STORMWATER REPORT

THORNDIKE PLACE
DOROTHY ROAD
ARLINGTON, MA

NOVEMBER 2020
REVISED: AUGUST 2021
SEPTEMBER 2023
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Owner/Applicant:

ARLINGTON LAND REALTY LLC
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BSC Job Number: 23407.00

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SECTION 1.0

PROJECT INFORMATION

1.01 PROJECT DESCRIPTION

Arlington Land Realty, LLC (The Applicant) is seeking to construct a new age restricted multi-family housing development in Arlington, Massachusetts, hereinafter referred to as "the Project." The total property area is approximately 17.66 acres and is located off Dorothy Road near the intersection with Littlejohn Street. The project is bounded on the north by Dorothy Road, on the east by residential properties and Thorndike Field, and bounded on the south and west by Concord Turnpike (Route 2).

The Project consists of clearing and grubbing of the northwest section of the property and construction of one 4-story senior living residential building with a lower-level parking garage, six duplex townhouses with covered carports, as well as surface parking, walkways, utility services, and a stormwater management system. The buildings have a combined footprint of approximately 46,100 square feet.

The Project is designed to comply with the Massachusetts General Laws (M.G.L.) Chapter 40B, which allows developers to override certain aspects of municipal zoning bylaws by providing a certain percentage of affordable housing, as well as the Department of Environmental Protection's Stormwater Management Standards. There are wetland resource areas in the south, west and east portions of the property. The Project is concentrated in the northwest area of the property and minimizes impacts to the 100-foot wetland buffer zones. Part of the site is located within the 1% Chance Annual Flood as defined by FEMA which is regulated under the Wetlands Protection Act as Bordering Land Subject to Flooding (BLSF). Compensatory flood storage is proved at a 2:1 ratio as described in section 2.12 below. This Stormwater Report and design were extensively peer reviewed in November 2020 and August 2021 by BETA Group during the Comprehensive Permit Application process and again by both Hatch Associates Consultants, Inc. and GZA GeoEnvironmental, Inc. during the Conservation Commission's review of the Project's Notice of Intent.

1.02 PRE-DEVELOPMENT CONDITIONS

The existing site topography generally slopes southeast across the property towards the wetlands located on the property with slopes ranging from 0-15%. The current site is comprised of forest and the primary soil classification identified by the NRCS Web Soil Survey is udorthents (655), which accounts for the majority of the property and all of the project area. On November 25, 2020, BSC Group conducted three test pits on the site, the locations of which are noted on the Grading and Drainage plan, and the test pit logs attached in Appendix D. The test pits consisted primarily of fill material to a depth of 9-11 feet generally conforming with the soils mapping. Even though the material was fill, all samples textured as sandy loam in test pits TP-1 and TP-2, closest to the proposed stormwater management systems. At the bottom of test pit TP-3, a layer of clay material was found. Based on the fill materials found, runoff calculations have been performed using curve numbers corresponding to Hydrologic Soil Group (HSG) C.

Due to changes to the site design over the course of the Comprehensive Permit process, the proposed infiltration systems were relocated. As such, and to comply with Conditions C.2(k) and I.17 of the Comprehensive Permit that was issued by the Arlington Zoning Board of Appeals for the project in 2021, BSC conducted 8 additional soil test pits on May 18 and 19, 2023. The soil types for these test pits generally consisted of fill materials overlaying fine sandy loam, consistent with the previous test pits conducted in 2020. In accordance with the Comprehensive Permit conditions, BSC coordinated with the Town of Arlington to ensure that Town staff or a representative designated by the Town would be on site during test pit work to witness and confirm the results. BSC contacted Claire Ricker, Director of Planning & Community Development to coordinate a test pit witness for the Town and was referred through Town Engineer, Wayne Chouinard to David Morgan, Environmental Planner and Conservation Agent. Mr. Morgan arranged to have a representative from Whitestone Associates on site to witness the test pits on May 18 and 19, 2023. These test pit locations have been added to the revised Grading and Drainage plan and the additional test pit logs are included in Appendix D.

Five more test pits were conducted on April 17, 2024, to gather additional soil and groundwater data and confirm that the design of the infiltration system would meet the Stormwater Standards per the DEP's Massachusetts Stormwater Handbook. These test pits were consistent with the others that were conducted previously and consisted mainly of fill

that textured as sandy loam. One test pit, TP-9, found parent material 100-inches down, which was also a fine sandy loam. Additional test pit logs are included in Appendix D.

In November 2024, McPhail Associates, LLC (McPhail) performed two (2) soil borings on the Project site in the areas of proposed Infiltration Systems 1 and 7. These soil borings were performed to better understand the depth to a restrictive layer to more accurately determine the initial saturated thickness to be used in groundwater mounding analyses for the Project. A memorandum documenting this work is included in Appendix G. The borings showed a marine clay layer with a highest elevation between -12.1 and -17.4. Based on this additional data, all groundwater mounding analyses have been performed using an initial saturated thickness of 16-feet representing the depth between ESHGW (4.0) and the marine clay layer (-12.1).

The existing site being largely undeveloped has no existing drainage facilities and the majority of the stormwater runoff is directed to the wetlands on the property. A small portion of the site discharges to the north to Dorothy Road.

1.03 POST-DEVELOPMENT CONDITIONS

The proposed stormwater management system has been designed in a manner that will meet or exceed the provisions of the Department of Environmental Protection (DEP) Stormwater Management Standards for a new construction project.

Stormwater runoff from the site driveway and small parking/drop-off area at the main entrance to the building will be collected via a deep sump catch basin, conveyed through a water quality unit before being directed to an underground infiltration system. Stormwater runoff from a portion the driveway into the garage below the building will be collected via a trench drain and conveyed through a water quality unit before being directed to the underground system. Due to its elevation difference, this leg of the system has been provided with a backflow preventer device. This underground infiltration system provides for recharge to groundwater and provides peak flow rate attenuation. In larger storm events, this system will overflow through an outlet control structure to a flared end section with a rip-rap apron to the south.

Runoff from the townhouse and carport roofs, as well as the landscaped areas between the townhouses and 4-story building will be collected and routed to a second underground infiltration area. This underground infiltration area will also collect runoff from the roof of the 4-story building. This underground infiltration system provides for recharge to groundwater and provides peak flow rate attenuation. In larger storm events, this system will overflow through an outlet control structure to a flared end section with a rip-rap apron to the south.

Stormwater runoff from the townhouse driveways along Dorothy Rd will be collected via individual trench drains and routed to small underground infiltration chamber systems beneath each driveway. These systems provide localized infiltration to groundwater and help meet the required recharge volume for the Project. Overflow from these systems will be routed to the same infiltration system as the townhouse roofs and 4-story building.

Runoff from a small portion of the driveway to the garage will be collected in a trench drain and routed through a water quality unit for treatment prior to discharge through the flared end section with a rip-rap apron to the south.

Although all soils sampled in test pits TP-1 and TP-2, as well as the 8 test pits conducted in May 2023 and 5 conducted in April 2024, were identified as sandy loam (see above), the infiltration rate for silt loam (0.27-inches per hour) has been used in the infiltration system design to account for the materials found being primarily fill. Based upon the test pit data and groundwater monitoring performed in Spring 2024, the estimated seasonal high groundwater has been determined to be elevation 4.0. As such, to provide the minimum 2-feet of separation, the infiltration systems for the townhouse trench drains have been set with a bottom elevation of 7.0, the infiltration system collecting the majority of the driveways and parking areas has been set with a bottom elevation of 7.15, and the infiltration system collecting roofs and overflow from the townhouse trench drains has been set with a bottom elevation of 8.0. Groundwater mounding calculations for the 100-year event have been provided for all infiltration systems with less than 4.0-feet of separation to estimated seasonal high groundwater.

To provide emergency access to the sides and rear of the building, a reinforced grass access lane will be installed. A portion of this access lane will include a 6-foot wide, porous asphalt walkway to allow residents to have ADA/AAB accessible access the rear of the site. Both the reinforced grass and porous asphalt will allow stormwater runoff to freely infiltrate back to the ground and will result in negligible runoff.

Specifics of the project's compliance with the Stormwater Standards are discussed in detail in the following sections.

SECTION 2.0

DRAINAGE SUMMARY

2.01 Stormwater Standard 1 – New Stormwater Conveyances

Per Massachusetts Stormwater Management Standard #1, no new outfalls may discharge untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth. No new untreated stormwater discharges are proposed. Rip-rap outlet protection sizing calculations are included in Section 6.0 of this Report.

2.02 Stormwater Standard 2 – Stormwater Runoff Rates

Watershed modeling was performed using HydroCAD Stormwater Modeling Software version 10.20, a computer aided design program that combines SCS runoff methodology with standard hydraulic calculations. A model of the site's hydrology was developed for both pre- and post-development conditions to assess the effects of the proposed development on the project site and surrounding areas.

Stormwater runoff was modeled using data from the NOAA 14++ rainfall atlas. The NOAA 14++ precipitation values are higher than the TP-40 rainfall values that are required by Wetlands Protection Act (WPA) and consistent with the requirements of the updated Arlington Wetland Bylaw. The following rainfall values have been used in the analysis and the NOAA 14++ data is included in Appendix D:

Storm Frequency	**NOAA 14++ Rainfall (Inches)**
2-year	4.02
10-year	6.40
25-year	8.30
50-year	9.67
100-year	11.50

The stormwater management system for the project has been designed such that the post-development conditions result in no increase to peak runoff rates off the property for the 2, 10, 25, 50, and 100-year, 24-hour storm events, as detailed in the table below.

Peak Flow Discharge Rates

Node 1L – Flow to Wetlands

Storm Event	**Pre-Development Peak Discharge Rate (cfs)**	**Post-Development Peak Discharge Rate (cfs)**	**Change in Peak Discharge Rate (cfs)**
2-Year	3.7	3.6	-0.1
10-Year	9.0	9.0	0.0
25-Year	13.7	13.7	0.0
50-Year	17.2	17.0	-0.2
100-Year	22.0	21.4	-0.6

Node 2L – Flow Towards Street

Storm Event	Pre-Development Peak Discharge Rate (cfs)	Post-Development Peak Discharge Rate (cfs)	Change in Peak Discharge Rate (cfs)
2-Year	0.3	0.3	0.0
10-Year	0.7	0.6	-0.1
25-Year	1.0	0.9	-0.1
50-Year	1.2	1.1	-0.1
100-Year	1.5	1.3	-0.2

Node 100L – Total Flows

Storm Event	Pre-Development Peak Discharge Rate (cfs)	Post-Development Peak Discharge Rate (cfs)	Change in Peak Discharge Rate (cfs)
2-Year	3.8	3.8	0.0
10-Year	9.4	9.4	0.0
25-Year	14.2	14.2	0.0
50-Year	17.9	17.8	-0.1
100-Year	22.7	22.3	-0.4

2.03 Stormwater Standard 3 – Groundwater Recharge

Groundwater recharge is provided on site via multiple underground structural infiltration systems beneath the surface parking area to the north of the building and smaller systems beneath each individual driveway of the duplex townhouses. Overall, the project will result in no loss of annual recharge to groundwater as required by Standard 3. Refer to Section 6.0 of this Report for groundwater recharge information.

As the townhouse driveway infiltration systems and the infiltration system collecting the majority of the driveway have more than 2-feet but less than 4-feet separation to estimated seasonal high groundwater, a mounding analysis has been performed in accordance with the Hantush Method for each to ensure that a groundwater mound does not extend into the bottom of the infiltration system preventing infiltration of the required recharge volume. This analysis has been performed utilizing the infiltration volume that occurs during the 100-year storm event and is included in Section 6.0 of this Report. As the system that collects the 4-story building roof has 4-feet of separation to groundwater, a mounding analysis is not required for this system.

2.04 Stormwater Standard 4 – TSS Removal

As a new development, the Project stormwater management system will achieve a TSS removal greater than 80%. The proposed stormwater management system has been designed to provide treatment of runoff in order to reduce suspended solids prior to discharge off-site through the implementation of the following best management practices:

- Deep Sump Hooded Catch Basins
- Proprietary Hydrodynamic Separators

- Underground Stormwater Infiltration Systems
- Rain Garden

The water quality volume is defined as the runoff volume requiring TSS Removal for the site and is equal to 0.5-inches of runoff over the total impervious area of the post-development site. The required water quality volume for the project is provided in Section 6.0 of this Report.

The underground infiltration systems have been sized to treat the required water quality volume and calculations are included in Section 6.0 of this Report.

A long-term pollution prevention plan complying with the requirements of Standard 4 is included in Section 4.0 of this Report.

2.05 Stormwater Standard 5 – Land Uses with Higher Potential Pollutant Loads

This standard is not applicable as the proposed project is not a land use with higher potential pollutant loads (LUHPPL).

2.06 Stormwater Standard 6 – Stormwater Discharges to a Critical Area

This standard is not applicable as runoff from the project site does not discharge to a critical area.

2.07 Stormwater Standard 7 – Redevelopment Projects

This project is a new development and therefore has been designed to fully comply with the Stormwater Management Standards.

2.08 Stormwater Standard 8 – Sedimentation and Erosion Control Plan

Erosion and sedimentation controls are shown on the Project Plans. Additionally, a Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan is included in Section 3.0 of this Report.

2.09 Stormwater Standard 9 – Long Term Operation and Maintenance Plan

A Long-Term Operation and Maintenance Plan is included in Section 4.0 of this Report.

2.10 Stormwater Standard 10 – Illicit Discharges

There are no known illicit discharges on the project site, and none are proposed. An illicit discharge compliance statement is included in Section 6.0 and will be signed by the Applicant prior to issuance of any permits.

2.11 Conclusion

The project has been designed in accordance with DEP Stormwater Management Standards. Through the construction of the aforementioned stormwater systems, the project will provide peak rate attenuation, TSS removal and groundwater recharge.

2.12 Compensatory Flood Storage

A portion of the project site is located within the 1% Chance Annual Flood as defined by FEMA, which is regulated under the Wetlands Protection Act as Bordering Land Subject to Flooding (BLSF). In order to protect the values provided by BLSF and prevent downstream flooding impacts, the project is required to provide compensatory flood storage on a 1-foot incremental basis to match whatever is lost due to the project's development. In order to provide this compensatory flood storage, the project will minimize the area of BLSF impacted and regrade a portion of the project property southeast of the proposed building as shown on the Plans. This regraded area will provide compensatory flood storage at a 2 to 1 ratio for any flood storage lost. A breakdown of the flood storage impacts and compensatory storage provided is shown below:

Elevations	Existing Incremental Available Flood Storage (CU.FT.)	Incremental Available Flood Storage with No Compensatory Storage (CU.FT.)	Incremental Flood Storage Change w/No Compensatory Storage (CU.FT.)	Proposed Incremental Compensatory Storage (CU.FT.)	Ratio of Compensatory Storage to Storage Lost
5.0 - 6.0	**136.0**	**67.5**	**-68.5**	**146.0**	**2.1**
6.0 - 6.8	**9,327.6**	**5,003.2**	**-4,324.4**	**9,014.8**	**2.1**

As shown above, the project will exceed the 2 to 1 ratio of compensatory flood storage for all flood storage lost due to the project development. In addition, as shown on the Plans, the proposed compensatory storage is hydrologically connected to the flood plain impacted by the project. Therefore, the project as proposed meets the applicable requirements for BLSF in the Wetlands Protection Act.

SECTION 3.0

CONSTRUCTION PERIOD POLLUTION PREVENTION AND EROSION AND SEDIMENTATION CONTROL PLAN

3.0 CONSTRUCTION PERIOD POLLUTION PREVENTION AND EROSION AND SEDIMENTATION CONTROL PLAN

This Section specifies requirements and suggestions for implementation of a Stormwater Pollution Prevention Plan (SWPPP) for **Thorndike Place, in Arlington, Massachusetts**. The SWPPP shall be provided and maintained on-site by the Contractor(s) during all construction activities. The SWPPP shall be updated as required to reflect changes to construction activity.

The stormwater pollution prevention measures contained in the SWPPP shall be at least the minimum required by Local Regulations. The Contractor shall provide additional measures to prevent pollution from stormwater discharges in compliance with the National Pollution Discharge Elimination System (NPDES) Phase II permit requirements and all other local, state and federal requirements.

The SWPPP shall include provisions for, but not be limited to, the following:

1. Construction Trailers
2. Lay-down Areas
3. Equipment Storage Areas
4. Stockpile Areas
5. Disturbed Areas

The Contractor shall NOT begin construction without submitting evidence that a NPDES Notice of Intent (NOI) governing the discharge of stormwater from the construction site for the entire construction period has been filed **at least fourteen (14) days prior to construction**. It is the Contractor's responsibility to complete and file the NOI, unless otherwise determined by the project team.

The cost of any fines, construction delays and remedial actions resulting from the Contractor's failure to comply with all provisions of local regulations and Federal NPDES permit requirements shall be paid for by the Contractor at no additional cost to the Owner.

As a requirement of the EPA's NPDES permitting program, each Contractor and Subcontractor responsible for implementing and maintaining stormwater Best Management Practices shall execute a Contractor's Certification form.

Erosion and Sedimentation Control

The Contractor shall be solely responsible for erosion and sedimentation control at the site. The Contractor shall utilize a system of operations and all necessary erosion and sedimentation control measures, even if not specified herein or elsewhere, to minimize erosion damage at the site to prevent the migration of sediment into environmentally sensitive areas. Environmentally sensitive areas include all wetland resource areas within, and downstream of, the site, and those areas of the site that are not being altered.

Erosion and sedimentation control shall be in accordance with this Section, the design drawings, and the following:

- "National Pollutant Discharge Elimination System General Permit for Discharges from Construction Activities (EPA Construction General Permit February 16, 2022).
- Massachusetts Stormwater Management Policy Handbook issued by the Massachusetts Department of Environmental Protection, January 2008.
- Massachusetts Erosion and Sediment Control Guidelines for Urban and Suburban Areas, A Guide for Planners, Designers and Municipal Officials, March 1997.

The BMP's presented herein should be used as a guide for erosion and sedimentation control and are not intended to be considered specifications for construction. The most important BMP is maintaining a rapid

construction process, resulting in prompt stabilization of surfaces, thereby reducing erosion potential. Given the primacy of rapid construction, these guidelines have been designed to allow construction to progress with essentially no hindrance by the erosion control methods prescribed. These guidelines have also been designed with sufficient flexibility to allow the Contractor to modify the suggested methods as required to suit seasonal, atmospheric, and site-specific physical constraints.

Another important BMP is the prevention of concentrated water flow. Sheet flow does not have the erosive potential of a concentrated rivulet. These guidelines recommend construction methods that allow localized erosion control and a system of construction, which inhibits the development of shallow concentrated flow. These BMP's shall be maintained throughout the construction process.

CONTACT INFORMATION AND RESPONSIBLE PARTIES

The following is a list of all project-associated parties:

Owner
Arlington Land Realty, LLC
c/o Mugar Enterprises, Inc.
116 Huntington Avenue
Boston, MA 02116

Contractor
To be determined

Environmental Consultant
BSC Group, Inc.
803 Summer Street
Boston, MA 02127

Contact: Dominic Rinaldi, P.E.
Phone: (617) 896–4300
Email: drinaldi@bscgroup.com

Qualified SWPPP Inspectors
To Be Determined

3.1 Procedural Conditions of the Construction General Permit (CGP)

The following list outlines the Stormwater Responsibilities for all construction operators working on the Project. The operators below agree through a cooperative agreement to abide by the following conditions throughout the duration of the construction project, effective the date of signature of the required SWPPP. These conditions apply to all operators on the project site.

The project is subject to EPA's NPDES General Permit through the CGP. The goal of this permit is to prevent the discharge of pollutants associated with construction activity from entering the existing and proposed storm drain system or surface waters.

All contractors/operators involved in clearing, grading and excavation construction activities must sign the appropriate certification statement required, which will remain with the SWPPP. The owner must also sign

a certification, which is to remain with the SWPPP in accordance with the signatory requirements of the SWPPP.

Once the SWPPP is finalized, a signed copy, plus supporting documents, must be held at the project site during construction. A copy must remain available to EPA, State and Local agencies, and other interested parties during normal business hours.

The following items associated with this SWPPP must be posted in a prominent place at the construction site until final stabilization has been achieved:

- The completed/submitted NOI form
- Location where the public can view the SWPPP during normal business hours
- A copy of the signed/submitted NOI, permit number issued by the EPA and a copy of the current CGP.

Project specific SWPPP documents are not submitted to the US EPA unless the agency specifically requests a copy for review. SWPPP documents requested by a permitting authority, the permitee(s) will submit it in a timely manner.

EPA inspectors will be allowed free and unrestricted access to the project site and all related documentation and records kept under the conditions of the permit.

The permitee is expected to keep all BMP's and Stormwater controls operating correctly and maintained regularly.

Any additions to the project which will significantly change the anticipated discharges of pollutants, must be reported to the EPA. The EPA should also be notified in advance of any anticipated events of noncompliance. The permitee must also orally inform the EPA of any discharge, which may endanger health or the environment within 24 hours, with a written report following within 5 days.

In maintaining the SWPPP, all records and supporting documents will be compiled together in an orderly fashion. Inspection reports and amendments to the SWPPP must remain with the document. Federal regulations require permitee(s) to keep their Project Specific SWPPP and all reports and documents for at least three (3) years after the project is complete.

3.2 Existing Site and Soil Conditions

The total project area is approximately 17.66 acres and is located off Dorothy Road. The project is bounded on the north by Dorothy Road, bounded on the east by residential properties, and bounded on the south and west by Concord Turnpike (Route 2).

The current site is comprised of forest and the primary soil classification identified by the NRCS Web Soil Survey is udorthents (655), which accounts for the majority of the property and all of the project area. On November 25, 2020, BSC Group conducted three test pits on the site, the locations of which are noted on the Grading and Drainage plan, and the test pit logs are attached in Appendix D. The test pits consisted of primarily fill material to a depth of 9-11 feet generally conforming with the soils mapping. Even though the material was fill, all samples textured as sandy loam in test pits TP-1 and TP-2, closest to the proposed stormwater management systems. At the bottom of test pit TP-3, a layer of clay material was found. On May 18 and 19, 2023, BSC Group conducted 8 additional test pits on site, and on April 17, 2024, BSC Group conducted another 5 test pits on site to determine soil conditions at the locations of each of the infiltration systems in the revised drainage design. These test pits were consistent with the 2020 test pits and generally consisted of fill material over fine sandy loam. These test pits have been added to the Grading and Drainage plan and test pit logs are attached in Appendix D as well. Based on the fill materials found,

runoff calculations have been performed using curve numbers corresponding to Hydrologic Soil Group (HSG) C.

3.3 Project Description and Intended Construction Sequence

The site is currently comprised of woods. The proposed activities will include the following major components:

- The construction of one (1) multi-family housing building and six (6) duplex townhouses with associated parking, driveways, walkways, and retaining walls,
- The construction of stormwater management systems,
- Site grading and compensatory flood storage creation, and
- Utility connections and installation.

The proposed project will disturb a total of approximately 175,000± S.F. (4.02± acres).

Soil disturbing activities will include site demolition, installing stabilized construction exits, installation of erosion and sedimentation controls, grading, storm drain inlets, stormwater management systems, utilities, building foundation, construction of site driveways and preparation for final landscaping. Please refer to Table 1 for the projects anticipated construction timetable. A description of BMP's associated with project timetable and construction-phasing elements is provided in this Erosion and Sediment Control Plan.

Table 1 – Anticipated Construction Timetable

Construction Phasing Activity	Anticipated Timetable
Grubbing and Stripping of Limits of Construction Phase	To be determined
Rough Site Grading and Site Utilities	To be determined
Utility Plan Construction	To be determined
Landscaping	To be determined

3.4 Potential Sources of Pollution

Any project site activities that have the potential to add pollutants to runoff are subject to the requirements of the SWPPP. Listed below are a description of potential sources of pollution from both sedimentation to Stormwater runoff, and pollutants from sources other than sedimentation.

Table 2 – Potential Sources of Sediment to Stormwater Runoff

Potential Source	Activities/Comments
Construction Site Entrance and Site Vehicles	Vehicles leaving the site can track soils onto public roadways. Site Vehicles can readily transport exposed soils throughout the site and off-site areas.
Grading Operations	Exposed soils have the potential for erosion and discharge of sediment to off-site areas.
Material Excavation, Relocation, and Stockpiling	Stockpiling of materials during excavation and relocation of soils can contribute to erosion and sedimentation. In addition, fugitive dust from stockpiled material, vehicle transport and site grading can be deposited in wetlands and waterway.
Landscaping Operations	Landscaping operations specifically associated with exposed soils can contribute to erosion and sedimentation. Hydroseeding, if not properly applied, can runoff to adjacent wetlands and waterways.

Table 3 – Potential Pollutants and Sources, other than Sediment to Stormwater Runoff

Potential Source	Activities/Comments
Staging Areas and Construction Vehicles	Vehicle refueling, minor equipment maintenance, sanitary facilities and hazardous waste storage
Materials Storage Area	General building materials, solvents, adhesives, paving materials, paints, aggregates, trash, etc.
Construction Activities	Construction, paving, curb/gutter installation, concrete pouring/mortar/stucco

3.5 Erosion and Sedimentation Control Best Management Practices

All construction activities will implement Best Management Practices (BMP's) in order to minimize overall site disturbance and impacts to the sites natural features. Please refer to the following sections for a detailed description of site specific BMP's. In addition, an Erosion and Sedimentation Control Plan is provided in the Site Plans.

3.6 Timetable and Construction Phasing

This section provides the Owner and Contractor with a suggested order of construction that shall minimize erosion and the transport of sediments. The individual objectives of the construction techniques described herein shall be considered an integral component of the project design intent of each project phase. The construction sequence is not intended to prescribe definitive construction methods and should not be interpreted as a construction specification document. However, the Contractor shall follow the general construction phase principles provided below:

- Protect and maintain existing vegetation wherever possible.
- Minimize the area of disturbance.
- To the extent possible, route unpolluted flows around disturbed areas.
- Install mitigation devices as early as possible.
- Minimize the time disturbed areas are left unstabilized.
- Maintain siltation control devices in proper condition.
- The contractor should use the suggested sequence and techniques as a general guide and modify the suggested methods and procedures as required to best suit seasonal, atmospheric, and site specific physical constraints for the purpose of minimizing the environmental impact of construction.

Demolition, Grubbing and Stripping of Limits of Construction Phase

- Install Temporary Erosion Control (TEC) devices as required to prevent sediment transport into resource areas.
- Place a ring of silt socks and/or haybales around stockpiles.
- Stabilize all exposed surfaces that will not be under immediate construction.
- Store and/or dispose all pavement and building demolition debris as indicated in accordance with all applicable local, state, and federal regulations.

Driveway Area Sub-Base Construction

- Install temporary culverts and diversion ditches and additional TEC devices as required by individual construction area constraints to direct potential runoff toward detention areas designated for the current construction phase.
- Compact gravel as work progresses to control erosion potential.

- Apply water to control air suspension of dust.
- Avoid creating an erosive condition due to over-watering.
- Install piped utility systems as required as work progresses, keeping all inlets sealed until all downstream drainage system components are functional.

Binder Construction

- Fine grade gravel base and install processed gravel to the design grades.
- Compact pavement base as work progresses.
- Install pavement binder coat starting from the downhill end of the site and work toward the top.

Finish Paving

- Repair and stabilize damaged side slopes.
- Clean inverts of drainage structures.
- Install final top coat of pavement.

Final Clean-up

- Clean inverts of culverts and catch basins.
- Remove sediment and debris from rip-rap outlet areas.
- Remove TEC devices only after permanent vegetation and erosion control has been fully established.

3.7 Site Stabilization

Grubbing Stripping and Grading

- Erosion control devices shall be in place as shown on the design plans before grading commences.
- Stripping shall be done in a manner, which will not concentrate runoff. If precipitation is expected, earthen berms shall be constructed around the area being stripped, with a silt sock, silt fence or haybale dike situated in an arc at the low point of the berm.
- If intense precipitation is anticipated, silt socks, haybales, dikes and /or silt fences shall be used as required to prevent erosion and sediment transport. The materials required shall be stored on site at all time.
- If water is required for soil compaction, it shall be added in a uniform manner that does not allow excess water to flow off the area being compacted.
- Dust shall be held at a minimum by sprinkling exposed soil with an appropriate amount of water.

Maintenance of Disturbed Surfaces

- Runoff shall be diverted from disturbed side slopes in both cut and fill.
- Mulching may be used for temporary stabilization.
- Silt sock, haybale or silt fences shall be set where required to trap products of erosion and shall be maintained on a continuing basis during the construction process.

Loaming and Seeding

- Loam shall not be placed unless it is to be seeded directly thereafter.
- All disturbed areas shall have a minimum of 4” of loam placed before seeded and mulched.
- Consideration shall be given to hydro-mulching, especially on slopes in excess of 3 to 1.
- Loamed and seeded slopes shall be protected from washout by mulching or other acceptable slope protection until vegetation begins to grow.

Stormwater Collection System Installation

- The Stormwater drainage system shall be installed from the downstream end up and in a manner which will not allow runoff from disturbed areas to enter pipes.
- Excavation for the drainage system shall not be left open when rainfall is expected overnight. If left open under other circumstances, pipe ends shall be closed by a staked board or by an equivalent method.
- All catch basin openings shall be covered by a silt bag between the grate and the frame or protected from sediment by silt fence surrounding the catch basin grate.
- During the installation of the infiltration systems, ensure that loose material from the construction of the town home roof shingles is swept and removed from the area prior to connecting the roof drains to the infiltration systems. No roof drains shall be connected to the infiltration systems until all tributary roof areas have been thoroughly cleared of debris that could impact the infiltration system functions.

Completion of Paved Areas

- During the placement of sub-base and pavement, the entrance to the Stormwater drainage systems shall be sealed when rain is expected. When these entrances are closed, consideration must be given to the direction of run-off and measures shall be undertaken to minimize erosion and to provide for the collection of sediment.
- In some situations, it may be necessary to keep catch basins open.
- Appropriate arrangements shall be made downstream to remove all sediment deposition.

Stabilization of Surfaces

- Stabilization of surfaces includes the placement of pavement, rip-rap, wood bark mulch and the establishment of vegetated surfaces.
- Upon completion of construction, all surfaces shall be stabilized even though it is apparent that future construction efforts will cause their disturbance.
- Vegetated cover shall be established during the proper growing season and shall be enhanced by soil adjustment for proper pH, nutrients and moisture content.
- Surfaces that are disturbed by erosion processes or vandalism shall be stabilized as soon as possible.
- Areas where construction activities have permanently or temporarily ceased shall be stabilized within 14 days from the last construction activity, except when construction activity will resume within 21 days (e.g., the total time period that construction activity is temporarily ceased is less than 21 days).
- Hydro-mulching of grass surfaces is recommended, especially if seeding of the surfaces is required outside the normal growing season.
- Hay mulch is an effective method of temporarily stabilizing surfaces, but only if it is properly secured by branches, weighted snow fences or weighted chicken wire.

3.8 Temporary Structural Erosion Control Measures

Temporary erosion control measures serve to minimize construction-associated impacts to wetland resource and undisturbed areas. Please refer to the following sections for a description of temporary erosion control measures implemented as part of the project and this sample SWPPP.

3.8.1 Silt Socks, Haybales, and Silt Fencing

The siltation barriers will demarcate the limit of work, form a work envelope and provide additional assurance that construction equipment will not enter the adjacent wetlands or undisturbed portions of the site. All barriers will remain in place until disturbed areas are stabilized.

3.8.2 Temporary Stormwater Diversion Swale

A temporary diversion swale is an effective practice for temporarily diverting stormwater flows and to reduce stormwater runoff velocities during storm events. The swale channel can be installed before infrastructure construction begins at the site, or as needed throughout the construction process. The diversion swale should be routinely compacted or seeded to minimize the amount of exposed soil.

3.8.3 Dewatering Basins

Dewatering may be required during stormwater system, foundation construction and utility installation. Should the need for dewatering arise, groundwater will be pumped directly into a temporary settling basin, which will act as a sediment trap during construction. All temporary settling basins will be located within close proximity of daily work activities. Prior to discharge, all groundwater will be treated by means of the settling basin or acceptable substitute. Discharges from sediment basins will be free of visible floating, suspended and settleable solids that would impair the functions of a wetland or degrade the chemical composition of the wetland resource area receiving ground or surface water flows and will be to the combined system.

3.8.4 Material Stockpiling Locations

Piping and trench excavate associated with the subsurface utility work will be contained with a single row of silt socks and/or haybales.

3.9 Permanent Structural Erosion Control Measures

Permanent erosion control measures serve to minimize post-construction impacts to wetland resource areas and undisturbed areas. Please refer to the Site Plans and Long-Term Operations and Maintenance Plan for a description of permanent erosion control measures implemented as part of the project and this SWPPP.

3.10 Good Housekeeping Best Management Practices

3.10.1 Street Sweeping

Dorothy Road in front of the project property shall be swept clean on a daily basis at the conclusion of the work day of any soils tracked onto it from the project site. All sweepings shall be disposed of off-site in accordance with all applicable laws and regulations.

3.10.2 Material Handling and Waste Management

Solid waste generation during the construction period will be primarily construction debris. The debris will include scrap lumber (used forming and shoring pallets and other shipping containers), waste packaging materials (plastic sheeting and cardboard), scrap cable and wire, roll-off containers (or dumpsters) and will be removed by a contract hauler to a properly licensed landfill. The roll-off containers will be covered with a properly secured tarp before the hauler exits the site. In addition to construction debris, the construction work force will generate some amount of household-type wastes (food packing, soft drink containers, and other paper). Trash containers for these wastes will be located around the site and will be emptied regularly so as to prevent wind-blown litter. This waste will also be removed by a contract hauler.

All hazardous waste material such as oil filters, petroleum products, paint and equipment maintenance fluids will be stored in structurally sound and sealed shipping containers in the hazardous-materials storage area and segregated from other non-waste materials. Secondary containment will be provided for all

materials in the hazardous materials storage area and will consist of commercially available spill pallets. Additionally, all hazardous materials will be disposed of in accordance with federal, state and municipal regulations.

Two temporary sanitary facilities (portable toilets) will be provided at the site in the combined staging area. The toilets will be away from a concentrated flow path and traffic flow and will have collection pans underneath as secondary treatment. All sanitary waste will be collected from an approved party at a minimum of three times per week.

3.10.3 Building Material Staging Areas

Construction equipment and maintenance materials will be stored at the combined staging area and materials storage areas. Silt fence will be installed around the perimeter to designate the staging and materials storage area. A watertight shipping container will be used to store hand tools, small parts and other construction materials.

Non-hazardous building materials such as packaging material (wood, plastic and glass) and construction scrap material (brick, wood, steel, metal scraps, and pine cuttings) will be stored in a separate covered storage facility adjacent to other stored materials. All hazardous-waste materials such as oil filters, petroleum products, paint and equipment maintenance fluids will be stored in structurally sound and sealed containers under cover within the hazardous materials storage area.

Large items such as framing materials and stockpiled lumber will be stored in the open storage area. Such materials will be elevated on wood blocks to minimize contact with runoff.

The combined storage areas are expected to remain clean, well-organized and equipped with ample cleaning supplies as appropriate for the materials being stored. Perimeter controls such as containment structures, covers and liners will be repaired or replaced as necessary to maintain proper function.

3.10.4 Designated Washout Areas

Designated temporary, below-ground concrete washout areas will be constructed, as required, to minimize the pollution potential associated with concrete, paint, stucco, mixers etc. Signs will, if required, be posted marking the location of the washout area to ensure that concrete equipment operators use the proper facility. Concrete pours will not be conducted during or before an anticipated precipitation event. All excess concrete and concrete washout slurries from the concrete mixer trucks and chutes will be discharged to the washout area or hauled off-site for disposal.

3.10.5 Equipment/Vehicle Maintenance and Fueling Areas

Several types of vehicles and equipment will be used on-site throughout the project including graders, scrapers, excavators, loaders, paving equipment, rollers, trucks and trailers, backhoes and forklifts. All major equipment/vehicle fueling and maintenance will be performed off-site. A small, 20-gallon pickup bed fuel tank will be kept on-site in the combined staging area. When vehicle fueling must occur on-site, the fueling activity will occur in the staging area. Only minor equipment maintenance will occur on-site. Vehicular refueling or maintenance shall not be allowed within the Adjacent Upland Resource Area (AURA) or in any protected wetland resource areas as defined by the Town of Arlington Regulations for Wetland Protection. All equipment fluids generated from maintenance activities will be disposed of into designated drums stored on spill pallets. Absorbent, spill-cleanup materials and spill kits will be available at the combined staging and materials storage area. Drip pans will be placed under all equipment receiving maintenance and vehicles and equipment parked overnight.

3.10.6 Equipment/Vehicle Wash down Area

All equipment and vehicle washing will be performed off-site.

3.10.7 Spill Prevention Plan

A spill containment kit will be kept on-site in the Contractor's trailer and/or the designated staging area throughout the duration of construction. Should there be an accidental release of petroleum product into a resource area, the appropriate agencies will be immediately notified.

3.10.8 Inspections

Maintenance of existing and proposed BMP's to address stormwater management facilities during construction is an on-going process. The purpose of the inspections is to observe all sources of stormwater or non-stormwater discharge as identified in the SWPPP as well as the status of the receiving waters and fulfill the requirements of the Order of Conditions. The following sections describe the appropriate inspection measures to adequately implement the project's SWPPP. A blank inspection form is provided at the end of this section. Completed inspection forms are to be maintained on site.

Inspection Personnel

The owner's appointed representative will be responsible for performing regular inspections of erosion controls and ordering repairs as necessary.

Inspection Frequency

Inspections will be performed by qualified personnel once every 7 days, in accordance with the CGP. The inspections must be documented on the inspection form provided at the end of this section, and completed forms will be provided to the on-site supervisor and maintained at the Owner's office throughout the entire duration of construction.

Inspection Reporting

Each inspection report will summarize the scope of the inspection, name(s) and qualifications of personnel making the inspection, and major observations relating to the implementation of the SWPPP, including compliance and non-compliance items. Completed inspection reports will remain with the completed SWPPP on site.

3.10.9 Amendment Requirements

The final SWPPP is intended to be a working document that is utilized regularly on the construction site, and provides guidance to the Contractor. It must reflect changes made to the originally proposed plan and will be updated to include project specific activities and ensure that they are in compliance with the NPDES General Permit and state and local laws and regulations. It should be amended whenever there is a change in design, construction, operation or maintenance that affects discharge of pollutants. The following items should be addressed should an amendment to the SWPPP occur:

- Dates of certain construction activities such as major grading activities, clearing and initiation of and completion of stabilization measures should be recorded.
- Future amendments to the SWPPP will be recorded as required. As this SWPPP is amended, all amendments will be kept on site and made part of the SWPPP.
- Upon completion of site stabilization (completed as designed and/or 70% background vegetative cover), it can be documented and marked on the plans. Inspections are no longer required at this time.
- Inspections often identify areas not included in the original SWPPP, which will require the SWPPP to be amended. These updates should be made within seven days of being recognized by the inspector.

3.11 SWPPP Inspection and Maintenance Report

The following form is an example to be used for SWPPP Inspection Reporting.

Stormwater Construction Site Inspection and Maintenance Report

TO BE COMPLETED AT LEAST EVERY 7 DAYS. AFTER SITE STABILIZATION, TO BE COMPLETED AT LEAST ONCE PER MONTH FOR THREE YEARS OR UNTIL A NOTICE OF TERMINATION IS FILED (IF APPLICABLE).

General Information			
Project Name	Thorndike Place		
NPDES Tracking No. (if applicable)		**Location**	Dorothy Road Arlington, MA
Date of Inspection		**Start/End Time**	
Inspector's Name(s)			
Inspector's Title(s)			
Inspector's Contact Information			
Inspector's Qualifications			
Describe present phase of construction			
Type of Inspection: ❑ Regular ❑ Pre-storm event ❑ During storm event ❑ Post-storm event			
Weather Information			
Has there been a storm event since the last inspection? ❑Yes ❑No **If yes, provide:** Storm Start Date & Time: Storm Duration (hrs): Approximate Amount of Precipitation (in):			
Weather at time of this inspection? ❑ Clear ❑Cloudy ❑ Rain ❑ Sleet ❑ Fog ❑ Snowing ❑ High Winds ❑ Other: Temperature:			
Have any discharges occurred since the last inspection? ❑Yes ❑No **If yes, describe:**			
Are there any discharges at the time of inspection? ❑Yes ❑No **If yes, describe:**			

Site-specific BMPs

- *Number the structural and non-structural BMPs identified in your SWPPP on your site map and list them below (add as many BMPs as necessary). Carry a copy of the numbered site map with you during your inspections. This list will ensure that you are inspecting all required BMPs at your site.*
- *Describe corrective actions initiated, date completed, and note the person that completed the work in the Corrective Action Log.*

	BMP	**BMP Installed?**	**BMP Maintenance Required?**	**Corrective Action Needed and Notes Action required by whom and when**
1	Catch Basin Protection	❑Yes ❑No	❑Yes ❑No	

	BMP	BMP Installed?	BMP Maintenance Required?	Corrective Action Needed and Notes Action required by whom and when
2	Haybale & Silt Fencing	❑Yes ❑No	❑Yes ❑No	
3	Straw Wattles	❑Yes ❑No	❑Yes ❑No	
4	Construction Entrance	❑Yes ❑No	❑Yes ❑No	
5	Sediment Basins	❑Yes ❑No	❑Yes ❑No	
6	Dewatering Pit	❑Yes ❑No	❑Yes ❑No	
7		❑Yes ❑No	❑Yes ❑No	

Overall Site Issues

Below are some general site issues that should be assessed during inspections. Customize this list as needed for conditions at your site.

	BMP/activity	Implemented?	Maintenance Required?	Corrective Action Needed and Notes Action required by whom and when
1	Are all slopes and disturbed areas not actively being worked properly stabilized?	❑Yes ❑No	❑Yes ❑No	
2	Are natural resource areas (e.g., streams, wetlands, mature trees, etc.) protected with barriers or similar BMPs?	❑Yes ❑No	❑Yes ❑No	
3	Are perimeter controls and sediment barriers adequately installed	❑Yes ❑No	❑Yes ❑No	

	BMP/activity	Implemented?	Maintenance Required?	Corrective Action Needed and Notes Action required by whom and when
	(keyed into substrate) and maintained?			
4	Are discharge points and receiving waters free of any sediment deposits?	❑Yes ❑No	❑Yes ❑No	
5	Are storm drain inlets properly protected?	❑Yes ❑No	❑Yes ❑No	
6	Is the construction exit preventing sediment from being tracked into the street?	❑Yes ❑No	❑Yes ❑No	
7	Is trash/litter from work areas collected and placed in covered dumpsters?	❑Yes ❑No	❑Yes ❑No	
8	Are washout facilities (e.g., paint, stucco, concrete) available, clearly marked, and maintained?	❑Yes ❑No	❑Yes ❑No	
9	Are vehicle and equipment fueling, cleaning, and maintenance areas free of spills, leaks, or any other deleterious material?	❑Yes ❑No	❑Yes ❑No	Vehicle Maintenance not allowed on site
10	Are materials that are potential stormwater contaminants stored inside or under cover?	❑Yes ❑No	❑Yes ❑No	
11	Are non-stormwater discharges (e.g., wash water, dewatering) properly controlled?	❑Yes ❑No	❑Yes ❑No	
12	(Other)	❑Yes ❑No	❑Yes ❑No	

Non-Compliance

Describe any incidents of non-compliance not described above:

CERTIFICATION STATEMENT

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

Print name and title: _____
(Qualified Person Performing the Inspection)

Signature:_____ **Date:** _____

Print name and title: _____
(Contractor/Operator)

Signature:_____ **Date:**_____

SECTION 4.0

LONG-TERM POLLUTION PREVENTION & OPERATION AND MAINTENANCE PLAN

4.0 LONG-TERM POLLUTION PREVENTION & OPERATION AND MAINTENANCE PLAN

As required by Standard #4 of the Stormwater Management Policy, this Long-Term Pollution Prevention Plan has been developed for source control and pollution prevention at the site after construction.

MAINTENANCE RESPONSIBILITY

Ensuring that the provisions of the Long-Term Pollution Prevention Plan are followed will be the responsibility of The Applicant, Arlington Land Realty, LLC.

GOOD HOUSEKEEPING PRACTICES

The site to be kept clean of trash and debris at all times. Trash, junk, etc. is not to be left outside.

VEHICLE WASHING CONTROLS

The following BMP's, or equivalent measures, methods or practices are required if you are engaged in vehicle washing and/or steam cleaning:

It is allowable to rinse down the body or a vehicle, including the bed of a truck, with just water without doing any wash water control BMP's.

If you wash (with mild detergents) on an area that infiltrates water, such as gravel, grass, or loose soil, it is acceptable to let the wash water infiltrate as long as you only wash the body of vehicles.

However, if you wash on a paved area and use detergents or other cleansers, or if you wash/rinse the engine compartment or the underside of vehicles, you must take the vehicles to a commercial vehicle wash.

REQUIREMENTS FOR ROUTINE INSPECTIONS AND MAINTENANCE OF STORMWATER BMPS

All stormwater BMPs are to be inspected and maintained as follows;

Haybales, Silt Fence, and other temporary measures

The temporary erosion control measures will be installed up gradient of any wetland resource area where any disturbance or alteration might otherwise allow for erosion or sedimentation. They will be regularly inspected to ensure that they are functioning adequately. Additional supplies of these temporary measures will be stockpiled on site for any immediate needs or routine replacement.

Deep Sump Hooded Catch Basins

Regular maintenance is essential. Catch basins remain effective at removing pollutants only if they are cleaned out frequently. Inspect or clean basins at least four times per year and at the end of the foliage and snow removal seasons. Sediments must also be removed four times per year or whenever the depth of the deposits in the catch basin sump is greater than or equal to one half the depth from the bottom of the invert of the lowest pipe in the basin.

Water Quality Treatment Units

The water quality treatment structures require periodic inspection and cleaning to maintain operation and function. Owners should have these units inspected on a semi-annual basis and after periods of intense precipitation. Inspections can be done by using a clear Plexiglas tube ("sludge judge") to extract a water column sample. When sediment accumulation reaches 15% of storage capacity, cleaning of the unit is required.

These water quality structures must and will be checked and cleaned immediately after petroleum spills; contact appropriate regulatory agencies.

Maintenance of these units should be done by a vacuum truck that will remove the water, sediment, debris, floating hydrocarbons and other materials in unit. Proper cleaning and disposal of the removed materials and liquid must be followed.

Underground Infiltration Systems

Maintenance is required for the proper operation of the underground infiltration system. Infiltration systems are prone to failure due to clogging if the upstream water quality units are not maintained. The use of pretreatment BMPs will minimize failure and maintenance requirements.

After construction, the infiltration system shall be inspected after every major storm for the first few months to ensure proper stabilization and function. Water levels in the access ports shall be recorded over several days to check the drainage of the systems. It is recommended that a log book be maintained showing the depth of water in the detention/infiltration systems at each observation in order to determine the rate at which the system dewaters after runoff producing storm events. Once the performance characteristics of the detention/infiltration have been verified, the monitoring schedule can be reduced to an annual basis, unless the performance data suggests that a more frequent schedule is required.

Preventive maintenance on the infiltration system shall be performed at least twice a year, and sediment shall be removed from any and all pretreatment and collection structures. Sediment shall be removed when deposits approach within six inches of the invert heights of connecting pipes between unit rows, or in sumped inlet structures. Ponded water inside the systems (as visible from the access ports) that remains after several days most likely indicates that the bottom of the system is clogged and will require cleaning or replacement.

The system is designed with a defined top portal area at the "down-flow" end of the chamber that can be cut out to accept up to a 10-inch diameter riser pipe. The 10-inch riser can be used as an observation well and as access for a vacuum truck tube for use in removing sediment. The "down flow" ends of the units have end walls that are closed on the bottom. The closed bottom functions like a coffer dam, with most of the sediment depositing prior to flowing into the next chamber, facilitating its removal through the riser pipe, which is positioned directly above this area.

In addition to the routine maintenance described above, an operation and maintenance log. This log must be maintained for a minimum of three years after construction of the system, and include inspection reports and notes on any repairs, replacement, and disposal (including material and location). This log must be made available to MassDEP and the Conservation Commission upon request. In addition, members and agents of MassDEP shall be allowed to enter and inspect the property and drainage system to ensure compliance with this O&M plan.

Pipe Outlet Protection

The outlet protection should be checked at least annually and after every major storm. If the rip-rap has been displaced, undermined or damaged, it should be repaired immediately. The channel immediately below the outlet should be checked to see that erosion is not occurring. The downstream channel should be kept clear of obstructions such as fallen trees, debris, and sediment that could change flow patterns and/or tailwater depths on the pipes. Repairs must be carried out immediately to avoid additional damage to the outlet protection apron.

PROVISIONS FOR MAINTENANCE OF LAWNS, GARDENS AND OTHER LANDSCAPE AREAS

Suggested Maintenance Operations

A. Trees and Shrubs

Disease and Pest Management - Prevention of disease or infestation is the first step of Pest Management. A plant that is in overall good health is far less susceptible to disease. Good general landscape maintenance can reduce problems from disease.

Inspections of plant materials for signs of disease or infestation are to be performed monthly by the Landscape Maintenance Contractor's Certified Arborist. This is a critical step for early diagnosis. Trees and Shrubs that have been diagnosed to have a plant disease or an infestation of insect pests are to be treated promptly with an appropriate material by a licensed applicator.

Fertilization - Trees and shrubs live outside their natural environment and should be given proper care to maintain health and vigor. Fertilizing trees and shrubs provides the plants with nutrients needed to resist insect attack, to resist drought and to grow thicker foliage. Fertilizing of new and old trees may be done in one of three ways, in either the early spring or the late fall.

- Systemic Injection of new and existing trees on trees 2 inches or greater in diameter. You must be licensed to apply this method.
- Soil Injection – a liquid fertilizer with a product such as Arbor Green or Rapid Grow injected into the soil under the drip zone of a tree or shrub. Material must be used according to manufacturers' specifications to be effective. Outside contracting is recommended.
- Punch Bar Method – a dry fertilizer such as 10-10-10, may be used by punched holes in the drip zone of the tree 12-18" deep, two feet apart around the circumference, to the edge of the drip line. Three pounds of fertilizer should be used per diameter inch for trees with trunks six inches or more in diameter.
- Fertilizer of shrubs – use a fertilizer such as 10-10-10, broadcast over the planting area according to the manufacturers' rate and water in.
- All fertilization must be noted on daily maintenance log.

Watering - Trees and Shrubs will need supplemental watering to remain in vigorous health. All new plants need to be watered once a week in cool weather, twice a week during warm weather, and up to three times in a week during periods of extreme heat and drought. Trees and shrubs should be watered in such a manner as to totally saturate the soil in the root zone area. Over-watering or constant saturation of the soil must be avoided as this could lead to root rot and other disease problems. The use of a soil moisture meter can help you monitor the soil's water intake.

Plant Replacement - Unhealthy plants that may cause widespread infestation of other nearby plants shall be immediately removed from the site. Any vegetation removed from the site must be recorded and submitted with the daily maintenance log. The area shall be treated to prevent further infestation. The plant shall then be replaced with a healthy specimen of the same species and size. This work shall have a pre-established budget allowance for the year.

A spring inspection of all plant materials shall be performed to identify those plant materials that are not in vigorously healthy condition. Unhealthy plant materials shall be evaluated. If the problem is determined to be minor the plant material shall be given appropriate restorative care in accordance with this maintenance guideline until it is restored to a vigorously healthy condition. Unhealthy plant materials that do not respond to restorative care or are determined to be beyond saving shall be replaced with a healthy specimen of the same species and size. In the case of the necessity of replacing extremely large plant materials the Landscape Architect shall determine the size of the replacement plant.

Pruning - Proper pruning is the selective removal of branches without changing the plant's natural appearance, or habit of growth. All tree pruning is to be performed by a licensed Arborist. All branches that are dead, broken, scared or crossing should be removed. All cuts should be made at the collar and not cut flush with the base.

Pruning on the site shall be done for the following purposes;

- To maintain or reduce the size of a tree or shrub
- To remove dead, diseased or damaged branches
- To rejuvenate old shrubs and encourage new growth
- To stimulate future flower and fruit development
- To maximize the visibility of twig color
- To prevent damage and reduce hazards to people and properties

All shrubs are recommended to be pruned on an annual basis to prevent the shrub from becoming overgrown and eliminate the need for drastic pruning. There are several types of pruning for deciduous shrubs. Hand snips should be used to maintain a more natural look or hand shears can be used for a more formal appearance.

Winter Protection - All trees and shrubs are to be watered, fertilized, and mulched before the first frost. All stakes should be checked and ties adjusted. Damaged branches should be pruned.

Broadleaf and Coniferous Evergreen plant materials are to be sprayed with an anti-desiccant product to prevent winter burn. The application shall be repeated during a suitable mid-winter thaw.

Shrubs located in areas likely to be piled with snow during snow removal (but not designated as Snow Storage Areas) shall be marked by six-foot high poles with bright green banner flags. Stockpiles of snow are not to be located in these areas due to potential damage to the plant materials from both the weight of the snow and the snow melting chemicals.

At the fall landscape maintenance conference parameters will be discussed between the Landscape Maintenance Contractor and the snow removal contractor to assure minimal damage and loss of landscape amenities during the winter season.

Seasonal Clean Up - A thorough spring cleanup is to be performed. This includes the removal and replacement of dead or unhealthy plant materials and the cleanup of plant debris and any general debris that has accumulated over the winter season. Mulch is to be lightly raked to clean debris from the surface without removing any mulch. Twigs and debris are to be removed from the planting beds throughout the growing season.

Mulching - Planting beds shall be mulched with a treated shredded hardwood mulch free from dirt, debris, and insects. A sample of this mulch shall be given to the Owner for approval prior to installation.

Maintain a 2-3" maximum depth and keep free of weeds either by hand weeding or by the use of a pre-emergent weed control such as Treflan or Serfian. Seasonal re-mulching shall occur as necessary in the spring and the fall to maintain this minimum depth. When new mulch is added to the planting bed it shall be spread to create a total depth of no more than three inches. Edges should be maintained in a cleanly edged fashion.

Mulch shall not be placed directly against the trunk of any tree or shrub.

B. Groundcover and Perennials

Disease and Pest Management – Pesticides and herbicides should be applied only as problems occur, with the proper chemical applied only by a trained professional or in the case of pesticide, a Certified Pesticide Applicator. Plants should be monitored weekly and treated accordingly.

Fertilizer – The health of the plants can be maintained or improved, and their growth encouraged by an application of complete fertilizer. Apply a fertilizer such as 4-12-4 as growth becomes apparent and before mulching. Apply to all groundcover and perennial planting areas by hand and avoid letting the fertilizer come in contact with the foliage, or use a liquid fertilizer and apply by soaking the soil. Apply according to the manufacturers' specifications.

Fertilization shall stop at the end of July.

Water – Groundcovers and Perennials will need supplemental watering in order to become established, healthy plants. All new plants need to be watered once a week in cool weather, twice a week during warm weather, and up to three times in a week during periods of extreme heat and drought. Until established, groundcovers and perennials should be watered in such a manner as to totally saturate the soil in the root zone area, to a depth of 6 inches. Once established, perennials shall continue to be watered as necessary to maintain them in a vigorous healthy condition. Over-watering or constant saturation of the soil must be avoided as this could lead to root rot and other disease problems. The use of a soil moisture meter can help you monitor the soil's water intake.

On-site water shall be furnished by the Owner. Hose and other watering equipment shall be furnished by the Landscape Maintenance Contractor.

Replacement – Any unhealthy plant/s that may cause widespread infestation of other nearby plants shall be immediately removed from the site. Any vegetation removed from the site must be recorded and submitted with the landscape maintenance log. The area shall be treated to prevent further infestation. The plant/s shall then be replaced with healthy

specimen/s of the same species and size. Old Forge shall have a pre-established budget allowance for this type of replacement, each year.

Plant material that is damaged as a result of other landscape maintenance activities, such as mowing, shall be replaced with healthy specimens of the same species and size, at no additional cost to the owner.

Deadheading – Perennials shall be checked on a weekly basis and dead-headed once flowers have faded or as necessary based on plant type and duration of flower. Spent flowers can be pinched off with the thumb and forefinger. Continue to remove all faded flowers until Fall. All associated debris shall be removed from site daily.

Staking – Upright-growing perennials need support especially when in flower. Use of bamboo stakes, galvanized wire hoops or mesh may be necessary for their support. Supports should be put in place before they have become too difficult to handle. The supports should not be taller than the mature height of the perennial plant.

Division of Perennials – Two or three-year-old perennials are easily divided in the spring if more plants are needed. To divide, cut out the entire section of plant to be divided, including roots. The larger divisions (those with three or more shoots), can be set out immediately in their permanent location, where they can be expected to bloom the same season. Smaller divisions are best planted in an out-of-the-way planting bed until the following autumn or spring, when they can be moved to their permanent location.

Weeding – All planting beds should be kept weed-free. Weed either by hand or with a pre-emergent herbicide such as Treflen used according to manufacturers' specifications. Manual weeding is to be used in combination with the use of spot applications of herbicides. Both live and dead weeds are to be pulled and removed from the site.

All herbicide applications shall be documented in the Landscape Maintenance Log. The actual product label or the manufacturer's product specification sheet for the specific product shall also be included in the Log.

Only personnel with appropriate applicator licenses shall supervise and/or perform the application of pesticide products requiring a license.

Winterizing – Perennial gardens should be cleaned-up when growth ceases in the fall. Remove foliage of plants that normally die down to the ground. Divide and replant over-grown clumps.

C. Lawn Areas - Turf Systems

Mowing – Proper mowing is an integral part of any good turf maintenance program. Without it, the finest in fertilization, watering and other vital maintenance practices would be completely ineffective. Proper mowing will help control dicot weeds; help the turf survive during periods of extreme heat, and gain strength and vigor to resist disease and other infestations.

Mowing height – The proper mowing height will vary somewhat according to the type of grass. The most common type of seed & sod lawns contain a mixture of bluegrass, fine fescue and perennial rye, which should be mowed at 2-3 inches.

Mowing frequency – The basic rule of thumb for mowing frequency is to never remove more than 1/3 of the grass blade in one mowing. Example: if you want to mow your turf at 2 inches, you should cut it when it reaches 3 inches. Removing more than ½ of the grass plant at a time can put the plant into shock, thus making it more susceptible to stress disease and weed infestation.

Mowing frequency will vary with the growing season and should be set by the plant height and not a set date. It will often be necessary to mow twice a week during periods of surge growth to help maintain plant health and color. Mowing should be cut back during periods of stress.

Grass clippings should be removed whenever they are thick enough to layer the turf. The return of clippings to the soil actually adds nutrients and helps retain moisture. Heavily clumped grass clippings are a sign of infrequent mowing, calling for an adjustment in the mowing schedule.

When mowing any area, try to alternate mowing patterns. This tends to keep grass blades more erect and assures an even cut. A dull mower will cause color loss due to tearing of the turf plant, and since mowing will ultimately determine the appearance of any turf area there is an absolute necessity for a clean sharp cut.

Weed & Pest Control and Fertilizing- In order to maintain turf grass health, vigor color, and nutrients, fertilizer must be added to the soil. Recommendations for fertilization of lawn areas are as follows; fertilize at the rate of one (1) pound of nitrogen per thousand square feet, per year is optimum. Fertilizer should be a balanced slow release, sulfur coated type fertilizer.

Weed Control - All turf areas will require some weed control, for both weed grasses and dicot weeds. Weeds should be treated at the appropriate time and with a material labeled for the target weed. Please refer to the fertilizer weed and pest schedule for timing.

Pest Control - All turf areas will require some pest control. Pests should be treated at the appropriate time with a material labeled for the target pest. Please refer to the fertilizer, weed and pest schedule for timing.

Lime - A common cause for an unhealthy lawn is acidic soil. When the pH is below the neutral range (between 6-7) vital plant nutrients become fixed in the soil and cannot be absorbed by the grass plant. Lime corrects an acid soil condition, supplies calcium for plant growth and improves air and water circulation. Limestone applied at the rate of 50 lbs. per thousand square feet will adjust the soil pH one point over a period of 6-9 months.

D. Fertilizer, Weed & Pest Control Schedule – Turf Systems

Spring - (April)	Fertilize one (1) pound of nitrogen per 1,000 square feet Pre-emergent weed grass control Broadleaf weed control
Late Spring - (June)	Fertilize one (1) pound of nitrogen per 1,000 square feet Pre-emergent weed grass control Broadleaf weed control Insect Control (if needed)
*Summer - (August)	Fertilize one (1) pound of nitrogen per 1,000 square feet Broadleaf weed control (if needed) Insect Control (if needed)
Fall - (September)	Fertilize one (1) pound of nitrogen per 1,000 square feet

*Omit if area is not to be irrigated

Lawn Maintenance Task Schedule

MARCH (Weather permitting)
- Clean up winter debris, sand, leaves, trash etc.
- Re-edge mulch beds, maintain at 2-3" maximum.
- Fertilize plants
- Aerate and thatch turf (conditions permitting)

APRIL
- Reseed or sod all areas needing attention.
- Fertilize and weed control

- Lime
- Start mowing when grass reaches 2-1/2", mow to 2"

MAY
- Mow turf to 2-2-1/2"
- Weed as necessary.
- Check for disease and pest problems in both turf and plants.

JUNE
- Mow turf to 2-1/2" – 3"
- Fertilize and weed control.
- Weed
- Check for disease and pest problems in both turf and plants, treat as necessary.

PROVISIONS FOR SOLID WASTE MANAGEMENT (SITE TRASH)

Trash will be placed in on-site dumpsters and the Owner will make provisions for its regular and timely removal.

SNOW DISPOSAL AND PLOWING PLANS

The purpose of the snow and snowmelt management plan is to provide guidelines regarding snow disposal site selection, site preparation and maintenance that are acceptable to the Department of Environmental Protection. For the areas that require snow removal, snow storage onsite will largely be accomplished by using pervious areas along the shoulder of the roadway and development as windrowed by plows.

- Avoid dumping of snow into any water body, including rivers, ponds, or wetlands. In addition to water quality impacts and flooding, snow disposed of in open water can cause navigational hazards when it freezes into ice blocks.
- Avoid disposing of snow on top of storm drain catch basins or in stormwater basins. Snow combined with sand and debris may block a storm drainage system, causing localized flooding. A high volume of sand, sediment, and litter released from melting snow also may be quickly transported through the system into surface water.
- In significant storm events, the melting or off-site trucking of snow may be implemented. These activities shall be conducted in accordance with all local, state and federal regulations.
- Snow shall be removed from the areas around on-site fire-hydrants to maintain emergency access to hydrants at all times. Removable flags or markers should be placed on hydrants to allow snow removal crews to more easily locate hydrants and not damage them with plows or other snow removal equipment.

WINTER ROAD SALT AND/OR SAND USE AND STORAGE RESTRICTIONS

The applicant will be responsible for sanding and salting the site. No storage on site.

STREET SWEEPING SCHEDULES

There are three types of sweepers: Mechanical, Regenerative Air, and Vacuum Filter.

1) Mechanical: Mechanical sweepers use brooms or rotary brushes to scour the pavement.
2) Regenerative Air: These sweepers blow air onto the road or parking lot surface, causing fines to rise where they are vacuumed.
3) Vacuum filter: These sweepers remove fines along roads. Two general types of vacuum filter sweepers are available - wet and dry. The dry type uses a broom in combination with the vacuum. The wet type uses water for dust suppression

Regardless of the type chosen, the efficiency of street sweeping is increased when sweepers are operated in tandem.

This project has not included street sweeping as part of the TSS removal calculations. However, it is recommended that street sweeping of the parking areas occur four times a year, including once after the spring snow melt.

Reuse and Disposal of Street Sweepings

Once removed from paved surfaces, the sweepings must be handled and disposed of properly. Mass DEP's Bureau of Waste Prevention has issued a written policy regarding the reuse and disposal of street sweepings. These sweepings are regulated as a solid waste, and can be used in three ways:

- In one of the ways already approved by Mass DEP (e.g., daily cover in a landfill, additive to compost, fill in a public way)
- If approved under a Beneficial Use Determination
- Disposed in a landfill

TRAINING OF STAFF OR PERSONNEL INVOLVED WITH IMPLEMENTING LONG-TERM POLLUTION PREVENTION PLAN

The Long-Term Pollution Prevention Plan is to be implemented by property owner of the site. Trained and, if required, licensed Professionals are to be hired by the owner as applicable to implement the Long-Term Pollution Prevention Plan.

LIST OF EMERGENCY CONTACTS FOR IMPLEMENTING LONG-TERM POLLUTION PREVENTION PLAN

The applicant will be required to implement the Long-Term Pollution Prevention Plan and will create and maintain a list of emergency contacts.

ESTIMATED OPERATION AND MAINTENANCE BUDGET

An estimated operation and maintenance budget in accordance with the schedule for inspections and routine maintenance in for each BMP above is as follows:

Stormwater BMP	**Maintenance Schedule**	**Cost per Cleaning /Inspection**	**Total Cost (per year)**
Catch Basins	4 times per year	$500	$2,000
Water Quality Units	Twice per year and after major storm events	$500	$1,000
Infiltration Systems	Twice per year and after major storm events	$2500	$5,000
Inspections	Annual	$1000	$1,000
Total Annual Cost			**$9,000**

POST CONSTRUCTION PHASE INSPECTION SCHEDULE AND EVALUATION CHECKLIST

Inspection Date	Inspector	BMP Inspected	Inspection Frequency Requirements	Comments	Recommendation	Follow-up Inspection Required (yes/no)
		Catch Basin	Four times a year			
		Water Quality Units	Four times a year			
		Infiltration System	Twice a year			
		Pipe Outlet Protection	Once a year			

1. Refer to the Massachusetts Stormwater Handbook Volume Two: Stormwater Technical Handbook (February 2008) for recommendations regarding frequency for inspections and maintenance of specific BMP's

2. Inspections to be conducted by a qualified professional such as an environmental scientist or civil engineer.

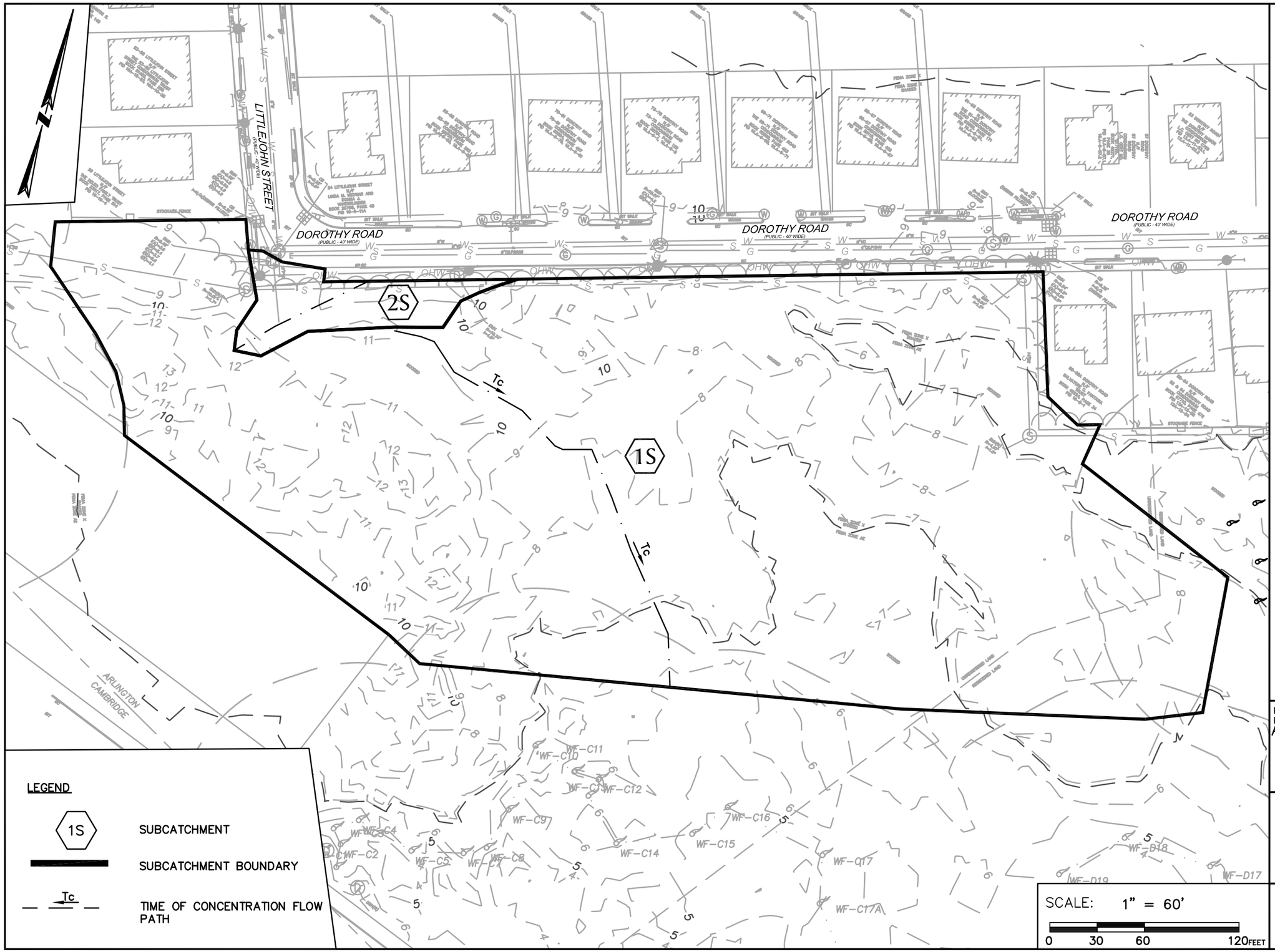
3. Limited or no use of sodium chloride salts, fertilizers or pesticides recommended.

