Stormwater Management Report

Whitney's Way

Off Pine Street

Norfolk, Massachusetts

November 12, 2019

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NARRATIVE

STORMWATER NARRATIVE
35 Pine Street, Norfolk, Massachusetts

The storm drainage system at the proposed residential development located at 35 Pine Street in Norfolk, Massachusetts, has been designed to create a reduction in the rate and volume of storm water runoff when compared to the existing site. In addition, the project's design will not reduce the quality of the runoff discharging from the site. The collection and treatment systems will be in the form of deep sump catch basins, water quality units, a subsurface infiltration system and infiltration basins. Hydrologic computations were performed in order to model the rate of flow of stormwater from the site under both existing and proposed conditions for a broad range of design storms.

1.0 STORM WATER COLLECTION SYSTEM

Throughout the proposed project, storm water will be collected from the impervious areas by a series of catch basins. The catch basins will be precast concrete with 4 foot deep sumps for sediment settlement and will be equipped with cast iron hoods on the outlets to prevent the discharge of floating debris and other substances.

The collected runoff will be conveyed to the water quality and infiltration components through smooth interior walled HDPE piping with corrugated exterior walls. The corrugated exterior of the piping provides for exceptional strength and bearing capacity. The smooth interior walls of the piping provide a smoothness that exceeds that of concrete pipe, thus providing increased hydraulic capacity. The piping is designed to provide self cleansing velocities in large storm events to remain essentially maintenance free throughout its life.

All runoff from paved surfaces will then be directed through a water quality unit for removal of Total Suspended Solids (TSS) and then into a subsurface infiltration system designed to infiltrate all runoff up to, and including, the 100 year storm event. All roof runoff, which is considered clean by the Stormwater Management Standards, will be directed into infiltration basins where it will recharge into the groundwater. The infiltration systems have been designed to meet the requirement for recharge and to handle more than the 100-year design storm event.

2.0 STORM WATER MANAGEMENT FACILITIES

Current Department of Environmental Protection Policies require that the peak runoff rate after development is not more than peak runoff rate prior to development for the 2 and 10 year 24-hour storm events. Additionally, it is required that the storm water management system be evaluated for the 100-year storm projections.

Hydrologic modeling has been conducted for the design of the infiltration areas to determine appropriate sizing and infiltration characteristics. HydroCAD Version 10.00 was utilized to

perform this hydrologic and hydraulic modeling. The 2, 10, and 100 year - design storms were evaluated. The hydrologic and hydraulic modeling established that the stormwater management systems will effectively attenuate the full range of design storms. That is, the peak rate of flow after development will be less than under existing conditions. The drainage summary provided with this document tabulates the projected decrease in runoff rate when the site is subjected to the design storm events. The complete hydrologic and hydraulic computational output is presented in this document.

2.1 LOW IMPACT DEVELOPMENT (LID) CONSIDERATIONS

The Massachusetts Stormwater Handbook encourages the use of Low Impact Development (LID) techniques by offering design credits for their implementation. No credits are sought or required for this project and, therefore, no LID techniques are required. Nevertheless, the project design incorporates LID techniques by proposing the minimum amount of pavement necessary to provide the parking spaces required by the town and the accessibility of the site for emergency response vehicles. The roadway is designed with a width of 20 feet and the driveways are designed with just enough length to allow a car to park in front of each garage door. In addition, the project proposes to utilize three areas for stormwater infiltration rather than collecting and infiltrating all of the stormwater runoff in one centralized location.

3.0 WATER QUALITY CONSIDERATIONS

On November 18, 1996, The Massachusetts Department of Environmental Protection (MADEP) issued the Storm Water Management Policy. The goal of this policy is to improve water quality and address flooding problems, which are sometimes caused by development projects, by the implementation of performance standards for storm water management. These standards were issued as guidelines with the possibility that in several years, after review by design engineers, they might be implemented as regulations. The project was designed to meet and exceed all relevant standards established in the policy. The following sections describe how each of these standards will be achieved on this project by incorporating Best Management Practices into the design. In January, 2008, the revised policy was issued.

3.1 UNTREATED STORM WATER - Standard 1

Standard 1 recommends that no new storm water conveyance, such as storm drain outfalls, discharge untreated storm water directly to wetlands or waterways of the Commonwealth. Flows from woods, fields, and other undeveloped areas are to be considered uncontaminated, however, runoff from paved road surfaces should receive treatment prior to discharge.

In designing this project, provisions have been made so that the runoff from all paved surfaces will receive proper treatment prior to discharge. All the proposed improvements will be located and graded such that runoff from the roadways will be directed to a series of BMP structures. Runoff from these areas will be collected and conveyed to the water quality measures through a

series of deep sump catch basins, manholes and subsurface piping. This collected runoff will receive a treatment utilizing Best Management Practice (BMP) measures designed into the water quality unit as further described under the discussions for Standards 2 through 9. Through the collection and treatment of all runoff from paved areas, DEP Standard 1 is satisfied.

3.2 POST DEVELOPMENT PEAK DISCHARGE RATES - Standard 2

Standard 2 prescribes that storm water management systems be implemented in order to ensure that post-development peak rates of discharge do not exceed existing rates of runoff for standard 2-year and 10-year design storms. In addition, the pre and post peak rates for the 100 year storm must be evaluated to assure that there will not be increased off-site flooding. Hydrologic calculations have been conducted in designing the storm water control measures to ensure that this standard is satisfied.

HydroCAD version 10.00, a computer aided design program, was selected for modeling the hydrology and hydraulics of storm water runoff for the site and its contributing drainage area. This program utilizes the latest techniques to predict the consequences of any given storm event and to verify that the drainage system is adequate to meet the performance standards for the area under consideration. The HydroCAD computer model uses TR-20 and TR-55 methodologies to generate runoff hydrographs and perform hydraulic routings through the modeled project.

Runoff hydrographs were generated for each subcatchment area. For post-development, all roadways, driveways, roof areas and lawn areas were considered in determining composite runoff curve numbers for each subcatchment. For pre-development, all subcatchments were evaluated in their existing condition. The soils within the development area of this project are described as hydrologic soils group A, according to the U.S.D.A., Soil Conservation Service mapping.

In evaluating the same areas under pre and post development conditions, a direct comparison can be made as to the net increase or decrease in runoff rates attributable to altered land uses. The Drainage Summary table included in this report presents a summary of the hydrologic modeling conducted for this project. As presented in this table, the drainage system successfully moderates the flow for the full range of design storms and this standard is met.

3.3 RECHARGE TO GROUNDWATER - STANDARD 3

The loss of annual recharge to groundwater will be minimized through the infiltration of roof runoff from the proposed homes and the treated stormwater from the paved and unpaved surface areas of the project site. The annual recharge from the post development site will approximate the annual recharge from the pre-development conditions based on an assessment of soil types. Standard 3 of the DEP Stormwater Policy prescribes that the storm water runoff volume to be recharged to groundwater should be determined using existing soil. According to the U.S.D.A. Soil Conservation Service mapping, the surficial soils are Hydrologic Soil Groups A. The DEP

Stormwater Policy requires that a certain volume of runoff be infiltrated to groundwater based on the type of soil present and the amount of impervious area being generated by the proposed development. For Type A soils, the recharge rate has been established to be 0.6 inches of runoff.

The proposed amount of impervious area on the site is 25,009 sf. So, the required volume of recharge is:

25,009 sf x 0.6 in = 1,251 cf

For this project, all of the runoff from the proposed roofs, pavement and sidewalks is designed to be infiltrated on site. Based on the HydroCAD model, in the 2-year storm, 1,263 cf of runoff is recharged. Thus, this criterion is easily satisfied.

3.4 REMOVAL OF 80% OF TOTAL SUSPENDED SOLIDS - Standard 4

A series of stormwater BMP's have been designed in order to meet the objectives of removing 80% of the average annual load of total suspended solids. These proposed measures include:

- All catch basins to be installed on this project will be equipped with Massachusetts Highway Department standard hoods mounted over the catch basin outlet pipe.
- All catch basins will be constructed with a four (4) foot deep sump beneath the outlet pipe invert elevation.
- A water quality unit will be provided for the runoff from all paved areas.

The combination of the above features will result in the removal of over 80% of the total suspended solids as demonstrating through the following table:

A BMP	B TSS Removal Rate*	C Starting TSS Load**	D Amount Removed (BxC)	E Remaining load (C-D)
Deep-Sump, Hooded Catch Basins	25%	1.00**	.25	.75
Water Quality Units	80%	.75	.60	.15
Infiltration System	80%	.15	.12	.03
TOTAL TSS REMOVAL			**.97 x 100 = 97% Removal**	

** Equals remaining load from previous BMP (E)

* TSS Removal Rates as Published in the DEP Storm Water Policy Handbook (3/97)

3.5 USES WITH HIGHER POTENTIAL POLLUTANT LOADS - Standard 5

The DEP Storm Water Management Policy - Standard 5 requires that storm water discharges with higher potential pollutant loads, such as gas stations, be provided with specific BMP's. The use of infiltration practices for these discharges prior to pretreatment is prohibited. However, DEP has determined that roofs and roadways are not to be considered to be high yield potential pollutant loads, therefore, this standard does not apply to this project.

3.6 STORM WATER DISCHARGES TO CRITICAL AREAS - Standard 6

Standard 6 of the DEP Storm water Policy seeks to protect critical areas. Critical areas are specifically designated Outstanding Resource Waters (ORW's) such as shell fish beds, swimming beaches, cold water fisheries and recharge areas for public water supplies. Such areas require the use of specific BMP's, however, the proposed project will not discharge to any of these areas, therefore, this standard does not apply.

3.7 REDEVELOPMENT OF PREVIOUSLY DEVELOPED SITES - Standard 7

Standard 7 applies to sites which have been previously developed and are being redeveloped. Diminished performance of BMP's is allowed in these areas. This project is not a re-development and therefore, the design of the storm water management system meets all of the design standards.

3.8 EROSION AND SEDIMENT CONTROL -Standard 8

Erosion and sediment control measures have been developed for this project and are included in the construction set of drawings. These plans show the proposed locations for erosion control devices. The following supplemental provisions are also a part of this plan.

Erosion and Sedimentation Control measures which are proposed to be implemented during construction include the installation of and silt fencing which has the bottom 6 inches buried in the ground. Any extra excavated soil which is not used to bury the base of the fence will be cast up-gradient of the silt fence.

- Erosion control devices such as silt fence, haybales and silt socks shall be inspected after every major rainfall runoff event (over 1½" depth of precipitation). All damaged or misaligned devices shall be immediately repaired. Silt shall be immediately removed from all areas of the silt fence when depth of accumulation exceeds 6 inches.

- Sumps and out falls shall be inspected after every major rainfall runoff event (over 1½" depth of precipitation). Silt shall be immediately removed from all sumps where the depth of accumulation exceeds 9 inches.)

- All exposed construction areas will be stabilized upon completion in order to minimize the time that these areas are unstabilized.

With the full impact of the measures presented on the Erosion and Sedimentation Control Plans, along with the provisions stipulated above, Standard 8 will be satisfied.

3.9 OPERATIONS AND MAINTENANCE PLANS - Standard 9

Standard 9 of the DEP Storm Water Policy prescribes the adoption of a formal operation and maintenance plan to ensure that the storm water management systems function properly as designed. The proposed Operations and Maintenance Plan is attached in an appendix to this report.

DRAINAGE SUMMARY

Proposed
Pondville Heights
Norfolk, Massachusetts

Drainage Summary

2 YR STORM (3.2 in.)

Receptor	Pre Development		Post Development	
	Q Max (cfs)	V (AF)	Q Max (cfs)	V (AF)
Pine Street	0.00	0.000	0.00	0.000
West	0.00	0.000	0.00	0.000

10 YR STORM (4.8 in.)

Receptor	Pre Development		Post Development	
	Q Max (cfs)	V (AF)	Q Max (cfs)	V (AF)
Pine Street	0.00	0.000	0.00	0.000
West	0.00	0.001	0.00	0.001

25 YR STORM (5.5 in.)

Receptor	Pre Development		Post Development	
	Q Max (cfs)	V (AF)	Q Max (cfs)	V (AF)
Pine Street	0.01	0.008	0.00	0.000
West	0.00	0.002	0.00	0.002

50 YR STORM (6.1 in.)

Receptor	Pre Development		Post Development	
	Q Max (cfs)	V (AF)	Q Max (cfs)	V (AF)
Pine Street	0.03	0.019	0.00	0.000
West	0.01	0.007	0.01	0.004

100 YR STORM (6.8 in.)

Receptor	Pre Development		Post Development	
	Q Max (cfs)	V (AF)	Q Max (cfs)	V (AF)
Pine Street	0.06	0.038	0.00	0.000
West	0.02	0.015	0.02	0.006

SOIL REPORT

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 Norfolk and Suffolk Counties, Massachusetts

35 Pine Street, Norfolk, MA

July 22, 2019

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

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.

Map Scale: 1:1,840 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 25 50 100 150

Feet
0 50 100 200 300

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 1:25,000.

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

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

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

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

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

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

Soil Survey Area: Norfolk and Suffolk Counties, Massachusetts
Survey Area Data: Version 14, Sep 12, 2018

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

Date(s) aerial images were photographed: May 14, 2010—Apr 1, 2017

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
245C	Hinckley loamy sand, 8 to 15 percent slopes	9.4	55.0%
253D	Hinckley loamy sand, 15 to 35 percent slopes	2.3	13.2%
315B	Scituate fine sandy loam, 3 to 8 percent slopes	1.7	9.7%
317B	Scituate fine sandy loam, 3 to 8 percent slopes, extremely stony	0.9	5.1%
600	Pits, sand and gravel	1.0	5.7%
653	Udorthents, sandy	1.9	11.4%
Totals for Area of Interest		**17.1**	**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.

Norfolk and Suffolk Counties, Massachusetts

245C—Hinckley loamy sand, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2svm9
Elevation: 0 to 1,480 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

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

Description of Hinckley

Setting

Landform: Eskers, moraines, outwash terraces, outwash deltas, kame terraces, outwash plains, kames
Landform position (two-dimensional): Shoulder, toeslope, footslope, backslope
Landform position (three-dimensional): Crest, head slope, nose slope, side slope, riser
Down-slope shape: Convex, concave, linear
Across-slope shape: Concave, linear, convex
Parent material: Sandy and gravelly glaciofluvial deposits derived from gneiss and/or granite and/or schist

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material
A - 1 to 8 inches: loamy sand
Bw1 - 8 to 11 inches: gravelly loamy sand
Bw2 - 11 to 16 inches: gravelly loamy sand
BC - 16 to 19 inches: very gravelly loamy sand
C - 19 to 65 inches: very gravelly sand

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Low (about 3.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: A

Hydric soil rating: No

Minor Components

Windsor

Percent of map unit: 5 percent
Landform: Outwash terraces, outwash deltas, kames, eskers, moraines, kame terraces, outwash plains
Landform position (two-dimensional): Shoulder, backslope, footslope, toeslope
Landform position (three-dimensional): Nose slope, side slope, crest, head slope, riser
Down-slope shape: Linear, concave, convex
Across-slope shape: Convex, linear, concave
Hydric soil rating: No

Sudbury

Percent of map unit: 5 percent
Landform: Kame terraces, outwash plains, moraines, outwash deltas, outwash terraces
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Base slope, tread
Down-slope shape: Concave, linear
Across-slope shape: Linear, concave
Hydric soil rating: No

Merrimac

Percent of map unit: 5 percent
Landform: Outwash terraces, outwash plains, kames, eskers, moraines
Landform position (two-dimensional): Shoulder, backslope, footslope, toeslope
Landform position (three-dimensional): Side slope, crest, head slope, nose slope, riser
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

253D—Hinckley loamy sand, 15 to 35 percent slopes

Map Unit Setting

National map unit symbol: 2svmd
Elevation: 0 to 860 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

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

Description of Hinckley

Setting

Landform: Eskers, moraines, outwash terraces, outwash deltas, kame terraces, outwash plains, kames
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Crest, nose slope, side slope, head slope, riser
Down-slope shape: Linear, convex, concave
Across-slope shape: Linear, concave, convex
Parent material: Sandy and gravelly glaciofluvial deposits derived from gneiss and/or granite and/or schist

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material
A - 1 to 8 inches: loamy sand
Bw1 - 8 to 11 inches: gravelly loamy sand
Bw2 - 11 to 16 inches: gravelly loamy sand
BC - 16 to 19 inches: very gravelly loamy sand
C - 19 to 65 inches: very gravelly sand

Properties and qualities

Slope: 15 to 35 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Low (about 3.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Windsor

Percent of map unit: 10 percent
Landform: Outwash terraces, outwash deltas, kames, eskers, moraines, kame terraces, outwash plains
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Nose slope, crest, side slope, head slope, riser
Down-slope shape: Linear, concave, convex
Across-slope shape: Linear, concave, convex
Hydric soil rating: No

Merrimac

Percent of map unit: 3 percent

Landform: Moraines, outwash terraces, outwash plains, kame terraces, kames, eskers
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope, crest, head slope, nose slope, riser
Down-slope shape: Linear, convex, concave
Across-slope shape: Convex, linear, concave
Hydric soil rating: No

Sudbury

Percent of map unit: 2 percent
Landform: Outwash terraces, kame terraces, outwash plains, outwash deltas, moraines
Landform position (two-dimensional): Backslope, footslope, toeslope
Landform position (three-dimensional): Base slope, tread
Down-slope shape: Linear, concave
Across-slope shape: Concave, linear
Hydric soil rating: No

315B—Scituate fine sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: vky0
Mean annual precipitation: 45 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days
Farmland classification: All areas are prime farmland

Map Unit Composition

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

Description of Scituate

Setting

Landform: Drumlins
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Friable coarse-loamy eolian deposits over dense sandy lodgment till derived from granite and gneiss

Typical profile

H1 - 0 to 4 inches: fine sandy loam
H2 - 4 to 24 inches: sandy loam
H3 - 24 to 60 inches: loamy sand

Properties and qualities

Slope: 3 to 8 percent

Depth to restrictive feature: 18 to 34 inches to densic material
Natural drainage class: Moderately well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Montauk

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

Ridgebury

Percent of map unit: 5 percent
Landform: Depressions
Hydric soil rating: Yes

Woodbridge

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

317B—Scituate fine sandy loam, 3 to 8 percent slopes, extremely stony

Map Unit Setting

National map unit symbol: vky2
Mean annual precipitation: 45 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Scituate

Setting

Landform: Drumlins
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Side slope

Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Friable coarse-loamy eolian deposits over dense sandy lodgment till derived from granite and gneiss

Typical profile

H1 - 0 to 4 inches: fine sandy loam
H2 - 4 to 24 inches: sandy loam
H3 - 24 to 60 inches: loamy sand

Properties and qualities

Slope: 3 to 8 percent
Percent of area covered with surface fragments: 1.6 percent
Depth to restrictive feature: 18 to 34 inches to densic material
Natural drainage class: Moderately well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Woodbridge

Percent of map unit: 7 percent
Hydric soil rating: No

Montauk

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

Ridgebury

Percent of map unit: 3 percent
Landform: Depressions
Hydric soil rating: Yes

600—Pits, sand and gravel

Map Unit Setting

National map unit symbol: vkxc
Mean annual precipitation: 32 to 50 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 120 to 200 days
Farmland classification: Not prime farmland

Map Unit Composition

Pits: 100 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pits

Setting

Parent material: Loose, excavated sandy and gravelly glaciofluvial deposits

653—Udorthents, sandy

Map Unit Setting

National map unit symbol: vky8

Elevation: 0 to 3,000 feet

Mean annual precipitation: 45 to 54 inches

Mean annual air temperature: 43 to 54 degrees F

Frost-free period: 145 to 240 days

Farmland classification: Not prime farmland

Map Unit Composition

Udorthents and similar soils: 85 percent

Minor components: 15 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Udorthents

Setting

Landform position (two-dimensional): Summit, shoulder

Landform position (three-dimensional): Tread, riser

Down-slope shape: Linear, convex

Across-slope shape: Linear, convex

Parent material: Excavated and filled sandy glaciofluvial deposits

Typical profile

H1 - 0 to 6 inches: variable

H2 - 6 to 60 inches: variable

Properties and qualities

Slope: 0 to 25 percent

Depth to restrictive feature: More than 80 inches

Runoff class: Low

Capacity of the most limiting layer to transmit water (Ksat): Moderately low to very high (0.06 to 20.00 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None

Frequency of ponding: None

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 6s

Hydrologic Soil Group: A

Hydric soil rating: Unranked

Minor Components

Udorthents

Percent of map unit: 8 percent
Hydric soil rating: Unranked

Urban land

Percent of map unit: 5 percent
Hydric soil rating: Unranked

Swansea

Percent of map unit: 2 percent
Landform: Bogs
Hydric soil rating: Yes

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PIPE CALCULATIONS AND GRATE ANALYSIS
100 YEAR STORM

PINE STREET

Input Values

K Values for grate R-3405-A with a transverse gutter slope of 2%	
LONGITUDINAL SLOPE (%)	K FOR R-3405-A
1	19
1.5	20.75
2	22.5
2.5	24.25
3	26
3.5	27.25
4	28.5
4.5	29.5
5	30.5
5.5	31.5
6	32.5

K Values for grate R-3455-A with a transverse gutter slope of 2%	
LONGITUDINAL SLOPE (%)	K FOR R-3405-A
1	19
1.5	22
2	25
2.5	26.5
3	28
3.5	29.5
4	31
4.5	31.75
5	32.5
5.5	33.25
6	34

ROADWAY PROPERTIES	
Roughness Coefficient of Bituminous Asphalt	0.016
Transverse Slope	0.03

Geometric Values for grate R-3405-A	
Square Dimention (in.)	23.6
Free Area (sq. ft.)	1.3

GUTTER DEPTH OF FLOW

$$D = \left(\frac{QN}{0.56Z\sqrt{S}}\right)^{\frac{3}{8}}$$

Q = Channel flow (cfs)
Z = Reciprocal of transverse slope (ft/ft)
S = Longitudinal Slope
N = Roughness Coefficient
D = Depth (ft)

GUTTER CAPACITY OF GRATE

$$Q = KD^{\frac{5}{3}}$$

Q = Grate capacity (cfs)
K = Grate coef. from "Inlet Grate Capacities Manual"
D = Depth of flow in feet (from previous equation)

ORIFICE FLOW EQUATION

$$Q = .6A\sqrt{2gh}$$

Q = Capacity (cfs)
A = Free open area (sq. ft.)
g = Acceleration of Gravity (32.2 ft/s^2)
h = Head (ft.)

WEIR EQUATION

$$Q = 3.3P(h)^{\frac{3}{2}}$$

Q = Capacity (cfs)
P = Perimeter (ft.)
h = Head (ft.)

PINE STREET

GUTTER INLET CATCH BASINS

STRUCTURE	LONGITUDINAL SLOPE (%)	CONTRIBUTING FLOW (cfs)	CARRYOVER FLOW (cfs)	TOTAL FLOW (cfs)	DEPTH OF FLOW (ft)	WIDTH OF FLOW (ft)	K	CAPACITY (cfs)	OVERFLOW (cfs)	OVERFLOW TO
CB-1	5.0	0.89	0.00	0.89	0.12	3.96	30.50	0.88	0.01	CB-3
CB-3	5.0	0.82	0.01	0.83	0.12	3.87	30.50	0.84	0.00	CB-4
CB-4	6.7	0.40	0.00	0.40	0.08	2.79	32.50	0.52	0.00	PINE ST

PINE STREET

CATCH BASINS IN DEPRESSIONS

STRUCTURE	CONTRIBUTING FLOW (cfs)	CARRYOVER FLOW (cfs)	TOTAL FLOW (cfs)	SIDES ON CURB	(S)INGLE OR (D)OUBLE	P (ft)	HEAD OVER GRATE (ft)	ORIFICE		WEIR		MAX CAPACITY (cfs)	ACTUAL DEPTH (ft)	OVERFLOW (cfs)	OVERFLOW TO
								Q_{MAX} (cfs)	H (ft)	Q_{MAX} (cfs)	H (ft)				
CB-2	0.30	0.00	0.30	2	S	3.9	0.25	3.13	0.00	1.62	0.08	1.62 cfs	0.08 ft.	0.00	BASIN

RATIONAL METHOD OF FLOWS TOWARD INLET GRATES									
FROM	UNPAVED AREA	UNPAVED COEFFICIENT	PAVE/ROOF AREA	PAVE/ROOF COEFFICIENT	AREA ACRES	WEIGHTED C	TOC MIN.	i	Q cfs
CB-1	18392.0	0.20	4906.0	0.90	0.53	0.35	18	4.8^	0.89
CB-2	775.0	0.20	1872.0	0.90	0.06	0.70	6	7.0^	0.30
CB-3	2822.0	0.20	5075.0	0.90	0.18	0.65	6	7.0^	0.82
CB-4	2460.0	0.20	2249.0	0.90	0.11	0.53	6	7.0^	0.40

25-YEAR STORM INTENSITY
^ 100-YEAR STORM INTENSITY

OPEN CHANNEL FLOW CAPACITIES

FROM	TO	PIPE DIA.	FROM INVERT	TO INVERT	PIPE LENGTH	SLOPE FT./FT.	N VALUE	Q FULL cfs
CB-1	DMH-1	12	201.00	195.50	110	0.050	0.012	8.65
CB-2	DMH-1	12	199.00	195.50	87	0.040	0.012	7.76
CB-3	DMH-1	12	195.80	195.50	6	0.050	0.012	8.65
DMH-1	DMH-2	12	195.40	194.40	32	0.031	0.012	6.84
DMH-2	DMH-3	12	194.30	193.90	13	0.031	0.012	6.79
CB-4	DMH-3	12	194.15	193.90	7	0.036	0.012	7.31
DMH-3	INF	12	193.80	193.60	5	0.040	0.012	7.74

ZENITH CONSULTING ENGINEERS, LLC
CIVIL ENGINEERING

3 MAIN STREET
LAKEVILLE, MA 02347
TEL: (508) 947-4208

Pipe Design Calculations

PROJECT PINE STREET

INLET GRATE AND PIPE ANALYSIS

CALCULATED BY: RMF DATE

CHECKED BY: DATE

LOCATION		GRATE ANALYSIS						PIPE ANALYSIS							
FROM	TO	(S)ag or (G)utter	FLOW TO GRATE	GRATE CAPACITY	OVER-FLOW	DEPTH OF FLOW	FLOW TO PIPE	PIPE SIZE DIA.	LNGTH FT.	SLOPE FT./FT.	Q CAPACITY cfs	Q ACTUAL cfs	V FULL fps	V ACTUAL fps	CHECK?
CB-1	DMH-1	G	0.89	0.88	0.01	0.1"	0.88	12	110	0.0500	8.65	0.88	11.02	5.52	OK
CB-2	DMH-1	S	0.30	1.62	0.00	0.1"	0.30	12	87	0.0402	7.76	0.30	9.88	5.25	OK
CB-3	DMH-1	G	0.82	0.84	0.00	0.1"	0.82	12	6	0.0500	8.65	0.82	11.02	5.69	OK
DMH-1	DMH-2						2.00	12	32	0.0313	6.84	2.00	8.71	7.62	OK
DMH-2	DMH-3						2.00	12	13	0.0308	6.79	2.00	8.64	7.56	OK
CB-4	DMH-3	G	0.40	0.52	0.00	0.1"	0.40	12	7	0.0357	7.31	0.40	9.31	4.66	OK
DMH-3	INF						2.40	12	5	0.0400	7.74	2.40	9.86	8.87	OK

ILLICIT DISCHARGE STATEMENT

ZCE
Zenith Consulting Engineers, LLC

3 Main Street Lakeville, MA 02347
(508) 947-4208 - www.zcellc.com

- Civil Engineering
- Septic Design (Title 5)
- Septic Inspections (Title 5)
- Commercial and Industrial Site Plans
- Chapter 91 Permitting

ILLICIT DISCHARGE STATEMENT
(STANDARD #10)

RE: 35 PINE STREET, NORFOLK, MASSACHUSETTS

Standard 10 of the Massachusetts Stormwater Handbook prohibits illicit discharges to stormwater management systems. The following is an illicit discharge compliance statement based on existing conditions and design conditions for the proposed project.

EXISTING CONDITIONS

The existing site is a wooded area with no known illicit connections to the stormwater management systems in the area. Based on all the information available to the undersigned, and therefore, to the best of my knowledge, there are no current illicit discharges to the storm drainage system. If during construction, an illicit discharge is discovered, it shall be removed immediately.

PROPOSED DESIGN

The proposed project design does not include any illicit discharges. There are no points in the proposed storm drainage system where illicit discharges are likely to occur.

I hereby certify that the preceding is accurate.

