PennEast Pipeline Company, LLC

PENNEAST PIPELINE PROJECT

Multi-Permit Application
for
Freshwater Wetlands Individual Permit
Special Activity Transition Area Waiver
Letter of Interpretation
Water Quality Certificate
Flood Hazard Area Individual Permit
Flood Hazard Hardship Exception Request
Flood Hazard Area Verification

ATTACHMENT M-4 – Lambertville Interconnect Stormwater Management Report

Submitted to:
New Jersey Department of Environmental Protection
Division of Land Use Regulation

August 2019

Lambertville Interconnect

Stormwater Management Report

PennEast Pipeline Project
West Amwell Township, Hunterdon County, NJ

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June 28, 2019

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EXECUTIVE SUMMARY

PennEast Pipeline (PennEast) proposes to construct, install, and operate the Project facilities to provide approximately 1.1 million dekatherms per day of year-round transportation service from northern Pennsylvania to markets in New Jersey, eastern and southeastern Pennsylvania, and surrounding states. The Project is designed to provide a long-term solution to bring the lowest cost natural gas available in the country produced in the Marcellus Shale region in northern Pennsylvania to homes and businesses in New Jersey, Pennsylvania and surrounding states.

The overall Project facilities include a 36-inch diameter, 114-mile mainline pipeline, extending from Luzerne County, Pennsylvania, to Mercer County, New Jersey. The Project will extend from various receipt point interconnections in the eastern Marcellus region, including interconnections with Transcontinental Gas Pipe Line Company, LLC (Transco) and gathering systems operated by Williams Partners L.P., Energy Transfer Partners, L.P. (formerly Regency Energy Partners, LP), and UGI Energy Services, LLC, all in Luzerne County, Pennsylvania, to various delivery point interconnections in the heart of major northeastern natural gas-consuming markets, including interconnections with UGI Central Penn Gas, Inc. (Blue Mountain) in Carbon County, Pennsylvania, UGI Utilities, Inc. and Columbia Gas Transmission, LLC in Northampton County, Pennsylvania, and Elizabethtown Gas, NRG REMA, LLC, Texas Eastern Transmission, LP and Algonquin Gas Transmission, LLC, all in Hunterdon County, New Jersey. The terminus of the proposed PennEast system will be located at a delivery point with Transco in Mercer County, New Jersey.

The proposed Project facilities at the Lambertville Interconnect (Site) will result in an increase in the impervious surface area of the Site. One (1) additional drainage culvert passing under Queens Road will be added in the proposed condition. Overall drainage patterns will remain the same as in the existing condition. New Jersey Department of Environmental Protection (NJDEP) best management practices have been incorporated into the stormwater management system design, which include (2) subsurface detention basins and two (2) online bioretention basins, to satisfy compliance with the NJDEP Stormwater Management Regulations at N.J.A.C. 7:8.

1.0 INTRODUCTION/OVERVIEW

The Project was developed in response to market demands in New Jersey and Pennsylvania, and interest from shippers that require transportation capacity to accommodate increased demand and greater reliability of natural gas in the region. The Project will include a new pipeline and aboveground facilities that will provide a new source of natural gas supply from the Marcellus Shale producing region to New Jersey, Pennsylvania and surrounding states enhancing the region's supply diversity. The Project is designed to provide a new pipeline to serve markets in the region with firm, reliable access to the Marcellus supplies versus the traditional, higher cost Gulf Coast regional supplies and pipeline pathways. An additional supply of natural gas to the region will provide a benefit to consumers, utilities, and electric generators by providing enhanced competition among suppliers and pipeline transportation providers.

The proposed Lambertville Interconnect facility is located within the property boundary of the Lambertville Compressor Station, identified as Block 5, Lot 6. The 28.87-acre Compressor Station property is bounded by a wooded area and Queen Road to the north, wooded areas and open fields to the west, NJ-179 to the south, and wooded areas and open fields to the east. The Lambertville Interconnect Facility location is shown on a USGS Site Location Map on Figure 1, and on an aerial site plan on Figure 2 in Appendix B. Waterbodies located on and surrounding the Site are shown on Figure 3 in Appendix B. The Site is located on a 4.7-acre area of the Lambertville Compressor Station property, east of the water body identified as SOW-B on Figure 3. Access to the Site will be through an existing asphalt-paved access drive off Queen Road. Approximate latitude/ longitude of the center of Site are 40º24'08.76" N/ 74º54'23.14" W in WGS84 geographic coordinate system. Under existing conditions, the Site is primarily open space area with two existing buildings, one approximately 24 feet by 24 feet in size, and one approximately 60 feet by 68 feet in size. The Site also contains approximately 49,179 square feet (sf) of gravel, and 10,324 sf of pavement. The remaining 3.22 acres is a combination of grass and wooded areas. PennEast proposes to construct a 13,950-sf gas metering station building, a 3,600-sf generator building, gravel equipment and piping pad areas, and asphalt pavement vehicle maneuvering areas. This will result in a disturbance of 3.39 acres, and a net increase in impervious coverage of 1.27 acres.

This stormwater management report addresses the NJDEP Stormwater Management Requirements set forth in N.J.A.C. 7:8 for stormwater quantity, quality, and groundwater recharge. The Project will disturb more than one acre of land and result in a net increase of 1.27 acres impervious cover due to the construction of facility buildings, pavement, and gravel areas. Hence, the Project will be subject to the stormwater quantity and quality requirements of N.J.A.C. 7:8. The Project should be exempt from the groundwater recharge requirements of N.J.A.C. 7:8 because it will be an industrial facility that is directly or indirectly related to process, manufacturing or other industrial activities, which could be a source of pollutants in any industrial stormwater discharge to groundwater. Industrial stormwater exposed to "source material" shall not be recharged in accordance with N.J.A.C. 7: 8-5.4.2.iii. Therefore, the Project should be exempt from the recharge requirements under this section. The succeeding sections of this report will address these requirements and demonstrate compliance by this Project.

2.0 STORMWATER MANAGEMENT

2.1 Modeling Procedure

In accordance with N.J.A.C. 7:8-5.6(a), the Natural Resources Conservation Service (NRCS) methodology was used to compute stormwater pre- and post-development peak runoff rates, volumes, and hydrographs, using HydroCAD® Stormwater Modeling System v. 10 by HydroCAD Software Solutions, LLC. Time of concentration (Tc) was determined for pre- and post-developed conditions using the hydraulically longest flow path. Maximum sheet flow length used was 100 feet. The Tc flow paths can be found on the Drainage Area Plans located in Appendix I. Tc calculations are included in the HydroCAD® output in Appendix E and F.

Curve Numbers (CN) were generated for the drainage areas for pre- and post-developed conditions based on the soil group and land use. Runoff volumes for pervious and directly connected impervious areas were computed separately and then combined into a weighted average runoff volume technique to account for the difference in initial abstraction (I_a) for pervious and impervious areas.

Using the drainage areas, Tc's, and the CN's as input data, the NRCS TR-20 method using HydroCAD® software was used to generate Site runoff values in pre- and post-developed conditions.

A Type III, 24-hour rainfall distribution was used for the 2, 10, and 100-year design storms. Utilizing National Oceanic and Atmospheric Administration (NOAA) Point Precipitation Frequency Estimates at Lambertville, New Jersey, the rainfall frequency values associated with these design storms are 3.33, 4.96, and 7.99 inches, respectively (Appendix E, Rainfall Intensity – NOAA Point Precipitation Frequency Estimates).

Comprehensive hydrologic peak flow calculation models were set up for existing and proposed conditions using the HydroCAD® software to route peak runoff through subsurface detention basins and surface online bioretention basins, using the dynamic storage-indication routing method. Peak flow outputs from these models were compared to achieve regulatory compliance.

2.2 Existing Conditions

Under existing conditions, surface runoff flows from south to north across the Site and passes under Queen Road through three existing culverts. Runoff then flows via sheet flow and shallow concentrated flow approximately 250 feet to the Alexauken Creek, a Category One water body. Total contributing drainage area analyzed (hereinafter referred to as the study area) is 4.697 acres. The area that will be disturbed for construction of the proposed facility is 3.55 acres.

For the purposes of the stormwater management system design, since all areas drain to the Alexauken Creek, peak runoff flow rates from the onsite (disturbed) and offsite (undisturbed) areas were computed as one total combined flow leaving the Site.

The Site was delineated into three (3) drainage areas totaling 4.697 acres, as shown in Appendix I – Drawing EX-DA-1, Pre-Development Drainage Plan. The Tables located on Drawing EX-DA-1 summarize the pre- development drainage areas and CN values.

Utilizing these drainage areas, weighted average volume CN and Tc values, the pre-developed

Site runoff rates and volumes were generated for 2, 10, and 100-year design storms in 24-hour duration.

2.2.1 Soils and Topography

The topography within the Site can be described as flat to rolling, with an average slope range of 13 percent to 17 percent from south to north towards Alexauken Creek. Elevations range from a high of approximate elevation 200 feet in the south portion of the Site, and a low of approximate elevation 135 in the northwest corner of the Site (NAVD 88).

The NRCS Web Soil Survey of Hunterdon County, New Jersey identifies two (2) soil types within the Site area. A brief description for these soil types are as follows:

- Penn channery silt loam (PeoB) – The Penn channery silt loam component is located within the northern half of the Site and makes up 85 percent of the map unit. Reaville, Bucks, and Klinesville make up the remaining 15 percent minor components. Slopes are 2 to 6 percent. This component is on hills within the piedmonts. The parent material consists of fine-loamy residuum weathered from acid reddish shale, siltstone, and fine-grain sandstone. Depth to a root restrictive layer, bedrock, paralithic, is 20 to 40 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 3 percent. Non-irrigated land capability classification is 2e. This soil does not meet hydric criteria.

- Penn channery silt loam (PeoC2) – The Penn, eroded component makes up 85 percent of the map unit. Pattenburg, Klinesville, and Bucks, eroded, make up the remaining 15 percent minor components. Slopes are 6 to 12 percent. This component is on hills in the piedmonts. The parent material consists of fine-loamy residuum weathered from acid reddish shale, siltstone, and fine-grain sandstone. Depth to a root restrictive layer, bedrock, paralithic, is 20 to 40 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 3 percent. Non-irrigated land capability classification is 3e. This soil does not meet hydric criteria.

Table 2-1 summarizes the characteristics of the soil types present on the Site, and their associated Hydrologic Soil Groups (HSG). The soil map and description are shown on Figure 4 in Appendix B.

Table 2-1 Table of NRCS Soil Characteristics				
Map Unit	**Soils Name**	**Drainage Class**	**HSG**	**Slope**
PeoB	Penn channery silt loam	Well drained	C	2-6%
PeoC2	Penn channery silt loam	Well drained	C	6-12%, eroded
Source: Natural Resource Conservation Center Web Soil Survey, U.S. Department of Agriculture				

2.2.2 Geotechnical Investigation

A geotechnical investigation was conducted by GZA GeoEnvironmental, Inc. and is summarized in its Geotechnical Engineering Report, dated July 9, 2018, provided in Appendix C. The geotechnical report provides a subsurface exploration and geotechnical engineering evaluation for the design and construction of proposed improvements at the Project Site. Nine (9) test borings were advanced to depths ranging from 6 to 15 feet below the existing ground surface. A summary of existing soil strata, as found in the geotechnical report, is as follows:

Fill - Approximately 0.2 to 3.8 feet of fill was encountered in or near existing gravel or paved areas at test boring locations GZ-104 and GZ-107 to GZ-109. Fill was also encountered below the Topsoil/Subsoil in Test borings GZ-101 and GZ-1002. Approximately 1.5 to 4.5 feet of topsoil/subsoil was encountered at the ground surface that did not encounter fill.

Topsoil/Subsoil - Approximately 0.3 to 1 foot of Topsoil was encountered at the ground surface in 5 of the 9 test borings. Approximately 2.5 to 5.7 feet of Subsoil was encountered below Topsoil or Fill in 8 of the 9 test borings. Test boring GZ-109 did not encounter Subsoil.

Weathered Bedrock - Weathered bedrock was encountered in each of the explorations at depths between 0.4 and 7.2 feet below ground surface. The weathered bedrock varied between approximately 3 and 9.2 feet thick.

Bedrock - Competent bedrock was encountered at depths between 6 and 15.2 feet below ground surface.

Groundwater was attempted to be measured within each of the test borings prior to introduction of drilling was water. However, groundwater was only encountered in borings GZ-101 and GZ-102 at depths of 6.5 and 8 feet, respectively. Based on observations in the field, groundwater is likely at, or near the top of Weathered Bedrock seasonally and related to local precipitation.

Rock is present at relatively shallow depths, and may require heavy excavation equipment, mechanical chipping or blasting in some areas. Groundwater is likely at, or near the top of the weathered bedrock, and will require temporary dewatering pumps during excavation.

2.3 Proposed Conditions

As stated in Section 2.2, the applicant proposes to construct a 13,950-sf gas metering station building, a 3,600-sf generator building, gravel equipment and piping pad areas, and asphalt pavement vehicle maneuvering areas.

The overall Area of Disturbance for construction of the AGT/TETCO Interconnect Facility is 3.55 acres. Impervious coverage is increased by 1.27 acres, as shown in Table 2-2.

Table 2-2
Summary of Impervious Coverage

Existing Condition	0.35 Acres
Proposed Condition	1.62 Acres
Increase in Impervious Coverage	**1.27 Acres**

The Stormwater Management Rules at N.J.A.C. 7:8 define a "major development" as a development which ultimately disturbs one or more acres of land or increases impervious coverage by one-quarter of an acre or more. This Project meets the definition of "major development" by meeting both criteria. Thus, the stormwater quantity, quality soil erosion control, and low impact development requirements of N.J.A.C. 7:8 will have to be met. The Project should be exempt from the groundwater recharge requirement because it is an industrial site that contains "source material" that should not be recharged, in accordance with N.J.A.C. 7:8-5.4.2, iii.

Sections 2.3.1 to 2.3.4 illustrate how the Project complies with the N.J.A.C. 7:8 requirements.

2.3.1 Stormwater Quantity (N.J.A.C. 7:8-5.4)

To demonstrate compliance with stormwater quantity standards, the design engineer must, using the assumptions and factors for stormwater runoff calculations at N.J.A.C 7:8-5.6, demonstrate compliance using one of the 3 methods listed at N.J.A.C. 7:8-5.4 (a), 3:

i. Demonstrate through hydrologic and hydraulic analysis that for stormwater leaving the site, post-construction runoff hydrographs for the two, 10 and 100-year storm e v e n t s do not exceed, at any point in time, the pre-construction runoff hydrographs for the same storm events;

ii. Demonstrate through hydrologic and hydraulic analysis that there is no increase, as compared to the pre-construction condition, in the peak runoff rates of stormwater leaving the site for the two, 10 and 100-year storm events and that the increased volume or change in timing of stormwater runoff will not increase flood damage at or downstream of the site. This analysis shall include the analysis of impacts of existing land uses and projected land uses assuming full development under existing zoning and land use ordinances in the drainage area; or

iii. Design stormwater management measures so that the post-construction peak runoff rates for the two, 10 and 100-year storm events are 50, 75 and 80 percent, respectively, of the pre-construction peak runoff rates. The

percentages apply only to the post-construction stormwater runoff that is attributable to the portion of the site on which the proposed development or project is to be constructed;

Method "iii" was selected for this Project. The same overall drainage area of 4.697-acres used in the existing conditions analysis was subdivided into eight (8) drainage areas in the post-development drainage analysis, based upon site grading and storm sewer inlet and piping configuration. Weighted average CN and Tc values were calculated for each of the eight (8) drainage areas. Proposed drainage areas are shown in Appendix J – Drawing PR-DA-1, Post-Development Drainage Plan.

Quantity control was accomplished by dividing the Site into three (3) separate BMP systems:

System 1: Bioretention Basin 1

The eastern paved impervious and pervious developed areas of the Site, denoted as drainage areas 1 and 4, drain into Bioretention Basin 1. This basin is designed as an online basin with underdrains and a multi-stage outflow control structure. This basin receives runoff from all storm events, and provides storage and attenuation for the 2, 10 and 100-year storm events with use of the multi-stage outflow control structure OCS-1. The basin is lined with an impermeable PVC liner to prevent infiltration into the subsoil. Infiltration into the basin subsoil and underdrain system is routed through the basin outlet culvert, and therefore is included in routing calculations for quantity control.

System 2: Subsurface Detention Basin 1 to Bioretention Basin 2:

The western paved impervious and pervious developed areas of the Site, denoted as drainage areas 2 and 5, drain into Subsurface Detention Basin 1 (StormTrap precast concrete vaults), and are then routed into Bioretention Basin 2. Both basins contain multi-stage outflow control structures, and are designed to attenuate the 2, 10 and 100-year storm events. Like Bioretention Basin 1, Bioretention Basin 2 and Subsurface Detention Basin 1 are lined with an impermeable PVC liner to prevent infiltration into the subsoil. Infiltration into the Bioretention Basin 2 subsoil and underdrain system is routed through the basin outlet culvert, and therefore is included in routing calculations for quantity control.

System 3: Subsurface Detention Basin 2:

This basin is a StormTrap precast concrete vault system, like Subsurface Detention Basin 1. It receives isolated roof runoff from the new buildings only, denoted as drainage area 3. Isolated roof runoff from new buildings is considered clean by NJDEP standards and does not require water quality treatment. It contains an internal multi-stage outflow structure to provide storage and attenuation for the 2, 10 and 100-year storms. Subsurface Detention Basin 2 is also lined with an impermeable PVC liner to prevent infiltration into the subsoil.

A comparison of pre-and post-development runoff rates is shown in Table 2-3. This table demonstrates that the overall reductions required by N.J.A.C. 7:8-5.4 (a), 3, iii

are met. Detailed HydroCAD output for pre- and post-development runoff hydrographs are in Appendix E and F of this report.

Table 2-3
Pre- and Post-Development Peak Flow Rate Comparison

Storm Event	Pre-Development Flow Rate (cfs)	Pre-Development Flow Rate Reduction (per N.J.A.C. 7:8)	Maximum Allowable Post-Development Flow Rate (cfs)	Provided Post-Development Flow Rate (cfs)
2-year	6.43	50%	3.22	3.15
10-year	12.11	75%	9.08	5.91
100-year	23.47	80%	18.78	12.91

2.3.2 Stormwater Quality (N.J.A.C. 7:8-5.5)

Stormwater management measures are only required for water quality control if an additional one-quarter acre of impervious surface is being proposed on a development site. In accordance with N.J.A.C. 7:8-5.5, the water quality regulations generally require the removal of 80 percent of the Total Suspended Solids (TSS) from the water quality storm (defined as 1.25 inches of rainfall over 2 hours), and the removal of nutrients to the maximum extent feasible. However, as per N.J.A.C. 7:8-5.5 (i), pursuant to the Flood Hazard Area Control Act Rules at N.J.A.C. 7:13-11.2 (j) 4, runoff from the water quality design storm that is discharged within a 300-foot riparian zone of Category One waters shall be treated to reduce the post-construction load of total suspended solids by 95 percent of the anticipated load from the developed site. The Project discharged runoff from the water quality design storm within a 300-foot riparian zone of a Category One water, SOW-B and the Alexauken Creek. Therefore, the 95 percent TSS removal requirement must be met.

To the maximum extent practicable, these standards have been met by incorporating nonstructural stormwater management strategies at N.J.A.C. 7:8-5.3 into the design. However, these measures are insufficient to meet these standards, and therefore structural stormwater management measures have been incorporated into the design. A maintenance plan as described under N.J.A.C. 7:8-5.8 has also been provided for the stormwater management measures.

The proposed stormwater management system is designed in accordance with the Stormwater Management Regulations at N.J.A.C. 7:8, the NJDEP BMP Manual, and the Standards for Soil Erosion and Sediment Control in New Jersey Soil Erosion, latest editions.

The 95 percent TSS and nutrient removal requirement is accomplished through use of 2 BMP's in series. The upstream BMP is a 50 percent Department-certified manufactured treatment device (MTD), followed by a downstream Bioretention Basin designed for 90 percent TSS removal in accordance with Chapter 9.1 of the New Jersey Stormwater Best Management Practices Manual (BMP Manual).

The computation for 95 percent TSS removal is as per the "Equation for TSS removal rate (R) for two BMP's in series" (BMP Manual, Chapter 4, Stormwater Pollutant Removal Criteria):

$$R = A + B – [(A X B) / 100]$$

Where R = Total TSS Removal Rate
A = TSS Removal Rate of the First or Upstream BMP = 50 percent (CDS Unit)
B = TSS Removal Rate of the Second or Downstream BMP = 90 percent (Bioretention Basin)

$$R = 50\% + 90\% – [(50\% \times 90\%) / 100] = 95\%$$

Water quality calculations utilize the distribution of rainfall from the water quality design storm, a two-hour storm producing 1.25 inches of rain.

Due to the existing and proposed Site topography, two separate systems are required. A description of each system is as follows:

System 1: CDS Unit 1 and Bioretention Basin 1 (Provides Quantity and Quality Control)

System 1 consists of a Contech hydrodynamic separator unit (CDS-1) placed upstream of Bioretention Basin 1 as a pretreatment unit.

This system will treat all new impervious area located in the eastern and southern areas of the Site, indicated on Drawing PR-DA-1 as areas 1, 4, 7 and 8. The area contains 0.387 acres of new impervious cover, consisting of gravel and asphalt pavement, and will generate a water quality design storm peak runoff rate of 1.16 cubic feet per second (cfs). The unit is approved by NJDEP for a water quality treatment flow rate of up to 1.5 cfs.

Runoff will be collected in surface drainage inlets and subsurface HDPE storm drainage piping and will be directed to CDS-1. The CDS unit has an internal bypass weir, which diverts flows larger than the water quality storm to the unit's outflow pipe. The CDS unit is Department-certified for 50 percent TSS and has been designed for 50 percent TSS removal from the water quality storm. Treated runoff will then be directed via subsurface HDPE piping to Bioretention Basin 1 through a retaining wall equipped with rip rap stabilized conduit outlet protection at the base. See Appendix G for CDS-1 unit details and NJDEP certification.

Bioretention Basin 1 has been designed in accordance with BMP Manual chapter 9.1 as an online system to address both quality and quantity requirements. Pollutants are treated through the process of settling and uptake and filtration by the vegetation. Pollutants are also treated within the soil bed through infiltration. Design parameters for achievement of 90 percent TSS removal have been selected, which include 24-inch soil bed, 6-inch sand layer, and 4-inch diameter perforated underdrains in gravel bedding leading to the basin outlet structure. Basin side slopes are 3H:1V. Impervious PVC liner will be placed along the bottom and sides of the basin to prevent migration of fine particle from the surrounding soil and infiltration into the groundwater. Eighty-five percent Density terrestrial forested

vegetation has been selected and spaced in accordance with chapter 7 of the BMP manual.

The basin has been designed to store the entire water quality design storm volume. This volume is stored between basin bottom elevation 155.0 up to the level of the first orifice. All flows greater than this volume will be discharged through a controlled outlet structure with 2.5-inch circular orifice at elevation 156.0, a 6-inch by 6-inch rectangular orifice at elevation 157.30, and a horizontal overflow grate at elevation 158.61.

The imported subsoil will be specified to have a design permeability rate of 3 inches per hour. Therefore, the basin drain time has been designed with a permeability rate of 1.5 inches per hour, using a factor of safety of 2.

The 1.25 inch/2-hour water quality storm was modelled in HydroCAD and calculated at 1.16 cfs. The drainage areas 1, 4, 7 and 8 will be infiltrated to the underdrain system in less than 72 hours, and therefore, the basin complies with the water quality requirement. The results are shown in Appendix D, Water Quality Calculations.

System 2: CDS Unit 2, Subsurface Detention Basin 2 and Bioretention Basin 2 (Provides Quantity and Quality Control)

System 2 consists of a Contech hydrodynamic separator unit (CDS-2) placed upstream of Subsurface Detention Basin 2 and Bioretention Basin 2 as a pre-treatment unit.

This system will treat all new impervious areas located in the northern area of the Site, indicated on Drawing PR-DA-1 as area 2. The area contains 0.802 acres of new impervious cover, consisting of asphalt pavement and gravel, and will generate a water quality design storm peak runoff rate of 2.16 cfs. The CDS-2 unit is approved by NJDEP for a water quality treatment flow rate of up to 2.8 cfs.

Runoff will be collected in surface drainage inlets and subsurface HDPE storm drainage piping and will be directed through CDS-2. CDS-2 will direct treated water quality storm flow into Subsurface Detention Basin 2, followed by Bioretention Basin 2 via rip rap stabilized Headwall 2. The CDS-2 unit is Department-certified for 50 percent TSS and has been designed for 50 percent TSS removal from the water quality design storm. See Appendix G for CDS-2 unit details and NJDEP certification.

Bioretention Basin 2 has also been designed for 90 percent TSS removal, using the same criteria and procedure used for Bioretention Basin 1. The basin has been designed to store the entire water quality storm volume, from bottom elevation 156.0 up to the level of the first orifice at elevation 157.0. All flows greater than this volume will be discharged through a controlled outlet structure with 2.5-inch circular orifice at elevation 156.0, a 4-inch orifice at elevation 157.54, and a horizontal overflow grate at elevation 158.26. Impervious PVC liner will be placed along the bottom and sides of the basin to prevent migration of fine particle from the surrounding soil and infiltration into the groundwater. 85 percent Density terrestrial forested vegetation has been selected and spaced in accordance with chapter 7 of the BMP manual.

The water quality storm was again modelled in HydroCAD. The model indicates the inflow of 2.16 cfs for the water quality storm for drainage area 2 and 5 will be infiltrated to the underdrain system in less than 72 hours, and therefore, the basin complies with the water quality requirement. The results are shown in Appendix D, Water Quality Calculations.

2.3.3 Groundwater Recharge (N.J.A.C. 7:8-5.6)

Industrial stormwater exposed to “source material” shall not be recharged in accordance with N.J.A.C. 7:8-5.4.2.iii. The Site is an industrial facility that is directly or indirectly related to process, manufacturing or other industrial activities, which could be a source of pollutants in any industrial stormwater discharge to groundwater. Therefore, the Project should be exempt from the recharge requirements under this section.

2.3.4 Implementation of Non-Structural Stormwater Management

N.J.A.C 7:8 requires to the maximum extent practicable, the requirements be satisfied by incorporating nonstructural stormwater management strategies into the design. If these measures are not sufficient to satisfy the regulatory requirements, structural management measures may be incorporated into the design. Nonstructural stormwater management measures have been utilized to the maximum extent practicable for this Project. To demonstrate compliance with the nonstructural management strategies requirement of N.J.A.C. 7:8, the NJDEP Low Impact Development Checklist has been completed and is included in Appendix D.

2.3.5 Stormwater Conveyance System Design

The Rational Method using Autodesk Storm and Sanitary Analysis 2018 software was used to calculate peak runoff rates for the stormwater piping design. The proposed storm sewer pipes are designed to convey the peak flow rate of the 25-year storm event. The stormwater conveyance system calculations are included in Appendix H.

2.3.6 Soil Erosion and Sediment Control

The minimum design and performance standards for erosion control are those established under the Soil Erosion and Sediment Control Act, N.J.S.A. 4:24-39 et seq. and implementing rules. SESC plans and details are included within the Stormwater Management Drawings and will also be submitted to the Hunterdon County Soil Conservation District for certification.

3.0 CONCLUSION

As described in this report, the stormwater conveyance and management systems proposed for this Project are designed in accordance with the requirements set forth in N.J.A.C.7:8 and are expected to adequately collect and safely convey the peak runoff flows from the Site.

APPENDIX A

STORMWATER MANAGEMENT SYSTEM PLANS

(BOUND SEPARATELY)

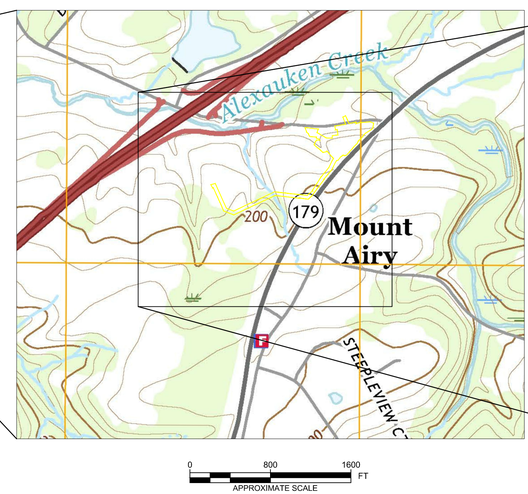
PENNEAST PIPELINE COMPANY, LLC

LAMBERTVILLE INTERCONNECT

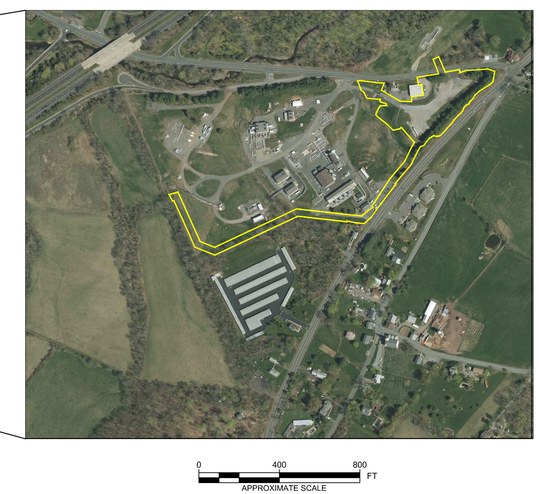
WEST AMWELL TOWNSHIP, HUNTERDON COUNTY, NEW JERSEY

STORMWATER MANAGEMENT PLANS

NEW JERSEY



HUNTERDON COUNTY MAP



SITE LOCATION

Sheet List Table	
Sheet Number	Sheet Title
C-100	COVER SHEET
C-101	EXISTING CONDITIONS PLAN
C-102	PROPOSED STORMWATER MANAGEMENT PLAN
C-103	OVERALL SOIL EROSION AND SEDIMENT CONTROL PLAN
C-103A	SOIL EROSION AND SEDIMENT CONTROL PLAN-AREA A
C-103B	SOIL EROSION AND SEDIMENT CONTROL PLAN-AREA B
C-103C	SOIL EROSION AND SEDIMENT CONTROL PLAN-AREA C
C-103D	SOIL EROSION AND SEDIMENT CONTROL PLAN-AREA D
C-104	OVERALL LANDSCAPING PLAN
C-105	ENLARGED LANDSCAPING PLAN-BIORETENTION BASIN 1
C-106	ENLARGED LANDSCAPING PLAN-BIORETENTION BASIN 2
C-107	ENLARGED LANDSCAPING PLAN-SOUTH BUILDING AREA
C-108	CONSTRUCTION DETAILS SHEET 1
C-109	CONSTRUCTION DETAILS SHEET 2
C-110	CONSTRUCTION DETAILS SHEET 3
C-111	CONSTRUCTION DETAILS SHEET 4
C-112	CONSTRUCTION DETAILS SHEET 5
C-113	CONSTRUCTION DETAILS SHEET 6
C-114	CONSTRUCTION DETAILS SHEET 7
C-115	CONSTRUCTION DETAILS SHEET 8
C-116	CONSTRUCTION DETAILS SHEET 9
C-117	SESC DETAILS SHEET 1
C-118	SESC DETAILS SHEET 2
C-119	SESC DETAILS SHEET 3
C-119A	SESC DETAILS SHEET 4
C-120	LANDSCAPE DETAILS SHEET 1

EXHIBIT A

PLANT W.B.S. NO. *CE.000147.001*

PIPE LINE W.B.S. NO. *N/A*

YEAR *2020*

GENERAL NOTES:

1. PLANS ARE FOR PERMITTING PURPOSES ONLY NOT CONSTRUCTION. ADDITIONAL PLANS AND DOCUMENTS WILL BE REQUIRED FOR CONSTRUCTION OF THE PROPOSED PROJECT.

TRC Engineers, Inc.
ENGINEER IN RESPONSIBLE CHARGE OF THE WORK SHOWN ON THIS DRAWING

DATE: 6/28/2019 SIGNATURE

PROFESSIONAL ENGINEER: BARRY J. SUTHERLAND
LIC. # 24GE02913500

STATE OF NEW JERSEY
BARRY J. SUTHERLAND
No. GE24GE02913500
LICENSED
PROFESSIONAL ENGINEER

NO.	BY	DATE	REVISION	APPD.

PREPARED BY:

TRC Engineers Inc.

41 SPRING STREET, SUITE 102
NEW PROVIDENCE, NEW JERSEY

Certificate of Authorization #24GA28080500

PennEast PIPELINE

Drawing: \\NEWPROV-FP1\Environmental\Office Files\Vision Project Folders\292931 - Penn East\Engineering\DWG\Drainage Area Mapping - PS&SWMP\Draft\292931_COVER SHEET.dwg
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Username: DLEBERT
IG #

LEGEND

Symbol	Description	Symbol	Description
202	EXISTING TOPOGRAPHY		UTILITY POLE
X	FENCELINE		LOT LINE
	TREELINE		
	EXISTING PAVEMENT		STATE OPEN WATER
	EXISTING GRAVEL	RZ	RIPARIAN ZONE (300 FT)
	DECIDUOUS TREE	WL	WETLAND AREA
	CONIFER TREE	WLB	WETLANDS BUFFER (50 FT)
		FHA	FLOOD HAZARD AREA
			PROJECT SITE

NOTES:

1. COORDINATES ARE REFERENCED TO THE NORTH AMERICAN DATUM (NAD) OF 1983 PROJECTED ONTO THE NEW JERSEY STATE PLANE COORDINATE SYSTEM.
2. ELEVATIONS DEPICTED ARE REFERENCED TO THE NORTH AMERICAN VERTICAL DATUM (NAVD) OF 1988 (NGVD29=NAVD88+0.90 FEET).
3. GRADING, ROAD, PAVEMENT, AND FENCE PERFORMED BY EN ENGERINEERING, INC.
4. SURVEY PERFORMED BY LRC GROUP, INC.
5. SOIL EROSION AND SEDIMENT CONTROL MEASURES ARE IN REFERENCE TO THE " STORMWATER MANAGEMENT SYSTEM PLANS" DATED AUGUST 31, 2018.
6. FRESHWATER WETLANDS/WATERS BOUNDARY LINE AS VERIFIED BY NJDEP (FRESHWATER WETLANDS LETTER OF INTERPRETATION: LINE VERIFICATION FILE NO. 1026-02-0003.1) FOR BLOCK 5, LOT 6 ONLY.
7. WETLANDS AND WATERS BOUNDARY LINE(S) FOR BLOCK 5, LOT 6 ONLY AS SHOWN ON THE MAP ENTITLED: "NJDEP LETTER OF INTERPRETATION, LINE VERIFICATION – ENTIRE SITE, MARCELLUS TO MARKET PROJECT, LAMBERTVILLE COMPRESSOR STATION, HUNTERDON COUNTY, NEW JERSEY", CONSISTING OF THREE SHEETS, DATED OCTOBER 2016, LAST REVISED JANUARY 20, 2017, AND PREPARED BY BARRY A. GLEISSNER, P.L.S. OF AECOM.
8. WETLANDS AND WATERS BOUNDARY LINES DEPICTED ON BLOCK 5, LOT 5 DELINEATED BY TRC ENVIRONMENTAL CORPORATION ON AUGUST 11, 2017.
9. RIPARIAN ZONES ARE 300 FOOT OFFSETS FROM EITHER TOP OF BANK OR STREAM CENTERLINES, AS APPROPRIATE.

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TRC Engineers, Inc.
ENGINEER IN RESPONSIBLE CHARGE OF THE WORK SHOWN ON THIS DRAWING
DATE: 6/29/2019 SIGNATURE
PROFESSIONAL ENGINEER: BARRY J. SUTHERLAND
LIC. # 24GE02913500

STATE OF NEW JERSEY ☆ BARRY J. SUTHERLAND ☆ No. GE2402913500 ☆ LICENSED ☆ PROFESSIONAL ENGINEER

NO.	BY	DATE	REVISION	APP'D.

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41 SPRING STREET
NEW PROVIDENCE, NEW JERSEY 07974
PHONE NO. (908) 988-1700
FAX NO. (973) 564-6442
Certificate of Authorization #24GA28047100

PENNEAST PIPELINE PROJECT
LAMBERTVILLE INTERCONNECT
EXISTING CONDITIONS PLAN

LOC. WEST AMWELL TOWNSHIP, HUNTERDON COUNTY, NEW JERSEY

PennEast PIPELINE

YEAR: 2020 | W.B.S CE.000147.001 | SCALE: AS SHOWN | DWG. C-101 | REV. 0

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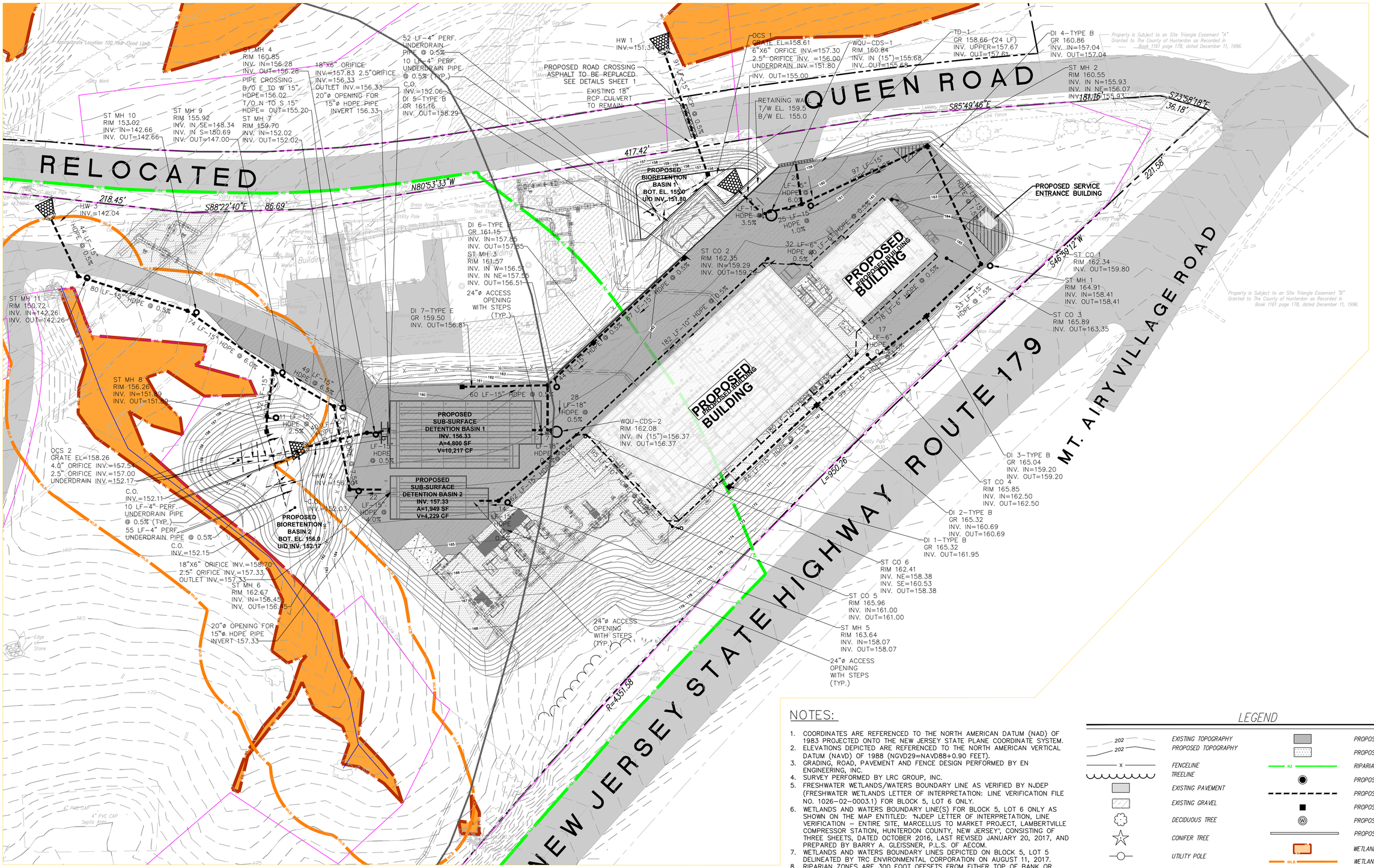

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LEGEND

202 EXISTING TOPOGRAPHY	PROPOSED PAVED AREAS
202 PROPOSED TOPOGRAPHY	PROPOSED GRAVEL AREAS
x FENCELINE	RZ RIPARIAN ZONE (300 FT)
TREELINE	PROPOSED MANHOLE
EXISTING PAVEMENT	PROPOSED PIPE
EXISTING GRAVEL	PROPOSED INLET
DECIDUOUS TREE	W PROPOSED WATER QUALITY UNIT
CONIFER TREE	PROPOSED CURB
UTILITY POLE	WETLAND AREA
LOT LINE	WLB WETLANDS BUFFER (50 FT)
STATE OPEN WATER	PROJECT SITE

0 30 60 Feet

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TRC Engineers, Inc.

ENGINEER IN RESPONSIBLE CHARGE OF THE WORK SHOWN ON THIS DRAWING

DATE: 6/29/19 SIGNATURE

PROFESSIONAL ENGINEER: BARRY J. SUTHERLAND
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New Providence, New Jersey 07974
Phone No. 908-988-1700
Certificate of Authorization #24GA28047100

PENNEAST PIPELINE PROJECT
LAMBERTVILLE INTERCONNECT
PROPOSED STORMWATER MANAGEMENT PLAN

LOC. WEST AMWELL TOWNSHIP, HUNTERDON COUNTY, NEW JERSEY

PennEast PIPELINE

YEAR: 2020 | W.B.S CE.000147.001 | SCALE: 1:30 | DWG. C-102 | REV. 0

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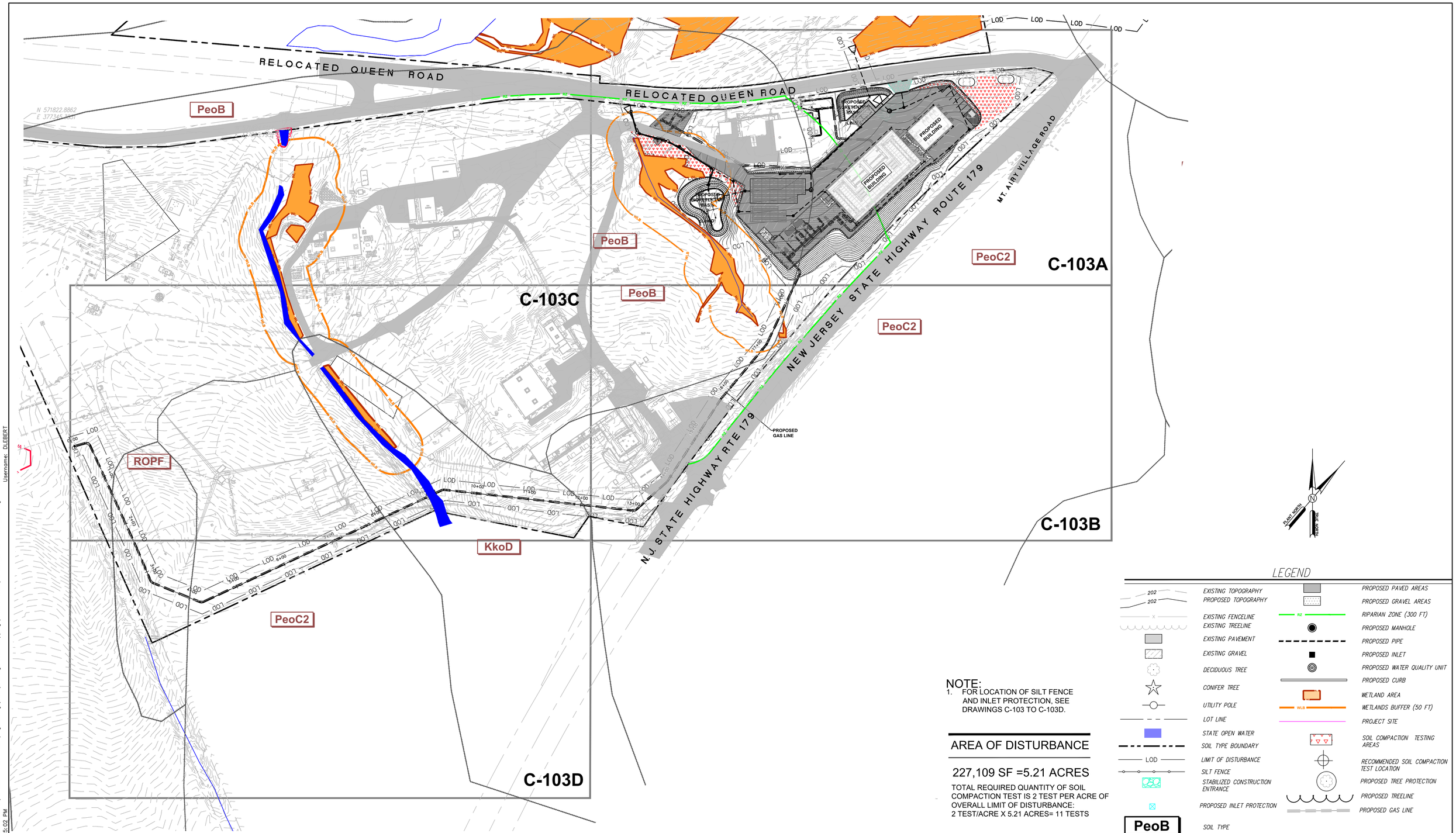

LEGEND

202	EXISTING TOPOGRAPHY		PROPOSED PAVED AREAS
202	PROPOSED TOPOGRAPHY		PROPOSED GRAVEL AREAS
X	EXISTING FENCELINE	RZ	RIPARIAN ZONE (300 FT)
	EXISTING TREELINE		PROPOSED MANHOLE
	EXISTING PAVEMENT		PROPOSED PIPE
	EXISTING GRAVEL		PROPOSED INLET
	DECIDUOUS TREE		PROPOSED WATER QUALITY UNIT
	CONIFER TREE		PROPOSED CURB
	UTILITY POLE		WETLAND AREA
	LOT LINE	WLB	WETLANDS BUFFER (50 FT)
	STATE OPEN WATER		PROJECT SITE
	SOIL TYPE BOUNDARY		SOIL COMPACTION TESTING AREAS
LOD	LIMIT OF DISTURBANCE		RECOMMENDED SOIL COMPACTION TEST LOCATION
	SILT FENCE		PROPOSED TREE PROTECTION
	STABILIZED CONSTRUCTION ENTRANCE		PROPOSED TREELINE
	PROPOSED INLET PROTECTION		PROPOSED GAS LINE
PeoB	SOIL TYPE		

NOTE:
1. FOR LOCATION OF SILT FENCE AND INLET PROTECTION, SEE DRAWINGS C-103 TO C-103D.

AREA OF DISTURBANCE

227,109 SF =5.21 ACRES

TOTAL REQUIRED QUANTITY OF SOIL COMPACTION TEST IS 2 TEST PER ACRE OF OVERALL LIMIT OF DISTURBANCE:
2 TEST/ACRE X 5.21 ACRES= 11 TESTS

Symbol	Description
KkoD	Klinesville channery loam, 12 to 18 percent slopes
PeoB	Penn channery silt loam, 2 to 6 percent slopes
PeoC2	Penn channery silt loam, 6 to 12 percent slopes, eroded
ROPF	Rough broken land, shale

0 80 160 Feet

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ENGINEER IN RESPONSIBLE CHARGE OF THE WORK SHOWN ON THIS DRAWING
DATE: 6/29/2019 SIGNATURE
PROFESSIONAL ENGINEER: BARRY J. SUTHERLAND
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STATE OF NEW JERSEY BARRY J. SUTHERLAND No. GE24GE02913500 LICENSED PROFESSIONAL ENGINEER

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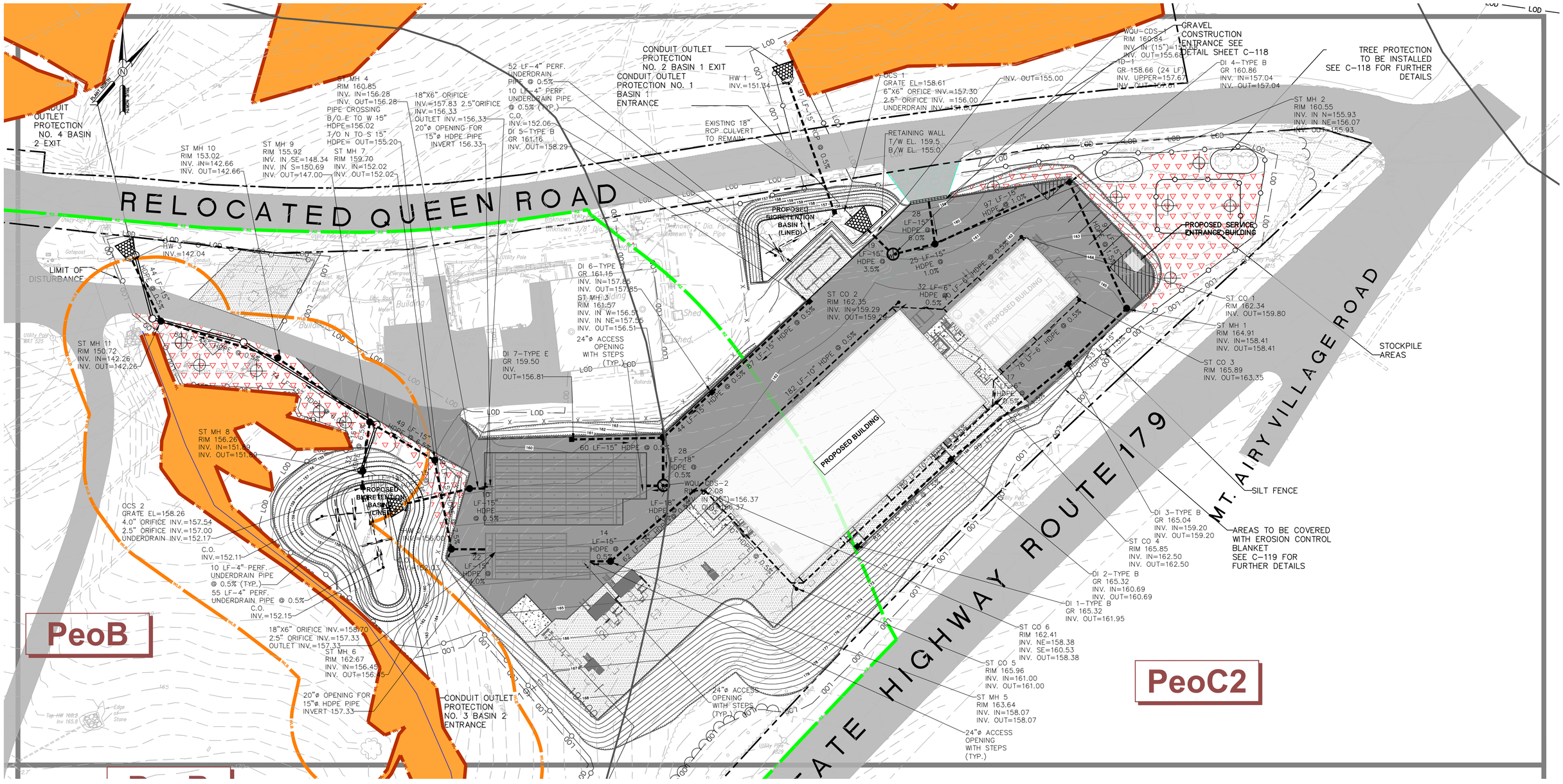
Certificate of Authorization #24GA28047100

PENNEAST PIPELINE PROJECT
LAMBERTVILLE INTERCONNECT
OVERALL SOIL EROSION AND SEDIMENT CONTROL PLAN

LOC. WEST AMWELL TOWNSHIP, HUNTERDON COUNTY, NEW JERSEY

PennEast PIPELINE

YEAR: 2020 | W.B.S CE.000147.001 | SCALE: AS SHOWN | DWG. C-103 | REV. 0



LEGEND

EXISTING TOPOGRAPHY
PROPOSED TOPOGRAPHY
FENCELINE
TREELINE
EXISTING PAVEMENT
EXISTING GRAVEL
DECIDUOUS TREE
CONIFER TREE
UTILITY POLE
LOT LINE
PROPOSED PAVED AREAS
PROPOSED GRAVEL AREAS
RIPARIAN ZONE (300 FT)
PROPOSED MANHOLE
PROPOSED PIPE
PROPOSED INLET
PROPOSED WATER QUALITY UNIT
PROPOSED CURB
WETLAND AREA
WETLANDS BUFFER (50 FT)
PROJECT SITE
STATE OPEN WATER
LIMIT OF DISTURBANCE
SOIL COMPACTION TESTING AREAS
SOIL TYPE BOUNDARY
SOIL TYPE
STABILIZED CONSTRUCTION ENTRANCE
PROPOSED INLET PROTECTION
SILT FENCE
PROPOSED TREELINE
PROPOSED GAS LINE
PROPOSED TREE PROTECTION
RECOMMENDED SOIL COMPACTION TEST LOCATION

0 30 60 Feet

AREA OF DISTURBANCE

226,772 SF =5.21 ACRES

TOTAL REQUIRED QUANTITY OF SOIL COMPACTION TEST IS 2 TEST PER ACRE OF OVERALL LIMIT OF DISTURBANCE:
2 TEST/ACRE X 5.21 ACRES= 11 TESTS

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KkoD	Klinesville channery loam, 12 to 18 percent slopes
PeoB	Penn channery silt loam, 2 to 6 percent slopes
PeoC2	Penn channery silt loam, 6 to 12 percent slopes, eroded
RDPF	Rough broken land, shale

TRC Engineers, Inc.
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LIC. # 24GE02913500

STATE OF NEW JERSEY — BARRY J. SUTHERLAND — No. GE02913500 — LICENSED PROFESSIONAL ENGINEER

NO.	BY	DATE	REVISION	APP'D.

TRC Engineers, Inc.
41 SPRING STREET
NEW PROVIDENCE, NEW JERSEY 07974
PHONE NO. (908) 988-1700
FAX NO. (973) 564-6442
Certificate of Authorization #24GA28047100

PENNEAST PIPELINE PROJECT
LAMBERTVILLE INTERCONNECT
SOIL EROSION AND SEDIMENT CONTROL PLAN–AREA A

LOC. WEST AMWELL TOWNSHIP, HUNTERDON COUNTY, NEW JERSEY

YEAR: 2020 | W.B.S CE.000147.001 | SCALE: 1:30 | DWG. C–103A | REV. 0

PennEast PIPELINE

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IG #

PeoB

PeoC2

NEW JERSEY STATE HIGHWAY RTE 179

PROPOSED GAS LINE

(TYP.)

Septic Area

Shed

Trailer

Electrical Substation

Aux Building

13+00

14+00

15+00

16+00

17+00

18+00

LEGEND

EXISTING TOPOGRAPHY	PROPOSED PAVED AREAS	STATE OPEN WATER	PROPOSED TREE PROTECTION
PROPOSED TOPOGRAPHY	PROPOSED GRAVEL AREAS	LIMIT OF DISTURBANCE	RECOMMENDED SOIL COMPACTION TEST LOCATION
FENCELINE	RIPARIAN ZONE (300 FT)	SOIL COMPACTION TESTING AREAS	
TREELINE	PROPOSED MANHOLE	SOIL TYPE BOUNDARY	
EXISTING PAVEMENT	PROPOSED PIPE	SOIL TYPE	
EXISTING GRAVEL	PROPOSED INLET	STABILIZED CONSTRUCTION ENTRANCE	
DECIDUOUS TREE	PROPOSED WATER QUALITY UNIT	PROPOSED INLET PROTECTION	
CONIFER TREE	PROPOSED CURB	SILT FENCE	
UTILITY POLE	WETLAND AREA	PROPOSED TREELINE	
LOT LINE	WETLANDS BUFFER (50 FT)	PROPOSED GAS LINE	
	PROJECT SITE		

0 30 60 Feet

Symbol	Description
KkoD	Klinesville channery loam, 12 to 18 percent slopes
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AREA OF DISTURBANCE

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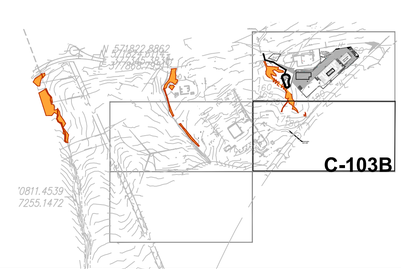

TRC Engineers, Inc.

ENGINEER IN RESPONSIBLE CHARGE OF THE WORK SHOWN ON THIS DRAWING

DATE: 6/29/2019 SIGNATURE

PROFESSIONAL ENGINEER: BARRY J. SUTHERLAND
LIC. # 24GE02913500

STATE OF NEW JERSEY — BARRY J. SUTHERLAND — No. GE24GE02913500 — PROFESSIONAL ENGINEER

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41 SPRING STREET
NEW PROVIDENCE, NEW JERSEY 07974
PHONE NO. (908) 988-1700
FAX NO. (973) 564-6442
Certificate of Authorization #24GA28047100

PENNEAST PIPELINE PROJECT
LAMBERTVILLE INTERCONNECT
SOIL EROSION AND SEDIMENT CONTROL
PLAN–AREA B

LOC. WEST AMWELL TOWNSHIP, HUNTERDON COUNTY, NEW JERSEY

PennEast PIPELINE

YEAR: 2020 | W.B.S CE.000147.001 | SCALE: AS SHOWN | DWG. C–103B | REV. 0

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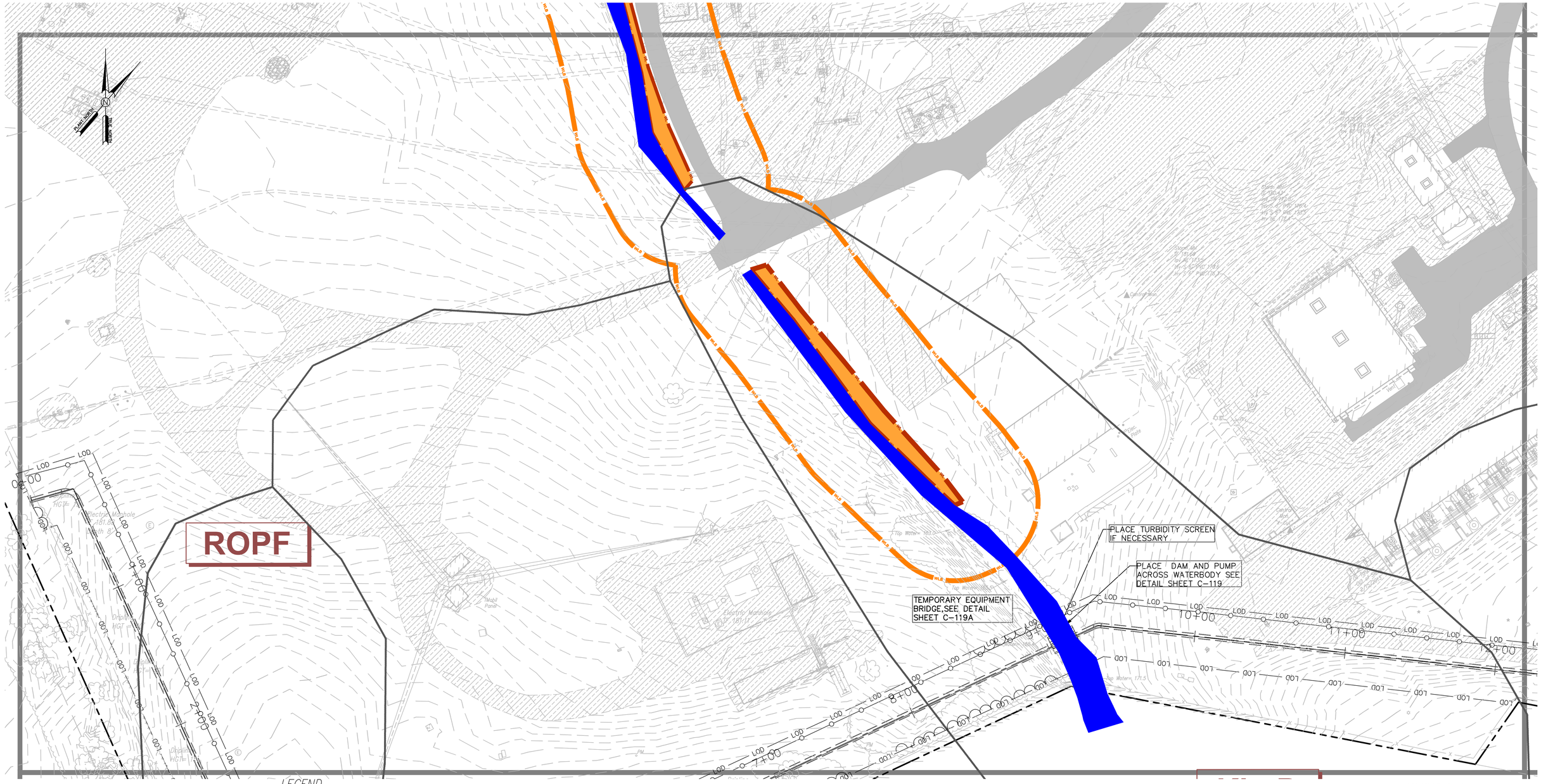

LEGEND

202	EXISTING TOPOGRAPHY		PROPOSED PAVED AREAS		STATE OPEN WATER		PROPOSED TREE PROTECTION
202	PROPOSED TOPOGRAPHY		PROPOSED GRAVEL AREAS	LOD	LIMIT OF DISTURBANCE		RECOMMENDED SOIL COMPACTION TEST LOCATION
x	FENCELINE	RZ	RIPARIAN ZONE (300 FT)		SOIL COMPACTION TESTING AREAS		
	TREELINE		PROPOSED MANHOLE		SOIL TYPE BOUNDARY		
	EXISTING PAVEMENT		PROPOSED PIPE	PeoB	SOIL TYPE		
	EXISTING GRAVEL		PROPOSED INLET		STABILIZED CONSTRUCTION ENTRANCE		
	DECIDUOUS TREE		PROPOSED WATER QUALITY UNIT		PROPOSED INLET PROTECTION		
	CONIFER TREE		PROPOSED CURB		SILT FENCE		
	UTILITY POLE		WETLAND AREA		PROPOSED TREELINE		
	LOT LINE	WLB	WETLANDS BUFFER (50 FT)		PROPOSED GAS LINE		
			PROJECT SITE				

0 30 60 Feet

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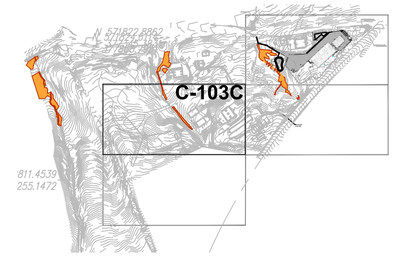

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LIC. # 24GE02913500

STATE OF NEW JERSEY — BARRY J. SUTHERLAND — No. GE24GE02913500 — LICENSED PROFESSIONAL ENGINEER

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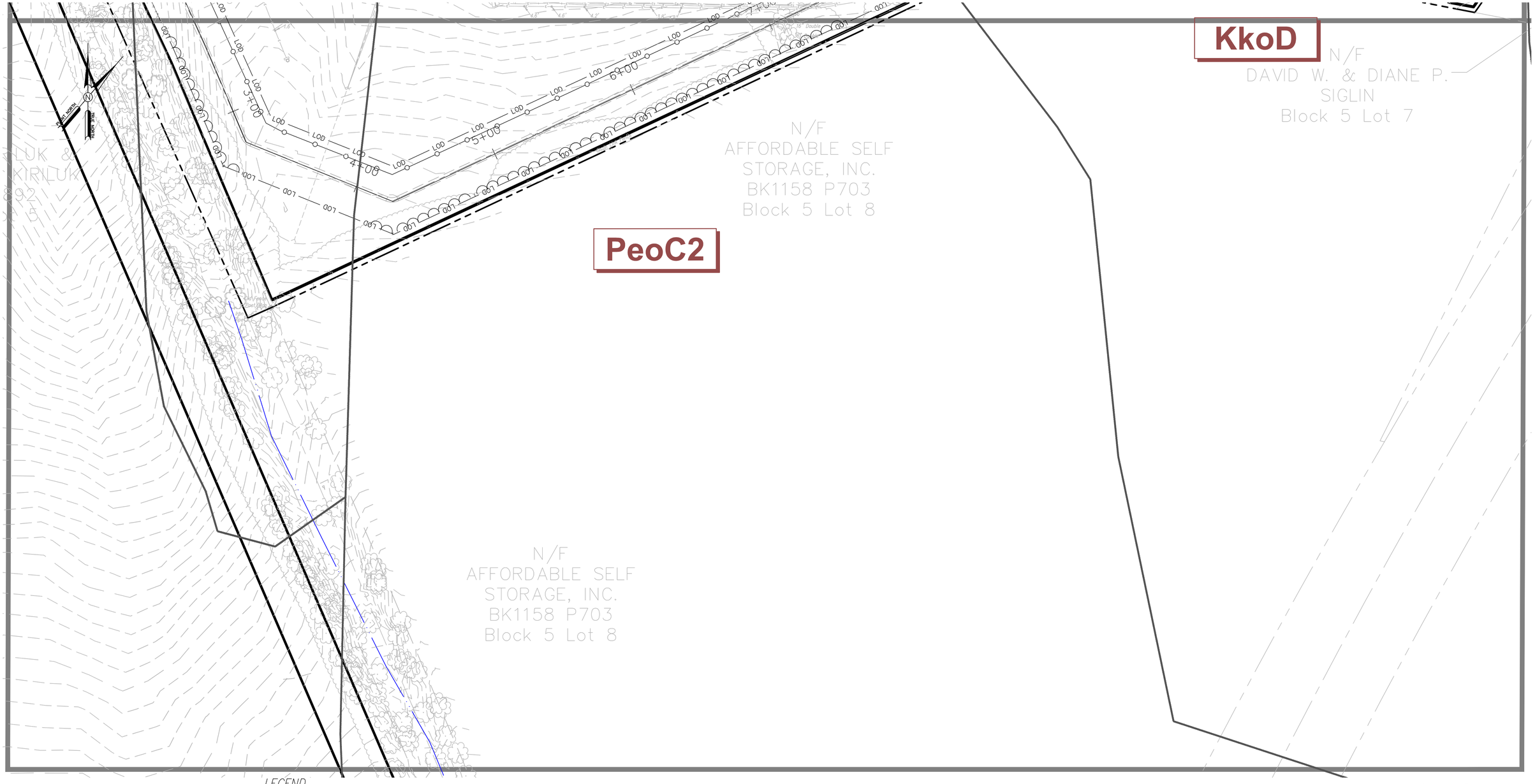
NEW PROVIDENCE, NEW JERSEY 07974
PHONE NO. (908) 988-1700
FAX NO. (973) 564-6442
Certificate of Authorization #24GA28047100

PENNEAST PIPELINE PROJECT
LAMBERTVILLE INTERCONNECT
SOIL EROSION AND SEDIMENT CONTROL
PLAN–AREA C

LOC. WEST AMWELL TOWNSHIP, HUNTERDON COUNTY, NEW JERSEY

YEAR: 2020 | W.B.S CE.000147.001 | SCALE: 1:30 | DWG. C–103C | REV. 0

PennEast PIPELINE



LEGEND

- EXISTING TOPOGRAPHY (202)
- PROPOSED TOPOGRAPHY (202)
- EXISTING FENCELINE
- EXISTING TREELINE
- EXISTING PAVEMENT
- EXISTING GRAVEL
- DECIDUOUS TREE
- CONIFER TREE
- UTILITY POLE
- LOT LINE
- PROPOSED PAVED AREAS
- PROPOSED GRAVEL AREAS
- RIPARIAN ZONE (300 FT) (RZ)
- PROPOSED MANHOLE
- PROPOSED PIPE
- PROPOSED INLET
- PROPOSED WATER QUALITY UNIT
- PROPOSED CURB
- WETLAND AREA
- WETLANDS BUFFER (50 FT) (WLB)
- PROJECT SITE
- STATE OPEN WATER
- LIMIT OF DISTURBANCE (LOD)
- SOIL COMPACTION TESTING AREAS
- SOIL TYPE BOUNDARY
- SOIL TYPE (PeoB)
- STABILIZED CONSTRUCTION ENTRANCE
- PROPOSED INLET PROTECTION
- SILT FENCE
- PROPOSED TREELINE
- PROPOSED GAS LINE
- PROPOSED TREE PROTECTION
- RECOMMENDED SOIL COMPACTION TEST LOCATION

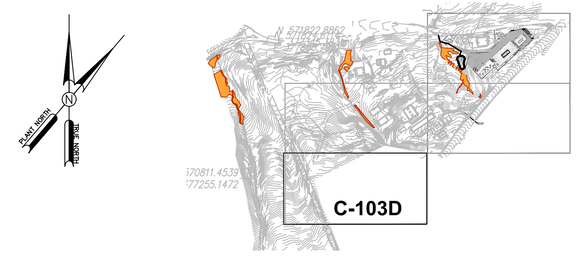
0 30 60 Feet

AREA OF DISTURBANCE

226,772 SF =5.21 ACRES

TOTAL REQUIRED QUANTITY OF SOIL COMPACTION TEST IS 2 TEST PER ACRE OF OVERALL LIMIT OF DISTURBANCE:
2 TEST/ACRE X 5.21 ACRES= 11 TESTS

Symbol	Description
KkoD	Klinesville channery loam, 12 to 18 percent slopes
PeoB	Penn channery silt loam, 2 to 6 percent slopes
PeoC2	Penn channery silt loam, 6 to 12 percent slopes, eroded
ROPF	Rough broken land, shale



TRC Engineers, Inc.

ENGINEER IN RESPONSIBLE CHARGE OF THE WORK SHOWN ON THIS DRAWING
6/29/2019
DATE: _____ SIGNATURE

PROFESSIONAL ENGINEER: BARRY J. SUTHERLAND
LIC. # 24GE02913500

STATE OF NEW JERSEY — BARRY J. SUTHERLAND — No. GE24GE02913500 — PROFESSIONAL ENGINEER

NO.	BY	DATE	REVISION	APP'D.

TRC Engineers, Inc.
41 SPRING STREET
NEW PROVIDENCE, NEW JERSEY 07974
PHONE NO. (908) 988-1700
FAX NO. (973) 564-6442
Certificate of Authorization #24GA28047100

PENNEAST PIPELINE PROJECT
LAMBERTVILLE INTERCONNECT
SOIL EROSION AND SEDIMENT CONTROL
PLAN–AREA D

LOC. WEST AMWELL TOWNSHIP, HUNTERDON COUNTY, NEW JERSEY

PennEast PIPELINE

YEAR: 2020 | W.B.S CE.000147.001 | SCALE: AS SHOWN | DWG. C–103D | REV. 0

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IG #

NOTES:

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8. RIPARIAN ZONES ARE 300 FOOT OFFSETS FROM EITHER TOP OF BANK OR STREAM CENTERLINES, AS APPROPRIATE.

LEGEND

202	EXISTING TOPOGRAPHY		PROPOSED PAVED AREAS
202	PROPOSED TOPOGRAPHY		PROPOSED GRAVEL AREAS
X	FENCELINE	RZ	RIPARIAN ZONE (300 FT)
	TREELINE		PROPOSED MANHOLE
	EXISTING PAVEMENT		PROPOSED PIPE
	EXISTING GRAVEL		PROPOSED INLET
	DECIDUOUS TREE	W	PROPOSED WATER QUALITY UNIT
	CONIFER TREE		PROPOSED CURB
	UTILITY POLE		WETLAND AREA
	LOT LINE	WLB	WETLANDS BUFFER (50 FT)
	STATE OPEN WATER		PROJECT SITE

Drawing: W:\Vision Project Folders\292931 – Penn East\Engineering\DWG\Drainage Area Mapping – PS&S Final Draft\SESC PLANS\292931_PR-LAM04-Proposed Landscape.dwg
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TRC Engineers, Inc.

ENGINEER IN RESPONSIBLE CHARGE OF THE WORK SHOWN ON THIS DRAWING

DATE: 6/29/2019 SIGNATURE

PROFESSIONAL ENGINEER: BARRY J. SUTHERLAND
LIC. # 24GE02913500

STATE OF NEW JERSEY — BARRY J. SUTHERLAND — No. 24GE02913500 — LICENSED PROFESSIONAL ENGINEER

NO.	BY	DATE	REVISION	APP'D.

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41 SPRING STREET
NEW PROVIDENCE, NEW JERSEY 07974
PHONE NO. (908) 988-1700
FAX NO. (973) 564-6442
Certificate of Authorization #24GA28047100

PENNEAST PIPELINE PROJECT
LAMBERTVILLE INTERCONNECT
OVERALL LANDSCAPING PLAN

LOC. WEST AMWELL TOWNSHIP, HUNTERDON COUNTY, NEW JERSEY

PennEast PIPELINE

YEAR: 2020	W.B.S CE.000147.001	SCALE: 1:30	DWG. C-104	REV. 0

LEGEND

LANDSCAPE PLANTING SCHEDULE – SMALL BASIN

TREES

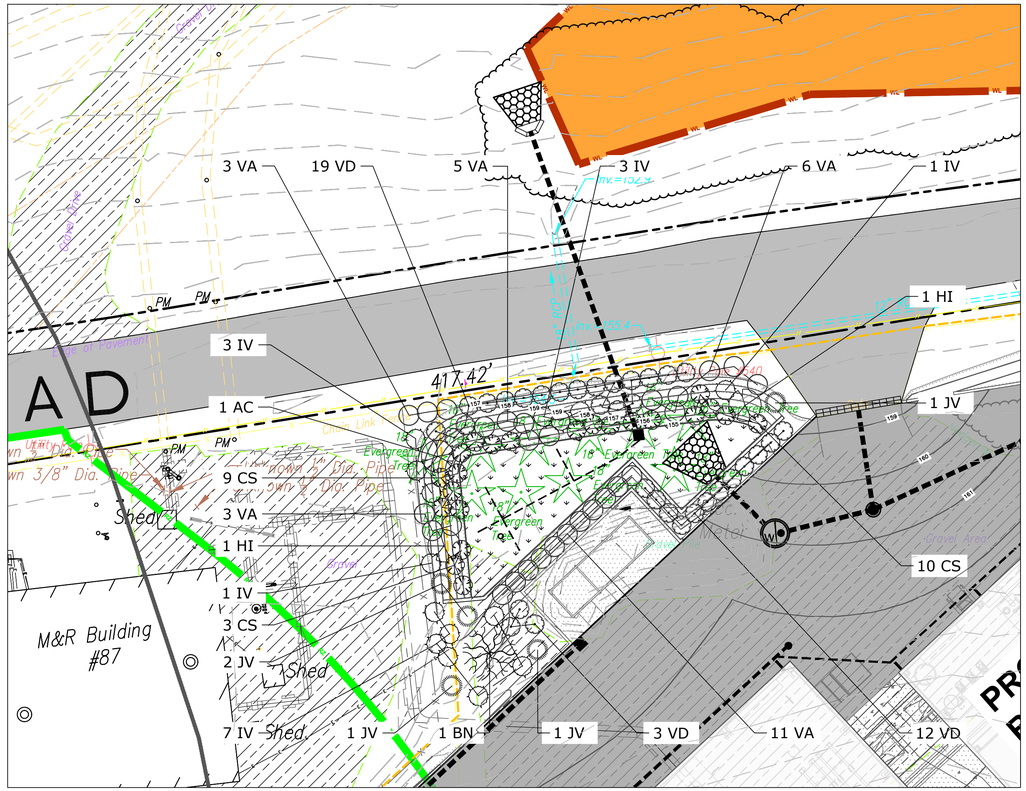
SYMBOL	BOTANICAL NAME/ COMMON PLANT NAME	QUANTITY	SIZE	ROOT
AC	AMELANCHIER CANADENSIS SHADBLOW SERVICEBERRY	1	6'-8' HT. CLUMP	B&B
BN	BETULA NIGRA 'HERITAGE' HERITAGE RIVERBIRCH	1	6'–8' HT. CLUMP	B&B
JV	JUNIPERUS VIRGINIANA EASTERN RED CEDAR	5	6'–7' HT.	B&B

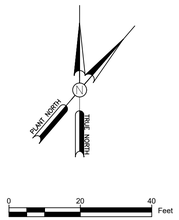
SHRUBS/EVERGREENS AND ORNAMENTAL TREES

SYMBOL	BOTANICAL NAME/ COMMON PLANT NAME	QUANTITY	SIZE	ROOT
CS	CORNUS STOLONIFERA REDTWIG DOGWOOD	22	30"–36" HT.	#3/5 CONT.
HI	HAMAMELIS x INTERMEDIA 'DIANE' DIANE WITCH HAZEL	2	3'-4' HT.	B&B
IV	ILEX VERTICILLATA COMMON WINTERBERRY	15	30"–36" HT.	#3/5 CONT.
VA	VACCINIUM ANGUSTIFOLIUM LOWBUSH BLUEBERRY	28	24"–30" HT.	#3/5 CONT.
VD	VIBURNUM DENTATUM ARROWOOD VIBURNUM	34	30"–36" HT.	#3/5 CONT.

NOTES:

- PLANT HARDINESS ZONE 6b (0 to -5)
- PHYSIOGRAPHIC PROVINCE- PIEDMONT
- 300 FOOT RIPARIAN ZONES SHALL BE MAINTAINED





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LEGEND

202	EXISTING TOPOGRAPHY		PROPOSED PAVED AREAS
202	PROPOSED TOPOGRAPHY		PROPOSED GRAVEL AREAS
X	FENCELINE	RZ	RIPARIAN ZONE (300 FT)
	TREELINE		PROPOSED MANHOLE
	EXISTING PAVEMENT		PROPOSED PIPE
	EXISTING GRAVEL		PROPOSED INLET
	DECIDUOUS TREE	W	PROPOSED WATER QUALITY UNIT
	CONIFER TREE		PROPOSED CURB
	UTILITY POLE		WETLAND AREA
	LOT LINE	WLB	WETLANDS BUFFER (50 FT)
	STATE OPEN WATER		PROJECT SITE

Drawing: W:\Vision Project Folders\292931 – Penn East\Engineering\DWG\Drainage Area Mapping – PS&S Final Draft\SESC PLANS\292931_PR-LAMBDA-Proposed Landscape.dwg
Time: 1/9/2018 3:15:26 PM Username: DLEBERT

TRC Engineers, Inc.

ENGINEER IN RESPONSIBLE CHARGE OF THE WORK SHOWN ON THIS DRAWING

DATE: 6/29/2019 SIGNATURE

PROFESSIONAL ENGINEER: BARRY J. SUTHERLAND
LIC. # 24GE02913500

STATE OF NEW JERSEY
BARRY J. SUTHERLAND
No. GE24GE02913500
LICENSED
PROFESSIONAL ENGINEER

NO.	BY	DATE	REVISION	APP'D.

TRC Engineers, Inc.
41 SPRING STREET
NEW PROVIDENCE, NEW JERSEY 07974
PHONE NO. (908) 988-1700
FAX NO. (973) 564-6442
Certificate of Authorization #24GA28047100

PENNEAST PIPELINE PROJECT
LAMBERTVILLE INTERCONNECT
ENLARGED LANDSCAPING PLAN–
BIORETENTION BASIN 1

LOC. WEST AMWELL TOWNSHIP, HUNTERDON COUNTY, NEW JERSEY

PennEast PIPELINE

YEAR: 2020	W.B.S CE.000147.001	SCALE: 1:20	DWG. C–105	REV. 0

LEGEND

LANDSCAPE PLANTING SCHEDULE – LARGE BASIN

TREES

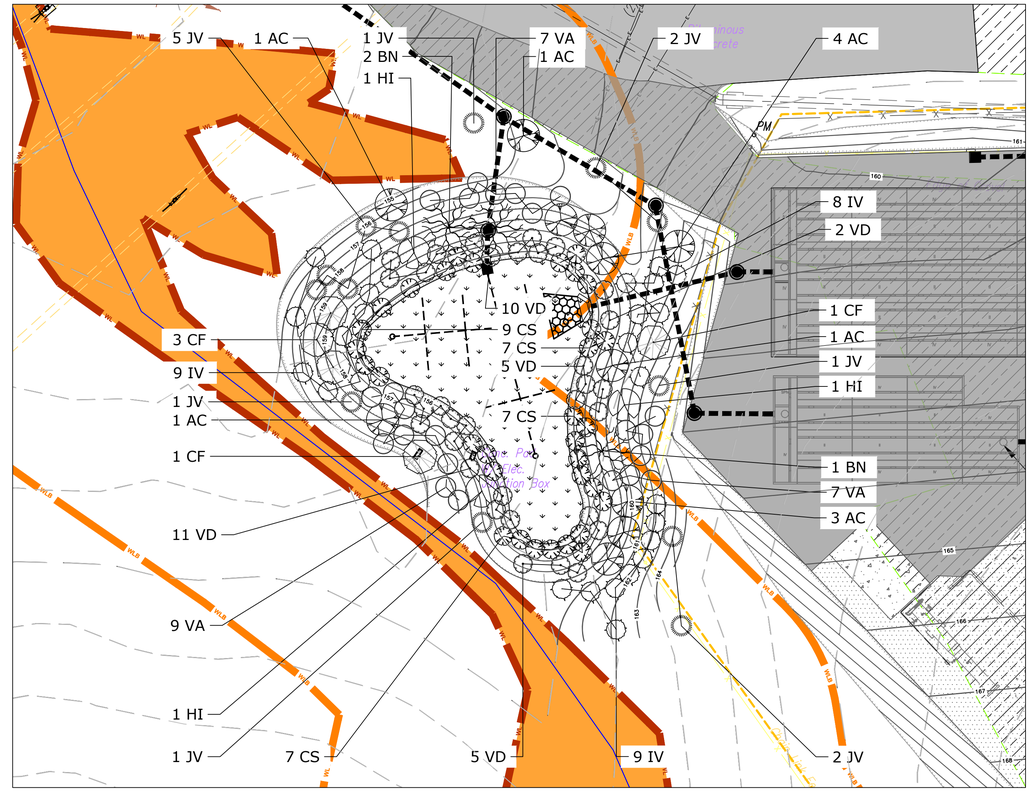
SYMBOL	BOTANICAL NAME/ COMMON PLANT NAME	QUANTITY	SIZE	ROOT
AC	AMELANCHIER CANADENSIS SHADBLOW SERVICEBERRY	11	6'-8' HT. CLUMP	B&B
BN	BETULA NIGRA 'HERITAGE' HERITAGE RIVERBIRCH	3	6'–8' HT. CLUMP	B&B
CF	CORNUS FLORIDA FLOWERING DOGWOOD	5	2" CAL. MIN.	B&B
JV	JUNIPERUS VIRGINIANA EASTERN RED CEDAR	13	6'–7' HT.	B&B

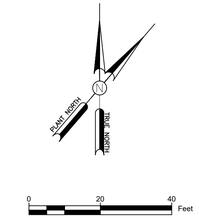
SHRUBS/EVERGREENS AND ORNAMENTAL TREES

SYMBOL	BOTANICAL NAME/ COMMON PLANT NAME	QUANTITY	SIZE	ROOT
CS	CORNUS STOLONIFERA REDTWIG DOGWOOD	30	30"–36" HT.	#3/5 CONT.
HI	HAMAMELIS x INTERMEDIA 'DIANE' DIANE WITCH HAZEL	3	3'-4' HT.	B&B
IV	ILEX VERTICILLATA COMMON WINTERBERRY	26	30"–36" HT.	#3/5 CONT.
VA	VACCINIUM ANGUSTIFOLIUM LOWBUSH BLUEBERRY	23	24"–30" HT.	#3/5 CONT.
VD	VIBURNUM DENTATUM ARROWOOD VIBURNUM	33	30"–36" HT.	#3/5 CONT.

NOTES:

- PLANT HARDINESS ZONE 6b (0 to -5)
- PHYSIOGRAPHIC PROVINCE- PIEDMONT
- 300 FOOT RIPARIAN ZONES SHALL BE MAINTAINED





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LEGEND

- EXISTING TOPOGRAPHY (202)
- PROPOSED TOPOGRAPHY (202)
- FENCELINE (X)
- TREELINE
- EXISTING PAVEMENT
- EXISTING GRAVEL
- DECIDUOUS TREE
- CONIFER TREE
- UTILITY POLE
- LOT LINE
- STATE OPEN WATER
- PROPOSED PAVED AREAS
- PROPOSED GRAVEL AREAS
- RIPARIAN ZONE (300 FT) (RZ)
- PROPOSED MANHOLE
- PROPOSED PIPE
- PROPOSED INLET
- PROPOSED WATER QUALITY UNIT
- PROPOSED CURB
- WETLAND AREA
- WETLANDS BUFFER (50 FT) (WLB)
- PROJECT SITE

TRC Engineers, Inc.

ENGINEER IN RESPONSIBLE CHARGE OF THE WORK SHOWN ON THIS DRAWING

DATE: 6/29/2019 SIGNATURE

PROFESSIONAL ENGINEER: BARRY J. SUTHERLAND
LIC. # 24GE02913500

STATE OF NEW JERSEY — BARRY J. SUTHERLAND — No. GE02913500 — PROFESSIONAL ENGINEER

NO.	BY	DATE	REVISION	APP'D.

TRC Engineers, Inc.
41 SPRING STREET
NEW PROVIDENCE, NEW JERSEY 07974
PHONE NO. (908) 988-1700
FAX NO. (973) 564-6442
Certificate of Authorization #24GA28047100

PENNEAST PIPELINE PROJECT
LAMBERTVILLE INTERCONNECT
ENLARGED LANDSCAPING PLAN–
BIORETENTION BASIN 2

LOC. WEST AMWELL TOWNSHIP, HUNTERDON COUNTY, NEW JERSEY

YEAR: 2020	W.B.S CE.000147.001	SCALE: 1:20	DWG. C–106	REV. 0

PennEast PIPELINE

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IG #

LEGEND

LANDSCAPE PLANTING SCHEDULE – EMBANKMENT

TREES

SYMBOL	BOTANICAL NAME/ COMMON PLANT NAME	QUANTITY	SIZE	ROOT
AB	ABIES BALSAMEA BALSAM FIR	10	7'–8' HT.	B&B
AC	AMELANCHIER CANADENSIS SHADBLOW SERVICEBERRY	8	6'-8' HT. CLUMP	B&B
CF	CORNUS FLORIDA FLOWERING DOGWOOD	4	2" CAL. MIN.	B&B
IA	ILEX x ATTENUATA 'FOSTERI' FOSTER'S HOLLY	21	5'–6' HT.	B&B
TP	THUJA PLICATA GREEN GIANT ARBORVITAE	34	6'–7' HT.	B&B

SHRUBS/EVERGREENS AND ORNAMENTAL TREES

SYMBOL	BOTANICAL NAME/ COMMON PLANT NAME	QUANTITY	SIZE	ROOT
IV	ILEX VERTICILLATA COMMON WINTERBERRY	20	30"–36" HT.	#3/5 CONT.
RG	RHUS GLABRA SMOOTH SUMAC	9	30"–36" HT.	#3/5 CONT.
VD	VIBURNUM DENTATUM ARROWOOD VIBURNUM	10	30"–36" HT.	#3/5 CONT.

NOTES:

- PLANT HARDINESS ZONE 6b (0 to -5)
- PHYSIOGRAPHIC PROVINCE- PIEDMONT
- 300 FOOT RIPARIAN ZONES SHALL BE MAINTAINED

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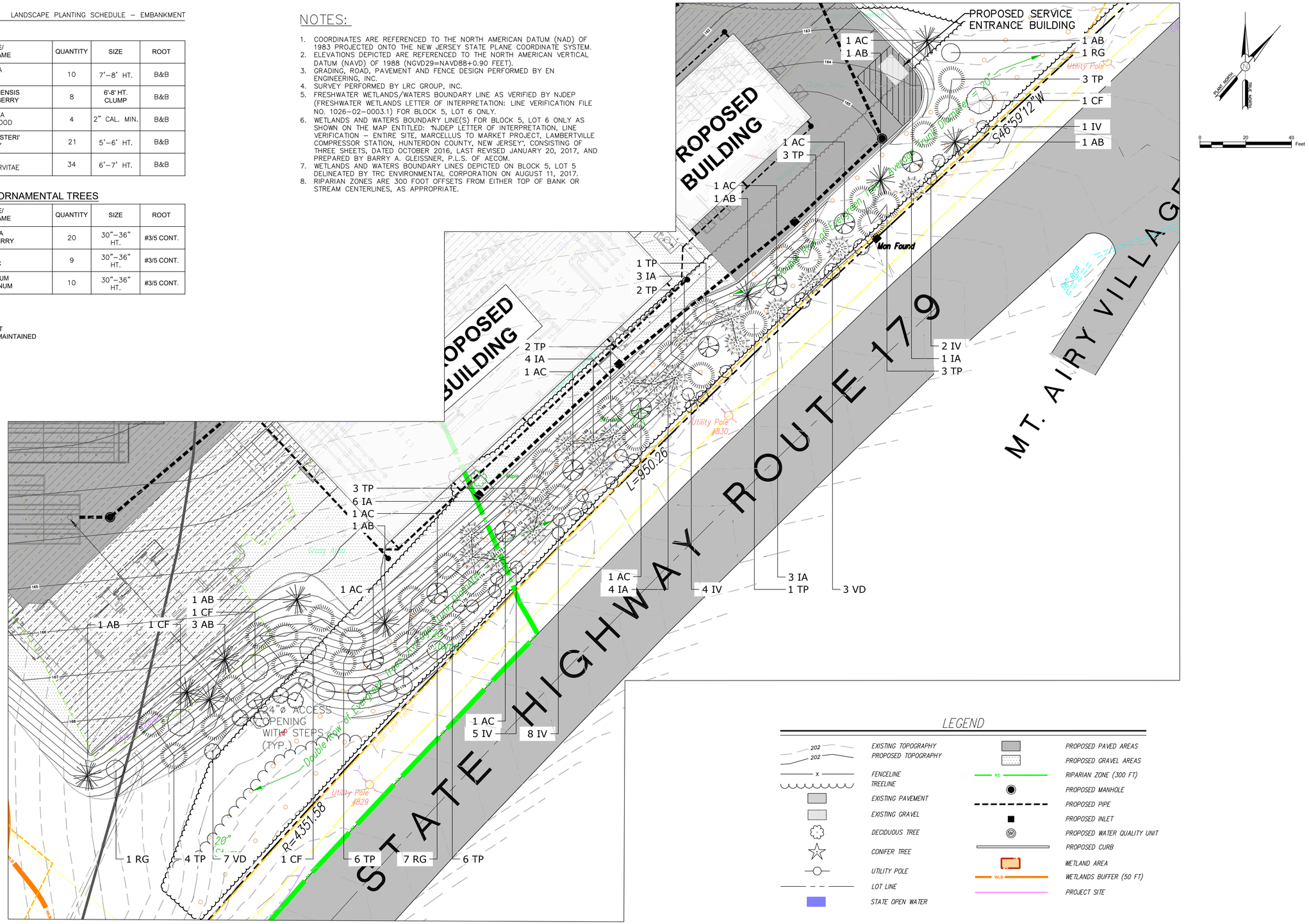

LEGEND

202	EXISTING TOPOGRAPHY
202	PROPOSED TOPOGRAPHY
X	FENCELINE
	TREELINE
	EXISTING PAVEMENT
	EXISTING GRAVEL
	DECIDUOUS TREE
	CONIFER TREE
	UTILITY POLE
	LOT LINE
	STATE OPEN WATER
	PROPOSED PAVED AREAS
	PROPOSED GRAVEL AREAS
RZ	RIPARIAN ZONE (300 FT)
	PROPOSED MANHOLE
	PROPOSED PIPE
	PROPOSED INLET
W	PROPOSED WATER QUALITY UNIT
	PROPOSED CURB
	WETLAND AREA
WLB	WETLANDS BUFFER (50 FT)
	PROJECT SITE

Drawing: W:\Vision Project Folders\292931 – Penn East\Engineering\DWG\Drainage Area Mapping – PS&S Final Draft\SESC PLANS\292931_PR–LAND–Proposed Landscape.dwg
Time: 1/9/2018 3:15:26 PM
Username: DLEBERT

TRC Engineers, Inc.

ENGINEER IN RESPONSIBLE CHARGE OF THE WORK SHOWN ON THIS DRAWING

DATE: 8/31/18 SIGNATURE

PROFESSIONAL ENGINEER: BARRY J. SUTHERLAND
LIC. # 24GE02913500

STATE OF NEW JERSEY — BARRY J. SUTHERLAND — No. GE24GE02913500 — LICENSED PROFESSIONAL ENGINEER

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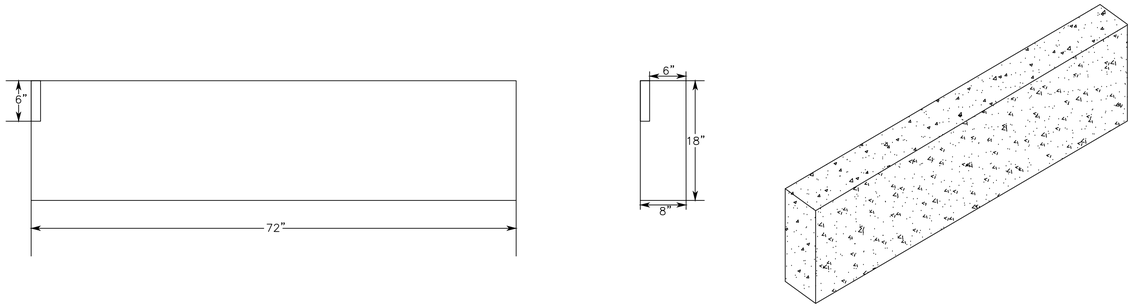
PENNEAST PIPELINE PROJECT
LAMBERTVILLE INTERCONNECT
ENLARGED LANDSCAPING PLAN–
SOUTH BUILDING AREA

LOC. WEST AMWELL TOWNSHIP, HUNTERDON COUNTY, NEW JERSEY

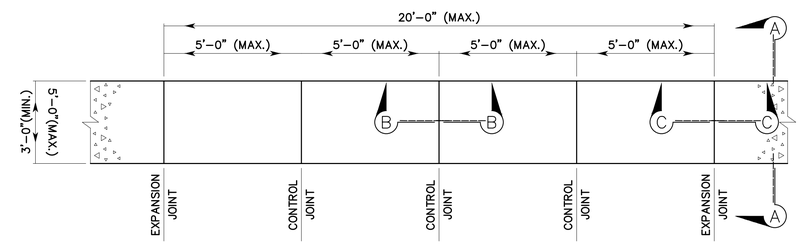
PennEast PIPELINE

YEAR: 2020 | W.B.S CE.000147.001 | SCALE: 1:20 | DWG. C–107 | REV. 0



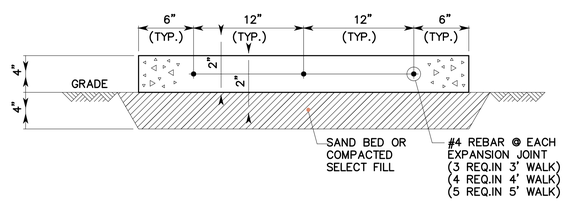
PRE CAST CURB DETAIL

N.T.S.



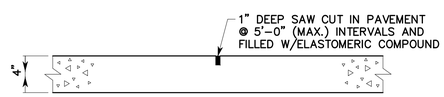
TYPICAL SIDEWALK PLAN

N.T.S.



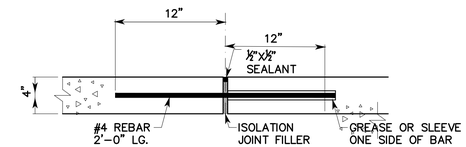
SECTION "A–A"

3'–0" WIDE WALK SHOWN



SECTION "B–B"

CONTROL JOINT



SECTION "C–C"

EXPANSION JOINT

GENERAL NOTES:

1. CONTRACTOR SHALL FURNISH ALL MATERIAL.
2. CONCRETE SHALL TEST A MINIMUM OF 3000# AT THE END OF 28 DAYS.
3. SAW CUT CONTROL JOINTS 1" DEEP SHALL BE PLACED IN PAVEMENT AT 5'–0" (MAX.) INTERVALS & FILLED WITH AN ELASTOMERIC COMPOUND.
4. EXPANSION JOINTS SHALL BE PLACED AT 20'–0" (MAX.) INTERVALS USING #4 REBAR AS SHOWN TO PREVENT DIFFERENTIAL SETTLEMENT.
5. CONTRACTOR SHALL ADD TO THE CONCRETE MIX 1½# "FIBERMESH" FIBRILLATED POLYPROPYLENE FIBER AS MANUFACTURED BY:
   SYNTHETIC INDUSTRIES
   4019 INDUSTRY DRIVE
   CHATTANOOGA, TN 37416
   PHONE (615) 892–7243
6. CONTRACTOR SHALL USE 1½LBS. OF "FIBERMESH" SYNTHETIC FIBER PER EACH CUBIC YARD OF CONCRETE MIX.
7. THE WATER/CEMENT RATIO OF THE CONCRETE MIX SHALL NOT EXCEED .45.
8. MIXING AND PLACING CONCRETE SHALL COMPLY WITH ASTM C 1116.

CONCRETE SIDEWALK DETAILS

N.T.S.

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Time: 1/9/2018 3:15:26 PM Username: DLEBERT

C.S.#

TRC Engineers, Inc.

ENGINEER IN RESPONSIBLE CHARGE OF THE WORK SHOWN ON THIS DRAWING

DATE: 6/20/2019 SIGNATURE

PROFESSIONAL ENGINEER: BARRY J. SUTHERLAND
LIC. # 24GE02913500

STATE OF NEW JERSEY
BARRY J. SUTHERLAND
No. GE24GE02913500
LICENSED
PROFESSIONAL ENGINEER

NO.	BY	DATE	REVISION	APP'D.

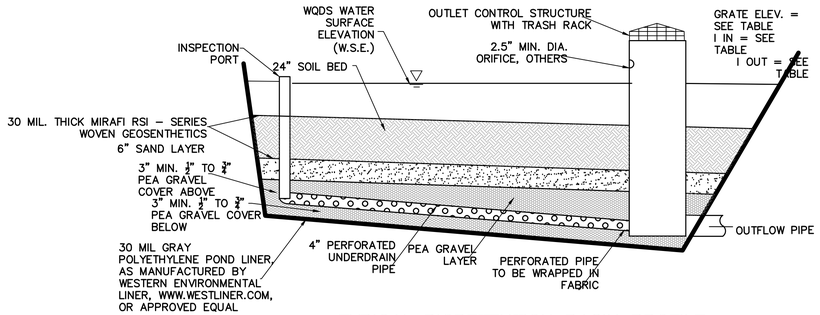
TRC Engineers, Inc.
41 SPRING STREET
NEW PROVIDENCE, NEW JERSEY 07974
PHONE NO. (908) 988-1700
FAX NO. (973) 564-6442
Certificate of Authorization #24GA28047100

PENNEAST PIPELINE PROJECT
LAMBERTVILLE INTERCONNECT
CONSTRUCTION DETAILS SHEET 1

LOC. WEST AMWELL TOWNSHIP, HUNTERDON COUNTY, NEW JERSEY

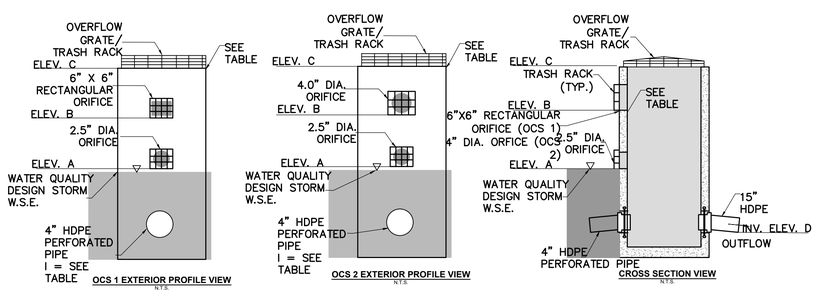
YEAR: 2020 | W.B.S CE.000147.001 | SCALE: AS SHOWN | DWG. C–108 | REV. 0

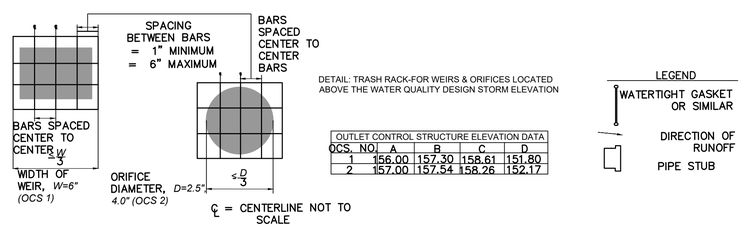
PennEast PIPELINE



TYPICAL BIORETENTION BASIN PROFILE

N.T.S.





NOTE: DIMENSIONS APPLICABLE TO HORIZONTAL AND VERTICAL BAR CONFIGURATIONS

DETAIL: TRASH RACK-FOR WEIRS & ORIFICES LOCATED ABOVE THE WATER QUALITY DESIGN STORM ELEVATION

OUTLET CONTROL STRUCTURE ELEVATION DATA				
OCS. NO	A	B	C	D
1	156.00	157.30	158.61	151.80
2	157.00	157.54	158.26	152.17

LEGEND

- WATERTIGHT GASKET OR SIMILAR
- DIRECTION OF RUNOFF
- PIPE STUB

BIORETENTION BASIN OUTLET CONTROL STRUCTURE

N.T.S.

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Username: DLIEBERT

IG #

TRC Engineers, Inc.

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PROFESSIONAL ENGINEER: BARRY J. SUTHERLAND
LIC. # 24GE02913500

STATE OF NEW JERSEY — BARRY J. SUTHERLAND — No. GE24GE02913500 — PROFESSIONAL ENGINEER

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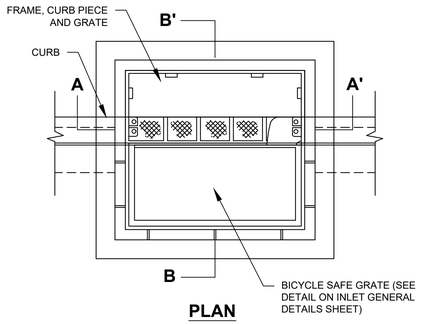
FAX NO. (973) 564-6442
Certificate of Authorization #24GA28047100

PENNEAST PIPELINE PROJECT
LAMBERTVILLE INTERCONNECT
CONSTRUCTION DETAILS SHEET 2

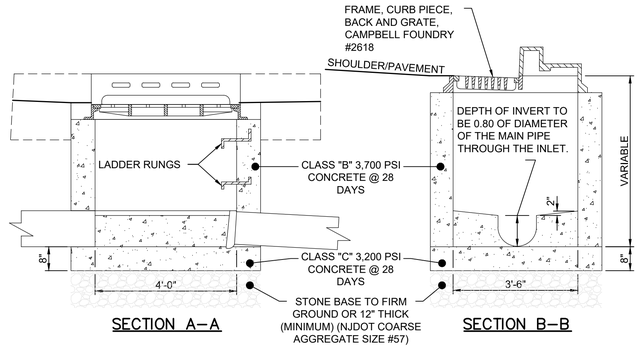
LOC. WEST AMWELL TOWNSHIP, HUNTERDON COUNTY, NEW JERSEY

PennEast PIPELINE

YEAR: 2020	W.B.S CE.000147.001	SCALE: AS SHOWN	DWG. C-109	REV. 2



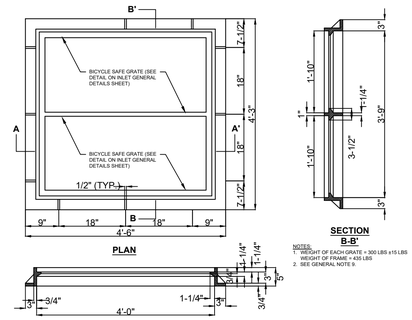
PLAN



SECTION A–A SECTION B–B

TYPE "B" NJDOT INLET DETAIL

N.T.S.

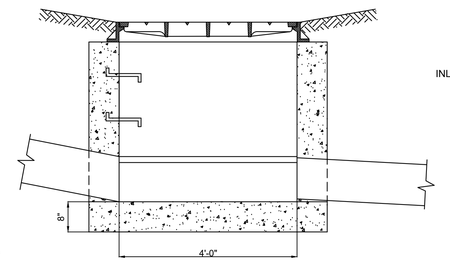


PLAN

SECTION A-A'
FRAME FOR INLET TYPE E
N.T.S.

SECTION B-B'

NOTES:
1. WEIGHT OF EACH GRATE = 300 LBS ±15 LBS
WEIGHT OF FRAME = 435 LBS
2. SEE GENERAL NOTE 9.

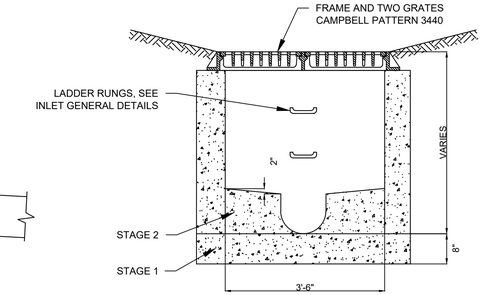


SECTION A-A'

INLET TYPE E

N.T.S.

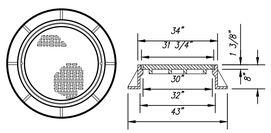
NOTES:
1. DEPTH OF INVERT TO BE 0.80 THE DIAMETER MAIN PIPE THROUGH THE INLET.
2. CONSTRUCT FOUNDATION AND INVERT IN 2 STAGES. LEAVE TOP SURFACE OF STAGE 1 ROUGH.



SECTION B-B'

TYPE "E" NJDOT INLET DETAIL

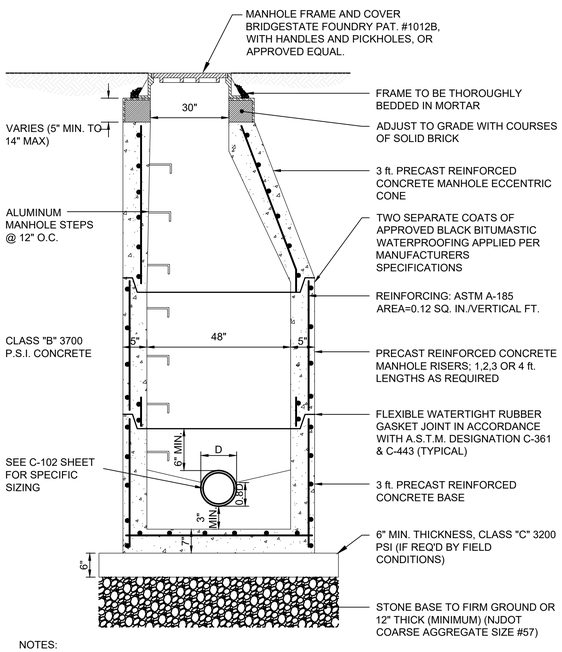
N.T.S.



BRIDGESTATE FOUNDRY OR APPROVED EQUAL
ROUND FLANGE PATTERN NUMBER 1012B

MANHOLE RIM DETAIL

N.T.S.



NOTES:

1. ALL MANHOLES SHALL BE CONSTRUCTED WATERTIGHT.
2. THE CONTRACTOR SHALL BE RESPONSIBLE FOR CONSTRUCTING ADEQUATE BALLAST TO OFFSET FLOATATION FORCES ACTING ON MANHOLES CONSTRUCTED IN WET AREAS.

STORM SEWER MANHOLE DETAIL

N.T.S.

Drawing: W:\Vision Project Folders\292931 – Penn East\Engineering\DWG\Drainage Area Mapping – PS&S Final Draft\292931_UTILITY DETAILS Sht003.dwg
Time: 1/9/2018 3:15:26 PM Username: DLEBERT

TRC Engineers, Inc.

ENGINEER IN RESPONSIBLE CHARGE OF THE WORK SHOWN ON THIS DRAWING

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LIC. # 24GE02913500

STATE OF NEW JERSEY — BARRY J. SUTHERLAND — No. GE24GE02913500 — LICENSED PROFESSIONAL ENGINEER

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PHONE NO. (908) 988-1700
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Certificate of Authorization #24GA28047100

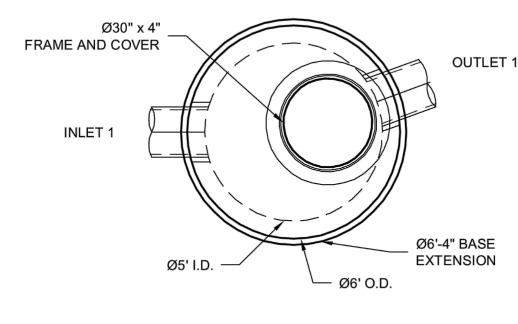
PENNEAST PIPELINE PROJECT
LAMBERTVILLE INTERCONNECT
CONSTRUCTION DETAILS SHEET 3

LOC. WEST AMWELL TOWNSHIP, HUNTERDON COUNTY, NEW JERSEY

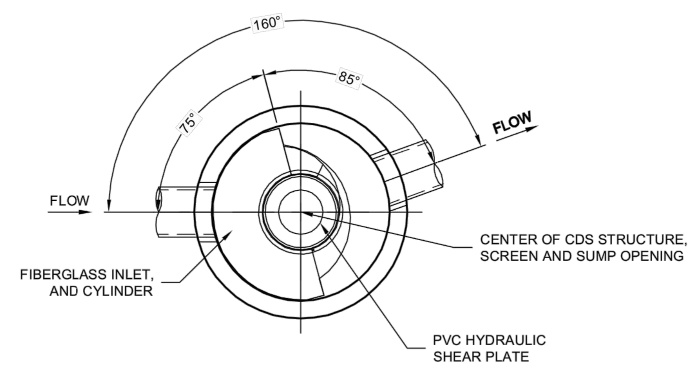
PennEast PIPELINE

YEAR: 2020 | W.B.S CE.000147.001 | SCALE: AS SHOWN | DWG. C–110 | REV. 0

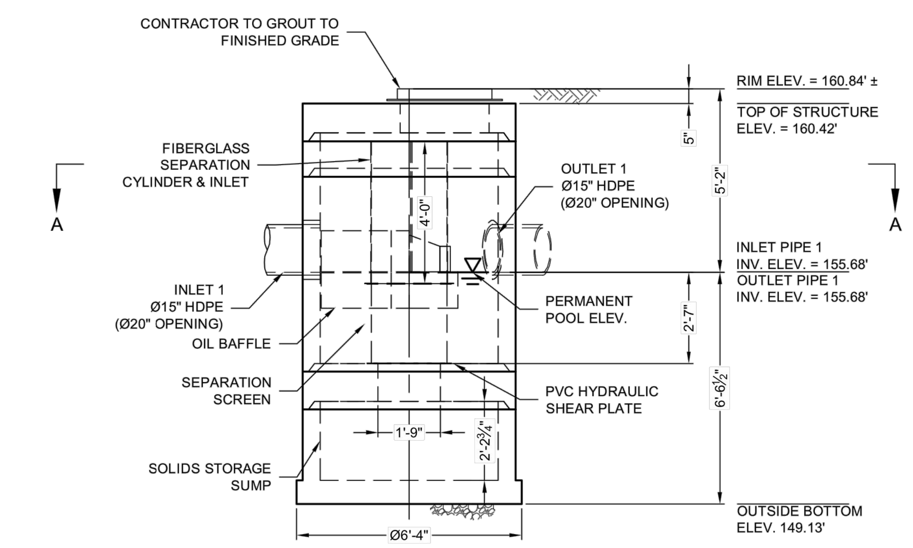
C.S.#



PLAN VIEW



SECTION A-A



ELEVATION VIEW

MATERIAL LIST (PROVIDED BY CONTECH)

COUNT	DESCRIPTION	INSTALLED BY
1	FIBERGLASS INLET AND CYLINDER	CONTECH
1	2400 micron, 2.5' O.D. x 2.25' SEP. SCREEN	CONTECH
1	SEALANT FOR JOINTS (BY PRECASTER)	CONTRACTOR
1	Ø30" x 4" FRAME & COVER, EJ#41600484, OR EQUIV.	CONTRACTOR

SITE DESIGN DATA

WATER QUALITY FLOW RATE	1.16 CFS
PEAK FLOW RATE	3.30 CFS
RETURN PERIOD OF PEAK FLOW	25 YRS

GENERAL NOTES
1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. FOR FABRICATION DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHT, PLEASE CONTACT YOUR CONTECH ENGINEERED SOLUTIONS LLC REPRESENTATIVE. www.ContechES.com
3. CDS WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING. CONTRACTOR TO CONFIRM STRUCTURE MEETS REQUIREMENTS OF PROJECT.
4. STRUCTURE SHALL MEET AASHTO HS-20 LOAD RATING, ASSUMING EARTH COVER OF 0' - 2', AND GROUNDWATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION. CASTINGS SHALL MEET AASHTO M306 AND BE CAST WITH THE CONTECH LOGO.
5. IF REQUIRED, PVC HYDRAULIC SHEAR PLATE IS PLACED ON SHELF AT BOTTOM OF SCREEN CYLINDER. REMOVE AND REPLACE AS NECESSARY DURING MAINTENANCE CLEANING.
6. CDS STRUCTURE SHALL BE PRECAST CONCRETE CONFORMING TO ASTM C-478 AND AASHTO LOAD FACTOR DESIGN METHOD.

INSTALLATION NOTES
A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE CDS MANHOLE STRUCTURE.
C. CONTRACTOR TO INSTALL JOINT SEALANT BETWEEN ALL STRUCTURE SECTIONS AND ASSEMBLE STRUCTURE.
D. CONTRACTOR TO PROVIDE, INSTALL, AND GROUT INLET AND OUTLET PIPE(S). MATCH PIPE INVERTS WITH ELEVATIONS SHOWN. ALL PIPE CENTERLINES TO MATCH PIPE OPENING CENTERLINES.
E. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO ASSURE UNIT IS WATER TIGHT, HOLDING WATER TO FLOWLINE INVERT MINIMUM. IT IS SUGGESTED THAT ALL JOINTS BELOW PIPE INVERTS ARE GROUTED.

STRUCTURE WEIGHT
APPROXIMATE HEAVIEST PICK = 12500 LBS.
STRUCTURE IS DELIVERED IN 4 PIECES

MAX FOOTPRINT = Ø6'-4"

CONTECH
PROPOSAL
DRAWING

GILL
LAYOUT 1H
2520-5-FGIS
5798 / GILL10
9.55T

MARK	DATE	REVISION DESCRIPTION	BY

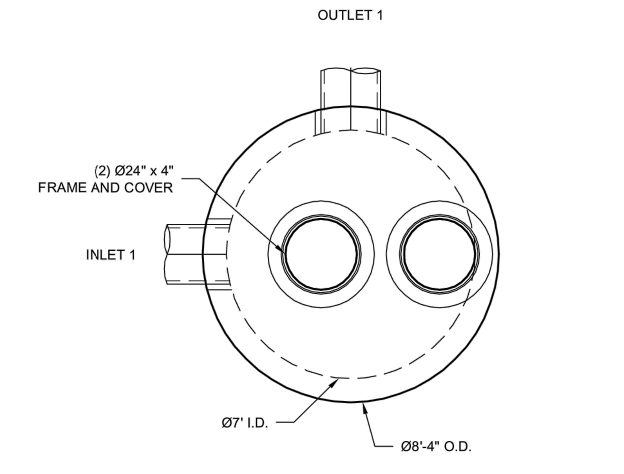
CDS2520-5-C - 596999-10
TEXAS EASTERN TRANSMISSION -
PENN EAST MODERNIZATION
WEST AMWELL, NJ
for SYSTEM: WQU-CDS-1

CONTECH ENGINEERED SOLUTIONS LLC
www.ContechES.com

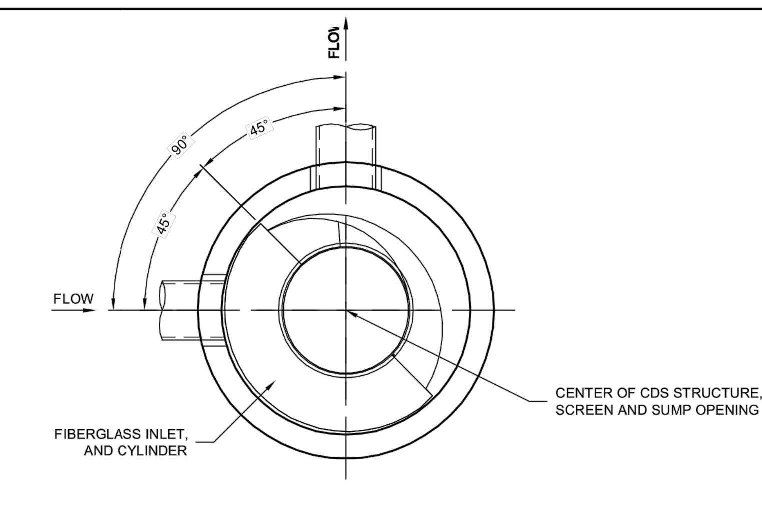
DATE: 08/23/18	SCALE: 1/4" = 1'-0"
DESIGNED: TKM	DRAWN: TKM
CHECKED: ###	APPROVED: ###
PROJECT No.: 596999	SEQUENCE No.: 10
SHEET: 1 OF 1	

WATER QUALITY TREATMENT UNIT 1 (CDS–1)

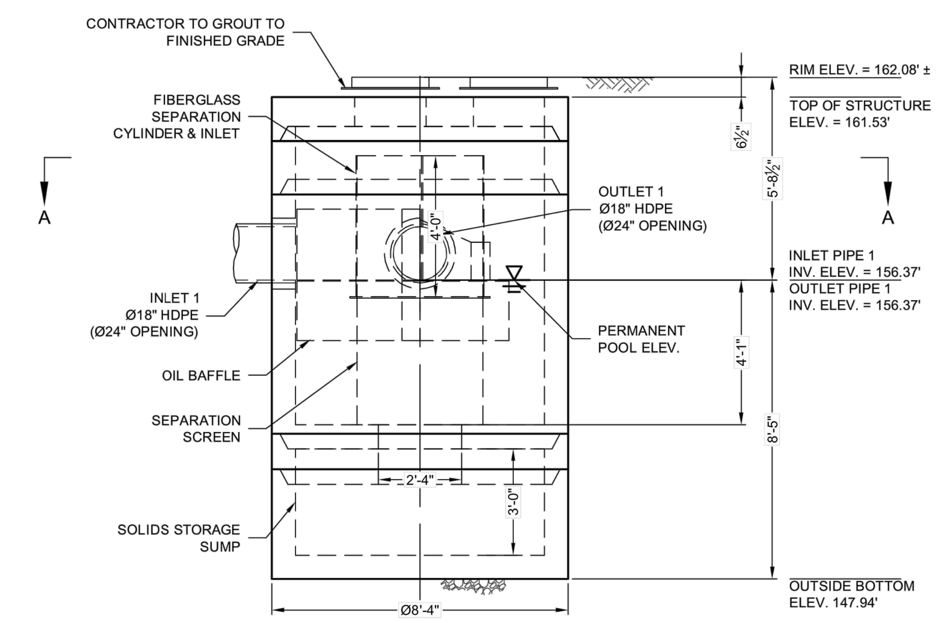
N.T.S.



PLAN VIEW



SECTION A-A



ELEVATION VIEW

MATERIAL LIST (PROVIDED BY CONTECH)

COUNT	DESCRIPTION	INSTALLED BY
1	FIBERGLASS INLET AND CYLINDER	CONTECH
1	2400 micron, 3.5' O.D. x 3.58' SEP. SCREEN	CONTECH
1	SEALANT FOR JOINTS (BY PRECASTER)	CONTRACTOR
2	Ø24" x 4" FRAME & COVER, EJ#41600389, OR EQUIV.	CONTRACTOR

SITE DESIGN DATA

WATER QUALITY FLOW RATE	2.16 CFS
PEAK FLOW RATE	5.49 CFS
RETURN PERIOD OF PEAK FLOW	25 YRS

GENERAL NOTES
1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. FOR FABRICATION DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHT, PLEASE CONTACT YOUR CONTECH ENGINEERED SOLUTIONS LLC REPRESENTATIVE. www.ContechES.com
3. CDS WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING. CONTRACTOR TO CONFIRM STRUCTURE MEETS REQUIREMENTS OF PROJECT.
4. STRUCTURE SHALL MEET AASHTO HS-20 LOAD RATING, ASSUMING EARTH COVER OF 0' - 2', AND GROUNDWATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION. CASTINGS SHALL MEET AASHTO M306 AND BE CAST WITH THE CONTECH LOGO.
5. IF REQUIRED, PVC HYDRAULIC SHEAR PLATE IS PLACED ON SHELF AT BOTTOM OF SCREEN CYLINDER. REMOVE AND REPLACE AS NECESSARY DURING MAINTENANCE CLEANING.
6. CDS STRUCTURE SHALL BE PRECAST CONCRETE CONFORMING TO ASTM C-478 AND AASHTO LOAD FACTOR DESIGN METHOD.

INSTALLATION NOTES
A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE CDS MANHOLE STRUCTURE.
C. CONTRACTOR TO INSTALL JOINT SEALANT BETWEEN ALL STRUCTURE SECTIONS AND ASSEMBLE STRUCTURE.
D. CONTRACTOR TO PROVIDE, INSTALL, AND GROUT INLET AND OUTLET PIPE(S). MATCH PIPE INVERTS WITH ELEVATIONS SHOWN. ALL PIPE CENTERLINES TO MATCH PIPE OPENING CENTERLINES.
E. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO ASSURE UNIT IS WATER TIGHT, HOLDING WATER TO FLOWLINE INVERT MINIMUM. IT IS SUGGESTED THAT ALL JOINTS BELOW PIPE INVERTS ARE GROUTED.

STRUCTURE WEIGHT
APPROXIMATE HEAVIEST PICK = 23000 LBS.
STRUCTURE IS DELIVERED IN 5 PIECES

MAX FOOTPRINT = Ø8'-4"

CONTECH
PROPOSAL
DRAWING

COAS
LAYOUT 1E
3535-7-FGIS
5767 / COAS11
17.17T

MARK	DATE	REVISION DESCRIPTION	BY

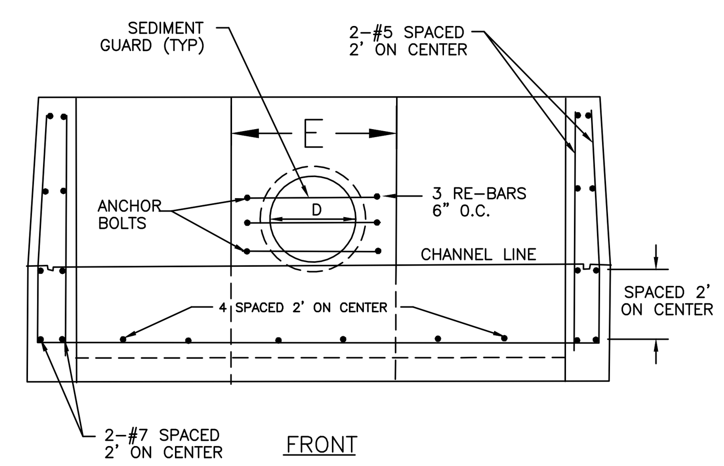
CDS3535-7-C - 596999-20
TEXAS EASTERN TRANSMISSION -
PENN EAST MODERNIZATION
WEST AMWELL, NJ
for SYSTEM: WQU-CDS-2

CONTECH ENGINEERED SOLUTIONS LLC
www.ContechES.com

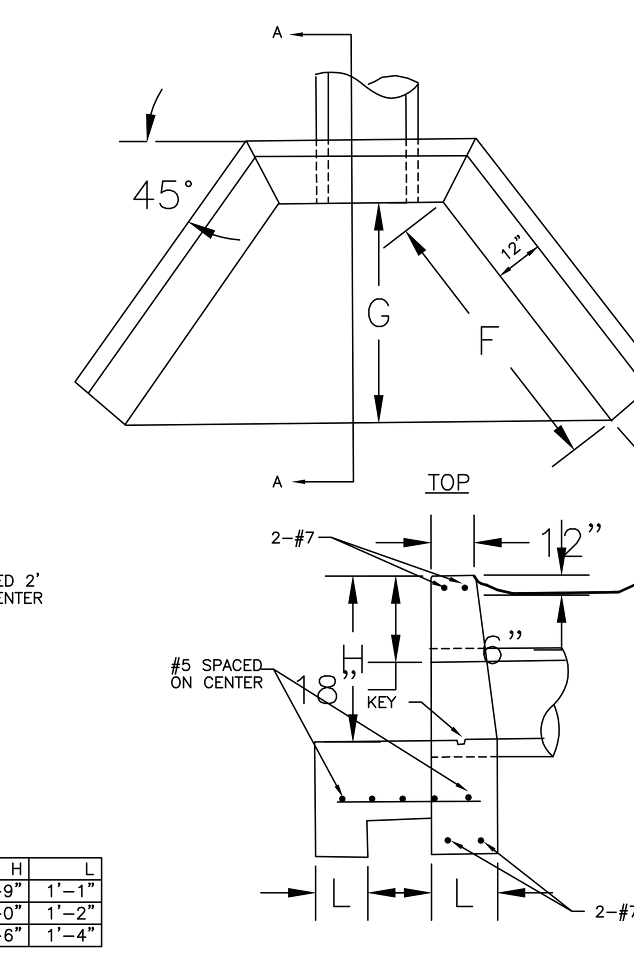
DATE: 08/21/18	SCALE: 1/4" = 1'-0"
DESIGNED: TKM	DRAWN: TKM
CHECKED: ###	APPROVED: ###
PROJECT No.: 596999	SEQUENCE No.: 20
SHEET: 1 OF 1	

WATER QUALITY TREATMENT UNIT 2 (CDS–2)

N.T.S.



FRONT



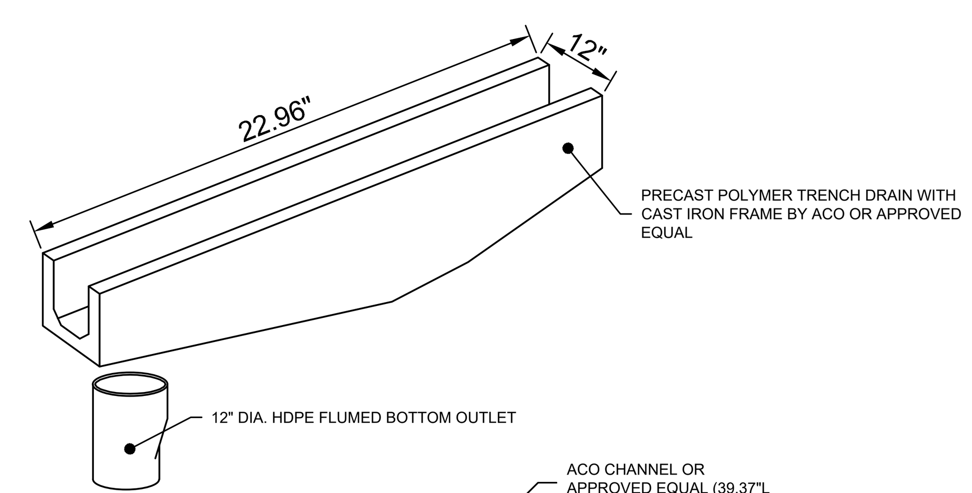
NOTE:

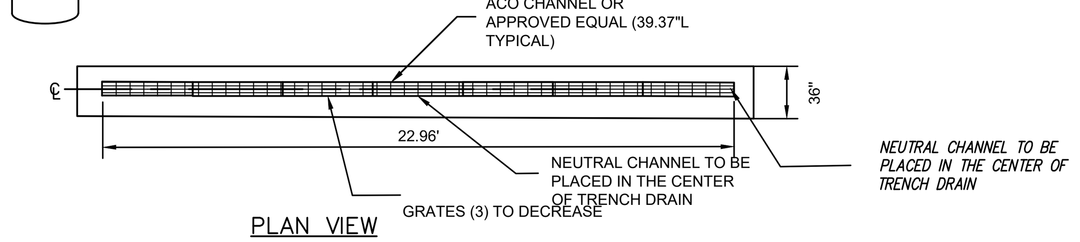
ALL CONCRETE TO BE CLASS "B" CONCRETE AIR ENTRAINED 3500 PSI MIN. ALL REINFORCED SHALL HAVE 2 INCHES ON COVER TO FACE OF WALL. AS DIRECTED BY THE TOWNSHIP ENGINEER.

D	E	F	G	H	L
15"	2'–5"	3'–2"	2'–3"	2'–9"	1'–1"
18"	2'–6"	3'–7"	2'–6"	3'–0"	1'–2"
24"	3'–6"	5'–0"	3'–6"	3'–6"	1'–4"

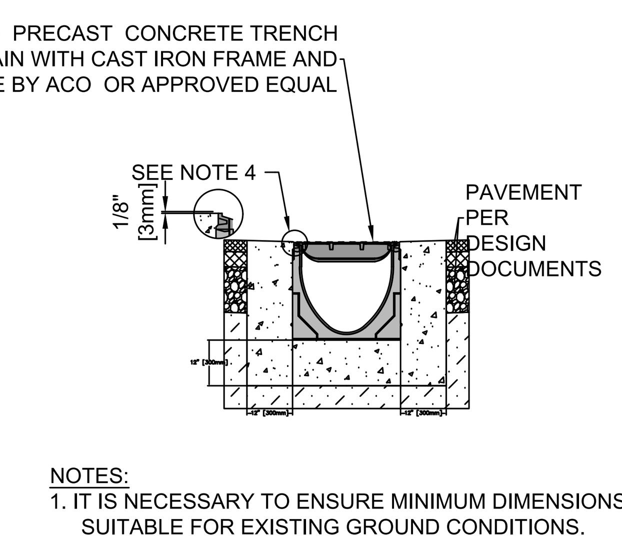
HEADWALL 1, 2 3 DETAIL

N.T.S.





PLAN VIEW



NOTES:
1. IT IS NECESSARY TO ENSURE MINIMUM DIMENSIONS SHOWN ARE SUITABLE FOR EXISTING GROUND CONDITIONS. *ENGINEERING ADVICE MAY BE REQUIRED.*
2. MINIMUM CONCRETE STRENGTH OF 4,000 PSI IS RECOMMENDED. CONCRETE SHOULD BE VIBRATED TO ELIMINATE AIR POCKETS.
3. EXPANSION AND CONTRACTION CONTROL JOINTS AND REINFORCEMENT ARE RECOMMENDED TO PROTECT CHANNEL AND CONCRETE SURROUND. *ENGINEERING ADVICE MAY BE REQUIRED.*
4. THE FINISHED LEVEL OF THE CONCRETE SURROUND MUST BE APPROX. 1/8" [3mm] ABOVE THE TOP OF THE CHANNEL EDGE.
5. CONCRETE BASE THICKNESS SHOULD MATCH SLAB THICKNESS. ENGINEERING ADVICE MAY BE REQUIRED TO DETERMINE PROPER LOAD CLASS.
6. REFER TO ACO'S LATEST INSTALLATION INSTRUCTIONS FOR FURTHER DETAILS.

PRE–CAST TRENCH DRAIN DETAIL

N.T.S.

SPECIFICATIONS

S300K POWERDRAIN - LOAD CLASS F

GENERAL
THE SURFACE DRAINAGE SYSTEM SHALL BE POLYMER CONCRETE S300K CHANNEL SYSTEM WITH DUCTILE IRON EDGE RAILS AS MANUFACTURED BY ACO POLYMER PRODUCTS, INC.

MATERIALS
CHANNELS SHALL BE MANUFACTURED FROM POLYESTER RESIN POLYMER CONCRETE WITH AN INTEGRALLY CAST-IN DUCTILE IRON EDGE RAIL. MINIMUM PROPERTIES OF POLYMER CONCRETE WILL BE AS FOLLOWS:

COMPRESSIVE STRENGTH:	14,000 PSI
FLEXURAL STRENGTH:	4,000 PSI
TENSILE STRENGTH:	1,500 PSI
WATER ABSORPTION:	0.07%
FROST PROOF	YES
DILUTE ACID AND ALKALI RESISTANT	YES
B117 SALT SPRAY TEST COMPLIANT	YES

THE SYSTEM SHALL BE 12" (300mm) NOMINAL INTERNAL WIDTH WITH A 14.2" (390mm) OVERALL WIDTH AND A BUILT-IN SLOPE OF 0.5%. CHANNEL INVERT SHALL HAVE DEVELOPED "V" SHAPE. ALL CHANNELS SHALL BE INTERLOCKING WITH A MALE/FEMALE JOINT.

THE COMPLETE DRAINAGE SYSTEM SHALL BE BY ACO POLYMER PRODUCTS, INC. ANY DEVIATION OR PARTIAL SYSTEM DESIGN AND/OR IMPROPER INSTALLATION WILL VOID ANY AND ALL WARRANTIES PROVIDED BY ACO POLYMER PRODUCTS, INC.

CHANNEL SHALL WITHSTAND LOADING TO PROPER LOAD CLASS AS OUTLINED BY EN 1433. GRATE TYPE SHALL BE APPROPRIATE TO MEET THE SYSTEM LOAD CLASS SPECIFIED AND INTENDED APPLICATION. GRATES SHALL BE SECURED USING 'POWERLOK' BOLTLESS LOCKING SYSTEM. CHANNEL AND GRATE SHALL BE CERTIFIED TO MEET THE SPECIFIED EN 1433 LOAD CLASS. THE SYSTEM SHALL BE INSTALLED IN ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS AND RECOMMENDATIONS.

Drawing: W:\Vision Project Folders\292931 – Penn East\Engineering\DWG\Drainage Area Mapping – PS&S Final Draft\292931_UTILITY DETAILS SHEETS.dwg
Time: 1/9/2018 3:15:26 PM Username: DLEBERT

IG.#

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LIC. # 24GE02913500

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Certificate of Authorization #24GA28047100

PENNEAST PIPELINE PROJECT
LAMBERTVILLE INTERCONNECT
CONSTRUCTION DETAILS SHEET 4

LOC. WEST AMWELL TOWNSHIP, HUNTERDON COUNTY, NEW JERSEY

YEAR: 2020	*W.B.S* CE.000147.001	*SCALE:* AS SHOWN	*DWG.* C–111	*REV.* 0

STRUCTURAL DESIGN LOADING CRITERIA

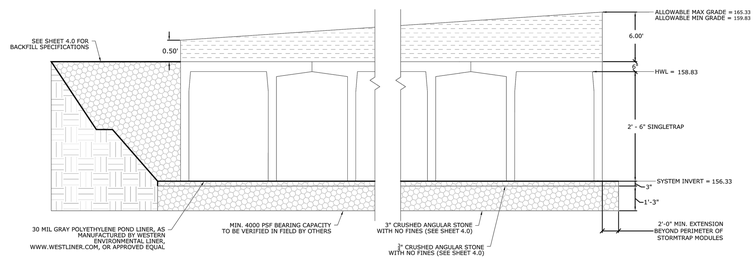
LIVE LOADING:	AASHTO HS-20 HIGHWAY LOADING
GROUND WATER TABLE:	BELOW INVERT OF SYSTEM
SOIL BEARING PRESSURE:	4000 PSF
SOIL DENSITY:	120 PCF
EQUIVALENT UNSAUTURATED LATERAL ACTIVE EARTH PRESSURE:	35 PSF / FT.
EQUIVALENT SATURATED LATERAL ACTIVE EARTH PRESSURE:	80 PSF/FT. (IF WATER TABLE PRESENT)
APPLICABLE CODES:	AASHTO ACI-318
BACKFILL TYPE:	1" STONE AGGREGATE

STORMTRAP SYSTEM INFORMATION

WATER STORAGE PROV:	10,314.91 CUBIC FEET
UNIT HEADROOM:	2' - 6" SINGLETRAP
UNIT QUANTITY:	41 TOTAL PIECES

SITE SPECIFIC DESIGN CRITERIA

1. STORMTRAP UNITS SHALL BE MANUFACTURED AND INSTALLED ACCORDING TO SHOP DRAWINGS APPROVED BY THE INSTALLING CONTRACTOR AND ENGINEER OF RECORD. THE SHOP DRAWINGS SHALL INDICATE SIZE AND LOCATION OF ROOF OPENINGS AND INLET/ OUTLET PIPE TYPES, SIZES, INVERT ELEVATIONS AND SIZE OF OPENINGS.
2. COVER RANGE: MIN. 0.50' MAX. 6.00' CONSULT STORMTRAP FOR ADDITIONAL COVER OPTIONS.
3. ALL DIMENSIONS AND SOIL CONDITIONS, INCLUDING BUT NOT LIMITED TO GROUNDWATER AND SOIL BEARING CAPACITY ARE REQUIRED TO BE VERIFIED IN THE FIELD BY OTHERS PRIOR TO STORMTRAP INSTALLATION.
4. FOR STRUCTURAL CALCULATIONS THE GROUND WATER TABLE IS ASSUMED TO BE BELOW INVERT OF SYSTEM . IF WATER TABLE IS DIFFERENT THAN ASSUMED, CONTACT STORMTRAP.