4. Other Notes: (Include deviations from Conservation Commission Approvals, Planning Board Approvals and Approved Plans)

SECTION 5.0

HYDROLOGY CALCULATIONS

5.01 EXISTING WATERSHED PLAN



THORNDIKE PLACE

DOROTHY ROAD

ARLINGTON
MASSACHUSETTS
(MIDDLESEX COUNTY)

EXISTING WATERSHED PLAN

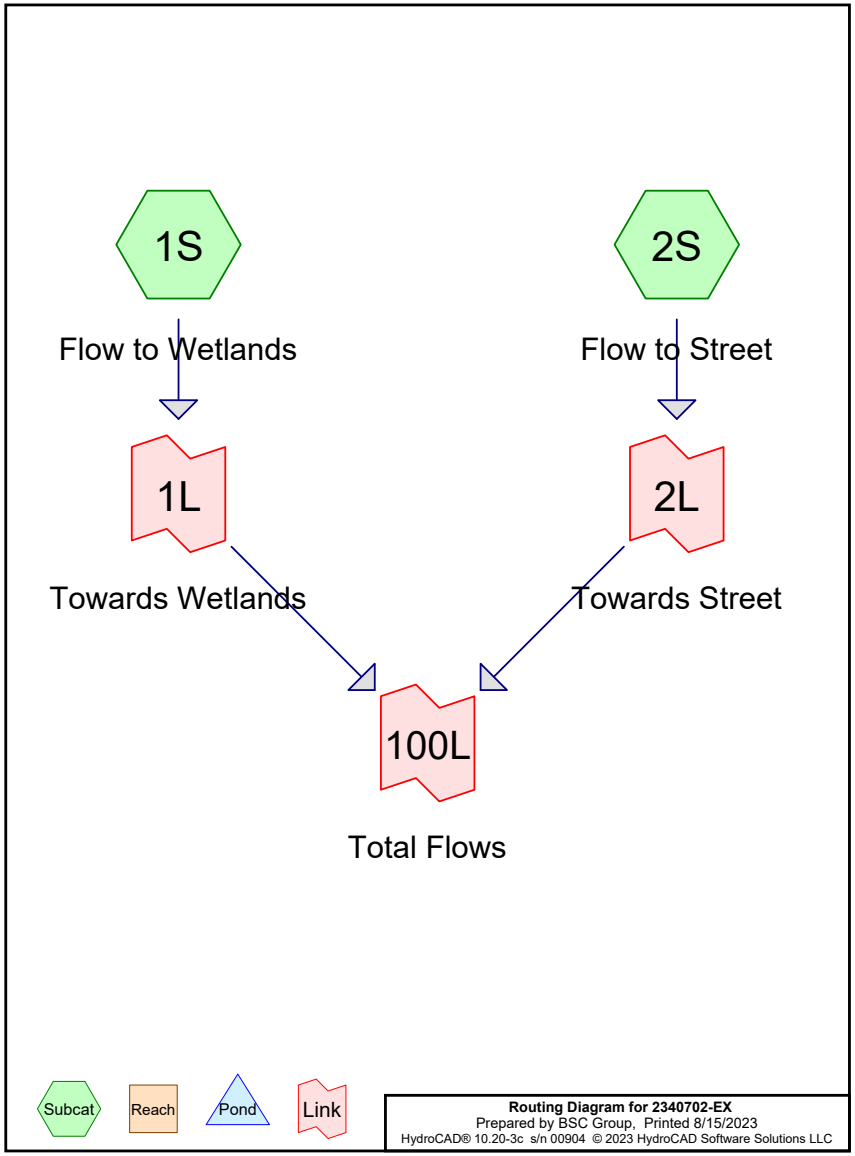
NOVEMBER 3, 2020

PREPARED FOR:
ARLINGTON LAND REALTY
84 SHERMAN STREET
CAMBRIDGE, MA

BSC GROUP
803 Summer Street
Boston, Massachusetts
02127
617 896 4300

Job No.: 23407.00 Date: 11/3/2020
Scale: 1" = 60' Revised: 08/18/2021
Dwg No: EXW
File: C\DRAINAGE DESIGN\2340700-EXW

5.02 EXISTING HYDROLOGY CALCULATIONS (HYDROCAD™ PRINTOUTS)



Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
925	98	Paved parking, HSG C (2S)
157,761	70	Woods, Good, HSG C (1S, 2S)
158,686	**70**	**TOTAL AREA**

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
0	HSG A	
0	HSG B	
158,686	HSG C	1S, 2S
0	HSG D	
0	Other	
158,686		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Subcatchment Numbers
0	0	925	0	0	925	Paved parking	2S
0	0	157,761	0	0	157,761	Woods, Good	1S, 2S
0	**0**	**158,686**	**0**	**0**	**158,686**	**TOTAL AREA**	

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Flow to Wetlands Runoff Area=151,732 sf 0.00% Impervious Runoff Depth>1.34"
Flow Length=310' Tc=17.5 min CN=70 Runoff=3.7 cfs 16,903 cf

Subcatchment 2S: Flow to Street Runoff Area=6,954 sf 13.30% Impervious Runoff Depth>1.61"
Flow Length=95' Tc=6.0 min CN=74 Runoff=0.3 cfs 932 cf

Link 1L: Towards Wetlands Inflow=3.7 cfs 16,903 cf
Primary=3.7 cfs 16,903 cf

Link 2L: Towards Street Inflow=0.3 cfs 932 cf
Primary=0.3 cfs 932 cf

Link 100L: Total Flows Inflow=3.8 cfs 17,836 cf
Primary=3.8 cfs 17,836 cf

Total Runoff Area = 158,686 sf Runoff Volume = 17,836 cf Average Runoff Depth = 1.35"
99.42% Pervious = 157,761 sf 0.58% Impervious = 925 sf

Summary for Subcatchment 1S: Flow to Wetlands

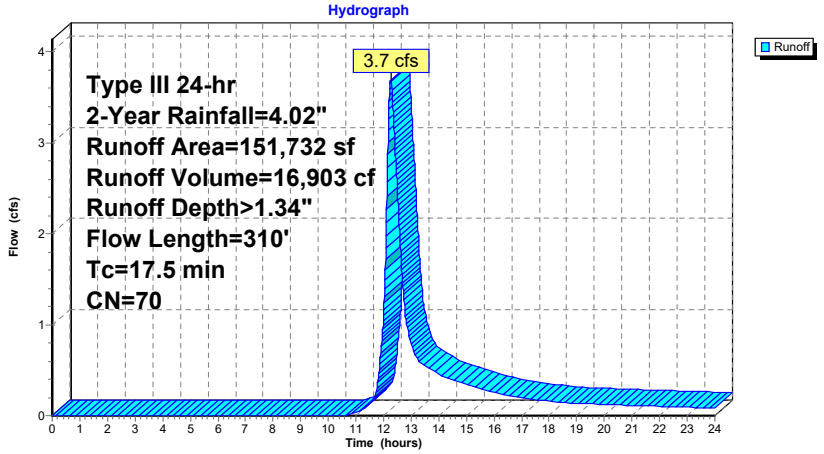
Runoff = 3.7 cfs @ 12.26 hrs, Volume= 16,903 cf, Depth> 1.34"
Routed to Link 1L : Towards Wetlands

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=4.02"

Area (sf)	CN	Description
151,732	70	Woods, Good, HSG C
151,732		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.4	50	0.0240	0.07		**Sheet Flow, A to B** Woods: Light underbrush n= 0.400 P2= 3.23"
6.1	260	0.0200	0.71		**Shallow Concentrated Flow, B to C** Woodland Kv= 5.0 fps
17.5	310	Total			

Subcatchment 1S: Flow to Wetlands



Summary for Subcatchment 2S: Flow to Street

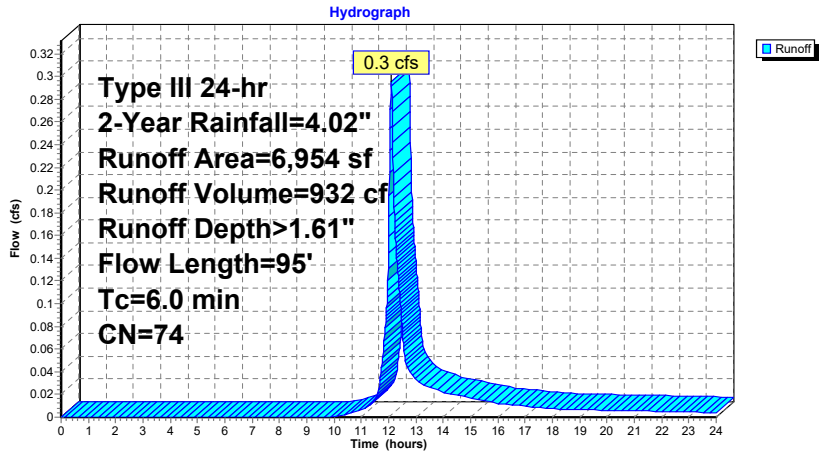
Runoff = 0.3 cfs @ 12.09 hrs, Volume= 932 cf, Depth> 1.61"
Routed to Link 2L : Towards Street

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=4.02"

Area (sf)	CN	Description
6,029	70	Woods, Good, HSG C
925	98	Paved parking, HSG C
6,954	74	Weighted Average
6,029		86.70% Pervious Area
925		13.30% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.5	20	0.0750	0.10		**Sheet Flow, A to B** Woods: Light underbrush n= 0.400 P2= 3.23"
1.8	75	0.0200	0.71		**Shallow Concentrated Flow, B to C** Woodland Kv= 5.0 fps
5.3	95	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 2S: Flow to Street

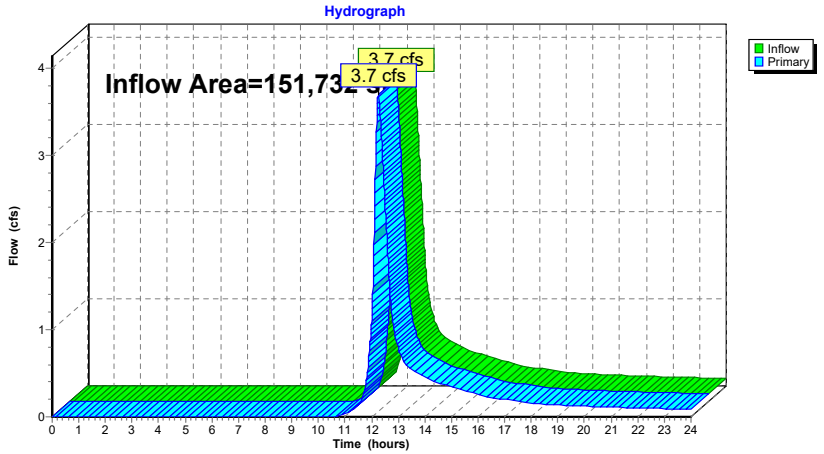


Summary for Link 1L: Towards Wetlands

Inflow Area = 151,732 sf, 0.00% Impervious, Inflow Depth > 1.34" for 2-Year event
Inflow = 3.7 cfs @ 12.26 hrs, Volume= 16,903 cf
Primary = 3.7 cfs @ 12.26 hrs, Volume= 16,903 cf, Atten= 0%, Lag= 0.0 min
Routed to Link 100L : Total Flows

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Link 1L: Towards Wetlands

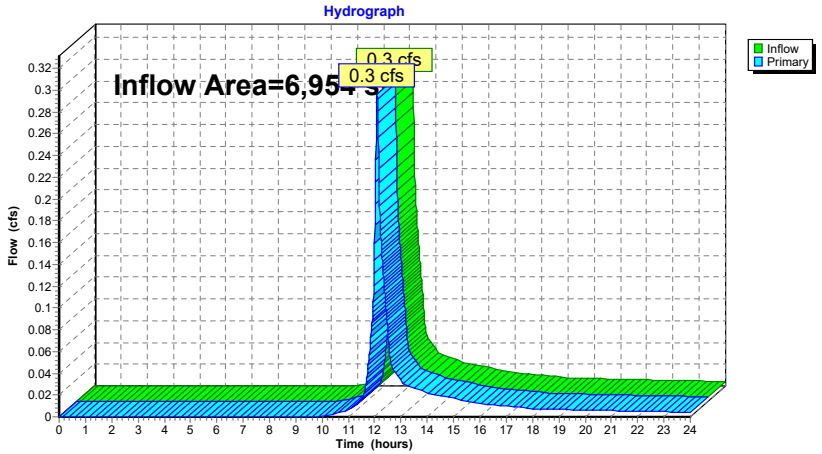


Summary for Link 2L: Towards Street

Inflow Area = 6,954 sf, 13.30% Impervious, Inflow Depth > 1.61" for 2-Year event
Inflow = 0.3 cfs @ 12.09 hrs, Volume= 932 cf
Primary = 0.3 cfs @ 12.09 hrs, Volume= 932 cf, Atten= 0%, Lag= 0.0 min
Routed to Link 100L : Total Flows

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Link 2L: Towards Street

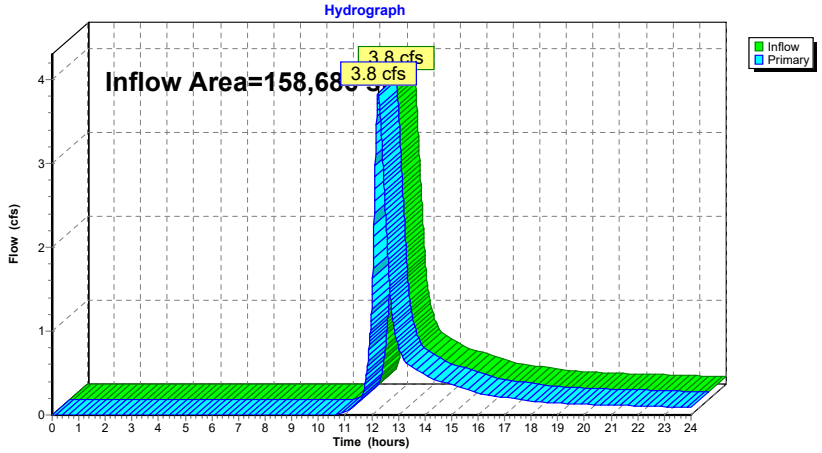


Summary for Link 100L: Total Flows

Inflow Area = 158,686 sf, 0.58% Impervious, Inflow Depth > 1.35" for 2-Year event
Inflow = 3.8 cfs @ 12.26 hrs, Volume= 17,836 cf
Primary = 3.8 cfs @ 12.26 hrs, Volume= 17,836 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Link 100L: Total Flows



Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Flow to Wetlands Runoff Area=151,732 sf 0.00% Impervious Runoff Depth>3.11"
Flow Length=310' Tc=17.5 min CN=70 Runoff=9.0 cfs 39,374 cf

Subcatchment 2S: Flow to Street Runoff Area=6,954 sf 13.30% Impervious Runoff Depth>3.52"
Flow Length=95' Tc=6.0 min CN=74 Runoff=0.7 cfs 2,040 cf

Link 1L: Towards Wetlands Inflow=9.0 cfs 39,374 cf
Primary=9.0 cfs 39,374 cf

Link 2L: Towards Street Inflow=0.7 cfs 2,040 cf
Primary=0.7 cfs 2,040 cf

Link 100L: Total Flows Inflow=9.4 cfs 41,414 cf
Primary=9.4 cfs 41,414 cf

Total Runoff Area = 158,686 sf Runoff Volume = 41,414 cf Average Runoff Depth = 3.13"
99.42% Pervious = 157,761 sf 0.58% Impervious = 925 sf

Summary for Subcatchment 1S: Flow to Wetlands

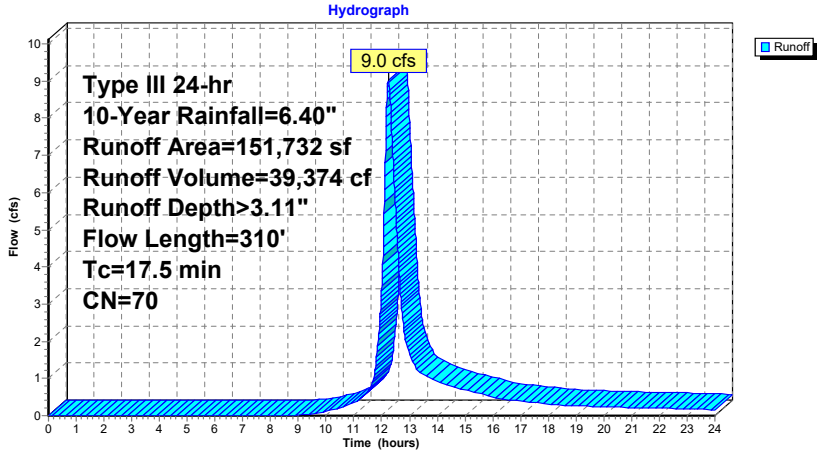
Runoff = 9.0 cfs @ 12.24 hrs, Volume= 39,374 cf, Depth> 3.11"
Routed to Link 1L : Towards Wetlands

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=6.40"

Area (sf)	CN	Description
151,732	70	Woods, Good, HSG C
151,732		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.4	50	0.0240	0.07		**Sheet Flow, A to B** Woods: Light underbrush n= 0.400 P2= 3.23"
6.1	260	0.0200	0.71		**Shallow Concentrated Flow, B to C** Woodland Kv= 5.0 fps
17.5	310	Total			

Subcatchment 1S: Flow to Wetlands



Summary for Subcatchment 2S: Flow to Street

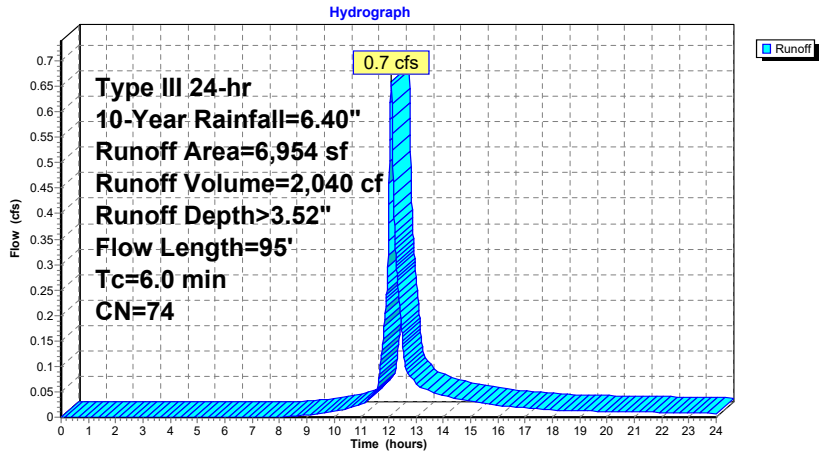
Runoff = 0.7 cfs @ 12.09 hrs, Volume= 2,040 cf, Depth> 3.52"
Routed to Link 2L : Towards Street

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=6.40"

Area (sf)	CN	Description
6,029	70	Woods, Good, HSG C
925	98	Paved parking, HSG C
6,954	74	Weighted Average
6,029		86.70% Pervious Area
925		13.30% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.5	20	0.0750	0.10		**Sheet Flow, A to B** Woods: Light underbrush n= 0.400 P2= 3.23"
1.8	75	0.0200	0.71		**Shallow Concentrated Flow, B to C** Woodland Kv= 5.0 fps
5.3	95	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 2S: Flow to Street

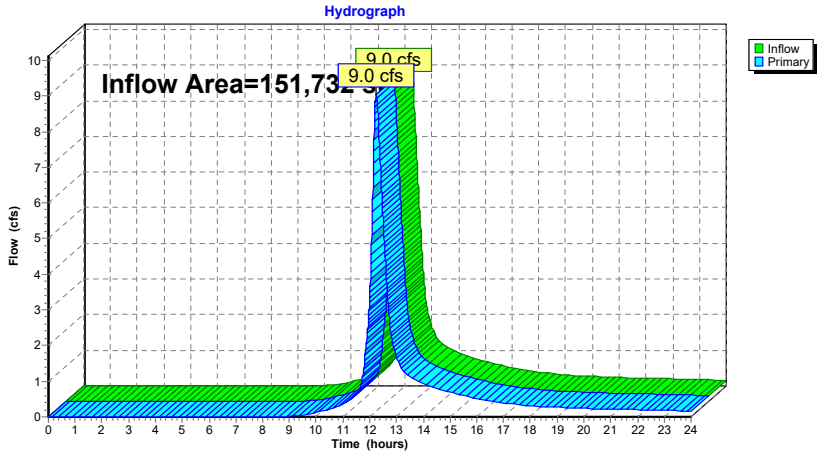


Summary for Link 1L: Towards Wetlands

Inflow Area = 151,732 sf, 0.00% Impervious, Inflow Depth > 3.11" for 10-Year event
Inflow = 9.0 cfs @ 12.24 hrs, Volume= 39,374 cf
Primary = 9.0 cfs @ 12.24 hrs, Volume= 39,374 cf, Atten= 0%, Lag= 0.0 min
Routed to Link 100L : Total Flows

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Link 1L: Towards Wetlands

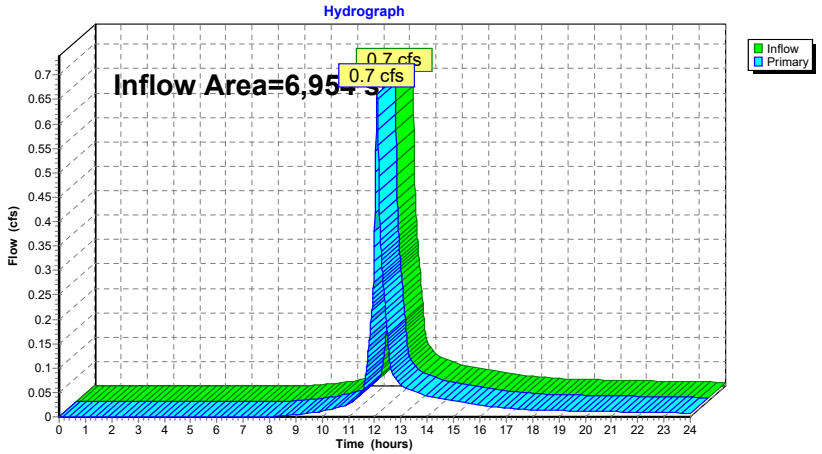


Summary for Link 2L: Towards Street

Inflow Area = 6,954 sf, 13.30% Impervious, Inflow Depth > 3.52" for 10-Year event
Inflow = 0.7 cfs @ 12.09 hrs, Volume= 2,040 cf
Primary = 0.7 cfs @ 12.09 hrs, Volume= 2,040 cf, Atten= 0%, Lag= 0.0 min
Routed to Link 100L : Total Flows

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Link 2L: Towards Street

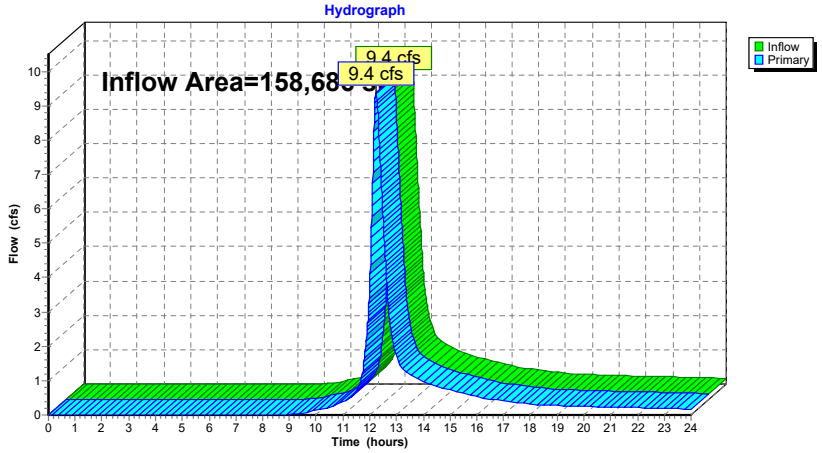


Summary for Link 100L: Total Flows

Inflow Area = 158,686 sf, 0.58% Impervious, Inflow Depth > 3.13" for 10-Year event
Inflow = 9.4 cfs @ 12.24 hrs, Volume= 41,414 cf
Primary = 9.4 cfs @ 12.24 hrs, Volume= 41,414 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Link 100L: Total Flows



Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Flow to Wetlands Runoff Area=151,732 sf 0.00% Impervious Runoff Depth>4.71"
Flow Length=310' Tc=17.5 min CN=70 Runoff=13.7 cfs 59,512 cf

Subcatchment 2S: Flow to Street Runoff Area=6,954 sf 13.30% Impervious Runoff Depth>5.19"
Flow Length=95' Tc=6.0 min CN=74 Runoff=1.0 cfs 3,007 cf

Link 1L: Towards Wetlands Inflow=13.7 cfs 59,512 cf
Primary=13.7 cfs 59,512 cf

Link 2L: Towards Street Inflow=1.0 cfs 3,007 cf
Primary=1.0 cfs 3,007 cf

Link 100L: Total Flows Inflow=14.2 cfs 62,519 cf
Primary=14.2 cfs 62,519 cf

Total Runoff Area = 158,686 sf Runoff Volume = 62,519 cf Average Runoff Depth = 4.73"
99.42% Pervious = 157,761 sf 0.58% Impervious = 925 sf

Summary for Subcatchment 1S: Flow to Wetlands

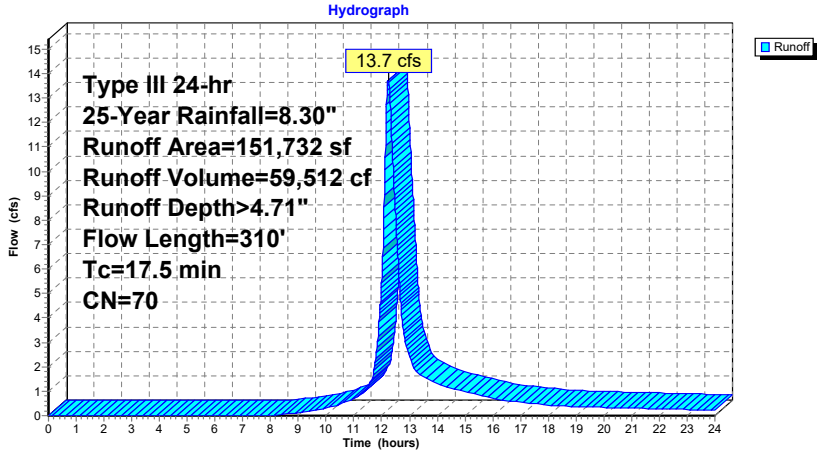
Runoff = 13.7 cfs @ 12.23 hrs, Volume= 59,512 cf, Depth> 4.71"
Routed to Link 1L : Towards Wetlands

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=8.30"

Area (sf)	CN	Description
151,732	70	Woods, Good, HSG C
151,732		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.4	50	0.0240	0.07		**Sheet Flow, A to B** Woods: Light underbrush n= 0.400 P2= 3.23"
6.1	260	0.0200	0.71		**Shallow Concentrated Flow, B to C** Woodland Kv= 5.0 fps
17.5	310	Total			

Subcatchment 1S: Flow to Wetlands



Summary for Subcatchment 2S: Flow to Street

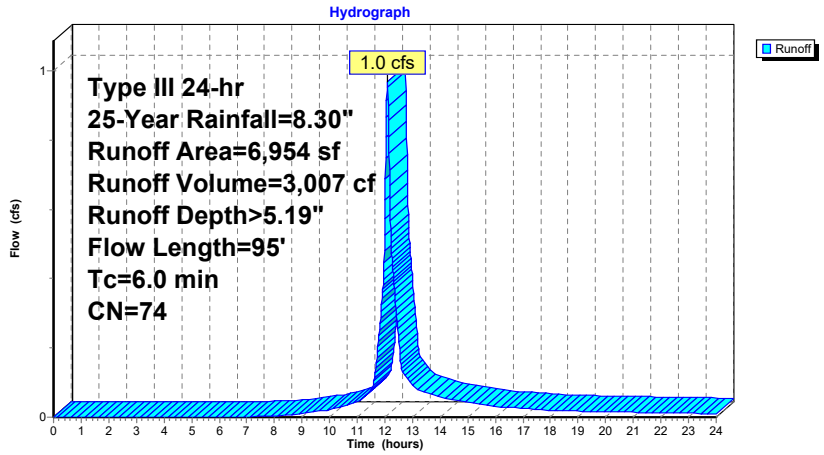
Runoff = 1.0 cfs @ 12.09 hrs, Volume= 3,007 cf, Depth> 5.19"
Routed to Link 2L : Towards Street

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=8.30"

Area (sf)	CN	Description
6,029	70	Woods, Good, HSG C
925	98	Paved parking, HSG C
6,954	74	Weighted Average
6,029		86.70% Pervious Area
925		13.30% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.5	20	0.0750	0.10		**Sheet Flow, A to B** Woods: Light underbrush n= 0.400 P2= 3.23"
1.8	75	0.0200	0.71		**Shallow Concentrated Flow, B to C** Woodland Kv= 5.0 fps
5.3	95	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 2S: Flow to Street

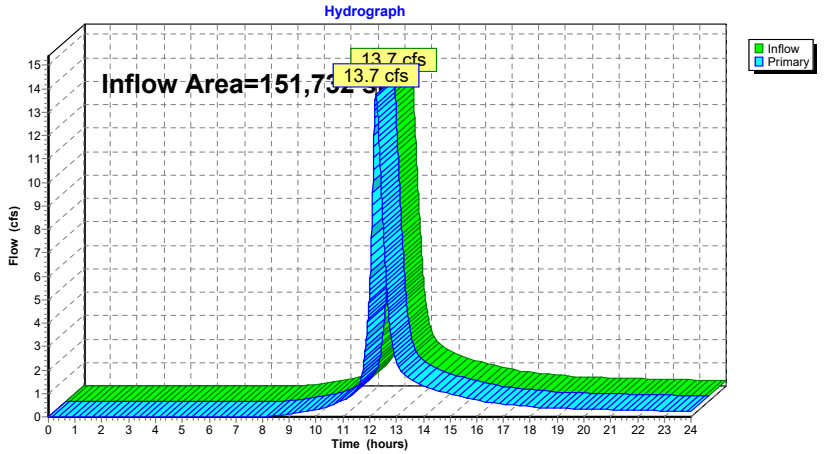


Summary for Link 1L: Towards Wetlands

Inflow Area = 151,732 sf, 0.00% Impervious, Inflow Depth > 4.71" for 25-Year event
Inflow = 13.7 cfs @ 12.23 hrs, Volume= 59,512 cf
Primary = 13.7 cfs @ 12.23 hrs, Volume= 59,512 cf, Atten= 0%, Lag= 0.0 min
Routed to Link 100L : Total Flows

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Link 1L: Towards Wetlands

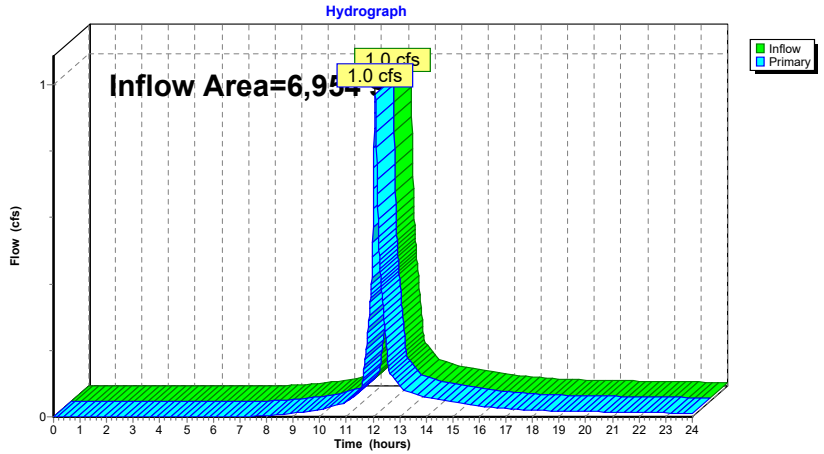


Summary for Link 2L: Towards Street

Inflow Area = 6,954 sf, 13.30% Impervious, Inflow Depth > 5.19" for 25-Year event
Inflow = 1.0 cfs @ 12.09 hrs, Volume= 3,007 cf
Primary = 1.0 cfs @ 12.09 hrs, Volume= 3,007 cf, Atten= 0%, Lag= 0.0 min
Routed to Link 100L : Total Flows

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Link 2L: Towards Street

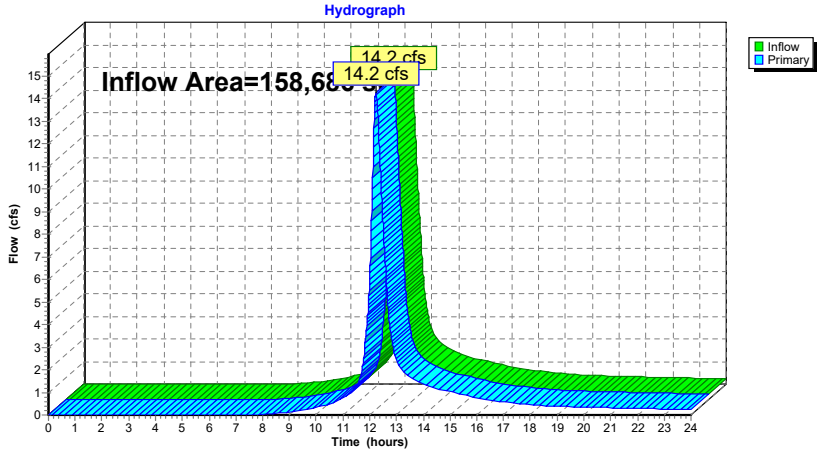


Summary for Link 100L: Total Flows

Inflow Area = 158,686 sf, 0.58% Impervious, Inflow Depth > 4.73" for 25-Year event
Inflow = 14.2 cfs @ 12.23 hrs, Volume= 62,519 cf
Primary = 14.2 cfs @ 12.23 hrs, Volume= 62,519 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Link 100L: Total Flows



Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Flow to Wetlands Runoff Area=151,732 sf 0.00% Impervious Runoff Depth>5.91"
Flow Length=310' Tc=17.5 min CN=70 Runoff=17.2 cfs 74,721 cf

Subcatchment 2S: Flow to Street Runoff Area=6,954 sf 13.30% Impervious Runoff Depth>6.44"
Flow Length=95' Tc=6.0 min CN=74 Runoff=1.2 cfs 3,730 cf

Link 1L: Towards Wetlands Inflow=17.2 cfs 74,721 cf
Primary=17.2 cfs 74,721 cf

Link 2L: Towards Street Inflow=1.2 cfs 3,730 cf
Primary=1.2 cfs 3,730 cf

Link 100L: Total Flows Inflow=17.9 cfs 78,451 cf
Primary=17.9 cfs 78,451 cf

Total Runoff Area = 158,686 sf Runoff Volume = 78,451 cf Average Runoff Depth = 5.93"
99.42% Pervious = 157,761 sf 0.58% Impervious = 925 sf

Summary for Subcatchment 1S: Flow to Wetlands

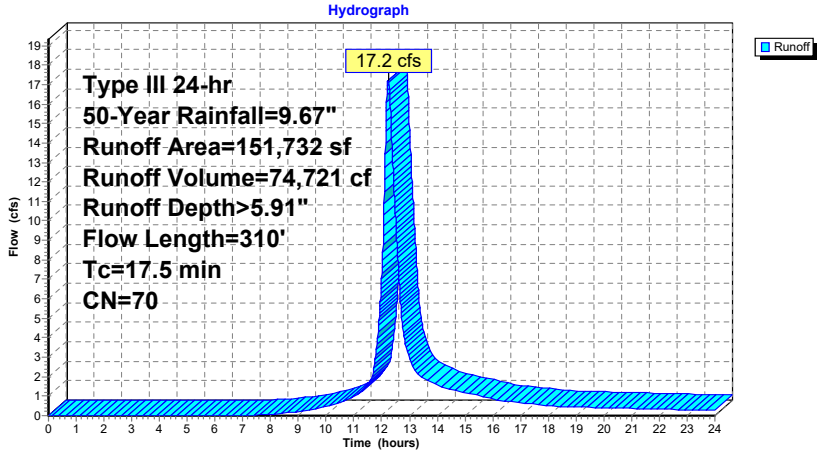
Runoff = 17.2 cfs @ 12.23 hrs, Volume= 74,721 cf, Depth> 5.91"
Routed to Link 1L : Towards Wetlands

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 50-Year Rainfall=9.67"

Area (sf)	CN	Description
151,732	70	Woods, Good, HSG C
151,732		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.4	50	0.0240	0.07		**Sheet Flow, A to B** Woods: Light underbrush n= 0.400 P2= 3.23"
6.1	260	0.0200	0.71		**Shallow Concentrated Flow, B to C** Woodland Kv= 5.0 fps
17.5	310	Total			

Subcatchment 1S: Flow to Wetlands



Summary for Subcatchment 2S: Flow to Street

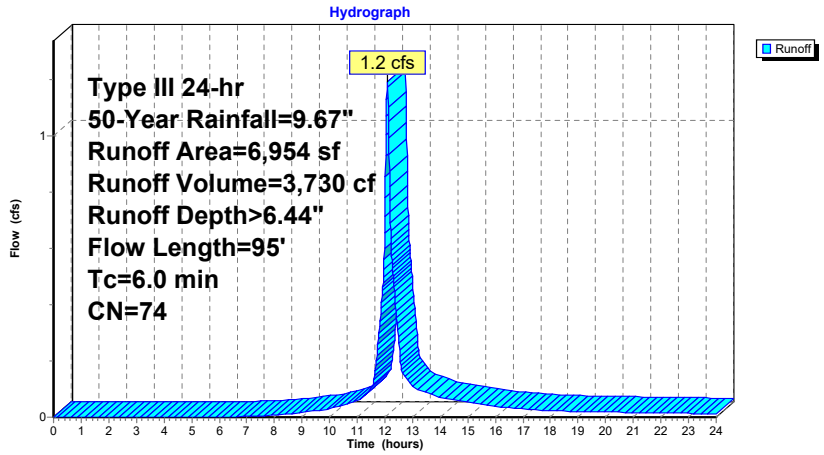
Runoff = 1.2 cfs @ 12.09 hrs, Volume= 3,730 cf, Depth> 6.44"
Routed to Link 2L : Towards Street

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 50-Year Rainfall=9.67"

Area (sf)	CN	Description
6,029	70	Woods, Good, HSG C
925	98	Paved parking, HSG C
6,954	74	Weighted Average
6,029		86.70% Pervious Area
925		13.30% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.5	20	0.0750	0.10		**Sheet Flow, A to B** Woods: Light underbrush n= 0.400 P2= 3.23"
1.8	75	0.0200	0.71		**Shallow Concentrated Flow, B to C** Woodland Kv= 5.0 fps
5.3	95	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 2S: Flow to Street

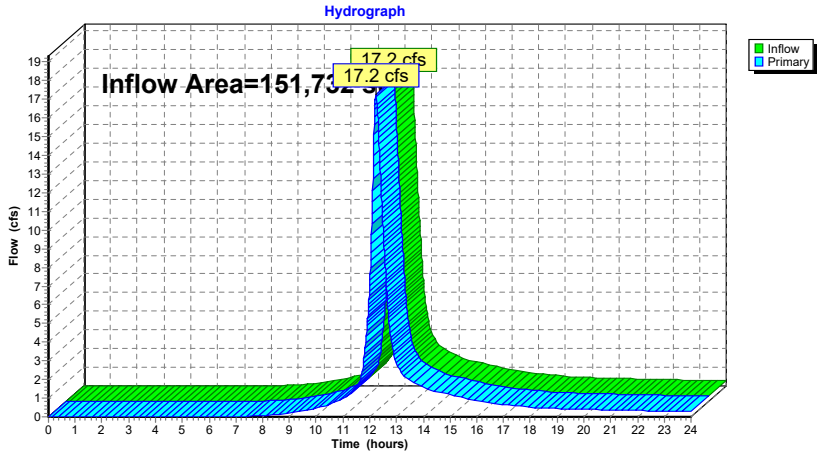


Summary for Link 1L: Towards Wetlands

Inflow Area = 151,732 sf, 0.00% Impervious, Inflow Depth > 5.91" for 50-Year event
Inflow = 17.2 cfs @ 12.23 hrs, Volume= 74,721 cf
Primary = 17.2 cfs @ 12.23 hrs, Volume= 74,721 cf, Atten= 0%, Lag= 0.0 min
Routed to Link 100L : Total Flows

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Link 1L: Towards Wetlands

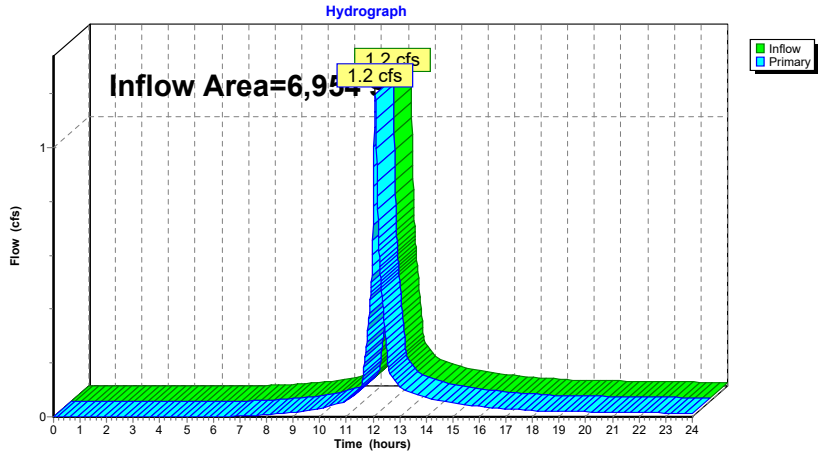


Summary for Link 2L: Towards Street

Inflow Area = 6,954 sf, 13.30% Impervious, Inflow Depth > 6.44" for 50-Year event
Inflow = 1.2 cfs @ 12.09 hrs, Volume= 3,730 cf
Primary = 1.2 cfs @ 12.09 hrs, Volume= 3,730 cf, Atten= 0%, Lag= 0.0 min
Routed to Link 100L : Total Flows

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Link 2L: Towards Street

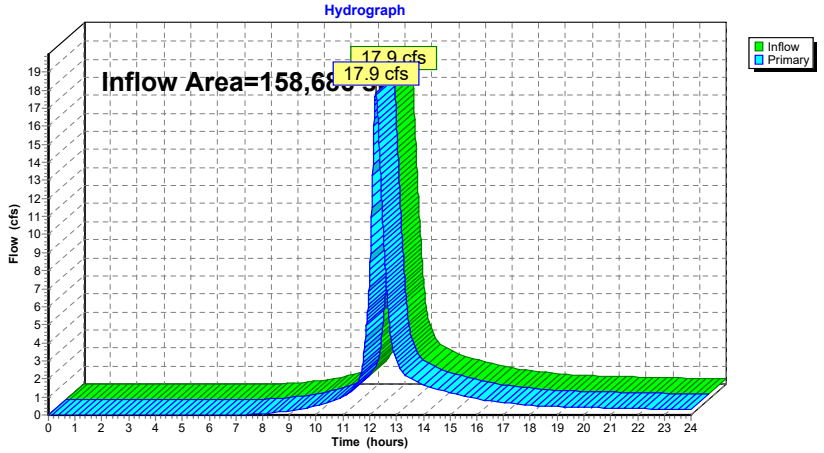


Summary for Link 100L: Total Flows

Inflow Area = 158,686 sf, 0.58% Impervious, Inflow Depth > 5.93" for 50-Year event
Inflow = 17.9 cfs @ 12.23 hrs, Volume= 78,451 cf
Primary = 17.9 cfs @ 12.23 hrs, Volume= 78,451 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Link 100L: Total Flows



Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Flow to Wetlands Runoff Area=151,732 sf 0.00% Impervious Runoff Depth>7.56"
Flow Length=310' Tc=17.5 min CN=70 Runoff=22.0 cfs 95,631 cf

Subcatchment 2S: Flow to Street Runoff Area=6,954 sf 13.30% Impervious Runoff Depth>8.14"
Flow Length=95' Tc=6.0 min CN=74 Runoff=1.5 cfs 4,716 cf

Link 1L: Towards Wetlands Inflow=22.0 cfs 95,631 cf
Primary=22.0 cfs 95,631 cf

Link 2L: Towards Street Inflow=1.5 cfs 4,716 cf
Primary=1.5 cfs 4,716 cf

Link 100L: Total Flows Inflow=22.7 cfs 100,347 cf
Primary=22.7 cfs 100,347 cf

Total Runoff Area = 158,686 sf Runoff Volume = 100,347 cf Average Runoff Depth = 7.59"
99.42% Pervious = 157,761 sf 0.58% Impervious = 925 sf

Summary for Subcatchment 1S: Flow to Wetlands

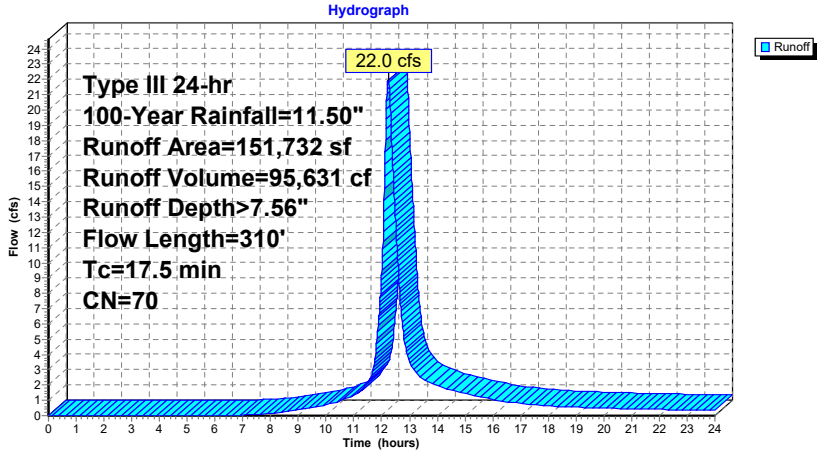
Runoff = 22.0 cfs @ 12.23 hrs, Volume= 95,631 cf, Depth> 7.56"
Routed to Link 1L : Towards Wetlands

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=11.50"

Area (sf)	CN	Description
151,732	70	Woods, Good, HSG C
151,732		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.4	50	0.0240	0.07		**Sheet Flow, A to B** Woods: Light underbrush n= 0.400 P2= 3.23"
6.1	260	0.0200	0.71		**Shallow Concentrated Flow, B to C** Woodland Kv= 5.0 fps
17.5	310	Total			

Subcatchment 1S: Flow to Wetlands



Summary for Subcatchment 2S: Flow to Street

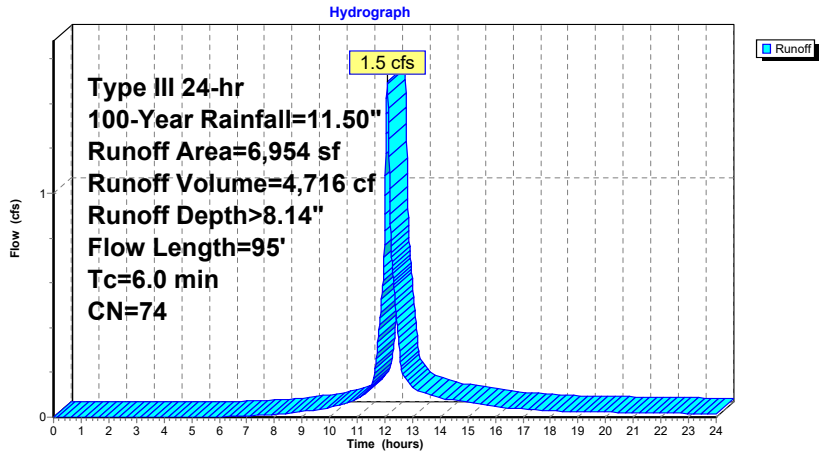
Runoff = 1.5 cfs @ 12.09 hrs, Volume= 4,716 cf, Depth> 8.14"
Routed to Link 2L : Towards Street

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=11.50"

Area (sf)	CN	Description
6,029	70	Woods, Good, HSG C
925	98	Paved parking, HSG C
6,954	74	Weighted Average
6,029		86.70% Pervious Area
925		13.30% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.5	20	0.0750	0.10		**Sheet Flow, A to B** Woods: Light underbrush n= 0.400 P2= 3.23"
1.8	75	0.0200	0.71		**Shallow Concentrated Flow, B to C** Woodland Kv= 5.0 fps
5.3	95	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 2S: Flow to Street

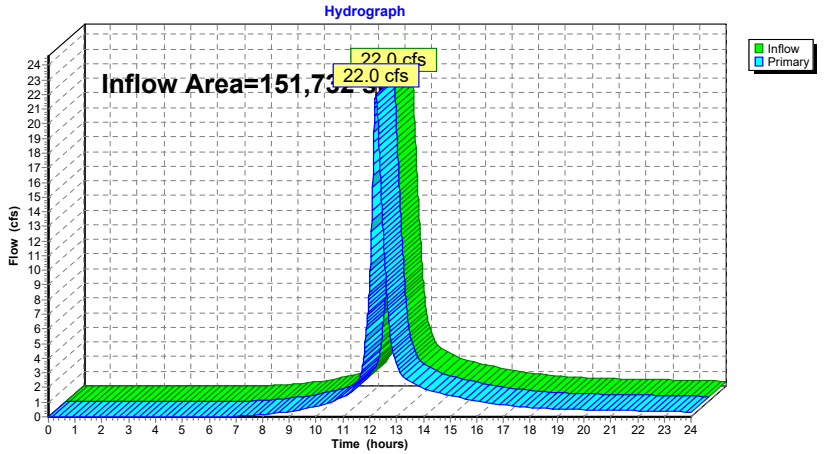


Summary for Link 1L: Towards Wetlands

Inflow Area = 151,732 sf, 0.00% Impervious, Inflow Depth > 7.56" for 100-Year event
Inflow = 22.0 cfs @ 12.23 hrs, Volume= 95,631 cf
Primary = 22.0 cfs @ 12.23 hrs, Volume= 95,631 cf, Atten= 0%, Lag= 0.0 min
Routed to Link 100L : Total Flows

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Link 1L: Towards Wetlands

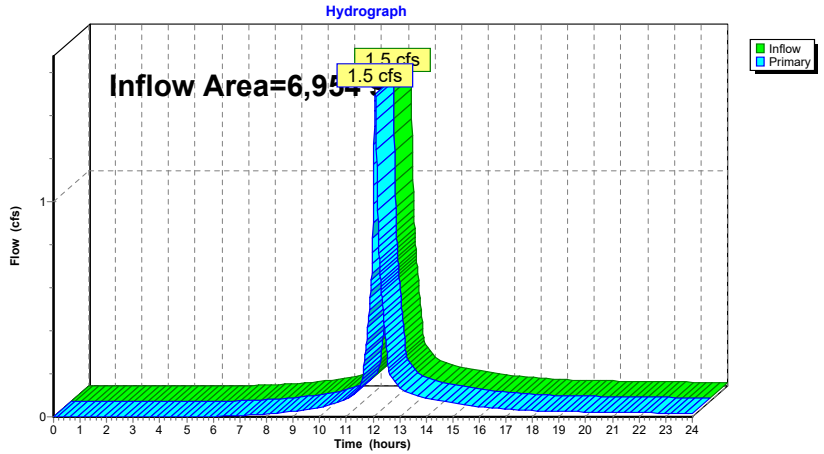


Summary for Link 2L: Towards Street

Inflow Area = 6,954 sf, 13.30% Impervious, Inflow Depth > 8.14" for 100-Year event
Inflow = 1.5 cfs @ 12.09 hrs, Volume= 4,716 cf
Primary = 1.5 cfs @ 12.09 hrs, Volume= 4,716 cf, Atten= 0%, Lag= 0.0 min
Routed to Link 100L : Total Flows

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Link 2L: Towards Street

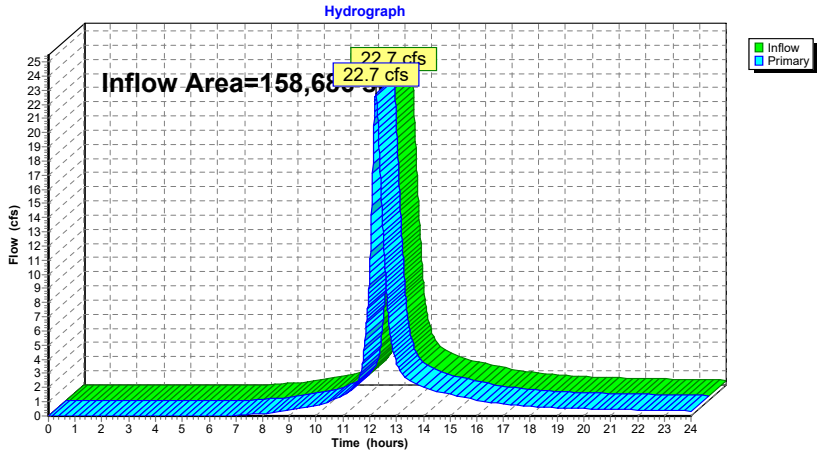


Summary for Link 100L: Total Flows

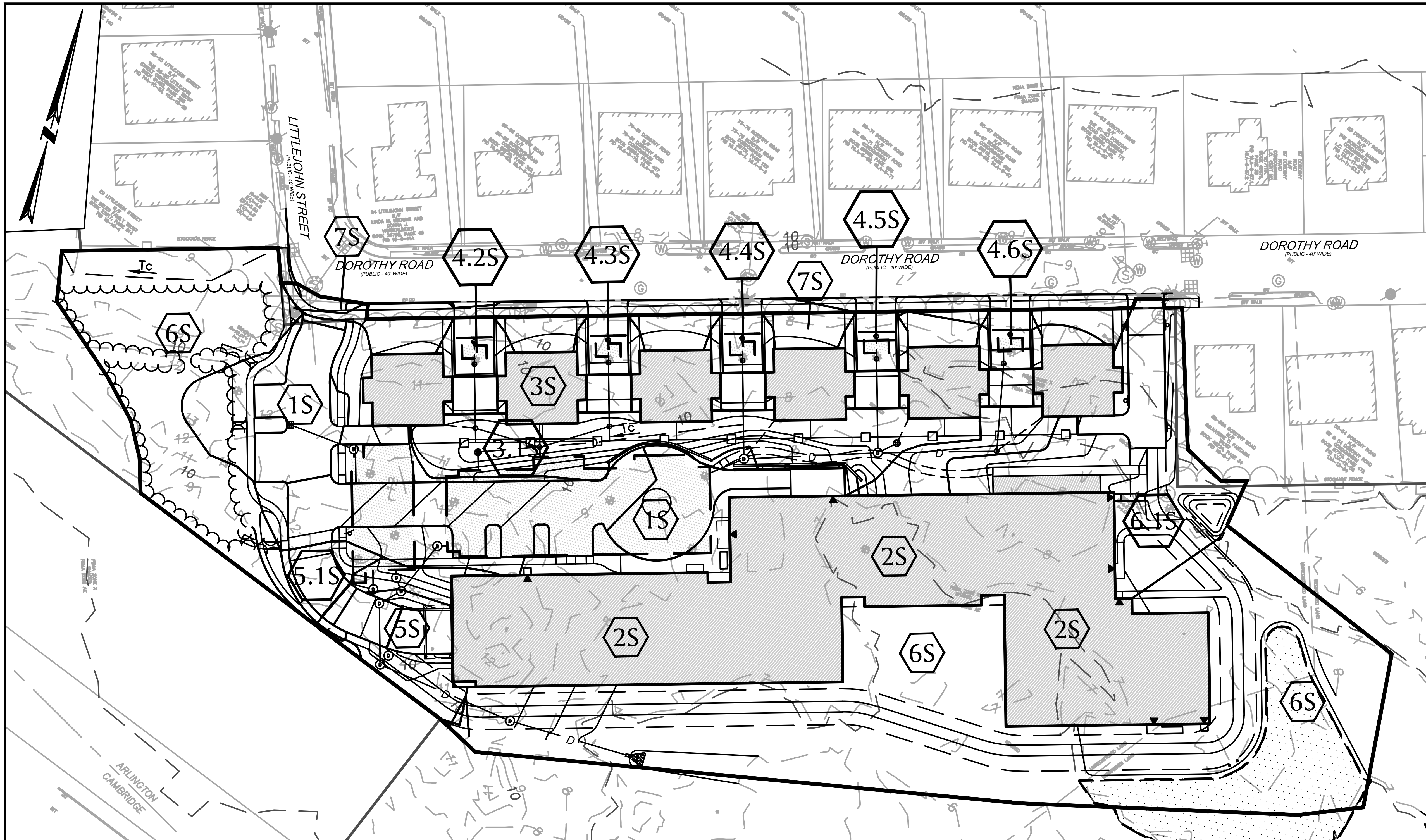
Inflow Area = 158,686 sf, 0.58% Impervious, Inflow Depth > 7.59" for 100-Year event
Inflow = 22.7 cfs @ 12.23 hrs, Volume= 100,347 cf
Primary = 22.7 cfs @ 12.23 hrs, Volume= 100,347 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Link 100L: Total Flows



5.03 PROPOSED WATERSHED PLAN



LEGEND

1S	SUBCATCHMENT
	SUBCATCHMENT BOUNDARY
Tc	TIME OF CONCENTRATION FLOW PATH

SCALE: 1" = 60'

0 30 60 120 FEET

THORNDIKE PLACE

DOROTHY ROAD

ARLINGTON MASSACHUSETTS

(MIDDLESEX COUNTY)

PROPOSED WATERSHED PLAN

NOVEMBER 3, 2020

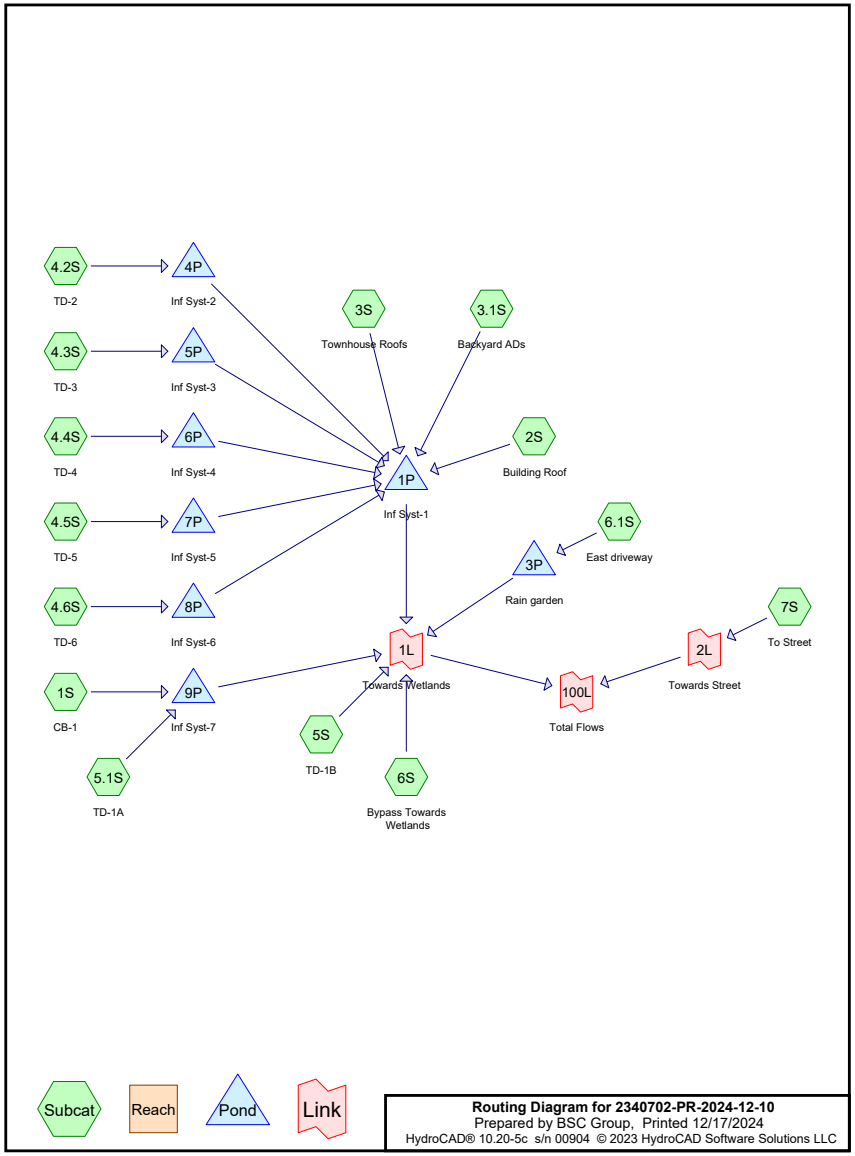
PREPARED FOR:

ARLINGTON LAND REALTY
84 SHERMAN STREET
CAMBRIDGE, MA

BSC GROUP
803 Summer Street
Boston, Massachusetts
02127
617 896 4300

Job No.: 23407.02 Date: 11/3/2020
Scale: 1" = 60' Revised: 12/10/2024
Dwg No: PRW
File: C\DRAINAGE DESIGN\2340700-PRW

5.04 PROPOSED HYDROLOGY CALCULATIONS (HYDROCAD™ PRINTOUTS)



Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-Year	Type III 24-hr		Default	24.00	1	4.02	2
2	10-Year	Type III 24-hr		Default	24.00	1	6.40	2
3	25-Year	Type III 24-hr		Default	24.00	1	8.30	2
4	50-Year	Type III 24-hr		Default	24.00	1	9.67	2
5	100-Year	Type III 24-hr		Default	24.00	1	11.50	2

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
74,381	74	>75% Grass cover, Good, HSG C (1S, 3.1S, 4.2S, 4.3S, 4.4S, 4.5S, 4.6S, 5.1S, 5S, 6.1S, 6S, 7S)
220	89	Gravel roads, HSG C (6.1S)
411	89	Gravel sidewalk, HSG C (3.1S)
25,874	98	Paved parking, HSG C (1S, 4.2S, 4.3S, 4.4S, 4.5S, 4.6S, 5.1S, 5S, 7S)
6,444	98	Paved roads w/curbs & sewers, HSG C (6.1S)
46,099	98	Roofs, HSG C (2S, 3S, 6S)
272	98	Unconnected pavement, HSG C (3.1S)
4,985	70	Woods, Good, HSG C (6S)
158,686	**86**	**TOTAL AREA**

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
0	HSG A	
0	HSG B	
158,686	HSG C	1S, 2S, 3.1S, 3S, 4.2S, 4.3S, 4.4S, 4.5S, 4.6S, 5.1S, 5S, 6.1S, 6S, 7S
0	HSG D	
0	Other	
158,686		**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
0	0	74,381	0	0	74,381	>75% Grass cover, Good
0	0	220	0	0	220	Gravel roads
0	0	411	0	0	411	Gravel sidewalk
0	0	25,874	0	0	25,874	Paved parking
0	0	6,444	0	0	6,444	Paved roads w/curbs & sewers
0	0	46,099	0	0	46,099	Roofs
0	0	272	0	0	272	Unconnected pavement
0	0	4,985	0	0	4,985	Woods, Good
0	**0**	**158,686**	**0**	**0**	**158,686**	**TOTAL AREA**

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

Subcatchment1S: CB-1 Runoff Area=22,742 sf 72.16% Impervious Runoff Depth=3.04"
Tc=6.0 min CN=91 Runoff=1.8 cfs 5,755 cf

Subcatchment2S: Building Roof Runoff Area=32,925 sf 100.00% Impervious Runoff Depth=3.79"
Tc=6.0 min CN=98 Runoff=3.0 cfs 10,385 cf

Subcatchment3.1S: Backyard ADs Runoff Area=8,985 sf 3.03% Impervious Runoff Depth=1.68"
Flow Length=147' Tc=10.3 min CN=75 Runoff=0.3 cfs 1,259 cf

Subcatchment3S: Townhouse Roofs Runoff Area=13,067 sf 100.00% Impervious Runoff Depth=3.79"
Tc=6.0 min CN=98 Runoff=1.2 cfs 4,122 cf

Subcatchment4.2S: TD-2 Runoff Area=1,112 sf 95.68% Impervious Runoff Depth=3.67"
Tc=6.0 min CN=97 Runoff=0.1 cfs 340 cf

Subcatchment4.3S: TD-3 Runoff Area=1,105 sf 97.29% Impervious Runoff Depth=3.67"
Tc=6.0 min CN=97 Runoff=0.1 cfs 338 cf

Subcatchment4.4S: TD-4 Runoff Area=1,104 sf 97.46% Impervious Runoff Depth=3.67"
Tc=6.0 min CN=97 Runoff=0.1 cfs 338 cf

Subcatchment4.5S: TD-5 Runoff Area=1,082 sf 98.06% Impervious Runoff Depth=3.79"
Tc=6.0 min CN=98 Runoff=0.1 cfs 341 cf

Subcatchment4.6S: TD-6 Runoff Area=1,056 sf 99.24% Impervious Runoff Depth=3.79"
Tc=6.0 min CN=98 Runoff=0.1 cfs 333 cf

Subcatchment5.1S: TD-1A Runoff Area=1,389 sf 84.59% Impervious Runoff Depth=3.34"
Tc=6.0 min CN=94 Runoff=0.1 cfs 387 cf

Subcatchment5S: TD-1B Runoff Area=4,462 sf 42.78% Impervious Runoff Depth=2.39"
Tc=6.0 min CN=84 Runoff=0.3 cfs 888 cf

Subcatchment6.1S: East driveway Runoff Area=12,275 sf 52.50% Impervious Runoff Depth=2.66"
Tc=6.0 min CN=87 Runoff=0.9 cfs 2,716 cf

Subcatchment6S: Bypass Towards Runoff Area=51,539 sf 0.21% Impervious Runoff Depth=1.61"
Flow Length=125' Tc=14.0 min CN=74 Runoff=1.7 cfs 6,919 cf

Subcatchment7S: To Street Runoff Area=5,843 sf 18.07% Impervious Runoff Depth=1.90"
Tc=6.0 min CN=78 Runoff=0.3 cfs 927 cf

Pond 1P: Inf Syst-1 Peak Elev=9.37' Storage=8,769 cf Inflow=4.8 cfs 16,622 cf
Discarded=0.1 cfs 13,377 cf Primary=0.3 cfs 3,246 cf Outflow=0.4 cfs 16,622 cf

Pond 3P: Rain garden Peak Elev=6.42' Storage=216 cf Inflow=0.9 cfs 2,716 cf
Discarded=0.0 cfs 444 cf Primary=0.9 cfs 2,272 cf Outflow=0.9 cfs 2,716 cf

Pond 4P: Inf Syst-2 Peak Elev=9.41' Storage=129 cf Inflow=0.1 cfs 340 cf
Discarded=0.0 cfs 156 cf Primary=0.1 cfs 171 cf Outflow=0.1 cfs 327 cf

Pond 5P: Inf Syst-3 Peak Elev=9.55' Storage=134 cf Inflow=0.1 cfs 338 cf
Discarded=0.0 cfs 156 cf Primary=0.1 cfs 163 cf Outflow=0.1 cfs 319 cf

Pond 6P: Inf Syst-4 Peak Elev=9.55' Storage=134 cf Inflow=0.1 cfs 338 cf
Discarded=0.0 cfs 156 cf Primary=0.1 cfs 163 cf Outflow=0.1 cfs 319 cf

Pond 7P: Inf Syst-5 Peak Elev=9.18' Storage=117 cf Inflow=0.1 cfs 341 cf
Discarded=0.0 cfs 157 cf Primary=0.1 cfs 183 cf Outflow=0.1 cfs 341 cf

Pond 8P: Inf Syst-6 Peak Elev=9.20' Storage=118 cf Inflow=0.1 cfs 333 cf
Discarded=0.0 cfs 157 cf Primary=0.1 cfs 175 cf Outflow=0.1 cfs 332 cf

Pond 9P: Inf Syst-7 Peak Elev=7.84' Storage=1,431 cf Inflow=1.9 cfs 6,142 cf
Discarded=0.0 cfs 1,379 cf Primary=1.1 cfs 4,762 cf Outflow=1.1 cfs 6,142 cf

Link 1L: Towards Wetlands Inflow=3.6 cfs 18,088 cf
Primary=3.6 cfs 18,088 cf

Link 2L: Towards Street Inflow=0.3 cfs 927 cf
Primary=0.3 cfs 927 cf

Link 100L: Total Flows Inflow=3.8 cfs 19,014 cf
Primary=3.8 cfs 19,014 cf

Total Runoff Area = 158,686 sf Runoff Volume = 35,048 cf Average Runoff Depth = 2.65"
50.41% Pervious = 79,997 sf 49.59% Impervious = 78,689 sf

Summary for Subcatchment 1S: CB-1

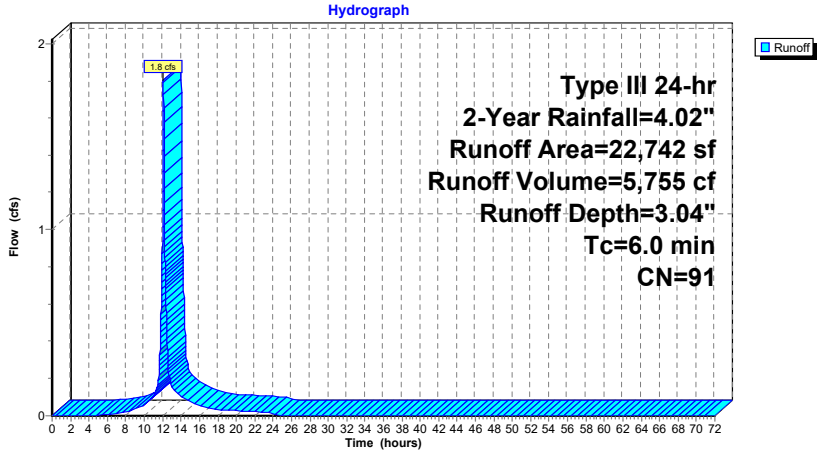
Runoff = 1.8 cfs @ 12.09 hrs, Volume= 5,755 cf, Depth= 3.04"
Routed to Pond 9P : Inf Syst-7

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-Year Rainfall=4.02"

Area (sf)	CN	Description
16,410	98	Paved parking, HSG C
6,332	74	>75% Grass cover, Good, HSG C
22,742	91	Weighted Average
6,332		27.84% Pervious Area
16,410		72.16% Impervious Area

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

Subcatchment 1S: CB-1



Summary for Subcatchment 2S: Building Roof

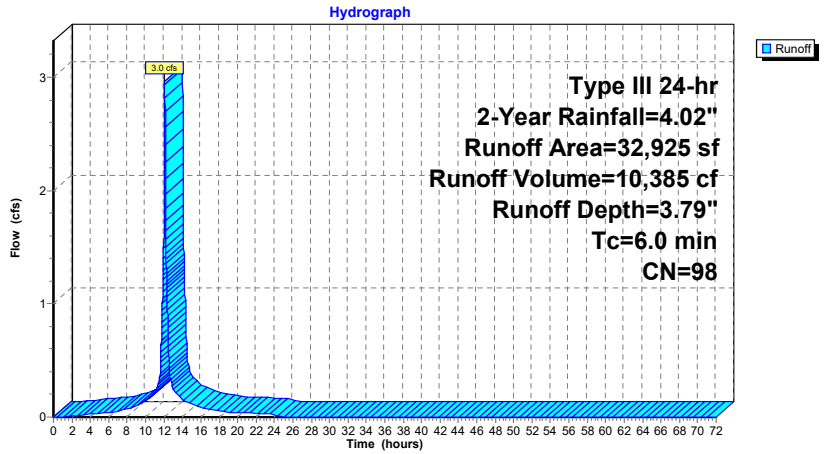
Runoff = 3.0 cfs @ 12.08 hrs, Volume= 10,385 cf, Depth= 3.79"
Routed to Pond 1P : Inf Syst-1

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-Year Rainfall=4.02"

Area (sf)	CN	Description
32,925	98	Roofs, HSG C
32,925		100.00% Impervious Area

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

Subcatchment 2S: Building Roof



Summary for Subcatchment 3.1S: Backyard ADs

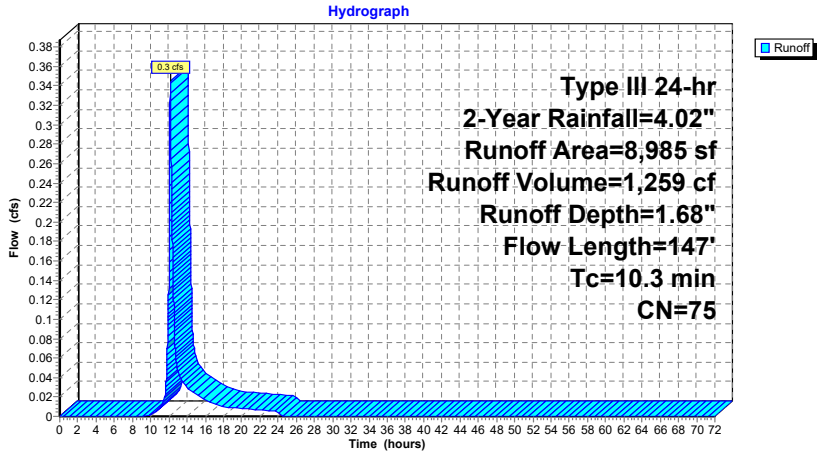
Runoff = 0.3 cfs @ 12.15 hrs, Volume= 1,259 cf, Depth= 1.68"
Routed to Pond 1P : Inf Syst-1