Robert M. Forbes, P.E.
Zenith Consulting Engineers, LLC.

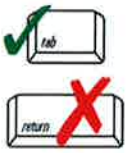
DEP STORMWATER CHECKLIST

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

Checklist for Stormwater Report

A. Introduction

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



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

The Stormwater Report must include:

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

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

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

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

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

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

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

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature

Robert M. Forbes 7-26-19
Signature and Date

Checklist

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

☒ New development

☐ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

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

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

Standard 1: No New Untreated Discharges

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

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

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

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

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

Standard 3: Recharge

☒ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

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

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

☐ Static ☒ Simple Dynamic ☐ Dynamic Field[1]

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

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

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

Standard 4: Water Quality

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

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

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

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

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

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

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

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

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

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

☐ All exposure has been eliminated.

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

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

Standard 6: Critical Areas

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

Standard 9: Operation and Maintenance Plan

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

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

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

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

Standard 10: Prohibition of Illicit Discharges

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

☒ An Illicit Discharge Compliance Statement is attached;

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

HYDROCAD OUTPUT

ATTACHMENT A
Pre-Development Calculations

2 Year 3.20"
10 Year 4.80"
25 Year 5.50"
50 Year 6.10"
100 Year 7.00"

Area flowing west

Area flowing toward Pine St

Subcat Reach Pond Link

Routing Diagram for pre-dev 35 pine

Prepared by {enter your company name here}, Printed 7/22/2019

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.172	39	>75% Grass cover, Good, HSG A (1S)
2.837	30	Woods, Good, HSG A (1S, 2S)
3.009	**31**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
3.009	HSG A	1S, 2S
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.000	Other	
3.009		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.172	0.000	0.000	0.000	0.000	0.172	>75% Grass cover, Good	1S
2.837	0.000	0.000	0.000	0.000	2.837	Woods, Good	1S, 2S
3.009	**0.000**	**0.000**	**0.000**	**0.000**	**3.009**	**TOTAL AREA**	

PRE-DEVELOPMENT CALCULATIONS
2-YEAR STORM - 3.20" RAINFALL

Time span=0.00-60.00 hrs, dt=0.01 hrs, 6001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Area flowing toward Runoff Area=88,392 sf 0.00% Impervious Runoff Depth=0.00"
Flow Length=605' Tc=10.9 min CN=31 Runoff=0.00 cfs 0.000 af

Subcatchment 2S: Area flowing west Runoff Area=42,662 sf 0.00% Impervious Runoff Depth=0.00"
Flow Length=418' Tc=16.2 min CN=30 Runoff=0.00 cfs 0.000 af

Total Runoff Area = 3.009 ac Runoff Volume = 0.000 af Average Runoff Depth = 0.00"
100.00% Pervious = 3.009 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1S: Area flowing toward Pine St

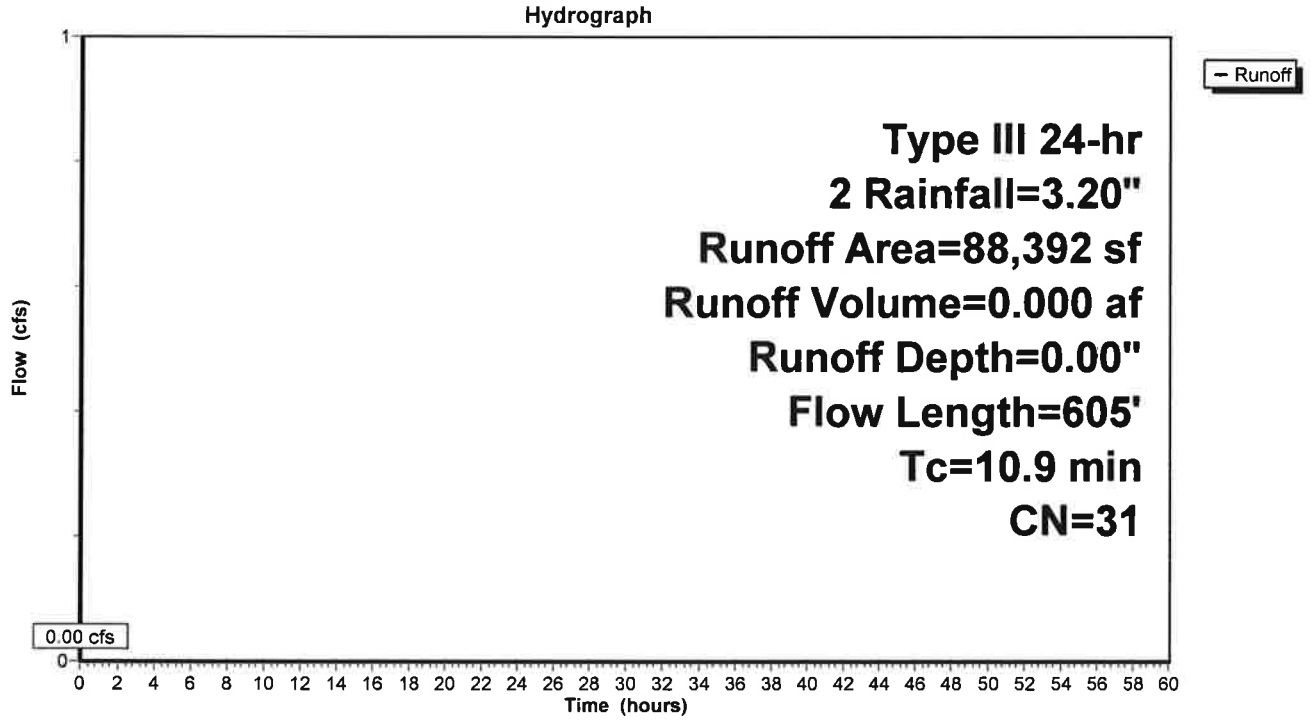
Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Rainfall=3.20"

Area (sf)	CN	Description
7,480	39	>75% Grass cover, Good, HSG A
80,912	30	Woods, Good, HSG A
88,392	31	Weighted Average
88,392		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.8	50	0.0300	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
0.6	50	0.0400	1.40		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
5.5	505	0.0950	1.54		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
10.9	605	Total			

Subcatchment 1S: Area flowing toward Pine St



Summary for Subcatchment 2S: Area flowing west

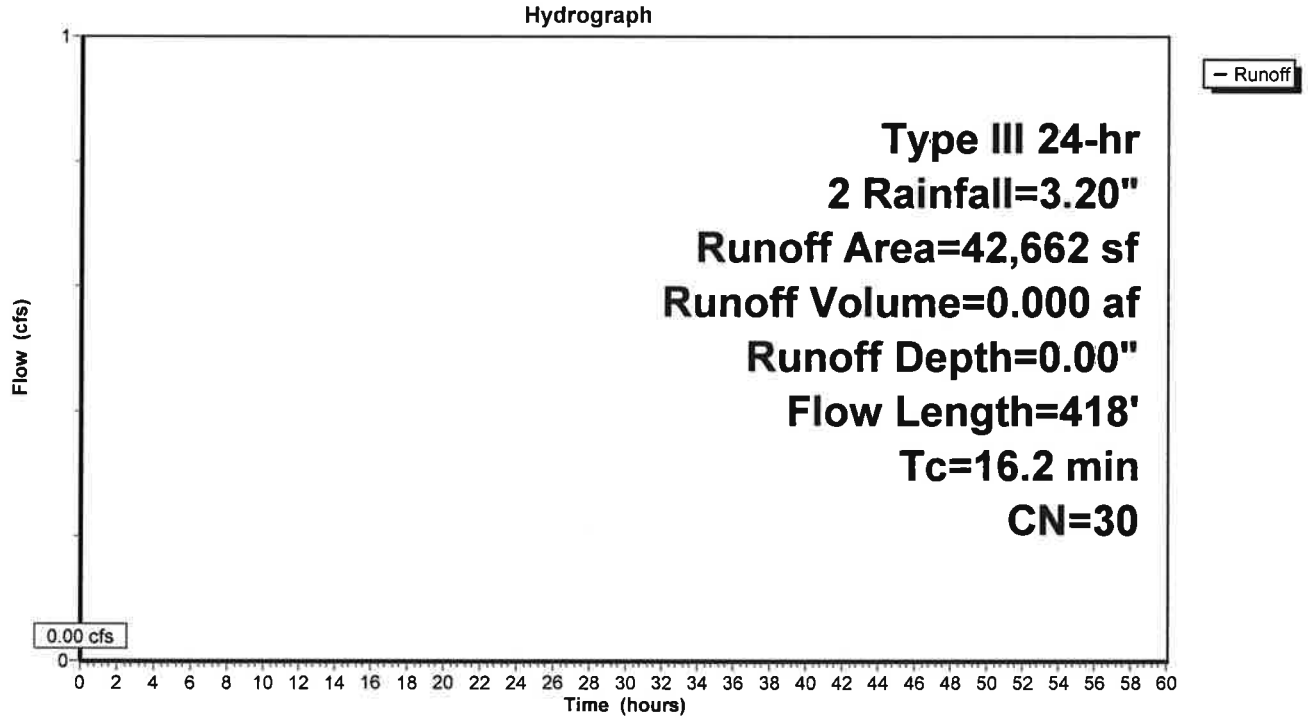
Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Rainfall=3.20"

Area (sf)	CN	Description
42,662	30	Woods, Good, HSG A
42,662		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0200	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
3.9	368	0.0980	1.57		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
16.2	418	Total			

Subcatchment 2S: Area flowing west



PRE-DEVELOPMENT CALCULATIONS
10-YEAR STORM - 4.80" RAINFALL

Time span=0.00-60.00 hrs, dt=0.01 hrs, 6001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Area flowing toward Runoff Area=88,392 sf 0.00% Impervious Runoff Depth=0.01"
Flow Length=605' Tc=10.9 min CN=31 Runoff=0.00 cfs 0.001 af

Subcatchment 2S: Area flowing west Runoff Area=42,662 sf 0.00% Impervious Runoff Depth=0.00"
Flow Length=418' Tc=16.2 min CN=30 Runoff=0.00 cfs 0.000 af

Total Runoff Area = 3.009 ac Runoff Volume = 0.001 af Average Runoff Depth = 0.00"
100.00% Pervious = 3.009 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1S: Area flowing toward Pine St

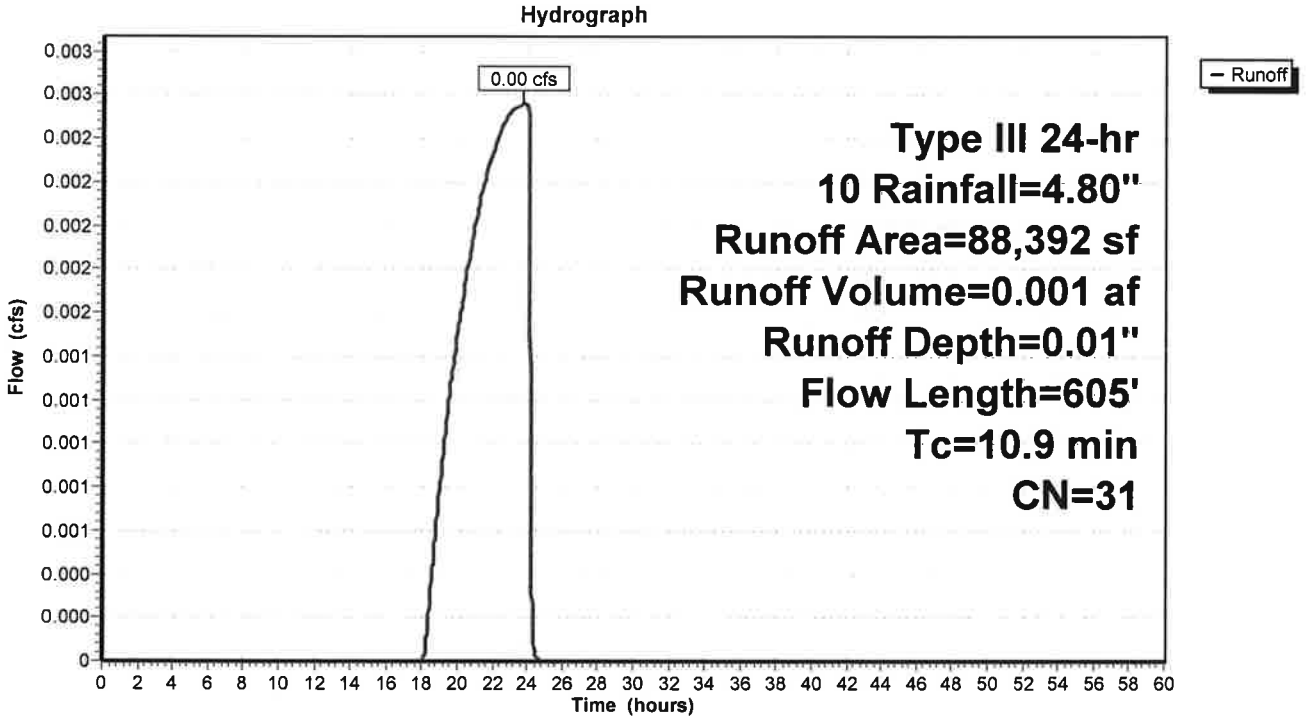
Runoff = 0.00 cfs @ 23.75 hrs, Volume= 0.001 af, Depth= 0.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Rainfall=4.80"

Area (sf)	CN	Description
7,480	39	>75% Grass cover, Good, HSG A
80,912	30	Woods, Good, HSG A
88,392	31	Weighted Average
88,392		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.8	50	0.0300	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
0.6	50	0.0400	1.40		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
5.5	505	0.0950	1.54		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
10.9	605	Total			

Subcatchment 1S: Area flowing toward Pine St



Summary for Subcatchment 2S: Area flowing west

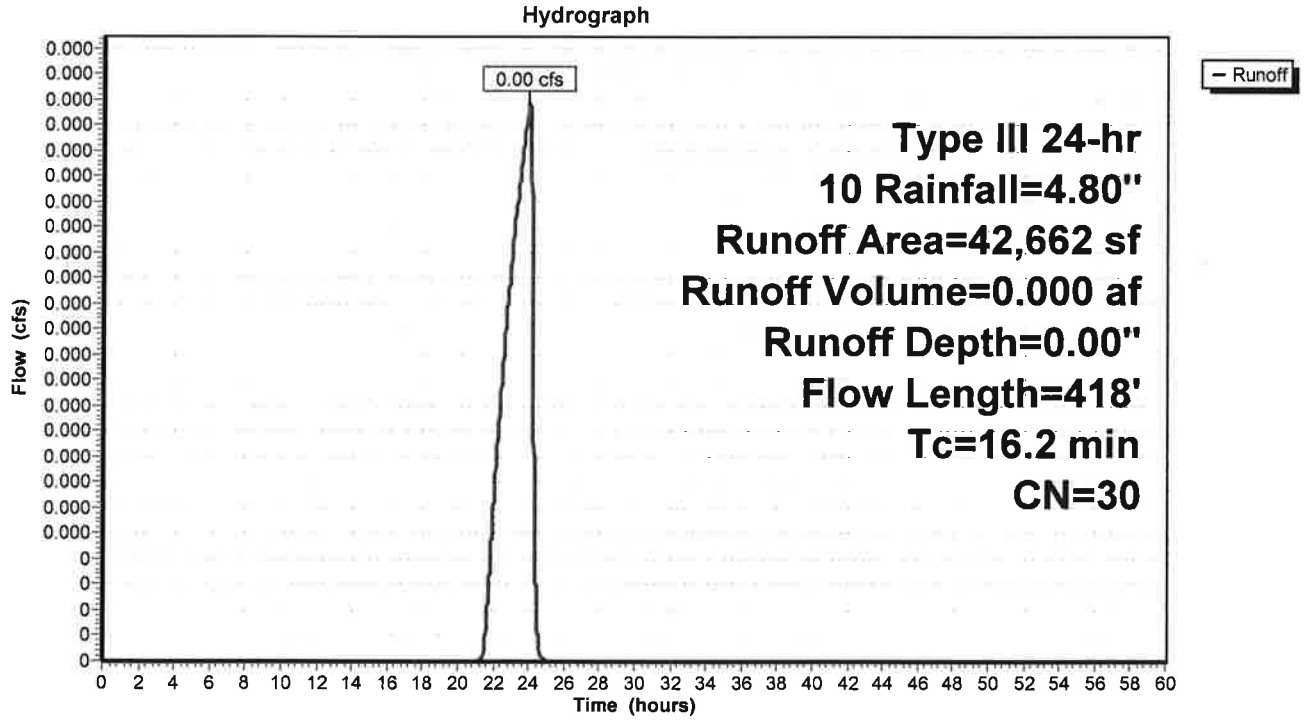
Runoff = 0.00 cfs @ 24.03 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Rainfall=4.80"

Area (sf)	CN	Description
42,662	30	Woods, Good, HSG A
42,662		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0200	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
3.9	368	0.0980	1.57		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
16.2	418	Total			

Subcatchment 2S: Area flowing west



PRE-DEVELOPMENT CALCULATIONS
25-YEAR STORM - 5.50" RAINFALL

Time span=0.00-60.00 hrs, dt=0.01 hrs, 6001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Area flowing toward Runoff Area=88,392 sf 0.00% Impervious Runoff Depth=0.05"
Flow Length=605' Tc=10.9 min CN=31 Runoff=0.01 cfs 0.008 af

Subcatchment 2S: Area flowing west Runoff Area=42,662 sf 0.00% Impervious Runoff Depth=0.03"
Flow Length=418' Tc=16.2 min CN=30 Runoff=0.00 cfs 0.002 af

Total Runoff Area = 3.009 ac Runoff Volume = 0.010 af Average Runoff Depth = 0.04"
100.00% Pervious = 3.009 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1S: Area flowing toward Pine St

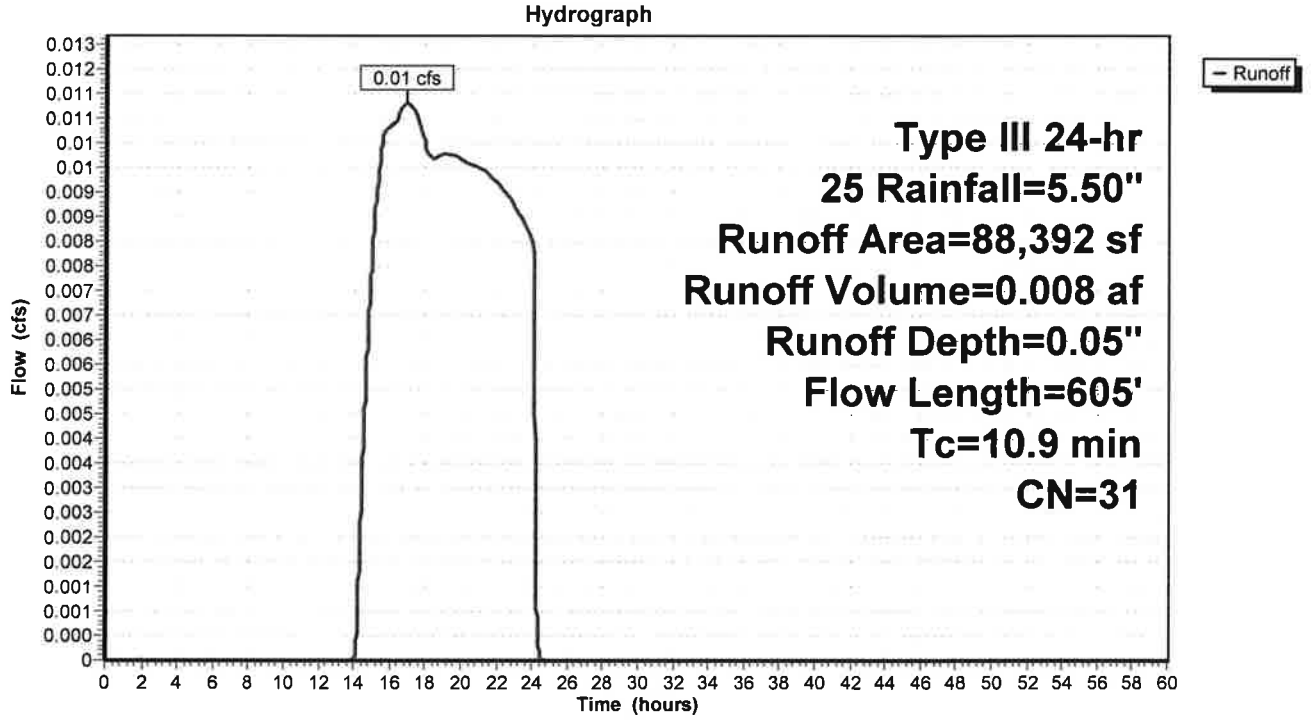
Runoff = 0.01 cfs @ 16.92 hrs, Volume= 0.008 af, Depth= 0.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 Rainfall=5.50"

Area (sf)	CN	Description
7,480	39	>75% Grass cover, Good, HSG A
80,912	30	Woods, Good, HSG A
88,392	31	Weighted Average
88,392		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.8	50	0.0300	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
0.6	50	0.0400	1.40		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
5.5	505	0.0950	1.54		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
10.9	605	Total			

Subcatchment 1S: Area flowing toward Pine St



Summary for Subcatchment 2S: Area flowing west

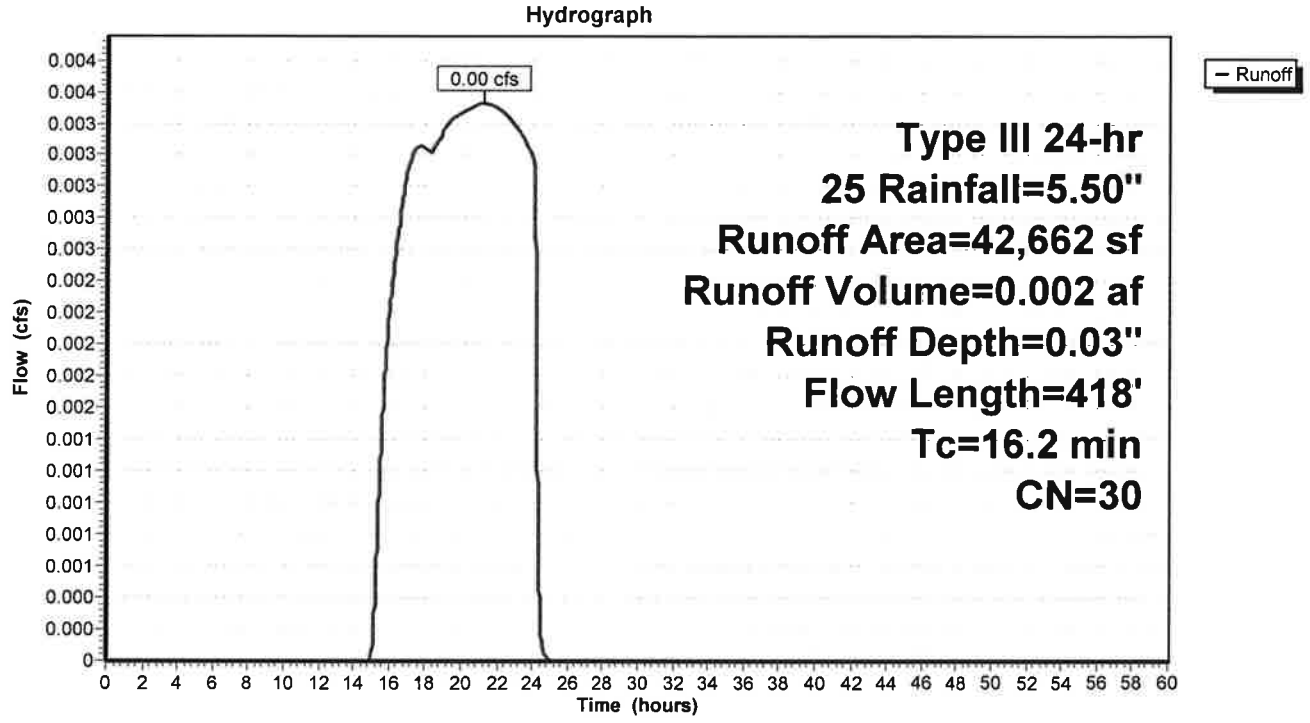
Runoff = 0.00 cfs @ 21.22 hrs, Volume= 0.002 af, Depth= 0.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 Rainfall=5.50"

Area (sf)	CN	Description
42,662	30	Woods, Good, HSG A
42,662		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0200	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
3.9	368	0.0980	1.57		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
16.2	418	Total			

Subcatchment 2S: Area flowing west



PRE-DEVELOPMENT CALCULATIONS
50-YEAR STORM – 6.10" RAINFALL

Time span=0.00-60.00 hrs, dt=0.01 hrs, 6001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Area flowing toward Runoff Area=88,392 sf 0.00% Impervious Runoff Depth=0.11"
Flow Length=605' Tc=10.9 min CN=31 Runoff=0.03 cfs 0.019 af

Subcatchment 2S: Area flowing west Runoff Area=42,662 sf 0.00% Impervious Runoff Depth=0.08"
Flow Length=418' Tc=16.2 min CN=30 Runoff=0.01 cfs 0.007 af

Total Runoff Area = 3.009 ac Runoff Volume = 0.026 af Average Runoff Depth = 0.10"
100.00% Pervious = 3.009 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1S: Area flowing toward Pine St

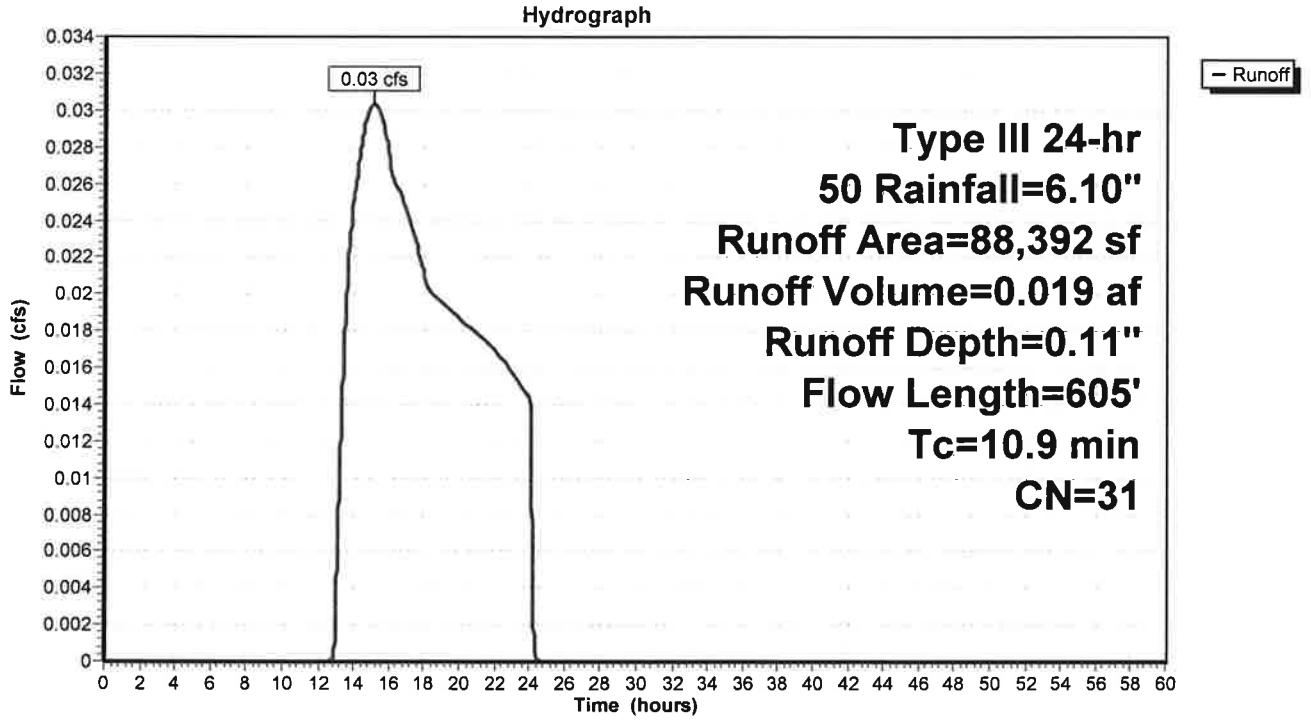
Runoff = 0.03 cfs @ 15.08 hrs, Volume= 0.019 af, Depth= 0.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Type III 24-hr 50 Rainfall=6.10"

Area (sf)	CN	Description
7,480	39	>75% Grass cover, Good, HSG A
80,912	30	Woods, Good, HSG A
88,392	31	Weighted Average
88,392		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.8	50	0.0300	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
0.6	50	0.0400	1.40		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
5.5	505	0.0950	1.54		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
10.9	605	Total			

Subcatchment 1S: Area flowing toward Pine St



Summary for Subcatchment 2S: Area flowing west

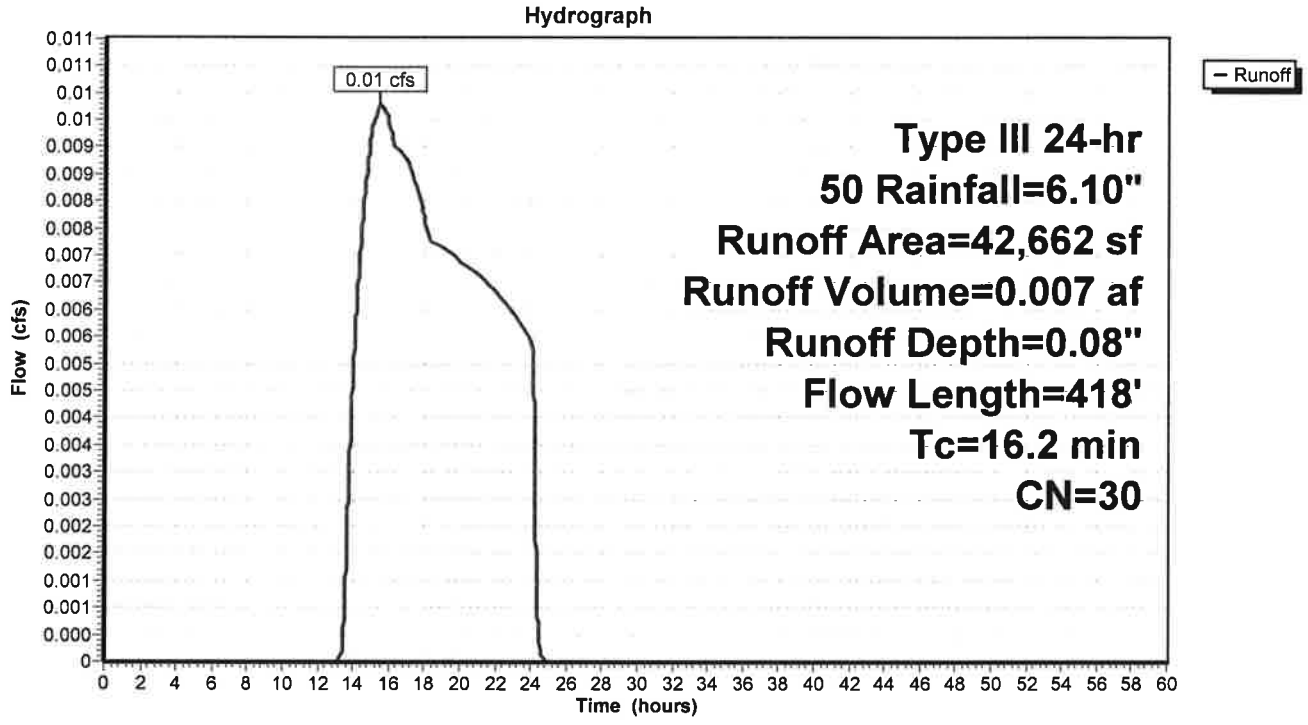
Runoff = 0.01 cfs @ 15.50 hrs, Volume= 0.007 af, Depth= 0.08"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Type III 24-hr 50 Rainfall=6.10"

Area (sf)	CN	Description
42,662	30	Woods, Good, HSG A
42,662		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0200	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
3.9	368	0.0980	1.57		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
16.2	418	Total			

Subcatchment 2S: Area flowing west



PRE-DEVELOPMENT CALCULATIONS
100-YEAR STORM – 6.80" RAINFALL

Time span=0.00-60.00 hrs, dt=0.01 hrs, 6001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Area flowing toward Runoff Area=88,392 sf 0.00% Impervious Runoff Depth=0.22"
Flow Length=605' Tc=10.9 min CN=31 Runoff=0.06 cfs 0.038 af

Subcatchment 2S: Area flowing west Runoff Area=42,662 sf 0.00% Impervious Runoff Depth=0.18"
Flow Length=418' Tc=16.2 min CN=30 Runoff=0.02 cfs 0.015 af

Total Runoff Area = 3.009 ac Runoff Volume = 0.052 af Average Runoff Depth = 0.21"
100.00% Pervious = 3.009 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1S: Area flowing toward Pine St

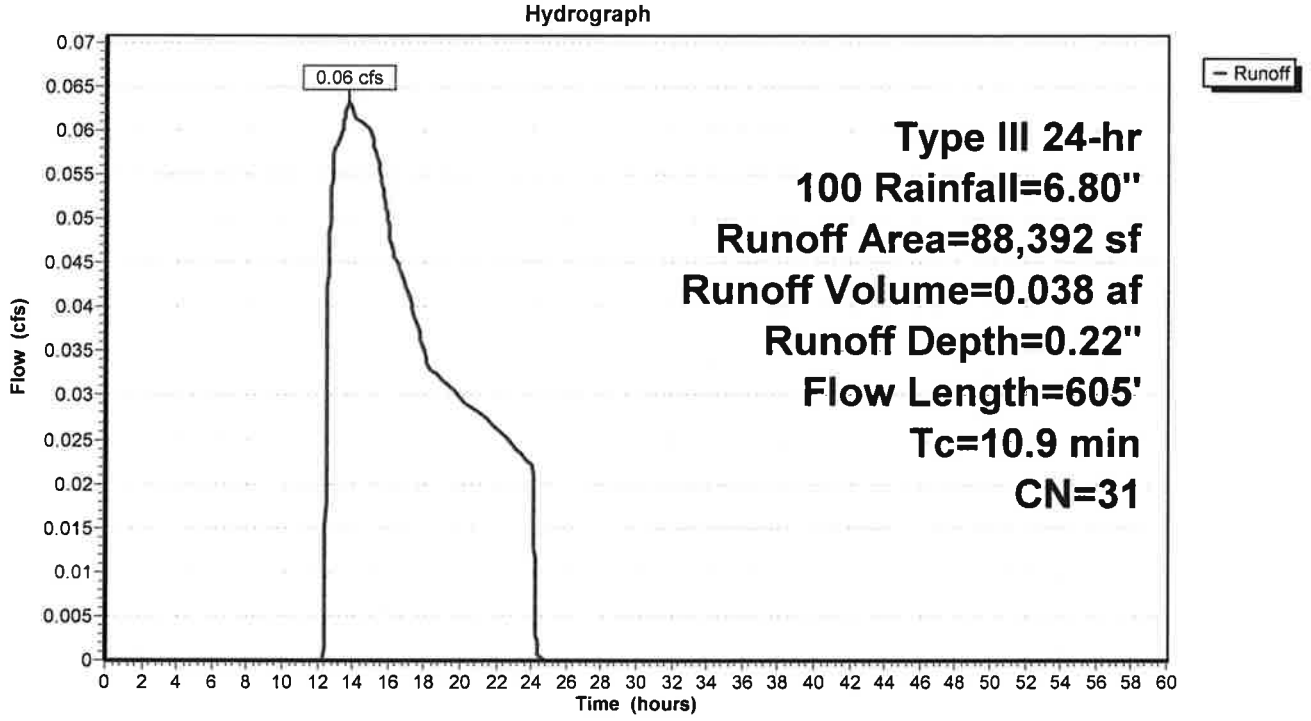
Runoff = 0.06 cfs @ 13.77 hrs, Volume= 0.038 af, Depth= 0.22"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Rainfall=6.80"

Area (sf)	CN	Description
7,480	39	>75% Grass cover, Good, HSG A
80,912	30	Woods, Good, HSG A
88,392	31	Weighted Average
88,392		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.8	50	0.0300	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
0.6	50	0.0400	1.40		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
5.5	505	0.0950	1.54		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
10.9	605	Total			

Subcatchment 1S: Area flowing toward Pine St



Summary for Subcatchment 2S: Area flowing west

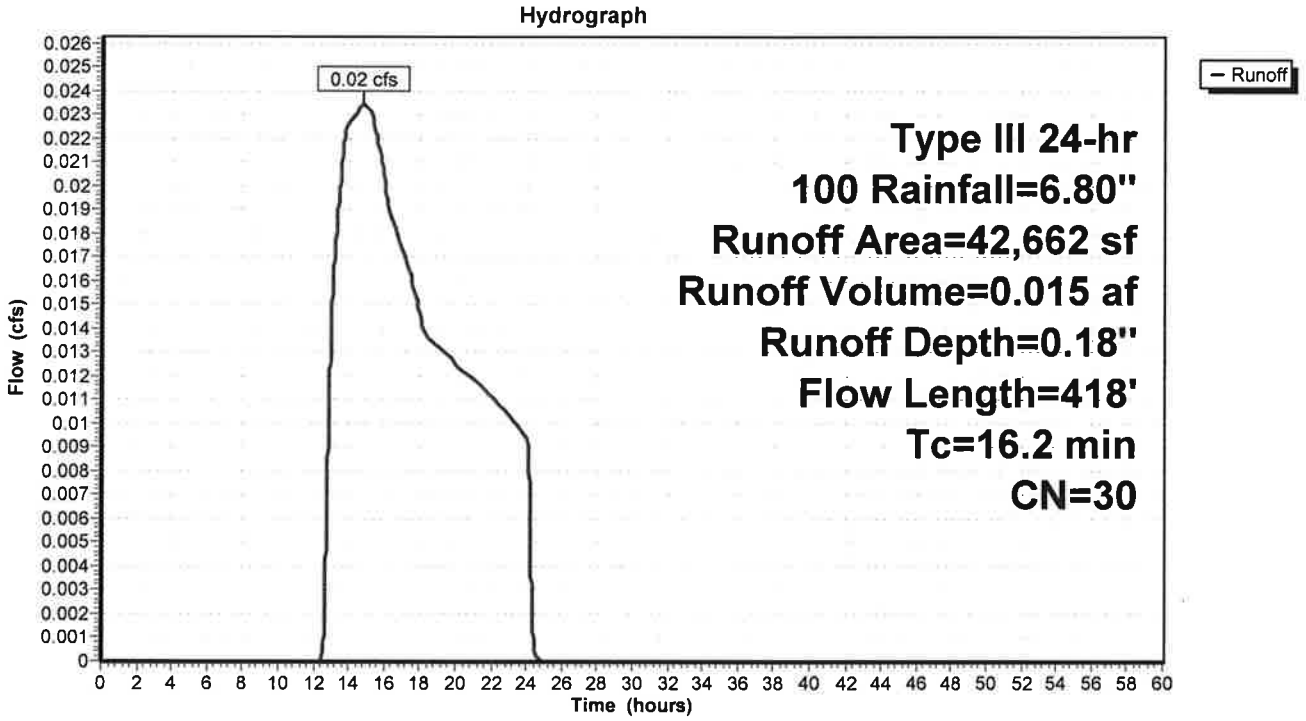
Runoff = 0.02 cfs @ 14.78 hrs, Volume= 0.015 af, Depth= 0.18"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Rainfall=6.80"

Area (sf)	CN	Description
42,662	30	Woods, Good, HSG A
42,662		100.00% Pervious Area

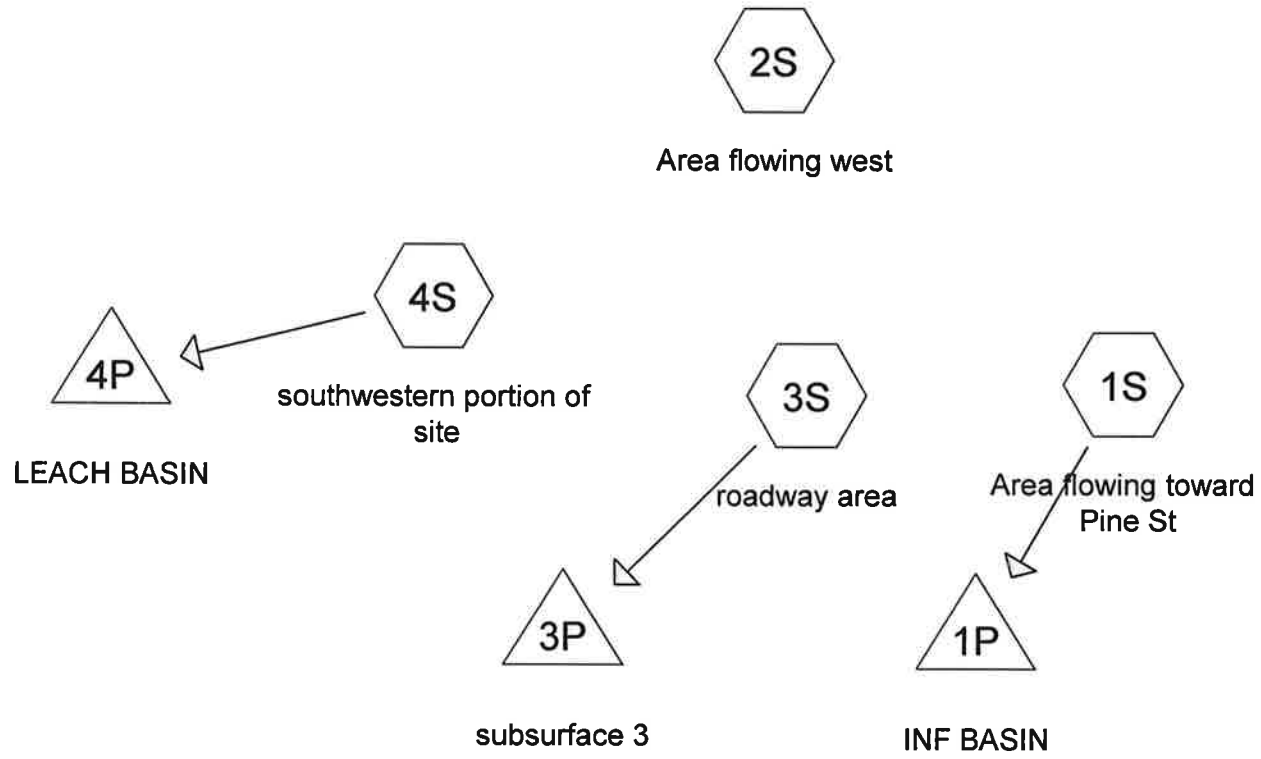
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0200	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
3.9	368	0.0980	1.57		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
16.2	418	Total			

Subcatchment 2S: Area flowing west



Post-Development Calculations

2 Year 3.20"
10 Year 4.80"
25 Year 5.50"
50 Year 6.10"
100 Year 7.00"



Subcat Reach Pond Link

Routing Diagram for post-dev 35 pine
Prepared by {enter your company name here}, Printed 7/22/2019

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
1.051	39	>75% Grass cover, Good, HSG A (1S, 2S, 3S, 4S)
1.263	30	Woods, Good, HSG A (1S, 2S, 3S, 4S)
0.322	98	paved (3S)
0.252	98	roof (1S, 4S)
2.888	**47**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
2.314	HSG A	1S, 2S, 3S, 4S
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.574	Other	1S, 3S, 4S
2.888		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
1.051	0.000	0.000	0.000	0.000	1.051	>75% Grass cover, Good	1S, 2S, 3S, 4S
1.263	0.000	0.000	0.000	0.000	1.263	Woods, Good	1S, 2S, 3S, 4S
0.000	0.000	0.000	0.000	0.322	0.322	paved	3S
0.000	0.000	0.000	0.000	0.252	0.252	roof	1S, 4S
2.314	**0.000**	**0.000**	**0.000**	**0.574**	**2.888**	**TOTAL AREA**	

POST-DEVELOPMENT CALCULATIONS
2-YEAR STORM - 3.20" RAINFALL

Time span=0.00-60.00 hrs, dt=0.01 hrs, 6001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Area flowing toward Runoff Area=49,416 sf 11.12% Impervious Runoff Depth=0.01"
Flow Length=520' Tc=10.3 min CN=41 Runoff=0.00 cfs 0.001 af

Subcatchment 2S: Area flowing west Runoff Area=7,342 sf 0.00% Impervious Runoff Depth=0.00"
Flow Length=195' Tc=13.8 min CN=35 Runoff=0.00 cfs 0.000 af

Subcatchment 3S: roadway area Runoff Area=37,783 sf 37.09% Impervious Runoff Depth=0.34"
Flow Length=615' Tc=8.6 min CN=58 Runoff=0.15 cfs 0.025 af

Subcatchment 4S: southwestern portion Runoff Area=31,279 sf 17.57% Impervious Runoff Depth=0.06"
Flow Length=498' Tc=16.6 min CN=46 Runoff=0.01 cfs 0.003 af

Pond 1P: INF BASIN Peak Elev=202.00' Storage=1 cf Inflow=0.00 cfs 0.001 af
Outflow=0.00 cfs 0.001 af

Pond 3P: subsurface 3 Peak Elev=192.12' Storage=80 cf Inflow=0.15 cfs 0.025 af
Outflow=0.09 cfs 0.025 af

Pond 4P: LEACH BASIN Peak Elev=183.10' Storage=4 cf Inflow=0.01 cfs 0.003 af
Outflow=0.01 cfs 0.003 af

Total Runoff Area = 2.888 ac Runoff Volume = 0.029 af Average Runoff Depth = 0.12"
80.12% Pervious = 2.314 ac 19.88% Impervious = 0.574 ac

Summary for Subcatchment 1S: Area flowing toward Pine St

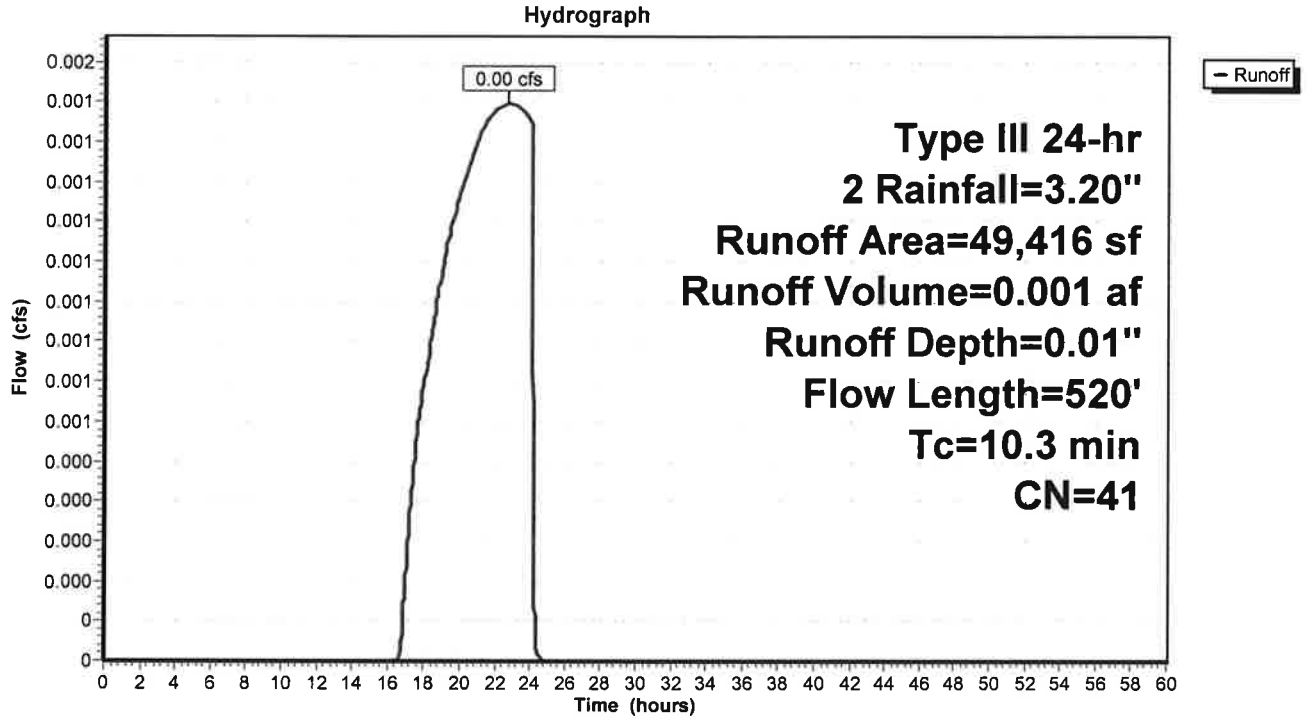
Runoff = 0.00 cfs @ 22.74 hrs, Volume= 0.001 af, Depth= 0.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Rainfall=3.20"

	Area (sf)	CN	Description
	17,391	39	>75% Grass cover, Good, HSG A
	26,528	30	Woods, Good, HSG A
*	5,497	98	roof
	49,416	41	Weighted Average
	43,919		88.88% Pervious Area
	5,497		11.12% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.8	50	0.0300	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
2.8	270	0.1040	1.61		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
2.7	200	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
10.3	520	Total			

Subcatchment 1S: Area flowing toward Pine St



Summary for Subcatchment 2S: Area flowing west

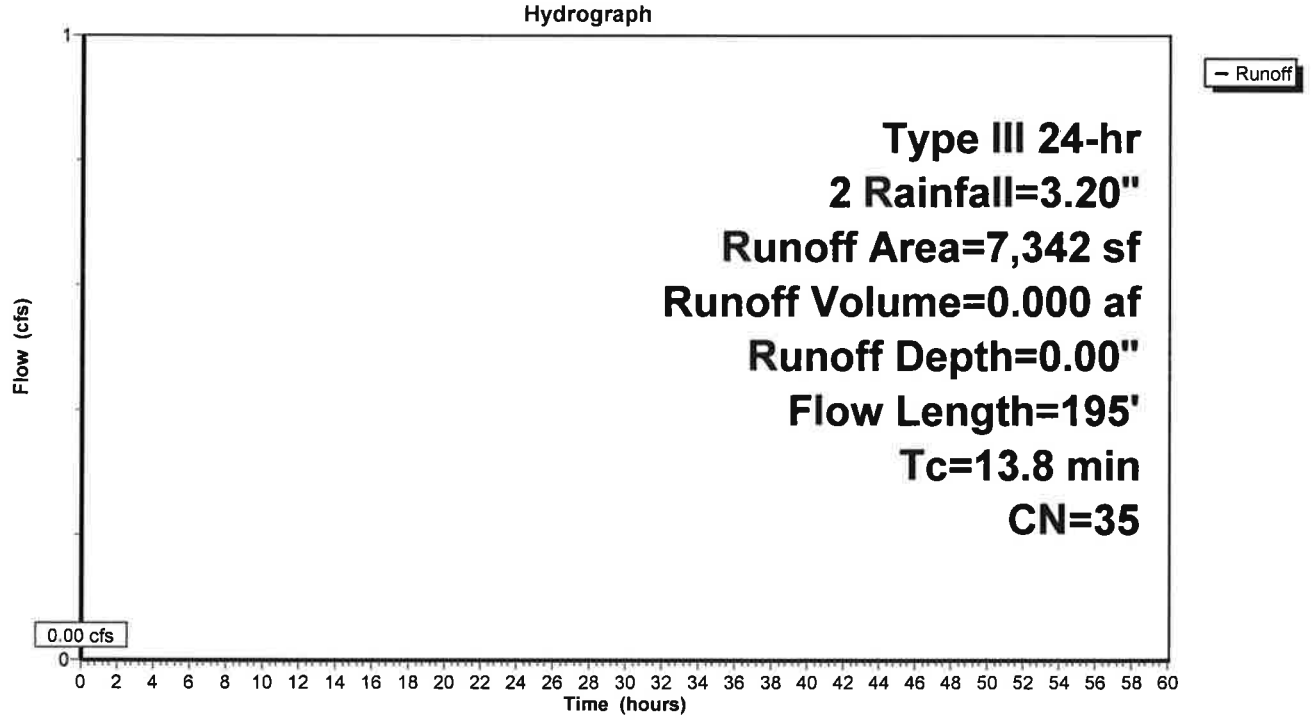
Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Rainfall=3.20"

Area (sf)	CN	Description
3,212	30	Woods, Good, HSG A
4,130	39	>75% Grass cover, Good, HSG A
7,342	35	Weighted Average
7,342		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0200	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
1.3	120	0.1000	1.58		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.2	25	0.0800	1.98		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
13.8	195	Total			

Subcatchment 2S: Area flowing west



Summary for Subcatchment 3S: roadway area

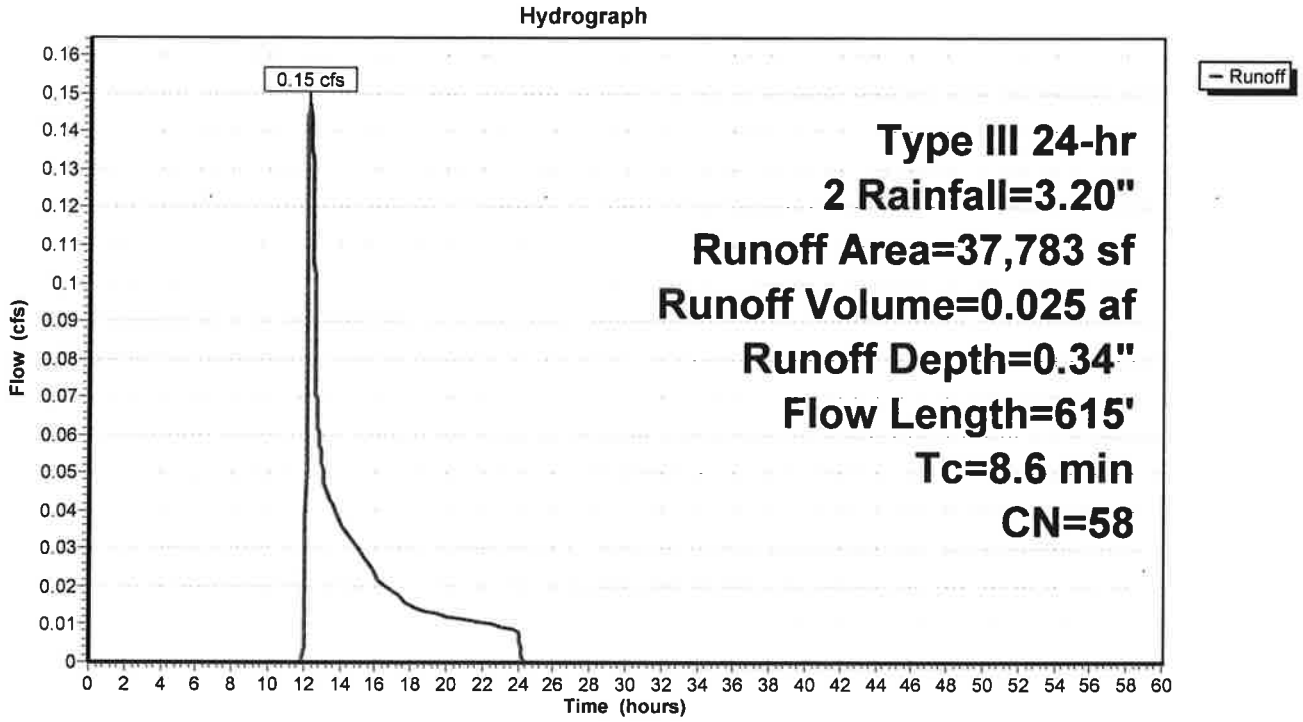
Runoff = 0.15 cfs @ 12.28 hrs, Volume= 0.025 af, Depth= 0.34"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Rainfall=3.20"

	Area (sf)	CN	Description
*	14,015	98	paved
	13,508	30	Woods, Good, HSG A
	10,260	39	>75% Grass cover, Good, HSG A
	37,783	58	Weighted Average
	23,768		62.91% Pervious Area
	14,015		37.09% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.8	50	0.0300	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
3.0	295	0.1050	1.62		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.4	100	0.0500	4.54		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.4	170	0.0250	7.77	6.10	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012
8.6	615	Total			