2' - 6" SINGLETRAP

StormTrap
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1287 WINDHAM PARKWAY
ROMEOVILLE, IL 60446
P:815-941-4549 / F:331-318-5347

ENGINEER INFORMATION:
TRC COMPANIES, INC
41 SPRING ST
SUITE 102
NEW PROVIDENCE, NJ
908-988-1700

PROJECT INFORMATION:
PENN EAST
MODERNIZATION
BASIN 1
STONE BASE OPTION
WEST AMWELL, NJ

CURRENT ISSUE DATE:
8/21/2018

ISSUED FOR:
PRELIMINARY

REV.	DATE:	ISSUED FOR:	DWN BY:
1	8/21/2018	PRELIMINARY	KW

SCALE: NTS

SHEET TITLE: SINGLETRAP DESIGN CRITERIA

SHEET NUMBER: 1.0

BILL OF MATERIALS

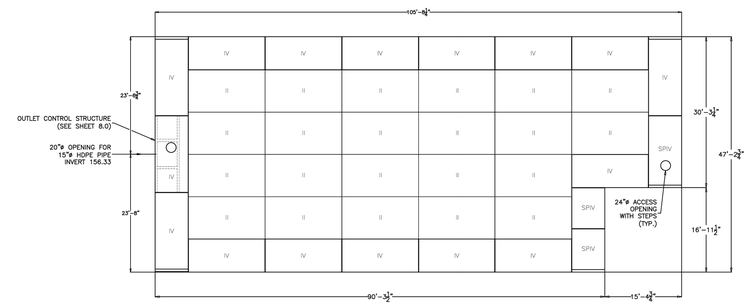
QTY.	UNIT TYPE	DESCRIPTION	WEIGHT
0	I	2' - 6" SINGLETRAP	14606
22	II	2' - 6" SINGLETRAP	14606
0	III	2' - 6" SINGLETRAP	12569
16	IV	2' - 6" SINGLETRAP	12569
0	VII	2' - 6" SINGLETRAP	10532
3	SPIV	2' - 6" SINGLETRAP	VARIES
5	PANEL	6" THICK PANELS	1491
8	JOINT WRAP	150' PER ROLL	

LOADING DISCLAIMER:

STORMTRAP IS NOT DESIGNED TO ACCEPT ANY ADDITIONAL LOADINGS FROM NEARBY STRUCTURES NEXT TO OR OVER THE TOP OF STORMTRAP. IF ADDITIONAL LOADING CONSIDERATIONS ARE REQUIRED FOR STRUCTURAL DESIGN OF STORMTRAP, PLEASE CONTACT STORMTRAP IMMEDIATELY.

DESIGN CRITERIA
ALLOWABLE MAX GRADE = 165.33
ALLOWABLE MIN GRADE = 159.83
INSIDE HEIGHT ELEVATION = 158.83
SYSTEM INVERT = 156.33

NOTES:
1. DIMENSIONING OF STORMTRAP SYSTEM SHOWN BELOW ALLOW FOR A 3/4" GAP BETWEEN EACH MODULE.
2. ALL DIMENSIONS TO BE VERIFIED IN THE FIELD BY OTHERS.
3. SEE SHEET 3.0 FOR INSTALLATION SPECIFICATIONS.
4. SP - INDICATES A MODULE WITH MODIFICATIONS.
5. P - INDICATES A MODULE WITH A PANEL ATTACHMENT.
6. CONTRACTORS RESPONSIBILITY TO ENSURE CONSISTENCY/ACCURACY TO FINAL ENGINEER OF RECORD PLAN SET.
7. IF A WATERTIGHT SOLUTION IS REQUIRED FOR THIS OUTLET CONTROL STRUCTURE, STORMTRAP RECOMMENDS THE USE OF XYPEX OR SIKAFLEX MATERIALS (OR APPROVED EQUIVALENT). WATERPROOFING MATERIALS TO BE SUPPLIED AND INSTALLED BY THE INSTALLING CONTRACTOR. CONTACT STORMTRAP FOR A LIST OF APPROVED APPLICATORS.



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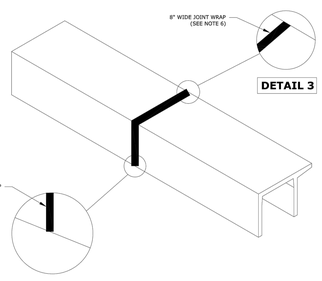
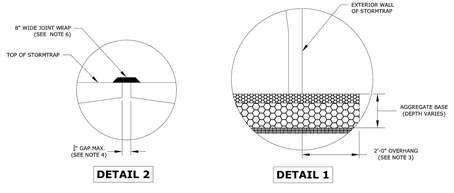
SHEET TITLE: SINGLETRAP LAYOUT DETAILS

SHEET NUMBER: 2.0

STORMTRAP INSTALLATION SPECIFICATIONS

1. STORMTRAP SHALL BE INSTALLED IN ACCORDANCE WITH ASTM C891 STANDARD PRACTICE FOR INSTALLATION OF UNDERGROUND PRE-CAST CONCRETE UTILITY STRUCTURES. THE FOLLOWING ADDITIONS AND/OR EXCEPTIONS SHALL APPLY:
2. IT IS THE RESPONSIBILITY OF THE INSTALLING CONTRACTOR TO ENSURE THAT PROPER/ADEQUATE EQUIPMENT IS USED TO SET/INSTALL THE MODULES.
3. THE AGGREGATE FOUNDATION HAS BEEN DESIGNED BASED ON THE FOLLOWING ASSUMPTIONS. THESE ASSUMPTIONS WILL NEED TO BE VERIFIED BY A GEOTECHNICAL ENGINEER WHICH WILL NEED TO BE EMPLOYED BY THE OWNER.
   - 3.1. A QUALIFIED GEOTECHNICAL ENGINEER WILL BE EMPLOYED, BY OWNER, TO PROVIDE ASSISTANCE IN EVALUATING THE EXISTING SOIL CONDITIONS BELOW THE PROPOSED ENGINEERED STONE FOUNDATION. IF A STONE FOUNDATION DESIGN IS TO BE USED, THE BEARING PRESSURE OF THE SOILS BELOW THE STONE WILL NEED TO MEET OR EXCEED ALLOWABLE CAPACITY. IF THIS IS NOT POSSIBLE, THE STONE FOUNDATION MAY NOT BE AN OPTION FOR THIS LOCATION.
   - 3.2. A QUALIFIED GEOTECHNICAL ENGINEER WILL BE EMPLOYED, BY OWNER, TO EVALUATE A SOURCE OF STONE AGGREGATES THAT WILL BE PLACED ON PROPERLY COMPACTED SOILS (SEE SHEET 1.0 FOR SOIL BEARING CAPACITY REQUIREMENTS). THE AGGREGATE BASE COURSE FOR WHICH THE STORMTRAP SYSTEM WILL BEAR DIRECTLY ON SHALL CONSIST OF A 3" THICK BED OF ¾" DIAMETER ANGULAR STONE, WELL COMPACTED AND SEATED, WITH NO FINES. AND A 15" THICK BED OF 3" DIAMETER STONE AGGREGATE (SEE SHEET 4.0 FOR FURTHER DESCRIPTION/EXPLANATION). PLEASE NOTE THAT THESE ARE ONLY MINIMUM RECOMMENDATIONS AND A QUALIFIED GEOTECHNICAL ENGINEER SHALL BE USED TO DETERMINE THE EXACT REQUIREMENTS FOR THE LOCATIONS THAT THE STORMTRAP SYSTEM IS TO BE LOCATED.
   - 3.3. THE CONTRACTOR SHALL REMOVE ANY AND ALL EXPANDABLE OR COLLAPSIBLE SOILS AT THE DIRECTION OF A QUALIFIED GEOTECHNICAL ENGINEER.
   - 3.4. THE AGGREGATE FOUNDATION SHALL BE INSTALLED SUCH THAT THE AGGREGATE EXTENDS A MINIMUM OF 2'-0" PAST THE OUTSIDE OF THE SYSTEM (SEE DETAIL 1).
   - 3.5. THE ¾" AGGREGATE SHALL BE COMPACTED USING A VIBRATING ROLLER WITH ITS' FULL DYNAMIC FORCE APPLIED TO ACHIEVE A FLAT SURFACE.
   - 3.6. DISK, DRY AND COMPACT THE TOP 8" OF THE SUBGRADE SOILS TO 95% OF THE STANDARD DRY DENSITY AND 110% OPTIMUM MOISTURE CONTENT.
   - 3.7. AGGREGATE SHALL BE GRADED WITHIN +/- ½" OF THE GRADE SHOWN ON THE PLANS.
   - 3.8. MINIMUM SOIL BEARING CAPACITY LISTED ON SHEET 1.0 SHALL BE VERIFIED IN FIELD BY OTHERS.
4. THE STORMTRAP MODULES SHALL BE PLACED SUCH THAT THE MAXIMUM SPACE BETWEEN ADJACENT MODULES DOES NOT EXCEED 2" (SEE DETAIL 2). IF THE SPACE EXCEEDS 2", THE MODULES SHALL BE RESET WITH APPROPRIATE ADJUSTMENT MADE TO LINE AND GRADE TO BRING THE SPACE INTO SPECIFICATION.
5. STORMTRAP MODULES ARE NOT WATERTIGHT. IF A WATERTIGHT SOLUTION IS REQUIRED, CONTACT STORMTRAP FOR RECOMMENDATIONS. THE WATERTIGHT APPLICATION IS TO BE PROVIDED AND IMPLEMENTED BY THE CONTRACTOR. THE CONTRACTOR IS RESPONSIBLE TO ENSURE THAT THE SELECTED WATERTIGHT SOLUTION PERFORMS AS SPECIFIED BY THE MANUFACTURER.
6. ALL EXTERIOR JOINTS BETWEEN ADJACENT STORMTRAP MODULES SHALL BE SEALED WITH 8" WIDE PRE-FORMED, COLD-APPLIED, SELF-ADHERING ELASTOMERIC RESIN, BONDED TO A WOVEN , HIGHLY PUNCTURE RESISTANT POLYMER WRAP, CONFORMING TO ASTM C891 AND SHALL BE INTEGRATED WITH PRIMER SEALANT AS APPROVED BY STORMTRAP (SEE DETAILS 3 & 4). THE JOINT WRAP DOES NOT PROVIDE A WATERTIGHT SEAL. THE SOLE PURPOSE OF THE JOINT WRAP IS TO PROVIDE A SILT AND SOIL TIGHT SYSTEM. THE ADHESIVE EXTERIOR JOINT WRAP SHALL BE INSTALLED ACCORDING TO THE FOLLOWING INSTALLATION INSTRUCTIONS:
   - 6.1. USE A BRUSH OR WET CLOTH TO THOROUGHLY CLEAN THE OUTSIDE SURFACE AT THE POINT WHERE THE JOINT WRAP IS TO BE APPLIED.
   - 6.2. A RELEASE PAPER PROTECTS THE ADHESIVE SIDE OF THE JOINT WRAP. PLACE THE ADHESIVE TAPE (ADHESIVE SIDE DOWN) AROUND THE STRUCTURE, REMOVING THE RELEASE PAPER AS YOU GO. PRESS THE JOINT WRAP FIRMLY AGAINST THE STORMTRAP MODULE SURFACE WHEN APPLYING.
7. IF THE CONTRACTOR NEEDS TO CANCEL ANY SHIPMENTS, THEY MUST DO SO 48 HOURS PRIOR TO THEIR SCHEDULED ARRIVAL AT THE JOB SITE. IF CANCELED AFTER THAT TIME, PLEASE CONTACT THE PROJECT MANAGER.
8. IF THE STORMTRAP MODULE(S) IS DAMAGED IN ANY WAY PRIOR, DURING, OR AFTER INSTALL, STORMTRAP, MUST BE CONTACTED IMMEDIATELY TO ASSESS THE DAMAGE AND TO DETERMINE WHETHER OR NOT THE MODULE(S) WILL NEED TO BE REPLACED. IF ANY MODULE ARRIVES AT THE JOBSITE DAMAGED DO NOT UNLOAD IT; CONTACT STORMTRAP, IMMEDIATELY. ANY DAMAGE NOT REPORTED BEFORE THE TRUCK IS UNLOADED WILL BE THE CONTRACTOR'S RESPONSIBILITY.
9. STORMTRAP MODULES CANNOT BE ALTERED IN ANY WAY AFTER MANUFACTURING WITHOUT WRITTEN CONSENT FROM STORMTRAP.





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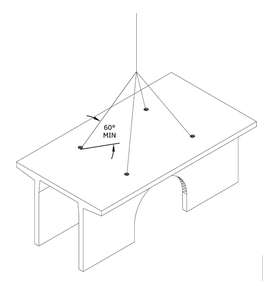
SHEET TITLE: SINGLETRAP INSTALLATION SPECIFICATIONS

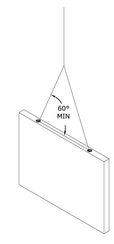
SHEET NUMBER: 3.0

END PANEL ERECTION/INSTALLATION NOTES

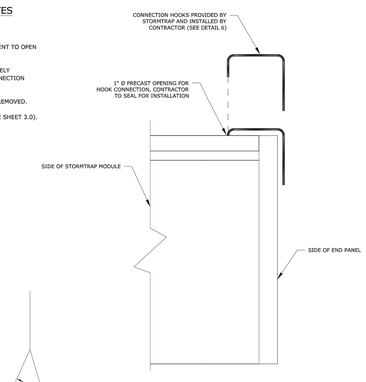
1. END PANELS WILL BE SUPPLIED TO CLOSE OFF OPEN ENDS OF ROWS.
2. PANELS SHALL BE INSTALLED IN A TILT UP FASHION DIRECTLY ADJACENT TO OPEN END OF MODULE (REFER TO SHEET 2.0 FOR END PANEL LOCATIONS).
3. CONNECTION HOOKS WILL BE SUPPLIED WITH END PANELS TO SECURELY CONNECT PANEL TO ADJACENT STORMTRAP MODULE (SEE PANEL CONNECTION ELEVATION VIEW).
4. ONCE CONNECTION HOOK IS ATTACHED, LIFTING CLUTCHES MAY BE REMOVED.
5. JOINT WRAP SHALL BE PLACED AROUND PERIMETER JOINT PANEL (SEE SHEET 3.0).



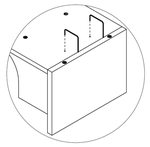
MODULE LIFTING DETAIL



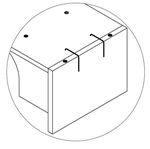
END PANEL LIFTING DETAIL



PANEL CONNECTION ELEVATION VIEW



STEP 1



STEP 2

DETAIL 6

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SHEET NUMBER: 3.1

STORMTRAP BASIN 1
N.T.S.

TRC Engineers, Inc.
ENGINEER IN RESPONSIBLE CHARGE OF THE WORK SHOWN ON THIS DRAWING
DATE: 8/31/18 SIGNATURE _____
PROFESSIONAL ENGINEER: BARRY J. SUTHERLAND
LIC. # 24GE02913500

NO.	BY	DATE	REVISION	APP'D.

TRC Engineers, Inc.
41 SPRING STREET
NEW PROVIDENCE, NEW JERSEY 07974
PHONE NO. (908) 988-1700
FAX NO. (973) 564-6442
Certificate of Authorization #24GA28047100

PENNEAST PIPELINE PROJECT
LAMBERTVILLE INTERCONNECT
CONSTRUCTION DETAILS SHEET 5

LOC. WEST AMWELL TOWNSHIP, HUNTERDON COUNTY, NEW JERSEY

PennEast PIPELINE

YEAR: 2020 | W.B.S CE.000147.001 | SCALE: AS SHOWN | DWG. C-112 | REV. 2

IG #

Drawing: W:\Vision Project Folders\292931 - Penn East\Engineering\DWG\Drainage Area Mapping - PS&S Final Draft\292931_UTILITY DETAILS SHEET5.dwg
Time: 1/9/2018 3:15:26 PM Username: DLEBERT

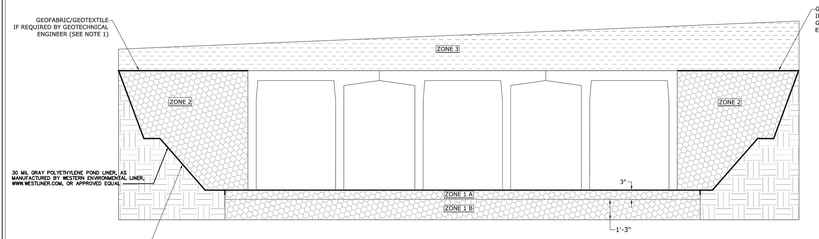
ZONE CHART		
ZONES	ZONE DESCRIPTIONS	REMARKS
ZONE 1 A	FOUNDATION AGGREGATE	#5 (2") STONE AGGREGATE (SEE NOTE 4 FOR DESCRIPTION)
ZONE 1 B	FOUNDATION AGGREGATE	3" STONE AGGREGATE (SEE NOTE 5 FOR DESCRIPTION)
ZONE 2	BACKFILL	#5 (2") STONE AGGREGATE (SEE NOTE 4 FOR DESCRIPTION)
ZONE 3	FINAL COVER OVERTOP	MATERIALS NOT TO EXCEED 120 PCF

FILL DEPTH	TRACK WIDTH	MAX VEHICLE WEIGHT (KIPS)	MAX GROUND PRESSURE
12"	12"	51.8	1690 psf
	18"	56.1	1219 psf
	24"	68.1	1111 psf
	30"	76.7	1000 psf
	36"	85.0	924 psf

NOTE:
TRACK LENGTH NOT TO EXCEED 15'-4".
ONLY TWO TRACKS PER VEHICLE.

STORMTRAP ZONE INSTALLATION SPECIFICATIONS/PROCEDURES

1. THE FILL PLACED AROUND THE STORMTRAP MODULES MUST DEPOSITED ON BOTH SIDES AT THE SAME TIME AND TO APPROXIMATELY THE SAME ELEVATION. AT NO TIME SHALL THE FILL BEHIND ONE SIDE WALL BE MORE THAN 2'-0" HIGHER THAN THE FILL ON THE OPPOSITE SIDE. BACKFILL SHALL EITHER BE COMPACTED AND/OR VIBRATED TO ENSURE THAT BACKFILL AGGREGATE/STONE MATERIAL IS WELL SEATED AND PROPERLY INTER LOCKED. CARE SHALL BE TAKEN TO PREVENT ANY WEDGING ACTION AGAINST THE STRUCTURE, AND ALL SLOPES WITHIN THE AREA TO BE BACKFILLED MUST BE STEPPED OR SERRATED TO PREVENT WEDGING ACTION. CARE SHALL ALSO BE TAKEN AS NOT TO DISRUPT THE JOINT WRAP FROM THE JOINT DURING THE BACKFILL PROCESS. BACKFILL MATERIAL SHALL BE CLEAN, CRUSHED, ANGULAR No. 5 (AASHTO M43) AGGREGATE. IF NATIVE EARTH IS SUSCEPTIBLE TO MIGRATION, CONFIRM WITH GEOTECHNICAL ENGINEER AND PROVIDE PROTECTION AS REQUIRED (PROVIDED BY OTHERS).
2. DURING PLACEMENT OF MATERIAL OVERTOP THE SYSTEM, AT NO TIME SHALL MACHINERY BE USED OVERTOP THAT EXCEEDS THE DESIGN LIMITATIONS OF THE SYSTEM. WHEN PLACEMENT OF MATERIAL OVERTOP, MATERIAL SHALL BE PLACED SUCH THAT THE DIRECTION OF PLACEMENT IS PARALLEL WITH THE OVERALL LONGITUDINAL DIRECTION OF THE SYSTEM WHENEVER POSSIBLE.
3. THE FILL PLACED OVERTOP THE SYSTEM SHALL BE PLACED AT A MINIMUM OF 6" LIFTS. AT NO TIME SHALL MACHINERY OR VEHICLES GREATER THAN THE DESIGN HS-20 LOADING CRITERIA TRAVEL OVERTOP THE SYSTEM WITHOUT THE MINIMUM DESIGN COVERAGE. IF TRAVEL IS NECESSARY OVERTOP THE SYSTEM PRIOR TO ACHIEVING THE MINIMUM DESIGN COVER, IT MAY BE NECESSARY TO REDUCE THE ULTIMATE LOAD/BURDEN OF THE OPERATING MACHINERY SO AS TO NOT EXCEED THE DESIGN CAPACITY OF THE SYSTEM. IN SOME CASES, IN ORDER TO ACHIEVE REQUIRED COMPACTION, HAND COMPACTION MAY BE NECESSARY IN ORDER NOT TO EXCEED THE ALLOTTED DESIGN LOADING. SEE CHART FOR TRACKED VEHICLE WIDTH AND ALLOWABLE MAXIMUM PRESSURE PER TRACK.
4. FREE DRAINING AGGREGATE - 80% AGGREGATE RETAINED ON $\frac{1}{2}$" SIEVE MAJORITY OF AGGREGATE SIZE BETWEEN $\frac{1}{2}$" AND 1" ONLY 5% OF MATERIAL PASSING #200 SIEVE NO FINES.
5. FREE DRAINING, NO FINES, 3" AGGREGATE - MAJORITY OF STONE SIZE IN BETWEEN 2" AND 3" - VERY SIMILAR TO COURSE AGGREGATE GRADATION #CA1.



BACKFILL DETAIL

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SHEET TITLE:
SINGLETRAP BACKFILL SPECIFICATIONS

SHEET NUMBER:
4.0

RECOMMENDED ACCESS OPENING SPECIFICATION

1. A TYPICAL ACCESS OPENING FOR THE STORMTRAP SYSTEM ARE 2'-0" IN DIAMETER. ACCESS OPENINGS LARGER THAN 3'-0" IN DIAMETER NEED TO BE APPROVED BY STORMTRAP. ALL OPENINGS MUST RETAIN AT LEAST 1'-0" OF CLEARANCE FROM THE END OF THE STORMTRAP MODULE UNLESS NOTED OTHERWISE. ALL ACCESS OPENINGS TO BE LOCATED ON INSIDE LEG UNLESS OTHERWISE SPECIFIED.
2. PLASTIC COATED STEEL STEPS PRODUCED BY M.A. INDUSTRIES PART #PS3-PFC OR APPROVED EQUAL (SEE STEP DETAIL) ARE PROVIDED INSIDE ANY MODULE WHERE DEEMED NECESSARY. THE HIGHEST STEP IN THE MODULE IS TO BE PLACED A DISTANCE OF 1'-0" FROM THE INSIDE EDGE OF THE STORMTRAP MODULES. ALL ENSUING STEPS SHALL BE PLACED WITH A MAXIMUM DISTANCE OF 1'-4" BETWEEN THEM. STEPS MAY BE MOVED OR ALTERED TO AVOID OPENINGS OR OTHER IRREGULARITIES IN THE MODULE.
3. STORMTRAP LIFTING INSERTS MAY BE RELOCATED TO AVOID INTERFERENCE WITH ACCESS OPENINGS OR THE CENTER OF GRAVITY OF THE MODULE AS NEEDED.
4. STORMTRAP ACCESS OPENINGS MAY BE RELOCATED TO AVOID INTERFERENCE WITH INLET AND/OR OUTLET PIPE OPENINGS SO PLACEMENT OF STEPS IS ATTAINABLE.
5. ACCESS OPENINGS SHOULD BE LOCATED IN ORDER TO MEET THE APPROPRIATE MUNICIPAL REQUIREMENTS. STORMTRAP RECOMMENDS AT LEAST TWO ACCESS OPENINGS PER SYSTEM FOR ACCESS AND INSPECTION.
6. USE PRECAST ADJUSTING RINGS AS NEEDED TO MEET GRADE. STORMTRAP RECOMMENDS FOR COVER OVER 2' TO USE PRECAST BARREL OR CONE INSPECTIONS. (PROVIDED BY OTHERS)

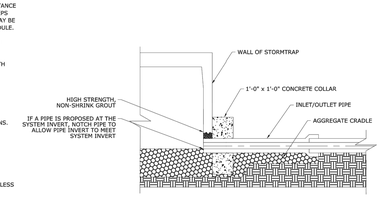
RECOMMENDED PIPE OPENING SPECIFICATION

1. MINIMUM EDGE DISTANCE FOR AN OPENING ON THE OUTSIDE WALL SHALL BE NO LESS THAN 1'-0".
2. MAXIMUM OPENING SIZE TO BE DETERMINED BY THE MODULE HEIGHT. PREFERRED OPENING SIZE IS Ø 36" OR LESS. ANY OPENING NEEDED THAT DOES NOT FIT THIS CRITERIA SHALL BE BROUGHT TO THE ATTENTION OF STORMTRAP FOR REVIEW.
3. CONNECTING PIPES SHALL BE INSTALLED WITH A 1'-0" CONCRETE COLLAR, AND AN AGGREGATE CRADLE FOR AT LEAST ONE PIPE LENGTH (SEE PIPE CONNECTION DETAIL). A STRUCTURAL GRADE CONCRETE OR HIGH STRENGTH, NON-SHRINK GROUT WITH A MINIMUM 28 DAY COMPRESSIVE STRENGTH OF 3000 PSI SHALL BE USED.
4. THE ANNULAR SPACE BETWEEN THE PIPE AND THE HOLE SHALL BE FILLED WITH HIGH STRENGTH NON-SHRINK GROUT.

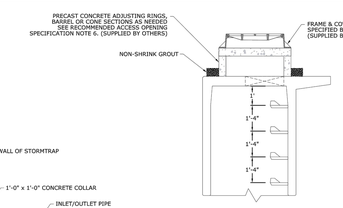
RECOMMENDED PIPE INSTALLATION INSTRUCTIONS

1. CLEAN AND LIGHTLY LUBRICATE ALL OF THE PIPE TO BE INSERTED INTO STORMTRAP.
2. IF PIPE IS CUT, CARE SHOULD BE TAKEN TO ALLOW NO SHARP EDGES. BEVEL AND LUBRICATE LEAD END OF PIPE.
3. ALIGN CENTER OF PIPE TO CORRECT ELEVATION AND INSERT INTO OPENING.

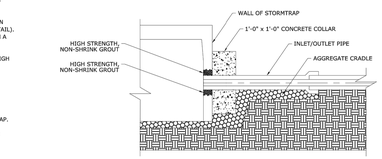
NOTE: ALL ANCILLARY PRODUCTS/SPECIFICATIONS RECOMMENDED AND SHOWN ON THIS SHEET ARE RECOMMENDATIONS ONLY AND SUBJECT TO CHANGE PER THE INSTALLING CONTRACTOR AND/OR PER LOCAL MUNICIPAL CODE/REQUIREMENTS.



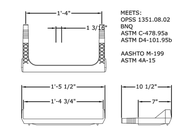
PIPE CONNECTION DETAIL



RISER / STAIR DETAIL



PIPE CONNECTION DETAIL



MEETS:
OPSS 1351.08.02
BNQ
ASTM C-478:95a
ASTM D4-101:95b

AASHTO M-199
ASTM 4A-15

STEP DETAIL

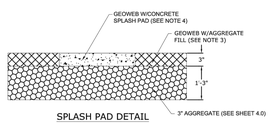
StormTrap
PATENTS LISTED AT: [HTTP://STORMTRAP.COM/PATENT]
1287 WINDHAM PARKWAY
ROMEOVILLE, IL 60446
P:815-941-4549 / F:331-318-5347
ENGINEER INFORMATION:
TRC COMPANIES, INC
41 SPRING ST
SUITE 102
NEW PROVIDENCE, NJ
908-988-1700
PROJECT INFORMATION:
PENN EAST
MODERNIZATION
BASIN 1
STONE BASE OPTION
WEST AMWELL, NJ
CURRENT ISSUE DATE:
8/21/2018
ISSUED FOR:
PRELIMINARY
REV. DATE: ISSUED FOR: DWN BY:
1 8/21/2018 PRELIMINARY KW
SCALE:
NTS

SHEET TITLE:
RECOMMENDED PIPE / ACCESS OPENING SPECIFICATIONS

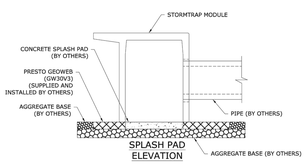
SHEET NUMBER:
5.0

NOTES:

1. THE APPROVED GEOWEB SHALL BE PRESTO GEOWEB (GW30V3). THE GEOWEB NOMINAL DIMENSIONS SHALL BE 9-FT x 25-FT.
2. THE CONCRETE SPLASH PAD AND GEOWEB SHALL BE INSTALLED PRIOR TO INSTALLATION OF THE STORMTRAP MODULES.
3. THE GEOWEB INFILL MATERIAL SHALL BE #5 AGGREGATE.
4. THE CONCRETE SPLASH PAD SHALL BE INSTALLED WITHIN THE GEOWEB AND IS REQUIRED AT ALL PIPE ENTRY LOCATIONS.
5. THE GEOWEB EDGE SHALL BE INSTALLED 1-FT BEYOND THE OUTER PERIMETER OF THE STORMTRAP SYSTEM.
6. THE GEOWEB LONGITUDINAL DIMENSION (25-FT) SHALL BE INSTALLED PARALLEL TO THE STORMTRAP LEGS.
7. THE CONCRETE SPLASH PAD AND GEOWEB SHALL BE CENTERED AT THE PIPE PENETRATION.
8. REFER TO SPLASH PAD LAYOUT FOR CONCRETE SPLASH PAD DIMENSIONS.
9. IF ANY PRODUCT OTHER THAN PRESTO GEOWEB IS TO BE INSTALLED, THE PRODUCT MANUFACTURER IS REQUIRED TO SUBMIT A LETTER STATING THAT THE PRODUCT IS EQUAL OR BETTER THEN PRESTO GEOWEB, BOTH IN PERFORMANCE AND IN STRUCTURAL CAPACITY.
10. ALL GEOWEB AND SPLASH PADS TO BE SUPPLIED AND INSTALLED BY CONTRACTOR.
11. A CONCRETE SPLASH PAD IS REQUIRED AT ANY ACCESS OPENING THAT HAS AN OPEN GRATE FOR DRAINAGE. THE CONCRETE SPLASH PAD SHALL EXTEND BETWEEN THE UNIT LEG WALLS AND 2'-0" FROM THE CENTERLINE OF THE OPENING ON BOTH SIDES UNLESS SPECIFIED OTHERWISE ON THE SPLASH PAD LAYOUT. GEOWEB IS NOT REQUIRED UNDER ACCESS OPENINGS.

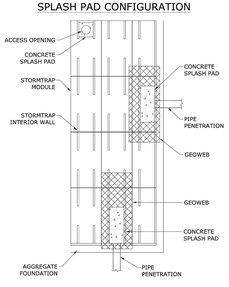


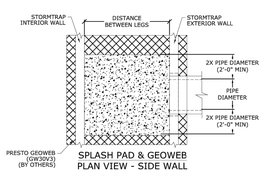
SPLASH PAD DETAIL



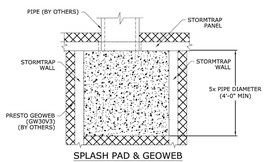
SPLASH PAD ELEVATION

SPLASH PAD CONFIGURATION





SPLASH PAD & GEOWEB PLAN VIEW - SIDE WALL



SPLASH PAD & GEOWEB PLAN VIEW - END PANEL

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ROMEOVILLE, IL 60446
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ENGINEER INFORMATION:
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908-988-1700
PROJECT INFORMATION:
PENN EAST
MODERNIZATION
BASIN 1
STONE BASE OPTION
WEST AMWELL, NJ
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SCALE:
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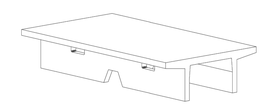
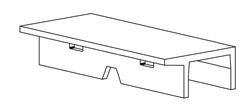
SHEET TITLE:
SPLASH PAD & GEOWEB DETAILS

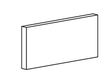
SHEET NUMBER:
6.0



TYPE II



TYPE IV



TYPE IV END PANEL

NOTES:
1. OPENING LOCATIONS AND SHAPES MAY VARY.
2. SP - INDICATES A MODULE WITH MODIFICATIONS.
3. P - INDICATES A MODULE WITH A PANEL ATTACHMENT.
4. POCKET WINDOW OPENINGS ARE OPTIONAL.

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1 8/21/2018 PRELIMINARY KW
SCALE:
NTS

SHEET TITLE:
SINGLETRAP MODULE TYPES

SHEET NUMBER:
7.0

STORMTRAP BASIN 1
N.T.S.

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IG #

TRC Engineers, Inc.
ENGINEER IN RESPONSIBLE CHARGE OF THE WORK SHOWN ON THIS DRAWING
DATE: 8/31/18 SIGNATURE
PROFESSIONAL ENGINEER: BARRY J. SUTHERLAND
LIC. # 24GE02913500

STATE OF NEW JERSEY — BARRY J. SUTHERLAND — No. 24GE02913500 — LICENSED PROFESSIONAL ENGINEER

NO.	BY	DATE	REVISION	APP'D.

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NEW PROVIDENCE, NEW JERSEY 07974
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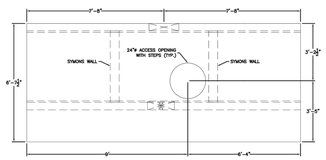
FAX NO. (973) 564-6442
Certificate of Authorization #24GA28047100

PENNEAST PIPELINE PROJECT
LAMBERTVILLE INTERCONNECT
CONSTRUCTION DETAILS SHEET 6

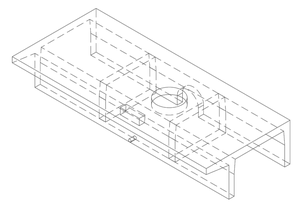
LOC. WEST AMWELL TOWNSHIP, HUNTERDON COUNTY, NEW JERSEY

PennEast PIPELINE

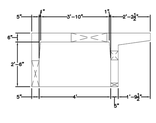
YEAR: 2020 | W.B.S CE.000147.001 | SCALE: AS SHOWN | DWG. C-113 | REV. 0



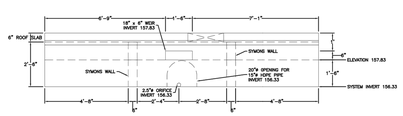
PLAN VIEW



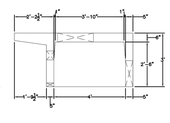
ISOMETRIC VIEW



LEFT SIDE VIEW



ELEVATION VIEW



RIGHT SIDE VIEW

NOTE: IF A WATERTIGHT SOLUTION IS REQUIRED FOR THIS OUTLET CONTROL STRUCTURE, STORMTRAP RECOMMENDS THE USE OF XYPEX OR SIKAFLEX MATERIALS (OR APPROVED EQUIVALENT). WATERPROOFING MATERIALS TO BE SUPPLIED AND INSTALLED BY THE INSTALLING CONTRACTOR. CONTACT STORMTRAP FOR A LIST OF APPROVED APPLICATORS.

StormTrap®
PATENTS LISTED AT: [HTTP://STORMTRAP.COM/PATENT]
1287 WINDHAM PARKWAY
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ENGINEER INFORMATION:
TRC COMPANIES, INC
41 SPRING ST
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NEW PROVIDENCE, NJ
908-988-1700

PROJECT INFORMATION:
PENN EAST
MODERNIZATION
BASIN 1
STONE BASE OPTION
WEST AMWELL, NJ

CURRENT ISSUE DATE:
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SCALE:
NTS

SHEET TITLE:
OUTLET CONTROL STRUCTURE DETAILS

SHEET NUMBER:
8.0

STORMTRAP BASIN 1
N.T.S.

STRUCTURAL DESIGN LOADING CRITERIA

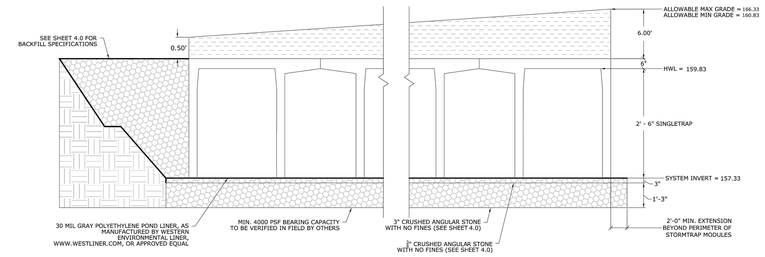
LIVE LOADING:	AASHTO HS-20 HIGHWAY LOADING
GROUND WATER TABLE:	BELOW INVERT OF SYSTEM
SOIL BEARING PRESSURE:	4000 PSF
SOIL DENSITY:	120 PCF
EQUIVALENT UNSATURATED LATERAL ACTIVE EARTH PRESSURE:	35 PSF / FT.
EQUIVALENT SATURATED LATERAL ACTIVE EARTH PRESSURE:	80 PSF/FT. (IF WATER TABLE PRESENT)
APPLICABLE CODES:	AASHTO ACI-318
BACKFILL TYPE:	2" STONE AGGREGATE

STORMTRAP SYSTEM INFORMATION

WATER STORAGE PROV:	4,173.57 CUBIC FEET
UNIT HEADROOM:	2' - 6" SINGLETRAP
UNIT QUANTITY:	17 TOTAL PIECES

SITE SPECIFIC DESIGN CRITERIA

1. STORMTRAP UNITS SHALL BE MANUFACTURED AND INSTALLED ACCORDING TO SHOP DRAWINGS APPROVED BY THE INSTALLING CONTRACTOR AND ENGINEER OF RECORD. THE SHOP DRAWINGS SHALL INDICATE SIZE AND LOCATION OF ROOF OPENINGS AND INLET/ OUTLET PIPE TYPES, SIZES, INVERT ELEVATIONS AND SIZE OF OPENINGS.
2. COVER RANGE: MIN. 0.50' MAX. 6.00' CONSULT STORMTRAP FOR ADDITIONAL COVER OPTIONS.
3. ALL DIMENSIONS AND SOIL CONDITIONS, INCLUDING BUT NOT LIMITED TO GROUNDWATER AND SOIL BEARING CAPACITY ARE REQUIRED TO BE VERIFIED IN THE FIELD BY OTHERS PRIOR TO STORMTRAP INSTALLATION.
4. FOR STRUCTURAL CALCULATIONS THE GROUND WATER TABLE IS ASSUMED TO BE BELOW INVERT OF SYSTEM . IF WATER TABLE IS DIFFERENT THAN ASSUMED, CONTACT STORMTRAP.



2' - 6" SINGLETRAP

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PROJECT INFORMATION:
PENN EAST
MODERNIZATION
BASIN 2
STONE BASE OPTION
WEST AMWELL, NJ

CURRENT ISSUE DATE:
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1	8/21/2018	PRELIMINARY	KW

SCALE:
NTS

SHEET TITLE:
SINGLETRAP DESIGN CRITERIA

SHEET NUMBER:
1.0

BILL OF MATERIALS

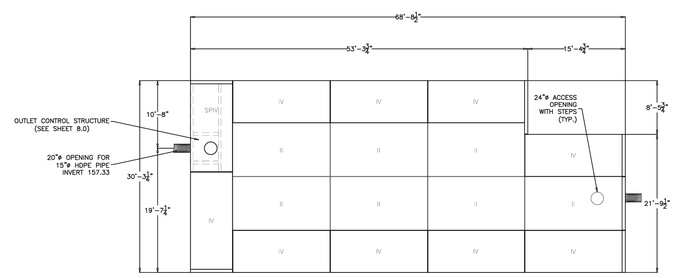
QTY.	UNIT TYPE	DESCRIPTION	WEIGHT
0	I	2' - 6" SINGLETRAP	14606
7	II	2' - 6" SINGLETRAP	14606
0	III	2' - 6" SINGLETRAP	12569
9	IV	2' - 6" SINGLETRAP	12569
0	VII	2' - 6" SINGLETRAP	10532
1	SPIV	2' - 6" SINGLETRAP	VARIES
6	PANEL	6" THICK PANELS	VARIES
4	JOINT WRAP	1.50' PER ROLL	

LOADING DISCLAIMER:

STORMTRAP IS NOT DESIGNED TO ACCEPT ANY ADDITIONAL LOADINGS FROM NEARBY STRUCTURES NEXT TO OR OVER THE TOP OF STORMTRAP. IF ADDITIONAL LOADING CONSIDERATIONS ARE REQUIRED FOR STRUCTURAL DESIGN OF STORMTRAP, PLEASE CONTACT STORMTRAP IMMEDIATELY.

DESIGN CRITERIA
ALLOWABLE MAX GRADE = 166.33
ALLOWABLE MIN GRADE = 160.83
INSIDE HEIGHT ELEVATION = 159.83
SYSTEM INVERT = 157.33

NOTES:
1. DIMENSIONING OF STORMTRAP SYSTEM SHOWN BELOW ALLOW FOR A 3/4" GAP BETWEEN EACH MODULE.
2. ALL DIMENSIONS TO BE VERIFIED IN THE FIELD BY OTHERS.
3. SEE SHEET 3.0 FOR INSTALLATION SPECIFICATIONS.
4. SP - INDICATES A MODULE WITH MODIFICATIONS.
5. P - INDICATES A MODULE WITH A PANEL ATTACHMENT.
6. CONTRACTORS RESPONSIBILITY TO ENSURE CONSISTENCY/ACCURACY TO FINAL ENGINEER OF RECORD PLAN SET.
7. IF A WATERTIGHT SOLUTION IS REQUIRED FOR THIS OUTLET CONTROL STRUCTURE, STORMTRAP RECOMMENDS THE USE OF XYPEX OR SIKAFLEX MATERIALS (OR APPROVED EQUIVALENT). WATERPROOFING MATERIALS TO BE SUPPLIED AND INSTALLED BY THE INSTALLING CONTRACTOR. CONTACT STORMTRAP FOR A LIST OF APPROVED APPLICATORS.



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ROMEOVILLE, IL 60446
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ENGINEER INFORMATION:
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NEW PROVIDENCE, NJ
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PROJECT INFORMATION:
PENN EAST
MODERNIZATION
BASIN 2
STONE BASE OPTION
WEST AMWELL, NJ

CURRENT ISSUE DATE:
8/24/2018

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2	8/24/2018	PRELIMINARY	JW
1	8/21/2018	PRELIMINARY	KW

SCALE:
NTS

SHEET TITLE:
SINGLETRAP LAYOUT DETAILS

SHEET NUMBER:
2.0

STORMTRAP BASIN 2
N.T.S.

TRC Engineers, Inc.
ENGINEER IN RESPONSIBLE CHARGE OF THE WORK SHOWN ON THIS DRAWING
DATE: 8/31/18 SIGNATURE
PROFESSIONAL ENGINEER: BARRY J. SUTHERLAND
LIC. # 24GE02913500

STATE OF NEW JERSEY — BARRY J. SUTHERLAND — No. GE24GE02913500 — LICENSED PROFESSIONAL ENGINEER

NO.	BY	DATE	REVISION	APP'D.

TRC Engineers, Inc.
41 SPRING STREET
NEW PROVIDENCE, NEW JERSEY 07974
PHONE NO. (908) 988-1700
FAX NO. (973) 564-6442
Certificate of Authorization #24GA28047100

PENNEAST PIPELINE PROJECT
LAMBERTVILLE INTERCONNECT
CONSTRUCTION DETAILS SHEET 7

LOC. WEST AMWELL TOWNSHIP, HUNTERDON COUNTY, NEW JERSEY

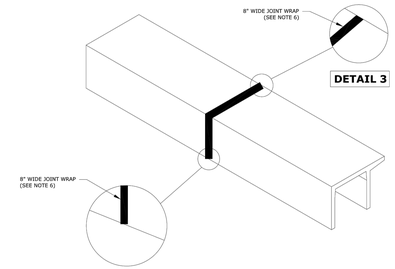
PennEast PIPELINE

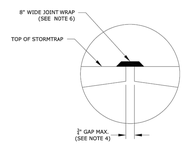
YEAR: 2020	W.B.S CE.000147.001	SCALE: AS SHOWN	DWG. C-114	REV. 0

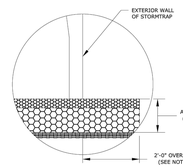
Drawing: W:\Vision Project Folders\292931 - Penn East\Engineering\DWG\Drainage Area Mapping - PS&S Final Draft\292931_UTILITY DETAILS SHEET.dwg
Time: 1/9/2018 3:15:26 PM
Username: DLEBERT
IG.#

STORMTRAP INSTALLATION SPECIFICATIONS

1. STORMTRAP SHALL BE INSTALLED IN ACCORDANCE WITH ASTM C891 STANDARD PRACTICE FOR INSTALLATION OF UNDERGROUND PRE-CAST CONCRETE UTILITY STRUCTURES. THE FOLLOWING ADDITIONS AND/OR EXCEPTIONS SHALL APPLY:
2. IT IS THE RESPONSIBILITY OF THE INSTALLING CONTRACTOR TO ENSURE THAT PROPER/ADEQUATE EQUIPMENT IS USED TO SET/INSTALL THE MODULES.
3. THE AGGREGATE FOUNDATION HAS BEEN DESIGNED BASED ON THE FOLLOWING ASSUMPTIONS. THESE ASSUMPTIONS WILL NEED TO BE VERIFIED BY A GEOTECHNICAL ENGINEER WHICH WILL NEED TO BE DELIVERED BY THE OWNER.
   - 3.1. A QUALIFIED GEOTECHNICAL ENGINEER WILL BE EMPLOYED, BY OWNER, TO PROVIDE ASSISTANCE IN EVALUATING THE EXISTING SOIL CONDITIONS BELOW THE PROPOSED ENGINEERED STONE FOUNDATION. IF A STONE FOUNDATION DESIGN IS TO BE USED, THE BEARING PRESSURE OF THE SOILS BELOW THE STONE WILL NEED TO MEET OR EXCEED ALLOWABLE CAPACITY. IF THIS IS NOT POSSIBLE, THE STONE FOUNDATION MAY NOT BE AN OPTION FOR THIS LOCATION.
   - 3.2. A QUALIFIED GEOTECHNICAL ENGINEER WILL BE EMPLOYED, BY OWNER, TO EVALUATE A SOURCE OF STONE AGGREGATES THAT WILL BE PLACED ON PROPERLY COMPACTED SOILS (SEE SHEET 1.0 FOR SOIL BEARING CAPACITY REQUIREMENTS). THE AGGREGATE BASE COURSE FOR WHICH THE STORMTRAP SYSTEM WILL BEAR DIRECTLY ON SHALL CONSIST OF A 3" THICK BED OF ¾" DIAMETER ANGULAR STONE, WELL COMPACTED AND SEATED, WITH NO FINES. AND A 15" THICK BED OF 3" DIAMETER STONE AGGREGATE (SEE SHEET 4.0 FOR FURTHER DESCRIPTION/EXPLANATION). PLEASE NOTE THAT THESE ARE ONLY MINIMUM RECOMMENDATIONS AND A QUALIFIED GEOTECHNICAL ENGINEER SHALL BE USED TO DETERMINE THE EXACT REQUIREMENTS FOR THE LOCATIONS THAT THE STORMTRAP SYSTEM IS TO BE LOCATED.
   - 3.3. THE CONTRACTOR SHALL REMOVE ANY AND ALL EXPANDABLE OR COLLAPSIBLE SOILS AT THE DIRECTION OF A QUALIFIED GEOTECHNICAL ENGINEER.
   - 3.4. THE AGGREGATE FOUNDATION SHALL BE INSTALLED SUCH THAT THE AGGREGATE EXTENDS A MINIMUM OF 2'-0" PAST THE OUTSIDE OF THE SYSTEM (SEE DETAIL 1).
   - 3.5. THE ¾" AGGREGATE SHALL BE COMPACTED USING A VIBRATING ROLLER WITH ITS' FULL DYNAMIC FORCE APPLIED TO ACHIEVE A FLAT SURFACE.
   - 3.6. DISK, DRY AND COMPACT THE TOP 8" OF THE SUBGRADE SOILS TO 95% OF THE STANDARD DRY DENSITY AND 110% OPTIMUM MOISTURE CONTENT.
   - 3.7. AGGREGATE SHALL BE GRADED WITHIN +/- ½" OF THE GRADE SHOWN ON THE PLANS.
   - 3.8. MINIMUM SOIL BEARING CAPACITY LISTED ON SHEET 1.0 SHALL BE VERIFIED IN FIELD BY OTHERS.
4. THE STORMTRAP MODULES SHALL BE PLACED SUCH THAT THE MAXIMUM SPACE BETWEEN ADJACENT MODULES DOES NOT EXCEED ¾" (SEE DETAIL 2). IF THE SPACE EXCEEDS ¾", THE MODULES SHALL BE RESET WITH APPROPRIATE ADJUSTMENT MADE TO LINE AND GRADE TO BRING THE SPACE INTO SPECIFICATION.
5. STORMTRAP MODULES ARE NOT WATERTIGHT. IF A WATERTIGHT SOLUTION IS REQUIRED, CONTACT STORMTRAP FOR RECOMMENDATIONS. THE WATERTIGHT APPLICATION IS TO BE PROVIDED AND IMPLIMENTED BY THE CONTRACTOR. THE CONTRACTOR IS RESPONSIBLE TO ENSURE THAT THE SELECTED WATERTIGHT SOLUTION PERFORMS AS SPECIFIED BY THE MANUFACTURER.
6. ALL EXTERIOR JOINTS BETWEEN ADJACENT STORMTRAP MODULES SHALL BE SEALED WITH 8" WIDE PRE-FORMED, COLD-APPLIED, SELF-ADHERING ELASTOMERIC RESIN, BONDED TO A WOVEN , HIGHLY PUNCTURE RESISTANT POLYMER WRAP, CONFORMING TO ASTM C891 AND SHALL BE INTEGRATED WITH PRIMER SEALANT AS APPROVED BY STORMTRAP (SEE DETAILS 3 & 4). THE JOINT WRAP DOES NOT PROVIDE A WATERTIGHT SEAL. THE SOLE PURPOSE OF THE JOINT WRAP IS TO PROVIDE A SILT AND SOIL TIGHT SYSTEM. THE ADHESIVE EXTERIOR JOINT WRAP SHALL BE INSTALLED ACCORDING TO THE FOLLOWING INSTALLATION INSTRUCTIONS:
   - 6.1. USE A BRUSH OR WET CLOTH TO THOROUGHLY CLEAN THE OUTSIDE SURFACE AT THE POINT WHERE THE JOINT WRAP IS TO BE APPLIED.
   - 6.2. A RELEASE PAPER PROTECTS THE ADHESIVE SIDE OF THE JOINT WRAP. PLACE THE ADHESIVE TAPE (ADHESIVE SIDE DOWN) AROUND THE STRUCTURE, REMOVING THE RELEASE PAPER AS YOU GO. PRESS THE JOINT WRAP FIRMLY AGAINST THE STORMTRAP MODULE SURFACE WHEN APPLYING.
7. IF THE CONTRACTOR NEEDS TO CANCEL ANY SHIPMENTS, THEY MUST DO SO 48 HOURS PRIOR TO THEIR SCHEDULED ARRIVAL AT THE JOB SITE. IF CANCELED AFTER THAT TIME, PLEASE CONTACT THE PROJECT MANAGER.
8. IF THE STORMTRAP MODULE(S) IS DAMAGED IN ANY WAY PRIOR, DURING, OR AFTER INSTALL, STORMTRAP, MUST BE CONTACTED IMMEDIATELY TO ASSESS THE DAMAGE AND TO DETERMINE WHETHER OR NOT THE MODULE(S) WILL NEED TO BE REPLACED. IF ANY MODULE ARRIVES AT THE JOBSITE DAMAGED DO NOT UNLOAD IT; CONTACT STORMTRAP, IMMEDIATELY. ANY DAMAGE NOT REPORTED BEFORE THE TRUCK IS UNLOADED WILL BE THE CONTRACTOR'S RESPONSIBILITY.
9. STORMTRAP MODULES CANNOT BE ALTERED IN ANY WAY AFTER MANUFACTURING WITHOUT WRITTEN CONSENT FROM STORMTRAP.







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PROJECT INFORMATION:
PENN EAST
MODERNIZATION
BASIN 2
STONE BASE OPTION
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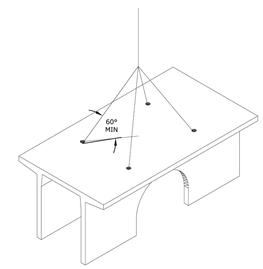
SHEET TITLE: SINGLETRAP INSTALLATION SPECIFICATIONS

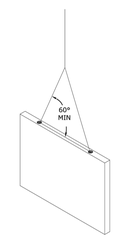
SHEET NUMBER: **3.0**

END PANEL ERECTION/INSTALLATION NOTES

1. END PANELS WILL BE SUPPLIED TO CLOSE OFF OPEN ENDS OF ROWS.
2. PANELS SHALL BE INSTALLED IN A TILT UP FASHION DIRECTLY ADJACENT TO OPEN END OF MODULE (REFER TO SHEET 2.0 FOR END PANEL LOCATIONS).
3. CONNECTION HOOKS WILL BE SUPPLIED WITH END PANELS TO SECURELY CONNECT PANEL TO ADJACENT STORMTRAP MODULE (SEE PANEL CONNECTION ELEVATION VIEW).
4. ONCE CONNECTION HOOK IS ATTACHED, LIFTING CLUTCHES MAY BE REMOVED.
5. JOINT WRAP SHALL BE PLACED AROUND PERIMETER JOINT PANEL (SEE SHEET 3.0).



MODULE LIFTING DETAIL



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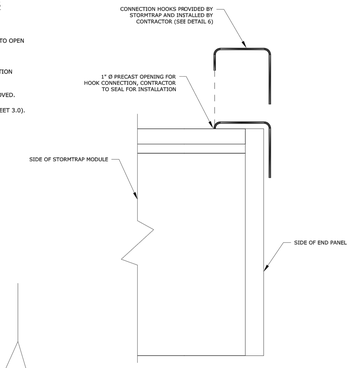
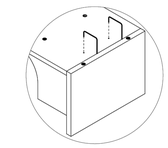
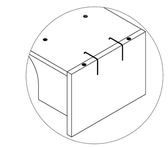


PANEL CONNECTION ELEVATION VIEW



STEP 1



STEP 2

DETAIL 6

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SHEET NUMBER: **3.1**

ZONE CHART

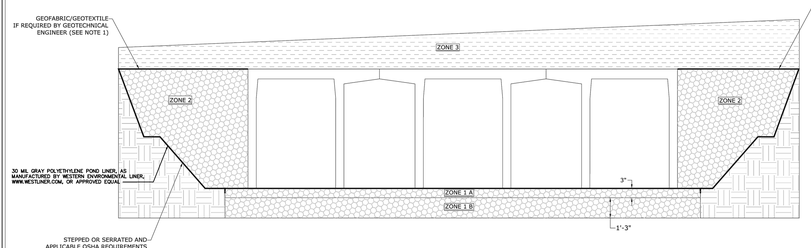
ZONES	ZONE DESCRIPTIONS	REMARKS
ZONE 1 A	FOUNDATION AGGREGATE	#5 (2") STONE AGGREGATE (SEE NOTE 4 FOR DESCRIPTION)
ZONE 1 B	FOUNDATION AGGREGATE	3" STONE AGGREGATE (SEE NOTE 5 FOR DESCRIPTION)
ZONE 2	BACKFILL	#5 (2") STONE AGGREGATE (SEE NOTE 4 FOR DESCRIPTION)
ZONE 3	FINAL COVER OVERTOP	MATERIALS NOT TO EXCEED 120 PCF

FILL DEPTH	TRACK WIDTH	MAX VEHICLE WEIGHT (KIPS)	MAX GROUND PRESSURE
12"	12"	51.8	1690 psf
	18"	56.1	1219 psf
	24"	68.1	1111 psf
	30"	76.7	1000 psf
	36"	85.0	924 psf

NOTE:
TRACK LENGTH NOT TO EXCEED 15'-4".
ONLY TWO TRACKS PER VEHICLE.

STORMTRAP ZONE INSTALLATION SPECIFICATIONS/PROCEDURES

1. THE FILL PLACED AROUND THE STORMTRAP MODULES MUST DEPOSITED ON BOTH SIDES AT THE SAME TIME AND TO APPROXIMATELY THE SAME ELEVATION. AT NO TIME SHALL THE FILL BEHIND ONE SIDE WALL BE MORE THAN 2'-0" HIGHER THAN THE FILL ON THE OPPOSITE SIDE. BACKFILL SHALL EITHER BE COMPACTED AND/OR VIBRATED TO ENSURE THAT BACKFILL AGGREGATE/STONE MATERIAL IS WELL SEATED AND PROPERLY INTER LOCKED. CARE SHALL BE TAKEN TO PREVENT ANY WEDGING ACTION AGAINST THE STRUCTURE, AND ALL SLOPES WITHIN THE AREA TO BE BACKFILLED MUST BE STEPPED OR SERRATED TO PREVENT WEDGING ACTION. CARE SHALL ALSO BE TAKEN AS NOT TO DISRUPT THE JOINT WRAP FROM THE JOINT DURING THE BACKFILL PROCESS. BACKFILL MATERIAL SHALL BE CLEAN, CRUSHED, ANGULAR No. 5 (AASHTO M43) AGGREGATE. IF NATIVE EARTH IS SUSCEPTIBLE TO MIGRATION, CONFIRM WITH GEOTECHNICAL ENGINEER AND PROVIDE PROTECTION AS REQUIRED (PROVIDED BY OTHERS).
2. DURING PLACEMENT OF MATERIAL OVERTOP THE SYSTEM, AT NO TIME SHALL MACHINERY BE USED OVERTOP THAT EXCEEDS THE DESIGN LIMITATIONS OF THE SYSTEM. WHEN PLACEMENT OF MATERIAL OVERTOP, MATERIAL SHALL BE PLACED SUCH THAT THE DIRECTION OF PLACEMENT IS PARALLEL WITH THE OVERALL LONGITUDINAL DIRECTION OF THE SYSTEM WHENEVER POSSIBLE.
3. THE FILL PLACED OVERTOP THE SYSTEM SHALL BE PLACED AT A MINIMUM OF 6" LIFTS. AT NO TIME SHALL MACHINERY OR VEHICLES GREATER THAN THE DESIGN HS-20 LOADING CRITERIA TRAVEL OVERTOP THE SYSTEM WITHOUT THE MINIMUM DESIGN COVERAGE. IF TRAVEL IS NECESSARY OVERTOP THE SYSTEM PRIOR TO ACHIEVING THE MINIMUM DESIGN COVER, IT MAY BE NECESSARY TO REDUCE THE ULTIMATE LOAD/BURDEN OF THE OPERATING MACHINERY SO AS TO NOT EXCEED THE DESIGN CAPACITY OF THE SYSTEM. IN SOME CASES, IN ORDER TO ACHIEVE REQUIRED COMPACTION, HAND COMPACTION MAY BE NECESSARY IN ORDER NOT TO EXCEED THE ALLOTTED DESIGN LOADING. SEE CHART FOR TRACKED VEHICLE WIDTH AND ALLOWABLE MAXIMUM PRESSURE PER TRACK.
4. FREE DRAINING AGGREGATE - 80% AGGREGATE RETAINED ON ¾" SIEVE MAJORITY OF AGGREGATE SIZE BETWEEN ¾" AND 1" ONLY 5% OF MATERIAL PASSING #200 SIEVE NO FINES.
5. FREE DRAINING, NO FINES, 3" AGGREGATE - MAJORITY OF STONE SIZE IN BETWEEN 2" AND 3" - VERY SIMILAR TO COURSE AGGREGATE GRADATION #CA1.



BACKFILL DETAIL

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SHEET NUMBER: **4.0**

RECOMMENDED ACCESS OPENING SPECIFICATION

1. A TYPICAL ACCESS OPENING FOR THE STORMTRAP SYSTEM ARE 2'-0" IN DIAMETER. ACCESS OPENINGS LARGER THAN 3'-0" IN DIAMETER NEED TO BE APPROVED BY STORMTRAP. ALL OPENINGS MUST RETAIN AT LEAST 1'-0" OF CLEARANCE FROM THE END OF THE STORMTRAP MODULE UNLESS NOTED OTHERWISE. ALL ACCESS OPENINGS TO BE LOCATED ON INSIDE LEG UNLESS OTHERWISE SPECIFIED.
2. PLASTIC COATED STEEL STEPS PRODUCED BY M.A. INDUSTRIES PART #PS3-PFC OR APPROVED EQUAL (SEE STEP DETAIL) ARE PROVIDED INSIDE ANY MODULE WHERE DEEMED NECESSARY. THE HIGHEST STEP IN THE MODULE IS TO BE PLACED A DISTANCE OF 1'-0" FROM THE INSIDE EDGE OF THE STORMTRAP MODULES. ALL ENSUING STEPS SHALL BE PLACED WITH A MAXIMUM DISTANCE OF 1'-4" BETWEEN THEM. STEPS MAY BE MOVED OR ALTERED TO AVOID OPENINGS OR OTHER IRREGULARITIES IN THE MODULE.
3. STORMTRAP LIFTING INSERTS MAY BE RELOCATED TO AVOID INTERFERENCE WITH ACCESS OPENINGS OR THE CENTER OF GRAVITY OF THE MODULE AS NEEDED.
4. STORMTRAP ACCESS OPENINGS MAY BE RELOCATED TO AVOID INTERFERENCE WITH INLET AND/OR OUTLET PIPE OPENINGS SO PLACEMENT OF STEPS IS ATTAINABLE.
5. ACCESS OPENINGS SHOULD BE LOCATED IN ORDER TO MEET THE APPROPRIATE MUNICIPAL REQUIREMENTS. STORMTRAP RECOMMENDS AT LEAST TWO ACCESS OPENINGS PER SYSTEM FOR ACCESS AND INSPECTION.
6. USE PRECAST ADJUSTING RINGS AS NEEDED TO MEET GRADE. STORMTRAP RECOMMENDS FOR COVER OVER 2' TO USE PRECAST BARREL OR CONE INSPECTIONS. (PROVIDED BY OTHERS)

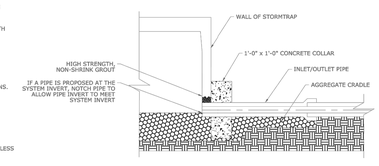
RECOMMENDED PIPE OPENING SPECIFICATION

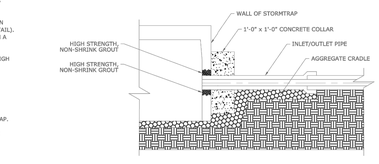
1. MINIMUM EDGE DISTANCE FOR AN OPENING ON THE OUTSIDE WALL SHALL BE NO LESS THAN 1'-0".
2. MAXIMUM OPENING SIZE TO BE DETERMINED BY THE MODULE HEIGHT. PREFERRED OPENING SIZE IS Ø 36" OR LESS. ANY OPENING NEEDED THAT DOES NOT FIT THIS CRITERIA SHALL BE BROUGHT TO THE ATTENTION OF STORMTRAP FOR REVIEW.
3. CONNECTING PIPES SHALL BE INSTALLED WITH A 1'-0" CONCRETE COLLAR, AND AN AGGREGATE CRADLE FOR AT LEAST ONE PIPE LENGTH (SEE PIPE CONNECTION DETAIL). A STRUCTURAL GRADE CONCRETE OR HIGH STRENGTH, NON-SHRINK GROUT WITH A MINIMUM 28 DAY COMPRESSIVE STRENGTH OF 3000 PSI SHALL BE USED.
4. THE ANNULAR SPACE BETWEEN THE PIPE AND THE HOLE SHALL BE FILLED WITH HIGH STRENGTH NON-SHRINK GROUT.

RECOMMENDED PIPE INSTALLATION INSTRUCTIONS

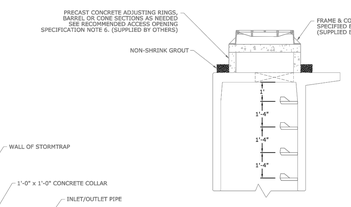
1. CLEAN AND LIGHTLY LUBRICATE ALL OF THE PIPE TO BE INSERTED INTO STORMTRAP.
2. IF PIPE IS CUT, CARE SHOULD BE TAKEN TO ALLOW NO SHARP EDGES. BEVEL AND LUBRICATE LEAD END OF PIPE.
3. ALIGN CENTER OF PIPE TO CORRECT ELEVATION AND INSERT INTO OPENING.

NOTE: ALL ANCILLARY PRODUCTS/SPECIFICATIONS RECOMMENDED AND SHOWN ON THIS SHEET ARE RECOMMENDATIONS ONLY AND SUBJECT TO CHANGE PER THE INSTALLING CONTRACTOR AND/OR PER LOCAL MUNICIPAL CODE/REQUIREMENTS.

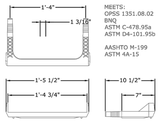




PIPE CONNECTION DETAIL



RISER / STAIR DETAIL



MEETS:
OPSS 1351.08.02
BNQ
ASTM C-478.95a
ASTM D4-101.95b

AASHTO M-199
ASTM 4A-15

STEP DETAIL

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SCALE: NTS

SHEET TITLE: RECOMMENDED PIPE / ACCESS OPENING SPECIFICATIONS

SHEET NUMBER: **5.0**

STORMTRAP BASIN 2
N.T.S.

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Time: 1/9/2018 3:15:26 PM Username: DLEBERT

TRC Engineers, Inc.
ENGINEER IN RESPONSIBLE CHARGE OF THE WORK SHOWN ON THIS DRAWING
DATE: 8/31/18 SIGNATURE
PROFESSIONAL ENGINEER: BARRY J. SUTHERLAND
LIC. # 24GE02913500

NO.	BY	DATE	REVISION	APP'D.

TRC Engineers, Inc.
41 SPRING STREET
NEW PROVIDENCE, NEW JERSEY 07974
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Certificate of Authorization #24GA28047100

PENNEAST PIPELINE PROJECT
LAMBERTVILLE INTERCONNECT
CONSTRUCTION DETAILS SHEET 8

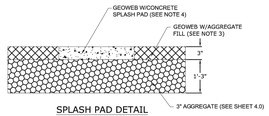
LOC. WEST AMWELL TOWNSHIP, HUNTERDON COUNTY, NEW JERSEY

PennEast PIPELINE

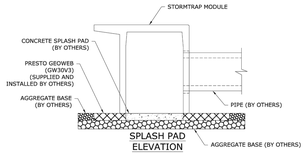
YEAR: 2019 | W.B.S CE.000147.001 | SCALE: AS SHOWN | DWG. C–115 | REV. 0

NOTES:

1. THE APPROVED GEOWEB SHALL BE PRESTO GEOWEB (GW30V3). THE GEOWEB NOMINAL DIMENSIONS SHALL BE 9-FT x 25-FT.
2. THE CONCRETE SPLASH PAD AND GEOWEB SHALL BE INSTALLED PRIOR TO INSTALLATION OF THE STORMTRAP MODULES.
3. THE GEOWEB INFILL MATERIAL SHALL BE #5 AGGREGATE.
4. THE CONCRETE SPLASH PAD SHALL BE INSTALLED WITHIN THE GEOWEB AND IS REQUIRED AT ALL PIPE ENTRY LOCATIONS.
5. THE GEOWEB EDGE SHALL BE INSTALLED 1-FT BEYOND THE OUTER PERIMETER OF THE STORMTRAP SYSTEM.
6. THE GEOWEB LONGITUDINAL DIMENSION (25-FT) SHALL BE INSTALLED PARALLEL TO THE STORMTRAP LEGS.
7. THE CONCRETE SPLASH PAD AND GEOWEB SHALL BE CENTERED AT THE PIPE PENETRATION.
8. REFER TO SPLASH PAD LAYOUT FOR CONCRETE SPLASH PAD DIMENSIONS.
9. IF ANY PRODUCT OTHER THAN PRESTO GEOWEB IS TO BE INSTALLED, THE PRODUCT MANUFACTURER IS REQUIRED TO SUBMIT A LETTER STATING THAT THE PRODUCT IS EQUAL OR BETTER THEN PRESTO GEOWEB, BOTH IN PERFORMANCE AND IN STRUCTURAL CAPACITY.
10. ALL GEOWEB AND SPLASH PADS TO BE SUPPLIED AND INSTALLED BY CONTRACTOR.
11. A CONCRETE SPLASH PAD IS REQUIRED AT ANY ACCESS OPENING THAT HAS AN OPEN GRATE FOR DRAINAGE. THE CONCRETE SPLASH PAD SHALL EXTEND BETWEEN THE UNIT LEG WALLS AND 2'-0" FROM THE CENTERLINE OF THE OPENING ON BOTH SIDES UNLESS SPECIFIED OTHERWISE ON THE SPLASH PAD LAYOUT. GEOWEB IS NOT REQUIRED UNDER ACCESS OPENINGS.

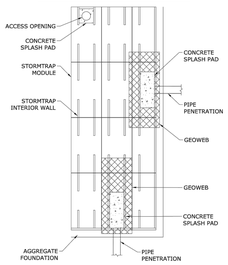


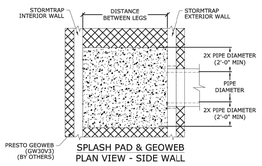
SPLASH PAD DETAIL



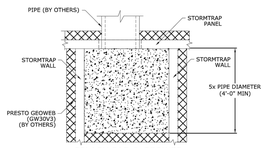
SPLASH PAD ELEVATION

SPLASH PAD CONFIGURATION





SPLASH PAD & GEOWEB PLAN VIEW - SIDE WALL



SPLASH PAD & GEOWEB PLAN VIEW - END PANEL

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SCALE:

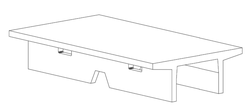
NTS

SHEET TITLE:

SPLASH PAD & GEOWEB DETAILS

SHEET NUMBER:

6.0



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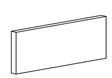

TYPE II
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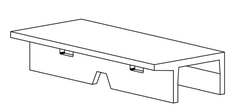


TYPE IV

TYPE IV
END PANEL

NOTES:
1. OPENING LOCATIONS AND SHAPES MAY VARY.
2. SP - INDICATES A MODULE WITH MODIFICATIONS.
3. P - INDICATES A MODULE WITH A PANEL ATTACHMENT.
4. POCKET WINDOW OPENINGS ARE OPTIONAL.

StormTrap®

PATENTS LISTED AT: [HTTP://STORMTRAP.COM/PATENT]

1287 WINDHAM PARKWAY
ROMEOVILLE, IL 60446
P:815-941-4549 / F:331-318-5347

ENGINEER INFORMATION:

TRC COMPANIES, INC
41 SPRING ST
SUITE 102
NEW PROVIDENCE, NJ
908-988-1700

PROJECT INFORMATION:

PENN EAST
MODERNIZATION
BASIN 2
STONE BASE OPTION
WEST AMWELL, NJ

CURRENT ISSUE DATE:

8/21/2018

ISSUED FOR:

PRELIMINARY

REV.	DATE:	ISSUED FOR:	DWN BY:
1	8/21/2018	PRELIMINARY	KW

SCALE:

NTS

SHEET TITLE:

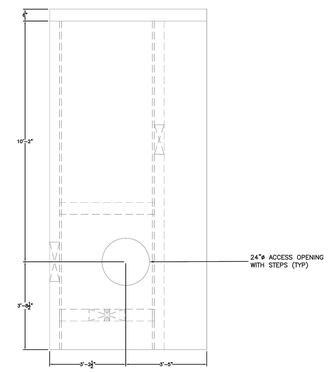
SINGLETRAP MODULE TYPES

SHEET NUMBER:

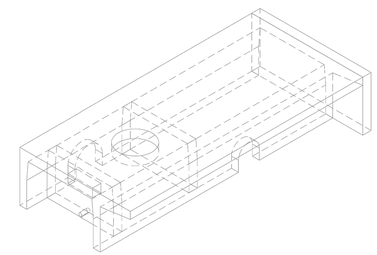
7.0

STORMTRAP BASIN 2

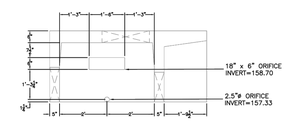
N.T.S.



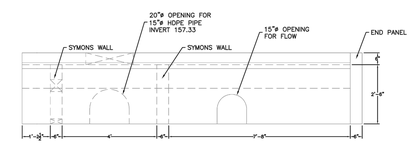
PLAN VIEW



ISOMETRIC VIEW



SIDE VIEW



ELEVATION VIEW

NOTE: IF A WATERTIGHT SOLUTION IS REQUIRED FOR THIS OUTLET CONTROL STRUCTURE, STORMTRAP RECOMMENDS THE USE OF XYPEX OR SIKAFLEX MATERIALS (OR APPROVED EQUIVALENT). WATERPROOFING MATERIALS TO BE SUPPLIED AND INSTALLED BY THE INSTALLING CONTRACTOR. CONTACT STORMTRAP FOR A LIST OF APPROVED APPLICATORS.

StormTrap®

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PROJECT INFORMATION:

PENN EAST
MODERNIZATION
BASIN 2
STONE BASE OPTION
WEST AMWELL, NJ

CURRENT ISSUE DATE:

8/24/2018

ISSUED FOR:

PRELIMINARY

REV.	DATE:	ISSUED FOR:	DWN BY:
2	8/24/2018	PRELIMINARY	JW
1	8/21/2018	PRELIMINARY	KW

SCALE:

NTS

SHEET TITLE:

OUTLET CONTROL STRUCTURE DETAILS

SHEET NUMBER:

8.0

Drawing: W:\Vision Project Folders\292931 - Penn East\Engineering\DWG\Drainage Area Mapping - PS&S Final Draft\292931_UTILITY DETAILS SHEETS.dwg
Time: 1/9/2018 3:15:26 PM Username: DLEBERT

TRC Engineers, Inc.

ENGINEER IN RESPONSIBLE CHARGE OF THE WORK SHOWN ON THIS DRAWING

DATE: 6/29/2019 SIGNATURE

PROFESSIONAL ENGINEER: BARRY J. SUTHERLAND
LIC. # 24GE02913500

STATE OF NEW JERSEY
BARRY J. SUTHERLAND
No. GE24GE02913500
PROFESSIONAL ENGINEER

NO.	BY	DATE	REVISION	APP'D.

TRC Engineers, Inc.
41 SPRING STREET
NEW PROVIDENCE, NEW JERSEY 07974
PHONE NO. (908) 988-1700
FAX NO. (973) 564-6442
Certificate of Authorization #24GA28047100

PENNEAST PIPELINE PROJECT
LAMBERTVILLE INTERCONNECT
CONSTRUCTION DETAILS SHEET 9

LOC. WEST AMWELL TOWNSHIP, HUNTERDON COUNTY, NEW JERSEY

YEAR: 2020 | W.B.S CE.000147.001 | SCALE: AS SHOWN | DWG. C-116 | REV. 0

PennEast PIPELINE

HUNTERDON COUNTY SOIL CONSERVATION DISTRICT
SOIL EROSION AND SEDIMENT CONTROL NOTES

1. THE HUNTERDON COUNTY SOIL CONSERVATION DISTRICT REQUIRES AN ADVANCED 48-HOUR WRITTEN NOTIFICATION PRIOR TO THE START OF ANY LAND DISTURBANCE. A FAILURE OF THIS NOTIFICATION PRIOR TO THE START OF CONSTRUCTION WILL RESULT IN THE ISSUANCE OF A STOP CONSTRUCTION ORDER AND MAY BE CAUSE FOR LEGAL ACTION. NOTICE MAY BE FAXED TO (908) 788-0795 OR MAILED TO:

   HUNTERDON COUNTY SOIL CONSERVATION DISTRICT
   687 PITTSTOWN ROAD
   FRENCHTOWN, NJ 08825

2. LAND DISTURBANCE AND CONSTRUCTION WORK START INCLUDES ANY DEMOLITION OR CLEARING THAT TAKES PLACE ON THE PROJECT SITE. APPROPRIATE SOIL EROSION AND SEDIMENT CONTROL MEASURES MUST BE INSTALLED AND MAINTAINED AT THE PROPOSED DEMOLITION AREAS.

3. THE PROJECT APPLICANT AND CONTRACTOR ARE TO BE AWARE THAT ADDITIONAL SOIL EROSION AND SEDIMENT CONTROL MEASURES MAY BE REQUIRED BY THE SOIL CONSERVATION DISTRICT OR MUNICIPAL ENGINEER IF FIELD CONDITIONS OR UNFORESEEN SITUATIONS WARRANT THEM.

4. THE HUNTERDON COUNTY SOIL CONSERVATION DISTRICT ENCOURAGES THE INSTALLATION AND STABILIZATION OF PERMANENT DETENTION OR RETENTION FACILITIES FROM THE START OF THE PROJECT. THIS IS PARTICULARLY IMPORTANT ON ACCOUNT OF THE STEEP TOPOGRAPHY AND SOILS OF HUNTERDON COUNTY. PRIORITY SHOULD TO BE SET ON CONSTRUCTION OF ANY THE DETENTION BASIN OR RETENTION BASIN FACILITY PRIOR TO ANY SIGNIFICANT AMOUNT OF LAND DISTURBANCE. SEDIMENT RISERS CAN BE USED ON A DETENTION BASIN AT ANY TIME AS LONG AS THEY MEET THE CRITERIA OF THE STATE SOIL EROSION AND SEDIMENT CONTROL STANDARDS. IF A SEDIMENT BASIN IS DESIGNED, AS EITHER WITHIN THE PERMANENT BASIN AREA OR AS A STAND-ALONE BASIN, THEY ARE TO BE DESIGN FULLY IN COMPLIANCE WITH THE STANDARDS AND ARE TO BE PROPERLY MAINTAINED DURING CONSTRUCTION. ALL DETENTION/RETENTION BASINS BE COMPLETED AND PERMANENTLY STABILIZED (ALONG WITH CONDUIT OUTLET PROTECTION AND LOW-FLOW CHANNEL) BEFORE ANY STORM DRAINAGE PIPING IS INSTALLED TO THE BASIN AND SAME PIPING IS FUNCTIONING. NO PAVING IS TO TAKE PLACE ON THE PROJECT SITE UNTIL ALL STORMWATER DETENTION/RETENTION FACILITIES ARE ADEQUATELY STABILIZED AS PER PLAN. FAILURE TO MAINTAIN A DETENTION, RETENTION, OR SEDIMENT FACILITY IN WORKING ORDER DURING CONSTRUCTION MAY BE GROUNDS FOR ISSUANCE OF A STOP CONSTRUCTION ORDER BY THE SOIL CONSERVATION DISTRICT.

5. THE HUNTERDON COUNTY SOIL CONSERVATION DISTRICT DOES NOT SUPPORT NOR ENDORSE MASS EXCAVATION. THE AMOUNT OF SOIL DISTURBED AT ONE TIME, AND SUBJECT TO EROSION, IS TO BE KEPT TO A MINIMUM. IT IS THE POLICY OF THE HUNTERDON COUNTY SOIL CONSERVATION DISTRICT THAT LARGE DISTURBANCES OF SOIL EXPOSED AT ONE TIME ON A PROJECT WILL REQUIRE A DETAILED PLAN AND TIME-LINE FOR GETTING AREAS STABILIZED. THE STANDARD FOR SEDIMENT BARRIERS WILL BE USED FOR LIMITING LARGE AREAS OF EXCAVATION. IF EXCAVATIONS ARE PROPOSED THAT EXCEED THE SEDIMENT BARRIER STANDARD, THEN ADDITIONAL MEASURES ARE TO BE DESIGNED AND DETAILED AND A DETAILED SEQUENCE OF CONSTRUCTION BE SUBMITTED FOR RE-CERTIFICATION AND APPROVAL. AS A MINIMUM, SOILS EXPOSED FOR LONGER THAN 30 DAYS WILL REQUIRE TEMPORARY STABILIZATION FOLLOWING THE AGRONOMIC SPECIFICATIONS ON THE PLAN.

6. A COPY OF THE CERTIFIED SOIL EROSION AND SEDIMENT CONTROL PLAN IS TO BE KEPT ON THE PROJECT SITE DURING CONSTRUCTION AND AVAILABLE FOR REVIEW BY THE CONTRACTOR AND SOIL CONSERVATION DISTRICT INSPECTORS.

7. THE LAND DISTURBANCE IS TO PROCEED IN ACCORDANCE WITH THE APPROVED SEQUENCE OF CONSTRUCTION AND THE CERTIFIED PLAN. ALL REQUIRED SOIL EROSION AND SEDIMENT CONTROL MEASURES MUST BE INSTALLED AND MAINTAINED AS OUTLINED IN THE PLAN

8. THE SOIL CONSERVATION DISTRICT IS TO BE NOTIFIED AND REPRESENTED AT A PRECONSTRUCTION CONFERENCE (USUALLY HELD AT THE MUNICIPAL ENGINEERS OFFICE) PRIOR TO THE START OF CONSTRUCTION OR ANY LAND DISTURBANCE.

9. ALL DISTURBED AREAS THAT ARE NOT BEING GRADED, NOT UNDER ACTIVE CONSTRUCTION, OR NOT SCHEDULED TO BE PERMANENTLY SEEDED WITHIN 30 DAYS MUST BE TEMPORARILY STABILIZED AS PER SPECIFICATIONS BELOW.

10. ALL EXPOSED AREAS WHICH ARE TO BE PERMANENTLY VEGETATED, ARE TO BE SEEDED AND MULCHED WITHIN 10 DAYS OF FINAL GRADING.

11. STRAW MULCH (HAY MULCH MAY BE SUBSTITUTED IF APPROVED BY THE DISTRICT) IS TO BE APPLIED TO ALL SEEDINGS AT A RATE OF 1-1/2 TO 2 TONS PER ACRE (APPROX. 100 TO 130 BALES PER ACRE).

12. MULCH ANCHORING IS REQUIRED AFTER MULCHING TO MINIMIZE LOSS BY WIND OR WATER. THIS IS TO BE DONE USING ONE OF THE METHODS (CRIMPING, LIQUID MULCH BINDERS, NETTINGS, ETC.) IN THE "STANDARDS FOR SOIL EROSION AND SEDIMENT CONTROL IN NEW JERSEY".

13. EXISTING WEEDY AND POORLY-VEGETATED AREAS WITH LESS THAN 80 PERCENT PERENNIAL GRASS COVER MUST RECEIVE PERMANENT STABILIZATION AS PER THESE SPECIFICATIONS.

14. ALL BAGS NEED TO BE SAVED FOR LIME, FERTILIZER, SEED, AND LIQUID MULCH BINDER (IF MULCH ANCHORING METHOD). SUCH PROOFS NEED TO BE SUBMITTED TO THE DISTRICT INSPECTOR FOR VERIFICATION OF MATERIALS AND QUANTITIES USED FOR ALL SEEDINGS.

15. AN ADDITIONAL FEE PER INSPECTION (AS PER THE CURRENT HUNTERDON COUNTY SOIL CONSERVATION DISTRICT FEE SCHEDULE AT THE TIME OF INSPECTION) WILL BE ASSESSED ON THOSE SITES WHERE ADDITIONAL INSPECTIONS ARE NECESSITATED AS A RESULT OF NON-COMPLIANCE WITH THE APPROVED PLAN. THIS INCLUDES ADDITIONAL INSPECTIONS PERFORMED AFTER THE FAILURE OF AN INITIAL REPORT OF COMPLIANCE INSPECTION. THE ENTIRE PROJECT SITE IS INSPECTED AT THE TIME OF A REQUEST FOR REPORT OF COMPLIANCE.

16. SOILS IN HUNTERDON COUNTY REQUIRE THAT ALL STONE TRACKING PADS (STABILIZED CONSTRUCTION ENTRANCE) BE INSTALLED AT A MINIMUM OF 100 FT. IN LENGTH FOR ROADWAY GRADES OF 0% TO 2% AND 200 FT. FOR ACCESS GRADES GREATER THAN 2%. THIS REQUIREMENT IS THE SAME, REGARDLESS IF MAIN PROJECT ENTRANCE OR INDIVIDUAL DWELLING LOT. STONE TRACKING PADS OR OTHER MEASURES APPROVED BY THE SOIL CONSERVATION DISTRICT ARE TO BE INSTALLED AT ALL CONSTRUCTION ACCESSES TO PAVEMENT. SEE DETAIL PLAN SHEET C-118.

   THE CONSTRUCTION ENTRANCE SHALL BE MAINTAINED IN A CONDITION THAT WILL PREVENT TRACKING OR FLOWING OF SEDIMENT ONTO ROADWAYS. THIS MAY REQUIRE PERIODIC TOP DRESSING WITH ADDITIONAL STONE OR ADDITIONAL LENGTH AS CONDITIONS DEMAND AND REPAIR AND/OR CLEANOUT OF ANY MEASURES USED TO TRAP SEDIMENT. ALL SEDIMENT SPILLED, DROPPED, WASHED, OR TRACKED ONTO ROADWAYS (PUBLIC OR PRIVATE) OR OTHER IMPERVIOUS SURFACES MUST BE REMOVED IMMEDIATELY.

   WHERE ACCUMULATING OF DUST/SEDIMENT IS INADEQUATELY CLEANED OR REMOVED BY CONVENTIONAL METHODS, A POWER BROOM OR STREET SWEEPER WILL BE REQUIRED TO CLEAN PAVED OR IMPERVIOUS SURFACES. ALL OTHER ACCESS POINTS, WHICH ARE NOT STABILIZED, SHALL BE ADEQUATELY BLOCKED OFF.

17. CONDUIT OUTLET PROTECTION (RIP-RAP APRONS OR SCOUR HOLES) MUST BE DESIGNED AND INSTALLED AT ALL PIPE OUTLETS AS PER THE CERTIFIED PLANS AND STANDARDS FOR SOIL EROSION AND SEDIMENT CONTROL IN NEW JERSEY. CONDUIT OUTLET PROTECTION MUST BE INSTALLED IMMEDIATELY FOLLOWING PIPE INSTALLATION AND PRIOR TO ANY PIPE FLOW. CONDUIT OUTLET PROTECTION MUST BE MAINTAINED AS PER DESIGN UNTIL THE COMPLETION OF THE PROJECT AND ISSUE OF FINAL REPORT OF COMPLIANCE. SEE CONDUIT OUTLET PROTECTION DETAIL AND SPECIFICATION TABLE ON PLAN SHEET C-113.

18. ALL STORMWATER INLET PROTECTION NEEDS TO BE MAINTAINED PERIODICALLY WITH FRESH HAYBALES OR CLEAN STONE BERMS (STONE SIZED 1 1/2"-2 1/2") OR APPROVED METHOD TO COMPLETELY ENCIRCLE, BUT NOT BLOCK THE INLETS. SEE DETAIL ON PLAN SHEET C-113.

    INSPECTIONS OF STORMWATER INLET PROTECTION SHALL BE FREQUENT. MAINTENANCE, REPAIR, AND REPLACEMENT SHALL BE MADE PROMPTLY, AS NEEDED. INLET PROTECTION NEEDS TO BE MAINTAINED UNTIL ALL AREAS OF THE SITE, OR AS A MINIMUM THE AREA DRAINING TO THE INLET, ARE PERMANENTLY STABILIZED AND APPROVED BY SOIL CONSERVATION DISTRICT INSPECTORS.

19. DUST CONTROL MEASURES ARE TO BE USED DURING ALL PHASES OF CONSTRUCTION OF THE PROJECT. SEE STANDARDS FOR SOIL EROSION AND SEDIMENT CONTROL IN NEW JERSEY PAGES 16-1 AND 16-2. SEE DUST CONTROL MATERIALS TABLE ON PLAN SHEET C-117.

20. ALL TREES THAT ARE TO BE PROTECTED FROM ENVIRONMENTAL AND MECHANICAL INJURY DURING CONSTRUCTION ARE TO BE ADEQUATELY MARKED IN FENCED-OFF PRIOR TO CONSTRUCTION AND MAINTAINED DURING CONSTRUCTION. FOR FURTHER INFORMATION SEE STANDARDS FOR SOIL EROSION AND SEDIMENT CONTROL IN NEW JERSEY PAGES 9-1 THROUGH 9-7. SEE PROPER TREE PROTECTION DETAIL ON PLAN SHEET C-118.

21. DEWATERING METHODS ARE TO BE FOLLOWED TO PROPERLY REMOVE SUSPENDED SEDIMENTS IN WATER FROM EXCAVATIONS AND/OR TRENCHES PRIOR TO DISCHARGE TO DOWNSTREAM AREAS AND/OR WATERCOURSES. THESE METHODS ARE TO FOLLOW THOSE FOUND IN THE STANDARDS FOR SOIL EROSION AND SEDIMENT CONTROL IN NEW JERSEY, PAGES 14-1TO 14-7.

22. AS PER THE TRAFFIC CONTROL STANDARD IN THE STANDARDS FOR SOIL EROSION AND SEDIMENT CONTROL IN NEW JERSEY (PAGE 33-1) STEEP BANKS, WETLAND BUFFERS, WATERWAYS, AND OTHER SENSITIVE AREAS ARE TO BE AVOIDED BY CONSTRUCTION TRAFFIC. WETLAND BUFFER AND WETLAND AREAS ARE TO BE ADEQUATELY MARKED IN FIELD PRIOR TO CONSTRUCTION AND MAINTAINED DURING CONSTRUCTION.

23. ANY FORMER AGRICULTURAL CROP FIELDS THAT ARE EITHER IN CROPS, CROP RESIDUE, OR ANNUAL WEED COVER ARE TO BE STABILIZED FOLLOWING THE AGRONOMIC SPECIFICATIONS FOR HUNTERDON COUNTY. THIS IS TO BE EITHER A COVER CROP FROM THE PERIOD OF LAST HARVEST AND CONSTRUCTION START-UP OR TEMPORARY STABILIZATION THROUGH SEEDING AND MULCHING. AREAS THAT ARE NOT GOING TO BE EITHER BUILT ON OR CONTINUED TO BE FARMED ARE TO RECEIVE PERMANENT STABILIZATION.

24. IF EXCESS FILL OR ANY OTHER MATERIAL IS TO BE REMOVED FROM THE SITE, THE PROJECT OWNER/APPLICANT SHALL BE RESPONSIBLE FOR ITS PROPER DISPOSAL AND WILL NOTIFY THE HUNTERDON COUNTY SOIL CONSERVATION DISTRICT AS TO THE PLANNED DISPOSAL SITE LOCATION. IF APPLICABLE, A SOIL EROSION AND SEDIMENT CONTROL PLAN MUST BE SUBMITTED TO, REVIEWED AND CERTIFIED BY THE HUNTERDON COUNTY SOIL CONSERVATION DISTRICT PRIOR TO ANY MATERIAL REMOVAL FROM THE PROJECT SITE. REMOVAL OF ANY SOIL MATERIAL FROM THE PROJECT SITE WITHOUT WRITTEN AUTHORIZATION FROM THE HUNTERDON COUNTY SOIL CONSERVATION DISTRICT IS A VIOLATION OF THE STATE SOIL EROSION AND SEDIMENT CONTROL ACT.

25. STOCKPILING OF FINES (SAND, QUARRY-PROCESS-BLEND, ETC.) IS NOT ALLOWED ON PAVED SURFACES OF THE PROJECT SITE.

26. ANY GABION BASKETS USED ON THE PROJECT ARE TO BE COATED WITH PLASTIC OR PVC AND FILLED WITH 4"-7" ANGULAR ROCK. THE GABION THICKNESS IS TO BE AT LEAST THE CALCULATED STONE D50 SIZE OF A REGULAR RIP-RAP APRON. FILTER FABRIC IS TO BE INSTALLED BETWEEN THE SUBGRADE AND THE GABIONS.

27. THE LIMITS OF DISTURBANCE SHOWN ON THE PLANS ARE NOT TO BE EXCEEDED UNLESS AUTHORIZED BY THE HUNTERDON COUNTY SOIL CONSERVATION DISTRICT AND A REVISED PLAN SUBMITTED FOR CERTIFICATION.

28. ALL DISTURBED ROADSIDE AREAS NEED TO BE TOPSOILED, FINAL-GRADED, LIMED, FERTILIZED, SEEDED, MULCHED, AND MULCH-ANCHORED (FOLLOWING DISTRICT AGRONOMIC SPECIFICATIONS FOR PERMANENT SEEDING)FOR A MINIMUM DISTANCE APPROVED BY THE DISTRICT BACK FROM THE CURB-LINE PRIOR TO APPROVAL OF PERMANENT IMPROVEMENT.

29. THE HUNTERDON COUNTY SOIL CONSERVATION DISTRICT DOES NOT RECOMMEND THE USE OF RIP-RAP D50 SIZES SMALLER THAN 6" FOR APRONS OR SCOUR HOLES SINCE SMALLER STONE SIZES (3" OR 4") TEND TO WASH/ERODE UNDER HIGH INTENSITY RAIN STORMS. THE HUNTERDON DISTRICT RECOMMENDS THAT THE SMALLEST D50 STONE SIZE BE SPECIFIED AS 6" WITH THICKNESS SPECIFIED AS 12" WITH FILTER FABRIC OR 18" WITHOUT FABRIC.

30. TEMPORARY DIVERSIONS TO DIRECT WATER OFF OF A GRADED RIGHT-OF-WAY ONTO A STABLE AREA ARE NEEDED DURING CONSTRUCTION. FOR FURTHER INFORMATION REFER TO THE STANDARDS FOR SOIL EROSION AND SEDIMENT CONTROL IN NEW JERSEY, (PAGE 15.3 ITEM 2 AND FIGURE 15-4) FOR THE REQUIRED DIMENSIONS AND SPACING. SEE DETAIL AND SPACING ON PLAN SHEET C-118.

31. HYDROSEEDING/HYDROMULCHING ARE NOT RECOMMENDED PRACTICES IN HUNTERDON COUNTY DUE TO THE HIGH FAILURE RATE OF SEEDINGS, STEEP TOPOGRAPHY, POOR SEED-TO-SOIL CONTACT AND POOR GROUND SURFACE COVERAGE. ALL SEED MUST BE INCORPORATED INTO THE SOIL. HYDROSEEDING EQUIPMENT MAY BE USED IN CONJUNCTION WITH STRAW/HAY MULCH FOR THE PURPOSE OF ANCHORING THE MULCH WITH LIQUID MULCH BINDERS.

32. IF SUBSURFACE WATER PROBLEMS ARE DISCOVERED DURING CONSTRUCTION, THEY WILL BE RECTIFIED FOLLOWING THE STANDARDS FOR SOIL EROSION AND SEDIMENT CONTROL IN NEW JERSEY (SUBSURFACE DRAINAGE, PAGE 32-1 THROUGH 32-4).

33. ALL DEVELOPMENT ROADWAYS ARE TO BE KEPT SCRAPED/SWEPT TO REMOVE SEDIMENT ACCUMULATIONS ALONG CURBS AND AROUND STORMWATER INLETS.

34. THE MAXIMUM ALLOWABLE VEGETATED SLOPE IS 2:1. SLOPES IN EXCESS OF 3:1 (BETWEEN 2:1 AND 3:1) REQUIRE TEMPORARY EROSION CONTROL MATTING, SUCH AS EXCELSIOR "CURLEX" OR EQUIVALENT, FOR STABILIZATION. THE MATTING IS TO BE PROPERLY INSTALLED WITH SPECIFIED OVERLAP, CHECK SLOTS, ANCHORING SPACING, AND ANCHORING DEVICE TYPE, GAUGE, AND SIZE.

35. ALL DISTURBED AREAS THAT ARE NOT BEING GRADED, NOT UNDER ACTIVE CONSTRUCTION, OR NOT SCHEDULED TO BE PERMANENTLY SEEDED WITHIN 30 DAYS MUST BE TEMPORARILY STABILIZED AS PER THE AGRONOMIC SPECIFICATIONS.

36. PURSUANT TO THE NEW JERSEY SOIL EROSION AND SEDIMENT CONTROL ACT, CHAPTER 251, P.L. 1975, THE HUNTERDON COUNTY SOIL CONSERVATION DISTRICT HAS REVIEWED THE PLANS FOR THIS PROJECT AND CERTIFIES THE SOIL EROSION AND SEDIMENT CONTROL PLAN. THE APPROVAL OF THE SOIL EROSION AND SEDIMENT CONTROL PLANS BY THE SOIL CONSERVATION DISTRICT IS LIMITED TO THE SOIL EROSION, SEDIMENTATION, AND RELATED STORMWATER MANAGEMENT CONTROLS SPECIFIED IN THIS PLAN. IT IS NOT AUTHORIZATION TO ENGAGE IN THE PROPOSED LAND USE UNLESS THE MUNICIPALITY OR OTHER CONTROLLING AGENCY HAS PREVIOUSLY APPROVED SUCH USE.

37. PLANS SUBMITTED TO THE HUNTERDON COUNTY SOIL CONSERVATION DISTRICT MUST BE CONSISTENT WITH PLANS ANY PLANS SUBMITTED TO A REGULATORY AGENCY SUCH AS NJDEP, MUNICIPALITY, ETC. ANY REVISIONS REQUIRED BY ANY REVIEWING AUTHORITY WOULD REQUIRE A RESUBMISSION TO THE DISTRICT FOR REVIEW.

38. ALL REVISIONS AND MUNICIPAL RENEWALS OF THIS PROJECT WILL REQUIRE RESUBMISSION AND APPROVAL BY THE SOIL CONSERVATION DISTRICT.

39. REPORT OF COMPLIANCE: A REPORT OF COMPLIANCE APPROVING PERMANENT STABILIZATION MEASURES (OR A SOIL EROSION AND SEDIMENT CONTROL COMPLETION BOND AGREEMENT WITH TEMPORARY STABILIZATION FOR THE WINTER SEASON) IS TO BE ISSUED BY THE SOIL CONSERVATION DISTRICT ON ALL PROJECTS AT THEIR COMPLETION. BEFORE ANY CERTIFICATE OF OCCUPANCY (PERMANENT OR TEMPORARY) CAN BE GRANTED BY THE MUNICIPALITY OR STATE, A WRITTEN REPORT OF COMPLIANCE MUST BE ISSUED BY THE SOIL CONSERVATION DISTRICT.

40. PURSUANT TO AUTHORITY GRANTED BY N.J.S.A. 4:24_47, THE HUNTERDON COUNTY SOIL CONSERVATION DISTRICT PERIODICALLY INSPECTS THE PROJECT SITE FOR COMPLIANCE WITH THE CERTIFIED SOIL EROSION AND SEDIMENT CONTROL PLANS AND THE STATE SOIL EROSION AND SEDIMENT CONTROL ACT. FAILURE TO COMPLY WITH THE PLANS AND THE ACT MAY BE CAUSE FOR COURT ACTION AND PENALTIES, PURSUANT TO N.J.S.A. 4:24_53. THE MAXIMUM STATUTORY PENALTY PROVIDED BY LAW FOR VIOLATIONS OF THE SOIL EROSION AND SEDIMENT CONTROL ACT IS A FINE OF UP TO $3,000 EACH DAY AND AN INJUNCTIVE ORDER OF THE SUPERIOR COURT.

41. IT IS POLICY OF THE HUNTERDON COUNTY SOIL CONSERVATION DISTRICT TO PERIODICALLY EVALUATE ALL PROJECTS TO DETERMINE IF THE COSTS FOR REVIEW AND INSPECTION EXCEED THE PAID FEES. PRIOR TO THE FEES BEING EXCEEDED AN ADDITIONAL FEE WILL BE ASSESSED. THIS FEE WILL BE BASED ON THE INCOMPLETE PORTION(S) OF THE PROJECT, REGARDLESS IF PRESENTLY UNDER CONSTRUCTION OR NOT, AS PER THE CURRENT HUNTERDON COUNTY SOIL CONSERVATION DISTRICT FEE SCHEDULE AT THE TIME OF EVALUATION.

SOIL COMPACTION: AREAS OF TRAVEL WITHIN A PROJECT SITE AND/OR STAGING AND PARKING AREAS MAY HAVE SOILS COMPACTED DURING THE COURSE OF PROJECT CONSTRUCTION. ALL SOIL COMPACTION IS TO BE CORRECTED PRIOR TO ANY PERMANENT STABILIZATION AND COMPLETION OF PROJECT. THE TOPSOILING STANDARD (NJ SE&SC STANDARDS PAGE 8-2) STATES THAT WHERE THERE IS COMPACTION, THE SURFACE IS TO BE SCARIFIED 6" TO 12" PRIOR TO APPLYING TOPSOIL FOR PERMANENT STABILIZATION. THE SOIL CONSERVATION DISTRICT WILL BE INSPECTING FOR THIS TO BE EMPLOYED PRIOR TO ANY PERMANENT STABILIZATION AND PRIOR TO ISSUE OF ANY REPORT OF COMPLIANCE. WHERE TOPSOIL IS NOT BEING STRIPPED DURING CONSTRUCTION, PRE AND POST COMPACTION TEST MAY BE USED TO VERIFY THAT CONSTRUCTION TRAFFIC HAS NOT CAUSED A SOIL COMPACTION PROBLEM TO THE SITE.

DETAILED CONSTRUCTION SEQUENCE

1. STAKE LIMIT OF DISTURBANCE IN THE FIELD PRIOR TO ANY CLEARING, GRUBBING OR EARTH MOVING ACTIVITIES. ALSO STAKE THE LIMIT OF EXCAVATION. (1 DAY)

2. INSTALL REQUIRED SOIL EROSION AND SEDIMENT CONTROL MEASURES. (5 DAYS)
   A. PLACE STABILIZED CONSTRUCTION ENTRANCE WHERE INDICATED ON PLAN.
   B. PLACE SILT FENCE WHERE INDICATED ON PLAN.
   C. INSTALL INLET PROTECTION WHERE INDICATED ON PLAN.

3. CLEAR AND GRUB CONSTRUCTION AREA. (3 DAYS)

4. PERFORM WORK TO INSTALL UNDERGROUND UTILITIES. CONSTRUCT BUILDING FOUNDATION, PAVEMENT, AND ACCESS ROADS. (3 MONTHS)

5. REMOVE STABILIZED CONSTRUCTION ENTRANCE . ESTABLISH PERMANENT COVER AS PER PERMANENT VEGETATION COVER NOTES. (1 DAYS)

TEMPORARY STABILIZATION WITH MULCH ONLY

Straw mulch (hay mulch may be substituted if approved by the District) is to be spread uniformly at the rate of 2 to 2-1/2 tons per acre (total ground surface coverage). This practice is limited to periods when vegetative cover cannot be established due to the season or other conditions. Mulch must be anchored in accordance with New Jersey Standards for Soil Erosion and Sediment Control. Mulch alone can only be used for short periods and will require maintenance and renewal. Other mulch materials may be utilized if approved by the District

TEMPORARY SEEDING

Temporary seeding is to be used on all disturbed areas where permanent stabilization will not be accomplished for a period of up to 6 months.

Product	Rate	Recommended optimum seeding dates
Perennial ryegrass	100 lbs. per acre	3/15-5/15 & 8/15-10/1
Spring Oats	86 lbs. per acre	3/15-6/1 & 8/1-10/1
Winter Cereal Rye	112 lbs. per acre	8/1-11/15
Winter Barley	96 lbs. per acre	8/15-10/1
Pearl Millet	20 lbs. per acre	5/15-8/15
German or Hungarian Millet	30 lbs. per acre	5/15-8/15

STABILIZATION WITH SOD

Stabilization with sod is permitted in areas where maintenance and irrigation are adequate to insure proper establishment and longevity. Seedbed preparation is to be consistent with any other stabilization requirements. (Lime and fertilizer bags are to be retained for District inspection.) On slopes greater than 3 to 1, sod must be properly anchored to the slope in accordance with the NJ Standards for Soil Erosion and Sediment Control.

PERMANENT SEEDING

A. Seed is to be incorporated into the soil to a depth of 1/4" - 1/2".
B. Lawn seedings are to be a mixture of bluegrasses, turf-type fescues, and turf-type perennial ryegrasses to insure longevity, tolerance, and durability. No seed shall be accepted with a germination test date of more than 12 months old unless retested.
C. Professional seed mixtures are recommended rather than mixing seeds yourself.
D. Seed mixture (as specified below) is to be **applied at a minimum rate of 200 lbs. per acre of perennial seed.**
E. **Optimum seeding period for Hunterdon County is from March 1 to May 15 and August 15 to October 1.** Outside of those periods, the seeding rates are to be **increased by 50%** (i.e.: 300 lbs. per acre of perennial seed instead of the required 200 lbs. per acre during optimum periods).
F. Seedings should receive an application of fertilizer such as 10-10-10 or equivalent at 400 lbs. per acre approximately 6 months after first application.

SEEDING MIXTURE FOR GENERAL SEEDING - (example: lawns)

40% turf-type tall fescue 10% creeping red fescue 10% chewings fescue 10% Kentucky bluegrass 30% turf-type perennial ryegrass	OR	60% Kentucky bluegrass 20% turf-type perennial ryegrass 20% chewings fescue

SEEDING MIXTURE FOR HIGH TRAFFIC & CRITICAL AREAS
(examples: athletic fields, waterways, diversions, etc.)

80% turf-type tall fescue
10% Kentucky bluegrass
10% turf-type perennial ryegrass

Other seed mixtures, such as blended varieties of perennial turf-type ryegrasses, turf-type tall fescues, or bluegrasses may also be acceptable if approved by the District.

Revised January 14, 2008

MATERIAL	WATER DILUTION	TYPE OF NOZZLE	APPLY GALLONS/ACRE
Anionic asphalt emulsion	7:1	Coarse Spray	1200
Latex emulsion	12.5:1	Fine Spray	235
Resin in water	4:1	Fine Spray	300
Polyacrylamide (PAM) - spray on Polyacrylamide (PAM) - dry spread	Apply according to manufacturer's instructions. May also be used as an additive to sediment basins to flocculate and precipitate suspended colloids. See Sediment Basin standard, p. 26-1		
Acidulated Soy Bean Soap Stick	None	Coarse Spray	1200

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IG #

TRC Engineers, Inc.
ENGINEER IN RESPONSIBLE CHARGE OF THE WORK SHOWN ON THIS DRAWING
DATE: 6/29/19 SIGNATURE
PROFESSIONAL ENGINEER: BARRY J. SUTHERLAND
LIC. # 24GE02913500

STATE OF NEW JERSEY — BARRY J. SUTHERLAND — No. GE24GE02913500 — LICENSED PROFESSIONAL ENGINEER

NO.	BY	DATE	REVISION	APP'D.

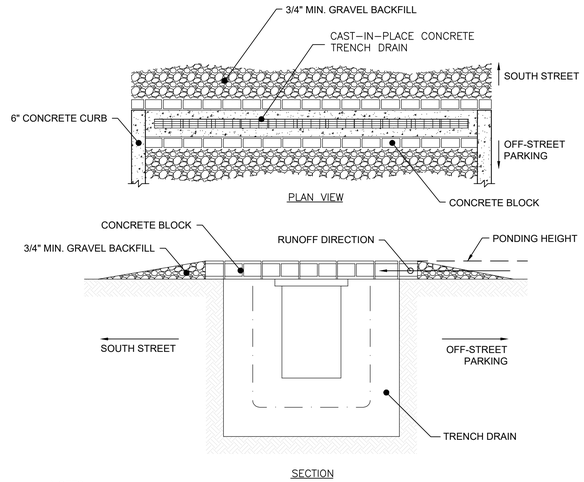
TRC Engineers, Inc.
41 Spring Street, Suite 102
New Providence, New Jersey 07974
Phone No. 908-988-1700
Certificate of Authorization #24GA28047100

PENNEAST PIPELINE PROJECT
LAMBERTVILLE INTERCONNECT
SESC DETAILS SHEET 1

LOC. WEST AMWELL TOWNSHIP, HUNTERDON COUNTY, NEW JERSEY

PennEast PIPELINE

YEAR: 2020 | W.B.S CE.000147.001 | SCALE: AS SHOWN | DWG. C-117 | REV. 0

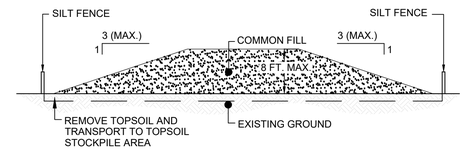


NOTES:

1. TRENCH DRAIN SEDIMENT BARRIERS ARE TO BE USED FOR SMALL, NEARLY LEVEL DRAINAGE AREAS.
2. EXCAVATE A BASIN OF SUFFICIENT SIZE ADJACENT TO THE TRENCH DRAIN.
3. THE TOP OF THE STRUCTURE (PONDING HEIGHT) MUST BE WELL BELOW THE GROUND ELEVATION TO PREVENT RUNOFF FROM BYPASSING THE TRENCH DRAIN.

TRENCH DRAIN SEDIMENT BARRIER DETAIL

N.T.S.

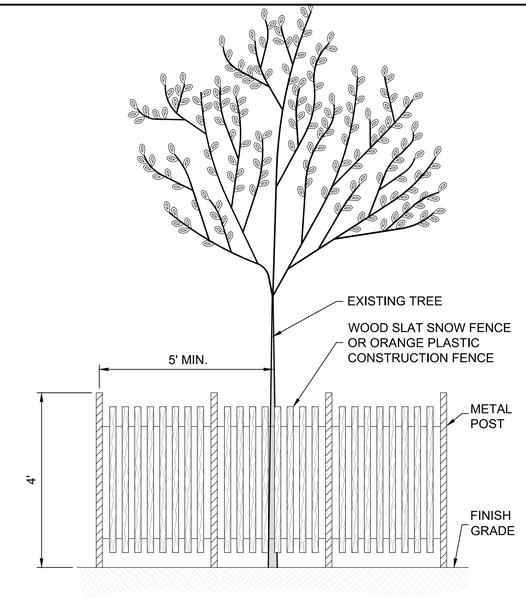


NOTES

1. STOCKPILE SHALL BE SURROUNDED BY SILT FENCE.
2. STOCKPILE SHALL RECEIVE TEMPORARY VEGETATIVE STABILIZATION IN ACCORDANCE WITH THE STANDARDS FOR SOIL EROSION AND SEDIMENT CONTROL IN NEW JERSEY IMMEDIATELY AFTER COMPLETION OF STOCKPILE.
3. STOCKPILES ARE NOT TO BE LOCATED WITHIN FIFTY FEET OF A FLOODPLAIN, SLOPES, ROADWAY, OR DRAINAGE FACILITY.

COMMON FILL STOCKPILE DETAIL

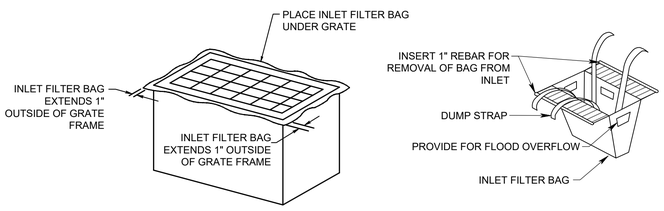
N.T.S.



NOTE:
LOCATE FENCE AT DRIPLINE OF TREE (MIN. 5' FROM TRUNK)

TREE PROTECTION FENCE DETAIL

N.T.S.

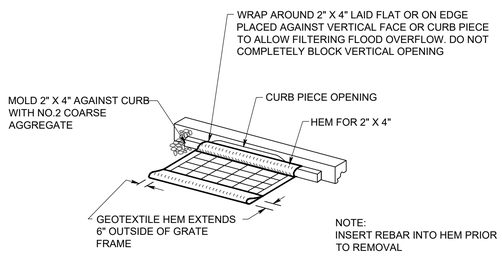


NOTES:

1. OUTLET STRUCTURE WEIR AND ORIFICE SHALL BE PLUGGED/BLOCKED.
2. INLET FILTER BAGS MUST BE DISPOSED OF ACCORDING TO MANUFACTURER'S INSTRUCTIONS. BAGS SHALL NOT BE REUSED.

OUTLET STRUCTURE PROTECTION DETAIL

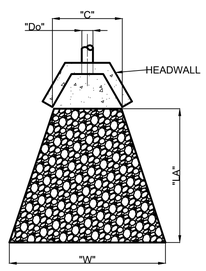
N.T.S.



NOTE:
INSERT REBAR INTO HEM PRIOR TO REMOVAL

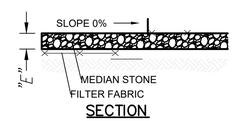
INLET PROTECTION DETAIL

N.T.S.



PLAN

CONDUIT OUTLET PROTECTION TABLE						
HEADWALL	LA	W	C	D_o	D_{50}	E
No. 1: Basin-1 Entrance	13.0'	17.0'	4.0'	1.25'	1.0'	12.0"
No. 2: Basin-1 Exit	10.0'	14.0'	4.0'	1.25'	1.0'	12.0"
No. 3: Basin-2 Entrance	9.0'	13.0'	4.0'	1.25'	1.0'	12.0"
No. 4: Basin-2 Exit	10.0'	13.0'	4.0'	1.25'	1.0'	12.0"



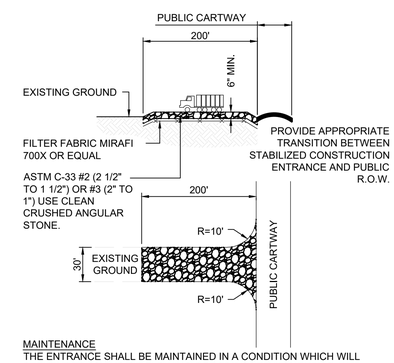
SECTION

NOTES:

1. SLOPE OF RIP-RAP SHALL BE 0%
2. SIDE SLOPES SHALL BE 2:1 OR FLATTER.
3. THERE SHALL BE NO OVERFALL AT THE END OF THE APRON OR AT THE END OF THE CULVERT.
4. WHERE THERE IS A WELL DEFINED CHANNEL DOWNSTREAM OF THE APRON, THE BOTTOM WIDTH OF THE APRON SHALL BE AT LEAST EQUAL TO THE BOTTOM WIDTH OF THE CHANNEL. THE STRUCTURAL LINING SHALL EXTEND AT LEAST ONE FOOT ABOVE THE TAILWATER ELEVATION BUT NO LOWER THAN TWO-THIRDS OF THE VERTICAL CONDUIT DIMENSION ABOVE THE CONDUIT INVERT.
5. THERE SHALL BE NO BENDS OR CURVES AT THE INTERSECTION OF THE CONDUIT AND APRON.
6. FIFTY PERCENT, BY WEIGHT OF THE RIP-RAP MIXTURE SHALL BE SMALLER THAN MEDIAN STONE SIZE DESIGNATED AS D50 THE LARGEST STONE SIZE IN THE MIXTURE SHALL BE 1.5 TIMES THE D SIZE. THE RIP-RAP SHALL BE REASONABLY WELL GRADED.
7. FILTER FABRIC SHALL BE PROVIDED UNDER RIP-RAP LINING. FABRIC SHALL BE MIRAFI 700X OR APPROVED EQUAL.

CONDUIT OUTLET PROTECTION DETAIL

N.T.S.



MAINTENANCE
THE ENTRANCE SHALL BE MAINTAINED IN A CONDITION WHICH WILL PREVENT TRACKING OR FLOWING OF SEDIMENT ONTO PUBLIC RIGHTS-OF-WAY. THIS MAY REQUIRE PERIODIC TOP DRESSING WITH ADDITIONAL STONE OR ADDITIONAL LENGTH AS CONDITIONS DEMAND AND REPAIR AND/OR CLEAN OUT OF ANY MEASURES USED TO TRAP SEDIMENT. ALL SEDIMENT SPILLED, DROPPED, WASHED, OR TRACKED ONTO PUBLIC RIGHTS-OF-WAY MUST BE REMOVED IMMEDIATELY.

STABILIZED CONSTRUCTION ENTRANCE DETAIL

N.T.S.

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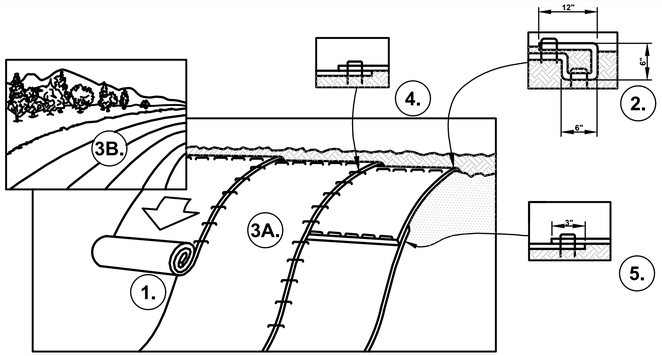
PENNEAST PIPELINE PROJECT
LAMBERTVILLE INTERCONNECT
SESC DETAILS 2

LOC. WEST AMWELL TOWNSHIP, HUNTERDON COUNTY, NEW JERSEY

YEAR: 2020 | W.B.S CE.000147.001 | SCALE: AS SHOWN | DWG. C-118 | REV. 0



1. PREPARE SOIL BEFORE INSTALLING BLANKETS, INCLUDING ANY NECESSARY APPLICATION OF LIME, FERTILIZER, AND SEED. NOTE: WHEN USING CELL-O- SEED DO NOT SEED PREPARED AREA. CELL-O-SEED MUST BE INSTALLED WITH PAPER SIDE DOWN.

2. BEGIN AT THE TOP OF THE SLOPE BY ANCHORING THE BLANKET IN A 6" DEEP X 6" WIDE TRENCH WITH APPROXIMATELY 12" OF BLANKET EXTENDED BEYOND THE UP-SLOPE PORTION OF THE TRENCH. ANCHOR THE BLANKET WITH A ROW OF STAPLES/STAKES APPROXIMATELY 12" APART IN THE BOTTOM OF THE TRENCH. BACKFILL AND COMPACT THE TRENCH AFTER STAPLING. APPLY SEED TO COMPACTED SOIL AND FOLD REMAINING 12" PORTION OF BLANKET BACK OVER SEED AND COMPACTED SOIL. SECURE BLANKET OVER COMPACTED SOIL WITH A ROW OF STAPLES/STAKES SPACED APPROXIMATELY 12" APART ACROSS THE WIDTH OF THE BLANKET.

3. ROLL THE BLANKETS (A.) DOWN OR (B.) HORIZONTALLY ACROSS THE SLOPE. BLANKETS WILL UNROLL WITH APPROPRIATE SIDE AGAINST THE SOIL SURFACE. ALL BLANKETS MUST BE SECURELY FASTENED TO SOIL SURFACE BY PLACING STAPLES/STAKES IN APPROPRIATE LOCATIONS AS SHOWN IN THE STAPLE PATTERN GUIDE. WHEN USING OPTIONAL DOT SYSTEM, STAPLES/STAKES SHOULD BE PLACED THROUGH EACH OF THE COLORED DOTS CORRESPONDING TO THE APPROPRIATE STAPLE PATTERN.

4. THE EDGES OF PARALLEL BLANKETS MUST BE STAPLED WITH APPROXIMATELY 2"-5" OVERLAP DEPENDING ON BLANKET TYPE. TO ENSURE PROPER SEAM ALIGNMENT, PLACE THE EDGE OF THE OVERLAPPING BLANKET (BLANKET BEING INSTALLED ON TOP) EVEN WITH THE COLORED SEAM STITCH ON THE PREVIOUSLY INSTALLED BLANKET.

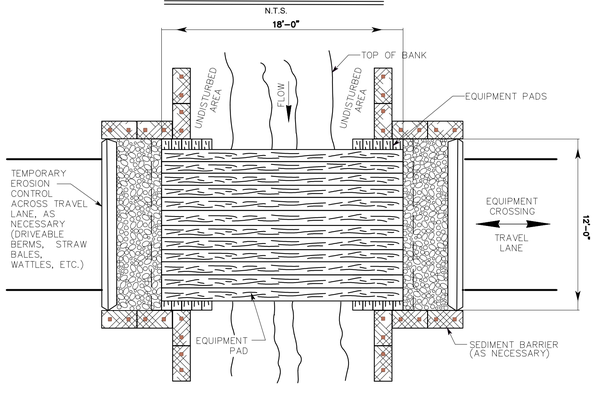
5. CONSECUTIVE BLANKETS SPLICED DOWN THE SLOPE MUST BE PLACED END OVER END (SHINGLE STYLE) WITH AN APPROXIMATE 3" OVERLAP. STAPLE THROUGH OVERLAPPED AREA, APPROXIMATELY 12" APART ACROSS ENTIRE BLANKET WIDTH.

NOTE:

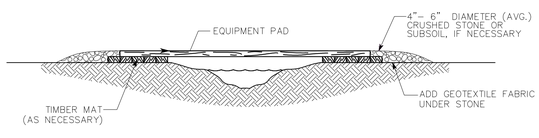
*IN LOOSE SOIL CONDITIONS, THE USE OF STAPLE OR STAKE LENGTHS GREATER THAN 6" MAY BE NECESSARY TO PROPERLY SECURE THE BLANKETS.

EROSION CONTROL BLANKET

N.T.S.



PLAN VIEW



CROSS SECTION VIEW

NOTES:

1. TEMPORARY SEDIMENT BARRIER CONSISTS OF SILT FENCE AND/ OR STRAW BALES, OR OTHER APPROPRIATE MATERIAL.
2. EQUIPMENT PAD, TYPICALLY CONSTRUCTED OF HARDWOOD, SHALL BE IN GOOD CONDITION AND MUST ACCOMMODATE THE LARGEST EQUIPMENT USED. ADDITIONAL EQUIPMENT PADS CAN BE PUT SIDE BY SIDE IF EXTRA WIDTH IS REQUIRED. BRIDGE MUST SPAN FROM TOP OF BANK TO TOP OF BANK.
3. CRUSHED STONE OR SUBSOIL MAY BE USED AS ILLUSTRATED, IF NECESSARY, WITHIN TRAVEL LANE AS RAMP.
4. CONSTRUCT AND MAINTAIN BRIDGE TO WITHSTAND THE HIGHEST EXPECTED FLOW WHILE BRIDGE IS IN USE AND PREVENT SOIL FROM ENTERING WATERBODY. DO NOT USE SOIL TO CONSTRUCT OR STABILIZE BRIDGE.

TEMPORARY EQUIPMENT BRIDGE (EQUIPMENT PADS)

N.T.S.

AGRONOMIC SPECIFICATIONS FOR LAWNS AND CONSTRUCTION SITES

GENERAL

1. All disturbed areas that are not being graded, not under active construction, or not scheduled to be permanently seeded within 30 days must be temporarily stabilized as per specifications below.

2. All exposed areas which are to be permanently vegetated, are to be seeded and mulched within 10 days of final grading.

3. **Straw mulch** (hay mulch may be substituted if approved by the District) is to be applied to all seedings at a rate of 1-1/2 to 2 tons per acre (approx. 100 to 130 bales per acre).

4. **Mulch anchoring is required** after mulching to minimize loss by wind or water. This is to be done using one of the methods (crimping, liquid mulch binders, nettings, etc.) in the "Standards for Soil Erosion and Sediment Control in New Jersey".

5. Existing weedy and poorly-vegetated areas with less than 80 percent perennial grass cover must receive permanent stabilization (as specified on back).

6. All bags need to be saved for lime, fertilizer, seed, and liquid mulch binder (if mulch anchoring method). Such proofs need to be submitted to the District inspector for verification of materials and quantities used for all seedings.

7. An additional fee of **$125.00** per inspection will be assessed on those sites where additional inspections are necessitated as a result of non-compliance with the approved plan. This includes additional inspections performed after the failure of an initial Report of Compliance inspection. The entire project site is inspected at the time of a request for Report of Compliance.

SEED-BED PREPARATION FOR ALL SEEDINGS

SUB-SOIL PREPERATION: Immediately prior to seeding and topsoil application, the surface should be scarified to a depth of 6" to 12" where there has been soil compaction (e.g. areas of heavy construction traffic). This practice is to be applied to all compacted areas where there is no danger to underground utilities (cables, irrigation systems, etc.).

TOPSOILING: Areas to be seeded should have a minimum of 5" of friable, loamy, topsoil free of objectionable weeds, stones and debris.

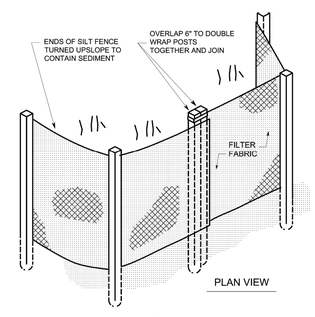
FINAL GRADING: Grading is to be smooth of ruts and free of objectionable stones, depressions, vehicle tracks, and rough edges. There is to be positive drainage away from all buildings and dwellings. Refuse from seedbed preparation (roots, sticks, stones, construction debris) must be disposed of properly.

LIMING/FERTILIZING: Apply limestone and fertilizer to soil test recommendations or as follows:

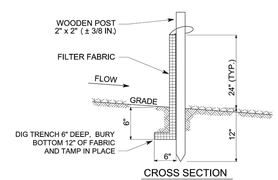
A. **Lime is** to be applied at the rate of **2 tons (4,000 lbs)**. per acre. Lime may be any product type as long as the CCE Calcium Carbonate Equivalency = 2 tons per/ acre. Pelletized and liquid products may be preferred because of their lack of dust and ease of handling but must meet the fore-mentioned criteria.

B. **Starter fertilizer**, specified as **10-20-10**, is to be applied at **500 lbs. per acre**

C. **Lime and fertilizer** are to be worked into the soil to a depth of 4 inches.



PLAN VIEW



CROSS SECTION

INSTALLATION REQUIREMENTS:

- WHEN USING SILT FENCE, PLACE IT:
  - BETWEEN DISTURBED AREAS AND DOWN-SLOPE ENVIRONMENTAL RESOURCE AREAS
  - AT THE BASE OF ALL SLOPES NEXT TO WETLANDS, WATERBODIES, AND ROAD CROSSINGS
  - AT THE INLET AND OUTLET OF OPEN DRAINAGE STRUCTURES
  - APPROXIMATELY 8 FEET BEYOND THE TOE OF THE SLOPE TO GIVE THE SEDIMENT ROOM TO COLLECT (IF POSSIBLE)
- USE SANDBAGS OR BACKFILLING TO KEY IN THE BOTTOM OF THE FABRIC WHERE IT IS NOT FEASIBLE TO TRENCH IT IN (LEDGES, ROCKY SOIL, LARGE ROOTS, ETC.)

MAINTENANCE REQUIREMENTS:

- INSPECT SILT FENCE:
  - DAILY IN AREAS OF ACTIVE CONSTRUCTION
  - WEEKLY IN AREAS WITH NO CONSTRUCTION
  - WITHIN 24 HOURS FOLLOWING EACH RAINFALL EVENT OF ≥ 0.5 INCH.
- REPAIR OR REPLACE SILT FENCE AS NEEDED
- REMOVE ACCUMULATED SEDIMENTS TO AN UPLAND AREA WHEN SEDIMENT REACHES 1/2 THE ABOVE GROUND HEIGHT OF THE SILT FENCE.

SILT FENCE DETAIL

N.T.S.

Soil De-compaction and Testing Requirements

Soil Compaction Testing Requirements

1. Subgrade soils **prior to the application of topsoil** (see permanent seeding and stabilization notes for topsoil requirements) shall be free of excessive compaction to a depth of 6.0 inches to enhance the establishment of permanent vegetative cover.

2. Areas of the site which are subject to compaction testing and/or mitigation are **graphically denoted** on the certified soil erosion control plan.

3. **Compaction testing locations** are denoted on the plan. A copy of the plan or portion of the plan shall be used to mark locations of tests, and attached to the compaction remediation form, available from the local soil conservation district. This form must be filled out and submitted prior to receiving a certificate of compliance from the district.

4. In the event that testing indicates compaction in excess of the maximum thresholds indicated for the simplified testing methods (see details below), the contractor/owner shall have the option to perform either (1) compaction mitigation over the entire mitigation area denoted on the plan (excluding exempt areas), or (2) perform additional, more detailed testing to establish the limits of excessive compaction whereupon only the excessively compacted areas would require compaction mitigation. Additional detailed testing shall be performed by a trained, licensed professional.

Compaction Testing Methods

A. Probing Wire Test (see detail)
B. Hand-held Penetrometer Test (see detail)
C .Tube Bulk Density Test (licensed professional engineer required
D. Nuclear Density Test (licensed professional engineer required)

Note: Additional testing methods which conform to ASTM standards and specifications, and which produce a dry weight, soil bulk density measurement may be allowed subject to District approval.

Soil compaction testing is not required if/when subsoil compaction remediation (scarification/tillage (6" minimum depth) or similar) is proposed as part of the sequence of construction.

Procedures for Soil Compaction Mitigation

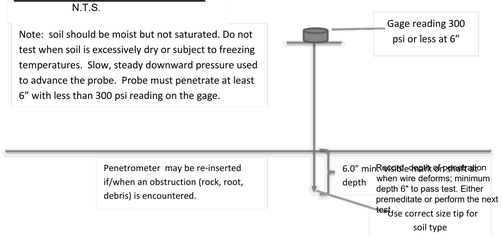
Procedures shall be used to mitigate excessive soil compaction **prior to placement of topsoil** and establishment of permanent vegetative cover.

Restoration of compacted soils shall be through deep scarification/tillage (6" minimum depth) where there is no danger to underground utilities (cables, irrigation systems, etc.). In the alternative, another method as specified by a New Jersey Licensed Professional Engineer maybe substituted subject to District Approval.

Handheld Soil Penetrometer Test

N.T.S.

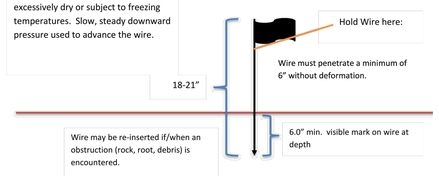
Note: soil should be moist but not saturated. Do not test when soil is excessively dry or subject to freezing temperatures. Slow, steady downward pressure used to advance the probe. Probe must penetrate at least 6" with less than 300 psi reading on the gage.



Probing Wire Test- 15.5 ga steel wire (survey flag)

N.T.S.

Note: soil should be moist but not saturated. Do not test when soil is excessively dry or subject to freezing temperatures. Slow, steady downward pressure used to advance the wire.



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STATE OF NEW JERSEY — BARRY J. SUTHERLAND — No. GE24GE02913500 — PROFESSIONAL ENGINEER

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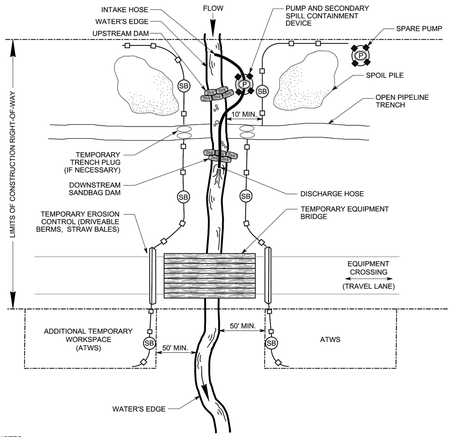
Certificate of Authorization #24GA28047100

PENNEAST PIPELINE PROJECT
LAMBERTVILLE INTERCONNECT
SESC DETAILS 3

LOC. WEST AMWELL TOWNSHIP, HUNTERDON COUNTY, NEW JERSEY

PennEast PIPELINE

YEAR: 2020 | W.B.S CE.000147.001 | SCALE: AS SHOWN | DWG. C–119 | REV. 0



NOTES:

1. SB TEMPORARY SEDIMENT BARRIER OF SILT FENCE AND/ OR STRAW BALES, OR OTHER APPROPRIATE MATERIALS
2. INSTALL AND SEAL SANDBAGS UPSTREAM AND DOWNSTREAM OF THE CROSSING.
3. CREATE AN UPSTREAM SUMP USING SANDBAGS IF NATURAL SUMP IS UNAVAILABLE FOR THE INTAKE HOSE.
4. EXCAVATE ACROSS STREAM CHANNEL FOLLOWING WATER REROUTING.
5. DO NOT REFUEL OR STORE FUEL WITHIN 100 FEET OF THE WATERBODY. IF NOT FEASIBLE, ALTERNATIVE METHODS MUST BE APPROVED BY ENVIRONMENTAL INSPECTOR.
6. MONITOR PUMPS AT ALL TIMES DURING STREAM CROSSING PROCEDURE.
7. P USE SUFFICIENT PUMPS, INCLUDING ONSITE BACKUP PUMPS, TO MAINTAIN DOWNSTREAM FLOW.
8. SCREEN PUMP INTAKES. PREVENT SCOURING WITHIN WATERBODY BY HOSE DISCHARGE.

TYPICAL DAM-AND-PUMP WATERBODY CROSSING

FIGURE WC-4

DWG. ES-0035 REV.

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PENNEAST PIPELINE PROJECT
LAMBERTVILLE INTERCONNECT
SESC DETAILS 4

LOC. WEST AMWELL TOWNSHIP, HUNTERDON COUNTY, NEW JERSEY

YEAR: 2020 | W.B.S CE.000147.001 | SCALE: AS SHOWN | DWG. C-119A | REV. 0

PennEast PIPELINE

GENERAL LANDSCAPE AND SEEDING NOTES

1. THE LANDSCAPE PLAN AND DETAILS ARE FOR LANDSCAPING INFORMATION ONLY. PLEASE REFER TO THE SITE LAYOUT PLAN, GRADING PLAN AND/OR UTILITIES PLAN FOR ALL OTHER INFORMATION.

2. THE CONTRACTOR SHALL MONITOR AND GUARANTEE THAT ALL PLANTS, TREES, AND SHRUBS SHALL BE HEALTHY AND FREE OF DISEASE FOR A PERIOD OF (1) ONE YEAR AFTER SUBSTANTIAL COMPLETION AND ACCEPTANCE BY THE OWNER. CONTRACTOR SHALL REPLACE ANY DEAD OR UNHEALTHY PLANTS AT CONTRACTOR'S EXPENSE. FINAL ACCEPTANCE SHALL BE MADE IF ALL PLANTS MEET THE GUARANTEE REQUIREMENTS INCLUDING MAINTENANCE. MAINTENANCE RESPONSIBILITIES INCLUDE INVASIVE SPECIES MONITORING, REMOVAL, AND SUPPLEMENTATION. MONITORING OF THE PROJECT SITE SHALL OCCUR IN THE SPRING AND THE FALL TO DETERMINE THE PRESENCE OF INVASIVE SPECIES. SHOULD ANY INVASIVE SPECIES BE IDENTIFIED WITHIN THE PROJECT SITE, THE INVASIVE SPECIES SHALL BE REMOVED ACCORDING TO METHODS MOST LIKELY TO BE EFFECTIVE IN CONTROLLING THAT SPECIES AND SUPPLEMENTING ITS REPLACEMENT WITH APPROPRIATE VEGETATION AND SEED MIX IDENTIFIED (AND APPROVED) ON THIS PLAN AND/OR AN APPROVED EQUAL. ADDITIONAL MAINTENANCE RESPONSIBILITIES INCLUDE: APPROVED CULTIVATING, SPRAYING, WEEDING, WATERING, TIGHTENING GUYS, PRUNING, FERTILIZING, MULCHING, AND ANY OTHER OPERATIONS NECESSARY TO MAINTAIN PLANT VIABILITY. MAINTENANCE SHALL BEGIN IMMEDIATELY AFTER PLANTING AND CONTINUE UNTIL 90 DAYS AFTER FINAL ACCEPTANCE.

3. THE CONTRACTOR SHALL SUPPLY ALL LABOR, PLANTS, APPROVED SEEDING MIX, AND MATERIALS IN QUANTITIES SUFFICIENT TO COMPLETE THE WORK SHOWN ON THE DRAWING(S) AND LISTED IN THE PLANT SCHEDULE(S) AND/OR SEEDING TABLE. IN THE EVENT OF A DISCREPANCY BETWEEN QUANTITIES SHOWN IN THE PLANT SCHEDULE AND/OR SEEDING TABLE AND THOSE REQUIRED BY THE DRAWINGS, THE LARGER SHALL APPLY. ALL PLANTS SHALL BE ACCLIMATED BY THE SUPPLY NURSERY TO THE LOCAL HARDINESS ZONE AND BE CERTIFIED THAT THE PLANTING MATERIAL HAS BEEN GROWN FOR A MINIMUM OF (2) TWO YEARS AT THE SOURCE AND OBTAINED WITHIN 200 MILES OF PROJECT SITE UNLESS OTHERWISE APPROVED BY OWNER, CERTIFIED LANDSCAPE INSPECTOR, OR LANDSCAPE ARCHITECT.

4. THE LOCATIONS FOR PLANT MATERIAL ARE APPROXIMATE AND ARE SUBJECT TO FIELD ADJUSTMENT DUE TO SLOPE, VEGETATION, AND SITE FACTORS SUCH AS THE LOCATION OF ROCK OUTCROPS. PRIOR TO PLANTING THE CONTRACTOR SHALL ACCURATELY STAKE OUT THE LOCATIONS FOR ALL PLANTS. THE OWNER, CERTIFIED LANDSCAPE INSPECTOR, OR LANDSCAPE ARCHITECT SHALL APPROVE THE FIELD LOCATIONS OR ADJUSTMENTS OF THE PLANT MATERIAL.

5. ALL SHRUB MASSING SHALL BE MULCHED TO A DEPTH OF 2" AND SHREDDED HARDWOOD BARK MULCH SHALL BE USED FOR SHRUB MASSING AREAS.

6. NO PLANT SHALL BE PLACED IN THE GROUND BEFORE ROUGH GRADING HAS BEEN COMPLETED AND APPROVED BY THE OWNER, CERTIFIED LANDSCAPE INSPECTOR, OR LANDSCAPE CONTRACTOR. STAKING THE LOCATION OF ALL TREES AND SHRUBS SHALL BE COMPLETED PRIOR TO PLANTING FOR APPROVAL BY THE OWNER, CERTIFIED LANDSCAPE INSPECTOR, OR LANDSCAPE ARCHITECT. STAKING OF THE INSTALLED TREE MUST BE COMPLETED THE SAME DAY AS IT IS INSTALLED. ALL TREES SHALL BE STAKED OR GUYED PER DETAIL. SEE LANDSCAPING PLAN FOR PLANTING DETAILS.

7. COORDINATE PLANT MATERIAL LOCATIONS WITH SITE UTILITIES. SEE SITE LAYOUT, GRADING AND/OR UTILITY PLANS FOR STORM, SANITARY, GAS, ELECTRIC, TELEPHONE AND WATER LINES. UTILITY LOCATIONS ARE APPROXIMATE. EXERCISE CARE WHEN DIGGING IN AREAS OF POTENTIAL CONFLICT WITH UNDERGROUND OR OVERHEAD UTILITIES. THE CONTRACTOR IS RESPONSIBLE FOR ANY DAMAGE DUE TO CONTRACTOR'S NEGLIGENCE AND SHALL REPLACE OR REPAIR ANY DAMAGE AT CONTRACTOR'S EXPENSE.

8. LANDSCAPE PLANTING PITS MUST BE FREE DRAINING. PAVEMENT, COMPACTED SUBGRADE, AND BLASTED ROCK SHALL BE REMOVED TO A DEPTH OF 2' OR TO A GREATER DEPTH IF REQUIRED BY PLANTING DETAILS OR SPECIFICATIONS. REPLACE SOIL WITH MODERATELY COMPACTED LOAM OR SANDY LOAM FREE FROM STONES AND RUBBISH 1" OR GREATER IN DIAMETER AND ANY OTHER MATERIAL HARMFUL TO PLANT GROWTH AND DEVELOPMENT. PLANTING INSTALLATION SHALL BE AS DETAILED AND CONTAIN PLANTING MIX AS SPECIFIED.

PLANTING SOIL MIXTURE:
2 PARTS PEAT MOSS
5 PARTS TOPSOIL
MYCORHIZA INOCULANT – "TRANSPLANT 1-STEP" AS MANUFACTURED BY ROOTS, INC. OR APPROVED EQUAL. USE PER MANUFACTURER'S RECOMMENDATIONS FOR TREES AND SHRUBS. FERTILIZER/LIME APPLY AS RECOMMENDED BY SOIL ANAYLSIS

- TREES, AND SHRUBS: TREES AND SHRUBS SHALL BE NURSERY GROWN UNLESS OTHERWISE NOTED AND HARDY UNDER CLIMATIC CONDITIONS SIMILAR TO THOSE IN THE LOCATION OF THE PROJECT. THEY SHALL BE TYPICAL OF THEIR SPECIES OR VARIETY, WITH NORMAL HABIT OF GROWTH. THEY SHALL BE SOUND, HEALTHY, VIGOROUS, WELL-BRANCHED AND DENSELY FOLIATED WHEN IN LEAF. THEY SHALL BE FREE OF DISEASE, INSECT PESTS, EGGS OR LARVAE. THEY SHALL HAVE HEALTHY AND WELL-DEVELOPED ROOT SYSTEMS. ALL TREES SHALL HAVE STRAIGHT SINGLE TRUNKS WITH THEIR MAIN LEADER INTACT UNLESS OTHERWISE STATED. THE OWNER, CERTIFIED LANDSCAPE INSPECTOR, OR LANDSCAPE ARCHITECT SHALL ONLY PERMIT SUBSTITUTIONS UPON WRITTEN APPROVAL. THEIR SIZES SHALL CONFORM TO THE MEASUREMENT SPECIFIED ON THE DRAWINGS. PLANTS LARGER THAN SPECIFIED ON THE DRAWINGS MAY BE USED IF APPROVED. THE USE OF SUCH PLANTS SHALL NOT INCREASE THE CONTRACT PRICE.

- ALL PRUNING SHALL CONFORM TO THE TREE CARE INDUSTRY ASSOCIATION (TCIA) ANSI A300 (PART 1) – 2017 PRUNING STANDARDS. PRUNING STANDARDS SHALL RECOGNIZE BUT, ARE NOT LIMITED TO, THE FOLLOWING PRUNING OBJECTIVES: MANAGE RISK, MANAGE HEALTH, DEVELOP STRUCTURE, PROVIDE CLEARANCE, MANAGE SIZE OR SHAPE, IMPROVE AESTHETICS, MANAGE PRODUCTION OF FRUIT, FLOWERS, OR OTHER PRODUCTS, AND/OR MANAGE WILDLIFE HABITAT. DEVELOPING STRUCTURE SHALL IMPROVE BRANCH AND TRUNK ARCHITECTURE, PROMOTE OR SUBORDINATE CERTAIN LEADERS, STEMS, OR BRANCHES; PROMOTE DESIRABLE BRANCH SPACING; PROMOTE OR DISCOURAGE GROWTH IN A PARTICULAR DIRECTION (DIRECTIONAL PRUNING); MINIMIZE FUTURE INTERFERENCE WITH TRAFFIC, LINES OF SIGHT, INFRASTRUCTURE, OR OTHER PLANTS; RESTORE PLANTS FOLLOWING DAMAGE; AND/OR REJUVENATE SHRUBS. PROVIDING CLEARANCE SHALL ENSURE SAFE AND RELIABLE UTILITY SERVICES; MINIMIZE CURRENT INTERFERENCE WITH TRAFFIC, LINES OF SITE, INFRASTRUCTURE, OR OTHER PLANTS; RAISE CROWN(S) FOR MOVEMENT OF TRAFFIC OR LIGHT PENETRATION; ENSURE LINES OF SIGHT OR DESIRED VIEWS; PROVIDE ACCESS TO SITES, BUILDINGS, OR OTHER STRUCTURES; AND/OR COMPLY WITH REGULATIONS.

- TOPSOIL SHALL BE INSTALLED AT A MINIMUM DEPTH OF 4 INCHES. CONTRACTOR SHALL SUBMIT TOPSOIL TO A CERTIFIED TESTING LABORATORY TO DETERMINE PH, FERTILITY, ORGANIC CONTENT AND MECHANICAL COMPOSITION. THE CONTRACTOR SHALL SUBMIT THE TEST RESULTS FROM REGIONAL EXTENSION OFFICE OF USDA TO THE OWNER, CERTIFIED LANDSCAPE INSPECTOR, OR LANDSCAPE ARCHITECT FOR REVIEW AND APPROVAL. CONTRACTOR SHALL INCORPORATE AMENDMENTS FOR GOOD PLANT GROWTH AND PROPER SOIL ACIDITY RECOMMENDED FROM THE TOPSOIL TEST.

- NO PHOSPHOROUS SHALL BE USED AT PLANTING TIME UNLESS SOIL TESTING HAS BEEN COMPLETED AND TESTED BY A HORTICULTURAL TESTING LAB AND SOIL TESTS SPECIFICALLY INDICATE A PHOSPHOROUS DEFICIENCY THAT IS HARMFUL, OR WILL PREVENT NEW LAWNS/GRASSES AND PLANTINGS FROM ESTABLISHING PROPERLY.

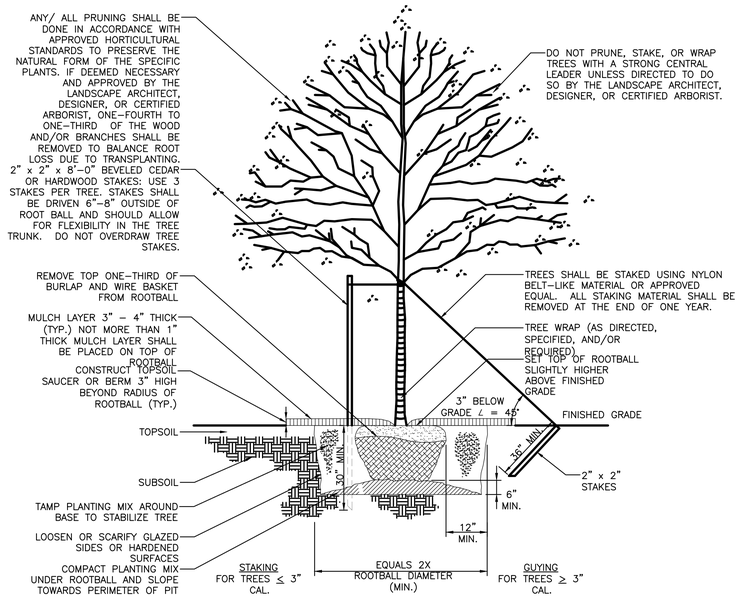
- IF SOIL TESTS INDICATE A PHOSPHOROUS DEFICIENCY THAT WILL IMPACT PLANT AND LAWN ESTABLISHMENT, PHOSPHOROUS SHALL BE APPLIED AT THE MINIMUM RECOMMENDED LEVEL PRESCRIBED IN THE SOIL TEST FOLLOWING ALL APPLICABLE STANDARDS, REQUIREMENTS, AND/OR REGULATIONS.

- ALL SLOPES GREATER THAN 3:1 RECEIVING A WILDFLOWER, WETLAND, AND/OR GRASS SEEDING MIXTURE SHALL BE COVERED WITH AN EROSION CONTROL BLANKET.

- ALL WILDFLOWERS AND GRASSES SOWED SHALL BE ALLOWED TO GROW TO THEIR NATURALLY OCCURRING HEIGHTS WHENEVER POSSIBLE. NATIVE WILDFLOWERS AND/OR GRASSES CAN BE MOWED/MAINTAINED (WITHIN ACCEPTABLE AREAS IDENTIFIED AND/OR APPROVED BY APPROPRIATE REGULATORY AGENCIES) AS OFTEN AS NEEDED TO KEEP THE VEGETATION AT A DESIRED AND/OR MANAGEABLE/MANICURED HEIGHT.

NOTES:

1. COORDINATES ARE REFERENCED TO THE NORTH AMERICAN DATUM (NAD) OF 1983 PROJECTED ONTO THE NEW JERSEY STATE PLANE COORDINATE SYSTEM.
2. ELEVATIONS DEPICTED ARE REFERENCED TO THE NORTH AMERICAN VERTICAL DATUM (NAVD) OF 1988 (NGVD29=NAVD88+0.90 FEET).
3. ENGINEERING AND DESIGN PERFORMED BY EN ENGINEERING, INC.
4. SURVEY PERFORMED BY LRC GROUP, INC.
5. FRESHWATER WETLANDS/WATERS BOUNDARY LINE AS VERIFIED BY NJDEP (FRESHWATER WETLANDS LETTER OF INTERPRETATION: LINE VERIFICATION FILE NO. 1026-02-0003.1) FOR BLOCK 5, LOT 6 ONLY.
6. WETLANDS AND WATERS BOUNDARY LINE(S) FOR BLOCK 5, LOT 6 ONLY AS SHOWN ON THE MAP ENTITLED: "NJDEP LETTER OF INTERPRETATION, LINE VERIFICATION – ENTIRE SITE, MARCELLUS TO MARKET PROJECT, LAMBERTVILLE COMPRESSOR STATION, HUNTERDON COUNTY, NEW JERSEY", CONSISTING OF THREE SHEETS, DATED OCTOBER 2016, LAST REVISED JANUARY 20, 2017, AND PREPARED BY BARRY A. GLEISSNER, P.L.S. OF AECOM.
7. WETLANDS AND WATERS BOUNDARY LINES DEPICTED ON BLOCK 5, LOT 5 DELINEATED BY TRC ENVIRONMENTAL CORPORATION ON AUGUST 11, 2017.
8. SOIL BOUNDARY INFORMATION OBTAINED FROM UNITED STATES GEOLOGICAL SURVEY (USGS) WEB SOIL SURVEY.



NATIVE/DECIDUOUS TREE PLANTING DETAIL

N.T.S.

NOTES:

- TREE PLANTING SHALL BEAR SAME RELATIONSHIP TO FINISH GRADE AS IT WAS PRE-DUG IN THE NURSERY.
- NEVER CUT THE PRIMARY LEADER.
- IT IS NOT RECOMMENDED TO AMEND THE EXISTING SOIL BEFORE BACKFILLING THE HOLE UNLESS SOIL CONDITIONS ARE POOR FOR PLANTING.
- WATER THOROUGHLY TO HELP ENSURE THE REMOVAL OF AIR POCKETS AND PROPERLY SET THE TREE.

LEGEND

LANDSCAPE PLANTING SCHEDULE - OVERALL SITE

TREES

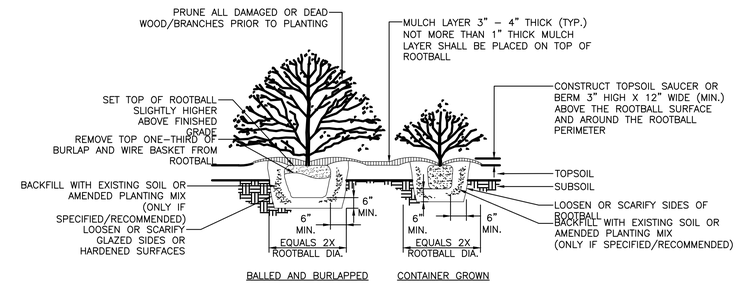
SYMBOL	BOTANICAL NAME/ COMMON PLANT NAME	QUANTITY	SIZE	ROOT
AB	ABIES BALSAMEA BALSAM FIR	10	7'-8' HT.	B&B
AC	AMELANCHIER CANADENSIS SHADBLOW SERVICEBERRY	20	6'-8' HT. CLUMP	B&B
BN	BETULA NIGRA 'HERITAGE' HERITAGE RIVERBIRCH	4	6'-8' HT. CLUMP	B&B
CF	CORNUS FLORIDA FLOWERING DOGWOOD	9	2" CAL. MIN.	B&B
IA	ILEX x ATTENUATA 'FOSTERI' FOSTER'S HOLLY	21	5'-6' HT.	B&B
JV	JUNIPERUS VIRGINIANA EASTERN RED CEDAR	18	6'-7' HT.	B&B
TP	THUJA PLICATA GREEN GIANT ARBORVITAE	34	6'-7' HT.	B&B

SHRUBS/EVERGREENS AND ORNAMENTAL TREES

SYMBOL	BOTANICAL NAME/ COMMON PLANT NAME	QUANTITY	SIZE	ROOT
CS	CORNUS STOLONIFERA REDTWIG DOGWOOD	52	30"-36" HT.	#3/5 CONT.
HI	HAMAMELIS x INTERMEDIA 'DIANE' DIANE WITCH HAZEL	5	3'-4' HT.	B&B
IV	ILEX VERTICILLATA COMMON WINTERBERRY	61	30"-36" HT.	#3/5 CONT.
RG	RHUS GLABRA SMOOTH SUMAC	9	30"-36" HT.	#3/5 CONT.
VA	VACCINIUM ANGUSTIFOLIUM LOWBUSH BLUEBERRY	51	24"-30" HT.	#3/5 CONT.
VD	VIBURNUM DENTATUM ARROWOOD VIBURNUM	77	30"-36" HT.	#3/5 CONT.

NOTES:

- PLANT HARDINESS ZONE 6b (0 to -5)
- PHYSIOGRAPHIC PROVINCE- PIEDMONT
- 300 FOOT RIPARIAN ZONES SHALL BE MAINTAINED

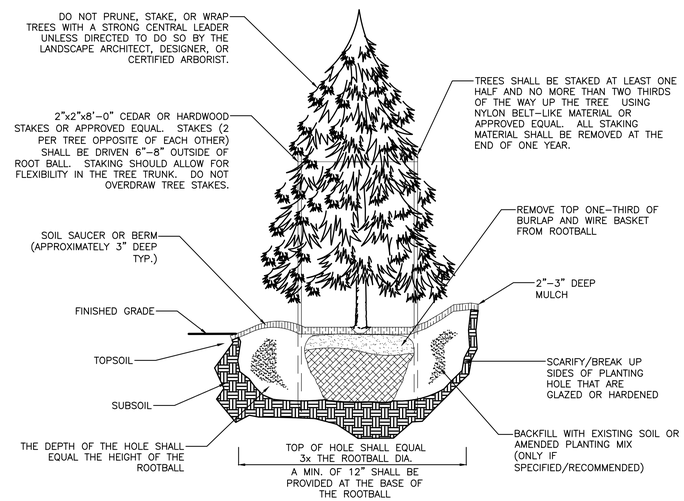


SHRUB PLANTING DETAIL

N.T.S.

NOTE:

- IN AREAS WITH MASS PLANTINGS, CONTINUOUS EXCAVATION AND MULCHING PRACTICES SHALL BE IMPLEMENTED WHENEVER POSSIBLE
- IT IS NOT RECOMMENDED TO AMEND THE EXISTING SOIL BEFORE BACKFILLING THE HOLE UNLESS SOIL CONDITIONS ARE POOR FOR PLANTING.
- WATER THOROUGHLY TO HELP ENSURE THE REMOVAL OF AIR POCKETS.



EVERGREEN TREE PLANTING DETAIL

N.T.S.

NOTES:

- TREE PLANTING SHALL BEAR SAME RELATIONSHIP TO FINISH GRADE AS IT WAS PRE-DUG IN THE NURSERY.
- NEVER CUT THE PRIMARY LEADER.
- IT IS NOT RECOMMENDED TO AMEND THE EXISTING SOIL BEFORE BACKFILLING THE HOLE UNLESS SOIL CONDITIONS ARE POOR FOR PLANTING.
- WATER THOROUGHLY TO HELP ENSURE THE REMOVAL OF AIR POCKETS AND PROPERLY SET THE TREE.

NATIVE DETENTION AREA SEED MIX				
BOTANICAL NAME	COMMON NAME	MIX CONCENTRATION	RATE (LBS/ACRE)	RATE (LBS/1000 FT^2)
PANICUM CLANDESTINUM 'TIOGA'	TIOGA DEERTONGUE	28%	20	0.5
CAREX VULPINOIDEA	FOX SEDGE	24%		
ELYMUS VIRGINICUS	VIRGINIA WILDRYE	20%		
PANICUM VIRGATUM 'SHAWNEE'	SHAWNEE SWITCHGRASS	20%		
ARGROSTIS PERENNANS	AUTUMN BENTGRASS	4%		
JUNCUS TENUIS	PATH RUSH	3%		
JUNCUS EFFUSUS	SOFT RUSH	1%		

NOTE: NATIVE GRASS SEED MIXES ARE COMPRISED OF GRASSES THAT ARE NATIVE AND/OR INDIGENOUS TO THE AREA AND CONSIDERED FAVORABLE FOR WILDLIFE HABITAT. ADDITIONALLY, NATIVE GRASSES, SEDGES, AND RUSHES WILL ESTABLISH QUICKLY IN AREAS WHERE MOWING IS NOT ANTICIPATED. UTILIZING A HIGH SEED COUNT PER POUND, WILL ALLOW FOR NATIVE ESTABLISHMENT WITH MINIMUM RISK AND TOLERATE LOW-FERTILITY. THERE ARE NO WILDFLOWER OR POLLINATOR SEED SPECIES CONTAINED IN THIS NATIVE GRASS SEED MIX.

TRC Engineers, Inc.
ENGINEER IN RESPONSIBLE CHARGE OF THE WORK SHOWN ON THIS DRAWING
DATE: 6/20/2019 SIGNATURE
PROFESSIONAL ENGINEER: BARRY J. SUTHERLAND
LIC. # 24GE02913500

NO.	BY	DATE	REVISION	APP'D.

TRC Engineers, Inc.
41 SPRING STREET
NEW PROVIDENCE, NEW JERSEY 07974
PHONE NO. (908) 988-1700
FAX NO. (973) 564-6442
Certificate of Authorization #24GA28047100

PENNEAST PIPELINE PROJECT
LAMBERTVILLE INTERCONNECT
LANDSCAPE DETAILS SHEET 1

LOC. WEST AMWELL TOWNSHIP, HUNTERDON COUNTY, NEW JERSEY

YEAR: 2020 | W.B.S CE.000147.001 | SCALE: AS SHOWN | DWG. C-120 | REV. 0

Model:
Username: JHARKINS
Drawing: W:\Vision Project Folders\292931 – Penn East\Engineering\DWG\Drainage Area Mapping\292931_PR-LAND-Proposed Landscape.dwg
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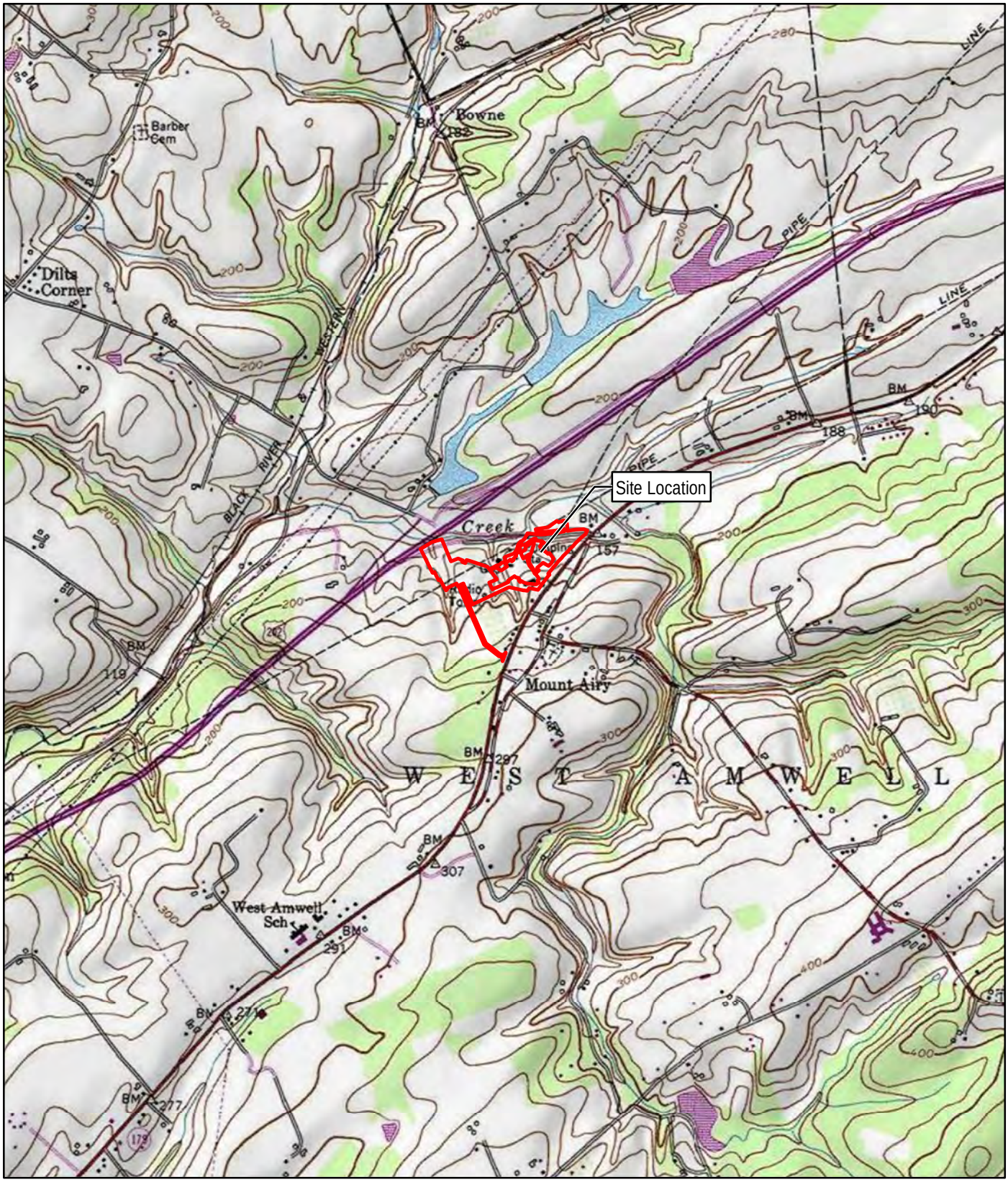
JG.#

APPENDIX B

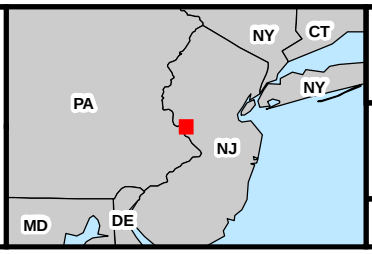
FIGURES



Temporary Workspace

0 1,000 2,000 FEET

N



PennEast PIPELINE

USGS Site Location Map
Lambertville Interconnect Facility
West Amwell Township, Hunterdon County, New Jersey

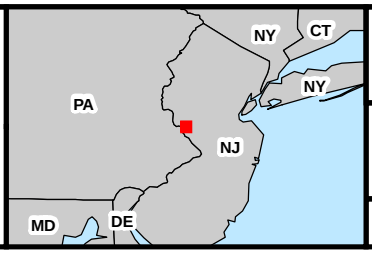
AUGUST 2018	Figure 1

Source Data: ESRI, USGS, TRC, ENBRIDGE Coordinate System: NAD 1983 UTM Zone 18N S:\LPROJECTS\ENBRIDGE\PennEast_AGT_TETCO_Interconnect_Facility\Figure_1_AGT_TETCO_Interconnect_20180823.mxd

Temporary Workspace

0 300 600 FEET

N

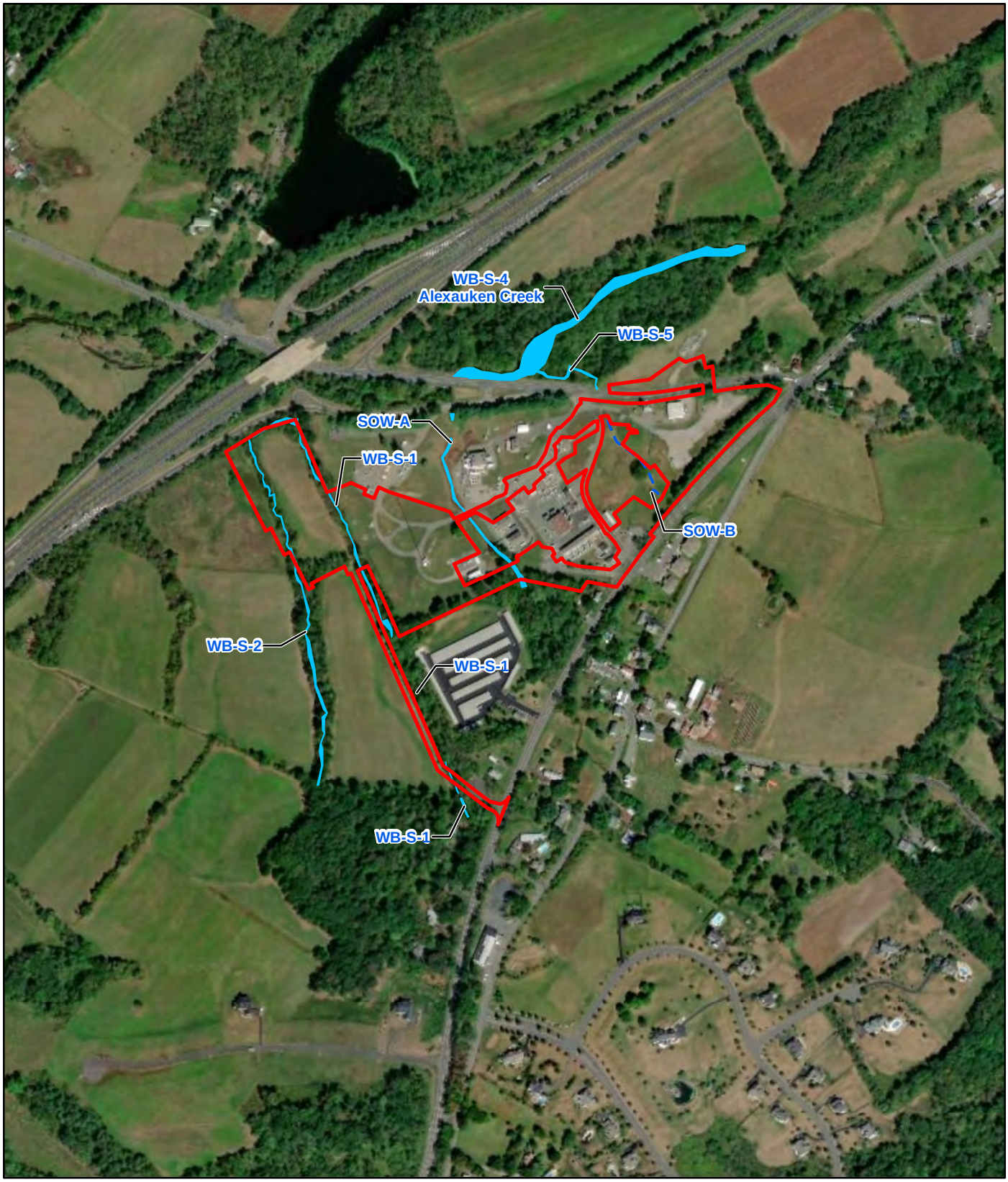


PennEast PIPELINE

Aerial Site Map
Lambertville Interconnect Facility
West Amwell Township, Hunterdon County, New Jersey

AUGUST 2018 | Figure 2

Source Data: ESRI, USGS, TRC, ENBRIDGE Coordinate System: NAD 1983 UTM Zone 18N S:\1-PROJECTS\ENBRIDGE\PennEast_AGT_TETCO_Interconnect_Facility\Figure_2_AGT_TETCO_Interconnect_20180823.mxd



Temporary Workspace

Ephemeral Stream

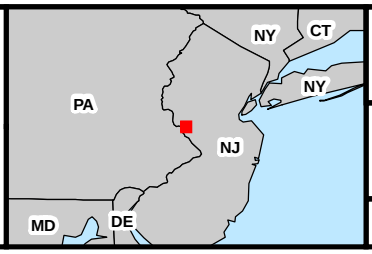
Intermittent Stream

Alexauken Creek

N

0 300 600

FEET



PennEast PIPELINE

Waterbody Map
Lambertville Interconnect Facility
West Amwell Township, Hunterdon County, New Jersey

AUGUST 2018

Figure 3

Source Data: ESRI, USGS, TRC, ENBRIDGE Coordinate System: NAD 1983 UTM Zone 18N S:\1-PROJECTS\ENBRIDGE\PennEast_AGT_TETCO_Interconnect_Facility\Figure_3_AGT_TETCO_Interconnect_20180823.mxd

FIGURE 4

Custom Soil Resource Report
Soil Map

Map Scale: 1:3,550 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 150 300 600 900

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Unit Polygons

Soil Map Unit Lines

Soil Map Unit Points

Special Point Features

Blowout

Borrow Pit

Clay Spot

Closed Depression

Gravel Pit

Gravelly Spot

Landfill

Lava Flow

Marsh or swamp

Mine or Quarry

Miscellaneous Water

Perennial Water

Rock Outcrop

Saline Spot

Sandy Spot

Severely Eroded Spot

Sinkhole

Slide or Slip

Sodic Spot

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Other

Special Line Features

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

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: Hunterdon County, New Jersey
Survey Area Data: Version 13, Oct 6, 2017

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

Date(s) aerial images were photographed: Aug 14, 2015—Apr 2, 2017

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
KkoD	Klinesville channery loam, 12 to 18 percent slopes	1.8	6.3%
PeoB	Penn channery silt loam, 2 to 6 percent slopes	19.1	67.3%
PeoC2	Penn channery silt loam, 6 to 12 percent slopes, eroded	6.5	22.8%
RepwB	Reaville wet variant silt loam, 2 to 6 percent slopes	0.1	0.2%
ROPF	Rough broken land, shale	1.0	3.4%
Totals for Area of Interest		**28.4**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Hunterdon County, New Jersey

KkoD—Klinesville channery loam, 12 to 18 percent slopes

Map Unit Setting

National map unit symbol: ldw9
Elevation: 250 to 1,500 feet
Mean annual precipitation: 30 to 64 inches
Mean annual air temperature: 46 to 79 degrees F
Frost-free period: 131 to 178 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Klinesville

Setting

Landform: Hills
Landform position (two-dimensional): Shoulder
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Fine-loamy residuum weathered from shale

Typical profile

Ap - 0 to 7 inches: channery loam
B - 7 to 14 inches: channery loam
C - 14 to 18 inches: very channery loam
R - 18 to 80 inches: weathered bedrock

Properties and qualities

Slope: 12 to 18 percent
Depth to restrictive feature: 10 to 20 inches to lithic bedrock
Natural drainage class: Somewhat excessively drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 1.5 inches)

Interpretive groups

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

Minor Components

Berks, eroded

Percent of map unit: 5 percent
Landform: Hills
Landform position (three-dimensional): Side slope

Down-slope shape: Convex
Across-slope shape: Linear
Hydric soil rating: No

Penn

Percent of map unit: 5 percent
Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Hydric soil rating: No

Bucks, eroded

Percent of map unit: 5 percent
Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Hydric soil rating: No

PeoB—Penn channery silt loam, 2 to 6 percent slopes

Map Unit Setting

National map unit symbol: ldxg
Elevation: 250 to 1,300 feet
Mean annual precipitation: 30 to 64 inches
Mean annual air temperature: 46 to 79 degrees F
Frost-free period: 131 to 178 days
Farmland classification: All areas are prime farmland

Map Unit Composition

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

Description of Penn

Setting

Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Fine-loamy residuum weathered from acid reddish shale, siltstone, and fine-grain sandstone

Typical profile

Ap - 0 to 9 inches: channery silt loam
Bt - 9 to 22 inches: channery silt loam

C - 22 to 30 inches: very channery loam
R - 30 to 80 inches: weathered bedrock

Properties and qualities

Slope: 2 to 6 percent
Depth to restrictive feature: 20 to 39 inches to lithic bedrock
Natural drainage class: Well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.2 inches)

Interpretive groups

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

Minor Components

Bucks

Percent of map unit: 5 percent
Landform: Hills
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Hydric soil rating: No

Klinesville

Percent of map unit: 5 percent
Landform: Hills
Down-slope shape: Linear
Across-slope shape: Convex
Hydric soil rating: No

Reaville

Percent of map unit: 5 percent
Landform: Interfluves
Down-slope shape: Convex
Across-slope shape: Linear
Hydric soil rating: No

PeoC2—Penn channery silt loam, 6 to 12 percent slopes, eroded

Map Unit Setting

National map unit symbol: ldxh
Elevation: 250 to 1,300 feet

Mean annual precipitation: 30 to 64 inches
Mean annual air temperature: 46 to 79 degrees F
Frost-free period: 131 to 178 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

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

Description of Penn, Eroded

Setting

Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Fine-loamy residuum weathered from acid reddish shale, siltstone, and fine-grain sandstone

Typical profile

Ap - 0 to 9 inches: channery silt loam
Bt - 9 to 22 inches: channery silt loam
C - 22 to 30 inches: very channery loam
R - 30 to 80 inches: weathered bedrock

Properties and qualities

Slope: 6 to 12 percent
Depth to restrictive feature: 20 to 39 inches to lithic bedrock
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Pattenburg

Percent of map unit: 5 percent
Landform: Hills
Down-slope shape: Linear
Across-slope shape: Convex
Hydric soil rating: No

Bucks, eroded

Percent of map unit: 5 percent
Landform: Hills

Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Hydric soil rating: No

Klinesville

Percent of map unit: 5 percent
Landform: Hills
Down-slope shape: Linear
Across-slope shape: Convex
Hydric soil rating: No

RepwB—Reaville wet variant silt loam, 2 to 6 percent slopes

Map Unit Setting

National map unit symbol: 1lmj3
Elevation: 300 to 1,000 feet
Mean annual precipitation: 30 to 64 inches
Mean annual air temperature: 46 to 79 degrees F
Frost-free period: 131 to 178 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Reaville, Poorly Drained

Setting

Landform: Depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Interbedded fine-grained fine-loamy residuum weathered from sandstone and siltstone and/or shale

Typical profile

A - 0 to 8 inches: silt loam
Bt1 - 8 to 12 inches: silty clay loam
Btg2 - 12 to 20 inches: silty clay loam
R - 20 to 80 inches: weathered bedrock

Properties and qualities

Slope: 2 to 6 percent
Depth to restrictive feature: 20 to 39 inches to lithic bedrock
Natural drainage class: Poorly drained
Runoff class: Very high

Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.6 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: D
Hydric soil rating: Yes

Minor Components

Reaville
Percent of map unit: 5 percent
Landform: Interfluves
Down-slope shape: Convex
Across-slope shape: Linear
Hydric soil rating: No

Chalfont
Percent of map unit: 5 percent
Landform: Flats
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Croton
Percent of map unit: 5 percent
Landform: Depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

ROPF—Rough broken land, shale

Map Unit Setting
National map unit symbol: 1lfvq
Elevation: 250 to 1,300 feet
Mean annual precipitation: 30 to 64 inches
Mean annual air temperature: 46 to 79 degrees F
Frost-free period: 131 to 178 days
Farmland classification: Not prime farmland

Map Unit Composition
Rubble land: 90 percent

Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Rubble Land

Setting

Landform: Hills
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Talus derived from conglomerate

Typical profile

R - 0 to 80 inches: unweathered bedrock

Properties and qualities

Slope: 25 to 40 percent
Depth to restrictive feature: 0 inches to lithic bedrock
Natural drainage class: Well drained

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8s
Hydrologic Soil Group: D
Hydric soil rating: Unranked

Minor Components

Klinesville

Percent of map unit: 5 percent
Landform: Hills
Down-slope shape: Linear
Across-slope shape: Convex
Hydric soil rating: No

Penn

Percent of map unit: 5 percent
Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Hydric soil rating: No

APPENDIX C

GEOTECHNICAL ENGINEERING REPORT

Proactive by Design

GEOTECHNICAL
ENVIRONMENTAL
ECOLOGICAL
WATER
CONSTRUCTION MANAGEMENT

856 So. White Horse Pike
Suite 1
Hammonton, NJ 08037
T: 609.567.9330
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www.gza.com

VIA EMAIL

July 9, 2018 (Revised from July 2, 2018)
File No. 05.0046118.03

EN Engineering
28100 Torch Parkway, Suite 400
Warrenville, Illinois 60555

Attention: Mr. Victor Gasca

Re: Geotechnical Engineering Report, Revision 2
PennEast Interconnect
1325 NJ-179
Lambertville, New Jersey

Dear Mr. Gasca:

GZA GeoEnvironmental, Inc. (GZA) is pleased to submit this geotechnical engineering report to EN Engineering (ENE; Client) for the design and construction of the PennEast Interconnect. GZA's Scope of Services for this work consisted of coordination, management and field observation of subsurface explorations, conducting laboratory testing, evaluating the subsurface conditions and preparing this report. This report summarizes our findings and presents our geotechnical design parameters and recommendations for the proposed PennEast Interconnect. Our Geotechnical Engineering Report, Revision No. 1 (dated July 2, 2018) was revised to address Enbridge comments.

Our work was completed pursuant to the Amendment of Subcontract Agreement between ENE and GZA, dated April 30, 2018. The contents of this report are subject to the *Limitations* contained in **Appendix A**. Unless indicated otherwise, elevations presented herein are in feet and are reference the North American Vertical Datum of 1988 (NAVD 88).

BACKGROUND

Our understanding of the project is based on:

- "Enbridge, PennEast Interconnect, Lambertville, NJ, Geotechnical Investigation Services Specification", prepared by EN Engineering, dated April 18, 2018, Revision No. 1 (Project Specifications);
- Plan entitled "EXR17206602.dwg", provided by EN Engineering;
- Plan entitled "Draft Proposed Drainage System, Penn East, West Amwell, Hunterdon County, New Jersey", prepared by TRX, dated June 2018;
- Plan entitled "PennEast Prelim Grading Plan", provided by EN Engineering via email on June 15, 2018;
- Communications with ENE personnel;
- Available on-line aerial imagery; and
- Observations made by GZA during vacuum excavations and test borings.

An Equal Opportunity Employer M/F/V/H

EXISTING CONDITIONS

The site is an existing natural gas facility that is owned and operated by Enbridge, Inc. (Enbridge) and is located at 1325 NJ-179 in Lambertville, New Jersey. The facility is bordered by a wooded area and Queen Road to the north, wooded areas and open fields to the west, NJ-179 to the south, and Queen Road to the east. The project location is presented on **Figure 1- Site Locus**.

The site generally slopes down from south to north at an inclination between approximately 6 horizontal to 1 vertical (6H:1V) and 8H:1V. Steeper slopes, with inclinations up to approximately 2H:1V, are present near the eastern and western property boundaries, but not within the development described in this report. The site has about 56 feet of topographic relief with a high of about El. 200 feet in the south portion of the site and a low of about El. 135 feet in the northwest corner of the site.

The portions of the site outside of structure footprints consists of grass areas, concrete walkways or asphalt-paved access roads. In the footprint of aboveground pipes, the ground surface is typically crushed stone.

SITE HISTORY

GZA reviewed publicly available aerial photographs and topographic maps of the site to understand site development changes over time. Aerial photographs were available from 1995, 2002, 2003, 2006, 2008, 2009, 2010, 2013, 2015, and 2016 and a topographic map was available that was published between about 1870 to 1887 (date estimated by New Jersey Department of Environmental Protection).

The 2006 through 2016 aerial photographs appear to show the site in its current condition. The above-referenced aerial photographs are presented in **Appendix F**.

PROPOSED CONSTRUCTION

We understand the proposed improvements have been identified as part of the PennEast Interconnect. The PennEast Interconnect includes 1,800 linear feet of new gas piping, a 14,000 square-foot (sf) site building with a partial below-grade level, a 3,300-sf heater building, a 325 sf EGM building, a 5,500 sf bioretention basin, two approximate 2,200 sf sub-surface detention basins, three filter separators, a pig receiver, and ancillary pipeline equipment at the Site. The linear footage of piping and building square footages are approximate. Gravel and asphalt paved access roads are planned through the site. The proposed footprints of primary equipment are shown and labeled on **Figure 2- Exploration Location Plan**.

The new site building has a proposed finish floor elevation between El. 162.5 and El. 166 feet and will require cuts up to about 9.5 feet to construct. The bioretention basin is planned to the west of the site building, has a proposed bottom elevation of 155.4 feet, and will require cuts up to about 5.5 feet and fills up to about 4 feet to construct. Based on a preliminary grading plan, cuts up to 9 feet are required to meet design grade and proposed slopes will be as steep as 3H:1V.

Based on the data provided in the Project Specifications, we understand column loads for the planned foundations range from about 12 to 50 kips. Equipment loads vary, but the equipment is planned to be supported on either spread footing foundations or mat foundations. We understand typical foundation sizes for the planned equipment are 9 feet by 5 feet for a filter separator and 18 feet by 7 feet for a generator.

SUBSURFACE EXPLORATION PROGRAM

A subsurface exploration program consisting of nine test borings (GZ-101 through GZ-109) was conducted for the proposed PennEast Interconnect. The exploration locations and planned depths were selected by ENE and were staked in the field by others. The ground surface elevations at the test boring locations were interpolated from existing topography included in the Project Specifications. The approximate test boring locations are shown on **Figure 2-Exploration Location Plan**.

Test borings GZ-101, GZ-102 and GZ-109 were initially hydro-vacuum excavated by Lone Star, who was under contract to Enbridge. The hydro-vacuum excavations were performed between May 9 and 15, 2018. GZ-101 was excavated to a depth of 8 feet and GZ-102 and GZ-109 were excavated to refusal at depths of 7.2 and 3.8 feet, respectively. Disturbed "grab" samples were collected during vacuum excavation for geotechnical soil classification. GZA personnel used a combination of hand tools and or hand auger along the sidewall of the vacuum excavations to collect soil for the grab samples. Photographs of the vacuum excavations are presented in **Appendix G**. Enbridge personnel approved conventional drilling at each of the test boring locations.

The test borings were advanced beyond the hydro-vacuum excavation depths, or from the ground surface, with conventional drilling methods by Craig Test Boring Company (Craig) between May 18 and May 30, 2018. The field work was performed under the observation of Enbridge and GZA personnel. Test borings GZ-101 through GZ-103 were drilled with an ATV-mounted drill rig and the remaining test borings were drilled with a truck-mounted drill rig. The test borings were advanced using rotary wash drilling methods to depths of about 6 to 15 feet below the ground surface. Split spoon soil sampling was performed either starting below the vacuum excavation depth or from the ground surface at intervals up to 5 feet. Standard Penetration Tests (SPTs) were conducted and split-spoon soil samples were classified according to the Modified Burmister System. In addition, the soil classification symbol corresponding to the Unified Soil Classification System (USCS) is presented on the logs for each sample. NX size (2.1-inch diameter) rock core samples were obtained from GZ-104, GZ-106, and GZ-107 to confirm the presence of bedrock and to assess the type and quality of bedrock at the site. The recovered rock core was described using a modified International Society for Rock Mechanics (ISRM) system. The rock description, rock core recovery values, and Rock Quality Designation (RQD) values were recorded for each rock core run. The RQD reflects the fracture frequency and spacing within each core run and is calculated by summing the lengths of intact core pieces 4 inches or greater in length and dividing that value by the total length of the core run. Groundwater depths were measured during and after hydro-vacuum excavations as noted on the boring logs. The test boring logs are presented in **Appendix B**.

At the completion of drilling, boreholes were filled to the ground surface with cuttings from the boreholes, and/or bentonite chips and filter sand. The test borings were finished at the ground surface with straw and seed in grass areas, cold-patch in asphalt areas, and with gravel in gravel areas. Excess drill soils were spread on the ground surface adjacent to the borehole locations.

FIELD SOIL ELECTRICAL RESISTIVTY TESTING

On May 14, 2018, GZA performed four field electrical resistivity tests with an AEMC Model 6472 resistivity meter using the Wenner (Four-Point) Method. Each test included two sets of resistivity readings performed in an orthogonal array pattern with the midpoints at approximately the same location, field located by tape measurements referencing prominent site features. The probes were spaced at increments of 5 feet, 10 feet, 15 feet, 20 feet and 25 feet. The approximate array locations are shown on **Figure 2- Exploration Location Plan**. Soil electrical resistivity test results including electrode probe spacing, a, depth, b, and measured resistance are presented in **Appendix E**.

The weather conditions during the resistivity surveys consisted of temperatures of approximately 65°F with humidity of approximately 84 percent. The tests were conducted approximately 12 hours after an approximate 0.5-inch precipitation event. Surface water was not observed in the test areas. The test areas were generally level or gently sloping (approximate 10H:1V) and covered with grass.

LABORATORY TESTING

Laboratory tests were performed on soil and rock samples collected from the borings to confirm the visual-manual classifications made in the field and assess engineering and corrosivity properties of the encountered soil and strength of the bedrock included the following:

<u>Geotechnical Index Testing and Results</u>

- 10 water content analyses
- 6 gradation tests
- 1 Axial Point Load Strength Index of rock
- 1 Diametric Point Load Strength Index of rock

Sample ID	Sample Depth	Stratum	Percent Passing No. 200 Sieve	Water Content	Correlated Axial Compressive Strength of Rock**
GZ-104, S-2	2'-4'	Subsoil	39.2%	12.1%	---
GZ-104, S-3	4'-5.4'	Weathered Bedrock	---	7.1%	---
GZ-104, C-1	8'-8.25'	Bedrock	---	---	10.9 ksi
GZ-105, S-2A	2'-4'	Subsoil	85.9%	15.7%	---
GZ-106, S-2	2'-4'	Weathered Bedrock	---	12.4%	---
GZ-106, S-3	4'-6'	Weathered Bedrock	35.2%	10.8%	---
GZ-107, S-2	2'-4'	Subsoil	---	17%	---
GZ-108, S-2	2'-4'	Subsoil	76.2%	18.9%	---
GZ-108, S-3	4'-6'	Weathered Bedrock	---	11.8%	---
GZ-109, S-1	4'-4.8'	Weathered Bedrock	35.7%	13.5%	---
GZ-109, G-2	1'-3.75'	Fill	18.4%	8.1%	---
**Estimated compressive strength based on a generalized correction factor, K, equal to 24. Refer to laboratory data for Is(50mm) value.					

Corrosivity Test Suites and Results

GZA collected four representative samples from the test borings for submission for corrosivity testing in an attempt to characterize the typical condition for the site at the indicated depths. Corrosivity analyses include pH, electrical resistivity, Sulfate, Sulfide, Chloride, and Oxidation-Reduction Potential (ORP).

Sample ID	Sample Depth	Stratum	pH	Electrical Resistivity	Sulfates**	Sulfide**	Chloride	ORP
GZ-102	5'	Fill	5.04	15,496 ohm-cm	<10 mg/kg	<0.61 mg/kg	41 mg/kg	181.9
GZ-103	5'	Subsoil	6.18	2,583 ohm-cm	24 mg/kg	<0.60 mg/kg	54 mg/kg	177.4
GZ-105	4-6'	Weathered Bedrock	5.95	5,682 ohm-cm	26 mg/kg	<0.56 mg/kg	132 mg/kg	180.0
GZ-107	2-6'	Subsoil	5.75	6,715 ohm-cm	24 mg/kg	<0.54 mg/kg	30 mg/kg	180.6
** "<" indicates the constituent was not detected (ND) above the stated reporting limit for the analysis.								

Laboratory test reports are included in **Appendix C**.

SUBSURFACE CONDITIONS

Based on the 1999 U.S. Geological Survey (USGS) Map of New Jersey, bedrock at the Site is mapped to be within the red beds, which consists of Passaic Formation (Lower Jurassic and Upper Triassic) argillaceous siltstone, silty mudstone, fine grained sandstone, and shale. GZA's findings from the exploration program are consistent with published bedrock information.

SOIL STRATA

A general description of the subsurface strata encountered in the explorations is presented below, in order of increasing depth. Refer to the boring logs in **Appendix B** for conditions encountered in each exploration. A summary of subsurface conditions is provided in **Table 1**.

Fill – Approximately 0.2 to 3.8 feet of Fill was encountered at the ground surface at test boring locations GZ-104 and GZ-107 through GZ-109. These borings are located in or near existing gravel or paved areas. The fill at test boring GZ-104 and GZ-107 ranged from 2 to 6 inches thick and generally consisted of Gravel overlying geotextile fabric. At GZ-108, the Fill appeared to consist of 3 inches of topsoil overlying 4 inches of gravel overlying about 7 inches of base course. Within GZ-109, Fill was encountered below approximately 3 inches of asphalt pavement. The upper 9 inches of Fill appeared to be base course and consisted of gray, fine to coarse GRAVEL with up to 35% fine to coarse Sand and up to 20% Silt (USCS: GM). Below the base course, the Fill at GZ-109 appeared to be red-brown, fine to coarse GRAVEL with up to 50% SILT and up to 20% fine to coarse Sand (UCSC: GM). One sample of Fill was sampled with a split spoon in GZ-108 and the field SPT N-value was 18, indicating medium dense material.

Fill was also encountered below the Topsoil/Subsoil in test borings GZ-101 and GZ-102. The Topsoil/Subsoil at these two explorations ranged from 0.8 to 1 feet thick, and the underlying Fill extended to depths of about 4 feet and 7.2 feet, respectively. The upper several feet of the fill at GZ-101 and GZ-102 consisted of red-brown, COBBLES with up to 35% Silt, up to 20% fine to coarse Sand, and up to 20% fine to coarse Gravel (USCS: GM). Within GZ-102, the fill transitioned to debris-laden, brown, fine to coarse SAND with up to 35% Silt and up to 20% Gravel (USCS: SM) at a depth of about 4 feet. The debris was observed to include metal, wood, pieces of 1-inch piping, fabric, and wiring. SPT N-values were not measured for the Fill within test borings GZ-101 nor GZ-102 because it was within the depth of vacuum excavation. Photographs of the debris encountered at GZ-102 are included in **Appendix G**.

Topsoil/Subsoil – Approximately 0.3 to 1 foot of Topsoil was encountered at the ground surface in 5 of the 9 test borings. Topsoil generally consist of brown SILT with up to 50% fine to coarse Sand and up to 35% Gravel (UCSC: ML).

Approximately 2.5 to 5.7 feet of Subsoil was encountered below Topsoil or Fill in 8 of the 9 test borings. Test boring GZ-109 did not encounter Subsoil. Subsoil generally consisted of brown, SILT with 0% to 50% fine to coarse Gravel, 20% to 50% fine or fine to coarse Sand, and up to 10% Roots (USCS: ML). Field SPT N-values were obtained from the Topsoil/Subsoil layer within test borings GZ-104, GZ-105, GZ-107 and GZ-108; ranging from 12 to 34, averaging about 20, indicating a medium dense material.

Weathered Bedrock – Weathered Bedrock was encountered in each of the explorations at depths between 0.4 and 7.2 feet below the ground surface. Based on a combination of confirmatory rock coring and inferred top of competent Bedrock based on rollerbit resistance or split spoon refusals, the Weathered Bedrock varied between approximately 3 and 9.2 feet thick. Weathered Bedrock generally consisted of red-brown, SILT with up to 50% Gravel and 0% to 20% fine to coarse Sand (USCS: ML) or red-brown GRAVEL with 10% to 20% Silt (USCS: GM). Field SPT N-values ranged from 31 to refusal (greater than 50 blows over 6 inches), indicating a dense to very dense material.

Bedrock- Competent Bedrock was inferred in the test borings based on rollerbit resistance at depths between 6 and 15.2 feet below the ground surface. Bedrock was confirmed at test boring locations GZ-104, GZ-106 and GZ-107 by coring 5 feet. The Bedrock cores generally consisted of moderately hard, moderately weathered, moderately to extremely fractured, amorphous, red-brown SHALE. Rock core recovery values varied between 92% and 100% and RQD values varied between 0% and 7%, indicating very poor rock quality. Photographs of the rock cores are presented in **Appendix D**.

GROUNDWATER

Groundwater was attempted to be measured within each of the test borings prior to introduction of drilling wash water. However, groundwater was only measured in borings GZ-101 and GZ-102 at depths of 6.5 and 8 feet, respectively. Based on observations in the field, groundwater is likely at, or near the top of Weathered Bedrock seasonally and related to local precipitation. Measured groundwater depths and elevations at each boring are presented on the test boring logs in **Appendix B** and summarized on **Table 1**.

Groundwater observations have been made at the times and under the conditions stated in the boring logs. Groundwater measurements made during drilling may not represent stabilized groundwater conditions. Fluctuations in groundwater levels will occur due to seasonal influences, precipitation, nearby construction, and other factors different from those existing at the time the observations were made.

IMPLICATIONS OF SUBSURFACE CONDITIONS

The primary geotechnical issues impacting the design and construction of the proposed improvements is the presence of:

- 0.4 to 6 feet of Topsoil/Subsoil and/or 0.2 to 6.2 feet of Fill in each of the test borings;
- The presence of rock at relatively shallow depths; and
- Groundwater likely at the top of Weathered Bedrock, which corresponds to depths as shallow as 0.4 feet.

Topsoil/Subsoil and existing Fill are not suitable bearing layers and there is potential that footings or piping underlain by Topsoil/Subsoil or existing Fill could experience undesirable total and differential settlement. Therefore, these strata should be excavated and replaced with Structural Fill. Removal of the unsuitable material is estimated to require excavating to depths of up to about 7 feet below the ground surface based on the borings. The presence of relatively shallow rock may impact the planned pipeline construction by requiring more robust excavation equipment and/or the need to remove more competent rock via mechanical chipping, chemical/hydraulic fracturing, and/or blasting. Groundwater is likely at, or near the top of Weathered Bedrock and will need to be temporarily pumped during excavations.

RECOMMENDATIONS

This section presents geotechnical recommendations for the project, including foundation design parameters for shallow foundations, geotechnical seismic design parameters, and excavation considerations. The recommendations presented in this section are based on the results of our subsurface explorations and laboratory testing, and the 2015 International Building Code (IBC) with New Jersey errata, which together constitute the New Jersey Building Code (NJBC).

The engineering properties and recommendations are based on removal of existing Fill and Topsoil/Subsoil within the bearing zone of new structures and proof compaction of subgrades as described in the CONSTRUCTION section herein. The existing Fill and Topsoil/Subsoil should be removed from the footprint of the structure and the bearing zone, as defined by a 1 horizontal to 1 vertical (1H:1V) slope extending downward and outward from one foot outside the edge of the exterior foundation.

Soil Engineering Properties		
Soil Parameter	**Units**	**Design Value*** New Structural Fill or Weathered Bedrock**
Friction Angle, ϕ	degrees	36 – 38
Cohesion	psf	0
Unit Weight- Dry, γ_d	pcf	120 – 130
Unit Weight- Moist, Unsaturated, γ_m	pcf	125 – 135
Unit Weight- Saturated, γ_t	pcf	130 – 140
Unit Weight- Effective, Buoyant, γ_e	pcf	68 – 78
Shear Wave Velocity	ft/sec	700 – 1,500
Dynamic Shear Modulus, G	ksi	12 – 75
Poisson's Ratio, ν	Unitless	0.35 – 0.33

Shallow Foundation Design Parameters		
Design Parameter	**Units**	**Design Value*** New Structural Fill or Weathered Bedrock**
Net Allowable Bearing Capacity*	psf	4,000
Vertical Modulus of Subgrade Reaction	pci	250
Lateral Modulus of Subgrade Reaction	pci	150 – 400
Friction Against Unformed (mass) Concrete	degrees	28 – 29
Friction Against Formed Concrete	degrees	22
Shallow Foundation Design Parameters		
Design Parameter	**Units**	**Design Value*** New Structural Fill or Weathered Bedrock**
Passive Lateral Earth Pressure Coefficient**	K_p	3.85
Active Lateral Earth Pressure Coefficient**	K_a	0.26
At-Rest Lateral Earth Pressure Coefficient**	K_0	0.41

Notes:
* Allowable bearing capacity is based on an estimated 0.5 inches or less of settlement and a factor of safety of at least 3 relative to ultimate bearing capacity.
**Lateral earth pressure coefficients assume a horizontal backfill surface.
***Lower design value applicable to foundations bearing on Structural Fill and larger design value applicable to foundations bearing directly on Weathered Bedrock. Both values should be checked for design.

GZA has developed engineering properties for the design of proposed foundations at the site based on the results of the test borings. Recommended geotechnical soil design parameters are presented below.

FOUNDATIONS

Based on the subsurface conditions and the structural loads provided, we recommend shallow foundations to support the proposed structures and equipment. Accordingly, we have not provided deep foundation recommendations in this Report.

Spread Footings/Mat Foundations – Following subgrade preparation, spread footings or mat foundations may be supported on either new compacted Structural Fill, on Weathered Bedrock or on Bedrock. Net allowable bearing pressures for shallow foundations are indicated in the Soil Engineering Properties Table above. The minimum footing width is 2 feet for isolated footings and 2 feet for continuous footings.

For site preparation and foundations designed and constructed in accordance with the recommendations of this report, the estimated total post-construction settlement is 0.5 inch or less, with potential differential settlement of about half the total amount between adjacent columns or over a distance of 25 feet across a mat foundation.

For frost protection, all exterior footings and interior footings in unheated areas should be at least 3.5 feet below final grade. For interior footings in heated areas, the bottom of the footing should be at least 18 inches below the lowest ground surface or floor slab immediately adjacent to the footing.

Slab-on-Grade/Mat Foundation – Following subgrade preparation, recommended subgrade for slabs-on-grade/mats consists of Structural Fill placed over Weathered Bedrock or Bedrock. A minimum 8-inch-thick Sand-Gravel Fill or Crushed Stone base course is recommended beneath slabs-on-grade. Selection and installation of a vapor barrier, if used, is recommended to follow ACI 302.1R-6.

For slabs-on-grade in unheated areas with no perimeter wall footing that extends below the frost zone, the footprint of the slab should be over-excavated a minimum of 3.5 feet below finish grade and backfilled with non-frost susceptible material. Non-frost susceptible material includes Crushed Stone and Sand-Gravel fill

The recommended modulus of subgrade reaction (assuming a one-foot square plate at the ground surface) is provided in the Engineering Properties Table above**.**

Lateral Loads – The recommended soil-concrete interface friction angles to resist sliding for unformed and formed concrete are included in the Engineering Properties Table above. In cases where insulation or vapor barriers are used beneath the foundation element, the sliding resistance should be either neglected or further evaluated at the soil/insulation or soil/barrier interface by the structural engineer based on published friction factors for the selected product.

Recommended earth pressure coefficients are provided in the Engineering Properties Table above. These coefficients may be multiplied by the unit weight (total or buoyant as appropriate) provided in the Engineering Properties Table to develop equivalent fluid pressures**.** These coefficients assume horizontal backfill and a vertical soil/concrete interface. For buoyant lateral earth pressures, free draining backfill (Sand-Gravel) should be used for wall backfill within 3 feet laterally of the back of the wall. Wall drains are recommended for any building walls subject to unbalanced lateral earth pressures. Wall drains should consist of a 4-inch diameter perforated plastic (PVC) pipe surrounded by Crushed Stone, which is in turn is separated from the wall backfill with Filter Fabric at footing grade.

Larger deflections are required to mobilize passive resistance and it is recommended that passive pressure not be included as a resisting force when analyzing for overturning and sliding. Passive pressure should not be used to resist permanent lateral loads.

Dynamic Loading - The subgrade below vibrating equipment loads will consist of Weathered Bedrock, Bedrock or Structural Fill overlying Weathered Bedrock. Shear wave velocity, Poisson's ratio, and small-strain shear modulus recommended for dynamic design are presented in the Engineering Properties Table above.

Based on our experience with similar projects and in consideration of the relative density and bearing capacity of the foundation support soils, we do not anticipate that soil strength loss or additional permanent displacement will occur under transient dynamic loads if support soils are prepared in accordance with this Report. However, it should be noted that GZA was not provided with the actual vibration loading for the proposed equipment and has not conducted soil-structure interaction evaluations.

GEOTECHNICAL SEISMIC EVALUATION

Seismic Design Parameters – A review of the test boring data indicates the encountered soil has average SPT N-values greater than 50. Therefore, the site should be designated as Site Class C in accordance with Section 1613.3.2 of IBC 2015. Seismic design parameters were developed using Figures 1613.3.1 and Table 1613.3.3(1 and 2) of IBC 2015, and are presented in the table below.

SEISMIC DESIGN PARAMETERS	
Parameter	**Design Value (g, 5% critical damping)**
Mapped Short Period Spectral Value, S_S	0.225
Mapped 1-second Period Spectral Value, S_1	0.065
Short Period Site Coefficient, F_a	1.2
1-second Period Site Coefficient, F_v	1.7

Liquefaction Potential – The site was also evaluated for liquefaction potential during an earthquake. The term "liquefaction" describes a phenomenon in which cohesionless soil experiences a substantial reduction in effective stress during an earthquake, and acquires a degree of temporary mobility sufficient to permit substantial settlement and/or loss of bearing capacity. We evaluated the liquefaction susceptibility using the Idriss and Boulanger (2008) empirical methodology, and our results indicate the potential for liquefaction to occur during the IBC design earthquake is very low.

ACCESS ROAD DESIGN

Planned access road areas should be cleared and grubbed of Topsoil, trees and stumps, and cut to at least 1.5 feet below proposed road grade. It is anticipated that the subgrade will consist of Subsoil, Fill or Weathered Bedrock. The exposed subgrade should be proof-rolled and compacted under the observation of the Geotechnical Engineer as described in the CONSTRUCTION section below. Granular Fill should be used as fill to within 1.5 feet of final road grade.

It is anticipated that the access roads will be subject to predominantly lightweight vehicles (passenger cars/trucks). Heavy truck traffic is anticipated to consist of routine delivery vehicles and service/repair trucks, with a total traffic loading of less than 300,000 Equivalent Standard Axle Loads over a 20-year service life.

Based on the anticipated subgrade conditions, we recommend the following minimum cross-sections for new road areas:

Material	Recommended Road Section Thickness
Pavement Finish Course (Paved Roads Only)	1.5 inches
Pavement Binder Course (Paved Roads Only)	2 inches
Crushed Gravel (Dense Graded Aggregate)*	6 inches
Sand-Gravel	12 inches

*For gravel roads, gradation of upper 6 inches should be confirmed with Enbridge for standard requirements or preferences for use by vehicles.

ELECTRICAL RESISTIVITY

Calculated electrical resistivity values are presented in the table below. The results presented are the average of the two arrays performed at each test location and are generally consistent with referenced values provided in "Foundation Engineering" (Ralph B. Peck, 2nd Edition) for Clay and saturated Silt (0 – 10,000 ohm-centimeters) or Sandy Clay and Wet Silty Sand (10,000 – 25,000 ohm-centimeters). See **Appendix E** for additional details of the testing.

Electrode Spacing, a (feet)	ER-1 Apparent Resistivity, Average (Ohm-cm)	ER-2 Apparent Resistivity, Average (Ohm-cm)	ER-3 Apparent Resistivity, Average (Ohm-cm)	ER-4 Apparent Resistivity, Average (Ohm-cm)
5	12,200	7,330	11,900	3,500
10	14,900	6,020	12,100	4,650
15	16,100	6,000	12,300	5,220
20	16,200	6,330	12,600	5,080
25	15,500	6,920	12,200	4,530

PERMANENT SOIL SLOPES

Permanent cut and fill slopes in the on-site soils should not be steeper than 2.5H:1V and should be provided with loam and seed for permanent erosion protection. Soil slopes steeper than approximately 3H:1V are not currently planned. If debris-laden existing fill is exposed in the side slopes, it should be excavated to a lateral distance at least 5 feet behind the permanent slope and replaced with Ordinary Fill. Slopes of 4H:1V or steeper may exhibit surface instability prior to establishment of vegetation during rain events. A temporary, biodegradable erosion control mesh (jute mesh or equivalent) should be placed over the loam to limit instability prior to vegetation growth.

PERMANENT GROUNDWATER CONTROL

Groundwater was measured in the 2018 GZA explorations to be between 6.5 and 8 feet below the existing ground surface and was measured in the 2017 GZA explorations to be about 2 feet below the ground surface. Groundwater is likely directly over Weathered Bedrock. For structures that will require excavation of Weathered Bedrock to meet design finish floor elevations (i.e., Site Building), we recommend an underdrain system to reduce the likelihood of water becoming trapped beneath the slab-on-grades and top of Weathered Bedrock.

The underdrain system should consist of a 12-inch-thick layer of ¾-inch crushed stone underlain by geotextile filter fabric with a network of 4-inch diameter perforated SDR 35 pipes to collect water. Based on proposed grading, it appears the underdrain systems can gravity drain. However, if the system is unable to be drained by gravity, the

underdrain pipes should lead to a sump with a duplex pump system. We recommend a backup generator to run the pumps during power failures.

FILL MATERIALS

For the purposes of this report, the term Structural Fill is fill material placed and compacted for support of structures and can include the materials described below with the exception of Ordinary Fill and Sand Fill. The following materials and their respective applications are recommended for use on this project.

Crushed Stone

This material is recommended for use as an element of temporary drainage systems or as a stabilization layer. Where used in thicknesses over 4 inches, Crushed Stone should be wrapped in non-woven filter fabric. Crushed Stone should consist of ¾-inch minus angular crushed stone and shall conform to 2007 NJDOT Standard Specifications for Road and Bridge Construction, Table 901.11-1, gradation I-6. Crushed Stone shall consist of durable crushed rock or durable crushed gravel stone, free of organics, deleterious materials, clay, ice, snow, and waste of any kind and meet the gradation tabulated herein.

Crushed Gravel (Dense Graded Aggregate for Base)

This material is recommended for use as base course in the roadway section. Crushed Gravel should meet 2007 NJDOT Standard Specifications for Road and Bridge Construction, Table 901.10.01-1, Gradation Requirements for DGA and consist of durable stone and coarse sand, free of organics, deleterious materials, clay, ice, snow, and waste of any kind and meet the gradation tabulated herein.

Sand-Gravel

This material is recommended as backfill for foundation walls, as a base course beneath the floor slab, use within the bearing zone of footings, and in other free-draining, potential frost area applications. Sand-Gravel should meet 2007 NJDOT Standard Specifications for Road and Bridge Construction, Table 901.11-1, gradation I-3 and consist of clean sand, gravel and/or aggregate, free of organics, deleterious materials, ice, snow, and waste of any kind and meet the gradation tabulated below. The fine fraction should NOT consist of Clayey Silt, Silty Clay, Clay, Organic Silt, Organic Clay or Peat. Water content by weight during compaction should not exceed ±2 percent of optimum moisture as determined by ASTM D 1557.

Granular Fill

This material is recommended for use within the bearing zone of footings and below slab-on-grade base course. Granular Fill should meet the 2007 NJDOT Standard Specifications for Road and Bridge Construction, Table 901.11-1, gradation I-5 and consist of clean sand, gravel and/or aggregate, free of organics deleterious materials, ice, snow, and waste of any kind, and meet the gradation tabulated below. The fine fraction should NOT consist of Clayey Silt, Silty Clay, Clay, Organic Silt, Organic Clay or Peat. Water content by weight during compaction should not exceed ±2 percent of optimum moisture as determined by ASTM D 1557.

Filter Fabric

Filter Fabric should be used to separate Crushed Stone from surrounding soils. The fabric should consist of a filtration-type non-woven geotextile (i.e., Mirafi 140N or equivalent).

Structural Fill Gradations

Particle Size	Percent Passing by Weight			
	Crushed Stone	Crushed Gravel	Sand-Gravel	Granular Fill
5½ - inch				
4 - inch				
2 - inch				100
1½ inch		100	100	
1 - inch	100			
¾ - inch		55-90	60-90	70-100
½ - inch	80-100			
3/8 - inch				
¼ - inch				
No. 4		25-50	40-80	30-80
No. 8	45-100			
No. 16	30-90			
No. 50	0-20	5-20	10-35	10-35
No. 100	0-3			
No. 200		3-10	0-8	5-12

Ordinary Fill

Ordinary Fill for use in non-structural areas, provided the material is stable, can be compacted to the required density as described later in this report. Ordinary Fill should consist of on-site mineral material, free of organics, deleterious materials, ice, snow, and waste of any kind. The maximum particle size should be no greater than two-thirds of the lift thickness. Water content by weight during compaction should not exceed ±3 percent of optimum moisture as determined by ASTM D 1557.

Sand Fill

Sand Fill for use as backfill around utilities should meet Enbridge requirements (if any) or the following gradation: 100% passing No. ½-inch sieve, 85-100% passing the 3/8-inch sieve, 10-30% passing the No. 4 sieve, 0-10% passing the No. 8 sieve, and 0-5% passing the No. 16 sieve.

FILL PLACEMENT AND COMPACTION

Prior to placing new fills, all existing subgrades steeper than 5H:1V should be benched to roughly horizontal to facilitate equipment travel and to avoid sloped material interfaces. Fill operations should start at the lowest bench. In addition, all loose materials and slough created at the edges of compacted lifts should be cut during placement of adjacent lifts to ensure uniform compaction. Fill slopes are recommended to be over-built horizontally, and then cut back to finish slope grade to remove the uncompacted edges of each lift.

Representative samples of all fills and backfills for use on the project should be submitted to the Geotechnical Engineer and tested for gradation prior to use. The materials should be tested using the Modified Proctor method (ASTM D1557) to determine maximum dry density and optimum moisture content. Field compaction should be measured prior to placing subsequent lifts. The following minimum compaction criteria are recommended:

Location and Depth of Fill	Percent of Maximum Dry Density (ASTM D1557)
Beneath Foundations and Slabs (1)	95
Adjacent to exterior foundation walls	92
Gravel Road within 4 feet of finished grade (2)	95
Gravel Road greater than 4 feet below finished grade	92
Non-structural areas	90

1. Includes area within bearing zone (1H:1V slope) of bottom of footings.
2. The following paragraph regarding gravel fills applies to the crushed stone surfacing.

Gravel fills containing greater than 30 percent coarse gravel (¾-inch size) may not be reliably tested in the field for compaction using conventional methods. A visual compaction assessment method may be appropriate in the cases under the direction of the Geotechnical Engineer.

Guidance for maximum loose lift thicknesses for soil fill and the minimum number of passes of compaction equipment is summarized on the following table. Specifications should require the contractor to adjust loose lift thicknesses as required to meet the required compaction requirements. The table below provides guidance for loose lift thicknesses based on the compaction equipment to be used.

The Contractor should reduce or stop drum vibration if pumping or weaving of the subgrade is observed. Crushed Stone should be compacted to an unyielding surface.

Compaction within 5 feet of foundation walls should be performed using hand-operated roller or plate compactors to reduce the potential for construction-induced damage to the walls. Where walls are buried on both sides, backfill and compaction should proceed on both sides of the wall so that the difference in top of fill on either side does not exceed 2 feet.

		Maximum Loose Lift Thickness		Minimum Number of Passes	
Compaction Method	**Maximum Stone Size**	**Below/ Adjacent to Structures and Gravel Road**	**Non-Structural Areas**	**Below/ Adjacent to Structures and Gravel Road**	**Non-Structural Areas**
Hand-operated vibratory plate or light roller in confined areas	3”	6”	8”	6	4
Hand-operated vibratory drum rollers weighing at least 1,000# in confined areas	6”	8”	10”	6	4
Light vibratory drum roller, minimum dynamic force 3,000# per foot of drum width	6”	10”	14”	6	4
Medium to heavy vibratory drum roller, minimum dynamic force 5,000-8,000# per foot drum width	8”	12”	18”	6	4

EXCAVATED MATERIAL RE-USE AND DISPOSAL

The existing on-site materials and the recommended imported materials are non-expansive. Based on visual classifications and laboratory testing, the on-site soils (Subsoil, Fill and Weathered Bedrock) will not meet the gradation recommended for Granular Fill or Structural Fill and are frost susceptible. However, the on-site soils can be used as Ordinary Fill in non-structural and non-drainage areas. Excavated Topsoil and excess excavated material that cannot be re-used elsewhere on site in non-structural and non-drainage applications should be transported off-site in accordance with local, State, and federal regulations. GZA’s Scope of Services did not include chemical screening or testing.

CONSTRUCTION

Subgrade Preparation- Foundations and Slabs-On-Grades

Existing structures and foundations, existing Fill, Topsoil/Subsoil and existing utilities, if encountered, should be completely removed from within planned building areas, including the bearing zone of footings and mats, as defined by a 1 horizontal to 1 vertical (1H:1V) slope extending downward and outward from one foot outside the edge of the exterior foundation. Prior to placement of any new fills or construction of foundations, mats, and slabs, the exposed naturally-deposited subgrade soils should be proof-compacted with multiple passes of a large vibratory drum roller (with a minimum static drum weight of 15,000 pounds) under the observation of the Geotechnical Engineer, except where competent Bedrock is exposed. Weak or soft spots identified during proof-compaction should be excavated and replaced with Structural Fill. Vibration should be discontinued if disturbance or weaving of the subgrade is observed.

Proof-rolling and compaction may be waived or modified if, with the Geotechnical Engineer's concurrence, it is determined that this will disturb an otherwise suitable subgrade based on observed field conditions or it is not feasible to provide the specified equipment in the excavation area.

The natural bearing soil (Weathered Bedrock) has relatively high silt content and is susceptible to disturbance from water, weather and construction activities and should be protected with 6 inches of Sand-Gravel, or at least 4 inches of ¾-Crushed Stone, or a lean concrete mud mat. If the Crushed Stone is greater than 4 inches thick, it should be wrapped in non-woven filter fabric. If the subgrade soils become disturbed during construction, they should be over-excavated and replaced with compacted Structural Fill.

Frozen subgrades should be stripped and replaced with compacted Structural Fill. Optionally, the frozen subgrade may be thawed by means approved by the Geotechnical Engineer, scarified, and re-compacted. Soil bearing surfaces below completed foundations and slabs should also be protected against freezing after concrete placement. If construction is performed during freezing weather, footings on soil should be backfilled to a sufficient depth as soon as possible after they are constructed. Alternatively, insulating blankets or other measures should be used for protection against freezing.

Subgrade Preparation- Access Roads

Existing Fill and other deleterious materials (pavement, utilities, slabs, foundations, topsoil/subsoil, etc. if encountered) should be removed to 1.5 feet below the proposed finished elevation and 1.5 feet horizontally outside the access road limits. Debris-laden material should be completely removed. Prior to any fill placement, the subgrade soils should be proof-compacted with multiple passes of a large vibratory drum roller (with a minimum static drum weight of 15,000 pounds) under the observation of the Geotechnical Engineer. Any weak or unstable areas identified should be overexcavated and replaced with compacted Granular Fill. Vibrations should be discontinued if disturbance or weaving of the subgrade is observed.

Subgrade Preparation- Utilities

All existing Fill and other deleterious materials (pavement, utilities, slabs, foundations, etc. if encountered) should be removed within 1 foot (horizontally and vertically) of the proposed underground utility. Final excavation to trench bottom should be with a smooth-edged bucket to limit disturbance. Prior to any fill placement, the subgrades should be heeled with the bucket of an excavator. Any weak or unstable areas identified should be over-excavated and replaced with compacted Structural Fill.

Sand Fill should be placed around installed utilities. We recommend a minimum of 6 inches of Sand Fill Bedding and 12 inches around the sides and above utilities. Additional Sand Fill thickness is acceptable as required by ENE, Enbridge and/or the engineer responsible for pipe design. The Sand Fill should be chinked under and around utilities using hand tools. Granular Fill should be used to backfill the remainder of the utility trench. Compaction with a vibratory plate compactor should be performed after 18 inches of cover is placed above the utility.

For the proposed sub-surface detention basins, we recommend seepage collars between the proposed basins and down gradient manholes. The seepage collars are intended to reduce the potential for water (groundwater, surface water, and or basin stored water) to flow along the outside of the conduit, which is typically backfilled with more permeable material than the surrounding soil. The seepage collars are also intended to increase the length of flow path for seepage water. We recommend the seepage collar consist of concrete, extend to the width of the pipe trench, and extend to at least one foot above the top of drain pipe. Alternatively, the general contractor may choose to submit an alternative seepage collar for approval. The seepage collar should be backfilled to either one foot below proposed ground surface in landscaped areas or to the bottom of proposed access road section in parking or road areas. For the area above the

one foot of concrete extending above the drain pipe, the seepage collar can be backfilled with either recompacted Weathered Bedrock, recompacted Subsoil, or concrete.

These recommendations can be superseded by Enbridge standard trench details if desired by Enbridge or ENE. Excavation for proposed utilities should be coordinated with foundation construction. Utility excavations should not be performed within the bearing zone of foundations unless underpinning of the foundations is performed.

Subgrade Preparation- Site Grading

In areas of proposed grade raises, Topsoil and other deleterious material (roots, tree stumps, etc.) should be removed prior to start of grading operations. The exposed subgrade should be proof-compacted with multiple passes of a large drum roller. The proof-compaction can be performed using either vibrations or statically. Any weak or unstable areas identified should be over-excavated and replaced with compacted Ordinary Fill. Vibrations should be discontinued if disturbance or weaving of the subgrade is observed.

Bedrock Excavation

The proposed finish floor elevation of the Station Building is El. 162.5 to 166 feet. Weathered Bedrock was encountered in the vicinity of the Station Building at elevations ranging from 159.5 to 172 feet and Bedrock was inferred at elevations between 157 to 168.7 feet. Construction of the Station Building will require excavation of Weathered Bedrock and Bedrock. It is likely that portions of the proposed piping alignment and construction of the heater building may also require excavation of Weathered Bedrock.

In general, the upper several feet of Weathered Bedrock were able to be sampled with a split-spoon sampler and may be able to be excavated with larger excavation equipment. However, the Weathered Bedrock became more competent with depth and excavation by ripping may be ineffective. Mechanical Chipping, chemical/hydraulic fracturing, and/or blasting may be required to remove the more competent Weathered Bedrock and Bedrock. The method of Bedrock excavation is typically a function of multiple factors, including the Contractor's ability, Owner/Contractor preference, cost analyses, and perceived risk to adjacent structures and the public. We anticipate that mechanical chipping will be the method of choice.

Mechanical chipping is a process in which a hydraulic vibratory impact tool, commonly referred to as a hoe ram, is used to break the Bedrock via repeated impacts. In highly jointed Bedrock, as is expected at the Site, it is sometimes feasible to remove rock by mechanical chipping without drill holes. In harder and/or less jointed rock, it is typically necessary to drill a pattern of holes to allow the hoe ram to chip smaller pieces of rock from the rock mass. Mechanical chipping will impart a significant amount of low frequency vibrations into the ground, which will be transmitted to nearby structures. The imparted energy will be attenuated with increasing distance and it is not likely that the imparted energy would be damaging to nearby structures. However, the vibration threshold of human perception is much lower than that which may potentially damage a structure and may lead to complaints and or concerns from the Station facility.

Chemical/hydraulic splitting is often the most expensive option and is typically used to break apart boulders, concrete, or very small volumes of bedrock. Chemical/hydraulic splitting consists of predrilling holes and using hydraulic tools or chemical agents to split the bedrock. It requires extensive rock drilling but causes significantly less vibration than mechanical chipping.

Controlled blasting is commonly used for bedrock excavation where bedrock excavation depths are a few feet or more, a large quantity of rock requires removal, and/or rock is hard and competent. Controlled blasting often encounters resistance by the public. If blasting is used, precautions on this site should include: pre-blast and post-blast surveys; submittal of a detailed blasting plan to the owner for review by the geotechnical engineer; the limitation of peak particle velocities and air pressures; limiting explosives to appropriate scaled distances; and monitoring the blasting activity. All

over-blasted bedrock should be evaluated by the geotechnical engineer to determine if it can be compacted in-place or must be removed and replaced with controlled fill or crushed stone.

Excavation Support

Excavation slopes should be flattened or braced to maintain stability. All excavations should be performed in accordance with current OSHA and Enbridge requirements under the observation and responsibility of the project contractors. Construction site safety generally is the responsibility of the Contractor, who shall also be solely responsible for the means, methods, and sequencing of construction operations. We are providing this information as a service to our client.

Based on material encountered in the test borings, it is anticipated that Weathered Bedrock in excavations would generally be classified as Type B soil and Subsoil/Fill would be classified as Type C soil, in accordance with OSHA regulations. OSHA recommends a maximum slope inclination of 1H:1V for Type B soils and 1.5H:1V for Type C soils. However, the excavation should be evaluated and confirmed by the Contractor's Competent Person. Excavation slopes should be checked regularly for signs of instability and should be shored or flattened as required. Temporary slopes should be protected from surface run-off erosion to promote stability of the slope, by means of berms and swales located along the top of the slope, a flattened slope inclination and/or plastic sheeting placed over the slope.

Based on our understanding of the anticipated construction, we do not anticipate that an excavation support system will be required to reduce excavation requirements or to manage groundwater. However, if an excavation support system is used, the system should be designed by a Professional Engineer licensed in the State of New Jersey.

Protection of Existing Structures

Excavations for planned footings, slabs-on-grade, and utilities may be close to existing on-site foundations and utilities. Particular care should be taken to avoid undermining of these features that are to remain. The Contractor should obtain and review Enbridge information, particularly for buried utilities and grounding lines. The Contractor may be required to perform vacuum excavations or hand excavations at the proposed foundation locations to ensure the safety of workers and maintain uninterrupted service of existing on-site utilities during construction.

During excavation, construction procedures should be used that permit visual identification of foundation subgrades. In no case should excavation be performed within a 2H:1V line extending downward and outward from the bottom of existing footings/foundation walls/slabs of adjacent buildings or structures. Slopes adjacent and below existing footings should be protected from erosion and storm water runoff.

Construction Dewatering

Groundwater is anticipated to be encountered at, or near the top of, Weathered Bedrock. It is anticipated that excavation at or above these depths can be completed in-the-dry. Should groundwater be encountered during excavation, pumping from localized sumps should be sufficient to control groundwater.

It is also recommended that temporary control measures be implemented to reduce the amount of surface water (from rainfall runoff) from potentially entering and ponding in the excavations. Temporary measures should include, but not be limited to, construction of drainage ditches to divert and/or reduce the amount of surface water flowing over exposed subgrades during construction. Precipitation that results in standing water in the excavation should be removed immediately.

ADDITIONAL GEOTECHNICAL SERVICES

We recommend that GZA be consulted to prepare geotechnical specifications, review bids, submittals and shop drawings developed by earthwork contractor(s) to assess compliance with the plans and specifications. In addition, GZA should provide on-site construction quality assurance support during earthwork activities.

CLOSURE

We appreciate the opportunity to work with you on this project. Please call us with any questions.

Very truly yours,

GZA GEOENVIRONMENTAL, INC.

James F. Davis, P.E. (NY)
Project Manager

Ernest Hanna, P.E.
Principal-in-Charge

Andrew R. Blaisdell, P.E. (NY)
Consultant/Reviewer

J:_46,000-46,499\46118.h18 EN Engineering\46118-03.jfd Lambertville Compressor Station II\Reports\REV 2\46118.03- PennEast Interconnect- REV2 Geotechnical Engineering Report- GZA.docx

Attachments:
- Table 1 – Summary of Subsurface Conditions
- Figure 1 – Locus Plan
- Figure 2 – Exploration Location Plan
- Appendix A – Limitations
- Appendix B – GZA Test Boring Logs
- Appendix C – Laboratory Test Reports
- Appendix D – Rock Core Photographs
- Appendix E – Electrical Resistivity Log
- Appendix F – Previous Site Development Aerial Photographs
- Appendix G – Vacuum Excavation Photographs

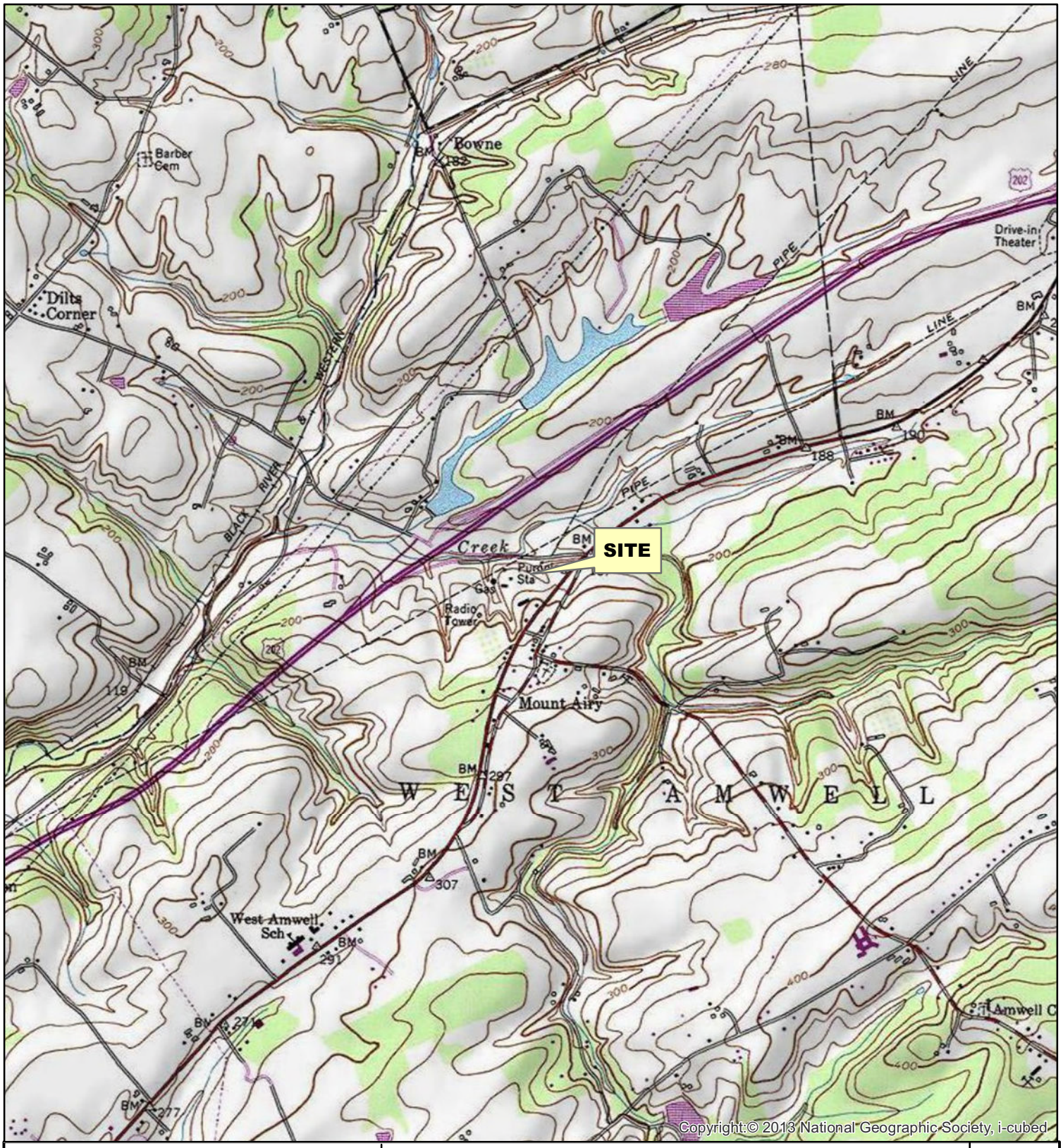
TABLES

TABLE 1
SUMMARY OF TEST BORING EXPLORATION DATA
PennEast Interconnect
Lambertville, New Jersey

	GZA TEST BORINGS								
	GZ-101	GZ-102	GZ-103	GZ-104	GZ-105	GZ-106	GZ-107	GZ-108	GZ-109
Proposed Location:	Pipeline	Pipeline	Pipeline	Filter Separators	Station Building	Station Building	Station Building	Heater Building	Pipeline
Depth (ft) to:									
Fill (Above Topsoil/Subsoil)	NE	NE	NE	0	NE	NE	0	0	0
Topsoil/Subsoil	0	0	0	0.2	0	0	0.5	1.5	NE
Fill (Below Topsoil/Subsoil)	0.8	1	NE	NE	NE	NE	NE	NE	NE
Weathered Bedrock	4	7.2	6	3	3	0.4	5.0	4	3.8
Groundwater[1]	8	6.5	NM	NM	NM	NM	NM	NM	NM
Bedrock[3]	12.3	12.1	15.2	6	6.3	8	7	7.3	6.4
Bottom of Exploration	12.3	12.1	15.2	11	6.3	13	12	7.3	6.4
Thickness (ft) of:									
Fill (Above Topsoil/Subsoil)	NE	NE	NE	0.2	NE	NE	0.5	1.5	3.8
Topsoil/Subsoil	0.8	1	6	2.8	3	0.4	5	2.5	NE
Fill (Below Topsoil/Subsoil)	3	6.2	NE	NE	NE	NE	NE	NE	NE
Weathered Bedrock	8.3	4.9	9.2	3	3.3	7.6	2.0	3.3	2.7
Approximate Elevations (ft):									
Ground Surface [2]	187.5	196	180	175	175	170	164	165	157.5
Top of Fill (Above Topsoil/Subsoil)	NE	NE	NE	175	NE	NE	164	165	157.5
Top of Topsoil/Subsoil	187.5	196	180	174.8	175	170	163.5	163.5	NE
Top of Fill (Below Topsoil/Subsoil)	186.7	195	NE	NE	NE	NE	NE	NE	NE
Top of Weathered Bedrock	183.5	188.8	174	172	172	169.6	159.0	161	153.8
Groundwater	179.5	189.5	NM	NM	NM	NM	NM	NM	NM
Top of Bedrock	175.2	183.9	164.8	169	168.7	162	157	157.7	151.1
Bottom of Exploration	175.2	183.9	164.8	164	168.7	157	152	157.7	151.1

NE - Not Encountered; NM - Not Measured
Notes:
1. Groundwater readings were taken at the times and conditions noted on the logs.
2. Ground surface elevation at the GZA test borings were interpolated from existing conditions topographic plan.
3. Bedrock depths based on a combination of drilling resistance and rock coring confirmation.

FIGURES



GZA GeoEnvironmental, Inc.
Engineers and Scientists
www.gza.com

S 7.5 MINUTE
NGLE BASE MAP:
TOCKTON
1997

SITE LOCUS

1325 ROUTE 179
LAMBERTVILLE, NEW JERSEY

Source: TOPO! maps are USGS topographic maps, Copyright:© 2011 National Geographic Society, i-cubed and are provided by arcgisonline.com.

PROJ MGR: JFD	REVIEWED BY: EH	PROJECT NO. 05.0046118.03
DESIGNED BY: JFD	DRAWN BY: MJS	DATE: 06-14-18

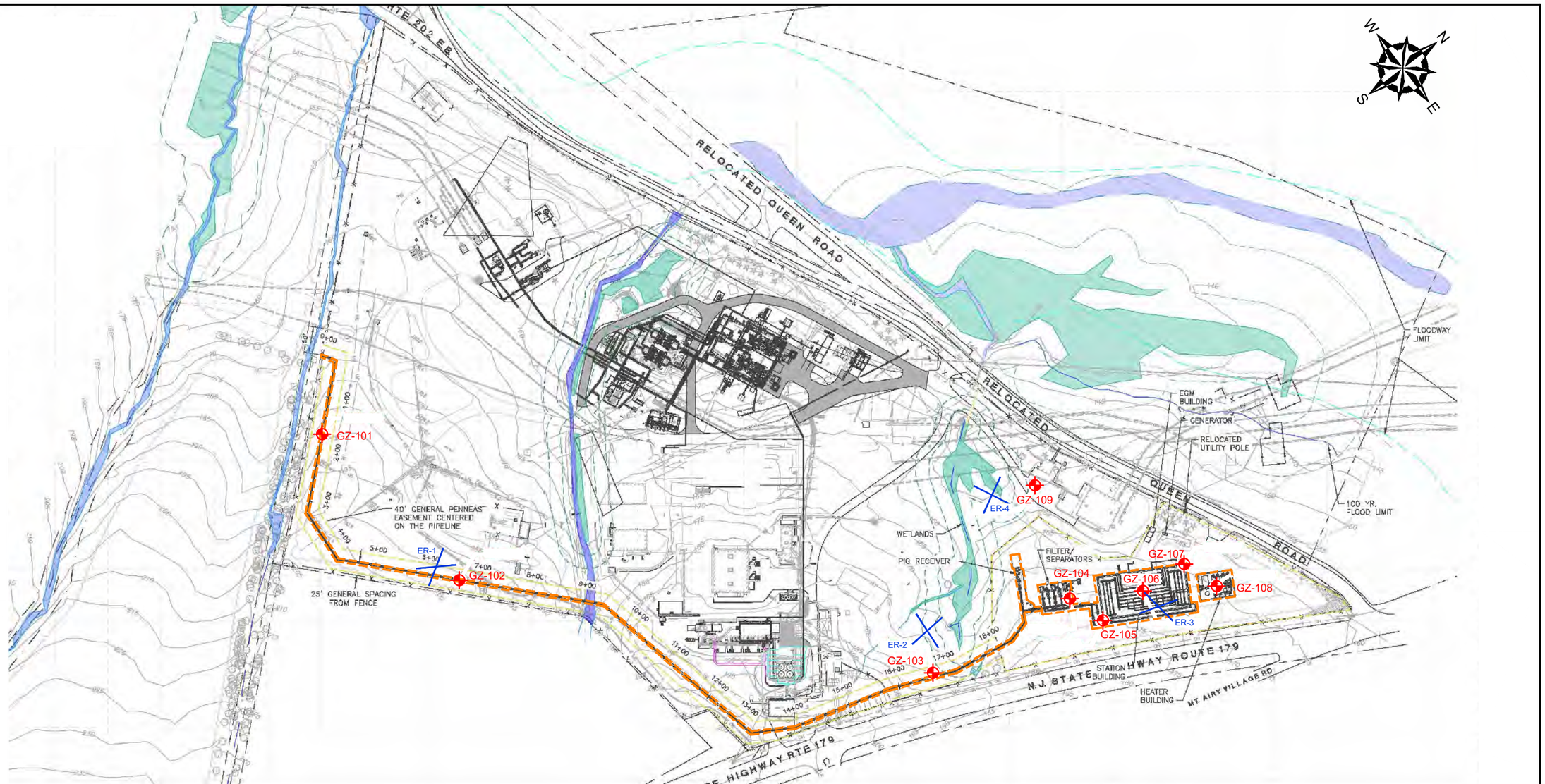
THIS MAP HAS BEEN COMPILED FROM OTHER MAPS,AND/OR SOURCES OF INFORMATION.
THIS MAP SHOULD NOT BE CONSTRUED AS A PROPERTY SURVEY, NOR USED FOR CONSTRUCTION PURPOSES.

0 1,000 2,000 4,000 6,000 8,000
Scale in Feet

N

FIGURE
1

© 2017 - GZA GeoEnvironmental, Inc. J:_46,000-46,499\46118.h18 EN Engineering\46118-01.jfd Lamberville Compressor Station\GIS\mxd\LOCUS.mxd, 10/6/2017, 2:54:03 PM, max.strubel



GENERAL NOTES

1. BASE MAP DEVELOPED FROM PLAN ENTITLED "EXHIBIT 4 - SITE PLAN".
2. THE EXPLORATIONS WERE LOCATED BY LINE OF SIGHT AND TAPE MEASUREMENTS FROM EXISTING STRUCTURES. LOCATIONS SHOULD BE CONSIDERED ACCURATE TO THE DEGREE IMPLIED BY THE METHOD USED.
3. THE PURPOSE OF THIS DRAWING IS TO LOCATE, DESCRIBE, AND REPRESENT THE POSITIONS OF EXPLORATIONS IN RELATION TO THE SUBJECT SITE. THIS DRAWING IS NOT CONSIDERED A LAND SURVEY.

LEGEND

GZ-101 — INDICATES BORINGS PERFORMED BY CRAIG TEST BORING COMPANY BETWEEN MAY 18, 2018 AND MAY 30, 2018 AND OBSERVED BY GZA PERSONNEL.

APPROXIMATE LOCATION OF PROPOSED EQUIPMENT AND PIPELINE.

APPROXIMATE LOCATION OF ELECTRICAL RESISTIVITY TESTING.

0 100' 200' 400' 600'

1"=200'

NO.	ISSUE/DESCRIPTION	BY	DATE

UNLESS SPECIFICALLY STATED BY WRITTEN AGREEMENT, THIS DRAWING IS THE SOLE PROPERTY OF GZA GEOENVIRONMENTAL, INC. (GZA). THE INFORMATION SHOWN ON THE DRAWING IS SOLELY FOR USE BY GZA'S CLIENT OR THE CLIENT'S DESIGNATED REPRESENTATIVE FOR THE SPECIFIC PROJECT AND LOCATION IDENTIFIED ON THE DRAWING. THE DRAWING SHALL NOT BE TRANSFERRED, REUSED, COPIED, OR ALTERED IN ANY MANNER FOR USE AT ANY OTHER LOCATION OR FOR ANY OTHER PURPOSE WITHOUT THE PRIOR WRITTEN CONSENT OF GZA. ANY TRANSFER, REUSE, OR MODIFICATION TO THE DRAWING BY THE CLIENT OR OTHERS, WITHOUT THE PRIOR WRITTEN EXPRESS CONSENT OF GZA, WILL BE AT THE USER'S SOLE RISK AND WITHOUT ANY RISK OR LIABILITY TO GZA.

1325 NJ-179
LAMBERTVILLE, NJ 08530

EXPLORATION LOCATION PLAN

PREPARED BY:
GZA GeoEnvironmental, Inc.
Engineers and Scientists
www.gza.com

PREPARED FOR:
EN ENGINEERING
28100 TORCH PARKWAY, SUITE 400
WARRENVILLE, ILLINOIS 60555

PROJ MGR: JFD	REVIEWED BY: JFD	CHECKED BY: JFD	FIGURE 2
DESIGNED BY: BPG	DRAWN BY: BPG	SCALE: 1"=200'	
DATE: JUNE 2018	PROJECT NO. 05.0046118.03	REVISION NO. -	SHEET NO. 1 OF 1

©2016 – GZA GeoEnvironmental, Inc. GZA-J:_46,000-46,499\46118.h18 EN Engineering\46118-03.jfd Lambertville Compressor Station II\CAD\DRAFT – Exploration Location Plan – BPG.dwg [ANSI B – 17x11] July 09,

APPENDIX A - LIMITATIONS

Use of Report

1. GZA GeoEnvironmental, Inc. (GZA) prepared this report on behalf of, and for the exclusive use of our Client for the stated purpose(s) and location(s) identified in the Proposal for Services and/or Report. Use of this report, in whole or in part, at other locations, or for other purposes, may lead to inappropriate conclusions; and we do not accept any responsibility for the consequences of such use(s). Further, reliance by any party not expressly identified in the agreement, for any use, without our prior written permission, shall be at that party's sole risk, and without any liability to GZA.

Standard of Care

2. GZA's findings and conclusions are based on the work conducted as part of the Scope of Services set forth in GZA's Proposal for Services and/or Report, and reflect our professional judgment. These findings and conclusions must be considered not as scientific or engineering certainties, but rather as our professional opinions concerning the limited data gathered during the course of our work. If conditions other than those described in this report are found at the subject location(s), or the design has been altered in any way, GZA shall be so notified and afforded the opportunity to revise the report, as appropriate, to reflect the unanticipated changed conditions .

3. GZA's services were performed using the degree of skill and care ordinarily exercised by qualified professionals performing the same type of services, at the same time, under similar conditions, at the same or a similar property. No warranty, expressed or implied, is made.

Subsurface Conditions

4. The generalized soil profile(s) provided in our Report are based on widely-spaced subsurface explorations and are intended only to convey trends in subsurface conditions. The boundaries between strata are approximate and idealized, and were based on our assessment of subsurface conditions. The composition of strata, and the transitions between strata, may be more variable and more complex than indicated. For more specific information on soil conditions at a specific location refer to the exploration logs.

5. In preparing this report, GZA relied on certain information provided by the Client, state and local officials, and other parties referenced therein which were made available to GZA at the time of our evaluation. GZA did not attempt to independently verify the accuracy or completeness of all information reviewed or received during the course of this evaluation.

6. Water level readings have been made in test holes (as described in the Report) at the specified times and under the stated conditions. These data have been reviewed and interpretations have been made in this Report. Fluctuations in the level of the groundwater however occur due to temporal or spatial variations in areal recharge rates, soil heterogeneities, the presence of subsurface utilities, and/or natural or artificially induced perturbations. The water table encountered in the course of the work may differ from that indicated in the Report.

7. GZA's services did not include an assessment of the presence of oil or hazardous materials at the property. Consequently, we did not consider the potential impacts (if any) that contaminants in soil or groundwater may have on construction activities, or the use of structures on the property.

8. Recommendations for foundation drainage, waterproofing, and moisture control address the conventional geotechnical engineering aspects of seepage control. These recommendations may not preclude an environment that allows the infestation of mold or other biological pollutants.

Compliance with Codes and Regulations

9. We used reasonable care in identifying and interpreting applicable codes and regulations. These codes and regulations are subject to various, and possibly contradictory, interpretations. Compliance with codes and regulations by other parties is beyond our control.

Cost Estimates

10. Unless otherwise stated, our cost estimates are only for comparative and general planning purposes. These estimates may involve approximate quantity evaluations. Note that these quantity estimates are not intended to be sufficiently accurate to develop construction bids, or to predict the actual cost of work addressed in this Report. Further, since we have no control over either when the work will take place or the labor and material costs required to plan and execute the anticipated work, our cost estimates were made by relying on our experience, the experience of others, and other sources of readily available information. Actual costs may vary over time and could be significantly more, or less, than stated in the Report.

Additional Services

11. GZA recommends that we be retained to provide services during any future: site observations, design, implementation activities, construction and/or property development/redevelopment. This will allow us the opportunity to: i) observe conditions and compliance with our design concepts and opinions; ii) allow for changes in the event that conditions are other than anticipated; iii) provide modifications to our design; and iv) assess the consequences of changes in technologies and/or regulations.

APPENDIX B – GZA TEST BORING LOGS

LOG KEY

GZA
Geo Environmental, Inc.
Engineers and Scientists

BURMISTER SOIL CLASSIFICATION

COMPONENT	NAME	PROPORTIONAL TERM	PERCENT BY WEIGHT
MAJOR	GRAVEL, SAND, FINES*		>50
Minor	Gravel, Sand, Fines*	and	35 - 50
		some	20-35
		little	10-20
		trace	0-10

*See identification of fines table.

IDENTIFICATION OF FINES

Material	PI	Atterberg Thread Dia.
SILT	0	Cannot Roll
Clayey SILT	1-5	1/4"
SILT & CLAY	5-10	1/8"
CLAY & SILT	10-20	1/16"
Silty CLAY	20-40	1/32"
CLAY	>40	1/64"

GRADATION DESIGNATION	PROPORTION OF COMPONENT
Fine to coarse	All fractions > 10%
Medium to coarse	<10% fine
Fine to medium	<10% coarse
Coarse	<10% fine and medium
Medium	<10% coarse and fine
Fine	<10% coarse and medium

PLASTIC SOILS

Consistency	Blows/Ft. SPT N-Value
Very Soft	< 2
Soft	2 - 4
Medium Stiff	4 - 8
Stiff	8 - 15
Very Stiff	15 - 30
Hard	>30

GRAVEL & SAND

Density	Blows/Ft. SPT N-Value
Very Loose	< 4
Loose	4 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	> 50

UNIFIED SOIL CLASSIFICATION SYSTEM (USCS) (ASTM D 2487)

MAJOR DIVISIONS			Group Symbols
Coarse Grained Soils More than 50% of material larger than No. 200 sieve.	Gravel More than 50% larger than No. 4 sieve.	Clean Gravels (Little or no fines)	GW GP
		Gravels with Fines (Appreciable amount of fines)	GM GC
	Sand More than 50% smaller than No. 4 sieve.	Clean Sands (Little or no fines)	SW SP
		Sands with Fines (Appreciable amount of fines)	SM SC
Fine Grained Soils More than 50% of material smaller than No. 200 sieve.		Silts and Clays Liquid Limit <50	ML CL
		Silts and CLays Liquid Limit >50	OL MH CH OH
		Highly Organic Soils	Pt

ORGANIC SOIL CLASSIFICATION

Fibrous PEAT (Pt) - Lightweight, spongy, mostly visible organic matter, water squeezes readily from sample. Typically near top of deposit.
Fine Grained PEAT (Pt) - Lightweight, spongy, little visible organic matter, water squeezes readily from sample. Typically below fibrous peat.
Organic Silt (OL) - Typically gray to dark gray, often has strong H2S odor. Typically contains shells or shell fragments. Lightweight. Usually found near coastal regions. May contain wide range of sand fractions.
Organic Clay (OH) - Typically gray to dark gray, high plasticity. Usually found near coastal regions. May contain wide range of sand fractions. Need organic content test for final identification.

ABBREVIATIONS

MR = Mud Rotary
HSA = Hollow Stem Auger
SSA = Solid Stem Auger
SS = Split Spoon Sampler
U = Undisturbed Sample (Shelby Tube)
MC = Modified California Sampler
V = Vibracore
M = Macrocore

USCS = Unified Soil Classification System (ASTM D2487)
NYCBC = New York City Building Code
WOR = Weight of Rods
WOH= Weight of Hammer
SPT = Standard Penetration Test (ASTM D1586)

Tv = Field Vane Shear Test (Torvane) Shear Strength
PP = Pocket Penetrometer Shear Strength
PI = Plasticity Index
Wn = Moisture Content
CO = Consolidation
UC = Unconfined Compression Test
UU = Unconsolidated Undrained (Triaxial) Test
SI = Sieve Analysis
DS = Direct Shear
PID = Photoionization Detector
ppm = Parts Per Million
REC = Recovery
RQD = Rock Quality Designation
▼ = Measured Water Level

N-Value = Cumulative number of uncorrected blows for the middle two six-inch intervals (blows/foot).

TEST BORING LOG

GZA GeoEnvironmental, Inc.
Engineers and Scientists

EN Engineering
PennEast Interconnect
Lambertville, New Jersey

EXPLORATION NO.: GZ-101
SHEET: 1 of 1
PROJECT NO: 05.0046118.03
REVIEWED BY: J. Davis

Logged By: B. Shachaf
Drilling Co.: Craig Test Boring Company
Foreman: P. Mullins

Type of Rig: ATV
Rig Model: CME 750X
Drilling Method: Rotary Wash

Boring Location: N571742, E379008
Ground Surface Elev. (ft.): 187.5
Final Boring Depth (ft.): 12.3
Date Start - Finish: 5/15/2018 - 5/30/2018

H. Datum: NJ STATE PLANE
V. Datum: NAVD88

Hammer Type: Automatic Hammer
Hammer Weight (lb.): 140
Hammer Fall (in.): 30
Auger or Casing O.D./I.D Dia (in.): 4" / 3-7/8"

Sampler Type: SS
Sampler O.D. (in.): 2.0
Sampler Length (in.): 24
Rock Core Size: NA

Groundwater Depth (ft.)			
Date	Time	Water Depth	Stab. Time
5/15/18	1015	8	15 min.

Depth (ft)	Casing Blows/ Core Rate	Sample No.	Sample Depth (ft.)	Pen. (in)	Rec. (in)	Blows (per 6 in.)	SPT Value	Sample Description and Identification (Modified Burmister Procedure)	Remark	Field Test Data	Stratum Description Depth (ft.)	Elev. (ft.)
		G-1	0-0.3					G-1 : Brown SILT, some fine to coarse Sand, little Gravel, trace Roots (ML)	1 2		0.8 TOPSOIL	186.7
		G-2	0.3-2					G-2 : Red-brown COBBLES, some Silt, little fine to coarse Sand, little Gravel (GM)			FILL	
		G-3	2-4					G-3 : Red-brown COBBLES, some Silt, little fine to coarse Sand, little Gravel (GM)			4	183.5
5		G-4	4-6					G-4 : Red-brown SILT and GRAVEL, some fine to coarse Sand (ML)				
		G-5	6-8					G-5 : Red-brown SILT, some Gravel, some fine to coarse Sand (ML)				
		S-1	8-9.3	15	15	27 38 100/3"	R	S-1 : Top 12": Red SILT, some GRAVEL (wet) (ML) Bottom 3": Red SILT and fine to coarse GRAVEL (Weathered Bedrock) (ML)	3		WEATHERED BEDROCK	
10		S-2	10-10.3	3	3	100/3"	R	S-2 : Red SILT and fine to coarse GRAVEL (Weathered Bedrock) (ML)				
		S-3	12-12.3	3	0	100/3"	R	S-3 : No Recovery.			12.3	175.2
								End of exploration at 12.3 feet.	4			
15												
20												
25												
30												

REMARKS

1 - Reported ground surface elevation based on interpolation of topographic survey plan.
2 - Borehole vacuum excavated to 8 feet on 5/15/18 by Lone Star.
3 - Borehole advanced with 4" casing and rotary wash drilling methods beyond vacuum excavation.
4 - Rollerbit refusal encountered at 12.3'. Borehole backfilled with soil cuttings.

See Log Key for explanation of sample description and identification procedures. Stratification lines represent approximate boundaries between soil and bedrock types. Actual transitions may be gradual. Water level readings have been made at the times and under the conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the times the measurements were made.

Exploration No.: GZ-101

GZA TEMPLATE TEST BORING; 7/5/2018; 2:43:18 PM

TEST BORING LOG

GZA GeoEnvironmental, Inc.
Engineers and Scientists

EN Engineering
PennEast Interconnect
Lambertville, New Jersey

EXPLORATION NO.: GZ-102
SHEET: 1 of 1
PROJECT NO: 05.0046118.03
REVIEWED BY: J. Davis

Logged By: B. Shachaf
Drilling Co.: Craig Test Boring Company
Foreman: P. Mullins

Type of Rig: ATV
Rig Model: CME 750X
Drilling Method: Rotary Wash

Boring Location: N571023, E377938
Ground Surface Elev. (ft.): 196
Final Boring Depth (ft.): 12.1
Date Start - Finish: 5/10/2018 - 5/30/2018

H. Datum: NJ STATE PLANE
V. Datum: NAVD88

Hammer Type: Automatic Hammer
Hammer Weight (lb.): 140
Hammer Fall (in.): 30
Auger or Casing O.D./I.D Dia (in.): 4" / 3-7/8"

Sampler Type: SS
Sampler O.D. (in.): 2.0
Sampler Length (in.): 24
Rock Core Size: NA

Groundwater Depth (ft.)			
Date	Time	Water Depth	Stab. Time
5/14/18	1030	6.5	4 days

Depth (ft)	Casing Blows/ Core Rate	Sample No.	Sample Depth (ft.)	Pen. (in)	Rec. (in)	Blows (per 6 in.)	SPT Value	Sample Description and Identification (Modified Burmister Procedure)	Remark	Field Test Data	Stratum Description	Depth (ft.)	Elev. (ft.)
		G-1	0-2					G-1 : Red-brown, fine to coarse SAND and SILT, some Gravel (SM)	1 2		TOPSOIL	1	195.0
		G-2	2-4					G-2 : Red-brown COBBLES, some Silt, some fine to coarse Sand, some Gravel (GM)			FILL		
5		G-3	4-6					G-3 : Brown, fine to coarse SAND, some Silt, little Gravel, little Debis (metal, wood, 1" pipe) (SM)					
		G-4	6-7.2					G-4 : Brown, fine to coarse SAND, some Silt, little Gravel, little Debis (metal, wood, 1" pipe) (SM)				7.2	188.8
		S-1	8-8.3	4	4	100/4"	R	S-1 : Red SILT, some GRAVEL (Weathered Bedrock) (ML)	3		WEATHERED BEDROCK		
10												12.1	183.9
		S-2	12-12.1	1	0	100/1"	R	S-2 : No Recovery.	4				
								End of exploration at 12.1 feet.					
15													
20													
25													
30													

REMARKS

1 - Reported ground surface elevation based on interpolation of topographic survey plan.
2 - Borehole vacuum excavated to refusal at 7.2 feet on 5/10/18 by Lone Star.
3 - Borehole advanced with 4" casing and rotary wash drilling methods beyond bacuum excavation.
4 - Rollerbit refusal encountered at 12.1'. Borehole backfilled with soil cuttings.

See Log Key for explanation of sample description and identification procedures. Stratification lines represent approximate boundaries between soil and bedrock types. Actual transitions may be gradual. Water level readings have been made at the times and under the conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the times the measurements were made.

Exploration No.: GZ-102

GZA TEMPLATE TEST BORING; 7/5/2018; 2:43:19 PM

TEST BORING LOG

GZA GeoEnvironmental, Inc.
Engineers and Scientists

EN Engineering
PennEast Interconnect
Lambertville, New Jersey

EXPLORATION NO.: GZ-103
SHEET: 1 of 1
PROJECT NO: 05.0046118.03
REVIEWED BY: J. Davis

Logged By: B. Shachaf
Drilling Co.: Craig Test Boring Company
Foreman: P. Mullins

Type of Rig: ATV
Rig Model: CME 750X
Drilling Method: Rotary Wash

Boring Location: N571398, E378771
Ground Surface Elev. (ft.): 180
Final Boring Depth (ft.): 15.2
Date Start - Finish: 5/30/2018 - 5/30/2018

H. Datum: NJ STATE PLANE
V. Datum: NAVD88

Hammer Type: Automatic Hammer
Hammer Weight (lb.): 140
Hammer Fall (in.): 30
Auger or Casing O.D./I.D Dia (in.): 4" / 3-7/8"

Sampler Type: SS
Sampler O.D. (in.): 2.0
Sampler Length (in.): 24
Rock Core Size: NA

Groundwater Depth (ft.)			
Date	Time	Water Depth	Stab. Time
		Note 2	

Depth (ft)	Casing Blows/ Core Rate	Sample No.	Sample Depth (ft.)	Pen. (in)	Rec. (in)	Blows (per 6 in.)	SPT Value	Sample Description and Identification (Modified Burmister Procedure)	Remark	Field Test Data	Stratum Description	Depth (ft.)	Elev. (ft.)
		G-1	0-0.3					G-1 : Brown, fine to coarse SAND and SILT, little fine to coarse Gravel (SM)	1 2		TOPSOIL	0.3	179.7
		G-2	0.3-5					G-2 : Light brown SILT, some fine to coarse Gravel, little fine to coarse Sand (ML)			SUBSOIL		
5		S-1	5-7	24	24	7 21 28 32	49	S-1 : Top 10": Light brown, SILT, little fine Sand Bottom 14": Red SILT, little fine to medium Sand (ML)				6	174.0
		S-2	7-9	24	18	39 40 40 24	80	S-2 : Very dense, red SILT, some fine to coarse Gravel (SM)					
10		S-3	9-9.4	5	5	100/5"	R	S-3 : Red, fine to coarse GRAVEL, trace Silt (Weathered Bedrock)			WEATHERED BEDROCK		
15		S-4	15-15.2	2	0	100/2"	R	S-4 : No Recovery.	3			15.2	164.8
								End of exploration at 15.2 feet.					
20													
25													
30													

REMARKS

1 - Reported ground surface elevation based on interpolation of topographic survey plan.
2 - Borehole advanced with 4" casing and rotary wash drilling methods. Groundwater not encountered prior to introduction of drilling fluid at 2 feet. Upper 5' of soil descriptions based on drill spoils and drill resistance.
3 - Rollerbit refusal encountered at 15.2'. Borehole backfilled with soil cuttings.

See Log Key for explanation of sample description and identification procedures. Stratification lines represent approximate boundaries between soil and bedrock types. Actual transitions may be gradual. Water level readings have been made at the times and under the conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the times the measurements were made.

Exploration No.: GZ-103

GZA TEMPLATE TEST BORING; 7/5/2018; 2:43:19 PM

TEST BORING LOG

GZA GeoEnvironmental, Inc.
Engineers and Scientists

EN Engineering
PennEast Interconnect
Lambertville, New Jersey

EXPLORATION NO.: GZ-104
SHEET: 1 of 1
PROJECT NO: 05.0046118.03
REVIEWED BY: J. Davis

Logged By: V. Larimore
Drilling Co.: Craig Test Boring Company
Foreman: D. Cooke

Type of Rig: Truck
Rig Model: CME-75
Drilling Method: Rotary Wash

Boring Location: N571651, E378902
Ground Surface Elev. (ft.): 175
Final Boring Depth (ft.): 11
Date Start - Finish: 5/21/2018 - 5/21/2018

H. Datum: NJ STATE PLANE
V. Datum: NAVD88

Hammer Type: Automatic Hammer
Hammer Weight (lb.): 140
Hammer Fall (in.): 30
Auger or Casing O.D./I.D Dia (in.): 4" / 3-7/8"

Sampler Type: SS
Sampler O.D. (in.): 2.0
Sampler Length (in.): 24
Rock Core Size: NQ

Groundwater Depth (ft.)			
Date	Time	Water Depth	Stab. Time
		Note 2	

Depth (ft)	Casing Blows/ Core Rate	Sample No.	Sample Depth (ft.)	Pen. (in)	Rec. (in)	Blows (per 6 in.)	SPT Value	Sample Description and Identification (Modified Burmister Procedure)	Remark	Field Test Data	Stratum Description Depth (ft.)	Elev. (ft.)
		S-1	0-2	24	13	10 8 10 6	18	S-1 : Top 2": Grey, fine to coarse GRAVEL and fine to coarse SAND (overlying geotextile fabric) (GP) Bottom 11": Brown SILT, little fine to coarse Gravel (ML)	1 2		0.2 FILL	174.8
		S-2	2-4	24	21	4 9 15 20	24	S-2 : Top 11": Brown SILT, trace fine to coarse Gravel (ML) Bottom 10": Red-brown SILT and fine to coarse GRAVEL (weathered rock) (ML)			SUBSOIL 3	172.0
5		S-3	4-5.4	17	19	21 38 50/5"	R	S-3 : Very dense, red-brown SILT and fine to coarse GRAVEL (weathered rock) (ML)			WEATHERED BEDROCK 6	169.0
		C-1	6-11	60	55			C-1 : Moderately hard, moderately weathered, extremely to moderately fractured, amorphous red SHALE (REC % = 92, RQD % = 7)	3 4 5		BEDROCK 11	164.0
10												
								End of exploration at 11 feet.	6			
15												
20												
25												
30												

REMARKS

1 - Reported ground surface elevation based on interpolation of topographic survey plan.
2 - Borehole advanced with 4" casing and rotary wash drilling methods. Groundwater not encountered prior to introduction of drilling fluid at 4 feet.
3 - Rollerbit refusal encountered at 6'. NQ-sized, double-tube core barrel used to advanced borehole from 6' to end of exploration. Core rate IN units of minutes/foot. RQD= Rock Quality Designation.
4 - Loss of drilling circulation at 7.5'. Regained circulation immediately.
5 - Loss of drilling circulation at 8.0'. Regained circulation immediately.
6 - Borehole backfilled with 3/4 bag of Hole Plug, 1 bag of filter sand, and drill spoils.

See Log Key for explanation of sample description and identification procedures. Stratification lines represent approximate boundaries between soil and bedrock types. Actual transitions may be gradual. Water level readings have been made at the times and under the conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the times the measurements were made.

Exploration No.: GZ-104

GZA TEMPLATE TEST BORING; 7/5/2018; 2:43:20 PM

TEST BORING LOG

GZA GeoEnvironmental, Inc.
Engineers and Scientists

EN Engineering
PennEast Interconnect
Lambertville, New Jersey

EXPLORATION NO.: GZ-105
SHEET: 1 of 1
PROJECT NO: 05.0046118.03
REVIEWED BY: J. Davis

Logged By: V. Larimore
Drilling Co.: Craig Test Boring Company
Foreman: D. Cooke

Type of Rig: Truck
Rig Model: CME-75
Drilling Method: Rotary Wash

Boring Location: N571652, E378977
Ground Surface Elev. (ft.): 175
Final Boring Depth (ft.): 6.25
Date Start - Finish: 5/9/2018 - 5/18/2018

H. Datum: NJ STATE PLANE
V. Datum: NAVD88

Hammer Type: Automatic Hammer
Hammer Weight (lb.): 140
Hammer Fall (in.): 30
Auger or Casing O.D./I.D Dia (in.): 4" / 3-7/8"

Sampler Type: SS
Sampler O.D. (in.): 2.0
Sampler Length (in.): 24
Rock Core Size: NA

Groundwater Depth (ft.)			
Date	Time	Water Depth	Stab. Time
		Note 2	

Depth (ft)	Casing Blows/ Core Rate	Sample No.	Sample Depth (ft.)	Pen. (in)	Rec. (in)	Blows (per 6 in.)	SPT Value	Sample Description and Identification (Modified Burmister Procedure)	Remark	Field Test Data	Stratum Description	Depth (ft.)	Elev. (ft.)
		S-1	0-2	24	18	1 6 7 9	13	S-1 : Top 3": Brown SILT, some fine to medium Sand, little fine Gravel (ML) Bottom 7": Light grey brown, SILT, trace fine to coarse Sand, trace coarse Gravel (ML)	1 2		TOPSOIL	0.25	174.8
		S-2	2-4	24	19	12 13 21 25	34	S-2 : Top 13": Light grey brown, SILT, trace fine to coarse Sand, trace coarse Gravel (ML) Bottom 6": Red SILT and fine to coarse GRAVEL (weathered rock) (ML)			SUBSOIL	3	172.0
5		S-3	4-6	24	20	21 25 40 50/5"	65	S-3 : Very dense, red, SILT and fine to coarse GRAVEL (weathered rock) (ML)			WEATHERED BEDROCK	6.3	168.7
		S-4	6-6.3	3	2	50/5"	R	S-4 : Very dense, red, SILT and fine to coarse GRAVEL (weathered rock) (ML)	3				
10								End of exploration at 6.25 feet.					
15													
20													
25													
30													

REMARKS

1 - Reported ground surface elevation based on interpolation of topographic survey plan.
2 - Borehole advanced with 4" casing and rotary wash drilling methods. Groundwater not encountered prior to introduction of drilling fluid at 6 feet.
3 - Rollerbit refusal encountered at 6.25'. Borehole backfilled with 1-1/2 bags of filler sand and drilling spoils.

See Log Key for explanation of sample description and identification procedures. Stratification lines represent approximate boundaries between soil and bedrock types. Actual transitions may be gradual. Water level readings have been made at the times and under the conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the times the measurements were made.

Exploration No.: GZ-105

GZA TEMPLATE TEST BORING; 7/5/2018; 2:43:20 PM

TEST BORING LOG

GZA GeoEnvironmental, Inc.
Engineers and Scientists

EN Engineering
PennEast Interconnect
Lambertville, New Jersey

EXPLORATION NO.: GZ-106
SHEET: 1 of 1
PROJECT NO: 05.0046118.03
REVIEWED BY: J. Davis

Logged By: V. Larimore
Drilling Co.: Craig Test Boring Company
Foreman: D. Cooke

Type of Rig: Truck
Rig Model: CME-75
Drilling Method: Rotary Wash

Boring Location: N571742, E379008
Ground Surface Elev. (ft.): 170
Final Boring Depth (ft.): 13
Date Start - Finish: 5/18/2018 - 5/18/2018

H. Datum: NJ STATE PLANE
V. Datum: NAVD88

Hammer Type: Automatic Hammer
Hammer Weight (lb.): 140
Hammer Fall (in.): 30
Auger or Casing O.D./I.D Dia (in.): 4" / 3-7/8"

Sampler Type: SS
Sampler O.D. (in.): 2.0
Sampler Length (in.): 24
Rock Core Size: NQ

Groundwater Depth (ft.)			
Date	Time	Water Depth	Stab. Time
		Note 2	

Depth (ft)	Casing Blows/ Core Rate	Sample No.	Sample Depth (ft.)	Pen. (in)	Rec. (in)	Blows (per 6 in.)	SPT Value	Sample Description and Identification (Modified Burmister Procedure)	Remark	Field Test Data	Stratum Description Depth (ft.)	Elev. (ft.)
		S-1	0-2	24	16	5 8 14 28	22	S-1 : Top 4.5": Topsoil (Overlying Geotextile Fabric (ML) Bottom 11.5": Red SILT and fine to coarse GRAVEL (weathered bedrock)	1 2		0.4 TOPSOIL	169.6
		S-2	2-4	24	24	12 17 14 20	31	S-2 : Dense, red SILT and fine to coarse GRAVEL (weathered bedrock) (ML)			WEATHERED BEDROCK	
5		S-3	4-6	24	24	17 20 17 31	37	S-3 : Dense, red SILT, some fine to coarse Gravel (weathered bedrock) (ML)				
		S-4	6-6.8	9	5	18 50/3"	R	S-4 : Red SILT, some fine to coarse Gravel (weathered bedrock) (ML)			8	162.0
	2.25	S-5	8-8	0	0	50/0"	R	S-5 : No Penetrartion.	3			
	2.5	C-1	8.01-13	60	60			C-1 : Moderately hard, moderately weathered, extremely to moderately fractured, amorphous red SHALE				
10	2.75										BEDROCK	
	2.25							(REC % = 100, RQD % = 7)				
	3.25										13	157.0
								End of exploration at 13 feet.	4			
15												
20												
25												
30												

REMARKS

1 - Reported ground surface elevation based on interpolation of topographic survey plan.
2 - Borehole advanced with 4" casing and rotary wash drilling methods. Groundwater not encountered prior to introduction of drilling fluid at 4 feet.
3 - Rollerbit refusal encountered at 8.0'. NQ-sized, double-tube core barrel used to advance borehole from 6.0' to end of exploration. Core rate in units of minutes/foot. RQD = Rock Quality Designation.
4 - Borehole backfilled with 1-1/4 bag of Hole Plug and drilling spoils.

See Log Key for explanation of sample description and identification procedures. Stratification lines represent approximate boundaries between soil and bedrock types. Actual transitions may be gradual. Water level readings have been made at the times and under the conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the times the measurements were made.

Exploration No.: GZ-106

GZA TEMPLATE TEST BORING; 7/5/2018; 2:43:21 PM

TEST BORING LOG

GZA GeoEnvironmental, Inc.
Engineers and Scientists

EN Engineering
PennEast Interconnect
Lambertville, New Jersey

EXPLORATION NO.: GZ-107
SHEET: 1 of 1
PROJECT NO: 05.0046118.03
REVIEWED BY: J. Davis

Logged By: V. Larimore
Drilling Co.: Craig Test Boring Company
Foreman: D. Cooke

Type of Rig: Truck
Rig Model: CME-75
Drilling Method: Rotary Wash

Boring Location: N571742, E379008
Ground Surface Elev. (ft.): 164
Final Boring Depth (ft.): 12
Date Start - Finish: 5/18/2018 - 5/18/2018

H. Datum: NJ STATE PLANE
V. Datum: NAVD88

Hammer Type: Automatic Hammer
Hammer Weight (lb.): 140
Hammer Fall (in.): 30
Auger or Casing O.D./I.D Dia (in.): 4" / 3-7/8"

Sampler Type: SS
Sampler O.D. (in.): 2.0
Sampler Length (in.): 24
Rock Core Size: NQ

Groundwater Depth (ft.)			
Date	Time	Water Depth	Stab. Time
		Note 2	

Depth (ft)	Casing Blows/ Core Rate	Sample No.	Sample Depth (ft.)	Pen. (in)	Rec. (in)	Blows (per 6 in.)	SPT Value	Sample Description and Identification (Modified Burmister Procedure)	Remark	Field Test Data	Stratum Description	Depth (ft.)	Elev. (ft.)
		S-1	0-2	24	4	5 11 9 6	20	S-1 : Top 3": Gray, fine to coarse GRAVEL (Overlying Geotextile Fabric) (GP) Bottom 1": Brown SILT and fine to coarse GRAVEL (ML)	1 2		FILL	0.5	163.5
		S-2	2-4	24	16	6 7 7 10	14	S-2 : Top 10": Grey-brown to light grey, SILT (ML) Bottom 6": Orange-brown to red-brown Clayey SILT, trace fine Sand (ML)	3		SUBSOIL		
5		S-3	4-6	24	22	8 19 35 50/4"	54	S-3 : Top 12": Brown, red brown, and light grey Clayey SILT, little fine Sand (ML)			WEATHERED BEDROCK	5	159.0
	2 2.5 2.75 3 3.75	S-4 C-1	6-6.3 7-12	4 60	3 57.5	50/4"	R	Bottom 10": Red SILT and fine to coarse GRAVEL (weathered rock) (ML) S-4 : Red, fine to coarse GRAVEL and little SILT (Weathered Bedrock) (GM) C-1 : Moderately hard, moderately weathered, extremely to moderately fractured, amorphous, red SHALE (REC % = 96, RQD % = 0)	4		BEDROCK	7 12	157.0 152.0
10													
								End of exploration at 12 feet.	5				
15													
20													
25													
30													

REMARKS

1 - Reported ground surface elevation based on interpolation of topographic survey plan.
2 - Borehole advanced with 4" casing and rotary wash drilling methods. Groundwater not encountered prior to introduction of drilling fluid at 4 feet.
3 - Rock in tip of SS sampler.
4 - Rollerbit refusal encountered at 7'. NQ-sized, double-tube core barrel used to advance borehole from 7' to end of exploration. Core rate in units of minutes/foot. RQD = Rock Quality Designation.
5 - Borehole backfilled with 3/4 bag of Hole Plug and soil cuttings.

See Log Key for explanation of sample description and identification procedures. Stratification lines represent approximate boundaries between soil and bedrock types. Actual transitions may be gradual. Water level readings have been made at the times and under the conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the times the measurements were made.

Exploration No.: GZ-107

GZA TEMPLATE TEST BORING; 7/5/2018; 2:43:21 PM

TEST BORING LOG

GZA GeoEnvironmental, Inc.
Engineers and Scientists

EN Engineering
PennEast Interconnect
Lambertville, New Jersey

EXPLORATION NO.: GZ-108
SHEET: 1 of 1
PROJECT NO: 05.0046118.03
REVIEWED BY: J. Davis

Logged By: V. Larimore
Drilling Co.: Craig Test Boring Company
Foreman: D. Cooke

Type of Rig: Truck
Rig Model: CME-75
Drilling Method: Rotary Wash

Boring Location: N571829, E379118
Ground Surface Elev. (ft.): 165
Final Boring Depth (ft.): 7.3
Date Start - Finish: 5/18/2018 - 5/18/2018

H. Datum: NJ STATE PLANE
V. Datum: NAVD88

Hammer Type: Automatic Hammer
Hammer Weight (lb.): 140
Hammer Fall (in.): 30
Auger or Casing O.D./I.D Dia (in.): 4" / 3-7/8"

Sampler Type: SS
Sampler O.D. (in.): 2.0
Sampler Length (in.): 24
Rock Core Size: NA

Groundwater Depth (ft.)			
Date	Time	Water Depth	Stab. Time
		Note 2	

Depth (ft)	Casing Blows/ Core Rate	Sample No.	Sample Depth (ft.)	Pen. (in)	Rec. (in)	Blows (per 6 in.)	SPT Value	Sample Description and Identification (Modified Burmister Procedure)	Remark	Field Test Data	Stratum Description	Depth (ft.)	Elev. (ft.)
		S-1	0-2	24	21	6 9 9 6	18	S-1 : Top 3": Dark brown to black SILT, some fine to medium Sand, moist (ML) 3"-7": Grey, fine to coarse GRAVEL (GP) 7"-14": Red SILT and fine to coarse GRAVEL (ML) Bottom 7": Grey-brown, red-brown SILT and fine to coarse SAND, little fine to coarse Gravel (ML) S-2 : Top 11": Brown Clayey SILT, trace fine Sand (ML) Bottom 7": Red-brown SILT, little fine Sand (ML) S-3 : Red-brown SILT, little fine Sand (ML) S-4 : Top 7": Red-brown SILT, little fine Sand (ML) Bottom 7": Red-brown SILT and fine to coarse GRAVEL (weathered bedrock) (ML)	1 2		FILL	1.5	163.5
		S-2	2-4	24	18	3 4 8 9	12				SUBSOIL	4	161.0
5		S-3	4-6	24	24	17 25 27 28	52				WEATHERED BEDROCK	7.3	157.7
		S-4	6-7.3	16	14	12 28 50/4"	R		3				
10								End of exploration at 7.3 feet.					
15													
20													
25													
30													

REMARKS

1 - Reported ground surface elevation based on interpolation of topographic survey plan.
2 - Borehole advanced with 4" casing and rotary wash drilling methods. Groundwater not encountered prior to introduction of drilling fluid at 4 feet.
3 - Rollerbit refusal encountered at 7.3'. Borehole backfilled with 1/2 bag of Hole Plug and soil cuttings.

See Log Key for explanation of sample description and identification procedures. Stratification lines represent approximate boundaries between soil and bedrock types. Actual transitions may be gradual. Water level readings have been made at the times and under the conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the times the measurements were made.

Exploration No.: GZ-108

GZA TEMPLATE TEST BORING; 7/5/2018; 2:43:22 PM

TEST BORING LOG

GZA GeoEnvironmental, Inc.
Engineers and Scientists

EN Engineering
PennEast Interconnect
Lambertville, New Jersey

EXPLORATION NO.: GZ-109
SHEET: 1 of 1
PROJECT NO: 05.0046118.03
REVIEWED BY: J. Davis

Logged By: V. Larimore
Drilling Co.: Craig Test Boring Company
Foreman: D. Cooke

Type of Rig: Truck
Rig Model: CME-75
Drilling Method: Rotary Wash

Boring Location: N571789, E378727
Ground Surface Elev. (ft.): 157.5
Final Boring Depth (ft.): 6.4
Date Start - Finish: 5/9/2018 - 5/18/2018

H. Datum: NJ STATE PLANE
V. Datum: NAVD88

Hammer Type: Automatic Hammer
Hammer Weight (lb.): 140
Hammer Fall (in.): 30
Auger or Casing O.D./I.D Dia (in.): 4" / 3-7/8"

Sampler Type: SS
Sampler O.D. (in.): 2.0
Sampler Length (in.): 24
Rock Core Size: NA

Groundwater Depth (ft.)			
Date	Time	Water Depth	Stab. Time
		Note 3	

Depth (ft)	Casing Blows/ Core Rate	Sample No.	Sample Depth (ft.)	Pen. (in)	Rec. (in)	Blows (per 6 in.)	SPT Value	Sample Description and Identification (Modified Burmister Procedure)	Remark	Field Test Data	Stratum Description	Depth (ft.)	Elev. (ft.)
		G-1	0.3-1					G-1 : Gray, fine to coarse GRAVEL, some fine to coarse Sand, little Silt (GM)	1 2		ASPHALT BASE COURSE	0.3	157.2
		G-2	1-3.75					G-2 : Red, fine to coarse GRAVEL and SILT, little fine to coarse Sand (GM)			FILL	1	156.5
5		S-1	4-4.8	9	9	29 50/3"	R	S-1 : Red, SILT, some fine to coarse Gravel (ML)	3		WEATHERED BEDROCK	3.75	153.8
		S-2	6-6.4	5	0	50/5"	R	S-2 : No Recovery.	4			6.4	151.1
								End of exploration at 6.4 feet.	5				
10													
15													
20													
25													
30													

REMARKS

1 - Reported ground surface elevation based on interpolation of topographic survey plan.
2 - Borehole vacuum excavated to refusal at 3.75 feet on 5/9/18 by Lone Star.
3 - Borehole advanced with 4" casing and rotary wash drilling methods. Groundwater not encountered prior to introduction of drilling fluid at 6 feet.
4 - Rock in tip of SS Sampler.
5 - Rollerbit refusal encountered at 6.5'. Borehole backfilled with 1/2 bag of Hole Plug and soil cuttings. Asphalt patched by Northern Construction, LLC.

See Log Key for explanation of sample description and identification procedures. Stratification lines represent approximate boundaries between soil and bedrock types. Actual transitions may be gradual. Water level readings have been made at the times and under the conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the times the measurements were made.

Exploration No.: GZ-109

GZA TEMPLATE TEST BORING; 7/5/2018; 2:43:22 PM

APPENDIX C - LABORATORY TEST REPORTS

THIELSCH ENGINEERING	195 Frances Avenue Cranston RI, 02910 Phone: (401)-467-6454 Fax: (401)-467-2398 http://www.thielsch.com *Let's Build a Solid Foundation*	Client Information: GZA GeoEnvironmental, Inc Philadelphia, PA PM: James Davis Assigned By: Ernest Hanna Collected By: Virginia Larimore	Project Information: **Lambertville, NJ** GZA Project Number: 05.0046118.03 Summary Page: 1 of 1 Report Date: 06.06.18

LABORATORY TESTING DATA SHEET

Boring No.	Sample No.	Depth (ft)	Laboratory No.	Specimen Data						Compressive Strength Tests								Rock Formation or Description or Remarks
				Mohs Hard-ness	Diameter (in)	Length (in)	(1) Unit Weight (PCF)	(2) Wet Density (PCF)	Bulk G_s	(3) Other Tests	(4) Strength PSI	(5) Strain %	(6) E sec PSI EE+06	(7) Poisson's Ratio	στ PSI	Is PSI	(8) s_c PSI	
GZ-104	C-1	8.0-8.25	S-1D		1.987	2.377	166.8			PLD						33		RED SANDSTONE; fresh break
			S-1A		1.991	1.132	157.8			PLA						454		

(1) Volume Determined By Measuring Dimensions (2) Determined by Measuring Dimensions and Weight of Saturated Sample	Notes	(3) PLD=Point Load (diametrical), PLA= Point Load (Axial) ST= Splitting Tensile U= Unconfined Compressive Strength (4) Taken at Peak Deviator Stress	Notes	(5) Strain at Peak Deviator Stress (6) Represents Secant Modulus at 50% of Total Failure Stress (7) Represents Secant Poisson's Ratio at 50% of Total Failure Stress (8) Estimated UCS from Table 1 of ASTM D5731 for NX cores (Is x 24)

Reviewed By _____ Date Reviewed 06.06.2018

Client:	GZA GeoEnvironmental, Inc.				
Project:					
Location:	Lambertville, NJ			Project No:	GTX-308297
Boring ID:	---	Sample Type:	---	Tested By:	GA
Sample ID:	---	Test Date:	06/18/18	Checked By:	bfs
Depth :	---	Test Id:	458136		

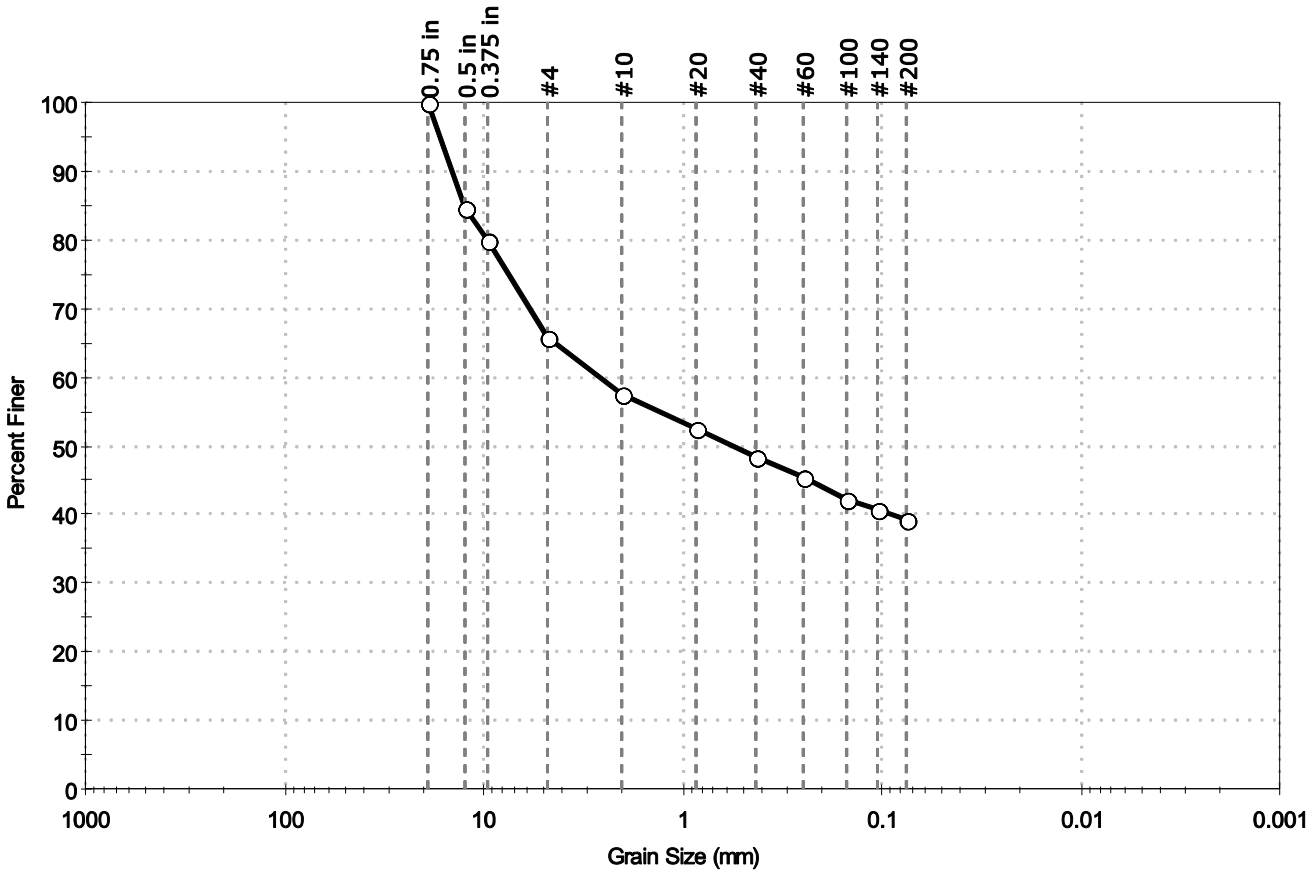
Moisture Content of Soil and Rock - ASTM D2216

Boring ID	Sample ID	Depth	Description	Moisture Content,%
GZ-104	S- 2	2-4	Moist, reddish brown silty gravel with sand	12.1
GZ-104	S- 3	4-6	Moist, red sand with gravel	7.1
GZ-106	S- 2	2-4	Moist, red sand with gravel	12.4
GZ-106	S- 3	4-6	Moist, reddish brown silty gravel with sand	10.8
GZ-107	S- 2	2-4	Moist, red sand with gravel	17.0
GZ-108	S- 3	4-6	Moist, dark reddish brown silty sand with gravel	11.8
GZ-109	S- 1	4-6	Moist, reddish brown silty sand with gravel	13.5
GZ-109	G- 2	1- 3.75	Moist, reddish brown silty gravel with sand	8.1

Notes: Temperature of Drying : 110º Celsius

Client:	GZA GeoEnvironmental, Inc.				
Project:					
Location:	Lambertville, NJ			Project No:	GTX-308297
Boring ID:	GZ-104	Sample Type:	jar	Tested By:	GA
Sample ID:	S-2	Test Date:	06/18/18	Checked By:	bfs
Depth :	2-4	Test Id:	458139		
Test Comment:	---				
Visual Description:	Moist, reddish brown silty gravel with sand				
Sample Comment:	---				

Particle Size Analysis - ASTM D6913



% Cobble	% Gravel	% Sand	% Silt & Clay Size
–	34.2	26.6	39.2

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.75 in	19.00	100		
0.5 in	12.50	85		
0.375 in	9.50	80		
#4	4.75	66		
#10	2.00	58		
#20	0.85	52		
#40	0.42	48		
#60	0.25	45		
#100	0.15	42		
#140	0.11	41		
#200	0.075	39		

Coefficients

D_{85} = 12.6525 mm D_{30} = N/A

D_{60} = 2.5759 mm D_{15} = N/A

D_{50} = 0.5661 mm D_{10} = N/A

C_u = N/A C_c = N/A

Classification

ASTM N/A

AASHTO Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

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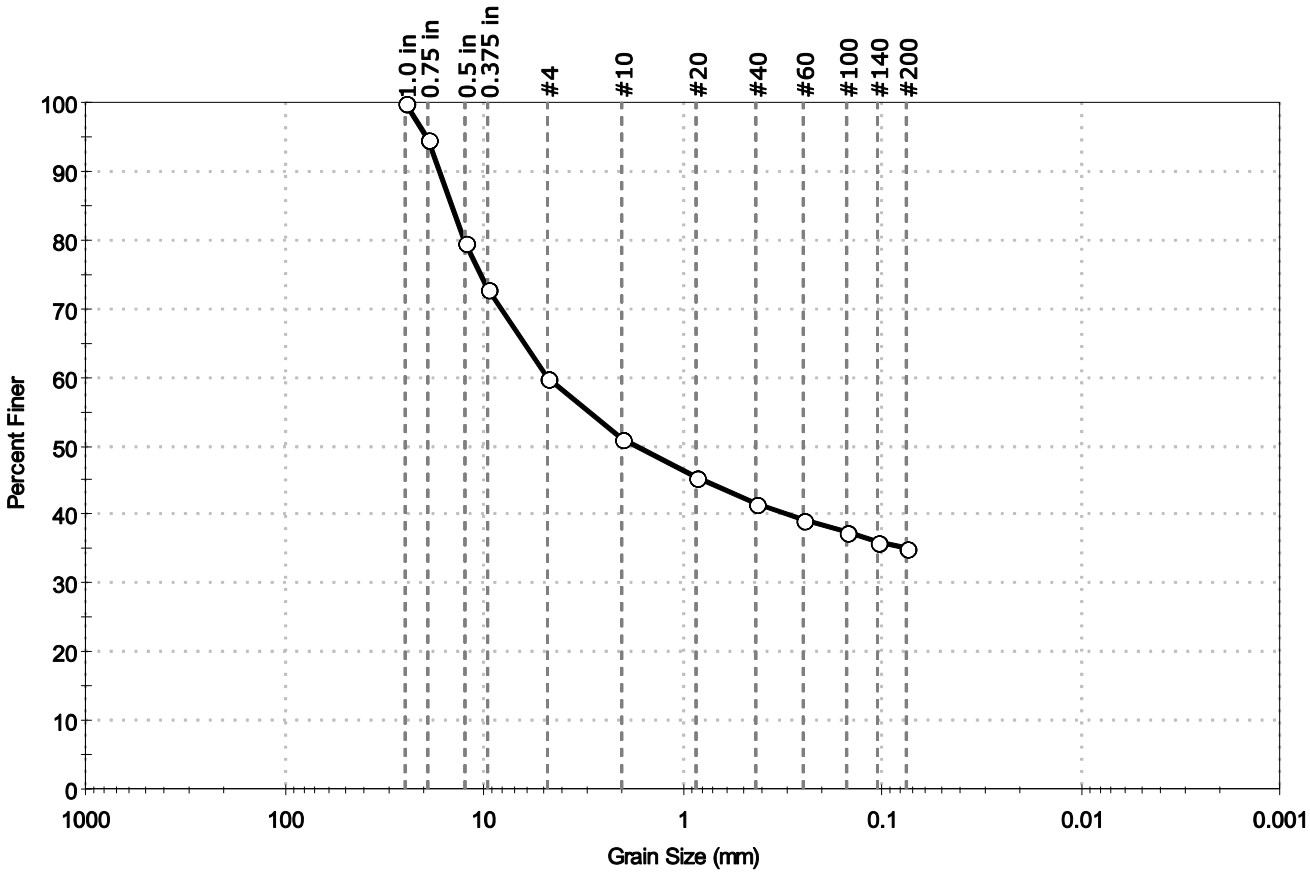
Client:	GZA GeoEnvironmental, Inc.				
Project:					
Location:	Lambertville, NJ			Project No:	GTX-308297
Boring ID:	GZ-106	Sample Type:	jar	Tested By:	GA
Sample ID:	S-3	Test Date:	06/18/18	Checked By:	bfs
Depth :	4-6	Test Id:	458140		
Test Comment:	---				
Visual Description:	Moist, reddish brown silty gravel with sand				
Sample Comment:	---				

Particle Size Analysis - ASTM D6913



% Cobble	% Gravel	% Sand	% Silt & Clay Size
–	40.1	24.7	35.2

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1.0 in	25.00	100		
0.75 in	19.00	95		
0.5 in	12.50	80		
0.375 in	9.50	73		
#4	4.75	60		
#10	2.00	51		
#20	0.85	45		
#40	0.42	42		
#60	0.25	39		
#100	0.15	37		
#140	0.11	36		
#200	0.075	35		

Coefficients

D_{85} = 14.5093 mm D_{30} = N/A
D_{60} = 4.7727 mm D_{15} = N/A
D_{50} = 1.6961 mm D_{10} = N/A
C_u = N/A C_c = N/A

Classification

ASTM N/A

AASHTO Silty Soils (A-4 (0))

Sample/Test Description

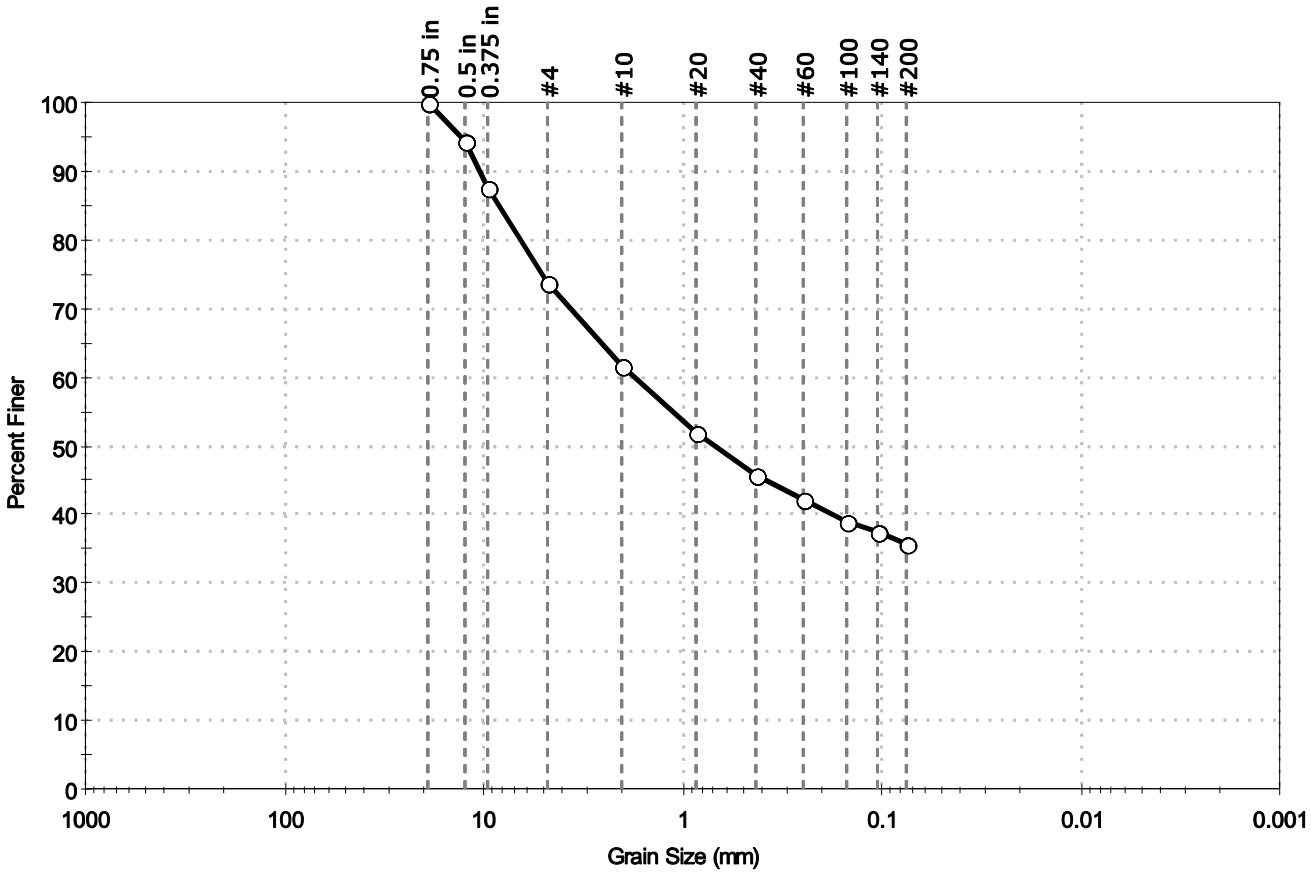
Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

printed 6/19/2018 9:38:37 AM

Client:	GZA GeoEnvironmental, Inc.				
Project:					
Location:	Lambertville, NJ			Project No:	GTX-308297
Boring ID:	GZ-109	Sample Type:	jar	Tested By:	GA
Sample ID:	S-1	Test Date:	06/18/18	Checked By:	bfs
Depth :	4-6	Test Id:	458141		
Test Comment:	---				
Visual Description:	Moist, reddish brown silty sand with gravel				
Sample Comment:	---				

Particle Size Analysis - ASTM D6913



% Cobble	% Gravel	% Sand	% Silt & Clay Size
–	26.1	38.2	35.7

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.75 in	19.00	100		
0.5 in	12.50	94		
0.375 in	9.50	88		
#4	4.75	74		
#10	2.00	62		
#20	0.85	52		
#40	0.42	46		
#60	0.25	42		
#100	0.15	39		
#140	0.11	37		
#200	0.075	36		

Coefficients

D_{85} = 8.3017 mm D_{30} = N/A
D_{60} = 1.7177 mm D_{15} = N/A
D_{50} = 0.6778 mm D_{10} = N/A
C_u = N/A C_c = N/A

Classification

ASTM N/A

AASHTO Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

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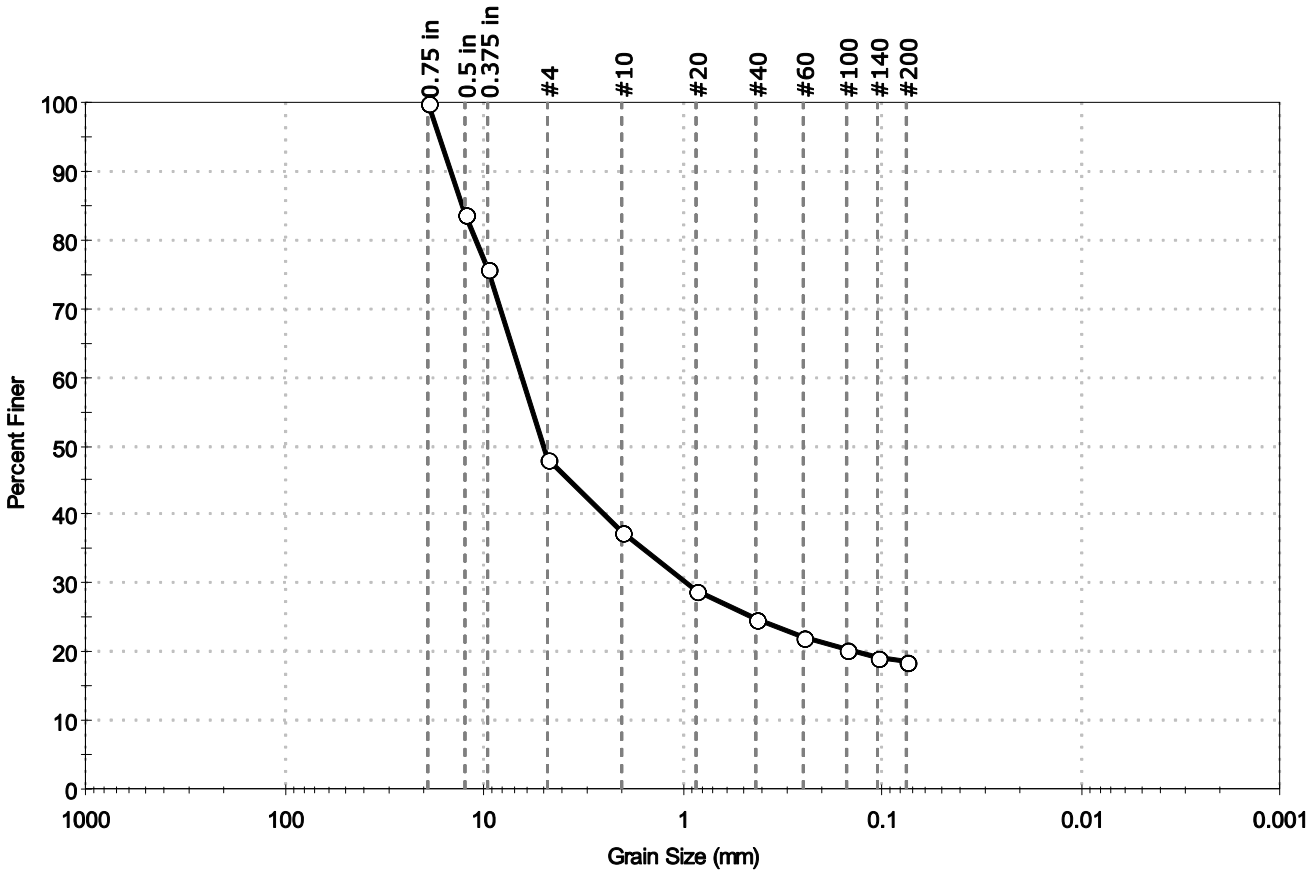
Client:	GZA GeoEnvironmental, Inc.				
Project:					
Location:	Lambertville, NJ			Project No:	GTX-308297
Boring ID:	GZ-109	Sample Type:	jar	Tested By:	GA
Sample ID:	G-2	Test Date:	06/18/18	Checked By:	bfs
Depth :	1-3.75	Test Id:	458143		
Test Comment:	---				
Visual Description:	Moist, reddish brown silty gravel with sand				
Sample Comment:	---				

Particle Size Analysis - ASTM D6913



% Cobble	% Gravel	% Sand	% Silt & Clay Size
–	51.9	29.7	18.4

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.75 in	19.00	100		
0.5 in	12.50	84		
0.375 in	9.50	76		
#4	4.75	48		
#10	2.00	37		
#20	0.85	29		
#40	0.42	25		
#60	0.25	22		
#100	0.15	20		
#140	0.11	19		
#200	0.075	18		

Coefficients

D_{85} = 12.8718 mm D_{30} = 0.9402 mm

D_{60} = 6.3860 mm D_{15} = N/A

D_{50} = 4.9742 mm D_{10} = N/A

C_u = N/A C_c = N/A

Classification

ASTM N/A

AASHTO Stone Fragments, Gravel and Sand (A-1-b (0))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

printed 6/19/2018 9:38:39 AM

Client:	GZA GeoEnvironmental, Inc.				
Project:					
Location:	Lambertville, NJ			Project No:	GTX-308297
Boring ID:	---	Sample Type:	---	Tested By:	GA
Sample ID:	---	Test Date:	06/19/18	Checked By:	emm
Depth :	---	Test Id:	459712		

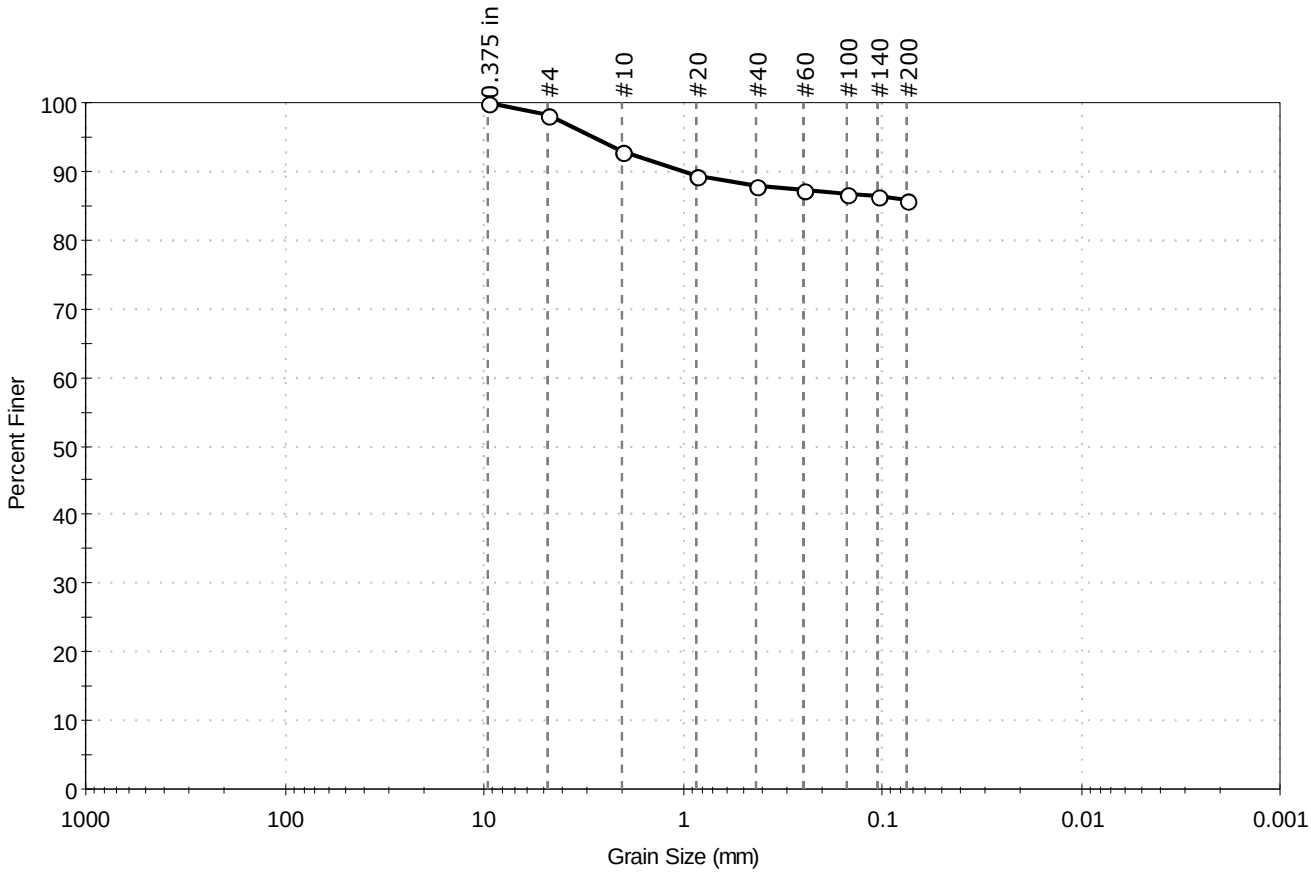
Moisture Content of Soil and Rock - ASTM D2216

Boring ID	Sample ID	Depth	Description	Moisture Content,%
GZ-105	S- 2A	2-4	Moist, reddish brown silt	15.7
GZ-108	S- 2	2-4	Moist, brown silt with sand	18.9

Notes: Temperature of Drying : 110º Celsius

Client:	GZA GeoEnvironmental, Inc.				
Project:					
Location:	Lambertville, NJ			Project No:	GTX-308297
Boring ID:	GZ-105	Sample Type:	bag	Tested By:	jbr
Sample ID:	S-2A	Test Date:	06/21/18	Checked By:	emm
Depth :	2-4	Test Id:	458138		
Test Comment:	---				
Visual Description:	Moist, reddish brown silt				
Sample Comment:	---				

Particle Size Analysis - ASTM D6913



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	1.9	12.2	85.9

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.375 in	9.50	100		
#4	4.75	98		
#10	2.00	93		
#20	0.85	89		
#40	0.42	88		
#60	0.25	87		
#100	0.15	87		
#140	0.11	86		
#200	0.075	86		

Coefficients

D_{85} = N/A D_{30} = N/A
D_{60} = N/A D_{15} = N/A
D_{50} = N/A D_{10} = N/A
C_u = N/A C_c = N/A

Classification

ASTM N/A

AASHTO Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

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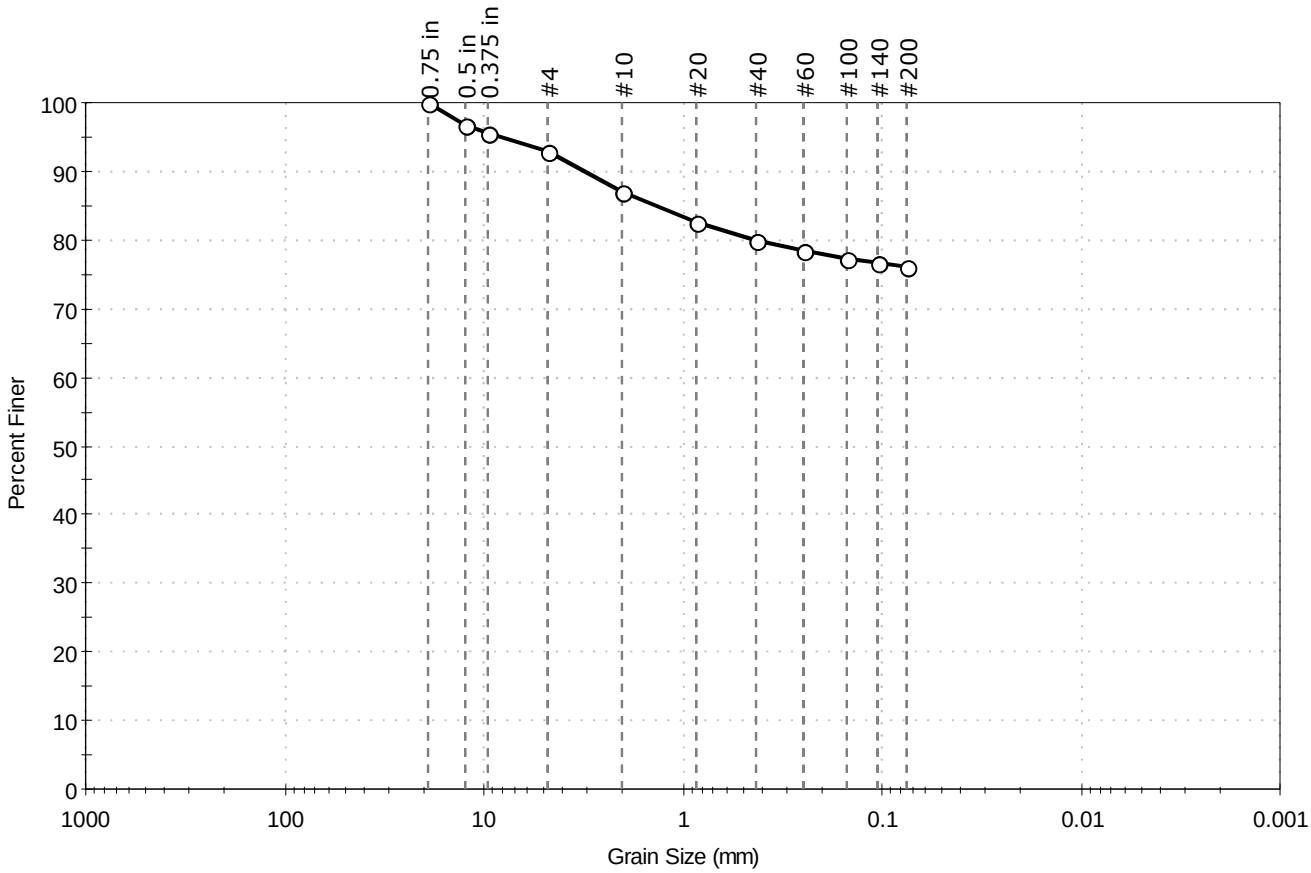
Client:	GZA GeoEnvironmental, Inc.				
Project:					
Location:	Lambertville, NJ			Project No:	GTX-308297
Boring ID:	GZ-108	Sample Type:	jar	Tested By:	GA
Sample ID:	S-2	Test Date:	06/19/18	Checked By:	emm
Depth :	2-4	Test Id:	459711		
Test Comment:	---				
Visual Description:	Moist, brown silt with sand				
Sample Comment:	---				

Particle Size Analysis - ASTM D6913



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	6.9	16.9	76.2

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.75 in	19.00	100		
0.5 in	12.50	97		
0.375 in	9.50	95		
#4	4.75	93		
#10	2.00	87		
#20	0.85	83		
#40	0.42	80		
#60	0.25	78		
#100	0.15	77		
#140	0.11	77		
#200	0.075	76		

Coefficients

D_{85} = 1.3462 mm D_{30} = N/A
D_{60} = N/A D_{15} = N/A
D_{50} = N/A D_{10} = N/A
C_u = N/A C_c = N/A

Classification

ASTM N/A

AASHTO Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

printed 6/26/2018 6:13:08 PM

Client:	GZA GeoEnvironmental, Inc.
Project Name:	
Project Location:	Lambertville, NJ
GTX #:	308297
Test Date:	06/20/18
Tested By:	jbr
Checked By:	emm

pH of Soil by ASTM G51

Boring ID	Sample ID	Depth, ft	Description	pH Reading
GZ-102	---	5	Moist, brown clay	5.04
GZ-103	---	5	Moist, brown clay	6.18
GZ-105	---	4-6	Moist, red clay	5.95
GZ-107	Composite	2-6	Moist, red clay	5.75

Notes:

Client:	GZA GeoEnvironmental, Inc.
Project:	
Location:	Lambertville, NJ
GTX#:	308297
Test Date:	06/20/18
Tested By:	jbr
Checked By:	emm

Laboratory Measurement of Soil Resistivity Using the Wenner Four-Electrode Method by ASTM G57 (Laboratory Measurement)

Boring ID	Sample ID	Depth, ft.	Sample Description	Electrical Resistivity, ohm-cm	Electrical Conductivity, $(ohm\text{-}cm)^{-1}$
GZ-102	---	5	Moist, brown clay	15,496	6.45E-05
GZ-103	---	5	Moist, brown clay	2,583	3.87E-04
GZ-105	---	4-6	Moist, red clay	5,682	1.76E-04
GZ-107	Comosite	2-6	Moist, red clay	6,715	1.49E-04

Notes: Test Equipment: Nilsson Model 400 Soil Resistance Meter, MC Miller Soil Box
Water added to sample to create a thick slurry prior to testing (saturated condition).
Electrical Conductivity is calculated as inverse of Electrical Resistivity (per ASTM G57)
Test conducted in standard laboratory atmosphere: 68-73 F

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GEOTESTING EXPRESS INCORPORATED
125 NAGOG PARK
ACTON MA 01720-3451
USA

Analysis No.	TS-A1807478
Report Date	22 June 2018
Date Sampled	18 June 2018
Date Received	2014 June 2018
Where Sampled	Acton, MA USA
Sampled By	Client

This is to attest that we have examined: Soil for Project Name: - Site Location: Lambertville, NJ; Job Number: GTX-308297

When examined to the applicable requirements of:

ASTM D 512 - 12	"Standard Test Methods for Chloride Ion in Water" Method B
ASTM D 516 - 16	"Standard Test Method for Sulfate Ion in Water"
ASTM G 200 – 14	"Standard Test Method for Measurement of Oxidation-Reduction Potential (ORP) of Soil"

Results:

ASTM D 512 - Chloride (soluble) Method B

Sample	Results		Detection Limit
	ppm (mg/kg)	%[1]	
GZ-102	41.	0.0041	10.
GZ-103	54.	0.0054	
GZ-105	132.	0.0132	
GZ-107	30.	0.0030	

NOTE: [1]Percent by weight as received

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Salt Lake City, UT 84115-4234 USA
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FAX: +1 801 262 9870

CERTIFICATE OF ANALYSIS

ASTM D 516 – Sulfates (Soluble)

Sample	Results		Detection Limit
	ppm (mg/kg)	%[1]	
GZ-102	<10.	<0.0010	10.
GZ-103	24.	0.0024	
GZ-105	26.	0.0026	
GZ-107	24.	0.0024	

NOTE: [1]Percent by weight as received

ASTM G 200 – Reduction Oxidation Potential (REDOX)

Sample	Results	Detection Limit
GZ-102	181.9 @ 21.7 ºC	0.1
GZ-103	177.4 @ 21.5 ºC	
GZ-105	180.0 @ 21.8 ºC	
GZ-107	180.6 @ 22.7 ºC	

END OF ANALYSIS

USEPA Laboratory ID UT00930

Merrill Gee P.E. – Engineer in Charge

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ANALYTICAL REPORT

Lab Number:	L1822856
Client:	Geo Testing Express 125 Nagog Park Acton, MA 01720
ATTN:	Jonathan Campbell
Phone:	(978) 893-1291
Project Name:	
Project Number:	GTX-308297
Report Date:	06/21/18

The original project report/data package is held by Alpha Analytical. This report/data package is paginated and should be reproduced only in its entirety. Alpha Analytical holds no responsibility for results and/or data that are not consistent with the original.

Certifications & Approvals: MA (M-MA086), NH NELAP (2064), CT (PH-0574), IL (200077), ME (MA00086), MD (348), NJ (MA935), NY (11148), NC (25700/666), PA (68-03671), RI (LAO00065), TX (T104704476), VT (VT-0935), VA (460195), USDA (Permit #P330-17-00196).

Eight Walkup Drive, Westborough, MA 01581-1019
508-898-9220 (Fax) 508-898-9193 800-624-9220 - www.alphalab.com

Project Name:
Project Number: GTX-308297

Lab Number: L1822856
Report Date: 06/21/18

Alpha Sample ID	Client ID	Matrix	Sample Location	Collection Date/Time	Receive Date
L1822856-01	GZ-102	SOIL	LAMBERTVILLE, NJ	06/18/18 00:00	06/18/18
L1822856-02	GZ-103	SOIL	LAMBERTVILLE, NJ	06/18/18 00:00	06/18/18
L1822856-03	GZ-105	SOIL	LAMBERTVILLE, NJ	06/18/18 00:00	06/18/18
L1822856-04	GZ-107	SOIL	LAMBERTVILLE, NJ	06/18/18 00:00	06/18/18

Project Name:
Project Number: GTX-308297

Lab Number: L1822856
Report Date: 06/21/18

Case Narrative

The samples were received in accordance with the Chain of Custody and no significant deviations were encountered during the preparation or analysis unless otherwise noted. Sample Receipt, Container Information, and the Chain of Custody are located at the back of the report.

Results contained within this report relate only to the samples submitted under this Alpha Lab Number and meet NELAP requirements for all NELAP accredited parameters unless otherwise noted in the following narrative. The data presented in this report is organized by parameter (i.e. VOC, SVOC, etc.). Sample specific Quality Control data (i.e. Surrogate Spike Recovery) is reported at the end of the target analyte list for each individual sample, followed by the Laboratory Batch Quality Control at the end of each parameter. Tentatively Identified Compounds (TICs), if requested, are reported for compounds identified to be present and are not part of the method/program Target Compound List, even if only a subset of the TCL are being reported. If a sample was re-analyzed or re-extracted due to a required quality control corrective action and if both sets of data are reported, the Laboratory ID of the re-analysis or re-extraction is designated with an "R" or "RE", respectively. When multiple Batch Quality Control elements are reported (e.g. more than one LCS), the associated samples for each element are noted in the grey shaded header line of each data table. Any Laboratory Batch, Sample Specific % recovery or RPD value that is outside the listed Acceptance Criteria is bolded in the report. All specific QC information is also incorporated in the Data Usability format of our Data Merger tool where it can be reviewed along with any associated usability implications. Soil/sediments, solids and tissues are reported on a dry weight basis unless otherwise noted. Definitions of all data qualifiers and acronyms used in this report are provided in the Glossary located at the back of the report.

In reference to questions H (CAM) or 4 (RCP) when "NO" is checked, the performance criteria for CAM and RCP methods allow for some quality control failures to occur and still be within method compliance. In these instances the specific failure is not narrated but noted in the associated QC table. The information is also incorporated in the Data Usability format of our Data Merger tool where it can be reviewed along with any associated usability implications.

Please see the associated ADEx data file for a comparison of laboratory reporting limits that were achieved with the regulatory Numerical Standards requested on the Chain of Custody.

HOLD POLICY
For samples submitted on hold, Alpha's policy is to hold samples (with the exception of Air canisters) free of charge for 21 calendar days from the date the project is completed. After 21 calendar days, we will dispose of all samples submitted including those put on hold unless you have contacted your Client Service Representative and made arrangements for Alpha to continue to hold the samples. Air canisters will be disposed after 3 business days from the date the project is completed.

Please contact Client Services at 800-624-9220 with any questions.

I, the undersigned, attest under the pains and penalties of perjury that, to the best of my knowledge and belief and based upon my personal inquiry of those responsible for providing the information contained in this analytical report, such information is accurate and complete. This certificate of analysis is not complete unless this page accompanies any and all pages of this report.

Authorized Signature: Kelly Stenstrom

Title: Technical Director/Representative

Date: 06/21/18

INORGANICS
&
MISCELLANEOUS

Project Name:

Project Number: GTX-308297

Lab Number: L1822856

Report Date: 06/21/18

SAMPLE RESULTS

Lab ID: L1822856-01
Client ID: GZ-102
Sample Location: LAMBERTVILLE, NJ

Date Collected: 06/18/18 00:00
Date Received: 06/18/18
Field Prep: Not Specified

Sample Depth:
Matrix: Soil

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Solids, Total	82.0		%	0.100	NA	1	-	06/19/18 13:51	121,2540G	RI
Sulfide	ND		mg/kg	0.61	--	1	06/19/18 19:00	06/19/18 23:07	1,9030B	CW

Project Name:

Project Number: GTX-308297

Lab Number: L1822856

Report Date: 06/21/18

SAMPLE RESULTS

Lab ID: L1822856-02
Client ID: GZ-103
Sample Location: LAMBERTVILLE, NJ

Sample Depth:
Matrix: Soil

Date Collected: 06/18/18 00:00
Date Received: 06/18/18
Field Prep: Not Specified

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Solids, Total	83.0		%	0.100	NA	1	-	06/19/18 13:51	121,2540G	RI
Sulfide	ND		mg/kg	0.60	--	1	06/19/18 19:00	06/19/18 23:07	1,9030B	CW

Project Name:

Project Number: GTX-308297

Lab Number: L1822856

Report Date: 06/21/18

SAMPLE RESULTS

Lab ID: L1822856-03
Client ID: GZ-105
Sample Location: LAMBERTVILLE, NJ

Sample Depth:
Matrix: Soil

Date Collected: 06/18/18 00:00
Date Received: 06/18/18
Field Prep: Not Specified

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Solids, Total	89.0		%	0.100	NA	1	-	06/19/18 13:51	121,2540G	RI
Sulfide	ND		mg/kg	0.56	--	1	06/19/18 19:00	06/19/18 23:07	1,9030B	CW

Project Name:

Project Number: GTX-308297

Lab Number: L1822856

Report Date: 06/21/18

SAMPLE RESULTS

Lab ID: L1822856-04
Client ID: GZ-107
Sample Location: LAMBERTVILLE, NJ

Sample Depth:
Matrix: Soil

Date Collected: 06/18/18 00:00
Date Received: 06/18/18
Field Prep: Not Specified

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Solids, Total	91.6		%	0.100	NA	1	-	06/19/18 13:51	121,2540G	RI
Sulfide	ND		mg/kg	0.54	--	1	06/19/18 19:00	06/19/18 23:07	1,9030B	CW

Project Name:

Project Number: GTX-308297

Lab Number: L1822856

Report Date: 06/21/18

Method Blank Analysis
Batch Quality Control

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab for sample(s): 01-04 Batch: WG1127647-1										
Sulfide	ND		mg/kg	0.50	--	1	06/19/18 19:00	06/19/18 23:06	1,9030B	CW

Lab Control Sample Analysis
Batch Quality Control

Project Name:

Project Number: GTX-308297

Lab Number: L1822856

Report Date: 06/21/18

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
General Chemistry - Westborough Lab Associated sample(s): 01-04 Batch: WG1127647-2								
Sulfide	78		-		75-125	-		25

Project Name:

Project Number: GTX-308297

Lab Number: L1822856

Report Date: 06/21/18

Sample Receipt and Container Information

Were project specific reporting limits specified? NO

Cooler Information

Cooler	Custody Seal
A	Absent

Container Information

Container ID	Container Type	Cooler	Initial pH	Final pH	Temp deg C	Pres	Seal	Frozen Date/Time	Analysis(*)
L1822856-01A	Bag	A	NA		2.7	Y	Absent		SULFIDE-9030(7),TS(7)
L1822856-02A	Bag	A	NA		2.7	Y	Absent		SULFIDE-9030(7),TS(7)
L1822856-03A	Bag	A	NA		2.7	Y	Absent		SULFIDE-9030(7),TS(7)
L1822856-04A	Bag	A	NA		2.7	Y	Absent		SULFIDE-9030(7),TS(7)

*Values in parentheses indicate holding time in days

Project Name:

Project Number: GTX-308297

Lab Number: L1822856

Report Date: 06/21/18

GLOSSARY

Acronyms

EDL	- Estimated Detection Limit: This value represents the level to which target analyte concentrations are reported as estimated values, when those target analyte concentrations are quantified below the reporting limit (RL). The EDL includes any adjustments from dilutions, concentrations or moisture content, where applicable. The use of EDLs is specific to the analysis of PAHs using Solid-Phase Microextraction (SPME).
EPA	- Environmental Protection Agency.
LCS	- Laboratory Control Sample: A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes.
LCSD	- Laboratory Control Sample Duplicate: Refer to LCS.
LFB	- Laboratory Fortified Blank: A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes.
MDL	- Method Detection Limit: This value represents the level to which target analyte concentrations are reported as estimated values, when those target analyte concentrations are quantified below the reporting limit (RL). The MDL includes any adjustments from dilutions, concentrations or moisture content, where applicable.
MS	- Matrix Spike Sample: A sample prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of target analyte concentration is available.
MSD	- Matrix Spike Sample Duplicate: Refer to MS.
NA	- Not Applicable.
NC	- Not Calculated: Term is utilized when one or more of the results utilized in the calculation are non-detect at the parameter's reporting unit.
NDPA/DPA	- N-Nitrosodiphenylamine/Diphenylamine.
NI	- Not Ignitable.
NP	- Non-Plastic: Term is utilized for the analysis of Atterberg Limits in soil.
RL	- Reporting Limit: The value at which an instrument can accurately measure an analyte at a specific concentration. The RL includes any adjustments from dilutions, concentrations or moisture content, where applicable.
RPD	- Relative Percent Difference: The results from matrix and/or matrix spike duplicates are primarily designed to assess the precision of analytical results in a given matrix and are expressed as relative percent difference (RPD). Values which are less than five times the reporting limit for any individual parameter are evaluated by utilizing the absolute difference between the values; although the RPD value will be provided in the report.
SRM	- Standard Reference Material: A reference sample of a known or certified value that is of the same or similar matrix as the associated field samples.
STLP	- Semi-dynamic Tank Leaching Procedure per EPA Method 1315.
TIC	- Tentatively Identified Compound: A compound that has been identified to be present and is not part of the target compound list (TCL) for the method and/or program. All TICs are qualitatively identified and reported as estimated concentrations.

Footnotes

1	- The reference for this analyte should be considered modified since this analyte is absent from the target analyte list of the original method.

Terms

Analytical Method: Both the document from which the method originates and the analytical reference method. (Example: EPA 8260B is shown as 1,8260B.) The codes for the reference method documents are provided in the References section of the Addendum.

Final pH: As it pertains to Sample Receipt & Container Information section of the report, Final pH reflects pH of container determined after adjustment at the laboratory, if applicable. If no adjustment required, value reflects Initial pH.

Frozen Date/Time: With respect to Volatile Organics in soil, Frozen Date/Time reflects the date/time at which associated Reagent Water-preserved vials were initially frozen. Note: If frozen date/time is beyond 48 hours from sample collection, value will be reflected in 'bold'.

Initial pH: As it pertains to Sample Receipt & Container Information section of the report, Initial pH reflects pH of container determined upon receipt, if applicable.

Total: With respect to Organic analyses, a 'Total' result is defined as the summation of results for individual isomers or Aroclors. If a 'Total' result is requested, the results of its individual components will also be reported. This is applicable to 'Total' results for methods 8260, 8081 and 8082.

Data Qualifiers

A	- Spectra identified as "Aldol Condensation Product".
B	- The analyte was detected above the reporting limit in the associated method blank. Flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank. For MCP-related

Report Format: Data Usability Report

Project Name: **Lab Number:** L1822856

Project Number: GTX-308297 **Report Date:** 06/21/18

Data Qualifiers

projects, flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank. For DOD-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank AND the analyte was detected above one-half the reporting limit (or above the reporting limit for common lab contaminants) in the associated method blank. For NJ-Air-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte above the reporting limit. For NJ-related projects (excluding Air), flag only applies to associated field samples that have detectable concentrations of the analyte, which was detected above the reporting limit in the associated method blank or above five times the reporting limit for common lab contaminants (Phthalates, Acetone, Methylene Chloride, 2-Butanone).

C - Co-elution: The target analyte co-elutes with a known lab standard (i.e. surrogate, internal standards, etc.) for co-extracted analyses.

D - Concentration of analyte was quantified from diluted analysis. Flag only applies to field samples that have detectable concentrations of the analyte.

E - Concentration of analyte exceeds the range of the calibration curve and/or linear range of the instrument.

G - The concentration may be biased high due to matrix interferences (i.e, co-elution) with non-target compound(s). The result should be considered estimated.

H - The analysis of pH was performed beyond the regulatory-required holding time of 15 minutes from the time of sample collection.

I - The lower value for the two columns has been reported due to obvious interference.

M - Reporting Limit (RL) exceeds the MCP CAM Reporting Limit for this analyte.

NJ - Presumptive evidence of compound. This represents an estimated concentration for Tentatively Identified Compounds (TICs), where the identification is based on a mass spectral library search.

P - The RPD between the results for the two columns exceeds the method-specified criteria.

Q - The quality control sample exceeds the associated acceptance criteria. For DOD-related projects, LCS and/or Continuing Calibration Standard exceedences are also qualified on all associated sample results. Note: This flag is not applicable for matrix spike recoveries when the sample concentration is greater than 4x the spike added or for batch duplicate RPD when the sample concentrations are less than 5x the RL. (Metals only.)

R - Analytical results are from sample re-analysis.

RE - Analytical results are from sample re-extraction.

S - Analytical results are from modified screening analysis.

J - Estimated value. This represents an estimated concentration for Tentatively Identified Compounds (TICs).

ND - Not detected at the reporting limit (RL) for the sample.

Report Format: Data Usability Report

Project Name:

Project Number: GTX-308297

Lab Number: L1822856

Report Date: 06/21/18

REFERENCES

1 Test Methods for Evaluating Solid Waste: Physical/Chemical Methods. EPA SW-846. Third Edition. Updates I - IV, 2007.

121 Standard Methods for the Examination of Water and Wastewater. APHA-AWWA-WEF. Standard Methods Online.

LIMITATION OF LIABILITIES

Alpha Analytical performs services with reasonable care and diligence normal to the analytical testing laboratory industry. In the event of an error, the sole and exclusive responsibility of Alpha Analytical shall be to re-perform the work at it's own expense. In no event shall Alpha Analytical be held liable for any incidental, consequential or special damages, including but not limited to, damages in any way connected with the use of, interpretation of, information or analysis provided by Alpha Analytical.

We strongly urge our clients to comply with EPA protocol regarding sample volume, preservation, cooling, containers, sampling procedures, holding time and splitting of samples in the field.

Certification Information

The following analytes are not included in our Primary NELAP Scope of Accreditation:

Westborough Facility
EPA 624: m/p-xylene, o-xylene
EPA 8260C: NPW: 1,2,4,5-Tetramethylbenzene; 4-Ethyltoluene, Azobenzene; SCM: Iodomethane (methyl iodide), Methyl methacrylate, 1,2,4,5-Tetramethylbenzene; 4-Ethyltoluene.
EPA 8270D: NPW: Dimethylnaphthalene,1,4-Diphenylhydrazine; SCM: Dimethylnaphthalene,1,4-Diphenylhydrazine.
EPA 300: DW: Bromide
EPA 6860: SCM: Perchlorate
EPA 9010: NPW and SCM: Amenable Cyanide Distillation
SM4500: NPW: Amenable Cyanide, Dissolved Oxygen; SCM: Total Phosphorus, TKN, NO2, NO3.

Mansfield Facility
SM 2540D: TSS
EPA 8082A: NPW: PCB: 1, 5, 31, 87,101, 110, 141, 151, 153, 180, 183, 187.
EPA TO-15: Halothane, 2,4,4-Trimethyl-2-pentene, 2,4,4-Trimethyl-1-pentene, Thiophene, 2-Methylthiophene, 3-Methylthiophene, 2-Ethylthiophene, 1,2,3-Trimethylbenzene, Indan, Indene, 1,2,4,5-Tetramethylbenzene, Benzothiophene, 1-Methylnaphthalene.
Biological Tissue Matrix: EPA 3050B

The following analytes are included in our Massachusetts DEP Scope of Accreditation

Westborough Facility:

Drinking Water
EPA 300.0: Chloride, Nitrate-N, Fluoride, Sulfate; **EPA 353.2**: Nitrate-N, Nitrite-N; **SM4500NO3-F**: Nitrate-N, Nitrite-N; **SM4500F-C, SM4500CN-CE, EPA 180.1, SM2130B, SM4500Cl-D, SM2320B, SM2540C, SM4500H-B**
EPA 332: Perchlorate; **EPA 524.2:** THMs and VOCs; **EPA 504.1:** EDB, DBCP.
Microbiology: **SM9215B; SM9223-P/A, SM9223B-Colilert-QT,SM9222D**.

Non-Potable Water
SM4500H,B, EPA 120.1, SM2510B, SM2540C, SM2320B, SM4500CL-E, SM4500F-BC, SM4500NH3-BH: Ammonia-N and Kjeldahl-N, **EPA 350.1**: Ammonia-N, **LACHAT 10-107-06-1-B**: Ammonia-N, **EPA 351.1, SM4500NO3-F, EPA 353.2**: Nitrate-N**, EPA 351.1, SM4500P-E, SM4500P-B, E, SM4500SO4-E, SM5220D, EPA 410.4, SM5210B, SM5310C, SM4500CL-D, EPA 1664, EPA 420.1, SM4500-CN-CE, SM2540D.**
EPA 624: Volatile Halocarbons & Aromatics,
EPA 608: Chlordane, Toxaphene, Aldrin, alpha-BHC, beta-BHC, gamma-BHC, delta-BHC, Dieldrin, DDD, DDE, DDT, Endosulfan I, Endosulfan II, Endosulfan sulfate, Endrin, Endrin Aldehyde, Heptachlor, Heptachlor Epoxide, PCBs
EPA 625: SVOC (Acid/Base/Neutral Extractables), **EPA 600/4-81-045**: PCB-Oil.
Microbiology: **SM9223B-Colilert-QT; Enterolert-QT, SM9221E, SM9222D.**

Mansfield Facility:

Drinking Water
EPA 200.7: Al, Ba, Be, Cd, Cr, Cu, Mn, Ni, Na, Ag, Ca, Zn. **EPA 200.8:** Al, Sb, As, Ba, Be, Cd, Cr, Cu, Pb, Mn, Ni, Se, Ag, TL, Zn. **EPA 245.1** Hg.
EPA 522.

Non-Potable Water
EPA 200.7: Al, Sb, As, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Mo, Ni, K, Se, Ag, Na, Sr, TL, Ti, V, Zn.
EPA 200.8: Al, Sb, As, Be, Cd, Cr, Cu, Pb, Mn, Ni, Se, Ag, TL, Zn.
EPA 245.1 Hg.
SM2340B

For a complete listing of analytes and methods, please contact your Alpha Project Manager.

alpha
L1822856

GeoTesting EXPRESS

SOIL CHAIN OF CUSTODY & TEST REQUEST

CLIENT	
Company: GeoTesting Express	
Address: 125 Nagog Park	
City, State, Zip: Acton, MA 01720	
Contact: Ethan Marro / Jon Campbell	Phone:978-635-0424
E-mail:emarro@geotesting.com / jcampbell@geotesting.com	Direct: 978-893-1267

INVOICE (complete if different from Client)	
Company: Same	
Address:	
City, State, Zip:	
Contact:	Phone:
E-mail:	Cell:

GeoTesting Express, Inc.
125 Nagog Park
Acton, MA 01720
800 434 1062 Toll Free
978 635 0266 Fax

2358 Perimeter Park Drive, Suite 320
Atlanta, GA 30341
770 645 6575 Tel
770 645 6570 Fax

www.geotesting.com

PROJECT		
Project Name: Lambertville Compressor	Client Project #: GTX- 308297	Purchase Order#:
Project Location: Lambertville, NJ	Requested Turnaround: 6/27/18	

SOIL			AASHTO T 290 –Soluble Sulfates in Soil	AASHTO T 291 –Soluble Chlorides in Soil	ASTM D516 - Sulfates	ASTM D512 - Chlorides	EPA 375.2 – Sulfates	EPA 325 - Chlorides	EPA 376.2 - Sulfides	G200 - -ORP	SM2580B - ORP	C1580 - Sulfates	ASTM D1498 - ORP			
Boring ID	Sample ID	Depth														
—	GZ-102	—							✓							
—	GZ-103	—							✓							
—	GZ-105	—							✓							
—	GZ-107	—							✓							

*Specify Test Conditions (Undisturbed or Remolded, Density and moisture, Test Normal Loads, Test Confining Stresses, etc.):

AUTHORIZE BY SIGNING AND DATING:

SIGNATURE: _____ PRINT NAME: Rachel Maloney DATE: 6/18/18

Relinquished By:	DATE: 6/18/18 TIME: 1557	Received By:	DATE: 6-18-18 TIME: 15:57
Relinquished By:	DATE: 6/18/18 TIME: 16:45	Received By:	DATE: 6/18/18 TIME: 16:45

APPENDX D- ROCK CORE PHOTOGRAPHS

Appendix D

PennEast Interconnect

Rock Core Photographs

Boring No.	Run	Depth (ft)	Recovery (in)	Recovery (%)	RQD (in)	RQD (%)	Rock Type	Box Row
GZ-106	C-1	8 - 13	60	100	4	7	SHALE	1
GZ-107	C-1	7 - 12	57.5	96	0	0	SHALE	2
GZ-104	C-1	6 - 11	55	92	4	7	SHALE	3

Notes: 1. Box row corresponds to the core box section in which the rock core sample is contained; Row 1=Top, Row 4=Bottom.
2. Top photo is dry, bottom photo is wetted.

APPENDIX E – ELECTRICAL RESISTIVITY LOG

SOIL ELECTRICAL RESISTIVITY DATA LOG

GZA GEOENVIRONMENTAL, INC.	CLIENT:	ELEC. RESISITIVITY LOCATIONS	ER-1
1515 Market Street	EN Engineering	SHEET	1 OF 1
Philadelphia, PA 19102	PennEast Interconnect	GZA PROJECT NO.	05.0046118.03
	Lambertville, New Jersey	PROJECT LOCATION	Lambertville, NJ

ELECTRICAL RESISTIVITY SURVEY- WENNER CONFIG.

TYPE OF SURV. EQUIPMENT: AEMC Instruments

MODEL: 6472

GZA ENGINEER: V. Larimore

WEATHER: Overcast-Sunny. Humidity 84% +-

TEMPERATURE: 60s

EL PROFILE COORDINATES: See Plan

GROUND SURFACE EL.(FT): 195 DATUM: NAVD 88

DATE START: May 14, 2018 DATE END: May 14, 2018

GROUNDWATER READINGS

BORING ID	DATE	TIME	WATER LEVEL	HOLE DIAM.	STABIL. TIME
GZ-102	5/14/18	0845	6.5'	6"	4 days

(Note: Groundwater measured in nearest borehole during vacuum excavation)

TEST NO.	TEST LOCATION	ARRAY ALIGNMENT N-S	ARRAY ALIGNMENT E-W	PROBE Depth, b (ft)	CURRENT I (mA)	SPACING a (ft)	RESISTANCE R (Ohms)	APPARENT RESISTIVITY Ro (Ohm-ft)	APPARENT RESISTIVITY Ro (Ohm-cm)
1	ER-1		X	0.5	31.4	5	12.4	396	12,078
2	ER-1		X	0.5	27.2	10	7.6	478	14,580
3	ER-1		X	0.5	21.3	15	5.5	522	15,917
4	ER-1		X	0.5	21.1	20	4.4	550	16,756
5	ER-1		X	0.5	18.1	25	3.7	575	17,536
1	ER-1	X		0.5	30.6	5	12.7	406	12,371
2	ER-1	X		0.5	29.1	10	7.9	500	15,234
3	ER-1	X		0.5	28.3	15	5.7	534	16,291
4	ER-1	X		0.5	23.4	20	4.1	515	15,683
5	ER-1	X		0.5	26	25	2.8	444	13,535

SOIL TYPES*	RESISTIVITY (Ohm-cm)
CLAY and saturated SILT	0-10,000
Sandy CLAY and wet silty SAND	10,000-25,000
Clayey SAND and saturated SAND	25,000-50,000
SAND	50,000-150,000
GRAVEL	150,000-500,000
Weathered ROCK	100,000-200,000
Sound ROCK	150,000-4,000,000

* Ralph B. Peck, Foundation Engineering, 2nd Edition

REMARKS: All tests performed in general accordance with ASTM G-57-95a and ANSI/IEEE std. 81-2012.

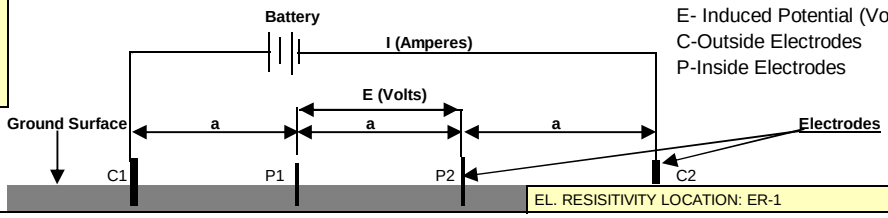
From IEEE std. 81-2012:

RESISTIVITY (Ro) = 2* π *a*R (for b≤0.1a)

$$= \frac{4\pi a R}{1 + \frac{2a}{\sqrt{a^2+4b^2}} - \frac{a}{\sqrt{a^2+b^2}}} \quad \text{(for b>0.1a)}$$

Ro-apparent resisitivity to depth " a "
a=Spacing between electrodes (ft)
R-Resistance (Ohms)
b= Probe Depth (ft)

I - El. Current (Amperes)
E- Induced Potential (Volts)
C-Outside Electrodes
P-Inside Electrodes



EL. RESISITIVITY LOCATION: ER-1

GZA

SOIL ELECTRICAL RESISTIVITY DATA LOG

GZA GEOENVIRONMENTAL, INC. 1515 Market Street Philadelphia, PA 19102	CLIENT: EN Engineering PennEast Interconnect Lambertville, New Jersey	ELEC. RESISITIVITY LOCATIONS	ER-2
		SHEET	1 OF 1
		GZA PROJECT NO.	05.0046118.03
		PROJECT LOCATION	Lambertville, NJ

ELECTRICAL RESISTIVITY SURVEY- WENNER CONFIG.

TYPE OF SURV. EQUIPMENT: AEMC Instruments

MODEL: 6472

GZA ENGINEER: V. Larimore

WEATHER: Overcast-Sunny. Humidity 84% +-

TEMPERATURE: 60s

EL PROFILE COORDINATES: See Plan

GROUND SURFACE EL.(FT): 180 DATUM: NAVD 88

DATE START: May 14, 2018 DATE END: May 14, 2018

GROUNDWATER READINGS

BORING ID	DATE	TIME	WATER LEVEL	HOLE DIAM.	STABIL. TIME
GZ-103	5/30/18	1000	5'	6"	15 min

(Note: Groundwater measured in nearest borehole during vacuum excavation)

TEST NO.	TEST LOCATION	ARRAY ALIGNMENT N-S	ARRAY ALIGNMENT E-W	PROBE Depth, b (ft)	CURRENT I (mA)	SPACING a (ft)	RESISTANCE R (Ohms)	APPARENT RESISTIVITY Ro (Ohm-ft)	APPARENT RESISTIVITY Ro (Ohm-cm)
1	ER-1		X	0.5	41.1	5	8.1	259	7,890
2	ER-1		X	0.5	36.6	10	3.1	194	5,924
3	ER-1		X	0.5	45.1	15	2.0	185	5,641
4	ER-1		X	0.5	50.6	20	1.6	196	5,982
5	ER-1		X	0.5	68.7	25	1.3	203	6,181
1	ER-1	X		0.5	48	5	7.0	222	6,779
2	ER-1	X		0.5	54.7	10	3.2	201	6,117
3	ER-1	X		0.5	53.8	15	2.2	209	6,361
4	ER-1	X		0.5	117	20	1.7	219	6,672
5	ER-1	X		0.5	127	25	1.6	252	7,666

SOIL TYPES*	RESISTIVITY (Ohm-cm)
CLAY and saturated SILT	0-10,000
Sandy CLAY and wet silty SAND	10,000-25,000
Clayey SAND and saturated SAND	25,000-50,000
SAND	50,000-150,000
GRAVEL	150,000-500,000
Weathered ROCK	100,000-200,000
Sound ROCK	150,000-4,000,000

* Ralph B. Peck, Foundation Engineering, 2nd Edition

REMARKS: All tests performed in general accordance with ASTM G-57-95a and ANSI/IEEE std. 81-2012.

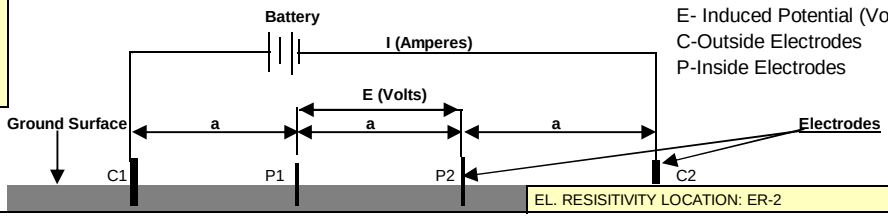
From IEEE std. 81-2012:

RESISTIVITY (Ro) = 2* π *a*R (for b≤0.1a)

$$= \frac{4\pi a R}{1 + \frac{2a}{\sqrt{a^2+4b^2}} - \frac{a}{\sqrt{a^2+b^2}}} \quad \text{(for b>0.1a)}$$

Ro-apparent resisitivity to depth " a "
a=Spacing between electrodes (ft)
R-Resistance (Ohms)
b= Probe Depth (ft)

I - El. Current (Amperes)
E- Induced Potential (Volts)
C-Outside Electrodes
P-Inside Electrodes



EL. RESISITIVITY LOCATION: ER-2

GZA

SOIL ELECTRICAL RESISTIVITY DATA LOG

GZA GEOENVIRONMENTAL, INC.	CLIENT:	ELEC. RESISITIVITY LOCATIONS	ER-3
1515 Market Street	EN Engineering	SHEET	1 OF 1
Philadelphia, PA 19102	PennEast Interconnect	GZA PROJECT NO.	05.0046118.03
	Lambertville, New Jersey	PROJECT LOCATION	Lambertville, NJ

ELECTRICAL RESISTIVITY SURVEY- WENNER CONFIG.

TYPE OF SURV. EQUIPMENT: AEMC Instruments

MODEL: 6472

GZA ENGINEER: V. Larimore

WEATHER: Overcast-Sunny. Humidity 84% +-

TEMPERATURE: 60s

EL PROFILE COORDINATES: See Plan

GROUND SURFACE EL.(FT): 172 DATUM: NAVD 88

DATE START: May 14, 2018 DATE END: May 14, 2018

GROUNDWATER READINGS

BORING ID	DATE	TIME	WATER LEVEL	HOLE DIAM.	STABIL. TIME
GZ-106	5/18/18	1030	(NOTE 1)	4"	NA

(Note: Groundwater measured in nearest borehole during vacuum excavation)

TEST NO.	TEST LOCATION	ARRAY ALIGNMENT N-S	ARRAY ALIGNMENT E-W	PROBE Depth, b (ft)	CURRENT I (mA)	SPACING a (ft)	RESISTANCE R (Ohms)	APPARENT RESISTIVITY Ro (Ohm-ft)	APPARENT RESISTIVITY Ro (Ohm-cm)
1	ER-1		X	0.5	35.3	5	12.3	393	11,981
2	ER-1		X	0.5	33.6	10	6.2	391	11,925
3	ER-1		X	0.5	40.6	15	4.3	401	12,233
4	ER-1		X	0.5	50.2	20	3.4	429	13,075
5	ER-1		X	0.5	32.1	25	2.7	418	12,744
1	ER-1	X		0.5	42.3	5	12.1	387	11,786
2	ER-1	X		0.5	32.8	10	6.4	405	12,329
3	ER-1	X		0.5	36	15	4.3	403	12,290
4	ER-1	X		0.5	28.8	20	3.2	396	12,078
5	ER-1	X		0.5	33.5	25	2.5	385	11,738

NOTE 1: Groundwater not encountered prior to introduction of driling fluid at 2 feet.

SOIL TYPES*	RESISTIVITY (Ohm-cm)
CLAY and saturated SILT	0-10,000
Sandy CLAY and wet silty SAND	10,000-25,000
Clayey SAND and saturated SAND	25,000-50,000
SAND	50,000-150,000
GRAVEL	150,000-500,000
Weathered ROCK	100,000-200,000
Sound ROCK	150,000-4,000,000

* Ralph B. Peck, Foundation Engineering, 2nd Edition

REMARKS: All tests performed in general accordance with ASTM G-57-95a and ANSI/IEEE std. 81-2012.

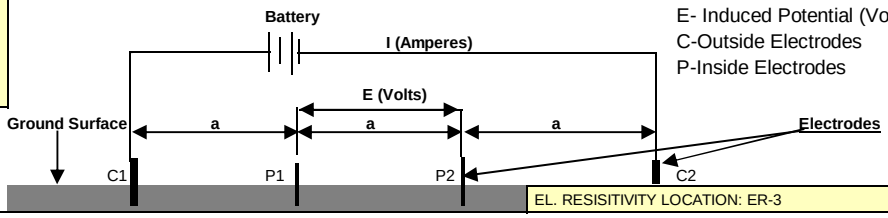
From IEEE std. 81-2012:

RESISTIVITY (Ro) = 2* π *a*R (for b≤0.1a)

$$= \frac{4\pi a R}{1 + \frac{2a}{\sqrt{a^2+4b^2}} - \frac{a}{\sqrt{a^2+b^2}}} \quad \text{(for b>0.1a)}$$

Ro-apparent resisitivity to depth " a "
a=Spacing between electrodes (ft)
R-Resistance (Ohms)
b= Probe Depth (ft)

I - El. Current (Amperes)
E- Induced Potential (Volts)
C-Outside Electrodes
P-Inside Electrodes



EL. RESISITIVITY LOCATION: ER-3

SOIL ELECTRICAL RESISTIVITY DATA LOG

GZA GEOENVIRONMENTAL, INC.	CLIENT:	ELEC. RESISITIVITY LOCATIONS	ER-4
1515 Market Street	EN Engineering	SHEET	1 OF 1
Philadelphia, PA 19102	PennEast Interconnect	GZA PROJECT NO.	05.0046118.03
	Lambertville, New Jersey	PROJECT LOCATION	Lambertville, NJ

ELECTRICAL RESISTIVITY SURVEY- WENNER CONFIG.

TYPE OF SURV. EQUIPMENT: AEMC Instruments

MODEL: 6472

GZA ENGINEER: V. Larimore

WEATHER: Overcast-Sunny. Humidity 84% +-

TEMPERATURE: 60s

EL PROFILE COORDINATES: See Plan

GROUND SURFACE EL.(FT): 155 DATUM: NAVD 88

DATE START: May 14, 2018 DATE END: May 14, 2018

GROUNDWATER READINGS

BORING ID	DATE	TIME	WATER LEVEL	HOLE DIAM.	STABIL. TIME
GZ-109	5/14/18	1030	>4'	12"	5 days

(Note: Groundwater measured in nearest borehole during vacuum excavation)

TEST NO.	TEST LOCATION	ARRAY ALIGNMENT N-S	ARRAY ALIGNMENT E-W	PROBE Depth, b (ft)	CURRENT I (mA)	SPACING a (ft)	RESISTANCE R (Ohms)	APPARENT RESISTIVITY Ro (Ohm-ft)	APPARENT RESISTIVITY Ro (Ohm-cm)
1	ER-1		X	0.5	153	5	3.5	113	3,438
2	ER-1		X	0.5	148	10	2.3	147	4,482
3	ER-1		X	0.5	149	15	1.7	161	4,893
4	ER-1		X	0.5	146	20	1.2	152	4,640
5	ER-1		X	0.5	133	25	0.9	138	4,216
1	ER-1	X		0.5	151	5	3.7	117	3,565
2	ER-1	X		0.5	144	10	2.5	158	4,809
3	ER-1	X		0.5	90.6	15	1.9	182	5,555
4	ER-1	X		0.5	111	20	1.4	181	5,522
5	ER-1	X		0.5	84.5	25	1.0	159	4,839

SOIL TYPES*	RESISTIVITY (Ohm-cm)
CLAY and saturated SILT	0-10,000
Sandy CLAY and wet silty SAND	10,000-25,000
Clayey SAND and saturated SAND	25,000-50,000
SAND	50,000-150,000
GRAVEL	150,000-500,000
Weathered ROCK	100,000-200,000
Sound ROCK	150,000-4,000,000

* Ralph B. Peck, Foundation Engineering, 2nd Edition

REMARKS: All tests performed in general accordance with ASTM G-57-95a and ANSI/IEEE std. 81-2012.

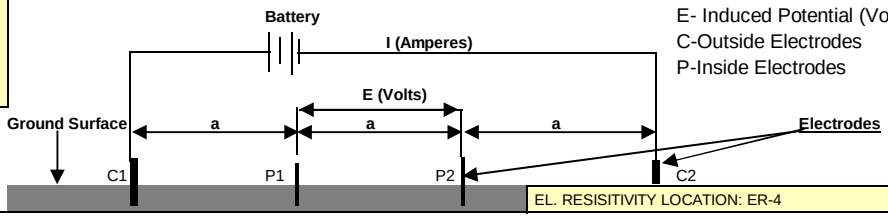
From IEEE std. 81-2012:

RESISTIVITY (Ro) = 2* π *a*R (for b≤0.1a)

$$= \frac{4\pi a R}{1 + \frac{2a}{\sqrt{a^2+4b^2}} - \frac{a}{\sqrt{a^2+b^2}}} \quad \text{(for b>0.1a)}$$

Ro-apparent resisitivity to depth " a "
a=Spacing between electrodes (ft)
R-Resistance (Ohms)
b= Probe Depth (ft)

I - El. Current (Amperes)
E- Induced Potential (Volts)
C-Outside Electrodes
P-Inside Electrodes



EL. RESISITIVITY LOCATION: ER-4

GZA

APPENDIX F - PREVIOUS SITE DEVELOPMENT AERIAL PHOTOGRAPHS

1995 Aerial Photograph – Lambertville, NJ

Appendix F, Geotechnical Engineering Report

2002 Aerial Photograph – Lambertville, NJ

Appendix F, Geotechnical Engineering Report

2003 Aerial Photograph – Lambertville, NJ

Appendix F, Geotechnical Engineering Report

2006 Aerial Photograph – Lambertville, NJ

Appendix F, Geotechnical Engineering Report

2008 Aerial Photograph – Lambertville, NJ

Appendix F, Geotechnical Engineering Report

2009 Aerial Photograph – Lambertville, NJ

Appendix F, Geotechnical Engineering Report

2010 Aerial Photograph – Lambertville, NJ

Appendix F, Geotechnical Engineering Report

2013 Aerial Photograph – Lambertville, NJ

Appendix F, Geotechnical Engineering Report

2015 Aerial Photograph – Lambertville, NJ

Appendix F, Geotechnical Engineering Report

2016 Aerial Photograph – Lambertville, NJ

Appendix F, Geotechnical Engineering Report

APPENDIX G- VACUUM EXCAVATION PHOTOGRAPHS

GZA GeoEnvironmental, Inc.

PHOTOGRAPHIC LOG

Project Name:	Site Location:	Project No.:
PennEast Interconnect	1325 NJ-179, Lambertville, NJ	05.0046118.03

Photo No.:	Date:
01	5/15/18

Exploration ID:
GZ-101

Photographer:
V. Larimore

Notes:

Vacuum excavation extended to a depth of 8 feet. Note groundwater at bottom of vacuum excavation.

Photo No.:	Date:
02	5/15/18

Exploration ID:
GZ-102

Photographer:
V. Larimore

Notes:

Vacuum excavation extended to a depth of 7.2 feet. Note debris in sidewall and groundwater.

GZA GeoEnvironmental, Inc.

PHOTOGRAPHIC LOG

Project Name:	Site Location:	Project No.:
PennEast Interconnect	1325 NJ-179, Lambertville, NJ	05.0046118.03

Photo No.:	Date:
03	5/15/18

Exploration ID:
GZ-102

Photographer:
V. Larimore

Notes:

Sidewall of excavation showing fill and debris.

Photo No.:	Date:
04	5/15/18

Exploration ID:
GZ-102

Photographer:
V. Larimore

Notes:

Debris encountered in GZ-102.

GZA GeoEnvironmental, Inc.

PHOTOGRAPHIC LOG

Project Name:	Site Location:	Project No.:
PennEast Interconnect	1325 NJ-179, Lambertville, NJ	05.0046118.03

Photo No.:	Date:
05	5/15/18

Exploration ID:
GZ-102

Photographer:
V. Larimore

Notes:

Debris encountered in GZ-102.

Photo No.:	Date:
06	5/15/18

Exploration ID:
GZ-109

Photographer:
V. Larimore

Notes:

Vacuum excavation extended to a depth of 3.75 feet.

APPENDIX D

NJDEP LOW IMPACT DEVELOPMENT CHECKLIST

New Jersey Stormwater Best Management Practices Manual

February 2004

A P P E N D I X A

Low Impact Development Checklist

A checklist for identifying nonstructural stormwater management strategies incorporated into proposed land development

According to the NJDEP Stormwater Management Rules at N.J.A.C. 7:8, the groundwater recharge, stormwater quality, and stormwater quantity standards established by the Rules for major land development projects must be met by incorporating nine specific nonstructural stormwater management strategies into the project's design to the maximum extent practicable.

To accomplish this, the Rules require an applicant seeking land development approval from a regulatory board or agency to identify those nonstructural strategies that have been incorporated into the project's design. In addition, if an applicant contends that it is not feasible to incorporate any of the specific strategies into the project's design, particularly for engineering, environmental, or safety reasons, the Rules further require that the applicant provide a basis for that contention.

This checklist has been prepared to assist applicants, site designers, and regulatory boards and agencies in ensuring that the nonstructural stormwater management requirements of the Rules are met. It provides an applicant with a means to identify both the nonstructural strategies incorporated into the development's design and the specific low impact development BMPs (LID-BMPs) that have been used to do so. It can also help an applicant explain the engineering, environmental, and/or safety reasons that a specific nonstructural strategy could not be incorporated into the development's design.

The checklist can also assist municipalities and other land development review agencies in the development of specific requirements for both nonstructural strategies and LID-BMPs in zoning and/or land use ordinances and regulations. As such, where requirements consistent with the Rules have been adopted, they may supersede this checklist.

Finally, the checklist can be used during a pre-design meeting between an applicant and pertinent review personnel to discuss local nonstructural strategies and LID-BMPs requirements in order to optimize the development's nonstructural stormwater management design.

Since this checklist is intended to promote the use of nonstructural stormwater management strategies and provide guidance in their incorporation in land development projects, municipalities are permitted to revise it as necessary to meet the goals and objectives of their specific stormwater management program and plan within the limits of N.J.A.C. 7:8.

Low Impact Development Checklist

A checklist for identifying nonstructural stormwater management strategies incorporated into proposed land development

Municipality: West Amwell Township

County: Hunterdon County Date: June 28, 2019

Review board or agency: New Jersey Department of Environmental Protection

Proposed land development name: Lambertville Interconnect

Lot(s): 6 Block(s): 5

Project or application number: _____

Applicant's name: UGI Energy Services - c/o Casey Monagan

Applicant's address: 1525 SR 292 East

Dallas, PA 18612

Telephone: (570) 333-0569 Fax: _____

Email address: cmonagan@ugies.com

Designer's name: Barry J. Sutherland, PE, PP

Designer's address: TRC Environmental Corporation

41 Spring Street, Suite 102, New Providence, New Jersey 07974

Telephone: (908) 988-1623 Fax: _____

Email address: BSutherland@trcsolutions.com

Part 1: Description of Nonstructural Approach to Site Design

In narrative form, provide an overall description of the nonstructural stormwater management approach and strategies incorporated into the proposed site's design. Attach additional pages as necessary. Details of each nonstructural strategy are provided in Part 3 below.

Disturbance is kept to the minimum required for facility construction and functionality.

Part 2: Review of Local Stormwater Management Regulations

Not applicable. Project is not required to seek local development approvals.

Title and date of stormwater management regulations used in development design:

_____

Do regulations include nonstructural requirements? Yes: _____ No: _____

If yes, briefly describe: _____

_____

_____

List LID-BMPs prohibited by local regulations: _____

_____

_____

Pre-design meeting held? Yes: _____ Date: _____ No: _____

Meeting held with: _____

_____

_____

Pre-design site walk held? Yes: _____ Date: _____ No: _____

Site walk held with: _____

_____

_____

Other agencies with stormwater review jurisdiction:

Name: _____

Required approval: _____

Name: _____

Required approval: _____

Name: _____

Required approval: _____

Part 3: Nonstructural Strategies and LID-BMPs in Design

3.1 Vegetation and Landscaping

Effective management of both existing and proposed site vegetation can reduce a development's adverse impacts on groundwater recharges and runoff quality and quantity. This section of the checklist helps identify the vegetation and landscaping strategies and nonstructural LID-BMPs that have been incorporated into the proposed development's design to help maintain existing recharge rates and/or minimize or prevent increases in runoff quantity and pollutant loading.

A. Has an inventory of existing site vegetation been performed? Yes: X No: _____

If yes, was this inventory a factor in the site's layout and design? Yes: X No: _____

See response to Part 1 for description of site layout/design strategy and constraints.

B. Does the site design utilize any of the following nonstructural LID-BMPs?

Preservation of natural areas? Yes: X No: _____ If yes, specify % of site: _____

As required by N.J.A.C. 7:7A and 7:13.

Native ground cover? Yes: X No: _____ If yes, specify % of site: _____

Selected native species used in bioretention basin planting design.

Vegetated buffers? Yes: _____ No: X If yes, specify % of site: _____

See response to Part 1 for description of site layout/design strategy and constraints.

C. Do the land development regulations require these nonstructural LID-BMPs?

Not applicable. Project is not required to seek local development approvals.

Preservation of natural areas? Yes: _____ No: _____ If yes, specify % of site: _____

Native ground cover? Yes: _____ No: _____ If yes, specify % of site: _____

Vegetated buffers? Yes: _____ No: _____ If yes, specify % of site: _____

D. If vegetated filter strips or buffers are utilized, specify their functions:

Not utilized. See response to Part 1.

Reduce runoff volume increases through lower runoff coefficient: Yes: _____ No: _____

Reduce runoff pollutant loads through runoff treatment: Yes: _____ No: _____

Maintain groundwater recharge by preserving natural areas: Yes: _____ No: _____

3.2 Minimize Land Disturbance

Minimizing land disturbance is a nonstructural LID-BMP that can be applied during both the development's construction and post-construction phases. This section of the checklist helps identify those land disturbance strategies and nonstructural LID-BMPs that have been incorporated into the proposed development's design to minimize land disturbance and the resultant change in the site's hydrologic character.

A. Have inventories of existing site soils and slopes been performed? Yes: X No: _____

If yes, were these inventories factors in the site's layout and design? Yes: X No: _____

B. Does the development's design utilize any of the following nonstructural LID-BMPs?

Restrict permanent site disturbance by land owners? Yes: X No: _____

If yes, how: Permanent site disturbance impacts limited to existing impervious cover areas to the extent practicable.

Restrict temporary site disturbance during construction? Yes: X No: _____

If yes, how: Temporary site disturbance impacts limited at the site to the extent practicable.

Consider soils and slopes in selecting disturbance limits? Yes: X No: _____

If yes, how: Areas with steep slopes and highly erodible soils were avoided where practicable.

C. Specify percentage of site to be cleared: 72% Regraded: 72%

D. Specify percentage of cleared areas done so for buildings: 15%

For driveways and parking: 33% For roadways: N/A

E. What design criteria and/or site changes would be required to reduce the percentages in C and D above?

The current design minimizes the extent of clearing on site for buildings, driveways, parking, and roadway to the extent practicable considering the overall project purpose and need.

F. Specify site's hydrologic soil group (HSG) percentages:

HSG A: 0% HSG B: 0% HSG C: 100% HSG D: 0%

G. Specify percentage of each HSG that will be permanently disturbed:

HSG A: 0% HSG B: 0% HSG C: 100% HSG D: 0%

H. Locating site disturbance within areas with less permeable soils (HSG C and D) and minimizing disturbance within areas with greater permeable soils (HSG A and B) can help maintain groundwater recharge rates and reduce runoff volume increases. In light of the HSG percentages in F and G above, what other practical measures if any can be taken to achieve this?

All soils disturbed by the project are located within areas with of less permeable soils already so no other measures are needed.

I. Does the site include Karst topography? Yes: _____ No: X

If yes, discuss measures taken to limit Karst impacts:

3.3 Impervious Area Management

New impervious surfaces at a development site can have the greatest adverse effect on groundwater recharge and stormwater quality and quantity. This section of the checklist helps identify those nonstructural strategies and LID-BMPs that have been incorporated into a proposed development's design to comprehensively manage the extent and impacts of new impervious surfaces.

A. Specify impervious cover at site: Existing: 0.35 acres Proposed: 1.62 acres

B. Specify maximum site impervious coverage allowed by regulations: Not applicable.

C. Compare proposed street cartway widths with those required by regulations:

Local regulations not applicable.

Type of Street	Proposed Cartway Width (feet)	Required Cartway Width (feet)
Residential access – low intensity		
Residential access – medium intensity		
Residential access – high intensity with parking		
Residential access – high intensity without parking		
Neighborhood		
Minor collector – low intensity without parking		
Minor collector – with one parking lane		
Minor collector – with two parking lanes		
Minor collector – without parking		
Major collector		

D. Compare proposed parking space dimensions with those required by regulations:

Proposed: 10 ft. x 20 ft. Regulations: Not applicable

Project is not subject to local approvals or land use regulation requirements.

E. Compare proposed number of parking spaces with those required by regulations:

Proposed: 6 spaces Regulations: Not applicable

(1.62 Ac)

F. Specify percentage of total site impervious cover created by buildings: 32% (0.515 Ac)

By driveways and parking: 68% (1.105 Ac) By roadways: ----

G. What design criteria and/or site changes would be required to reduce the percentages in F above?

The current design minimizes the impervious cover created by buidings, driveways, parking, and roadways to the extent practicable considering the overall project purpose and need.

H. Specify percentage of total impervious area that will be unconnected:

Total site: 0% Buildings: 0% Driveways and parking: 0% Roads: 0%

I. Specify percentage of total impervious area that will be porous:

Total site: 0% Buildings: 0% Driveways and parking: 0% Roads: 0%

J. Specify percentage of total building roof area that will be vegetated: 0%

K. Specify percentage of total parking area located beneath buildings: 0%

L. Specify percentage of total parking located within multi-level parking deck: 0%

3.4 Time of Concentration Modifications

Decreasing a site's time of concentration (Tc) can lead directly to increased site runoff rates which, in turn, can create new and/or aggravate existing erosion and flooding problems downstream. This section of the checklist helps identify those nonstructural strategies and LID-BMPs that have been incorporated into the proposed development's design to effectively minimize such Tc decreases.

When reviewing Tc modification strategies, it is important to remember that a drainage area's Tc should reflect the general conditions throughout the area. As a result, Tc modifications must generally be applied throughout a drainage area, not just along a specific Tc route.

A. Specify percentage of site's total stormwater conveyance system length that will be:

Storm sewer: 95% Vegetated swale: 0% Natural channel: 0%

Stormwater management facility: 5% Other: _____

Note: the total length of the stormwater conveyance system should be measured from the site's downstream property line to the downstream limit of sheet flow at the system's headwaters.

B. What design criteria and/or site changes would be required to reduce the storm sewer percentages and increase the vegetated swale and natural channel percentages in A above?

Due to 95% TSS removal requirement, storm sewer beneath proposed impervious areas is required to direct runoff through approved 50% TSS removal manufactured pretreatment units, followed by bioretention basins designed for 90% TSS removal. ~~Disturbance limits in category 1 water riparian zone prevent use of land area~~ for vegetated swales.

C. In conveyance system subareas that have overland or sheet flow over impervious surfaces or turf grass, what practical and effective site changes can be made to:

Decrease overland flow slope: Existing facilities and topography have been maintained to the maximum extent possible to minimize disturbance. Overall site pavement and building elevations were established by setting 5% maximum safe driveway slope to existing Queen Road.

Increase overland flow roughness: Fire protection safety and visual security requirements require use of mowed lawn, unless otherwise shown on landscaping plans. Sloped areas and bioretention basins have been landscaped with native plant materials.

3.5 Preventative Source Controls

The most effective way to address water quality concerns is by pollution prevention. This section of the checklist helps identify those nonstructural strategies and LID-BMPs that have been incorporated into the proposed development's design to reduce the exposure of pollutants to prevent their release into the stormwater runoff.

A. Trash Receptacles Not applicable. Not a public development.

Specify the number of trash receptacles provided: _____

Specify the spacing between the trash receptacles: _____

Compare trash receptacles proposed with those required by regulations:

Proposed: _____ Regulations: _____

B. Pet Waste Stations Not applicable. Not a public development.

Specify the number of pet waste stations provided: _____

Specify the spacing between the pet waste stations: _____

Compare pet waste stations proposed with those required by regulations:

Proposed: _____ Regulations: _____

C. Inlets, Trash Racks, and Other Devices that Prevent Discharge of Large Trash and Debris

Specify percentage of total inlets that comply with the NJPDES storm drain inlet criteria: 100%

NJPDES compatible drain inlets are used. Bioretention basin outlet structures are equipped with trash racks.

D. Maintenance

Specify the frequency of the following maintenance activities:

Street sweeping: Proposed: As needed Regulations: Not applicable

Litter collection: Proposed: As needed Regulations: Not applicable

Identify other stormwater management measures on the site that prevent discharge of large trash and debris:

Not a public site. Large trash and debris will not be generated.

E. Prevention and Containment of Spills

See Spill Prevention Control and Countermeasure Plan.

Identify locations where pollutants are located on the site, and the features that prevent these pollutants from being exposed to stormwater runoff:

Pollutant: _____ Location: _____

Feature utilized to prevent pollutant exposure, harmful accumulation, or contain spills:

Pollutant: _____ Location: _____

Feature utilized to prevent pollutant exposure, harmful accumulation, or contain spills:

Pollutant: _____ Location: _____

Feature utilized to prevent pollutant exposure, harmful accumulation, or contain spills:

Pollutant: _____ Location: _____

Feature utilized to prevent pollutant exposure, harmful accumulation, or contain spills:

Pollutant: _____ Location: _____

Part 4: Compliance with Nonstructural Requirements of NJDEP Stormwater Management Rules

1. Based upon the checklist responses above, indicate which nonstructural strategies have been incorporated into the proposed development's design in accordance with N.J.A.C. 7:8-5.3(b):

No.	Nonstructural Strategy	Yes	No
1.	Protect areas that provide water quality benefits or areas particularly susceptible to erosion and sediment loss.	X	
2.	Minimize impervious surfaces and break up or disconnect the flow of runoff over impervious surfaces.	X	
3.	Maximize the protection of natural drainage features and vegetation.	X	
4.	Minimize the decrease in the pre-construction time of concentration.	X	
5.	Minimize land disturbance including clearing and grading.	X	
6.	Minimize soil compaction.	X	
7.	Provide low maintenance landscaping that encourages retention and planting of native vegetation and minimizes the use of lawns, fertilizers, and pesticides.	X	
8.	Provide vegetated open-channel conveyance systems discharge into and through stable vegetated areas.		X
9.	Provide preventative source controls.	X	

2. For those strategies that have not been incorporated into the proposed development's design, provide engineering, environmental, and/or safety reasons. Attached additional pages as necessary.

For safety (fire prevention and visual security) reasons, this industrial facility maintains existing vegetated areas in and around its facilities at a low height (typically less than 6 inches). However, fertilizers and pesticide use is avoided at the facility. Limits on available area downstream of proposed development and the high level (95 percent) total suspended solids removal design requirement at the site have effectively eliminated options for open-channel conveyance systems on site.

APPENDIX E

PRE-DEVELOPMENTAL DRAINAGE ANALYSIS

New Jersey 24 Hour Rainfall Frequency Data

NEW JERSEY 24 HOUR RAINFALL FREQUENCY DATA

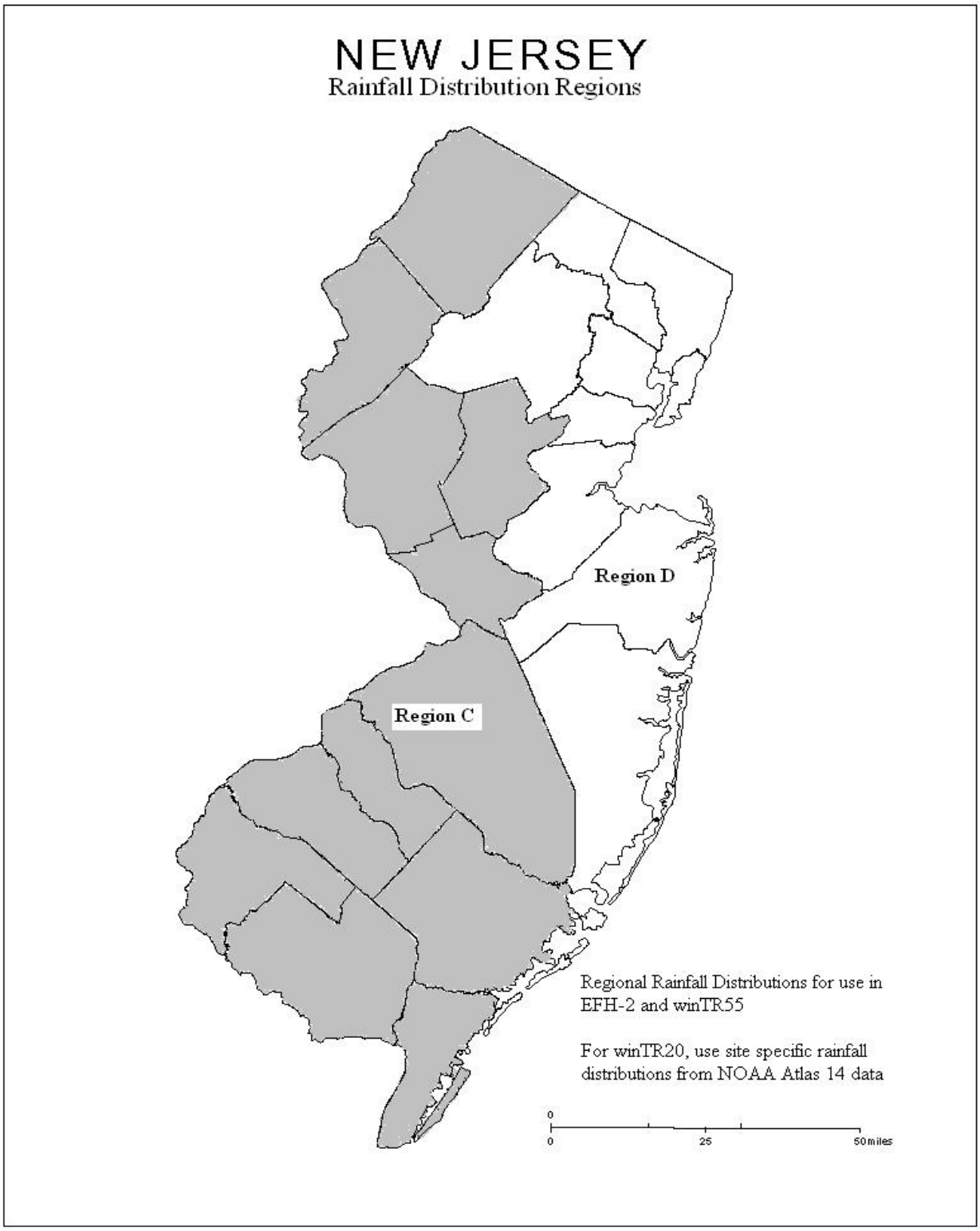
Rainfall amounts in Inches

County	1 year	2 year	5 year	10 year	25 year	50 year	100 year
Atlantic	2.72	3.31	4.30	5.16	6.46	7.61	8.90
Bergen	2.75	3.34	4.27	5.07	6.28	7.32	8.47
Burlington	2.77	3.36	4.34	5.18	6.45	7.56	8.81
Camden	2.73	3.31	4.25	5.06	6.28	7.34	8.52
Cape May	2.67	3.25	4.22	5.07	6.34	7.47	8.73
Cumberland	2.69	3.27	4.25	5.09	6.37	7.49	8.76
Essex	2.85	3.44	4.40	5.22	6.44	7.49	8.66
Gloucester	2.71	3.29	4.24	5.05	6.29	7.36	8.55
Hudson	2.73	3.31	4.23	5.02	6.19	7.20	8.31
Hunterdon	2.80	3.38	4.26	5.00	6.09	7.02	8.03
Mercer	2.74	3.31	4.23	5.01	6.19	7.20	8.33
Middlesex	2.76	3.35	4.30	5.12	6.36	7.43	8.63
Monmouth	2.79	3.38	4.38	5.23	6.53	7.66	8.94
Morris	2.94	3.54	4.47	5.24	6.37	7.32	8.35
Ocean	2.81	3.42	4.45	5.33	6.68	7.87	9.20
Passaic	2.87	3.47	4.42	5.23	6.43	7.47	8.62
Salem	2.69	3.26	4.20	5.00	6.22	7.28	8.45
Somerset	2.76	3.34	4.25	5.01	6.15	7.13	8.21
Sussex	2.68	3.22	4.02	4.70	5.72	6.60	7.58
Union	2.80	3.39	4.35	5.17	6.42	7.49	8.69
Warren	2.78	3.34	4.18	4.89	5.93	6.83	7.82

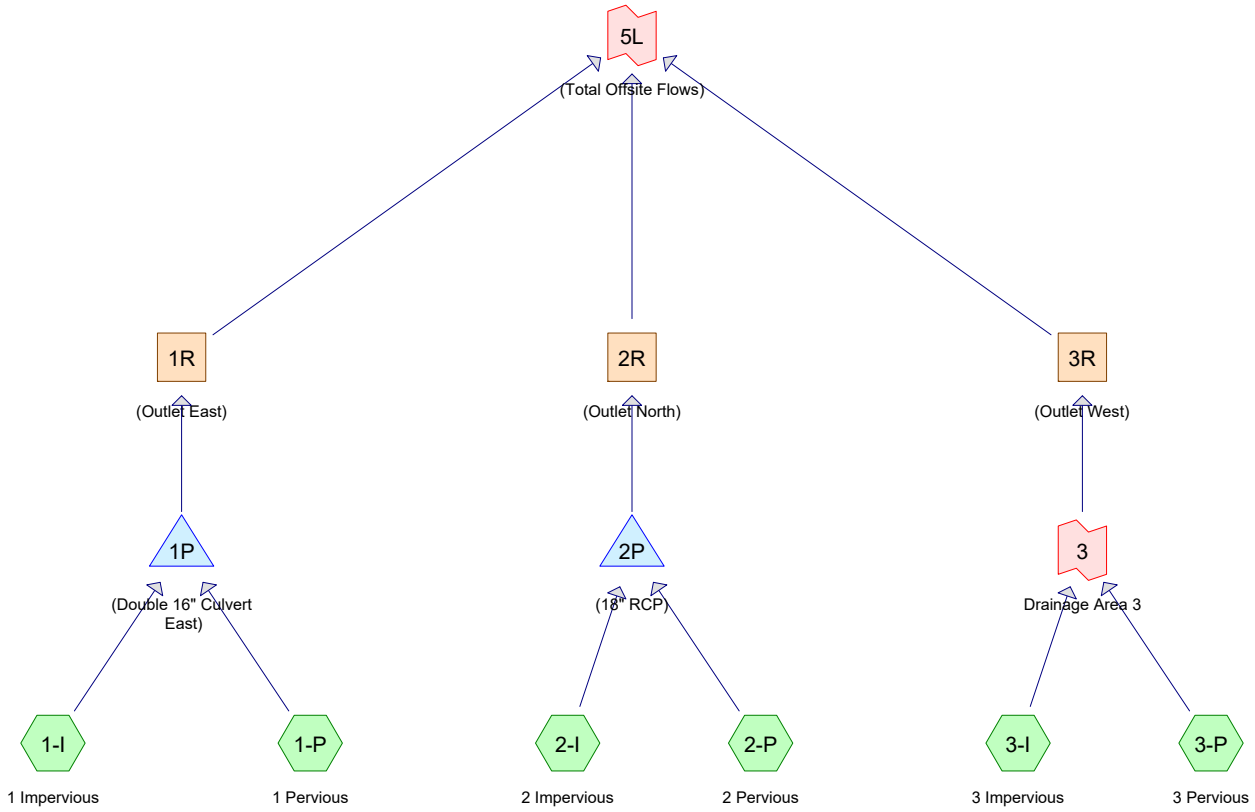
Notes: The average point rainfall amounts listed above were developed from data contained in NOAA Atlas 14 Volume 2.

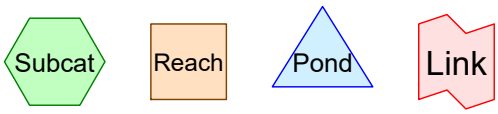
Point rainfall estimates for specific locations may be obtained from the Precipitation Frequency Data Server located at http://www.nws.noaa.gov/ohd/hdsc/

For most hydrologic design procedures, the rainfall amounts listed above may be rounded to the nearest tenth of an inch.


NEW JERSEY
Rainfall Distribution Regions
Region D
Region C
Regional Rainfall Distributions for use in EFH-2 and winTR55
For winTR20, use site specific rainfall distributions from NOAA Atlas 14 data
0
25
50 miles

Pre-Development Hydrographs





Routing Diagram for 292931 - 2018-08-30 EX-DA
Prepared by TRC Environmental Corp, Printed 8/30/2018
HydroCAD® 10.00-22 s/n 02814 © 2018 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
2.750	74	>75% Grass cover, Good, HSG C (1-P, 2-P, 3-P)
0.225	89	Gravel (1-I)
0.904	89	Gravel roads, HSG C (2-I, 3-I)
0.237	98	Unconnected pavement, HSG C (1-I, 2-I)
0.111	98	Unconnected roofs, HSG C (1-I, 2-I)
0.470	72	Woods/grass comb., Good, HSG C (1-P, 2-P, 3-P)
4.697	**79**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
4.472	HSG C	1-I, 1-P, 2-I, 2-P, 3-I, 3-P
0.000	HSG D	
0.225	Other	1-I
4.697		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	2.750	0.000	0.000	2.750	>75% Grass cover, Good	1-P, 2-P, 3-P
0.000	0.000	0.000	0.000	0.225	0.225	Gravel	1-I
0.000	0.000	0.904	0.000	0.000	0.904	Gravel roads	2-I, 3-I
0.000	0.000	0.237	0.000	0.000	0.237	Unconnected pavement	1-I, 2-I
0.000	0.000	0.111	0.000	0.000	0.111	Unconnected roofs	1-I, 2-I
0.000	0.000	0.470	0.000	0.000	0.470	Woods/grass comb., Good	1-P, 2-P, 3-P
0.000	**0.000**	**4.472**	**0.000**	**0.225**	**4.697**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	1-I	0.00	0.00	67.0	0.0776	0.012	16.0	0.0	0.0
2	3-I	0.00	0.00	43.0	0.0209	0.012	12.0	0.0	0.0
3	3-P	0.00	0.00	43.0	0.0281	0.012	12.0	0.0	0.0
4	1P	146.90	143.59	58.0	0.0571	0.013	16.0	0.0	0.0
5	2P	154.50	152.90	37.0	0.0432	0.012	18.0	0.0	0.0

Time span=0.00-96.00 hrs, dt=0.01 hrs, 9601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1-I: 1 Impervious Runoff Area=0.329 ac 31.61% Impervious Runoff Depth=2.52"
Flow Length=561' Tc=15.0 min CN=92 Runoff=0.72 cfs 0.069 af

Subcatchment 1-P: 1 Pervious Runoff Area=1.516 ac 0.00% Impervious Runoff Depth=1.16"
Tc=15.0 min CN=74 Runoff=1.48 cfs 0.146 af

Subcatchment 2-I: 2 Impervious Runoff Area=1.078 ac 22.63% Impervious Runoff Depth=2.34"
Flow Length=398' Tc=11.8 min UI Adjusted CN=90 Runoff=2.41 cfs 0.210 af

Subcatchment 2-P: 2 Pervious Runoff Area=0.980 ac 0.00% Impervious Runoff Depth=1.16"
Flow Length=398' Tc=11.8 min CN=74 Runoff=1.05 cfs 0.095 af

Subcatchment 3-I: 3 Impervious Runoff Area=0.070 ac 0.00% Impervious Runoff Depth=2.25"
Flow Length=484' Tc=12.1 min CN=89 Runoff=0.15 cfs 0.013 af

Subcatchment 3-P: 3 Pervious Runoff Area=0.724 ac 0.00% Impervious Runoff Depth=1.10"
Flow Length=484' Tc=12.1 min CN=73 Runoff=0.72 cfs 0.066 af

Reach 1R: (Outlet East) Inflow=2.20 cfs 0.215 af
Outflow=2.20 cfs 0.215 af

Reach 2R: (Outlet North) Inflow=3.45 cfs 0.304 af
Outflow=3.45 cfs 0.304 af

Reach 3R: (Outlet West) Inflow=0.87 cfs 0.079 af
Outflow=0.87 cfs 0.079 af

Pond 1P: (Double 16" Culvert East) Peak Elev=147.45' Storage=4 cf Inflow=2.20 cfs 0.215 af
16.0" Round Culvert x 2.00 n=0.013 L=58.0' S=0.0571 '/' Outflow=2.20 cfs 0.215 af

Pond 2P: (18" RCP) Peak Elev=155.01' Storage=5 cf Inflow=3.45 cfs 0.304 af
18.0" Round Culvert x 2.00 n=0.012 L=37.0' S=0.0432 '/' Outflow=3.45 cfs 0.304 af

Link 3: Drainage Area 3 Inflow=0.87 cfs 0.079 af
Primary=0.87 cfs 0.079 af

Link 5L: (Total Offsite Flows) Inflow=6.43 cfs 0.599 af
Primary=6.43 cfs 0.599 af

Total Runoff Area = 4.697 ac Runoff Volume = 0.599 af Average Runoff Depth = 1.53"
92.59% Pervious = 4.349 ac 7.41% Impervious = 0.348 ac

Summary for Subcatchment 1-I: 1 Impervious

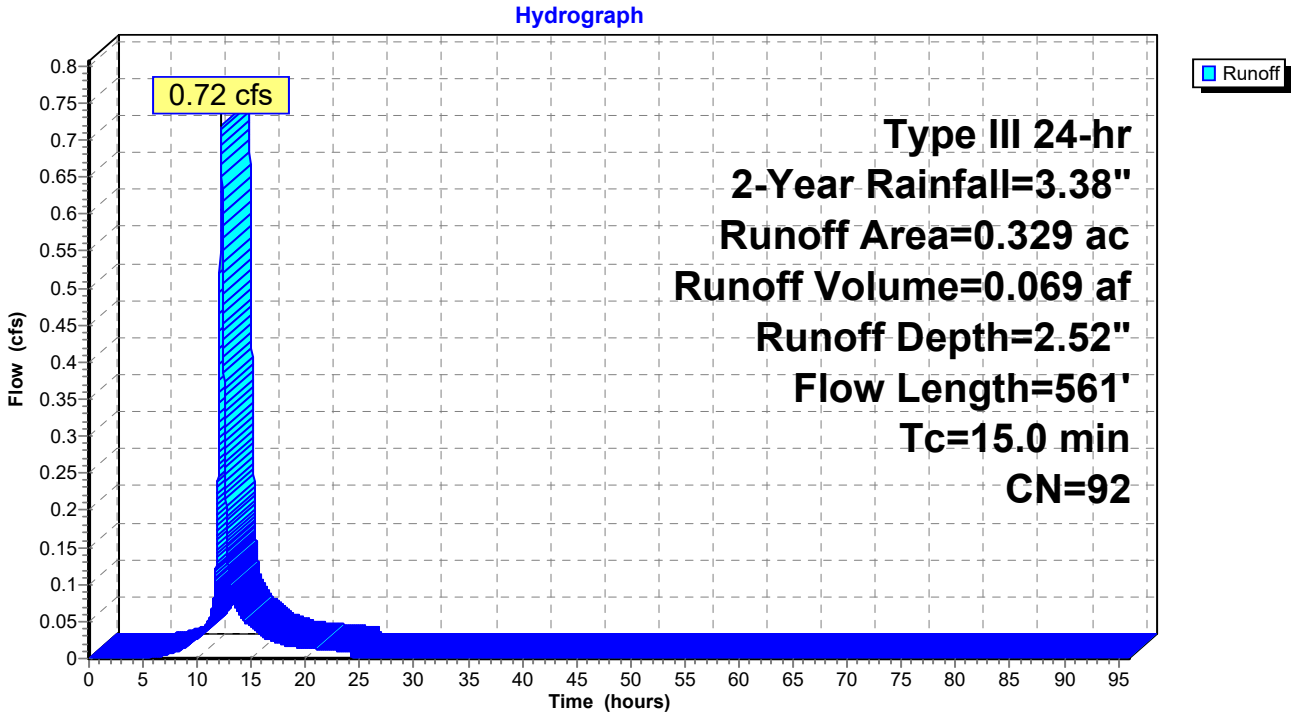
Runoff = 0.72 cfs @ 12.20 hrs, Volume= 0.069 af, Depth= 2.52"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.38"

	Area (ac)	CN	Description
*	0.225	89	Gravel
	0.102	98	Unconnected pavement, HSG C
	0.002	98	Unconnected roofs, HSG C
	0.329	92	Weighted Average
	0.225		68.39% Pervious Area
	0.104		31.61% Impervious Area
	0.104		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.6	40	0.1180	0.08		**Sheet Flow, SF1** Woods: Dense underbrush n= 0.800 P2= 3.38"
2.4	22	0.0818	0.16		**Sheet Flow, SF2** Grass: Dense n= 0.240 P2= 3.38"
0.3	38	0.0789	2.02		**Sheet Flow, SF2** Smooth surfaces n= 0.011 P2= 3.38"
0.3	74	0.0527	3.70		**Shallow Concentrated Flow, SCF1** Unpaved Kv= 16.1 fps
3.3	320	0.0424	1.61	1.61	**Channel Flow, CF1** Area= 1.0 sf Perim= 12.6' r= 0.08' n= 0.035 Earth, dense weeds
0.1	67	0.0776	16.58	23.16	**Pipe Channel,** 16.0" Round Area= 1.4 sf Perim= 4.2' r= 0.33' n= 0.012
15.0	561	Total			

Subcatchment 1-I: 1 Impervious



Summary for Subcatchment 1-P: 1 Pervious

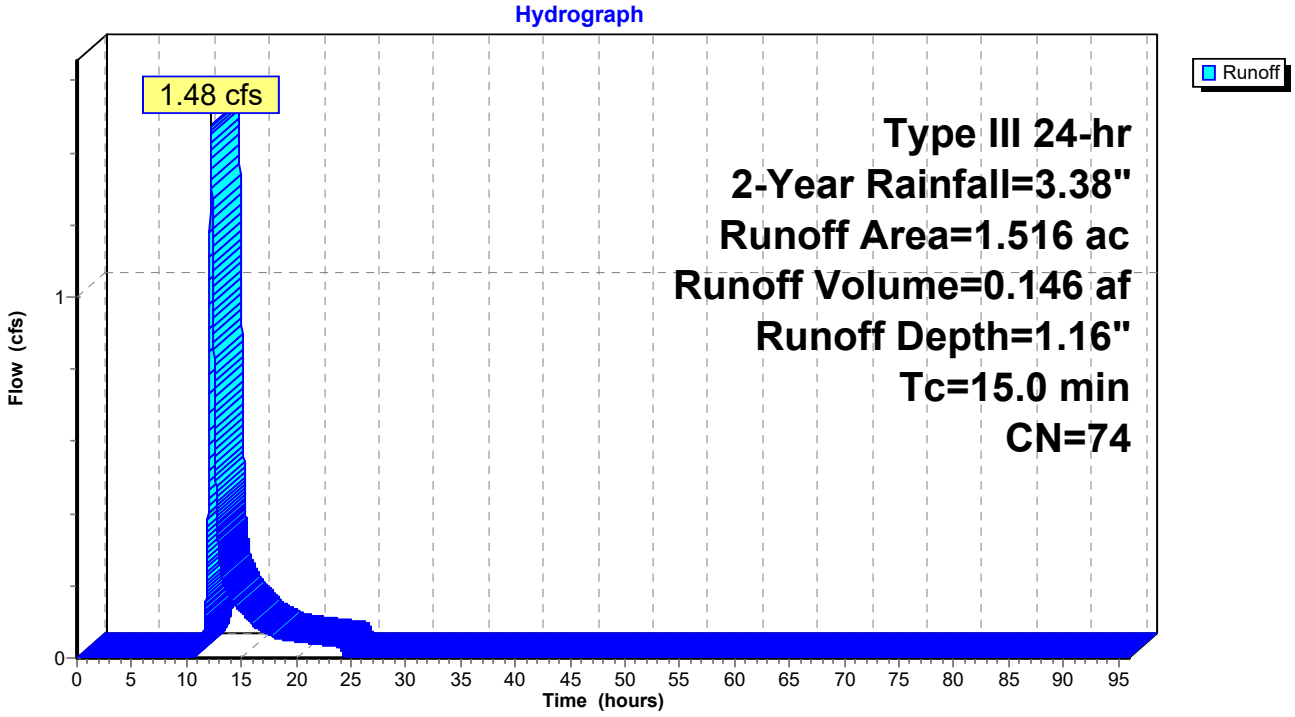
Runoff = 1.48 cfs @ 12.22 hrs, Volume= 0.146 af, Depth= 1.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.38"

Area (ac)	CN	Description
0.044	72	Woods/grass comb., Good, HSG C
1.472	74	>75% Grass cover, Good, HSG C
1.516	74	Weighted Average
1.516		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.0					**Direct Entry, Same as 1-I**

Subcatchment 1-P: 1 Pervious



Summary for Subcatchment 2-I: 2 Impervious

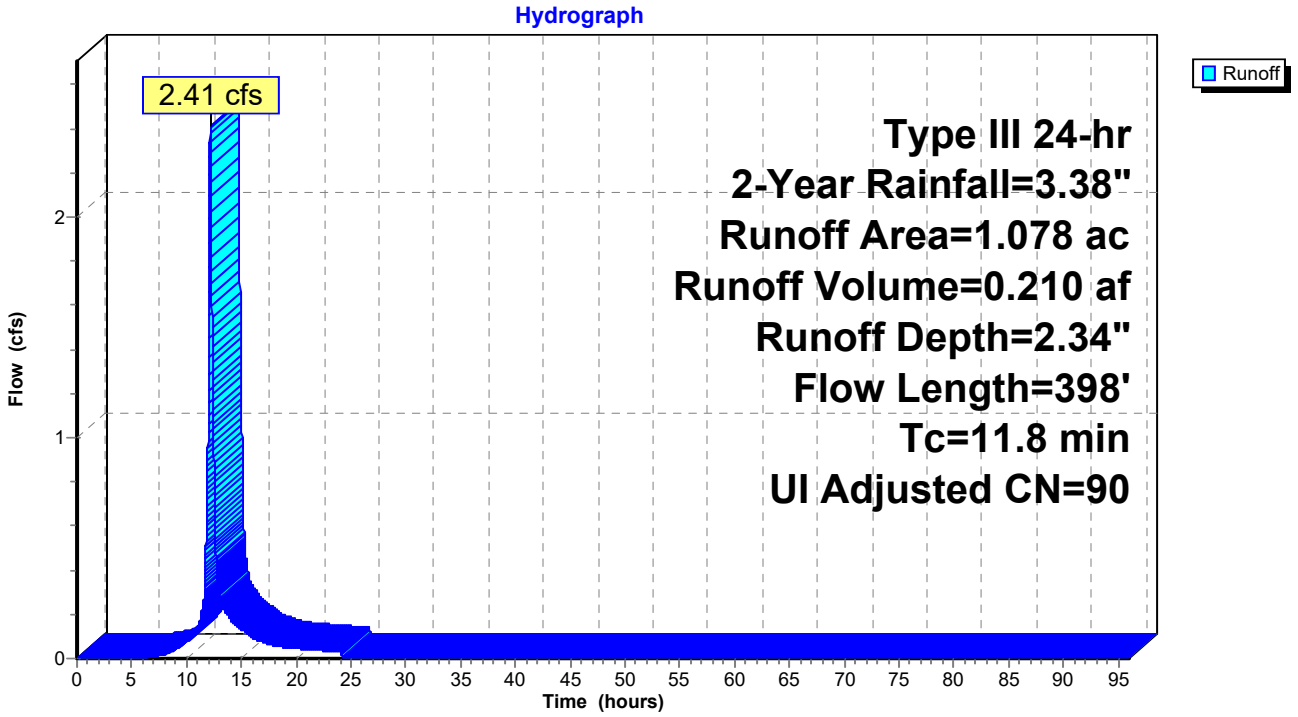
Runoff = 2.41 cfs @ 12.16 hrs, Volume= 0.210 af, Depth= 2.34"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.38"

Area (ac)	CN	Adj	Description
0.834	89		Gravel roads, HSG C
0.135	98		Unconnected pavement, HSG C
0.109	98		Unconnected roofs, HSG C
1.078	91	90	Weighted Average, UI Adjusted
0.834			77.37% Pervious Area
0.244			22.63% Impervious Area
0.244			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	48	0.0875	0.12		**Sheet Flow, SF1** Woods: Light underbrush n= 0.400 P2= 3.38"
3.5	52	0.0673	0.25		**Sheet Flow, SF2** Grass: Short n= 0.150 P2= 3.38"
0.2	21	0.0714	1.87		**Shallow Concentrated Flow, Short Grass Pasture C-2** Short Grass Pasture Kv= 7.0 fps
0.2	69	0.0841	4.67		**Shallow Concentrated Flow, Unpaved C-3** Unpaved Kv= 16.1 fps
0.1	30	0.2467	3.48		**Shallow Concentrated Flow, Short Grass Pasture C-4** Short Grass Pasture Kv= 7.0 fps
0.9	103	0.0136	1.88		**Shallow Concentrated Flow, Unpaved C-5** Unpaved Kv= 16.1 fps
0.4	17	0.0118	0.76		**Shallow Concentrated Flow, Short Grass Pasture C-6** Short Grass Pasture Kv= 7.0 fps
0.1	58	0.0517	11.51	74.82	**Parabolic Channel, Earth, clean & straight C-7** W=9.75' D=1.00' Area=6.5 sf Perim=10.0' n= 0.022 Earth, clean & straight
11.8	398	Total			

Subcatchment 2-I: 2 Impervious



Summary for Subcatchment 2-P: 2 Pervious

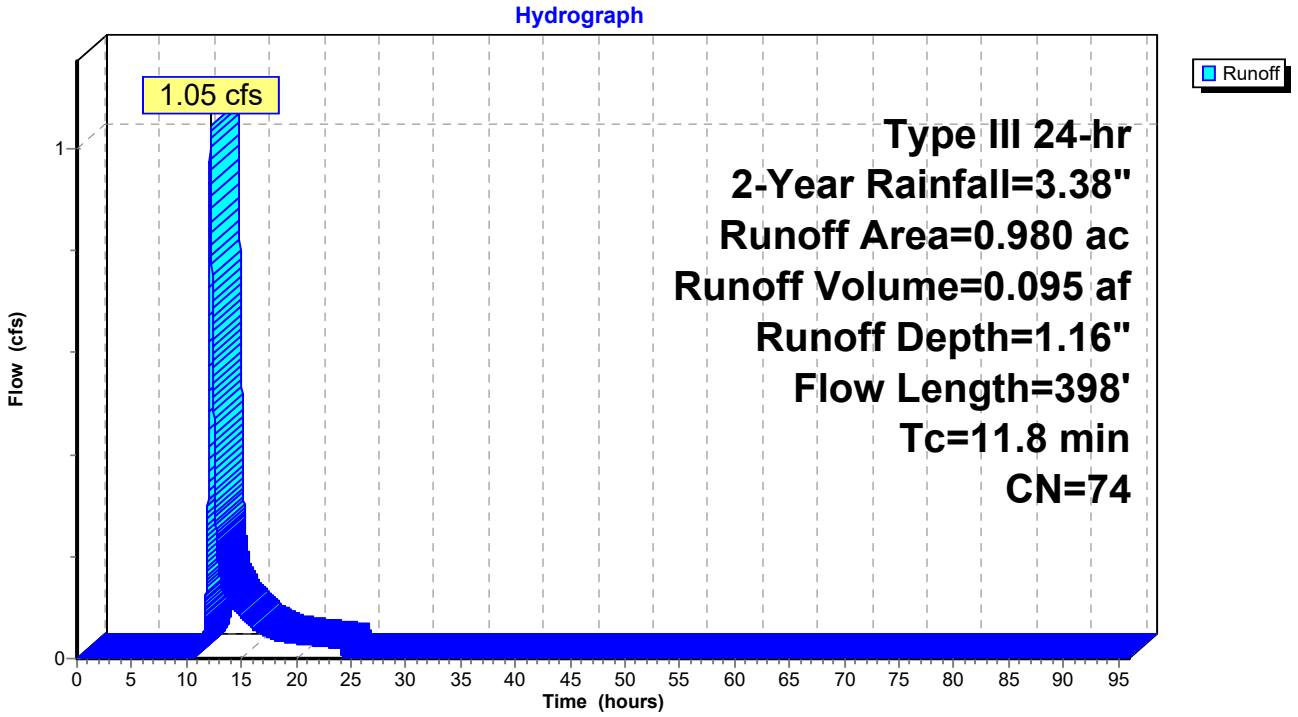
Runoff = 1.05 cfs @ 12.18 hrs, Volume= 0.095 af, Depth= 1.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.38"

Area (ac)	CN	Description
0.837	74	>75% Grass cover, Good, HSG C
0.143	72	Woods/grass comb., Good, HSG C
0.980	74	Weighted Average
0.980		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	48	0.0875	0.12		**Sheet Flow, SF1** Woods: Light underbrush n= 0.400 P2= 3.38"
3.5	52	0.0673	0.25		**Sheet Flow, SF2** Grass: Short n= 0.150 P2= 3.38"
0.2	21	0.0714	1.87		**Shallow Concentrated Flow, Short Grass Pasture C-2** Short Grass Pasture Kv= 7.0 fps
0.2	69	0.0841	4.67		**Shallow Concentrated Flow, Unpaved C-3** Unpaved Kv= 16.1 fps
0.1	30	0.2467	3.48		**Shallow Concentrated Flow, Short Grass Pasture C-4** Short Grass Pasture Kv= 7.0 fps
0.9	103	0.0136	1.88		**Shallow Concentrated Flow, Unpaved C-5** Unpaved Kv= 16.1 fps
0.4	17	0.0118	0.76		**Shallow Concentrated Flow, Short Grass Pasture C-6** Short Grass Pasture Kv= 7.0 fps
0.1	58	0.0517	11.51	74.82	**Parabolic Channel, Earth, clean & straight C-7** W=9.75' D=1.00' Area=6.5 sf Perim=10.0' n= 0.022 Earth, clean & straight
11.8	398	Total			

Subcatchment 2-P: 2 Pervious



Summary for Subcatchment 3-I: 3 Impervious

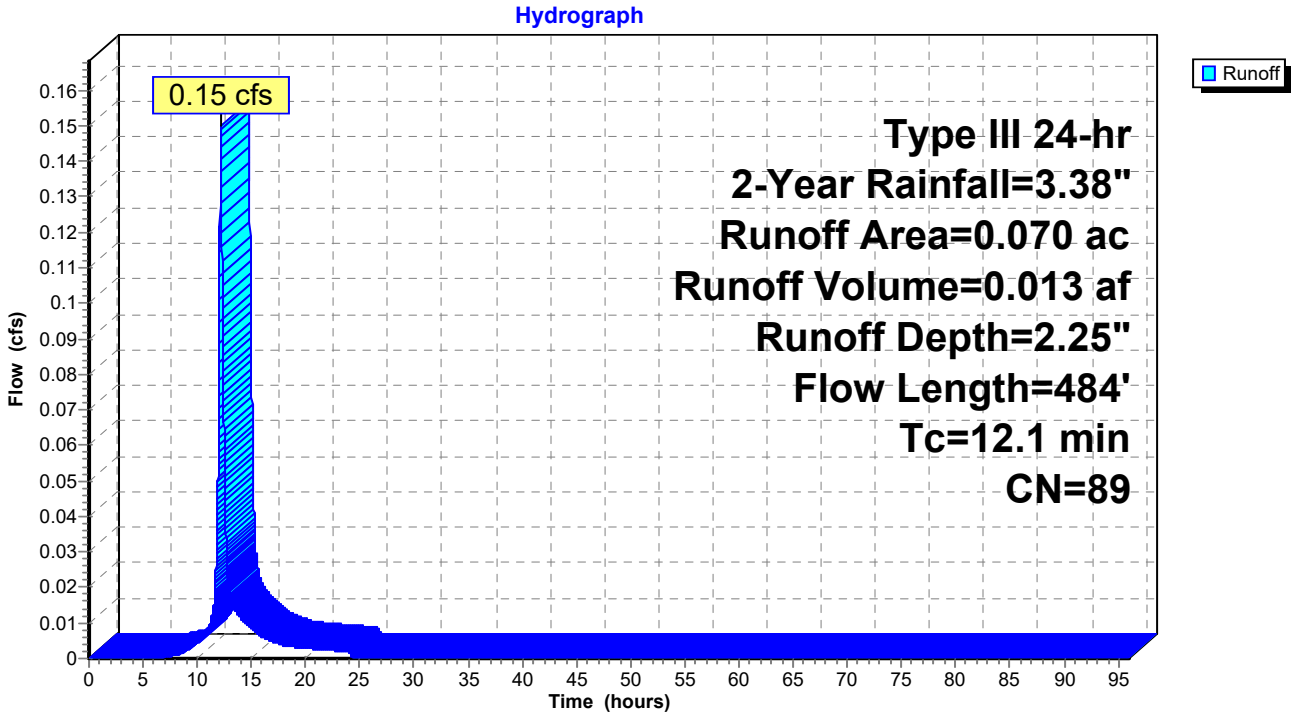
Runoff = 0.15 cfs @ 12.17 hrs, Volume= 0.013 af, Depth= 2.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.38"

Area (ac)	CN	Description
0.070	89	Gravel roads, HSG C
0.000	98	Unconnected pavement, HSG C
0.070	89	Weighted Average
0.070		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0	56	0.0964	0.13		**Sheet Flow, SF1** Woods: Light underbrush n= 0.400 P2= 3.38"
3.0	41	0.0610	0.23		**Sheet Flow, SF2** Grass: Short n= 0.150 P2= 3.38"
0.5	47	0.0617	1.74		**Shallow Concentrated Flow, Short Grass Pasture C-2** Short Grass Pasture Kv= 7.0 fps
0.2	53	0.0868	4.74		**Shallow Concentrated Flow, Unpaved C-3** Unpaved Kv= 16.1 fps
0.6	55	0.0436	1.46		**Shallow Concentrated Flow, Short Grass Pasture C-4** Short Grass Pasture Kv= 7.0 fps
0.7	189	0.0111	4.81	10.88	**Parabolic Channel, Earth, cobble bottom, clean sides C-5** W=3.39' D=1.00' Area=2.3 sf Perim=4.1' n= 0.022 Earth, clean & straight
0.1	43	0.0209	7.10	5.58	**Pipe Channel, RCP_Round 12" C-6** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012
12.1	484	Total			

Subcatchment 3-I: 3 Impervious



Summary for Subcatchment 3-P: 3 Pervious

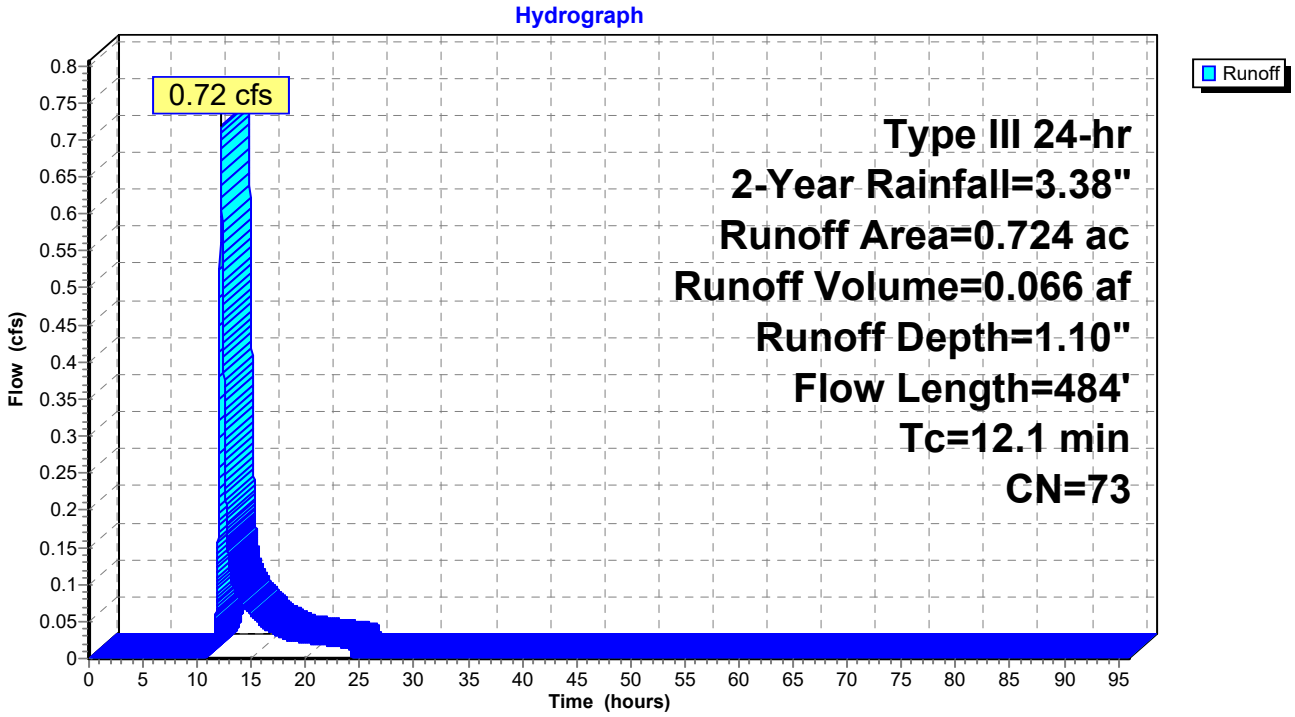
Runoff = 0.72 cfs @ 12.18 hrs, Volume= 0.066 af, Depth= 1.10"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.38"

Area (ac)	CN	Description
0.441	74	>75% Grass cover, Good, HSG C
0.283	72	Woods/grass comb., Good, HSG C
0.724	73	Weighted Average
0.724		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0	56	0.0964	0.13		**Sheet Flow, SF1** Woods: Light underbrush n= 0.400 P2= 3.38"
3.0	41	0.0610	0.23		**Sheet Flow, SF2** Grass: Short n= 0.150 P2= 3.38"
0.5	47	0.0617	1.74		**Shallow Concentrated Flow, Short Grass Pasture C-2** Short Grass Pasture Kv= 7.0 fps
0.2	53	0.0868	4.74		**Shallow Concentrated Flow, Unpaved C-3** Unpaved Kv= 16.1 fps
0.6	55	0.0436	1.46		**Shallow Concentrated Flow, Short Grass Pasture C-4** Short Grass Pasture Kv= 7.0 fps
0.7	189	0.0111	4.81	10.88	**Parabolic Channel, Earth, clean & straight C-5** W=3.39' D=1.00' Area=2.3 sf Perim=4.1' n= 0.022 Earth, clean & straight
0.1	43	0.0281	8.24	6.47	**Pipe Channel, RCP_Round 12" C-6** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012
12.1	484	Total			

Subcatchment 3-P: 3 Pervious



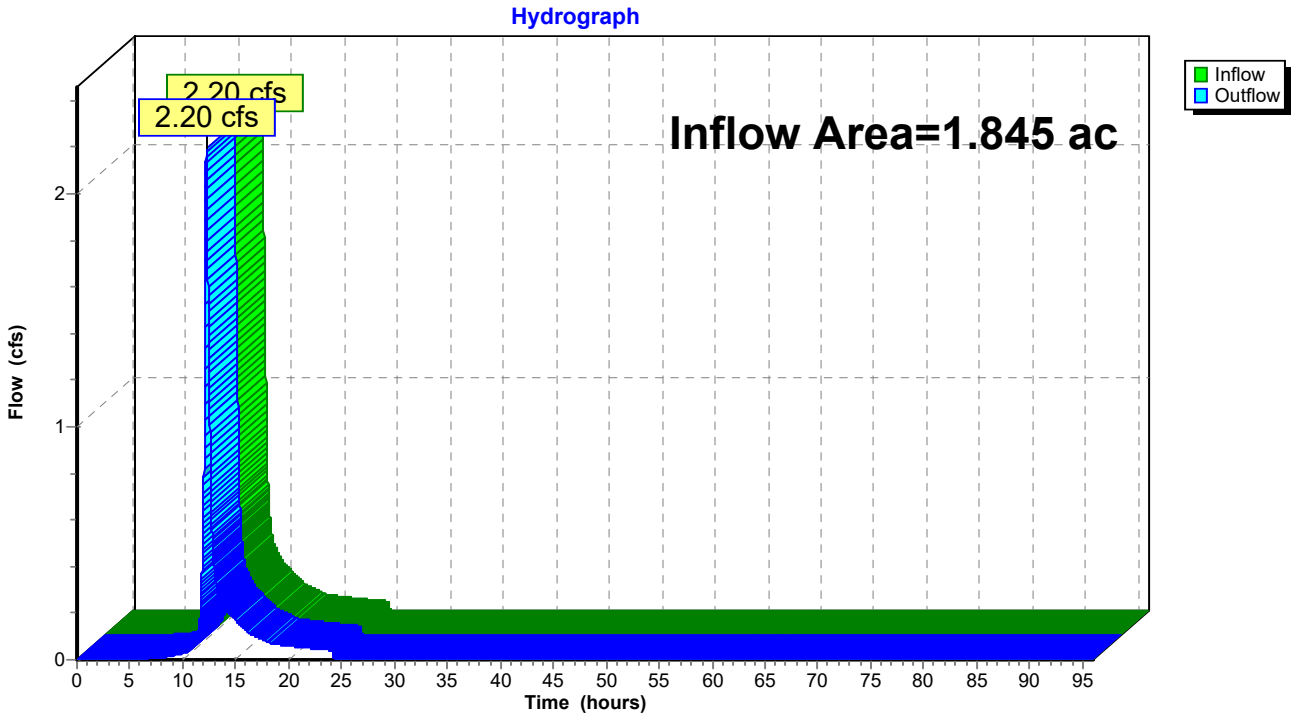
Summary for Reach 1R: (Outlet East)

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 1.845 ac, 5.64% Impervious, Inflow Depth = 1.40" for 2-Year event
Inflow = 2.20 cfs @ 12.22 hrs, Volume= 0.215 af
Outflow = 2.20 cfs @ 12.22 hrs, Volume= 0.215 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Reach 1R: (Outlet East)



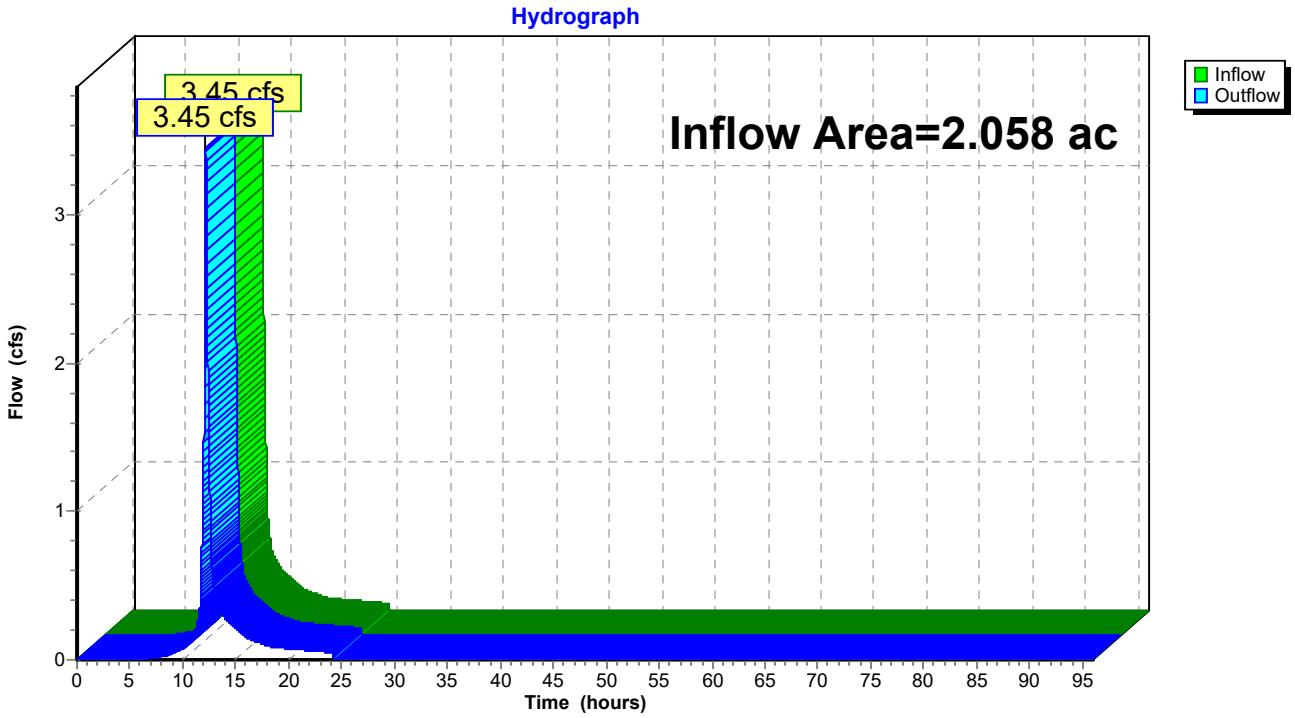
Summary for Reach 2R: (Outlet North)

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.058 ac, 11.86% Impervious, Inflow Depth = 1.77" for 2-Year event
Inflow = 3.45 cfs @ 12.16 hrs, Volume= 0.304 af
Outflow = 3.45 cfs @ 12.16 hrs, Volume= 0.304 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Reach 2R: (Outlet North)



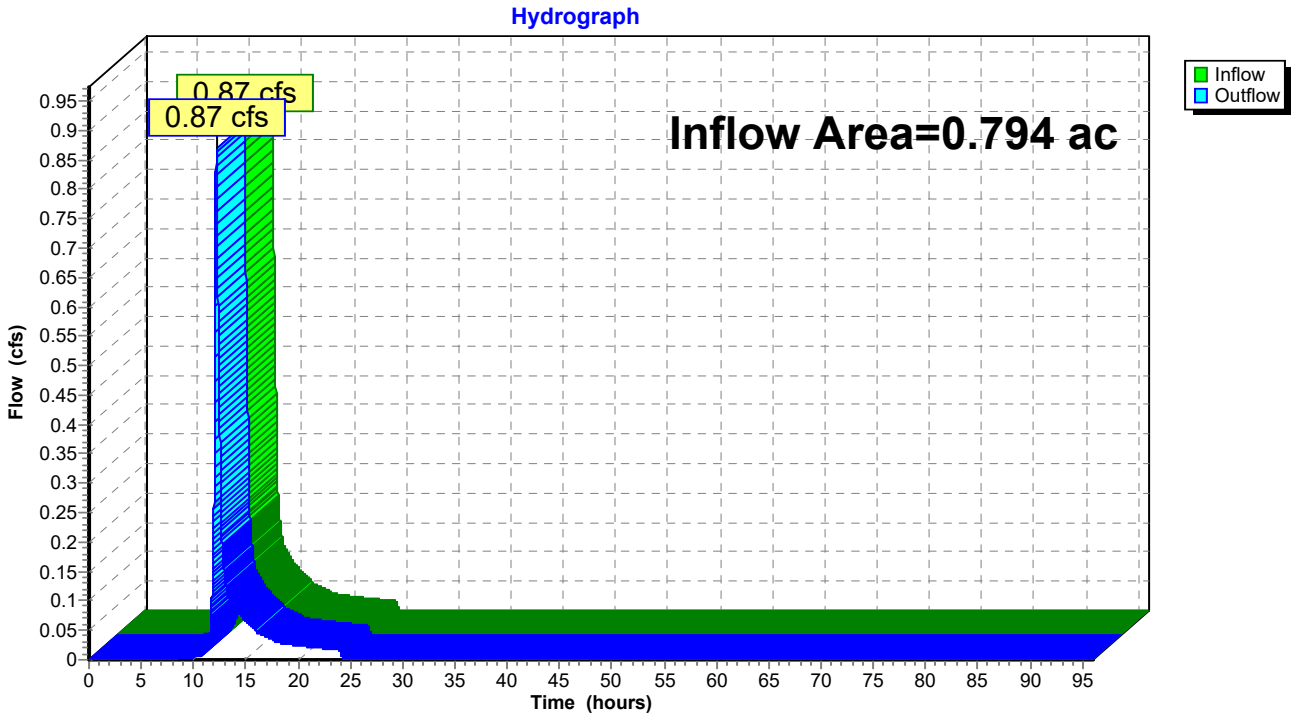
Summary for Reach 3R: (Outlet West)

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.794 ac, 0.00% Impervious, Inflow Depth = 1.20" for 2-Year event
Inflow = 0.87 cfs @ 12.17 hrs, Volume= 0.079 af
Outflow = 0.87 cfs @ 12.17 hrs, Volume= 0.079 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Reach 3R: (Outlet West)



Summary for Pond 1P: (Double 16" Culvert East)

Inflow Area = 1.845 ac, 5.64% Impervious, Inflow Depth = 1.40" for 2-Year event
Inflow = 2.20 cfs @ 12.21 hrs, Volume= 0.215 af
Outflow = 2.20 cfs @ 12.22 hrs, Volume= 0.215 af, Atten= 0%, Lag= 0.0 min
Primary = 2.20 cfs @ 12.22 hrs, Volume= 0.215 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Peak Elev= 147.45' @ 12.22 hrs Surf.Area= 14 sf Storage= 4 cf

Plug-Flow detention time= 0.0 min calculated for 0.215 af (100% of inflow)
Center-of-Mass det. time= 0.0 min (846.9 - 846.8)

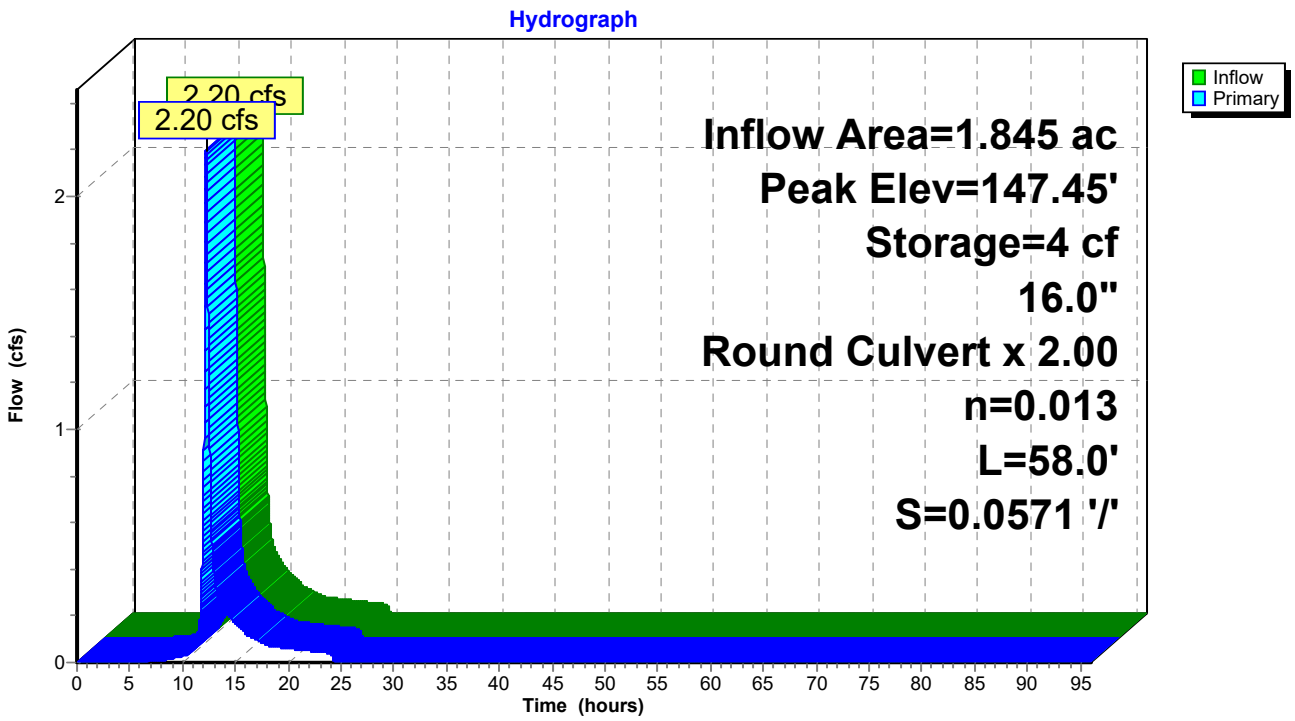
Volume	Invert	Avail.Storage	Storage Description
#1	146.90'	1,452 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
146.90	1	0	0
147.00	2	0	0
148.00	28	15	15
149.00	44	36	51
150.00	627	336	387
150.80	2,036	1,065	1,452

Device	Routing	Invert	Outlet Devices
#1	Primary	146.90'	**16.0" Round Culvert X 2.00** L= 58.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 146.90' / 143.59' S= 0.0571 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.40 sf

Primary OutFlow Max=2.19 cfs @ 12.22 hrs HW=147.45' TW=0.00' (Dynamic Tailwater)
└**1=Culvert** (Inlet Controls 2.19 cfs @ 2.00 fps)

Pond 1P: (Double 16" Culvert East)



Summary for Pond 2P: (18" RCP)

Inflow Area = 2.058 ac, 11.86% Impervious, Inflow Depth = 1.77" for 2-Year event
Inflow = 3.45 cfs @ 12.16 hrs, Volume= 0.304 af
Outflow = 3.45 cfs @ 12.16 hrs, Volume= 0.304 af, Atten= 0%, Lag= 0.0 min
Primary = 3.45 cfs @ 12.16 hrs, Volume= 0.304 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Peak Elev= 155.01' @ 12.16 hrs Surf.Area= 15 sf Storage= 5 cf

Plug-Flow detention time= 0.1 min calculated for 0.304 af (100% of inflow)
Center-of-Mass det. time= 0.0 min (827.0 - 826.9)

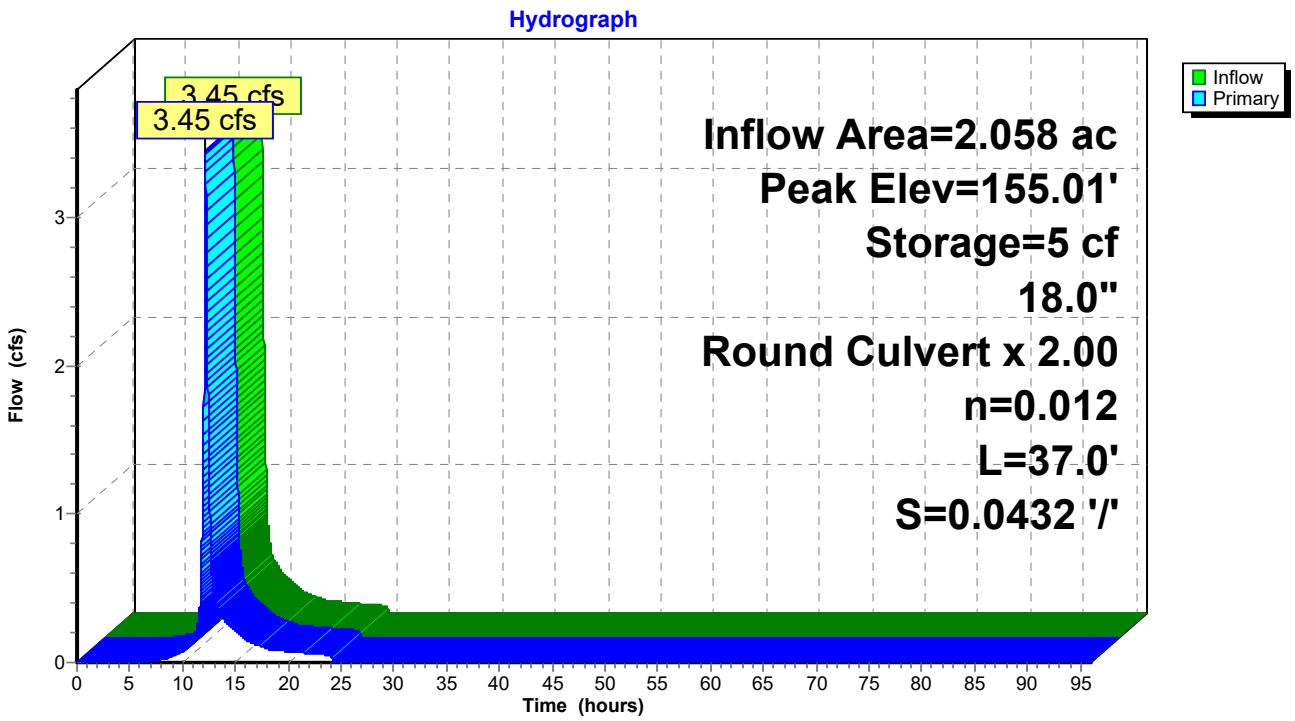
Volume	Invert	Avail.Storage	Storage Description
#1	154.40'	1,925 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
154.40	1	0	0
155.00	14	4	4
156.00	122	68	72
157.00	942	532	605
157.40	1,335	455	1,060
158.00	1,550	865	1,925

Device	Routing	Invert	Outlet Devices
#1	Primary	154.50'	**18.0" Round Culvert X 2.00** L= 37.0' RCP, rounded edge headwall, Ke= 0.100 Inlet / Outlet Invert= 154.50' / 152.90' S= 0.0432 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 1.77 sf

Primary OutFlow Max=3.45 cfs @ 12.16 hrs HW=155.01' TW=0.00' (Dynamic Tailwater)
└**1=Culvert** (Inlet Controls 3.45 cfs @ 3.30 fps)

Pond 2P: (18" RCP)

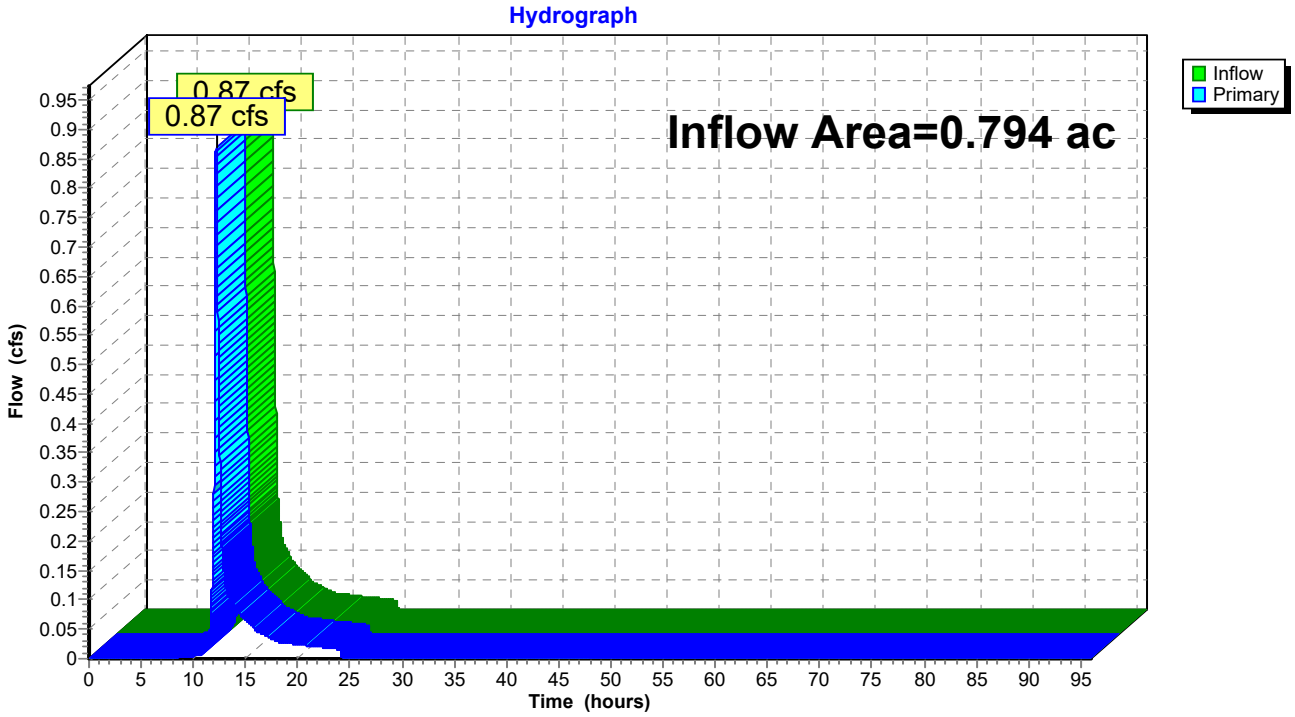


Summary for Link 3: Drainage Area 3

Inflow Area = 0.794 ac, 0.00% Impervious, Inflow Depth = 1.20" for 2-Year event
Inflow = 0.87 cfs @ 12.17 hrs, Volume= 0.079 af
Primary = 0.87 cfs @ 12.17 hrs, Volume= 0.079 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Link 3: Drainage Area 3

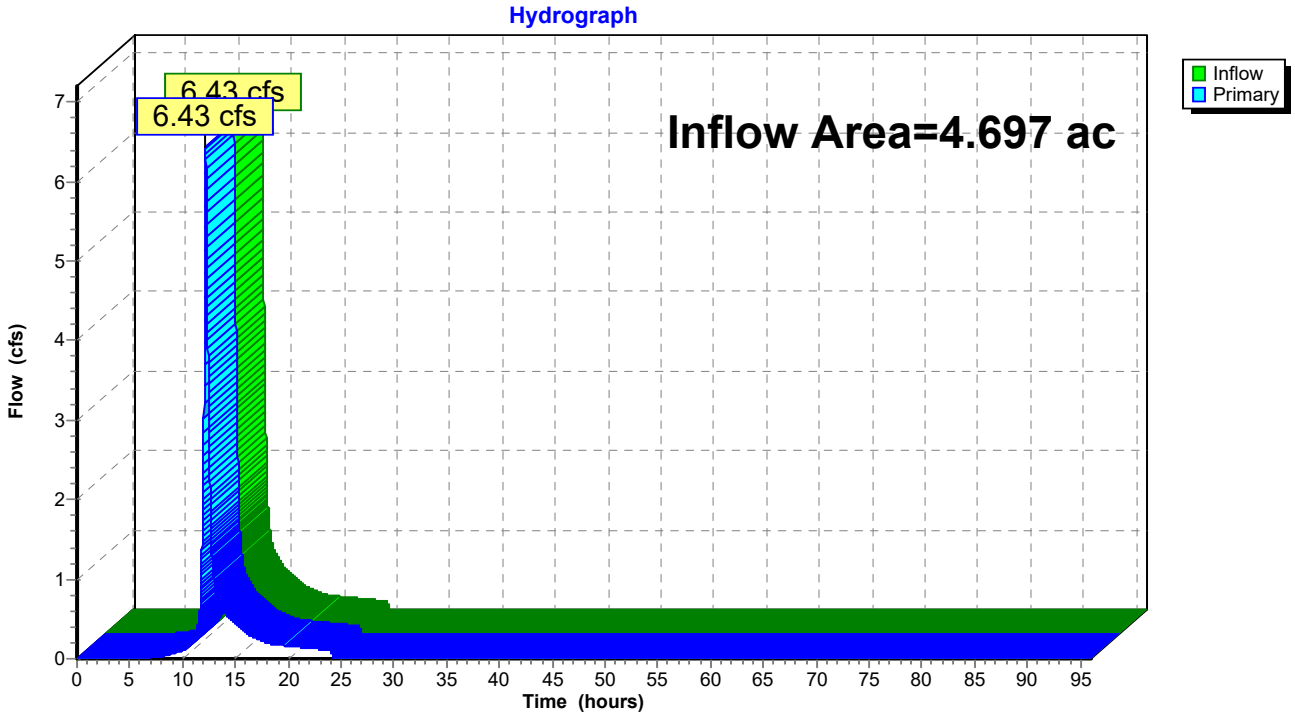


Summary for Link 5L: (Total Offsite Flows)

Inflow Area = 4.697 ac, 7.41% Impervious, Inflow Depth = 1.53" for 2-Year event
Inflow = 6.43 cfs @ 12.18 hrs, Volume= 0.599 af
Primary = 6.43 cfs @ 12.18 hrs, Volume= 0.599 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Link 5L: (Total Offsite Flows)



Time span=0.00-96.00 hrs, dt=0.01 hrs, 9601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1-I: 1 Impervious Runoff Area=0.329 ac 31.61% Impervious Runoff Depth=4.09"
Flow Length=561' Tc=15.0 min CN=92 Runoff=1.14 cfs 0.112 af

Subcatchment 1-P: 1 Pervious Runoff Area=1.516 ac 0.00% Impervious Runoff Depth=2.36"
Tc=15.0 min CN=74 Runoff=3.16 cfs 0.299 af

Subcatchment 2-I: 2 Impervious Runoff Area=1.078 ac 22.63% Impervious Runoff Depth=3.88"
Flow Length=398' Tc=11.8 min UI Adjusted CN=90 Runoff=3.92 cfs 0.348 af

Subcatchment 2-P: 2 Pervious Runoff Area=0.980 ac 0.00% Impervious Runoff Depth=2.36"
Flow Length=398' Tc=11.8 min CN=74 Runoff=2.23 cfs 0.193 af

Subcatchment 3-I: 3 Impervious Runoff Area=0.070 ac 0.00% Impervious Runoff Depth=3.77"
Flow Length=484' Tc=12.1 min CN=89 Runoff=0.25 cfs 0.022 af

Subcatchment 3-P: 3 Pervious Runoff Area=0.724 ac 0.00% Impervious Runoff Depth=2.28"
Flow Length=484' Tc=12.1 min CN=73 Runoff=1.57 cfs 0.138 af

Reach 1R: (Outlet East) Inflow=4.29 cfs 0.411 af
Outflow=4.29 cfs 0.411 af

Reach 2R: (Outlet North) Inflow=6.15 cfs 0.541 af
Outflow=6.15 cfs 0.541 af

Reach 3R: (Outlet West) Inflow=1.82 cfs 0.160 af
Outflow=1.82 cfs 0.160 af

Pond 1P: (Double 16" Culvert East) Peak Elev=147.71' Storage=8 cf Inflow=4.29 cfs 0.411 af
16.0" Round Culvert x 2.00 n=0.013 L=58.0' S=0.0571 '/' Outflow=4.29 cfs 0.411 af

Pond 2P: (18" RCP) Peak Elev=155.19' Storage=9 cf Inflow=6.15 cfs 0.541 af
18.0" Round Culvert x 2.00 n=0.012 L=37.0' S=0.0432 '/' Outflow=6.15 cfs 0.541 af

Link 3: Drainage Area 3 Inflow=1.82 cfs 0.160 af
Primary=1.82 cfs 0.160 af

Link 5L: (Total Offsite Flows) Inflow=12.11 cfs 1.112 af
Primary=12.11 cfs 1.112 af

Total Runoff Area = 4.697 ac Runoff Volume = 1.112 af Average Runoff Depth = 2.84"
92.59% Pervious = 4.349 ac 7.41% Impervious = 0.348 ac

Summary for Subcatchment 1-I: 1 Impervious

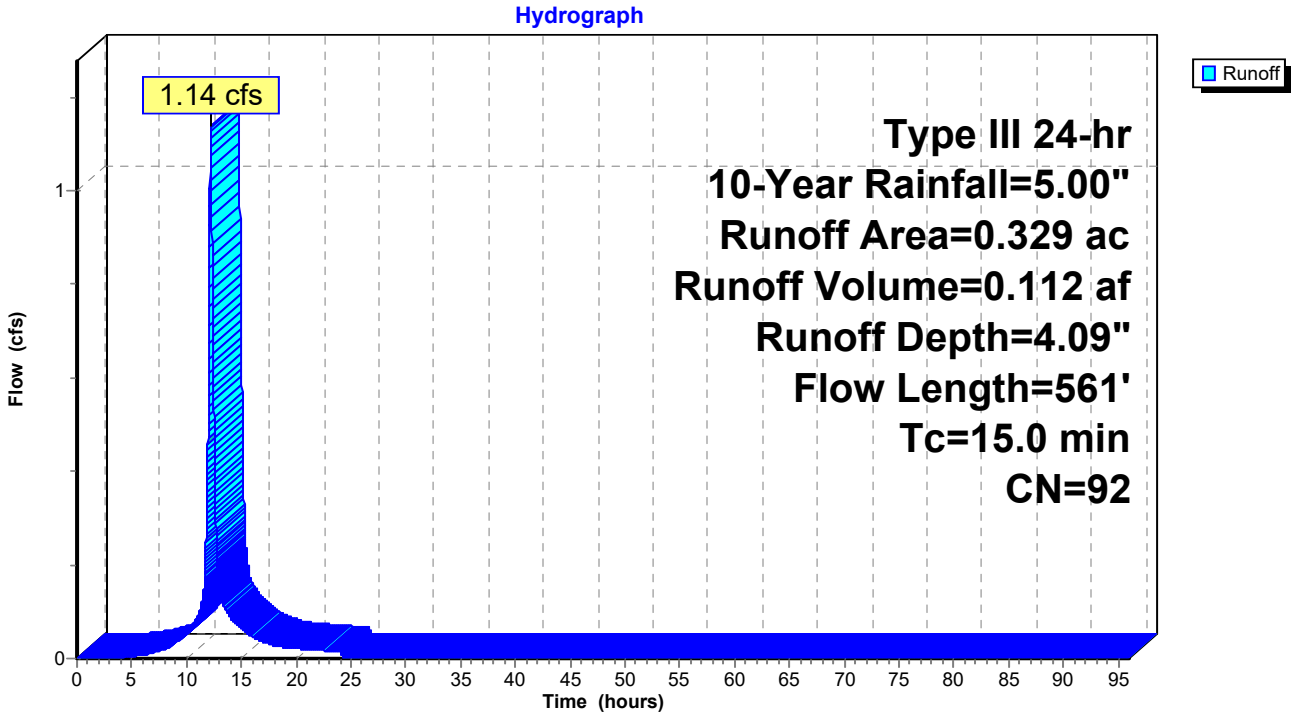
Runoff = 1.14 cfs @ 12.20 hrs, Volume= 0.112 af, Depth= 4.09"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.00"

	Area (ac)	CN	Description
*	0.225	89	Gravel
	0.102	98	Unconnected pavement, HSG C
	0.002	98	Unconnected roofs, HSG C
	0.329	92	Weighted Average
	0.225		68.39% Pervious Area
	0.104		31.61% Impervious Area
	0.104		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.6	40	0.1180	0.08		**Sheet Flow, SF1** Woods: Dense underbrush n= 0.800 P2= 3.38"
2.4	22	0.0818	0.16		**Sheet Flow, SF2** Grass: Dense n= 0.240 P2= 3.38"
0.3	38	0.0789	2.02		**Sheet Flow, SF2** Smooth surfaces n= 0.011 P2= 3.38"
0.3	74	0.0527	3.70		**Shallow Concentrated Flow, SCF1** Unpaved Kv= 16.1 fps
3.3	320	0.0424	1.61	1.61	**Channel Flow, CF1** Area= 1.0 sf Perim= 12.6' r= 0.08' n= 0.035 Earth, dense weeds
0.1	67	0.0776	16.58	23.16	**Pipe Channel,** 16.0" Round Area= 1.4 sf Perim= 4.2' r= 0.33' n= 0.012
15.0	561	Total			

Subcatchment 1-I: 1 Impervious



Summary for Subcatchment 1-P: 1 Pervious

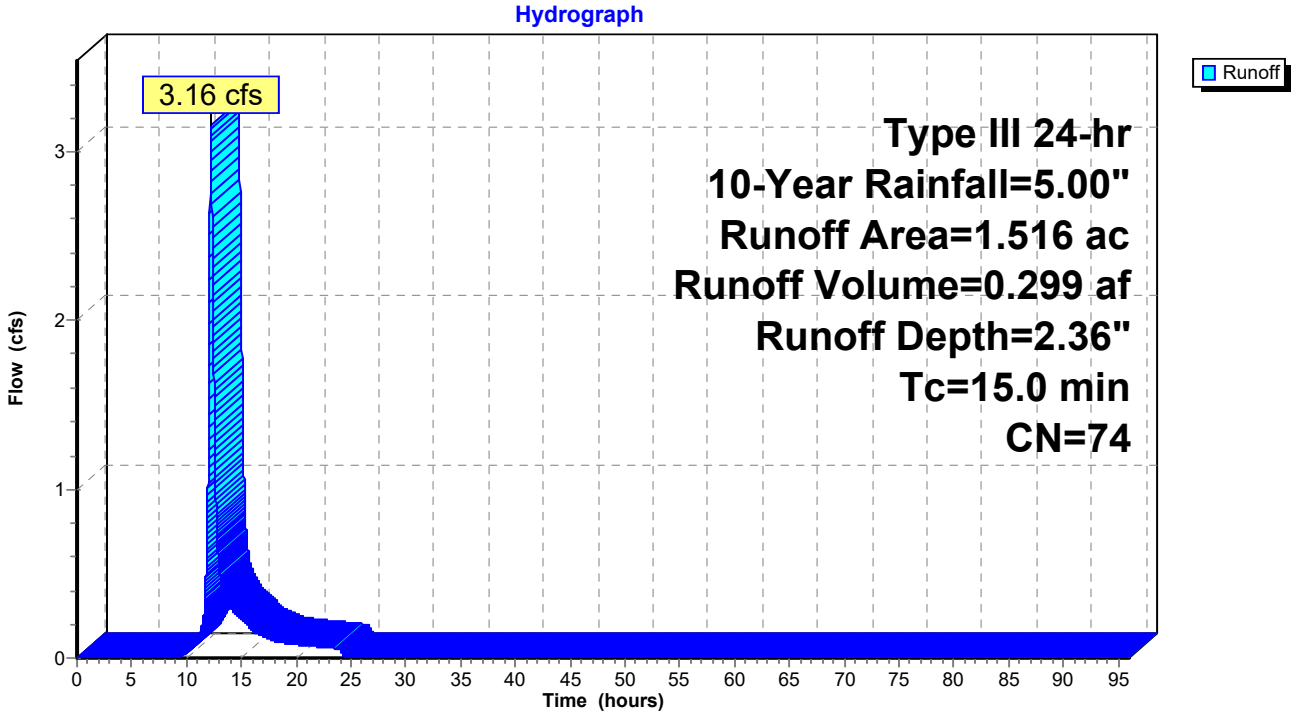
Runoff = 3.16 cfs @ 12.21 hrs, Volume= 0.299 af, Depth= 2.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.00"

Area (ac)	CN	Description
0.044	72	Woods/grass comb., Good, HSG C
1.472	74	>75% Grass cover, Good, HSG C
1.516	74	Weighted Average
1.516		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.0					**Direct Entry, Same as 1-I**

Subcatchment 1-P: 1 Pervious



Summary for Subcatchment 2-I: 2 Impervious

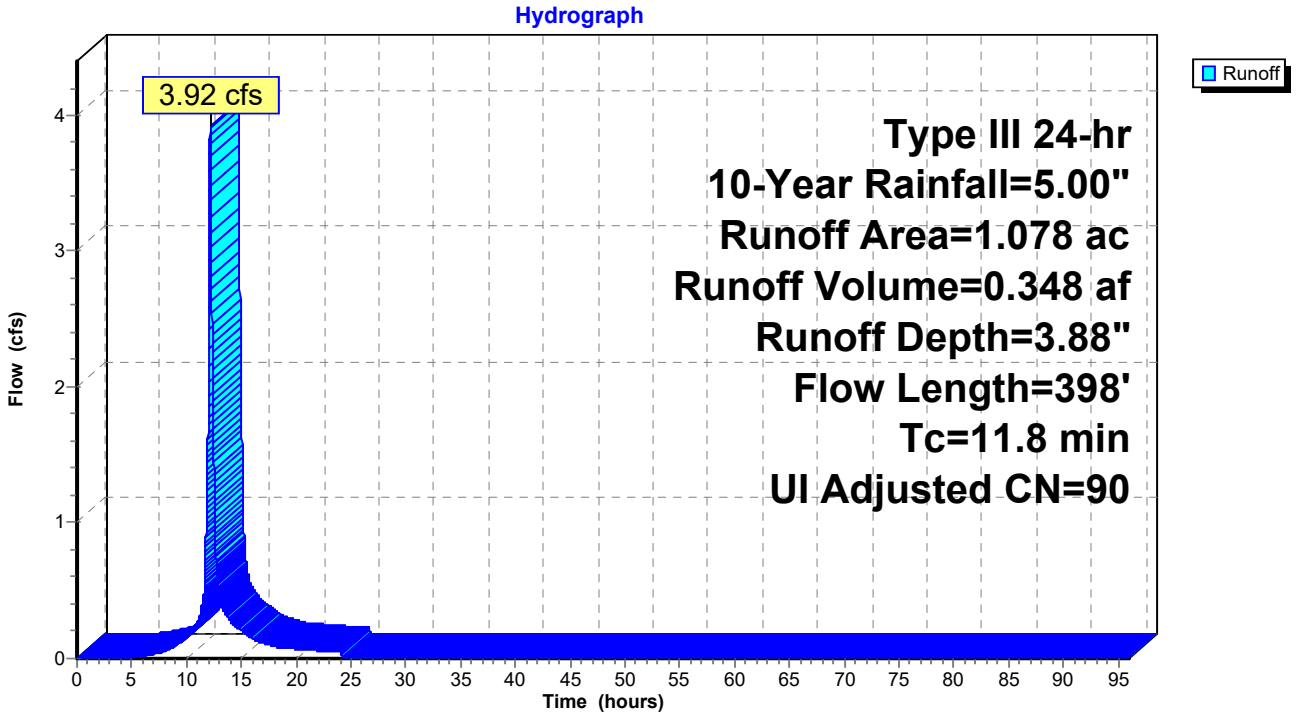
Runoff = 3.92 cfs @ 12.16 hrs, Volume= 0.348 af, Depth= 3.88"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.00"

Area (ac)	CN	Adj	Description
0.834	89		Gravel roads, HSG C
0.135	98		Unconnected pavement, HSG C
0.109	98		Unconnected roofs, HSG C
1.078	91	90	Weighted Average, UI Adjusted
0.834			77.37% Pervious Area
0.244			22.63% Impervious Area
0.244			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	48	0.0875	0.12		**Sheet Flow, SF1** Woods: Light underbrush n= 0.400 P2= 3.38"
3.5	52	0.0673	0.25		**Sheet Flow, SF2** Grass: Short n= 0.150 P2= 3.38"
0.2	21	0.0714	1.87		**Shallow Concentrated Flow, Short Grass Pasture C-2** Short Grass Pasture Kv= 7.0 fps
0.2	69	0.0841	4.67		**Shallow Concentrated Flow, Unpaved C-3** Unpaved Kv= 16.1 fps
0.1	30	0.2467	3.48		**Shallow Concentrated Flow, Short Grass Pasture C-4** Short Grass Pasture Kv= 7.0 fps
0.9	103	0.0136	1.88		**Shallow Concentrated Flow, Unpaved C-5** Unpaved Kv= 16.1 fps
0.4	17	0.0118	0.76		**Shallow Concentrated Flow, Short Grass Pasture C-6** Short Grass Pasture Kv= 7.0 fps
0.1	58	0.0517	11.51	74.82	**Parabolic Channel, Earth, clean & straight C-7** W=9.75' D=1.00' Area=6.5 sf Perim=10.0' n= 0.022 Earth, clean & straight
11.8	398	Total			

Subcatchment 2-I: 2 Impervious



Summary for Subcatchment 2-P: 2 Pervious

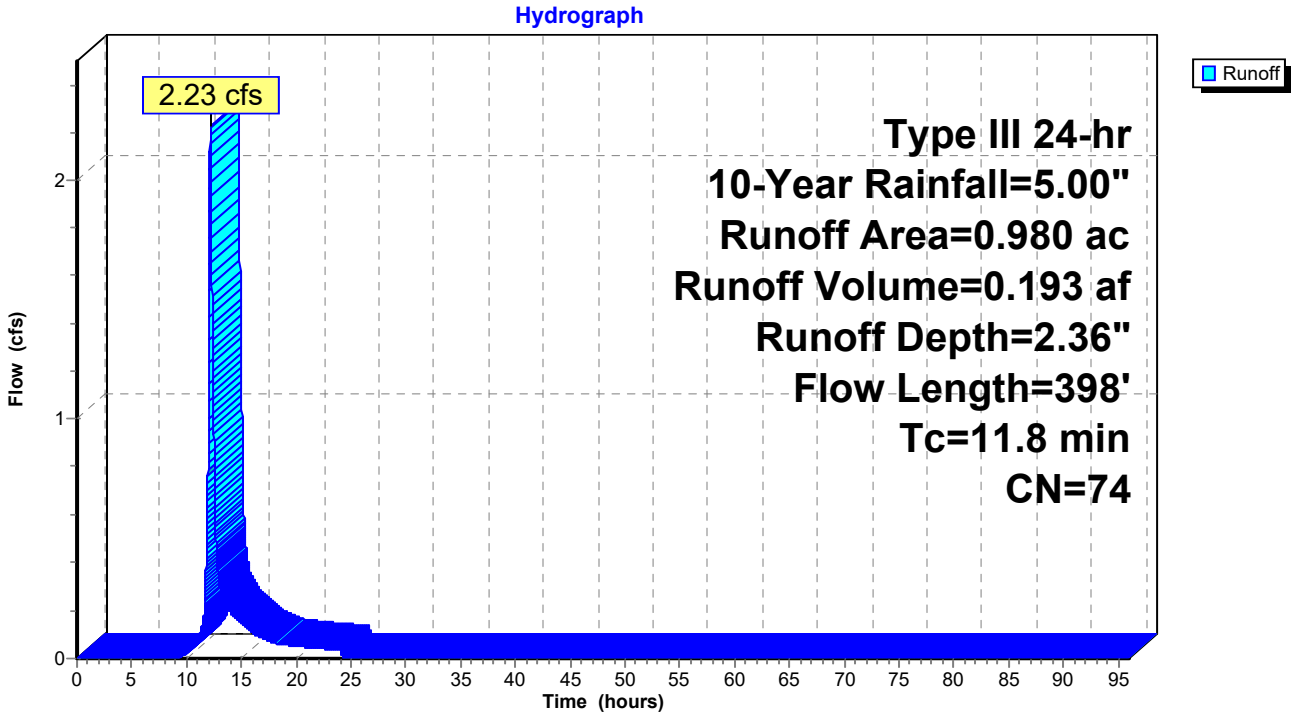
Runoff = 2.23 cfs @ 12.17 hrs, Volume= 0.193 af, Depth= 2.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.00"

Area (ac)	CN	Description
0.837	74	>75% Grass cover, Good, HSG C
0.143	72	Woods/grass comb., Good, HSG C
0.980	74	Weighted Average
0.980		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	48	0.0875	0.12		**Sheet Flow, SF1** Woods: Light underbrush n= 0.400 P2= 3.38"
3.5	52	0.0673	0.25		**Sheet Flow, SF2** Grass: Short n= 0.150 P2= 3.38"
0.2	21	0.0714	1.87		**Shallow Concentrated Flow, Short Grass Pasture C-2** Short Grass Pasture Kv= 7.0 fps
0.2	69	0.0841	4.67		**Shallow Concentrated Flow, Unpaved C-3** Unpaved Kv= 16.1 fps
0.1	30	0.2467	3.48		**Shallow Concentrated Flow, Short Grass Pasture C-4** Short Grass Pasture Kv= 7.0 fps
0.9	103	0.0136	1.88		**Shallow Concentrated Flow, Unpaved C-5** Unpaved Kv= 16.1 fps
0.4	17	0.0118	0.76		**Shallow Concentrated Flow, Short Grass Pasture C-6** Short Grass Pasture Kv= 7.0 fps
0.1	58	0.0517	11.51	74.82	**Parabolic Channel, Earth, clean & straight C-7** W=9.75' D=1.00' Area=6.5 sf Perim=10.0' n= 0.022 Earth, clean & straight
11.8	398	Total			

Subcatchment 2-P: 2 Pervious



Summary for Subcatchment 3-I: 3 Impervious

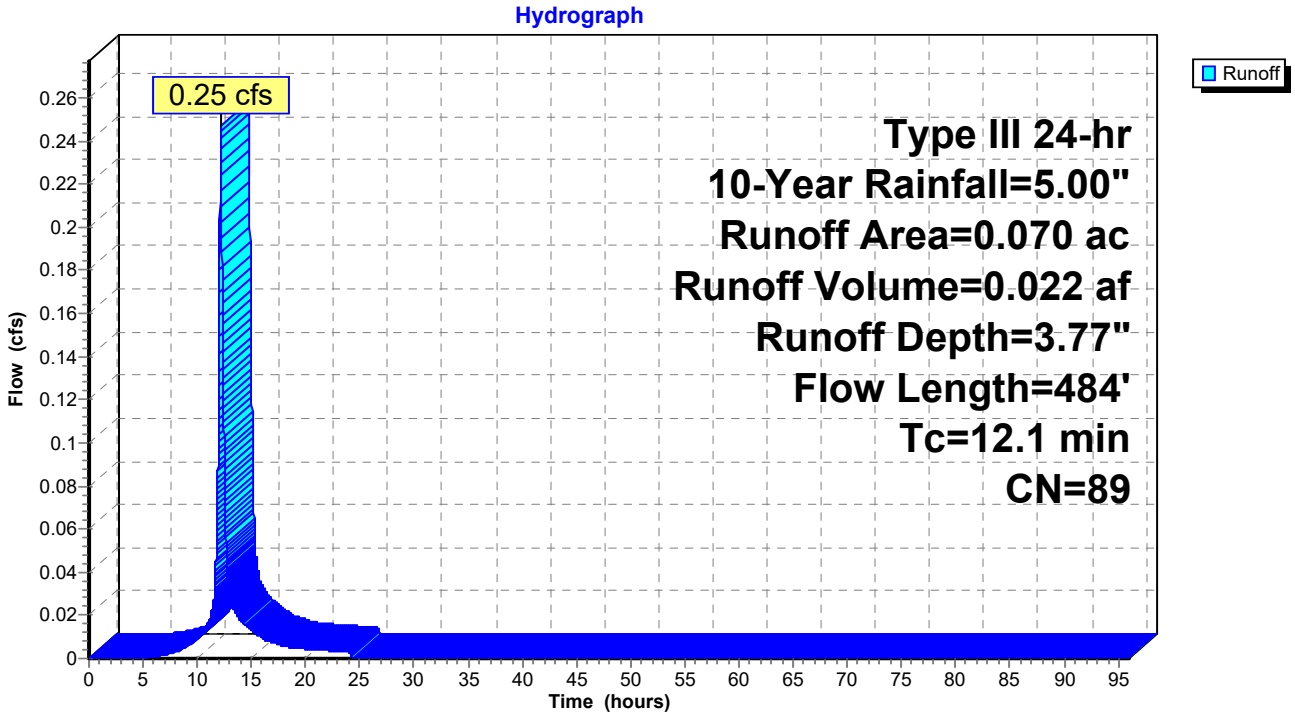
Runoff = 0.25 cfs @ 12.16 hrs, Volume= 0.022 af, Depth= 3.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.00"

Area (ac)	CN	Description
0.070	89	Gravel roads, HSG C
0.000	98	Unconnected pavement, HSG C
0.070	89	Weighted Average
0.070		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0	56	0.0964	0.13		**Sheet Flow, SF1** Woods: Light underbrush n= 0.400 P2= 3.38"
3.0	41	0.0610	0.23		**Sheet Flow, SF2** Grass: Short n= 0.150 P2= 3.38"
0.5	47	0.0617	1.74		**Shallow Concentrated Flow, Short Grass Pasture C-2** Short Grass Pasture Kv= 7.0 fps
0.2	53	0.0868	4.74		**Shallow Concentrated Flow, Unpaved C-3** Unpaved Kv= 16.1 fps
0.6	55	0.0436	1.46		**Shallow Concentrated Flow, Short Grass Pasture C-4** Short Grass Pasture Kv= 7.0 fps
0.7	189	0.0111	4.81	10.88	**Parabolic Channel, Earth, cobble bottom, clean sides C-5** W=3.39' D=1.00' Area=2.3 sf Perim=4.1' n= 0.022 Earth, clean & straight
0.1	43	0.0209	7.10	5.58	**Pipe Channel, RCP_Round 12" C-6** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012
12.1	484	Total			

Subcatchment 3-I: 3 Impervious



Summary for Subcatchment 3-P: 3 Pervious

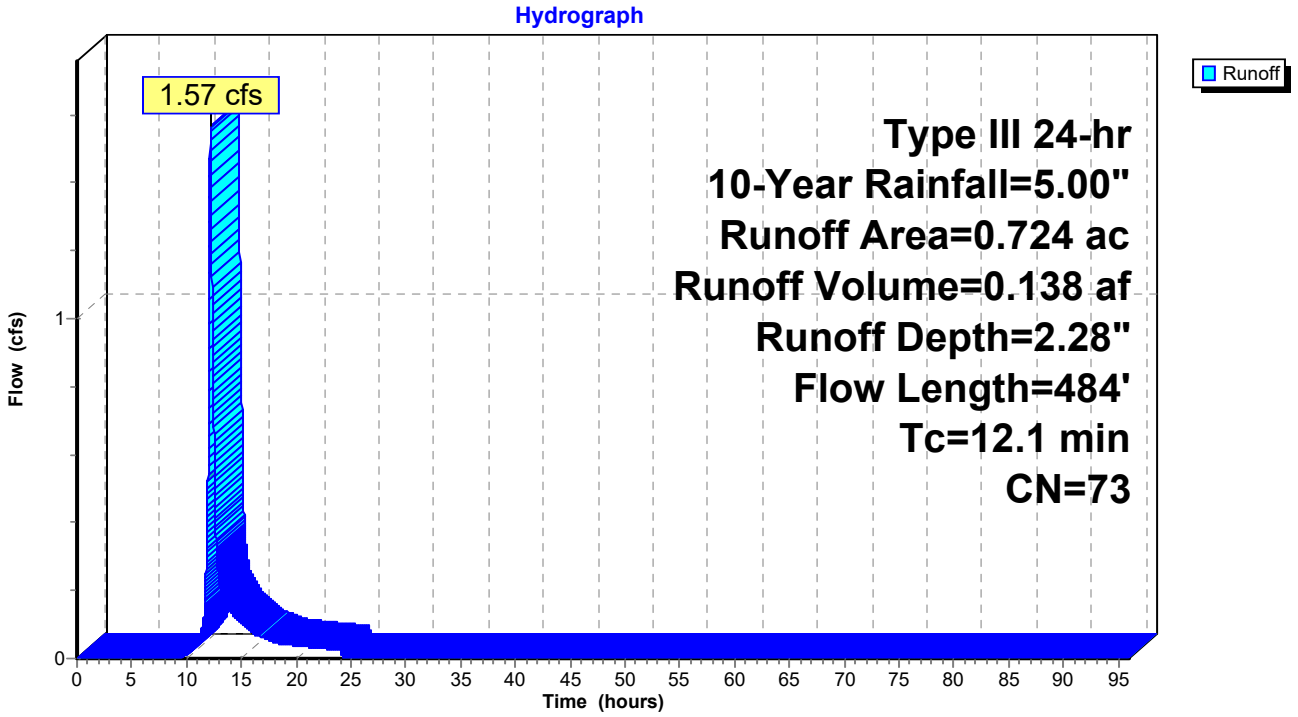
Runoff = 1.57 cfs @ 12.17 hrs, Volume= 0.138 af, Depth= 2.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.00"

Area (ac)	CN	Description
0.441	74	>75% Grass cover, Good, HSG C
0.283	72	Woods/grass comb., Good, HSG C
0.724	73	Weighted Average
0.724		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0	56	0.0964	0.13		**Sheet Flow, SF1** Woods: Light underbrush n= 0.400 P2= 3.38"
3.0	41	0.0610	0.23		**Sheet Flow, SF2** Grass: Short n= 0.150 P2= 3.38"
0.5	47	0.0617	1.74		**Shallow Concentrated Flow, Short Grass Pasture C-2** Short Grass Pasture Kv= 7.0 fps
0.2	53	0.0868	4.74		**Shallow Concentrated Flow, Unpaved C-3** Unpaved Kv= 16.1 fps
0.6	55	0.0436	1.46		**Shallow Concentrated Flow, Short Grass Pasture C-4** Short Grass Pasture Kv= 7.0 fps
0.7	189	0.0111	4.81	10.88	**Parabolic Channel, Earth, clean & straight C-5** W=3.39' D=1.00' Area=2.3 sf Perim=4.1' n= 0.022 Earth, clean & straight
0.1	43	0.0281	8.24	6.47	**Pipe Channel, RCP_Round 12" C-6** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012
12.1	484	Total			

Subcatchment 3-P: 3 Pervious



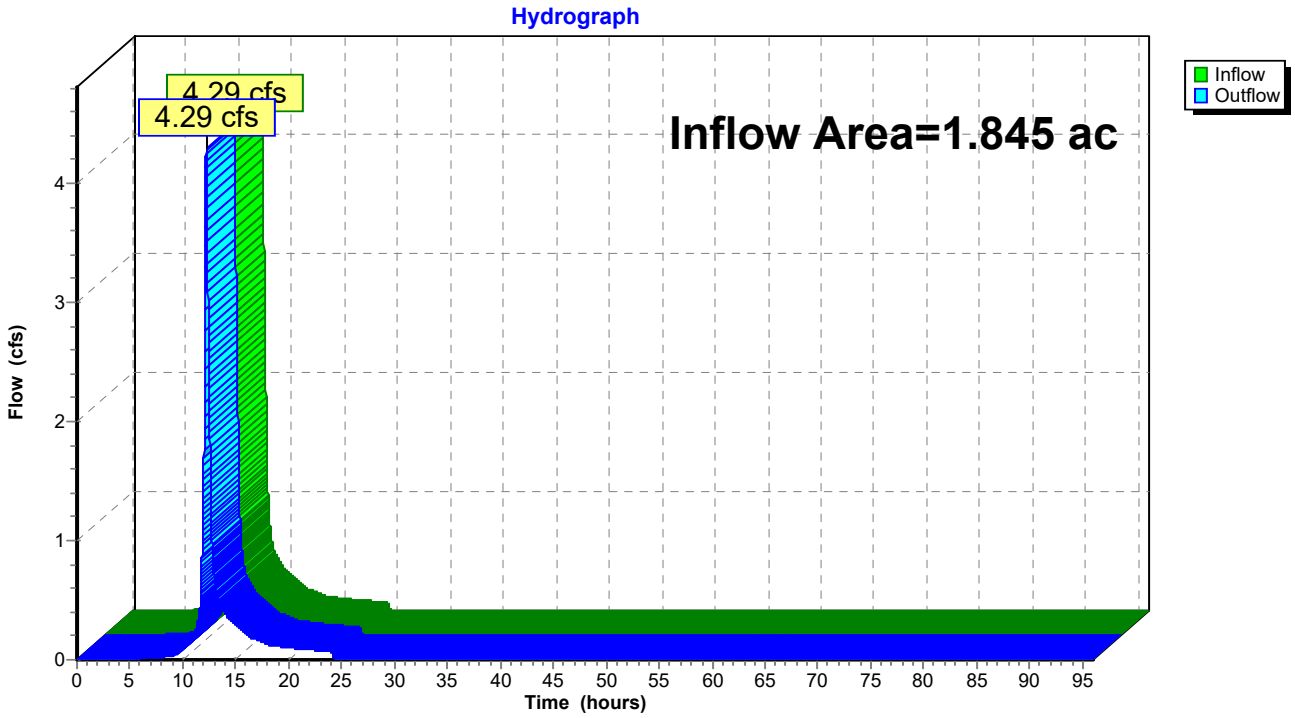
Summary for Reach 1R: (Outlet East)

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 1.845 ac, 5.64% Impervious, Inflow Depth = 2.67" for 10-Year event
Inflow = 4.29 cfs @ 12.21 hrs, Volume= 0.411 af
Outflow = 4.29 cfs @ 12.21 hrs, Volume= 0.411 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Reach 1R: (Outlet East)



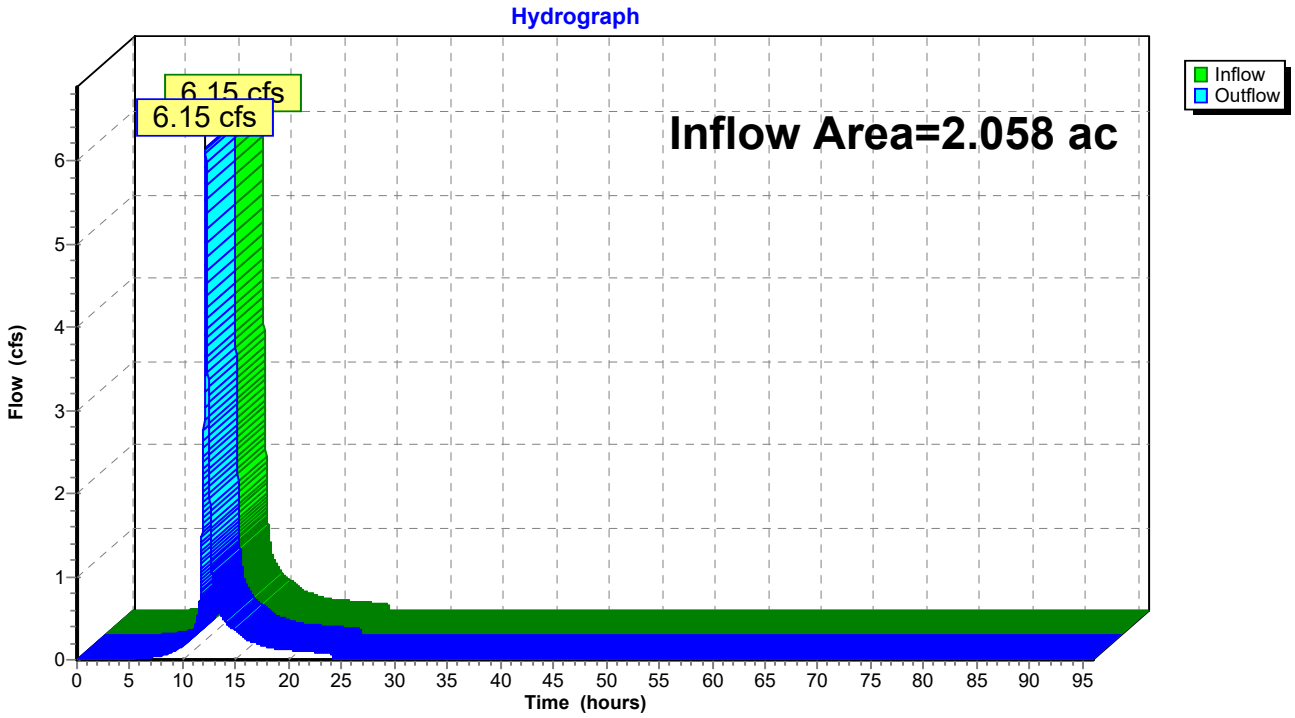
Summary for Reach 2R: (Outlet North)

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.058 ac, 11.86% Impervious, Inflow Depth = 3.16" for 10-Year event
Inflow = 6.15 cfs @ 12.16 hrs, Volume= 0.541 af
Outflow = 6.15 cfs @ 12.16 hrs, Volume= 0.541 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Reach 2R: (Outlet North)



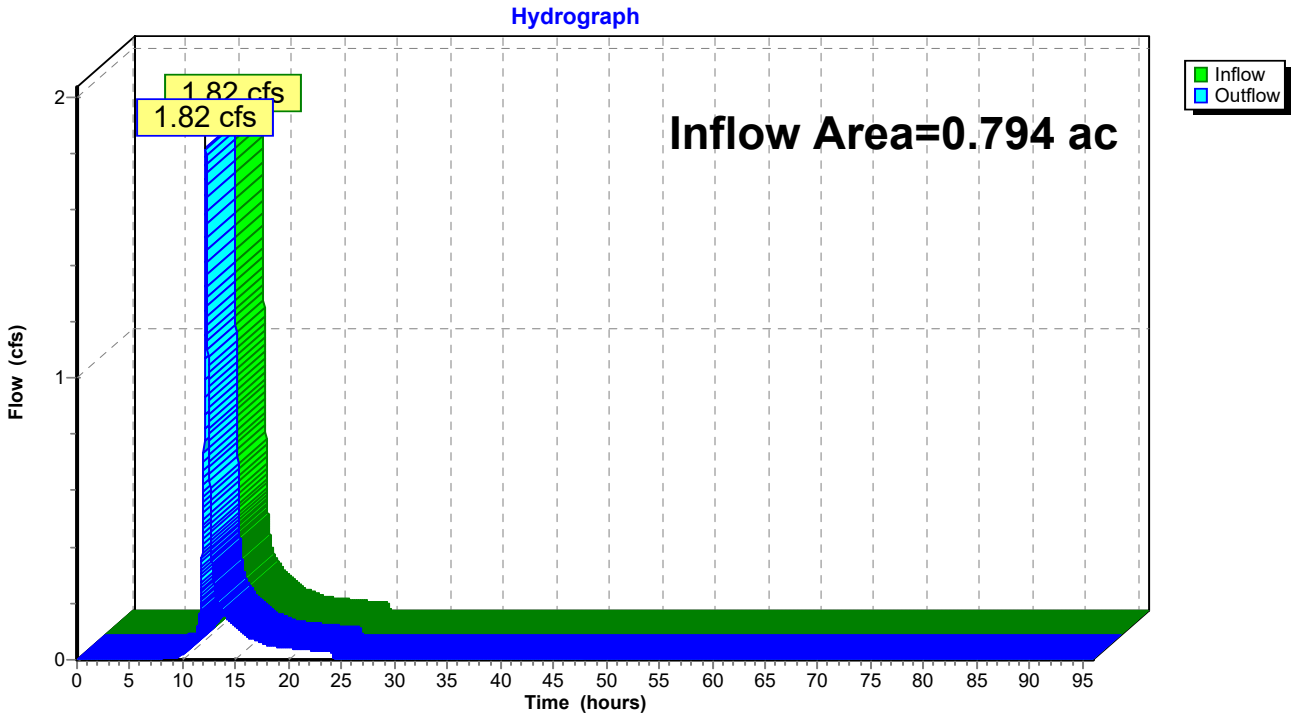
Summary for Reach 3R: (Outlet West)

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.794 ac, 0.00% Impervious, Inflow Depth = 2.41" for 10-Year event
Inflow = 1.82 cfs @ 12.17 hrs, Volume= 0.160 af
Outflow = 1.82 cfs @ 12.17 hrs, Volume= 0.160 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Reach 3R: (Outlet West)



Summary for Pond 1P: (Double 16" Culvert East)

Inflow Area = 1.845 ac, 5.64% Impervious, Inflow Depth = 2.67" for 10-Year event
Inflow = 4.29 cfs @ 12.21 hrs, Volume= 0.411 af
Outflow = 4.29 cfs @ 12.21 hrs, Volume= 0.411 af, Atten= 0%, Lag= 0.0 min
Primary = 4.29 cfs @ 12.21 hrs, Volume= 0.411 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Peak Elev= 147.71' @ 12.21 hrs Surf.Area= 20 sf Storage= 8 cf

Plug-Flow detention time= 0.0 min calculated for 0.411 af (100% of inflow)
Center-of-Mass det. time= 0.0 min (830.9 - 830.8)

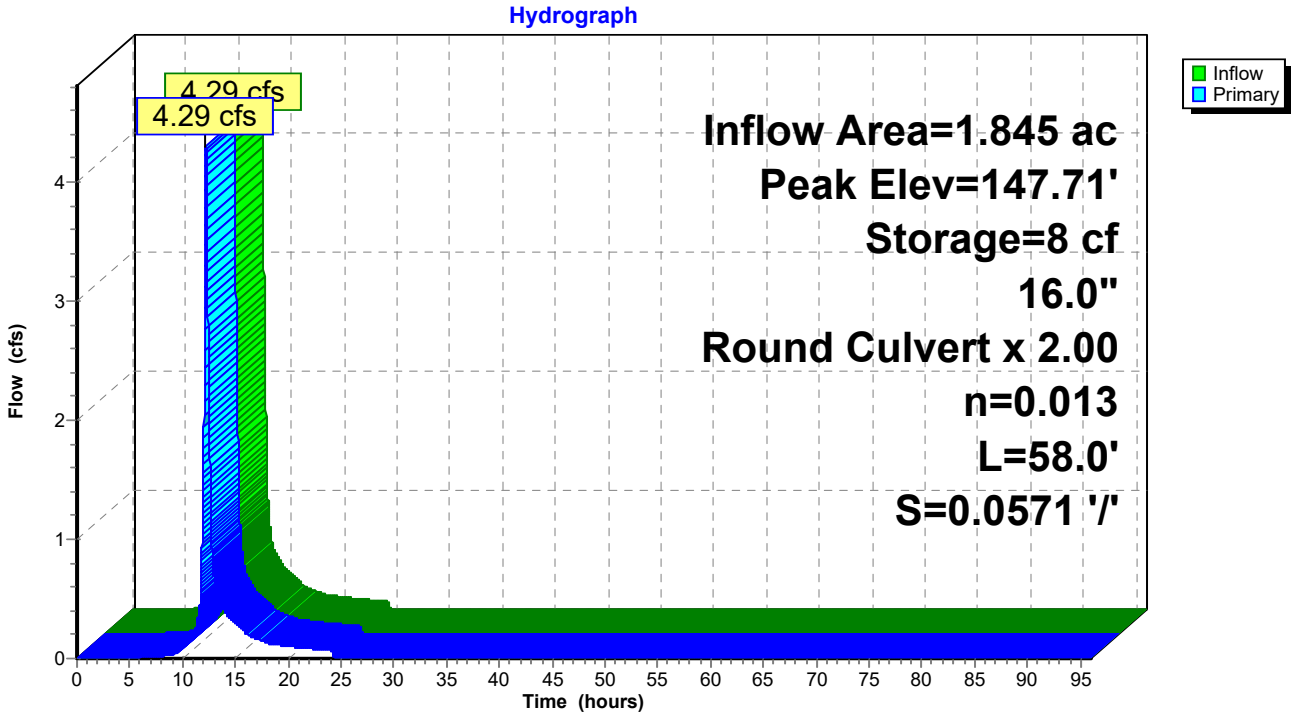
Volume	Invert	Avail.Storage	Storage Description
#1	146.90'	1,452 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
146.90	1	0	0
147.00	2	0	0
148.00	28	15	15
149.00	44	36	51
150.00	627	336	387
150.80	2,036	1,065	1,452

Device	Routing	Invert	Outlet Devices
#1	Primary	146.90'	**16.0" Round Culvert X 2.00** L= 58.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 146.90' / 143.59' S= 0.0571 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.40 sf

Primary OutFlow Max=4.29 cfs @ 12.21 hrs HW=147.71' TW=0.00' (Dynamic Tailwater)
└**1=Culvert** (Inlet Controls 4.29 cfs @ 2.42 fps)

Pond 1P: (Double 16" Culvert East)



Summary for Pond 2P: (18" RCP)

Inflow Area = 2.058 ac, 11.86% Impervious, Inflow Depth = 3.16" for 10-Year event
Inflow = 6.15 cfs @ 12.16 hrs, Volume= 0.541 af
Outflow = 6.15 cfs @ 12.16 hrs, Volume= 0.541 af, Atten= 0%, Lag= 0.0 min
Primary = 6.15 cfs @ 12.16 hrs, Volume= 0.541 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Peak Elev= 155.19' @ 12.16 hrs Surf.Area= 35 sf Storage= 9 cf

Plug-Flow detention time= 0.1 min calculated for 0.541 af (100% of inflow)
Center-of-Mass det. time= 0.0 min (812.8 - 812.8)

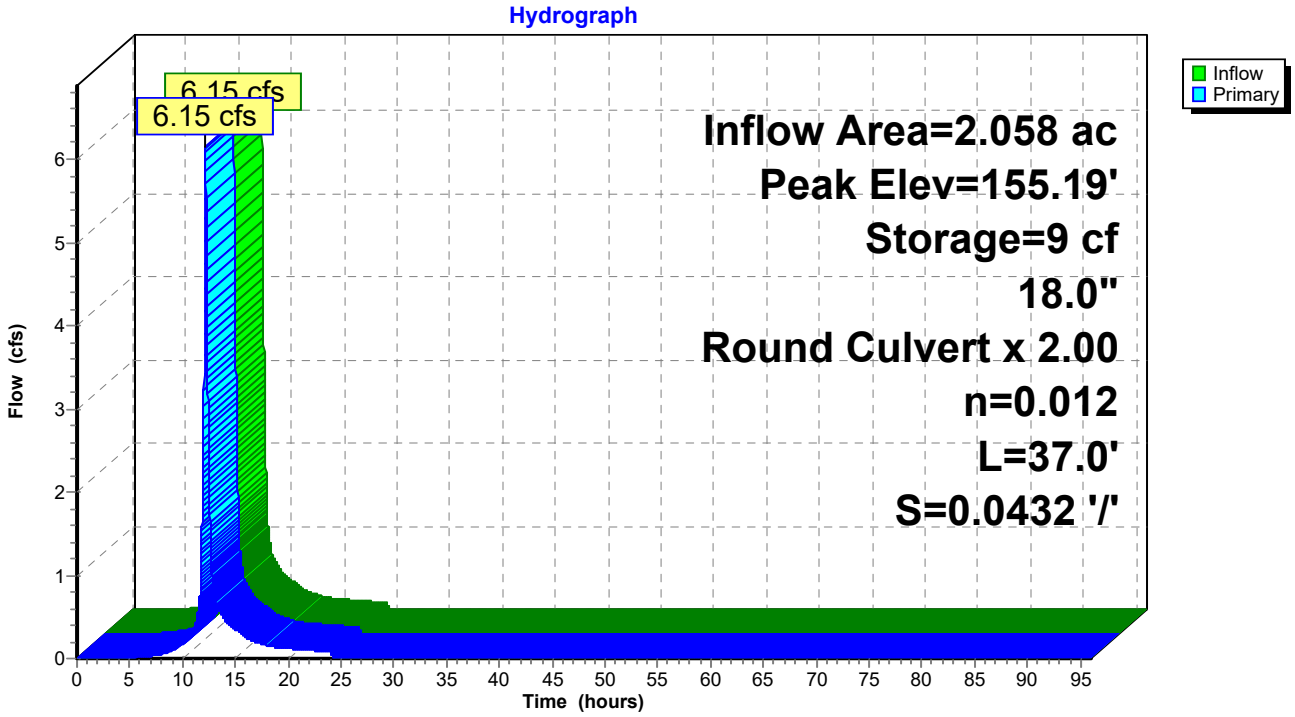
Volume	Invert	Avail.Storage	Storage Description
#1	154.40'	1,925 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
154.40	1	0	0
155.00	14	4	4
156.00	122	68	72
157.00	942	532	605
157.40	1,335	455	1,060
158.00	1,550	865	1,925

Device	Routing	Invert	Outlet Devices
#1	Primary	154.50'	**18.0" Round Culvert X 2.00** L= 37.0' RCP, rounded edge headwall, Ke= 0.100 Inlet / Outlet Invert= 154.50' / 152.90' S= 0.0432 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 1.77 sf

Primary OutFlow Max=6.15 cfs @ 12.16 hrs HW=155.19' TW=0.00' (Dynamic Tailwater)
└**1=Culvert** (Inlet Controls 6.15 cfs @ 3.86 fps)

Pond 2P: (18" RCP)

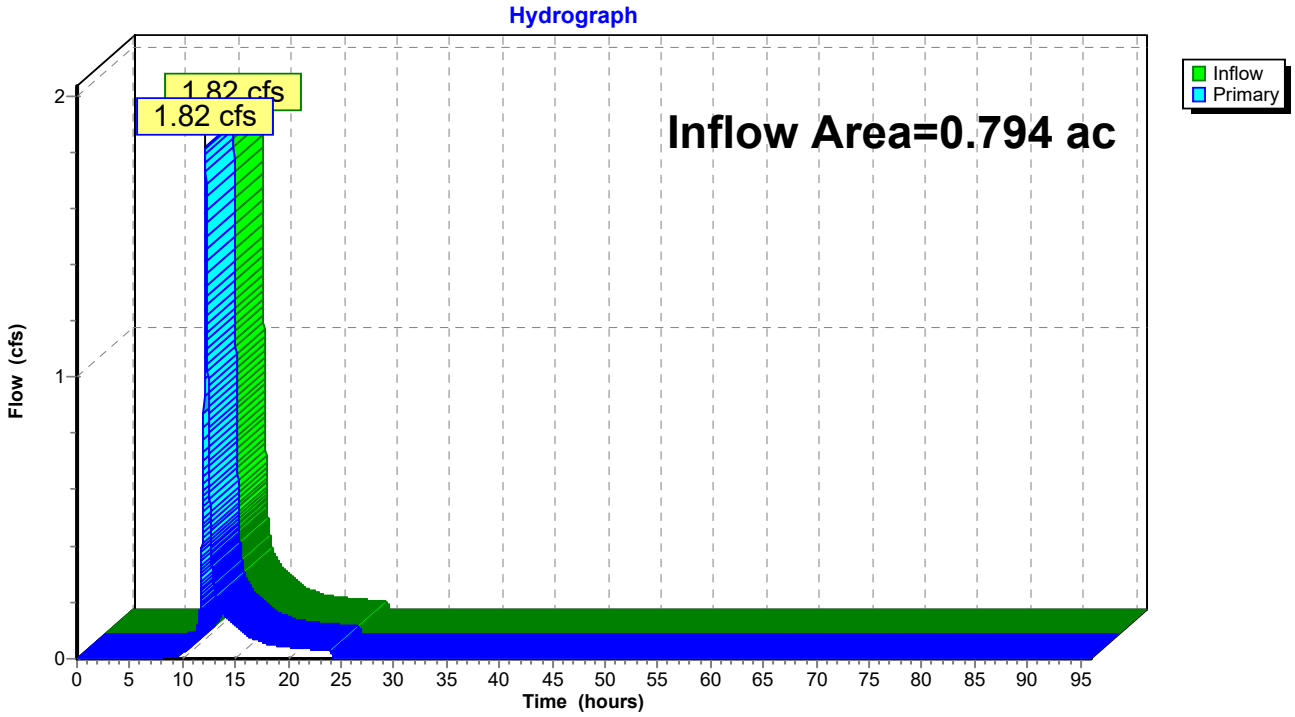


Summary for Link 3: Drainage Area 3

Inflow Area = 0.794 ac, 0.00% Impervious, Inflow Depth = 2.41" for 10-Year event
Inflow = 1.82 cfs @ 12.17 hrs, Volume= 0.160 af
Primary = 1.82 cfs @ 12.17 hrs, Volume= 0.160 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Link 3: Drainage Area 3

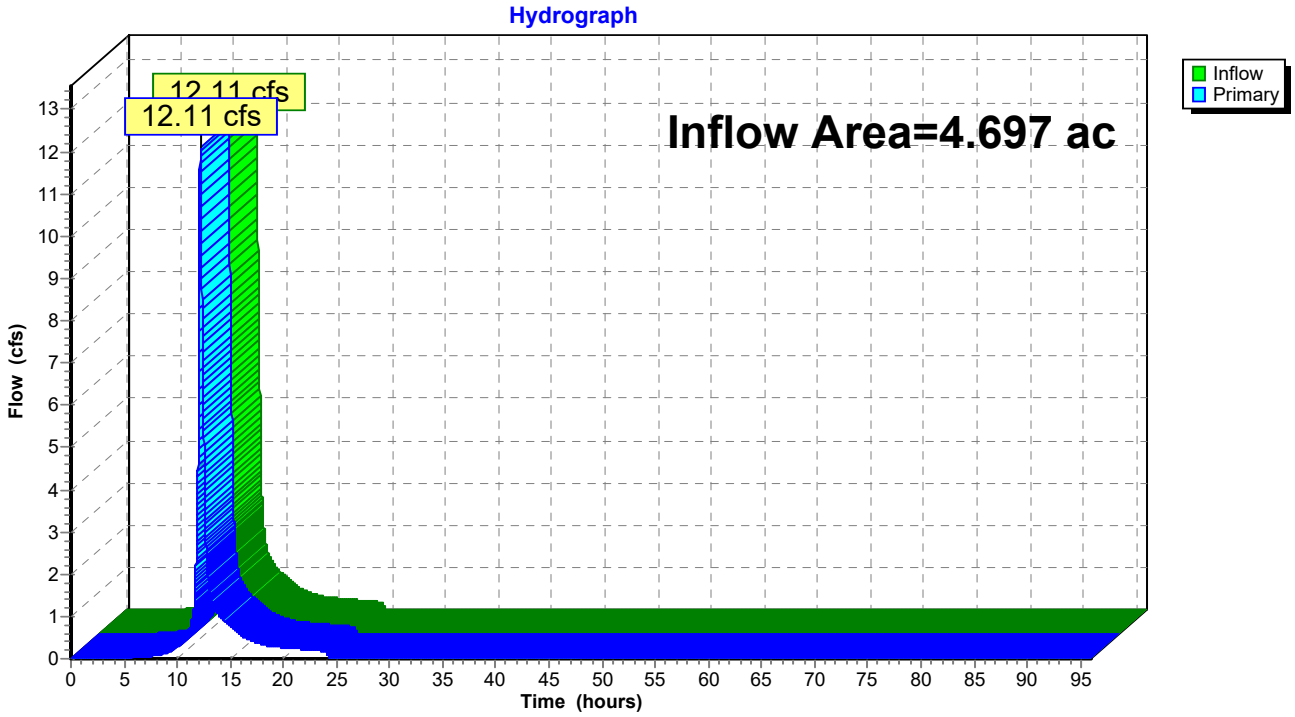


Summary for Link 5L: (Total Offsite Flows)

Inflow Area = 4.697 ac, 7.41% Impervious, Inflow Depth = 2.84" for 10-Year event
Inflow = 12.11 cfs @ 12.18 hrs, Volume= 1.112 af
Primary = 12.11 cfs @ 12.18 hrs, Volume= 1.112 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Link 5L: (Total Offsite Flows)



Time span=0.00-96.00 hrs, dt=0.01 hrs, 9601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1-I: 1 Impervious Runoff Area=0.329 ac 31.61% Impervious Runoff Depth=5.16"
Flow Length=561' Tc=15.0 min CN=92 Runoff=1.42 cfs 0.141 af

Subcatchment 1-P: 1 Pervious Runoff Area=1.516 ac 0.00% Impervious Runoff Depth=3.26"
Tc=15.0 min CN=74 Runoff=4.38 cfs 0.412 af

Subcatchment 2-I: 2 Impervious Runoff Area=1.078 ac 22.63% Impervious Runoff Depth=4.93"
Flow Length=398' Tc=11.8 min UI Adjusted CN=90 Runoff=4.93 cfs 0.443 af

Subcatchment 2-P: 2 Pervious Runoff Area=0.980 ac 0.00% Impervious Runoff Depth=3.26"
Flow Length=398' Tc=11.8 min CN=74 Runoff=3.09 cfs 0.266 af

Subcatchment 3-I: 3 Impervious Runoff Area=0.070 ac 0.00% Impervious Runoff Depth=4.82"
Flow Length=484' Tc=12.1 min CN=89 Runoff=0.31 cfs 0.028 af

Subcatchment 3-P: 3 Pervious Runoff Area=0.724 ac 0.00% Impervious Runoff Depth=3.16"
Flow Length=484' Tc=12.1 min CN=73 Runoff=2.20 cfs 0.191 af

Reach 1R: (Outlet East) Inflow=5.80 cfs 0.553 af
Outflow=5.80 cfs 0.553 af

Reach 2R: (Outlet North) Inflow=8.02 cfs 0.709 af
Outflow=8.02 cfs 0.709 af

Reach 3R: (Outlet West) Inflow=2.51 cfs 0.219 af
Outflow=2.51 cfs 0.219 af

Pond 1P: (Double 16" Culvert East) Peak Elev=147.87' Storage=12 cf Inflow=5.80 cfs 0.553 af
16.0" Round Culvert x 2.00 n=0.013 L=58.0' S=0.0571 '/' Outflow=5.80 cfs 0.553 af

Pond 2P: (18" RCP) Peak Elev=155.30' Storage=14 cf Inflow=8.02 cfs 0.709 af
18.0" Round Culvert x 2.00 n=0.012 L=37.0' S=0.0432 '/' Outflow=8.02 cfs 0.709 af

Link 3: Drainage Area 3 Inflow=2.51 cfs 0.219 af
Primary=2.51 cfs 0.219 af

Link 5L: (Total Offsite Flows) Inflow=16.13 cfs 1.482 af
Primary=16.13 cfs 1.482 af

Total Runoff Area = 4.697 ac Runoff Volume = 1.482 af Average Runoff Depth = 3.79"
92.59% Pervious = 4.349 ac 7.41% Impervious = 0.348 ac

Summary for Subcatchment 1-I: 1 Impervious

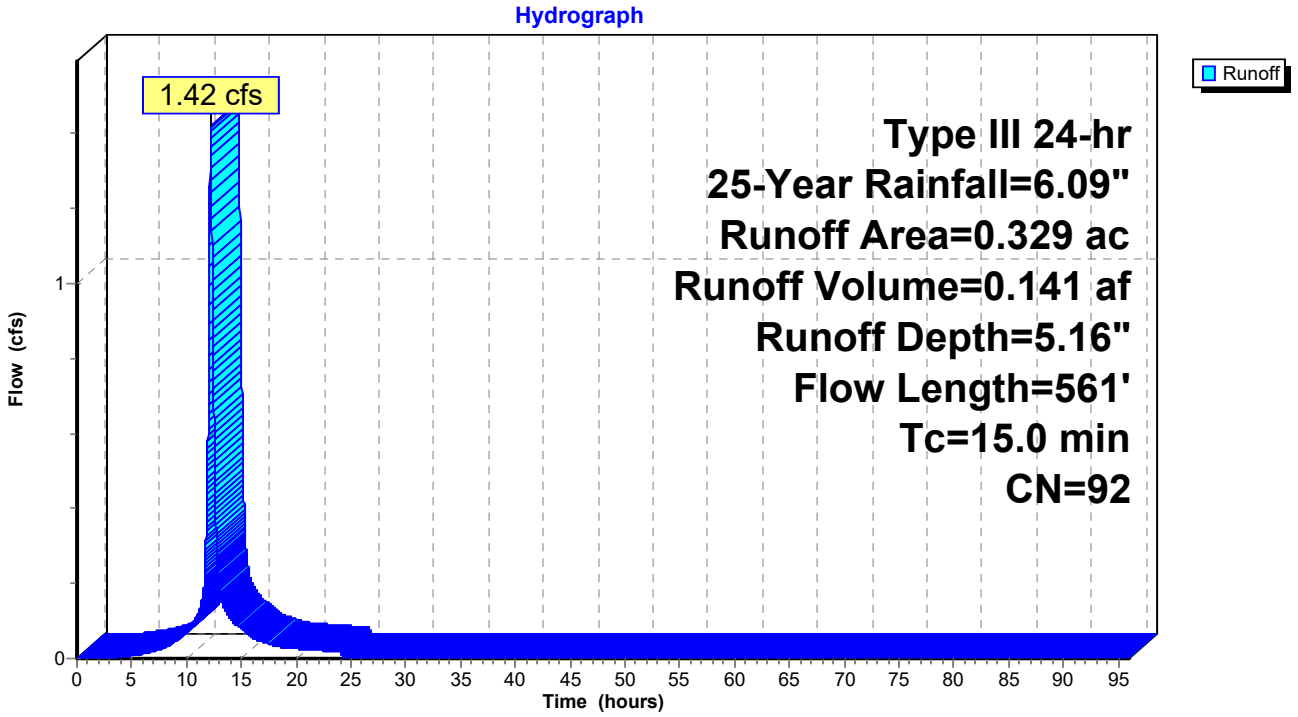
Runoff = 1.42 cfs @ 12.20 hrs, Volume= 0.141 af, Depth= 5.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.09"

	Area (ac)	CN	Description
*	0.225	89	Gravel
	0.102	98	Unconnected pavement, HSG C
	0.002	98	Unconnected roofs, HSG C
	0.329	92	Weighted Average
	0.225		68.39% Pervious Area
	0.104		31.61% Impervious Area
	0.104		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.6	40	0.1180	0.08		**Sheet Flow, SF1** Woods: Dense underbrush n= 0.800 P2= 3.38"
2.4	22	0.0818	0.16		**Sheet Flow, SF2** Grass: Dense n= 0.240 P2= 3.38"
0.3	38	0.0789	2.02		**Sheet Flow, SF2** Smooth surfaces n= 0.011 P2= 3.38"
0.3	74	0.0527	3.70		**Shallow Concentrated Flow, SCF1** Unpaved Kv= 16.1 fps
3.3	320	0.0424	1.61	1.61	**Channel Flow, CF1** Area= 1.0 sf Perim= 12.6' r= 0.08' n= 0.035 Earth, dense weeds
0.1	67	0.0776	16.58	23.16	**Pipe Channel,** 16.0" Round Area= 1.4 sf Perim= 4.2' r= 0.33' n= 0.012
15.0	561	Total			

Subcatchment 1-I: 1 Impervious



Summary for Subcatchment 1-P: 1 Pervious

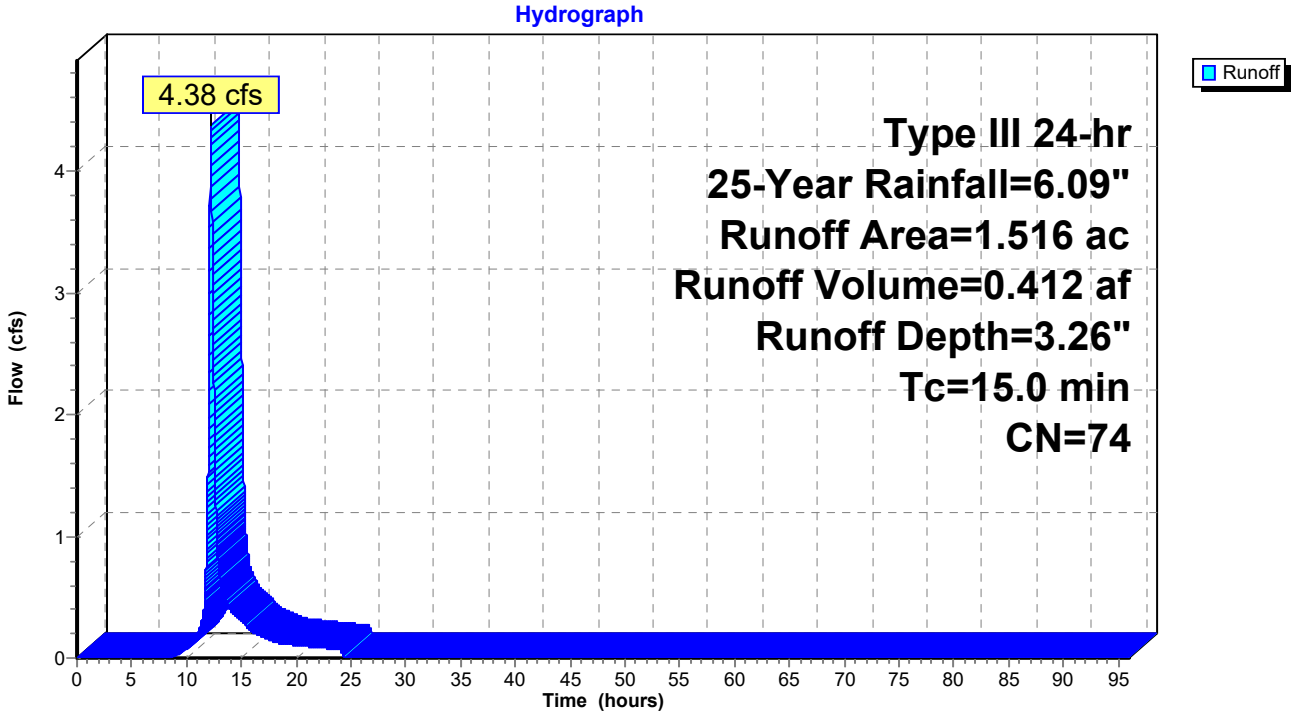
Runoff = 4.38 cfs @ 12.21 hrs, Volume= 0.412 af, Depth= 3.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.09"

Area (ac)	CN	Description
0.044	72	Woods/grass comb., Good, HSG C
1.472	74	>75% Grass cover, Good, HSG C
1.516	74	Weighted Average
1.516		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.0					**Direct Entry, Same as 1-I**

Subcatchment 1-P: 1 Pervious



Summary for Subcatchment 2-I: 2 Impervious

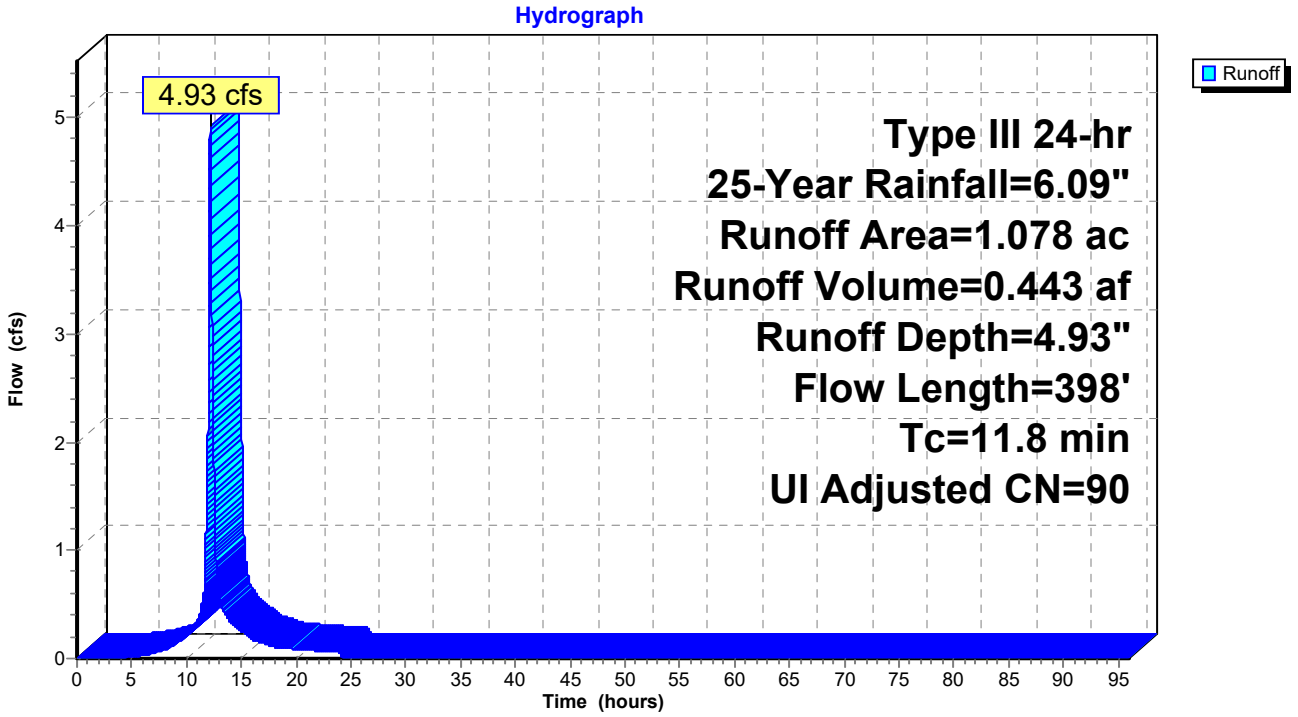
Runoff = 4.93 cfs @ 12.16 hrs, Volume= 0.443 af, Depth= 4.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.09"

Area (ac)	CN	Adj	Description
0.834	89		Gravel roads, HSG C
0.135	98		Unconnected pavement, HSG C
0.109	98		Unconnected roofs, HSG C
1.078	91	90	Weighted Average, UI Adjusted
0.834			77.37% Pervious Area
0.244			22.63% Impervious Area
0.244			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	48	0.0875	0.12		**Sheet Flow, SF1** Woods: Light underbrush n= 0.400 P2= 3.38"
3.5	52	0.0673	0.25		**Sheet Flow, SF2** Grass: Short n= 0.150 P2= 3.38"
0.2	21	0.0714	1.87		**Shallow Concentrated Flow, Short Grass Pasture C-2** Short Grass Pasture Kv= 7.0 fps
0.2	69	0.0841	4.67		**Shallow Concentrated Flow, Unpaved C-3** Unpaved Kv= 16.1 fps
0.1	30	0.2467	3.48		**Shallow Concentrated Flow, Short Grass Pasture C-4** Short Grass Pasture Kv= 7.0 fps
0.9	103	0.0136	1.88		**Shallow Concentrated Flow, Unpaved C-5** Unpaved Kv= 16.1 fps
0.4	17	0.0118	0.76		**Shallow Concentrated Flow, Short Grass Pasture C-6** Short Grass Pasture Kv= 7.0 fps
0.1	58	0.0517	11.51	74.82	**Parabolic Channel, Earth, clean & straight C-7** W=9.75' D=1.00' Area=6.5 sf Perim=10.0' n= 0.022 Earth, clean & straight
11.8	398	Total			

Subcatchment 2-I: 2 Impervious



Summary for Subcatchment 2-P: 2 Pervious

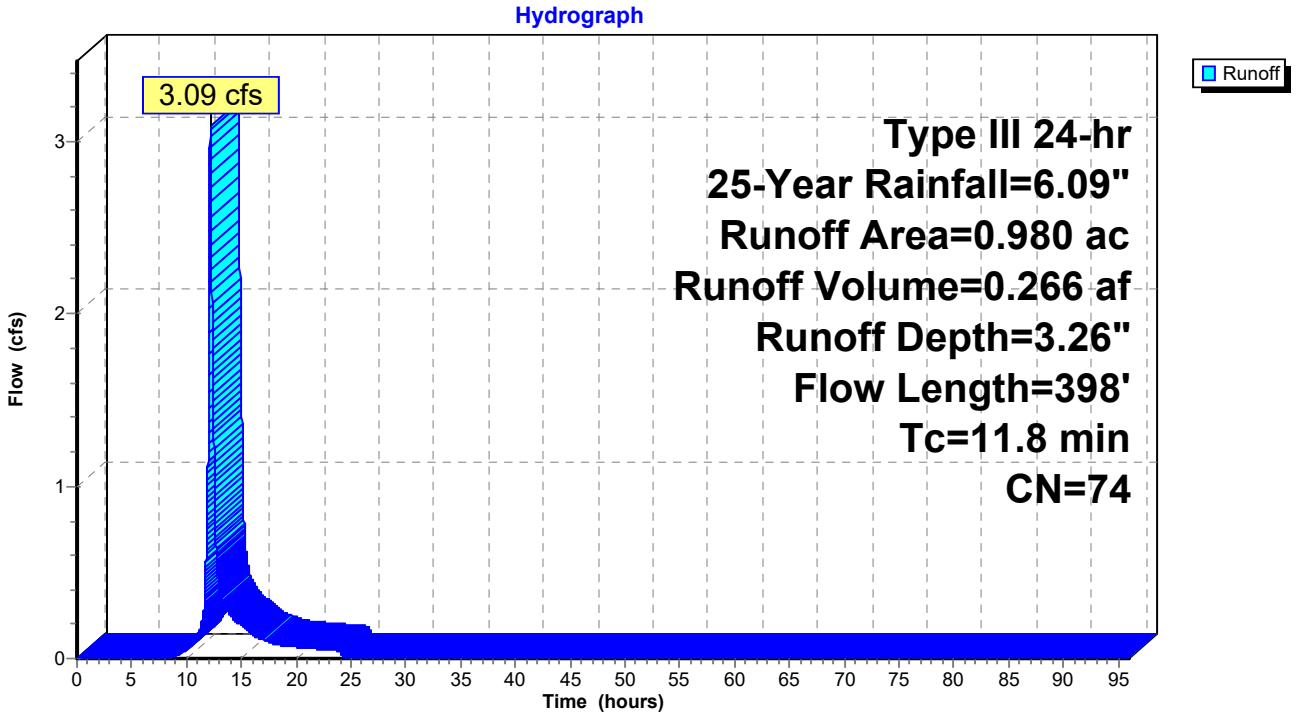
Runoff = 3.09 cfs @ 12.16 hrs, Volume= 0.266 af, Depth= 3.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.09"

Area (ac)	CN	Description
0.837	74	>75% Grass cover, Good, HSG C
0.143	72	Woods/grass comb., Good, HSG C
0.980	74	Weighted Average
0.980		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	48	0.0875	0.12		**Sheet Flow, SF1** Woods: Light underbrush n= 0.400 P2= 3.38"
3.5	52	0.0673	0.25		**Sheet Flow, SF2** Grass: Short n= 0.150 P2= 3.38"
0.2	21	0.0714	1.87		**Shallow Concentrated Flow, Short Grass Pasture C-2** Short Grass Pasture Kv= 7.0 fps
0.2	69	0.0841	4.67		**Shallow Concentrated Flow, Unpaved C-3** Unpaved Kv= 16.1 fps
0.1	30	0.2467	3.48		**Shallow Concentrated Flow, Short Grass Pasture C-4** Short Grass Pasture Kv= 7.0 fps
0.9	103	0.0136	1.88		**Shallow Concentrated Flow, Unpaved C-5** Unpaved Kv= 16.1 fps
0.4	17	0.0118	0.76		**Shallow Concentrated Flow, Short Grass Pasture C-6** Short Grass Pasture Kv= 7.0 fps
0.1	58	0.0517	11.51	74.82	**Parabolic Channel, Earth, clean & straight C-7** W=9.75' D=1.00' Area=6.5 sf Perim=10.0' n= 0.022 Earth, clean & straight
11.8	398	Total			

Subcatchment 2-P: 2 Pervious



Summary for Subcatchment 3-I: 3 Impervious

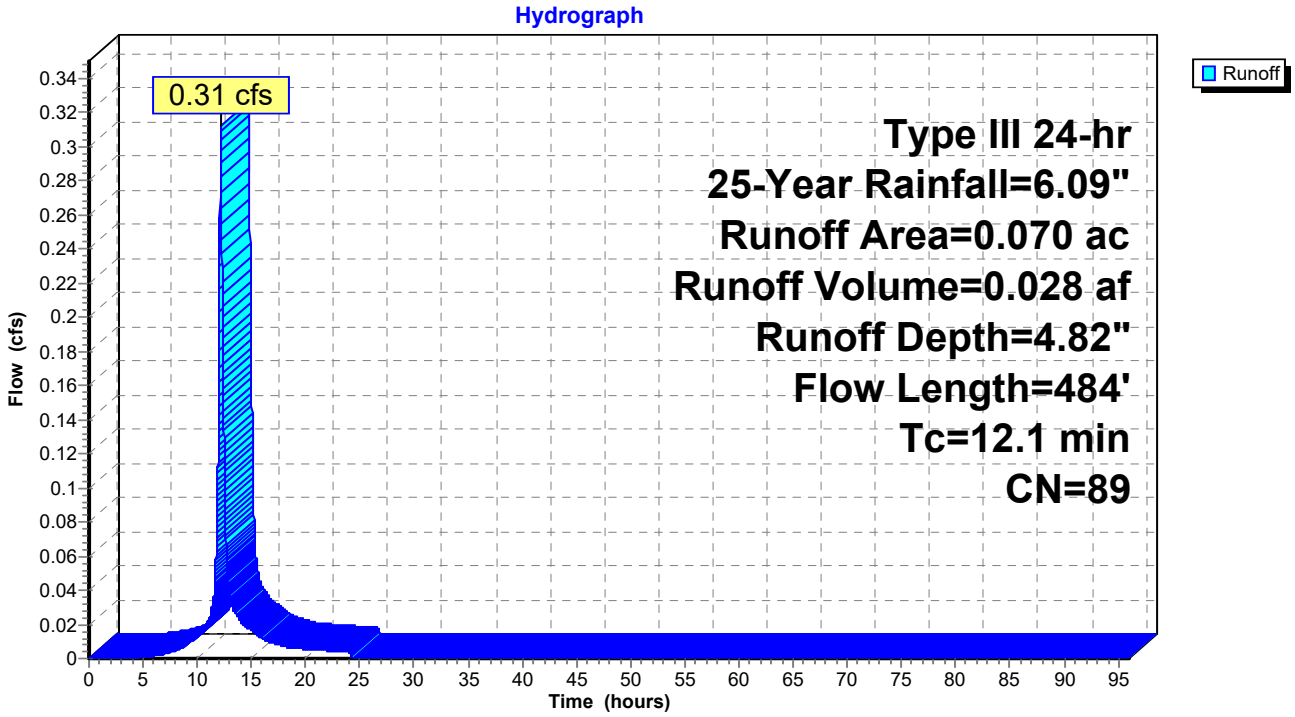
Runoff = 0.31 cfs @ 12.16 hrs, Volume= 0.028 af, Depth= 4.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.09"

Area (ac)	CN	Description
0.070	89	Gravel roads, HSG C
0.000	98	Unconnected pavement, HSG C
0.070	89	Weighted Average
0.070		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0	56	0.0964	0.13		**Sheet Flow, SF1** Woods: Light underbrush n= 0.400 P2= 3.38"
3.0	41	0.0610	0.23		**Sheet Flow, SF2** Grass: Short n= 0.150 P2= 3.38"
0.5	47	0.0617	1.74		**Shallow Concentrated Flow, Short Grass Pasture C-2** Short Grass Pasture Kv= 7.0 fps
0.2	53	0.0868	4.74		**Shallow Concentrated Flow, Unpaved C-3** Unpaved Kv= 16.1 fps
0.6	55	0.0436	1.46		**Shallow Concentrated Flow, Short Grass Pasture C-4** Short Grass Pasture Kv= 7.0 fps
0.7	189	0.0111	4.81	10.88	**Parabolic Channel, Earth, cobble bottom, clean sides C-5** W=3.39' D=1.00' Area=2.3 sf Perim=4.1' n= 0.022 Earth, clean & straight
0.1	43	0.0209	7.10	5.58	**Pipe Channel, RCP_Round 12" C-6** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012
12.1	484	Total			

Subcatchment 3-I: 3 Impervious



Summary for Subcatchment 3-P: 3 Pervious

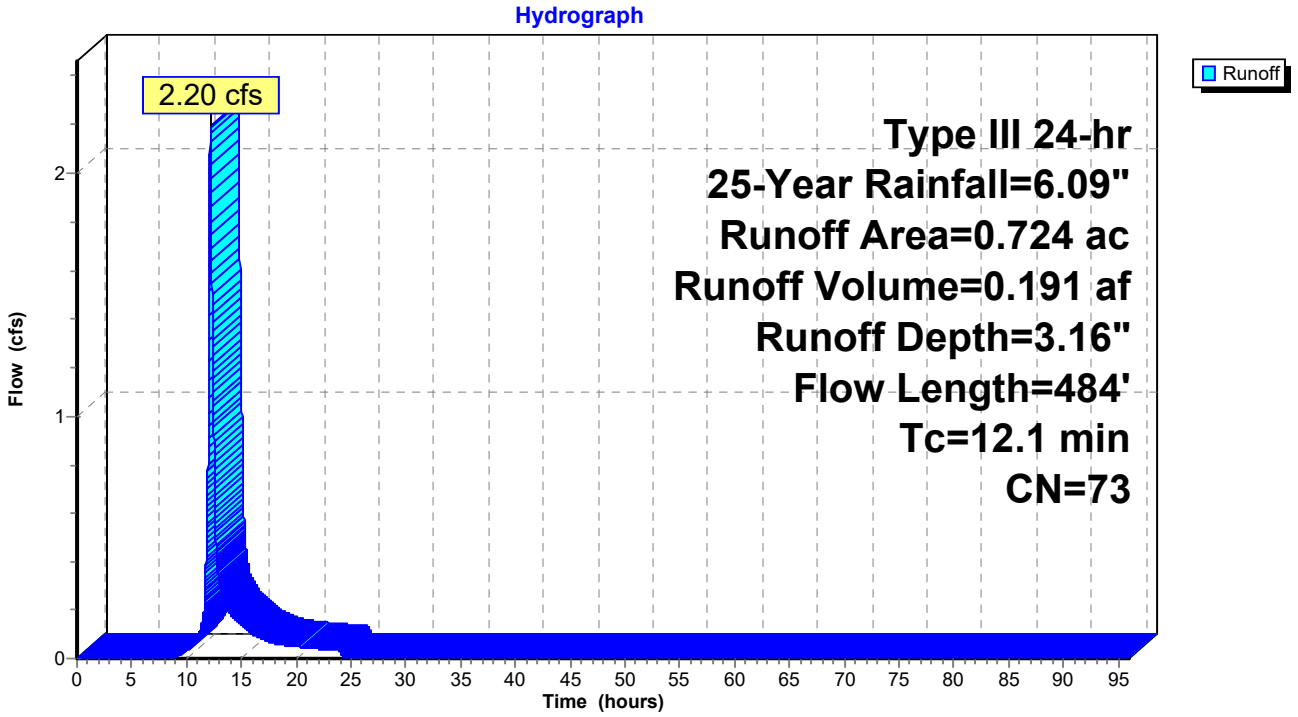
Runoff = 2.20 cfs @ 12.17 hrs, Volume= 0.191 af, Depth= 3.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.09"

Area (ac)	CN	Description
0.441	74	>75% Grass cover, Good, HSG C
0.283	72	Woods/grass comb., Good, HSG C
0.724	73	Weighted Average
0.724		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0	56	0.0964	0.13		**Sheet Flow, SF1** Woods: Light underbrush n= 0.400 P2= 3.38"
3.0	41	0.0610	0.23		**Sheet Flow, SF2** Grass: Short n= 0.150 P2= 3.38"
0.5	47	0.0617	1.74		**Shallow Concentrated Flow, Short Grass Pasture C-2** Short Grass Pasture Kv= 7.0 fps
0.2	53	0.0868	4.74		**Shallow Concentrated Flow, Unpaved C-3** Unpaved Kv= 16.1 fps
0.6	55	0.0436	1.46		**Shallow Concentrated Flow, Short Grass Pasture C-4** Short Grass Pasture Kv= 7.0 fps
0.7	189	0.0111	4.81	10.88	**Parabolic Channel, Earth, clean & straight C-5** W=3.39' D=1.00' Area=2.3 sf Perim=4.1' n= 0.022 Earth, clean & straight
0.1	43	0.0281	8.24	6.47	**Pipe Channel, RCP_Round 12" C-6** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012
12.1	484	Total			

Subcatchment 3-P: 3 Pervious



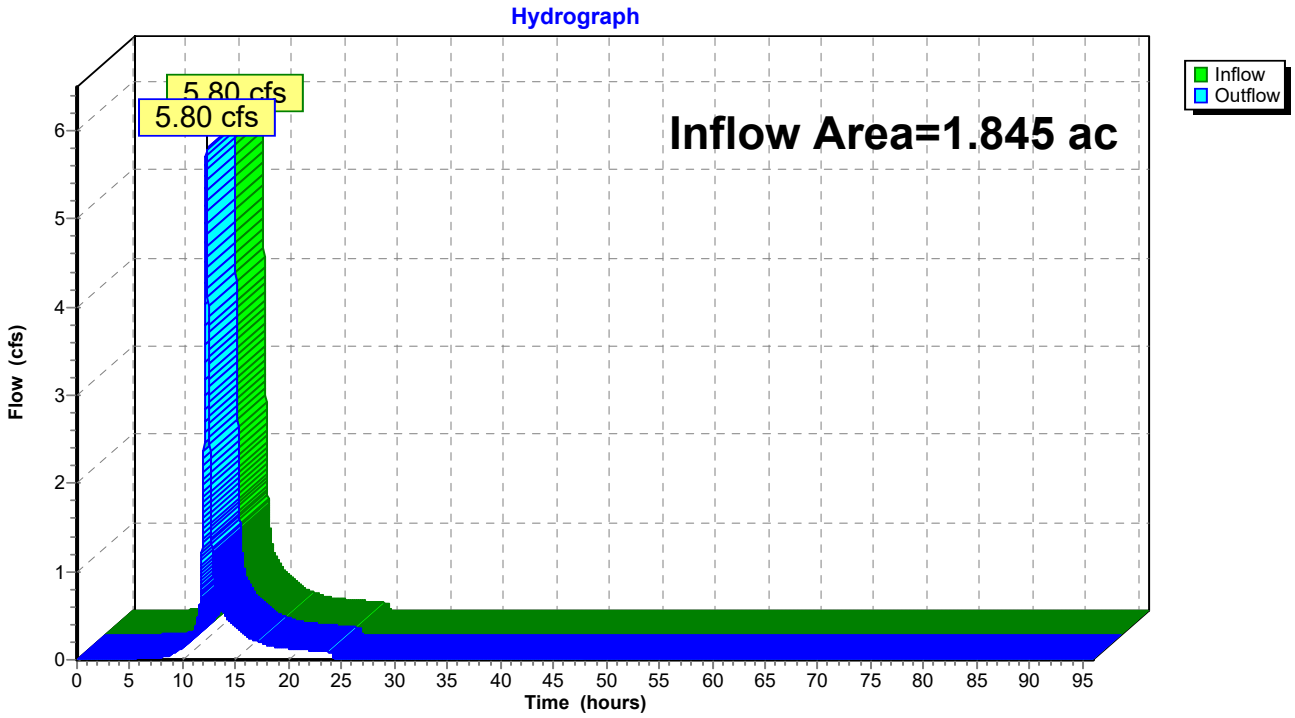
Summary for Reach 1R: (Outlet East)

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 1.845 ac, 5.64% Impervious, Inflow Depth = 3.60" for 25-Year event
Inflow = 5.80 cfs @ 12.21 hrs, Volume= 0.553 af
Outflow = 5.80 cfs @ 12.21 hrs, Volume= 0.553 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Reach 1R: (Outlet East)



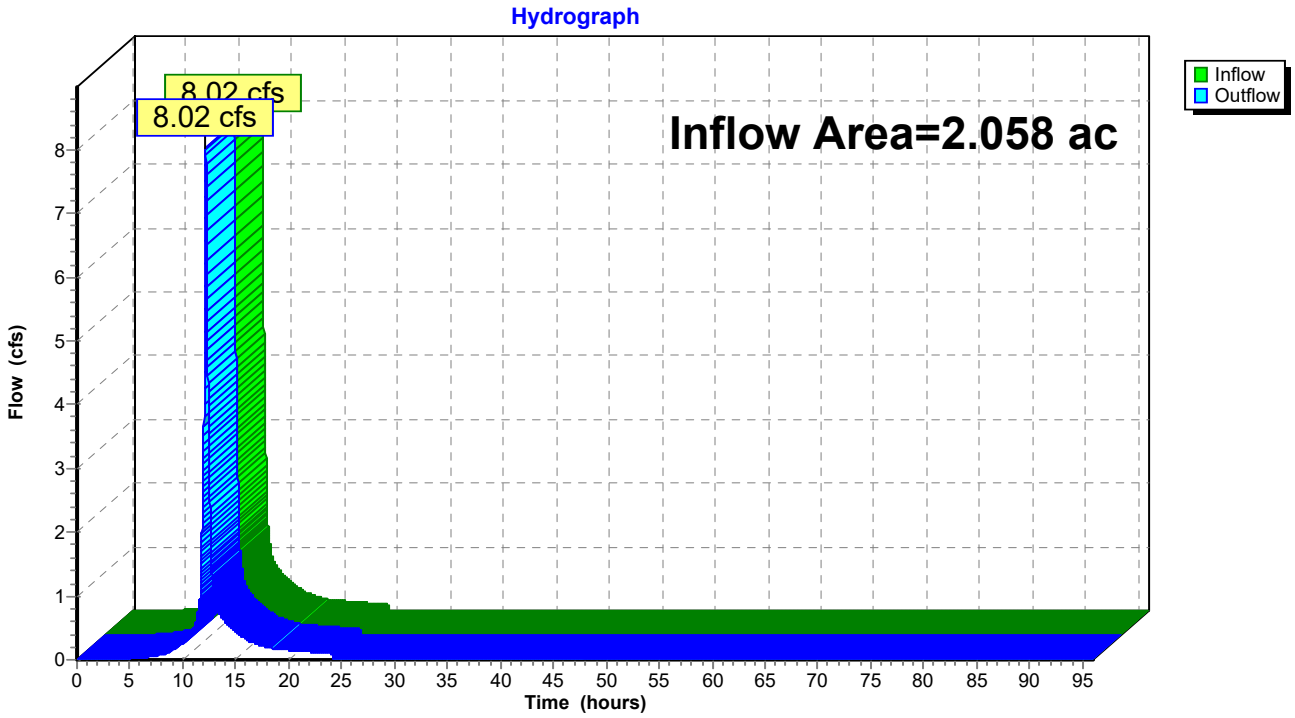
Summary for Reach 2R: (Outlet North)

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.058 ac, 11.86% Impervious, Inflow Depth = 4.14" for 25-Year event
Inflow = 8.02 cfs @ 12.16 hrs, Volume= 0.709 af
Outflow = 8.02 cfs @ 12.16 hrs, Volume= 0.709 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Reach 2R: (Outlet North)



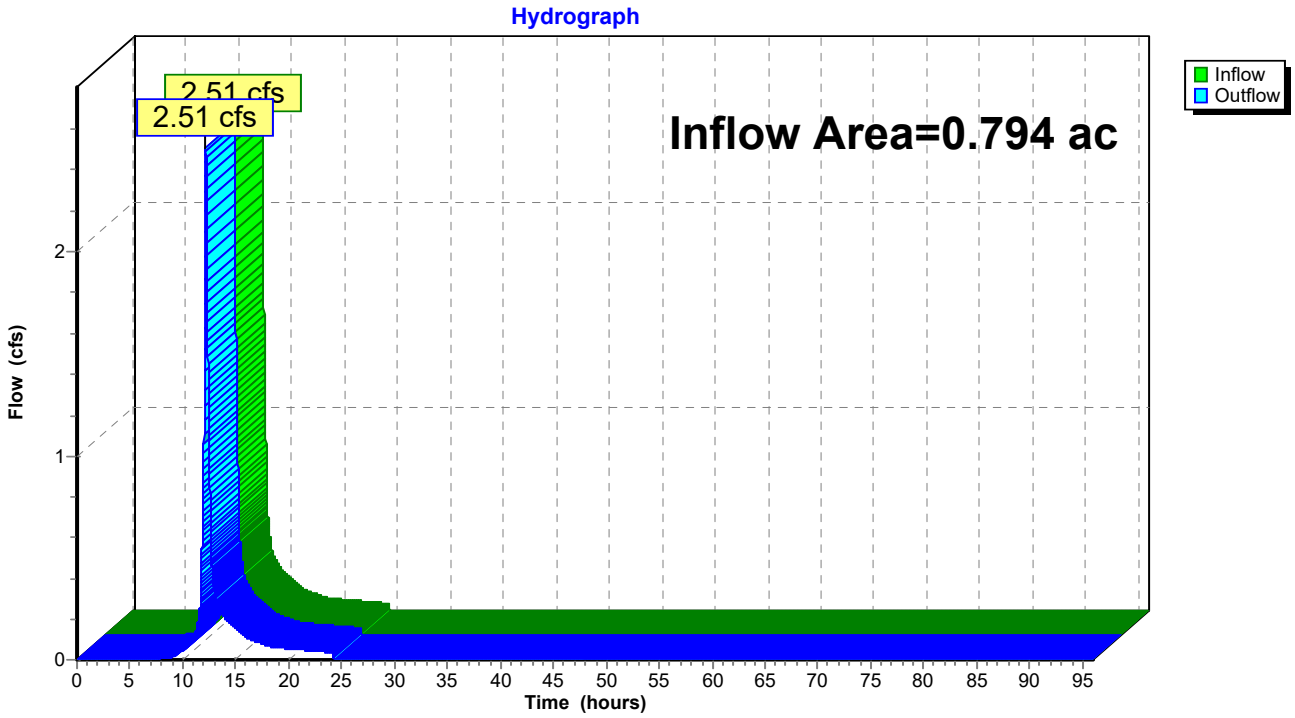
Summary for Reach 3R: (Outlet West)

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.794 ac, 0.00% Impervious, Inflow Depth = 3.31" for 25-Year event
Inflow = 2.51 cfs @ 12.17 hrs, Volume= 0.219 af
Outflow = 2.51 cfs @ 12.17 hrs, Volume= 0.219 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Reach 3R: (Outlet West)



Summary for Pond 1P: (Double 16" Culvert East)

Inflow Area = 1.845 ac, 5.64% Impervious, Inflow Depth = 3.60" for 25-Year event
Inflow = 5.80 cfs @ 12.21 hrs, Volume= 0.553 af
Outflow = 5.80 cfs @ 12.21 hrs, Volume= 0.553 af, Atten= 0%, Lag= 0.0 min
Primary = 5.80 cfs @ 12.21 hrs, Volume= 0.553 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Peak Elev= 147.87' @ 12.21 hrs Surf.Area= 25 sf Storage= 12 cf

Plug-Flow detention time= 0.0 min calculated for 0.553 af (100% of inflow)
Center-of-Mass det. time= 0.0 min (823.4 - 823.3)

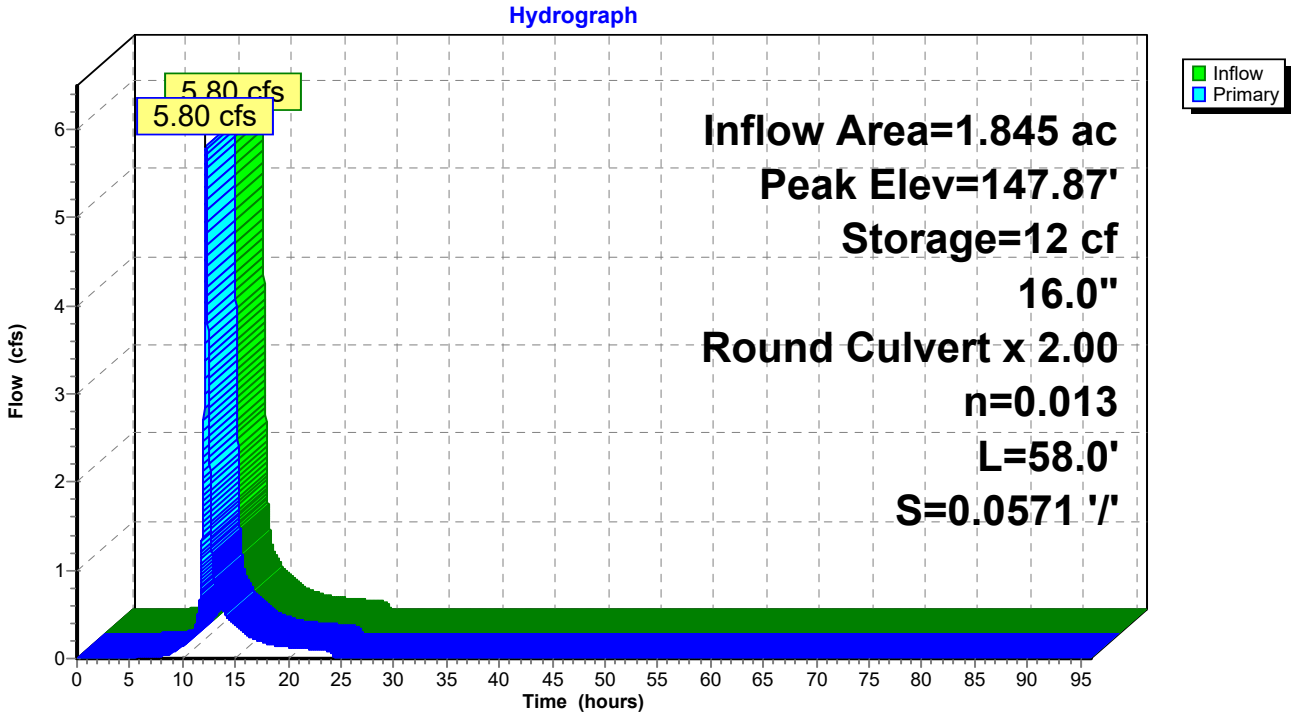
Volume	Invert	Avail.Storage	Storage Description
#1	146.90'	1,452 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
146.90	1	0	0
147.00	2	0	0
148.00	28	15	15
149.00	44	36	51
150.00	627	336	387
150.80	2,036	1,065	1,452

Device	Routing	Invert	Outlet Devices
#1	Primary	146.90'	**16.0" Round Culvert X 2.00** L= 58.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 146.90' / 143.59' S= 0.0571 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.40 sf

Primary OutFlow Max=5.80 cfs @ 12.21 hrs HW=147.87' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 5.80 cfs @ 2.65 fps)

Pond 1P: (Double 16" Culvert East)



Summary for Pond 2P: (18" RCP)

Inflow Area = 2.058 ac, 11.86% Impervious, Inflow Depth = 4.14" for 25-Year event
Inflow = 8.02 cfs @ 12.16 hrs, Volume= 0.709 af
Outflow = 8.02 cfs @ 12.16 hrs, Volume= 0.709 af, Atten= 0%, Lag= 0.0 min
Primary = 8.02 cfs @ 12.16 hrs, Volume= 0.709 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Peak Elev= 155.30' @ 12.16 hrs Surf.Area= 47 sf Storage= 14 cf

Plug-Flow detention time= 0.1 min calculated for 0.709 af (100% of inflow)
Center-of-Mass det. time= 0.0 min (806.1 - 806.1)

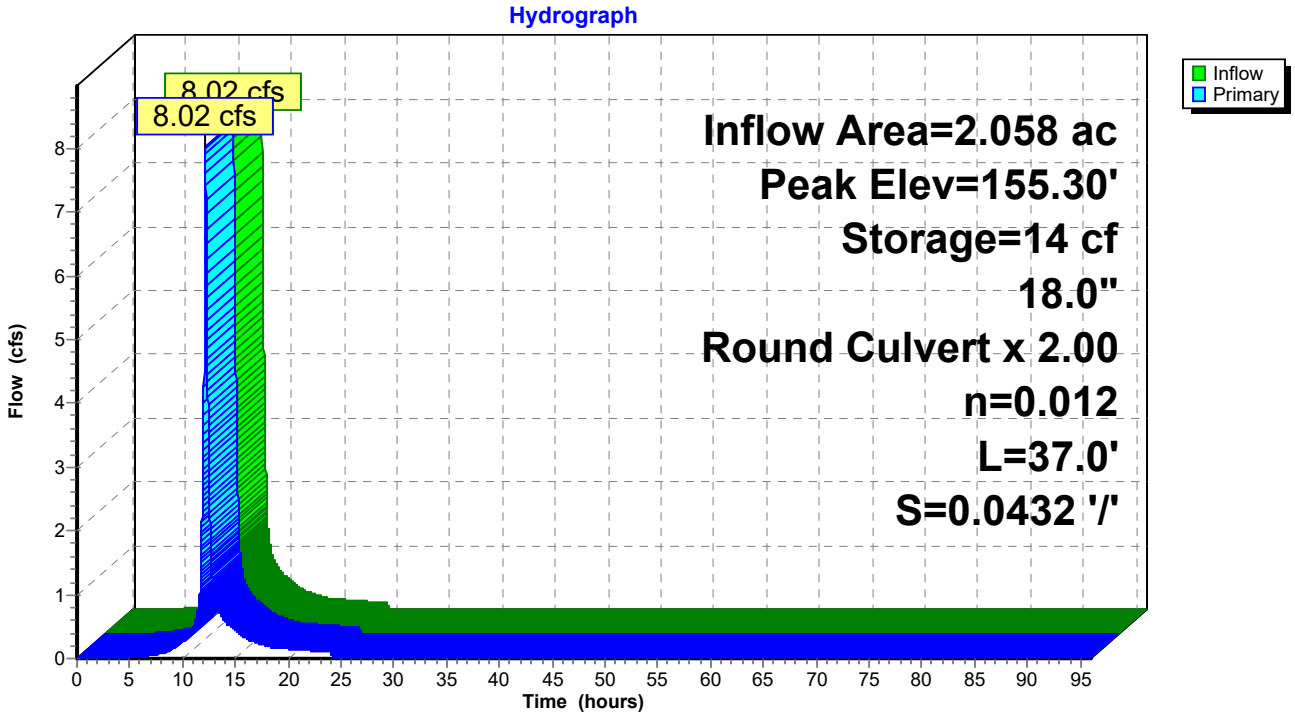
Volume	Invert	Avail.Storage	Storage Description
#1	154.40'	1,925 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
154.40	1	0	0
155.00	14	4	4
156.00	122	68	72
157.00	942	532	605
157.40	1,335	455	1,060
158.00	1,550	865	1,925

Device	Routing	Invert	Outlet Devices
#1	Primary	154.50'	**18.0" Round Culvert X 2.00** L= 37.0' RCP, rounded edge headwall, Ke= 0.100 Inlet / Outlet Invert= 154.50' / 152.90' S= 0.0432 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 1.77 sf

Primary OutFlow Max=8.02 cfs @ 12.16 hrs HW=155.30' TW=0.00' (Dynamic Tailwater)
└**1=Culvert** (Inlet Controls 8.02 cfs @ 4.16 fps)

Pond 2P: (18" RCP)

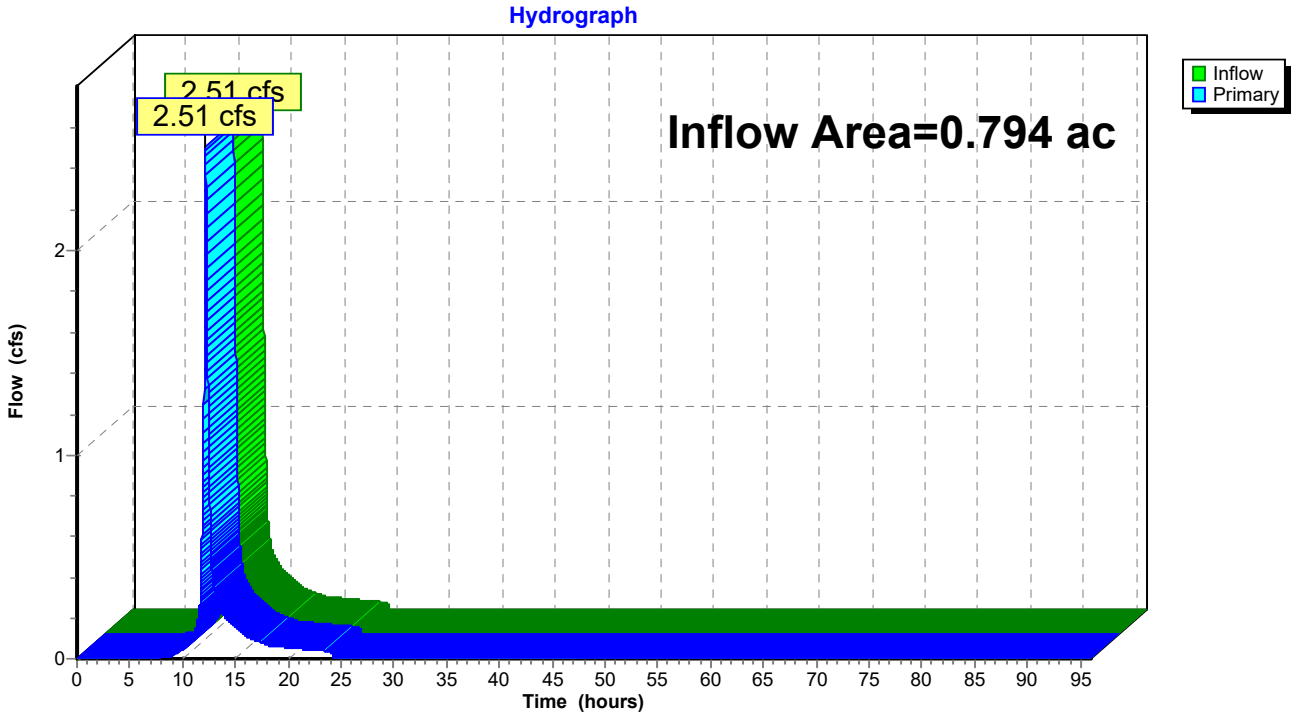


Summary for Link 3: Drainage Area 3

Inflow Area = 0.794 ac, 0.00% Impervious, Inflow Depth = 3.31" for 25-Year event
Inflow = 2.51 cfs @ 12.17 hrs, Volume= 0.219 af
Primary = 2.51 cfs @ 12.17 hrs, Volume= 0.219 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Link 3: Drainage Area 3

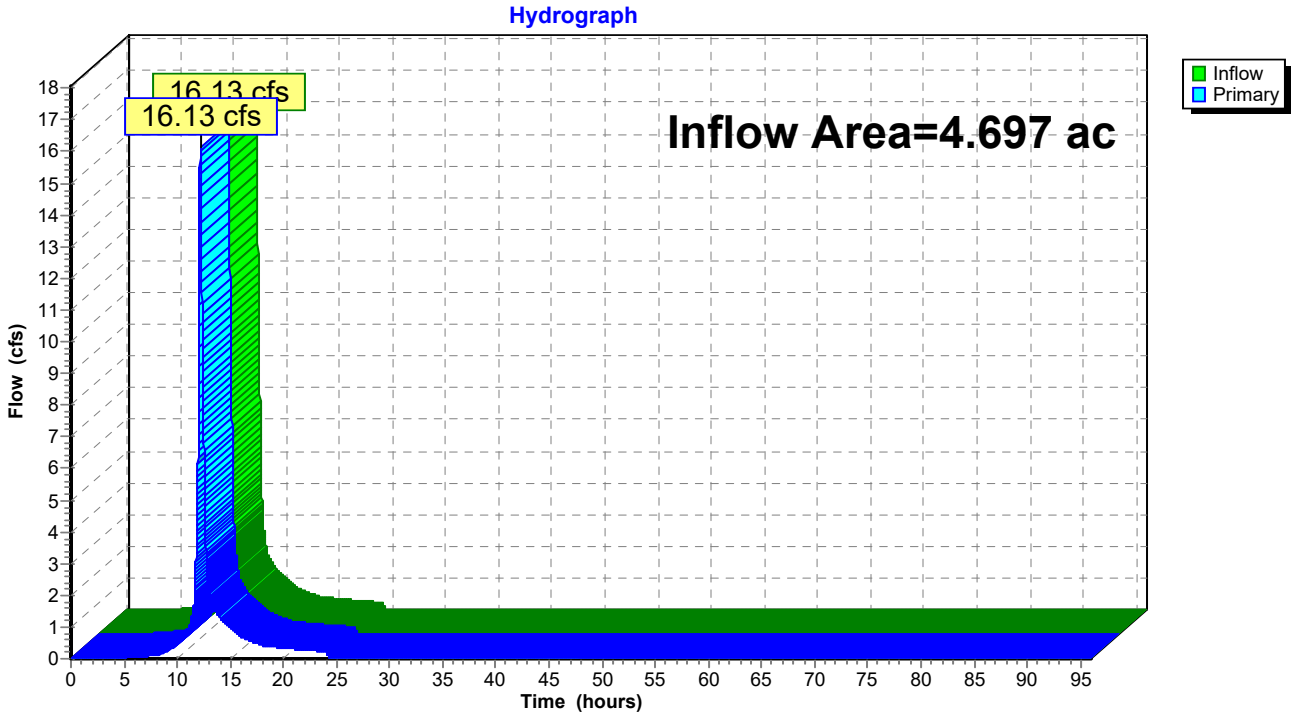


Summary for Link 5L: (Total Offsite Flows)

Inflow Area = 4.697 ac, 7.41% Impervious, Inflow Depth = 3.79" for 25-Year event
Inflow = 16.13 cfs @ 12.18 hrs, Volume= 1.482 af
Primary = 16.13 cfs @ 12.18 hrs, Volume= 1.482 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Link 5L: (Total Offsite Flows)



Time span=0.00-96.00 hrs, dt=0.01 hrs, 9601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1-I: 1 Impervious Runoff Area=0.329 ac 31.61% Impervious Runoff Depth=7.07"
Flow Length=561' Tc=15.0 min CN=92 Runoff=1.91 cfs 0.194 af

Subcatchment 1-P: 1 Pervious Runoff Area=1.516 ac 0.00% Impervious Runoff Depth=4.95"
Tc=15.0 min CN=74 Runoff=6.65 cfs 0.626 af

Subcatchment 2-I: 2 Impervious Runoff Area=1.078 ac 22.63% Impervious Runoff Depth=6.84"
Flow Length=398' Tc=11.8 min UI Adjusted CN=90 Runoff=6.71 cfs 0.614 af

Subcatchment 2-P: 2 Pervious Runoff Area=0.980 ac 0.00% Impervious Runoff Depth=4.95"
Flow Length=398' Tc=11.8 min CN=74 Runoff=4.70 cfs 0.404 af

Subcatchment 3-I: 3 Impervious Runoff Area=0.070 ac 0.00% Impervious Runoff Depth=6.72"
Flow Length=484' Tc=12.1 min CN=89 Runoff=0.43 cfs 0.039 af

Subcatchment 3-P: 3 Pervious Runoff Area=0.724 ac 0.00% Impervious Runoff Depth=4.84"
Flow Length=484' Tc=12.1 min CN=73 Runoff=3.36 cfs 0.292 af

Reach 1R: (Outlet East) Inflow=8.56 cfs 0.820 af
Outflow=8.56 cfs 0.820 af

Reach 2R: (Outlet North) Inflow=11.41 cfs 1.018 af
Outflow=11.41 cfs 1.018 af

Reach 3R: (Outlet West) Inflow=3.79 cfs 0.331 af
Outflow=3.79 cfs 0.331 af

Pond 1P: (Double 16" Culvert East) Peak Elev=148.21' Storage=21 cf Inflow=8.56 cfs 0.820 af
16.0" Round Culvert x 2.00 n=0.013 L=58.0' S=0.0571 '/' Outflow=8.56 cfs 0.820 af

Pond 2P: (18" RCP) Peak Elev=155.49' Storage=24 cf Inflow=11.41 cfs 1.018 af
18.0" Round Culvert x 2.00 n=0.012 L=37.0' S=0.0432 '/' Outflow=11.41 cfs 1.018 af

Link 3: Drainage Area 3 Inflow=3.79 cfs 0.331 af
Primary=3.79 cfs 0.331 af

Link 5L: (Total Offsite Flows) Inflow=23.47 cfs 2.169 af
Primary=23.47 cfs 2.169 af

Total Runoff Area = 4.697 ac Runoff Volume = 2.169 af Average Runoff Depth = 5.54"
92.59% Pervious = 4.349 ac 7.41% Impervious = 0.348 ac

Summary for Subcatchment 1-I: 1 Impervious

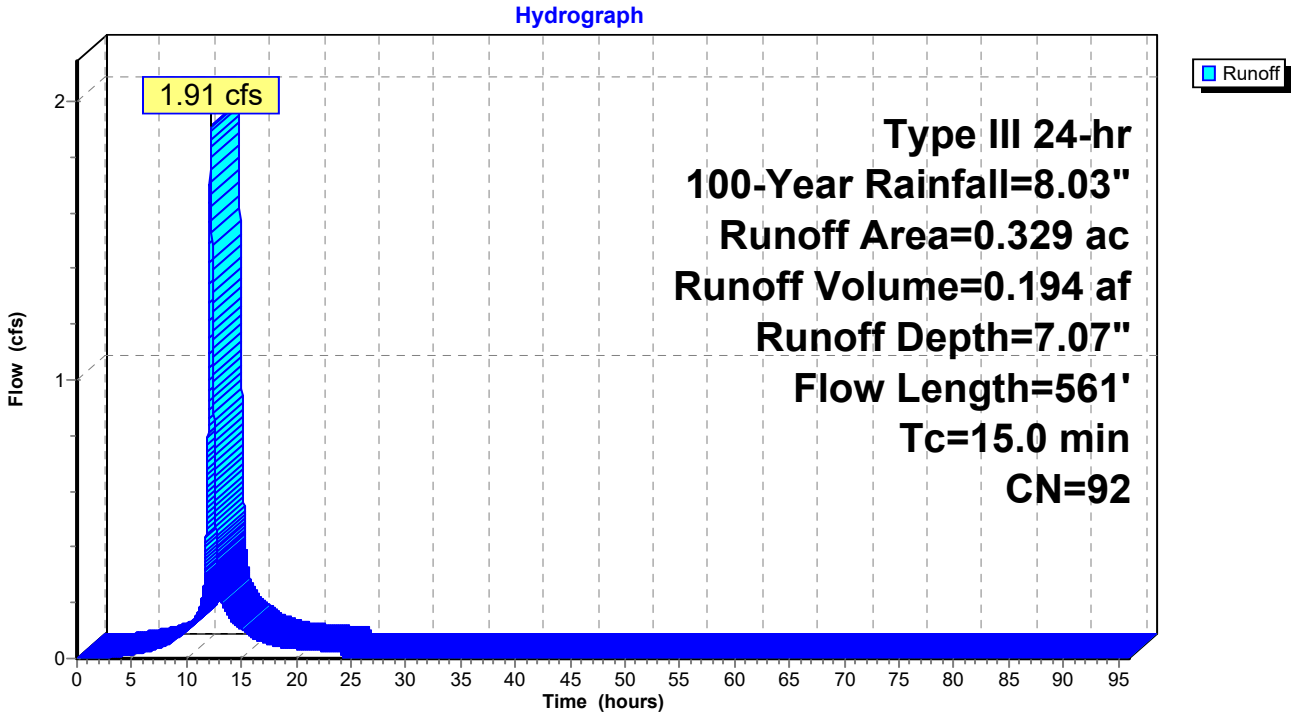
Runoff = 1.91 cfs @ 12.20 hrs, Volume= 0.194 af, Depth= 7.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.03"

	Area (ac)	CN	Description
*	0.225	89	Gravel
	0.102	98	Unconnected pavement, HSG C
	0.002	98	Unconnected roofs, HSG C
	0.329	92	Weighted Average
	0.225		68.39% Pervious Area
	0.104		31.61% Impervious Area
	0.104		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.6	40	0.1180	0.08		**Sheet Flow, SF1** Woods: Dense underbrush n= 0.800 P2= 3.38"
2.4	22	0.0818	0.16		**Sheet Flow, SF2** Grass: Dense n= 0.240 P2= 3.38"
0.3	38	0.0789	2.02		**Sheet Flow, SF2** Smooth surfaces n= 0.011 P2= 3.38"
0.3	74	0.0527	3.70		**Shallow Concentrated Flow, SCF1** Unpaved Kv= 16.1 fps
3.3	320	0.0424	1.61	1.61	**Channel Flow, CF1** Area= 1.0 sf Perim= 12.6' r= 0.08' n= 0.035 Earth, dense weeds
0.1	67	0.0776	16.58	23.16	**Pipe Channel,** 16.0" Round Area= 1.4 sf Perim= 4.2' r= 0.33' n= 0.012
15.0	561	Total			

Subcatchment 1-I: 1 Impervious



Summary for Subcatchment 1-P: 1 Pervious

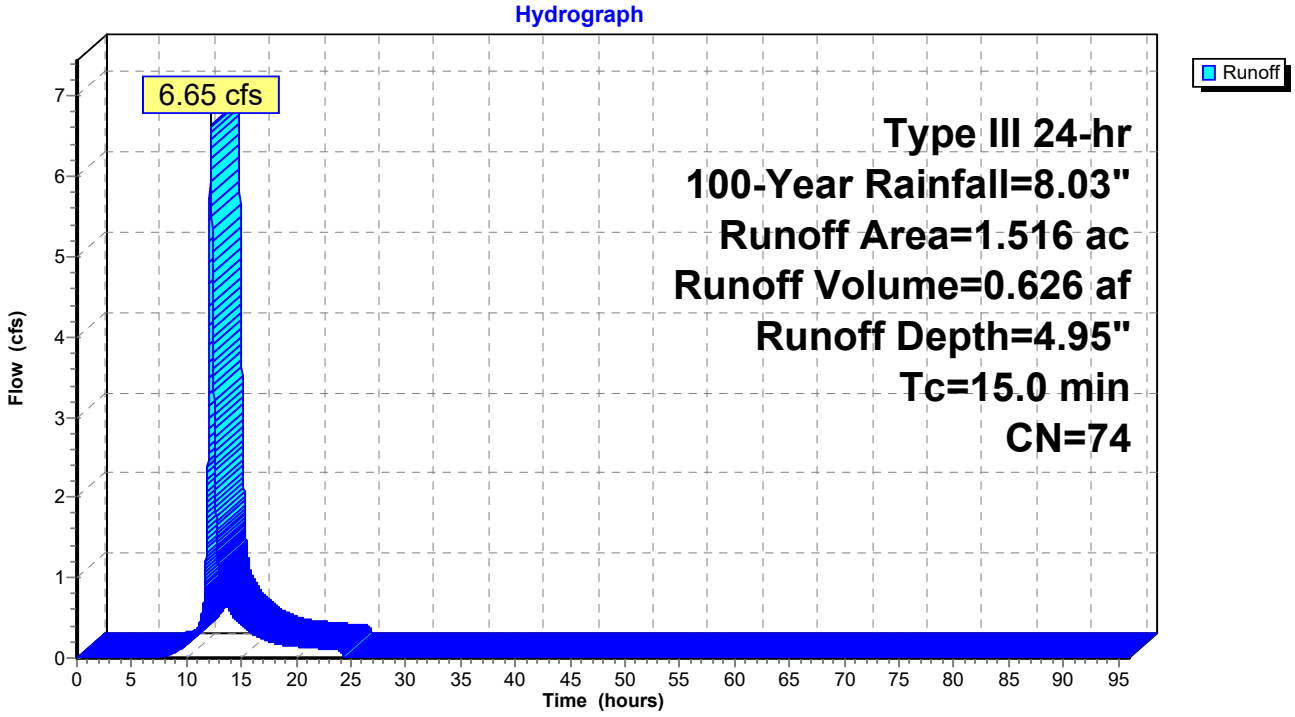
Runoff = 6.65 cfs @ 12.20 hrs, Volume= 0.626 af, Depth= 4.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.03"

Area (ac)	CN	Description
0.044	72	Woods/grass comb., Good, HSG C
1.472	74	>75% Grass cover, Good, HSG C
1.516	74	Weighted Average
1.516		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.0					**Direct Entry, Same as 1-I**

Subcatchment 1-P: 1 Pervious



Summary for Subcatchment 2-I: 2 Impervious

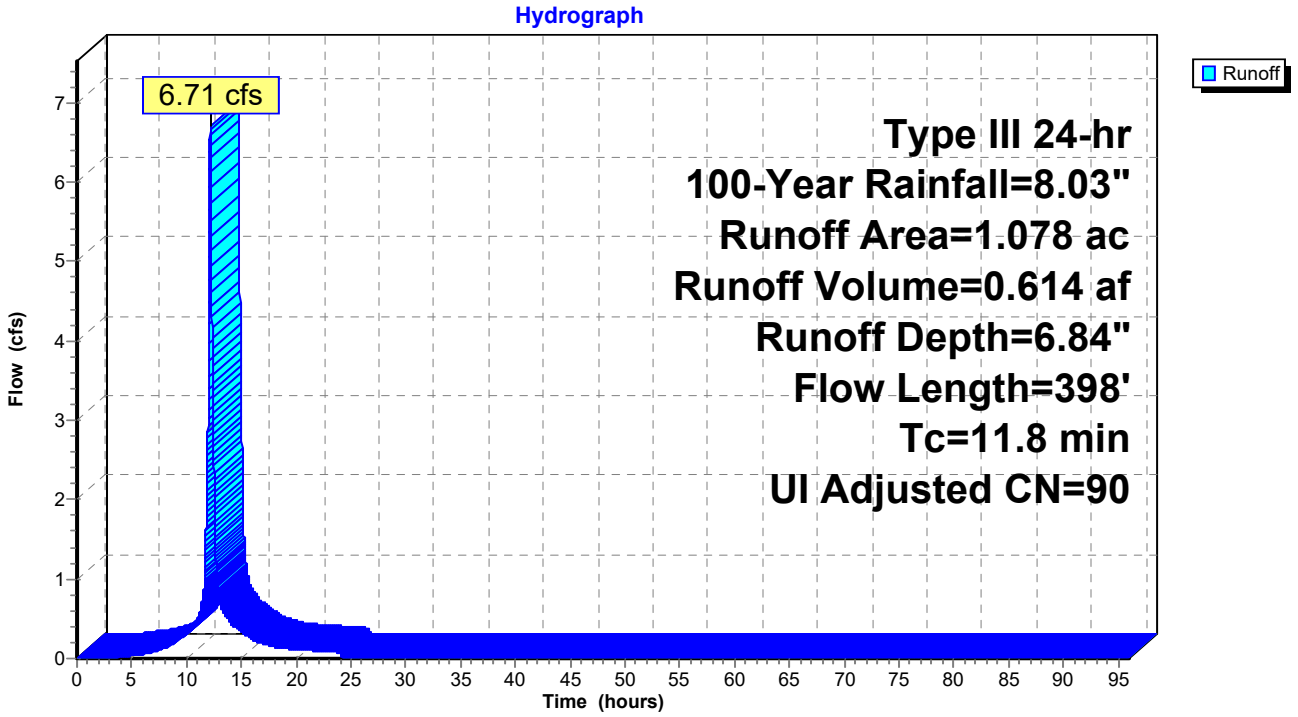
Runoff = 6.71 cfs @ 12.16 hrs, Volume= 0.614 af, Depth= 6.84"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.03"

Area (ac)	CN	Adj	Description
0.834	89		Gravel roads, HSG C
0.135	98		Unconnected pavement, HSG C
0.109	98		Unconnected roofs, HSG C
1.078	91	90	Weighted Average, UI Adjusted
0.834			77.37% Pervious Area
0.244			22.63% Impervious Area
0.244			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	48	0.0875	0.12		**Sheet Flow, SF1** Woods: Light underbrush n= 0.400 P2= 3.38"
3.5	52	0.0673	0.25		**Sheet Flow, SF2** Grass: Short n= 0.150 P2= 3.38"
0.2	21	0.0714	1.87		**Shallow Concentrated Flow, Short Grass Pasture C-2** Short Grass Pasture Kv= 7.0 fps
0.2	69	0.0841	4.67		**Shallow Concentrated Flow, Unpaved C-3** Unpaved Kv= 16.1 fps
0.1	30	0.2467	3.48		**Shallow Concentrated Flow, Short Grass Pasture C-4** Short Grass Pasture Kv= 7.0 fps
0.9	103	0.0136	1.88		**Shallow Concentrated Flow, Unpaved C-5** Unpaved Kv= 16.1 fps
0.4	17	0.0118	0.76		**Shallow Concentrated Flow, Short Grass Pasture C-6** Short Grass Pasture Kv= 7.0 fps
0.1	58	0.0517	11.51	74.82	**Parabolic Channel, Earth, clean & straight C-7** W=9.75' D=1.00' Area=6.5 sf Perim=10.0' n= 0.022 Earth, clean & straight
11.8	398	Total			

Subcatchment 2-I: 2 Impervious



Summary for Subcatchment 2-P: 2 Pervious

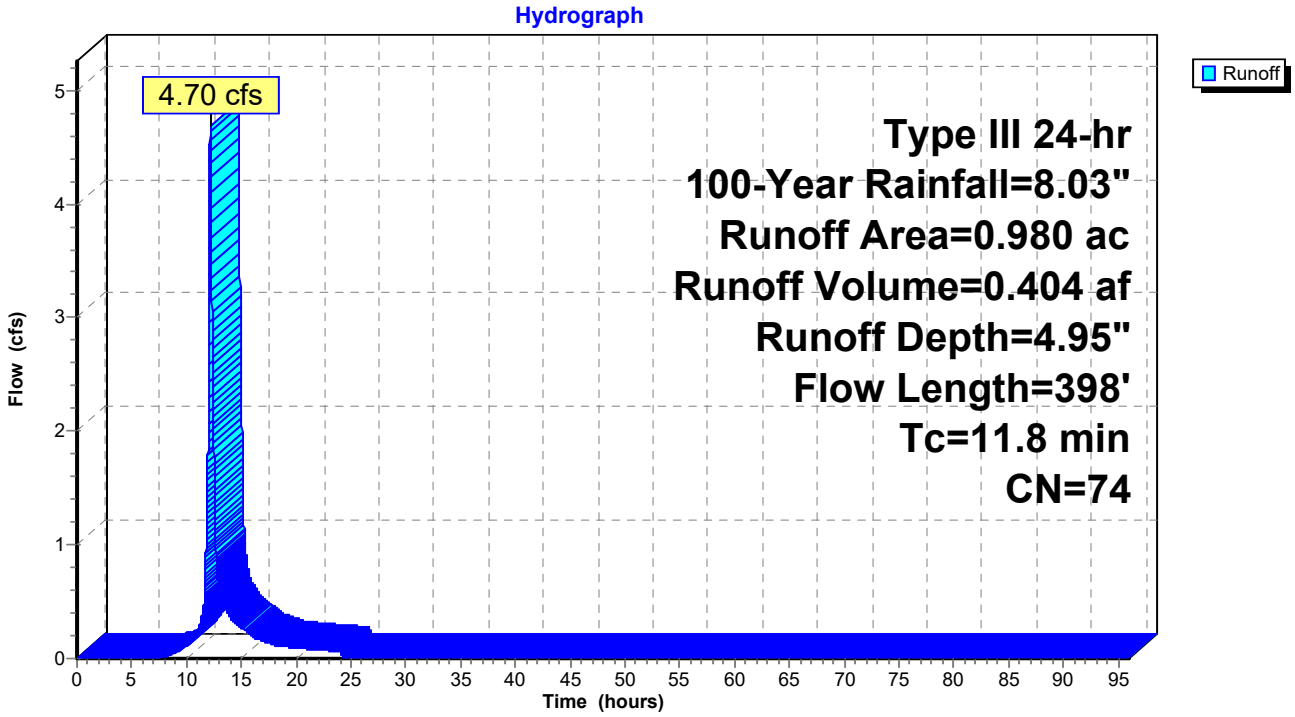
Runoff = 4.70 cfs @ 12.16 hrs, Volume= 0.404 af, Depth= 4.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.03"

Area (ac)	CN	Description
0.837	74	>75% Grass cover, Good, HSG C
0.143	72	Woods/grass comb., Good, HSG C
0.980	74	Weighted Average
0.980		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	48	0.0875	0.12		**Sheet Flow, SF1** Woods: Light underbrush n= 0.400 P2= 3.38"
3.5	52	0.0673	0.25		**Sheet Flow, SF2** Grass: Short n= 0.150 P2= 3.38"
0.2	21	0.0714	1.87		**Shallow Concentrated Flow, Short Grass Pasture C-2** Short Grass Pasture Kv= 7.0 fps
0.2	69	0.0841	4.67		**Shallow Concentrated Flow, Unpaved C-3** Unpaved Kv= 16.1 fps
0.1	30	0.2467	3.48		**Shallow Concentrated Flow, Short Grass Pasture C-4** Short Grass Pasture Kv= 7.0 fps
0.9	103	0.0136	1.88		**Shallow Concentrated Flow, Unpaved C-5** Unpaved Kv= 16.1 fps
0.4	17	0.0118	0.76		**Shallow Concentrated Flow, Short Grass Pasture C-6** Short Grass Pasture Kv= 7.0 fps
0.1	58	0.0517	11.51	74.82	**Parabolic Channel, Earth, clean & straight C-7** W=9.75' D=1.00' Area=6.5 sf Perim=10.0' n= 0.022 Earth, clean & straight
11.8	398	Total			

Subcatchment 2-P: 2 Pervious



Summary for Subcatchment 3-I: 3 Impervious

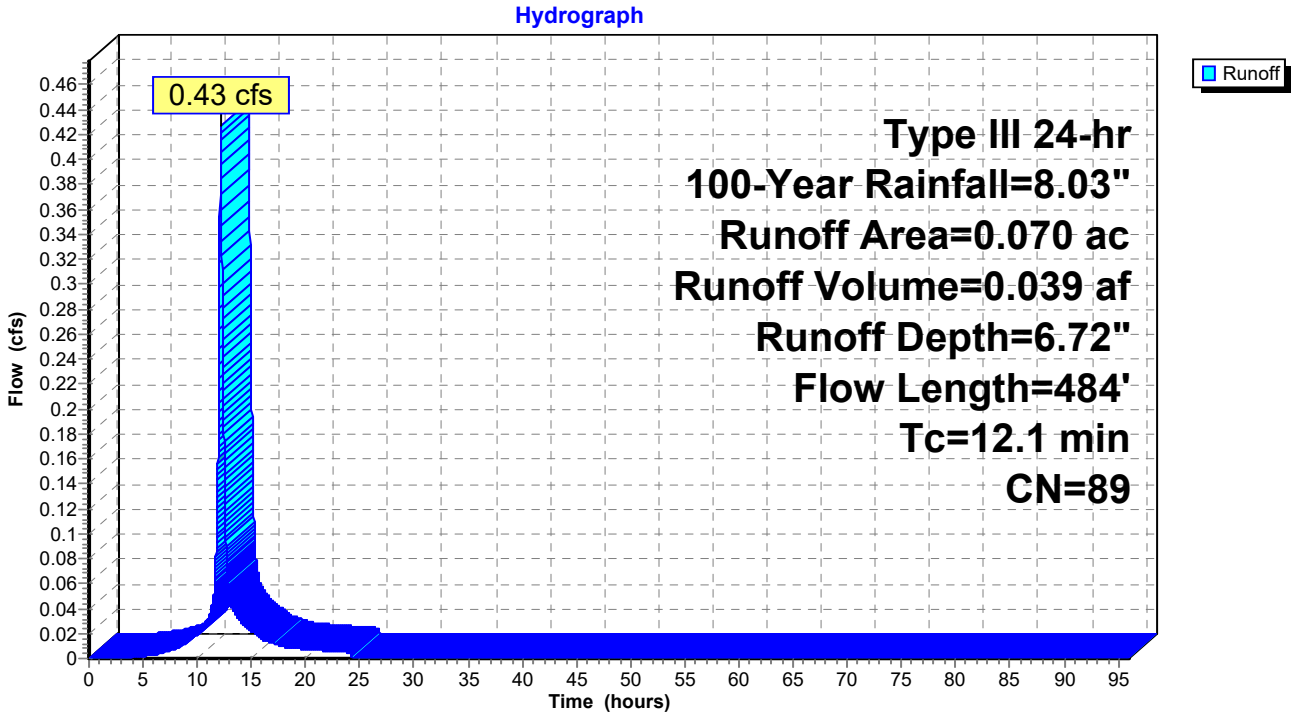
Runoff = 0.43 cfs @ 12.16 hrs, Volume= 0.039 af, Depth= 6.72"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.03"

Area (ac)	CN	Description
0.070	89	Gravel roads, HSG C
0.000	98	Unconnected pavement, HSG C
0.070	89	Weighted Average
0.070		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0	56	0.0964	0.13		**Sheet Flow, SF1** Woods: Light underbrush n= 0.400 P2= 3.38"
3.0	41	0.0610	0.23		**Sheet Flow, SF2** Grass: Short n= 0.150 P2= 3.38"
0.5	47	0.0617	1.74		**Shallow Concentrated Flow, Short Grass Pasture C-2** Short Grass Pasture Kv= 7.0 fps
0.2	53	0.0868	4.74		**Shallow Concentrated Flow, Unpaved C-3** Unpaved Kv= 16.1 fps
0.6	55	0.0436	1.46		**Shallow Concentrated Flow, Short Grass Pasture C-4** Short Grass Pasture Kv= 7.0 fps
0.7	189	0.0111	4.81	10.88	**Parabolic Channel, Earth, cobble bottom, clean sides C-5** W=3.39' D=1.00' Area=2.3 sf Perim=4.1' n= 0.022 Earth, clean & straight
0.1	43	0.0209	7.10	5.58	**Pipe Channel, RCP_Round 12" C-6** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012
12.1	484	Total			

Subcatchment 3-I: 3 Impervious



Summary for Subcatchment 3-P: 3 Pervious

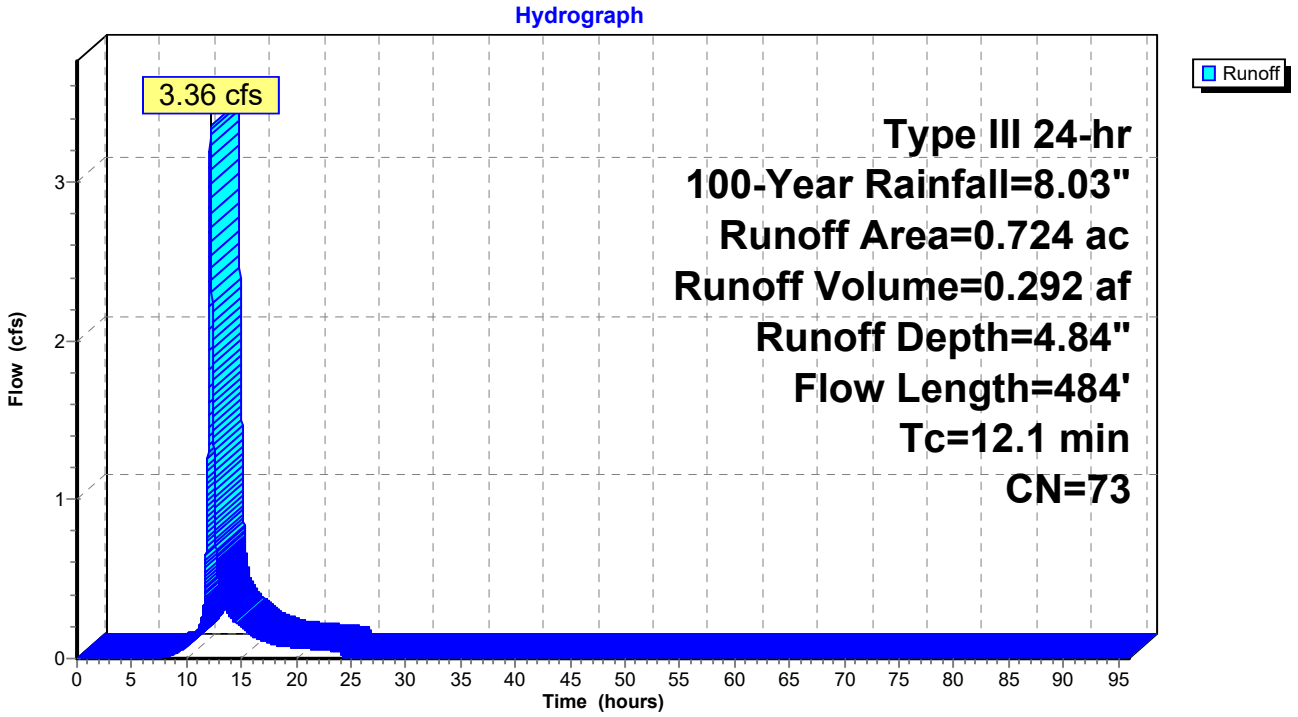
Runoff = 3.36 cfs @ 12.17 hrs, Volume= 0.292 af, Depth= 4.84"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.03"

Area (ac)	CN	Description
0.441	74	>75% Grass cover, Good, HSG C
0.283	72	Woods/grass comb., Good, HSG C
0.724	73	Weighted Average
0.724		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0	56	0.0964	0.13		**Sheet Flow, SF1** Woods: Light underbrush n= 0.400 P2= 3.38"
3.0	41	0.0610	0.23		**Sheet Flow, SF2** Grass: Short n= 0.150 P2= 3.38"
0.5	47	0.0617	1.74		**Shallow Concentrated Flow, Short Grass Pasture C-2** Short Grass Pasture Kv= 7.0 fps
0.2	53	0.0868	4.74		**Shallow Concentrated Flow, Unpaved C-3** Unpaved Kv= 16.1 fps
0.6	55	0.0436	1.46		**Shallow Concentrated Flow, Short Grass Pasture C-4** Short Grass Pasture Kv= 7.0 fps
0.7	189	0.0111	4.81	10.88	**Parabolic Channel, Earth, clean & straight C-5** W=3.39' D=1.00' Area=2.3 sf Perim=4.1' n= 0.022 Earth, clean & straight
0.1	43	0.0281	8.24	6.47	**Pipe Channel, RCP_Round 12" C-6** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012
12.1	484	Total			

Subcatchment 3-P: 3 Pervious



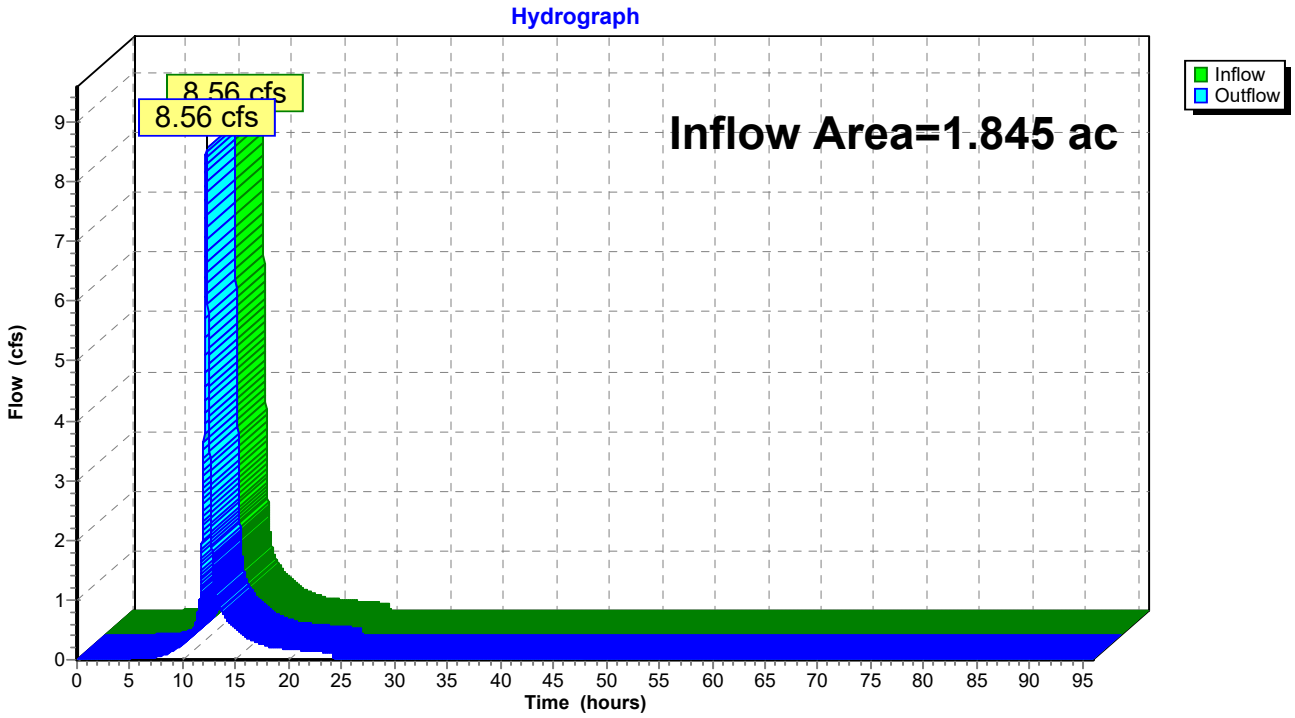
Summary for Reach 1R: (Outlet East)

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 1.845 ac, 5.64% Impervious, Inflow Depth = 5.33" for 100-Year event
Inflow = 8.56 cfs @ 12.20 hrs, Volume= 0.820 af
Outflow = 8.56 cfs @ 12.20 hrs, Volume= 0.820 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Reach 1R: (Outlet East)



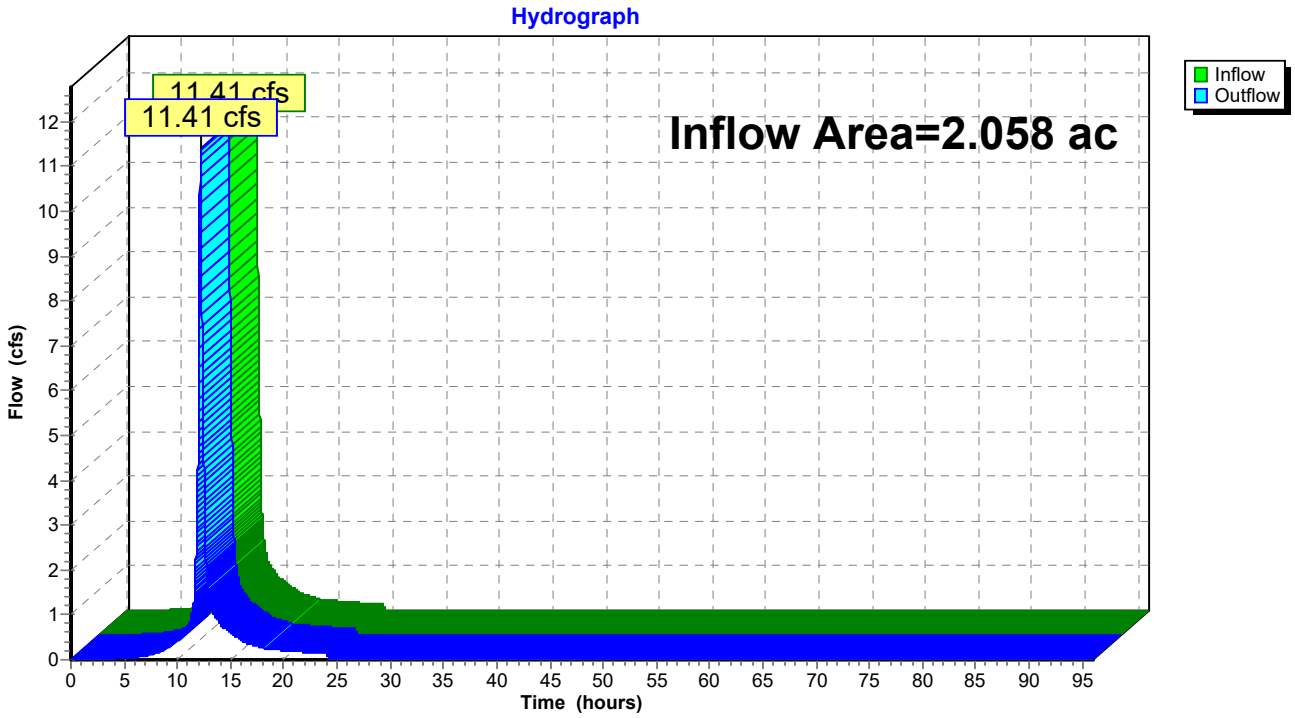
Summary for Reach 2R: (Outlet North)

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.058 ac, 11.86% Impervious, Inflow Depth = 5.94" for 100-Year event
Inflow = 11.41 cfs @ 12.16 hrs, Volume= 1.018 af
Outflow = 11.41 cfs @ 12.16 hrs, Volume= 1.018 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Reach 2R: (Outlet North)



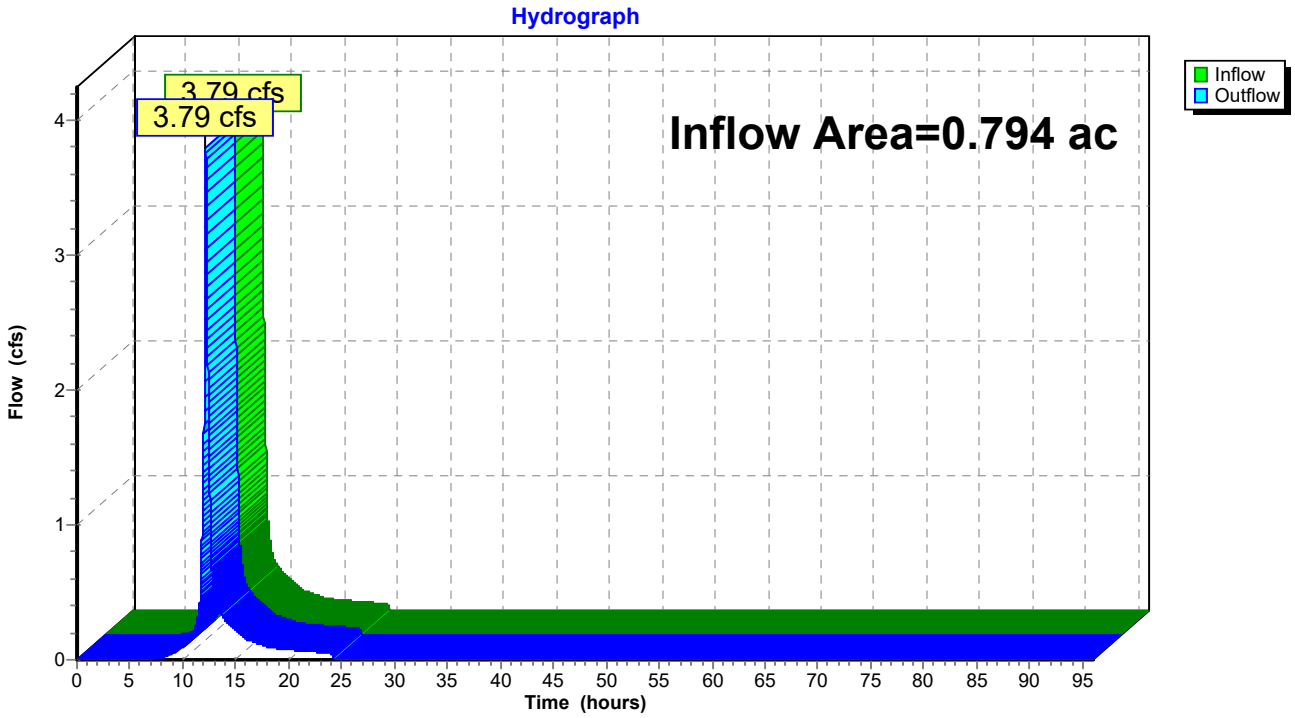
Summary for Reach 3R: (Outlet West)

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.794 ac, 0.00% Impervious, Inflow Depth = 5.00" for 100-Year event
Inflow = 3.79 cfs @ 12.17 hrs, Volume= 0.331 af
Outflow = 3.79 cfs @ 12.17 hrs, Volume= 0.331 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Reach 3R: (Outlet West)



Summary for Pond 1P: (Double 16" Culvert East)

Inflow Area = 1.845 ac, 5.64% Impervious, Inflow Depth = 5.33" for 100-Year event
Inflow = 8.56 cfs @ 12.20 hrs, Volume= 0.820 af
Outflow = 8.56 cfs @ 12.20 hrs, Volume= 0.820 af, Atten= 0%, Lag= 0.1 min
Primary = 8.56 cfs @ 12.20 hrs, Volume= 0.820 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Peak Elev= 148.21' @ 12.20 hrs Surf.Area= 31 sf Storage= 21 cf

Plug-Flow detention time= 0.0 min calculated for 0.820 af (100% of inflow)
Center-of-Mass det. time= 0.0 min (813.4 - 813.3)

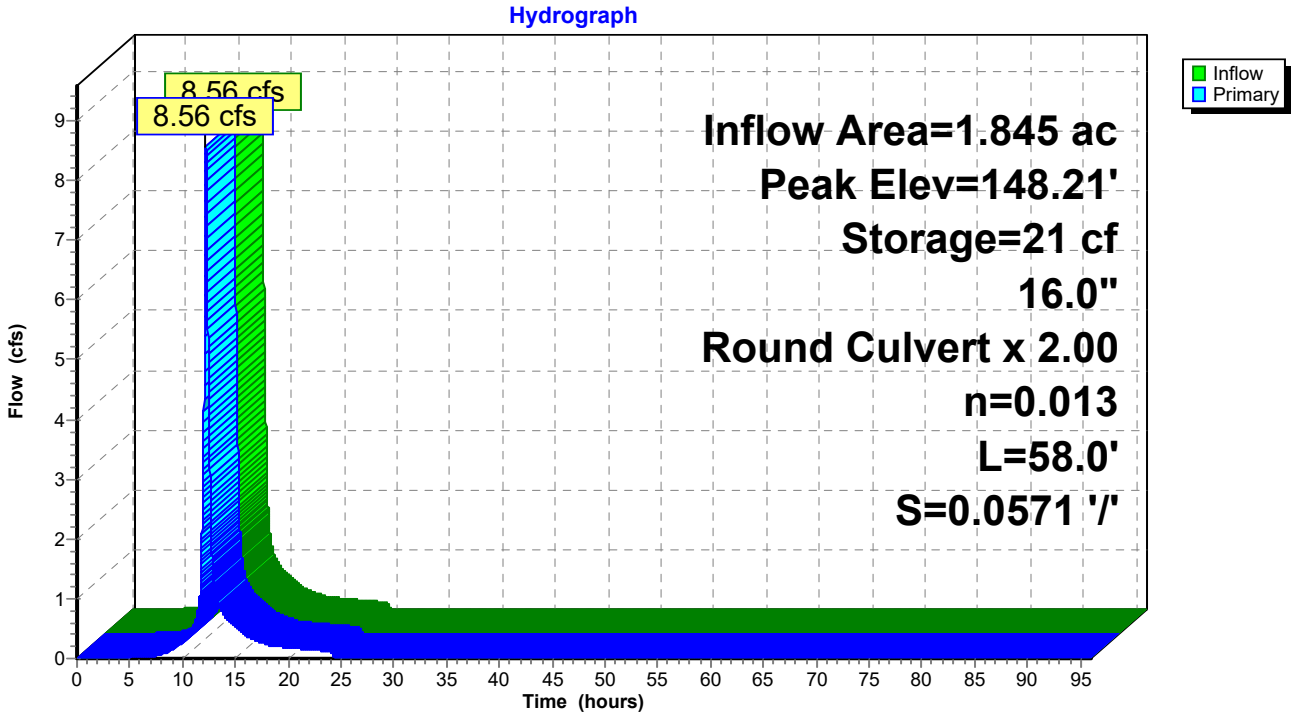
Volume	Invert	Avail.Storage	Storage Description
#1	146.90'	1,452 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
146.90	1	0	0
147.00	2	0	0
148.00	28	15	15
149.00	44	36	51
150.00	627	336	387
150.80	2,036	1,065	1,452

Device	Routing	Invert	Outlet Devices
#1	Primary	146.90'	**16.0" Round Culvert X 2.00** L= 58.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 146.90' / 143.59' S= 0.0571 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.40 sf

Primary OutFlow Max=8.56 cfs @ 12.20 hrs HW=148.21' TW=0.00' (Dynamic Tailwater)
└**1=Culvert** (Inlet Controls 8.56 cfs @ 3.08 fps)

Pond 1P: (Double 16" Culvert East)



Summary for Pond 2P: (18" RCP)

[90] Warning: Qout>Qin may require smaller dt or Finer Routing

Inflow Area = 2.058 ac, 11.86% Impervious, Inflow Depth = 5.94" for 100-Year event
Inflow = 11.41 cfs @ 12.16 hrs, Volume= 1.018 af
Outflow = 11.41 cfs @ 12.16 hrs, Volume= 1.018 af, Atten= 0%, Lag= 0.1 min
Primary = 11.41 cfs @ 12.16 hrs, Volume= 1.018 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Peak Elev= 155.49' @ 12.16 hrs Surf.Area= 67 sf Storage= 24 cf

Plug-Flow detention time= 0.1 min calculated for 1.018 af (100% of inflow)
Center-of-Mass det. time= 0.0 min (797.2 - 797.2)

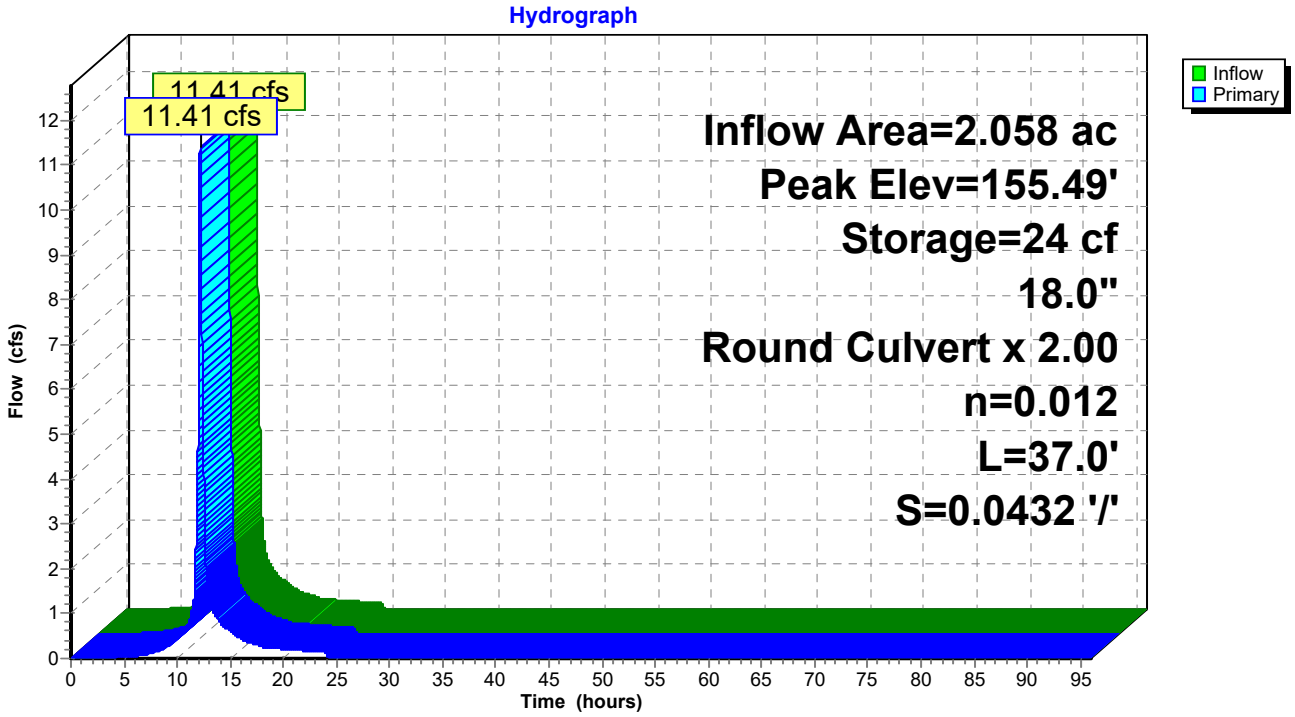
Volume	Invert	Avail.Storage	Storage Description
#1	154.40'	1,925 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
154.40	1	0	0
155.00	14	4	4
156.00	122	68	72
157.00	942	532	605
157.40	1,335	455	1,060
158.00	1,550	865	1,925

Device	Routing	Invert	Outlet Devices
#1	Primary	154.50'	**18.0" Round Culvert X 2.00** L= 37.0' RCP, rounded edge headwall, Ke= 0.100 Inlet / Outlet Invert= 154.50' / 152.90' S= 0.0432 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 1.77 sf

Primary OutFlow Max=11.40 cfs @ 12.16 hrs HW=155.49' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 11.40 cfs @ 4.62 fps)

Pond 2P: (18" RCP)

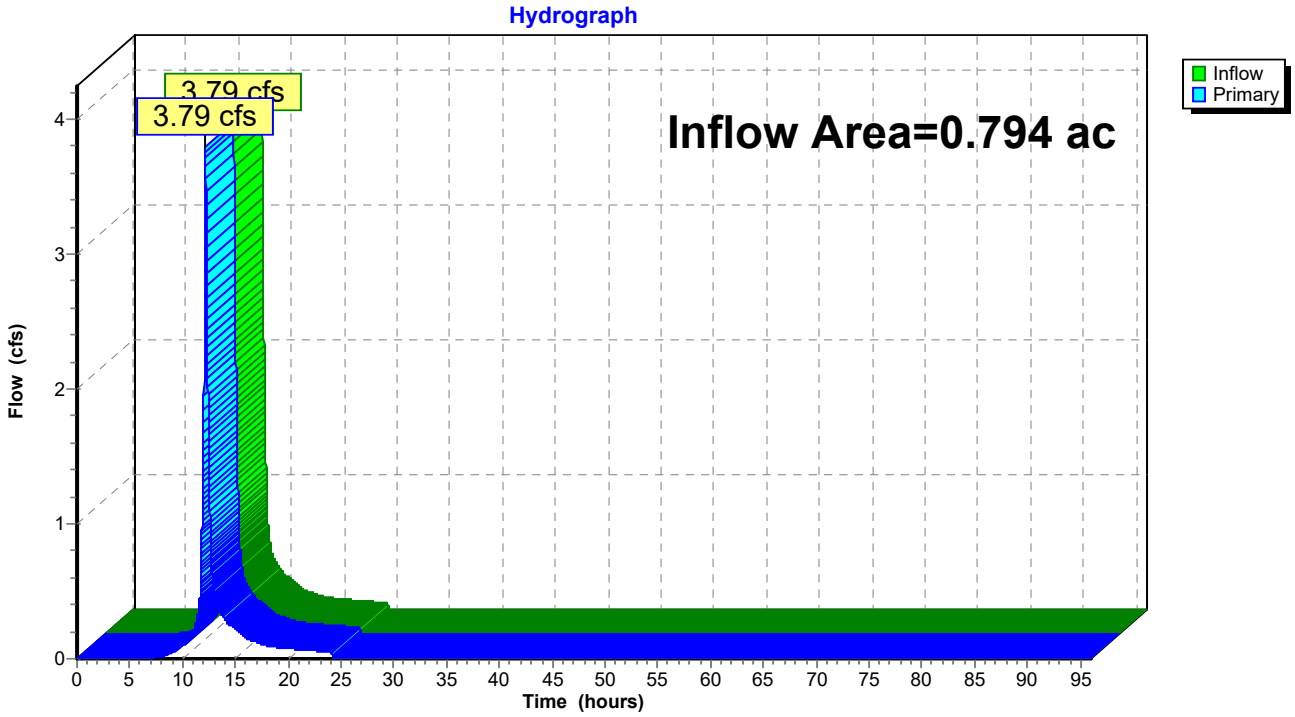


Summary for Link 3: Drainage Area 3

Inflow Area = 0.794 ac, 0.00% Impervious, Inflow Depth = 5.00" for 100-Year event
Inflow = 3.79 cfs @ 12.17 hrs, Volume= 0.331 af
Primary = 3.79 cfs @ 12.17 hrs, Volume= 0.331 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Link 3: Drainage Area 3

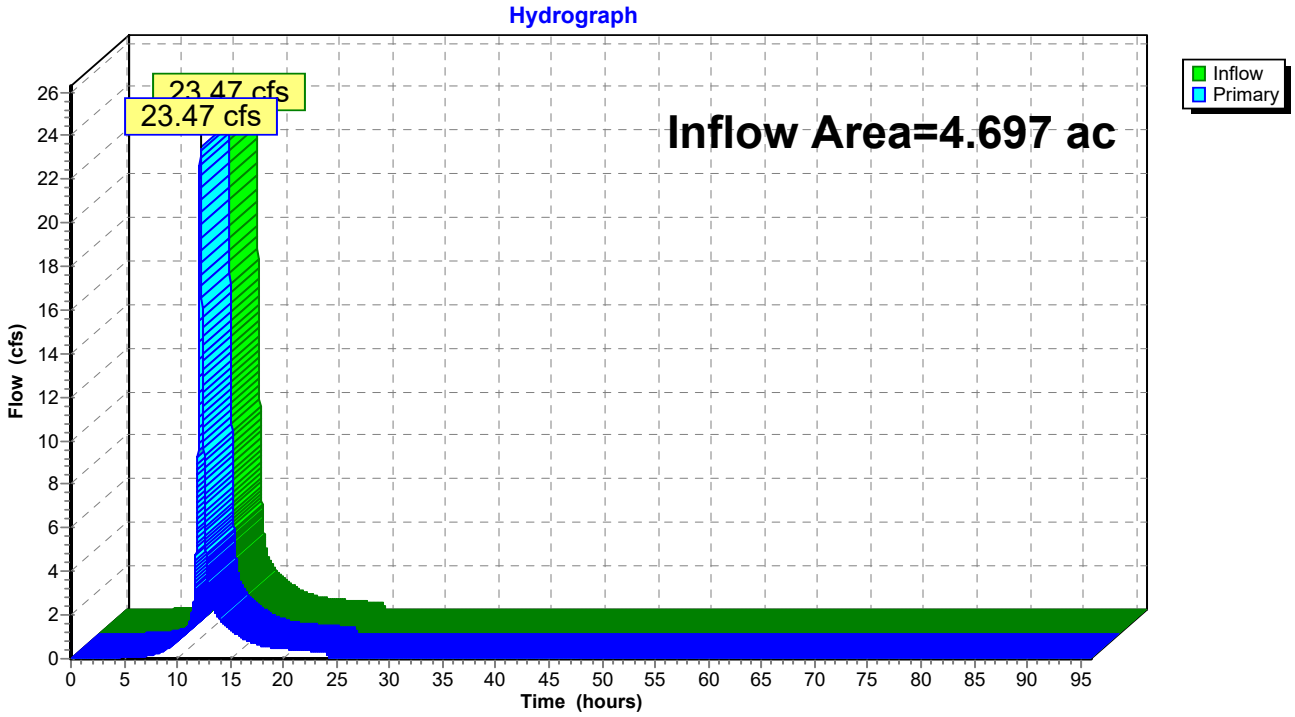


Summary for Link 5L: (Total Offsite Flows)

Inflow Area = 4.697 ac, 7.41% Impervious, Inflow Depth = 5.54" for 100-Year event
Inflow = 23.47 cfs @ 12.18 hrs, Volume= 2.169 af
Primary = 23.47 cfs @ 12.18 hrs, Volume= 2.169 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

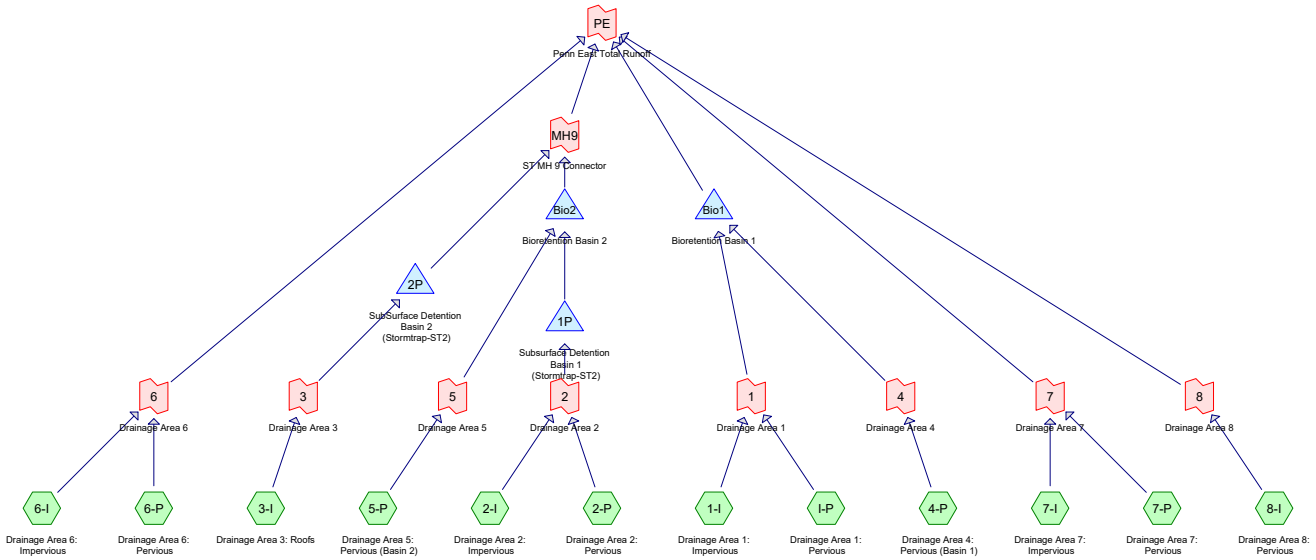
Link 5L: (Total Offsite Flows)

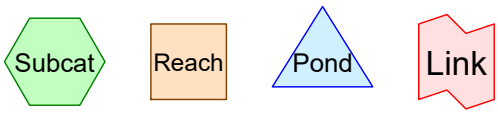


APPENDIX F

POST DEVELOPMENT DRAINAGE ANALYSIS

Post Development-Hydrographs





Routing Diagram for 292931 - 2018-08-30 PR-DA
Prepared by TRC Environmental Corp, Printed 8/30/2018
HydroCAD® 10.00-22 s/n 02814 © 2018 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
1.846	74	>75% Grass cover, Good, HSG C (2-P, 6-P, 7-P, 8-I, I-P)
0.598	96	Gravel surface, HSG C (1-I, 2-I, 6-I, 7-I)
0.924	98	Paved parking, HSG C (1-I, 2-I, 7-I)
0.183	98	Unconnected pavement, HSG C (1-I, 2-I, 6-I)
0.515	98	Unconnected roofs, HSG C (3-I, 6-I, 7-I)
0.631	72	Woods/grass comb., Good, HSG C (2-P, 4-P, 5-P, 6-P, 8-I, I-P)
4.697	**85**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
4.697	HSG C	1-I, 2-I, 2-P, 3-I, 4-P, 5-P, 6-I, 6-P, 7-I, 7-P, 8-I, I-P
0.000	HSG D	
0.000	Other	
4.697		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	1.846	0.000	0.000	1.846	>75% Grass cover, Good	2-P, 6-P, 7-P, 8-I, I-P
0.000	0.000	0.598	0.000	0.000	0.598	Gravel surface	1-I, 2-I, 6-I, 7-I
0.000	0.000	0.924	0.000	0.000	0.924	Paved parking	1-I, 2-I, 7-I
0.000	0.000	0.183	0.000	0.000	0.183	Unconnected pavement	1-I, 2-I, 6-I
0.000	0.000	0.515	0.000	0.000	0.515	Unconnected roofs	3-I, 6-I, 7-I
0.000	0.000	0.631	0.000	0.000	0.631	Woods/grass comb., Good	2-P, 4-P, 5-P, 6-P, 8-I, I-P
0.000	**0.000**	**4.697**	**0.000**	**0.000**	**4.697**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	6-I	0.00	0.00	67.0	0.0780	0.012	16.0	0.0	0.0
2	8-I	0.00	0.00	40.0	0.0270	0.012	12.0	0.0	0.0
3	1P	156.33	156.00	50.0	0.0066	0.012	15.0	0.0	0.0
4	2P	157.33	151.13	245.0	0.0253	0.012	15.0	0.0	0.0
5	Bio1	151.80	151.00	95.0	0.0084	0.013	15.0	0.0	0.0
6	Bio2	152.17	151.30	109.0	0.0080	0.012	15.0	0.0	0.0

Time span=0.00-96.00 hrs, dt=0.01 hrs, 9601 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1-I: Drainage Area 1: Runoff Area=0.387 ac 79.33% Impervious Runoff Depth=3.15"
Flow Length=119' Tc=6.0 min CN=98 Runoff=1.27 cfs 0.101 af

Subcatchment 2-I: Drainage Area 2: Runoff Area=0.802 ac 63.47% Impervious Runoff Depth=3.04"
Flow Length=252' Tc=7.0 min CN=97 Runoff=2.51 cfs 0.203 af

Subcatchment 2-P: Drainage Area 2: Runoff Area=0.241 ac 0.00% Impervious Runoff Depth=1.16"
Tc=7.0 min CN=74 Runoff=0.30 cfs 0.023 af

Subcatchment 3-I: Drainage Area 3: Roofs Runoff Area=0.404 ac 100.00% Impervious Runoff Depth=3.15"
Tc=6.0 min CN=98 Runoff=1.33 cfs 0.106 af

Subcatchment 4-P: Drainage Area 4: Runoff Area=0.083 ac 0.00% Impervious Runoff Depth=1.04"
Tc=6.0 min CN=72 Runoff=0.10 cfs 0.007 af

Subcatchment 5-P: Drainage Area 5: Runoff Area=0.192 ac 0.00% Impervious Runoff Depth=1.04"
Tc=6.0 min CN=72 Runoff=0.22 cfs 0.017 af

Subcatchment 6-I: Drainage Area 6: Runoff Area=0.223 ac 70.85% Impervious Runoff Depth=3.04"
Flow Length=596' Tc=17.7 min CN=97 Runoff=0.52 cfs 0.056 af

Subcatchment 6-P: Drainage Area 6: Runoff Area=0.991 ac 0.00% Impervious Runoff Depth=1.16"
Tc=17.7 min CN=74 Runoff=0.91 cfs 0.096 af

Subcatchment 7-I: Drainage Area 7: Runoff Area=0.404 ac 60.40% Impervious Runoff Depth=3.04"
Tc=6.0 min CN=97 Runoff=1.31 cfs 0.102 af

Subcatchment 7-P: Drainage Area 7: Runoff Area=0.338 ac 0.00% Impervious Runoff Depth=1.16"
Tc=6.0 min CN=74 Runoff=0.44 cfs 0.033 af

Subcatchment 8-I: Drainage Area 8: Pervious Runoff Area=0.380 ac 0.00% Impervious Runoff Depth=1.10"
Flow Length=327' Tc=14.6 min CN=73 Runoff=0.35 cfs 0.035 af

Subcatchment I-P: Drainage Area 1: Pervious Runoff Area=0.252 ac 0.00% Impervious Runoff Depth=1.10"
Tc=6.0 min CN=73 Runoff=0.31 cfs 0.023 af

Pond 1P: Subsurface Detention Basin 1 Peak Elev=157.83' Storage=4,691 cf Inflow=2.81 cfs 0.226 af
Outflow=0.20 cfs 0.226 af

Pond 2P: SubSurface Detention Basin 2 Peak Elev=158.70' Storage=1,595 cf Inflow=1.33 cfs 0.106 af
Outflow=0.19 cfs 0.106 af

Pond Bio1: Bioretention Basin 1 Peak Elev=156.30' Storage=2,448 cf Inflow=1.67 cfs 0.132 af
Outflow=0.14 cfs 0.132 af

Pond Bio2: Bioretention Basin 2 Peak Elev=156.66' Storage=2,324 cf Inflow=0.38 cfs 0.243 af
Outflow=0.13 cfs 0.243 af

Link 1: Drainage Area 1 Inflow=1.58 cfs 0.125 af
Primary=1.58 cfs 0.125 af

Link 2: Drainage Area 2 Inflow=2.81 cfs 0.226 af
Primary=2.81 cfs 0.226 af

Link 3: Drainage Area 3 Inflow=1.33 cfs 0.106 af
Primary=1.33 cfs 0.106 af

Link 4: Drainage Area 4 Inflow=0.10 cfs 0.007 af
Primary=0.10 cfs 0.007 af

Link 5: Drainage Area 5 Inflow=0.22 cfs 0.017 af
Primary=0.22 cfs 0.017 af

Link 6: Drainage Area 6 Inflow=1.42 cfs 0.152 af
Primary=1.42 cfs 0.152 af

Link 7: Drainage Area 7 Inflow=1.75 cfs 0.135 af
Primary=1.75 cfs 0.135 af

Link 8: Drainage Area 8 Inflow=0.35 cfs 0.035 af
Primary=0.35 cfs 0.035 af

Link MH9: ST MH 9 Connector Inflow=0.30 cfs 0.349 af
Primary=0.30 cfs 0.349 af

Link PE: Penn East Total Runoff Inflow=3.22 cfs 0.802 af
Primary=3.22 cfs 0.802 af

Total Runoff Area = 4.697 ac Runoff Volume = 0.802 af Average Runoff Depth = 2.05"
65.47% Pervious = 3.075 ac 34.53% Impervious = 1.622 ac

Summary for Subcatchment 1-I: Drainage Area 1: Impervious

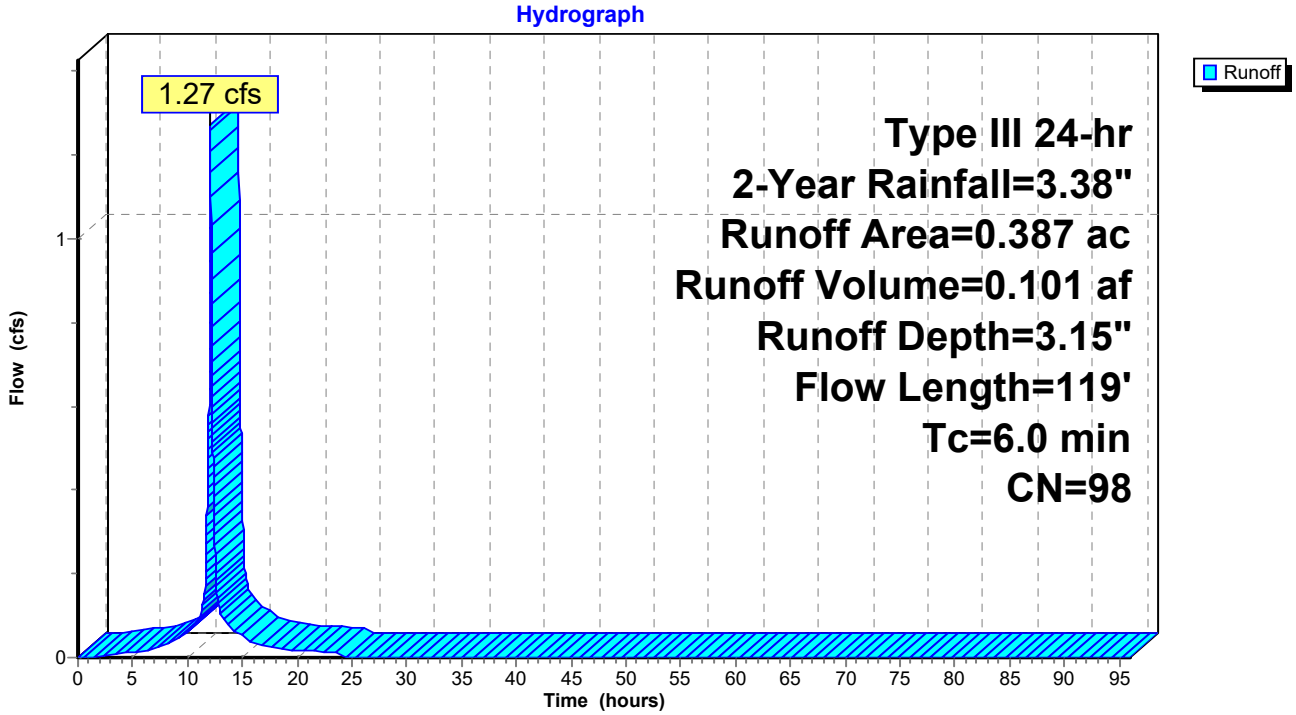
Runoff = 1.27 cfs @ 12.08 hrs, Volume= 0.101 af, Depth= 3.15"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.38"

Area (ac)	CN	Description
0.080	96	Gravel surface, HSG C
0.015	98	Unconnected pavement, HSG C
0.292	98	Paved parking, HSG C
0.387	98	Weighted Average
0.080		20.67% Pervious Area
0.307		79.33% Impervious Area
0.015		4.89% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	119		0.33		**Direct Entry, Direct**

Subcatchment 1-I: Drainage Area 1: Impervious



Summary for Subcatchment 2-I: Drainage Area 2: Impervious

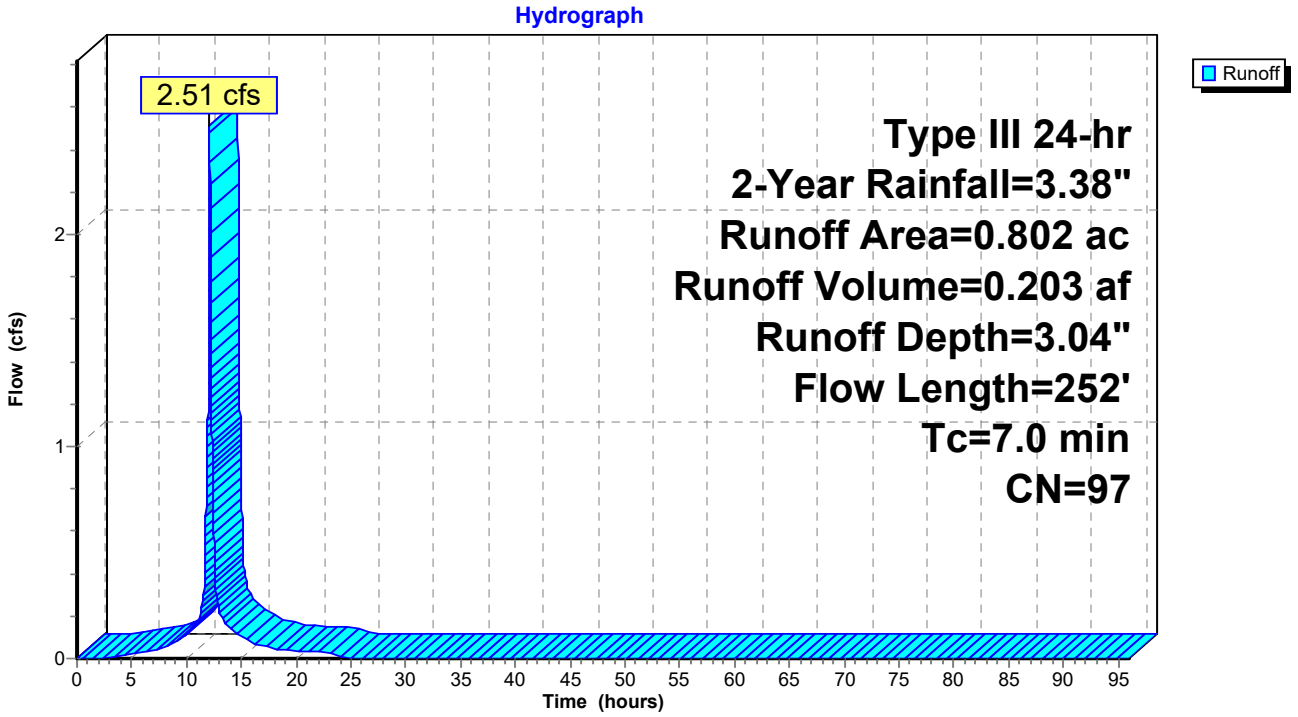
Runoff = 2.51 cfs @ 12.10 hrs, Volume= 0.203 af, Depth= 3.04"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.38"

Area (ac)	CN	Description
0.293	96	Gravel surface, HSG C
0.497	98	Paved parking, HSG C
0.012	98	Unconnected pavement, HSG C
0.802	97	Weighted Average
0.293		36.53% Pervious Area
0.509		63.47% Impervious Area
0.012		2.36% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.1	44	0.0840	0.18		**Sheet Flow, Grass: Dense** Grass: Dense n= 0.240 P2= 3.38"
2.1	38	0.3310	0.30		**Sheet Flow, Grass: Dense** Grass: Dense n= 0.240 P2= 3.38"
0.2	18	0.0500	1.45		**Sheet Flow, Smooth Surfaces** Smooth surfaces n= 0.011 P2= 3.38"
0.6	152	0.0370	3.90		**Shallow Concentrated Flow, Paved** Paved Kv= 20.3 fps
7.0	252	Total			

Subcatchment 2-I: Drainage Area 2: Impervious



Summary for Subcatchment 2-P: Drainage Area 2: Pervious

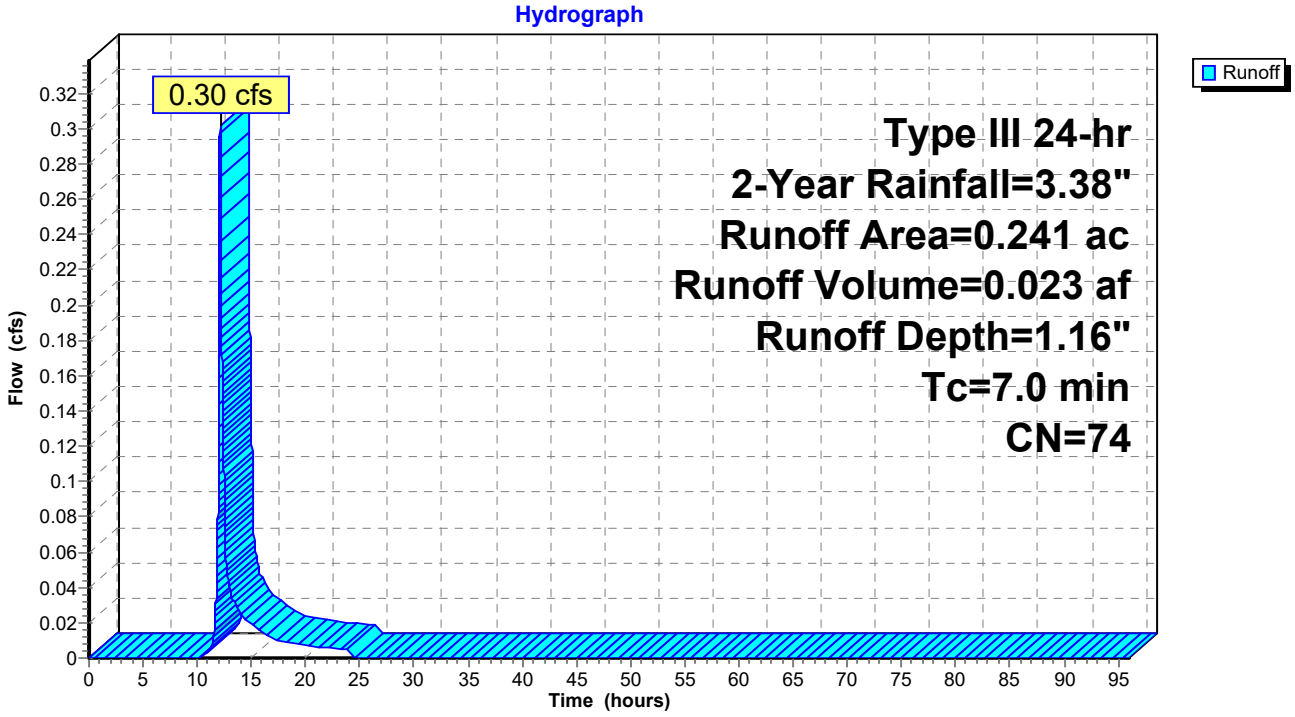
Runoff = 0.30 cfs @ 12.11 hrs, Volume= 0.023 af, Depth= 1.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.38"

Area (ac)	CN	Description
0.186	74	>75% Grass cover, Good, HSG C
0.055	72	Woods/grass comb., Good, HSG C
0.241	74	Weighted Average
0.241		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0					**Direct Entry, 2-I**

Subcatchment 2-P: Drainage Area 2: Pervious



Summary for Subcatchment 3-I: Drainage Area 3: Roofs

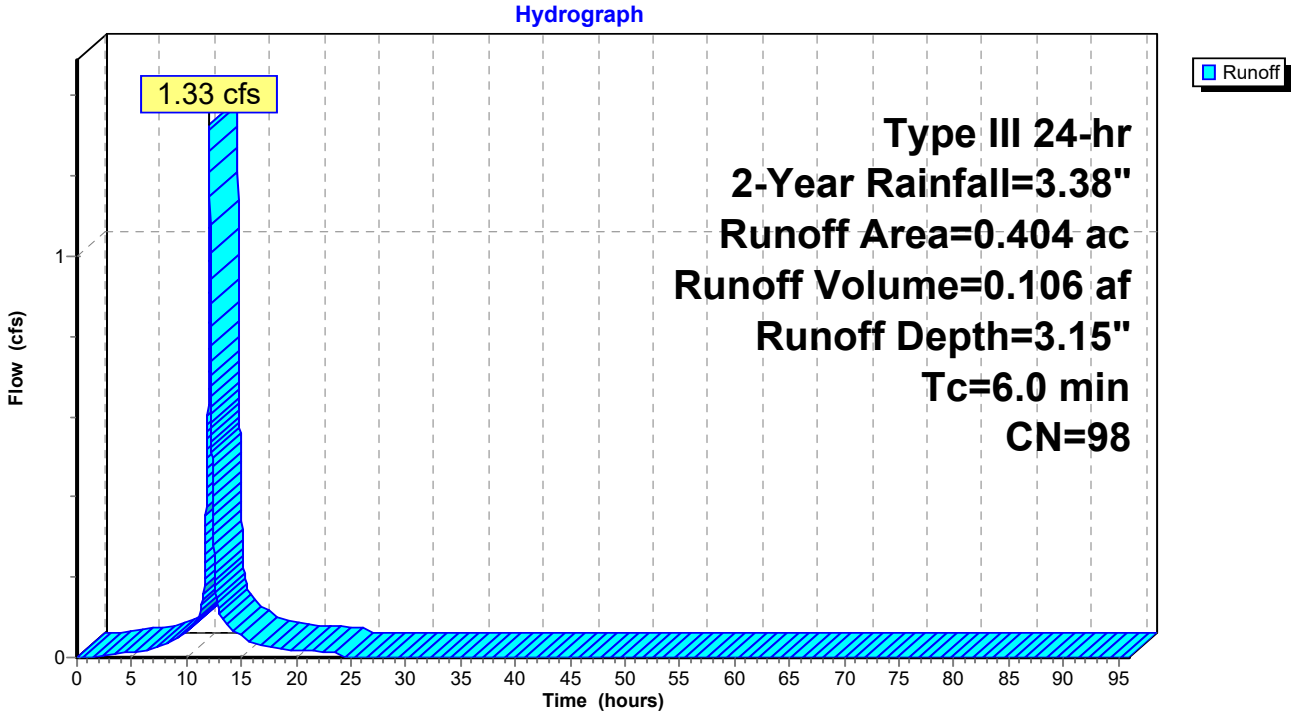
Runoff = 1.33 cfs @ 12.08 hrs, Volume= 0.106 af, Depth= 3.15"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.38"

Area (ac)	CN	Description
0.404	98	Unconnected roofs, HSG C
0.404		100.00% Impervious Area
0.404		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct C-1**

Subcatchment 3-I: Drainage Area 3: Roofs



Summary for Subcatchment 4-P: Drainage Area 4: Pervious (Basin 1)

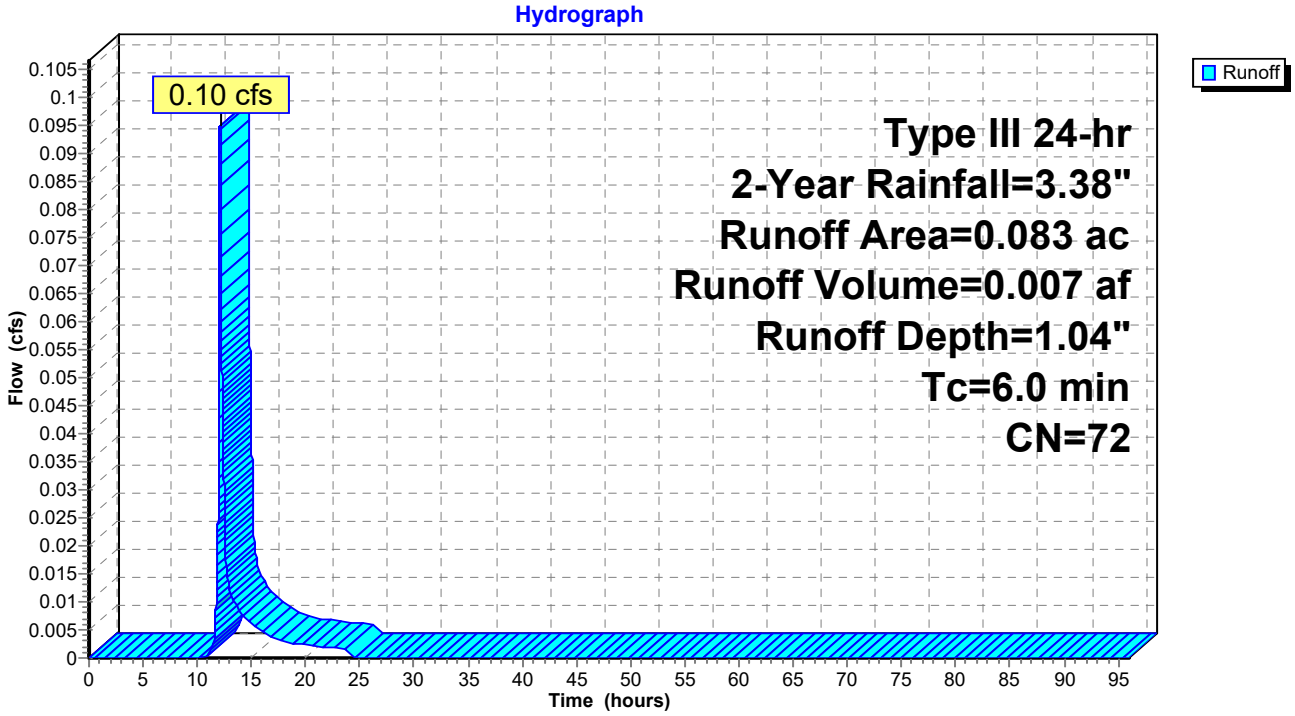
Runoff = 0.10 cfs @ 12.10 hrs, Volume= 0.007 af, Depth= 1.04"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.38"

Area (ac)	CN	Description
0.083	72	Woods/grass comb., Good, HSG C
0.083		100.00% Pervious Area

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

Subcatchment 4-P: Drainage Area 4: Pervious (Basin 1)



Summary for Subcatchment 5-P: Drainage Area 5: Pervious (Basin 2)

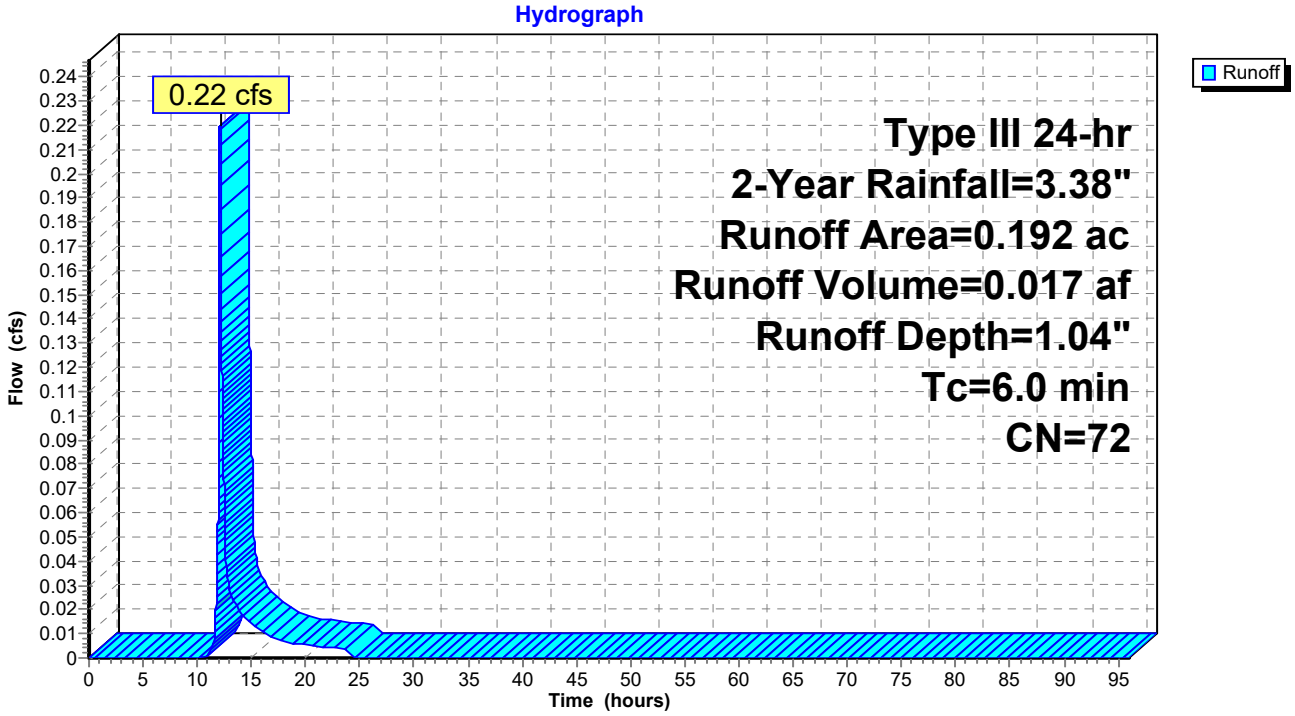
Runoff = 0.22 cfs @ 12.10 hrs, Volume= 0.017 af, Depth= 1.04"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.38"

Area (ac)	CN	Description
0.192	72	Woods/grass comb., Good, HSG C
0.192		100.00% Pervious Area

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

Subcatchment 5-P: Drainage Area 5: Pervious (Basin 2)



Summary for Subcatchment 6-I: Drainage Area 6: Impervious

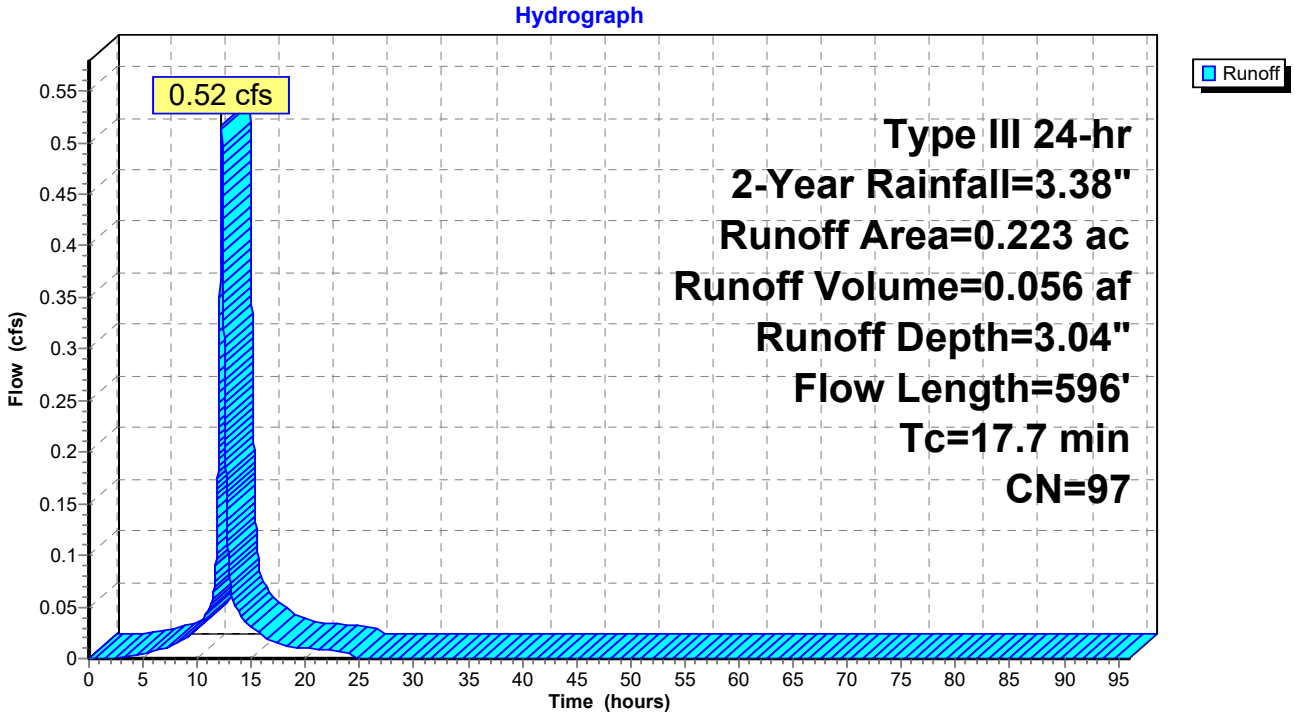
Runoff = 0.52 cfs @ 12.23 hrs, Volume= 0.056 af, Depth= 3.04"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.38"

Area (ac)	CN	Description
0.002	98	Unconnected roofs, HSG C
0.156	98	Unconnected pavement, HSG C
0.065	96	Gravel surface, HSG C
0.223	97	Weighted Average
0.065		29.15% Pervious Area
0.158		70.85% Impervious Area
0.158		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.6	40	0.1180	0.08		**Sheet Flow, SF1** Woods: Dense underbrush n= 0.800 P2= 3.38"
5.0	60	0.0923	0.20		**Sheet Flow, SF2** Grass: Dense n= 0.240 P2= 3.38"
0.7	86	0.0988	2.20		**Shallow Concentrated Flow, SCF1** Short Grass Pasture Kv= 7.0 fps
3.3	343	0.0499	1.75	1.75	**Channel Flow, CF1** Area= 1.0 sf Perim= 12.6' r= 0.08' n= 0.035 Earth, dense weeds
0.1	67	0.0780	16.63	23.22	**Pipe Channel, HDPE Pipe** 16.0" Round Area= 1.4 sf Perim= 4.2' r= 0.33' n= 0.012
17.7	596	Total			

Subcatchment 6-I: Drainage Area 6: Impervious



Summary for Subcatchment 6-P: Drainage Area 6: Pervious

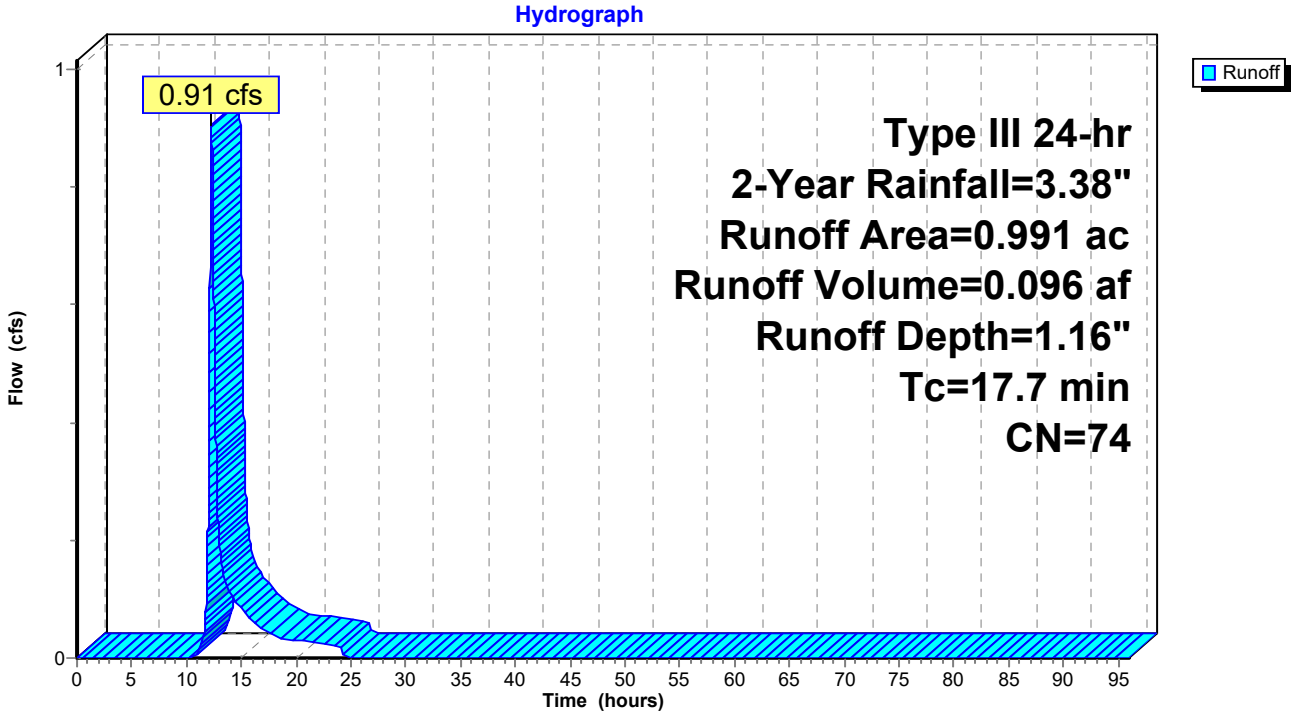
Runoff = 0.91 cfs @ 12.26 hrs, Volume= 0.096 af, Depth= 1.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.38"

Area (ac)	CN	Description
0.981	74	>75% Grass cover, Good, HSG C
0.010	72	Woods/grass comb., Good, HSG C
0.991	74	Weighted Average
0.991		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.7					**Direct Entry, Same as G1**

Subcatchment 6-P: Drainage Area 6: Pervious



Summary for Subcatchment 7-I: Drainage Area 7: Impervious

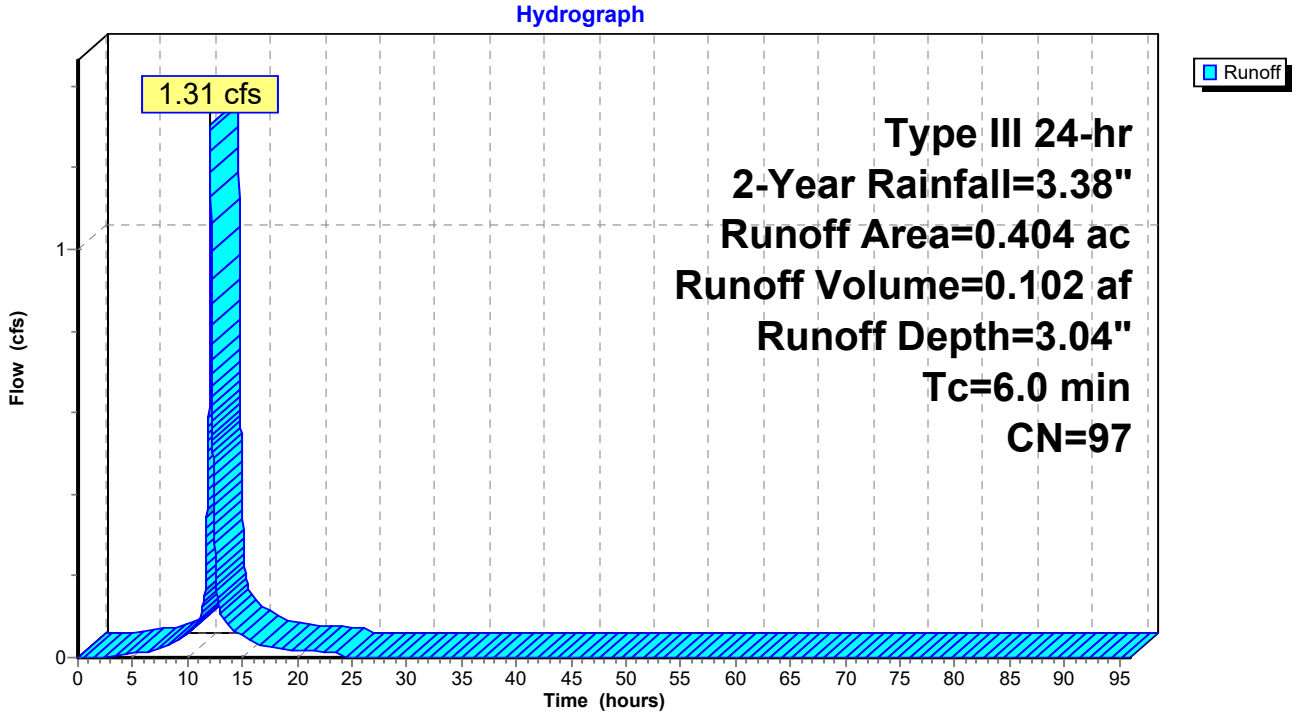
Runoff = 1.31 cfs @ 12.08 hrs, Volume= 0.102 af, Depth= 3.04"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.38"

Area (ac)	CN	Description
0.135	98	Paved parking, HSG C
0.160	96	Gravel surface, HSG C
0.109	98	Unconnected roofs, HSG C
0.404	97	Weighted Average
0.160		39.60% Pervious Area
0.244		60.40% Impervious Area
0.109		44.67% Unconnected

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

Subcatchment 7-I: Drainage Area 7: Impervious



Summary for Subcatchment 7-P: Drainage Area 7: Pervious

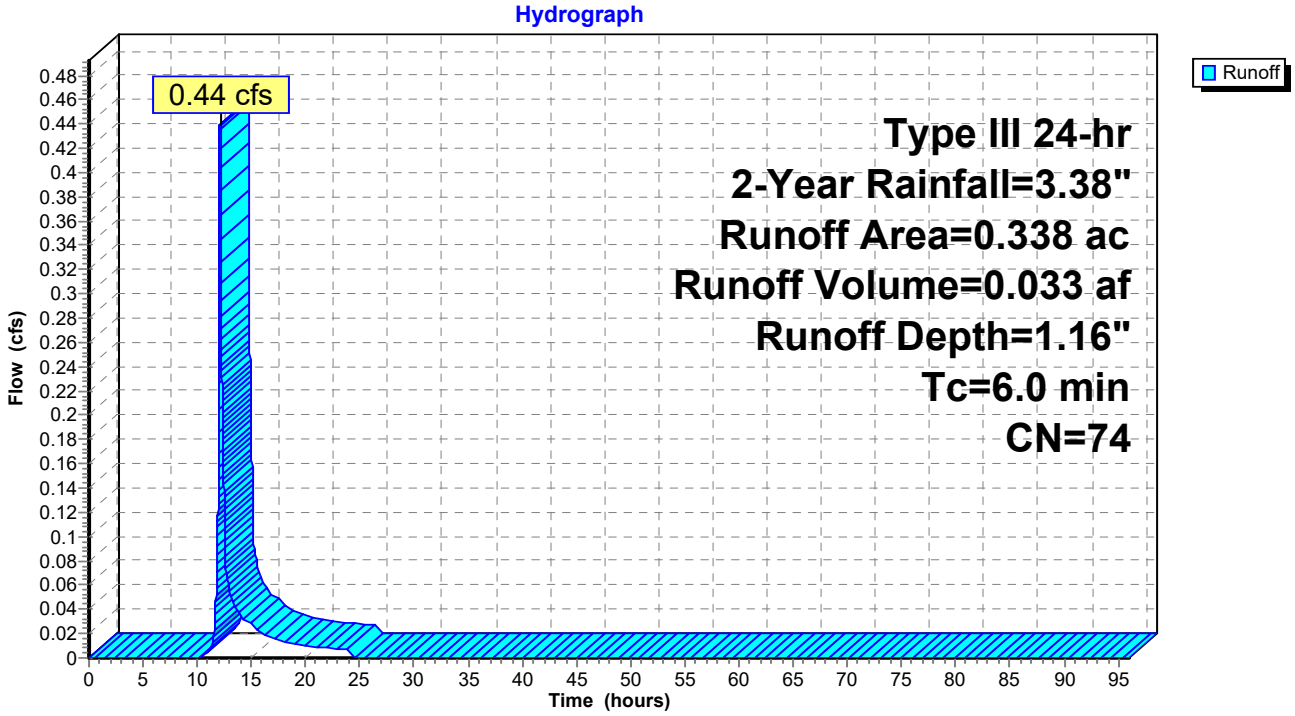
Runoff = 0.44 cfs @ 12.09 hrs, Volume= 0.033 af, Depth= 1.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.38"

Area (ac)	CN	Description
0.338	74	>75% Grass cover, Good, HSG C
0.338		100.00% Pervious Area

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

Subcatchment 7-P: Drainage Area 7: Pervious



Summary for Subcatchment 8-I: Drainage Area 8: Pervious

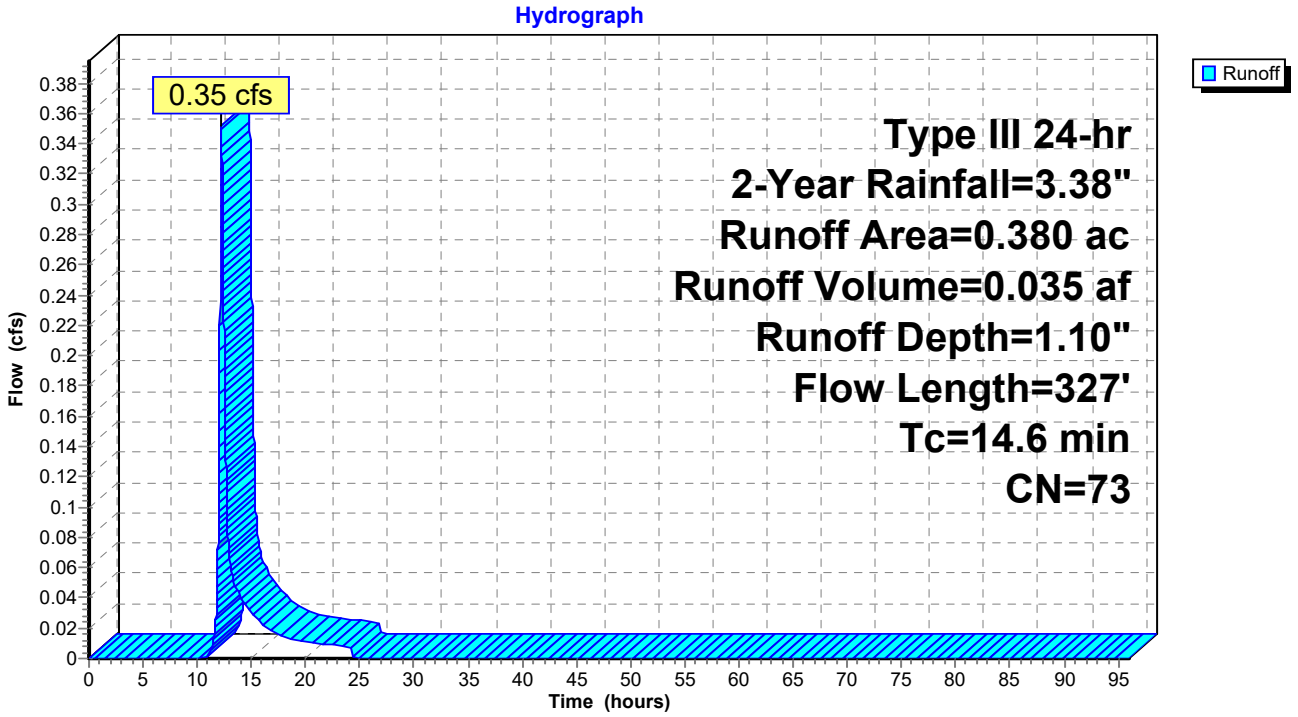
Runoff = 0.35 cfs @ 12.22 hrs, Volume= 0.035 af, Depth= 1.10"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.38"

Area (ac)	CN	Description
0.234	74	>75% Grass cover, Good, HSG C
0.146	72	Woods/grass comb., Good, HSG C
0.380	73	Weighted Average
0.380		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	16	0.1190	0.25		**Sheet Flow, Grass: Short** Grass: Short n= 0.150 P2= 3.38"
12.0	85	0.0580	0.12		**Sheet Flow, Woods: Light Underbrush** Woods: Light underbrush n= 0.400 P2= 3.38"
0.2	23	0.0850	2.04		**Shallow Concentrated Flow, Short Grass Pasture** Short Grass Pasture Kv= 7.0 fps
0.4	28	0.0480	1.10		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
0.3	27	0.0650	1.78		**Shallow Concentrated Flow, Short Grass Pasture** Short Grass Pasture Kv= 7.0 fps
0.5	108	0.0130	3.54	3.54	**Parabolic Channel, Earth Clean and Straight** W=3.00' D=0.50' Area=1.0 sf Perim=3.2' n= 0.022 Earth, clean & straight
0.1	40	0.0270	8.08	6.34	**Pipe Channel, Pipe** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012
14.6	327	Total			

Subcatchment 8-I: Drainage Area 8: Pervious



Summary for Subcatchment I-P: Drainage Area 1: Pervious

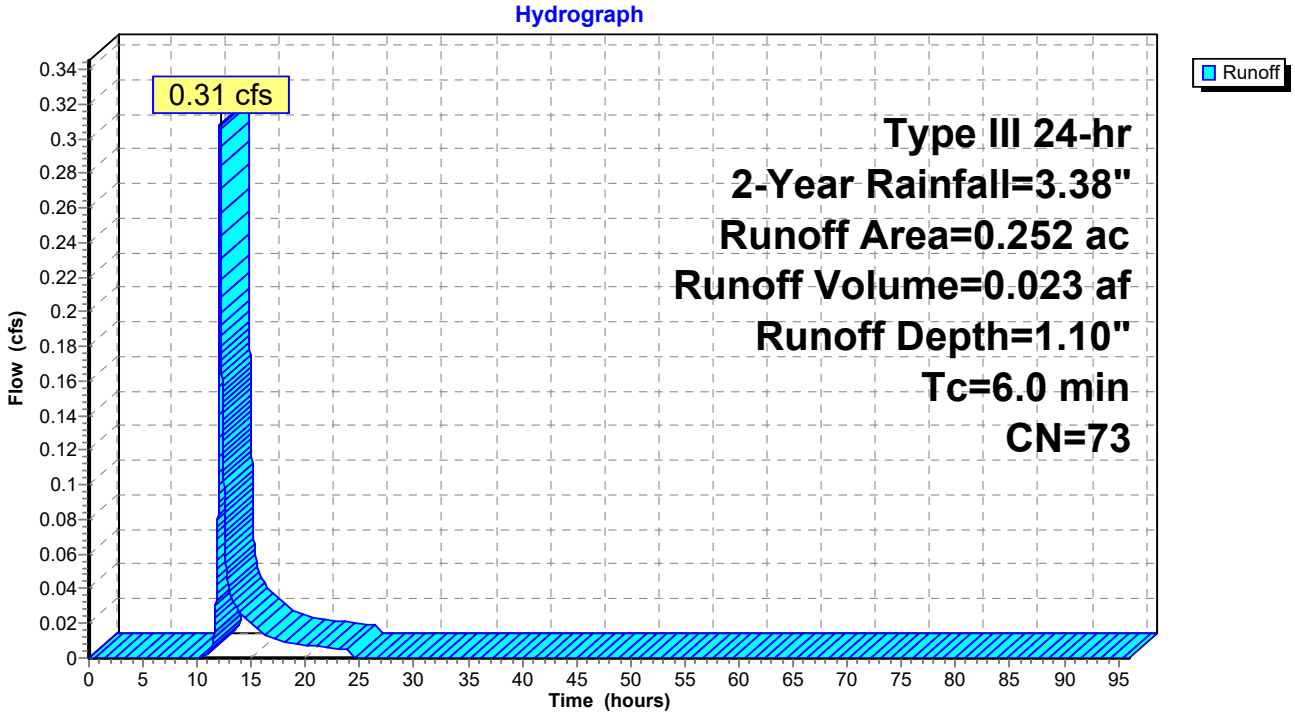
Runoff = 0.31 cfs @ 12.10 hrs, Volume= 0.023 af, Depth= 1.10"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.38"

Area (ac)	CN	Description
0.107	74	>75% Grass cover, Good, HSG C
0.145	72	Woods/grass comb., Good, HSG C
0.252	73	Weighted Average
0.252		100.00% Pervious Area

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

Subcatchment I-P: Drainage Area 1: Pervious



Summary for Pond 1P: Subsurface Detention Basin 1 (Stormtrap-ST2)

Inflow Area = 1.043 ac, 48.80% Impervious, Inflow Depth = 2.60" for 2-Year event
Inflow = 2.81 cfs @ 12.10 hrs, Volume= 0.226 af
Outflow = 0.20 cfs @ 13.60 hrs, Volume= 0.226 af, Atten= 93%, Lag= 89.8 min
Primary = 0.20 cfs @ 13.60 hrs, Volume= 0.226 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 157.83' @ 13.60 hrs Surf.Area= 6,240 sf Storage= 4,691 cf

Plug-Flow detention time= 260.0 min calculated for 0.226 af (100% of inflow)
Center-of-Mass det. time= 260.0 min (1,035.3 - 775.3)

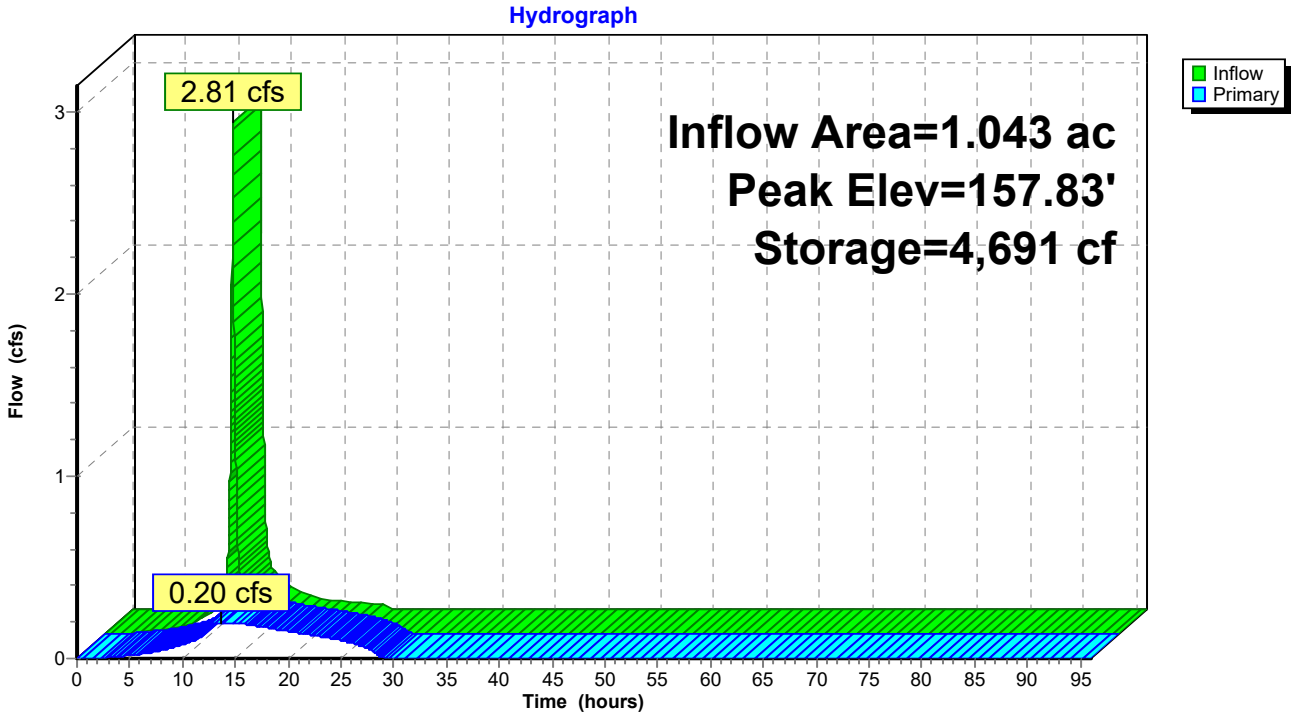
Volume	Invert	Avail.Storage	Storage Description
#1	156.33'	12,969 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
156.33	0	0	0
158.83	10,375	12,969	12,969

Device	Routing	Invert	Outlet Devices
#1	Primary	156.33'	**15.0" Round Culvert** L= 50.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 156.33' / 156.00' S= 0.0066 '/' Cc= 0.900 n= 0.012, Flow Area= 1.23 sf
#2	Device 1	156.33'	**2.5" Vert. Orifice/Grate** C= 0.600
#3	Device 1	157.83'	**18.0" W x 6.0" H Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.20 cfs @ 13.60 hrs HW=157.83' TW=156.25' (Dynamic Tailwater)
└─**1=Culvert** (Passes 0.20 cfs of 5.20 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.19 cfs @ 5.70 fps)
  └─**3=Orifice/Grate** (Orifice Controls 0.00 cfs @ 0.19 fps)

Pond 1P: Subsurface Detention Basin 1 (Stormtrap-ST2)



Summary for Pond 2P: SubSurface Detention Basin 2 (Stormtrap-ST2)

Inflow Area = 0.404 ac,100.00% Impervious, Inflow Depth = 3.15" for 2-Year event
Inflow = 1.33 cfs @ 12.08 hrs, Volume= 0.106 af
Outflow = 0.19 cfs @ 12.59 hrs, Volume= 0.106 af, Atten= 86%, Lag= 30.1 min
Primary = 0.19 cfs @ 12.59 hrs, Volume= 0.106 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 158.70' @ 12.59 hrs Surf.Area= 2,323 sf Storage= 1,595 cf

Plug-Flow detention time= 68.4 min calculated for 0.106 af (100% of inflow)
Center-of-Mass det. time= 68.4 min (823.7 - 755.3)

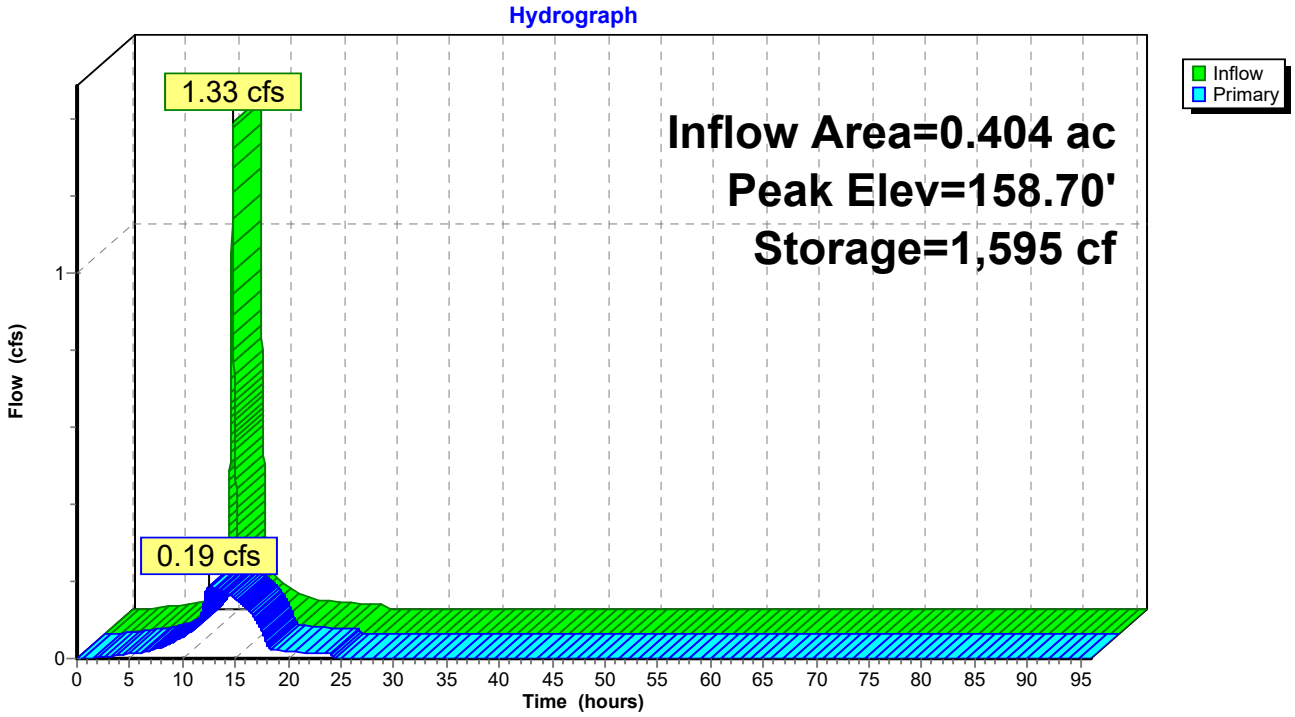
Volume	Invert	Avail.Storage	Storage Description
#1	157.33'	5,286 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
157.33	0	0	0
159.83	4,229	5,286	5,286

Device	Routing	Invert	Outlet Devices
#1	Primary	157.33'	**15.0" Round Culvert** L= 245.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 157.33' / 151.13' S= 0.0253 '/' Cc= 0.900 n= 0.012, Flow Area= 1.23 sf
#2	Device 1	157.33'	**2.5" Vert. Orifice/Grate** C= 0.600
#3	Device 1	158.70'	**18.0" W x 6.0" H Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.19 cfs @ 12.59 hrs HW=158.70' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Passes 0.19 cfs of 4.03 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.18 cfs @ 5.42 fps)
  └─**3=Orifice/Grate** (Orifice Controls 0.00 cfs @ 0.18 fps)

Pond 2P: SubSurface Detention Basin 2 (Stormtrap-ST2)



Summary for Pond Bio1: Bioretention Basin 1

Inflow Area = 0.722 ac, 42.52% Impervious, Inflow Depth = 2.19" for 2-Year event
Inflow = 1.67 cfs @ 12.09 hrs, Volume= 0.132 af
Outflow = 0.14 cfs @ 13.08 hrs, Volume= 0.132 af, Atten= 91%, Lag= 59.9 min
Primary = 0.14 cfs @ 13.08 hrs, Volume= 0.132 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 156.30' @ 13.08 hrs Surf.Area= 2,049 sf Storage= 2,448 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 246.5 min (1,026.5 - 780.0)

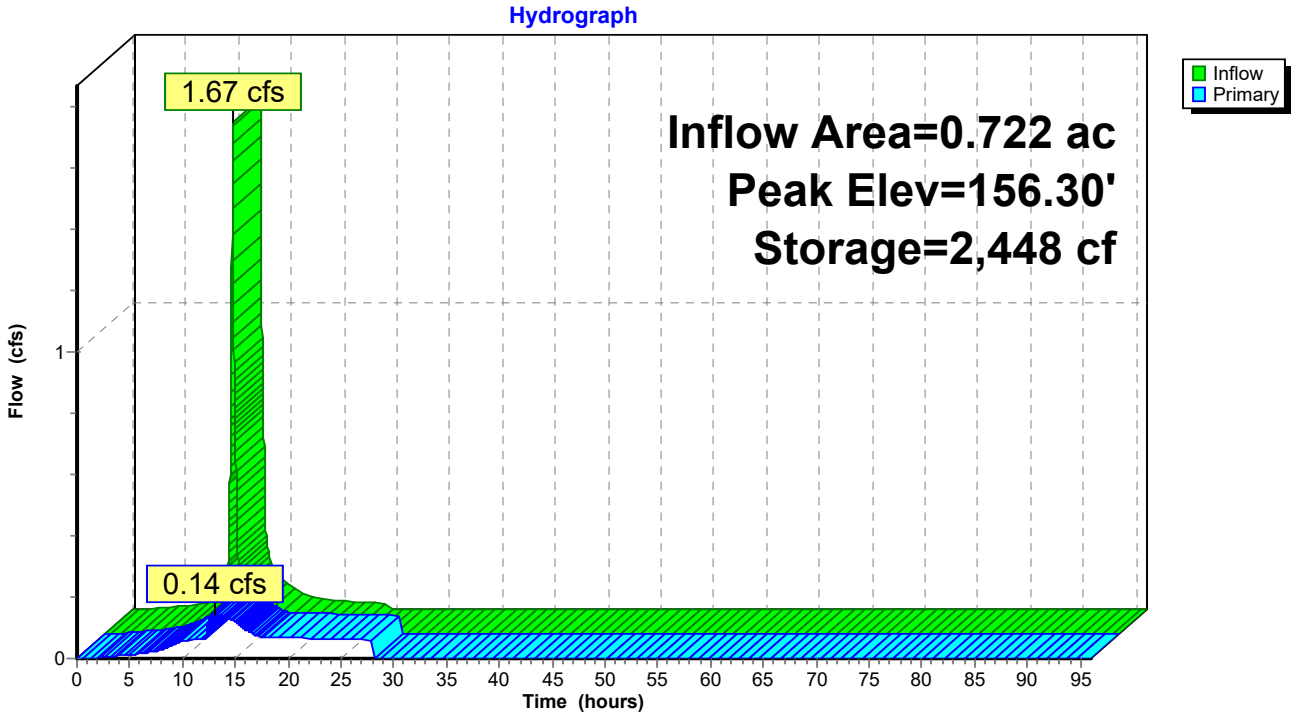
Volume	Invert	Avail.Storage	Storage Description
#1	155.00'	8,960 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
155.00	1,718	0	0
156.00	1,970	1,844	1,844
157.00	2,232	2,101	3,945
158.00	2,505	2,369	6,314
159.00	2,787	2,646	8,960

Device	Routing	Invert	Outlet Devices
#1	Primary	151.80'	**15.0" Round Culvert** L= 95.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 151.80' / 151.00' S= 0.0084 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Device 1	155.00'	**1.500 in/hr Exfiltration over Surface area**
#3	Device 1	156.00'	**2.5" Vert. Orifice/Grate** C= 0.600
#4	Device 1	157.30'	**6.0" W x 6.0" H Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.14 cfs @ 13.08 hrs HW=156.30' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Passes 0.14 cfs of 10.28 cfs potential flow)
  ├─**2=Exfiltration** (Exfiltration Controls 0.07 cfs)
  ├─**3=Orifice/Grate** (Orifice Controls 0.07 cfs @ 2.13 fps)
  └─**4=Orifice/Grate** (Controls 0.00 cfs)

Pond Bio1: Bioretention Basin 1



Summary for Pond Bio2: Bioretention Basin 2

Inflow Area = 1.235 ac, 41.21% Impervious, Inflow Depth = 2.36" for 2-Year event
Inflow = 0.38 cfs @ 12.10 hrs, Volume= 0.243 af
Outflow = 0.13 cfs @ 22.32 hrs, Volume= 0.243 af, Atten= 66%, Lag= 613.1 min
Primary = 0.13 cfs @ 22.32 hrs, Volume= 0.243 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 156.66' @ 22.32 hrs Surf.Area= 3,790 sf Storage= 2,324 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 181.4 min (1,205.0 - 1,023.6)

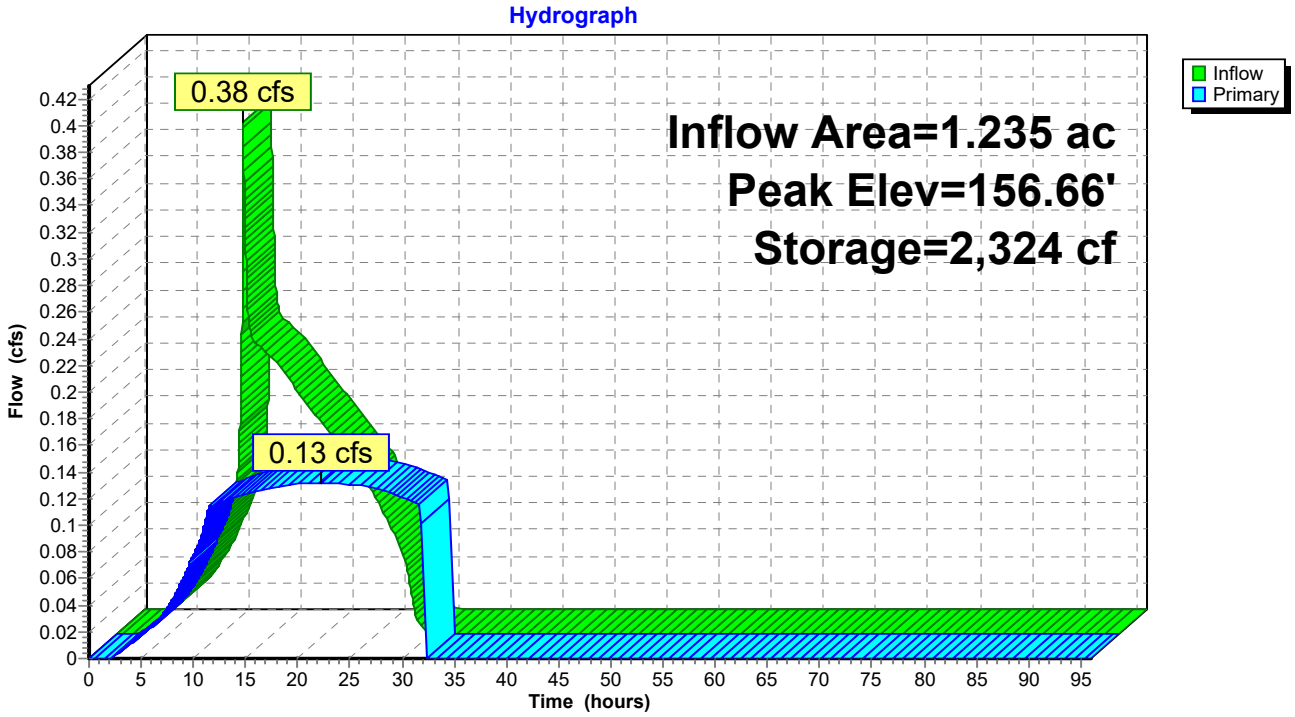
Volume	Invert	Avail.Storage	Storage Description
#1	156.00'	13,443 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
156.00	3,288	0	0
157.00	4,052	3,670	3,670
158.00	4,872	4,462	8,132
159.00	5,749	5,311	13,443

Device	Routing	Invert	Outlet Devices
#1	Primary	152.17'	**15.0" Round Culvert** L= 109.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 152.17' / 151.30' S= 0.0080 '/' Cc= 0.900 n= 0.012, Flow Area= 1.23 sf
#2	Device 1	156.00'	**1.500 in/hr Exfiltration over Surface area**
#3	Device 1	157.00'	**2.5" Vert. Orifice/Grate** C= 0.600
#4	Device 1	157.54'	**4.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.13 cfs @ 22.32 hrs HW=156.66' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Passes 0.13 cfs of 10.42 cfs potential flow)
  ├─**2=Exfiltration** (Exfiltration Controls 0.13 cfs)
  ├─**3=Orifice/Grate** (Controls 0.00 cfs)
  └─**4=Orifice/Grate** (Controls 0.00 cfs)

Pond Bio2: Bioretention Basin 2

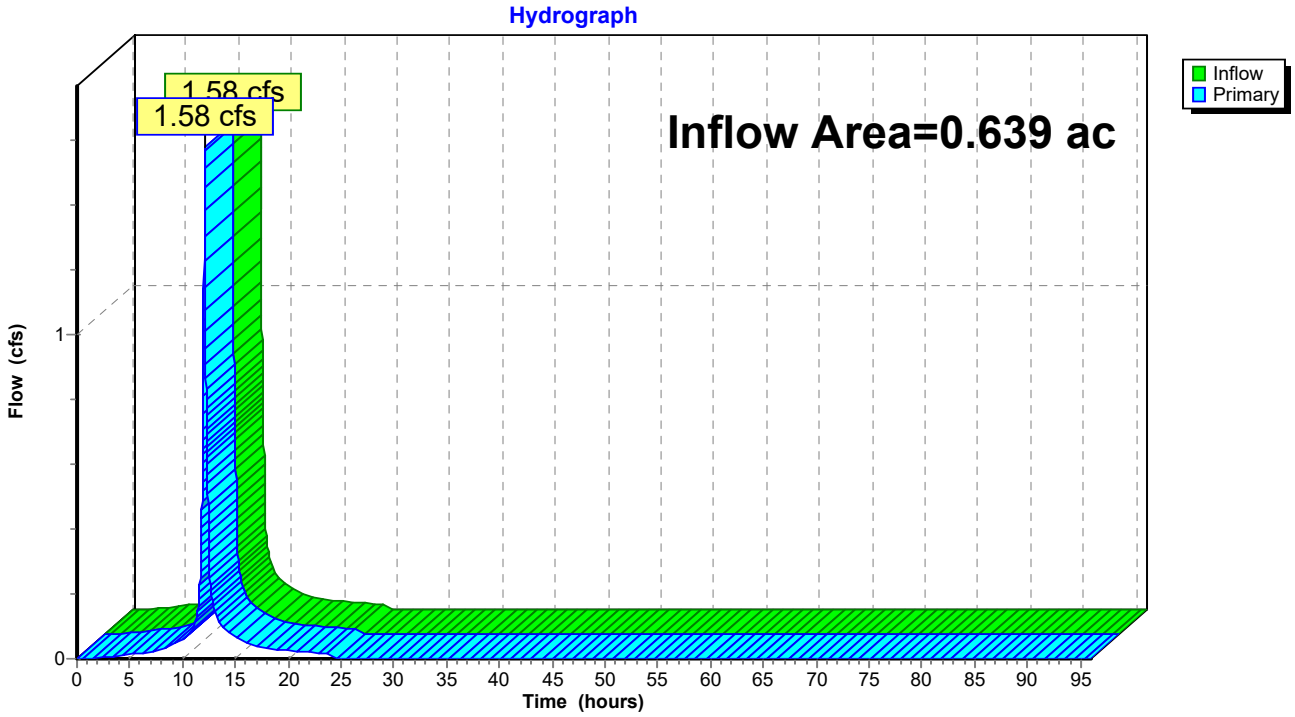


Summary for Link 1: Drainage Area 1

Inflow Area = 0.639 ac, 48.04% Impervious, Inflow Depth = 2.34" for 2-Year event
Inflow = 1.58 cfs @ 12.09 hrs, Volume= 0.125 af
Primary = 1.58 cfs @ 12.09 hrs, Volume= 0.125 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Link 1: Drainage Area 1

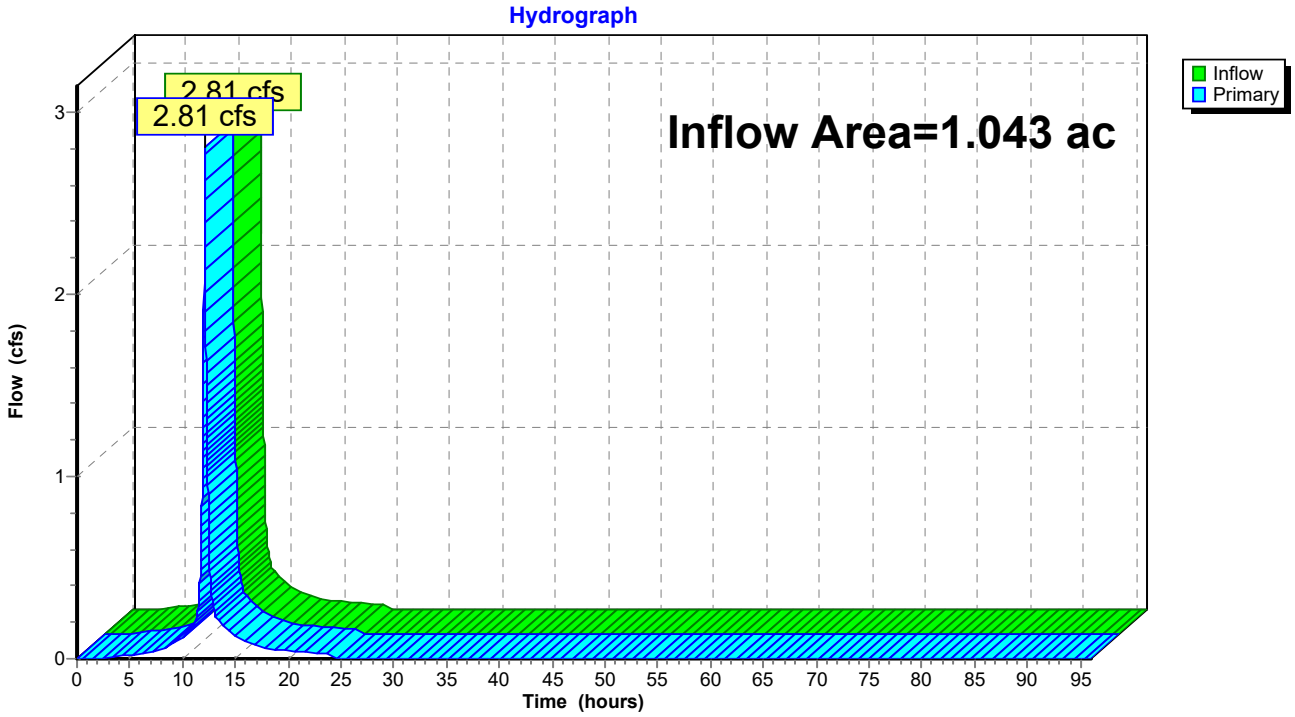


Summary for Link 2: Drainage Area 2

Inflow Area = 1.043 ac, 48.80% Impervious, Inflow Depth = 2.60" for 2-Year event
Inflow = 2.81 cfs @ 12.10 hrs, Volume= 0.226 af
Primary = 2.81 cfs @ 12.10 hrs, Volume= 0.226 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Link 2: Drainage Area 2

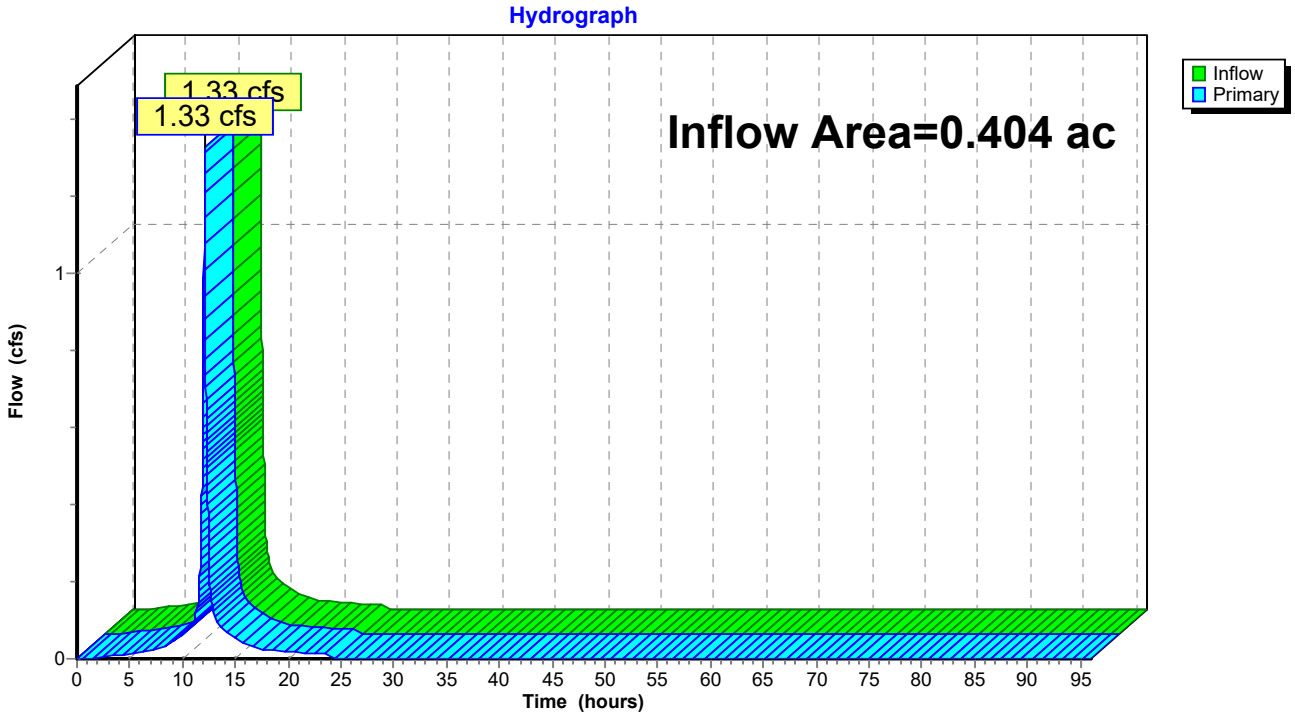


Summary for Link 3: Drainage Area 3

Inflow Area = 0.404 ac,100.00% Impervious, Inflow Depth = 3.15" for 2-Year event
Inflow = 1.33 cfs @ 12.08 hrs, Volume= 0.106 af
Primary = 1.33 cfs @ 12.08 hrs, Volume= 0.106 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Link 3: Drainage Area 3

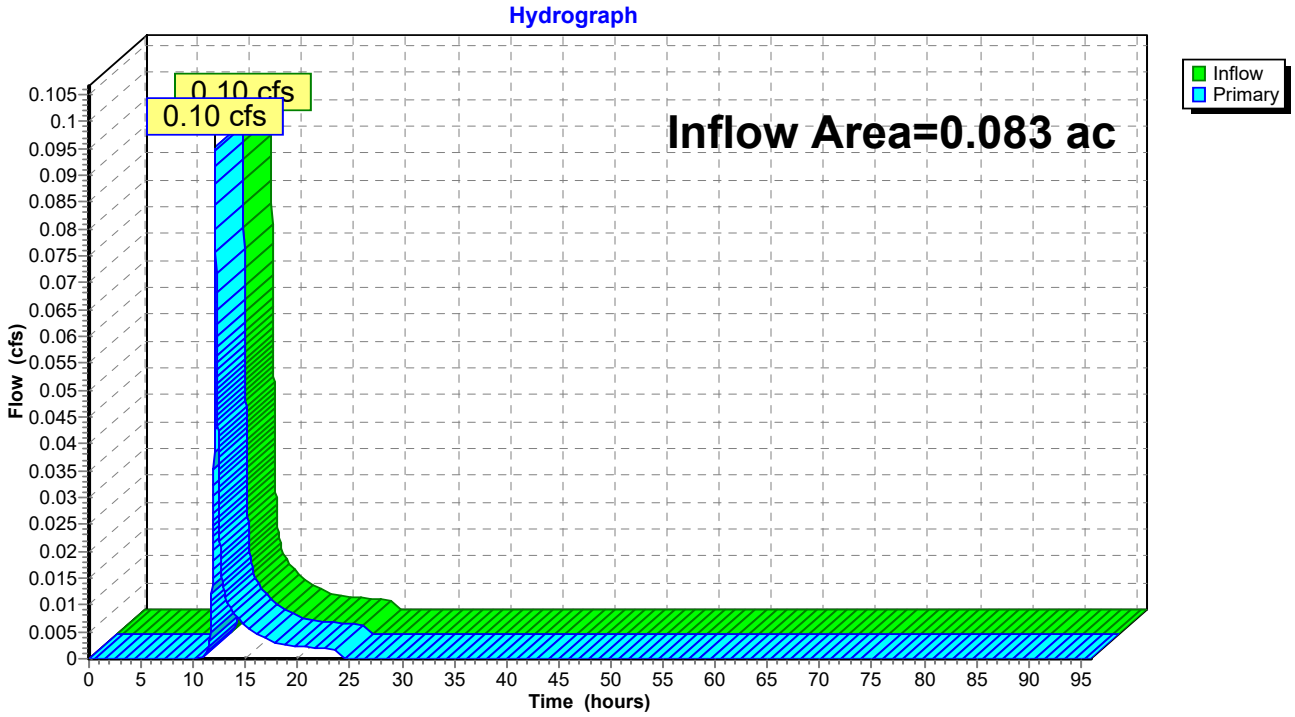


Summary for Link 4: Drainage Area 4

Inflow Area = 0.083 ac, 0.00% Impervious, Inflow Depth = 1.04" for 2-Year event
Inflow = 0.10 cfs @ 12.10 hrs, Volume= 0.007 af
Primary = 0.10 cfs @ 12.10 hrs, Volume= 0.007 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Link 4: Drainage Area 4

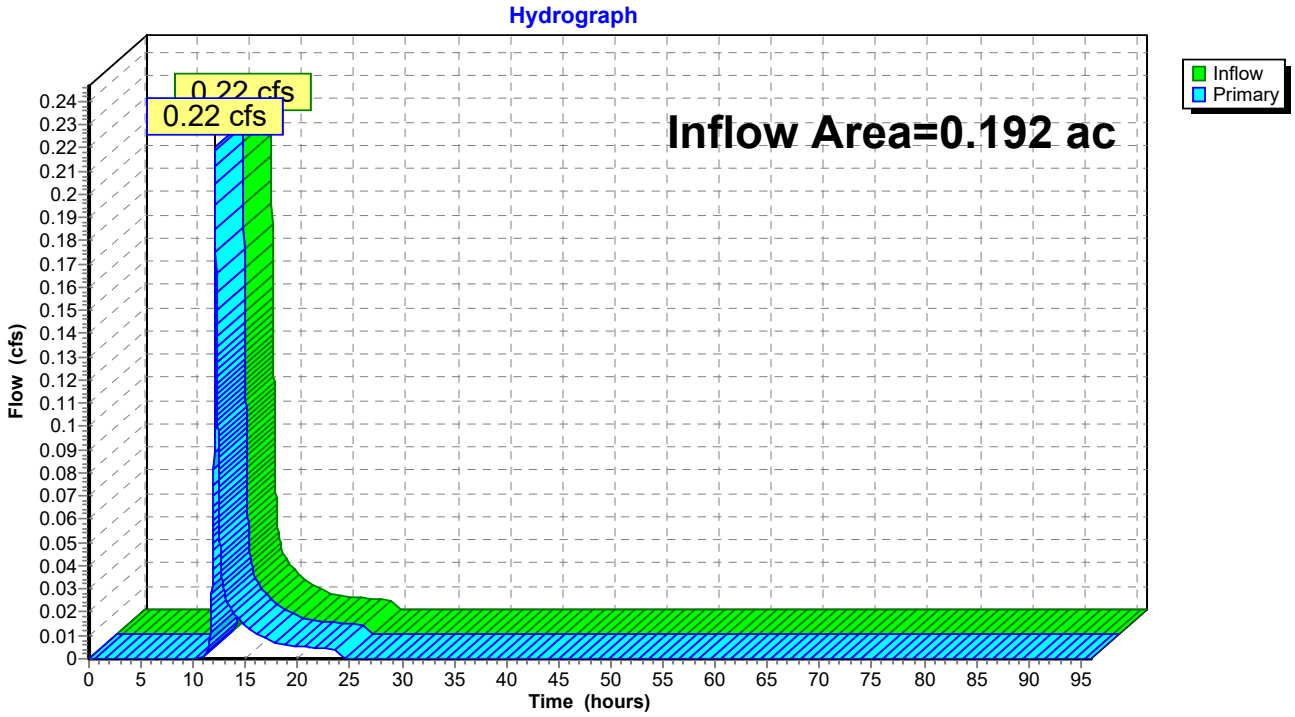


Summary for Link 5: Drainage Area 5

Inflow Area = 0.192 ac, 0.00% Impervious, Inflow Depth = 1.04" for 2-Year event
Inflow = 0.22 cfs @ 12.10 hrs, Volume= 0.017 af
Primary = 0.22 cfs @ 12.10 hrs, Volume= 0.017 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Link 5: Drainage Area 5

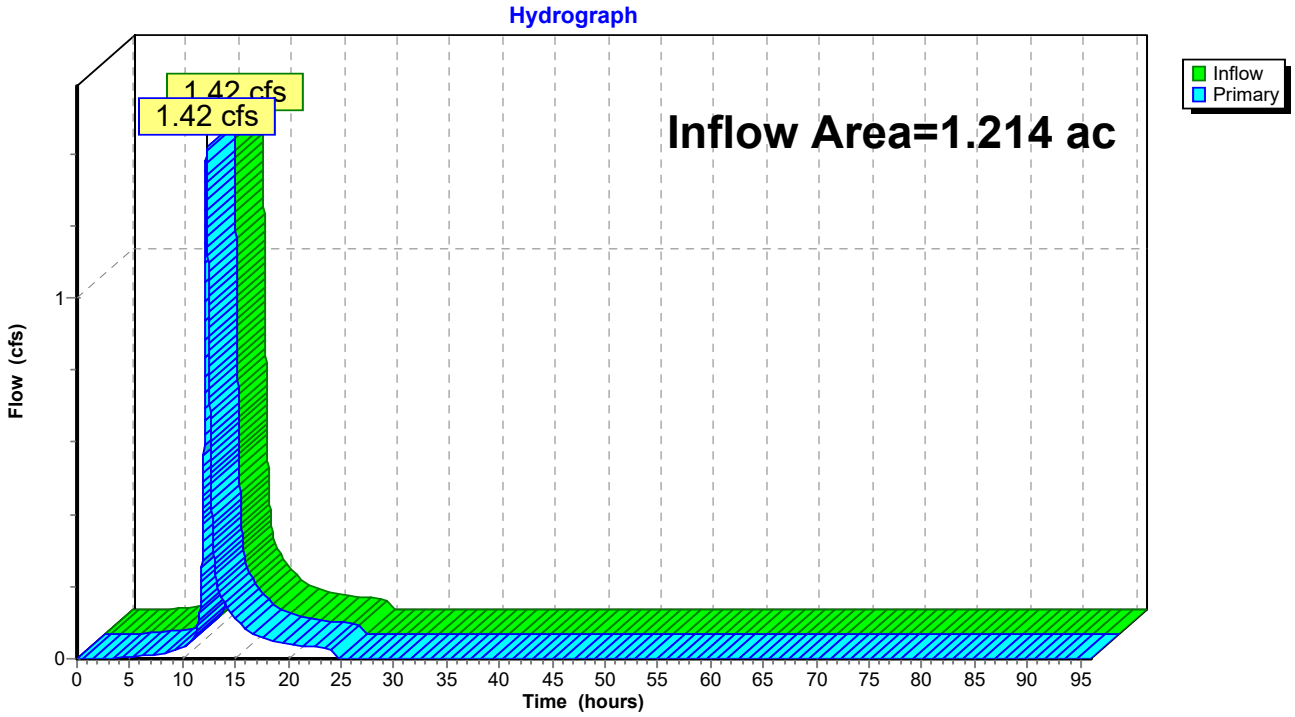


Summary for Link 6: Drainage Area 6

Inflow Area = 1.214 ac, 13.01% Impervious, Inflow Depth = 1.50" for 2-Year event
Inflow = 1.42 cfs @ 12.25 hrs, Volume= 0.152 af
Primary = 1.42 cfs @ 12.25 hrs, Volume= 0.152 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Link 6: Drainage Area 6

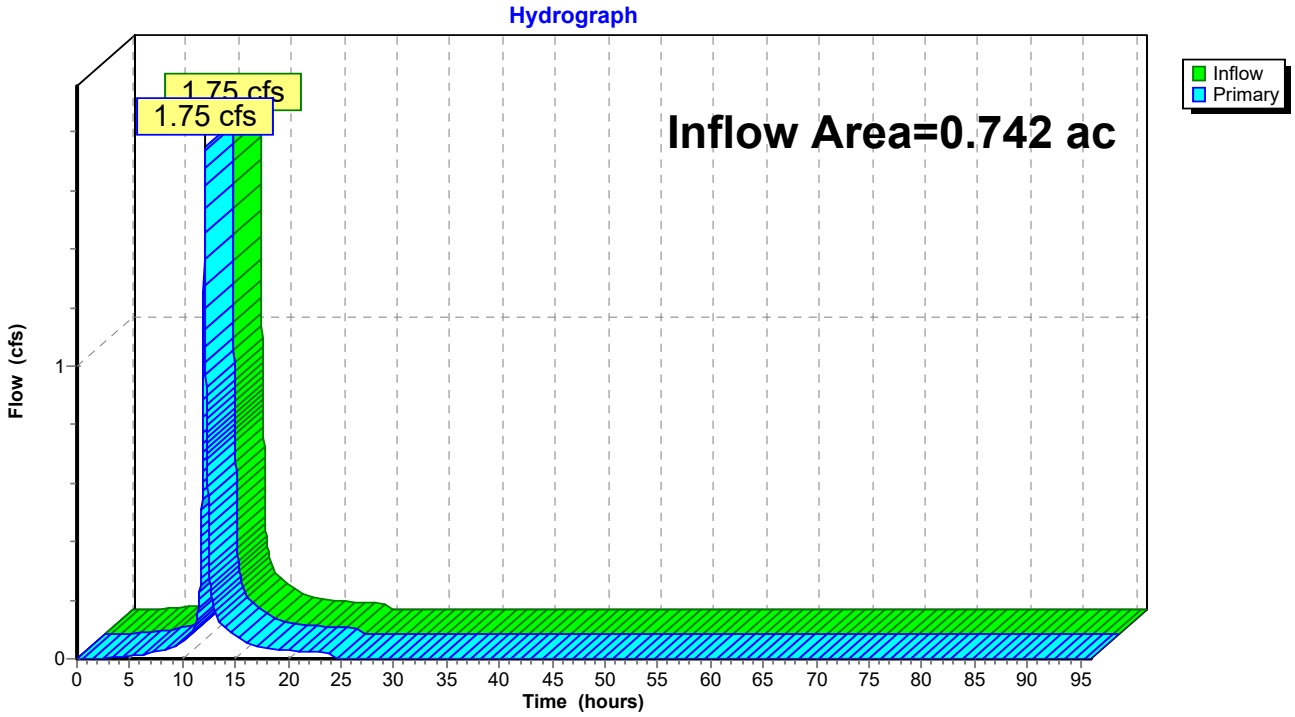


Summary for Link 7: Drainage Area 7

Inflow Area = 0.742 ac, 32.88% Impervious, Inflow Depth = 2.18" for 2-Year event
Inflow = 1.75 cfs @ 12.09 hrs, Volume= 0.135 af
Primary = 1.75 cfs @ 12.09 hrs, Volume= 0.135 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Link 7: Drainage Area 7

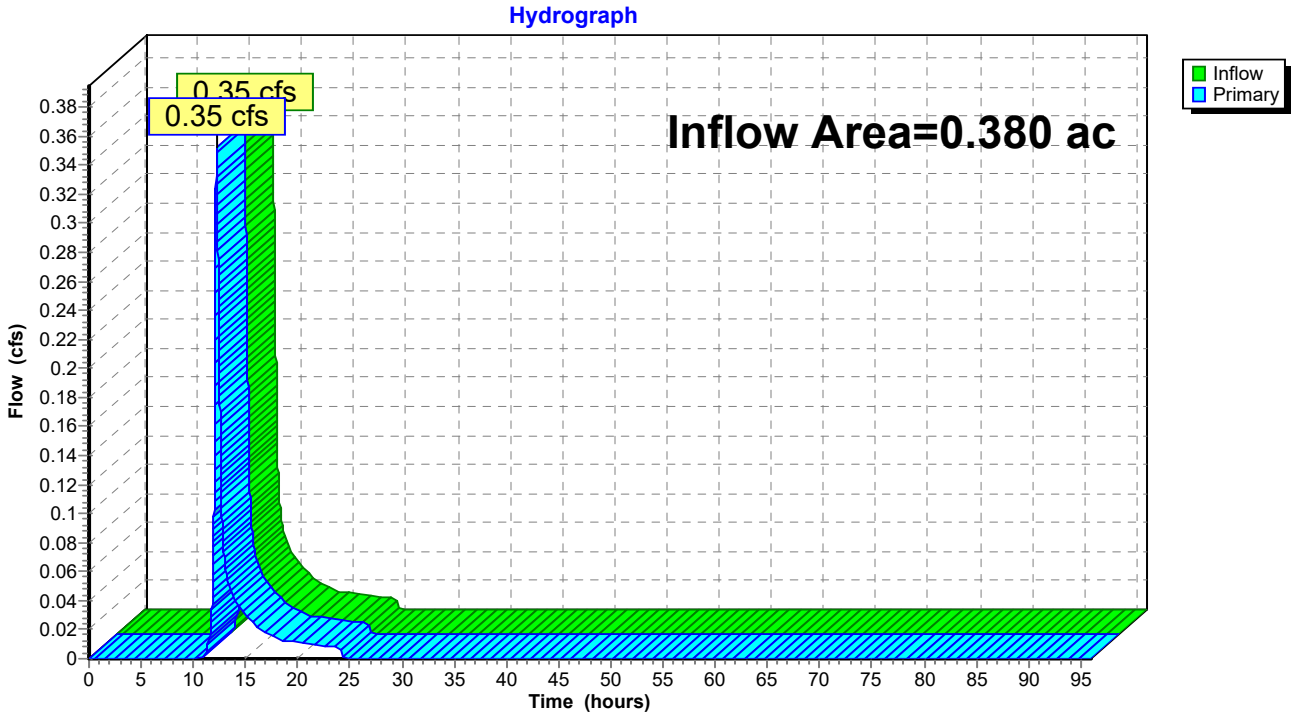


Summary for Link 8: Drainage Area 8

Inflow Area = 0.380 ac, 0.00% Impervious, Inflow Depth = 1.10" for 2-Year event
Inflow = 0.35 cfs @ 12.22 hrs, Volume= 0.035 af
Primary = 0.35 cfs @ 12.22 hrs, Volume= 0.035 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Link 8: Drainage Area 8

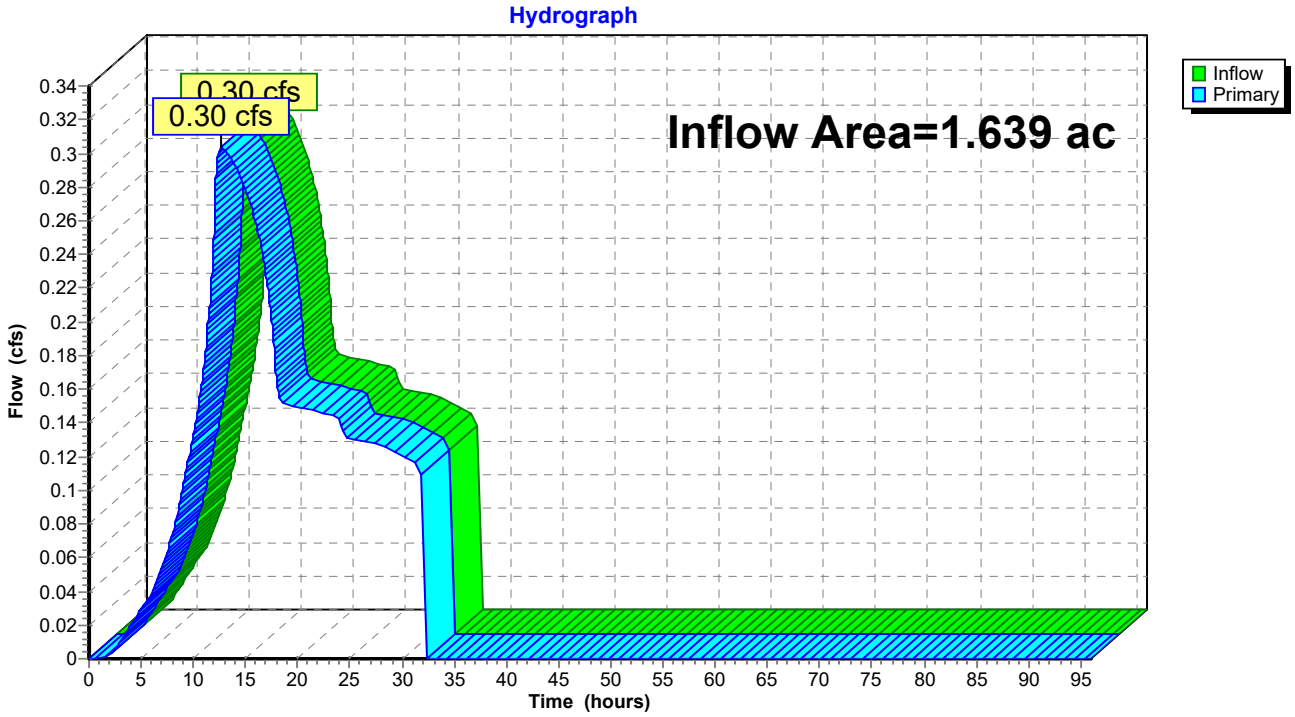


Summary for Link MH9: ST MH 9 Connector

Inflow Area = 1.639 ac, 55.70% Impervious, Inflow Depth = 2.55" for 2-Year event
Inflow = 0.30 cfs @ 12.59 hrs, Volume= 0.349 af
Primary = 0.30 cfs @ 12.59 hrs, Volume= 0.349 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Link MH9: ST MH 9 Connector

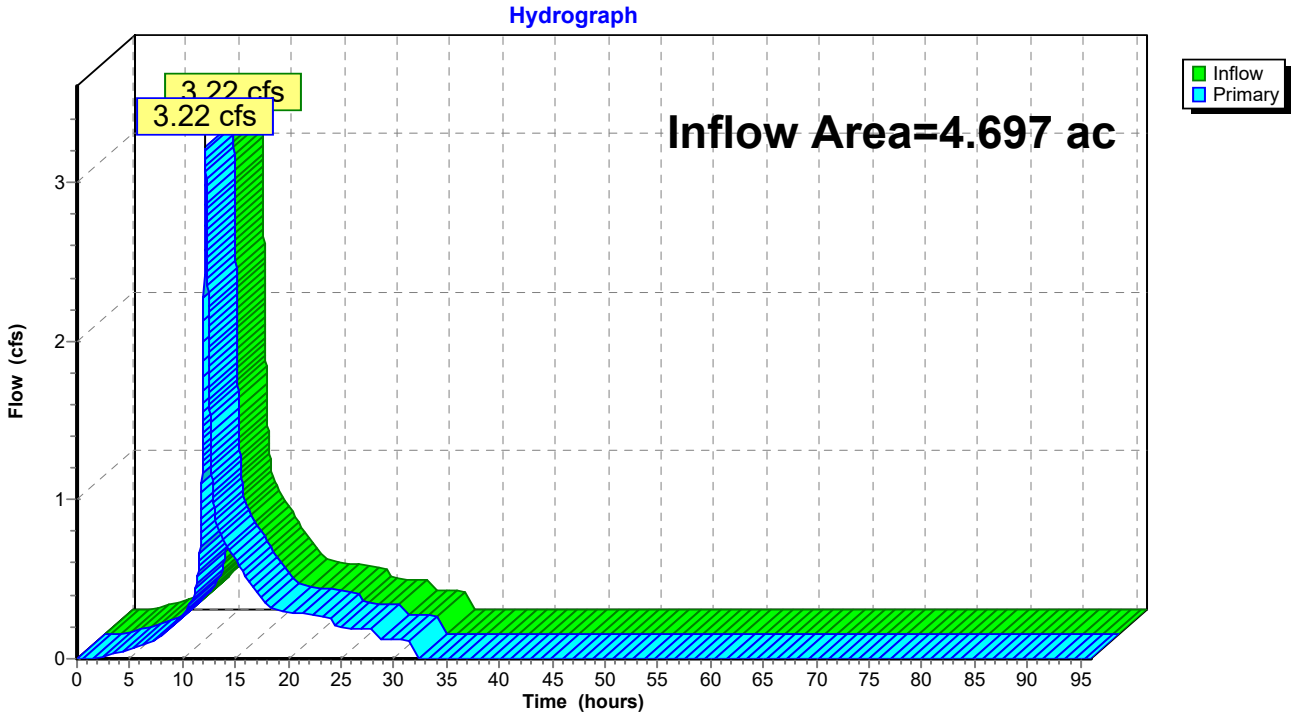


Summary for Link PE: Penn East Total Runoff

Inflow Area = 4.697 ac, 34.53% Impervious, Inflow Depth = 2.05" for 2-Year event
Inflow = 3.22 cfs @ 12.12 hrs, Volume= 0.802 af
Primary = 3.22 cfs @ 12.12 hrs, Volume= 0.802 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Link PE: Penn East Total Runoff



Time span=0.00-96.00 hrs, dt=0.01 hrs, 9601 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1-I: Drainage Area 1: Runoff Area=0.387 ac 79.33% Impervious Runoff Depth=4.76"
Flow Length=119' Tc=6.0 min CN=98 Runoff=1.89 cfs 0.154 af

Subcatchment 2-I: Drainage Area 2: Runoff Area=0.802 ac 63.47% Impervious Runoff Depth=4.65"
Flow Length=252' Tc=7.0 min CN=97 Runoff=3.76 cfs 0.311 af

Subcatchment 2-P: Drainage Area 2: Runoff Area=0.241 ac 0.00% Impervious Runoff Depth=2.36"
Tc=7.0 min CN=74 Runoff=0.64 cfs 0.047 af

Subcatchment 3-I: Drainage Area 3: Roofs Runoff Area=0.404 ac 100.00% Impervious Runoff Depth=4.76"
Tc=6.0 min CN=98 Runoff=1.98 cfs 0.160 af

Subcatchment 4-P: Drainage Area 4: Runoff Area=0.083 ac 0.00% Impervious Runoff Depth=2.20"
Tc=6.0 min CN=72 Runoff=0.21 cfs 0.015 af

Subcatchment 5-P: Drainage Area 5: Runoff Area=0.192 ac 0.00% Impervious Runoff Depth=2.20"
Tc=6.0 min CN=72 Runoff=0.49 cfs 0.035 af

Subcatchment 6-I: Drainage Area 6: Runoff Area=0.223 ac 70.85% Impervious Runoff Depth=4.65"
Flow Length=596' Tc=17.7 min CN=97 Runoff=0.78 cfs 0.086 af

Subcatchment 6-P: Drainage Area 6: Runoff Area=0.991 ac 0.00% Impervious Runoff Depth=2.36"
Tc=17.7 min CN=74 Runoff=1.93 cfs 0.195 af

Subcatchment 7-I: Drainage Area 7: Runoff Area=0.404 ac 60.40% Impervious Runoff Depth=4.65"
Tc=6.0 min CN=97 Runoff=1.96 cfs 0.156 af

Subcatchment 7-P: Drainage Area 7: Runoff Area=0.338 ac 0.00% Impervious Runoff Depth=2.36"
Tc=6.0 min CN=74 Runoff=0.93 cfs 0.067 af

Subcatchment 8-I: Drainage Area 8: Pervious Runoff Area=0.380 ac 0.00% Impervious Runoff Depth=2.28"
Flow Length=327' Tc=14.6 min CN=73 Runoff=0.77 cfs 0.072 af

Subcatchment I-P: Drainage Area 1: Pervious Runoff Area=0.252 ac 0.00% Impervious Runoff Depth=2.28"
Tc=6.0 min CN=73 Runoff=0.67 cfs 0.048 af

Pond 1P: Subsurface Detention Basin 1 Peak Elev=158.12' Storage=6,664 cf Inflow=4.40 cfs 0.358 af
Outflow=0.97 cfs 0.358 af

Pond 2P: SubSurface Detention Basin 2 Peak Elev=158.92' Storage=2,131 cf Inflow=1.98 cfs 0.160 af
Outflow=0.69 cfs 0.160 af

Pond Bio1: Bioretention Basin 1 Peak Elev=157.16' Storage=4,315 cf Inflow=2.77 cfs 0.217 af
Outflow=0.25 cfs 0.217 af

Pond Bio2: Bioretention Basin 2 Peak Elev=157.31' Storage=4,965 cf Inflow=1.11 cfs 0.393 af
Outflow=0.22 cfs 0.393 af

Link 1: Drainage Area 1 Inflow=2.56 cfs 0.202 af
Primary=2.56 cfs 0.202 af

Link 2: Drainage Area 2 Inflow=4.40 cfs 0.358 af
Primary=4.40 cfs 0.358 af

Link 3: Drainage Area 3 Inflow=1.98 cfs 0.160 af
Primary=1.98 cfs 0.160 af

Link 4: Drainage Area 4 Inflow=0.21 cfs 0.015 af
Primary=0.21 cfs 0.015 af

Link 5: Drainage Area 5 Inflow=0.49 cfs 0.035 af
Primary=0.49 cfs 0.035 af

Link 6: Drainage Area 6 Inflow=2.71 cfs 0.282 af
Primary=2.71 cfs 0.282 af

Link 7: Drainage Area 7 Inflow=2.89 cfs 0.223 af
Primary=2.89 cfs 0.223 af

Link 8: Drainage Area 8 Inflow=0.77 cfs 0.072 af
Primary=0.77 cfs 0.072 af

Link MH9: ST MH 9 Connector Inflow=0.81 cfs 0.554 af
Primary=0.81 cfs 0.554 af

Link PE: Penn East Total Runoff Inflow=5.91 cfs 1.347 af
Primary=5.91 cfs 1.347 af

Total Runoff Area = 4.697 ac Runoff Volume = 1.347 af Average Runoff Depth = 3.44"
65.47% Pervious = 3.075 ac 34.53% Impervious = 1.622 ac

Summary for Subcatchment 1-I: Drainage Area 1: Impervious

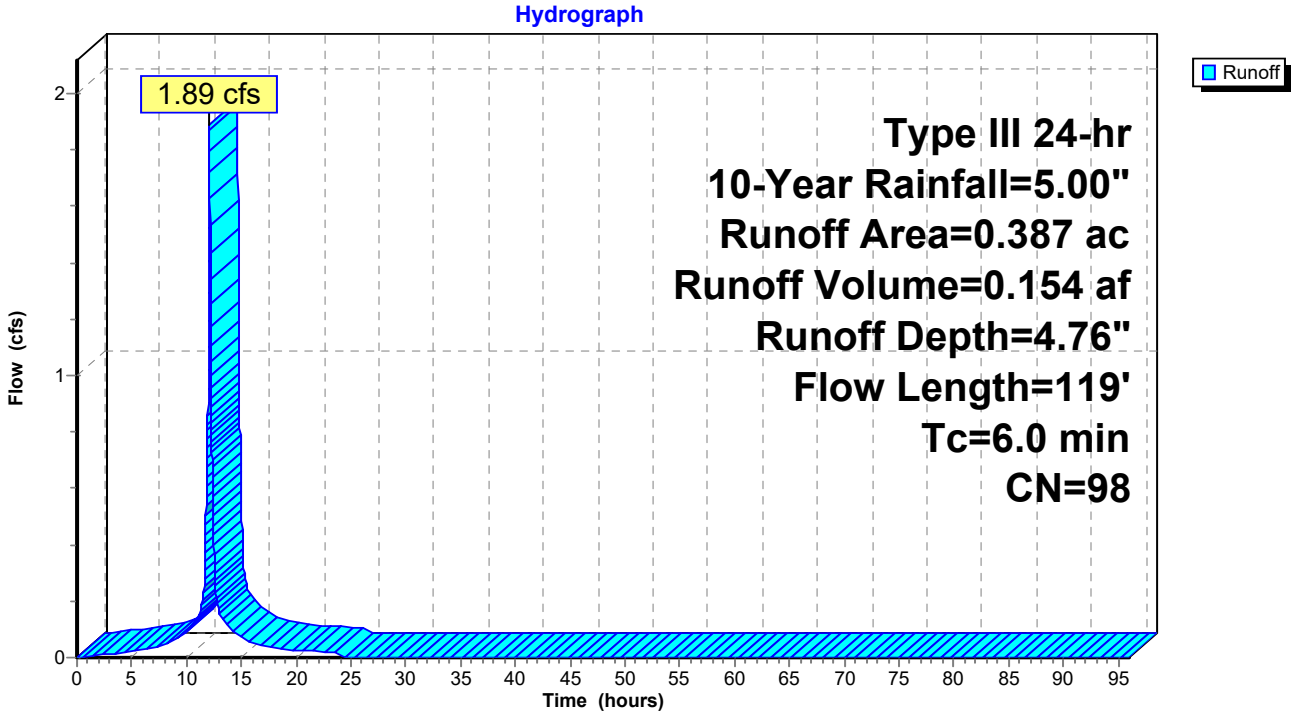
Runoff = 1.89 cfs @ 12.08 hrs, Volume= 0.154 af, Depth= 4.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.00"

Area (ac)	CN	Description
0.080	96	Gravel surface, HSG C
0.015	98	Unconnected pavement, HSG C
0.292	98	Paved parking, HSG C
0.387	98	Weighted Average
0.080		20.67% Pervious Area
0.307		79.33% Impervious Area
0.015		4.89% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	119		0.33		**Direct Entry, Direct**

Subcatchment 1-I: Drainage Area 1: Impervious



Summary for Subcatchment 2-I: Drainage Area 2: Impervious

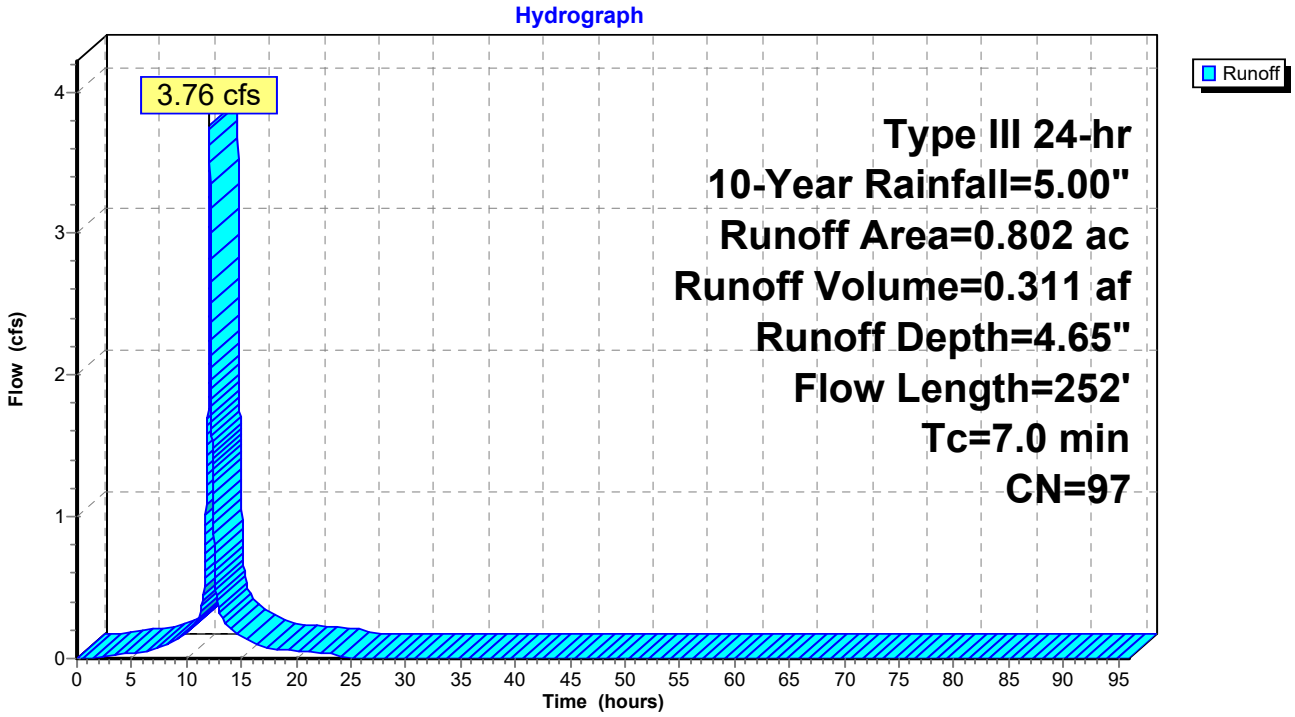
Runoff = 3.76 cfs @ 12.10 hrs, Volume= 0.311 af, Depth= 4.65"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.00"

Area (ac)	CN	Description
0.293	96	Gravel surface, HSG C
0.497	98	Paved parking, HSG C
0.012	98	Unconnected pavement, HSG C
0.802	97	Weighted Average
0.293		36.53% Pervious Area
0.509		63.47% Impervious Area
0.012		2.36% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.1	44	0.0840	0.18		**Sheet Flow, Grass: Dense** Grass: Dense n= 0.240 P2= 3.38"
2.1	38	0.3310	0.30		**Sheet Flow, Grass: Dense** Grass: Dense n= 0.240 P2= 3.38"
0.2	18	0.0500	1.45		**Sheet Flow, Smooth Surfaces** Smooth surfaces n= 0.011 P2= 3.38"
0.6	152	0.0370	3.90		**Shallow Concentrated Flow, Paved** Paved Kv= 20.3 fps
7.0	252	Total			

Subcatchment 2-I: Drainage Area 2: Impervious



Summary for Subcatchment 2-P: Drainage Area 2: Pervious

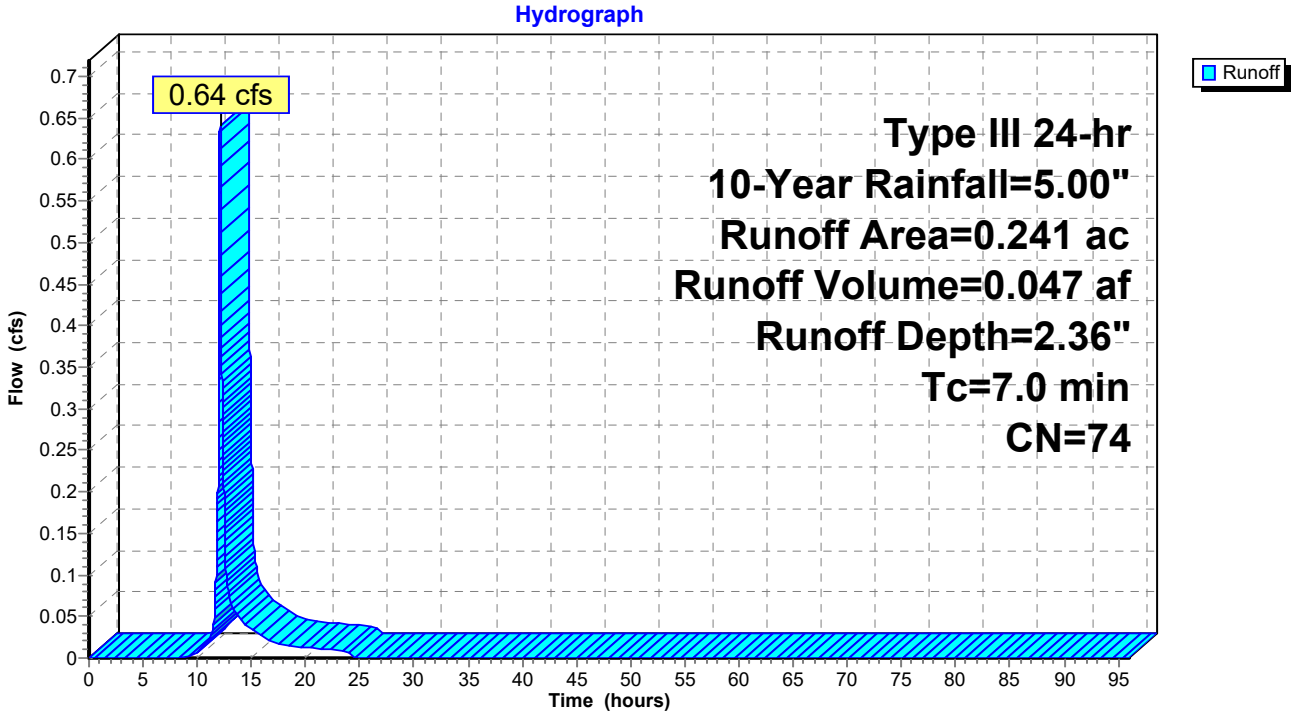
Runoff = 0.64 cfs @ 12.10 hrs, Volume= 0.047 af, Depth= 2.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.00"

Area (ac)	CN	Description
0.186	74	>75% Grass cover, Good, HSG C
0.055	72	Woods/grass comb., Good, HSG C
0.241	74	Weighted Average
0.241		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0					**Direct Entry, 2-I**

Subcatchment 2-P: Drainage Area 2: Pervious



Summary for Subcatchment 3-I: Drainage Area 3: Roofs

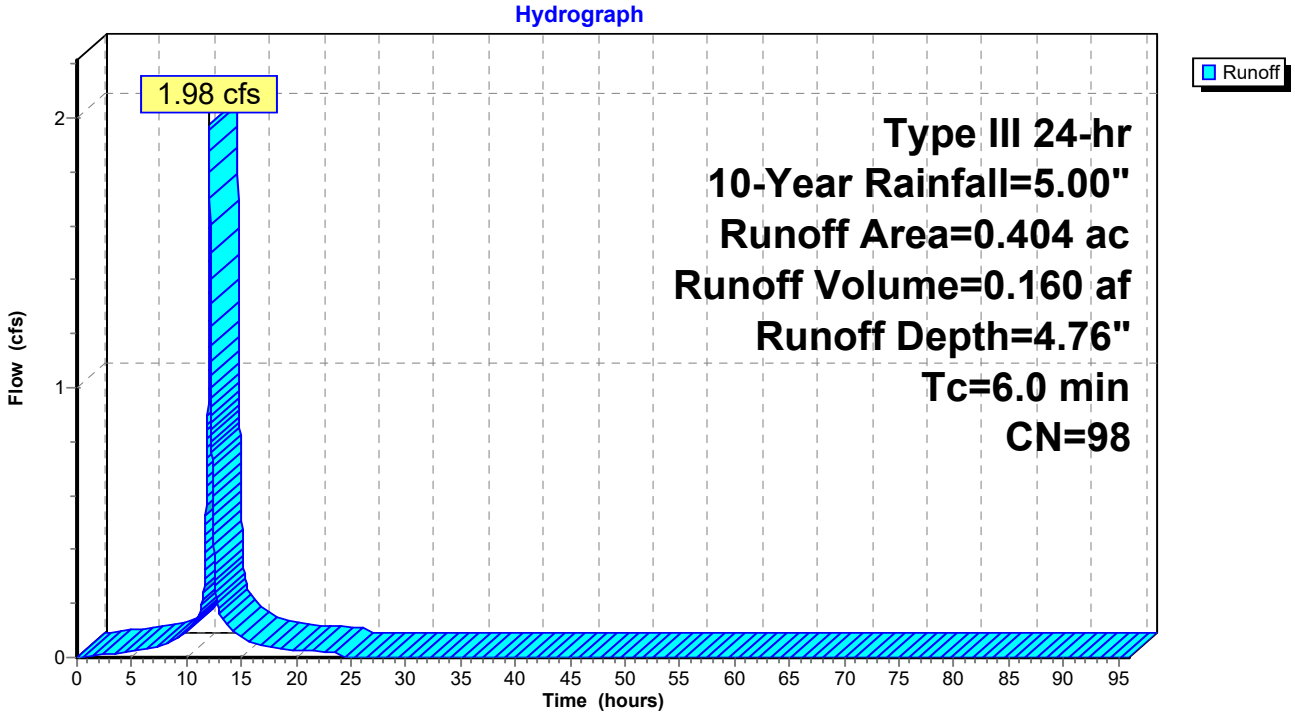
Runoff = 1.98 cfs @ 12.08 hrs, Volume= 0.160 af, Depth= 4.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.00"

Area (ac)	CN	Description
0.404	98	Unconnected roofs, HSG C
0.404		100.00% Impervious Area
0.404		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct C-1**

Subcatchment 3-I: Drainage Area 3: Roofs



Summary for Subcatchment 4-P: Drainage Area 4: Pervious (Basin 1)

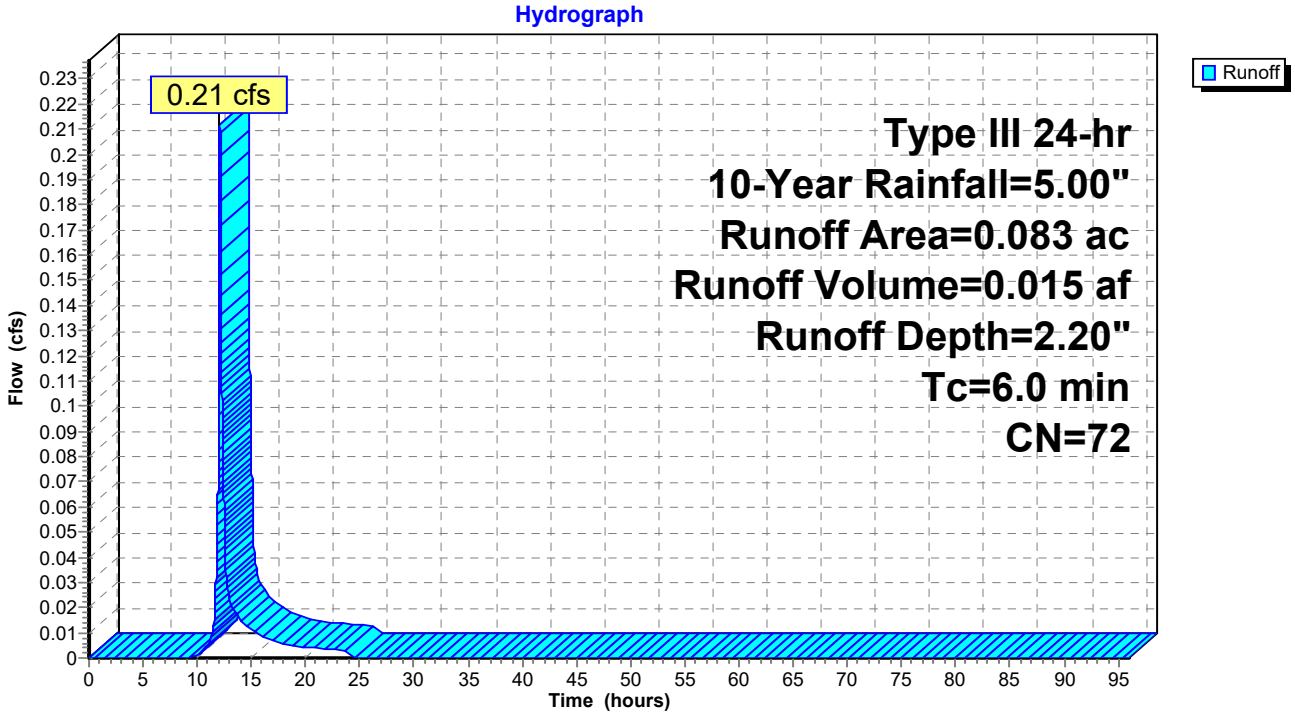
Runoff = 0.21 cfs @ 12.09 hrs, Volume= 0.015 af, Depth= 2.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.00"

Area (ac)	CN	Description
0.083	72	Woods/grass comb., Good, HSG C
0.083		100.00% Pervious Area

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

Subcatchment 4-P: Drainage Area 4: Pervious (Basin 1)



Summary for Subcatchment 5-P: Drainage Area 5: Pervious (Basin 2)

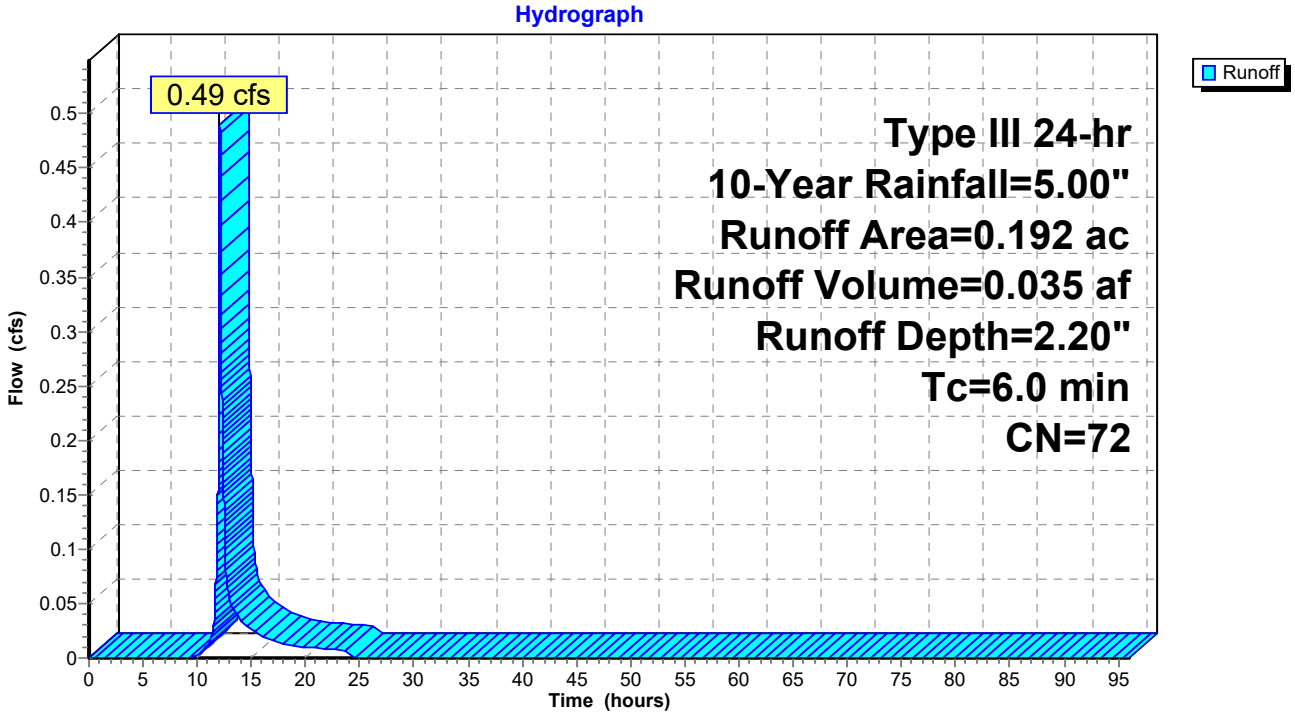
Runoff = 0.49 cfs @ 12.09 hrs, Volume= 0.035 af, Depth= 2.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.00"

Area (ac)	CN	Description
0.192	72	Woods/grass comb., Good, HSG C
0.192		100.00% Pervious Area

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

Subcatchment 5-P: Drainage Area 5: Pervious (Basin 2)



Summary for Subcatchment 6-I: Drainage Area 6: Impervious

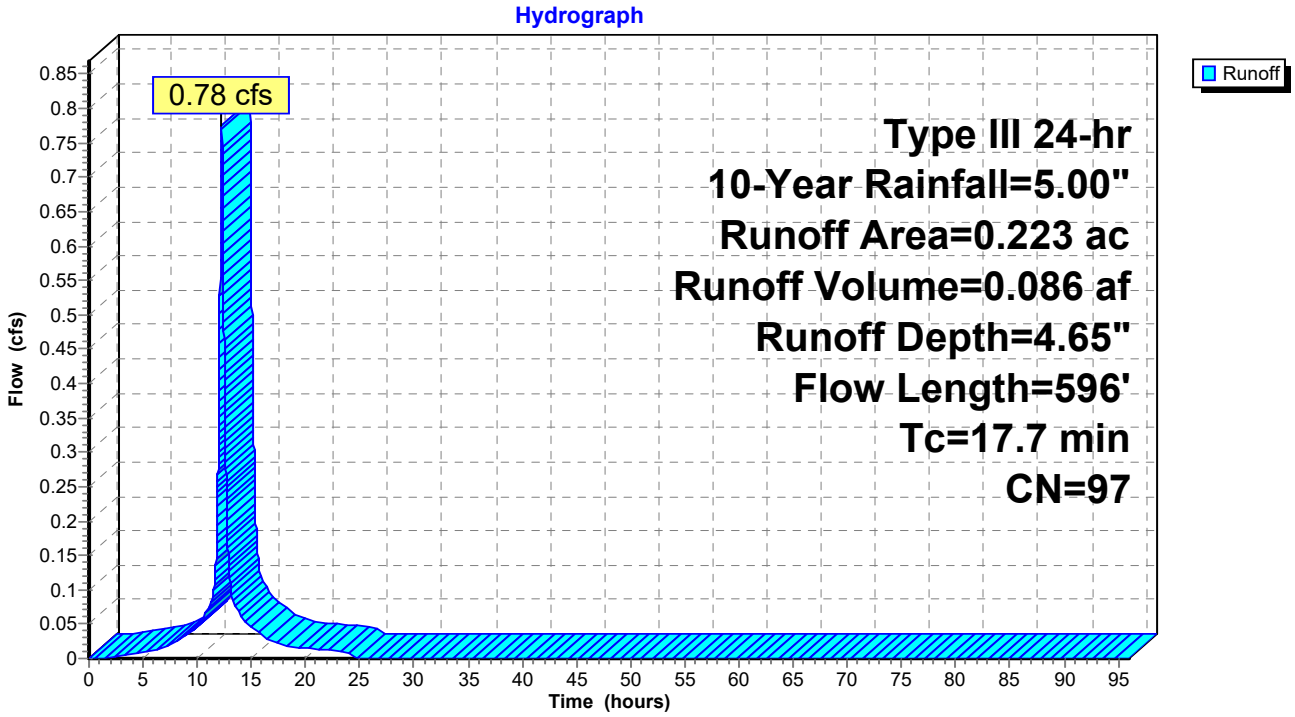
Runoff = 0.78 cfs @ 12.23 hrs, Volume= 0.086 af, Depth= 4.65"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.00"

Area (ac)	CN	Description
0.002	98	Unconnected roofs, HSG C
0.156	98	Unconnected pavement, HSG C
0.065	96	Gravel surface, HSG C
0.223	97	Weighted Average
0.065		29.15% Pervious Area
0.158		70.85% Impervious Area
0.158		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.6	40	0.1180	0.08		**Sheet Flow, SF1** Woods: Dense underbrush n= 0.800 P2= 3.38"
5.0	60	0.0923	0.20		**Sheet Flow, SF2** Grass: Dense n= 0.240 P2= 3.38"
0.7	86	0.0988	2.20		**Shallow Concentrated Flow, SCF1** Short Grass Pasture Kv= 7.0 fps
3.3	343	0.0499	1.75	1.75	**Channel Flow, CF1** Area= 1.0 sf Perim= 12.6' r= 0.08' n= 0.035 Earth, dense weeds
0.1	67	0.0780	16.63	23.22	**Pipe Channel, HDPE Pipe** 16.0" Round Area= 1.4 sf Perim= 4.2' r= 0.33' n= 0.012
17.7	596	Total			

Subcatchment 6-I: Drainage Area 6: Impervious



Summary for Subcatchment 6-P: Drainage Area 6: Pervious

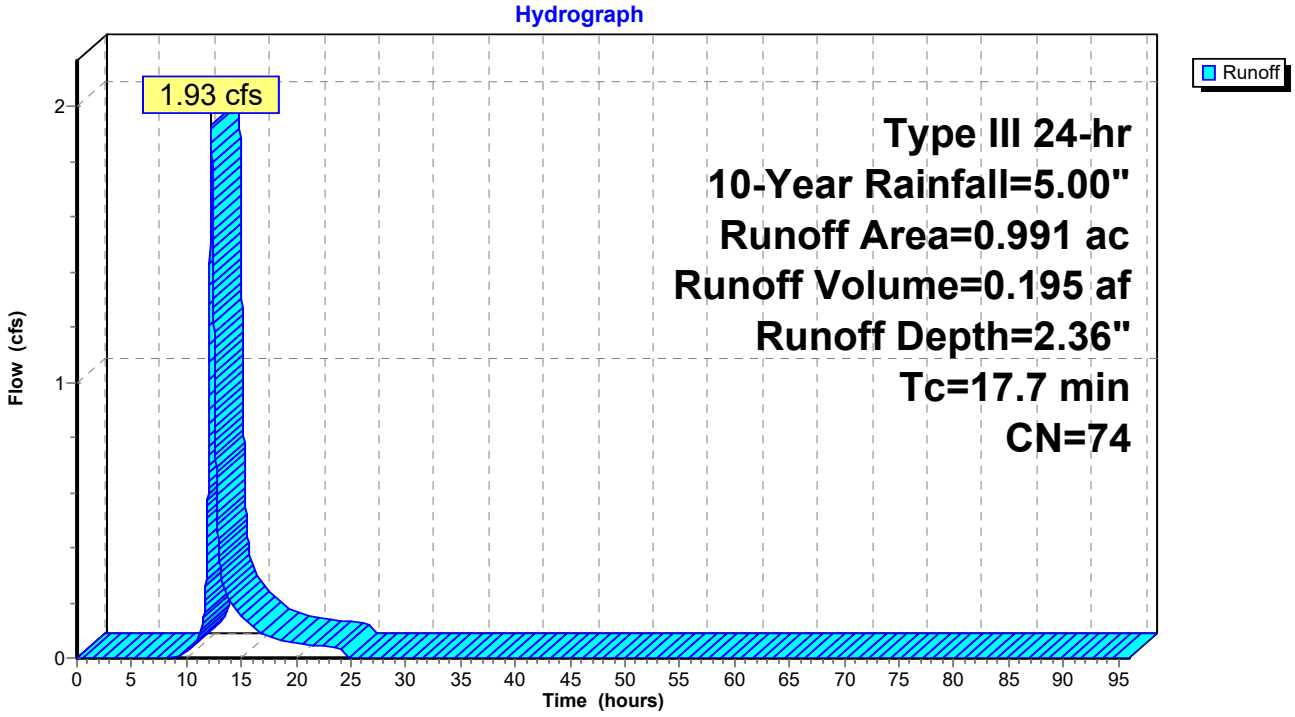
Runoff = 1.93 cfs @ 12.25 hrs, Volume= 0.195 af, Depth= 2.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.00"

Area (ac)	CN	Description
0.981	74	>75% Grass cover, Good, HSG C
0.010	72	Woods/grass comb., Good, HSG C
0.991	74	Weighted Average
0.991		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.7					**Direct Entry, Same as G1**

Subcatchment 6-P: Drainage Area 6: Pervious



Summary for Subcatchment 7-I: Drainage Area 7: Impervious

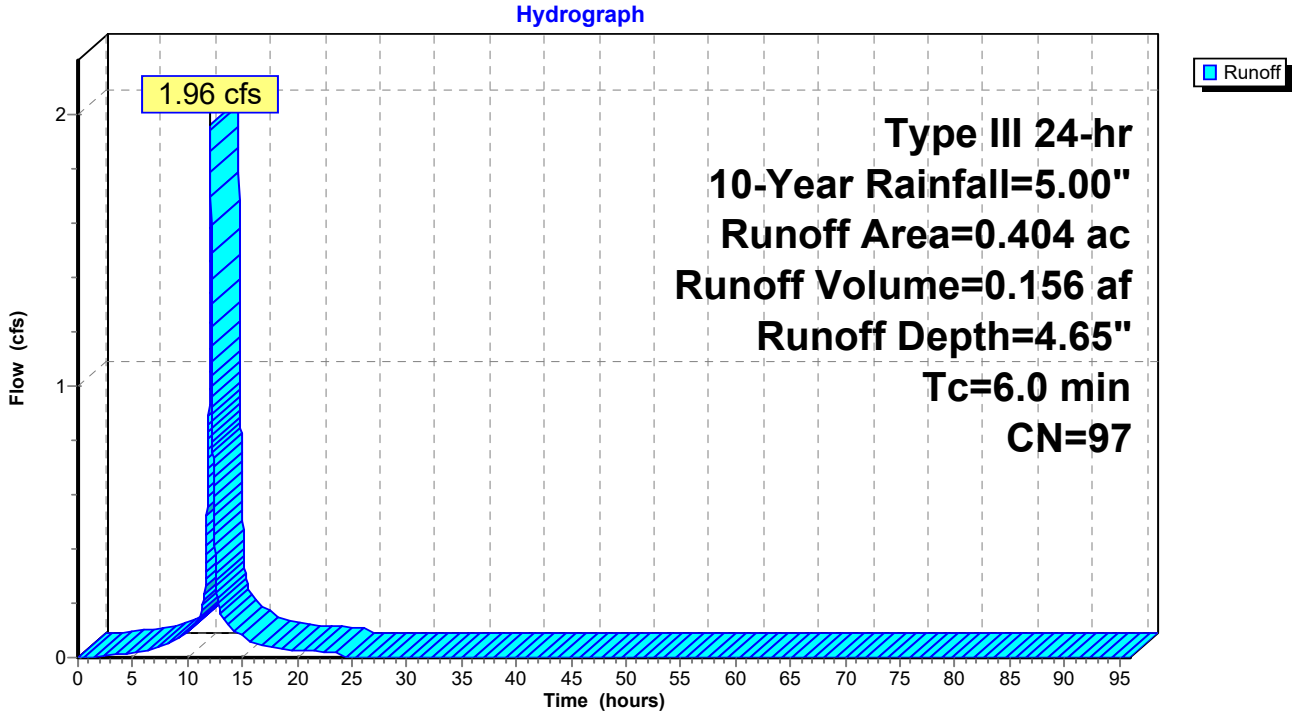
Runoff = 1.96 cfs @ 12.08 hrs, Volume= 0.156 af, Depth= 4.65"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.00"

Area (ac)	CN	Description
0.135	98	Paved parking, HSG C
0.160	96	Gravel surface, HSG C
0.109	98	Unconnected roofs, HSG C
0.404	97	Weighted Average
0.160		39.60% Pervious Area
0.244		60.40% Impervious Area
0.109		44.67% Unconnected

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

Subcatchment 7-I: Drainage Area 7: Impervious



Summary for Subcatchment 7-P: Drainage Area 7: Pervious

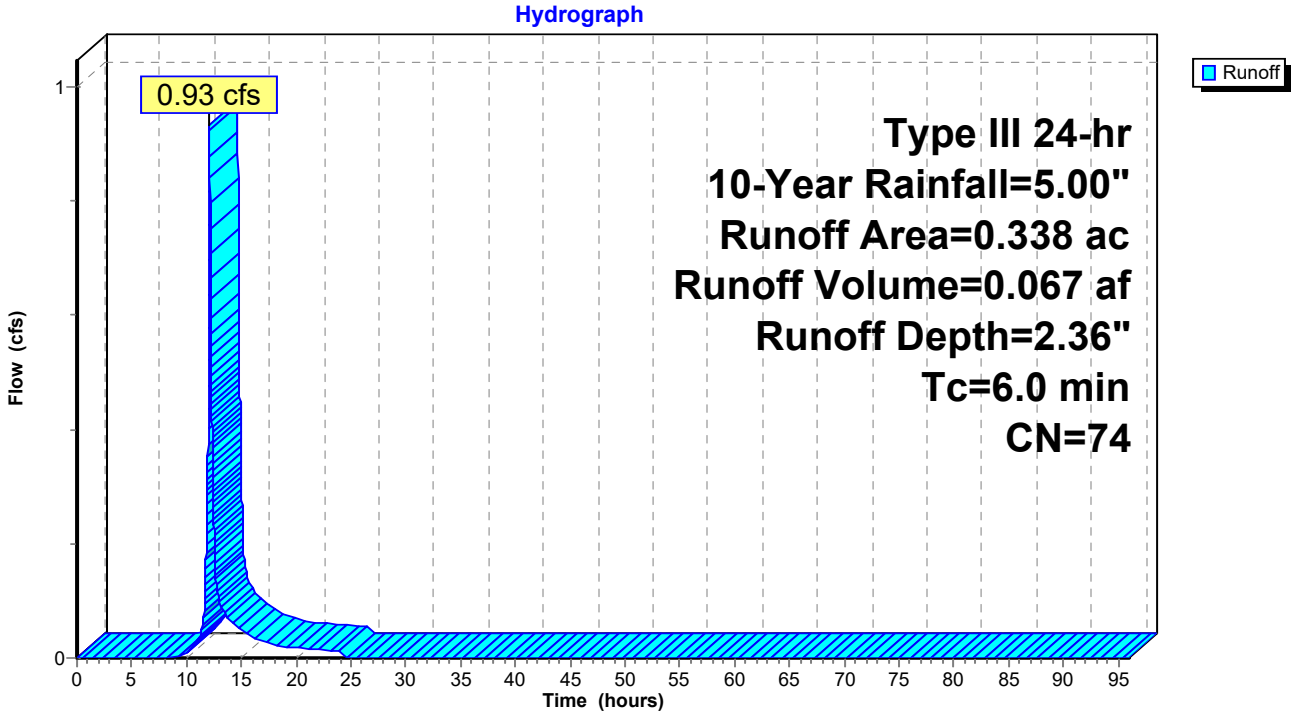
Runoff = 0.93 cfs @ 12.09 hrs, Volume= 0.067 af, Depth= 2.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.00"

Area (ac)	CN	Description
0.338	74	>75% Grass cover, Good, HSG C
0.338		100.00% Pervious Area

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

Subcatchment 7-P: Drainage Area 7: Pervious



Summary for Subcatchment 8-I: Drainage Area 8: Pervious

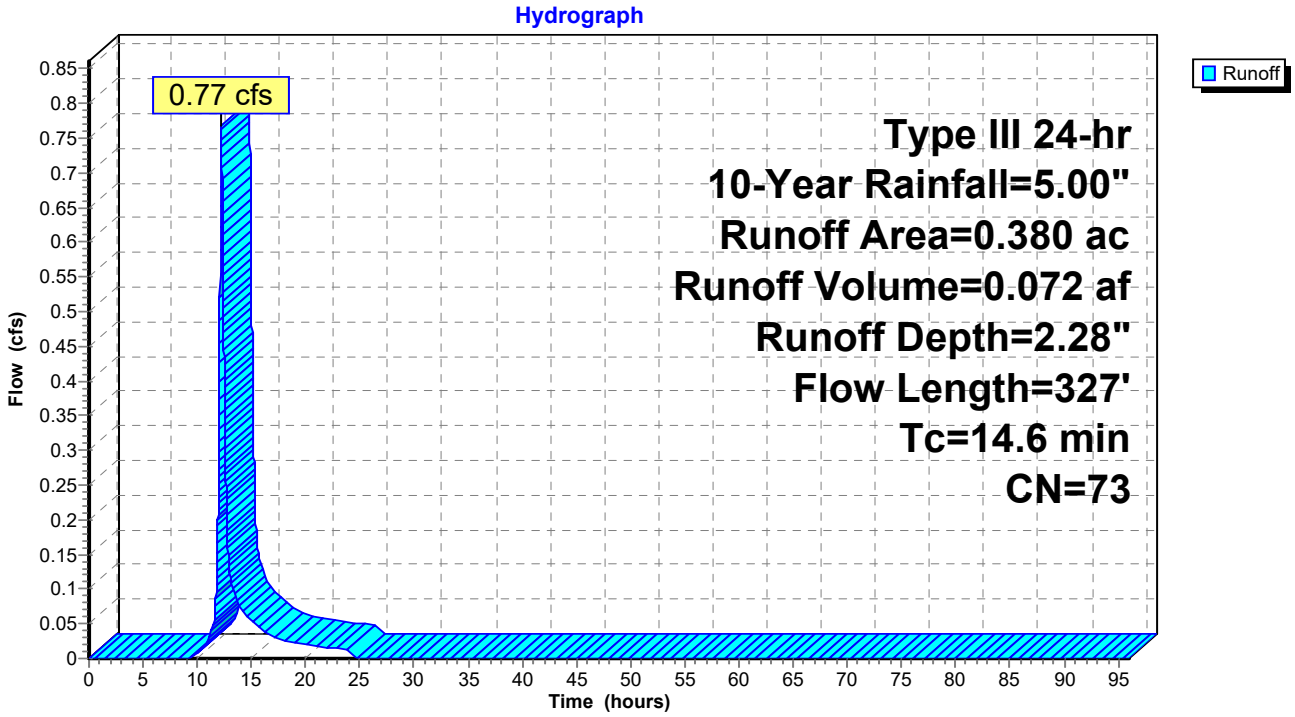
Runoff = 0.77 cfs @ 12.21 hrs, Volume= 0.072 af, Depth= 2.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.00"

Area (ac)	CN	Description
0.234	74	>75% Grass cover, Good, HSG C
0.146	72	Woods/grass comb., Good, HSG C
0.380	73	Weighted Average
0.380		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	16	0.1190	0.25		**Sheet Flow, Grass: Short** Grass: Short n= 0.150 P2= 3.38"
12.0	85	0.0580	0.12		**Sheet Flow, Woods: Light Underbrush** Woods: Light underbrush n= 0.400 P2= 3.38"
0.2	23	0.0850	2.04		**Shallow Concentrated Flow, Short Grass Pasture** Short Grass Pasture Kv= 7.0 fps
0.4	28	0.0480	1.10		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
0.3	27	0.0650	1.78		**Shallow Concentrated Flow, Short Grass Pasture** Short Grass Pasture Kv= 7.0 fps
0.5	108	0.0130	3.54	3.54	**Parabolic Channel, Earth Clean and Straight** W=3.00' D=0.50' Area=1.0 sf Perim=3.2' n= 0.022 Earth, clean & straight
0.1	40	0.0270	8.08	6.34	**Pipe Channel, Pipe** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012
14.6	327	Total			

Subcatchment 8-I: Drainage Area 8: Pervious



Summary for Subcatchment I-P: Drainage Area 1: Pervious

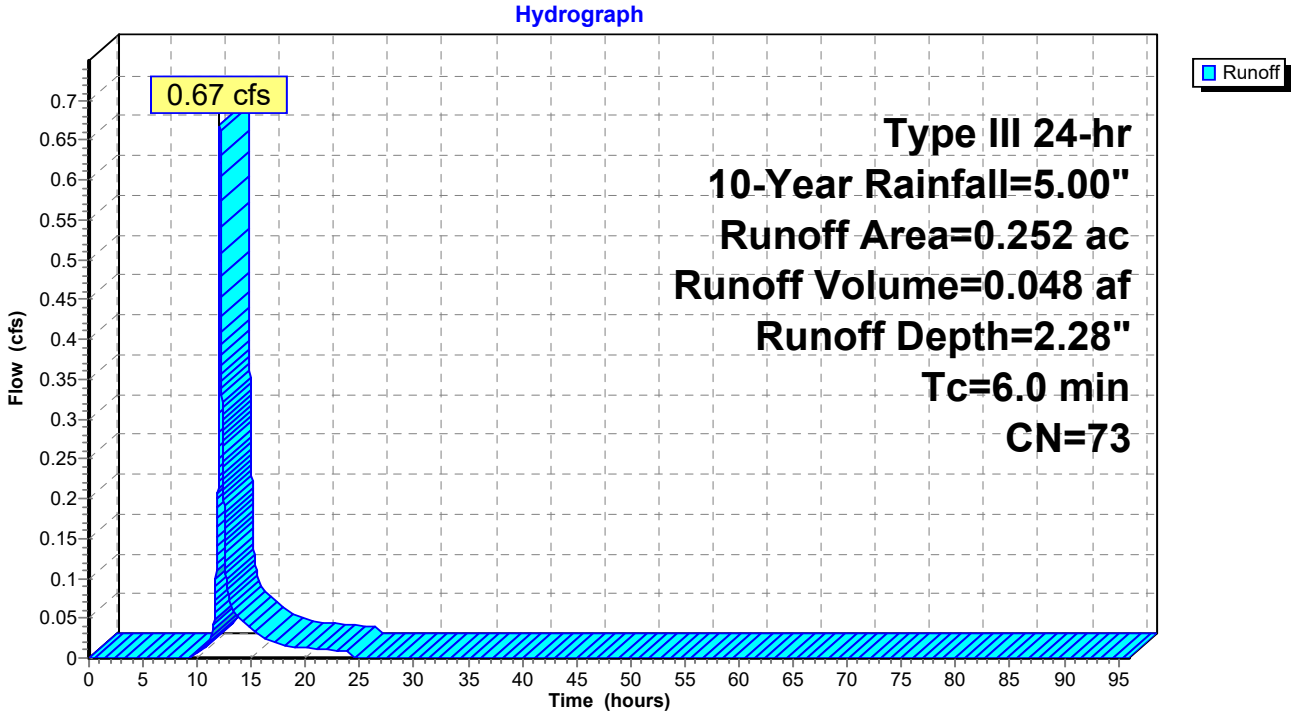
Runoff = 0.67 cfs @ 12.09 hrs, Volume= 0.048 af, Depth= 2.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.00"

Area (ac)	CN	Description
0.107	74	>75% Grass cover, Good, HSG C
0.145	72	Woods/grass comb., Good, HSG C
0.252	73	Weighted Average
0.252		100.00% Pervious Area

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

Subcatchment I-P: Drainage Area 1: Pervious



Summary for Pond 1P: Subsurface Detention Basin 1 (Stormtrap-ST2)

Inflow Area = 1.043 ac, 48.80% Impervious, Inflow Depth = 4.12" for 10-Year event
Inflow = 4.40 cfs @ 12.10 hrs, Volume= 0.358 af
Outflow = 0.97 cfs @ 12.51 hrs, Volume= 0.358 af, Atten= 78%, Lag= 24.7 min
Primary = 0.97 cfs @ 12.51 hrs, Volume= 0.358 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 158.12' @ 12.52 hrs Surf.Area= 7,437 sf Storage= 6,664 cf

Plug-Flow detention time= 287.5 min calculated for 0.358 af (100% of inflow)
Center-of-Mass det. time= 287.6 min (1,055.1 - 767.5)

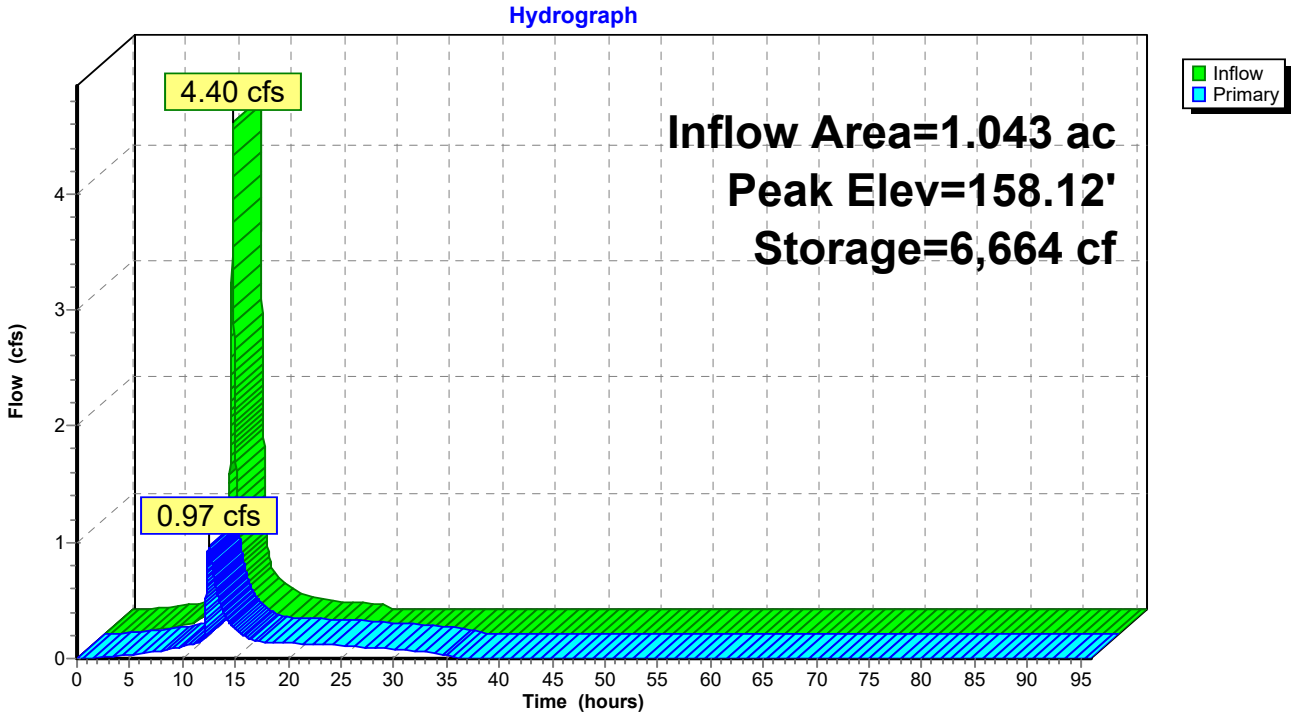
Volume	Invert	Avail.Storage	Storage Description
#1	156.33'	12,969 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
156.33	0	0	0
158.83	10,375	12,969	12,969

Device	Routing	Invert	Outlet Devices
#1	Primary	156.33'	**15.0" Round Culvert** L= 50.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 156.33' / 156.00' S= 0.0066 '/' Cc= 0.900 n= 0.012, Flow Area= 1.23 sf
#2	Device 1	156.33'	**2.5" Vert. Orifice/Grate** C= 0.600
#3	Device 1	157.83'	**18.0" W x 6.0" H Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.97 cfs @ 12.51 hrs HW=158.12' TW=156.49' (Dynamic Tailwater)
└─**1=Culvert** (Passes 0.97 cfs of 5.82 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.21 cfs @ 6.15 fps)
  └─**3=Orifice/Grate** (Orifice Controls 0.76 cfs @ 1.73 fps)

Pond 1P: Subsurface Detention Basin 1 (Stormtrap-ST2)



Summary for Pond 2P: SubSurface Detention Basin 2 (Stormtrap-ST2)

Inflow Area = 0.404 ac,100.00% Impervious, Inflow Depth = 4.76" for 10-Year event
Inflow = 1.98 cfs @ 12.08 hrs, Volume= 0.160 af
Outflow = 0.69 cfs @ 12.35 hrs, Volume= 0.160 af, Atten= 65%, Lag= 15.7 min
Primary = 0.69 cfs @ 12.35 hrs, Volume= 0.160 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 158.92' @ 12.35 hrs Surf.Area= 2,685 sf Storage= 2,131 cf

Plug-Flow detention time= 66.3 min calculated for 0.160 af (100% of inflow)
Center-of-Mass det. time= 66.3 min (814.3 - 748.0)

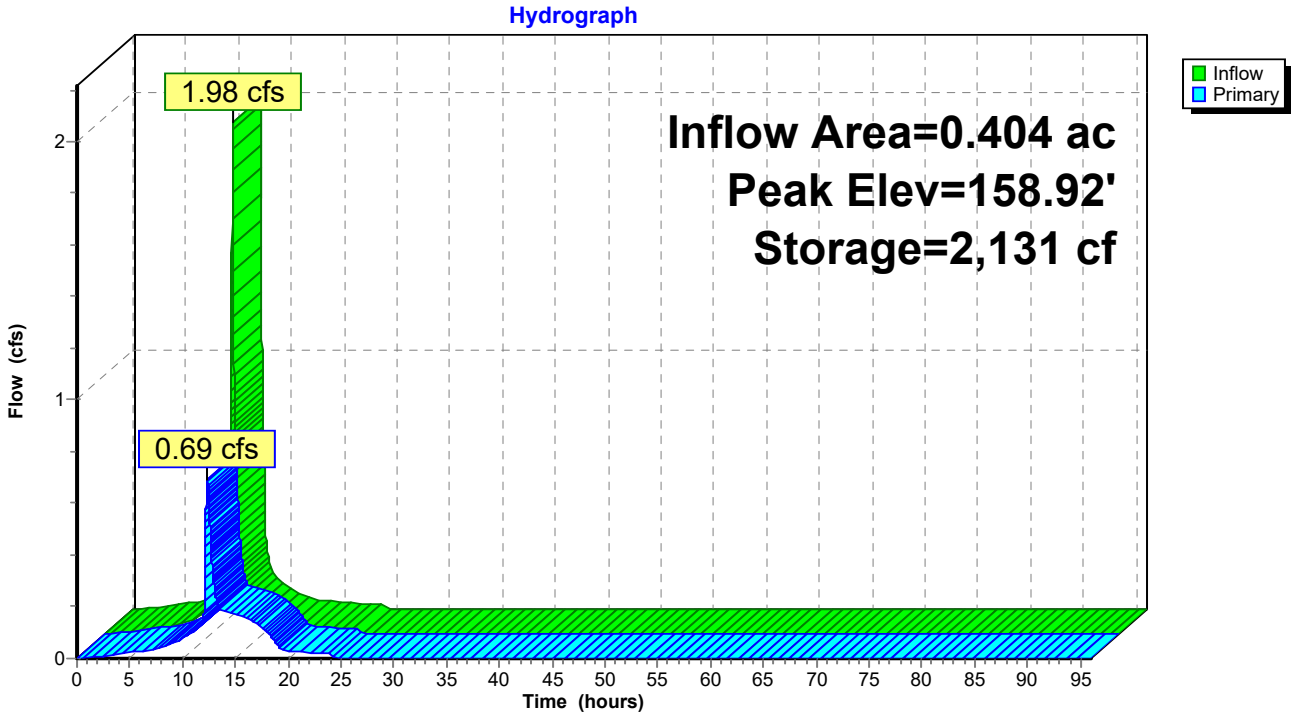
Volume	Invert	Avail.Storage	Storage Description
#1	157.33'	5,286 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
157.33	0	0	0
159.83	4,229	5,286	5,286

Device	Routing	Invert	Outlet Devices
#1	Primary	157.33'	**15.0" Round Culvert** L= 245.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 157.33' / 151.13' S= 0.0253 '/' Cc= 0.900 n= 0.012, Flow Area= 1.23 sf
#2	Device 1	157.33'	**2.5" Vert. Orifice/Grate** C= 0.600
#3	Device 1	158.70'	**18.0" W x 6.0" H Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.69 cfs @ 12.35 hrs HW=158.92' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Passes 0.69 cfs of 4.58 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.20 cfs @ 5.86 fps)
  └─**3=Orifice/Grate** (Orifice Controls 0.49 cfs @ 1.50 fps)

Pond 2P: SubSurface Detention Basin 2 (Stormtrap-ST2)



Summary for Pond Bio1: Bioretention Basin 1

Inflow Area = 0.722 ac, 42.52% Impervious, Inflow Depth = 3.60" for 10-Year event
Inflow = 2.77 cfs @ 12.09 hrs, Volume= 0.217 af
Outflow = 0.25 cfs @ 13.02 hrs, Volume= 0.217 af, Atten= 91%, Lag= 56.0 min
Primary = 0.25 cfs @ 13.02 hrs, Volume= 0.217 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 157.16' @ 13.02 hrs Surf.Area= 2,277 sf Storage= 4,315 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 250.5 min (1,025.5 - 775.0)

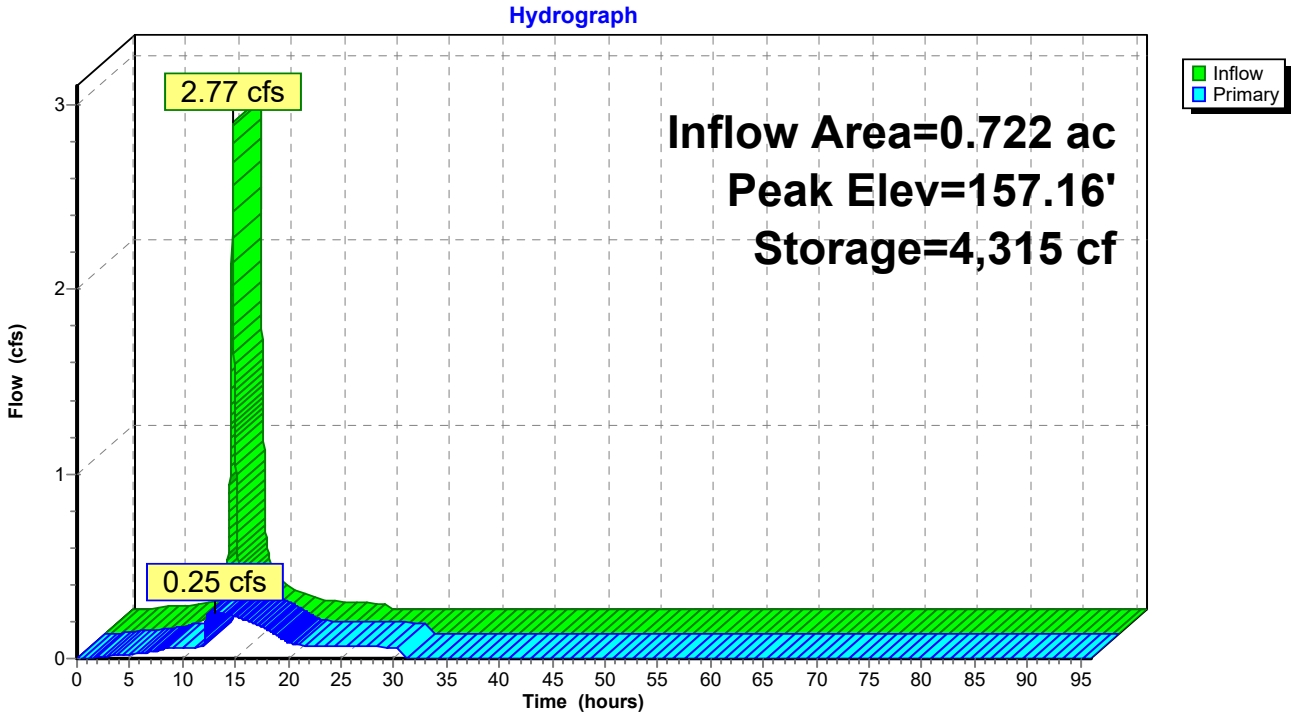
Volume	Invert	Avail.Storage	Storage Description
#1	155.00'	8,960 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
155.00	1,718	0	0
156.00	1,970	1,844	1,844
157.00	2,232	2,101	3,945
158.00	2,505	2,369	6,314
159.00	2,787	2,646	8,960

Device	Routing	Invert	Outlet Devices
#1	Primary	151.80'	**15.0" Round Culvert** L= 95.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 151.80' / 151.00' S= 0.0084 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Device 1	155.00'	**1.500 in/hr Exfiltration over Surface area**
#3	Device 1	156.00'	**2.5" Vert. Orifice/Grate** C= 0.600
#4	Device 1	157.30'	**6.0" W x 6.0" H Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.25 cfs @ 13.02 hrs HW=157.16' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Passes 0.25 cfs of 11.33 cfs potential flow)
  ├─**2=Exfiltration** (Exfiltration Controls 0.08 cfs)
  ├─**3=Orifice/Grate** (Orifice Controls 0.17 cfs @ 4.96 fps)
  └─**4=Orifice/Grate** (Controls 0.00 cfs)

Pond Bio1: Bioretention Basin 1



Summary for Pond Bio2: Bioretention Basin 2

Inflow Area = 1.235 ac, 41.21% Impervious, Inflow Depth = 3.82" for 10-Year event
Inflow = 1.11 cfs @ 12.45 hrs, Volume= 0.393 af
Outflow = 0.22 cfs @ 15.74 hrs, Volume= 0.393 af, Atten= 80%, Lag= 197.0 min
Primary = 0.22 cfs @ 15.74 hrs, Volume= 0.393 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 157.31' @ 15.74 hrs Surf.Area= 4,306 sf Storage= 4,965 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 302.9 min (1,339.0 - 1,036.1)

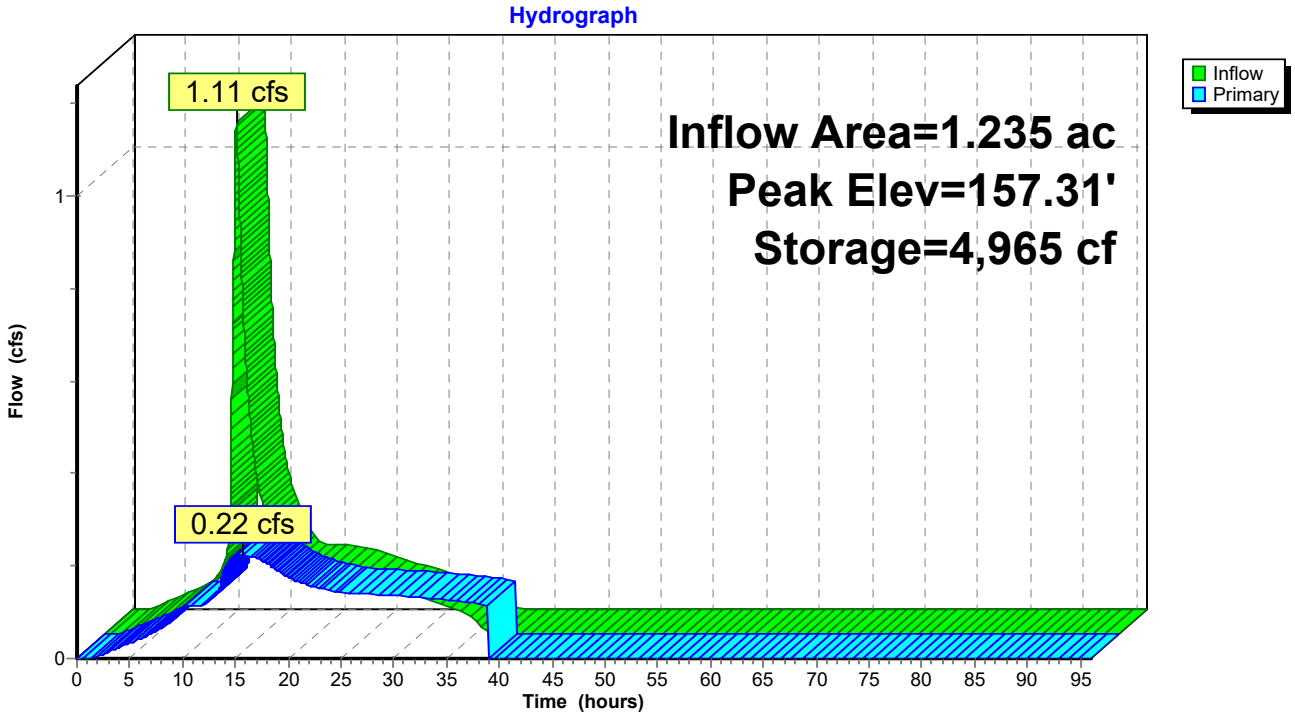
Volume	Invert	Avail.Storage	Storage Description
#1	156.00'	13,443 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
156.00	3,288	0	0
157.00	4,052	3,670	3,670
158.00	4,872	4,462	8,132
159.00	5,749	5,311	13,443

Device	Routing	Invert	Outlet Devices
#1	Primary	152.17'	**15.0" Round Culvert** L= 109.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 152.17' / 151.30' S= 0.0080 '/' Cc= 0.900 n= 0.012, Flow Area= 1.23 sf
#2	Device 1	156.00'	**1.500 in/hr Exfiltration over Surface area**
#3	Device 1	157.00'	**2.5" Vert. Orifice/Grate** C= 0.600
#4	Device 1	157.54'	**4.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.22 cfs @ 15.74 hrs HW=157.31' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Passes 0.22 cfs of 11.22 cfs potential flow)
  ├─**2=Exfiltration** (Exfiltration Controls 0.15 cfs)
  ├─**3=Orifice/Grate** (Orifice Controls 0.07 cfs @ 2.18 fps)
  └─**4=Orifice/Grate** (Controls 0.00 cfs)

Pond Bio2: Bioretention Basin 2

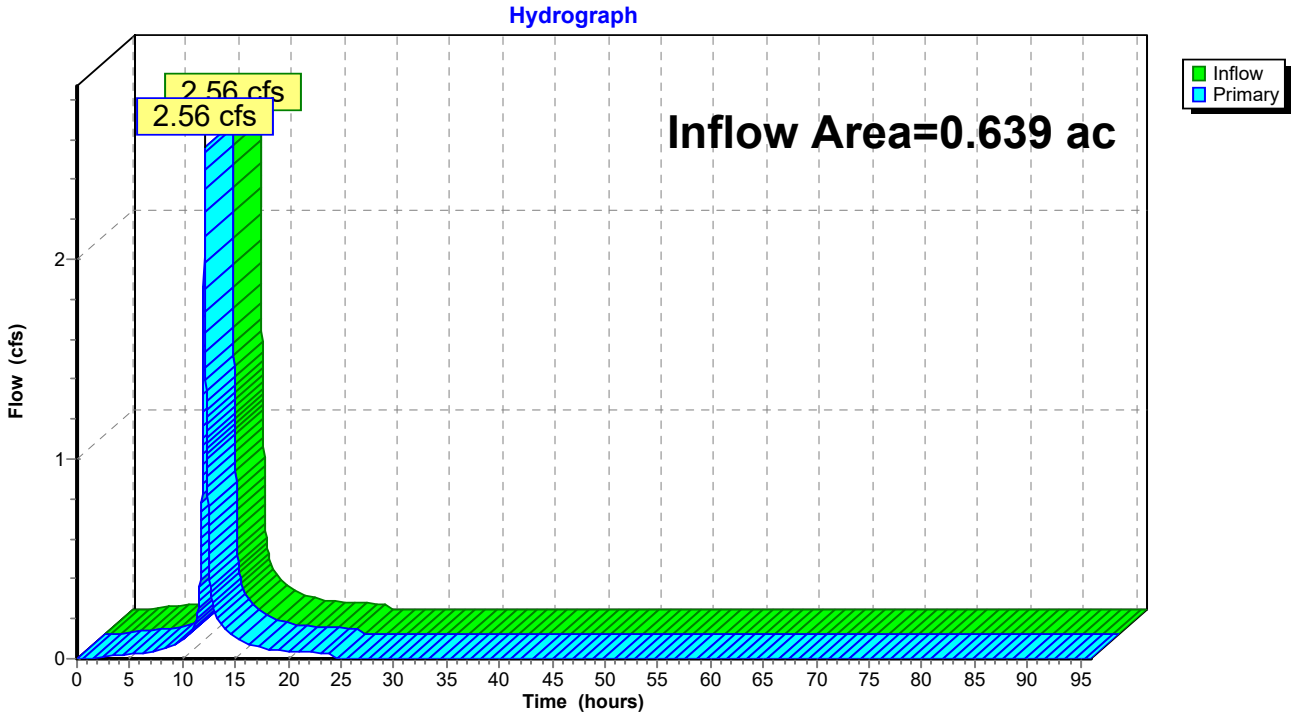


Summary for Link 1: Drainage Area 1

Inflow Area = 0.639 ac, 48.04% Impervious, Inflow Depth = 3.78" for 10-Year event
Inflow = 2.56 cfs @ 12.09 hrs, Volume= 0.202 af
Primary = 2.56 cfs @ 12.09 hrs, Volume= 0.202 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Link 1: Drainage Area 1

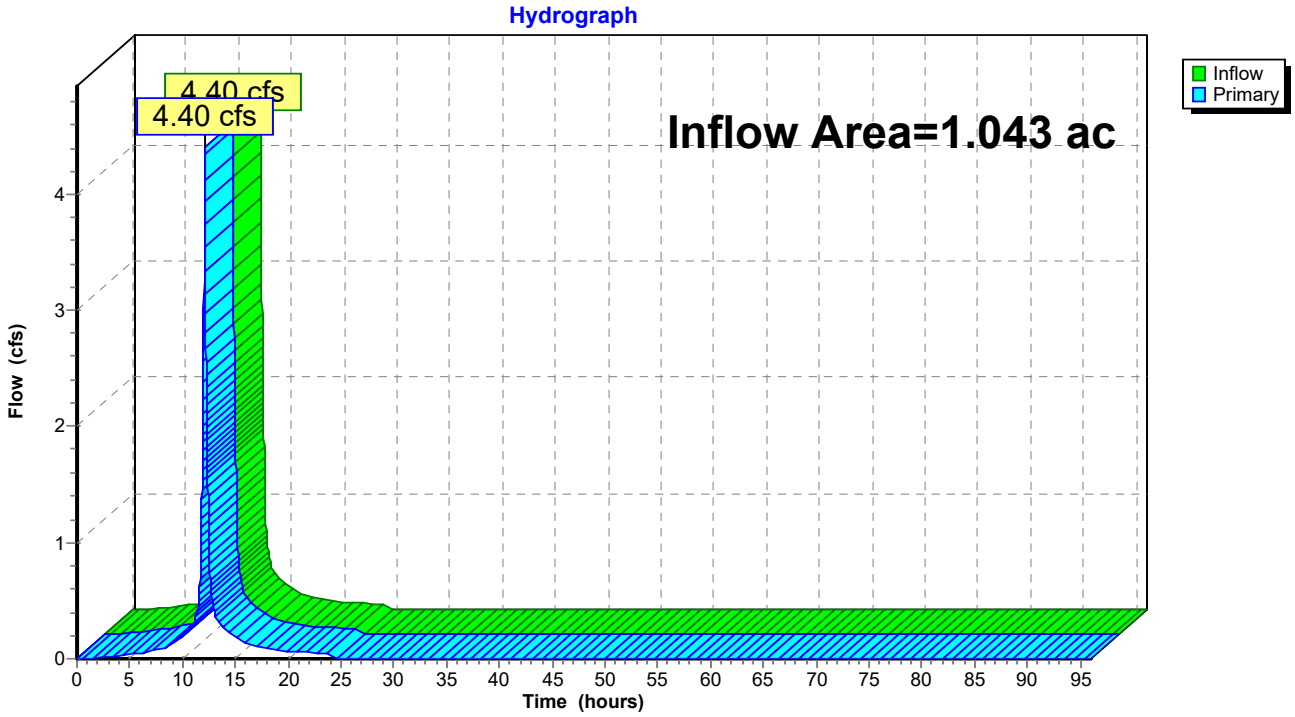


Summary for Link 2: Drainage Area 2

Inflow Area = 1.043 ac, 48.80% Impervious, Inflow Depth = 4.12" for 10-Year event
Inflow = 4.40 cfs @ 12.10 hrs, Volume= 0.358 af
Primary = 4.40 cfs @ 12.10 hrs, Volume= 0.358 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Link 2: Drainage Area 2

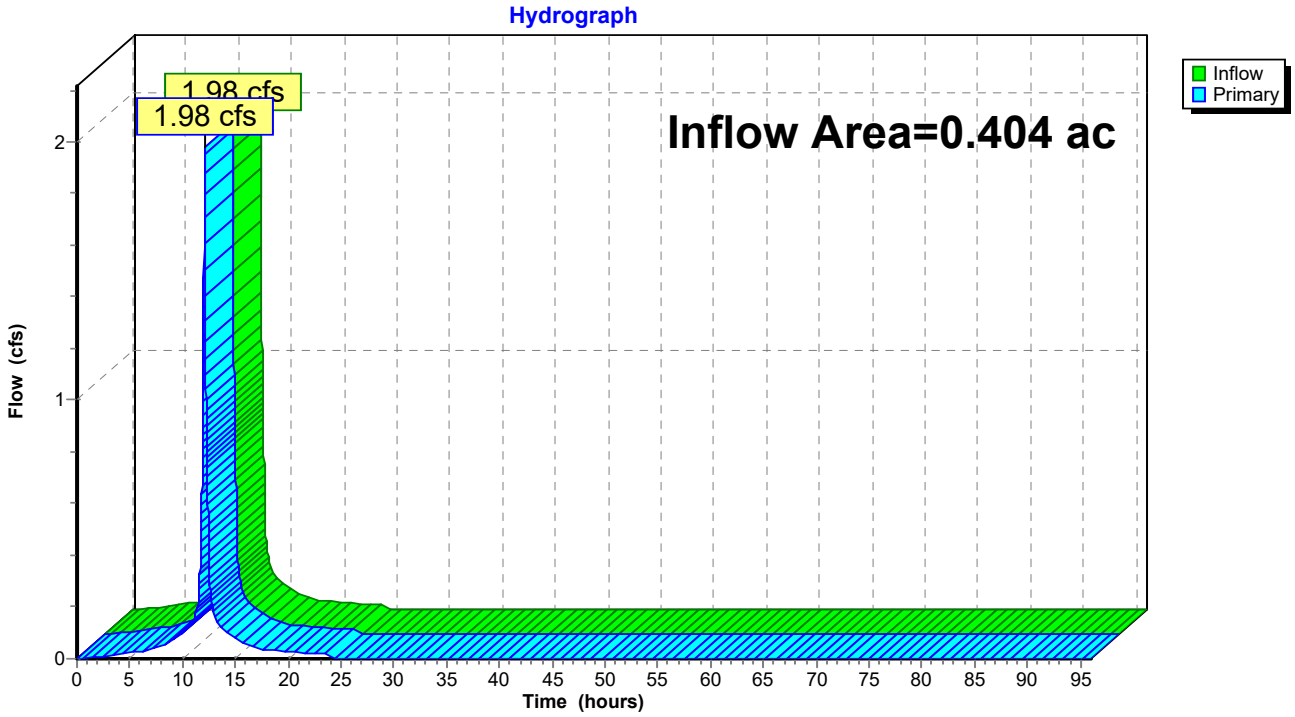


Summary for Link 3: Drainage Area 3

Inflow Area = 0.404 ac,100.00% Impervious, Inflow Depth = 4.76" for 10-Year event
Inflow = 1.98 cfs @ 12.08 hrs, Volume= 0.160 af
Primary = 1.98 cfs @ 12.08 hrs, Volume= 0.160 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Link 3: Drainage Area 3

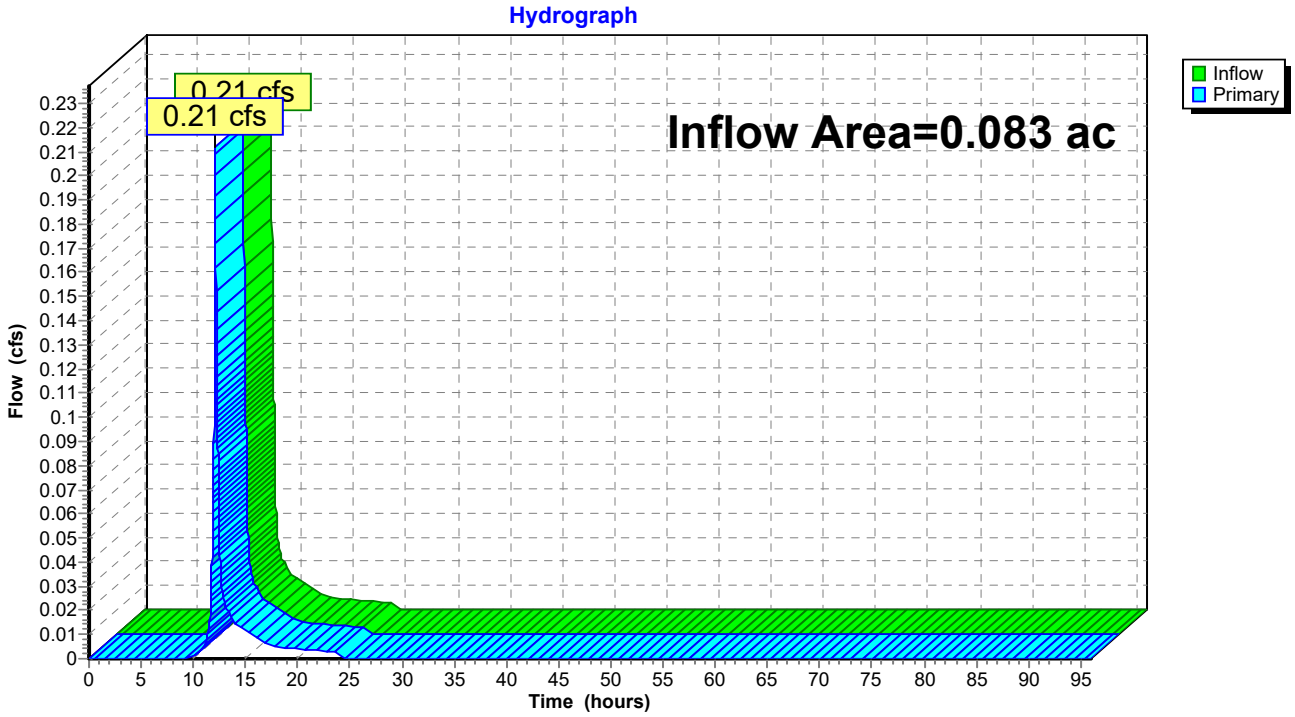


Summary for Link 4: Drainage Area 4

Inflow Area = 0.083 ac, 0.00% Impervious, Inflow Depth = 2.20" for 10-Year event
Inflow = 0.21 cfs @ 12.09 hrs, Volume= 0.015 af
Primary = 0.21 cfs @ 12.09 hrs, Volume= 0.015 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Link 4: Drainage Area 4

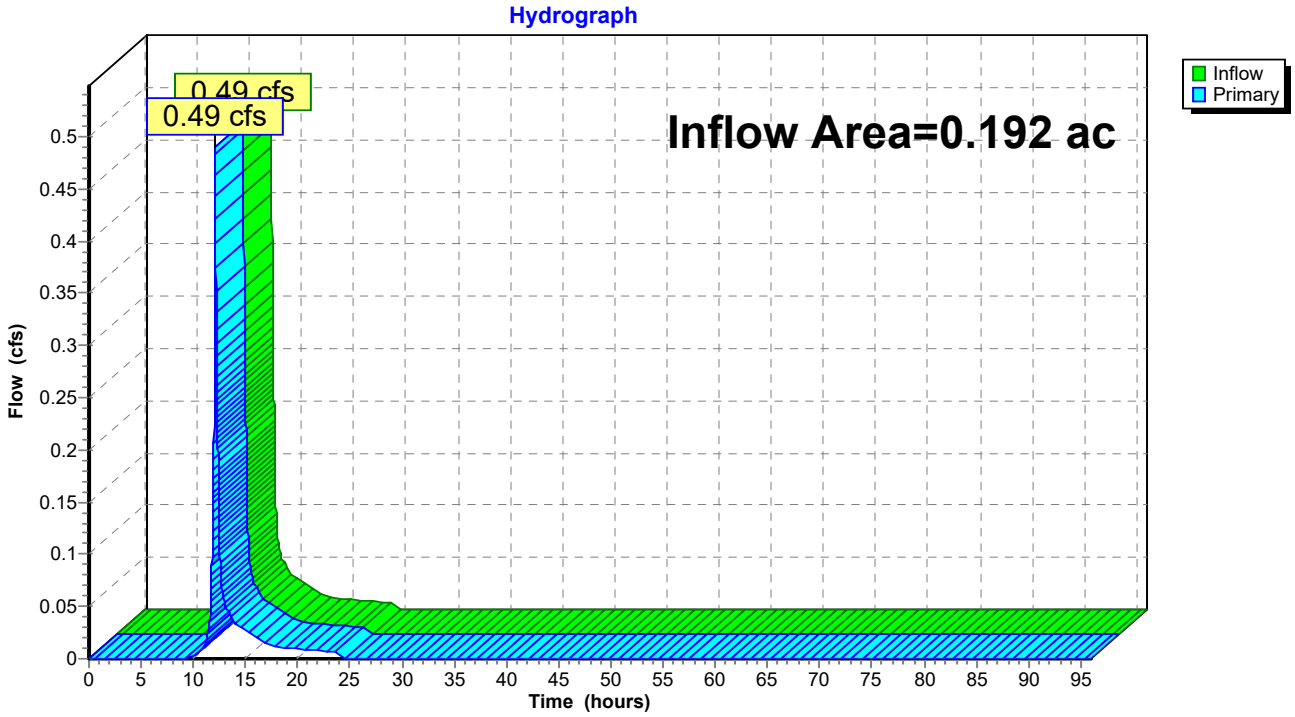


Summary for Link 5: Drainage Area 5

Inflow Area = 0.192 ac, 0.00% Impervious, Inflow Depth = 2.20" for 10-Year event
Inflow = 0.49 cfs @ 12.09 hrs, Volume= 0.035 af
Primary = 0.49 cfs @ 12.09 hrs, Volume= 0.035 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Link 5: Drainage Area 5

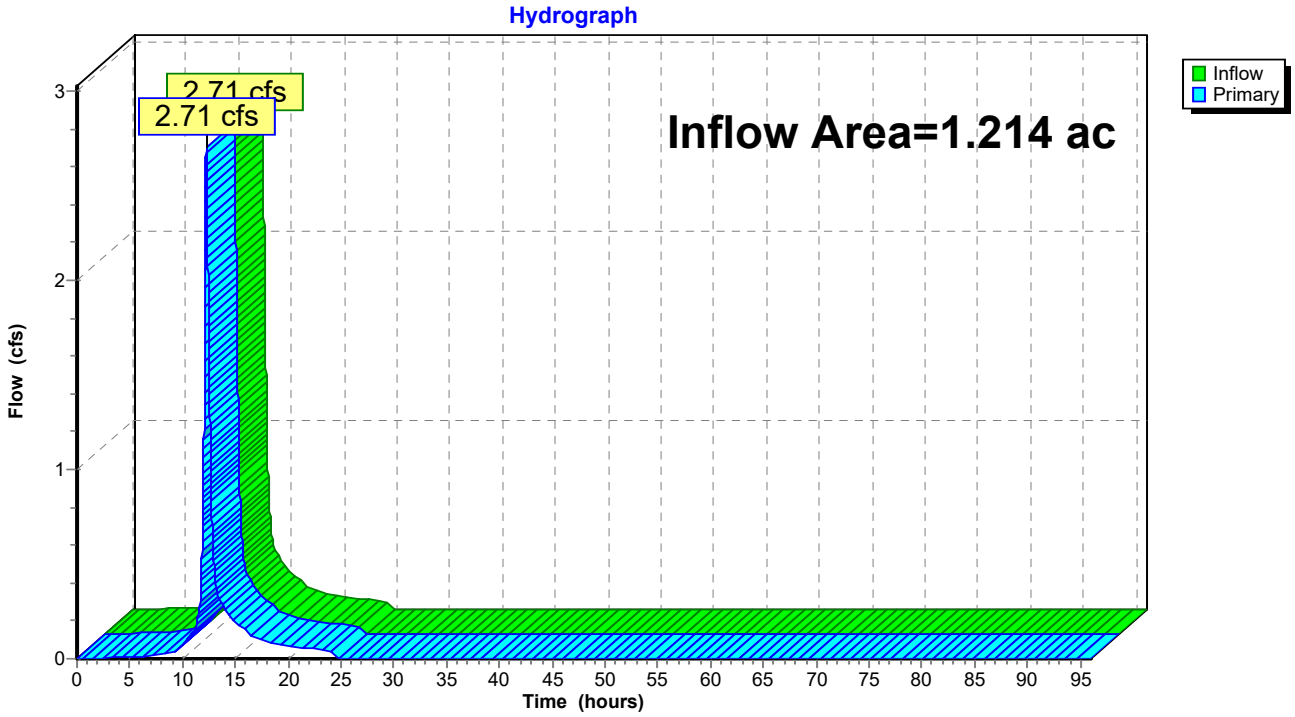


Summary for Link 6: Drainage Area 6

Inflow Area = 1.214 ac, 13.01% Impervious, Inflow Depth = 2.78" for 10-Year event
Inflow = 2.71 cfs @ 12.25 hrs, Volume= 0.282 af
Primary = 2.71 cfs @ 12.25 hrs, Volume= 0.282 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Link 6: Drainage Area 6

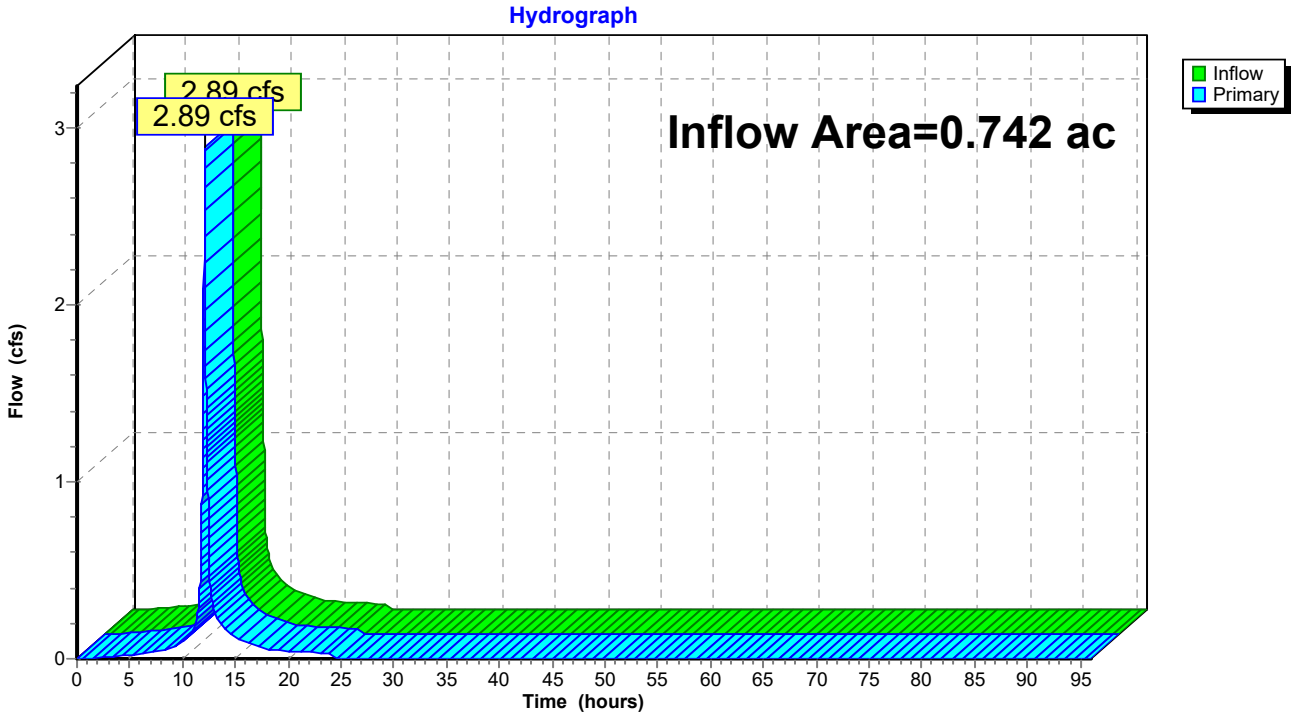


Summary for Link 7: Drainage Area 7

Inflow Area = 0.742 ac, 32.88% Impervious, Inflow Depth = 3.61" for 10-Year event
Inflow = 2.89 cfs @ 12.09 hrs, Volume= 0.223 af
Primary = 2.89 cfs @ 12.09 hrs, Volume= 0.223 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Link 7: Drainage Area 7

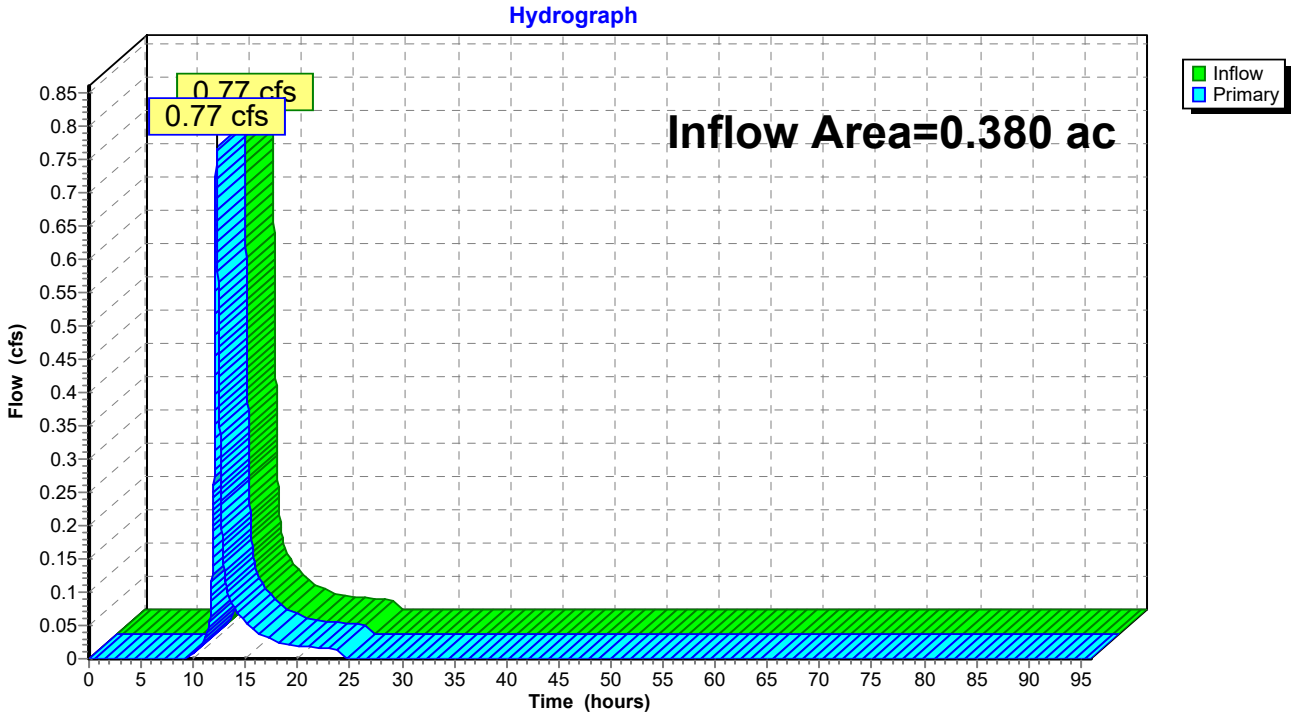


Summary for Link 8: Drainage Area 8

Inflow Area = 0.380 ac, 0.00% Impervious, Inflow Depth = 2.28" for 10-Year event
Inflow = 0.77 cfs @ 12.21 hrs, Volume= 0.072 af
Primary = 0.77 cfs @ 12.21 hrs, Volume= 0.072 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Link 8: Drainage Area 8

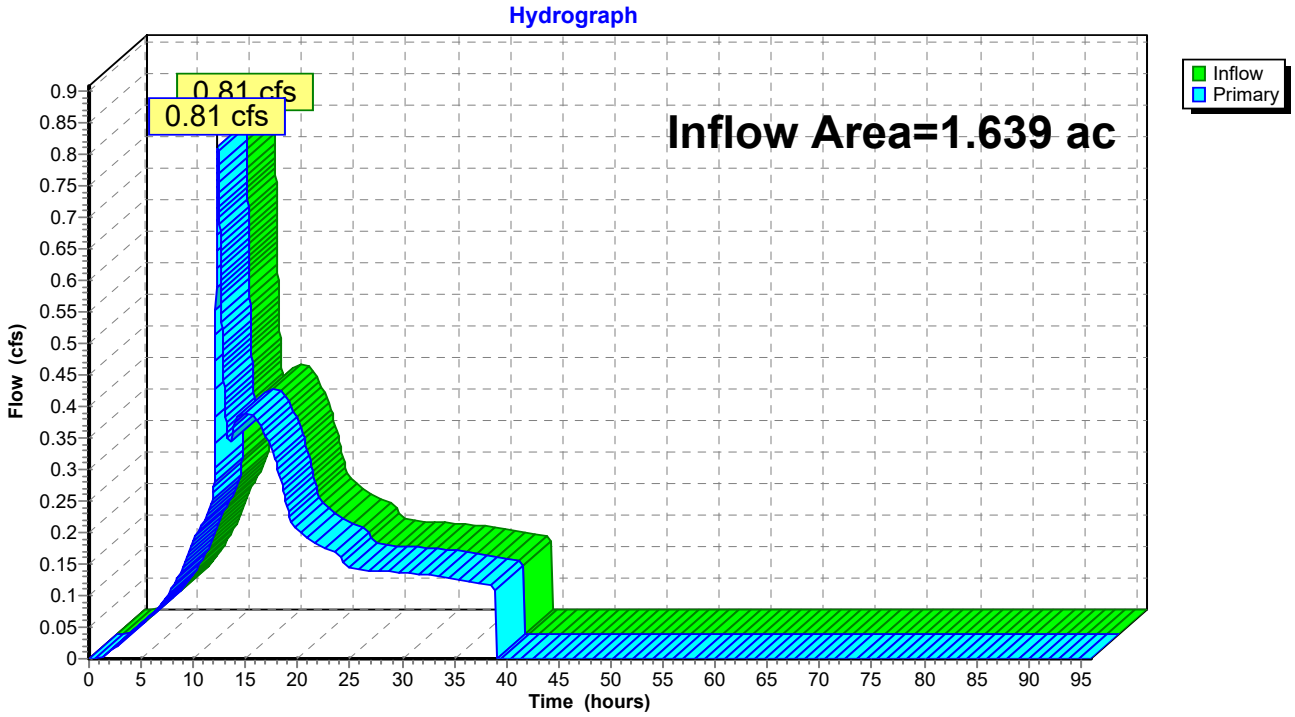


Summary for Link MH9: ST MH 9 Connector

Inflow Area = 1.639 ac, 55.70% Impervious, Inflow Depth = 4.05" for 10-Year event
Inflow = 0.81 cfs @ 12.35 hrs, Volume= 0.554 af
Primary = 0.81 cfs @ 12.35 hrs, Volume= 0.554 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Link MH9: ST MH 9 Connector

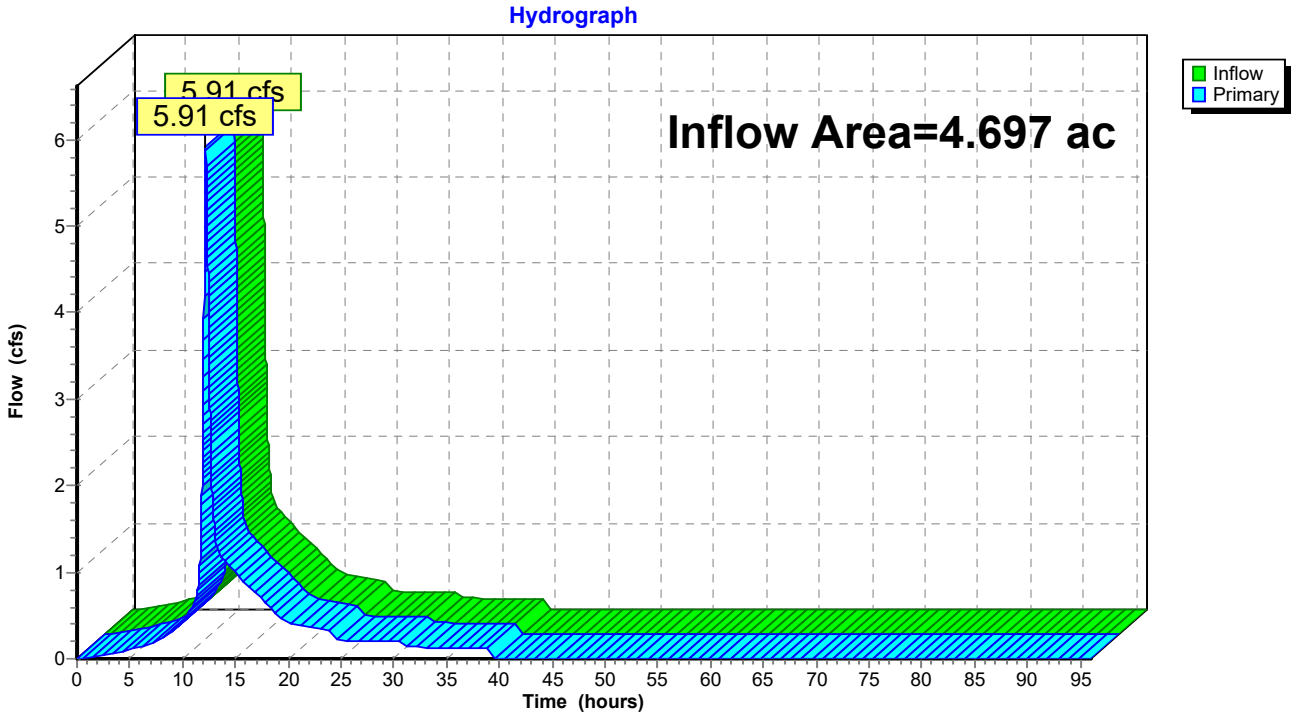


Summary for Link PE: Penn East Total Runoff

Inflow Area = 4.697 ac, 34.53% Impervious, Inflow Depth = 3.44" for 10-Year event
Inflow = 5.91 cfs @ 12.18 hrs, Volume= 1.347 af
Primary = 5.91 cfs @ 12.18 hrs, Volume= 1.347 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Link PE: Penn East Total Runoff



Time span=0.00-96.00 hrs, dt=0.01 hrs, 9601 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1-I: Drainage Area 1: Runoff Area=0.387 ac 79.33% Impervious Runoff Depth=5.85"
Flow Length=119' Tc=6.0 min CN=98 Runoff=2.31 cfs 0.189 af

Subcatchment 2-I: Drainage Area 2: Runoff Area=0.802 ac 63.47% Impervious Runoff Depth=5.73"
Flow Length=252' Tc=7.0 min CN=97 Runoff=4.60 cfs 0.383 af

Subcatchment 2-P: Drainage Area 2: Runoff Area=0.241 ac 0.00% Impervious Runoff Depth=3.26"
Tc=7.0 min CN=74 Runoff=0.89 cfs 0.065 af

Subcatchment 3-I: Drainage Area 3: Roofs Runoff Area=0.404 ac 100.00% Impervious Runoff Depth=5.85"
Tc=6.0 min CN=98 Runoff=2.41 cfs 0.197 af

Subcatchment 4-P: Drainage Area 4: Runoff Area=0.083 ac 0.00% Impervious Runoff Depth=3.07"
Tc=6.0 min CN=72 Runoff=0.30 cfs 0.021 af

Subcatchment 5-P: Drainage Area 5: Runoff Area=0.192 ac 0.00% Impervious Runoff Depth=3.07"
Tc=6.0 min CN=72 Runoff=0.69 cfs 0.049 af

Subcatchment 6-I: Drainage Area 6: Runoff Area=0.223 ac 70.85% Impervious Runoff Depth=5.73"
Flow Length=596' Tc=17.7 min CN=97 Runoff=0.95 cfs 0.107 af

Subcatchment 6-P: Drainage Area 6: Runoff Area=0.991 ac 0.00% Impervious Runoff Depth=3.26"
Tc=17.7 min CN=74 Runoff=2.69 cfs 0.269 af

Subcatchment 7-I: Drainage Area 7: Runoff Area=0.404 ac 60.40% Impervious Runoff Depth=5.73"
Tc=6.0 min CN=97 Runoff=2.40 cfs 0.193 af

Subcatchment 7-P: Drainage Area 7: Runoff Area=0.338 ac 0.00% Impervious Runoff Depth=3.26"
Tc=6.0 min CN=74 Runoff=1.29 cfs 0.092 af

Subcatchment 8-I: Drainage Area 8: Pervious Runoff Area=0.380 ac 0.00% Impervious Runoff Depth=3.16"
Flow Length=327' Tc=14.6 min CN=73 Runoff=1.07 cfs 0.100 af

Subcatchment I-P: Drainage Area 1: Pervious Runoff Area=0.252 ac 0.00% Impervious Runoff Depth=3.16"
Tc=6.0 min CN=73 Runoff=0.93 cfs 0.066 af

Pond 1P: Subsurface Detention Basin 1 Peak Elev=158.28' Storage=7,852 cf Inflow=5.49 cfs 0.449 af
Outflow=1.63 cfs 0.449 af

Pond 2P: SubSurface Detention Basin 2 Peak Elev=159.02' Storage=2,421 cf Inflow=2.41 cfs 0.197 af
Outflow=1.09 cfs 0.197 af

Pond Bio1: Bioretention Basin 1 Peak Elev=157.62' Storage=5,388 cf Inflow=3.54 cfs 0.276 af
Outflow=0.58 cfs 0.276 af

Pond Bio2: Bioretention Basin 2 Peak Elev=157.74' Storage=6,914 cf Inflow=1.87 cfs 0.498 af
Outflow=0.38 cfs 0.498 af

Link 1: Drainage Area 1 Inflow=3.24 cfs 0.255 af
Primary=3.24 cfs 0.255 af

Link 2: Drainage Area 2 Inflow=5.49 cfs 0.449 af
Primary=5.49 cfs 0.449 af

Link 3: Drainage Area 3 Inflow=2.41 cfs 0.197 af
Primary=2.41 cfs 0.197 af

Link 4: Drainage Area 4 Inflow=0.30 cfs 0.021 af
Primary=0.30 cfs 0.021 af

Link 5: Drainage Area 5 Inflow=0.69 cfs 0.049 af
Primary=0.69 cfs 0.049 af

Link 6: Drainage Area 6 Inflow=3.63 cfs 0.376 af
Primary=3.63 cfs 0.376 af

Link 7: Drainage Area 7 Inflow=3.69 cfs 0.285 af
Primary=3.69 cfs 0.285 af

Link 8: Drainage Area 8 Inflow=1.07 cfs 0.100 af
Primary=1.07 cfs 0.100 af

Link MH9: ST MH 9 Connector Inflow=1.21 cfs 0.695 af
Primary=1.21 cfs 0.695 af

Link PE: Penn East Total Runoff Inflow=8.17 cfs 1.732 af
Primary=8.17 cfs 1.732 af

Total Runoff Area = 4.697 ac Runoff Volume = 1.732 af Average Runoff Depth = 4.43"
65.47% Pervious = 3.075 ac 34.53% Impervious = 1.622 ac

Summary for Subcatchment 1-I: Drainage Area 1: Impervious

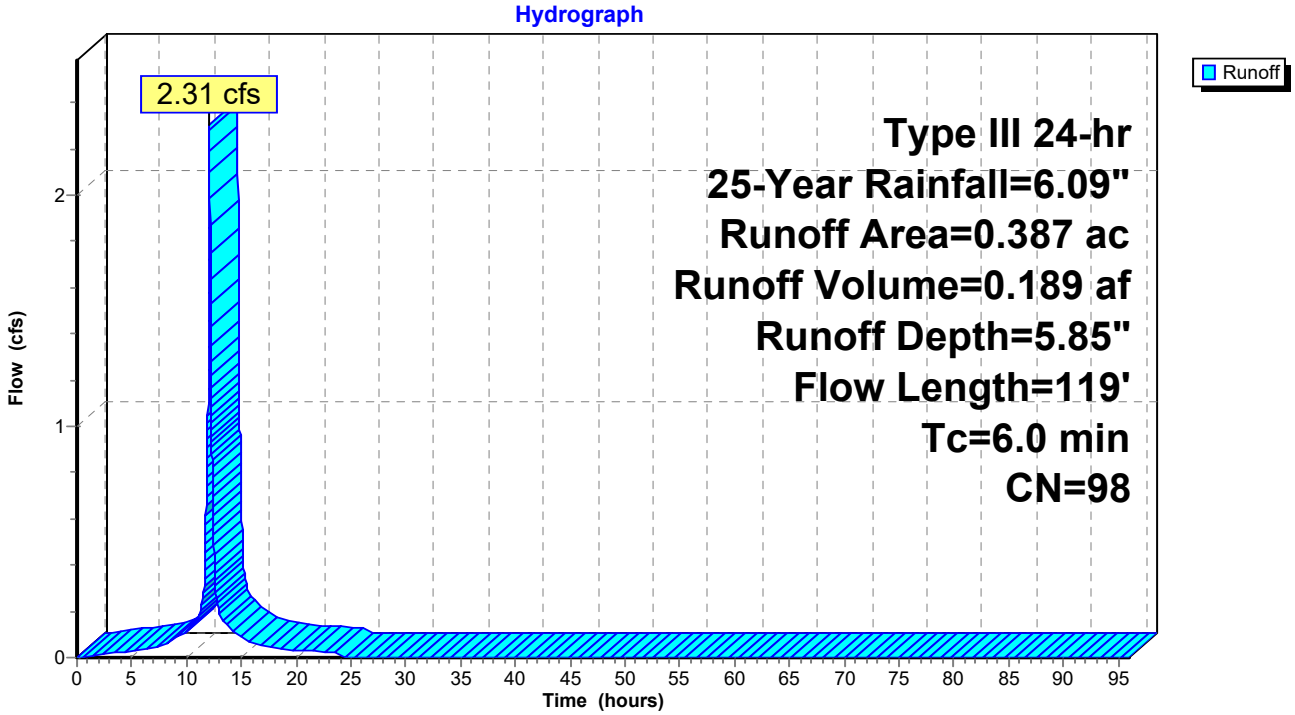
Runoff = 2.31 cfs @ 12.08 hrs, Volume= 0.189 af, Depth= 5.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.09"

Area (ac)	CN	Description
0.080	96	Gravel surface, HSG C
0.015	98	Unconnected pavement, HSG C
0.292	98	Paved parking, HSG C
0.387	98	Weighted Average
0.080		20.67% Pervious Area
0.307		79.33% Impervious Area
0.015		4.89% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	119		0.33		**Direct Entry, Direct**

Subcatchment 1-I: Drainage Area 1: Impervious



Summary for Subcatchment 2-I: Drainage Area 2: Impervious

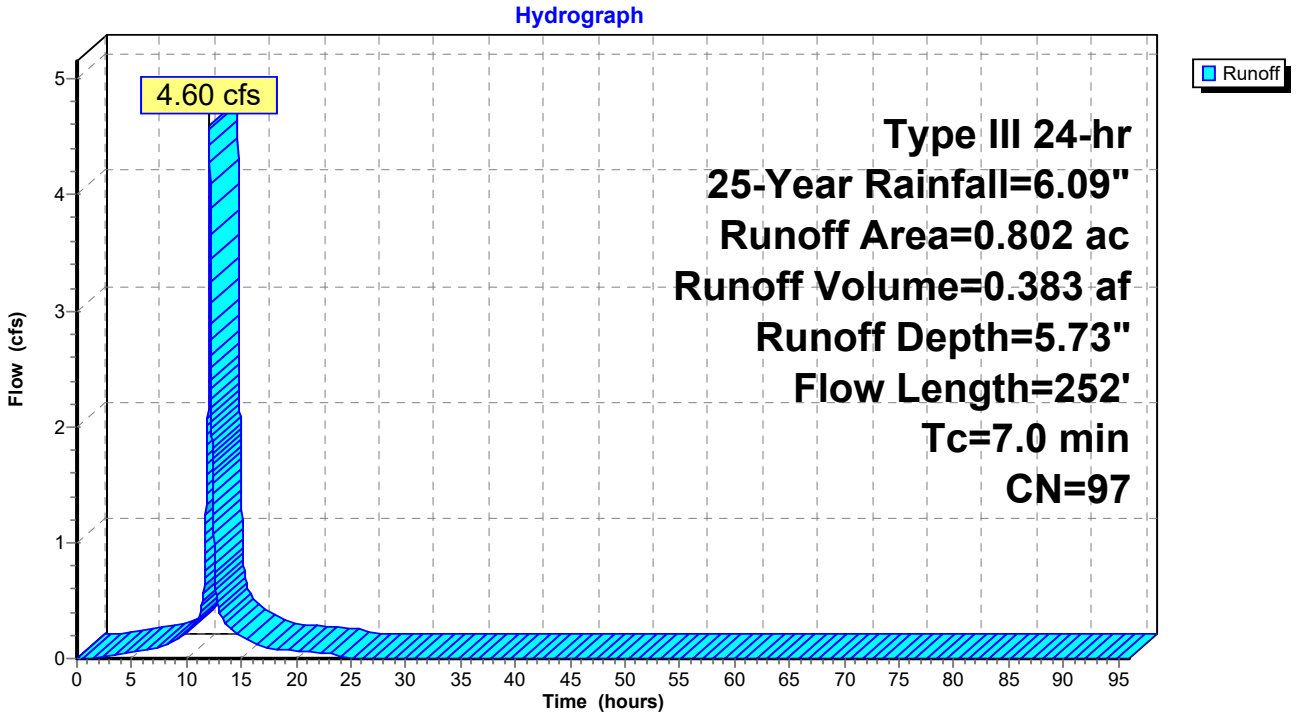
Runoff = 4.60 cfs @ 12.10 hrs, Volume= 0.383 af, Depth= 5.73"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.09"

Area (ac)	CN	Description
0.293	96	Gravel surface, HSG C
0.497	98	Paved parking, HSG C
0.012	98	Unconnected pavement, HSG C
0.802	97	Weighted Average
0.293		36.53% Pervious Area
0.509		63.47% Impervious Area
0.012		2.36% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.1	44	0.0840	0.18		**Sheet Flow, Grass: Dense** Grass: Dense n= 0.240 P2= 3.38"
2.1	38	0.3310	0.30		**Sheet Flow, Grass: Dense** Grass: Dense n= 0.240 P2= 3.38"
0.2	18	0.0500	1.45		**Sheet Flow, Smooth Surfaces** Smooth surfaces n= 0.011 P2= 3.38"
0.6	152	0.0370	3.90		**Shallow Concentrated Flow, Paved** Paved Kv= 20.3 fps
7.0	252	Total			

Subcatchment 2-I: Drainage Area 2: Impervious



Summary for Subcatchment 2-P: Drainage Area 2: Pervious

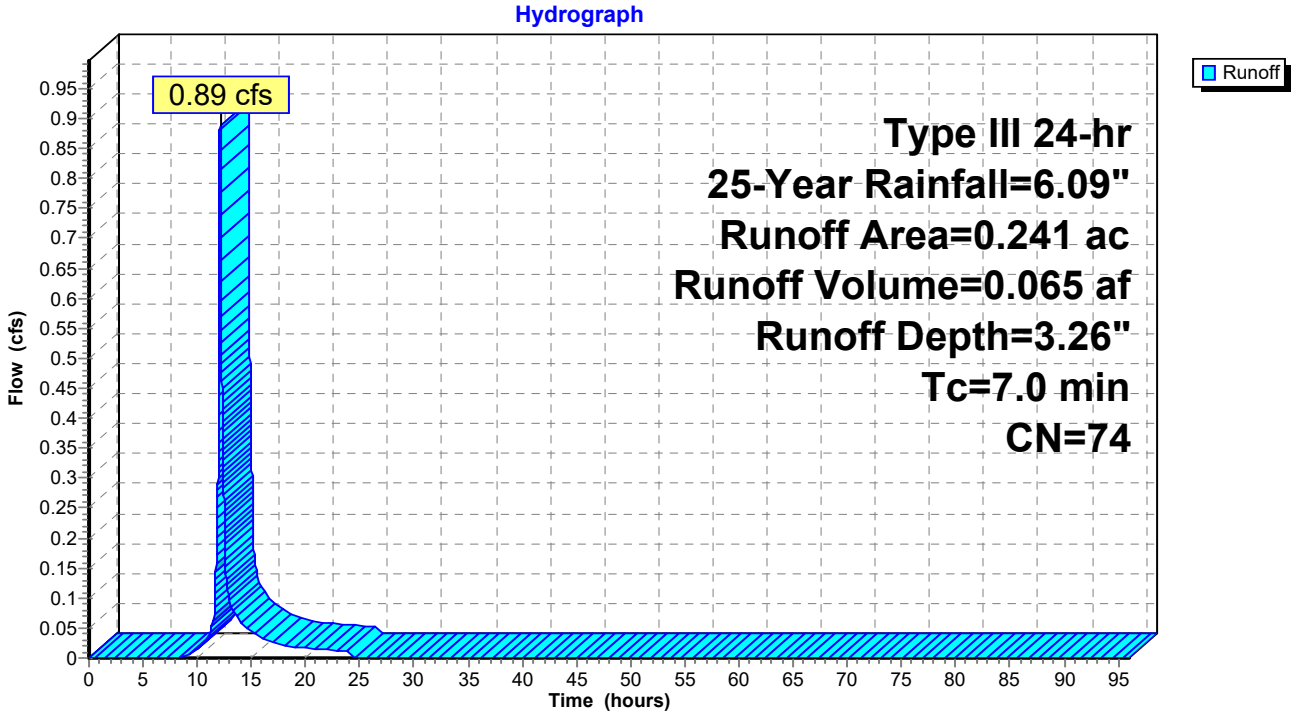
Runoff = 0.89 cfs @ 12.10 hrs, Volume= 0.065 af, Depth= 3.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.09"

Area (ac)	CN	Description
0.186	74	>75% Grass cover, Good, HSG C
0.055	72	Woods/grass comb., Good, HSG C
0.241	74	Weighted Average
0.241		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0					**Direct Entry, 2-I**

Subcatchment 2-P: Drainage Area 2: Pervious



Summary for Subcatchment 3-I: Drainage Area 3: Roofs

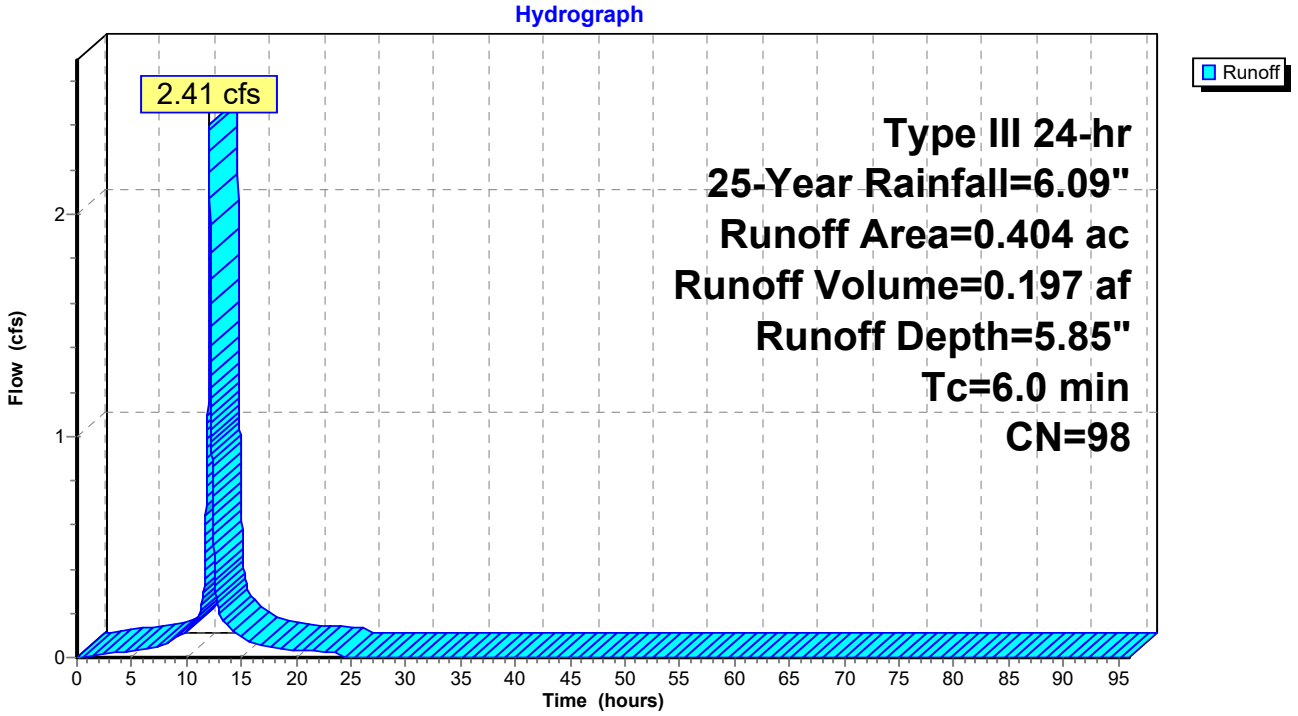
Runoff = 2.41 cfs @ 12.08 hrs, Volume= 0.197 af, Depth= 5.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.09"

Area (ac)	CN	Description
0.404	98	Unconnected roofs, HSG C
0.404		100.00% Impervious Area
0.404		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct C-1**

Subcatchment 3-I: Drainage Area 3: Roofs



Summary for Subcatchment 4-P: Drainage Area 4: Pervious (Basin 1)

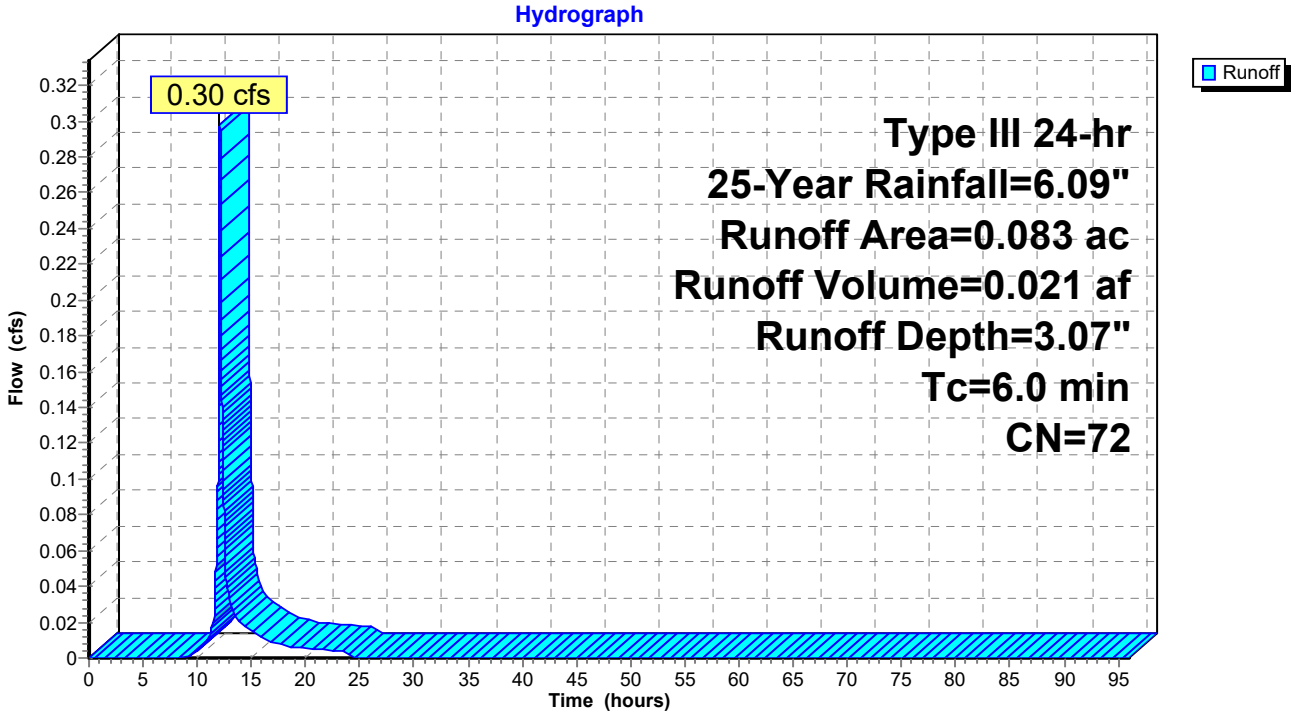
Runoff = 0.30 cfs @ 12.09 hrs, Volume= 0.021 af, Depth= 3.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.09"

Area (ac)	CN	Description
0.083	72	Woods/grass comb., Good, HSG C
0.083		100.00% Pervious Area

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

Subcatchment 4-P: Drainage Area 4: Pervious (Basin 1)



Summary for Subcatchment 5-P: Drainage Area 5: Pervious (Basin 2)

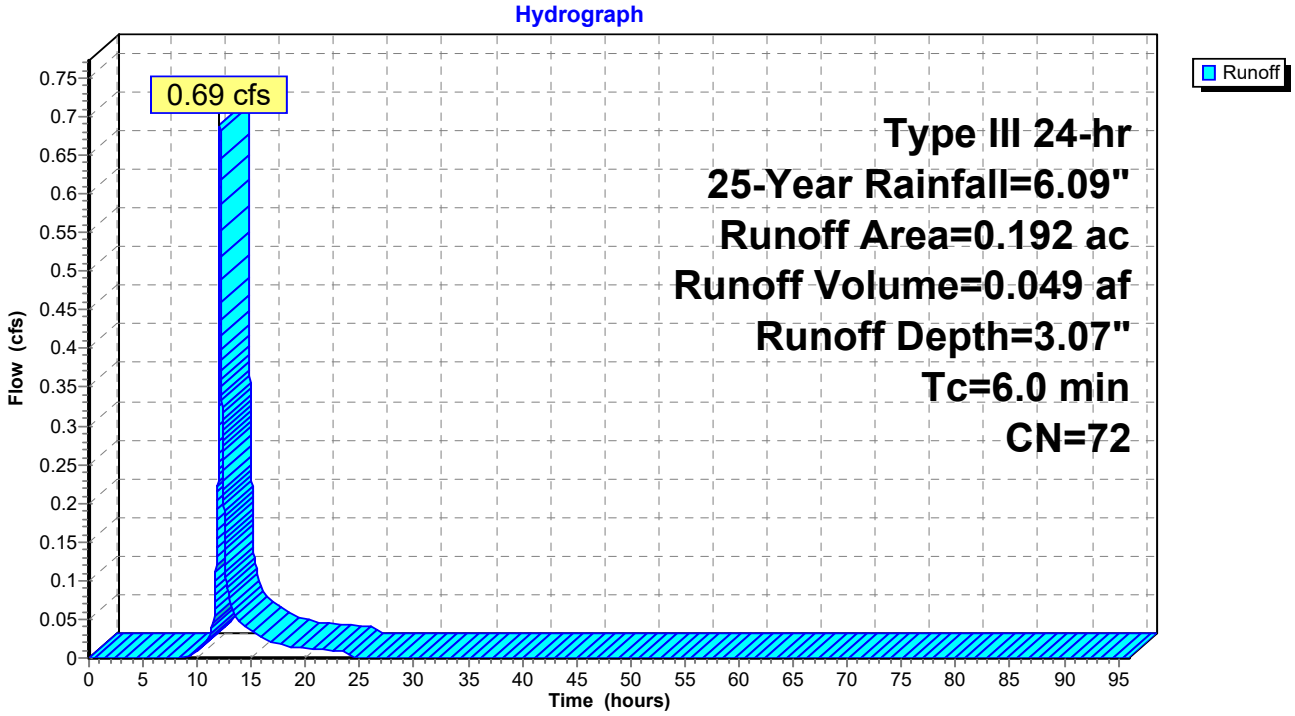
Runoff = 0.69 cfs @ 12.09 hrs, Volume= 0.049 af, Depth= 3.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.09"

Area (ac)	CN	Description
0.192	72	Woods/grass comb., Good, HSG C
0.192		100.00% Pervious Area

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

Subcatchment 5-P: Drainage Area 5: Pervious (Basin 2)



Summary for Subcatchment 6-I: Drainage Area 6: Impervious

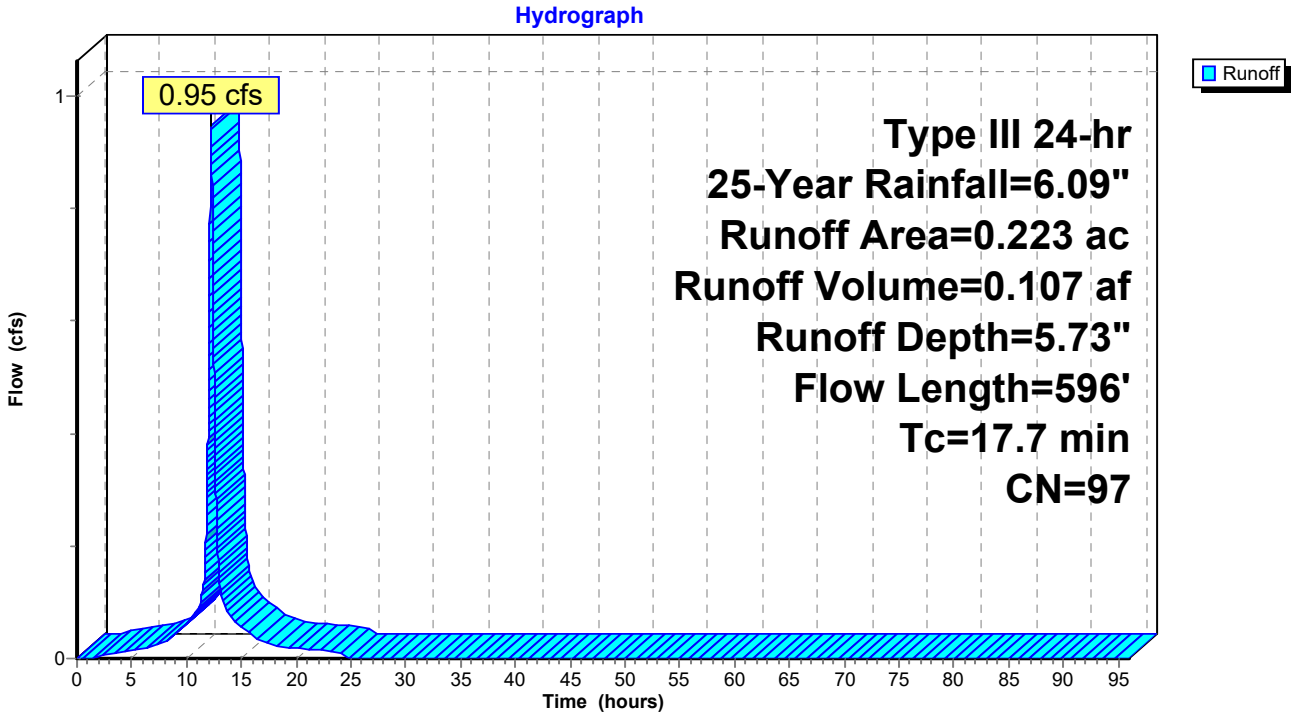
Runoff = 0.95 cfs @ 12.23 hrs, Volume= 0.107 af, Depth= 5.73"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.09"

Area (ac)	CN	Description
0.002	98	Unconnected roofs, HSG C
0.156	98	Unconnected pavement, HSG C
0.065	96	Gravel surface, HSG C
0.223	97	Weighted Average
0.065		29.15% Pervious Area
0.158		70.85% Impervious Area
0.158		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.6	40	0.1180	0.08		**Sheet Flow, SF1** Woods: Dense underbrush n= 0.800 P2= 3.38"
5.0	60	0.0923	0.20		**Sheet Flow, SF2** Grass: Dense n= 0.240 P2= 3.38"
0.7	86	0.0988	2.20		**Shallow Concentrated Flow, SCF1** Short Grass Pasture Kv= 7.0 fps
3.3	343	0.0499	1.75	1.75	**Channel Flow, CF1** Area= 1.0 sf Perim= 12.6' r= 0.08' n= 0.035 Earth, dense weeds
0.1	67	0.0780	16.63	23.22	**Pipe Channel, HDPE Pipe** 16.0" Round Area= 1.4 sf Perim= 4.2' r= 0.33' n= 0.012
17.7	596	Total			

Subcatchment 6-I: Drainage Area 6: Impervious



Summary for Subcatchment 6-P: Drainage Area 6: Pervious

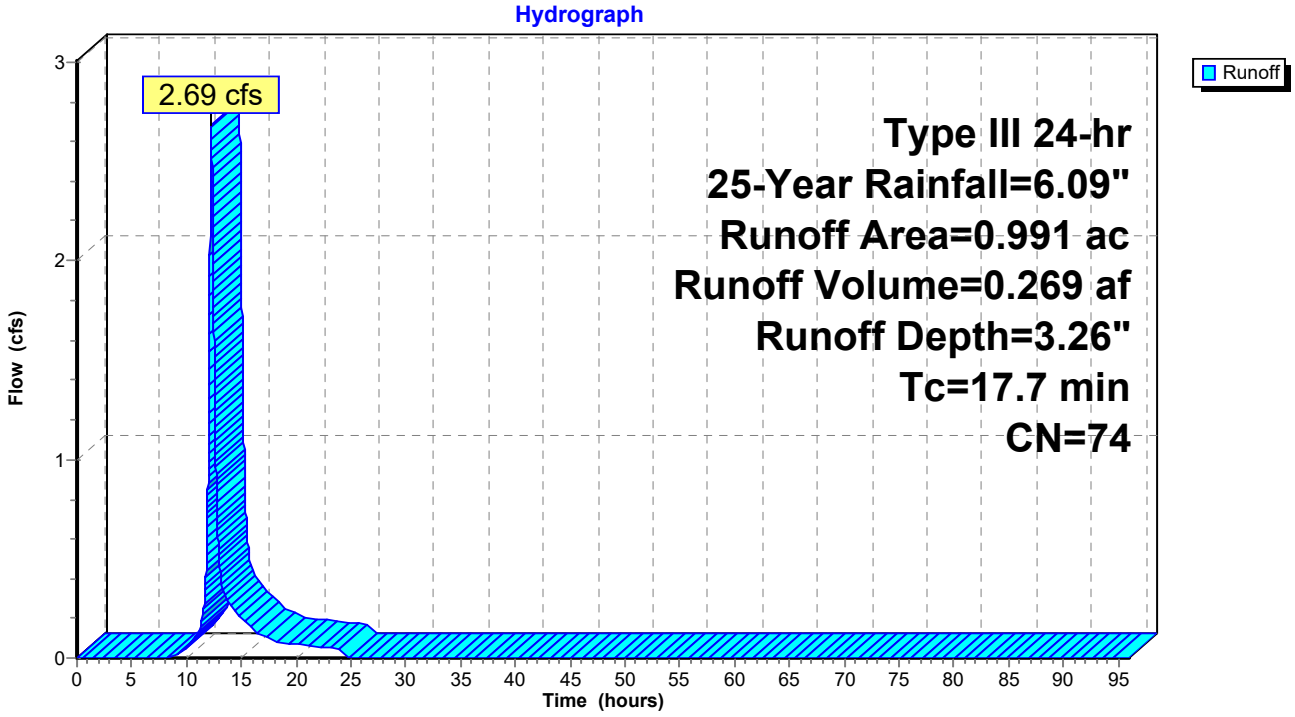
Runoff = 2.69 cfs @ 12.25 hrs, Volume= 0.269 af, Depth= 3.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.09"

Area (ac)	CN	Description
0.981	74	>75% Grass cover, Good, HSG C
0.010	72	Woods/grass comb., Good, HSG C
0.991	74	Weighted Average
0.991		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.7					**Direct Entry, Same as G1**

Subcatchment 6-P: Drainage Area 6: Pervious



Summary for Subcatchment 7-I: Drainage Area 7: Impervious

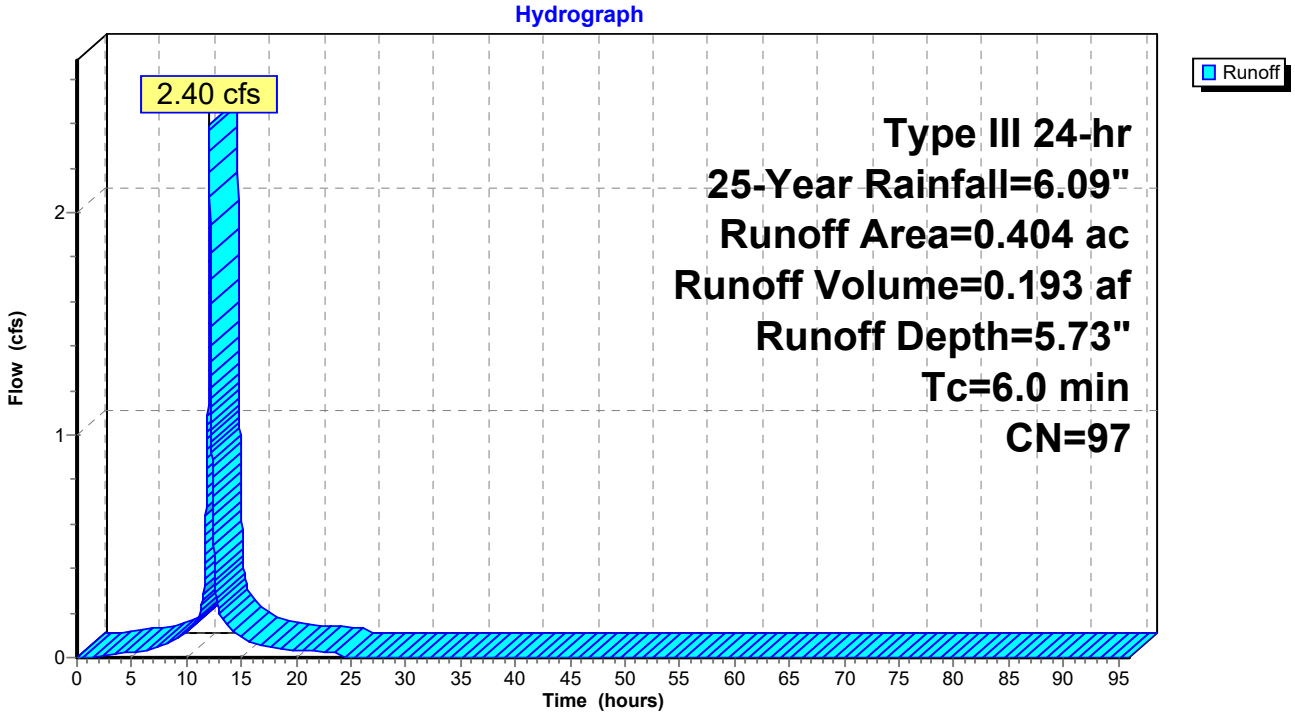
Runoff = 2.40 cfs @ 12.08 hrs, Volume= 0.193 af, Depth= 5.73"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.09"

Area (ac)	CN	Description
0.135	98	Paved parking, HSG C
0.160	96	Gravel surface, HSG C
0.109	98	Unconnected roofs, HSG C
0.404	97	Weighted Average
0.160		39.60% Pervious Area
0.244		60.40% Impervious Area
0.109		44.67% Unconnected

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

Subcatchment 7-I: Drainage Area 7: Impervious



Summary for Subcatchment 7-P: Drainage Area 7: Pervious

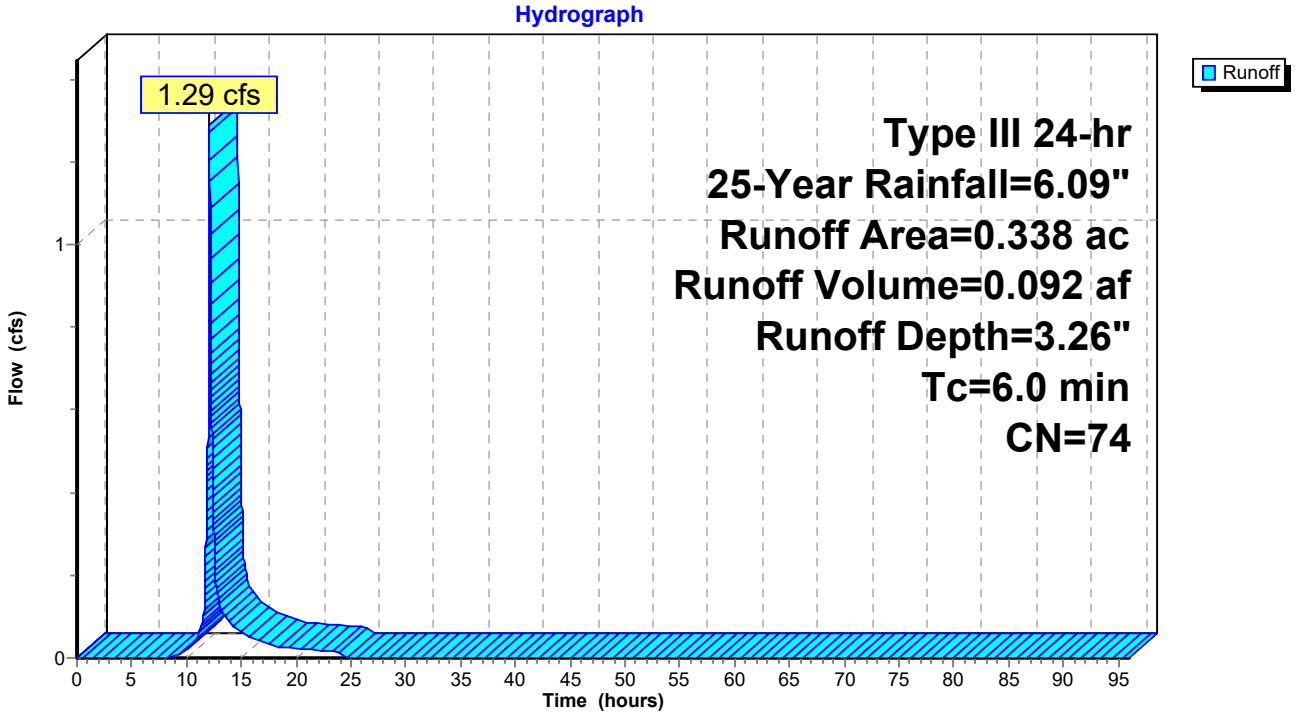
Runoff = 1.29 cfs @ 12.09 hrs, Volume= 0.092 af, Depth= 3.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.09"

Area (ac)	CN	Description
0.338	74	>75% Grass cover, Good, HSG C
0.338		100.00% Pervious Area

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

Subcatchment 7-P: Drainage Area 7: Pervious



Summary for Subcatchment 8-I: Drainage Area 8: Pervious

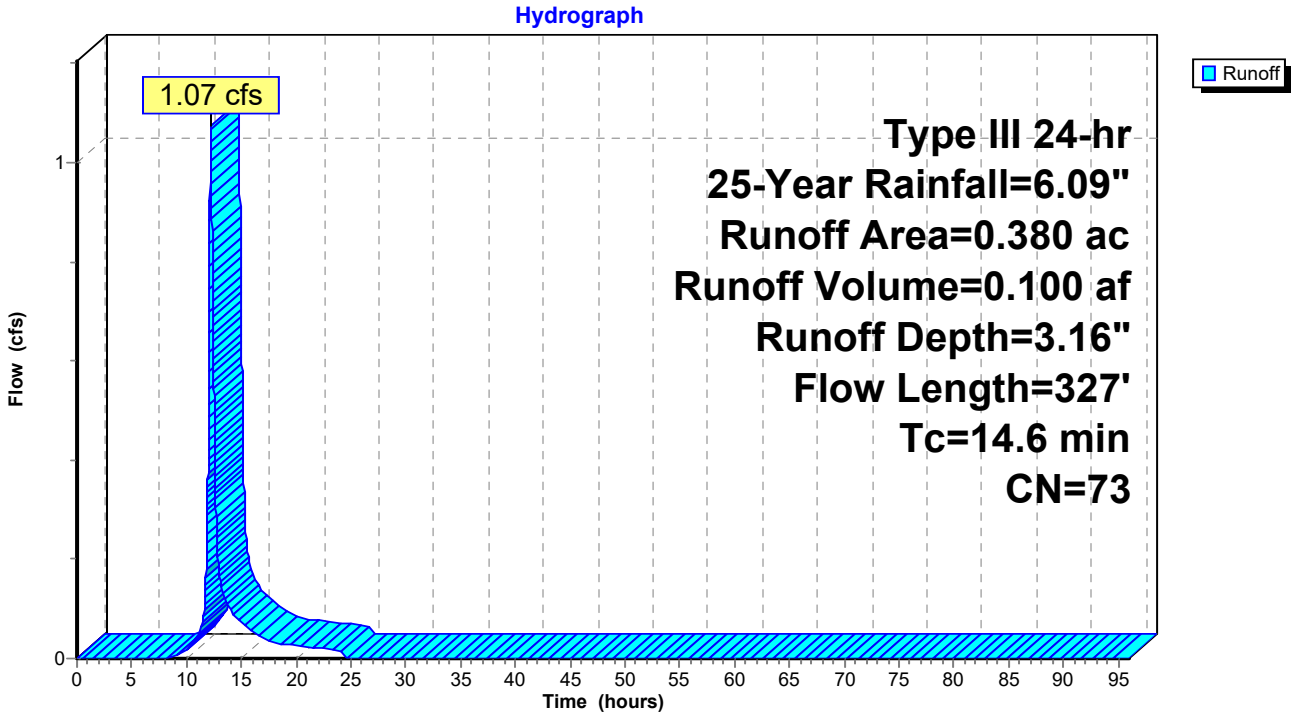
Runoff = 1.07 cfs @ 12.20 hrs, Volume= 0.100 af, Depth= 3.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.09"

Area (ac)	CN	Description
0.234	74	>75% Grass cover, Good, HSG C
0.146	72	Woods/grass comb., Good, HSG C
0.380	73	Weighted Average
0.380		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	16	0.1190	0.25		**Sheet Flow, Grass: Short** Grass: Short n= 0.150 P2= 3.38"
12.0	85	0.0580	0.12		**Sheet Flow, Woods: Light Underbrush** Woods: Light underbrush n= 0.400 P2= 3.38"
0.2	23	0.0850	2.04		**Shallow Concentrated Flow, Short Grass Pasture** Short Grass Pasture Kv= 7.0 fps
0.4	28	0.0480	1.10		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
0.3	27	0.0650	1.78		**Shallow Concentrated Flow, Short Grass Pasture** Short Grass Pasture Kv= 7.0 fps
0.5	108	0.0130	3.54	3.54	**Parabolic Channel, Earth Clean and Straight** W=3.00' D=0.50' Area=1.0 sf Perim=3.2' n= 0.022 Earth, clean & straight
0.1	40	0.0270	8.08	6.34	**Pipe Channel, Pipe** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012
14.6	327	Total			

Subcatchment 8-I: Drainage Area 8: Pervious



Summary for Subcatchment I-P: Drainage Area 1: Pervious

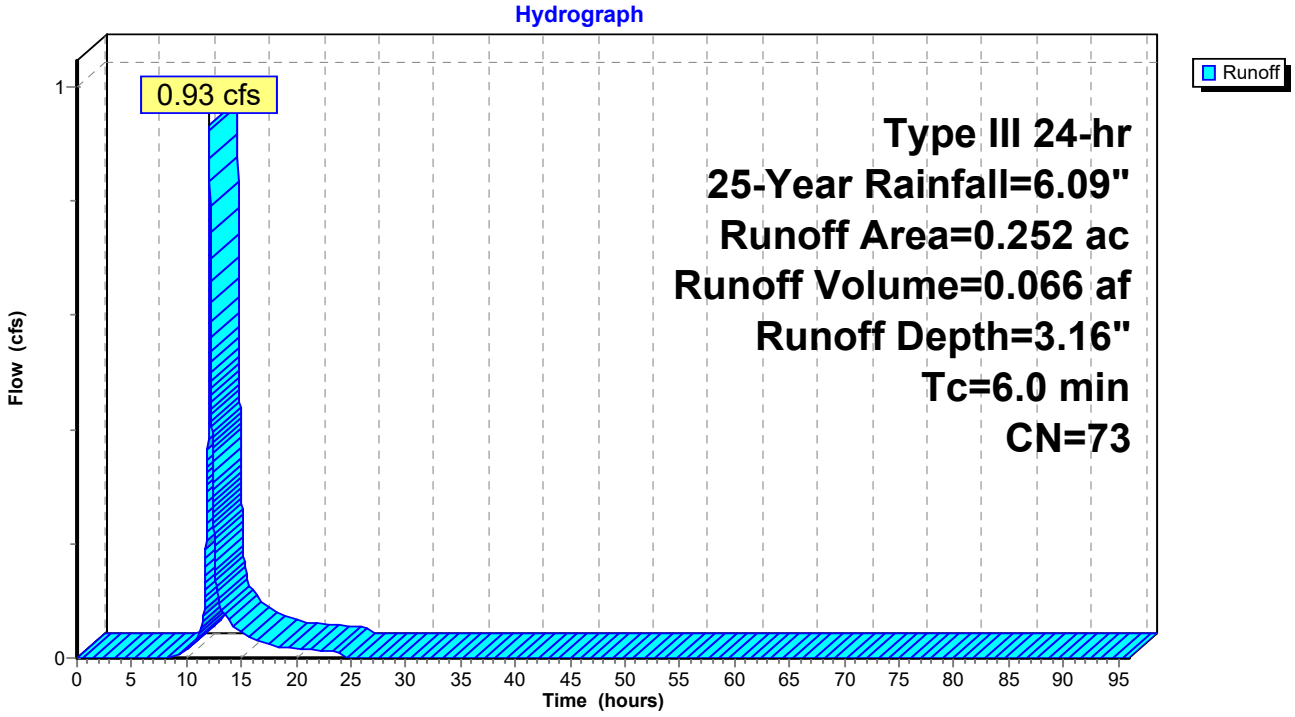
Runoff = 0.93 cfs @ 12.09 hrs, Volume= 0.066 af, Depth= 3.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.09"

Area (ac)	CN	Description
0.107	74	>75% Grass cover, Good, HSG C
0.145	72	Woods/grass comb., Good, HSG C
0.252	73	Weighted Average
0.252		100.00% Pervious Area

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

Subcatchment I-P: Drainage Area 1: Pervious



Summary for Pond 1P: Subsurface Detention Basin 1 (Stormtrap-ST2)

Inflow Area = 1.043 ac, 48.80% Impervious, Inflow Depth = 5.16" for 25-Year event
Inflow = 5.49 cfs @ 12.10 hrs, Volume= 0.449 af
Outflow = 1.63 cfs @ 12.42 hrs, Volume= 0.449 af, Atten= 70%, Lag= 19.7 min
Primary = 1.63 cfs @ 12.42 hrs, Volume= 0.449 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 158.28' @ 12.43 hrs Surf.Area= 8,073 sf Storage= 7,852 cf

Plug-Flow detention time= 268.2 min calculated for 0.449 af (100% of inflow)
Center-of-Mass det. time= 268.2 min (1,032.2 - 763.9)

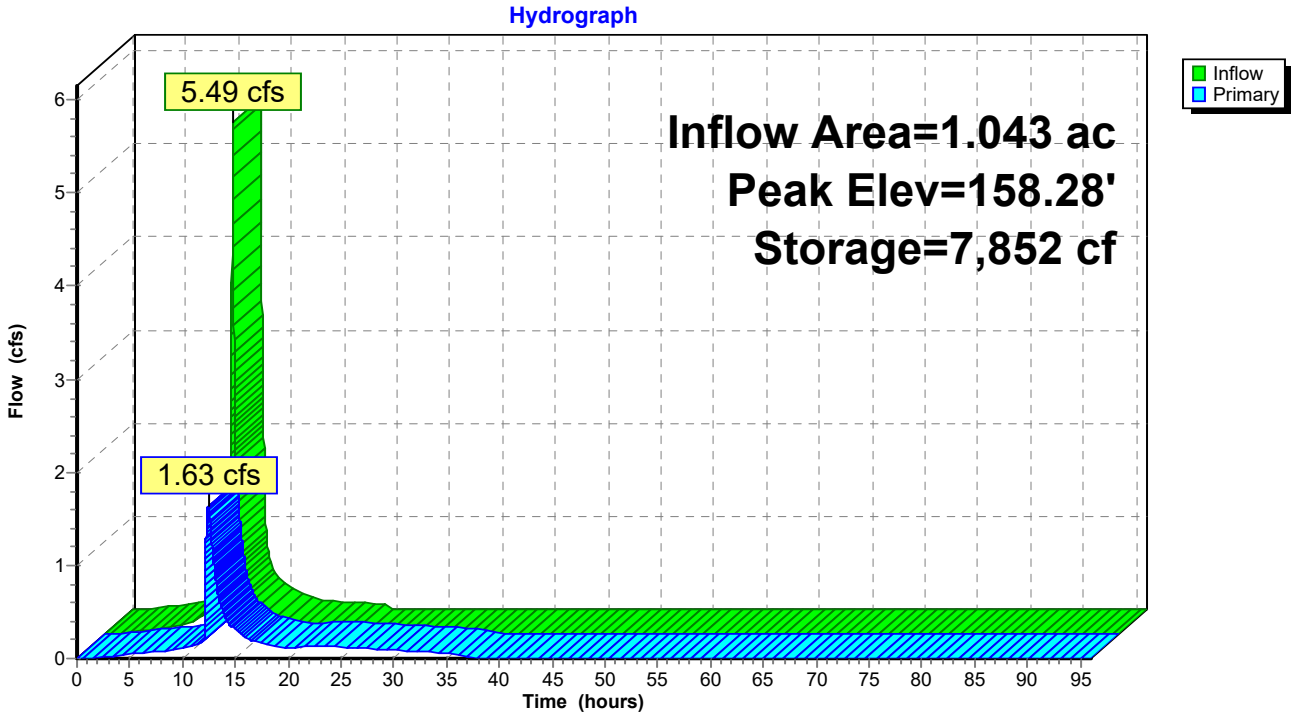
Volume	Invert	Avail.Storage	Storage Description
#1	156.33'	12,969 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
156.33	0	0	0
158.83	10,375	12,969	12,969

Device	Routing	Invert	Outlet Devices
#1	Primary	156.33'	**15.0" Round Culvert** L= 50.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 156.33' / 156.00' S= 0.0066 '/' Cc= 0.900 n= 0.012, Flow Area= 1.23 sf
#2	Device 1	156.33'	**2.5" Vert. Orifice/Grate** C= 0.600
#3	Device 1	157.83'	**18.0" W x 6.0" H Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=1.63 cfs @ 12.42 hrs HW=158.28' TW=156.76' (Dynamic Tailwater)
└─**1=Culvert** (Passes 1.63 cfs of 6.31 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.20 cfs @ 5.94 fps)
  └─**3=Orifice/Grate** (Orifice Controls 1.43 cfs @ 2.14 fps)

Pond 1P: Subsurface Detention Basin 1 (Stormtrap-ST2)



Summary for Pond 2P: SubSurface Detention Basin 2 (Stormtrap-ST2)

Inflow Area = 0.404 ac,100.00% Impervious, Inflow Depth = 5.85" for 25-Year event
Inflow = 2.41 cfs @ 12.08 hrs, Volume= 0.197 af
Outflow = 1.09 cfs @ 12.25 hrs, Volume= 0.197 af, Atten= 55%, Lag= 10.2 min
Primary = 1.09 cfs @ 12.25 hrs, Volume= 0.197 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 159.02' @ 12.25 hrs Surf.Area= 2,862 sf Storage= 2,421 cf

Plug-Flow detention time= 63.4 min calculated for 0.197 af (100% of inflow)
Center-of-Mass det. time= 63.4 min (808.3 - 744.9)

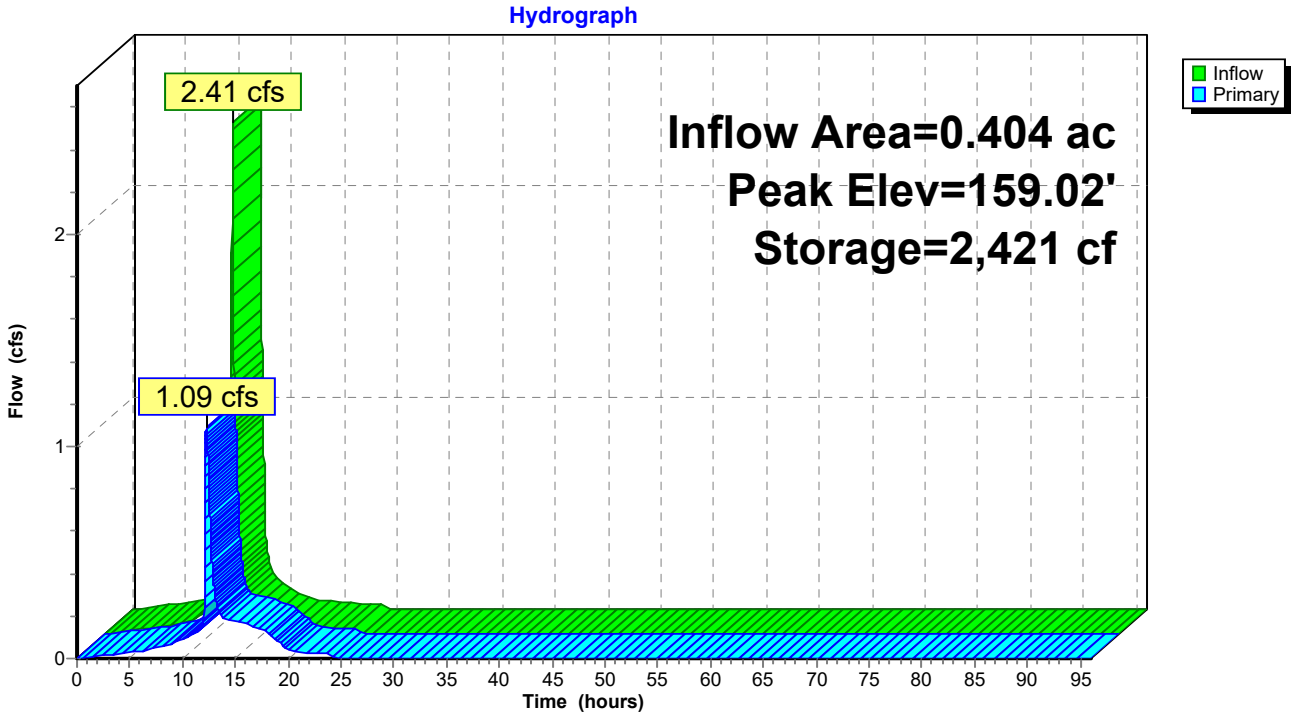
Volume	Invert	Avail.Storage	Storage Description
#1	157.33'	5,286 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
157.33	0	0	0
159.83	4,229	5,286	5,286

Device	Routing	Invert	Outlet Devices
#1	Primary	157.33'	**15.0" Round Culvert** L= 245.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 157.33' / 151.13' S= 0.0253 '/' Cc= 0.900 n= 0.012, Flow Area= 1.23 sf
#2	Device 1	157.33'	**2.5" Vert. Orifice/Grate** C= 0.600
#3	Device 1	158.70'	**18.0" W x 6.0" H Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=1.09 cfs @ 12.25 hrs HW=159.02' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Passes 1.09 cfs of 4.82 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.21 cfs @ 6.07 fps)
  └─**3=Orifice/Grate** (Orifice Controls 0.88 cfs @ 1.82 fps)

Pond 2P: SubSurface Detention Basin 2 (Stormtrap-ST2)



Summary for Pond Bio1: Bioretention Basin 1

Inflow Area = 0.722 ac, 42.52% Impervious, Inflow Depth = 4.59" for 25-Year event
Inflow = 3.54 cfs @ 12.09 hrs, Volume= 0.276 af
Outflow = 0.58 cfs @ 12.56 hrs, Volume= 0.276 af, Atten= 84%, Lag= 28.6 min
Primary = 0.58 cfs @ 12.56 hrs, Volume= 0.276 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 157.62' @ 12.56 hrs Surf.Area= 2,402 sf Storage= 5,388 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 237.1 min (1,009.3 - 772.2)

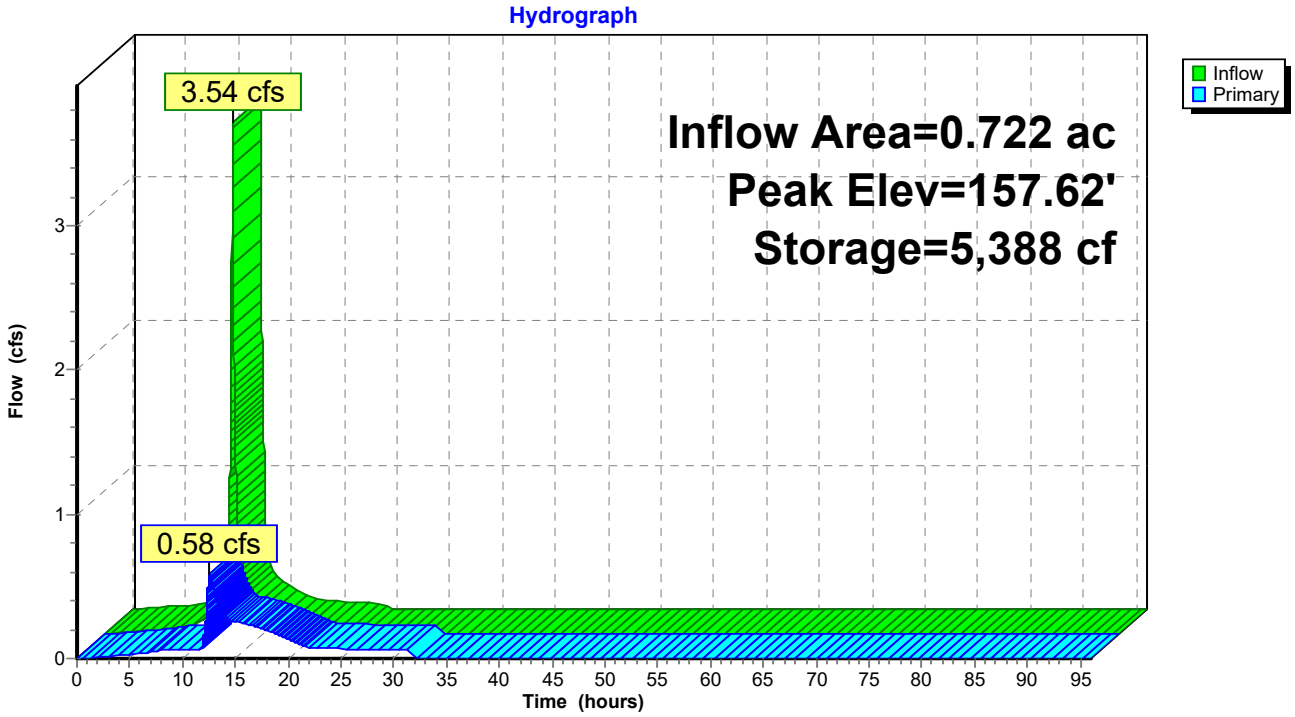
Volume	Invert	Avail.Storage	Storage Description
#1	155.00'	8,960 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
155.00	1,718	0	0
156.00	1,970	1,844	1,844
157.00	2,232	2,101	3,945
158.00	2,505	2,369	6,314
159.00	2,787	2,646	8,960

Device	Routing	Invert	Outlet Devices
#1	Primary	151.80'	**15.0" Round Culvert** L= 95.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 151.80' / 151.00' S= 0.0084 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Device 1	155.00'	**1.500 in/hr Exfiltration over Surface area**
#3	Device 1	156.00'	**2.5" Vert. Orifice/Grate** C= 0.600
#4	Device 1	157.30'	**6.0" W x 6.0" H Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.58 cfs @ 12.56 hrs HW=157.62' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Passes 0.58 cfs of 11.84 cfs potential flow)
  ├─**2=Exfiltration** (Exfiltration Controls 0.08 cfs)
  ├─**3=Orifice/Grate** (Orifice Controls 0.20 cfs @ 5.93 fps)
  └─**4=Orifice/Grate** (Orifice Controls 0.29 cfs @ 1.82 fps)

Pond Bio1: Bioretention Basin 1



Summary for Pond Bio2: Bioretention Basin 2

Inflow Area = 1.235 ac, 41.21% Impervious, Inflow Depth = 4.84" for 25-Year event
Inflow = 1.87 cfs @ 12.37 hrs, Volume= 0.498 af
Outflow = 0.38 cfs @ 14.64 hrs, Volume= 0.498 af, Atten= 80%, Lag= 136.1 min
Primary = 0.38 cfs @ 14.64 hrs, Volume= 0.498 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 157.74' @ 14.64 hrs Surf.Area= 4,662 sf Storage= 6,914 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 300.9 min (1,313.4 - 1,012.5)

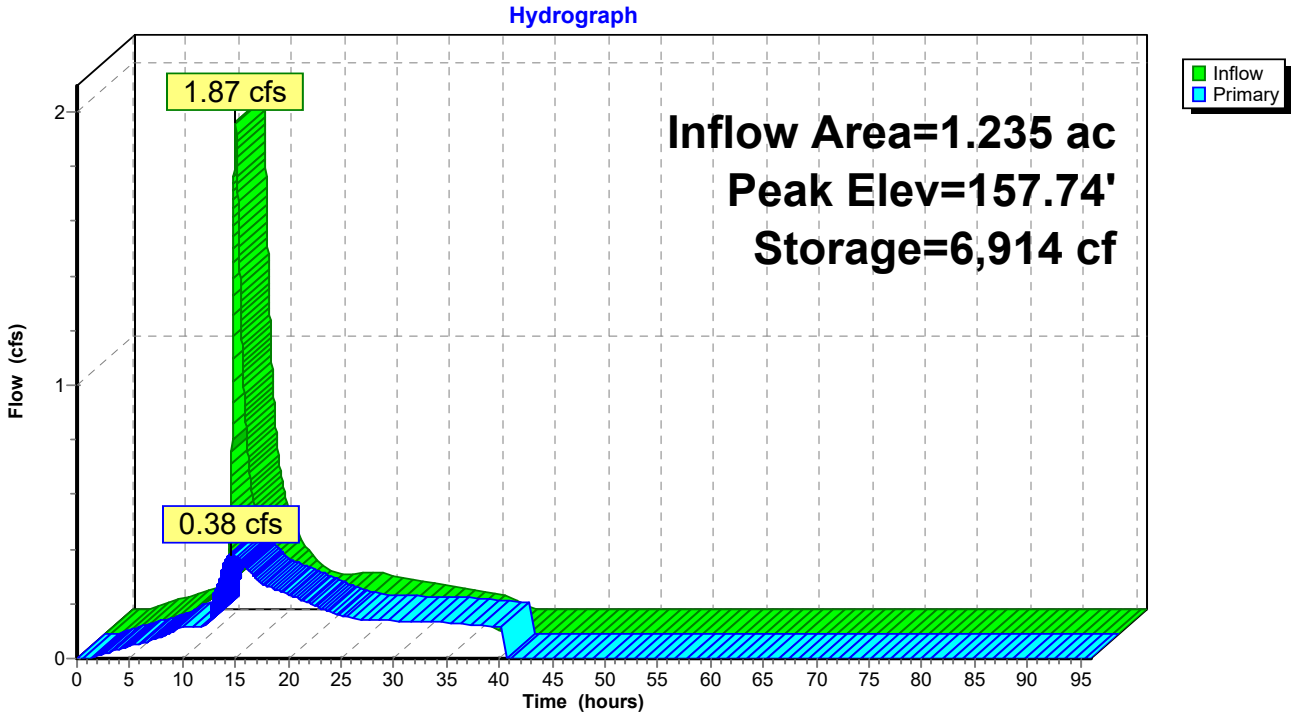
Volume	Invert	Avail.Storage	Storage Description
#1	156.00'	13,443 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
156.00	3,288	0	0
157.00	4,052	3,670	3,670
158.00	4,872	4,462	8,132
159.00	5,749	5,311	13,443

Device	Routing	Invert	Outlet Devices
#1	Primary	152.17'	**15.0" Round Culvert** L= 109.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 152.17' / 151.30' S= 0.0080 '/' Cc= 0.900 n= 0.012, Flow Area= 1.23 sf
#2	Device 1	156.00'	**1.500 in/hr Exfiltration over Surface area**
#3	Device 1	157.00'	**2.5" Vert. Orifice/Grate** C= 0.600
#4	Device 1	157.54'	**4.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.38 cfs @ 14.64 hrs HW=157.74' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Passes 0.38 cfs of 11.72 cfs potential flow)
  ├─**2=Exfiltration** (Exfiltration Controls 0.16 cfs)
  ├─**3=Orifice/Grate** (Orifice Controls 0.13 cfs @ 3.85 fps)
  └─**4=Orifice/Grate** (Orifice Controls 0.09 cfs @ 1.54 fps)

Pond Bio2: Bioretention Basin 2

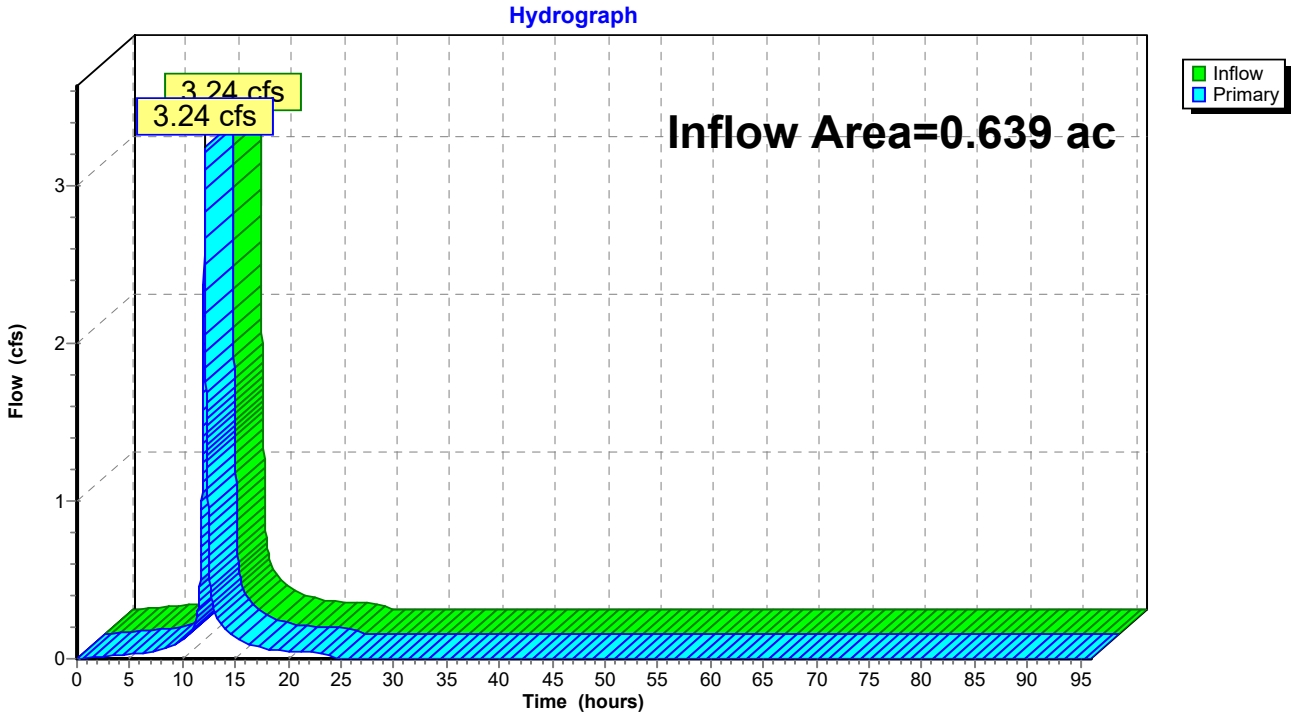


Summary for Link 1: Drainage Area 1

Inflow Area = 0.639 ac, 48.04% Impervious, Inflow Depth = 4.79" for 25-Year event
Inflow = 3.24 cfs @ 12.09 hrs, Volume= 0.255 af
Primary = 3.24 cfs @ 12.09 hrs, Volume= 0.255 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Link 1: Drainage Area 1

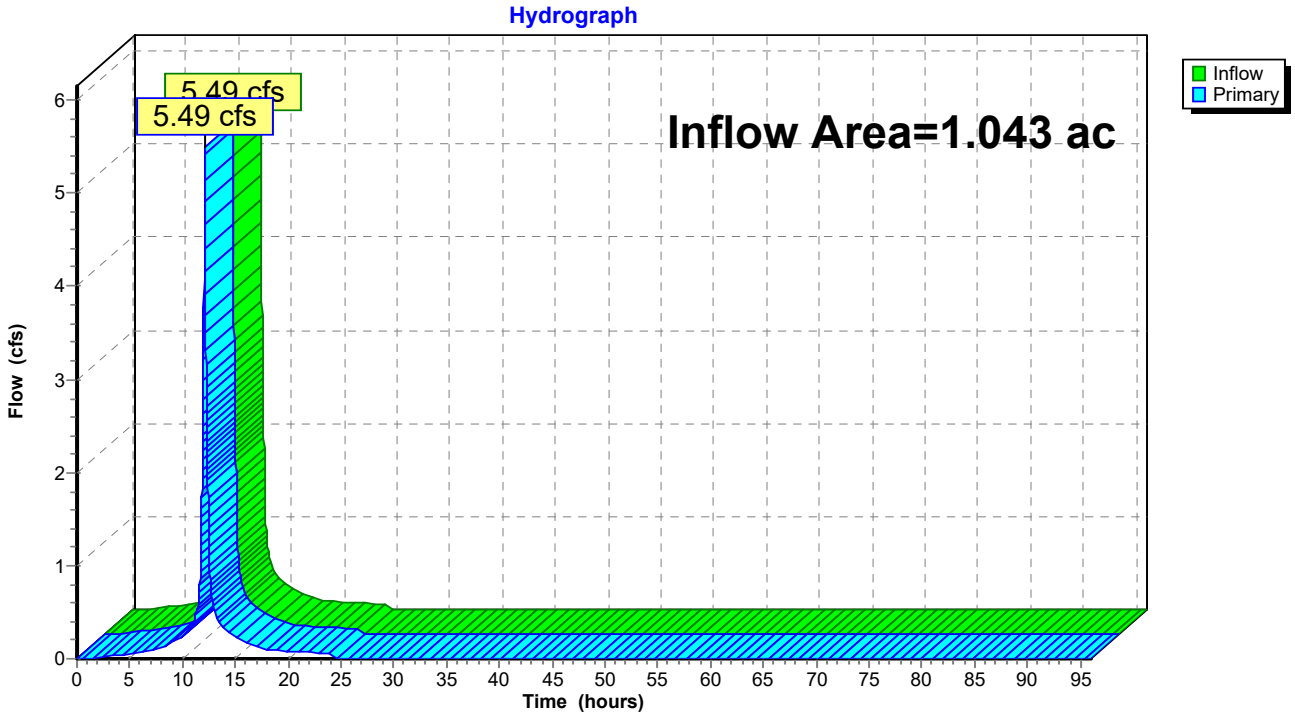


Summary for Link 2: Drainage Area 2

Inflow Area = 1.043 ac, 48.80% Impervious, Inflow Depth = 5.16" for 25-Year event
Inflow = 5.49 cfs @ 12.10 hrs, Volume= 0.449 af
Primary = 5.49 cfs @ 12.10 hrs, Volume= 0.449 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Link 2: Drainage Area 2

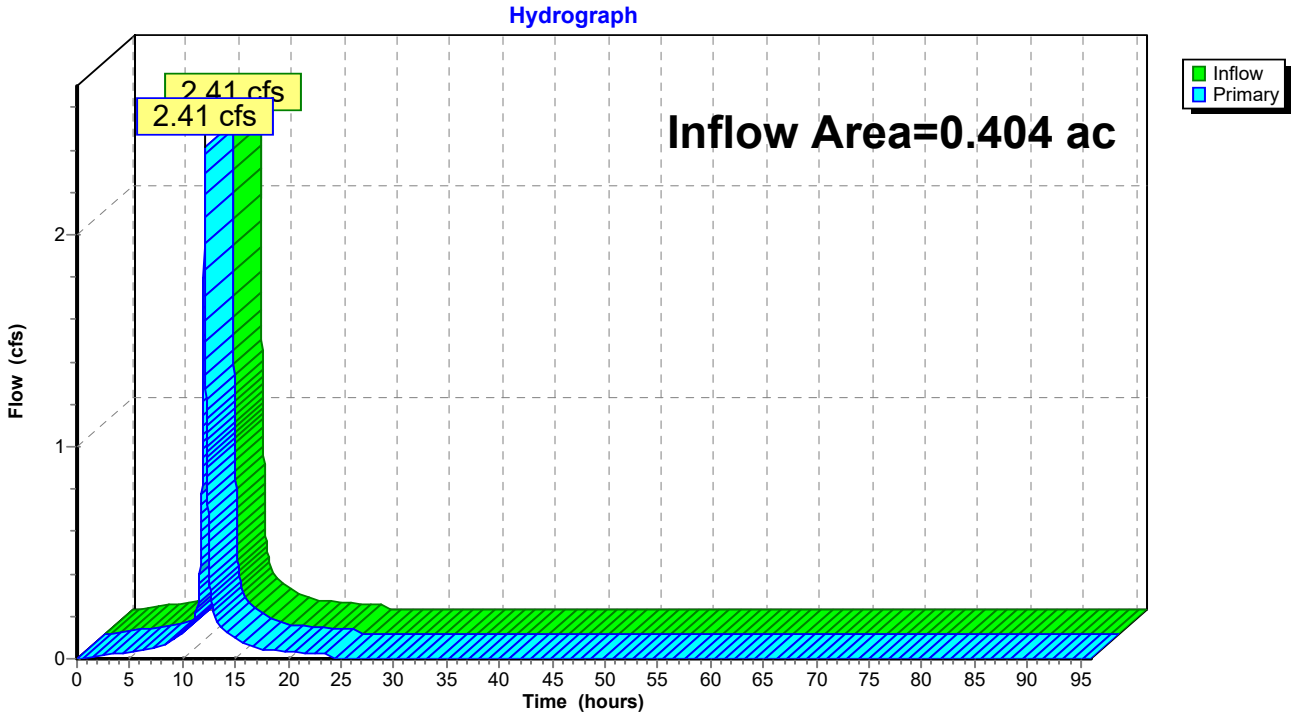


Summary for Link 3: Drainage Area 3

Inflow Area = 0.404 ac,100.00% Impervious, Inflow Depth = 5.85" for 25-Year event
Inflow = 2.41 cfs @ 12.08 hrs, Volume= 0.197 af
Primary = 2.41 cfs @ 12.08 hrs, Volume= 0.197 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Link 3: Drainage Area 3

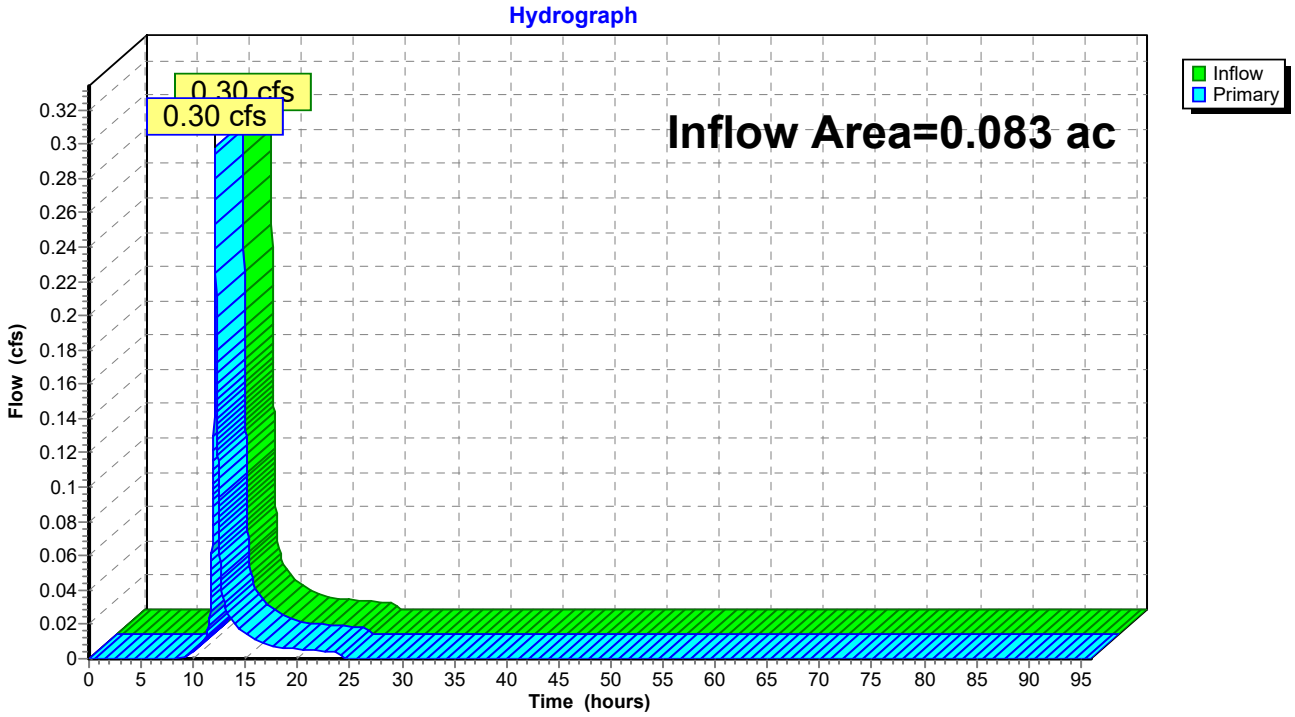


Summary for Link 4: Drainage Area 4

Inflow Area = 0.083 ac, 0.00% Impervious, Inflow Depth = 3.07" for 25-Year event
Inflow = 0.30 cfs @ 12.09 hrs, Volume= 0.021 af
Primary = 0.30 cfs @ 12.09 hrs, Volume= 0.021 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Link 4: Drainage Area 4

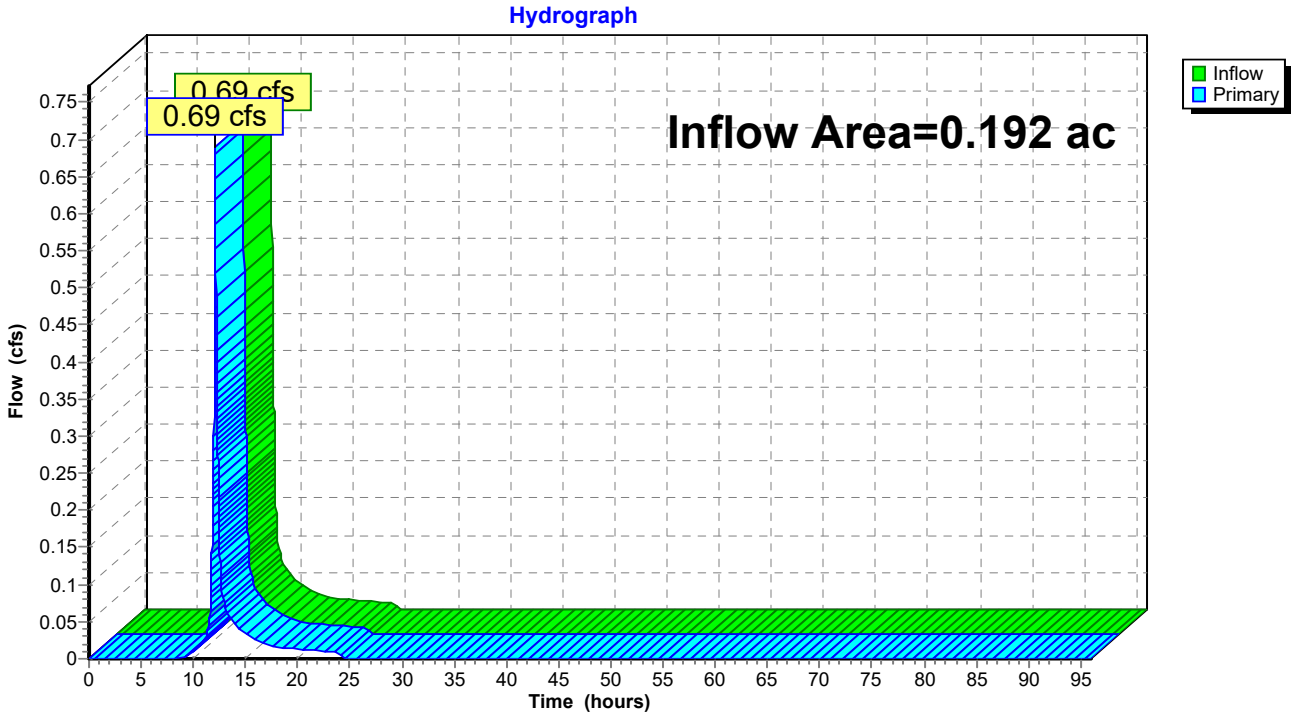


Summary for Link 5: Drainage Area 5

Inflow Area = 0.192 ac, 0.00% Impervious, Inflow Depth = 3.07" for 25-Year event
Inflow = 0.69 cfs @ 12.09 hrs, Volume= 0.049 af
Primary = 0.69 cfs @ 12.09 hrs, Volume= 0.049 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Link 5: Drainage Area 5

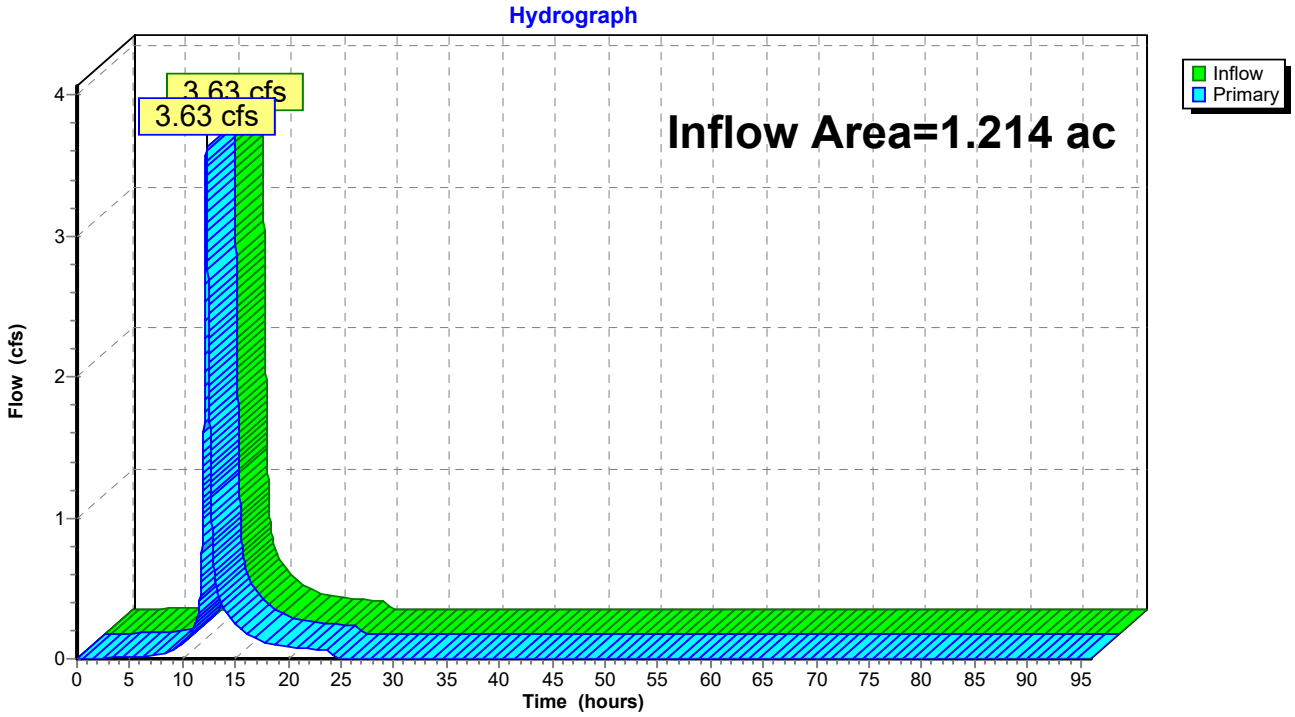


Summary for Link 6: Drainage Area 6

Inflow Area = 1.214 ac, 13.01% Impervious, Inflow Depth = 3.72" for 25-Year event
Inflow = 3.63 cfs @ 12.25 hrs, Volume= 0.376 af
Primary = 3.63 cfs @ 12.25 hrs, Volume= 0.376 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Link 6: Drainage Area 6

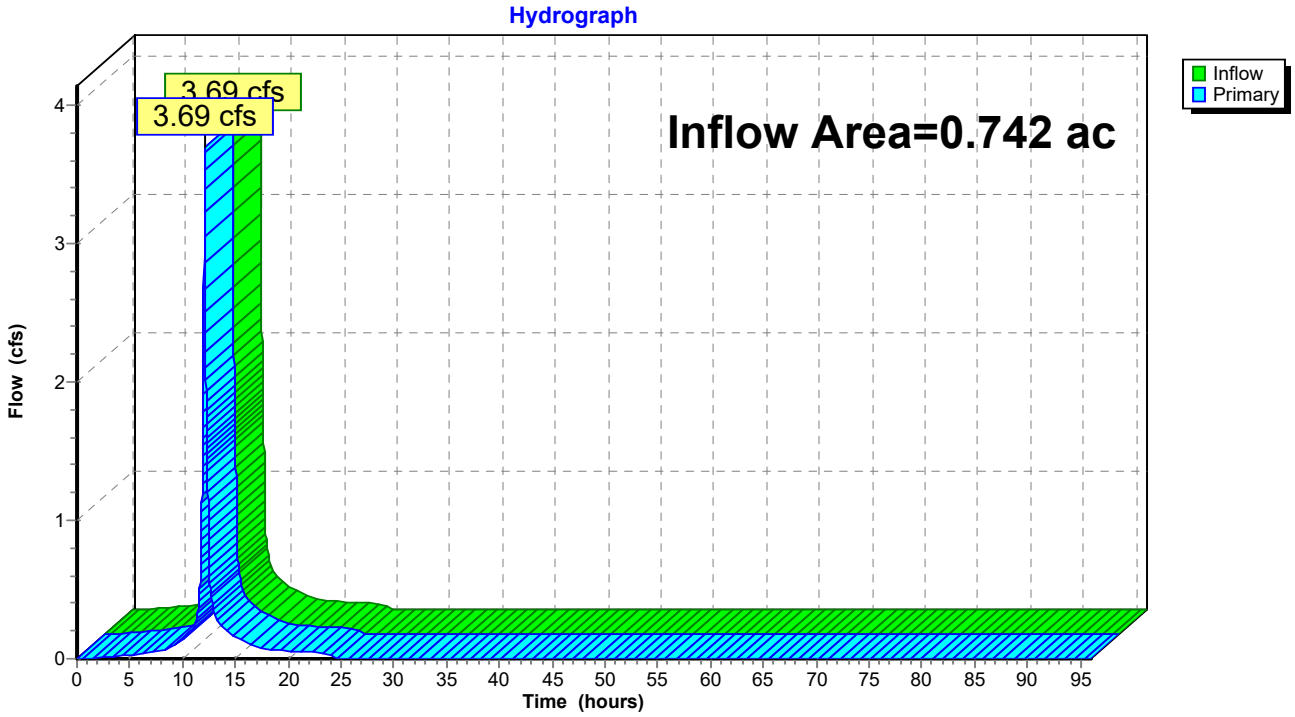


Summary for Link 7: Drainage Area 7

Inflow Area = 0.742 ac, 32.88% Impervious, Inflow Depth = 4.61" for 25-Year event
Inflow = 3.69 cfs @ 12.09 hrs, Volume= 0.285 af
Primary = 3.69 cfs @ 12.09 hrs, Volume= 0.285 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Link 7: Drainage Area 7

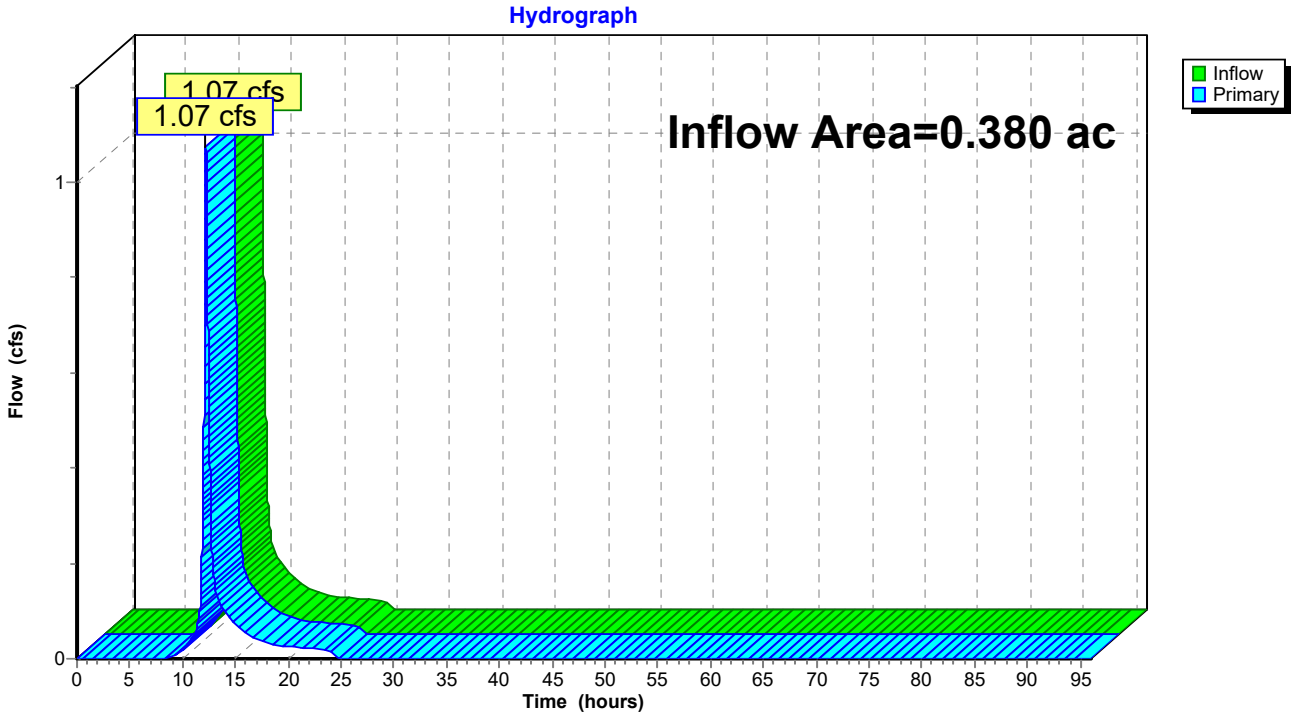


Summary for Link 8: Drainage Area 8

Inflow Area = 0.380 ac, 0.00% Impervious, Inflow Depth = 3.16" for 25-Year event
Inflow = 1.07 cfs @ 12.20 hrs, Volume= 0.100 af
Primary = 1.07 cfs @ 12.20 hrs, Volume= 0.100 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Link 8: Drainage Area 8

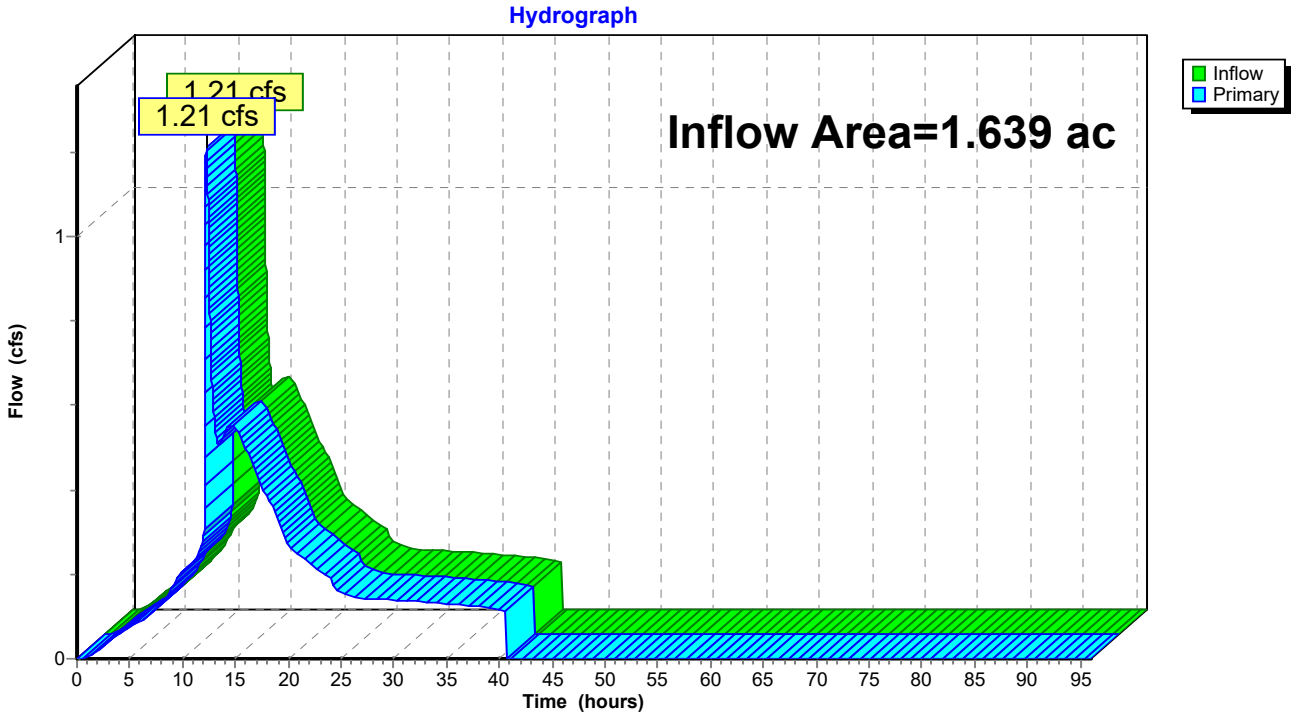


Summary for Link MH9: ST MH 9 Connector

Inflow Area = 1.639 ac, 55.70% Impervious, Inflow Depth = 5.09" for 25-Year event
Inflow = 1.21 cfs @ 12.26 hrs, Volume= 0.695 af
Primary = 1.21 cfs @ 12.26 hrs, Volume= 0.695 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Link MH9: ST MH 9 Connector

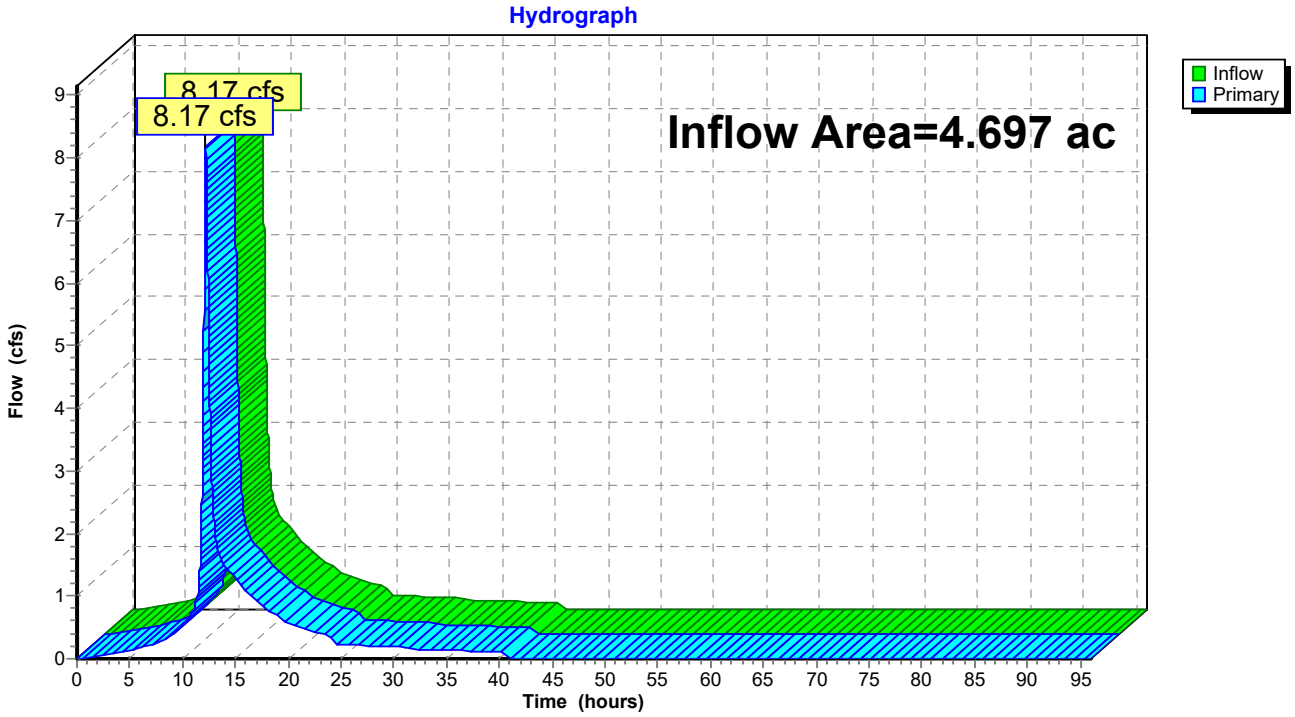


Summary for Link PE: Penn East Total Runoff

Inflow Area = 4.697 ac, 34.53% Impervious, Inflow Depth = 4.43" for 25-Year event
Inflow = 8.17 cfs @ 12.17 hrs, Volume= 1.732 af
Primary = 8.17 cfs @ 12.17 hrs, Volume= 1.732 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Link PE: Penn East Total Runoff



Time span=0.00-96.00 hrs, dt=0.01 hrs, 9601 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1-I: Drainage Area 1: Runoff Area=0.387 ac 79.33% Impervious Runoff Depth=7.79"
Flow Length=119' Tc=6.0 min CN=98 Runoff=3.05 cfs 0.251 af

Subcatchment 2-I: Drainage Area 2: Runoff Area=0.802 ac 63.47% Impervious Runoff Depth=7.67"
Flow Length=252' Tc=7.0 min CN=97 Runoff=6.09 cfs 0.513 af

Subcatchment 2-P: Drainage Area 2: Runoff Area=0.241 ac 0.00% Impervious Runoff Depth=4.95"
Tc=7.0 min CN=74 Runoff=1.35 cfs 0.099 af

Subcatchment 3-I: Drainage Area 3: Roofs Runoff Area=0.404 ac 100.00% Impervious Runoff Depth=7.79"
Tc=6.0 min CN=98 Runoff=3.19 cfs 0.262 af

Subcatchment 4-P: Drainage Area 4: Runoff Area=0.083 ac 0.00% Impervious Runoff Depth=4.72"
Tc=6.0 min CN=72 Runoff=0.46 cfs 0.033 af

Subcatchment 5-P: Drainage Area 5: Runoff Area=0.192 ac 0.00% Impervious Runoff Depth=4.72"
Tc=6.0 min CN=72 Runoff=1.06 cfs 0.076 af

Subcatchment 6-I: Drainage Area 6: Runoff Area=0.223 ac 70.85% Impervious Runoff Depth=7.67"
Flow Length=596' Tc=17.7 min CN=97 Runoff=1.26 cfs 0.143 af

Subcatchment 6-P: Drainage Area 6: Runoff Area=0.991 ac 0.00% Impervious Runoff Depth=4.95"
Tc=17.7 min CN=74 Runoff=4.08 cfs 0.409 af

Subcatchment 7-I: Drainage Area 7: Runoff Area=0.404 ac 60.40% Impervious Runoff Depth=7.67"
Tc=6.0 min CN=97 Runoff=3.18 cfs 0.258 af

Subcatchment 7-P: Drainage Area 7: Runoff Area=0.338 ac 0.00% Impervious Runoff Depth=4.95"
Tc=6.0 min CN=74 Runoff=1.96 cfs 0.139 af

Subcatchment 8-I: Drainage Area 8: Pervious Runoff Area=0.380 ac 0.00% Impervious Runoff Depth=4.84"
Flow Length=327' Tc=14.6 min CN=73 Runoff=1.65 cfs 0.153 af

Subcatchment I-P: Drainage Area 1: Pervious Runoff Area=0.252 ac 0.00% Impervious Runoff Depth=4.84"
Tc=6.0 min CN=73 Runoff=1.43 cfs 0.102 af

Pond 1P: Subsurface Detention Basin 1 Peak Elev=158.53' Storage=10,081 cf Inflow=7.44 cfs 0.612 af
Outflow=2.59 cfs 0.612 af

Pond 2P: SubSurface Detention Basin 2 Peak Elev=159.19' Storage=2,917 cf Inflow=3.19 cfs 0.262 af
Outflow=1.85 cfs 0.262 af

Pond Bio1: Bioretention Basin 1 Peak Elev=158.24' Storage=6,916 cf Inflow=4.94 cfs 0.385 af
Outflow=1.32 cfs 0.385 af

Pond Bio2: Bioretention Basin 2 Peak Elev=158.23' Storage=9,263 cf Inflow=3.06 cfs 0.688 af
Outflow=0.65 cfs 0.688 af

Link 1: Drainage Area 1 Inflow=4.48 cfs 0.353 af
Primary=4.48 cfs 0.353 af

Link 2: Drainage Area 2 Inflow=7.44 cfs 0.612 af
Primary=7.44 cfs 0.612 af

Link 3: Drainage Area 3 Inflow=3.19 cfs 0.262 af
Primary=3.19 cfs 0.262 af

Link 4: Drainage Area 4 Inflow=0.46 cfs 0.033 af
Primary=0.46 cfs 0.033 af

Link 5: Drainage Area 5 Inflow=1.06 cfs 0.076 af
Primary=1.06 cfs 0.076 af

Link 6: Drainage Area 6 Inflow=5.33 cfs 0.552 af
Primary=5.33 cfs 0.552 af

Link 7: Drainage Area 7 Inflow=5.13 cfs 0.398 af
Primary=5.13 cfs 0.398 af

Link 8: Drainage Area 8 Inflow=1.65 cfs 0.153 af
Primary=1.65 cfs 0.153 af

Link MH9: ST MH 9 Connector Inflow=1.99 cfs 0.950 af
Primary=1.99 cfs 0.950 af

Link PE: Penn East Total Runoff Inflow=12.91 cfs 2.438 af
Primary=12.91 cfs 2.438 af

Total Runoff Area = 4.697 ac Runoff Volume = 2.438 af Average Runoff Depth = 6.23"
65.47% Pervious = 3.075 ac 34.53% Impervious = 1.622 ac

Summary for Subcatchment 1-I: Drainage Area 1: Impervious

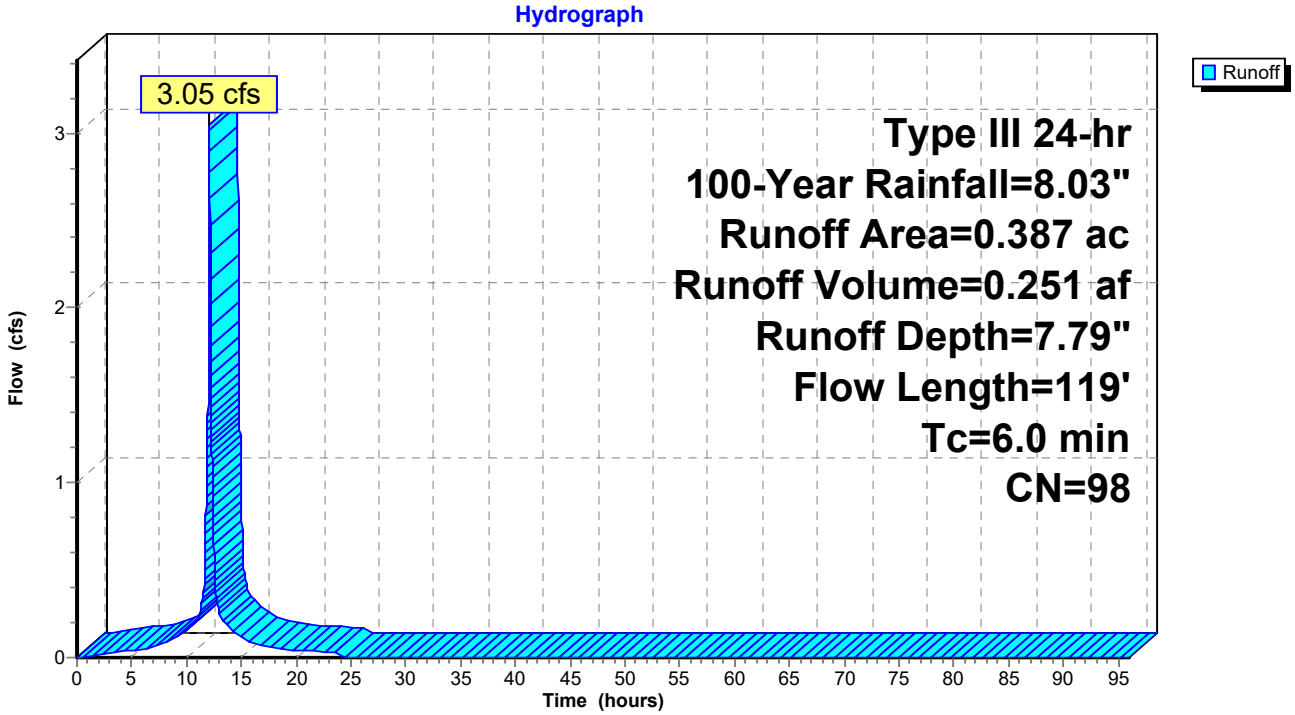
Runoff = 3.05 cfs @ 12.08 hrs, Volume= 0.251 af, Depth= 7.79"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.03"

Area (ac)	CN	Description
0.080	96	Gravel surface, HSG C
0.015	98	Unconnected pavement, HSG C
0.292	98	Paved parking, HSG C
0.387	98	Weighted Average
0.080		20.67% Pervious Area
0.307		79.33% Impervious Area
0.015		4.89% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	119		0.33		**Direct Entry, Direct**

Subcatchment 1-I: Drainage Area 1: Impervious



Summary for Subcatchment 2-I: Drainage Area 2: Impervious

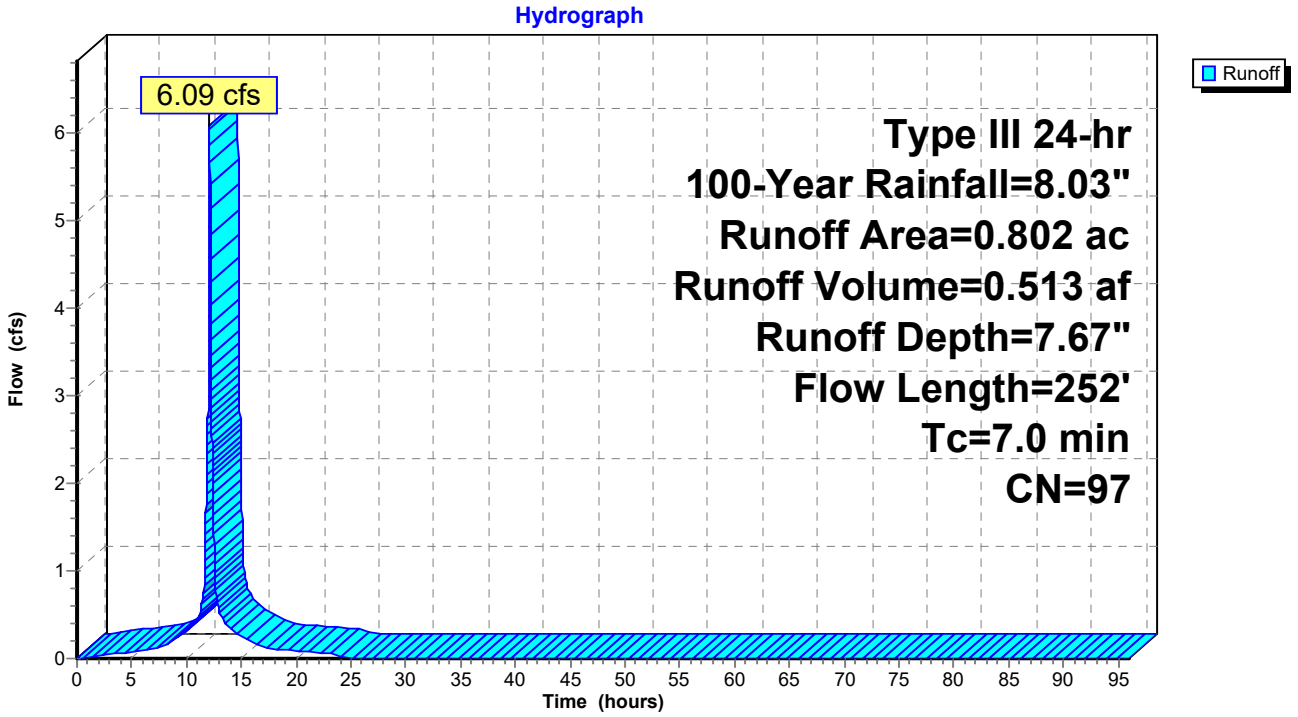
Runoff = 6.09 cfs @ 12.10 hrs, Volume= 0.513 af, Depth= 7.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.03"

Area (ac)	CN	Description
0.293	96	Gravel surface, HSG C
0.497	98	Paved parking, HSG C
0.012	98	Unconnected pavement, HSG C
0.802	97	Weighted Average
0.293		36.53% Pervious Area
0.509		63.47% Impervious Area
0.012		2.36% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.1	44	0.0840	0.18		**Sheet Flow, Grass: Dense** Grass: Dense n= 0.240 P2= 3.38"
2.1	38	0.3310	0.30		**Sheet Flow, Grass: Dense** Grass: Dense n= 0.240 P2= 3.38"
0.2	18	0.0500	1.45		**Sheet Flow, Smooth Surfaces** Smooth surfaces n= 0.011 P2= 3.38"
0.6	152	0.0370	3.90		**Shallow Concentrated Flow, Paved** Paved Kv= 20.3 fps
7.0	252	Total			

Subcatchment 2-I: Drainage Area 2: Impervious



Summary for Subcatchment 2-P: Drainage Area 2: Pervious

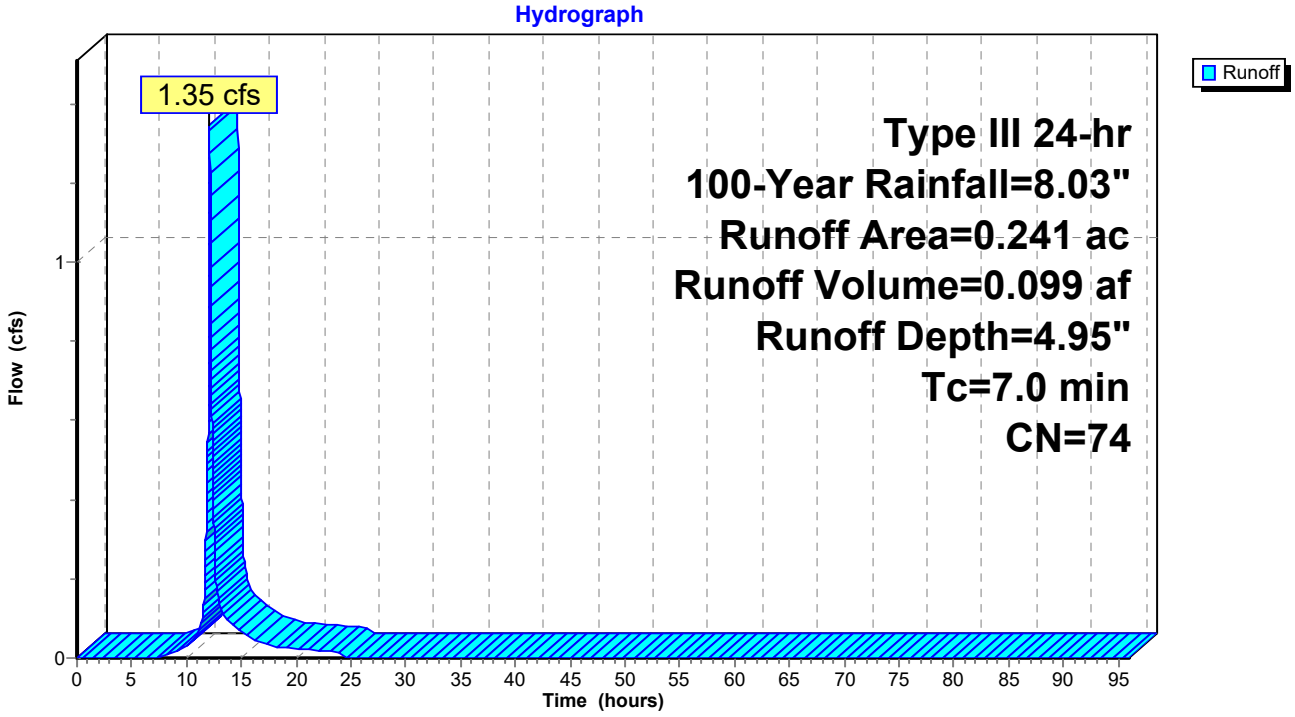
Runoff = 1.35 cfs @ 12.10 hrs, Volume= 0.099 af, Depth= 4.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.03"

Area (ac)	CN	Description
0.186	74	>75% Grass cover, Good, HSG C
0.055	72	Woods/grass comb., Good, HSG C
0.241	74	Weighted Average
0.241		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0					**Direct Entry, 2-I**

Subcatchment 2-P: Drainage Area 2: Pervious



Summary for Subcatchment 3-I: Drainage Area 3: Roofs

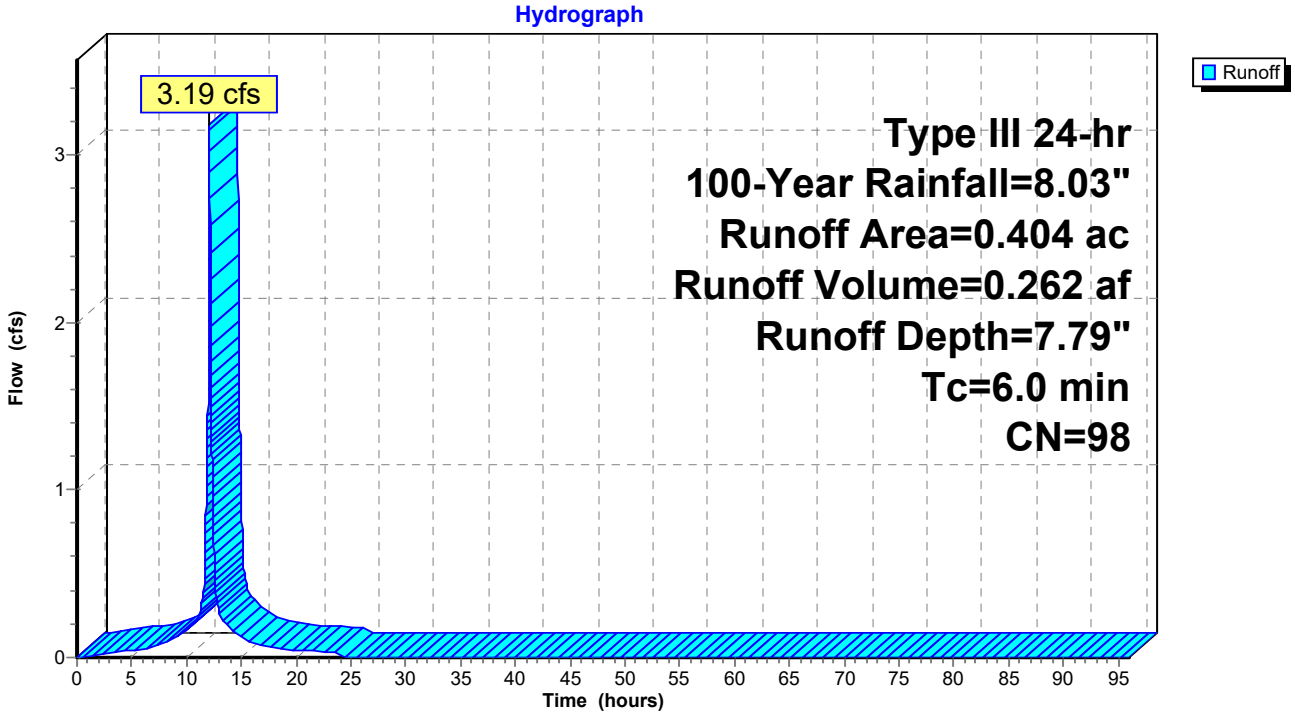
Runoff = 3.19 cfs @ 12.08 hrs, Volume= 0.262 af, Depth= 7.79"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.03"

Area (ac)	CN	Description
0.404	98	Unconnected roofs, HSG C
0.404		100.00% Impervious Area
0.404		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct C-1**

Subcatchment 3-I: Drainage Area 3: Roofs



Summary for Subcatchment 4-P: Drainage Area 4: Pervious (Basin 1)

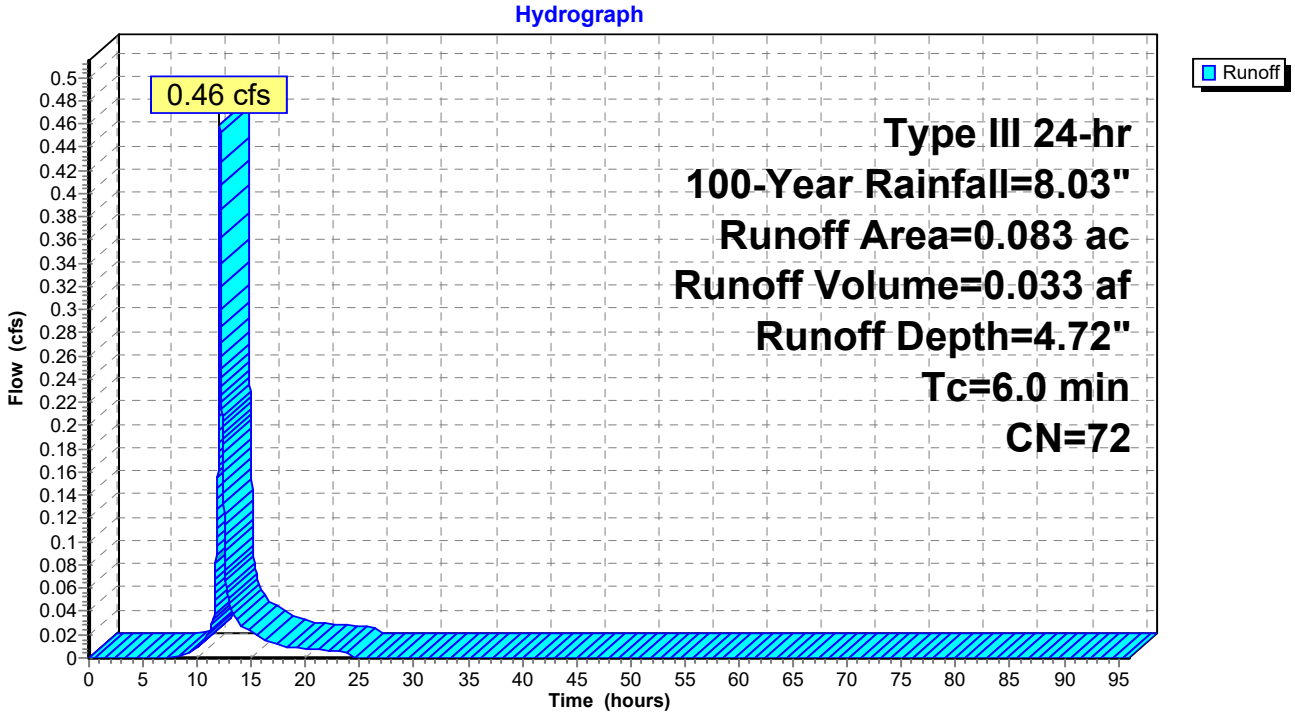
Runoff = 0.46 cfs @ 12.09 hrs, Volume= 0.033 af, Depth= 4.72"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.03"

Area (ac)	CN	Description
0.083	72	Woods/grass comb., Good, HSG C
0.083		100.00% Pervious Area

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

Subcatchment 4-P: Drainage Area 4: Pervious (Basin 1)



Summary for Subcatchment 5-P: Drainage Area 5: Pervious (Basin 2)

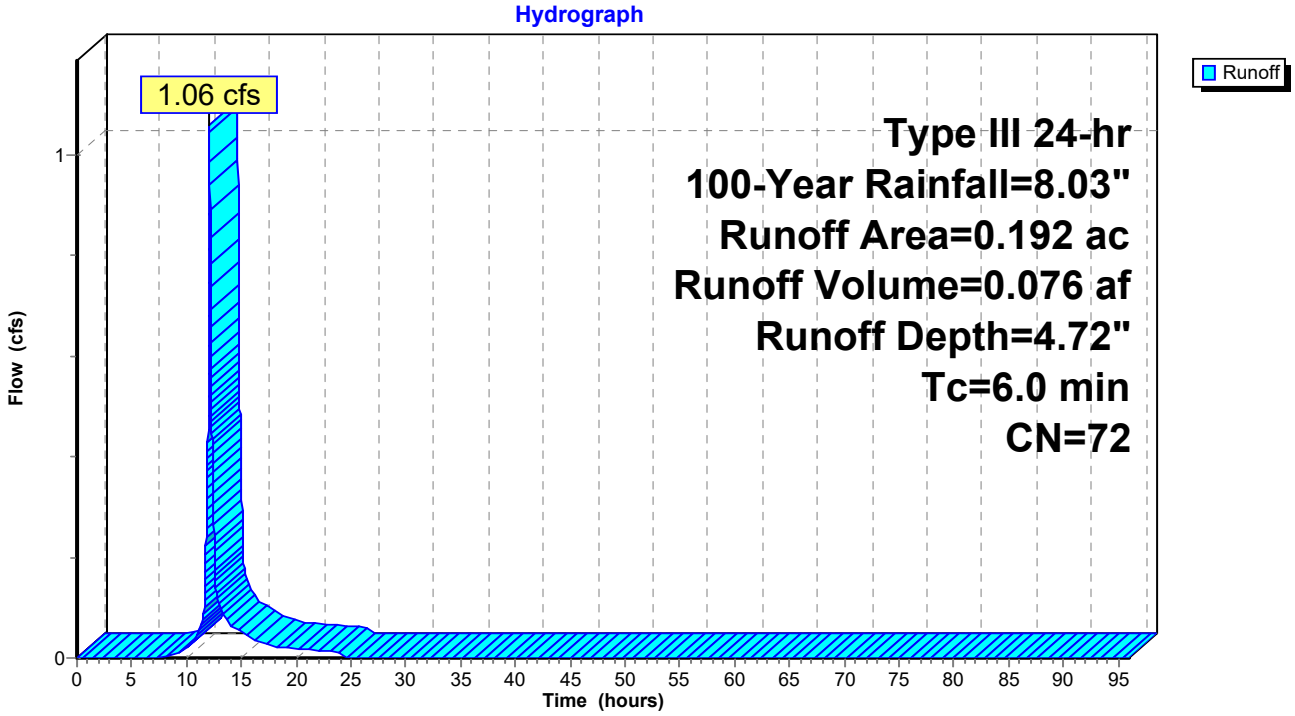
Runoff = 1.06 cfs @ 12.09 hrs, Volume= 0.076 af, Depth= 4.72"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.03"

Area (ac)	CN	Description
0.192	72	Woods/grass comb., Good, HSG C
0.192		100.00% Pervious Area

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

Subcatchment 5-P: Drainage Area 5: Pervious (Basin 2)



Summary for Subcatchment 6-I: Drainage Area 6: Impervious

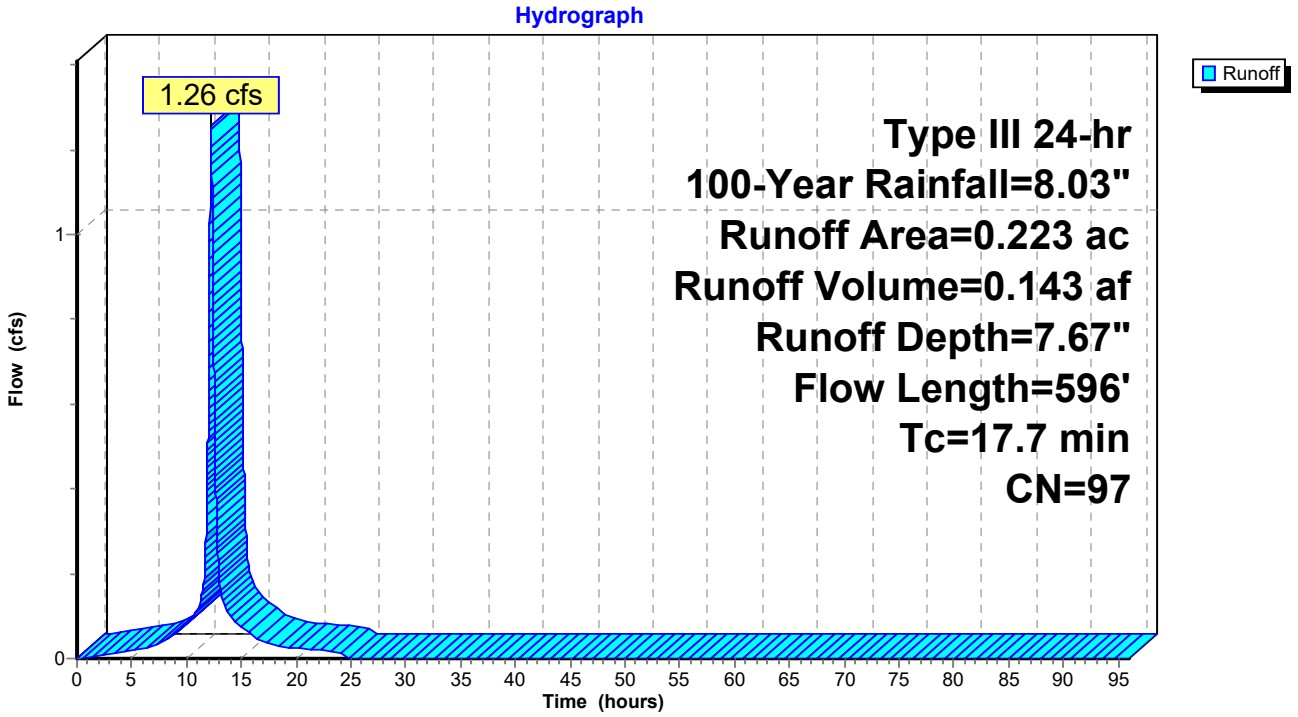
Runoff = 1.26 cfs @ 12.23 hrs, Volume= 0.143 af, Depth= 7.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.03"

Area (ac)	CN	Description
0.002	98	Unconnected roofs, HSG C
0.156	98	Unconnected pavement, HSG C
0.065	96	Gravel surface, HSG C
0.223	97	Weighted Average
0.065		29.15% Pervious Area
0.158		70.85% Impervious Area
0.158		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.6	40	0.1180	0.08		**Sheet Flow, SF1** Woods: Dense underbrush n= 0.800 P2= 3.38"
5.0	60	0.0923	0.20		**Sheet Flow, SF2** Grass: Dense n= 0.240 P2= 3.38"
0.7	86	0.0988	2.20		**Shallow Concentrated Flow, SCF1** Short Grass Pasture Kv= 7.0 fps
3.3	343	0.0499	1.75	1.75	**Channel Flow, CF1** Area= 1.0 sf Perim= 12.6' r= 0.08' n= 0.035 Earth, dense weeds
0.1	67	0.0780	16.63	23.22	**Pipe Channel, HDPE Pipe** 16.0" Round Area= 1.4 sf Perim= 4.2' r= 0.33' n= 0.012
17.7	596	Total			

Subcatchment 6-I: Drainage Area 6: Impervious



Summary for Subcatchment 6-P: Drainage Area 6: Pervious

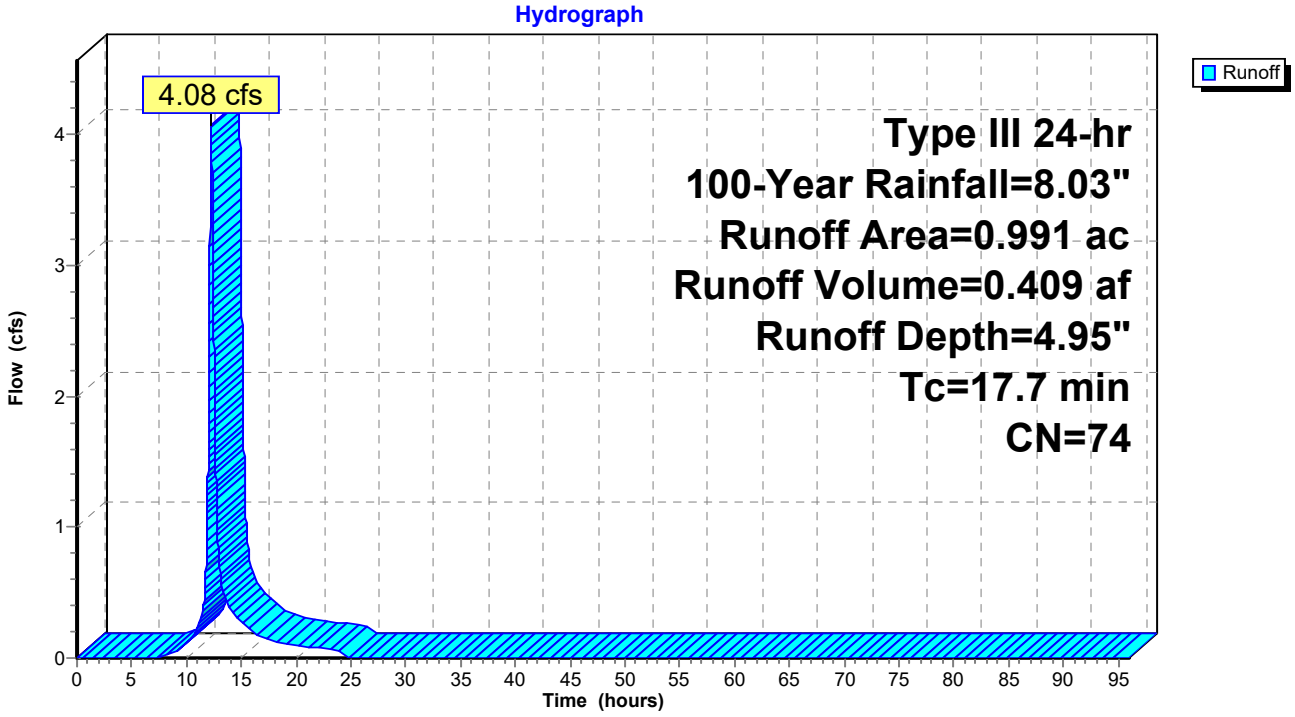
Runoff = 4.08 cfs @ 12.25 hrs, Volume= 0.409 af, Depth= 4.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.03"

Area (ac)	CN	Description
0.981	74	>75% Grass cover, Good, HSG C
0.010	72	Woods/grass comb., Good, HSG C
0.991	74	Weighted Average
0.991		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.7					**Direct Entry, Same as G1**

Subcatchment 6-P: Drainage Area 6: Pervious



Summary for Subcatchment 7-I: Drainage Area 7: Impervious

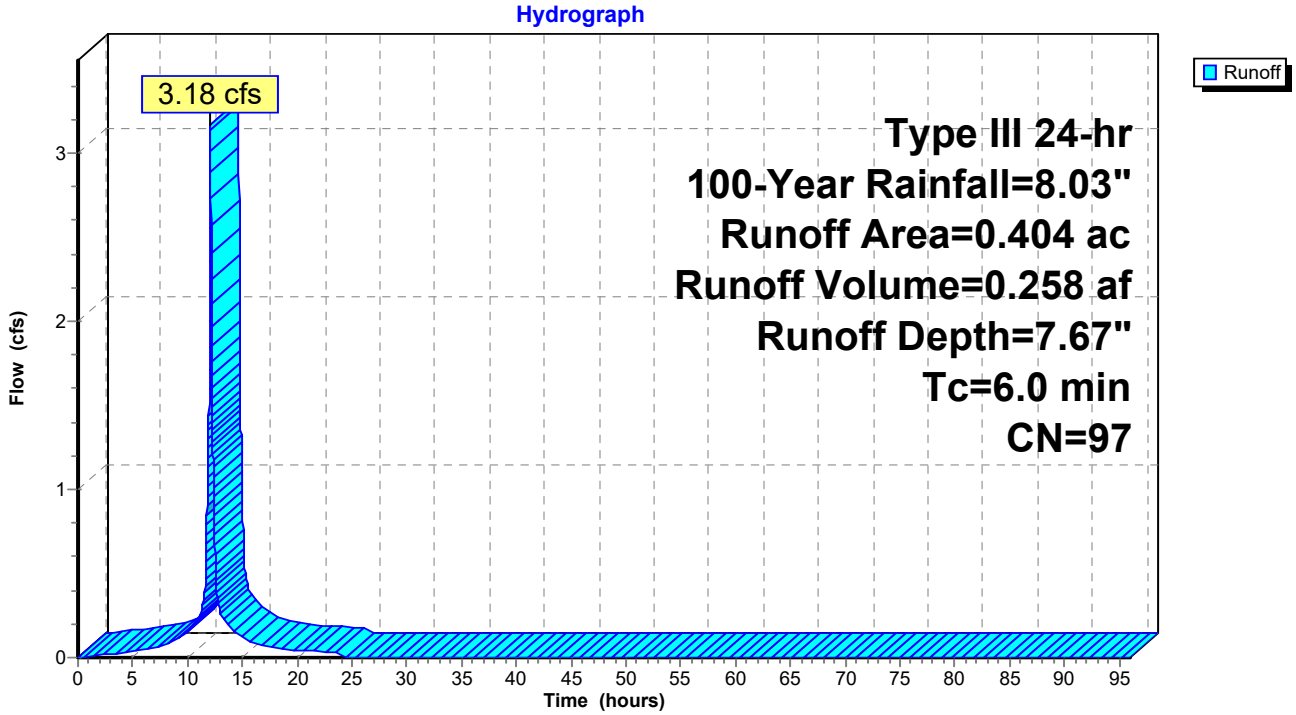
Runoff = 3.18 cfs @ 12.08 hrs, Volume= 0.258 af, Depth= 7.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.03"

Area (ac)	CN	Description
0.135	98	Paved parking, HSG C
0.160	96	Gravel surface, HSG C
0.109	98	Unconnected roofs, HSG C
0.404	97	Weighted Average
0.160		39.60% Pervious Area
0.244		60.40% Impervious Area
0.109		44.67% Unconnected

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

Subcatchment 7-I: Drainage Area 7: Impervious



Summary for Subcatchment 7-P: Drainage Area 7: Pervious

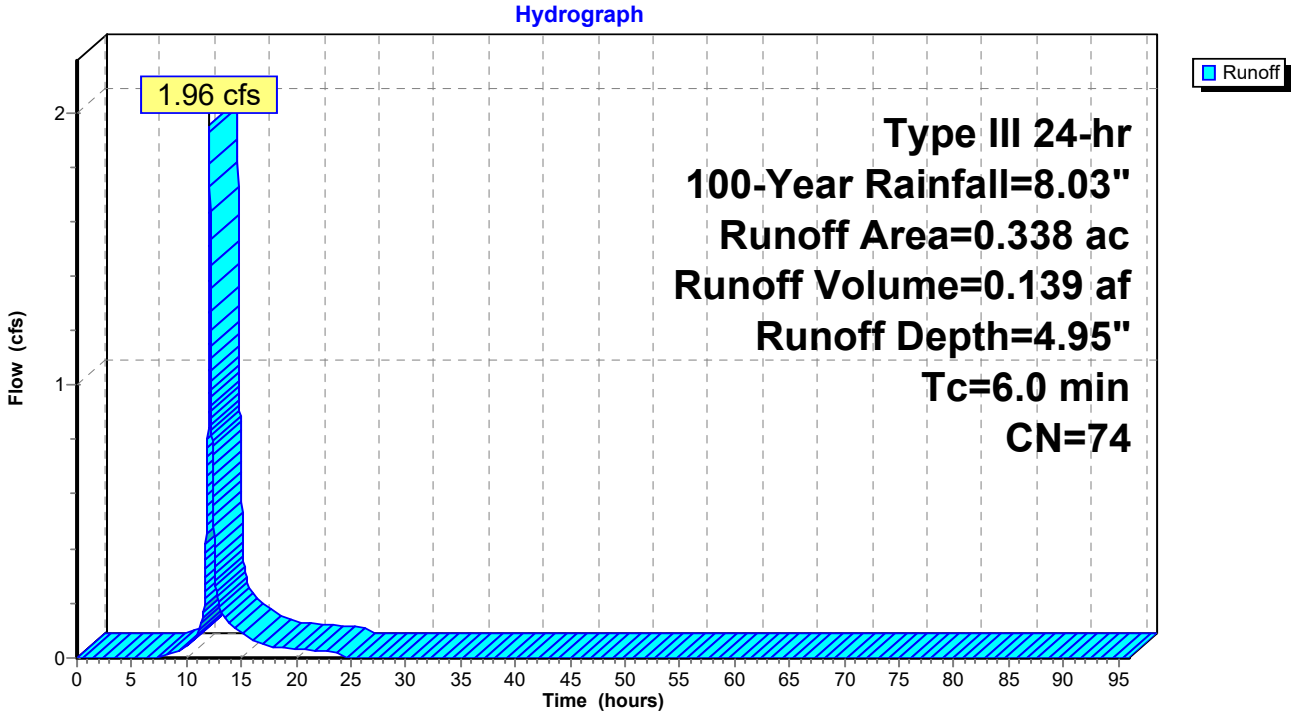
Runoff = 1.96 cfs @ 12.09 hrs, Volume= 0.139 af, Depth= 4.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.03"

Area (ac)	CN	Description
0.338	74	>75% Grass cover, Good, HSG C
0.338		100.00% Pervious Area

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

Subcatchment 7-P: Drainage Area 7: Pervious



Summary for Subcatchment 8-I: Drainage Area 8: Pervious

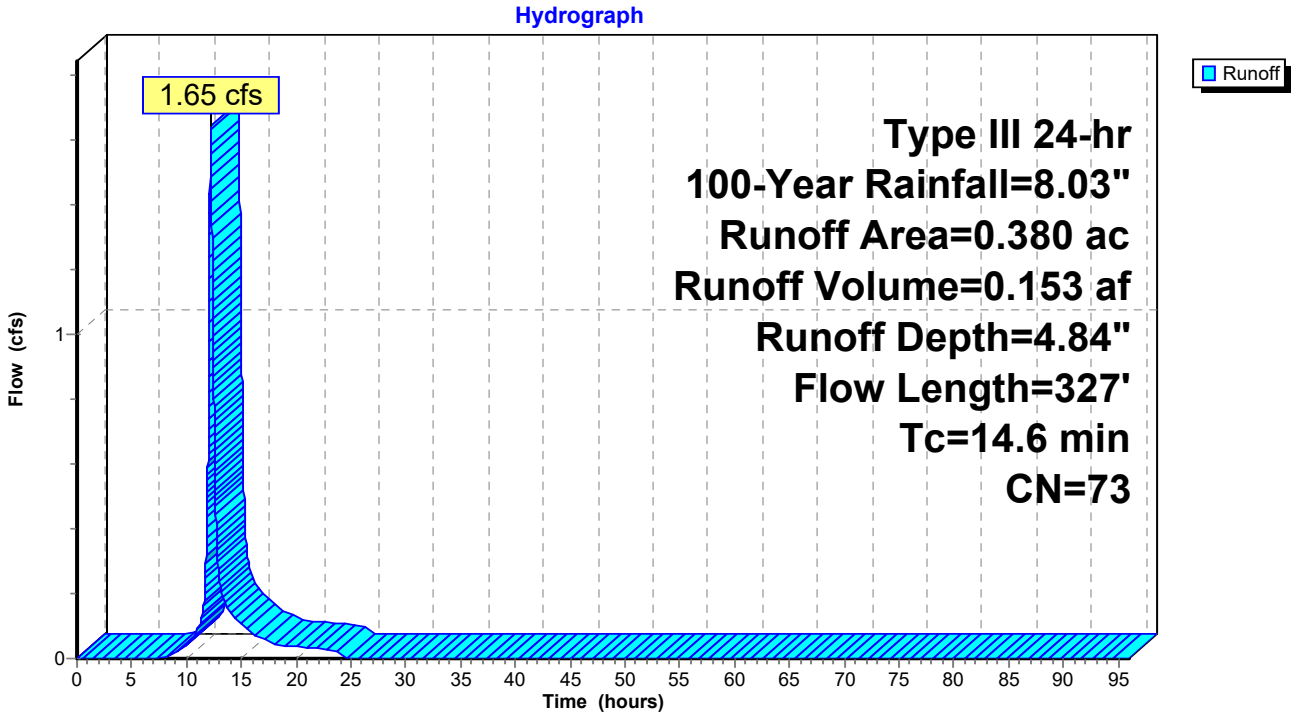
Runoff = 1.65 cfs @ 12.20 hrs, Volume= 0.153 af, Depth= 4.84"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.03"

Area (ac)	CN	Description
0.234	74	>75% Grass cover, Good, HSG C
0.146	72	Woods/grass comb., Good, HSG C
0.380	73	Weighted Average
0.380		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	16	0.1190	0.25		**Sheet Flow, Grass: Short** Grass: Short n= 0.150 P2= 3.38"
12.0	85	0.0580	0.12		**Sheet Flow, Woods: Light Underbrush** Woods: Light underbrush n= 0.400 P2= 3.38"
0.2	23	0.0850	2.04		**Shallow Concentrated Flow, Short Grass Pasture** Short Grass Pasture Kv= 7.0 fps
0.4	28	0.0480	1.10		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
0.3	27	0.0650	1.78		**Shallow Concentrated Flow, Short Grass Pasture** Short Grass Pasture Kv= 7.0 fps
0.5	108	0.0130	3.54	3.54	**Parabolic Channel, Earth Clean and Straight** W=3.00' D=0.50' Area=1.0 sf Perim=3.2' n= 0.022 Earth, clean & straight
0.1	40	0.0270	8.08	6.34	**Pipe Channel, Pipe** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012
14.6	327	Total			

Subcatchment 8-I: Drainage Area 8: Pervious



Summary for Subcatchment I-P: Drainage Area 1: Pervious

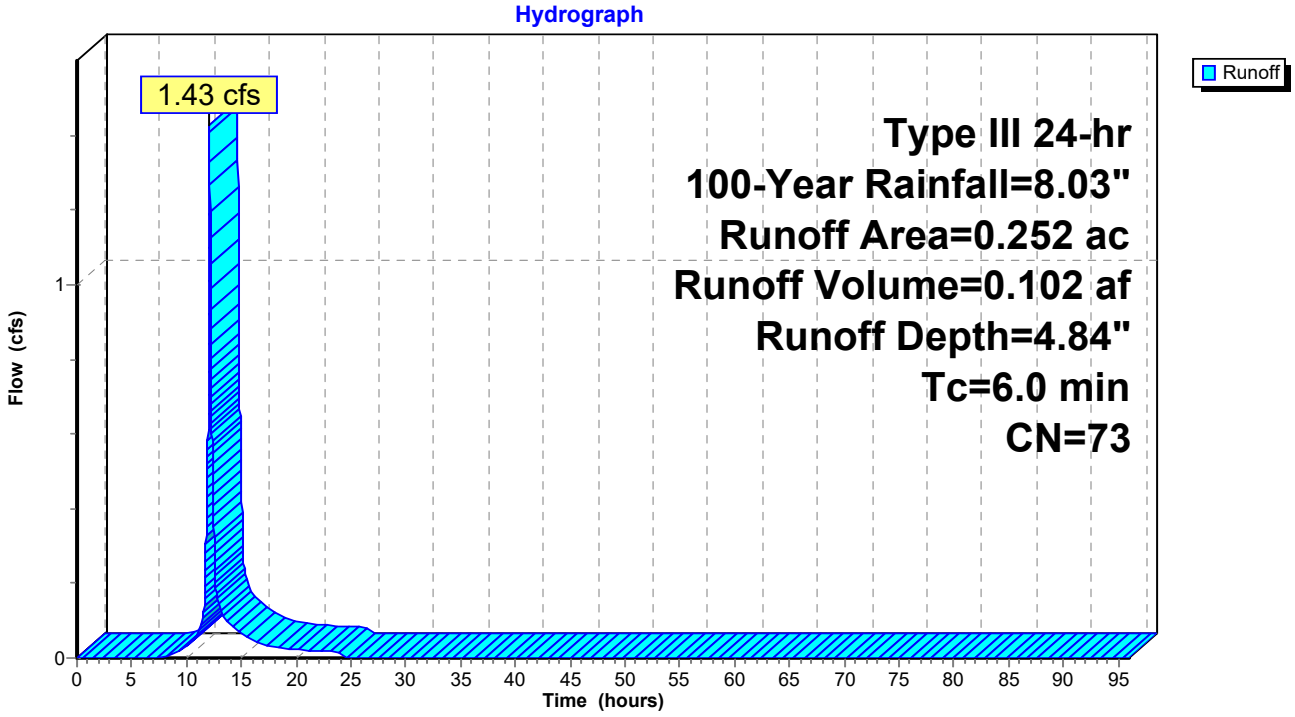
Runoff = 1.43 cfs @ 12.09 hrs, Volume= 0.102 af, Depth= 4.84"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.03"

Area (ac)	CN	Description
0.107	74	>75% Grass cover, Good, HSG C
0.145	72	Woods/grass comb., Good, HSG C
0.252	73	Weighted Average
0.252		100.00% Pervious Area

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

Subcatchment I-P: Drainage Area 1: Pervious



Summary for Pond 1P: Subsurface Detention Basin 1 (Stormtrap-ST2)

Inflow Area = 1.043 ac, 48.80% Impervious, Inflow Depth = 7.04" for 100-Year event
Inflow = 7.44 cfs @ 12.10 hrs, Volume= 0.612 af
Outflow = 2.59 cfs @ 12.36 hrs, Volume= 0.612 af, Atten= 65%, Lag= 15.9 min
Primary = 2.59 cfs @ 12.36 hrs, Volume= 0.612 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 158.53' @ 12.38 hrs Surf.Area= 9,147 sf Storage= 10,081 cf

Plug-Flow detention time= 240.8 min calculated for 0.612 af (100% of inflow)
Center-of-Mass det. time= 240.9 min (1,000.1 - 759.2)

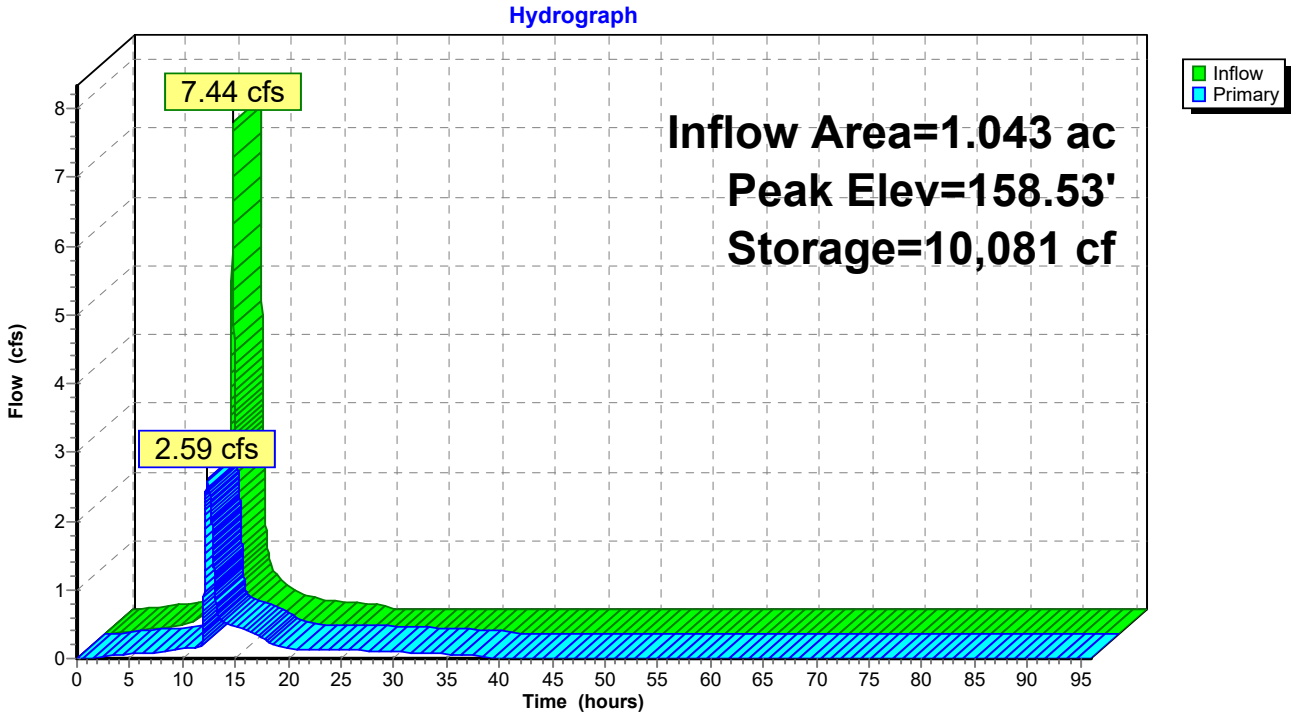
Volume	Invert	Avail.Storage	Storage Description
#1	156.33'	12,969 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
156.33	0	0	0
158.83	10,375	12,969	12,969

Device	Routing	Invert	Outlet Devices
#1	Primary	156.33'	**15.0" Round Culvert** L= 50.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 156.33' / 156.00' S= 0.0066 '/' Cc= 0.900 n= 0.012, Flow Area= 1.23 sf
#2	Device 1	156.33'	**2.5" Vert. Orifice/Grate** C= 0.600
#3	Device 1	157.83'	**18.0" W x 6.0" H Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=2.59 cfs @ 12.36 hrs HW=158.53' TW=157.23' (Dynamic Tailwater)
└─**1=Culvert** (Passes 2.59 cfs of 6.74 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.19 cfs @ 5.49 fps)
  └─**3=Orifice/Grate** (Orifice Controls 2.40 cfs @ 3.20 fps)

Pond 1P: Subsurface Detention Basin 1 (Stormtrap-ST2)



Summary for Pond 2P: SubSurface Detention Basin 2 (Stormtrap-ST2)

Inflow Area = 0.404 ac,100.00% Impervious, Inflow Depth = 7.79" for 100-Year event
Inflow = 3.19 cfs @ 12.08 hrs, Volume= 0.262 af
Outflow = 1.85 cfs @ 12.19 hrs, Volume= 0.262 af, Atten= 42%, Lag= 6.5 min
Primary = 1.85 cfs @ 12.19 hrs, Volume= 0.262 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 159.19' @ 12.19 hrs Surf.Area= 3,141 sf Storage= 2,917 cf

Plug-Flow detention time= 60.3 min calculated for 0.262 af (100% of inflow)
Center-of-Mass det. time= 60.3 min (801.5 - 741.2)

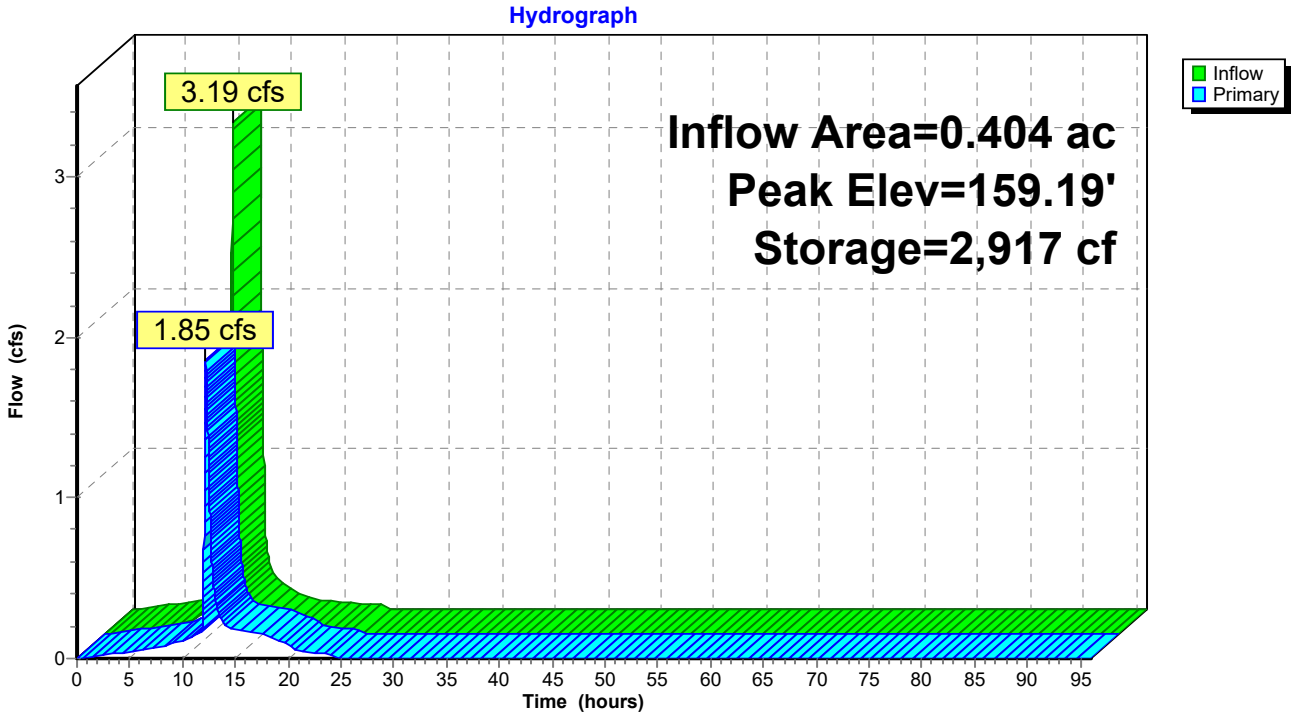
Volume	Invert	Avail.Storage	Storage Description
#1	157.33'	5,286 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
157.33	0	0	0
159.83	4,229	5,286	5,286

Device	Routing	Invert	Outlet Devices
#1	Primary	157.33'	**15.0" Round Culvert** L= 245.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 157.33' / 151.13' S= 0.0253 '/' Cc= 0.900 n= 0.012, Flow Area= 1.23 sf
#2	Device 1	157.33'	**2.5" Vert. Orifice/Grate** C= 0.600
#3	Device 1	158.70'	**18.0" W x 6.0" H Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=1.85 cfs @ 12.19 hrs HW=159.19' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Passes 1.85 cfs of 5.18 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.22 cfs @ 6.37 fps)
  └─**3=Orifice/Grate** (Orifice Controls 1.64 cfs @ 2.24 fps)

Pond 2P: SubSurface Detention Basin 2 (Stormtrap-ST2)



Summary for Pond Bio1: Bioretention Basin 1

Inflow Area = 0.722 ac, 42.52% