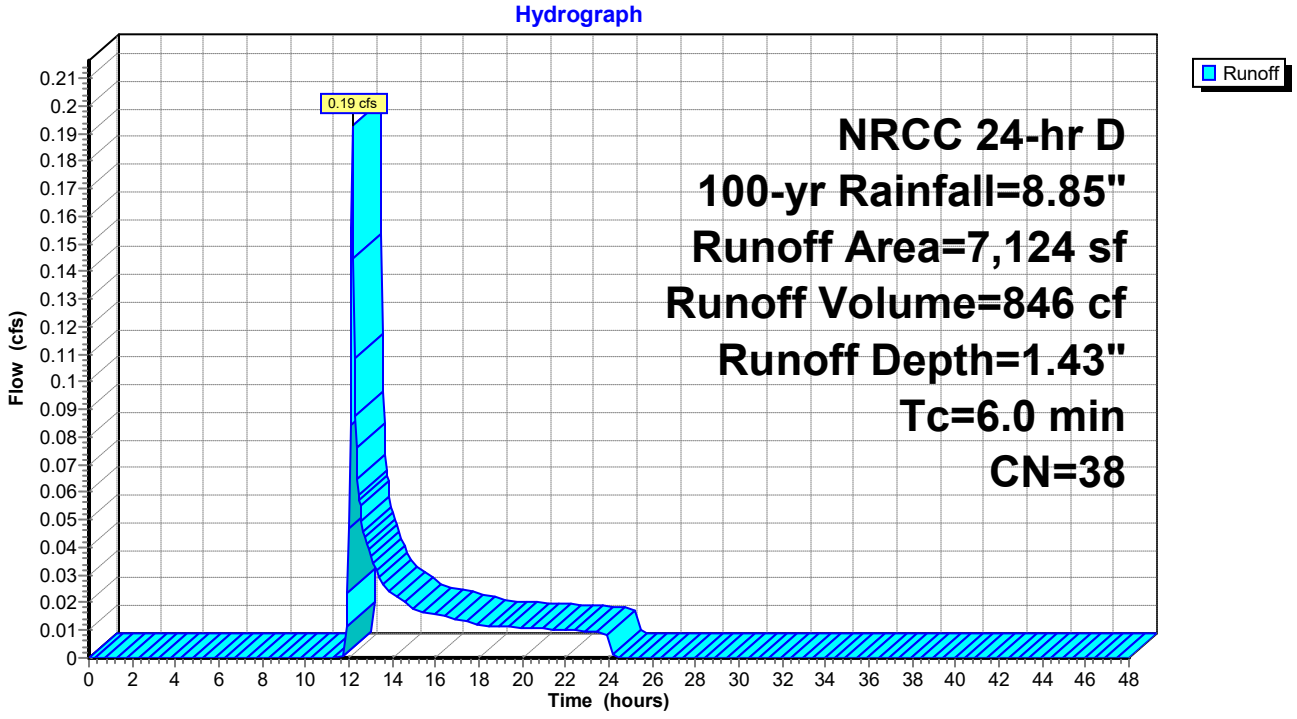
Link DP: Design Point #1- Ponds Inflow=0.21 cfs 1,220 cf
Primary=0.21 cfs 1,220 cf

Total Runoff Area = 12,601 sf Runoff Volume = 1,220 cf Average Runoff Depth = 1.16"
100.00% Pervious = 12,601 sf 0.00% Impervious = 0 sf

Subcatchment 10: Area to 15" Culvert

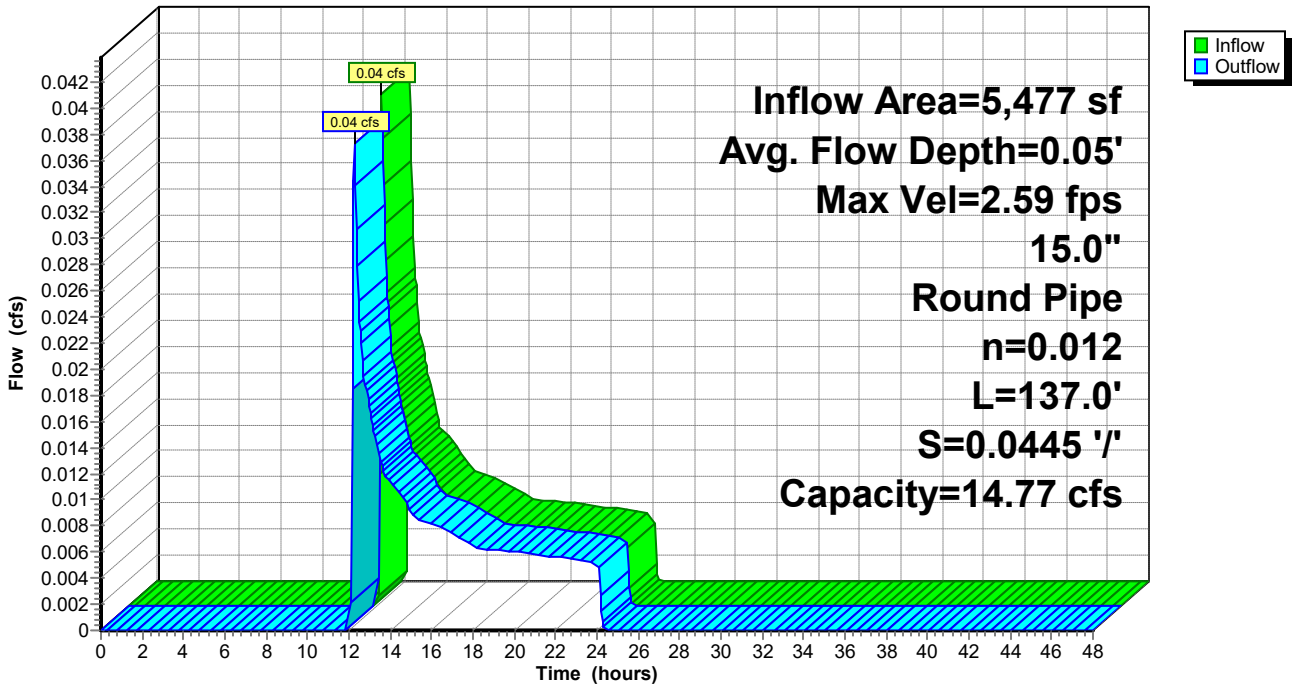


Subcatchment 11: Area to DP#1



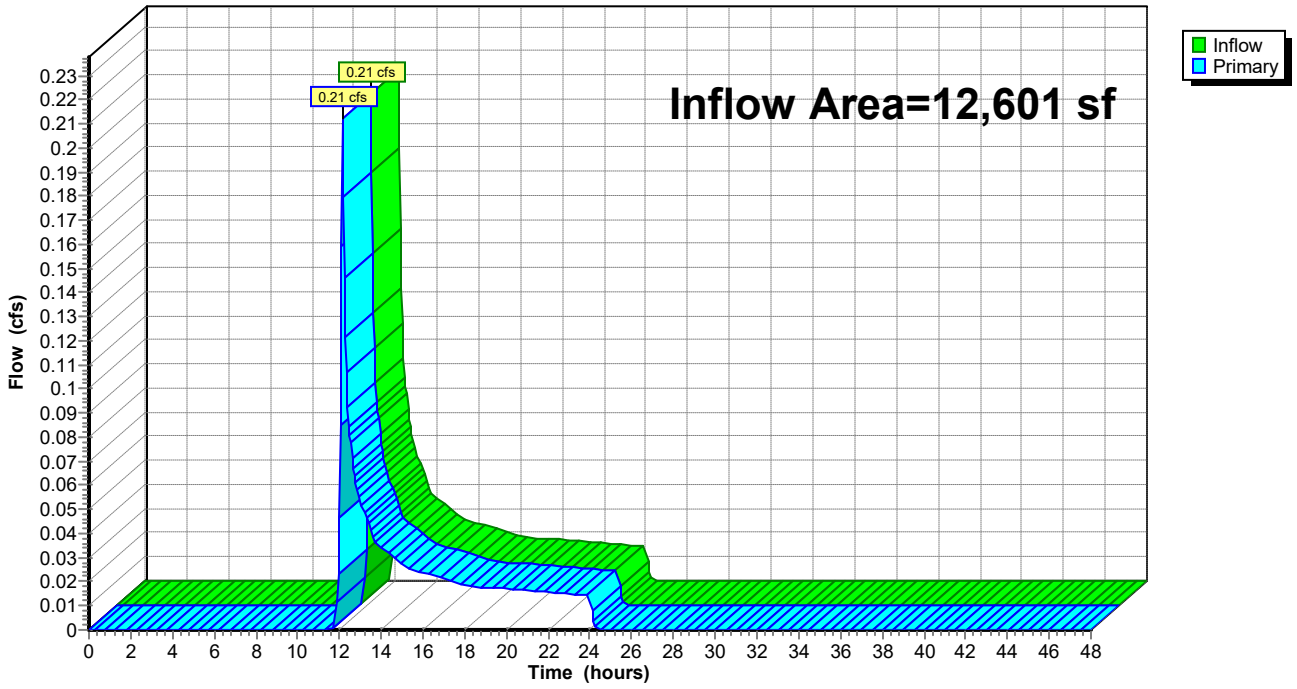
Reach 1R: 15" Culvert

Hydrograph



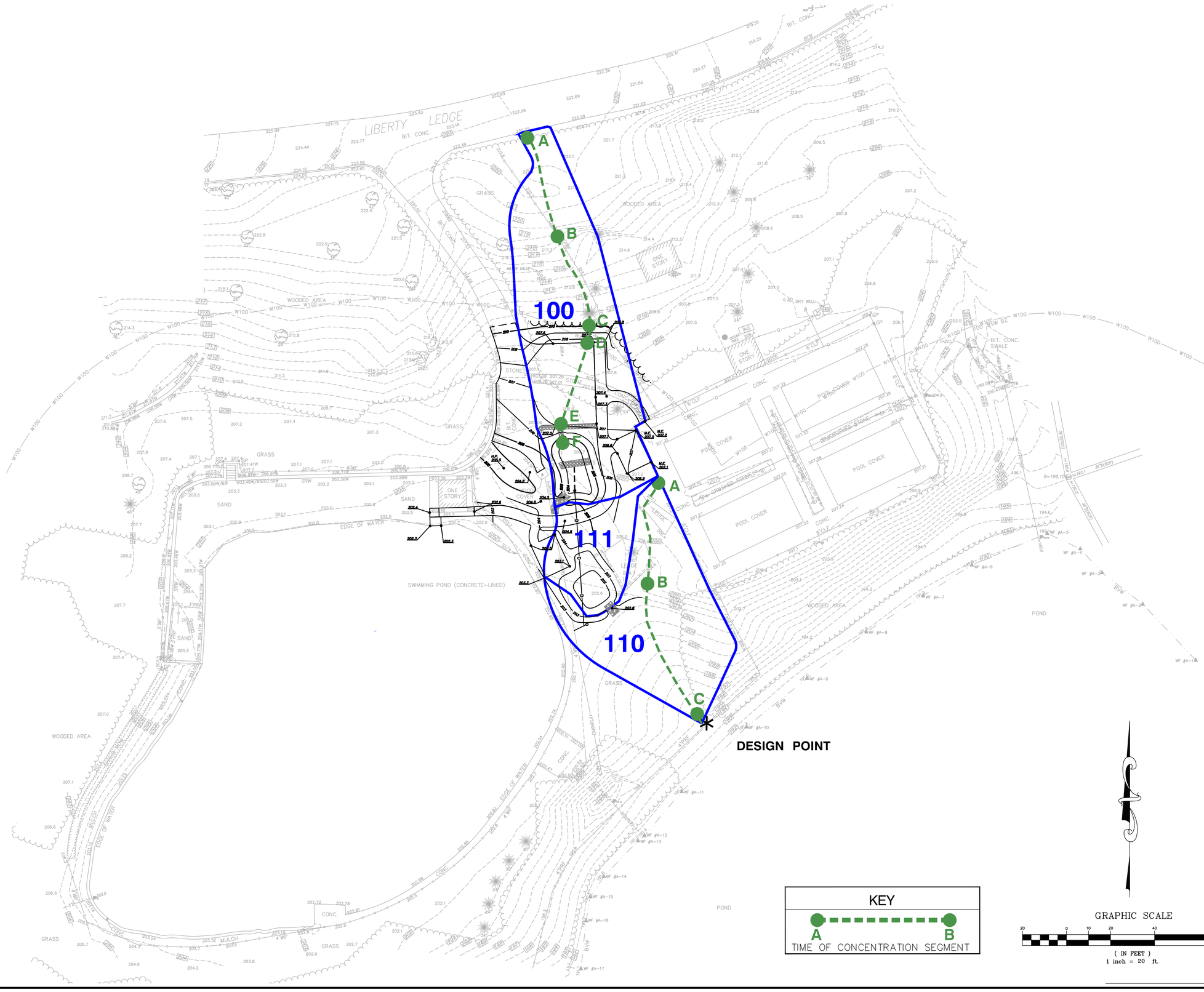
Link DP: Design Point #1- Ponds

Hydrograph



APPENDIX C

HYDROCAD REPORTS
POST-DEVELOPMENT



GRAVES ENGINEERING, Inc.
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gravesengineering.com

NO.	DATE	BY	REVISIONS
5	07/10/23	KPM	REVISED PER PEER REVIEW
1	04/10/23	KPM	ISSUED FOR PERMITTING

COMMONWEALTH OF MASSACHUSETTS
MICHAEL R. ANDRADE
No. 46508
REGISTERED PROFESSIONAL ENGINEER

ELECTRONICALLY STAMPED
BY MICHAEL ANDRADE, P.E.

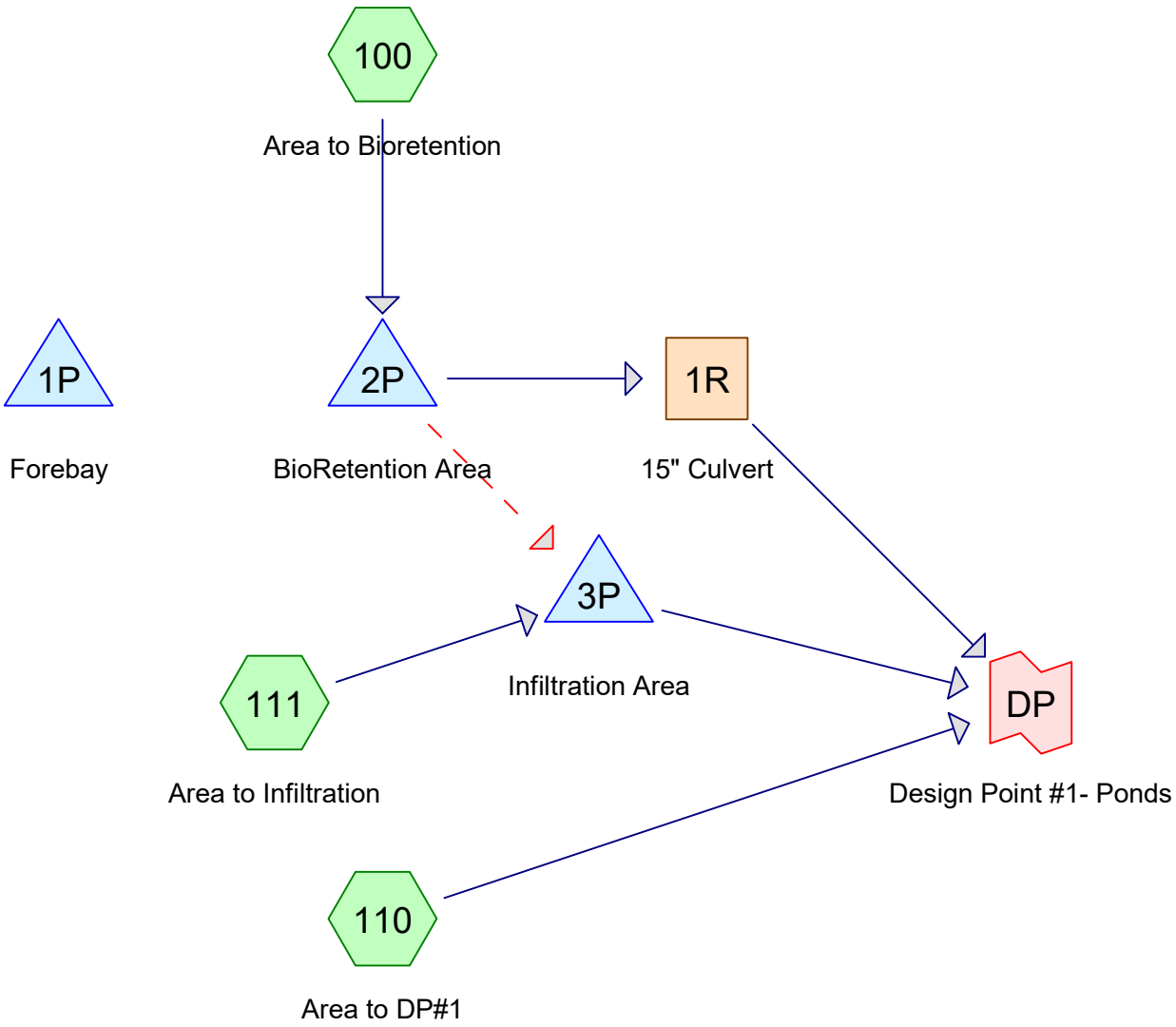
POST-DEVELOPMENT DRAINAGE AREA PLAN

HANDICAP ACCESSIBILITY IMPROVEMENTS
CAMP SEWATARO, 1 LIBERTY LEDGE, SUDBURY, MA 01776

PREPARED FOR:
CAMP SEWATARO, LLC
1 LIBERTY LEDGE, SUDBURY, MA 01776

DATE: 04/10/23 | SCALE: 1"=20' | DES. BY: KPM | DRW. BY: KPM | CHK. BY: MRA | PRJ. NO.: 22148

POST



Subcat Reach Pond Link

Routing Diagram for 22148_Post-Development_Rev071023
Prepared by Graves Engineering, Inc, Printed 7/10/2023

Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-yr	NRCC 24-hr	D	Default	24.00	1	3.25	2

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
6,706	39	>75% Grass cover, Good, HSG A (100, 110, 111)
1,833	98	Paved parking, HSG A (100)
216	98	Unconnected pavement, HSG A (111)
3,846	30	Woods, Good, HSG A (100, 110)
12,601	**46**	**TOTAL AREA**

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
12,601	HSG A	100, 110, 111
0	HSG B	
0	HSG C	
0	HSG D	
0	Other	
12,601		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Subcatchment Numbers
6,706	0	0	0	0	6,706	>75% Grass cover, Good	100, 110, 111
1,833	0	0	0	0	1,833	Paved parking	100
216	0	0	0	0	216	Unconnected pavement	111
3,846	0	0	0	0	3,846	Woods, Good	100, 110
12,601	**0**	**0**	**0**	**0**	**12,601**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)	Node Name
1	1R	0.00	-6.10	137.0	0.0445	0.012	0.0	15.0	0.0	15" Culvert
2	2P	201.30	200.63	67.0	0.0100	0.012	0.0	6.0	0.0	BioRetention Area

Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 100: Area to Bioretention Runoff Area=6,627 sf 27.66% Impervious Runoff Depth=0.16"
Flow Length=151' Tc=7.4 min CN=51 Runoff=0.00 cfs 89 cf

Subcatchment 110: Area to DP#1 Runoff Area=4,237 sf 0.00% Impervious Runoff Depth=0.00"
Tc=6.0 min CN=37 Runoff=0.00 cfs 0 cf

Subcatchment 111: Area to Infiltration Runoff Area=1,737 sf 12.44% Impervious Runoff Depth=0.03"
Tc=6.0 min UI Adjusted CN=43 Runoff=0.00 cfs 4 cf

Reach 1R: 15" Culvert Avg. Flow Depth=0.01' Max Vel=1.27 fps Inflow=0.00 cfs 89 cf
15.0" Round Pipe n=0.012 L=137.0' S=0.0445 '/' Capacity=14.77 cfs Outflow=0.00 cfs 89 cf

Pond 1P: Forebay Peak Elev=0.00' Storage=0 cf
Primary=0.00 cfs 0 cf

Pond 2P: BioRetention Area Peak Elev=204.00' Storage=1 cf Inflow=0.00 cfs 89 cf
Primary=0.00 cfs 89 cf Secondary=0.00 cfs 0 cf Outflow=0.00 cfs 89 cf

Pond 3P: Infiltration Area Peak Elev=202.00' Storage=0 cf Inflow=0.00 cfs 4 cf
Discarded=0.00 cfs 4 cf Primary=0.00 cfs 0 cf Outflow=0.00 cfs 4 cf

Link DP: Design Point #1- Ponds Inflow=0.00 cfs 89 cf
Primary=0.00 cfs 89 cf

Total Runoff Area = 12,601 sf Runoff Volume = 93 cf Average Runoff Depth = 0.09"
83.74% Pervious = 10,552 sf 16.26% Impervious = 2,049 sf

Summary for Subcatchment 100: Area to Bioretention

Runoff = 0.00 cfs @ 12.95 hrs, Volume= 89 cf, Depth= 0.16"
Routed to Pond 2P : BioRetention Area

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 2-yr Rainfall=3.25"

Area (sf)	CN	Description
2,951	30	Woods, Good, HSG A
1,843	39	>75% Grass cover, Good, HSG A
1,833	98	Paved parking, HSG A
6,627	51	Weighted Average
4,794		72.34% Pervious Area
1,833		27.66% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.9	50	0.0860	0.12		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.18"
0.3	44	0.1800	2.12		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
0.0	9	0.2500	3.50		**Shallow Concentrated Flow, C-D** Short Grass Pasture Kv= 7.0 fps
0.2	40	0.0180	2.72		**Shallow Concentrated Flow, D-E** Paved Kv= 20.3 fps
0.0	8	0.2500	7.50		**Shallow Concentrated Flow, E-F** Grassed Waterway Kv= 15.0 fps
7.4	151	Total			

Summary for Subcatchment 110: Area to DP#1

Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Depth= 0.00"
Routed to Link DP : Design Point #1- Ponds

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 2-yr Rainfall=3.25"

Area (sf)	CN	Description
895	30	Woods, Good, HSG A
3,342	39	>75% Grass cover, Good, HSG A
4,237	37	Weighted Average
4,237		100.00% Pervious Area

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

Summary for Subcatchment 111: Area to Infiltration

Runoff = 0.00 cfs @ 24.00 hrs, Volume= 4 cf, Depth= 0.03"
Routed to Pond 3P : Infiltration Area

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 2-yr Rainfall=3.25"

Area (sf)	CN	Adj	Description
1,521	39		>75% Grass cover, Good, HSG A
216	98		Unconnected pavement, HSG A
1,737	46	43	Weighted Average, UI Adjusted
1,521			87.56% Pervious Area
216			12.44% Impervious Area
216			100.00% Unconnected

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

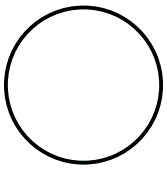
Summary for Reach 1R: 15" Culvert

Inflow Area = 6,627 sf, 27.66% Impervious, Inflow Depth = 0.16" for 2-yr event
Inflow = 0.00 cfs @ 13.00 hrs, Volume= 89 cf
Outflow = 0.00 cfs @ 13.04 hrs, Volume= 89 cf, Atten= 0%, Lag= 2.9 min
Routed to Link DP : Design Point #1- Ponds

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs / 2
Max. Velocity= 1.27 fps, Min. Travel Time= 1.8 min
Avg. Velocity = 1.10 fps, Avg. Travel Time= 2.1 min

Peak Storage= 0 cf @ 13.01 hrs
Average Depth at Peak Storage= 0.01' , Surface Width= 0.27'
Bank-Full Depth= 1.25' Flow Area= 1.2 sf, Capacity= 14.77 cfs

15.0" Round Pipe
n= 0.012
Length= 137.0' Slope= 0.0445 '/'
Inlet Invert= 0.00', Outlet Invert= -6.10'



Summary for Pond 1P: Forebay

Volume	Invert	Avail.Storage	Storage Description
#1	204.00'	112 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
204.00	70	0	0
204.50	113	46	46
205.00	151	66	112

Device	Routing	Invert	Outlet Devices
#1	Primary	204.50'	**14.0' long x 10.0' breadth Broad-Crested Rectangular Weir**
			Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60
			Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=0.00' (Free Discharge)
1=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond 2P: BioRetention Area

Inflow Area = 6,627 sf, 27.66% Impervious, Inflow Depth = 0.16" for 2-yr event
Inflow = 0.00 cfs @ 12.95 hrs, Volume= 89 cf
Outflow = 0.00 cfs @ 13.00 hrs, Volume= 89 cf, Atten= 0%, Lag= 2.9 min
Primary = 0.00 cfs @ 13.00 hrs, Volume= 89 cf
Routed to Reach 1R : 15" Culvert
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Pond 3P : Infiltration Area

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 204.00' @ 13.00 hrs Surf.Area= 226 sf Storage= 1 cf

Plug-Flow detention time= 3.0 min calculated for 89 cf (100% of inflow)
Center-of-Mass det. time= 3.0 min (1,054.3 - 1,051.4)

Volume	Invert	Avail.Storage	Storage Description
#1	204.00'	343 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
204.00	225	0	0
205.00	460	343	343

Device	Routing	Invert	Outlet Devices
#1	Secondary	204.50'	**4.0' long x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32
#2	Primary	201.30'	**6.0" Round Solid PVC Outlet from Underdrain** L= 67.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 201.30' / 200.63' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 0.20 sf
#3	Device 2	204.00'	**2.410 in/hr Exfiltration over Surface area**

Primary OutFlow Max=0.01 cfs @ 13.00 hrs HW=204.00' (Free Discharge)
↑**2=Solid PVC Outlet from Underdrain** (Passes 0.01 cfs of 1.09 cfs potential flow)
↑**3=Exfiltration** (Exfiltration Controls 0.01 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=204.00' (Free Discharge)
↑**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 3P: Infiltration Area

Inflow Area = 1,737 sf, 12.44% Impervious, Inflow Depth = 0.03" for 2-yr event
Inflow = 0.00 cfs @ 24.00 hrs, Volume= 4 cf
Outflow = 0.00 cfs @ 24.00 hrs, Volume= 4 cf, Atten= 1%, Lag= 0.0 min
Discarded = 0.00 cfs @ 24.00 hrs, Volume= 4 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Link DP : Design Point #1- Ponds

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 202.00' @ 24.00 hrs Surf.Area= 195 sf Storage= 0 cf

Plug-Flow detention time= 3.0 min calculated for 4 cf (100% of inflow)
Center-of-Mass det. time= 3.0 min (1,227.9 - 1,224.9)

Volume	Invert	Avail.Storage	Storage Description
#1	202.00'	383 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
202.00	195	0	0
203.00	570	383	383

Device	Routing	Invert	Outlet Devices
#1	Discarded	202.00'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	202.80'	**4.0' long x 3.0' breadth Broad-Crested Rectangular Weir**
			Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50
			Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Discarded OutFlow Max=0.01 cfs @ 24.00 hrs HW=202.00' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=202.00' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Link DP: Design Point #1- Ponds

Inflow Area = 12,601 sf, 16.26% Impervious, Inflow Depth = 0.08" for 2-yr event
Inflow = 0.00 cfs @ 13.04 hrs, Volume= 89 cf
Primary = 0.00 cfs @ 13.04 hrs, Volume= 89 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 100: Area to Bioretention Runoff Area=6,627 sf 27.66% Impervious Runoff Depth=0.70"
Flow Length=151' Tc=7.4 min CN=51 Runoff=0.08 cfs 389 cf

Subcatchment 110: Area to DP#1 Runoff Area=4,237 sf 0.00% Impervious Runoff Depth=0.12"
Tc=6.0 min CN=37 Runoff=0.00 cfs 43 cf

Subcatchment 111: Area to Infiltration Runoff Area=1,737 sf 12.44% Impervious Runoff Depth=0.33"
Tc=6.0 min UI Adjusted CN=43 Runoff=0.00 cfs 47 cf

Reach 1R: 15" Culvert Avg. Flow Depth=0.03' Max Vel=1.99 fps Inflow=0.02 cfs 389 cf
15.0" Round Pipe n=0.012 L=137.0' S=0.0445 '/' Capacity=14.77 cfs Outflow=0.02 cfs 389 cf

Pond 1P: Forebay Peak Elev=0.00' Storage=0 cf
Primary=0.00 cfs 0 cf

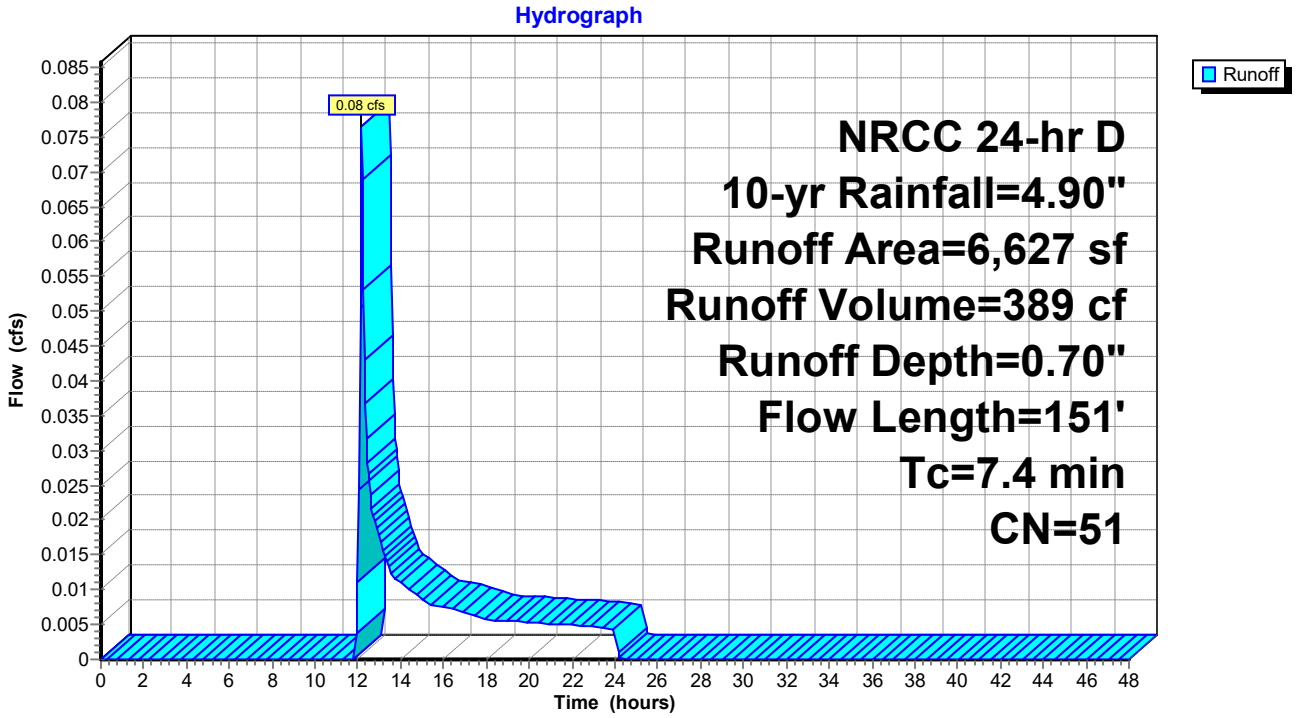
Pond 2P: BioRetention Area Peak Elev=204.25' Storage=64 cf Inflow=0.08 cfs 389 cf
Primary=0.02 cfs 389 cf Secondary=0.00 cfs 0 cf Outflow=0.02 cfs 389 cf

