LUCAS
ENVIRONMENTAL, LLC

APPENDIX E

DRAINAGE SUMMARY

ProTerra
DESIGN GROUP, LLC

September 1, 2023

Town of Franklin
Conservation Commission
355 East Central Street
Franklin, MA 02038

RE: Wireless Communications Facility Drainage Summary for:
Applicant: KJS Realty
Site Name: Franklin Bent Street
Site Address: Bent Street
Franklin, MA 02038

Members of the Conservation Commission,

KJS Realty ("Applicant") proposes to construct an unmanned wireless telecommunications facility within in the central portion of the property designated as Assessor's Parcel 206-103 located along the southern side of Bent Street in Franklin, Massachusetts. This stormwater drainage summary is intended to provide description of the proposed project's stormwater and erosion control design for the proposed telecommunications facility and gravel access driveway.

Background Information

The tower facility parcel is owned by Stephen J. Kelleher. The parcel contains undeveloped woodland and delineated wetland areas. Vehicular access to the tower facility will be off of Bent Street via a proposed curb cut to the gravel driveway and will consist of one or two vehicle visits per carrier per month for inspections. Utilities will follow the proposed access driveway from Bent Street to the tower compound.

Multiple wetland resource areas were located within and adjacent to the tower facility parcel by Lucas Environmental, LLC during site investigations on April 12, 2019 and September 18, 2020. The wetland resources are described as follows:

- Wetland A – A Bordering Vegetated Wetland (BVW) system located along the western property line of Parcel 206-103. Wetland A was delineated with consecutively numbered survey flags A-27 to A-77.
    - A 100-foot BVW Buffer is associated with this wetland. A small portion of the stormwater basin near the tower compound is located within the regulated jurisdictional BVW wetland buffer; however, no point source stormwater discharges will be directed into the wetland areas.
- Wetlands B & C – BVW systems located in the extreme southern portions of Parcel 206-103. Wetland B was delineated with consecutively numbered survey flags B-1 to B-22. Wetland C was delineated with consecutively numbered survey flags C-1 to C-21.
    - A 100-foot BVW Buffer is associated with each wetland. All work is outside of regulated jurisdictional wetland areas.

- Wetland D – A Bordering Vegetated Wetland (BVW) system located just south of Bent Street along the eastern property line of Parcel 206-103. Wetland D was delineated with consecutively numbered survey flags D-1 to D-16.
    - A 100-foot BVW Buffer is associated with this wetland. The gravel access driveway is located within the regulated jurisdictional BVW wetland buffer; however, no point source stormwater discharges will be directed into the wetland areas.

The soils underlying the tower facility parcel are classified as "Woodbridge Fine Sandy Loam." These soils were assumed a USDA Natural Resources Conservation Service (NRCS) classification as hydrologic soil groups C. A representative of R.W. Gillespie & Associates, Inc. conducted a geotechnical investigation to verify soil classification and to determine the depth to groundwater within the project area. During the investigation, the soils were described as sandy loam with an infiltration rate of 1.02 inches per hour. Seasonal high groundwater levels were approximated around 3.5 feet below ground level based on redoximorphic features observed in the borings.

See Site Plans for vicinity map and existing conditions.

Proposed Improvements

Tower Compound & Access Improvements

The Applicant intends to construct the proposed unmanned wireless telecommunications facility within a 75'x75' square (5,625 SF) lease area in the central portion of parcel 206-103. Trees bordering the extents of the new facility and driveway will be minimally cleared. A proposed 609-foot long, 12-foot-wide gravel access drive (5% maximum slope) through the property will be used for access to and from the facility. All vehicular access will utilize the proposed curb cut off of Bent Street.

The facility itself will be constructed of a 60'x60' (3,600 SF) fenced-in compound with a surface consisting of 4-inch depth clean stone over filter fabric. The stone voids create a reservoir of 475± cubic feet which is equal to storage of 1.6± inches of rainfall. A galvanized steel self-support tower supporting antenna equipment will be placed on a reinforced concrete foundation below grade. Ground and tower space will be allotted for up to four carriers estimated to be about 1,350 SF of impervious area at full build-out. Development of the tower compound creates small, disconnected, impervious areas comparable to a single-family house with a garage. Clean, granular, structural fill (<10% passing the #200 sieve) will be installed to raise the compound surface elevation as shown on the site plans.

Drainage within the limits of work is divided into five drainage basins.

- Drainage Basin P-1 is the tributary area to the east of the proposed gravel driveway that drains un-detained to Wetland D.
- Drainage Basin P-2 is the tributary area to the north of the proposed gravel driveway that drains un-detained to Wetland D. Stormwater runoff from the gravel

driveway within this drainage basin is conveyed along the edge of the driveway within a vegetated swale prior to discharge under the driveway.

- Drainage Basin P-3 is the tributary area along the middle section of the proposed gravel driveway and eastern side of the tower compound that drains to the east after treatment by a constructed pocket wetland with sediment forebay pretreatment.
- Drainage Basin P-4 is the tributary area including the western side of the tower compound and gravel parking/turnaround area. Stormwater from this basin is treated via an infiltration basin with sediment forebay pretreatment prior to discharge into the wooded areas near Wetland A.
- Drainage Basin P-5 is the tributary area northwest of the tower compound and gravel driveway that drains un-detained to Wetland A.

Stormwater Management Improvements

All drainage discharges near the tower compound or along the access driveway are provided with devices to level spread stormwater flows and eliminate point source discharges. The project seeks to avoid drainage impacts to surrounding resources by directing sheet flow runoff through existing vegetated areas that promotes sediment removal through filtering, absorption, and settling as the velocity of flow and resultant energy is reduced. Structural Best Management Practices (BMPs) along the tower compound and gravel driveway include sediment forebays (pretreatment), an infiltration basin, a constructed pocket wetland, vegetated swales, and culvert outlet protection with level spreaders.

Erosion controls will be provided between the improvements and the existing surrounding wooded or wetland resource areas. During construction, silt-laden stormwater runoff or discharge from dewatering operations (if necessary) will be prevented from exiting the construction area untreated. Siltation barriers consisting of a filter fabric silt fence, straw bales, or silt socks will be erected in advance of construction along the down-gradient edge of all disturbed areas and maintained through the construction period. The control of dust and erosion during the construction period will be managed using BMPs as shown on the site plans.

Hydrologic & Hydraulic Method

The goal of the calculations is to mitigate pre- and post-development stormwater flow differences and reduce erosive conditions generated by the addition of the 60’x60’ fenced compound and 609-foot long, 12-foot-wide gravel access driveway.

The HydroCAD Stormwater Modeling System computer program (version 10.00-26) by Applied Microcomputer Systems, Inc. is used to develop stormwater runoff rates and volumes for the proposed conditions at the project site. The HydroCAD software is a hydrograph generation and routing program similar to TR-20. The software uses Soil Conservation Service (SCS) Unit Hydrograph Methodology. This drainage analysis was developed utilizing a Type III 24-hour storm as developed by the SCS. Information

regarding the equations and calculation procedures utilized in HydroCAD will be made available upon request. A drainage area map is attached.

If the calculated time of concentration for a drainage basin was found to be less than six minutes, an assumed minimum time of concentration of six minutes was utilized to calculate peak flows.

The design storm frequencies and corresponding rainfall depths were compiled from the Northeast Regional Climate Center, "Extreme Precipitation Tables" and have been estimated as follows for The Town of Franklin, Massachusetts:

Storm Frequency (Years)	Rainfall Depth (Inches)
2	3.25
10	4.89
100	8.81

The groundwater recharge volume applied to the infiltration basin was calculated based on the proposed impervious area over the Hydrologic Soil Group C. Because not all of the proposed impervious area within the tower compound will be directed toward the infiltration basin, an adjustment factor for the groundwater recharge volume was applied to the design volume. Based on lab testing performed by R.W. Gillespie & Associates, Inc. during their geotechnical investigation, a recommended long-term infiltration rate of 1.02 inches per hour was utilized within the stormwater analysis. Infiltration above the 2-year design storm was disallowed in the drainage analysis model.

The proposed electronic and radio equipment at the tower compound will be contained within cabinets, shelters, or weather-resistant housings. The equipment will be isolated from precipitation that would create untreated runoff. However, stormwater runoff from the compound and gravel parking area will be pretreated by a sediment forebay prior to the infiltration basin or constructed pocket wetland. Required storage volume within the stormwater basins below the lowest outlet orifice was estimated to provide for a water quality volume using the "1 inch rule". Runoff from the paved driveway apron is considered *de miminis*; therefore, it is not required to meet Standard 4. However, runoff from the paved driveway apron will flow through a vegetated swale allowing for sediment to settle out of the stormwater prior to discharge under the driveway.

Summary of Hydrologic Calculations

The results of the pre- and post-construction hydrology provided are summarized in the following tables. The tables correspond to the design points or study areas as indicated on the drainage area maps and hydrograph routing calculations. The project aim was to study pre and post runoff for the proposed development improvement and meet the MassDEP Stormwater Standards to the maximum extent practicable which include but are not limited to: adding stormwater treatment facilities and increasing groundwater recharge.

TOTAL RUNOFF PEAK (CFS) FROM THE SITE TO DESIGN POINT 1/10

Type III SCS 24-HR STORM	EXISTING (DP#1)	PROPOSED (DP#10)	DIFFERENCE
2 – YEAR	2.4	2.2	-0.2
10 – YEAR	5.6	5.3	-0.3
100 – YEAR	14.6	14.5	-0.1

TOTAL RUNOFF PEAK (CFS) FROM THE SITE TO DESIGN POINT 2/20

Type III SCS 24-HR STORM	EXISTING (DP#2)	PROPOSED (DP#20) *	DIFFERENCE
2 – YEAR	1.2	1.2	0.0
10 – YEAR	3.0	2.8	-0.2
100 – YEAR	8.3	7.2	-1.1

* Infiltration was not allowed in the model for the 10-year and 100-year proposed analysis.

The new development peak runoff flows at the design points (DP1/10 and DP2/20) show the same or slight decreases indicating no change in the proposed construction condition versus the pre-construction condition for the 2-year, 10-year, and 100-year design storm events. The proposed stormwater system will not discharge untreated stormwater runoff generated by new impervious surfaces into any resource area.

Stormwater generated along the driveway will be collected within vegetated swales along the downhill sides. Each swale is sized to contain the 10-year storm event with 1-foot of freeboard. The swales will convey stormwater runoff to the infiltration basin, the constructed pocket wetland, or the driveway culvert with outlet protection level spreader. Outlets at each of these BMPs are constructed at zero grade across the slope and consist of riprap stone to disperse or spread concentrated flow thinly over the receiving area. Stormwater flows are slowed and spread out to reduce potential for erosion in the surrounding wooded areas.

See attached swale capacity and level spreader calculations.

Summary and Conclusion

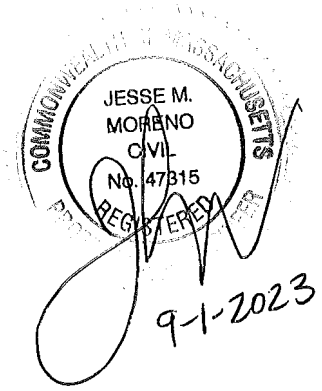
Based on the scope of the proposed improvements and limited vehicular access, it is our opinion the Applicant has provided adequate BMPs to control stormwater generated by the tower compound and gravel access driveway. Stormwater management associated with the compound and access drive will provide BMPs to promote sediment capture, increase infiltrative cover, and

reduce erosive stormwater flows. The compound stone surface will also provide 475± cubic feet of reservoir storage to mitigate runoff volume in addition to the volumes within the infiltration basin and constructed pocket wetland. New construction stormwater runoff volumes and flows will be maintained over the existing conditions for the 2-year, 10-year, and 100-year design storm events, and stormwater runoff produced by the telecommunications facility will not negatively impact the adjacent wetlands and/or abutting properties.

If you have any questions or need further information, please do not hesitate to call us at (413) 320-4918.

Sincerely,
ProTerra Design Group, LLC

Jesse Moreno, PE
Managing Partner
Enclosures



MassDEP Checklist, Reference Table, & Maps

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.

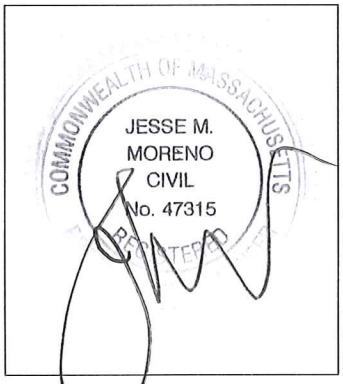
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the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



8-17-2023

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.

ILLICIT DISCHARGE COMPLIANCE STATEMENT

Standard 10: Massachusetts Stormwater Standards Handbook

Illicit discharges are defined as discharges into waters of the State or municipal separate stormwater system (MS4) that are not entirely comprised of stormwater. A significant portion of these dry weather flows were from illicit and/or inappropriate discharges and connections. Illicit discharges enter the system through either direct connections (e.g., wastewater piping either mistakenly or deliberately connected to the storm drains) or indirect connections (e.g., infiltration from cracked sanitary systems, spills collected by drain outlets, or paint or used oil dumped directly into a drain). The result is untreated discharges that contribute high levels of pollutants, including heavy metals, toxics, oil and grease, solvents, nutrients, viruses, and bacteria to receiving waterbodies.

Exclusions for non-stormwater discharges into drainage systems include activities or facilities for firefighting, water line flushing, landscape irrigation, uncontaminated groundwater discharge, potable water sources, foundation drains, air conditioning condensation, footing drains, individual resident car washing, water used to clean residential buildings without detergents, water used for street washing, and flows from riparian habitats/wetlands. These exclusions are subject to change and are under the discretion of the local governing authority.

To the best of our knowledge and belief no illicit discharges to the stormwater system, surface waters, or wetland resource areas currently exist or will remain within the lease area or its immediate periphery after construction. The Applicant will agree to implement a pollution prevention plan to prevent illicit discharges from the lease area. The Owner agrees to notify the Applicant of any known contamination, illicit discharge, or potentially unsecured condition that may affect the lease area.

The design of the site is based on the plans, *"Franklin Bent Street; Bent Street; Frankin, MA 02038,"* latest revision as prepared by ProTerra Design Group, LLC. All stormwater discharges are treated with vegetated swales, culvert outlet protection with level spreaders, forested vegetated filter strips, sediment forebays, an infiltration basin, and/or a constructed stormwater wetland (pocket wetland) between the stormwater management systems and the existing resource areas on or off the site. The site is unmanned and will not use water or sewer utilities that could contribute to cross-contamination. No storage of refuse will be proposed on site. Additionally, electronic, battery components, and backup power generation facilities are contained within covered buildings or cabinets with the necessary environmental containment systems. To the extent practicable, the design prevents entry of illicit discharges into the stormwater management system by covering and separation of potential contaminants from precipitation.

By promoting good design, employing proper Best Management Practices, and agreeing to maintain these devices in perpetuity, we hereby collectively acknowledge that this site will have no known illicit discharges.

Applicant's Name: Stephen Kelleher -President of KJS Realty, Inc
(please print)

Applicant's Signature: _____ Date: September 1, 2023

Owner's Name: Stephen Kelleher - President of KJS Realty, Inc
(please print)

Owner's Signature: _____ Date: September 1, 2023

Engineer's Name: Jesse Moreno, PE
(please print)

Engineer's Signature: _____ Date: 9-1-2023
Company: ProTerra Design Group, LLC

Extreme Precipitation Tables

Northeast Regional Climate Center

Data represents point estimates calculated from partial duration series. All precipitation amounts are displayed in inches.

Metadata for Point

Smoothing	Yes
State	Massachusetts
Location	Massachusetts, United States
Latitude	42.131 degrees North
Longitude	71.396 degrees West
Elevation	80 feet
Date/Time	Tue Jul 11 2023 17:03:47 GMT-0600 (Mountain Daylight Time)

Extreme Precipitation Estimates

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.29	0.44	0.55	0.72	0.90	1.14	**1yr**	0.78	1.08	1.32	1.68	2.13	2.72	2.98	**1yr**	2.41	2.87	3.32	4.00	4.66	**1yr**
2yr	0.36	0.55	0.68	0.90	1.13	1.42	**2yr**	0.97	1.31	1.64	2.06	2.59	3.25	3.58	**2yr**	2.88	3.44	3.94	4.70	5.33	**2yr**
5yr	0.42	0.66	0.83	1.11	1.42	1.80	**5yr**	1.22	1.63	2.09	2.62	3.28	4.10	4.57	**5yr**	3.63	4.39	5.03	5.95	6.62	**5yr**
10yr	0.48	0.75	0.95	1.29	1.68	2.16	**10yr**	1.45	1.93	2.51	3.16	3.94	4.89	5.49	**10yr**	4.33	5.28	6.04	7.11	7.82	**10yr**
25yr	0.56	0.90	1.15	1.59	2.12	2.74	**25yr**	1.83	2.41	3.21	4.03	5.01	6.17	7.02	**25yr**	5.46	6.75	7.71	8.99	9.73	**25yr**
50yr	0.65	1.04	1.34	1.87	2.52	3.29	**50yr**	2.18	2.85	3.85	4.84	6.00	7.37	8.46	**50yr**	6.52	8.13	9.28	10.75	11.50	**50yr**
100yr	0.74	1.20	1.55	2.20	3.01	3.94	**100yr**	2.59	3.37	4.63	5.82	7.20	8.81	10.19	**100yr**	7.80	9.80	11.17	12.86	13.58	**100yr**
200yr	0.86	1.41	1.82	2.60	3.59	4.73	**200yr**	3.10	3.99	5.55	6.98	8.63	10.53	12.29	**200yr**	9.32	11.82	13.45	15.39	16.05	**200yr**
500yr	1.04	1.71	2.23	3.24	4.54	6.02	**500yr**	3.91	5.00	7.09	8.91	10.99	13.35	15.75	**500yr**	11.82	15.15	17.20	19.53	20.02	**500yr**

Lower Confidence Limits

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.24	0.37	0.45	0.61	0.74	0.91	**1yr**	0.64	0.89	1.07	1.41	1.85	2.36	2.63	**1yr**	2.09	2.53	2.99	3.35	4.06	**1yr**
2yr	0.34	0.53	0.65	0.88	1.09	1.29	**2yr**	0.94	1.26	1.48	1.94	2.49	3.14	3.45	**2yr**	2.78	3.32	3.80	4.53	5.13	**2yr**
5yr	0.39	0.60	0.74	1.02	1.29	1.54	**5yr**	1.12	1.51	1.75	2.29	2.90	3.75	4.18	**5yr**	3.32	4.02	4.61	5.49	6.08	**5yr**
10yr	0.43	0.66	0.82	1.14	1.48	1.75	**10yr**	1.27	1.71	1.98	2.59	3.26	4.26	4.84	**10yr**	3.77	4.65	5.33	6.24	6.91	**10yr**
25yr	0.49	0.75	0.93	1.33	1.75	2.07	**25yr**	1.51	2.03	2.34	3.06	3.80	5.07	5.87	**25yr**	4.49	5.64	6.45	7.49	8.20	**25yr**
50yr	0.54	0.83	1.03	1.48	1.99	2.35	**50yr**	1.72	2.30	2.66	3.46	4.28	5.79	6.81	**50yr**	5.12	6.55	7.47	8.63	9.34	**50yr**
100yr	0.60	0.91	1.14	1.65	2.26	2.68	**100yr**	1.95	2.62	3.02	3.92	4.82	6.61	7.92	**100yr**	5.85	7.61	8.63	9.94	10.65	**100yr**
200yr	0.67	1.00	1.27	1.84	2.57	3.05	**200yr**	2.21	2.98	3.43	4.46	5.42	7.57	9.18	**200yr**	6.70	8.83	10.00	11.46	12.17	**200yr**
500yr	0.76	1.13	1.46	2.12	3.01	3.62	**500yr**	2.60	3.54	4.05	5.29	6.36	9.08	11.25	**500yr**	8.04	10.82	12.13	13.86	14.52	**500yr**

Upper Confidence Limits

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.32	0.50	0.61	0.82	1.00	1.21	**1yr**	0.87	1.18	1.38	1.80	2.33	2.99	3.24	**1yr**	2.65	3.11	3.83	4.45	5.12	**1yr**
2yr	0.37	0.57	0.71	0.96	1.18	1.38	**2yr**	1.02	1.35	1.59	2.08	2.66	3.41	3.75	**2yr**	3.02	3.61	4.16	4.92	5.54	**2yr**
5yr	0.46	0.72	0.89	1.22	1.55	1.81	**5yr**	1.34	1.77	2.07	2.68	3.38	4.50	4.98	**5yr**	3.98	4.79	5.45	6.50	7.23	**5yr**
10yr	0.56	0.86	1.07	1.49	1.93	2.23	**10yr**	1.66	2.18	2.54	3.25	4.06	5.55	6.21	**10yr**	4.91	5.97	6.79	8.17	8.85	**10yr**
25yr	0.72	1.10	1.37	1.95	2.56	2.94	**25yr**	2.21	2.87	3.32	4.18	5.18	7.36	8.29	**25yr**	6.51	7.98	9.08	10.89	11.55	**25yr**
50yr	0.87	1.33	1.65	2.37	3.19	3.62	**50yr**	2.76	3.54	4.08	5.07	6.21	9.11	10.33	**50yr**	8.06	9.93	11.30	13.56	14.13	**50yr**
100yr	1.06	1.60	2.01	2.90	3.98	4.47	**100yr**	3.44	4.37	5.01	6.13	7.47	11.28	12.85	**100yr**	9.98	12.35	14.06	16.87	17.28	**100yr**
200yr	1.29	1.94	2.46	3.56	4.97	5.51	**200yr**	4.29	5.39	6.16	7.44	8.98	13.95	15.96	**200yr**	12.34	15.35	17.49	20.97	21.14	**200yr**
500yr	1.69	2.52	3.24	4.71	6.69	7.27	**500yr**	5.78	7.11	8.09	9.60	11.45	18.47	21.30	**500yr**	16.35	20.48	23.37	27.93	27.56	**500yr**

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Northeast Regional Climate Center

BENT STREET

OHW

OHW

DP-1

310B
HSG 'C/D'
(ASSUMED 'C' OUTSIDE
OF WETLAND AREAS)

DP-2

EX-1

EX-2

100–FOOT
BVW BUFFER

40' WIDE R.O.W.

DELINEATED
WETLAND
LINE, TYP.

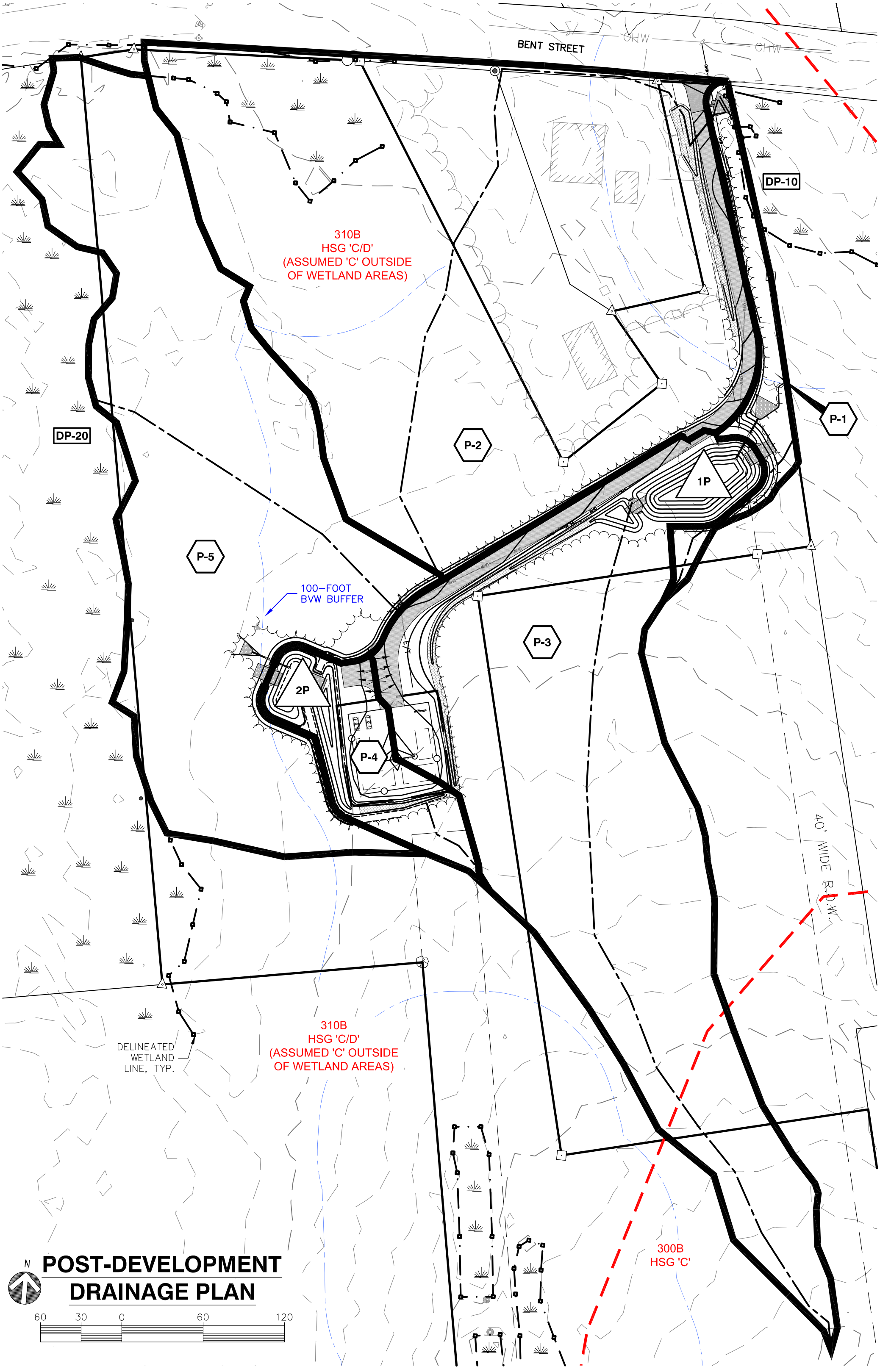
310B
HSG 'C/D'
(ASSUMED 'C' OUTSIDE
OF WETLAND AREAS)

300B
HSG 'C'

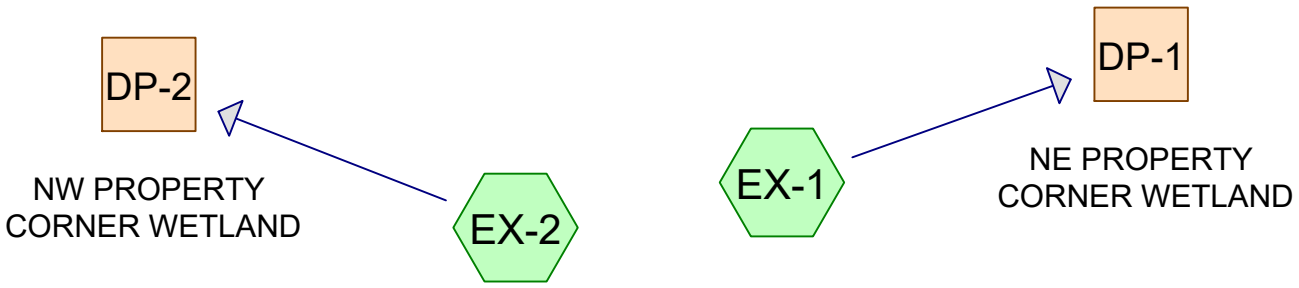
N

PRE-DEVELOPMENT DRAINAGE PLAN

60 30 0 60 120


BENT STREET
OHW
OHW
OHW
OHW
DP-10
P-1
DP-20
P-2
1P
P-5
100-FOOT
BVW BUFFER
P-3
2P
P-4
40' WIDE R.O.W.
310B
HSG 'C/D'
(ASSUMED 'C' OUTSIDE
OF WETLAND AREAS)
DELINEATED
WETLAND
LINE, TYP.
310B
HSG 'C/D'
(ASSUMED 'C' OUTSIDE
OF WETLAND AREAS)
300B
HSG 'C'
N
POST-DEVELOPMENT
DRAINAGE PLAN
60
30
0
60
120

Hydrologic & Hydraulic Calculations



Subcat Reach Pond Link

Routing Diagram for KJS_Franklin Bent Street_Drainage-PRE & POST
Prepared by ProTerra Design Group, LLC, Printed 8/15/2023

Area Listing (selected nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
32,558	74	>75% Grass cover, Good, HSG C (EX-1)
3,492	89	Gravel roads, HSG C (EX-1)
2,416	98	Paved parking, HSG C (EX-1)
3,150	98	Roofs, HSG C (EX-1)
259,355	70	Woods, Good, HSG C (EX-1, EX-2)

Soil Listing (selected nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
0	HSG A	
0	HSG B	
300,971	HSG C	EX-1, EX-2
0	HSG D	
0	Other	

Ground Covers (selected nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Sub Num
0	0	32,558	0	0	32,558	>75% Grass cover, Good	
0	0	3,492	0	0	3,492	Gravel roads	
0	0	2,416	0	0	2,416	Paved parking	
0	0	3,150	0	0	3,150	Roofs	
0	0	259,355	0	0	259,355	Woods, Good	

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 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 EX-1: Runoff Area=199,749 sf 2.79% Impervious Runoff Depth=0.96"
Flow Length=830' Slope=0.0200 '/' Tc=38.5 min CN=72 Runoff=2.4 cfs 15,994 cf

Subcatchment EX-2: Runoff Area=101,222 sf 0.00% Impervious Runoff Depth=0.86"
Flow Length=338' Tc=27.8 min CN=70 Runoff=1.2 cfs 7,232 cf

Reach DP-1: NE PROPERTY CORNER WETLAND Inflow=2.4 cfs 15,994 cf
Outflow=2.4 cfs 15,994 cf