Subcatchment 3S: roadway area



Summary for Subcatchment 4S: southwestern portion of site

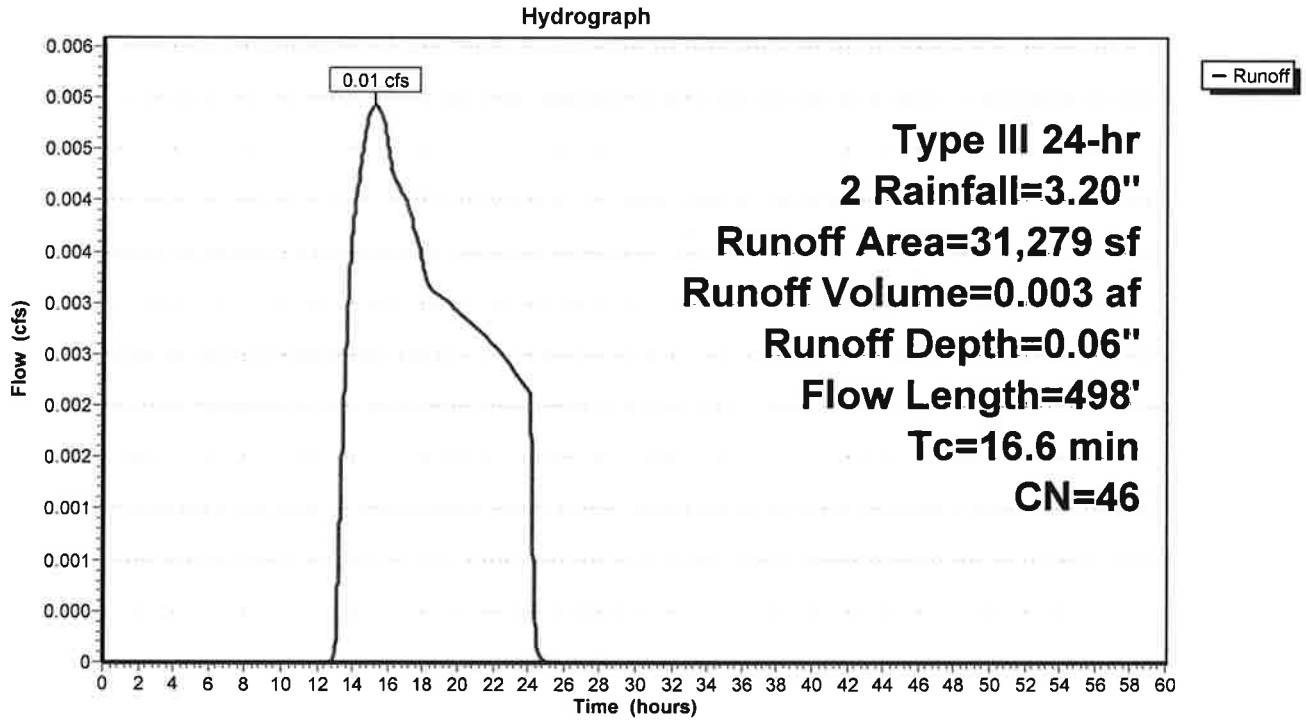
Runoff = 0.01 cfs @ 15.22 hrs, Volume= 0.003 af, Depth= 0.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Rainfall=3.20"

	Area (sf)	CN	Description
*	5,497	98	roof
	14,015	39	>75% Grass cover, Good, HSG A
	11,767	30	Woods, Good, HSG A
	31,279	46	Weighted Average
	25,782		82.43% Pervious Area
	5,497		17.57% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0200	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
1.8	188	0.1200	1.73		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
2.5	260	0.0615	1.74		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
16.6	498	Total			

Subcatchment 4S: southwestern portion of site



Summary for Pond 1P: INF BASIN

Inflow Area = 1.134 ac, 11.12% Impervious, Inflow Depth = 0.01" for 2 event
Inflow = 0.00 cfs @ 22.74 hrs, Volume= 0.001 af
Outflow = 0.00 cfs @ 22.91 hrs, Volume= 0.001 af, Atten= 0%, Lag= 10.1 min
Discarded = 0.00 cfs @ 22.91 hrs, Volume= 0.001 af

Routing by Stor-Ind method, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Peak Elev= 202.00' @ 22.91 hrs Surf.Area= 425 sf Storage= 1 cf

Plug-Flow detention time= 8.9 min calculated for 0.001 af (100% of inflow)
Center-of-Mass det. time= 8.9 min (1,273.8 - 1,265.0)

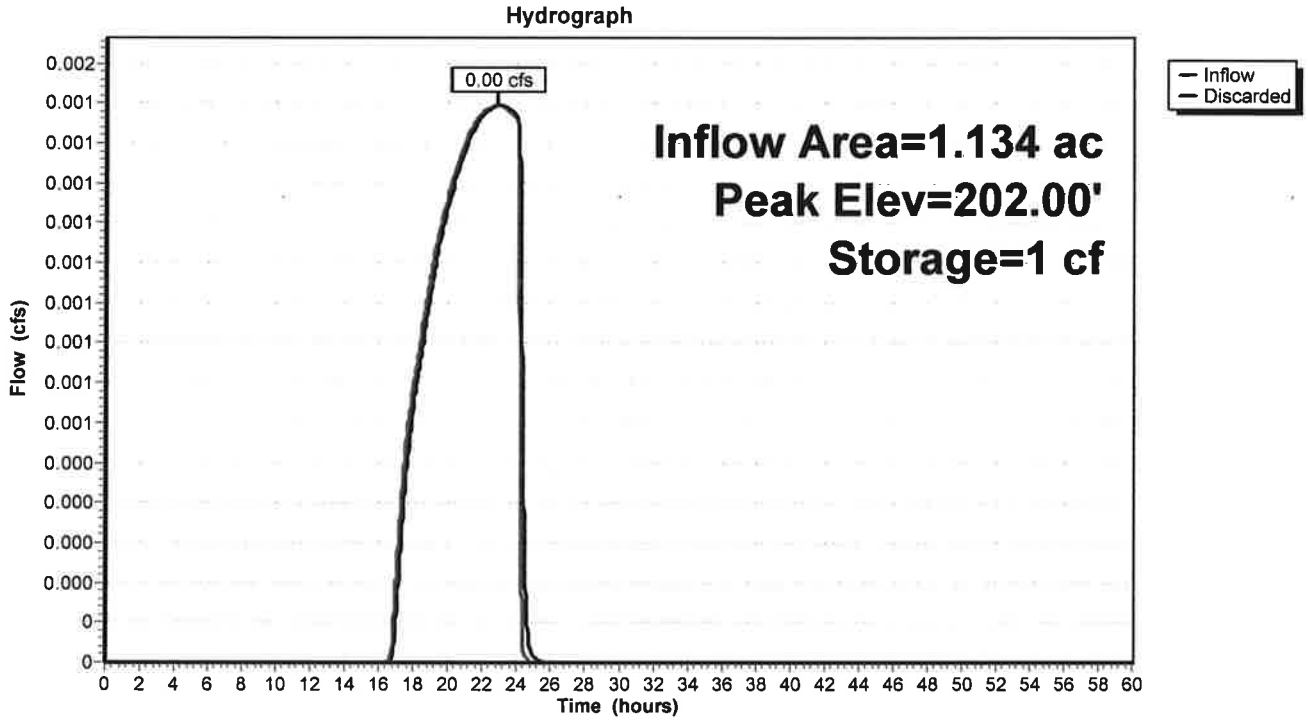
Volume	Invert	Avail.Storage	Storage Description
#1	202.00'	2,974 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
202.00	424	0	0
203.00	759	592	592
204.00	1,172	966	1,557
205.00	1,661	1,417	2,974

Device	Routing	Invert	Outlet Devices
#1	Discarded	202.00'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.02 cfs @ 22.91 hrs HW=202.00' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.02 cfs)

Pond 1P: INF BASIN



Summary for Pond 3P: subsurface 3

Inflow Area = 0.867 ac, 37.09% Impervious, Inflow Depth = 0.34" for 2 event
Inflow = 0.15 cfs @ 12.28 hrs, Volume= 0.025 af
Outflow = 0.09 cfs @ 12.19 hrs, Volume= 0.025 af, Atten= 36%, Lag= 0.0 min
Discarded = 0.09 cfs @ 12.19 hrs, Volume= 0.025 af

Routing by Stor-Ind method, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Peak Elev= 192.12' @ 12.55 hrs Surf.Area= 1,677 sf Storage= 80 cf

Plug-Flow detention time= 6.3 min calculated for 0.025 af (100% of inflow)
Center-of-Mass det. time= 6.3 min (941.5 - 935.2)

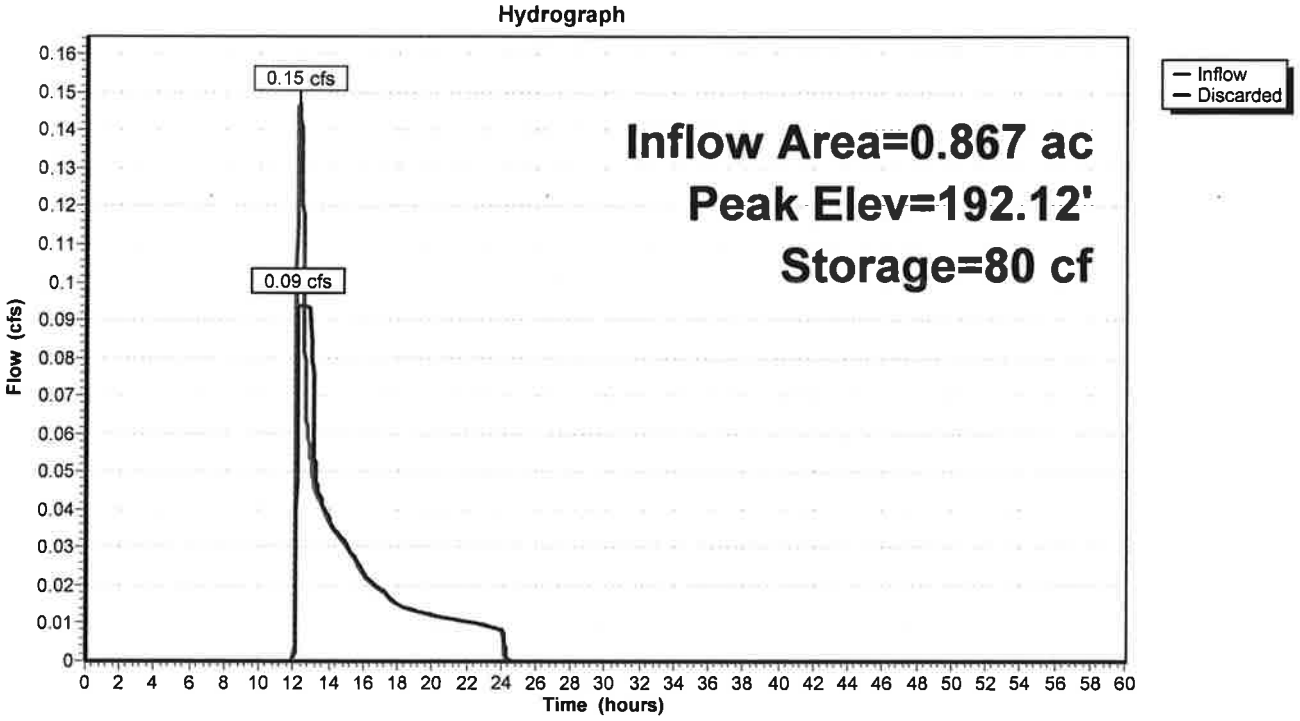
Volume	Invert	Avail.Storage	Storage Description
#1A	192.00'	1,775 cf	**20.83'W x 80.50'L x 4.04'H Field A** 6,778 cf Overall - 2,340 cf Embedded = 4,439 cf x 40.0% Voids
#2A	192.75'	2,340 cf	**Cultec R-330XLHD** x 44 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 4 rows
		4,115 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	192.00'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.09 cfs @ 12.19 hrs HW=192.04' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.09 cfs)

Pond 3P: subsurface 3



Summary for Pond 4P: LEACH BASIN

Inflow Area = 0.718 ac, 17.57% Impervious, Inflow Depth = 0.06" for 2 event
Inflow = 0.01 cfs @ 15.22 hrs, Volume= 0.003 af
Outflow = 0.01 cfs @ 15.45 hrs, Volume= 0.003 af, Atten= 1%, Lag= 14.2 min
Discarded = 0.01 cfs @ 15.45 hrs, Volume= 0.003 af

Routing by Stor-Ind method, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Peak Elev= 183.10' @ 15.45 hrs Surf.Area= 113 sf Storage= 4 cf

Plug-Flow detention time= 13.8 min calculated for 0.003 af (100% of inflow)
Center-of-Mass det. time= 13.8 min (1,105.8 - 1,092.0)

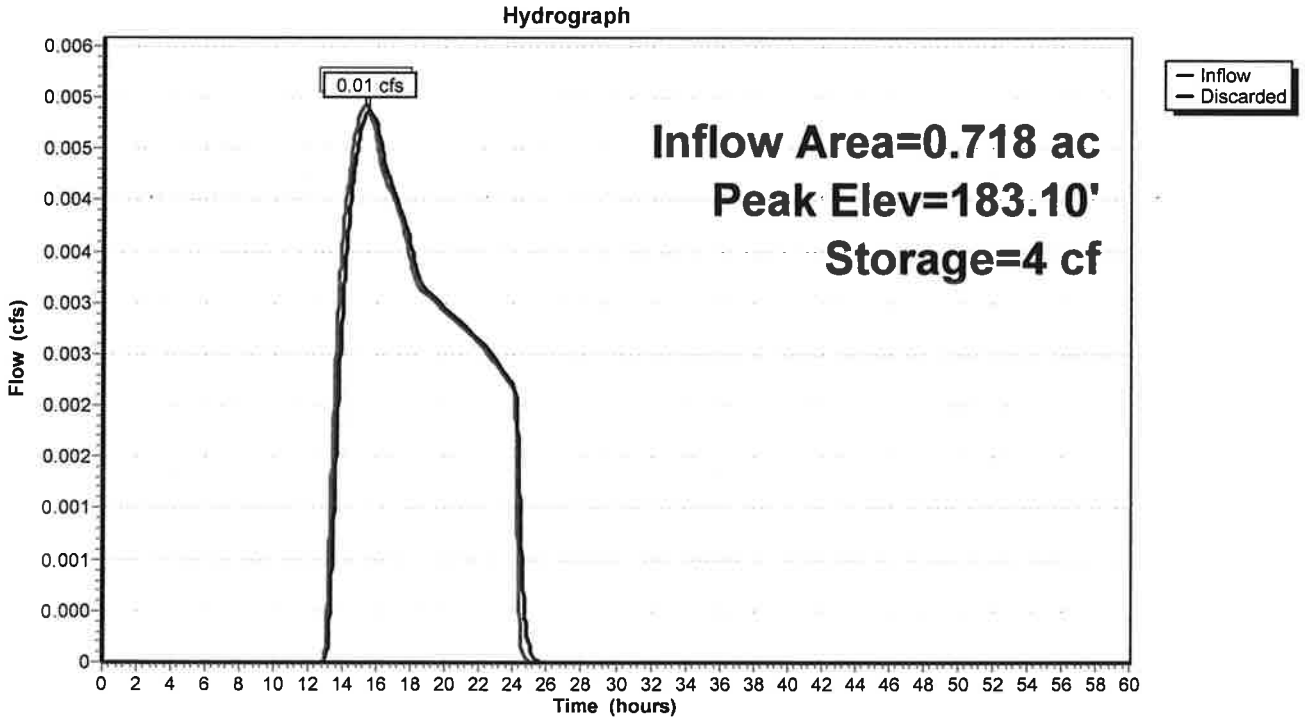
Volume	Invert	Avail.Storage	Storage Description
#1	183.00'	249 cf	**12.00'D x 7.00'H Vertical Cone/Cylinder** 792 cf Overall - 170 cf Embedded = 622 cf x 40.0% Voids
#2	184.00'	170 cf	**6.00'D x 6.00'H Vertical Cone/Cylinder** Inside #1
#3	190.00'	2,332 cf	**Custom Stage Data (Conic)** Listed below (Recalc)
		2,751 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
190.00	3	0	0	3
191.90	4	7	7	16
192.00	236	9	16	248
193.00	552	383	399	571
194.00	956	745	1,143	986
195.00	1,438	1,189	2,332	1,484

Device	Routing	Invert	Outlet Devices
#1	Discarded	183.00'	**2.410 in/hr Exfiltration over Wetted area**

Discarded OutFlow Max=0.01 cfs @ 15.45 hrs HW=183.10' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.01 cfs)

Pond 4P: LEACH BASIN



POST-DEVELOPMENT CALCULATIONS
10-YEAR STORM - 4.80" RAINFALL

Time span=0.00-60.00 hrs, dt=0.01 hrs, 6001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Area flowing toward Runoff Area=49,416 sf 11.12% Impervious Runoff Depth=0.23"
Flow Length=520' Tc=10.3 min CN=41 Runoff=0.06 cfs 0.021 af

Subcatchment 2S: Area flowing west Runoff Area=7,342 sf 0.00% Impervious Runoff Depth=0.06"
Flow Length=195' Tc=13.8 min CN=35 Runoff=0.00 cfs 0.001 af

Subcatchment 3S: roadway area Runoff Area=37,783 sf 37.09% Impervious Runoff Depth=1.06"
Flow Length=615' Tc=8.6 min CN=58 Runoff=0.83 cfs 0.077 af

Subcatchment 4S: southwestern portion Runoff Area=31,279 sf 17.57% Impervious Runoff Depth=0.42"
Flow Length=498' Tc=16.6 min CN=46 Runoff=0.12 cfs 0.025 af

Pond 1P: INF BASIN Peak Elev=202.26' Storage=122 cf Inflow=0.06 cfs 0.021 af
Outflow=0.03 cfs 0.021 af

Pond 3P: subsurface 3 Peak Elev=193.23' Storage=1,172 cf Inflow=0.83 cfs 0.077 af
Outflow=0.09 cfs 0.077 af

Pond 4P: LEACH BASIN Peak Elev=191.93' Storage=426 cf Inflow=0.12 cfs 0.025 af
Outflow=0.03 cfs 0.025 af

Total Runoff Area = 2.888 ac Runoff Volume = 0.124 af Average Runoff Depth = 0.52"
80.12% Pervious = 2.314 ac 19.88% Impervious = 0.574 ac

Summary for Subcatchment 1S: Area flowing toward Pine St

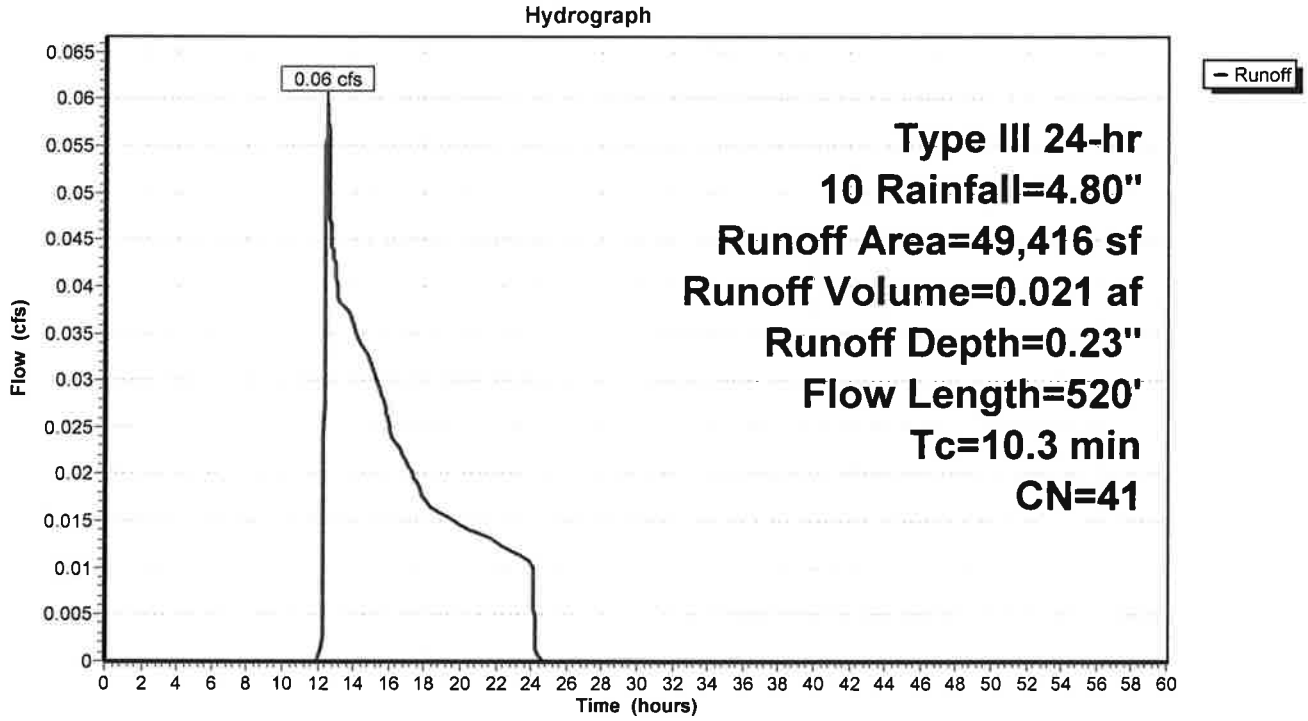
Runoff = 0.06 cfs @ 12.51 hrs, Volume= 0.021 af, Depth= 0.23"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Rainfall=4.80"

	Area (sf)	CN	Description
	17,391	39	>75% Grass cover, Good, HSG A
	26,528	30	Woods, Good, HSG A
*	5,497	98	roof
	49,416	41	Weighted Average
	43,919		88.88% Pervious Area
	5,497		11.12% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.8	50	0.0300	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
2.8	270	0.1040	1.61		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
2.7	200	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
10.3	520	Total			

Subcatchment 1S: Area flowing toward Pine St



Summary for Subcatchment 2S: Area flowing west

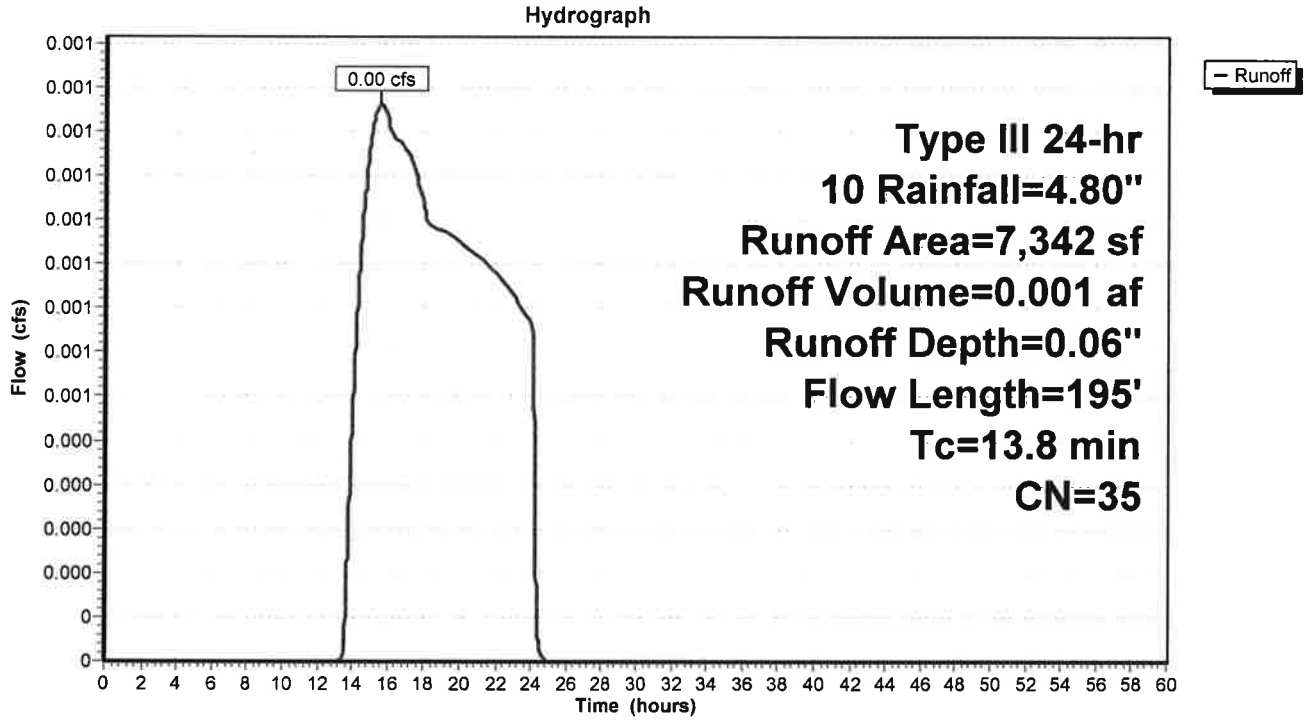
Runoff = 0.00 cfs @ 15.56 hrs, Volume= 0.001 af, Depth= 0.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Rainfall=4.80"

Area (sf)	CN	Description
3,212	30	Woods, Good, HSG A
4,130	39	>75% Grass cover, Good, HSG A
7,342	35	Weighted Average
7,342		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0200	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
1.3	120	0.1000	1.58		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.2	25	0.0800	1.98		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
13.8	195	Total			

Subcatchment 2S: Area flowing west



Summary for Subcatchment 3S: roadway area

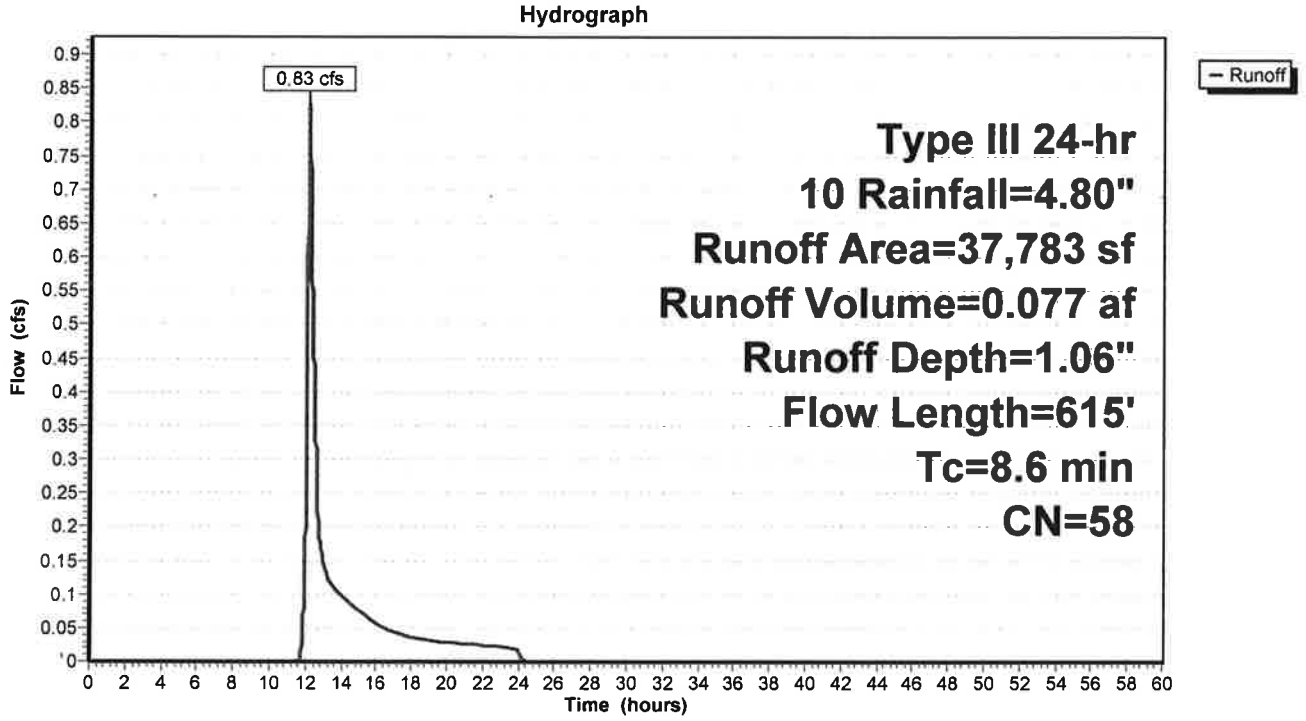
Runoff = 0.83 cfs @ 12.14 hrs, Volume= 0.077 af, Depth= 1.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Rainfall=4.80"

	Area (sf)	CN	Description
*	14,015	98	paved
	13,508	30	Woods, Good, HSG A
	10,260	39	>75% Grass cover, Good, HSG A
	37,783	58	Weighted Average
	23,768		62.91% Pervious Area
	14,015		37.09% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.8	50	0.0300	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
3.0	295	0.1050	1.62		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.4	100	0.0500	4.54		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.4	170	0.0250	7.77	6.10	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012
8.6	615	Total			