Pond 3P: Infiltration Area Peak Elev=202.00' Storage=0 cf Inflow=0.00 cfs 47 cf
Discarded=0.00 cfs 47 cf Primary=0.00 cfs 0 cf Outflow=0.00 cfs 47 cf

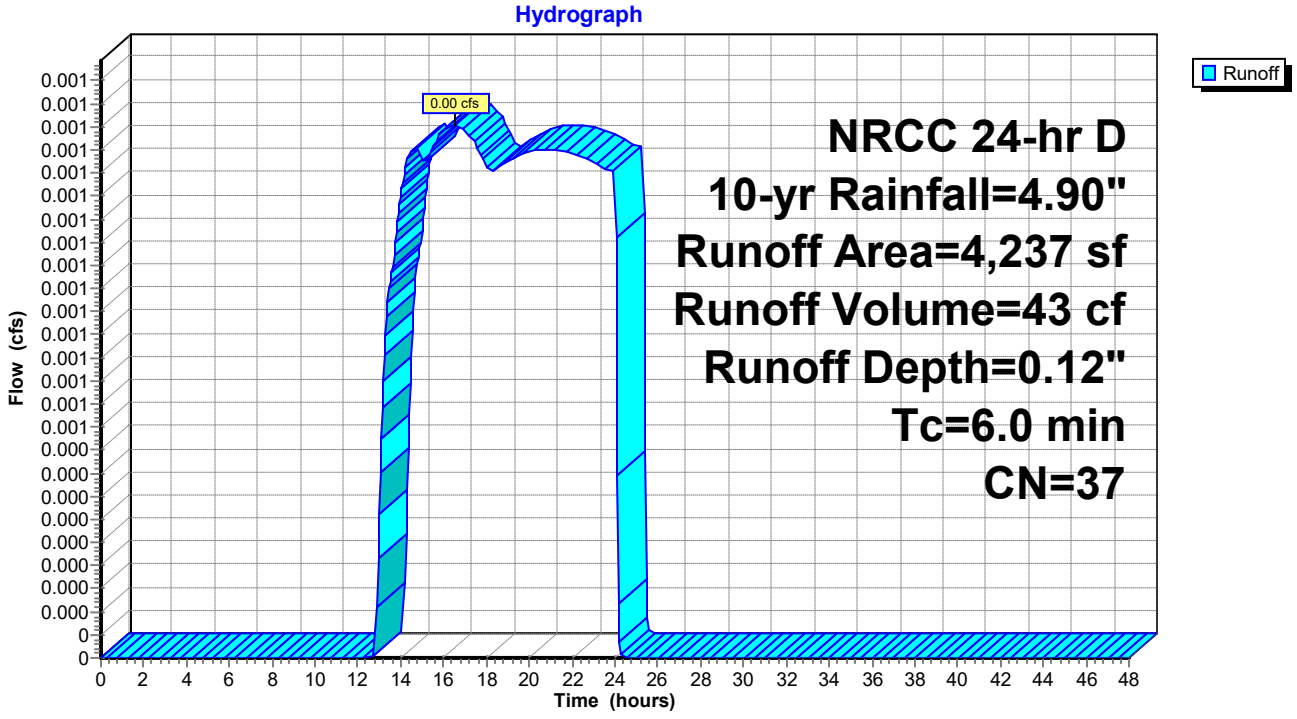
Link DP: Design Point #1- Ponds Inflow=0.02 cfs 432 cf
Primary=0.02 cfs 432 cf

Total Runoff Area = 12,601 sf Runoff Volume = 479 cf Average Runoff Depth = 0.46"
83.74% Pervious = 10,552 sf 16.26% Impervious = 2,049 sf

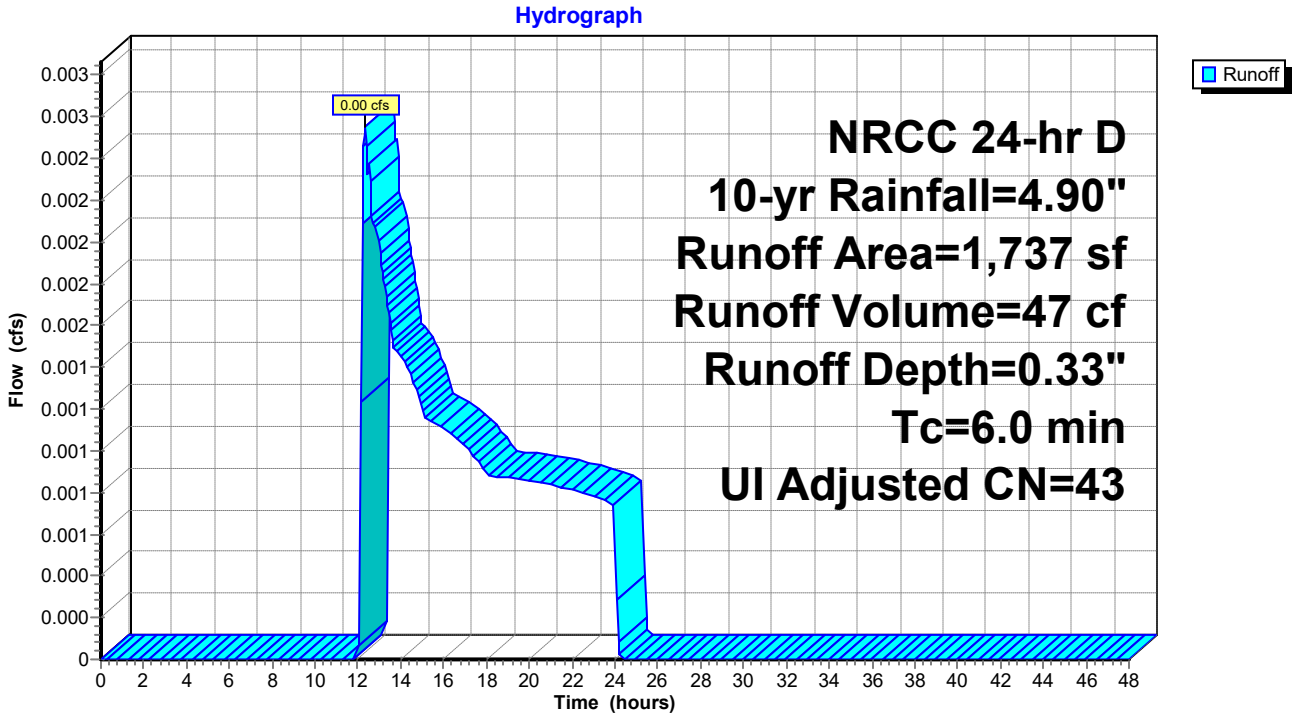
Subcatchment 100: Area to Bioretention



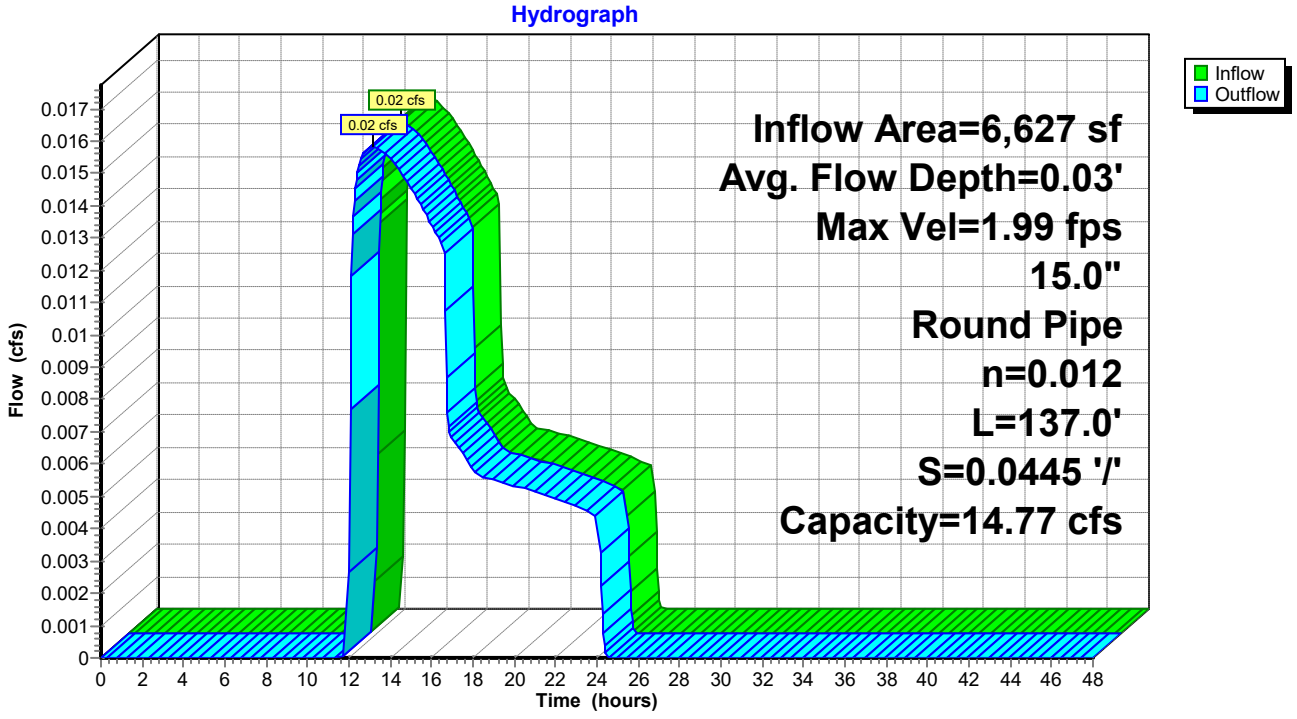
Subcatchment 110: Area to DP#1



Subcatchment 111: Area to Infiltration

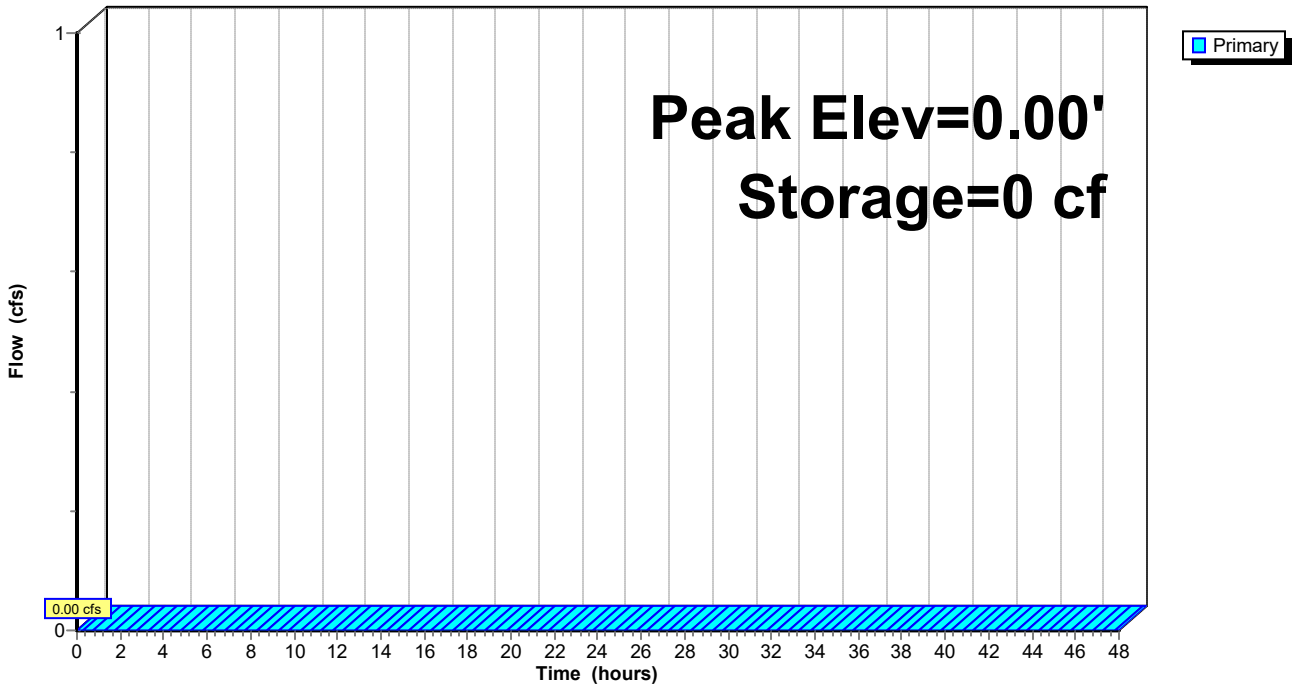


Reach 1R: 15" Culvert



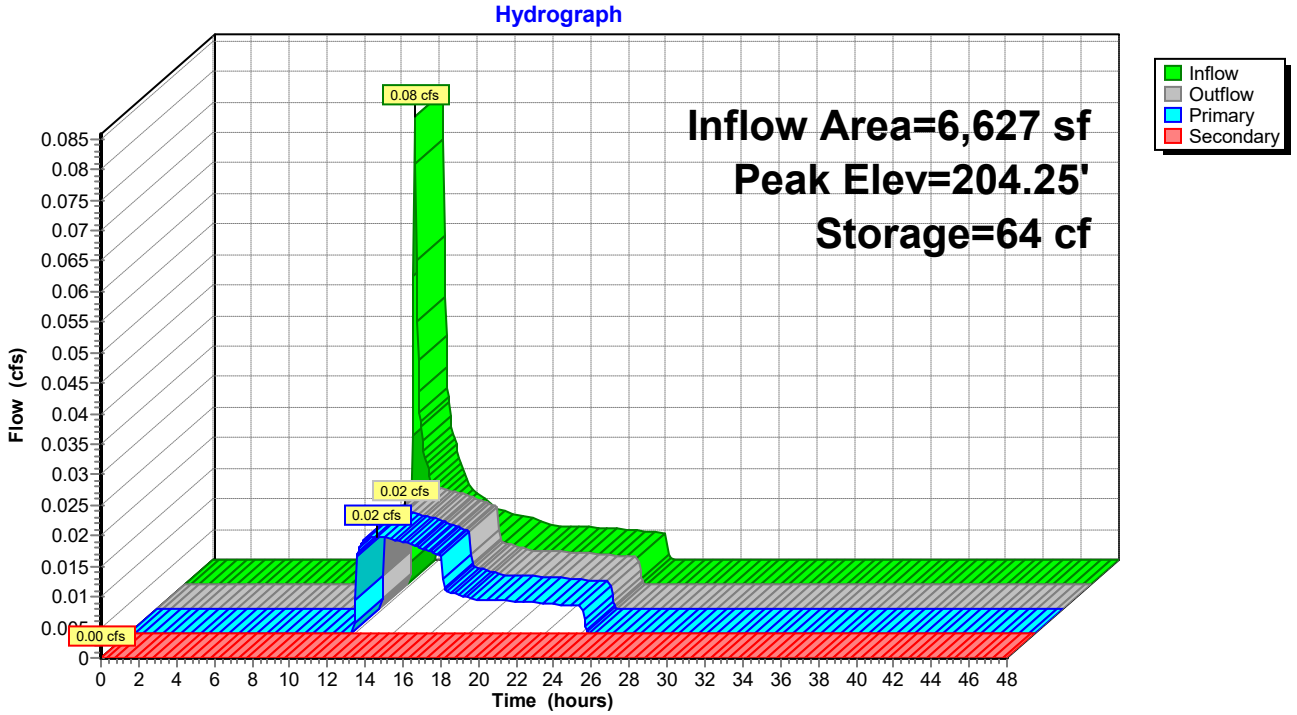
Pond 1P: Forebay

Hydrograph

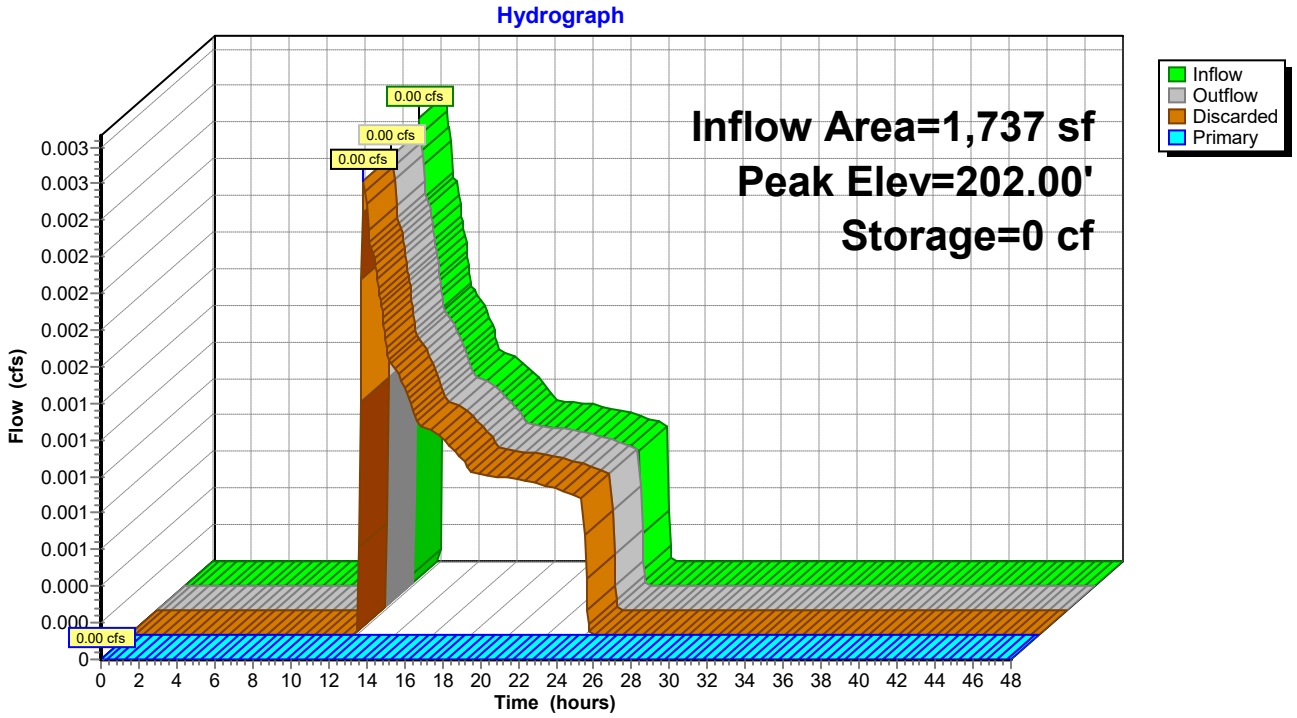


Pond 2P: BioRetention Area

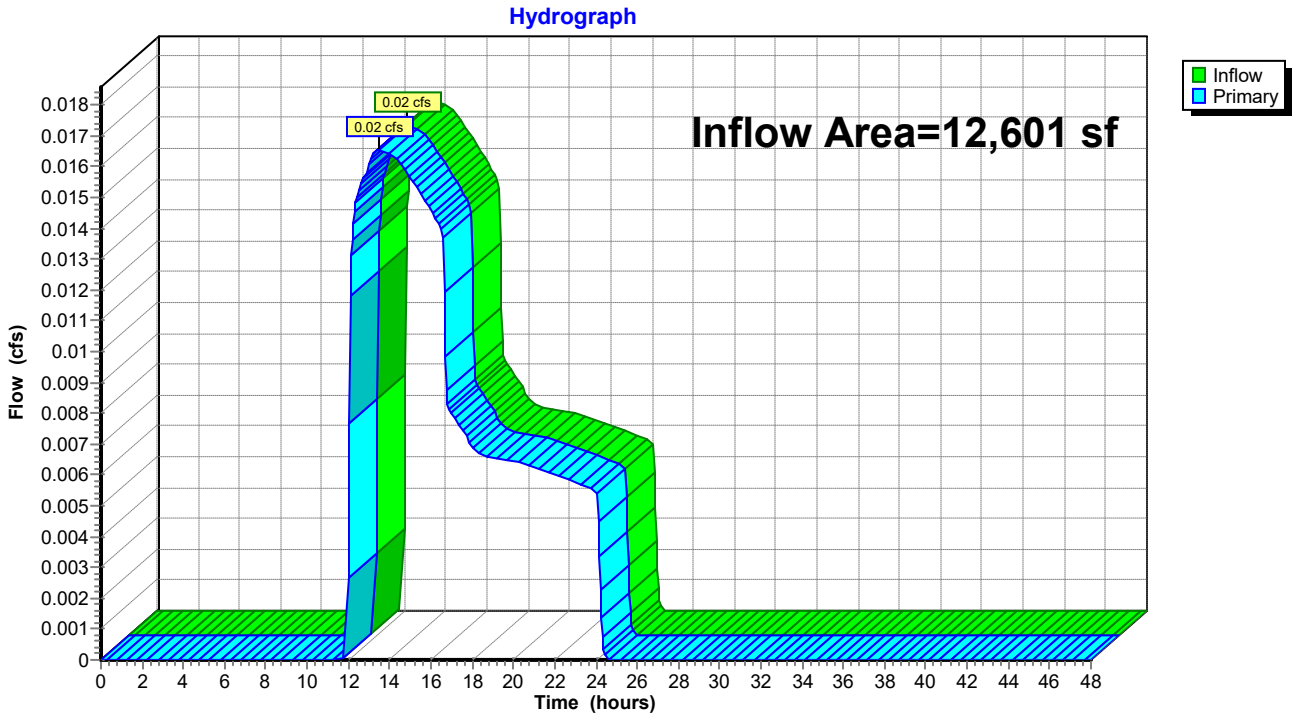
Hydrograph



Pond 3P: Infiltration Area



Link DP: Design Point #1- Ponds



Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 100: Area to Bioretention Runoff Area=6,627 sf 27.66% Impervious Runoff Depth=1.32"
Flow Length=151' Tc=7.4 min CN=51 Runoff=0.18 cfs 728 cf

Subcatchment 110: Area to DP#1 Runoff Area=4,237 sf 0.00% Impervious Runoff Depth=0.39"
Tc=6.0 min CN=37 Runoff=0.01 cfs 139 cf

Subcatchment 111: Area to Infiltration Runoff Area=1,737 sf 12.44% Impervious Runoff Depth=0.75"
Tc=6.0 min UI Adjusted CN=43 Runoff=0.02 cfs 108 cf

Reach 1R: 15" Culvert Avg. Flow Depth=0.03' Max Vel=2.11 fps Inflow=0.02 cfs 658 cf
15.0" Round Pipe n=0.012 L=137.0' S=0.0445 '/' Capacity=14.77 cfs Outflow=0.02 cfs 658 cf

Pond 1P: Forebay Peak Elev=0.00' Storage=0 cf
Primary=0.00 cfs 0 cf

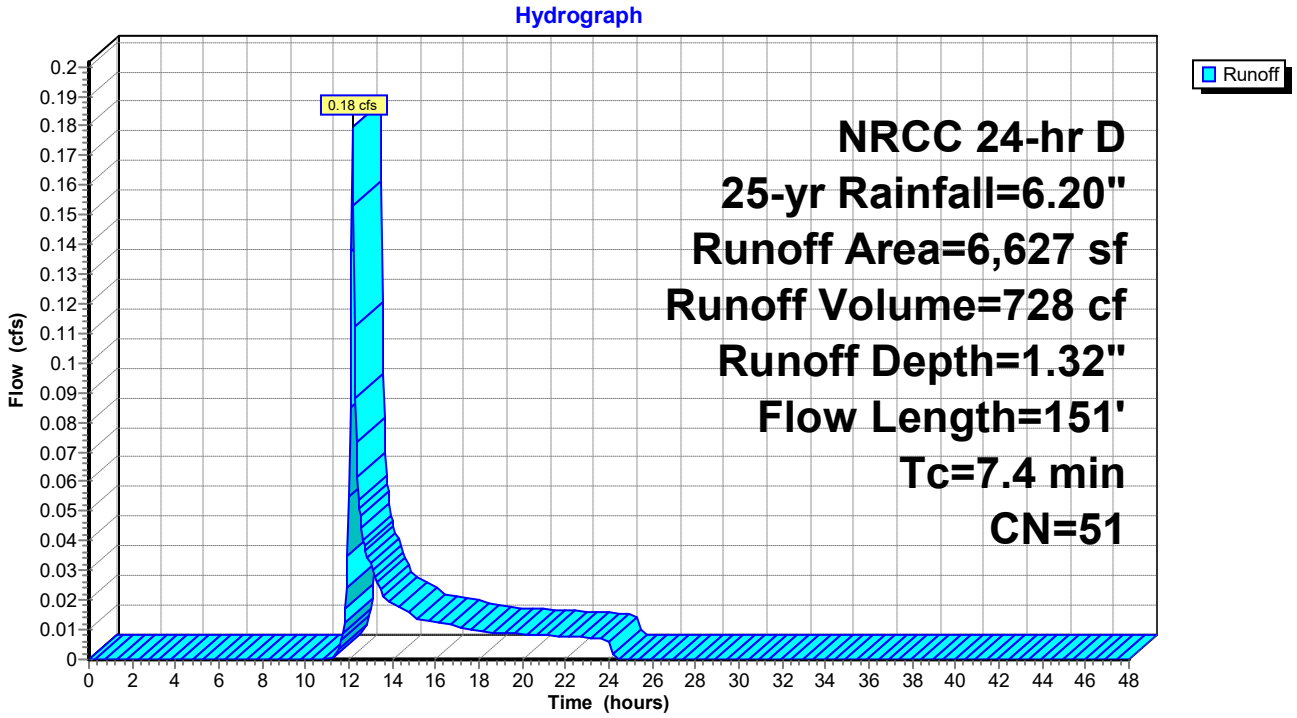
Pond 2P: BioRetention Area Peak Elev=204.52' Storage=150 cf Inflow=0.18 cfs 728 cf
Primary=0.02 cfs 658 cf Secondary=0.03 cfs 70 cf Outflow=0.05 cfs 728 cf

Pond 3P: Infiltration Area Peak Elev=202.17' Storage=39 cf Inflow=0.04 cfs 179 cf
Discarded=0.01 cfs 179 cf Primary=0.00 cfs 0 cf Outflow=0.01 cfs 179 cf

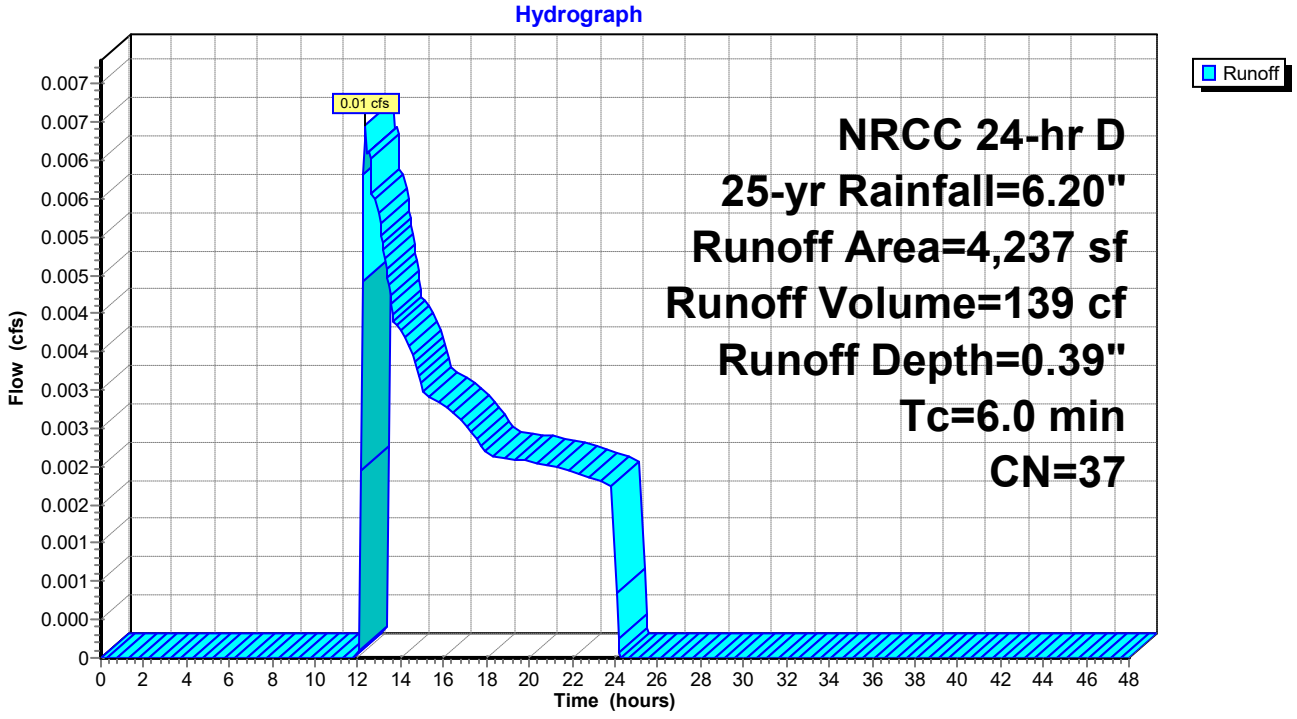
Link DP: Design Point #1- Ponds Inflow=0.03 cfs 797 cf
Primary=0.03 cfs 797 cf

Total Runoff Area = 12,601 sf Runoff Volume = 976 cf Average Runoff Depth = 0.93"
83.74% Pervious = 10,552 sf 16.26% Impervious = 2,049 sf

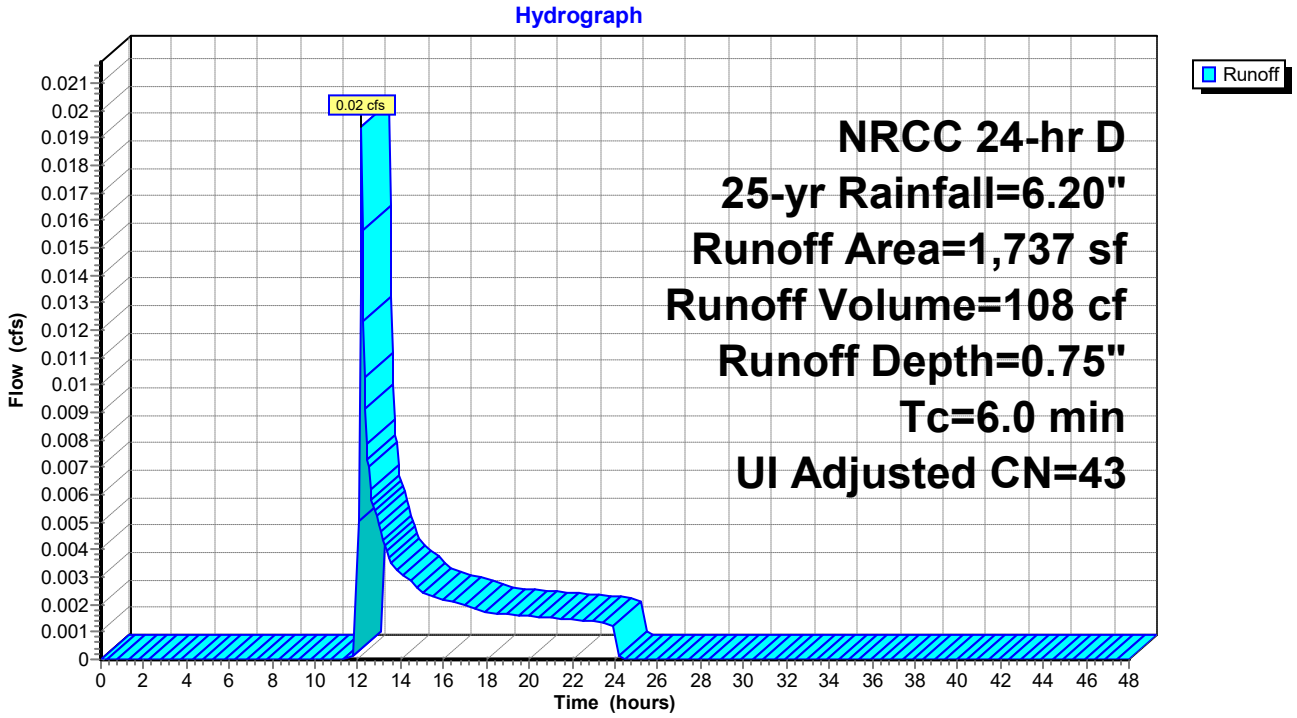
Subcatchment 100: Area to Bioretention



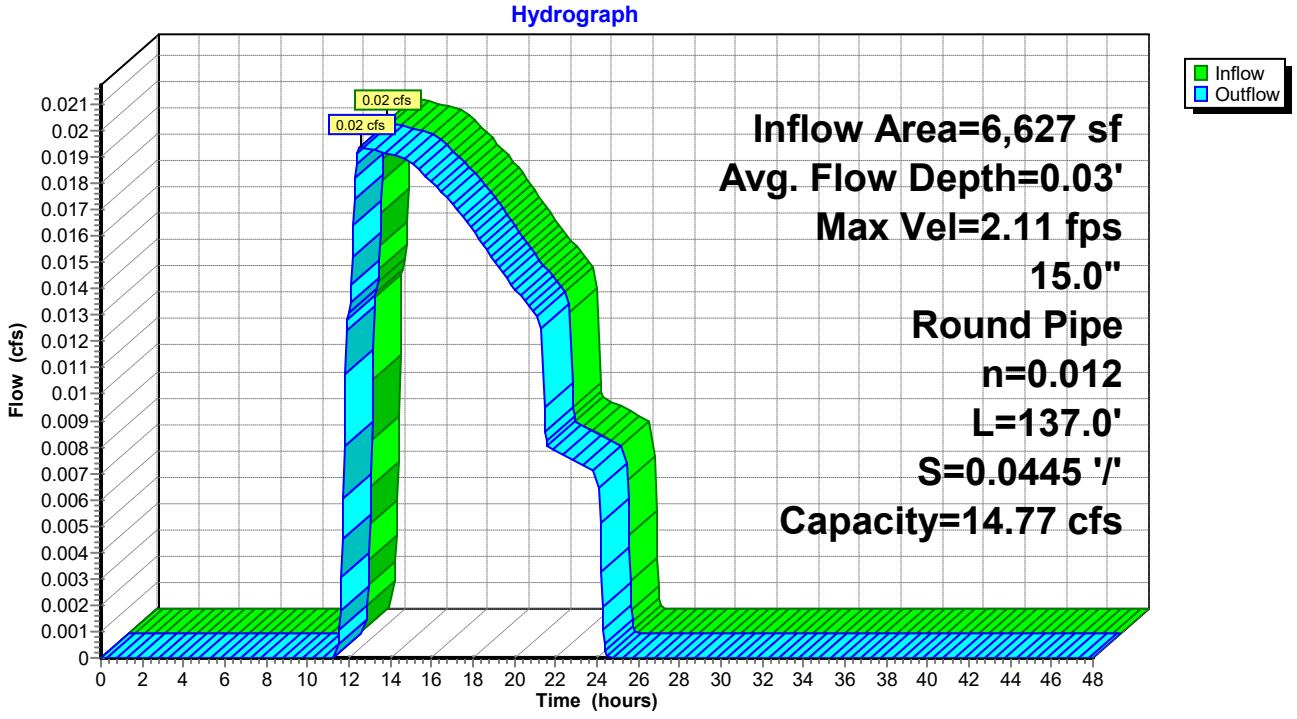
Subcatchment 110: Area to DP#1



Subcatchment 111: Area to Infiltration

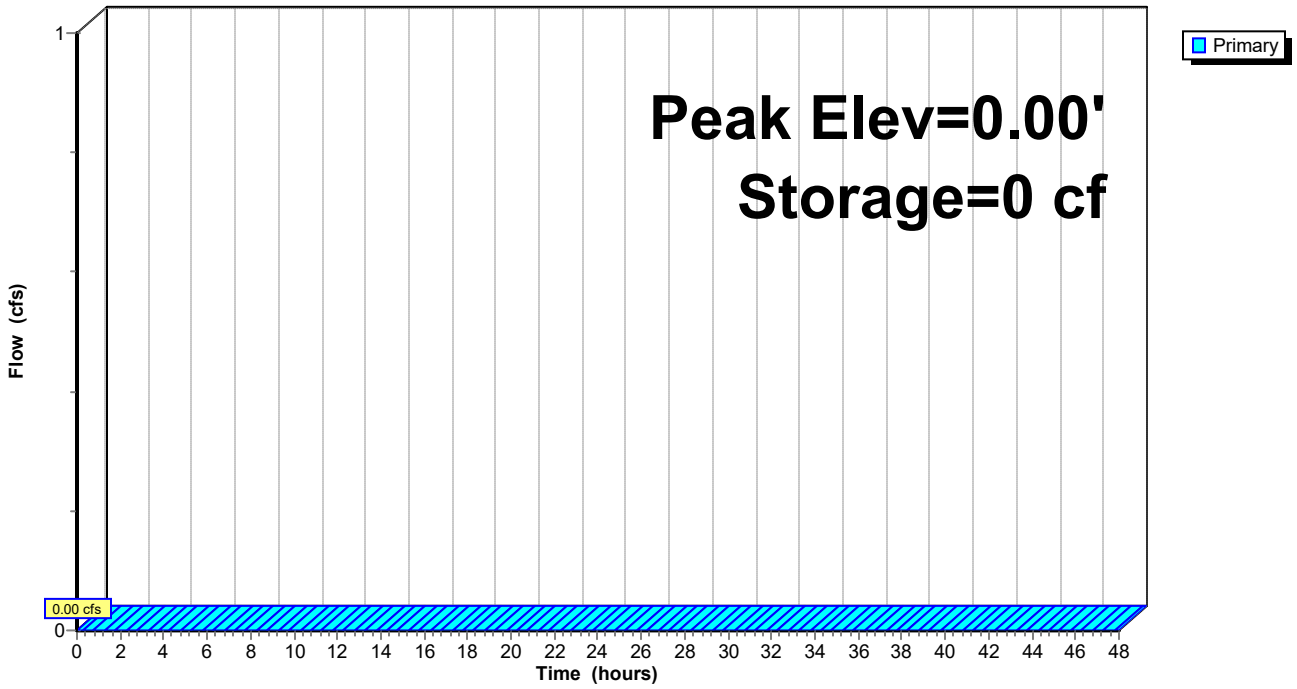


Reach 1R: 15" Culvert



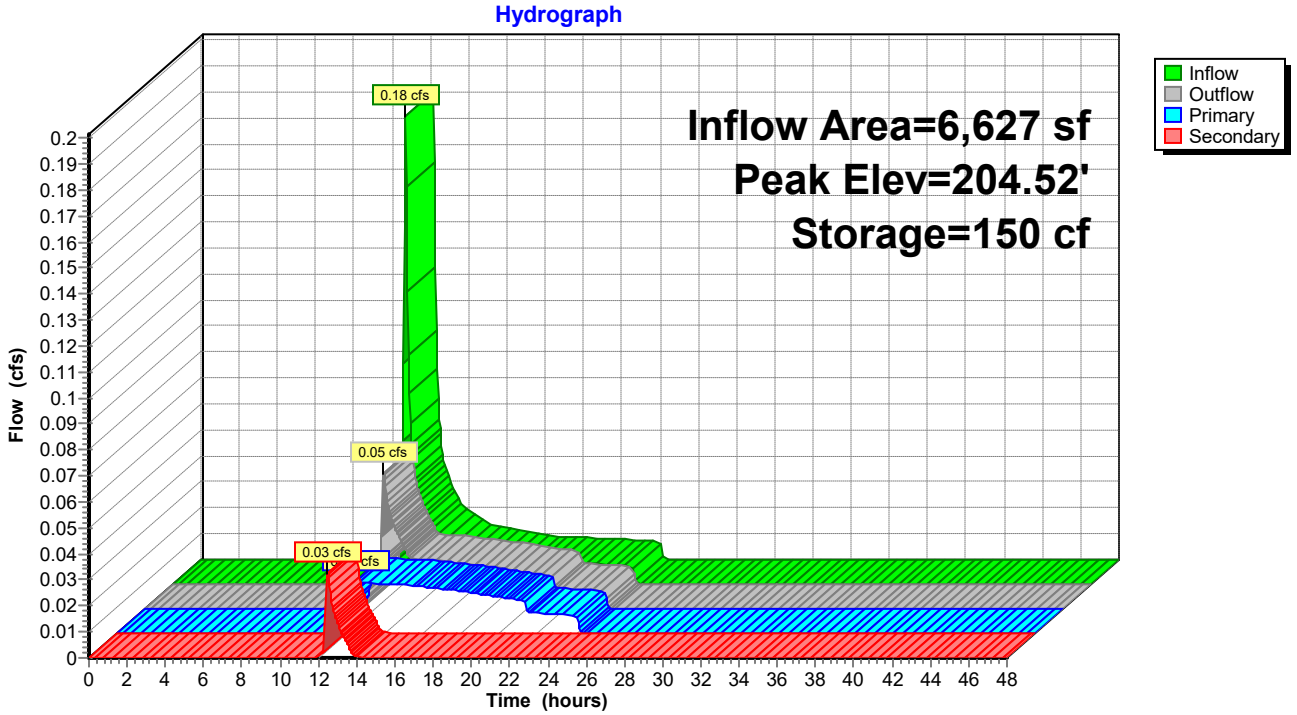
Pond 1P: Forebay

Hydrograph

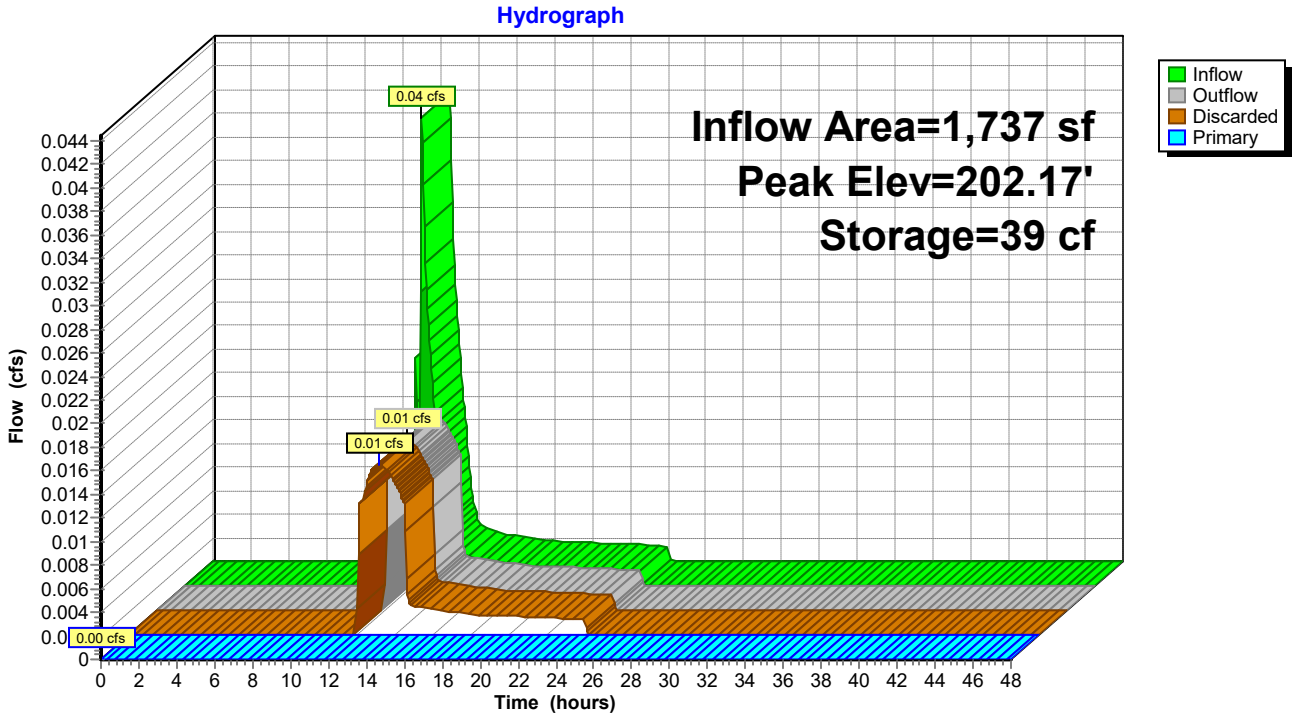


Pond 2P: BioRetention Area

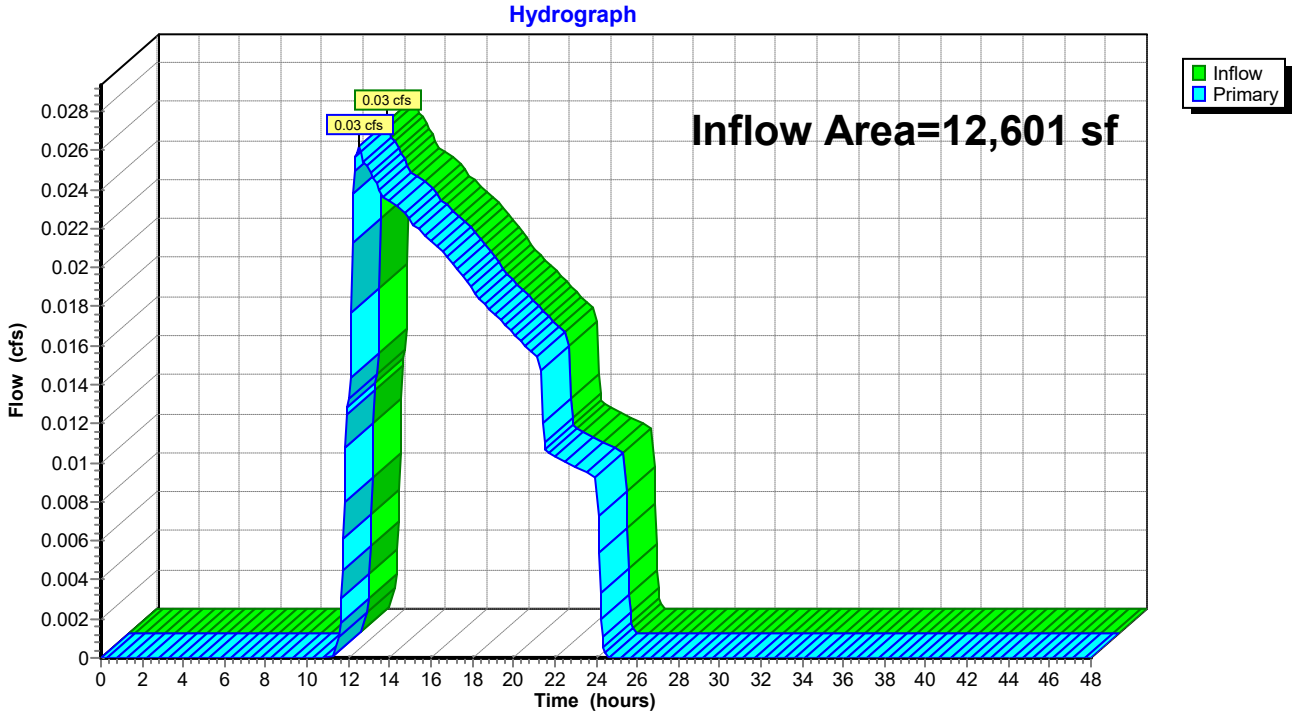
Hydrograph



Pond 3P: Infiltration Area



Link DP: Design Point #1- Ponds



Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 100: Area to Bioretention Runoff Area=6,627 sf 27.66% Impervious Runoff Depth=2.90"
Flow Length=151' Tc=7.4 min CN=51 Runoff=0.44 cfs 1,603 cf

Subcatchment 110: Area to DP#1 Runoff Area=4,237 sf 0.00% Impervious Runoff Depth=1.32"
Tc=6.0 min CN=37 Runoff=0.10 cfs 466 cf

Subcatchment 111: Area to Infiltration Runoff Area=1,737 sf 12.44% Impervious Runoff Depth=1.98"
Tc=6.0 min UI Adjusted CN=43 Runoff=0.08 cfs 286 cf

Reach 1R: 15" Culvert Avg. Flow Depth=0.03' Max Vel=2.14 fps Inflow=0.02 cfs 950 cf
15.0" Round Pipe n=0.012 L=137.0' S=0.0445 '/' Capacity=14.77 cfs Outflow=0.02 cfs 950 cf

Pond 1P: Forebay Peak Elev=0.00' Storage=0 cf
Primary=0.00 cfs 0 cf

Pond 2P: BioRetention Area Peak Elev=204.62' Storage=186 cf Inflow=0.44 cfs 1,603 cf
Primary=0.02 cfs 950 cf Secondary=0.41 cfs 654 cf Outflow=0.44 cfs 1,603 cf

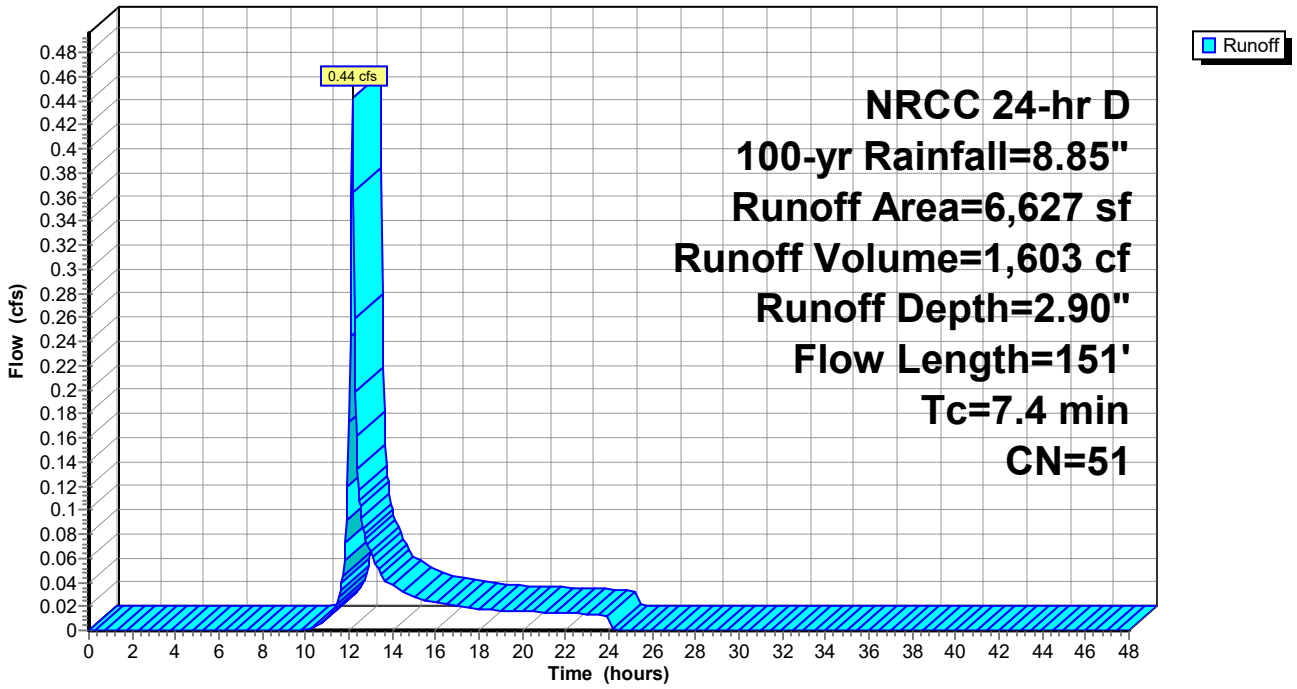
Pond 3P: Infiltration Area Peak Elev=202.86' Storage=305 cf Inflow=0.48 cfs 939 cf
Discarded=0.03 cfs 709 cf Primary=0.13 cfs 231 cf Outflow=0.16 cfs 939 cf

Link DP: Design Point #1- Ponds Inflow=0.19 cfs 1,646 cf
Primary=0.19 cfs 1,646 cf

Total Runoff Area = 12,601 sf Runoff Volume = 2,355 cf Average Runoff Depth = 2.24"
83.74% Pervious = 10,552 sf 16.26% Impervious = 2,049 sf

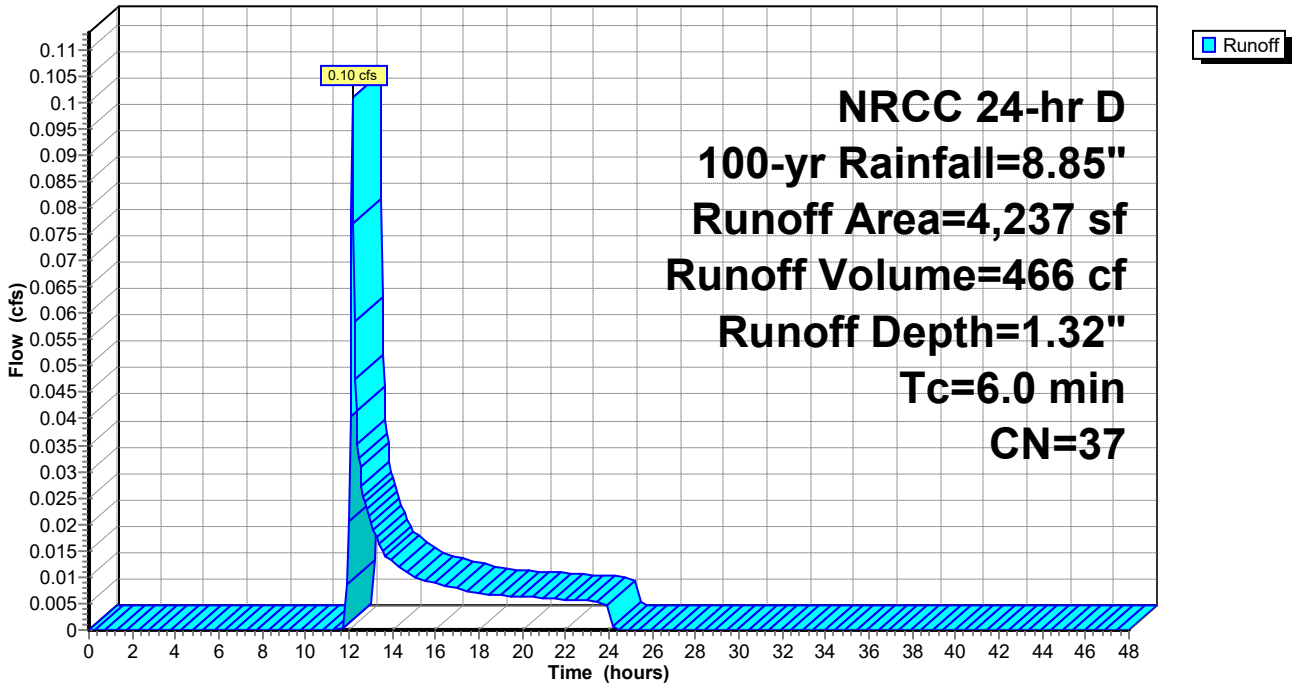
Subcatchment 100: Area to Bioretention

Hydrograph

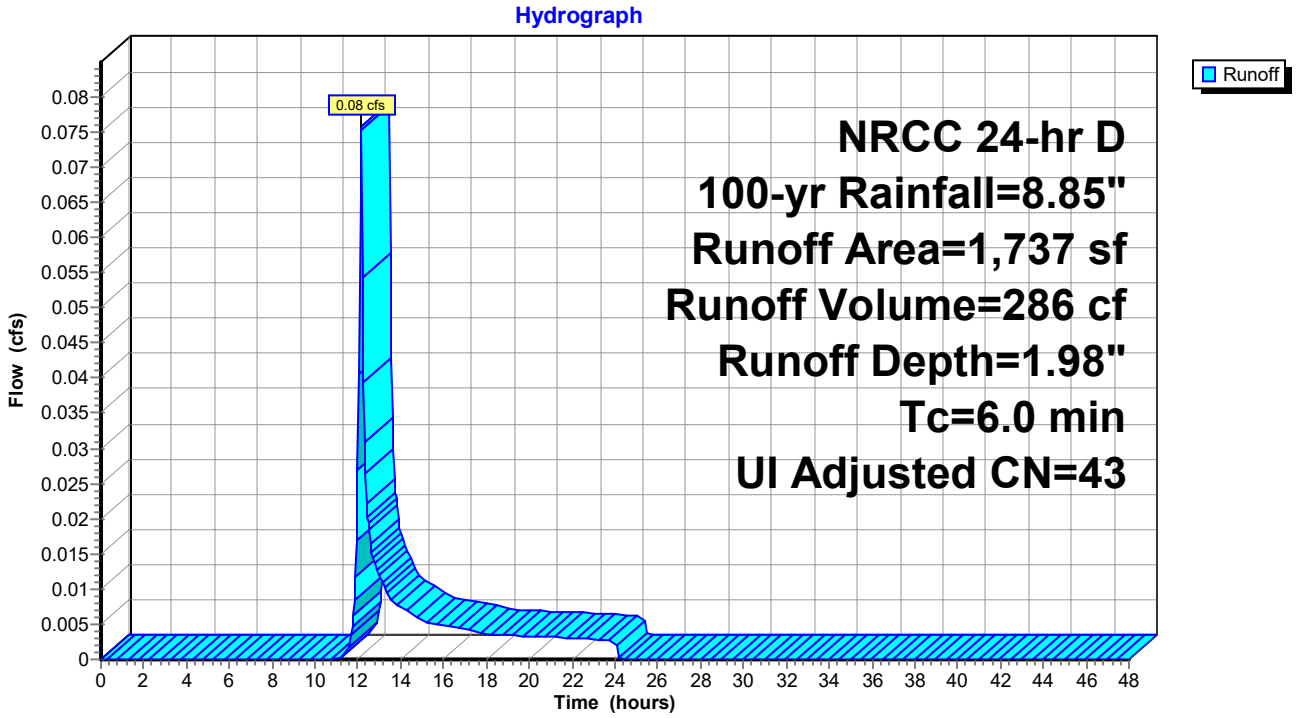


Subcatchment 110: Area to DP#1

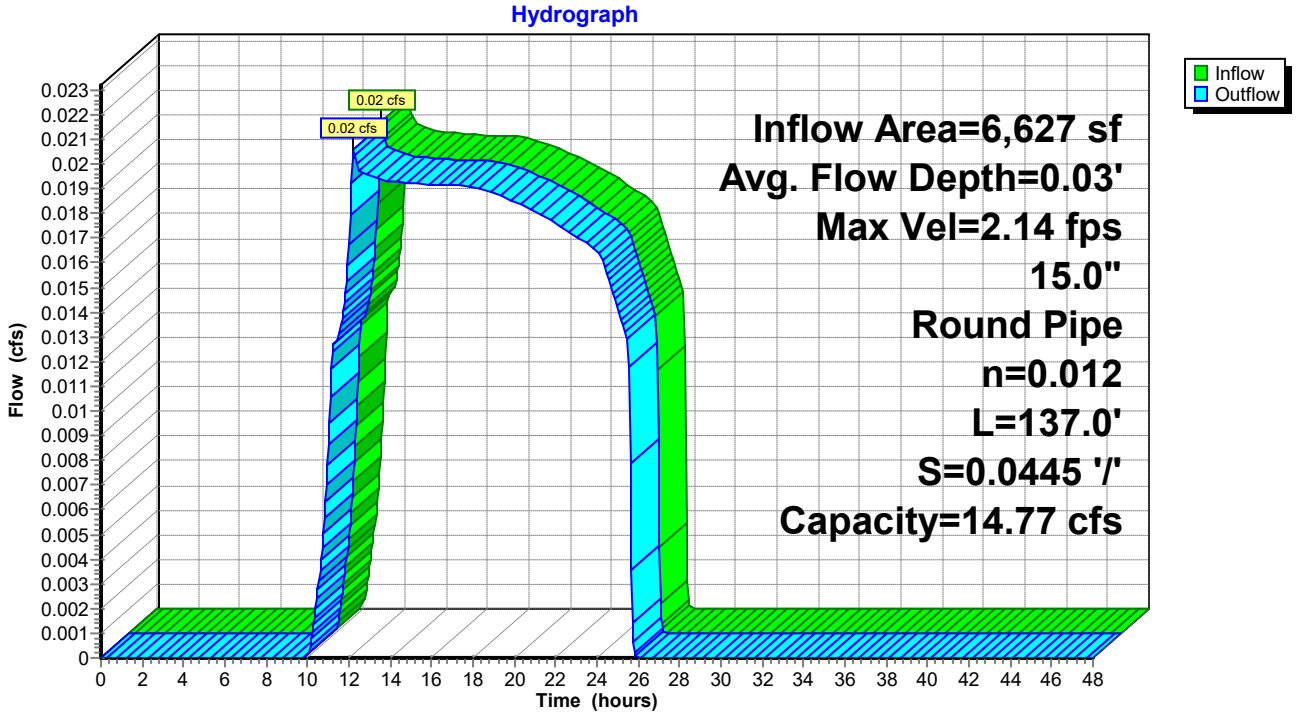
Hydrograph



Subcatchment 111: Area to Infiltration

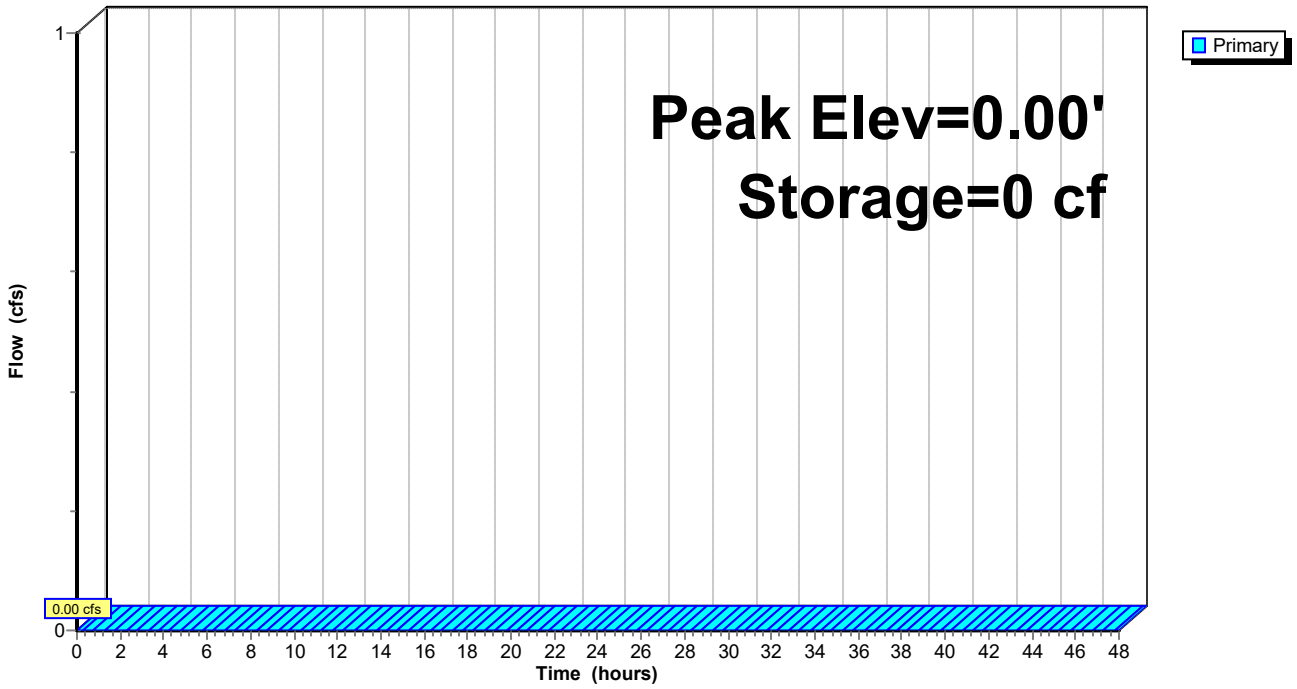


Reach 1R: 15" Culvert



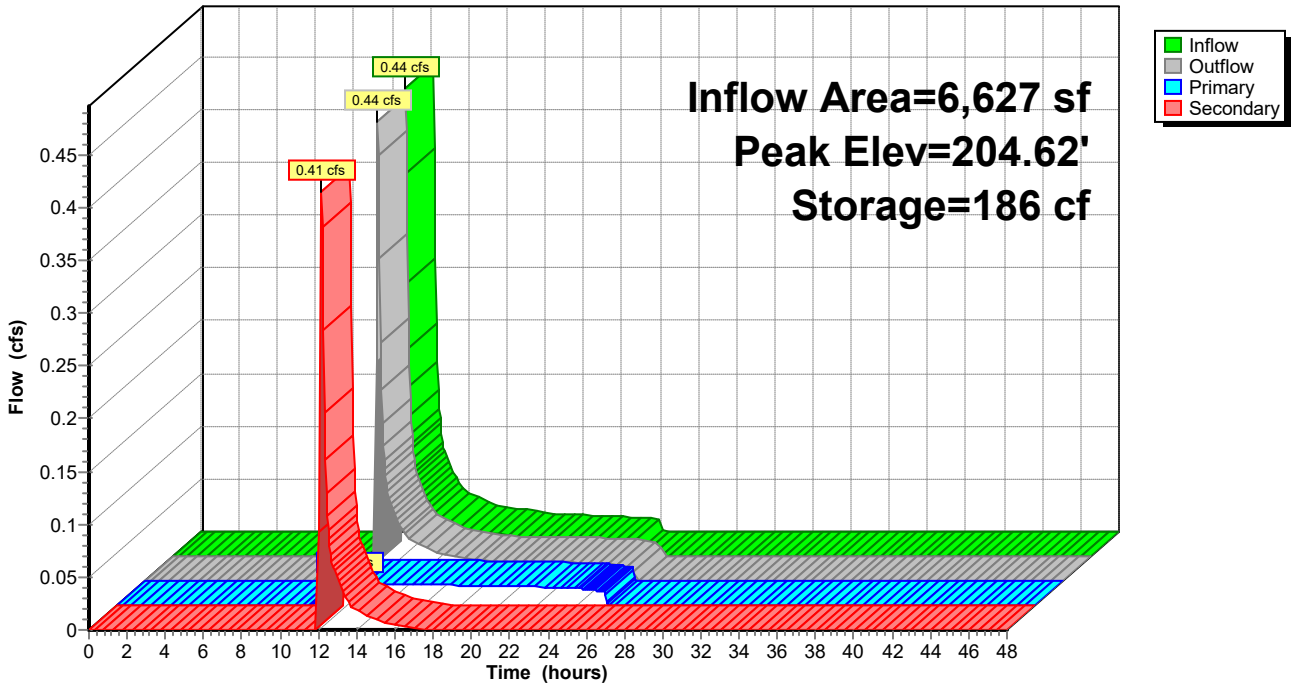
Pond 1P: Forebay

Hydrograph



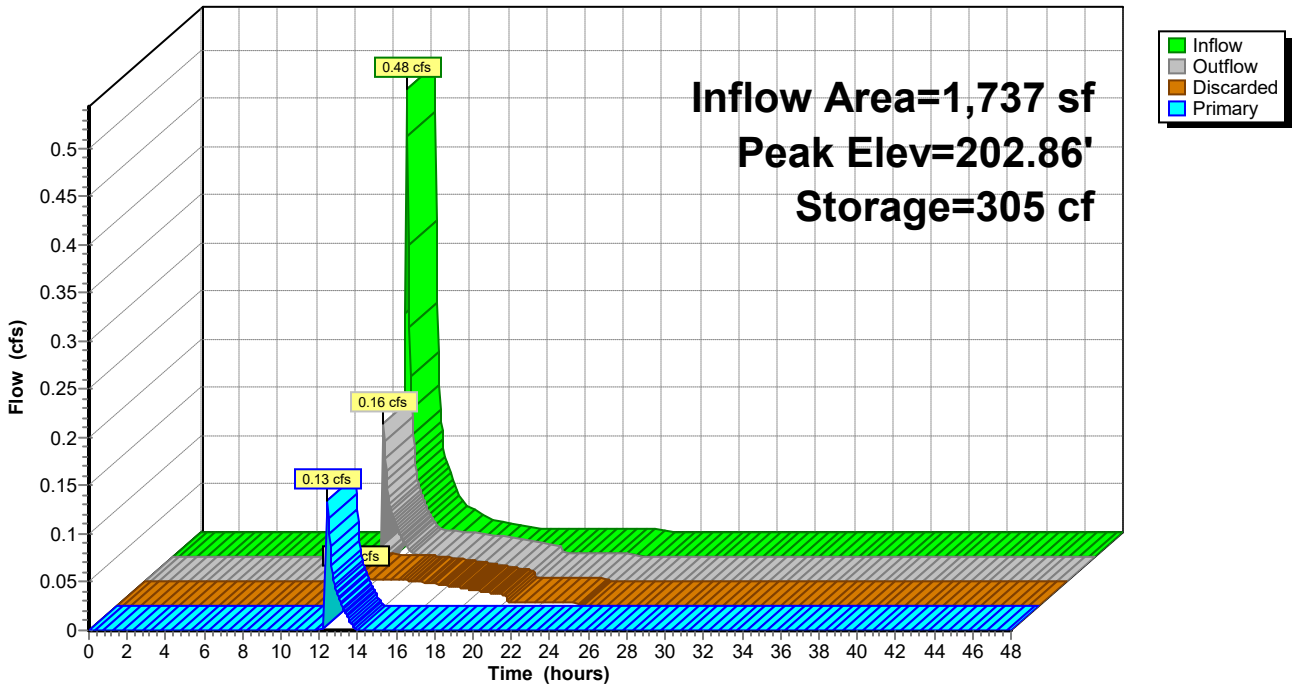
Pond 2P: BioRetention Area

Hydrograph



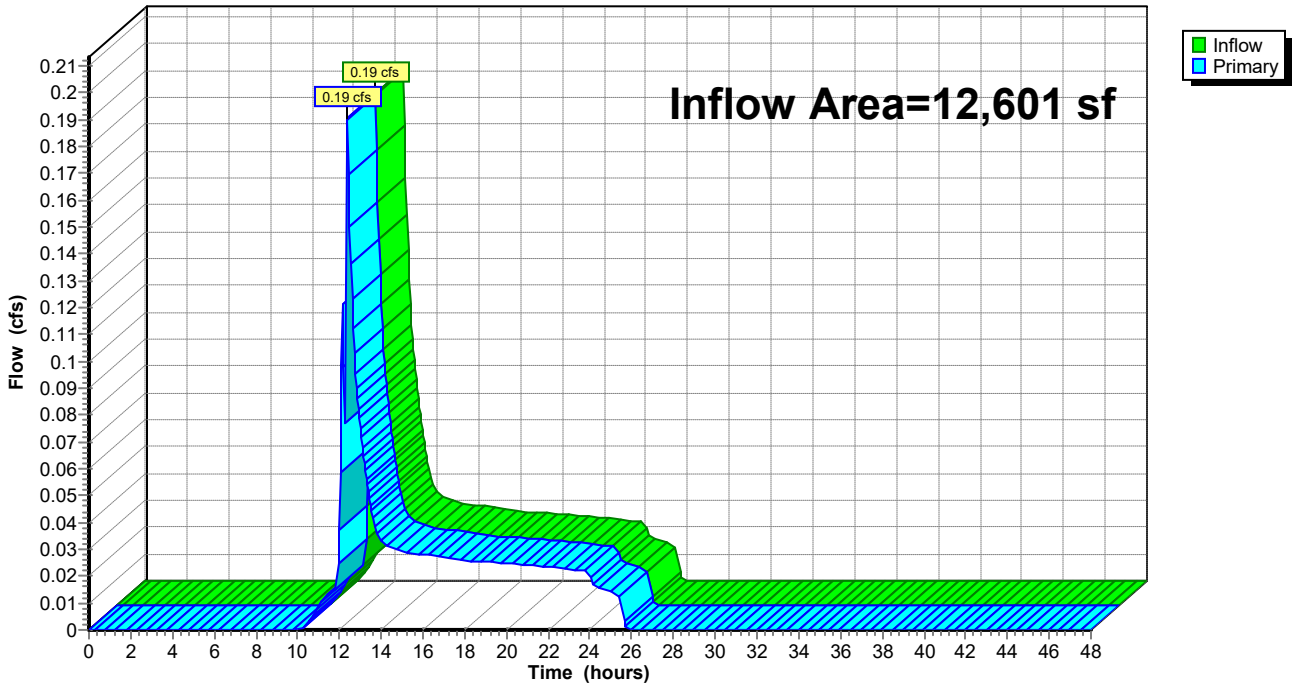
Pond 3P: Infiltration Area

Hydrograph



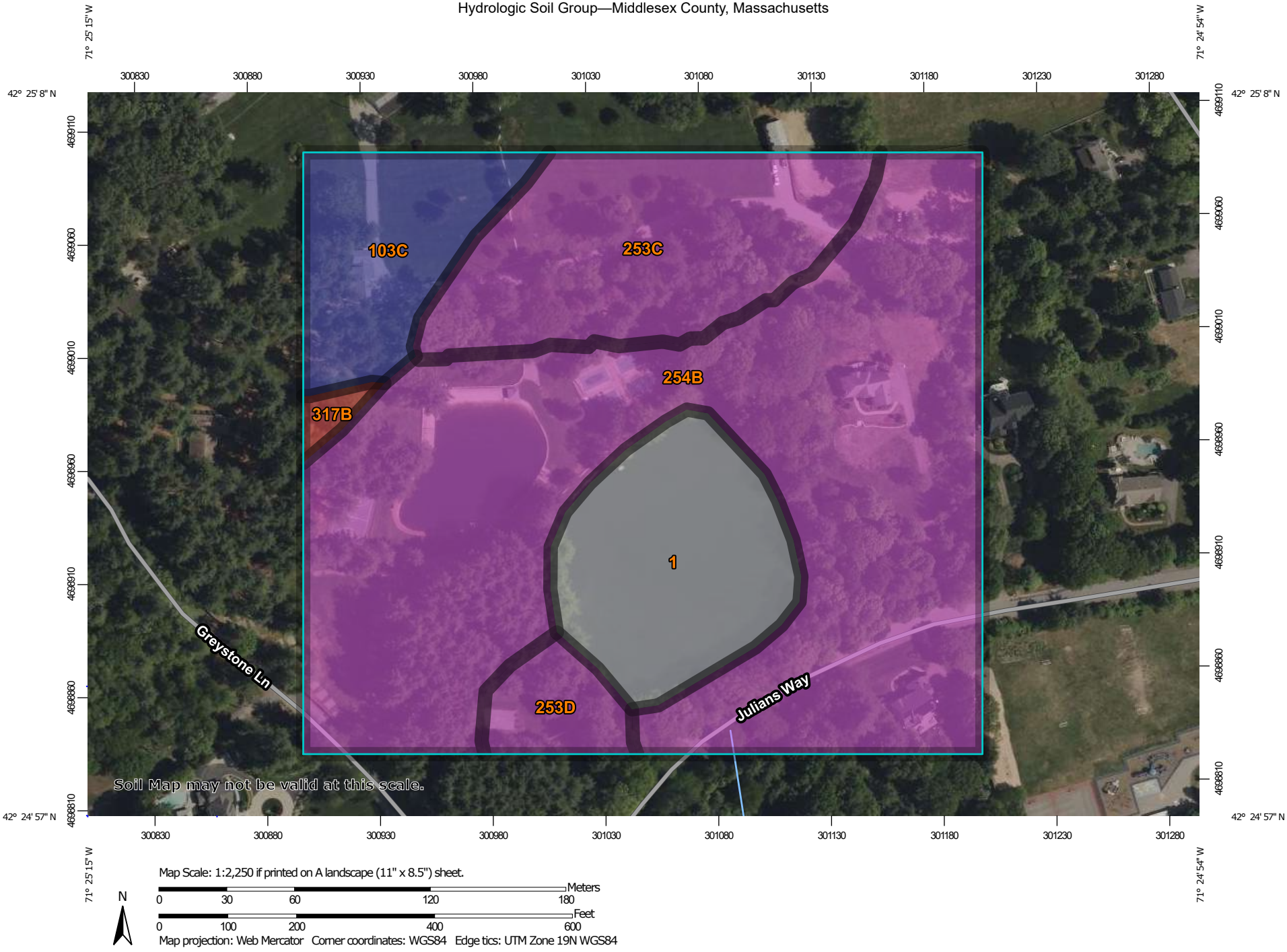
Link DP: Design Point #1- Ponds

Hydrograph



APPENDIX D

USDA-NRCS SITE SOILS MAP



Map Scale: 1:2,250 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 30 60 120 180

Feet: 0 100 200 400 600

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

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:25,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Middlesex County, Massachusetts
Survey Area Data: Version 22, Sep 9, 2022

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: May 22, 2022—Jun 5, 2022

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
1	Water		2.5	12.6%
103C	Charlton-Hollis-Rock outcrop complex, 8 to 15 percent slopes	B	1.8	9.0%
253C	Hinckley loamy sand, 8 to 15 percent slopes	A	3.3	16.5%
253D	Hinckley loamy sand, 15 to 25 percent slopes	A	0.7	3.3%
254B	Merrimac fine sandy loam, 3 to 8 percent slopes	A	11.5	57.9%
317B	Scituate fine sandy loam, 3 to 8 percent slopes, extremely stony	D	0.1	0.7%
Totals for Area of Interest			**19.9**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

APPENDIX E

SHORT TERM CONSTRUCTION OPERATION & MAINTENANCE PLAN

SHORT TERM CONSTRUCTION OPERATION & MAINTENANCE PLAN

Construction Period

During construction, the owner's site contractor/builder is responsible for the following Operation and Maintenance.

Responsible Parties

The owners must designate "qualified personnel" to perform the inspections associated with this plan. This means a person knowledgeable of the layout and overall function of the stormwater system. As necessary, this "qualified personnel" shall employ the services of a registered professional engineer when inspections reveal a failing stormwater system component or when similar attention is needed beyond the knowledge or experience of the inspector.

Operation and Maintenance Duties

The following duties shall be considered the minimum required and may be supplemented by additional measures as necessary to maintenance of the program.

General:
The property and drainage infrastructure shall be inspected and maintained on a routine basis to ensure sediment and debris does not enter the drainage system. This includes leaf litter from roof drain down spouts.

Erosion Control:
Erosion control barriers shall be inspected on a weekly basis. The inspector shall require repair of any part of the erosion control that is found to be damaged or not functioning properly.

Any siltation against the erosion control barriers shall be removed. If erosion control barriers must be replaced, they shall be replaced as soon as possible after discovery.

Areas being revegetated shall be inspected for areas of erosion. If any areas have become bare additional stabilization methods shall be employed to achieve stabilization through vegetation.

Contractor: :

Names: To be determined

Address:

Office:
Cell:

Signature: _____

APPENDIX F

LONG-TERM DRAINAGE SYSTEM OPERATION & MAINTENANCE PLAN

LONG-TERM DRAINAGE SYSTEM OPERATION & MAINTENANCE PLAN

System

The drainage system at Camp Sewataro is a combination of open and closed drainage system consisting of a Bioretention Area including a sediment forebay and outlet drainage pipe connecting to the existing 15" HDE drainpipe.

Responsible Parties

The drainage system will be operated and maintained by the Contractor during construction and the property owner post-construction. Drainage system maintenance tasks shall include routine cleaning of the overall drainage network and specific duties as listed below.

The responsible party must designate a "qualified personnel" to perform the inspections associated with this plan. This means a person knowledgeable of the layout and overall function of the stormwater system. As necessary, this "qualified personnel" shall employ the services of a registered professional engineer when inspections reveal a failing stormwater system component or when similar attention is needed beyond the knowledge or experience of the inspector.

Responsible Party for O&M: Camp Sewataro, LLC (1 Liberty Ledge, Sudbury, MA 01776)
Names: Responsible Party
Scott Brody
Combined Facility Director
275 Lancaster Road
Sudbury, MA 01776
Office: 978-440-5465
Cell: 978-405-4753

Owner: Andrew Sheehan
Town of Sudbury
Flynn Building
278 Old Sudbury Road
Sudbury, MA 01776

Operation and Maintenance Duties

The following duties shall be considered the minimum required and may be supplemented by additional measures as necessary to maintain the function of the drainage system. This operation and maintenance plan shall serve as a supplement to any and all existing drainage system duties.

Sweeping:
Sweeping of the impervious areas, parking lots and driveways should be done at lest 2 times annually, namely in the spring and fall. It is imperative that sweeping take place immediately following final winter snowmelt to remove winter sand. All sediments containing hydrocarbons shall be handled properly and disposed of in accordance with local, state and federal guidelines and regulation.

Culverts and pipes: All culverts and pipes shall be inspected four times per year and cleaned when drainage impediments are discovered. Flushing of pipes may be required to remove accumulated sediment.

Riprap Drain Outfalls (located at end of pipes): All riprap drain outfalls shall be inspected four times per year and repaired as necessary. Riprap shall be replace/repaired as necessary, debris and accumulated sediment removed, and any woody growth removed.

Sediment Forebay: The sediment forebay shall be inspected every month. If necessary, remove any accumulated sediment and replace or repair dislodged riprap.

Bioretention Area:
Bioretention area maintenance begins with education of the function and purpose of the structure: namely that of stormwater management and treatment. It is imperative that sand used in winter conditions not be allowed to enter the bioretention area as it will clog the soil media. Reduced sanding should be employed in the draining to the bioretention area and any accumulated sand should be removed immediately. Snow must not be stored in the bioretention area. Deicing chemicals should not be used in the area draining to the bioretention area.

Inspections should be performed monthly and/or after every rainfall event of more than 2 inches of rainfall in 24 hours; there should be no ponding water within the bioretention area after 72 hours following a rainstorm. Inspect the bioretention area for signs of erosion and repair immediately if found. Re-mulch void areas as needed (use only shredded hardwood mulch, 3" depth). The mulch needs to be replaced every two years, in the early spring. Monthly inspection must also include the following:

- Remove litter and debris.
- Treat diseased planting as needed; prune and replace dead vegetation with like material.
- Remove invasive vegetation and weeds.
- Maintain all culvert, outlet structures, and piping free of debris and blockages.

Infiltration Area:
The infiltration area shall be inspected every six (6) months and after every rainfall event exceeding the 2-year storm frequency (3 inches within 24 hours) and maintained at least twice per year. This bi-annual preventative maintenance must include mowing the basin area, removing trash and debris, removing grass clippings and accumulated organic matter, repairs to the outlet structure if needed, and repair of any eroded areas. Woody growth must be removed from anywhere within the basin bottom of on the berms.

The infiltration basin is designed to fully drain after a storm event therefore if standing water is observed within the system beyond 24 hours since the cessation of inflow to the system from a rain storm, this may indicate a problem and should be noted on the inspection log and further inspected for repairs. The Owner may need to contact a Registered Professional Engineer to evaluate the system in the event of major problems.

Snow Management Plan

The goal of this plan is to employ proper management of snow and snow melt, in terms of snow removal and storage, use of de-icing compounds, and other practices that can prevent or minimize runoff pollutant loading impacts. The following measures shall be taken (the following applies only to areas of the site that are so maintained during winter and may not apply to the project areas as they are not open in the winter):

- *Use on de-icing compounds:*
  - Use alternative de-icing compounds such as calcium chloride ($CaCl_2$) and calcium magnesium acetate (CMS).
  - Reduce the use of de-icing compounds through better training and careful application.

- *Storage of de-icing compounds:*
  - Store compounds in sheltered (protected from precipitation and wind) impervious pads or in original shipment containers if possible.

- *Snow removal and storage:*
    - Place snow in a designated aera where it can slowly infiltrate. However, it should not be placed over any component of the site's stormwater management system nor in the wetland buffer area.

Annual Budget

An annual budget for the operation and maintenance tasks described above is estimated at $1,500.

Records

A copy of the O&M Plan will be kept with Scott Brody at 275 Lancaster County Road, c/o Camp Sewataro.

Responsible Party: Scott Brody
Combined Facility Director
275 Lancaster Road
Sudbury, MA 01776
Office: 978-440-5465
Cell: 978-405-4753
Cell: 978-405-4753

Signature: _____

Owner: Andrew Sheehan
Town of Sudbury
Flynn Building
278 Old Sudbury Road
Sudbury, MA 01776

Signature _____

PLAN TO ACCOMPANY THE LONG-TERM DRAINAGE/STORMWATER OPERATION & MAINTENANCE PLAN
07/10/23

LEGEND

HC	HANDICAP SIGN
WV	WATER SHUT OFF VALVE
W — W	WATER LINE
D — D	DRAIN LINE
X — X	CHAIN LINK FENCE
	WOOD FENCE (PRF–POST AND RAIL, WF – WOOD FENCE)
W100 — W100	100–FOOT BUFFER ZONE
HSF — HSF	HAYBALE AND SILTFENCE
CFS — CFS	COMPOST FILTER SOCK
207.4	SPOT ELEVATION
EOP	EDGE OF PAVEMENT
R&D	REMOVE AND DISPOSE (OFF SITE)

CULVERT INLET (UNDER WOOD COVER)

SEDIMENT FOREBAY

BIORETENTION AREA

INFILTRATION AREA

STABILIZED CONSTRUCTION ENTRANCE

SAW-CUT LINE

PROPOSED TREELINE

8'X18.5' PAVED HANDICAP PARKING SPACES, AISLES AND SYMBOLS

S–1 SIGN

WHEEL STOP (TYP)

S–1 AND S–2 SIGNS

5' BIT. ASPHALT WALKWAY: 2% LONGITUDINAL SLOPE MAX, 1.5% CROSS–SLOPE MAX

BIT. PAVEMENT

STOCKPILE AREA

CRUSHED STONE FILTER STRIP

COMPOST FILTER SOCK

FOREBAY

H.P. 205.5

M.E. 207.0

M.E. 207.1

PAVED PICNIC AREA

5' BIT. ASPHALT WALKWAY: 4.7% LONGITUDINAL SLOPE MAX, 1.5% CROSS–SLOPE MAX

SANDBAG CRESCENT TO PROTECT DRAIN INLET (2' HIGH)

STORMWATER BIORETENTION AREA

CLEANOUT INV=201.30 (SEE DETAIL)

4' WIDE VEGETATED SPILLWAY, CREST ELEV=204.50 (SEE DETAIL)

HANDICAP ACCESS MAT TO EDGE OF WATER

4' CONCRETE WALK (R&D EXISTING) PITCH TO POND (2% MAX)

HAYBALE AND SILTFENCE

PAVED PICNIC AREA

STORMWATER INFILTRATION AREA: BOTTOM ELEV.=202.0 BOTTOM AREA SHALL BE 6–INCHES DEEP OF A 50–50 BLEND OF SCREENED TOPSOIL AND SAND; SEED INSIDE THE AREA UP TO ELEV. 203.0 WITH A WATER–TOLERANT MIX (ERNST RETENTION BASIN FLOOR MIX, ERNMX–126, OR ENGINEER–APPROVED EQUAL)

6" SCH40 SOLID PVC 62 LF, S=1.0%

INV 15"=200.26 INV 6"=200.63 (USE INSERT–A–TEE OR EQUAL)

6" SCH40 PVC, 5', S=1.0% (CONTRACTOR TO VERIFY EXISTING 15" HDPE PIPE ELEVATION AT CONNECTION PRIOR TO CONSTRUCTION)

4' WIDE VEGETATED SPILLWAY, CREST ELEV=202.80 (SEE DETAIL FOR BIORETENTION AREA)

CLEANOUT (SEE DETAIL)

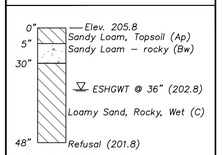
WYE 200.68

SWIMMING POND (CONCRETE–LINED)

SIGNATURE BLOCK

PLANNING BOARD	APPROVAL DATE:
BUILDING INSPECTOR	
PUBLIC WORKS DIRECTOR	
DIRECTOR OF PLANNING/COMMUNITY DEV.	

SOIL TESTING DATA



No Standing GW Observed

NOTE: SOIL TESTING PERFORMED BY GRAVES ENGINEERING ON 02/13/23.

SIGNAGE KEY

GEI ID	FEDERAL ID	SIGN SIZE WIDTH	SIGN SIZE HEIGHT	SIGN LAYOUT	QUANTITY
S–1	R7–8	12"	18"	RESERVED PARKING	2
S–2	R7–8a	12"	6"	VAN ACCESSIBLE	1

SHEET NOTES

1) PAVEMENT MARKINGS SHALL BE PAINTED WITH WHITE TRAFFIC PAINT CONFORMING TO SECTION M7.01.08 OF THE MASSDOT STANDARD SPECIFICATIONS FOR HIGHWAYS AND BRIDGES, LATEST EDITION. LINE WIDTH SHALL BE 4 INCHES. HANDICAP SYMBOL MARKINGS SHALL COMPLY WITH 521 CMR WITH WHITE SYMBOL ON BLUE BACKGROUND.

2) ALL JOINTS OF EXISTING & PROPOSED BITUMINOUS PAVEMENT SHALL BE SEALED WITH HOT RUBBERIZED ASPHALT JOINT SEALANT AND SANDED.

3) GRADING IN HANDICAP PARKING, ISLES. AND WALKWAYS SHALL CONFORM TO MASS AAB (521 CMR) STANDARDS.

GRAPHIC SCALE

10 0 5 10 20 40

(IN FEET)
1 inch = 10 ft.

Know what's below. Call before you dig.

GRAVES ENGINEERING, Inc.
100 GROVE STREET | WORCESTER MA 01605
T. 508-856-0321 | F 508-856-0357
gravesengineering.com

NO.	DATE	BY	REVISIONS
5	07/10/23	KPM	REVISED PER PEER REVIEW
4	06/23/23	KPM	REVISED PER PEER REVIEW
3	05/10/23	KPM	PER CONS. COM. COMMENTS
2	04/14/23	KPM	ADD SITE PLAN SIGNATURE BLOCK
1	04/10/23	KPM	ISSUED FOR PERMITTING

COMMONWEALTH OF MASSACHUSETTS — MICHAEL RICHARD ANDRADE — NO. 45638 — REGISTERED PROFESSIONAL ENGINEER

ELECTRONICALLY SIGNED AND CERTIFIED BY: MICHAEL ANDRADE, P.E.

SITE PLAN - SWIMMING AREA
HANDICAP ACCESSIBILITY IMPROVEMENTS
CAMP SEWATARO, 1 LIBERTY LEDGE, SUDBURY, MA 01776

PREPARED FOR:
CAMP SEWATARO, LLC
1 LIBERTY LEDGE, SUDBURY, MA 01776

PRJ. NO.: 22148
CHK. BY: MRA
DRW. BY: KPM
DES. BY: KPM
SCALE: 1"=10'
DATE: 04/10/23

C101

O&M LOG

PROJECT: Camp Sewataro
ADDRESS: 1 Liberty Ledge, Sudbury, MA 01776

					ACTION		
LOG #	BY	DATE	BMP FEATURE	OBSERVATIONS	CORRECTIVE ACTION TAKEN (IF NEEDED)	DATE	NOTES

APPENDIX G

LONG-TERM POLLUTION PREVENTION PLAN

LONG-TERM POLLUTION PREVENTION PLAN

Pollution Prevention and Source Control Plan

The site owner, Camp Sewataro, LLC, shall designate a pollution prevention team whose responsibilities are the following:

- *Good housekeeping*: General trash and litter cleanup of the site provides routine visual inspections of potential pollution sources. Initiate and maintain record keeping of activity with regard to the contents of this plan.

- *Storing materials and waste products inside or under cover*: All materials and waste products shall be stored within a building or within a covered dumpster.

- *Routine inspections and maintenance of stormwater BMP's*: Follow the requirements of the site *Long-Term Drainage System Operation & Maintenance Plan*. Be aware of site drainage components and Best Management Practices (BMP's) and their locations including drainpipe downspouts and subsurface detention system.

- *Spill prevention and response*: In the event of a spill outside of the building, immediately initiate containment and cleanup procedures appropriate for the material including but not limited to sorbent media (speedy dry), towels and barriers, as well as notifying the proper authorities. All attempts must be made to prevent spilled material from entering the drainage system or infiltrating into the ground.

- *Maintenance of lawns and landscaped areas*: Regularly mow lawn areas and weed landscaped areas. Make all attempts to use grass clippings by leaving them on the lawn. If the grass clippings are removed, do not dispose of them in or near any wetlands. Designate an upland area to compost the clippings.

- *Watering of vegetated areas*: Minimize watering lawn areas. Water lawns in the early morning if possible, and water deeply and infrequently.

- *Storage and use of fertilizers, herbicides, and pesticides*: All such materials shall be stored inside the building. It is recommended not to store such materials in large quantities.

- *Pet waste*: Per waste must be collected and disposed of properly. They should not be allowed to biodegrade in stormwater runoff, or adjacent resource areas.

Snow Management Plan

The goal of this plan is to employ proper management of snow and snow melt, in terms of snow removal and storage, use of de-icing compounds, and other practices that can prevent or minimize runoff pollutant loading impacts. The following measures shall be taken:

- *Snow removal and storage:* Place snow in pervious areas where it can slowly infiltrate, however it should not be placed over any component of the site's stormwater management system.

Illicit Discharges

An illicit discharge is defined as discharges to the drainage system that are not entirely comprised of stormwater, excluding the following: firefighting, water line flushing, landscape irrigation, uncontaminated groundwater, potable water sources, foundation and footing drains, air conditioning condensation, individual resident car washing, water from swimming pools, water used for street washing and water used to clean residential buildings without detergents.

There are believed to be no existing illicit discharges on the site. There are no cross-connections between the stormwater system and the wastewater system and discharges to each and shall remain separate. The homeowner shall prevent illicit discharges such as oil and grease from coming into contact with stormwater (see spill prevention and response).

APPENDIX H

TSS REMOVAL CALCULATION WORKSHEET

INSTRUCTIONS:

Version 1, Automated: Mar. 4, 2008

1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Location: To Design Point

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Bioretention Area	**0.90**	**1.00**	**0.90**	**0.10**
	0.00	**0.10**	**0.00**	**0.10**
	0.00	**0.10**	**0.00**	**0.10**
	0.00	**0.10**	**0.00**	**0.10**
	0.00	**0.10**	**0.00**	**0.10**

Total TSS Removal = **90%**

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: **Camp Sewataro, Sudbury**

Prepared By: **KPM**

Date: **7/10/2023**

*Equals remaining load from previous BMP (E) which enters the BMP

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed

1. From MassDEP Stormwater Handbook Vol. 1