Reach DP-2: NW PROPERTY CORNER WETLAND Inflow=1.2 cfs 7,232 cf
Outflow=1.2 cfs 7,232 cf

Summary for Subcatchment EX-1:

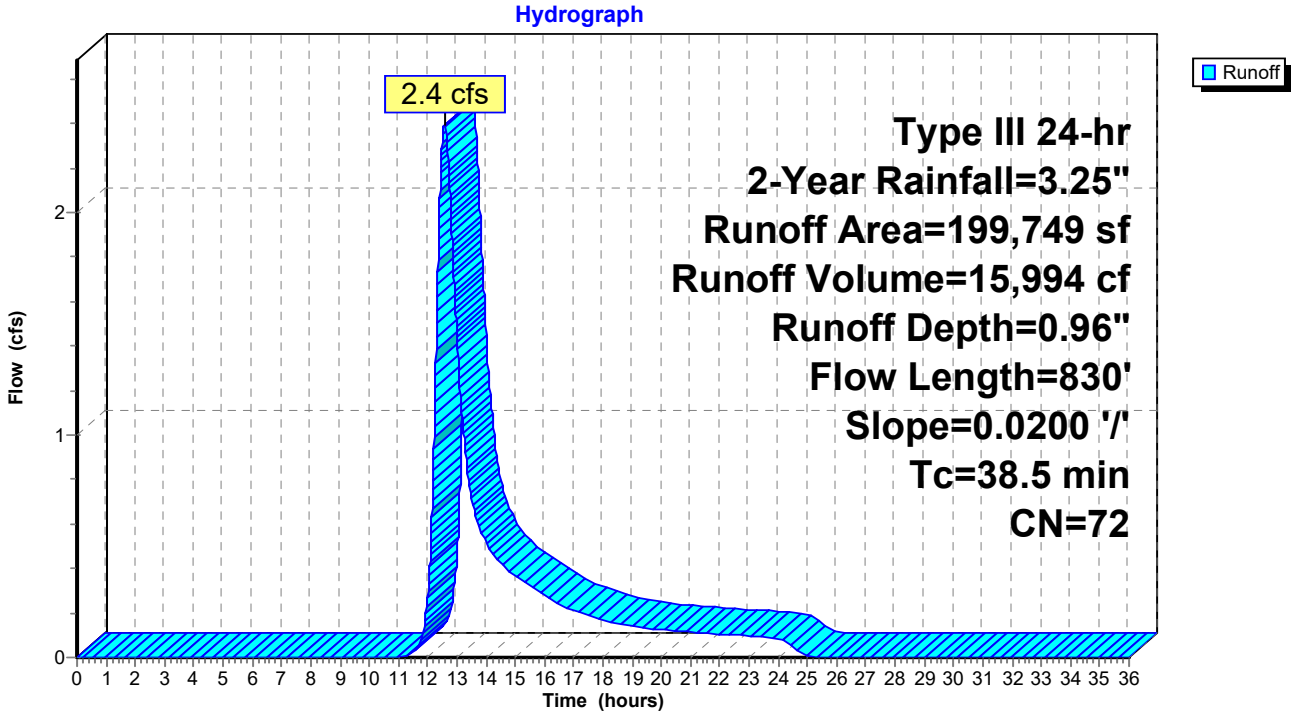
Runoff = 2.4 cfs @ 12.58 hrs, Volume= 15,994 cf, Depth= 0.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.25"

Area (sf)	CN	Description
3,150	98	Roofs, HSG C
2,416	98	Paved parking, HSG C
32,558	74	>75% Grass cover, Good, HSG C
3,492	89	Gravel roads, HSG C
158,133	70	Woods, Good, HSG C
199,749	72	Weighted Average
194,183		97.21% Pervious Area
5,566		2.79% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.3	100	0.0200	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.25"
17.2	730	0.0200	0.71		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
38.5	830	Total			

Subcatchment EX-1:



Summary for Subcatchment EX-2:

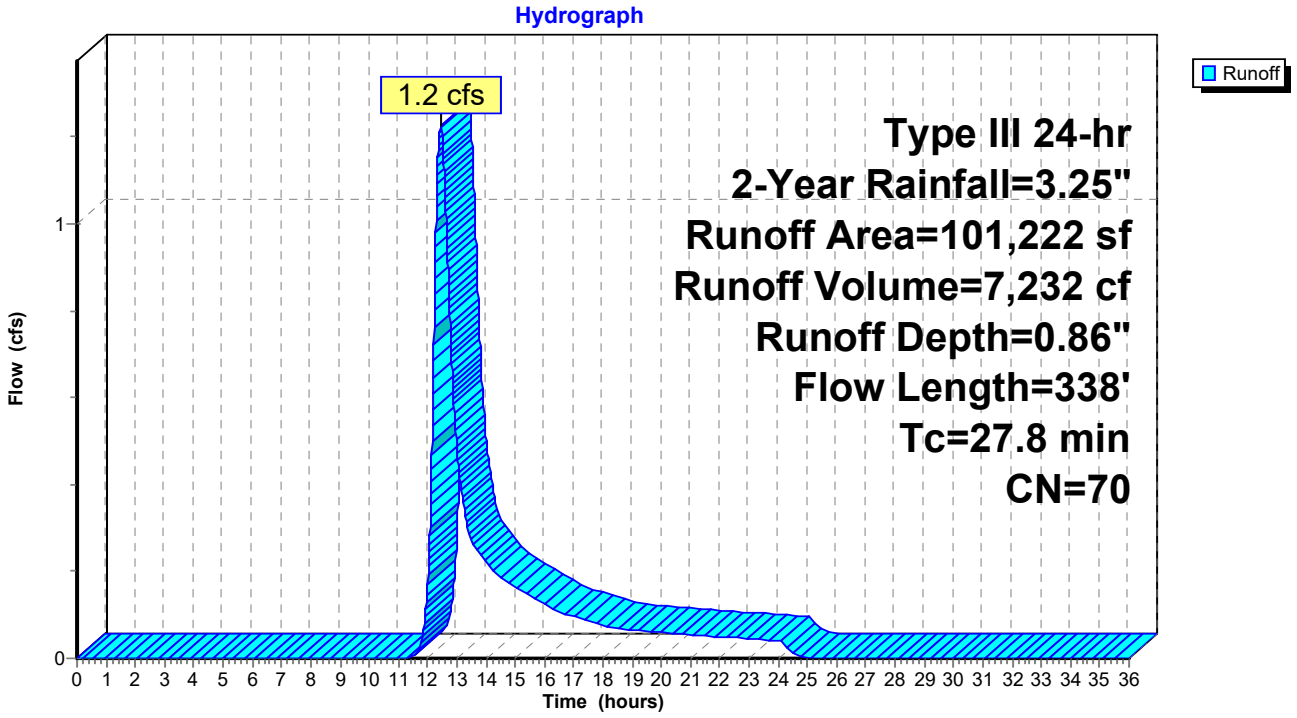
Runoff = 1.2 cfs @ 12.45 hrs, Volume= 7,232 cf, Depth= 0.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.25"

Area (sf)	CN	Description
101,222	70	Woods, Good, HSG C
101,222		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.3	100	0.0200	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.25"
6.5	238	0.0150	0.61		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
27.8	338	Total			

Subcatchment EX-2:

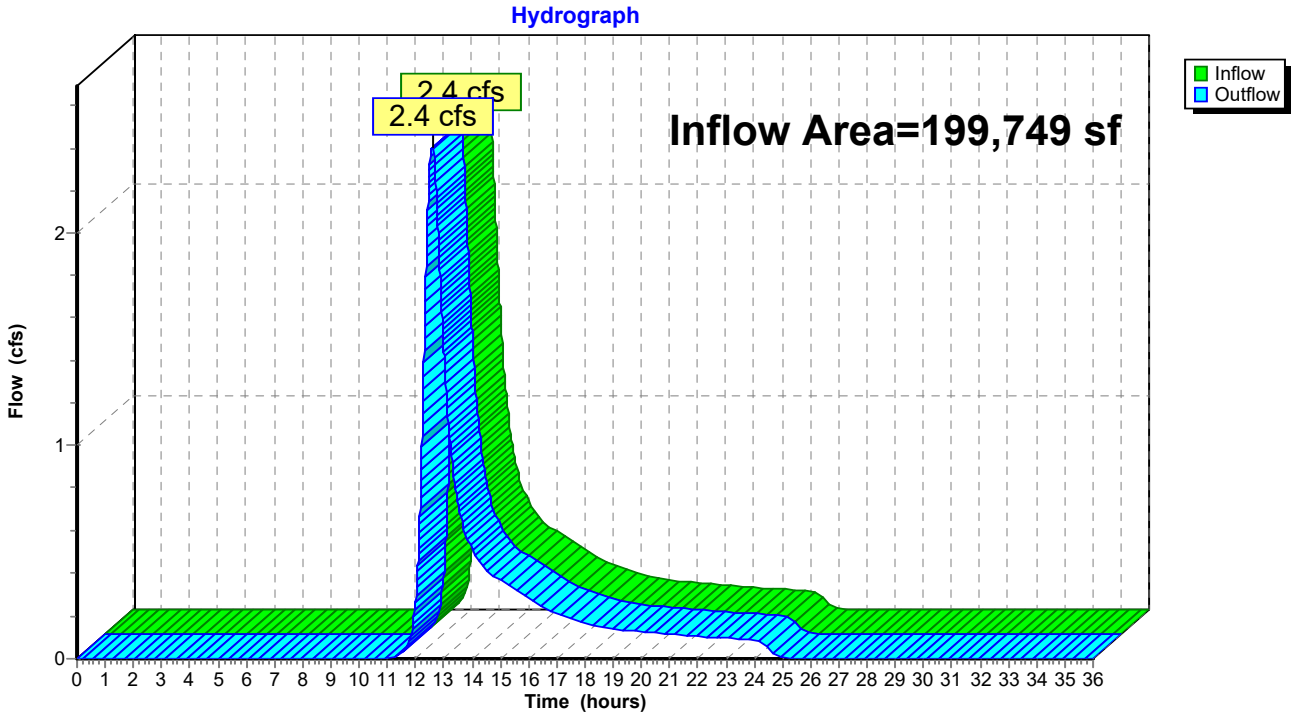


Summary for Reach DP-1: NE PROPERTY CORNER WETLAND

Inflow Area = 199,749 sf, 2.79% Impervious, Inflow Depth = 0.96" for 2-Year event
Inflow = 2.4 cfs @ 12.58 hrs, Volume= 15,994 cf
Outflow = 2.4 cfs @ 12.58 hrs, Volume= 15,994 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Reach DP-1: NE PROPERTY CORNER WETLAND

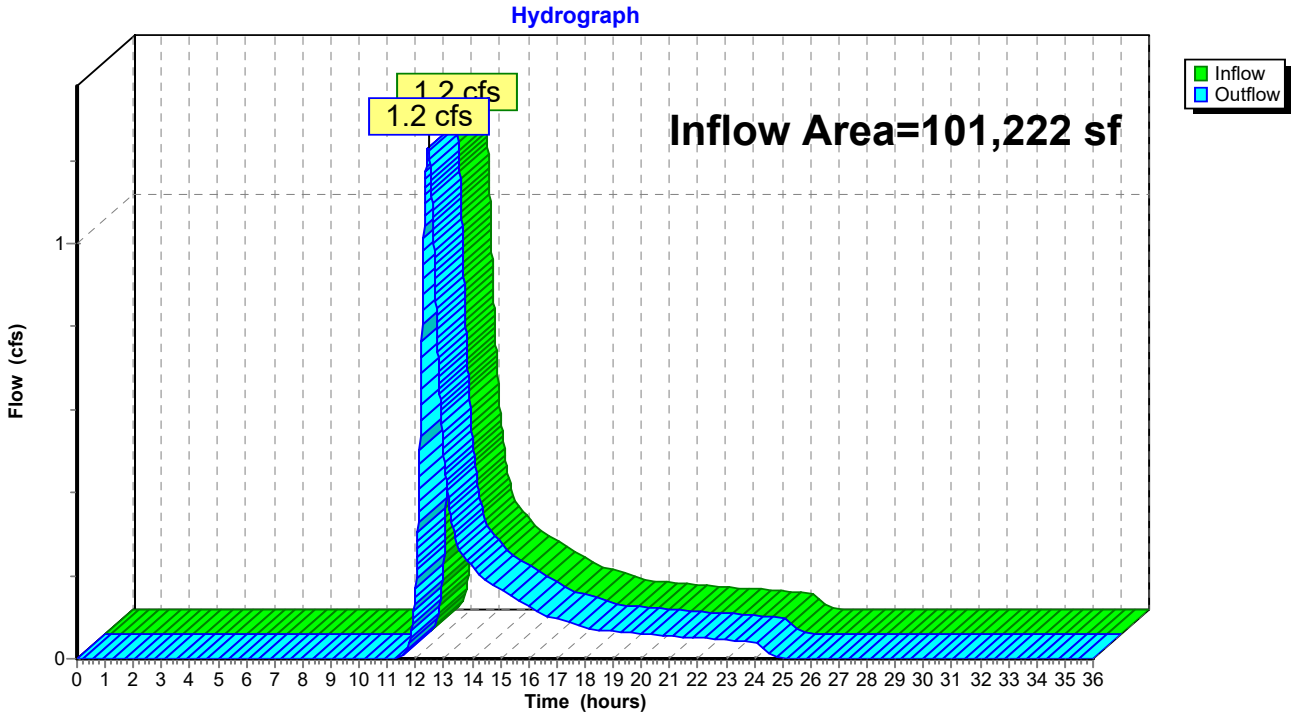


Summary for Reach DP-2: NW PROPERTY CORNER WETLAND

Inflow Area = 101,222 sf, 0.00% Impervious, Inflow Depth = 0.86" for 2-Year event
Inflow = 1.2 cfs @ 12.45 hrs, Volume= 7,232 cf
Outflow = 1.2 cfs @ 12.45 hrs, Volume= 7,232 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Reach DP-2: NW PROPERTY CORNER WETLAND



Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 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 EX-1: Runoff Area=199,749 sf 2.79% Impervious Runoff Depth=2.11"
Flow Length=830' Slope=0.0200 '/' Tc=38.5 min CN=72 Runoff=5.6 cfs 35,181 cf

Subcatchment EX-2: Runoff Area=101,222 sf 0.00% Impervious Runoff Depth=1.96"
Flow Length=338' Tc=27.8 min CN=70 Runoff=3.0 cfs 16,492 cf

Reach DP-1: NE PROPERTY CORNER WETLAND Inflow=5.6 cfs 35,181 cf
Outflow=5.6 cfs 35,181 cf

Reach DP-2: NW PROPERTY CORNER WETLAND Inflow=3.0 cfs 16,492 cf
Outflow=3.0 cfs 16,492 cf

Summary for Subcatchment EX-1:

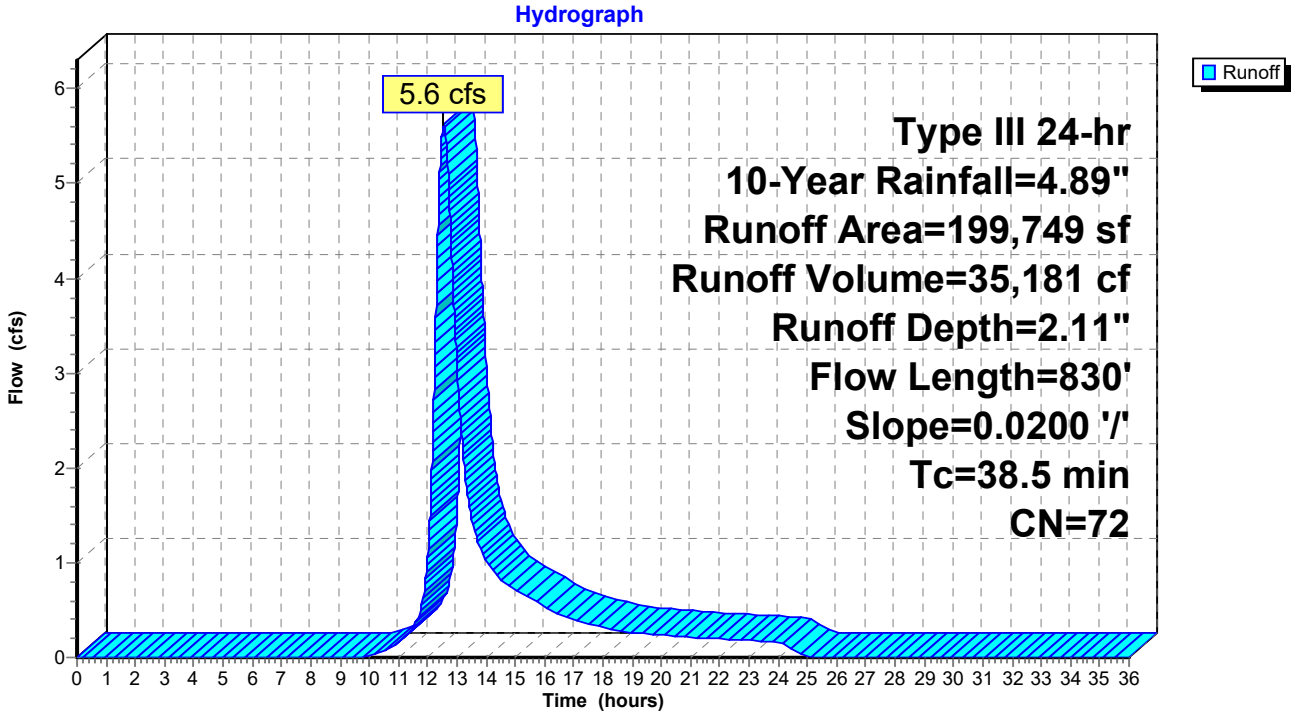
Runoff = 5.6 cfs @ 12.54 hrs, Volume= 35,181 cf, Depth= 2.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.89"

Area (sf)	CN	Description
3,150	98	Roofs, HSG C
2,416	98	Paved parking, HSG C
32,558	74	>75% Grass cover, Good, HSG C
3,492	89	Gravel roads, HSG C
158,133	70	Woods, Good, HSG C
199,749	72	Weighted Average
194,183		97.21% Pervious Area
5,566		2.79% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.3	100	0.0200	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.25"
17.2	730	0.0200	0.71		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
38.5	830	Total			

Subcatchment EX-1:



Summary for Subcatchment EX-2:

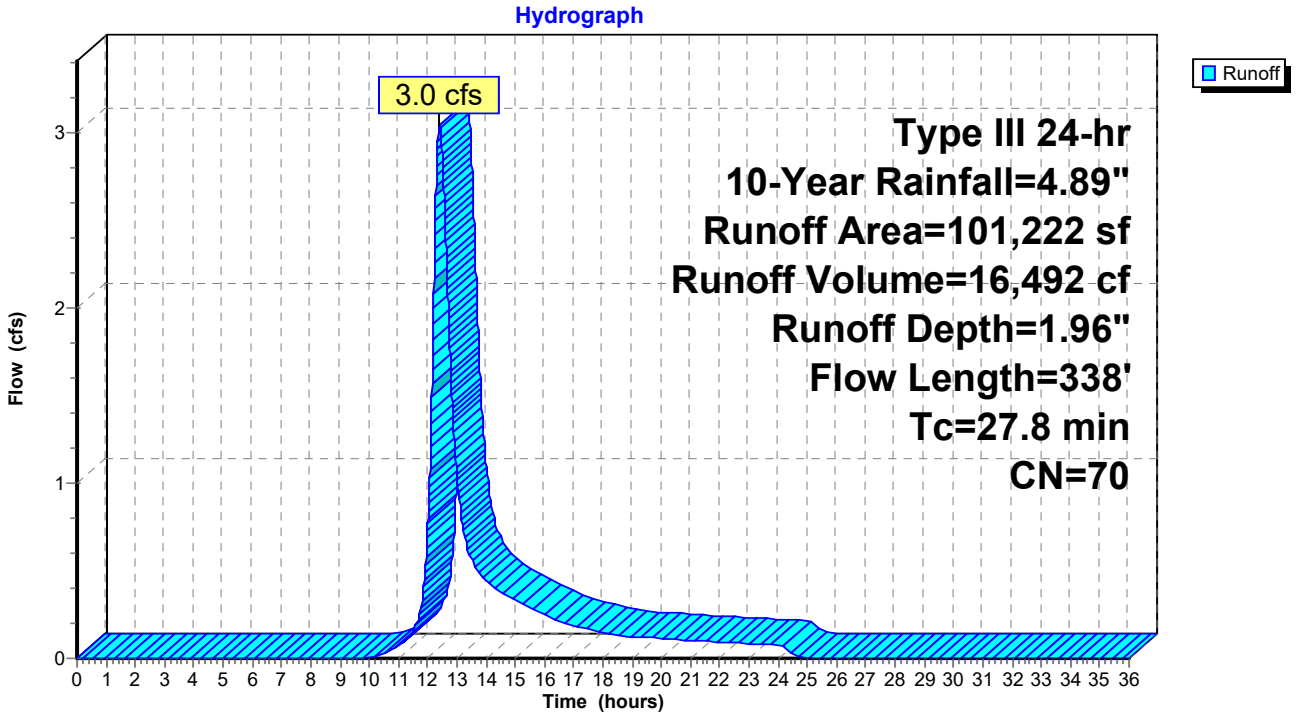
Runoff = 3.0 cfs @ 12.39 hrs, Volume= 16,492 cf, Depth= 1.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.89"

Area (sf)	CN	Description
101,222	70	Woods, Good, HSG C
101,222		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.3	100	0.0200	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.25"
6.5	238	0.0150	0.61		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
27.8	338	Total			

Subcatchment EX-2:

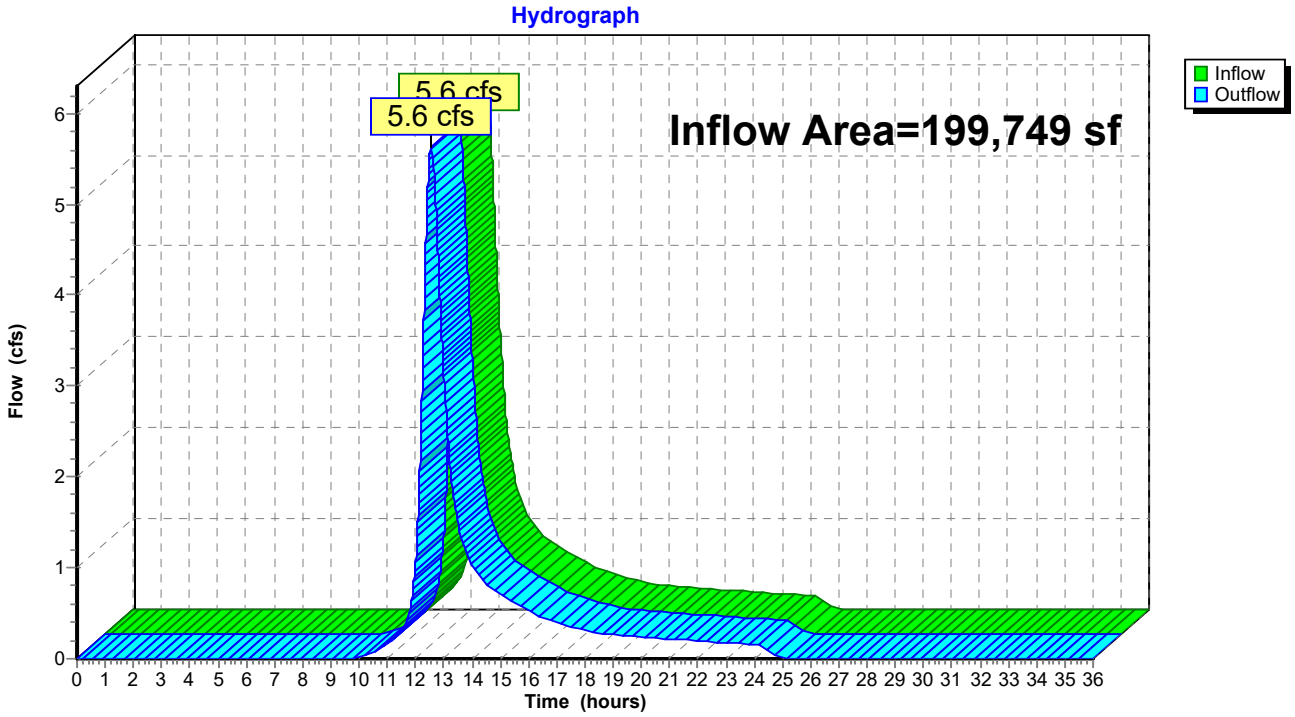


Summary for Reach DP-1: NE PROPERTY CORNER WETLAND

Inflow Area = 199,749 sf, 2.79% Impervious, Inflow Depth = 2.11" for 10-Year event
Inflow = 5.6 cfs @ 12.54 hrs, Volume= 35,181 cf
Outflow = 5.6 cfs @ 12.54 hrs, Volume= 35,181 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Reach DP-1: NE PROPERTY CORNER WETLAND

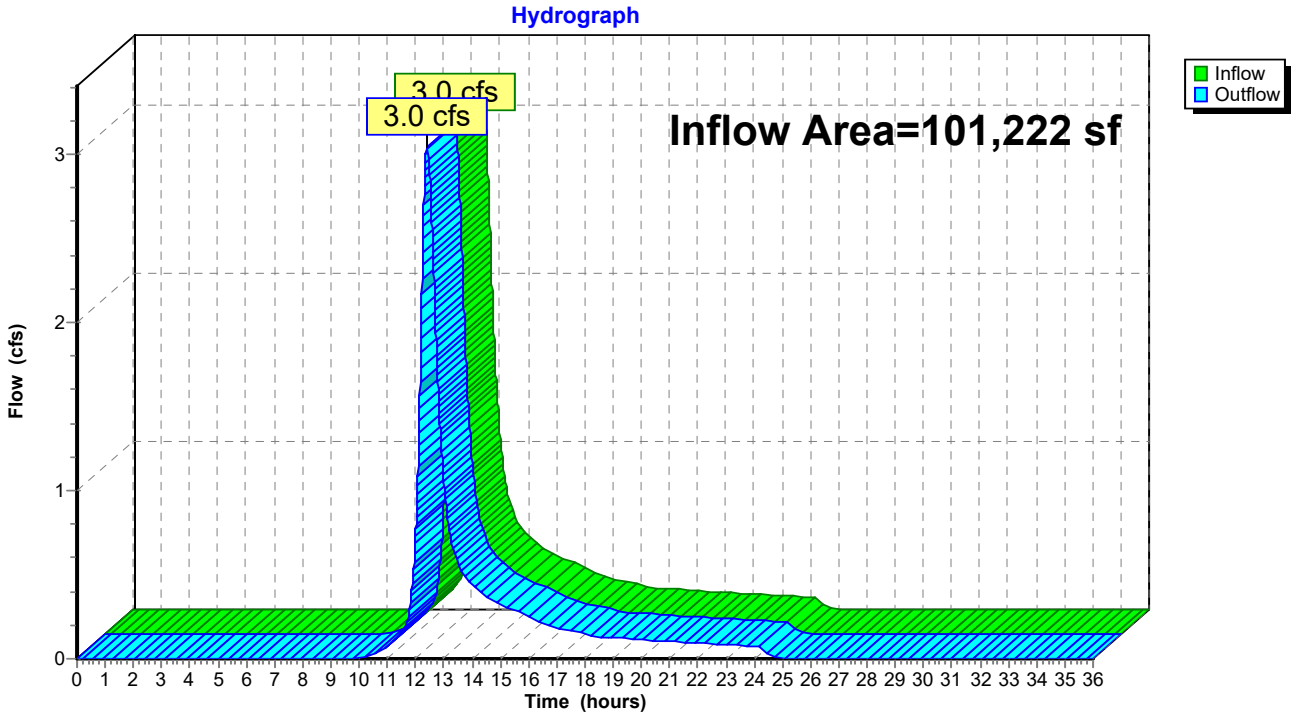


Summary for Reach DP-2: NW PROPERTY CORNER WETLAND

Inflow Area = 101,222 sf, 0.00% Impervious, Inflow Depth = 1.96" for 10-Year event
Inflow = 3.0 cfs @ 12.39 hrs, Volume= 16,492 cf
Outflow = 3.0 cfs @ 12.39 hrs, Volume= 16,492 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Reach DP-2: NW PROPERTY CORNER WETLAND



Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 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 EX-1: Runoff Area=199,749 sf 2.79% Impervious Runoff Depth=5.41"
Flow Length=830' Slope=0.0200 '/' Tc=38.5 min CN=72 Runoff=14.6 cfs 90,086 cf

Subcatchment EX-2: Runoff Area=101,222 sf 0.00% Impervious Runoff Depth=5.17"
Flow Length=338' Tc=27.8 min CN=70 Runoff=8.3 cfs 43,592 cf

Reach DP-1: NE PROPERTY CORNER WETLAND Inflow=14.6 cfs 90,086 cf
Outflow=14.6 cfs 90,086 cf

Reach DP-2: NW PROPERTY CORNER WETLAND Inflow=8.3 cfs 43,592 cf
Outflow=8.3 cfs 43,592 cf

Summary for Subcatchment EX-1:

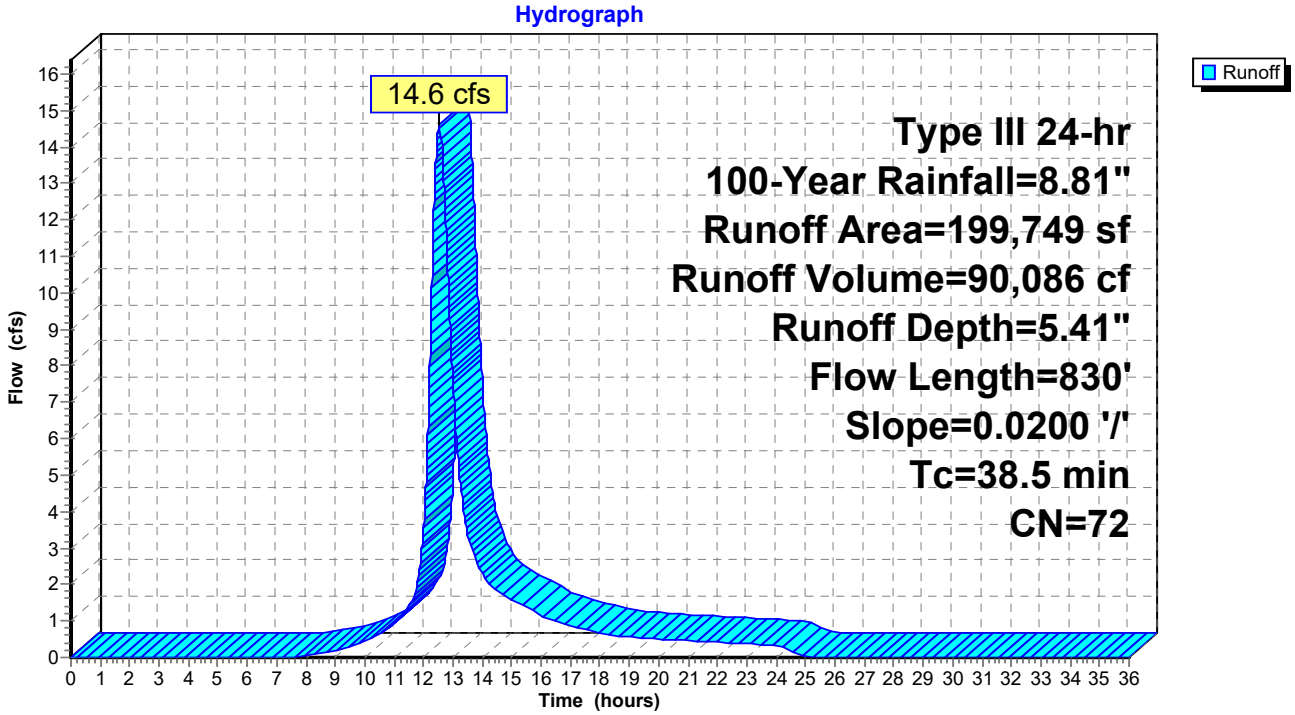
Runoff = 14.6 cfs @ 12.53 hrs, Volume= 90,086 cf, Depth= 5.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.81"

Area (sf)	CN	Description
3,150	98	Roofs, HSG C
2,416	98	Paved parking, HSG C
32,558	74	>75% Grass cover, Good, HSG C
3,492	89	Gravel roads, HSG C
158,133	70	Woods, Good, HSG C
199,749	72	Weighted Average
194,183		97.21% Pervious Area
5,566		2.79% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.3	100	0.0200	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.25"
17.2	730	0.0200	0.71		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
38.5	830	Total			

Subcatchment EX-1:



Summary for Subcatchment EX-2:

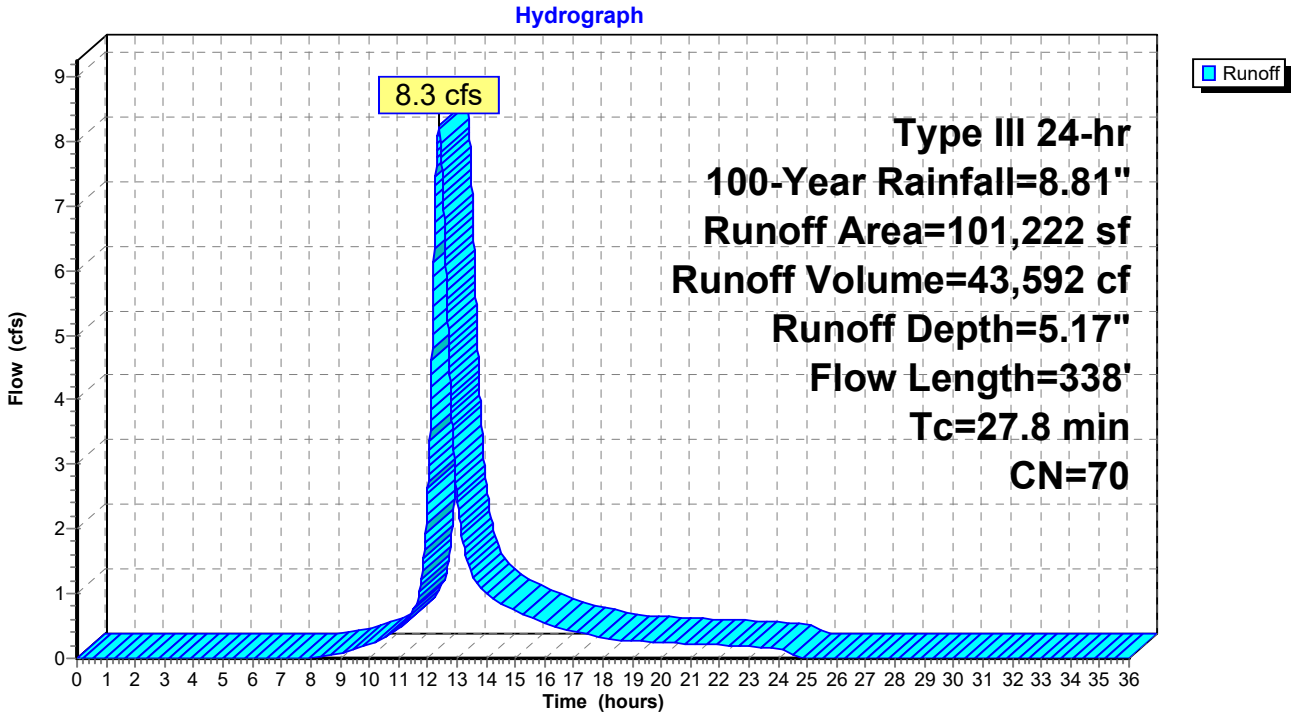
Runoff = 8.3 cfs @ 12.39 hrs, Volume= 43,592 cf, Depth= 5.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.81"

Area (sf)	CN	Description
101,222	70	Woods, Good, HSG C
101,222		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.3	100	0.0200	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.25"
6.5	238	0.0150	0.61		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
27.8	338	Total			

Subcatchment EX-2:

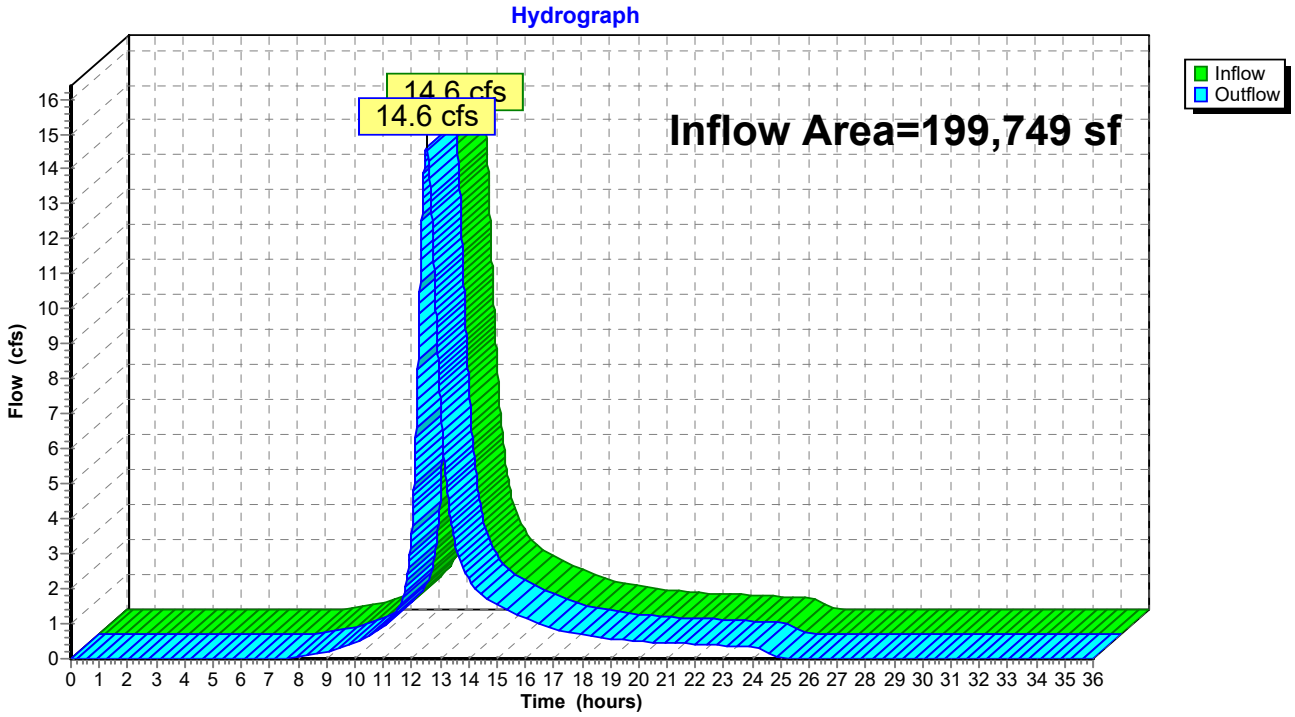


Summary for Reach DP-1: NE PROPERTY CORNER WETLAND

Inflow Area = 199,749 sf, 2.79% Impervious, Inflow Depth = 5.41" for 100-Year event
Inflow = 14.6 cfs @ 12.53 hrs, Volume= 90,086 cf
Outflow = 14.6 cfs @ 12.53 hrs, Volume= 90,086 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Reach DP-1: NE PROPERTY CORNER WETLAND

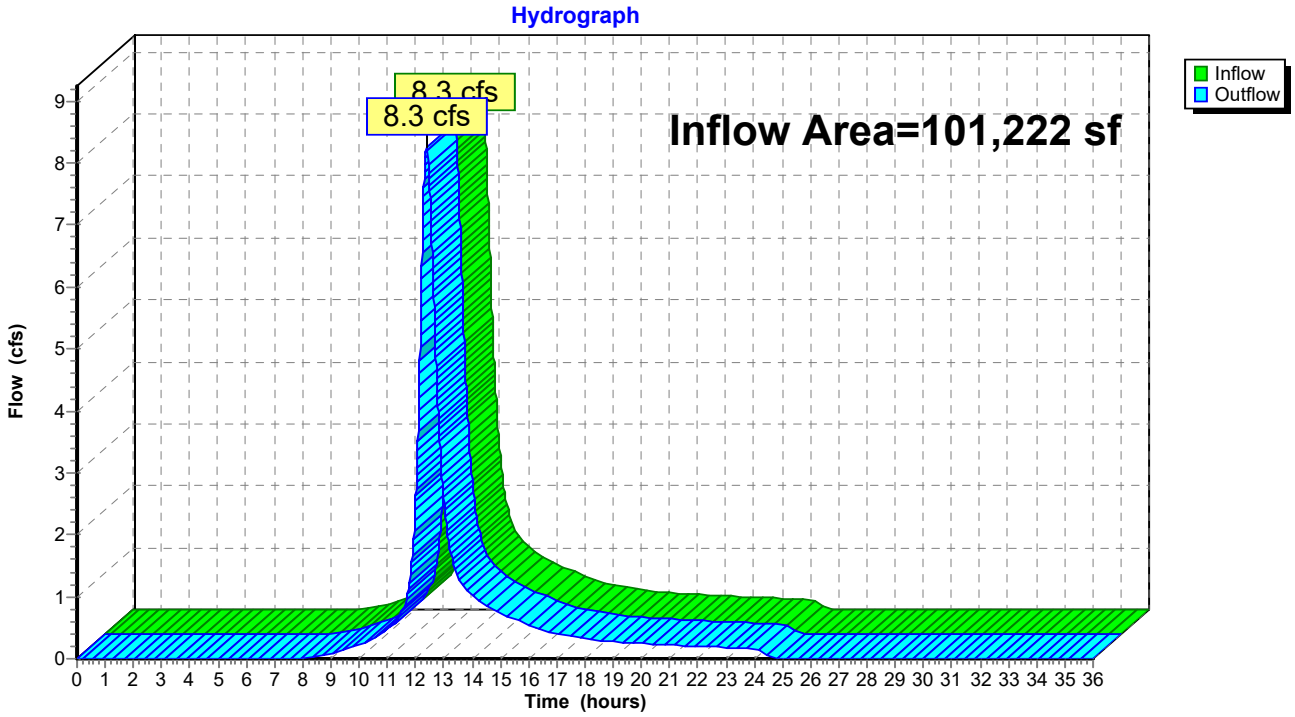


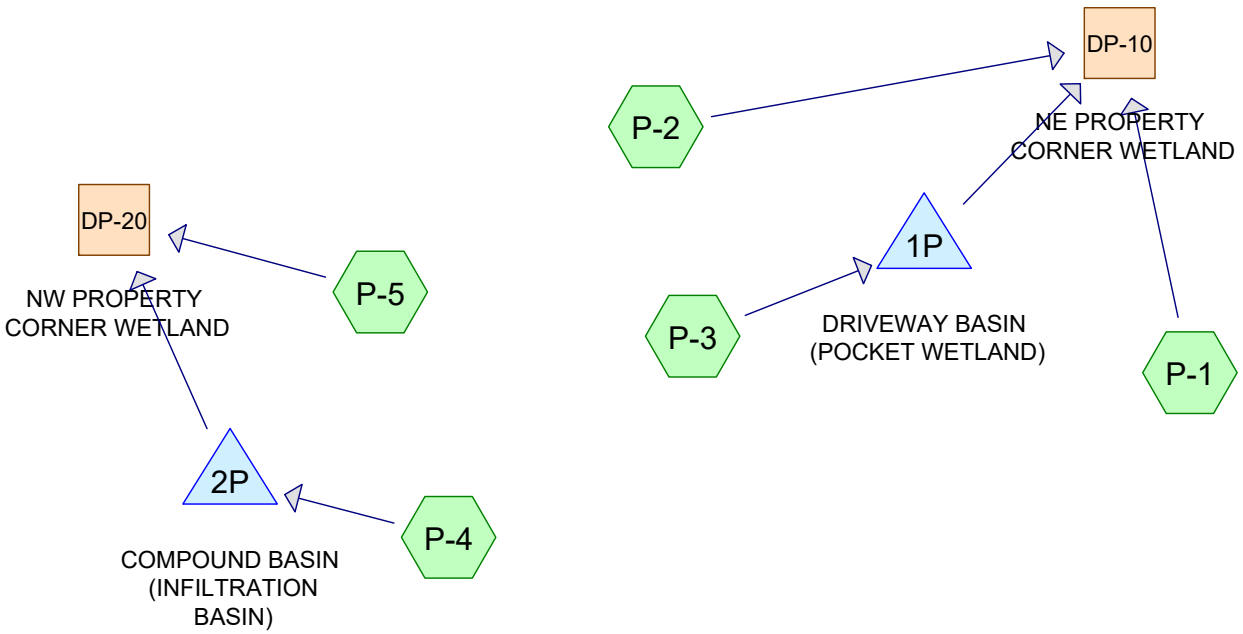
Summary for Reach DP-2: NW PROPERTY CORNER WETLAND

Inflow Area = 101,222 sf, 0.00% Impervious, Inflow Depth = 5.17" for 100-Year event
Inflow = 8.3 cfs @ 12.39 hrs, Volume= 43,592 cf
Outflow = 8.3 cfs @ 12.39 hrs, Volume= 43,592 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Reach DP-2: NW PROPERTY CORNER WETLAND





Subcat Reach Pond Link

Routing Diagram for KJS_Franklin Bent Street_Drainage-PRE & POST
Prepared by ProTerra Design Group, LLC, Printed 8/15/2023

Area Listing (selected nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
60,610	74	>75% Grass cover, Good, HSG C (P-1, P-2, P-3, P-4, P-5)
13,520	89	Gravel roads, HSG C (P-2, P-3, P-4)
4,186	98	Paved parking, HSG C (P-2, P-3, P-4)
807	89	Riprap, HSG C (P-1, P-3, P-4, P-5)
3,150	98	Roofs, HSG C (P-2)
218,698	70	Woods, Good, HSG C (P-1, P-2, P-3, P-4, P-5)

Soil Listing (selected nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
0	HSG A	
0	HSG B	
300,971	HSG C	P-1, P-2, P-3, P-4, P-5
0	HSG D	
0	Other	

Ground Covers (selected nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Sub Num
0	0	60,610	0	0	60,610	>75% Grass cover, Good	
0	0	13,520	0	0	13,520	Gravel roads	
0	0	4,186	0	0	4,186	Paved parking	
0	0	807	0	0	807	Riprap	
0	0	3,150	0	0	3,150	Roofs	
0	0	218,698	0	0	218,698	Woods, Good	

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 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 P-1: Runoff Area=7,999 sf 0.00% Impervious Runoff Depth=1.01"
Flow Length=160' Tc=21.5 min CN=73 Runoff=0.1 cfs 677 cf

Subcatchment P-2: Runoff Area=120,294 sf 4.98% Impervious Runoff Depth=1.07"
Flow Length=597' Tc=23.7 min CN=74 Runoff=2.1 cfs 10,732 cf

Subcatchment P-3: Runoff Area=82,885 sf 0.42% Impervious Runoff Depth=0.96"
Flow Length=680' Slope=0.0200 '/' Tc=35.0 min CN=72 Runoff=1.0 cfs 6,636 cf

Subcatchment P-4: Runoff Area=11,367 sf 8.80% Impervious Runoff Depth=1.31"
Flow Length=83' Slope=0.0200 '/' Tc=18.4 min CN=78 Runoff=0.3 cfs 1,241 cf

Subcatchment P-5: Runoff Area=78,426 sf 0.00% Impervious Runoff Depth=0.86"
Flow Length=277' Tc=24.4 min CN=70 Runoff=1.0 cfs 5,603 cf

Reach DP-10: NE PROPERTY CORNER WETLAND Inflow=2.2 cfs 17,031 cf
Outflow=2.2 cfs 17,031 cf

Reach DP-20: NW PROPERTY CORNER WETLAND Inflow=1.2 cfs 6,324 cf
Outflow=1.2 cfs 6,324 cf

Pond 1P: DRIVEWAY BASIN (POCKET Peak Elev=285.04' Storage=2,533 cf Inflow=1.0 cfs 6,636 cf
Outflow=0.5 cfs 5,622 cf

Pond 2P: COMPOUND BASIN (INFILTRATION Peak Elev=287.80' Storage=251 cf Inflow=0.3 cfs 1,241 cf
Discarded=0.0 cfs 520 cf Primary=0.2 cfs 721 cf Outflow=0.2 cfs 1,241 cf

Summary for Subcatchment P-1:

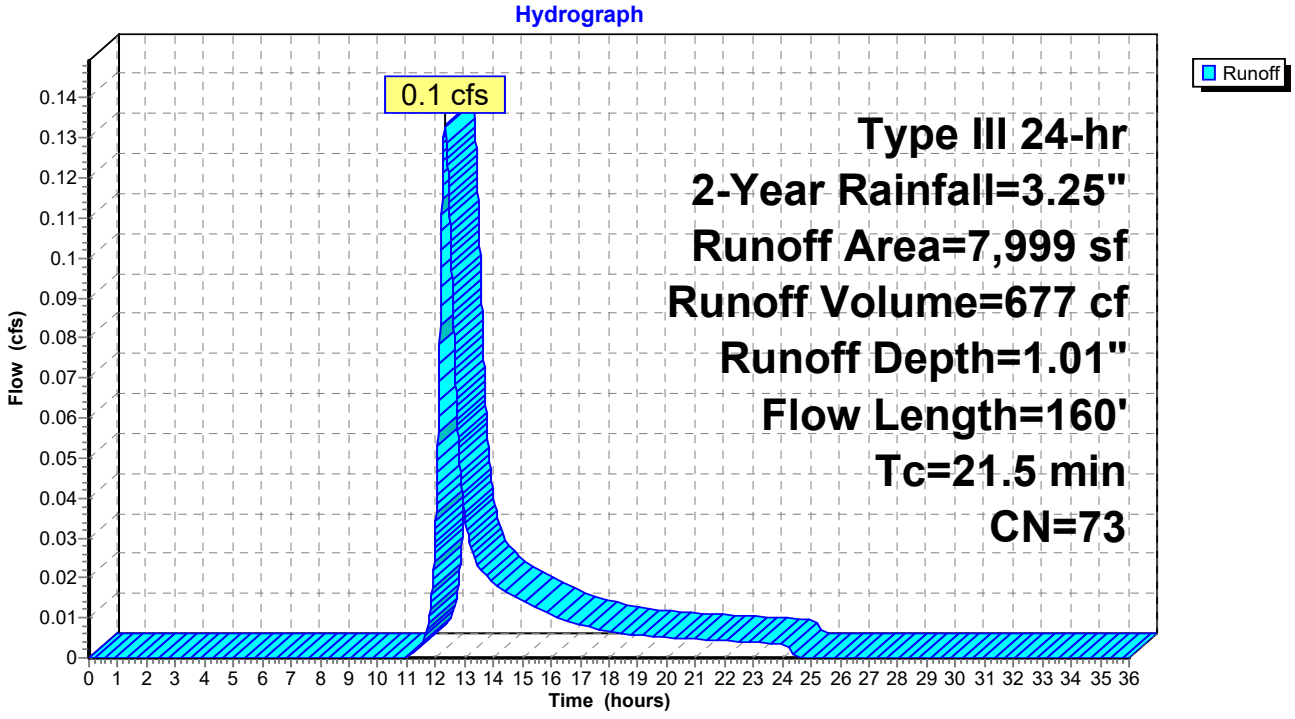
Runoff = 0.1 cfs @ 12.32 hrs, Volume= 677 cf, Depth= 1.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.25"

	Area (sf)	CN	Description
	3,984	74	>75% Grass cover, Good, HSG C
	3,688	70	Woods, Good, HSG C
*	327	89	Riprap, HSG C
	7,999	73	Weighted Average
	7,999		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.5	100	0.0220	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.25"
1.0	60	0.0400	1.00		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
21.5	160	Total			

Subcatchment P-1:



Summary for Subcatchment P-2:

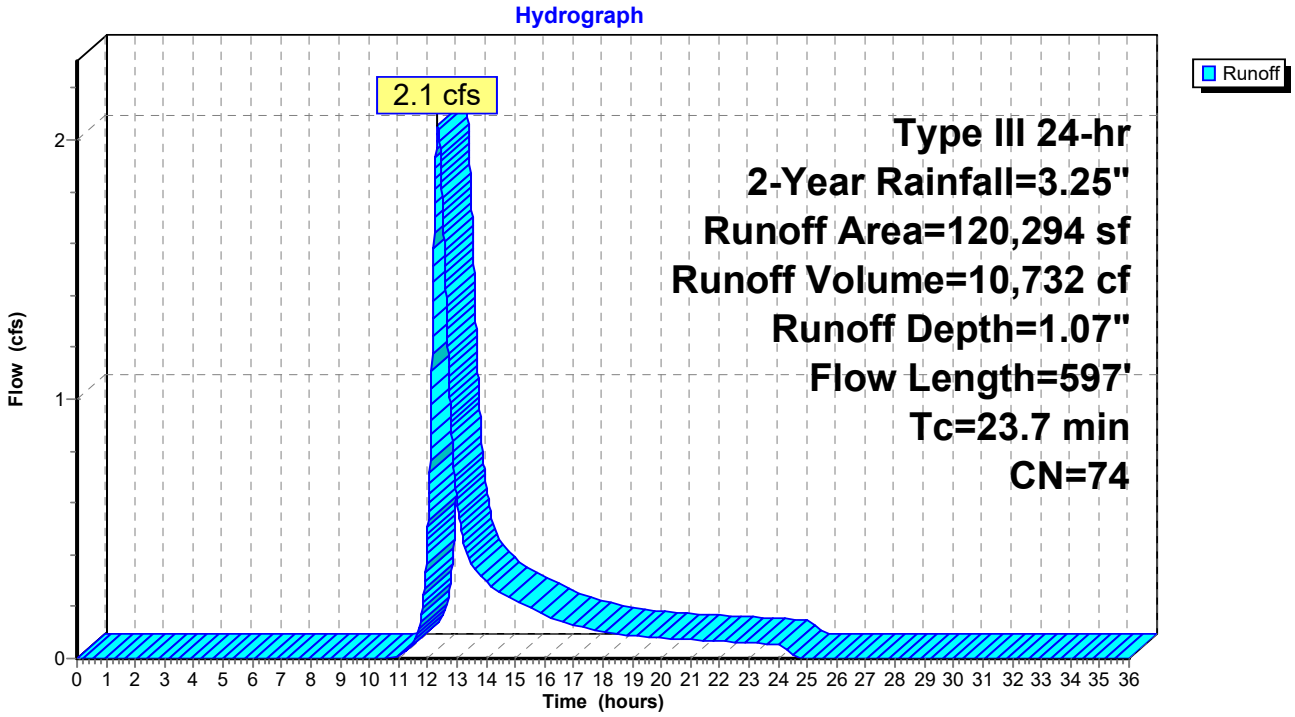
Runoff = 2.1 cfs @ 12.35 hrs, Volume= 10,732 cf, Depth= 1.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.25"

Area (sf)	CN	Description
3,150	98	Roofs, HSG C
2,836	98	Paved parking, HSG C
36,006	74	>75% Grass cover, Good, HSG C
6,592	89	Gravel roads, HSG C
71,710	70	Woods, Good, HSG C
120,294	74	Weighted Average
114,308		95.02% Pervious Area
5,986		4.98% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.1	100	0.0400	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.25"
4.3	173	0.0180	0.67		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
2.6	126	0.0130	0.80		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.5	168	0.0160	5.37	26.85	**Channel Flow,** Area= 5.0 sf Perim= 5.0' r= 1.00' n= 0.035 Earth, dense weeds
0.2	30	0.0100	2.74	3.36	**Pipe Channel,** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.025 Corrugated metal
23.7	597	Total			

Subcatchment P-2:



Summary for Subcatchment P-3:

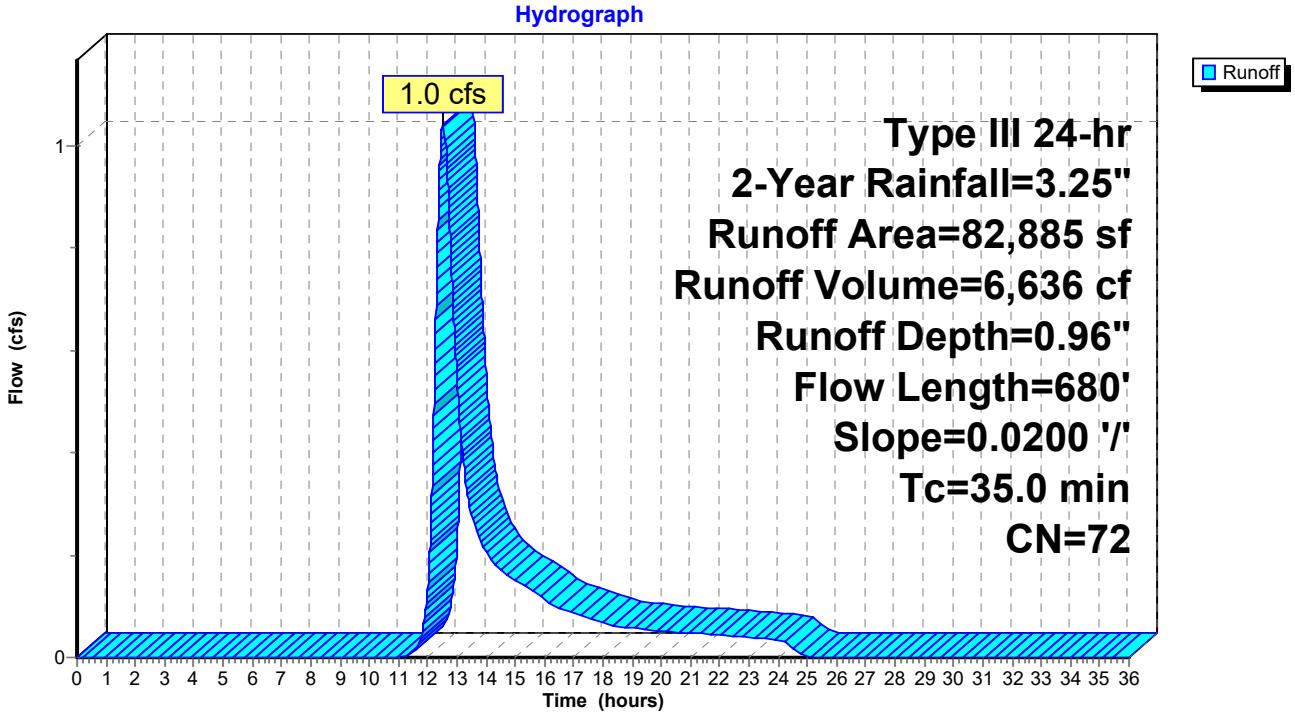
Runoff = 1.0 cfs @ 12.53 hrs, Volume= 6,636 cf, Depth= 0.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.25"

	Area (sf)	CN	Description
	350	98	Paved parking, HSG C
	10,443	74	>75% Grass cover, Good, HSG C
	5,265	89	Gravel roads, HSG C
	66,692	70	Woods, Good, HSG C
*	135	89	Riprap, HSG C
	82,885	72	Weighted Average
	82,535		99.58% Pervious Area
	350		0.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.3	100	0.0200	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.25"
13.7	580	0.0200	0.71		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
35.0	680	Total			

Subcatchment P-3:



Summary for Subcatchment P-4:

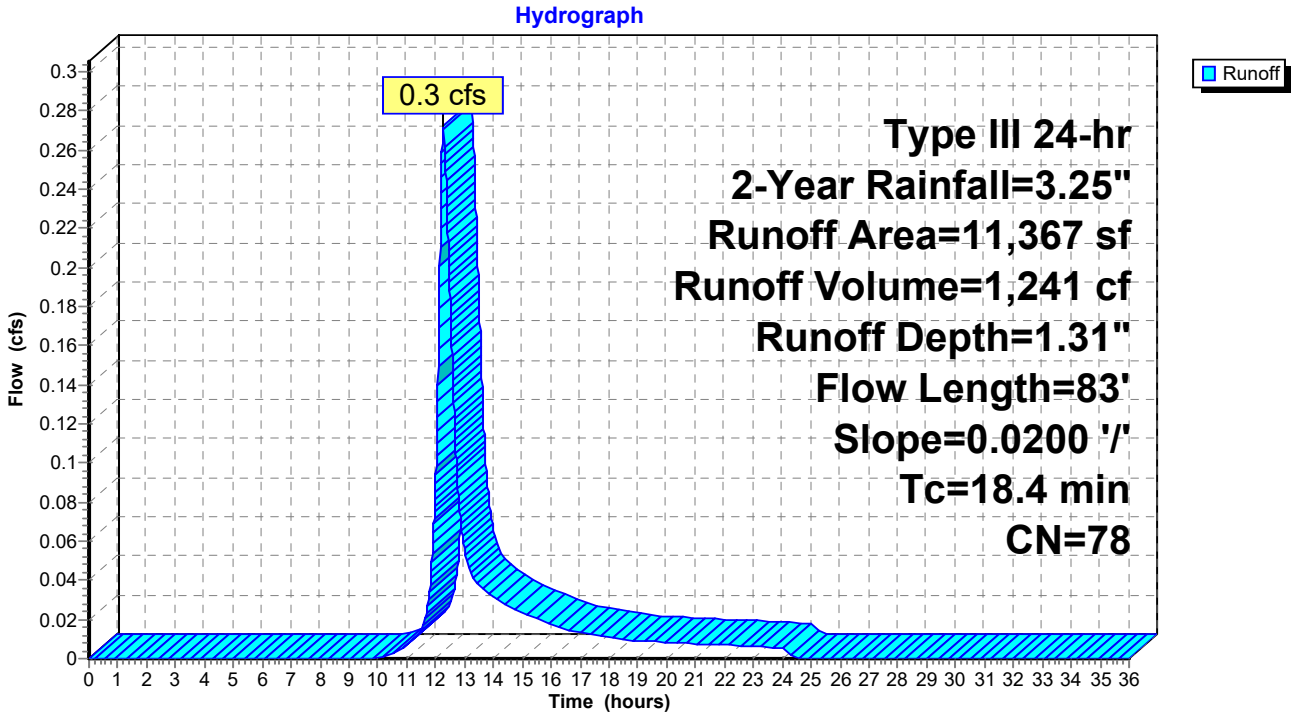
Runoff = 0.3 cfs @ 12.26 hrs, Volume= 1,241 cf, Depth= 1.31"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.25"

	Area (sf)	CN	Description
	1,000	98	Paved parking, HSG C
	6,403	74	>75% Grass cover, Good, HSG C
	1,663	89	Gravel roads, HSG C
	2,067	70	Woods, Good, HSG C
*	234	89	Riprap, HSG C
	11,367	78	Weighted Average
	10,367		91.20% Pervious Area
	1,000		8.80% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.4	83	0.0200	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.25"

Subcatchment P-4:



Summary for Subcatchment P-5:

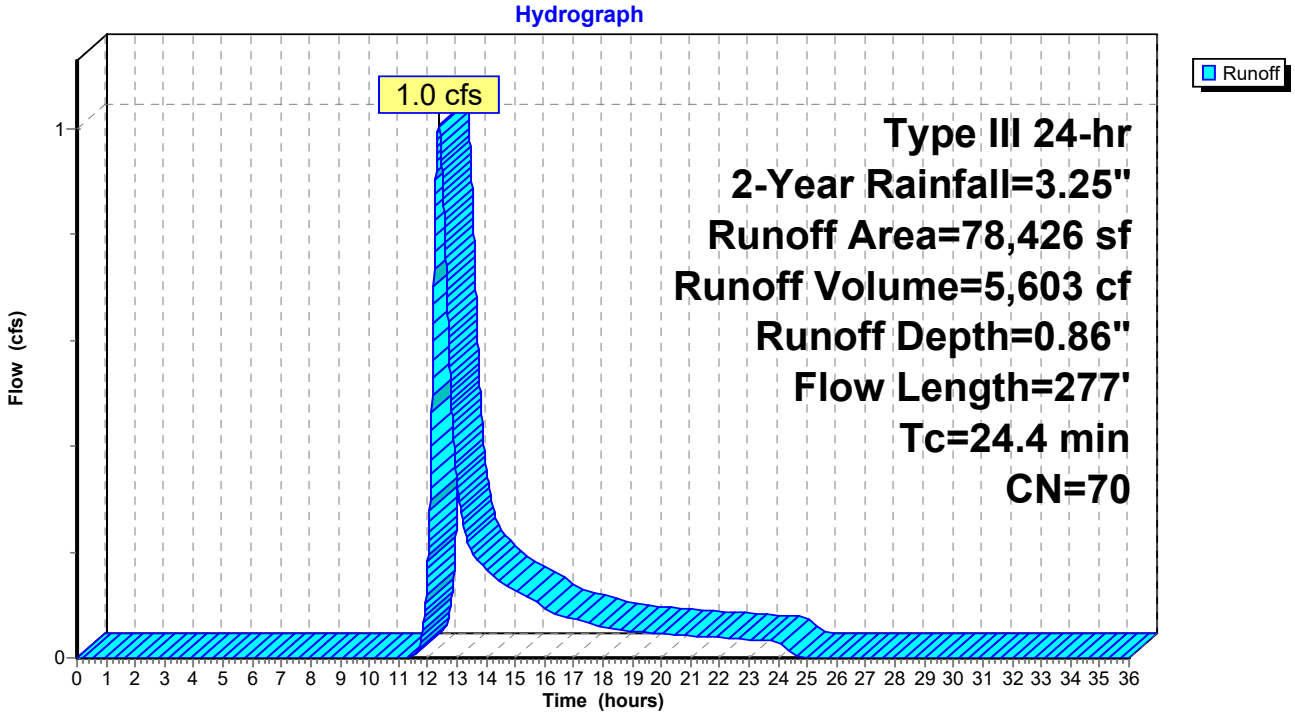
Runoff = 1.0 cfs @ 12.39 hrs, Volume= 5,603 cf, Depth= 0.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.25"

	Area (sf)	CN	Description
	3,774	74	>75% Grass cover, Good, HSG C
	74,541	70	Woods, Good, HSG C
*	111	89	Riprap, HSG C
	78,426	70	Weighted Average
	78,426		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.1	100	0.0400	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.25"
8.3	177	0.0050	0.35		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
24.4	277	Total			

Subcatchment P-5:

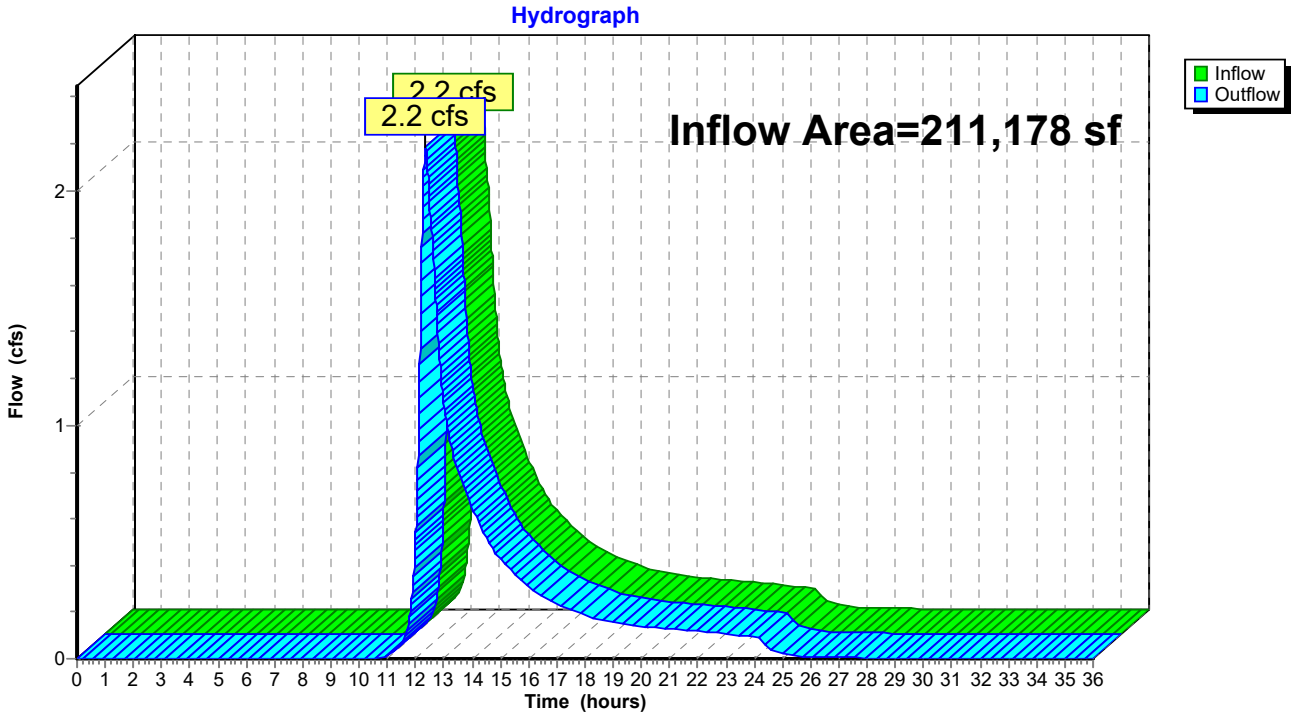


Summary for Reach DP-10: NE PROPERTY CORNER WETLAND

Inflow Area = 211,178 sf, 3.00% Impervious, Inflow Depth = 0.97" for 2-Year event
Inflow = 2.2 cfs @ 12.35 hrs, Volume= 17,031 cf
Outflow = 2.2 cfs @ 12.35 hrs, Volume= 17,031 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Reach DP-10: NE PROPERTY CORNER WETLAND

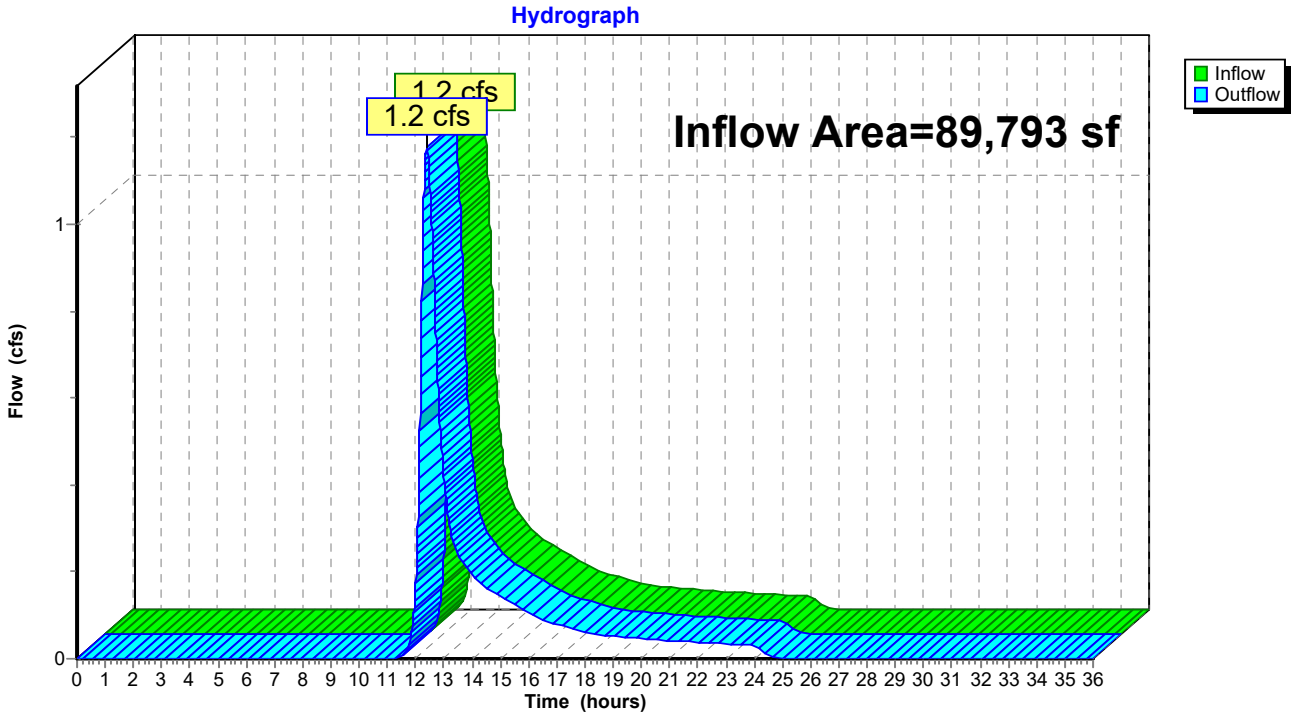


Summary for Reach DP-20: NW PROPERTY CORNER WETLAND

Inflow Area = 89,793 sf, 1.11% Impervious, Inflow Depth = 0.85" for 2-Year event
Inflow = 1.2 cfs @ 12.39 hrs, Volume= 6,324 cf
Outflow = 1.2 cfs @ 12.39 hrs, Volume= 6,324 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Reach DP-20: NW PROPERTY CORNER WETLAND



Summary for Pond 1P: DRIVEWAY BASIN (POCKET WETLAND)

Inflow Area = 82,885 sf, 0.42% Impervious, Inflow Depth = 0.96" for 2-Year event
Inflow = 1.0 cfs @ 12.53 hrs, Volume= 6,636 cf
Outflow = 0.5 cfs @ 13.11 hrs, Volume= 5,622 cf, Atten= 57%, Lag= 34.9 min
Primary = 0.5 cfs @ 13.11 hrs, Volume= 5,622 cf

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Starting Elev= 283.50' Surf.Area= 998 sf Storage= 443 cf
Peak Elev= 285.04' @ 13.11 hrs Surf.Area= 1,743 sf Storage= 2,533 cf (2,090 cf above start)

Plug-Flow detention time= 180.9 min calculated for 5,179 cf (78% of inflow)
Center-of-Mass det. time= 75.7 min (970.3 - 894.6)

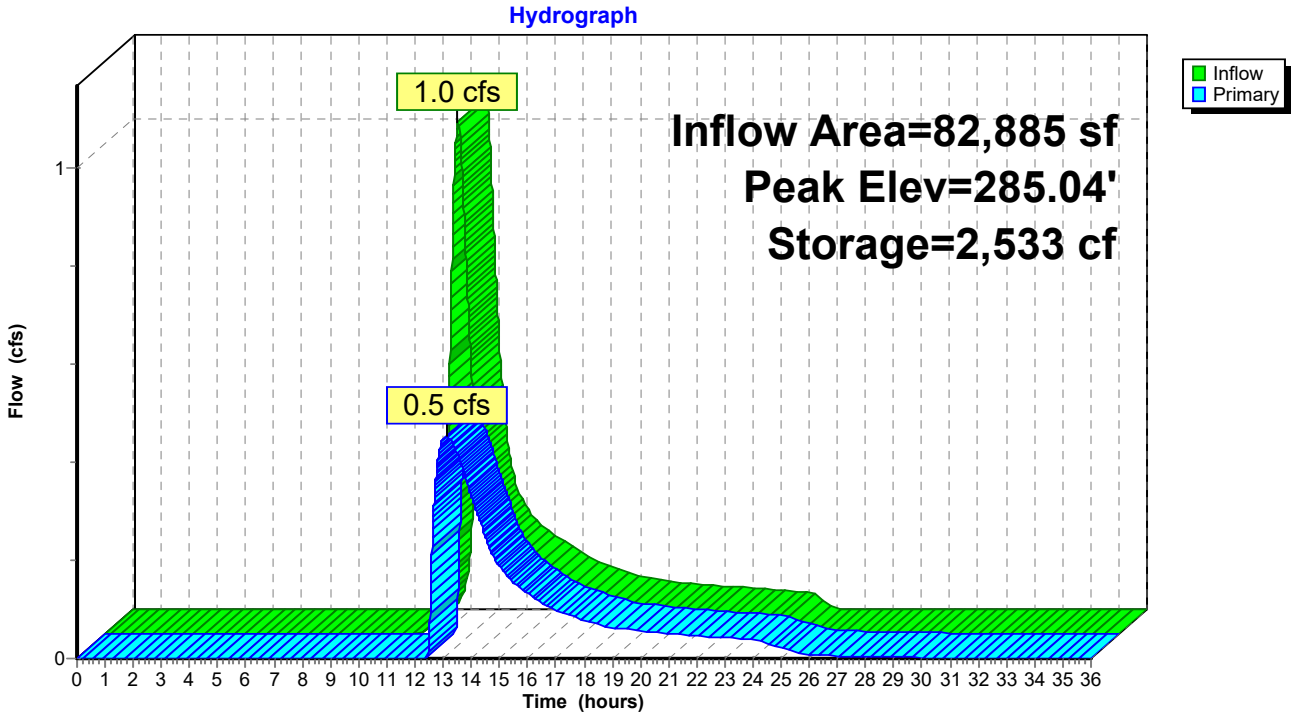
Volume	Invert	Avail.Storage	Storage Description
#1	283.00'	12,279 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
283.00	775	0	0
284.00	1,221	998	998
285.00	1,723	1,472	2,470
286.00	2,282	2,003	4,473
287.00	2,897	2,590	7,062
288.00	4,068	3,483	10,545
288.40	4,606	1,735	12,279

Device	Routing	Invert	Outlet Devices
#1	Primary	287.33'	**10.0' long x 11.4' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.54 2.60 2.70 2.68 2.67 2.68 2.66 2.64
#2	Primary	284.35'	**15.0" Round Culvert** L= 34.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 284.35' / 284.00' S= 0.0103 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf
#3	Device 2	284.35'	**5.0" Vert. Orifice** C= 0.600
#4	Device 2	285.18'	**5.5" Vert. Orifice** C= 0.600
#5	Device 2	287.00'	**24.0" Horiz. Orifice w/Trash Rack** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.5 cfs @ 13.11 hrs HW=285.04' (Free Discharge)
- **1=Broad-Crested Rectangular Weir** (Controls 0.0 cfs)
- **2=Culvert** (Passes 0.5 cfs of 1.5 cfs potential flow)
  - **3=Orifice** (Orifice Controls 0.5 cfs @ 3.33 fps)
  - **4=Orifice** (Controls 0.0 cfs)
  - **5=Orifice w/Trash Rack** (Controls 0.0 cfs)

Pond 1P: DRIVEWAY BASIN (POCKET WETLAND)



Summary for Pond 2P: COMPOUND BASIN (INFILTRATION BASIN)

Inflow Area = 11,367 sf, 8.80% Impervious, Inflow Depth = 1.31" for 2-Year event
Inflow = 0.3 cfs @ 12.26 hrs, Volume= 1,241 cf
Outflow = 0.2 cfs @ 12.49 hrs, Volume= 1,241 cf, Atten= 30%, Lag= 13.4 min
Discarded = 0.0 cfs @ 12.49 hrs, Volume= 520 cf
Primary = 0.2 cfs @ 12.49 hrs, Volume= 721 cf

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 287.80' @ 12.49 hrs Surf.Area= 571 sf Storage= 251 cf

Plug-Flow detention time= 65.8 min calculated for 1,241 cf (100% of inflow)
Center-of-Mass det. time= 65.8 min (925.6 - 859.8)

Volume	Invert	Avail.Storage	Storage Description
#1	287.20'	4,318 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

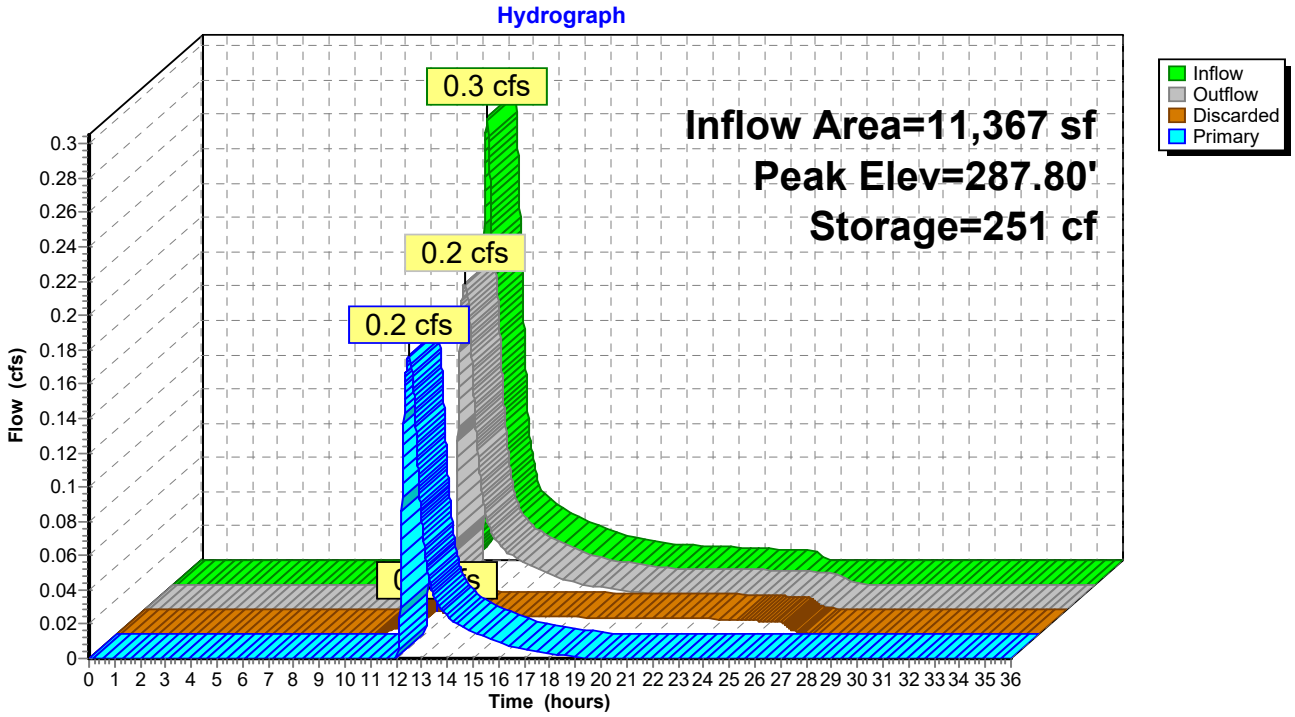
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
287.20	264	0	0
288.00	671	374	374
289.00	1,542	1,107	1,481
289.50	2,132	919	2,399
290.00	3,012	1,286	3,685
290.20	3,314	633	4,318

Device	Routing	Invert	Outlet Devices
#1	Discarded	287.20'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	289.05'	**10.0' long x 11.9' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.56 2.61 2.70 2.67 2.66 2.67 2.66 2.64
#3	Primary	287.28'	**12.0" Round Culvert** L= 16.8' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 287.28' / 287.20' S= 0.0048 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#4	Device 3	287.46'	**4.0" Vert. Orifice** C= 0.600
#5	Device 3	289.05'	**24.0" Horiz. Orifice w/Trash Rack** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.0 cfs @ 12.49 hrs HW=287.80' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.2 cfs @ 12.49 hrs HW=287.80' (Free Discharge)
├**2=Broad-Crested Rectangular Weir** (Controls 0.0 cfs)
└**3=Culvert** (Passes 0.2 cfs of 0.7 cfs potential flow)
  ├**4=Orifice** (Orifice Controls 0.2 cfs @ 2.02 fps)
  └**5=Orifice w/Trash Rack** (Controls 0.0 cfs)

Pond 2P: COMPOUND BASIN (INFILTRATION BASIN)



Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 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 P-1: Runoff Area=7,999 sf 0.00% Impervious Runoff Depth=2.19"
Flow Length=160' Tc=21.5 min CN=73 Runoff=0.3 cfs 1,463 cf

Subcatchment P-2: Runoff Area=120,294 sf 4.98% Impervious Runoff Depth=2.28"
Flow Length=597' Tc=23.7 min CN=74 Runoff=4.6 cfs 22,824 cf

Subcatchment P-3: Runoff Area=82,885 sf 0.42% Impervious Runoff Depth=2.11"
Flow Length=680' Slope=0.0200 '/' Tc=35.0 min CN=72 Runoff=2.4 cfs 14,598 cf

Subcatchment P-4: Runoff Area=11,367 sf 8.80% Impervious Runoff Depth=2.62"
Flow Length=83' Slope=0.0200 '/' Tc=18.4 min CN=78 Runoff=0.6 cfs 2,480 cf

Subcatchment P-5: Runoff Area=78,426 sf 0.00% Impervious Runoff Depth=1.96"
Flow Length=277' Tc=24.4 min CN=70 Runoff=2.5 cfs 12,778 cf

Reach DP-10: NE PROPERTY CORNER WETLAND Inflow=5.3 cfs 37,870 cf
Outflow=5.3 cfs 37,870 cf

Reach DP-20: NW PROPERTY CORNER WETLAND Inflow=2.8 cfs 15,172 cf
Outflow=2.8 cfs 15,172 cf

Pond 1P: DRIVEWAY BASIN (POCKET Peak Elev=286.02' Storage=4,522 cf Inflow=2.4 cfs 14,598 cf
Outflow=1.4 cfs 13,584 cf

Pond 2P: COMPOUND BASIN (INFILTRATION Peak Elev=288.22' Storage=540 cf Inflow=0.6 cfs 2,480 cf
Discarded=0.0 cfs 0 cf Primary=0.3 cfs 2,394 cf Outflow=0.3 cfs 2,394 cf

Summary for Subcatchment P-1:

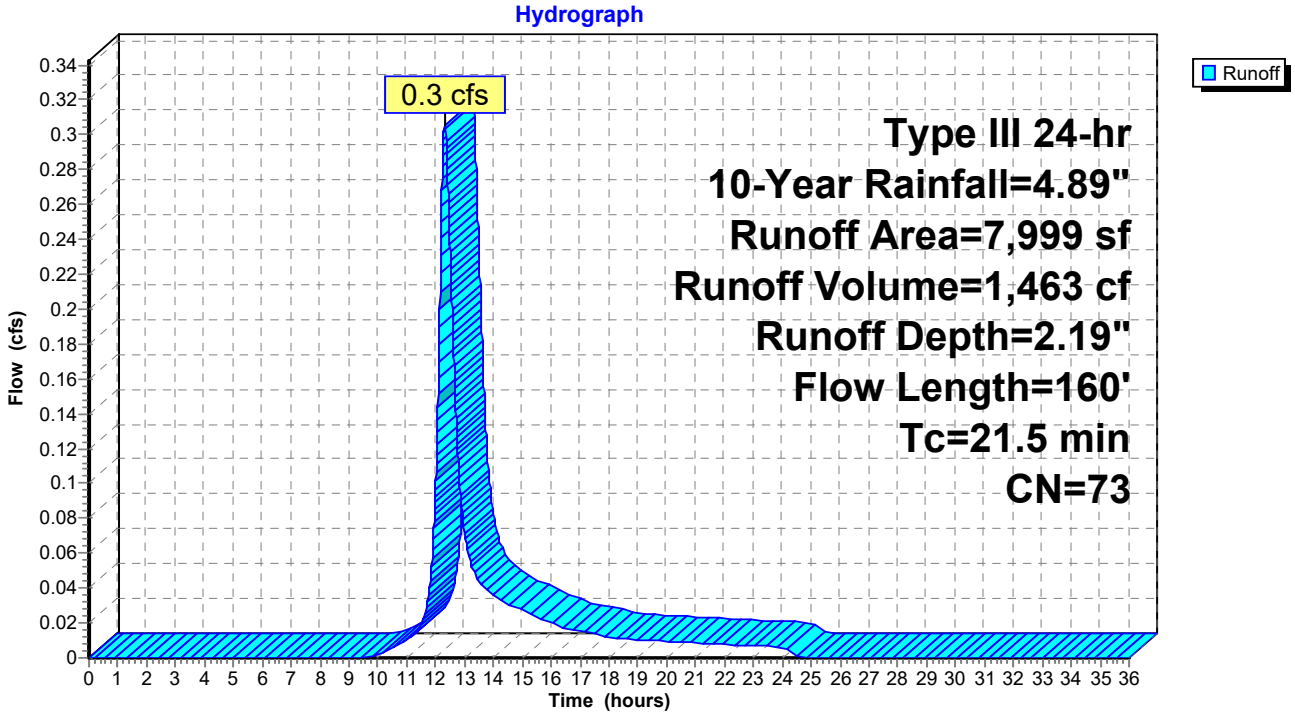
Runoff = 0.3 cfs @ 12.30 hrs, Volume= 1,463 cf, Depth= 2.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.89"

	Area (sf)	CN	Description
	3,984	74	>75% Grass cover, Good, HSG C
	3,688	70	Woods, Good, HSG C
*	327	89	Riprap, HSG C
	7,999	73	Weighted Average
	7,999		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.5	100	0.0220	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.25"
1.0	60	0.0400	1.00		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
21.5	160	Total			

Subcatchment P-1:



Summary for Subcatchment P-2:

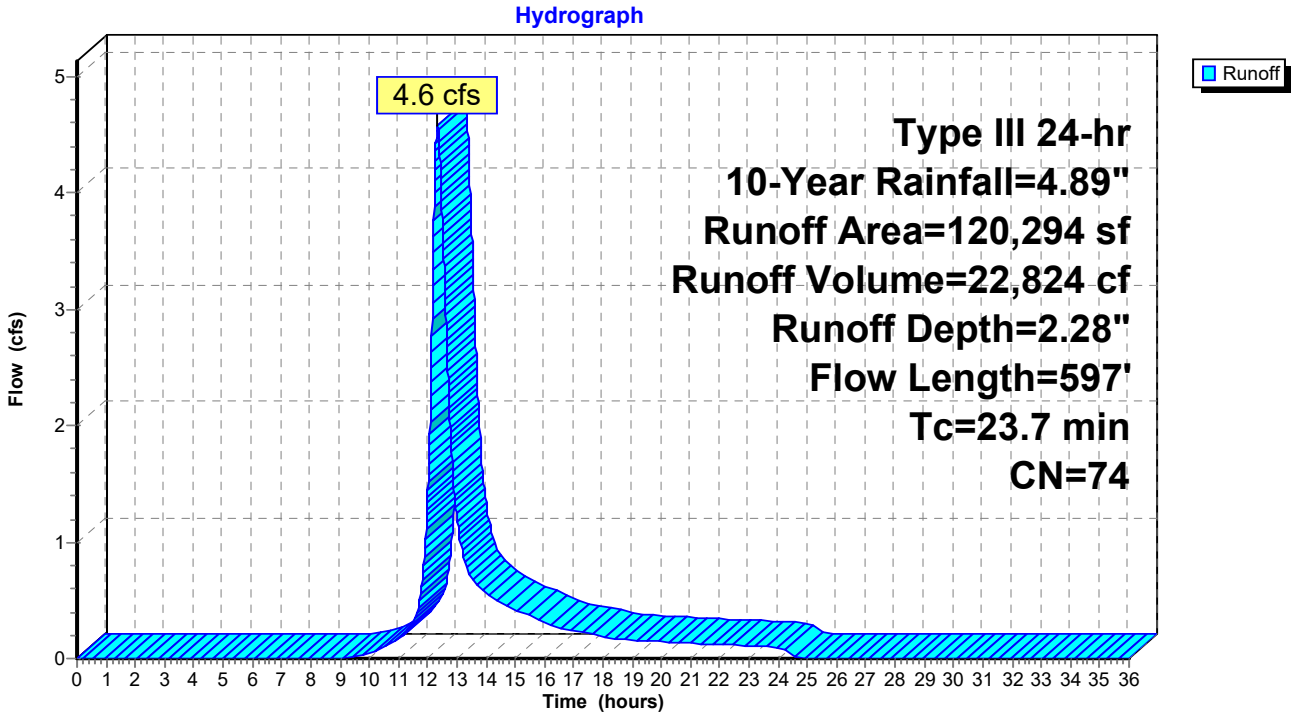
Runoff = 4.6 cfs @ 12.35 hrs, Volume= 22,824 cf, Depth= 2.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.89"

Area (sf)	CN	Description
3,150	98	Roofs, HSG C
2,836	98	Paved parking, HSG C
36,006	74	>75% Grass cover, Good, HSG C
6,592	89	Gravel roads, HSG C
71,710	70	Woods, Good, HSG C
120,294	74	Weighted Average
114,308		95.02% Pervious Area
5,986		4.98% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.1	100	0.0400	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.25"
4.3	173	0.0180	0.67		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
2.6	126	0.0130	0.80		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.5	168	0.0160	5.37	26.85	**Channel Flow,** Area= 5.0 sf Perim= 5.0' r= 1.00' n= 0.035 Earth, dense weeds
0.2	30	0.0100	2.74	3.36	**Pipe Channel,** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.025 Corrugated metal
23.7	597	Total			

Subcatchment P-2:



Summary for Subcatchment P-3:

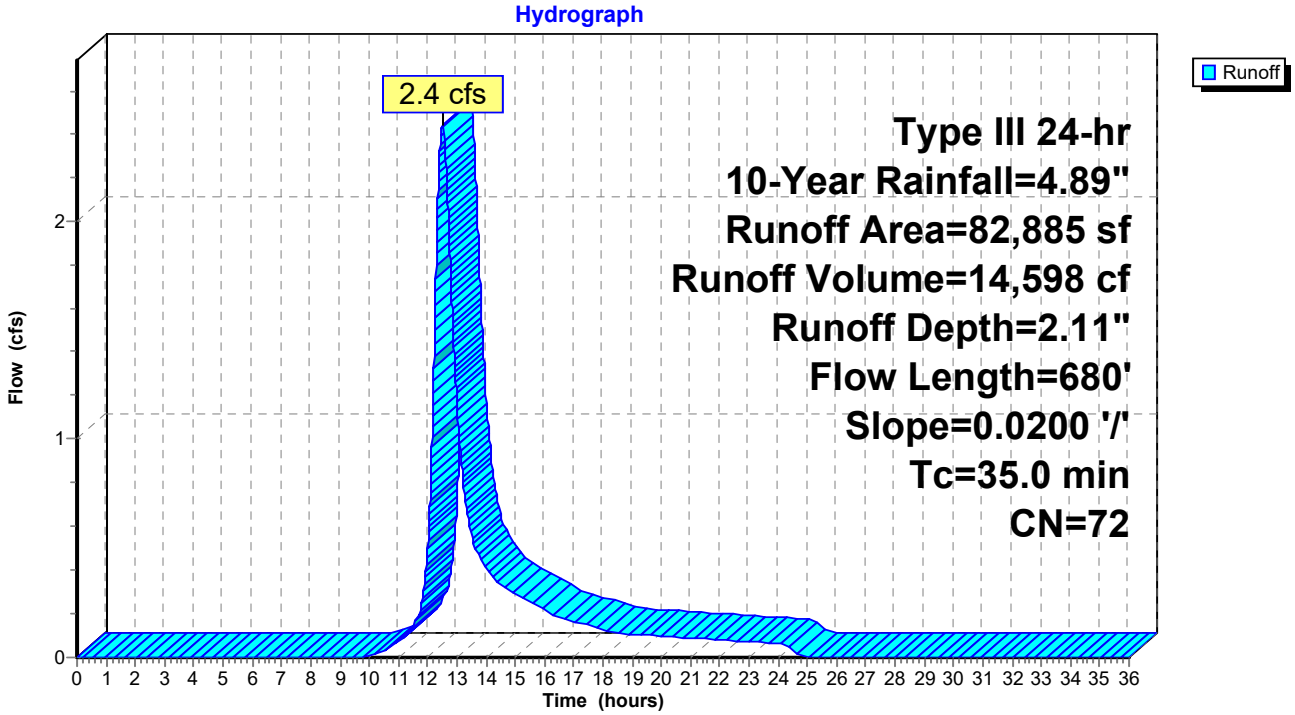
Runoff = 2.4 cfs @ 12.49 hrs, Volume= 14,598 cf, Depth= 2.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.89"

	Area (sf)	CN	Description
	350	98	Paved parking, HSG C
	10,443	74	>75% Grass cover, Good, HSG C
	5,265	89	Gravel roads, HSG C
	66,692	70	Woods, Good, HSG C
*	135	89	Riprap, HSG C
	82,885	72	Weighted Average
	82,535		99.58% Pervious Area
	350		0.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.3	100	0.0200	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.25"
13.7	580	0.0200	0.71		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
35.0	680	Total			

Subcatchment P-3:



Summary for Subcatchment P-4:

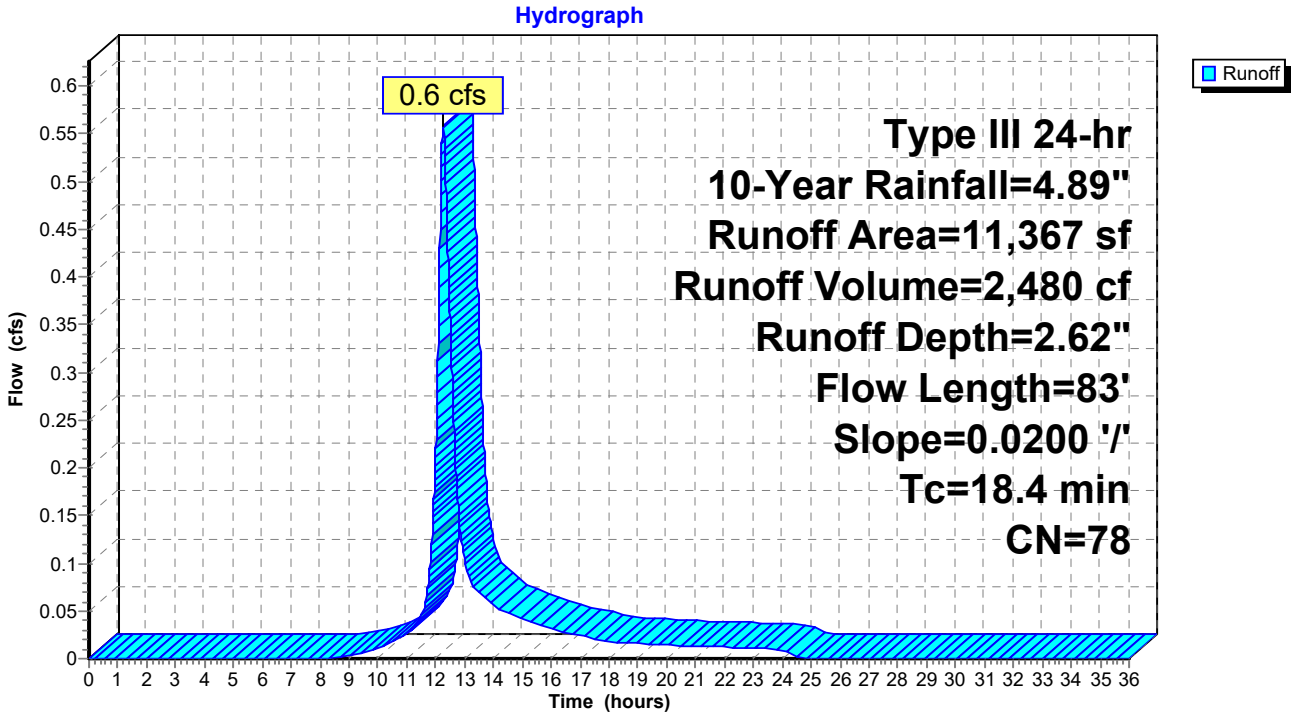
Runoff = 0.6 cfs @ 12.25 hrs, Volume= 2,480 cf, Depth= 2.62"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.89"

	Area (sf)	CN	Description
	1,000	98	Paved parking, HSG C
	6,403	74	>75% Grass cover, Good, HSG C
	1,663	89	Gravel roads, HSG C
	2,067	70	Woods, Good, HSG C
*	234	89	Riprap, HSG C
	11,367	78	Weighted Average
	10,367		91.20% Pervious Area
	1,000		8.80% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.4	83	0.0200	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.25"

Subcatchment P-4:



Summary for Subcatchment P-5:

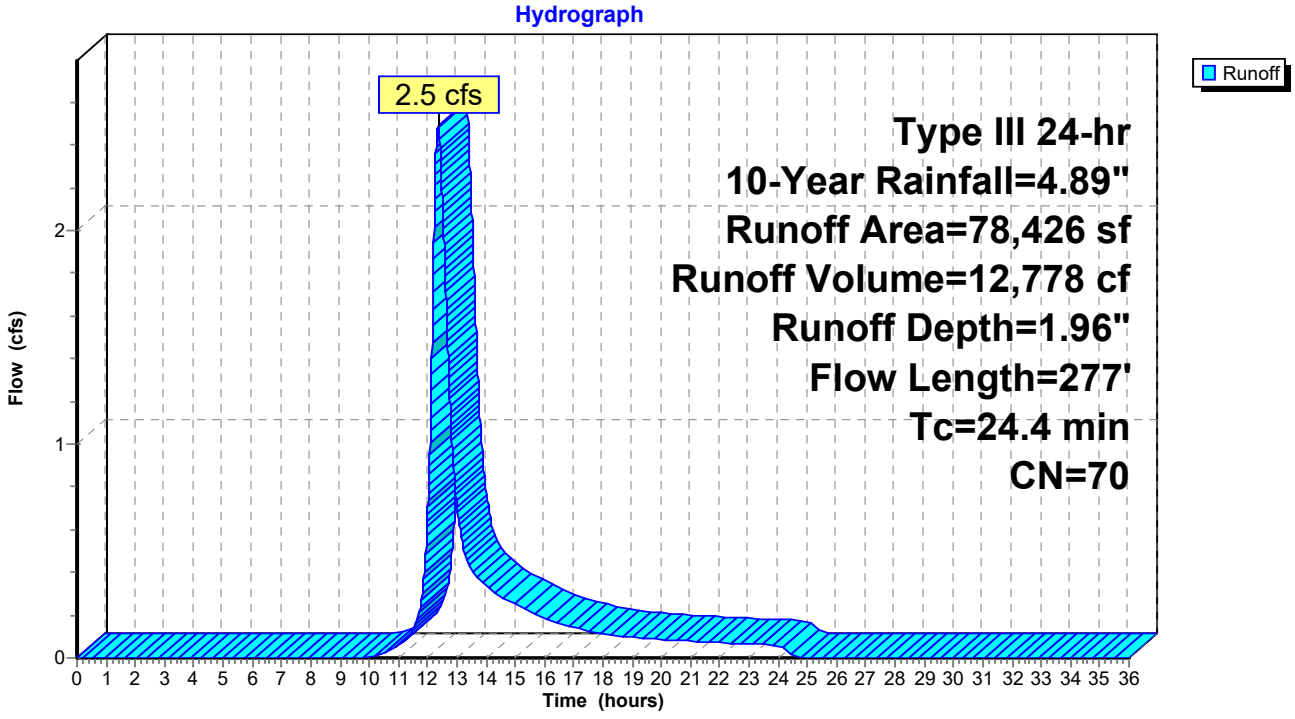
Runoff = 2.5 cfs @ 12.36 hrs, Volume= 12,778 cf, Depth= 1.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.89"

	Area (sf)	CN	Description
	3,774	74	>75% Grass cover, Good, HSG C
	74,541	70	Woods, Good, HSG C
*	111	89	Riprap, HSG C
	78,426	70	Weighted Average
	78,426		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.1	100	0.0400	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.25"
8.3	177	0.0050	0.35		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
24.4	277	Total			

Subcatchment P-5:

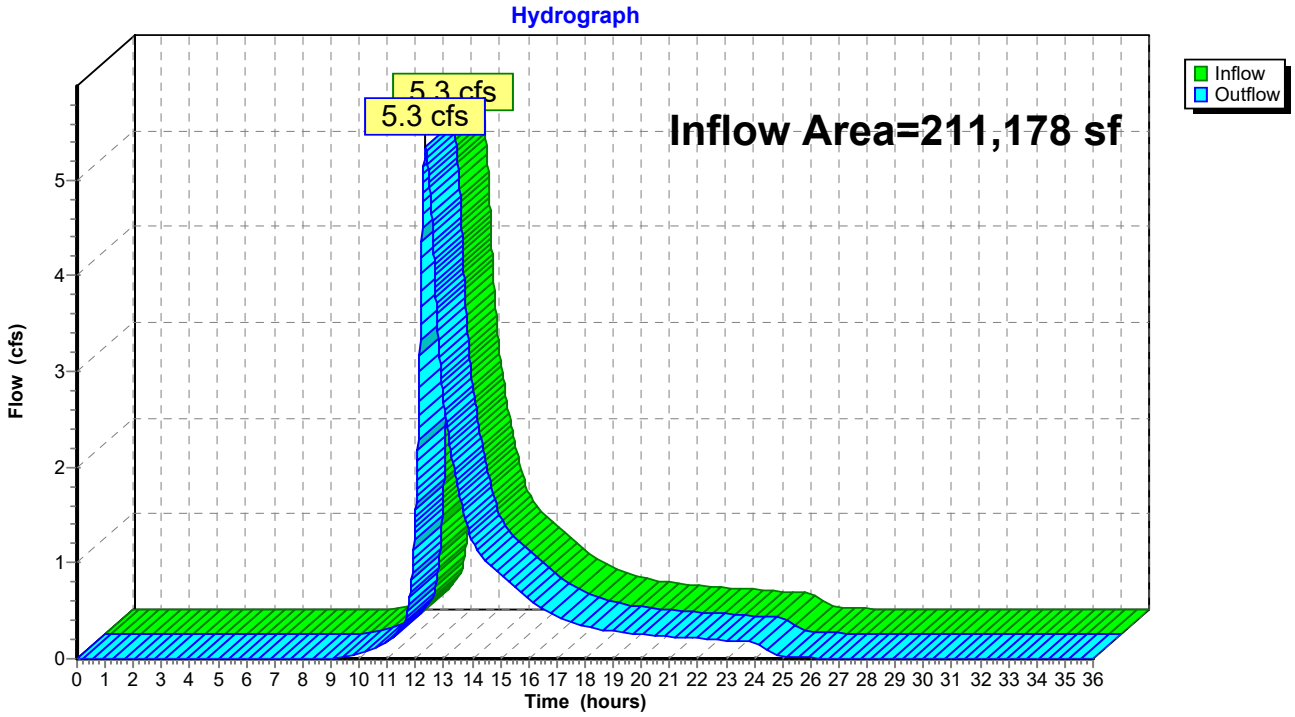


Summary for Reach DP-10: NE PROPERTY CORNER WETLAND

Inflow Area = 211,178 sf, 3.00% Impervious, Inflow Depth = 2.15" for 10-Year event
Inflow = 5.3 cfs @ 12.35 hrs, Volume= 37,870 cf
Outflow = 5.3 cfs @ 12.35 hrs, Volume= 37,870 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Reach DP-10: NE PROPERTY CORNER WETLAND

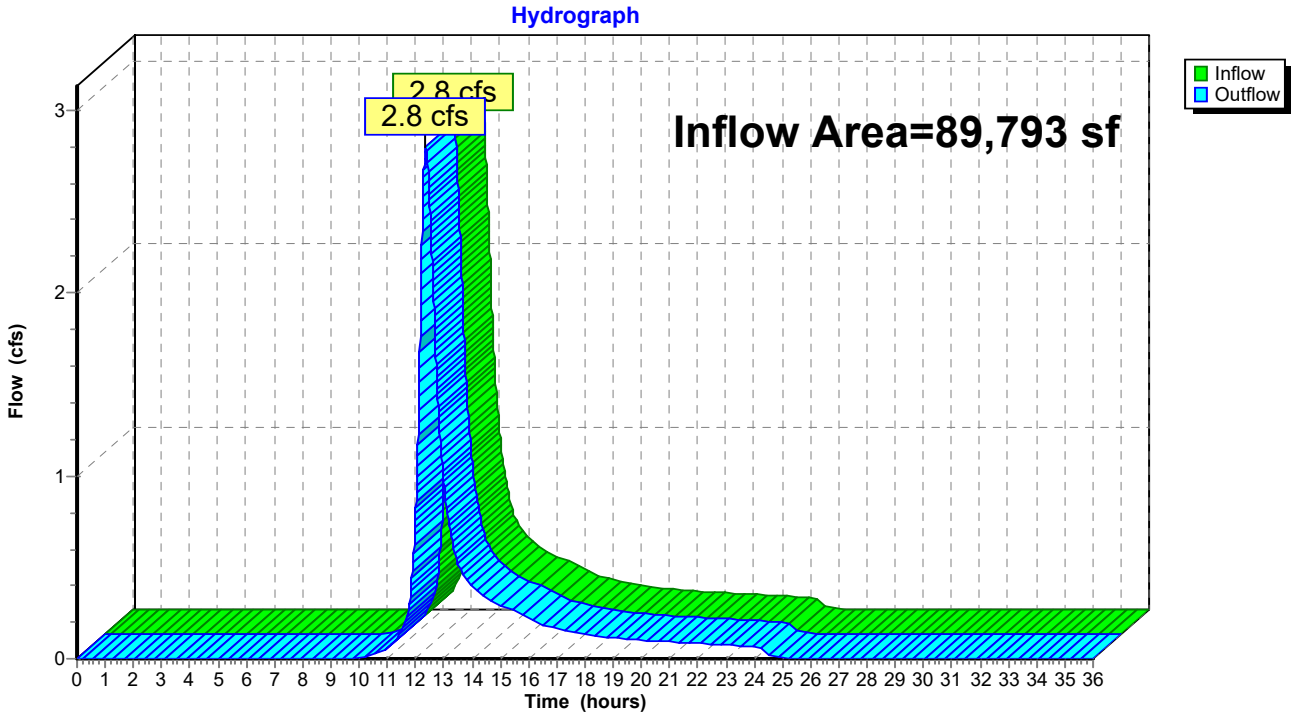


Summary for Reach DP-20: NW PROPERTY CORNER WETLAND

Inflow Area = 89,793 sf, 1.11% Impervious, Inflow Depth = 2.03" for 10-Year event
Inflow = 2.8 cfs @ 12.36 hrs, Volume= 15,172 cf
Outflow = 2.8 cfs @ 12.36 hrs, Volume= 15,172 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Reach DP-20: NW PROPERTY CORNER WETLAND



Summary for Pond 1P: DRIVEWAY BASIN (POCKET WETLAND)

Inflow Area = 82,885 sf, 0.42% Impervious, Inflow Depth = 2.11" for 10-Year event
Inflow = 2.4 cfs @ 12.49 hrs, Volume= 14,598 cf
Outflow = 1.4 cfs @ 12.90 hrs, Volume= 13,584 cf, Atten= 42%, Lag= 24.5 min
Primary = 1.4 cfs @ 12.90 hrs, Volume= 13,584 cf

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Starting Elev= 283.50' Surf.Area= 998 sf Storage= 443 cf
Peak Elev= 286.02' @ 12.90 hrs Surf.Area= 2,295 sf Storage= 4,522 cf (4,078 cf above start)

Plug-Flow detention time= 108.1 min calculated for 13,137 cf (90% of inflow)
Center-of-Mass det. time= 53.4 min (923.9 - 870.6)

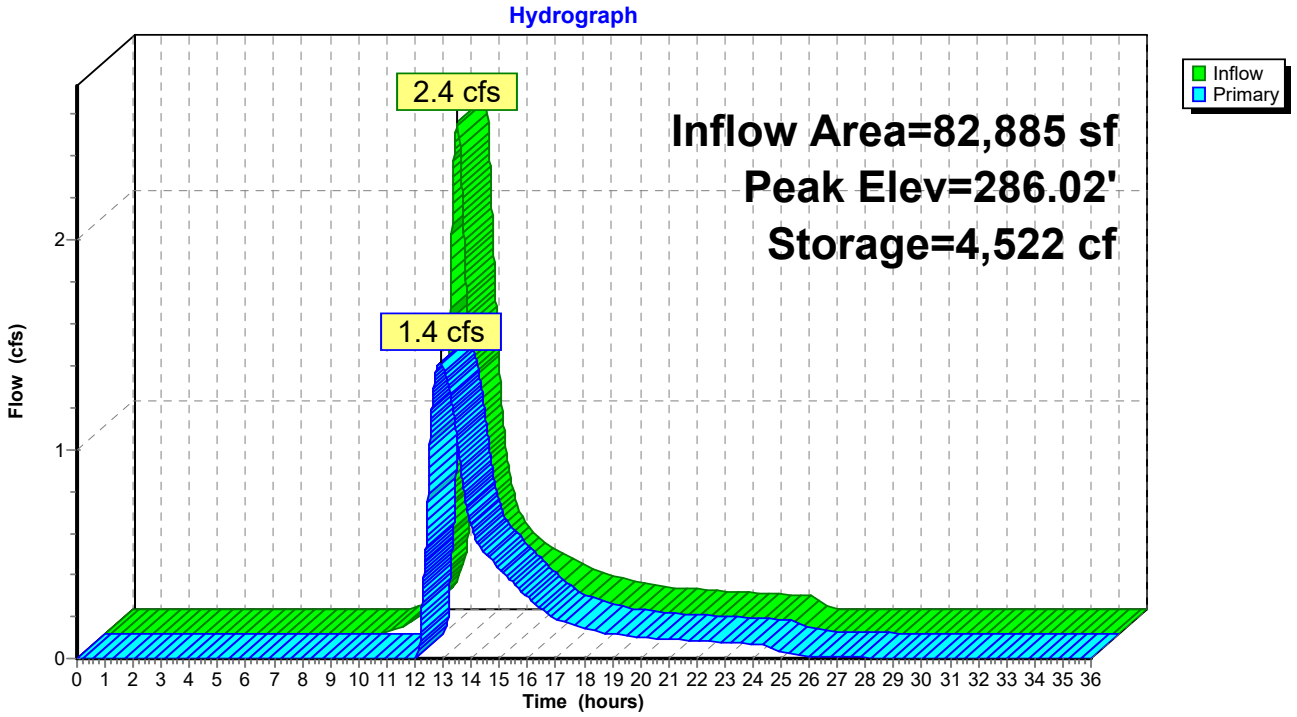
Volume	Invert	Avail.Storage	Storage Description
#1	283.00'	12,279 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
283.00	775	0	0
284.00	1,221	998	998
285.00	1,723	1,472	2,470
286.00	2,282	2,003	4,473
287.00	2,897	2,590	7,062
288.00	4,068	3,483	10,545
288.40	4,606	1,735	12,279

Device	Routing	Invert	Outlet Devices
#1	Primary	287.33'	**10.0' long x 11.4' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.54 2.60 2.70 2.68 2.67 2.68 2.66 2.64
#2	Primary	284.35'	**15.0" Round Culvert** L= 34.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 284.35' / 284.00' S= 0.0103 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf
#3	Device 2	284.35'	**5.0" Vert. Orifice** C= 0.600
#4	Device 2	285.18'	**5.5" Vert. Orifice** C= 0.600
#5	Device 2	287.00'	**24.0" Horiz. Orifice w/Trash Rack** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=1.4 cfs @ 12.90 hrs HW=286.02' (Free Discharge)
- **1=Broad-Crested Rectangular Weir** (Controls 0.0 cfs)
- **2=Culvert** (Passes 1.4 cfs of 4.8 cfs potential flow)
  - **3=Orifice** (Orifice Controls 0.8 cfs @ 5.82 fps)
  - **4=Orifice** (Orifice Controls 0.6 cfs @ 3.77 fps)
  - **5=Orifice w/Trash Rack** (Controls 0.0 cfs)

Pond 1P: DRIVEWAY BASIN (POCKET WETLAND)



Summary for Pond 2P: COMPOUND BASIN (INFILTRATION BASIN)

Inflow Area = 11,367 sf, 8.80% Impervious, Inflow Depth = 2.62" for 10-Year event
Inflow = 0.6 cfs @ 12.25 hrs, Volume= 2,480 cf
Outflow = 0.3 cfs @ 12.54 hrs, Volume= 2,394 cf, Atten= 42%, Lag= 17.2 min
Discarded = 0.0 cfs @ 0.00 hrs, Volume= 0 cf
Primary = 0.3 cfs @ 12.54 hrs, Volume= 2,394 cf

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 288.22' @ 12.54 hrs Surf.Area= 859 sf Storage= 540 cf

Plug-Flow detention time= 51.3 min calculated for 2,393 cf (96% of inflow)
Center-of-Mass det. time= 31.8 min (871.4 - 839.6)

Volume	Invert	Avail.Storage	Storage Description
#1	287.20'	4,318 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

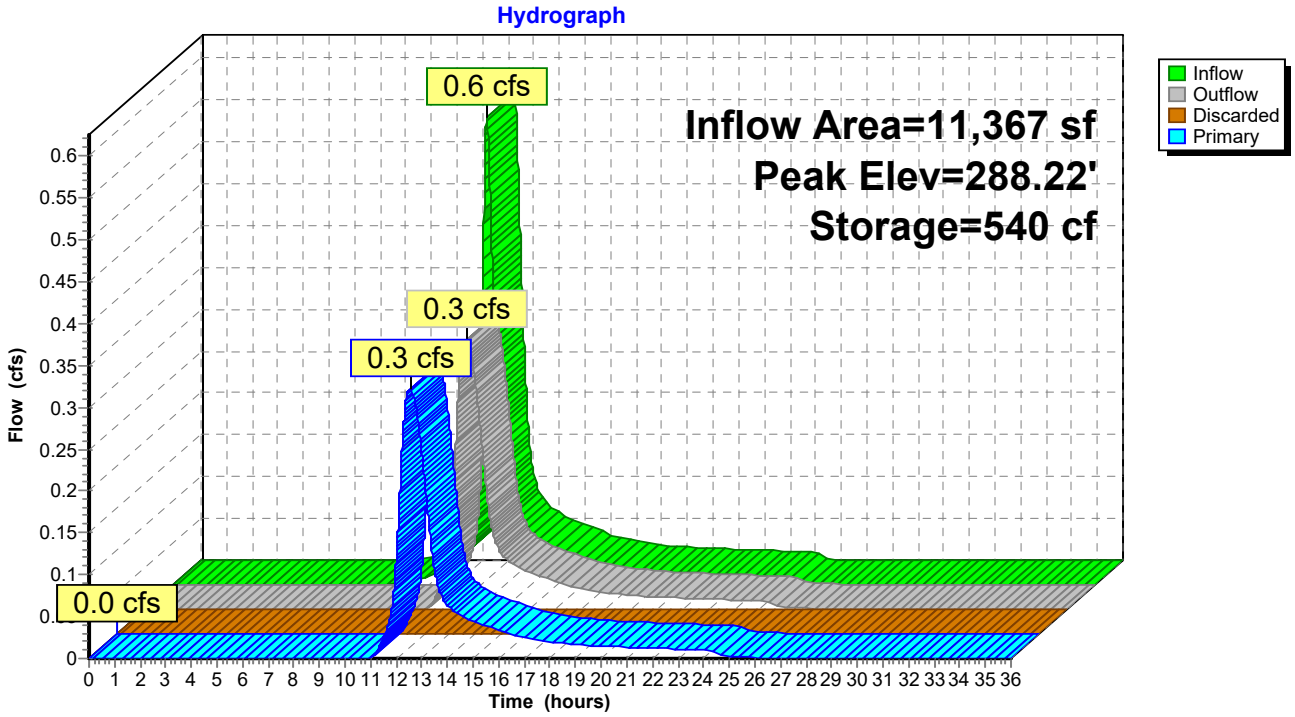
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
287.20	264	0	0
288.00	671	374	374
289.00	1,542	1,107	1,481
289.50	2,132	919	2,399
290.00	3,012	1,286	3,685
290.20	3,314	633	4,318