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-Year Rainfall=4.02"

	Area (sf)	CN	Description
	272	98	Unconnected pavement, HSG C
	8,302	74	>75% Grass cover, Good, HSG C
*	411	89	Gravel sidewalk, HSG C
	8,985	75	Weighted Average
	8,713		96.97% Pervious Area
	272		3.03% Impervious Area
	272		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.4	50	0.0142	0.09		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.23"
0.9	97	0.0154	1.86		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
10.3	147	Total			

Subcatchment 3.1S: Backyard ADs



Summary for Subcatchment 3S: Townhouse Roofs

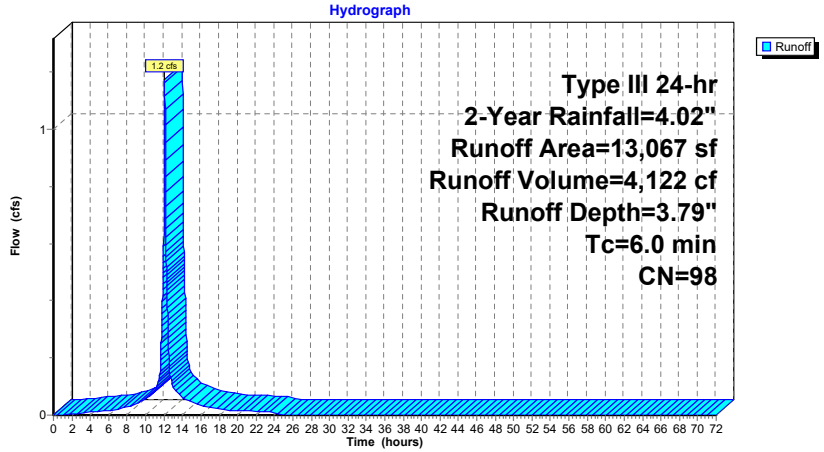
Runoff = 1.2 cfs @ 12.08 hrs, Volume= 4,122 cf, Depth= 3.79"
Routed to Pond 1P : Inf Syst-1

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-Year Rainfall=4.02"

Area (sf)	CN	Description
13,067	98	Roofs, HSG C
13,067		100.00% Impervious Area

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

Subcatchment 3S: Townhouse Roofs



Summary for Subcatchment 4.2S: TD-2

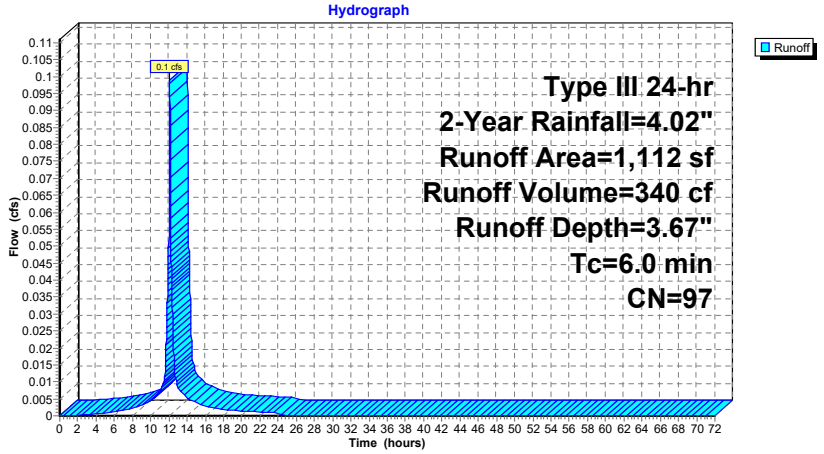
Runoff = 0.1 cfs @ 12.08 hrs, Volume= 340 cf, Depth= 3.67"
Routed to Pond 4P : Inf Syst-2

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-Year Rainfall=4.02"

Area (sf)	CN	Description
1,064	98	Paved parking, HSG C
48	74	>75% Grass cover, Good, HSG C
1,112	97	Weighted Average
48		4.32% Pervious Area
1,064		95.68% Impervious Area

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

Subcatchment 4.2S: TD-2



Summary for Subcatchment 4.3S: TD-3

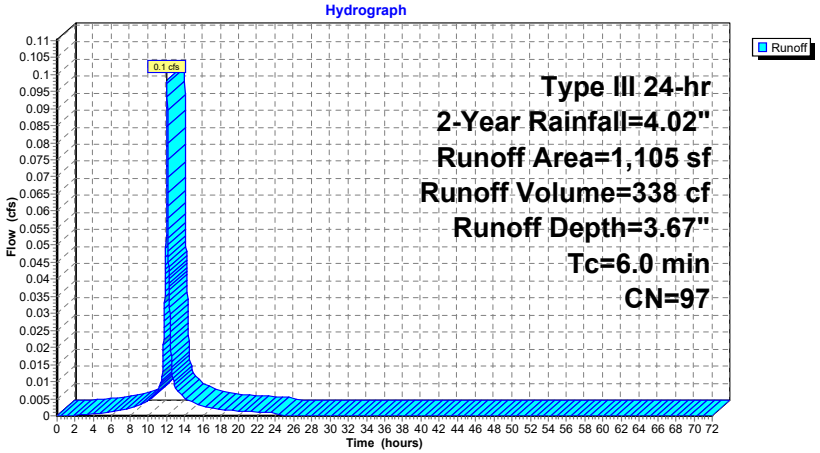
Runoff = 0.1 cfs @ 12.08 hrs, Volume= 338 cf, Depth= 3.67"
Routed to Pond 5P : Inf Syst-3

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-Year Rainfall=4.02"

Area (sf)	CN	Description
1,075	98	Paved parking, HSG C
30	74	>75% Grass cover, Good, HSG C
1,105	97	Weighted Average
30		2.71% Pervious Area
1,075		97.29% Impervious Area

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

Subcatchment 4.3S: TD-3



Summary for Subcatchment 4.4S: TD-4

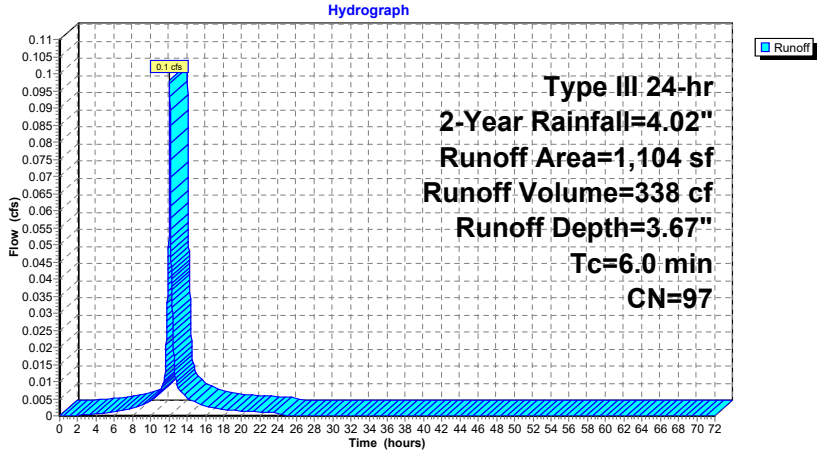
Runoff = 0.1 cfs @ 12.08 hrs, Volume= 338 cf, Depth= 3.67"
Routed to Pond 6P : Inf Syst-4

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-Year Rainfall=4.02"

Area (sf)	CN	Description
1,076	98	Paved parking, HSG C
28	74	>75% Grass cover, Good, HSG C
1,104	97	Weighted Average
28		2.54% Pervious Area
1,076		97.46% Impervious Area

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

Subcatchment 4.4S: TD-4



Summary for Subcatchment 4.5S: TD-5

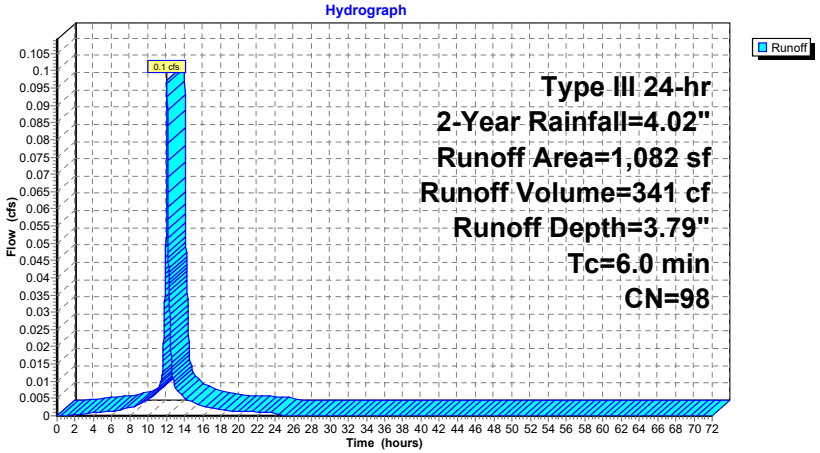
Runoff = 0.1 cfs @ 12.08 hrs, Volume= 341 cf, Depth= 3.79"
Routed to Pond 7P : Inf Syst-5

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-Year Rainfall=4.02"

Area (sf)	CN	Description
1,061	98	Paved parking, HSG C
21	74	>75% Grass cover, Good, HSG C
1,082	98	Weighted Average
21		1.94% Pervious Area
1,061		98.06% Impervious Area

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

Subcatchment 4.5S: TD-5



Summary for Subcatchment 4.6S: TD-6

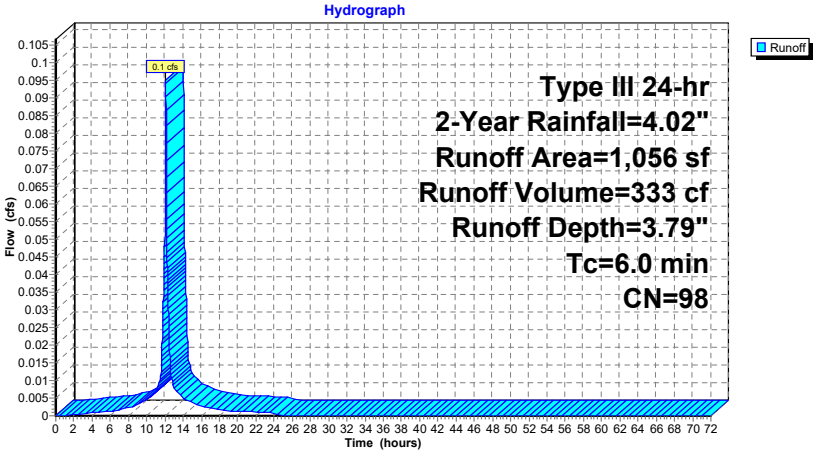
Runoff = 0.1 cfs @ 12.08 hrs, Volume= 333 cf, Depth= 3.79"
Routed to Pond 8P : Inf Syst-6

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-Year Rainfall=4.02"

Area (sf)	CN	Description
1,048	98	Paved parking, HSG C
8	74	>75% Grass cover, Good, HSG C
1,056	98	Weighted Average
8		0.76% Pervious Area
1,048		99.24% Impervious Area

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

Subcatchment 4.6S: TD-6



Summary for Subcatchment 5.1S: TD-1A

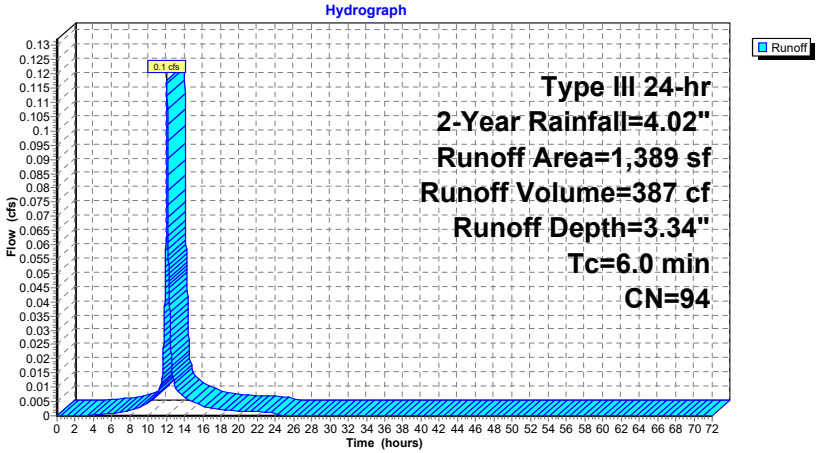
Runoff = 0.1 cfs @ 12.08 hrs, Volume= 387 cf, Depth= 3.34"
Routed to Pond 9P : Inf Syst-7

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-Year Rainfall=4.02"

Area (sf)	CN	Description
1,175	98	Paved parking, HSG C
214	74	>75% Grass cover, Good, HSG C
1,389	94	Weighted Average
214		15.41% Pervious Area
1,175		84.59% Impervious Area

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

Subcatchment 5.1S: TD-1A



Summary for Subcatchment 5S: TD-1B

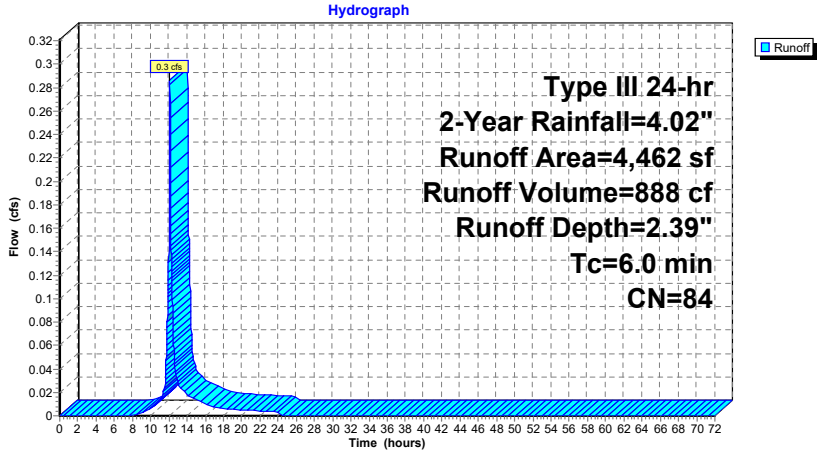
Runoff = 0.3 cfs @ 12.09 hrs, Volume= 888 cf, Depth= 2.39"
Routed to Link 1L : Towards Wetlands

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-Year Rainfall=4.02"

Area (sf)	CN	Description
1,909	98	Paved parking, HSG C
2,553	74	>75% Grass cover, Good, HSG C
4,462	84	Weighted Average
2,553		57.22% Pervious Area
1,909		42.78% Impervious Area

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

Subcatchment 5S: TD-1B



Summary for Subcatchment 6.1S: East driveway

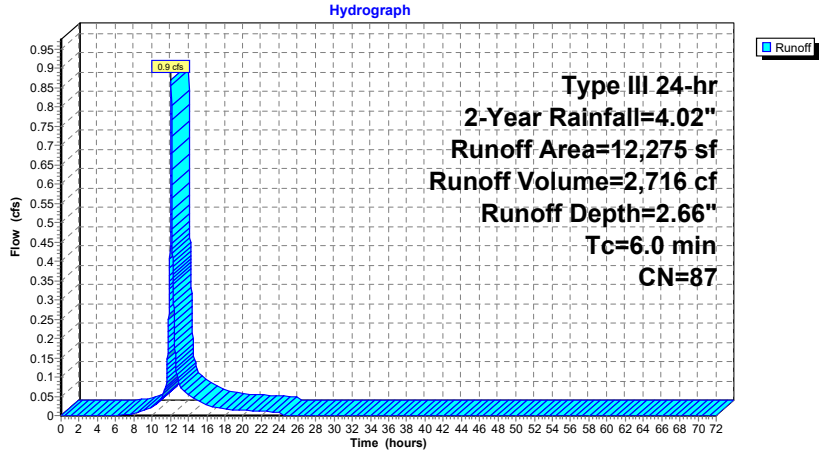
Runoff = 0.9 cfs @ 12.09 hrs, Volume= 2,716 cf, Depth= 2.66"
Routed to Pond 3P : Rain garden

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-Year Rainfall=4.02"

Area (sf)	CN	Description
5,611	74	>75% Grass cover, Good, HSG C
6,444	98	Paved roads w/curbs & sewers, HSG C
220	89	Gravel roads, HSG C
12,275	87	Weighted Average
5,831		47.50% Pervious Area
6,444		52.50% Impervious Area

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

Subcatchment 6.1S: East driveway



Summary for Subcatchment 6S: Bypass Towards Wetlands

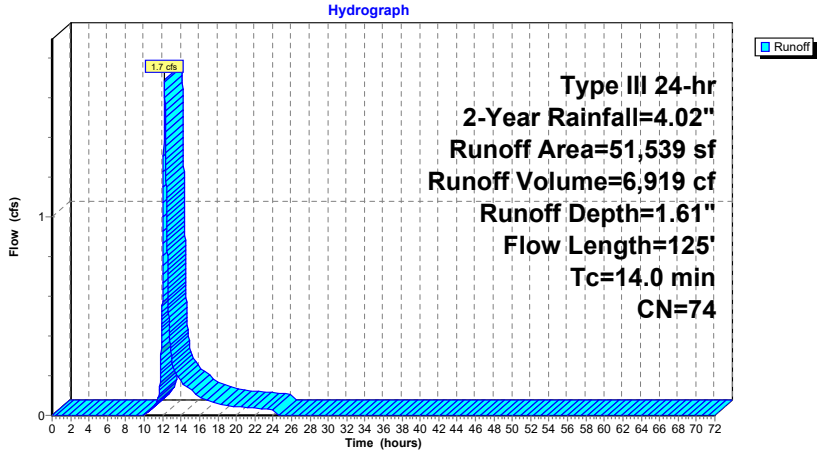
Runoff = 1.7 cfs @ 12.20 hrs, Volume= 6,919 cf, Depth= 1.61"
Routed to Link 1L : Towards Wetlands

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-Year Rainfall=4.02"

Area (sf)	CN	Description
4,985	70	Woods, Good, HSG C
46,447	74	>75% Grass cover, Good, HSG C
107	98	Roofs, HSG C
51,539	74	Weighted Average
51,432		99.79% Pervious Area
107		0.21% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.8	50	0.0220	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.23"
2.2	75	0.0133	0.58		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
14.0	125	Total			

Subcatchment 6S: Bypass Towards Wetlands



Summary for Subcatchment 7S: To Street

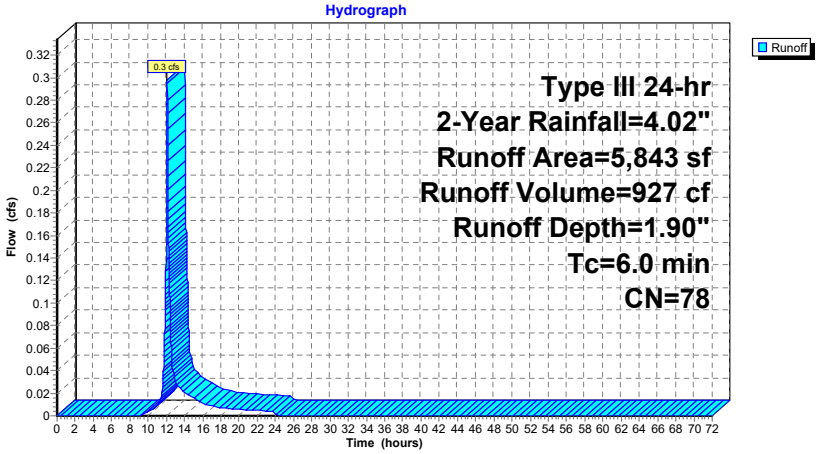
Runoff = 0.3 cfs @ 12.09 hrs, Volume= 927 cf, Depth= 1.90"
Routed to Link 2L : Towards Street

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-Year Rainfall=4.02"

Area (sf)	CN	Description
1,056	98	Paved parking, HSG C
4,787	74	>75% Grass cover, Good, HSG C
5,843	78	Weighted Average
4,787		81.93% Pervious Area
1,056		18.07% Impervious Area

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

Subcatchment 7S: To Street



Summary for Pond 1P: Inf Syst-1

Inflow Area = 60,436 sf, 85.36% Impervious, Inflow Depth = 3.30" for 2-Year event
Inflow = 4.8 cfs @ 12.09 hrs, Volume= 16,622 cf
Outflow = 0.4 cfs @ 13.02 hrs, Volume= 16,622 cf, Atten= 91%, Lag= 55.8 min
Discarded = 0.1 cfs @ 8.25 hrs, Volume= 13,377 cf
Primary = 0.3 cfs @ 13.02 hrs, Volume= 3,246 cf
Routed to Link 1L : Towards Wetlands

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 9.37' @ 13.02 hrs Surf.Area= 7,459 sf Storage= 8,769 cf

Plug-Flow detention time= 660.2 min calculated for 16,620 cf (100% of inflow)
Center-of-Mass det. time= 660.3 min (1,423.4 - 763.1)

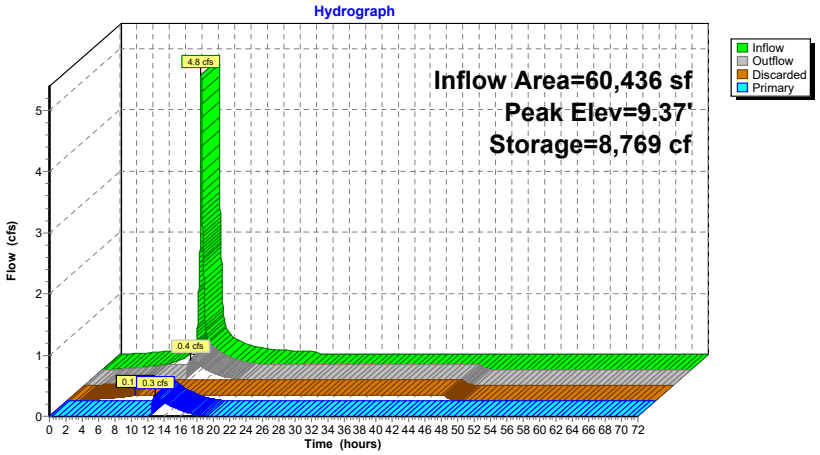
Volume	Invert	Avail.Storage	Storage Description
#1	8.00'	19,245 cf	**6.89'W x 14.06'L x 3.00'H StormTrap ST-1 Units (Irregular Shape)** x 77 22,378 cf Overall x 86.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Discarded	8.00'	**0.520 in/hr Exfiltration over Surface area**
#2	Primary	8.00'	**15.0" Round Culvert** L= 26.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 8.00' / 7.13' S= 0.0335 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#3	Device 2	9.22'	**22.0" W x 4.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 2	10.05'	**20.0" W x 4.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Device 2	10.79'	**3.7' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Discarded OutFlow Max=0.1 cfs @ 8.25 hrs HW=8.03' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.1 cfs)

Primary OutFlow Max=0.3 cfs @ 13.02 hrs HW=9.37' (Free Discharge)
└**2=Culvert** (Passes 0.3 cfs of 5.1 cfs potential flow)
  ├**3=Orifice/Grate** (Orifice Controls 0.3 cfs @ 1.23 fps)
  ├**4=Orifice/Grate** (Controls 0.0 cfs)
  └**5=Sharp-Crested Rectangular Weir** (Controls 0.0 cfs)

Pond 1P: Inf Syst-1



Summary for Pond 3P: Rain garden

Inflow Area = 12,275 sf, 52.50% Impervious, Inflow Depth = 2.66" for 2-Year event
Inflow = 0.9 cfs @ 12.09 hrs, Volume= 2,716 cf
Outflow = 0.9 cfs @ 12.09 hrs, Volume= 2,716 cf, Atten= 0%, Lag= 0.3 min
Discarded = 0.0 cfs @ 12.09 hrs, Volume= 444 cf
Primary = 0.9 cfs @ 12.09 hrs, Volume= 2,272 cf
Routed to Link 1L : Towards Wetlands

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 6.42' @ 12.09 hrs Surf.Area= 412 sf Storage= 216 cf

Plug-Flow detention time= 90.5 min calculated for 2,715 cf (100% of inflow)
Center-of-Mass det. time= 90.6 min (900.2 - 809.6)

Volume	Invert	Avail.Storage	Storage Description
#1	5.60'	253 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

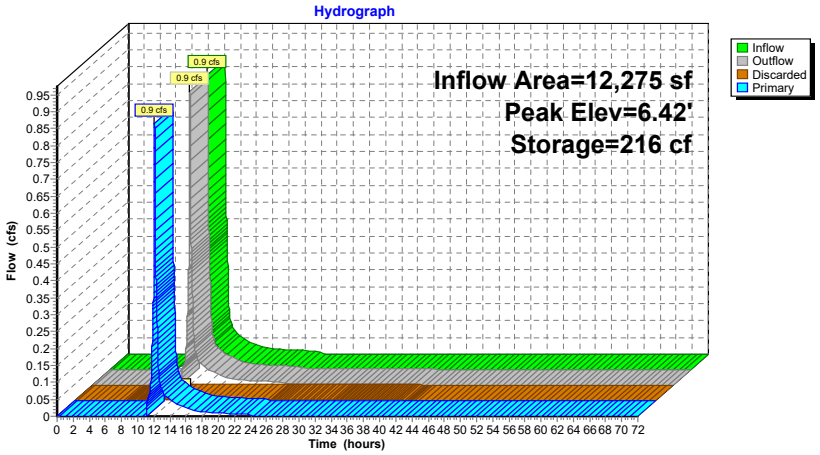
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
5.60	125	46.0	0	0	125
6.00	276	66.0	78	78	305
6.30	350	73.0	94	172	385
6.50	460	87.0	81	253	564

Device	Routing	Invert	Outlet Devices
#1	Discarded	5.60'	**0.520 in/hr Exfiltration over Surface area**
#2	Primary	6.35'	**22.0' 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

Discarded OutFlow Max=0.0 cfs @ 12.09 hrs HW=6.42' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.9 cfs @ 12.09 hrs HW=6.42' (Free Discharge)
↑**2=Broad-Crested Rectangular Weir** (Weir Controls 0.9 cfs @ 0.60 fps)

Pond 3P: Rain garden



Summary for Pond 4P: Inf Syst-2

Inflow Area = 1,112 sf, 95.68% Impervious, Inflow Depth = 3.67" for 2-Year event
Inflow = 0.1 cfs @ 12.08 hrs, Volume= 340 cf
Outflow = 0.1 cfs @ 12.11 hrs, Volume= 327 cf, Atten= 4%, Lag= 1.4 min
Discarded = 0.0 cfs @ 4.64 hrs, Volume= 156 cf
Primary = 0.1 cfs @ 12.11 hrs, Volume= 171 cf
Routed to Pond 1P : Inf Syst-1

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 9.41' @ 12.11 hrs Surf.Area= 101 sf Storage= 129 cf

Plug-Flow detention time= 773.3 min calculated for 327 cf (96% of inflow)
Center-of-Mass det. time= 749.8 min (1,510.3 - 760.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	7.00'	84 cf	**7.28'W x 13.84'L x 2.72'H Field A** 274 cf Overall - 64 cf Embedded = 210 cf x 40.0% Voids
#2A	7.25'	57 cf	**Ferguson R-Tank XD 12** x 10 Inside #1 Inside= 19.7"W x 23.6"H => 2.91 sf x 1.97'L = 5.7 cf Outside= 19.7"W x 23.6"H => 3.23 sf x 1.97'L = 6.4 cf 10 Chambers in 2 Rows
		141 cf	Total Available Storage

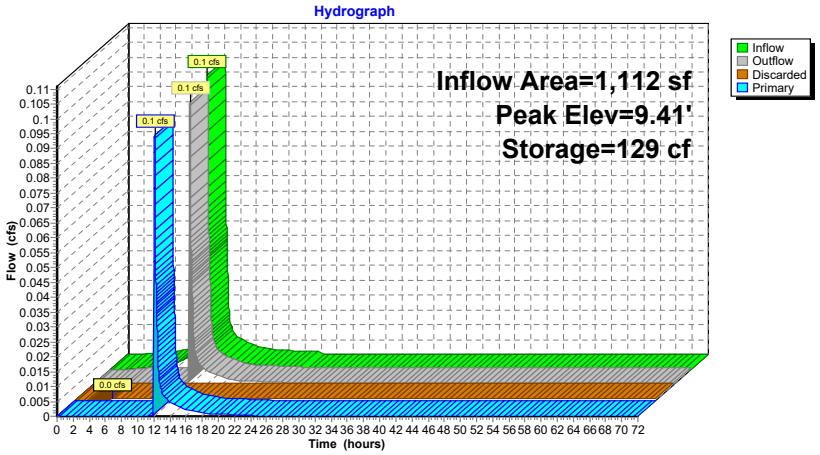
Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	7.00'	**0.270 in/hr Exfiltration over Surface area**
#2	Primary	9.23'	**6.0" Round Culvert** L= 33.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 9.23' / 8.72' S= 0.0155 '/' Cc= 0.900 n= 0.013, Flow Area= 0.20 sf

Discarded OutFlow Max=0.0 cfs @ 4.64 hrs HW=7.03' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.1 cfs @ 12.11 hrs HW=9.41' (Free Discharge)
↑**2=Culvert** (Inlet Controls 0.1 cfs @ 1.45 fps)

Pond 4P: Inf Syst-2



Summary for Pond 5P: Inf Syst-3

Inflow Area = 1,105 sf, 97.29% Impervious, Inflow Depth = 3.67" for 2-Year event
Inflow = 0.1 cfs @ 12.08 hrs, Volume= 338 cf
Outflow = 0.1 cfs @ 12.12 hrs, Volume= 319 cf, Atten= 8%, Lag= 2.2 min
Discarded = 0.0 cfs @ 4.68 hrs, Volume= 156 cf
Primary = 0.1 cfs @ 12.12 hrs, Volume= 163 cf
Routed to Pond 1P : Inf Syst-1

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 9.55' @ 12.12 hrs Surf.Area= 101 sf Storage= 134 cf

Plug-Flow detention time= 799.9 min calculated for 319 cf (94% of inflow)
Center-of-Mass det. time= 768.5 min (1,529.0 - 760.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	7.00'	84 cf	**7.28'W x 13.84'L x 2.72'H Field A** 274 cf Overall - 64 cf Embedded = 210 cf x 40.0% Voids
#2A	7.25'	57 cf	**Ferguson R-Tank XD 12** x 10 Inside #1 Inside= 19.7"W x 23.6"H => 2.91 sf x 1.97'L = 5.7 cf Outside= 19.7"W x 23.6"H => 3.23 sf x 1.97'L = 6.4 cf 10 Chambers in 2 Rows
		141 cf	Total Available Storage

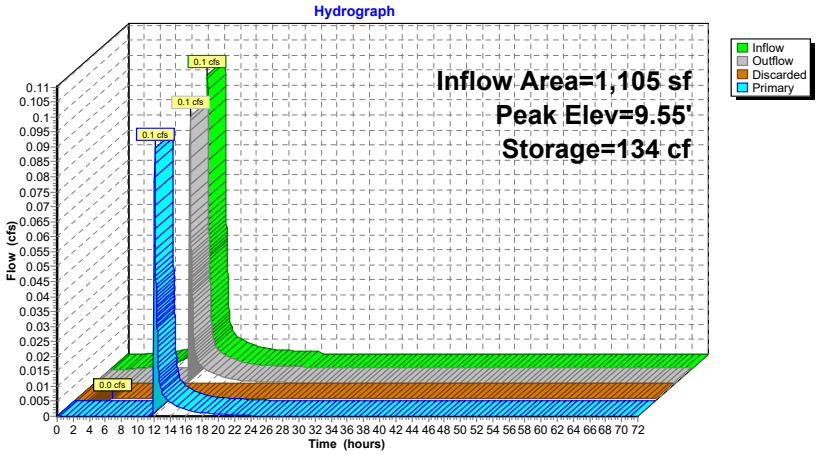
Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	7.00'	**0.270 in/hr Exfiltration over Surface area**
#2	Primary	9.37'	**6.0" Round Culvert** L= 33.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 9.37' / 8.73' S= 0.0194 '/' Cc= 0.900 n= 0.013, Flow Area= 0.20 sf

Discarded OutFlow Max=0.0 cfs @ 4.68 hrs HW=7.03' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.1 cfs @ 12.12 hrs HW=9.55' (Free Discharge)
↑**2=Culvert** (Inlet Controls 0.1 cfs @ 1.43 fps)

Pond 5P: Inf Syst-3



Summary for Pond 6P: Inf Syst-4

Inflow Area = 1,104 sf, 97.46% Impervious, Inflow Depth = 3.67" for 2-Year event
Inflow = 0.1 cfs @ 12.08 hrs, Volume= 338 cf
Outflow = 0.1 cfs @ 12.12 hrs, Volume= 319 cf, Atten= 9%, Lag= 2.2 min
Discarded = 0.0 cfs @ 4.68 hrs, Volume= 156 cf
Primary = 0.1 cfs @ 12.12 hrs, Volume= 163 cf
Routed to Pond 1P : Inf Syst-1

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 9.55' @ 12.12 hrs Surf.Area= 101 sf Storage= 134 cf

Plug-Flow detention time= 800.6 min calculated for 319 cf (94% of inflow)
Center-of-Mass det. time= 769.2 min (1,529.7 - 760.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	7.00'	84 cf	**7.28'W x 13.84'L x 2.72'H Field A** 274 cf Overall - 64 cf Embedded = 210 cf x 40.0% Voids
#2A	7.25'	57 cf	**Ferguson R-Tank XD 12** x 10 Inside #1 Inside= 19.7"W x 23.6"H => 2.91 sf x 1.97'L = 5.7 cf Outside= 19.7"W x 23.6"H => 3.23 sf x 1.97'L = 6.4 cf 10 Chambers in 2 Rows
		141 cf	Total Available Storage

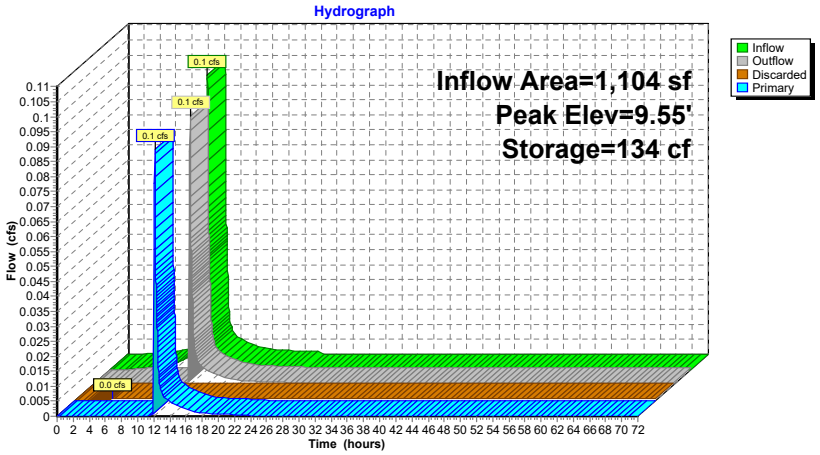
Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	7.00'	**0.270 in/hr Exfiltration over Surface area**
#2	Primary	9.37'	**6.0" Round Culvert** L= 51.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 9.37' / 8.10' S= 0.0249 '/' Cc= 0.900 n= 0.013, Flow Area= 0.20 sf

Discarded OutFlow Max=0.0 cfs @ 4.68 hrs HW=7.03' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.1 cfs @ 12.12 hrs HW=9.55' (Free Discharge)
↑**2=Culvert** (Inlet Controls 0.1 cfs @ 1.43 fps)

Pond 6P: Inf Syst-4



Summary for Pond 7P: Inf Syst-5

Inflow Area = 1,082 sf, 98.06% Impervious, Inflow Depth = 3.79" for 2-Year event
Inflow = 0.1 cfs @ 12.08 hrs, Volume= 341 cf
Outflow = 0.1 cfs @ 12.10 hrs, Volume= 341 cf, Atten= 1%, Lag= 0.7 min
Discarded = 0.0 cfs @ 3.77 hrs, Volume= 157 cf
Primary = 0.1 cfs @ 12.10 hrs, Volume= 183 cf
Routed to Pond 1P : Inf Syst-1

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 9.18' @ 12.10 hrs Surf.Area= 101 sf Storage= 117 cf

Plug-Flow detention time= 722.0 min calculated for 341 cf (100% of inflow)
Center-of-Mass det. time= 721.1 min (1,473.0 - 751.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	7.00'	73 cf	**7.28'W x 13.84'L x 2.39'H Field A** 241 cf Overall - 58 cf Embedded = 182 cf x 40.0% Voids
#2A	7.25'	52 cf	**Ferguson R-Tank XD 11** x 10 Inside #1 Inside= 19.7"W x 21.7"H => 2.66 sf x 1.97'L = 5.2 cf Outside= 19.7"W x 21.7"H => 2.96 sf x 1.97'L = 5.8 cf 10 Chambers in 2 Rows
		125 cf	Total Available Storage

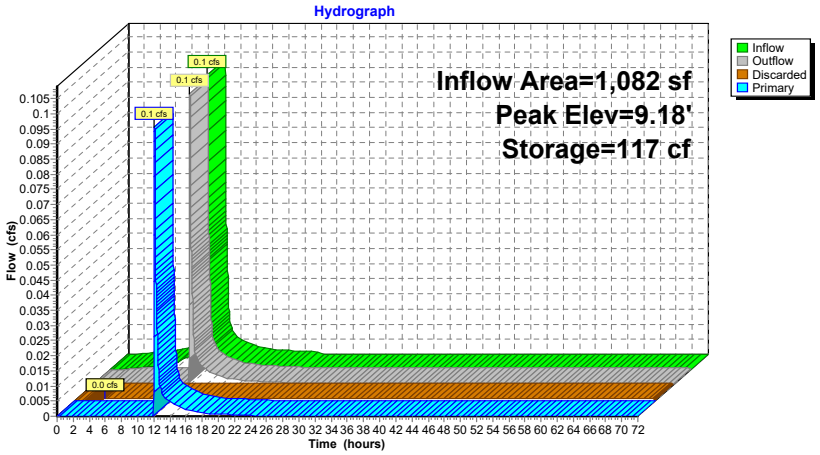
Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	7.00'	**0.270 in/hr Exfiltration over Surface area**
#2	Primary	9.00'	**6.0" Round Culvert** L= 48.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 9.00' / 8.35' S= 0.0135 '/' Cc= 0.900 n= 0.013, Flow Area= 0.20 sf

Discarded OutFlow Max=0.0 cfs @ 3.77 hrs HW=7.03' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.1 cfs @ 12.10 hrs HW=9.18' (Free Discharge)
↑**2=Culvert** (Inlet Controls 0.1 cfs @ 1.46 fps)

Pond 7P: Inf Syst-5



Summary for Pond 8P: Inf Syst-6

Inflow Area = 1,056 sf, 99.24% Impervious, Inflow Depth = 3.79" for 2-Year event
Inflow = 0.1 cfs @ 12.08 hrs, Volume= 333 cf
Outflow = 0.1 cfs @ 12.10 hrs, Volume= 332 cf, Atten= 1%, Lag= 0.8 min
Discarded = 0.0 cfs @ 3.86 hrs, Volume= 157 cf
Primary = 0.1 cfs @ 12.10 hrs, Volume= 175 cf
Routed to Pond 1P : Inf Syst-1

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 9.20' @ 12.10 hrs Surf.Area= 101 sf Storage= 118 cf

Plug-Flow detention time= 739.6 min calculated for 332 cf (100% of inflow)
Center-of-Mass det. time= 738.4 min (1,490.2 - 751.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	7.00'	73 cf	**7.28'W x 13.84'L x 2.39'H Field A** 241 cf Overall - 58 cf Embedded = 182 cf x 40.0% Voids
#2A	7.25'	52 cf	**Ferguson R-Tank XD 11** x 10 Inside #1 Inside= 19.7"W x 21.7"H => 2.66 sf x 1.97'L = 5.2 cf Outside= 19.7"W x 21.7"H => 2.96 sf x 1.97'L = 5.8 cf 10 Chambers in 2 Rows
		125 cf	Total Available Storage

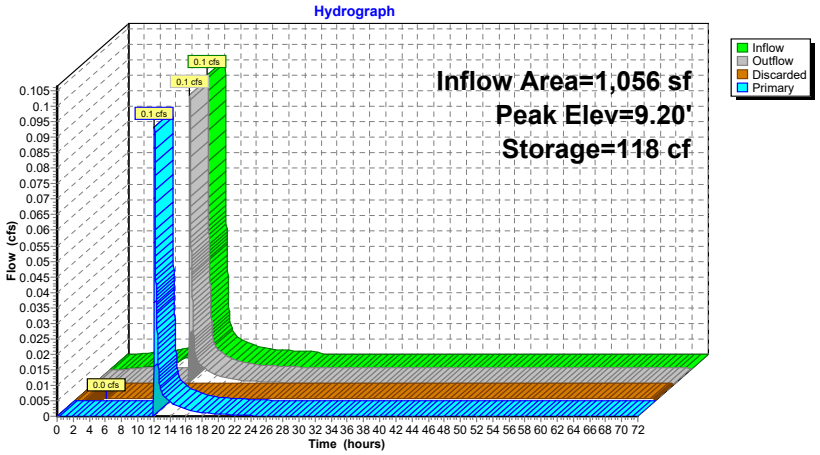
Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	7.00'	**0.270 in/hr Exfiltration over Surface area**
#2	Primary	9.00'	**8.0" Round Culvert** L= 46.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 9.00' / 8.77' S= 0.0050 '/' Cc= 0.900 n= 0.013, Flow Area= 0.35 sf

Discarded OutFlow Max=0.0 cfs @ 3.86 hrs HW=7.03' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.1 cfs @ 12.10 hrs HW=9.20' (Free Discharge)
↑**2=Culvert** (Barrel Controls 0.1 cfs @ 1.58 fps)

Pond 8P: Inf Syst-6



Summary for Pond 9P: Inf Syst-7

Inflow Area = 24,131 sf, 72.87% Impervious, Inflow Depth = 3.05" for 2-Year event
Inflow = 1.9 cfs @ 12.09 hrs, Volume= 6,142 cf
Outflow = 1.1 cfs @ 12.19 hrs, Volume= 6,142 cf, Atten= 41%, Lag= 6.4 min
Discarded = 0.0 cfs @ 7.94 hrs, Volume= 1,379 cf
Primary = 1.1 cfs @ 12.19 hrs, Volume= 4,762 cf
Routed to Link 1L : Towards Wetlands

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 7.84' @ 12.19 hrs Surf.Area= 2,422 sf Storage= 1,431 cf

Plug-Flow detention time= 91.3 min calculated for 6,141 cf (100% of inflow)
Center-of-Mass det. time= 91.4 min (884.7 - 793.3)

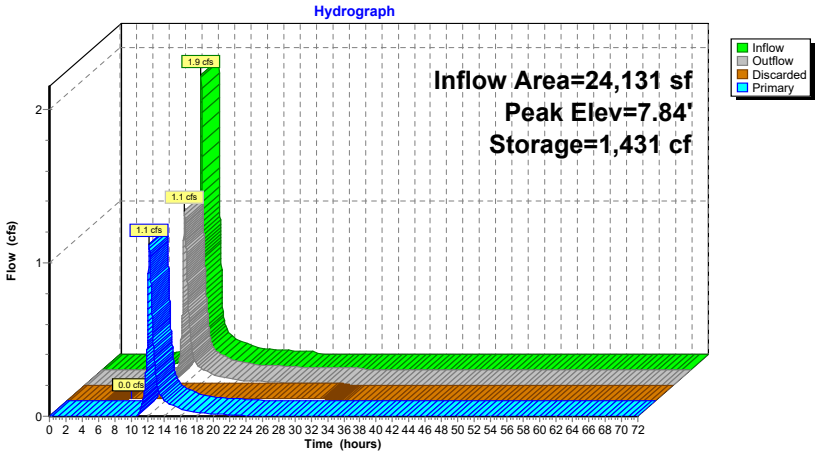
Volume	Invert	Avail.Storage	Storage Description
#1	7.15'	3,645 cf	**6.89'W x 14.06'L x 1.75'H StormTrap ST-1 Units (Irregular Shape)** x 25 4,238 cf Overall x 86.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Discarded	7.15'	**0.270 in/hr Exfiltration over Surface area**
#2	Primary	7.15'	**12.0" Round Culvert** L= 4.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 7.15' / 7.13' S= 0.0050 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#3	Device 2	7.35'	**22.0" W x 4.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.0 cfs @ 7.94 hrs HW=7.17' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=1.1 cfs @ 12.19 hrs HW=7.84' (Free Discharge)
↑**2=Culvert** (Barrel Controls 1.1 cfs @ 2.76 fps)
↑**3=Orifice/Grate** (Passes 1.1 cfs of 1.6 cfs potential flow)

Pond 9P: Inf Syst-7

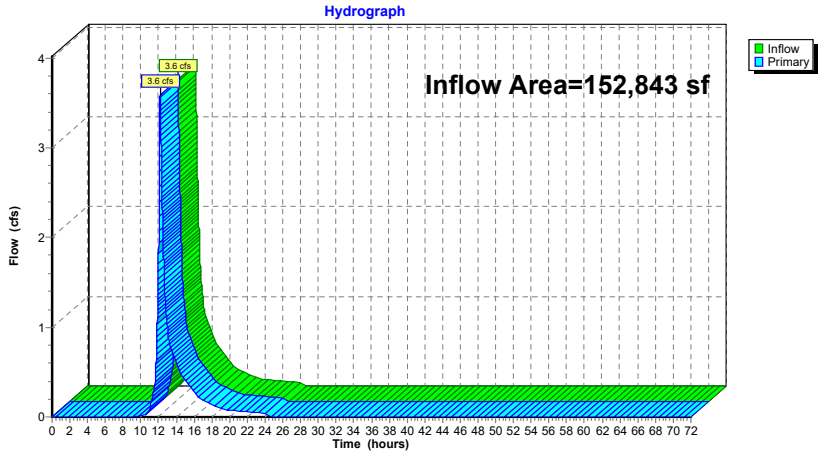


Summary for Link 1L: Towards Wetlands

Inflow Area = 152,843 sf, 50.79% Impervious, Inflow Depth = 1.42" for 2-Year event
Inflow = 3.6 cfs @ 12.16 hrs, Volume= 18,088 cf
Primary = 3.6 cfs @ 12.16 hrs, Volume= 18,088 cf, Atten= 0%, Lag= 0.0 min
Routed to Link 100L : Total Flows

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

Link 1L: Towards Wetlands

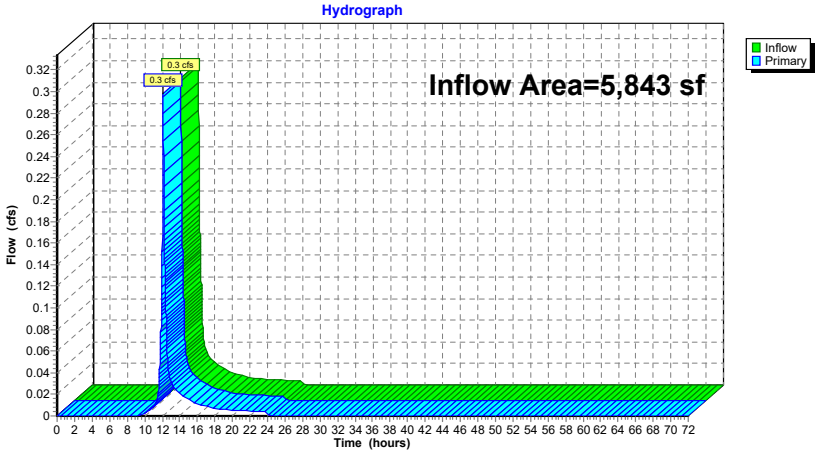


Summary for Link 2L: Towards Street

Inflow Area = 5,843 sf, 18.07% Impervious, Inflow Depth = 1.90" for 2-Year event
Inflow = 0.3 cfs @ 12.09 hrs, Volume= 927 cf
Primary = 0.3 cfs @ 12.09 hrs, Volume= 927 cf, Atten= 0%, Lag= 0.0 min
Routed to Link 100L : Total Flows

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

Link 2L: Towards Street

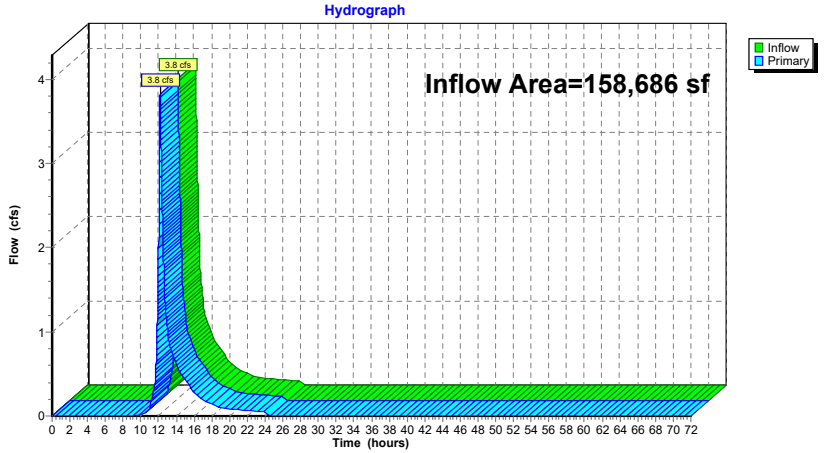


Summary for Link 100L: Total Flows

Inflow Area = 158,686 sf, 49.59% Impervious, Inflow Depth = 1.44" for 2-Year event
Inflow = 3.8 cfs @ 12.15 hrs, Volume= 19,014 cf
Primary = 3.8 cfs @ 12.15 hrs, Volume= 19,014 cf, Atten= 0%, Lag= 0.0 min

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

Link 100L: Total Flows



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

Subcatchment1S: CB-1 Runoff Area=22,742 sf 72.16% Impervious Runoff Depth=5.35"
Tc=6.0 min CN=91 Runoff=3.1 cfs 10,138 cf

Subcatchment2S: Building Roof Runoff Area=32,925 sf 100.00% Impervious Runoff Depth=6.16"
Tc=6.0 min CN=98 Runoff=4.7 cfs 16,905 cf

Subcatchment3.1S: Backyard ADs Runoff Area=8,985 sf 3.03% Impervious Runoff Depth=3.63"
Flow Length=147' Tc=10.3 min CN=75 Runoff=0.8 cfs 2,715 cf

Subcatchment3S: Townhouse Roofs Runoff Area=13,067 sf 100.00% Impervious Runoff Depth=6.16"
Tc=6.0 min CN=98 Runoff=1.9 cfs 6,709 cf

Subcatchment4.2S: TD-2 Runoff Area=1,112 sf 95.68% Impervious Runoff Depth=6.04"
Tc=6.0 min CN=97 Runoff=0.2 cfs 560 cf

Subcatchment4.3S: TD-3 Runoff Area=1,105 sf 97.29% Impervious Runoff Depth=6.04"
Tc=6.0 min CN=97 Runoff=0.2 cfs 556 cf

Subcatchment4.4S: TD-4 Runoff Area=1,104 sf 97.46% Impervious Runoff Depth=6.04"
Tc=6.0 min CN=97 Runoff=0.2 cfs 556 cf

Subcatchment4.5S: TD-5 Runoff Area=1,082 sf 98.06% Impervious Runoff Depth=6.16"
Tc=6.0 min CN=98 Runoff=0.2 cfs 556 cf

Subcatchment4.6S: TD-6 Runoff Area=1,056 sf 99.24% Impervious Runoff Depth=6.16"
Tc=6.0 min CN=98 Runoff=0.2 cfs 542 cf

Subcatchment5.1S: TD-1A Runoff Area=1,389 sf 84.59% Impervious Runoff Depth=5.69"
Tc=6.0 min CN=94 Runoff=0.2 cfs 659 cf

Subcatchment5S: TD-1B Runoff Area=4,462 sf 42.78% Impervious Runoff Depth=4.57"
Tc=6.0 min CN=84 Runoff=0.5 cfs 1,700 cf

Subcatchment6.1S: East driveway Runoff Area=12,275 sf 52.50% Impervious Runoff Depth=4.90"
Tc=6.0 min CN=87 Runoff=1.6 cfs 5,013 cf

Subcatchment6S: Bypass Towards Runoff Area=51,539 sf 0.21% Impervious Runoff Depth=3.52"
Flow Length=125' Tc=14.0 min CN=74 Runoff=3.8 cfs 15,135 cf

Subcatchment7S: To Street Runoff Area=5,843 sf 18.07% Impervious Runoff Depth=3.93"
Tc=6.0 min CN=78 Runoff=0.6 cfs 1,916 cf

Pond 1P: Inf Syst-1 Peak Elev=9.96' Storage=12,545 cf Inflow=8.0 cfs 28,251 cf
Discarded=0.1 cfs 14,540 cf Primary=2.2 cfs 13,710 cf Outflow=2.3 cfs 28,251 cf

Pond 3P: Rain garden Peak Elev=6.45' Storage=229 cf Inflow=1.6 cfs 5,013 cf
Discarded=0.0 cfs 477 cf Primary=1.6 cfs 4,537 cf Outflow=1.6 cfs 5,013 cf

Pond 4P: Inf Syst-2 Peak Elev=9.47' Storage=131 cf Inflow=0.2 cfs 560 cf
Discarded=0.0 cfs 159 cf Primary=0.2 cfs 388 cf Outflow=0.2 cfs 547 cf

Pond 5P: Inf Syst-3 Peak Elev=9.61' Storage=137 cf Inflow=0.2 cfs 556 cf
Discarded=0.0 cfs 159 cf Primary=0.2 cfs 379 cf Outflow=0.2 cfs 537 cf

Pond 6P: Inf Syst-4 Peak Elev=9.61' Storage=137 cf Inflow=0.2 cfs 556 cf
Discarded=0.0 cfs 159 cf Primary=0.2 cfs 378 cf Outflow=0.2 cfs 537 cf

Pond 7P: Inf Syst-5 Peak Elev=9.24' Storage=119 cf Inflow=0.2 cfs 556 cf
Discarded=0.0 cfs 160 cf Primary=0.2 cfs 395 cf Outflow=0.2 cfs 555 cf

Pond 8P: Inf Syst-6 Peak Elev=9.26' Storage=120 cf Inflow=0.2 cfs 542 cf
Discarded=0.0 cfs 160 cf Primary=0.2 cfs 382 cf Outflow=0.2 cfs 541 cf

Pond 9P: Inf Syst-7 Peak Elev=8.14' Storage=2,069 cf Inflow=3.3 cfs 10,797 cf
Discarded=0.0 cfs 1,502 cf Primary=2.1 cfs 9,295 cf Outflow=2.1 cfs 10,797 cf

Link 1L: Towards Wetlands Inflow=9.0 cfs 44,377 cf
Primary=9.0 cfs 44,377 cf

Link 2L: Towards Street Inflow=0.6 cfs 1,916 cf
Primary=0.6 cfs 1,916 cf

Link 100L: Total Flows Inflow=9.4 cfs 46,293 cf
Primary=9.4 cfs 46,293 cf

Total Runoff Area = 158,686 sf Runoff Volume = 63,661 cf Average Runoff Depth = 4.81"
50.41% Pervious = 79,997 sf 49.59% Impervious = 78,689 sf

Summary for Subcatchment 1S: CB-1

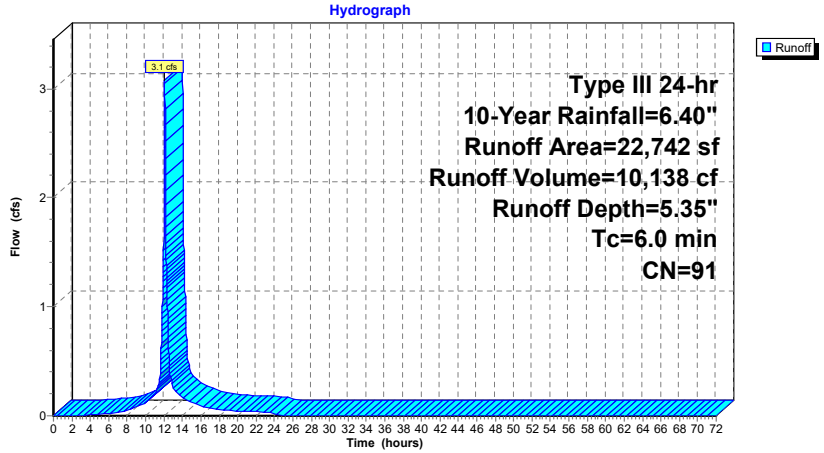
Runoff = 3.1 cfs @ 12.08 hrs, Volume= 10,138 cf, Depth= 5.35"
Routed to Pond 9P : Inf Syst-7

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-Year Rainfall=6.40"

Area (sf)	CN	Description
16,410	98	Paved parking, HSG C
6,332	74	>75% Grass cover, Good, HSG C
22,742	91	Weighted Average
6,332		27.84% Pervious Area
16,410		72.16% Impervious Area

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

Subcatchment 1S: CB-1



Summary for Subcatchment 2S: Building Roof

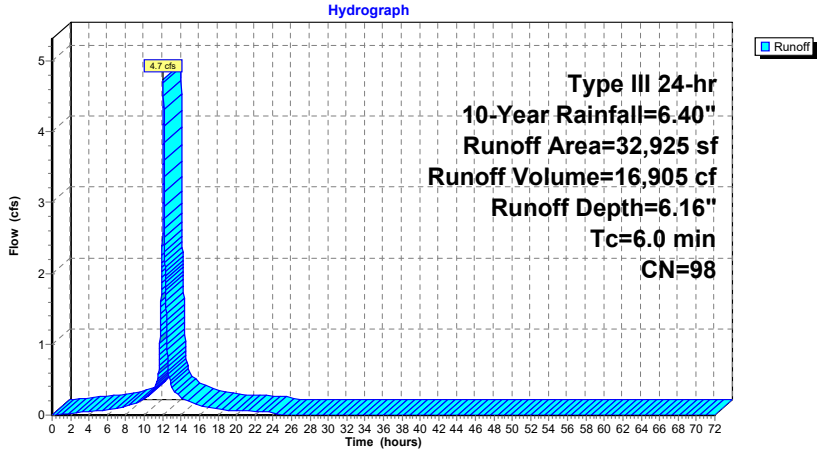
Runoff = 4.7 cfs @ 12.08 hrs, Volume= 16,905 cf, Depth= 6.16"
Routed to Pond 1P : Inf Syst-1

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-Year Rainfall=6.40"

Area (sf)	CN	Description
32,925	98	Roofs, HSG C
32,925		100.00% Impervious Area

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

Subcatchment 2S: Building Roof



Summary for Subcatchment 3.1S: Backyard ADs

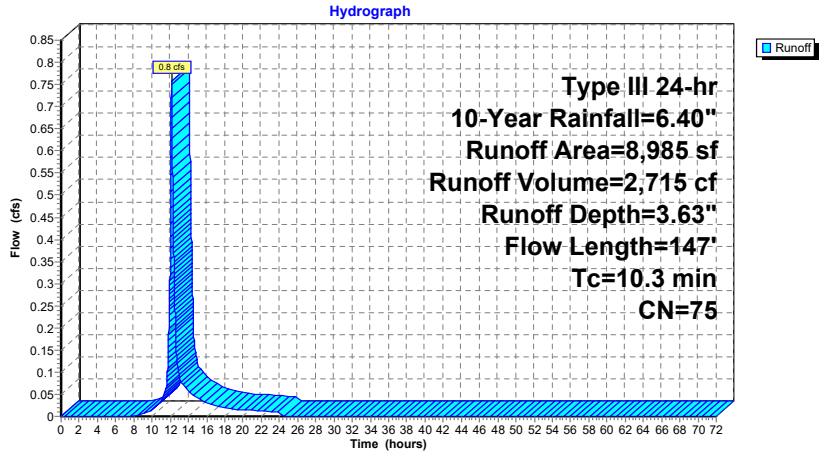
Runoff = 0.8 cfs @ 12.14 hrs, Volume= 2,715 cf, Depth= 3.63"
Routed to Pond 1P : Inf Syst-1

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-Year Rainfall=6.40"

	Area (sf)	CN	Description
	272	98	Unconnected pavement, HSG C
	8,302	74	>75% Grass cover, Good, HSG C
*	411	89	Gravel sidewalk, HSG C
	8,985	75	Weighted Average
	8,713		96.97% Pervious Area
	272		3.03% Impervious Area
	272		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.4	50	0.0142	0.09		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.23"
0.9	97	0.0154	1.86		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
10.3	147	Total			

Subcatchment 3.1S: Backyard ADs



Summary for Subcatchment 3S: Townhouse Roofs

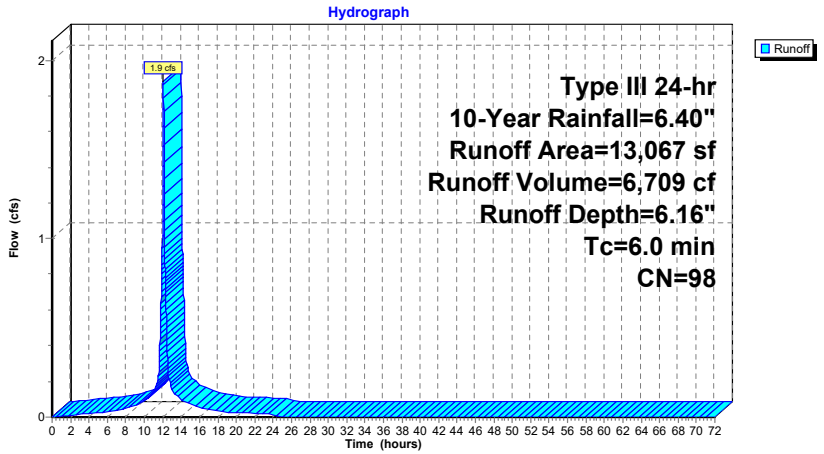
Runoff = 1.9 cfs @ 12.08 hrs, Volume= 6,709 cf, Depth= 6.16"
Routed to Pond 1P : Inf Syst-1

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-Year Rainfall=6.40"

Area (sf)	CN	Description
13,067	98	Roofs, HSG C
13,067		100.00% Impervious Area

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

Subcatchment 3S: Townhouse Roofs



Summary for Subcatchment 4.2S: TD-2

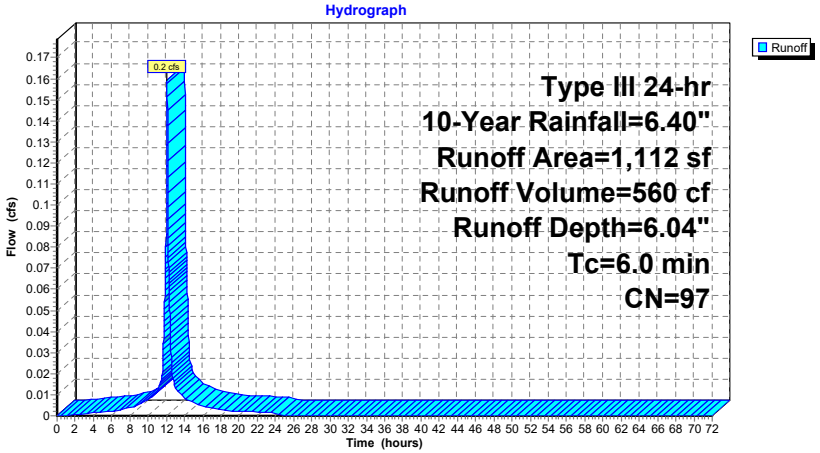
Runoff = 0.2 cfs @ 12.08 hrs, Volume= 560 cf, Depth= 6.04"
Routed to Pond 4P : Inf Syst-2

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-Year Rainfall=6.40"

Area (sf)	CN	Description
1,064	98	Paved parking, HSG C
48	74	>75% Grass cover, Good, HSG C
1,112	97	Weighted Average
48		4.32% Pervious Area
1,064		95.68% Impervious Area

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

Subcatchment 4.2S: TD-2



Summary for Subcatchment 4.3S: TD-3

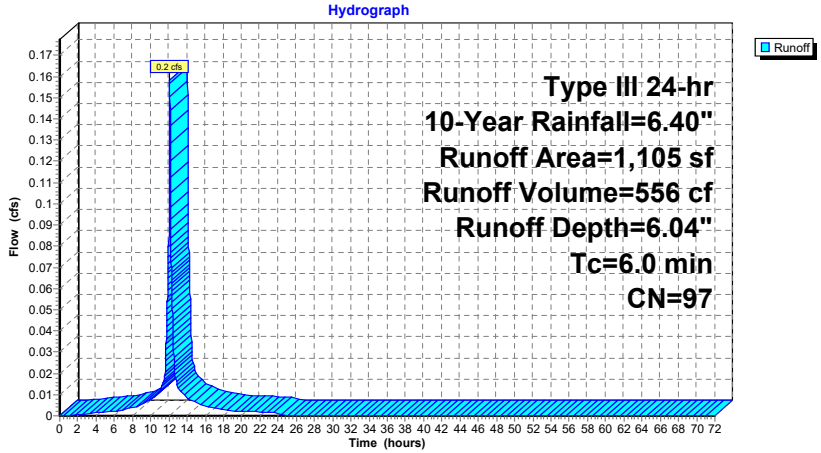
Runoff = 0.2 cfs @ 12.08 hrs, Volume= 556 cf, Depth= 6.04"
Routed to Pond 5P : Inf Syst-3

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-Year Rainfall=6.40"

Area (sf)	CN	Description
1,075	98	Paved parking, HSG C
30	74	>75% Grass cover, Good, HSG C
1,105	97	Weighted Average
30		2.71% Pervious Area
1,075		97.29% Impervious Area

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

Subcatchment 4.3S: TD-3



Summary for Subcatchment 4.4S: TD-4

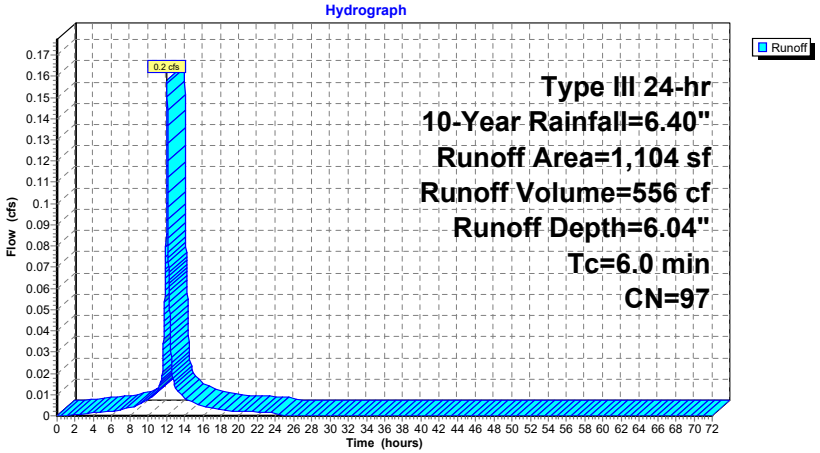
Runoff = 0.2 cfs @ 12.08 hrs, Volume= 556 cf, Depth= 6.04"
Routed to Pond 6P : Inf Syst-4

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-Year Rainfall=6.40"

Area (sf)	CN	Description
1,076	98	Paved parking, HSG C
28	74	>75% Grass cover, Good, HSG C
1,104	97	Weighted Average
28		2.54% Pervious Area
1,076		97.46% Impervious Area

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

Subcatchment 4.4S: TD-4



Summary for Subcatchment 4.5S: TD-5

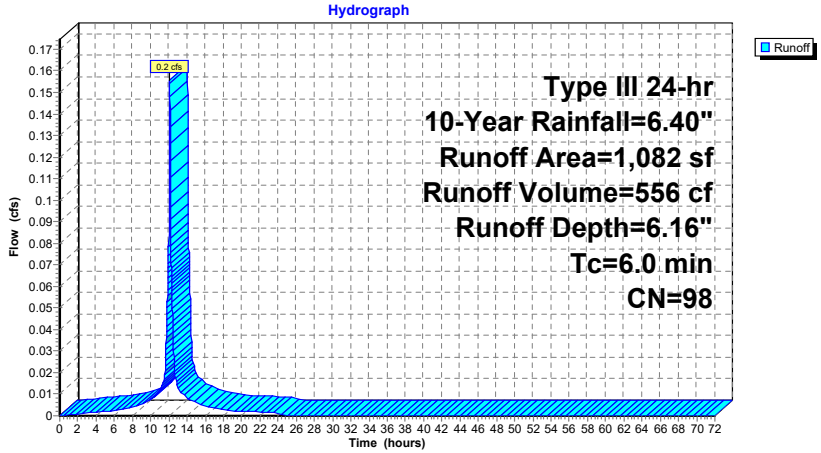
Runoff = 0.2 cfs @ 12.08 hrs, Volume= 556 cf, Depth= 6.16"
Routed to Pond 7P : Inf Syst-5

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-Year Rainfall=6.40"

Area (sf)	CN	Description
1,061	98	Paved parking, HSG C
21	74	>75% Grass cover, Good, HSG C
1,082	98	Weighted Average
21		1.94% Pervious Area
1,061		98.06% Impervious Area

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

Subcatchment 4.5S: TD-5



Summary for Subcatchment 4.6S: TD-6

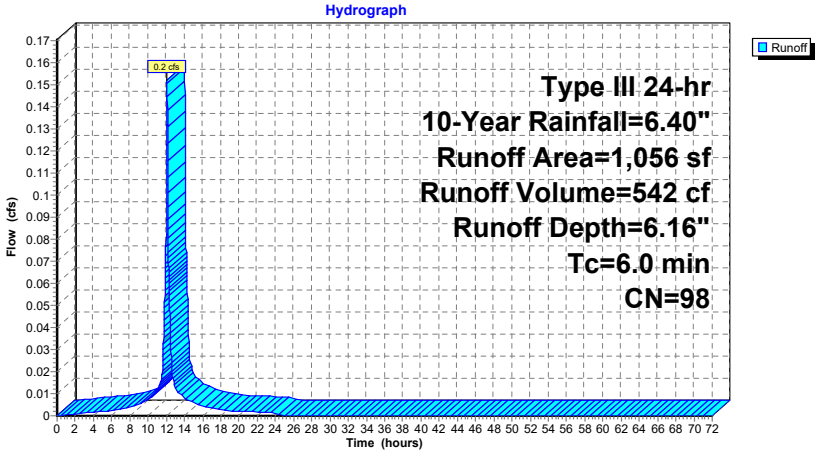
Runoff = 0.2 cfs @ 12.08 hrs, Volume= 542 cf, Depth= 6.16"
Routed to Pond 8P : Inf Syst-6

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-Year Rainfall=6.40"

Area (sf)	CN	Description
1,048	98	Paved parking, HSG C
8	74	>75% Grass cover, Good, HSG C
1,056	98	Weighted Average
8		0.76% Pervious Area
1,048		99.24% Impervious Area

