HYDRAULIC / HYDROLOGIC REPORT

"Purple Paws"
A
Proposed Site Plan
At
At 0 Mechanic Street
(Formerly 79 Mechanic Street)
Bellingham, Massachusetts

Applicant / Owner
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DRAINAGE ANALYSIS SUMMARY

D&L Design Group Inc. is pleased to provide the following Hydraulic / Hydrologic Report for the project known as "**Purple Paws**", a Proposed Site Plan consisting of a proposed 6,000 S.F. building with 20 proposed parking spaces, utilities, stormwater / drainage, and associated grading. The project is adjacent to Crystal Way, one of the main drives that provides access to the Crystal Springs Condominiums.

The drainage analysis is being performed to Analyze the Pre- Development and Post Development flow rates associated with the project / development.

The hydrologic conditions were analyzed using Soil Cover Complex Method – Rainfall NOAA 14, HydroCAD & The Rational Method.

According to the online USGS soil survey, the area consists of soils with Group "A" hydrologic ratings, Windsor.

EXISTING CONDITIONS:

The 0 Mechanic Street Parcel consists of 41, 000 S.F. of land, Zoned B1 - Business 1. The parcel had been previously which had a single-family house, driveway, utilities, and large yard area. The site currently is cleared with much of the ground cover being grass.

The site abuts an existing commercial site which is located along the western property line. Crystal Way is adjacent to the site along the eastern side of the project. Crystal Springs Condominiums are located towards the southern portion of the site along with the towns existing sewage Pump Station.

The site consists of topography that slopes from west to east towards Crystal Way. Crystal Way has a small area drain between the pavement of Crystal Way and the eastern property line (which appears to be some type of retrofit to the drainage system. Once the drainage enters the area drain and Crystal Way the drainage enters stormwater basins and eventually into a wetland system east of Crystal Way.

The drainage analysis for the Pre-Development Conditions has one (1) "Pre" development drainage area. "Pre-DA#1" Eastern Property Line is the predevelopment area that drains towards the Eastern Property Line, Interest Point #1 (IP#1-Pre).

Proposed Conditions:

The project is a Proposed Site Plan consisting of a proposed 6,000 S.F. building with 20 proposed parking spaces, utilities, stormwater / drainage, and associated grading. The project is adjacent to Crystal Way, one of the main drives that provides access to the Crystal Springs Condominiums. The site will be serviced by town sewer, water and natural gas.

The proposed infrastructure servicing the proposed use / building is a parking area with 20 total spaces, with typical catch basin to drain manhole (DMH) connections. The catch basins will have oil and gas separators with deep sumps. The catch basins drain to DMH's then into a proprietary stormwater treatment unit / Hydrodynamic unit (**Stormceptor 900** or equal) then connects to an underground detention basin (Cultec units) located under the front portion of the parking area. There is also an open surface stormwater basin that collects the roof run-off and some overland flow, this is located behind the proposed building.

The soils consist of all sands and gravels with cobbles, the soils are a **Hydraulic Group "A"**, Windsor.

The post drainage analysis is compared to the same interest point referenced above in the Existing Conditions, the Eastern Property Line IP#1-Post. In the post conditions there are two stormwater basins being proposed, underground basin #1 is in the front portion of the site (under the parking area), the second, stormwater basin #2 is an open surface basin located behind the proposed building.

When Crystal Way was constructed, there where no provisions made to handle flow from Locus, therefore, this proposal takes the collected run-off and directs it around the Crystal Way property, via the public way and places the runoff back into the same wetland system.

Following the analysis, the calculations show that there is little to no water flowing off this site during the 2-year storm event.

In summary, the peak rates of runoff were compared under pre-development and post-development conditions for analysis of the 2-year, 10 year, 50 and 100 year storm events.

The following is a **Peak Discharge Summary Table**:

PRE & POST DEVELOPMENT PEAK FLOW RATES					
INTEREST POINT #			**STORM EVENT (YR.)**		
		2	**10**	**50**	**100**
IP# 1					
Eastern Property Line – Crystal Way	**PRE** (CFS)	0.03	0.53	1.69	2.33
	POST (CFS)	0.0	0.24	1.21	2.05

DEP Stormwater Management Standards:

Standard #1: The proposed changes will not cause erosion in adjacent water of the Commonwealth, as BMP measures are proposed in accordance with the design requirements of the Stormwater Management handbook. The Erosion & Sedimentation Control Plan provides for the installation of siltation barriers, temporary basins, temporary construction entrances and outlines intermediary measures to control runoff during construction and after construction.

Standard #2: The proposed development peak discharge rates for the total off-site flow rate are less than or equal to pre-development discharge rates for the 2, 10, 50 and 100 year storm events for the design points analyzed. Attached calculations show how the site mitigates the increased flow rates due to surface changes from the site development.

Standard #3: The proposed project proposes to recharge the required amount of runoff through the bottom of the underground detention basin. The Sands and Gravels on the site are conducive do this proposal.

Standard #4: Over 80% TSS shall occur based on the BMP measurements provided. The treatment train varies for each section. TSS worksheets are provided in the report for each treatment train in the site.

Standard #5: The proposed development will not generate higher potential pollutant loads and therefore will not require additional BMP practices.

Standard #6: The proposed project is not near a critical area.

Standard #7: The proposed project is not a redevelopment project.

Standard #8: Erosion and sediment control measures are proposed as part of the proposed project.

Standard #9: An Operation & Maintenance plan is provided within this document

Standard #10: This project does not propose any illicit discharges.

STORMWATER MANAGEMENT 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.

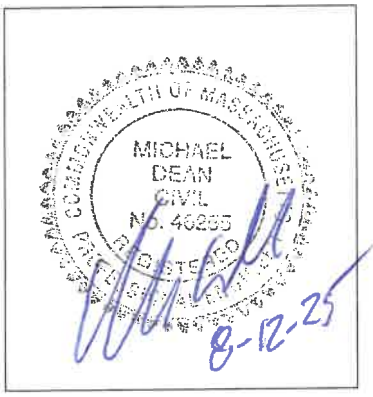
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the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



Signature and Date 8-12-25

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): hydroDynamic seperator, underground basin

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.

STANDARD #3 –LOSS OF ANNUAL RECHARGE

Recharge will take place in the stormwater basins following the Stormwater Regulations. Soils were found to be Class A permeability.

The table below shows the required and provided recharge volumes for the project. As shown, the proposed condition exceeds the minimum requirement for the additional impervious areas.

Recharge Volume Summary

Soil Type	Recharge Factor (in. runoff)	Existing Impervious Area (sf)	Additional Impervious Area (sf)	Min. Req. Recharge Volume (cf)
A	0.60	0	18,090	905
B	0.35	0	0	0
C	0.25	0	0	0
D	0.10	0	0	0
Total Required				**905**

Standard #3 Applies to Proposed Impervious

Provided Recharge Volume (cf)		
Underground Basin		
*Conservative – direct volume		1,000
Open Surface Basin		
*Conservative – Direct Volume		716
Total Provided *		**1,716**

*** the conservative approach is the direct volume below the outlet inverts in the basins. Dynamically looking at HydroCAD, there is no stormwater leaving the site up to the 2-year storm event. The 2-year storm event produces a total volume of run-off of 0.085-acre feet (af) (0.023 + 0.062) = 0.085 af x 43,560 sf / acre= 3,702.5 cf of recharge. This proposed drainage system realistically recharges 4 times the required volume up to a 2 year storm event.**

Rechage Volume Calculation:

Rv = F x I
Rv = Required Recharge Volume
F = Recharge Factor
I = Total Impervious Area (Proposed)
Rv = (0.6")/(1'/12") x 18,090 s.f. = 905 cf (Required)

Provided Infiltration is 1,716 cf taken from Stage Storage Worksheet and hydrocad files for the recharge design.

STANDARD #4- 80% TSS REMOVAL

ESTIMATED PROPOSED NEW PAVED COVER= 18,090 S.F.

REQUIRED WATER QUALITY VOLUME:

Water Quality Volume		
Required Treatment Volume	1.0	Inches Over Impervious Areas
Watershed Series	Paved Area	Water Quality Volume
Post DA#1 (roof run off)		
Post DA#2 (PAVEMENT)	11,340	945

The design of the drainage system is such that the site is routed through a series of treatment BMP's meeting the Standard. The attached TSS worksheets show the water treatment prior to the existing basin.

Water Quality Volume Calculation:
Wv = F x I
Wv = Required Water Quality Volume
F = Water Factor
I = Total Impervious Area
Rv = (1")/(1'/12") x 11,340 s.f. = 945 cf (Required)

Provided 1,000 c.f. in underground basin – however the hydrodynamic separator can handle 0.45 Acres (only have 11,340 sf) of Impervious area at 77% TSS removal rate, the proposal has 0.26 Acres of impervious flowing into the underground basin. There is no flow off the site from the drainage system until rain depths of over the 2-year storm event

INSTRUCTIONS:

1. Sheet is nonautomated. Print sheet and complete using hand calculations. Column A and B: See MassDEP Structural BMP Table
2. The calculations must be completed using the Column Headings specified in Chart and Not the Excel Column Headings
3. To complete Chart Column D, multiple Column B value within Row x Column C value within Row
4. To complete Chart Column E value, subtract Column D value within Row from Column C within Row
5. Total TSS Removal = Sum All Values in Column D

Non-automated: Mar. 4, 2008

Location: From Parking To Underground Basin / Infiltration

TSS Removal Calculation Worksheet

A BMP[1]	B TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Deep Sump Catchbasins	25%	1.00	0.25	0.75
Hydro Dynamic Storm Captor 900	77%	0.75	0.5775	0.1725
→	*Pre Treatment Prior To Undergroun Detentio		= 0.8275	
Underground Infiltration	80%	0.1725	0.1380	0.0345
			0.25 + 0.5775 + 0.1380 =	

Total TSS Removal = 0.96 (96%)

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

Project: 43 Cypress
Prepared By: MD
Date: 3/17/25

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

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed
1. From MassDEP Stormwater Handbook Vol. 1

Fact Sheet #4

Stormwater Technology: Stormceptor

(Hydro Conduit, formerly CSR New England Pipe)

Revised February 2003

*The **Stormceptor Fact Sheet** is one in a series of fact sheets for stormwater technologies and related performance evaluations, which are undertaken by the **Massachusetts STrategic Envirotechnology Partnership (STEP).***

The STEP evaluation entitled, *Technology Assessment, Stormceptor CSR New England Pipe*, January 1998 is the information source for this fact sheet. When a more thorough understanding of a system is required, the full *Technology Assessment* should be reviewed. Copies are available for downloading from the STEP Web site (www.STEPSITE.org/) or by contacting the STEP Program (Phone: 617/626/1197, FAX: 617/626/1180, email: linda.benevides@state.ma.us). This fact sheet is subject to future updates as additional performance information becomes available.

Description/Definition

Stormceptor is a prefabricated, underground unit that separates oils, grease, and sediment from stormwater runoff when installed with an existing or new pipe conveyance system. The unit is divided into two chambers–a treatment and a flow bypass chamber. During typical storm events, runoff is directed by the inflow weir through a drop pipe into the lower treatment chamber where sediment, oil, and grease are separated from the flow by gravity. The bypass chamber is designed to convey excess stormwater, which overtops the inflow weir, through the system without treatment.

Equipment and Sizing

The on-line Stormceptor units are available in eight sizes ranging from six and twelve feet in diameter with capacities of 900 to 7200 gallons. Since issuing the STEP assessment in 1998, the manufacturer has expanded the Stormceptor product line to include a storm drain inlet (STC 450i) and three units (Models STC 11000, STC 13000, and STC16000). These systems are not included in the STEP evaluation. Users and decision-makers may require additional field test results and new data for these new systems in order to accept performance ratings, particularly if they are higher than those reported in the STEP technology assessment and this fact sheet.

Stormceptor units are available in either precast concrete or fiberglass for special applications. Concrete units are pre-engineered for HS-20 min. traffic loading at the surface. Fiberglass units can be used in areas where there is a potential for oil and chemical spills.

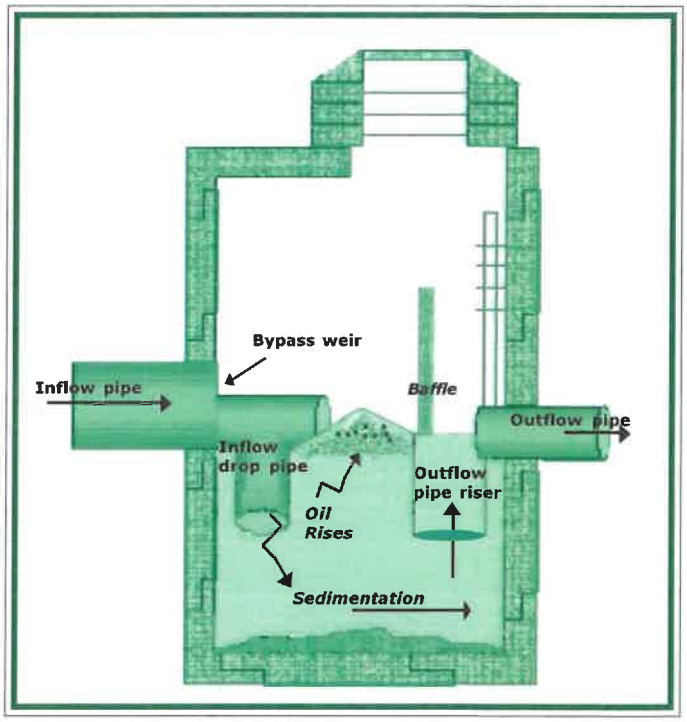


Figure 1. Stormceptor operation during average flow conditions.

Performance/Effectiveness

The system is designed to provide separation of sediment, oil, and grease from stormwater by routing runoff into a low-turbulence environment where solids settle and oils float out of solution. The system sizing is based on the drainage area, historical rainfall data, and the solids removal efficiency required. It is recommended that the system be used in combination with other stormwater controls to conform with the Massachusetts Stormwater Management Policy and standards.

An Imperial Model STC 2000 (equivalent to the Model STC 2400) in Edmonton, Canada treats flow from a 9.8 acre commercial parking lot. This system was monitored during four storm events in 1996 and shown to have an average total suspended solids (TSS) removal efficiency of 52 percent. In designing a system to achieve a comparable removal efficiency, the relationship between system size and impervious drainage area should be considered, as detailed in Table 1 and the Technology Assessment Report.

A Model STC 1200 in Westwood, Massachusetts treats flow from 0.65 acres consisting of a paved truck loading area at a manufacturing facility. The unit was monitored for six storm events in 1997, but only four events had measurable TSS influent concentrations. Of these four events, the average TSS removal efficiency was calculated to be 77 percent, which is less than the 80 percent removal targeted by the manufacturer.

Based on these field monitoring results, and when the unit sizing follows the guidance in Table 1, removal efficiencies between 52 percent and 77 percent may be achieved where installations have similar rainfall and land use characteristics as those reviewed for the STEP evaluation. It is recommended that additional field research and new data be evaluated to validate performance ratings higher than those verified by STEP.

Specific performance claims for oil and grease were not evaluated by STEP. However, total petroleum hydrocarbons (TPH) were analyzed during the Westwood study. Results indicated that the unit was effective in capturing oils.

Stormceptor	Maximum Impervious Area (acres)	
Model Number	77% TSS removal	52% TSS removal
STC 900	0.45	0.9
STC 1200	0.7	1.45
STC 1800	1.25	2.55
STC 2400	1.65	3.35
STC 3600	2.6	5.3
STC 4800	3.6	7.25
STC 6000	4.6	9.25
STC 7200	5.55	11.25

Table 1: Sizing for TSS removal (adapted from the manufacturer's sizing in the 1998 STEP Report) Use the table to determine a TSS removal rate. Use the new Rinker method for sizing Stormceptor units. The sizing method has been changed since publication of the STEP Report. **Note:** To achieve 52% and 77% TSS removal rates on some sites, it may be necessary to use lower maximum impervious areas than those in Table 1.

Technology Status

The Stormceptor system provides greater solids separation and higher TSS removal efficiencies than oil and grit separators. Stormceptor systems are among the category of hydrodynamic separators, which are flow-through devices with the capacity to settle or separate grit, oil, sediment, or other pollutants from stormwater. According to the U.S. Environmental Protection Agency, "Hydrodynamic separators are most effective where the materials to be removed from runoff are heavy particulates - which can be settled - or floatables - which can be captured, rather than solids with poor settleability or dissolved pollutants."

The field studies evaluated for the STEP assessment predate the Stormwater Best Management Practice Demonstration Tier II Protocol (2001), which is applicable in Massachusetts and other states in the Technology Acceptance Reciprocity Partnership (TARP), to ensure quality controlled studies that can be shared among participating states. Therefore, interstate reciprocity is not available to the manufacturer, based on performance claims that were evaluated by STEP in 1998. If the TARP Protocol requirements are fulfilled in the future, the manufacturer could pursue reciprocal verification for Stormceptor systems in participating TARP states. More information on the TARP Protocol is available on the following Web site: www.dep.state.pa.us/dep/deputate/pollprev/techservices/tarp.

Applications/Advantages

- Stormceptor systems identified in Table 1 should be used in combination with other BMPs to remove 80 percent of the average annual load of TSS (DEP Stormwater Policy Standard 4). Systems may be well suited for pretreatment in a mixed component system designed for stormwater recharge.
- Performance data show that Stormceptor may provide TSS removal rates in the range of 52 percent to 77 percent when sized according to Table 1. Higher TSS removal rates were achieved during low flow, low intensity storms with less than one third of an inch of runoff. Also, by reducing the impervious drainage area, relative to the system size, the STEP Technology Assessment Report indicated that higher removal efficiencies may be achievable. However, STEP recommends collection of additional data "representing a varied set of operating conditions over a realistic maintenance cycle to verify TSS removal rates greater than 80 percent."
- The Stormceptor system is suitable for new and retrofit applications. For retrofit applications, it should not

take the place of a catch basin for the systems that have been verified. Also, for retrofit applications, it should be installed in lateral lines and not main trunk lines.

- The system is particularly well suited in constricted areas and where space is limited.
- It also is suitable for use in areas of high potential pollutant loads (DEP Stormwater Policy Standard 5), where it may be used effectively in capturing and containing oil and chemical spills. *Web site:* www.state.ma.us/dep/brp/stormwtr/stormpub.htm.

Considerations/Limitations

- Systems are not expected to provide significant nutrient (nitrogen and phosphorus) or fecal coliform removal.
- The systems are not recommended for use in critical areas, such as public drinking water supplies, certified vernal pools, public swimming beaches, shellfish growing areas, cold water fisheries, and some Areas of Critical Environmental Concern (ACECs), except as a pretreatment device for BMPs that have been approved by DEP for use in critical areas. The structural BMPs approved for use in critical areas are described in Standard 6 of the Stormwater Management Policy, www.state.ma.us/dep/brp/stormwtr/stormpub.htm.
- There is a limited set of useful data for predicting the relationship between treatment efficiency and loading rates. Removal efficiencies have not been demonstrated for all unit sizes.
- Further research is needed to determine how much TSS bypasses the treatment chamber during certain, higher velocity storm events which recur less frequently.
- Systems require regular maintenance to minimize the potential for washout of the accumulated sediments.

Reliability/Maintenance

All BMPs require scheduled, routine maintenance to ensure that they operate as efficiently as possible. Although maintenance requirements are site specific, a general relationship between cleaning needs and depths of sediment has been established by the manufacturer. Inspection of the Stormceptor interior should be done after major storm events, particularly in the first year of operation. It is recommended that material in the treatment chamber be pumped out by a vacuum truck semiannually, or when the sediment and pollutant loads reach about 15 percent of the total storage. If the unit is used for spill containment, it should be pumped after the event is contained. Typical cleaning costs were estimated by the manufacturer in 1998 to be $250, with disposal costs averaging $300 to $500. The expected life of a system has been estimated to be 50 to 100 years.

Sediment Depths Indicating Required Maintenance	
Model Number	**Sediment Depth (feet)**
STC 900	0.5
STC 1200	0.75
STC 1800	1
STC 2400	1
STC 3600	1.25
STC 4800	1
STC 6000	1.5
STC 7200	1.25

Table 2: The Stormceptor clean out is based on 15 percent of the sediment storage volume in the

References

Winkler, E.S. 1998. "Technology Assessment, Stormceptor." University of Massachusetts, Amherst, MA. *STEP Web site:* www.STEPSITE.org/

Massachusetts Department of Environmental Protection and Office of Coastal Zone Management. 1997. "Stormwater Management Handbooks, Volumes One and Two." Boston, MA. *Handbooks Web site:* www.state.ma.us/dep/brp/stormwtr/stormpub.htm.

United States Environmental Protection Agency. "Storm Water Technology Fact Sheet Hydrodynamic Separators." EPA 832-F-99-017.

Stormceptor Web sites: www.rinkermaterials.com/stormceptor

TARP Web site: www.dep.state.pa.us/dep/deputate/pollprev/techservices/tarp

STEP Verification vs. Regulatory Approval

STEP assistance to developers of innovative technologies and STEP verification of stormwater treatment systems is not required to receive necessary approvals from conservation commissions or the Department of Environmental Protection (DEP). However, if a system has received verfication, a conservation commission shall presume that the technology will function as proposed, provided the conditions are similar to those in which performance was verified. STEP reports are not technology approvals, and do not constitute an endorsement or recommendation for use. Questions on regulatory issues should be referred to the DEP regional offices.

STANDARD #9- OPERATION & MAINTENANCE

OPERATION & MAINTENANCE PLAN:

CURRENT OWNER & RESPONSIBLE PARTY:
Nicole & Marek Rutkowski (Contractor shall be responsible during construction)

FUTURE OWNER & RESPONSIBLE PARTY:
Nicole & Marek Rutkowski

DURING CONSTRUCTION:

***SILT FENCE BARRIER*:**

The silt fence barrier shall be installed prior to construction.

During construction, the contractor shall inspect the silt fence barrier on a weekly basis and after any significant rainstorm resulting in greater than 0.5" of rainfall. The barrier shall be inspected for any breaches or disturbed silt fence and repaired immediately.

After construction, the barrier shall be maintained as stated above until all new areas are vegetated.

After construction, these duties shall transfer to the property owner.

***CONSTRUCTION ENTRANCE APRONS*:**

Construction aprons shall be installed to protect Cypress Street. The construction entrance apron shall be installed prior to commencement of construction and shall be inspected weekly. The construction entrance apron shall be replaced when debris becomes noticeable on the existing pavement surfaces leading to and from the construction site.

***SLOPE STABILIZATION*:**

The slope stabilization controls shall be installed immediately upon obtaining final grades as shown on the project plans. Slopes in the swale area shall be stabilized according to the details provided. All 3:1 slopes established on-site shall be loamed and seeded as soon as weather permits. Any 2:1 slopes established shall be covered with slope stabilization fabric, then loamed and seeded as soon as weather permits. Areas in failure shall be re-graded to final grade and stabilized, as necessary.

***TEMPORARY BASINS*:**

The temporary basins shall be inspected immediately after storm events and cleaned to remove sediment build-up. Outfalls shall be inspected for erosion or scouring. Additional rip rap shall be added as required to minimize erosion.

***OUTLET CONTROL STRUCTURE*:**

Outlet control structures at basins have temporary stone or other filtration device installed around inlet to prevent sediment deposits. Sediment shall be removed when accumulation exceeds 1" depth on paved surfaces.

***CHECK DAMS*:**

Check Dams shall be inspected weekly and after rainfall in excess of 0.5". Accumulated sediment shall be removed when depth exceeds 3" on the upstream sided of the dam. Stone or fabric shall be replaced when evidence of clogging is present.

***CONSTRUCTION COMPLETION*:**

The entire stormwater management system shall be inspected upon completion of construction. Portions of the system containing sediment shall be cleaned and all sediment properly removed.

AFTER CONSTRUCTION:

CATCH BASIN, Drain Manhole with sumps & DROP INLET:

At a minimum, the catch basins shall be inspected and cleaned on a quarterly basis. It is preferred that collection of accumulated sediment shall be accomplished by means of vacuum pumping and not by means of a clamshell bucket. Disposal of accumulated sediment shall be performed in accordance with applicable local, state, and federal guidelines and regulations.

INFILTRATION BASIN:

Inspect infiltration basin after major storm events (>3.0 inches) to verify stabilization and infiltration. Mow slopes, berms quarterly. Removed accumulated clippings from infiltration stone. Inspect basin semi-annually for the following:

- Signs of differential settlement
- Cracking

- Erosion
- Leakage in embankments
- Tree growth on embankments
- Condition of rip rap
- Sediment accumulation
- Turf health.

LONG TERM POLLUTION PREVENTION PLAN

The following are the material management practices that shall be used to reduce the risk of spills or other accidental exposure of materials and substances to stormwater runoff.

Good Housekeeping: The following good housekeeping practices will be followed on site during the construction project and continued upon completion of the construction activities.

1. A concerted effort shall be made to store only enough product required to complete a particular task.
2. All materials stored on site shall be stored in a neat and orderly fashion in their appropriate containers and, if possible, under a roof or other secure enclosure.
3. Products shall be kept in their original containers with the original manufacture's label.
4. Substances shall not be mixed with one another unless recommended by the manufacturer.
5. Whenever possible, all of the products shall be used up before disposing of the container.
6. Manufacture's recommendations for proper use and disposal shall be followed.
7. The site superintendent shall inspect daily to ensure proper use and disposal of materials on site.

Hazardous Products: The following practices are intended to reduce the risks associated with hazardous materials.

1. Products shall be kept in original containers unless they are not re-sealable.
2. Where feasible, the original label and material safety data shall be retained, whereas they contain important product information.
3. If surplus product must be disposed of, follow manufacturers or local and State recommended methods for proper disposal.

Product Specific Practices: The following product-specific practices shall be followed on site: Petroleum Products:

1. All on site vehicles shall be monitored for leaks and receive regular preventative maintenance to reduce the risk of leakage.
2. Petroleum products shall be stored in tightly sealed containers which are clearly labeled.

3. Petroleum Products shall be stored in compliance with Fire Marshall regulations.

Bituminous Concrete:
Any bituminous concrete or asphalt substances used on site shall be applied according to the manufacturer's recommendations.

Fertilizers:
Fertilizers shall be applied in the minimum amounts recommended by the manufacturer. Once applied, fertilizers shall be worked into the soil to limit exposure to stormwater. Storage shall be in a covered shed or trailer. The contents of any partially used bags of fertilizer shall be transferred to a sealable plastic bag or bin to avoid spills

Paints:
1. All containers shall be tightly sealed and stored when not required for use.
2. Excess paint shall not be discharged into any catch basin, drain manhole or any portion of the stormwater management system.
3. Excess paint shall be properly disposed of according to manufacturer's recommendations or State and local regulations.

Concrete Trucks:
Concrete trucks shall not be allowed to wash out or discharge surplus concrete or drum wash water on site.

SPILL CONTROL PRACTICES
In addition to the good housekeeping and material management practices discussed in the previous sections of this plan, the following practices shall be followed for spill prevention and cleanup:
1. Manufacturer's recommended methods for cleanup shall be readily available at the onsite trailer, and site personnel shall be made aware of the procedures and the location of the information.
2. Materials and equipment necessary for spill clean up shall be kept in the material storage area on site. Equipment and materials shall include, but not be limited to, brooms, dust pans, mops, rags, gloves, goggles, kitty litter, sand, sawdust and plastic and metal trash containers specifically for this purpose.
3. All spills shall be cleaned up immediately after discovery.
4. The spill area shall be kept well ventilated, and personnel shall wear appropriate protective clothing to prevent injury from contact with hazardous substance.
5. Spills of toxic or hazardous material shall be reported to the appropriate State and/or local authority in accordance with local and/or State regulations.
6. The spill prevention plan shall be adjusted to include measures to prevent a particular type of spill from reoccurring and instructions on how to clean up the spill if there is another occurrence. A description of the spill, what caused it, and the cleanup measures shall also be included.
7. The "Manager" shall be the spill prevention and cleanup coordinator. The "Manager" shall designate at least three other site personnel who will be trained in the spill control practices identified above.

WEEKLY
Inspection and Maintenance Log FOR: 43 Cypress St
DURING CONSTRUCTION & After 1.0" Rain

Components	**Date**
Erosion Control – Weekly	
Comments during insp.	
Note corrective measures performed & Date	
On Site Pavement Sweeping – as Needed	
Comments during insp.	
Note corrective measures performed & date	
Silt Fence & Composite Sock– Monthly	
Comments during insp.	
Note corrective measures performed & date	
Temporary Basin Area as Needed	
Comments during insp.	
Note corrective measures performed & date	
Construction Entrance as Needed	
Comments during insp.	
Note corrective measures performed & date	
_____. Inspector Title Date	
_____. Address Tel#	

WEEKLY
Inspection and Maintenance Log FOR: 43 Cypress St
DURING CONSTRUCTION & After 1.0" Rain

Components	**Date**
Notify Cons. Comm. Issues effecting Resource Areas	
Comments during insp.	
Note corrective measures performed & date	
Silt of Public (S Worcester Street) Streets – Daily	
Comments during insp.	
Note corrective measures performed & date	
Stockpile Materials Ring with Composite Sock – Weekly	
Comments during insp.	
Note corrective measures performed & date	
Any Spill Fuel, Chemical- Daily	
Comments during insp.	
Note corrective measures performed & date	
Temporary Ground Cover Area – Weekly	
Comments during insp.	
Note corrective measures performed & date	
Temporary Stone at Access Drive as Needed	
Comments during insp.	
Note corrective measures performed & date _____. Inspector Title Date	
_____. Address Tel#	

WEEKLY
Inspection and Maintenance Log FOR: 43 Cypress St
DURING CONSTRUCTION & After 1.0" Rain

Components	**Date**
Lawn Area / Mulch Area **Erosion, Washouts**	
Comments during insp.	
Note corrective measures performed & date	
Stone Aprons at Outfalls Exit **as Needed**	
Comments during insp.	
Note corrective measures performed & date	
Forebays **as Needed**	
Comments during insp.	
Note corrective measures performed & date	
Note corrective measures performed & date _____. Inspector Title Date	
_____. Address Tel#	

WEEKLY
Inspection and Maintenance Log
DURING CONSTRUCTION

FOR: 43 Cypress St
& After 1.0" Rain

Inspection and Maintenance Log FOR: 43 Cypress St
AFTER CONSTRUCTION & After 3.0" Rain

Components	**Date**
Catch Basin in Driveway Entrance – twice a year	
Comments during insp.	
Note corrective measures performed & Date	
Catch Basins -twice a year	
Comments during insp.	
Note corrective measures performed & date	
Drain Manholes Prior to Basin -twice a year	
Comments during insp.	
Note corrective measures performed & date	
Drop Inlets along Back yards -twice a year	
Comments during insp.	
Note corrective measures performed & date	
Rip Rap - Basin outlet #3 – 8 inches of sediment or twice a year	
Comments during insp.	
Note corrective measures performed & date _____. Inspector Title Date	
_____. Address Tel#	

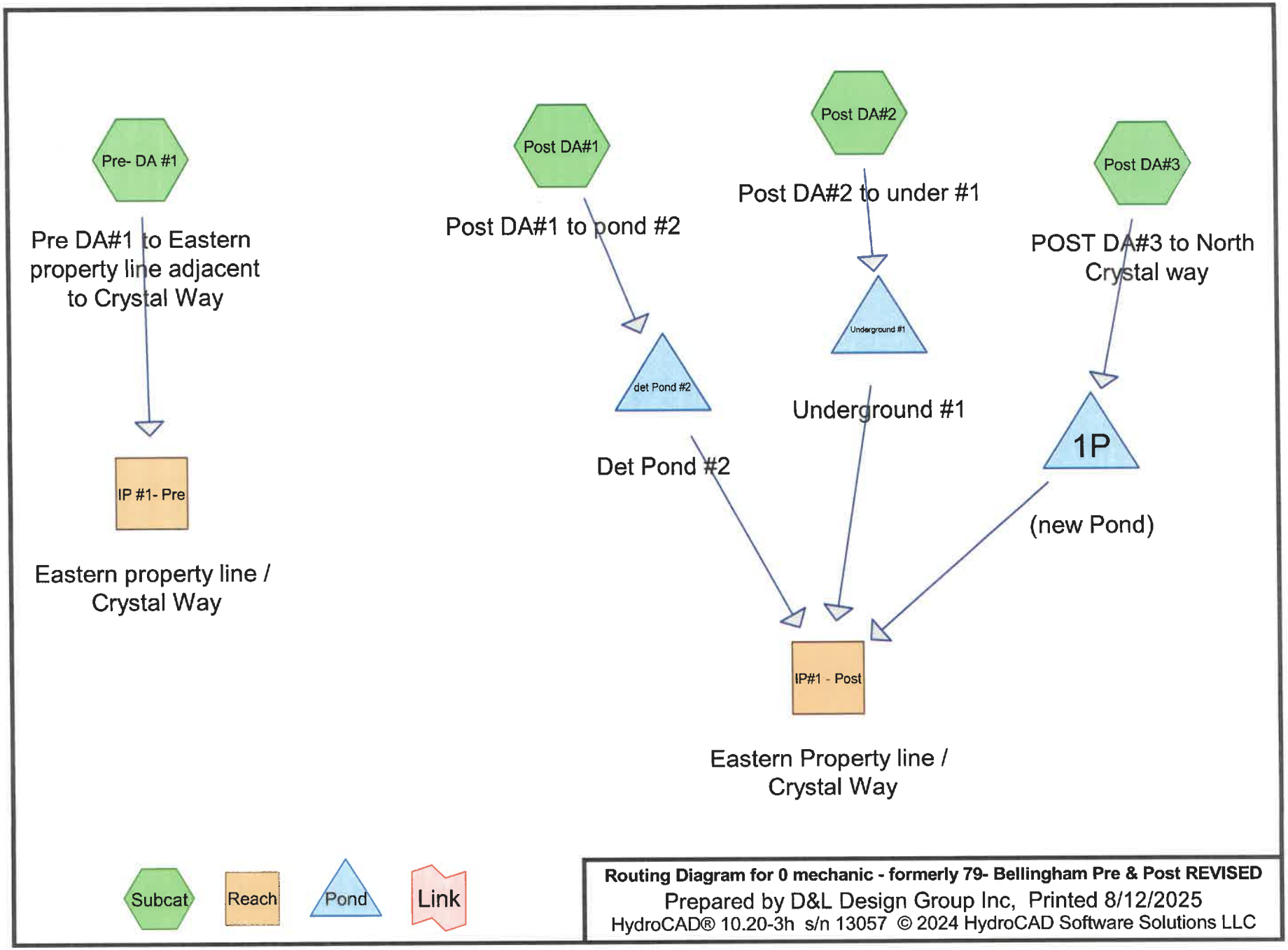
Inspection and Maintenance Log FOR: 43 Cypress St
AFTER CONSTRUCTION & After 3.0" Rain

Components Date **UG Basins** **– twice a year** **Comments during insp.** **Note corrective measures performed & Date** **Forebay Basin** **-twice a year** **Comments during insp.** **Note corrective measures performed & date** **Rip Rap Spillway for Basin** **-twice a year** **Comments during insp.** **Note corrective measures performed & date** **Inspector Title Date** **Address Tel#**	

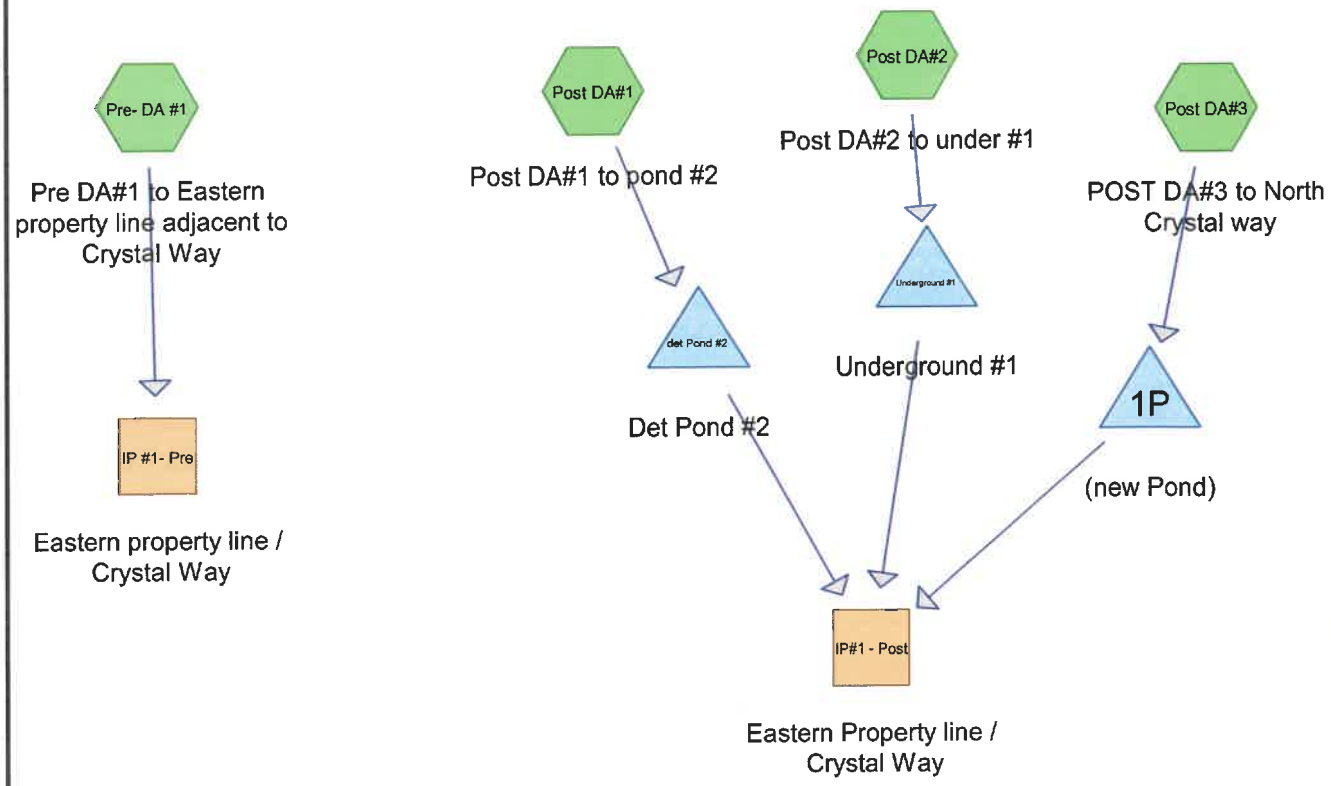
Inspection and Maintenance Log FOR: 43 Cypress St

AFTER CONSTRUCTION & After 3.0" Rain

HydroCAD Files


Pre- DA #1
Pre DA#1 to Eastern property line adjacent to Crystal Way
IP #1- Pre
Eastern property line / Crystal Way
Post DA#1
Post DA#1 to pond #2
det Pond #2
Det Pond #2
Post DA#2
Post DA#2 to under #1
Underground #1
Underground #1
Post DA#3
POST DA#3 to North Crystal way
1P
(new Pond)
IP#1 - Post
Eastern Property line / Crystal Way
Subcat
Reach
Pond
Link
Routing Diagram for 0 mechanic - formerly 79- Bellingham Pre & Post REVISED
Prepared by D&L Design Group Inc, Printed 8/12/2025
HydroCAD® 10.20-3h s/n 13057 © 2024 HydroCAD Software Solutions LLC

HYDROCAD - 2-YEAR STORM EVENT



Subcat Reach Pond Link

Routing Diagram for 0 mechanic - formerly 79- Bellingham Pre & Post REVISED
Prepared by D&L Design Group Inc, Printed 8/12/2025

Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2 Year	Type III 24-hr		Default	24.00	1	3.37	2
2	10 Year	Type III 24-hr		Default	24.00	1	5.23	2
3	50 Year	Type III 24-hr		Default	24.00	1	7.25	2
4	100 Year	Type III 24-hr		Default	24.00	1	8.18	2

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.935	49	50-75% Grass cover, Fair, HSG A (Pre- DA #1)
0.011	68	<50% Grass cover, Poor, HSG A (Post DA#2)
0.470	39	>75% Grass cover, Good, HSG A (Post DA#1, Post DA#2, Post DA#3)
0.039	96	Gravel surface, HSG A (Post DA#1)
0.278	98	Paved parking, HSG A (Post DA#1, Post DA#2)
0.138	98	Roofs, HSG A (Post DA#1)
0.046	36	Woods, Fair, HSG A (Post DA#1, Pre- DA #1)
1.917	**58**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
1.917	HSG A	Post DA#1, Post DA#2, Post DA#3, Pre- DA #1
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.000	Other	
1.917		**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
0.935	0.000	0.000	0.000	0.000	0.935	50-75% Grass cover, Fair	Pre- DA #1
0.011	0.000	0.000	0.000	0.000	0.011	<50% Grass cover, Poor	Post DA#2
0.470	0.000	0.000	0.000	0.000	0.470	>75% Grass cover, Good	Post DA#1, Post DA#2, Post DA#3
0.039	0.000	0.000	0.000	0.000	0.039	Gravel surface	Post DA#1
0.278	0.000	0.000	0.000	0.000	0.278	Paved parking	Post DA#1, Post DA#2
0.138	0.000	0.000	0.000	0.000	0.138	Roofs	Post DA#1
0.046	0.000	0.000	0.000	0.000	0.046	Woods, Fair	Post DA#1, Pre- DA #1
1.917	**0.000**	**0.000**	**0.000**	**0.000**	**1.917**	**TOTAL AREA**	

Time span=2.00-48.00 hrs, dt=0.05 hrs, 921 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 Post DA#1: Post DA#1 to Runoff Area=20,364 sf 33.15% Impervious Runoff Depth=0.60"
Flow Length=500' Tc=6.4 min CN=63 Runoff=0.24 cfs 0.023 af

Subcatchment Post DA#2: Post DA#2 to Runoff Area=12,840 sf 88.32% Impervious Runoff Depth=2.51"
Tc=4.0 min CN=92 Runoff=0.89 cfs 0.062 af

Subcatchment Post DA#3: POST DA#3 to Runoff Area=8,550 sf 0.00% Impervious Runoff Depth=0.00"
Tc=5.0 min CN=39 Runoff=0.00 cfs 0.000 af

Subcatchment Pre- DA #1: Pre DA#1 to Runoff Area=41,750 sf 0.00% Impervious Runoff Depth=0.14"
Tc=5.0 min CN=49 Runoff=0.03 cfs 0.011 af

Reach IP #1- Pre: Eastern property line / Crystal Way Inflow=0.03 cfs 0.011 af
Outflow=0.03 cfs 0.011 af

Reach IP#1 - Post: Eastern Property line / Crystal Way Inflow=0.00 cfs 0.000 af
Outflow=0.00 cfs 0.000 af

Pond 1P: (new Pond) Peak Elev=257.00' Storage=0 cf Inflow=0.00 cfs 0.000 af
Discarded=0.00 cfs 0.000 af Primary=0.00 cfs 0.000 af Outflow=0.00 cfs 0.000 af

Pond det Pond #2: Det Pond #2 Peak Elev=257.17' Storage=111 cf Inflow=0.24 cfs 0.023 af
Discarded=0.11 cfs 0.023 af Primary=0.00 cfs 0.000 af Outflow=0.11 cfs 0.023 af

Pond Underground #1: Underground #1 Peak Elev=254.15' Storage=765 cf Inflow=0.89 cfs 0.062 af
Discarded=0.14 cfs 0.062 af Primary=0.00 cfs 0.000 af Outflow=0.14 cfs 0.062 af

Total Runoff Area = 1.917 ac Runoff Volume = 0.096 af Average Runoff Depth = 0.60"
78.34% Pervious = 1.502 ac 21.66% Impervious = 0.415 ac

Summary for Subcatchment Post DA#1: Post DA#1 to pond #2

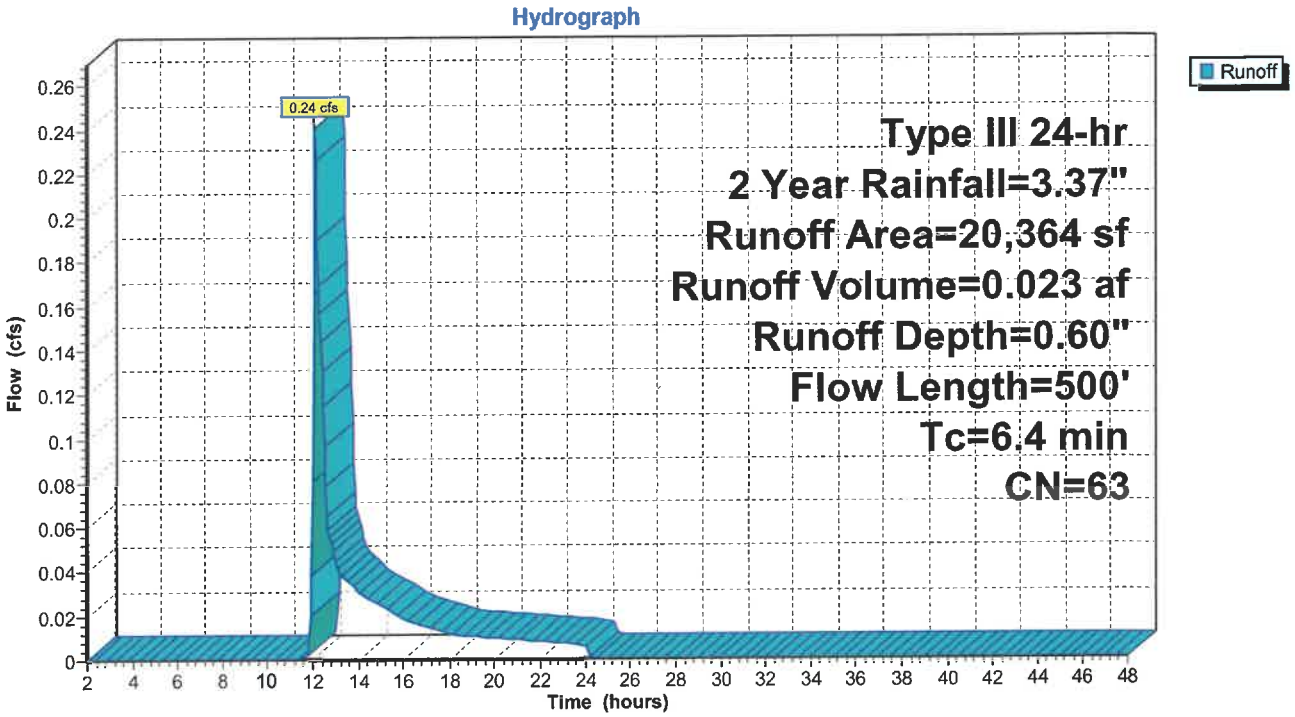
Runoff = 0.24 cfs @ 12.12 hrs, Volume= 0.023 af, Depth= 0.60"
Routed to Pond det Pond #2 : Det Pond #2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.37"

Area (sf)	CN	Description
6,000	98	Roofs, HSG A
0	74	>75% Grass cover, Good, HSG C
10,914	39	>75% Grass cover, Good, HSG A
1,000	36	Woods, Fair, HSG A
0	70	Woods, Good, HSG C
1,700	96	Gravel surface, HSG A
750	98	Paved parking, HSG A
20,364	63	Weighted Average
13,614		66.85% Pervious Area
6,750		33.15% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.0	20	0.0400	0.17		**Sheet Flow, grass** Grass: Short n= 0.150 P2= 3.37"
2.9	300	0.1200	1.73		**Shallow Concentrated Flow, woods** Woodland Kv= 5.0 fps
1.5	180	0.0150	1.97		**Shallow Concentrated Flow, grass** Unpaved Kv= 16.1 fps
6.4	500	Total			

Subcatchment Post DA#1: Post DA#1 to pond #2



Summary for Subcatchment Post DA#2: Post DA#2 to under #1

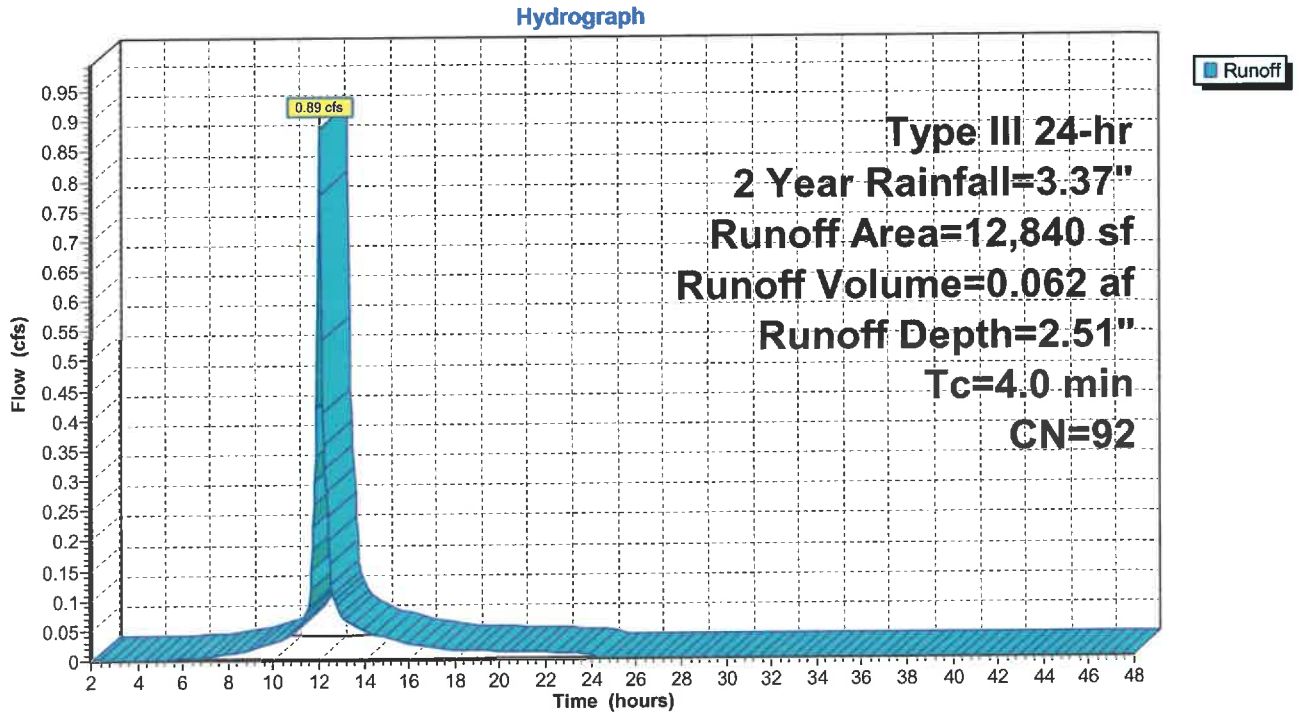
Runoff = 0.89 cfs @ 12.06 hrs, Volume= 0.062 af, Depth= 2.51"
Routed to Pond Underground #1 : Underground #1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.37"

Area (sf)	CN	Description
11,340	98	Paved parking, HSG A
0	74	>75% Grass cover, Good, HSG C
1,000	39	>75% Grass cover, Good, HSG A
0	36	Woods, Fair, HSG A
0	70	Woods, Good, HSG C
0	98	Roofs, HSG A
500	68	<50% Grass cover, Poor, HSG A
12,840	92	Weighted Average
1,500		11.68% Pervious Area
11,340		88.32% Impervious Area

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

Subcatchment Post DA#2: Post DA#2 to under #1



Summary for Subcatchment Post DA#3: POST DA#3 to North Crystal way

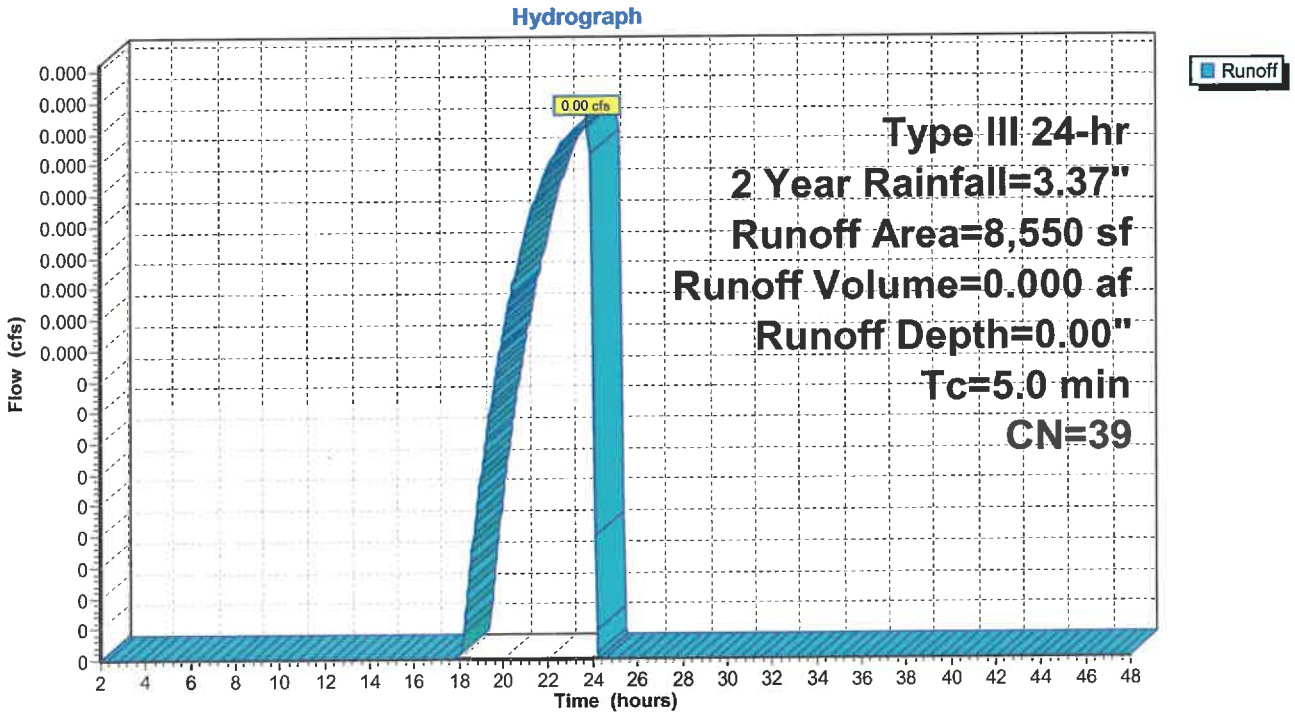
Runoff = 0.00 cfs @ 23.74 hrs, Volume= 0.000 af, Depth= 0.00"
Routed to Pond 1P : (new Pond)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.37"

Area (sf)	CN	Description
0	98	Roofs, HSG C
0	74	>75% Grass cover, Good, HSG C
0	39	>75% Grass cover, Good, HSG A
0	36	Woods, Fair, HSG A
0	70	Woods, Good, HSG C
8,550	39	>75% Grass cover, Good, HSG A
8,550	39	Weighted Average
8,550		100.00% Pervious Area

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

Subcatchment Post DA#3: POST DA#3 to North Crystal way



Summary for Subcatchment Pre- DA #1: Pre DA#1 to Eastern property line adjacent to Crystal Way

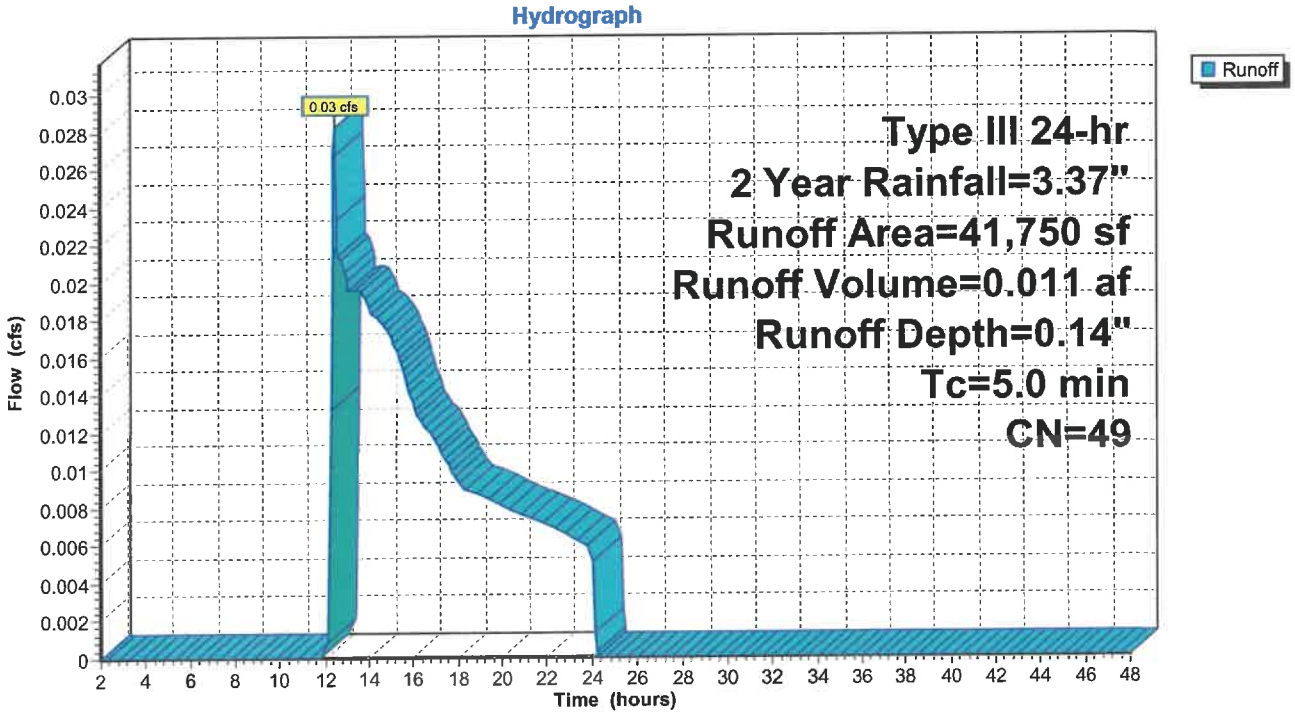
Runoff = 0.03 cfs @ 12.45 hrs, Volume= 0.011 af, Depth= 0.14"
Routed to Reach IP #1- Pre : Eastern property line / Crystal Way

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.37"

Area (sf)	CN	Description
0	98	Roofs, HSG C
0	74	>75% Grass cover, Good, HSG C
40,750	49	50-75% Grass cover, Fair, HSG A
1,000	36	Woods, Fair, HSG A
0	70	Woods, Good, HSG C
41,750	49	Weighted Average
41,750		100.00% Pervious Area

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

Subcatchment Pre- DA #1: Pre DA#1 to Eastern property line adjacent to Crystal Way

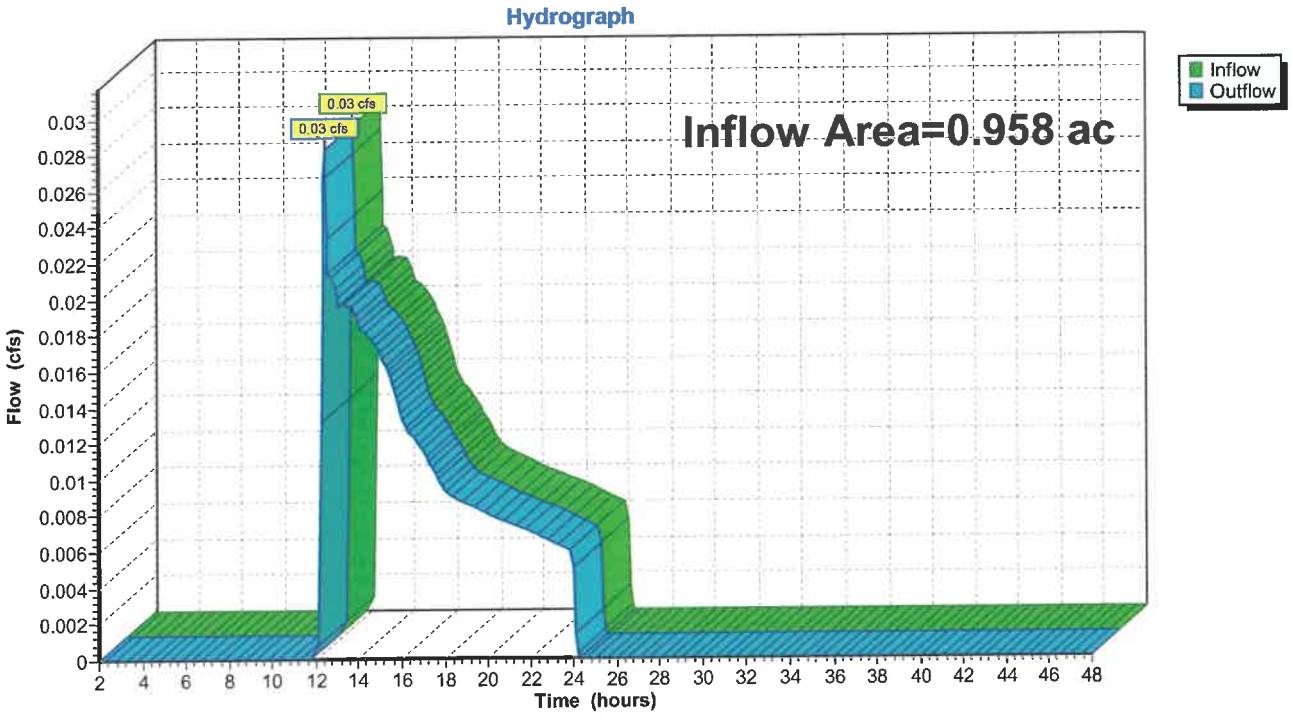


Summary for Reach IP #1- Pre: Eastern property line / Crystal Way

Inflow Area = 0.958 ac, 0.00% Impervious, Inflow Depth = 0.14" for 2 Year event
Inflow = 0.03 cfs @ 12.45 hrs, Volume= 0.011 af
Outflow = 0.03 cfs @ 12.45 hrs, Volume= 0.011 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 2.00-48.00 hrs, dt= 0.05 hrs

Reach IP #1- Pre: Eastern property line / Crystal Way

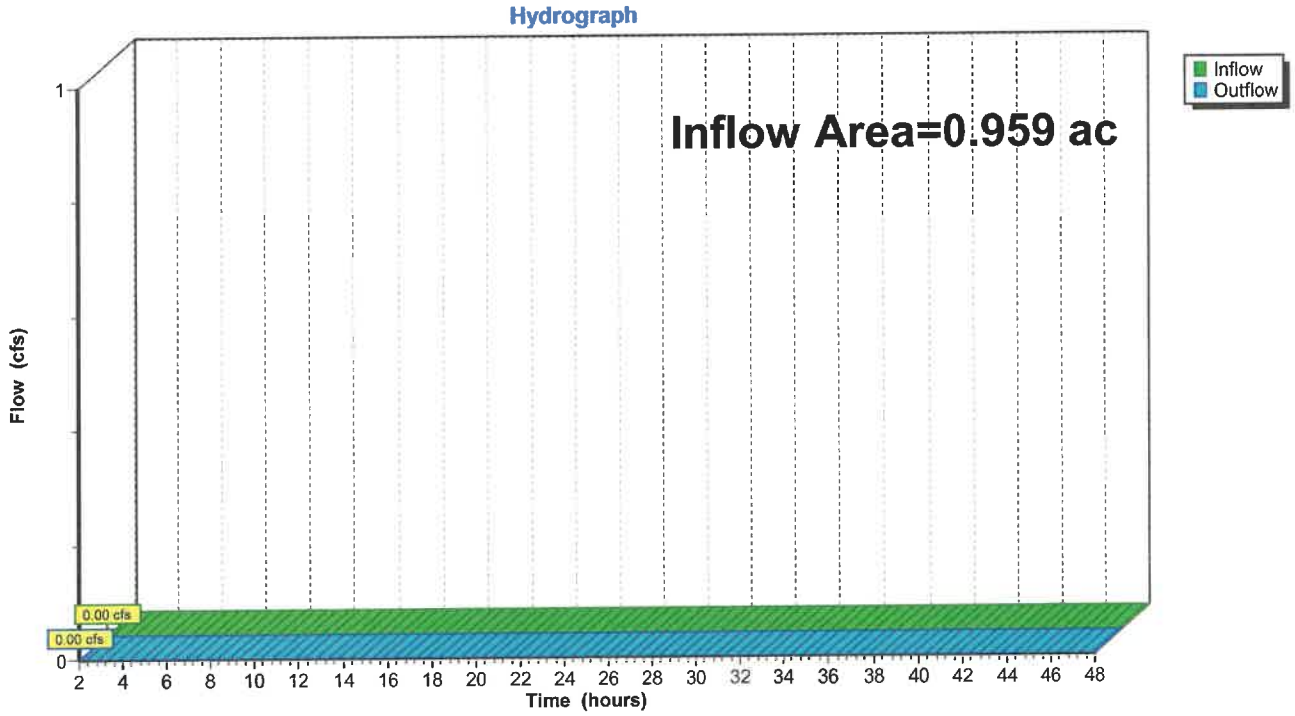


Summary for Reach IP#1 - Post: Eastern Property line / Crystal Way

Inflow Area = 0.959 ac, 43.33% Impervious, Inflow Depth = 0.00" for 2 Year event
Inflow = 0.00 cfs @ 2.00 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 2.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 2.00-48.00 hrs, dt= 0.05 hrs

Reach IP#1 - Post: Eastern Property line / Crystal Way



Summary for Pond 1P: (new Pond)

Inflow Area = 0.196 ac, 0.00% Impervious, Inflow Depth = 0.00" for 2 Year event
Inflow = 0.00 cfs @ 23.74 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 23.83 hrs, Volume= 0.000 af, Atten= 0%, Lag= 5.6 min
Discarded = 0.00 cfs @ 23.83 hrs, Volume= 0.000 af
Primary = 0.00 cfs @ 2.00 hrs, Volume= 0.000 af
Routed to Reach IP#1 - Post : Eastern Property line / Crystal Way

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 257.00' @ 23.83 hrs Storage= 0 cf

Plug-Flow detention time= 6.3 min calculated for 0.000 af (100% of inflow)
Center-of-Mass det. time= 6.2 min (1,311.6 - 1,305.4)

Volume	Invert	Avail.Storage	Storage Description
#1	257.00'	1,500 cf	**Custom Stage Data** Listed below

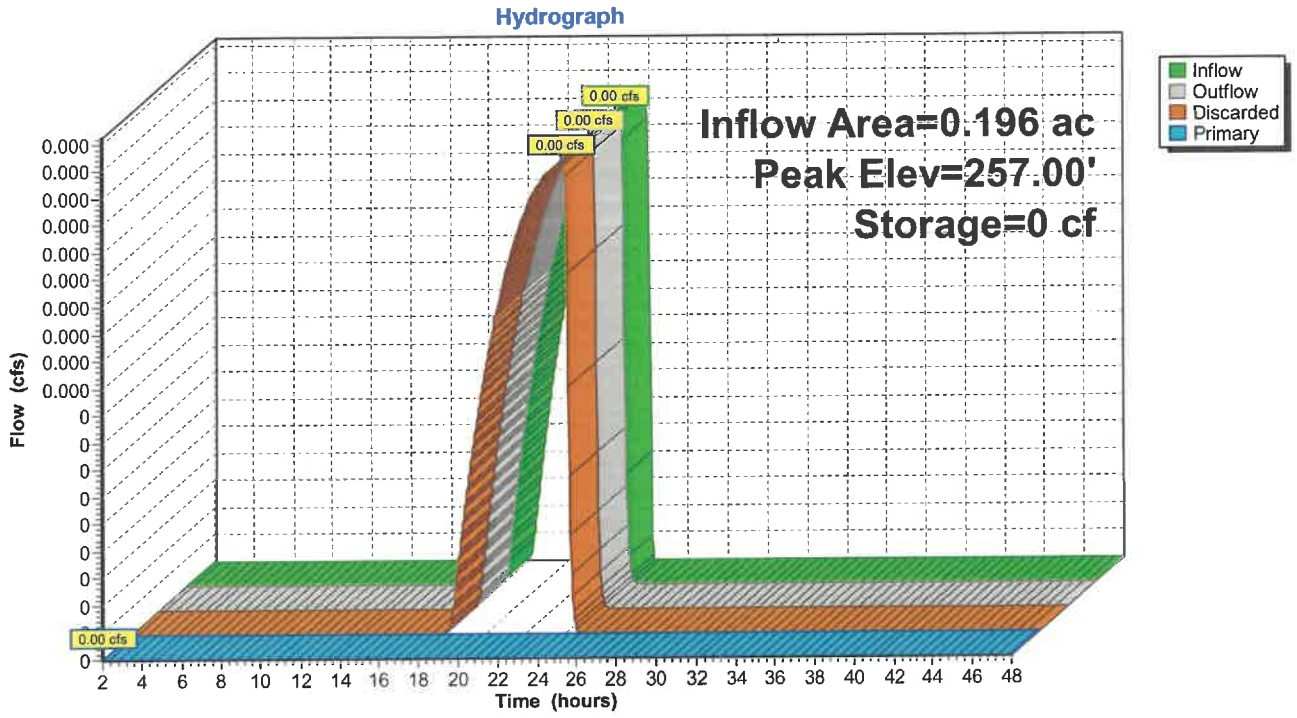
Elevation (feet)	Cum.Store (cubic-feet)
257.00	0
258.50	1,500

Device	Routing	Invert	Outlet Devices
#1	Discarded	257.00'	**0.04 cfs Exfiltration at all elevations**
#2	Primary	257.50'	**6.0' long + 3.0 '/' SideZ x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Discarded OutFlow Max=0.04 cfs @ 23.83 hrs HW=257.00' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.04 cfs)

Primary OutFlow Max=0.00 cfs @ 2.00 hrs HW=257.00' (Free Discharge)
↑—**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 1P: (new Pond)



Summary for Pond det Pond #2: Det Pond #2

Inflow Area = 0.467 ac, 33.15% Impervious, Inflow Depth = 0.60" for 2 Year event
Inflow = 0.24 cfs @ 12.12 hrs, Volume= 0.023 af
Outflow = 0.11 cfs @ 12.10 hrs, Volume= 0.023 af, Atten= 54%, Lag= 0.0 min
Discarded = 0.11 cfs @ 12.10 hrs, Volume= 0.023 af
Primary = 0.00 cfs @ 2.00 hrs, Volume= 0.000 af
Routed to Reach IP#1 - Post : Eastern Property line / Crystal Way

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 257.17' @ 12.46 hrs Storage= 111 cf

Plug-Flow detention time= 6.1 min calculated for 0.023 af (100% of inflow)
Center-of-Mass det. time= 6.1 min (905.4 - 899.3)

Volume	Invert	Avail.Storage	Storage Description
#1	257.00'	2,000 cf	**Custom Stage Data** Listed below

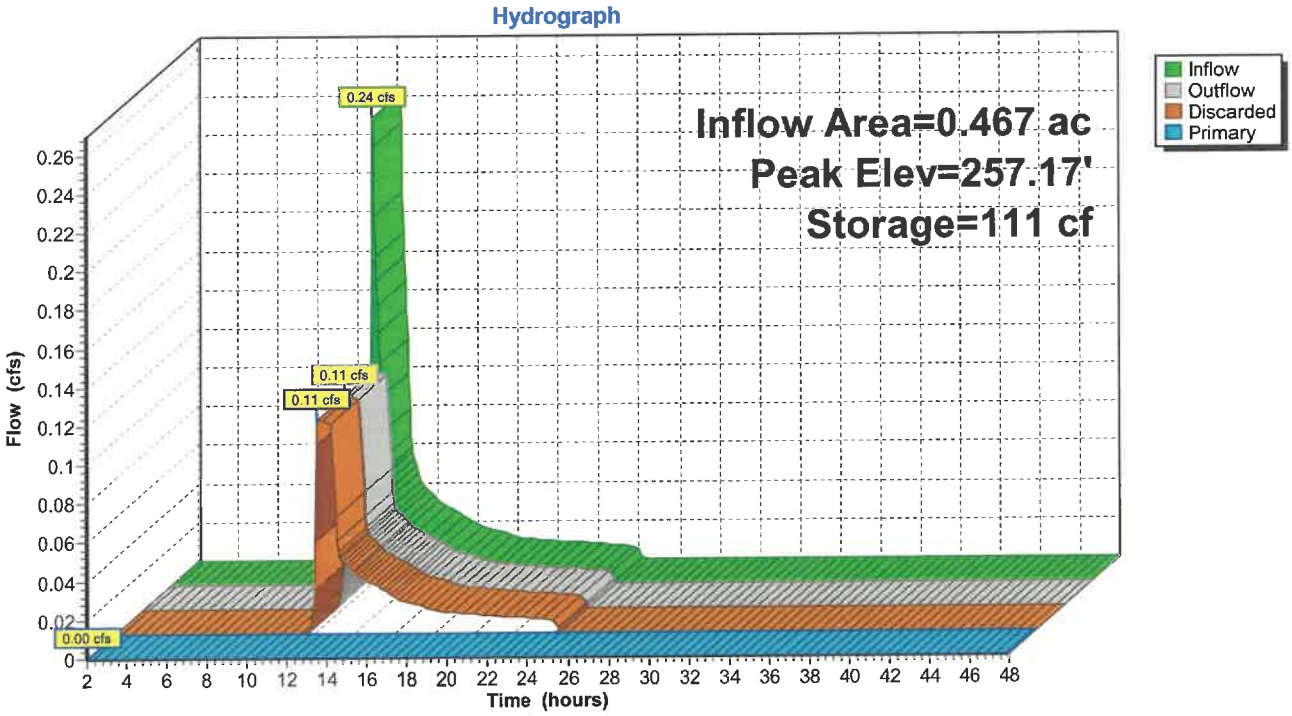
Elevation (feet)	Cum.Store (cubic-feet)
257.00	0
260.00	2,000

Device	Routing	Invert	Outlet Devices
#1	Discarded	257.00'	**0.11 cfs Exfiltration at all elevations**
#2	Primary	258.30'	**4.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Primary	258.90'	**8.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.11 cfs @ 12.10 hrs HW=257.05' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.11 cfs)

Primary OutFlow Max=0.00 cfs @ 2.00 hrs HW=257.00' (Free Discharge)
↑—**2=Orifice/Grate** (Controls 0.00 cfs)
—**3=Orifice/Grate** (Controls 0.00 cfs)

Pond det Pond #2: Det Pond #2



Summary for Pond Underground #1: Underground #1

Inflow Area = 0.295 ac, 88.32% Impervious, Inflow Depth = 2.51" for 2 Year event
Inflow = 0.89 cfs @ 12.06 hrs, Volume= 0.062 af
Outflow = 0.14 cfs @ 11.70 hrs, Volume= 0.062 af, Atten= 84%, Lag= 0.0 min
Discarded = 0.14 cfs @ 11.70 hrs, Volume= 0.062 af
Primary = 0.00 cfs @ 2.00 hrs, Volume= 0.000 af
Routed to Reach IP#1 - Post : Eastern Property line / Crystal Way

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 254.15' @ 12.53 hrs Storage= 765 cf

Plug-Flow detention time= 33.7 min calculated for 0.062 af (100% of inflow)
Center-of-Mass det. time= 33.7 min (827.7 - 794.1)

Volume	Invert	Avail.Storage	Storage Description
#1	253.00'	2,000 cf	**Custom Stage Data** Listed below

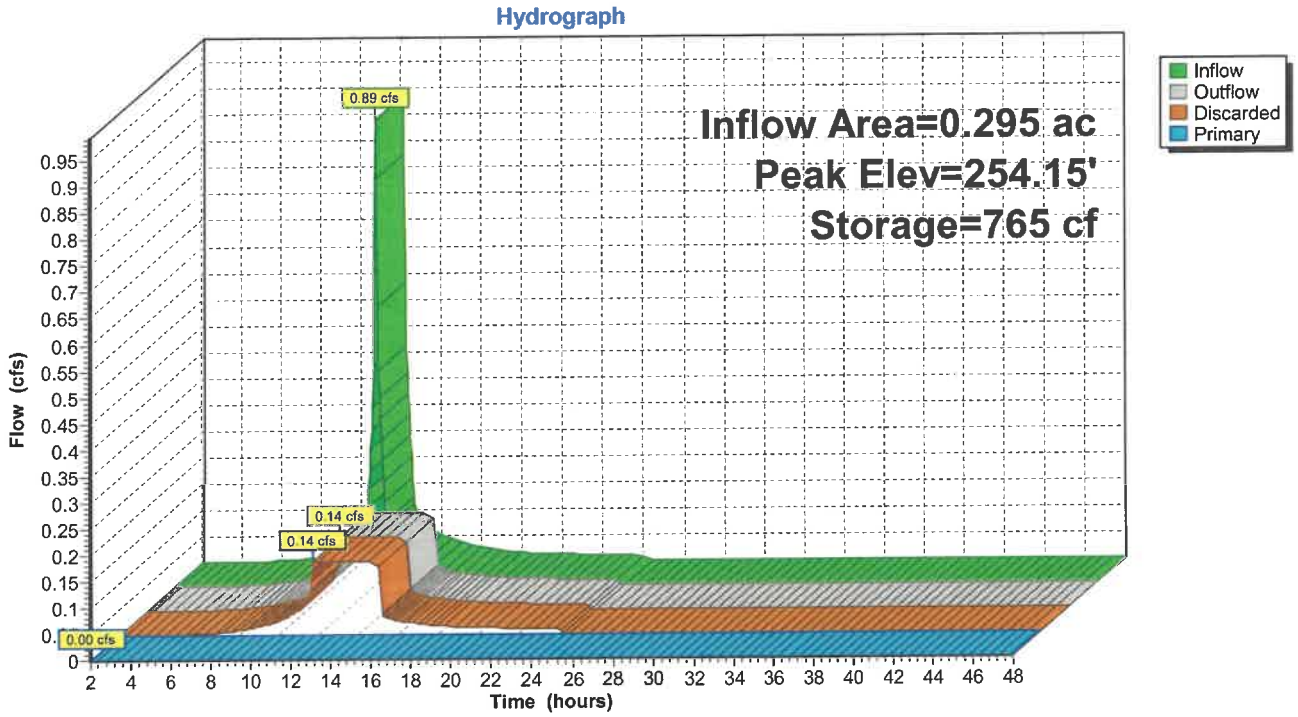
Elevation (feet)	Cum.Store (cubic-feet)
253.00	0
256.00	2,000

Device	Routing	Invert	Outlet Devices
#1	Discarded	253.00'	**0.14 cfs Exfiltration at all elevations**
#2	Primary	254.50'	**4.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Primary	255.00'	**8.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Primary	255.30'	**6.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.14 cfs @ 11.70 hrs HW=253.04' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.14 cfs)

Primary OutFlow Max=0.00 cfs @ 2.00 hrs HW=253.00' (Free Discharge)
├**2=Orifice/Grate** (Controls 0.00 cfs)
├**3=Orifice/Grate** (Controls 0.00 cfs)
└**4=Orifice/Grate** (Controls 0.00 cfs)

Pond Underground #1: Underground #1



HYDROCAD – 10 -YEAR STORM EVENT

Time span=2.00-48.00 hrs, dt=0.05 hrs, 921 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 Post DA#1: Post DA#1 to Runoff Area=20,364 sf 33.15% Impervious Runoff Depth=1.66"
Flow Length=500' Tc=6.4 min CN=63 Runoff=0.83 cfs 0.065 af

Subcatchment Post DA#2: Post DA#2 to Runoff Area=12,840 sf 88.32% Impervious Runoff Depth=4.31"
Tc=4.0 min CN=92 Runoff=1.48 cfs 0.106 af

Subcatchment Post DA#3: POST DA#3 to Runoff Area=8,550 sf 0.00% Impervious Runoff Depth=0.25"
Tc=5.0 min CN=39 Runoff=0.01 cfs 0.004 af

Subcatchment Pre- DA #1: Pre DA#1 to Runoff Area=41,750 sf 0.00% Impervious Runoff Depth=0.73"
Tc=5.0 min CN=49 Runoff=0.53 cfs 0.058 af

Reach IP #1- Pre: Eastern property line / Crystal Way Inflow=0.53 cfs 0.058 af
Outflow=0.53 cfs 0.058 af

Reach IP#1 - Post: Eastern Property line / Crystal Way Inflow=0.24 cfs 0.013 af
Outflow=0.24 cfs 0.013 af

Pond 1P: (new Pond) Peak Elev=257.00' Storage=4 cf Inflow=0.01 cfs 0.004 af
Discarded=0.01 cfs 0.004 af Primary=0.00 cfs 0.000 af Outflow=0.01 cfs 0.004 af

Pond det Pond #2: Det Pond #2 Peak Elev=258.34' Storage=892 cf Inflow=0.83 cfs 0.065 af
Discarded=0.11 cfs 0.064 af Primary=0.00 cfs 0.000 af Outflow=0.11 cfs 0.065 af

Pond Underground #1: Underground #1 Peak Elev=255.00' Storage=1,334 cf Inflow=1.48 cfs 0.106 af
Discarded=0.14 cfs 0.093 af Primary=0.24 cfs 0.013 af Outflow=0.38 cfs 0.106 af

Total Runoff Area = 1.917 ac Runoff Volume = 0.233 af Average Runoff Depth = 1.46"
78.34% Pervious = 1.502 ac 21.66% Impervious = 0.415 ac

Summary for Subcatchment Post DA#1: Post DA#1 to pond #2

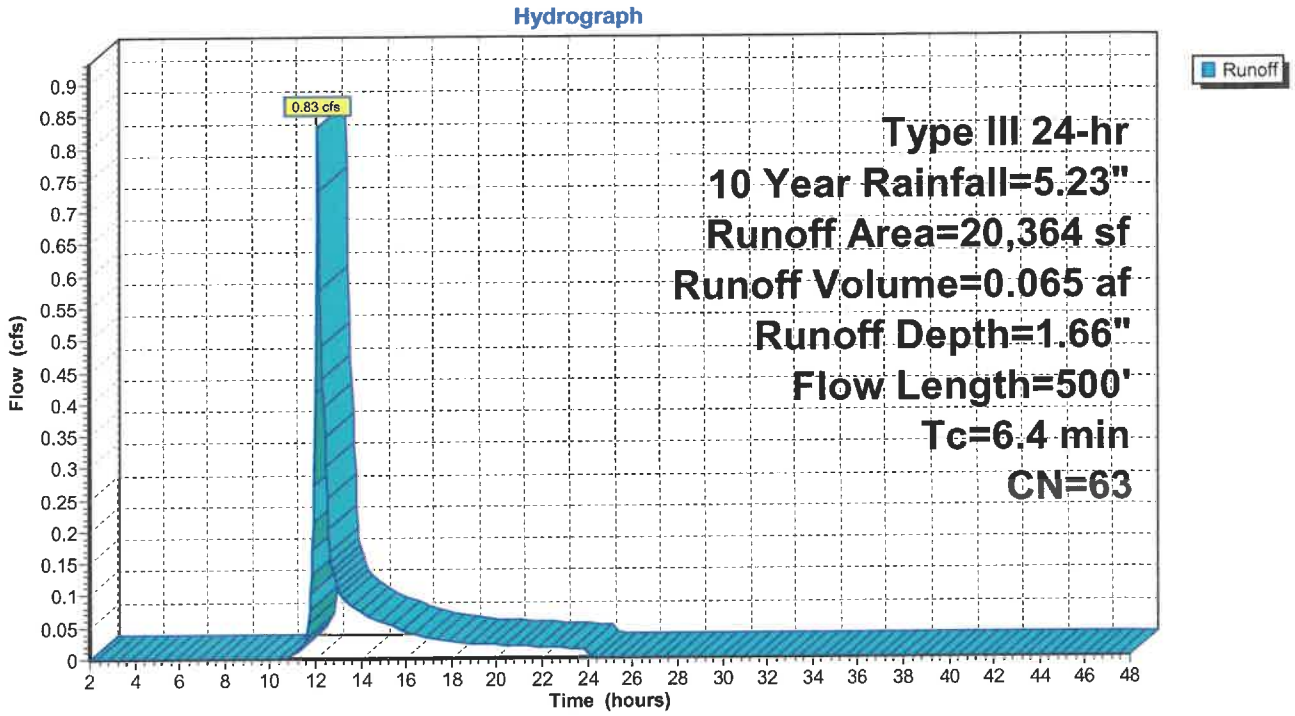
Runoff = 0.83 cfs @ 12.11 hrs, Volume= 0.065 af, Depth= 1.66"
Routed to Pond det Pond #2 : Det Pond #2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=5.23"

Area (sf)	CN	Description
6,000	98	Roofs, HSG A
0	74	>75% Grass cover, Good, HSG C
10,914	39	>75% Grass cover, Good, HSG A
1,000	36	Woods, Fair, HSG A
0	70	Woods, Good, HSG C
1,700	96	Gravel surface, HSG A
750	98	Paved parking, HSG A
20,364	63	Weighted Average
13,614		66.85% Pervious Area
6,750		33.15% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.0	20	0.0400	0.17		**Sheet Flow, grass** Grass: Short n= 0.150 P2= 3.37"
2.9	300	0.1200	1.73		**Shallow Concentrated Flow, woods** Woodland Kv= 5.0 fps
1.5	180	0.0150	1.97		**Shallow Concentrated Flow, grass** Unpaved Kv= 16.1 fps
6.4	500	Total			

Subcatchment Post DA#1: Post DA#1 to pond #2



Summary for Subcatchment Post DA#2: Post DA#2 to under #1

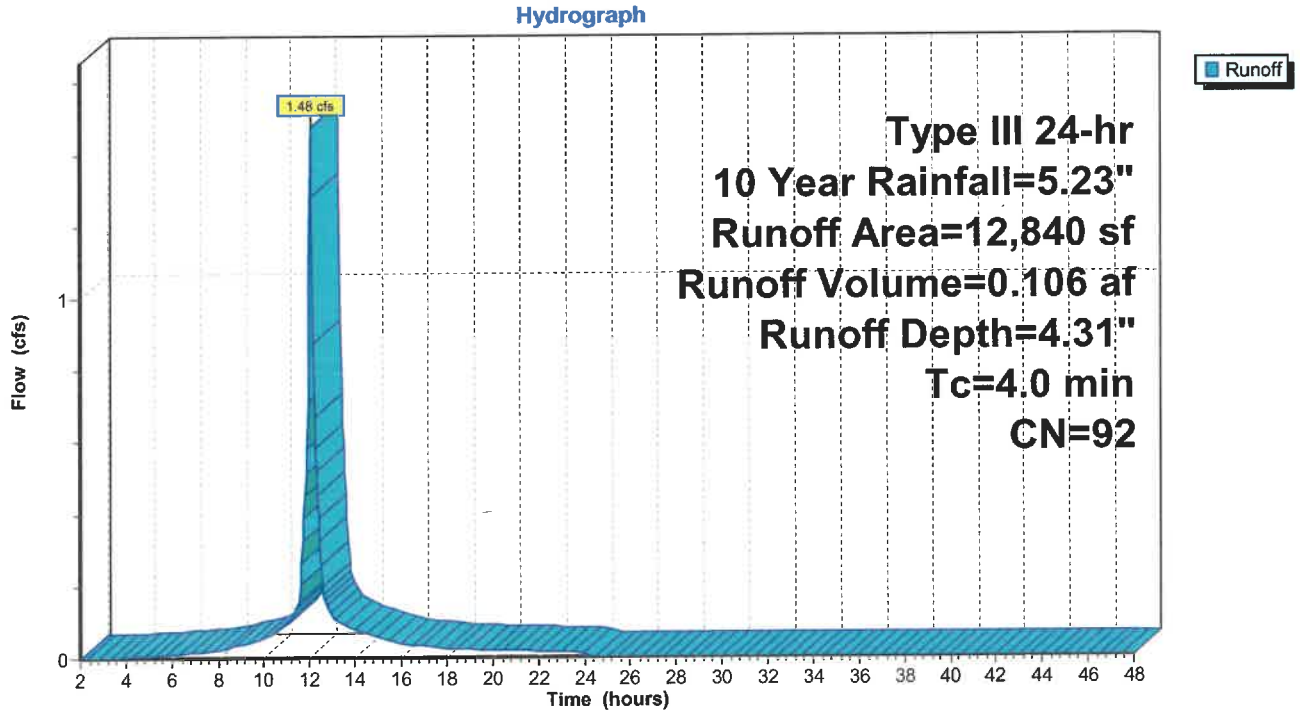
Runoff = 1.48 cfs @ 12.06 hrs, Volume= 0.106 af, Depth= 4.31"
Routed to Pond Underground #1 : Underground #1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=5.23"

Area (sf)	CN	Description
11,340	98	Paved parking, HSG A
0	74	>75% Grass cover, Good, HSG C
1,000	39	>75% Grass cover, Good, HSG A
0	36	Woods, Fair, HSG A
0	70	Woods, Good, HSG C
0	98	Roofs, HSG A
500	68	<50% Grass cover, Poor, HSG A
12,840	92	Weighted Average
1,500		11.68% Pervious Area
11,340		88.32% Impervious Area

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

Subcatchment Post DA#2: Post DA#2 to under #1



Summary for Subcatchment Post DA#3: POST DA#3 to North Crystal way

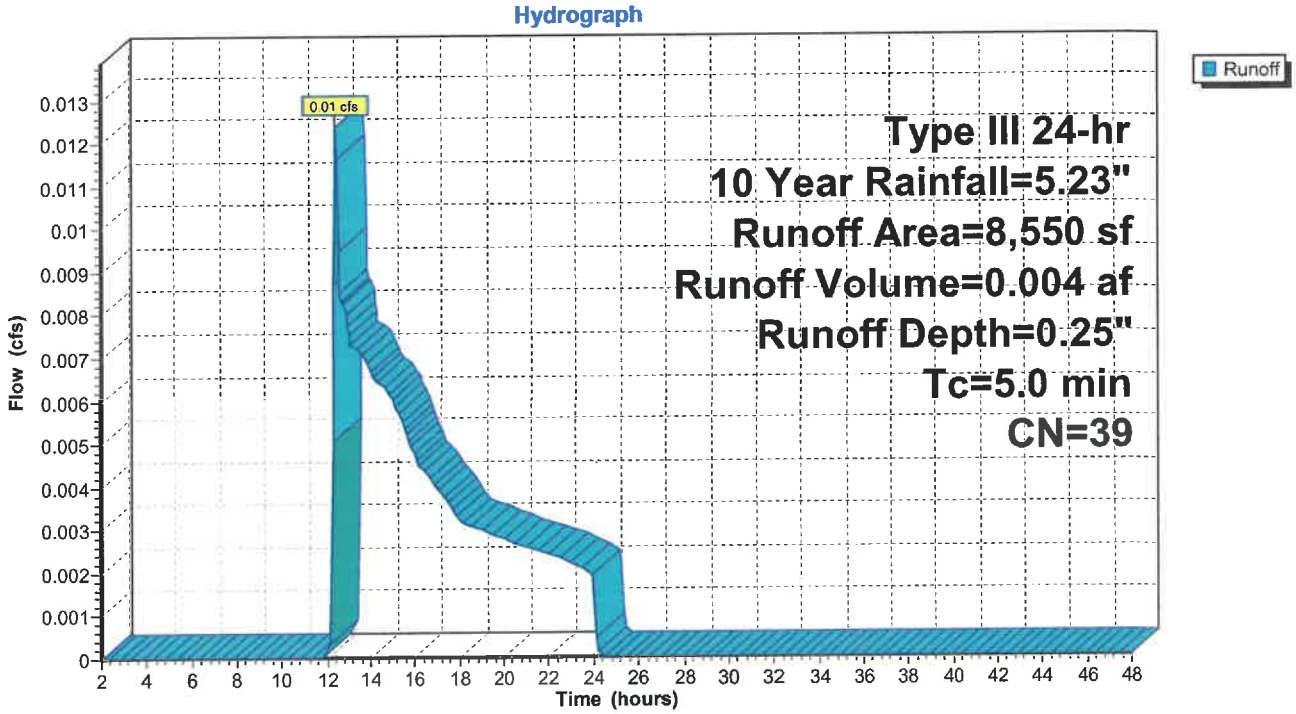
Runoff = 0.01 cfs @ 12.42 hrs, Volume= 0.004 af, Depth= 0.25"
Routed to Pond 1P : (new Pond)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=5.23"

Area (sf)	CN	Description
0	98	Roofs, HSG C
0	74	>75% Grass cover, Good, HSG C
0	39	>75% Grass cover, Good, HSG A
0	36	Woods, Fair, HSG A
0	70	Woods, Good, HSG C
8,550	39	>75% Grass cover, Good, HSG A
8,550	39	Weighted Average
8,550		100.00% Pervious Area

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

Subcatchment Post DA#3: POST DA#3 to North Crystal way



Summary for Subcatchment Pre- DA #1: Pre DA#1 to Eastern property line adjacent to Crystal Way

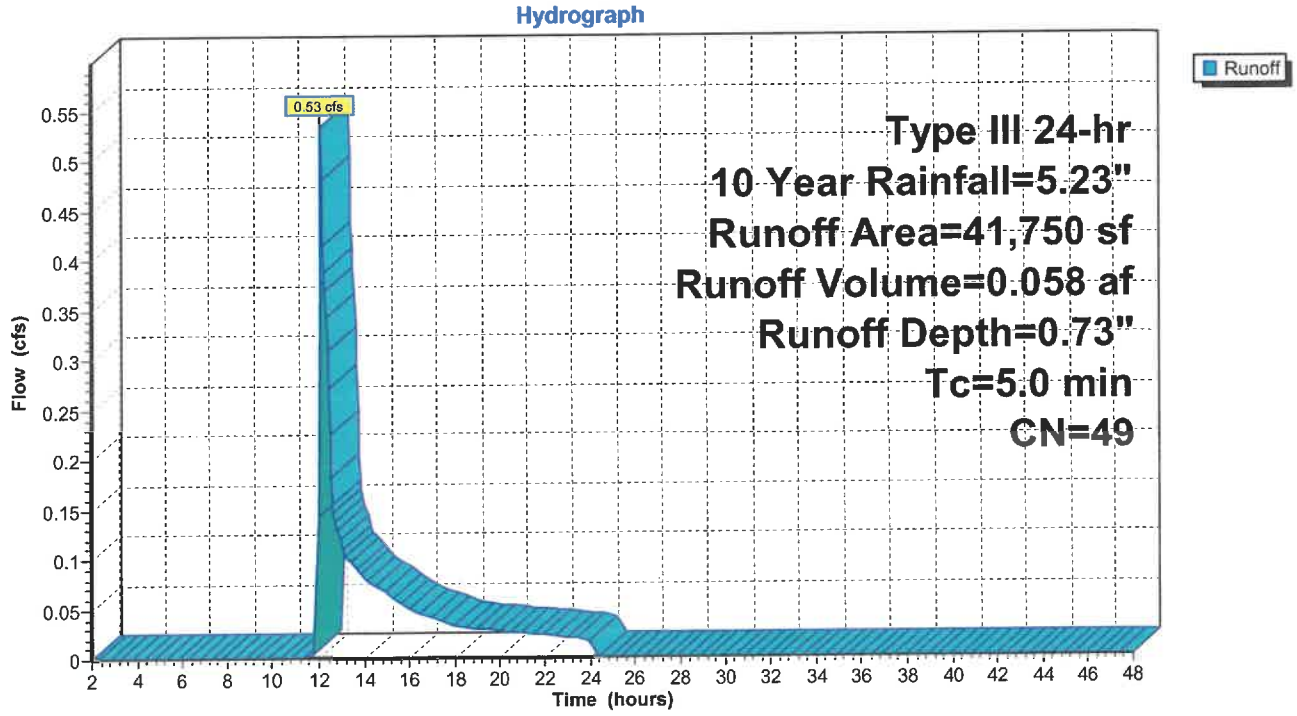
Runoff = 0.53 cfs @ 12.11 hrs, Volume= 0.058 af, Depth= 0.73"
Routed to Reach IP #1- Pre : Eastern property line / Crystal Way

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=5.23"

Area (sf)	CN	Description
0	98	Roofs, HSG C
0	74	>75% Grass cover, Good, HSG C
40,750	49	50-75% Grass cover, Fair, HSG A
1,000	36	Woods, Fair, HSG A
0	70	Woods, Good, HSG C
41,750	49	Weighted Average
41,750		100.00% Pervious Area

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

Subcatchment Pre- DA #1: Pre DA#1 to Eastern property line adjacent to Crystal Way

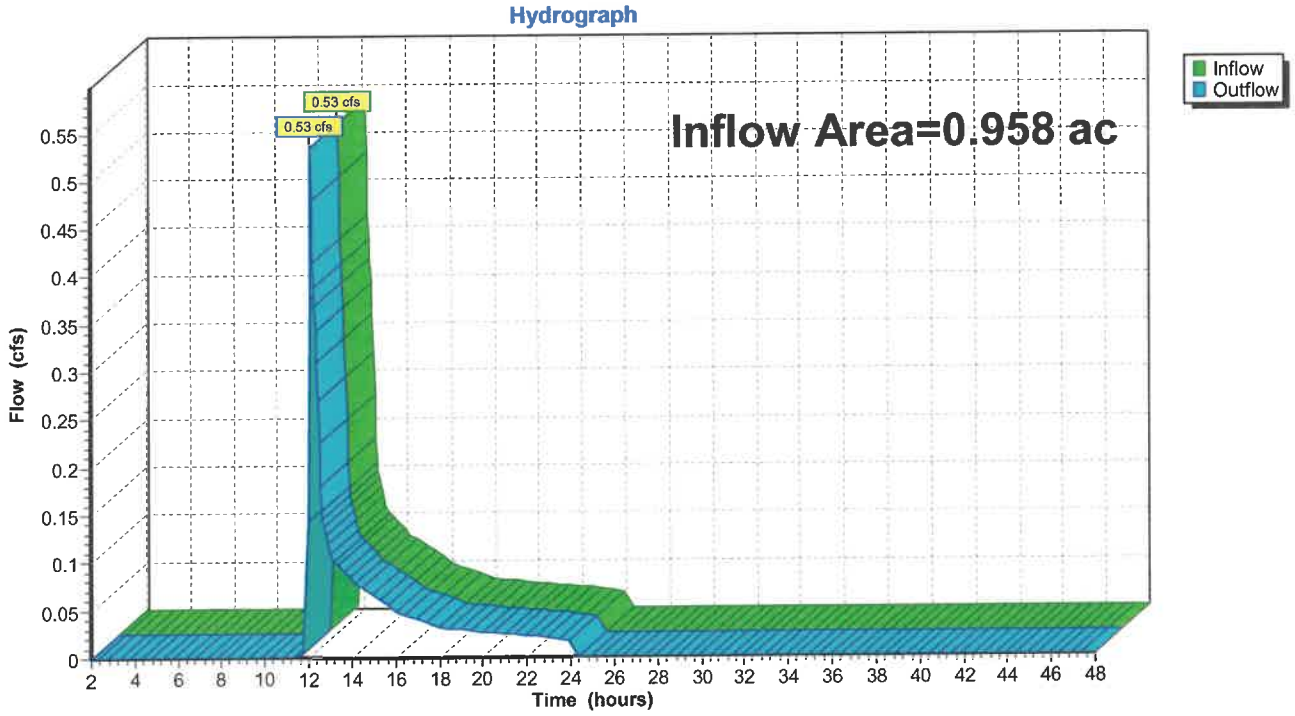


Summary for Reach IP #1- Pre: Eastern property line / Crystal Way

Inflow Area = 0.958 ac, 0.00% Impervious, Inflow Depth = 0.73" for 10 Year event
Inflow = 0.53 cfs @ 12.11 hrs, Volume= 0.058 af
Outflow = 0.53 cfs @ 12.11 hrs, Volume= 0.058 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 2.00-48.00 hrs, dt= 0.05 hrs

Reach IP #1- Pre: Eastern property line / Crystal Way

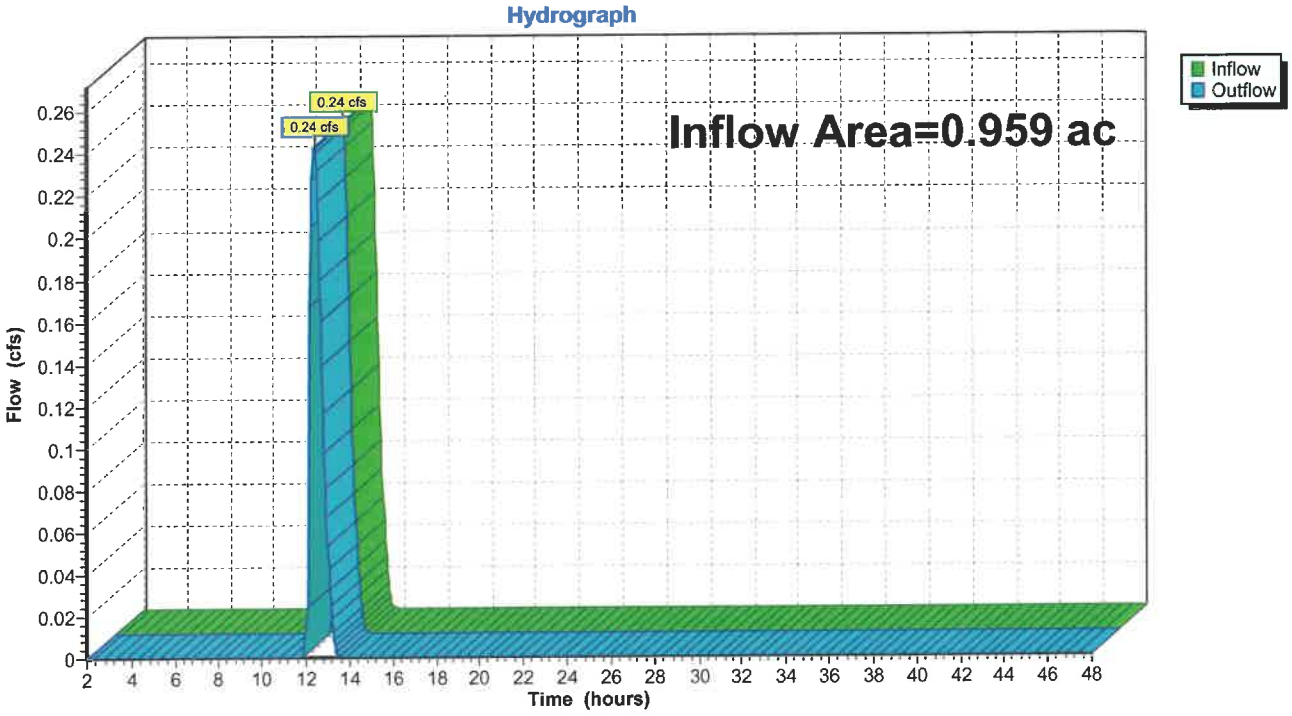


Summary for Reach IP#1 - Post: Eastern Property line / Crystal Way

Inflow Area = 0.959 ac, 43.33% Impervious, Inflow Depth = 0.16" for 10 Year event
Inflow = 0.24 cfs @ 12.41 hrs, Volume= 0.013 af
Outflow = 0.24 cfs @ 12.41 hrs, Volume= 0.013 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 2.00-48.00 hrs, dt= 0.05 hrs

Reach IP#1 - Post: Eastern Property line / Crystal Way



Summary for Pond 1P: (new Pond)

Inflow Area = 0.196 ac, 0.00% Impervious, Inflow Depth = 0.25" for 10 Year event
Inflow = 0.01 cfs @ 12.42 hrs, Volume= 0.004 af
Outflow = 0.01 cfs @ 12.52 hrs, Volume= 0.004 af, Atten= 15%, Lag= 5.9 min
Discarded = 0.01 cfs @ 12.52 hrs, Volume= 0.004 af
Primary = 0.00 cfs @ 2.00 hrs, Volume= 0.000 af
Routed to Reach IP#1 - Post : Eastern Property line / Crystal Way

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 257.00' @ 12.52 hrs Storage= 4 cf

Plug-Flow detention time= 6.3 min calculated for 0.004 af (100% of inflow)
Center-of-Mass det. time= 6.2 min (1,000.8 - 994.5)

Volume	Invert	Avail.Storage	Storage Description
#1	257.00'	1,500 cf	**Custom Stage Data** Listed below

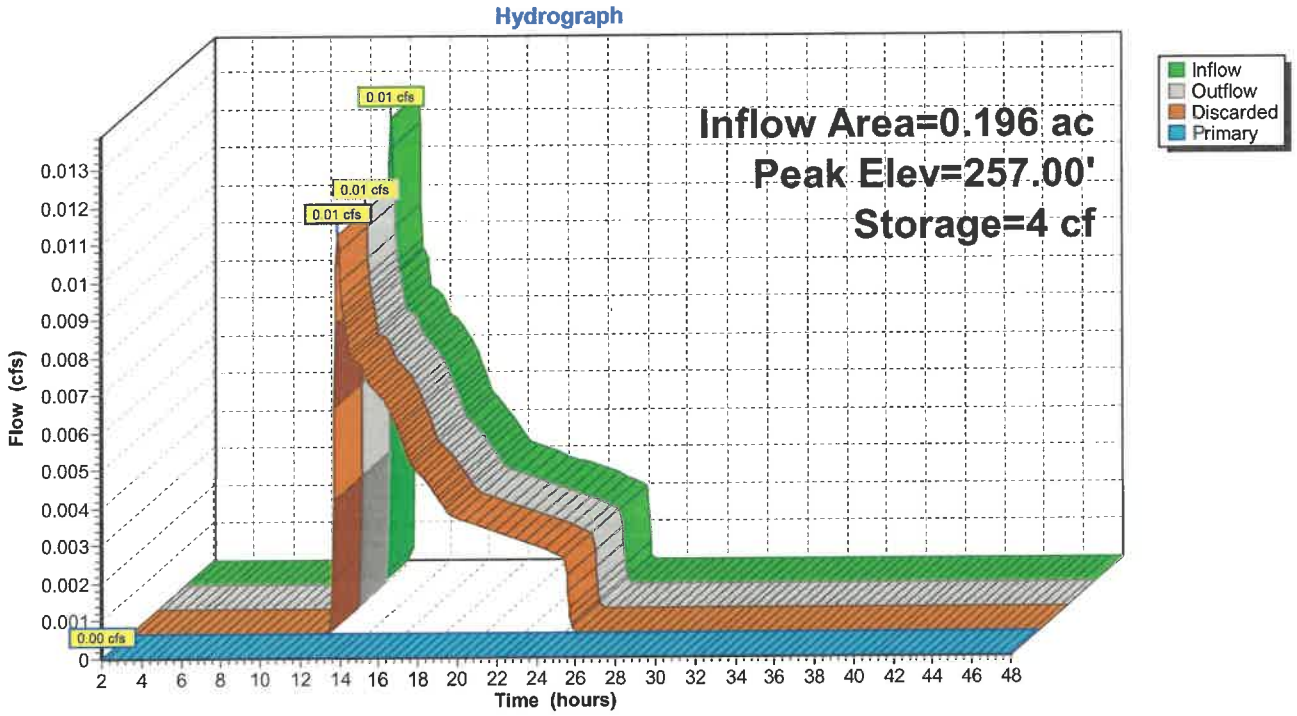
Elevation (feet)	Cum.Store (cubic-feet)
257.00	0
258.50	1,500

Device	Routing	Invert	Outlet Devices
#1	Discarded	257.00'	**0.04 cfs Exfiltration at all elevations**
#2	Primary	257.50'	**6.0' long + 3.0 '/' SideZ x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Discarded OutFlow Max=0.04 cfs @ 12.52 hrs HW=257.00' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.04 cfs)

Primary OutFlow Max=0.00 cfs @ 2.00 hrs HW=257.00' (Free Discharge)
↑—**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 1P: (new Pond)



Summary for Pond det Pond #2: Det Pond #2

Inflow Area = 0.467 ac, 33.15% Impervious, Inflow Depth = 1.66" for 10 Year event
Inflow = 0.83 cfs @ 12.11 hrs, Volume= 0.065 af
Outflow = 0.11 cfs @ 12.94 hrs, Volume= 0.065 af, Atten= 86%, Lag= 50.1 min
Discarded = 0.11 cfs @ 11.85 hrs, Volume= 0.064 af
Primary = 0.00 cfs @ 12.94 hrs, Volume= 0.000 af
Routed to Reach IP#1 - Post : Eastern Property line / Crystal Way

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 258.34' @ 12.94 hrs Storage= 892 cf

Plug-Flow detention time= 67.9 min calculated for 0.064 af (100% of inflow)
Center-of-Mass det. time= 67.8 min (931.7 - 863.9)

Volume	Invert	Avail.Storage	Storage Description
#1	257.00'	2,000 cf	**Custom Stage Data** Listed below

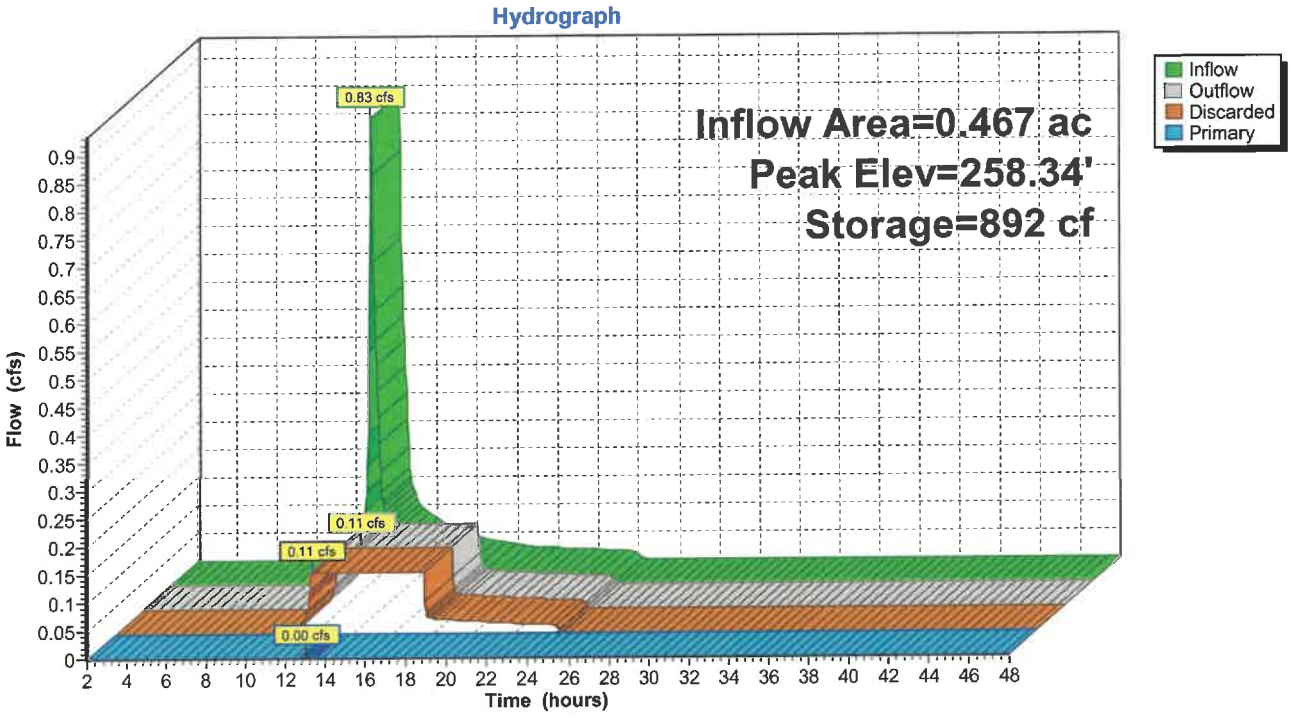
Elevation (feet)	Cum.Store (cubic-feet)
257.00	0
260.00	2,000

Device	Routing	Invert	Outlet Devices
#1	Discarded	257.00'	**0.11 cfs Exfiltration at all elevations**
#2	Primary	258.30'	**4.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Primary	258.90'	**8.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.11 cfs @ 11.85 hrs HW=257.04' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.11 cfs)

Primary OutFlow Max=0.00 cfs @ 12.94 hrs HW=258.34' (Free Discharge)
↑—**2=Orifice/Grate** (Orifice Controls 0.00 cfs @ 0.67 fps)
—**3=Orifice/Grate** (Controls 0.00 cfs)

Pond det Pond #2: Det Pond #2



Summary for Pond Underground #1: Underground #1

Inflow Area = 0.295 ac, 88.32% Impervious, Inflow Depth = 4.31" for 10 Year event
Inflow = 1.48 cfs @ 12.06 hrs, Volume= 0.106 af
Outflow = 0.38 cfs @ 12.41 hrs, Volume= 0.106 af, Atten= 74%, Lag= 20.9 min
Discarded = 0.14 cfs @ 11.50 hrs, Volume= 0.093 af
Primary = 0.24 cfs @ 12.41 hrs, Volume= 0.013 af
Routed to Reach IP#1 - Post : Eastern Property line / Crystal Way

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 255.00' @ 12.41 hrs Storage= 1,334 cf

Plug-Flow detention time= 48.2 min calculated for 0.106 af (100% of inflow)
Center-of-Mass det. time= 48.1 min (827.6 - 779.5)

Volume	Invert	Avail.Storage	Storage Description
#1	253.00'	2,000 cf	**Custom Stage Data** Listed below

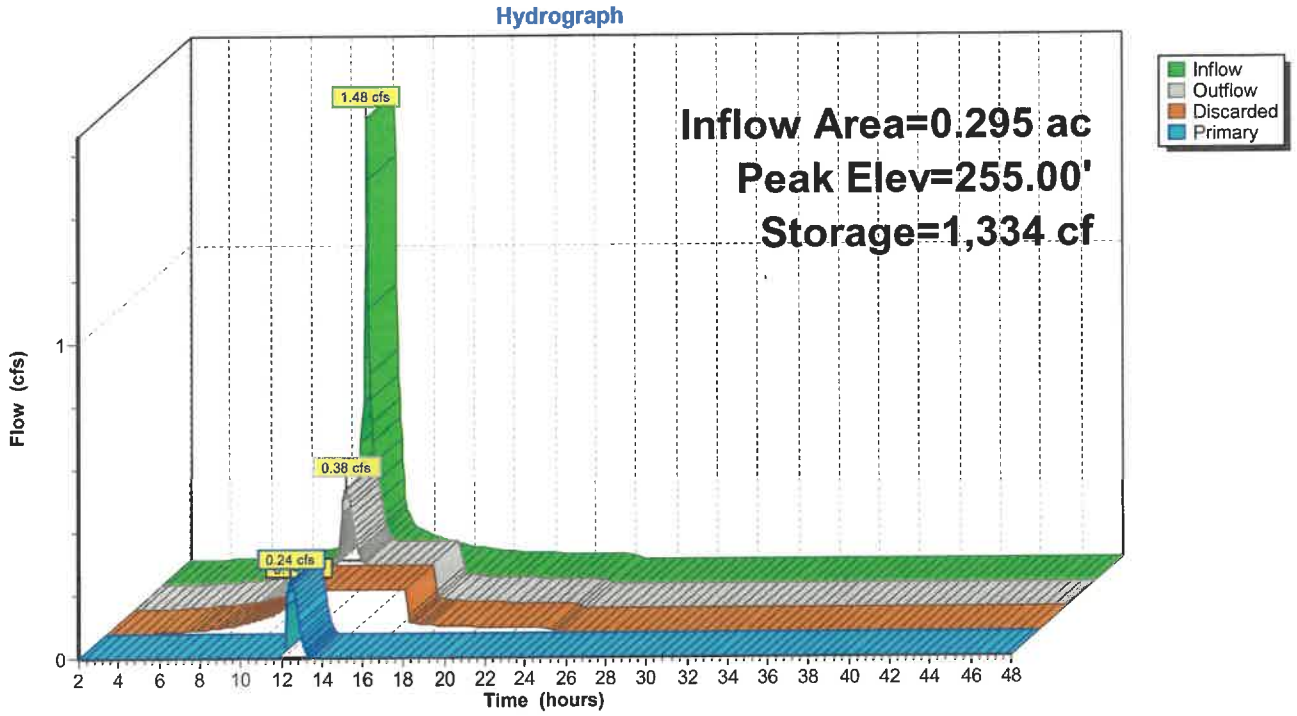
Elevation (feet)	Cum.Store (cubic-feet)
253.00	0
256.00	2,000

Device	Routing	Invert	Outlet Devices
#1	Discarded	253.00'	**0.14 cfs Exfiltration at all elevations**
#2	Primary	254.50'	**4.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Primary	255.00'	**8.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Primary	255.30'	**6.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.14 cfs @ 11.50 hrs HW=253.03' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.14 cfs)

Primary OutFlow Max=0.24 cfs @ 12.41 hrs HW=255.00' (Free Discharge)
├**2=Orifice/Grate** (Orifice Controls 0.24 cfs @ 2.78 fps)
├**3=Orifice/Grate** (Controls 0.00 cfs)
└**4=Orifice/Grate** (Controls 0.00 cfs)

Pond Underground #1: Underground #1



HYDROCAD - 50-YEAR STORM EVENT

Time span=2.00-48.00 hrs, dt=0.05 hrs, 921 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 Post DA#1: Post DA#1 to Runoff Area=20,364 sf 33.15% Impervious Runoff Depth=3.09"
Flow Length=500' Tc=6.4 min CN=63 Runoff=1.62 cfs 0.120 af

Subcatchment Post DA#2: Post DA#2 to Runoff Area=12,840 sf 88.32% Impervious Runoff Depth=6.30"
Tc=4.0 min CN=92 Runoff=2.12 cfs 0.155 af

Subcatchment Post DA#3: POST DA#3 to Runoff Area=8,550 sf 0.00% Impervious Runoff Depth=0.86"
Tc=5.0 min CN=39 Runoff=0.11 cfs 0.014 af

Subcatchment Pre- DA #1: Pre DA#1 to Runoff Area=41,750 sf 0.00% Impervious Runoff Depth=1.71"
Tc=5.0 min CN=49 Runoff=1.69 cfs 0.137 af

Reach IP #1- Pre: Eastern property line / Crystal Way Inflow=1.69 cfs 0.137 af
Outflow=1.69 cfs 0.137 af

Reach IP#1 - Post: Eastern Property line / Crystal Way Inflow=1.21 cfs 0.071 af
Outflow=1.21 cfs 0.071 af

Pond 1P: (new Pond) Peak Elev=257.08' Storage=79 cf Inflow=0.11 cfs 0.014 af
Discarded=0.04 cfs 0.014 af Primary=0.00 cfs 0.000 af Outflow=0.04 cfs 0.014 af

Pond det Pond #2: Det Pond #2 Peak Elev=259.14' Storage=1,427 cf Inflow=1.62 cfs 0.120 af
Discarded=0.11 cfs 0.087 af Primary=0.54 cfs 0.033 af Outflow=0.65 cfs 0.120 af

Pond Underground #1: Underground #1 Peak Elev=255.43' Storage=1,623 cf Inflow=2.12 cfs 0.155 af
Discarded=0.14 cfs 0.117 af Primary=0.96 cfs 0.038 af Outflow=1.10 cfs 0.155 af

Total Runoff Area = 1.917 ac Runoff Volume = 0.426 af Average Runoff Depth = 2.67"
78.34% Pervious = 1.502 ac 21.66% Impervious = 0.415 ac

Summary for Subcatchment Post DA#1: Post DA#1 to pond #2

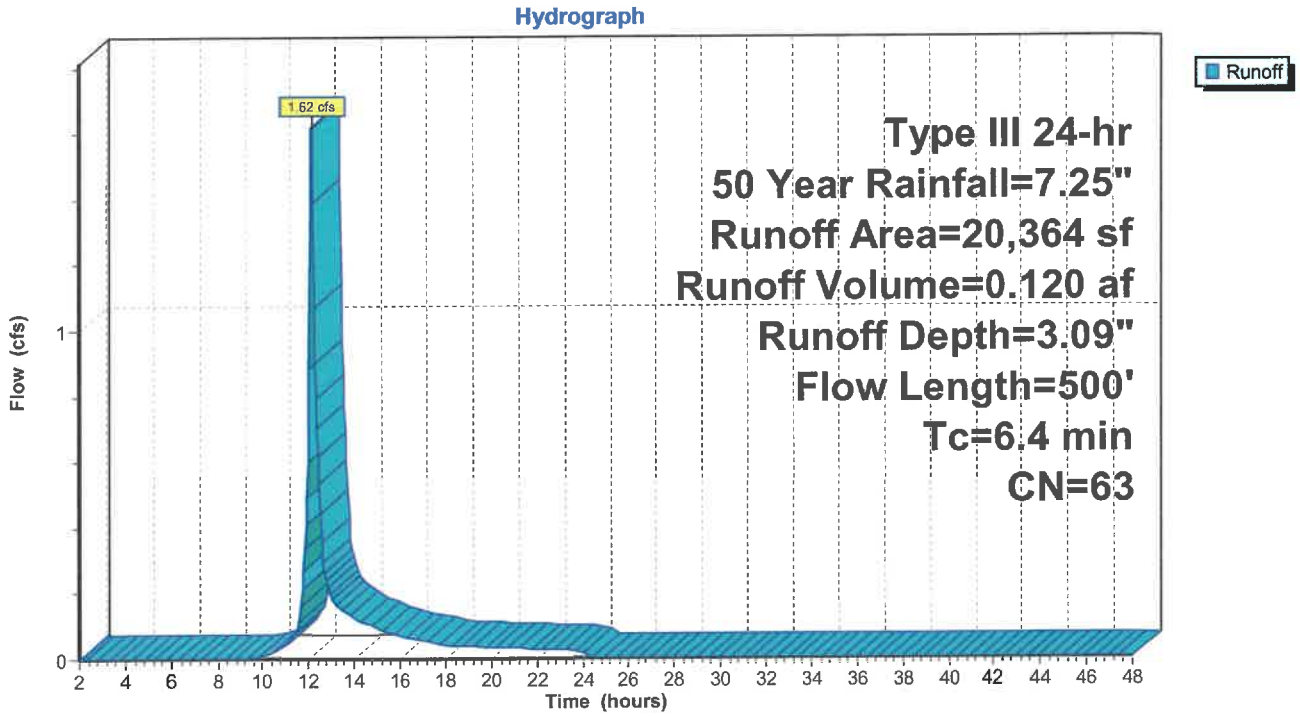
Runoff = 1.62 cfs @ 12.10 hrs, Volume= 0.120 af, Depth= 3.09"
Routed to Pond det Pond #2 : Det Pond #2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 50 Year Rainfall=7.25"

Area (sf)	CN	Description
6,000	98	Roofs, HSG A
0	74	>75% Grass cover, Good, HSG C
10,914	39	>75% Grass cover, Good, HSG A
1,000	36	Woods, Fair, HSG A
0	70	Woods, Good, HSG C
1,700	96	Gravel surface, HSG A
750	98	Paved parking, HSG A
20,364	63	Weighted Average
13,614		66.85% Pervious Area
6,750		33.15% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.0	20	0.0400	0.17		**Sheet Flow, grass** Grass: Short n= 0.150 P2= 3.37"
2.9	300	0.1200	1.73		**Shallow Concentrated Flow, woods** Woodland Kv= 5.0 fps
1.5	180	0.0150	1.97		**Shallow Concentrated Flow, grass** Unpaved Kv= 16.1 fps
6.4	500	Total			

Subcatchment Post DA#1: Post DA#1 to pond #2



Summary for Subcatchment Post DA#2: Post DA#2 to under #1

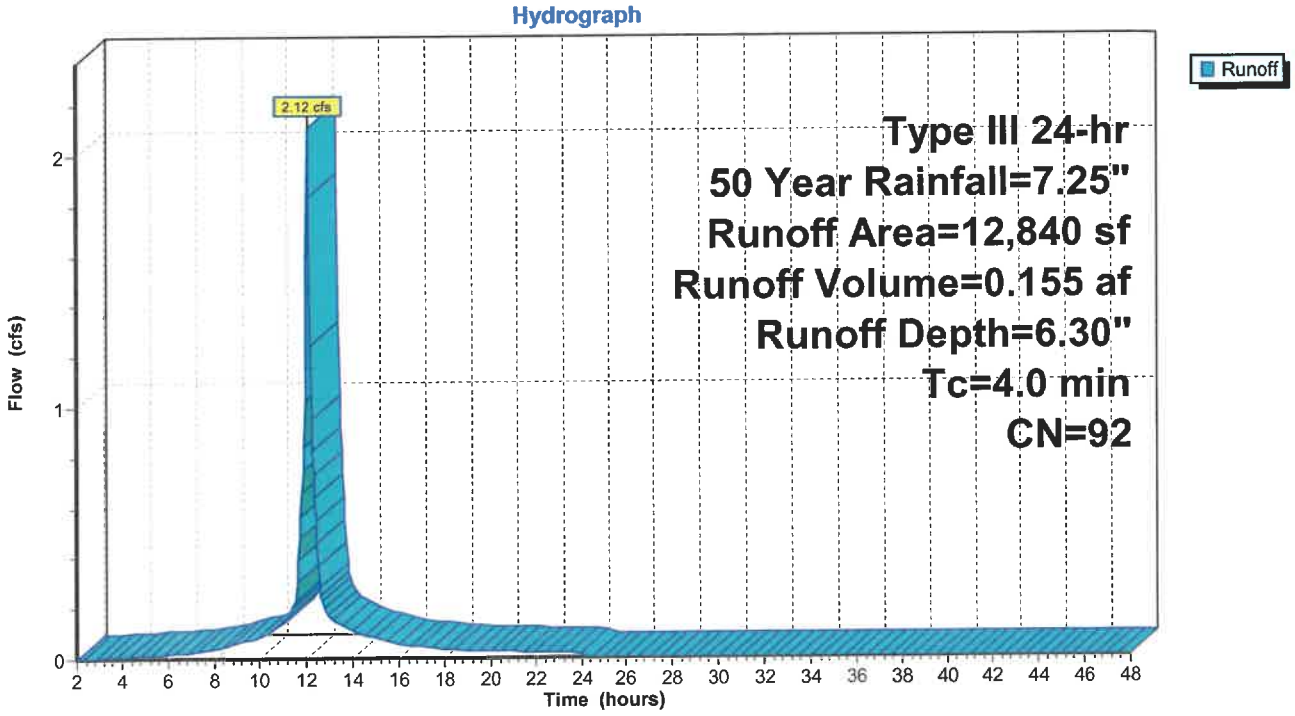
Runoff = 2.12 cfs @ 12.06 hrs, Volume= 0.155 af, Depth= 6.30"
Routed to Pond Underground #1 : Underground #1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 50 Year Rainfall=7.25"

Area (sf)	CN	Description
11,340	98	Paved parking, HSG A
0	74	>75% Grass cover, Good, HSG C
1,000	39	>75% Grass cover, Good, HSG A
0	36	Woods, Fair, HSG A
0	70	Woods, Good, HSG C
0	98	Roofs, HSG A
500	68	<50% Grass cover, Poor, HSG A
12,840	92	Weighted Average
1,500		11.68% Pervious Area
11,340		88.32% Impervious Area

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

Subcatchment Post DA#2: Post DA#2 to under #1



Summary for Subcatchment Post DA#3: POST DA#3 to North Crystal way

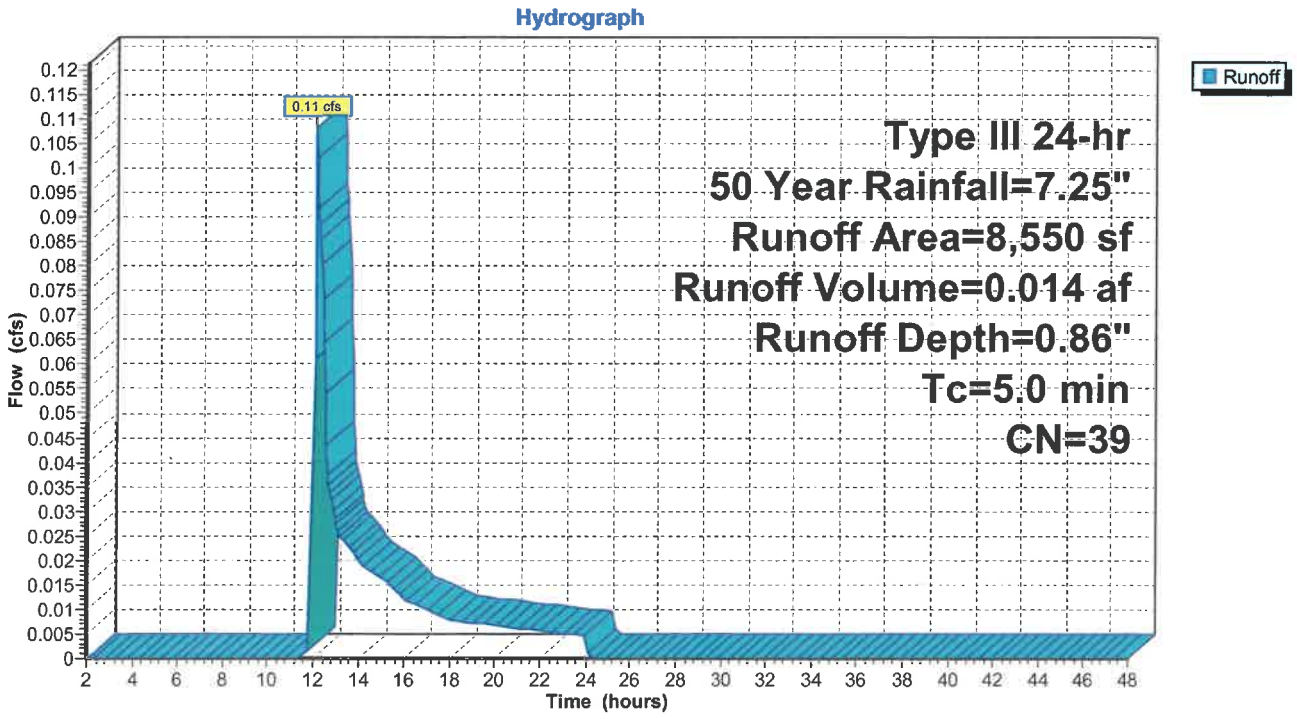
Runoff = 0.11 cfs @ 12.12 hrs, Volume= 0.014 af, Depth= 0.86"
Routed to Pond 1P : (new Pond)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 50 Year Rainfall=7.25"

Area (sf)	CN	Description
0	98	Roofs, HSG C
0	74	>75% Grass cover, Good, HSG C
0	39	>75% Grass cover, Good, HSG A
0	36	Woods, Fair, HSG A
0	70	Woods, Good, HSG C
8,550	39	>75% Grass cover, Good, HSG A
8,550	39	Weighted Average
8,550		100.00% Pervious Area

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

Subcatchment Post DA#3: POST DA#3 to North Crystal way



Summary for Subcatchment Pre- DA #1: Pre DA#1 to Eastern property line adjacent to Crystal Way

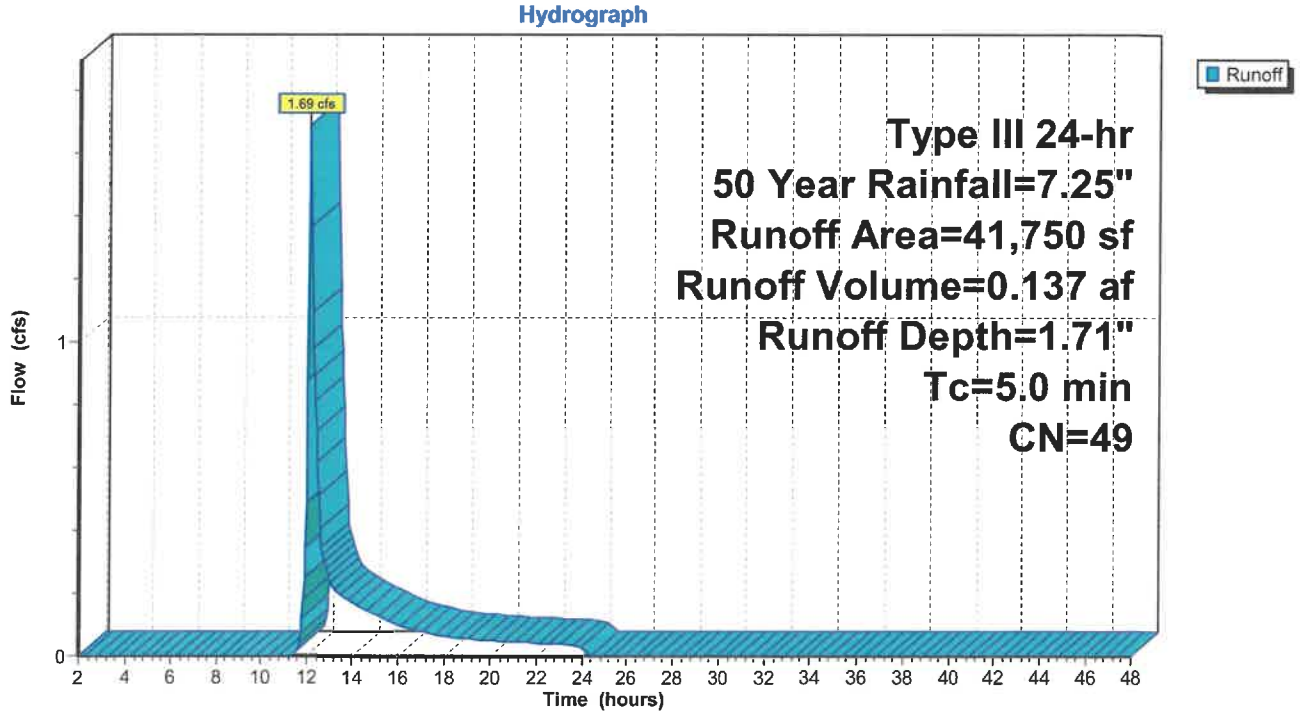
Runoff = 1.69 cfs @ 12.09 hrs, Volume= 0.137 af, Depth= 1.71"
Routed to Reach IP #1- Pre : Eastern property line / Crystal Way

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 50 Year Rainfall=7.25"

Area (sf)	CN	Description
0	98	Roofs, HSG C
0	74	>75% Grass cover, Good, HSG C
40,750	49	50-75% Grass cover, Fair, HSG A
1,000	36	Woods, Fair, HSG A
0	70	Woods, Good, HSG C
41,750	49	Weighted Average
41,750		100.00% Pervious Area

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

Subcatchment Pre- DA #1: Pre DA#1 to Eastern property line adjacent to Crystal Way

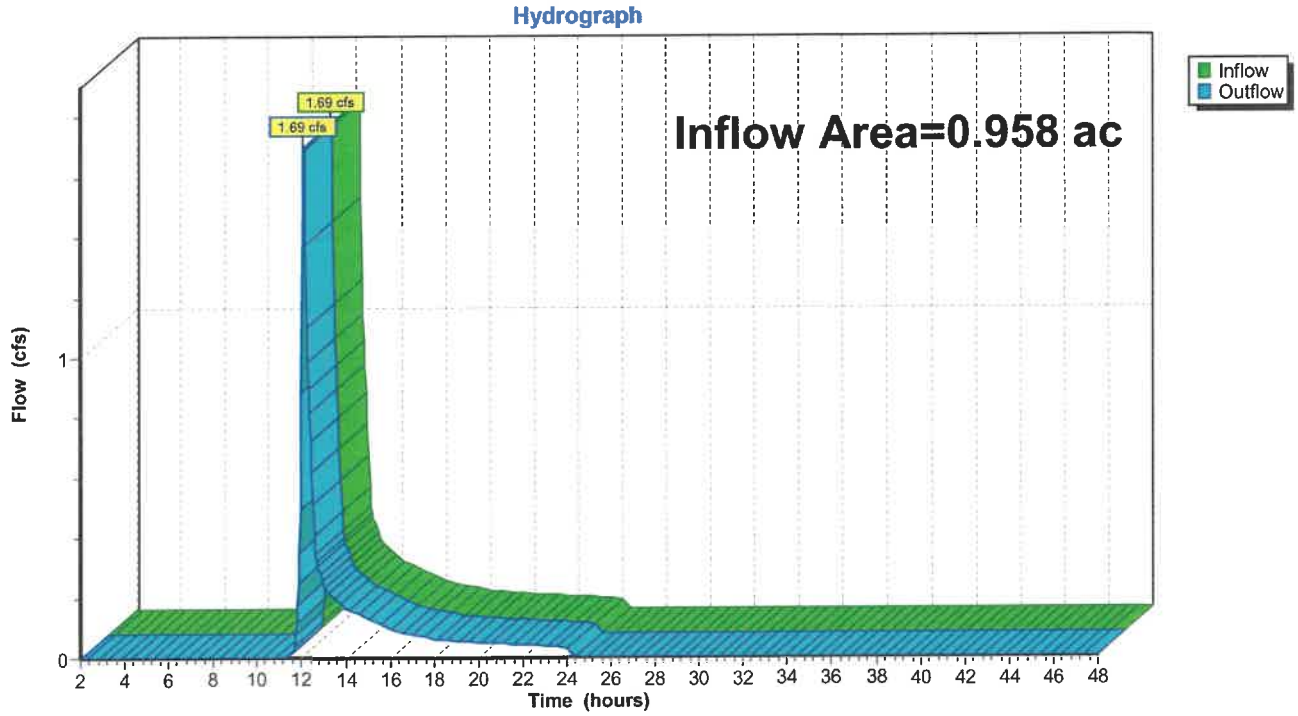


Summary for Reach IP #1- Pre: Eastern property line / Crystal Way

Inflow Area = 0.958 ac, 0.00% Impervious, Inflow Depth = 1.71" for 50 Year event
Inflow = 1.69 cfs @ 12.09 hrs, Volume= 0.137 af
Outflow = 1.69 cfs @ 12.09 hrs, Volume= 0.137 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 2.00-48.00 hrs, dt= 0.05 hrs

Reach IP #1- Pre: Eastern property line / Crystal Way

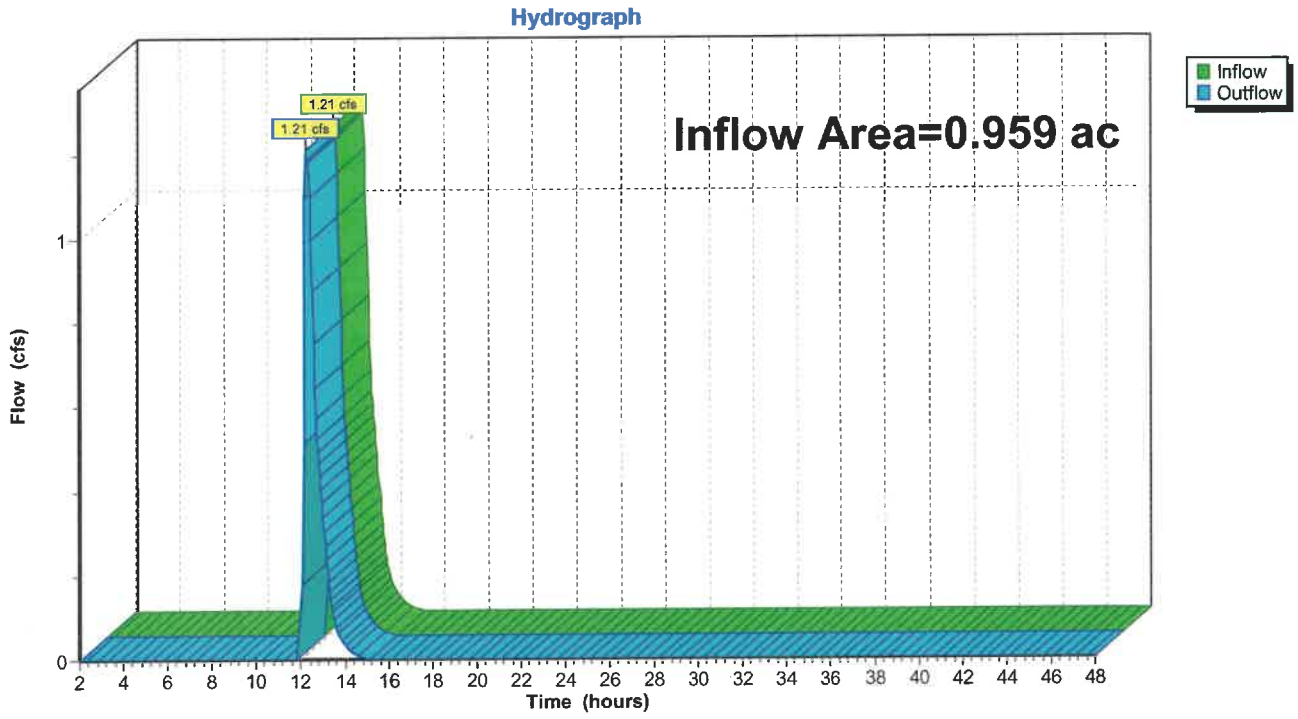


Summary for Reach IP#1 - Post: Eastern Property line / Crystal Way

Inflow Area = 0.959 ac, 43.33% Impervious, Inflow Depth = 0.89" for 50 Year event
Inflow = 1.21 cfs @ 12.20 hrs, Volume= 0.071 af
Outflow = 1.21 cfs @ 12.20 hrs, Volume= 0.071 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 2.00-48.00 hrs, dt= 0.05 hrs

Reach IP#1 - Post: Eastern Property line / Crystal Way



Summary for Pond 1P: (new Pond)

Inflow Area = 0.196 ac, 0.00% Impervious, Inflow Depth = 0.86" for 50 Year event
Inflow = 0.11 cfs @ 12.12 hrs, Volume= 0.014 af
Outflow = 0.04 cfs @ 12.10 hrs, Volume= 0.014 af, Atten= 63%, Lag= 0.0 min
Discarded = 0.04 cfs @ 12.10 hrs, Volume= 0.014 af
Primary = 0.00 cfs @ 2.00 hrs, Volume= 0.000 af
Routed to Reach IP#1 - Post : Eastern Property line / Crystal Way

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 257.08' @ 12.58 hrs Storage= 79 cf

Plug-Flow detention time= 13.1 min calculated for 0.014 af (100% of inflow)
Center-of-Mass det. time= 13.1 min (937.6 - 924.5)

Volume	Invert	Avail.Storage	Storage Description
#1	257.00'	1,500 cf	**Custom Stage Data** Listed below

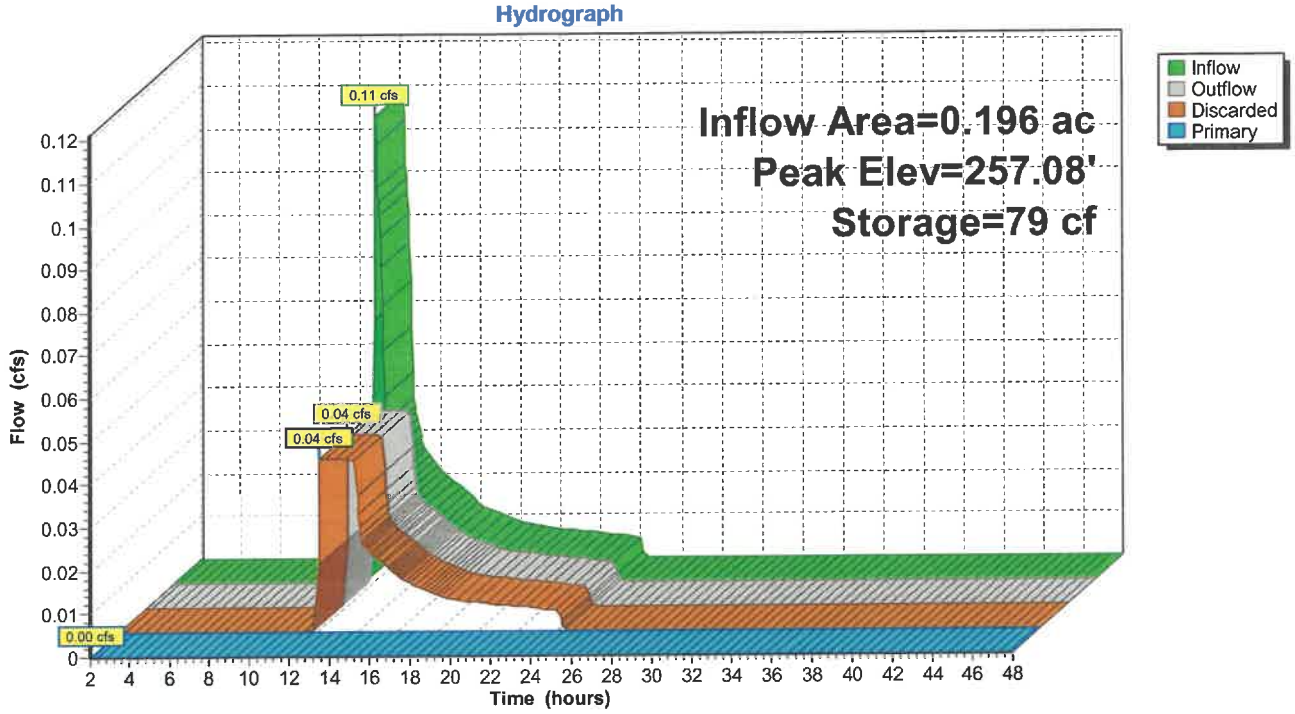
Elevation (feet)	Cum.Store (cubic-feet)
257.00	0
258.50	1,500

Device	Routing	Invert	Outlet Devices
#1	Discarded	257.00'	**0.04 cfs Exfiltration at all elevations**
#2	Primary	257.50'	**6.0' long + 3.0 '/' SideZ x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Discarded OutFlow Max=0.04 cfs @ 12.10 hrs HW=257.02' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.04 cfs)

Primary OutFlow Max=0.00 cfs @ 2.00 hrs HW=257.00' (Free Discharge)
↑—**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 1P: (new Pond)



Summary for Pond det Pond #2: Det Pond #2

Inflow Area = 0.467 ac, 33.15% Impervious, Inflow Depth = 3.09" for 50 Year event
Inflow = 1.62 cfs @ 12.10 hrs, Volume= 0.120 af
Outflow = 0.65 cfs @ 12.39 hrs, Volume= 0.120 af, Atten= 60%, Lag= 17.3 min
Discarded = 0.11 cfs @ 11.65 hrs, Volume= 0.087 af
Primary = 0.54 cfs @ 12.39 hrs, Volume= 0.033 af
Routed to Reach IP#1 - Post : Eastern Property line / Crystal Way

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 259.14' @ 12.39 hrs Storage= 1,427 cf

Plug-Flow detention time= 62.9 min calculated for 0.120 af (100% of inflow)
Center-of-Mass det. time= 62.9 min (907.9 - 845.0)

Volume	Invert	Avail.Storage	Storage Description
#1	257.00'	2,000 cf	**Custom Stage Data** Listed below

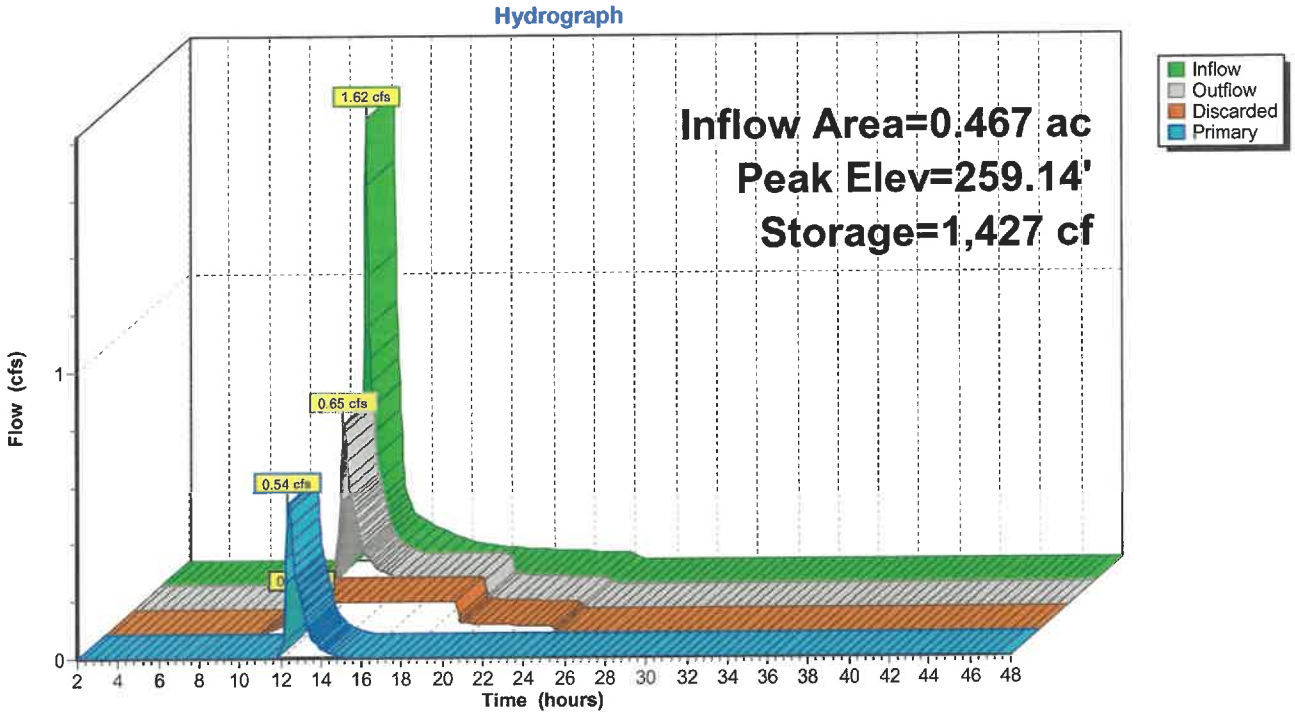
Elevation (feet)	Cum.Store (cubic-feet)
257.00	0
260.00	2,000

Device	Routing	Invert	Outlet Devices
#1	Discarded	257.00'	**0.11 cfs Exfiltration at all elevations**
#2	Primary	258.30'	**4.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Primary	258.90'	**8.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.11 cfs @ 11.65 hrs HW=257.04' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.11 cfs)

Primary OutFlow Max=0.53 cfs @ 12.39 hrs HW=259.14' (Free Discharge)
├**2=Orifice/Grate** (Orifice Controls 0.34 cfs @ 3.95 fps)
└**3=Orifice/Grate** (Orifice Controls 0.19 cfs @ 1.67 fps)

Pond det Pond #2: Det Pond #2



Summary for Pond Underground #1: Underground #1

Inflow Area = 0.295 ac, 88.32% Impervious, Inflow Depth = 6.30" for 50 Year event
Inflow = 2.12 cfs @ 12.06 hrs, Volume= 0.155 af
Outflow = 1.10 cfs @ 12.18 hrs, Volume= 0.155 af, Atten= 48%, Lag= 7.3 min
Discarded = 0.14 cfs @ 11.10 hrs, Volume= 0.117 af
Primary = 0.96 cfs @ 12.18 hrs, Volume= 0.038 af
Routed to Reach IP#1 - Post : Eastern Property line / Crystal Way

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 255.43' @ 12.18 hrs Storage= 1,623 cf

Plug-Flow detention time= 43.9 min calculated for 0.155 af (100% of inflow)
Center-of-Mass det. time= 43.9 min (813.7 - 769.9)

Volume	Invert	Avail.Storage	Storage Description
#1	253.00'	2,000 cf	**Custom Stage Data** Listed below

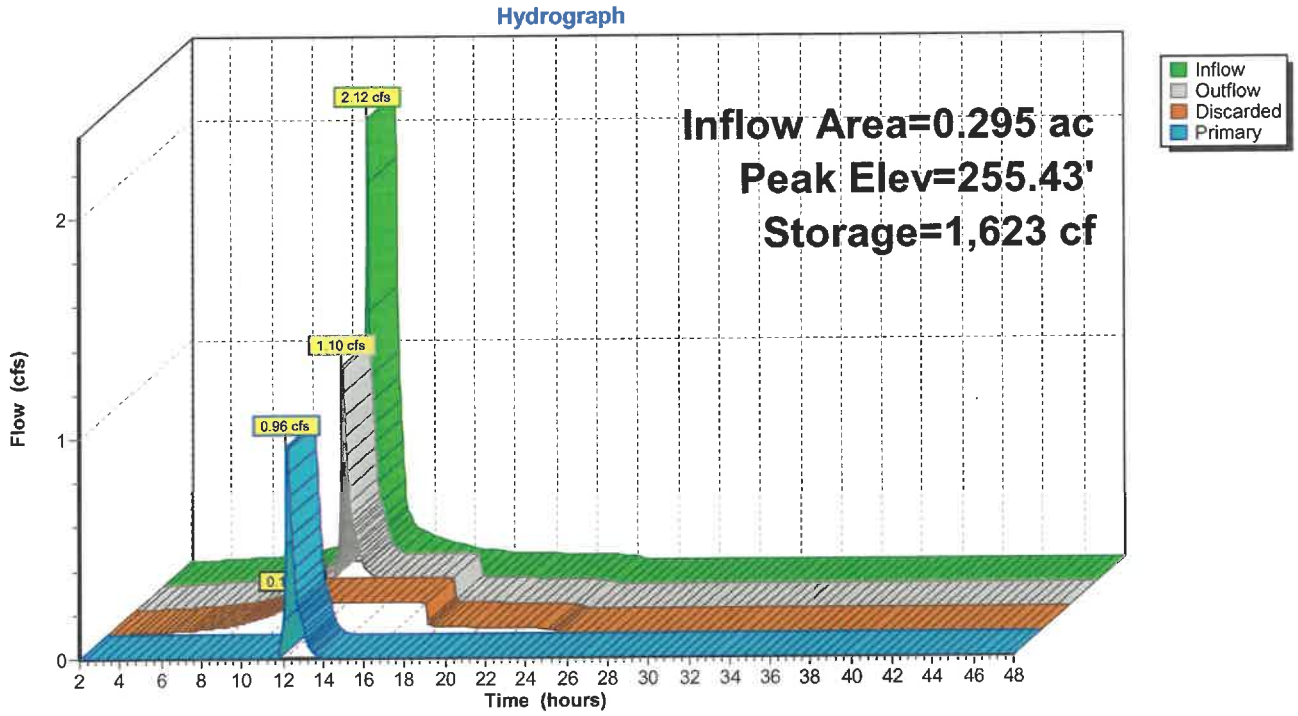
Elevation (feet)	Cum.Store (cubic-feet)
253.00	0
256.00	2,000

Device	Routing	Invert	Outlet Devices		
#1	Discarded	253.00'	**0.14 cfs Exfiltration at all elevations**		
#2	Primary	254.50'	**4.0" Vert. Orifice/Grate**	C= 0.600	Limited to weir flow at low heads
#3	Primary	255.00'	**8.0" Vert. Orifice/Grate**	C= 0.600	Limited to weir flow at low heads
#4	Primary	255.30'	**6.0" Vert. Orifice/Grate**	C= 0.600	Limited to weir flow at low heads

Discarded OutFlow Max=0.14 cfs @ 11.10 hrs HW=253.03' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.14 cfs)

Primary OutFlow Max=0.95 cfs @ 12.18 hrs HW=255.43' (Free Discharge)
↑—**2=Orifice/Grate** (Orifice Controls 0.37 cfs @ 4.20 fps)
—**3=Orifice/Grate** (Orifice Controls 0.53 cfs @ 2.23 fps)
—**4=Orifice/Grate** (Orifice Controls 0.05 cfs @ 1.22 fps)

Pond Underground #1: Underground #1



HYDROCAD – 100 -YEAR STORM EVENT

Time span=2.00-48.00 hrs, dt=0.05 hrs, 921 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 Post DA#1: Post DA#1 to Runoff Area=20,364 sf 33.15% Impervious Runoff Depth=3.81"
Flow Length=500' Tc=6.4 min CN=63 Runoff=2.02 cfs 0.148 af

Subcatchment Post DA#2: Post DA#2 to Runoff Area=12,840 sf 88.32% Impervious Runoff Depth=7.22"
Tc=4.0 min CN=92 Runoff=2.41 cfs 0.177 af

Subcatchment Post DA#3: POST DA#3 to Runoff Area=8,550 sf 0.00% Impervious Runoff Depth=1.23"
Tc=5.0 min CN=39 Runoff=0.20 cfs 0.020 af

Subcatchment Pre- DA #1: Pre DA#1 to Runoff Area=41,750 sf 0.00% Impervious Runoff Depth=2.25"
Tc=5.0 min CN=49 Runoff=2.33 cfs 0.180 af

Reach IP #1- Pre: Eastern property line / Crystal Way Inflow=2.33 cfs 0.180 af
Outflow=2.33 cfs 0.180 af

Reach IP#1 - Post: Eastern Property line / Crystal Way Inflow=2.05 cfs 0.103 af
Outflow=2.05 cfs 0.103 af

Pond 1P: (new Pond) Peak Elev=257.19' Storage=190 cf Inflow=0.20 cfs 0.020 af
Discarded=0.04 cfs 0.020 af Primary=0.00 cfs 0.000 af Outflow=0.04 cfs 0.020 af

Pond det Pond #2: Det Pond #2 Peak Elev=259.34' Storage=1,563 cf Inflow=2.02 cfs 0.148 af
Discarded=0.11 cfs 0.096 af Primary=0.96 cfs 0.052 af Outflow=1.07 cfs 0.148 af

Pond Underground #1: Underground #1 Peak Elev=255.59' Storage=1,726 cf Inflow=2.41 cfs 0.177 af
Discarded=0.14 cfs 0.127 af Primary=1.47 cfs 0.051 af Outflow=1.61 cfs 0.177 af

Total Runoff Area = 1.917 ac Runoff Volume = 0.526 af Average Runoff Depth = 3.29"
78.34% Pervious = 1.502 ac 21.66% Impervious = 0.415 ac

Summary for Subcatchment Post DA#1: Post DA#1 to pond #2

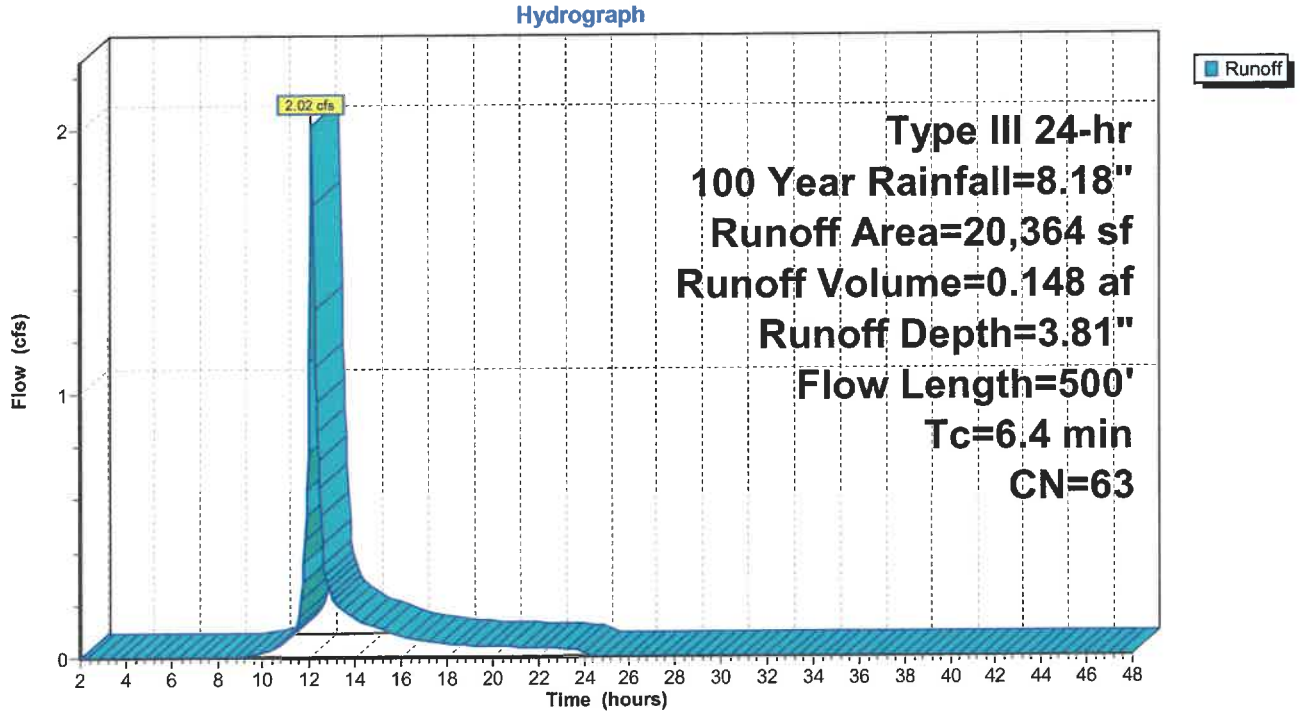
Runoff = 2.02 cfs @ 12.10 hrs, Volume= 0.148 af, Depth= 3.81"
Routed to Pond det Pond #2 : Det Pond #2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 Year Rainfall=8.18"

Area (sf)	CN	Description
6,000	98	Roofs, HSG A
0	74	>75% Grass cover, Good, HSG C
10,914	39	>75% Grass cover, Good, HSG A
1,000	36	Woods, Fair, HSG A
0	70	Woods, Good, HSG C
1,700	96	Gravel surface, HSG A
750	98	Paved parking, HSG A
20,364	63	Weighted Average
13,614		66.85% Pervious Area
6,750		33.15% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.0	20	0.0400	0.17		**Sheet Flow, grass** Grass: Short n= 0.150 P2= 3.37"
2.9	300	0.1200	1.73		**Shallow Concentrated Flow, woods** Woodland Kv= 5.0 fps
1.5	180	0.0150	1.97		**Shallow Concentrated Flow, grass** Unpaved Kv= 16.1 fps
6.4	500	Total			

Subcatchment Post DA#1: Post DA#1 to pond #2



Summary for Subcatchment Post DA#2: Post DA#2 to under #1

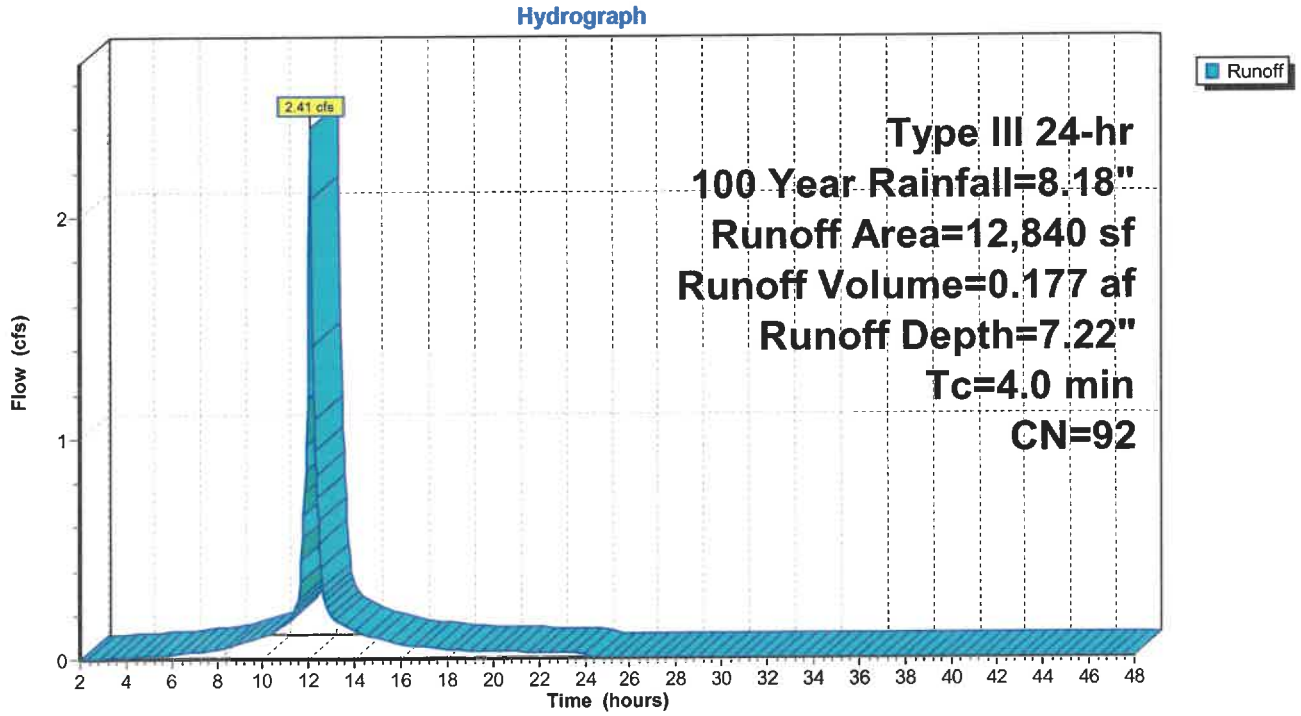
Runoff = 2.41 cfs @ 12.06 hrs, Volume= 0.177 af, Depth= 7.22"
Routed to Pond Underground #1 : Underground #1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 Year Rainfall=8.18"

Area (sf)	CN	Description
11,340	98	Paved parking, HSG A
0	74	>75% Grass cover, Good, HSG C
1,000	39	>75% Grass cover, Good, HSG A
0	36	Woods, Fair, HSG A
0	70	Woods, Good, HSG C
0	98	Roofs, HSG A
500	68	<50% Grass cover, Poor, HSG A
12,840	92	Weighted Average
1,500		11.68% Pervious Area
11,340		88.32% Impervious Area

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

Subcatchment Post DA#2: Post DA#2 to under #1



Summary for Subcatchment Post DA#3: POST DA#3 to North Crystal way

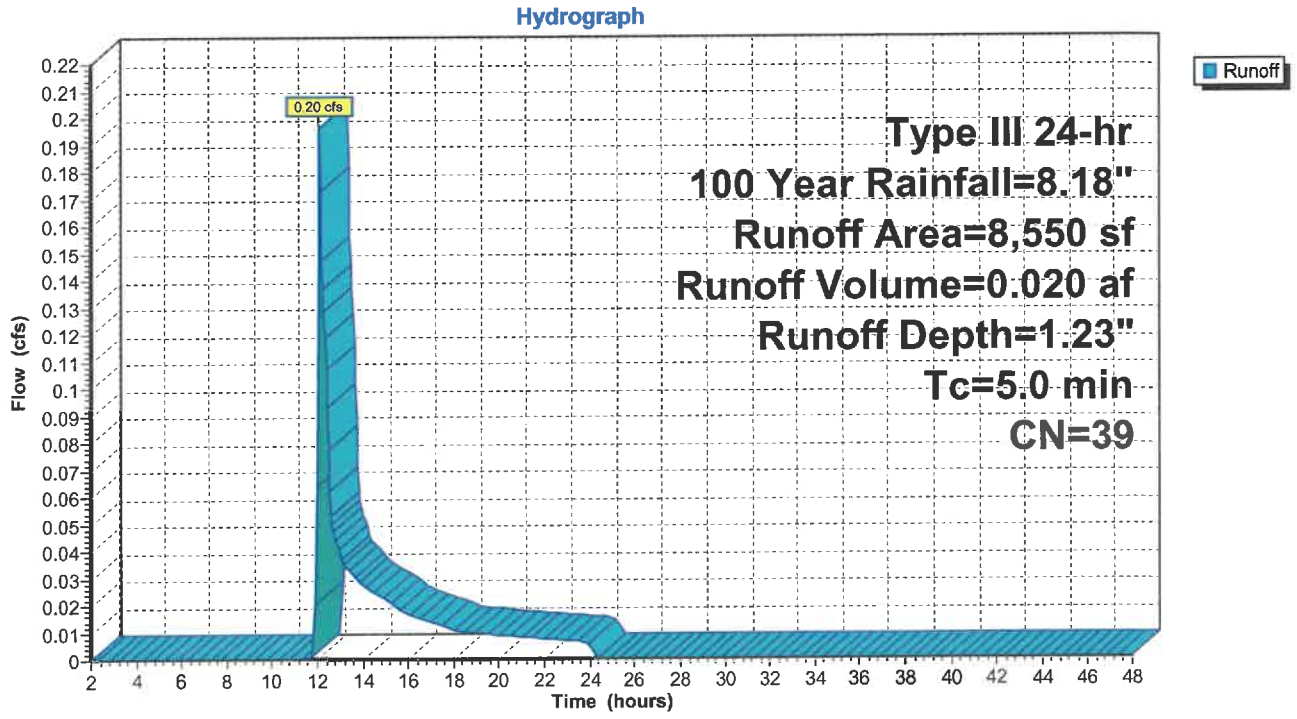
Runoff = 0.20 cfs @ 12.11 hrs, Volume= 0.020 af, Depth= 1.23"
Routed to Pond 1P : (new Pond)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 Year Rainfall=8.18"

Area (sf)	CN	Description
0	98	Roofs, HSG C
0	74	>75% Grass cover, Good, HSG C
0	39	>75% Grass cover, Good, HSG A
0	36	Woods, Fair, HSG A
0	70	Woods, Good, HSG C
8,550	39	>75% Grass cover, Good, HSG A
8,550	39	Weighted Average
8,550		100.00% Pervious Area

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

Subcatchment Post DA#3: POST DA#3 to North Crystal way



Summary for Subcatchment Pre- DA #1: Pre DA#1 to Eastern property line adjacent to Crystal Way

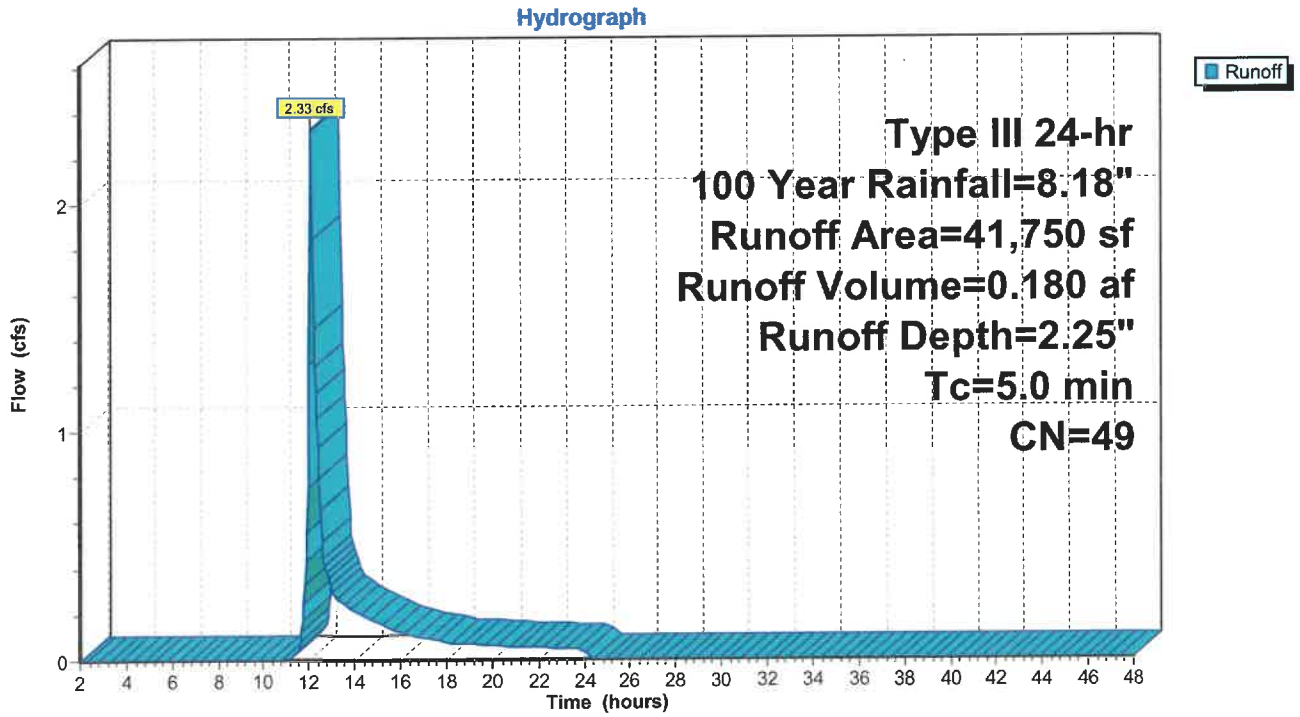
Runoff = 2.33 cfs @ 12.09 hrs, Volume= 0.180 af, Depth= 2.25"
Routed to Reach IP #1- Pre : Eastern property line / Crystal Way

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 Year Rainfall=8.18"

Area (sf)	CN	Description
0	98	Roofs, HSG C
0	74	>75% Grass cover, Good, HSG C
40,750	49	50-75% Grass cover, Fair, HSG A
1,000	36	Woods, Fair, HSG A
0	70	Woods, Good, HSG C
41,750	49	Weighted Average
41,750		100.00% Pervious Area

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

Subcatchment Pre- DA #1: Pre DA#1 to Eastern property line adjacent to Crystal Way

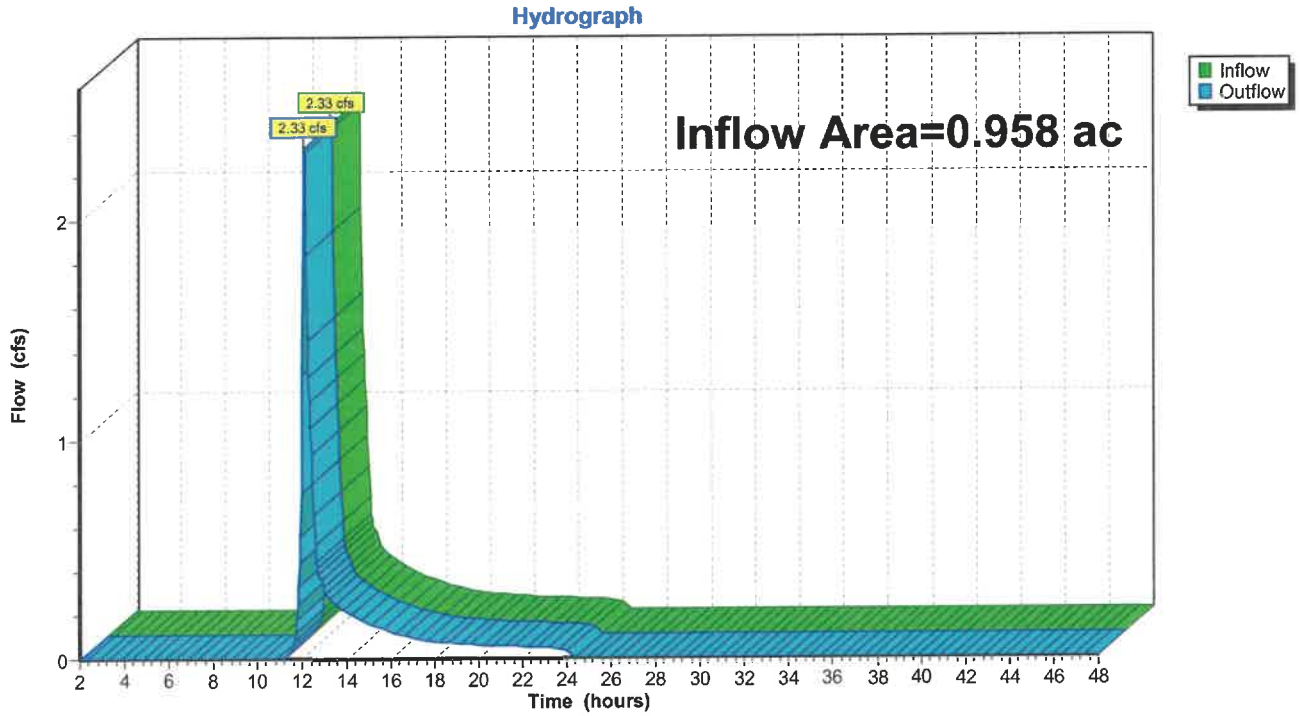


Summary for Reach IP #1- Pre: Eastern property line / Crystal Way

Inflow Area = 0.958 ac, 0.00% Impervious, Inflow Depth = 2.25" for 100 Year event
Inflow = 2.33 cfs @ 12.09 hrs, Volume= 0.180 af
Outflow = 2.33 cfs @ 12.09 hrs, Volume= 0.180 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 2.00-48.00 hrs, dt= 0.05 hrs

Reach IP #1- Pre: Eastern property line / Crystal Way

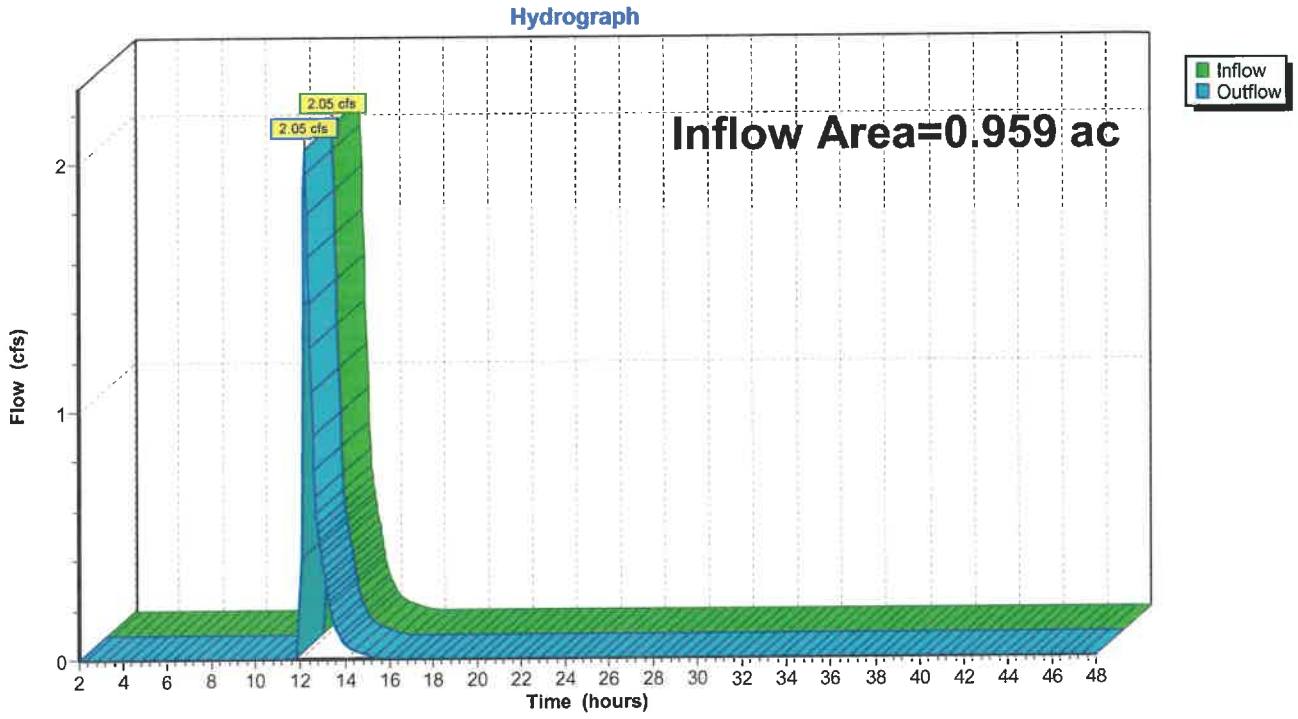


Summary for Reach IP#1 - Post: Eastern Property line / Crystal Way

Inflow Area = 0.959 ac, 43.33% Impervious, Inflow Depth = 1.29" for 100 Year event
Inflow = 2.05 cfs @ 12.21 hrs, Volume= 0.103 af
Outflow = 2.05 cfs @ 12.21 hrs, Volume= 0.103 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 2.00-48.00 hrs, dt= 0.05 hrs

Reach IP#1 - Post: Eastern Property line / Crystal Way



Summary for Pond 1P: (new Pond)

Inflow Area = 0.196 ac, 0.00% Impervious, Inflow Depth = 1.23" for 100 Year event
Inflow = 0.20 cfs @ 12.11 hrs, Volume= 0.020 af
Outflow = 0.04 cfs @ 12.05 hrs, Volume= 0.020 af, Atten= 80%, Lag= 0.0 min
Discarded = 0.04 cfs @ 12.05 hrs, Volume= 0.020 af
Primary = 0.00 cfs @ 2.00 hrs, Volume= 0.000 af
Routed to Reach IP#1 - Post : Eastern Property line / Crystal Way

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 257.19' @ 12.94 hrs Storage= 190 cf

Plug-Flow detention time= 38.2 min calculated for 0.020 af (100% of inflow)
Center-of-Mass det. time= 38.2 min (946.6 - 908.4)

Volume	Invert	Avail.Storage	Storage Description
#1	257.00'	1,500 cf	**Custom Stage Data** Listed below

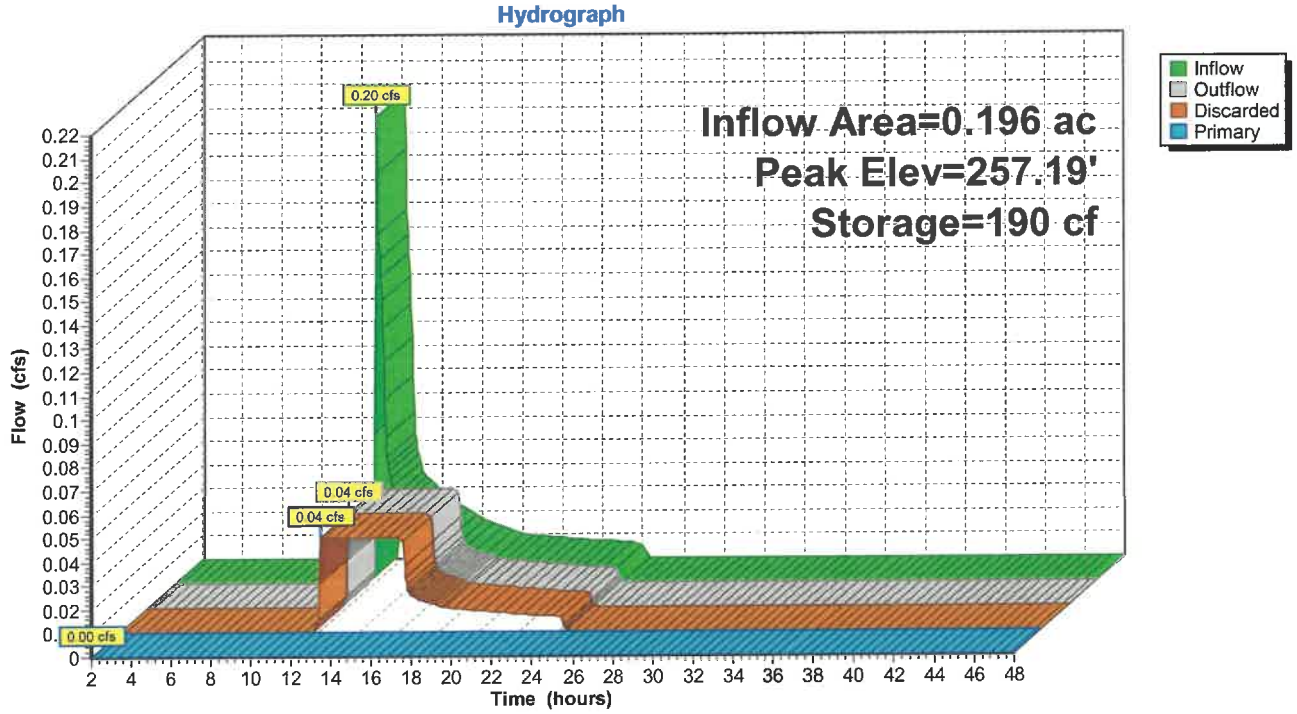
Elevation (feet)	Cum.Store (cubic-feet)
257.00	0
258.50	1,500

Device	Routing	Invert	Outlet Devices
#1	Discarded	257.00'	**0.04 cfs Exfiltration at all elevations**
#2	Primary	257.50'	**6.0' long + 3.0 '/' SideZ x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Discarded OutFlow Max=0.04 cfs @ 12.05 hrs HW=257.02' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.04 cfs)

Primary OutFlow Max=0.00 cfs @ 2.00 hrs HW=257.00' (Free Discharge)
↑—**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 1P: (new Pond)



Summary for Pond det Pond #2: Det Pond #2

Inflow Area = 0.467 ac, 33.15% Impervious, Inflow Depth = 3.81" for 100 Year event
Inflow = 2.02 cfs @ 12.10 hrs, Volume= 0.148 af
Outflow = 1.07 cfs @ 12.27 hrs, Volume= 0.148 af, Atten= 47%, Lag= 10.3 min
Discarded = 0.11 cfs @ 11.45 hrs, Volume= 0.096 af
Primary = 0.96 cfs @ 12.27 hrs, Volume= 0.052 af
Routed to Reach IP#1 - Post : Eastern Property line / Crystal Way

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 259.34' @ 12.27 hrs Storage= 1,563 cf

Plug-Flow detention time= 58.4 min calculated for 0.148 af (100% of inflow)
Center-of-Mass det. time= 58.3 min (897.2 - 838.9)

Volume	Invert	Avail.Storage	Storage Description
#1	257.00'	2,000 cf	**Custom Stage Data** Listed below

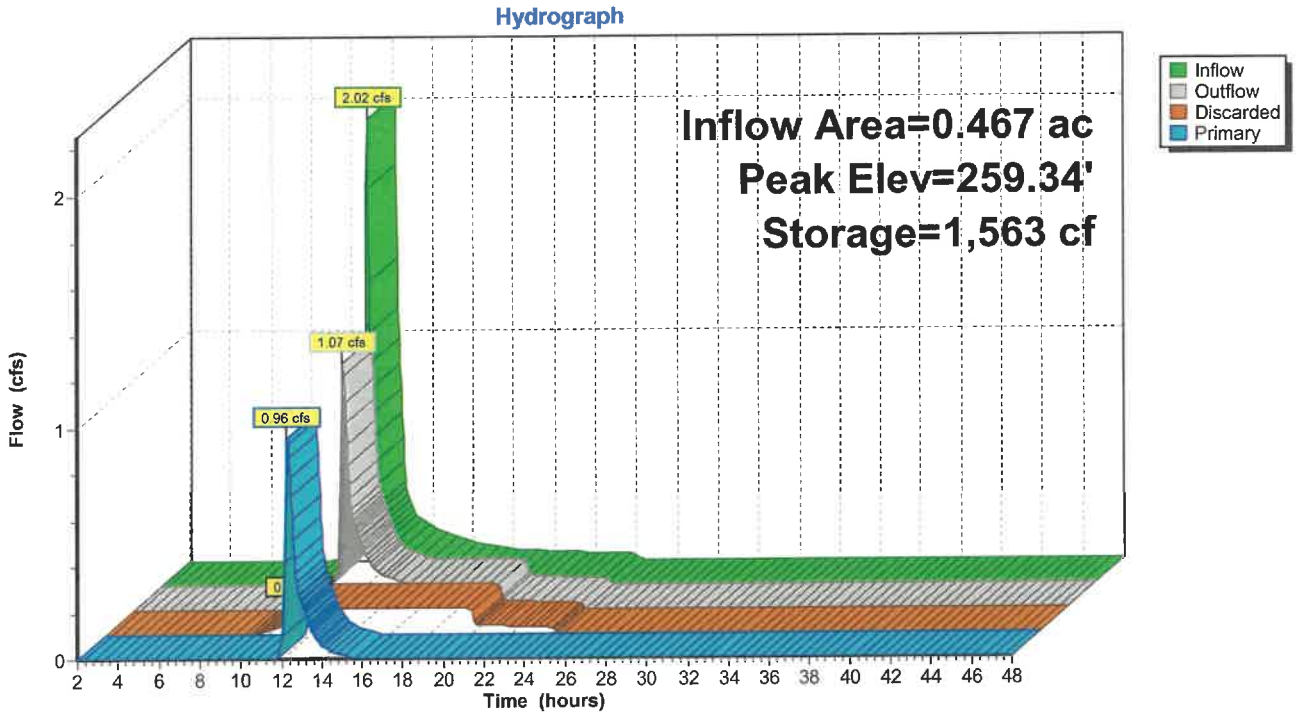
Elevation (feet)	Cum.Store (cubic-feet)
257.00	0
260.00	2,000

Device	Routing	Invert	Outlet Devices
#1	Discarded	257.00'	**0.11 cfs Exfiltration at all elevations**
#2	Primary	258.30'	**4.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Primary	258.90'	**8.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.11 cfs @ 11.45 hrs HW=257.03' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.11 cfs)

Primary OutFlow Max=0.94 cfs @ 12.27 hrs HW=259.34' (Free Discharge)
├**2=Orifice/Grate** (Orifice Controls 0.39 cfs @ 4.49 fps)
└**3=Orifice/Grate** (Orifice Controls 0.55 cfs @ 2.25 fps)

Pond det Pond #2: Det Pond #2



Summary for Pond Underground #1: Underground #1

Inflow Area = 0.295 ac, 88.32% Impervious, Inflow Depth = 7.22" for 100 Year event
Inflow = 2.41 cfs @ 12.06 hrs, Volume= 0.177 af
Outflow = 1.61 cfs @ 12.15 hrs, Volume= 0.177 af, Atten= 33%, Lag= 5.6 min
Discarded = 0.14 cfs @ 10.80 hrs, Volume= 0.127 af
Primary = 1.47 cfs @ 12.15 hrs, Volume= 0.051 af
Routed to Reach IP#1 - Post : Eastern Property line / Crystal Way

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 255.59' @ 12.15 hrs Storage= 1,726 cf

Plug-Flow detention time= 42.4 min calculated for 0.177 af (100% of inflow)
Center-of-Mass det. time= 42.4 min (809.0 - 766.6)

Volume	Invert	Avail.Storage	Storage Description
#1	253.00'	2,000 cf	**Custom Stage Data** Listed below

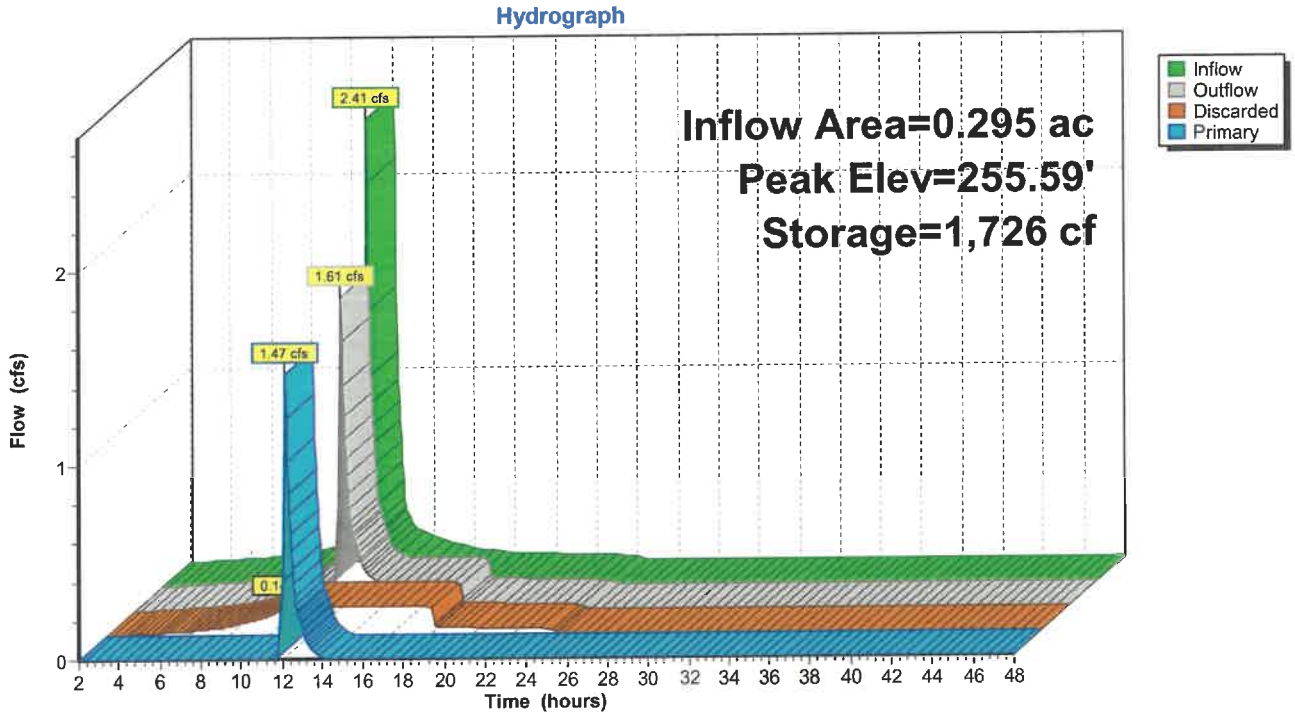
Elevation (feet)	Cum.Store (cubic-feet)
253.00	0
256.00	2,000

Device	Routing	Invert	Outlet Devices
#1	Discarded	253.00'	**0.14 cfs Exfiltration at all elevations**
#2	Primary	254.50'	**4.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Primary	255.00'	**8.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Primary	255.30'	**6.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.14 cfs @ 10.80 hrs HW=253.03' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.14 cfs)

Primary OutFlow Max=1.47 cfs @ 12.15 hrs HW=255.59' (Free Discharge)
├**2=Orifice/Grate** (Orifice Controls 0.40 cfs @ 4.62 fps)
├**3=Orifice/Grate** (Orifice Controls 0.85 cfs @ 2.61 fps)
└**4=Orifice/Grate** (Orifice Controls 0.21 cfs @ 1.83 fps)

Pond Underground #1: Underground #1



RATIONAL METHOD SUPPORTING DOCUEMENTS - CHARTS

Exhibit 8-8
Recommended Runoff Coefficients (C) for Rational Method
(By Overall Character of Area)

Description of Area	Runoff Coefficients
Business	
Downtown	0.70 to 0.95
Neighborhood	0.50 to 0.70
Residential	
Single-Family	0.30 to 0.50
Multi-Family, Detached	0.40 to 0.60
Multi-Family, Attached	0.60 to 0.75
Residential (Suburban)	0.25 to 0.40
Apartment	0.50 to 0.70
Industrial	
Light	0.50 to 0.80
Heavy	0.60 to 0.90
Parks, Cemeteries	0.10 to 0.25
Playgrounds	0.20 to 0.35
Railroad Yard	0.20 to 0.35
Unimproved	0.10 to 0.30
Woodland	0.15 to 0.25
Cultivated	0.40 to 0.60

Source: Design Manual for Storm Drainage, ASCE 1960

Exhibit 8-9
Recommended Runoff Coefficients (C) For Rational Method
(For Surface Type)

Character of Surface	Runoff Coefficients
Pavement	
Asphaltic and Concrete	0.70 to 0.95
Brick	0.70 to 0.85
Roofs	0.75 to 0.95
Lawns, Sandy Soil	
Flat, 2 Percent	0.05 to 0.10 0.
Average, 2 to 7 Percent	10 to 0.15
Steep, 7 Percent	0.15 to 0.20
Lawns, Heavy Soil	
Flat, 2 Percent	0.13 to 0.17
Average, 2 to 7 Percent	0.18 to 0.22
Steep, 7 Percent	0.25 to 0.35

Source: Design Manual for Storm Drainage, ASCE 1960

Exhibit 8-10
Recommended Ca Values (Rational Method)
(For Greater Than 10-year Design Runoff)

Recurrence Interval (Years)	C_a
2 to 10	1.0
25	1.1
50	1.2
100	1.25

Note: The product of C x Ca should not exceed 1.
Source: WPCF Manual of Practice No. 9, Design and Construction of Sanitary and Storm Sewers.

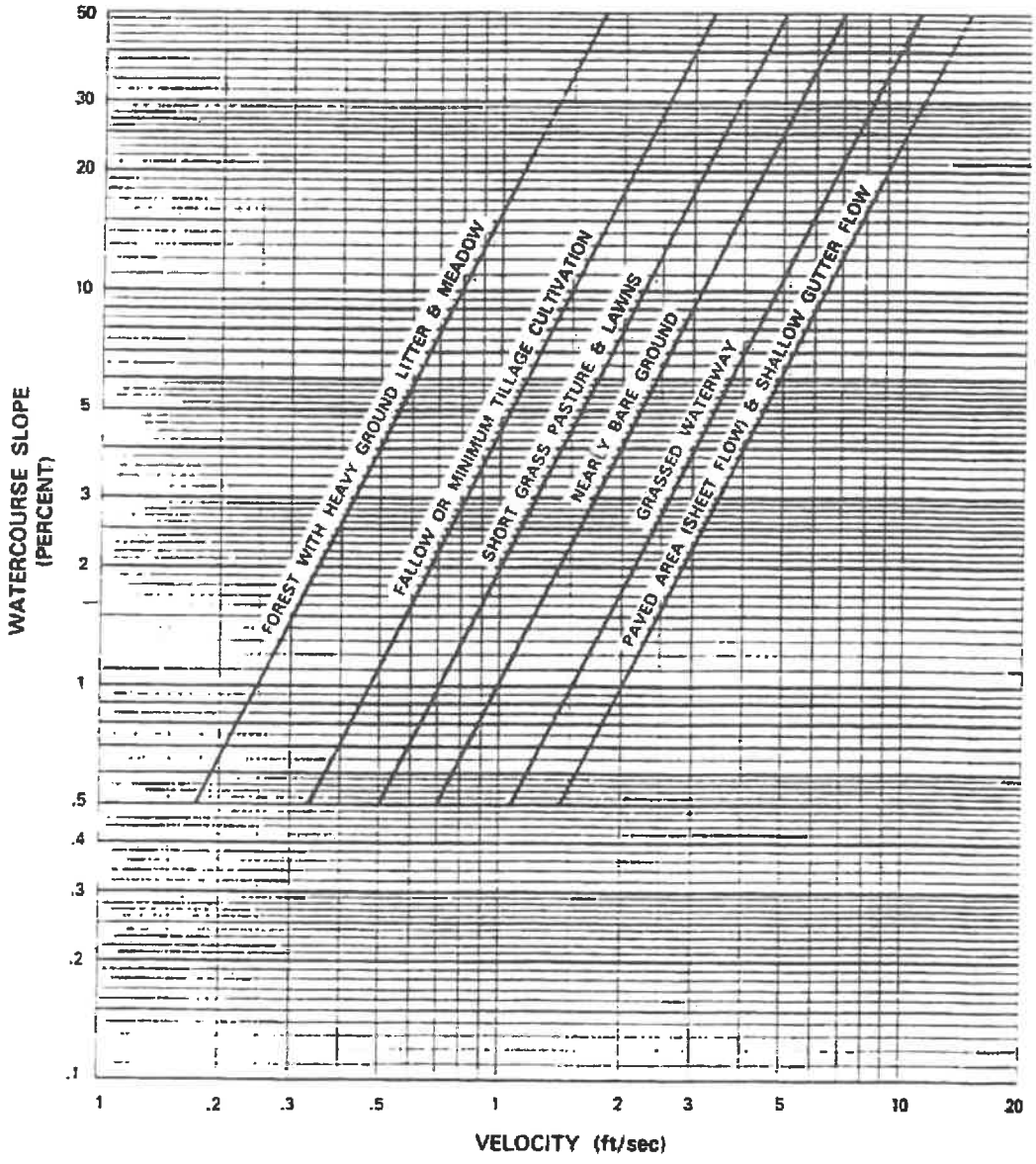
Rainfall Intensity (I; in inches/hour)

Rainfall intensity in the Rational Method is a function of: 1) selection of design flood frequency (see Exhibit 8-2) and 2) time of concentration (T_C), or the time required for the runoff to travel from the hydraulically most distant part of the watershed to the design site. It is usually computed by determining the water travel time through the watershed. The hydraulically most distant location will not necessarily be the linearly most distant site.

To determine i, follow this procedure:

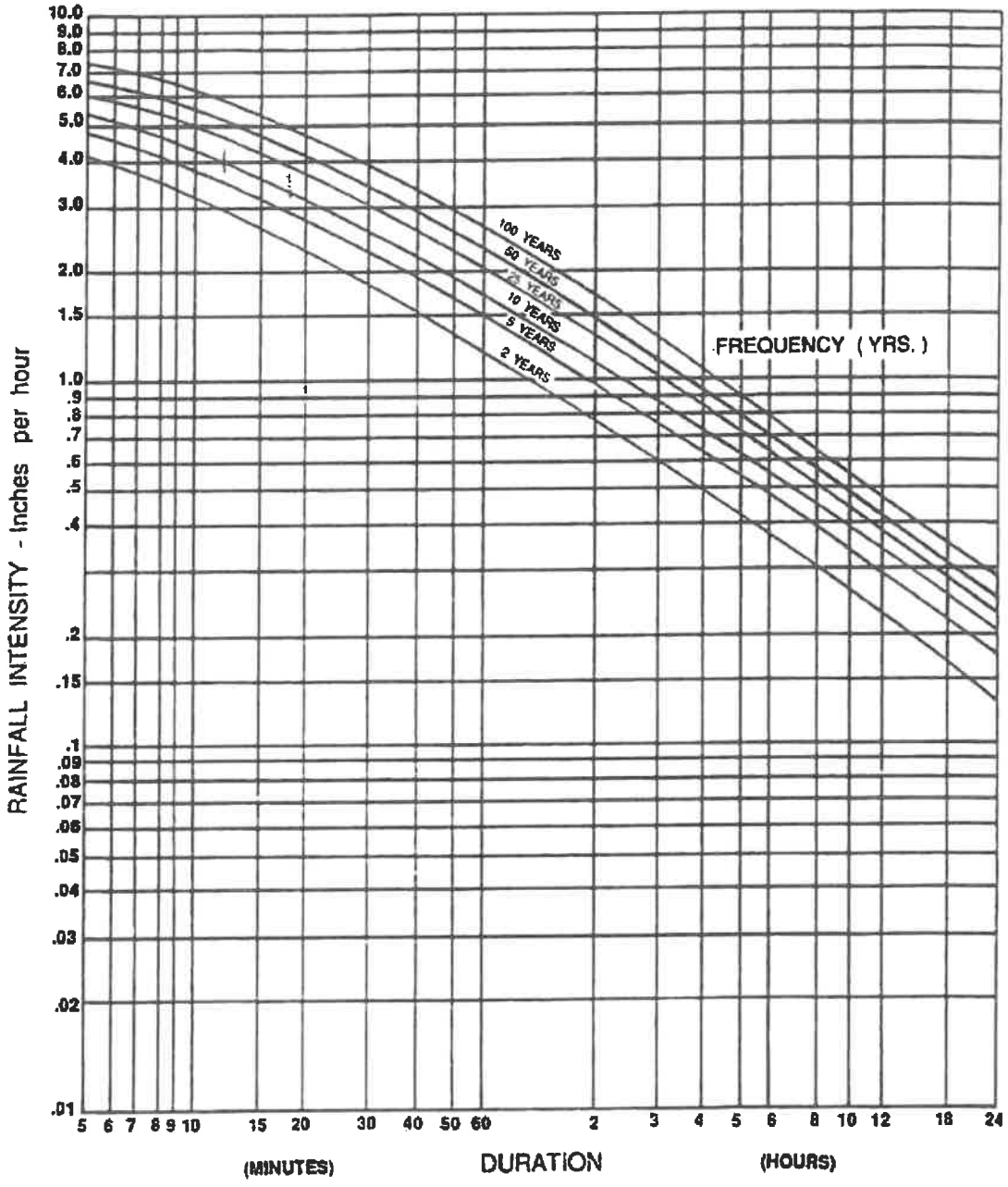
- To calculate T_C, use Exhibit 8-11. For pavements T_C is normally assumed to be 5 minutes for the first inlet only. T_C is based on the slope of the water course and the type of surface cover. The designer should check several overland watercourses or flow routes to determine T_C. See the example for a T_C calculation. For an alternate method for computing T_C, the designer should refer to the procedure in FHWA-NHI-01-021 *Urban Drainage Design Manual* (HEC-22).
- Exhibits 8-12 to 8-16 provide intensity-duration-frequency (I-D-F) curves for Boston, Barnstable, Worcester, Springfield, and Pittsfield. The designer should select the station closest to the design site.
- Enter the selected I-D-F curve with the calculated T_C and turn at the selected design flood frequency. Read i from the vertical axis.

Exhibit 8-11
Average Velocities for Overland Flow



Source: TR55 - Urban Hydrology for Small Wetlands, NRCS

Exhibit 8-12
Intensity - Duration - Frequency Curve for Boston, MA



Source: TR55 - Urban Hydrology for Small Wetlands, NRCS

MANNING FORMULA PIPE FLOW CALCULATIONS

Manning Formula Uniform Pipe Flow at Given Slope and Depth

10" pipe leaving site

Printable Subtitle

Inputs

Pipe diameter, d_0	10	in
Manning roughness, n	0.01	
Pressure slope (possibly ? equal to pipe slope), S_0	0.01	rise/run
Relative flow depth, y/d_0	.9	fraction

Results

Flow depth, y	0.7500	ft
Flow area, a	0.5170	ft^2
Pipe area, a0	0.5454	ft^2
Relative area, a/a0	0.9480	fraction
Wetted perimeter, P_w	2.0817	ft
Hydraulic radius, R_h	0.2484	ft
Top width, T	0.5000	ft
Velocity, v	5.8711	ft/sec
Velocity head, h_v	0.5357	ft H2O
Froude number, F	1.02	
Average shear stress (tractive force), tau	0.1551	psf
Flow, Q (See notes)	3.0354	cfs
Full flow, Q0	2.8480	cfs
Ratio to full flow, Q/Q0	1.0658	fraction

Notes:

This is the flow and depth inside an *infinitely long* pipe.
Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

* From HydroCAD Calculations
100 Year Storm Event shows
2.05 CFS Leaving Site —
10" @ 1% Flowing Full Can Handle 2.84 CFS
O.K.

ROOF DRAIN SIZING

Q=CIA

Q= FLOW RATE (CFS)

C=RUNOFF COEFICIENT

I=INTENSITY FOR 100-YEAR STORM EVENT

A= AREA IN ACRES

C=0.90

I = 7.5

A=6,000 SF / 43560 = 0.137

Q= (.9)(7.5)(0.137) = 0.92 CFS

8" PIPE AT 1% CAN HANDLE 1.57 CFS FLOWING FULL > 0.92 CFS O.K.

Manning Formula Uniform Pipe Flow at Given Slope and Depth

8" pipe roof drain

Printable Subtitle

Inputs

Pipe diameter, d_0	8	in
Manning roughness, n	0.01	
Pressure slope (possibly ? equal to pipe slope), S_0	0.01	rise/run
Relative flow depth, y/d_0	.9	fraction

Results

Flow depth, y	0.6000	ft
Flow area, a	0.3309	ft^2
Pipe area, a0	0.3491	ft^2
Relative area, a/a0	0.9480	fraction
Wetted perimeter, P_w	1.6654	ft
Hydraulic radius, R_h	0.1987	ft
Top width, T	0.4000	ft
Velocity, v	5.0595	ft/sec
Velocity head, h_v	0.3978	ft H2O
Froude number, F	0.98	
Average shear stress (tractive force), tau	0.1240	psf
Flow, Q (See notes)	1.6741	cfs
Full flow, Q0	1.5708	cfs
Ratio to full flow, Q/Q0	1.0658	fraction

Notes:

This is the flow and depth inside an *infinitely long* pipe.

Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

NOAA ATLAS 14- 24-HOUR RAIN DEPTHS & FREQUENCY

www.nws.noaa.gov

NOAA's National Weather Service
Hydrometeorological Design Studies Center
Precipitation Frequency Data Server (PFDS)

NOAA ATLAS 14 POINT PRECIPITATION FREQUENCY ESTIMATES: MA

Data description

Data type: Precipitation depth **Units:** English **Time series type:** Partial duration

Select location

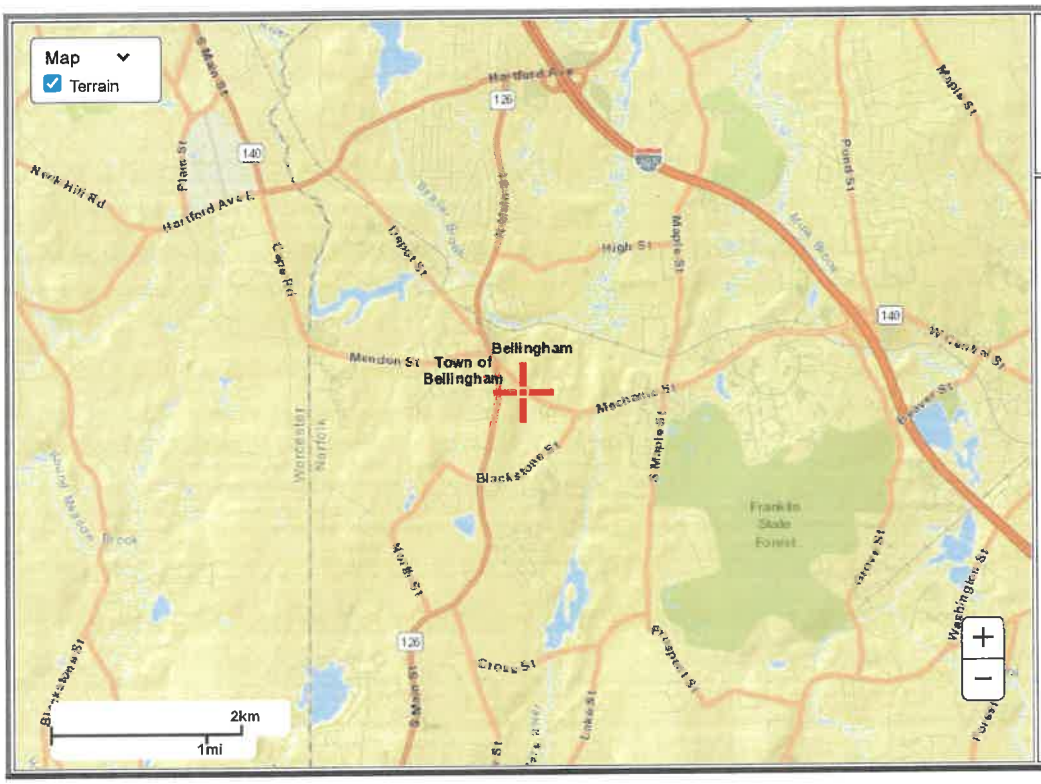
1) Manually:

a) By location (decimal degrees, use "-" for S and W): Latitude: Longitude: Submit

b) By station (list of MA stations): Select station

c) By address 79 Mechanic Street, Bellingham, MA,

2) Use map:



a) Select location
Move crosshair or double click

b) Click on station icon
Show stations on map

Location information:
Name: Bellingham, Massachusetts USA*
Latitude: 42.0835°
Longitude: -71.4706°
Elevation: 261 ft **

* Source: ESRI Maps
** Source: USGS

POINT PRECIPITATION FREQUENCY (PF) ESTIMATES

WITH 90% CONFIDENCE INTERVALS AND SUPPLEMENTARY INFORMATION
NOAA Atlas 14, Volume 10, Version 3

PF tabular PF graphical Supplementary information Print page

PDS-based precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.328** (0.255-0.416)	**0.396** (0.308-0.504)	**0.508** (0.393-0.648)	**0.601** (0.463-0.770)	**0.729** (0.543-0.975)	**0.825** (0.603-1.13)	**0.925** (0.656-1.31)	**1.04** (0.697-1.50)	**1.19** (0.773-1.79)	**1.32** (0.834-2.02)
10-min	**0.465** (0.361-0.590)	**0.562** (0.436-0.714)	**0.720** (0.557-0.918)	**0.851** (0.655-1.09)	**1.03** (0.769-1.38)	**1.17** (0.853-1.60)	**1.31** (0.929-1.86)	**1.47** (0.987-2.13)	**1.69** (1.10-2.54)	**1.87** (1.18-2.86)
15-min	**0.547** (0.425-0.694)	**0.661** (0.513-0.839)	**0.847** (0.656-1.08)	**1.00** (0.771-1.28)	**1.21** (0.905-1.62)	**1.38** (1.00-1.88)	**1.54** (1.09-2.18)	**1.73** (1.16-2.50)	**1.99** (1.29-2.98)	**2.20** (1.39-3.36)
30-min	**0.745** (0.579-0.945)	**0.901** (0.700-1.14)	**1.16** (0.894-1.47)	**1.37** (1.05-1.75)	**1.66** (1.24-2.22)	**1.88** (1.37-2.57)	**2.11** (1.50-2.99)	**2.36** (1.59-3.43)	**2.72** (1.76-4.08)	**3.01** (1.90-4.60)
60-min	**0.943** (0.733-1.20)	**1.14** (0.887-1.45)	**1.47** (1.14-1.87)	**1.74** (1.34-2.22)	**2.11** (1.57-2.82)	**2.39** (1.74-3.26)	**2.68** (1.90-3.79)	**3.00** (2.02-4.35)	**3.45** (2.24-5.18)	**3.82** (2.42-5.84)
2-hr	**1.21** (0.947-1.53)	**1.48** (1.16-1.87)	**1.92** (1.49-2.43)	**2.28** (1.76-2.90)	**2.78** (2.08-3.70)	**3.15** (2.32-4.29)	**3.55** (2.54-5.02)	**4.00** (2.70-5.77)	**4.65** (3.02-6.94)	**5.20** (3.30-7.90)
3-hr	**1.40** (1.10-1.76)	**1.72** (1.35-2.16)	**2.23** (1.74-2.81)	**2.66** (2.06-3.37)	**3.24** (2.44-4.31)	**3.68** (2.72-5.00)	**4.15** (2.98-5.86)	**4.69** (3.17-6.73)	**5.49** (3.57-8.15)	**6.15** (3.91-9.32)

24 Hr.

	1	2	5	10	25	50	100	200	500	1000
6-hr	1.81 (1.43-2.25)	2.21 (1.74-2.76)	2.86 (2.25-3.59)	3.41 (2.67-4.30)	4.16 (3.15-5.50)	4.72 (3.51-6.38)	5.32 (3.85-7.49)	6.03 (4.10-8.61)	7.11 (4.64-10.5)	8.02 (5.12-12.1)
12-hr	2.30 (1.83-2.85)	2.80 (2.22-3.47)	3.61 (2.86-4.50)	4.29 (3.38-5.37)	5.22 (3.99-6.87)	5.92 (4.43-7.96)	6.66 (4.86-9.35)	7.57 (5.16-10.7)	8.96 (5.87-13.1)	10.2 (6.50-15.2)
24-hr	2.75 (2.29-3.39)	3.37 (2.70-4.16)	4.39 (3.50-5.43)	5.23 (4.14-6.51)	6.39 (4.91-8.37)	7.25 (5.46-9.72)	8.18 (6.02-11.5)	9.35 (6.39-13.2)	11.2 (7.33-16.3)	12.7 (8.17-18.9)
2-day	3.10 (2.50-3.80)	3.87 (3.11-4.73)	5.11 (4.10-6.28)	6.15 (4.90-7.59)	7.57 (5.85-9.86)	8.61 (6.54-11.5)	9.76 (7.24-13.6)	11.2 (7.70-15.7)	13.5 (8.92-19.6)	15.6 (10.0-22.9)
3-day	3.38 (2.73-4.12)	4.20 (3.39-5.12)	5.54 (4.46-6.78)	6.65 (5.32-8.19)	8.18 (6.35-10.6)	9.30 (7.08-12.4)	10.5 (7.84-14.7)	12.1 (8.33-16.9)	14.6 (9.63-21.0)	16.8 (10.8-24.6)
4-day	3.65 (2.96-4.43)	4.50 (3.64-5.47)	5.89 (4.75-7.19)	7.04 (5.64-8.64)	8.63 (6.71-11.2)	9.80 (7.47-13.0)	11.1 (8.24-15.3)	12.7 (8.75-17.6)	15.2 (10.1-21.9)	17.4 (11.3-25.5)
7-day	4.40 (3.58-5.31)	5.30 (4.31-6.41)	6.78 (5.50-8.23)	8.01 (6.45-9.77)	9.70 (7.56-12.4)	10.9 (8.36-14.3)	12.3 (9.13-16.8)	14.0 (9.66-19.3)	16.5 (10.9-23.5)	18.6 (12.1-27.1)
10-day	5.11 (4.17-6.15)	6.04 (4.93-7.28)	7.58 (6.16-9.16)	8.85 (7.15-10.8)	10.6 (8.28-13.5)	11.9 (9.09-15.5)	13.3 (9.85-18.0)	14.9 (10.4-20.5)	17.4 (11.6-24.7)	19.5 (12.6-28.2)
20-day	7.21 (5.93-8.62)	8.20 (6.74-9.82)	9.84 (8.05-11.8)	11.2 (9.10-13.5)	13.1 (10.2-16.4)	14.5 (11.1-18.6)	15.9 (11.8-21.2)	17.5 (12.3-23.9)	19.8 (13.3-28.0)	21.7 (14.1-31.2)
30-day	8.94 (7.38-10.6)	9.98 (8.23-11.9)	11.7 (9.59-14.0)	13.1 (10.7-15.7)	15.0 (11.8-18.7)	16.5 (12.6-21.0)	18.0 (13.3-23.6)	19.6 (13.7-26.5)	21.7 (14.5-30.4)	23.3 (15.2-33.4)
45-day	11.1 (9.20-13.2)	12.2 (10.1-14.5)	13.9 (11.5-16.6)	15.4 (12.6-18.5)	17.4 (13.7-21.6)	19.0 (14.6-24.0)	20.5 (15.1-26.6)	22.0 (15.5-29.7)	23.9 (16.1-33.3)	25.2 (16.5-36.0)
60-day	12.9 (10.7-15.3)	14.0 (11.6-16.6)	15.8 (13.1-18.8)	17.4 (14.3-20.7)	19.4 (15.3-23.9)	21.1 (16.2-26.4)	22.7 (16.6-29.1)	24.0 (17.0-32.3)	25.7 (17.3-35.7)	26.7 (17.5-38.0)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

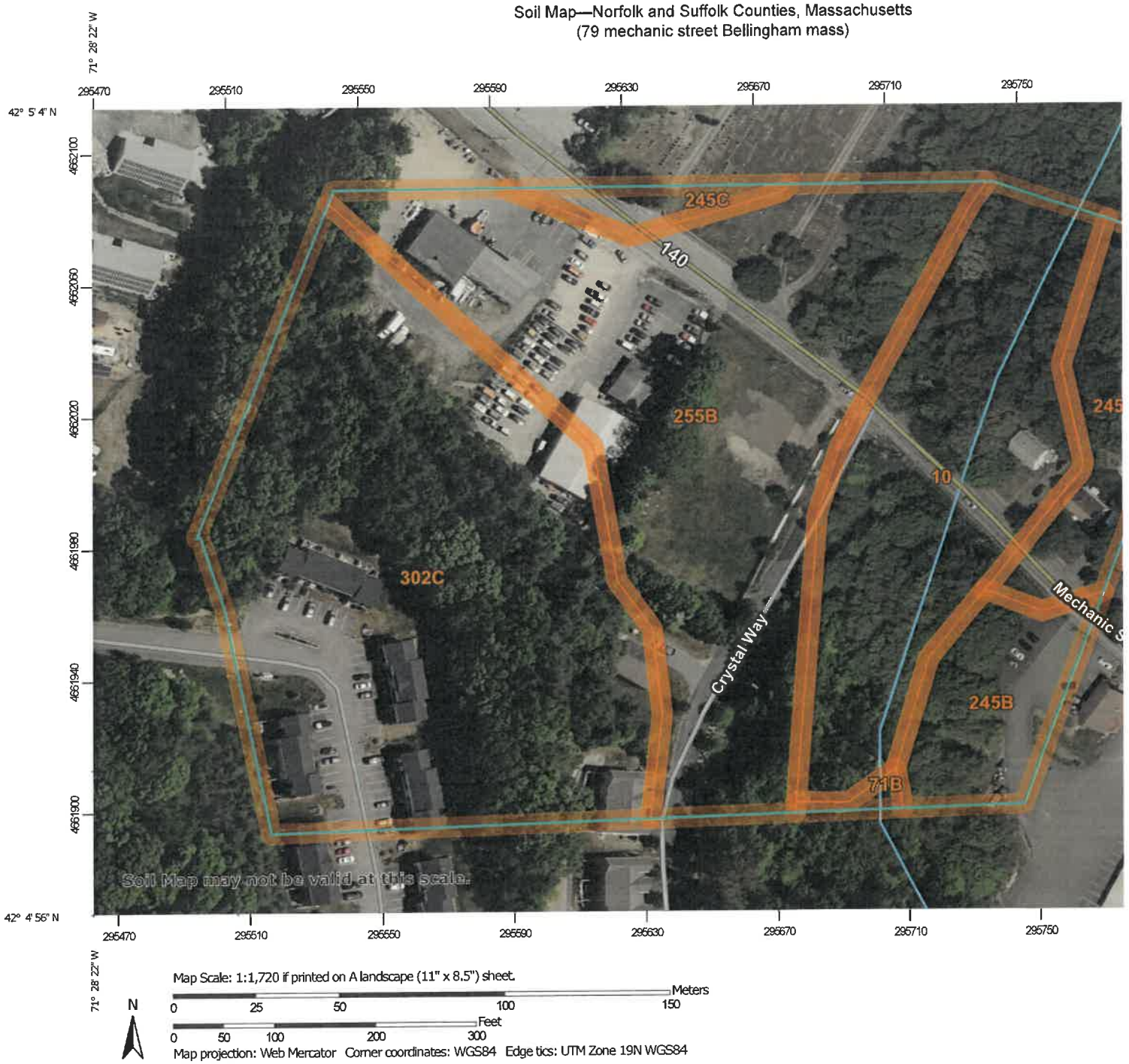
Please refer to NOAA Atlas 14 document for more information.

Estimates from the table in CSV format: Precipitation frequency estimates Submit

Main Link Categories:
Home | OWP

US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
Office of Water Prediction (OWP)
1325 East West Highway
Silver Spring, MD 20910
Page Author: HDSC webmaster
Page last modified: April 21, 2017

Soil Map—Norfolk and Suffolk Counties, Massachusetts
(79 mechanic street Bellingham mass)



Map Scale: 1:1,720 if printed on A landscape (11" x 8.5") 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

USDA **Natural Resources Conservation Service**

Web Soil Survey
National Cooperative Soil Survey

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 INFOR

The soil surveys that comprise your 1:25,000.

Warning: Soil Map may not be valid

Enlargement of maps beyond the sc misunderstanding of the detail of ma line placement. The maps do not sh contrasting soils that could have bee scale.

Please rely on the bar scale on eacl measurements.

Source of Map: Natural Resources Web Soil Survey URL:
Coordinate System: Web Mercato

Maps from the Web Soil Survey are projection, which preserves directior distance and area. A projection that Albers equal-area conic projection, s accurate calculations of distance or

This product is generated from the U of the version date(s) listed below.

Soil Survey Area: Norfolk and Suff
Survey Area Data: Version 20, Aug

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

Date(s) aerial images were photogra 5, 2022

The orthophoto or other base map o compiled and digitized probably diffe imagery displayed on these maps. A shifting of map unit boundaries may

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
10	Scarboro and Birdsall soils, 0 to 3 percent slopes	2.3	18.1%
71B	Ridgebury fine sandy loam, 3 to 8 percent slopes, extremely stony	0.0	0.3%
245B	Hinckley loamy sand, 3 to 8 percent slopes	0.7	5.3%
245C	Hinckley loamy sand, 8 to 15 percent slopes	1.1	8.5%
255B	Windsor loamy sand, 3 to 8 percent slopes	4.0	32.0%
302C	Montauk fine sandy loam, 8 to 15 percent slopes, extremely stony	4.5	35.8%
Totals for Area of Interest		**12.6**	**100.0%**

Norfolk and Suffolk Counties, Massachusetts

255B—Windsor loamy sand, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2svkf
Elevation: 0 to 1,210 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 250 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

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

Description of Windsor

Setting

Landform: Outwash terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loose sandy glaciofluvial deposits derived from granite and/or schist and/or gneiss

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material
A - 1 to 3 inches: loamy sand
Bw - 3 to 25 inches: loamy sand
C - 25 to 65 inches: sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Runoff class: Negligible
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
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 4.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2s
Hydrologic Soil Group: A

Ecological site: F145XY008MA - Dry Outwash
Hydric soil rating: No

Minor Components

Hinckley
Percent of map unit: 10 percent
Landform: Eskers
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Ecological site: F145XY008MA - Dry Outwash
Hydric soil rating: No

Deerfield, loamy sand
Percent of map unit: 5 percent
Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: F144AY027MA - Moist Sandy Outwash
Hydric soil rating: No

Data Source Information

Soil Survey Area: Norfolk and Suffolk Counties, Massachusetts
Survey Area Data: Version 20, Aug 27, 2024

APPENDICES:

Inspection & Maintenance Logs During Construction

Inspection & Maintenance Logs After Construction

Pre-Development Watershed Map

Post-Development Watershed Map

WEEKLY
Inspection and Maintenance Log FOR: 43 Cypress St
DURING CONSTRUCTION & After 1.0" Rain

Components	**Date**
Erosion Control – Weekly	
Comments during insp.	
Note corrective measures performed & Date	
On Site Pavement Sweeping – as Needed	
Comments during insp.	
Note corrective measures performed & date	
Silt Fence & Composite Sock– Monthly	
Comments during insp.	
Note corrective measures performed & date	
Temporary Basin Area as Needed	
Comments during insp.	
Note corrective measures performed & date	
Construction Entrance as Needed	
Comments during insp.	
Note corrective measures performed & date _____. Inspector Title Date	
 _____. Address Tel#	

WEEKLY
Inspection and Maintenance Log FOR: 43 Cypress St
DURING CONSTRUCTION & After 1.0" Rain

Components	**Date**
Notify Cons. Comm. Issues effecting Resource Areas	
Comments during insp.	
Note corrective measures performed & date	
Silt of Public (S Worcester Street) Streets – Daily	
Comments during insp.	
Note corrective measures performed & date	
Stockpile Materials Ring with Composite Sock – Weekly	
Comments during insp.	
Note corrective measures performed & date	
Any Spill Fuel, Chemical- Daily	
Comments during insp.	
Note corrective measures performed & date	
Temporary Ground Cover Area – Weekly	
Comments during insp.	
Note corrective measures performed & date	
Temporary Stone at Access Drive as Needed	
Comments during insp.	
Note corrective measures performed & date _____. Inspector Title Date	
_____. Address Tel#	

WEEKLY
Inspection and Maintenance Log FOR: 43 Cypress St
DURING CONSTRUCTION & After 1.0" Rain

Components	**Date**
Lawn Area / Mulch Area **Erosion, Washouts**	
Comments during insp.	
Note corrective measures performed & date	
Stone Aprons at Outfalls Exit **as Needed**	
Comments during insp.	
Note corrective measures performed & date	
Forebays **as Needed**	
Comments during insp.	
Note corrective measures performed & date	
Note corrective measures performed & date _____. Inspector Title Date	
_____. Address Tel#	

WEEKLY
Inspection and Maintenance Log FOR: 43 Cypress St
DURING CONSTRUCTION & After 1.0" Rain

Inspection and Maintenance Log FOR: 43 Cypress St
AFTER CONSTRUCTION & After 3.0" Rain

Components	**Date**
Catch Basin in Driveway Entrance – twice a year	
Comments during insp.	
Note corrective measures performed & Date	
Catch Basins -twice a year	
Comments during insp.	
Note corrective measures performed & date	
Drain Manholes Prior to Basin -twice a year	
Comments during insp.	
Note corrective measures performed & date	
Drop Inlets along Back yards -twice a year	
Comments during insp.	
Note corrective measures performed & date	
Rip Rap - Basin outlet #3 – 8 inches of sediment or twice a year	
Comments during insp.	
Note corrective measures performed & date _____. Inspector Title Date	
_____. Address Tel#	

Inspection and Maintenance Log FOR: 43 Cypress St
AFTER CONSTRUCTION & After 3.0" Rain

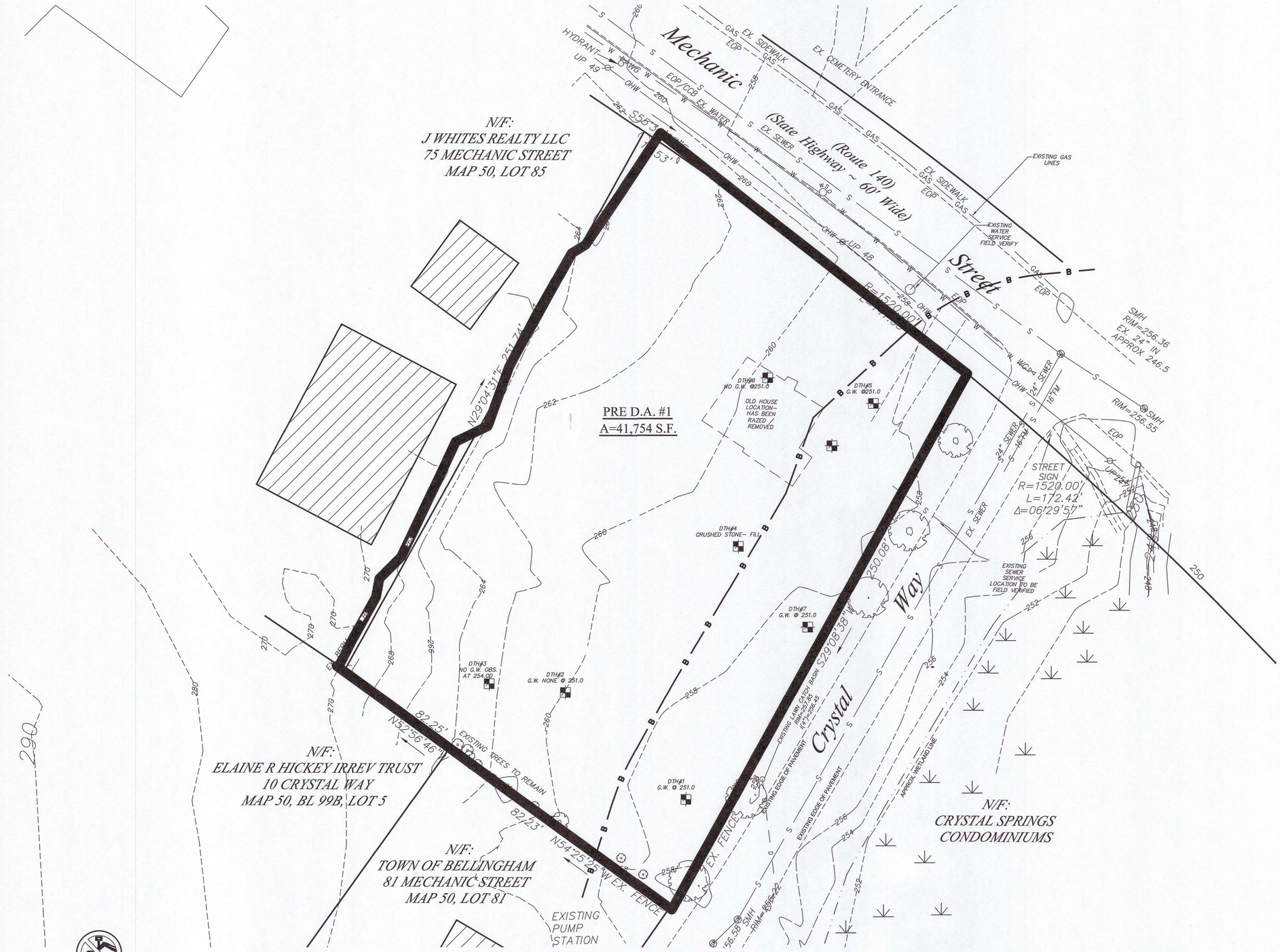
Components Date **UG Basins** **– twice a year** **Comments during insp.** **Note corrective measures performed & Date** **Forebay Basin** **-twice a year** **Comments during insp.** **Note corrective measures performed & date** **Rip Rap Spillway for Basin** **-twice a year** **Comments during insp.** **Note corrective measures performed & date** **Inspector Title Date** **Address Tel#**	

Inspection and Maintenance Log FOR: 43 Cypress St

AFTER CONSTRUCTION & After 3.0" Rain

PROPOSED DESIGN PLANS
(See definitive submittal)

DRAIANGE AREA MAPS



DIG SAFE NOTE:

UTILITIES ARE PLOTTED FROM FIELD LOCATION AND ANY RECORD INFORMATION AVAILABLE, AND SHOULD BE CONSIDERED APPROXIMATE. OTHER UTILITIES MAY EXIST WHICH ARE NOT EVIDENT OR FOR WHICH RECORD INFORMATION WAS NOT AVAILABLE. CONTRACTORS (IN ACCORDANCE WITH MASS.G.L. CHAPTER 82 SECTION 40 AS AMENDED) MUST CONTACT ALL UTILITY COMPANIES BEFORE EXCAVATING AND DRILLING. ALSO, CALL "DIG-SAFE" AT 1(888)344-7233 1(888)DIG-SAFE).

EXISTING LINES OTHER THAN THOSE INDICATED ON THESE DRAWINGS MAY BE ON THE SITE. THE CONTRACTOR IS WARNED TO PROCEED WITH CAUTION WITH ALL WORK, ESPECIALLY EXCAVATION WORK, AND TO MAKE ALL POSSIBLE INVESTIGATIONS AS TO POSSIBLE UNMARKED UTILITY LINES.

GRAPHIC SCALE

20 0 10 20 40

(IN FEET)
1 inch = 20 feet

P.E.	P.L.S.
COMMONWEALTH OF MASSACHUSETTS MICHAEL DEAN CIVIL No. 46255 REGISTERED PROFESSIONAL ENGINEER 8.12.25	

APPROVAL UNDER SITE PLAN REVIEW.
BELLINGHAM PLANNING BOARD

BEING A MAJORITY

APPROVAL DATE: _____

ENDORSEMENT DATE: _____

OWNER:

NICOLE & MAREK RUTKOWSKI
13 HIGHRIDGE ROAD
BELLINGHAM, MA 02019

APPLICANT:

NICOLE & MAREK RUTKOWSKI
13 HIGHRIDGE ROAD
BELLINGHAM, MA 02019

REVISIONS

REV.	DATE	DESCRIPTION

PROJECT NO.	J-114
DESIGNED BY	PML
CHECKED BY	MD
DATE	7/26/23
CAD FILE	J-114 site plan
PLAN NO.	

TITLE:

0 Mechanic Street
(Formerly 79 Mechanic)
Bellingham,
Massachusetts

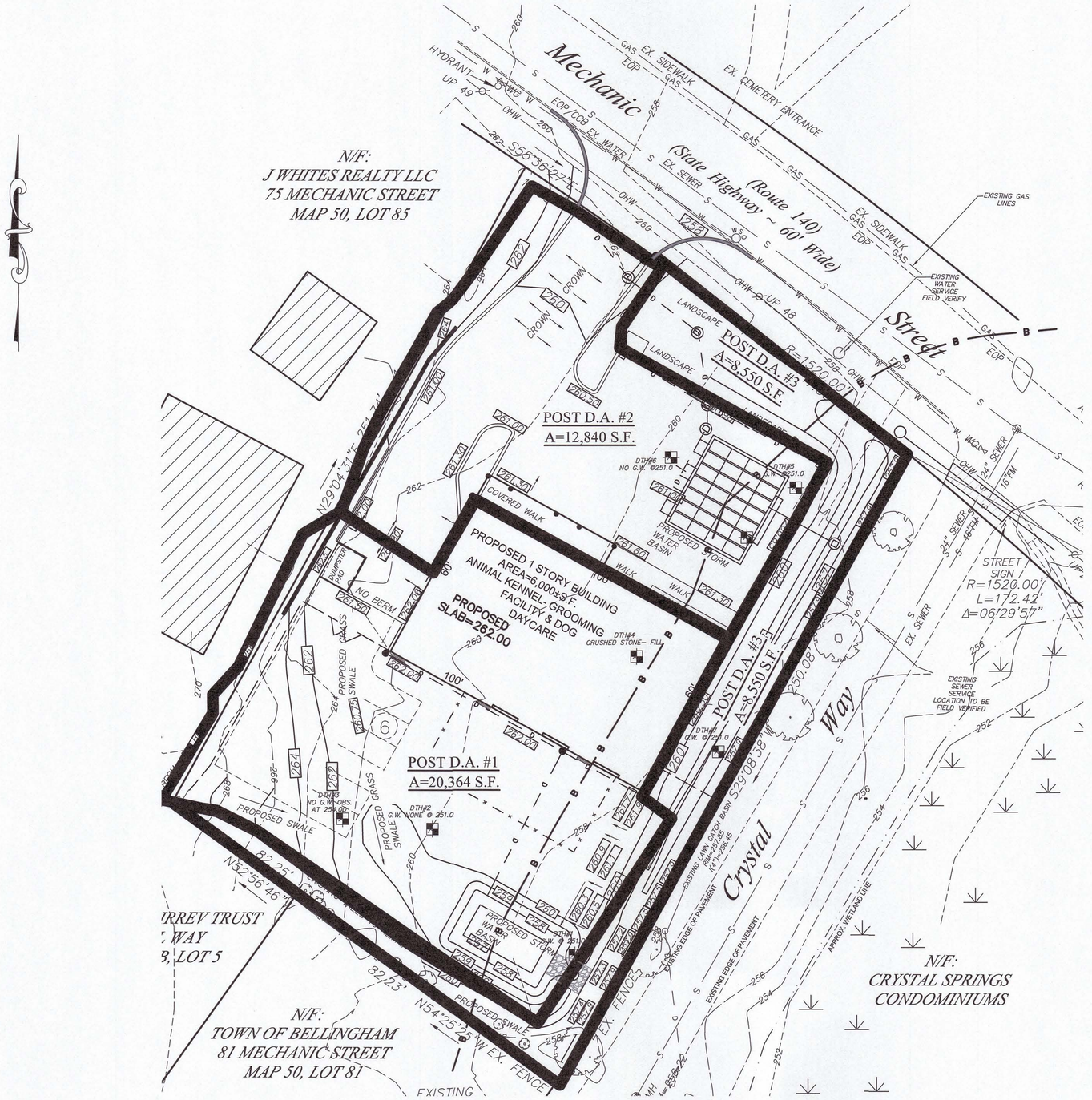
D&L Design Group
CIVIL ENGINEERING & LAND SURVEYING
115 Water Street • Milford, MA 01757
P:(508) 408-2577
www.dandldesigngroup.com

SHEET TITLE

PRE-DEVELOPMENT
SHEET 1 OF1

SHEET NO.

C-1.0



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P.E.	P.L.S.
COMMONWEALTH OF MASSACHUSETTS MICHAEL DEAN CIVIL No. 40225 REGISTERED PROFESSIONAL ENGINEER 8.12.25	

APPROVAL UNDER SITE PLAN REVIEW.
BELLINGHAM PLANNING BOARD

BEING A MAJORITY

APPROVAL DATE: _____

ENDORSEMENT DATE: _____

OWNER:
NICOLE & MAREK RUTKOWSKI
13 HIGHRIDGE ROAD
BELLINGHAM, MA 02019

APPLICANT:
NICOLE & MAREK RUTKOWSKI
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BELLINGHAM, MA 02019

REVISIONS

REV.	DATE	DESCRIPTION

PROJECT NO.	J-114
DESIGNED BY	PML
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D&L Design Group
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115 Water Street • Milford, MA 01757
P:(508) 408-2577
www.dandldesigngroup.com

SHEET TITLE

POST DEVELOPMENT PLAN
SHEET 1 OF 1

SHEET NO.