Device	Routing	Invert	Outlet Devices
#1	Discarded	287.20'	**1.020 in/hr Exfiltration X 0.00 over Surface area**
#2	Primary	289.05'	**10.0' long x 11.9' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.56 2.61 2.70 2.67 2.66 2.67 2.66 2.64
#3	Primary	287.28'	**12.0" Round Culvert** L= 16.8' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 287.28' / 287.20' S= 0.0048 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#4	Device 3	287.46'	**4.0" Vert. Orifice** C= 0.600
#5	Device 3	289.05'	**24.0" Horiz. Orifice w/Trash Rack** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.0 cfs @ 0.00 hrs HW=287.20' (Free Discharge)
└**1=Exfiltration** (Controls 0.0 cfs)

Primary OutFlow Max=0.3 cfs @ 12.54 hrs HW=288.22' (Free Discharge)
├**2=Broad-Crested Rectangular Weir** (Controls 0.0 cfs)
└**3=Culvert** (Passes 0.3 cfs of 1.7 cfs potential flow)
  ├**4=Orifice** (Orifice Controls 0.3 cfs @ 3.70 fps)
  └**5=Orifice w/Trash Rack** (Controls 0.0 cfs)

Pond 2P: COMPOUND BASIN (INFILTRATION BASIN)



Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 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 P-1: Runoff Area=7,999 sf 0.00% Impervious Runoff Depth=5.53"
Flow Length=160' Tc=21.5 min CN=73 Runoff=0.8 cfs 3,689 cf

Subcatchment P-2: Runoff Area=120,294 sf 4.98% Impervious Runoff Depth=5.66"
Flow Length=597' Tc=23.7 min CN=74 Runoff=11.4 cfs 56,699 cf

Subcatchment P-3: Runoff Area=82,885 sf 0.42% Impervious Runoff Depth=5.41"
Flow Length=680' Slope=0.0200 '/' Tc=35.0 min CN=72 Runoff=6.4 cfs 37,381 cf

Subcatchment P-4: Runoff Area=11,367 sf 8.80% Impervious Runoff Depth=6.14"
Flow Length=83' Slope=0.0200 '/' Tc=18.4 min CN=78 Runoff=1.3 cfs 5,820 cf

Subcatchment P-5: Runoff Area=78,426 sf 0.00% Impervious Runoff Depth=5.17"
Flow Length=277' Tc=24.4 min CN=70 Runoff=6.8 cfs 33,775 cf

Reach DP-10: NE PROPERTY CORNER WETLAND Inflow=14.5 cfs 96,754 cf
Outflow=14.5 cfs 96,754 cf

Reach DP-20: NW PROPERTY CORNER WETLAND Inflow=7.2 cfs 39,509 cf
Outflow=7.2 cfs 39,509 cf

Pond 1P: DRIVEWAY BASIN (POCKET Peak Elev=287.32' Storage=8,050 cf Inflow=6.4 cfs 37,381 cf
Outflow=5.9 cfs 36,366 cf

Pond 2P: COMPOUND BASIN (INFILTRATION Peak Elev=289.04' Storage=1,551 cf Inflow=1.3 cfs 5,820 cf
Discarded=0.0 cfs 0 cf Primary=0.5 cfs 5,734 cf Outflow=0.5 cfs 5,734 cf

Summary for Subcatchment P-1:

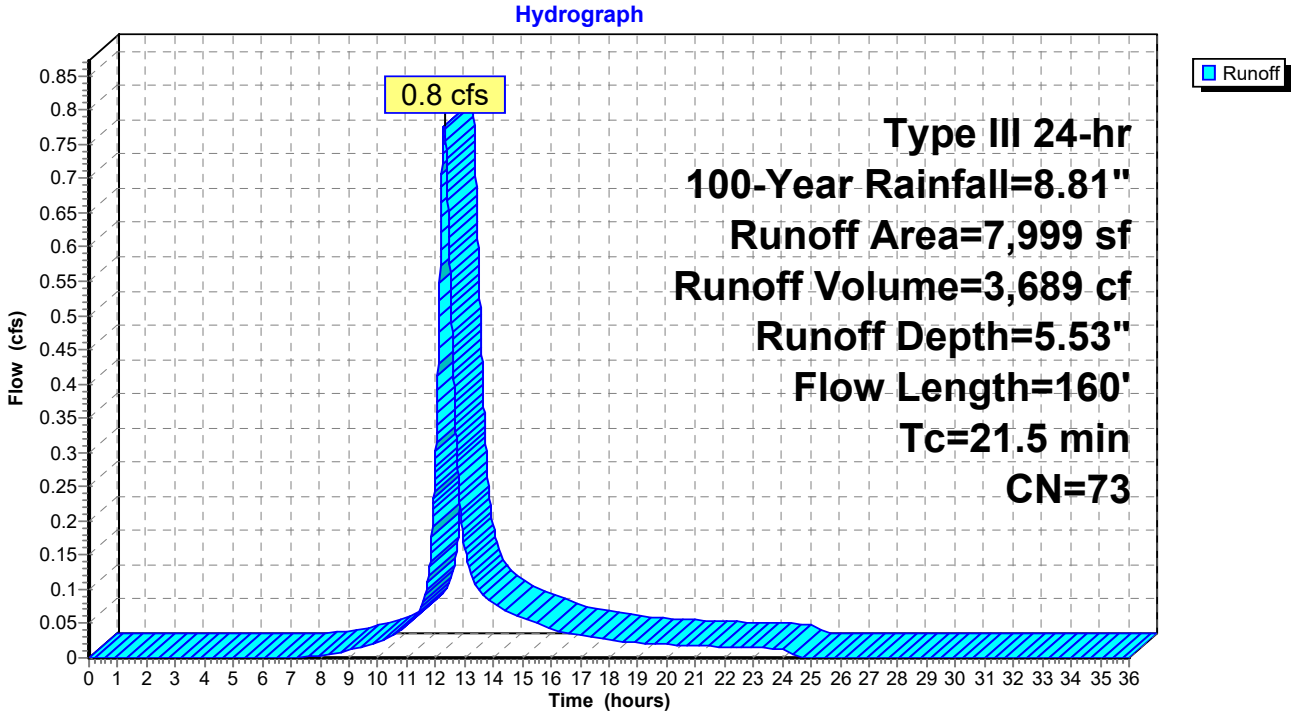
Runoff = 0.8 cfs @ 12.30 hrs, Volume= 3,689 cf, Depth= 5.53"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.81"

	Area (sf)	CN	Description
	3,984	74	>75% Grass cover, Good, HSG C
	3,688	70	Woods, Good, HSG C
*	327	89	Riprap, HSG C
	7,999	73	Weighted Average
	7,999		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.5	100	0.0220	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.25"
1.0	60	0.0400	1.00		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
21.5	160	Total			

Subcatchment P-1:



Summary for Subcatchment P-2:

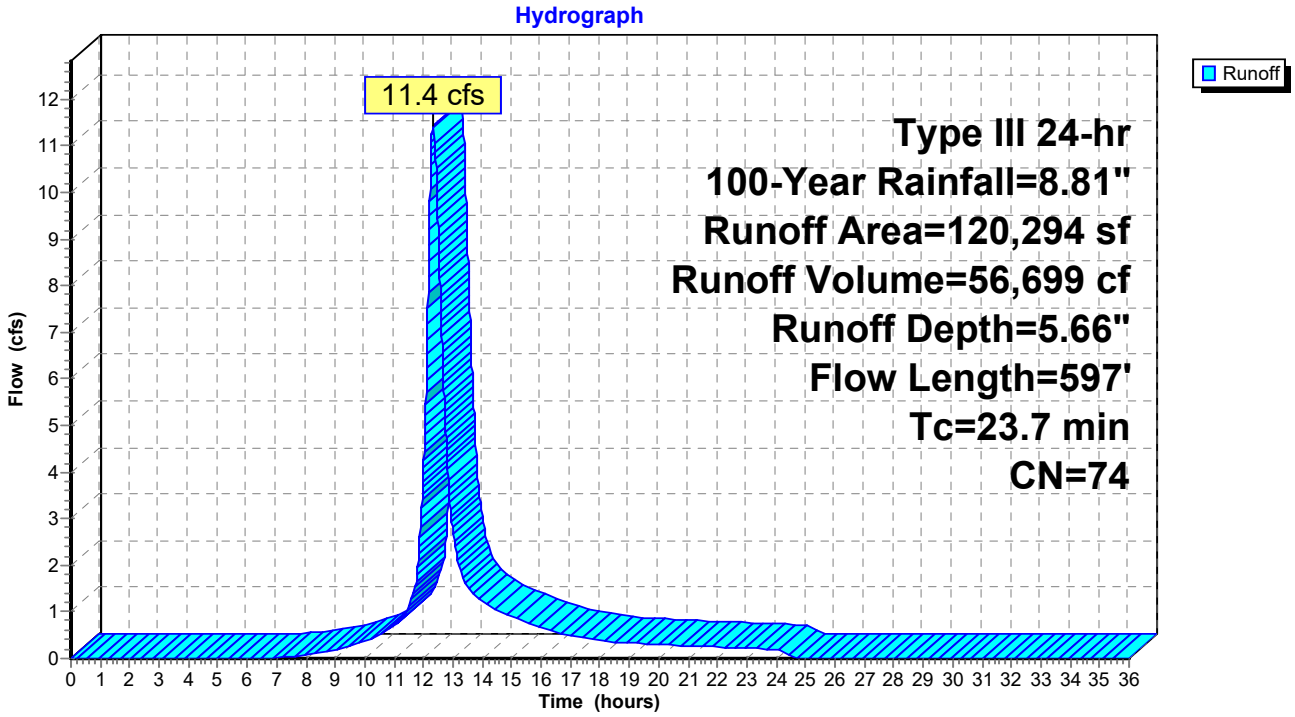
Runoff = 11.4 cfs @ 12.32 hrs, Volume= 56,699 cf, Depth= 5.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.81"

Area (sf)	CN	Description
3,150	98	Roofs, HSG C
2,836	98	Paved parking, HSG C
36,006	74	>75% Grass cover, Good, HSG C
6,592	89	Gravel roads, HSG C
71,710	70	Woods, Good, HSG C
120,294	74	Weighted Average
114,308		95.02% Pervious Area
5,986		4.98% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.1	100	0.0400	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.25"
4.3	173	0.0180	0.67		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
2.6	126	0.0130	0.80		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.5	168	0.0160	5.37	26.85	**Channel Flow,** Area= 5.0 sf Perim= 5.0' r= 1.00' n= 0.035 Earth, dense weeds
0.2	30	0.0100	2.74	3.36	**Pipe Channel,** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.025 Corrugated metal
23.7	597	Total			

Subcatchment P-2:



Summary for Subcatchment P-3:

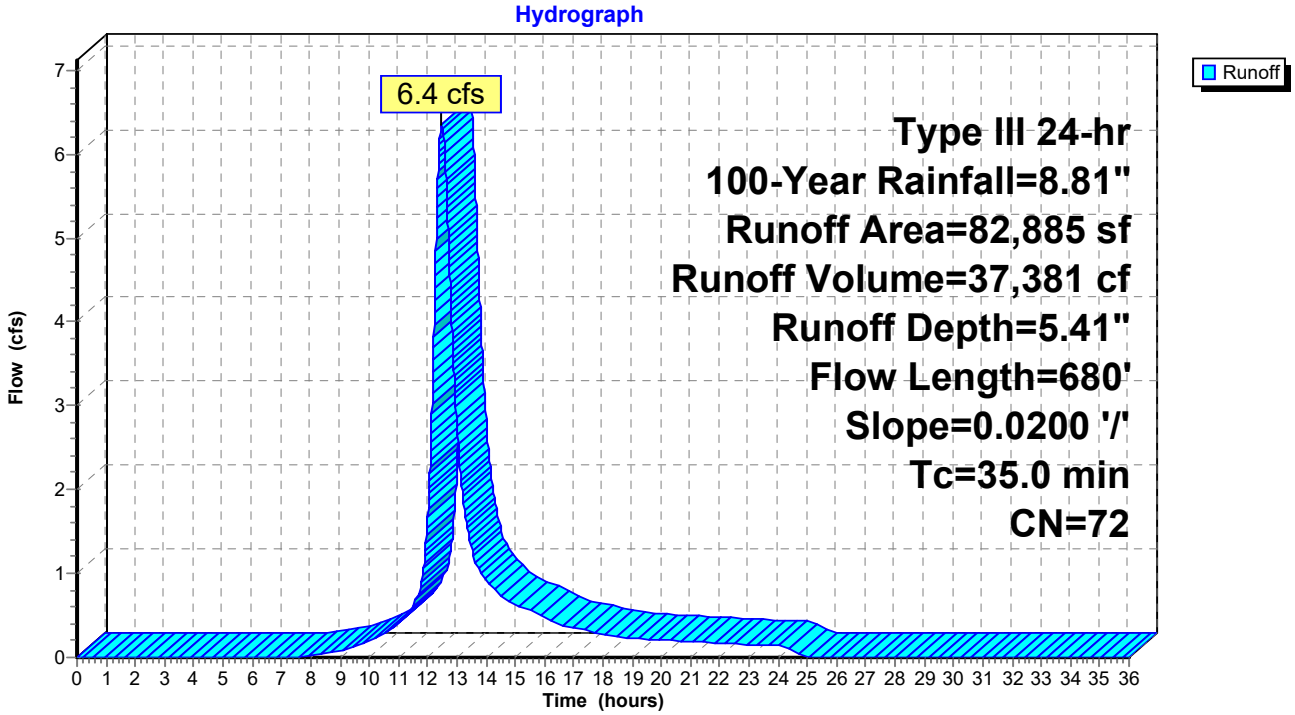
Runoff = 6.4 cfs @ 12.48 hrs, Volume= 37,381 cf, Depth= 5.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.81"

	Area (sf)	CN	Description
	350	98	Paved parking, HSG C
	10,443	74	>75% Grass cover, Good, HSG C
	5,265	89	Gravel roads, HSG C
	66,692	70	Woods, Good, HSG C
*	135	89	Riprap, HSG C
	82,885	72	Weighted Average
	82,535		99.58% Pervious Area
	350		0.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.3	100	0.0200	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.25"
13.7	580	0.0200	0.71		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
35.0	680	Total			

Subcatchment P-3:



Summary for Subcatchment P-4:

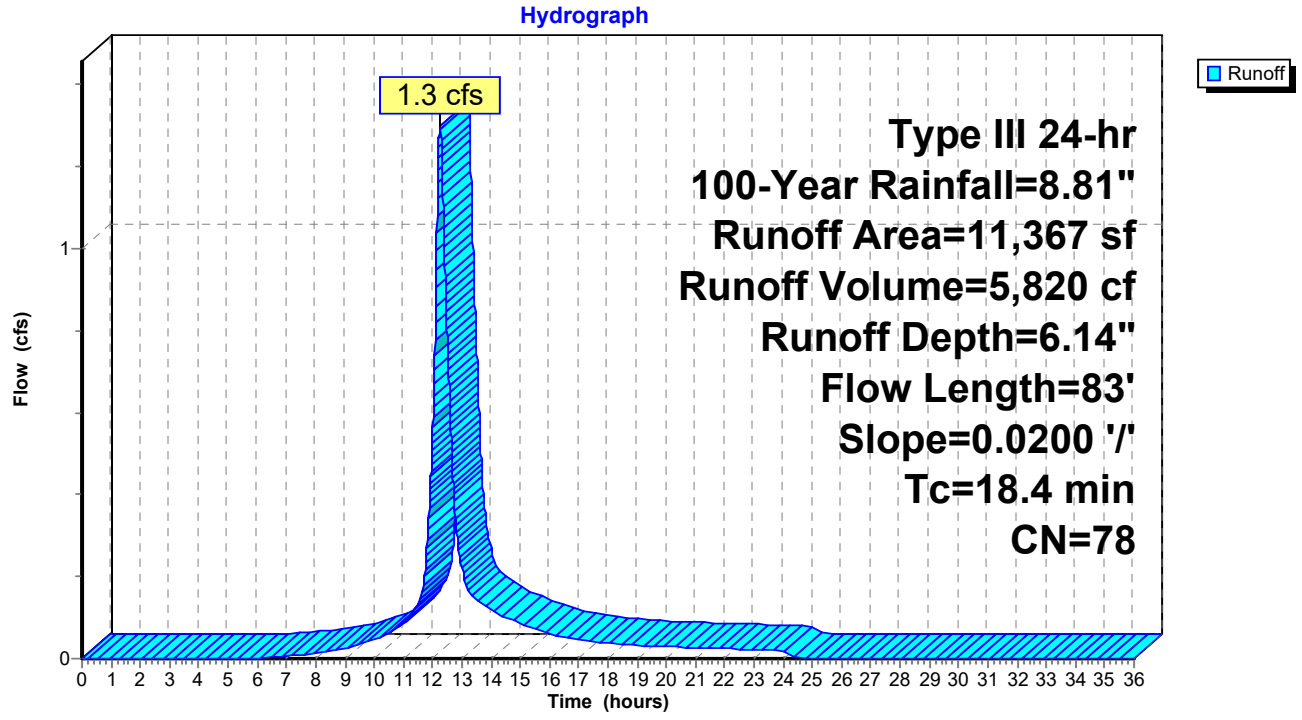
Runoff = 1.3 cfs @ 12.25 hrs, Volume= 5,820 cf, Depth= 6.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.81"

	Area (sf)	CN	Description
	1,000	98	Paved parking, HSG C
	6,403	74	>75% Grass cover, Good, HSG C
	1,663	89	Gravel roads, HSG C
	2,067	70	Woods, Good, HSG C
*	234	89	Riprap, HSG C
	11,367	78	Weighted Average
	10,367		91.20% Pervious Area
	1,000		8.80% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.4	83	0.0200	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.25"

Subcatchment P-4:



Summary for Subcatchment P-5:

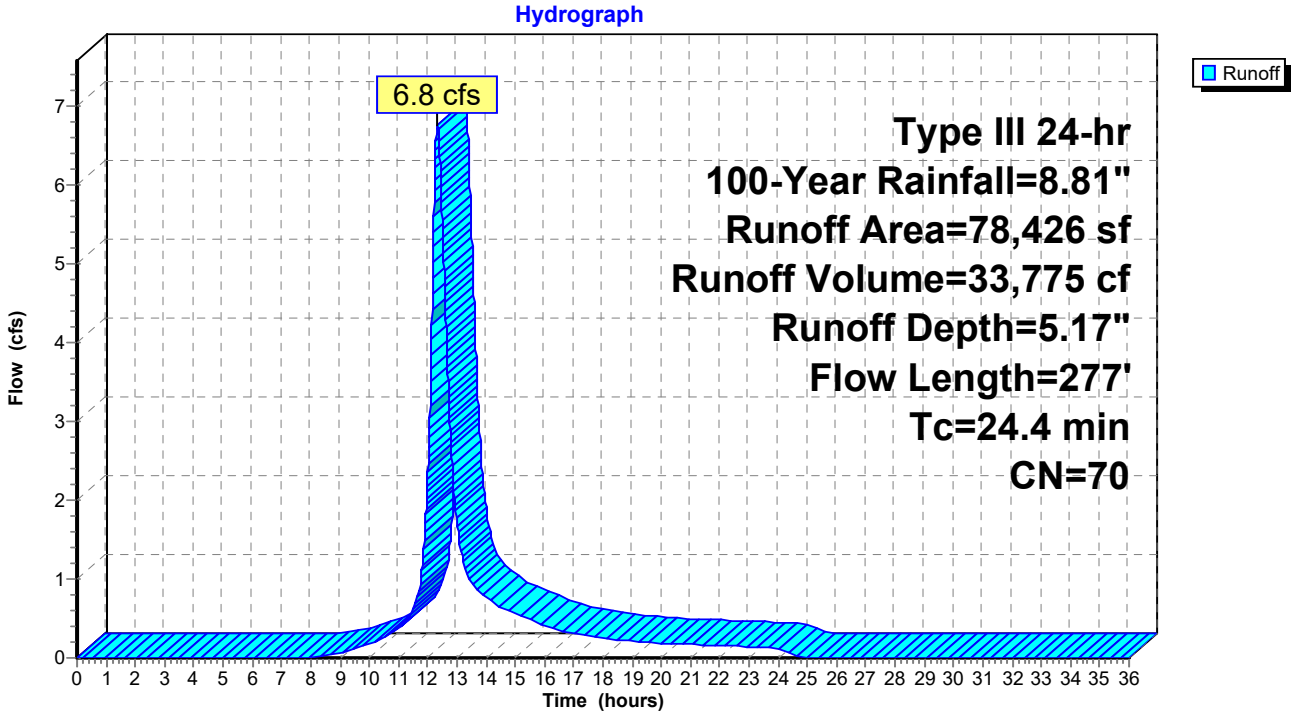
Runoff = 6.8 cfs @ 12.34 hrs, Volume= 33,775 cf, Depth= 5.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.81"

	Area (sf)	CN	Description
	3,774	74	>75% Grass cover, Good, HSG C
	74,541	70	Woods, Good, HSG C
*	111	89	Riprap, HSG C
	78,426	70	Weighted Average
	78,426		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.1	100	0.0400	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.25"
8.3	177	0.0050	0.35		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
24.4	277	Total			

Subcatchment P-5:

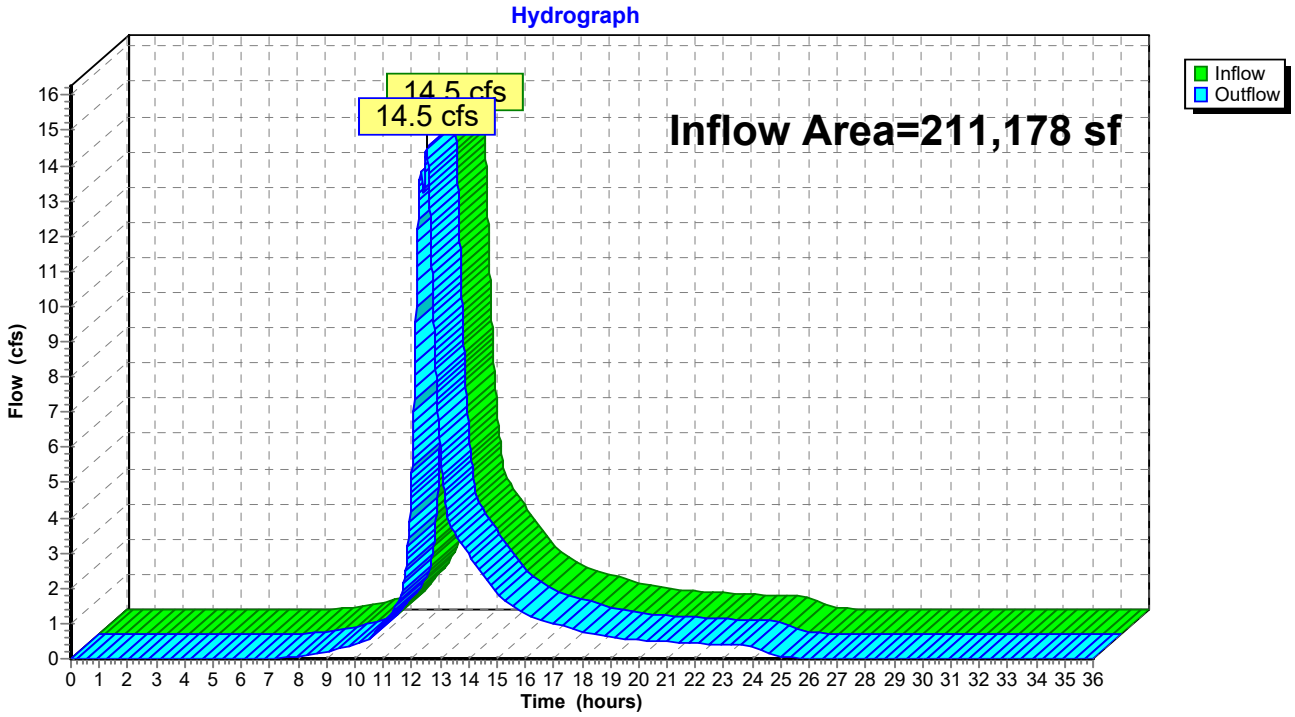


Summary for Reach DP-10: NE PROPERTY CORNER WETLAND

Inflow Area = 211,178 sf, 3.00% Impervious, Inflow Depth = 5.50" for 100-Year event
Inflow = 14.5 cfs @ 12.52 hrs, Volume= 96,754 cf
Outflow = 14.5 cfs @ 12.52 hrs, Volume= 96,754 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Reach DP-10: NE PROPERTY CORNER WETLAND

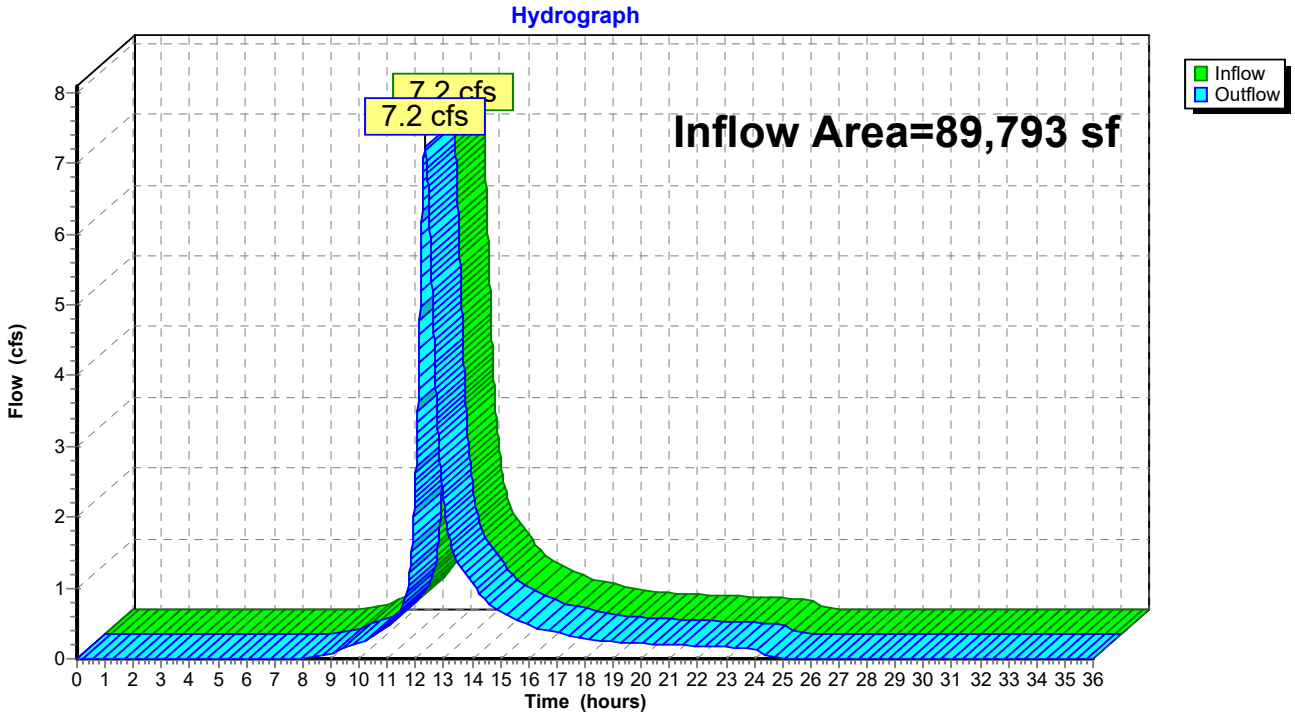


Summary for Reach DP-20: NW PROPERTY CORNER WETLAND

Inflow Area = 89,793 sf, 1.11% Impervious, Inflow Depth = 5.28" for 100-Year event
Inflow = 7.2 cfs @ 12.34 hrs, Volume= 39,509 cf
Outflow = 7.2 cfs @ 12.34 hrs, Volume= 39,509 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Reach DP-20: NW PROPERTY CORNER WETLAND



Summary for Pond 1P: DRIVEWAY BASIN (POCKET WETLAND)

Inflow Area = 82,885 sf, 0.42% Impervious, Inflow Depth = 5.41" for 100-Year event
Inflow = 6.4 cfs @ 12.48 hrs, Volume= 37,381 cf
Outflow = 5.9 cfs @ 12.60 hrs, Volume= 36,366 cf, Atten= 7%, Lag= 7.1 min
Primary = 5.9 cfs @ 12.60 hrs, Volume= 36,366 cf

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Starting Elev= 283.50' Surf.Area= 998 sf Storage= 443 cf
Peak Elev= 287.32' @ 12.60 hrs Surf.Area= 3,272 sf Storage= 8,050 cf (7,607 cf above start)

Plug-Flow detention time= 67.7 min calculated for 35,923 cf (96% of inflow)
Center-of-Mass det. time= 42.7 min (886.1 - 843.4)

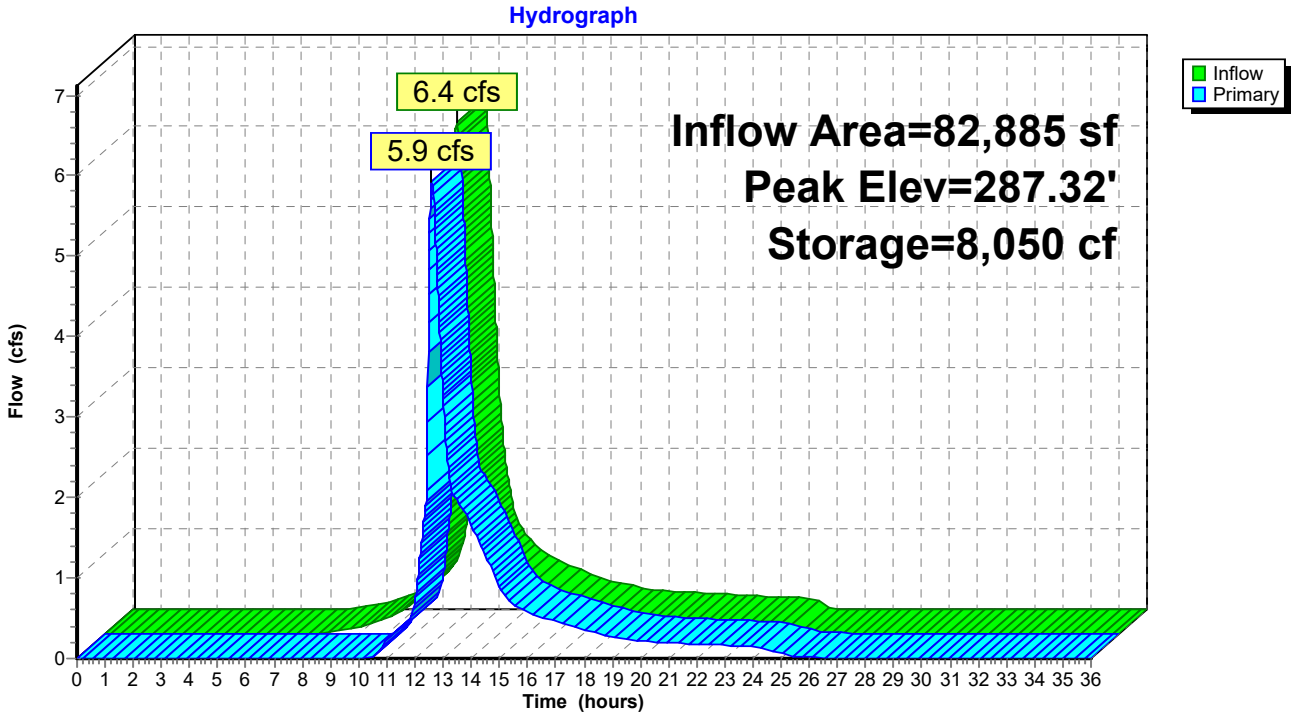
Volume	Invert	Avail.Storage	Storage Description
#1	283.00'	12,279 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
283.00	775	0	0
284.00	1,221	998	998
285.00	1,723	1,472	2,470
286.00	2,282	2,003	4,473
287.00	2,897	2,590	7,062
288.00	4,068	3,483	10,545
288.40	4,606	1,735	12,279

Device	Routing	Invert	Outlet Devices
#1	Primary	287.33'	**10.0' long x 11.4' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.54 2.60 2.70 2.68 2.67 2.68 2.66 2.64
#2	Primary	284.35'	**15.0" Round Culvert** L= 34.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 284.35' / 284.00' S= 0.0103 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf
#3	Device 2	284.35'	**5.0" Vert. Orifice** C= 0.600
#4	Device 2	285.18'	**5.5" Vert. Orifice** C= 0.600
#5	Device 2	287.00'	**24.0" Horiz. Orifice w/Trash Rack** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=5.9 cfs @ 12.60 hrs HW=287.32' (Free Discharge)
- **1=Broad-Crested Rectangular Weir** (Controls 0.0 cfs)
- **2=Culvert** (Passes 5.9 cfs of 7.1 cfs potential flow)
  - **3=Orifice** (Orifice Controls 1.1 cfs @ 8.00 fps)
  - **4=Orifice** (Orifice Controls 1.1 cfs @ 6.66 fps)
  - **5=Orifice w/Trash Rack** (Weir Controls 3.7 cfs @ 1.85 fps)

Pond 1P: DRIVEWAY BASIN (POCKET WETLAND)



Summary for Pond 2P: COMPOUND BASIN (INFILTRATION BASIN)

Inflow Area = 11,367 sf, 8.80% Impervious, Inflow Depth = 6.14" for 100-Year event
Inflow = 1.3 cfs @ 12.25 hrs, Volume= 5,820 cf
Outflow = 0.5 cfs @ 12.65 hrs, Volume= 5,734 cf, Atten= 61%, Lag= 24.3 min
Discarded = 0.0 cfs @ 0.00 hrs, Volume= 0 cf
Primary = 0.5 cfs @ 12.65 hrs, Volume= 5,734 cf

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 289.04' @ 12.65 hrs Surf.Area= 1,595 sf Storage= 1,551 cf

Plug-Flow detention time= 44.1 min calculated for 5,732 cf (98% of inflow)
Center-of-Mass det. time= 35.2 min (850.5 - 815.3)

Volume	Invert	Avail.Storage	Storage Description
#1	287.20'	4,318 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

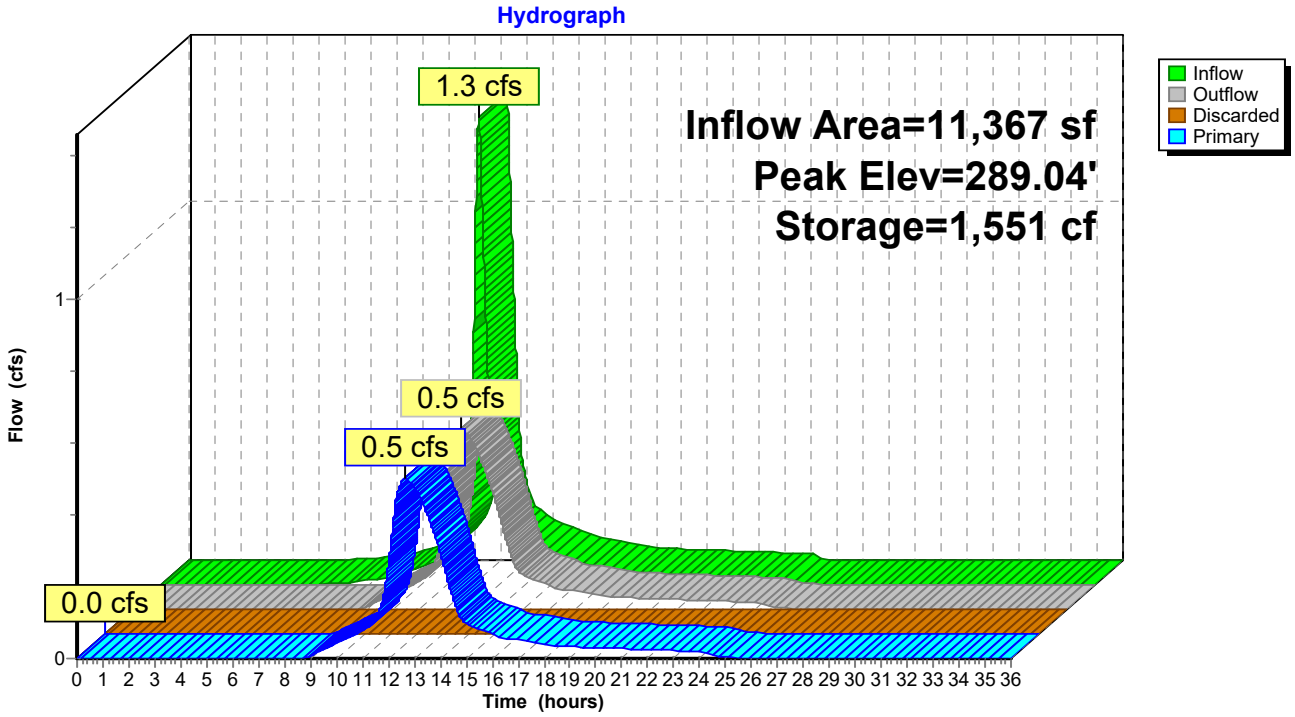
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
287.20	264	0	0
288.00	671	374	374
289.00	1,542	1,107	1,481
289.50	2,132	919	2,399
290.00	3,012	1,286	3,685
290.20	3,314	633	4,318

Device	Routing	Invert	Outlet Devices
#1	Discarded	287.20'	**1.020 in/hr Exfiltration X 0.00 over Surface area**
#2	Primary	289.05'	**10.0' long x 11.9' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.56 2.61 2.70 2.67 2.66 2.67 2.66 2.64
#3	Primary	287.28'	**12.0" Round Culvert** L= 16.8' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 287.28' / 287.20' S= 0.0048 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#4	Device 3	287.46'	**4.0" Vert. Orifice** C= 0.600
#5	Device 3	289.05'	**24.0" Horiz. Orifice w/Trash Rack** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.0 cfs @ 0.00 hrs HW=287.20' (Free Discharge)
└**1=Exfiltration** (Controls 0.0 cfs)

Primary OutFlow Max=0.5 cfs @ 12.65 hrs HW=289.04' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Controls 0.0 cfs)
└**3=Culvert** (Passes 0.5 cfs of 3.4 cfs potential flow)
└**4=Orifice** (Orifice Controls 0.5 cfs @ 5.73 fps)
└**5=Orifice w/Trash Rack** (Controls 0.0 cfs)

Pond 2P: COMPOUND BASIN (INFILTRATION BASIN)



Driveway Culvert (Sta. 0+38) Outlet Riprap Apron Design

Apron Length

$$L_a = \frac{1.8 * Q}{D_o * 1.5} + 7 * D_o$$

Q_{10} =	4.6	CFS
D_o =	1.25	FT
TW =	0.25	FT
L_a =	14	FT

Apron Width

$$W_{\text{outlet end of apron}} = 3 * D_o + L_a$$

$W_{\text{outlet end of apron}}$ =	18	FT

$$W_{\text{culvert end of apron}} = 3 * D_o$$

$W_{\text{culvert end of apron}}$ =	4	FT

Riprap Diameter

$$D_{50} = \frac{0.02 * Q^{1.5}}{TW * D_o}$$

D_{50} =	0.47	FT	
D_{50} =	6	IN	**USE D_{50} = 8" min.**

Driveway Basin (Pocket Wetland [1P])

(Water Quality Volume)

$WQV = WQD * Imperv_{(area)}$

WQV = Water Quality Volume

WQD = Water Quality Depth

$Imperv_{(area)}$ = Proposed Tributary Impervious Area to Treatment Train

WQD Based on Status of Tributary Area

WQD =	0.50	IN (for Non-Critical Areas)
WQD =	1.00	IN (for Critical Areas)

Project Input

Critical Area =	YES	
$Imperv_{(area)}$ =	350	SF
WQD =	1.00	IN

WQV = 29 CF

Driveway Basin (Pocket Wetland [1P]) Outlet Riprap Apron Design

Apron Length

$$L_a = \frac{1.8 * Q}{D_o * 1.5} + 7 * D_o$$

Q_{100} =	5.9	CFS
D_o =	1.25	FT
TW =	0.25	FT
L_a =	15	FT

Apron Width

$$W_{\text{outlet end of apron}} = 3 * D_o + L_a$$

$W_{\text{outlet end of apron}}$ =	19	FT

$$W_{\text{culvert end of apron}} = 3 * D_o$$

$W_{\text{culvert end of apron}}$ =	4	FT

Riprap Diameter

$$D_{50} = \frac{0.02 * Q^{1.3}}{TW * D_o}$$

D_{50} =	0.64	FT	
D_{50} =	8	IN	**USE D_{50} = 8" min.**

Compound Basin (Infiltration Basin [2P])

(Recharge to Groundwater)

$Rv = F * Imperv_{(area)}$

Rv = Required Recharge Volume (CF)

F = Target Depth Factor associated with each Hydrologic Soil Group (HSG)

$Imperv_{(area)}$ = Proposed Tributary Impervious Area to Design Point

Table 2.3.2, Volume 3, Ch 1, Page 16

F = 0.60 IN (for A soils)
F = 0.35 IN (for B soils)
F = 0.25 IN (for C soils)
F = 0.10 IN (for D soils)

Project Input

Soil Group =	A		Soil Group =	B		Soil Group =	C		Soil Group =	D	
$Imperv_{(area)}$ =	0	SF	$Imperv_{(area)}$ =	0	SF	$Imperv_{(area)}$ =	1,350	SF	$Imperv_{(area)}$ =	0	SF
Rv(A)	**0.0**	**CF**	**Rv(B)**	**0.0**	**CF**	**Rv(C)**	**28.1**	**CF**	**Rv(D)**	**0.0**	**CF**

Does all proposed impervious area drain to infiltration BMP = NO

Impervious area draining to infiltration BMP = 1000 SF

Rv(Adjustment) Factor = 1.35

Adjusted Rv(Total) = 38.0 CF

Volume provided in the infiltration basin below the lowest outlet = **86 CF** **(4" Inv. = 287.46)**

(See HydroCAD calculations)

86 > 38 **THEREFORE OK**

Compound Basin (Infiltration Basin [2P])

(Water Quality Volume)

$WQV = WQD * Imperv_{(area)}$

WQV = Water Quality Volume

WQD = Water Quality Depth

$Imperv_{(area)}$ = Proposed Tributary Impervious Area to Treatment Train

WQD Based on Status of Tributary Area

WQD =	0.50	IN (for Non-Critical Areas)
WQD =	1.00	IN (for Critical Areas)

Project Input

Critical Area =	YES	
$Imperv_{(area)}$ =	1,000	SF
WQD =	1.00	IN

WQV = 83 CF

Compound Basin (Infiltration Basin [2P]) - Required Surface Area

$$\text{Surface Area}_{\text{U/G Basin}} = \frac{V}{(D + K * T / 12)}$$

V = Volume Below Lowest Orifice (CF)
D = Basin Depth (FT) below lowest outlet orifice
K = Saturated Hydraulic Conductivity, Rawls Rate (IN/HR)
T = Fill Time (HR)

V =	86	CF	
D =	1.00	FT	
K =	1.02	IN/HR	(1982 Rawls Rate Sandy Loam)
T =	2	HR	

$\text{Surface Area}_{\text{U/G Basin}}$ = 74 SF

Area Provided = 264 SF

264 > 74 THEREFORE OK

Compound Basin (Infiltration Basin [2P]) - Drawdown Time

$$Time_{drawdown} = \frac{V}{K * Basin\ Area}$$

V = Total Storage Volume Below Lowest Orifice
K = Saturated Hydraulic Conductivity, Rawls Rate
Basin Area = Area of Basin at Water Surface Elevation

V =	86	CF	
K =	1.02	IN/HR	(1982 Rawls Rate Sandy Loam)
Basin Area =	264	SF	

$Time_{drawdown}$ =	**3.8**	**HR**

The calculation shows that the infiltration basin will drawdown within the required 72 hours between storm events (assuming linear application of infiltration rate & no mounding occurs).

Compound Basin (Infiltration Basin [2P]) Outlet Riprap Apron Design

Apron Length

$$L_a = \frac{1.8 * Q}{D_o * 1.5} + 7 * D_o$$

Q_{100} =	0.5	CFS
D_o =	1	FT
TW =	0.25	FT
L_a =	8	FT

Apron Width

$$W_{\text{outlet end of apron}} = 3 * D_o + L_a$$

$W_{\text{outlet end of apron}}$ =	11	FT

$$W_{\text{culvert end of apron}} = 3 * D_o$$

$W_{\text{culvert end of apron}}$ =	3	FT

Riprap Diameter

$$D_{50} = \frac{0.02 * Q^{1.3}}{TW * D_o}$$

D_{50} =	0.03	FT	
D_{50} =	0	IN	**USE D_{50} = 8" min.**

INSTRUCTIONS:

Non-automated: Mar. 4, 2008

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

Location: Driveway Basin (Pocket Wetland [1P])

TSS Removal Calculation Worksheet

A BMP[1]	B TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Grass Channel	**0.00**	**1.00**	**0.00**	**1.00**
Sediment Forebay (Pretreatment)	**0.00**	**1.00**	**0.00**	**1.00**
Constructed Stormwater Wetland (Pocket Wetland)	**0.80**	**1.00**	**0.80**	**0.20**
		0.20	**0.00**	**0.20**
		0.20	**0.00**	**0.20**

Total TSS Removal = **80%**

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

Project: **Franklin Bent Street**

Prepared By: **BLM**

Date: **8/15/2023**

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

INSTRUCTIONS:

Non-automated: Mar. 4, 2008

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

Location: Compound Basin (Infiltration Basin [2P])

TSS Removal Calculation Worksheet

A BMP[1]	B TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Sediment Forebay (Pretreatment)	**0.00**	**1.00**	**0.00**	**1.00**
Infiltration Basin with Partial Exfiltration	**0.80**	**1.00**	**0.80**	**0.20**
		0.20	**0.00**	**0.20**
		0.20	**0.00**	**0.20**
		0.20	**0.00**	**0.20**

Total TSS Removal = **80%**

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

Project: **Franklin Bent Street**

Prepared By: **BLM**

Date: **8/15/2023**

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

O&M Plan

ProTerra
DESIGN GROUP, LLC

RECOMMENDED LONG-TERM STORMWATER POLLUTION PREVENTION PLAN and OPERATION & MAINTENANCE (O&M) PLAN TO COMPLY WITH THE MASSDEP STORMWATER STANDARDS 4, 8, 9 & 10 FOR RAW LAND CELL TOWER

PROJECT OVERVIEW

KJS Realty ("Applicant") proposes to construct an unmanned wireless telecommunications facility within a 75'x75' [5,625 square foot (SF)] lease area in the central portion of the property designated as Assessor's Parcel 206-103 located off Bent Street in Franklin, Massachusetts. The project proposes to install a new gravel driveway from a proposed curb cut off Bent Street to the tower facility. The facility itself will be constructed of a 60'x60' (3,600 SF) fenced-in compound surfaced with clean 3/4" stone over filter fabric. A galvanized steel self-support tower supporting antenna equipment will be placed on a reinforced concrete foundation below grade. Ground and tower space will be allotted for up to four carriers. A common utility area will be located at the northeast corner of the compound. The project also includes the addition of stormwater facilities for runoff treatment tributary to the proposed tower compound and driveway.

The project seeks to avoid drainage impacts to surrounding resources by directing non-point source sheet flow runoff through existing vegetated areas that promotes sediment removal through filtering, absorption, and settling as the velocity of flow and resultant energy is reduced. Structural Best Management Practices (BMPs) near the tower compound and driveway include an infiltration basin with sediment forebay (pretreatment), vegetated swales, a constructed pocket wetland with sediment forebay (pretreatment), and culvert outlet protection with level spreaders. The project will require disturbance of ~42,500 square feet of land.

The proposed site improvements are shown on the plans provided under separate cover entitled *"Franklin Bent Street; Bent Street; Frankin, MA 02038"* latest revision as prepared by ProTerra Design Group, LLC.

OWNER AND RESPONSIBLE PARTY

Landlord (Lessor/Property Owner):

(Parcel 206-103)
N/F Stephen J. Kelleher
3 Briarwood Road
Norfolk, MA 02056

Telecommunication Facility
Lessee & Responsible Party:

KJS Realty
2 Commercial Street
Sharon, MA 02067
(617) 817-8564

The Responsible Party and landlord (Owner) are entities under the same management which allows for maintenance of the stormwater system and the associated telecommunications equipment.

ProTerra
DESIGN GROUP, LLC

CONSTRUCTION MANAGEMENT

Contractor: _____
Address: _____
_____
Phone Number: _____

A construction manager with adequate knowledge and experience on projects of similar size and scope shall be employed to oversee all site work related construction. The contractor shall incorporate appropriate techniques to control sediment and erosion pollution during construction in accordance with the Massachusetts Erosion and Sediment Control Guidelines for Urban and Suburban Areas.

Care should be taken when constructing stormwater control structures and dewatering (if required) to install foundations. Light earthmoving equipment shall be used to excavate in the vicinity of the infiltration basin. Use of heavy-equipment causes excessive compaction of the soils resulting in reduced infiltration capacity. At no time, shall temporary settling basins be constructed in the vicinity of the proposed infiltration basin in order to prevent the soils from becoming clogged with sediment.

Dewatering activities (if required) shall be directed towards a berm and filter sack to promote infiltration into the ground. If silt-laden sediment is encountered, a frac tank or temporary sediment trap approximately 5,000 gallons in size or greater may be employed to settle pumped groundwater before discharge.

EROSION CONTROL BEST MANAGEMENT PRACTICES (BMPs)

During construction, silt-laden runoff or discharge from dewatering operations (if necessary) will be prevented from exiting the construction area untreated. Siltation barriers consisting of a filter fabric silt fence with straw bales will be erected in advance of construction along the down-gradient edge of all disturbed areas and maintained throughout the construction period. The control of dust and erosion during the construction period will be managed using a number of Best Management Practices (BMPs) described below and as shown on the Erosion Control sheets (EC-1 and EC-2) of the Construction Drawings.

Stabilized Construction Entrance

An apron constructed of coarse aggregate over a geotextile fabric shall cover the transition between the existing roadway and the proposed work zone. The size and construction of the entrance is shown on the EC-1 and EC-2 sheets. This entrance shall be inspected daily and maintained throughout construction activities and optionally removed after completion.

Temporary Sediment Traps (During Construction)

Small depressions that have stormwater runoff directed into them for increase retention time that promotes settling out of suspended solids. Tributary drainage area shall be under 1 acre. The storage volumes should be 1,800 cubic feet per acre of tributary area. During construction, total storage within the temporary sediment traps of 1,760 cubic feet is required for the compound, parking area, and tributary driveway. Multiple sediment traps shall be utilized for this project.

Silt Fence with Straw Bales

Silt fence with straw bales is installed at the down gradient limit of work. It should be trenched into the ground 6" and staked without drooping. The woven fabric will allow the passage of stormwater while filtering out suspended solids. Straw bales give added filtering and erosion control. Every 100' two bales or silt socks shall be placed and staked perpendicular to the fence. Straw bales shall be inert straw or salt hay type.

Chipping Trees & Slash Debris

Residual materials made available from tree and brush clearing and grubbing the site shall be stockpiled and re-used to retain sediment from the disturbed areas. At the completion of construction, the shredded or chipped wood shall be spread as ground cover to provide stabilization over the disturbed areas.

Dewatering

Although groundwater is not anticipated, if dewatering is required, discharges shall be directed through a settling pool or filter bag prior to discharge and infiltration into the ground. Outflow of silt-laden runoff shall not be permitted to flow directly into resource areas. Upon completion of site stabilization, the BMP's and conveyance systems shall be thoroughly cleaned of silt and sediment and made ready for the proposed operation. Discharge points shall be set back from the edge of the resource areas and monitored by qualified personnel to ensure no impacts to resource areas and compliance with applicable federal and state regulations. Discharges shall be free from visible floating, suspended, and settleable solids that would impair the functions of the wetlands and downstream river.

Concrete Washout Pit

A concrete washout pit/area must be designated to receive wash water from washing of tools and concrete mixer chutes, liquid concrete waste from dump trucks, mobile batch mixers, or pump trucks. Concrete washout activities must be conducted in a manner that does not contribute pollutants to surface waters or stormwater runoff. Concrete washout areas may be lined or unlined excavated pits in the ground, commercially manufactured prefabricated washout containers, or aboveground holding areas constructed of berms, sandbags or straw bales with a plastic liner.

ON-GOING MAINTENANCE CONTRACT

The Responsible Party shall hire appropriate staff, contract with a maintenance company, or designate a qualified party to complete ongoing maintenance for the tower compound, access drive, and stormwater features for the facility.

LIVING DOCUMENT PROVISIONS

Due to the difficulty of identifying all sources of potential stormwater contamination and maintenance activities, this document shall be updated as necessary to reflect new procedures, technologies or

requirements over the life span of the facility. Ultimately, the Responsible Party will have the authority to implement a plan and frequency of maintenance as required.

MAINTENANCE LOG

The Responsible Party shall develop and maintain a log of inspections, maintenance, repairs, and disposal (including location of disposal) during the life of the project. Records shall be maintained for at least three years and be made available to regulatory agencies in accordance with the provisions of the Massachusetts Stormwater Handbook. A sample of such a maintenance log is provided.

GOOD HOUSEKEEPING PRACTICES DURING CONSTRUCTION

The Responsible Party shall maintain good housekeeping practices by maintaining a clean and orderly facility to prevent potential pollution sources from coming into contact with stormwater and degrading water quality. This includes establishing protocols to reduce the possibility of mishandling materials or equipment and training employees in good housekeeping techniques.

Common areas where good housekeeping practices should be followed shall include: material storage areas, vehicle and equipment maintenance areas, and loading areas. Good housekeeping practices must include a designated and secure location for garbage. A schedule for regular pickup and disposal of garbage and waste materials during construction and routine inspections of containers for leaks and structural integrity shall be developed. After construction, no trash shall be kept on-site and shall be removed by service technicians or contractors when they leave. Portable toilets shall be installed on site and maintained throughout construction. Excess concrete and cleanout water from redi-mix vehicles shall be directed towards small excavations or constructed boxes for cleanup. Drainage conveyance systems shall not be used for this purpose. On-site refueling of construction vehicles and equipment is prohibited unless an impervious spill containment area for refueling is provided.

MINIMIZING EXPOSURE

The Responsible Party shall minimize exposure of potential pollutant sources from coming into contact with precipitation and being picked up by stormwater and carried into drains and surface waters. All materials shall be plainly labeled and stored in an appropriate container in an appropriate location. All activities which can generate sources of contaminants shall be contained.

LONG-TERM DRIVEWAY & BMP: MAINTENANCE

The proposed gravel driveway must be maintained during active use, after construction operations have been completed, and after major storm events to ensure that the drainage structures are functioning properly. The proposed gravel access drive is to be inspected at the end of construction and repaired as required to provide all weather access.

Prior to final completion and full occupancy of the telecommunications facility, a representative of the Contractor and/or Engineer shall properly instruct the user of the required maintenance responsibilities to maintain the effectiveness of the driveway and drainage system. The Responsible Party will implement the procedures and frequencies under their current plan and inspect the systems as needed to maintain maximum effectiveness.

Gravel Driveway

During the construction of the gravel parking/turnaround area, the contractor shall verify the subgrade provides adequate strength to support the gravel base and gravel top layers. If weak or soft spots are encountered during construction, an AASHTO Class III geotextile reinforcement or angular stone layer shall be installed along the subgrade prior to placing any structural fill or gravel base. Groundwater can affect the strength of the parking/turnaround area subbase.

After the completion of construction, maintenance items that should be performed routinely include:

- Grading and shaping the driveway surface to maintain a distinct in-sloped, out-sloped, or crown shape to move water rapidly off the road surface
    - Do not leave a berm on the side of the driveway that could channel stormwater down the driveway
- Compacting the graded driveway surface to keep a hard driving surface and prevent the loss of fines. Replace surfacing material when needed
- Removing ruts through rolling dips and water bars
- Replacing and/or repairing rock armor or vegetation used for slope protection, scour protection, or energy dissipation
- Trimming roadside vegetation adequately, but not excessively, for sight distance and traffic safety
- Cleaning sediment and debris accumulation within drainage culverts
- Check for slide debris and remove as needed
- If snow plowing occurs, grading and shaping of the driveway surface shall be returned to the original plan design to maintain design drainage patterns toward the stormwater BMPs
- Refer to “Matrix of Road Surface BMP’s For Maintenance Work”

Matrix of Road Surface BMP's For Maintenance Work		
What you observe…	*How bad is the problem…*	*How to fix it…*
Improper drainage	Minor	☑ Grade shoulders and ditches ☑ Clean ditches ☑ Install waterbars if appropriate
Improper drainage	Major	☑ Clean ditches ☑ Reconstruct surface, base, and drainage ☑ Install waterbars if appropriate
Dust	Minor	☑ Apply liquid/solid dust control
Dust	Major	☑ Add minor gravel, regrade, compact
Improper Cross Section	Minor	☑ Reshape (blading or dragging), ☑ Reshape with minor added material
Improper Cross Section	Major	☑ Regrade ☑ Add major gravel, regrade, compact
Potholes	Minor	☑ Spot regravelling
Potholes	Major	☑ Regrade ☑ Add major gravel, regrade, compact
Rutting	Minor	☑ Reshape (blading or dragging) ☑ Reshape with minor added material
Rutting	Major	☑ Regrade ☑ Add major gravel, regrade, compact
Loose Aggregates *or* Ravelling	Minor	☑ Reshape (blading or dragging) ☑ Reshape with minor added material
Loose Aggregates *or* Ravelling	Major	☑ Regrade ☑ Add major gravel, regrade, compact
Corrugations	Minor	☑ Reshape (blading or dragging) ☑ Reshape with minor added material
Corrugations	Major	☑ Regrade ☑ Add major gravel, regrade, compact
Soft Spots	Minor	☑ Reshape (blading or dragging) ☑ Reshape with minor added material
Soft Spots	Major	☑ Regrade ☑ Add major gravel, regrade, compact
Depressions	Minor	☑ Reshape (blading or dragging) ☑ Reshape with minor added material
Depressions	Major	☑ Regrade ☑ Add major gravel, regrade, compact

Vegetated Swales

During the construction phases of the project, the vegetated swales shall be inspected monthly and cleaned as necessary and/or after storms events with 1" of rainfall or greater. Thereafter, this structure shall be inspected every six months during the responsible party's regular maintenance of the grounds.