Subcatchment 3S: roadway area



Summary for Subcatchment 4S: southwestern portion of site

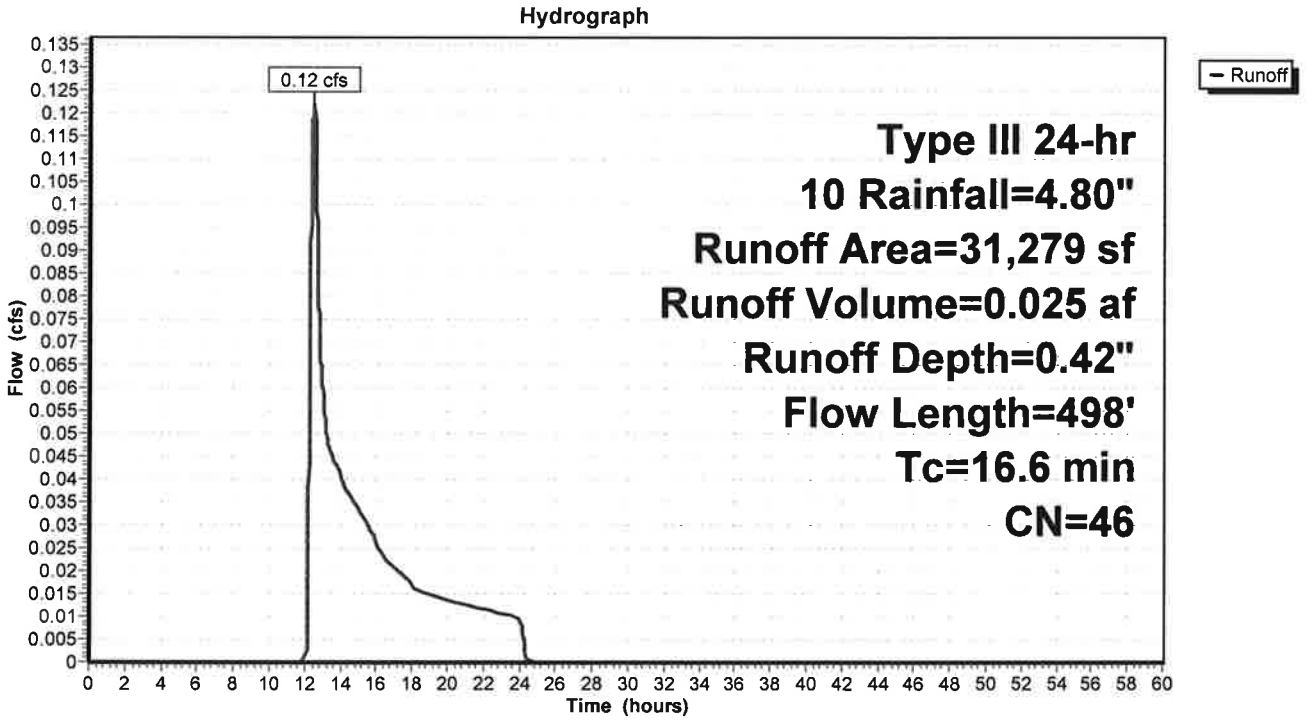
Runoff = 0.12 cfs @ 12.47 hrs, Volume= 0.025 af, Depth= 0.42"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Rainfall=4.80"

	Area (sf)	CN	Description
*	5,497	98	roof
	14,015	39	>75% Grass cover, Good, HSG A
	11,767	30	Woods, Good, HSG A
	31,279	46	Weighted Average
	25,782		82.43% Pervious Area
	5,497		17.57% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0200	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
1.8	188	0.1200	1.73		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
2.5	260	0.0615	1.74		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
16.6	498	Total			

Subcatchment 4S: southwestern portion of site



Summary for Pond 1P: INF BASIN

Inflow Area = 1.134 ac, 11.12% Impervious, Inflow Depth = 0.23" for 10 event
Inflow = 0.06 cfs @ 12.51 hrs, Volume= 0.021 af
Outflow = 0.03 cfs @ 15.55 hrs, Volume= 0.021 af, Atten= 52%, Lag= 182.7 min
Discarded = 0.03 cfs @ 15.55 hrs, Volume= 0.021 af

Routing by Stor-Ind method, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Peak Elev= 202.26' @ 15.55 hrs Surf.Area= 512 sf Storage= 122 cf

Plug-Flow detention time= 41.2 min calculated for 0.021 af (100% of inflow)
Center-of-Mass det. time= 41.2 min (1,041.4 - 1,000.2)

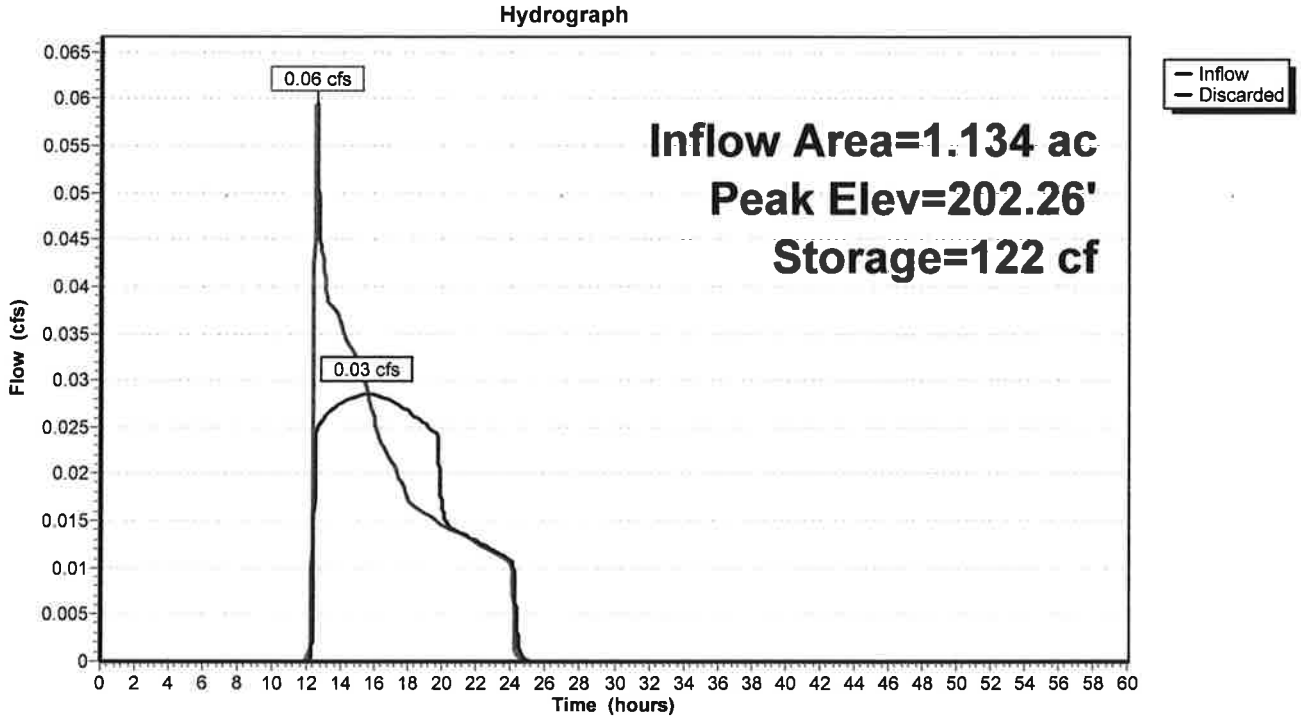
Volume	Invert	Avail.Storage	Storage Description
#1	202.00'	2,974 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
202.00	424	0	0
203.00	759	592	592
204.00	1,172	966	1,557
205.00	1,661	1,417	2,974

Device	Routing	Invert	Outlet Devices
#1	Discarded	202.00'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.03 cfs @ 15.55 hrs HW=202.26' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Pond 1P: INF BASIN



Summary for Pond 3P: subsurface 3

Inflow Area = 0.867 ac, 37.09% Impervious, Inflow Depth = 1.06" for 10 event
Inflow = 0.83 cfs @ 12.14 hrs, Volume= 0.077 af
Outflow = 0.09 cfs @ 11.94 hrs, Volume= 0.077 af, Atten= 89%, Lag= 0.0 min
Discarded = 0.09 cfs @ 11.94 hrs, Volume= 0.077 af

Routing by Stor-Ind method, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Peak Elev= 193.23' @ 14.06 hrs Surf.Area= 1,677 sf Storage= 1,172 cf

Plug-Flow detention time= 125.9 min calculated for 0.077 af (100% of inflow)
Center-of-Mass det. time= 125.9 min (1,013.6 - 887.7)

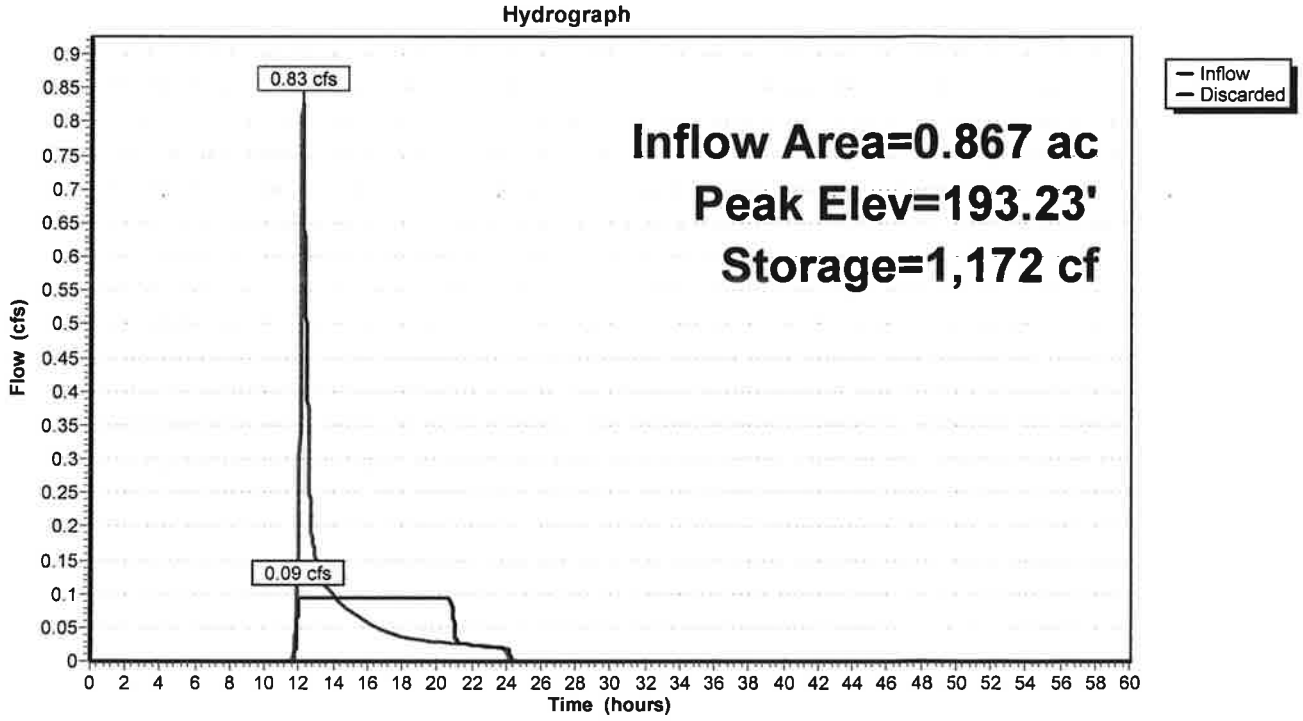
Volume	Invert	Avail.Storage	Storage Description
#1A	192.00'	1,775 cf	**20.83'W x 80.50'L x 4.04'H Field A** 6,778 cf Overall - 2,340 cf Embedded = 4,439 cf x 40.0% Voids
#2A	192.75'	2,340 cf	**Cultec R-330XLHD** x 44 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 4 rows
		4,115 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	192.00'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.09 cfs @ 11.94 hrs HW=192.04' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.09 cfs)

Pond 3P: subsurface 3



Summary for Pond 4P: LEACH BASIN

Inflow Area = 0.718 ac, 17.57% Impervious, Inflow Depth = 0.42" for 10 event
Inflow = 0.12 cfs @ 12.47 hrs, Volume= 0.025 af
Outflow = 0.03 cfs @ 16.03 hrs, Volume= 0.025 af, Atten= 79%, Lag= 213.2 min
Discarded = 0.03 cfs @ 16.03 hrs, Volume= 0.025 af

Routing by Stor-Ind method, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Peak Elev= 191.93' @ 16.03 hrs Surf.Area= 146 sf Storage= 426 cf

Plug-Flow detention time= 275.2 min calculated for 0.025 af (100% of inflow)
Center-of-Mass det. time= 275.2 min (1,231.5 - 956.3)

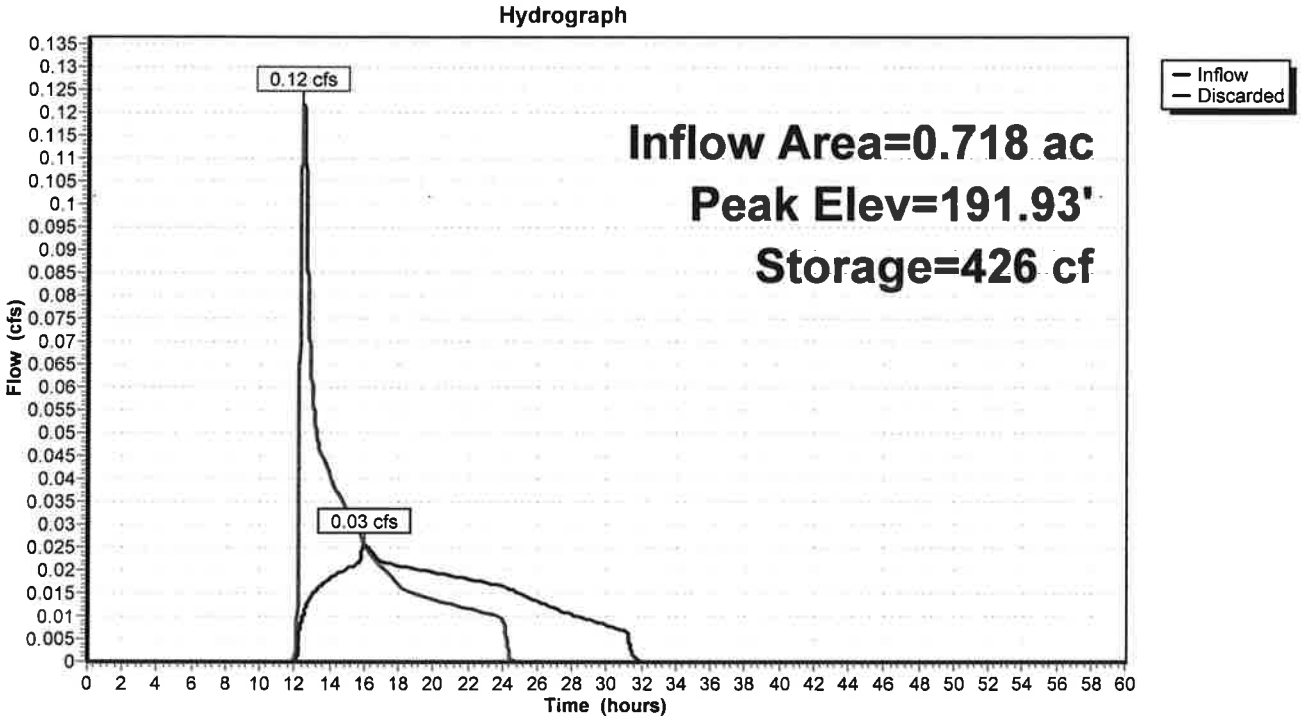
Volume	Invert	Avail.Storage	Storage Description
#1	183.00'	249 cf	**12.00'D x 7.00'H Vertical Cone/Cylinder** 792 cf Overall - 170 cf Embedded = 622 cf x 40.0% Voids
#2	184.00'	170 cf	**6.00'D x 6.00'H Vertical Cone/Cylinder** Inside #1
#3	190.00'	2,332 cf	**Custom Stage Data (Conic)** Listed below (Recalc)
		2,751 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
190.00	3	0	0	3
191.90	4	7	7	16
192.00	236	9	16	248
193.00	552	383	399	571
194.00	956	745	1,143	986
195.00	1,438	1,189	2,332	1,484

Device	Routing	Invert	Outlet Devices
#1	Discarded	183.00'	**2.410 in/hr Exfiltration over Wetted area**

Discarded OutFlow Max=0.02 cfs @ 16.03 hrs HW=191.93' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.02 cfs)

Pond 4P: LEACH BASIN



POST-DEVELOPMENT CALCULATIONS
25-YEAR STORM – 5.50" RAINFALL

Time span=0.00-60.00 hrs, dt=0.01 hrs, 6001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Area flowing toward Runoff Area=49,416 sf 11.12% Impervious Runoff Depth=0.40"
Flow Length=520' Tc=10.3 min CN=41 Runoff=0.17 cfs 0.038 af

Subcatchment 2S: Area flowing west Runoff Area=7,342 sf 0.00% Impervious Runoff Depth=0.16"
Flow Length=195' Tc=13.8 min CN=35 Runoff=0.00 cfs 0.002 af

Subcatchment 3S: roadway area Runoff Area=37,783 sf 37.09% Impervious Runoff Depth=1.45"
Flow Length=615' Tc=8.6 min CN=58 Runoff=1.21 cfs 0.105 af

Subcatchment 4S: southwestern portion Runoff Area=31,279 sf 17.57% Impervious Runoff Depth=0.67"
Flow Length=498' Tc=16.6 min CN=46 Runoff=0.24 cfs 0.040 af

Pond 1P: INF BASIN Peak Elev=202.85' Storage=481 cf Inflow=0.17 cfs 0.038 af
Outflow=0.04 cfs 0.038 af

Pond 3P: subsurface 3 Peak Elev=193.84' Storage=2,010 cf Inflow=1.21 cfs 0.105 af
Outflow=0.09 cfs 0.105 af

Pond 4P: LEACH BASIN Peak Elev=192.58' Storage=618 cf Inflow=0.24 cfs 0.040 af
Outflow=0.04 cfs 0.040 af

Total Runoff Area = 2.888 ac Runoff Volume = 0.185 af Average Runoff Depth = 0.77"
80.12% Pervious = 2.314 ac 19.88% Impervious = 0.574 ac

Summary for Subcatchment 1S: Area flowing toward Pine St

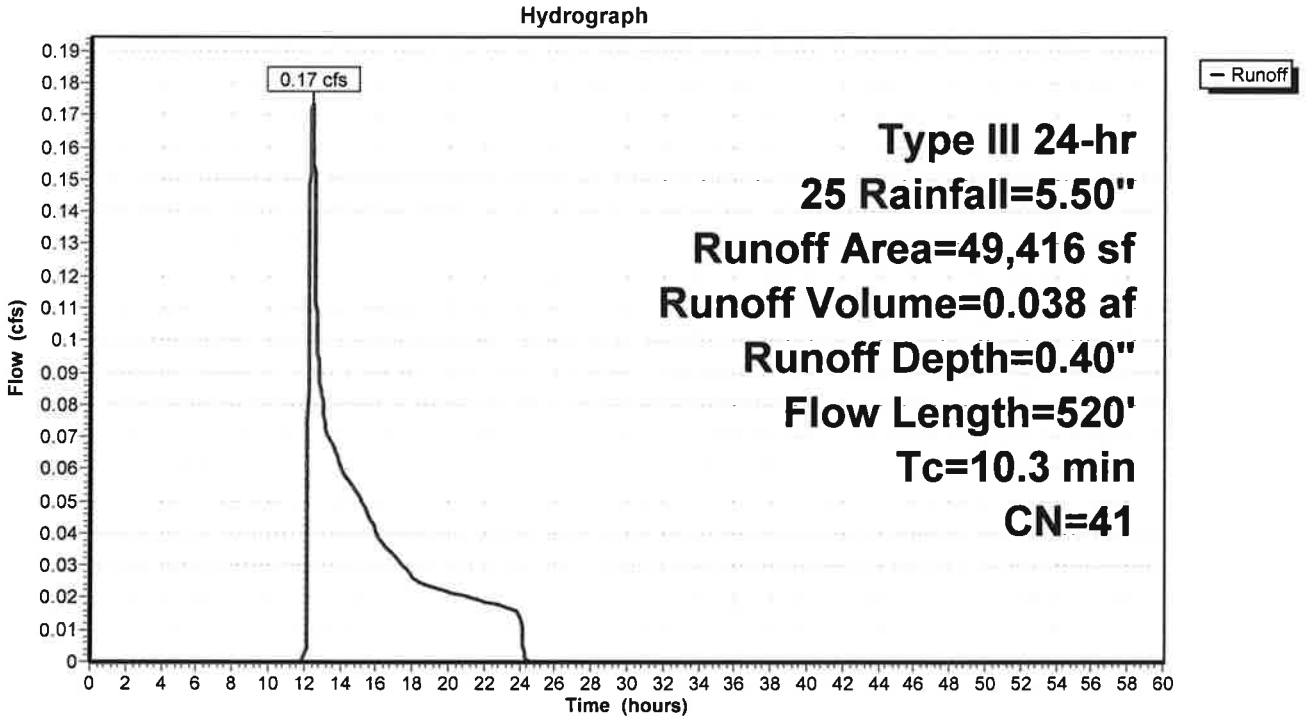
Runoff = 0.17 cfs @ 12.42 hrs, Volume= 0.038 af, Depth= 0.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 Rainfall=5.50"

	Area (sf)	CN	Description
	17,391	39	>75% Grass cover, Good, HSG A
	26,528	30	Woods, Good, HSG A
*	5,497	98	roof
	49,416	41	Weighted Average
	43,919		88.88% Pervious Area
	5,497		11.12% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.8	50	0.0300	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
2.8	270	0.1040	1.61		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
2.7	200	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
10.3	520	Total			

Subcatchment 1S: Area flowing toward Pine St



Summary for Subcatchment 2S: Area flowing west

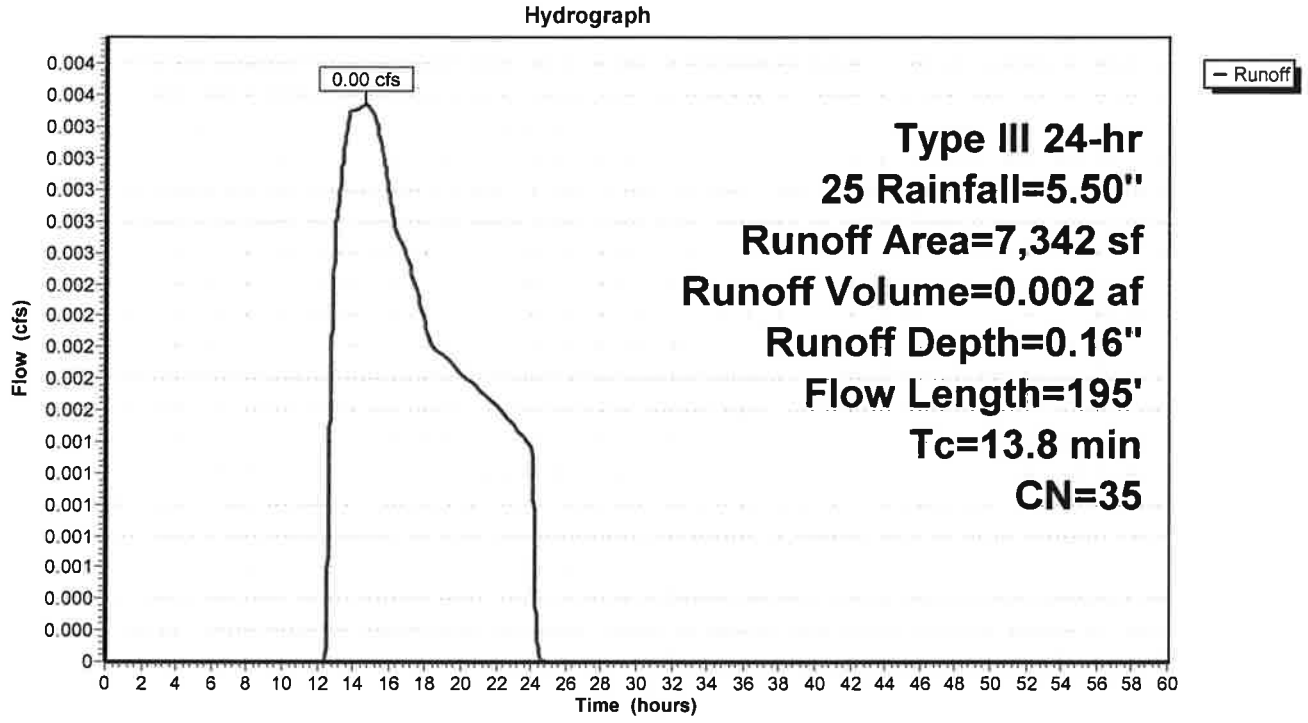
Runoff = 0.00 cfs @ 14.64 hrs, Volume= 0.002 af, Depth= 0.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 Rainfall=5.50"

Area (sf)	CN	Description
3,212	30	Woods, Good, HSG A
4,130	39	>75% Grass cover, Good, HSG A
7,342	35	Weighted Average
7,342		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0200	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
1.3	120	0.1000	1.58		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.2	25	0.0800	1.98		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
13.8	195	Total			

Subcatchment 2S: Area flowing west



Summary for Subcatchment 3S: roadway area

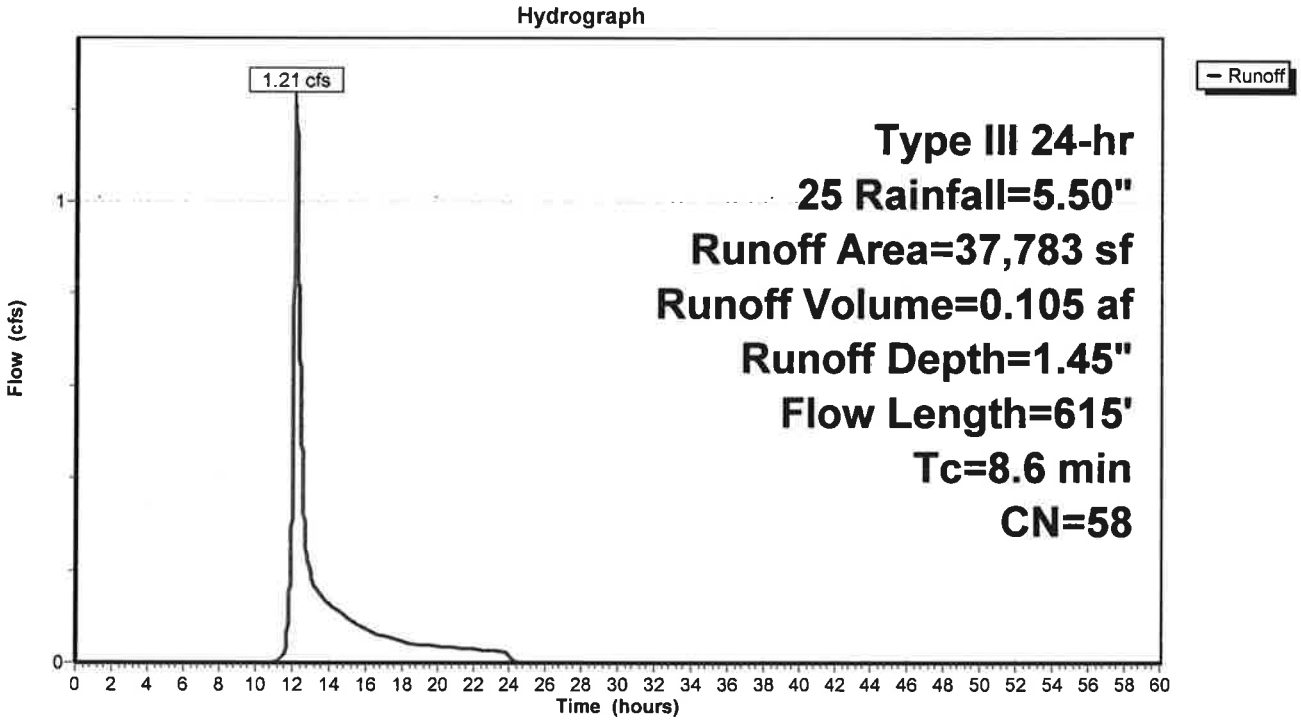
Runoff = 1.21 cfs @ 12.13 hrs, Volume= 0.105 af, Depth= 1.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 Rainfall=5.50"

	Area (sf)	CN	Description
*	14,015	98	paved
	13,508	30	Woods, Good, HSG A
	10,260	39	>75% Grass cover, Good, HSG A
	37,783	58	Weighted Average
	23,768		62.91% Pervious Area
	14,015		37.09% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.8	50	0.0300	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
3.0	295	0.1050	1.62		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.4	100	0.0500	4.54		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.4	170	0.0250	7.77	6.10	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012
8.6	615	Total			

Subcatchment 3S: roadway area



Summary for Subcatchment 4S: southwestern portion of site

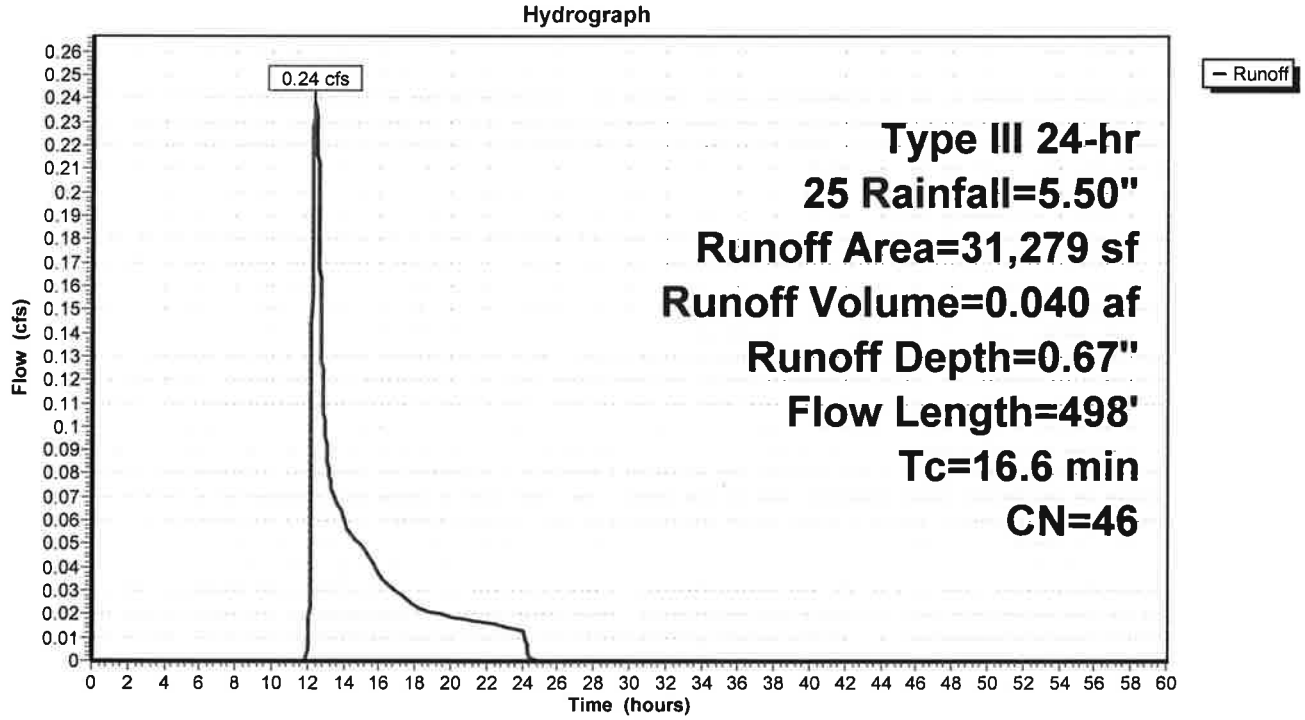
Runoff = 0.24 cfs @ 12.38 hrs, Volume= 0.040 af, Depth= 0.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 Rainfall=5.50"

	Area (sf)	CN	Description
*	5,497	98	roof
	14,015	39	>75% Grass cover, Good, HSG A
	11,767	30	Woods, Good, HSG A
	31,279	46	Weighted Average
	25,782		82.43% Pervious Area
	5,497		17.57% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0200	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
1.8	188	0.1200	1.73		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
2.5	260	0.0615	1.74		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
16.6	498	Total			

Subcatchment 4S: southwestern portion of site



Summary for Pond 1P: INF BASIN

Inflow Area = 1.134 ac, 11.12% Impervious, Inflow Depth = 0.40" for 25 event
Inflow = 0.17 cfs @ 12.42 hrs, Volume= 0.038 af
Outflow = 0.04 cfs @ 16.01 hrs, Volume= 0.038 af, Atten= 77%, Lag= 215.5 min
Discarded = 0.04 cfs @ 16.01 hrs, Volume= 0.038 af

Routing by Stor-Ind method, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Peak Elev= 202.85' @ 16.01 hrs Surf.Area= 709 sf Storage= 481 cf

Plug-Flow detention time= 150.1 min calculated for 0.038 af (100% of inflow)
Center-of-Mass det. time= 150.1 min (1,114.4 - 964.3)

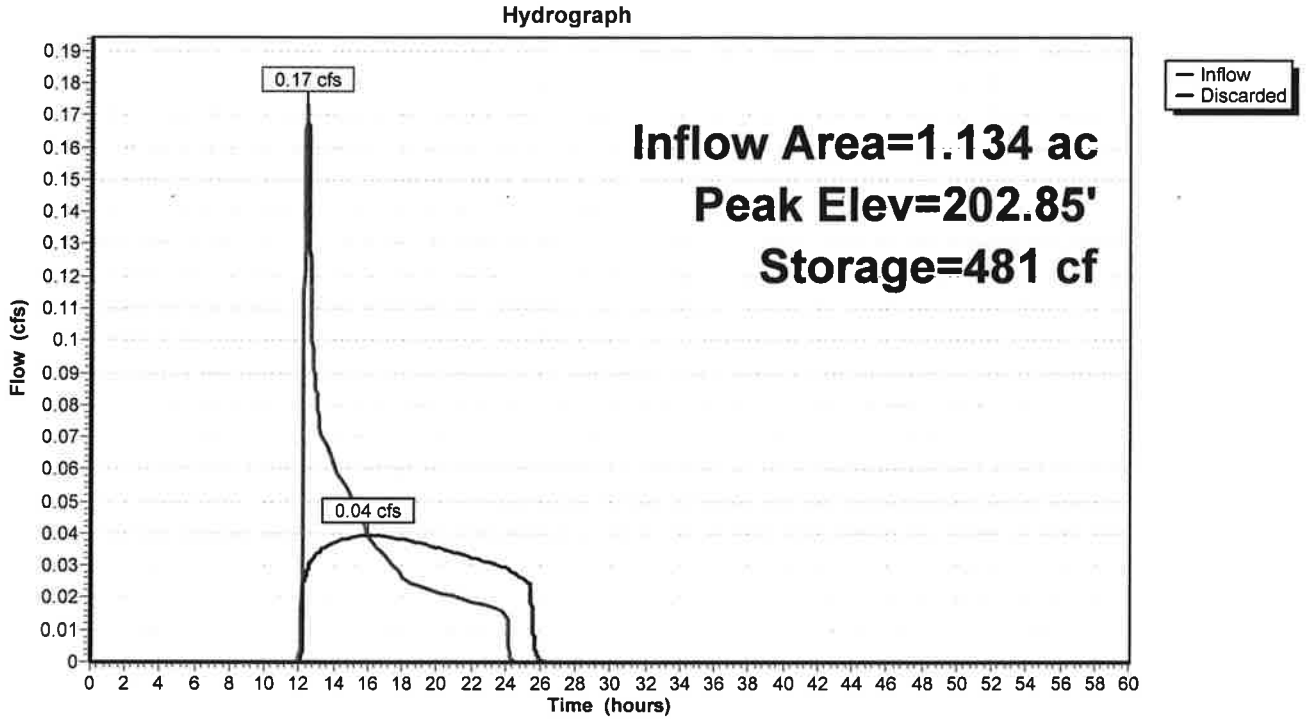
Volume	Invert	Avail.Storage	Storage Description
#1	202.00'	2,974 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
202.00	424	0	0
203.00	759	592	592
204.00	1,172	966	1,557
205.00	1,661	1,417	2,974

Device	Routing	Invert	Outlet Devices
#1	Discarded	202.00'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.04 cfs @ 16.01 hrs HW=202.85' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.04 cfs)

Pond 1P: INF BASIN



Summary for Pond 3P: subsurface 3

Inflow Area = 0.867 ac, 37.09% Impervious, Inflow Depth = 1.45" for 25 event
Inflow = 1.21 cfs @ 12.13 hrs, Volume= 0.105 af
Outflow = 0.09 cfs @ 11.82 hrs, Volume= 0.105 af, Atten= 92%, Lag= 0.0 min
Discarded = 0.09 cfs @ 11.82 hrs, Volume= 0.105 af

Routing by Stor-Ind method, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Peak Elev= 193.84' @ 15.17 hrs Surf.Area= 1,677 sf Storage= 2,010 cf

Plug-Flow detention time= 232.1 min calculated for 0.105 af (100% of inflow)
Center-of-Mass det. time= 232.1 min (1,109.0 - 876.9)

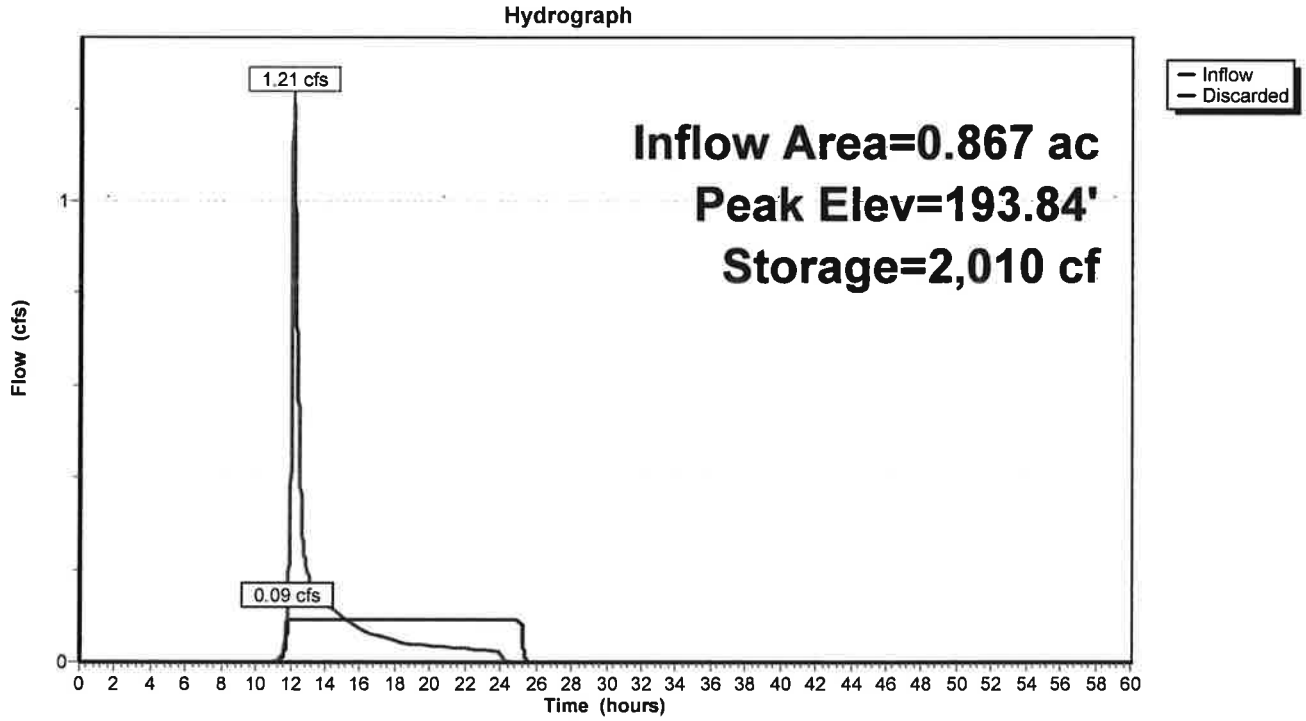
Volume	Invert	Avail.Storage	Storage Description
#1A	192.00'	1,775 cf	**20.83'W x 80.50'L x 4.04'H Field A** 6,778 cf Overall - 2,340 cf Embedded = 4,439 cf x 40.0% Voids
#2A	192.75'	2,340 cf	**Cultec R-330XLHD** x 44 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 4 rows
		4,115 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	192.00'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.09 cfs @ 11.82 hrs HW=192.04' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.09 cfs)

Pond 3P: subsurface 3



Summary for Pond 4P: LEACH BASIN

Inflow Area = 0.718 ac, 17.57% Impervious, Inflow Depth = 0.67" for 25 event
Inflow = 0.24 cfs @ 12.38 hrs, Volume= 0.040 af
Outflow = 0.04 cfs @ 15.37 hrs, Volume= 0.040 af, Atten= 81%, Lag= 179.5 min
Discarded = 0.04 cfs @ 15.37 hrs, Volume= 0.040 af

Routing by Stor-Ind method, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Peak Elev= 192.58' @ 15.37 hrs Surf.Area= 516 sf Storage= 618 cf

Plug-Flow detention time= 240.8 min calculated for 0.040 af (100% of inflow)
Center-of-Mass det. time= 240.8 min (1,174.5 - 933.6)

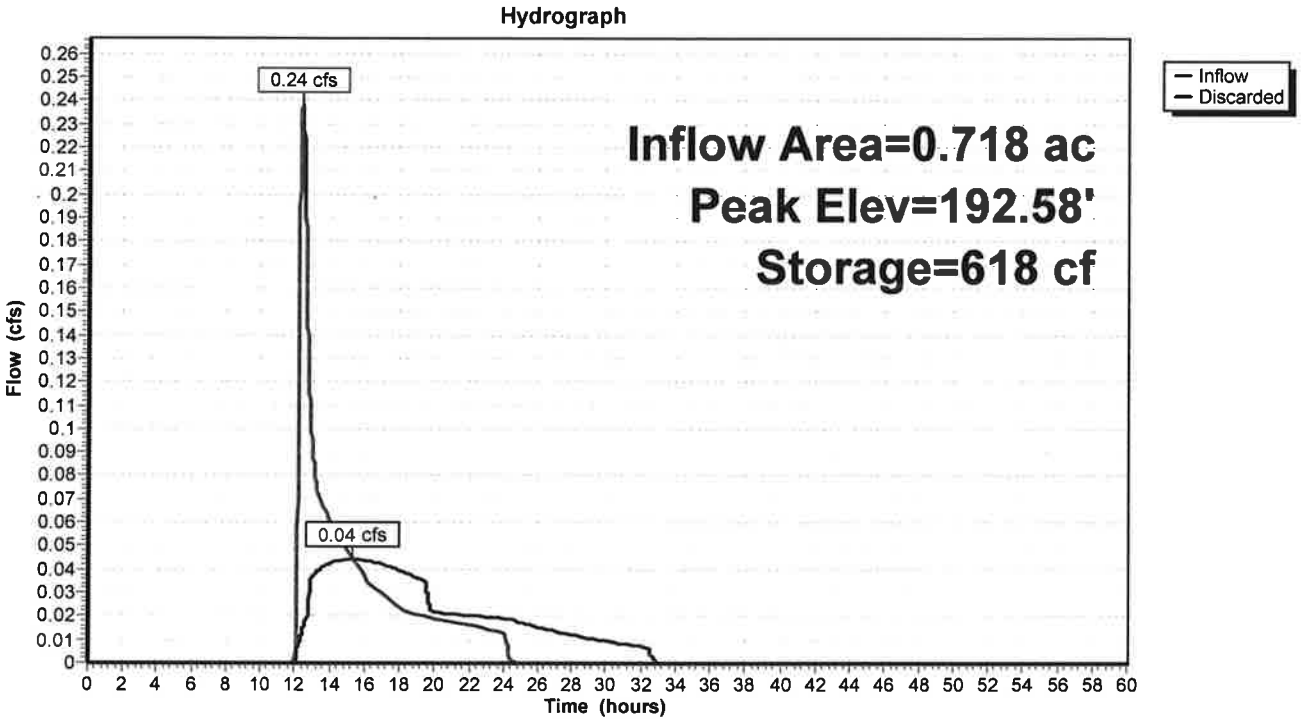
Volume	Invert	Avail.Storage	Storage Description
#1	183.00'	249 cf	**12.00'D x 7.00'H Vertical Cone/Cylinder** 792 cf Overall - 170 cf Embedded = 622 cf x 40.0% Voids
#2	184.00'	170 cf	**6.00'D x 6.00'H Vertical Cone/Cylinder** Inside #1
#3	190.00'	2,332 cf	**Custom Stage Data (Conic)** Listed below (Recalc)
		2,751 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
190.00	3	0	0	3
191.90	4	7	7	16
192.00	236	9	16	248
193.00	552	383	399	571
194.00	956	745	1,143	986
195.00	1,438	1,189	2,332	1,484

Device	Routing	Invert	Outlet Devices
#1	Discarded	183.00'	**2.410 in/hr Exfiltration over Wetted area**

Discarded OutFlow Max=0.04 cfs @ 15.37 hrs HW=192.58' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.04 cfs)

Pond 4P: LEACH BASIN



POST-DEVELOPMENT CALCULATIONS
50-YEAR STORM – 6.10" RAINFALL

Time span=0.00-60.00 hrs, dt=0.01 hrs, 6001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Area flowing toward Runoff Area=49,416 sf 11.12% Impervious Runoff Depth=0.59"
Flow Length=520' Tc=10.3 min CN=41 Runoff=0.31 cfs 0.056 af

Subcatchment 2S: Area flowing west Runoff Area=7,342 sf 0.00% Impervious Runoff Depth=0.27"
Flow Length=195' Tc=13.8 min CN=35 Runoff=0.01 cfs 0.004 af

Subcatchment 3S: roadway area Runoff Area=37,783 sf 37.09% Impervious Runoff Depth=1.82"
Flow Length=615' Tc=8.6 min CN=58 Runoff=1.57 cfs 0.132 af

Subcatchment 4S: southwestern portion Runoff Area=31,279 sf 17.57% Impervious Runoff Depth=0.91"
Flow Length=498' Tc=16.6 min CN=46 Runoff=0.37 cfs 0.054 af

Pond 1P: INF BASIN Peak Elev=203.36' Storage=895 cf Inflow=0.31 cfs 0.056 af
Outflow=0.05 cfs 0.056 af

Pond 3P: subsurface 3 Peak Elev=194.51' Storage=2,859 cf Inflow=1.57 cfs 0.132 af
Outflow=0.09 cfs 0.132 af

Pond 4P: LEACH BASIN Peak Elev=193.17' Storage=919 cf Inflow=0.37 cfs 0.054 af
Outflow=0.06 cfs 0.054 af

Total Runoff Area = 2.888 ac Runoff Volume = 0.245 af Average Runoff Depth = 1.02"
80.12% Pervious = 2.314 ac 19.88% Impervious = 0.574 ac

Summary for Subcatchment 1S: Area flowing toward Pine St

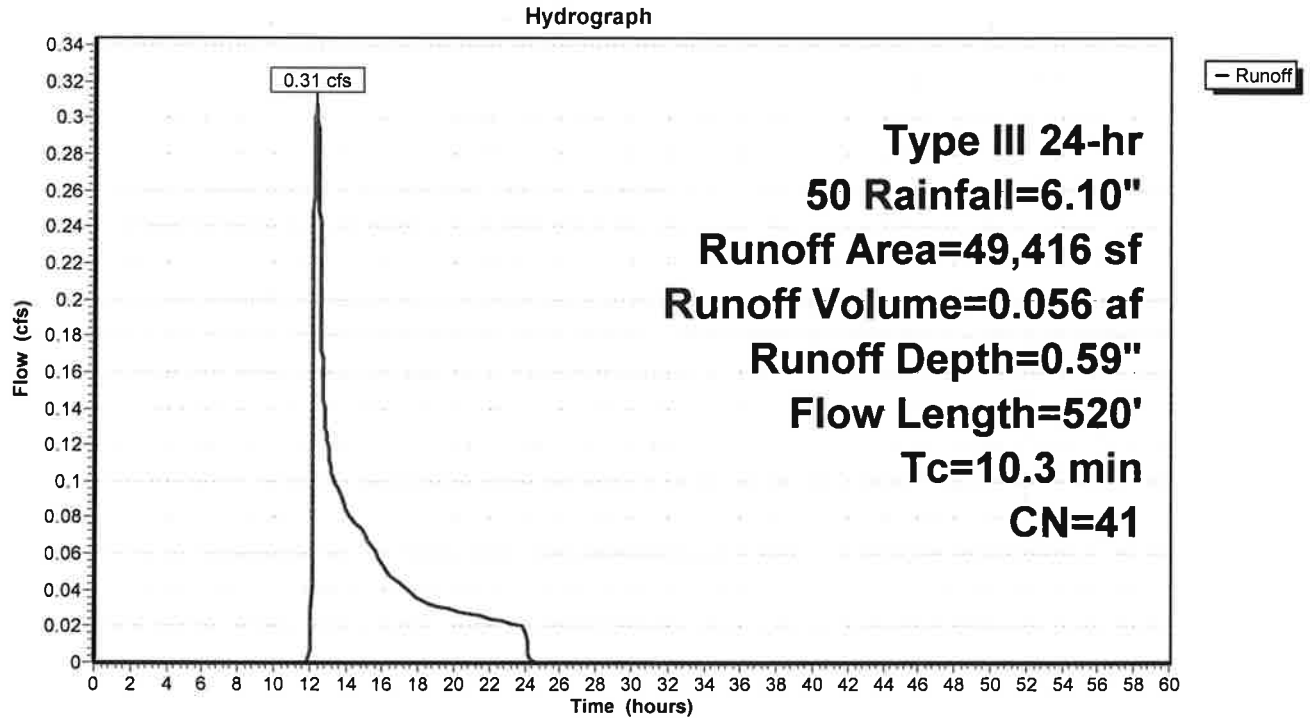
Runoff = 0.31 cfs @ 12.35 hrs, Volume= 0.056 af, Depth= 0.59"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Type III 24-hr 50 Rainfall=6.10"

	Area (sf)	CN	Description
	17,391	39	>75% Grass cover, Good, HSG A
	26,528	30	Woods, Good, HSG A
*	5,497	98	roof
	49,416	41	Weighted Average
	43,919		88.88% Pervious Area
	5,497		11.12% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.8	50	0.0300	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
2.8	270	0.1040	1.61		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
2.7	200	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
10.3	520	Total			

Subcatchment 1S: Area flowing toward Pine St



Summary for Subcatchment 2S: Area flowing west

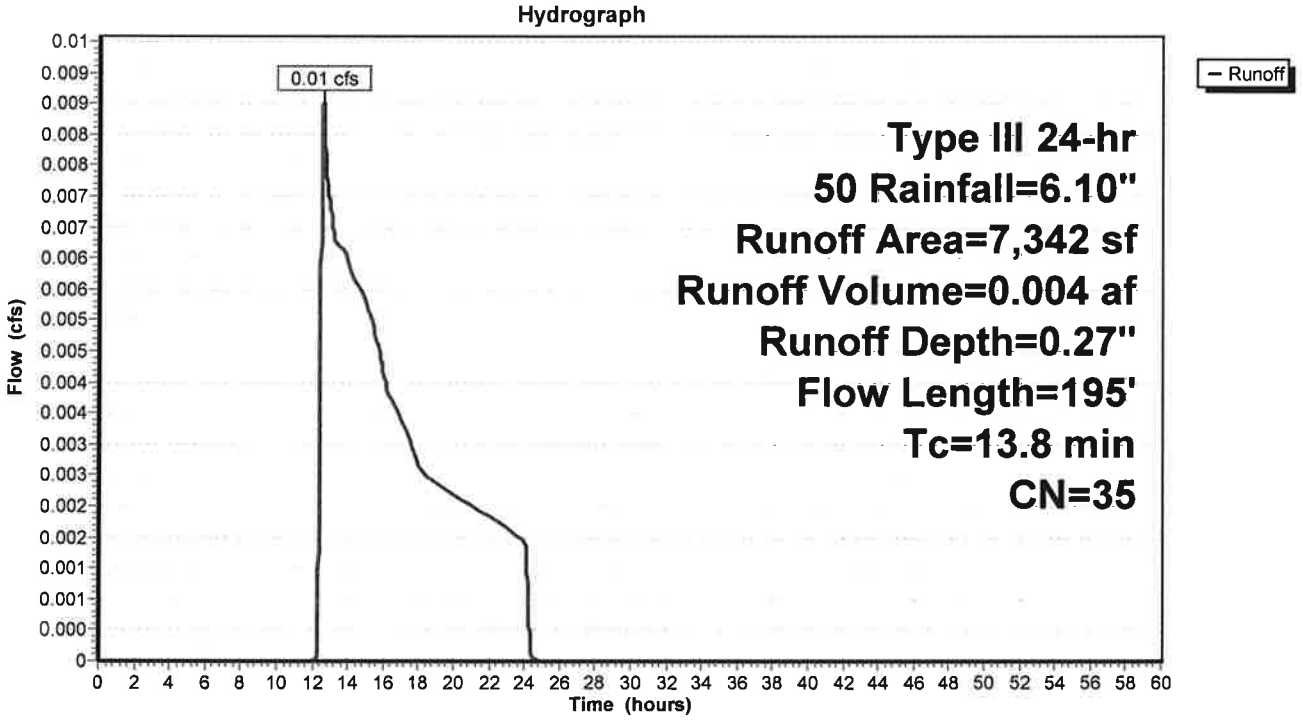
Runoff = 0.01 cfs @ 12.57 hrs, Volume= 0.004 af, Depth= 0.27"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Type III 24-hr 50 Rainfall=6.10"

Area (sf)	CN	Description
3,212	30	Woods, Good, HSG A
4,130	39	>75% Grass cover, Good, HSG A
7,342	35	Weighted Average
7,342		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0200	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
1.3	120	0.1000	1.58		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.2	25	0.0800	1.98		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
13.8	195	Total			

Subcatchment 2S: Area flowing west



Summary for Subcatchment 3S: roadway area

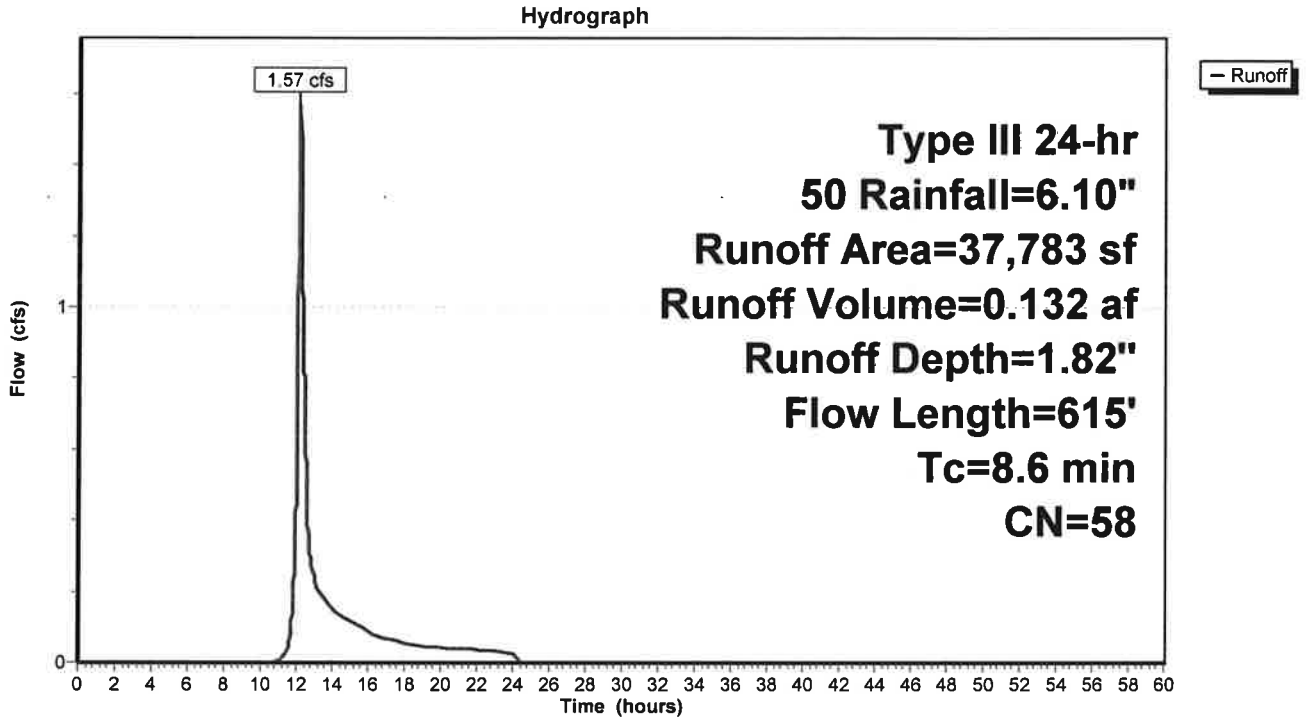
Runoff = 1.57 cfs @ 12.13 hrs, Volume= 0.132 af, Depth= 1.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Type III 24-hr 50 Rainfall=6.10"

	Area (sf)	CN	Description
*	14,015	98	paved
	13,508	30	Woods, Good, HSG A
	10,260	39	>75% Grass cover, Good, HSG A
	37,783	58	Weighted Average
	23,768		62.91% Pervious Area
	14,015		37.09% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.8	50	0.0300	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
3.0	295	0.1050	1.62		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.4	100	0.0500	4.54		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.4	170	0.0250	7.77	6.10	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012
8.6	615	Total			

Subcatchment 3S: roadway area



Summary for Subcatchment 4S: southwestern portion of site

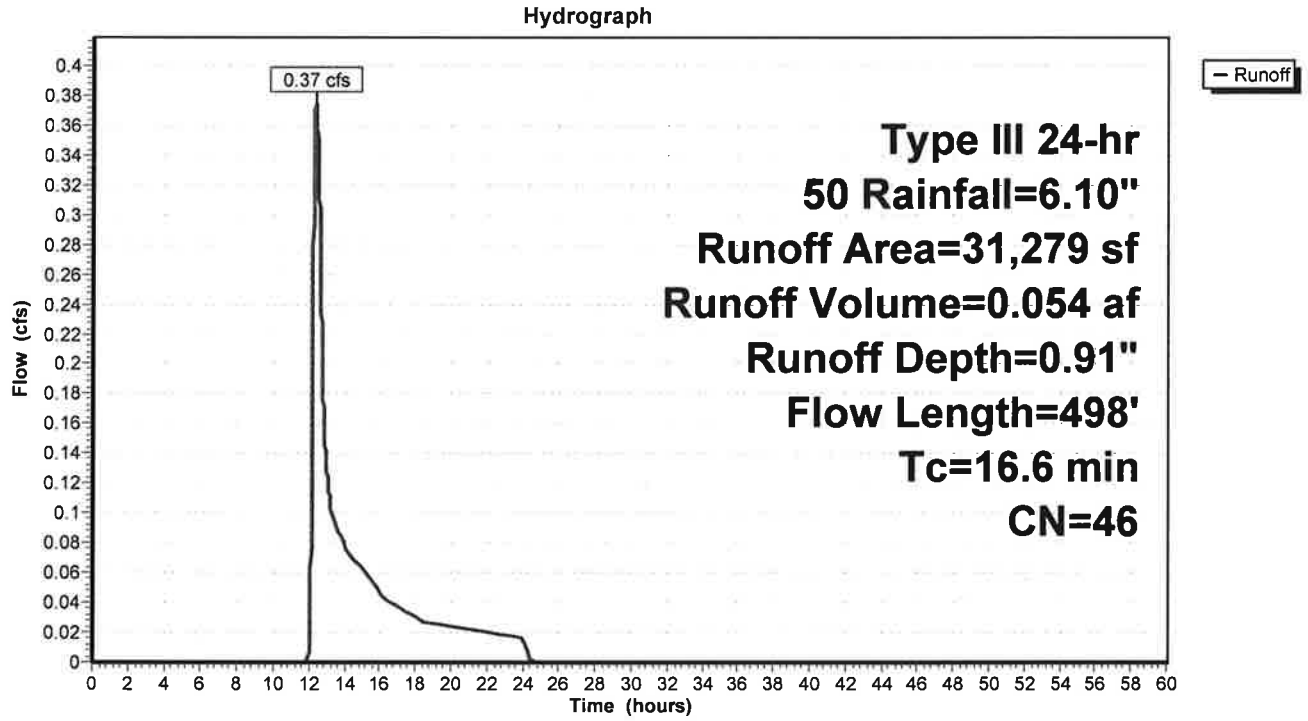
Runoff = 0.37 cfs @ 12.31 hrs, Volume= 0.054 af, Depth= 0.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Type III 24-hr 50 Rainfall=6.10"

	Area (sf)	CN	Description
*	5,497	98	roof
	14,015	39	>75% Grass cover, Good, HSG A
	11,767	30	Woods, Good, HSG A
	31,279	46	Weighted Average
	25,782		82.43% Pervious Area
	5,497		17.57% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0200	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
1.8	188	0.1200	1.73		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
2.5	260	0.0615	1.74		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
16.6	498	Total			

Subcatchment 4S: southwestern portion of site



Summary for Pond 1P: INF BASIN

Inflow Area = 1.134 ac, 11.12% Impervious, Inflow Depth = 0.59" for 50 event
Inflow = 0.31 cfs @ 12.35 hrs, Volume= 0.056 af
Outflow = 0.05 cfs @ 16.14 hrs, Volume= 0.056 af, Atten= 83%, Lag= 227.5 min
Discarded = 0.05 cfs @ 16.14 hrs, Volume= 0.056 af

Routing by Stor-Ind method, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Peak Elev= 203.36' @ 16.14 hrs Surf.Area= 909 sf Storage= 895 cf

Plug-Flow detention time= 229.6 min calculated for 0.056 af (100% of inflow)
Center-of-Mass det. time= 229.6 min (1,173.4 - 943.8)

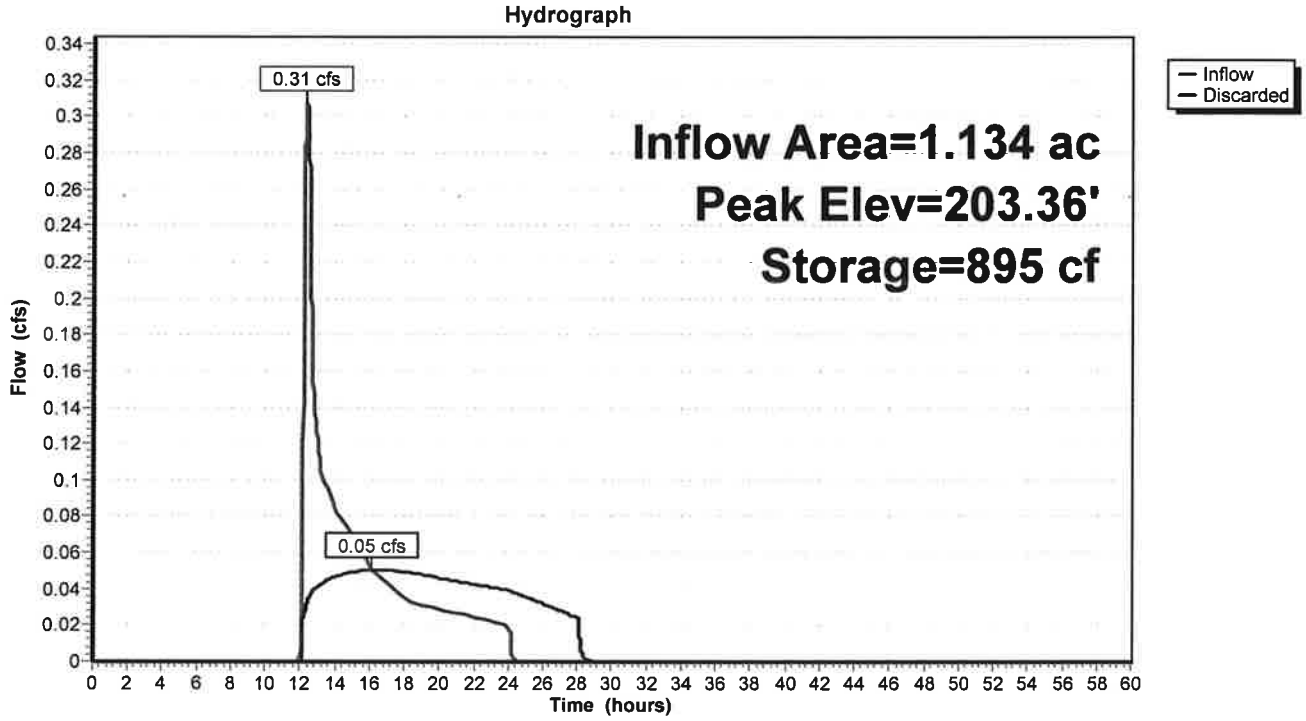
Volume	Invert	Avail.Storage	Storage Description
#1	202.00'	2,974 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
202.00	424	0	0
203.00	759	592	592
204.00	1,172	966	1,557
205.00	1,661	1,417	2,974

Device	Routing	Invert	Outlet Devices
#1	Discarded	202.00'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.05 cfs @ 16.14 hrs HW=203.36' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.05 cfs)

Pond 1P: INF BASIN



Summary for Pond 3P: subsurface 3

Inflow Area = 0.867 ac, 37.09% Impervious, Inflow Depth = 1.82" for 50 event
Inflow = 1.57 cfs @ 12.13 hrs, Volume= 0.132 af
Outflow = 0.09 cfs @ 11.74 hrs, Volume= 0.132 af, Atten= 94%, Lag= 0.0 min
Discarded = 0.09 cfs @ 11.74 hrs, Volume= 0.132 af

Routing by Stor-Ind method, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Peak Elev= 194.51' @ 15.75 hrs Surf.Area= 1,677 sf Storage= 2,859 cf

Plug-Flow detention time= 332.4 min calculated for 0.131 af (100% of inflow)
Center-of-Mass det. time= 332.4 min (1,201.9 - 869.6)

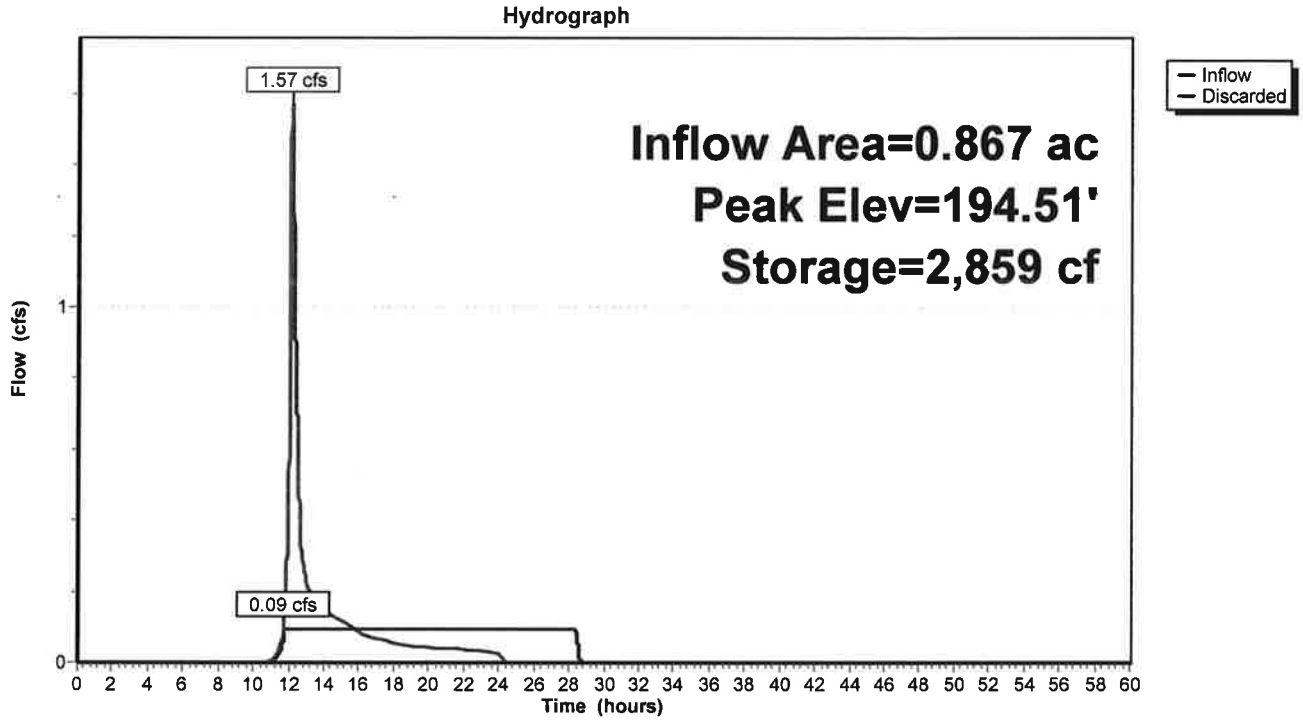
Volume	Invert	Avail.Storage	Storage Description
#1A	192.00'	1,775 cf	**20.83'W x 80.50'L x 4.04'H Field A** 6,778 cf Overall - 2,340 cf Embedded = 4,439 cf x 40.0% Voids
#2A	192.75'	2,340 cf	**Cultec R-330XLHD** x 44 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 4 rows
		4,115 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	192.00'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.09 cfs @ 11.74 hrs HW=192.04' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.09 cfs)

Pond 3P: subsurface 3



Summary for Pond 4P: LEACH BASIN

Inflow Area = 0.718 ac, 17.57% Impervious, Inflow Depth = 0.91" for 50 event
Inflow = 0.37 cfs @ 12.31 hrs, Volume= 0.054 af
Outflow = 0.06 cfs @ 15.40 hrs, Volume= 0.054 af, Atten= 85%, Lag= 185.1 min
Discarded = 0.06 cfs @ 15.40 hrs, Volume= 0.054 af

Routing by Stor-Ind method, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Peak Elev= 193.17' @ 15.40 hrs Surf.Area= 728 sf Storage= 919 cf

Plug-Flow detention time= 247.2 min calculated for 0.054 af (100% of inflow)
Center-of-Mass det. time= 247.2 min (1,167.1 - 919.9)

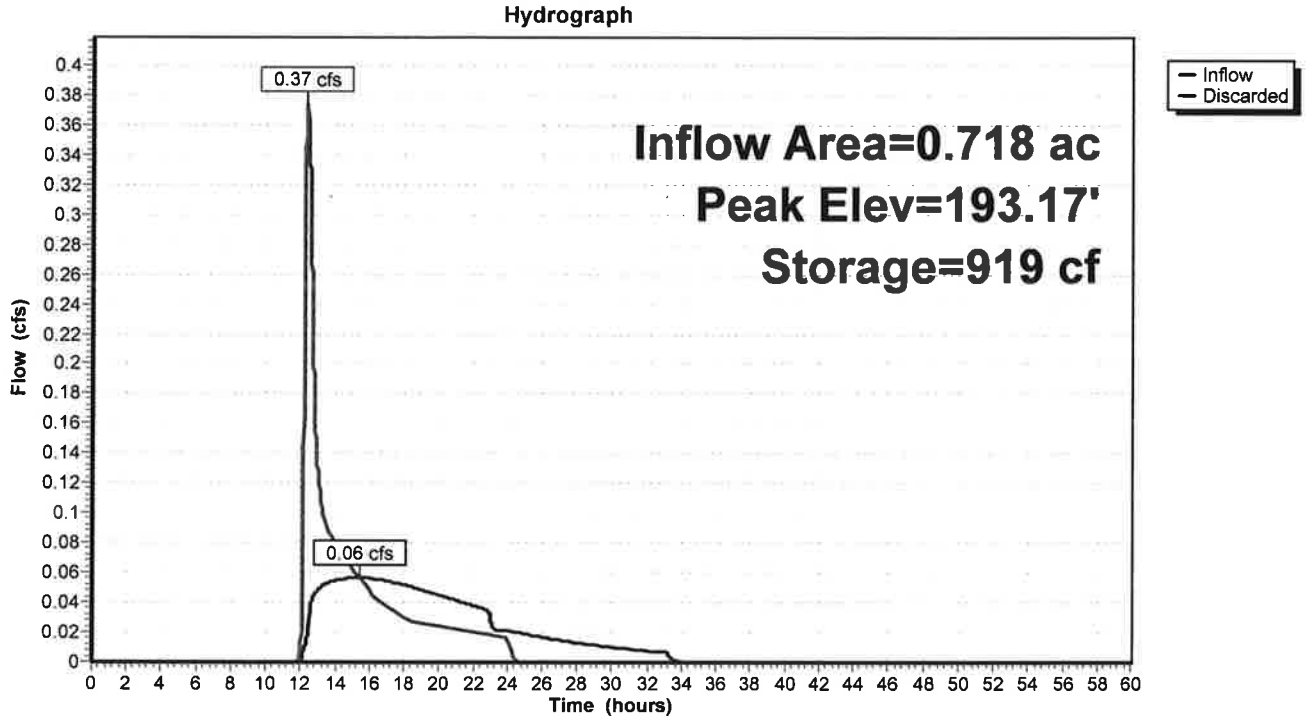
Volume	Invert	Avail.Storage	Storage Description
#1	183.00'	249 cf	**12.00'D x 7.00'H Vertical Cone/Cylinder** 792 cf Overall - 170 cf Embedded = 622 cf x 40.0% Voids
#2	184.00'	170 cf	**6.00'D x 6.00'H Vertical Cone/Cylinder** Inside #1
#3	190.00'	2,332 cf	**Custom Stage Data (Conic)** Listed below (Recalc)
		2,751 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
190.00	3	0	0	3
191.90	4	7	7	16
192.00	236	9	16	248
193.00	552	383	399	571
194.00	956	745	1,143	986
195.00	1,438	1,189	2,332	1,484

Device	Routing	Invert	Outlet Devices
#1	Discarded	183.00'	**2.410 in/hr Exfiltration over Wetted area**

Discarded OutFlow Max=0.06 cfs @ 15.40 hrs HW=193.17' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.06 cfs)

Pond 4P: LEACH BASIN



POST-DEVELOPMENT CALCULATIONS
100-YEAR STORM – 6.80" RAINFALL

Time span=0.00-60.00 hrs, dt=0.01 hrs, 6001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Area flowing toward Runoff Area=49,416 sf 11.12% Impervious Runoff Depth=0.84"
Flow Length=520' Tc=10.3 min CN=41 Runoff=0.53 cfs 0.079 af

Subcatchment 2S: Area flowing west Runoff Area=7,342 sf 0.00% Impervious Runoff Depth=0.44"
Flow Length=195' Tc=13.8 min CN=35 Runoff=0.02 cfs 0.006 af

Subcatchment 3S: roadway area Runoff Area=37,783 sf 37.09% Impervious Runoff Depth=2.27"
Flow Length=615' Tc=8.6 min CN=58 Runoff=2.01 cfs 0.164 af

Subcatchment 4S: southwestern portion Runoff Area=31,279 sf 17.57% Impervious Runoff Depth=1.22"
Flow Length=498' Tc=16.6 min CN=46 Runoff=0.57 cfs 0.073 af

Pond 1P: INF BASIN Peak Elev=203.94' Storage=1,491 cf Inflow=0.53 cfs 0.079 af
Outflow=0.06 cfs 0.079 af

Pond 3P: subsurface 3 Peak Elev=195.80' Storage=3,954 cf Inflow=2.01 cfs 0.164 af
Outflow=0.09 cfs 0.164 af

Pond 4P: LEACH BASIN Peak Elev=193.78' Storage=1,360 cf Inflow=0.57 cfs 0.073 af
Outflow=0.07 cfs 0.073 af

Total Runoff Area = 2.888 ac Runoff Volume = 0.323 af Average Runoff Depth = 1.34"
80.12% Pervious = 2.314 ac 19.88% Impervious = 0.574 ac

Summary for Subcatchment 1S: Area flowing toward Pine St

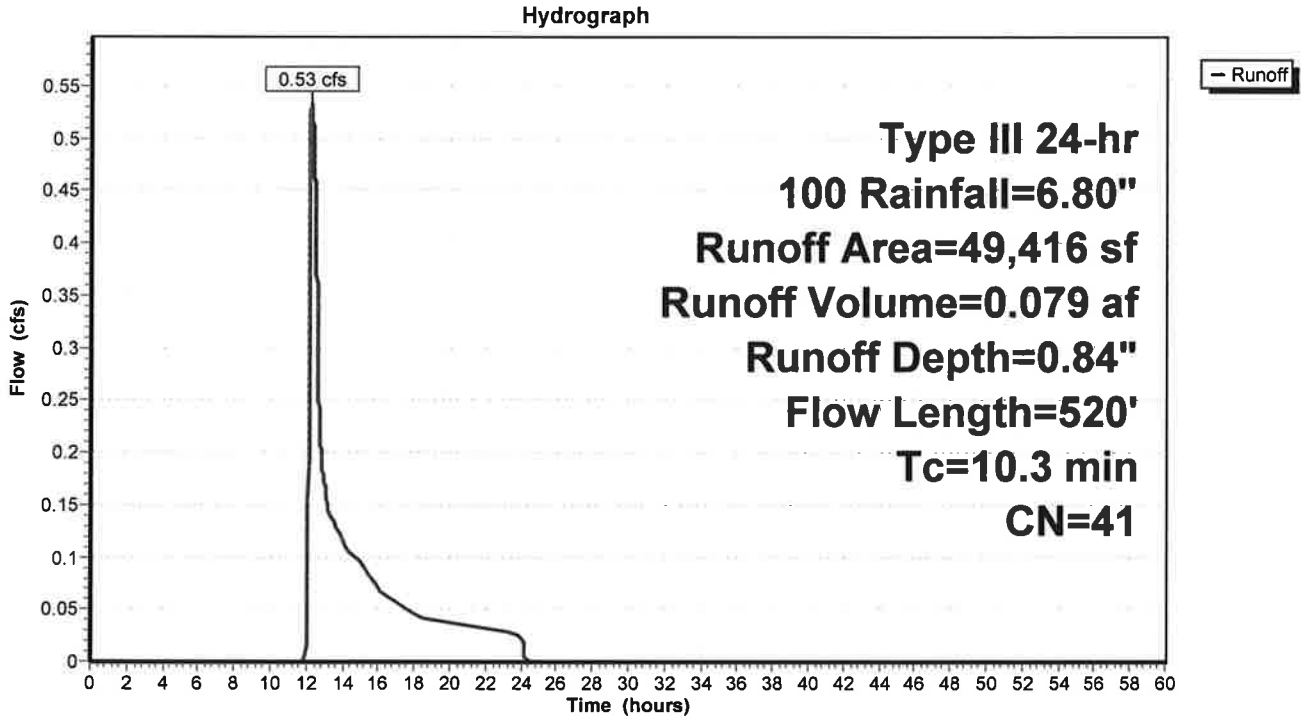
Runoff = 0.53 cfs @ 12.21 hrs, Volume= 0.079 af, Depth= 0.84"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Rainfall=6.80"

	Area (sf)	CN	Description
	17,391	39	>75% Grass cover, Good, HSG A
	26,528	30	Woods, Good, HSG A
*	5,497	98	roof
	49,416	41	Weighted Average
	43,919		88.88% Pervious Area
	5,497		11.12% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.8	50	0.0300	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
2.8	270	0.1040	1.61		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
2.7	200	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
10.3	520	Total			

Subcatchment 1S: Area flowing toward Pine St



Summary for Subcatchment 2S: Area flowing west

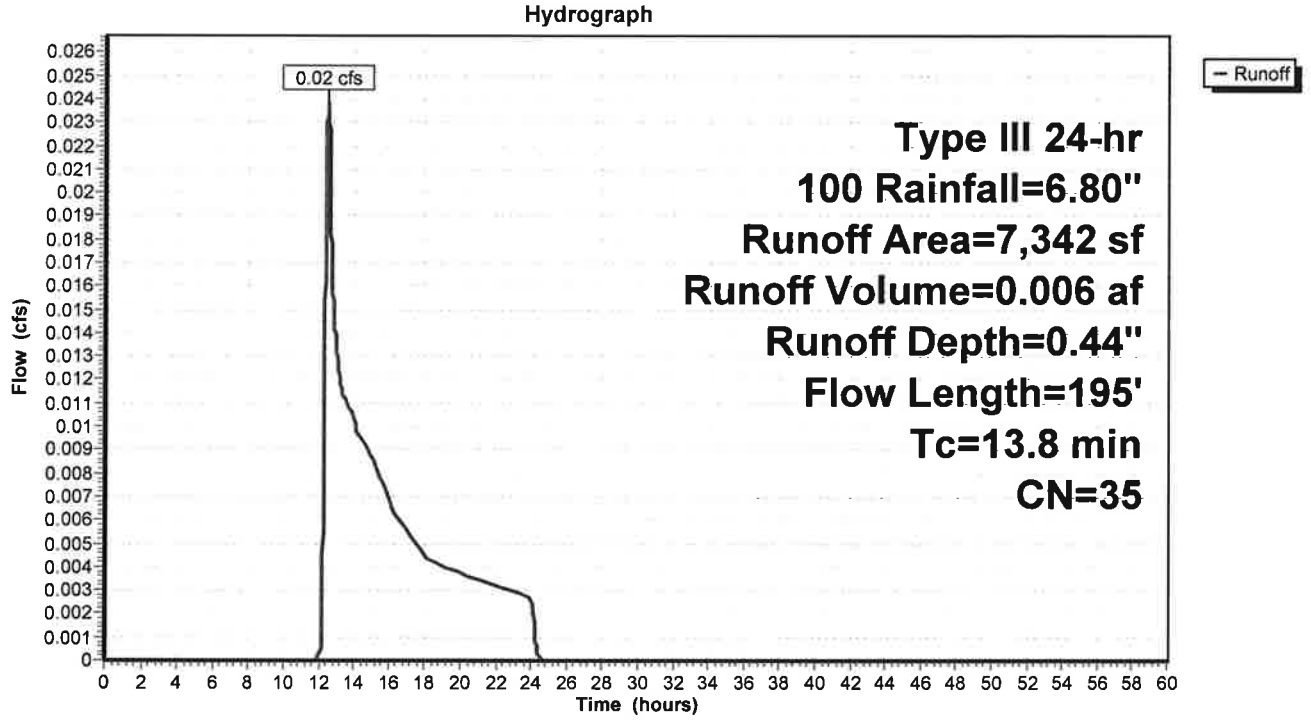
Runoff = 0.02 cfs @ 12.50 hrs, Volume= 0.006 af, Depth= 0.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Rainfall=6.80"

Area (sf)	CN	Description
3,212	30	Woods, Good, HSG A
4,130	39	>75% Grass cover, Good, HSG A
7,342	35	Weighted Average
7,342		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0200	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
1.3	120	0.1000	1.58		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.2	25	0.0800	1.98		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
13.8	195	Total			

Subcatchment 2S: Area flowing west



Summary for Subcatchment 3S: roadway area

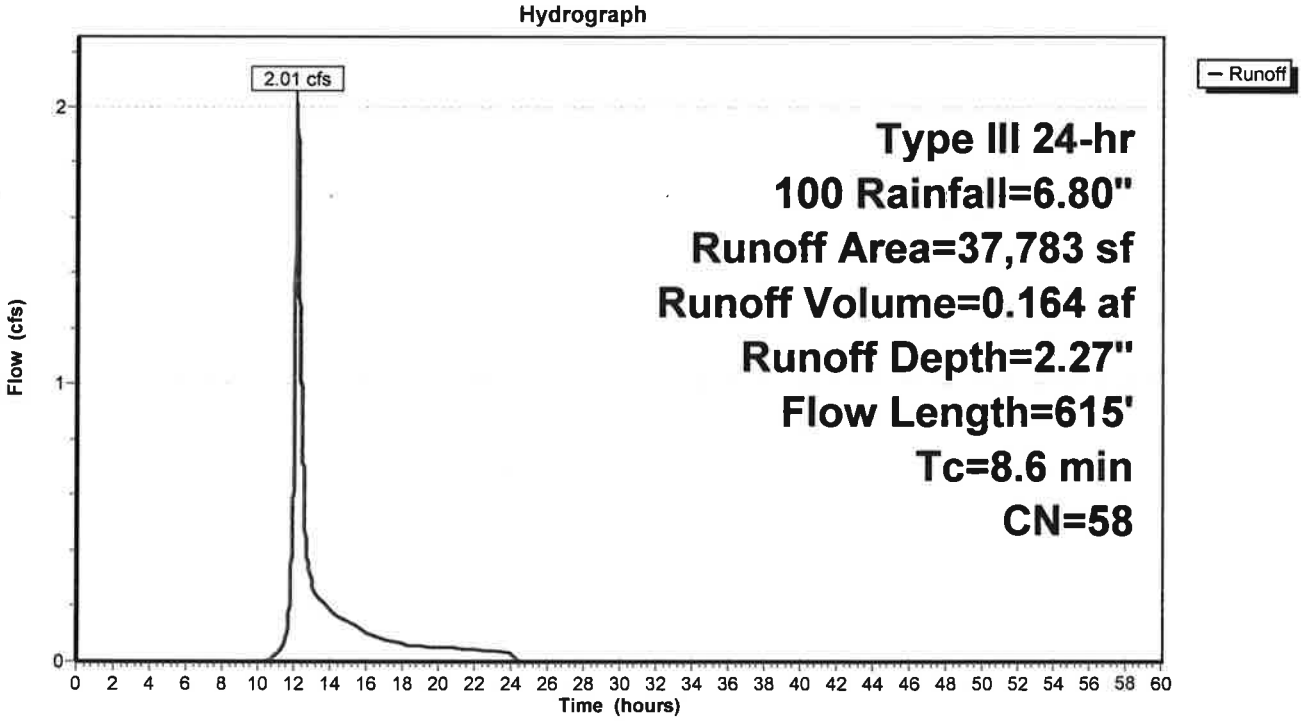
Runoff = 2.01 cfs @ 12.13 hrs, Volume= 0.164 af, Depth= 2.27"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Rainfall=6.80"

	Area (sf)	CN	Description
*	14,015	98	paved
	13,508	30	Woods, Good, HSG A
	10,260	39	>75% Grass cover, Good, HSG A
	37,783	58	Weighted Average
	23,768		62.91% Pervious Area
	14,015		37.09% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.8	50	0.0300	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
3.0	295	0.1050	1.62		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.4	100	0.0500	4.54		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.4	170	0.0250	7.77	6.10	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012
8.6	615	Total			

Subcatchment 3S: roadway area



Summary for Subcatchment 4S: southwestern portion of site

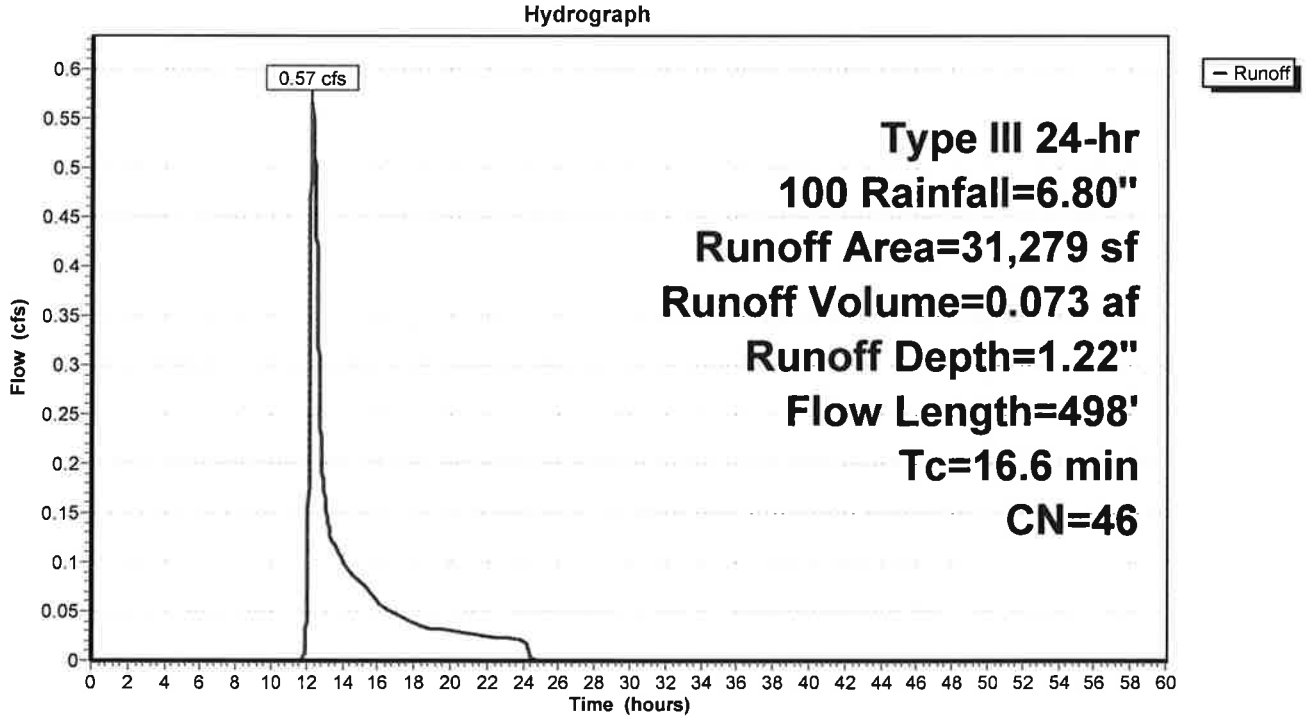
Runoff = 0.57 cfs @ 12.29 hrs, Volume= 0.073 af, Depth= 1.22"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Rainfall=6.80"

	Area (sf)	CN	Description
*	5,497	98	roof
	14,015	39	>75% Grass cover, Good, HSG A
	11,767	30	Woods, Good, HSG A
	31,279	46	Weighted Average
	25,782		82.43% Pervious Area
	5,497		17.57% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0200	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
1.8	188	0.1200	1.73		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
2.5	260	0.0615	1.74		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
16.6	498	Total			

Subcatchment 4S: southwestern portion of site



Summary for Pond 1P: INF BASIN

Inflow Area = 1.134 ac, 11.12% Impervious, Inflow Depth = 0.84" for 100 event
Inflow = 0.53 cfs @ 12.21 hrs, Volume= 0.079 af
Outflow = 0.06 cfs @ 16.36 hrs, Volume= 0.079 af, Atten= 88%, Lag= 248.7 min
Discarded = 0.06 cfs @ 16.36 hrs, Volume= 0.079 af

Routing by Stor-Ind method, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Peak Elev= 203.94' @ 16.36 hrs Surf.Area= 1,148 sf Storage= 1,491 cf

Plug-Flow detention time= 305.8 min calculated for 0.079 af (100% of inflow)
Center-of-Mass det. time= 305.9 min (1,232.4 - 926.6)

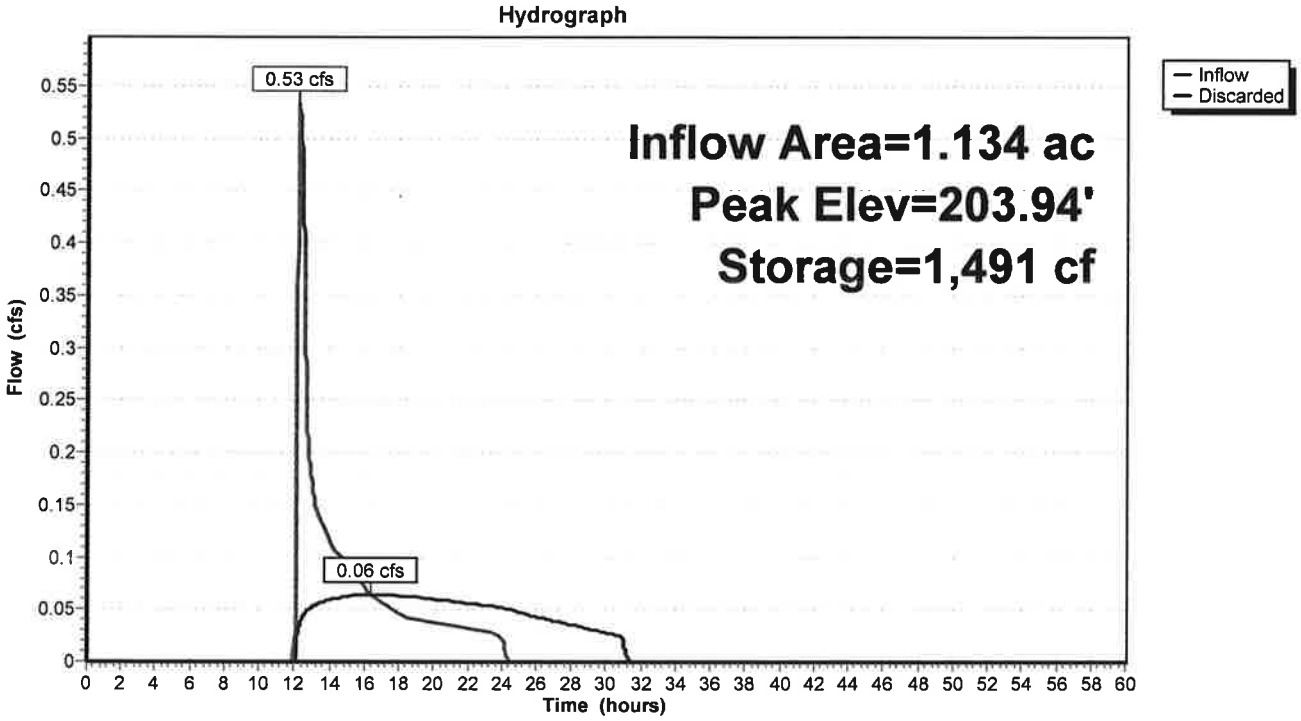
Volume	Invert	Avail.Storage	Storage Description
#1	202.00'	2,974 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
202.00	424	0	0
203.00	759	592	592
204.00	1,172	966	1,557
205.00	1,661	1,417	2,974

Device	Routing	Invert	Outlet Devices
#1	Discarded	202.00'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.06 cfs @ 16.36 hrs HW=203.94' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.06 cfs)

Pond 1P: INF BASIN



Summary for Pond 3P: subsurface 3

Inflow Area = 0.867 ac, 37.09% Impervious, Inflow Depth = 2.27" for 100 event
Inflow = 2.01 cfs @ 12.13 hrs, Volume= 0.164 af
Outflow = 0.09 cfs @ 11.64 hrs, Volume= 0.164 af, Atten= 95%, Lag= 0.0 min
Discarded = 0.09 cfs @ 11.64 hrs, Volume= 0.164 af

Routing by Stor-Ind method, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Peak Elev= 195.80' @ 16.31 hrs Surf.Area= 1,677 sf Storage= 3,954 cf

Plug-Flow detention time= 453.3 min calculated for 0.164 af (100% of inflow)
Center-of-Mass det. time= 453.3 min (1,315.9 - 862.6)

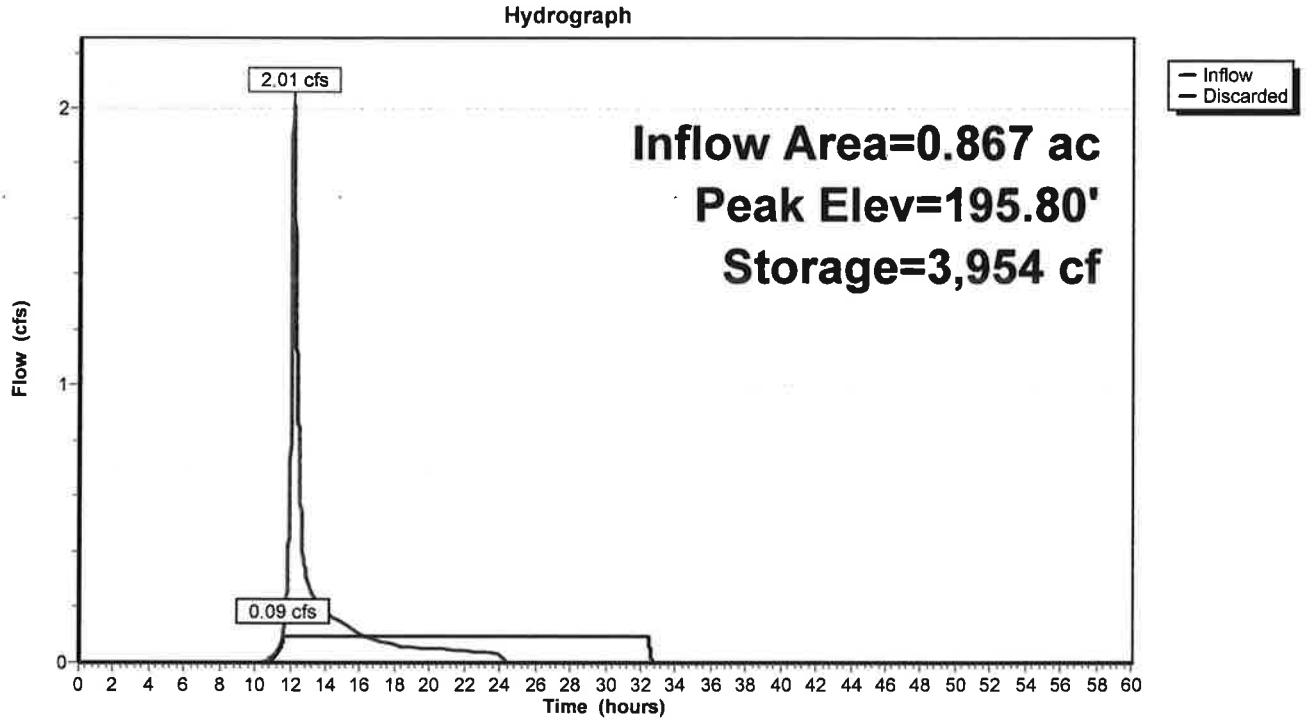
Volume	Invert	Avail.Storage	Storage Description
#1A	192.00'	1,775 cf	**20.83'W x 80.50'L x 4.04'H Field A** 6,778 cf Overall - 2,340 cf Embedded = 4,439 cf x 40.0% Voids
#2A	192.75'	2,340 cf	**Cultec R-330XLHD** x 44 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 4 rows
		4,115 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	192.00'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.09 cfs @ 11.64 hrs HW=192.04' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.09 cfs)

Pond 3P: subsurface 3



Summary for Pond 4P: LEACH BASIN

Inflow Area = 0.718 ac, 17.57% Impervious, Inflow Depth = 1.22" for 100 event
Inflow = 0.57 cfs @ 12.29 hrs, Volume= 0.073 af
Outflow = 0.07 cfs @ 15.47 hrs, Volume= 0.073 af, Atten= 88%, Lag= 191.0 min
Discarded = 0.07 cfs @ 15.47 hrs, Volume= 0.073 af

Routing by Stor-Ind method, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Peak Elev= 193.78' @ 15.47 hrs Surf.Area= 969 sf Storage= 1,360 cf

Plug-Flow detention time= 277.8 min calculated for 0.073 af (100% of inflow)
Center-of-Mass det. time= 277.8 min (1,185.6 - 907.8)

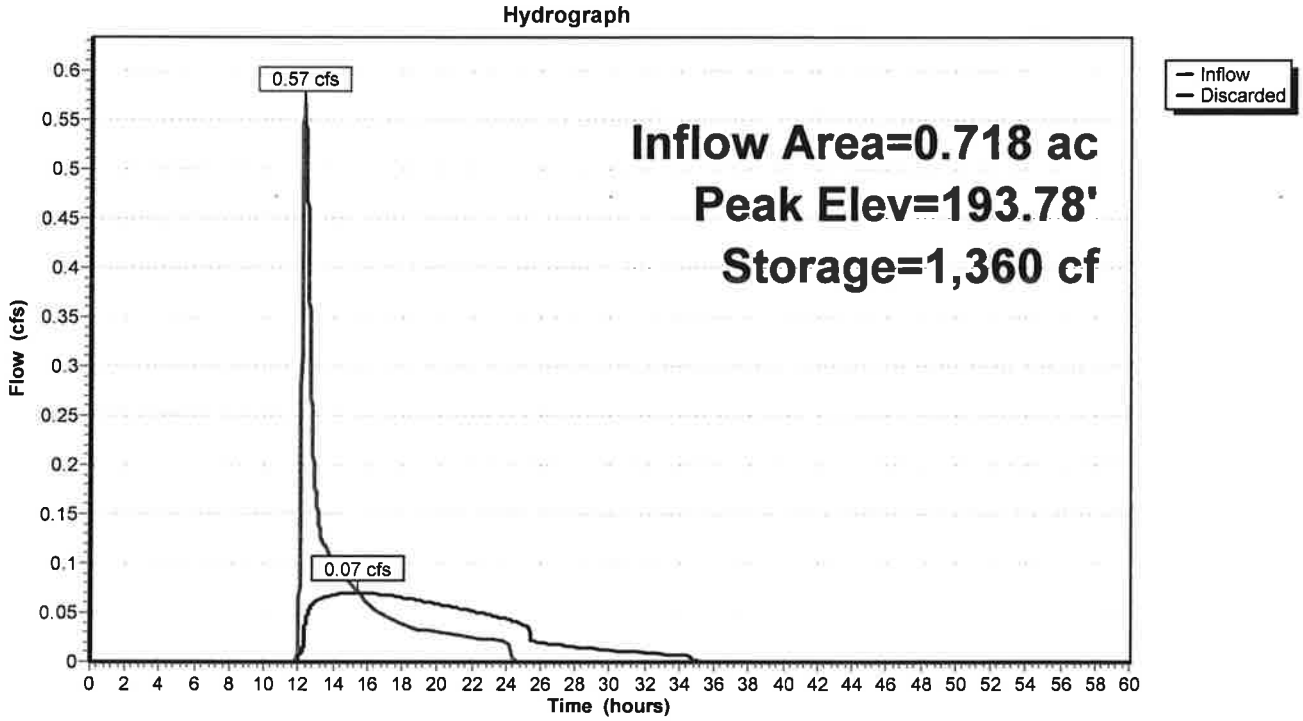
Volume	Invert	Avail.Storage	Storage Description
#1	183.00'	249 cf	**12.00'D x 7.00'H Vertical Cone/Cylinder** 792 cf Overall - 170 cf Embedded = 622 cf x 40.0% Voids
#2	184.00'	170 cf	**6.00'D x 6.00'H Vertical Cone/Cylinder** Inside #1
#3	190.00'	2,332 cf	**Custom Stage Data (Conic)** Listed below (Recalc)
		2,751 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
190.00	3	0	0	3
191.90	4	7	7	16
192.00	236	9	16	248
193.00	552	383	399	571
194.00	956	745	1,143	986
195.00	1,438	1,189	2,332	1,484

Device	Routing	Invert	Outlet Devices
#1	Discarded	183.00'	**2.410 in/hr Exfiltration over Wetted area**

Discarded OutFlow Max=0.07 cfs @ 15.47 hrs HW=193.78' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.07 cfs)

Pond 4P: LEACH BASIN



OPERATIONS AND MAINTENANCE PLAN

OPERATIONS AND MAINTENANCE PLAN

The following is the proposed operation and maintenance plan for the storm water management systems at the residential development located at 35 Pine Street in Norfolk, Massachusetts:

- Owner: Rocco Realty II, LLC
  P.O. Box 657
  Walpole, MA 02081

- Parties responsible for Operation and Maintenance:
  Same as above

The storm water management facilities were designed to require little or no intervention in the operation and to require little or no maintenance once the project is built and stable vegetative cover is established. However, the drainage improvements shall be subject to the following maintenance schedule:

A. Routine Maintenance

1. Debris: All debris and litter are to be removed from all catch basins, trench drains, swales, infiltration basins and surrounding areas at least twice per year.

2. Re-seeding: Embankments that have excessive erosion or slumping are to be re-graded and seeded (with canary grass or tall fescue grass) during the spring or fall growing seasons as needed.

3. Inspect: infiltration basins and infiltration chamber systems shall be inspected for signs of proper functioning on a monthly basis. Any potential blockages in the roof down spouts will be removed if discovered. Gutters will be cleaned at least twice per year.

4. Mowing: The infiltration basin sideslopes shall be mowed at least twice per year. The detention basin bottoms shall be inspected at each mowing event. If vegetation has accumulated that could cause a negative impact on the function of the basin, then it will be removed.

B. Periodic Maintenance

1. All catch basin sumps, trench drains and Stormceptor units will be cleaned a minimum of once per year and inspected monthly during the active construction stage. In this cleaning, the entire contents of the sumps and trench drains will be removed.

2. Accumulated sediment in the water quality units will be inspected and removed in accordance with the manufacturer's recommendations or, at a minimum, once per year. If the accumulated sediment is equal to 15% of the capacity of the device, the sediment shall be cleaned out using a vacuum truck.

C. Non-routine Maintenance

1. Structural: All catch basins, trench drains, Stormceptor units, pipes, and infiltration basin sideslopes should be inspected once every four (4) years for proper function, clogging, signs of deterioration and structural inadequacy. Any adverse situations are to be repaired as needed.

D. Non-periodic Inspection

1. The storm water management system shall be inspected after two years of full operation by a Registered Professional Civil Engineer to confirm its adequacy. The inspection shall include an examination of all components of the system including catch basins, water quality units and infiltration systems.

E. Annual Budget

1. The estimated annual budget to complete the tasks listed in this plan is $1,500.

OPERATION AND MAINTENANCE PLAN LOG FORM

Refer to Site Plan set of parking lots and drainage system. Use Log Form that follows as required upon completion of inspections and maintenance tasks, and file.

Residential Development
35 Pine Street, Norfolk, MA Drainage System
Operation & Maintenance Log Form

SEDIMENT STRUCTURAL CONTROLS

CONTROL	DATE INSPECTED	SEDIMENT BUILDUP (YES/NO)	IF SEDIMENT BUILDUP, DATE CLEANED
CB-1			
CB-2			
CB-3			
CB-4			
DMH-3 (STC)			
OTHER:			

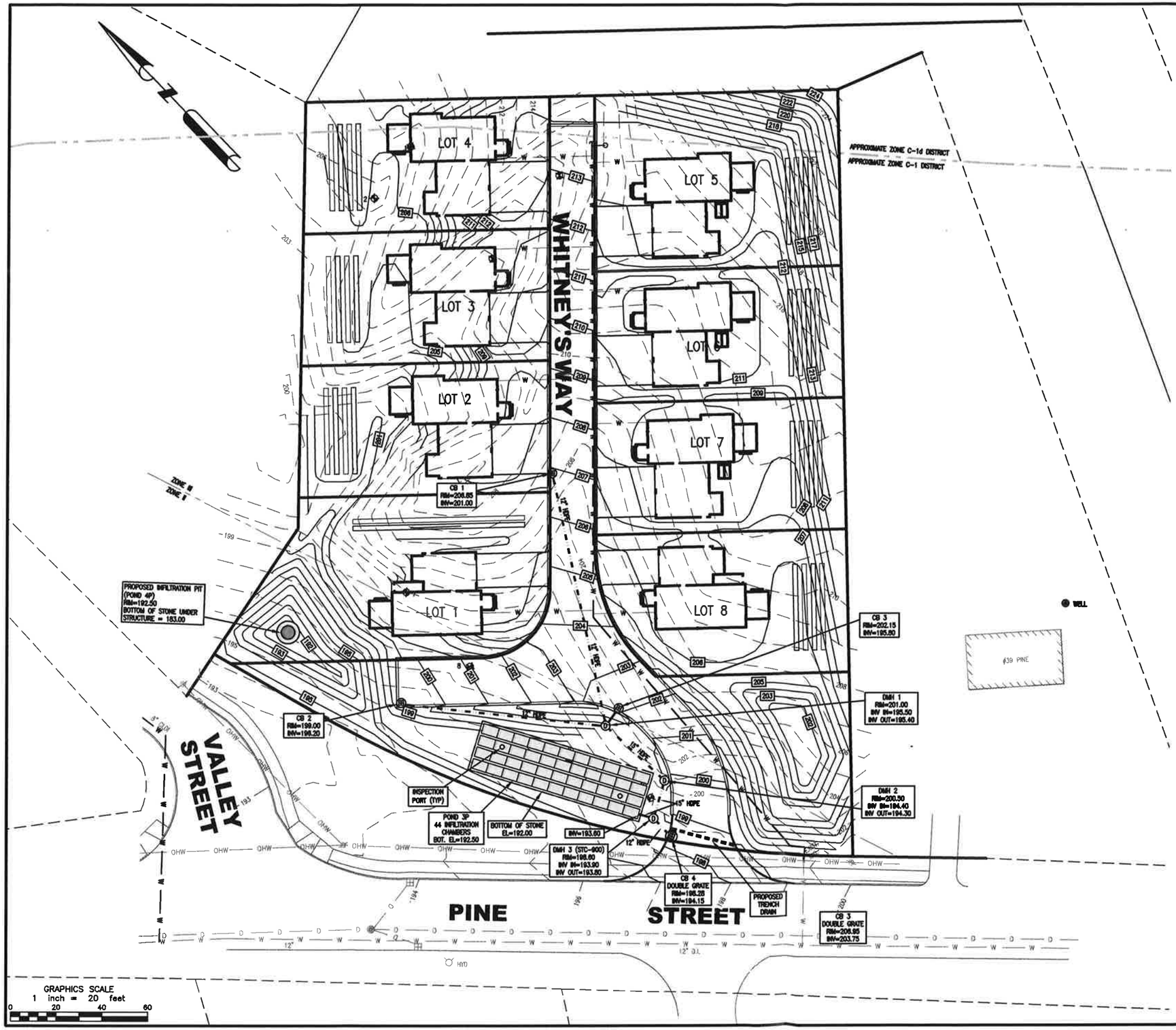
Note: Sediment to be removed from catch basins once the depth reaches 24".

REQUIRED MAINTENANCE:

_____

_____

TO BE PERFORMED BY:_____ON_____



NORFOLK ZONING BOARD

APPROVED UNDER SECTION G.6, J.4.a AND J.7.a.2.E OF THE ZONING BYLAW

APPROVED: _____

ENDORSED: _____

I CERTIFY THAT 20 DAYS HAVE PASSED SINCE THE PLANNING BOARD APPROVAL AND NO APPEAL HAS BEEN FILED WITH THIS OFFICE.

DATE: _____

_____
TOWN CLERK OF NORFOLK

LEGEND

EXISTING	DESCRIPTION	PROPOSED
98	CONTOURS	202
	BOUND	
	TEST PIT	
19X24	SPOT GRADE	+88.5
WELL	WELL	
D D D	DRAIN LINE	
	DRAIN MANHOLE	
	CATCH BASIN	
CCB	CAPE COD BERM	CCB
OHW OHW	OVERHEAD WIRES	OHW OHW
	UTILITY POLE	
	SINGLE POLE SIGN	
X X X	CHAIN LINKED FENCE	

PROGRESS PRINT NOT ISSUED FOR CONSTRUCTION

P.E. STAMP

ZCE
ZENITH CONSULTING ENGINEERS, LLC
3 MAIN STREET LAKEVILLE, MA 02347
PHONE: (508) 947-4208

REV.	DATE	DESCRIPTION	BY	APP.

DRAWN BY: RMF/AB
DESIGNED BY: RMF/AB
CHECKED BY: MCZ
APPROVED BY: AB
DATE: 6/26/2019
PROJECT NUMBER 0101-07-01
DRAWING SCALE: 1" = 20'
SHEET ID 01

SHEET NAME: PLAN TO ACCOMPANY O & M PLAN

PROJECT SITE: 35 PINE STREET / 0 VALLEY STREET NORFOLK, MASSACHUSETTS

CLIENT INFO: ROCCO REALTY II, LLC. P.O. BOX 657 WALPOLE, MASSACHUSETTS 02081

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ZCE
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3 MAIN STREET LAKEVILLE, MA 02347
PHONE: (508) 947-4208
P.E. STAMP

REV.	DATE	DESCRIPTION	BY

DRAWN BY: AB/NF
DESIGNED BY: AB/NF
CHECKED BY:
APPROVED BY
DATE: 7/24/2019
PROJECT NUMBER 0101-07-01
SCALE: 1" = 20'
SHEET 8 PRE

SHEET NAME: PRE-DEVELOPMENT DRAINAGE AREAS PLAN
PROJECT SITE: 35 PINE STREET / 0 VALLEY STREET NORFOLK, MASSACHUSETTS
CLIENT INFO: ROCCO REALTY II, LLC. P.O. BOX 657 WALPOLE, MASSACHUSETTS 02081

S:\Civil Engineering Projects\Norfolk\Pine St\35 Pine Street\Work\Comprehensive Site Plan Set.dwg

SHEET NAME: POST-DEVELOPMENT DRAINAGE AREAS PLAN	DRAWN BY: JLB/RMF	DATE: 7/24/2019	REV.	DATE	DESCRIPTION	BY	APP.
PROJECT SITE: 35 PINE STREET / 0 VALLEY STREET NORFOLK, MASSACHUSETTS	DESIGNED BY: JLB/RMF	PROJECT NUMBER 0101-07-01					
CLIENT INFO: ROCCO REALTY II, LLC. P.O. BOX 657 WALPOLE, MASSACHUSETTS 02081	CHECKED BY:	SCALE: 1" = 20'					
	APPROVED BY	SHEET ID POST					

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P.E. STAMP

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SHEET NAME: CATCH BASIN DRAINAGE AREAS PLAN	DRAWN BY: JLB/RMF	DATE: 7/24/2019	REV.	DATE	DESCRIPTION	BY	APP.	
PROJECT SITE: 35 PINE STREET / 0 VALLEY STREET NORFOLK, MASSACHUSETTS	DESIGNED BY: JLB/RMF	PROJECT NUMBER 0101-07-01						
CLIENT INFO: ROCCO REALTY II, LLC. P.O. BOX 657 WALPOLE, MASSACHUSETTS 02081	CHECKED BY:	SCALE: 1" = 20'						
	APPROVED BY	SHEET ID CB						

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ZENITH CONSULTING ENGINEERS, LLC
3 MAIN STREET LAKEVILLE, MA 02347
PHONE: (508) 947-4208

P.E. STAMP

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