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

Subcatchment 4.6S: TD-6



Summary for Subcatchment 5.1S: TD-1A

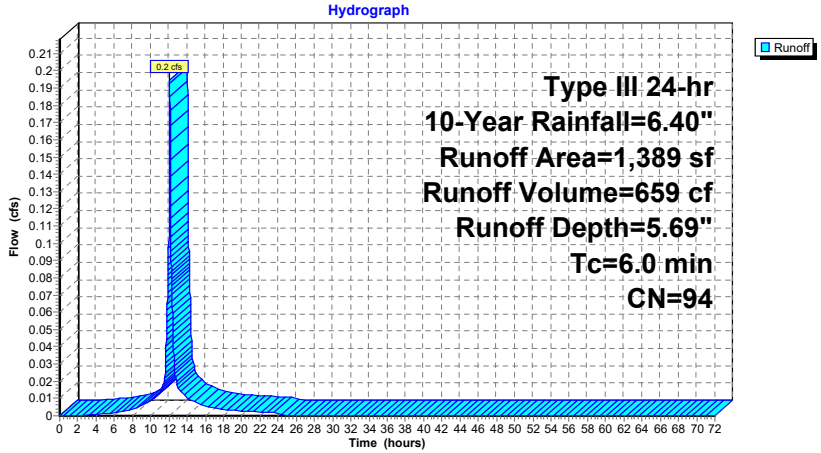
Runoff = 0.2 cfs @ 12.08 hrs, Volume= 659 cf, Depth= 5.69"
Routed to Pond 9P : Inf Syst-7

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-Year Rainfall=6.40"

Area (sf)	CN	Description
1,175	98	Paved parking, HSG C
214	74	>75% Grass cover, Good, HSG C
1,389	94	Weighted Average
214		15.41% Pervious Area
1,175		84.59% Impervious Area

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

Subcatchment 5.1S: TD-1A



Summary for Subcatchment 5S: TD-1B

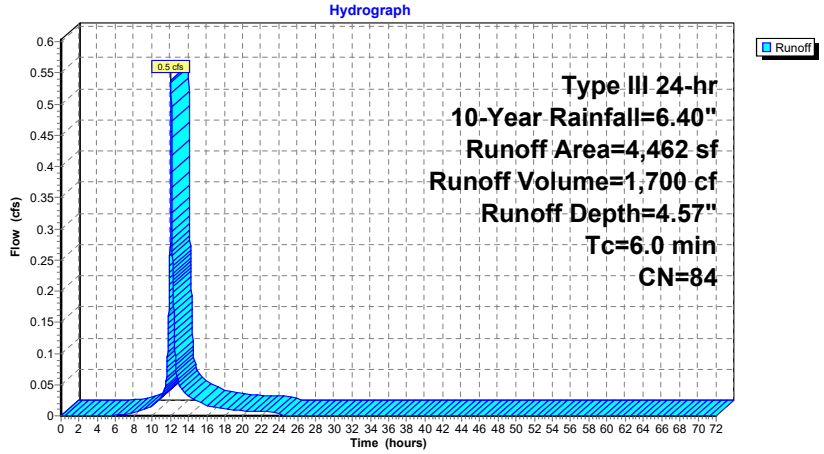
Runoff = 0.5 cfs @ 12.09 hrs, Volume= 1,700 cf, Depth= 4.57"
Routed to Link 1L : Towards Wetlands

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-Year Rainfall=6.40"

Area (sf)	CN	Description
1,909	98	Paved parking, HSG C
2,553	74	>75% Grass cover, Good, HSG C
4,462	84	Weighted Average
2,553		57.22% Pervious Area
1,909		42.78% Impervious Area

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

Subcatchment 5S: TD-1B



Summary for Subcatchment 6.1S: East driveway

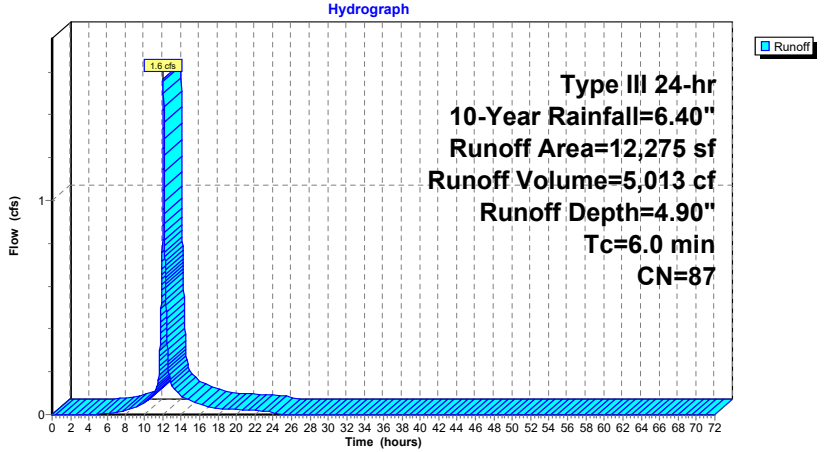
Runoff = 1.6 cfs @ 12.09 hrs, Volume= 5,013 cf, Depth= 4.90"
Routed to Pond 3P : Rain garden

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-Year Rainfall=6.40"

Area (sf)	CN	Description
5,611	74	>75% Grass cover, Good, HSG C
6,444	98	Paved roads w/curbs & sewers, HSG C
220	89	Gravel roads, HSG C
12,275	87	Weighted Average
5,831		47.50% Pervious Area
6,444		52.50% Impervious Area

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

Subcatchment 6.1S: East driveway



Summary for Subcatchment 6S: Bypass Towards Wetlands

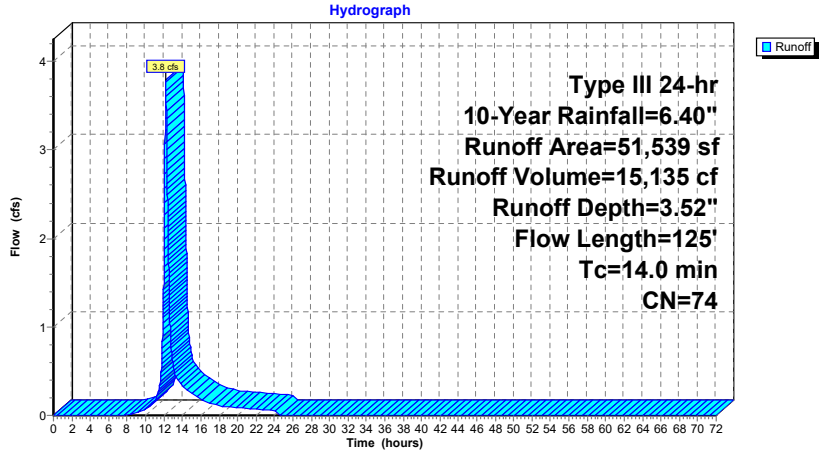
Runoff = 3.8 cfs @ 12.19 hrs, Volume= 15,135 cf, Depth= 3.52"
Routed to Link 1L : Towards Wetlands

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-Year Rainfall=6.40"

Area (sf)	CN	Description
4,985	70	Woods, Good, HSG C
46,447	74	>75% Grass cover, Good, HSG C
107	98	Roofs, HSG C
51,539	74	Weighted Average
51,432		99.79% Pervious Area
107		0.21% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.8	50	0.0220	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.23"
2.2	75	0.0133	0.58		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
14.0	125	Total			

Subcatchment 6S: Bypass Towards Wetlands



Summary for Subcatchment 7S: To Street

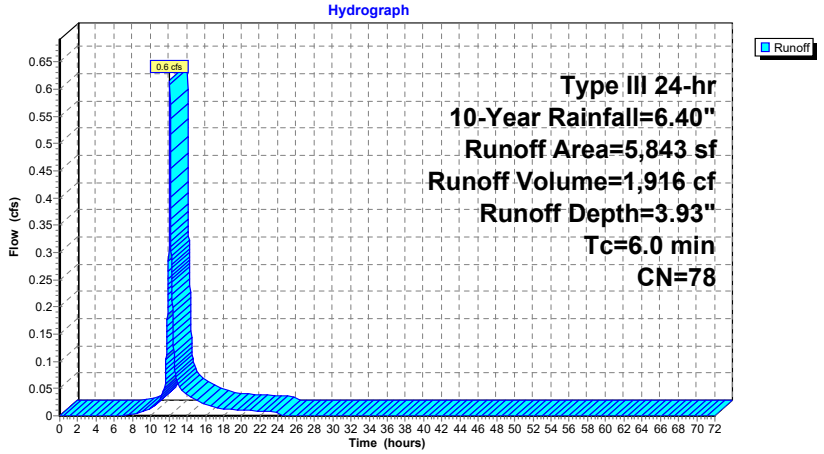
Runoff = 0.6 cfs @ 12.09 hrs, Volume= 1,916 cf, Depth= 3.93"
Routed to Link 2L : Towards Street

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-Year Rainfall=6.40"

Area (sf)	CN	Description
1,056	98	Paved parking, HSG C
4,787	74	>75% Grass cover, Good, HSG C
5,843	78	Weighted Average
4,787		81.93% Pervious Area
1,056		18.07% Impervious Area

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

Subcatchment 7S: To Street



Summary for Pond 1P: Inf Syst-1

Inflow Area = 60,436 sf, 85.36% Impervious, Inflow Depth = 5.61" for 10-Year event
Inflow = 8.0 cfs @ 12.09 hrs, Volume= 28,251 cf
Outflow = 2.3 cfs @ 12.43 hrs, Volume= 28,251 cf, Atten= 71%, Lag= 20.8 min
Discarded = 0.1 cfs @ 6.13 hrs, Volume= 14,540 cf
Primary = 2.2 cfs @ 12.43 hrs, Volume= 13,710 cf
Routed to Link 1L : Towards Wetlands

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 9.96' @ 12.43 hrs Surf.Area= 7,459 sf Storage= 12,545 cf

Plug-Flow detention time= 442.3 min calculated for 28,251 cf (100% of inflow)
Center-of-Mass det. time= 442.2 min (1,198.8 - 756.6)

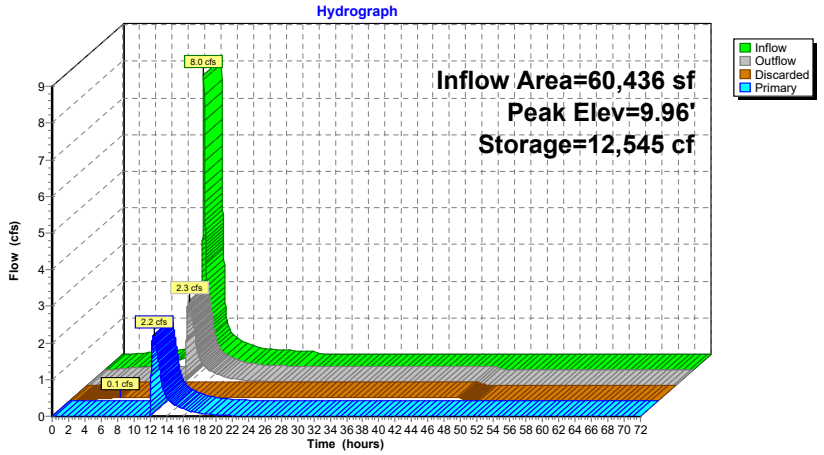
Volume	Invert	Avail.Storage	Storage Description
#1	8.00'	19,245 cf	**6.89'W x 14.06'L x 3.00'H StormTrap ST-1 Units (Irregular Shape)** x 77 22,378 cf Overall x 86.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Discarded	8.00'	**0.520 in/hr Exfiltration over Surface area**
#2	Primary	8.00'	**15.0" Round Culvert** L= 26.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 8.00' / 7.13' S= 0.0335 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#3	Device 2	9.22'	**22.0" W x 4.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 2	10.05'	**20.0" W x 4.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Device 2	10.79'	**3.7' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Discarded OutFlow Max=0.1 cfs @ 6.13 hrs HW=8.03' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.1 cfs)

Primary OutFlow Max=2.2 cfs @ 12.43 hrs HW=9.96' (Free Discharge)
└**2=Culvert** (Passes 2.2 cfs of 6.8 cfs potential flow)
  ├**3=Orifice/Grate** (Orifice Controls 2.2 cfs @ 3.62 fps)
  ├**4=Orifice/Grate** (Controls 0.0 cfs)
  └**5=Sharp-Crested Rectangular Weir** (Controls 0.0 cfs)

Pond 1P: Inf Syst-1



Summary for Pond 3P: Rain garden

Inflow Area = 12,275 sf, 52.50% Impervious, Inflow Depth = 4.90" for 10-Year event
Inflow = 1.6 cfs @ 12.09 hrs, Volume= 5,013 cf
Outflow = 1.6 cfs @ 12.09 hrs, Volume= 5,013 cf, Atten= 0%, Lag= 0.3 min
Discarded = 0.0 cfs @ 12.09 hrs, Volume= 477 cf
Primary = 1.6 cfs @ 12.09 hrs, Volume= 4,537 cf
Routed to Link 1L : Towards Wetlands

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 6.45' @ 12.09 hrs Surf.Area= 429 sf Storage= 229 cf

Plug-Flow detention time= 53.5 min calculated for 5,012 cf (100% of inflow)
Center-of-Mass det. time= 53.6 min (846.0 - 792.4)

Volume	Invert	Avail.Storage	Storage Description
#1	5.60'	253 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

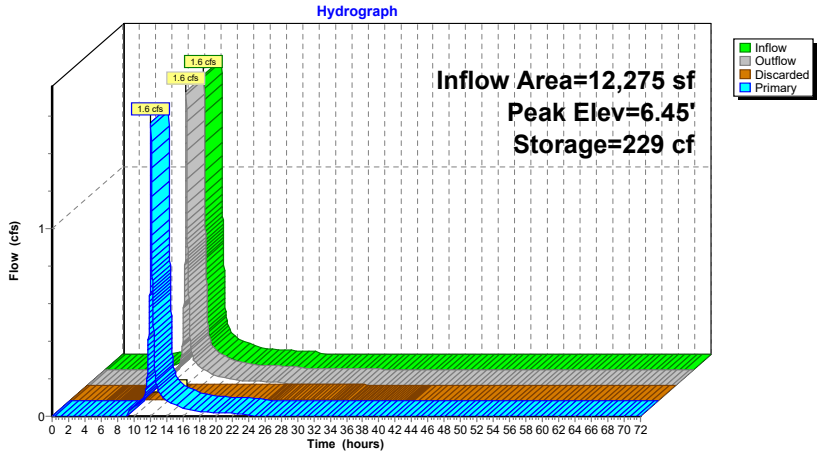
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
5.60	125	46.0	0	0	125
6.00	276	66.0	78	78	305
6.30	350	73.0	94	172	385
6.50	460	87.0	81	253	564

Device	Routing	Invert	Outlet Devices
#1	Discarded	5.60'	**0.520 in/hr Exfiltration over Surface area**
#2	Primary	6.35'	**22.0' 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

Discarded OutFlow Max=0.0 cfs @ 12.09 hrs HW=6.45' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=1.6 cfs @ 12.09 hrs HW=6.45' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Weir Controls 1.6 cfs @ 0.73 fps)

Pond 3P: Rain garden



Summary for Pond 4P: Inf Syst-2

Inflow Area = 1,112 sf, 95.68% Impervious, Inflow Depth = 6.04" for 10-Year event
Inflow = 0.2 cfs @ 12.08 hrs, Volume= 560 cf
Outflow = 0.2 cfs @ 12.09 hrs, Volume= 547 cf, Atten= 1%, Lag= 0.6 min
Discarded = 0.0 cfs @ 2.79 hrs, Volume= 159 cf
Primary = 0.2 cfs @ 12.09 hrs, Volume= 388 cf
Routed to Pond 1P : Inf Syst-1

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 9.47' @ 12.09 hrs Surf.Area= 101 sf Storage= 131 cf

Plug-Flow detention time= 483.5 min calculated for 546 cf (98% of inflow)
Center-of-Mass det. time= 468.6 min (1,219.5 - 751.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	7.00'	84 cf	**7.28'W x 13.84'L x 2.72'H Field A** 274 cf Overall - 64 cf Embedded = 210 cf x 40.0% Voids
#2A	7.25'	57 cf	**Ferguson R-Tank XD 12** x 10 Inside #1 Inside= 19.7"W x 23.6"H => 2.91 sf x 1.97'L = 5.7 cf Outside= 19.7"W x 23.6"H => 3.23 sf x 1.97'L = 6.4 cf 10 Chambers in 2 Rows
		141 cf	Total Available Storage

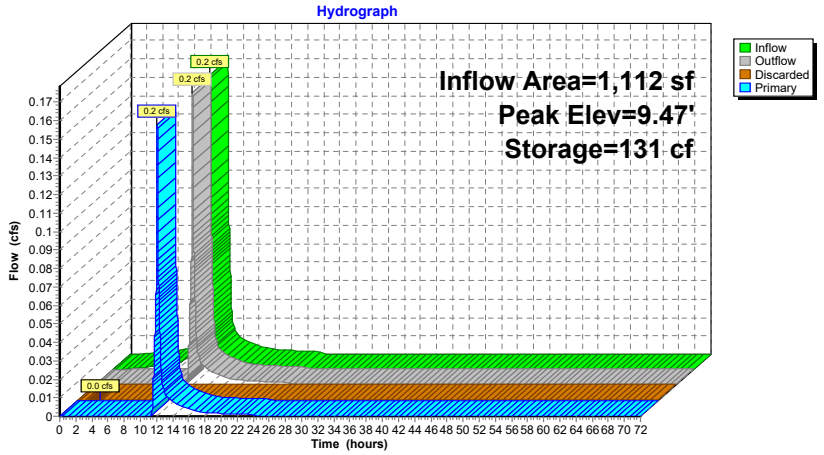
Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	7.00'	**0.270 in/hr Exfiltration over Surface area**
#2	Primary	9.23'	**6.0" Round Culvert** L= 33.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 9.23' / 8.72' S= 0.0155 '/' Cc= 0.900 n= 0.013, Flow Area= 0.20 sf

Discarded OutFlow Max=0.0 cfs @ 2.79 hrs HW=7.03' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.2 cfs @ 12.09 hrs HW=9.47' (Free Discharge)
↑**2=Culvert** (Inlet Controls 0.2 cfs @ 1.67 fps)

Pond 4P: Inf Syst-2



Summary for Pond 5P: Inf Syst-3

Inflow Area = 1,105 sf, 97.29% Impervious, Inflow Depth = 6.04" for 10-Year event
Inflow = 0.2 cfs @ 12.08 hrs, Volume= 556 cf
Outflow = 0.2 cfs @ 12.09 hrs, Volume= 537 cf, Atten= 1%, Lag= 0.6 min
Discarded = 0.0 cfs @ 2.83 hrs, Volume= 159 cf
Primary = 0.2 cfs @ 12.09 hrs, Volume= 379 cf
Routed to Pond 1P : Inf Syst-1

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 9.61' @ 12.09 hrs Surf.Area= 101 sf Storage= 137 cf

Plug-Flow detention time= 497.7 min calculated for 537 cf (97% of inflow)
Center-of-Mass det. time= 476.9 min (1,227.8 - 751.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	7.00'	84 cf	**7.28'W x 13.84'L x 2.72'H Field A** 274 cf Overall - 64 cf Embedded = 210 cf x 40.0% Voids
#2A	7.25'	57 cf	**Ferguson R-Tank XD 12** x 10 Inside #1 Inside= 19.7"W x 23.6"H => 2.91 sf x 1.97'L = 5.7 cf Outside= 19.7"W x 23.6"H => 3.23 sf x 1.97'L = 6.4 cf 10 Chambers in 2 Rows
		141 cf	Total Available Storage

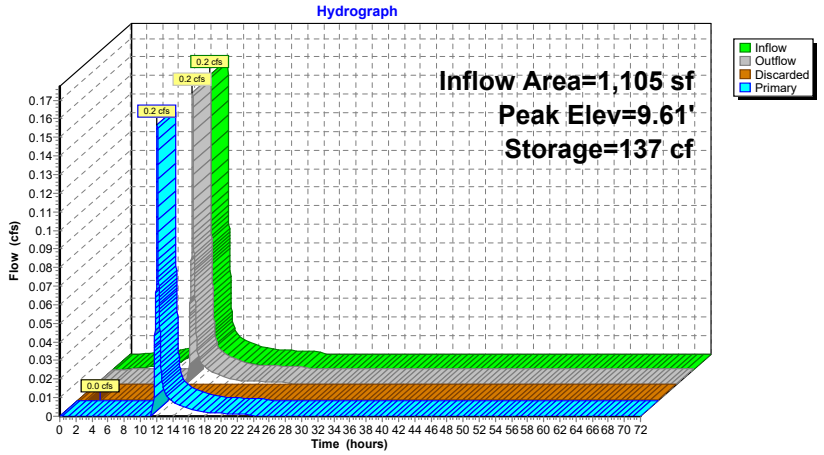
Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	7.00'	**0.270 in/hr Exfiltration over Surface area**
#2	Primary	9.37'	**6.0" Round Culvert** L= 33.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 9.37' / 8.73' S= 0.0194 '/' Cc= 0.900 n= 0.013, Flow Area= 0.20 sf

Discarded OutFlow Max=0.0 cfs @ 2.83 hrs HW=7.03' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.2 cfs @ 12.09 hrs HW=9.61' (Free Discharge)
↑**2=Culvert** (Inlet Controls 0.2 cfs @ 1.67 fps)

Pond 5P: Inf Syst-3



Summary for Pond 6P: Inf Syst-4

Inflow Area = 1,104 sf, 97.46% Impervious, Inflow Depth = 6.04" for 10-Year event
Inflow = 0.2 cfs @ 12.08 hrs, Volume= 556 cf
Outflow = 0.2 cfs @ 12.09 hrs, Volume= 537 cf, Atten= 1%, Lag= 0.6 min
Discarded = 0.0 cfs @ 2.83 hrs, Volume= 159 cf
Primary = 0.2 cfs @ 12.09 hrs, Volume= 378 cf
Routed to Pond 1P : Inf Syst-1

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 9.61' @ 12.09 hrs Surf.Area= 101 sf Storage= 137 cf

Plug-Flow detention time= 498.4 min calculated for 537 cf (97% of inflow)
Center-of-Mass det. time= 477.3 min (1,228.2 - 751.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	7.00'	84 cf	**7.28'W x 13.84'L x 2.72'H Field A** 274 cf Overall - 64 cf Embedded = 210 cf x 40.0% Voids
#2A	7.25'	57 cf	**Ferguson R-Tank XD 12** x 10 Inside #1 Inside= 19.7"W x 23.6"H => 2.91 sf x 1.97'L = 5.7 cf Outside= 19.7"W x 23.6"H => 3.23 sf x 1.97'L = 6.4 cf 10 Chambers in 2 Rows
		141 cf	Total Available Storage

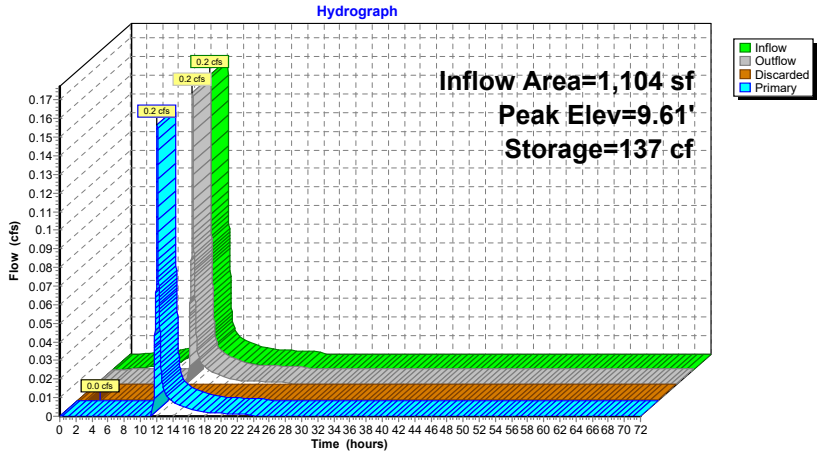
Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	7.00'	**0.270 in/hr Exfiltration over Surface area**
#2	Primary	9.37'	**6.0" Round Culvert** L= 51.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 9.37' / 8.10' S= 0.0249 '/' Cc= 0.900 n= 0.013, Flow Area= 0.20 sf

Discarded OutFlow Max=0.0 cfs @ 2.83 hrs HW=7.03' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.2 cfs @ 12.09 hrs HW=9.61' (Free Discharge)
↑**2=Culvert** (Inlet Controls 0.2 cfs @ 1.67 fps)

Pond 6P: Inf Syst-4



Summary for Pond 7P: Inf Syst-5

Inflow Area = 1,082 sf, 98.06% Impervious, Inflow Depth = 6.16" for 10-Year event
Inflow = 0.2 cfs @ 12.08 hrs, Volume= 556 cf
Outflow = 0.2 cfs @ 12.09 hrs, Volume= 555 cf, Atten= 1%, Lag= 0.6 min
Discarded = 0.0 cfs @ 2.12 hrs, Volume= 160 cf
Primary = 0.2 cfs @ 12.09 hrs, Volume= 395 cf
Routed to Pond 1P : Inf Syst-1

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 9.24' @ 12.09 hrs Surf.Area= 101 sf Storage= 119 cf

Plug-Flow detention time= 464.5 min calculated for 555 cf (100% of inflow)
Center-of-Mass det. time= 463.9 min (1,208.1 - 744.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	7.00'	73 cf	**7.28'W x 13.84'L x 2.39'H Field A** 241 cf Overall - 58 cf Embedded = 182 cf x 40.0% Voids
#2A	7.25'	52 cf	**Ferguson R-Tank XD 11** x 10 Inside #1 Inside= 19.7"W x 21.7"H => 2.66 sf x 1.97'L = 5.2 cf Outside= 19.7"W x 21.7"H => 2.96 sf x 1.97'L = 5.8 cf 10 Chambers in 2 Rows
		125 cf	Total Available Storage

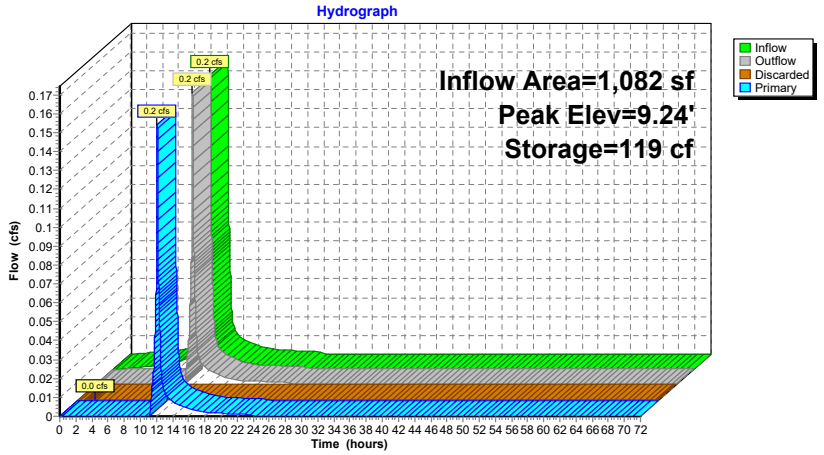
Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	7.00'	**0.270 in/hr Exfiltration over Surface area**
#2	Primary	9.00'	**6.0" Round Culvert** L= 48.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 9.00' / 8.35' S= 0.0135 '/' Cc= 0.900 n= 0.013, Flow Area= 0.20 sf

Discarded OutFlow Max=0.0 cfs @ 2.12 hrs HW=7.03' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.2 cfs @ 12.09 hrs HW=9.24' (Free Discharge)
↑**2=Culvert** (Inlet Controls 0.2 cfs @ 1.66 fps)

Pond 7P: Inf Syst-5



Summary for Pond 8P: Inf Syst-6

Inflow Area = 1,056 sf, 99.24% Impervious, Inflow Depth = 6.16" for 10-Year event
Inflow = 0.2 cfs @ 12.08 hrs, Volume= 542 cf
Outflow = 0.2 cfs @ 12.09 hrs, Volume= 541 cf, Atten= 1%, Lag= 0.6 min
Discarded = 0.0 cfs @ 2.19 hrs, Volume= 160 cf
Primary = 0.2 cfs @ 12.09 hrs, Volume= 382 cf
Routed to Pond 1P : Inf Syst-1

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 9.26' @ 12.09 hrs Surf.Area= 101 sf Storage= 120 cf

Plug-Flow detention time= 475.6 min calculated for 541 cf (100% of inflow)
Center-of-Mass det. time= 474.9 min (1,219.1 - 744.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	7.00'	73 cf	**7.28'W x 13.84'L x 2.39'H Field A** 241 cf Overall - 58 cf Embedded = 182 cf x 40.0% Voids
#2A	7.25'	52 cf	**Ferguson R-Tank XD 11** x 10 Inside #1 Inside= 19.7"W x 21.7"H => 2.66 sf x 1.97'L = 5.2 cf Outside= 19.7"W x 21.7"H => 2.96 sf x 1.97'L = 5.8 cf 10 Chambers in 2 Rows
		125 cf	Total Available Storage

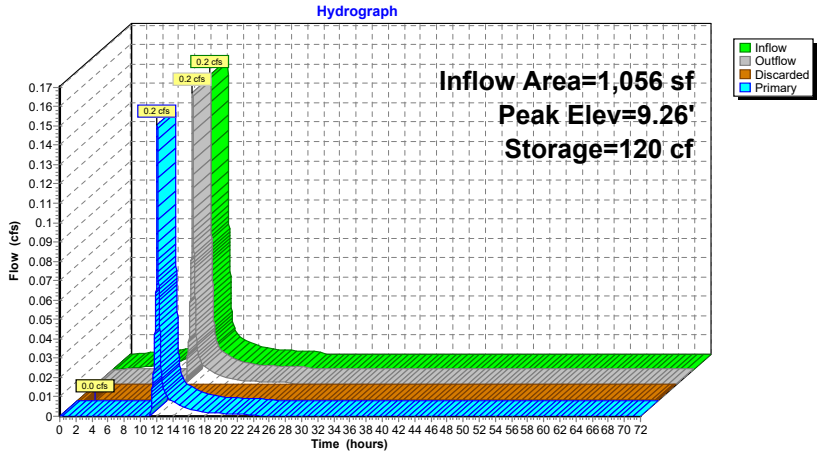
Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	7.00'	**0.270 in/hr Exfiltration over Surface area**
#2	Primary	9.00'	**8.0" Round Culvert** L= 46.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 9.00' / 8.77' S= 0.0050 '/' Cc= 0.900 n= 0.013, Flow Area= 0.35 sf

Discarded OutFlow Max=0.0 cfs @ 2.19 hrs HW=7.03' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.1 cfs @ 12.09 hrs HW=9.26' (Free Discharge)
↑**2=Culvert** (Barrel Controls 0.1 cfs @ 1.80 fps)

Pond 8P: Inf Syst-6



Summary for Pond 9P: Inf Syst-7

Inflow Area = 24,131 sf, 72.87% Impervious, Inflow Depth = 5.37" for 10-Year event
Inflow = 3.3 cfs @ 12.08 hrs, Volume= 10,797 cf
Outflow = 2.1 cfs @ 12.18 hrs, Volume= 10,797 cf, Atten= 37%, Lag= 5.7 min
Discarded = 0.0 cfs @ 5.84 hrs, Volume= 1,502 cf
Primary = 2.1 cfs @ 12.18 hrs, Volume= 9,295 cf
Routed to Link 1L : Towards Wetlands

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 8.14' @ 12.18 hrs Surf.Area= 2,422 sf Storage= 2,069 cf

Plug-Flow detention time= 63.5 min calculated for 10,795 cf (100% of inflow)
Center-of-Mass det. time= 63.5 min (841.9 - 778.3)

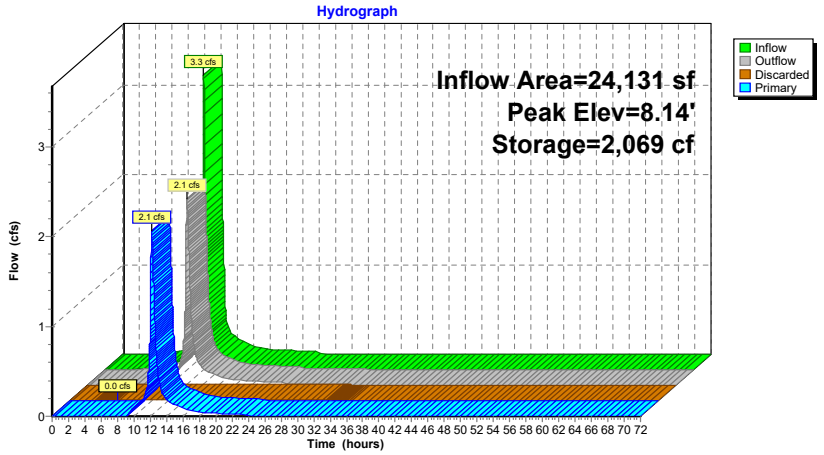
Volume	Invert	Avail.Storage	Storage Description
#1	7.15'	3,645 cf	**6.89'W x 14.06'L x 1.75'H StormTrap ST-1 Units (Irregular Shape)** x 25 4,238 cf Overall x 86.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Discarded	7.15'	**0.270 in/hr Exfiltration over Surface area**
#2	Primary	7.15'	**12.0" Round Culvert** L= 4.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 7.15' / 7.13' S= 0.0050 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#3	Device 2	7.35'	**22.0" W x 4.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.0 cfs @ 5.84 hrs HW=7.17' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=2.1 cfs @ 12.18 hrs HW=8.14' (Free Discharge)
└**2=Culvert** (Barrel Controls 2.1 cfs @ 3.29 fps)
└**3=Orifice/Grate** (Passes 2.1 cfs of 2.3 cfs potential flow)

Pond 9P: Inf Syst-7

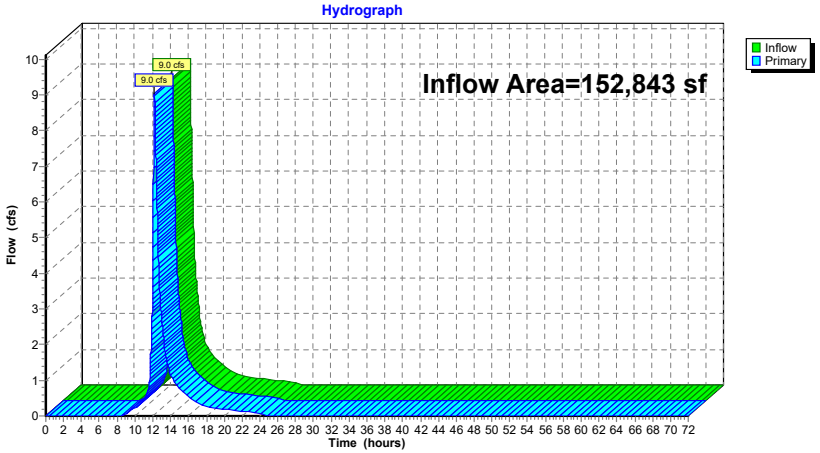


Summary for Link 1L: Towards Wetlands

Inflow Area = 152,843 sf, 50.79% Impervious, Inflow Depth = 3.48" for 10-Year event
Inflow = 9.0 cfs @ 12.18 hrs, Volume= 44,377 cf
Primary = 9.0 cfs @ 12.18 hrs, Volume= 44,377 cf, Atten= 0%, Lag= 0.0 min
Routed to Link 100L : Total Flows

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

Link 1L: Towards Wetlands

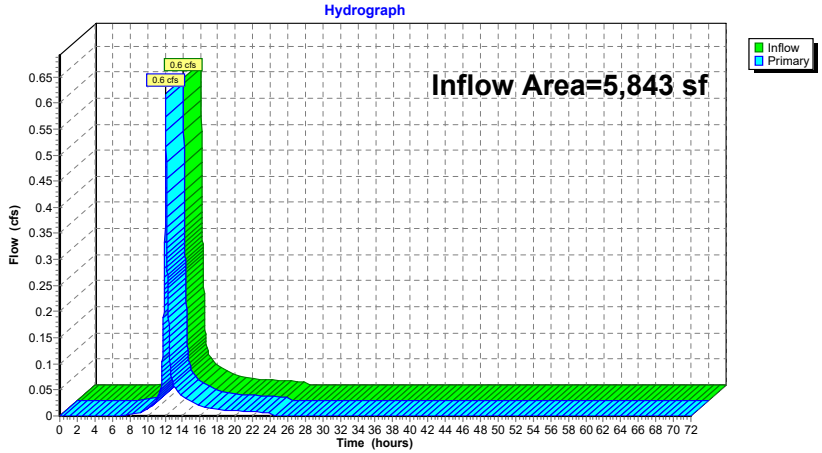


Summary for Link 2L: Towards Street

Inflow Area = 5,843 sf, 18.07% Impervious, Inflow Depth = 3.93" for 10-Year event
Inflow = 0.6 cfs @ 12.09 hrs, Volume= 1,916 cf
Primary = 0.6 cfs @ 12.09 hrs, Volume= 1,916 cf, Atten= 0%, Lag= 0.0 min
Routed to Link 100L : Total Flows

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

Link 2L: Towards Street

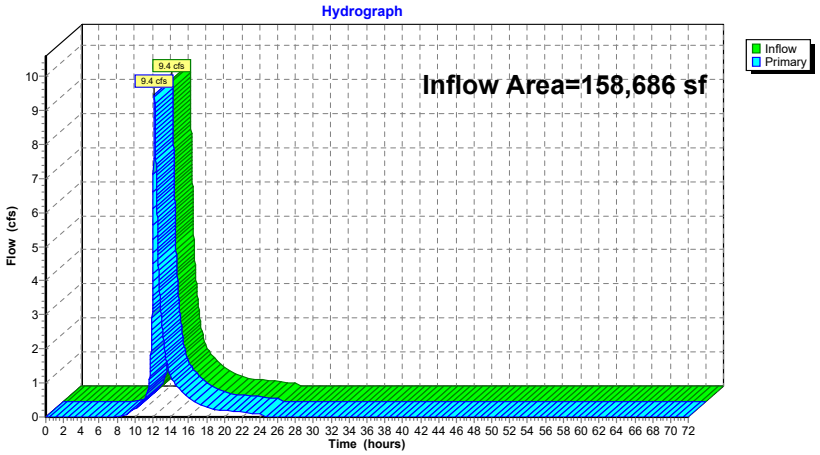


Summary for Link 100L: Total Flows

Inflow Area = 158,686 sf, 49.59% Impervious, Inflow Depth = 3.50" for 10-Year event
Inflow = 9.4 cfs @ 12.17 hrs, Volume= 46,293 cf
Primary = 9.4 cfs @ 12.17 hrs, Volume= 46,293 cf, Atten= 0%, Lag= 0.0 min

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

Link 100L: Total Flows



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

Subcatchment1S: CB-1 Runoff Area=22,742 sf 72.16% Impervious Runoff Depth=7.22"
Tc=6.0 min CN=91 Runoff=4.1 cfs 13,685 cf

Subcatchment2S: Building Roof Runoff Area=32,925 sf 100.00% Impervious Runoff Depth=8.06"
Tc=6.0 min CN=98 Runoff=6.2 cfs 22,115 cf

Subcatchment3.1S: Backyard ADs Runoff Area=8,985 sf 3.03% Impervious Runoff Depth=5.31"
Flow Length=147' Tc=10.3 min CN=75 Runoff=1.1 cfs 3,978 cf

Subcatchment3S: Townhouse Roofs Runoff Area=13,067 sf 100.00% Impervious Runoff Depth=8.06"
Tc=6.0 min CN=98 Runoff=2.4 cfs 8,777 cf

Subcatchment4.2S: TD-2 Runoff Area=1,112 sf 95.68% Impervious Runoff Depth=7.94"
Tc=6.0 min CN=97 Runoff=0.2 cfs 736 cf

Subcatchment4.3S: TD-3 Runoff Area=1,105 sf 97.29% Impervious Runoff Depth=7.94"
Tc=6.0 min CN=97 Runoff=0.2 cfs 731 cf

Subcatchment4.4S: TD-4 Runoff Area=1,104 sf 97.46% Impervious Runoff Depth=7.94"
Tc=6.0 min CN=97 Runoff=0.2 cfs 730 cf

Subcatchment4.5S: TD-5 Runoff Area=1,082 sf 98.06% Impervious Runoff Depth=8.06"
Tc=6.0 min CN=98 Runoff=0.2 cfs 727 cf

Subcatchment4.6S: TD-6 Runoff Area=1,056 sf 99.24% Impervious Runoff Depth=8.06"
Tc=6.0 min CN=98 Runoff=0.2 cfs 709 cf

Subcatchment5.1S: TD-1A Runoff Area=1,389 sf 84.59% Impervious Runoff Depth=7.58"
Tc=6.0 min CN=94 Runoff=0.3 cfs 877 cf

Subcatchment5S: TD-1B Runoff Area=4,462 sf 42.78% Impervious Runoff Depth=6.38"
Tc=6.0 min CN=84 Runoff=0.7 cfs 2,374 cf

Subcatchment6.1S: East driveway Runoff Area=12,275 sf 52.50% Impervious Runoff Depth=6.74"
Tc=6.0 min CN=87 Runoff=2.1 cfs 6,897 cf

Subcatchment6S: Bypass Towards Runoff Area=51,539 sf 0.21% Impervious Runoff Depth=5.19"
Flow Length=125' Tc=14.0 min CN=74 Runoff=5.6 cfs 22,311 cf

Subcatchment7S: To Street Runoff Area=5,843 sf 18.07% Impervious Runoff Depth=5.67"
Tc=6.0 min CN=78 Runoff=0.9 cfs 2,760 cf

Pond 1P: Inf Syst-1 Peak Elev=10.41' Storage=15,470 cf Inflow=10.6 cfs 37,649 cf
Discarded=0.1 cfs 14,969 cf Primary=4.1 cfs 22,680 cf Outflow=4.2 cfs 37,649 cf

Pond 3P: Rain garden Peak Elev=6.47' Storage=239 cf Inflow=2.1 cfs 6,897 cf
Discarded=0.0 cfs 495 cf Primary=2.1 cfs 6,401 cf Outflow=2.1 cfs 6,897 cf

Pond 4P: Inf Syst-2 Peak Elev=9.51' Storage=133 cf Inflow=0.2 cfs 736 cf
Discarded=0.0 cfs 160 cf Primary=0.2 cfs 562 cf Outflow=0.2 cfs 722 cf

Pond 5P: Inf Syst-3 Peak Elev=9.65' Storage=139 cf Inflow=0.2 cfs 731 cf
Discarded=0.0 cfs 160 cf Primary=0.2 cfs 552 cf Outflow=0.2 cfs 712 cf

Pond 6P: Inf Syst-4 Peak Elev=9.65' Storage=139 cf Inflow=0.2 cfs 730 cf
Discarded=0.0 cfs 160 cf Primary=0.2 cfs 552 cf Outflow=0.2 cfs 711 cf

Pond 7P: Inf Syst-5 Peak Elev=9.28' Storage=121 cf Inflow=0.2 cfs 727 cf
Discarded=0.0 cfs 161 cf Primary=0.2 cfs 565 cf Outflow=0.2 cfs 726 cf

Pond 8P: Inf Syst-6 Peak Elev=9.29' Storage=122 cf Inflow=0.2 cfs 709 cf
Discarded=0.0 cfs 161 cf Primary=0.2 cfs 548 cf Outflow=0.2 cfs 708 cf

Pond 9P: Inf Syst-7 Peak Elev=8.38' Storage=2,562 cf Inflow=4.3 cfs 14,562 cf
Discarded=0.0 cfs 1,561 cf Primary=2.7 cfs 13,001 cf Outflow=2.7 cfs 14,562 cf

Link 1L: Towards Wetlands Inflow=13.7 cfs 66,767 cf
Primary=13.7 cfs 66,767 cf

Link 2L: Towards Street Inflow=0.9 cfs 2,760 cf
Primary=0.9 cfs 2,760 cf

Link 100L: Total Flows Inflow=14.2 cfs 69,527 cf
Primary=14.2 cfs 69,527 cf

Total Runoff Area = 158,686 sf Runoff Volume = 87,407 cf Average Runoff Depth = 6.61"
50.41% Pervious = 79,997 sf 49.59% Impervious = 78,689 sf

Summary for Subcatchment 1S: CB-1

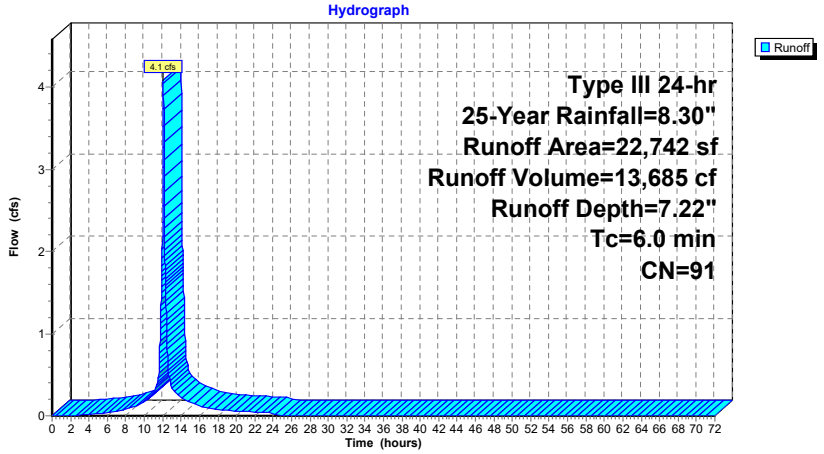
Runoff = 4.1 cfs @ 12.08 hrs, Volume= 13,685 cf, Depth= 7.22"
Routed to Pond 9P : Inf Syst-7

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-Year Rainfall=8.30"

Area (sf)	CN	Description
16,410	98	Paved parking, HSG C
6,332	74	>75% Grass cover, Good, HSG C
22,742	91	Weighted Average
6,332		27.84% Pervious Area
16,410		72.16% Impervious Area

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

Subcatchment 1S: CB-1



Summary for Subcatchment 2S: Building Roof

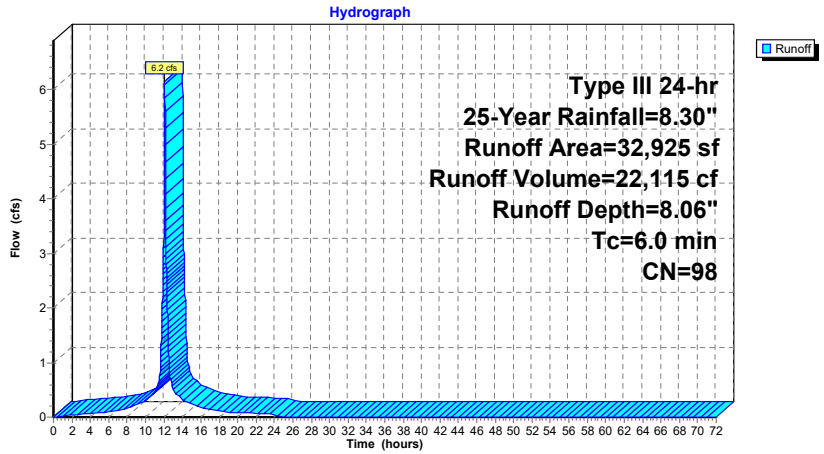
Runoff = 6.2 cfs @ 12.08 hrs, Volume= 22,115 cf, Depth= 8.06"
Routed to Pond 1P : Inf Syst-1

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-Year Rainfall=8.30"

Area (sf)	CN	Description
32,925	98	Roofs, HSG C
32,925		100.00% Impervious Area

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

Subcatchment 2S: Building Roof



Summary for Subcatchment 3.1S: Backyard ADs

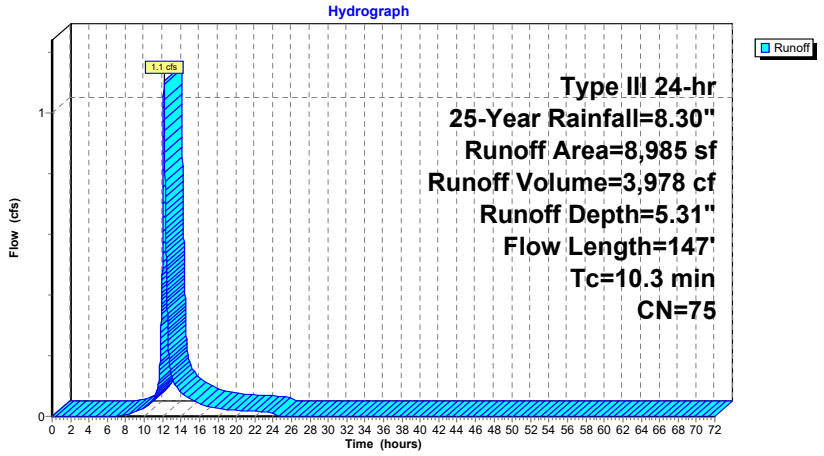
Runoff = 1.1 cfs @ 12.14 hrs, Volume= 3,978 cf, Depth= 5.31"
Routed to Pond 1P : Inf Syst-1

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-Year Rainfall=8.30"

	Area (sf)	CN	Description
	272	98	Unconnected pavement, HSG C
	8,302	74	>75% Grass cover, Good, HSG C
*	411	89	Gravel sidewalk, HSG C
	8,985	75	Weighted Average
	8,713		96.97% Pervious Area
	272		3.03% Impervious Area
	272		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.4	50	0.0142	0.09		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.23"
0.9	97	0.0154	1.86		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
10.3	147	Total			

Subcatchment 3.1S: Backyard ADs



Summary for Subcatchment 3S: Townhouse Roofs

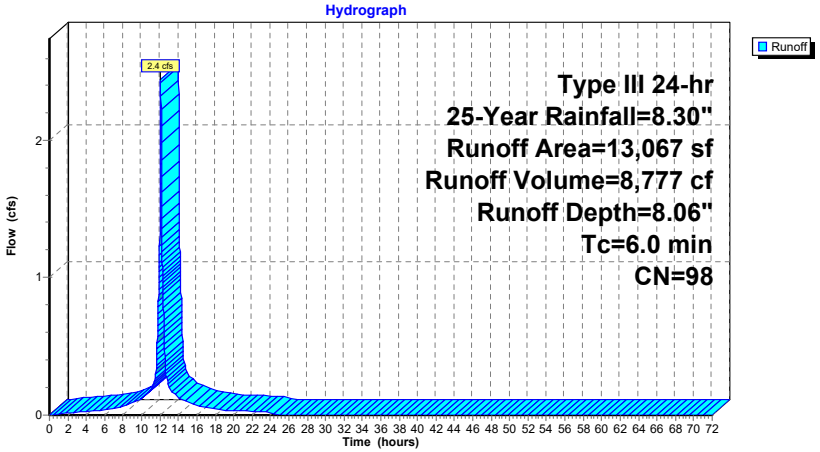
Runoff = 2.4 cfs @ 12.08 hrs, Volume= 8,777 cf, Depth= 8.06"
Routed to Pond 1P : Inf Syst-1

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-Year Rainfall=8.30"

Area (sf)	CN	Description
13,067	98	Roofs, HSG C
13,067		100.00% Impervious Area

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

Subcatchment 3S: Townhouse Roofs



Summary for Subcatchment 4.2S: TD-2

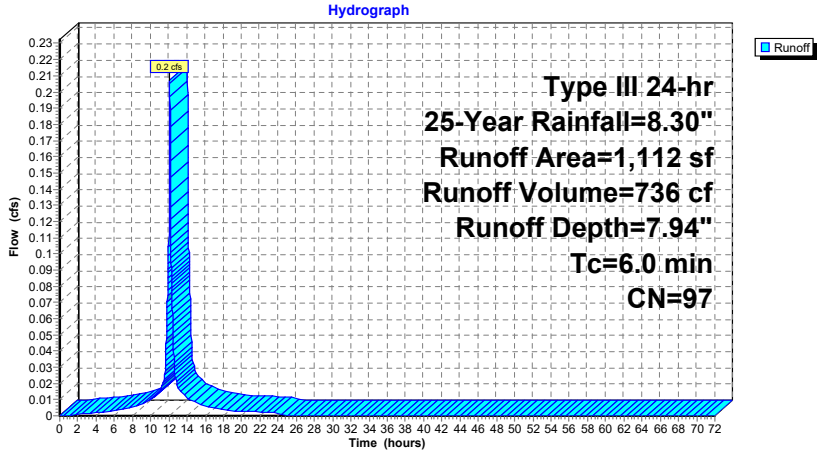
Runoff = 0.2 cfs @ 12.08 hrs, Volume= 736 cf, Depth= 7.94"
Routed to Pond 4P : Inf Syst-2

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-Year Rainfall=8.30"

Area (sf)	CN	Description
1,064	98	Paved parking, HSG C
48	74	>75% Grass cover, Good, HSG C
1,112	97	Weighted Average
48		4.32% Pervious Area
1,064		95.68% Impervious Area

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

Subcatchment 4.2S: TD-2



Summary for Subcatchment 4.3S: TD-3

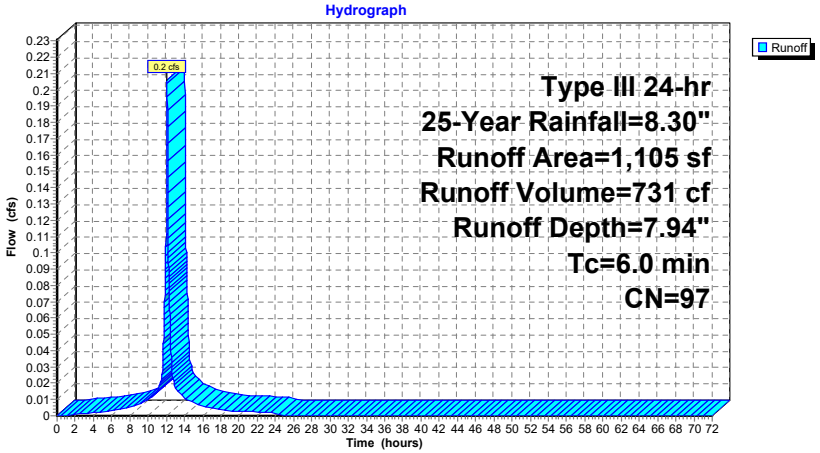
Runoff = 0.2 cfs @ 12.08 hrs, Volume= 731 cf, Depth= 7.94"
Routed to Pond 5P : Inf Syst-3

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-Year Rainfall=8.30"

Area (sf)	CN	Description
1,075	98	Paved parking, HSG C
30	74	>75% Grass cover, Good, HSG C
1,105	97	Weighted Average
30		2.71% Pervious Area
1,075		97.29% Impervious Area

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

Subcatchment 4.3S: TD-3



Summary for Subcatchment 4.4S: TD-4

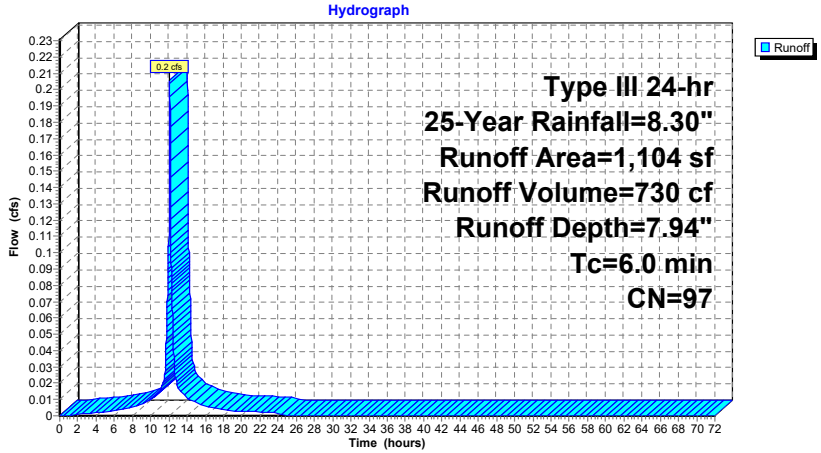
Runoff = 0.2 cfs @ 12.08 hrs, Volume= 730 cf, Depth= 7.94"
Routed to Pond 6P : Inf Syst-4

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-Year Rainfall=8.30"

Area (sf)	CN	Description
1,076	98	Paved parking, HSG C
28	74	>75% Grass cover, Good, HSG C
1,104	97	Weighted Average
28		2.54% Pervious Area
1,076		97.46% Impervious Area

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

Subcatchment 4.4S: TD-4



Summary for Subcatchment 4.5S: TD-5

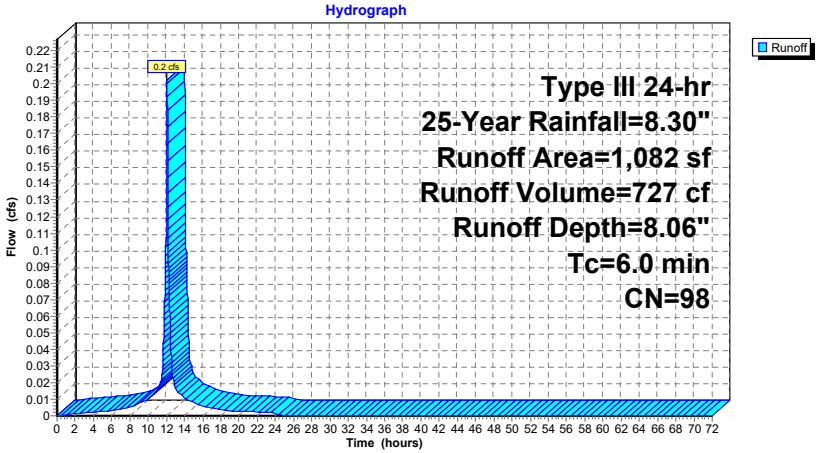
Runoff = 0.2 cfs @ 12.08 hrs, Volume= 727 cf, Depth= 8.06"
Routed to Pond 7P : Inf Syst-5

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-Year Rainfall=8.30"

Area (sf)	CN	Description
1,061	98	Paved parking, HSG C
21	74	>75% Grass cover, Good, HSG C
1,082	98	Weighted Average
21		1.94% Pervious Area
1,061		98.06% Impervious Area

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

Subcatchment 4.5S: TD-5



Summary for Subcatchment 4.6S: TD-6

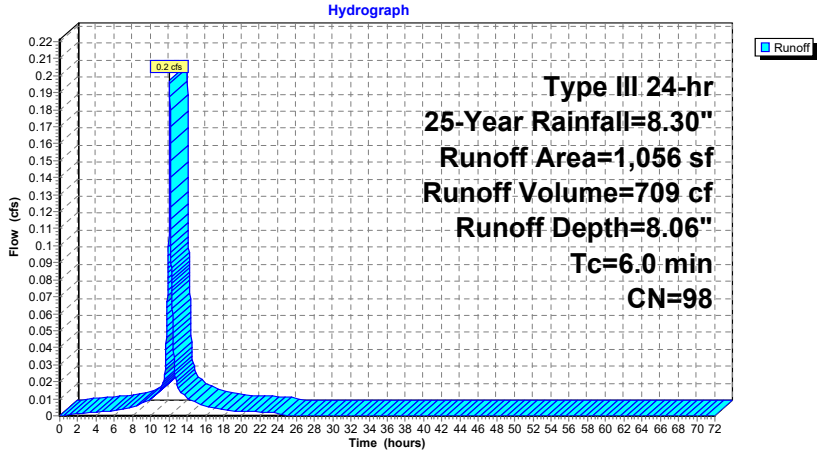
Runoff = 0.2 cfs @ 12.08 hrs, Volume= 709 cf, Depth= 8.06"
Routed to Pond 8P : Inf Syst-6

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-Year Rainfall=8.30"

Area (sf)	CN	Description
1,048	98	Paved parking, HSG C
8	74	>75% Grass cover, Good, HSG C
1,056	98	Weighted Average
8		0.76% Pervious Area
1,048		99.24% Impervious Area

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

Subcatchment 4.6S: TD-6



Summary for Subcatchment 5.1S: TD-1A

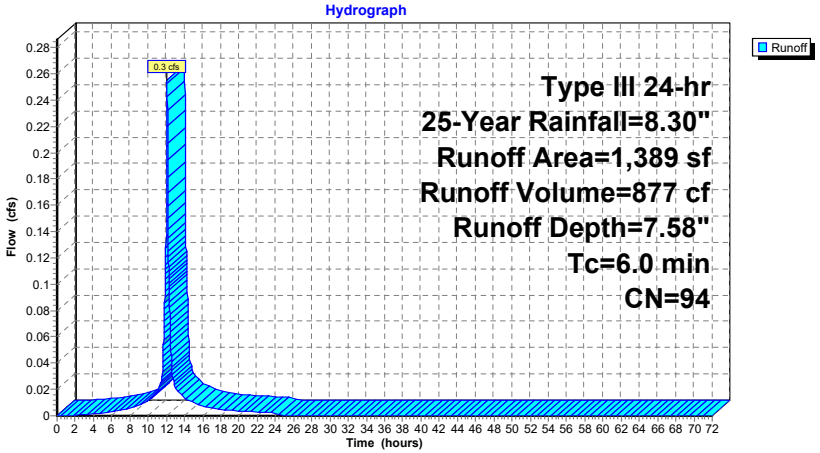
Runoff = 0.3 cfs @ 12.08 hrs, Volume= 877 cf, Depth= 7.58"
Routed to Pond 9P : Inf Syst-7

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-Year Rainfall=8.30"

Area (sf)	CN	Description
1,175	98	Paved parking, HSG C
214	74	>75% Grass cover, Good, HSG C
1,389	94	Weighted Average
214		15.41% Pervious Area
1,175		84.59% Impervious Area

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

Subcatchment 5.1S: TD-1A



Summary for Subcatchment 5S: TD-1B

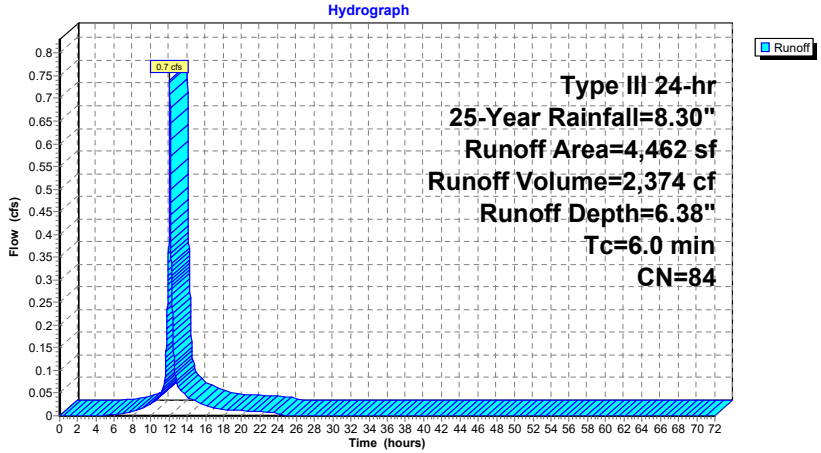
Runoff = 0.7 cfs @ 12.09 hrs, Volume= 2,374 cf, Depth= 6.38"
Routed to Link 1L : Towards Wetlands

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-Year Rainfall=8.30"

Area (sf)	CN	Description
1,909	98	Paved parking, HSG C
2,553	74	>75% Grass cover, Good, HSG C
4,462	84	Weighted Average
2,553		57.22% Pervious Area
1,909		42.78% Impervious Area

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

Subcatchment 5S: TD-1B



Summary for Subcatchment 6.1S: East driveway

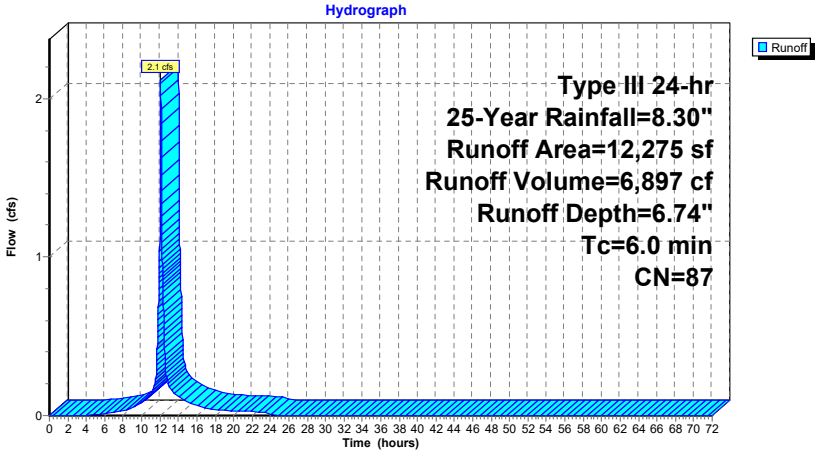
Runoff = 2.1 cfs @ 12.08 hrs, Volume= 6,897 cf, Depth= 6.74"
Routed to Pond 3P : Rain garden

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-Year Rainfall=8.30"

Area (sf)	CN	Description
5,611	74	>75% Grass cover, Good, HSG C
6,444	98	Paved roads w/curbs & sewers, HSG C
220	89	Gravel roads, HSG C
12,275	87	Weighted Average
5,831		47.50% Pervious Area
6,444		52.50% Impervious Area

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

Subcatchment 6.1S: East driveway



Summary for Subcatchment 6S: Bypass Towards Wetlands

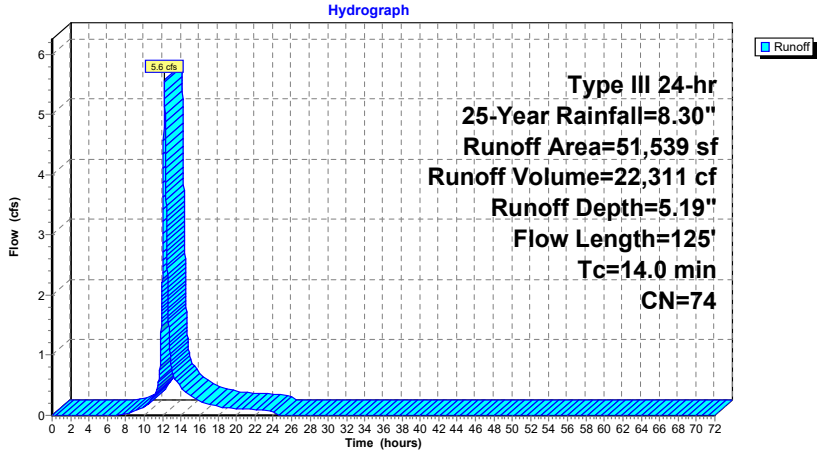
Runoff = 5.6 cfs @ 12.19 hrs, Volume= 22,311 cf, Depth= 5.19"
Routed to Link 1L : Towards Wetlands

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-Year Rainfall=8.30"

Area (sf)	CN	Description
4,985	70	Woods, Good, HSG C
46,447	74	>75% Grass cover, Good, HSG C
107	98	Roofs, HSG C
51,539	74	Weighted Average
51,432		99.79% Pervious Area
107		0.21% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.8	50	0.0220	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.23"
2.2	75	0.0133	0.58		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
14.0	125	Total			

Subcatchment 6S: Bypass Towards Wetlands



Summary for Subcatchment 7S: To Street

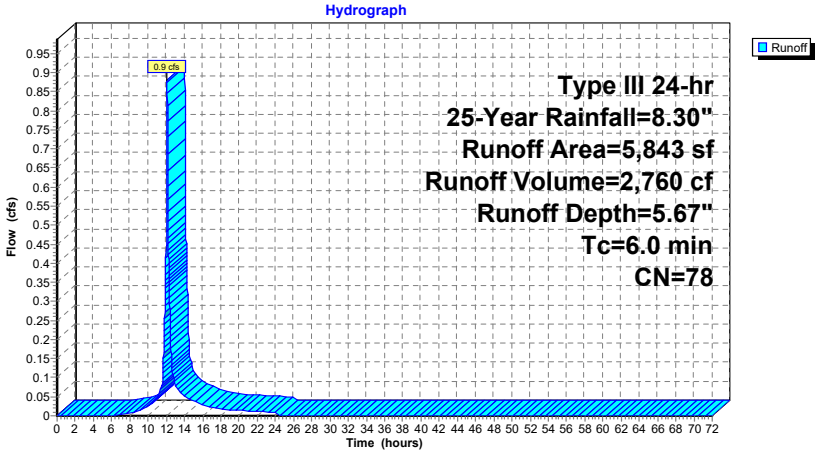
Runoff = 0.9 cfs @ 12.09 hrs, Volume= 2,760 cf, Depth= 5.67"
Routed to Link 2L : Towards Street

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-Year Rainfall=8.30"

Area (sf)	CN	Description
1,056	98	Paved parking, HSG C
4,787	74	>75% Grass cover, Good, HSG C
5,843	78	Weighted Average
4,787		81.93% Pervious Area
1,056		18.07% Impervious Area

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

Subcatchment 7S: To Street



Summary for Pond 1P: Inf Syst-1

Inflow Area = 60,436 sf, 85.36% Impervious, Inflow Depth = 7.48" for 25-Year event
Inflow = 10.6 cfs @ 12.09 hrs, Volume= 37,649 cf
Outflow = 4.2 cfs @ 12.32 hrs, Volume= 37,649 cf, Atten= 60%, Lag= 14.1 min
Discarded = 0.1 cfs @ 4.33 hrs, Volume= 14,969 cf
Primary = 4.1 cfs @ 12.32 hrs, Volume= 22,680 cf
Routed to Link 1L : Towards Wetlands

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 10.41' @ 12.32 hrs Surf.Area= 7,459 sf Storage= 15,470 cf

Plug-Flow detention time= 354.1 min calculated for 37,649 cf (100% of inflow)
Center-of-Mass det. time= 354.1 min (1,107.3 - 753.2)

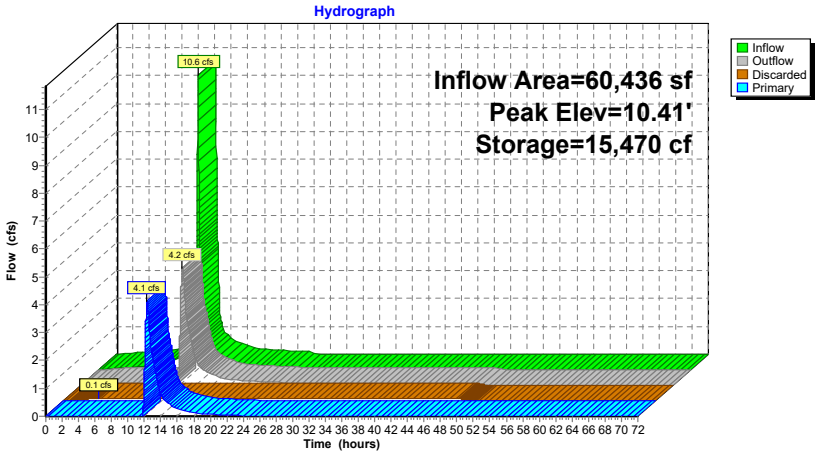
Volume	Invert	Avail.Storage	Storage Description
#1	8.00'	19,245 cf	**6.89'W x 14.06'L x 3.00'H StormTrap ST-1 Units (Irregular Shape)** x 77 22,378 cf Overall x 86.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Discarded	8.00'	**0.520 in/hr Exfiltration over Surface area**
#2	Primary	8.00'	**15.0" Round Culvert** L= 26.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 8.00' / 7.13' S= 0.0335 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#3	Device 2	9.22'	**22.0" W x 4.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 2	10.05'	**20.0" W x 4.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Device 2	10.79'	**3.7' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Discarded OutFlow Max=0.1 cfs @ 4.33 hrs HW=8.03' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.1 cfs)

Primary OutFlow Max=4.1 cfs @ 12.32 hrs HW=10.41' (Free Discharge)
└**2=Culvert** (Passes 4.1 cfs of 7.9 cfs potential flow)
  ├**3=Orifice/Grate** (Orifice Controls 3.0 cfs @ 4.87 fps)
  ├**4=Orifice/Grate** (Orifice Controls 1.1 cfs @ 2.05 fps)
  └**5=Sharp-Crested Rectangular Weir** (Controls 0.0 cfs)

Pond 1P: Inf Syst-1



Summary for Pond 3P: Rain garden

Inflow Area = 12,275 sf, 52.50% Impervious, Inflow Depth = 6.74" for 25-Year event
Inflow = 2.1 cfs @ 12.08 hrs, Volume= 6,897 cf
Outflow = 2.1 cfs @ 12.09 hrs, Volume= 6,897 cf, Atten= 0%, Lag= 0.3 min
Discarded = 0.0 cfs @ 12.09 hrs, Volume= 495 cf
Primary = 2.1 cfs @ 12.09 hrs, Volume= 6,401 cf
Routed to Link 1L : Towards Wetlands

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 6.47' @ 12.09 hrs Surf.Area= 442 sf Storage= 239 cf

Plug-Flow detention time= 40.9 min calculated for 6,896 cf (100% of inflow)
Center-of-Mass det. time= 41.0 min (824.8 - 783.8)

Volume	Invert	Avail.Storage	Storage Description
#1	5.60'	253 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

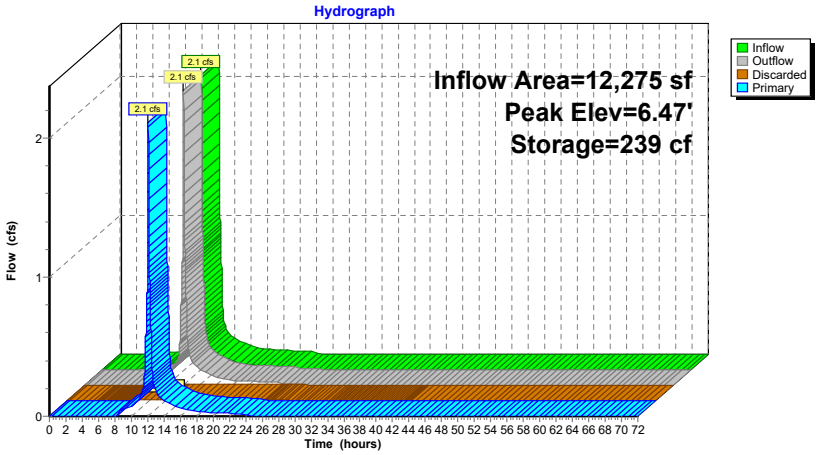
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
5.60	125	46.0	0	0	125
6.00	276	66.0	78	78	305
6.30	350	73.0	94	172	385
6.50	460	87.0	81	253	564

Device	Routing	Invert	Outlet Devices
#1	Discarded	5.60'	**0.520 in/hr Exfiltration over Surface area**
#2	Primary	6.35'	**22.0' 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

Discarded OutFlow Max=0.0 cfs @ 12.09 hrs HW=6.47' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=2.1 cfs @ 12.09 hrs HW=6.47' (Free Discharge)
↑**2=Broad-Crested Rectangular Weir** (Weir Controls 2.1 cfs @ 0.81 fps)

Pond 3P: Rain garden



Summary for Pond 4P: Inf Syst-2

Inflow Area = 1,112 sf, 95.68% Impervious, Inflow Depth = 7.94" for 25-Year event
Inflow = 0.2 cfs @ 12.08 hrs, Volume= 736 cf
Outflow = 0.2 cfs @ 12.09 hrs, Volume= 722 cf, Atten= 1%, Lag= 0.5 min
Discarded = 0.0 cfs @ 2.05 hrs, Volume= 160 cf
Primary = 0.2 cfs @ 12.09 hrs, Volume= 562 cf
Routed to Pond 1P : Inf Syst-1

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 9.51' @ 12.09 hrs Surf.Area= 101 sf Storage= 133 cf

Plug-Flow detention time= 377.3 min calculated for 722 cf (98% of inflow)
Center-of-Mass det. time= 365.7 min (1,112.2 - 746.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	7.00'	84 cf	**7.28'W x 13.84'L x 2.72'H Field A** 274 cf Overall - 64 cf Embedded = 210 cf x 40.0% Voids
#2A	7.25'	57 cf	**Ferguson R-Tank XD 12** x 10 Inside #1 Inside= 19.7"W x 23.6"H => 2.91 sf x 1.97'L = 5.7 cf Outside= 19.7"W x 23.6"H => 3.23 sf x 1.97'L = 6.4 cf 10 Chambers in 2 Rows
		141 cf	Total Available Storage

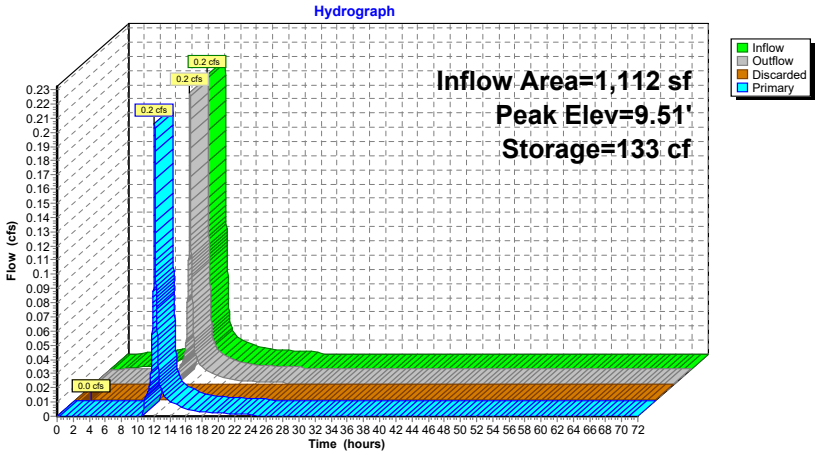
Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	7.00'	**0.270 in/hr Exfiltration over Surface area**
#2	Primary	9.23'	**6.0" Round Culvert** L= 33.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 9.23' / 8.72' S= 0.0155 '/' Cc= 0.900 n= 0.013, Flow Area= 0.20 sf

Discarded OutFlow Max=0.0 cfs @ 2.05 hrs HW=7.03' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.2 cfs @ 12.09 hrs HW=9.51' (Free Discharge)
↑**2=Culvert** (Inlet Controls 0.2 cfs @ 1.81 fps)

Pond 4P: Inf Syst-2



Summary for Pond 5P: Inf Syst-3

Inflow Area = 1,105 sf, 97.29% Impervious, Inflow Depth = 7.94" for 25-Year event
Inflow = 0.2 cfs @ 12.08 hrs, Volume= 731 cf
Outflow = 0.2 cfs @ 12.09 hrs, Volume= 712 cf, Atten= 1%, Lag= 0.5 min
Discarded = 0.0 cfs @ 2.08 hrs, Volume= 160 cf
Primary = 0.2 cfs @ 12.09 hrs, Volume= 552 cf
Routed to Pond 1P : Inf Syst-1

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 9.65' @ 12.09 hrs Surf.Area= 101 sf Storage= 139 cf

Plug-Flow detention time= 388.2 min calculated for 712 cf (97% of inflow)
Center-of-Mass det. time= 371.5 min (1,118.0 - 746.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	7.00'	84 cf	**7.28'W x 13.84'L x 2.72'H Field A** 274 cf Overall - 64 cf Embedded = 210 cf x 40.0% Voids
#2A	7.25'	57 cf	**Ferguson R-Tank XD 12** x 10 Inside #1 Inside= 19.7"W x 23.6"H => 2.91 sf x 1.97'L = 5.7 cf Outside= 19.7"W x 23.6"H => 3.23 sf x 1.97'L = 6.4 cf 10 Chambers in 2 Rows
		141 cf	Total Available Storage

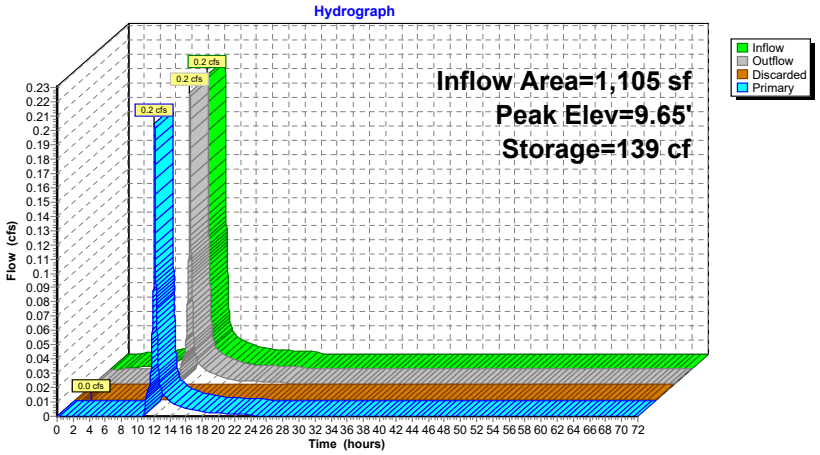
Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	7.00'	**0.270 in/hr Exfiltration over Surface area**
#2	Primary	9.37'	**6.0" Round Culvert** L= 33.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 9.37' / 8.73' S= 0.0194 '/' Cc= 0.900 n= 0.013, Flow Area= 0.20 sf

Discarded OutFlow Max=0.0 cfs @ 2.08 hrs HW=7.03' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.2 cfs @ 12.09 hrs HW=9.65' (Free Discharge)
↑**2=Culvert** (Inlet Controls 0.2 cfs @ 1.80 fps)

Pond 5P: Inf Syst-3



Summary for Pond 6P: Inf Syst-4

Inflow Area = 1,104 sf, 97.46% Impervious, Inflow Depth = 7.94" for 25-Year event
Inflow = 0.2 cfs @ 12.08 hrs, Volume= 730 cf
Outflow = 0.2 cfs @ 12.09 hrs, Volume= 711 cf, Atten= 1%, Lag= 0.5 min
Discarded = 0.0 cfs @ 2.08 hrs, Volume= 160 cf
Primary = 0.2 cfs @ 12.09 hrs, Volume= 552 cf
Routed to Pond 1P : Inf Syst-1

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 9.65' @ 12.09 hrs Surf.Area= 101 sf Storage= 139 cf

Plug-Flow detention time= 388.1 min calculated for 711 cf (97% of inflow)
Center-of-Mass det. time= 371.8 min (1,118.4 - 746.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	7.00'	84 cf	**7.28'W x 13.84'L x 2.72'H Field A** 274 cf Overall - 64 cf Embedded = 210 cf x 40.0% Voids
#2A	7.25'	57 cf	**Ferguson R-Tank XD 12** x 10 Inside #1 Inside= 19.7"W x 23.6"H => 2.91 sf x 1.97'L = 5.7 cf Outside= 19.7"W x 23.6"H => 3.23 sf x 1.97'L = 6.4 cf 10 Chambers in 2 Rows
		141 cf	Total Available Storage

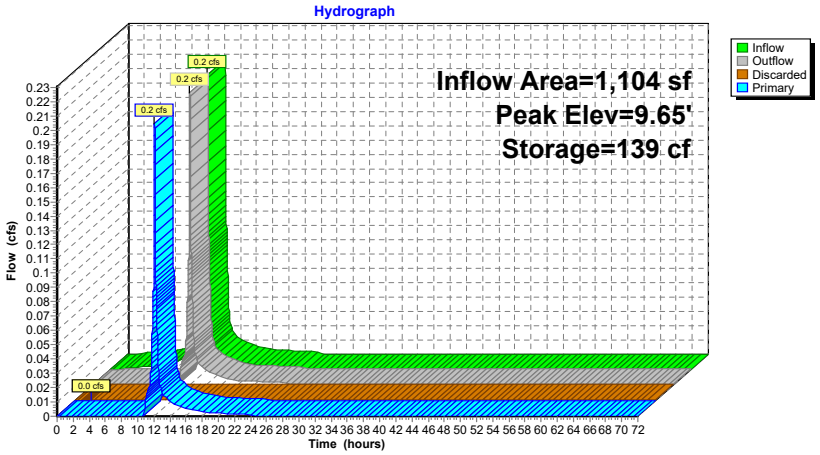
Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	7.00'	**0.270 in/hr Exfiltration over Surface area**
#2	Primary	9.37'	**6.0" Round Culvert** L= 51.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 9.37' / 8.10' S= 0.0249 '/' Cc= 0.900 n= 0.013, Flow Area= 0.20 sf

Discarded OutFlow Max=0.0 cfs @ 2.08 hrs HW=7.03' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.2 cfs @ 12.09 hrs HW=9.65' (Free Discharge)
↑**2=Culvert** (Inlet Controls 0.2 cfs @ 1.80 fps)

Pond 6P: Inf Syst-4



Summary for Pond 7P: Inf Syst-5

Inflow Area = 1,082 sf, 98.06% Impervious, Inflow Depth = 8.06" for 25-Year event
Inflow = 0.2 cfs @ 12.08 hrs, Volume= 727 cf
Outflow = 0.2 cfs @ 12.09 hrs, Volume= 726 cf, Atten= 1%, Lag= 0.5 min
Discarded = 0.0 cfs @ 1.52 hrs, Volume= 161 cf
Primary = 0.2 cfs @ 12.09 hrs, Volume= 565 cf
Routed to Pond 1P : Inf Syst-1

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 9.28' @ 12.09 hrs Surf.Area= 101 sf Storage= 121 cf

Plug-Flow detention time= 365.7 min calculated for 726 cf (100% of inflow)
Center-of-Mass det. time= 365.2 min (1,106.0 - 740.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	7.00'	73 cf	**7.28'W x 13.84'L x 2.39'H Field A** 241 cf Overall - 58 cf Embedded = 182 cf x 40.0% Voids
#2A	7.25'	52 cf	**Ferguson R-Tank XD 11** x 10 Inside #1 Inside= 19.7"W x 21.7"H => 2.66 sf x 1.97'L = 5.2 cf Outside= 19.7"W x 21.7"H => 2.96 sf x 1.97'L = 5.8 cf 10 Chambers in 2 Rows
		125 cf	Total Available Storage

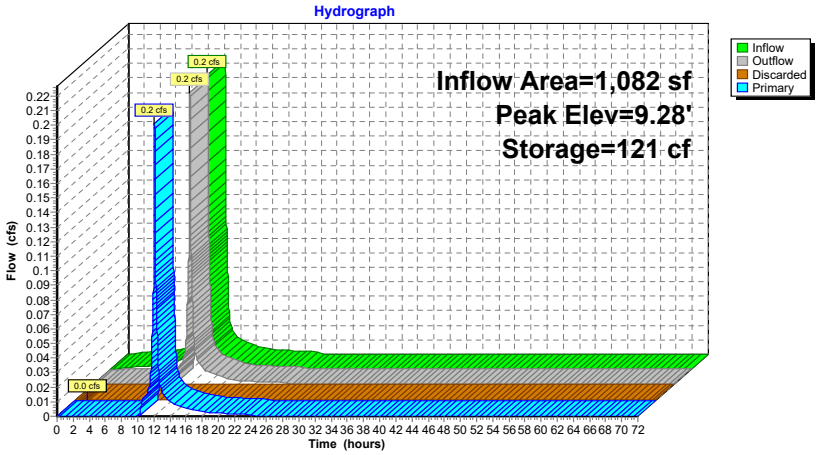
Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	7.00'	**0.270 in/hr Exfiltration over Surface area**
#2	Primary	9.00'	**6.0" Round Culvert** L= 48.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 9.00' / 8.35' S= 0.0135 '/' Cc= 0.900 n= 0.013, Flow Area= 0.20 sf

Discarded OutFlow Max=0.0 cfs @ 1.52 hrs HW=7.03' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.2 cfs @ 12.09 hrs HW=9.28' (Free Discharge)
↑**2=Culvert** (Inlet Controls 0.2 cfs @ 1.79 fps)

Pond 7P: Inf Syst-5



Summary for Pond 8P: Inf Syst-6

Inflow Area = 1,056 sf, 99.24% Impervious, Inflow Depth = 8.06" for 25-Year event
Inflow = 0.2 cfs @ 12.08 hrs, Volume= 709 cf
Outflow = 0.2 cfs @ 12.09 hrs, Volume= 708 cf, Atten= 1%, Lag= 0.6 min
Discarded = 0.0 cfs @ 1.56 hrs, Volume= 161 cf
Primary = 0.2 cfs @ 12.09 hrs, Volume= 548 cf
Routed to Pond 1P : Inf Syst-1

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 9.29' @ 12.09 hrs Surf.Area= 101 sf Storage= 122 cf

Plug-Flow detention time= 374.4 min calculated for 708 cf (100% of inflow)
Center-of-Mass det. time= 373.8 min (1,114.6 - 740.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	7.00'	73 cf	**7.28'W x 13.84'L x 2.39'H Field A** 241 cf Overall - 58 cf Embedded = 182 cf x 40.0% Voids
#2A	7.25'	52 cf	**Ferguson R-Tank XD 11** x 10 Inside #1 Inside= 19.7"W x 21.7"H => 2.66 sf x 1.97'L = 5.2 cf Outside= 19.7"W x 21.7"H => 2.96 sf x 1.97'L = 5.8 cf 10 Chambers in 2 Rows
		125 cf	Total Available Storage

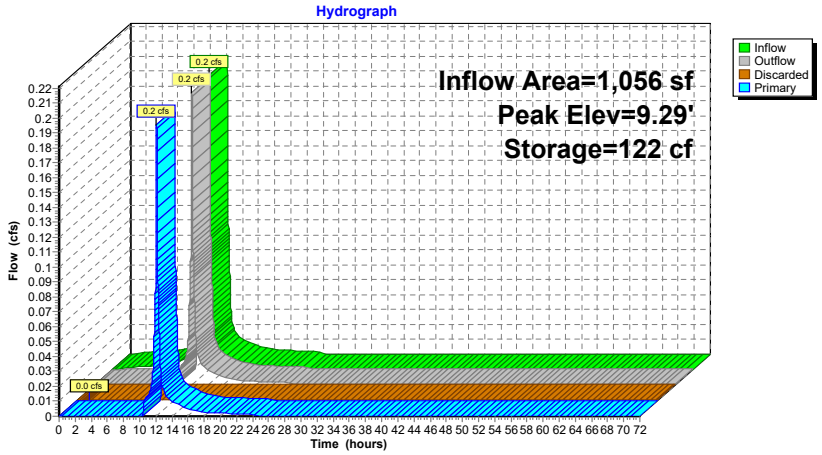
Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	7.00'	**0.270 in/hr Exfiltration over Surface area**
#2	Primary	9.00'	**8.0" Round Culvert** L= 46.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 9.00' / 8.77' S= 0.0050 '/' Cc= 0.900 n= 0.013, Flow Area= 0.35 sf

Discarded OutFlow Max=0.0 cfs @ 1.56 hrs HW=7.03' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.2 cfs @ 12.09 hrs HW=9.29' (Free Discharge)
↑**2=Culvert** (Barrel Controls 0.2 cfs @ 1.94 fps)

Pond 8P: Inf Syst-6



Summary for Pond 9P: Inf Syst-7

Inflow Area = 24,131 sf, 72.87% Impervious, Inflow Depth = 7.24" for 25-Year event
Inflow = 4.3 cfs @ 12.08 hrs, Volume= 14,562 cf
Outflow = 2.7 cfs @ 12.18 hrs, Volume= 14,562 cf, Atten= 37%, Lag= 5.7 min
Discarded = 0.0 cfs @ 4.62 hrs, Volume= 1,561 cf
Primary = 2.7 cfs @ 12.18 hrs, Volume= 13,001 cf
Routed to Link 1L : Towards Wetlands

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 8.38' @ 12.18 hrs Surf.Area= 2,422 sf Storage= 2,562 cf

Plug-Flow detention time= 53.2 min calculated for 14,562 cf (100% of inflow)
Center-of-Mass det. time= 53.1 min (824.0 - 770.9)

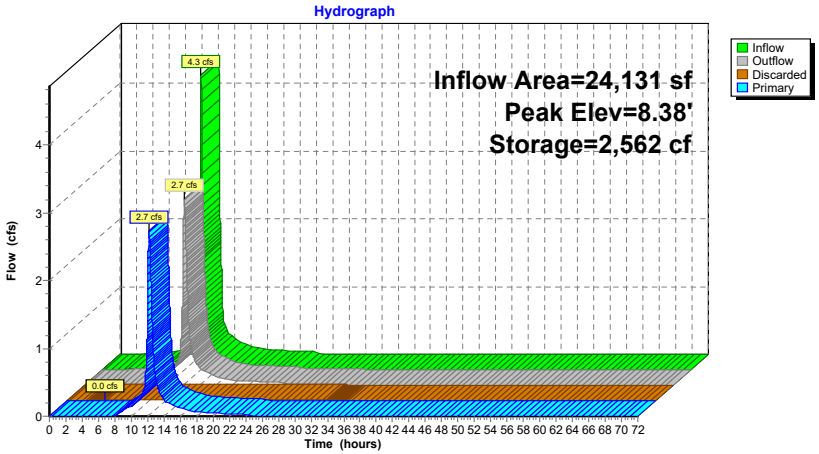
Volume	Invert	Avail.Storage	Storage Description
#1	7.15'	3,645 cf	**6.89'W x 14.06'L x 1.75'H StormTrap ST-1 Units (Irregular Shape)** x 25 4,238 cf Overall x 86.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Discarded	7.15'	**0.270 in/hr Exfiltration over Surface area**
#2	Primary	7.15'	**12.0" Round Culvert** L= 4.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 7.15' / 7.13' S= 0.0050 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#3	Device 2	7.35'	**22.0" W x 4.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.0 cfs @ 4.62 hrs HW=7.17' (Free Discharge)
↑└**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=2.7 cfs @ 12.18 hrs HW=8.38' (Free Discharge)
↑└**2=Culvert** (Passes 2.7 cfs of 2.7 cfs potential flow)
↑└**3=Orifice/Grate** (Orifice Controls 2.7 cfs @ 4.47 fps)

Pond 9P: Inf Syst-7

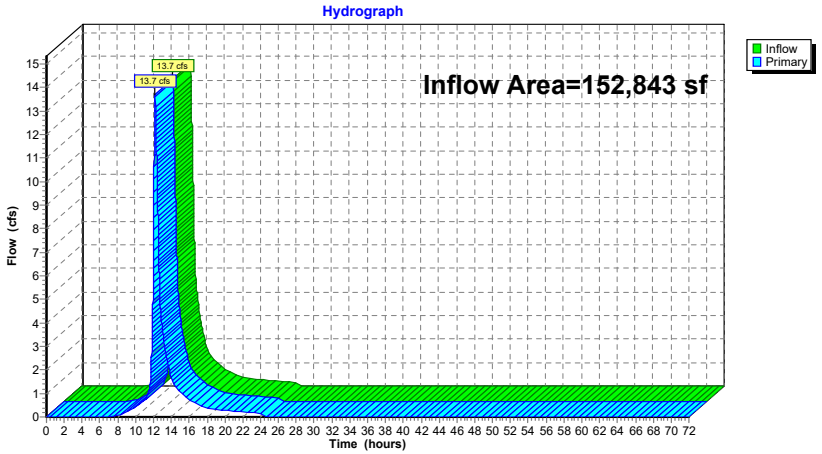


Summary for Link 1L: Towards Wetlands

Inflow Area = 152,843 sf, 50.79% Impervious, Inflow Depth = 5.24" for 25-Year event
Inflow = 13.7 cfs @ 12.18 hrs, Volume= 66,767 cf
Primary = 13.7 cfs @ 12.18 hrs, Volume= 66,767 cf, Atten= 0%, Lag= 0.0 min
Routed to Link 100L : Total Flows

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

Link 1L: Towards Wetlands

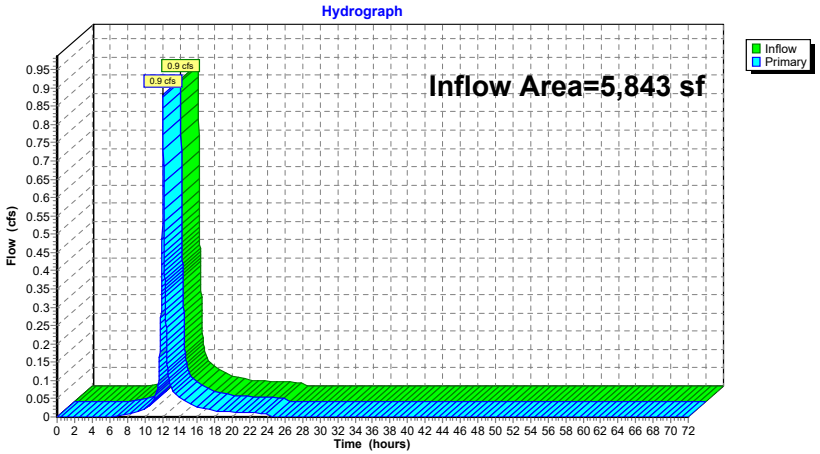


Summary for Link 2L: Towards Street

Inflow Area = 5,843 sf, 18.07% Impervious, Inflow Depth = 5.67" for 25-Year event
Inflow = 0.9 cfs @ 12.09 hrs, Volume= 2,760 cf
Primary = 0.9 cfs @ 12.09 hrs, Volume= 2,760 cf, Atten= 0%, Lag= 0.0 min
Routed to Link 100L : Total Flows

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

Link 2L: Towards Street

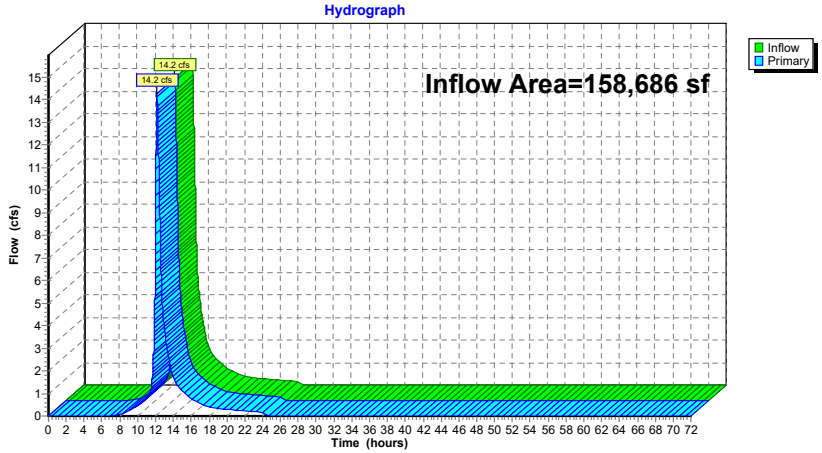


Summary for Link 100L: Total Flows

Inflow Area = 158,686 sf, 49.59% Impervious, Inflow Depth = 5.26" for 25-Year event
Inflow = 14.2 cfs @ 12.18 hrs, Volume= 69,527 cf
Primary = 14.2 cfs @ 12.18 hrs, Volume= 69,527 cf, Atten= 0%, Lag= 0.0 min

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

Link 100L: Total Flows



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

Subcatchment1S: CB-1 Runoff Area=22,742 sf 72.16% Impervious Runoff Depth=8.58"
Tc=6.0 min CN=91 Runoff=4.8 cfs 16,254 cf

Subcatchment2S: Building Roof Runoff Area=32,925 sf 100.00% Impervious Runoff Depth=9.43"
Tc=6.0 min CN=98 Runoff=7.2 cfs 25,872 cf

Subcatchment3.1S: Backyard ADs Runoff Area=8,985 sf 3.03% Impervious Runoff Depth=6.57"
Flow Length=147' Tc=10.3 min CN=75 Runoff=1.4 cfs 4,920 cf

Subcatchment3S: Townhouse Roofs Runoff Area=13,067 sf 100.00% Impervious Runoff Depth=9.43"
Tc=6.0 min CN=98 Runoff=2.9 cfs 10,268 cf

Subcatchment4.2S: TD-2 Runoff Area=1,112 sf 95.68% Impervious Runoff Depth=9.31"
Tc=6.0 min CN=97 Runoff=0.2 cfs 863 cf

Subcatchment4.3S: TD-3 Runoff Area=1,105 sf 97.29% Impervious Runoff Depth=9.31"
Tc=6.0 min CN=97 Runoff=0.2 cfs 857 cf

Subcatchment4.4S: TD-4 Runoff Area=1,104 sf 97.46% Impervious Runoff Depth=9.31"
Tc=6.0 min CN=97 Runoff=0.2 cfs 856 cf

Subcatchment4.5S: TD-5 Runoff Area=1,082 sf 98.06% Impervious Runoff Depth=9.43"
Tc=6.0 min CN=98 Runoff=0.2 cfs 850 cf

Subcatchment4.6S: TD-6 Runoff Area=1,056 sf 99.24% Impervious Runoff Depth=9.43"
Tc=6.0 min CN=98 Runoff=0.2 cfs 830 cf

Subcatchment5.1S: TD-1A Runoff Area=1,389 sf 84.59% Impervious Runoff Depth=8.94"
Tc=6.0 min CN=94 Runoff=0.3 cfs 1,035 cf

Subcatchment5S: TD-1B Runoff Area=4,462 sf 42.78% Impervious Runoff Depth=7.71"
Tc=6.0 min CN=84 Runoff=0.9 cfs 2,866 cf

Subcatchment6.1S: East driveway Runoff Area=12,275 sf 52.50% Impervious Runoff Depth=8.08"
Tc=6.0 min CN=87 Runoff=2.5 cfs 8,268 cf

Subcatchment6S: Bypass Towards Runoff Area=51,539 sf 0.21% Impervious Runoff Depth=6.44"
Flow Length=125' Tc=14.0 min CN=74 Runoff=6.9 cfs 27,672 cf

Subcatchment7S: To Street Runoff Area=5,843 sf 18.07% Impervious Runoff Depth=6.95"
Tc=6.0 min CN=78 Runoff=1.1 cfs 3,385 cf

Pond 1P: Inf Syst-1 Peak Elev=10.70' Storage=17,296 cf Inflow=12.4 cfs 44,458 cf
Discarded=0.1 cfs 15,169 cf Primary=5.2 cfs 29,289 cf Outflow=5.3 cfs 44,458 cf

Pond 3P: Rain garden Peak Elev=6.48' Storage=245 cf Inflow=2.5 cfs 8,268 cf
Discarded=0.0 cfs 506 cf Primary=2.5 cfs 7,762 cf Outflow=2.5 cfs 8,268 cf

Pond 4P: Inf Syst-2 Peak Elev=9.54' Storage=134 cf Inflow=0.2 cfs 863 cf
Discarded=0.0 cfs 160 cf Primary=0.2 cfs 689 cf Outflow=0.2 cfs 849 cf

Pond 5P: Inf Syst-3 Peak Elev=9.68' Storage=140 cf Inflow=0.2 cfs 857 cf
Discarded=0.0 cfs 160 cf Primary=0.2 cfs 678 cf Outflow=0.2 cfs 838 cf

Pond 6P: Inf Syst-4 Peak Elev=9.68' Storage=140 cf Inflow=0.2 cfs 856 cf
Discarded=0.0 cfs 160 cf Primary=0.2 cfs 677 cf Outflow=0.2 cfs 837 cf

Pond 7P: Inf Syst-5 Peak Elev=9.30' Storage=122 cf Inflow=0.2 cfs 850 cf
Discarded=0.0 cfs 161 cf Primary=0.2 cfs 688 cf Outflow=0.2 cfs 849 cf

Pond 8P: Inf Syst-6 Peak Elev=9.32' Storage=123 cf Inflow=0.2 cfs 830 cf
Discarded=0.0 cfs 161 cf Primary=0.2 cfs 668 cf Outflow=0.2 cfs 829 cf

Pond 9P: Inf Syst-7 Peak Elev=8.58' Storage=2,968 cf Inflow=5.1 cfs 17,290 cf
Discarded=0.0 cfs 1,591 cf Primary=3.0 cfs 15,699 cf Outflow=3.0 cfs 17,290 cf

Link 1L: Towards Wetlands Inflow=17.0 cfs 83,287 cf
Primary=17.0 cfs 83,287 cf

Link 2L: Towards Street Inflow=1.1 cfs 3,385 cf
Primary=1.1 cfs 3,385 cf

Link 100L: Total Flows Inflow=17.8 cfs 86,673 cf
Primary=17.8 cfs 86,673 cf

Total Runoff Area = 158,686 sf Runoff Volume = 104,796 cf Average Runoff Depth = 7.92"
50.41% Pervious = 79,997 sf 49.59% Impervious = 78,689 sf

Summary for Subcatchment 1S: CB-1

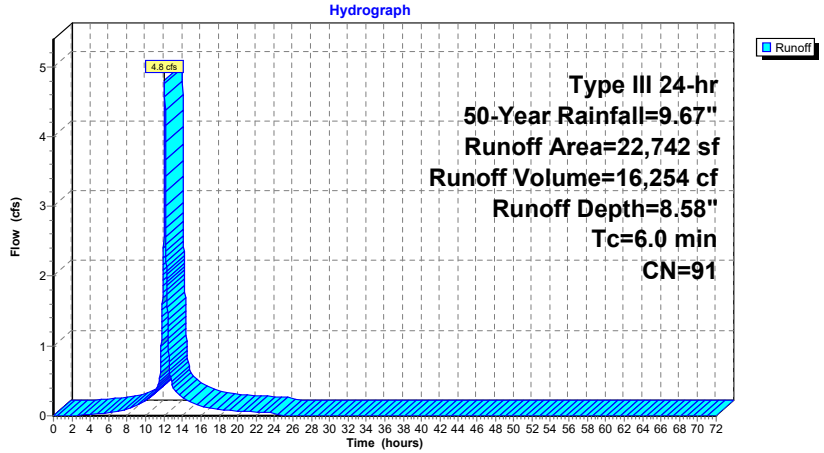
Runoff = 4.8 cfs @ 12.08 hrs, Volume= 16,254 cf, Depth= 8.58"
Routed to Pond 9P : Inf Syst-7

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 50-Year Rainfall=9.67"

Area (sf)	CN	Description
16,410	98	Paved parking, HSG C
6,332	74	>75% Grass cover, Good, HSG C
22,742	91	Weighted Average
6,332		27.84% Pervious Area
16,410		72.16% Impervious Area

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

Subcatchment 1S: CB-1



Summary for Subcatchment 2S: Building Roof

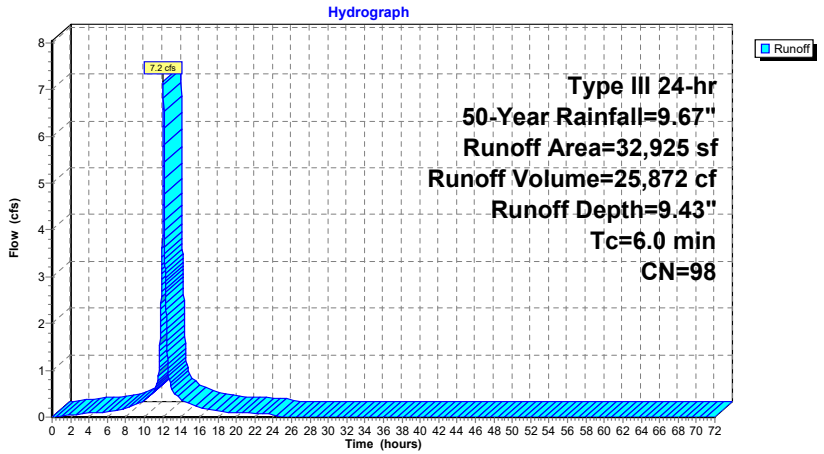
Runoff = 7.2 cfs @ 12.08 hrs, Volume= 25,872 cf, Depth= 9.43"
Routed to Pond 1P : Inf Syst-1

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 50-Year Rainfall=9.67"

Area (sf)	CN	Description
32,925	98	Roofs, HSG C
32,925		100.00% Impervious Area

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

Subcatchment 2S: Building Roof



Summary for Subcatchment 3.1S: Backyard ADs

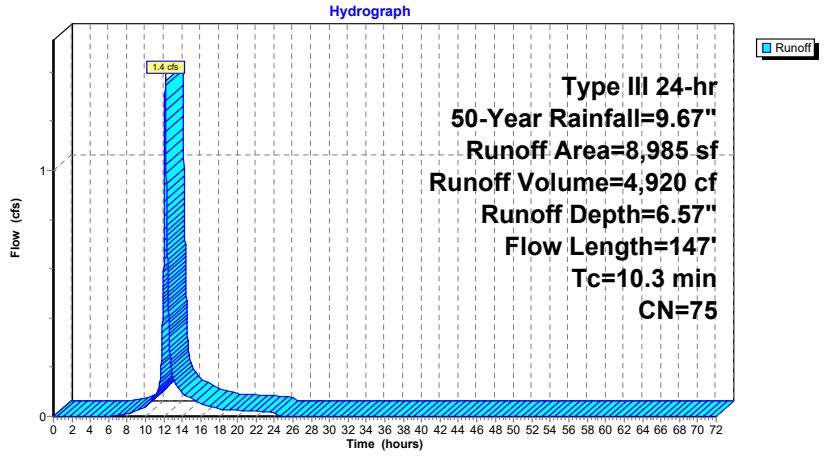
Runoff = 1.4 cfs @ 12.14 hrs, Volume= 4,920 cf, Depth= 6.57"
Routed to Pond 1P : Inf Syst-1

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 50-Year Rainfall=9.67"

	Area (sf)	CN	Description
	272	98	Unconnected pavement, HSG C
	8,302	74	>75% Grass cover, Good, HSG C
*	411	89	Gravel sidewalk, HSG C
	8,985	75	Weighted Average
	8,713		96.97% Pervious Area
	272		3.03% Impervious Area
	272		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.4	50	0.0142	0.09		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.23"
0.9	97	0.0154	1.86		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
10.3	147	Total			

Subcatchment 3.1S: Backyard ADs



Summary for Subcatchment 3S: Townhouse Roofs

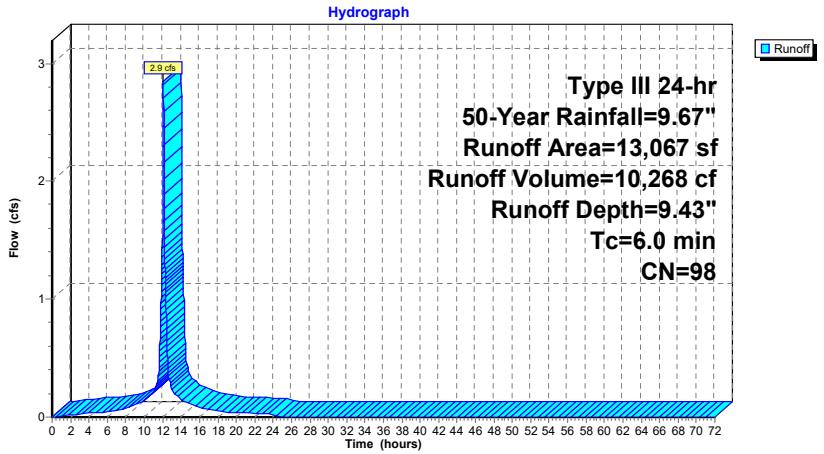
Runoff = 2.9 cfs @ 12.08 hrs, Volume= 10,268 cf, Depth= 9.43"
Routed to Pond 1P : Inf Syst-1

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 50-Year Rainfall=9.67"

Area (sf)	CN	Description
13,067	98	Roofs, HSG C
13,067		100.00% Impervious Area

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

Subcatchment 3S: Townhouse Roofs



Summary for Subcatchment 4.2S: TD-2

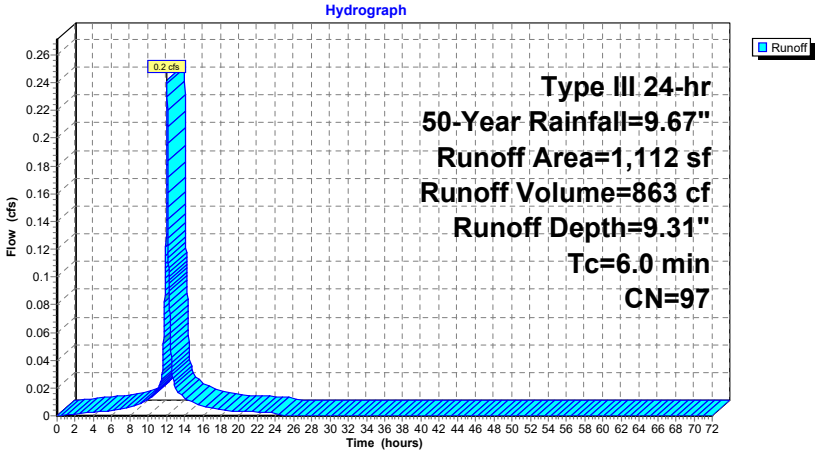
Runoff = 0.2 cfs @ 12.08 hrs, Volume= 863 cf, Depth= 9.31"
Routed to Pond 4P : Inf Syst-2

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 50-Year Rainfall=9.67"

Area (sf)	CN	Description
1,064	98	Paved parking, HSG C
48	74	>75% Grass cover, Good, HSG C
1,112	97	Weighted Average
48		4.32% Pervious Area
1,064		95.68% Impervious Area

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

Subcatchment 4.2S: TD-2



Summary for Subcatchment 4.3S: TD-3

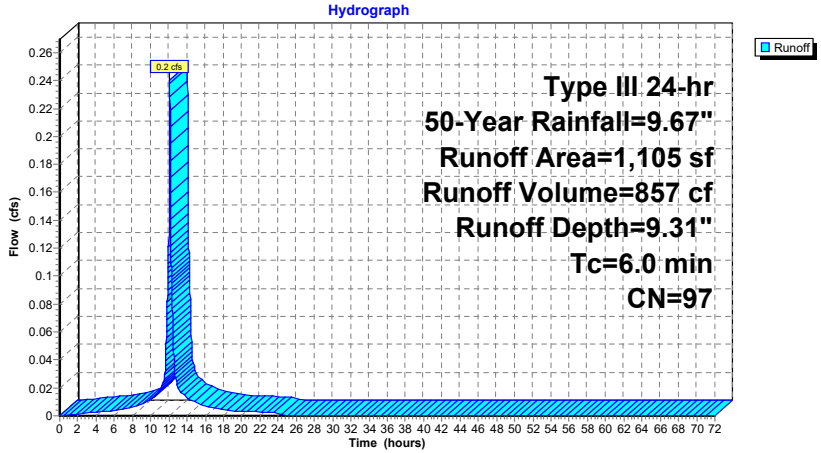
Runoff = 0.2 cfs @ 12.08 hrs, Volume= 857 cf, Depth= 9.31"
Routed to Pond 5P : Inf Syst-3

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 50-Year Rainfall=9.67"

Area (sf)	CN	Description
1,075	98	Paved parking, HSG C
30	74	>75% Grass cover, Good, HSG C
1,105	97	Weighted Average
30		2.71% Pervious Area
1,075		97.29% Impervious Area

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

Subcatchment 4.3S: TD-3



Summary for Subcatchment 4.4S: TD-4

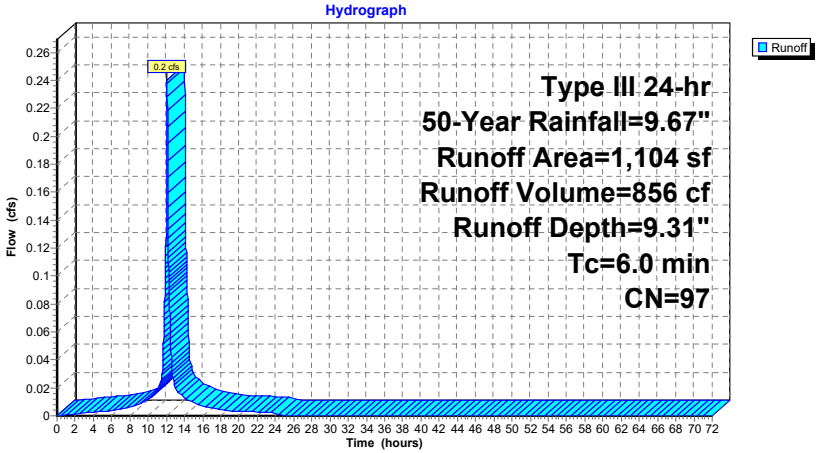
Runoff = 0.2 cfs @ 12.08 hrs, Volume= 856 cf, Depth= 9.31"
Routed to Pond 6P : Inf Syst-4

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 50-Year Rainfall=9.67"

Area (sf)	CN	Description
1,076	98	Paved parking, HSG C
28	74	>75% Grass cover, Good, HSG C
1,104	97	Weighted Average
28		2.54% Pervious Area
1,076		97.46% Impervious Area

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

Subcatchment 4.4S: TD-4



Summary for Subcatchment 4.5S: TD-5

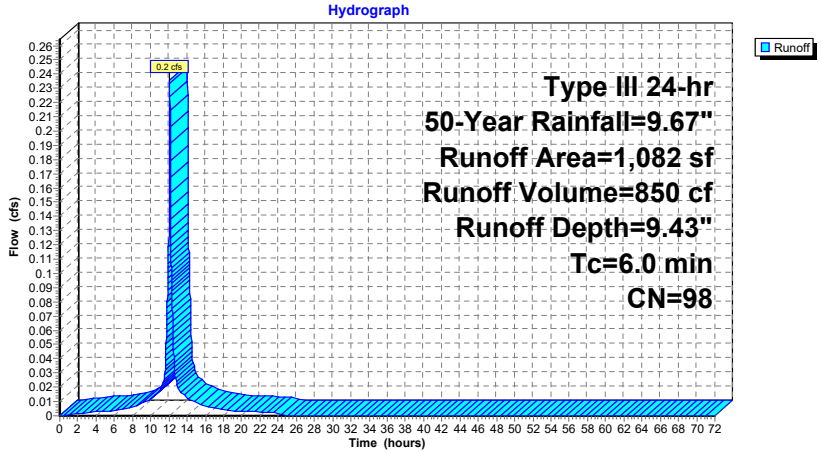
Runoff = 0.2 cfs @ 12.08 hrs, Volume= 850 cf, Depth= 9.43"
Routed to Pond 7P : Inf Syst-5

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 50-Year Rainfall=9.67"

Area (sf)	CN	Description
1,061	98	Paved parking, HSG C
21	74	>75% Grass cover, Good, HSG C
1,082	98	Weighted Average
21		1.94% Pervious Area
1,061		98.06% Impervious Area

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

Subcatchment 4.5S: TD-5



Summary for Subcatchment 4.6S: TD-6

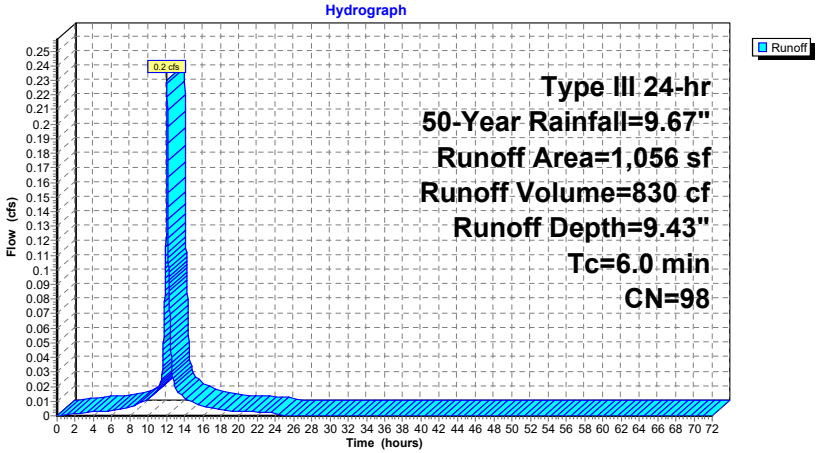
Runoff = 0.2 cfs @ 12.08 hrs, Volume= 830 cf, Depth= 9.43"
Routed to Pond 8P : Inf Syst-6

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 50-Year Rainfall=9.67"

Area (sf)	CN	Description
1,048	98	Paved parking, HSG C
8	74	>75% Grass cover, Good, HSG C
1,056	98	Weighted Average
8		0.76% Pervious Area
1,048		99.24% Impervious Area

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

Subcatchment 4.6S: TD-6



Summary for Subcatchment 5.1S: TD-1A

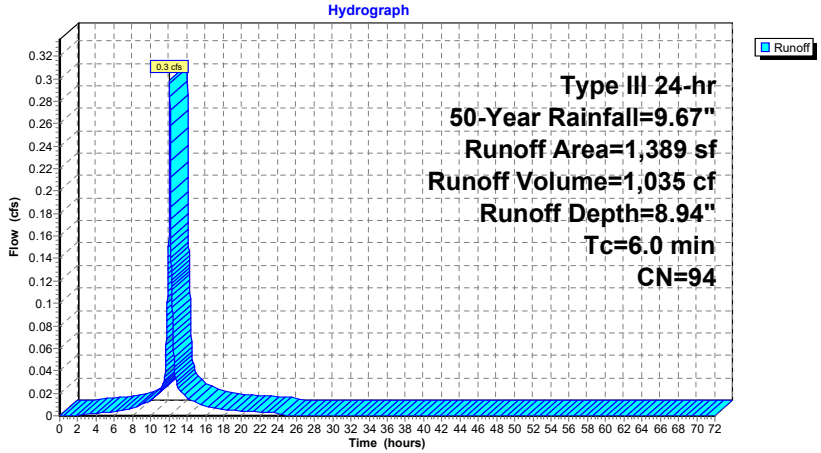
Runoff = 0.3 cfs @ 12.08 hrs, Volume= 1,035 cf, Depth= 8.94"
Routed to Pond 9P : Inf Syst-7

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 50-Year Rainfall=9.67"

Area (sf)	CN	Description
1,175	98	Paved parking, HSG C
214	74	>75% Grass cover, Good, HSG C
1,389	94	Weighted Average
214		15.41% Pervious Area
1,175		84.59% Impervious Area

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

Subcatchment 5.1S: TD-1A



Summary for Subcatchment 5S: TD-1B

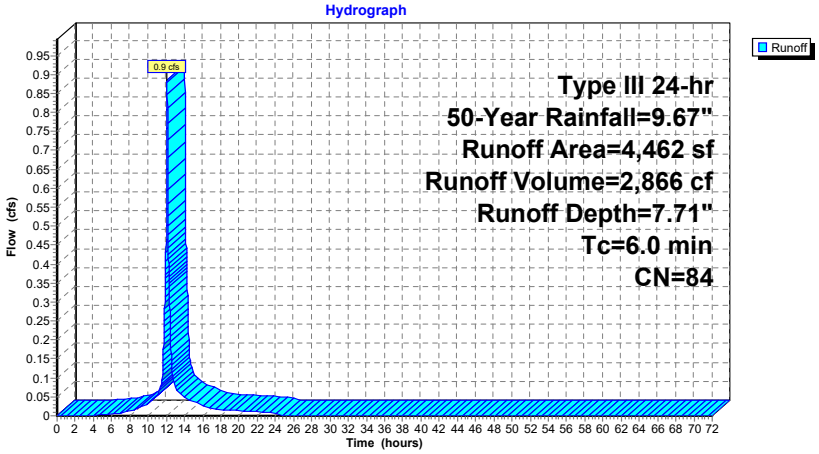
Runoff = 0.9 cfs @ 12.08 hrs, Volume= 2,866 cf, Depth= 7.71"
Routed to Link 1L : Towards Wetlands

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 50-Year Rainfall=9.67"

Area (sf)	CN	Description
1,909	98	Paved parking, HSG C
2,553	74	>75% Grass cover, Good, HSG C
4,462	84	Weighted Average
2,553		57.22% Pervious Area
1,909		42.78% Impervious Area

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

Subcatchment 5S: TD-1B



Summary for Subcatchment 6.1S: East driveway

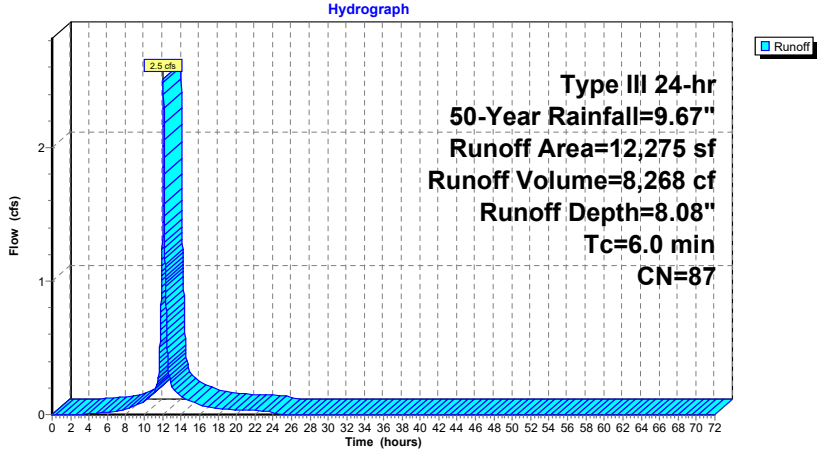
Runoff = 2.5 cfs @ 12.08 hrs, Volume= 8,268 cf, Depth= 8.08"
Routed to Pond 3P : Rain garden

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 50-Year Rainfall=9.67"

Area (sf)	CN	Description
5,611	74	>75% Grass cover, Good, HSG C
6,444	98	Paved roads w/curbs & sewers, HSG C
220	89	Gravel roads, HSG C
12,275	87	Weighted Average
5,831		47.50% Pervious Area
6,444		52.50% Impervious Area

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

Subcatchment 6.1S: East driveway



Summary for Subcatchment 6S: Bypass Towards Wetlands

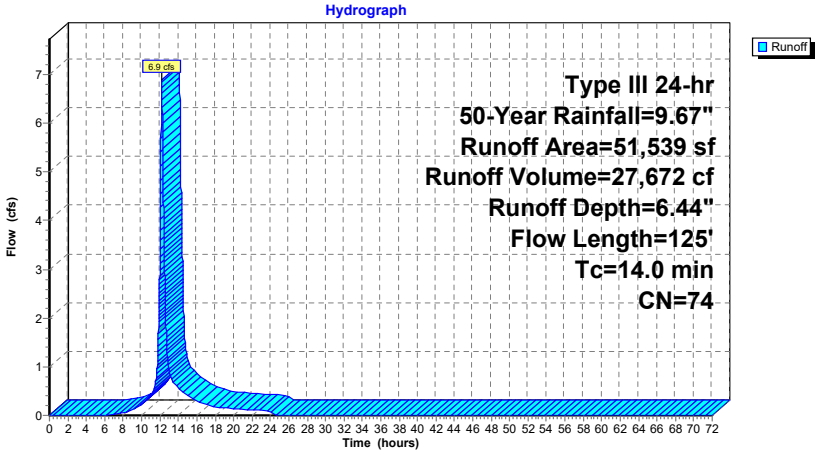
Runoff = 6.9 cfs @ 12.19 hrs, Volume= 27,672 cf, Depth= 6.44"
Routed to Link 1L : Towards Wetlands

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 50-Year Rainfall=9.67"

Area (sf)	CN	Description
4,985	70	Woods, Good, HSG C
46,447	74	>75% Grass cover, Good, HSG C
107	98	Roofs, HSG C
51,539	74	Weighted Average
51,432		99.79% Pervious Area
107		0.21% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.8	50	0.0220	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.23"
2.2	75	0.0133	0.58		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
14.0	125	Total			

Subcatchment 6S: Bypass Towards Wetlands



Summary for Subcatchment 7S: To Street

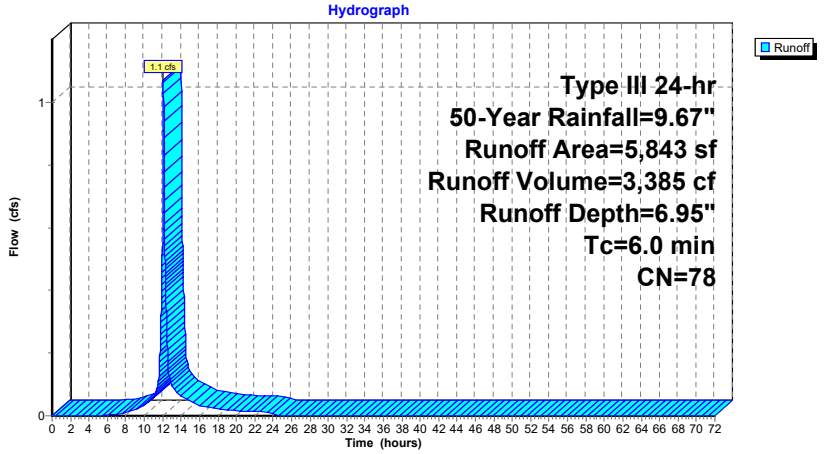
Runoff = 1.1 cfs @ 12.09 hrs, Volume= 3,385 cf, Depth= 6.95"
Routed to Link 2L : Towards Street

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 50-Year Rainfall=9.67"

Area (sf)	CN	Description
1,056	98	Paved parking, HSG C
4,787	74	>75% Grass cover, Good, HSG C
5,843	78	Weighted Average
4,787		81.93% Pervious Area
1,056		18.07% Impervious Area

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

Subcatchment 7S: To Street



Summary for Pond 1P: Inf Syst-1

Inflow Area = 60,436 sf, 85.36% Impervious, Inflow Depth = 8.83" for 50-Year event
Inflow = 12.4 cfs @ 12.09 hrs, Volume= 44,458 cf
Outflow = 5.3 cfs @ 12.30 hrs, Volume= 44,458 cf, Atten= 57%, Lag= 12.5 min
Discarded = 0.1 cfs @ 3.50 hrs, Volume= 15,169 cf
Primary = 5.2 cfs @ 12.30 hrs, Volume= 29,289 cf
Routed to Link 1L : Towards Wetlands

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 10.70' @ 12.30 hrs Surf.Area= 7,459 sf Storage= 17,296 cf

Plug-Flow detention time= 312.6 min calculated for 44,458 cf (100% of inflow)
Center-of-Mass det. time= 312.5 min (1,063.8 - 751.2)

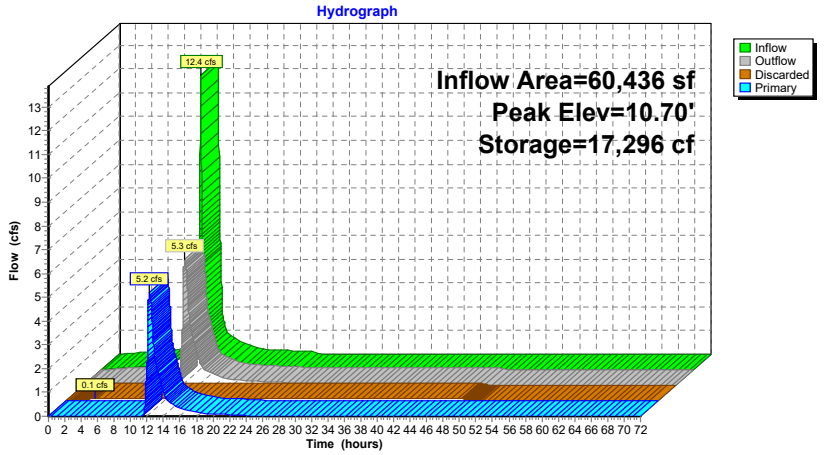
Volume	Invert	Avail.Storage	Storage Description
#1	8.00'	19,245 cf	**6.89'W x 14.06'L x 3.00'H StormTrap ST-1 Units (Irregular Shape)** x 77 22,378 cf Overall x 86.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Discarded	8.00'	**0.520 in/hr Exfiltration over Surface area**
#2	Primary	8.00'	**15.0" Round Culvert** L= 26.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 8.00' / 7.13' S= 0.0335 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#3	Device 2	9.22'	**22.0" W x 4.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 2	10.05'	**20.0" W x 4.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Device 2	10.79'	**3.7' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Discarded OutFlow Max=0.1 cfs @ 3.50 hrs HW=8.03' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.1 cfs)

Primary OutFlow Max=5.2 cfs @ 12.30 hrs HW=10.70' (Free Discharge)
└**2=Culvert** (Passes 5.2 cfs of 8.5 cfs potential flow)
  ├**3=Orifice/Grate** (Orifice Controls 3.4 cfs @ 5.51 fps)
  ├**4=Orifice/Grate** (Orifice Controls 1.8 cfs @ 3.32 fps)
  └**5=Sharp-Crested Rectangular Weir** (Controls 0.0 cfs)

Pond 1P: Inf Syst-1



Summary for Pond 3P: Rain garden

Inflow Area = 12,275 sf, 52.50% Impervious, Inflow Depth = 8.08" for 50-Year event
Inflow = 2.5 cfs @ 12.08 hrs, Volume= 8,268 cf
Outflow = 2.5 cfs @ 12.09 hrs, Volume= 8,268 cf, Atten= 0%, Lag= 0.3 min
Discarded = 0.0 cfs @ 12.09 hrs, Volume= 506 cf
Primary = 2.5 cfs @ 12.09 hrs, Volume= 7,762 cf
Routed to Link 1L : Towards Wetlands

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 6.48' @ 12.09 hrs Surf.Area= 450 sf Storage= 245 cf

Plug-Flow detention time= 35.3 min calculated for 8,268 cf (100% of inflow)
Center-of-Mass det. time= 35.2 min (814.3 - 779.1)

Volume	Invert	Avail.Storage	Storage Description
#1	5.60'	253 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

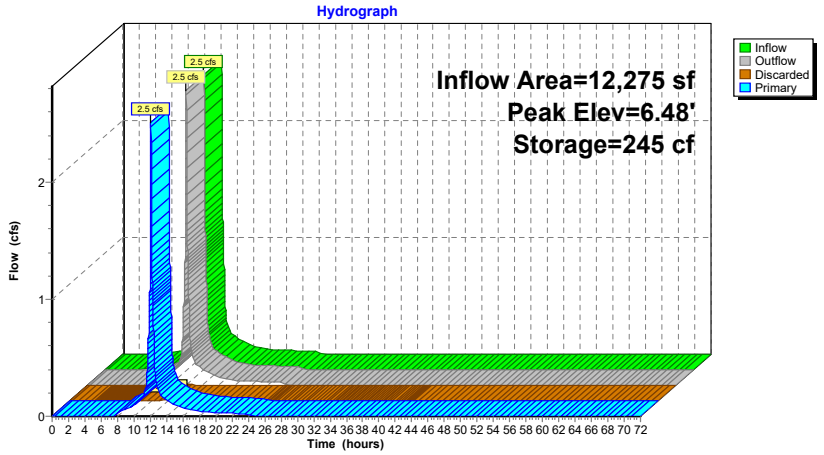
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
5.60	125	46.0	0	0	125
6.00	276	66.0	78	78	305
6.30	350	73.0	94	172	385
6.50	460	87.0	81	253	564

Device	Routing	Invert	Outlet Devices
#1	Discarded	5.60'	**0.520 in/hr Exfiltration over Surface area**
#2	Primary	6.35'	**22.0' 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

Discarded OutFlow Max=0.0 cfs @ 12.09 hrs HW=6.48' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=2.5 cfs @ 12.09 hrs HW=6.48' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Weir Controls 2.5 cfs @ 0.85 fps)

Pond 3P: Rain garden



Summary for Pond 4P: Inf Syst-2

Inflow Area = 1,112 sf, 95.68% Impervious, Inflow Depth = 9.31" for 50-Year event
Inflow = 0.2 cfs @ 12.08 hrs, Volume= 863 cf
Outflow = 0.2 cfs @ 12.09 hrs, Volume= 849 cf, Atten= 1%, Lag= 0.5 min
Discarded = 0.0 cfs @ 1.70 hrs, Volume= 160 cf
Primary = 0.2 cfs @ 12.09 hrs, Volume= 689 cf
Routed to Pond 1P : Inf Syst-1

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 9.54' @ 12.09 hrs Surf.Area= 101 sf Storage= 134 cf

Plug-Flow detention time= 326.9 min calculated for 849 cf (98% of inflow)
Center-of-Mass det. time= 316.9 min (1,061.1 - 744.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	7.00'	84 cf	**7.28'W x 13.84'L x 2.72'H Field A** 274 cf Overall - 64 cf Embedded = 210 cf x 40.0% Voids
#2A	7.25'	57 cf	**Ferguson R-Tank XD 12** x 10 Inside #1 Inside= 19.7"W x 23.6"H => 2.91 sf x 1.97'L = 5.7 cf Outside= 19.7"W x 23.6"H => 3.23 sf x 1.97'L = 6.4 cf 10 Chambers in 2 Rows
		141 cf	Total Available Storage

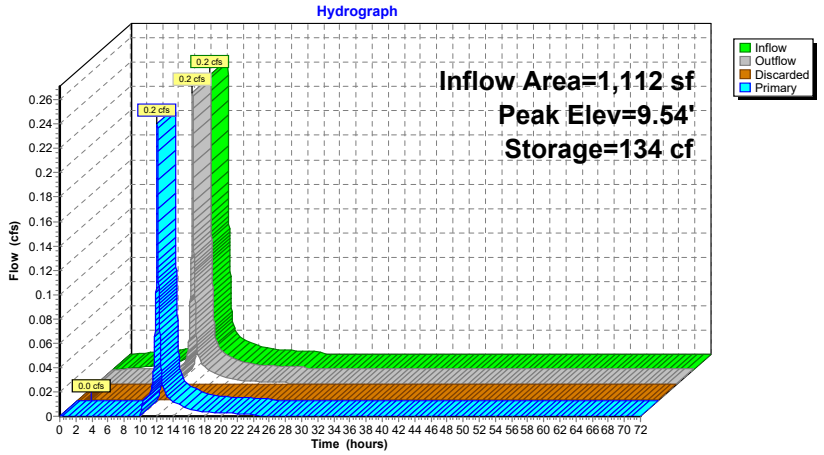
Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	7.00'	**0.270 in/hr Exfiltration over Surface area**
#2	Primary	9.23'	**6.0" Round Culvert** L= 33.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 9.23' / 8.72' S= 0.0155 '/' Cc= 0.900 n= 0.013, Flow Area= 0.20 sf

Discarded OutFlow Max=0.0 cfs @ 1.70 hrs HW=7.03' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.2 cfs @ 12.09 hrs HW=9.54' (Free Discharge)
└**2=Culvert** (Inlet Controls 0.2 cfs @ 1.89 fps)

Pond 4P: Inf Syst-2



Summary for Pond 5P: Inf Syst-3

Inflow Area = 1,105 sf, 97.29% Impervious, Inflow Depth = 9.31" for 50-Year event
Inflow = 0.2 cfs @ 12.08 hrs, Volume= 857 cf
Outflow = 0.2 cfs @ 12.09 hrs, Volume= 838 cf, Atten= 1%, Lag= 0.5 min
Discarded = 0.0 cfs @ 1.73 hrs, Volume= 160 cf
Primary = 0.2 cfs @ 12.09 hrs, Volume= 678 cf
Routed to Pond 1P : Inf Syst-1

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 9.68' @ 12.09 hrs Surf.Area= 101 sf Storage= 140 cf

Plug-Flow detention time= 335.8 min calculated for 838 cf (98% of inflow)
Center-of-Mass det. time= 321.7 min (1,066.0 - 744.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	7.00'	84 cf	**7.28'W x 13.84'L x 2.72'H Field A** 274 cf Overall - 64 cf Embedded = 210 cf x 40.0% Voids
#2A	7.25'	57 cf	**Ferguson R-Tank XD 12** x 10 Inside #1 Inside= 19.7"W x 23.6"H => 2.91 sf x 1.97'L = 5.7 cf Outside= 19.7"W x 23.6"H => 3.23 sf x 1.97'L = 6.4 cf 10 Chambers in 2 Rows
		141 cf	Total Available Storage

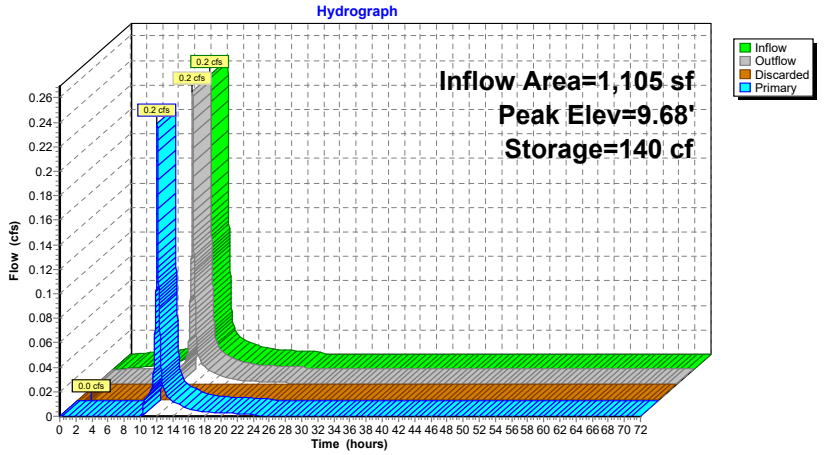
Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	7.00'	**0.270 in/hr Exfiltration over Surface area**
#2	Primary	9.37'	**6.0" Round Culvert** L= 33.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 9.37' / 8.73' S= 0.0194 '/' Cc= 0.900 n= 0.013, Flow Area= 0.20 sf

Discarded OutFlow Max=0.0 cfs @ 1.73 hrs HW=7.03' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.2 cfs @ 12.09 hrs HW=9.68' (Free Discharge)
↑**2=Culvert** (Inlet Controls 0.2 cfs @ 1.89 fps)

Pond 5P: Inf Syst-3



Summary for Pond 6P: Inf Syst-4

Inflow Area = 1,104 sf, 97.46% Impervious, Inflow Depth = 9.31" for 50-Year event
Inflow = 0.2 cfs @ 12.08 hrs, Volume= 856 cf
Outflow = 0.2 cfs @ 12.09 hrs, Volume= 837 cf, Atten= 1%, Lag= 0.5 min
Discarded = 0.0 cfs @ 1.73 hrs, Volume= 160 cf
Primary = 0.2 cfs @ 12.09 hrs, Volume= 677 cf
Routed to Pond 1P : Inf Syst-1

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 9.68' @ 12.09 hrs Surf.Area= 101 sf Storage= 140 cf

Plug-Flow detention time= 336.1 min calculated for 837 cf (98% of inflow)
Center-of-Mass det. time= 322.0 min (1,066.2 - 744.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	7.00'	84 cf	**7.28'W x 13.84'L x 2.72'H Field A** 274 cf Overall - 64 cf Embedded = 210 cf x 40.0% Voids
#2A	7.25'	57 cf	**Ferguson R-Tank XD 12** x 10 Inside #1 Inside= 19.7"W x 23.6"H => 2.91 sf x 1.97'L = 5.7 cf Outside= 19.7"W x 23.6"H => 3.23 sf x 1.97'L = 6.4 cf 10 Chambers in 2 Rows
		141 cf	Total Available Storage

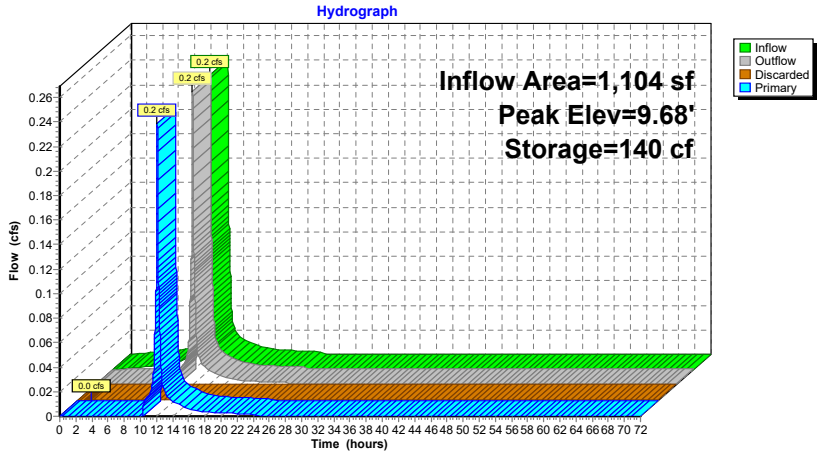
Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	7.00'	**0.270 in/hr Exfiltration over Surface area**
#2	Primary	9.37'	**6.0" Round Culvert** L= 51.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 9.37' / 8.10' S= 0.0249 '/' Cc= 0.900 n= 0.013, Flow Area= 0.20 sf

Discarded OutFlow Max=0.0 cfs @ 1.73 hrs HW=7.03' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.2 cfs @ 12.09 hrs HW=9.68' (Free Discharge)
↑**2=Culvert** (Inlet Controls 0.2 cfs @ 1.89 fps)

Pond 6P: Inf Syst-4



Summary for Pond 7P: Inf Syst-5

Inflow Area = 1,082 sf, 98.06% Impervious, Inflow Depth = 9.43" for 50-Year event
Inflow = 0.2 cfs @ 12.08 hrs, Volume= 850 cf
Outflow = 0.2 cfs @ 12.09 hrs, Volume= 849 cf, Atten= 1%, Lag= 0.5 min
Discarded = 0.0 cfs @ 1.27 hrs, Volume= 161 cf
Primary = 0.2 cfs @ 12.09 hrs, Volume= 688 cf
Routed to Pond 1P : Inf Syst-1

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 9.30' @ 12.09 hrs Surf.Area= 101 sf Storage= 122 cf

Plug-Flow detention time= 318.0 min calculated for 849 cf (100% of inflow)
Center-of-Mass det. time= 317.6 min (1,056.6 - 739.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	7.00'	73 cf	**7.28'W x 13.84'L x 2.39'H Field A** 241 cf Overall - 58 cf Embedded = 182 cf x 40.0% Voids
#2A	7.25'	52 cf	**Ferguson R-Tank XD 11** x 10 Inside #1 Inside= 19.7"W x 21.7"H => 2.66 sf x 1.97'L = 5.2 cf Outside= 19.7"W x 21.7"H => 2.96 sf x 1.97'L = 5.8 cf 10 Chambers in 2 Rows
		125 cf	Total Available Storage

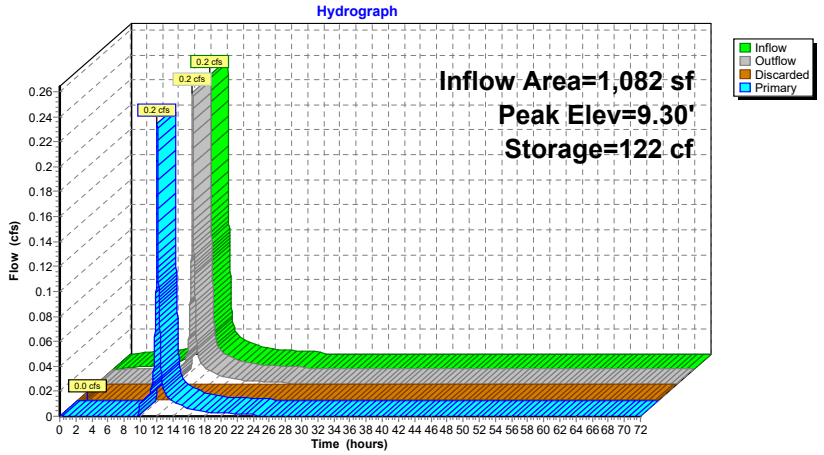
Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	7.00'	**0.270 in/hr Exfiltration over Surface area**
#2	Primary	9.00'	**6.0" Round Culvert** L= 48.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 9.00' / 8.35' S= 0.0135 '/' Cc= 0.900 n= 0.013, Flow Area= 0.20 sf

Discarded OutFlow Max=0.0 cfs @ 1.27 hrs HW=7.03' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.2 cfs @ 12.09 hrs HW=9.30' (Free Discharge)
↑**2=Culvert** (Inlet Controls 0.2 cfs @ 1.88 fps)

Pond 7P: Inf Syst-5



Summary for Pond 8P: Inf Syst-6

Inflow Area = 1,056 sf, 99.24% Impervious, Inflow Depth = 9.43" for 50-Year event
Inflow = 0.2 cfs @ 12.08 hrs, Volume= 830 cf
Outflow = 0.2 cfs @ 12.09 hrs, Volume= 829 cf, Atten= 1%, Lag= 0.5 min
Discarded = 0.0 cfs @ 1.30 hrs, Volume= 161 cf
Primary = 0.2 cfs @ 12.09 hrs, Volume= 668 cf
Routed to Pond 1P : Inf Syst-1

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 9.32' @ 12.09 hrs Surf.Area= 101 sf Storage= 123 cf

Plug-Flow detention time= 325.6 min calculated for 829 cf (100% of inflow)
Center-of-Mass det. time= 325.0 min (1,064.0 - 739.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	7.00'	73 cf	**7.28'W x 13.84'L x 2.39'H Field A** 241 cf Overall - 58 cf Embedded = 182 cf x 40.0% Voids
#2A	7.25'	52 cf	**Ferguson R-Tank XD 11** x 10 Inside #1 Inside= 19.7"W x 21.7"H => 2.66 sf x 1.97'L = 5.2 cf Outside= 19.7"W x 21.7"H => 2.96 sf x 1.97'L = 5.8 cf 10 Chambers in 2 Rows
		125 cf	Total Available Storage

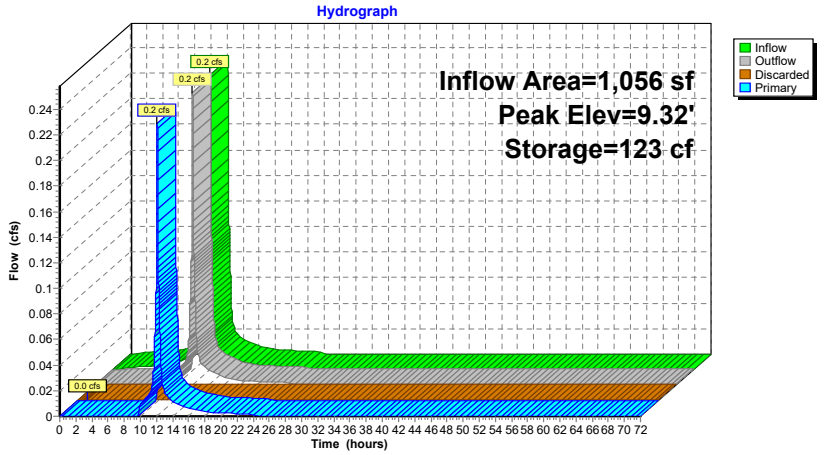
Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	7.00'	**0.270 in/hr Exfiltration over Surface area**
#2	Primary	9.00'	**8.0" Round Culvert** L= 46.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 9.00' / 8.77' S= 0.0050 '/' Cc= 0.900 n= 0.013, Flow Area= 0.35 sf

Discarded OutFlow Max=0.0 cfs @ 1.30 hrs HW=7.03' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.2 cfs @ 12.09 hrs HW=9.32' (Free Discharge)
↑**2=Culvert** (Barrel Controls 0.2 cfs @ 2.02 fps)

Pond 8P: Inf Syst-6



Summary for Pond 9P: Inf Syst-7

Inflow Area = 24,131 sf, 72.87% Impervious, Inflow Depth = 8.60" for 50-Year event
Inflow = 5.1 cfs @ 12.08 hrs, Volume= 17,290 cf
Outflow = 3.0 cfs @ 12.19 hrs, Volume= 17,290 cf, Atten= 41%, Lag= 6.3 min
Discarded = 0.0 cfs @ 4.01 hrs, Volume= 1,591 cf
Primary = 3.0 cfs @ 12.19 hrs, Volume= 15,699 cf
Routed to Link 1L : Towards Wetlands

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 8.58' @ 12.19 hrs Surf.Area= 2,422 sf Storage= 2,968 cf

Plug-Flow detention time= 48.3 min calculated for 17,290 cf (100% of inflow)
Center-of-Mass det. time= 48.2 min (815.1 - 766.9)

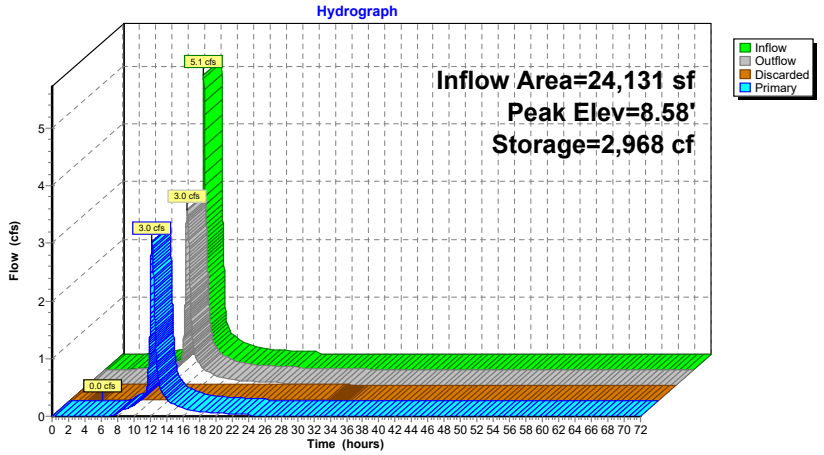
Volume	Invert	Avail.Storage	Storage Description
#1	7.15'	3,645 cf	**6.89'W x 14.06'L x 1.75'H StormTrap ST-1 Units (Irregular Shape)** x 25 4,238 cf Overall x 86.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Discarded	7.15'	**0.270 in/hr Exfiltration over Surface area**
#2	Primary	7.15'	**12.0" Round Culvert** L= 4.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 7.15' / 7.13' S= 0.0050 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#3	Device 2	7.35'	**22.0" W x 4.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.0 cfs @ 4.01 hrs HW=7.17' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=3.0 cfs @ 12.19 hrs HW=8.58' (Free Discharge)
└**2=Culvert** (Passes 3.0 cfs of 3.3 cfs potential flow)
└**3=Orifice/Grate** (Orifice Controls 3.0 cfs @ 4.95 fps)

Pond 9P: Inf Syst-7

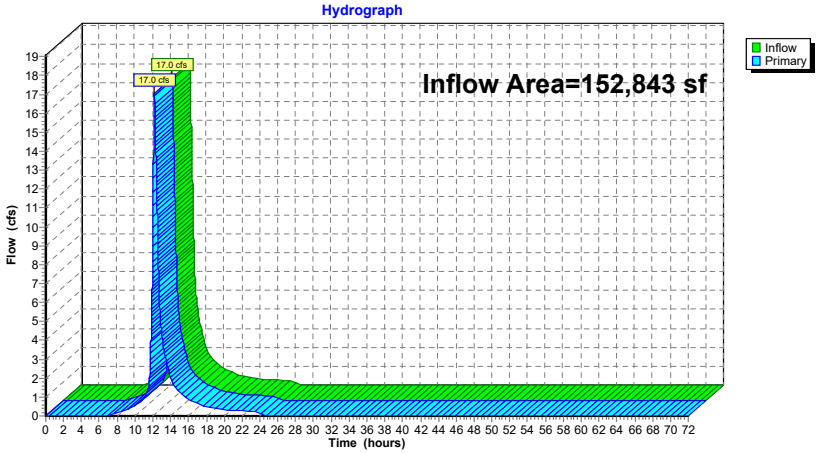


Summary for Link 1L: Towards Wetlands

Inflow Area = 152,843 sf, 50.79% Impervious, Inflow Depth = 6.54" for 50-Year event
Inflow = 17.0 cfs @ 12.18 hrs, Volume= 83,287 cf
Primary = 17.0 cfs @ 12.18 hrs, Volume= 83,287 cf, Atten= 0%, Lag= 0.0 min
Routed to Link 100L : Total Flows

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

Link 1L: Towards Wetlands

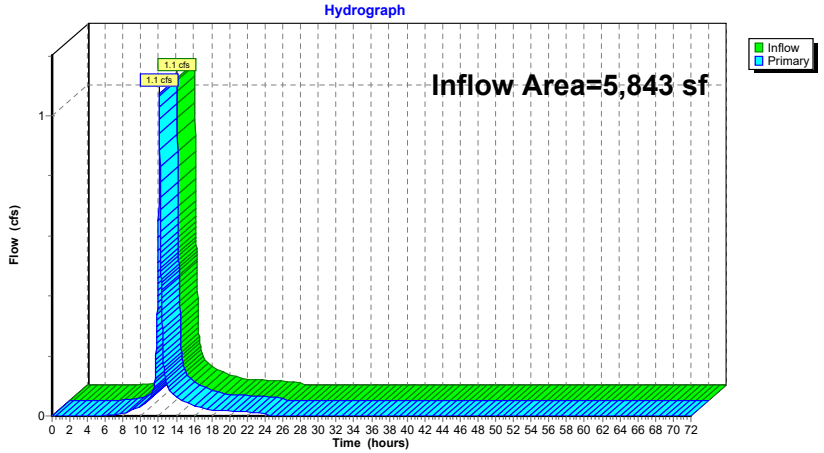


Summary for Link 2L: Towards Street

Inflow Area = 5,843 sf, 18.07% Impervious, Inflow Depth = 6.95" for 50-Year event
Inflow = 1.1 cfs @ 12.09 hrs, Volume= 3,385 cf
Primary = 1.1 cfs @ 12.09 hrs, Volume= 3,385 cf, Atten= 0%, Lag= 0.0 min
Routed to Link 100L : Total Flows

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

Link 2L: Towards Street

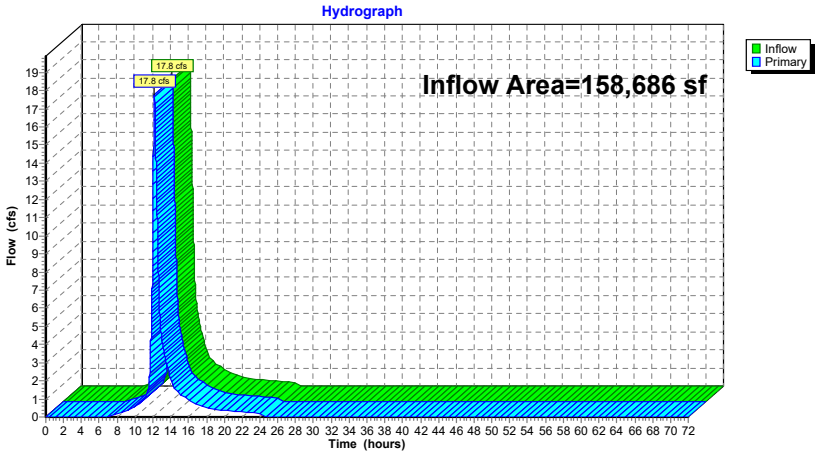


Summary for Link 100L: Total Flows

Inflow Area = 158,686 sf, 49.59% Impervious, Inflow Depth = 6.55" for 50-Year event
Inflow = 17.8 cfs @ 12.16 hrs, Volume= 86,673 cf
Primary = 17.8 cfs @ 12.16 hrs, Volume= 86,673 cf, Atten= 0%, Lag= 0.0 min

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

Link 100L: Total Flows



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

Subcatchment1S: CB-1 Runoff Area=22,742 sf 72.16% Impervious Runoff Depth=10.39"
Tc=6.0 min CN=91 Runoff=5.8 cfs 19,696 cf

Subcatchment2S: Building Roof Runoff Area=32,925 sf 100.00% Impervious Runoff Depth=11.26"
Tc=6.0 min CN=98 Runoff=8.5 cfs 30,891 cf

Subcatchment3.1S: Backyard ADs Runoff Area=8,985 sf 3.03% Impervious Runoff Depth=8.28"
Flow Length=147' Tc=10.3 min CN=75 Runoff=1.7 cfs 6,203 cf

Subcatchment3S: Townhouse Roofs Runoff Area=13,067 sf 100.00% Impervious Runoff Depth=11.26"
Tc=6.0 min CN=98 Runoff=3.4 cfs 12,260 cf

Subcatchment4.2S: TD-2 Runoff Area=1,112 sf 95.68% Impervious Runoff Depth=11.14"
Tc=6.0 min CN=97 Runoff=0.3 cfs 1,032 cf

Subcatchment4.3S: TD-3 Runoff Area=1,105 sf 97.29% Impervious Runoff Depth=11.14"
Tc=6.0 min CN=97 Runoff=0.3 cfs 1,026 cf

Subcatchment4.4S: TD-4 Runoff Area=1,104 sf 97.46% Impervious Runoff Depth=11.14"
Tc=6.0 min CN=97 Runoff=0.3 cfs 1,025 cf

Subcatchment4.5S: TD-5 Runoff Area=1,082 sf 98.06% Impervious Runoff Depth=11.26"
Tc=6.0 min CN=98 Runoff=0.3 cfs 1,015 cf

Subcatchment4.6S: TD-6 Runoff Area=1,056 sf 99.24% Impervious Runoff Depth=11.26"
Tc=6.0 min CN=98 Runoff=0.3 cfs 991 cf

Subcatchment5.1S: TD-1A Runoff Area=1,389 sf 84.59% Impervious Runoff Depth=10.77"
Tc=6.0 min CN=94 Runoff=0.4 cfs 1,246 cf

Subcatchment5S: TD-1B Runoff Area=4,462 sf 42.78% Impervious Runoff Depth=9.49"
Tc=6.0 min CN=84 Runoff=1.1 cfs 3,530 cf

Subcatchment6.1S: East driveway Runoff Area=12,275 sf 52.50% Impervious Runoff Depth=9.88"
Tc=6.0 min CN=87 Runoff=3.0 cfs 10,109 cf

Subcatchment6S: Bypass Towards Runoff Area=51,539 sf 0.21% Impervious Runoff Depth=8.15"
Flow Length=125' Tc=14.0 min CN=74 Runoff=8.7 cfs 34,988 cf

Subcatchment7S: To Street Runoff Area=5,843 sf 18.07% Impervious Runoff Depth=8.69"
Tc=6.0 min CN=78 Runoff=1.3 cfs 4,233 cf

Pond 1P: Inf Syst-1 Peak Elev=11.00' Storage=19,245 cf Inflow=14.8 cfs 53,582 cf
Discarded=0.1 cfs 15,354 cf Primary=7.3 cfs 38,228 cf Outflow=7.4 cfs 53,582 cf

Pond 3P: Rain garden Peak Elev=6.50' Storage=253 cf Inflow=3.0 cfs 10,109 cf
Discarded=0.0 cfs 518 cf Primary=3.0 cfs 9,592 cf Outflow=3.0 cfs 10,109 cf

Pond 4P: Inf Syst-2 Peak Elev=9.57' Storage=136 cf Inflow=0.3 cfs 1,032 cf
Discarded=0.0 cfs 161 cf Primary=0.3 cfs 858 cf Outflow=0.3 cfs 1,018 cf

Pond 5P: Inf Syst-3 Peak Elev=9.71' Storage=141 cf Inflow=0.3 cfs 1,026 cf
Discarded=0.0 cfs 161 cf Primary=0.3 cfs 846 cf Outflow=0.3 cfs 1,006 cf

Pond 6P: Inf Syst-4 Peak Elev=9.71' Storage=141 cf Inflow=0.3 cfs 1,025 cf
Discarded=0.0 cfs 161 cf Primary=0.3 cfs 845 cf Outflow=0.3 cfs 1,005 cf

Pond 7P: Inf Syst-5 Peak Elev=9.34' Storage=123 cf Inflow=0.3 cfs 1,015 cf
Discarded=0.0 cfs 161 cf Primary=0.3 cfs 853 cf Outflow=0.3 cfs 1,014 cf

Pond 8P: Inf Syst-6 Peak Elev=9.35' Storage=124 cf Inflow=0.3 cfs 991 cf
Discarded=0.0 cfs 161 cf Primary=0.3 cfs 828 cf Outflow=0.3 cfs 990 cf

Pond 9P: Inf Syst-7 Peak Elev=8.86' Storage=3,555 cf Inflow=6.1 cfs 20,942 cf
Discarded=0.0 cfs 1,621 cf Primary=3.4 cfs 19,322 cf Outflow=3.4 cfs 20,942 cf

Link 1L: Towards Wetlands Inflow=21.4 cfs 105,660 cf
Primary=21.4 cfs 105,660 cf

Link 2L: Towards Street Inflow=1.3 cfs 4,233 cf
Primary=1.3 cfs 4,233 cf

Link 100L: Total Flows Inflow=22.3 cfs 109,893 cf
Primary=22.3 cfs 109,893 cf

Total Runoff Area = 158,686 sf Runoff Volume = 128,244 cf Average Runoff Depth = 9.70"
50.41% Pervious = 79,997 sf 49.59% Impervious = 78,689 sf

Summary for Subcatchment 1S: CB-1

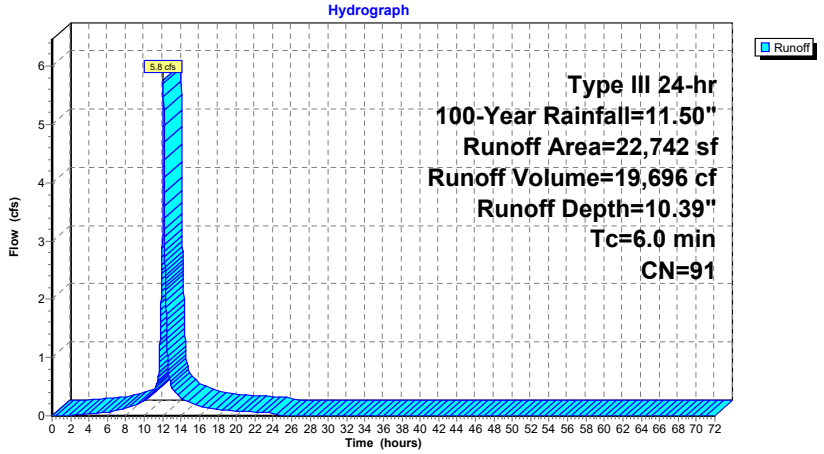
Runoff = 5.8 cfs @ 12.08 hrs, Volume= 19,696 cf, Depth=10.39"
Routed to Pond 9P : Inf Syst-7

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-Year Rainfall=11.50"

Area (sf)	CN	Description
16,410	98	Paved parking, HSG C
6,332	74	>75% Grass cover, Good, HSG C
22,742	91	Weighted Average
6,332		27.84% Pervious Area
16,410		72.16% Impervious Area

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

Subcatchment 1S: CB-1



Summary for Subcatchment 2S: Building Roof

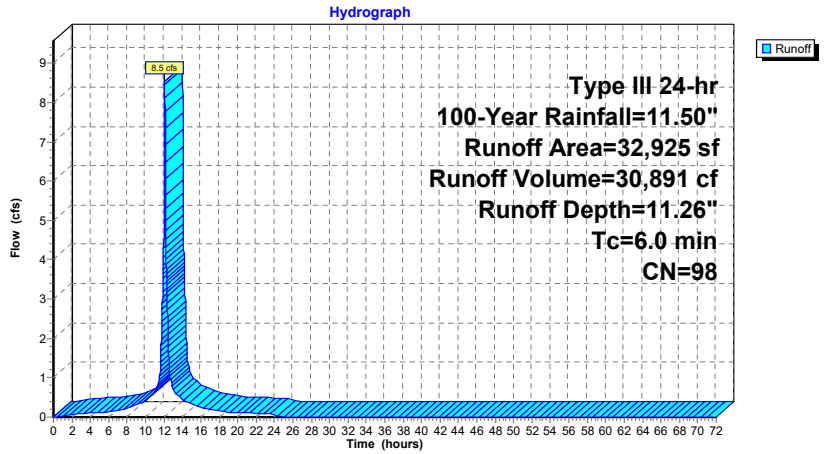
Runoff = 8.5 cfs @ 12.08 hrs, Volume= 30,891 cf, Depth=11.26"
Routed to Pond 1P : Inf Syst-1

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-Year Rainfall=11.50"

Area (sf)	CN	Description
32,925	98	Roofs, HSG C
32,925		100.00% Impervious Area

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

Subcatchment 2S: Building Roof



Summary for Subcatchment 3.1S: Backyard ADs

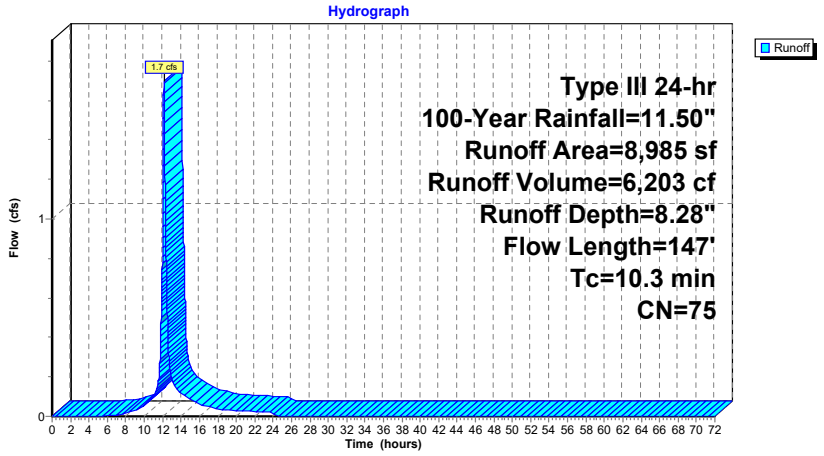
Runoff = 1.7 cfs @ 12.14 hrs, Volume= 6,203 cf, Depth= 8.28"
Routed to Pond 1P : Inf Syst-1

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-Year Rainfall=11.50"

	Area (sf)	CN	Description
	272	98	Unconnected pavement, HSG C
	8,302	74	>75% Grass cover, Good, HSG C
*	411	89	Gravel sidewalk, HSG C
	8,985	75	Weighted Average
	8,713		96.97% Pervious Area
	272		3.03% Impervious Area
	272		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.4	50	0.0142	0.09		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.23"
0.9	97	0.0154	1.86		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
10.3	147	Total			

Subcatchment 3.1S: Backyard ADs



Summary for Subcatchment 3S: Townhouse Roofs

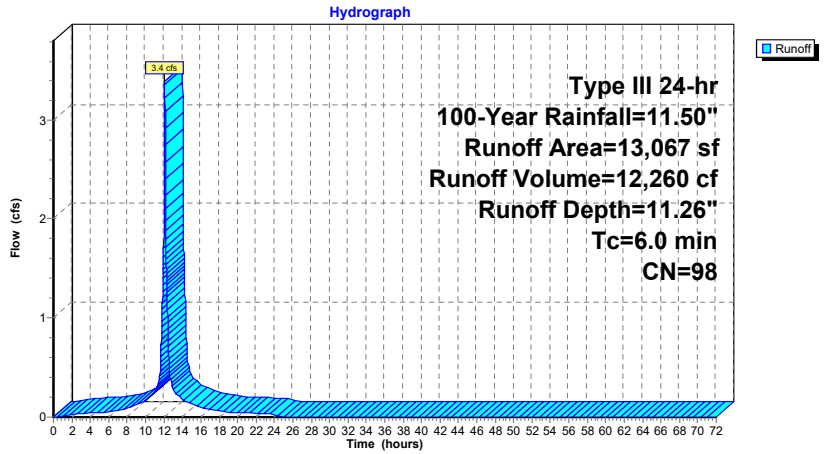
Runoff = 3.4 cfs @ 12.08 hrs, Volume= 12,260 cf, Depth=11.26"
Routed to Pond 1P : Inf Syst-1

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-Year Rainfall=11.50"

Area (sf)	CN	Description
13,067	98	Roofs, HSG C
13,067		100.00% Impervious Area

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

Subcatchment 3S: Townhouse Roofs



Summary for Subcatchment 4.2S: TD-2

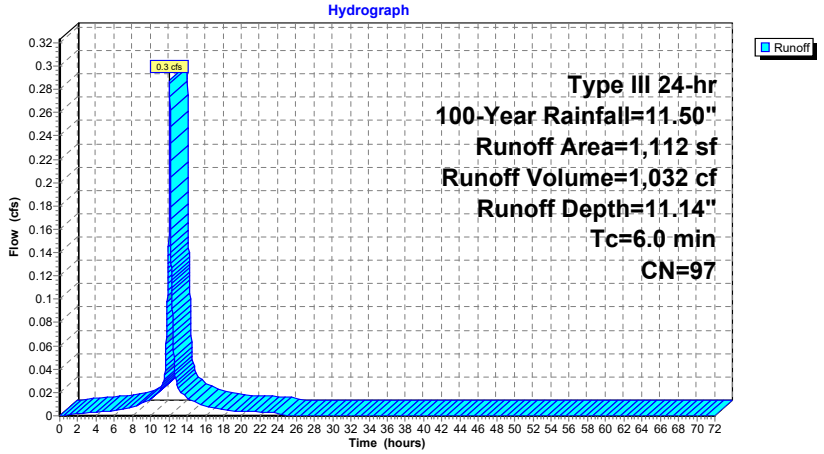
Runoff = 0.3 cfs @ 12.08 hrs, Volume= 1,032 cf, Depth=11.14"
Routed to Pond 4P : Inf Syst-2

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-Year Rainfall=11.50"

Area (sf)	CN	Description
1,064	98	Paved parking, HSG C
48	74	>75% Grass cover, Good, HSG C
1,112	97	Weighted Average
48		4.32% Pervious Area
1,064		95.68% Impervious Area

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

Subcatchment 4.2S: TD-2



Summary for Subcatchment 4.3S: TD-3

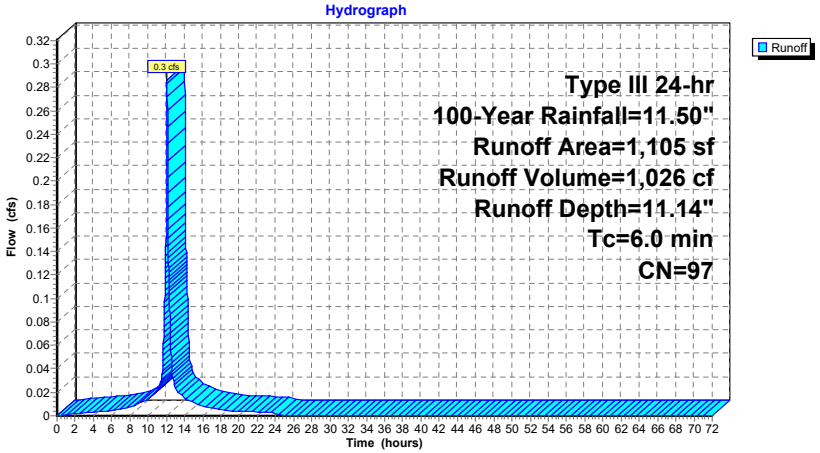
Runoff = 0.3 cfs @ 12.08 hrs, Volume= 1,026 cf, Depth=11.14"
Routed to Pond 5P : Inf Syst-3

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-Year Rainfall=11.50"

Area (sf)	CN	Description
1,075	98	Paved parking, HSG C
30	74	>75% Grass cover, Good, HSG C
1,105	97	Weighted Average
30		2.71% Pervious Area
1,075		97.29% Impervious Area

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

Subcatchment 4.3S: TD-3



Summary for Subcatchment 4.4S: TD-4

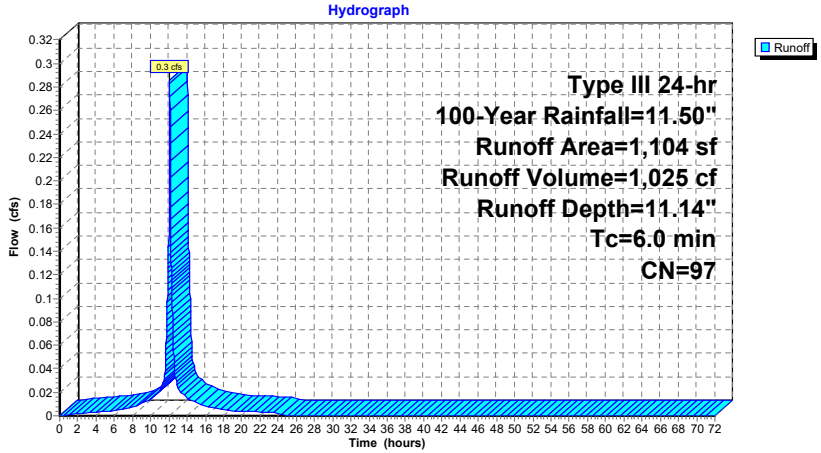
Runoff = 0.3 cfs @ 12.08 hrs, Volume= 1,025 cf, Depth=11.14"
Routed to Pond 6P : Inf Syst-4

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-Year Rainfall=11.50"

Area (sf)	CN	Description
1,076	98	Paved parking, HSG C
28	74	>75% Grass cover, Good, HSG C
1,104	97	Weighted Average
28		2.54% Pervious Area
1,076		97.46% Impervious Area

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

Subcatchment 4.4S: TD-4



Summary for Subcatchment 4.5S: TD-5

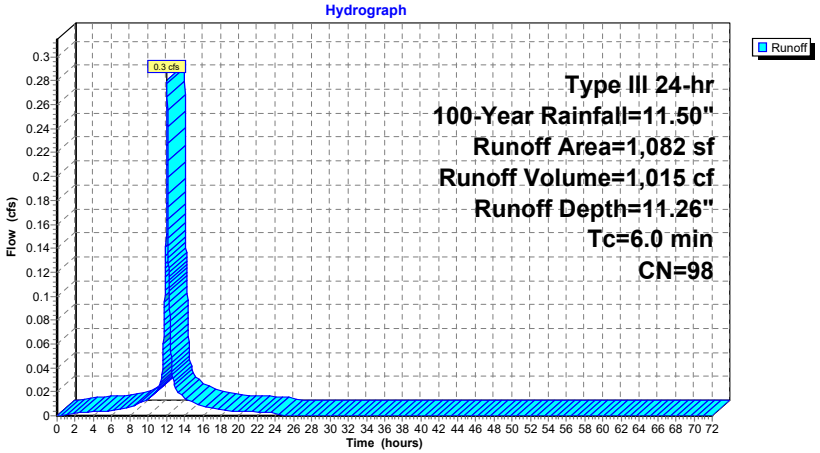
Runoff = 0.3 cfs @ 12.08 hrs, Volume= 1,015 cf, Depth=11.26"
Routed to Pond 7P : Inf Syst-5

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-Year Rainfall=11.50"

Area (sf)	CN	Description
1,061	98	Paved parking, HSG C
21	74	>75% Grass cover, Good, HSG C
1,082	98	Weighted Average
21		1.94% Pervious Area
1,061		98.06% Impervious Area

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

Subcatchment 4.5S: TD-5



Summary for Subcatchment 4.6S: TD-6

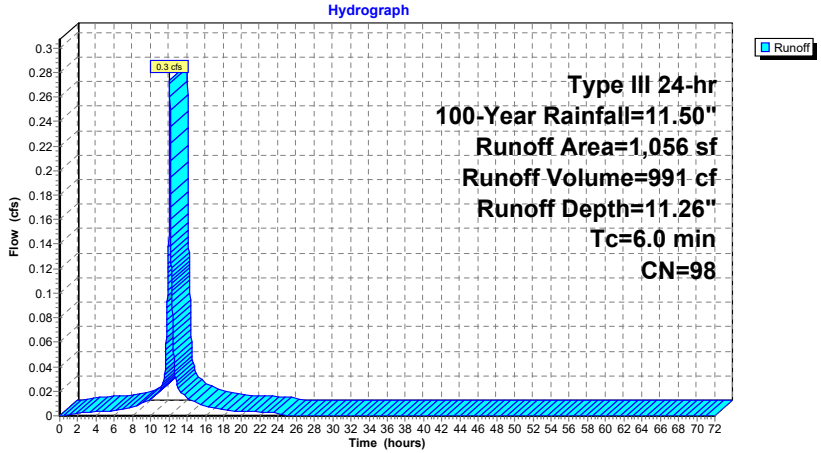
Runoff = 0.3 cfs @ 12.08 hrs, Volume= 991 cf, Depth=11.26"
Routed to Pond 8P : Inf Syst-6

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-Year Rainfall=11.50"

Area (sf)	CN	Description
1,048	98	Paved parking, HSG C
8	74	>75% Grass cover, Good, HSG C
1,056	98	Weighted Average
8		0.76% Pervious Area
1,048		99.24% Impervious Area

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

Subcatchment 4.6S: TD-6



Summary for Subcatchment 5.1S: TD-1A

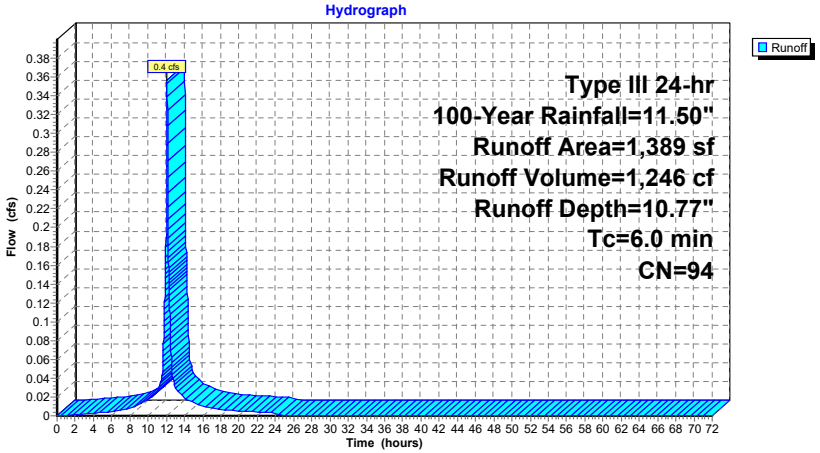
Runoff = 0.4 cfs @ 12.08 hrs, Volume= 1,246 cf, Depth=10.77"
Routed to Pond 9P : Inf Syst-7

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-Year Rainfall=11.50"

Area (sf)	CN	Description
1,175	98	Paved parking, HSG C
214	74	>75% Grass cover, Good, HSG C
1,389	94	Weighted Average
214		15.41% Pervious Area
1,175		84.59% Impervious Area

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

Subcatchment 5.1S: TD-1A



Summary for Subcatchment 5S: TD-1B

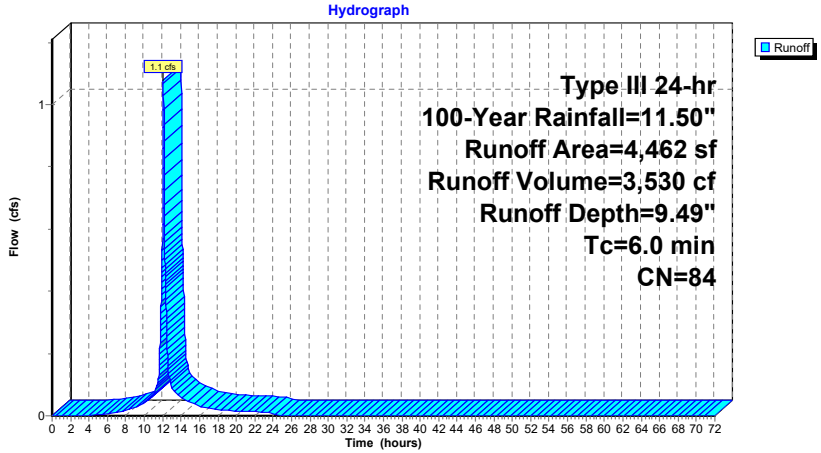
Runoff = 1.1 cfs @ 12.08 hrs, Volume= 3,530 cf, Depth= 9.49"
Routed to Link 1L : Towards Wetlands

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-Year Rainfall=11.50"

Area (sf)	CN	Description
1,909	98	Paved parking, HSG C
2,553	74	>75% Grass cover, Good, HSG C
4,462	84	Weighted Average
2,553		57.22% Pervious Area
1,909		42.78% Impervious Area

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

Subcatchment 5S: TD-1B



Summary for Subcatchment 6.1S: East driveway

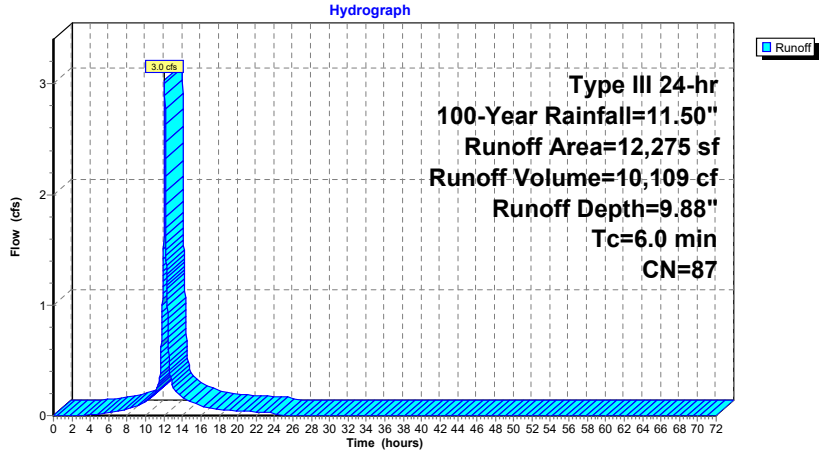
Runoff = 3.0 cfs @ 12.08 hrs, Volume= 10,109 cf, Depth= 9.88"
Routed to Pond 3P : Rain garden

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-Year Rainfall=11.50"

Area (sf)	CN	Description
5,611	74	>75% Grass cover, Good, HSG C
6,444	98	Paved roads w/curbs & sewers, HSG C
220	89	Gravel roads, HSG C
12,275	87	Weighted Average
5,831		47.50% Pervious Area
6,444		52.50% Impervious Area

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

Subcatchment 6.1S: East driveway



Summary for Subcatchment 6S: Bypass Towards Wetlands

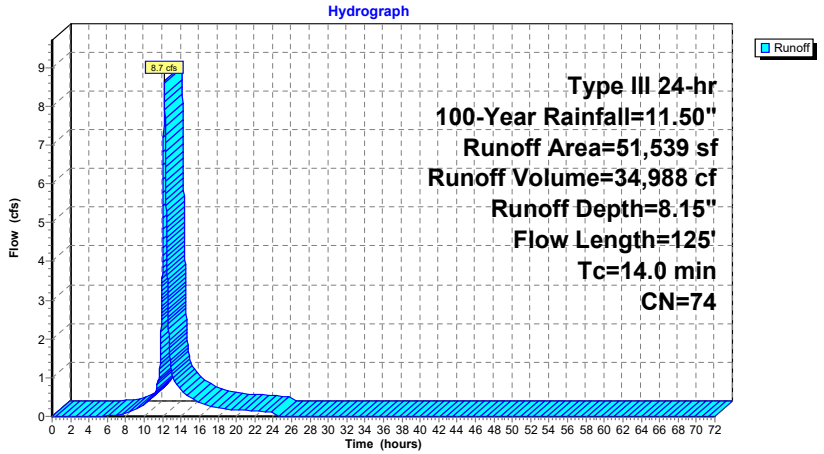
Runoff = 8.7 cfs @ 12.18 hrs, Volume= 34,988 cf, Depth= 8.15"
Routed to Link 1L : Towards Wetlands

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-Year Rainfall=11.50"

Area (sf)	CN	Description
4,985	70	Woods, Good, HSG C
46,447	74	>75% Grass cover, Good, HSG C
107	98	Roofs, HSG C
51,539	74	Weighted Average
51,432		99.79% Pervious Area
107		0.21% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.8	50	0.0220	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.23"
2.2	75	0.0133	0.58		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
14.0	125	Total			

Subcatchment 6S: Bypass Towards Wetlands



Summary for Subcatchment 7S: To Street

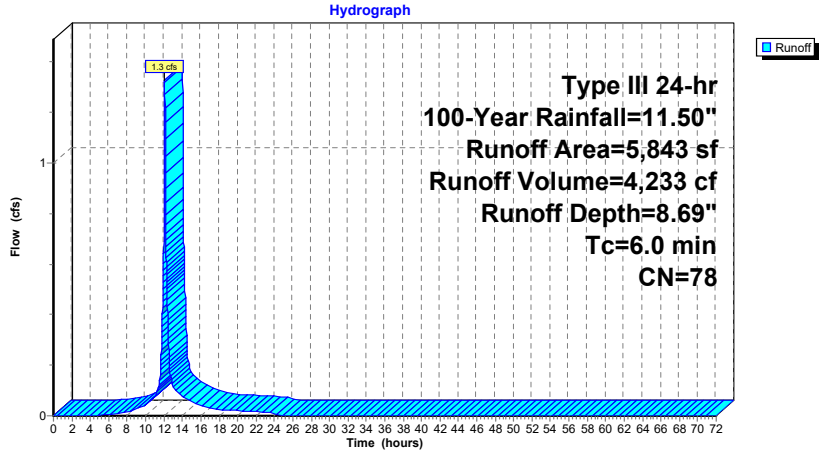
Runoff = 1.3 cfs @ 12.09 hrs, Volume= 4,233 cf, Depth= 8.69"
Routed to Link 2L : Towards Street

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-Year Rainfall=11.50"

Area (sf)	CN	Description
1,056	98	Paved parking, HSG C
4,787	74	>75% Grass cover, Good, HSG C
5,843	78	Weighted Average
4,787		81.93% Pervious Area
1,056		18.07% Impervious Area

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

Subcatchment 7S: To Street



Summary for Pond 1P: Inf Syst-1

Inflow Area = 60,436 sf, 85.36% Impervious, Inflow Depth = 10.64" for 100-Year event
Inflow = 14.8 cfs @ 12.09 hrs, Volume= 53,582 cf
Outflow = 7.4 cfs @ 12.25 hrs, Volume= 53,582 cf, Atten= 50%, Lag= 9.7 min
Discarded = 0.1 cfs @ 2.72 hrs, Volume= 15,354 cf
Primary = 7.3 cfs @ 12.25 hrs, Volume= 38,228 cf
Routed to Link 1L : Towards Wetlands

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 11.00' @ 12.25 hrs Surf.Area= 7,459 sf Storage= 19,245 cf

Plug-Flow detention time= 272.3 min calculated for 53,582 cf (100% of inflow)
Center-of-Mass det. time= 272.2 min (1,021.3 - 749.0)

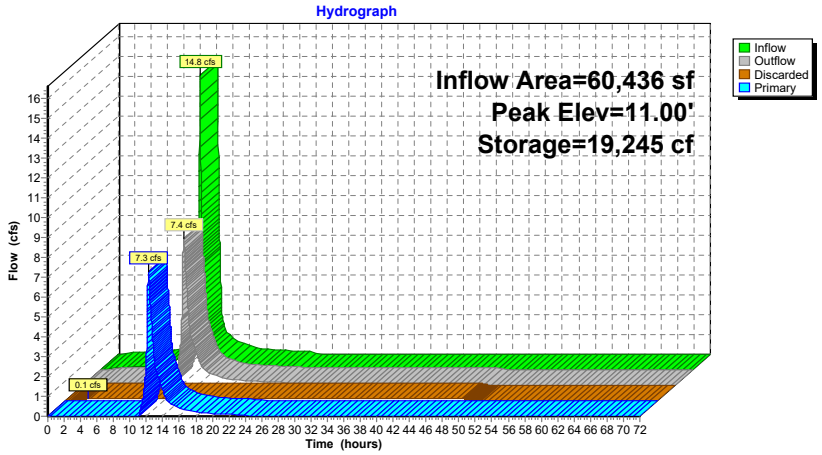
Volume	Invert	Avail.Storage	Storage Description
#1	8.00'	19,245 cf	**6.89'W x 14.06'L x 3.00'H StormTrap ST-1 Units (Irregular Shape)** x 77 22,378 cf Overall x 86.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Discarded	8.00'	**0.520 in/hr Exfiltration over Surface area**
#2	Primary	8.00'	**15.0" Round Culvert** L= 26.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 8.00' / 7.13' S= 0.0335 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#3	Device 2	9.22'	**22.0" W x 4.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 2	10.05'	**20.0" W x 4.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Device 2	10.79'	**3.7' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Discarded OutFlow Max=0.1 cfs @ 2.72 hrs HW=8.03' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.1 cfs)

Primary OutFlow Max=7.3 cfs @ 12.25 hrs HW=11.00' (Free Discharge)
└**2=Culvert** (Passes 7.3 cfs of 9.1 cfs potential flow)
├**3=Orifice/Grate** (Orifice Controls 3.7 cfs @ 6.12 fps)
├**4=Orifice/Grate** (Orifice Controls 2.4 cfs @ 4.26 fps)
└**5=Sharp-Crested Rectangular Weir** (Weir Controls 1.2 cfs @ 1.51 fps)

Pond 1P: Inf Syst-1



Summary for Pond 3P: Rain garden

Inflow Area = 12,275 sf, 52.50% Impervious, Inflow Depth = 9.88" for 100-Year event
Inflow = 3.0 cfs @ 12.08 hrs, Volume= 10,109 cf
Outflow = 3.0 cfs @ 12.08 hrs, Volume= 10,109 cf, Atten= 0%, Lag= 0.0 min
Discarded = 0.0 cfs @ 12.08 hrs, Volume= 518 cf
Primary = 3.0 cfs @ 12.08 hrs, Volume= 9,592 cf
Routed to Link 1L : Towards Wetlands

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 6.50' @ 12.08 hrs Surf.Area= 460 sf Storage= 253 cf

Plug-Flow detention time= 29.6 min calculated for 10,108 cf (100% of inflow)
Center-of-Mass det. time= 29.8 min (803.8 - 774.0)

Volume	Invert	Avail.Storage	Storage Description
#1	5.60'	253 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

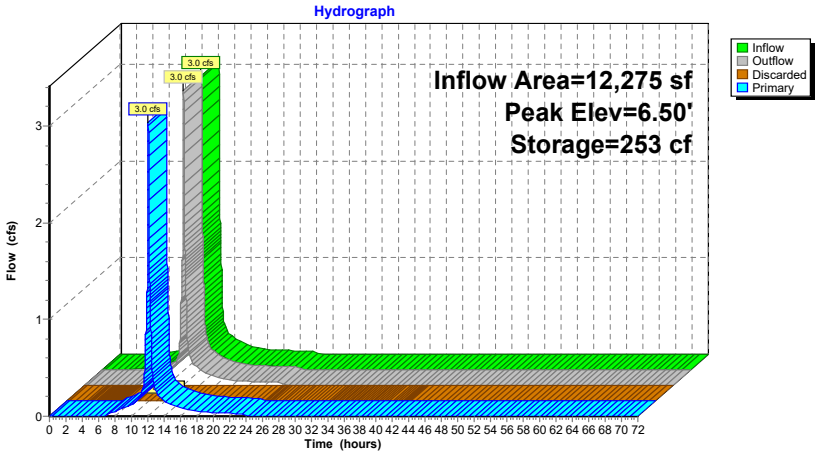
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
5.60	125	46.0	0	0	125
6.00	276	66.0	78	78	305
6.30	350	73.0	94	172	385
6.50	460	87.0	81	253	564

Device	Routing	Invert	Outlet Devices
#1	Discarded	5.60'	**0.520 in/hr Exfiltration over Surface area**
#2	Primary	6.35'	**22.0' 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

Discarded OutFlow Max=0.0 cfs @ 12.08 hrs HW=6.50' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=3.0 cfs @ 12.08 hrs HW=6.50' (Free Discharge)
↑**2=Broad-Crested Rectangular Weir** (Weir Controls 3.0 cfs @ 0.91 fps)

Pond 3P: Rain garden



Summary for Pond 4P: Inf Syst-2

Inflow Area = 1,112 sf, 95.68% Impervious, Inflow Depth = 11.14" for 100-Year event
Inflow = 0.3 cfs @ 12.08 hrs, Volume= 1,032 cf
Outflow = 0.3 cfs @ 12.09 hrs, Volume= 1,018 cf, Atten= 1%, Lag= 0.5 min
Discarded = 0.0 cfs @ 1.40 hrs, Volume= 161 cf
Primary = 0.3 cfs @ 12.09 hrs, Volume= 858 cf
Routed to Pond 1P : Inf Syst-1

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 9.57' @ 12.09 hrs Surf.Area= 101 sf Storage= 136 cf

Plug-Flow detention time= 278.5 min calculated for 1,018 cf (99% of inflow)
Center-of-Mass det. time= 269.7 min (1,011.6 - 741.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	7.00'	84 cf	**7.28'W x 13.84'L x 2.72'H Field A** 274 cf Overall - 64 cf Embedded = 210 cf x 40.0% Voids
#2A	7.25'	57 cf	**Ferguson R-Tank XD 12** x 10 Inside #1 Inside= 19.7"W x 23.6"H => 2.91 sf x 1.97'L = 5.7 cf Outside= 19.7"W x 23.6"H => 3.23 sf x 1.97'L = 6.4 cf 10 Chambers in 2 Rows
		141 cf	Total Available Storage

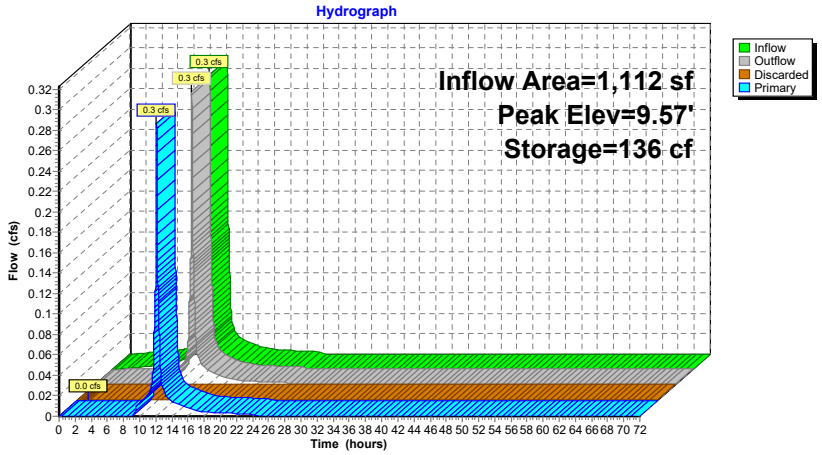
Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	7.00'	**0.270 in/hr Exfiltration over Surface area**
#2	Primary	9.23'	**6.0" Round Culvert** L= 33.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 9.23' / 8.72' S= 0.0155 '/' Cc= 0.900 n= 0.013, Flow Area= 0.20 sf

Discarded OutFlow Max=0.0 cfs @ 1.40 hrs HW=7.03' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.3 cfs @ 12.09 hrs HW=9.57' (Free Discharge)
↑**2=Culvert** (Inlet Controls 0.3 cfs @ 1.99 fps)

Pond 4P: Inf Syst-2



Summary for Pond 5P: Inf Syst-3

Inflow Area = 1,105 sf, 97.29% Impervious, Inflow Depth = 11.14" for 100-Year event
Inflow = 0.3 cfs @ 12.08 hrs, Volume= 1,026 cf
Outflow = 0.3 cfs @ 12.09 hrs, Volume= 1,006 cf, Atten= 1%, Lag= 0.5 min
Discarded = 0.0 cfs @ 1.42 hrs, Volume= 161 cf
Primary = 0.3 cfs @ 12.09 hrs, Volume= 846 cf
Routed to Pond 1P : Inf Syst-1

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 9.71' @ 12.09 hrs Surf.Area= 101 sf Storage= 141 cf

Plug-Flow detention time= 286.0 min calculated for 1,006 cf (98% of inflow)
Center-of-Mass det. time= 273.7 min (1,015.6 - 741.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	7.00'	84 cf	**7.28'W x 13.84'L x 2.72'H Field A** 274 cf Overall - 64 cf Embedded = 210 cf x 40.0% Voids
#2A	7.25'	57 cf	**Ferguson R-Tank XD 12** x 10 Inside #1 Inside= 19.7"W x 23.6"H => 2.91 sf x 1.97'L = 5.7 cf Outside= 19.7"W x 23.6"H => 3.23 sf x 1.97'L = 6.4 cf 10 Chambers in 2 Rows
		141 cf	Total Available Storage

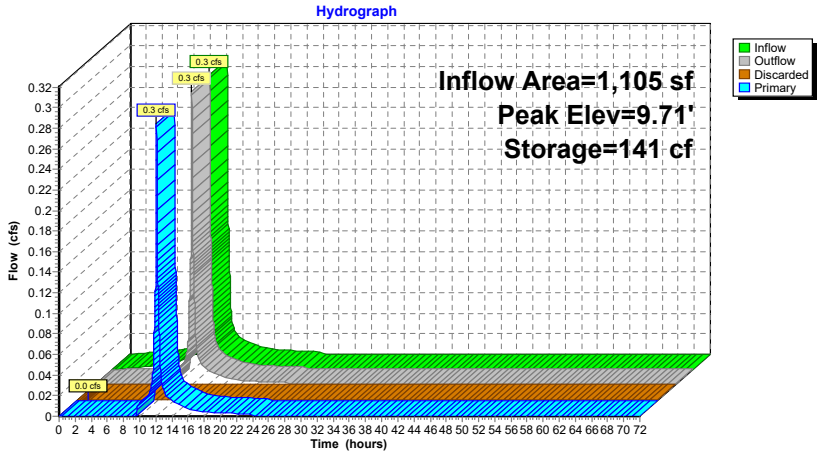
Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	7.00'	**0.270 in/hr Exfiltration over Surface area**
#2	Primary	9.37'	**6.0" Round Culvert** L= 33.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 9.37' / 8.73' S= 0.0194 '/' Cc= 0.900 n= 0.013, Flow Area= 0.20 sf

Discarded OutFlow Max=0.0 cfs @ 1.42 hrs HW=7.03' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.3 cfs @ 12.09 hrs HW=9.71' (Free Discharge)
↑**2=Culvert** (Inlet Controls 0.3 cfs @ 1.99 fps)

Pond 5P: Inf Syst-3



Summary for Pond 6P: Inf Syst-4

Inflow Area = 1,104 sf, 97.46% Impervious, Inflow Depth = 11.14" for 100-Year event
Inflow = 0.3 cfs @ 12.08 hrs, Volume= 1,025 cf
Outflow = 0.3 cfs @ 12.09 hrs, Volume= 1,005 cf, Atten= 1%, Lag= 0.5 min
Discarded = 0.0 cfs @ 1.42 hrs, Volume= 161 cf
Primary = 0.3 cfs @ 12.09 hrs, Volume= 845 cf
Routed to Pond 1P : Inf Syst-1

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 9.71' @ 12.09 hrs Surf.Area= 101 sf Storage= 141 cf

Plug-Flow detention time= 285.9 min calculated for 1,005 cf (98% of inflow)
Center-of-Mass det. time= 274.0 min (1,015.8 - 741.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	7.00'	84 cf	**7.28'W x 13.84'L x 2.72'H Field A** 274 cf Overall - 64 cf Embedded = 210 cf x 40.0% Voids
#2A	7.25'	57 cf	**Ferguson R-Tank XD 12** x 10 Inside #1 Inside= 19.7"W x 23.6"H => 2.91 sf x 1.97'L = 5.7 cf Outside= 19.7"W x 23.6"H => 3.23 sf x 1.97'L = 6.4 cf 10 Chambers in 2 Rows
		141 cf	Total Available Storage

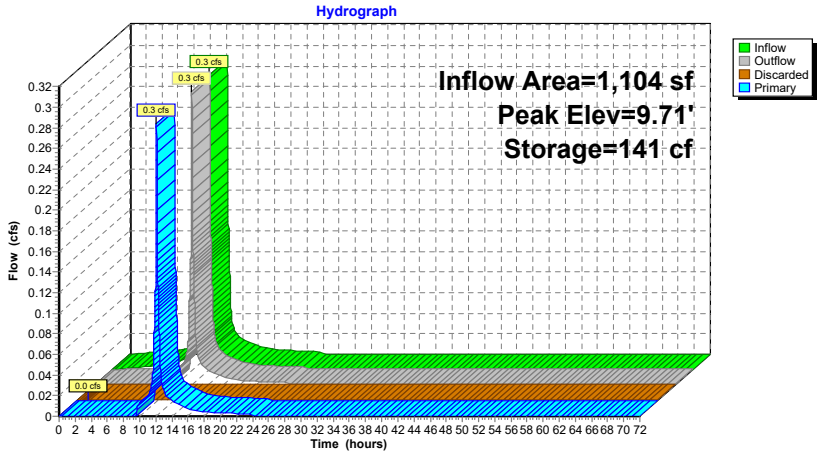
Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	7.00'	**0.270 in/hr Exfiltration over Surface area**
#2	Primary	9.37'	**6.0" Round Culvert** L= 51.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 9.37' / 8.10' S= 0.0249 '/' Cc= 0.900 n= 0.013, Flow Area= 0.20 sf

Discarded OutFlow Max=0.0 cfs @ 1.42 hrs HW=7.03' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.3 cfs @ 12.09 hrs HW=9.71' (Free Discharge)
↑**2=Culvert** (Inlet Controls 0.3 cfs @ 1.99 fps)

Pond 6P: Inf Syst-4



Summary for Pond 7P: Inf Syst-5

Inflow Area = 1,082 sf, 98.06% Impervious, Inflow Depth = 11.26" for 100-Year event
Inflow = 0.3 cfs @ 12.08 hrs, Volume= 1,015 cf
Outflow = 0.3 cfs @ 12.09 hrs, Volume= 1,014 cf, Atten= 1%, Lag= 0.5 min
Discarded = 0.0 cfs @ 1.05 hrs, Volume= 161 cf
Primary = 0.3 cfs @ 12.09 hrs, Volume= 853 cf
Routed to Pond 1P : Inf Syst-1

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 9.34' @ 12.09 hrs Surf.Area= 101 sf Storage= 123 cf

Plug-Flow detention time= 271.3 min calculated for 1,014 cf (100% of inflow)
Center-of-Mass det. time= 271.0 min (1,008.3 - 737.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	7.00'	73 cf	**7.28'W x 13.84'L x 2.39'H Field A** 241 cf Overall - 58 cf Embedded = 182 cf x 40.0% Voids
#2A	7.25'	52 cf	**Ferguson R-Tank XD 11** x 10 Inside #1 Inside= 19.7"W x 21.7"H => 2.66 sf x 1.97'L = 5.2 cf Outside= 19.7"W x 21.7"H => 2.96 sf x 1.97'L = 5.8 cf 10 Chambers in 2 Rows
		125 cf	Total Available Storage

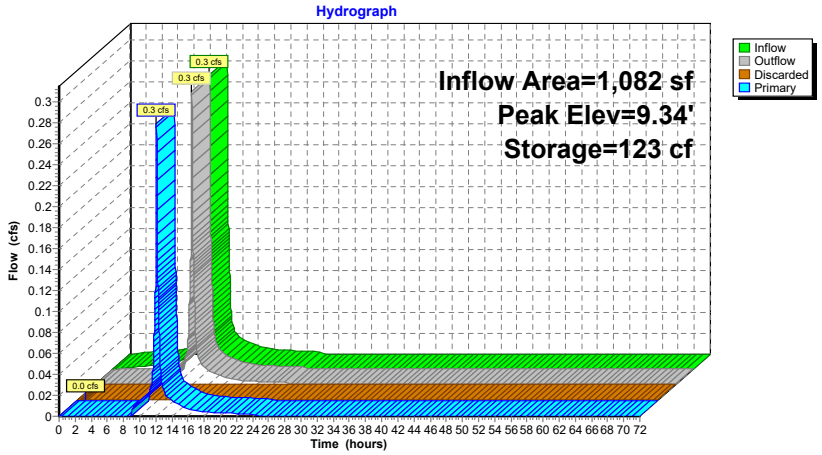
Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	7.00'	**0.270 in/hr Exfiltration over Surface area**
#2	Primary	9.00'	**6.0" Round Culvert** L= 48.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 9.00' / 8.35' S= 0.0135 '/' Cc= 0.900 n= 0.013, Flow Area= 0.20 sf

Discarded OutFlow Max=0.0 cfs @ 1.05 hrs HW=7.03' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.3 cfs @ 12.09 hrs HW=9.34' (Free Discharge)
↑**2=Culvert** (Inlet Controls 0.3 cfs @ 1.98 fps)

Pond 7P: Inf Syst-5



Summary for Pond 8P: Inf Syst-6

Inflow Area = 1,056 sf, 99.24% Impervious, Inflow Depth = 11.26" for 100-Year event
Inflow = 0.3 cfs @ 12.08 hrs, Volume= 991 cf
Outflow = 0.3 cfs @ 12.09 hrs, Volume= 990 cf, Atten= 0%, Lag= 0.5 min
Discarded = 0.0 cfs @ 1.08 hrs, Volume= 161 cf
Primary = 0.3 cfs @ 12.09 hrs, Volume= 828 cf
Routed to Pond 1P : Inf Syst-1

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 9.35' @ 12.09 hrs Surf.Area= 101 sf Storage= 124 cf

Plug-Flow detention time= 277.9 min calculated for 990 cf (100% of inflow)
Center-of-Mass det. time= 277.4 min (1,014.7 - 737.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	7.00'	73 cf	**7.28'W x 13.84'L x 2.39'H Field A** 241 cf Overall - 58 cf Embedded = 182 cf x 40.0% Voids
#2A	7.25'	52 cf	**Ferguson R-Tank XD 11** x 10 Inside #1 Inside= 19.7"W x 21.7"H => 2.66 sf x 1.97'L = 5.2 cf Outside= 19.7"W x 21.7"H => 2.96 sf x 1.97'L = 5.8 cf 10 Chambers in 2 Rows
		125 cf	Total Available Storage

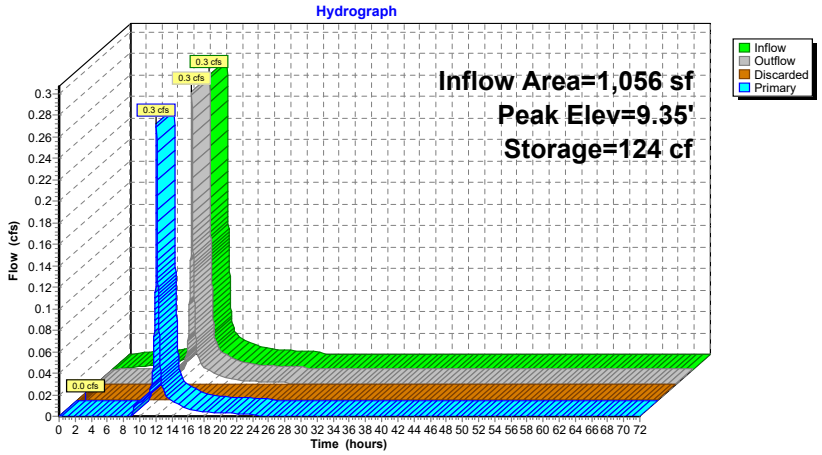
Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	7.00'	**0.270 in/hr Exfiltration over Surface area**
#2	Primary	9.00'	**8.0" Round Culvert** L= 46.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 9.00' / 8.77' S= 0.0050 '/' Cc= 0.900 n= 0.013, Flow Area= 0.35 sf

Discarded OutFlow Max=0.0 cfs @ 1.08 hrs HW=7.03' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.3 cfs @ 12.09 hrs HW=9.35' (Free Discharge)
↑**2=Culvert** (Barrel Controls 0.3 cfs @ 2.11 fps)

Pond 8P: Inf Syst-6



Summary for Pond 9P: Inf Syst-7

Inflow Area = 24,131 sf, 72.87% Impervious, Inflow Depth = 10.41" for 100-Year event
Inflow = 6.1 cfs @ 12.08 hrs, Volume= 20,942 cf
Outflow = 3.4 cfs @ 12.20 hrs, Volume= 20,942 cf, Atten= 44%, Lag= 7.0 min
Discarded = 0.0 cfs @ 3.41 hrs, Volume= 1,621 cf
Primary = 3.4 cfs @ 12.20 hrs, Volume= 19,322 cf
Routed to Link 1L : Towards Wetlands

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 8.86' @ 12.20 hrs Surf.Area= 2,422 sf Storage= 3,555 cf

Plug-Flow detention time= 43.5 min calculated for 20,940 cf (100% of inflow)
Center-of-Mass det. time= 43.6 min (806.2 - 762.6)

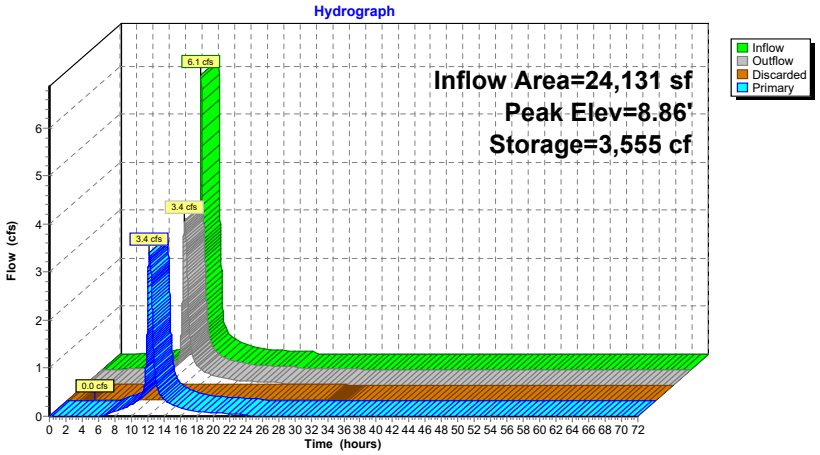
Volume	Invert	Avail.Storage	Storage Description
#1	7.15'	3,645 cf	**6.89'W x 14.06'L x 1.75'H StormTrap ST-1 Units (Irregular Shape)** x 25 4,238 cf Overall x 86.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Discarded	7.15'	**0.270 in/hr Exfiltration over Surface area**
#2	Primary	7.15'	**12.0" Round Culvert** L= 4.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 7.15' / 7.13' S= 0.0050 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#3	Device 2	7.35'	**22.0" W x 4.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.0 cfs @ 3.41 hrs HW=7.17' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=3.4 cfs @ 12.20 hrs HW=8.86' (Free Discharge)
↑**2=Culvert** (Passes 3.4 cfs of 4.2 cfs potential flow)
↑**3=Orifice/Grate** (Orifice Controls 3.4 cfs @ 5.57 fps)

Pond 9P: Inf Syst-7

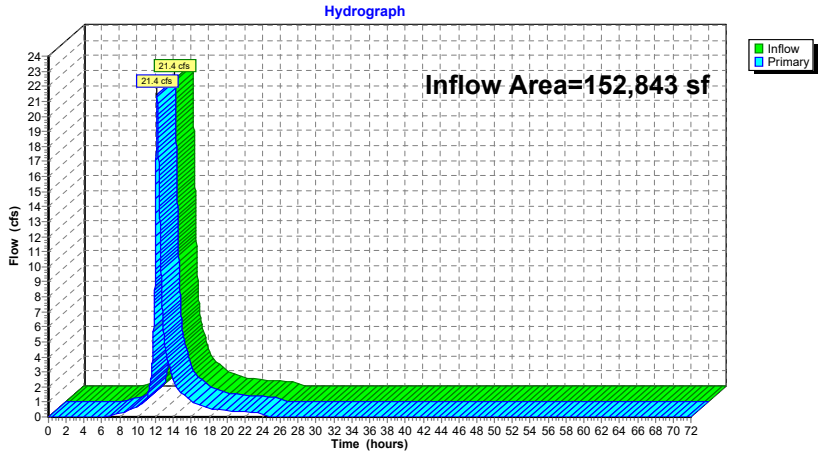


Summary for Link 1L: Towards Wetlands

Inflow Area = 152,843 sf, 50.79% Impervious, Inflow Depth = 8.30" for 100-Year event
Inflow = 21.4 cfs @ 12.19 hrs, Volume= 105,660 cf
Primary = 21.4 cfs @ 12.19 hrs, Volume= 105,660 cf, Atten= 0%, Lag= 0.0 min
Routed to Link 100L : Total Flows

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

Link 1L: Towards Wetlands

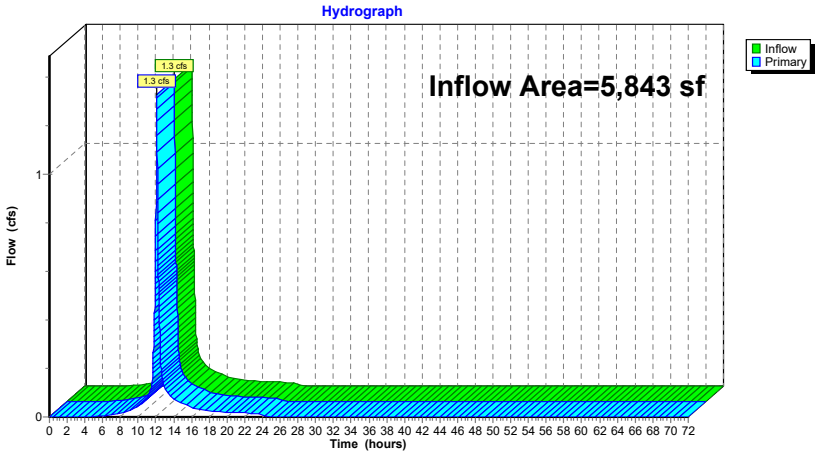


Summary for Link 2L: Towards Street

Inflow Area = 5,843 sf, 18.07% Impervious, Inflow Depth = 8.69" for 100-Year event
Inflow = 1.3 cfs @ 12.09 hrs, Volume= 4,233 cf
Primary = 1.3 cfs @ 12.09 hrs, Volume= 4,233 cf, Atten= 0%, Lag= 0.0 min
Routed to Link 100L : Total Flows

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

Link 2L: Towards Street

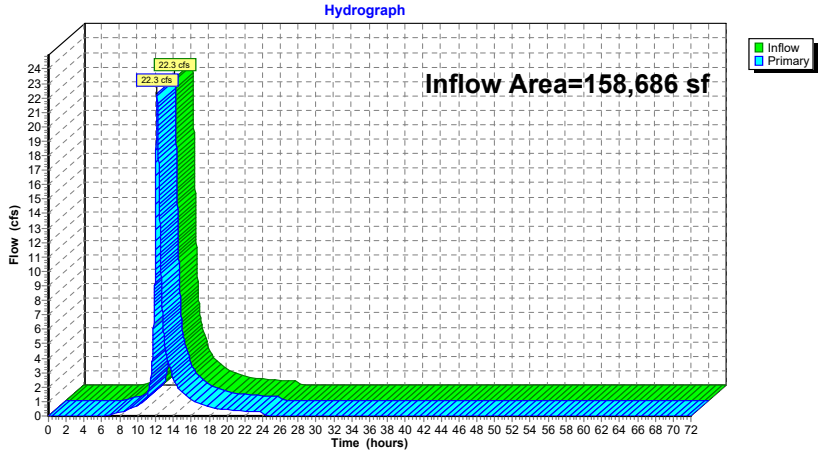


Summary for Link 100L: Total Flows

Inflow Area = 158,686 sf, 49.59% Impervious, Inflow Depth = 8.31" for 100-Year event
Inflow = 22.3 cfs @ 12.18 hrs, Volume= 109,893 cf
Primary = 22.3 cfs @ 12.18 hrs, Volume= 109,893 cf, Atten= 0%, Lag= 0.0 min

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

Link 100L: Total Flows



SECTION 6.0

ADDITIONAL DRAINAGE CALCULATIONS

6.01 TSS REMOVAL CALCULATIONS

TSS Removal Calculation Worksheet

Location: Thorndike Place, Arlington, MA

Project: 23407.02

Prepared By: E. Derrig

Date: 12/09/2024

AREA 1 - CB-1

Total Impervious Area, Acres= 0.377

A	B	C	D	E
BMP	TSS Removal Rate	Starting TSS Load*	Amount Removed (BxC)	Remaining Load (C-D)
Deep Sump and Hooded Catchbasins	0.25	1.00	0.25	0.75
Hydrodynamic Separator	0.7	0.75	0.53	0.23
Infiltration Basin	0.8	0.23	0.18	0.05

TSS Removal = 0.96

AREA 2A - TD-1A

Total Impervious Area, Acres= 0.027

A	B	C	D	E
BMP	TSS Removal Rate	Starting TSS Load*	Amount Removed (BxC)	Remaining Load (C-D)
Hydrodynamic Separator	0.7	1.00	0.70	0.30
Infiltration Basin	0.8	0.30	0.24	0.06

TSS Removal = 0.94

AREA 2B - TD-1B

Total Impervious Area, Acres= 0.044

A	B	C	D	E
BMP	TSS Removal Rate	Starting TSS Load*	Amount Removed (BxC)	Remaining Load (C-D)
Hydrodynamic Separator	0.7	1.00	0.70	0.30

TSS Removal = 0.70

AREA 3 - TD-2-6

Total Impervious Area, Acres= 0.122

A	B	C	D	E
BMP	TSS Removal Rate	Starting TSS Load*	Amount Removed (BxC)	Remaining Load (C-D)
Infiltration Basin	0.8	1.00	0.80	0.20

TSS Removal = 0.80

AREA 4 - Bypass to Street

Total Impervious Area, Acres= 0.024

A	B	C	D	E
BMP	TSS Removal Rate	Starting TSS Load*	Amount Removed (BxC)	Remaining Load (C-D)
		1.00		

TSS Removal =

AREA 5 - East Driveway

Total Impervious Area, Acres= 0.148

A	B	C	D	E
BMP	TSS Removal Rate	Starting TSS Load*	Amount Removed (BxC)	Remaining Load (C-D)
Rain Garden	0.8	1.00	0.80	0.20

TSS Removal = 0.80

Weighted Annual Average TSS Removal Rate

[TSS Removal-1 (Area-1) + TSS Revoval-2 (Area-2)+ ….] / [Area-1 + Area-2 + ...] = 0.85

Project Site TSS Removal = 0.85

6.02 GROUNDWATER RECHARGE VOLUME CALCULATIONS

Required Recharge Volume

Rv = F x Impervious Area

Where:

Rv = Recharge Volume

F=Target Depth Factor associated with each Hydrologic Soil Group

(F=0.25-inch for Soil Type C)

Impervious Area = Proposed Pavement and Rooftop area on-site

$$Rv = \left(\frac{0.25in}{12}\right)(78{,}689sft) =$$

Rv = 1,640 cf (required recharge volume)

As not all impervious surfaces are directed to an infiltration BMP, an adjusted Required Volume must be provided. The adjusted Required Volume (Rva) is calculated as:

$$Rva = \frac{Total\ Imp.Area}{Imp.Area\ to\ BMP}\ (\text{Rv}) =$$

$$Rva = \left(\frac{78{,}689sft}{75{,}617sft}\right)(1{,}640cf) =$$

$$Rva = 1{,}707\ cf$$

Storage Provided

- Underground Infiltration System 1 = 7,826 cubic feet provided
- Underground Infiltration System 2 = 122 cubic feet provided
- Underground Infiltration System 3/4 = 254 cubic feet provided (systems are the same)
- Underground Infiltration System 5/6 = 218 cubic feet provided (systems are the same)
- Underground Infiltration System 7 = 417 cubic feet provided
- **Underground Infiltration Systems Total = 8,837 cubic feet provided > 1,707 cf required**
  Rain garden not required to meet volume, but provides additional infiltration above and beyond that required.
  Refer to the HydroCAD storage table provided for more information.

Stage-Area-Storage for Pond 1P: Inf Syst-1

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
8.00	**7,459**	0	8.52	7,459	3,336
8.01	7,459	64	8.53	7,459	3,400
8.02	7,459	128	8.54	7,459	3,464
8.03	7,459	192	8.55	7,459	3,528
8.04	7,459	257	8.56	7,459	3,592
8.05	7,459	321	8.57	7,459	3,657
8.06	7,459	385	8.58	7,459	3,721
8.07	7,459	449	8.59	7,459	3,785
8.08	7,459	513	8.60	7,459	3,849
8.09	7,459	577	8.61	7,459	3,913
8.10	7,459	641	8.62	7,459	3,977
8.11	7,459	706	8.63	7,459	4,041
8.12	7,459	770	8.64	7,459	4,106
8.13	7,459	834	8.65	7,459	4,170
8.14	7,459	898	8.66	7,459	4,234
8.15	7,459	962	8.67	7,459	4,298
8.16	7,459	1,026	8.68	7,459	4,362
8.17	7,459	1,091	8.69	7,459	4,426
8.18	7,459	1,155	8.70	7,459	4,490
8.19	7,459	1,219	8.71	7,459	4,555
8.20	7,459	1,283	8.72	7,459	4,619
8.21	7,459	1,347	8.73	7,459	4,683
8.22	7,459	1,411	8.74	7,459	4,747
8.23	7,459	1,475	8.75	7,459	4,811
8.24	7,459	1,540	8.76	7,459	4,875
8.25	7,459	1,604	8.77	7,459	4,940
8.26	7,459	1,668	8.78	7,459	5,004
8.27	7,459	1,732	8.79	7,459	5,068
8.28	7,459	1,796	8.80	7,459	5,132
8.29	7,459	1,860	8.81	7,459	5,196
8.30	7,459	1,924	8.82	7,459	5,260
8.31	7,459	1,989	8.83	7,459	5,324
8.32	7,459	2,053	8.84	7,459	5,389
8.33	7,459	2,117	8.85	7,459	5,453
8.34	7,459	2,181	8.86	7,459	5,517
8.35	7,459	2,245	8.87	7,459	5,581
8.36	7,459	2,309	8.88	7,459	5,645
8.37	7,459	2,374	8.89	7,459	5,709
8.38	7,459	2,438	8.90	7,459	5,773
8.39	7,459	2,502	8.91	7,459	5,838
8.40	7,459	2,566	8.92	7,459	5,902
8.41	7,459	2,630	8.93	7,459	5,966
8.42	7,459	2,694	8.94	7,459	6,030
8.43	7,459	2,758	8.95	7,459	6,094
8.44	7,459	2,823	8.96	7,459	6,158
8.45	7,459	2,887	8.97	7,459	6,223
8.46	7,459	2,951	8.98	7,459	6,287
8.47	7,459	3,015	8.99	7,459	6,351
8.48	7,459	3,079	9.00	7,459	6,415
8.49	7,459	3,143	9.01	7,459	6,479
8.50	7,459	3,207	9.02	7,459	6,543
8.51	7,459	3,272	9.03	7,459	6,607

2340702-PR-2024-12-10 *Type III 24-hr 100-Year Rainfall=11.50"*
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Stage-Area-Storage for Pond 1P: Inf Syst-1 (continued)

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
9.04	7,459	6,672	9.56	7,459	10,007
9.05	7,459	6,736	9.57	7,459	10,071
9.06	7,459	6,800	9.58	7,459	10,136
9.07	7,459	6,864	9.59	7,459	10,200
9.08	7,459	6,928	9.60	7,459	10,264
9.09	7,459	6,992	9.61	7,459	10,328
9.10	7,459	7,056	9.62	7,459	10,392
9.11	7,459	7,121	9.63	7,459	10,456
9.12	7,459	7,185	9.64	7,459	10,521
9.13	7,459	7,249	9.65	7,459	10,585
9.14	7,459	7,313	9.66	7,459	10,649
9.15	7,459	7,377	9.67	7,459	10,713
9.16	7,459	7,441	9.68	7,459	10,777
9.17	7,459	7,505	9.69	7,459	10,841
9.18	7,459	7,570	9.70	7,459	10,905
9.19	7,459	7,634	9.71	7,459	10,970
9.20	7,459	7,698	9.72	7,459	11,034
9.21	7,459	7,762	9.73	7,459	11,098
9.22	7,459	7,826	9.74	7,459	11,162
9.23	7,459	7,890	9.75	7,459	11,226
9.24	7,459	7,955	9.76	7,459	11,290
9.25	7,459	8,019	9.77	7,459	11,354
9.26	7,459	8,083	9.78	7,459	11,419
9.27	7,459	8,147	9.79	7,459	11,483
9.28	7,459	8,211	9.80	7,459	11,547
9.29	7,459	8,275	9.81	7,459	11,611
9.30	7,459	8,339	9.82	7,459	11,675
9.31	7,459	8,404	9.83	7,459	11,739
9.32	7,459	8,468	9.84	7,459	11,804
9.33	7,459	8,532	9.85	7,459	11,868
9.34	7,459	8,596	9.86	7,459	11,932
9.35	7,459	8,660	9.87	7,459	11,996
9.36	7,459	8,724	9.88	7,459	12,060
9.37	7,459	8,788	9.89	7,459	12,124
9.38	7,459	8,853	9.90	7,459	12,188
9.39	7,459	8,917	9.91	7,459	12,253
9.40	7,459	8,981	9.92	7,459	12,317
9.41	7,459	9,045	9.93	7,459	12,381
9.42	7,459	9,109	9.94	7,459	12,445
9.43	7,459	9,173	9.95	7,459	12,509
9.44	7,459	9,238	9.96	7,459	12,573
9.45	7,459	9,302	9.97	7,459	12,637
9.46	7,459	9,366	9.98	7,459	12,702
9.47	7,459	9,430	9.99	7,459	12,766
9.48	7,459	9,494	10.00	7,459	12,830
9.49	7,459	9,558	10.01	7,459	12,894
9.50	7,459	9,622	10.02	7,459	12,958
9.51	7,459	9,687	10.03	7,459	13,022
9.52	7,459	9,751	10.04	7,459	13,087
9.53	7,459	9,815	10.05	7,459	13,151
9.54	7,459	9,879	10.06	7,459	13,215
9.55	7,459	9,943	10.07	7,459	13,279

Stage-Area-Storage for Pond 4P: Inf Syst-2 (continued)

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
9.08	101	113
9.09	101	114
9.10	101	115
9.11	101	115
9.12	101	116
9.13	101	116
9.14	101	117
9.15	101	117
9.16	101	118
9.17	101	118
9.18	101	119
9.19	101	120
9.20	101	120
9.21	101	121
9.22	101	121
9.23	101	122
9.24	101	122
9.25	101	122
9.26	101	123
9.27	101	123
9.28	101	124
9.29	101	124
9.30	101	125
9.31	101	125
9.32	101	125
9.33	101	126
9.34	101	126
9.35	101	127
9.36	101	127
9.37	101	127
9.38	101	128
9.39	101	128
9.40	101	129
9.41	101	129
9.42	101	129
9.43	101	130
9.44	101	130
9.45	101	131
9.46	101	131
9.47	101	131
9.48	101	132
9.49	101	132
9.50	101	133
9.51	101	133
9.52	101	133
9.53	101	134
9.54	101	134
9.55	101	135
9.56	101	135
9.57	101	135
9.58	101	136
9.59	101	136
9.60	101	137
9.61	101	137
9.62	101	137
9.63	101	138
9.64	101	138
9.65	101	139
9.66	101	139
9.67	101	139
9.68	101	140
9.69	101	140
9.70	101	141
9.71	101	141
9.72	101	**141**
9.73	101	141

Stage-Area-Storage for Pond 5P: Inf Syst-3 (continued)

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
9.08	101	113
9.09	101	114
9.10	101	115
9.11	101	115
9.12	101	116
9.13	101	116
9.14	101	117
9.15	101	117
9.16	101	118
9.17	101	118
9.18	101	119
9.19	101	120
9.20	101	120
9.21	101	121
9.22	101	121
9.23	101	122
9.24	101	122
9.25	101	122
9.26	101	123
9.27	101	123
9.28	101	124
9.29	101	124
9.30	101	125
9.31	101	125
9.32	101	125
9.33	101	126
9.34	101	126
9.35	101	127
9.36	101	127
9.37	101	127
9.38	101	128
9.39	101	128
9.40	101	129
9.41	101	129
9.42	101	129
9.43	101	130
9.44	101	130
9.45	101	131
9.46	101	131
9.47	101	131
9.48	101	132
9.49	101	132
9.50	101	133
9.51	101	133
9.52	101	133
9.53	101	134
9.54	101	134
9.55	101	135
9.56	101	135
9.57	101	135
9.58	101	136
9.59	101	136
9.60	101	137
9.61	101	137
9.62	101	137
9.63	101	138
9.64	101	138
9.65	101	139
9.66	101	139
9.67	101	139
9.68	101	140
9.69	101	140
9.70	101	141
9.71	101	141
9.72	101	**141**
9.73	101	141
9.74	101	141
9.75	101	141
9.76	101	141
9.77	101	141
9.78	101	141
9.79	101	141
9.80	101	141
9.81	101	141
9.82	101	141
9.83	101	141
9.84	101	141
9.85	101	141
9.86	101	141
9.87	101	141

Stage-Area-Storage for Pond 7P: Inf Syst-5

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
7.00	**101**	0
7.05	101	2
7.10	101	4
7.15	101	6
7.20	101	8
7.25	101	10
7.30	101	13
7.35	101	16
7.40	101	19
7.45	101	21
7.50	101	24
7.55	101	27
7.60	101	30
7.65	101	33
7.70	101	35
7.75	101	38
7.80	101	41
7.85	101	44
7.90	101	47
7.95	101	50
8.00	101	52
8.05	101	55
8.10	101	58
8.15	101	61
8.20	101	64
8.25	101	67
8.30	101	69
8.35	101	72
8.40	101	75
8.45	101	78
8.50	101	81
8.55	101	83
8.60	101	86
8.65	101	89
8.70	101	92
8.75	101	95
8.80	101	98
8.85	101	100
8.90	101	103
8.95	101	106
9.00	101	109
9.05	101	112
9.10	101	114
9.15	101	116
9.20	101	118
9.25	101	120
9.30	101	122
9.35	101	**124**
9.40	101	**125**
9.45	101	125
9.50	101	125

Stage-Area-Storage for Pond 9P: Inf Syst-7

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
7.15	**2,422**	0	8.19	2,422	2,166
7.17	2,422	42	8.21	2,422	2,208
7.19	2,422	83	8.23	2,422	2,249
7.21	2,422	125	8.25	2,422	2,291
7.23	2,422	167	8.27	2,422	2,333
7.25	2,422	208	8.29	2,422	2,374
7.27	2,422	250	8.31	2,422	2,416
7.29	2,422	292	8.33	2,422	2,458
7.31	2,422	333	8.35	2,422	2,499
7.33	2,422	375	8.37	2,422	2,541
7.35	2,422	417	8.39	2,422	2,583
7.37	2,422	458	8.41	2,422	2,624
7.39	2,422	500	8.43	2,422	2,666
7.41	2,422	542	8.45	2,422	2,708
7.43	2,422	583	8.47	2,422	2,749
7.45	2,422	625	8.49	2,422	2,791
7.47	2,422	666	8.51	2,422	2,833
7.49	2,422	708	8.53	2,422	2,874
7.51	2,422	750	8.55	2,422	2,916
7.53	2,422	791	8.57	2,422	2,958
7.55	2,422	833	8.59	2,422	2,999
7.57	2,422	875	8.61	2,422	3,041
7.59	2,422	916	8.63	2,422	3,083
7.61	2,422	958	8.65	2,422	3,124
7.63	2,422	1,000	8.67	2,422	3,166
7.65	2,422	1,041	8.69	2,422	3,207
7.67	2,422	1,083	8.71	2,422	3,249
7.69	2,422	1,125	8.73	2,422	3,291
7.71	2,422	1,166	8.75	2,422	3,332
7.73	2,422	1,208	8.77	2,422	3,374
7.75	2,422	1,250	8.79	2,422	3,416
7.77	2,422	1,291	8.81	2,422	3,457
7.79	2,422	1,333	8.83	2,422	3,499
7.81	2,422	1,375	8.85	2,422	3,541
7.83	2,422	1,416	8.87	2,422	3,582
7.85	2,422	1,458	8.89	2,422	**3,624**
7.87	2,422	1,500			
7.89	2,422	1,541			
7.91	2,422	1,583			
7.93	2,422	1,625			
7.95	2,422	1,666			
7.97	2,422	1,708			
7.99	2,422	1,750			
8.01	2,422	1,791			
8.03	2,422	1,833			
8.05	2,422	1,875			
8.07	2,422	1,916			
8.09	2,422	1,958			
8.11	2,422	1,999			
8.13	2,422	2,041			
8.15	2,422	2,083			
8.17	2,422	2,124			

Drawdown Within 72-Hours

Pond 1P

Rv = Recharge Volume, 7,826 cu.ft. (see above)

K = Saturated Hydraulic Conductivity, 0.27 in/hr (from Rawls Table) = 0.0225 ft/hr

Bottom Area = Area of Infiltration System Bottom, 7,459 sq.ft. (see HydroCAD)

$$Time = \frac{Rv}{(K)(Bottom\ Area)}$$

$$Time = \left(\frac{7{,}826\ cu.ft.}{(0.0225\ ft/hr)(7{,}459 sq.ft.)}\right) =$$

$$Time = 46.6\ hours$$

- 46.6 hours < 72 hours

Pond 3P (Rain Garden)

Rv = Recharge Volume, 190 cu.ft. (see HydroCAD)

K = Saturated Hydraulic Conductivity, 0.27 in/hr (from Rawls Table) = 0.0225 ft/hr

Bottom Area = Area of Infiltration System Bottom, 125 sq.ft. (see HydroCAD)

$$Time = \frac{Rv}{(K)(Bottom\ Area)}$$

$$Time = \left(\frac{190\ cu.ft.}{(0.0225\ ft/hr)(125 sq.ft.)}\right) =$$

$$Time = 67.6\ hours$$

- 67.6 hours < 72 hours

Pond 4P-6P (Townhouse Trench Drain Infiltration Systems)
Same bottom area, worst case provided

Rv = Recharge Volume, 127 cu.ft. (see above)

K = Saturated Hydraulic Conductivity, 0.27 in/hr (from Rawls Table) = 0.0225 ft/hr

Bottom Area = Area of Infiltration System Bottom, 100.75 sq.ft.

$$Time = \frac{Rv}{(K)(Bottom\ Area)}$$

$$Time = \left(\frac{127\ cu.ft.}{(0.0225\ ft/hr)(100.75 sq.ft.)}\right) =$$

$$Time = 56.0\ hours$$

- 56.0 hours < 72 hours

Pond 7P

Rv = Recharge Volume, 417 cu.ft (see HydroCAD)

K = Saturated Hydraulic Conductivity, 0.27 in/hr (from Rawls Table) = 0.0225 ft/hr

Bottom Area = Area of Infiltration System Bottom, 2,421.8 sq.ft.

$$Time = \frac{Rv}{(K)(Bottom\ Area)}$$

$$Time = \left(\frac{417\ cu.ft.}{(0.0225\ ft/hr)(2{,}421 sq.ft.)}\right) =$$

$$Time = 7.7\ hours$$

- 7.7 hours < 72 hours

6.03 WATER QUALITY VOLUME CALCULATIONS

Water Quality Volume Calculation

V_{WQ} = (D_{WQ}/12 inches/foot) * (A_{IMP} square feet)

V_{WQ} = Required Water Quality Volume (in cubic feet)
D_{WQ} = Water Quality Depth: **0.5-inch**
A_{IMP} = Total Impervious Area (in acres) used for driveways, parking, etc.

Underground Infiltration Systems and Bio-Retention Areas

A_{IMP} = 32,590 sq.ft.

V_{WQ} = (0.5 inches/12 inches/foot) * (32,590 sq.ft.)

V_{WQ} = 1,358 cubic feet (required volume)

Provided volume = 8,783 cubic feet in Underground Infiltration System (refer to the HydroCAD storage tables provided in groundwater recharge section)

6.04 RIP-RAP OUTLET PROTECTION SIZING

OUTLET PROTECTION SIZING

BSC GROUP

Project No.	23407.02	**Calc By**	EAD
Subject	Outlet Protection Sizing Calcs	**Date**	12/16/2024
Location	Arlington, MA	**Checked by**	DRR
		Date	12/16/2024

FES-1

Q=Design Discharge, (ft^3/s)	=	11.1	cfs
D=Culvert Diameter, (ft)	=	1.50	ft
TW=Tailwater Depth, (ft)	=	0.6	ft, (0.4xD for unknow tailwater, or enter known tailwater)
			(Tailwater depth is to be limited to between 0.4D and 1.0D)

Riprap Rock Sizing

$$D_{50} = 0.2D\left[\frac{Q}{\sqrt{gD^{2.5}}}\right]^{4/3}\left[\frac{D}{TW}\right]$$

g=32.2 fps

D_{50} = median rock size, ft

$$D_{50} = 0.28\,\frac{11.10}{15.64}^{(4/3)}\,\frac{1.50}{0.60} = 0.44 \text{ ft}$$

= 5.32 inches

Table 1 : Riprap Classes and Apron Dimensions

Class	D_{50} (in)	Apron Length	Apron Depth	
1	5	4D	$3.5D_{50}$	
2	**6**	**4D**	**$3.5D_{50}$**	**Use Class 2**
3	10	5D	$3.3D_{50}$	
4	14	6D	$2.2D_{50}$	
5	20	7D	$2.0D_{50}$	
6	22	8D	$2.0D_{50}$	

Apron Dimensions

Length, L=5D	=	**8 ft**	
Depth=$3.3D_{50}$	=	**19.80 Inches**	
Width=3D+(2/3)L	=	**9.50 ft**	(at apron end)

Riprap Rock Sizing Gradation

Given Size	Size of Stone, inches		
100	**9**	to	**12**
85	**8**	to	**11**
50	**6**	to	**9**
15	**3**	to	**8**

Reference Note: Sizing based in accordance with HEC #14 as required by MassHighway Design Manual

6.05 GROUNDWATER MOUNDING ANALYSIS

Input Values

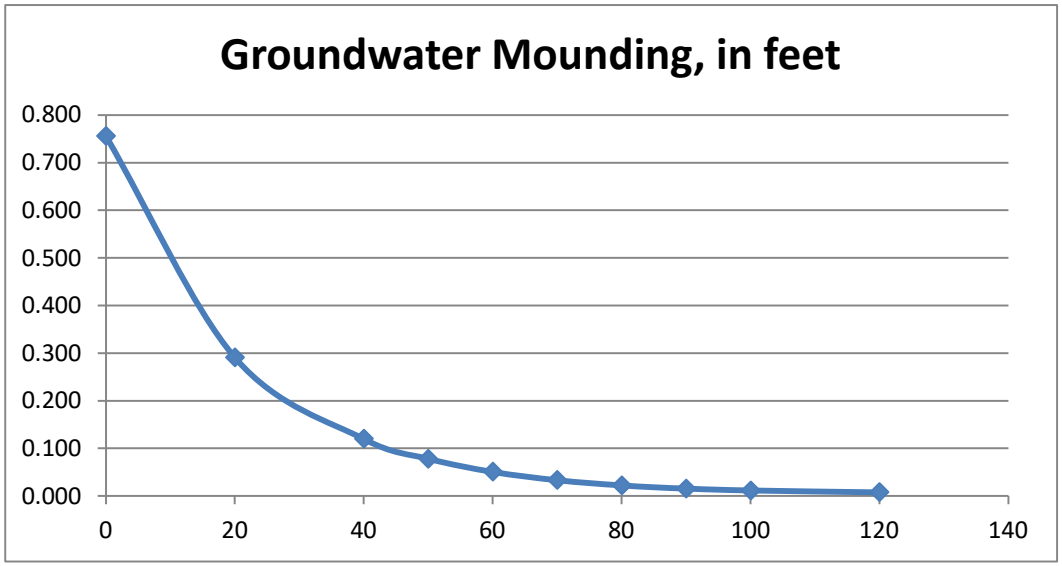
			inch/hour	feet/day	
1.5979	*R*	Recharge (infiltration) rate (feet/day)	0.67	1.33	
0.080	Sy	Specific yield, Sy (dimensionless, between 0 and 1)			
5.40	K	Horizontal hydraulic conductivity, Kh (feet/day)*	2.00	4.00	In the repor
6.920	x	1/2 length of basin (x direction, in feet)			(USGS SIR 2(
3.640	y	1/2 width of basin (y direction, in feet)	hours	days	(ft/d) is assu
1.000	t	duration of infiltration period (days)	36	1.50	hydraulic co
16.000	hi(0)	initial thickness of saturated zone (feet)			

16.756	h(max)	maximum thickness of saturated zone (beneath center of basin at end of infiltration period)
0.756	Δh(max)	maximum groundwater mounding (beneath center of basin at end of infiltration period)

ESHGW=4.0
Bot System=7.0
Separation=3.0
Mound=0.756 < 3.0

Ground-water Mounding, in feet	Distance from center of basin in x direction, in feet
0.756	0
0.291	20
0.120	40
0.078	50
0.051	60
0.033	70
0.022	80
0.015	90
0.012	100
0.008	120

Re-Calculate Now



Disclaimer

This spreadsheet solving the Hantush (1967) equation for ground-water mounding beneath an infiltration basin is made available to the general public as a convenience for those wishing to replicate values documented in the USGS Scientific Investigations Report 2010-5102 "Groundwater mounding beneath hypothetical stormwater infiltration basins" or to calculate values based on user-specified site conditions. Any changes made to the spreadsheet (other than values identified as user-specified) after transmission from the USGS could have unintended, undesirable consequences. These consequences could include, but may not be limited to: erroneous output, numerical instabilities, and violations of underlying assumptions that are inherent in results presented in the accompanying USGS published report. The USGS assumes no responsibility for the consequences of any changes made to the spreadsheet. If changes are made to the spreadsheet, the user is responsible for documenting the changes and justifying the results and conclusions.

Recharge/Infiltration Rate (ft/day) = [Required Recharge Volume (cft)/Bottom Recharge System (sft)]/Duration (day)

100 year recharge volume	161	cft
Bottom Recharge System	100.755	sft
Duration	1	day
Recharge/Infiltration Rate	**1.5979**	**ft/day**

Horizontal Hydraulic Conductivity (ft/day) = [Rawls Rate (in/hr) * (1ft/12in) * (24hr/1day)] * 10

Rawls Rate (silt loam)	0.27	in/hr
Horizontal Hydraulic Conductivity	**5.40**	**ft/day**

NOTE: All driveway infiltration systems are the same size and have the same discarded volume in the 100-year event

Summary for Pond 8P: Inf Syst-6

Inflow Area = 1,056 sf, 99.24% Impervious, Inflow Depth = 11.26" for 100-Year event
Inflow = 0.3 cfs @ 12.08 hrs, Volume= 991 cf
Outflow = 0.3 cfs @ 12.09 hrs, Volume= 990 cf, Atten= 0%, Lag= 0.5 min
Discarded = 0.0 cfs @ 1.08 hrs, Volume= 161 cf
Primary = 0.3 cfs @ 12.09 hrs, Volume= 828 cf
Routed to Pond 1P : Underground Infiltration System

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 9.35' @ 12.09 hrs Surf.Area= 101 sf Storage= 124 cf

Plug-Flow detention time= 277.9 min calculated for 990 cf (100% of inflow)
Center-of-Mass det. time= 277.4 min (1,014.7 - 737.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	7.00'	73 cf	**7.28'W x 13.84'L x 2.39'H Field A** 241 cf Overall - 58 cf Embedded = 182 cf x 40.0% Voids
#2A	7.25'	52 cf	**Ferguson R-Tank XD 11** x 10 Inside #1 Inside= 19.7"W x 21.7"H => 2.66 sf x 1.97'L = 5.2 cf Outside= 19.7"W x 21.7"H => 2.96 sf x 1.97'L = 5.8 cf 10 Chambers in 2 Rows
		125 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	7.00'	**0.270 in/hr Exfiltration over Surface area**
#2	Primary	9.00'	**8.0" Round Culvert** L= 46.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 9.00' / 8.77' S= 0.0050 '/' Cc= 0.900 n= 0.013, Flow Area= 0.35 sf

Discarded OutFlow Max=0.0 cfs @ 1.08 hrs HW=7.03' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.3 cfs @ 12.09 hrs HW=9.35' (Free Discharge)
└**2=Culvert** (Barrel Controls 0.3 cfs @ 2.11 fps)

Infiltration System 7

Input Values

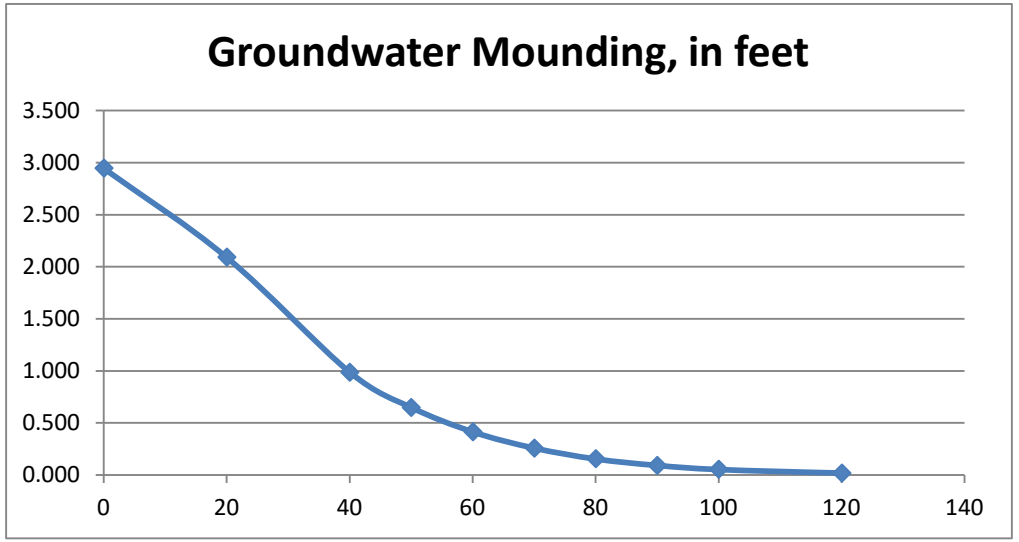
			inch/hour	feet/day	
0.6631	*R*	Recharge (infiltration) rate (feet/day)	0.67	1.33	
0.080	Sy	Specific yield, Sy (dimensionless, between 0 and 1)			
5.40	K	Horizontal hydraulic conductivity, Kh (feet/day)*	2.00	4.00	In the repor
17.225	x	1/2 length of basin (x direction, in feet)			(USGS SIR 2(
35.150	y	1/2 width of basin (y direction, in feet)	hours	days	(ft/d) is assu
1.000	t	duration of infiltration period (days)	36	1.50	hydraulic co
16.000	hi(0)	initial thickness of saturated zone (feet)			

18.946	h(max)	maximum thickness of saturated zone (beneath center of basin at end of infiltration period)
2.946	Δh(max)	maximum groundwater mounding (beneath center of basin at end of infiltration period)

ESHGW=4.0
Bottom System=7.15
Separation=3.15
Mound=2.946 < 3.15

Ground-water Mounding, in feet	Distance from center of basin in x direction, in feet
2.946	0
2.091	20
0.985	40
0.647	50
0.413	60
0.256	70
0.154	80
0.091	90
0.052	100
0.017	120

Re-Calculate Now



Disclaimer

This spreadsheet solving the Hantush (1967) equation for ground-water mounding beneath an infiltration basin is made available to the general public as a convenience for those wishing to replicate values documented in the USGS Scientific Investigations Report 2010-5102 "Groundwater mounding beneath hypothetical stormwater infiltration basins" or to calculate values based on user-specified site conditions. Any changes made to the spreadsheet (other than values identified as user-specified) after transmission from the USGS could have unintended, undesirable consequences. These consequences could include, but may not be limited to: erroneous output, numerical instabilities, and violations of underlying assumptions that are inherent in results presented in the accompanying USGS published report. The USGS assumes no responsibility for the consequences of any changes made to the spreadsheet. If changes are made to the spreadsheet, the user is responsible for documenting the changes and justifying the results and conclusions.

Recharge/Infiltration Rate (ft/day) = [Required Recharge Volume (cft)/Bottom Recharge System (sft)]/Duration (day)

100 year recharge volume	1,606	cft
Bottom Recharge System	2,421.835	sft
Duration	1	day
Recharge/Infiltration Rate	**0.6631**	**ft/day**

Horizontal Hydraulic Conductivity (ft/day) = [Rawls Rate (in/hr) * (1ft/12in) * (24hr/1day)] * 10

Rawls Rate (silt loam)	0.27	in/hr
Horizontal Hydraulic Conductivity	**5.40**	**ft/day**

Summary for Pond 9P: Inf Syst-7

Inflow Area = 24,698 sf, 71.15% Impervious, Inflow Depth = 10.36" for 100-Year event
Inflow = 6.3 cfs @ 12.08 hrs, Volume= 21,328 cf
Outflow = 3.5 cfs @ 12.20 hrs, Volume= 21,328 cf, Atten= 45%, Lag= 7.1 min
Discarded = 0.0 cfs @ 3.69 hrs, Volume= 1,606 cf
Primary = 3.5 cfs @ 12.20 hrs, Volume= 19,722 cf
Routed to Link 1L : Towards Wetlands

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 8.89' @ 12.20 hrs Surf.Area= 2,422 sf Storage= 3,633 cf

Plug-Flow detention time= 43.0 min calculated for 21,325 cf (100% of inflow)
Center-of-Mass det. time= 43.1 min (806.8 - 763.8)

Volume	Invert	Avail.Storage	Storage Description
#1	7.15'	5,207 cf	**6.89'W x 14.06'L x 2.50'H StormTrap ST-1 Units (Irregular Shape)** x 25 6,055 cf Overall x 86.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Discarded	7.15'	**0.270 in/hr Exfiltration over Surface area**
#2	Primary	7.15'	**12.0" Round Culvert** L= 4.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 7.15' / 7.13' S= 0.0050 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#3	Device 2	7.35'	**22.0" W x 4.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.0 cfs @ 3.69 hrs HW=7.18' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=3.5 cfs @ 12.20 hrs HW=8.89' (Free Discharge)
↑—**2=Culvert** (Passes 3.5 cfs of 4.2 cfs potential flow)
↑—**3=Orifice/Grate** (Orifice Controls 3.5 cfs @ 5.65 fps)

Specific Yield--

Compilation of Specific Yields for Various Materials

GEOLOGICAL SURVEY WATER SUPPLY PAPER 1662-D

Prepared in cooperation with the California Department of Water Resources

TABLE 29.—*Compilation of specific yields for various materials*

[All values rounded off to nearest whole percentage]

Material	Valley fill, California (Eckis, 1934)	Mokelumne area, California (Piper and others, 1939)	Santa Ynez River basin, California (Upson and Thomasson, 1951)	Sacramento Valley, Calif. (Poland and others, 1949)	Smith River plain, California (Back, 1957)	Ventura County, Calif. (Calif. Water Resources Board, 1956)	Santa Margarita Valley, Calif. (Calif. Dept. Public Works, 1956)	Tia Juana Basin, Calif. (Calif. Water Rights Board. 1957)	San Luis Obispo County, Calif. (Calif. Water Resources Board, 1958)	San Joaquin Valley, Calif. (Davis and others, 1959)	Eureka area, California (Evenson, 1959)	Santa Ynez Basin, Calif. (Wilson, 1959)	Rechna Doab, Pakistan (Kazmi, 1961)	Napa-Sonoma Valleys, Calif. (Kunkel and Upson, 1960)	Humboldt River Valley, Nev. (Cohen, 1963)	Unconsolidated alluvium (Preuss and Todd, 1963)	Little Bighorn River valley, Montana (Moulder and Others, 1960)	Average specific yield
Clay	1	4	2	3	1	0	1	1	3	3	3	5	3	3	1	-----	-----	2
Silt	10	4	12	3	-----	3	10	10	5	5	10	5	5	5	19	4	17	8
Sandy clay	10	4	12	3	5	5	5	5	5	5	10	-----	-----	10	-----	-----	-----	7
Fine sand	21	26	12	10	10	25	28	25	25	10	20	20	27	20	26	23	32	21
Medium sand	31	26	30	20	15	25	28	30	25	25	20	30	28	20	28	28	32	26
Coarse sand	31	35	35	20	25	25	28	32	25	25	20	30	23	20	27	28	32	27
Gravelly sand	31	35	35	20	25	21	22	28	21	25	20	-----	23	20	-----	22	32	25
Fine gravel	27	35	35	25	25	21	22	26	21	25	25	25	26	25	19	17	25	25
Medium gravel	21	-----	-----	25	25	21	22	23	21	25	25	25	26	25	-----	13	25	23
Coarse gravel	14	-----	-----	25	25	21	22	18	21	25	25	25	26	25	-----	12	-----	22

6.06 ILLICIT DISCHARGE COMPLIANCE STATEMENT

Illicit Discharge Compliance Statement

This statement is to document that, to the best of my knowledge and belief, there are no and will be no illicit discharges to the stormwater management systems or protected wetland resource areas for the Thorndike Place residential development on Dorothy Road in Arlington, Massachusetts.

Authorized Signature/Title

Date

APPENDIX A

USGS LOCUS MAP

PREPARED FOR:

ARLINGTON LAND REALTY, LLC
84 SHERMAN ST, 2ND FLOOR
CAMBRIDGE, MA 02140

USGS LOCUS MAP

THRONDIKE PLACE
DOROTHY ROAD
ARLINGTON, MA

BSC GROUP
803 Summer Street
Boston, Massachusetts
02127
617 896 4300

Job No.: 23407.02 Date: 08/22/2023
Scale: 1"=1,000' Revised:
Dwg. No: Figure: 1 OF 1

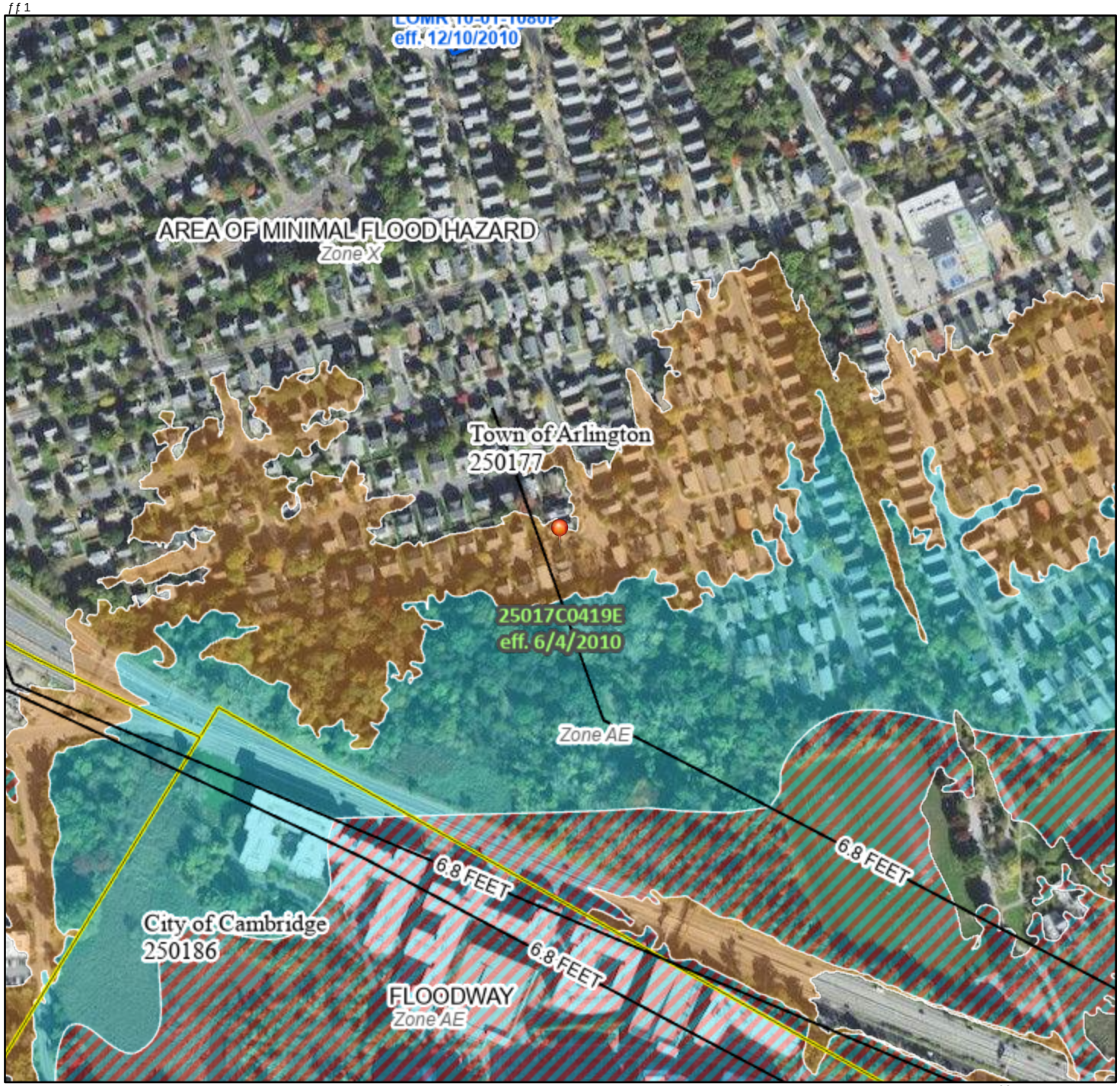
File: 2340702/C/D/2340702-USGS

APPENDIX B

FEMA MAP

1DWLRQDO)ORRG+D]DUG'DWD)ORRGZD\V

FEMA



)HHW

ff 1

ff 1

%DVH)ORRG(OHYDWLRQ DQG)ORRGZD\V

/HJHQG

6)(5 $5($6 2) 0,1,0$/)/22' +$=$5'

L:WKRXW %DVH)ORRG(OHYDWLRQ %)(

=RQH$ 9 $

L:WK%DVH)ORRG(OHYDWLRQ =RQH$($+ $2 $3 9($9

5HGXFHG)ORRG5LVN'XH7R/HYHH6\VWHP

$&&5(',7('

$QQXDO &KDQFH)ORRG+D]DUG $UHDV

R DQQXDO FKDQFH IORRG ZDWHUV

G+D]DUGV WKDW WRQRW IRRW RU ZDWHUVKHG

DUHDV RI OHVV WKDQ RQH VTXDUH PLOH =RQH;

)WXUH&RQGLWLRQV $QQXDO

&KDQFH)ORRG+D]DUG =RQH;

$UHDV WKH5HGXFHG)ORRG5LVNGXHWR

/HYHH6\VWHPV =RQH;

$UHDV WKI)ORRG5LVNGXHWR/HYHH =RQH'

2WKHU$UHDV

$UHDV RI0LQRU)ORRG+D]DUG =RQH;

(IIHFWLYH/HYHHV

$UHDV 8QGHWHUPLQHG)ORRG+D]DUG =RQH'

*HRORJLF &KDUDFWHULVWLFV

&KDQQHO &XOYHUW RU6WUXFWXUH

/HYHH L'NH RU)ORRGZDOO

&URVV6HFWLRQV ZLWK$QQXDO &KDQFH

DWHU 6XUIDFH(OHYDWLRQ

&RDVWDO 7UDQVHFW

%DVH)ORRG(OHYDWLRQ/LQH %)(

/LPLW R6WUXFW

-XULVGLFWLRQ%RXQGDU\

&RDVWDO 7UDQVHFW %DVHOLQH

3URWHFWHG%DVHOLQH

+GURJUDSKLF)HDWXUH

/LWWDWDWD$UHDV

1RW/LWWDWDWHG

8QSSHG

7KHSLQGLVSODHGRQWKHPDSLV DQDSSURSULDWH
SRQW VHOHFWHGE\WKHXVHU DQGGRHV QRW UHSUHV
DQDWWKRULWDWLYHSURSHUW\ORFDWLRQ

7KLVPSFRROLHVZLWKJVVWDQGDUGV/IRU WKHXVHR
GL.LWDO IORRGPS/LI LW LVQRW YRLGV/GHVFULEHGEHORZ
7KHEDVHPS VKRZQRROLHVZLWKJVEDVHPS
DFFXUDWHGDWD/

7KHIORRGKDUGLQRUPDWLRQLV GHULYHGLUHFWO\IURPWKH
DWKRULWDWLYHJZEVHUYLFHVSURYLGHGE\ 7KLVPS
ZVHSRUWHGRQ DW 3 DQGRHVQW UHOHFW FKDQJHV RU
WLFH 7KHJHDQGHIHFWLYHQRUPDWLRQPRFKDQJHRU
EHFRPXSUVHGEQHZGDWDRYHU WLFH

7KLVPSLDHLV YRLGLI WKHIRQHRU RHWHIO ORZQVPS
HOHPQWV GRQW DSSHDU EDVHPSLDHU\ IORRGRQHODEOV
OHHQG VFDOHEU PSFUDWLRQGDWH FRQW\LGHQWLILHUV
)5$DQG QXEU DQG)5$IIHFWLYHGDWH DSLDHV IRU
XQSSHGDQGXQRGHUQL}GDUHDV FDQQW EHXVHGIRU
UHDOWRU\SUSRVHV

%DVHPS,DHU\6RXUFH 86DWLRQDO DS

APPENDIX C

WEB SOIL SURVEY

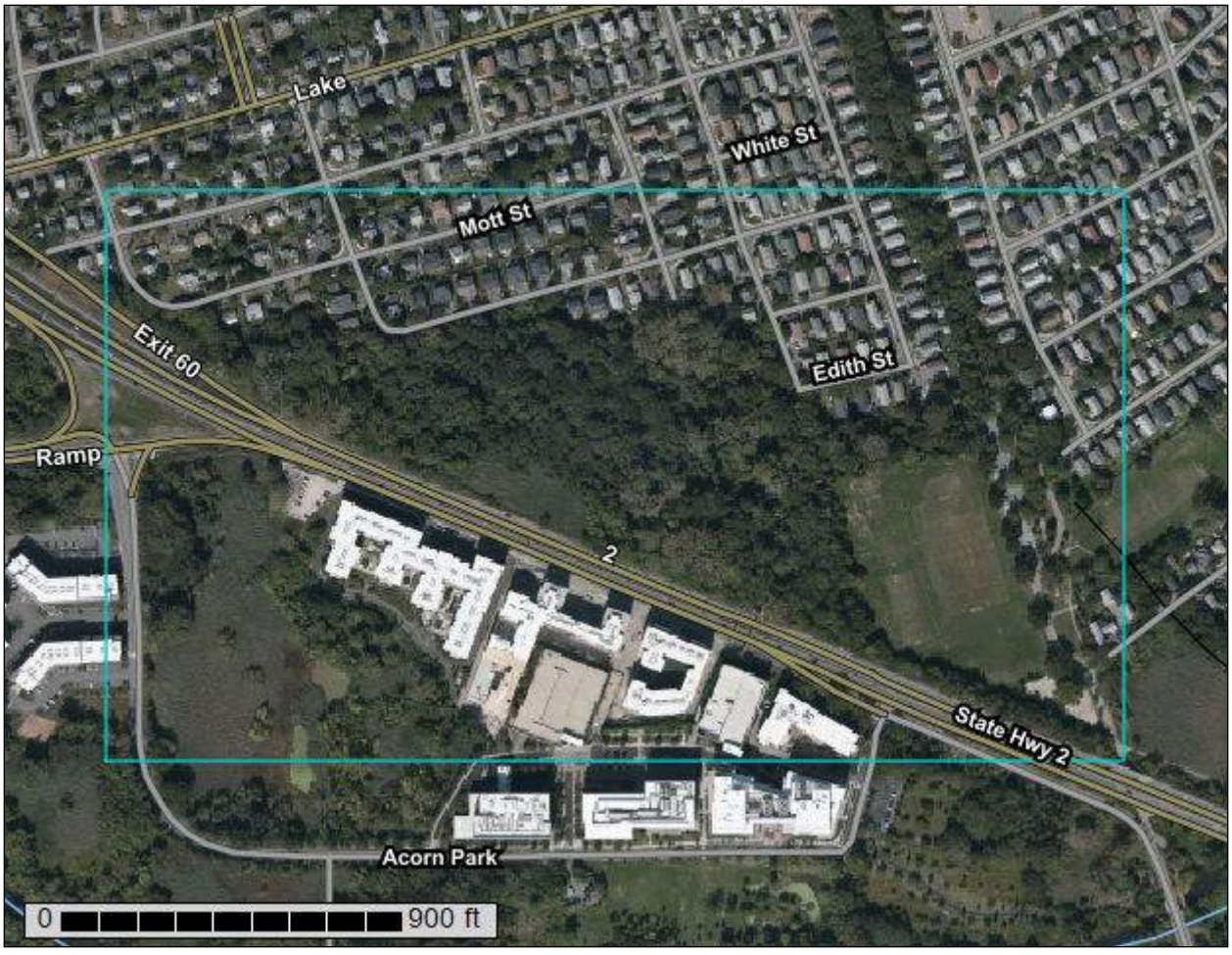
United States Department of Agriculture

NRCS

Natural Resources Conservation Service

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

Custom Soil Resource Report for Middlesex County, Massachusetts



November 2, 2020

Preface

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

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

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

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

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

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

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Contents

How Soil Surveys Are Made

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

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

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

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

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

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

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

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

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

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

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

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

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

Custom Soil Resource Report
Soil Map

Map Scale: 1:4,500 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 50 100 200 300

Feet
0 200 400 800 1200

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

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Middlesex County, Massachusetts
Survey Area Data: Version 20, Jun 9, 2020

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

Date(s) aerial images were photographed: Sep 11, 2019—Oct 5, 2019

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
51A	Swansea muck, 0 to 1 percent slopes	4.3	4.6%
52A	Freetown muck, 0 to 1 percent slopes	10.4	11.2%
603	Urban land, wet substratum	32.1	34.5%
626B	Merrimac-Urban land complex, 0 to 8 percent slopes	14.3	15.4%
655	Udorthents, wet substratum	31.9	34.3%
Totals for Area of Interest		**92.9**	**100.0%**

Map Unit Descriptions

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

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

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

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

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

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

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

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

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

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

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

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

Middlesex County, Massachusetts

51A—Swansea muck, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: 2trl2
Elevation: 0 to 1,140 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Swansea

Setting

Landform: Swamps, bogs
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Highly decomposed organic material over loose sandy and gravelly glaciofluvial deposits

Typical profile

Oa1 - 0 to 24 inches: muck
Oa2 - 24 to 34 inches: muck
Cg - 34 to 79 inches: coarse sand

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: Rare
Frequency of ponding: Frequent
Available water capacity: Very high (about 16.5 inches)

Interpretive groups

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

Minor Components

Freetown

Percent of map unit: 10 percent
Landform: Bogs, swamps

Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Whitman

Percent of map unit: 5 percent
Landform: Depressions, drainageways
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Scarboro

Percent of map unit: 5 percent
Landform: Drainageways, depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope, tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

52A—Freetown muck, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: 2t2q9
Elevation: 0 to 1,110 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Freetown

Setting

Landform: Depressions, depressions, bogs, marshes, kettles, swamps
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Highly decomposed organic material

Typical profile

Oe - 0 to 2 inches: mucky peat
Oa - 2 to 79 inches: muck

Properties and qualities

Slope: 0 to 1 percent
Surface area covered with cobbles, stones or boulders: 0.0 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: Rare
Frequency of ponding: Frequent
Available water capacity: Very high (about 19.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: B/D
Ecological site: F144AY043MA - Acidic Organic Wetlands
Hydric soil rating: Yes

Minor Components

Swansea

Percent of map unit: 5 percent
Landform: Kettles, depressions, depressions, marshes, swamps, bogs
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Scarboro

Percent of map unit: 5 percent
Landform: Depressions, drainageways
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope, tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Whitman

Percent of map unit: 5 percent
Landform: Depressions, drainageways
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

603—Urban land, wet substratum

Map Unit Setting

National map unit symbol: 9951
Mean annual precipitation: 32 to 50 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 110 to 200 days
Farmland classification: Not prime farmland

Map Unit Composition

Urban land: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Urban Land

Setting

Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Excavated and filled land over alluvium and/or marine deposits

Minor Components

Udorthents, loamy

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

Rock outcrop

Percent of map unit: 5 percent
Landform: Ledges
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Head slope
Down-slope shape: Concave
Across-slope shape: Concave

626B—Merrimac-Urban land complex, 0 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2tyr9
Elevation: 0 to 820 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F

Frost-free period: 140 to 250 days
Farmland classification: Not prime farmland

Map Unit Composition

Merrimac and similar soils: 45 percent
Urban land: 40 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Merrimac

Setting

Landform: Eskers, moraines, outwash terraces, outwash plains, kames
Landform position (two-dimensional): Backslope, footslope, summit, shoulder
Landform position (three-dimensional): Side slope, crest, riser, tread
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy glaciofluvial deposits derived from granite, schist, and gneiss over sandy and gravelly glaciofluvial deposits derived from granite, schist, and gneiss

Typical profile

Ap - 0 to 10 inches: fine sandy loam
Bw1 - 10 to 22 inches: fine sandy loam
Bw2 - 22 to 26 inches: stratified gravel to gravelly loamy sand
2C - 26 to 65 inches: stratified gravel to very gravelly sand

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 2 percent
Maximum salinity: Nonsaline (0.0 to 1.4 mmhos/cm)
Sodium adsorption ratio, maximum: 1.0
Available water capacity: Low (about 4.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: A
Ecological site: F144AY022MA - Dry Outwash
Hydric soil rating: No

Description of Urban Land

Typical profile

M - 0 to 10 inches: cemented material

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: 0 inches to manufactured layer

Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)
Available water capacity: Very low (about 0.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydrologic Soil Group: D
Hydric soil rating: Unranked

Minor Components

Windsor

Percent of map unit: 5 percent
Landform: Dunes, outwash terraces, deltas, outwash plains
Landform position (three-dimensional): Tread, riser
Down-slope shape: Convex, linear
Across-slope shape: Convex, linear
Hydric soil rating: No

Sudbury

Percent of map unit: 5 percent
Landform: Outwash plains, terraces, deltas
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Hinckley

Percent of map unit: 5 percent
Landform: Eskers, kames, deltas, outwash plains
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Nose slope, side slope, crest, head slope, rise
Down-slope shape: Convex
Across-slope shape: Convex, linear
Hydric soil rating: No

655—Udorthents, wet substratum

Map Unit Setting

National map unit symbol: vr1n
Elevation: 0 to 3,000 feet
Mean annual precipitation: 32 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 110 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Udorthents, Wet Substratum

Setting

Parent material: Loamy alluvium and/or sandy glaciofluvial deposits and/or loamy glaciolacustrine deposits and/or loamy marine deposits and/or loamy basal till and/or loamy lodgment till

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: More than 80 inches
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Minor Components

Urban land

Percent of map unit: 8 percent
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear

Freetown

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

Swansea

Percent of map unit: 3 percent
Landform: Bogs, depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

National Research Council. 1995. Wetlands: Characteristics and boundaries.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577

Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580

Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.

United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374

United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf

APPENDIX D

TEST PIT LOGS

Commonwealth of Massachusetts
City/Town of Arlington

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

A. Facility Information

Arlington Land Realty, LLC
Owner Name

Dorothy Road
Street Address

16-8-2, 16-8-3, 16-8-4, 16-8-5, 16-8-6, 16-8-7A
Map/Lot #

Arlington
City

MA
State

02474
Zip Code

B. Site Information

1. (Check one) ☒ New Construction ☐ Upgrade ☐ Repair

2. Soil Survey Available? ☒ Yes ☐ No If yes: Web Soil Survey (Source) 655, 51A (Soil Map Unit)

Udorthents, Swansea Muck
Soil Name

Fill throughout site; clay base layer in one test pit
Soil Limitations

Glaciofluvial deposit
Soil Parent material

Depression
Landform

3. Surficial Geological Report Available? ☒ Yes ☐ No If yes: 2018/USGS (Year Published/Source) Glaciomarine fine deposits, stagnant ice deposits (Map Unit)

fine/very fine sand down to very fine sand, silt, silty clay, and clay
Description of Geologic Map Unit:

4. Flood Rate Insurance Map Within a regulatory floodway? ☐ Yes ☒ No

5. Within a velocity zone? ☐ Yes ☒ No

6. Within a Mapped Wetland Area? ☒ Yes ☐ No If yes, MassGIS Wetland Data Layer: Shallow marsh meadow (Wetland Type)

7. Current Water Resource Conditions (USGS): 11/25/2020 (Month/Day/ Year) Range: ☒ Above Normal ☐ Normal ☐ Below Normal

8. Other references reviewed: Not in Zone I, II, or IWPA (OLIVER)

Commonwealth of Massachusetts
City/Town of Arlington

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP-1 (Hole #) | 11/25/2020 (Date) | 7:45 AM (Time) | Cloudy, 30deg (Weather) | 42.40 N (Latitude) | 71.15 W (Longitude:)

1. Land Use: Woodland adjacent to residential/highway (e.g., woodland, agricultural field, vacant lot, etc.) | Forest (Vegetation) | Some large boulders (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 0-2% (Slope (%))

Description of Location:

2. Soil Parent Material: Glaciofluvial deposits | Depression (Landform) | SU (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body >100 feet | Drainage Way >100 feet | Wetlands >100 feet | Property Line >100 feet | Drinking Water Well >100 feet | Other _____ feet

4. Unsuitable Materials Present: ☒ Yes ☐ No If Yes: ☐ Disturbed Soil ☒ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: 108" Depth Weeping from Pit | 108" Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0"-10	A	SL	7.5YR 2.5/1	--	--	--	0	0	massive	friable	
10"-36"	B (fill)	gravelly sandy loam	10YR 3/3	--	--	--	10	2-4	massive	very friable	
36"-48"											
48"-108"	C1 (fill)	gravelly sandy loam	10YR 2/1	--	--	--	15-20	4-6	massive	very friable	
36"-78"	C2 (fill)	loamy sand	10YR 5/4	--	--	--	0	0	single grain	loose	sandy layer (only on E side of test pit)
78"-108"	2C2 (fill)	gravelly sandy loam	10YR 2/1	--	--	--	15-20	4-6	massive	very friable	gravelly layer below sandy layer on E side of test pit

Additional Notes:
Elevation of TP-1 = 12.0. Groundwater at bottom of test pit (9' - elevation 3.0). Test pit mostly fill

Commonwealth of Massachusetts
City/Town of Arlington

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP-2 (Hole #) | 11/25/20 20 | 8:45AM (Time) | Cloudy, 35deg (Weather) | 42.40 N (Latitude) | 71.15 W (Longitude:)

1. Land Use: Woodland adjacent to residential/highway (e.g., woodland, agricultural field, vacant lot, etc.) | Forest (Vegetation) | Some large boulders around (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 0-2% (Slope (%))

Description of Location:

2. Soil Parent Material: Glaciofluvial deposits | Depression (Landform) | SU (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body >100 feet | Drainage Way >100 feet | Wetlands >100 feet | Property Line >100 feet | Drinking Water Well >100 feet | Other _____ feet

4. Unsuitable Materials Present: ☒ Yes ☐ No If Yes: ☐ Disturbed Soil ☒ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: _____ Depth Weeping from Pit _____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-7	A	sandy loam	10YR 2.5/1	--	--	--	0	0	massive	friable	
7-132	C (fill)	gravelly sandy loam	10YR 3/2	--	--	--	15-20	4-6	massive	friable	

Additional Notes:
Elevation of TP-2 = 11.2. Estimated groundwater elevation (to bottom of test pit) = 0.2. Fill throughout test pit. No groundwater observed

Commonwealth of Massachusetts
City/Town of Arlington

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

D. Determination of High Groundwater Elevation

1. Method Used:	Obs. Hole #TP-1	Obs. Hole #TP-2
☒ Depth observed standing water in observation hole	108 inches	_____ inches
☐ Depth weeping from side of observation hole	_____ inches	_____ inches
☐ Depth to soil redoximorphic features (mottles)	_____ inches	_____ inches
☐ Depth to adjusted seasonal high groundwater (S_h) (USGS methodology)	_____ inches	_____ inches

_____ Index Well Number _____ Reading Date

$S_h = S_c – [S_r \times (OW_c – OW_{max})/OW_r]$

Obs. Hole/Well# _____ S_c _____ S_r _____ OW_c _____ OW_{max} _____ OW_r _____ S_h _____

2. Estimated Depth to High Groundwater: 108 inches

E. Depth of Pervious Material

1. Depth of Naturally Occurring Pervious Material

a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

☐ Yes ☒ No

b. If yes, at what depth was it observed (exclude A and O Horizons)?	Upper boundary:	_____ inches	Lower boundary:	_____ inches
c. If no, at what depth was impervious material observed?	Upper boundary:	108 inches	Lower boundary:	>108 (fill material) inches

Commonwealth of Massachusetts
City/Town of Arlington

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

F. Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct soil evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.100 through 15.107.

	11/25/2020
Signature of Soil Evaluator	Date
Emily Derrig SE14158	12/1/2020
Typed or Printed Name of Soil Evaluator / License #	Expiration Date of License
Name of Approving Authority Witness	Approving Authority

Note: In accordance with 310 CMR 15.018(2) this form must be submitted to the approving authority within 60 days of the date of field testing, and to the designer and the property owner with Percolation Test Form 12.

Field Diagrams: Use this area for field diagrams:

Commonwealth of Massachusetts
City/Town of Arlington

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

A. Facility Information

Arlington Land Realty, LLC
Owner Name

Dorothy Road
Street Address

16-8-2, 16-8-3, 16-8-4, 16-8-5, 16-8-6, 16-8-7A
Map/Lot #

Arlington
City

MA
State

02474
Zip Code

B. Site Information

1. (Check one) ☒ New Construction ☐ Upgrade ☐ Repair

2. Soil Survey Available? ☒ Yes ☐ No If yes: Web Soil Survey (Source) 655, 51A (Soil Map Unit)

Udorthents, Swansea Muck
Soil Name

Fill throughout site; clay base layer in one test pit
Soil Limitations

Glaciofluvial deposit
Soil Parent material

Depression
Landform

3. Surficial Geological Report Available? ☒ Yes ☐ No If yes: 2018/USGS (Year Published/Source) Glaciomarine fine deposits, stagnant ice deposits (Map Unit)

fine/very fine sand down to very fine sand, silt, silty clay, and clay
Description of Geologic Map Unit:

4. Flood Rate Insurance Map Within a regulatory floodway? ☐ Yes ☒ No

5. Within a velocity zone? ☐ Yes ☒ No

6. Within a Mapped Wetland Area? ☒ Yes ☐ No If yes, MassGIS Wetland Data Layer: Shallow marsh meadow (Wetland Type)

7. Current Water Resource Conditions (USGS): 11/25/2020 (Month/Day/ Year) Range: ☒ Above Normal ☐ Normal ☐ Below Normal

8. Other references reviewed: Not in Zone I, II, or IWPA (OLIVER)

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C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP-3 (Hole #) | 11/25/2020 (Date) | 9:45 AM (Time) | Cloudy, 40deg (Weather) | 42.40 N (Latitude) | 71.15 W (Longitude:)

1. Land Use: Woodland adjacent to residential/highway (e.g., woodland, agricultural field, vacant lot, etc.) | Forest (Vegetation) | Some large boulders (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 0-2% (Slope (%))

Description of Location:

2. Soil Parent Material: Glaciofluvial deposits | Depression (Landform) | FS (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body >100 feet | Drainage Way >100 feet | Wetlands >100 feet | Property Line >100 feet | Drinking Water Well >100 feet | Other _____ feet

4. Unsuitable Materials Present: ☒ Yes ☐ No If Yes: ☐ Disturbed Soil ☒ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: 84" Depth Weeping from Pit | 144" Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0"-8"	A	SL	10YR 2/1	--	--	--	0	0	massive	very friable	
8"-84"	B	SL	7.5YR 2.5/2	36"	7.5YR 5/8	2-4%	2-4	0	massive	friable	
84"-108"	C1	Sandy Clay Loam	10YR 2/1	--	--	--	0	0	massive	firm	
108"-144"	C2	Clay	GLEY 2 4/5B	--	--	--	0	0	massive	very firm	

Additional Notes:
TP-3 Elevation = 6.5. Groundwater observed at bottom of test pit (12') and weeping from sides at 7' - estimated groundwater elevation = -0.5

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Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: _____ Hole # _____ Date _____ Time _____ Weather _____ Latitude _____ Longitude:

1. Land Use: _____ (e.g., woodland, agricultural field, vacant lot, etc.) _____ Vegetation _____ Surface Stones (e.g., cobbles, stones, boulders, etc.) _____ Slope (%)

Description of Location: _____

2. Soil Parent Material: _____ _____ Landform _____ Position on Landscape (SU, SH, BS, FS, TS)

3. Distances from: Open Water Body _____ feet Drainage Way _____ feet Wetlands _____ feet
Property Line _____ feet Drinking Water Well _____ feet Other _____ feet

4. Unsuitable Materials Present: ☐ Yes ☐ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☐ No If yes: _____ Depth Weeping from Pit _____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			

Additional Notes: _____

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D. Determination of High Groundwater Elevation

1. Method Used:

	Obs. Hole # TP-3	Obs. Hole # _____
☒ Depth observed standing water in observation hole	132 inches	_____ inches
☒ Depth weeping from side of observation hole	84 inches	_____ inches
☐ Depth to soil redoximorphic features (mottles)	_____ inches	_____ inches
☐ Depth to adjusted seasonal high groundwater (S_h) (USGS methodology)	_____ inches	_____ inches

Index Well Number _____ Reading Date _____

$S_h = S_c – [S_r \times (OW_c – OW_{max})/OW_r]$

Obs. Hole/Well# _____ S_c _____ S_r _____ OW_c _____ OW_{max} _____ OW_r _____ S_h _____

2. Estimated Depth to High Groundwater: 84 inches

E. Depth of Pervious Material

1. Depth of Naturally Occurring Pervious Material

a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

☐ Yes ☒ No

b. If yes, at what depth was it observed (exclude A and O Horizons)?	Upper boundary:	_____ inches	Lower boundary:	_____ inches
c. If no, at what depth was impervious material observed?	Upper boundary:	84 inches	Lower boundary:	132 inches

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F. Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct soil evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.100 through 15.107.

	11/25/2020
Signature of Soil Evaluator	Date
Emily Derrig SE14158	12/1/2020
Typed or Printed Name of Soil Evaluator / License #	Expiration Date of License
Name of Approving Authority Witness	Approving Authority

Note: In accordance with 310 CMR 15.018(2) this form must be submitted to the approving authority within 60 days of the date of field testing, and to the designer and the property owner with Percolation Test Form 12.

Field Diagrams: Use this area for field diagrams:

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Street Address

16-8-2, 16-8-3, 16-8-4, 16-8-5, 16-8-6, 16-8-7A
Map/Lot #

Arlington
City

MA
State

02474
Zip Code

B. Site Information

1. (Check one) ☒ New Construction ☐ Upgrade

2. Soil Survey NRCS USDA Web Soil Survey
Source

655
Soil Map Unit

Udorthents, wet substratum
Soil Series

Depressions
Landform

Soil Limitations

Loamy alluvium and/or sandy glaciofluvial deposits and/or loamy glaciolacustrine deposites and/or loamy marine deposits and/or loamy basal till and/or loamy lodgment till
Soil Parent material

3. Surficial Geological Report 2018/USGS
Year Published/Source

Artificial fill, glaciomarine fine deposits, stagnant ice deposits
Map Unit

Fine/very fine sand down to very fine sand, silt, silty clay, and clay
Description of Geologic Map Unit:

4. Flood Rate Insurance Map Within a regulatory floodway? ☐ Yes ☒ No

5. Within a velocity zone? ☐ Yes ☒ No

6. Within a Mapped Wetland Area? ☐ Yes ☒ No If yes, MassGIS Wetland Data Layer:
Wetland Type

7. Current Water Resource Conditions (USGS): Month/Day/ Year Range: ☐ Above Normal ☐ Normal ☐ Below Normal

8. Other references reviewed: Not in Zone II or IWPA (MassMapper)
(Zone II, IWPA, Zone A, EEA Data Portal, etc.)

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C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP-1 (Hole #) | 5/18/23 (Date) | 9:00AM (Time) | Clear (Weather) | 42.4' N (Latitude) | 71.2' W (Longitude)

1. Land Use: Wooded lot in residential area (e.g., woodland, agricultural field, vacant lot, etc.) | Trees (Vegetation) | Some surface stones, not many (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 3% (Slope (%))

Description of Location: At the front of the site along Dorothy Road, about 32' in from the edge of the road

2. Soil Parent Material: Glaciofluvial deposits | Depression (Landform) | SU (Position on Landscape (SU, SH, BS, FS, TS, Plain))

3. Distances from: Open Water Body >100 feet | Drainage Way >100 feet | Wetlands 280 feet | Property Line 22 feet | Drinking Water Well >100 feet | Other ____ feet

4. Unsuitable Materials Present: ☒ Yes ☐ No If Yes: ☒ Disturbed Soil/Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: 108" Depth to Weeping in Hole | 114" Depth to Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-90	Fill	Sandy Loam	7.5YR 3/2		Cnc : Dpl:		0	4-6	Massive	Friable	
90-120	C	Fine Sandy Loam	7.5YR 5/2		Cnc : Dpl:		0	0	Massive	Friable	
					Cnc : Dpl:						
					Cnc : Dpl:						
					Cnc : Dpl:						
					Cnc : Dpl:						

Additional Notes: Top of monitoring well 3'-8" from ground surface

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C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP-2 (Hole #) | 5/18/23 (Date) | 1:30PM (Time) | Clear (Weather) | 42.4' N (Latitude) | 71.2' W (Longitude)

1. Land Use: Wooded lot in residential area (e.g., woodland, agricultural field, vacant lot, etc.) | Trees (Vegetation) | Some surface stones, not many (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 2% (Slope (%))

Description of Location: At the front of the site along Dorothy Road, about 30' in from the edge of the road

2. Soil Parent Material: Glaciofluvial deposits | Depression (Landform) | BS (Position on Landscape (SU, SH, BS, FS, TS, Plain))

3. Distances from: Open Water Body >100 feet | Drainage Way >100 feet | Wetlands 270 feet | Property Line 22 feet | Drinking Water Well >100 feet | Other _____ feet

4. Unsuitable Materials Present: ☒ Yes ☐ No If Yes: ☒ Disturbed Soil/Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: _____ Depth to Weeping in Hole | 97" Depth to Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-83	Fill	Sandy Loam	10YR 3/2		Cnc : Dpl:		0	4-6	Massive	Friable	
83-104	C	Fine Sandy Loam	10YR 5/1		Cnc : Dpl:		0	0	Massive	Friable	
					Cnc : Dpl:						
					Cnc : Dpl:						
					Cnc : Dpl:						
					Cnc : Dpl:						

Additional Notes:

Shifted back a few feet because of boulder or buried piece of debris

Seemed like there may have been a second layer of sandy material below the point where groundwater broke into the hole

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D. Determination of High Groundwater Elevation

1. Method Used (Choose one):

	Obs. Hole # TP-1	Obs. Hole # TP-2
☐ Depth to soil redoximorphic features	_____ inches	_____ inches
☒ Depth to observed standing water in observation hole	108 inches	97 inches
☐ Depth to adjusted seasonal high groundwater (S_h) (USGS methodology)	_____ inches	_____ inches

Index Well Number _____ Reading Date _____

$S_h = S_c – [S_r \times (OW_c – OW_{max})/OW_r]$

Obs. Hole/Well# _____ S_c _____ S_r _____ OW_c _____ OW_{max} _____ OW_r _____ S_h _____

E. Depth of Pervious Material

1. Depth of Naturally Occurring Pervious Material

   a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

   ☐ Yes ☒ No

   b. If yes, at what depth was it observed (exclude O, A, and E Horizons)? Upper boundary: _____ inches Lower boundary: _____ inches

   c. If no, at what depth was impervious material observed? Upper boundary: 97 inches Lower boundary: 104 inches

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C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP-3 (Hole #) | 5/18/23 (Date) | 2:30PM (Time) | Clear (Weather) | 42.4' N (Latitude) | 71.2' W (Longitude)

1. Land Use: Wooded lot in residential area (e.g., woodland, agricultural field, vacant lot, etc.) | Trees (Vegetation) | Some surface stones, not many (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 6% (Slope (%))

Description of Location: At the front of the site along Dorothy Road, about 32' in from the edge of the road

2. Soil Parent Material: Glaciofluvial deposits | Depression (Landform) | BS (Position on Landscape (SU, SH, BS, FS, TS, Plain))

3. Distances from: Open Water Body >100 feet | Drainage Way >100 feet | Wetlands 280 feet | Property Line 22 feet | Drinking Water Well >100 feet | Other _____ feet

4. Unsuitable Materials Present: ☒ Yes ☐ No If Yes: ☒ Disturbed Soil/Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: _____ Depth to Weeping in Hole | 82" Depth to Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-27	Fill	Sandy Loam	10YR 2/2		Cnc : Dpl:		0	4-6	Massive	Friable	Buried A layer at 21"
27-87	C	Fine Sandy Loam	10YR 4/3	51"	Cnc : 7.5YR5/8 Dpl:		0	0	Massive	Friable	
					Cnc : Dpl:						
					Cnc : Dpl:						
					Cnc : Dpl:						
					Cnc : Dpl:						

Additional Notes:

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Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP-4 (Hole #) | 5/19/23 (Date) | 8:15AM (Time) | Clear (Weather) | 42.4' N (Latitude) | 71.2' W (Longitude)

1. Land Use: Wooded lot in residential area (e.g., woodland, agricultural field, vacant lot, etc.) | Trees (Vegetation) | Some surface stones, not many (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 6% (Slope (%))

Description of Location: At the front of the site along Dorothy Road, about 30' in from the edge of the road

2. Soil Parent Material: Glaciofluvial deposits | Depression (Landform) | TS (Position on Landscape (SU, SH, BS, FS, TS, Plain))

3. Distances from: Open Water Body >100 feet | Drainage Way >100 feet | Wetlands 310 feet | Property Line 24 feet | Drinking Water Well >100 feet | Other _____ feet

4. Unsuitable Materials Present: ☒ Yes ☐ No If Yes: ☒ Disturbed Soil/Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: 68" Depth to Weeping in Hole | 72" Depth to Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-64	Fill	Gravelly Sandy Loam	7.5YR 3/1		Cnc : Dpl:		10-15	2-4	Massive	Friable	
64-96	C	Fine Loamy Sand	10YR 4/2		Cnc : Dpl:		2-4	0	Massive	Very Friable	
					Cnc : Dpl:						
					Cnc : Dpl:						
					Cnc : Dpl:						
					Cnc : Dpl:						

Additional Notes:

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Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

D. Determination of High Groundwater Elevation

1. Method Used (Choose one):

	Obs. Hole # TP-3	Obs. Hole # TP-4
☒ Depth to soil redoximorphic features	51 inches	_____ inches
☒ Depth to observed standing water in observation hole	82 inches	68 inches
☐ Depth to adjusted seasonal high groundwater (S_h) (USGS methodology)	_____ inches	_____ inches

_____ Index Well Number

_____ Reading Date

$S_h = S_c – [S_r \times (OW_c – OW_{max})/OW_r]$

Obs. Hole/Well# _____ S_c _____ S_r _____ OW_c _____ OW_{max} _____ OW_r _____ S_h _____

E. Depth of Pervious Material

1. Depth of Naturally Occurring Pervious Material

   a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

   ☐ Yes ☒ No

   b. If yes, at what depth was it observed (exclude O, A, and E Horizons)? Upper boundary: _____ inches Lower boundary: _____ inches

   c. If no, at what depth was impervious material observed? Upper boundary: 68 inches Lower boundary: 96 inches

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C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP-5 (Hole #) | 5/19/23 (Date) | 10:30AM (Time) | Clear (Weather) | 42.4' N (Latitude) | 71.2' W (Longitude)

1. Land Use: Wooded lot in residential area (e.g., woodland, agricultural field, vacant lot, etc.) | Trees (Vegetation) | Some surface stones, not many (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 10% (Slope (%))

Description of Location: At the front of the site along Dorothy Road, about 35' in from the edge of the road

2. Soil Parent Material: Glaciofluvial deposits | Depression (Landform) | BS (Position on Landscape (SU, SH, BS, FS, TS, Plain))

3. Distances from: Open Water Body >100 feet | Drainage Way >100 feet | Wetlands 230 feet | Property Line 24 feet | Drinking Water Well >100 feet | Other _____ feet

4. Unsuitable Materials Present: ☒ Yes ☐ No If Yes: ☒ Disturbed Soil/Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: 60" Depth to Weeping in Hole | 60" Depth to Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-33	Fill	Gravelly Sandy Loam	10YR 3/2		Cnc : Dpl:		10	4-6	Massive	Friable	Buried A layer at 26"
33-74	C	Fine Sandy Loam	10YR 5/2	48"	Cnc : Dpl:		0	0	Massive	Friable	
					Cnc : Dpl:						
					Cnc : Dpl:						
					Cnc : Dpl:						
					Cnc : Dpl:						

Additional Notes:

Commonwealth of Massachusetts
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Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP-6 (Hole #) | 5/19/23 (Date) | 9:00AM (Time) | Clear (Weather) | 42.4' N (Latitude) | 71.2' W (Longitude)

1. Land Use: Wooded lot in residential area (e.g., woodland, agricultural field, vacant lot, etc.) | Trees (Vegetation) | Some surface stones, not many (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 5% (Slope (%))

Description of Location: At the front of the site along Dorothy Road, about 120' in from the edge of the road

2. Soil Parent Material: Glaciofluvial deposits | Depression (Landform) | TS (Position on Landscape (SU, SH, BS, FS, TS, Plain))

3. Distances from: Open Water Body >100 feet | Drainage Way >100 feet | Wetlands 110 feet | Property Line 12 feet | Drinking Water Well >100 feet | Other _____ feet

4. Unsuitable Materials Present: ☒ Yes ☐ No If Yes: ☒ Disturbed Soil/Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: 110" Depth to Weeping in Hole | 110" Depth to Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-30	Fill	Gravelly Sandy Loam	7.5YR 3/2		Cnc : Dpl:		10-15	4-6	Massive	Friable	
30-132	C	Fine Sandy Loam	10YR 5/2	39"	Cnc : 7.5YR5/8 Dpl:		0	0	Massive	Friable	
				64"	Cnc : 7.5YR5/8 Dpl:						Second redox band - calling ESGW here
					Cnc : Dpl:						
					Cnc : Dpl:						
					Cnc : Dpl:						

Additional Notes:

Multiple redox bands in C horizon

Top of monitoring well 1'-8" from ground surface

Commonwealth of Massachusetts
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Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

D. Determination of High Groundwater Elevation

1. Method Used (Choose one):

	Obs. Hole # TP-5	Obs. Hole # TP-6
☒ Depth to soil redoximorphic features	48 inches	64 inches
☒ Depth to observed standing water in observation hole	60 inches	110 inches
☐ Depth to adjusted seasonal high groundwater (S_h) (USGS methodology)	_____ inches	_____ inches

_____ Index Well Number _____ Reading Date

$S_h = S_c – [S_r \times (OW_c – OW_{max})/OW_r]$

Obs. Hole/Well# _____ S_c _____ S_r _____ OW_c _____ OW_{max} _____ OW_r _____ S_h _____

E. Depth of Pervious Material

1. Depth of Naturally Occurring Pervious Material

   a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

   ☐ Yes ☒ No

   b. If yes, at what depth was it observed (exclude O, A, and E Horizons)? Upper boundary: _____ inches Lower boundary: _____ inches

   c. If no, at what depth was impervious material observed? Upper boundary: 60 inches Lower boundary: 74 inches

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C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP-7 (Hole #) | 5/18/23 (Date) | 11:00AM (Time) | Clear (Weather) | 42.4' N (Latitude) | 71.2' W (Longitude)

1. Land Use: Wooded lot in residential area (e.g., woodland, agricultural field, vacant lot, etc.) | Trees (Vegetation) | Some surface stones, not many (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 3% (Slope (%))

Description of Location: At the front of the site along Dorothy Road, about 110' in from the edge of the road

2. Soil Parent Material: Glaciofluvial deposits | Depression (Landform) | BS (Position on Landscape (SU, SH, BS, FS, TS, Plain))

3. Distances from: Open Water Body >100 feet | Drainage Way >100 feet | Wetlands 190 feet | Property Line 100 feet | Drinking Water Well >100 feet | Other _____ feet

4. Unsuitable Materials Present: ☒ Yes ☐ No If Yes: ☒ Disturbed Soil/Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: _____ Depth to Weeping in Hole | 110" Depth to Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-108	Fill	Gravelly Sandy Loam	7.5YR 3/1		Cnc : Dpl:		10	4-6	Massive	Friable	
108-114	C	Fine Sandy Loam	5Y 5/1		Cnc : Dpl:		0	0	Massive	Friable	
					Cnc : Dpl:						
					Cnc : Dpl:						
					Cnc : Dpl:						
					Cnc : Dpl:						

Additional Notes:
Sand layer was completely saturated
Top of monitoring well 4'-6" from ground surface

Commonwealth of Massachusetts
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C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP-8 (Hole #) | 5/18/23 (Date) | 10:00AM (Time) | Clear (Weather) | 42.4' N (Latitude) | 71.2' W (Longitude)

1. Land Use: Wooded lot in residential area (e.g., woodland, agricultural field, vacant lot, etc.) | Trees (Vegetation) | Some surface stones, not many (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 4% (Slope (%))

Description of Location: At the front of the site along Dorothy Road, about 110' in from the edge of the road

2. Soil Parent Material: Glaciofluvial deposits | Depression (Landform) | TS (Position on Landscape (SU, SH, BS, FS, TS, Plain))

3. Distances from: Open Water Body >100 feet | Drainage Way >100 feet | Wetlands 210 feet | Property Line 98 feet | Drinking Water Well >100 feet | Other _____ feet

4. Unsuitable Materials Present: ☒ Yes ☐ No If Yes: ☒ Disturbed Soil/Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: 112" Depth to Weeping in Hole _____ Depth to Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-120	Fill	Gravelly Sandy Loam	7.5YR 3/1		Cnc : Dpl:		10	4-6	Massive	Friable	
					Cnc : Dpl:						
					Cnc : Dpl:						
					Cnc : Dpl:						
					Cnc : Dpl:						
					Cnc : Dpl:						

Additional Notes:

Commonwealth of Massachusetts
City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

D. Determination of High Groundwater Elevation

1. Method Used (Choose one):

	Obs. Hole # TP-7	Obs. Hole # TP-8
☐ Depth to soil redoximorphic features	_____ inches	_____ inches
☒ Depth to observed standing water in observation hole	110 inches	112 inches
☐ Depth to adjusted seasonal high groundwater (S_h) (USGS methodology)	_____ inches	_____ inches

Index Well Number _____ Reading Date _____

$S_h = S_c – [S_r \times (OW_c – OW_{max})/OW_r]$

Obs. Hole/Well# _____ S_c _____ S_r _____ OW_c _____ OW_{max} _____ OW_r _____ S_h _____

E. Depth of Pervious Material

1. Depth of Naturally Occurring Pervious Material

   a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

   ☐ Yes ☒ No

   b. If yes, at what depth was it observed (exclude O, A, and E Horizons)? Upper boundary: _____ inches Lower boundary: _____ inches

   c. If no, at what depth was impervious material observed? Upper boundary: 120 inches Lower boundary: 120 inches

Commonwealth of Massachusetts
City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

F. Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct soil evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.100 through 15.107.

Signature of Soil Evaluator	Date: 5/22/2023
Typed or Printed Name of Soil Evaluator / License #: Emily Derrig, SE 14158	Expiration Date of License: 6/30/2023
Name of Approving Authority Witness	Approving Authority

Note: In accordance with 310 CMR 15.018(2) this form must be submitted to the approving authority within 60 days of the date of field testing, and to the designer and the property owner with Percolation Test Form 12.

Field Diagrams: Use this area for field diagrams:

Commonwealth of Massachusetts
City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

A. Facility Information

Arlington Land Realty, LLC.
Owner Name

Dorothy Road
Street Address

16-8-2, 16-8-3, 16-8-4, 16-8-5, 16-8-6, 16-8-7A
Map/Lot #

Arlington
City

MA
State

02474
Zip Code

B. Site Information

1. (Check one) ☒ New Construction ☐ Upgrade

2. Soil Survey NRCS USDA Web Soil Survey (Source) 655 (Soil Map Unit) Udorthents, wet substratum (Soil Series)

Depressions
Landform

Soil Limitations

Loamy alluvium and/or sandy glaciofluvial deposits and/or loamy glaciolacustrine deposites and/or loamy marine deposits and/or loamy basal till and/or loamy lodgment till
Soil Parent material

3. Surficial Geological Report 2018/USGS (Year Published/Source) Artificial fill, glaciomarine fine deposits, stagnant ice deposits (Map Unit)

Fine/very fine sand down to very fine sand, silt, silty clay, and clay
Description of Geologic Map Unit:

4. Flood Rate Insurance Map Within a regulatory floodway? ☐ Yes ☒ No

5. Within a velocity zone? ☐ Yes ☒ No

6. Within a Mapped Wetland Area? ☐ Yes ☒ No If yes, MassGIS Wetland Data Layer: (Wetland Type)

7. Current Water Resource Conditions (USGS): April 17, 2024 (Month/Day/ Year) Range: ☐ Above Normal ☒ Normal ☐ Below Normal

8. Other references reviewed: (Zone II, IWPA, Zone A, EEA Data Portal, etc.) Not in Zone II or IWPA (MassMapper)

Commonwealth of Massachusetts
City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP-9 (Hole #) | 4/17/24 (Date) | 8:30AM (Time) | Clear, 50 (Weather) | 42.4' N (Latitude) | 71.2' W (Longitude)

1. Land Use: Wooded lot in residential area (e.g., woodland, agricultural field, vacant lot, etc.) | Trees (Vegetation) | Some surface stones, not many (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 7% (Slope (%))

Description of Location: Center of proposed infiltration system (large); between TP-7 and TP-8; about 110 feet from Dorothy Road

2. Soil Parent Material: Glaciofluvial deposits | Depression (Landform) | FS (Position on Landscape (SU, SH, BS, FS, TS, Plain))

3. Distances from: Open Water Body >100 feet | Drainage Way >100 feet | Wetlands 205 feet | Property Line 110 feet | Drinking Water Well >100 feet | Other _____ feet

4. Unsuitable Materials Present: ☒ Yes ☐ No If Yes: ☒ Disturbed Soil/Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: 90" Depth to Weeping in Hole | 116" Depth to Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-100	Fill	Sandy Loam	7.5YR 4/7		Cnc : Dpl:		0	4-6	Massive	Friable	
100-118	C	Fine Sandy Loam	10YR 4/1		Cnc : Dpl:		0	0	Massive	Friable	
					Cnc : Dpl:						
					Cnc : Dpl:						
					Cnc : Dpl:						
					Cnc : Dpl:						

Additional Notes: Installed monitoring well; groundwater weeping from side of pit and standing water at bottom of pit

Commonwealth of Massachusetts
City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP-10 (Hole #) | 4/17/24 (Date) | 10:00 AM (Time) | Clear, 50 (Weather) | 42.4' N (Latitude) | 71.2' W (Longitude)

1. Land Use: Wooded lot in residential area (e.g., woodland, agricultural field, vacant lot, etc.) | Trees (Vegetation) | Some surface stones, not many (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 3% (Slope (%))

Description of Location: Northwest corner of infiltration system; about 100' from Dorothy Road

2. Soil Parent Material: Glaciofluvial deposits | Depression (Landform) | BS (Position on Landscape (SU, SH, BS, FS, TS, Plain))

3. Distances from: Open Water Body >100 feet | Drainage Way >100 feet | Wetlands 250 feet | Property Line 79 feet | Drinking Water Well >100 feet | Other _____ feet

4. Unsuitable Materials Present: ☒ Yes ☐ No If Yes: ☒ Disturbed Soil/Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: 94" Depth to Weeping in Hole | 126" Depth to Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-130	Fill	Sandy Loam	7.5YR 4/2		Cnc : Dpl:		0	4-6	Massive	Friable	
					Cnc : Dpl:						
					Cnc : Dpl:						
					Cnc : Dpl:						
					Cnc : Dpl:						
					Cnc : Dpl:						

Additional Notes: Groundwater weeping from side of hole and standing water at bottom of pit; debris and construction material present throughout fill

Commonwealth of Massachusetts
City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

D. Determination of High Groundwater Elevation

1. Method Used (Choose one):	Obs. Hole # TP-9	Obs. Hole # TP-10
☐ Depth to soil redoximorphic features	_____ inches	_____ inches
☒ Depth to observed standing water in observation hole	90 inches	94 inches
☐ Depth to adjusted seasonal high groundwater (S_h) (USGS methodology)	_____ inches	_____ inches

_____ Index Well Number _____ Reading Date

$S_h = S_c – [S_r \times (OW_c – OW_{max})/OW_r]$

Obs. Hole/Well# _____ S_c _____ S_r _____ OW_c _____ OW_{max} _____ OW_r _____ S_h _____

E. Depth of Pervious Material

1. Depth of Naturally Occurring Pervious Material

   a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

      ☐ Yes ☒ No

   b. If yes, at what depth was it observed (exclude O, A, and E Horizons)? Upper boundary: _____ inches Lower boundary: _____ inches

   c. If no, at what depth was impervious material observed? Upper boundary: 90 inches Lower boundary: 118 inches

Commonwealth of Massachusetts
City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP-11 (Hole #) | 4/17/24 (Date) | 10:45AM (Time) | Clear, 55 (Weather) | 42.4' N (Latitude) | 71.2' W (Longitude)

1. Land Use: Wooded lot in residential area (e.g., woodland, agricultural field, vacant lot, etc.) | Trees (Vegetation) | Some surface stones, not many (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 6% (Slope (%))

Description of Location: Southwest corner of infiltration system; about 135' from Dorothy Road

2. Soil Parent Material: Glaciofluvial deposits | Depression (Landform) | FS (Position on Landscape (SU, SH, BS, FS, TS, Plain))

3. Distances from: Open Water Body >100 feet | Drainage Way >100 feet | Wetlands 215 feet | Property Line 46 feet | Drinking Water Well >100 feet | Other _____ feet

4. Unsuitable Materials Present: ☒ Yes ☐ No If Yes: ☒ Disturbed Soil/Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: 93" Depth to Weeping in Hole | 111" Depth to Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-114	Fill	Sandy Loam	7.5YR 4/2		Cnc : Dpl:		0	4-6	Massive	Friable	
					Cnc : Dpl:						
					Cnc : Dpl:						
					Cnc : Dpl:						
					Cnc : Dpl:						
					Cnc : Dpl:						

Additional Notes:

Commonwealth of Massachusetts
City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP-12 (Hole #) | 4/17/24 (Date) | 11:30AM (Time) | Clear, 55 (Weather) | 42.4' N (Latitude) | 71.2' W (Longitude)

1. Land Use: Wooded lot in residential area (e.g., woodland, agricultural field, vacant lot, etc.) | Trees (Vegetation) | Some surface stones, not many (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 3% (Slope (%))

Description of Location: Northeast corner of infiltration system; about 95' from Dorothy Road

2. Soil Parent Material: Glaciofluvial deposits | Depression (Landform) | FS (Position on Landscape (SU, SH, BS, FS, TS, Plain))

3. Distances from: Open Water Body >100 feet | Drainage Way >100 feet | Wetlands 215 feet | Property Line 92 feet | Drinking Water Well >100 feet | Other _____ feet

4. Unsuitable Materials Present: ☒ Yes ☐ No If Yes: ☒ Disturbed Soil/Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: 53" Depth to Weeping in Hole | 68" Depth to Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-76	Fill	Sandy Loam	7.5YR 3/2		Cnc : Dpl:		0	50	Massive	Friable	
					Cnc : Dpl:						
					Cnc : Dpl:						
					Cnc : Dpl:						
					Cnc : Dpl:						
					Cnc : Dpl:						

Additional Notes: Larger cobbles/boulders throughout test pit

Commonwealth of Massachusetts
City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

D. Determination of High Groundwater Elevation

1. Method Used (Choose one):

	Obs. Hole # TP-11	Obs. Hole # TP-12
☐ Depth to soil redoximorphic features	_____ inches	_____ inches
☒ Depth to observed standing water in observation hole	93 inches	53 inches
☐ Depth to adjusted seasonal high groundwater (S_h) (USGS methodology)	_____ inches	_____ inches

Index Well Number _____ Reading Date _____

$S_h = S_c – [S_r \times (OW_c – OW_{max})/OW_r]$

Obs. Hole/Well# _____ S_c _____ S_r _____ OW_c _____ OW_{max} _____ OW_r _____ S_h _____

E. Depth of Pervious Material

1. Depth of Naturally Occurring Pervious Material

   a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

   ☐ Yes ☒ No

   b. If yes, at what depth was it observed (exclude O, A, and E Horizons)? Upper boundary: _____ inches Lower boundary: _____ inches

   c. If no, at what depth was impervious material observed? Upper boundary: 53 inches Lower boundary: 76 inches

Commonwealth of Massachusetts
City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP-13 (Hole #) | 4/17/24 (Date) | 11:45AM (Time) | Clear, 55 (Weather) | 42.4' N (Latitude) | 71.2' W (Longitude)

1. Land Use: Wooded lot in residential area (e.g., woodland, agricultural field, vacant lot, etc.) | Trees (Vegetation) | Some surface stones, not many (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 1% (Slope (%))

Description of Location: Southeast corner of infiltration system; about 135' from Dorothy Road

2. Soil Parent Material: Glaciofluvial deposits | Depression (Landform) | TS (Position on Landscape (SU, SH, BS, FS, TS, Plain))

3. Distances from: Open Water Body >100 feet | Drainage Way >100 feet | Wetlands 180 feet | Property Line 130 feet | Drinking Water Well >100 feet | Other _____ feet

4. Unsuitable Materials Present: ☒ Yes ☐ No If Yes: ☒ Disturbed Soil/Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: 57" Depth to Weeping in Hole | 67" Depth to Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-74	Fill	Sandy Loam	7.5YR 3/2		Cnc : Dpl:	5-10	0	10-20	Massive	Friable	
					Cnc : Dpl:						
					Cnc : Dpl:						
					Cnc : Dpl:						
					Cnc : Dpl:						
					Cnc : Dpl:						

Additional Notes:

Commonwealth of Massachusetts
City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

D. Determination of High Groundwater Elevation

1. Method Used (Choose one):

	Obs. Hole # TP-13	Obs. Hole # _____
☐ Depth to soil redoximorphic features	_____ inches	_____ inches
☒ Depth to observed standing water in observation hole	57 inches	_____ inches
☐ Depth to adjusted seasonal high groundwater (S_h) (USGS methodology)	_____ inches	_____ inches

_____ Index Well Number _____ Reading Date

$S_h = S_c – [S_r \times (OW_c – OW_{max})/OW_r]$

Obs. Hole/Well# _____ S_c _____ S_r _____ OW_c _____ OW_{max} _____ OW_r _____ S_h _____

E. Depth of Pervious Material

1. Depth of Naturally Occurring Pervious Material

   a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

   ☐ Yes ☒ No

   b. If yes, at what depth was it observed (exclude O, A, and E Horizons)? Upper boundary: _____ inches Lower boundary: _____ inches

   c. If no, at what depth was impervious material observed? Upper boundary: 57 inches Lower boundary: 74 inches

Commonwealth of Massachusetts
City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

F. Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct soil evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.100 through 15.107.

Signature of Soil Evaluator	Date: 4/17/2024
Typed or Printed Name of Soil Evaluator / License #: Emily Derrig, SE 14158	Expiration Date of License: 6/30/2026
Name of Approving Authority Witness	Approving Authority

Note: In accordance with 310 CMR 15.018(2) this form must be submitted to the approving authority within 60 days of the date of field testing, and to the designer and the property owner with Percolation Test Form 12.

Field Diagrams: Use this area for field diagrams:

APPENDIX E

NOAA 14++ PRECIPITATION TABLES

NOAA Atlas 14, Volume 10, Version 3
Location name: Arlington, Massachusetts, USA*
Latitude: 42.4008°, Longitude: -71.1485°
Elevation: 5 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sandra Pavlovic, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Orlan Wilhite

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

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

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.303** (0.237-0.383)	**0.372** (0.290-0.471)	**0.484** (0.377-0.617)	**0.578** (0.447-0.739)	**0.706** (0.530-0.954)	**0.802** (0.590-1.11)	**0.905** (0.649-1.31)	**1.03** (0.691-1.52)	**1.21** (0.784-1.86)	**1.36** (0.864-2.14)
10-min	**0.429** (0.335-0.543)	**0.527** (0.411-0.668)	**0.687** (0.535-0.874)	**0.819** (0.633-1.05)	**1.00** (0.751-1.35)	**1.14** (0.837-1.58)	**1.28** (0.919-1.86)	**1.46** (0.979-2.15)	**1.71** (1.11-2.63)	**1.93** (1.22-3.03)
15-min	**0.505** (0.395-0.639)	**0.620** (0.484-0.785)	**0.808** (0.628-1.03)	**0.963** (0.745-1.23)	**1.18** (0.884-1.59)	**1.34** (0.983-1.85)	**1.51** (1.08-2.18)	**1.71** (1.15-2.52)	**2.02** (1.31-3.09)	**2.28** (1.44-3.56)
30-min	**0.690** (0.540-0.874)	**0.849** (0.663-1.08)	**1.11** (0.862-1.41)	**1.32** (1.02-1.70)	**1.62** (1.22-2.19)	**1.84** (1.36-2.55)	**2.08** (1.49-3.02)	**2.36** (1.59-3.48)	**2.80** (1.81-4.29)	**3.17** (2.01-4.96)
60-min	**0.876** (0.685-1.11)	**1.08** (0.842-1.37)	**1.41** (1.10-1.79)	**1.68** (1.30-2.16)	**2.06** (1.55-2.79)	**2.34** (1.73-3.25)	**2.64** (1.90-3.85)	**3.01** (2.03-4.44)	**3.58** (2.32-5.49)	**4.06** (2.57-6.37)
2-hr	**1.14** (0.896-1.43)	**1.40** (1.10-1.77)	**1.84** (1.44-2.32)	**2.20** (1.71-2.79)	**2.69** (2.04-3.62)	**3.06** (2.27-4.22)	**3.46** (2.51-5.01)	**3.96** (2.67-5.79)	**4.74** (3.08-7.21)	**5.43** (3.45-8.42)
3-hr	**1.33** (1.05-1.66)	**1.63** (1.29-2.05)	**2.14** (1.68-2.69)	**2.56** (2.00-3.24)	**3.13** (2.38-4.20)	**3.55** (2.65-4.90)	**4.02** (2.93-5.81)	**4.61** (3.12-6.70)	**5.54** (3.60-8.36)	**6.35** (4.04-9.79)
6-hr	**1.72** (1.37-2.14)	**2.11** (1.68-2.63)	**2.76** (2.18-3.44)	**3.29** (2.59-4.14)	**4.02** (3.07-5.34)	**4.56** (3.42-6.22)	**5.15** (3.77-7.37)	**5.90** (4.01-8.50)	**7.06** (4.61-10.6)	**8.08** (5.16-12.3)
12-hr	**2.20** (1.76-2.71)	**2.69** (2.15-3.33)	**3.50** (2.79-4.34)	**4.17** (3.31-5.21)	**5.10** (3.92-6.71)	**5.78** (4.35-7.80)	**6.52** (4.79-9.21)	**7.44** (5.08-10.6)	**8.85** (5.80-13.1)	**10.1** (6.45-15.2)
24-hr	**2.64** (2.13-3.24)	**3.27** (2.64-4.02)	**4.31** (3.46-5.31)	**5.16** (4.12-6.40)	**6.34** (4.91-8.30)	**7.21** (5.47-9.67)	**8.16** (6.03-11.5)	**9.35** (6.41-13.2)	**11.2** (7.36-16.4)	**12.8** (8.22-19.1)
2-day	**3.01** (2.45-3.67)	**3.80** (3.09-4.64)	**5.10** (4.13-6.24)	**6.18** (4.97-7.61)	**7.66** (5.97-9.97)	**8.74** (6.69-11.7)	**9.94** (7.43-13.9)	**11.5** (7.91-16.1)	**14.0** (9.23-20.3)	**16.2** (10.4-23.9)
3-day	**3.30** (2.70-4.01)	**4.16** (3.39-5.05)	**5.56** (4.52-6.78)	**6.72** (5.43-8.24)	**8.32** (6.52-10.8)	**9.48** (7.29-12.6)	**10.8** (8.09-15.1)	**12.5** (8.60-17.4)	**15.2** (10.1-21.9)	**17.7** (11.4-25.9)
4-day	**3.58** (2.93-4.33)	**4.46** (3.65-5.41)	**5.91** (4.82-7.18)	**7.11** (5.76-8.69)	**8.76** (6.88-11.3)	**9.96** (7.68-13.2)	**11.3** (8.51-15.7)	**13.1** (9.02-18.1)	**15.9** (10.5-22.8)	**18.4** (11.9-26.9)
7-day	**4.34** (3.58-5.23)	**5.26** (4.33-6.34)	**6.77** (5.55-8.18)	**8.02** (6.53-9.74)	**9.74** (7.68-12.5)	**11.0** (8.50-14.4)	**12.4** (9.33-17.0)	**14.2** (9.85-19.5)	**17.1** (11.4-24.3)	**19.7** (12.7-28.5)
10-day	**5.04** (4.17-6.05)	**5.99** (4.95-7.19)	**7.54** (6.20-9.07)	**8.82** (7.21-10.7)	**10.6** (8.37-13.5)	**11.9** (9.20-15.5)	**13.3** (10.0-18.1)	**15.1** (10.5-20.7)	**18.0** (12.0-25.4)	**20.5** (13.3-29.5)
20-day	**7.05** (5.88-8.40)	**8.08** (6.73-9.63)	**9.76** (8.09-11.7)	**11.2** (9.19-13.4)	**13.1** (10.4-16.4)	**14.5** (11.2-18.6)	**16.0** (12.0-21.2)	**17.8** (12.5-24.0)	**20.3** (13.6-28.4)	**22.4** (14.6-32.0)
30-day	**8.72** (7.30-10.3)	**9.81** (8.20-11.6)	**11.6** (9.65-13.8)	**13.1** (10.8-15.6)	**15.1** (12.0-18.7)	**16.7** (12.9-21.1)	**18.3** (13.6-23.8)	**19.9** (14.0-26.8)	**22.2** (14.9-30.9)	**24.0** (15.7-34.0)
45-day	**10.8** (9.08-12.7)	**12.0** (10.0-14.1)	**13.9** (11.6-16.4)	**15.4** (12.8-18.4)	**17.6** (14.0-21.6)	**19.3** (14.9-24.1)	**20.9** (15.5-26.9)	**22.6** (15.9-30.1)	**24.6** (16.6-33.9)	**26.2** (17.1-36.8)
60-day	**12.6** (10.6-14.8)	**13.8** (11.6-16.2)	**15.8** (13.2-18.6)	**17.4** (14.5-20.7)	**19.7** (15.7-24.0)	**21.4** (16.6-26.7)	**23.1** (17.1-29.5)	**24.7** (17.5-32.8)	**26.7** (18.0-36.6)	**28.0** (18.3-39.2)

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

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

Please refer to NOAA Atlas 14 document for more information.

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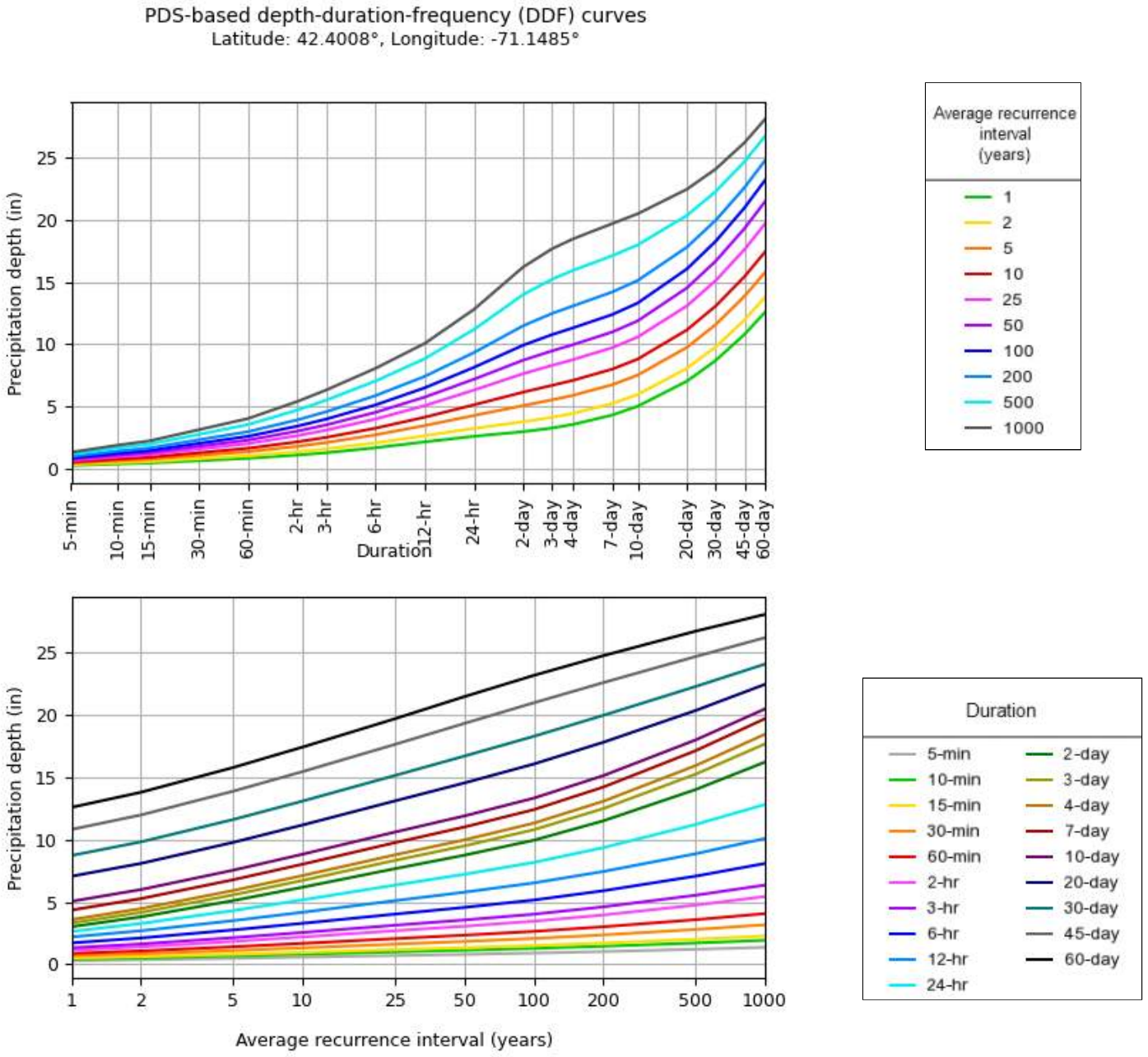
PF graphical



NOAA Atlas 14, Volume 10, Version 3

Created (GMT): Fri Aug 11 18:14:24 2023

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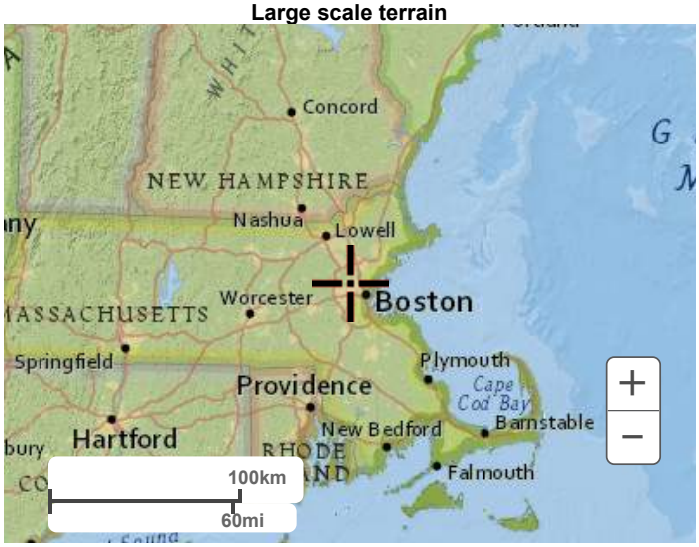
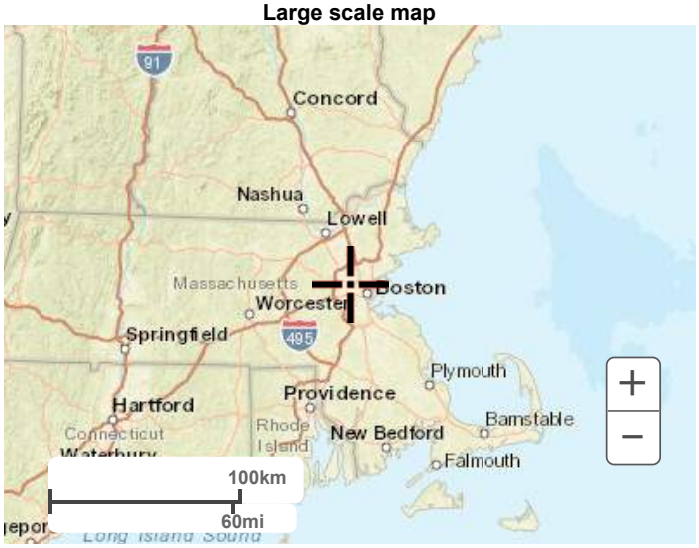
Maps & aerials

Small scale terrain

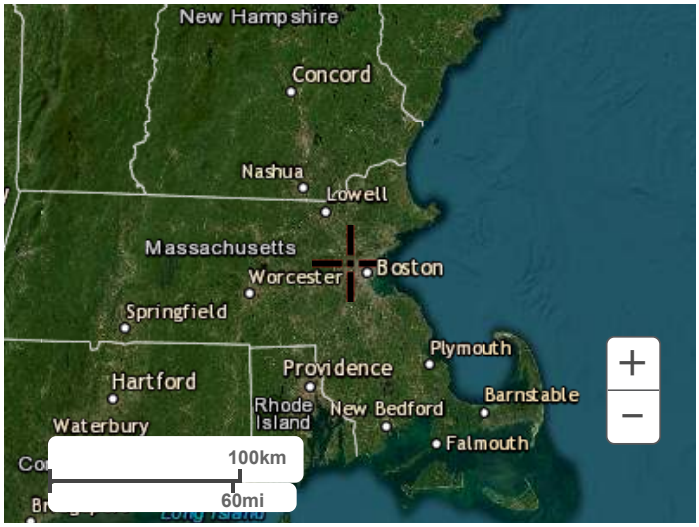
Large scale terrain



Large scale map



Large scale aerial



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National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
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Questions?: HDSC.Questions@noaa.gov

Disclaimer

APPENDIX F

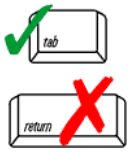
STORMWATER CHECKLIST

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

Checklist for Stormwater Report

A. Introduction

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



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

The Stormwater Report must include:

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

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

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

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

---

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

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

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

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature

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 G

MCPHAIL GEOTECHNICAL MEMORANDUM

Memorandum

Date:	December 9, 2024
Recipient:	Arlington Land Manager LLC c/o Dinosaur Capital Partners LLC – Scott Oran
Sender:	Scott S. Smith, P.E.
Project:	Thorndike Place; Arlington, MA
Project No:	7679.2.01
Subject:	Subsurface Conditions at Proposed Stormwater Infiltration System

Background

This memorandum documents the subsurface soil and groundwater conditions encountered in the borings performed at the Thorndike Place project site during November 2024. The purpose of the borings was to provide supplemental information to the project civil engineer related to stormwater infiltration system design, including the saturated soil thickness within the footprint of the proposed stormwater infiltration system.

The 5.8-acre subject property is bounded by Dorothy Road and residences to the north, residences and undeveloped conservation land to the east, undeveloped conservation land to the south and the Concord Turnpike (Route 2) to the west. The subject property is currently unoccupied, undeveloped wooded land. Refer to the Project Location Plan, **Figure 1**, for the general site locus.

Based on the information provided to us, the proposed development is planned to consist of six (6), 3-story townhouses with footprints of about 1,700 square feet that are planned to include basements, and a 4-story multi-family residential building with a footprint of about 33,000 square feet that is planned to have 1-level of below-grade parking.

It is understood that as part of the proposed development, a stormwater infiltration system with a footprint of about 8,100 square feet will be constructed within the western portion of the site.

Elevations cited herein are in feet and are referenced to the North American Vertical Datum of 1988 (NAVD88).

Subsurface Explorations

The approximate locations of the subsurface explorations are indicated on the enclosed Subsurface Exploration Plan, **Figure 2**. The following subsurface explorations were completed at the project site under contract to McPhail:

- Two (2) borings (MA-1 through MA-2) were completed on November 20, 2024 by Carr-Dee Corp. of Medford, Massachusetts.

The borings were drilled to depths ranging from 37 to 42 feet below the existing ground surface and were terminated within a natural marine clay deposit. The boring logs are attached to this memorandum.

Thirteen (13) test pits were previously excavated at the site by others during May 2023 and April 2024. Additionally, four (4) groundwater monitoring wells were installed within completed test pits TP-1, TP-6, TP-7, and TP-9.

Soil Conditions

A detailed description of the subsurface conditions encountered in the explorations is documented on the boring logs attached to this memorandum. The approximate locations of the subsurface explorations are indicated on the enclosed Subsurface Exploration Plan, **Figure 2**.

Based on the results of the borings performed at the site, the following is a description of the generalized subsurface conditions encountered from ground surface downward.

Generalized Subsurface Strata	***Approximate Thickness (Feet)***	***Top of Soil Strata (Elevation)***
Fill	5.5 to 9.5	El. +7.9 to El. +11.1 (Ground Surface)
Peat	2.5 (At boring MA-2 only)	El. +2.4
Alluvium	12 to 19	El. -0.1 to El. +1.6
Marine Clay	Not Penetrated	El. -17.4 to El. -12.1

Fill Material: The fill material generally consists of compact to dense sand and gravel, trace to some silt, varying to a silt and sand, trace gravel and containing brick, wood, ash and cinders.

Organic Deposit: Underlying the fill at boring MA-2, the organic deposit generally consists of soft to firm, brown fibrous peat. The organic deposit was not encountered in boring MA-1 and appears to be discontinuous between MA-1 and MA-2.

Alluvium Deposit: Underlying the fill at boring MA-1 and the organic deposit at boring MA-2, the alluvium deposit generally consists of a compact to dense gray-brown stratified silty sand, varying to sand, trace silt.

Marine Clay Deposit: Underlying the alluvium deposit, the marine clay deposit generally consists of a very soft to stiff, gray silty marine clay deposit with occasional to frequent sand lenses of varying thickness. At boring MA-2, an approximate 2.5-foot-thick sand seam was observed from about Elevation -13.1 to Elevation -15.6. The depth to the top of the marine clay deposit was observed at about 28.5 feet and 20 feet below the existing ground surface at MA-1 and MA-2, respectively. The borings were terminated within the marine clay deposit which is anticipated to extend to depths greater than 100 feet below the existing ground surface and be underlain by glacial till and bedrock.

Groundwater Conditions

Where encountered in the borings during drilling, groundwater was observed at depths ranging from about 12 and 11 feet below the existing ground surface at boring MA-1 and MA-2, corresponding to Elevation -0.9 and Elevation -3.1, respectively.

It is anticipated that future groundwater levels across the site may vary from those reported herein due to factors such as normal seasonal changes, runoff particularly during or following periods of heavy precipitation, and alterations of existing drainage patterns.

Summary and Conclusions

The subsurface soil conditions in borings MA-1 and MA-2 consisted of a granular fill material, underlain by a discontinuous peat deposit, underlain by an alluvium deposit, overlying a marine clay deposit. The depth to the top of the marine clay deposit was observed at about 28.5 feet and 20 feet below the existing ground surface, corresponding to Elevation -17.4 and Elevation -12.1 at MA-1 and MA-2, respectively. The marine clay deposit is anticipated to have a low permeability and would be considered a barrier to groundwater flow, typically signifying the bottom of the permeable soils.

Closing

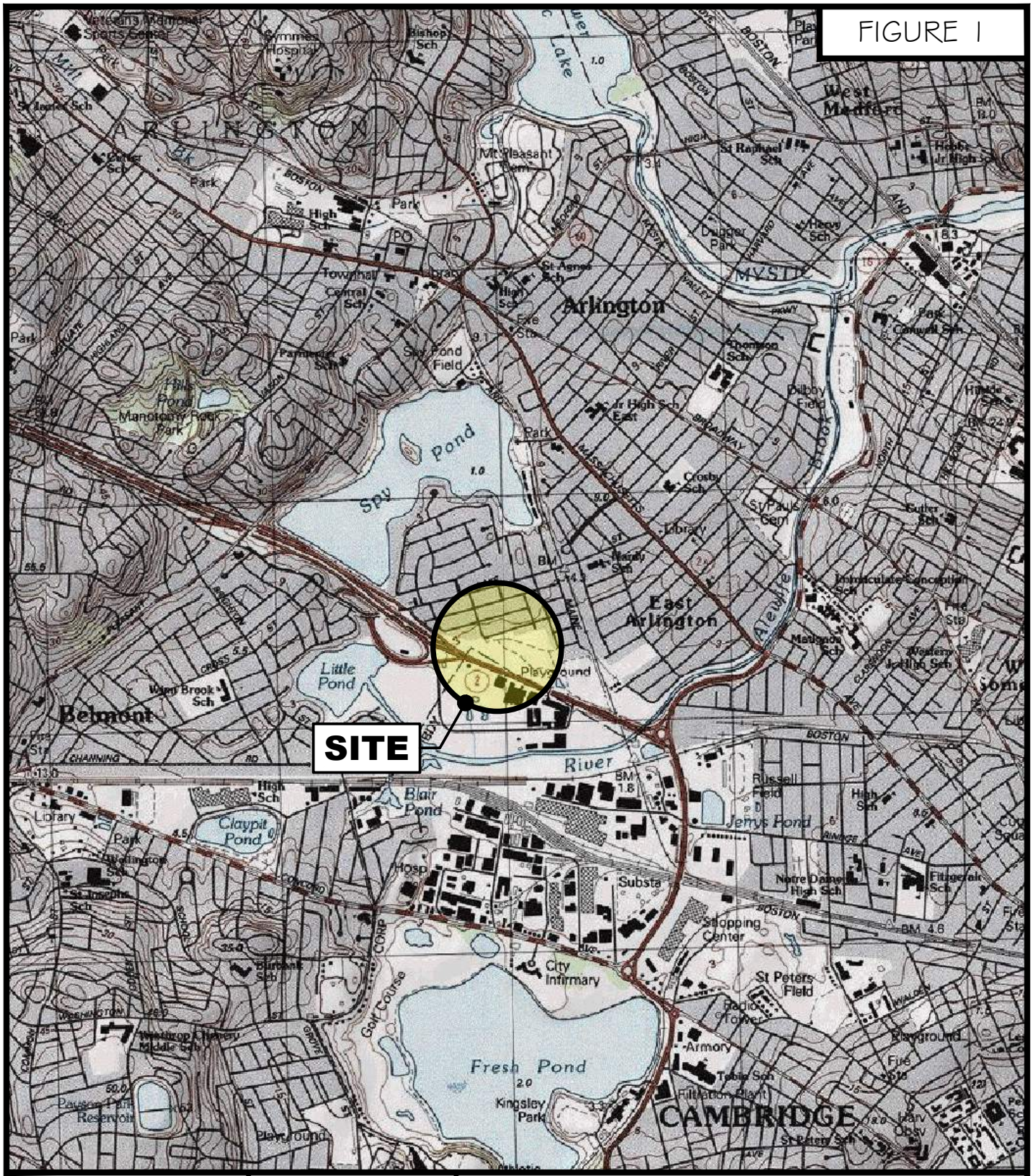
We trust that the above is sufficient for your present requirements. Should you have any questions concerning the recommendations presented herein, please do not hesitate to contact us.

N:\Working Documents\Jobs\7679 - Thorndike Place\Geotechnical Data Report\7679_ThorndikePlace_GeotechnicalData_Memo-rev2 120924.docx
SSS/ada

Attachments: Figure 1: Project Location Plan
Figure 2: Subsurface Exploration Plan
Boring Logs

GEOTECHNICAL AND GEOENVIRONMENTAL ENGINEERS
42 3rd Avenue
Burlington, MA 01803
(617) 868-1420

FIGURE 1



McPHAIL ASSOCIATES, LLC
42 3rd Avenue
Burlington, MA 01803
617-868-1420
www.mcphailgeo.com

N

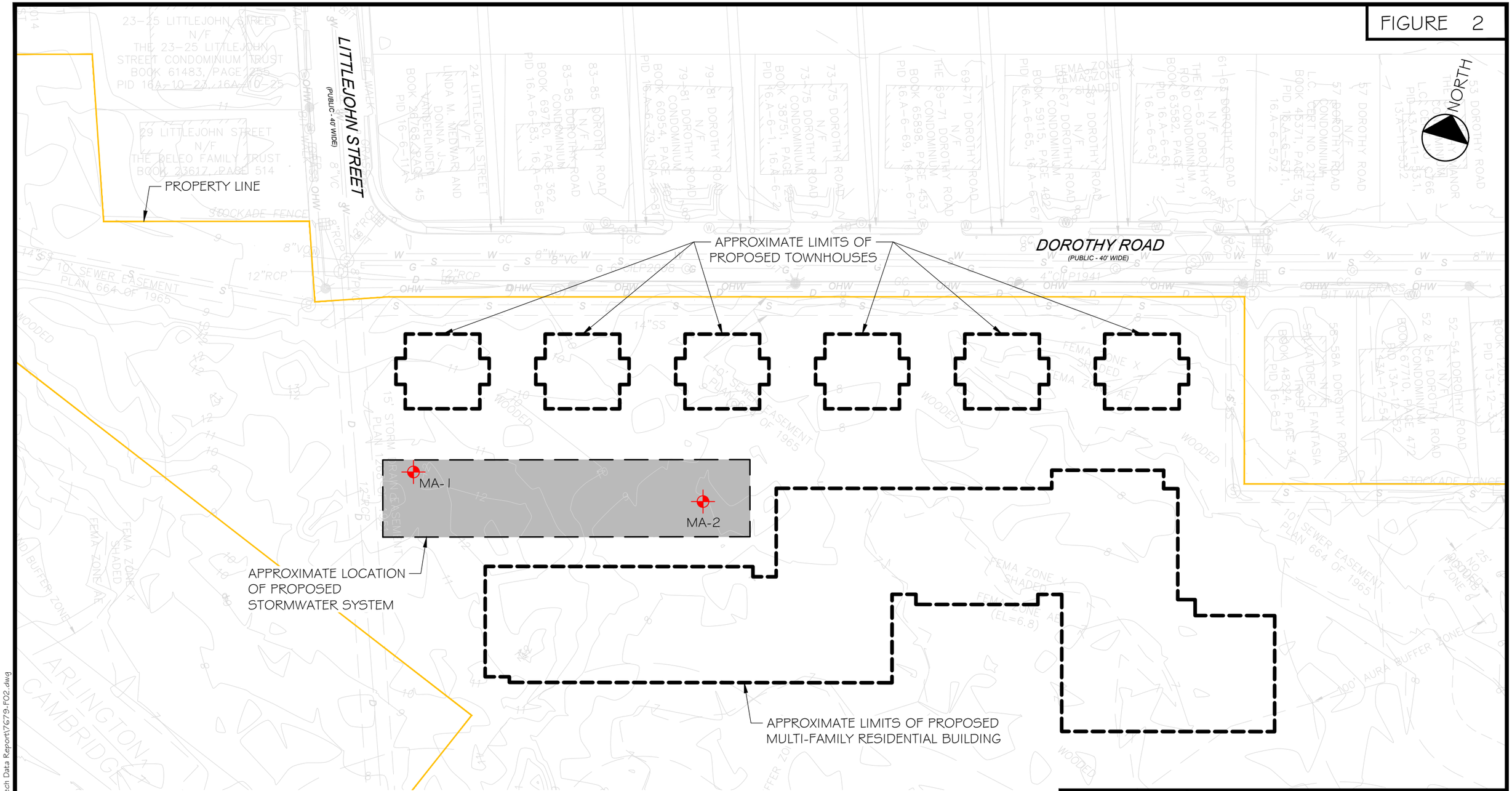
SCALE 1:25,000

PROJECT LOCATION PLAN

THORNDIKE PLACE

ARLINGTON MASSACHUSETTS

FIGURE 2



LEGEND

— APPROXIMATE LOCATION OF BOREHOLE PERFORMED BY CARR-DEE CORP. ON NOVEMBER 20, 2024 FOR McPHAIL ASSOCIATES, LLC

REFERENCE: THIS PLAN WAS PREPARED FROM AN 80-SCALE DRAWING ENTITLED "EXISTING CONDITIONS" DATED SEPTEMBER 6, 2023 BY BSC GROUP, INC.

GRAPHIC SCALE

50 0 50 100

McPHAIL ASSOCIATES, LLC
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THORNDIKE PLACE

ARLINGTON MASSACHUSETTS

SUBSURFACE EXPLORATION PLAN

FOR

DINOSAUR CAPITAL PARTNERS LLC

BY

McPHAIL ASSOCIATES, LLC

Date: DECEMBER 2024	Dwn: I.J.M.	Chkd: S.S.S.	Scale: 1" = 50'
Project No: 7679			

FILE NAME: N:\AcadJOBS\7679\Geotech Data Report\7679-F02.dwg

Project:	Thorndike Place	**Job #:**	7679.2.01
Location:	See Plan	**Date Started:**	11-20-24
City/State:	Arlington, Massachusetts	**Date Finished:**	11-20-24

Boring No.

MA-1

Contractor: Carr-Dee Corp
Driller/Helper: J. DeSimone/C. Smith
Logged By/Reviewed By: T. M. Cormican
Surface Elevation (ft): 11.1

Casing Type/Depth (ft): 2.25" I.D. HSA/NW Casing
Casing Hammer (lbs)/Drop (in): 300 lbs./24 inches
Sampler Size/Type: 1-3/8" I.D. Split Spoon
Sampler Hammer (lbs)/Drop (in): 140 lbs./30 inches

Groundwater Observations

Date	Depth	Elev.	Notes
11-20-24	12	-0.9	

Depth (ft)	Elev. (ft)	Symbol	Depth/EL to Strata Change (ft)	Stratum	Sample N-Value	Sample No.	Sample Pen./Rec. (in)	Sample Depth (ft)	Sample Blows Per 6"	Sample Description and Boring Notes
1	10			FILL	12	S-1	24/8	0.0-2.0	3 5 7 12	Compact light brown silty SAND and GRAVEL. (FILL)
2	9									
3	8									
4	7									
5	6				70	S-2	24/16	5.0-7.0	14 37 33 49	Very dense, gray-brown SAND and GRAVEL, trace to some silt to BRICK. (FILL)
6	5									
7	4									
8	3									
9	2		9.5 / 1.6							
10	1			ALLUVIUM DEPOSIT	19	S-3	24/0	10.0-12.0	16 12 7 14	No Recovery
11	0				45	S-4	24/14	12.0-14.0	14 23 22 20	Dense, dark gray SAND, trace to some silt. (ALLUVIUM DEPOSIT)
12	-1									
13	-2									
14	-3									
15	-4				23	S-5	24/12	15.0-17.0	9 12 11 12	Compact, gray-brown SAND, trace silt. (ALLUVIUM DEPOSIT)
16	-5									
17	-6									
18	-7									
19	-8									
20	-9				17	S-6	24/18	20.0-22.0	8 8 9 12	Compact, orange-brown and yellow-brown stratified silty SAND to SAND, trace silt. (ALLUVIUM DEPOSIT)
21	-10									
22	-11									

GRANULAR SOILS	
BLOWS/FT.	DENSITY
0-4	V.LOOSE
4-10	LOOSE
10-30	COMPACT
30-50	DENSE
>50	V.DENSE

COHESIVE SOILS	
BLOWS/FT.	CONSISTENCY
<2	V.SOFT
2-4	SOFT
4-8	FIRM
8-15	STIFF
15-30	V.STIFF
>30	HARD

SOIL COMPONENT

DESCRIPTIVE TERM	PROPORTION OF TOTAL
"TRACE"	0-10%
"SOME"	10-20%
"ADJECTIVE" (eg SANDY, SILTY)	20-35%
"AND"	35-50%

SOIL CONTAINING THREE COMPONENTS EACH OF WHICH COMPRISE AT LEAST 25% OF THE TOTAL ARE CLASSIFIED AS "A WELL-GRADED MIXTURE OF"

Notes:
1. Used Automatic Hammer for SPT.
2. Drillers switched to casing after obtaining sample from 12-14'.

Weather: Variable

McPHAIL ASSOCIATES, LLC
42 3rd AVENUE
Burlington, MA 01803
TEL: 617-868-1420
FAX: 617-868-1423

Project: Thorndike Place
Location: See Plan
City/State: Arlington, Massachusetts

Job #: 7679.2.01
Date Started: 11-20-24
Date Finished: 11-20-24

Boring No.

MA-1

Contractor: Carr-Dee Corp
Driller/Helper: J. DeSimone/C. Smith
Logged By/Reviewed By: T. M. Cormican
Surface Elevation (ft): 11.1

Casing Type/Depth (ft): 2.25" I.D. HSA/NW Casing
Casing Hammer (lbs)/Drop (in): 300 lbs./24 inches
Sampler Size/Type: 1-3/8" I.D. Split Spoon
Sampler Hammer (lbs)/Drop (in): 140 lbs./30 inches

Groundwater Observations

Date	Depth	Elev.	Notes
11-20-24	12	-0.9	

Depth (ft)	Elev. (ft)	Symbol	Depth/EL to Strata Change (ft)	Stratum	Sample N-Value	Sample No.	Sample Pen./Rec. (in)	Sample Depth (ft)	Sample Blows Per 6"	Sample Description and Boring Notes
24	-13									
25	-14			ALLUVIUM DEPOSIT	33	S-7	24/18	25.0-27.0	19 17 16 15	Dense, gray stratified silty SAND to SAND, trace silt. (ALLUVIUM DEPOSIT)
26	-15									
27	-16									
28	-17		28.5 / -17.4							
29	-18			MARINE CLAY						
30	-19				9	S-8	24/18	30.0-32.0	3 4 5 3	Stiff, gray silty CLAY with ~ 6 inch layer of sand. (MARINE CLAY)
31	-20									
32	-21									
33	-22									
34	-23									
35	-24									
36	-25				1/24"	S-9	24/22	35.0-37.0	1/24"	Very soft, gray silty CLAY. (MARINE CLAY)
37	-26		37.0 / -25.9	Bottom of Borehole at 37.0 feet below existing grade.						
38	-27									
39	-28									
40	-29									
41	-30									
42	-31									
43	-32									
44	-33									
45	-34									

GRANULAR SOILS	
BLOWS/FT.	DENSITY
0-4	V.LOOSE
4-10	LOOSE
10-30	COMPACT
30-50	DENSE
>50	V.DENSE

COHESIVE SOILS	
BLOWS/FT.	CONSISTENCY
<2	V.SOFT
2-4	SOFT
4-8	FIRM
8-15	STIFF
15-30	V.STIFF
>30	HARD

SOIL COMPONENT

DESCRIPTIVE TERM	PROPORTION OF TOTAL
"TRACE"	0-10%
"SOME"	10-20%
"ADJECTIVE" (eg SANDY, SILTY)	20-35%
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SOIL CONTAINING THREE COMPONENTS EACH OF WHICH COMPRISE AT LEAST 25% OF THE TOTAL ARE CLASSIFIED AS "A WELL-GRADED MIXTURE OF"

Notes:
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2. Drillers switched to casing after obtaining sample from 12-14'.

Weather: Variable

McPHAIL ASSOCIATES, LLC
42 3rd AVENUE
Burlington, MA 01803
TEL: 617-868-1420
FAX: 617-868-1423

Project: Thorndike Place
Location: See Plan
City/State: Arlington, Massachusetts

Job #: 7679.2.01
Date Started: 11-20-24
Date Finished: 11-20-24

Boring No.

MA-2

Contractor: Carr-Dee Corp
Driller/Helper: J. DeSimone/C. Smith
Logged By/Reviewed By: T. M. Cormican
Surface Elevation (ft): 7.9

Casing Type/Depth (ft): 2.25" I.D. HSA/NW Casing
Casing Hammer (lbs)/Drop (in): 300 lbs./24 inches
Sampler Size/Type: 1-3/8" I.D. Split Spoon
Sampler Hammer (lbs)/Drop (in): 140 lbs./30 inches

Groundwater Observations

Date	Depth	Elev.	Notes
11-20-24	11	-3.1	

Depth (ft)	Elev. (ft)	Symbol	Depth/EL to Strata Change (ft)	Stratum	Sample N-Value	Sample No.	Sample Pen./Rec. (in)	Sample Depth (ft)	Sample Blows Per 6"	Sample Description and Boring Notes
			0.4 / 7.5	TOPSOIL						
1	7				4	S-1	24/16	0.0-2.0	3 2 2 3	Very loose to loose, mottled gray-brown SILT and SAND, trace gravel. (FILL)
2	6									
3	5			FILL						
4	4									
5	3		5.5 / 2.4		4	S-2	6/6	5.0-5.5	2	Very loose, mottled orange-brown and black SILT and SAND, with wood, ash and cinders. (FILL)
6	2			ORGANIC DEPOSIT	4	S-2a	18/18	5.5-7.0	2 2 2	Soft to firm, brown FIBROUS PEAT. (ORGANIC DEPOSIT)
7	1									
8	0		8.0 / -0.1							
9	-1									
10	-2									
11	-3				17	S-3	24/14	10.0-12.0	9 8 9 9	Compact, gray-brown stratified silty SAND to SAND, trace silt. (ALLUVIUM DEOSIT)
12	-4									
13	-5									
14	-6			ALLUVIUM DEPOSIT						
15	-7									
16	-8				18	S-4	24/16	15.0-17.0	8 8 10 9	Compact, stratified gray silty SAND to SAND, trace silt. (ALLUVIUM DEPOSIT)
17	-9									
18	-10									
19	-11									
20	-12		20.0 / -12.1							
21	-13		21.0 / -13.1	MARINE CLAY	5	S-5	12/12	20.0-21.0	3 2	Very soft to soft, gray silty CLAY with silt and sand seams. (MARINE CLAY)
22	-14			MARINE SAND	22	S-5a	12/12	21.0-22.0	8 14	Compact, gray stratified silty SAND to SAND, trace silt. (MARINE SAND)

GRANULAR SOILS	
BLOWS/FT.	DENSITY
0-4	V.LOOSE
4-10	LOOSE
10-30	COMPACT
30-50	DENSE
>50	V.DENSE

COHESIVE SOILS	
BLOWS/FT.	CONSISTENCY
<2	V.SOFT
2-4	SOFT
4-8	FIRM
8-15	STIFF
15-30	V.STIFF
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Weather: Variable

McPHAIL ASSOCIATES, LLC
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Burlington, MA 01803
TEL: 617-868-1420
FAX: 617-868-1423

Project:	Thorndike Place	**Job #:**	7679.2.01
Location:	See Plan	**Date Started:**	11-20-24
City/State:	Arlington, Massachusetts	**Date Finished:**	11-20-24

Boring No.

MA-2

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Logged By/Reviewed By: T. M. Cormican
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Casing Type/Depth (ft): 2.25" I.D. HSA/NW Casing
Casing Hammer (lbs)/Drop (in): 300 lbs./24 inches
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Depth (ft)	Elev. (ft)	Symbol	Depth/EL to Strata Change (ft)	Stratum	Sample N-Value	Sample No.	Sample Pen./Rec. (in)	Sample Depth (ft)	Sample Blows Per 6"	Sample Description and Boring Notes
			23.5 / -15.6	MARINE SAND						
24	-16									
25	-17									
26	-18				2	S-6	24/24	25.0-27.0	1/12' 1 1	Very soft, gray silty CLAY with frequent sand partings in bottom ~ 10 inches of sample. (MARINE CLAY)
27	-19									
28	-20									
29	-21									
30	-22									
31	-23				1	S-7	24/24	30.0-32.0	WOH WOH 1 1	Very soft, gray silty CLAY with frequent sand partings. (MARINE CLAY)
32	-24									
33	-25			MARINE CLAY						
34	-26									
35	-27									
36	-28				1	S-8	24/24	35.0-37.0	WOH WOH 1 1	Very soft, gray silty CLAY, with occasional sand partings. (MARINE CLAY)
37	-29									
38	-30									
39	-31									
40	-32									
41	-33				1	S-9	24/24	40.0-42.0	WOH WOH 1 WOH	Very soft, gray silty CLAY, with occasional sand partings. (MARINE CLAY)
42	-34		42.0 / -34.1							
43	-35			Bottom of Borehole at 42.0 feet below existing grade.						
44	-36									
45	-37									

GRANULAR SOILS	
BLOWS/FT.	DENSITY
0-4	V.LOOSE
4-10	LOOSE
10-30	COMPACT
30-50	DENSE
>50	V.DENSE

COHESIVE SOILS	
BLOWS/FT.	CONSISTENCY
<2	V.SOFT
2-4	SOFT
4-8	FIRM
8-15	STIFF
15-30	V.STIFF
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DESCRIPTIVE TERM	PROPORTION OF TOTAL
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