Cleanings shall include:

- Regularly (2-3 times a year) mowing the grass (4-6" height)
- Cleaning sediment buildup, and reseeding bare spots
- Removal of large vegetation and trash
- Check for signs of rilling/gullying and repair with soil and vegetation as needed.
- Refer to "Matrix of Ditch BMP's for Maintenance"

Matrix of Ditch BMP's for Maintenance		
What you observe…	*How bad is the problem…*	*How to fix It…*
Erosion in Ditch	Minor	☑ Perform regular maintenance ☑ Line ditch appropriately ☑ Install velocity controls*
Erosion in Ditch	Major	☑ Perform regular maintenance ☑ Regrade ditch ☑ Line ditch appropriately ☑ Install velocity controls*
Ditch can't handle volume	Minor	☑ Install ditch turnouts ☑ Increase ditch width/depth
Ditch can't handle volume	Major	☑ Install ditch turnouts ☑ Construct diversion itches/berms ☑ Increase width/depth

** When making decisions about the use of velocity controls, keep in mind that the size of the ditch and amount and velocity of the water will determine the type and the design. The use of velocity controls in anything but a small shallow ditch should generally be referred to an engineer to ensure appropriate design.*

Culvert Outlet Protection with Level Spreader

During the construction phases of the project, the culvert outlet protections with level spreaders shall be inspected monthly and cleaned as necessary and/or after storms events with 1" of rainfall or greater. Thereafter, this structure shall be inspected and cleaned at least once per year or as needed during the responsible party's regular maintenance of the grounds.

Cleanings shall include:

- Removal of vegetation
- Removal of excess sediment accumulation and inspection of condition of stone

Forested Vegetated Filter Strips

The forested vegetated filter strips shall be inspected monthly to monitor the vegetation growth and as necessary after storm events with 1" of rainfall or greater during the construction phases of the project. Thereafter, the forested vegetated filter strips shall be inspected at least once per year as needed during the responsible party's regular maintenance of the site.

Cleanings shall include:

- Cleaning sediment buildup
- Verify sediment is not leaving the site.

Sediment Forebay

During the construction phases of the project, the sediment forebays shall be inspected monthly and cleaned as necessary and/or after storms events with 1" of rainfall or greater. Thereafter, these structures shall be inspected at least two times per year and cleaned as necessary or as needed during the owner's regular maintenance of the grounds. A fixed vertical sediment marker shall be installed to measure the depth of accumulated sediment.

Cleanings shall include:

- Mowing the perimeter berm
- Removal of large vegetation and trash
- Removal of excess sediment accumulation
- Cleaning of outlet weir
- Check for signs of rilling/gullying and repair with soil and vegetation as needed.

Infiltration Basin with Partial Exfiltration

During the construction phases of the project, the basins shall be inspected monthly and cleaned as necessary and/or after storm events with 1" of rainfall or greater. Once the systems go online, inspections shall occur after each storm event for the first three months as required to ensure proper stabilization, function, and to ensure that the inlets and outlets remain free of obstructions. Thereafter, these structures shall be inspected and cleaned as necessary at least twice per year.

Cleanings shall include:

- Removal of accumulated sediment
- Inspection of the infiltration structure
- Monitoring of groundwater to ensure proper operation of the system
- Important items to check for include
    - Differential settlement
    - Cracking and/or erosion
    - Breakout in the embankments
    - Tree growth on the embankments
    - Condition of rip-rap
    - Sediment accumulation
    - Health of turf
    - Clogging of outlets
    - Root infestation
    - Water levels should be checked and recorded against rainfall amounts to verify that the drainage system is working properly.

Constructed Stormwater Wetlands (Pocket Wetland)

During the construction phases of the project, the constructed stormwater wetland (pocket wetland) shall be inspected monthly and cleaned as necessary and/or after storms events with 1" of rainfall or greater. Thereafter, this structure shall be inspected and cleaned at least twice per year (growing and non-growing seasons) for the first three years after construction or as needed during the owner's regular maintenance of the grounds.

Inspections shall include:

- Documentation and mapping the types/distribution of the wetland plants
- Removal of invasive wetland species
- Percentage of standing water
- Maximum elevation of the normal pool maintained
- Replacement of dead plants
- Once every 10 years, the accumulated sediment shall be cleaned from the wetland areas.

Broad Crested Weirs / Energy Dissipaters

During the construction phases of the project, the broad crested weirs / energy dissipaters shall be inspected monthly and cleaned as necessary and/or after storms events with 1" of rainfall or greater. Thereafter, these structures shall be cleaned at least once per year or as needed during the owner's regular maintenance of the grounds.

Cleanings shall include:

- Removal of vegetation
- Removal of excess sediment accumulation
- Inspection of condition of stone.

Stormwater BMP Inspection and Maintenance Log

Project Name: Franklin Bent Street; Bent Street; Franklin, MA 02038
SWPPP Contact: KJS Realty
Contact: _____
Phone: _____

Begin Date	End Date

Date	BMP ID#	BMP Description	Inspected by:	Cause for Inspection	Exceptions Noted	Comments and Actions Taken

LONG TERM STRUCTURAL BEST MANAGEMENT PRACTICE INSPECTION & MAINTENANCE MATRIX AFTER CONSTRUCTION

Note: BMP's shall be visually inspected and repaired by a qualified party in accordance with the following chart. Note these are minimum inspection criteria/frequencies and should be adjusted throughout the project lifespan as required to maintain effectiveness. Refer to maintenance standards for drainage facilities and structural best management practices in the "Recommended Long-Term Stormwater Pollution Prevention Plan."

Conventional & LID Best Management Practices	Recommended Minimum Inspection & Maintenance Frequency	Erosion/Scouring	Tree Growth Hazards	Differential Settlement/Seepage	Structural Damage/Obstructions	Trash & Debris	Removal of Accumulated Sediment	Slope Integrity	*Mow Vegetation/Poor Vegetation Coverage	Remove/Reset Filter Fabric & Stone As Required	Check - Remove & Replace mulch/media/stone	Remove/Reset Riprap as Required
Infiltration Basin with Partial Exfiltration	*Semi-Annual*	☑	☑	☑	☑	☑	☑	☑	☑			☑
Forested Vegetated Filter Strip	*Annually*	☑			☑	☑	☑	☑	☑			☑
Overflow Weir	*Semi-Annual*	☑			☑	☑	☑	☑	☑			☑
Constructed Stormwater Wetlands (Pocket Wetland)	*Semi-Annual*	☑		☑	☑	☑	☑	☑				☑
Culvert Outlet Protection with Level Spreaders	*Annually*	☑			☑	☑	☑			☑		☑
Vegetated Swale	*Semi-Annual*	☑	☑		☑	☑	☑	☑	☑			

Soil Data

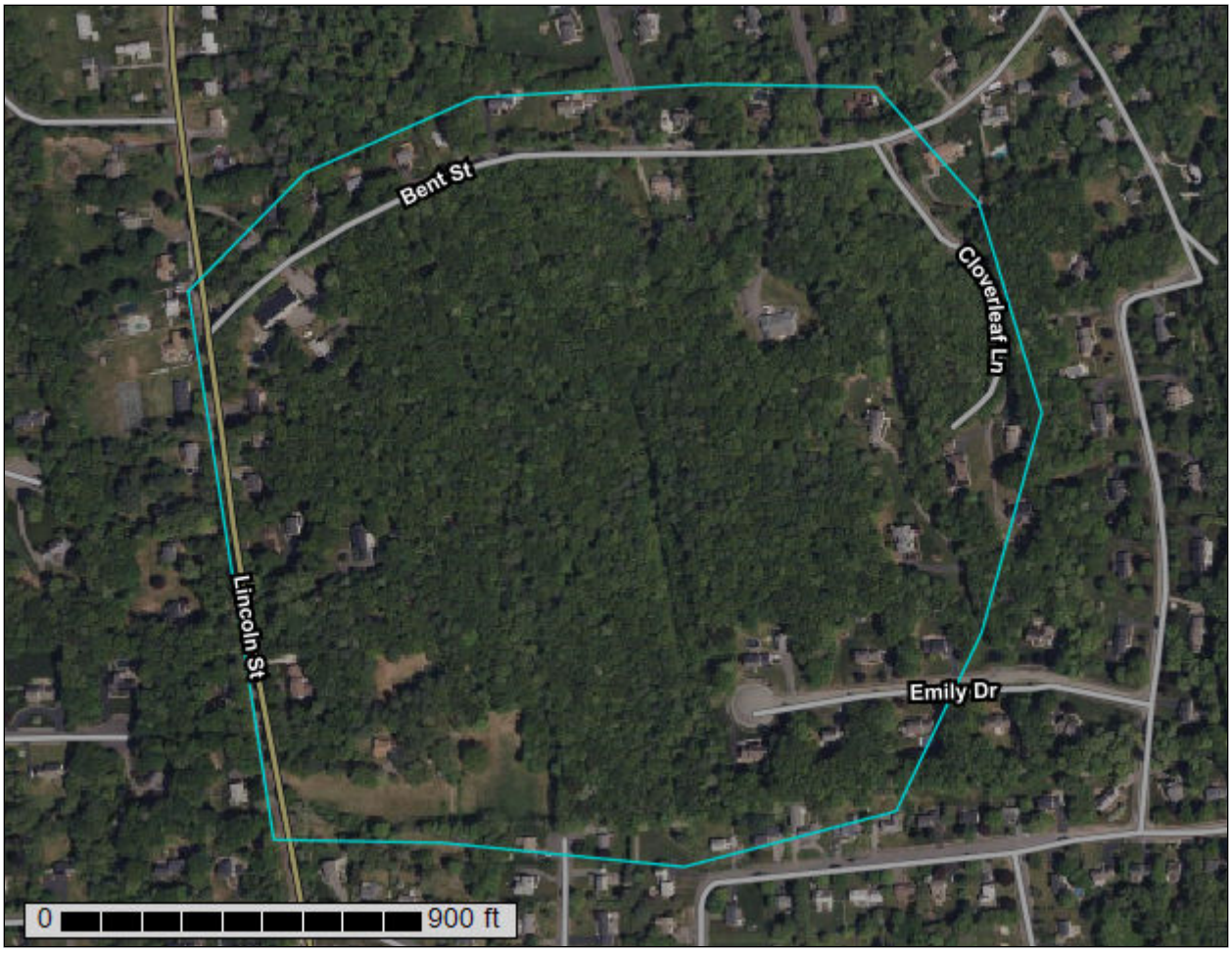
United States Department of Agriculture

NRCS

Natural Resources Conservation Service

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

Custom Soil Resource Report for Norfolk and Suffolk Counties, Massachusetts



July 12, 2023

Soil Information for All Uses

Soil Properties and Qualities

The Soil Properties and Qualities section includes various soil properties and qualities displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each property or quality.

Soil Qualities and Features

Soil qualities are behavior and performance attributes that are not directly measured, but are inferred from observations of dynamic conditions and from soil properties. Example soil qualities include natural drainage, and frost action. Soil features are attributes that are not directly part of the soil. Example soil features include slope and depth to restrictive layer. These features can greatly impact the use and management of the soil.

Hydrologic Soil Group

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

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

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

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

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

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

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

Custom Soil Resource Report
Map—Hydrologic Soil Group

Map Scale: 1:5,020 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 Rating Polygons

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

Soil Rating Lines

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

Soil Rating Points

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

Water Features

- Streams and Canals

Transportation

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

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:25,000.

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

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

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

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

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

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

Soil Survey Area: Norfolk and Suffolk Counties, Massachusetts
Survey Area Data: Version 18, Sep 9, 2022

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

Date(s) aerial images were photographed: May 22, 2022—Jun 5, 2022

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.

Table—Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
71B	Ridgebury fine sandy loam, 3 to 8 percent slopes, extremely stony	D	4.8	6.2%
103C	Charlton-Hollis-Rock outcrop complex, 8 to 15 percent slopes	B	1.2	1.6%
103D	Charlton-Hollis-Rock outcrop complex, 15 to 25 percent slopes		15.3	19.5%
104D	Hollis-Rock outcrop-Charlton complex, 15 to 35 percent slopes		1.2	1.6%
300B	Montauk fine sandy loam, 3 to 8 percent slopes	C	14.9	19.1%
300C	Montauk fine sandy loam, 8 to 15 percent slopes	C	0.8	1.0%
305B	Paxton fine sandy loam, 3 to 8 percent slopes	C	3.6	4.7%
310B	Woodbridge fine sandy loam, 3 to 8 percent slopes	C/D	34.1	43.7%
315B	Scituate fine sandy loam, 3 to 8 percent slopes	C	2.1	2.7%
Totals for Area of Interest			**78.1**	**100.0%**

Rating Options—Hydrologic Soil Group

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Depth to Any Soil Restrictive Layer

A "restrictive layer" is a nearly continuous layer that has one or more physical, chemical, or thermal properties that significantly impede the movement of water and air through the soil or that restrict roots or otherwise provide an unfavorable root environment. Examples are bedrock, cemented layers, dense layers, and frozen layers.

This theme presents the depth to any type of restrictive layer that is described for each map unit. If more than one type of restrictive layer is described for an

R.W. Gillespie & Associates, Inc.
Geotechnical Engineering • Environmental Consulting • Materials Testing Services

16 June 2023

Steve Kelleher
Vertex Towers, LLC
155 South Street
Wrentham, MA 02093

VIA EMAIL: stephen@vertextowers.com

Subject: Geotechnical Engineering Evaluation
190-foot Self-Supported Tower – 97 Bent Street
Franklin, Massachusetts
RWG&A Project No. 1724-042

Dear Mr. Kelleher:

R. W. Gillespie & Associates, Inc. (RWG&A) is pleased to present the results of the geotechnical engineering evaluation for a planned 190-foot self-supported tower to be built at 97 Bent Street in Franklin, Massachusetts. The purpose of RWG&A's services was to obtain and evaluate subsurface information and to provide recommendations for design and construction of the tower foundation and obtaining information for strormwater management design. The services were performed in accordance with RWG&A Proposal No. P-11328.GI dated 30 March 2023.

In summary, the subsurface conditions encountered in the tower, roadway, and stormwater areas consisted of topsoil over naturally deposited, very loose, silty sand over medium dense to very dense silty sand with gravel underlain by dense silty sand. Free water was observed at depths of about 7 feet to 19 feet below ground surface and refusal surfaces were not encountered within the depths drilled. The following presents the findings of the subsurface explorations, laboratory testing, engineering evaluations, and geotechnical engineering design recommendations.

INTRODUCTION

The project consists of an approximately 640-foot long access road, a 190-foot self-supported tower, and two stormwater basins at 97 Bent Street in Franklin, Massachusetts. The approximate site location is shown in Figure 1, *Locus Map*. RWG&A's understanding of the existing conditions and proposed construction is based on a review of the drawing titled *Site Plan, undated,* prepared by Vertex Towers, LLC (Adobe PDF file titled VT-MA-XXXX Franklin MA (Bent St)).

The project site is moderately wooded and the ground surface is relatively flat but slopes down from south to north. The planned tower would be 190 feet high above grade and located near the center of the compound. Stormwater basins would be located near about Sta. 3+50 and 5+00 of the access road and the depth of the basins are planned to be about 2 to 3 feet below current ground surface.

SUBSURFACE EXPLORATION PROGRAM

The subsurface exploration program consisted of test boring B-1 drilled within the proposed tower compound area, auger probe P-1 drilled along the proposed access road alignment, and borings SW-1 and SW-2 drilled at the planned stormwater basin. The approximate exploration locations are shown in Figure 2, *Exploration Location Plan*. Drilex Environmental, Inc. of Auburn, Massachusetts drilled the explorations on 26 May 2023 using a track-mounted drilling rig.

Exploration activities were monitored by RWG&A personnel. The explorations were advanced using hollow-stem augers. Split-barrel sampling with standard penetration testing was performed in the tower test boring at 5-foot intervals and in the stormwater borings generally continuously in general accordance with *ASTM D1586, Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils*. The soils were described per *ASTM D2488, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure).* The exploration logs are included in Appendix A, attached. Stratification lines shown on the exploration logs represent the approximate boundaries between the different soil types encountered; the actual transitions will be more gradual and vary over short distances.

The tower center was marked by Vertex Towers, LLC before drilling. Based on measurements taken in the field after drilling, it appears the tower center was marked about 75 feet north of the actual tower location. The as-drilled exploration horizontal locations shown in Figure 2 were determined by RWG&A using a commercial-grade hand-held GPS unit with a clear sky accuracy of 6 feet. The exploration locations should be considered accurate only to the degree implied by the methodology used to determine them.

LABORATORY TESTING

Laboratory testing was performed using selected soil samples recovered from the soil boring to assist in classifying the soils and estimating engineering properties. The testing program included one particle-size distribution test with moisture-content determinations and two particle-size distribution with hydrometer tests; moisture content determinations were also performed with the particle-size distribution tests. The tests were performed in general accordance with the following methods and procedures:

- *ASTM D6913/6913M – 17, Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis.*
- *ASTM D2216, Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.*

- *ASTM D7928-17, Standard Test Method for Particle-Size Distribution (Gradation) of Fine-Grained Soils Using the Sedimentation (Hydrometer) Analysis.*

- *ASTM D1140, Standard Test Method for Amount of Material in Soils Finer Than the No. 200 (75-µm) Sieve by Washing*.

Results of moisture content tests are shown on the exploration logs. The particle-size distribution analysis and hydrometer test results are provided in Appendix B. All tests were conducted at the RWG&A soil and materials testing laboratory in Biddeford, Maine, which is accredited by the American Association of State Highway and Transportation Officials (AASHTO) for the tests performed.

SUBSURFACE CONDITIONS

Soils

The conditions encountered within the 32-foot vertical reach of boring B-1 consisted of topsoil over naturally deposited silty sand over silty sand with gravel. The naturally deposited soil consisted of loose, medium to fine sand with silt over dense to very dense, coarse to fine sand with varying amounts of silt and gravel underlain by dense medium to fine sand with silt.

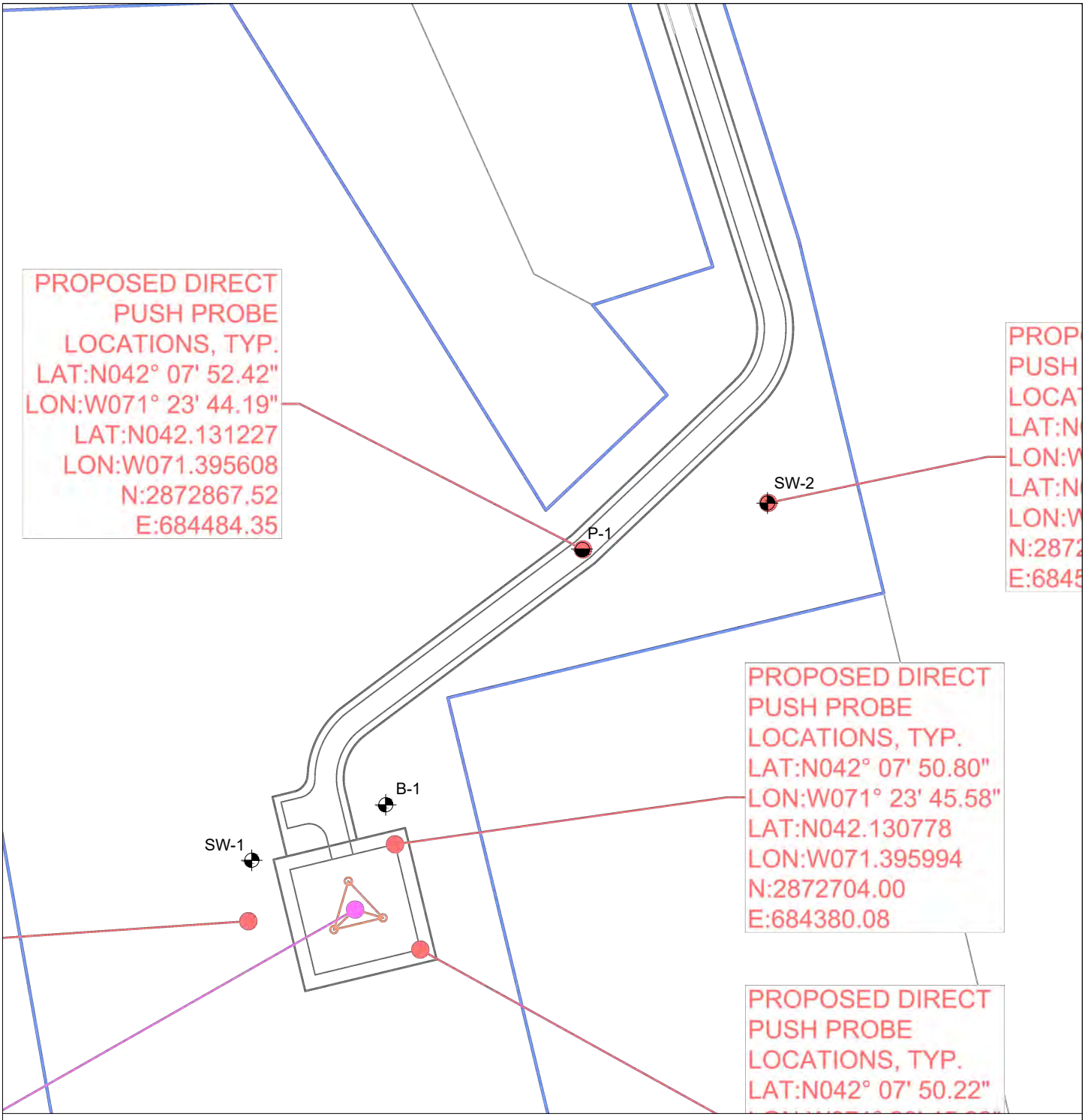
Subsurface conditions along the proposed access road and in the stormwater areas consisted of topsoil over naturally deposited silty sand over silty sand with gravel extending to depths of more than 10 feet below current ground surface. The naturally deposited silty sand with gravel consisted of coarse to fine sand with some silt and contained cobbles and boulders at P-1. Please refer to the exploration logs in Appendix A for detailed soil descriptions at specific locations.

Groundwater

Free water was observed in the explorations at the time of drilling. The United States Department of Agriculture medium-intensity soil survey indicates that seasonal high groundwater for the soil type mapped at the site is greater than 6.5 feet below ground surface. Groundwater levels at the site will fluctuate due to season, temperature, rainfall, nearby utilities, and construction activity in the area; therefore, water levels during and following construction will vary from those observed in the explorations. Seasonal high groundwater levels of about 3.5 feet below ground surface were estimated from redoximorphic features observed in borings SW-1 and SW-2.

Infiltration

Sieve analysis tests were performed using samples of naturally deposited soil from 2 to 4 feet below ground surface. The gradations indicate the material is sandy silt over silty sand (USCS Classification SM and ML) and the lab test results indicate both materials have a USDA soil classification of Sandy Loam. The *Massachusetts Stormwater Handbook* indicates this soil is of Hydrologic Soil Group B and has a Rawls infiltration rate of 1.02 inches per hour.



LEGEND:

B-1 APPROXIMATE LOCATION OF SOIL BORING DRILLED 26 MAY 2023.

P-1 APPROXIMATE LOCATION OF SOIL PROBE DRILLED 26 MAY 2023.

N

0 80 120 160

SCALE, FEET

SOURCE:
DRAWING TITLED "SITE PLAN", UNDATED, FILE LABELED "VT-MA-XXXX FRANKLIN MA (BENT ST) ZD REV1-GEO-TECH BORING.PDF" SHOWING CONCEPT GRADING AND LAYOUT.

FIGURE 2
EXPLORATION LOCATION PLAN
GEOTECHNICAL EVALUATION
190 FT SELF SUPPORTED TOWER
FRANKLIN, MASSACHUSETTS

JUNE 2023 PROJECT NO. 1724-042

R.W. Gillespie & Associates
Geotechnical Engineering ● Materials Testing Services
Environmental Consulting ● www.rwgillespie.com

G:\PROJECTS\1700\1724\1724-042 Franklin MA GIS\Drafting\FIG 2, ELP 1724-042.dwg, 06/14/2023 6:07:27 PM

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Boring Log: B-1
Total Depth (ft): 30
Sheet 1 of 2

Project Name: 190 Ft. Self Supported Tower
RWG&A Project No. 1724-042
Location: Franklin, Massachusetts
Client: Vertex Towers, LLC
RWG&A Representative: Marc Grenier
Boring Location: See Exploration Location Plan
Boring Abandonment Method: Backfill with cuttings
Observed Water Depth: 17'

Drilling Co.: Drilex
Drill Rig: CME 55 Rubber Track
Driller Rep.: Jamie Hastings
Date Started: 05/26/2023
Date Completed: 05/26/2023
Surface Elevation:
Drilling Method: 4 1/4" HSA
Casing Type: N/A

DEPTH, FT.	SYMBOL	SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N VALUE	MOISTURE CONTENT %	LAB TESTS
0			S-1	TOPSOIL AND ORGANIC MATERIAL (12 inches).	12	1 1 1 15	2		
				SANDY SILT (ML); Very loose, moist, fine sand, with silt, tan.					
				SILTY SAND WITH GRAVEL (SM); Dense to very dense, coarse to fine sand, little silt, little gravel, gray.					
5			S-2		24	11 17 19 23	36	9	GS NM
10			S-3		21	22 32 37 50/3"	73		
15			S-4		15	34 50 50/5"	100+		
20			S-5	Becomes wet.	8	42 50/5"	100+		
				SILTY SAND (SM); Dense, wet, coarse to fine sand, little silt, tan.					
25			S-6		20	13 18 13 30	31		
30									

Notes:

R.W. Gillespie & Associates

- Geotechnical Engineering
- Environmental Consulting
- Materials Testing Services

Boring Log: B-1

Total Depth: 30

Sheet 2 of 2

Project Name: 190 Ft. Self Supported Tower
Location: Franklin Massachusetts
Client: Vertex Towers, LLC
Observed Water Depth: 17'

RWG&A Project No. 1724-042
Surface Elevation:
Casing Type: N/A

DEPTH, FT.	SYMBOL	SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N VALUE	MOISTURE CONTENT %	LAB TESTS
30				Bottom of Exploration at 30'; Not refusal.					
35									
40									
45									
50									
55									
60									

Notes:

R.W. Gillespie & Associates
- Geotechnical Engineering
- Environmental Consulting
- Materials Testing Services

Boring Log: P-1
Total Depth (ft): 10
Sheet 1 of 1

Project Name: 190 Ft. Self Supported Tower
RWG&A Project No. 1724-042
Location: Franklin, Massachusetts
Client: Vertex Towers, LLC
RWG&A Representative: Marc Grenier
Boring Location: See Exploration Location Plan
Boring Abandonment Method: Backfill with cuttings
Observed Water Depth: Not Obs.

Drilling Co.: Drilex
Drill Rig: CME 55 Rubber Track
Driller Rep.: Jamie Hastings
Date Started: 05/26/2023
Date Completed: 05/26/2023
Surface Elevation:
Drilling Method: 4 1/4" HSA
Casing Type: N/A

DEPTH, FT.	SYMBOL	SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N VALUE	MOISTURE CONTENT %	LAB TESTS
0				TOPSOIL AND ORGANIC MATERIAL (12 inches).					
				SANDY SILT (ML);					
				SILTY SAND WITH GRAVEL (SM);					
5				Cobbles and boulders from 6' to 8'.					
10				Bottom of Exploration at 9'; Not refusal.					
15									
20									
25									
30									

Notes:

R.W. Gillespie & Associates
- Geotechnical Engineering
- Environmental Consulting
- Materials Testing Services

Boring Log: SW-1
Total Depth (ft): 9
Sheet 1 of 1

Project Name: 190 Ft. Self Supported Tower
RWG&A Project No. 1724-042
Location: Franklin, Massachusetts
Client: Vertex Towers, LLC
RWG&A Representative: Marc Grenier
Boring Location: See Exploration Location Plan
Boring Abandonment Method: Backfill with cuttings
Observed Water Depth: Not Obs.

Drilling Co.: Drilex
Drill Rig: CME 55 Rubber Track
Driller Rep.: Jamie Hastings
Date Started: 05/26/2023
Date Completed: 05/26/2023
Surface Elevation:
Drilling Method: 4 1/4" HSA
Casing Type: N/A

DEPTH, FT.	SYMBOL	SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N VALUE	MOISTURE CONTENT %	LAB TESTS
0			S-1	TOPSOIL AND ORGANIC MATERIAL (8 inches).	12	1 1 1	2		
				SANDY SILT (ML); Very loose, moist, medium to fine sand, little silt, tan.					
			S-2		18	1 7	62	9	GS NM
				SILTY SAND WITH GRAVEL (SM); Very dense, coarse to fine sand, little silt, little gravel, gravel. Mottling at 3.5' to 4'.		37 25 22			
5			S-3		16	12 17 28	45		
			S-4		24	24 49 19	36		
				Bottom of Exploration at 9'; Not refusal.		17 19			
10									
15									
20									
25									
30									

Notes:

R.W. Gillespie & Associates
- Geotechnical Engineering
- Environmental Consulting
- Materials Testing Services

Boring Log: SW-2
Total Depth (ft): 9
Sheet 1 of 1

Project Name: 190 Ft. Self Supported Tower
RWG&A Project No. 1724-042
Location: Franklin, Massachusetts
Client: Vertex Towers, LLC
RWG&A Representative: Marc Grenier
Boring Location: See Exploration Location Plan
Boring Abandonment Method: Backfill with cuttings
Observed Water Depth: 8'

Drilling Co.: Drilex
Drill Rig: CME 55 Rubber Track
Driller Rep.: Jamie Hastings
Date Started: 05/26/2023
Date Completed: 05/26/2023
Surface Elevation:
Drilling Method: 4 1/4" HSA
Casing Type: N/A

DEPTH, FT.	SYMBOL	SAMPLES	SAMPLE NUMBER	DESCRIPTION OF MATERIAL	SAMPLE RECOVERY, IN.	BLOWS PER 6"	SPT-N VALUE	MOISTURE CONTENT %	LAB TESTS
0			S-1	TOPSOIL AND ORGANIC MATERIAL (12 inches).	8	1 1 1	2		
			S-2	SANDY SILT (ML); Very loose, moist, silt, with medium to fine sand, tan.	20	1 2	30	10	GS NM
5			S-3	SILTY SAND WITH GRAVEL (SM); Dense, coarse to fine sand, few silt, little gravel, gray. Mottling at 3.5' to 4'.	16	5 25 30 14 23	45		
			S-4		18	22 20 17 19 16 19	35		
10				Bottom of Exploration at 9'; Not refusal.					
15									
20									
25									
30									

Notes: