STORMWATER REPORT

For

LEGGAT MCCALL PROPERTIES, LLC

PROPOSED

"RESIDENTIAL DEVELOPMENT"

299 Salem Street	***202-204 Tedesco Street***	***20 Vinnin Street***
Swampscott, Massachusetts	***Marblehead, Massachusetts***	***Salem, Massachusetts***
Essex County	***Essex County***	***Essex County***

Prepared by:

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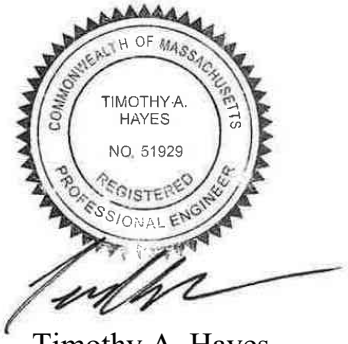

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September 20, 2022
#M211002

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I. EXECUTIVE SUMMARY

This report examines the changes in drainage that can be expected as the result of a proposed residential development located at the intersection of Swampscott, Salem, and Marblehead, Massachusetts (the "Project"). The approximately 4.06-acre site located at 299 Salem Street currently consists of four one-story buildings, paved parking areas, and landscaped areas. The existing buildings and parking areas are proposed to be razed and replaced with three four-story residential buildings, two of which will have first floor garage parking. Additional benefits of the project include new utilities, a reduction in impervious area, new landscaped areas, and a new stormwater management system.

This report addresses a comparative analysis of the pre- and post-development site runoff conditions. Additionally, this report provides calculations documenting the design of the proposed stormwater conveyance/management system as illustrated within the accompanying Site Development Plans prepared by Bohler. The project will also provide erosion and sedimentation controls during the demolition and construction periods, as well as long term stabilization of the site.

For the purposes of this analysis the pre- and post-development drainage conditions were analyzed at three (3) "design points" where stormwater runoff currently drains to under existing conditions. These design points are described in further detail in **Section II** below. A summary of the existing and proposed conditions peak runoff rates for the 2-, 10-, 25-, and 100-year storms can be found in **Table 1.1** below. In addition, the project has been designed to meet or exceed the Stormwater Management Standards as detailed herein.

Table 1.1: Design Point Peak Runoff Rate Summary

Point of Analysis	2-Year Storm			10-Year Storm			25-Year Storm			100-Year Storm		
	Pre	Post	Δ	Pre	Post	Δ	Pre	Post	Δ	Pre	Post	Δ
DP1	1.82	0.87	**-0.95**	5.21	3.07	**-2.14**	6.83	4.14	**-2.69**	9.30	6.06	**-3.24**
DP2	2.68	0.00	**-2.68**	4.59	1.69	**-2.90**	4.81	2.75	**-2.06**	5.02	4.35	**-0.67**
DP3	0.00	0.00	**0.00**	0.00	0.00	**0.00**	0.00	0.00	**0.00**	0.00	0.00	**0.00**

**Flows are represented in cubic feet per second (cfs)*

II. EXISTING SITE CONDITIONS

Existing Site Description

The site consists of approximately 4.06 acres of land located between Vinnin Street and Salem Street in Salem, Marblehead, and Swampscott, MA. The majority of the site is comprised of paved parking areas and one-story buildings, along with several landscape areas.

On-Site Soil and Groundwater Information

Per the Natural Resource Conservation Service (NRCS) Web Soil Survey, the soils on site are mapped as Urban Land (Map Unit 602). The NRCS does not assign a Hydrologic Soil Group (HSG) rating for this map units. However, abutting land southeast of the Site has been mapped as Hinckley loamy sand (Map Unit 242A), which generally consists of very gravelly sand from glaciofluvial deposits. The Web Soil Survey indicates that groundwater is not anticipated within the first 80 inches of the soil profile.

Additional soil information is described within a report entitled "Foundation Engineering Report," prepared by McPhail Associates, Inc. (McPhail) and dated November 21, 1997 (McPhail Report). This report was produced as part of a previously proposed project at the Site that was not constructed. Per McPhail's report, on-site soils generally consist of 12 to 90 inches of fill material overlaying native granular glacial outwash deposits. The fill layer generally consists of sand and gravel with traces of silt, cobbles, boulders, and deleterious materials. The native soil consists of compact to dense sandy gravel with traces of silt.

Groundwater was not encountered in any of the 24 test pits conducted during the subsurface exploration program, which is consistent with the Web Soil Survey. The McPhail Report and the associated boring logs are included in **Appendix C**.

Based on soil information from the Web Soil Survey and the McPhail report, the soils have been categorized as Loamy Sand, Hydrologic Soil Group (HSG) A. As such, a Rawl's Rate of 2.41 inches per hour has been utilized for the purposes of stormwater analysis and calculations.

Existing Collection and Conveyance

Based on a review of the Site's existing conditions and topography, slopes range from approximately 1%-20% with on-site elevations ranging from approximately El. 40 adjacent to Salem Street to approximately El. 49 at the eastern corner of the property. As described in greater specificity below, the Site appears to have several low points that may result in ponding during select storm events. As such, the Site's existing conditions hydrologic model accounts for these depressions for the purposes of calculating the existing peak rates of discharge to each "design point."

The western and northwestern portions of the site drains into several catch basins in the adjacent Salem Street. The eastern and northeastern portions of the site drains to a catch basin on site, which appears to be connected to the drainage system in Vinnin Street. The southern portion of the site appears to pond on-site before overtopping and draining to the adjacent Tedesco Country Club to the south during larger storm events.

Existing Watersheds and Design Point Information

The site was subdivided into five (5) separate subcatchments for the existing conditions as described below to analyze existing and proposed flow rates at each design point. The minimum time of concentration for all proposed areas is calculated as 6 minutes (0.1 hr).

The pre-development drainage conditions for the site were then analyzed at three (3) design points where stormwater runoff currently drains to under existing conditions. **Design Point #1** (DP1) is defined as Salem Street. Under existing conditions, this design point receives stormwater runoff from Subcatchments EX-1, EX-4, and EX-5 one of two ways: via overland flow or via an assumed pipe connection from an existing on-site catch basin to the municipal storm drain system. **Design Point #2** (DP2) is defined as Vinnin Street and receives stormwater runoff from Subcatchment EX-2 via overland flow. **Design Point #3** (DP3) is defined as the area southeast of the site on the adjacent Tedesco County Club property. Under existing conditions, this design point receives stormwater runoff from Subcatchment EX-3 via overland flow.

Subcatchment EX-1 in total is 1.36 acres consisting of building, landscape, and paved areas. This area flows overland and appears to pond at the southwestern portion of the subcatchment area

before overflowing into Salem Street. The time of concentration for EX-1 was calculated as 6.0 minutes, as further detailed in the drainage calculations.

Subcatchment EX-2 in total is 1.37 acres consisting of building, landscape, and paved areas. This area flows overland from all directions to a catch basin at the center of the subcatchment before appearing to discharge to the drainage system in Vinnin Street. The time of concentration for EX-2 was calculated as 6.0 minutes, as further detailed in the drainage calculation.

Subcatchment EX-3 in total is 0.62 acres consisting of building, landscape, and paved areas. This area flows overland from all directions and appears to pond at the southern portion of the subcatchment area before overflowing into the adjacent Tedesco Country Club. The time of concentration for EX-3 was calculated as 6.0 minutes, as further detailed in the drainage calculations.

Subcatchment EX-4 in total is 0.70 acres consisting of building, landscape, and paved areas. This area flows overland from east to east to west to a catch basin at the western edge of the subcatchment area before appearing to discharge to the drainage system in Salem Street. The time of concentration for EX-4 was calculated as 6.0 minutes, as further detailed in the drainage calculations.

Subcatchment EX-5 in total is 0.01 acres consisting of landscape and paved areas. This area flows overland from all directions and appears to pond at the western portion of the subcatchment area before overflowing into Salem Street. The time of concentration for EX-5 was calculated as 6.0 minutes, as further detailed in the drainage calculations.

Refer to **Table 1.1 and 5.1** for the calculated existing conditions peak rates of runoff. For additional hydrologic information, refer to **Appendix D** and the Drainage Area Maps in the appendices of this report for a graphical representation of the existing drainage areas.

III. PROPOSED SITE CONDITIONS

Proposed Development Description

The proposed project consists of the construction of three four-story residential buildings, two of which have first floor garage parking. Additional improvements include new paved parking areas,

landscaping, utilities, and a new stormwater management system. Notable stormwater best management practices (BMPs) include water quality units (hydrodynamic separators) and two subsurface infiltration systems to treat and recharge stormwater runoff.

Proposed Development Collection and Conveyance

Surface runoff from the proposed parking areas is directed to and collected by deep-sump, hooded catch basins. Stormwater is then routed to water quality units for pre-treatment prior to discharging to one of the two subsurface infiltration systems. The water quality units are hydrodynamic separators sized to remove a minimum of 50% of Total Suspected Solids (TSS) and have been designed to meet the pre-treatment requirements set forth in the Massachusetts Department of Environmental Protection (MassDEP) Stormwater Management Standards. Refer to **Appendix F** for calculations.

Per the Town of Swampscott's Rules and Regulations for Stormwater Management and Erosion Control, storm drain pipes have been designed for the 25-year storm using the Rational Method. Pipe calculations are included in **Appendix F**.

In addition, a Stormwater Operation and Maintenance (O&M) Plan, attached in **Appendix G**, has been developed which includes scheduled maintenance and periodic inspections of stormwater management structures and BMPs.

Proposed Watersheds and Design Point Information

The Site was subdivided into five (5) separate subcatchments for the proposed conditions as described below. The minimum time of concentration for all proposed areas is calculated as 6 minutes (0.1 hr). The existing watersheds have been maintained to the greatest extent practicable. As described in **Section II** above, three Design Points have been identified for the project as common points of analysis for the pre- and post-conditions hydrologic analysis; however, Design Point #3 (DP3) will be eliminated as part of the proposed work.

Subcatchment PR1 consists of 0.21 acres of landscape area. This area drains via overland flow to Salem Street where flow is collected by catch basins. The time of concentration was calculated as the minimum of 6 minutes.

Subcatchment PR2 consists of 1.77 acres of building, landscape, and paved areas. This area drains to proposed catch basins and is routed through a water quality unit for pretreatment prior to discharge into a subsurface infiltration basin. The time of concentration was calculated as the minimum of 6 minutes.

Subcatchment PR3 consists of 0.44 acres of concrete path and landscape areas. This area drains via overland flow to Salem Street where flow is collected by catch basins. The time of concentration was calculated as the minimum of 6 minutes.

Subcatchment PR4 consists of 1.49 acres of building, parking lot, landscape areas. This area drains to proposed catch basins and is routed through a water quality unit for pretreatment prior to discharge into a subsurface infiltration basin. The time of concentration was calculated as the minimum of 6 minutes.

Subcatchment PR5 consists of 0.15 acres of asphalt pavement, concrete paths, and landscape areas. This area drains via overland flow to Salem Street where flow is collected by catch basins. The time of concentration was calculated as the minimum of 6 minutes.

Refer to **Table 1.1 and 6.1** for the calculated proposed conditions peak rates of runoff. For additional hydrologic information, refer to **Appendix D** and the Drainage Area Maps in the appendices of this report for a graphical representation of the proposed drainage areas.

IV. METHODOLOGY

Peak Flow Calculations

Methodology utilized to design the proposed stormwater management system includes compliance with the guidelines set forth in the latest edition of the Massachusetts DEP Stormwater Handbook. The pre- and post-development runoff rates being discharged from the site were computed using the HydroCAD computer program. The drainage area and outlet information were entered into the program, which routes storm flows based on NRCS TR-20 and TR-55 methods. The other components of the model were determined following standard NRCS procedures for Curve Numbers (CNs) and times of concentrations documented in the appendices of this report. The rainfall data utilized and listed below in table 4.1 below for stormwater calculations is based on

National Oceanic and Atmospheric Administration (NOAA) Atlas 14 Rainfall Data. Refer to **Appendix F** for more information.

Table 4.1: NOAA Rainfall Intensities

Frequency	2 year	10 year	25 year	100 year
Rainfall* (inches)	3.17	5.01	6.16	7.93

Values derived from NOAA ATLAS 14 on 11/18/2021

The proposed stormwater management as designed will provide a decrease in peak rates of runoff from the proposed facility for the 2-, 10-, 25- and 100-year design storm events. Additionally, the proposed project meets, or exceeds, the MassDEP Stormwater Management Standards. Compliance with these standards is described further below.

V. STORMWATER MANAGEMENT STANDARDS

Standard #1: No New Untreated Discharges

The project has been designed so that proposed impervious areas (including the building roof and paved parking/driveway areas) shall be collected and passed through the proposed drainage system for treatment prior to discharge. No new untreated discharges are proposed as part of the project.

Standard #2: Peak Rate Attenuation

As outlined in **Table 1.1** and **Table 5.1**, the development of the site and the proposed stormwater management system, have been designed so that post-development peak rates of runoff are below pre-development conditions for the 2-, 10-, 25- and 100-year storm events at all design points.

Standard #3: Recharge

Stormwater runoff from the project will be collected and routed to one of two proposed subsurface infiltration systems. The proposed project will result in the reduction of approximately 1,800 square feet of impervious area, thus increasing the annual recharge of stormwater in the proposed conditions; however, to satisfy the requirements of Standards 2 and 4, the subsurface infiltration systems have been designed to provided additional recharge. Subsurface Infiltration System #1 (Pond 1P) provides 12,148 cf of recharge volume while Subsurface Infiltration System #2 (Pond 2P) provides 3,358 cf of recharge volume. Refer to **Appendix F** of this report for calculations documenting required and provided recharge volumes.

The MassDEP Stormwater Standards require that an infiltration BMP draws down completely within 72 hours of the end of the storm event. Based on on-site soil information, the proposed subsurface infiltration systems are estimated to draw down at a rate of 2.41 inches per hour, the Rawls Rate for loamy sand. Calculations showing that the proposed subsurface infiltration systems will draw down within 72 hours are included in **Appendix F** of this report.

Standard #4: Water Quality

Water quality treatment is provided via a combination of deep-sump catch basins, two water quality units (hydrodynamic separators), and two subsurface infiltration systems. The project does not discharge from a Land Use with Higher Potential Pollutant Load (LUHPPL), to a Zone II or

Interim Wellhead Protection area, or to/near a Critical Area; however, runoff is being routed to infiltration systems with an infiltration rate greater than 2.4 in/hr. Therefore, structural BMPs have been sized treat a water quality volume equal to the product of the contributing impervious area and one inch. Additionally, the Project is required to provide a TSS removal rate of 44% prior to discharging to the proposed subsurface infiltration systems. All proprietary water quality units have been sized per MassDEP's "Standard Method to Convert Required Water Quality Volume to a Discharge Rate for Sizing Flow Based Manufactured Proprietary Stormwater Treatment Practices." TSS removal calculations are included in **Appendix F** of this **report. As noted above,** Subsurface Infiltration System #1 (Pond 1P) provides 12,148 cf of water quality volume while Subsurface Infiltration System #2 (Pond 2P) provides 3,358 cf of water quality volume. Refer to **Appendix F** of this report for calculations documenting required and provided water quality volumes. This project achieves 88% TSS removal.

Standard #5: Land Use with Higher Potential Pollutant Loads

Not Applicable for this project.

Standard #6: Critical Areas

Not Applicable for this project.

Standard #7: Redevelopment

The Project involves the proposed development of a previously developed site that will result in a net reduction in impervious area and improve existing conditions. Therefore, the Project qualifies as a redevelopment under the Standard 7 and shall meet Standard 2, Standard 3, and the pretreatment and structural stormwater best management practice requirements of Standards 4, 5, and 6.

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

The proposed project will provide construction period erosion and sedimentation controls as indicated within the site plan set provided for this project. This includes a proposed construction entrance/exit, protection for stormwater inlets, sediment and erosion control barriers at the limit of disturbance, protection around temporary material stock piles, and various other techniques as

outlined on the erosion and sediment control sheets. Additionally, the project is required to file a Notice of Intent with the US EPA and implement a Stormwater Pollution Prevention Plan (SWPPP) during the construction period. The SWPPP will be prepared prior to the start of construction and will be implemented by the site contractor under the guidance and responsibility of the project's proponent. A draft version of the Project SWPPP has been included as part this submission under separate cover.

Standard #9: Operation and Maintenance Plan (O&M Plan)

An Operation and Maintenance (O&M) Plan for this site has been prepared and is included in **Appendix G** of this report. The O&M Plan outlines procedures and time tables for the long term operation and maintenance of the proposed site stormwater management system, including initial inspections upon completion of construction, and periodic monitoring of the system components, in accordance with established practices and the manufacturer's recommendations. The O&M Plan includes a list of responsible parties and an estimated budget for inspections and maintenance.

Standard #10: Prohibition of Illicit Discharges

The proposed stormwater system will only convey allowable non-stormwater discharges (firefighting waters, irrigation, air conditioning condensates, etc.) and will not contain any illicit discharges from prohibited sources. An Illicit Discharge Statement is included in **Appendix G** of this report.

VI. SUMMARY

In summary, the proposed stormwater management system illustrated on the drawings prepared by Bohler results in a reduction in peak rates of runoff from the subject site when compared to pre-development conditions for the 2-, 10-, 25- and 100-year storm frequencies. In addition, the proposed best management practices will result in an effective removal of total suspended solids from the post-development runoff. The pre-development versus post-development stormwater discharge comparisons are contained in **Table 5.1** below.

Table 6.1: Design Point Peak Runoff Rate Summary

Point of Analysis	2-Year Storm			10-Year Storm			25-Year Storm			100-Year Storm		
	Pre	Post	Δ	Pre	Post	Pre	Post	Δ	Pre	Pre	Pre	Post
DP1	1.82	0.87	**-0.95**	5.21	**DP1**	1.82	0.87	**-0.95**	5.21	**DP1**	1.82	0.87
DP2	2.68	0.00	**-2.68**	4.59	**DP2**	2.68	0.00	**-2.68**	4.59	**DP2**	2.68	0.00
DP3	0.00	0.00	**0.00**	0.00	**DP3**	0.00	0.00	**0.00**	0.00	**DP3**	0.00	0.00

**Flows are represented in cubic feet per second (cfs)*

As outlined in the table above, the proposed stormwater management system as designed will provide a decrease in peak rates of runoff from the proposed facility for the 2-, 10-, 25- and 100-year storm events. Additionally, the proposed project will provide a substantial improvement over existing condition. Despite qualifying as a redevelopment under Standard 7, the Project will achieve full compliance with the ten Stormwater Management Standards required for new developments. The proposed stormwater management system will provide treatment, infiltration, and peak rate attenuation of stormwater runoff. Furthermore, stormwater runoff that currently ponds and overflows onto the abutting Tedesco Country Club site will be reduced to de minimis flows along the southern property line.

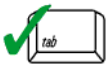
APPENDIX A: MASSACHUSETTS STORMWATER MANAGEMENT CHECKLIST

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.

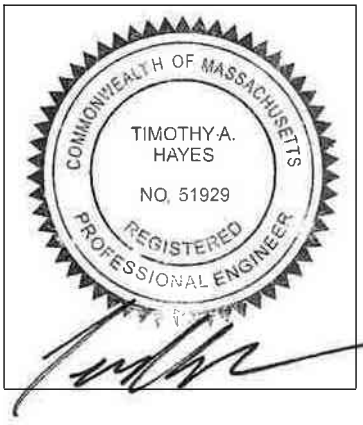
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the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



07/14/2022

Signature and Date

Checklist

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

☐ New development

☒ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

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

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

Standard 1: No New Untreated Discharges

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

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

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

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

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

Standard 3: Recharge

☐ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

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

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

☒ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

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

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

Standard 4: Water Quality

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

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

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

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

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

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

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

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

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

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

☐ All exposure has been eliminated.

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

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

Standard 6: Critical Areas

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

Standard 9: Operation and Maintenance Plan

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

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

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

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

Standard 10: Prohibition of Illicit Discharges

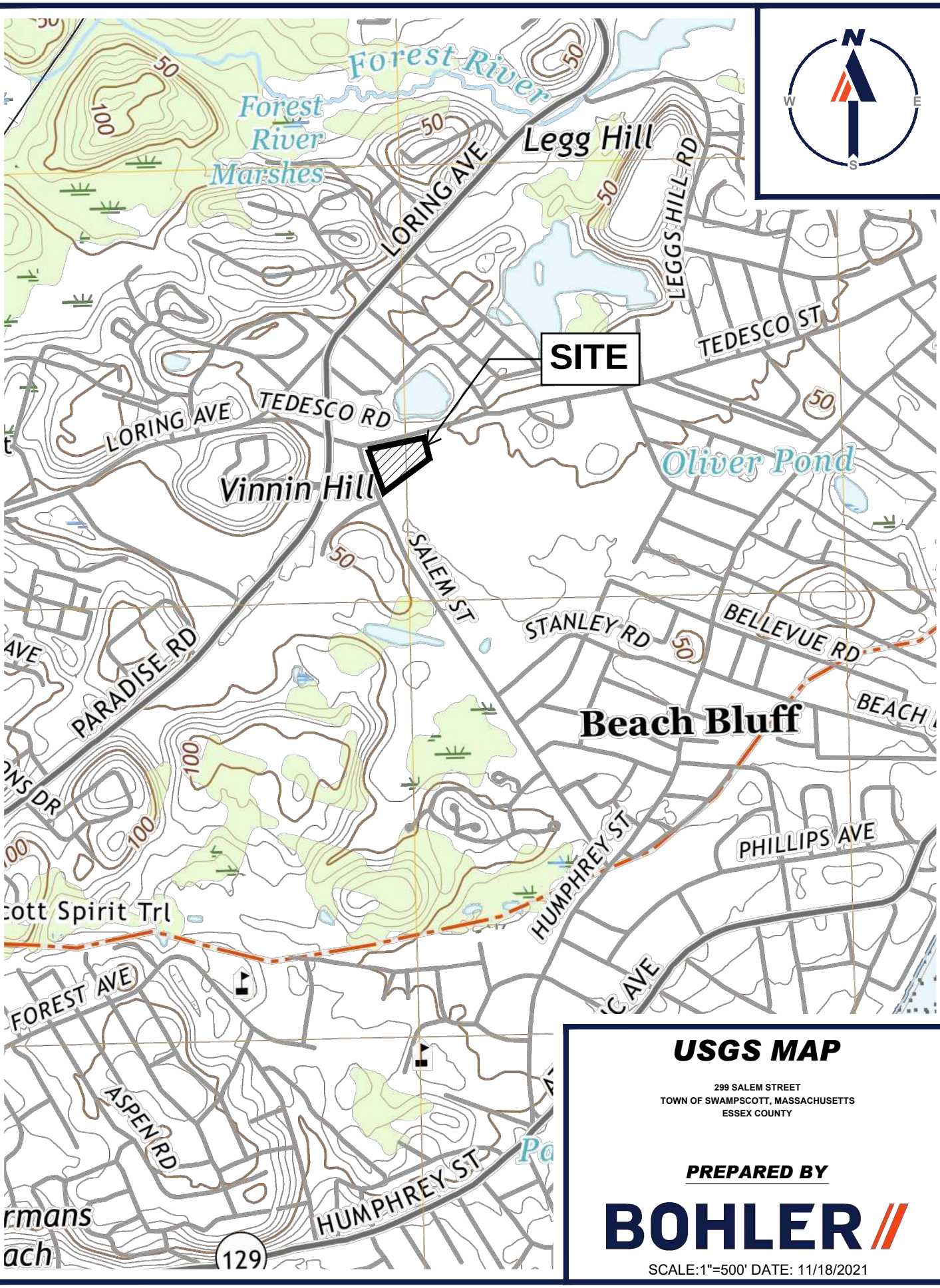
☒ The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;

☒ An Illicit Discharge Compliance Statement is attached;

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

APPENDIX B: PROJECT LOCATION MAPS

- *USGS MAP*
- *FEMA FIRMETTE*



USGS MAP

299 SALEM STREET
TOWN OF SWAMPSCOTT, MASSACHUSETTS
ESSEX COUNTY

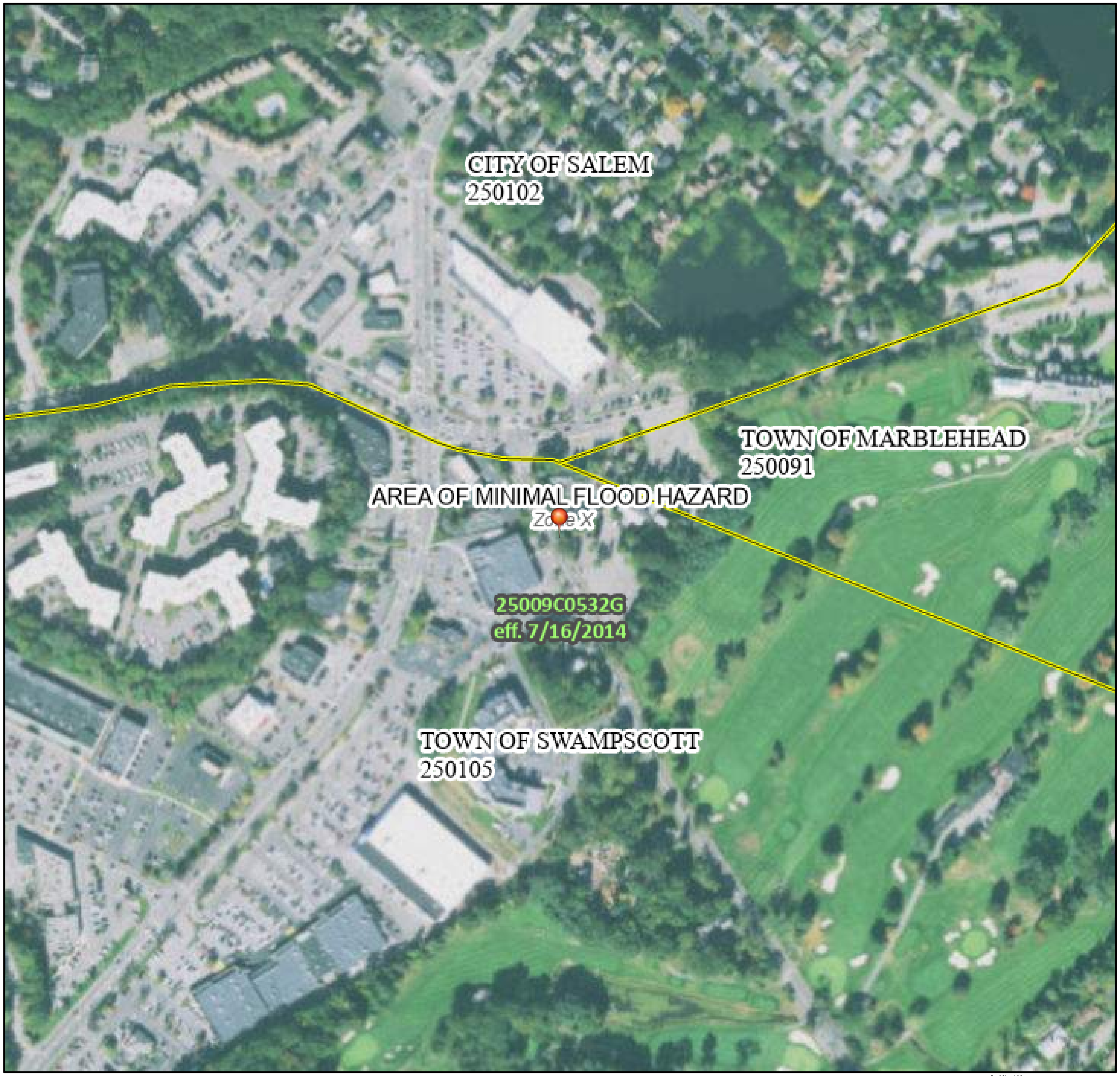
PREPARED BY

BOHLER

SCALE:1"=500' DATE: 11/18/2021

1DWLRQDO)ORRG+D]DUG/DHU)50HWWH

FEMA



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APPENDIX C: SOIL AND WETLAND INFORMATION

- *NCRS CUSTOM SOIL RESOURCE REPORT*
- *REPORT OF GEOTECHNICAL INVESTIGATION*

Map Scale: 1:2,040 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 30 60 120 180

Feet: 0 50 100 200 300

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

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

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

Soil Rating Lines

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

Soil Rating Points

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

Water Features

- Streams and Canals

Transportation

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

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

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

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

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

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

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

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

Soil Survey Area: Essex County, Massachusetts, Southern Part
Survey Area Data: Version 18, Sep 2, 2021

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

Date(s) aerial images were photographed: Aug 10, 2014—Aug 25, 2014

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
102E	Chatfield-Hollis-Rock outcrop complex, 15 to 35 percent slopes	D	0.1	0.4%
242A	Hinckley loamy sand, 0 to 3 percent slopes	A	6.4	47.9%
602	Urban land		6.9	51.7%
Totals for Area of Interest			**13.4**	**100.0%**

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Essex County, Massachusetts, Southern Part

242A—Hinckley loamy sand, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2svm7
Elevation: 0 to 1,420 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

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

Description of Hinckley

Setting

Landform: Outwash terraces, outwash plains, kame terraces, outwash deltas
Landform position (three-dimensional): Tread
Down-slope shape: Concave, convex, linear
Across-slope shape: Convex, linear, concave
Parent material: Sandy and gravelly glaciofluvial deposits derived from gneiss and/or granite and/or schist

Typical profile

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

Properties and qualities

Slope: 0 to 3 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 (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 3.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 3s
Hydrologic Soil Group: A
Ecological site: F144AY022MA - Dry Outwash
Hydric soil rating: No

Minor Components

Merrimac

Percent of map unit: 5 percent
Landform: Outwash deltas, outwash terraces, kame terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave, convex, linear
Across-slope shape: Convex, linear, concave
Hydric soil rating: No

Windsor

Percent of map unit: 5 percent
Landform: Outwash deltas, kame terraces, outwash terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave, convex, linear
Across-slope shape: Convex, linear, concave
Hydric soil rating: No

Sudbury

Percent of map unit: 5 percent
Landform: Outwash deltas, outwash terraces, kame terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave, convex, linear
Across-slope shape: Convex, linear, concave
Hydric soil rating: No

Data Source Information

Soil Survey Area: Essex County, Massachusetts, Southern Part
Survey Area Data: Version 18, Sep 2, 2021

McPHAIL ASSOCIATES, INC.
Geotechnical Engineers

FOUNDATION ENGINEERING REPORT

PROPOSED STAR MARKET

SWAMPSCOTT MASSACHUSETTS

for

Sunbeam Development Limited Partnership

McPHAIL ASSOCIATES, INC.
Geotechnical Engineers

November 21, 1997

Sunbeam Development Limited Partnership
299 Salem Street
Swampscott, MA 01907

Attention: Mr. George Gamache

Reference: Proposed Star Market; Marblehead/Swampscott, Massachusetts
Foundation Engineering Report

Gentlemen:

This letter report documents the results of our subsurface investigation and foundation study for the proposed Star Market development to be constructed near the intersection of Vinnin and Salem Streets in Marblehead/Swampscott, Massachusetts. Refer to the Project Location Plan (Figure 1) for the general site locus. This report was prepared in accordance with our proposal dated October 3, 1997 and the subsequent authorization of Mr. Anthony Athanas, Jr. of Sunbeam Development Limited Partnership on November 6, 1997. These services are subject to the limitations contained in Appendix A.

Purpose

The purposes of our subsurface investigation and engineering report are to define the subsurface soil and groundwater conditions at the site as they relate to foundation design and construction and, based on this information, to provide recommendations for safe and economical foundation design and construction for the proposed building.

Foundation design includes foundation support of the proposed building structure and its lowest level slab, treatment of the lowest level slab in consideration of groundwater, and seismic design considerations in accordance with the provisions of the Massachusetts State Building Code. Foundation construction considerations and site development issues are also addressed herein.

Available Information

Information provided to McPhail Associates, Inc. included a 30-scale topographic site plan dated July 23, 1996, entitled "Existing Conditions in Salem, Marblehead & Swampscott, MA", and a 30-scale proposed site plan dated September 24, 1997, entitled "Preliminary Site Plan in Salem, Marblehead & Swampscott, MA". Both plans were prepared by Allen & Major Associates, Inc. of Woburn, Massachusetts for General Glover Properties of Swampscott, Massachusetts.

Existing Site Conditions

The project site consists of a 4.06 acre parcel that is located within the Towns of Marblehead and Swampscott and the City of Salem. Salem and Vinnin Streets border the site to the south and west, respectively, with the Tedesco Country Club bounding the site to the east and north. Several one- to two-story wood frame structures are located within the middle portion of the site as indicated on the enclosed Subsurface Exploration Plan, Figure 2. The existing structures include the General Glover House Restaurant, a one-story brick bank building, an irregular-shaped, 2-1/2-story wood-framed residence and a 2-story wood-framed house. The existing structures are planned to be demolished as part of the proposed site development.

The remainder of the site surrounding the existing structures generally consists of paved parking and landscaped areas. Existing ground surface typically slopes downward from north to south across the site, with grades generally varying from about Elevations +42 to +47.

Proposed Development

As indicated on the enclosed Subsurface Exploration Plan, the proposed Star Market building site is located within Marblehead and Swampscott. The proposed one-story steel-framed structure is understood to encompass a plan footprint of 46,356 square feet. Based on preliminary discussions with the project Architect, E. Berman Architects of Cambridge, Massachusetts, the lowest level floor slab of the building is currently planned at Elevation +47. Associated site development will also include site grading for paved parking and roadway areas, the construction of site retaining walls and landscaped areas.

Investigation Procedures

On October 29 and 30, 1997, twenty-four (24) test pits were completed at the site by C. Greene Construction Co., Inc. of Boston, Massachusetts under contract to McPhail Associates, Inc. using a John Deere 410 D rubber tire backhoe. Approximate test pit locations are as indicated on the enclosed Figure 2. Field locations of the test pits were determined by taping from existing site features indicated on the referenced 30-scale site plan. The existing ground surface elevation at each test pit location was determined by a level survey performed by McPhail Associates, Inc. utilizing existing vertical control indicated on the referenced site plan.

The test pits were monitored by personnel of McPhail Associates, Inc. who performed field layout, prepared field logs, obtained and visually classified soil samples, monitored groundwater conditions in the open test pits, made minor relocations of the test pits and determined the required test pit depths based upon the actual subsurface conditions encountered. McPhail Associates' logs of test pits TP-1 through TP-24, inclusive, are presented in Appendix B following the text of this report. The test pits varied in depth from 6.5 to 11 feet below ground surface and were terminated in the

Laboratory Testing

At the completion of the field work, the soil samples obtained from the test pit explorations were brought to our laboratory for classification, analyses and testing. The laboratory testing of representative soil samples consisted of gradation analyses to confirm the visual soil classifications. Laboratory test procedures were in general accordance with applicable ASTM Standards. Grain size distributions of representative soil samples of the fill, subsoil and outwash deposit are presented in the enclosed Figures 3, 4 and 5, respectively.

Subsurface Conditions

A detailed description of the subsurface conditions encountered at each of the twenty-four (24) test pit explorations is documented on the logs contained in Appendix B. Following is a discussion of the generalized subsurface conditions across the site which are inferred primarily from these explorations but also from a knowledge of the geology of the general area and from experience at geologically similar sites.

The test pits indicate that ground surface at the project site is typically underlain by a 1.0 to 7.5-foot thick layer of fill. The fill consists of a loose to compact, light brown to black sand and gravel, with some to a trace of silt and occasional cobbles, boulders, roots, tree branches, fieldstones, glass, brick, metal, ash and cinders. At seven (7) of the test pit locations across the site, topsoil was observed directly below ground surface. Topsoil was typically found to underlie areas of the site where the fill was not present directly below ground surface. The topsoil generally consists of a loose to compact dark brown silty sand with some to a trace of gravel and organics. At one test pit location, TP-15, a 6-foot thick layer of fill was encountered below a 1-foot thickness of topsoil.

Underlying the fill and topsoil, a 0.5 to 3.2-foot thick layer of subsoil was encountered at eleven (11) test pit locations throughout the site. The subsoil consist of a loose to compact, light rust-brown silty sand with some to a trace of gravel and occasional roots.

A granular glacial outwash deposit was encountered below the fill, topsoil and/or subsoil at each test pit location. The outwash deposit consists of a compact to dense light brown to rust-brown sandy gravel with a trace of silt. Interbedded layers of compact gray to light brown sand were encountered within the outwash deposit. The glacial outwash layer was not fully penetrated at any of the test pit locations. The top of the outwash was encountered at depths of 0.2 to 8.0 feet below ground surface, corresponding to Elevations +45.4 and +36.2, respectively.

Groundwater was not encountered in any of the test pit excavations upon completion. However, it is anticipated that future groundwater levels across the project site may vary from those reported herein. Groundwater levels may also vary due to factors such as normal seasonal changes and runoff, particularly during or following periods of heavy precipitation, and alterations of existing drainage patterns.

Foundation Design Recommendations

Based on our current understanding of the proposed project, the anticipated building loads, and the subsurface conditions as characterized above, we recommend that foundation support for the proposed Star Market building be provided by conventional spread footings in combination with an economical slab-on-grade bearing directly on the natural, undisturbed outwash deposit or on compacted granular fill in areas where the surface of the natural, outwash soil is below normal foundation depths. Based on the subsurface conditions encountered in test pits TP-6 and TP-7, it is anticipated that 5 to 7 feet of overexcavation for foundation construction may be required in isolated areas within the building footprint. The spread footings should be proportioned utilizing a maximum allowable bearing pressure of 2.5 tons per square foot. Recommended minimum footing widths for continuous and isolated spread footings are 24 and 30-inches, respectively.

All bearing surfaces adjacent to unheated areas should be provided with a minimum 4-foot thickness of soil cover as frost protection. Interior footings below heated areas should be located such that the top of the foundation concrete is at least 6 inches below the underside of the lowest level slab. All foundations should be located such that they are below an imaginary line drawn upward and outward at 2 to 1 (horizontal to vertical) slope from the bottom exterior edge of all adjacent footings, structures and utilities.

We recommend that the slab-on-grade be underlain by a polyethylene vapor barrier spread across a minimum 6-inch thickness of compacted granular fill. Since the proposed floor slab is above the proposed finished perimeter grades, no underslab or perimeter drainage is recommended. The exterior sites grades should however be sloped to drain surface water away from the perimeter of the proposed building.

It is anticipated that compacted granular fill will be required for foundation support within the plan limits of the existing buildings to be demolished and in areas requiring overexcavation of unsuitable soils. In areas where existing foundations interfere with proposed construction, it is recommended that existing building foundations be completely removed at the location of the new footing and be removed to a depth of at least 2 feet below the proposed slab-on-grade. Building basement floor slabs may remain in-place during demolition of the existing structures provided the above criteria are met. Compacted granular fill should then be placed directly above the floor slab after removal of all demolition debris to the top of the basement floor slab. Test pits will be required below the existing floor slab prior to fill placement as discussed under the "Foundation Construction Considerations" section of this report.

Granular fill placed for support of foundations should extend laterally beyond the edge of footings a distance equal to the depth of fill plus 2 feet. All granular fill placed within the footprint of the proposed building for support of the foundations should be placed in lifts having a compacted thickness of 6 inches and be compacted to a minimum of 95 percent of its maximum modified Proctor dry density. Fill for use within the proposed building area should consist of a well-graded natural sand and gravel containing less than 8 percent passing the No. 200 sieve. Existing on-site

Seismic Design Considerations

For purposes of determining the total lateral seismic force or base shear for earthquake design, the site is considered to have a S_2 soil-profile type; therefore, the site coefficient "S" for this site should be 1.2. The bearing stratum is not considered to be subject to liquefaction during the design earthquake based on the criterion of Section 1805.3 of the State Building Code.

Lateral forces can be considered to be transmitted from the structure to the bearing strata by passive pressure against the perimeter foundation walls utilizing an equivalent fluid density of 120 pounds per cubic foot providing that the foundation walls are designed to resist these pressures. Lateral force can also be considered to be transmitted from the structure to the soil by friction on the base of footings using a frictional coefficient of 0.5, to which a factor of safety of 1.5 should be applied.

Foundation Construction Considerations

The primary foundation construction considerations include subgrade preparation of foundation bearing surfaces and the slab-on-grade.

To limit disturbance of the natural outwash bearing stratum it is recommended that the soil bearing surfaces be excavated with a backhoe bucket which has a smooth, toothless cutting edge. This may be achieved by either removing the teeth or by welding a steel plate across the teeth. Alternatively, depending of the extent of gravel and cobbles present in the outwash deposit, the bearing surface excavation may require the use of a toothed bucket followed by compaction of the bearing surface or hand excavation of all loose soil. Should it be necessary to expose a subgrade for an extended period of time, the exposed subgrade soils should be protected by a minimum 3-inch thickness of crushed stone.

Since groundwater was not encountered in the test pit explorations, it is not anticipated that groundwater will adversely impact the proposed construction. However, surface runoff may accumulate within localized depressions in the ground surface across the site after periods of heavy precipitation and would necessitate the implementation of construction dewatering measures such as localized sumping.

As indicated on Figure 2, the existing one-story bank building and the 2-1/2-story wood-framed residential structure are located within the southern portion of the proposed building footprint and will require demolition. Below-grade demolition of the structure should be conducted in accordance with the recommendations presented in the "Foundation Design Recommendation" section of this report. Prior to placement of compacted granular fill above the existing basement floor slabs, it is recommended that the floor slab be removed and the underlying soils exposed at two and eight equally-spaced locations throughout the one- and 2-1/2-story building basement areas, respectively. This work should be conducted to confirm the assumption that natural, inorganic soils exist directly below the slab such that backfilling above the slab is technically feasible. If unsuitable material is

encountered below the existing floor slabs, the material should be excavated to the top of the outwash deposit and replaced with compacted granular fill.

Existing on-site fill and the natural outwash deposit may be used as granular fill for foundation backfilling providing they meet the gradation requirements of the granular fill as previously discussed. Based on the composition of the soils encountered in the recent test pits, re-use of these materials will likely require segregation of unsuitable, oversized materials, particularly within the fill.

Site Development Recommendations

Proposed project site development includes parking areas, roadways and site retaining walls along the northeast corner of the site that abuts the Tedesco Country Club.

Prior to site grading within proposed parking and roadway areas, existing building foundations, as previously described, should be removed to a depth of at least 3 feet below the final finished grade. All topsoil and subsoil should also be removed from within proposed parking and roadway areas to the top of the natural outwash deposit. Where required, site filling should be conducted with compacted granular fill. Prior to placement of the compacted granular fill for site grading and/or subbase material, the exposed parking lot and roadway subgrades should be proofrolled with a minimum of 6 passes of a vibratory steel drum roller weighing at least 20,000 pounds. All soft or compressible zones or pockets observed during the proofrolling should be excavated and replaced with compacted granular fill. In areas where isolated voids may be present due to the composition of demolition debris, the voids should be thoroughly choked with 3/4-inch crushed stone prior to the granular fill placement.

Proposed cantilevered retaining walls to be constructed along the northeast corner of the site should be backfilled with free-draining granular fill and be provided with weep holes to preclude hydrostatic pressures from acting on the walls. The design of these walls should utilize a lateral earth pressure corresponding to an equivalent fluid density of 40 pounds per cubic foot (pcf). To these values must be added the pressures attributable to earthquake forces per Section 1612.4.9 of the Massachusetts State Building Code. For the retaining walls, the recommended criteria for allowable bearing pressure, minimum soil cover for frost protection and preparation of foundation bearing surfaces should be as described above for the proposed building.

The retaining walls should be designed for a minimum factors of safety of 1.5 to 2.0 against sliding and overturning, respectively. For use in sliding analysis, an ultimate friction coefficient of 0.5 is recommended along the base of the retaining wall footing. Passive pressure in front of the retaining walls may be applied utilizing an equivalent fluid density of 120 pounds per cubic foot.

Final Comments

If excess excavated soil remains after all site filling operations are completed, and off-site disposal of the material is required, disposal should be conducted in accordance with the current policies of the Massachusetts Department of Environmental Protection. Conformance with the existing environmental regulations and policies will necessitate undertaking some chemical testing of representative samples of the excess soil for disposal purposes. These services could be performed by McPhail Associates, Inc. as additional services should they be required for this project.

It is recommended that McPhail Associates, Inc. be retained to provide design assistance services to the design team during the final design phase of this project. The purpose of this involvement would be to review of the structural foundation drawings and foundation notes for conformance with the recommendations herein, and to generate the earthwork specification section for inclusion into the Contract Documents for construction.

In addition, it is recommended that a representative of McPhail Associates, Inc. be present during the earthwork phase of the project to monitor the placement and compaction of the granular fill, to monitor the preparation of the foundation bearing surfaces, and to monitor preparation of the slab subgrade. Further, our involvement during the construction phase of the work would also assure that costly delays due to unanticipated field problems are minimized since our field engineer would be under the direct supervision of our project engineer who was responsible for the subsurface investigation and foundation design recommendations documented herein.

We trust that the above is sufficient for your present requirements. Should you have any questions concerning the recommendations presented herein, please do not hesitate to call us.

Very truly yours,

McPHAIL ASSOCIATES, INC.

Chris M. Erikson, P.E.

Enclosures

3229-L.REP

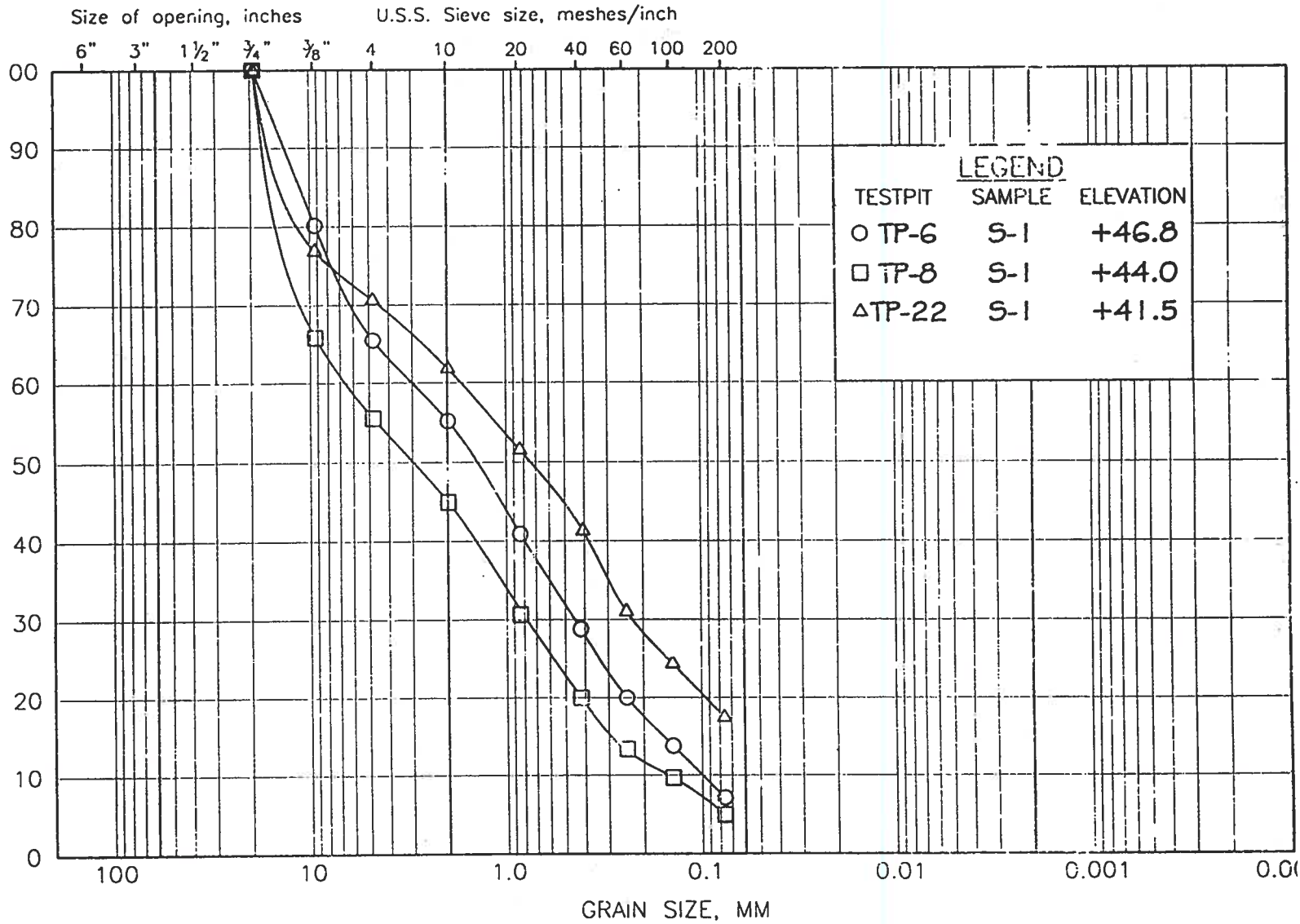
CME/gon

N

PROJECT LOCATION PLAN

PROJECT No._

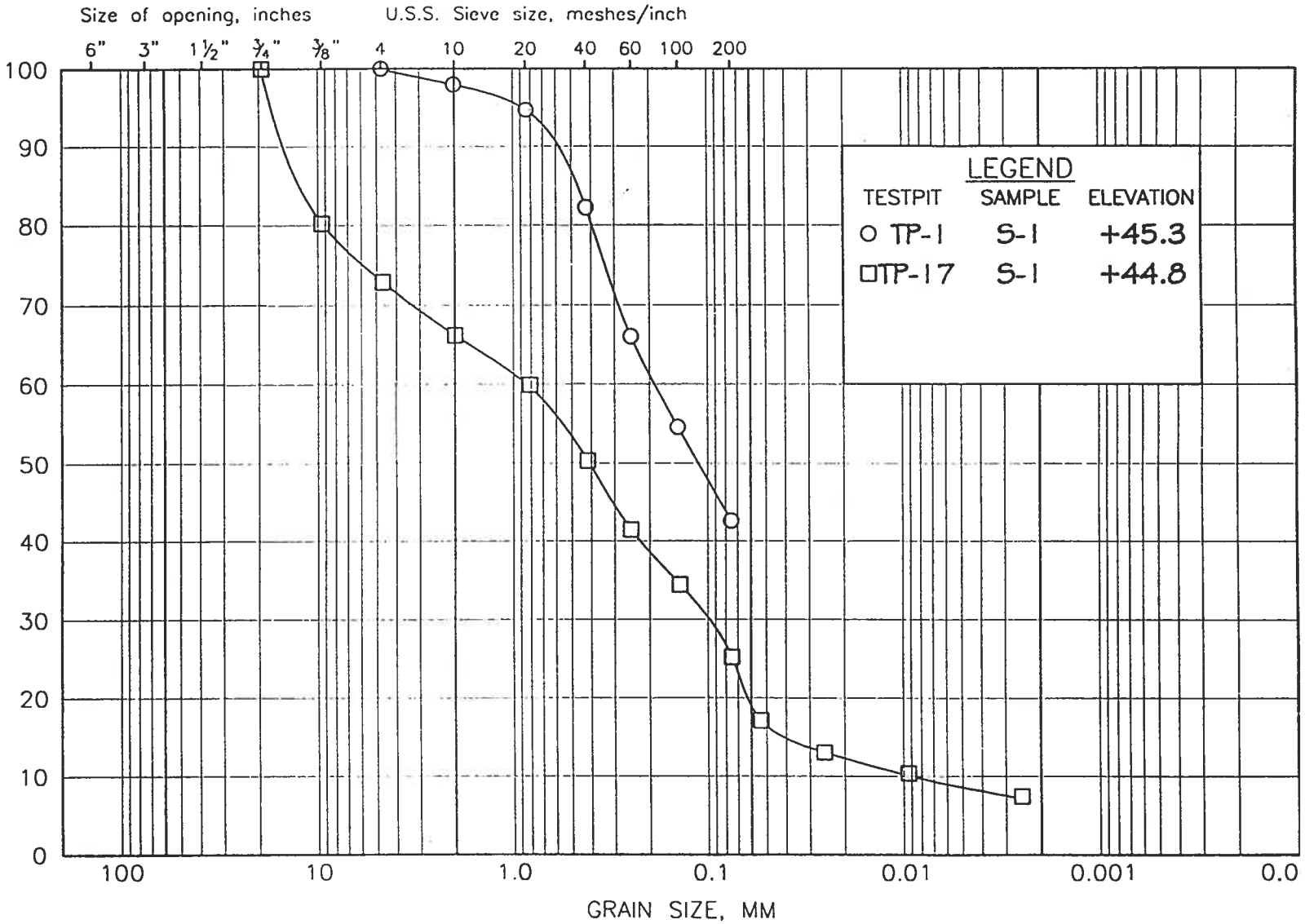
M.I.T. GRAIN SIZE SCALE



COBBLE SIZE	GRAVEL SIZE			SAND SIZE			SILT SIZE	CLAY SIZE
	COARSE	MEDIUM	FINE	COARSE	MEDIUM	FINE	FINE GRAINED	

PROJECT No._

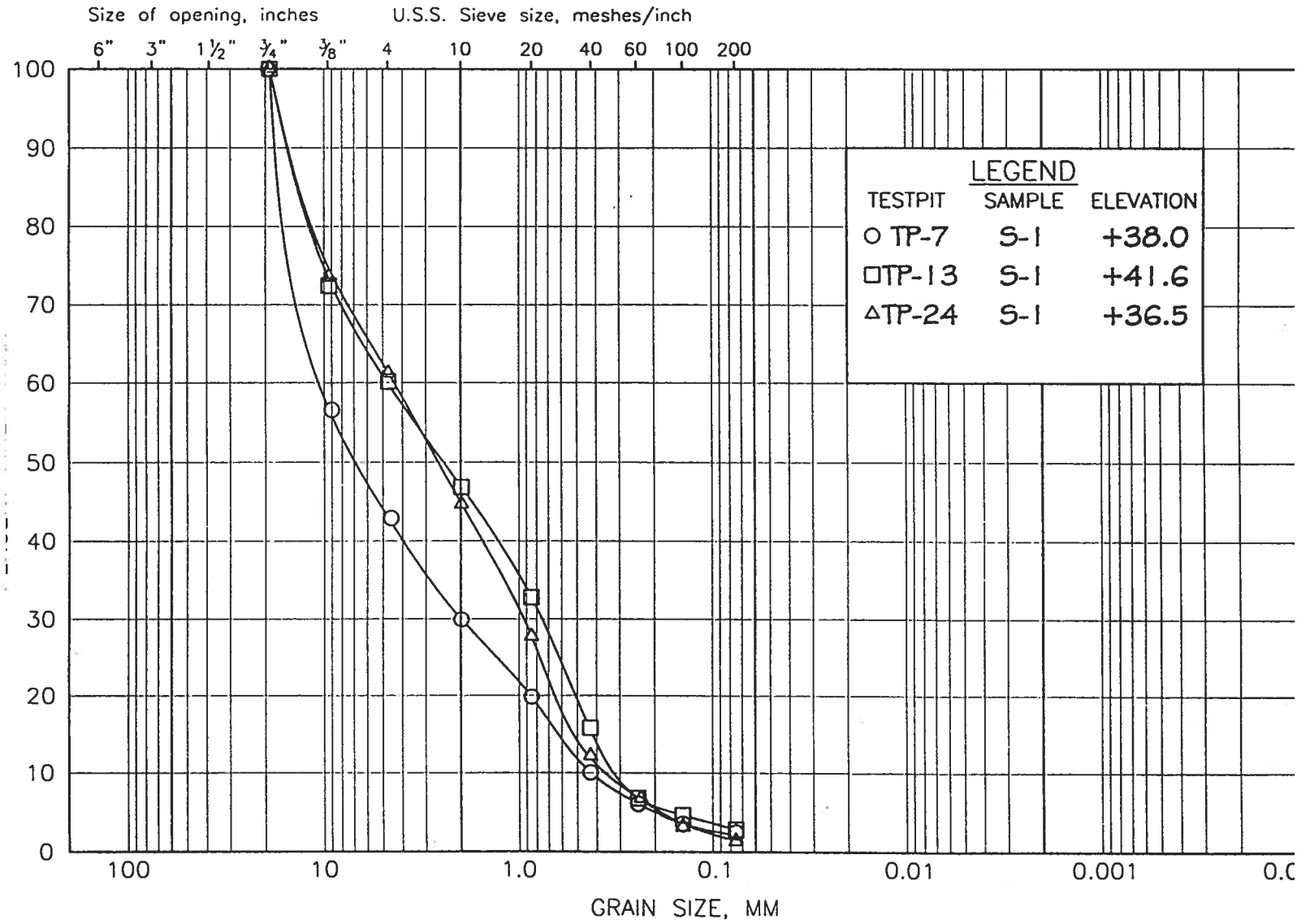
M.I.T. GRAIN SIZE SCALE



COBBLE SIZE	GRAVEL SIZE			SAND SIZE			FINE GRAINED	
	COARSE	MEDIUM	FINE	COARSE	MEDIUM	FINE	SILT SIZE	CLAY SIZE

PROJECT No.

M.I.T. GRAIN SIZE SCALE



COBBLE SIZE	COARSE	MEDIUM	FINE	COARSE	MEDIUM	FINE	SILT SIZE	CLAY SIZE
	GRAVEL SIZE			SAND SIZE			FINE GRAINED	

McPHAIL ASSOCIATES, INC.
Geotechnical Engineers

Appendix A

Limitations

McPHAIL ASSOCIATES, INC.
Geotechnical Engineers

Limitations

This report has been prepared on behalf of and for the exclusive use of Sunbeam Development Limited Partnership for specific application to the proposed Star Market Development to be located in Marblehead/Swampscott, Massachusetts in accordance with generally accepted soil and foundation engineering practices. No other warranty, expressed or implied, is made. In the event that any changes in the nature, design, or location of the proposed building is planned, the conclusions and recommendations contained in this report should not be considered valid, unless the changes are reviewed and the conclusions of this report modified or verified in writing.

The analysis and recommendations submitted in this report are based upon the data obtained from the test pits performed at the approximate locations indicated on the enclosed Figure 2. If variations in the nature and extent of subsurface conditions between the explorations become evident during the course of construction, it will be necessary for a re-evaluation of the recommendations of this report to be made after performing on-site observations during the construction period and noting the characteristics of any variations.

It is recommended that McPhail Associates, Inc. be retained to provide design assistance to the Architect and Structural Engineer during the final design phase of this project. The purpose of this involvement is to review the structural foundation drawings and foundation notes for conformance with the recommendations herein, and to review or prepare the earthwork specification section for inclusion into the Contract Documents for construction.

McPHAIL ASSOCIATES, INC.
Geotechnical Engineers

Appendix B

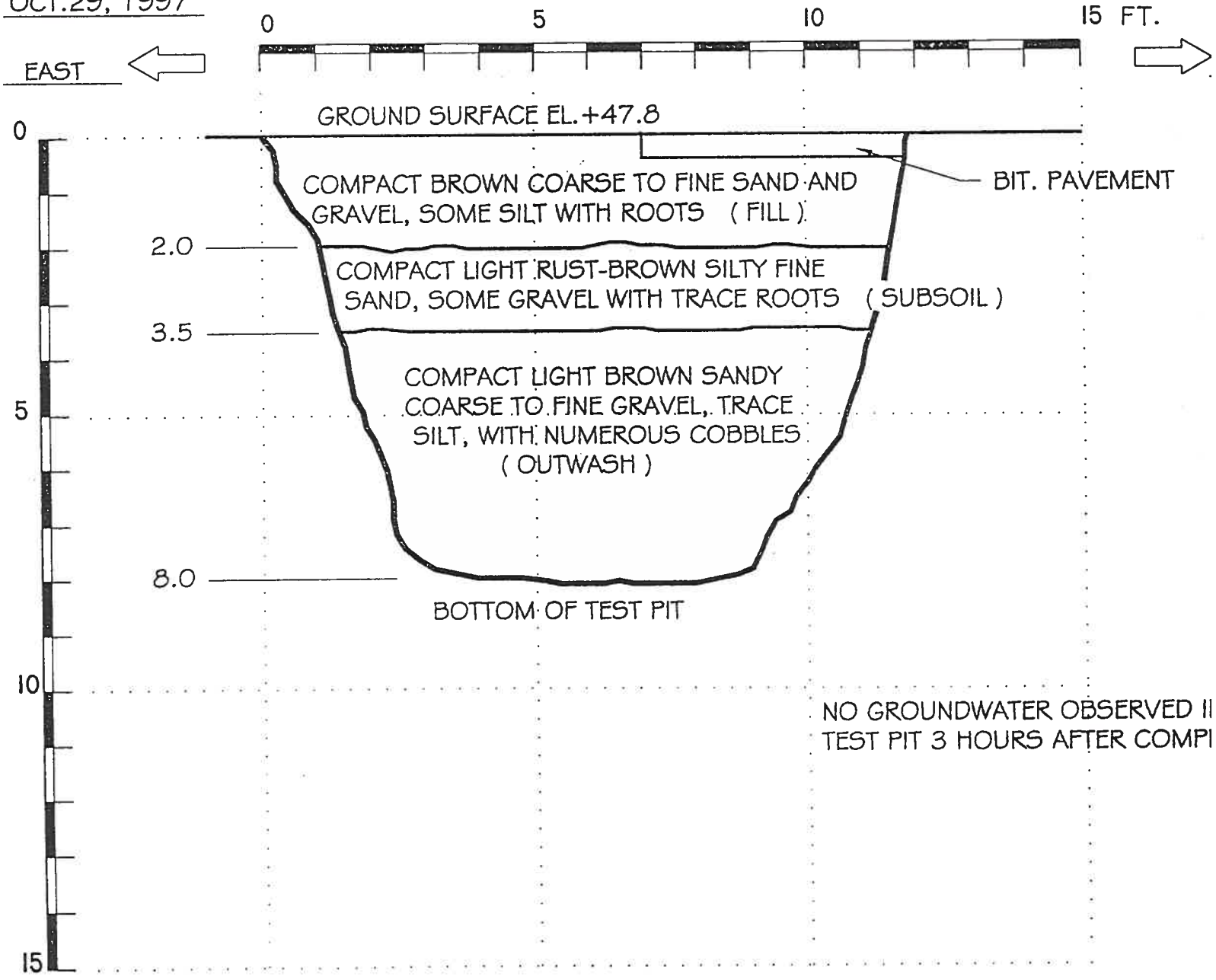
McPhail Associates, Inc.
Logs of Test Pit Explorations
TP-1 through TP-24

O. 3229

OCT.29, 1997

TEST PIT LOG

TEST PIT NO. 1

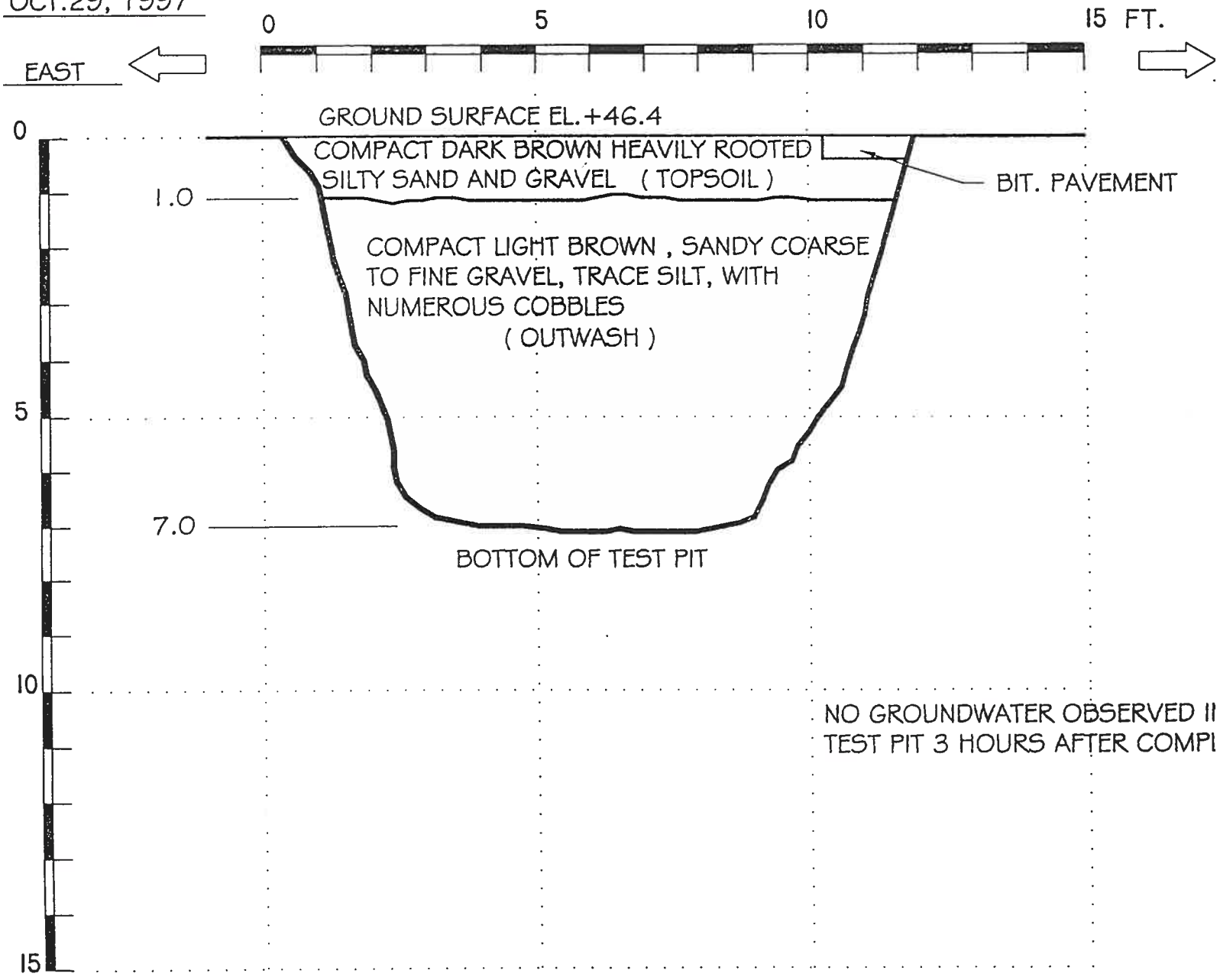


O. 3229

OCT.29, 1997

TEST PIT LOG

TEST PIT NO. 2

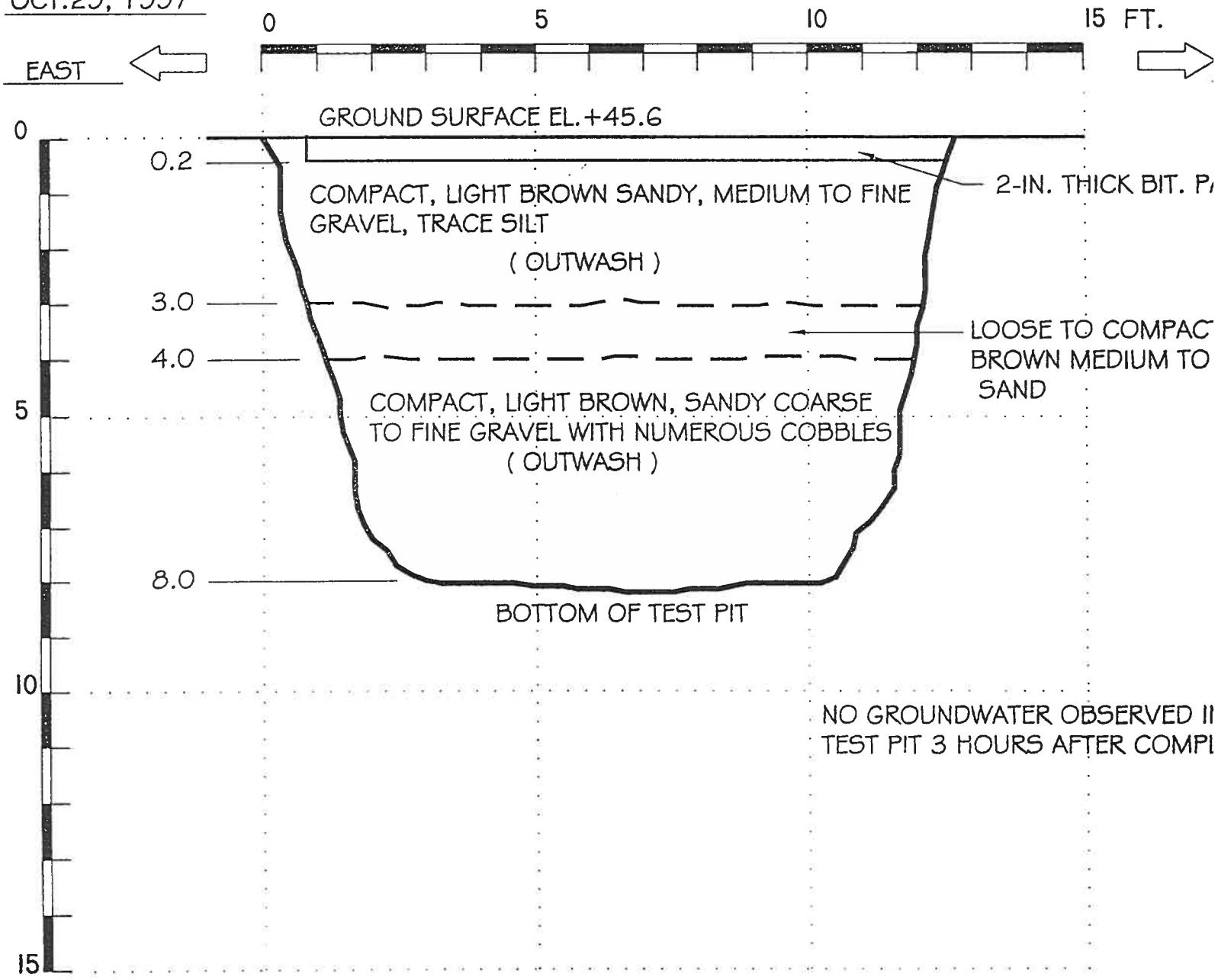


O. 3229

OCT.29, 1997

TEST PIT LOG

TEST PIT NO. 3

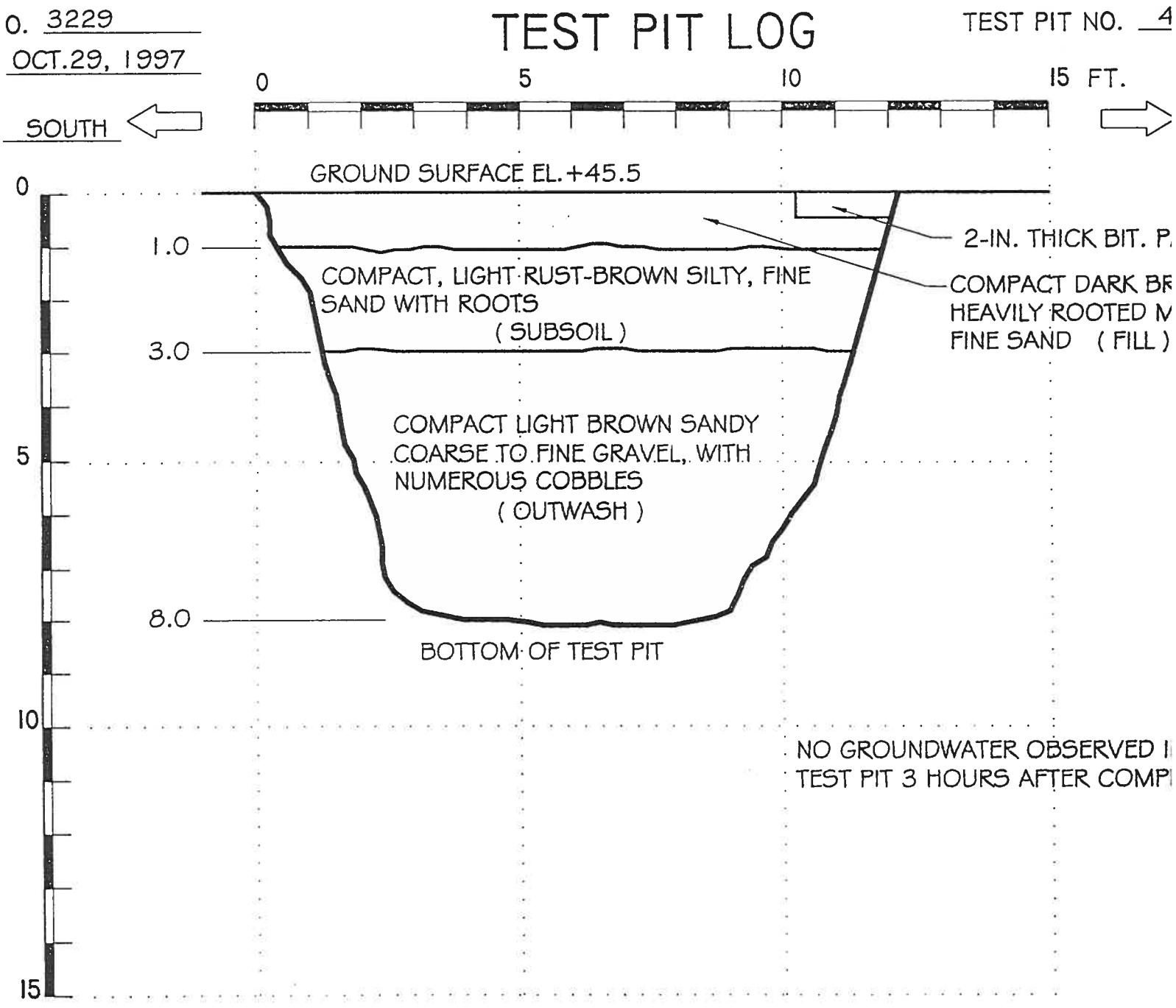


O. 3229

OCT.29, 1997

TEST PIT LOG

TEST PIT NO. 4



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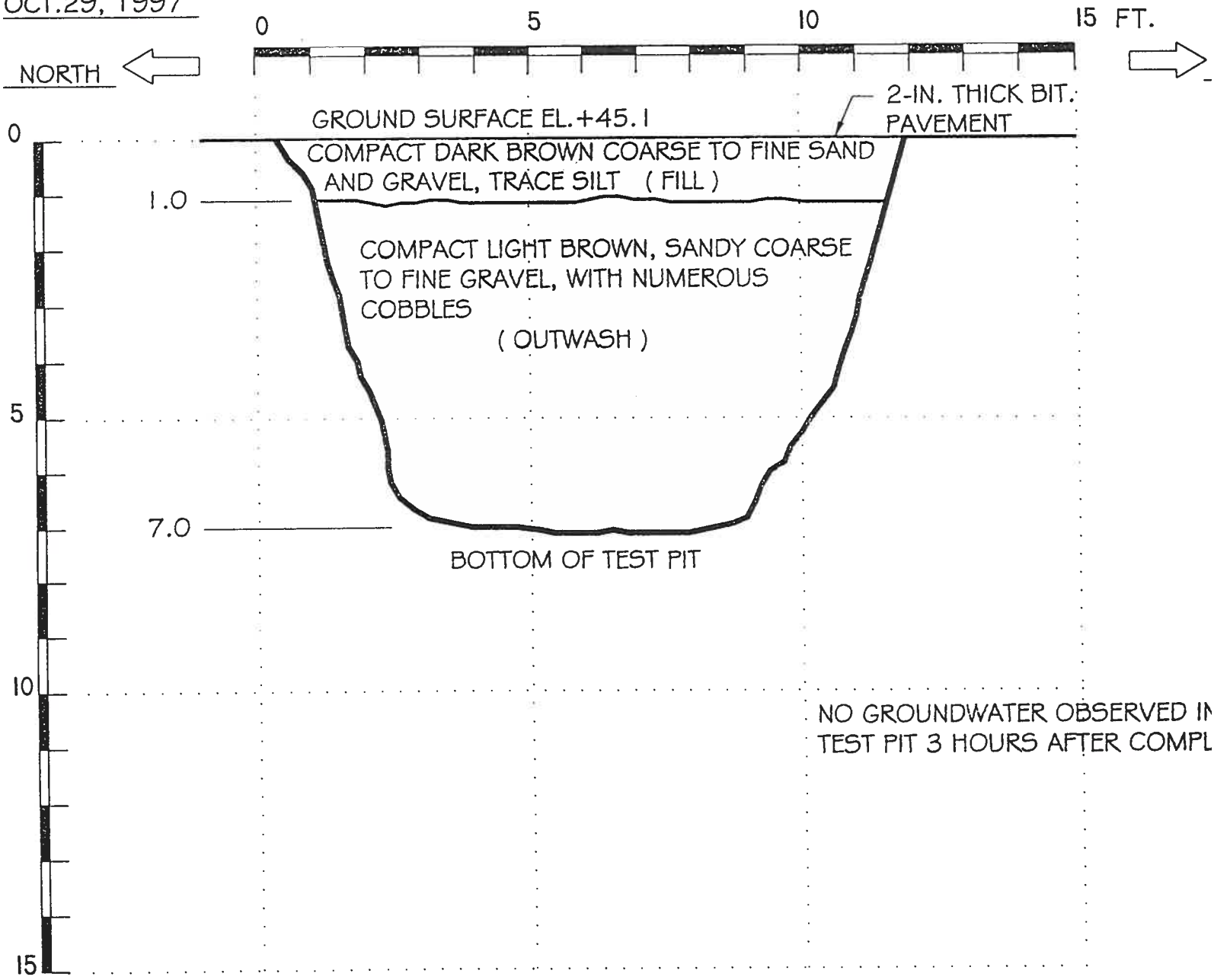
OCT.29, 1997

TEST PIT LOG

TEST PIT NO. 5

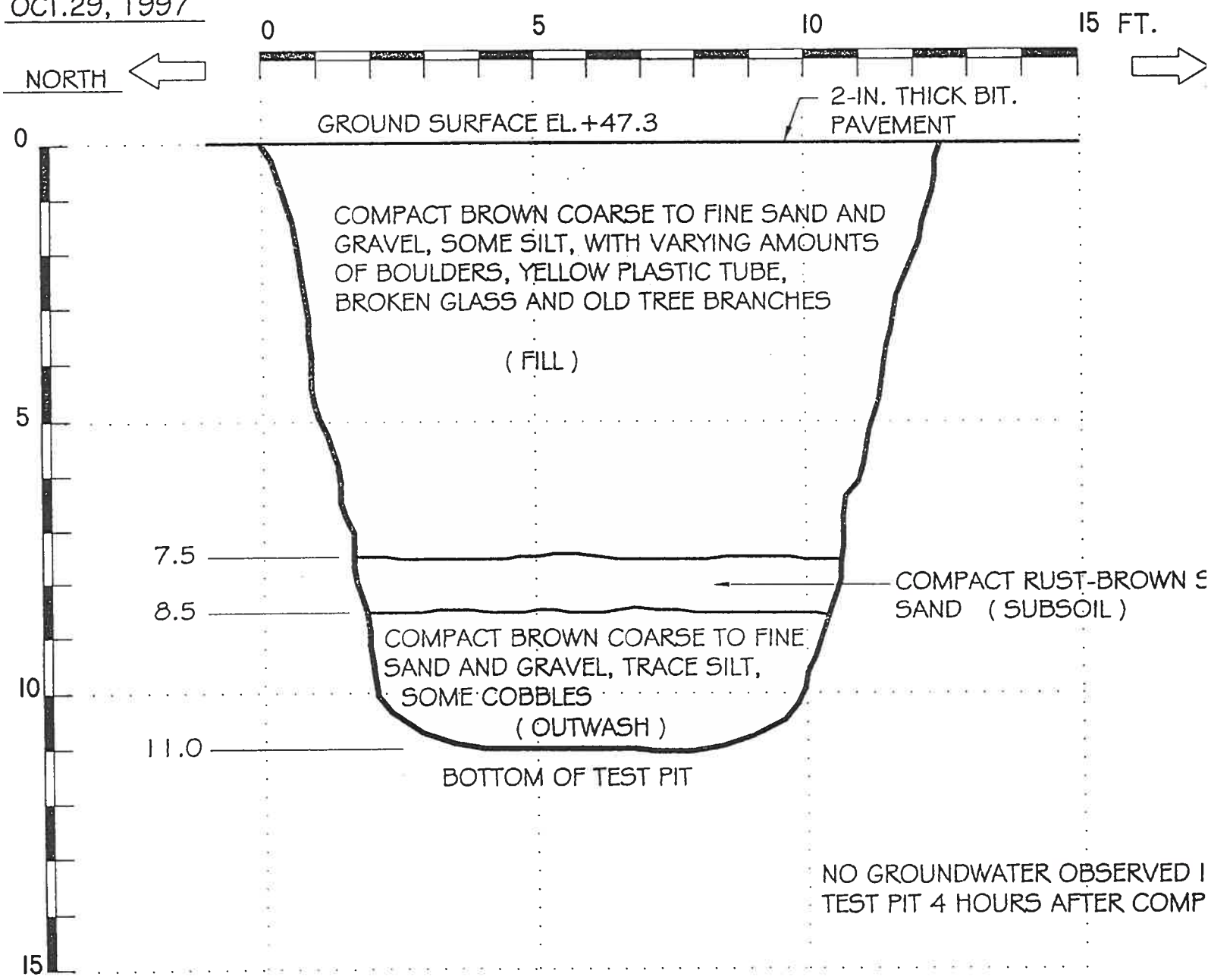


O. 3229

OCT.29, 1997

TEST PIT LOG

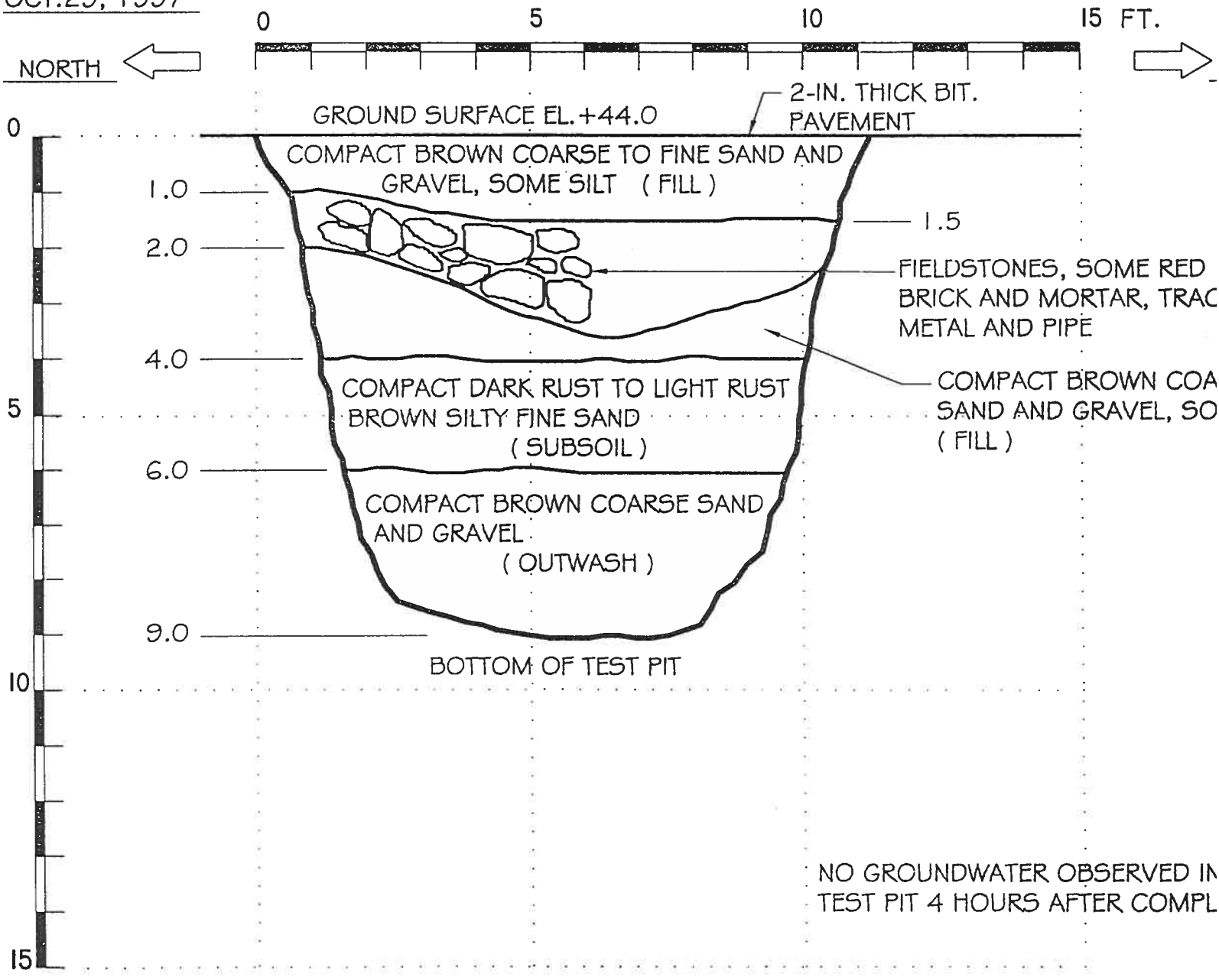
TEST PIT NO. 6



). 3229
OCT.29, 1997

TEST PIT LOG

TEST PIT NO. 7



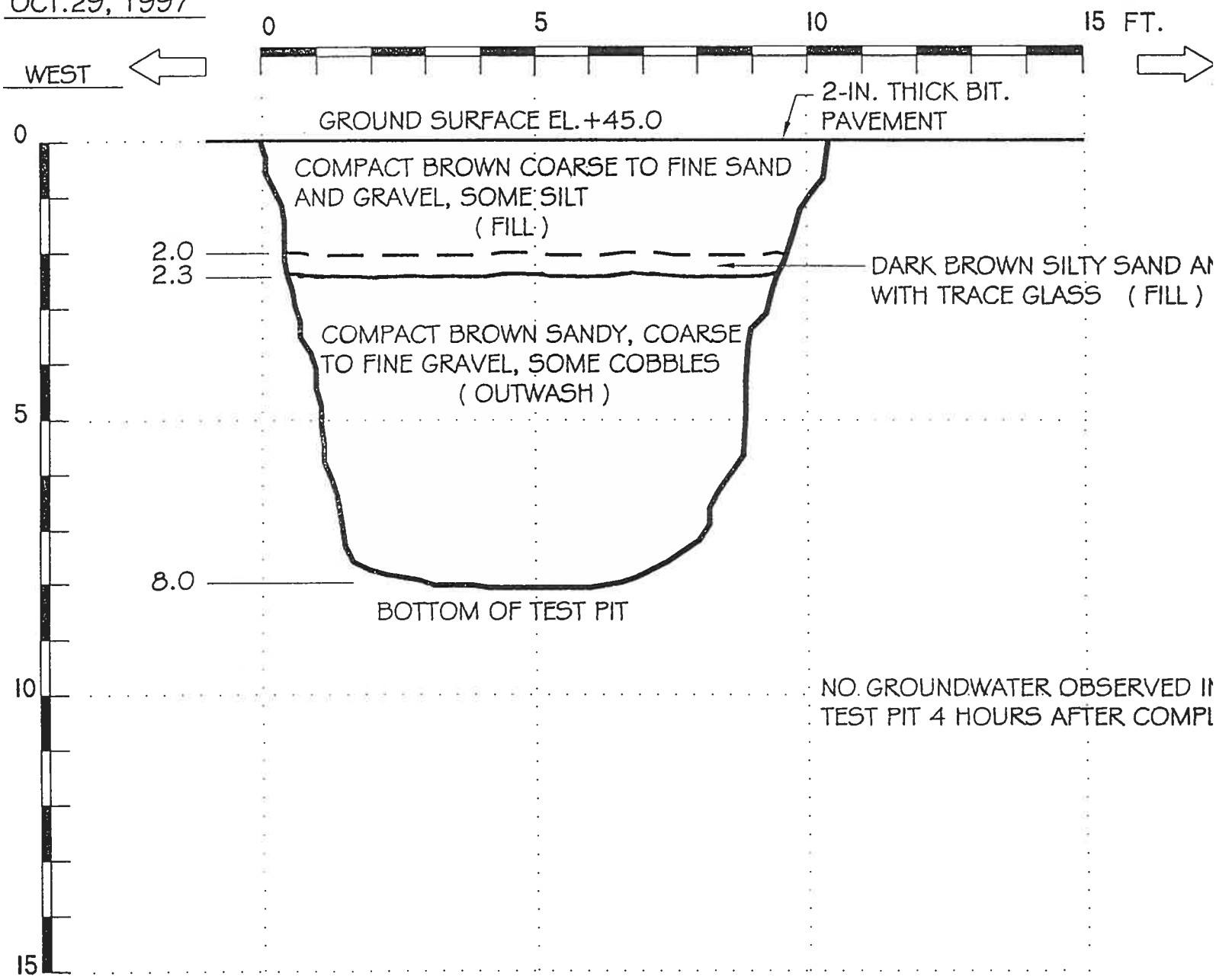
NO GROUNDWATER OBSERVED IN
TEST PIT 4 HOURS AFTER COMPL

O. 3229

OCT.29, 1997

TEST PIT LOG

TEST PIT NO. 8

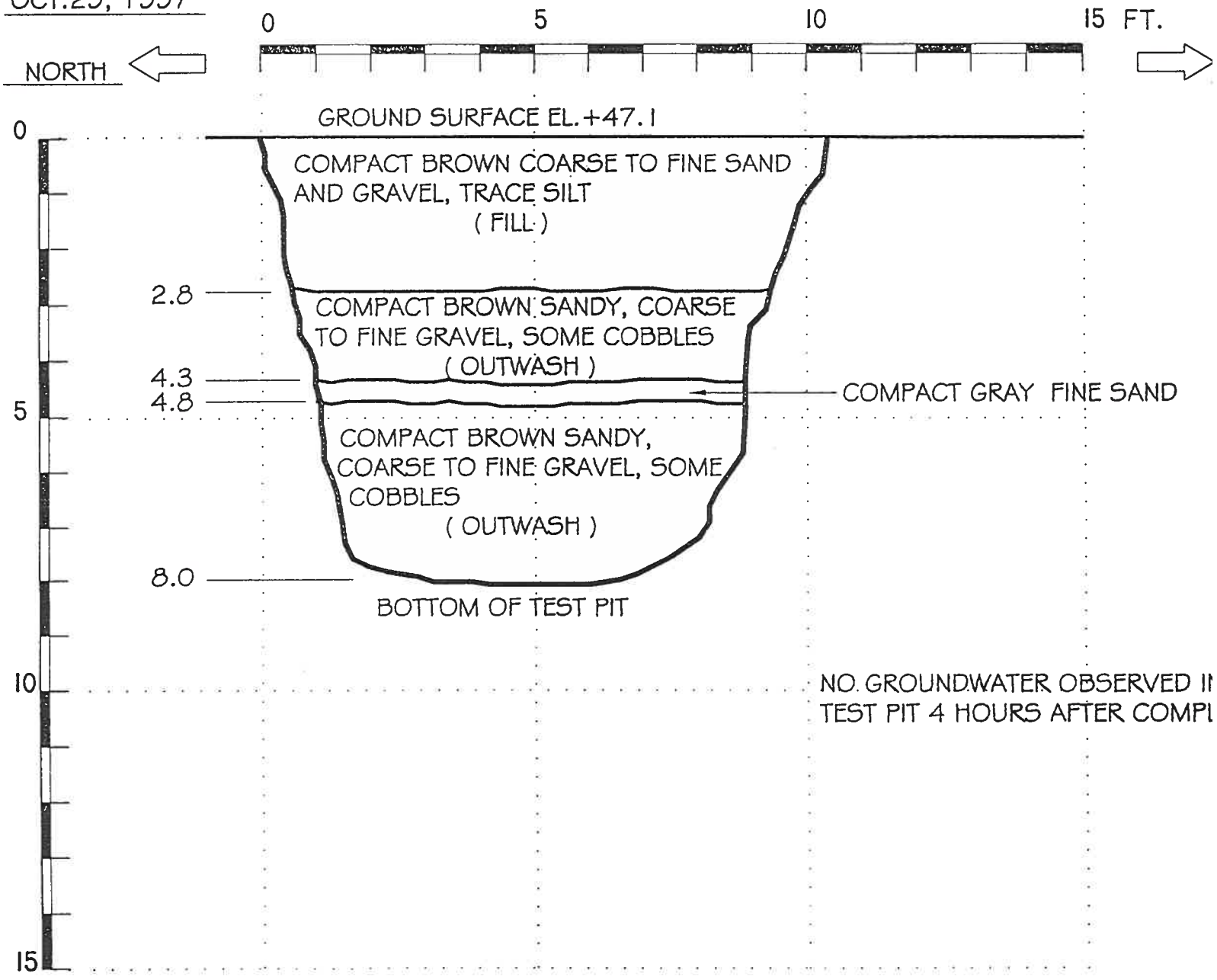


O. 3229

OCT.29, 1997

TEST PIT LOG

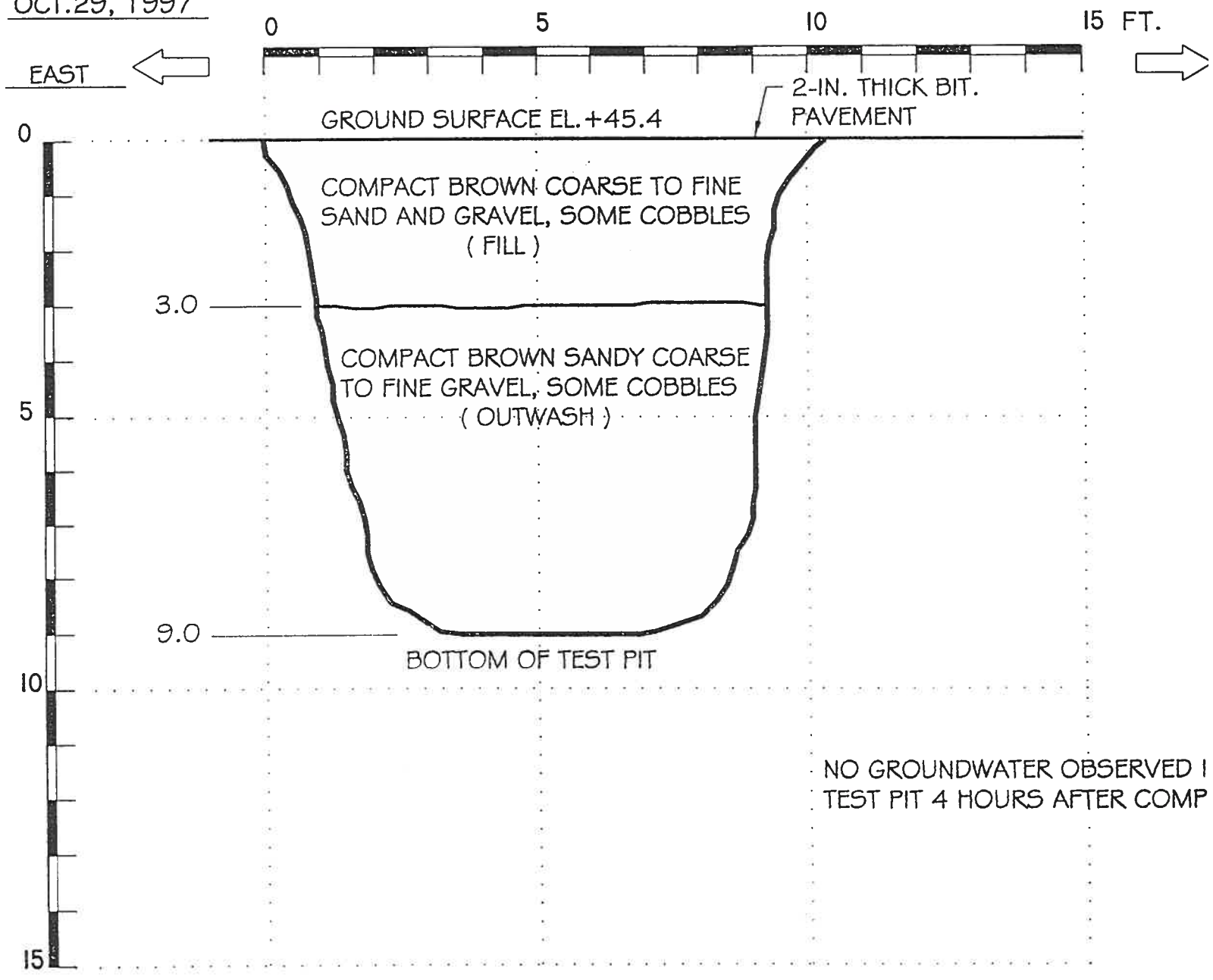
TEST PIT NO. 9

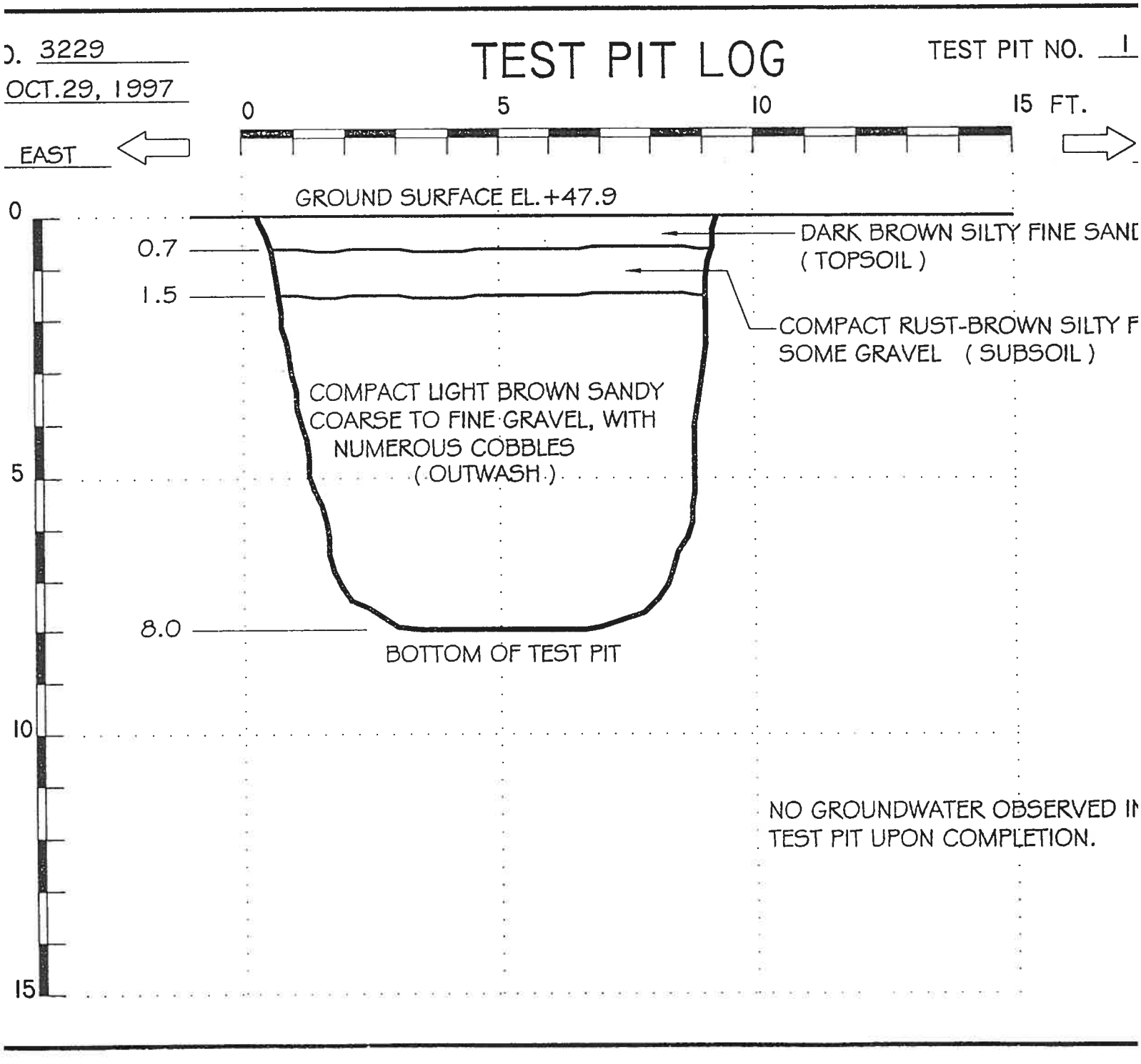


O. 3229
OCT.29, 1997

TEST PIT LOG

TEST PIT NO. 1



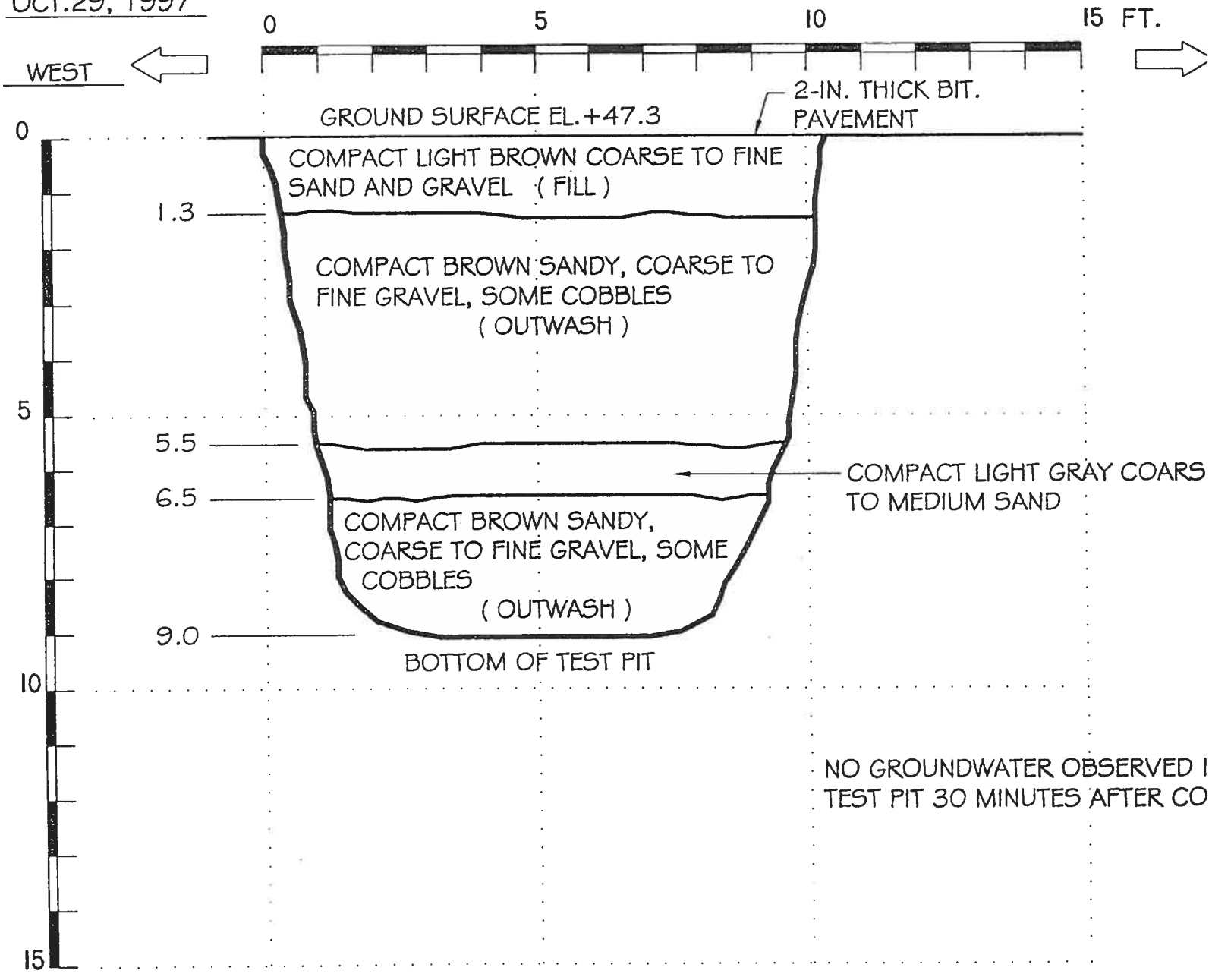

TEST PIT LOG
TEST PIT NO. 1
0
5
10
15 FT.
EAST
GROUND SURFACE EL.+47.9
0.7
1.5
8.0
DARK BROWN SILTY FINE SAND
(TOPSOIL)
COMPACT RUST-BROWN SILTY F
SOME GRAVEL (SUBSOIL)
COMPACT LIGHT BROWN SANDY
COARSE TO FINE GRAVEL, WITH
NUMEROUS COBBLES
(OUTWASH)
BOTTOM OF TEST PIT
NO GROUNDWATER OBSERVED I
TEST PIT UPON COMPLETION.

O. 3229

OCT.29, 1997

TEST PIT LOG

TEST PIT NO. 1

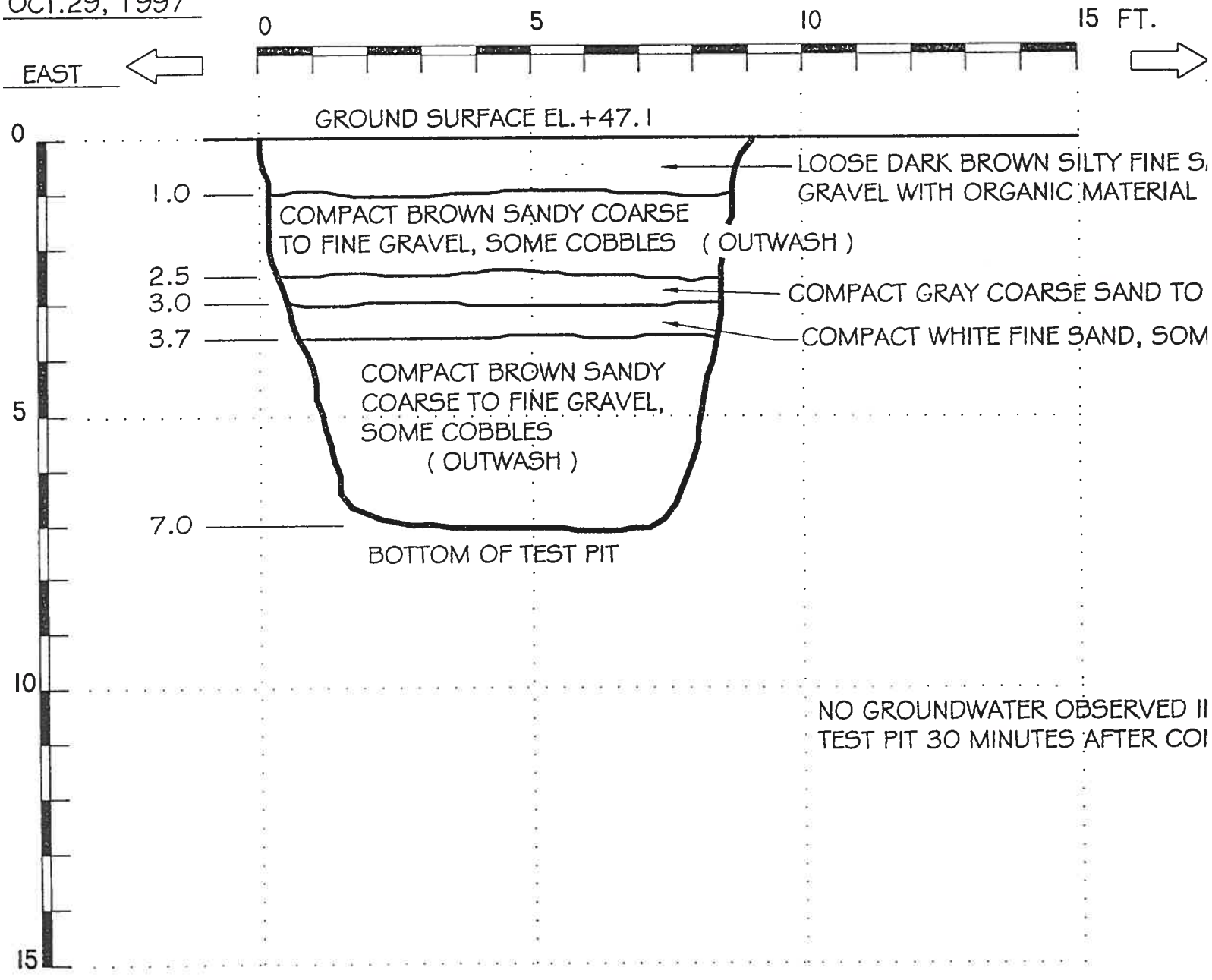


O. 3229

OCT.29, 1997

TEST PIT LOG

TEST PIT NO. 1

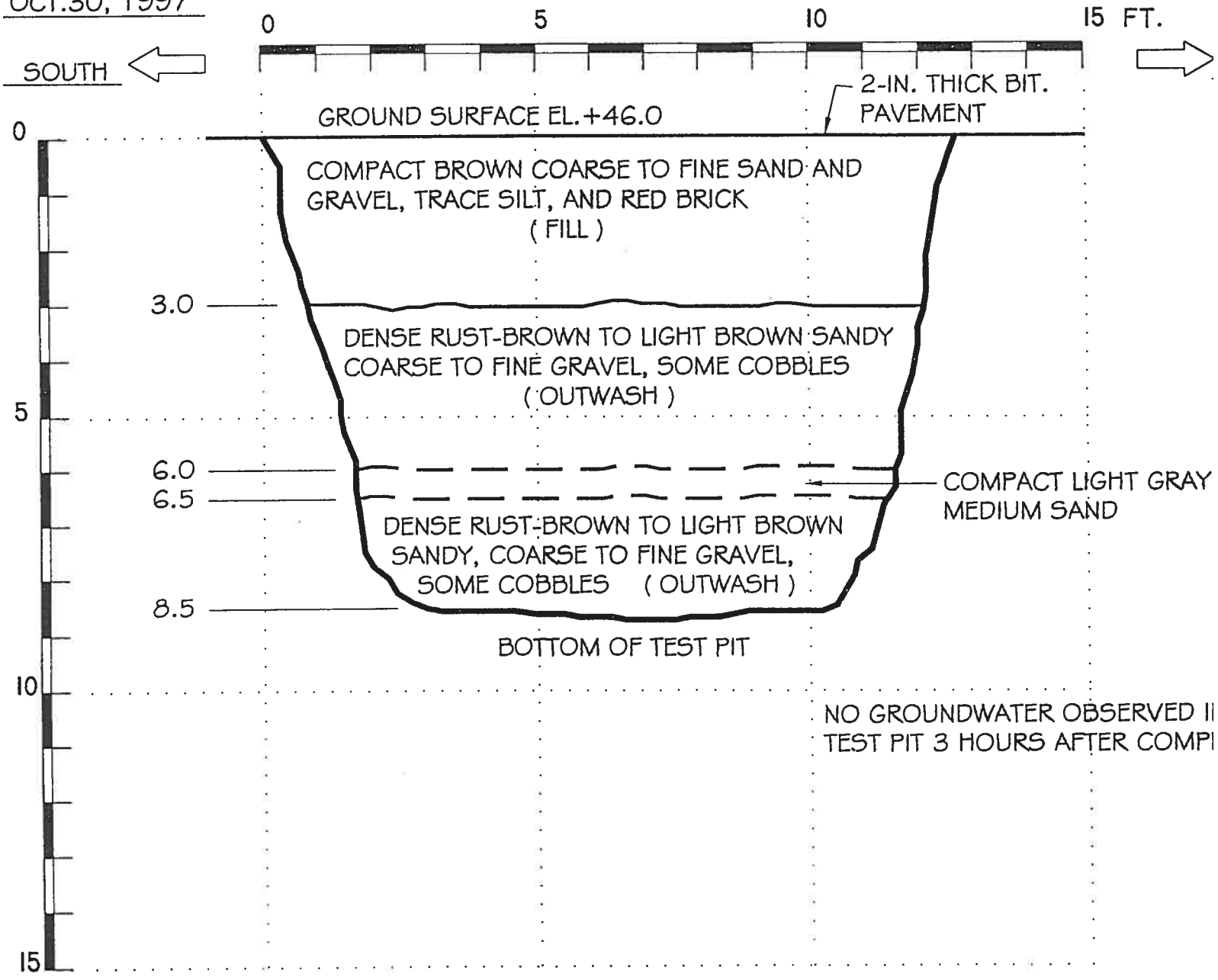


O. 3229

OCT.30, 1997

TEST PIT LOG

TEST PIT NO. 1

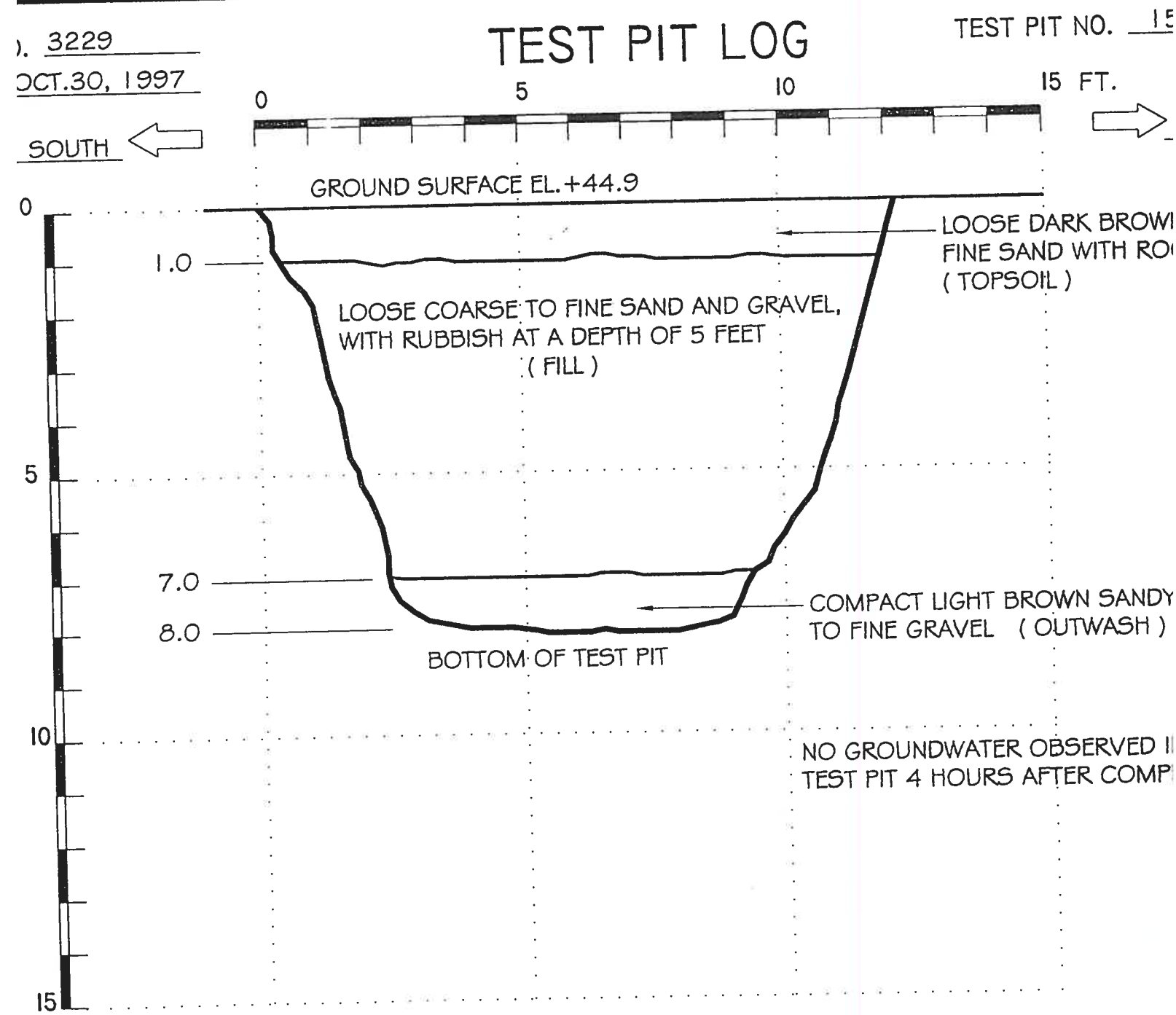


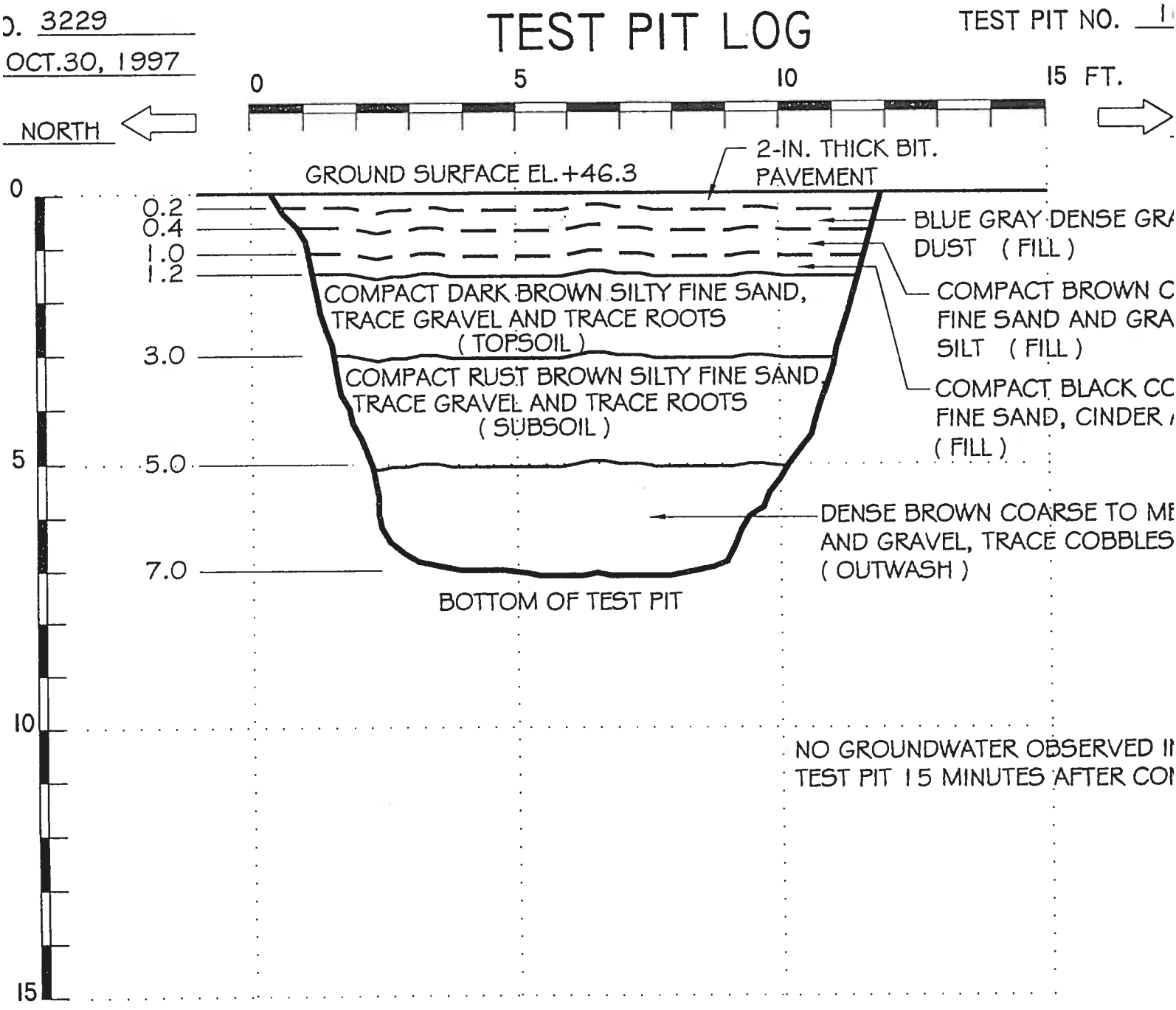
). 3229
OCT.30, 1997

TEST PIT LOG

TEST PIT NO. 15

SOUTH



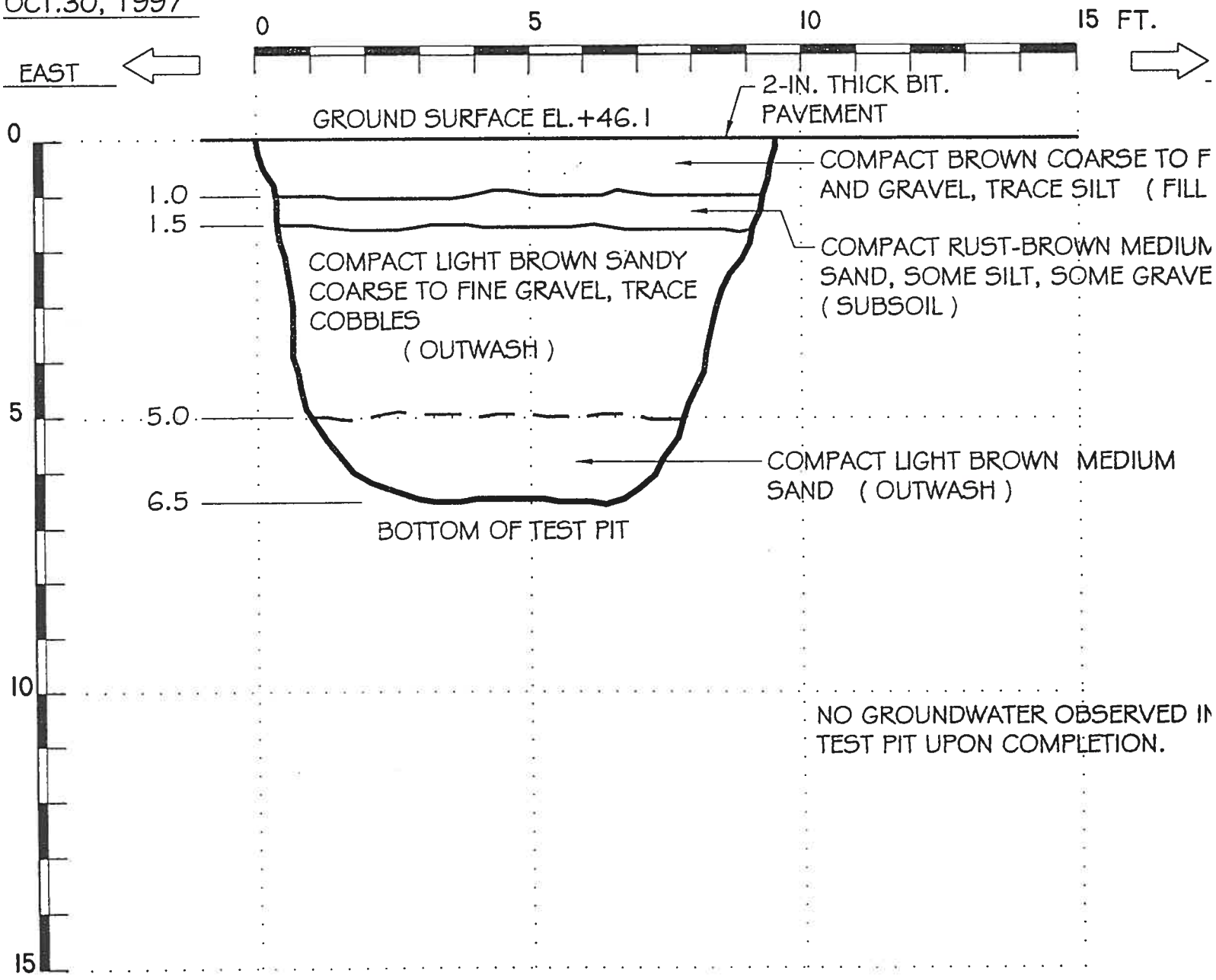

TEST PIT LOG
TEST PIT NO. 1
0. 3229
OCT.30, 1997
NORTH
0
5
10
15 FT.
GROUND SURFACE EL.+46.3
2-IN. THICK BIT. PAVEMENT
0.2
0.4
1.0
1.2
BLUE GRAY DENSE GRA
DUST (FILL)
COMPACT DARK BROWN SILTY FINE SAND, TRACE GRAVEL AND TRACE ROOTS (TOPSOIL)
COMPACT BROWN C
FINE SAND AND GRA
SILT (FILL)
3.0
COMPACT RUST BROWN SILTY FINE SAND, TRACE GRAVEL AND TRACE ROOTS (SUBSOIL)
COMPACT BLACK CC
FINE SAND, CINDER
(FILL)
5.0
DENSE BROWN COARSE TO ME
AND GRAVEL, TRACE COBBLES
(OUTWASH)
7.0
BOTTOM OF TEST PIT
NO GROUNDWATER OBSERVED I
TEST PIT 15 MINUTES AFTER CO
0
5
10
15

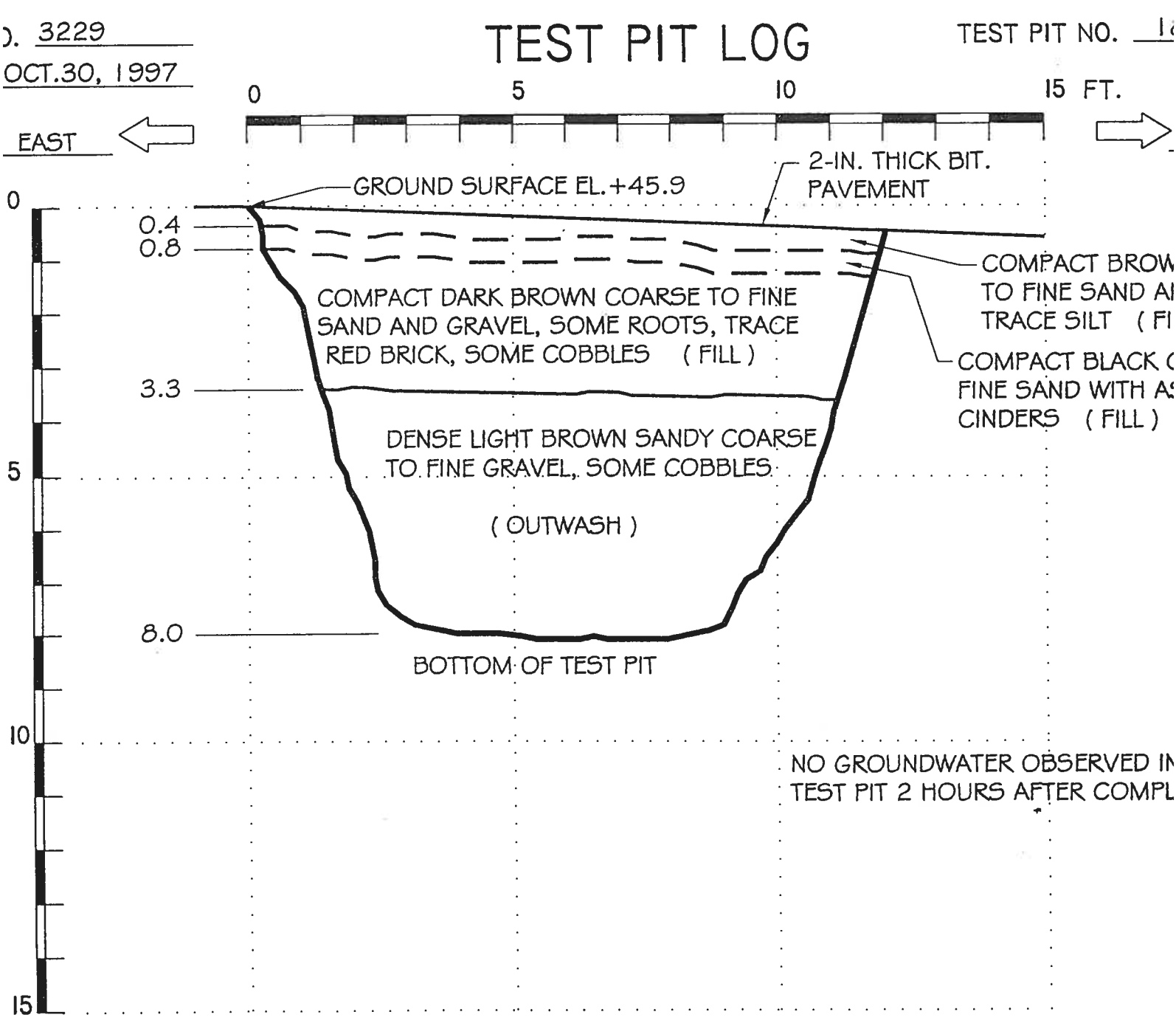
). 3229

OCT.30, 1997

TEST PIT LOG

TEST PIT NO. 1





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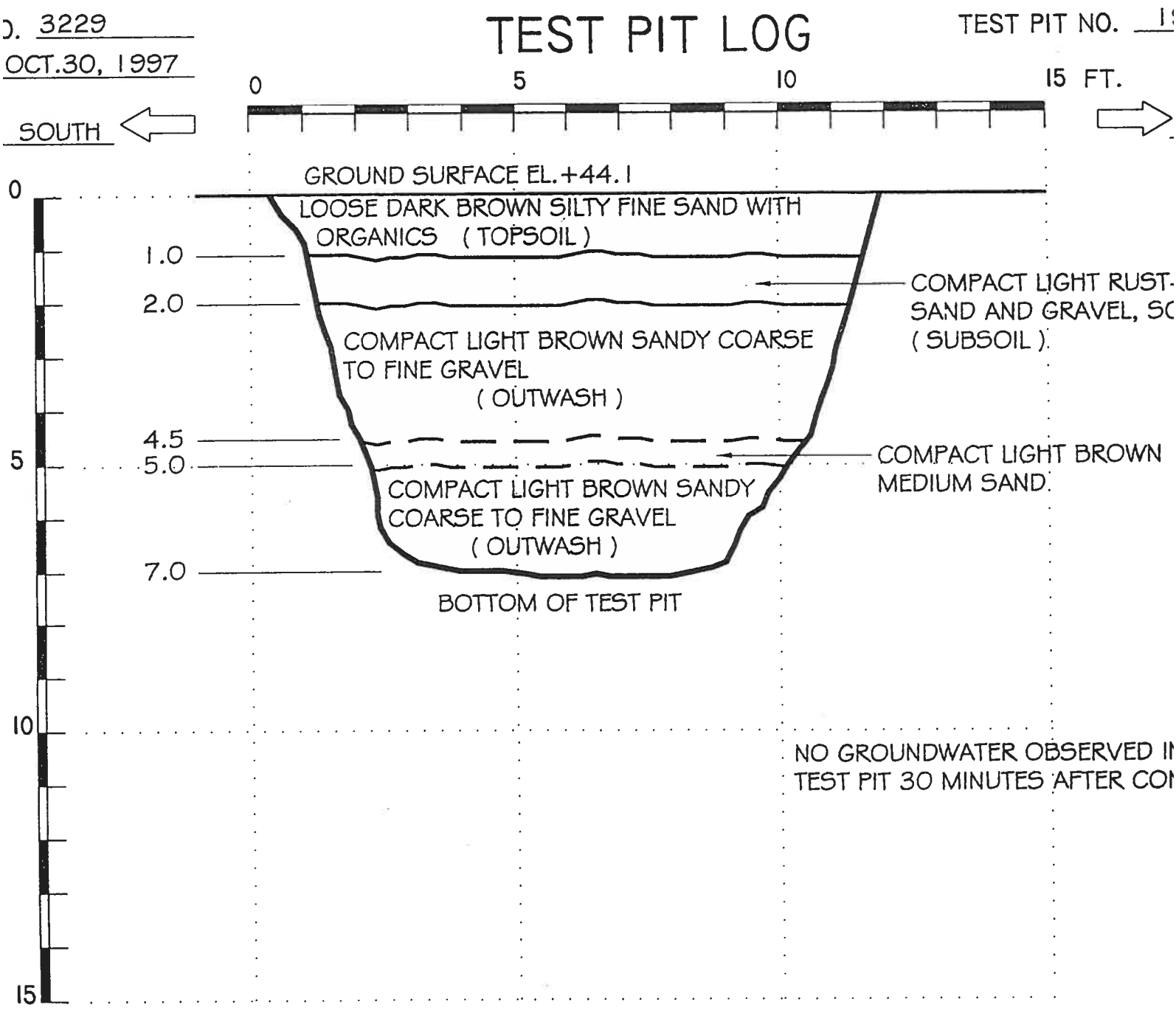
OCT.30, 1997



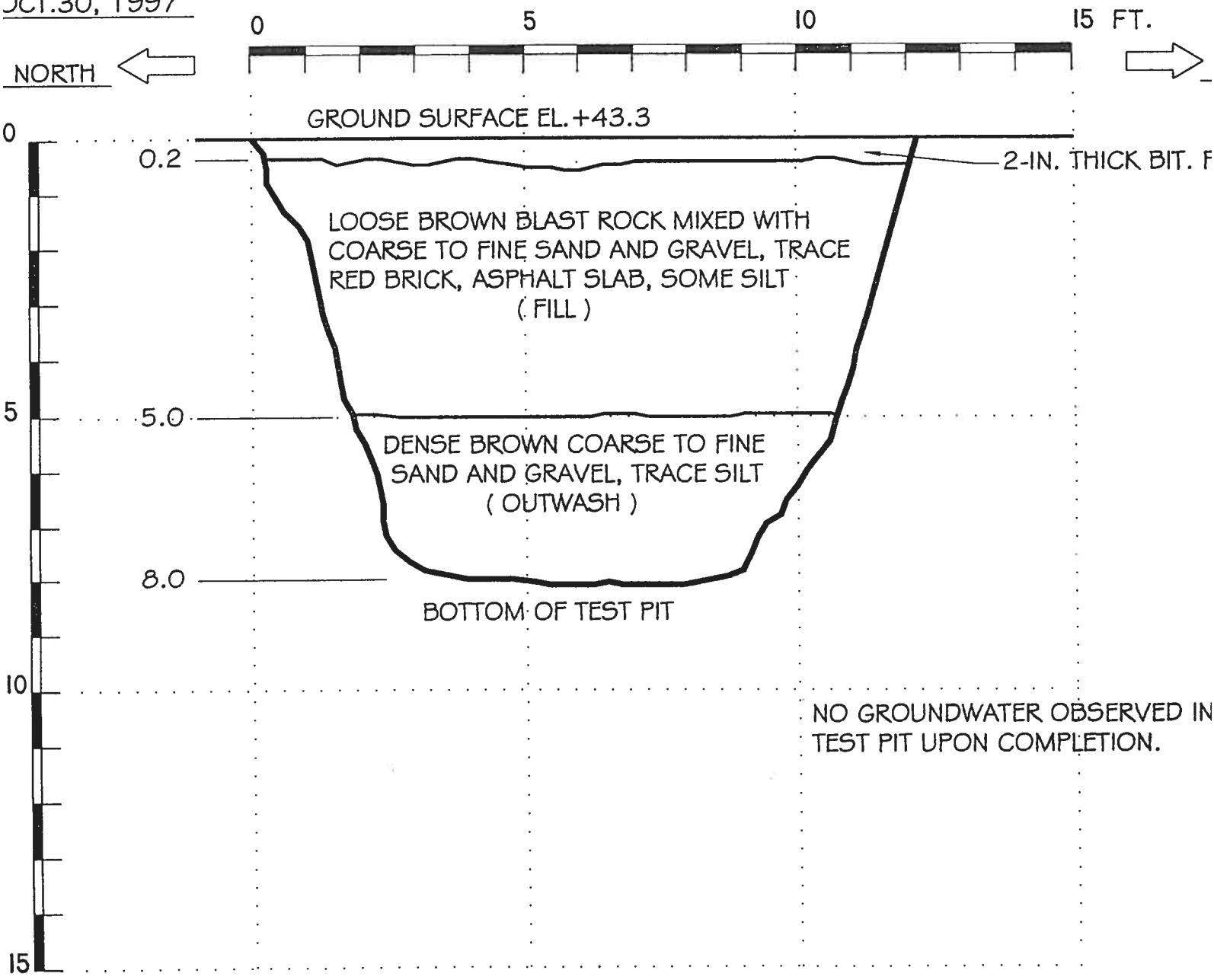
D. 3229
OCT.30, 1997

). 3229

OCT.30, 1997

TEST PIT LOG

TEST PIT NO. 2C



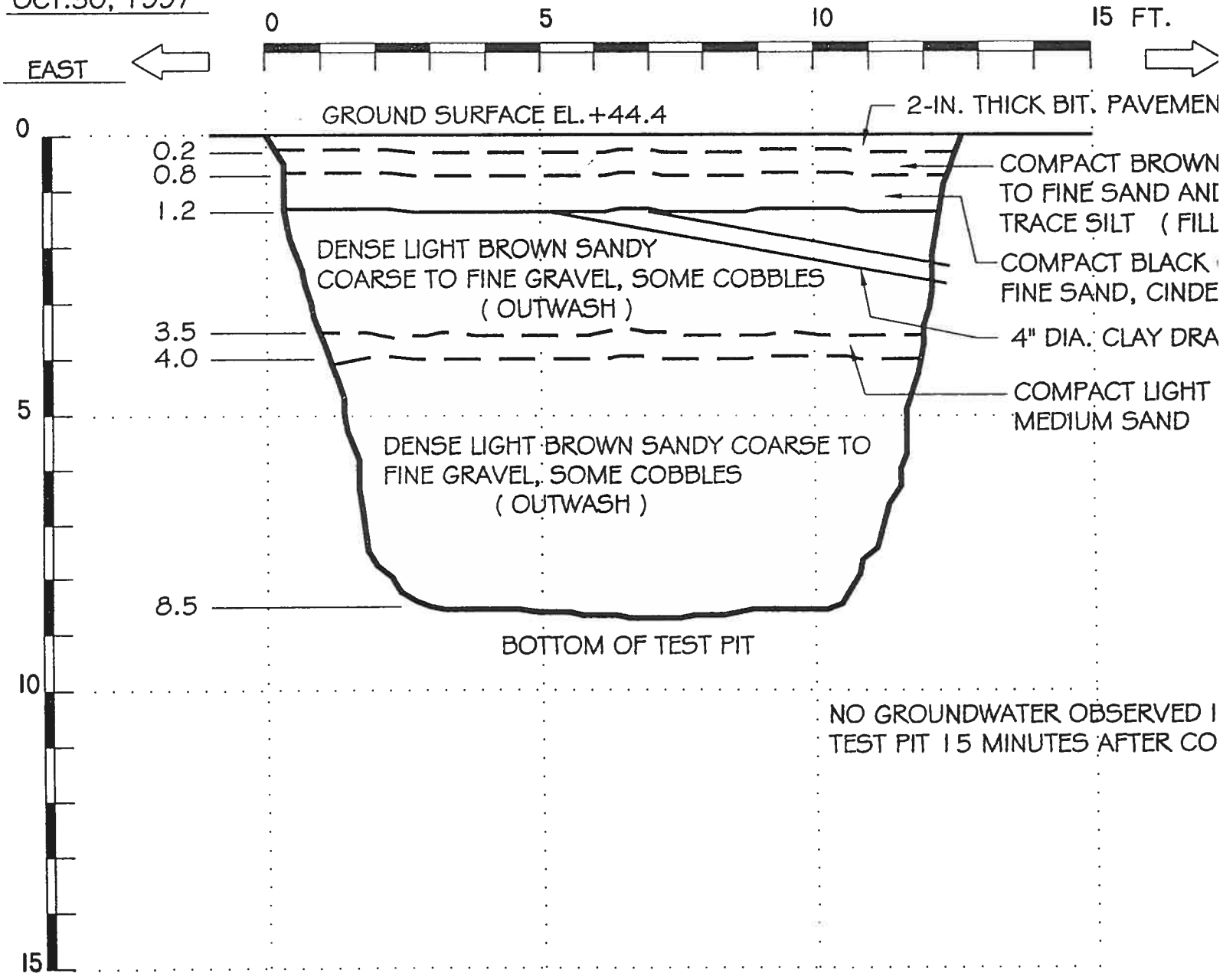
NO GROUNDWATER OBSERVED IN TEST PIT UPON COMPLETION.

O. 3229

OCT.30, 1997

TEST PIT LOG

TEST PIT NO. 2



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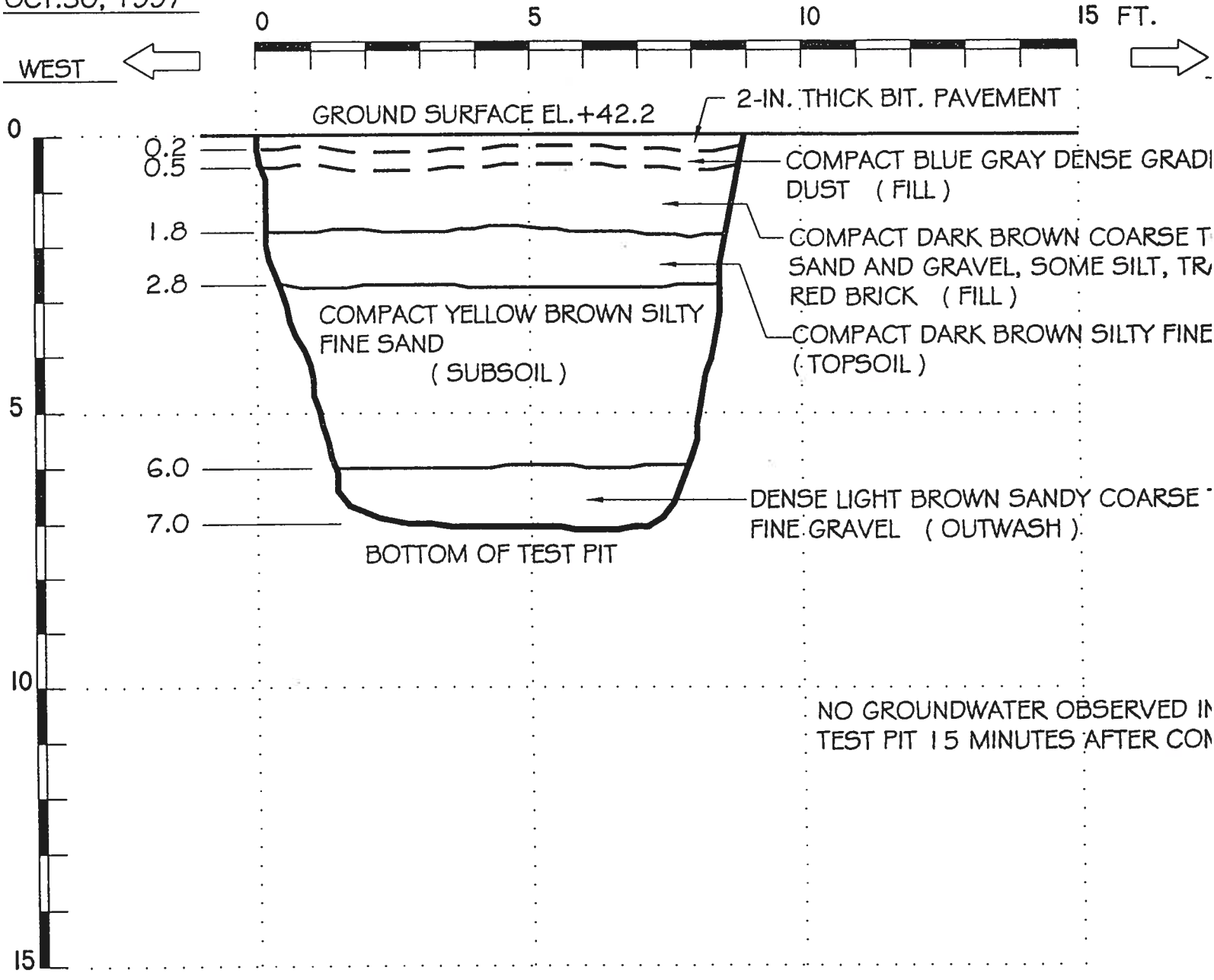
OCT.30, 1997

TEST PIT LOG

TEST PIT NO. 2

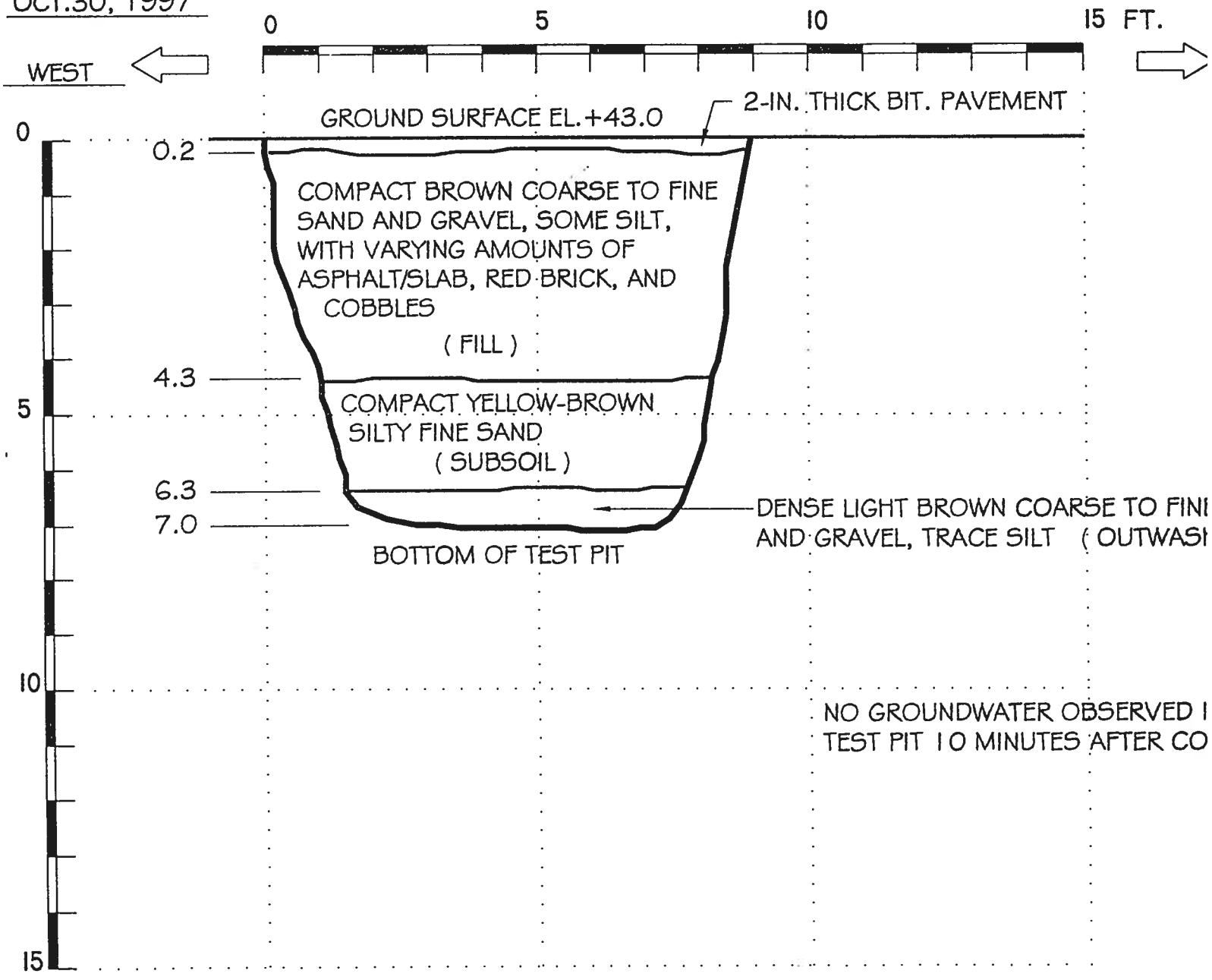


O. 3229

OCT.30, 1997

TEST PIT LOG

TEST PIT NO. 2

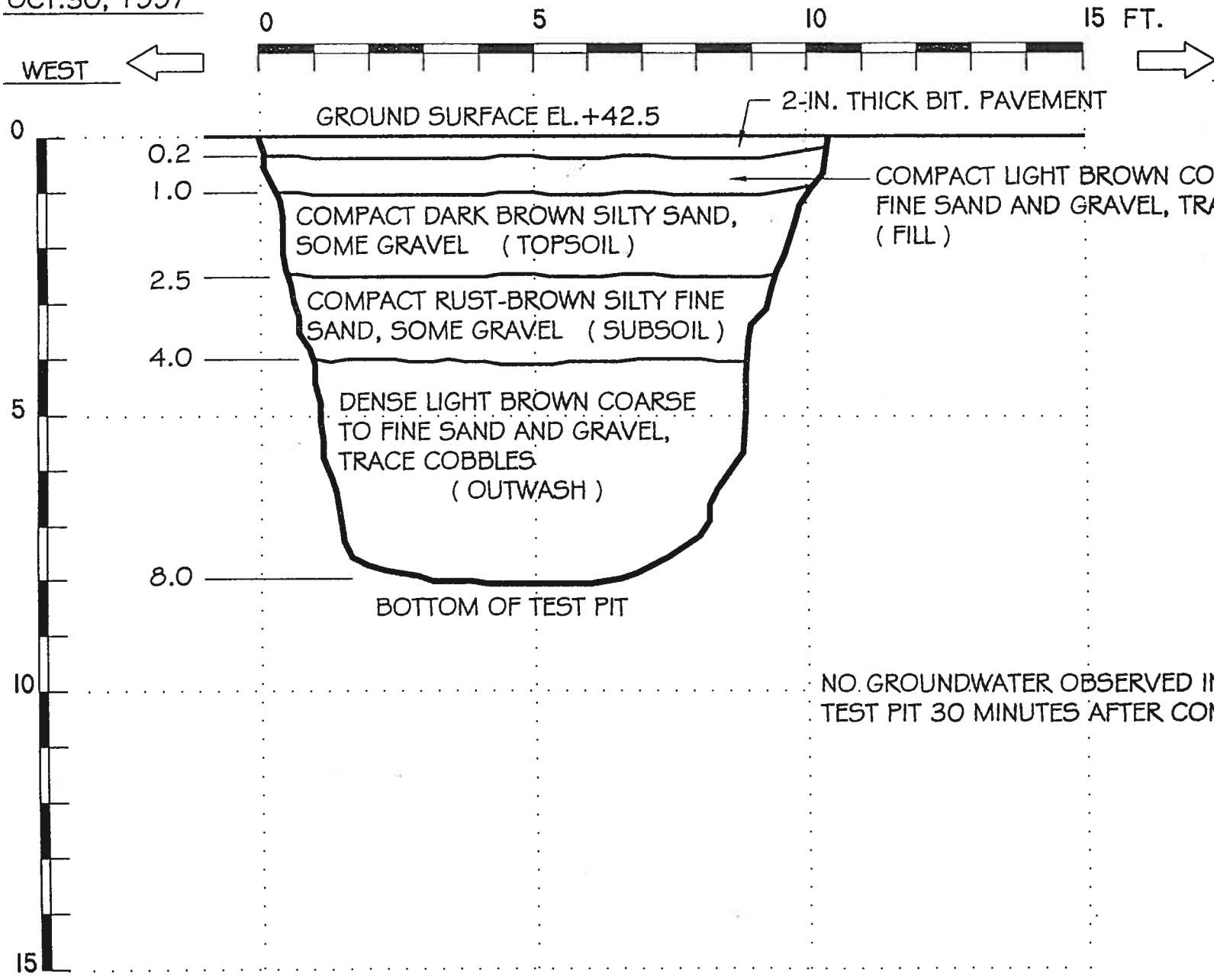


O. 3229

OCT.30, 1997

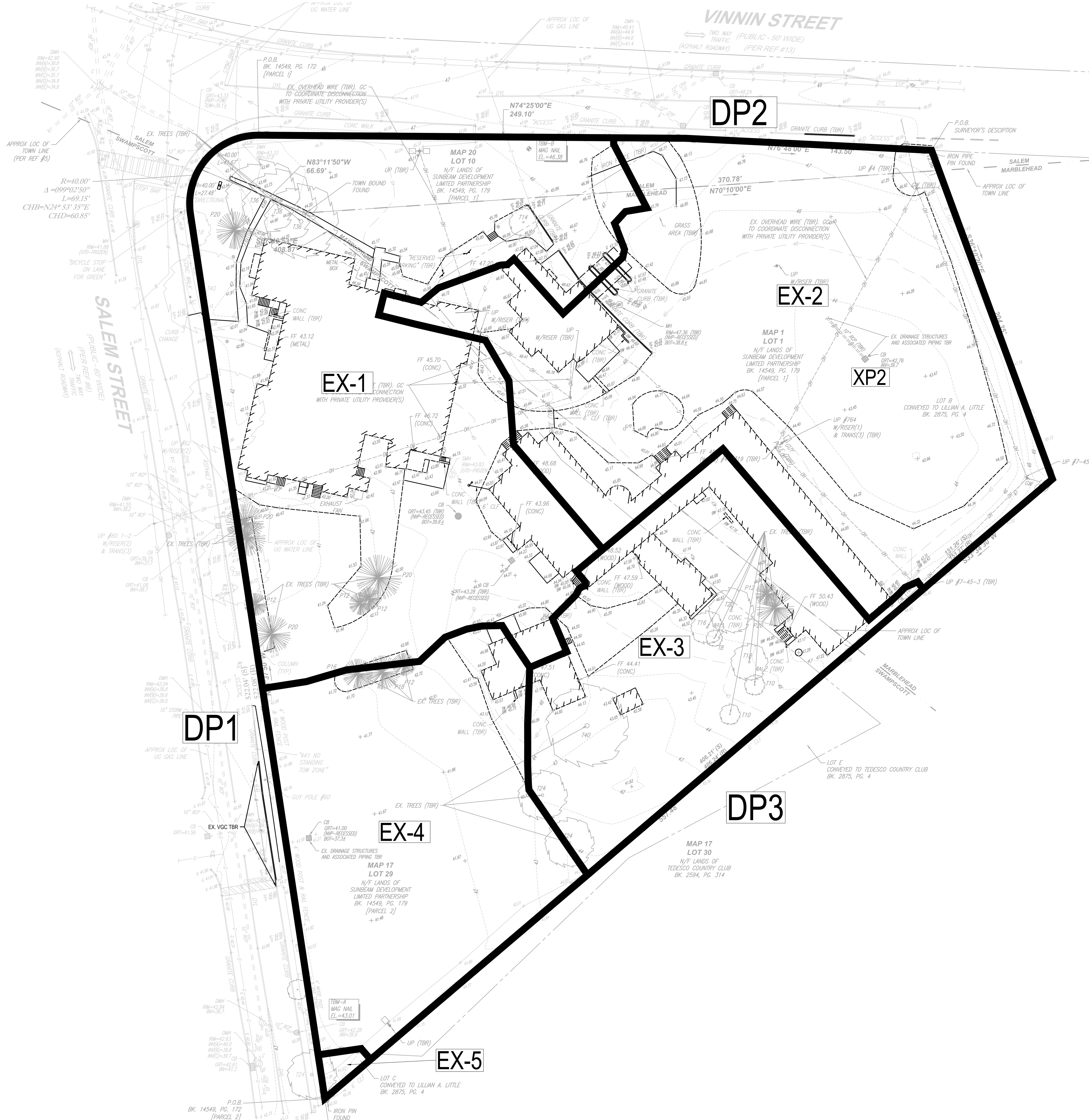
TEST PIT LOG

TEST PIT NO. 2



APPENDIX D: EXISTING CONDITIONS HYDROLOGIC ANALYSIS

- *EXISTING CONDITIONS DRAINAGE MAP*
- *EXISTING CONDITIONS HYDROCAD COMPUTATIONS*



THIS PLAN TO BE UTILIZED FOR UTILITIES PURPOSES ONLY. REFER TO GENERAL NOTES SHEET FOR ADDITIONAL GRADING & UTILITY NOTES

30 15 7.5 0 30

1"= 30'

P:\21\M211002\CAD\DRAWINGS\PLAN SETS\CIVIL SITE PLANS\M211002-SPPD-0E----->LAYOUT: EXISTING DRAIN MAP

BOHLER//

SITE CIVIL AND CONSULTING ENGINEERING
LAND SURVEYING
PROGRAM MANAGEMENT
LANDSCAPE ARCHITECTURE
SUSTAINABLE DESIGN
PERMITTING SERVICES
TRANSPORTATION SERVICES

REVISIONS

REV	DATE	COMMENT	DRAWN BY / CHECKED BY

811 Know what's below. Call before you dig.
ALWAYS CALL 811
It's fast. It's free. It's the law.

ISSUED FOR PERMIT

THIS DRAWING IS INTENDED FOR MUNICIPAL AND/OR AGENCY REVIEW AND APPROVAL. IT IS NOT INTENDED AS A CONSTRUCTION DOCUMENT UNLESS INDICATED OTHERWISE.

PROJECT No.:	M211002
DRAWN BY:	APM/ACL
CHECKED BY:	EEG/TAH
DATE:	10/14/2021
CAD I.D.:	M211002-SPPD-0E

PROJECT:

SITE PLAN DOCUMENTS

FOR

LEGGAT McCALL PROPERTIES, LLC

PROPOSED
RESIDENTIAL DEVELOPMENT

299 SALEM ST,
TOWN OF SWAMPSCOTT;
202-204 TEDESCO ST, TOWN OF MARBLEHEAD;
20 VINNIN SQ, CITY OF SALEM
ESSEX COUNTY, MA

BOHLER//
45 FRANKLIN STREET, 5th FLOOR
BOSTON, MA 02110
Phone: (617) 849-8040
www.BohlerEngineering.com

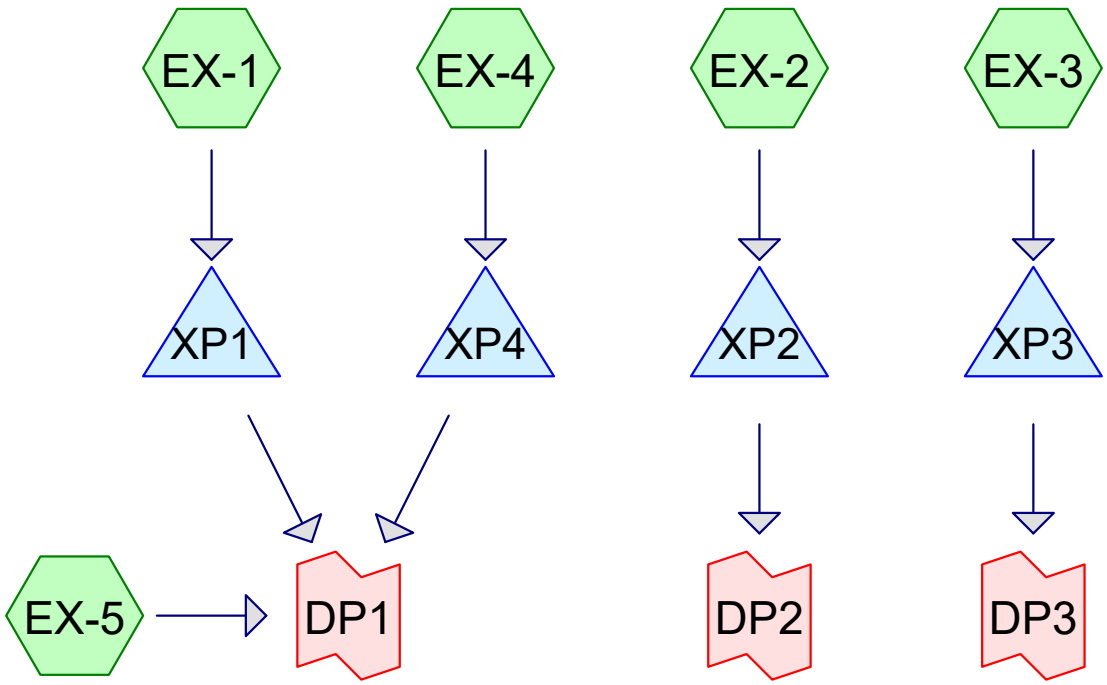
SHEET TITLE:

UTILITY PLAN

SHEET NUMBER:

Exist

ORG. DATE - 10/14/2021



Subcat Reach Pond Link

Routing Diagram for Existing
Prepared by Bohler Engineering, Printed 12/9/2021

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
51,819	49	50-75% Grass cover, Fair, HSG A (EX-1, EX-2, EX-3, EX-4, EX-5)
92,743	98	Paved parking, HSG A (EX-1, EX-2, EX-3, EX-4, EX-5)
32,420	98	Roofs, HSG A (EX-1, EX-2, EX-3, EX-4)
176,982	**84**	**TOTAL AREA**

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
176,982	HSG A	EX-1, EX-2, EX-3, EX-4, EX-5
0	HSG B	
0	HSG C	
0	HSG D	
0	Other	
176,982		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Su Nu
51,819	0	0	0	0	51,819	50-75% Grass cover, Fair	
92,743	0	0	0	0	92,743	Paved parking	
32,420	0	0	0	0	32,420	Roofs	
176,982	**0**	**0**	**0**	**0**	**176,982**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	XP2	39.70	39.60	10.0	0.0100	0.012	10.0	0.0	0.0

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentEX-1: Runoff Area=59,119 sf 78.07% Impervious Runoff Depth=1.89"
Tc=6.0 min CN=87 Runoff=3.00 cfs 9,303 cf

SubcatchmentEX-2: Runoff Area=60,234 sf 72.35% Impervious Runoff Depth=1.66"
Tc=6.0 min CN=84 Runoff=2.69 cfs 8,319 cf

SubcatchmentEX-3: Runoff Area=26,841 sf 30.32% Impervious Runoff Depth=0.55"
Tc=6.0 min CN=64 Runoff=0.29 cfs 1,220 cf

SubcatchmentEX-4: Runoff Area=30,313 sf 89.48% Impervious Runoff Depth=2.42"
Tc=6.0 min CN=93 Runoff=1.91 cfs 6,105 cf

SubcatchmentEX-5: Runoff Area=475 sf 36.00% Impervious Runoff Depth=0.67"
Tc=6.0 min CN=67 Runoff=0.01 cfs 27 cf

Pond XP1: Peak Elev=41.53' Storage=2,494 cf Inflow=3.00 cfs 9,303 cf
Discarded=0.31 cfs 7,604 cf Primary=1.82 cfs 1,699 cf Outflow=2.13 cfs 9,303 cf

Pond XP2: Peak Elev=41.16' Storage=18 cf Inflow=2.69 cfs 8,319 cf
Discarded=0.00 cfs 39 cf Primary=2.68 cfs 8,279 cf Outflow=2.69 cfs 8,319 cf

Pond XP3: Peak Elev=42.47' Storage=287 cf Inflow=0.29 cfs 1,220 cf
Discarded=0.07 cfs 1,220 cf Primary=0.00 cfs 0 cf Outflow=0.07 cfs 1,220 cf

Pond XP4: Peak Elev=41.72' Storage=1,989 cf Inflow=1.91 cfs 6,105 cf
Discarded=0.46 cfs 6,105 cf Primary=0.00 cfs 0 cf Outflow=0.46 cfs 6,105 cf

Link DP1: Inflow=1.82 cfs 1,726 cf
Primary=1.82 cfs 1,726 cf

Link DP2: Inflow=2.68 cfs 8,279 cf
Primary=2.68 cfs 8,279 cf

Link DP3: Inflow=0.00 cfs 0 cf
Primary=0.00 cfs 0 cf

Total Runoff Area = 176,982 sf Runoff Volume = 24,973 cf Average Runoff Depth = 1.69"
29.28% Pervious = 51,819 sf 70.72% Impervious = 125,163 sf

Summary for Subcatchment EX-1:

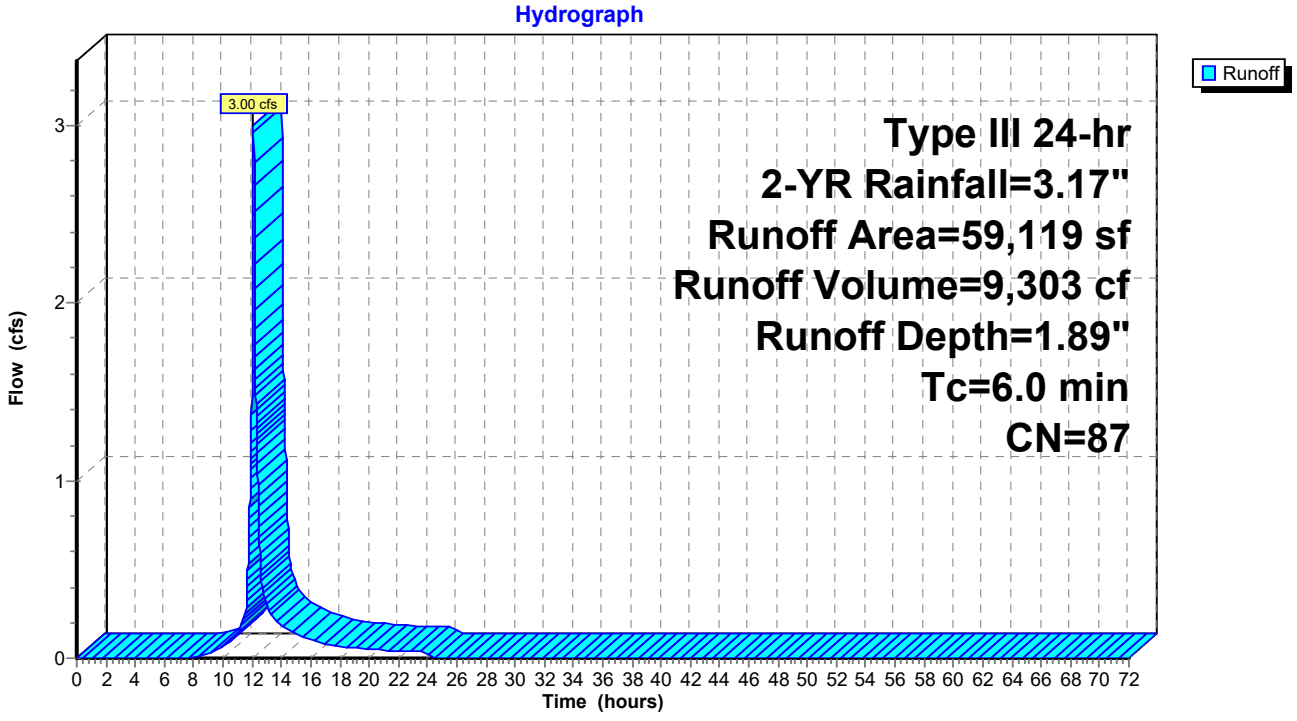
Runoff = 3.00 cfs @ 12.09 hrs, Volume= 9,303 cf, Depth= 1.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.17"

Area (sf)	CN	Description
12,967	49	50-75% Grass cover, Fair, HSG A
18,026	98	Roofs, HSG A
28,126	98	Paved parking, HSG A
59,119	87	Weighted Average
12,967		21.93% Pervious Area
46,152		78.07% Impervious Area

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

Subcatchment EX-1:



Summary for Subcatchment EX-2:

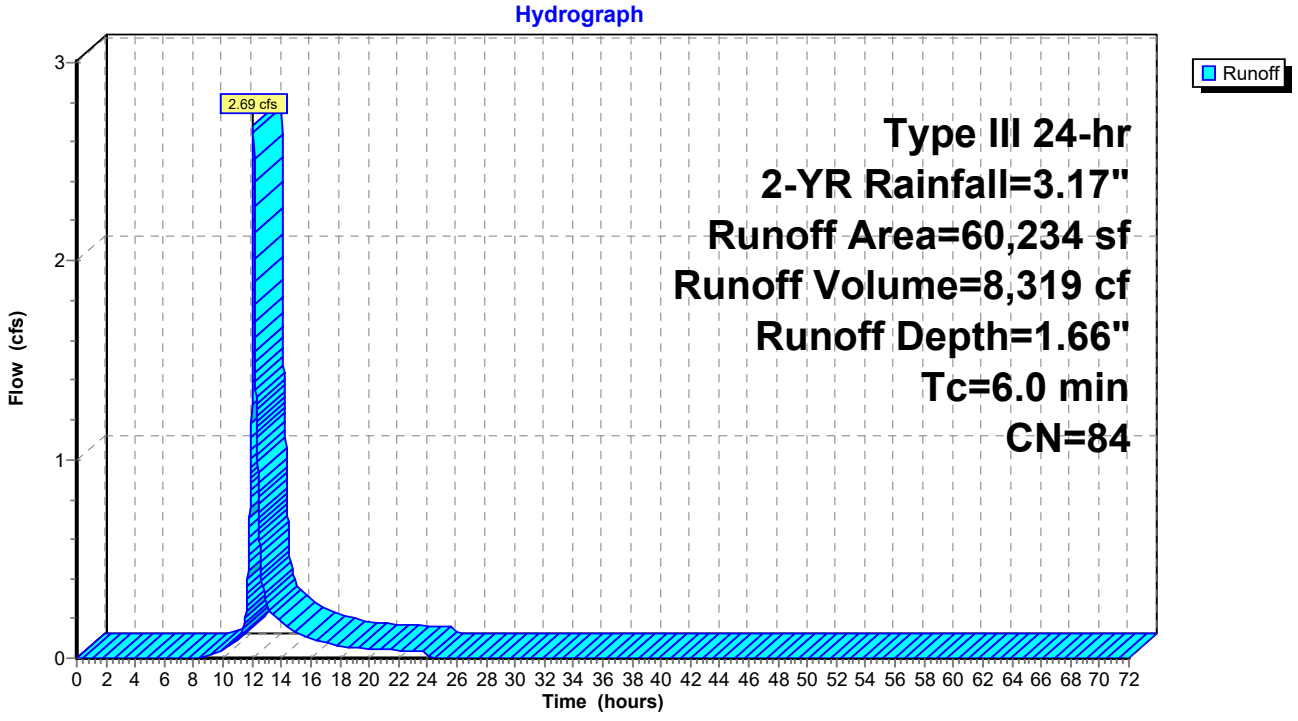
Runoff = 2.69 cfs @ 12.09 hrs, Volume= 8,319 cf, Depth= 1.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.17"

Area (sf)	CN	Description
7,425	98	Roofs, HSG A
16,654	49	50-75% Grass cover, Fair, HSG A
36,155	98	Paved parking, HSG A
60,234	84	Weighted Average
16,654		27.65% Pervious Area
43,580		72.35% Impervious Area

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

Subcatchment EX-2:



Summary for Subcatchment EX-3:

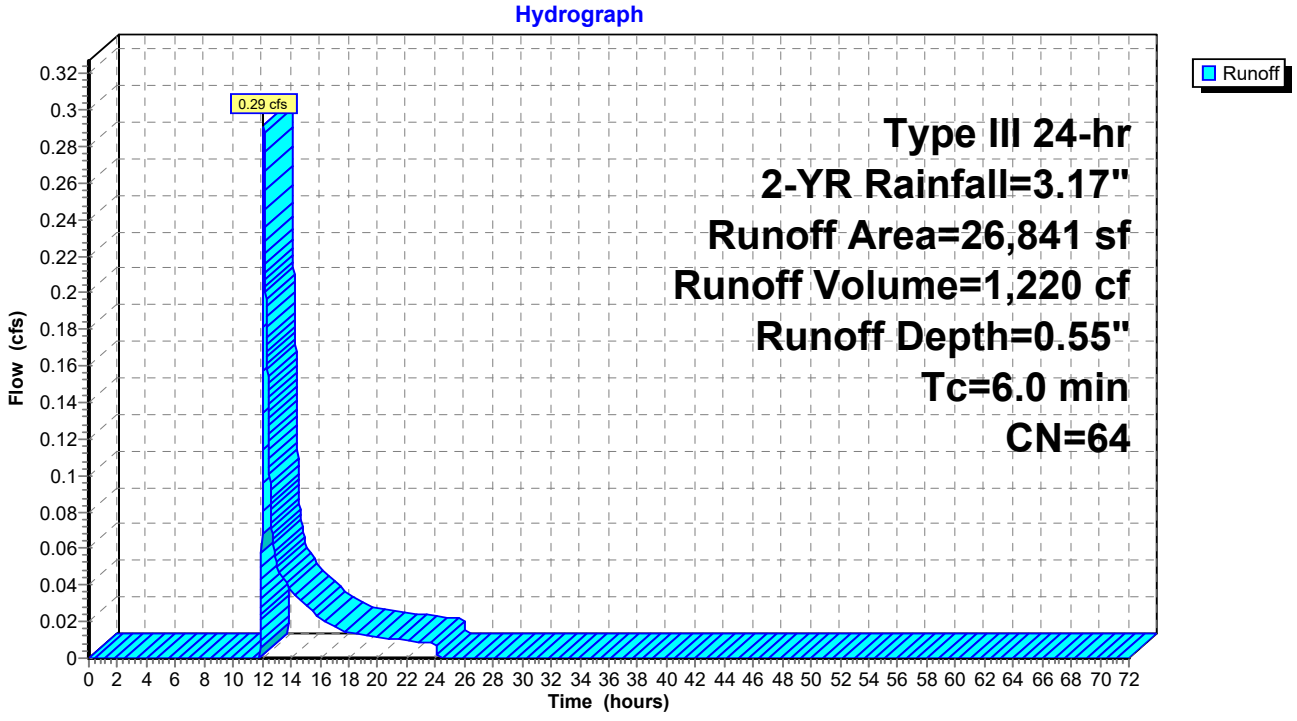
Runoff = 0.29 cfs @ 12.11 hrs, Volume= 1,220 cf, Depth= 0.55"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.17"

Area (sf)	CN	Description
18,704	49	50-75% Grass cover, Fair, HSG A
6,328	98	Roofs, HSG A
1,809	98	Paved parking, HSG A
26,841	64	Weighted Average
18,704		69.68% Pervious Area
8,137		30.32% Impervious Area

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

Subcatchment EX-3:



Summary for Subcatchment EX-4:

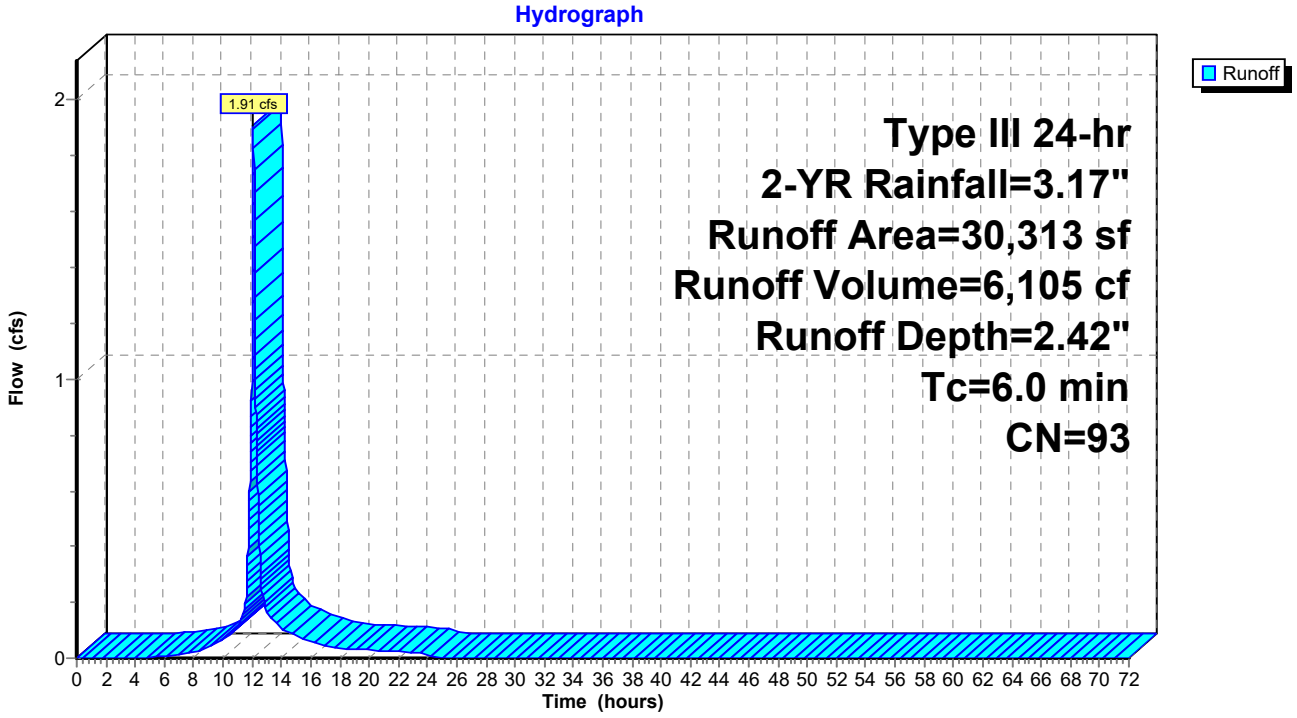
Runoff = 1.91 cfs @ 12.09 hrs, Volume= 6,105 cf, Depth= 2.42"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.17"

Area (sf)	CN	Description
3,190	49	50-75% Grass cover, Fair, HSG A
641	98	Roofs, HSG A
26,482	98	Paved parking, HSG A
30,313	93	Weighted Average
3,190		10.52% Pervious Area
27,123		89.48% Impervious Area

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

Subcatchment EX-4:



Summary for Subcatchment EX-5:

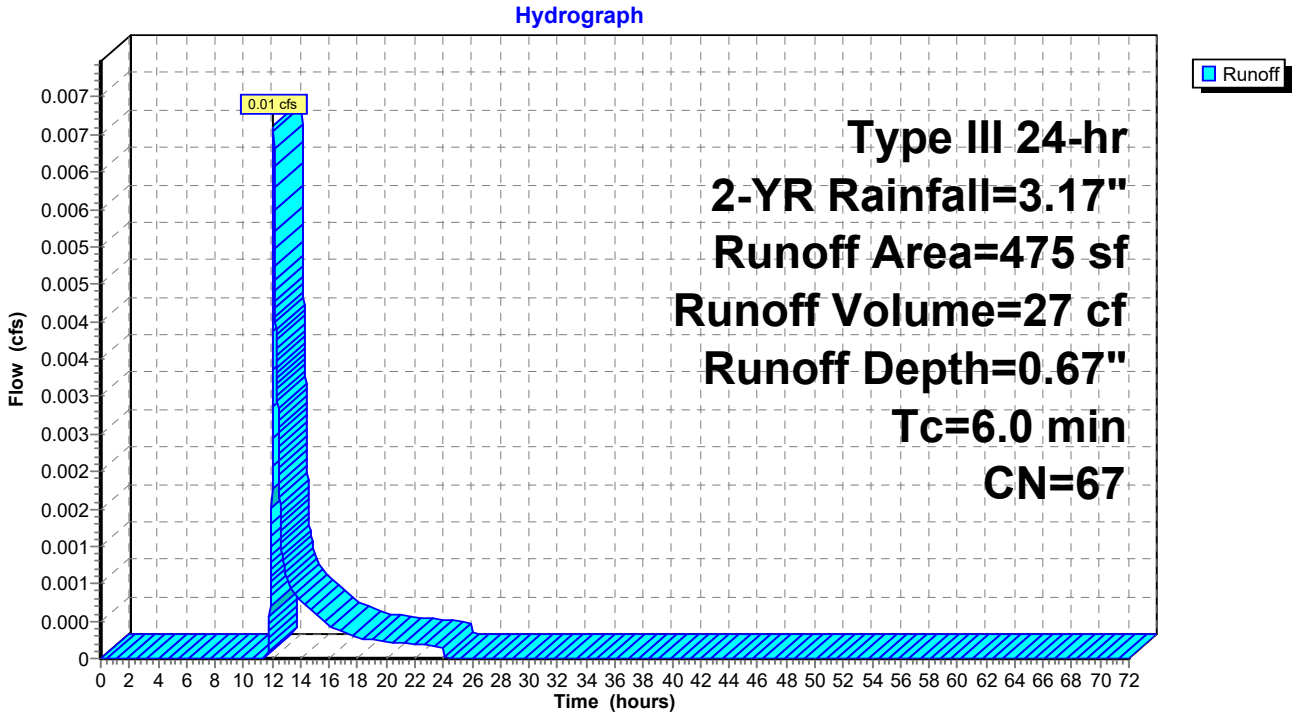
Runoff = 0.01 cfs @ 12.10 hrs, Volume= 27 cf, Depth= 0.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.17"

Area (sf)	CN	Description
304	49	50-75% Grass cover, Fair, HSG A
171	98	Paved parking, HSG A
475	67	Weighted Average
304		64.00% Pervious Area
171		36.00% Impervious Area

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

Subcatchment EX-5:



Summary for Pond XP1:

Inflow Area = 59,119 sf, 78.07% Impervious, Inflow Depth = 1.89" for 2-YR event
Inflow = 3.00 cfs @ 12.09 hrs, Volume= 9,303 cf
Outflow = 2.13 cfs @ 12.17 hrs, Volume= 9,303 cf, Atten= 29%, Lag= 4.8 min
Discarded = 0.31 cfs @ 12.17 hrs, Volume= 7,604 cf
Primary = 1.82 cfs @ 12.17 hrs, Volume= 1,699 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 41.53' @ 12.17 hrs Surf.Area= 5,507 sf Storage= 2,494 cf

Plug-Flow detention time= 76.2 min calculated for 9,303 cf (100% of inflow)
Center-of-Mass det. time= 76.2 min (895.5 - 819.3)

Volume	Invert	Avail.Storage	Storage Description
#1	40.43'	2,878 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

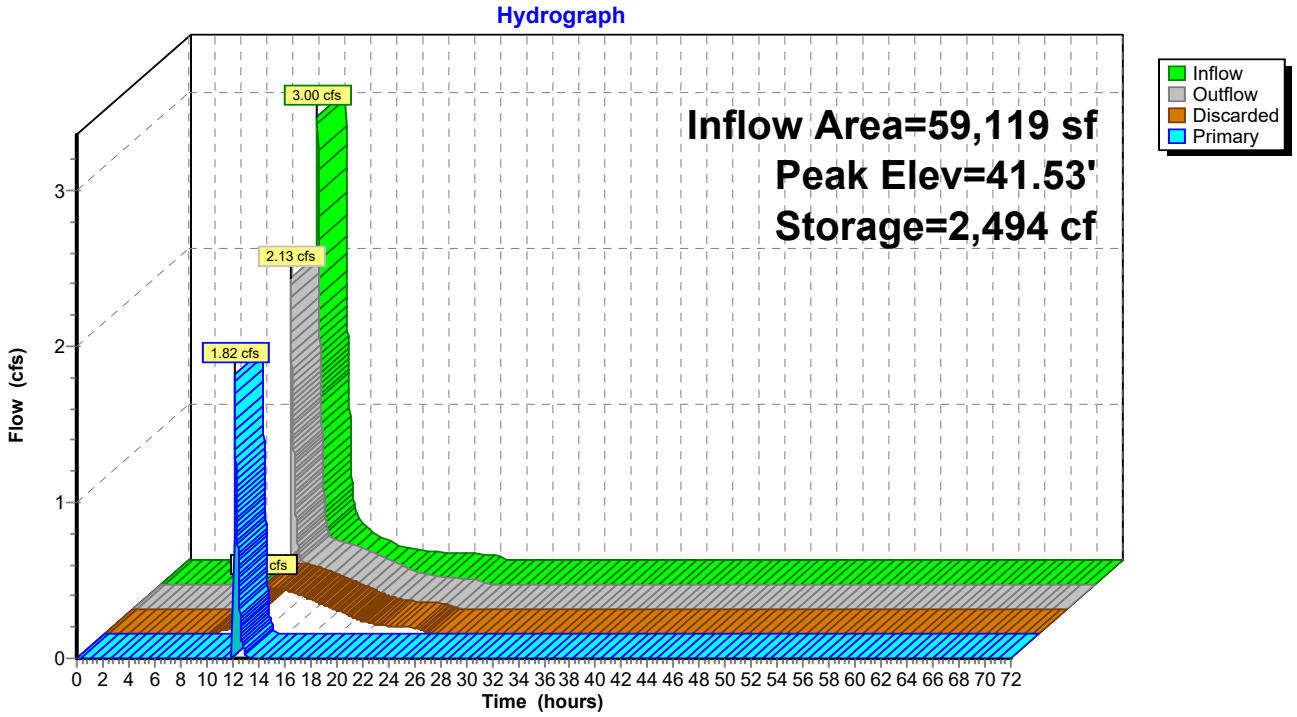
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
40.43	1	0	0	1
41.00	2,354	457	457	2,355
41.60	5,995	2,421	2,878	5,998

Device	Routing	Invert	Outlet Devices
#1	Primary	41.50'	**127.0' long x 5.0' 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 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88
#2	Discarded	40.43'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.31 cfs @ 12.17 hrs HW=41.53' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.31 cfs)

Primary OutFlow Max=1.80 cfs @ 12.17 hrs HW=41.53' (Free Discharge)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 1.80 cfs @ 0.43 fps)

Pond XP1:


Hydrograph
Inflow Area=59,119 sf
Peak Elev=41.53'
Storage=2,494 cf
3.00 cfs
2.13 cfs
1.82 cfs
cfs
Inflow
Outflow
Discarded
Primary
Flow (cfs)
0
1
2
3
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72
Time (hours)

Summary for Pond XP2:

Inflow Area = 60,234 sf, 72.35% Impervious, Inflow Depth = 1.66" for 2-YR event
Inflow = 2.69 cfs @ 12.09 hrs, Volume= 8,319 cf
Outflow = 2.69 cfs @ 12.09 hrs, Volume= 8,319 cf, Atten= 0%, Lag= 0.2 min
Discarded = 0.00 cfs @ 8.81 hrs, Volume= 39 cf
Primary = 2.68 cfs @ 12.09 hrs, Volume= 8,279 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 41.16' @ 12.09 hrs Surf.Area= 13 sf Storage= 18 cf

Plug-Flow detention time= 0.3 min calculated for 8,317 cf (100% of inflow)
Center-of-Mass det. time= 0.3 min (830.2 - 830.0)

Volume	Invert	Avail.Storage	Storage Description
#1	39.70'	38 cf	**4.00'D x 3.06'H Vertical Cone/Cylinder**
#2	42.76'	3,754 cf	**Custom Stage Data (Conic)** Listed below (Recalc)
		3,793 cf	Total Available Storage

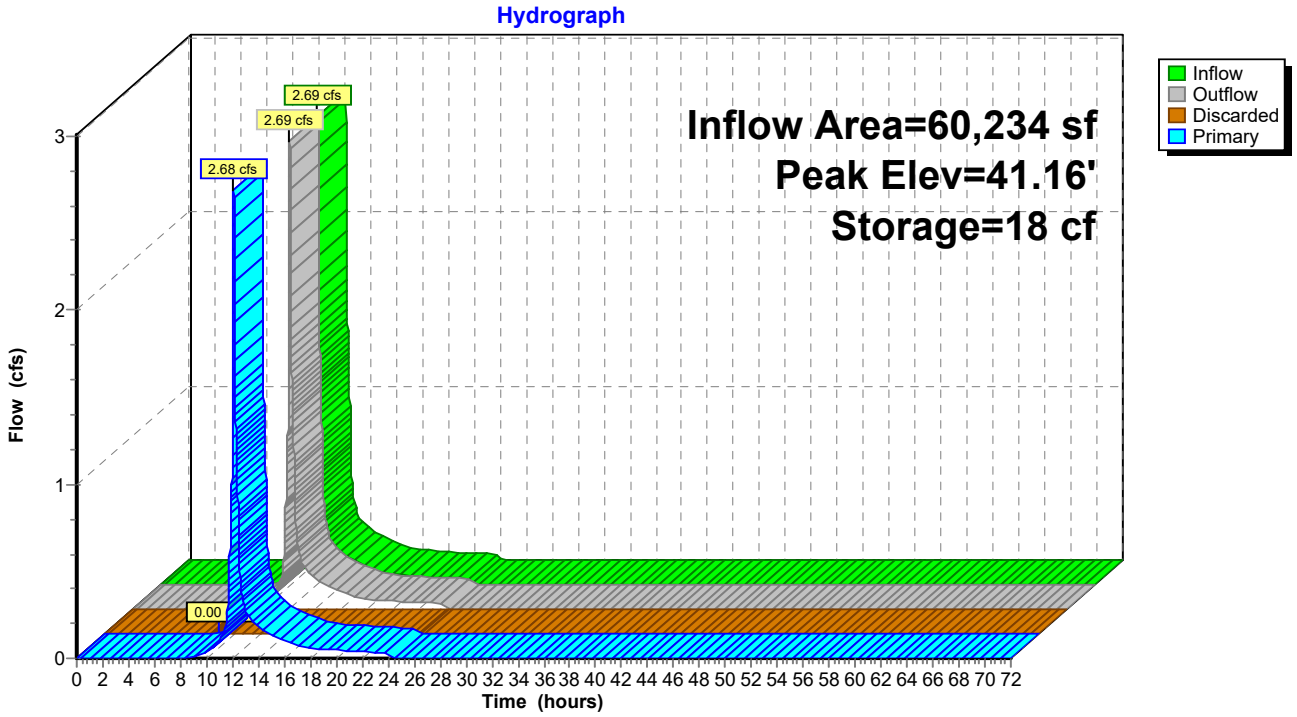
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
42.76	1	0	0	1
44.00	8,987	3,754	3,754	8,989

Device	Routing	Invert	Outlet Devices
#1	Primary	39.70'	**10.0" Round Culvert** L= 10.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 39.70' / 39.60' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 0.55 sf
#2	Discarded	39.70'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.00 cfs @ 8.81 hrs HW=39.74' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=2.68 cfs @ 12.09 hrs HW=41.16' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 2.68 cfs @ 4.92 fps)

Pond XP2:


Hydrograph
Inflow Area=60,234 sf
Peak Elev=41.16'
Storage=18 cf
2.69 cfs
2.69 cfs
2.68 cfs
0.00
Inflow
Outflow
Discarded
Primary
Flow (cfs)
Time (hours)
0 1 2 3
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72

Summary for Pond XP3:

Inflow Area = 26,841 sf, 30.32% Impervious, Inflow Depth = 0.55" for 2-YR event
Inflow = 0.29 cfs @ 12.11 hrs, Volume= 1,220 cf
Outflow = 0.07 cfs @ 12.64 hrs, Volume= 1,220 cf, Atten= 76%, Lag= 31.5 min
Discarded = 0.07 cfs @ 12.64 hrs, Volume= 1,220 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 42.47' @ 12.64 hrs Surf.Area= 1,279 sf Storage= 287 cf

Plug-Flow detention time= 48.8 min calculated for 1,219 cf (100% of inflow)
Center-of-Mass det. time= 48.8 min (949.7 - 900.8)

Volume	Invert	Avail.Storage	Storage Description
#1	41.83'	4,750 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

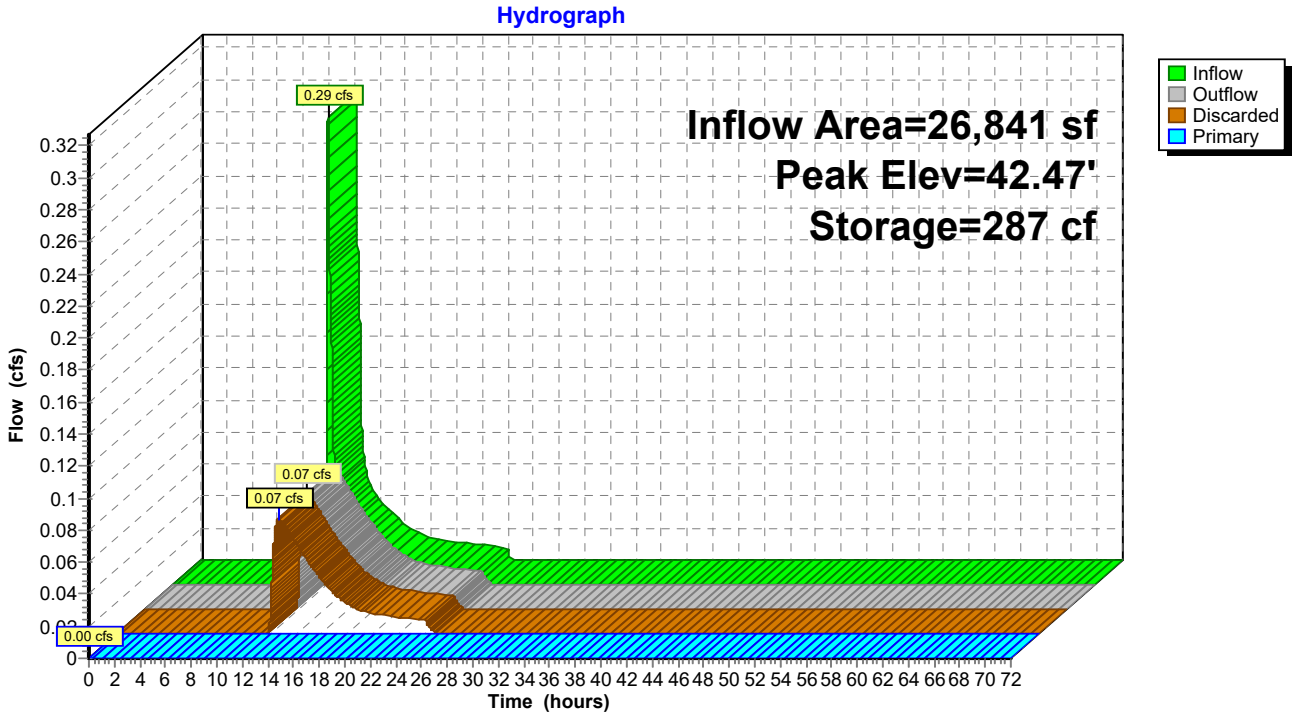
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
41.83	1	0	0	1
42.00	119	7	7	119
43.00	4,090	1,636	1,643	4,092
43.60	6,348	3,107	4,750	6,355

Device	Routing	Invert	Outlet Devices
#1	Primary	43.50'	**56.0' long x 5.0' 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 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88
#2	Discarded	41.83'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.07 cfs @ 12.64 hrs HW=42.47' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.07 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=41.83' (Free Discharge)
↑—**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond XP3:


Hydrograph
Inflow Area=26,841 sf
Peak Elev=42.47'
Storage=287 cf
Inflow
Outflow
Discarded
Primary
0.29 cfs
0.07 cfs
0.07 cfs
0.00 cfs
Flow (cfs)
0.32
0.3
0.28
0.26
0.24
0.22
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72
Time (hours)

Summary for Pond XP4:

Inflow Area = 30,313 sf, 89.48% Impervious, Inflow Depth = 2.42" for 2-YR event
Inflow = 1.91 cfs @ 12.09 hrs, Volume= 6,105 cf
Outflow = 0.46 cfs @ 12.48 hrs, Volume= 6,105 cf, Atten= 76%, Lag= 23.5 min
Discarded = 0.46 cfs @ 12.48 hrs, Volume= 6,105 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 41.72' @ 12.48 hrs Surf.Area= 8,166 sf Storage= 1,989 cf

Plug-Flow detention time= 48.3 min calculated for 6,105 cf (100% of inflow)
Center-of-Mass det. time= 48.3 min (841.3 - 793.0)

Volume	Invert	Avail.Storage	Storage Description
#1	41.00'	6,940 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

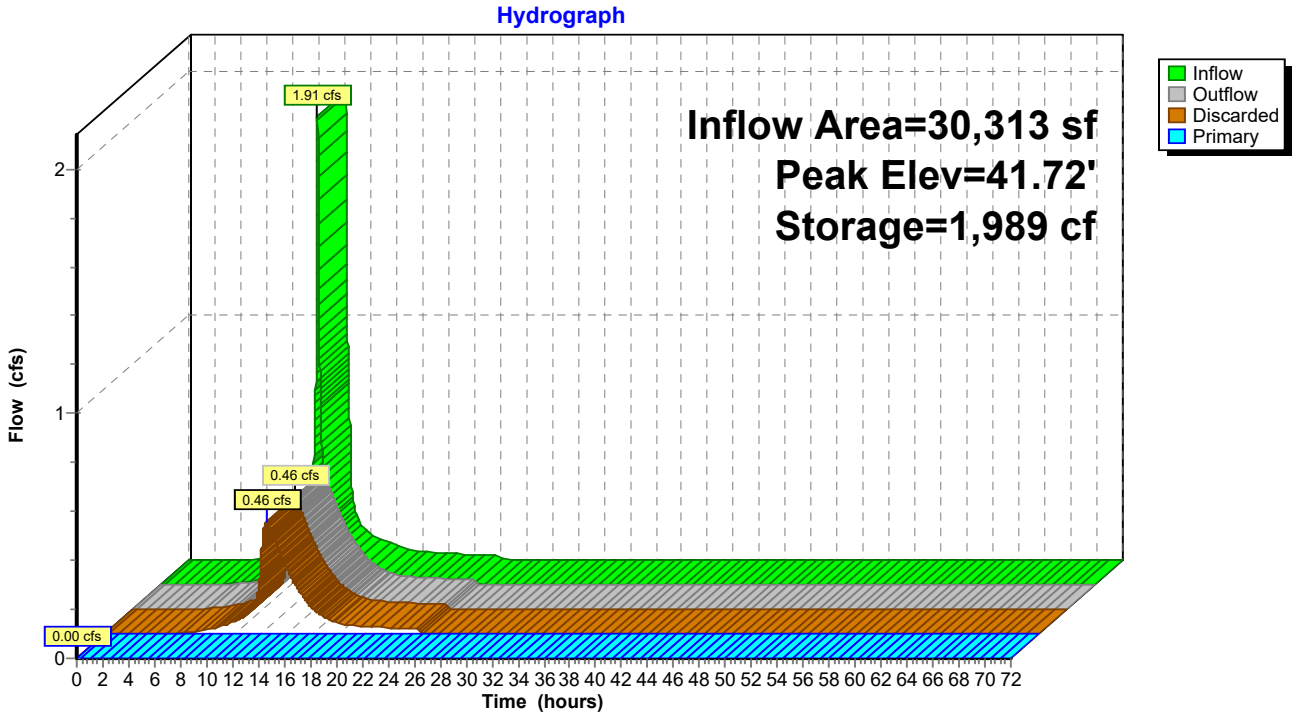
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
41.00	1	0	0	1
42.10	18,789	6,940	6,940	18,791

Device	Routing	Invert	Outlet Devices
#1	Primary	42.00'	**132.0' long x 5.0' 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 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88
#2	Discarded	41.00'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.46 cfs @ 12.48 hrs HW=41.72' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.46 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=41.00' (Free Discharge)
↑—**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond XP4:

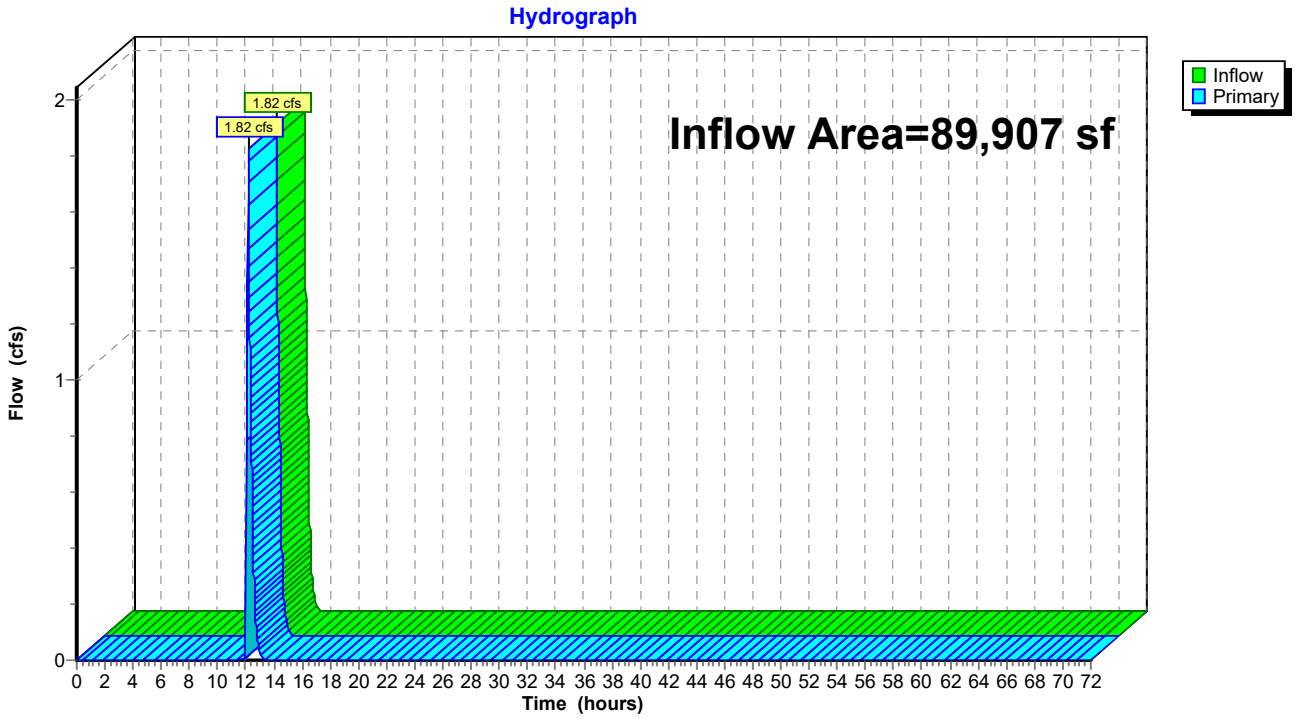

Hydrograph
Inflow Area=30,313 sf
Peak Elev=41.72'
Storage=1,989 cf
1.91 cfs
0.46 cfs
0.46 cfs
0.00 cfs
Inflow
Outflow
Discarded
Primary
Flow (cfs)
0
1
2
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72
Time (hours)

Summary for Link DP1:

Inflow Area = 89,907 sf, 81.69% Impervious, Inflow Depth = 0.23" for 2-YR event
Inflow = 1.82 cfs @ 12.17 hrs, Volume= 1,726 cf
Primary = 1.82 cfs @ 12.17 hrs, Volume= 1,726 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link DP1:

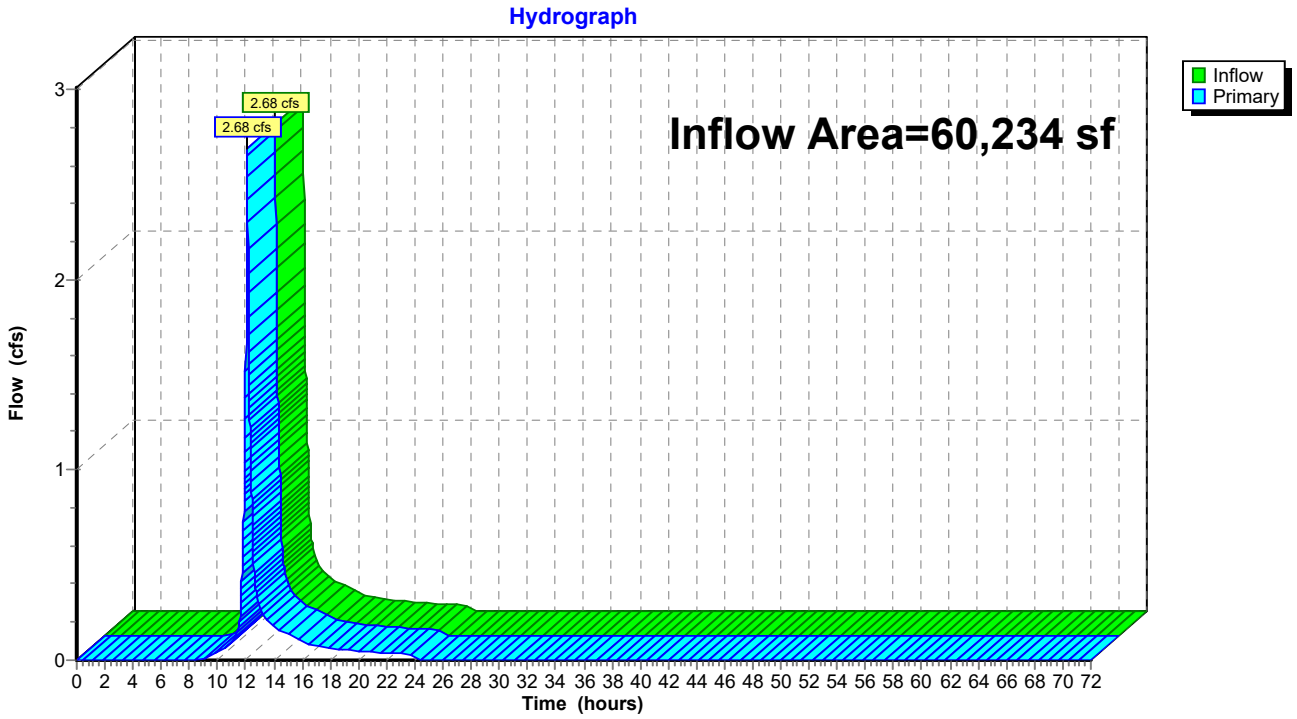


Summary for Link DP2:

Inflow Area = 60,234 sf, 72.35% Impervious, Inflow Depth = 1.65" for 2-YR event
Inflow = 2.68 cfs @ 12.09 hrs, Volume= 8,279 cf
Primary = 2.68 cfs @ 12.09 hrs, Volume= 8,279 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link DP2:

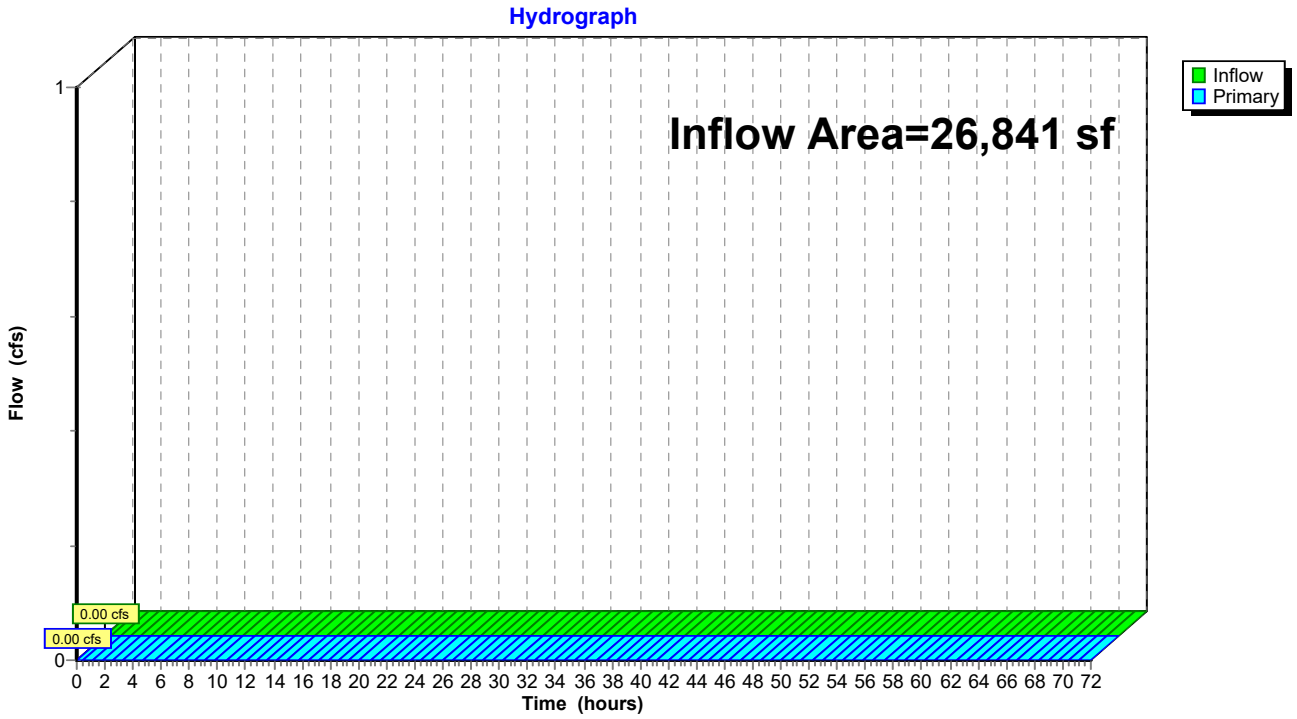


Summary for Link DP3:

Inflow Area = 26,841 sf, 30.32% Impervious, Inflow Depth = 0.00" for 2-YR event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link DP3:



Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentEX-1: Runoff Area=59,119 sf 78.07% Impervious Runoff Depth=3.58"
Tc=6.0 min CN=87 Runoff=5.59 cfs 17,621 cf

SubcatchmentEX-2: Runoff Area=60,234 sf 72.35% Impervious Runoff Depth=3.28"
Tc=6.0 min CN=84 Runoff=5.28 cfs 16,462 cf

SubcatchmentEX-3: Runoff Area=26,841 sf 30.32% Impervious Runoff Depth=1.59"
Tc=6.0 min CN=64 Runoff=1.08 cfs 3,550 cf

SubcatchmentEX-4: Runoff Area=30,313 sf 89.48% Impervious Runoff Depth=4.21"
Tc=6.0 min CN=93 Runoff=3.23 cfs 10,629 cf

SubcatchmentEX-5: Runoff Area=475 sf 36.00% Impervious Runoff Depth=1.81"
Tc=6.0 min CN=67 Runoff=0.02 cfs 72 cf

Pond XP1: Peak Elev=41.57' Storage=2,685 cf Inflow=5.59 cfs 17,621 cf
Discarded=0.32 cfs 10,725 cf Primary=5.19 cfs 6,896 cf Outflow=5.51 cfs 17,621 cf

Pond XP2: Peak Elev=43.18' Storage=191 cf Inflow=5.28 cfs 16,462 cf
Discarded=0.06 cfs 65 cf Primary=4.59 cfs 16,396 cf Outflow=4.65 cfs 16,462 cf

Pond XP3: Peak Elev=42.88' Storage=1,202 cf Inflow=1.08 cfs 3,550 cf
Discarded=0.19 cfs 3,550 cf Primary=0.00 cfs 0 cf Outflow=0.19 cfs 3,550 cf

Pond XP4: Peak Elev=41.89' Storage=3,673 cf Inflow=3.23 cfs 10,629 cf
Discarded=0.69 cfs 10,629 cf Primary=0.00 cfs 0 cf Outflow=0.69 cfs 10,629 cf

Link DP1: Inflow=5.21 cfs 6,967 cf
Primary=5.21 cfs 6,967 cf

Link DP2: Inflow=4.59 cfs 16,396 cf
Primary=4.59 cfs 16,396 cf

Link DP3: Inflow=0.00 cfs 0 cf
Primary=0.00 cfs 0 cf

Total Runoff Area = 176,982 sf Runoff Volume = 48,333 cf Average Runoff Depth = 3.28"
29.28% Pervious = 51,819 sf 70.72% Impervious = 125,163 sf

Summary for Subcatchment EX-1:

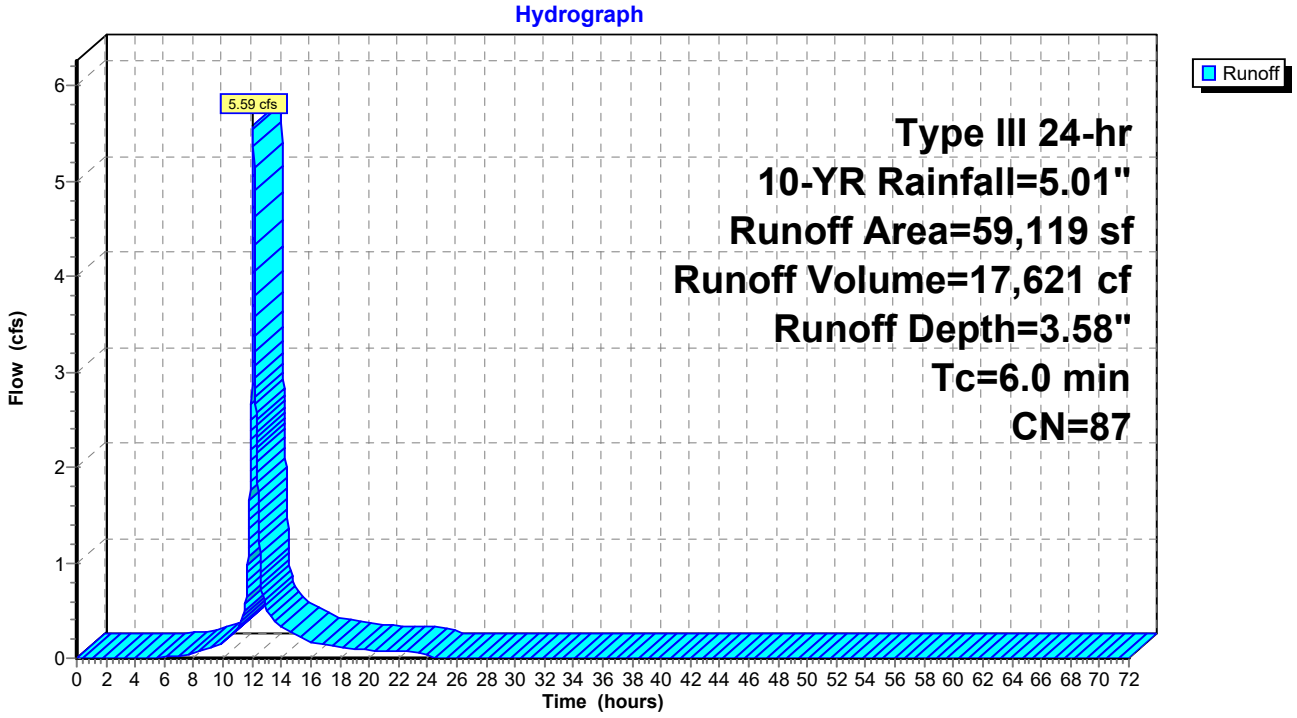
Runoff = 5.59 cfs @ 12.09 hrs, Volume= 17,621 cf, Depth= 3.58"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=5.01"

Area (sf)	CN	Description
12,967	49	50-75% Grass cover, Fair, HSG A
18,026	98	Roofs, HSG A
28,126	98	Paved parking, HSG A
59,119	87	Weighted Average
12,967		21.93% Pervious Area
46,152		78.07% Impervious Area

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

Subcatchment EX-1:



Summary for Subcatchment EX-2:

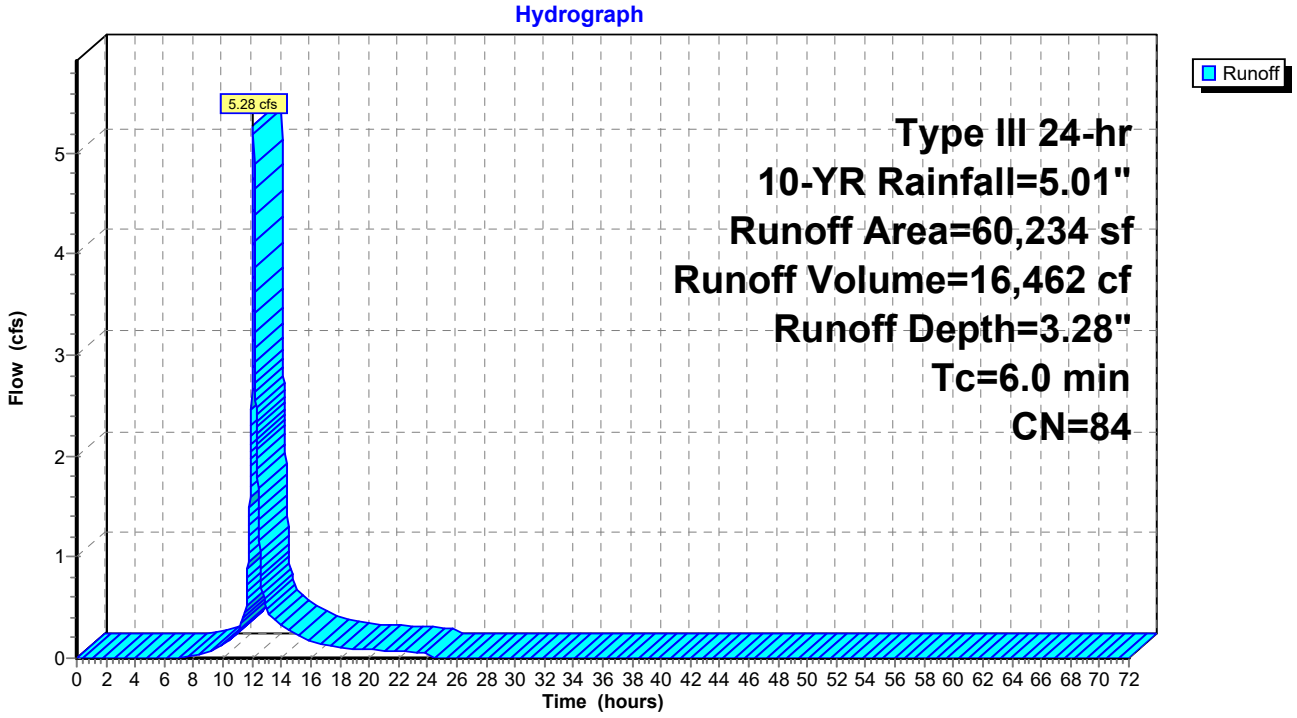
Runoff = 5.28 cfs @ 12.09 hrs, Volume= 16,462 cf, Depth= 3.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=5.01"

Area (sf)	CN	Description
7,425	98	Roofs, HSG A
16,654	49	50-75% Grass cover, Fair, HSG A
36,155	98	Paved parking, HSG A
60,234	84	Weighted Average
16,654		27.65% Pervious Area
43,580		72.35% Impervious Area

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

Subcatchment EX-2:



Summary for Subcatchment EX-3:

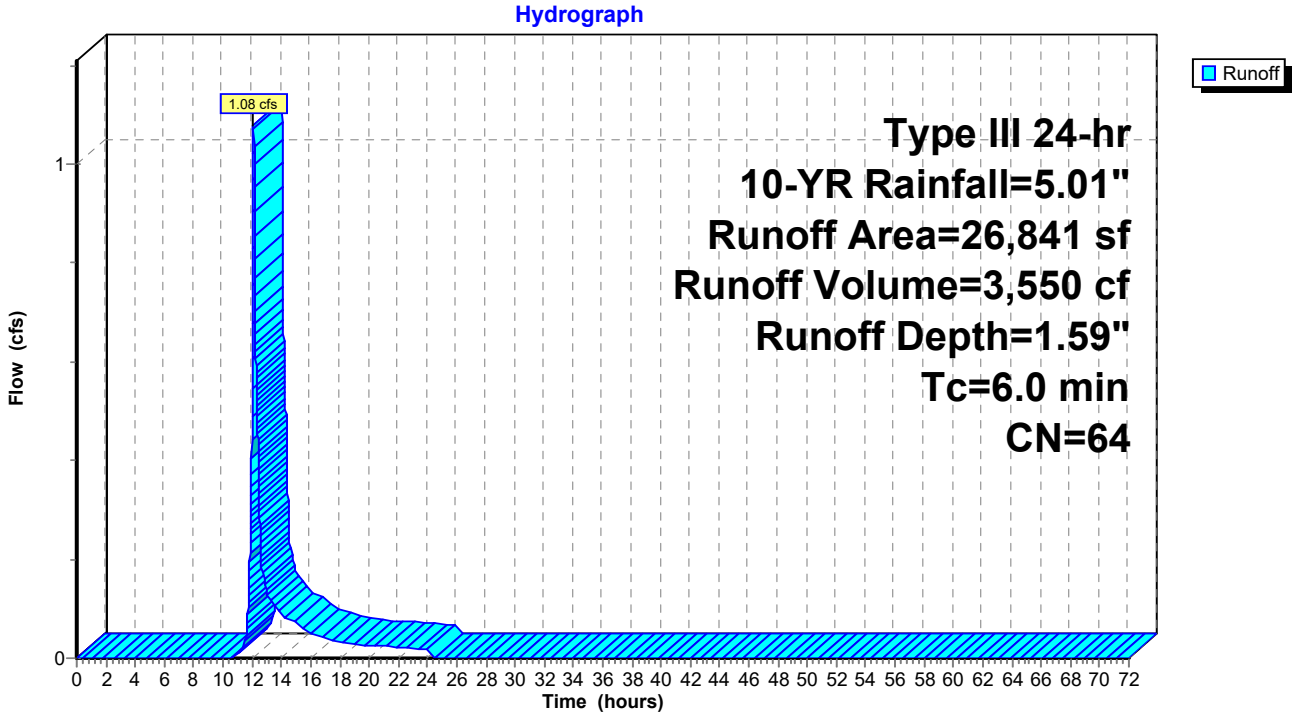
Runoff = 1.08 cfs @ 12.10 hrs, Volume= 3,550 cf, Depth= 1.59"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=5.01"

Area (sf)	CN	Description
18,704	49	50-75% Grass cover, Fair, HSG A
6,328	98	Roofs, HSG A
1,809	98	Paved parking, HSG A
26,841	64	Weighted Average
18,704		69.68% Pervious Area
8,137		30.32% Impervious Area

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

Subcatchment EX-3:



Summary for Subcatchment EX-4:

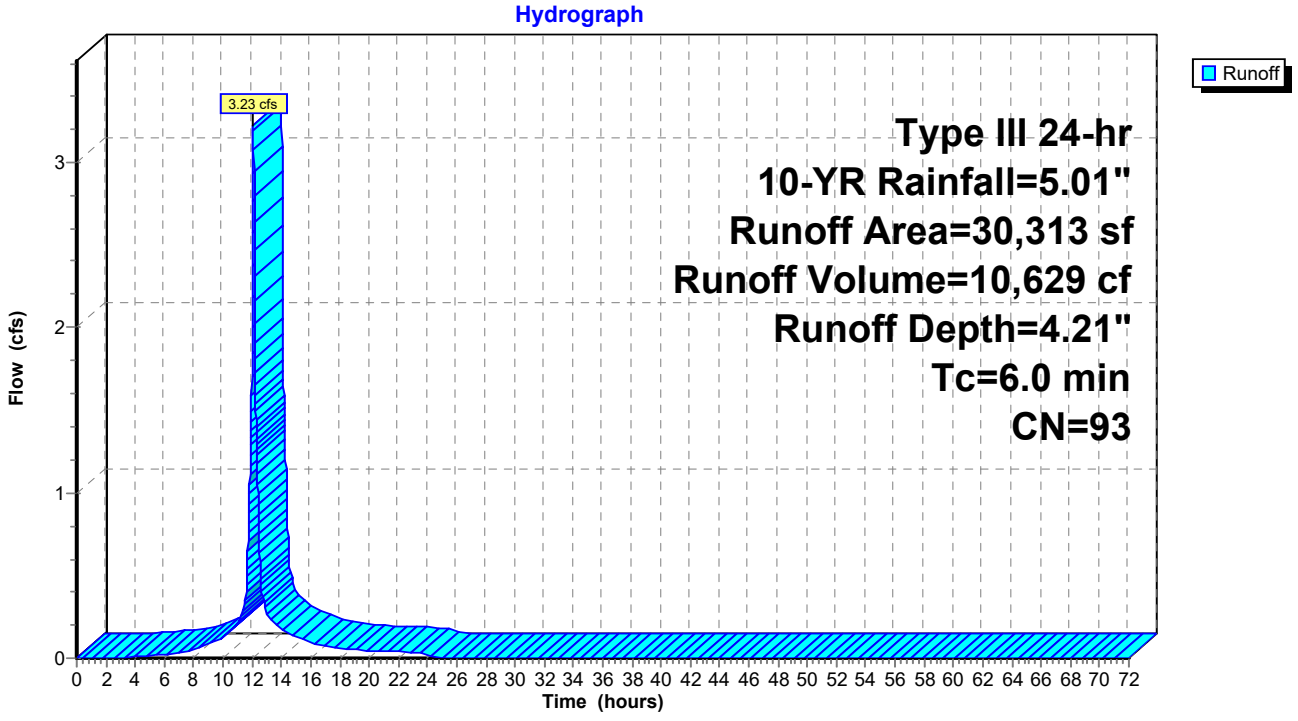
Runoff = 3.23 cfs @ 12.08 hrs, Volume= 10,629 cf, Depth= 4.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=5.01"

Area (sf)	CN	Description
3,190	49	50-75% Grass cover, Fair, HSG A
641	98	Roofs, HSG A
26,482	98	Paved parking, HSG A
30,313	93	Weighted Average
3,190		10.52% Pervious Area
27,123		89.48% Impervious Area

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

Subcatchment EX-4:



Summary for Subcatchment EX-5:

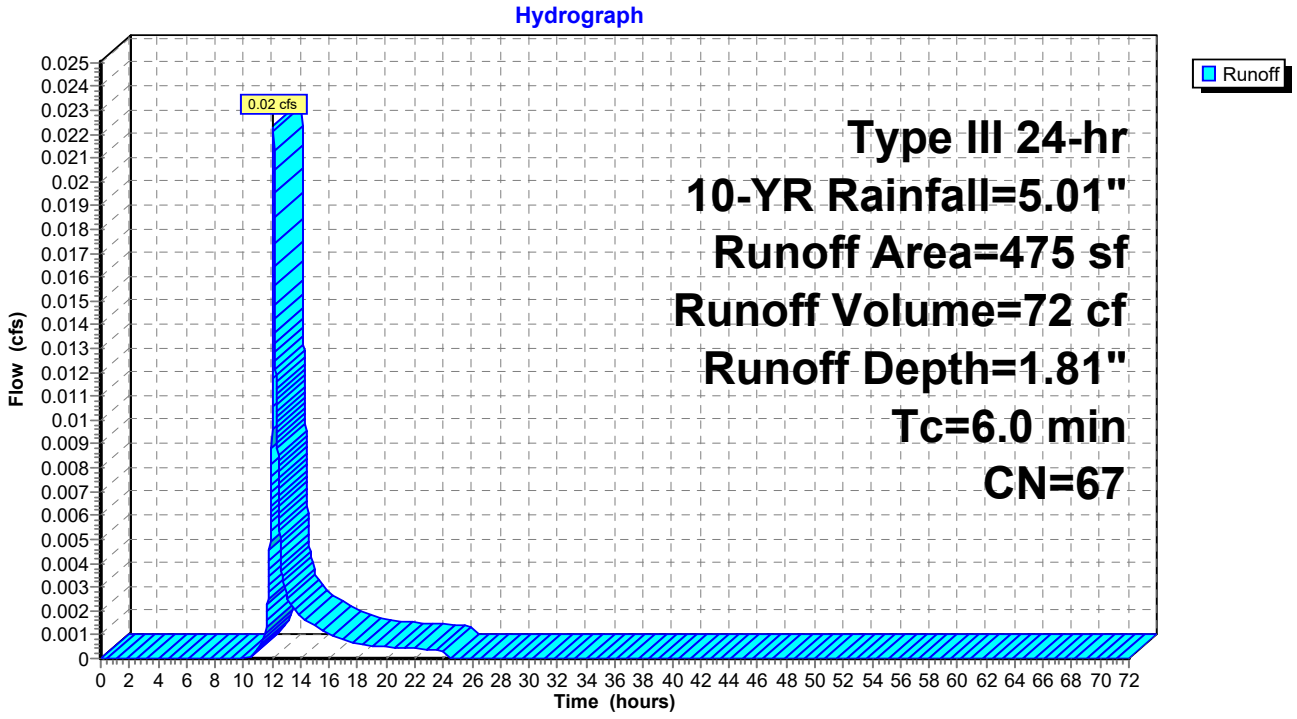
Runoff = 0.02 cfs @ 12.09 hrs, Volume= 72 cf, Depth= 1.81"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=5.01"

Area (sf)	CN	Description
304	49	50-75% Grass cover, Fair, HSG A
171	98	Paved parking, HSG A
475	67	Weighted Average
304		64.00% Pervious Area
171		36.00% Impervious Area

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

Subcatchment EX-5:



Summary for Pond XP1:

Inflow Area = 59,119 sf, 78.07% Impervious, Inflow Depth = 3.58" for 10-YR event
Inflow = 5.59 cfs @ 12.09 hrs, Volume= 17,621 cf
Outflow = 5.51 cfs @ 12.10 hrs, Volume= 17,621 cf, Atten= 1%, Lag= 0.8 min
Discarded = 0.32 cfs @ 12.10 hrs, Volume= 10,725 cf
Primary = 5.19 cfs @ 12.10 hrs, Volume= 6,896 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 41.57' @ 12.10 hrs Surf.Area= 5,753 sf Storage= 2,685 cf

Plug-Flow detention time= 61.0 min calculated for 17,619 cf (100% of inflow)
Center-of-Mass det. time= 61.0 min (862.1 - 801.2)

Volume	Invert	Avail.Storage	Storage Description
#1	40.43'	2,878 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

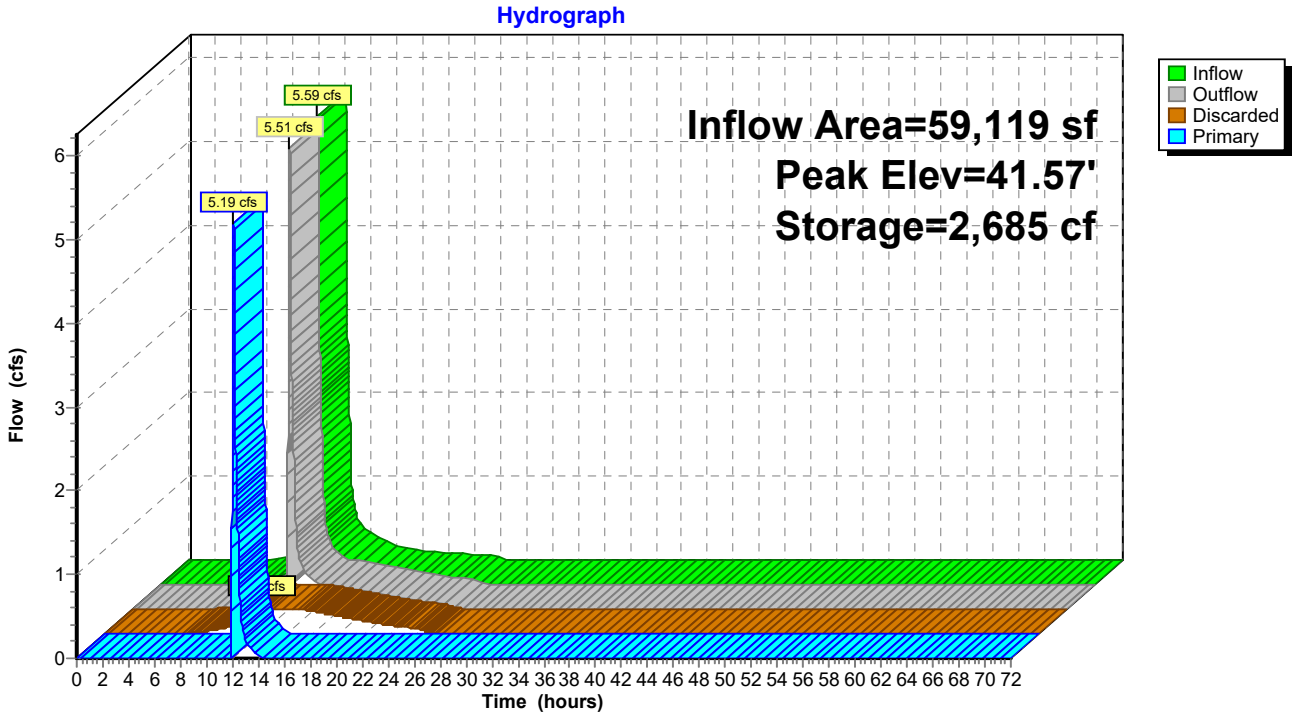
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
40.43	1	0	0	1
41.00	2,354	457	457	2,355
41.60	5,995	2,421	2,878	5,998

Device	Routing	Invert	Outlet Devices
#1	Primary	41.50'	**127.0' long x 5.0' 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 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88
#2	Discarded	40.43'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.32 cfs @ 12.10 hrs HW=41.57' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.32 cfs)

Primary OutFlow Max=5.18 cfs @ 12.10 hrs HW=41.57' (Free Discharge)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 5.18 cfs @ 0.61 fps)

Pond XP1:


Hydrograph
Inflow Area=59,119 sf
Peak Elev=41.57'
Storage=2,685 cf
5.59 cfs
5.51 cfs
5.19 cfs
Inflow
Outflow
Discarded
Primary
Flow (cfs)
Time (hours)
0 1 2 3 4 5 6
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72

Summary for Pond XP2:

Inflow Area = 60,234 sf, 72.35% Impervious, Inflow Depth = 3.28" for 10-YR event
Inflow = 5.28 cfs @ 12.09 hrs, Volume= 16,462 cf
Outflow = 4.65 cfs @ 12.13 hrs, Volume= 16,462 cf, Atten= 12%, Lag= 2.6 min
Discarded = 0.06 cfs @ 12.13 hrs, Volume= 65 cf
Primary = 4.59 cfs @ 12.13 hrs, Volume= 16,396 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 43.18' @ 12.13 hrs Surf.Area= 1,073 sf Storage= 191 cf

Plug-Flow detention time= 0.3 min calculated for 16,460 cf (100% of inflow)
Center-of-Mass det. time= 0.3 min (810.7 - 810.5)

Volume	Invert	Avail.Storage	Storage Description
#1	39.70'	38 cf	**4.00'D x 3.06'H Vertical Cone/Cylinder**
#2	42.76'	3,754 cf	**Custom Stage Data (Conic)** Listed below (Recalc)
		3,793 cf	Total Available Storage

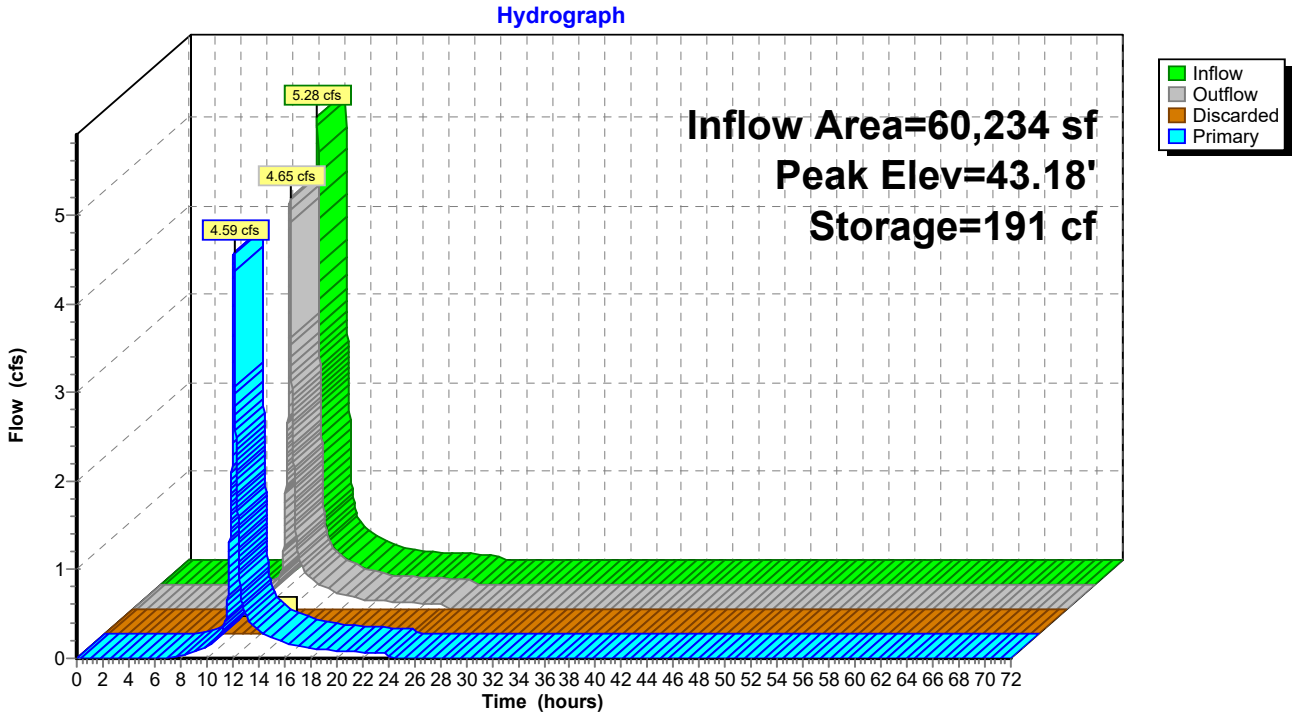
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
42.76	1	0	0	1
44.00	8,987	3,754	3,754	8,989

Device	Routing	Invert	Outlet Devices
#1	Primary	39.70'	**10.0" Round Culvert** L= 10.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 39.70' / 39.60' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 0.55 sf
#2	Discarded	39.70'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.06 cfs @ 12.13 hrs HW=43.18' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.06 cfs)

Primary OutFlow Max=4.59 cfs @ 12.13 hrs HW=43.18' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 4.59 cfs @ 8.42 fps)

Pond XP2:


Hydrograph
Inflow Area=60,234 sf
Peak Elev=43.18'
Storage=191 cf
5.28 cfs
4.65 cfs
4.59 cfs
Inflow
Outflow
Discarded
Primary
Flow (cfs)
0
1
2
3
4
5
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72
Time (hours)

Summary for Pond XP3:

Inflow Area = 26,841 sf, 30.32% Impervious, Inflow Depth = 1.59" for 10-YR event
Inflow = 1.08 cfs @ 12.10 hrs, Volume= 3,550 cf
Outflow = 0.19 cfs @ 12.65 hrs, Volume= 3,550 cf, Atten= 83%, Lag= 33.4 min
Discarded = 0.19 cfs @ 12.65 hrs, Volume= 3,550 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 42.88' @ 12.65 hrs Surf.Area= 3,321 sf Storage= 1,202 cf

Plug-Flow detention time= 81.7 min calculated for 3,549 cf (100% of inflow)
Center-of-Mass det. time= 81.7 min (945.2 - 863.5)

Volume	Invert	Avail.Storage	Storage Description
#1	41.83'	4,750 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

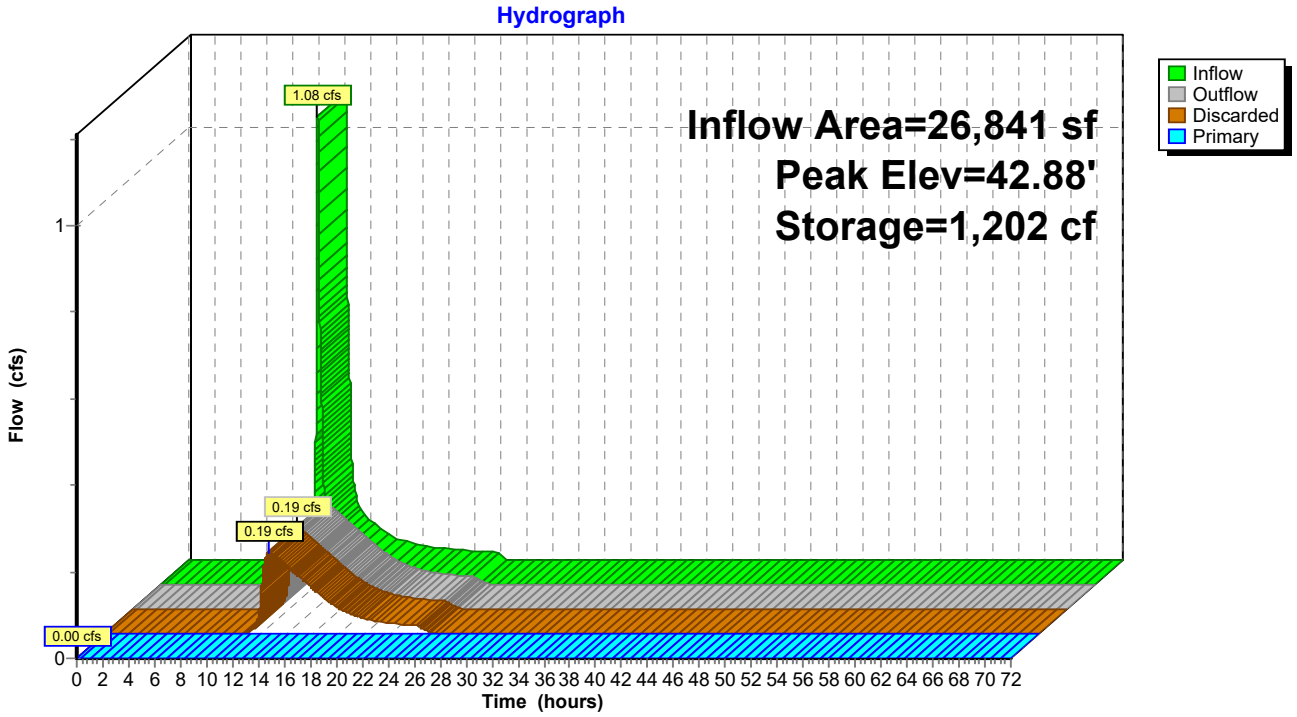
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
41.83	1	0	0	1
42.00	119	7	7	119
43.00	4,090	1,636	1,643	4,092
43.60	6,348	3,107	4,750	6,355

Device	Routing	Invert	Outlet Devices
#1	Primary	43.50'	**56.0' long x 5.0' 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 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88
#2	Discarded	41.83'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.19 cfs @ 12.65 hrs HW=42.88' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.19 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=41.83' (Free Discharge)
↑—**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond XP3:


Hydrograph
Inflow Area=26,841 sf
Peak Elev=42.88'
Storage=1,202 cf
Inflow
Outflow
Discarded
Primary
1.08 cfs
0.19 cfs
0.19 cfs
0.00 cfs
Flow (cfs)
0
1
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72
Time (hours)

Summary for Pond XP4:

Inflow Area = 30,313 sf, 89.48% Impervious, Inflow Depth = 4.21" for 10-YR event
Inflow = 3.23 cfs @ 12.08 hrs, Volume= 10,629 cf
Outflow = 0.69 cfs @ 12.50 hrs, Volume= 10,629 cf, Atten= 79%, Lag= 24.8 min
Discarded = 0.69 cfs @ 12.50 hrs, Volume= 10,629 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 41.89' @ 12.50 hrs Surf.Area= 12,294 sf Storage= 3,673 cf

Plug-Flow detention time= 60.1 min calculated for 10,629 cf (100% of inflow)
Center-of-Mass det. time= 60.1 min (838.3 - 778.2)

Volume	Invert	Avail.Storage	Storage Description
#1	41.00'	6,940 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

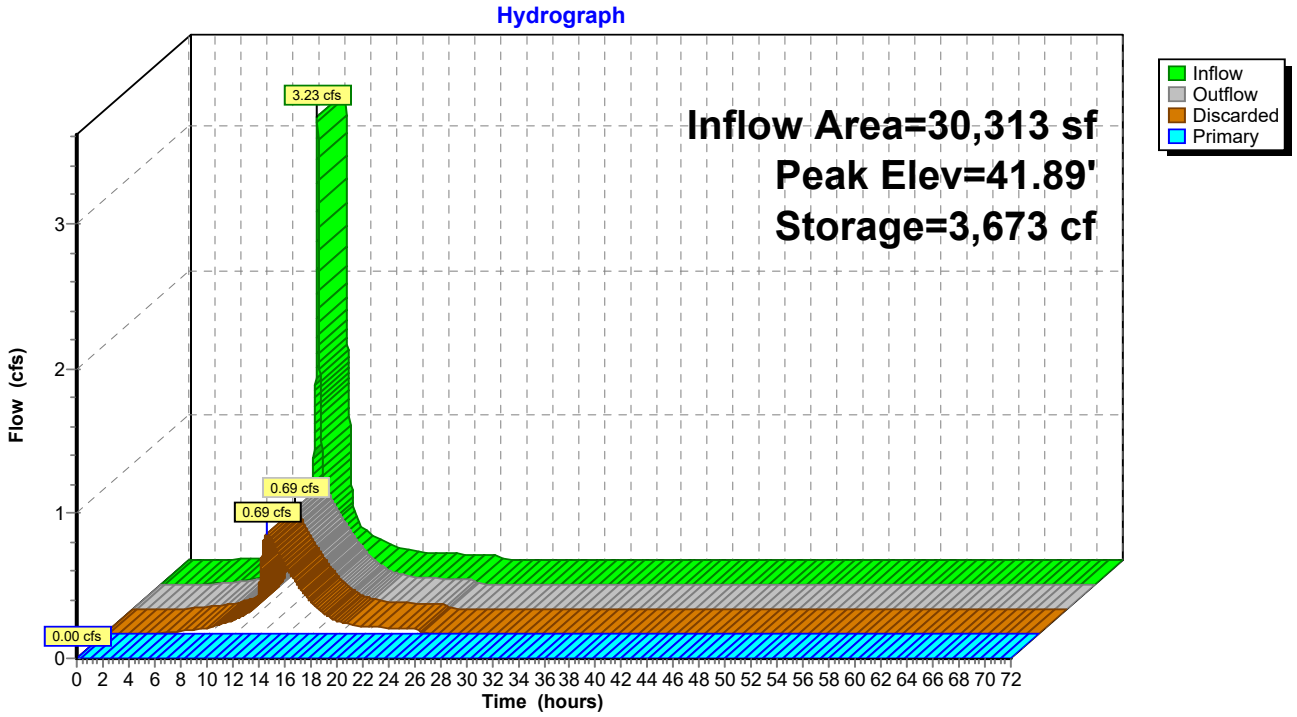
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
41.00	1	0	0	1
42.10	18,789	6,940	6,940	18,791

Device	Routing	Invert	Outlet Devices
#1	Primary	42.00'	**132.0' long x 5.0' 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 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88
#2	Discarded	41.00'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.69 cfs @ 12.50 hrs HW=41.89' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.69 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=41.00' (Free Discharge)
↑—**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond XP4:

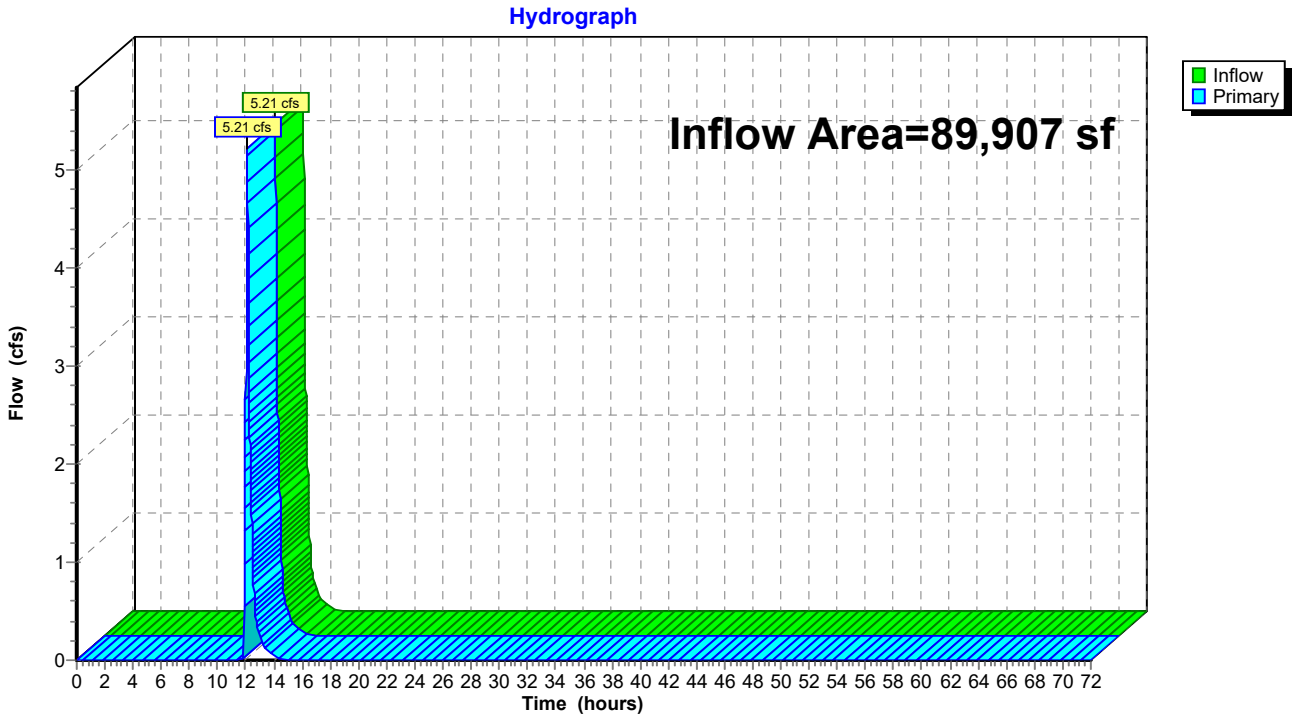

Hydrograph
Inflow Area=30,313 sf
Peak Elev=41.89'
Storage=3,673 cf
Inflow
Outflow
Discarded
Primary
3.23 cfs
0.69 cfs
0.69 cfs
0.00 cfs
Flow (cfs)
0
1
2
3
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72
Time (hours)

Summary for Link DP1:

Inflow Area = 89,907 sf, 81.69% Impervious, Inflow Depth = 0.93" for 10-YR event
Inflow = 5.21 cfs @ 12.10 hrs, Volume= 6,967 cf
Primary = 5.21 cfs @ 12.10 hrs, Volume= 6,967 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link DP1:

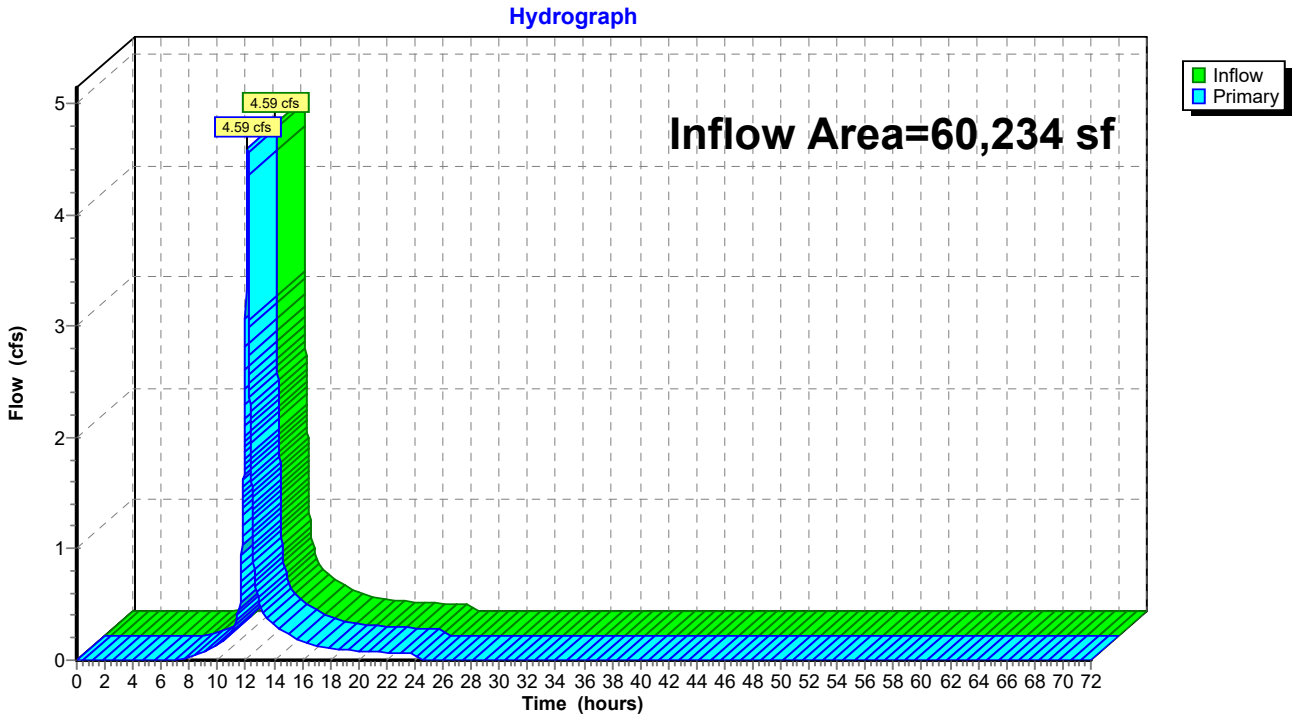


Summary for Link DP2:

Inflow Area = 60,234 sf, 72.35% Impervious, Inflow Depth = 3.27" for 10-YR event
Inflow = 4.59 cfs @ 12.13 hrs, Volume= 16,396 cf
Primary = 4.59 cfs @ 12.13 hrs, Volume= 16,396 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link DP2:

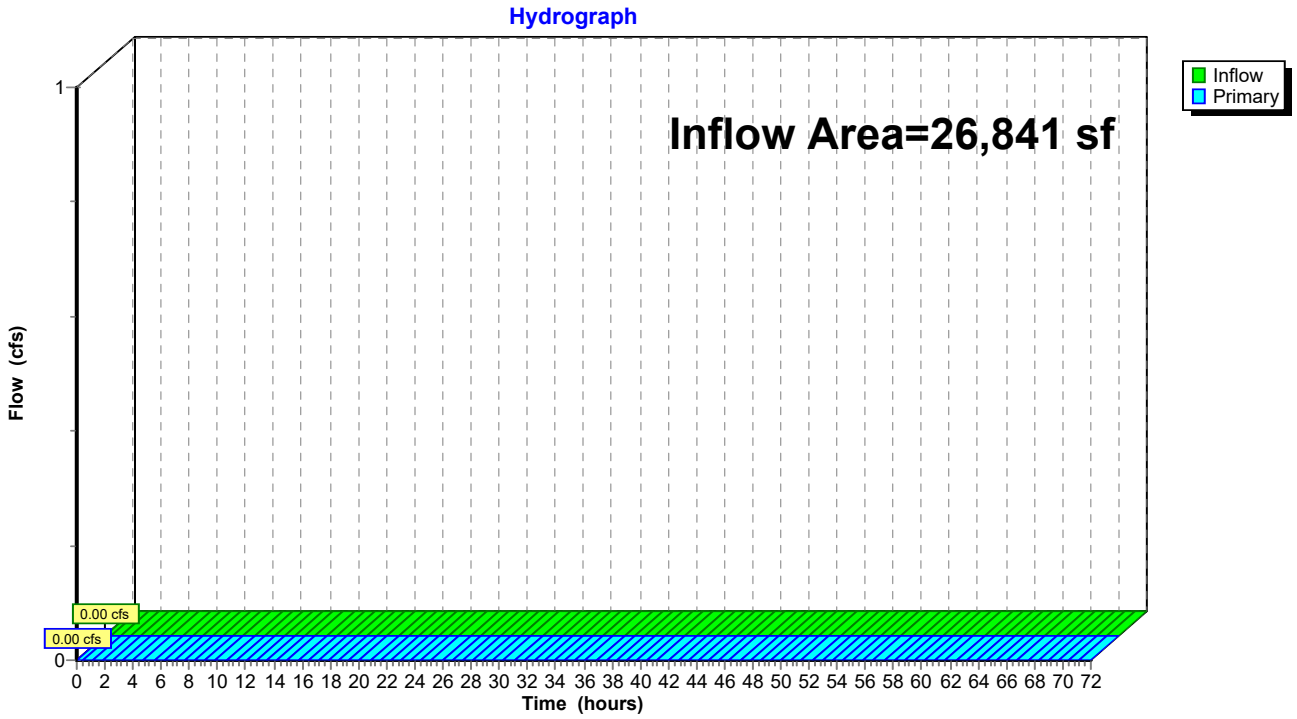


Summary for Link DP3:

Inflow Area = 26,841 sf, 30.32% Impervious, Inflow Depth = 0.00" for 10-YR event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link DP3:



Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentEX-1: Runoff Area=59,119 sf 78.07% Impervious Runoff Depth=4.67"
Tc=6.0 min CN=87 Runoff=7.21 cfs 23,009 cf

SubcatchmentEX-2: Runoff Area=60,234 sf 72.35% Impervious Runoff Depth=4.35"
Tc=6.0 min CN=84 Runoff=6.93 cfs 21,817 cf

SubcatchmentEX-3: Runoff Area=26,841 sf 30.32% Impervious Runoff Depth=2.38"
Tc=6.0 min CN=64 Runoff=1.68 cfs 5,319 cf

SubcatchmentEX-4: Runoff Area=30,313 sf 89.48% Impervious Runoff Depth=5.34"
Tc=6.0 min CN=93 Runoff=4.04 cfs 13,491 cf

SubcatchmentEX-5: Runoff Area=475 sf 36.00% Impervious Runoff Depth=2.65"
Tc=6.0 min CN=67 Runoff=0.03 cfs 105 cf

Pond XP1: Peak Elev=41.58' Storage=2,762 cf Inflow=7.21 cfs 23,009 cf
Discarded=0.33 cfs 12,316 cf Primary=6.79 cfs 10,694 cf Outflow=7.12 cfs 23,009 cf

Pond XP2: Peak Elev=43.47' Storage=763 cf Inflow=6.93 cfs 21,817 cf
Discarded=0.17 cfs 167 cf Primary=4.81 cfs 21,650 cf Outflow=4.98 cfs 21,817 cf

Pond XP3: Peak Elev=43.08' Storage=1,988 cf Inflow=1.68 cfs 5,319 cf
Discarded=0.24 cfs 5,319 cf Primary=0.00 cfs 0 cf Outflow=0.24 cfs 5,319 cf

Pond XP4: Peak Elev=41.97' Storage=4,770 cf Inflow=4.04 cfs 13,491 cf
Discarded=0.82 cfs 13,491 cf Primary=0.00 cfs 0 cf Outflow=0.82 cfs 13,491 cf

Link DP1: Inflow=6.83 cfs 10,799 cf
Primary=6.83 cfs 10,799 cf

Link DP2: Inflow=4.81 cfs 21,650 cf
Primary=4.81 cfs 21,650 cf

Link DP3: Inflow=0.00 cfs 0 cf
Primary=0.00 cfs 0 cf

Total Runoff Area = 176,982 sf Runoff Volume = 63,741 cf Average Runoff Depth = 4.32"
29.28% Pervious = 51,819 sf 70.72% Impervious = 125,163 sf

Summary for Subcatchment EX-1:

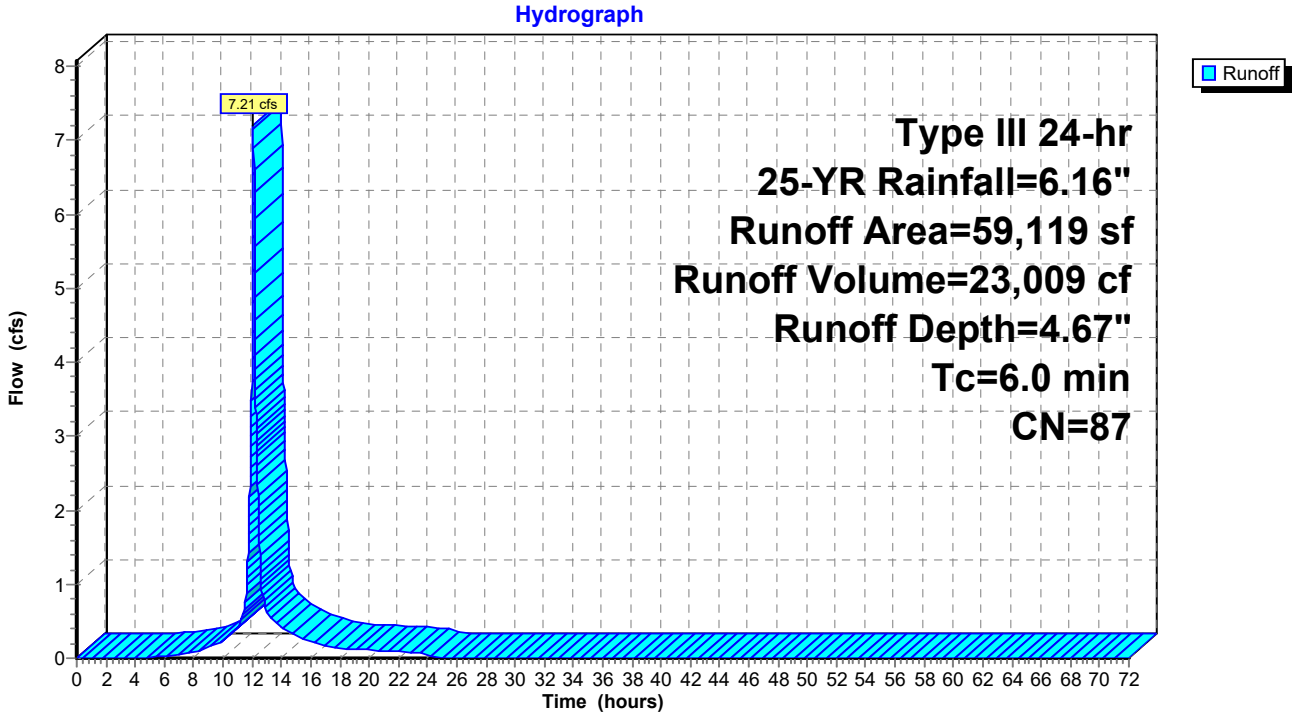
Runoff = 7.21 cfs @ 12.09 hrs, Volume= 23,009 cf, Depth= 4.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-YR Rainfall=6.16"

Area (sf)	CN	Description
12,967	49	50-75% Grass cover, Fair, HSG A
18,026	98	Roofs, HSG A
28,126	98	Paved parking, HSG A
59,119	87	Weighted Average
12,967		21.93% Pervious Area
46,152		78.07% Impervious Area

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

Subcatchment EX-1:



Summary for Subcatchment EX-2:

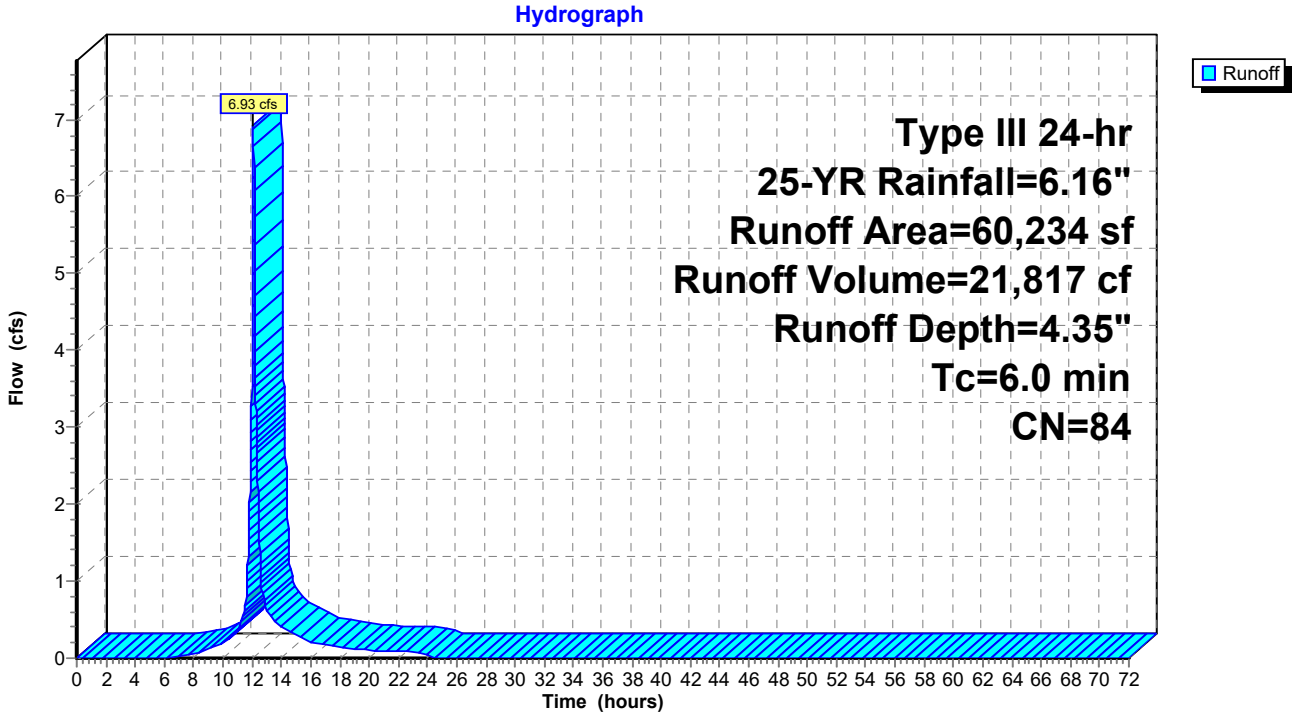
Runoff = 6.93 cfs @ 12.09 hrs, Volume= 21,817 cf, Depth= 4.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-YR Rainfall=6.16"

Area (sf)	CN	Description
7,425	98	Roofs, HSG A
16,654	49	50-75% Grass cover, Fair, HSG A
36,155	98	Paved parking, HSG A
60,234	84	Weighted Average
16,654		27.65% Pervious Area
43,580		72.35% Impervious Area

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

Subcatchment EX-2:



Summary for Subcatchment EX-3:

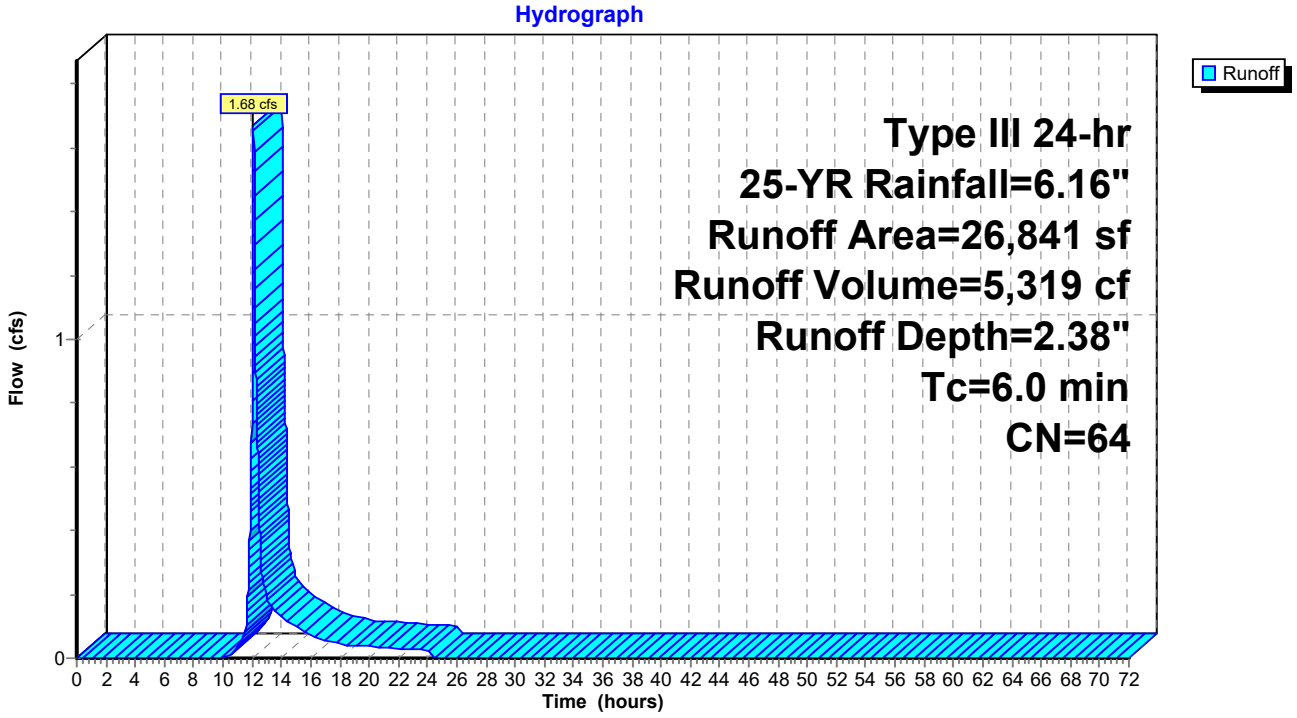
Runoff = 1.68 cfs @ 12.09 hrs, Volume= 5,319 cf, Depth= 2.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-YR Rainfall=6.16"

Area (sf)	CN	Description
18,704	49	50-75% Grass cover, Fair, HSG A
6,328	98	Roofs, HSG A
1,809	98	Paved parking, HSG A
26,841	64	Weighted Average
18,704		69.68% Pervious Area
8,137		30.32% Impervious Area

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

Subcatchment EX-3:



Summary for Subcatchment EX-4:

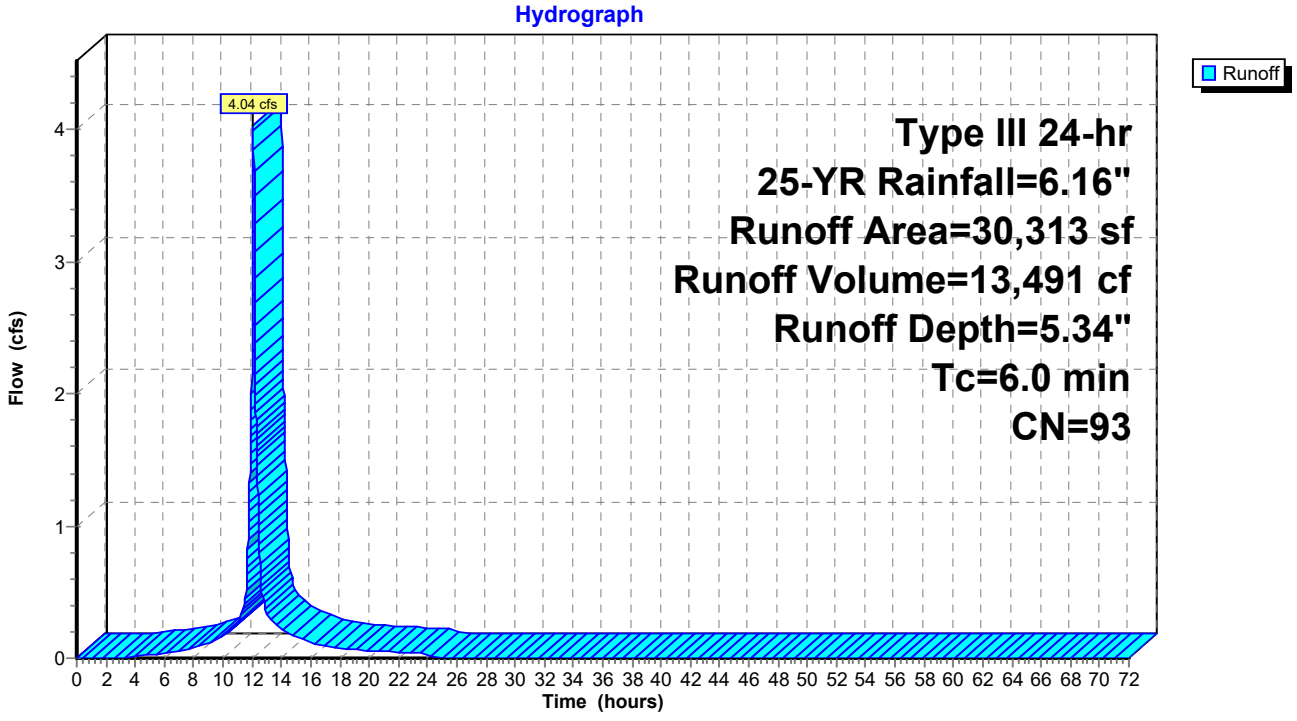
Runoff = 4.04 cfs @ 12.08 hrs, Volume= 13,491 cf, Depth= 5.34"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-YR Rainfall=6.16"

Area (sf)	CN	Description
3,190	49	50-75% Grass cover, Fair, HSG A
641	98	Roofs, HSG A
26,482	98	Paved parking, HSG A
30,313	93	Weighted Average
3,190		10.52% Pervious Area
27,123		89.48% Impervious Area

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

Subcatchment EX-4:



Summary for Subcatchment EX-5:

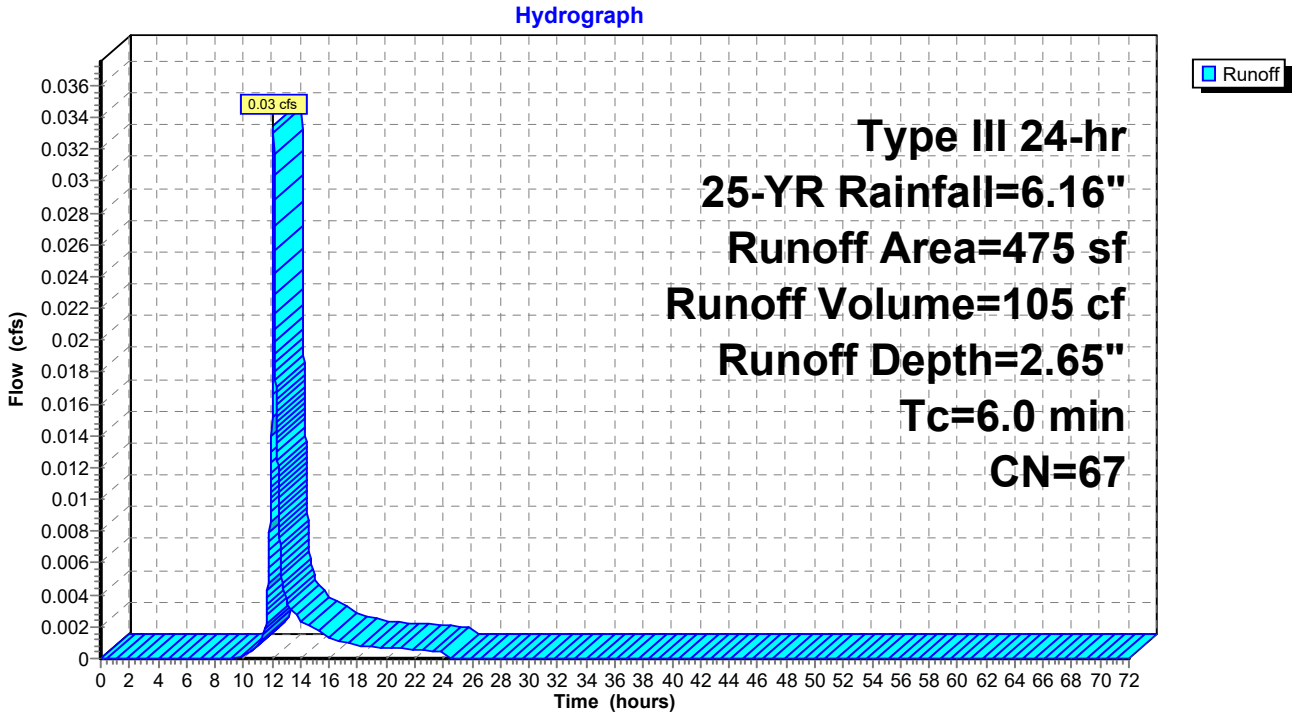
Runoff = 0.03 cfs @ 12.09 hrs, Volume= 105 cf, Depth= 2.65"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-YR Rainfall=6.16"

Area (sf)	CN	Description
304	49	50-75% Grass cover, Fair, HSG A
171	98	Paved parking, HSG A
475	67	Weighted Average
304		64.00% Pervious Area
171		36.00% Impervious Area

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

Subcatchment EX-5:



Summary for Pond XP1:

Inflow Area = 59,119 sf, 78.07% Impervious, Inflow Depth = 4.67" for 25-YR event
Inflow = 7.21 cfs @ 12.09 hrs, Volume= 23,009 cf
Outflow = 7.12 cfs @ 12.10 hrs, Volume= 23,009 cf, Atten= 1%, Lag= 0.8 min
Discarded = 0.33 cfs @ 12.10 hrs, Volume= 12,316 cf
Primary = 6.79 cfs @ 12.10 hrs, Volume= 10,694 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 41.58' @ 12.10 hrs Surf.Area= 5,850 sf Storage= 2,762 cf

Plug-Flow detention time= 55.4 min calculated for 23,006 cf (100% of inflow)
Center-of-Mass det. time= 55.4 min (849.2 - 793.7)

Volume	Invert	Avail.Storage	Storage Description
#1	40.43'	2,878 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

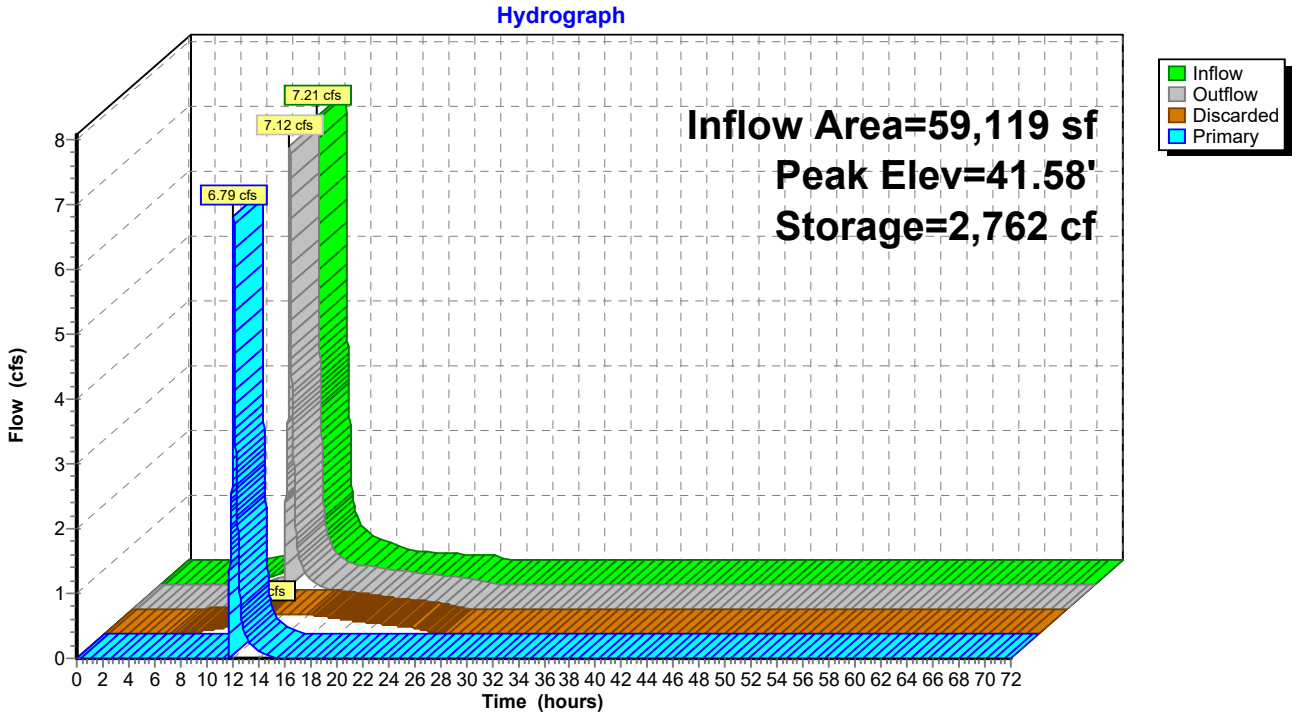
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
40.43	1	0	0	1
41.00	2,354	457	457	2,355
41.60	5,995	2,421	2,878	5,998

Device	Routing	Invert	Outlet Devices
#1	Primary	41.50'	**127.0' long x 5.0' 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 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88
#2	Discarded	40.43'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.33 cfs @ 12.10 hrs HW=41.58' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.33 cfs)

Primary OutFlow Max=6.77 cfs @ 12.10 hrs HW=41.58' (Free Discharge)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 6.77 cfs @ 0.66 fps)

Pond XP1:


Hydrograph
Inflow Area=59,119 sf
Peak Elev=41.58'
Storage=2,762 cf
7.21 cfs
7.12 cfs
6.79 cfs
Inflow
Outflow
Discarded
Primary
Flow (cfs)
Time (hours)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72
0 1 2 3 4 5 6 7 8

Summary for Pond XP2:

Inflow Area = 60,234 sf, 72.35% Impervious, Inflow Depth = 4.35" for 25-YR event
Inflow = 6.93 cfs @ 12.09 hrs, Volume= 21,817 cf
Outflow = 4.98 cfs @ 12.16 hrs, Volume= 21,817 cf, Atten= 28%, Lag= 4.6 min
Discarded = 0.17 cfs @ 12.16 hrs, Volume= 167 cf
Primary = 4.81 cfs @ 12.16 hrs, Volume= 21,650 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 43.47' @ 12.16 hrs Surf.Area= 3,014 sf Storage= 763 cf

Plug-Flow detention time= 0.5 min calculated for 21,814 cf (100% of inflow)
Center-of-Mass det. time= 0.5 min (803.0 - 802.5)

Volume	Invert	Avail.Storage	Storage Description
#1	39.70'	38 cf	**4.00'D x 3.06'H Vertical Cone/Cylinder**
#2	42.76'	3,754 cf	**Custom Stage Data (Conic)** Listed below (Recalc)
		3,793 cf	Total Available Storage

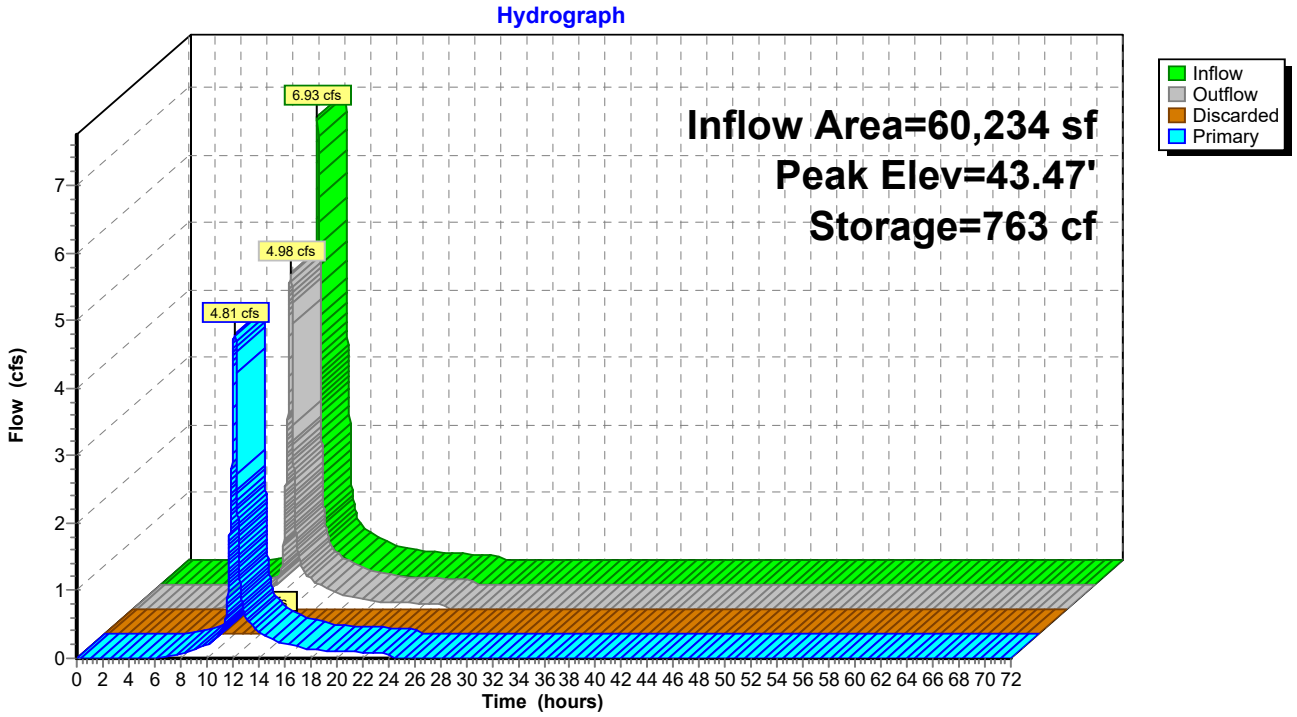
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
42.76	1	0	0	1
44.00	8,987	3,754	3,754	8,989

Device	Routing	Invert	Outlet Devices
#1	Primary	39.70'	**10.0" Round Culvert** L= 10.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 39.70' / 39.60' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 0.55 sf
#2	Discarded	39.70'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.17 cfs @ 12.16 hrs HW=43.47' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.17 cfs)

Primary OutFlow Max=4.81 cfs @ 12.16 hrs HW=43.47' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 4.81 cfs @ 8.82 fps)

Pond XP2:


Hydrograph
Inflow Area=60,234 sf
Peak Elev=43.47'
Storage=763 cf
6.93 cfs
4.98 cfs
4.81 cfs
Inflow
Outflow
Discarded
Primary
Flow (cfs)
0 1 2 3 4 5 6 7
Time (hours)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72

Summary for Pond XP3:

Inflow Area = 26,841 sf, 30.32% Impervious, Inflow Depth = 2.38" for 25-YR event
Inflow = 1.68 cfs @ 12.09 hrs, Volume= 5,319 cf
Outflow = 0.24 cfs @ 12.74 hrs, Volume= 5,319 cf, Atten= 85%, Lag= 38.8 min
Discarded = 0.24 cfs @ 12.74 hrs, Volume= 5,319 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 43.08' @ 12.74 hrs Surf.Area= 4,368 sf Storage= 1,988 cf

Plug-Flow detention time= 99.2 min calculated for 5,319 cf (100% of inflow)
Center-of-Mass det. time= 99.2 min (950.3 - 851.1)

Volume	Invert	Avail.Storage	Storage Description
#1	41.83'	4,750 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

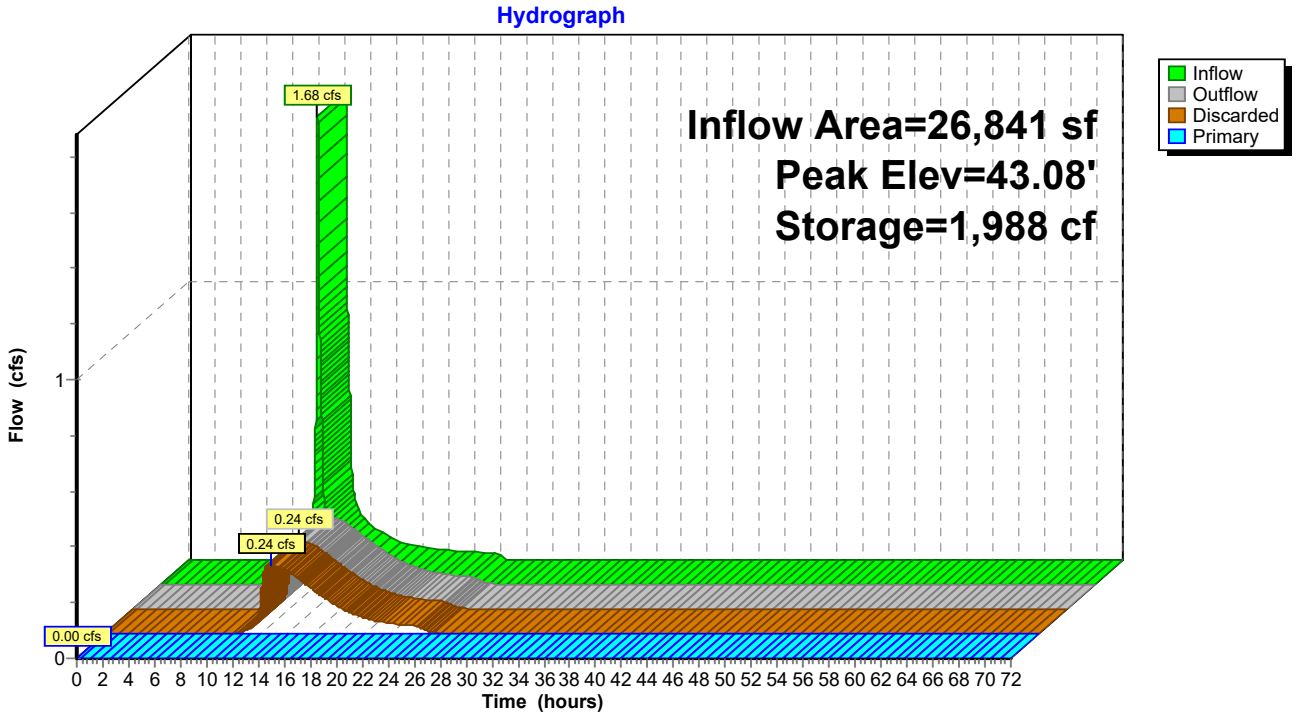
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
41.83	1	0	0	1
42.00	119	7	7	119
43.00	4,090	1,636	1,643	4,092
43.60	6,348	3,107	4,750	6,355

Device	Routing	Invert	Outlet Devices
#1	Primary	43.50'	**56.0' long x 5.0' 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 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88
#2	Discarded	41.83'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.24 cfs @ 12.74 hrs HW=43.08' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.24 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=41.83' (Free Discharge)
↑—**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond XP3:


Hydrograph
Inflow Area=26,841 sf
Peak Elev=43.08'
Storage=1,988 cf
Inflow
Outflow
Discarded
Primary
1.68 cfs
0.24 cfs
0.24 cfs
0.00 cfs
Flow (cfs)
0
1
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72
Time (hours)

Summary for Pond XP4:

Inflow Area = 30,313 sf, 89.48% Impervious, Inflow Depth = 5.34" for 25-YR event
Inflow = 4.04 cfs @ 12.08 hrs, Volume= 13,491 cf
Outflow = 0.82 cfs @ 12.51 hrs, Volume= 13,491 cf, Atten= 80%, Lag= 25.4 min
Discarded = 0.82 cfs @ 12.51 hrs, Volume= 13,491 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 41.97' @ 12.51 hrs Surf.Area= 14,634 sf Storage= 4,770 cf

Plug-Flow detention time= 65.9 min calculated for 13,491 cf (100% of inflow)
Center-of-Mass det. time= 65.9 min (838.2 - 772.3)

Volume	Invert	Avail.Storage	Storage Description
#1	41.00'	6,940 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

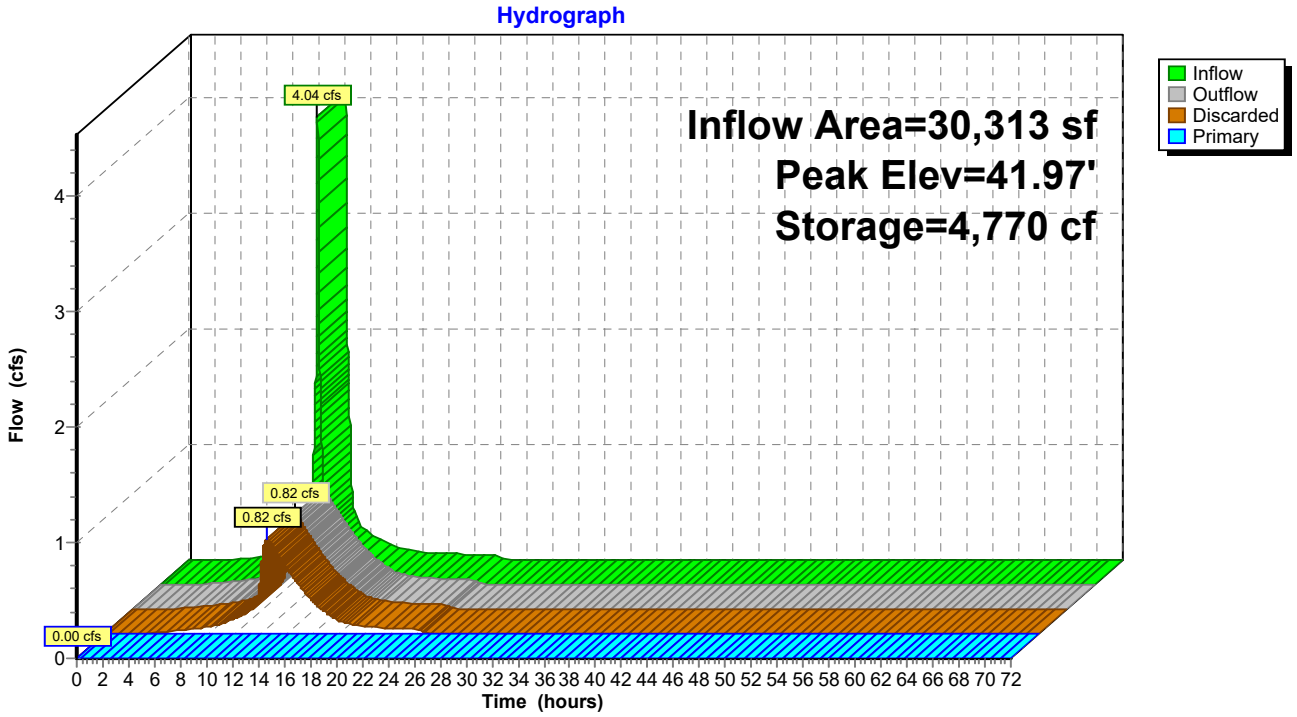
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
41.00	1	0	0	1
42.10	18,789	6,940	6,940	18,791

Device	Routing	Invert	Outlet Devices
#1	Primary	42.00'	**132.0' long x 5.0' 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 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88
#2	Discarded	41.00'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.82 cfs @ 12.51 hrs HW=41.97' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.82 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=41.00' (Free Discharge)
↑—**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond XP4:

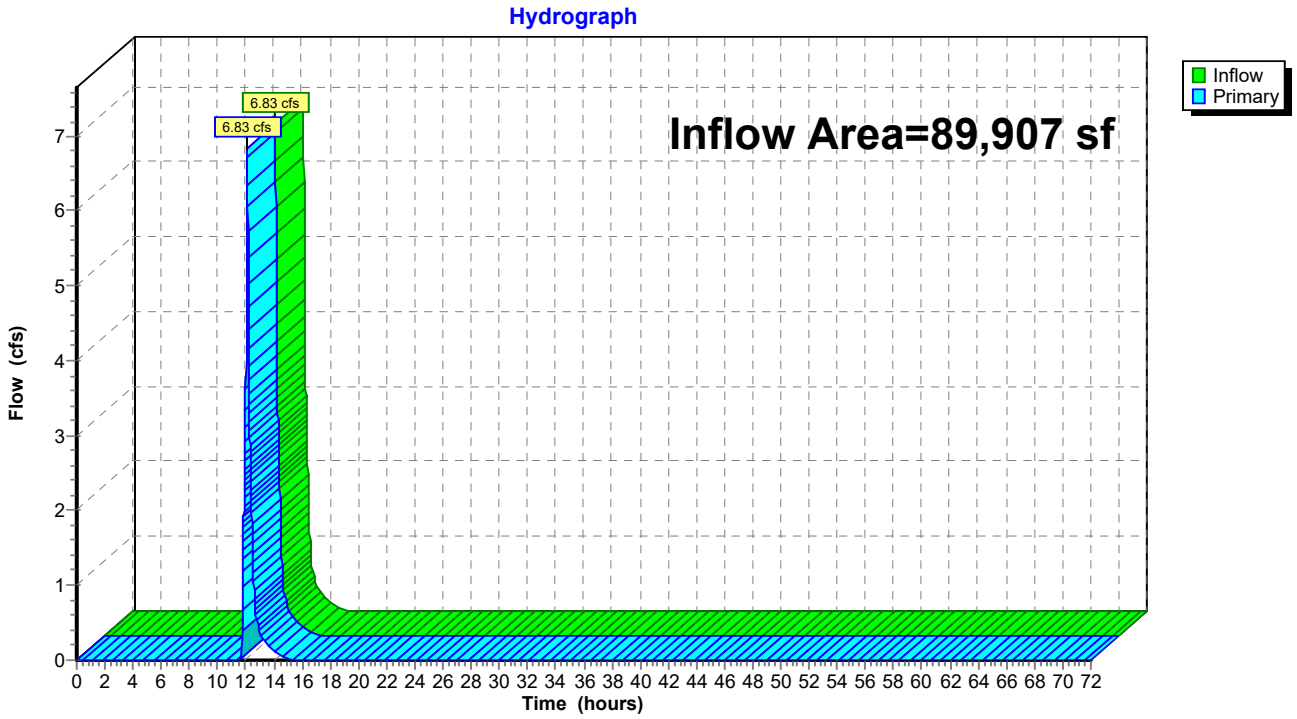

Hydrograph
Inflow Area=30,313 sf
Peak Elev=41.97'
Storage=4,770 cf
4.04 cfs
0.82 cfs
0.82 cfs
0.00 cfs
Inflow
Outflow
Discarded
Primary
Flow (cfs)
0 1 2 3 4
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72
Time (hours)

Summary for Link DP1:

Inflow Area = 89,907 sf, 81.69% Impervious, Inflow Depth = 1.44" for 25-YR event
Inflow = 6.83 cfs @ 12.10 hrs, Volume= 10,799 cf
Primary = 6.83 cfs @ 12.10 hrs, Volume= 10,799 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link DP1:

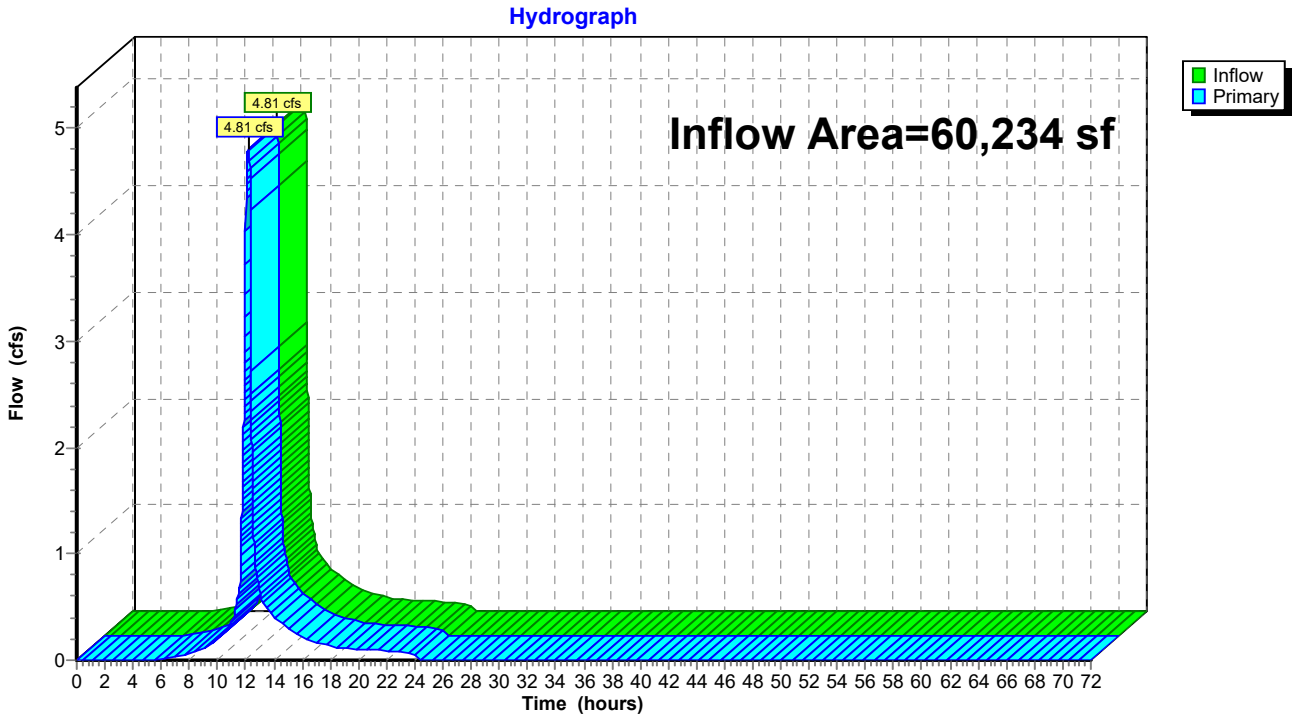


Summary for Link DP2:

Inflow Area = 60,234 sf, 72.35% Impervious, Inflow Depth = 4.31" for 25-YR event
Inflow = 4.81 cfs @ 12.16 hrs, Volume= 21,650 cf
Primary = 4.81 cfs @ 12.16 hrs, Volume= 21,650 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link DP2:

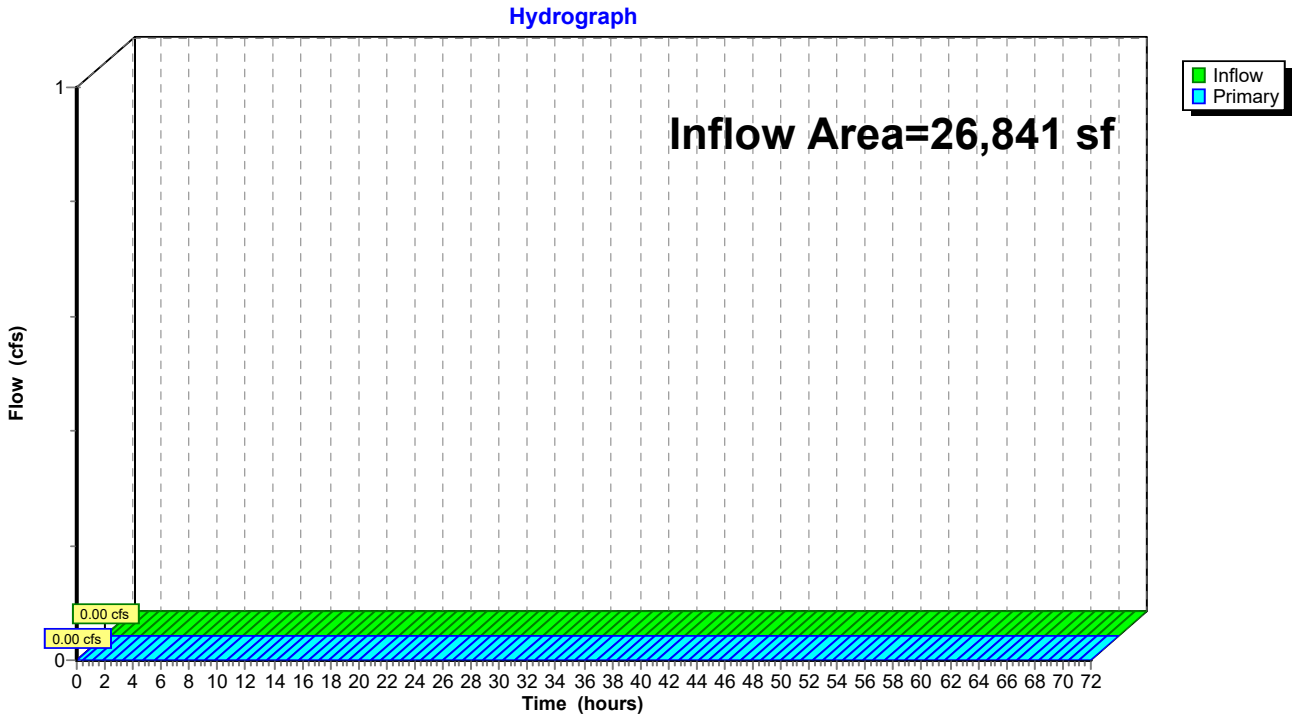


Summary for Link DP3:

Inflow Area = 26,841 sf, 30.32% Impervious, Inflow Depth = 0.00" for 25-YR event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link DP3:



Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentEX-1: Runoff Area=59,119 sf 78.07% Impervious Runoff Depth=6.38"
Tc=6.0 min CN=87 Runoff=9.69 cfs 31,439 cf

SubcatchmentEX-2: Runoff Area=60,234 sf 72.35% Impervious Runoff Depth=6.03"
Tc=6.0 min CN=84 Runoff=9.47 cfs 30,258 cf

SubcatchmentEX-3: Runoff Area=26,841 sf 30.32% Impervious Runoff Depth=3.73"
Tc=6.0 min CN=64 Runoff=2.68 cfs 8,333 cf

SubcatchmentEX-4: Runoff Area=30,313 sf 89.48% Impervious Runoff Depth=7.09"
Tc=6.0 min CN=93 Runoff=5.28 cfs 17,918 cf

SubcatchmentEX-5: Runoff Area=475 sf 36.00% Impervious Runoff Depth=4.06"
Tc=6.0 min CN=67 Runoff=0.05 cfs 161 cf

Pond XP1: Peak Elev=41.60' Storage=2,871 cf Inflow=9.69 cfs 31,439 cf
Discarded=0.33 cfs 14,440 cf Primary=9.25 cfs 16,999 cf Outflow=9.58 cfs 31,439 cf

Pond XP2: Peak Elev=43.76' Storage=2,049 cf Inflow=9.47 cfs 30,258 cf
Discarded=0.33 cfs 477 cf Primary=5.02 cfs 29,781 cf Outflow=5.35 cfs 30,258 cf

Pond XP3: Peak Elev=43.39' Storage=3,490 cf Inflow=2.68 cfs 8,333 cf
Discarded=0.31 cfs 8,333 cf Primary=0.00 cfs 0 cf Outflow=0.31 cfs 8,333 cf

Pond XP4: Peak Elev=42.03' Storage=5,635 cf Inflow=5.28 cfs 17,918 cf
Discarded=0.91 cfs 16,646 cf Primary=1.28 cfs 1,272 cf Outflow=2.20 cfs 17,918 cf

Link DP1: Inflow=9.30 cfs 18,432 cf
Primary=9.30 cfs 18,432 cf

Link DP2: Inflow=5.02 cfs 29,781 cf
Primary=5.02 cfs 29,781 cf

Link DP3: Inflow=0.00 cfs 0 cf
Primary=0.00 cfs 0 cf

Total Runoff Area = 176,982 sf Runoff Volume = 88,109 cf Average Runoff Depth = 5.97"
29.28% Pervious = 51,819 sf 70.72% Impervious = 125,163 sf

Summary for Subcatchment EX-1:

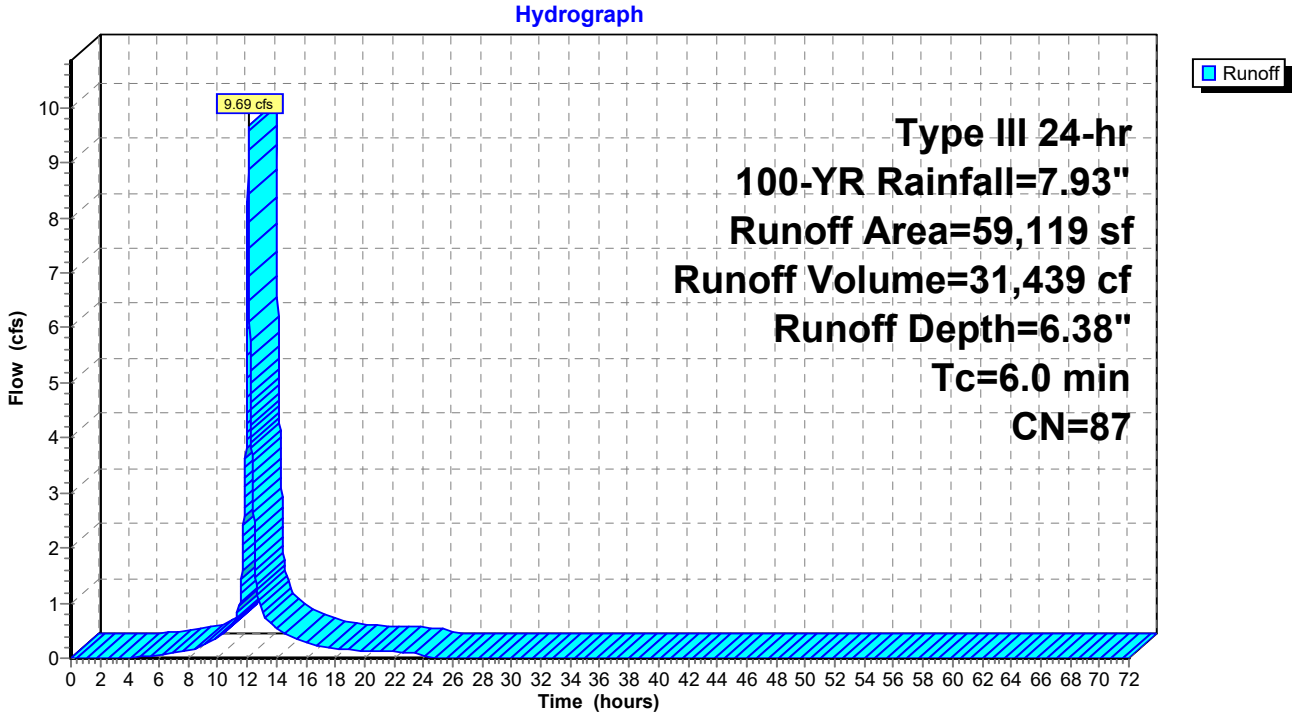
Runoff = 9.69 cfs @ 12.08 hrs, Volume= 31,439 cf, Depth= 6.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-YR Rainfall=7.93"

Area (sf)	CN	Description
12,967	49	50-75% Grass cover, Fair, HSG A
18,026	98	Roofs, HSG A
28,126	98	Paved parking, HSG A
59,119	87	Weighted Average
12,967		21.93% Pervious Area
46,152		78.07% Impervious Area

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

Subcatchment EX-1:



Summary for Subcatchment EX-2:

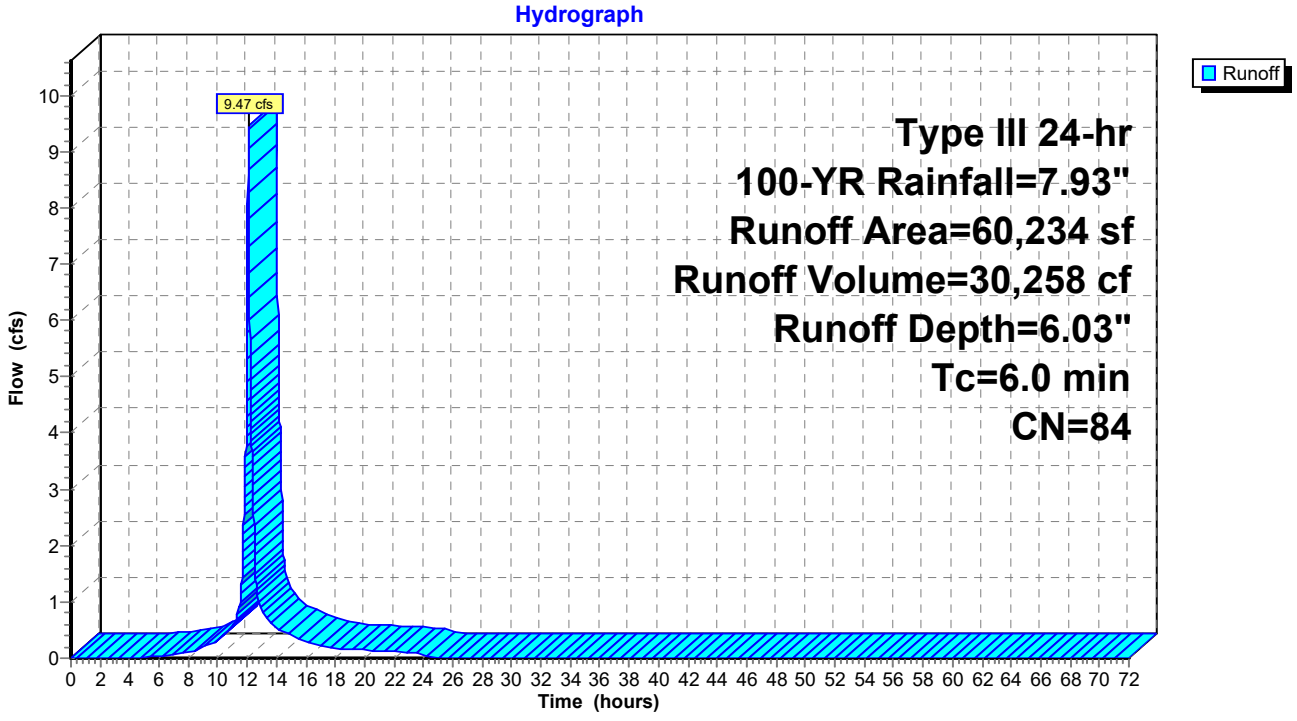
Runoff = 9.47 cfs @ 12.09 hrs, Volume= 30,258 cf, Depth= 6.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-YR Rainfall=7.93"

Area (sf)	CN	Description
7,425	98	Roofs, HSG A
16,654	49	50-75% Grass cover, Fair, HSG A
36,155	98	Paved parking, HSG A
60,234	84	Weighted Average
16,654		27.65% Pervious Area
43,580		72.35% Impervious Area

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

Subcatchment EX-2:



Summary for Subcatchment EX-3:

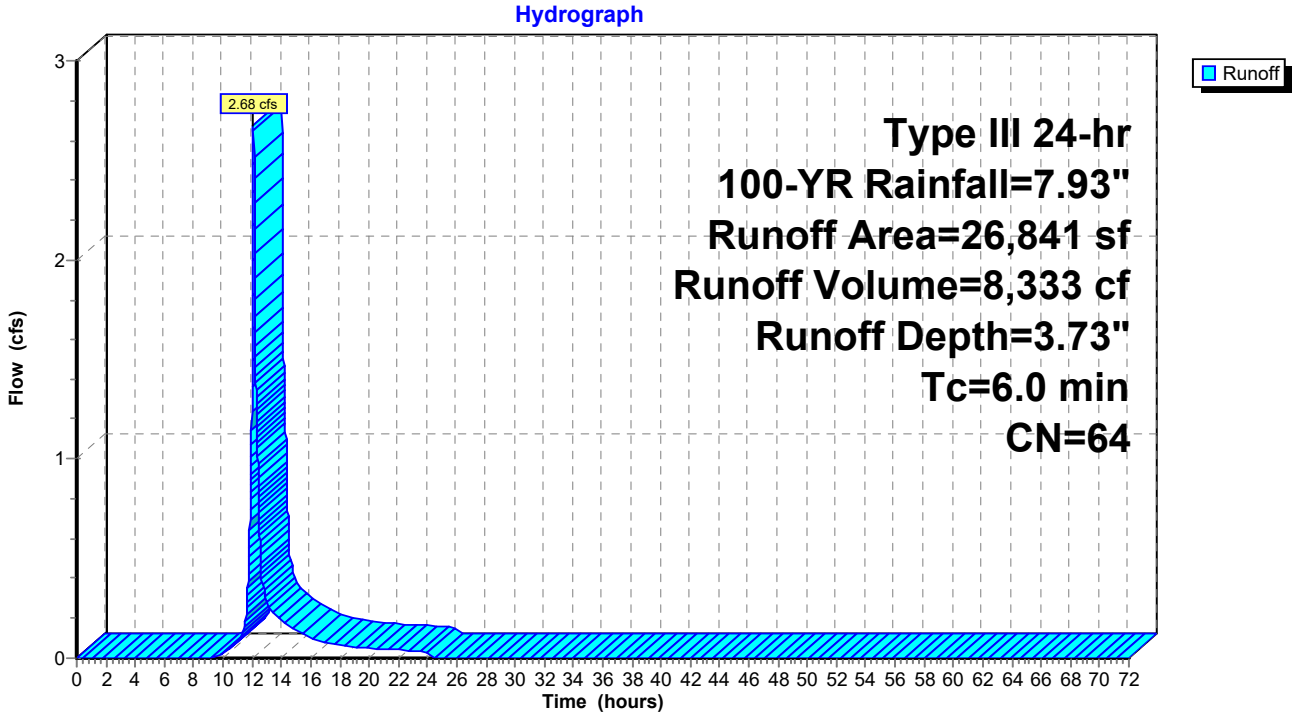
Runoff = 2.68 cfs @ 12.09 hrs, Volume= 8,333 cf, Depth= 3.73"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-YR Rainfall=7.93"

Area (sf)	CN	Description
18,704	49	50-75% Grass cover, Fair, HSG A
6,328	98	Roofs, HSG A
1,809	98	Paved parking, HSG A
26,841	64	Weighted Average
18,704		69.68% Pervious Area
8,137		30.32% Impervious Area

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

Subcatchment EX-3:



Summary for Subcatchment EX-4:

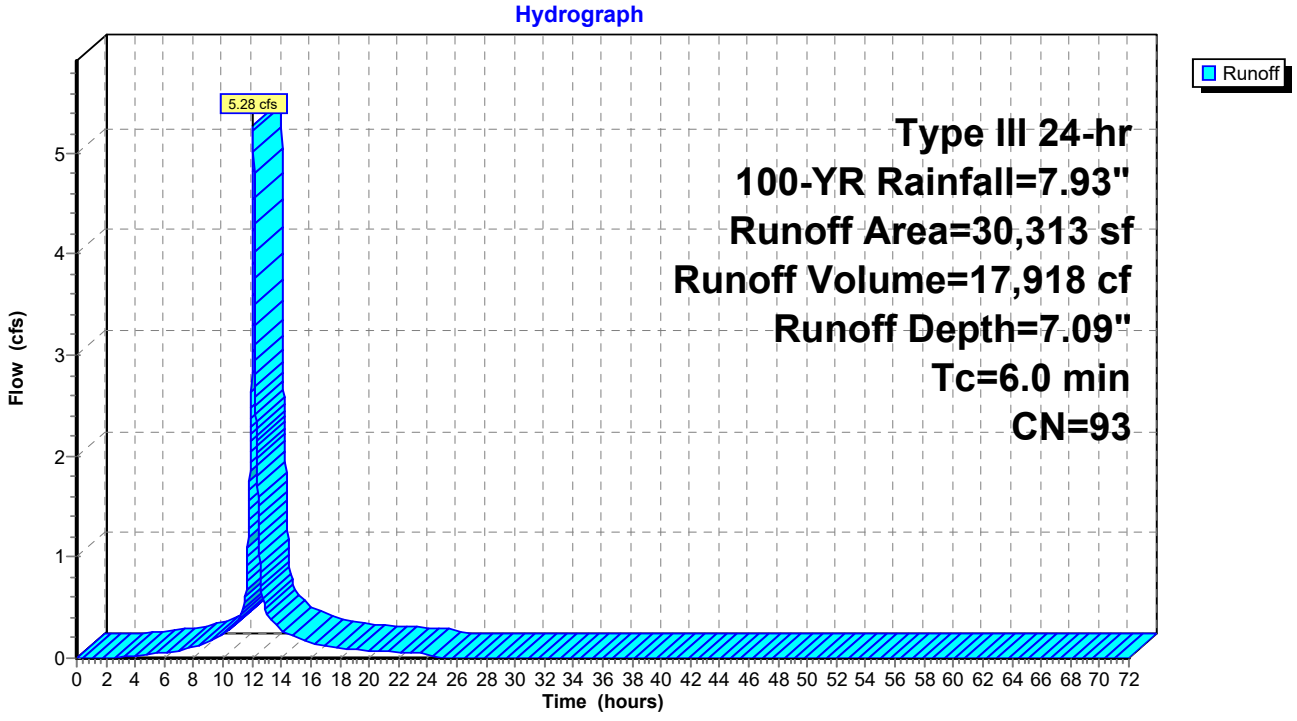
Runoff = 5.28 cfs @ 12.08 hrs, Volume= 17,918 cf, Depth= 7.09"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-YR Rainfall=7.93"

Area (sf)	CN	Description
3,190	49	50-75% Grass cover, Fair, HSG A
641	98	Roofs, HSG A
26,482	98	Paved parking, HSG A
30,313	93	Weighted Average
3,190		10.52% Pervious Area
27,123		89.48% Impervious Area

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

Subcatchment EX-4:



Summary for Subcatchment EX-5:

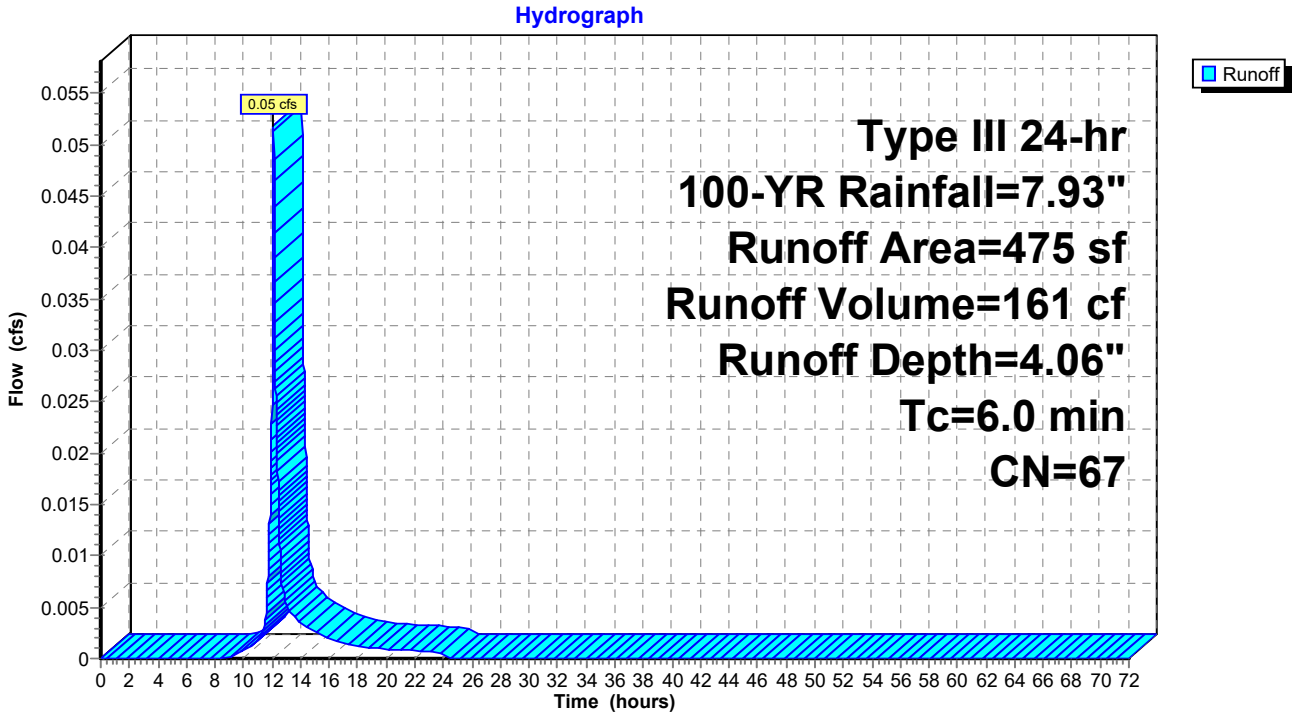
Runoff = 0.05 cfs @ 12.09 hrs, Volume= 161 cf, Depth= 4.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-YR Rainfall=7.93"

Area (sf)	CN	Description
304	49	50-75% Grass cover, Fair, HSG A
171	98	Paved parking, HSG A
475	67	Weighted Average
304		64.00% Pervious Area
171		36.00% Impervious Area

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

Subcatchment EX-5:



Summary for Pond XP1:

Inflow Area = 59,119 sf, 78.07% Impervious, Inflow Depth = 6.38" for 100-YR event
Inflow = 9.69 cfs @ 12.08 hrs, Volume= 31,439 cf
Outflow = 9.58 cfs @ 12.10 hrs, Volume= 31,439 cf, Atten= 1%, Lag= 0.7 min
Discarded = 0.33 cfs @ 12.10 hrs, Volume= 14,440 cf
Primary = 9.25 cfs @ 12.10 hrs, Volume= 16,999 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 41.60' @ 12.10 hrs Surf.Area= 5,987 sf Storage= 2,871 cf

Plug-Flow detention time= 49.7 min calculated for 31,439 cf (100% of inflow)
Center-of-Mass det. time= 49.7 min (835.0 - 785.3)

Volume	Invert	Avail.Storage	Storage Description
#1	40.43'	2,878 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

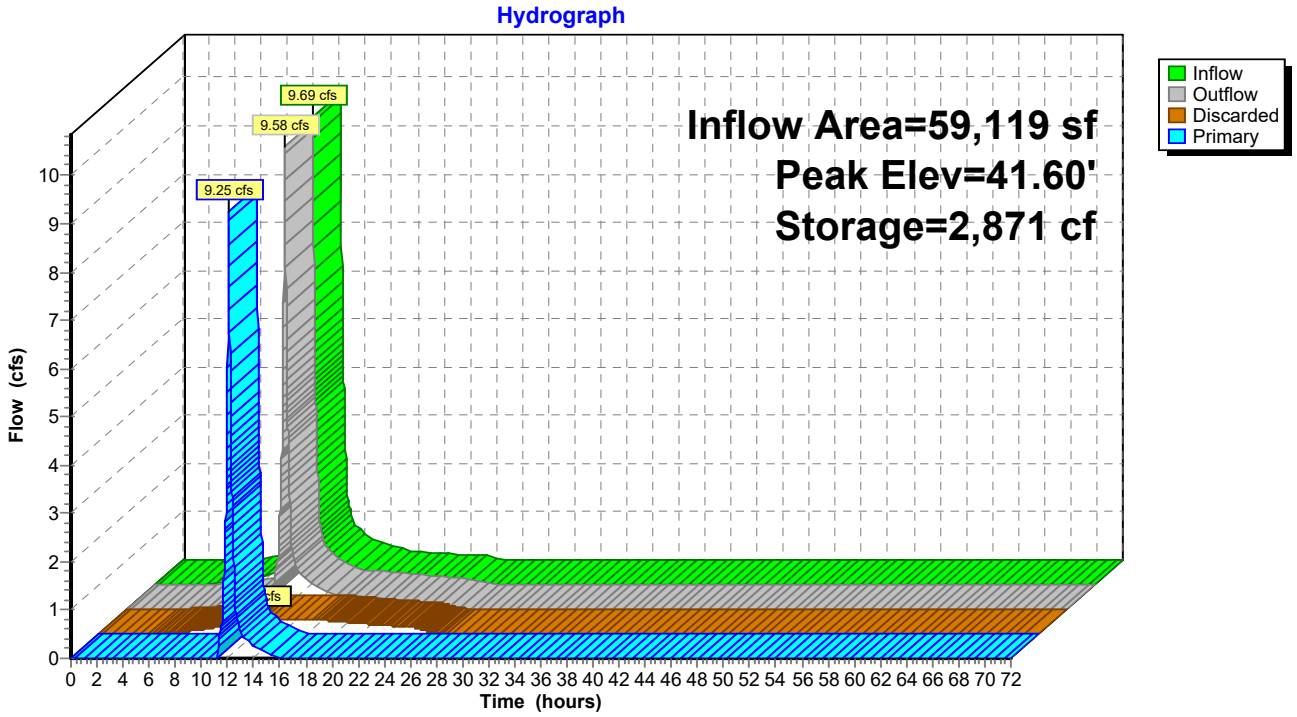
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
40.43	1	0	0	1
41.00	2,354	457	457	2,355
41.60	5,995	2,421	2,878	5,998

Device	Routing	Invert	Outlet Devices
#1	Primary	41.50'	**127.0' long x 5.0' 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 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88
#2	Discarded	40.43'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.33 cfs @ 12.10 hrs HW=41.60' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.33 cfs)

Primary OutFlow Max=9.23 cfs @ 12.10 hrs HW=41.60' (Free Discharge)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 9.23 cfs @ 0.74 fps)

Pond XP1:


Hydrograph
Inflow Area=59,119 sf
Peak Elev=41.60'
Storage=2,871 cf
9.69 cfs
9.58 cfs
9.25 cfs
Inflow
Outflow
Discarded
Primary
Flow (cfs)
Time (hours)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72
0 1 2 3 4 5 6 7 8 9 10

Summary for Pond XP2:

Inflow Area = 60,234 sf, 72.35% Impervious, Inflow Depth = 6.03" for 100-YR event
Inflow = 9.47 cfs @ 12.09 hrs, Volume= 30,258 cf
Outflow = 5.35 cfs @ 12.20 hrs, Volume= 30,258 cf, Atten= 44%, Lag= 7.0 min
Discarded = 0.33 cfs @ 12.20 hrs, Volume= 477 cf
Primary = 5.02 cfs @ 12.20 hrs, Volume= 29,781 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 43.76' @ 12.20 hrs Surf.Area= 5,940 sf Storage= 2,049 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 1.4 min (794.8 - 793.4)

Volume	Invert	Avail.Storage	Storage Description
#1	39.70'	38 cf	**4.00'D x 3.06'H Vertical Cone/Cylinder**
#2	42.76'	3,754 cf	**Custom Stage Data (Conic)** Listed below (Recalc)
		3,793 cf	Total Available Storage

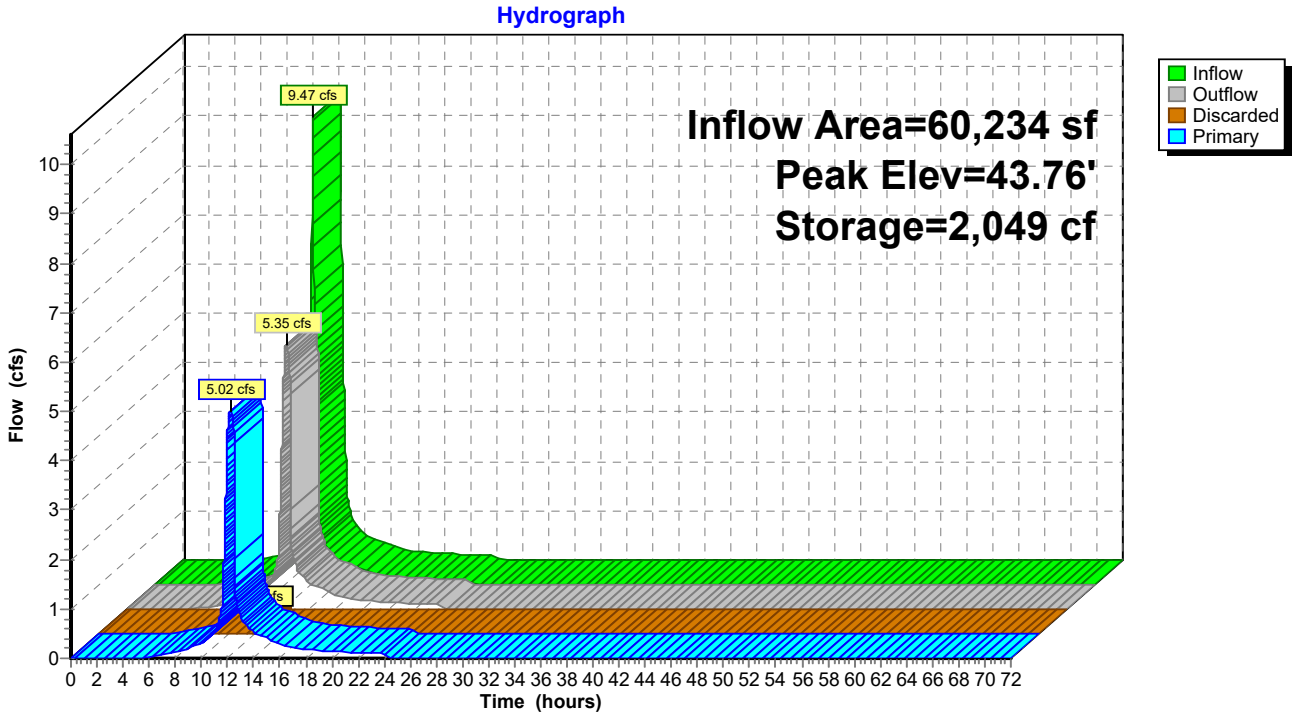
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
42.76	1	0	0	1
44.00	8,987	3,754	3,754	8,989

Device	Routing	Invert	Outlet Devices
#1	Primary	39.70'	**10.0" Round Culvert** L= 10.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 39.70' / 39.60' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 0.55 sf
#2	Discarded	39.70'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.33 cfs @ 12.20 hrs HW=43.76' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.33 cfs)

Primary OutFlow Max=5.02 cfs @ 12.20 hrs HW=43.76' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 5.02 cfs @ 9.20 fps)

Pond XP2:


Hydrograph
Inflow Area=60,234 sf
Peak Elev=43.76'
Storage=2,049 cf
9.47 cfs
5.35 cfs
5.02 cfs
Inflow
Outflow
Discarded
Primary
Flow (cfs)
Time (hours)
0 1 2 3 4 5 6 7 8 9 10
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72

Summary for Pond XP3:

Inflow Area = 26,841 sf, 30.32% Impervious, Inflow Depth = 3.73" for 100-YR event
Inflow = 2.68 cfs @ 12.09 hrs, Volume= 8,333 cf
Outflow = 0.31 cfs @ 12.93 hrs, Volume= 8,333 cf, Atten= 89%, Lag= 50.1 min
Discarded = 0.31 cfs @ 12.93 hrs, Volume= 8,333 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 43.39' @ 12.93 hrs Surf.Area= 5,490 sf Storage= 3,490 cf

Plug-Flow detention time= 134.2 min calculated for 8,332 cf (100% of inflow)
Center-of-Mass det. time= 134.2 min (972.1 - 837.9)

Volume	Invert	Avail.Storage	Storage Description
#1	41.83'	4,750 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

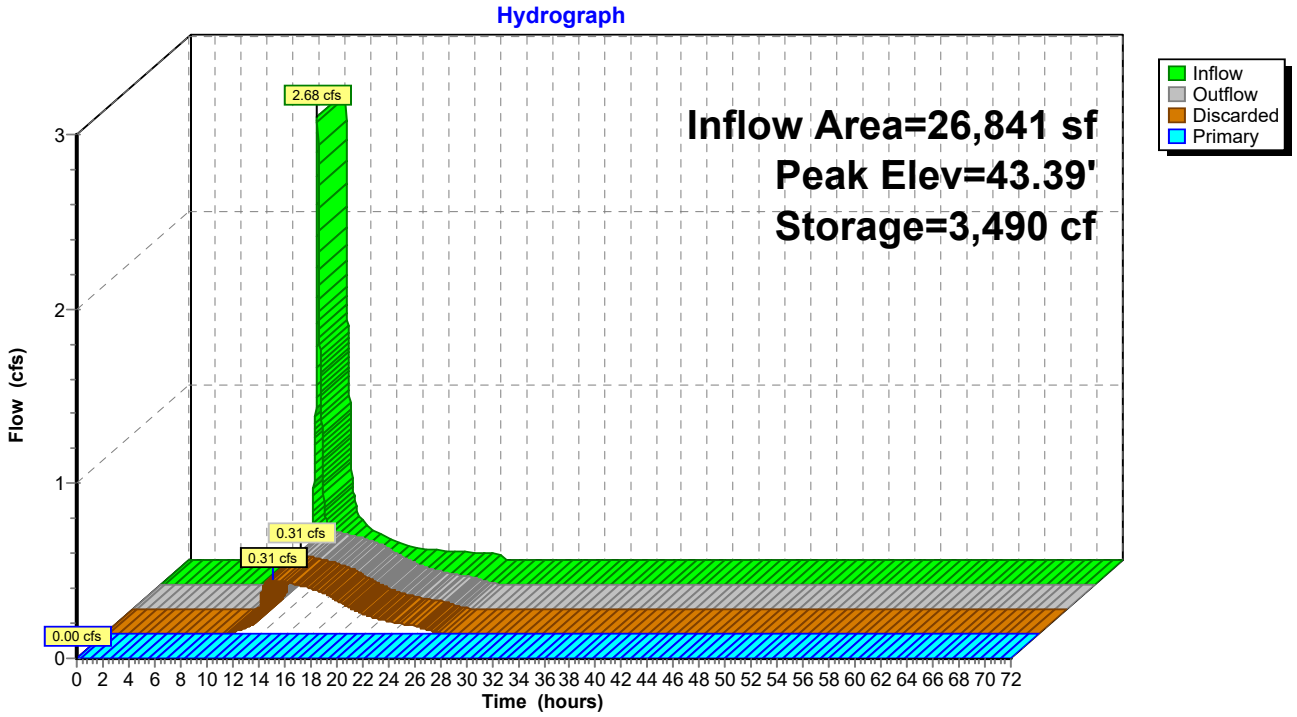
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
41.83	1	0	0	1
42.00	119	7	7	119
43.00	4,090	1,636	1,643	4,092
43.60	6,348	3,107	4,750	6,355

Device	Routing	Invert	Outlet Devices
#1	Primary	43.50'	**56.0' long x 5.0' 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 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88
#2	Discarded	41.83'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.31 cfs @ 12.93 hrs HW=43.39' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.31 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=41.83' (Free Discharge)
↑—**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond XP3:


Hydrograph
Inflow Area=26,841 sf
Peak Elev=43.39'
Storage=3,490 cf
Inflow
Outflow
Discarded
Primary
2.68 cfs
0.31 cfs
0.31 cfs
0.00 cfs
Flow (cfs)
0 1 2 3
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72
Time (hours)

Summary for Pond XP4:

Inflow Area = 30,313 sf, 89.48% Impervious, Inflow Depth = 7.09" for 100-YR event
Inflow = 5.28 cfs @ 12.08 hrs, Volume= 17,918 cf
Outflow = 2.20 cfs @ 12.28 hrs, Volume= 17,918 cf, Atten= 58%, Lag= 11.9 min
Discarded = 0.91 cfs @ 12.28 hrs, Volume= 16,646 cf
Primary = 1.28 cfs @ 12.28 hrs, Volume= 1,272 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 42.03' @ 12.28 hrs Surf.Area= 16,352 sf Storage= 5,635 cf

Plug-Flow detention time= 64.7 min calculated for 17,915 cf (100% of inflow)
Center-of-Mass det. time= 64.7 min (830.3 - 765.6)

Volume	Invert	Avail.Storage	Storage Description
#1	41.00'	6,940 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

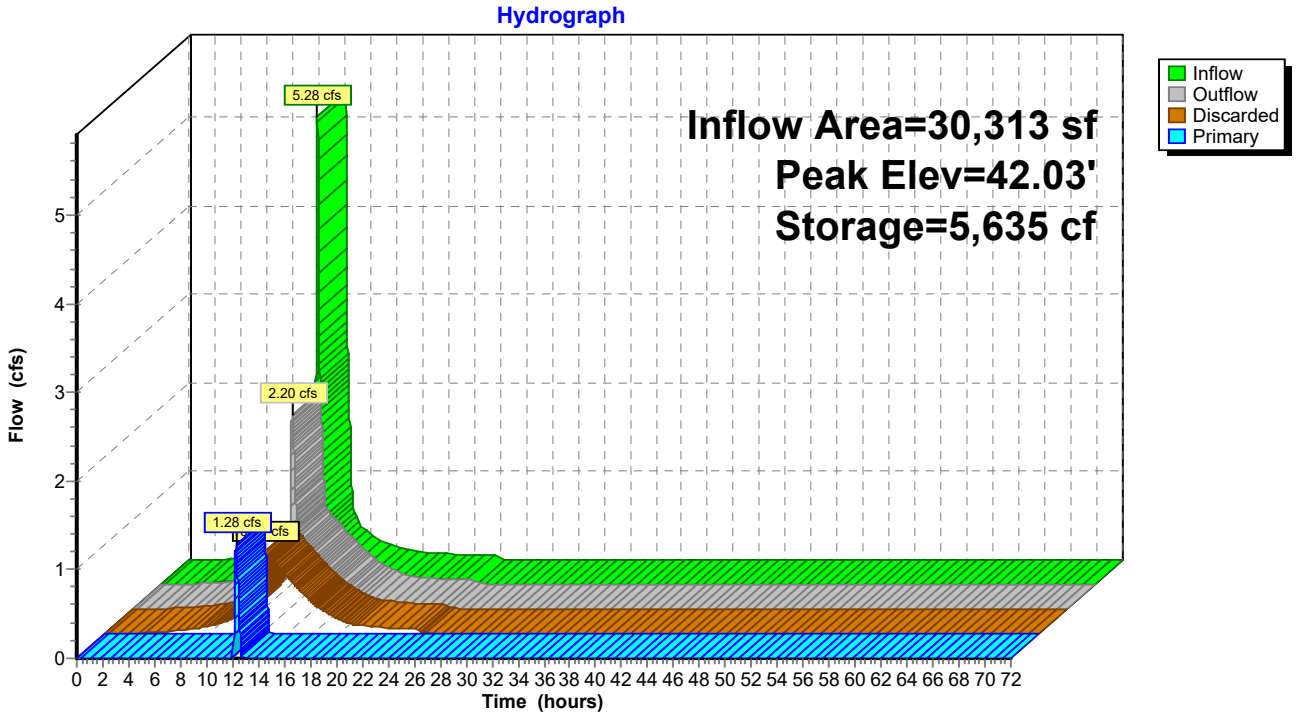
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
41.00	1	0	0	1
42.10	18,789	6,940	6,940	18,791

Device	Routing	Invert	Outlet Devices
#1	Primary	42.00'	**132.0' long x 5.0' 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 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88
#2	Discarded	41.00'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.91 cfs @ 12.28 hrs HW=42.03' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.91 cfs)

Primary OutFlow Max=1.27 cfs @ 12.28 hrs HW=42.03' (Free Discharge)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 1.27 cfs @ 0.37 fps)

Pond XP4:

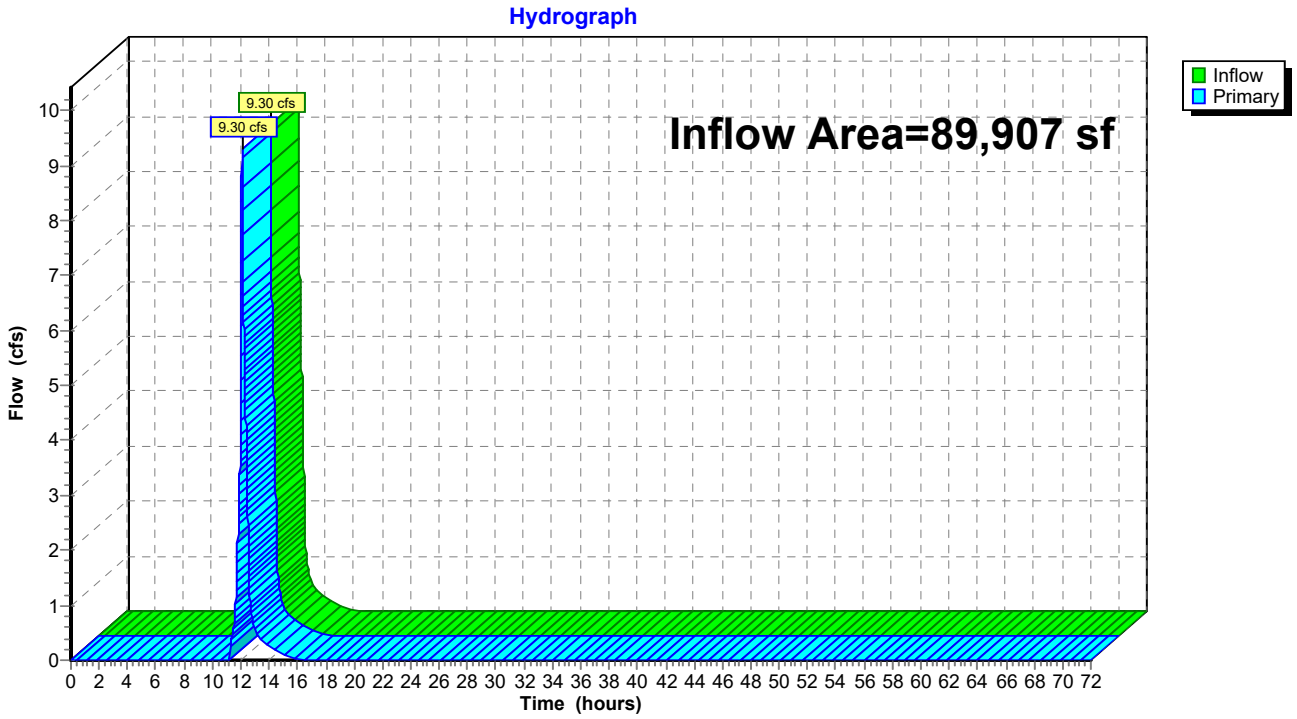

Hydrograph
Inflow Area=30,313 sf
Peak Elev=42.03'
Storage=5,635 cf
5.28 cfs
2.20 cfs
1.28 cfs
Inflow
Outflow
Discarded
Primary
Flow (cfs)
0 1 2 3 4 5
Time (hours)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72

Summary for Link DP1:

Inflow Area = 89,907 sf, 81.69% Impervious, Inflow Depth = 2.46" for 100-YR event
Inflow = 9.30 cfs @ 12.10 hrs, Volume= 18,432 cf
Primary = 9.30 cfs @ 12.10 hrs, Volume= 18,432 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link DP1:

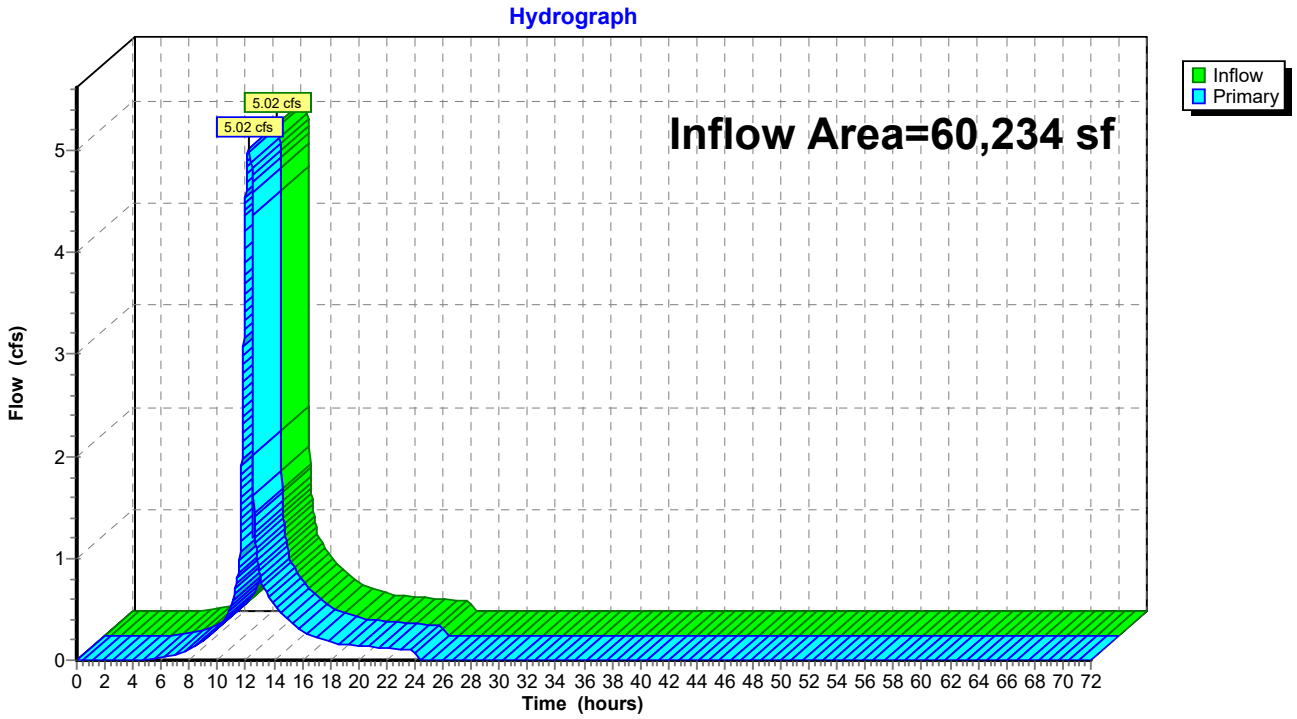


Summary for Link DP2:

Inflow Area = 60,234 sf, 72.35% Impervious, Inflow Depth = 5.93" for 100-YR event
Inflow = 5.02 cfs @ 12.20 hrs, Volume= 29,781 cf
Primary = 5.02 cfs @ 12.20 hrs, Volume= 29,781 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link DP2:

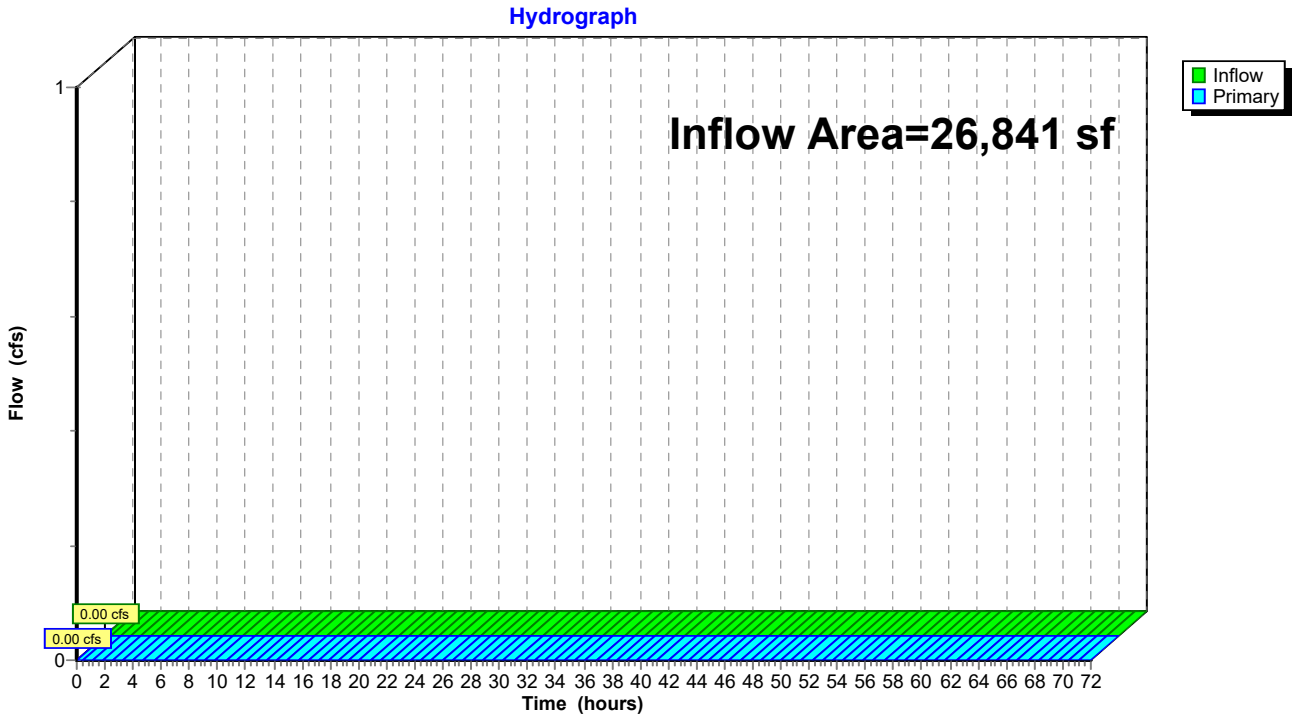


Summary for Link DP3:

Inflow Area = 26,841 sf, 30.32% Impervious, Inflow Depth = 0.00" for 100-YR event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

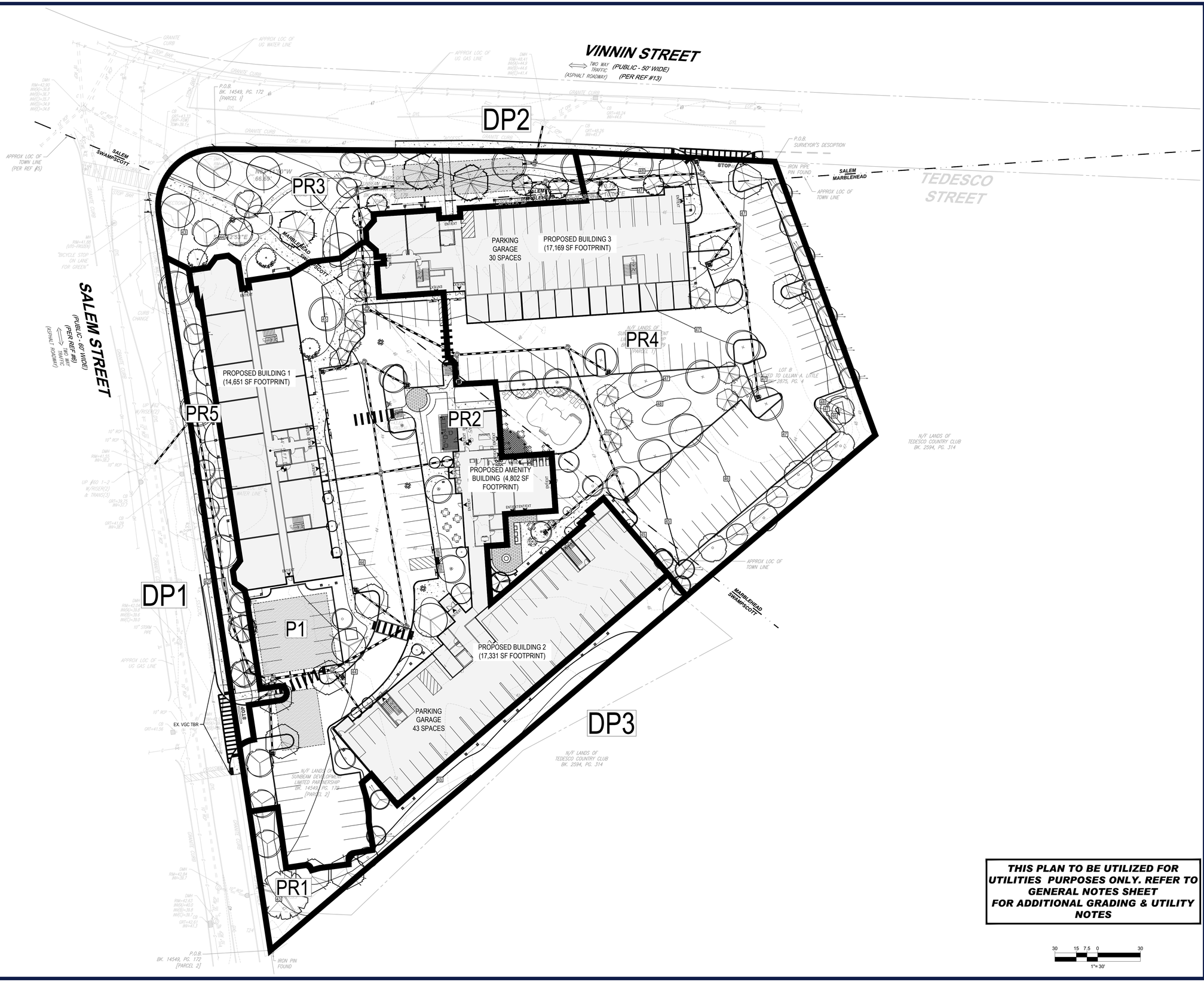
Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link DP3:



APPENDIX E: PROPOSED CONDITIONS HYDROLOGIC ANALYSIS

- *PROPOSED CONDITIONS DRAINAGE MAP*
- *PROPOSED CONDITIONS HYDROCAD CALCULATIONS*



THIS PLAN TO BE UTILIZED FOR UTILITIES PURPOSES ONLY. REFER TO GENERAL NOTES SHEET FOR ADDITIONAL GRADING & UTILITY NOTES

30 15 7.5 0 30
1"= 30'

BOHLER
SITE CIVIL AND CONSULTING ENGINEERING
LAND SURVEYING
PROGRAM MANAGEMENT
LANDSCAPE ARCHITECTURE
LOCAL/STATE/FEDERAL PERMITTING SERVICES
TRANSPORTATION SERVICES

REVISIONS

REV	DATE	COMMENT	DRAWN BY / CHECKED BY
1	09/20/2022	BUILDING FOOTPRINT REVISIONS	ACL / TAH

811 Know what's below. Call before you dig.
ALWAYS CALL 811
It's fast. It's free. It's the law.

ISSUED FOR PERMIT

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PROJECT No.: M211002
DRAWN BY: APM/ACL
CHECKED BY: EEG/TAH
DATE: 07/14/2022
CAD I.D.: M211002-SPPD-0G

PROJECT:

SITE PLAN DOCUMENTS

FOR

GLOVER RESIDENCES AT VINNIN SQUARE

PROPOSED RESIDENTIAL DEVELOPMENT

299 SALEM ST, TOWN OF SWAMPSCOTT; 202-204 TEDESCO ST, TOWN OF MARBLEHEAD; 20 VINNIN SQ, CITY OF SALEM ESSEX COUNTY, MA

BOHLER
45 FRANKLIN STREET, 5th FLOOR
BOSTON, MA 02110
Phone: (617) 849-8040
www.BohlerEngineering.com

SHEET TITLE:

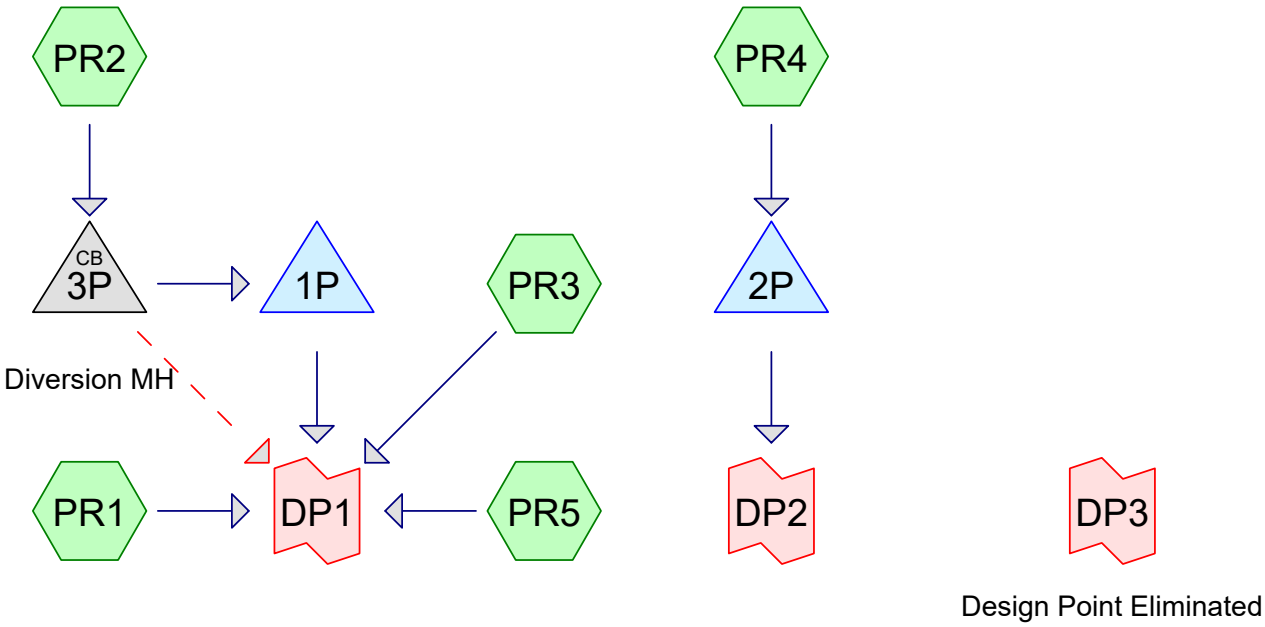
UTILITY PLAN

SHEET NUMBER:

Propo

REVISION 1 -

P:\211\M211002\CAD\DRAWINGS\PLAN SETS\CIVIL SITE PLANS\M211002-SPPD-0G---LAYOUT PROPOSED DRAIN MAP



Subcat Reach Pond Link

Routing Diagram for 2022.09.20_Proposed
Prepared by {enter your company name here}, Printed 9/20/2022

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
61,319	39	>75% Grass cover, Good, HSG A (PR1, PR2, PR3, PR4, PR5)
66,513	98	Paved parking, HSG A (PR2, PR3, PR4, PR5)
49,151	98	Roofs, HSG A (PR2, PR4)
176,983	**78**	**TOTAL AREA**

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
176,983	HSG A	PR1, PR2, PR3, PR4, PR5
0	HSG B	
0	HSG C	
0	HSG D	
0	Other	
176,983		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Sub Num
61,319	0	0	0	0	61,319	>75% Grass cover, Good	
66,513	0	0	0	0	66,513	Paved parking	
49,151	0	0	0	0	49,151	Roofs	
176,983	**0**	**0**	**0**	**0**	**176,983**	**TOTAL AREA**	

Summary for Subcatchment PR1:

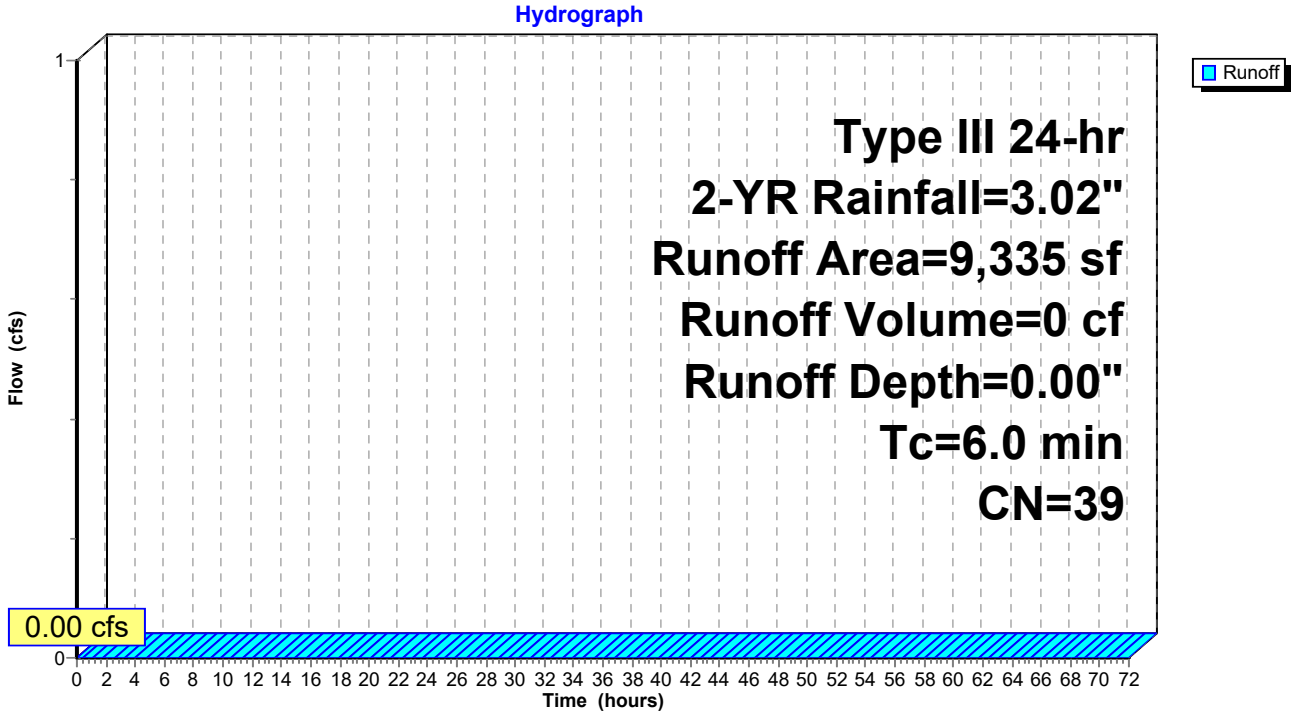
Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.02"

Area (sf)	CN	Description
9,335	39	>75% Grass cover, Good, HSG A
9,335		100.00% Pervious Area

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

Subcatchment PR1:



Summary for Subcatchment PR2:

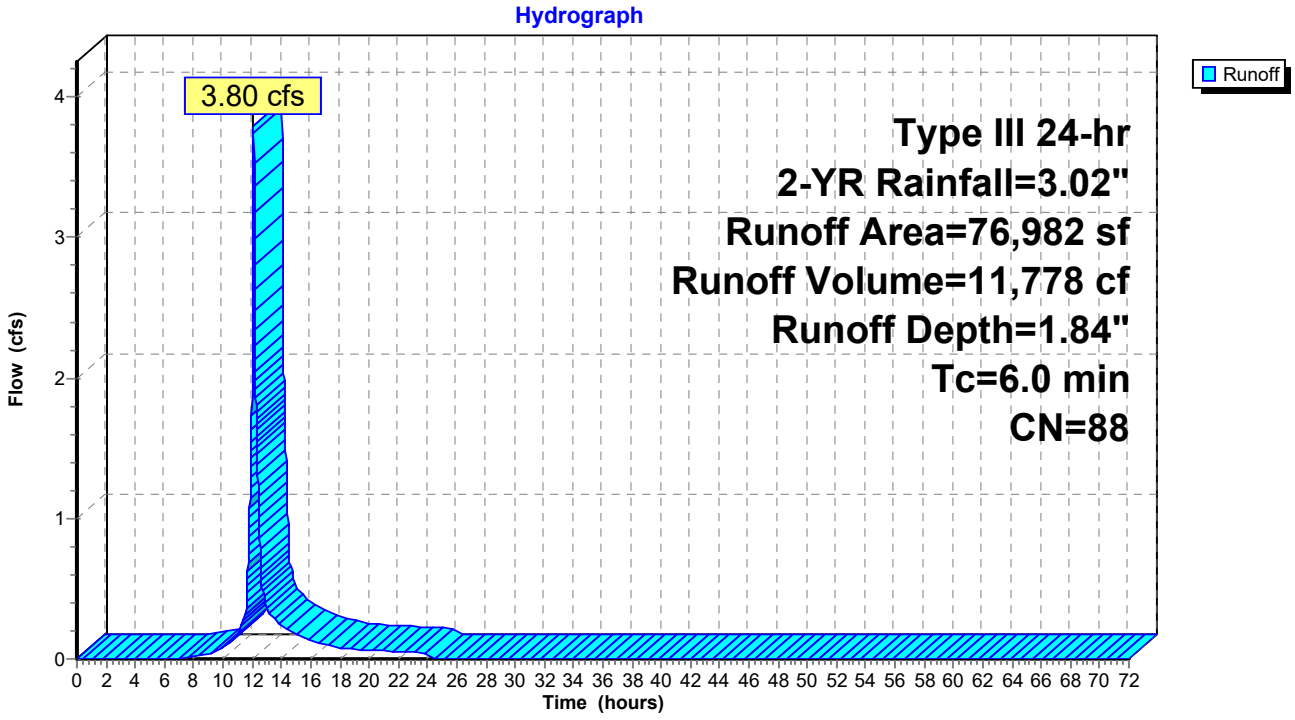
Runoff = 3.80 cfs @ 12.09 hrs, Volume= 11,778 cf, Depth= 1.84"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.02"

Area (sf)	CN	Description
31,982	98	Roofs, HSG A
31,955	98	Paved parking, HSG A
13,045	39	>75% Grass cover, Good, HSG A
76,982	88	Weighted Average
13,045		16.95% Pervious Area
63,937		83.05% Impervious Area

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

Subcatchment PR2:



Summary for Subcatchment PR3:

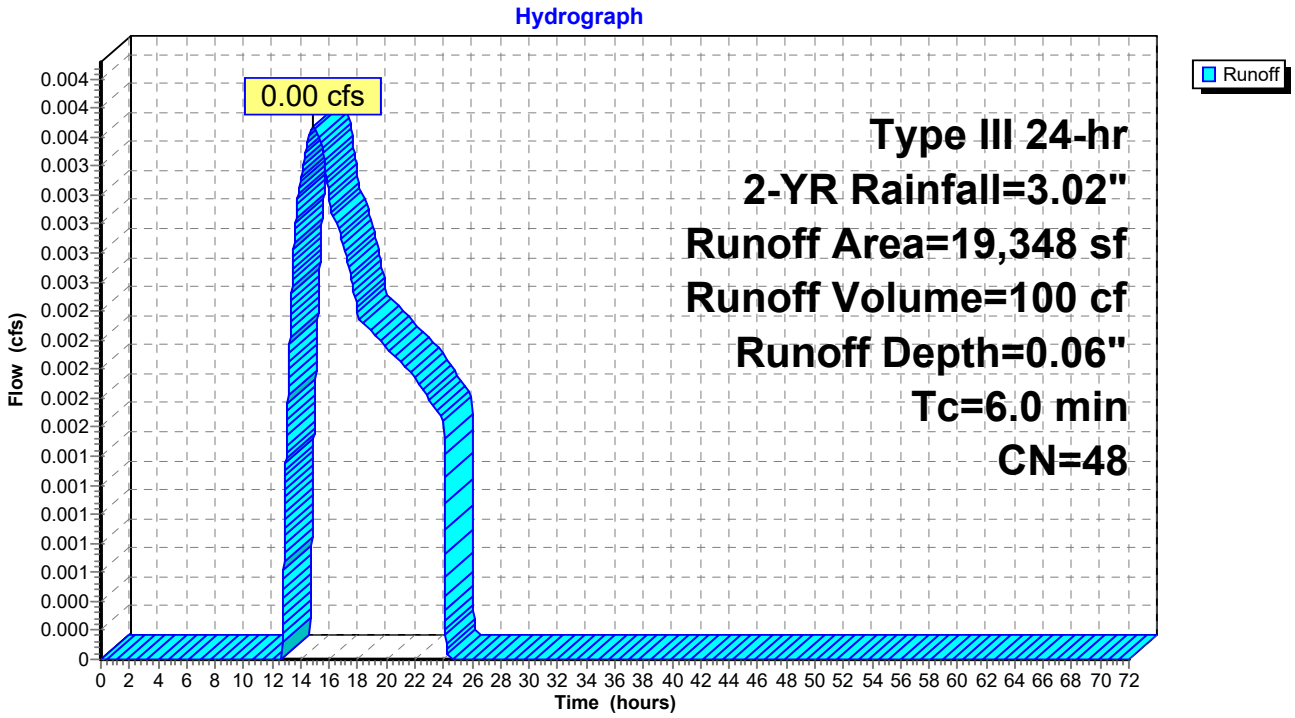
Runoff = 0.00 cfs @ 14.90 hrs, Volume= 100 cf, Depth= 0.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.02"

Area (sf)	CN	Description
16,277	39	>75% Grass cover, Good, HSG A
3,071	98	Paved parking, HSG A
19,348	48	Weighted Average
16,277		84.13% Pervious Area
3,071		15.87% Impervious Area

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

Subcatchment PR3:



Summary for Subcatchment PR4:

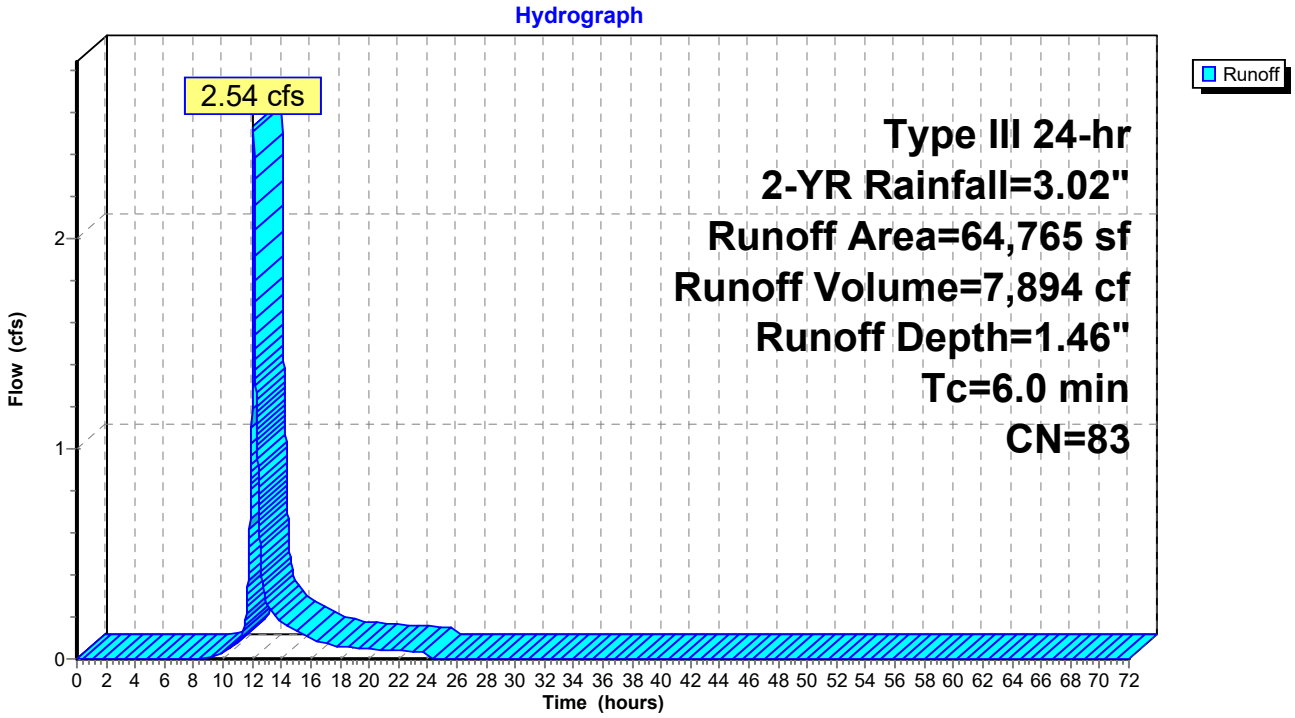
Runoff = 2.54 cfs @ 12.09 hrs, Volume= 7,894 cf, Depth= 1.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.02"

Area (sf)	CN	Description
16,792	39	>75% Grass cover, Good, HSG A
30,804	98	Paved parking, HSG A
17,169	98	Roofs, HSG A
64,765	83	Weighted Average
16,792		25.93% Pervious Area
47,973		74.07% Impervious Area

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

Subcatchment PR4:



Summary for Subcatchment PR5:

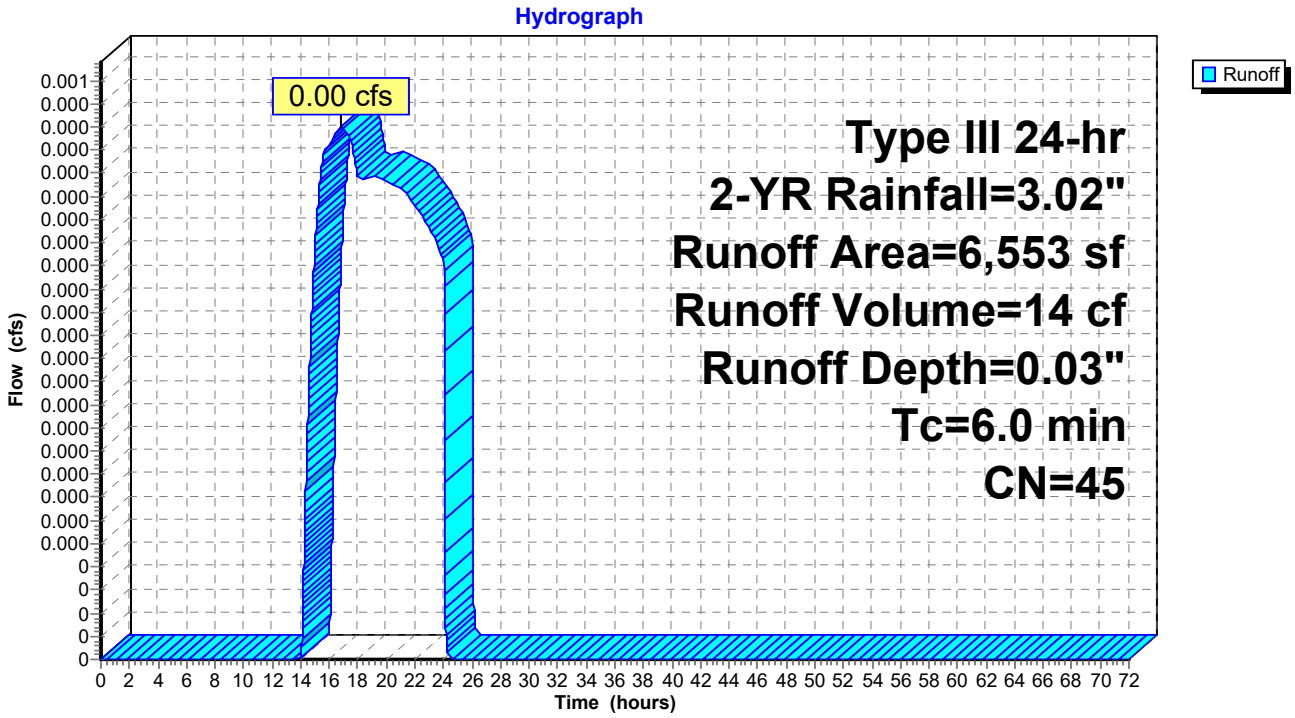
Runoff = 0.00 cfs @ 16.86 hrs, Volume= 14 cf, Depth= 0.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.02"

Area (sf)	CN	Description
5,870	39	>75% Grass cover, Good, HSG A
683	98	Paved parking, HSG A
6,553	45	Weighted Average
5,870		89.58% Pervious Area
683		10.42% Impervious Area

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

Subcatchment PR5:



Summary for Pond 1P:

Inflow Area = 76,982 sf, 83.05% Impervious, Inflow Depth = 1.79" for 2-YR event
Inflow = 2.92 cfs @ 12.09 hrs, Volume= 11,481 cf
Outflow = 0.21 cfs @ 11.56 hrs, Volume= 11,481 cf, Atten= 93%, Lag= 0.0 min
Discarded = 0.21 cfs @ 11.56 hrs, Volume= 11,481 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 37.03' @ 14.39 hrs Surf.Area= 3,758 sf Storage= 5,243 cf

Plug-Flow detention time= 237.4 min calculated for 11,479 cf (100% of inflow)
Center-of-Mass det. time= 237.3 min (1,057.2 - 819.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	34.95'	3,435 cf	**52.00'W x 47.03'L x 5.75'H Field A** 14,063 cf Overall - 5,476 cf Embedded = 8,587 cf x 40.0% Voids
#2A	35.70'	5,476 cf	**Cultec R-902HD** x 84 Inside #1 Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap 84 Chambers in 7 Rows Cap Storage= +2.8 cf x 2 x 7 rows = 38.6 cf
#3B	34.95'	1,869 cf	**30.25'W x 43.37'L x 5.75'H Field B** 7,543 cf Overall - 2,870 cf Embedded = 4,673 cf x 40.0% Voids
#4B	35.70'	2,870 cf	**Cultec R-902HD** x 44 Inside #3 Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap 44 Chambers in 4 Rows Cap Storage= +2.8 cf x 2 x 4 rows = 22.1 cf
		13,651 cf	Total Available Storage

Storage Group A created with Chamber Wizard
Storage Group B created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	34.95'	**2.410 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Primary	39.70'	**10.0" Round Culvert** L= 60.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 39.70' / 39.10' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.55 sf

Discarded OutFlow Max=0.21 cfs @ 11.56 hrs HW=35.01' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.21 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=34.95' TW=0.00' (Dynamic Tailwater)
↑—**2=Culvert** (Controls 0.00 cfs)

Pond 1P: - Chamber Wizard Field A

Chamber Model = Cultec R-902HD (Cultec Recharger® 902HD)
Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf
Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap
Cap Storage= +2.8 cf x 2 x 7 rows = 38.6 cf

78.0" Wide + 9.0" Spacing = 87.0" C-C Row Spacing

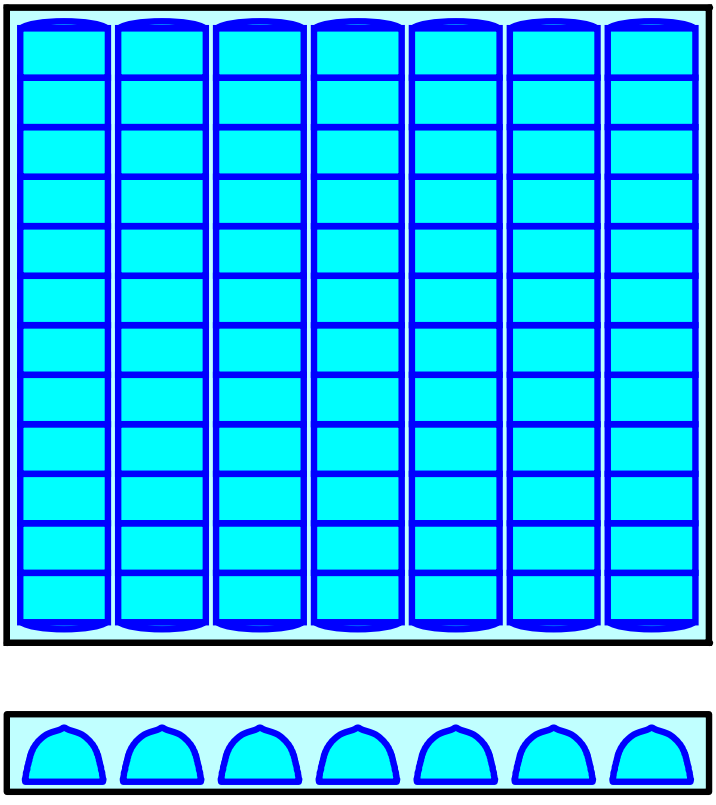
12 Chambers/Row x 3.67' Long +0.52' Cap Length x 2 = 45.03' Row Length +12.0" End Stone x 2 = 47.03' Base Length
7 Rows x 78.0" Wide + 9.0" Spacing x 6 + 12.0" Side Stone x 2 = 52.00' Base Width
9.0" Base + 48.0" Chamber Height + 12.0" Cover = 5.75' Field Height

84 Chambers x 64.7 cf + 2.8 cf Cap Volume x 2 x 7 Rows = 5,476.4 cf Chamber Storage

14,063.0 cf Field - 5,476.4 cf Chambers = 8,586.6 cf Stone x 40.0% Voids = 3,434.6 cf Stone Storage

Chamber Storage + Stone Storage = 8,911.0 cf = 0.205 af
Overall Storage Efficiency = 63.4%
Overall System Size = 47.03' x 52.00' x 5.75'

84 Chambers
520.9 cy Field
318.0 cy Stone



Pond 1P: - Chamber Wizard Field B

Chamber Model = Cultec R-902HD (Cultec Recharger® 902HD)
Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf
Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap
Cap Storage= +2.8 cf x 2 x 4 rows = 22.1 cf

78.0" Wide + 9.0" Spacing = 87.0" C-C Row Spacing

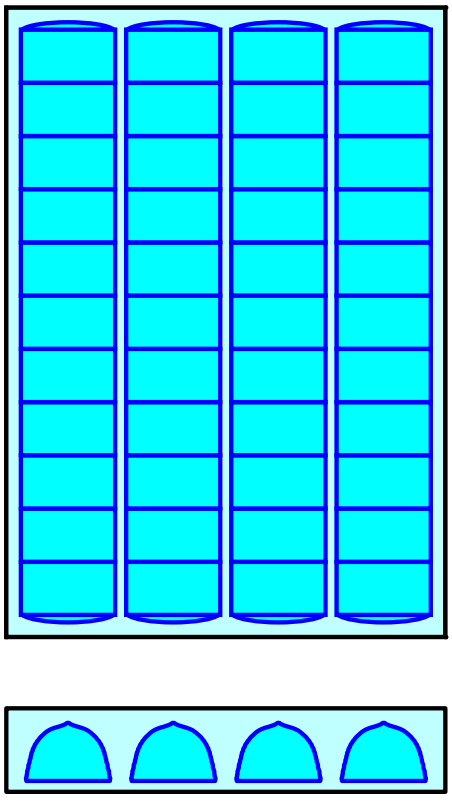
11 Chambers/Row x 3.67' Long +0.52' Cap Length x 2 = 41.37' Row Length +12.0" End Stone x 2 = 43.37' Base Length
4 Rows x 78.0" Wide + 9.0" Spacing x 3 + 12.0" Side Stone x 2 = 30.25' Base Width
9.0" Base + 48.0" Chamber Height + 12.0" Cover = 5.75' Field Height

44 Chambers x 64.7 cf + 2.8 cf Cap Volume x 2 x 4 Rows = 2,870.4 cf Chamber Storage

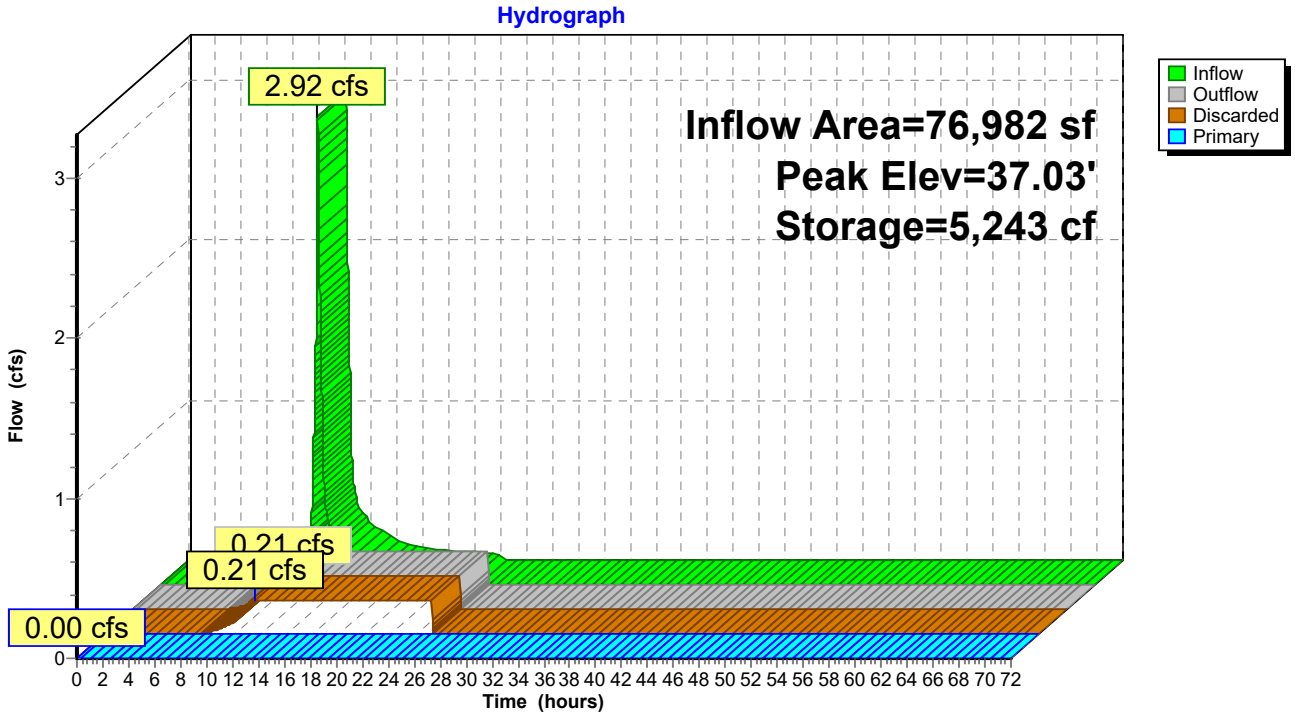
7,543.1 cf Field - 2,870.4 cf Chambers = 4,672.7 cf Stone x 40.0% Voids = 1,869.1 cf Stone Storage

Chamber Storage + Stone Storage = 4,739.5 cf = 0.109 af
Overall Storage Efficiency = 62.8%
Overall System Size = 43.37' x 30.25' x 5.75'

44 Chambers
279.4 cy Field
173.1 cy Stone



Pond 1P:


Hydrograph
Inflow
Outflow
Discarded
Primary
2.92 cfs
Inflow Area=76,982 sf
Peak Elev=37.03'
Storage=5,243 cf
0.21 cfs
0.21 cfs
0.00 cfs
Flow (cfs)
0
1
2
3
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72
Time (hours)

Summary for Pond 2P:

Inflow Area = 64,765 sf, 74.07% Impervious, Inflow Depth = 1.46" for 2-YR event
Inflow = 2.54 cfs @ 12.09 hrs, Volume= 7,894 cf
Outflow = 0.14 cfs @ 11.67 hrs, Volume= 7,894 cf, Atten= 94%, Lag= 0.0 min
Discarded = 0.14 cfs @ 11.67 hrs, Volume= 7,894 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 41.06' @ 14.81 hrs Surf.Area= 2,515 sf Storage= 3,779 cf

Plug-Flow detention time= 270.2 min calculated for 7,894 cf (100% of inflow)
Center-of-Mass det. time= 270.2 min (1,105.9 - 835.7)

Volume	Invert	Avail.Storage	Storage Description
#1A	38.85'	3,526 cf	**23.00'W x 109.37'L x 5.75'H Field A** 14,464 cf Overall - 5,649 cf Embedded = 8,815 cf x 40.0% Voids
#2A	39.60'	5,649 cf	**Cultec R-902HD** x 87 Inside #1 Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap 87 Chambers in 3 Rows Cap Storage= +2.8 cf x 2 x 3 rows = 16.6 cf
		9,175 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	38.85'	**2.410 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Primary	40.85'	**12.0" Round Culvert** L= 25.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 40.85' / 40.60' S= 0.0100 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf
#3	Device 2	41.30'	**5.0" Vert. Orifice/Grate X 4.00** C= 0.600

Discarded OutFlow Max=0.14 cfs @ 11.67 hrs HW=38.91' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.14 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=38.85' TW=0.00' (Dynamic Tailwater)
↑—**2=Culvert** (Controls 0.00 cfs)
↑—**3=Orifice/Grate** (Controls 0.00 cfs)

Pond 2P: - Chamber Wizard Field A

Chamber Model = Cultec R-902HD (Cultec Recharger® 902HD)
Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf
Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap
Cap Storage= +2.8 cf x 2 x 3 rows = 16.6 cf

78.0" Wide + 9.0" Spacing = 87.0" C-C Row Spacing

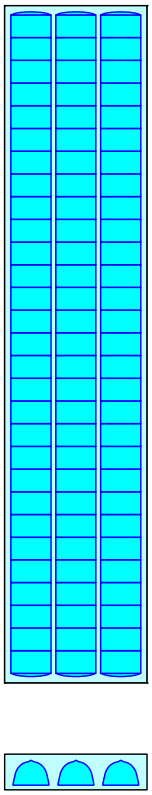
29 Chambers/Row x 3.67' Long +0.52' Cap Length x 2 = 107.37' Row Length +12.0" End Stone x 2 = 109.37' Base Length
3 Rows x 78.0" Wide + 9.0" Spacing x 2 + 12.0" Side Stone x 2 = 23.00' Base Width
9.0" Base + 48.0" Chamber Height + 12.0" Cover = 5.75' Field Height

87 Chambers x 64.7 cf + 2.8 cf Cap Volume x 2 x 3 Rows = 5,648.5 cf Chamber Storage

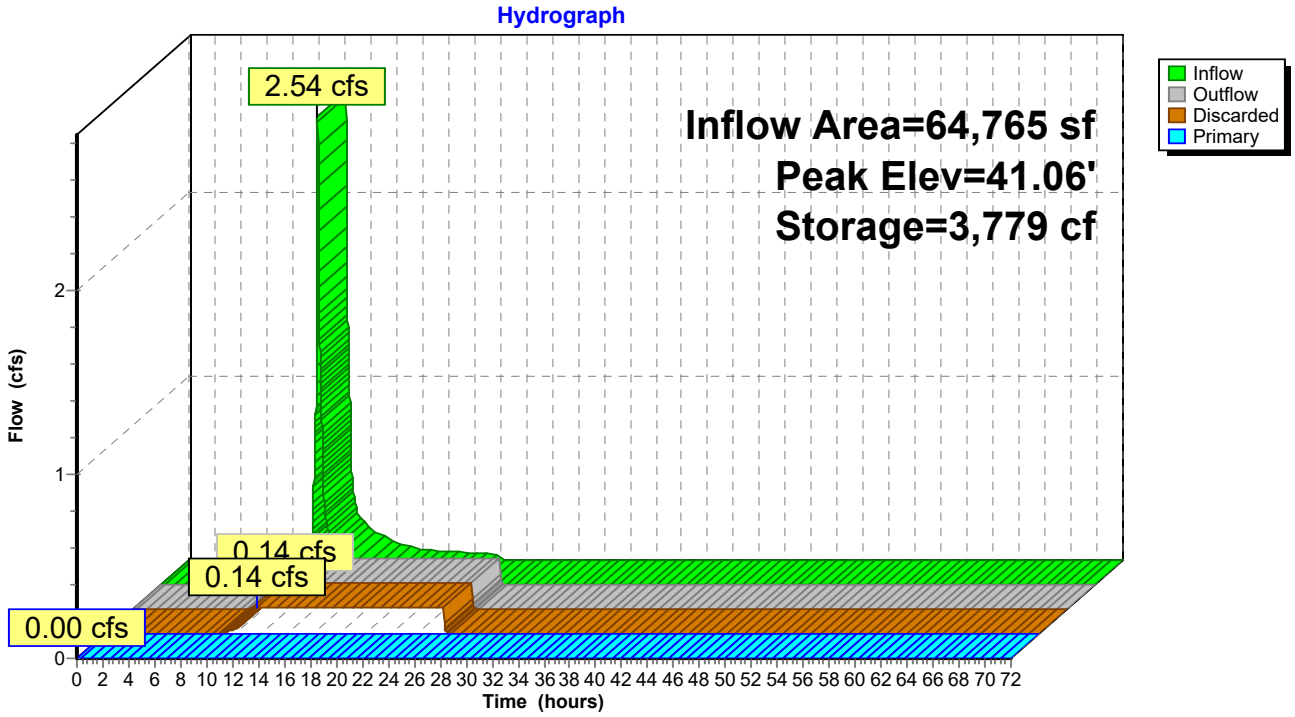
14,463.7 cf Field - 5,648.5 cf Chambers = 8,815.2 cf Stone x 40.0% Voids = 3,526.1 cf Stone Storage

Chamber Storage + Stone Storage = 9,174.6 cf = 0.211 af
Overall Storage Efficiency = 63.4%
Overall System Size = 109.37' x 23.00' x 5.75'

87 Chambers
535.7 cy Field
326.5 cy Stone



Pond 2P:


Hydrograph
Inflow
Outflow
Discarded
Primary
2.54 cfs
Inflow Area=64,765 sf
Peak Elev=41.06'
Storage=3,779 cf
0.14 cfs
0.14 cfs
0.00 cfs
Flow (cfs)
0
1
2
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72
Time (hours)

Summary for Pond 3P: Diversion MH

Inflow Area = 76,982 sf, 83.05% Impervious, Inflow Depth = 1.84" for 2-YR event
Inflow = 3.80 cfs @ 12.09 hrs, Volume= 11,778 cf
Outflow = 3.80 cfs @ 12.09 hrs, Volume= 11,778 cf, Atten= 0%, Lag= 0.0 min
Primary = 2.92 cfs @ 12.09 hrs, Volume= 11,481 cf
Secondary = 0.87 cfs @ 12.09 hrs, Volume= 297 cf

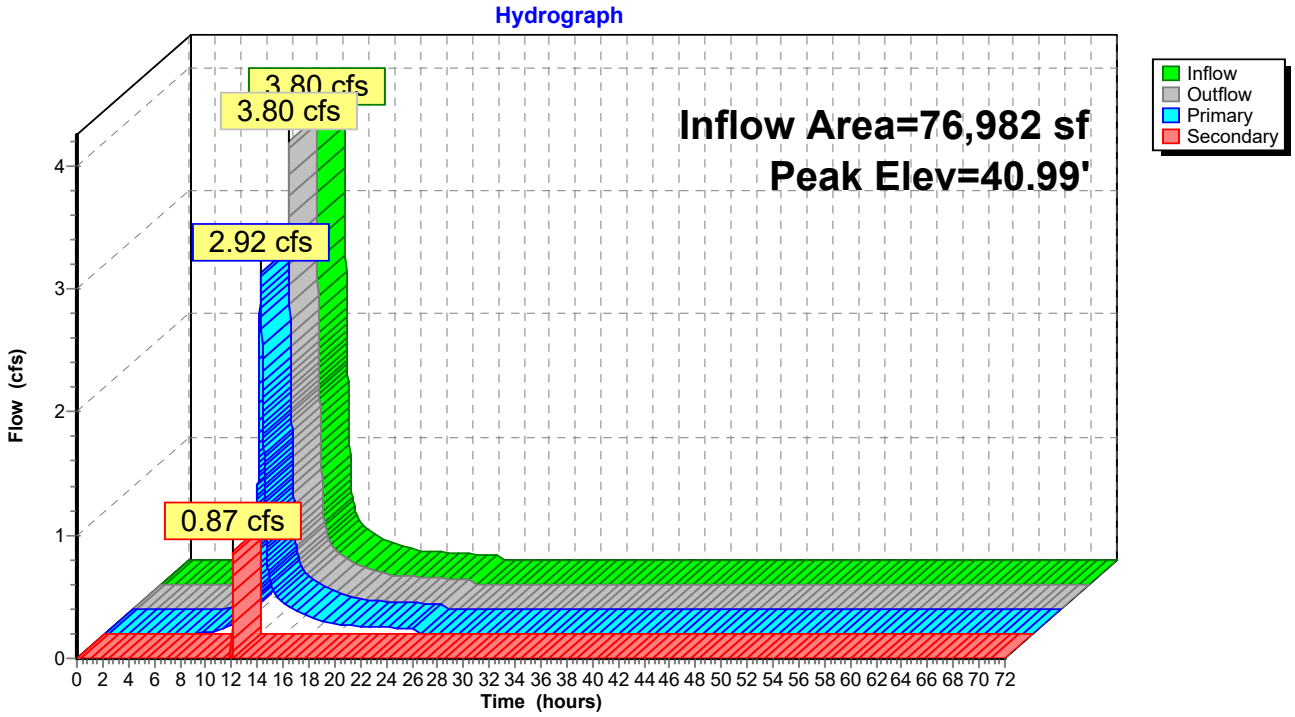
Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 40.99' @ 12.09 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	39.80'	**12.0" Round Culvert to 1P** L= 10.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 39.80' / 39.70' S= 0.0100 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf
#2	Device 3	40.85'	**5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#3	Secondary	39.70'	**10.0" Round Culvert to Salem Street** L= 60.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 39.70' / 39.10' S= 0.0100 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.55 sf

Primary OutFlow Max=2.92 cfs @ 12.09 hrs HW=40.99' TW=36.00' (Dynamic Tailwater)
└**1=Culvert to 1P** (Barrel Controls 2.92 cfs @ 3.95 fps)

Secondary OutFlow Max=0.87 cfs @ 12.09 hrs HW=40.99' TW=0.00' (Dynamic Tailwater)
└**3=Culvert to Salem Street** (Passes 0.87 cfs of 2.46 cfs potential flow)
└**2=Sharp-Crested Rectangular Weir** (Weir Controls 0.87 cfs @ 1.23 fps)

Pond 3P: Diversion MH

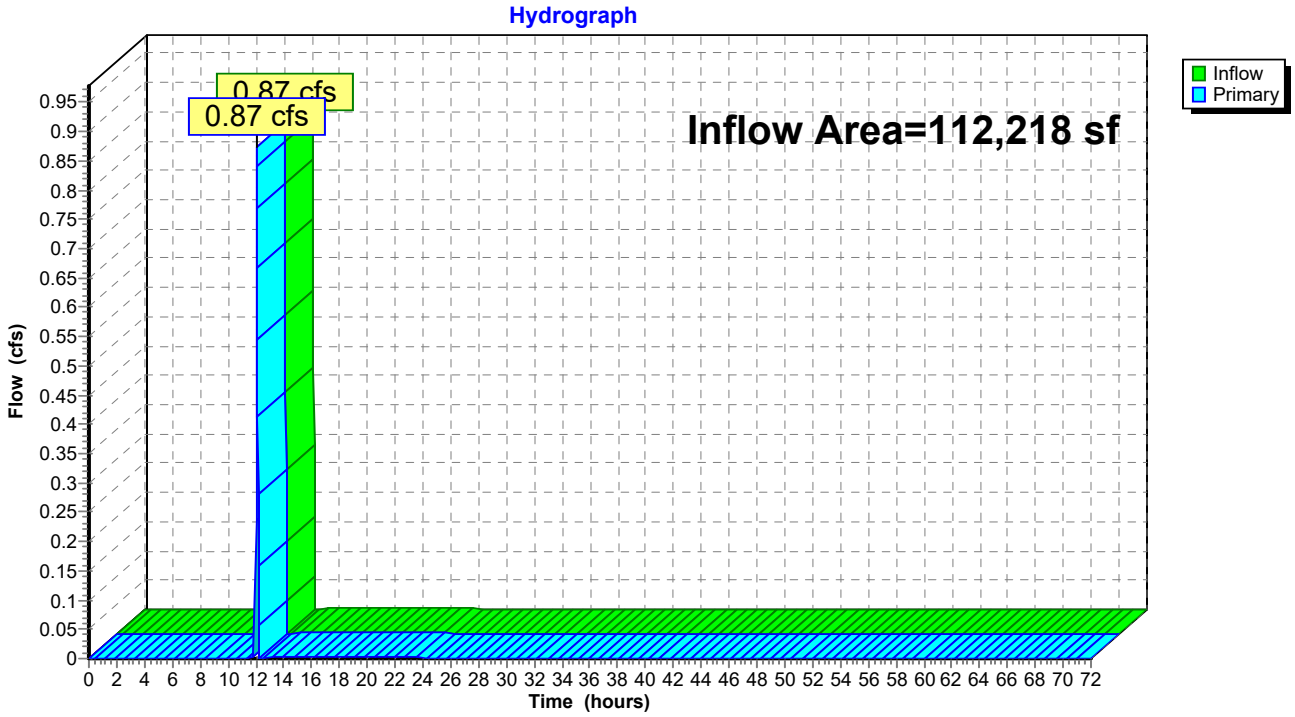


Summary for Link DP1:

Inflow Area = 112,218 sf, 60.32% Impervious, Inflow Depth = 0.04" for 2-YR event
Inflow = 0.87 cfs @ 12.09 hrs, Volume= 412 cf
Primary = 0.87 cfs @ 12.09 hrs, Volume= 412 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link DP1:

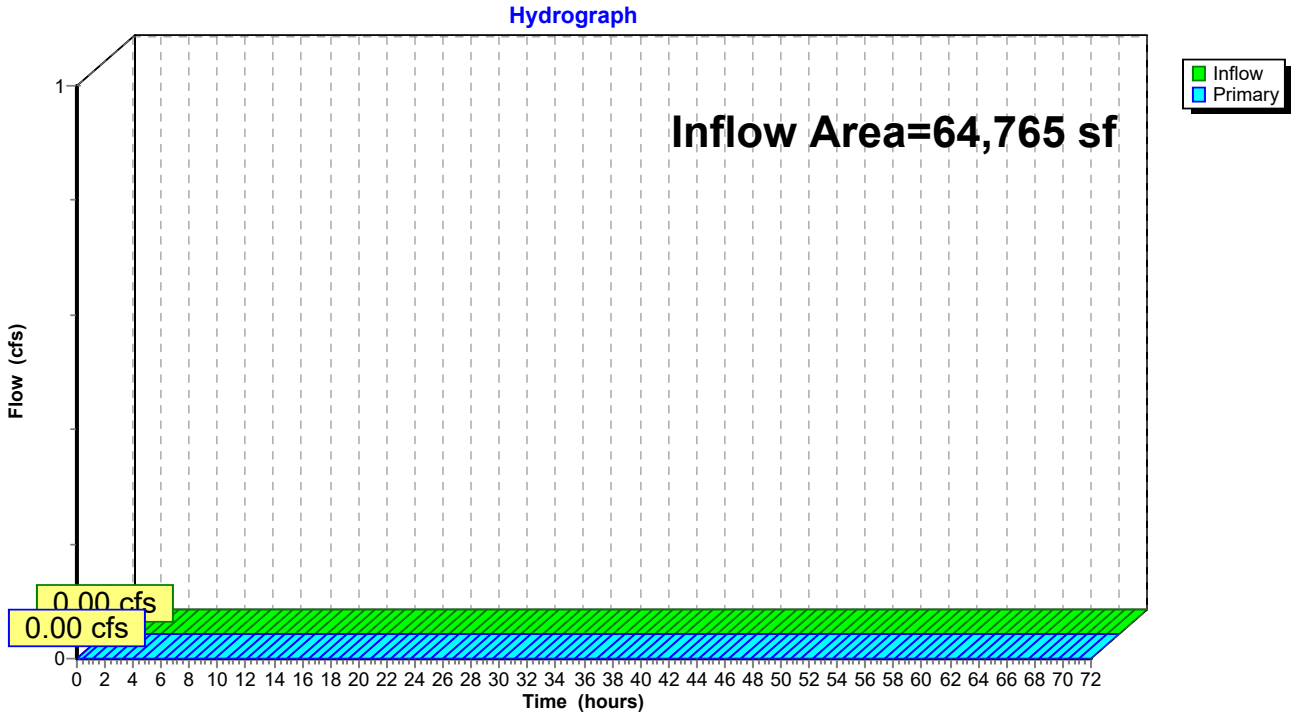


Summary for Link DP2:

Inflow Area = 64,765 sf, 74.07% Impervious, Inflow Depth = 0.00" for 2-YR event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link DP2:

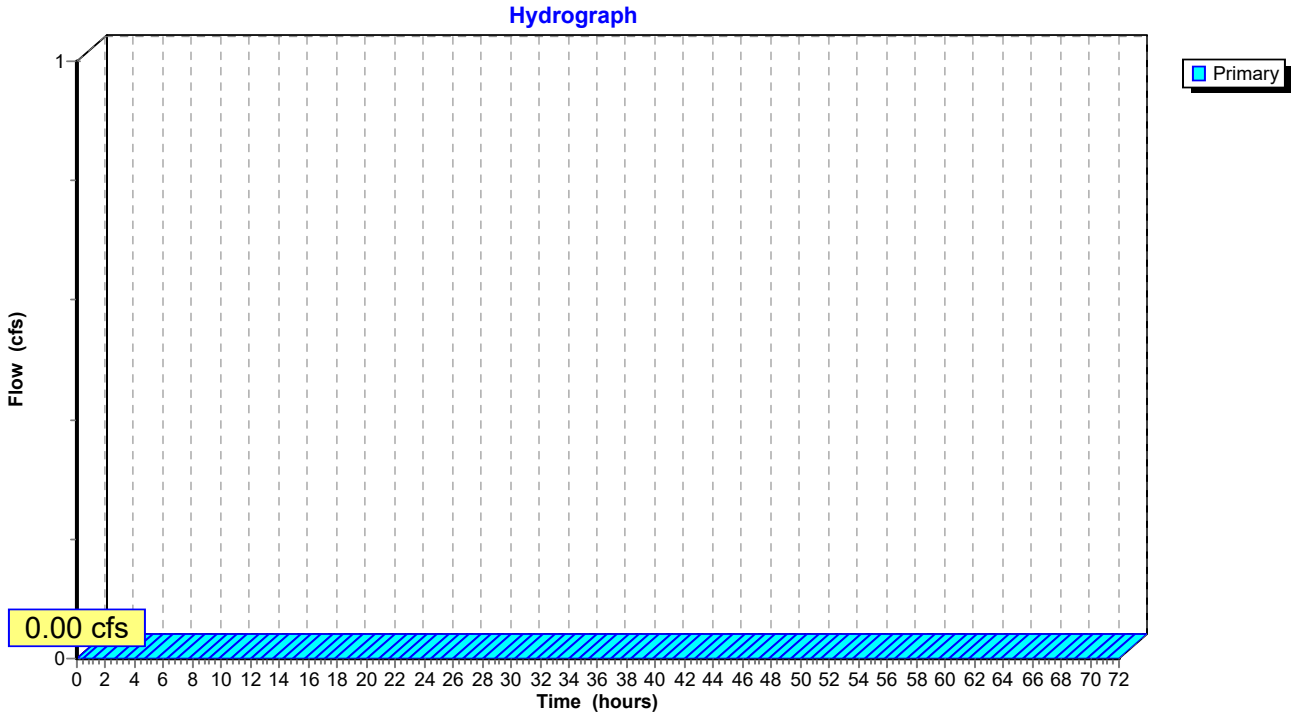


Summary for Link DP3: Design Point Eliminated

Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link DP3: Design Point Eliminated



Summary for Subcatchment PR1:

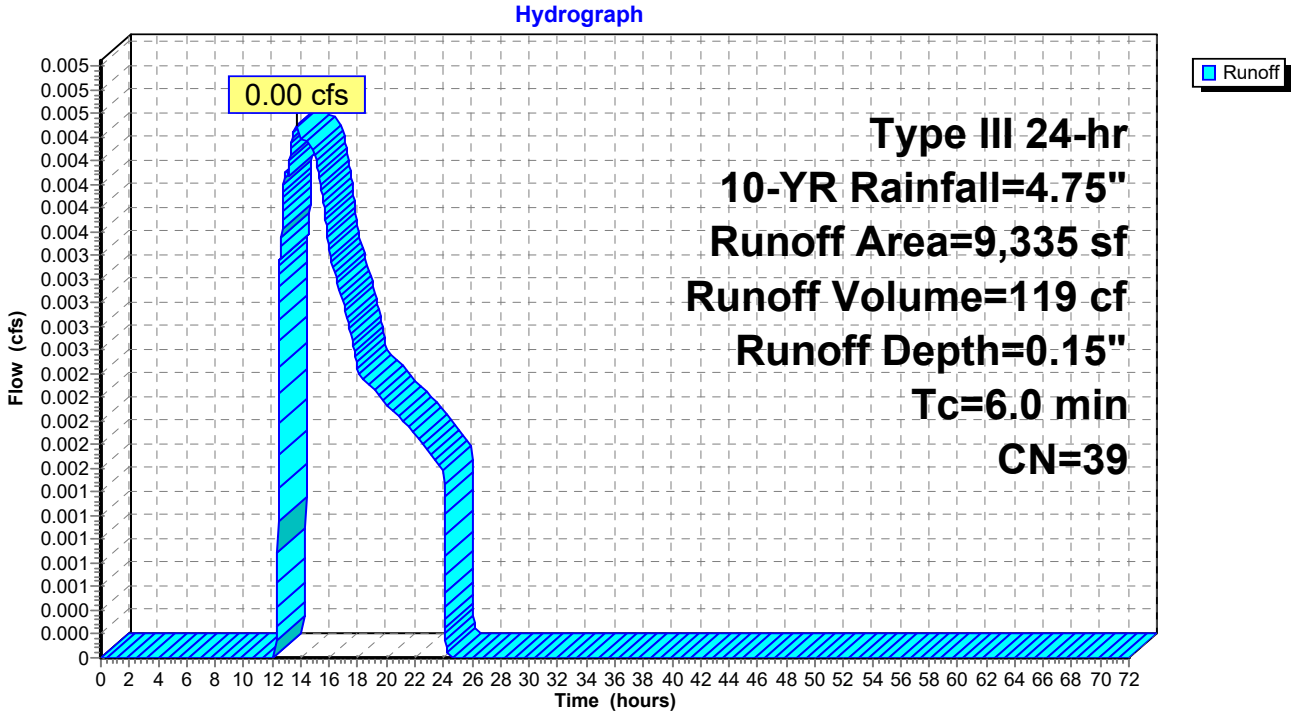
Runoff = 0.00 cfs @ 13.70 hrs, Volume= 119 cf, Depth= 0.15"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=4.75"

Area (sf)	CN	Description
9,335	39	>75% Grass cover, Good, HSG A
9,335		100.00% Pervious Area

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

Subcatchment PR1:



Summary for Subcatchment PR2:

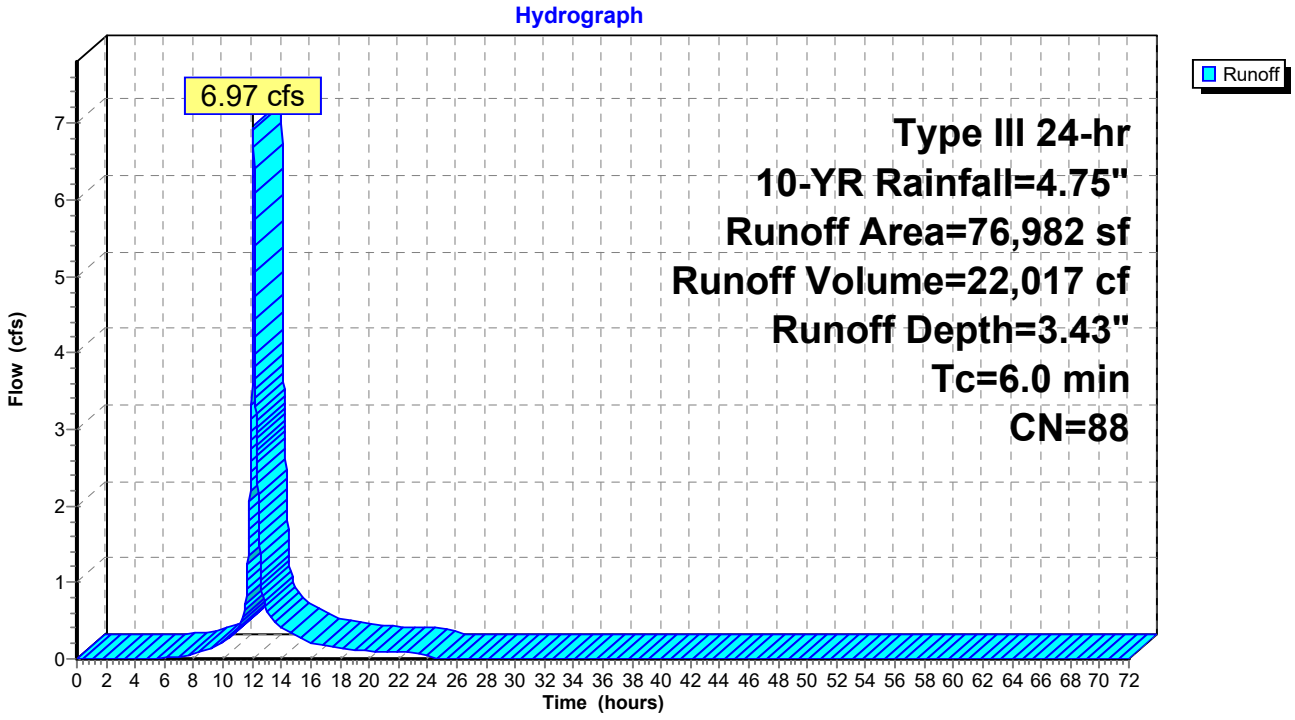
Runoff = 6.97 cfs @ 12.09 hrs, Volume= 22,017 cf, Depth= 3.43"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=4.75"

Area (sf)	CN	Description
31,982	98	Roofs, HSG A
31,955	98	Paved parking, HSG A
13,045	39	>75% Grass cover, Good, HSG A
76,982	88	Weighted Average
13,045		16.95% Pervious Area
63,937		83.05% Impervious Area

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

Subcatchment PR2:



Summary for Subcatchment PR3:

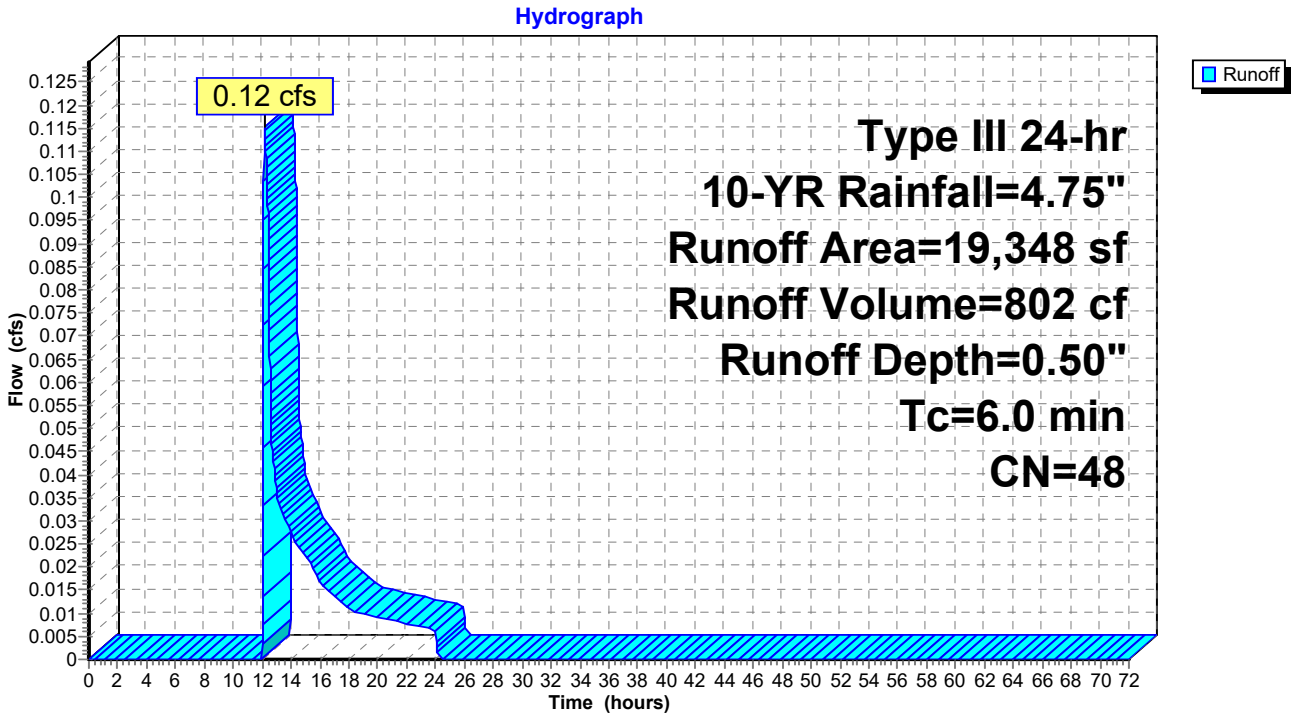
Runoff = 0.12 cfs @ 12.15 hrs, Volume= 802 cf, Depth= 0.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=4.75"

Area (sf)	CN	Description
16,277	39	>75% Grass cover, Good, HSG A
3,071	98	Paved parking, HSG A
19,348	48	Weighted Average
16,277		84.13% Pervious Area
3,071		15.87% Impervious Area

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

Subcatchment PR3:



Summary for Subcatchment PR4:

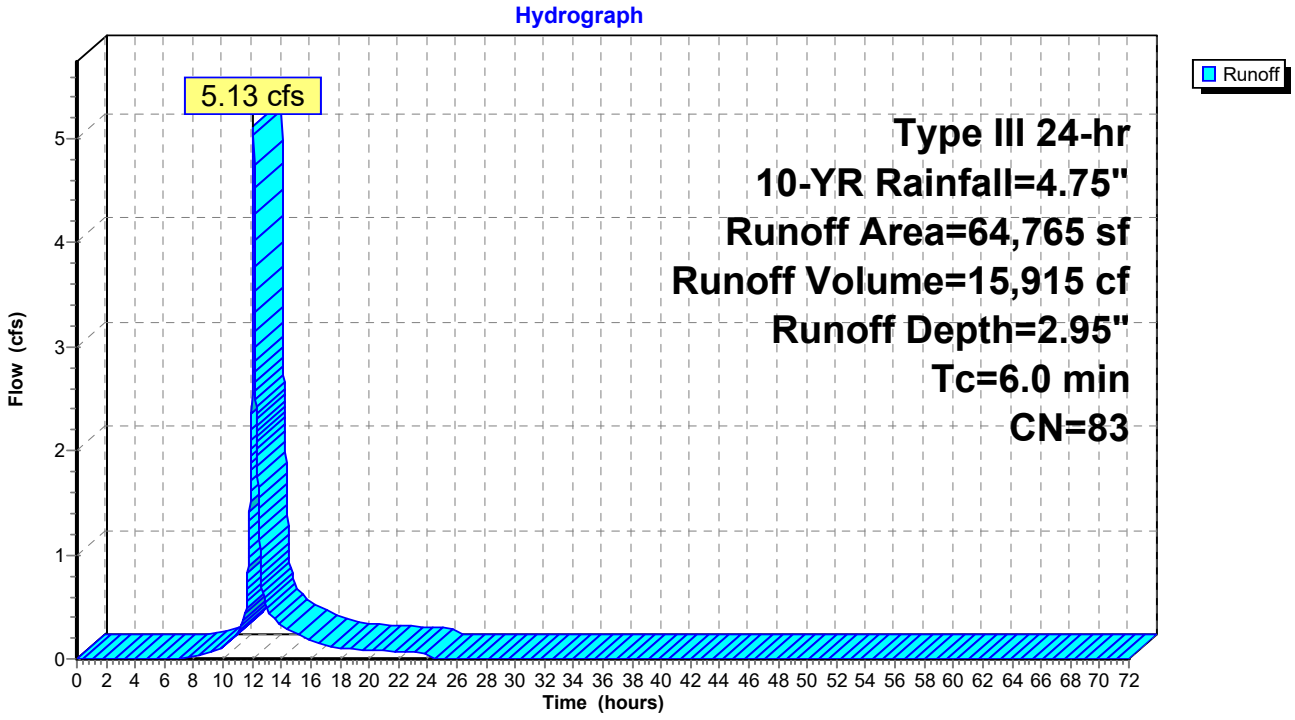
Runoff = 5.13 cfs @ 12.09 hrs, Volume= 15,915 cf, Depth= 2.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=4.75"

Area (sf)	CN	Description
16,792	39	>75% Grass cover, Good, HSG A
30,804	98	Paved parking, HSG A
17,169	98	Roofs, HSG A
64,765	83	Weighted Average
16,792		25.93% Pervious Area
47,973		74.07% Impervious Area

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

Subcatchment PR4:



Summary for Subcatchment PR5:

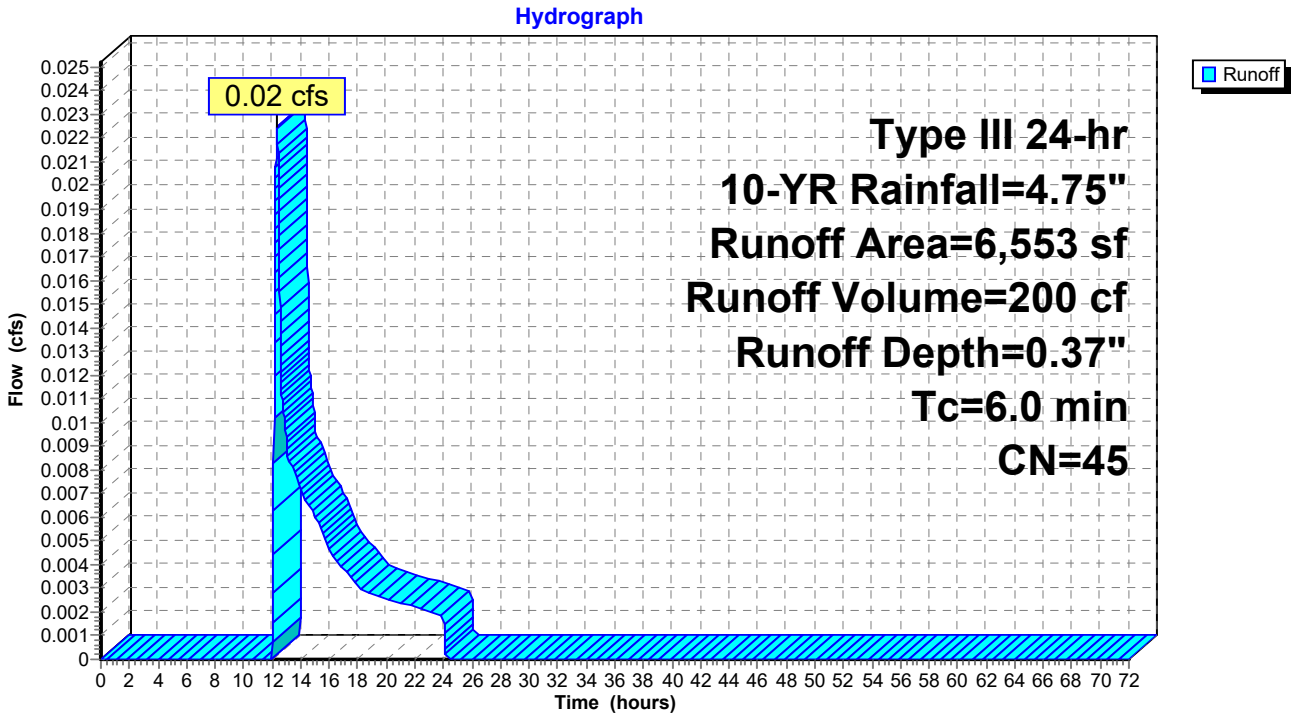
Runoff = 0.02 cfs @ 12.34 hrs, Volume= 200 cf, Depth= 0.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=4.75"

Area (sf)	CN	Description
5,870	39	>75% Grass cover, Good, HSG A
683	98	Paved parking, HSG A
6,553	45	Weighted Average
5,870		89.58% Pervious Area
683		10.42% Impervious Area

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

Subcatchment PR5:



Summary for Pond 1P:

Inflow Area = 76,982 sf, 83.05% Impervious, Inflow Depth = 3.12" for 10-YR event
Inflow = 3.98 cfs @ 12.09 hrs, Volume= 20,003 cf
Outflow = 0.21 cfs @ 10.53 hrs, Volume= 20,003 cf, Atten= 95%, Lag= 0.0 min
Discarded = 0.21 cfs @ 10.53 hrs, Volume= 20,003 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 39.09' @ 16.05 hrs Surf.Area= 3,758 sf Storage= 10,966 cf

Plug-Flow detention time= 493.0 min calculated for 20,000 cf (100% of inflow)
Center-of-Mass det. time= 493.1 min (1,300.2 - 807.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	34.95'	3,435 cf	**52.00'W x 47.03'L x 5.75'H Field A** 14,063 cf Overall - 5,476 cf Embedded = 8,587 cf x 40.0% Voids
#2A	35.70'	5,476 cf	**Cultec R-902HD** x 84 Inside #1 Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap 84 Chambers in 7 Rows Cap Storage= +2.8 cf x 2 x 7 rows = 38.6 cf
#3B	34.95'	1,869 cf	**30.25'W x 43.37'L x 5.75'H Field B** 7,543 cf Overall - 2,870 cf Embedded = 4,673 cf x 40.0% Voids
#4B	35.70'	2,870 cf	**Cultec R-902HD** x 44 Inside #3 Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap 44 Chambers in 4 Rows Cap Storage= +2.8 cf x 2 x 4 rows = 22.1 cf
		13,651 cf	Total Available Storage

Storage Group A created with Chamber Wizard
Storage Group B created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	34.95'	**2.410 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Primary	39.70'	**10.0" Round Culvert** L= 60.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 39.70' / 39.10' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.55 sf

Discarded OutFlow Max=0.21 cfs @ 10.53 hrs HW=35.01' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.21 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=34.95' TW=0.00' (Dynamic Tailwater)
↑—**2=Culvert** (Controls 0.00 cfs)

Pond 1P: - Chamber Wizard Field A

Chamber Model = Cultec R-902HD (Cultec Recharger® 902HD)
Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf
Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap
Cap Storage= +2.8 cf x 2 x 7 rows = 38.6 cf

78.0" Wide + 9.0" Spacing = 87.0" C-C Row Spacing

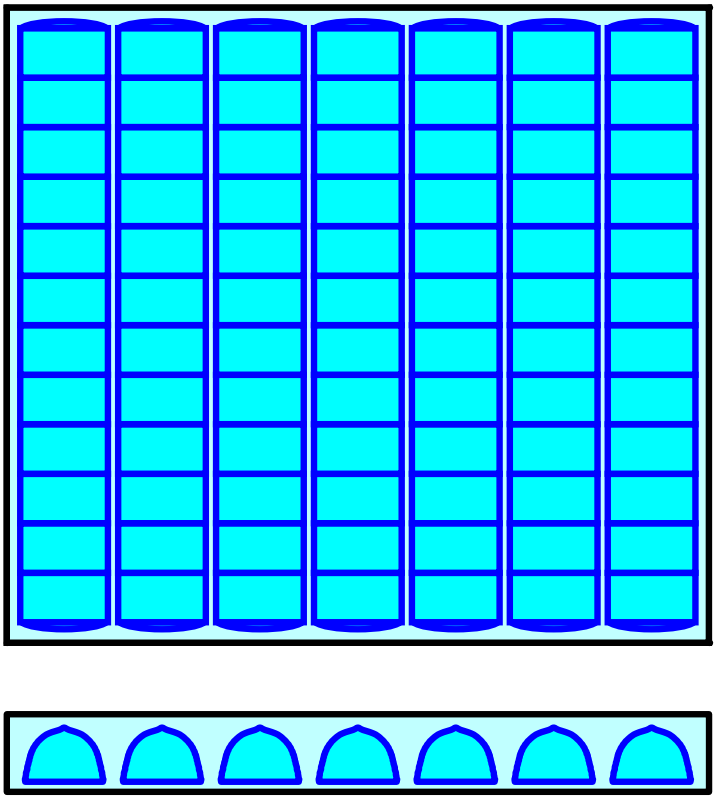
12 Chambers/Row x 3.67' Long +0.52' Cap Length x 2 = 45.03' Row Length +12.0" End Stone x 2 = 47.03' Base Length
7 Rows x 78.0" Wide + 9.0" Spacing x 6 + 12.0" Side Stone x 2 = 52.00' Base Width
9.0" Base + 48.0" Chamber Height + 12.0" Cover = 5.75' Field Height

84 Chambers x 64.7 cf + 2.8 cf Cap Volume x 2 x 7 Rows = 5,476.4 cf Chamber Storage

14,063.0 cf Field - 5,476.4 cf Chambers = 8,586.6 cf Stone x 40.0% Voids = 3,434.6 cf Stone Storage

Chamber Storage + Stone Storage = 8,911.0 cf = 0.205 af
Overall Storage Efficiency = 63.4%
Overall System Size = 47.03' x 52.00' x 5.75'

84 Chambers
520.9 cy Field
318.0 cy Stone



Pond 1P: - Chamber Wizard Field B

Chamber Model = Cultec R-902HD (Cultec Recharger® 902HD)
Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf
Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap
Cap Storage= +2.8 cf x 2 x 4 rows = 22.1 cf

78.0" Wide + 9.0" Spacing = 87.0" C-C Row Spacing

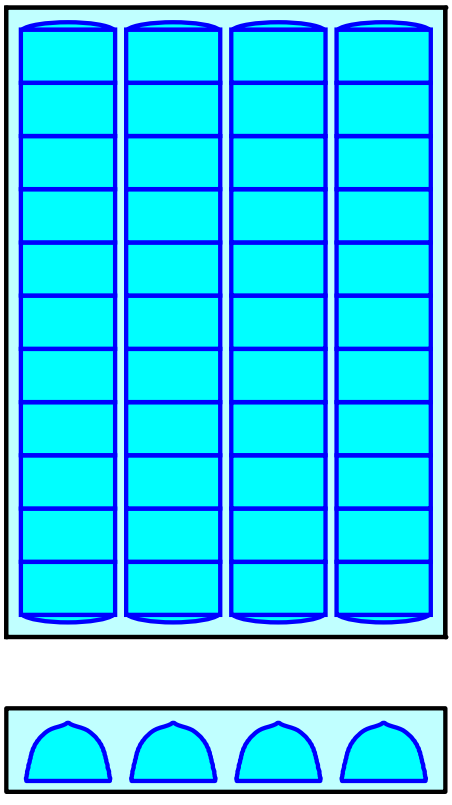
11 Chambers/Row x 3.67' Long +0.52' Cap Length x 2 = 41.37' Row Length +12.0" End Stone x 2 = 43.37' Base Length
4 Rows x 78.0" Wide + 9.0" Spacing x 3 + 12.0" Side Stone x 2 = 30.25' Base Width
9.0" Base + 48.0" Chamber Height + 12.0" Cover = 5.75' Field Height

44 Chambers x 64.7 cf + 2.8 cf Cap Volume x 2 x 4 Rows = 2,870.4 cf Chamber Storage

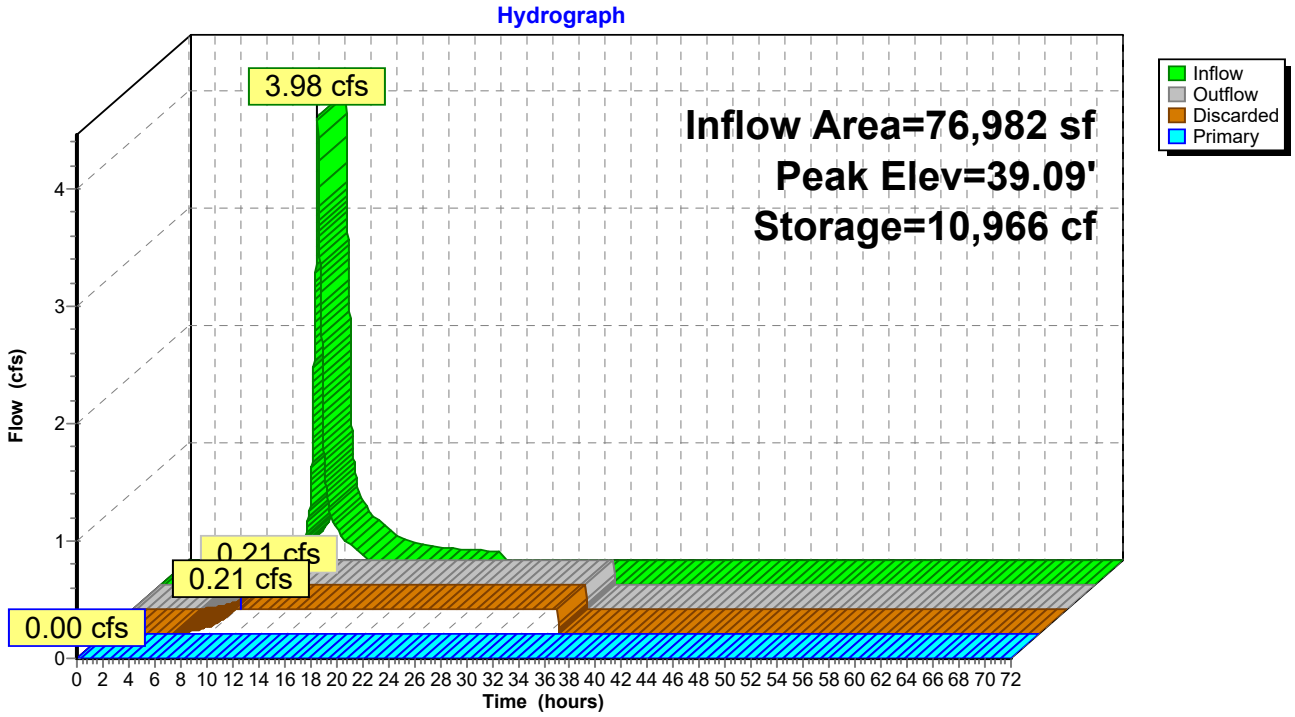
7,543.1 cf Field - 2,870.4 cf Chambers = 4,672.7 cf Stone x 40.0% Voids = 1,869.1 cf Stone Storage

Chamber Storage + Stone Storage = 4,739.5 cf = 0.109 af
Overall Storage Efficiency = 62.8%
Overall System Size = 43.37' x 30.25' x 5.75'

44 Chambers
279.4 cy Field
173.1 cy Stone



Pond 1P:


Hydrograph
Inflow
Outflow
Discarded
Primary
3.98 cfs
Inflow Area=76,982 sf
Peak Elev=39.09'
Storage=10,966 cf
0.21 cfs
0.21 cfs
0.00 cfs
Flow (cfs)
0 1 2 3 4
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72
Time (hours)

Summary for Pond 2P:

Inflow Area = 64,765 sf, 74.07% Impervious, Inflow Depth = 2.95" for 10-YR event
Inflow = 5.13 cfs @ 12.09 hrs, Volume= 15,915 cf
Outflow = 1.83 cfs @ 12.37 hrs, Volume= 15,915 cf, Atten= 64%, Lag= 16.9 min
Discarded = 0.14 cfs @ 10.75 hrs, Volume= 10,404 cf
Primary = 1.69 cfs @ 12.37 hrs, Volume= 5,511 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 41.92' @ 12.37 hrs Surf.Area= 2,515 sf Storage= 5,477 cf

Plug-Flow detention time= 217.9 min calculated for 15,913 cf (100% of inflow)
Center-of-Mass det. time= 217.9 min (1,033.4 - 815.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	38.85'	3,526 cf	**23.00'W x 109.37'L x 5.75'H Field A** 14,464 cf Overall - 5,649 cf Embedded = 8,815 cf x 40.0% Voids
#2A	39.60'	5,649 cf	**Cultec R-902HD** x 87 Inside #1 Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap 87 Chambers in 3 Rows Cap Storage= +2.8 cf x 2 x 3 rows = 16.6 cf
		9,175 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	38.85'	**2.410 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Primary	40.85'	**12.0" Round Culvert** L= 25.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 40.85' / 40.60' S= 0.0100 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf
#3	Device 2	41.30'	**5.0" Vert. Orifice/Grate X 4.00** C= 0.600

Discarded OutFlow Max=0.14 cfs @ 10.75 hrs HW=38.91' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.14 cfs)

Primary OutFlow Max=1.69 cfs @ 12.37 hrs HW=41.92' TW=0.00' (Dynamic Tailwater)
↑—**2=Culvert** (Passes 1.69 cfs of 2.86 cfs potential flow)
↑—**3=Orifice/Grate** (Orifice Controls 1.69 cfs @ 3.09 fps)

Pond 2P: - Chamber Wizard Field A

Chamber Model = Cultec R-902HD (Cultec Recharger® 902HD)
Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf
Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap
Cap Storage= +2.8 cf x 2 x 3 rows = 16.6 cf

78.0" Wide + 9.0" Spacing = 87.0" C-C Row Spacing

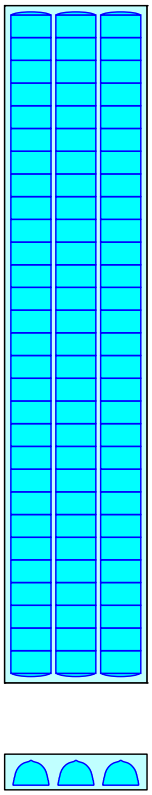
29 Chambers/Row x 3.67' Long +0.52' Cap Length x 2 = 107.37' Row Length +12.0" End Stone x 2 = 109.37' Base Length
3 Rows x 78.0" Wide + 9.0" Spacing x 2 + 12.0" Side Stone x 2 = 23.00' Base Width
9.0" Base + 48.0" Chamber Height + 12.0" Cover = 5.75' Field Height

87 Chambers x 64.7 cf + 2.8 cf Cap Volume x 2 x 3 Rows = 5,648.5 cf Chamber Storage

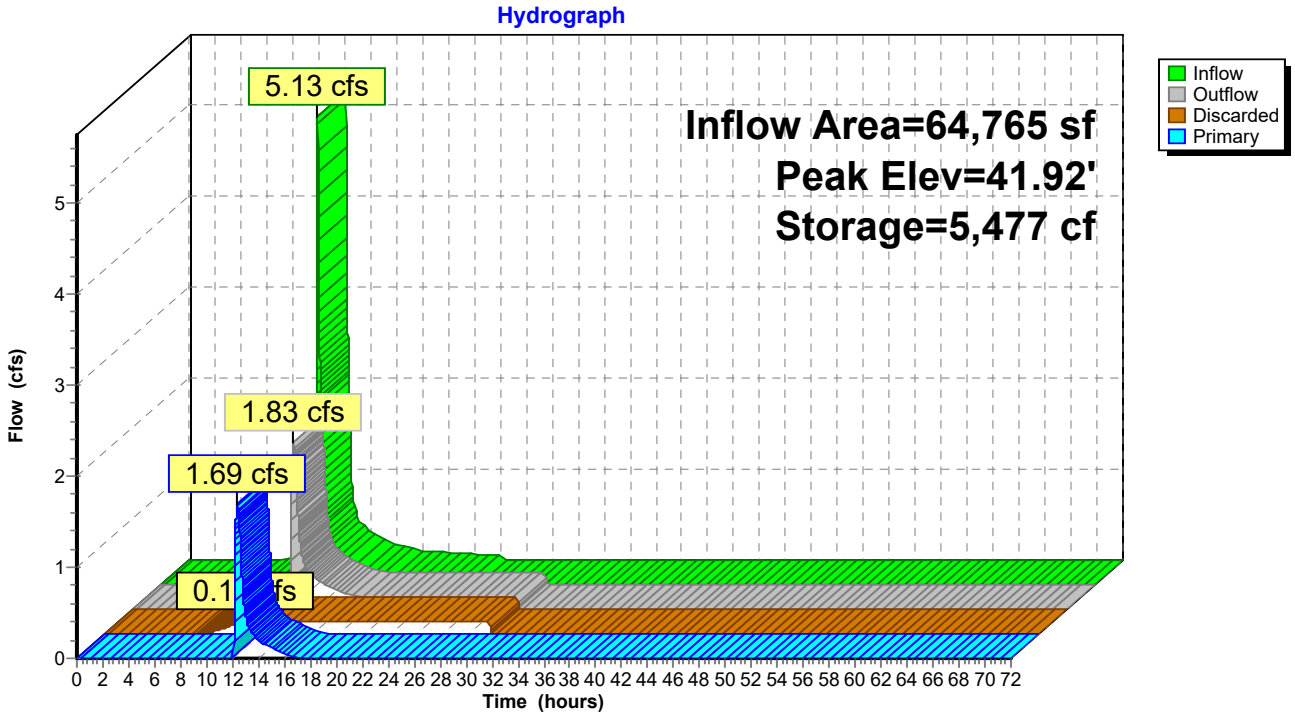
14,463.7 cf Field - 5,648.5 cf Chambers = 8,815.2 cf Stone x 40.0% Voids = 3,526.1 cf Stone Storage

Chamber Storage + Stone Storage = 9,174.6 cf = 0.211 af
Overall Storage Efficiency = 63.4%
Overall System Size = 109.37' x 23.00' x 5.75'

87 Chambers
535.7 cy Field
326.5 cy Stone



Pond 2P:


Hydrograph
5.13 cfs
1.83 cfs
1.69 cfs
Inflow Area=64,765 sf
Peak Elev=41.92'
Storage=5,477 cf
Inflow
Outflow
Discarded
Primary
Flow (cfs)
0 1 2 3 4 5
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72
Time (hours)

Summary for Pond 3P: Diversion MH

Inflow Area = 76,982 sf, 83.05% Impervious, Inflow Depth = 3.43" for 10-YR event
Inflow = 6.97 cfs @ 12.09 hrs, Volume= 22,017 cf
Outflow = 6.97 cfs @ 12.09 hrs, Volume= 22,017 cf, Atten= 0%, Lag= 0.0 min
Primary = 3.98 cfs @ 12.09 hrs, Volume= 20,003 cf
Secondary = 2.99 cfs @ 12.09 hrs, Volume= 2,014 cf

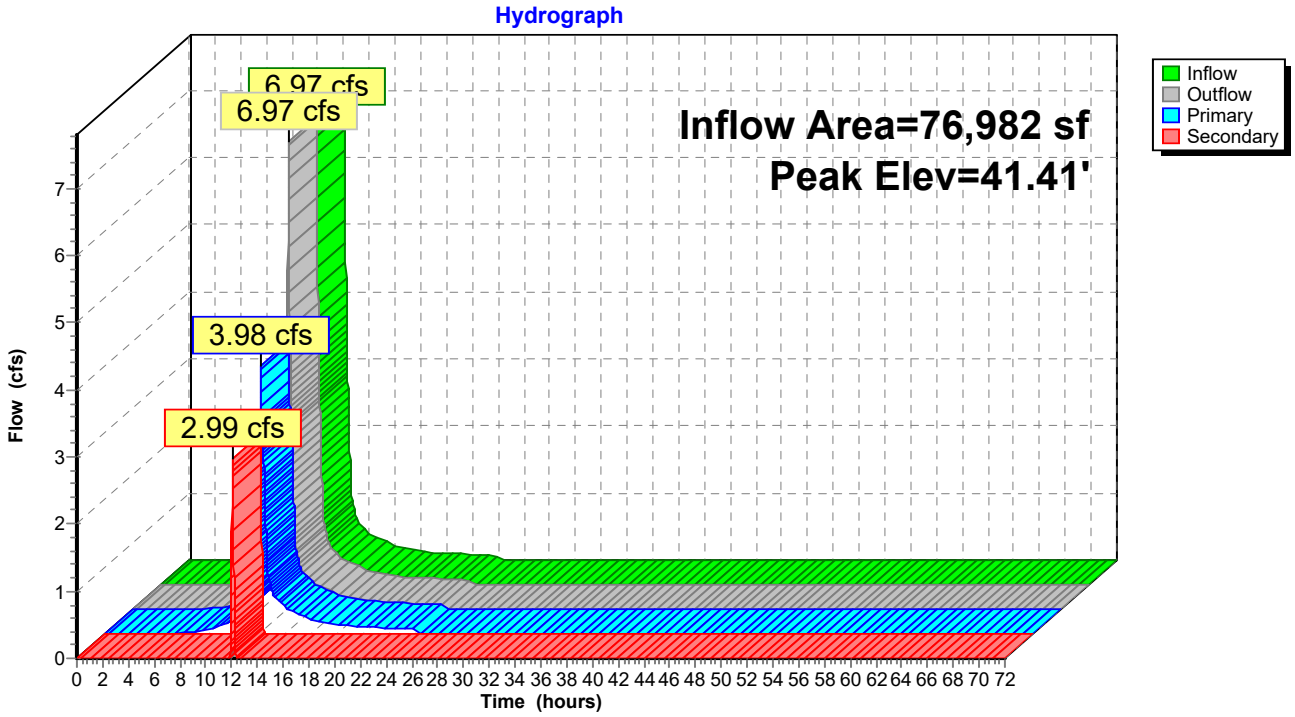
Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 41.41' @ 12.09 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	39.80'	**12.0" Round Culvert to 1P** L= 10.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 39.80' / 39.70' S= 0.0100 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf
#2	Device 3	40.85'	**5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#3	Secondary	39.70'	**10.0" Round Culvert to Salem Street** L= 60.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 39.70' / 39.10' S= 0.0100 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.55 sf

Primary OutFlow Max=3.97 cfs @ 12.09 hrs HW=41.40' TW=36.77' (Dynamic Tailwater)
└**1=Culvert to 1P** (Inlet Controls 3.97 cfs @ 5.06 fps)

Secondary OutFlow Max=2.98 cfs @ 12.09 hrs HW=41.40' TW=0.00' (Dynamic Tailwater)
└**3=Culvert to Salem Street** (Inlet Controls 2.98 cfs @ 5.46 fps)
└**2=Sharp-Crested Rectangular Weir** (Passes 2.98 cfs of 6.60 cfs potential flow)

Pond 3P: Diversion MH

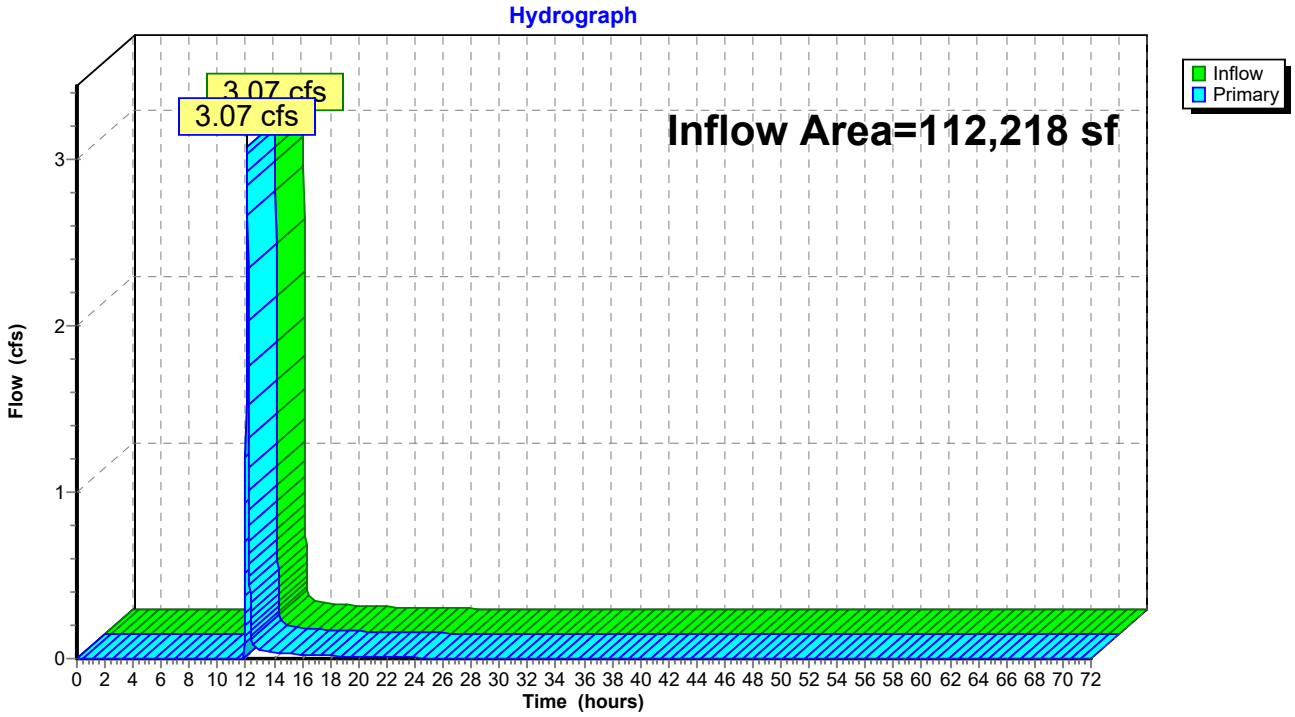


Summary for Link DP1:

Inflow Area = 112,218 sf, 60.32% Impervious, Inflow Depth = 0.34" for 10-YR event
Inflow = 3.07 cfs @ 12.09 hrs, Volume= 3,134 cf
Primary = 3.07 cfs @ 12.09 hrs, Volume= 3,134 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link DP1:

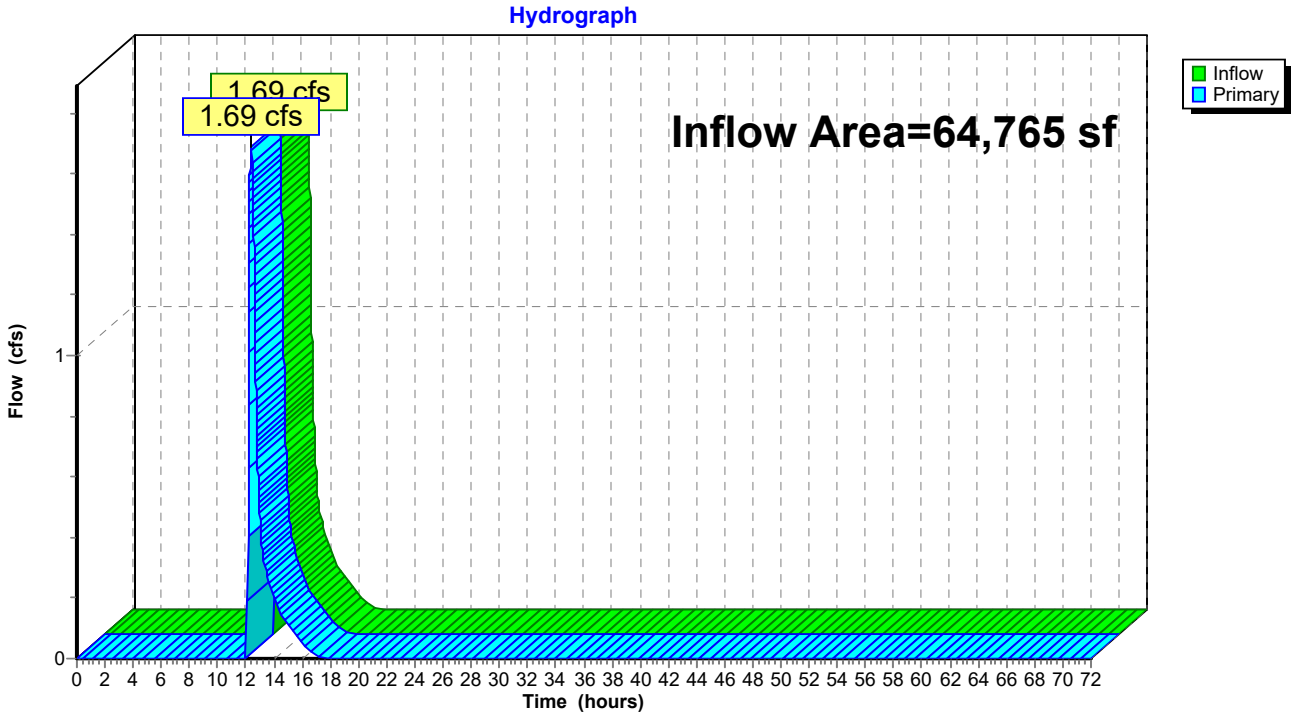


Summary for Link DP2:

Inflow Area = 64,765 sf, 74.07% Impervious, Inflow Depth = 1.02" for 10-YR event
Inflow = 1.69 cfs @ 12.37 hrs, Volume= 5,511 cf
Primary = 1.69 cfs @ 12.37 hrs, Volume= 5,511 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link DP2:

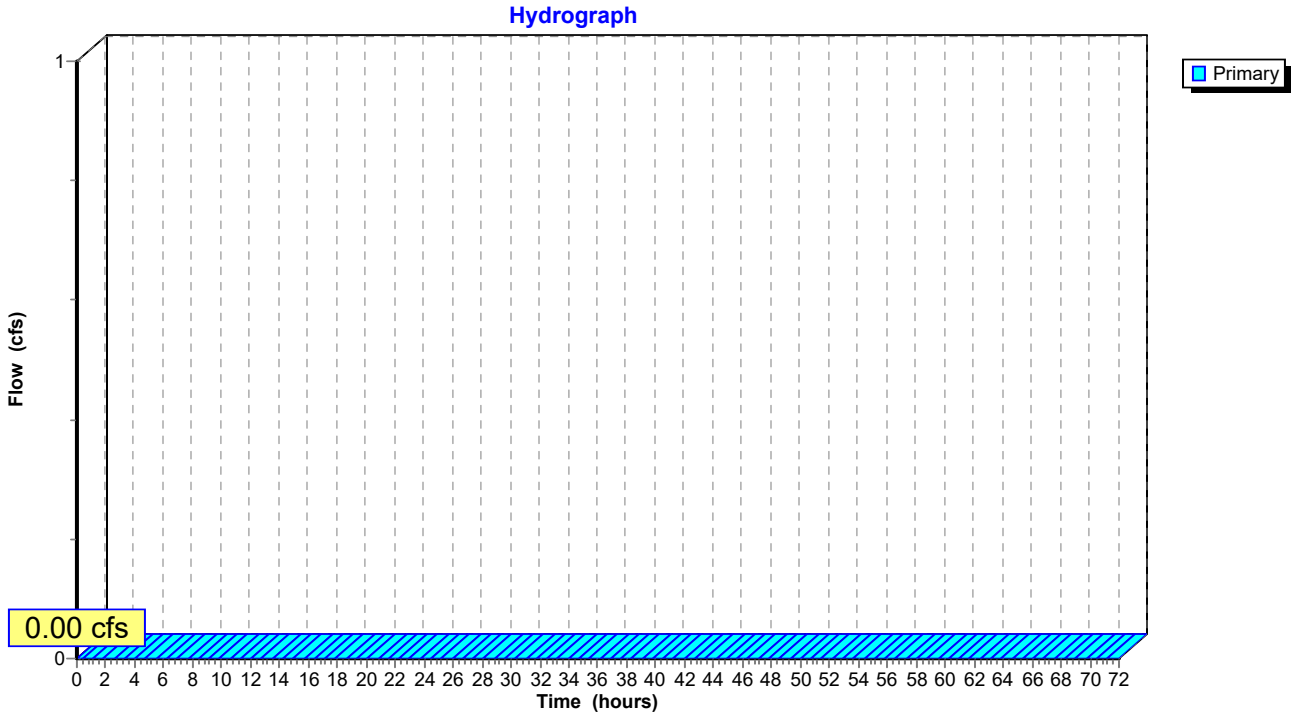


Summary for Link DP3: Design Point Eliminated

Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link DP3: Design Point Eliminated



Summary for Subcatchment PR1:

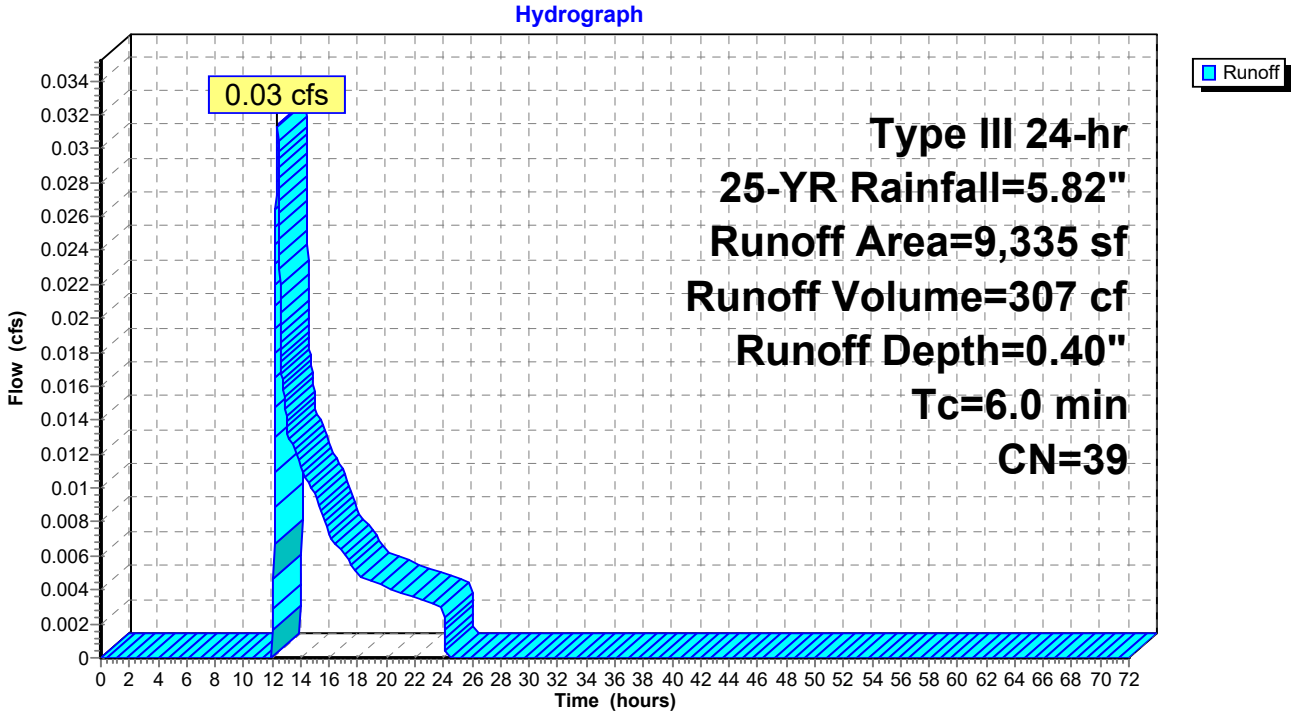
Runoff = 0.03 cfs @ 12.36 hrs, Volume= 307 cf, Depth= 0.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-YR Rainfall=5.82"

Area (sf)	CN	Description
9,335	39	>75% Grass cover, Good, HSG A
9,335		100.00% Pervious Area

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

Subcatchment PR1:



Summary for Subcatchment PR2:

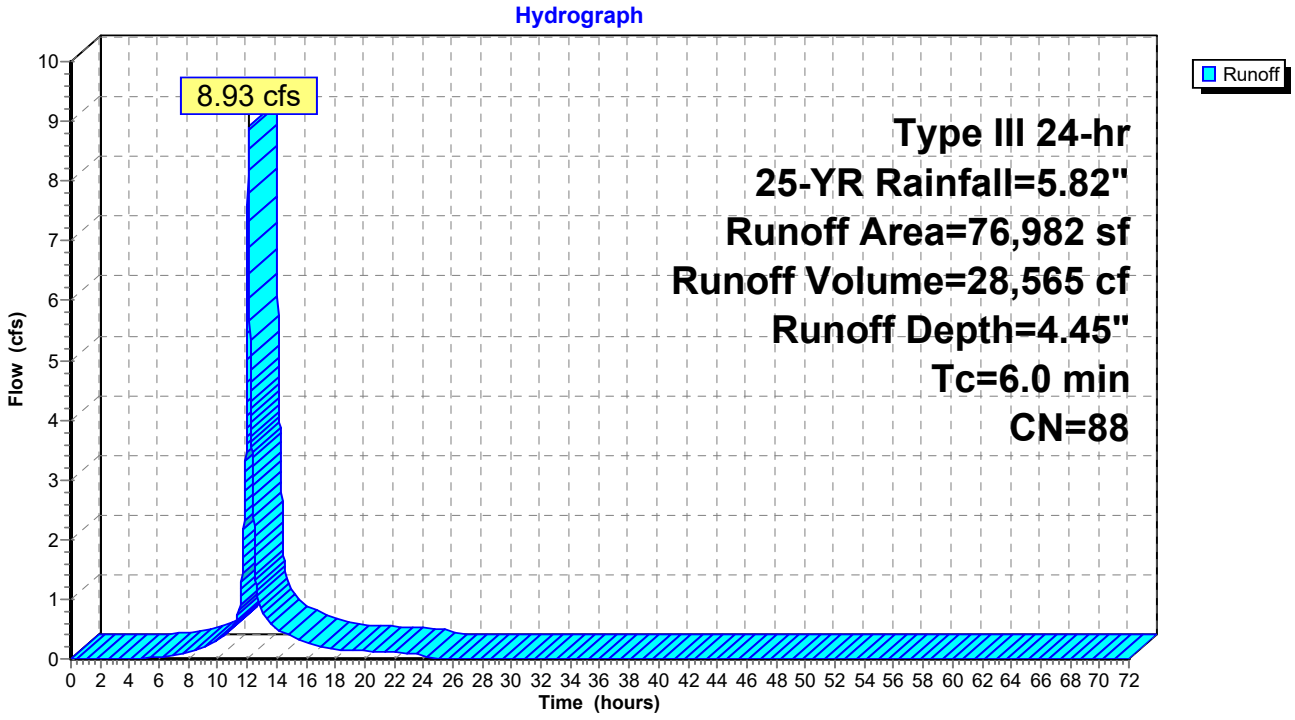
Runoff = 8.93 cfs @ 12.09 hrs, Volume= 28,565 cf, Depth= 4.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-YR Rainfall=5.82"

Area (sf)	CN	Description
31,982	98	Roofs, HSG A
31,955	98	Paved parking, HSG A
13,045	39	>75% Grass cover, Good, HSG A
76,982	88	Weighted Average
13,045		16.95% Pervious Area
63,937		83.05% Impervious Area

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

Subcatchment PR2:



Summary for Subcatchment PR3:

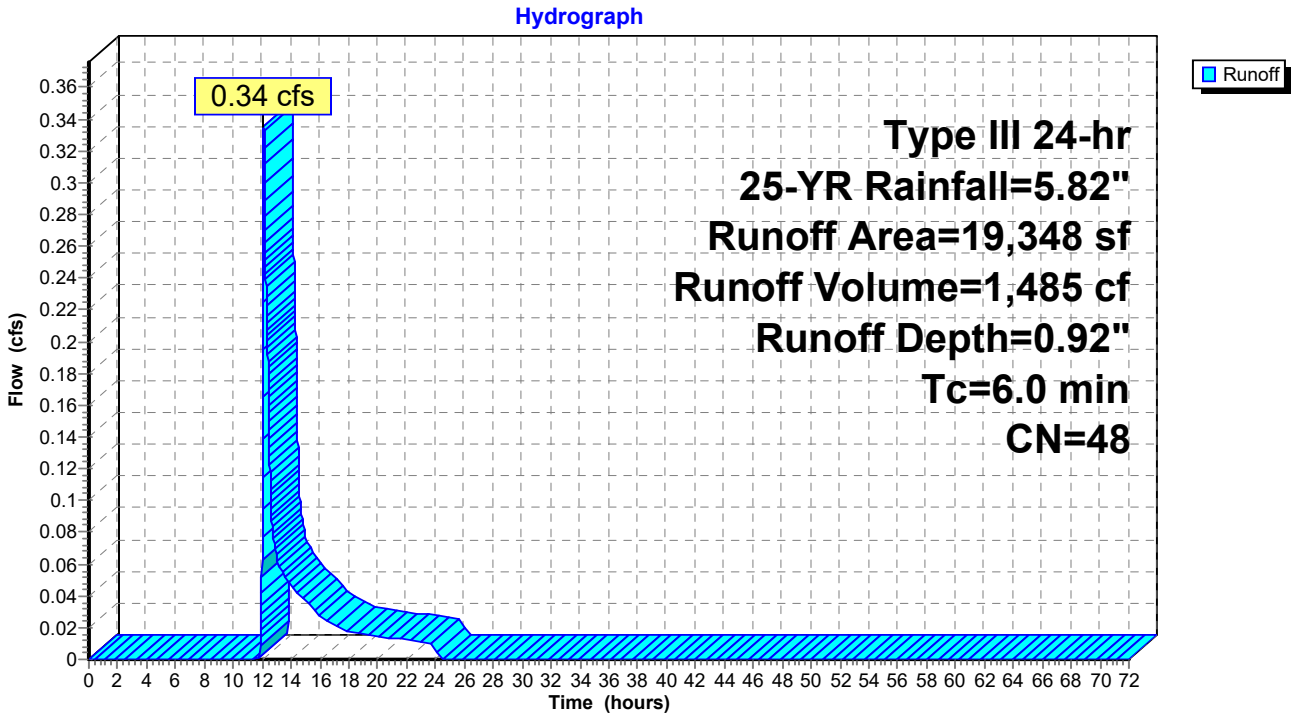
Runoff = 0.34 cfs @ 12.11 hrs, Volume= 1,485 cf, Depth= 0.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-YR Rainfall=5.82"

Area (sf)	CN	Description
16,277	39	>75% Grass cover, Good, HSG A
3,071	98	Paved parking, HSG A
19,348	48	Weighted Average
16,277		84.13% Pervious Area
3,071		15.87% Impervious Area

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

Subcatchment PR3:



Summary for Subcatchment PR4:

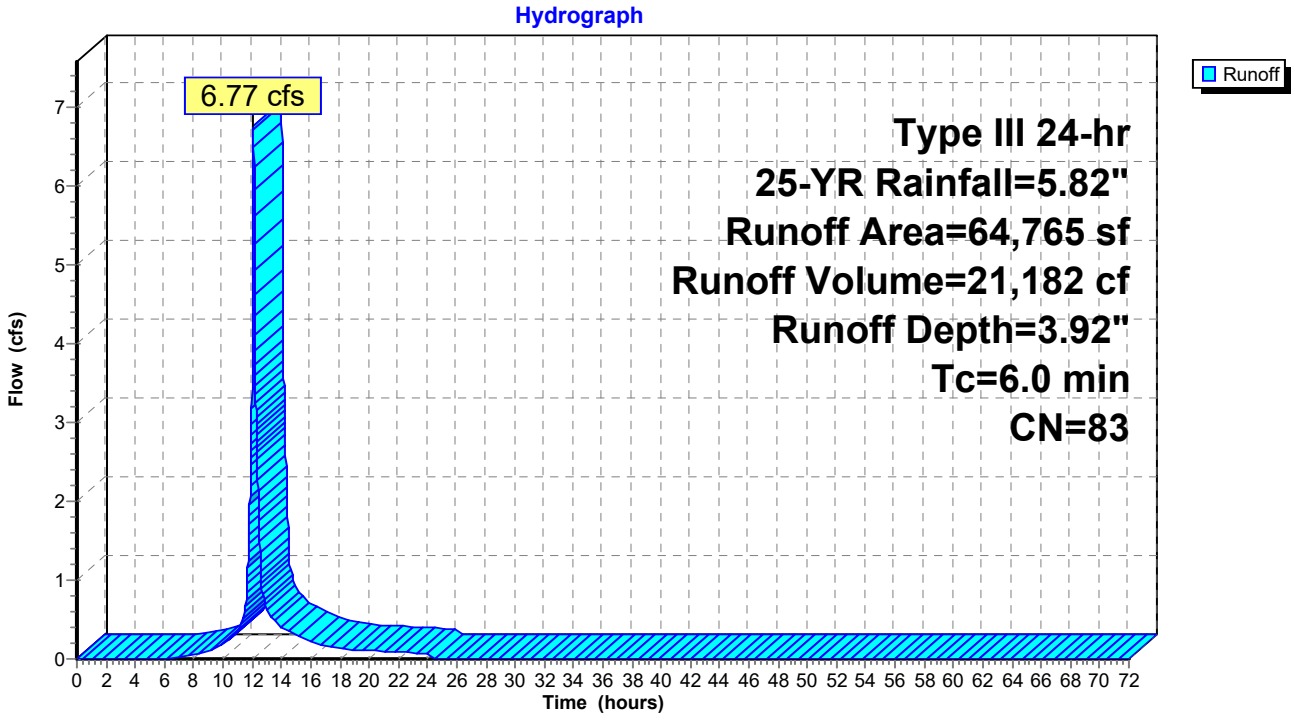
Runoff = 6.77 cfs @ 12.09 hrs, Volume= 21,182 cf, Depth= 3.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-YR Rainfall=5.82"

Area (sf)	CN	Description
16,792	39	>75% Grass cover, Good, HSG A
30,804	98	Paved parking, HSG A
17,169	98	Roofs, HSG A
64,765	83	Weighted Average
16,792		25.93% Pervious Area
47,973		74.07% Impervious Area

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

Subcatchment PR4:



Summary for Subcatchment PR5:

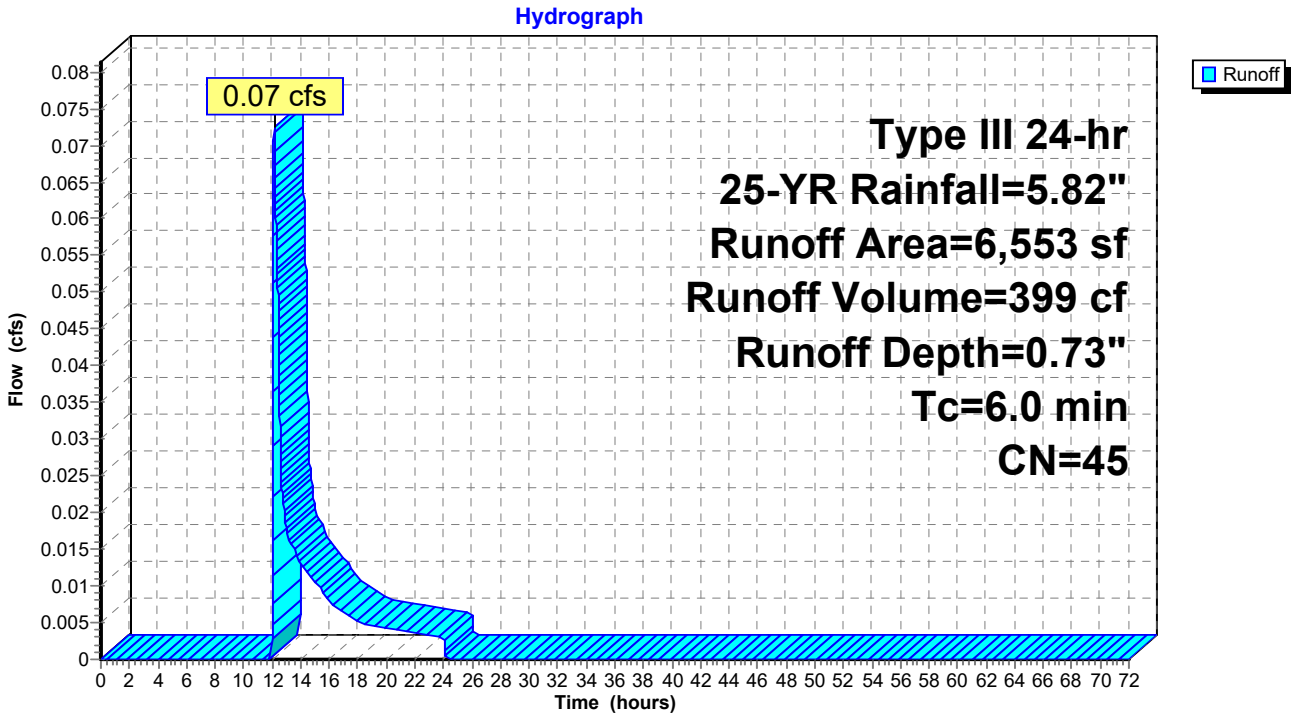
Runoff = 0.07 cfs @ 12.13 hrs, Volume= 399 cf, Depth= 0.73"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-YR Rainfall=5.82"

Area (sf)	CN	Description
5,870	39	>75% Grass cover, Good, HSG A
683	98	Paved parking, HSG A
6,553	45	Weighted Average
5,870		89.58% Pervious Area
683		10.42% Impervious Area

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

Subcatchment PR5:



Summary for Pond 1P:

Inflow Area = 76,982 sf, 83.05% Impervious, Inflow Depth = 3.93" for 25-YR event
Inflow = 5.17 cfs @ 12.09 hrs, Volume= 25,232 cf
Outflow = 0.58 cfs @ 13.66 hrs, Volume= 25,232 cf, Atten= 89%, Lag= 94.8 min
Discarded = 0.21 cfs @ 9.82 hrs, Volume= 22,593 cf
Primary = 0.37 cfs @ 13.66 hrs, Volume= 2,639 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 40.02' @ 13.66 hrs Surf.Area= 3,758 sf Storage= 12,634 cf

Plug-Flow detention time= 504.5 min calculated for 25,229 cf (100% of inflow)
Center-of-Mass det. time= 504.5 min (1,305.8 - 801.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	34.95'	3,435 cf	**52.00'W x 47.03'L x 5.75'H Field A** 14,063 cf Overall - 5,476 cf Embedded = 8,587 cf x 40.0% Voids
#2A	35.70'	5,476 cf	**Cultec R-902HD** x 84 Inside #1 Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap 84 Chambers in 7 Rows Cap Storage= +2.8 cf x 2 x 7 rows = 38.6 cf
#3B	34.95'	1,869 cf	**30.25'W x 43.37'L x 5.75'H Field B** 7,543 cf Overall - 2,870 cf Embedded = 4,673 cf x 40.0% Voids
#4B	35.70'	2,870 cf	**Cultec R-902HD** x 44 Inside #3 Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap 44 Chambers in 4 Rows Cap Storage= +2.8 cf x 2 x 4 rows = 22.1 cf
		13,651 cf	Total Available Storage

Storage Group A created with Chamber Wizard
Storage Group B created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	34.95'	**2.410 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Primary	39.70'	**10.0" Round Culvert** L= 60.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 39.70' / 39.10' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.55 sf

Discarded OutFlow Max=0.21 cfs @ 9.82 hrs HW=35.01' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.21 cfs)

Primary OutFlow Max=0.37 cfs @ 13.66 hrs HW=40.02' TW=0.00' (Dynamic Tailwater)
↑—**2=Culvert** (Barrel Controls 0.37 cfs @ 2.80 fps)

Pond 1P: - Chamber Wizard Field A

Chamber Model = Cultec R-902HD (Cultec Recharger® 902HD)
Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf
Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap
Cap Storage= +2.8 cf x 2 x 7 rows = 38.6 cf

78.0" Wide + 9.0" Spacing = 87.0" C-C Row Spacing

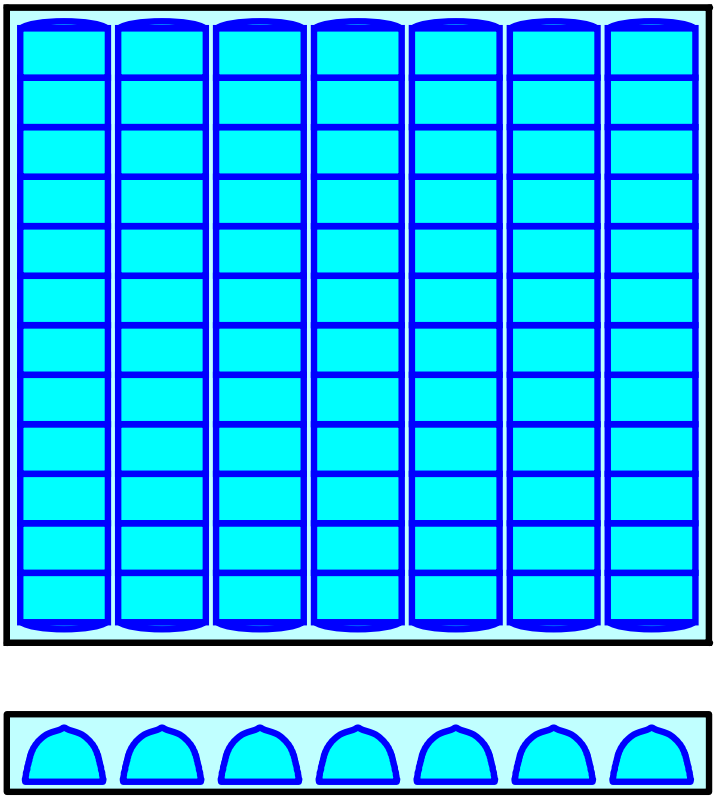
12 Chambers/Row x 3.67' Long +0.52' Cap Length x 2 = 45.03' Row Length +12.0" End Stone x 2 = 47.03' Base Length
7 Rows x 78.0" Wide + 9.0" Spacing x 6 + 12.0" Side Stone x 2 = 52.00' Base Width
9.0" Base + 48.0" Chamber Height + 12.0" Cover = 5.75' Field Height

84 Chambers x 64.7 cf + 2.8 cf Cap Volume x 2 x 7 Rows = 5,476.4 cf Chamber Storage

14,063.0 cf Field - 5,476.4 cf Chambers = 8,586.6 cf Stone x 40.0% Voids = 3,434.6 cf Stone Storage

Chamber Storage + Stone Storage = 8,911.0 cf = 0.205 af
Overall Storage Efficiency = 63.4%
Overall System Size = 47.03' x 52.00' x 5.75'

84 Chambers
520.9 cy Field
318.0 cy Stone



Pond 1P: - Chamber Wizard Field B

Chamber Model = Cultec R-902HD (Cultec Recharger® 902HD)
Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf
Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap
Cap Storage= +2.8 cf x 2 x 4 rows = 22.1 cf

78.0" Wide + 9.0" Spacing = 87.0" C-C Row Spacing

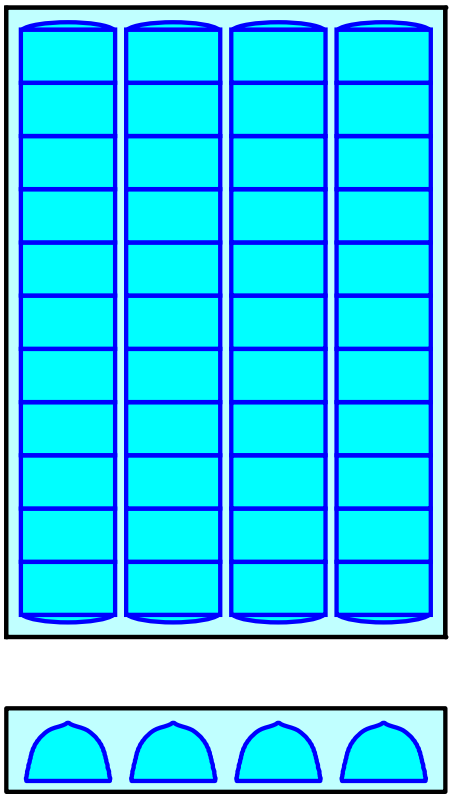
11 Chambers/Row x 3.67' Long +0.52' Cap Length x 2 = 41.37' Row Length +12.0" End Stone x 2 = 43.37' Base Length
4 Rows x 78.0" Wide + 9.0" Spacing x 3 + 12.0" Side Stone x 2 = 30.25' Base Width
9.0" Base + 48.0" Chamber Height + 12.0" Cover = 5.75' Field Height

44 Chambers x 64.7 cf + 2.8 cf Cap Volume x 2 x 4 Rows = 2,870.4 cf Chamber Storage

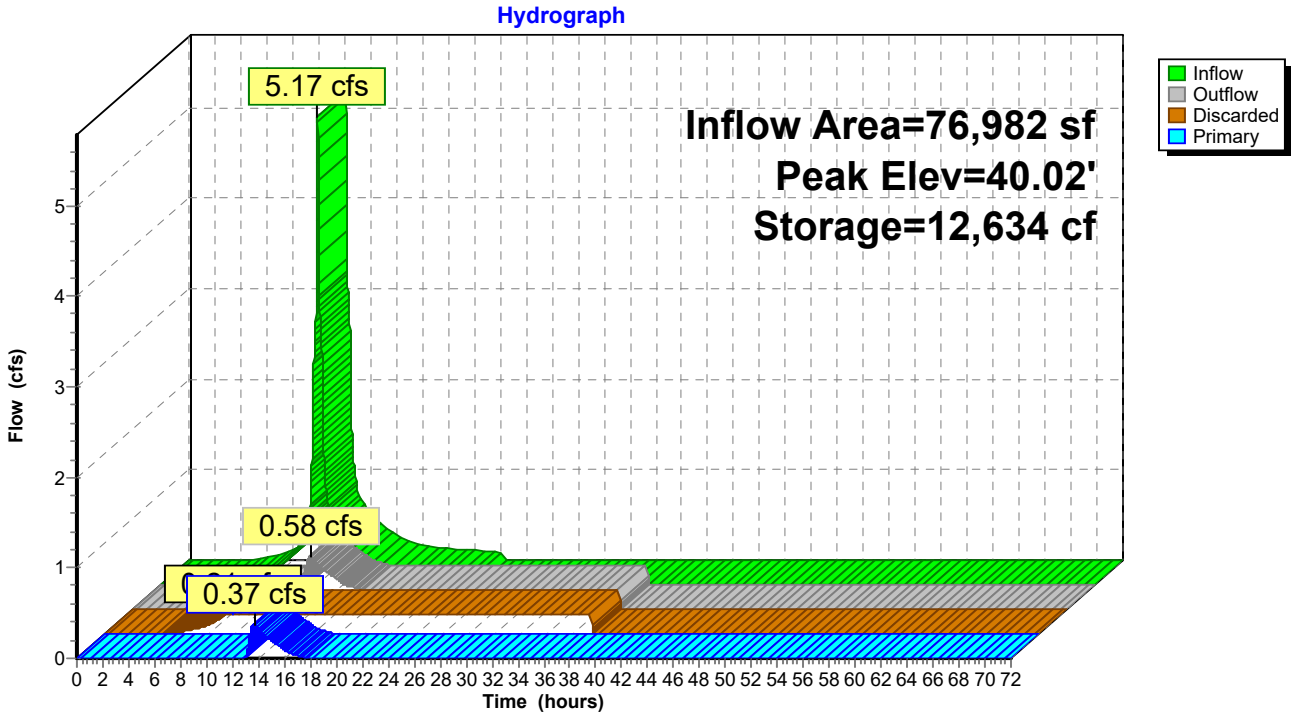
7,543.1 cf Field - 2,870.4 cf Chambers = 4,672.7 cf Stone x 40.0% Voids = 1,869.1 cf Stone Storage

Chamber Storage + Stone Storage = 4,739.5 cf = 0.109 af
Overall Storage Efficiency = 62.8%
Overall System Size = 43.37' x 30.25' x 5.75'

44 Chambers
279.4 cy Field
173.1 cy Stone



Pond 1P:


Hydrograph
Inflow Area=76,982 sf
Peak Elev=40.02'
Storage=12,634 cf
5.17 cfs
0.58 cfs
0.37 cfs
Inflow
Outflow
Discarded
Primary
Flow (cfs)
0 1 2 3 4 5
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72
Time (hours)

Summary for Pond 2P:

Inflow Area = 64,765 sf, 74.07% Impervious, Inflow Depth = 3.92" for 25-YR event
Inflow = 6.77 cfs @ 12.09 hrs, Volume= 21,182 cf
Outflow = 2.89 cfs @ 12.29 hrs, Volume= 21,182 cf, Atten= 57%, Lag= 12.4 min
Discarded = 0.14 cfs @ 10.11 hrs, Volume= 11,317 cf
Primary = 2.75 cfs @ 12.29 hrs, Volume= 9,865 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 42.60' @ 12.29 hrs Surf.Area= 2,515 sf Storage= 6,729 cf

Plug-Flow detention time= 184.1 min calculated for 21,182 cf (100% of inflow)
Center-of-Mass det. time= 184.1 min (991.5 - 807.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	38.85'	3,526 cf	**23.00'W x 109.37'L x 5.75'H Field A** 14,464 cf Overall - 5,649 cf Embedded = 8,815 cf x 40.0% Voids
#2A	39.60'	5,649 cf	**Cultec R-902HD** x 87 Inside #1 Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap 87 Chambers in 3 Rows Cap Storage= +2.8 cf x 2 x 3 rows = 16.6 cf
		9,175 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	38.85'	**2.410 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Primary	40.85'	**12.0" Round Culvert** L= 25.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 40.85' / 40.60' S= 0.0100 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf
#3	Device 2	41.30'	**5.0" Vert. Orifice/Grate X 4.00** C= 0.600

Discarded OutFlow Max=0.14 cfs @ 10.11 hrs HW=38.91' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.14 cfs)

Primary OutFlow Max=2.75 cfs @ 12.29 hrs HW=42.60' TW=0.00' (Dynamic Tailwater)
↑—**2=Culvert** (Passes 2.75 cfs of 4.23 cfs potential flow)
↑—**3=Orifice/Grate** (Orifice Controls 2.75 cfs @ 5.04 fps)

Pond 2P: - Chamber Wizard Field A

Chamber Model = Cultec R-902HD (Cultec Recharger® 902HD)
Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf
Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap
Cap Storage= +2.8 cf x 2 x 3 rows = 16.6 cf

78.0" Wide + 9.0" Spacing = 87.0" C-C Row Spacing

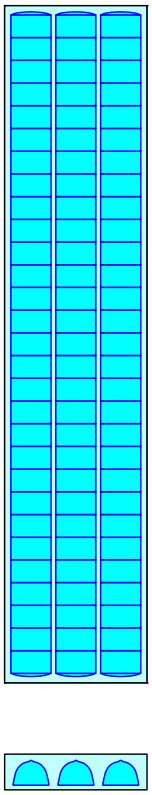
29 Chambers/Row x 3.67' Long +0.52' Cap Length x 2 = 107.37' Row Length +12.0" End Stone x 2 = 109.37' Base Length
3 Rows x 78.0" Wide + 9.0" Spacing x 2 + 12.0" Side Stone x 2 = 23.00' Base Width
9.0" Base + 48.0" Chamber Height + 12.0" Cover = 5.75' Field Height

87 Chambers x 64.7 cf + 2.8 cf Cap Volume x 2 x 3 Rows = 5,648.5 cf Chamber Storage

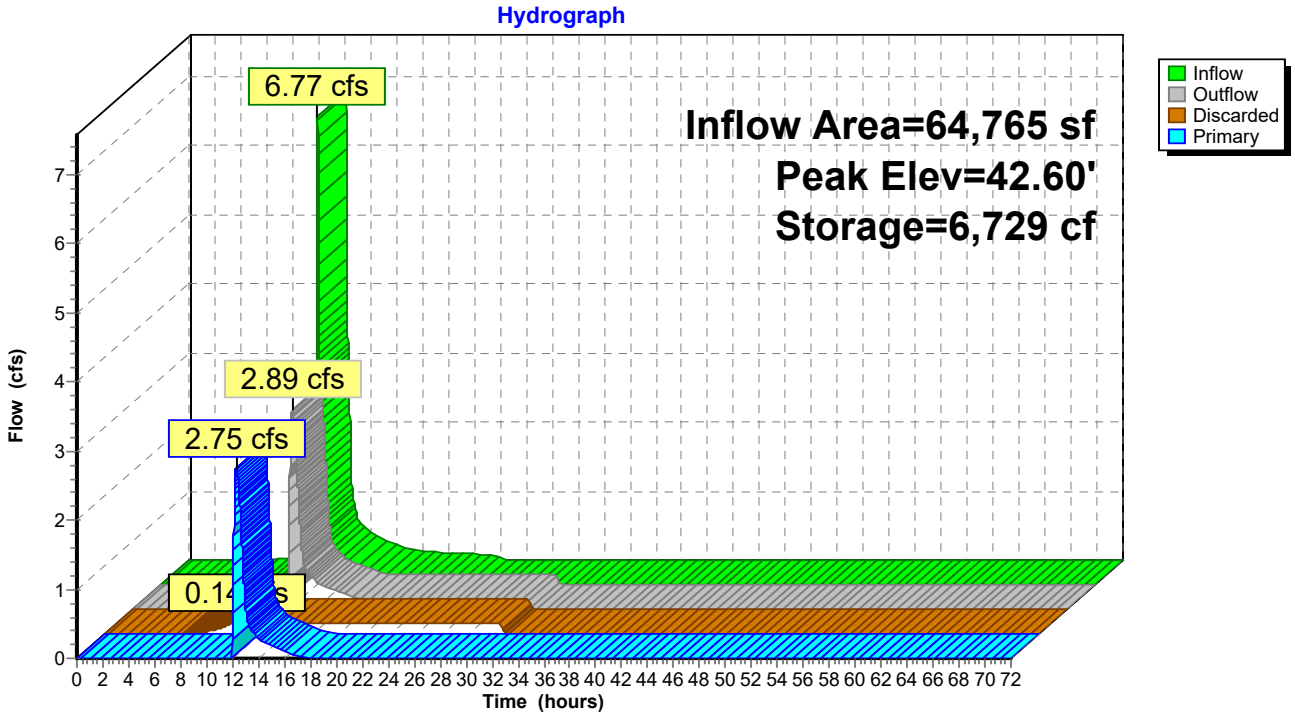
14,463.7 cf Field - 5,648.5 cf Chambers = 8,815.2 cf Stone x 40.0% Voids = 3,526.1 cf Stone Storage

Chamber Storage + Stone Storage = 9,174.6 cf = 0.211 af
Overall Storage Efficiency = 63.4%
Overall System Size = 109.37' x 23.00' x 5.75'

87 Chambers
535.7 cy Field
326.5 cy Stone



Pond 2P:


Hydrograph
6.77 cfs
2.89 cfs
2.75 cfs
Inflow Area=64,765 sf
Peak Elev=42.60'
Storage=6,729 cf
Inflow
Outflow
Discarded
Primary
Flow (cfs)
Time (hours)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72

Summary for Pond 3P: Diversion MH

Inflow Area = 76,982 sf, 83.05% Impervious, Inflow Depth = 4.45" for 25-YR event
Inflow = 8.93 cfs @ 12.09 hrs, Volume= 28,565 cf
Outflow = 8.93 cfs @ 12.09 hrs, Volume= 28,565 cf, Atten= 0%, Lag= 0.0 min
Primary = 5.17 cfs @ 12.09 hrs, Volume= 25,232 cf
Secondary = 3.76 cfs @ 12.09 hrs, Volume= 3,332 cf

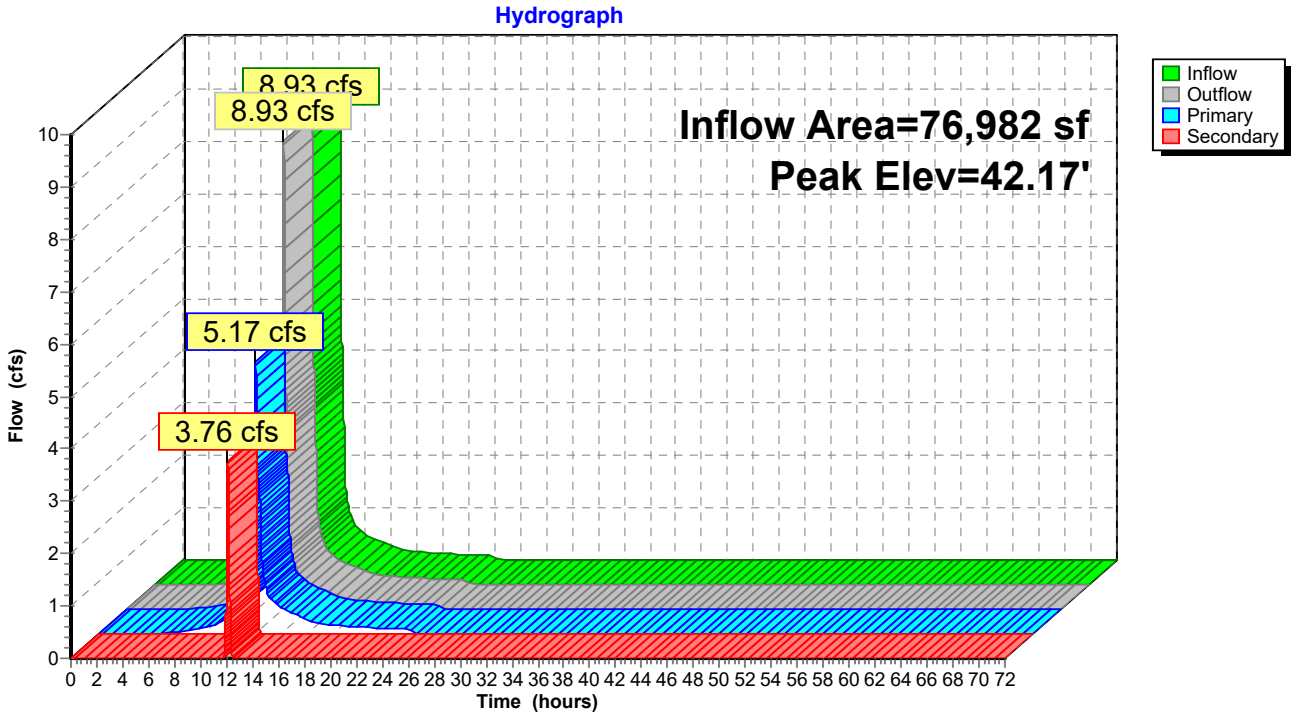
Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 42.17' @ 12.09 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	39.80'	**12.0" Round Culvert to 1P** L= 10.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 39.80' / 39.70' S= 0.0100 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf
#2	Device 3	40.85'	**5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#3	Secondary	39.70'	**10.0" Round Culvert to Salem Street** L= 60.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 39.70' / 39.10' S= 0.0100 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.55 sf

Primary OutFlow Max=5.16 cfs @ 12.09 hrs HW=42.16' TW=37.35' (Dynamic Tailwater)
└**1=Culvert to 1P** (Inlet Controls 5.16 cfs @ 6.57 fps)

Secondary OutFlow Max=3.75 cfs @ 12.09 hrs HW=42.16' TW=0.00' (Dynamic Tailwater)
└**3=Culvert to Salem Street** (Inlet Controls 3.75 cfs @ 6.88 fps)
└**2=Sharp-Crested Rectangular Weir** (Passes 3.75 cfs of 23.25 cfs potential flow)

Pond 3P: Diversion MH

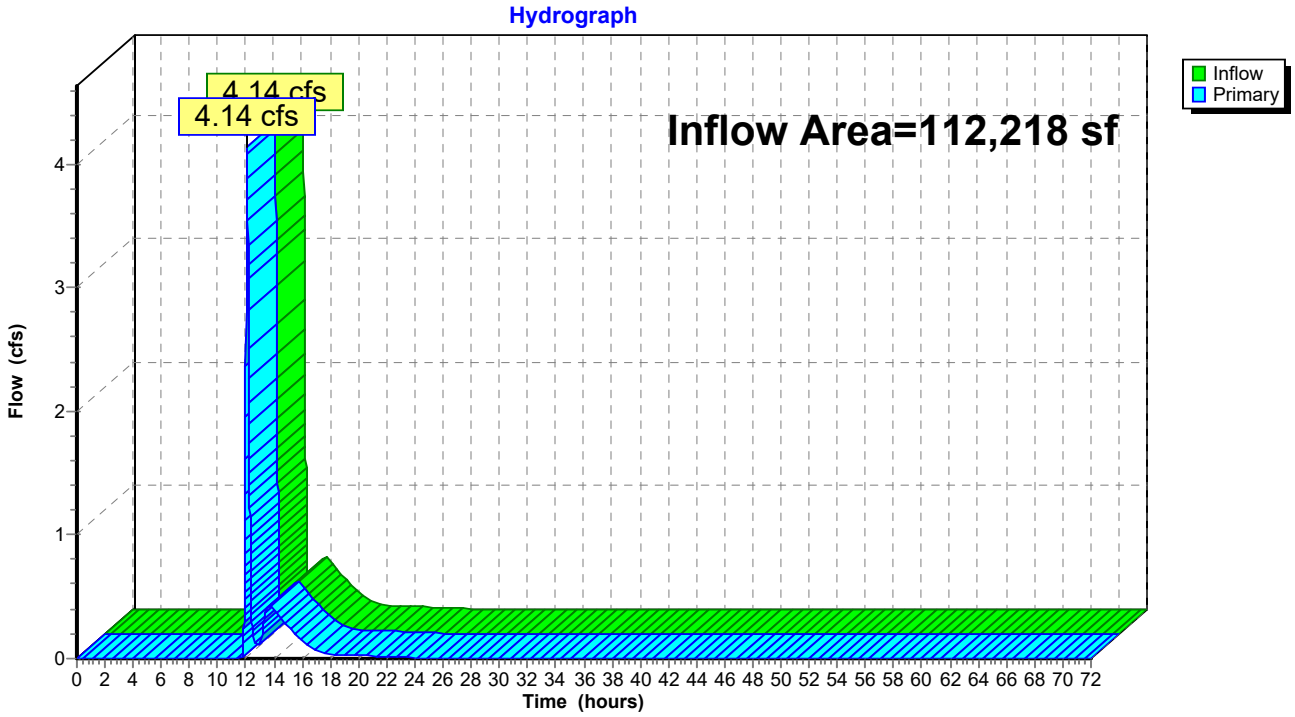


Summary for Link DP1:

Inflow Area = 112,218 sf, 60.32% Impervious, Inflow Depth = 0.87" for 25-YR event
Inflow = 4.14 cfs @ 12.09 hrs, Volume= 8,163 cf
Primary = 4.14 cfs @ 12.09 hrs, Volume= 8,163 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link DP1:

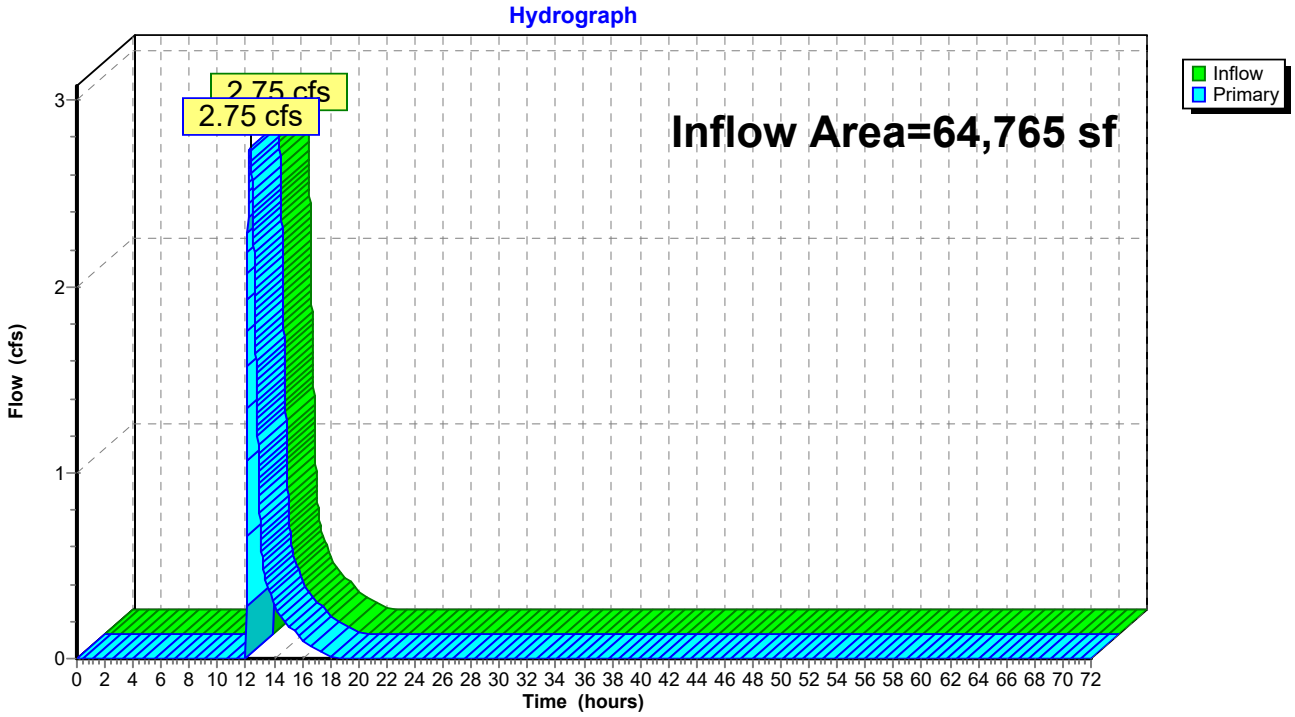


Summary for Link DP2:

Inflow Area = 64,765 sf, 74.07% Impervious, Inflow Depth = 1.83" for 25-YR event
Inflow = 2.75 cfs @ 12.29 hrs, Volume= 9,865 cf
Primary = 2.75 cfs @ 12.29 hrs, Volume= 9,865 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link DP2:

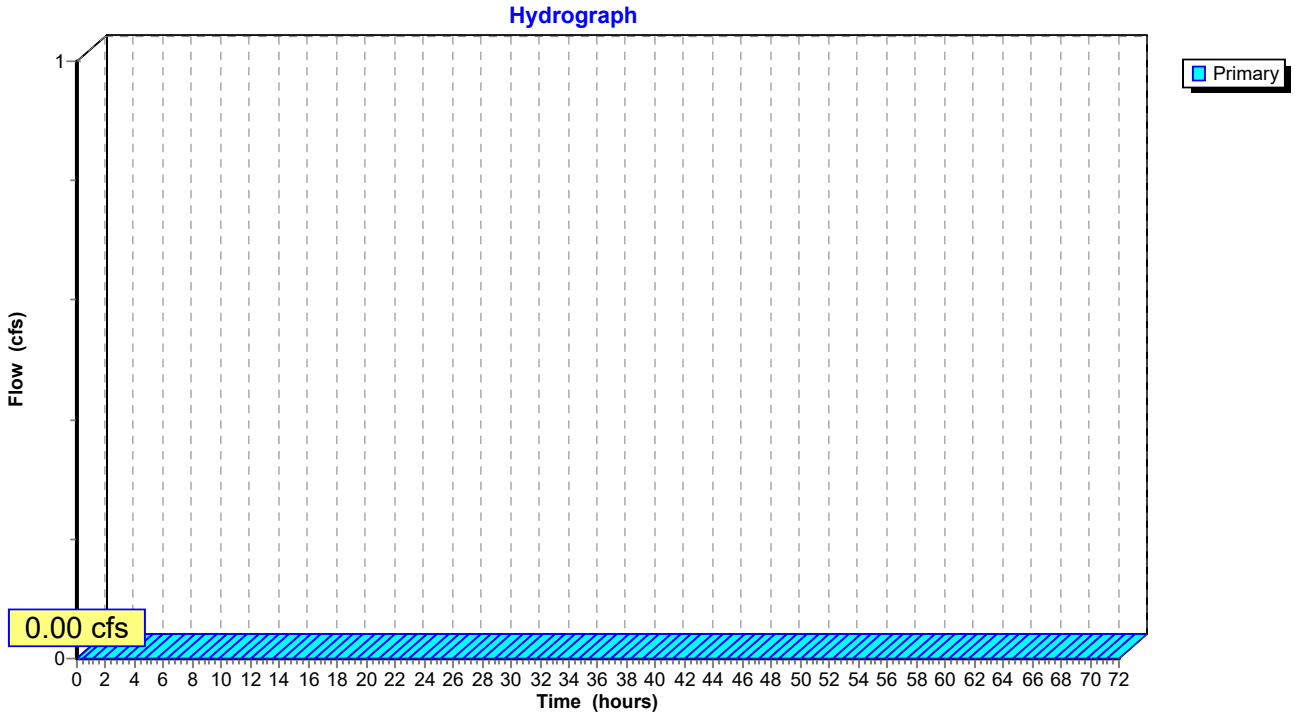


Summary for Link DP3: Design Point Eliminated

Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link DP3: Design Point Eliminated



Summary for Subcatchment PR1:

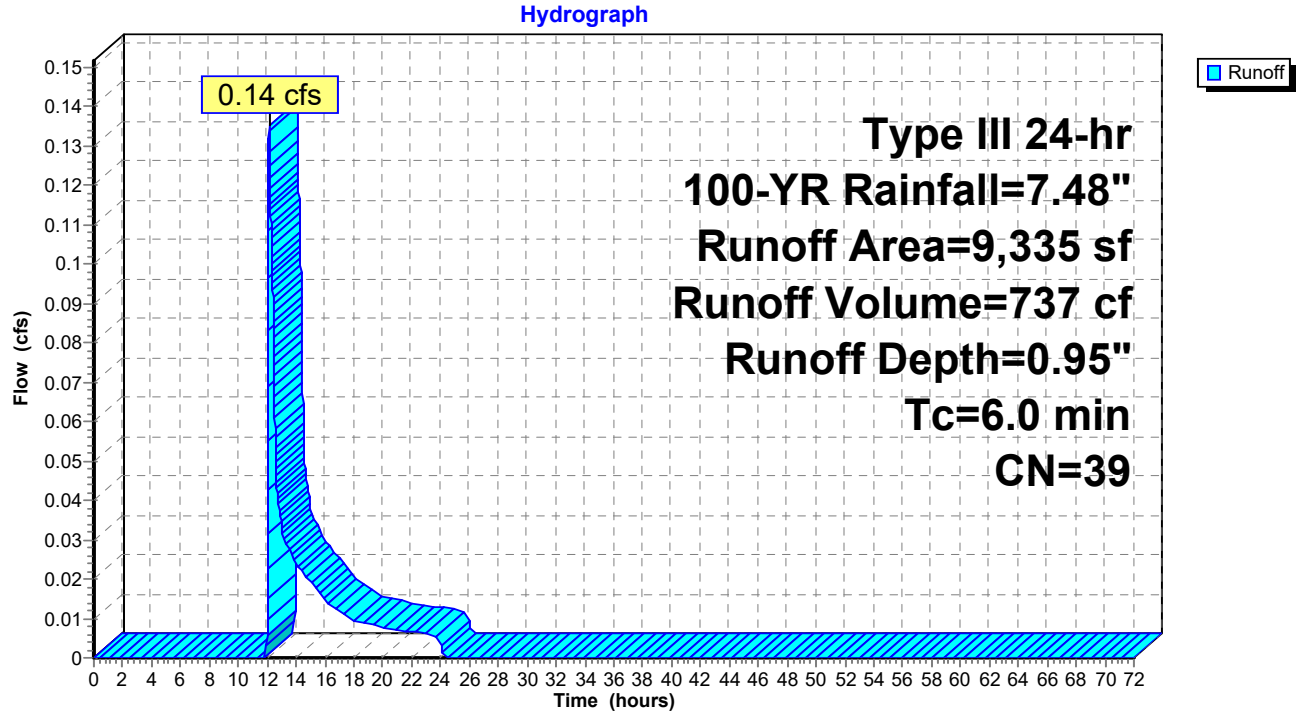
Runoff = 0.14 cfs @ 12.13 hrs, Volume= 737 cf, Depth= 0.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-YR Rainfall=7.48"

Area (sf)	CN	Description
9,335	39	>75% Grass cover, Good, HSG A
9,335		100.00% Pervious Area

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

Subcatchment PR1:



Summary for Subcatchment PR2:

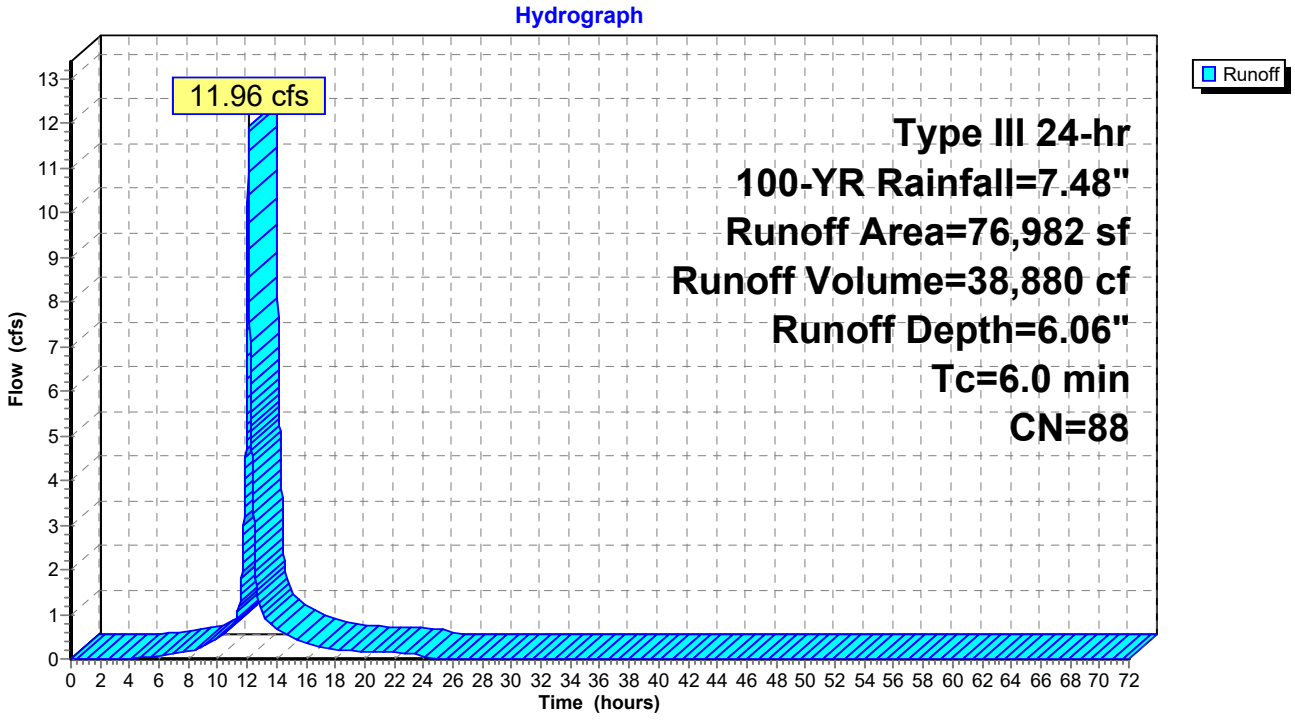
Runoff = 11.96 cfs @ 12.08 hrs, Volume= 38,880 cf, Depth= 6.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-YR Rainfall=7.48"

Area (sf)	CN	Description
31,982	98	Roofs, HSG A
31,955	98	Paved parking, HSG A
13,045	39	>75% Grass cover, Good, HSG A
76,982	88	Weighted Average
13,045		16.95% Pervious Area
63,937		83.05% Impervious Area

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

Subcatchment PR2:



Summary for Subcatchment PR3:

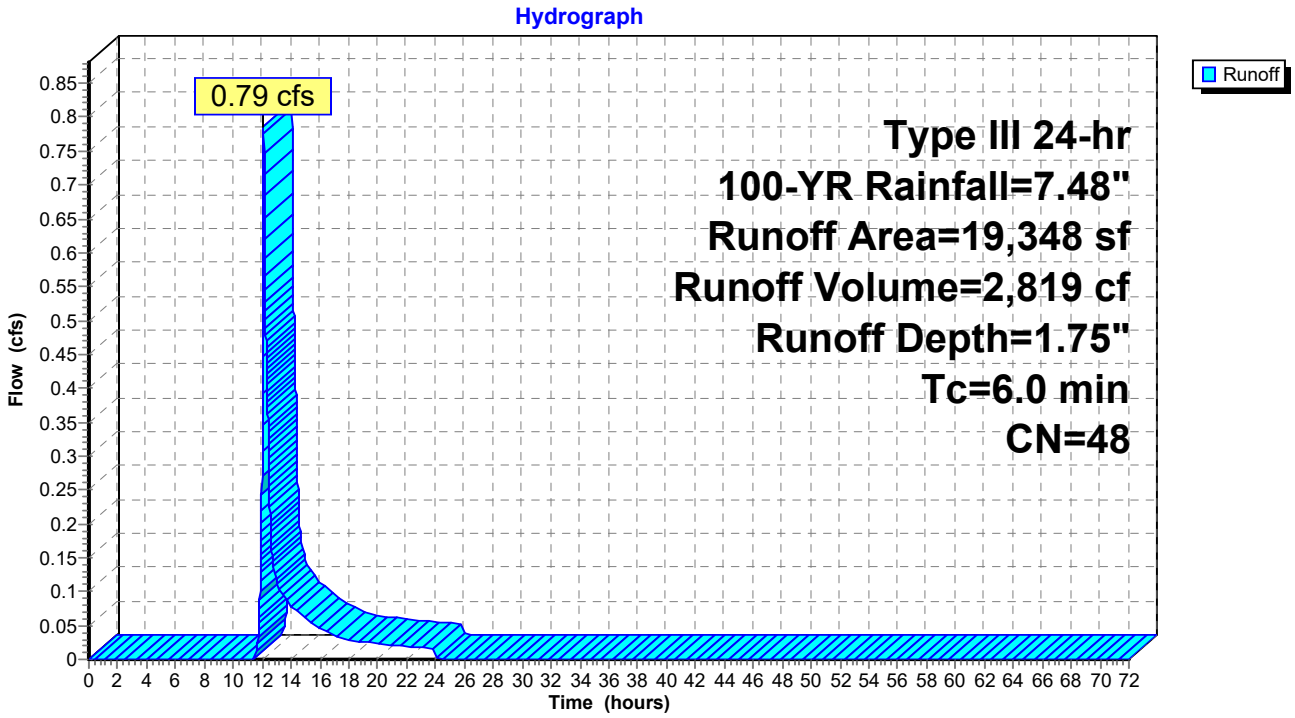
Runoff = 0.79 cfs @ 12.10 hrs, Volume= 2,819 cf, Depth= 1.75"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-YR Rainfall=7.48"

Area (sf)	CN	Description
16,277	39	>75% Grass cover, Good, HSG A
3,071	98	Paved parking, HSG A
19,348	48	Weighted Average
16,277		84.13% Pervious Area
3,071		15.87% Impervious Area

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

Subcatchment PR3:



Summary for Subcatchment PR4:

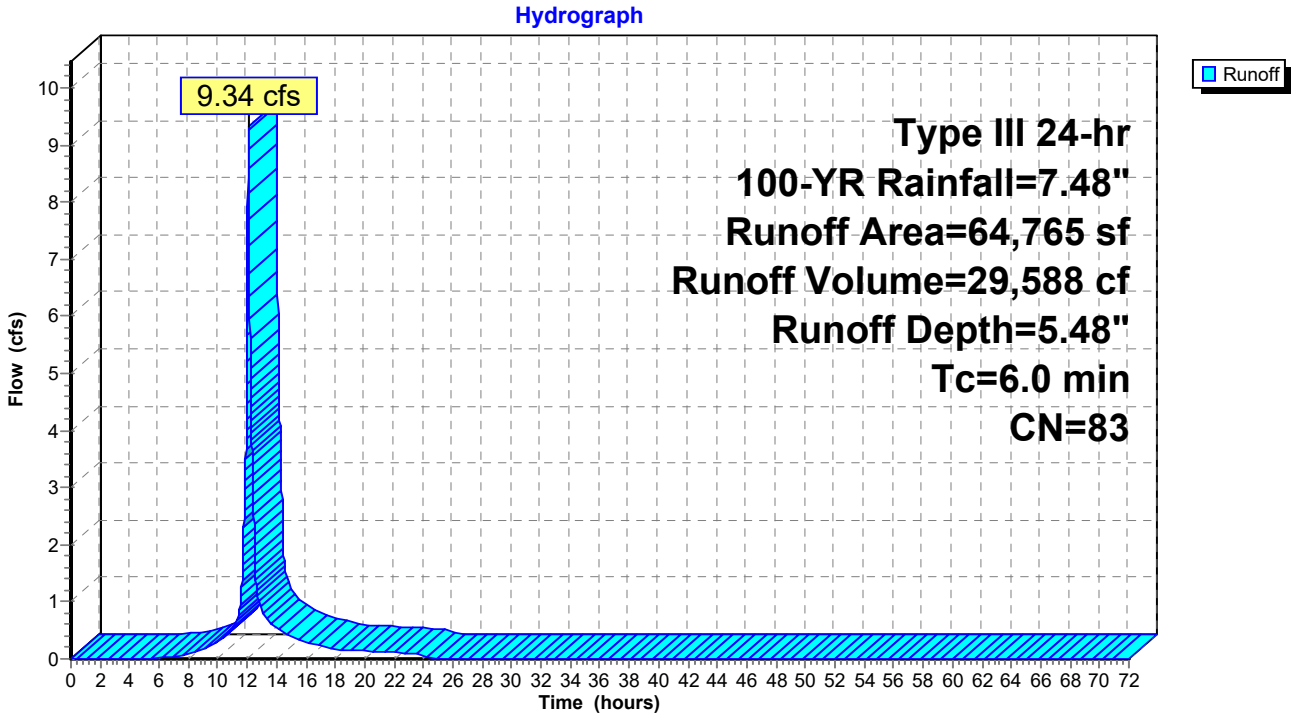
Runoff = 9.34 cfs @ 12.09 hrs, Volume= 29,588 cf, Depth= 5.48"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-YR Rainfall=7.48"

Area (sf)	CN	Description
16,792	39	>75% Grass cover, Good, HSG A
30,804	98	Paved parking, HSG A
17,169	98	Roofs, HSG A
64,765	83	Weighted Average
16,792		25.93% Pervious Area
47,973		74.07% Impervious Area

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

Subcatchment PR4:



Summary for Subcatchment PR5:

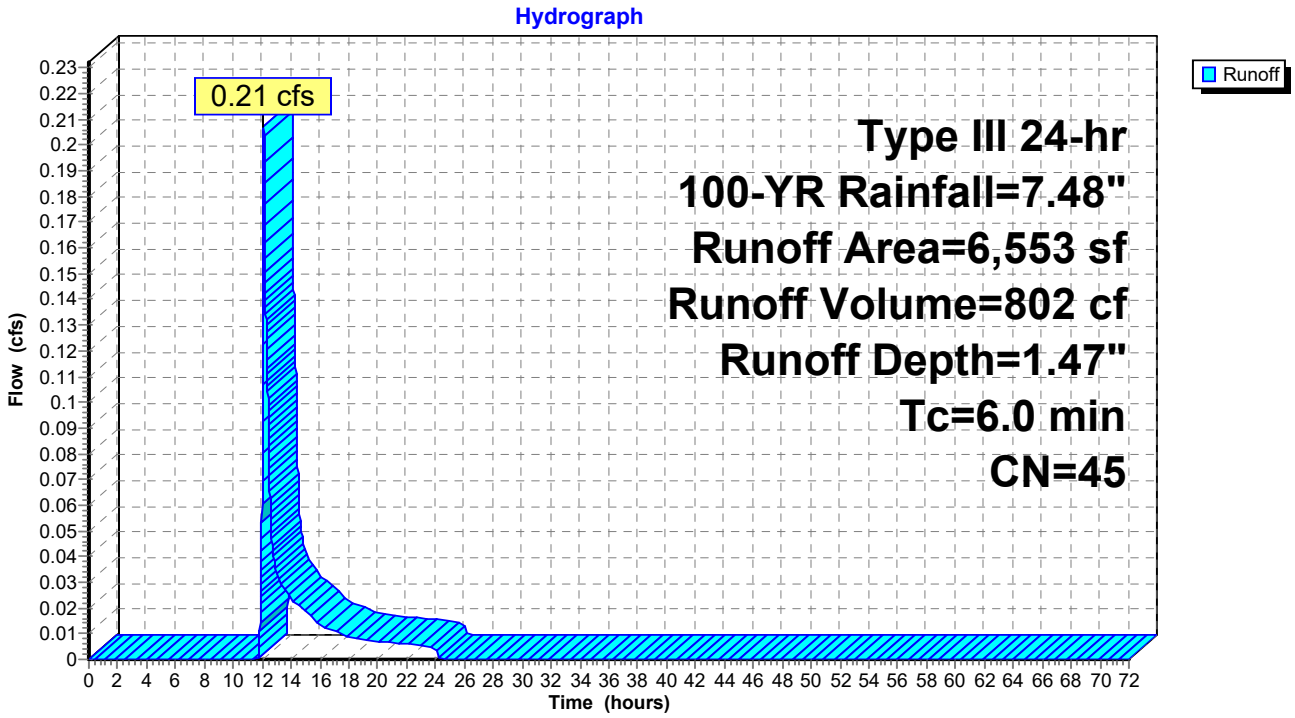
Runoff = 0.21 cfs @ 12.11 hrs, Volume= 802 cf, Depth= 1.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-YR Rainfall=7.48"

Area (sf)	CN	Description
5,870	39	>75% Grass cover, Good, HSG A
683	98	Paved parking, HSG A
6,553	45	Weighted Average
5,870		89.58% Pervious Area
683		10.42% Impervious Area

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

Subcatchment PR5:



Summary for Pond 1P:

Inflow Area = 76,982 sf, 83.05% Impervious, Inflow Depth = 5.17" for 100-YR event
Inflow = 6.98 cfs @ 12.08 hrs, Volume= 33,175 cf
Outflow = 2.00 cfs @ 12.55 hrs, Volume= 33,175 cf, Atten= 71%, Lag= 27.9 min
Discarded = 0.21 cfs @ 8.94 hrs, Volume= 24,221 cf
Primary = 1.79 cfs @ 12.55 hrs, Volume= 8,954 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 40.58' @ 12.55 hrs Surf.Area= 3,758 sf Storage= 13,470 cf

Plug-Flow detention time= 422.8 min calculated for 33,175 cf (100% of inflow)
Center-of-Mass det. time= 422.8 min (1,216.9 - 794.1)

Volume	Invert	Avail.Storage	Storage Description
#1A	34.95'	3,435 cf	**52.00'W x 47.03'L x 5.75'H Field A** 14,063 cf Overall - 5,476 cf Embedded = 8,587 cf x 40.0% Voids
#2A	35.70'	5,476 cf	**Cultec R-902HD** x 84 Inside #1 Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap 84 Chambers in 7 Rows Cap Storage= +2.8 cf x 2 x 7 rows = 38.6 cf
#3B	34.95'	1,869 cf	**30.25'W x 43.37'L x 5.75'H Field B** 7,543 cf Overall - 2,870 cf Embedded = 4,673 cf x 40.0% Voids
#4B	35.70'	2,870 cf	**Cultec R-902HD** x 44 Inside #3 Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap 44 Chambers in 4 Rows Cap Storage= +2.8 cf x 2 x 4 rows = 22.1 cf
		13,651 cf	Total Available Storage

Storage Group A created with Chamber Wizard
Storage Group B created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	34.95'	**2.410 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Primary	39.70'	**10.0" Round Culvert** L= 60.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 39.70' / 39.10' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.55 sf

Discarded OutFlow Max=0.21 cfs @ 8.94 hrs HW=35.01' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.21 cfs)

Primary OutFlow Max=1.79 cfs @ 12.55 hrs HW=40.58' TW=0.00' (Dynamic Tailwater)
↑—**2=Culvert** (Inlet Controls 1.79 cfs @ 3.28 fps)

Pond 1P: - Chamber Wizard Field A

Chamber Model = Cultec R-902HD (Cultec Recharger® 902HD)
Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf
Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap
Cap Storage= +2.8 cf x 2 x 7 rows = 38.6 cf

78.0" Wide + 9.0" Spacing = 87.0" C-C Row Spacing

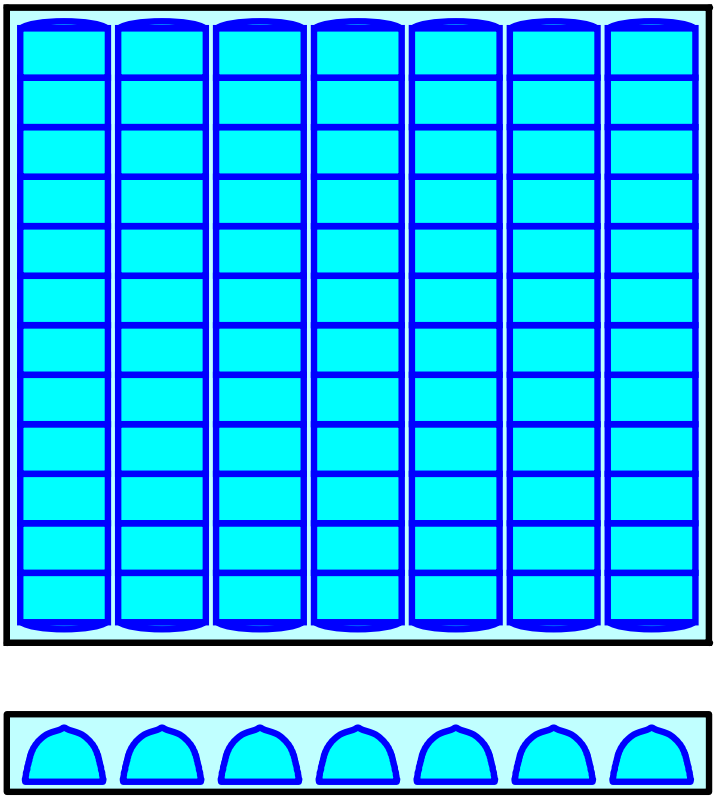
12 Chambers/Row x 3.67' Long +0.52' Cap Length x 2 = 45.03' Row Length +12.0" End Stone x 2 = 47.03' Base Length
7 Rows x 78.0" Wide + 9.0" Spacing x 6 + 12.0" Side Stone x 2 = 52.00' Base Width
9.0" Base + 48.0" Chamber Height + 12.0" Cover = 5.75' Field Height

84 Chambers x 64.7 cf + 2.8 cf Cap Volume x 2 x 7 Rows = 5,476.4 cf Chamber Storage

14,063.0 cf Field - 5,476.4 cf Chambers = 8,586.6 cf Stone x 40.0% Voids = 3,434.6 cf Stone Storage

Chamber Storage + Stone Storage = 8,911.0 cf = 0.205 af
Overall Storage Efficiency = 63.4%
Overall System Size = 47.03' x 52.00' x 5.75'

84 Chambers
520.9 cy Field
318.0 cy Stone



Pond 1P: - Chamber Wizard Field B

Chamber Model = Cultec R-902HD (Cultec Recharger® 902HD)
Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf
Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap
Cap Storage= +2.8 cf x 2 x 4 rows = 22.1 cf

78.0" Wide + 9.0" Spacing = 87.0" C-C Row Spacing

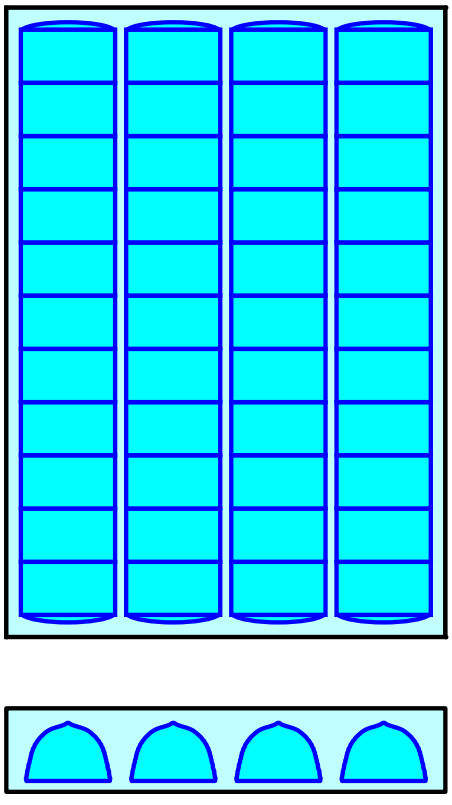
11 Chambers/Row x 3.67' Long +0.52' Cap Length x 2 = 41.37' Row Length +12.0" End Stone x 2 = 43.37' Base Length
4 Rows x 78.0" Wide + 9.0" Spacing x 3 + 12.0" Side Stone x 2 = 30.25' Base Width
9.0" Base + 48.0" Chamber Height + 12.0" Cover = 5.75' Field Height

44 Chambers x 64.7 cf + 2.8 cf Cap Volume x 2 x 4 Rows = 2,870.4 cf Chamber Storage

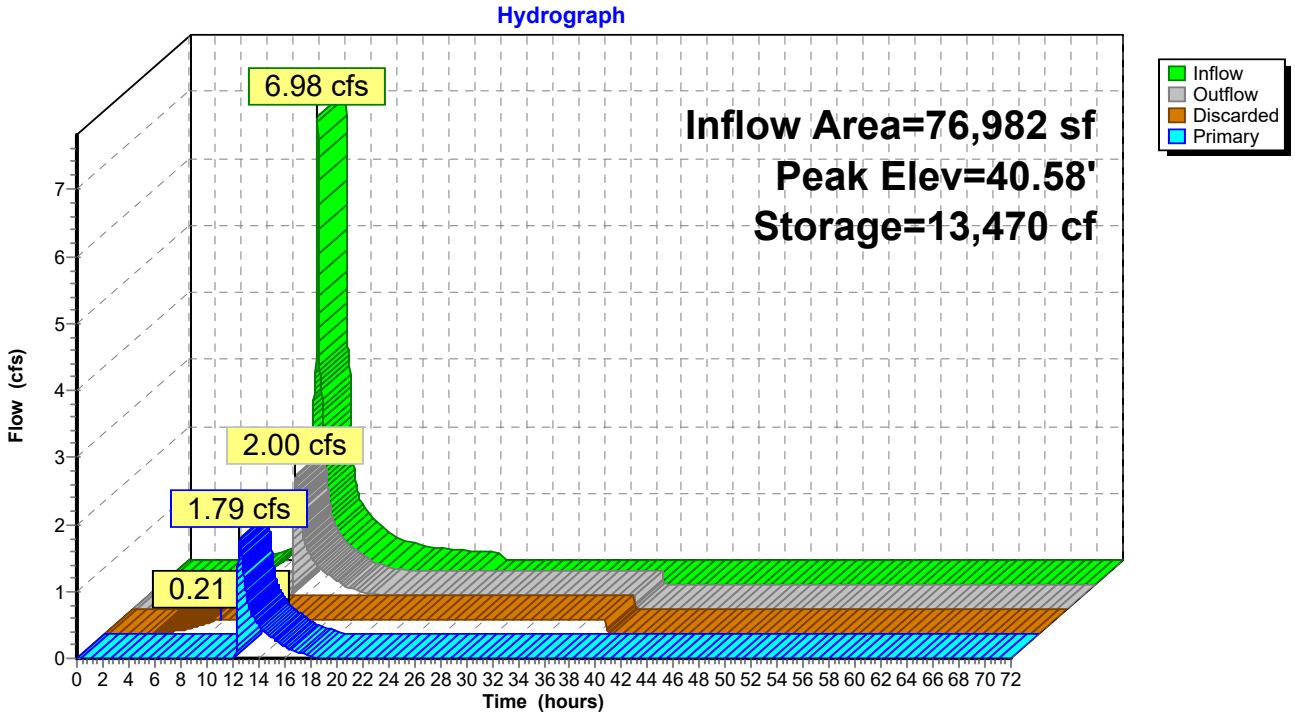
7,543.1 cf Field - 2,870.4 cf Chambers = 4,672.7 cf Stone x 40.0% Voids = 1,869.1 cf Stone Storage

Chamber Storage + Stone Storage = 4,739.5 cf = 0.109 af
Overall Storage Efficiency = 62.8%
Overall System Size = 43.37' x 30.25' x 5.75'

44 Chambers
279.4 cy Field
173.1 cy Stone



Pond 1P:


Hydrograph
6.98 cfs
2.00 cfs
1.79 cfs
0.21
Inflow Area=76,982 sf
Peak Elev=40.58'
Storage=13,470 cf
Inflow
Outflow
Discarded
Primary
Flow (cfs)
0 1 2 3 4 5 6 7
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72
Time (hours)

Summary for Pond 2P:

Inflow Area = 64,765 sf, 74.07% Impervious, Inflow Depth = 5.48" for 100-YR event
Inflow = 9.34 cfs @ 12.09 hrs, Volume= 29,588 cf
Outflow = 4.49 cfs @ 12.24 hrs, Volume= 29,588 cf, Atten= 52%, Lag= 9.5 min
Discarded = 0.14 cfs @ 9.18 hrs, Volume= 12,378 cf
Primary = 4.35 cfs @ 12.24 hrs, Volume= 17,210 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 44.25' @ 12.24 hrs Surf.Area= 2,515 sf Storage= 8,824 cf

Plug-Flow detention time= 151.6 min calculated for 29,588 cf (100% of inflow)
Center-of-Mass det. time= 151.6 min (949.6 - 798.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	38.85'	3,526 cf	**23.00'W x 109.37'L x 5.75'H Field A** 14,464 cf Overall - 5,649 cf Embedded = 8,815 cf x 40.0% Voids
#2A	39.60'	5,649 cf	**Cultec R-902HD** x 87 Inside #1 Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap 87 Chambers in 3 Rows Cap Storage= +2.8 cf x 2 x 3 rows = 16.6 cf
		9,175 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	38.85'	**2.410 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Primary	40.85'	**12.0" Round Culvert** L= 25.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 40.85' / 40.60' S= 0.0100 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf
#3	Device 2	41.30'	**5.0" Vert. Orifice/Grate X 4.00** C= 0.600

Discarded OutFlow Max=0.14 cfs @ 9.18 hrs HW=38.91' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.14 cfs)

Primary OutFlow Max=4.35 cfs @ 12.24 hrs HW=44.25' TW=0.00' (Dynamic Tailwater)
↑—**2=Culvert** (Passes 4.35 cfs of 6.44 cfs potential flow)
↑—**3=Orifice/Grate** (Orifice Controls 4.35 cfs @ 7.97 fps)

Pond 2P: - Chamber Wizard Field A

Chamber Model = Cultec R-902HD (Cultec Recharger® 902HD)
Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf
Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap
Cap Storage= +2.8 cf x 2 x 3 rows = 16.6 cf

78.0" Wide + 9.0" Spacing = 87.0" C-C Row Spacing

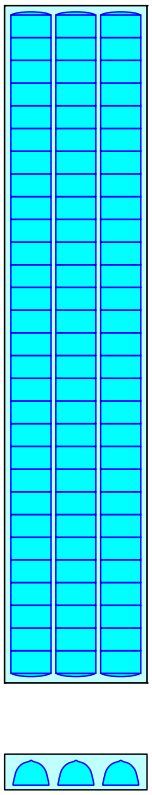
29 Chambers/Row x 3.67' Long +0.52' Cap Length x 2 = 107.37' Row Length +12.0" End Stone x 2 = 109.37' Base Length
3 Rows x 78.0" Wide + 9.0" Spacing x 2 + 12.0" Side Stone x 2 = 23.00' Base Width
9.0" Base + 48.0" Chamber Height + 12.0" Cover = 5.75' Field Height

87 Chambers x 64.7 cf + 2.8 cf Cap Volume x 2 x 3 Rows = 5,648.5 cf Chamber Storage

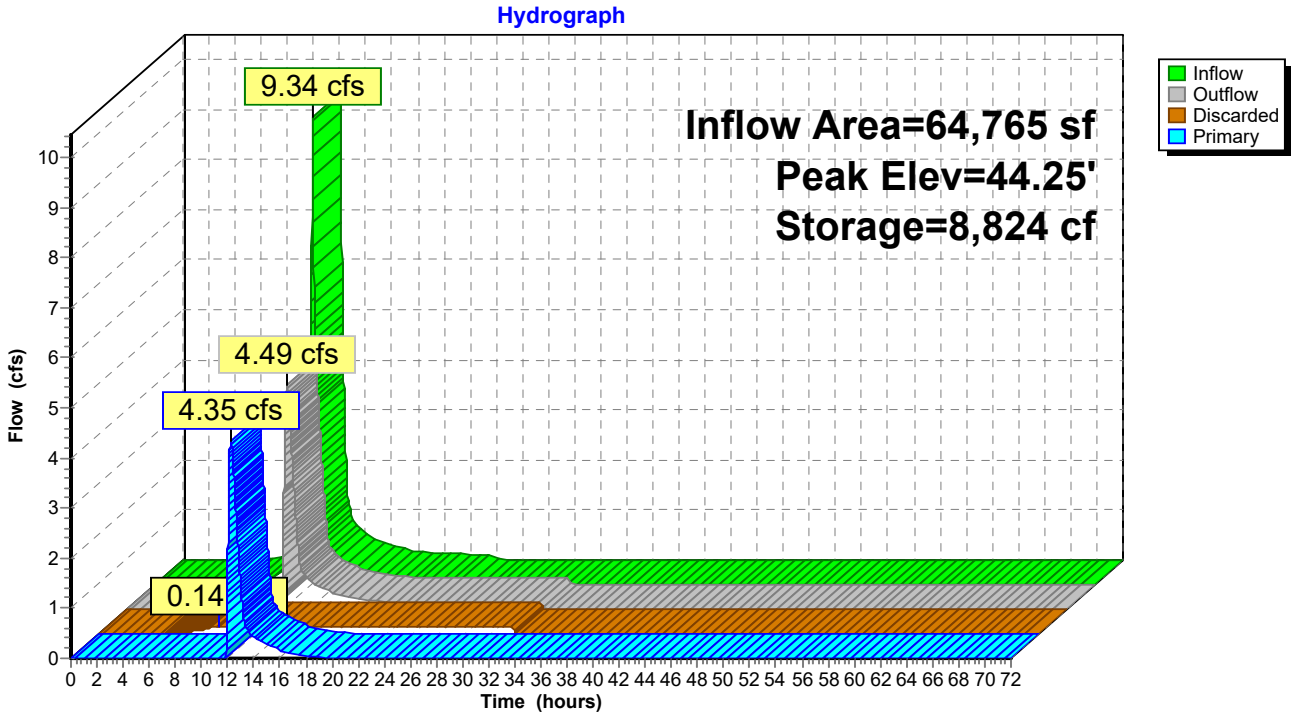
14,463.7 cf Field - 5,648.5 cf Chambers = 8,815.2 cf Stone x 40.0% Voids = 3,526.1 cf Stone Storage

Chamber Storage + Stone Storage = 9,174.6 cf = 0.211 af
Overall Storage Efficiency = 63.4%
Overall System Size = 109.37' x 23.00' x 5.75'

87 Chambers
535.7 cy Field
326.5 cy Stone



Pond 2P:


Hydrograph
9.34 cfs
4.49 cfs
4.35 cfs
0.14
Inflow Area=64,765 sf
Peak Elev=44.25'
Storage=8,824 cf
Inflow
Outflow
Discarded
Primary
Flow (cfs)
Time (hours)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72
0 1 2 3 4 5 6 7 8 9 10

Summary for Pond 3P: Diversion MH

Inflow Area = 76,982 sf, 83.05% Impervious, Inflow Depth = 6.06" for 100-YR event
Inflow = 11.96 cfs @ 12.08 hrs, Volume= 38,880 cf
Outflow = 11.96 cfs @ 12.08 hrs, Volume= 38,880 cf, Atten= 0%, Lag= 0.0 min
Primary = 6.98 cfs @ 12.08 hrs, Volume= 33,175 cf
Secondary = 4.98 cfs @ 12.08 hrs, Volume= 5,705 cf

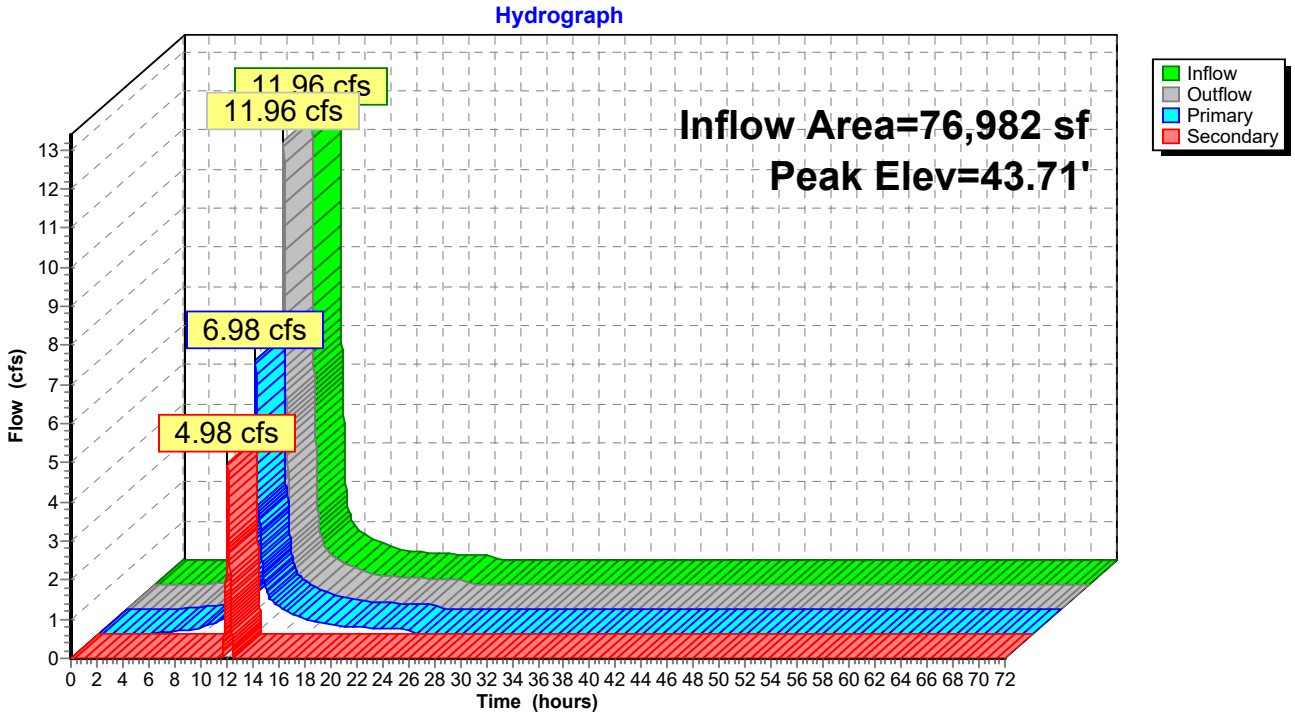
Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 43.71' @ 12.08 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	39.80'	**12.0" Round Culvert to 1P** L= 10.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 39.80' / 39.70' S= 0.0100 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf
#2	Device 3	40.85'	**5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#3	Secondary	39.70'	**10.0" Round Culvert to Salem Street** L= 60.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 39.70' / 39.10' S= 0.0100 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.55 sf

Primary OutFlow Max=6.97 cfs @ 12.08 hrs HW=43.69' TW=38.35' (Dynamic Tailwater)
└─**1=Culvert to 1P** (Inlet Controls 6.97 cfs @ 8.87 fps)

Secondary OutFlow Max=4.97 cfs @ 12.08 hrs HW=43.69' TW=0.00' (Dynamic Tailwater)
└─**3=Culvert to Salem Street** (Barrel Controls 4.97 cfs @ 9.11 fps)
└─**2=Sharp-Crested Rectangular Weir** (Passes 4.97 cfs of 69.52 cfs potential flow)

Pond 3P: Diversion MH

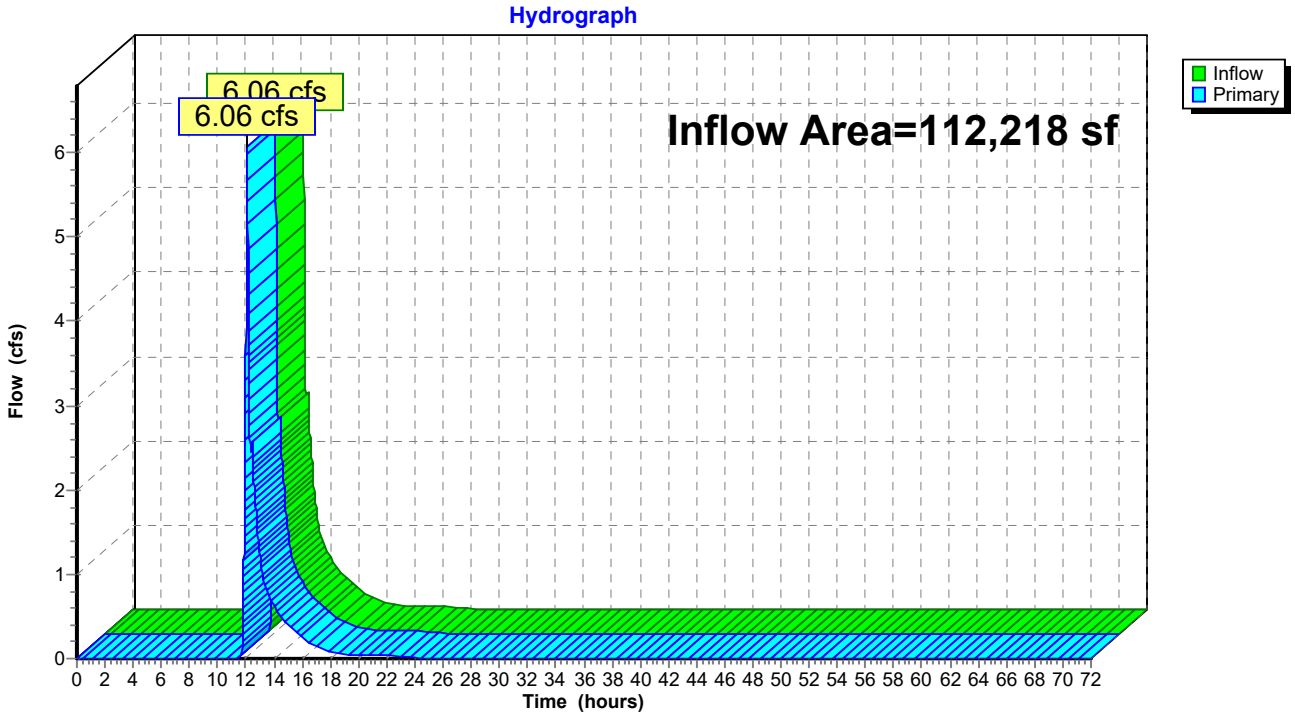


Summary for Link DP1:

Inflow Area = 112,218 sf, 60.32% Impervious, Inflow Depth = 2.03" for 100-YR event
Inflow = 6.06 cfs @ 12.09 hrs, Volume= 19,017 cf
Primary = 6.06 cfs @ 12.09 hrs, Volume= 19,017 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link DP1:

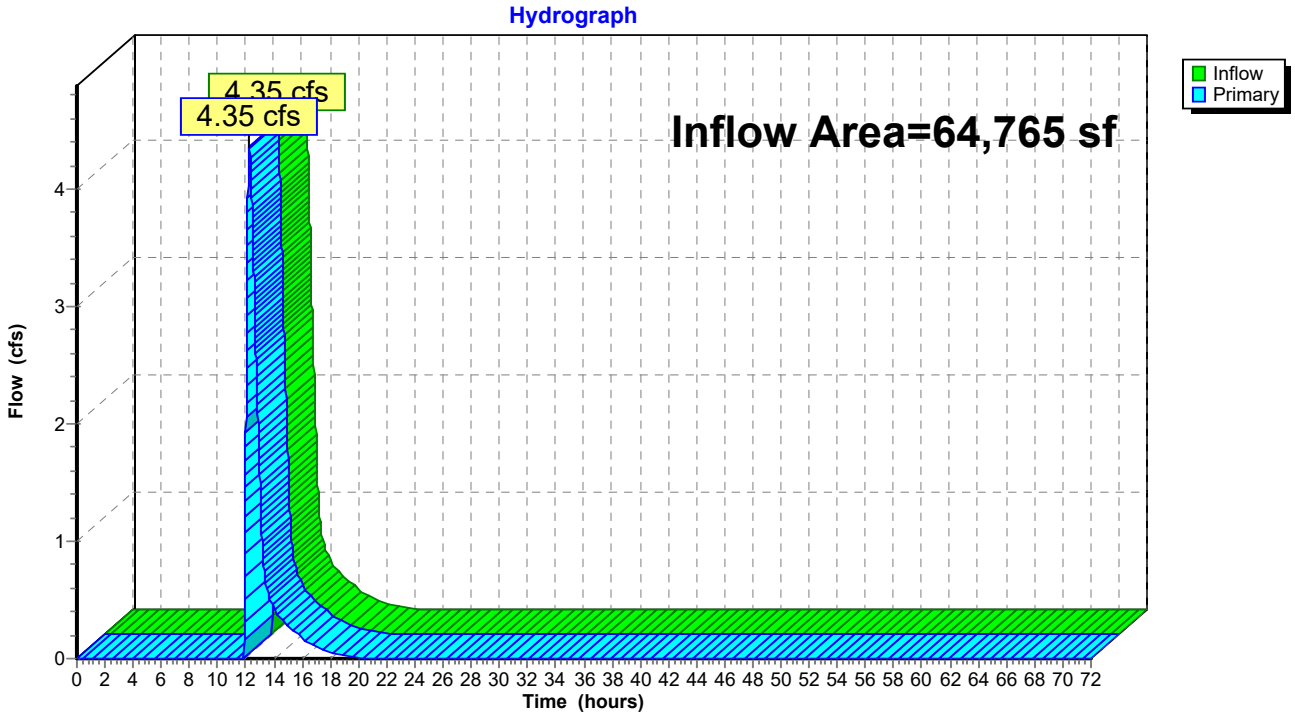


Summary for Link DP2:

Inflow Area = 64,765 sf, 74.07% Impervious, Inflow Depth = 3.19" for 100-YR event
Inflow = 4.35 cfs @ 12.24 hrs, Volume= 17,210 cf
Primary = 4.35 cfs @ 12.24 hrs, Volume= 17,210 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link DP2:

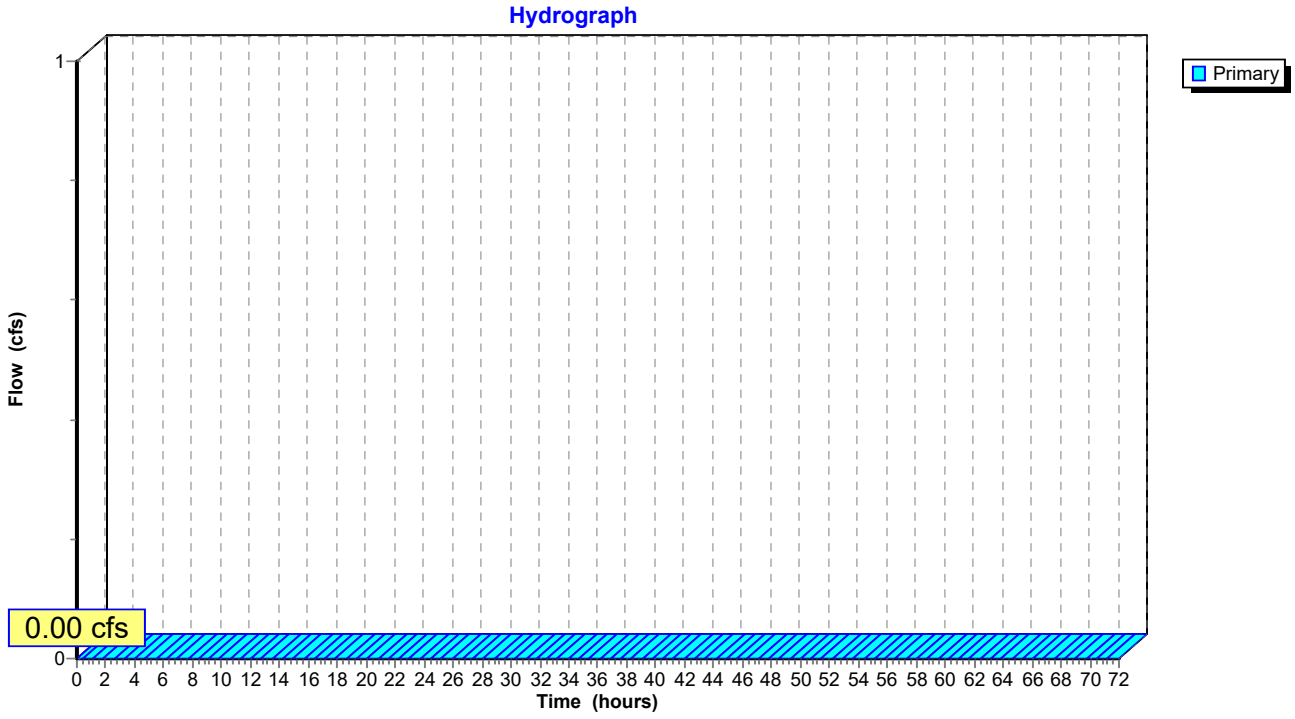


Summary for Link DP3: Design Point Eliminated

Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link DP3: Design Point Eliminated



APPENDIX F: STORMWATER CALCULATIONS

- *MA STANDARD #3 – RECHARGE AND DRAWDOWN TIME*
- *MA STANDARD #4 – WATER QUALITY AND TSS REMOVAL*
- *NOAA RAINFALL DATA*
- *PIPE SIZING*

Proposed Residential Development
299 Salem Street, Swampscott, MA
Boston, MA
Bohler Job Number: M211002
September 20, 2022

MA DEP Standard 3: Recharge Volume Calculations

Required Recharge Volume - A Soils (0.60 in.)	
Existing Site Impervious Area (ac)	2.873
Proposed Site Impervious Area (ac)	2.655
Proposed Increase in Site Impervious Area (ac)	-0.218
Recharge Volume Required (cf)	**0**

Required Recharge Volume - B Soils (0.35 in.)	
Existing Site Impervious Area (ac)	0.000
Proposed Site Impervious Area (ac)	0.000
Proposed Increase in Site Impervious Area (ac)	0.000
Recharge Volume Required (cf)	**0**

Required Recharge Volume - C Soils (0.25 in.)	
Existing Site Impervious Area (ac)	0.000
Proposed Site Impervious Area (ac)	0.000
Proposed Increase in Site Impervious Area (ac)	0.000
Recharge Volume Required (cf)	**0**

Required Recharge Volume - D Soils (0.10 in.)	
Existing Site Impervious Area (ac)	0.000
Proposed Site Impervious Area (ac)	0.000
Proposed Increase in Site Impervious Area (ac)	0.000
Recharge Volume Required (cf)	**0**

Total Recharge Volume Required (cf)	**0**

Recharge Volume Adjustment Factor	
Impervious Area Directed to Infiltration BMP (ac)	**0.000**
% Impervious Directed to Infiltration BMP	
Adjustment Factor	
Adjusted Total Recharge Volume Required (cf)	

Provided Recharge Volume*	
Proposed Subsurface Infiltration System #1	12,148
Proposed Subsurface Infiltration System #2	3,358
Total Recharge Volume Provided (cf)	**15,506**

*Volume provided below lowest outlet in cubic feet (cf)

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Proposed Residential Development
299 Salem Street, Swampscott, MA
Boston, MA
Bohler Job Number: M211002
September 20, 2022

MA DEP Standard 3: Drawdown Time Calculations

Drawdown Time - Proposed Subsurface Infiltration System #1	
Volume below outlet pipe (Rv) (cf)	12,148
Soil Type	Loamy Sand - A
Infiltration rate (K)*	2.41
Bottom Area (sf)	3,758
Drawdown time (Hours)*	16.1

Drawdown Time - Proposed Subsurface Infiltration System #2	
Volume below outlet pipe (Rv) (cf)	3,358
Soil Type	Loamy Sand - A
Infiltration rate (K)*	2.41
Bottom Area (sf)	2,515
Drawdown time (Hours)**	6.6

*Infiltration Rates taken from Rawls Table
**Drawdown time = Rv / (K) x (bottom area)

Prepared By:
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Proposed Residential Development
299 Salem Street, Swampscott, MA
Boston, MA
Bohler Job Number: M211002
September 20, 2022

MA DEP Standard 4: Water Quality Volume Calculations

Water Quality Volume Required	
Water Quality Volume runoff (in.)*	1.0
Total Post Development Impervious Area (sf)	115,664
Required Water Quality Volume (cf)	9,639

Water Quality Volume Provided*	
Proposed Subsurface Infiltration System #1	12,148
Proposed Subsurface Infiltration System #2	3,358
Total Provided Water Quality Volume (cf)	15,506

Provided greater than or Equal to Required

*Volume provided below lowest outlet pipe in cubic feet (cf)

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TSS Removal Calculation Worksheet

Subcatchment: PR2 & PR-4 (SURFACE RUNOFF)

A BMP[1]	B TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Deep-Sump Hooded Catch Basin	**0.25**	**1.00**	**0.25**	**0.75**
Water Quality Units (Hydrodynamic Separator)	**0.50**	**0.75**	**0.38**	**0.38**
Subsurface Infiltration System	**0.80**	**0.38**	**0.30**	**0.08**

Total TSS Removal = **93%**

Project: **Vinnen Street**
Prepared By: **Bohler Engineering**
Date: **9/20/2022**

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

Prepared By:
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TSS Removal Calculation Worksheet

Subcatchment: PR4 (ROOF RUNOFF)

A BMP[1]	B TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Subsurface Infiltration System	**0.80**	**1.00**	**0.80**	**0.20**

Total TSS Removal = **80%**

Project: **Vinnen Street**

Prepared By: **Bohler Engineering**

Date: **9/20/2022**

*Equals remaining load from previous BMP (E)

which enters the BMP

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TSS Removal Calculation Worksheet

Subcatchment: PR2 (ROOF RUNOFF)

A BMP[1]	B TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Water Quality Units (Hydrodynamic Separator)	**0.50**	**1.00**	**0.50**	**0.50**
Subsurface Infiltration System	**0.80**	**0.50**	**0.40**	**0.10**

Total TSS Removal = **90%**

Project: **Vinnen Street**

Prepared By: **Bohler Engineering**

Date: **9/20/2022**

*Equals remaining load from previous BMP (E)

which enters the BMP

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Proposed Residential Development
299 Salem Street, Swampscott, MA
Boston, MA
Bohler Job Number: M211002
September 20, 2022

MA DEP Standard 4: Weighted TSS Removal Rate

Subcatchment	Treatment Train	TSS Removal (%)	Treated Imp. Area* (sf)	Untreated Imp. Area (sf)
PR1	N/A	0%	0	0
PR2	Treatment Train #1	93%	31,988	0
PR2 (Roof Runoff)	Treatment Train #3	90%	31,982	0
PR3	N/A	0%	0	1,839
PR4 (Surface Runoff)	Treatment Train #1	93%	30,600	0
PR4 (Roof Runoff)	Treatment Train #2	80%	17,169	0
PR5	N/A	0%	0	525
Weighted TSS Removal Rate		**88%**		

*Pre-treatment not required for roof runoff

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Stage-Area-Storage for Pond 1P:

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
34.95	**3,758**	0	36.01	3,758	2,101
34.97	3,758	30	36.03	3,758	2,163
34.99	3,758	60	36.05	3,758	2,226
35.01	3,758	90	36.07	3,758	2,288
35.03	3,758	120	36.09	3,758	2,350
35.05	3,758	150	36.11	3,758	2,413
35.07	3,758	180	36.13	3,758	2,475
35.09	3,758	210	36.15	3,758	2,538
35.11	3,758	240	36.17	3,758	2,600
35.13	3,758	271	36.19	3,758	2,662
35.15	3,758	301	36.21	3,758	2,724
35.17	3,758	331	36.23	3,758	2,786
35.19	3,758	361	36.25	3,758	2,848
35.21	3,758	391	36.27	3,758	2,910
35.23	3,758	421	36.29	3,758	2,972
35.25	3,758	451	36.31	3,758	3,034
35.27	3,758	481	36.33	3,758	3,096
35.29	3,758	511	36.35	3,758	3,158
35.31	3,758	541	36.37	3,758	3,220
35.33	3,758	571	36.39	3,758	3,282
35.35	3,758	601	36.41	3,758	3,344
35.37	3,758	631	36.43	3,758	3,406
35.39	3,758	661	36.45	3,758	3,468
35.41	3,758	691	36.47	3,758	3,530
35.43	3,758	721	36.49	3,758	3,591
35.45	3,758	752	36.51	3,758	3,653
35.47	3,758	782	36.53	3,758	3,714
35.49	3,758	812	36.55	3,758	3,775
35.51	3,758	842	36.57	3,758	3,837
35.53	3,758	872	36.59	3,758	3,898
35.55	3,758	902	36.61	3,758	3,959
35.57	3,758	932	36.63	3,758	4,020
35.59	3,758	962	36.65	3,758	4,081
35.61	3,758	992	36.67	3,758	4,142
35.63	3,758	1,022	36.69	3,758	4,203
35.65	3,758	1,052	36.71	3,758	4,264
35.67	3,758	1,082	36.73	3,758	4,325
35.69	3,758	1,112	36.75	3,758	4,386
35.71	3,758	1,159	36.77	3,758	4,447
35.73	3,758	1,221	36.79	3,758	4,508
35.75	3,758	1,284	36.81	3,758	4,569
35.77	3,758	1,347	36.83	3,758	4,630
35.79	3,758	1,410	36.85	3,758	4,691
35.81	3,758	1,472	36.87	3,758	4,752
35.83	3,758	1,535	36.89	3,758	4,812
35.85	3,758	1,598	36.91	3,758	4,873
35.87	3,758	1,661	36.93	3,758	4,933
35.89	3,758	1,724	36.95	3,758	4,994
35.91	3,758	1,787	36.97	3,758	5,054
35.93	3,758	1,850	36.99	3,758	5,114
35.95	3,758	1,913	37.01	3,758	5,175
35.97	3,758	1,976	37.03	3,758	5,235
35.99	3,758	2,038	37.05	3,758	5,295

Stage-Area-Storage for Pond 1P: (continued)

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
37.07	3,758	5,355	38.13	3,758	8,450
37.09	3,758	5,415	38.15	3,758	8,506
37.11	3,758	5,475	38.17	3,758	8,562
37.13	3,758	5,535	38.19	3,758	8,618
37.15	3,758	5,595	38.21	3,758	8,674
37.17	3,758	5,654	38.23	3,758	8,730
37.19	3,758	5,714	38.25	3,758	8,786
37.21	3,758	5,774	38.27	3,758	8,841
37.23	3,758	5,833	38.29	3,758	8,896
37.25	3,758	5,893	38.31	3,758	8,951
37.27	3,758	5,952	38.33	3,758	9,006
37.29	3,758	6,012	38.35	3,758	9,061
37.31	3,758	6,071	38.37	3,758	9,116
37.33	3,758	6,130	38.39	3,758	9,170
37.35	3,758	6,190	38.41	3,758	9,225
37.37	3,758	6,249	38.43	3,758	9,279
37.39	3,758	6,308	38.45	3,758	9,333
37.41	3,758	6,368	38.47	3,758	9,387
37.43	3,758	6,427	38.49	3,758	9,441
37.45	3,758	6,486	38.51	3,758	9,495
37.47	3,758	6,545	38.53	3,758	9,548
37.49	3,758	6,604	38.55	3,758	9,601
37.51	3,758	6,662	38.57	3,758	9,654
37.53	3,758	6,721	38.59	3,758	9,707
37.55	3,758	6,780	38.61	3,758	9,760
37.57	3,758	6,838	38.63	3,758	9,812
37.59	3,758	6,897	38.65	3,758	9,865
37.61	3,758	6,956	38.67	3,758	9,917
37.63	3,758	7,014	38.69	3,758	9,969
37.65	3,758	7,073	38.71	3,758	10,021
37.67	3,758	7,131	38.73	3,758	10,072
37.69	3,758	7,190	38.75	3,758	10,124
37.71	3,758	7,248	38.77	3,758	10,175
37.73	3,758	7,306	38.79	3,758	10,226
37.75	3,758	7,364	38.81	3,758	10,276
37.77	3,758	7,422	38.83	3,758	10,327
37.79	3,758	7,480	38.85	3,758	10,377
37.81	3,758	7,537	38.87	3,758	10,427
37.83	3,758	7,595	38.89	3,758	10,476
37.85	3,758	7,653	38.91	3,758	10,526
37.87	3,758	7,710	38.93	3,758	10,575
37.89	3,758	7,768	38.95	3,758	10,624
37.91	3,758	7,825	38.97	3,758	10,672
37.93	3,758	7,883	38.99	3,758	10,721
37.95	3,758	7,940	39.01	3,758	10,769
37.97	3,758	7,997	39.03	3,758	10,817
37.99	3,758	8,054	39.05	3,758	10,865
38.01	3,758	8,111	39.07	3,758	10,912
38.03	3,758	8,168	39.09	3,758	10,959
38.05	3,758	8,224	39.11	3,758	11,006
38.07	3,758	8,281	39.13	3,758	11,052
38.09	3,758	8,337	39.15	3,758	11,098
38.11	3,758	8,394	39.17	3,758	11,144

Stage-Area-Storage for Pond 1P: (continued)

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
39.19	3,758	11,189
39.21	3,758	11,234
39.23	3,758	11,279
39.25	3,758	11,323
39.27	3,758	11,366
39.29	3,758	11,409
39.31	3,758	11,452
39.33	3,758	11,494
39.35	3,758	11,535
39.37	3,758	11,575
39.39	3,758	11,615
39.41	3,758	11,654
39.43	3,758	11,692
39.45	3,758	11,730
39.47	3,758	11,767
39.49	3,758	11,803
39.51	3,758	11,838
39.53	3,758	11,873
39.55	3,758	11,907
39.57	3,758	11,940
39.59	3,758	11,973
39.61	3,758	12,006
39.63	3,758	12,038
39.65	3,758	12,070
39.67	3,758	12,101
39.69	3,758	12,132
39.71	3,758	12,163
39.73	3,758	12,193
39.75	3,758	12,223
39.77	3,758	12,253
39.79	3,758	12,283
39.81	3,758	12,313
39.83	3,758	12,343
39.85	3,758	12,373
39.87	3,758	12,403
39.89	3,758	12,433
39.91	3,758	12,463
39.93	3,758	12,493
39.95	3,758	12,523
39.97	3,758	12,553
39.99	3,758	12,583
40.01	3,758	12,613
40.03	3,758	12,643
40.05	3,758	12,674
40.07	3,758	12,704
40.09	3,758	12,734
40.11	3,758	12,764
40.13	3,758	12,794
40.15	3,758	12,824
40.17	3,758	12,854
40.19	3,758	12,884
40.21	3,758	12,914
40.23	3,758	12,944
40.25	3,758	12,974
40.27	3,758	13,004
40.29	3,758	13,034
40.31	3,758	13,064
40.33	3,758	13,094
40.35	3,758	13,124
40.37	3,758	13,155
40.39	3,758	13,185
40.41	3,758	13,215
40.43	3,758	13,245
40.45	3,758	13,275
40.47	3,758	13,305
40.49	3,758	13,335
40.51	3,758	13,365
40.53	3,758	13,395
40.55	3,758	13,425
40.57	3,758	13,455
40.59	3,758	13,485
40.61	3,758	13,515
40.63	3,758	13,545
40.65	3,758	13,575
40.67	3,758	13,605
40.69	3,758	**13,635**

Stage-Area-Storage for Pond 2P:

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
38.85	**2,515**	0	39.91	2,515	1,410
38.87	2,515	20	39.93	2,515	1,452
38.89	2,515	40	39.95	2,515	1,494
38.91	2,515	60	39.97	2,515	1,536
38.93	2,515	80	39.99	2,515	1,578
38.95	2,515	101	40.01	2,515	1,620
38.97	2,515	121	40.03	2,515	1,662
38.99	2,515	141	40.05	2,515	1,704
39.01	2,515	161	40.07	2,515	1,746
39.03	2,515	181	40.09	2,515	1,788
39.05	2,515	201	40.11	2,515	1,830
39.07	2,515	221	40.13	2,515	1,871
39.09	2,515	241	40.15	2,515	1,913
39.11	2,515	262	40.17	2,515	1,955
39.13	2,515	282	40.19	2,515	1,997
39.15	2,515	302	40.21	2,515	2,038
39.17	2,515	322	40.23	2,515	2,080
39.19	2,515	342	40.25	2,515	2,122
39.21	2,515	362	40.27	2,515	2,164
39.23	2,515	382	40.29	2,515	2,205
39.25	2,515	402	40.31	2,515	2,247
39.27	2,515	423	40.33	2,515	2,289
39.29	2,515	443	40.35	2,515	2,330
39.31	2,515	463	40.37	2,515	2,372
39.33	2,515	483	40.39	2,515	2,413
39.35	2,515	503	40.41	2,515	2,455
39.37	2,515	523	40.43	2,515	2,496
39.39	2,515	543	40.45	2,515	2,537
39.41	2,515	563	40.47	2,515	2,579
39.43	2,515	584	40.49	2,515	2,620
39.45	2,515	604	40.51	2,515	2,661
39.47	2,515	624	40.53	2,515	2,702
39.49	2,515	644	40.55	2,515	2,743
39.51	2,515	664	40.57	2,515	2,784
39.53	2,515	684	40.59	2,515	2,825
39.55	2,515	704	40.61	2,515	2,866
39.57	2,515	724	40.63	2,515	2,908
39.59	2,515	745	40.65	2,515	2,949
39.61	2,515	776	40.67	2,515	2,990
39.63	2,515	818	40.69	2,515	3,031
39.65	2,515	860	40.71	2,515	3,072
39.67	2,515	902	40.73	2,515	3,113
39.69	2,515	945	40.75	2,515	3,154
39.71	2,515	987	40.77	2,515	3,195
39.73	2,515	1,029	40.79	2,515	3,235
39.75	2,515	1,072	40.81	2,515	3,276
39.77	2,515	1,114	40.83	2,515	3,317
39.79	2,515	1,157	40.85	2,515	3,358
39.81	2,515	1,199	40.87	2,515	3,398
39.83	2,515	1,241	40.89	2,515	3,439
39.85	2,515	1,284	40.91	2,515	3,479
39.87	2,515	1,326	40.93	2,515	3,520
39.89	2,515	1,368	40.95	2,515	3,560

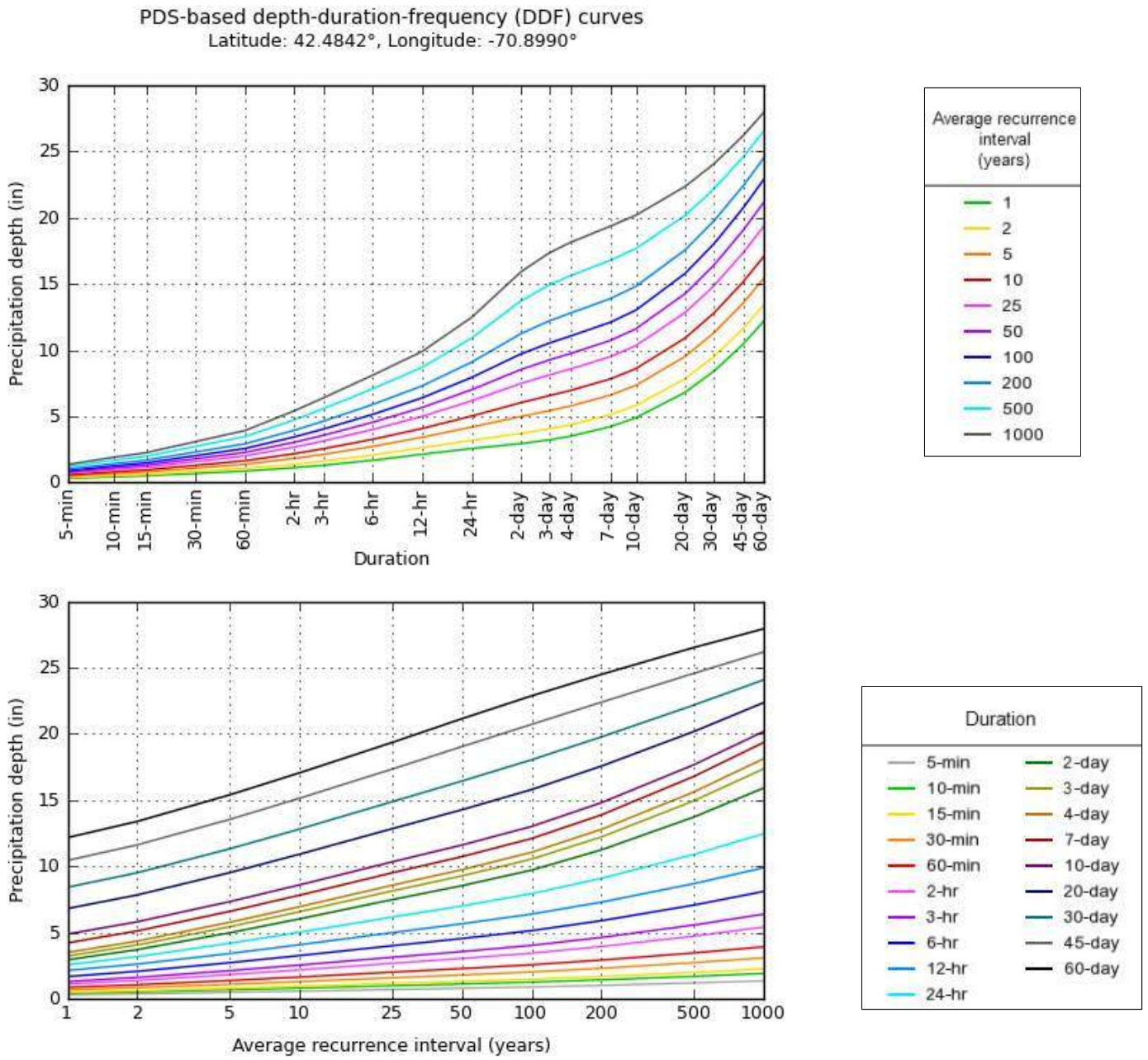
Stage-Area-Storage for Pond 2P: (continued)

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
40.97	2,515	3,600	42.03	2,515	5,683
40.99	2,515	3,641	42.05	2,515	5,721
41.01	2,515	3,681	42.07	2,515	5,759
41.03	2,515	3,722	42.09	2,515	5,797
41.05	2,515	3,762	42.11	2,515	5,834
41.07	2,515	3,802	42.13	2,515	5,872
41.09	2,515	3,842	42.15	2,515	5,909
41.11	2,515	3,883	42.17	2,515	5,947
41.13	2,515	3,923	42.19	2,515	5,984
41.15	2,515	3,963	42.21	2,515	6,021
41.17	2,515	4,003	42.23	2,515	6,058
41.19	2,515	4,043	42.25	2,515	6,095
41.21	2,515	4,083	42.27	2,515	6,131
41.23	2,515	4,123	42.29	2,515	6,168
41.25	2,515	4,162	42.31	2,515	6,205
41.27	2,515	4,202	42.33	2,515	6,241
41.29	2,515	4,242	42.35	2,515	6,278
41.31	2,515	4,282	42.37	2,515	6,314
41.33	2,515	4,322	42.39	2,515	6,350
41.35	2,515	4,362	42.41	2,515	6,386
41.37	2,515	4,401	42.43	2,515	6,422
41.39	2,515	4,441	42.45	2,515	6,458
41.41	2,515	4,480	42.47	2,515	6,494
41.43	2,515	4,520	42.49	2,515	6,529
41.45	2,515	4,559	42.51	2,515	6,565
41.47	2,515	4,599	42.53	2,515	6,600
41.49	2,515	4,638	42.55	2,515	6,635
41.51	2,515	4,678	42.57	2,515	6,670
41.53	2,515	4,717	42.59	2,515	6,705
41.55	2,515	4,757	42.61	2,515	6,740
41.57	2,515	4,796	42.63	2,515	6,775
41.59	2,515	4,835	42.65	2,515	6,809
41.61	2,515	4,875	42.67	2,515	6,844
41.63	2,515	4,914	42.69	2,515	6,878
41.65	2,515	4,953	42.71	2,515	6,912
41.67	2,515	4,992	42.73	2,515	6,946
41.69	2,515	5,031	42.75	2,515	6,979
41.71	2,515	5,069	42.77	2,515	7,013
41.73	2,515	5,108	42.79	2,515	7,046
41.75	2,515	5,147	42.81	2,515	7,080
41.77	2,515	5,186	42.83	2,515	7,113
41.79	2,515	5,224	42.85	2,515	7,146
41.81	2,515	5,263	42.87	2,515	7,178
41.83	2,515	5,302	42.89	2,515	7,211
41.85	2,515	5,340	42.91	2,515	7,243
41.87	2,515	5,379	42.93	2,515	7,275
41.89	2,515	5,417	42.95	2,515	7,307
41.91	2,515	5,455	42.97	2,515	7,339
41.93	2,515	5,494	42.99	2,515	7,371
41.95	2,515	5,532	43.01	2,515	7,402
41.97	2,515	5,570	43.03	2,515	7,433
41.99	2,515	5,608	43.05	2,515	7,464
42.01	2,515	5,646	43.07	2,515	7,495

Stage-Area-Storage for Pond 2P: (continued)

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
43.09	2,515	7,525
43.11	2,515	7,556
43.13	2,515	7,586
43.15	2,515	7,615
43.17	2,515	7,644
43.19	2,515	7,673
43.21	2,515	7,702
43.23	2,515	7,730
43.25	2,515	7,758
43.27	2,515	7,785
43.29	2,515	7,811
43.31	2,515	7,838
43.33	2,515	7,863
43.35	2,515	7,889
43.37	2,515	7,913
43.39	2,515	7,937
43.41	2,515	7,961
43.43	2,515	7,984
43.45	2,515	8,007
43.47	2,515	8,030
43.49	2,515	8,052
43.51	2,515	8,074
43.53	2,515	8,095
43.55	2,515	8,116
43.57	2,515	8,137
43.59	2,515	8,158
43.61	2,515	8,178
43.63	2,515	8,199
43.65	2,515	8,219
43.67	2,515	8,239
43.69	2,515	8,259
43.71	2,515	8,279
43.73	2,515	8,299
43.75	2,515	8,319
43.77	2,515	8,339
43.79	2,515	8,360
43.81	2,515	8,380
43.83	2,515	8,400
43.85	2,515	8,420
43.87	2,515	8,440
43.89	2,515	8,460
43.91	2,515	8,480
43.93	2,515	8,500
43.95	2,515	8,521
43.97	2,515	8,541
43.99	2,515	8,561
44.01	2,515	8,581
44.03	2,515	8,601
44.05	2,515	8,621
44.07	2,515	8,641
44.09	2,515	8,661
44.11	2,515	8,682
44.13	2,515	8,702
44.15	2,515	8,722
44.17	2,515	8,742
44.19	2,515	8,762
44.21	2,515	8,782
44.23	2,515	8,802
44.25	2,515	8,822
44.27	2,515	8,843
44.29	2,515	8,863
44.31	2,515	8,883
44.33	2,515	8,903
44.35	2,515	8,923
44.37	2,515	8,943
44.39	2,515	8,963
44.41	2,515	8,983
44.43	2,515	9,004
44.45	2,515	9,024
44.47	2,515	9,044
44.49	2,515	9,064
44.51	2,515	9,084
44.53	2,515	9,104
44.55	2,515	9,124
44.57	2,515	9,144
44.59	2,515	**9,165**

PF graphical



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Created (GMT): Thu Nov 18 15:54:36 2021

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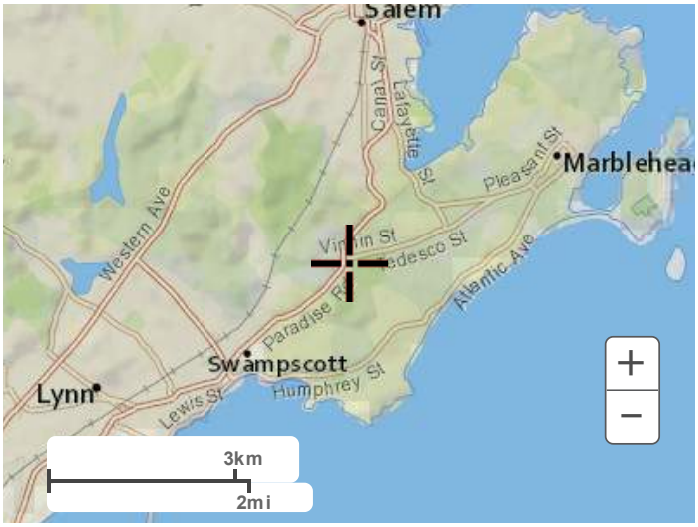
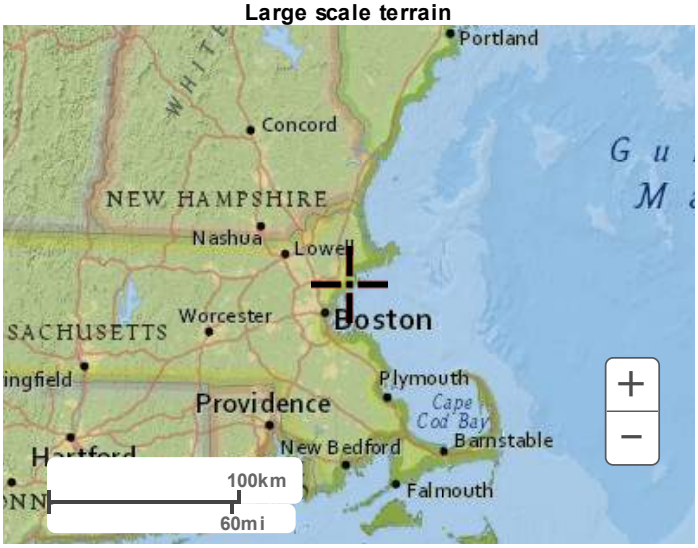
Maps & aerials

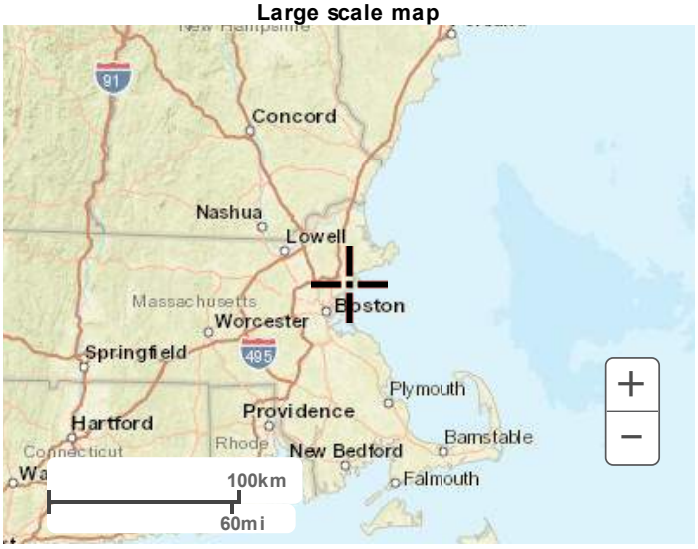
Small scale terrain



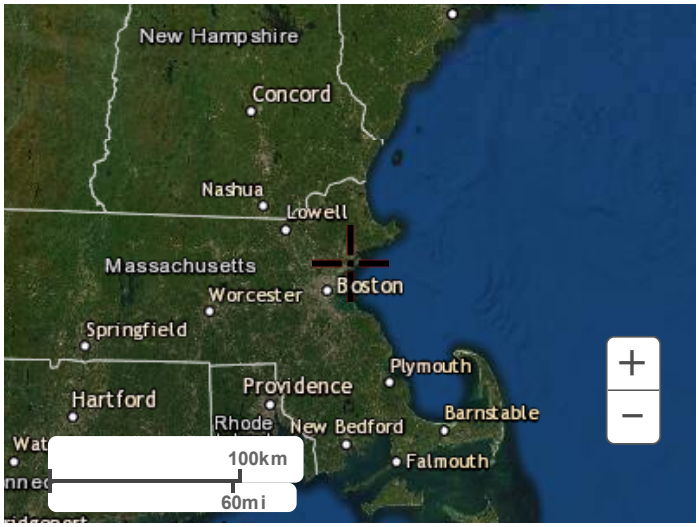
Large scale terrain



Large scale map



Large scale aerial



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US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

Proposed Residential Development
299 Salem Street, Swampscott, MA
Boston, MA
Bohler Job Number: M211002
September 20, 2022

Rational Pipe Sizing Calculations

Design Period Storm:		25	Year	Design Period Intensity*			6.16	in/hr									
LOCATION		IMPERVIOUS			OTHER												
FROM	TO	A	C	CA	A	C	CA	SUM CA	Tc (min)	I (in/hr)	Q (cfs)	D (in)	S (ft/ft)	Material	n	Q Full (cfs)	V Full (fps)
CB-1	WQU-2	0.00	0.95	0.00	0.00	0.30	0.00	0.00	6	6.16	0.02	12	0.010	HDPE	0.012	3.86	4.91
CB-2	DMH-1	0.04	0.95	0.04	0.01	0.30	0.00	0.04	6	6.16	0.24	12	0.010	HDPE	0.012	3.86	4.91
CB-3	DMH-1	0.08	0.95	0.08	0.05	0.30	0.01	0.09	6	6.16	0.56	12	0.010	HDPE	0.012	3.86	4.91
TD-2	DMH-1	0.07	0.95	0.07	0.04	0.30	0.01	0.08	6	6.16	0.51	12	0.010	HDPE	0.012	3.86	4.91
DMH-1	WQU-2	0.19	0.95	0.18	0.10	0.30	0.03	0.21	6	6.16	1.31	12	0.010	HDPE	0.012	3.86	4.91
CB-15	DMH-6	0.00	0.95	0.00	0.04	0.30	0.01	0.02	6	6.16	0.11	12	0.010	HDPE	0.012	3.86	4.91
WQU-2	DMH-6	0.20	0.95	0.19	0.10	0.30	0.03	0.22	6	6.16	1.33	12	0.010	HDPE	0.012	3.86	4.91
RL-1	DMH-6	0.31	0.95	0.30	0.00	0.30	0.00	0.30	6	6.16	1.84	12	0.010	HDPE	0.012	3.86	4.91
RL-2	PSIS-2	0.08	0.95	0.08	0.00	0.30	0.00	0.08	6	6.16	0.47	12	0.010	HDPE	0.012	3.86	4.91
CB-4	DMH-2	0.10	0.95	0.09	0.04	0.30	0.00	0.10	6	6.16	0.59	12	0.005	HDPE	0.012	2.73	3.47
DMH-2	DMH-4	0.34	0.95	0.32	0.26	0.30	0.08	0.40	6	6.16	2.49	15	0.005	HDPE	0.012	4.95	4.03
CB-6	DMH-3	0.19	0.95	0.18	0.14	0.30	0.04	0.22	6	6.16	1.37	12	0.005	HDPE	0.012	2.73	3.47
CB-7	DMH-3	0.05	0.95	0.05	0.09	0.30	0.03	0.08	6	6.16	0.47	12	0.005	HDPE	0.012	2.73	3.47
DMH-3	DMH-2	0.25	0.95	0.23	0.22	0.30	0.07	0.30	6	6.16	1.85	12	0.005	HDPE	0.012	2.73	3.47
CB-8	DMH-4	0.16	0.95	0.15	0.03	0.30	0.01	0.16	6	6.16	1.00	12	0.005	HDPE	0.012	2.73	3.47
DMH-4	DMH-5	0.50	0.95	0.48	0.29	0.30	0.09	0.57	6	6.16	3.49	15	0.005	HDPE	0.012	4.95	4.03
DMH-5	WQU-1	0.50	0.95	0.48	0.32	0.30	0.10	0.57	6	6.16	3.54	15	0.005	HDPE	0.012	4.95	4.03
WQU-1	PSIS-2	0.50	0.95	0.48	0.32	0.30	0.10	0.57	6.00	6.16	3.54	15	0.005	HDPE	0.012	4.95	4.03
CB-9	DMH-6	0.06	0.95	0.06	0.00	0.30	0.00	0.06	6	6.16	0.37	12	0.005	HDPE	0.012	2.73	3.47
CB-10	DMH-6	0.07	0.95	0.07	0.07	0.30	0.02	0.09	6	6.16	0.52	12	0.005	HDPE	0.012	2.73	3.47
DMH-7	DMH-8	0.13	0.95	0.12	0.07	0.30	0.02	0.14	6	6.16	0.89	12	0.005	HDPE	0.012	2.73	3.47
RL-3	DMH-8	0.34	0.95	0.32	0.00	0.30	0.00	0.32	6	6.16	1.97	12	0.005	HDPE	0.012	2.73	3.47
RL-5	DMH-8	0.11	0.95	0.10	0.00	0.30	0.00	0.10	6	6.16	0.65	12	0.005	HDPE	0.012	2.73	3.47
DMH-8	DMH-9	0.58	0.95	0.55	0.07	0.30	0.02	0.57	6	6.16	3.51	15	0.005	HDPE	0.012	4.95	4.03
CB-11	DMH-9	0.29	0.95	0.27	0.05	0.30	0.01	0.29	6	6.16	1.76	12	0.005	HDPE	0.012	2.73	3.47
DMH-9	WQU-4	0.86	0.95	0.82	0.11	0.30	0.03	0.86	6	6.16	5.27	18	0.005	HDPE	0.012	8.05	4.55
CB-12	WQU-4	0.06	0.95	0.06	0.02	0.30	0.00	0.06	6	6.16	0.39	12	0.005	HDPE	0.012	2.73	3.47
RL-4	WQU-4	0.40	0.95	0.38	0.00	0.30	0.00	0.38	6	6.16	2.33	12	0.005	HDPE	0.012	2.73	3.47
WQU-4	DV MH	1.32	0.95	1.26	0.13	0.30	0.04	1.30	6	6.16	7.99	18	0.005	HDPE	0.012	8.05	4.55
CB-13	WQU-3	0.11	0.95	0.11	0.03	0.30	0.01	0.12	6	6.16	0.72	12	0.005	HDPE	0.012	2.73	3.47
CB-14	WQU-3	0.10	0.95	0.10	0.03	0.30	0.01	0.10	6	6.16	0.64	12	0.005	HDPE	0.012	2.73	3.47
TD-1	WQU-3	0.06	0.95	0.06	0.00	0.30	0.00	0.06	6	6.16	0.35	12	0.005	HDPE	0.012	2.73	3.47
WQU-3	DV MH	0.27	0.95	0.26	0.06	0.30	0.02	0.28	6	6.16	1.71	12	0.005	HDPE	0.012	2.73	3.47
															0.012		

*Rainfall intensity provided by TR55 Exhibit X-XX or Cornell University's NRCC Atlas of Precipitation Extremes for the North Eastern United States and Canada or NOAA Atlas 14, Volume 10, Version 2 on DATE

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APPENDIX G: OPERATION AND MAINTENANCE

- *STORMWATER OPERATION AND MAINTENANCE PLAN*
- *INSPECTION REPORT*
- *INSPECTION AND MAINTENANCE LOG FORM*
- *LONG-TERM POLLUTION PREVENTION PLAN*
- *ILLICIT DISCHARGE STATEMENT*
- *SPILL PREVENTION*
- *PROPOSED OPERATION AND MAINTENANCE MAP*
- *MANUFACTURER'S INSPECTION AND MAINTENANCE MANUALS*

STORMWATER OPERATION AND MAINTENANCE PLAN

299 Salem Street	*202-204 Tedesco Street*	*20 Vinnin Street*
Swampscott, MA	*Marblehead, MA*	*Salem, MA*

RESPONSIBLE PARTY DURING CONSTRUCTION:

Sunbeam Development Limited Partnership
299 Salem Street
Swampscott, MA

RESPONSIBLE PARTY POST CONSTRUCTION:

Sunbeam Development Limited Partnership
299 Salem Street
Swampscott, MA

Construction Phase

During the construction phase, all erosion control devices and measures shall be maintained in accordance with the final record plans, local/state approvals and conditions, the EPA Construction General Permit and the Stormwater Pollution Prevention Plan (SWPPP) if applicable. Additionally, the maintenance of all erosion / siltation control measures during construction shall be the responsibility of the general contractor. Contact information of the OWNER and CONTRACTOR shall be listed in the SWPPP for this site. The SWPPP also includes information regarding construction period allowable and illicit discharges, housekeeping and emergency response procedures. Upon proper notice to the property owner, the Town/City or its authorized designee shall be allowed to enter the property at a reasonable time and in a reasonable manner for the purposes of inspection.

Post Development Controls

Once construction is completed, the post development stormwater controls are to be operated and maintained in compliance with the following permanent procedures (note that the continued implementation of these procedures shall be the responsibility of the Owner or its assignee):

1. Parking lots and on-site driveways: Sweep at least four (4) times per year and on a more frequent basis depending on sanding operations. All resulting sweepings shall be collected and properly disposed of off-site in accordance with MADEP and other applicable requirements.

   Approximate Maintenance Budget: $1,000/year

2. Catch basins, manholes, and piping: Inspect four (4) times per year and at the end of foliage and snow-removal seasons. These features shall be cleaned four (4) times per year or whenever the depth of deposits is greater than or equal to one half the depth from the bottom of the invert of the lowest pipe in the catch basin or underground system. Accumulated sediment and hydrocarbons present must be removed and properly disposed of off-site in accordance with MADEP and other applicable requirements.

Approximate Maintenance Budget: $500/year per structure.

3. Water Quality Unit (Proprietary Separator): Follow manufacturer's recommendations (attached).

   Approximate Maintenance Budget: $1,000/year per unit.

4. Underground Infiltration Basins: Preventative maintenance after every major storm event during the first three (3) months of operation and at least twice per year thereafter. Inspect structure and pretreatment BMP to ensure proper operation after every major storm event (generally equal or greater to 3.0 inches in 24 hours) for the first three months. The outlet of the basin, if any, shall be inspected for erosion and sedimentation, and rip-rap shall be promptly repaired in the case of erosion. Sediment collecting in the bottom of the basin shall be inspected twice annually, and removal shall commence any time the sediment reaches a depth of six inches anywhere in the basin. Any sediment removed shall be disposed of in accordance with MADEP and other applicable requirements. Approximate Maintenance Budget: Cleaning - $1,000/year, Inspection - $200/year

All components of the stormwater system will be accessible by the owner or their assignee.

STORMWATER MANAGEMENT SYSTEM

POST-CONSTRUCTION INSPECTION REPORT

LOCATION:

299 Salem Street	***202-204 Tedesco Street***	***20 Vinnin Street***
Swampscott, MA	***Marblehead, MA***	***Salem, MA***

RESPONSIBLE PARTY:

Sunbeam Development Limited Partnership
299 Salem Street
Swampscott, MA

NAME OF INSPECTOR:	INSPECTION DATE:
Note Condition of the Following (sediment depth, debris, standing water, damage, etc.):	
Catch Basins:	
Discharge Points/ Flared End Sections / Rip Rap:	
Infiltration Basin:	
Water Quality Units:	
Other:	
Note Recommended Actions to be taken on the Following (sediment and/or debris removal, repairs, etc.):	

Catch Basins:
Discharge Points / Flared End Sections / Rip Rap:
Infiltration Basin:
Water Quality Units:
Other:
Comments:

STORMWATER INSPECTION AND MAINTENANCE LOG FORM

299 Salem Street – Swampscott, MA

Stormwater Management Practice	Responsible Party	Date	Maintenance Activity Performed

LONG-TERM POLLUTION PREVENTION PLAN

299 Salem Street	***202-204 Tedesco Street***	***20 Vinnin Street***
Swampscott, MA	***Marblehead, MA***	***Salem, MA***

RESPONSIBLE PARTY DURING CONSTRUCTION:

Sunbeam Development Limited Partnership
299 Salem Street
Swampscott, MA

RESPONSIBLE PARTY POST CONSTRUCTION:

Sunbeam Development Limited Partnership
299 Salem Street
Swampscott, MA

For this site, the Long-Term Pollution Prevention Plan will consist of the following:

- The property owner shall be responsible for "good housekeeping" including proper periodic maintenance of building and pavement areas, curbing, landscaping, etc.
- Proper storage and removal of solid waste (dumpsters).
- Sweeping of driveways a minimum of twice per year with a commercial cleaning unit. Any sediment removed shall be disposed of in accordance with applicable local and state requirements.
- Regular inspections and maintenance of Stormwater Management System as noted in the "O&M Plan".
- Snow removal shall be the responsibility of the property owner. Snow shall not be plowed, dumped and/or placed in forebays, infiltration basins or similar stormwater controls. Salting and/or sanding of pavement / walkway areas during winter conditions shall only be done in accordance with all state/local requirements and approvals.

OPERATON AND MAINTENANCE TRAINING PROGRAM

The Owner will coordinate an annual in-house training session to discuss the Operations and Maintenance Plan, the Long-Term Pollution Prevention Plan, and the Spill Prevention Plan and response procedures. Annual training will include the following:

Discuss the Operations and Maintenance Plan

- Explain the general operations of the stormwater management system and its BMPs
- Identify potential sources of stormwater pollution and measures / methods of reducing or eliminating that pollution
- Emphasize good housekeeping measures

Discuss the Spill Prevention and Response Procedures

- Explain the process in the event of a spill
- Identify potential sources of spills and procedures for cleanup and /or reporting and notification
- Complete a yearly inventory or Materials Safety Data sheets of all tenants and confirm that no potentially harmful chemicals are in use.
- No outdoor maintenance or washing of vehicles allowed.
- Homeowners will be encouraged to implement the following methods when washing vehicles: Use soap sparingly, use a hose nozzle with a trigger to save water, and pour the bucket of soapy water down the sink or in a landscape area when done and not in the street or when possible use a commercial car wash.
- Trash and other debris shall be removed from all areas of the site at least twice yearly.
- Reseed any bare areas as soon as they occur. Erosion control measures shall be installed in these areas to prevent deposits of sediment from entering the drainage system.
- Grass shall be maintained at a minimum blade height of two to three inches and only 1/3 of the plant height shall be removed at a time. Clippings shall not be disposed of within stormwater management areas or adjacent resource areas.
- Plants shall be pruned as necessary.
- The use of fertilizers will be kept at a level consistent with typical residential use. Fertilizer will be applied a maximum of once to twice per year during the initial

planting and stabilization of landscaped areas. Once plants are established and growing well fertilizer will be applied judiciously.

- The use of pesticides will be kept at a level consistent with typical residential use. Where possible mechanical methods (i.e. pest traps) or biological methods (i.e. beneficial insects) of pest control shall be implemented. If pesticides (insecticide, herbicide, and fungicide) are required to be used, a pesticide which poses the lowest risk to public health and the environment shall be used.

- Pet waste shall be disposed of in accordance with local regulations. Pet waste shall not be disposed of in a storm drain or catch basin.

- Snow piles shall be located adjacent to or on pervious surfaces in upland areas. This will allow snow melt water to filter in to the soil, leaving behind sand and debris which can be removed in the springtime.

- If necessary, stockpiled snow will be removed from the Site and disposed of at an off-site location in accordance with all local, state and federal regulations.

- The amount of sand and deicing chemicals shall be kept at the minimum amount required to provide safe pedestrian and vehicle travel.

- Deicing chemicals are recommended as a pretreatment to storm events to minimize the amount of applied sand.

- Sand and deicing chemicals should be stockpiled under covered storage facilities that prevent precipitation and adjacent runoff from coming in contact with the deicing materials. Stockpile areas shall be located outside resource areas.

- The primary agents used for deicing at parking lots, sidewalks and the access roads shall consist of salt alternatives such as calcium carbonate (CaCO3) or potassium chloride (KCl) or sodium chloride.

- Deliveries shall be monitored by owner or owner's representative to ensure proper delivery and in the event that a spillage occurs it shall be contained and cleaned up immediately in accordance with the spill prevention program for the project.

- Recycle materials whenever possible. Provide separate containers for recycle materials. Recycling products will be removed by a certified waste hauler.

ILLICIT DISCHARGE STATEMENT

Certain types of non-stormwater discharges are allowed under the U.S. Environmental Protection Agency Construction General Permit. These types of discharges will be allowed under the conditions that no pollutants will be allowed to come in contact with the water prior to or after its discharge. The control measures which have been outlined previously in this LTPPP will be strictly followed to ensure that no contamination of these non-storm water discharges takes place. Any existing illicit discharges, if discovered during the course of the work, will be reported to MassDEP and the local DPW, as applicable, to be addressed in accordance with their respective policies. No illicit discharges will be allowed in conjunction with the proposed improvements.

Duly Acknowledged:

_____

Name & Title

SPILL PREVENTION AND RESPONSE PROCEDURES (POST CONSTRUCTION)

In order to prevent or minimize the potential for a spill of Hazardous Substances or Oil or come into contact with stormwater, the following steps will be implemented:

1. All Hazardous Substances or Oil (such as pesticides, petroleum products, fertilizers, detergents, acids, paints, paint solvents, cleaning solvents, etc.) will be stored in a secure location, with their lids on, preferably under cover, when not in use.

2. The minimum practical quantity of all such materials will be kept on site.

3. A spill control and containment kit (containing, for example, absorbent materials, acid neutralizing powder, brooms, dust pans, mops, rags, gloves, goggles, plastic and metal trash containers, etc.) will be provided on site.

4. Manufacturer's recommended methods for spill cleanup will be clearly posted and site personnel will be trained regarding these procedures and the location of the information and cleanup supplies.

5. It is the OWNER's responsibility to ensure that all Hazardous Waste on site is disposed of properly by a licensed hazardous material disposal company. The OWNER is responsible for not exceeding Hazardous Waste storage requirements mandated by the EPA or state and local authorities.

In the event of a spill of Hazardous Substances or Oil, the following procedures should be followed:

1. All measures should be taken to contain and abate the spill and to prevent the discharge of the Hazardous Substance or Oil to stormwater or off-site. (The spill area should be kept well ventilated and personnel should wear appropriate protective clothing to prevent injury from contact with the Hazardous Substances.)

2. For spills of less than five (5) gallons of material, proceed with source control and containment, clean-up with absorbent materials or other applicable means unless an imminent hazard or other circumstances dictate that the spill should be treated by a professional emergency response contractor.

3. For spills greater than five (5) gallons of material immediately contact the MADEP at the toll-free 24-hour statewide emergency number: **1-888-304-1133**, the local fire department (**9-1-1**) and an approved emergency response contractor. Provide information on the type of material spilled, the location of the spill, the quantity spilled, and the time of the spill to the emergency response contractor or coordinator, and proceed with prevention, containment and/or clean-up if so desired. (Use the form provided, or similar).

4. If there is a Reportable Quantity (RQ) release, then the National Response Center should be notified immediately at (800) 424-8802; within 14 days a report should be submitted to the EPA regional office describing the release, the date and circumstances of the release and the steps taken to prevent another release. This Pollution Prevention Plan should be updated to reflect any such steps or actions taken and measures to prevent the same from reoccurring.

SPILL PREVENTION CONTROL AND COUNTERMEASURE FORM

299 Salem Street	***202-204 Tedesco Street***	***20 Vinnin Street***
Swampscott, MA	***Marblehead, MA***	***Salem, MA***

Where a release containing a hazardous substance occurs, the following steps shall be taken by the facility manager and/or supervisor:

1. Immediately notify The Swampscott Fire Department (at **9-1-1**)
2. All measures must be taken to contain and abate the spill and to prevent the discharge of the pollutant(s) to off-site locations, receiving waters, wetlands and/or resource areas.
3. Notify the Swampscott Health Department at (781) 596-8864 and the Swampscott Conservation Commission at (781) 596-8829.
4. Provide documentation from licensed contractor showing disposal and cleanup procedures were completed as well as details on chemicals that were spilled to the Town of Swampscott Health Department and Conservation Commission.

Date of spill:_____ Time:_____ Reported By:_____

Weather Conditions:_____

Material Spilled	**Location of Spill**	**Approximate Quantity of Spill (in gallons)**	**Agency(s) Notified**	**Date of Notification**

Cause of Spill:_____

_____

Measures Taken to Clean up Spill:_____

_____

Type of equipment: _____ Make: _____ Size:_____

License or S/N: _____

Location and Method of Disposal_____

_____

Procedures, method, and precautions instituted to prevent a similar occurrence from recurring:_____

_____

Additional Contact Numbers:

- DEPARTMENT OF ENVIRONMENTAL PROTECTION (DEP) EMERGENCY PHONE: 1-888-304-1133
- NATIONAL RESPONSE CENTER PHONE: (800) 424-8802
- U.S. ENVIRONMENTAL PROTECTION AGENCYPHONE: (888) 372-7341

CONTECH®
ENGINEERED SOLUTIONS

CDS® Inspection and Maintenance Guide

CDS TECHNOLOGIES

Maintenance

The CDS system should be inspected at regular intervals and maintained when necessary to ensure optimum performance. The rate at which the system collects pollutants will depend more heavily on site activities than the size of the unit. For example, unstable soils or heavy winter sanding will cause the grit chamber to fill more quickly but regular sweeping of paved surfaces will slow accumulation.

Inspection

Inspection is the key to effective maintenance and is easily performed. Pollutant transport and deposition may vary from year to year and regular inspections will help ensure that the system is cleaned out at the appropriate time. At a minimum, inspections should be performed twice per year (e.g. spring and fall) however more frequent inspections may be necessary in climates where winter sanding operations may lead to rapid accumulations, or in equipment washdown areas. Installations should also be inspected more frequently where excessive amounts of trash are expected.

The visual inspection should ascertain that the system components are in working order and that there are no blockages or obstructions in the inlet and separation screen. The inspection should also quantify the accumulation of hydrocarbons, trash, and sediment in the system. Measuring pollutant accumulation can be done with a calibrated dipstick, tape measure or other measuring instrument. If absorbent material is used for enhanced removal of hydrocarbons, the level of discoloration of the sorbent material should also be identified during inspection. It is useful and often required as part of an operating permit to keep a record of each inspection. A simple form for doing so is provided.

Access to the CDS unit is typically achieved through two manhole access covers. One opening allows for inspection and cleanout of the separation chamber (cylinder and screen) and isolated sump. The other allows for inspection and cleanout of sediment captured and retained outside the screen. For deep units, a single manhole access point would allows both sump cleanout and access outside the screen.

The CDS system should be cleaned when the level of sediment has reached 75% of capacity in the isolated sump or when an appreciable level of hydrocarbons and trash has accumulated. If absorbent material is used, it should be replaced when significant discoloration has occurred. Performance will not be impacted until 100% of the sump capacity is exceeded however it is recommended that the system be cleaned prior to that for easier removal of sediment. The level of sediment is easily determined by measuring from finished grade down to the top of the sediment pile. To avoid underestimating the level of sediment in the chamber, the measuring device must be lowered to the top of the sediment pile carefully. Particles at the top of the pile typically offer less resistance to the end of the rod than consolidated particles toward the bottom of the pile. Once this measurement is recorded, it should be compared to the as-built drawing for the unit to determine weather the height of the sediment pile off the bottom of the sump floor exceeds 75% of the total height of isolated sump.

Cleaning

Cleaning of a CDS systems should be done during dry weather conditions when no flow is entering the system. The use of a vacuum truck is generally the most effective and convenient method of removing pollutants from the system. Simply remove the manhole covers and insert the vacuum hose into the sump. The system should be completely drained down and the sump fully evacuated of sediment. The area outside the screen should also be cleaned out if pollutant build-up exists in this area.

In installations where the risk of petroleum spills is small, liquid contaminants may not accumulate as quickly as sediment. However, the system should be cleaned out immediately in the event of an oil or gasoline spill should be cleaned out immediately. Motor oil and other hydrocarbons that accumulate on a more routine basis should be removed when an appreciable layer has been captured. To remove these pollutants, it may be preferable to use absorbent pads since they are usually less expensive to dispose than the oil/water emulsion that may be created by vacuuming the oily layer. Trash and debris can be netted out to separate it from the other pollutants. The screen should be power washed to ensure it is free of trash and debris.

Manhole covers should be securely seated following cleaning activities to prevent leakage of runoff into the system from above and also to ensure that proper safety precautions have been followed. Confined space entry procedures need to be followed if physical access is required. Disposal of all material removed from the CDS system should be done in accordance with local regulations. In many jurisdictions, disposal of the sediments may be handled in the same manner as the disposal of sediments removed from catch basins or deep sump manholes.

CDS Model	Diameter		Distance from Water Surface to Top of Sediment Pile		Sediment Storage Capacity	
	ft	m	ft	m	y^3	m^3
CDS1515	3	0.9	3.0	0.9	0.5	0.4
CDS2015	4	1.2	3.0	0.9	0.9	0.7
CDS2015	5	1.3	3.0	0.9	1.3	1.0
CDS2020	5	1.3	3.5	1.1	1.3	1.0
CDS2025	5	1.3	4.0	1.2	1.3	1.0
CDS3020	6	1.8	4.0	1.2	2.1	1.6
CDS3025	6	1.8	4.0	1.2	2.1	1.6
CDS3030	6	1.8	4.6	1.4	2.1	1.6
CDS3035	6	1.8	5.0	1.5	2.1	1.6
CDS4030	8	2.4	4.6	1.4	5.6	4.3
CDS4040	8	2.4	5.7	1.7	5.6	4.3
CDS4045	8	2.4	6.2	1.9	5.6	4.3
CDS5640	10	3.0	6.3	1.9	8.7	6.7
CDS5653	10	3.0	7.7	2.3	8.7	6.7
CDS5668	10	3.0	9.3	2.8	8.7	6.7
CDS5678	10	3.0	10.3	3.1	8.7	6.7

Table 1: CDS Maintenance Indicators and Sediment Storage Capacities

Support

- Drawings and specifications are available at www.contechstormwater.com.
- Site-specific design support is available from our engineers.

Contech Engineered Solutions LLC provides site solutions for the civil engineering industry. Contech's portfolio includes bridges, drainage, sanitary sewer, stormwater, earth stabilization and wastewater treament products. For information, visit www.ContechES.com or call 800.338.1122

CONTECH ENGINEERED SOLUTIONS
800.925.5240
www.ContechES.com

CDS Inspection & Maintenance Log

CDS Model: _____ Location: _____

Date	Water depth to sediment[1]	Floatable Layer Thickness[2]	Describe Maintenance Performed	Maintenance Personnel	Comments

1. The water depth to sediment is determined by taking two measurements with a stadia rod: one measurement from the manhole opening to the top of the sediment pile and the other from the manhole opening to the water surface. If the difference between these measurements is less than the values listed in table 1 the system should be cleaned out. **Note: to avoid underestimating the volume of sediment in the chamber, the measuring device must be carefully lowered to the top of the sediment pile.**

2. For optimum performance, the system should be cleaned out when the floating hydrocarbon layer accumulates to an appreciable thickness. In the event of an oil spill, the system should be cleaned immediately.