Stormwater Report

Project: **STRAFFORD EAST**
15 Strafford Road
Strafford, NH 03884

Project Number: **NAV-31**

Applicant/Owner: **Mariner Tower Navigator Properties, LLC**
Address: P.O. Box 1160
Kennebunkport, ME 04046

Designer: TEP OPCO, LLC.
45 Beechwood Drive,
North Andover, MA 01845
Phone: (978) 557-5553

Date: April 17, 2023 (Rev0)
August 11, 2023 (Rev1)

STATE OF NEW HAMPSHIRE – DANIEL P. HAMM No. 11013 LICENSED PROFESSIONAL ENGINEER

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Section 1: Analysis Summary:

Table 1: Peak Discharge Rates						
Analysis Point	Design Storm Event					
	2 - Year			10-Year		
	Existing	**Proposed**	Q (CFS)	Existing	Proposed	Q (CFS)
Rate, Q (CFS)	33	POST-DEVELOPMENT-P1	26.49	55.02	POST-DEVELOPMENT-P1	45.1
		Initial-Junction-P1	26.48		Initial-Junction-P1	45.05
		ROAD-SIDE-DITCH-P1	26.34		ROAD-SIDE-DITCH-P1	44.88
		End-Junction-P-1	26.34		End-Junction-P-1	44.88
		(2)-HDPE-PIPES	26.29		(2)-HDPE-PIPES	44.84
		SAND FILTER	26.29		SAND FILTER	44.84
		(1)-HDPE-PIPE	26.07		(1)-HDPE-PIPE	44.44
		POST-DEVELOPMENT-P2	0.36		POST-DEVELOPMENT-P2	0.69
		Initial-Junction-P2	0.36		Initial-Junction-P2	0.69
		ROAD-SIDE-DITCH-P2	0.36		ROAD-SIDE-DITCH-P2	0.68
		End-Junction-P-2	26.21		End-Junction-P-2	44.68
		DIRECTLINK	26.21		DIRECTLINK	44.68
		POST-DEVELOPMENT (POINT-ANLYSIS)	26.21		POST-DEVELOPMENT (POINT-ANLYSIS)	44.68
			20.6%			18.8%

Analysis Point	**Table 1.1: Peak Discharge Rates**					
	25-Year			**50-Year**		
	Existing	**Proposed**	Q (CFS)	Existing	Proposed	Q (CFS)
Rate, Q (CFS)	68.27	POST-DEVELOPMENT-P1	56.74	75.66	POST-DEVELOPMENT-P1	64.08
		Initial-Junction-P1	56.7		Initial-Junction-P1	63.98
		ROAD-SIDE-DITCH-P1	56.51		ROAD-SIDE-DITCH-P1	63.78
		End-Junction-P-1	56.51		End-Junction-P-1	63.78
		(2)-HDPE-PIPES	56.43		(2)-HDPE-PIPES	63.69
		SAND FILTER	56.43		SAND FILTER	63.69
		(1)-HDPE-PIPE	55.89		(1)-HDPE-PIPE	63.01
		POST-DEVELOPMENT-P2	0.91		POST-DEVELOPMENT-P2	1.05
		Initial-Junction-P2	0.91		Initial-Junction-P2	1.04
		ROAD-SIDE-DITCH-P2	0.9		ROAD-SIDE-DITCH-P2	1.04
		End-Junction-P-2	56.21		End-Junction-P-2	63.37
		DIRECTLINK	56.21		DIRECTLINK	63.37
		POST-DEVELOPMENT (POINT-ANLYSIS)	56.21		POST-DEVELOPMENT (POINT-ANLYSIS)	63.37
			17.7%			16.2%

Analysis Point	Table 1.2: Peak Discharge Rates					
	1-Inch Storm			100-Year		
	Existing	**Proposed**	Q (CFS)	Existing	**Proposed**	Q (CFS)
Rate, Q (CFS)	68.27	POST-DEVELOPMENT-P1	56.74	87.2	POST-DEVELOPMENT-P1	74.24
		Initial-Junction-P1	56.7			
		ROAD-SIDE-DITCH-P1	56.51			
		End-Junction-P-1	56.51			
		(2)-HDPE-PIPES	56.43			
		SAND FILTER	56.43			
		(1)-HDPE-PIPE	55.89			
		POST-DEVELOPMENT-P2	0.91			
		Initial-Junction-P2	0.91			
		ROAD-SIDE-DITCH-P2	0.9			
		End-Junction-P-2	56.21			
		DIRECTLINK	56.21			
		POST-DEVELOPMENT(POINT-ANLYSIS)	56.21		POST-DEVELOPMENT(POINT-ANLYSIS)	73.31
			17.7%			15.9%

1.1. Proposal & Impacts

The Strafford East project seeks to install a Cellular Communications 160-foot Self-Support Tower with a 75’ x75’ fenced crushed stone equipment area at the base, serviced by a new 12’x 777’ long gravel driveway and a 15’ x 75’ gravel turn around area that will be fronted by Strafford Road.

The project is located on the Southwestern portion of an approximately 111 -acre parcel in Strafford, New Hampshire. The property is identified by the Town of Stafford as Tax Assessor’s map 11, Lot 83.

The proposed Cellular Site will add approximately 0.39 acres of impervious surface cover. Stormwater controls have been designed to address all Strafford Stormwater Management Requirements. This is not a redevelopment project.

1.2. Stormwater Standards

The analysis and design of the Stormwater Management system has been done in accordance with the State of New Hampshire, December 2008, Clean Water Act Section 319 Nonpoint Source Program grant and a Clean Water Act Section 104(b)(3) grant from the U.S. Environmental Protection Agency through the New Hampshire Department of Environmental Services, Watershed Assistance Section.

A complete evaluation of possible stormwater management measures, including environmentally sensitive site design; Low Impact Development (LID) techniques; structural stormwater Best Management Practices (BMPs); pollution prevention, erosion, and sedimentation control; and proper operation and maintenance of stormwater BMPs is included in this report. This document includes (8) eight Stormwater design standards to reduce and properly manage stormwater which are summarized and addressed below.

1) Low Impact Development (LID) site planning and design.

Requirement - Low Impact Development (LID) site planning and design strategies must be used to the maximum extent practicable in order to reduce the generation of the stormwater runoff volume. An applicant must document in writing why LID strategies are not appropriate if none are proposed for the management of stormwater.

Compliance - The project infrastructure was placed with Low Impact Development (LID) criteria in mind. Impervious area and ground disturbance are located outside jurisdictional environmental resources and buffer areas. Runoff from impervious surfaces is disconnected and directed to pervious surfaces. Catch basins and unnecessary pipe are not used, promoting “country drainage”.

2) Best Management Practices (BMPs)

Requirement - Best Management Practices (BMPs) as a minimum shall be employed to manage the quantity and quality of stormwater runoff both pre- and post-construction. See the most recent edition of the New Hampshire Stormwater Manual for guidelines.

Compliance –A BMP (Sand Filter) was implemented in the stormwater management design to address antidegradation.

3) Water Quality Volume

Requirement - There shall be no negative impact to water quality post-development from pre-development conditions.

Compliance – Stormwater BMPs and controls have been devised to treat runoff and prevent erosion.

4) Total Suspended Solids (TSS) Removal

Requirement - Remove 80 percent of the average annual load of total suspended solids (TSS), floatable, greases, and oils, remove 40 percent of phosphorous and nitrogen and, meet state water quality standards for all other parameters after the site is developed.

Compliance – Pre-treatment is provided and structural stormwater Best Management Practices (BMPs) are sized in accordance with the New Hampshire Stormwater design manual. Source control and pollution prevention practices are identified in the Long-term Pollution Prevention Plan.

5) Peak Discharge Rates

Requirement - Post-development peak runoff rate and volume shall not exceed predevelopment levels for a 50-year storm event.

Compliance – Flow attenuation has been provided such that peak discharge rates are no higher after the development than the existing condition for the 1-inch storm, 2, 10, 25 and 50-year storms. See Table 1: Peak Discharge Rates

6) Groundwater Recharge

Requirement - Stormwater management designs shall demonstrate that annual average pre-development groundwater recharge volume (GRV) is maintained post-development, when compared to pre-development conditions.

Compliance – The recharge volume has been determined in accordance with the New Hampshire Stormwater design manual and will be infiltrated to the groundwater.

7) Pre-development conditions

Requirement - For the purposes of calculating pre-development conditions, any site that was wooded in the last five (5) years shall be treated as though the predevelopment conditions are undisturbed woods.

Compliance – This standard is not applicable.

8) Long Term Operation & Maintenance

Requirement - All stormwater management plans shall include an Operation and Maintenance (O&M) Plan for the proposed system (prior to final approval of any permits) to ensure continued proper functioning of the system.

Compliance – The Long-Term O & M plan is included in this submittal. It includes general. controls for construction and long-term maintenance of the stormwater management system.

Section 2 Project Narrative

2.1. Introduction and methodology

This report is intended to accompany an application to the municipal review agent. Information is presented under two conditions, "Existing" and "Proposed", so that potential impacts due to the project can be identified, quantified and, if necessary, mitigated.

The objective of the calculations are as follows:

- Delineate hydrologic drainage areas and determine peak rates of runoff for the site under both existing and proposed conditions for the 1-Inch, 2, 10, 25 and 50- year design storms.

- Design a stormwater detention system to mitigate proposed increases in peak rates of runoff from existing to proposed conditions for the 1-Inch, 2, 10, 25 and 50- year storm events.

- Implement the New Hampshire Stormwater Manual, volume 1 through volume 3 and Town of Strafford Stormwater Design Standards, 1 through 8 to address both water quality and water quantity.

The final design intent seeks to meet the following interrelated goals:

- Prevent appreciable sediment transport by trapping sediment on site.

- Provide adequate drainage and mitigation measures for new impervious surfaces so that damage does not occur during a 50-year storm.

- Provide a cost-effective engineering solution that addresses regulatory as well as practical constraints.

2.2. Site Description & Resource Area Delineation

The proposed tower and facility are situated in proximity of a cultivated crop area within a wooded sliver of land situated on an existing farmland. Please see TEP OPCO, LLC Zoning Drawings submittal for additional information.

a) Soil Evaluation

Per the USDA's Natural Resource Conservation Service, the majority of the site and the entirety of the tower pad lies within Paxton fine sandy loam, please refer to Appendix 7.6 NRCS Soils Report for additional details on soils.

The estimated seasonal high groundwater table is at least 36 inches below the existing grade in this area. This is the depth used in the design regarding groundwater offset.

2.3. Project Description

a) Overview
Stormwater is collected by surface runoff ("country drainage") to a Sand filter BMP. The BMP is protected by a series of sediment Check dams and a forebay.
Peak discharge rates are ameliorated by a proposed Sand filter and the outlet control structure.

Table 2: Surface Covers

Condition	Impervious **(Gravel and Bare soil)**	Open **(Yard, Woods & Landscape)**
Existing	13,811 SF	773,106 SF
proposed	17,149 SF	769,768 SF
Difference	**↑3,338.34 SF Impervious Area (including gravel surfaces)**	

2.4. Hydraulic Drainage Areas

The entire locus property is not modeled in this analysis; only the immediate 786,917 SF of land around the tower is analyzed.

a) Existing Condition

The analyzed area is a single hydrologic drainage area (subcatchment), based on site survey and proximity to proposed impervious area. The area is mostly wooded, with some grass areas and a farmland.
Stormwater follows the ground's slope, moving to the Southeast. For a visual of existing conditions, subcatchment(s) and times of concentration, please refer to attached plan in Section 7.7 "Subcatchment Areas: Existing Conditions."

Table 3: Existing Subcatchments

Subcatchment	Area Sf.	Impervious	Curve Number	Time Of Concentration, Min.
E1	786,917.10	1.76%	88.03	23.12
Total Area	**786,917.10**	**13,811 SF**		

b) Proposed Condition

The analyzed area is divided into two subcatchments. The area is mostly Farmland, with some gravel, bare soil, and woods. Subcatchment P1 encompasses most of the proposed development area and discharges stormwater run-off to a proposed Sand filter situated along the southerly portion of locus. Subcatchment P2 envelopes a smaller area of the proposed development and discharges runoff to the southeasterly portion of the locus property towards a wooded area. For a visual of existing conditions, subcatchment(s) and times of concentration, please refer to attached plan in Section 7.8 "Subcatchment Areas: Proposed Conditions."

Table 4: Proposed Subcatchments

Subcatchment	Area S.F.	Impervious	Curve Number	Time of Concentration
P1	776,734.10	1.86%	85.7	29.31
P2	10,183	1.29%	77.78	10.18
Total Area	**786,917 SF**	**17,149 SF**		

c) Contributing & Impervious Areas

The Contributing Drainage Areas are shown in the attached subcatchment plans.
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2.5. Analysis Point

The analysis point for existing and proposed conditions is along the eastern and southwestern edge of the property respectively.

2.6. Pipe Sizing

For the purpose of determining pipe sizes to accommodate the site plus any upland tributary (pass-through) flows, the 50-year storm was used. This has a rainfall depth of 5.60 inches. The pipe run is short, and the pipe's characteristics control the basin's outlet flow rate.

See 50 – Year Storm event calculation worksheet for pipe sizing data on the analysis work sheet.

2.7. Hydraulic Analysis Methodology

1. Autodesk® Storm and Sanitary Analysis 2022. The Storm and Sanitary Analysis program was used to generate the runoff hydrographs for the watershed areas, to determine discharge/stage/storage characteristics for the Sand filter, to perform drainage routing and to combine the results of the runoff hydrographs.

2. Storm and Sanitary Analysis combines the most-used capabilities of TR-55[1] and many other techniques and features not provided by other programs.

3. Calculation Settings:

3.1. Flow Units ....CFS
3.2. Subbasin Hydrograph Method. ....SCS TR-55
3.3. Time of Concentration..........................SCS TR-55
3.4. Link Routing Method ....Kinematic Wave
3.5 Storage Node Exfiltration……………...Constant rate, wetted area.

1 TR-55 Technical Release 55: Urban Hydrology for Small Watersheds by USDA Soil Conservation Service (now Natural Resources Conservation Service)

Table 5: Local Storm Events	
Storm Event (Year)	NRCS Rainfall (inches)
2	3.0
10	4.30
25	4.30
50	5.60

Source: Rainfall data is interpolated from Technical Paper No. (TP40) Rainfall Frequency +Atlas of the Eastern United States.

The time of concentration, Tc, for each drainage area was calculated by Civil 3D waterdrop tool to determine the longest (hydrological) path rainfall would travel from the most distant point of the drainage area to the corresponding analysis point. Tc s were calculated via the Storm and Sanitary platform.

`Section 3 Stormwater Standards -Supporting Information

Section 3 Stormwater Standards – Supporting Information

For a summary of compliance with Stormwater Standards, please refer to Section 1.2 Stormwater Standards. Below are calculations, methodology and other information supporting each Standard, as necessary.

3.1 Standard 1 Low Impact Development (LID) Site Planning & Design Strategies

Please see section 1.2. on page 9 for all information on this standard

3.2 Standard 2 – Best Management Practice

Please see section 1.2. on page 10 for all information on this standard

_3.3 Standard 3 – Water Quality (WQV)

Drainage area = 18.07ac
Impervious area = 0.39 ac
I= 0.39/18.07 = 0.02

Rv = (0.05+0.9(I)
= 0.05+0.9(0.02)
= 0.07

WQV=(P)(Rv)(A)
= (1inch) x(0.07)x 18.07ac
=1.26 ac-inch
=1.26 ac-inch x 43560ft^2 / 1ft / 12-inch
=4,565.88 ft^3

Sand filter Void: 75% (WQV) **= 3,424.41 ft3**

The Structural BMP in structured to capture and treat the required Water Quality Volume.

WQV, provided (10,758 CF) > WQV, Required (3,424.41 CF) ← **OK**

Where:
P= 1 inch
I = The percent of impervious cover draining to the structure,
Rv = Unitless runoff coefficient, RV = 0.05+0.9(I)
in decimal form 0.39ac/18.07ac = 0.07
A= Total Site area draining to the structure

3.4 Standard 4 – Total Suspended Solids (TSS) Removal

The runoff volume is captured through a single treatment train.
The details follow:

1. Runoff reaches the BMP via sheet or shallow concentration flow via grassed surfaces. Check dams will trap sediment before entering the main BMP. This treatment train will reduce TSS by 90%.

3.5 Standard 5 – Peak Discharge Rates

Please see table 1 on page 6 for all information on this standard

3.6 Standard 6 – Groundwater Recharge

Proposed Impervious is 0.39 Acres or 17,149.90 SF

Require Recharge Volume is given:
GRV = $(A_I)(R_d)$

A_I = Area of impervious surface post development
R_d = Groundwater recharge depth per USDA/NRCS hydrologic soil group
GRV = (0.39 ac) (0.10 inch) = 0.039 Ac-Inch
= 142.91 Ft^3

The proposed basin has a peak 50-year storm volume of 4,822.51 CF, per Storm & Sanitary Analysis.
V, provided (4,822.51 CF) >> V, Required (142.91 CF) ← **OK**

Table 6 Recharge Volume

	F_{HSG} "A"	Area A	F_{HSG} "B"	Area B	F_{HSG} "C"	Area C	F_{HSG} "D"	Area D	Sums	
Impervious	(in.)	SF	(in.)	SF	(in.)	SF	(in.)	SF	AC-Inc	Rev (CF)
Proposed	0.4	0	0.25	0.00	0.1	17,149.00	0	0.00	0.039	142.9

Recharge Volume, Rv = 142.9 CF

3.7 Standard 7 – Pre-development conditions

Please see section 1.2. on page 11 for all information on this standard

3.8 Standard 8 – Long Term Operation & Maintenance

Please see section 1.2. on page 11 for all information on this standard

3.9 Riprap apron Sizing

Apron Length: L_a = $3.0Q/D_o$ x1.5 +$7D_o$ (Where TW >Do/2), Q=63.37 cfs TW=2.12ft
= 3.0 (63.37) /(2.5 x1.5) +7(2.5)
= 7.46 ft

Apron Width: W = $3D_o + 0.4L_a$
= 3(2.5) +0.4(7.46)
= 11.98 ft

Riprap Diameter D_{50} = $0.02Q^{1.3}/TW \times D_o$
= $0.02(63.37)^{1.3}/2.12 \times 2.5$
= 0.67 ft or 8 inches

3.10 Emergency overflow length

$CLH^{1.5}$ = Q (Where for 100-Yr Q =73.31 cfs)
= $3.0 \times 24.45(1)^{1.5}$
= 73.35 cfs Q> 73.31 **OK**

Where C= Coefficient 3.0
L= Bottom Length: 24.45ft
H= Height of Spillway: 1ft

Section 4 Construction Period Pollution Control Plan

1. Contact the regulating municipal agent at least fourteen (14) days prior to start of construction to schedule a pre-construction meeting.
2. Notify "DIGSAFE" at least 3 business days before site activity. Renew every 30 days.
3. Install sediment control perimeter as shown on the plan. This normally consists of silt fence and/or erosion control logs (wattles).
4. Install temporary construction entrance, if shown on plan.
5. Install sedimentation basin, if shown on plan.
6. As needed, cut, stump, clear and grub areas within limit of work.
7. Wood chips generated from clearing activities may be used as a temporary surface stabilization measure in addition to other required controls.
8. Place material stockpiles as far from environmentally sensitive areas as possible.
9. Inactive stockpiles of soil shall be stabilized with erosion control matting or temporary seeding whenever practicable. Surround with silt fence or filter log ("wattle").
10. When storm inlets are nearby and downgradient, install "silt sacks" around each storm inlet as soon as practicable. Sediment accumulation on all adjacent catch basin inlets shall be removed and the silt barrier replaced if torn or damaged. Silt barriers must be easy to remove, replace and/or clean and made of an appropriate material – burlap or woven geotextiles are not appropriate materials.
11. Install Erosion control fabric on all vegetated slopes (greater than 3H:1V).
12. All erosion control measures shall be inspected weekly and after every rainfall event.
13. All erosion control measures shall be maintained, repaired or replaced as required or at the direction of the owner's engineer, the municipal engineer, or the municipal conservation agent.
14. Sediment accumulation up-gradient of the silt fence greater than 6" in depth, or 40% the height of erosion logs, shall be removed and disposed of in accordance with all applicable regulations. Sediment shall be removed from any sedimentation basin when the sediment depth reaches half the basin's depth.

15. If soil is tracking off the site via the construction vehicle tires, adjacent roadways shall be kept clean by means of mechanical street sweeping.

16. Dust pollution shall be controlled using water trucks and or and approved soil stabilization product.

Section 5 Long-Term Pollution Prevention Plan

In conformance with Standard 4: Water Quality, the following Long-Term Pollution Prevention Plan is offered.

5.1. Project Ownership

Project:	Strafford East 15 Strafford Road, Strafford, NH 03884
Applicant/Owner:	Mariner Tower Navigator Properties, LLC
Address:	P.O. Box 1160 Kennebunkport, ME 04046
Date:	March 2023

5.2. Responsible Party for emergencies:

Owner:	Mariner Tower Navigator Properties, LLC P.O. Box 1160 Kennebunkport, ME 04046

5.3. Notification Procedures for Change of Responsibility

The Owner of the Stormwater Management System (SMS) for this project is referenced in Section 5 Long-Term Pollution Prevention Plan. The Owner shall be legally responsible for the long-term pollution prevention as well as operation and maintenance of this SMS as outlined in this Operation and Maintenance (O&M) Plan. Should ownership of the SMS change, the Owner will continue to be responsible until the succeeding Owner notifies the Commission or regulating municipal agency that the succeeding owner has assumed such responsibility. Upon subsequent transfers, the responsibility shall continue to be that of transferring Owner until the transferee Owner notifies the regulating municipal agency of its assumption of responsibility.

In the event the SMS will serve multiple lots/owners, such as the subdivision of the existing parcel or creation of lease areas, the Owner(s) shall establish an association on other legally enforceable arrangements under which the association or a single party shall have legal responsibility for the operation and maintenance of the entire SMS. The legal instrument creating such responsibility shall be recorded with the Registry of Deeds and promptly following its recording, a copy thereof shall be furnished to the regulating municipal agency.

5.4. Good Housekeeping Practices

The proposed site improvements have been designed to maintain a high level of water quality treatment for the waters down gradient of the site. Proper use and maintenance of the site for the purpose of reducing downstream impacts include regular street sweeping, and regular inspection and cleaning of the Sand Filter, Run-off Diversion Berms, proprietary water quality device, pipe outlet/ditch, and other Best Management Practices in place. Please refer to the following Operation & Maintenance Protocol schedule for further details.

5.5. Storing Materials & Waste Products

All potentially hazardous materials kept on site shall be stored in a neat and orderly fashion in their appropriate containers and under a roof or other secure enclosure. Waste products should be placed in secure receptacles until they are emptied by a licensed solid waste management company.

5.6. Vehicle Washing Controls

Vehicle washing should not occur on site. Outdoor vehicle washing has the potential to result in high loads of nutrients, metals, and hydrocarbons during dry weather conditions, as the detergent-rich water used to wash the grime off the vehicle enters the stormwater drainage system.

5.7. Inspections and Maintenance BMPs

Regular inspection and maintenance of stormwater infrastructure is essential for long-term protection of the environment and installed BMPs. Please refer to the following Operation & Maintenance Protocol schedule for further details.

5.8. Spill Prevention and Response

Sources of potential spill hazards include vehicle fluids, liquid fuels, pesticides, herbicides, paints, solvents, and liquid cleaning products. The majority of the spill hazards would likely occur within the building and would not enter the stormwater drainage system. However, there are spill hazards from vehicle fluids outside of the building.

a) Prevention

All potentially hazardous materials kept on site shall be stored in a neat and orderly fashion in their appropriate containers and under a roof or other secure enclosure. Products must be kept in their original containers with the manufacturer's label. All products should be used up before disposing of the container. If excess product remains, it should be disposed of according to the manufacturer's directions in a facility designed to accept the particular class of waste. Never dispose of products directly to the ground or stormwater inlets.

b) Response

Spills should be cleaned up immediately upon discovery. Manufacturer's recommended methods for cleanup shall be followed. The spill area shall be kept well ventilated, and personnel shall wear appropriate protective clothing to prevent injury from contact with a hazardous substance. Vehicle fluids and liquid fuel spill shall be remediated according to the local and state regulations governing fuel spills.

The owner shall have the following equipment and materials on hand to address a spill clean-up: brooms, dust pans, mops, rags, gloves, absorptive material, sand, sawdust, plastic, and metal trash containers. Spills of toxic or hazardous material shall be reported, regardless of size, to the NH Department of Environmental Services Waste Management Division, Solid Waste Management Bureau at (603-271-2919.

Should a spill occur, the pollution prevention plan will be adjusted to include measures to prevent another spill of a similar nature. A description of the spill, along with the causes and cleanup measures will be included in the updated pollution prevention plan.

5.9. Provisions for Maintenance of Landscaped Areas

Lawns, gardens, and other landscaped areas shall be maintained such that surface water flows are not impeded. Special attention is to be paid to the infiltration system intake(s). This is a general guideline towards achieving high quality and well-groomed landscaped areas. Grounds staff / landscape contractor must recognize the shortcomings of a general maintenance plan such as this and modify and/or augment it based on weekly, monthly, and yearly observations.

5.10. Storage and Use of Fertilizers, Herbicides, & Pesticides

All fertilizers, herbicides, and pesticides shall be applied in the minimum amounts recommended by the manufacturer. Storage shall be under a roof or other secure enclosure. The contents of any partially used containers shall be transferred to a sealable plastic container.

a) Fertilizers

Maintenance practices should be aimed at reducing environmental, mechanical and pest stresses to promote healthy and vigorous growth. Applied fertilizers shall be nitrogen "slow release" and contain no phosphate (such as GreenView Lawn Food, or similar).

b) Herbicides

Applied herbicides shall be eco-friendly or organic (such as FIESTA Turf Weed Killer, or similar). Synthetic chemical controls and pest management applications (when necessary) should be performed only by licensed applicators in accordance with the manufacturer's label instructions when environmental conditions are conducive to controlled product application.

c) Pesticides

When necessary, pest outbreaks should be treated with the most sensitive control measure available. Synthetic chemical controls should be used only as a last resort to organic and biological control methods. Applied pesticides shall be eco-friendly or organic (such as *AzaGuard Botanical Insecticide/Nematicide*, or similar).

Integrated Pest Management is the combination of all methods (of pest control) which may prevent, reduce, suppress, eliminate, or repel an insect population. The main requirements necessary to support any pest population are food, shelter and water, and any upset of the balance of these will assist in controlling a pest population. Scientific pest management is the knowledgeable use of all pest control methods (sanitation, mechanical, chemical) to benefit mankind's health, welfare, comfort, property, and food. A Pest Management Professional (PMP) will be retained who is licensed with the NH Department of Agriculture, Markets and Food at (603) 271-3551

5.11. Pet Waste Management

Pet waste shall be removed by pet owners within the project area. The pet waste shall be disposed of in accordance with local and state regulations.

5.12. Operation and Management of Septic System

Individual septic systems shall be inspected every 2 to 3 years and pumped according to licensed septage hauler’s recommendation.

5.13. Solid Waste Management

Waste products shall be placed in secure receptacles until they are emptied by or transported to a solid waste management company licensed in New Hampshire.

5.14. Snow Disposal and Plowing

Snow cannot be stored in BMPs. Snow will be stockpiled on site within open space areas until the stockpile areas become a hazard to the daily operations of the site. At that point, snow will be disposed of off-site. Snow disposal shall be in accordance with the State of New Hampshire Department of Transportation - Snow Removal general policy.

For more information see:- https://www.nh.gov/dot/org/operations/highwaymaintenance/documents/wmsrip.pdf

In general, snow will be plowed in accordance with standard industry operating procedures.

5.15. Winter Road Salt and/or Sand Use

Snow and ice melt products must be stored in sealed bins under a roof or in a secure container. Sand may be mixed and applied to increase traction. Applied snow melt products shall be eco-friendly (such as Subzero 20 Ice Melt, or similar). Avoid rock salt or products containing urea. Use the minimum amount recommended by the manufacturer and for public safety.

5.16. Street Sweeping

To minimize Total Suspended Solids (TSS) load to the BMPs, where applicable, street sweeping shall be performed. Sweeping early in the spring (before heavy rains occur) and late fall is required and sweeping during dry periods mid-winter is encouraged.

Street sweepings shall be handled according to New Hampshire Department of Environmental Services (NHDES), Regulation RSA 149-M:29,& Disposal of Street Sweepings.

5.17. Illicit Discharge Compliance Statement

Illicit discharges are generally any discharge into a storm system. This is not composed entirely of stormwater. Illicit discharges often include pathogens, nutrients, surfactants, and various toxic pollutants.

No illicit discharges are permitted on site. The Facility Owner is responsible for implementing the Operation and Maintenance Plan and overseeing activities at the facility to prevent illicit discharges to the drainage system from occurring. To achieve this, the owner shall inform staff (particularly maintenance and custodial personnel) that no substance or wash-water can be discharged to the ground, facility managers shall make themselves familiar with the BMPs and stormwater outlets, and an emergency spill kit shall be kept on site.
Should a spill occur, immediate action must be taken to contain the spill, cordon off the area, clean it up immediately and properly dispose of contaminants. The owner shall immediately notify the Conservation

Commission, Board of Health, and the local fire department as to the nature and extend of the discharge. [12]

12 Additional information on Illicit Discharges can be found under the US EPA's NPDES program: http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=min_measure&min_measure_id=3.

Section 6 Long-Term Operation & Maintenance Plan

6.1. The following is a description of the Project stormwater management system.

a) Stormwater Collection System

The proposed stormwater collection system utilizes surface flow ("country drainage") to convey water to the stormwater management system. The majority of the stormwater flows over a proposed gravel driveway and crushed stone surface. All storm flows over impervious areas will be directed to sediment, grass lined ditches, check dams and forebay before flowing to the BMP. The BMP has a control structure that meters the outflow via a pipe that directs outflow to a riprap apron Southwest of the infrastructure. An emergency overflow would direct runoff to the Southeast, should the overflow system fail.

Refer to attached plans for locations and system geometry.

b) Proprietary Separator

No proprietary separators are proposed for this project.

c) Proprietary Inlet Filter and Storage

No proprietary filters or storage are proposed for this project.

6.2. Standard Operation & Maintenance Protocol

This section presents the inspection and maintenance procedures associated with the stormwater management system. Inspections and maintenance methods are routine and will require a modest portion of the facility's maintenance budget.

Installation records of the stormwater facilities must be maintained in perpetuity and all maintenance and inspection records must be retained for a minimum three (3) years.

Operation and maintenance of the stormwater system will be provided by the Owner, or their designated representative:

Project:	Strafford East NH 15 Strafford Road, Strafford, NH 03884
Applicant/Owner:	Mariner Tower Navigator Properties, LLC
Address:	P.O. Box 1160 Kennebunkport, ME 04046
Date:	March 2023

6.3. O & M Schedule

The following is a schedule of stormwater components, required maintenance and frequency of necessary actions.

Table 7: O & M Schedule

Component	Maintenance Required	Frequency
Control Structure	The control structure shall be visually inspected to ensure inlets are clear, internal components are clean and structure is sound.	Quarterly
" "	Remove sediment from sumps using a vacuum truck or clam shell.	Inspect or clean structure at least four times per year and at the end of the foliage and snow removal seasons. Sediments must also be removed four times per year or whenever the depth of deposits is greater than or equal to one half the depth from the bottom of the sump of the lowest pipe in the structure. If handling runoff from LUHPPL or discharging runoff near or to a critical area, more frequent cleaning may be necessary.
Sediment Barriers (Silt Fence/ Wattles)	Remove sediment accumulation up- gradient of silt fence greater than 6" in depth or 40% of the height of wattles	Within 24-hours of storm events and every 2 weeks, at a minimum.
Snow Storage	Snow cannot be stored in forebays or the basin. Debris from melted snow piles shall be cleared from the site and properly disposed of at the end of the snow season, and no later than May 15th	Annually
Component	Maintenance Required	Frequency
Forebays	Inspect for sediment accumulation, erosion or other anomalies.	Inspect sediment forebays monthly and clean them out at least four times per year. Keep the grass height no greater than 6 inches. Set mower blades no lower than 3 to 4 inches.
Infiltration/ Detention Basin	Visual inspection shall be made of the basin's surface. The infiltration media shall be inspected via the inspection port. If standing water remains 72 hours after last rain event, infiltration interface shall be rehabilitated.	Quarterly for first year. No less than annually thereafter.
Slope Armament and Emergency Overflows	Inspect surface for irregularities. Verify overflow weirs remain at design elevations.	Annually or after an emergency overflow event.

6.4. Operation and Maintenance Log Form

The O & M Log Form

Table 8 O & M Log Form

Operation & Maintenance Log Form Stormwater Management System							
	Type/Location of BMP	Repairs or Other Maintenance Needed? *		Corrective Action Required? *		Date on Which Maintenance or Corrective Action First Identified?	Notes
1.		☐Yes	☐No	☐Yes	☐No		
2.		☐Yes	☐No	☐Yes	☐No		
3.		☐Yes	☐No	☐Yes	☐No		
4.		☐Yes	☐No	☐Yes	☐No		
5.		☐Yes	☐No	☐Yes	☐No		
6.		☐Yes	☐No	☐Yes	☐No		
7.		☐Yes	☐No	☐Yes	☐No		
8.		☐Yes	☐No	☐Yes	☐No		
9.		☐Yes	☐No	☐Yes	☐No		
10.		☐Yes	☐No	☐Yes	☐No		

* Note: The permit differentiates between conditions requiring repairs and maintenance, and those requiring corrective action. The permit requires maintenance in order to keep controls in effective operating condition and requires repairs if controls are not operating as intended. Corrective actions are triggered only for specific, more serious conditions, which include: 1) A required stormwater control was never installed, was installed incorrectly, or not in accordance with the requirements; 2) You become aware that the stormwater controls you have installed and are maintaining are not effective enough for the discharge to meet applicable water quality standards or applicable requirements; 3) One of the prohibited discharges is occurring or has occurred; or 4) EPA requires corrective actions as a result of a permit violation found during an inspection carried out. If a condition on your site requires a corrective action, you must also fill out a corrective action form.

6.6. Sand filter Filtration Worksheet Maintenance Requirements

The Sand filter practice filtration worksheet and maintenance requirements follows.

FILTRATION PRACTICE DESIGN CRITERIA
(Env-Wq 1508.07)

Type/Node Name: **SAND FILTER**

Enter the type of filtration practice (e.g., bioretention system) and the node name in the drainage analysis, if applicable.

YES		Check if you reviewed the restrictions on unlined systems outlined in Env-Wq 1508.07(a).	
18.07	ac	A = Area draining to the practice	
0.39	ac	A_I = Impervious area draining to the practice	
0.02	decimal	I = Percent impervious area draining to the practice, in decimal form	
0.07	unitless	Rv = Runoff coefficient = 0.05 + (0.9 x I)	
1.26	ac-in	WQV= 1" x Rv x A	
4,566	cf	WQV conversion (ac-in x 43,560 sf/ac x 1ft/12")	
1,141	cf	25% x WQV (check calc for sediment forebay volume)	
3,424	cf	75% x WQV (check calc for surface sand filter volume)	
FOREBAY		Method of Pretreatment? (not required for clean or roof runoff)	
2,394	cf	V_{SED} = Sediment forebay volume, if used for pretreatment	**≥ 25%WQV**
Calculate time to drain if system IS NOT underdrained:			
1,455	sf	A_{SA} = Surface area of the practice	
0.20	iph	$Ksat_{DESIGN}$ = Design infiltration rate[1]	
YES	Yes/No	If Ksat (prior to factor of safety) is < 0.50 iph, has an underdrain been provided? (Use the calculations below)	
188.3	hours	T_{DRAIN} = Drain time = V / (A_{SA} * I_{DESIGN})	**≤ 72-hrs**
Calculate time to drain if system IS underdrained:			
581.00	ft	E_{WQV} = Elevation of WQV (attach stage-storage table)	
63.37	cfs	Q_{WQV} = Discharge at the E_{WQV} (attach stage-discharge table)	
0.04	hours	T_{DRAIN} = Drain time = 2WQV/Q_{WQV}	**≤ 72-hrs**
578.77	feet	E_{FC} = Elevation of the bottom of the filter course material[2]	
577.77	feet	E_{UD} = Invert elevation of the underdrain (UD), if applicable	
576.43	feet	E_{SHWT} = Elevation of SHWT (if none found, enter the lowest elevation of the test pit)	
572.76	feet	E_{ROCK} = Elevation of bedrock (if none found, enter the lowest elevation of the test pit)	
1.00	feet	$D_{FC\ to\ UD}$ = Depth to UD from the bottom of the filter course	**≥ 1'**
6.01	feet	$D_{FC\ to\ ROCK}$ = Depth to bedrock from the bottom of the filter course	**≥ 1'**
2.34	feet	$D_{FC\ to\ SHWT}$ = Depth to SHWT from the bottom of the filter course	**≥ 1'**
579.68	ft	Peak elevation of the 50-year storm event (infiltration can be used in analysis)	
581.44	ft	Elevation of the top of the practice	
YES		50 peak elevation ≤ Elevation of the top of the practice	**← yes**
If a surface sand filter or underground sand filter is proposed:			
NO	ac	Drainage Area check.	**< 10 ac**
10,758	cf	V = Volume of storage[3] (attach a stage-storage table)	**≥ 75%WQV**
18.0	inches	D_{FC} = Filter course thickness	**18", or 24" if within GPA**
Sheet	A-10	Note what sheet in the plan set contains the filter course specification.	
YES	Yes/No	Access grate provided?	**← yes**

If a bioretention area is proposed:			
NO	ac	Drainage Area no larger than 5 ac?	← yes
	cf	V = Volume of storage[3] (attach a stage-storage table)	≥ WQV
	inches	D_{FC} = Filter course thickness	18", or 24" if within GPA
Sheet		Note what sheet in the plan set contains the filter course specification	
	:1	Pond side slopes	≥ 3:1
Sheet		Note what sheet in the plan set contains the planting plans and surface cover	
If porous pavement is proposed:			
		Type of pavement proposed (Concrete? Asphalt? Pavers? Etc.)	
	acres	A_{SA} = Surface area of the pervious pavement	
	:1	Ratio of the contributing area to the pervious surface area	≤ 5:1
	inches	D_{FC} = Filter course thickness	12", or 18" if within GPA
Sheet		Note what sheet in the plan set contains the filter course spec.	mod. 304.1 (see spec)

1. Rate of the limiting layer (either the filter course or the underlying soil). $Ksat_{design}$ includes factor of safey. See Env-Wq 1504.14 for guidance on determining the infiltration rate.

2. See lines 34, 40 and 48 for required depths of filter media.

3. Volume without depending on infiltration. The volume includes the storage above the filter (but below the invert of the outlet stucture, if any), the filter media voids, and the pretreatment area. The storage above the filter media shall not include the volume above the outlet structure, if any.

Designer's Notes: ____________________

Maintenance requirements - Sand filter

- Systems should be inspected at least twice annually and following any rainfall event exceeding 2.5 inches in a 24-hour period, with maintenance or rehabilitation conducted as warranted by such inspection.

- Pretreatment measures should be inspected at least twice annually, and cleaned of accumulated sediment as warranted by inspection, but no less than once annually.

- Trash and debris should be removed at each inspection.

- Manufactured filter media should be replaced periodically per manufacturer's specifications.

- At least once annually, the system should be inspected for drawdown time. If a filtration system does not drain within 72-hours following a rainfall event, then qualified professional should assess the condition of the facility to determine measures required to restore filtration function, including but not limited to removal of accumulated sediments or reconstruction of the filter.

Section 7 Supplemental Information & Plans

7.6. Locus Map

7.7. Subcatchment Areas: Existing

7.8. Subcatchment Areas: Proposed Conditions

7.9. Storm & Sanitary Analysis Worksheets: Existing & Proposed Conditions

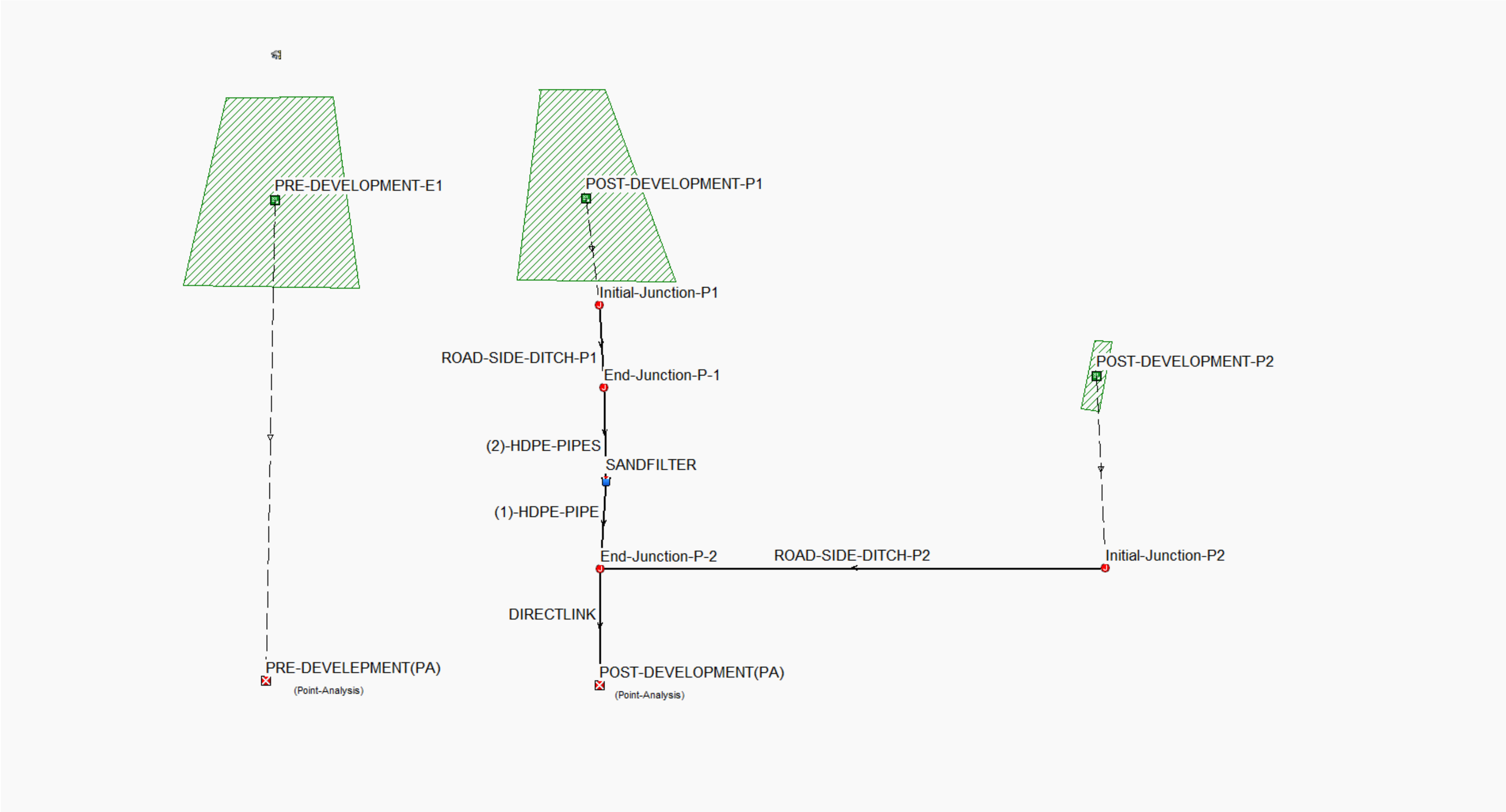
7.10. NRCS Soils Report

7.6. Locus Map


Parker Mountain Rd
Strafford Town Hall
Army National Guard
126
Strafford School
202A
202A
126

7.6.1. Pre / Post condition nodes & link modeling plan:

Existing & Proposed Conditions nodes & links routing follows.


PRE-DEVELOPMENT-E1
POST-DEVELOPMENT-P1
Initial-Junction-P1
ROAD-SIDE-DITCH-P1
End-Junction-P-1
POST-DEVELOPMENT-P2
(2)-HDPE-PIPES
SANDFILTER
(1)-HDPE-PIPE
End-Junction-P-2
ROAD-SIDE-DITCH-P2
Initial-Junction-P2
DIRECTLINK
PRE-DEVELEPMENT(PA)
(Point-Analysis)
POST-DEVELOPMENT(PA)
(Point-Analysis)

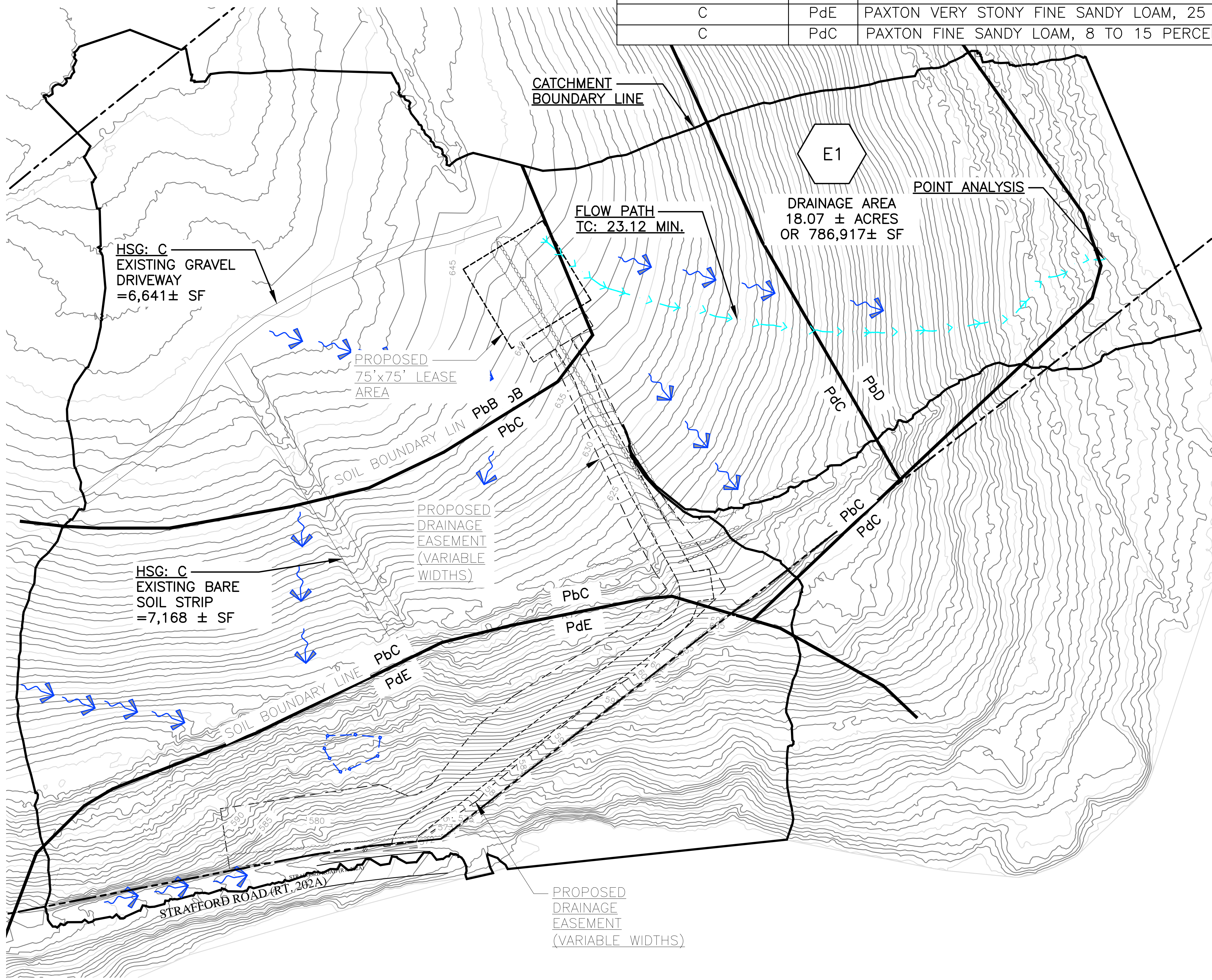
7.7. Subcatchment Areas: Existing Conditions

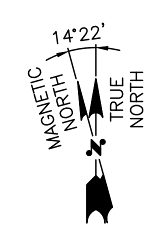
The sketch of Existing Conditions subcatchments follows.

LEGEND

- PROPERTY LINE – SUBJECT PARCEL
- ABUTTERS PROPERTY LINE
- EXISTING CONTOUR LINE
- EXISTING TREE LINE
- BARBED WIRE FENCE REMAINS
- OHW — OVERHEAD WIRE (TRANSMISSION LINE)
- EXISTING CHAIN LINK FENCE
- S — EXISTING UNDERGROUND SEWER LINE
- A–1 / A–2 — DELINEATED WETLAND LINE
- EXISTING BUILDING
- PROPOSED EQUIPMENT CONCRETE PAD
- CB — CATCH BASIN
- CONIFEROUS TREE
- DECIDUOUS TREE
- EXISTING GROUND WELL
- EXISTING SEWER MANHOLE
- STONEWALL
- WELL
- UTILITY POLE
- PROPOSED UTILITY POLE
- PROPOSED LIMIT OF TREE CLEARANCE
- 1086 — PROPOSED CONTOUR LINE
- PROPOSED CONSTRUCTION SILT SOCK
- LOD — LIMIT OF DISTURBANCE
- PROPOSED TOWER

NRCS SOIL TYPE	HSG	DESCRIPTION
C	PbB	PAXTON FINE SANDY LOAM, 3 TO 8 PERCENT SLOPES
C	PbC	PAXTON FINE SANDY LOAM, 8 TO 15 PERCENT SLOPES
C	PdE	PAXTON VERY STONY FINE SANDY LOAM, 25 TO 60 PERCENT SLOPES
C	PdC	PAXTON FINE SANDY LOAM, 8 TO 15 PERCENT SLOPES, VERY STONY





GRAPHIC SCALE

0 30 60 120 180 FEET

TITLE SHEET:	SITE NAME:
EXISTING CONDITIONS DRAINAGE PLAN	STRAFFORD EAST
DRAWING NO.: D–1	SITE ADDRESS: 15 STRAFFORD ROADSTRAFFORD, NH 03884
SCALE: 1"= 60'	

REV.	DATE	DESCRIPTION	BY
1	07/31/23	REVISED DRIVEWAY & BMP	SLY
0	3/27/23	ISSUED FOR USE	SLY

TEP NORTHEAST
TEP OPCO, LLC.
45 BEECHWOOD DRIVE, NORTH ANDOVER, MA 01845
TEL: (978) 557-5553

PREPARED FOR:
MARINER TOWER
Navigator Properties, LLC
P.O. BOX 1160, KENNEBUNKPORT, ME 04046

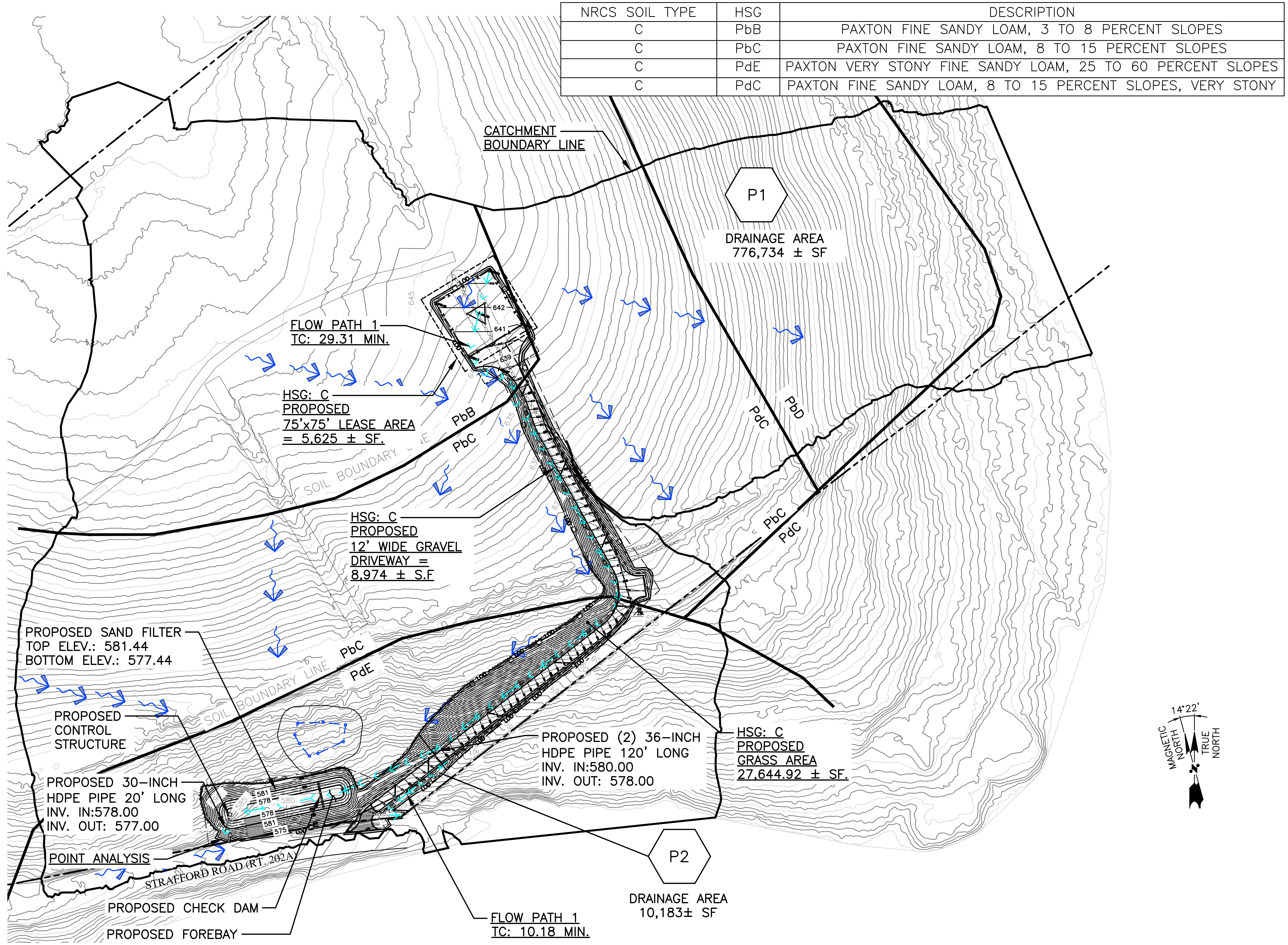
7.8. Subcatchment Areas: Proposed Conditions

The sketch of Proposed Conditions subcatchments follows.

NRCS SOIL TYPE	HSG	DESCRIPTION
C	PbB	PAXTON FINE SANDY LOAM, 3 TO 8 PERCENT SLOPES
C	PbC	PAXTON FINE SANDY LOAM, 8 TO 15 PERCENT SLOPES
C	PdE	PAXTON VERY STONY FINE SANDY LOAM, 25 TO 60 PERCENT SLOPES
C	PdC	PAXTON FINE SANDY LOAM, 8 TO 15 PERCENT SLOPES, VERY STONY

LEGEND

- PROPERTY LINE – SUBJECT PARCEL
- ABUTTERS PROPERTY LINE
- EXISTING CONTOUR LINE
- EXISTING TREE LINE
- BARBED WIRE FENCE REMAINS
- OVERHEAD WIRE (TRANSMISSION LINE)
- EXISTING CHAIN LINK FENCE
- EXISTING UNDERGROUND SEWER LINE
- DELINEATED WETLAND LINE
- EXISTING BUILDING
- PROPOSED EQUIPMENT CONCRETE PAD
- CATCH BASIN
- CONIFEROUS TREE
- DECIDUOUS TREE
- EXISTING GROUND WELL
- EXISTING SEWER MANHOLE
- STONEWALL
- WELL
- UTILITY POLE
- PROPOSED UTILITY POLE
- PROPOSED LIMIT OF TREE CLEARANCE
- PROPOSED CONTOUR LINE
- PROPOSED CONSTRUCTION SILT SOCK
- LIMIT OF DISTURBANCE
- PROPOSED TOWER



TITLE SHEET:
PROPOSED CONDITIONS
DRAINAGE PLAN

DRAWING NO.: D-2
SCALE: 1"= 60'

SITE NAME:
STRAFFORD EAST
SITE ADDRESS:
15 STRAFFORD
ROADSTRAFFORD, NH 03884

REV.	DATE	DESCRIPTION	BY
1	07/31/23	REVISED DRIVEWAY & BMP	SLY
0	3/27/23	ISSUED FOR USE	SLY

TEP NORTHEAST
TEP OPCO, LLC.
45 BEECHWOOD DRIVE, NORTH ANDOVER, MA 01845
TEL: (978) 557-5553

PREPARED FOR:
MARINER TOWER
Navigator Properties, LLC
P.O. BOX 1160, KENNEBUNKPORT, ME 04046

7.9. Stormwater and Sanitary Analysis Worksheets: Existing and Proposed Conditions

Stormwater and Sanitary Analysis data output follows.

Project Description

File Name NAV-31.SPF

Project Options

Flow Units .... CFS
Elevation Type .... Elevation
Hydrology Method .... SCS TR-55
Time of Concentration (TOC) Method .... SCS TR-55
Link Routing Method .... Kinematic Wave
Enable Overflow Ponding at Nodes .... YES
Skip Steady State Analysis Time Periods ..... YES

Analysis Options

Start Analysis On	00:00:00	0:00:00
End Analysis On	00:00:00	0:00:00
Start Reporting On	00:00:00	0:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins..	3
Nodes...	7
Junctions	4
Outfalls	2
Flow Diversions	0
Inlets	0
Storage Nodes	1
Links..	5
Channels	2
Pipes	3
Pumps	0
Orifices	0
Weirs	0
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
49		Time Series	1-Inch Storm	Cumulative	inches	New Hampshire	Strafford	1.00	1.00	SCS Type II 24-hr

Subbasin Summary

SN	Subbasin ID	Area (ac)	Peak Rate Factor	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	POST-DEVELOPMENT-P1	18.07	484.00	85.70	1.00	0.19	3.43	2.39	0 00:29:18
2	POST-DEVELOPMENT-P2	0.23	484.00	77.78	1.00	0.03	0.01	0.01	0 00:10:10
3	PRE-DEVELOPMENT-E1	18.07	484.00	88.03	1.00	0.25	4.59	4.18	0 00:23:07

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft^2)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	End-Junction-P-1	Junction	579.00	581.00	579.00	581.00	0.00	2.36	580.36	0.00	2.64	0 00:00	0.00	0.00
2	End-Junction-P-2	Junction	577.00	580.00	577.00	0.00	0.00	2.30	577.29	0.00	2.71	0 00:00	0.00	0.00
3	Initial-Junction-P1	Junction	635.50	637.50	635.50	637.50	34.00	2.38	635.72	0.00	1.78	0 00:00	0.00	0.00
4	Initial-Junction-P2	Junction	580.00	582.00	580.00	0.00	0.00	0.01	580.01	0.00	1.99	0 00:00	0.00	0.00
5	POST-DEVELOPMENT(PA)	Outfall	577.00					2.30	577.00					
6	PRE-DEVELEPMENT(PA)	Outfall	578.90					4.13	578.90					
7	SANDFILTER	Storage Node	578.00	581.00	578.00		0.00	2.36	578.29				0.00	0.00

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Diameter or Height (in)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Reported Condition
1	(1)-HDPE-PIPE	Pipe	SANDFILTER	End-Junction-P-2	20.00	578.00	577.00	5.0000	30.000	0.0150	2.30	79.49	0.03	7.19	0.29	0.12	0.00	Calculated
2	(2)-HDPE-PIPES	Pipe	End-Junction-P-1	SANDFILTER	120.00	580.00	579.50	0.4200	36.000	0.0150	2.36	74.63	0.03	2.42	0.36	0.12	0.00	Calculated
3	DIRECTLINK	Pipe	End-Junction-P-2	POST-DEVELOPMENT(PA)	2356.93	577.00	577.00	0.0000	0.000	0.0150	2.30	0.00	0.03	0.00	0.36	0.12	0.00	Calculated
4	ROAD-SIDE-DITCH-P1	Channel	Initial-Junction-P1	End-Junction-P-1	577.00	635.50	580.00	9.6200	24.000	0.0320	2.36	132.33	0.02	4.73	0.22	0.11	0.00	
5	ROAD-SIDE-DITCH-P2	Channel	Initial-Junction-P2	End-Junction-P-2	117.00	580.00	577.00	2.5600	24.000	0.0320	0.00	68.32	0.00	0.00	0.01	0.00	0.00	

Subbasin Hydrology

Subbasin : POST-DEVELOPMENT-P1

Input Data

Area (ac) 18.07
Peak Rate Factor 484
Weighted Curve Number 85.7
Rain Gage ID .... Rain Gage-01

Composite Curve Number

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Gravel roads	0.33	C	89
> 75% grass cover, Good	0.63	C	74
Fallow, bare soil	0.16	C	91
Gravel roads	0.15	C	89
< 50% grass cover, Poor	16.8	C	86
Composite Area & Weighted CN	18.07		85.7

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where :

Tc = Time of Concentration (hr)
n = Manning's roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where :

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft²)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's roughness

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.3	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	3	0	0
2 yr, 24 hr Rainfall (in) :	1	0	0
Velocity (ft/sec) :	0.06	0	0
Computed Flow Time (min) :	25.95	0	0

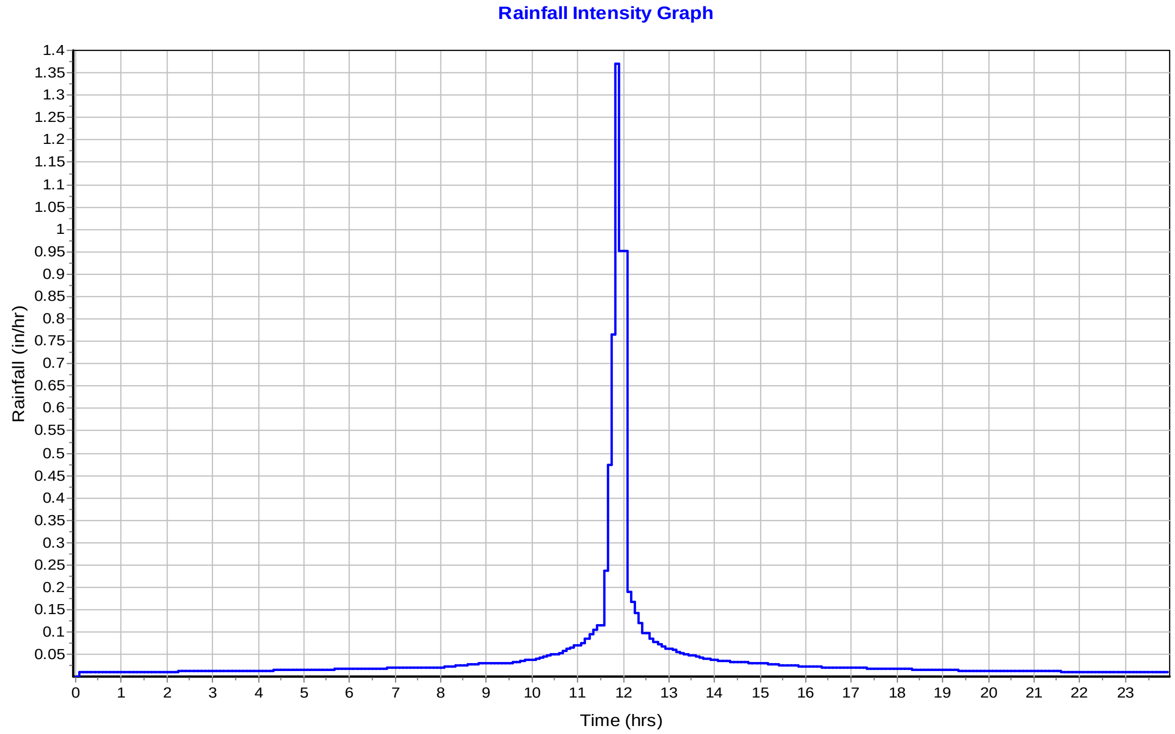
Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	918.85	0	0
Slope (%) :	8	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	4.56	0	0
Computed Flow Time (min) :	3.36	0	0

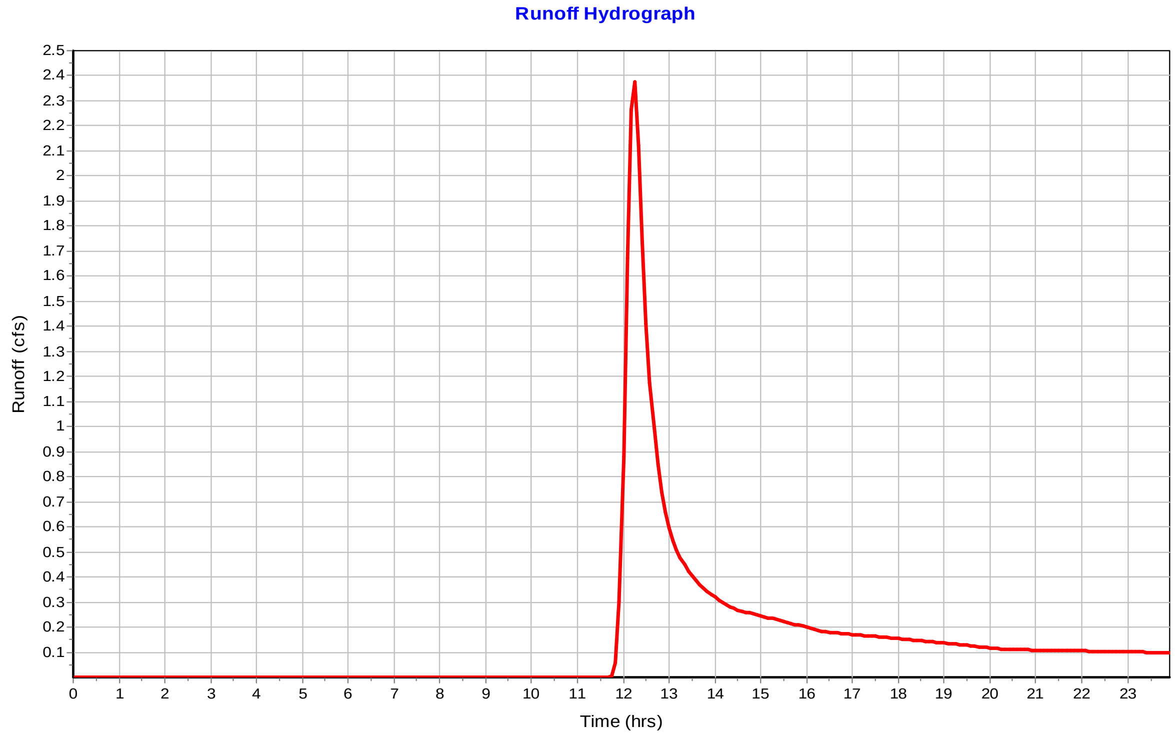
Total TOC (min) 29.31

Subbasin Runoff Results

Total Rainfall (in) 1
Total Runoff (in) 0.19
Peak Runoff (cfs) 2.39
Weighted Curve Number 85.7
Time of Concentration (days hh:mm:ss) 0 00:29:19

Subbasin : POST-DEVELOPMENT-P1





Subbasin : POST-DEVELOPMENT-P2

Input Data

Area (ac) 0.23
Peak Rate Factor 484
Weighted Curve Number 77.78
Rain Gage ID .... Rain Gage-01

Composite Curve Number

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
> 75% grass cover, Good	0.18	C	74
Gravel roads	0.06	C	89
Composite Area & Weighted CN	0.24		77.78

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.3	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	8	0	0
2 yr, 24 hr Rainfall (in) :	3	0	0
Velocity (ft/sec) :	0.16	0	0
Computed Flow Time (min) :	10.12	0	0

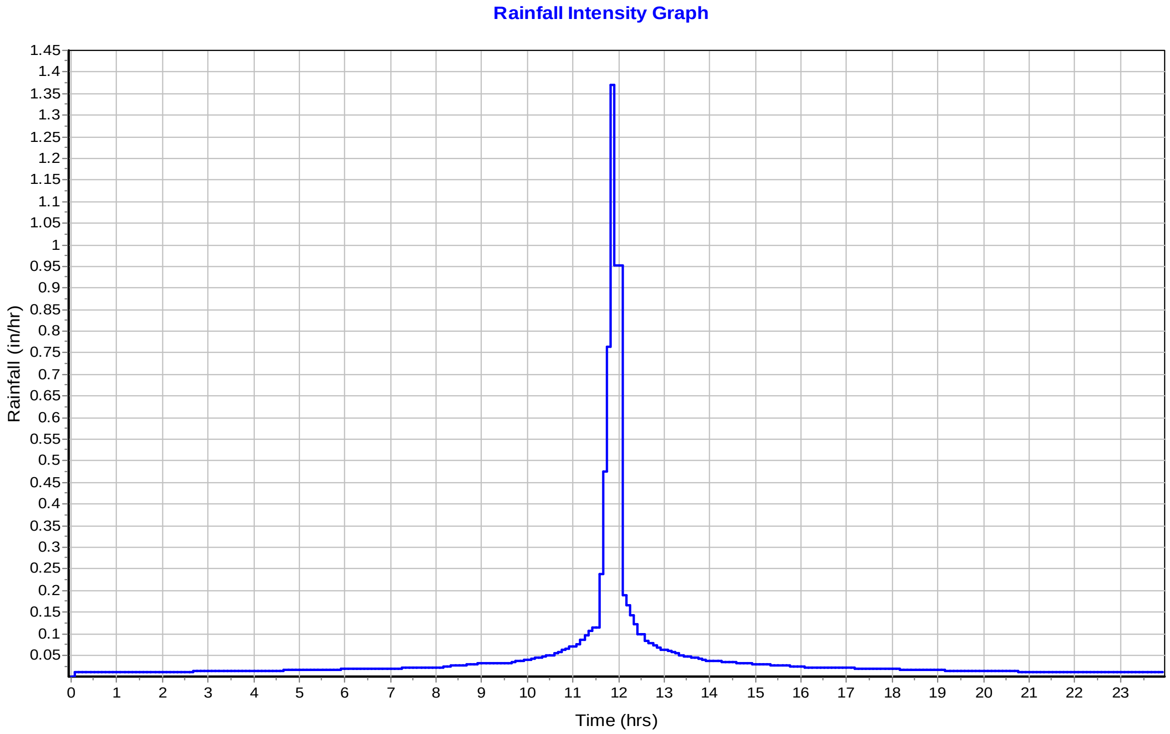
Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	17	0	0
Slope (%) :	8	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	4.56	0	0
Computed Flow Time (min) :	0.06	0	0

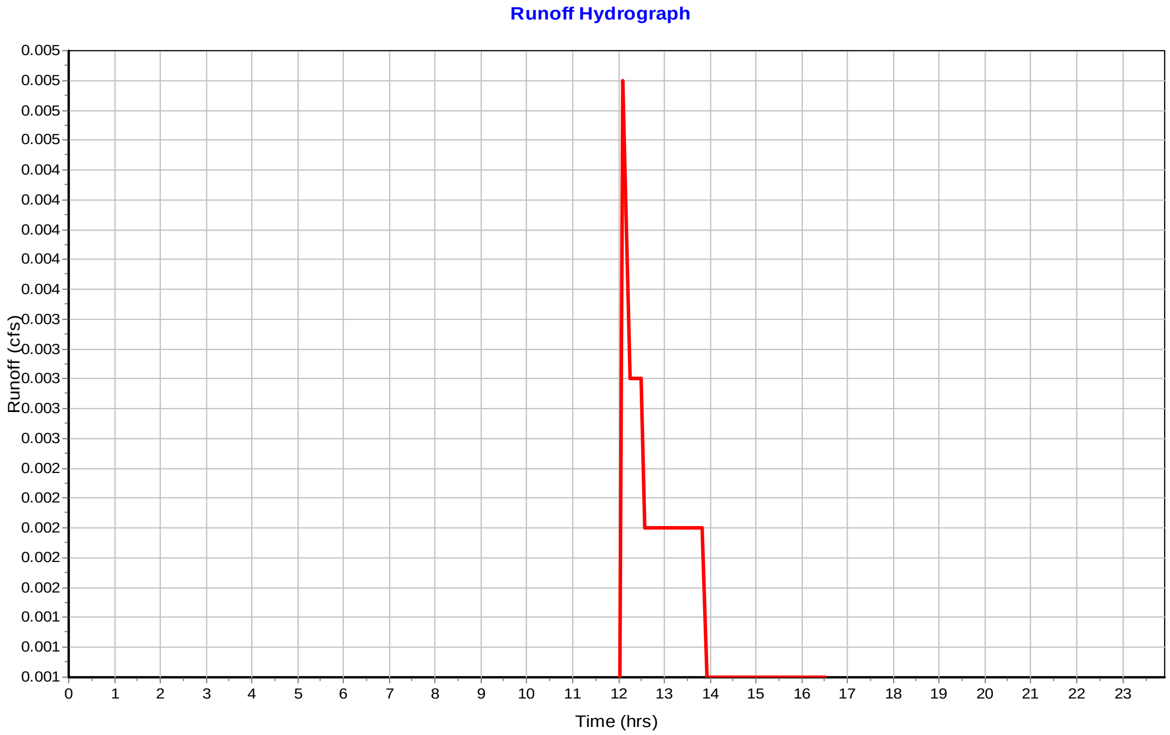
Total TOC (min) 10.18

Subbasin Runoff Results

Total Rainfall (in) 1
Total Runoff (in) 0.03
Peak Runoff (cfs) 0.01
Weighted Curve Number 77.78
Time of Concentration (days hh:mm:ss) 0 00:10:11

Subbasin : POST-DEVELOPMENT-P2





Subbasin : PRE-DEVELOPMENT-E1

Input Data

Area (ac) 18.07
Peak Rate Factor 484
Weighted Curve Number 88.03
Rain Gage ID .... Rain Gage-01

Composite Curve Number

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Fallow, crop residue, Good	17.76	C	88
Fallow, bare soil	0.16	C	91
Gravel roads	0.15	C	89
Composite Area & Weighted CN	18.07		88.03

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.3	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	4.8	0	0
2 yr, 24 hr Rainfall (in) :	1	0	0
Velocity (ft/sec) :	0.08	0	0
Computed Flow Time (min) :	21.5	0	0

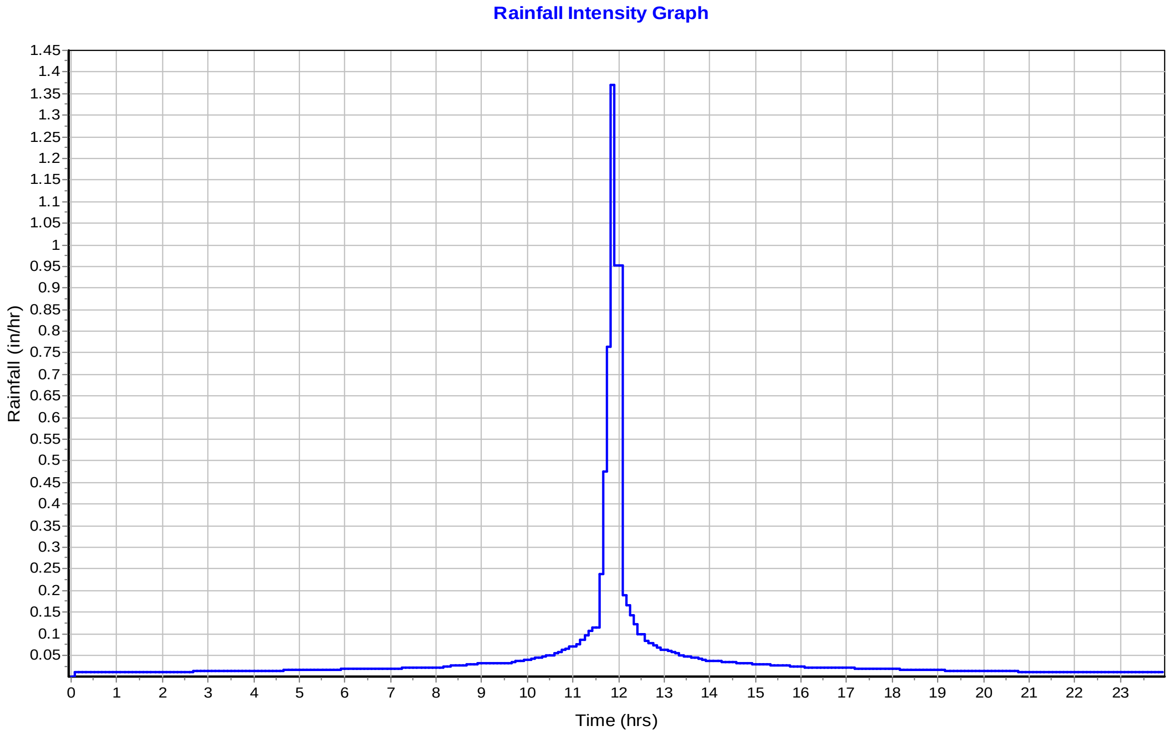
Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	566.4872	0	0
Slope (%) :	13	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	5.82	0	0
Computed Flow Time (min) :	1.62	0	0

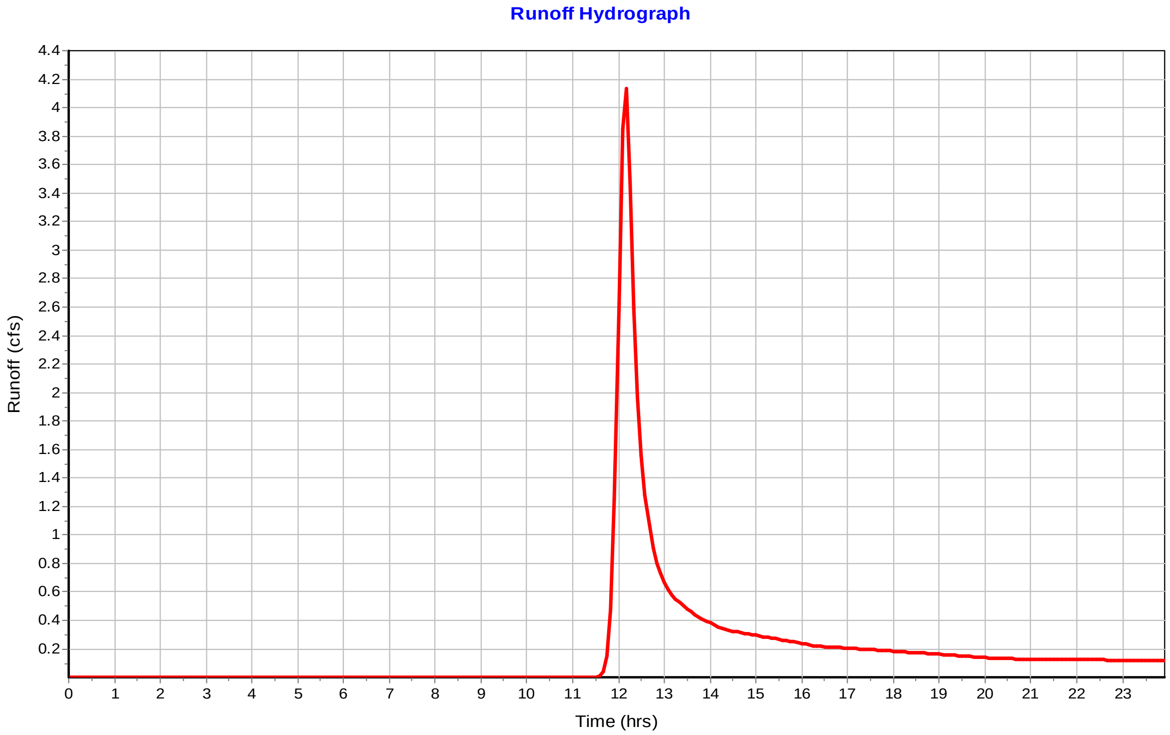
Total TOC (min) 23.12

Subbasin Runoff Results

Total Rainfall (in) 1
Total Runoff (in) 0.25
Peak Runoff (cfs) 4.18
Weighted Curve Number 88.03
Time of Concentration (days hh:mm:ss) 0 00:23:07

Subbasin : PRE-DEVELOPMENT-E1





Junction Input

SN	Element ID	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Ground/Rim (Max) Offset (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Surcharge Elevation (ft)	Surcharge Depth (ft)	Ponded Area (ft²)	Minimum Pipe Cover (in)
1	End-Junction-P-1	579.00	581.00	2.00	579.00	0.00	581.00	0.00	0.00	0.00
2	End-Junction-P-2	577.00	580.00	3.00	577.00	0.00	0.00	-580.00	0.00	0.00
3	Initial-Junction-P1	635.50	637.50	2.00	635.50	0.00	637.50	0.00	34.00	0.00
4	Initial-Junction-P2	580.00	582.00	2.00	580.00	0.00	0.00	-582.00	0.00	0.00

Junction Results

SN	Element ID	Peak Inflow (cfs)	Peak Lateral Inflow (cfs)	Max HGL Elevation Attained (ft)	Max HGL Depth Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Average HGL Elevation Attained (ft)	Average HGL Depth Attained (ft)	Time of Max HGL Occurrence (days hh:mm)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	End-Junction-P-1	2.36	0.00	580.36	1.36	0.00	2.64	580.06	1.06	0 12:20	0 00:00	0.00	0.00
2	End-Junction-P-2	2.30	0.00	577.29	0.29	0.00	2.71	577.05	0.05	0 12:24	0 00:00	0.00	0.00
3	Initial-Junction-P1	2.38	2.38	635.72	0.22	0.00	1.78	635.53	0.03	0 12:20	0 00:00	0.00	0.00
4	Initial-Junction-P2	0.01	0.01	580.01	0.01	0.00	1.99	580.00	0.00	0 12:10	0 00:00	0.00	0.00

Channel Input

SN	Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Shape	Height (ft)	Width (ft)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate
1	ROAD-SIDE-DITCH-P1	577.00	635.50	0.00	580.00	1.00	55.50	9.6200	Trapezoidal	2.000	6.800	0.0320	0.5000	0.5000	0.0000	0.00	No
2	ROAD-SIDE-DITCH-P2	117.00	580.00	0.00	577.00	0.00	3.00	2.5600	Trapezoidal	2.000	6.800	0.0320	0.5000	0.5000	0.0000	0.00	No

Channel Results

SN	Element ID	Peak Flow (cfs)	Time of Peak Flow Occurrence (days hh:mm)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Travel Time (min)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Froude Number	Reported Condition
1	ROAD-SIDE-DITCH-P1	2.36	0 12:20	132.33	0.02	4.73	2.03	0.22	0.11	0.00		
2	ROAD-SIDE-DITCH-P2	0.00	0 12:17	68.32	0.00	0.00		0.01	0.00	0.00		

Pipe Input

SN	Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Pipe Shape	Pipe Diameter or Height (in)	Pipe Width (in)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate	No. of Barrels
1	(1)-HDPE-PIPE	20.00	578.00	0.00	577.00	0.00	1.00	5.0000	CIRCULAR	30.000	30.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
2	(2)-HDPE-PIPES	120.00	580.00	1.00	579.50	1.50	0.50	0.4200	CIRCULAR	36.000	36.000	0.0150	0.5000	0.5000	0.0000	0.00	No	2
3	DIRECTLINK	2356.93	577.00	0.00	577.00	0.00	0.00	0.0000	Dummy	0.000	0.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1

Pipe Results

SN	Element ID	Peak Flow	Time of Peak Flow Occurrence	Design Flow Capacity	Peak Flow/ Design Flow Ratio	Peak Flow Velocity	Travel Time	Peak Flow Depth	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged	Froude Number	Reported Condition
		(cfs)	(days hh:mm)	(cfs)		(ft/sec)	(min)	(ft)		(min)		
1	(1)-HDPE-PIPE	2.30	0 12:24	79.49	0.03	7.19	0.05	0.29	0.12	0.00		Calculated
2	(2)-HDPE-PIPES	2.36	0 12:21	74.63	0.03	2.42	0.83	0.36	0.12	0.00		Calculated
3	DIRECTLINK	2.30	0 12:24	0.00	0.03	0.00		0.36	0.12	0.00		Calculated

Storage Nodes

Storage Node : SANDFILTER

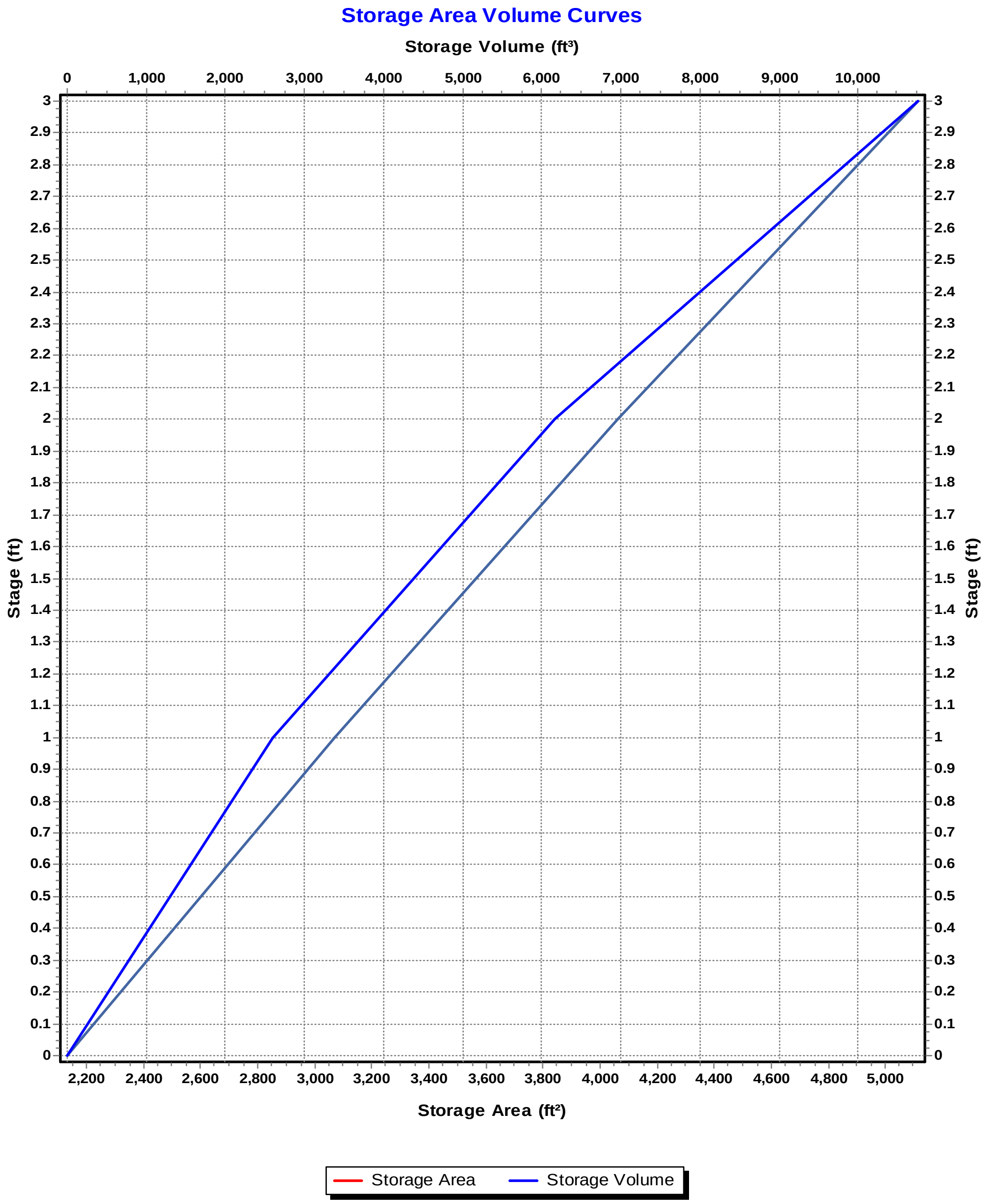
Input Data

Invert Elevation (ft) 578.00
Max (Rim) Elevation (ft) 581.00
Max (Rim) Offset (ft) 3.00
Initial Water Elevation (ft) 578.00
Initial Water Depth (ft) 0.00
Ponded Area (ft²) 0.00
Evaporation Loss 0.00

Storage Area Volume Curves

Storage Curve : Storage-10

Stage (ft)	Storage Area (ft²)	Storage Volume (ft³)
0	2133.53	0
1	3070.53	2602.03
2	4064.03	6169.31
3	5114.09	10758.37


Storage Area Volume Curves
Storage Volume (ft³)
0
1,000
2,000
3,000
4,000
5,000
6,000
7,000
8,000
9,000
10,000
Stage (ft)
3
2.9
2.8
2.7
2.6
2.5
2.4
2.3
2.2
2.1
2
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
2,200
2,400
2,600
2,800
3,000
3,200
3,400
3,600
3,800
4,000
4,200
4,400
4,600
4,800
5,000
Storage Area (ft²)
Storage Area
Storage Volume

Storage Node : SANDFILTER (continued)

Output Summary Results

Peak Inflow (cfs) 2.36
Peak Lateral Inflow (cfs) 0
Peak Outflow (cfs) 2.3
Peak Exfiltration Flow Rate (cfm) 0
Max HGL Elevation Attained (ft) 578.29
Max HGL Depth Attained (ft) 0.29
Average HGL Elevation Attained (ft) 578.05
Average HGL Depth Attained (ft) 0.05
Time of Max HGL Occurrence (days hh:mm) 0 12:24
Total Exfiltration Volume (1000-ft³) 0
Total Flooded Volume (ac-in) 0
Total Time Flooded (min) 0
Total Retention Time (sec) 0

Project Description

File Name	NAV-31.SPF

Project Options

Flow Units	CFS
Elevation Type	Elevation
Hydrology Method	SCS TR-55
Time of Concentration (TOC) Method	SCS TR-55
Link Routing Method	Kinematic Wave
Enable Overflow Ponding at Nodes	YES
Skip Steady State Analysis Time Periods	YES

Analysis Options

Start Analysis On	00:00:00	0:00:00
End Analysis On	00:00:00	0:00:00
Start Reporting On	00:00:00	0:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins	3
Nodes	7
Junctions	4
Outfalls	2
Flow Diversions	0
Inlets	0
Storage Nodes	1
Links	5
Channels	2
Pipes	3
Pumps	0
Orifices	0
Weirs	0
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
49		Time Series	2-Year	Cumulative	inches	New Hampshire	Strafford	2.00	3.00	SCS Type II 24-hr

Subbasin Summary

SN	Subbasin ID	Area (ac)	Peak Rate Factor	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	POST-DEVELOPMENT-P1	18.07	484.00	85.70	3.00	1.64	29.63	26.49	0 00:29:18
2	POST-DEVELOPMENT-P2	0.23	484.00	77.78	3.00	1.12	0.26	0.36	0 00:10:10
3	PRE-DEVELOPMENT-E1	18.07	484.00	88.03	3.00	1.82	32.91	33.69	0 00:23:07

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft^2)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	End-Junction-P-1	Junction	579.00	581.00	579.00	581.00	0.00	26.34	581.23	0.00	1.77	0 00:00	0.00	0.00
2	End-Junction-P-2	Junction	577.00	580.00	577.00	0.00	0.00	26.21	577.99	0.00	2.01	0 00:00	0.00	0.00
3	Initial-Junction-P1	Junction	635.50	637.50	635.50	637.50	34.00	26.48	636.38	0.00	1.12	0 00:00	0.00	0.00
4	Initial-Junction-P2	Junction	580.00	582.00	580.00	0.00	0.00	0.36	580.11	0.00	1.89	0 00:00	0.00	0.00
5	POST-DEVELOPMENT(PA)	Outfall	577.00					26.21	577.00					
6	PRE-DEVELEPMENT(PA)	Outfall	578.90					33.00	578.90					
7	SANDFILTER	Storage Node	578.00	581.00	578.00		0.00	26.29	578.99				0.00	0.00

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Diameter or Height (in)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Reported Condition
1	(1)-HDPE-PIPE	Pipe	SANDFILTER	End-Junction-P-2	20.00	578.00	577.00	5.0000	30.000	0.0150	26.07	79.49	0.33	14.50	0.97	0.39	0.00	Calculated
2	(2)-HDPE-PIPES	Pipe	End-Junction-P-1	SANDFILTER	120.00	580.00	579.50	0.4200	36.000	0.0150	26.29	74.63	0.35	4.82	1.22	0.41	0.00	Calculated
3	DIRECTLINK	Pipe	End-Junction-P-2	POST-DEVELOPMENT(PA)	2356.93	577.00	577.00	0.0000	0.000	0.0150	26.21	0.00	0.35	0.00	1.22	0.41	0.00	Calculated
4	ROAD-SIDE-DITCH-P1	Channel	Initial-Junction-P1	End-Junction-P-1	577.00	635.50	580.00	9.6200	24.000	0.0320	26.34	132.33	0.20	9.86	0.88	0.44	0.00	
5	ROAD-SIDE-DITCH-P2	Channel	Initial-Junction-P2	End-Junction-P-2	117.00	580.00	577.00	2.5600	24.000	0.0320	0.36	68.32	0.01	1.58	0.11	0.05	0.00	

Subbasin Hydrology

Subbasin : POST-DEVELOPMENT-P1

Input Data

Area (ac) 18.07
Peak Rate Factor 484
Weighted Curve Number 85.7
Rain Gage ID .... Rain Gage-01

Composite Curve Number

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Gravel roads	0.33	C	89
> 75% grass cover, Good	0.63	C	74
Fallow, bare soil	0.16	C	91
Gravel roads	0.15	C	89
< 50% grass cover, Poor	16.8	C	86
Composite Area & Weighted CN	18.07		85.7

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where :

Tc = Time of Concentration (hr)
n = Manning's roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where :

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft²)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's roughness

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.3	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	3	0	0
2 yr, 24 hr Rainfall (in) :	1	0	0
Velocity (ft/sec) :	0.06	0	0
Computed Flow Time (min) :	25.95	0	0

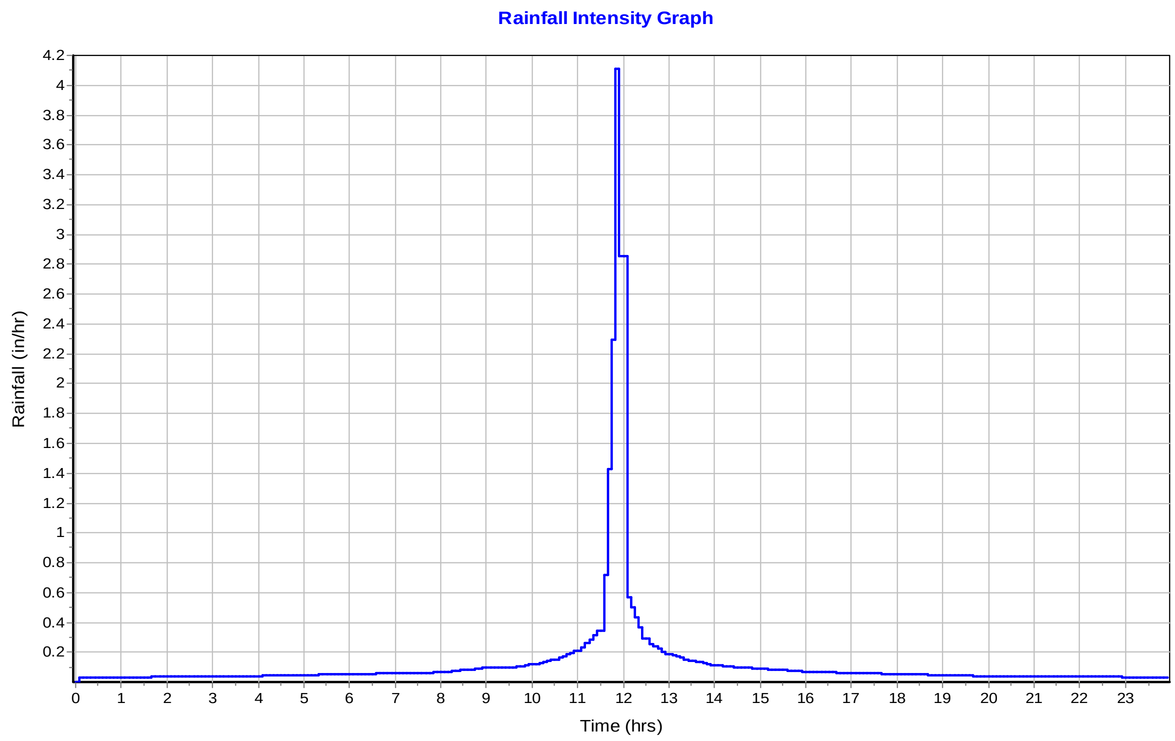
Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	918.85	0	0
Slope (%) :	8	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	4.56	0	0
Computed Flow Time (min) :	3.36	0	0

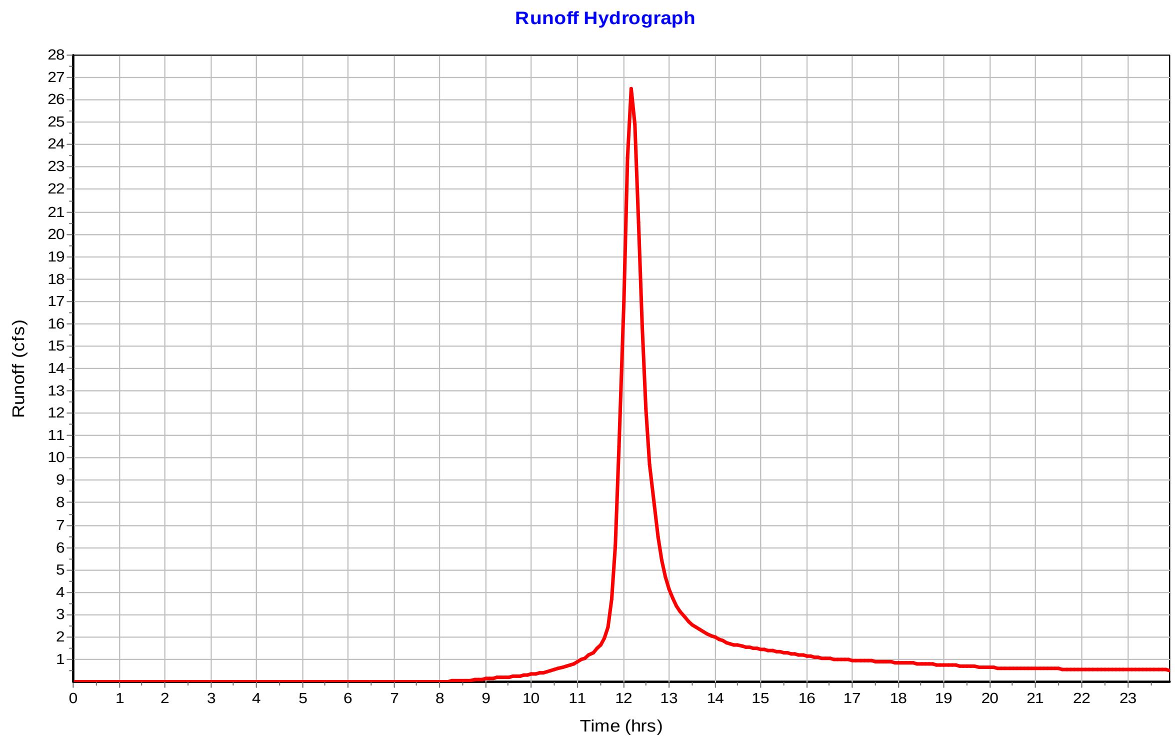
Total TOC (min) 29.31

Subbasin Runoff Results

Total Rainfall (in) 3
Total Runoff (in) 1.64
Peak Runoff (cfs) 26.49
Weighted Curve Number 85.7
Time of Concentration (days hh:mm:ss) 0 00:29:19

Subbasin : POST-DEVELOPMENT-P1





Subbasin : POST-DEVELOPMENT-P2

Input Data

Area (ac) 0.23
Peak Rate Factor 484
Weighted Curve Number 77.78
Rain Gage ID .... Rain Gage-01

Composite Curve Number

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
> 75% grass cover, Good	0.18	C	74
Gravel roads	0.06	C	89
Composite Area & Weighted CN	0.24		77.78

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.3	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	8	0	0
2 yr, 24 hr Rainfall (in) :	3	0	0
Velocity (ft/sec) :	0.16	0	0
Computed Flow Time (min) :	10.12	0	0

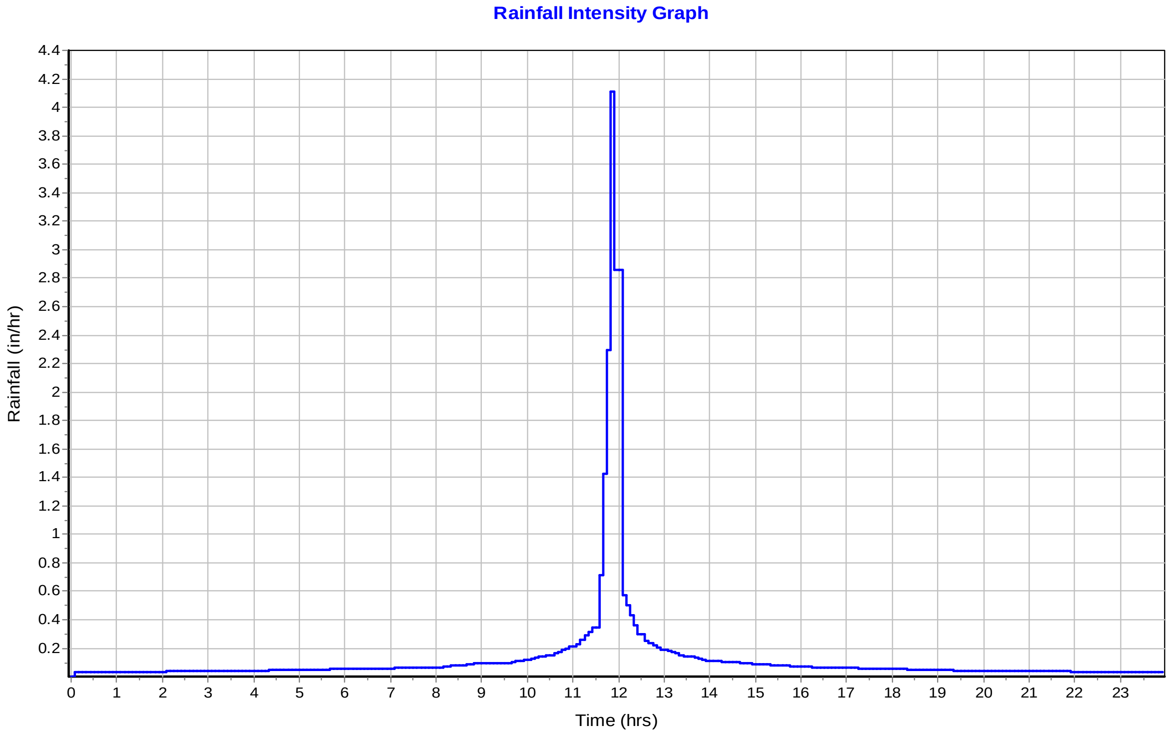
Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	17	0	0
Slope (%) :	8	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	4.56	0	0
Computed Flow Time (min) :	0.06	0	0

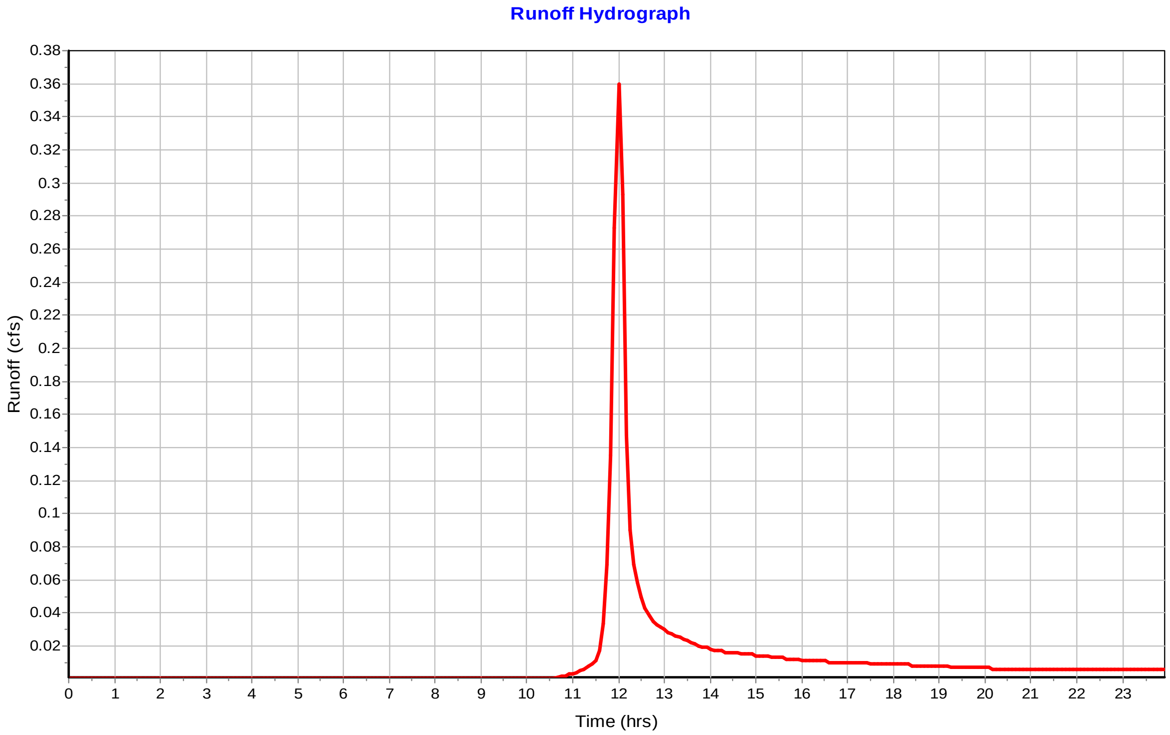
Total TOC (min) 10.18

Subbasin Runoff Results

Total Rainfall (in) 3
Total Runoff (in) 1.12
Peak Runoff (cfs) 0.36
Weighted Curve Number 77.78
Time of Concentration (days hh:mm:ss) 0 00:10:11

Subbasin : POST-DEVELOPMENT-P2





Subbasin : PRE-DEVELOPMENT-E1

Input Data

Area (ac) 18.07
Peak Rate Factor 484
Weighted Curve Number 88.03
Rain Gage ID .... Rain Gage-01

Composite Curve Number

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Fallow, crop residue, Good	17.76	C	88
Fallow, bare soil	0.16	C	91
Gravel roads	0.15	C	89
Composite Area & Weighted CN	18.07		88.03

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.3	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	4.8	0	0
2 yr, 24 hr Rainfall (in) :	1	0	0
Velocity (ft/sec) :	0.08	0	0
Computed Flow Time (min) :	21.5	0	0

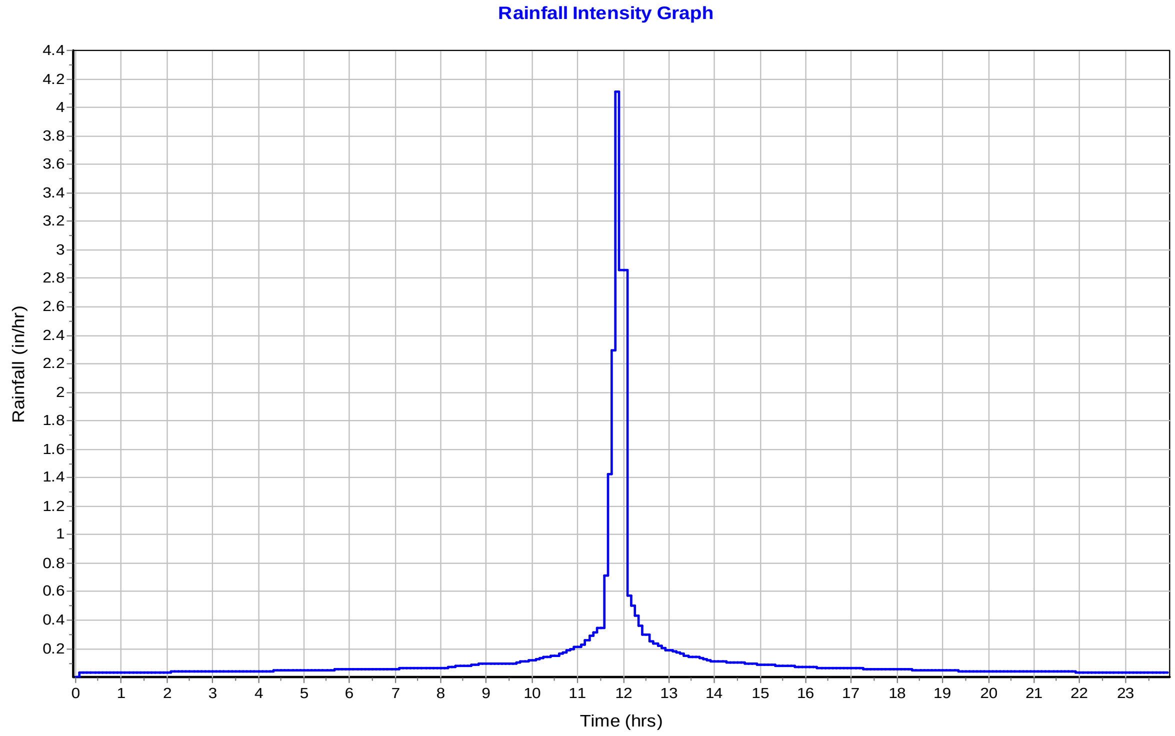
Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	566.4872	0	0
Slope (%) :	13	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	5.82	0	0
Computed Flow Time (min) :	1.62	0	0

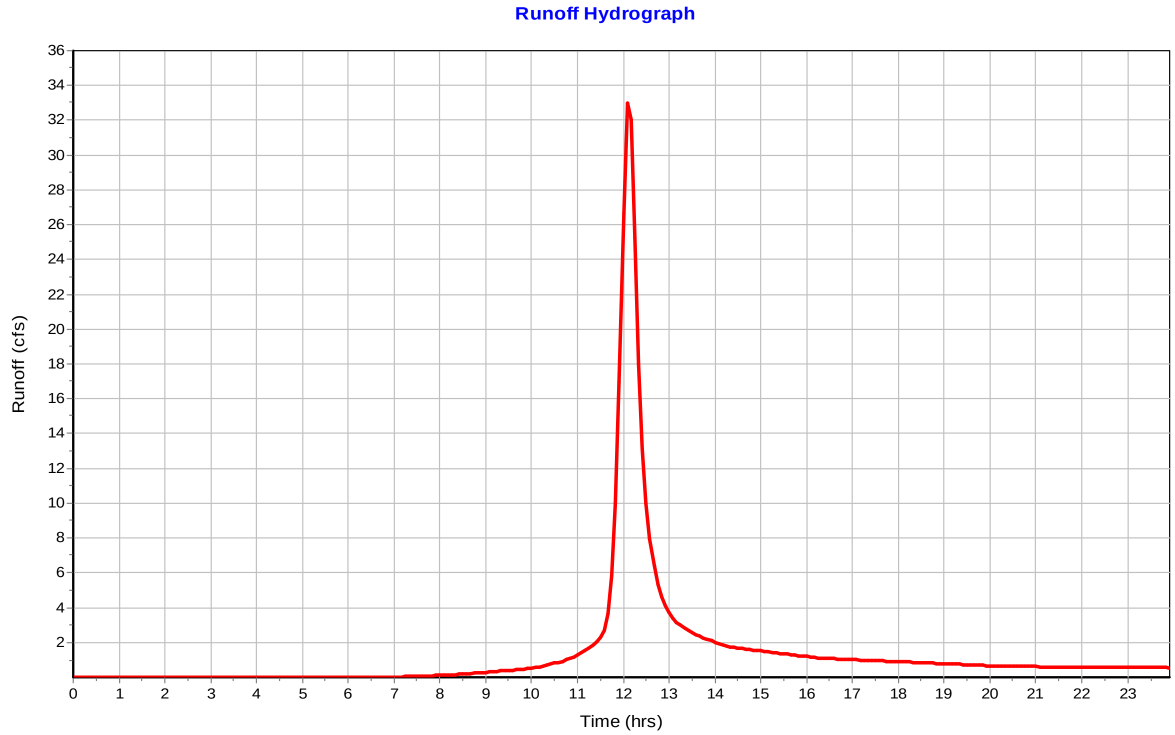
Total TOC (min) 23.12

Subbasin Runoff Results

Total Rainfall (in) 3
Total Runoff (in) 1.82
Peak Runoff (cfs) 33.69
Weighted Curve Number 88.03
Time of Concentration (days hh:mm:ss) 0 00:23:07

Subbasin : PRE-DEVELOPMENT-E1





Junction Input

SN	Element ID	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Ground/Rim (Max) Offset (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Surcharge Elevation (ft)	Surcharge Depth (ft)	Ponded Area (ft²)	Minimum Pipe Cover (in)
1	End-Junction-P-1	579.00	581.00	2.00	579.00	0.00	581.00	0.00	0.00	0.00
2	End-Junction-P-2	577.00	580.00	3.00	577.00	0.00	0.00	-580.00	0.00	0.00
3	Initial-Junction-P1	635.50	637.50	2.00	635.50	0.00	637.50	0.00	34.00	0.00
4	Initial-Junction-P2	580.00	582.00	2.00	580.00	0.00	0.00	-582.00	0.00	0.00

Junction Results

SN	Element ID	Peak Inflow (cfs)	Peak Lateral Inflow (cfs)	Max HGL Elevation Attained (ft)	Max HGL Depth Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Average HGL Elevation Attained (ft)	Average HGL Depth Attained (ft)	Time of Max HGL Occurrence (days hh:mm)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	End-Junction-P-1	26.34	0.00	581.23	2.23	0.00	1.77	580.18	1.18	0 12:15	0 00:00	0.00	0.00
2	End-Junction-P-2	26.21	0.00	577.99	0.99	0.00	2.01	577.14	0.14	0 12:17	0 00:00	0.00	0.00
3	Initial-Junction-P1	26.48	26.48	636.38	0.88	0.00	1.12	635.60	0.10	0 12:15	0 00:00	0.00	0.00
4	Initial-Junction-P2	0.36	0.36	580.11	0.11	0.00	1.89	580.01	0.01	0 12:05	0 00:00	0.00	0.00

Channel Input

SN	Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Shape	Height (ft)	Width (ft)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate
1	ROAD-SIDE-DITCH-P1	577.00	635.50	0.00	580.00	1.00	55.50	9.6200	Trapezoidal	2.000	6.800	0.0320	0.5000	0.5000	0.0000	0.00	No
2	ROAD-SIDE-DITCH-P2	117.00	580.00	0.00	577.00	0.00	3.00	2.5600	Trapezoidal	2.000	6.800	0.0320	0.5000	0.5000	0.0000	0.00	No

Channel Results

SN	Element ID	Peak Flow (cfs)	Time of Peak Flow Occurrence (days hh:mm)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Travel Time (min)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Froude Number	Reported Condition
1	ROAD-SIDE-DITCH-P1	26.34	0 12:15	132.33	0.20	9.86	0.98	0.88	0.44	0.00		
2	ROAD-SIDE-DITCH-P2	0.36	0 12:05	68.32	0.01	1.58	1.23	0.11	0.05	0.00		

Pipe Input

SN	Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Pipe Shape	Pipe Diameter or Height (in)	Pipe Width (in)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate	No. of Barrels
1	(1)-HDPE-PIPE	20.00	578.00	0.00	577.00	0.00	1.00	5.0000	CIRCULAR	30.000	30.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
2	(2)-HDPE-PIPES	120.00	580.00	1.00	579.50	1.50	0.50	0.4200	CIRCULAR	36.000	36.000	0.0150	0.5000	0.5000	0.0000	0.00	No	2
3	DIRECTLINK	2356.93	577.00	0.00	577.00	0.00	0.00	0.0000	Dummy	0.000	0.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1

Pipe Results

SN	Element ID	Peak Flow (cfs)	Time of Peak Flow Occurrence (days hh:mm)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Travel Time (min)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Froude Number	Reported Condition
1	(1)-HDPE-PIPE	26.07	0 12:17	79.49	0.33	14.50	0.02	0.97	0.39	0.00		Calculated
2	(2)-HDPE-PIPES	26.29	0 12:16	74.63	0.35	4.82	0.41	1.22	0.41	0.00		Calculated
3	DIRECTLINK	26.21	0 12:17	0.00	0.35	0.00		1.22	0.41	0.00		Calculated

Storage Nodes

Storage Node : SANDFILTER

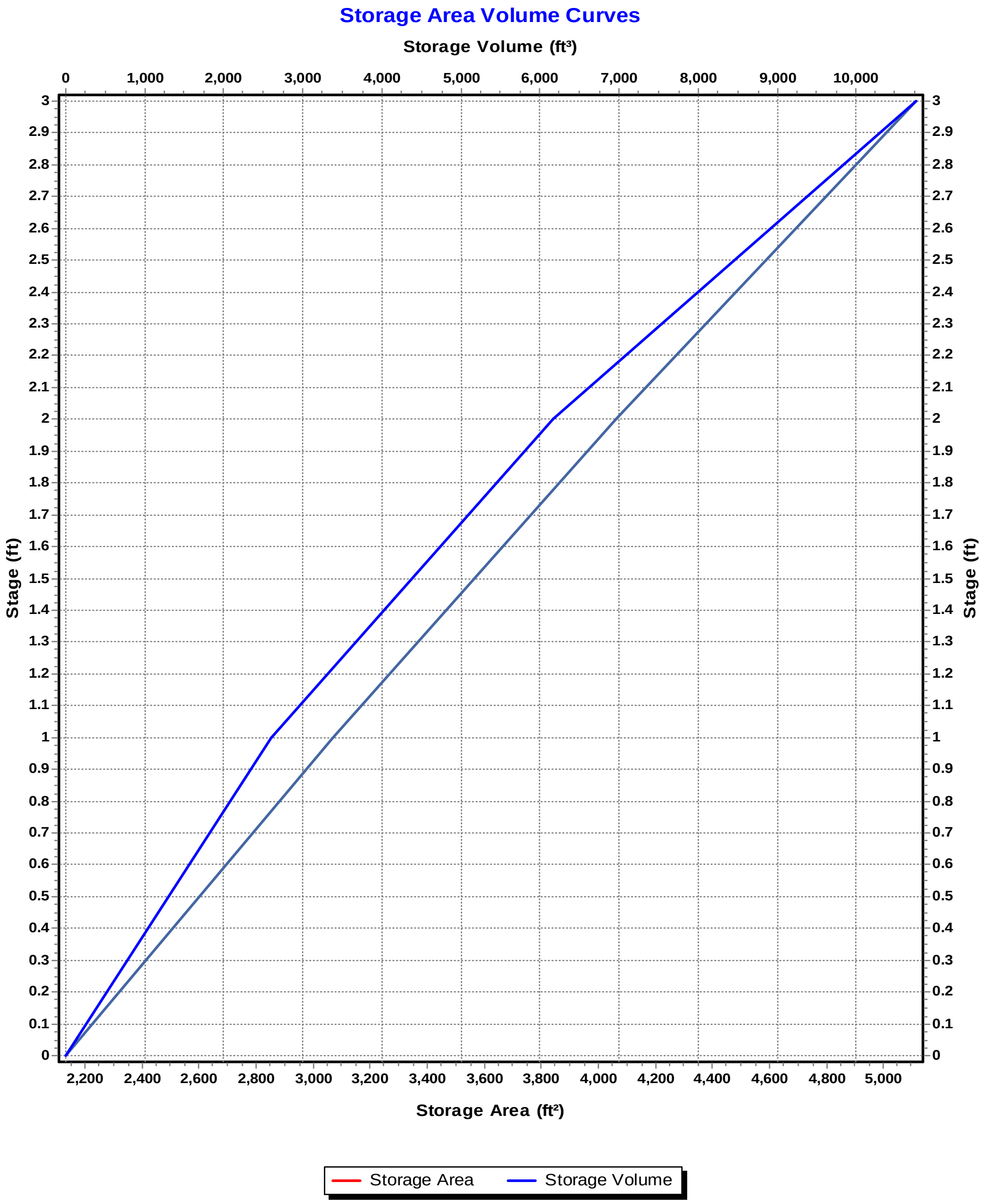
Input Data

Invert Elevation (ft) 578.00
Max (Rim) Elevation (ft) 581.00
Max (Rim) Offset (ft) 3.00
Initial Water Elevation (ft) 578.00
Initial Water Depth (ft) 0.00
Ponded Area (ft²) 0.00
Evaporation Loss 0.00

Storage Area Volume Curves

Storage Curve : Storage-10

Stage (ft)	Storage Area (ft²)	Storage Volume (ft³)
0	2133.53	0
1	3070.53	2602.03
2	4064.03	6169.31
3	5114.09	10758.37


Storage Area Volume Curves
Storage Volume (ft³)
0
1,000
2,000
3,000
4,000
5,000
6,000
7,000
8,000
9,000
10,000
Stage (ft)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.1
1.2
1.3
1.4
1.5
1.6
1.7
1.8
1.9
2
2.1
2.2
2.3
2.4
2.5
2.6
2.7
2.8
2.9
3
2,200
2,400
2,600
2,800
3,000
3,200
3,400
3,600
3,800
4,000
4,200
4,400
4,600
4,800
5,000
Storage Area (ft²)
Storage Area
Storage Volume

Storage Node : SANDFILTER (continued)

Output Summary Results

Peak Inflow (cfs) 26.29
Peak Lateral Inflow (cfs) 0
Peak Outflow (cfs) 26.07
Peak Exfiltration Flow Rate (cfm) 0
Max HGL Elevation Attained (ft) 578.99
Max HGL Depth Attained (ft) 0.99
Average HGL Elevation Attained (ft) 578.14
Average HGL Depth Attained (ft) 0.14
Time of Max HGL Occurrence (days hh:mm) 0 12:17
Total Exfiltration Volume (1000-ft³) 0
Total Flooded Volume (ac-in) 0
Total Time Flooded (min) 0
Total Retention Time (sec) 0

Project Description

File Name NAV-31.SPF

Project Options

Flow Units .... CFS
Elevation Type .... Elevation
Hydrology Method .... SCS TR-55
Time of Concentration (TOC) Method .... SCS TR-55
Link Routing Method .... Kinematic Wave
Enable Overflow Ponding at Nodes .... YES
Skip Steady State Analysis Time Periods ... YES

Analysis Options

Start Analysis On	00:00:00	0:00:00
End Analysis On	00:00:00	0:00:00
Start Reporting On	00:00:00	0:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins...	3
Nodes...	7
Junctions	4
Outfalls	2
Flow Diversions	0
Inlets	0
Storage Nodes	1
Links...	5
Channels	2
Pipes	3
Pumps	0
Orifices	0
Weirs	0
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
49		Time Series	10-Year	Cumulative	inches	New Hampshire	Strafford	10.00	4.30	SCS Type II 24-hr

Subbasin Summary

SN	Subbasin ID	Area (ac)	Peak Rate Factor	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	POST-DEVELOPMENT-P1	18.07	484.00	85.70	4.30	2.79	50.45	45.10	0 00:29:18
2	POST-DEVELOPMENT-P2	0.23	484.00	77.78	4.30	2.11	0.49	0.69	0 00:10:10
3	PRE-DEVELOPMENT-E1	18.07	484.00	88.03	4.30	3.01	54.41	55.02	0 00:23:07

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft²)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	End-Junction-P-1	Junction	579.00	581.00	579.00	581.00	0.00	44.88	581.68	0.00	1.32	0 00:00	0.00	0.00
2	End-Junction-P-2	Junction	577.00	580.00	577.00	0.00	0.00	44.68	578.34	0.00	1.66	0 00:00	0.00	0.00
3	Initial-Junction-P1	Junction	635.50	637.50	635.50	637.50	34.00	45.05	636.67	0.00	0.83	0 00:00	0.00	0.00
4	Initial-Junction-P2	Junction	580.00	582.00	580.00	0.00	0.00	0.69	580.16	0.00	1.84	0 00:00	0.00	0.00
5	POST-DEVELOPMENT(PA)	Outfall	577.00					44.68	577.00					
6	PRE-DEVELEPMENT(PA)	Outfall	578.90					54.31	578.90					
7	SANDFILTER	Storage Node	578.00	581.00	578.00		0.00	44.84	579.34				0.00	0.00

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Diameter or Height (in)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Reported Condition
1	(1)-HDPE-PIPE	Pipe	SANDFILTER	End-Junction-P-2	20.00	578.00	577.00	5.0000	30.000	0.0150	44.44	79.49	0.56	16.64	1.32	0.53	0.00	Calculated
2	(2)-HDPE-PIPES	Pipe	End-Junction-P-1	SANDFILTER	120.00	580.00	579.50	0.4200	36.000	0.0150	44.84	74.63	0.60	5.52	1.67	0.56	0.00	Calculated
3	DIRECTLINK	Pipe	End-Junction-P-2	POST-DEVELOPMENT(PA)	2356.93	577.00	577.00	0.0000	0.000	0.0150	44.68	0.00	0.60	0.00	1.67	0.56	0.00	Calculated
4	ROAD-SIDE-DITCH-P1	Channel	Initial-Junction-P1	End-Junction-P-1	577.00	635.50	580.00	9.6200	24.000	0.0320	44.88	132.33	0.34	11.39	1.16	0.58	0.00	
5	ROAD-SIDE-DITCH-P2	Channel	Initial-Junction-P2	End-Junction-P-2	117.00	580.00	577.00	2.5600	24.000	0.0320	0.68	68.32	0.01	2.00	0.16	0.08	0.00	

Subbasin Hydrology

Subbasin : POST-DEVELOPMENT-P1

Input Data

Area (ac) 18.07
Peak Rate Factor 484
Weighted Curve Number 85.7
Rain Gage ID .... Rain Gage-01

Composite Curve Number

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Gravel roads	0.33	C	89
> 75% grass cover, Good	0.63	C	74
Fallow, bare soil	0.16	C	91
Gravel roads	0.15	C	89
< 50% grass cover, Poor	16.8	C	86
Composite Area & Weighted CN	18.07		85.7

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where :

Tc = Time of Concentration (hr)
n = Manning's roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where :

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft²)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's roughness

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.3	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	3	0	0
2 yr, 24 hr Rainfall (in) :	1	0	0
Velocity (ft/sec) :	0.06	0	0
Computed Flow Time (min) :	25.95	0	0

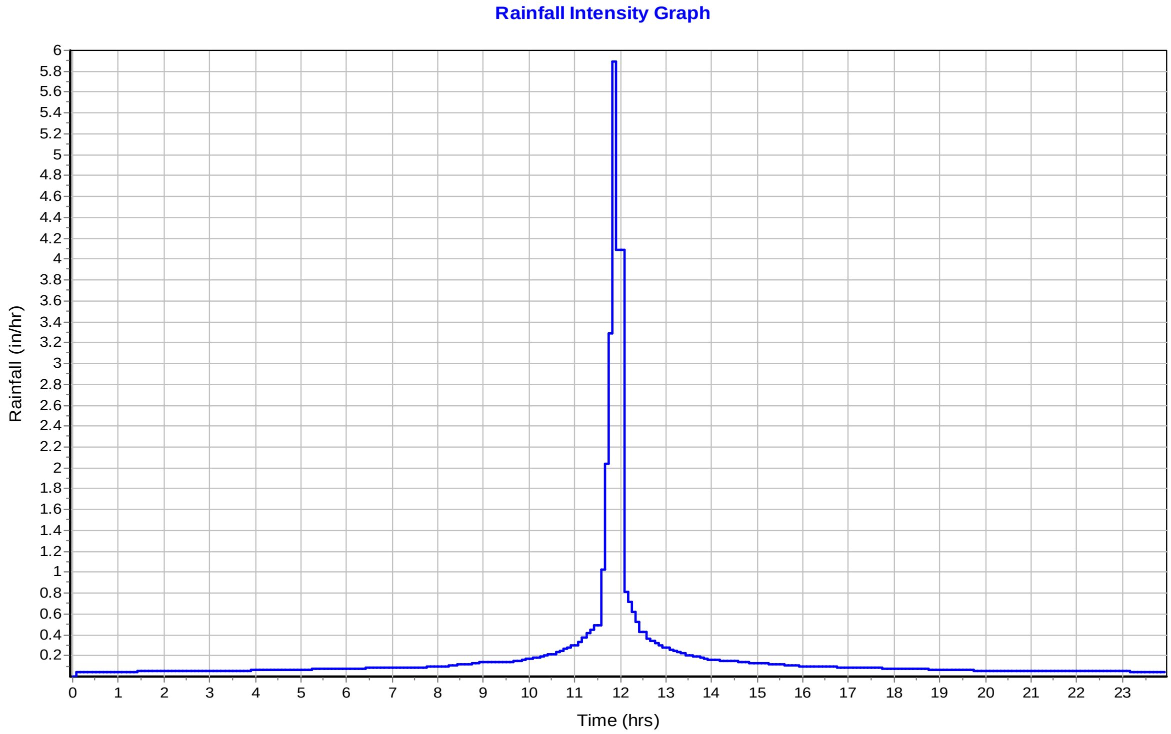
Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	918.85	0	0
Slope (%) :	8	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	4.56	0	0
Computed Flow Time (min) :	3.36	0	0

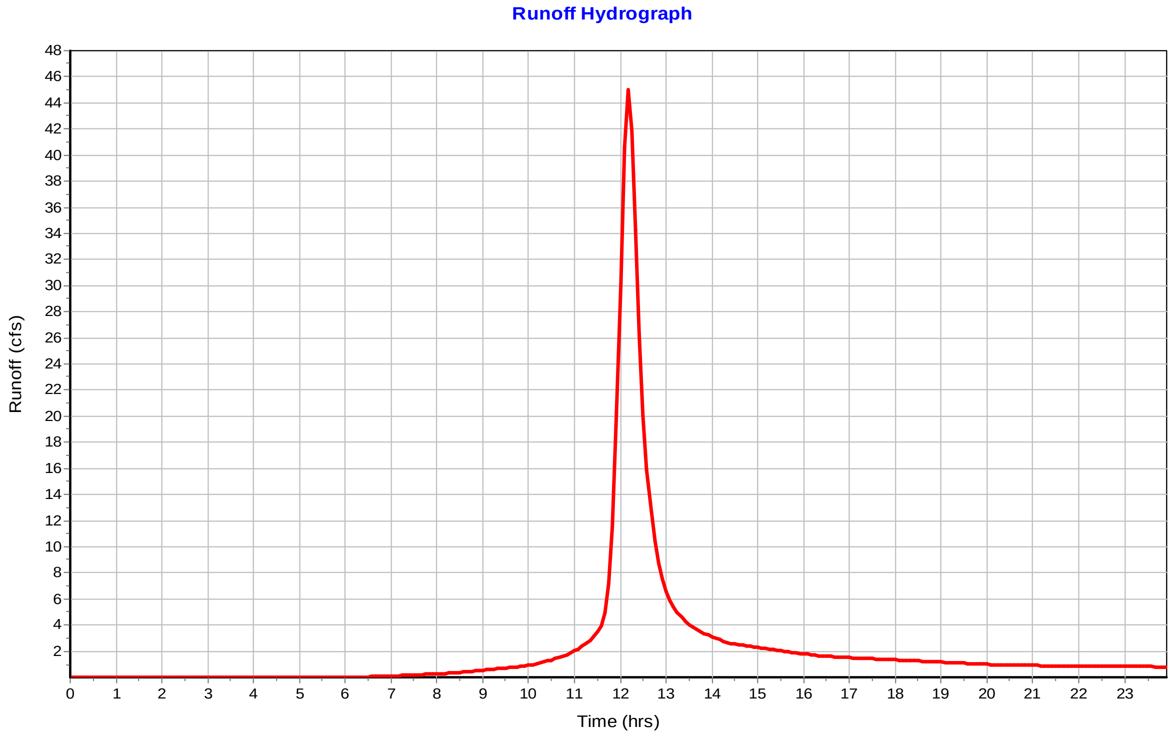
Total TOC (min) 29.31

Subbasin Runoff Results

Total Rainfall (in) 4.3
Total Runoff (in) 2.79
Peak Runoff (cfs) 45.1
Weighted Curve Number 85.7
Time of Concentration (days hh:mm:ss) 0 00:29:19

Subbasin : POST-DEVELOPMENT-P1





Subbasin : POST-DEVELOPMENT-P2

Input Data

Area (ac) 0.23
Peak Rate Factor 484
Weighted Curve Number 77.78
Rain Gage ID .... Rain Gage-01

Composite Curve Number

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
> 75% grass cover, Good	0.18	C	74
Gravel roads	0.06	C	89
Composite Area & Weighted CN	0.24		77.78

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.3	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	8	0	0
2 yr, 24 hr Rainfall (in) :	3	0	0
Velocity (ft/sec) :	0.16	0	0
Computed Flow Time (min) :	10.12	0	0

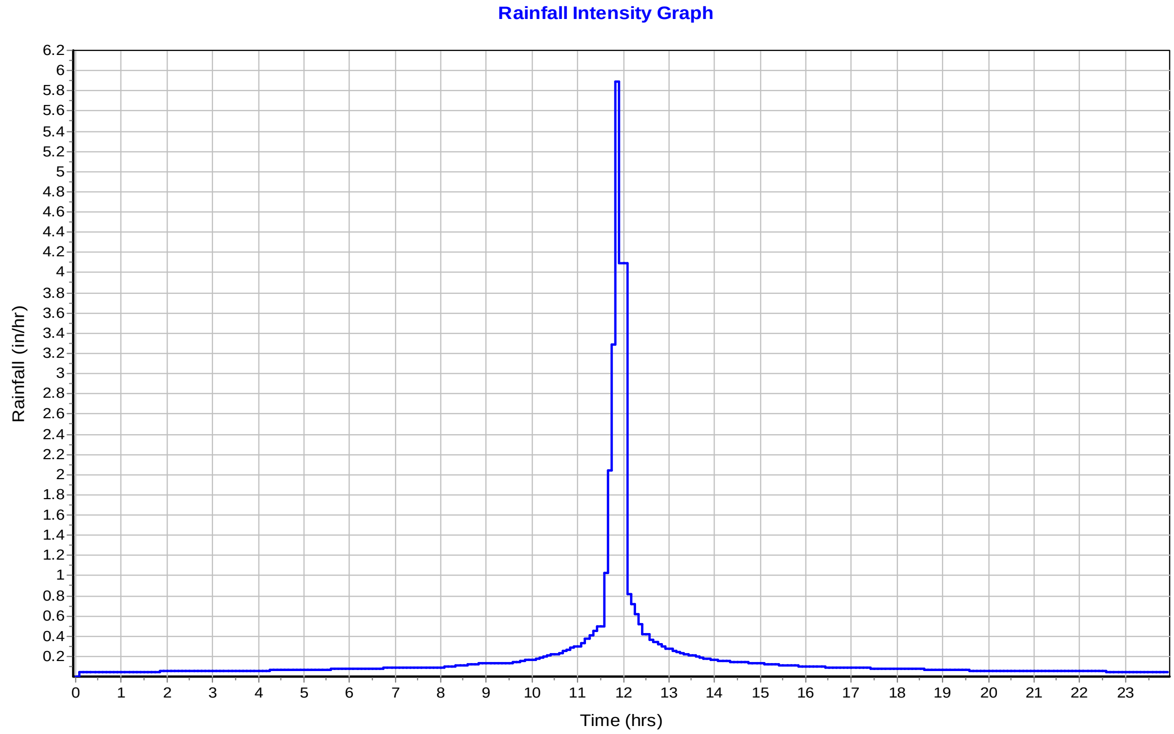
Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	17	0	0
Slope (%) :	8	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	4.56	0	0
Computed Flow Time (min) :	0.06	0	0

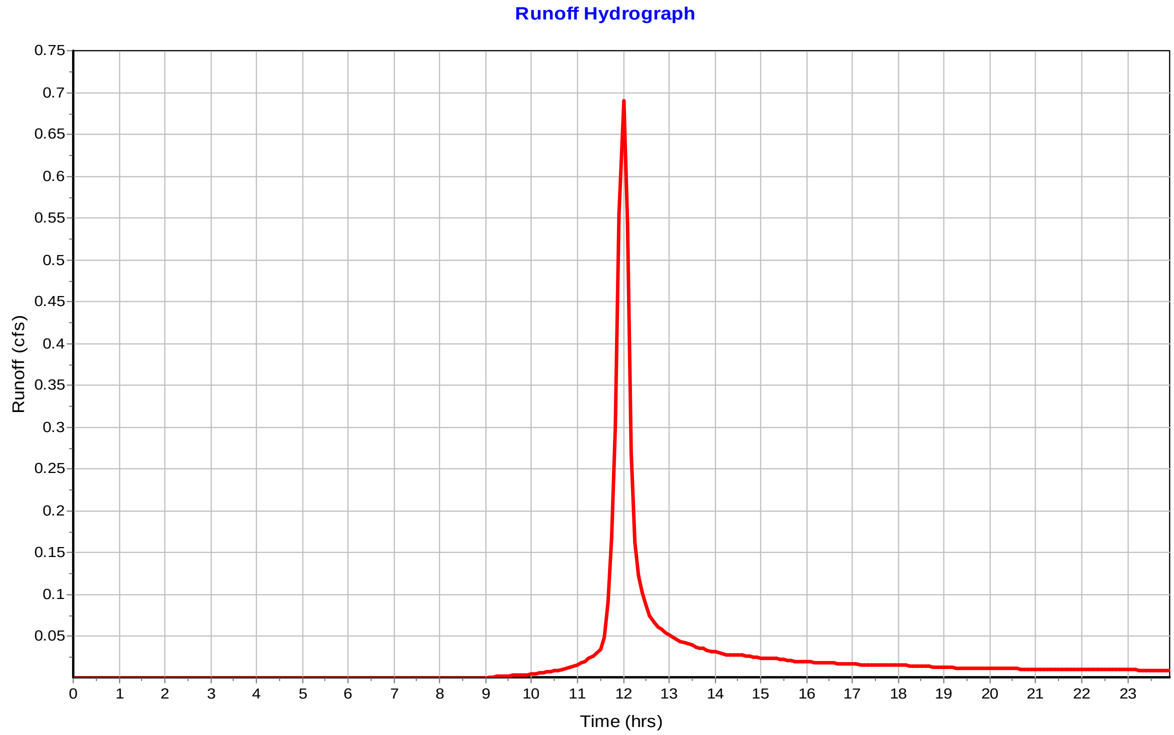
Total TOC (min) 10.18

Subbasin Runoff Results

Total Rainfall (in) 4.3
Total Runoff (in) 2.11
Peak Runoff (cfs) 0.69
Weighted Curve Number 77.78
Time of Concentration (days hh:mm:ss) 0 00:10:11

Subbasin : POST-DEVELOPMENT-P2





Subbasin : PRE-DEVELOPMENT-E1

Input Data

Area (ac) 18.07
Peak Rate Factor 484
Weighted Curve Number 88.03
Rain Gage ID .... Rain Gage-01

Composite Curve Number

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Fallow, crop residue, Good	17.76	C	88
Fallow, bare soil	0.16	C	91
Gravel roads	0.15	C	89
Composite Area & Weighted CN	18.07		88.03

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.3	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	4.8	0	0
2 yr, 24 hr Rainfall (in) :	1	0	0
Velocity (ft/sec) :	0.08	0	0
Computed Flow Time (min) :	21.5	0	0

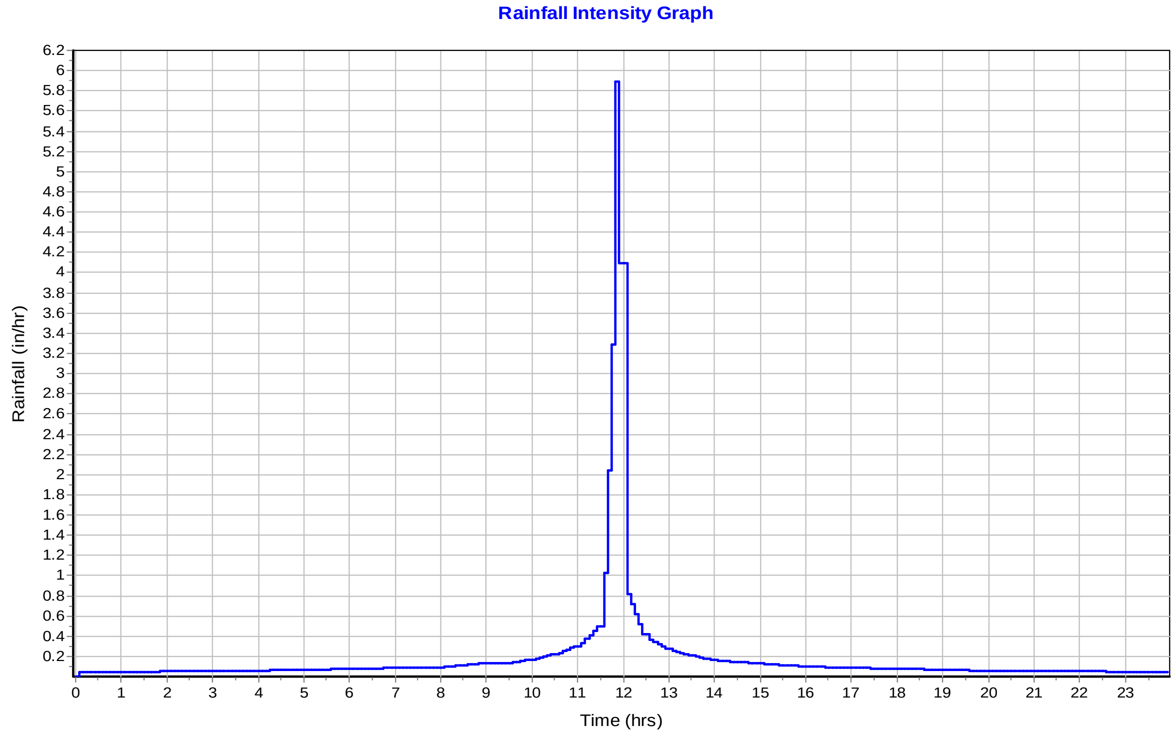
Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	566.4872	0	0
Slope (%) :	13	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	5.82	0	0
Computed Flow Time (min) :	1.62	0	0

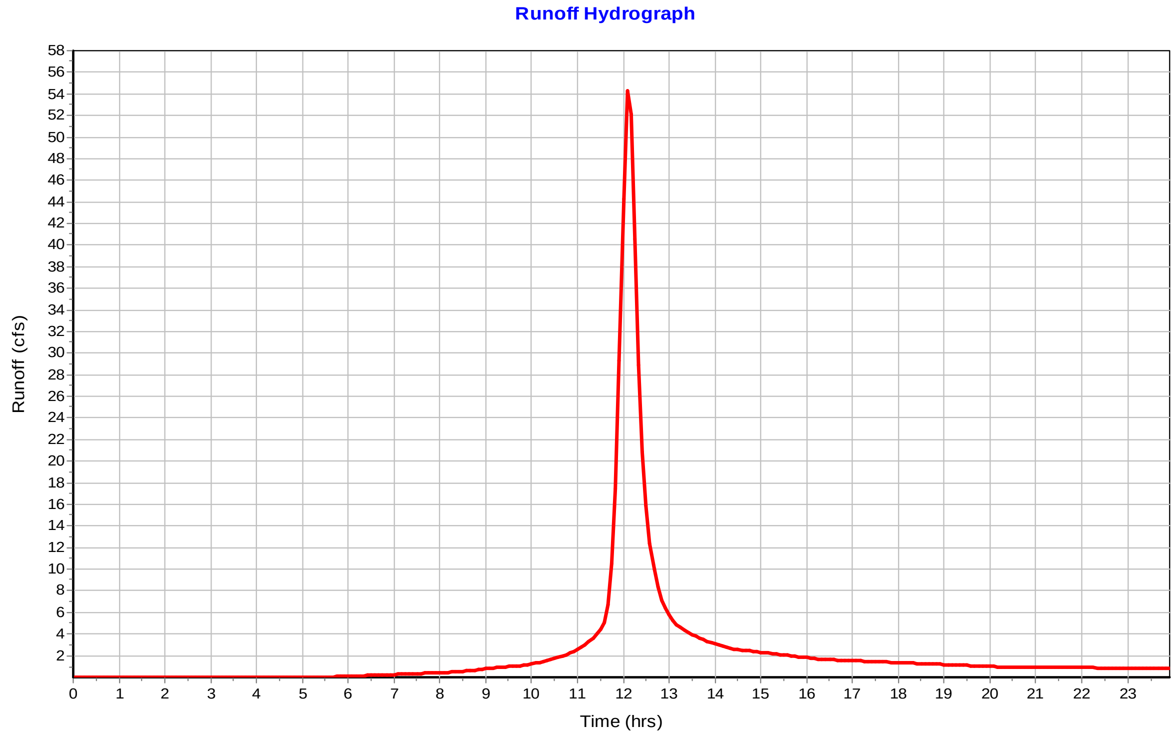
Total TOC (min) 23.12

Subbasin Runoff Results

Total Rainfall (in) 4.3
Total Runoff (in) 3.01
Peak Runoff (cfs) 55.02
Weighted Curve Number 88.03
Time of Concentration (days hh:mm:ss) 0 00:23:07

Subbasin : PRE-DEVELOPMENT-E1





Junction Input

SN	Element ID	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Ground/Rim (Max) Offset (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Surcharge Elevation (ft)	Surcharge Depth (ft)	Ponded Area (ft²)	Minimum Pipe Cover (in)
1	End-Junction-P-1	579.00	581.00	2.00	579.00	0.00	581.00	0.00	0.00	0.00
2	End-Junction-P-2	577.00	580.00	3.00	577.00	0.00	0.00	-580.00	0.00	0.00
3	Initial-Junction-P1	635.50	637.50	2.00	635.50	0.00	637.50	0.00	34.00	0.00
4	Initial-Junction-P2	580.00	582.00	2.00	580.00	0.00	0.00	-582.00	0.00	0.00

Junction Results

SN	Element ID	Peak Inflow (cfs)	Peak Lateral Inflow (cfs)	Max HGL Elevation Attained (ft)	Max HGL Depth Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Average HGL Elevation Attained (ft)	Average HGL Depth Attained (ft)	Time of Max HGL Occurrence (days hh:mm)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	End-Junction-P-1	44.88	0.00	581.68	2.68	0.00	1.32	580.24	1.24	0 12:15	0 00:00	0.00	0.00
2	End-Junction-P-2	44.68	0.00	578.34	1.34	0.00	1.66	577.19	0.19	0 12:17	0 00:00	0.00	0.00
3	Initial-Junction-P1	45.05	45.05	636.67	1.17	0.00	0.83	635.64	0.14	0 12:15	0 00:00	0.00	0.00
4	Initial-Junction-P2	0.69	0.69	580.16	0.16	0.00	1.84	580.01	0.01	0 12:05	0 00:00	0.00	0.00

Channel Input

SN	Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Shape	Height (ft)	Width (ft)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate
1	ROAD-SIDE-DITCH-P1	577.00	635.50	0.00	580.00	1.00	55.50	9.6200	Trapezoidal	2.000	6.800	0.0320	0.5000	0.5000	0.0000	0.00	No
2	ROAD-SIDE-DITCH-P2	117.00	580.00	0.00	577.00	0.00	3.00	2.5600	Trapezoidal	2.000	6.800	0.0320	0.5000	0.5000	0.0000	0.00	No

Channel Results

SN	Element ID	Peak Flow (cfs)	Time of Peak Flow Occurrence (days hh:mm)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Travel Time (min)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Froude Number	Reported Condition
1	ROAD-SIDE-DITCH-P1	44.88	0 12:15	132.33	0.34	11.39	0.84	1.16	0.58	0.00		
2	ROAD-SIDE-DITCH-P2	0.68	0 12:05	68.32	0.01	2.00	0.98	0.16	0.08	0.00		

Pipe Input

SN	Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Pipe Shape	Pipe Diameter or Height (in)	Pipe Width (in)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate	No. of Barrels
1	(1)-HDPE-PIPE	20.00	578.00	0.00	577.00	0.00	1.00	5.0000	CIRCULAR	30.000	30.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
2	(2)-HDPE-PIPES	120.00	580.00	1.00	579.50	1.50	0.50	0.4200	CIRCULAR	36.000	36.000	0.0150	0.5000	0.5000	0.0000	0.00	No	2
3	DIRECTLINK	2356.93	577.00	0.00	577.00	0.00	0.00	0.0000	Dummy	0.000	0.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1

Pipe Results

SN	Element ID	Peak Flow (cfs)	Time of Peak Flow Occurrence (days hh:mm)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Travel Time (min)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Froude Number	Reported Condition
1	(1)-HDPE-PIPE	44.44	0 12:17	79.49	0.56	16.64	0.02	1.32	0.53	0.00		Calculated
2	(2)-HDPE-PIPES	44.84	0 12:16	74.63	0.60	5.52	0.36	1.67	0.56	0.00		Calculated
3	DIRECTLINK	44.68	0 12:17	0.00	0.60	0.00		1.67	0.56	0.00		Calculated

Storage Nodes

Storage Node : SANDFILTER

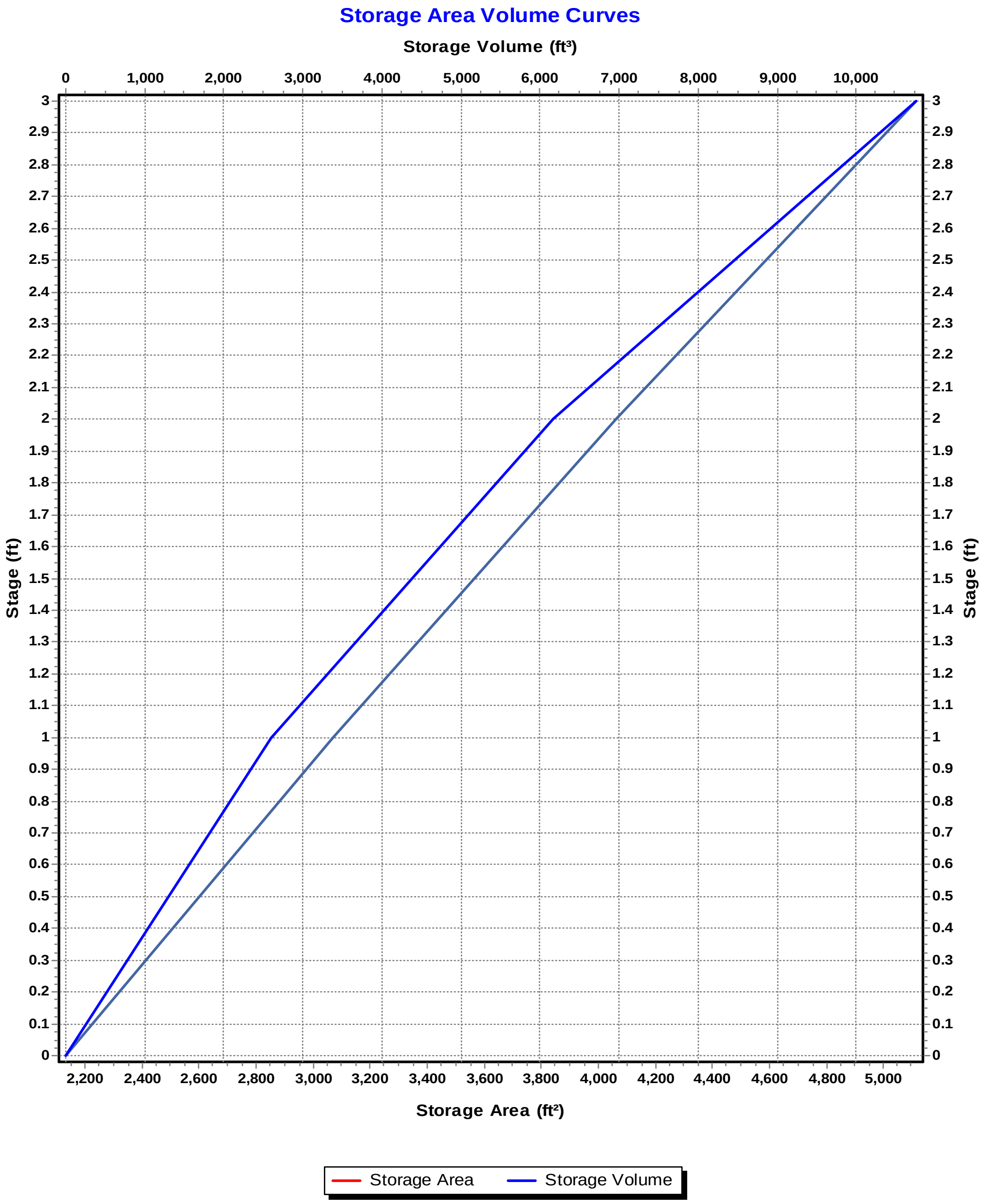
Input Data

Invert Elevation (ft) 578.00
Max (Rim) Elevation (ft) 581.00
Max (Rim) Offset (ft) 3.00
Initial Water Elevation (ft) 578.00
Initial Water Depth (ft) 0.00
Ponded Area (ft²) 0.00
Evaporation Loss 0.00

Storage Area Volume Curves

Storage Curve : Storage-10

Stage (ft)	Storage Area (ft²)	Storage Volume (ft³)
0	2133.53	0
1	3070.53	2602.03
2	4064.03	6169.31
3	5114.09	10758.37


Storage Area Volume Curves
Storage Volume (ft³)
0
1,000
2,000
3,000
4,000
5,000
6,000
7,000
8,000
9,000
10,000
Stage (ft)
3
2.9
2.8
2.7
2.6
2.5
2.4
2.3
2.2
2.1
2
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
2,200
2,400
2,600
2,800
3,000
3,200
3,400
3,600
3,800
4,000
4,200
4,400
4,600
4,800
5,000
Storage Area (ft²)
Storage Area
Storage Volume

Storage Node : SANDFILTER (continued)

Output Summary Results

Peak Inflow (cfs) 44.84
Peak Lateral Inflow (cfs) 0
Peak Outflow (cfs) 44.44
Peak Exfiltration Flow Rate (cfm) 0
Max HGL Elevation Attained (ft) 579.34
Max HGL Depth Attained (ft) 1.34
Average HGL Elevation Attained (ft) 578.19
Average HGL Depth Attained (ft) 0.19
Time of Max HGL Occurrence (days hh:mm) 0 12:17
Total Exfiltration Volume (1000-ft³) 0
Total Flooded Volume (ac-in) 0
Total Time Flooded (min) 0
Total Retention Time (sec) 0

Project Description

File Name NAV-31.SPF

Project Options

Flow Units .... CFS
Elevation Type .... Elevation
Hydrology Method .... SCS TR-55
Time of Concentration (TOC) Method .... SCS TR-55
Link Routing Method .... Kinematic Wave
Enable Overflow Ponding at Nodes .... YES
Skip Steady State Analysis Time Periods ... YES

Analysis Options

Start Analysis On	00:00:00	0:00:00
End Analysis On	00:00:00	0:00:00
Start Reporting On	00:00:00	0:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins	3
Nodes	7
Junctions	4
Outfalls	2
Flow Diversions	0
Inlets	0
Storage Nodes	1
Links	5
Channels	2
Pipes	3
Pumps	0
Orifices	0
Weirs	0
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
49		Time Series	25-year	Cumulative	inches	New Hampshire	Strafford	25.00	5.10	SCS Type II 24-hr

Subbasin Summary

SN	Subbasin ID	Area (ac)	Peak Rate Factor	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	POST-DEVELOPMENT-P1	18.07	484.00	85.70	5.10	3.53	63.79	56.74	0 00:29:18
2	POST-DEVELOPMENT-P2	0.23	484.00	77.78	5.10	2.78	0.65	0.91	0 00:10:10
3	PRE-DEVELOPMENT-E1	18.07	484.00	88.03	5.10	3.77	68.07	68.27	0 00:23:07

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft²)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	End-Junction-P-1	Junction	579.00	581.00	579.00	581.00	0.00	56.51	581.95	0.00	1.05	0 00:00	0.00	0.00
2	End-Junction-P-2	Junction	577.00	580.00	577.00	0.00	0.00	56.21	578.55	0.00	1.45	0 00:00	0.00	0.00
3	Initial-Junction-P1	Junction	635.50	637.50	635.50	637.50	34.00	56.70	636.81	0.00	0.69	0 00:00	0.00	0.00
4	Initial-Junction-P2	Junction	580.00	582.00	580.00	0.00	0.00	0.91	580.19	0.00	1.81	0 00:00	0.00	0.00
5	POST-DEVELOPMENT(PA)	Outfall	577.00					56.21	577.00					
6	PRE-DEVELEPMENT(PA)	Outfall	578.90					67.48	578.90					
7	SANDFILTER	Storage Node	578.00	581.00	578.00		0.00	56.43	579.55				0.00	0.00

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Diameter or Height (in)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Reported Condition
1	(1)-HDPE-PIPE	Pipe	SANDFILTER	End-Junction-P-2	20.00	578.00	577.00	5.0000	30.000	0.0150	55.89	79.49	0.70	17.53	1.52	0.62	0.00	Calculated
2	(2)-HDPE-PIPES	Pipe	End-Junction-P-1	SANDFILTER	120.00	580.00	579.50	0.4200	36.000	0.0150	56.43	74.63	0.76	5.81	1.94	0.65	0.00	Calculated
3	DIRECTLINK	Pipe	End-Junction-P-2	POST-DEVELOPMENT(PA)	2356.93	577.00	577.00	0.0000	0.000	0.0150	56.21	0.00	0.76	0.00	1.94	0.65	0.00	Calculated
4	ROAD-SIDE-DITCH-P1	Channel	Initial-Junction-P1	End-Junction-P-1	577.00	635.50	580.00	9.6200	24.000	0.0320	56.51	132.33	0.43	12.10	1.31	0.65	0.00	
5	ROAD-SIDE-DITCH-P2	Channel	Initial-Junction-P2	End-Junction-P-2	117.00	580.00	577.00	2.5600	24.000	0.0320	0.90	68.32	0.01	2.20	0.18	0.09	0.00	

Subbasin Hydrology

Subbasin : POST-DEVELOPMENT-P1

Input Data

Area (ac) 18.07
Peak Rate Factor 484
Weighted Curve Number 85.7
Rain Gage ID .... Rain Gage-01

Composite Curve Number

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Gravel roads	0.33	C	89
> 75% grass cover, Good	0.63	C	74
Fallow, bare soil	0.16	C	91
Gravel roads	0.15	C	89
< 50% grass cover, Poor	16.8	C	86
Composite Area & Weighted CN	18.07		85.7

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where :

Tc = Time of Concentration (hr)
n = Manning's roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where :

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft²)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's roughness

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.3	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	3	0	0
2 yr, 24 hr Rainfall (in) :	1	0	0
Velocity (ft/sec) :	0.06	0	0
Computed Flow Time (min) :	25.95	0	0

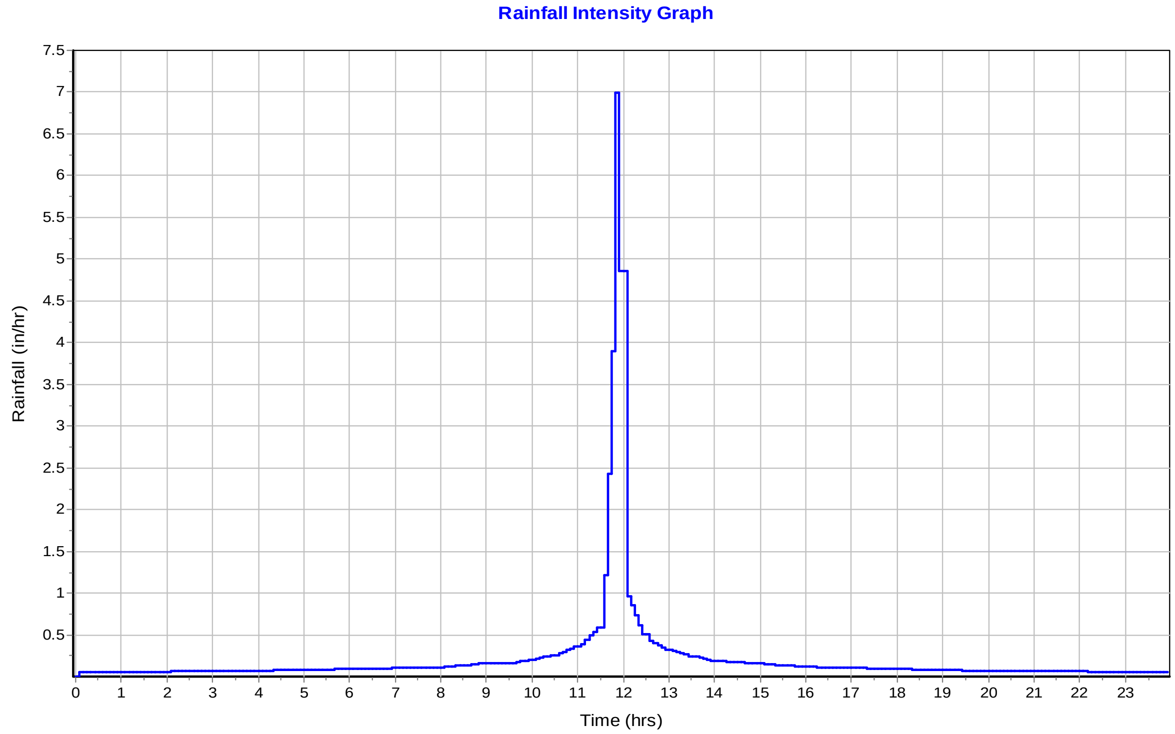
Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	918.85	0	0
Slope (%) :	8	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	4.56	0	0
Computed Flow Time (min) :	3.36	0	0

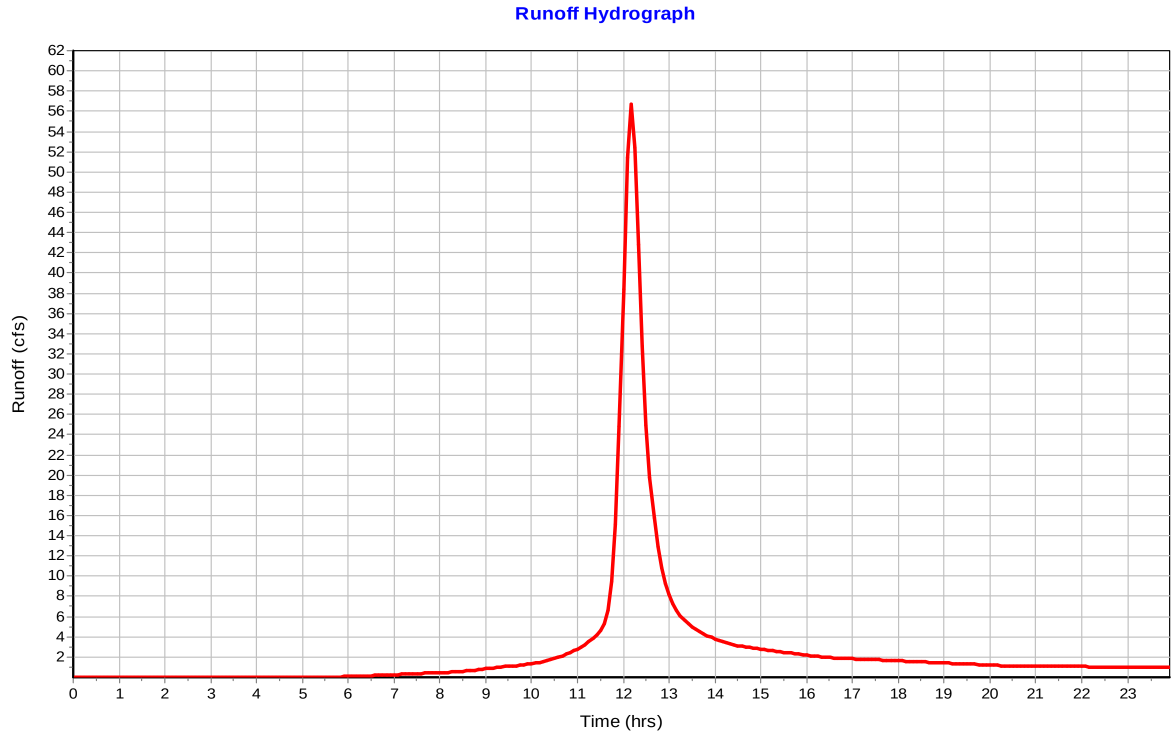
Total TOC (min) 29.31

Subbasin Runoff Results

Total Rainfall (in) 5.1
Total Runoff (in) 3.53
Peak Runoff (cfs) 56.74
Weighted Curve Number 85.7
Time of Concentration (days hh:mm:ss) 0 00:29:19

Subbasin : POST-DEVELOPMENT-P1





Subbasin : POST-DEVELOPMENT-P2

Input Data

Area (ac) 0.23
Peak Rate Factor 484
Weighted Curve Number 77.78
Rain Gage ID .... Rain Gage-01

Composite Curve Number

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
> 75% grass cover, Good	0.18	C	74
Gravel roads	0.06	C	89
Composite Area & Weighted CN	0.24		77.78

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.3	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	8	0	0
2 yr, 24 hr Rainfall (in) :	3	0	0
Velocity (ft/sec) :	0.16	0	0
Computed Flow Time (min) :	10.12	0	0

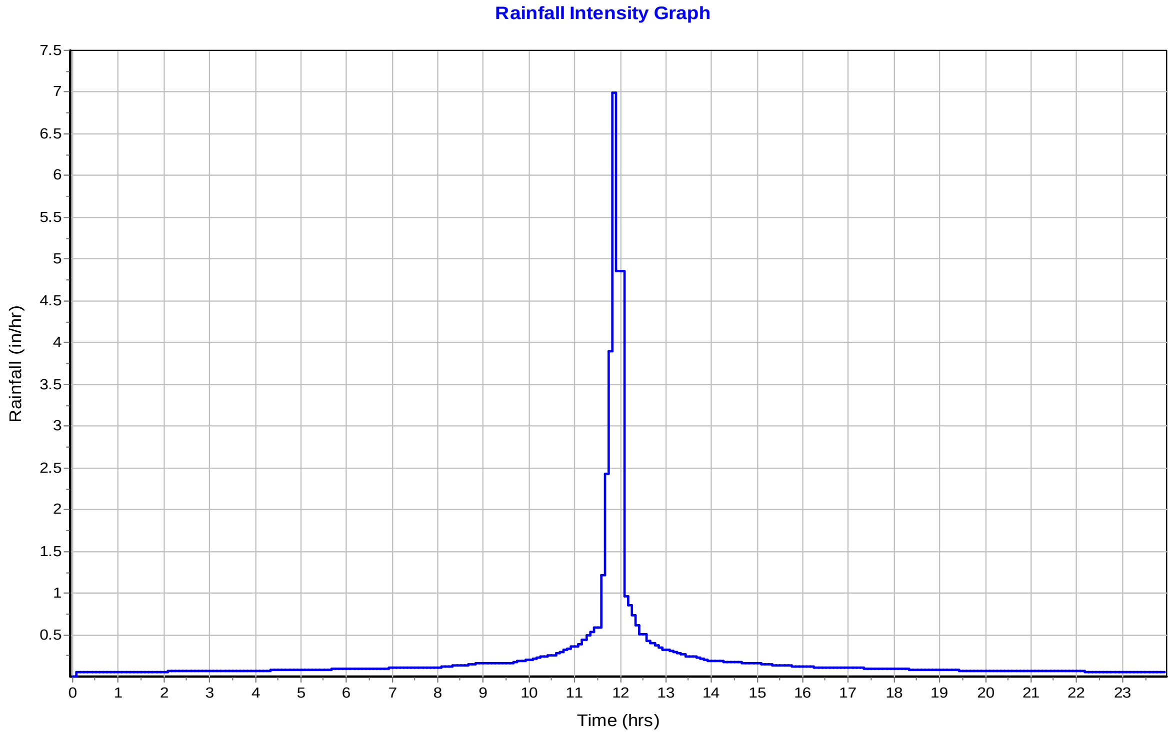
Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	17	0	0
Slope (%) :	8	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	4.56	0	0
Computed Flow Time (min) :	0.06	0	0

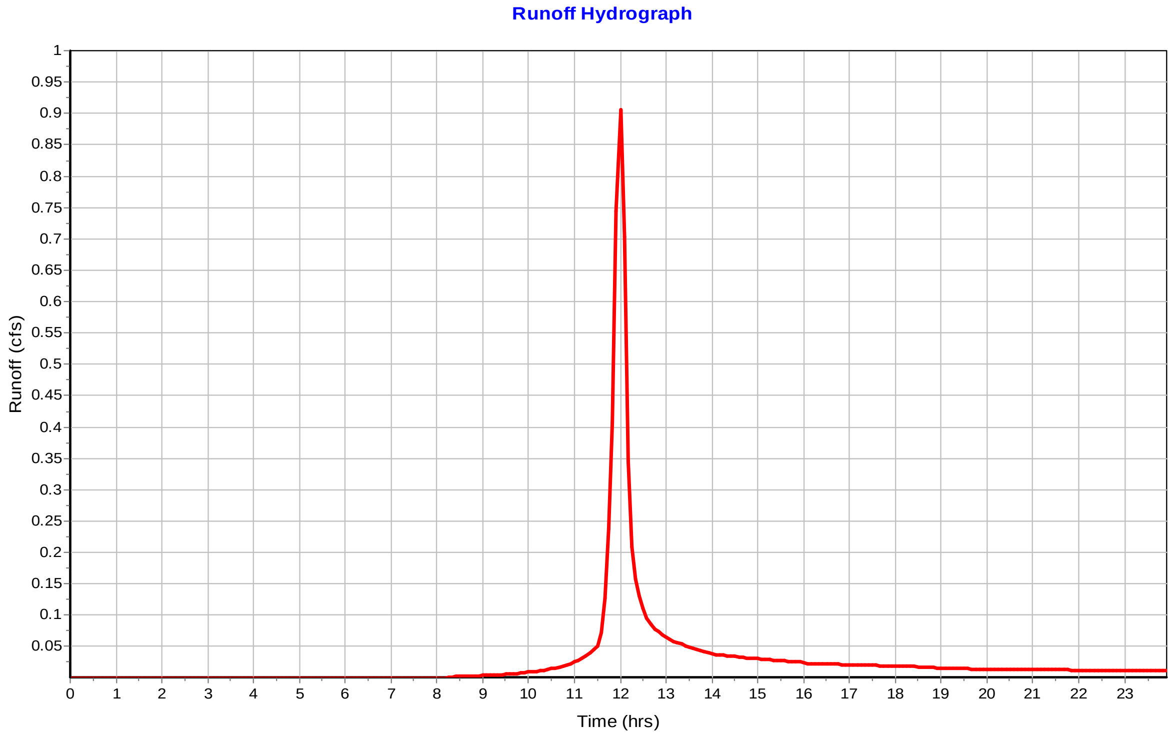
Total TOC (min) 10.18

Subbasin Runoff Results

Total Rainfall (in) 5.1
Total Runoff (in) 2.78
Peak Runoff (cfs) 0.91
Weighted Curve Number 77.78
Time of Concentration (days hh:mm:ss) 0 00:10:11

Subbasin : POST-DEVELOPMENT-P2





Subbasin : PRE-DEVELOPMENT-E1

Input Data

Area (ac) 18.07
Peak Rate Factor 484
Weighted Curve Number 88.03
Rain Gage ID .... Rain Gage-01

Composite Curve Number

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Fallow, crop residue, Good	17.76	C	88
Fallow, bare soil	0.16	C	91
Gravel roads	0.15	C	89
Composite Area & Weighted CN	18.07		88.03

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.3	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	4.8	0	0
2 yr, 24 hr Rainfall (in) :	1	0	0
Velocity (ft/sec) :	0.08	0	0
Computed Flow Time (min) :	21.5	0	0

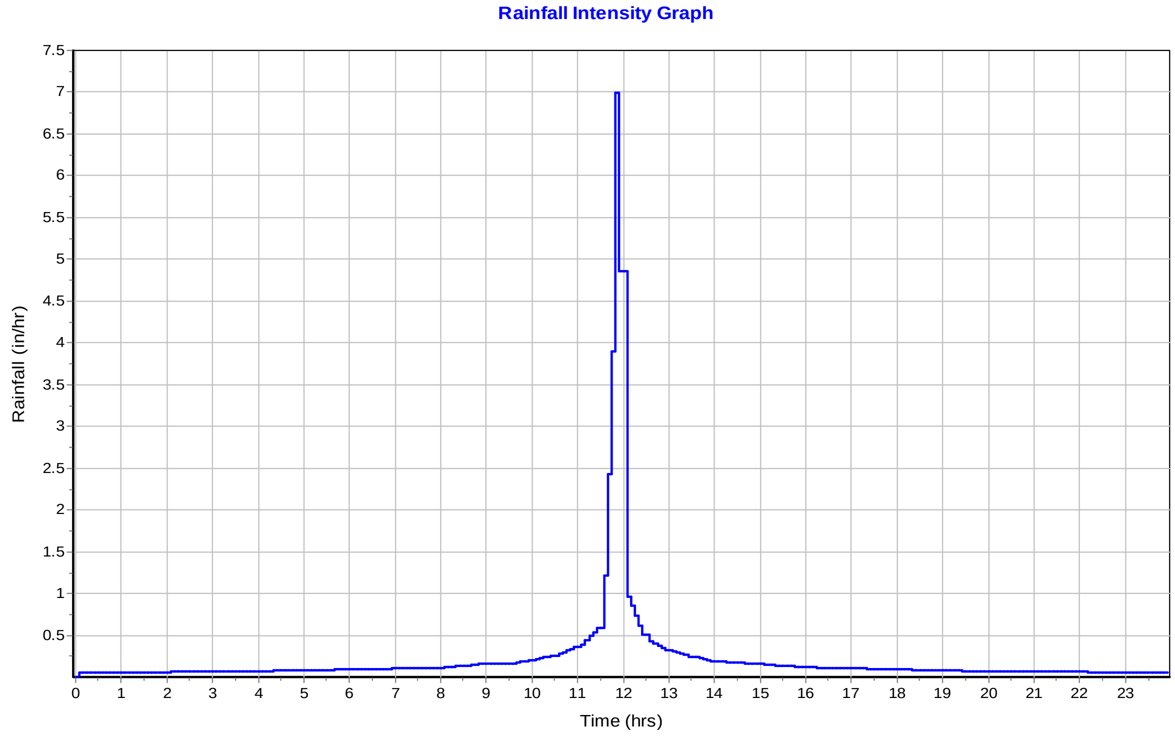
Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	566.4872	0	0
Slope (%) :	13	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	5.82	0	0
Computed Flow Time (min) :	1.62	0	0

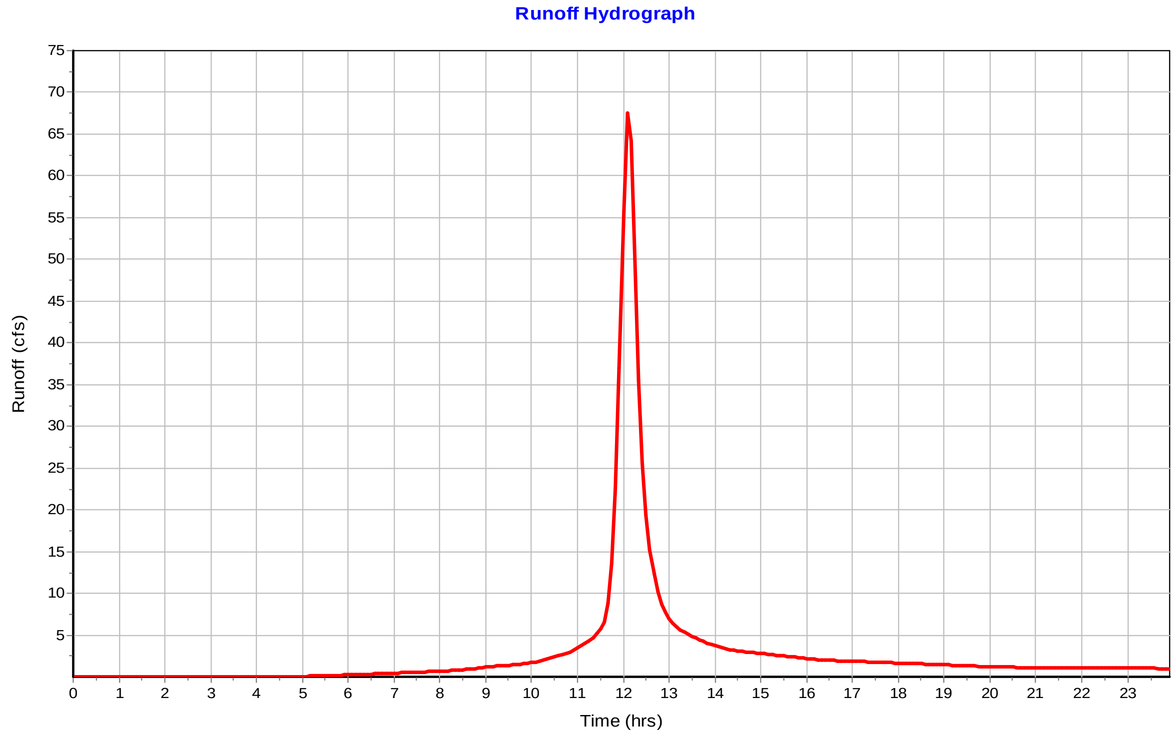
Total TOC (min) 23.12

Subbasin Runoff Results

Total Rainfall (in) 5.1
Total Runoff (in) 3.77
Peak Runoff (cfs) 68.27
Weighted Curve Number 88.03
Time of Concentration (days hh:mm:ss) 0 00:23:07

Subbasin : PRE-DEVELOPMENT-E1





Junction Input

SN	Element ID	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Ground/Rim (Max) Offset (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Surcharge Elevation (ft)	Surcharge Depth (ft)	Ponded Area (ft²)	Minimum Pipe Cover (in)
1	End-Junction-P-1	579.00	581.00	2.00	579.00	0.00	581.00	0.00	0.00	0.00
2	End-Junction-P-2	577.00	580.00	3.00	577.00	0.00	0.00	-580.00	0.00	0.00
3	Initial-Junction-P1	635.50	637.50	2.00	635.50	0.00	637.50	0.00	34.00	0.00
4	Initial-Junction-P2	580.00	582.00	2.00	580.00	0.00	0.00	-582.00	0.00	0.00

Junction Results

SN	Element ID	Peak Inflow (cfs)	Peak Lateral Inflow (cfs)	Max HGL Elevation Attained (ft)	Max HGL Depth Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Average HGL Elevation Attained (ft)	Average HGL Depth Attained (ft)	Time of Max HGL Occurrence (days hh:mm)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	End-Junction-P-1	56.51	0.00	581.95	2.95	0.00	1.05	580.27	1.27	0 12:15	0 00:00	0.00	0.00
2	End-Junction-P-2	56.21	0.00	578.55	1.55	0.00	1.45	577.22	0.22	0 12:17	0 00:00	0.00	0.00
3	Initial-Junction-P1	56.70	56.70	636.81	1.31	0.00	0.69	635.67	0.17	0 12:15	0 00:00	0.00	0.00
4	Initial-Junction-P2	0.91	0.91	580.19	0.19	0.00	1.81	580.02	0.02	0 12:05	0 00:00	0.00	0.00

Channel Input

SN	Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Shape	Height (ft)	Width (ft)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate
1	ROAD-SIDE-DITCH-P1	577.00	635.50	0.00	580.00	1.00	55.50	9.6200	Trapezoidal	2.000	6.800	0.0320	0.5000	0.5000	0.0000	0.00	No
2	ROAD-SIDE-DITCH-P2	117.00	580.00	0.00	577.00	0.00	3.00	2.5600	Trapezoidal	2.000	6.800	0.0320	0.5000	0.5000	0.0000	0.00	No

Channel Results

SN	Element ID	Peak Flow (cfs)	Time of Peak Flow Occurrence (days hh:mm)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Travel Time (min)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Froude Number	Reported Condition
1	ROAD-SIDE-DITCH-P1	56.51	0 12:15	132.33	0.43	12.10	0.79	1.31	0.65	0.00		
2	ROAD-SIDE-DITCH-P2	0.90	0 12:05	68.32	0.01	2.20	0.89	0.18	0.09	0.00		

Pipe Input

SN	Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Pipe Shape	Pipe Diameter or Height (in)	Pipe Width (in)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate	No. of Barrels
1	(1)-HDPE-PIPE	20.00	578.00	0.00	577.00	0.00	1.00	5.0000	CIRCULAR	30.000	30.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
2	(2)-HDPE-PIPES	120.00	580.00	1.00	579.50	1.50	0.50	0.4200	CIRCULAR	36.000	36.000	0.0150	0.5000	0.5000	0.0000	0.00	No	2
3	DIRECTLINK	2356.93	577.00	0.00	577.00	0.00	0.00	0.0000	Dummy	0.000	0.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1

Pipe Results

SN	Element ID	Peak Flow (cfs)	Time of Peak Flow Occurrence (days hh:mm)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Travel Time (min)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Froude Number	Reported Condition
1	(1)-HDPE-PIPE	55.89	0 12:17	79.49	0.70	17.53	0.02	1.52	0.62	0.00		Calculated
2	(2)-HDPE-PIPES	56.43	0 12:16	74.63	0.76	5.81	0.34	1.94	0.65	0.00		Calculated
3	DIRECTLINK	56.21	0 12:17	0.00	0.76	0.00		1.94	0.65	0.00		Calculated

Storage Nodes

Storage Node : SANDFILTER

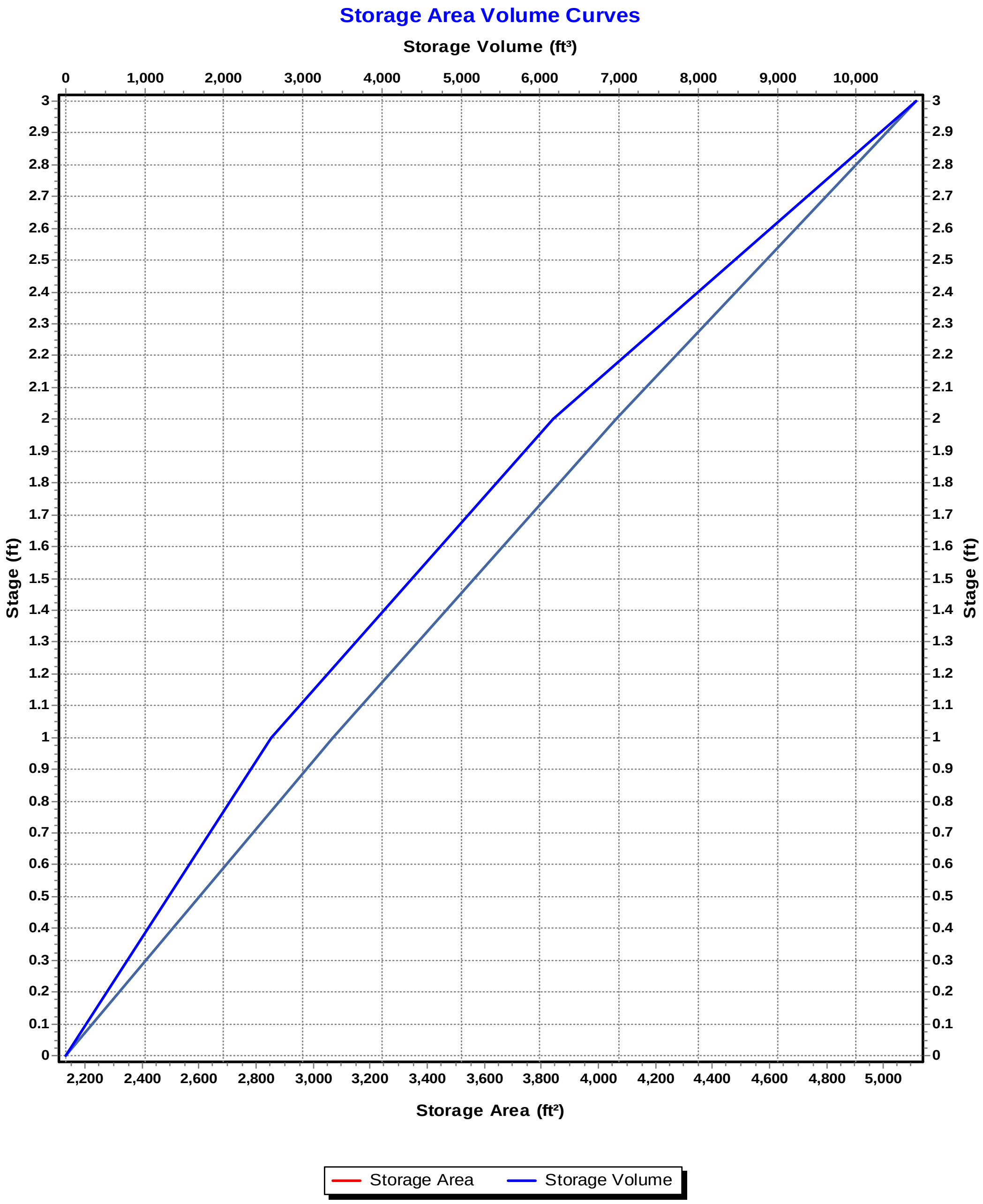
Input Data

Invert Elevation (ft) 578.00
Max (Rim) Elevation (ft) 581.00
Max (Rim) Offset (ft) 3.00
Initial Water Elevation (ft) 578.00
Initial Water Depth (ft) 0.00
Ponded Area (ft²) 0.00
Evaporation Loss 0.00

Storage Area Volume Curves

Storage Curve : Storage-10

Stage (ft)	Storage Area (ft²)	Storage Volume (ft³)
0	2133.53	0
1	3070.53	2602.03
2	4064.03	6169.31
3	5114.09	10758.37


Storage Area Volume Curves
Storage Volume (ft³)
0
1,000
2,000
3,000
4,000
5,000
6,000
7,000
8,000
9,000
10,000
Stage (ft)
Storage Area (ft²)
2,200
2,400
2,600
2,800
3,000
3,200
3,400
3,600
3,800
4,000
4,200
4,400
4,600
4,800
5,000
Storage Area
Storage Volume

Storage Node : SANDFILTER (continued)

Output Summary Results

Peak Inflow (cfs) 56.43
Peak Lateral Inflow (cfs) 0
Peak Outflow (cfs) 55.89
Peak Exfiltration Flow Rate (cfm) 0
Max HGL Elevation Attained (ft) 579.55
Max HGL Depth Attained (ft) 1.55
Average HGL Elevation Attained (ft) 578.22
Average HGL Depth Attained (ft) 0.22
Time of Max HGL Occurrence (days hh:mm) 0 12:17
Total Exfiltration Volume (1000-ft³) 0
Total Flooded Volume (ac-in) 0
Total Time Flooded (min) 0
Total Retention Time (sec) 0

Project Description

File Name NAV-31.SPF

Project Options

Flow Units .... CFS
Elevation Type .... Elevation
Hydrology Method .... SCS TR-55
Time of Concentration (TOC) Method .... SCS TR-55
Link Routing Method .... Kinematic Wave
Enable Overflow Ponding at Nodes .... YES
Skip Steady State Analysis Time Periods ... YES

Analysis Options

Start Analysis On	00:00:00	0:00:00
End Analysis On	00:00:00	0:00:00
Start Reporting On	00:00:00	0:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins...	3
Nodes...	7
Junctions	4
Outfalls	2
Flow Diversions	0
Inlets	0
Storage Nodes	1
Links..	5
Channels	2
Pipes	3
Pumps	0
Orifices	0
Weirs	0
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
49		Time Series	50-Year	Cumulative	inches	New Hampshire	Strafford	50.00	5.60	SCS Type II 24-hr

Subbasin Summary

SN	Subbasin ID	Area (ac)	Peak Rate Factor	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	POST-DEVELOPMENT-P1	18.07	484.00	85.70	5.60	4.00	72.26	64.08	0 00:29:18
2	POST-DEVELOPMENT-P2	0.23	484.00	77.78	5.60	3.21	0.75	1.05	0 00:10:10
3	PRE-DEVELOPMENT-E1	18.07	484.00	88.03	5.60	4.25	76.71	76.50	0 00:23:07

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft²)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	End-Junction-P-1	Junction	579.00	581.00	579.00	581.00	0.00	63.78	582.14	0.00	0.86	0 00:00	0.00	0.00
2	End-Junction-P-2	Junction	577.00	580.00	577.00	0.00	0.00	63.37	578.68	0.00	1.32	0 00:00	0.00	0.00
3	Initial-Junction-P1	Junction	635.50	637.50	635.50	637.50	34.00	63.98	636.90	0.00	0.60	0 00:00	0.00	0.00
4	Initial-Junction-P2	Junction	580.00	582.00	580.00	0.00	0.00	1.04	580.20	0.00	1.80	0 00:00	0.00	0.00
5	POST-DEVELOPMENT(PA)	Outfall	577.00					63.37	577.00					
6	PRE-DEVELEPMENT(PA)	Outfall	578.90					75.66	578.90					
7	SANDFILTER	Storage Node	578.00	581.00	578.00		0.00	63.69	579.68				0.00	0.00

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Diameter or Height (in)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Reported Condition
1	(1)-HDPE-PIPE	Pipe	SANDFILTER	End-Junction-P-2	20.00	578.00	577.00	5.0000	30.000	0.0150	63.01	79.49	0.79	17.96	1.65	0.67	0.00	Calculated
2	(2)-HDPE-PIPES	Pipe	End-Junction-P-1	SANDFILTER	120.00	580.00	579.50	0.4200	36.000	0.0150	63.69	74.63	0.85	5.93	2.12	0.71	0.00	Calculated
3	DIRECTLINK	Pipe	End-Junction-P-2	POST-DEVELOPMENT(PA)	2356.93	577.00	577.00	0.0000	0.000	0.0150	63.37	0.00	0.85	0.00	2.12	0.71	0.00	Calculated
4	ROAD-SIDE-DITCH-P1	Channel	Initial-Junction-P1	End-Junction-P-1	577.00	635.50	580.00	9.6200	24.000	0.0320	63.78	132.33	0.48	12.49	1.39	0.70	0.00	
5	ROAD-SIDE-DITCH-P2	Channel	Initial-Junction-P2	End-Junction-P-2	117.00	580.00	577.00	2.5600	24.000	0.0320	1.04	68.32	0.02	2.31	0.20	0.10	0.00	

Subbasin Hydrology

Subbasin : POST-DEVELOPMENT-P1

Input Data

Area (ac) 18.07
Peak Rate Factor 484
Weighted Curve Number 85.7
Rain Gage ID .... Rain Gage-01

Composite Curve Number

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Gravel roads	0.33	C	89
> 75% grass cover, Good	0.63	C	74
Fallow, bare soil	0.16	C	91
Gravel roads	0.15	C	89
< 50% grass cover, Poor	16.8	C	86
Composite Area & Weighted CN	18.07		85.7

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where :

Tc = Time of Concentration (hr)
n = Manning's roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where :

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft²)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's roughness

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.3	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	3	0	0
2 yr, 24 hr Rainfall (in) :	1	0	0
Velocity (ft/sec) :	0.06	0	0
Computed Flow Time (min) :	25.95	0	0

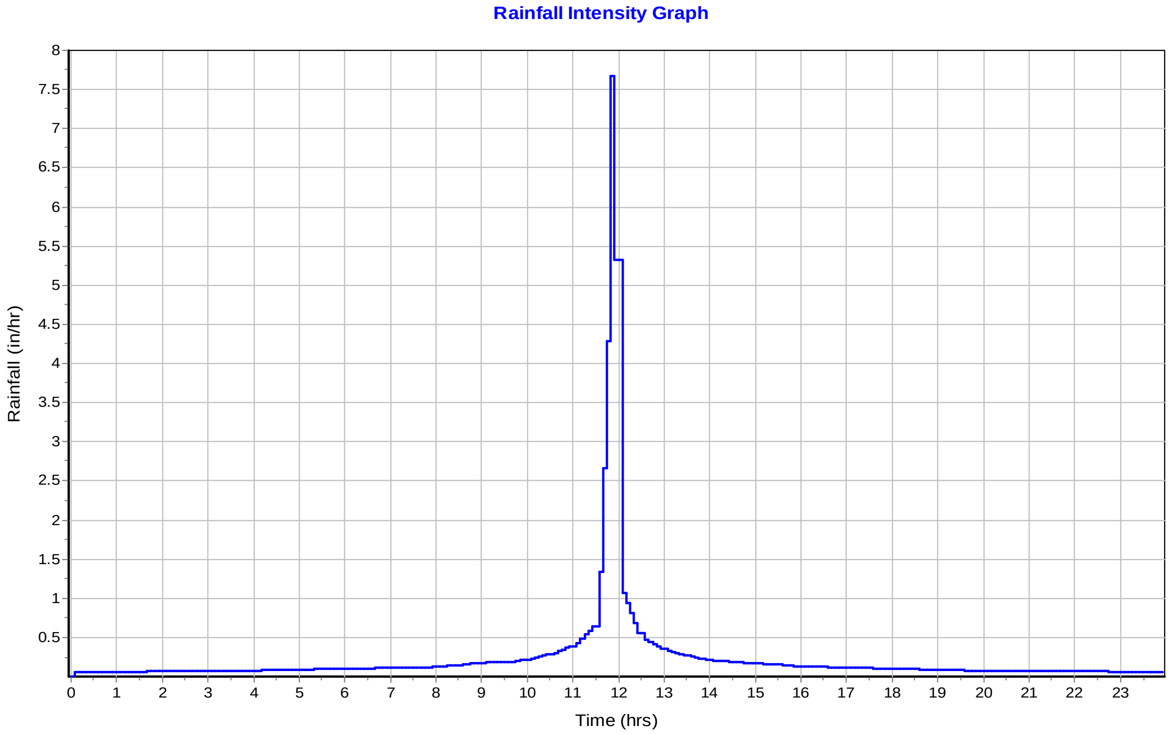
Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	918.85	0	0
Slope (%) :	8	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	4.56	0	0
Computed Flow Time (min) :	3.36	0	0

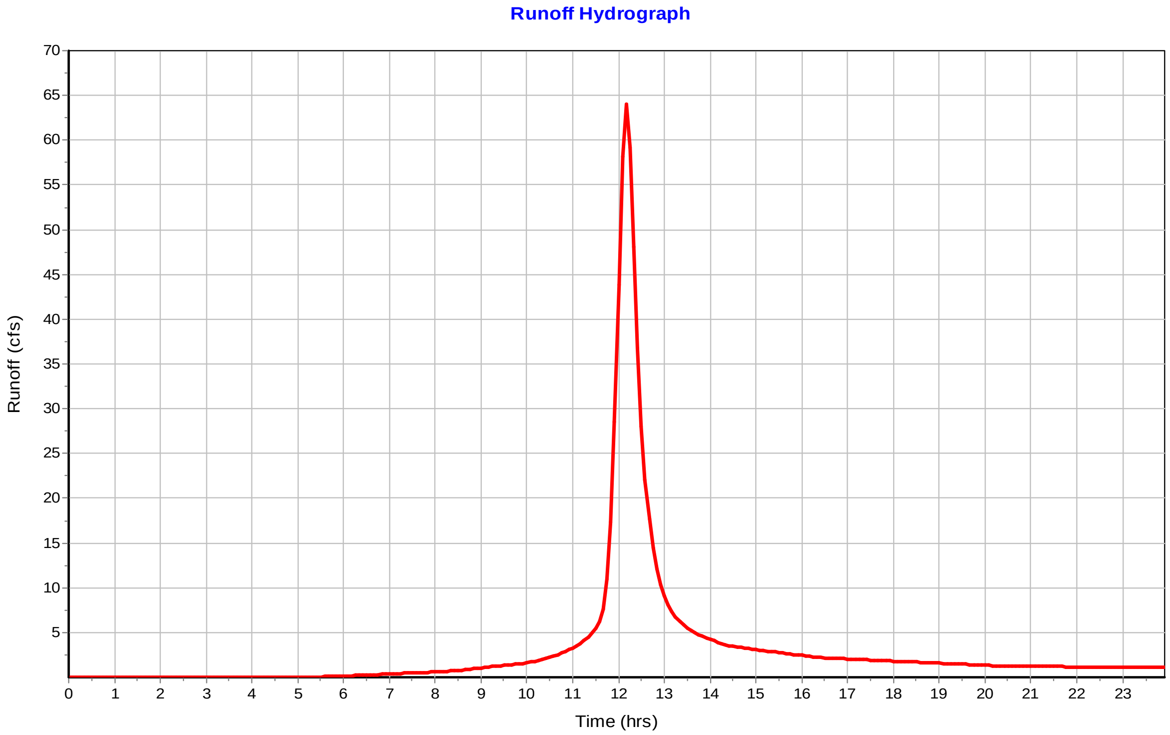
Total TOC (min) 29.31

Subbasin Runoff Results

Total Rainfall (in) 5.6
Total Runoff (in) 4
Peak Runoff (cfs) 64.08
Weighted Curve Number 85.7
Time of Concentration (days hh:mm:ss) 0 00:29:19

Subbasin : POST-DEVELOPMENT-P1





Subbasin : POST-DEVELOPMENT-P2

Input Data

Area (ac) 0.23
Peak Rate Factor 484
Weighted Curve Number 77.78
Rain Gage ID .... Rain Gage-01

Composite Curve Number

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
> 75% grass cover, Good	0.18	C	74
Gravel roads	0.06	C	89
Composite Area & Weighted CN	0.24		77.78

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.3	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	8	0	0
2 yr, 24 hr Rainfall (in) :	3	0	0
Velocity (ft/sec) :	0.16	0	0
Computed Flow Time (min) :	10.12	0	0

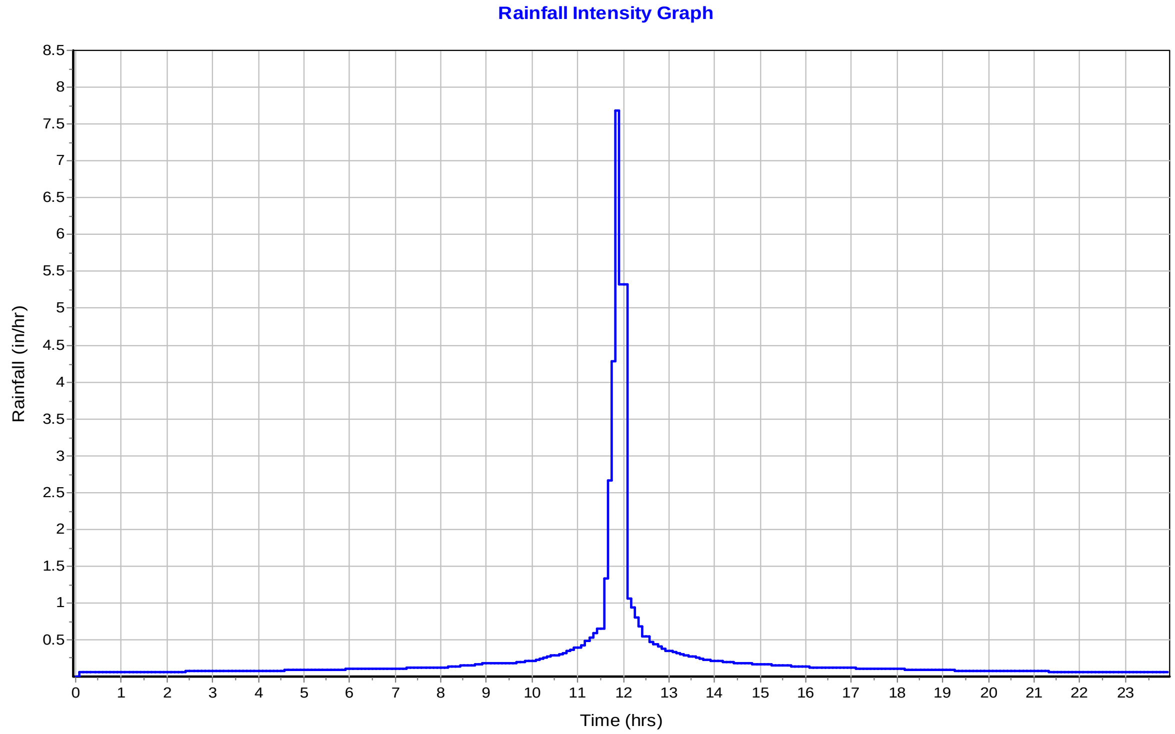
Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	17	0	0
Slope (%) :	8	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	4.56	0	0
Computed Flow Time (min) :	0.06	0	0

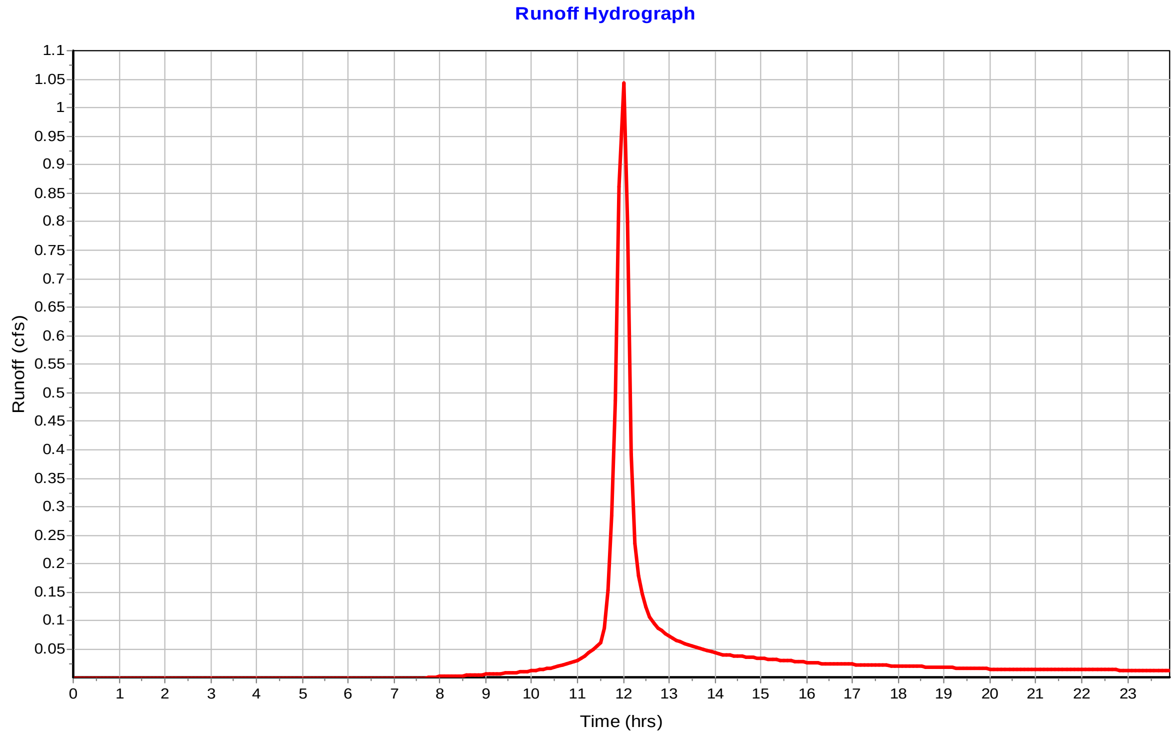
Total TOC (min) 10.18

Subbasin Runoff Results

Total Rainfall (in) 5.6
Total Runoff (in) 3.21
Peak Runoff (cfs) 1.05
Weighted Curve Number 77.78
Time of Concentration (days hh:mm:ss) 0 00:10:11

Subbasin : POST-DEVELOPMENT-P2





Subbasin : PRE-DEVELOPMENT-E1

Input Data

Area (ac) 18.07
Peak Rate Factor 484
Weighted Curve Number 88.03
Rain Gage ID .... Rain Gage-01

Composite Curve Number

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Fallow, crop residue, Good	17.76	C	88
Fallow, bare soil	0.16	C	91
Gravel roads	0.15	C	89
Composite Area & Weighted CN	18.07		88.03

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.3	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	4.8	0	0
2 yr, 24 hr Rainfall (in) :	1	0	0
Velocity (ft/sec) :	0.08	0	0
Computed Flow Time (min) :	21.5	0	0

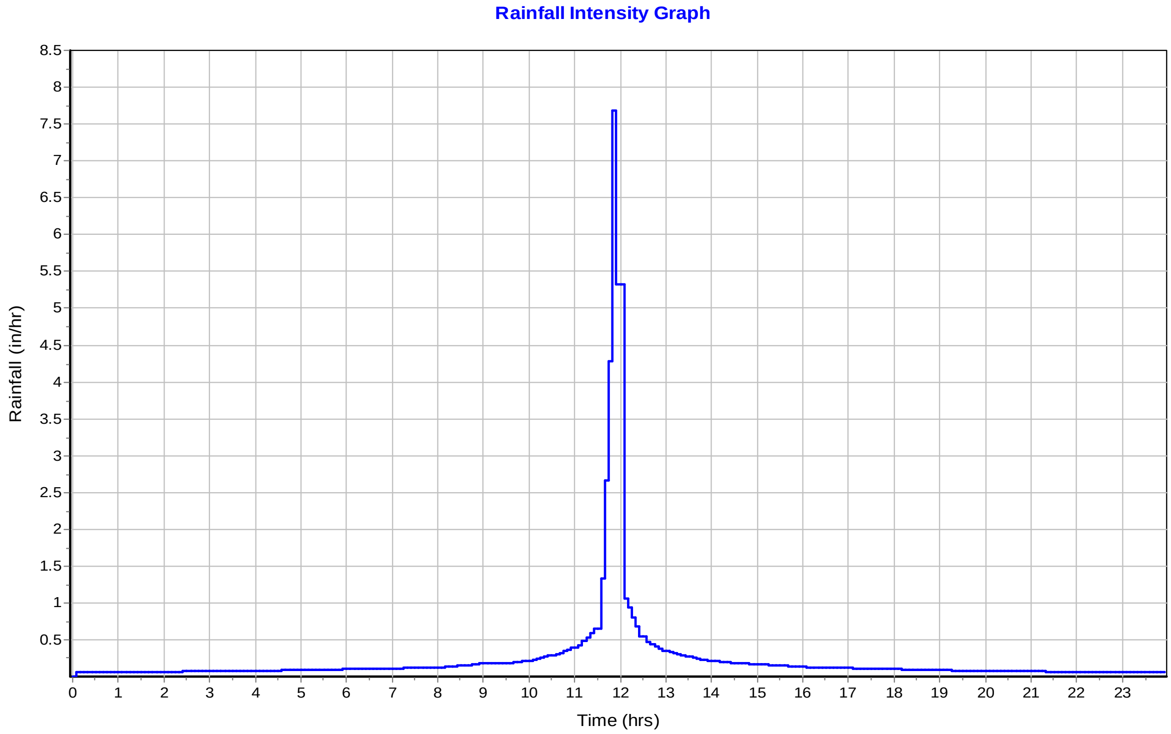
Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	566.4872	0	0
Slope (%) :	13	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	5.82	0	0
Computed Flow Time (min) :	1.62	0	0

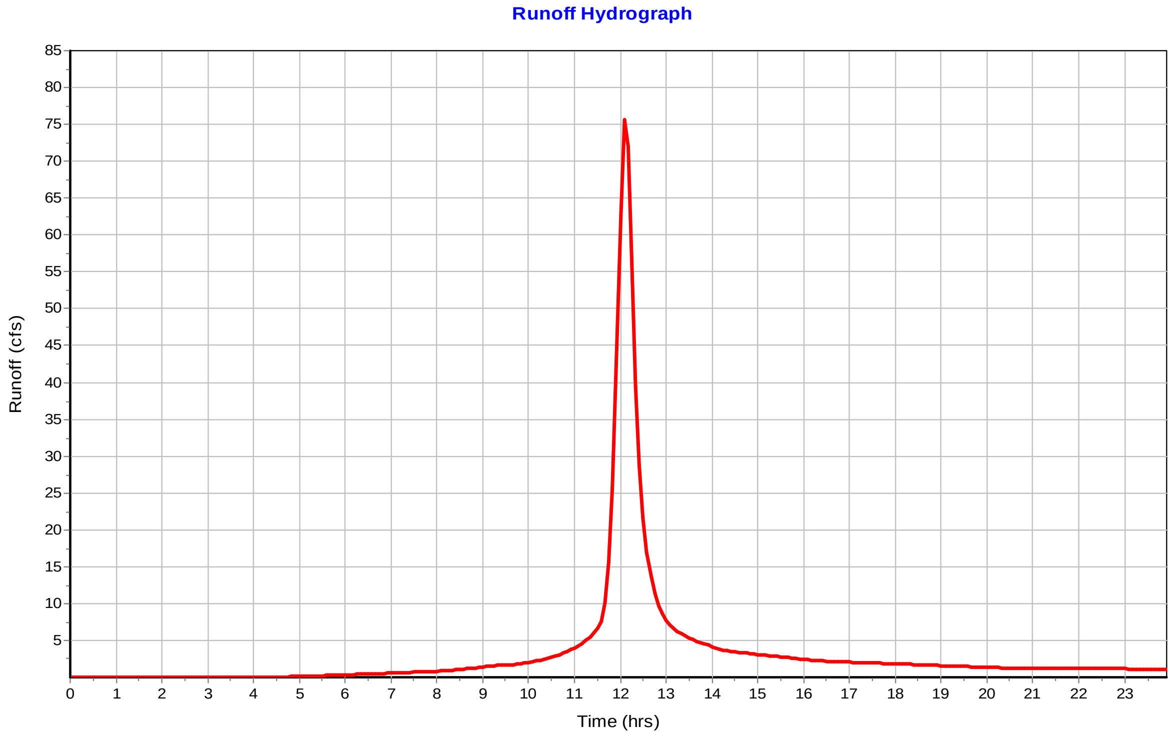
Total TOC (min) 23.12

Subbasin Runoff Results

Total Rainfall (in) 5.6
Total Runoff (in) 4.25
Peak Runoff (cfs) 76.5
Weighted Curve Number 88.03
Time of Concentration (days hh:mm:ss) 0 00:23:07

Subbasin : PRE-DEVELOPMENT-E1





Junction Input

SN	Element ID	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Ground/Rim (Max) Offset (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Surcharge Elevation (ft)	Surcharge Depth (ft)	Ponded Area (ft²)	Minimum Pipe Cover (in)
1	End-Junction-P-1	579.00	581.00	2.00	579.00	0.00	581.00	0.00	0.00	0.00
2	End-Junction-P-2	577.00	580.00	3.00	577.00	0.00	0.00	-580.00	0.00	0.00
3	Initial-Junction-P1	635.50	637.50	2.00	635.50	0.00	637.50	0.00	34.00	0.00
4	Initial-Junction-P2	580.00	582.00	2.00	580.00	0.00	0.00	-582.00	0.00	0.00

Junction Results

SN	Element ID	Peak Inflow (cfs)	Peak Lateral Inflow (cfs)	Max HGL Elevation Attained (ft)	Max HGL Depth Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Average HGL Elevation Attained (ft)	Average HGL Depth Attained (ft)	Time of Max HGL Occurrence (days hh:mm)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	End-Junction-P-1	63.78	0.00	582.14	3.14	0.00	0.86	580.29	1.29	0 12:15	0 00:00	0.00	0.00
2	End-Junction-P-2	63.37	0.00	578.68	1.68	0.00	1.32	577.23	0.23	0 12:17	0 00:00	0.00	0.00
3	Initial-Junction-P1	63.98	63.98	636.90	1.40	0.00	0.60	635.68	0.18	0 12:15	0 00:00	0.00	0.00
4	Initial-Junction-P2	1.04	1.04	580.20	0.20	0.00	1.80	580.02	0.02	0 12:05	0 00:00	0.00	0.00

Channel Input

SN	Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Shape	Height (ft)	Width (ft)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate
1	ROAD-SIDE-DITCH-P1	577.00	635.50	0.00	580.00	1.00	55.50	9.6200	Trapezoidal	2.000	6.800	0.0320	0.5000	0.5000	0.0000	0.00	No
2	ROAD-SIDE-DITCH-P2	117.00	580.00	0.00	577.00	0.00	3.00	2.5600	Trapezoidal	2.000	6.800	0.0320	0.5000	0.5000	0.0000	0.00	No

Channel Results

SN	Element ID	Peak Flow (cfs)	Time of Peak Flow Occurrence (days hh:mm)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Travel Time (min)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Froude Number	Reported Condition
1	ROAD-SIDE-DITCH-P1	63.78	0 12:15	132.33	0.48	12.49	0.77	1.39	0.70	0.00		
2	ROAD-SIDE-DITCH-P2	1.04	0 12:05	68.32	0.02	2.31	0.84	0.20	0.10	0.00		

Pipe Input

SN	Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Pipe Shape	Pipe Diameter or Height (in)	Pipe Width (in)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate	No. of Barrels
1	(1)-HDPE-PIPE	20.00	578.00	0.00	577.00	0.00	1.00	5.0000	CIRCULAR	30.000	30.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
2	(2)-HDPE-PIPES	120.00	580.00	1.00	579.50	1.50	0.50	0.4200	CIRCULAR	36.000	36.000	0.0150	0.5000	0.5000	0.0000	0.00	No	2
3	DIRECTLINK	2356.93	577.00	0.00	577.00	0.00	0.00	0.0000	Dummy	0.000	0.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1

Pipe Results

SN	Element ID	Peak Flow (cfs)	Time of Peak Flow Occurrence (days hh:mm)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Travel Time (min)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Froude Number	Reported Condition
1	(1)-HDPE-PIPE	63.01	0 12:17	79.49	0.79	17.96	0.02	1.65	0.67	0.00		Calculated
2	(2)-HDPE-PIPES	63.69	0 12:16	74.63	0.85	5.93	0.34	2.12	0.71	0.00		Calculated
3	DIRECTLINK	63.37	0 12:17	0.00	0.85	0.00		2.12	0.71	0.00		Calculated

Storage Nodes

Storage Node : SANDFILTER

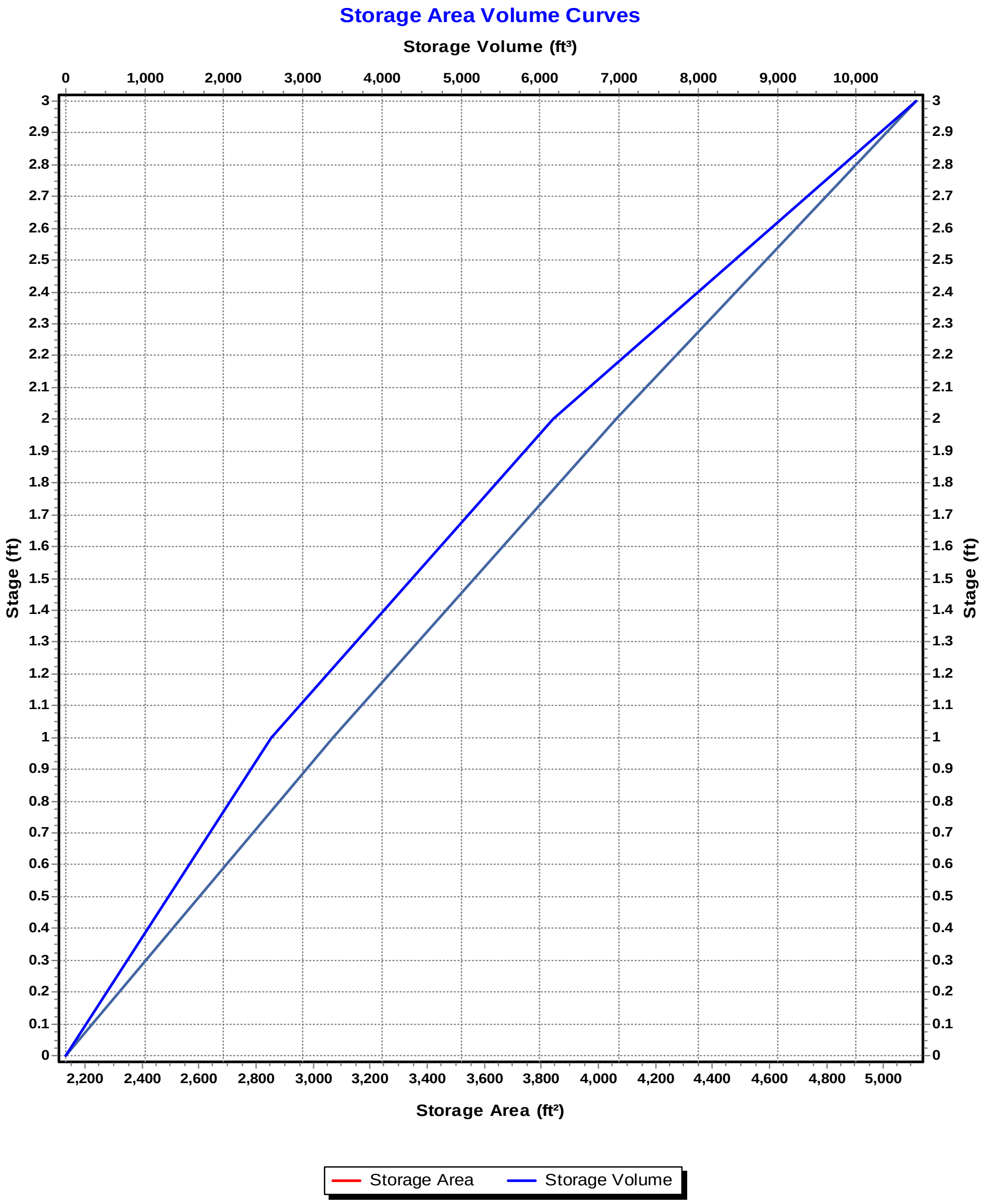
Input Data

Invert Elevation (ft) 578.00
Max (Rim) Elevation (ft) 581.00
Max (Rim) Offset (ft) 3.00
Initial Water Elevation (ft) 578.00
Initial Water Depth (ft) 0.00
Ponded Area (ft²) 0.00
Evaporation Loss 0.00

Storage Area Volume Curves

Storage Curve : Storage-10

Stage (ft)	Storage Area (ft²)	Storage Volume (ft³)
0	2133.53	0
1	3070.53	2602.03
2	4064.03	6169.31
3	5114.09	10758.37


Storage Area Volume Curves
Storage Volume (ft³)
0
1,000
2,000
3,000
4,000
5,000
6,000
7,000
8,000
9,000
10,000
Stage (ft)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.1
1.2
1.3
1.4
1.5
1.6
1.7
1.8
1.9
2
2.1
2.2
2.3
2.4
2.5
2.6
2.7
2.8
2.9
3
2,200
2,400
2,600
2,800
3,000
3,200
3,400
3,600
3,800
4,000
4,200
4,400
4,600
4,800
5,000
Storage Area (ft²)
Storage Area
Storage Volume

Storage Node : SANDFILTER (continued)

Output Summary Results

Peak Inflow (cfs)	63.69
Peak Lateral Inflow (cfs)	0
Peak Outflow (cfs)	63.01
Peak Exfiltration Flow Rate (cfm)	0
Max HGL Elevation Attained (ft)	579.68
Max HGL Depth Attained (ft)	1.68
Average HGL Elevation Attained (ft)	578.23
Average HGL Depth Attained (ft)	0.23
Time of Max HGL Occurrence (days hh:mm)	0 12:17
Total Exfiltration Volume (1000-ft³)	0
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0

7.10. NRCS Soils Report

The following is the NRCS Custom Soil Resource Report for the project.

United States Department of Agriculture

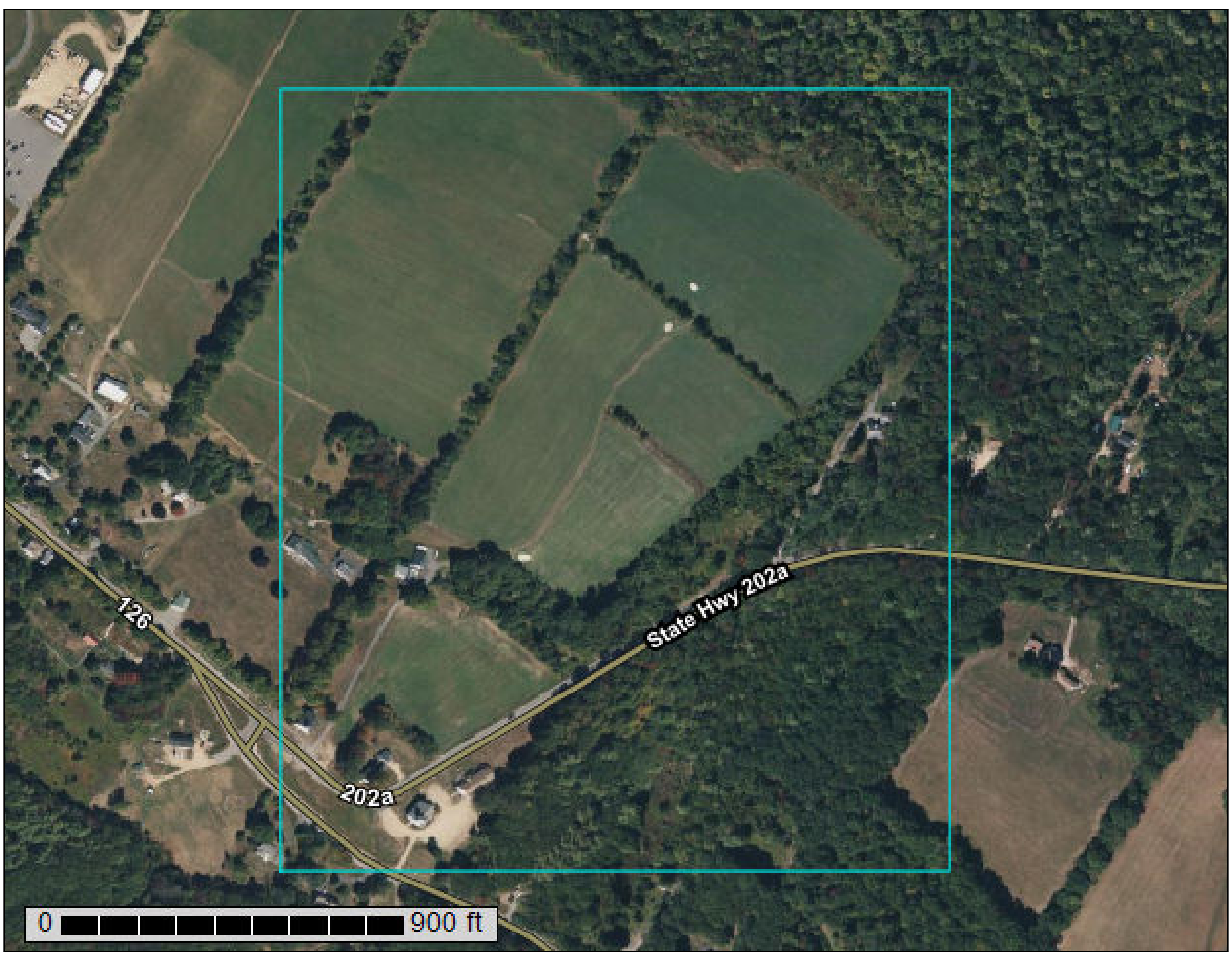
NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for

Strafford County, New Hampshire



March 12, 2023

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

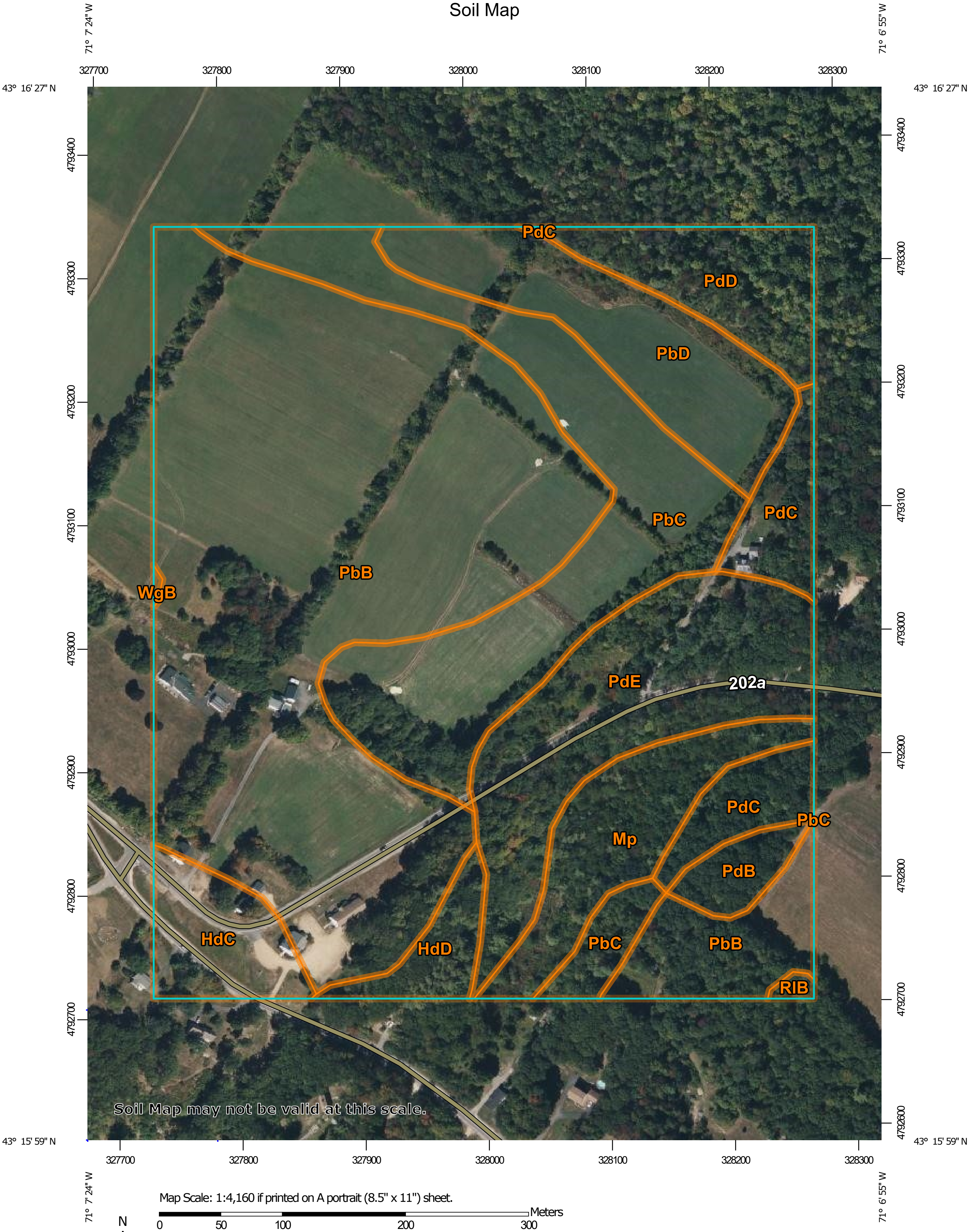
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Soil Map



Map Scale: 1:4,160 if printed on A portrait (8.5" x 11") sheet.

Meters: 0, 50, 100, 200, 300

Feet: 0, 200, 400, 800, 1200

N

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 Map Unit Polygons

Soil Map Unit Lines

Soil Map Unit Points

Special Point Features

Blowout

Borrow Pit

Clay Spot

Closed Depression

Gravel Pit

Gravelly Spot

Landfill

Lava Flow

Marsh or swamp

Mine or Quarry

Miscellaneous Water

Perennial Water

Rock Outcrop

Saline Spot

Sandy Spot

Severely Eroded Spot

Sinkhole

Slide or Slip

Sodic Spot

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Other

Special Line Features

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 1:20,000.

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: Strafford County, New Hampshire
Survey Area Data: Version 23, 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: Data not available.

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.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
HdC	Hollis-Charlton very rocky fine sandy loams, 8 to 15 percent slopes	2.8	3.4%
HdD	Hollis-Charlton very rocky fine sandy loams, 15 to 25 percent slopes	1.5	1.8%
Mp	Freetown and Swansea mucky peats, 0 to 2 percent slopes	4.4	5.3%
PbB	Paxton fine sandy loam, 3 to 8 percent slopes	37.0	44.6%
PbC	Paxton fine sandy loam, 8 to 15 percent slopes	13.4	16.1%
PbD	Paxton fine sandy loam, 15 to 25 percent slopes	6.3	7.6%
PdB	Paxton fine sandy loam, 0 to 8 percent slopes, very stony	1.2	1.4%
PdC	Paxton fine sandy loam, 8 to 15 percent slopes, very stony	3.5	4.2%
PdD	Paxton fine sandy loam, 15 to 25 percent slopes, very stony	3.7	4.4%
PdE	Paxton very stony fine sandy loam, 25 to 60 percent slopes	9.1	11.0%
RlB	Ridgebury fine sandy loam, 3 to 8 percent slopes, very stony	0.2	0.2%
WgB	Woodbridge fine sandy loam, 3 to 8 percent slopes	0.0	0.0%
Totals for Area of Interest		**83.1**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Strafford County, New Hampshire

HdC—Hollis-Charlton very rocky fine sandy loams, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 9d7n
Elevation: 0 to 1,200 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 120 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Hollis and similar soils: 40 percent
Charlton and similar soils: 30 percent
Minor components: 30 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hollis

Setting

Parent material: Till

Typical profile

H1 - 0 to 14 inches: very stony fine sandy loam
H2 - 14 to 18 inches: bedrock

Properties and qualities

Slope: 8 to 15 percent
Surface area covered with cobbles, stones or boulders: 1.6 percent
Depth to restrictive feature: 10 to 20 inches to lithic bedrock
Drainage class: Well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Very low (about 2.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: D
Ecological site: F144AY033MA - Shallow Dry Till Uplands
Hydric soil rating: No

Description of Charlton

Setting

Parent material: Till

Typical profile

H1 - 0 to 13 inches: very stony fine sandy loam
H2 - 13 to 36 inches: fine sandy loam

H3 - 36 to 40 inches: gravelly loamy sand

Properties and qualities

Slope: 8 to 15 percent
Surface area covered with cobbles, stones or boulders: 1.6 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 5.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: A
Ecological site: F144AY034CT - Well Drained Till Uplands
Hydric soil rating: No

Minor Components

Rock outcrop

Percent of map unit: 10 percent
Hydric soil rating: No

Not named

Percent of map unit: 10 percent
Hydric soil rating: No

Woodbridge

Percent of map unit: 5 percent
Hydric soil rating: No

Sutton

Percent of map unit: 5 percent
Hydric soil rating: No

HdD—Hollis-Charlton very rocky fine sandy loams, 15 to 25 percent slopes

Map Unit Setting

National map unit symbol: 9d7p
Elevation: 0 to 1,280 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 120 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Hollis and similar soils: 40 percent
Charlton and similar soils: 30 percent
Minor components: 30 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hollis

Setting

Parent material: Till

Typical profile

H1 - 0 to 14 inches: very stony fine sandy loam
H2 - 14 to 18 inches: bedrock

Properties and qualities

Slope: 15 to 25 percent
Surface area covered with cobbles, stones or boulders: 1.6 percent
Depth to restrictive feature: 10 to 20 inches to lithic bedrock
Drainage class: Well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Very low (about 2.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: D
Ecological site: F144AY033MA - Shallow Dry Till Uplands
Hydric soil rating: No

Description of Charlton

Setting

Parent material: Till

Typical profile

H1 - 0 to 13 inches: very stony fine sandy loam
H2 - 13 to 36 inches: fine sandy loam
H3 - 36 to 40 inches: gravelly loamy sand

Properties and qualities

Slope: 15 to 25 percent
Surface area covered with cobbles, stones or boulders: 1.6 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 5.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: A
Ecological site: F144AY034CT - Well Drained Till Uplands
Hydric soil rating: No

Minor Components

Not named

Percent of map unit: 20 percent
Hydric soil rating: No

Rock outcrop

Percent of map unit: 10 percent
Hydric soil rating: No

Mp—Freetown and Swansea mucky peats, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2w68w
Elevation: 10 to 940 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Freetown and similar soils: 50 percent
Swansea and similar soils: 30 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Freetown

Setting

Landform: Marshes, kettles, depressions, swamps, bogs
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Moderately decomposed organic material

Typical profile

Oe1 - 0 to 2 inches: mucky peat
Oe2 - 2 to 79 inches: mucky peat

Properties and qualities

Slope: 0 to 2 percent
Surface area covered with cobbles, stones or boulders: 0.0 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained

Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Available water supply, 0 to 60 inches: Very high (about 20.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydrologic Soil Group: B/D
Ecological site: F144AY043MA - Acidic Organic Wetlands
Hydric soil rating: Yes

Description of Swansea

Setting

Landform: Swamps, marshes, depressions, bogs, kettles
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Moderately decomposed organic material over sandy and gravelly glaciofluvial deposits

Typical profile

Oe1 - 0 to 12 inches: mucky peat
Oe2 - 12 to 25 inches: mucky peat
Cg - 25 to 79 inches: sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Available water supply, 0 to 60 inches: High (about 11.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydrologic Soil Group: B/D
Ecological site: F144AY043MA - Acidic Organic Wetlands
Hydric soil rating: Yes

Minor Components

Natchaug

Percent of map unit: 10 percent
Landform: Depressions, depressions, depressions
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Scarboro

Percent of map unit: 4 percent
Landform: Outwash deltas, outwash terraces, drainageways, depressions
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Whitman

Percent of map unit: 4 percent
Landform: Hills, depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Maybid

Percent of map unit: 2 percent
Landform: Marine terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

PbB—Paxton fine sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2t2qp
Elevation: 0 to 1,570 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Paxton and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Paxton

Setting

Landform: Hills, ground moraines, drumlins
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Nose slope, side slope, crest
Down-slope shape: Convex, linear
Across-slope shape: Convex

Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Ap - 0 to 8 inches: fine sandy loam
Bw1 - 8 to 15 inches: fine sandy loam
Bw2 - 15 to 26 inches: fine sandy loam
Cd - 26 to 65 inches: gravelly fine sandy loam

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 18 to 39 inches to densic material
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 18 to 37 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 3.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2s
Hydrologic Soil Group: C
Ecological site: F144AY007CT - Well Drained Dense Till Uplands
Hydric soil rating: No

Minor Components

Woodbridge

Percent of map unit: 9 percent
Landform: Hills, ground moraines, drumlins
Landform position (two-dimensional): Summit, backslope, footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Ridgebury

Percent of map unit: 6 percent
Landform: Hills, ground moraines, drainageways, depressions
Landform position (two-dimensional): Toeslope, backslope, footslope
Landform position (three-dimensional): Base slope, head slope, dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Charlton

Percent of map unit: 5 percent
Landform: Hills
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

PbC—Paxton fine sandy loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2w66y
Elevation: 0 to 1,320 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Paxton and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Paxton

Setting

Landform: Hills, ground moraines, drumlins
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex, linear
Across-slope shape: Convex
Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Ap - 0 to 8 inches: fine sandy loam
Bw1 - 8 to 15 inches: fine sandy loam
Bw2 - 15 to 26 inches: fine sandy loam
Cd - 26 to 65 inches: gravelly fine sandy loam

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: 20 to 39 inches to densic material
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 18 to 37 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 4.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Ecological site: F144AY007CT - Well Drained Dense Till Uplands

Hydric soil rating: No

Minor Components

Charlton

Percent of map unit: 7 percent
Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Woodbridge

Percent of map unit: 6 percent
Landform: Hills, ground moraines, drumlins
Landform position (two-dimensional): Summit, backslope, footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Ridgebury

Percent of map unit: 2 percent
Landform: Hills, ground moraines, drumlins, drainageways, depressions
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Head slope, base slope
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Hydric soil rating: Yes

PbD—Paxton fine sandy loam, 15 to 25 percent slopes

Map Unit Setting

National map unit symbol: 2w67j
Elevation: 0 to 1,450 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Paxton and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Paxton

Setting

Landform: Hills, ground moraines, drumlins
Landform position (two-dimensional): Backslope

Landform position (three-dimensional): Side slope
Down-slope shape: Convex, linear
Across-slope shape: Convex
Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Ap - 0 to 8 inches: fine sandy loam
Bw1 - 8 to 15 inches: fine sandy loam
Bw2 - 15 to 26 inches: fine sandy loam
Cd - 26 to 65 inches: gravelly fine sandy loam

Properties and qualities

Slope: 15 to 25 percent
Depth to restrictive feature: 20 to 39 inches to densic material
Drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 18 to 37 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 4.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Ecological site: F144AY007CT - Well Drained Dense Till Uplands
Hydric soil rating: No

Minor Components

Charlton

Percent of map unit: 8 percent
Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Woodbridge

Percent of map unit: 6 percent
Landform: Hills, ground moraines, drumlins
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Ridgebury

Percent of map unit: 1 percent
Landform: Hills, ground moraines, drumlins, drainageways, depressions
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Head slope, base slope

Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Hydric soil rating: Yes

PdB—Paxton fine sandy loam, 0 to 8 percent slopes, very stony

Map Unit Setting

National map unit symbol: 2w673
Elevation: 0 to 1,340 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Farmland of local importance

Map Unit Composition

Paxton, very stony, and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Paxton, Very Stony

Setting

Landform: Hills, ground moraines, drumlins
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Convex, linear
Across-slope shape: Linear, convex
Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Oe - 0 to 2 inches: moderately decomposed plant material
A - 2 to 10 inches: fine sandy loam
Bw1 - 10 to 17 inches: fine sandy loam
Bw2 - 17 to 28 inches: fine sandy loam
Cd - 28 to 67 inches: gravelly fine sandy loam

Properties and qualities

Slope: 0 to 8 percent
Surface area covered with cobbles, stones or boulders: 1.6 percent
Depth to restrictive feature: 20 to 43 inches to densic material
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 18 to 37 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 4.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: C
Ecological site: F144AY007CT - Well Drained Dense Till Uplands
Hydric soil rating: No

Minor Components

Woodbridge, very stony

Percent of map unit: 8 percent
Landform: Hills, ground moraines, drumlins
Landform position (two-dimensional): Summit, backslope, footslope
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Ridgebury, very stony

Percent of map unit: 4 percent
Landform: Hills, ground moraines, drumlins, drainageways, depressions
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Head slope, base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Charlton, very stony

Percent of map unit: 3 percent
Landform: Hills
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

PdC—Paxton fine sandy loam, 8 to 15 percent slopes, very stony

Map Unit Setting

National map unit symbol: 2w677
Elevation: 0 to 1,330 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Paxton, very stony, and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Paxton, Very Stony

Setting

Landform: Hills, ground moraines, drumlins
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex, linear
Across-slope shape: Linear, convex
Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Oe - 0 to 2 inches: moderately decomposed plant material
A - 2 to 10 inches: fine sandy loam
Bw1 - 10 to 17 inches: fine sandy loam
Bw2 - 17 to 28 inches: fine sandy loam
Cd - 28 to 67 inches: gravelly fine sandy loam

Properties and qualities

Slope: 8 to 15 percent
Surface area covered with cobbles, stones or boulders: 1.6 percent
Depth to restrictive feature: 20 to 43 inches to densic material
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 18 to 37 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 4.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: C
Ecological site: F144AY007CT - Well Drained Dense Till Uplands
Hydric soil rating: No

Minor Components

Woodbridge, very stony

Percent of map unit: 8 percent
Landform: Hills, ground moraines, drumlins
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Charlton, very stony

Percent of map unit: 5 percent
Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex

Across-slope shape: Convex
Hydric soil rating: No

Ridgebury, very stony
Percent of map unit: 2 percent
Landform: Hills, ground moraines, drumlins, drainageways, depressions
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Head slope, base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

PdD—Paxton fine sandy loam, 15 to 25 percent slopes, very stony

Map Unit Setting
National map unit symbol: 2w67h
Elevation: 0 to 1,400 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition
Paxton, very stony, and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Paxton, Very Stony

Setting
Landform: Hills, ground moraines, drumlins
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex, linear
Across-slope shape: Linear, convex
Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile
Oe - 0 to 2 inches: moderately decomposed plant material
A - 2 to 10 inches: fine sandy loam
Bw1 - 10 to 17 inches: fine sandy loam
Bw2 - 17 to 28 inches: fine sandy loam
Cd - 28 to 67 inches: gravelly fine sandy loam

Properties and qualities
Slope: 15 to 25 percent
Surface area covered with cobbles, stones or boulders: 1.6 percent
Depth to restrictive feature: 20 to 43 inches to densic material
Drainage class: Well drained
Runoff class: High

Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 18 to 37 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 4.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: C
Ecological site: F144AY007CT - Well Drained Dense Till Uplands
Hydric soil rating: No

Minor Components

Woodbridge, very stony

Percent of map unit: 5 percent
Landform: Hills, ground moraines, drumlins
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Charlton, very stony

Percent of map unit: 4 percent
Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Ridgebury, very stony

Percent of map unit: 1 percent
Landform: Hills, ground moraines, drumlins, drainageways, depressions
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Head slope, base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

PdE—Paxton very stony fine sandy loam, 25 to 60 percent slopes

Map Unit Setting

National map unit symbol: 9d8h
Elevation: 150 to 1,100 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F

Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Paxton and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Paxton

Setting

Parent material: Basal lodgement till derived from granite and gneiss and/or basal lodgement till derived from schist

Typical profile

H1 - 0 to 11 inches: very stony fine sandy loam
H2 - 11 to 22 inches: fine sandy loam
H3 - 22 to 41 inches: fine sandy loam

Properties and qualities

Slope: 25 to 60 percent
Surface area covered with cobbles, stones or boulders: 1.6 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)
Depth to water table: About 24 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: C
Ecological site: F144AY007CT - Well Drained Dense Till Uplands
Hydric soil rating: No

Minor Components

Not named

Percent of map unit: 12 percent
Hydric soil rating: No

Hollis

Percent of map unit: 3 percent
Hydric soil rating: No

RIB—Ridgebury fine sandy loam, 3 to 8 percent slopes, very stony

Map Unit Setting

National map unit symbol: 2xffx
Elevation: 40 to 1,320 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Ridgebury, very stony, and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ridgebury, Very Stony

Setting

Landform: Hills, ground moraines, drumlins, drainageways, depressions
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Head slope, base slope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material
A - 1 to 6 inches: fine sandy loam
Bw - 6 to 10 inches: sandy loam
Bg - 10 to 19 inches: gravelly sandy loam
Cd - 19 to 66 inches: gravelly sandy loam

Properties and qualities

Slope: 3 to 8 percent
Surface area covered with cobbles, stones or boulders: 1.6 percent
Depth to restrictive feature: 15 to 35 inches to densic material
Drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 3.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w

Hydrologic Soil Group: D
Ecological site: F144AY009CT - Wet Till Depressions
Hydric soil rating: Yes

Minor Components

Woodbridge, very stony

Percent of map unit: 7 percent
Landform: Hills, ground moraines, drumlins
Landform position (two-dimensional): Summit, backslope, footslope
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Convex
Across-slope shape: Linear
Hydric soil rating: No

Whitman, very stony

Percent of map unit: 4 percent
Landform: Hills, ground moraines, drumlins, drainageways, depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Walpole

Percent of map unit: 2 percent
Landform: Outwash terraces, drainageways, depressions
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Scituate, very stony

Percent of map unit: 2 percent
Landform: Hills, ground moraines, drumlins
Landform position (two-dimensional): Summit, backslope, footslope
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Convex, linear
Across-slope shape: Convex
Hydric soil rating: No

WgB—Woodbridge fine sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2t2ql
Elevation: 0 to 1,470 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Woodbridge, fine sandy loam, and similar soils: 82 percent
Minor components: 18 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Woodbridge, Fine Sandy Loam

Setting

Landform: Hills, ground moraines, drumlins
Landform position (two-dimensional): Summit, backslope, footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Ap - 0 to 7 inches: fine sandy loam
Bw1 - 7 to 18 inches: fine sandy loam
Bw2 - 18 to 30 inches: fine sandy loam
Cd - 30 to 65 inches: gravelly fine sandy loam

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 20 to 39 inches to densic material
Drainage class: Moderately well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 18 to 30 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 3.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: C/D
Ecological site: F144AY037MA - Moist Dense Till Uplands
Hydric soil rating: No

Minor Components

Paxton

Percent of map unit: 10 percent
Landform: Hills, ground moraines, drumlins
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Nose slope, side slope, crest
Down-slope shape: Convex, linear
Across-slope shape: Convex
Hydric soil rating: No

Ridgebury

Percent of map unit: 8 percent
Landform: Hills, ground moraines, drainageways, depressions

Landform position (two-dimensional): Toeslope, backslope, footslope
Landform position (three-dimensional): Base slope, head slope, dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

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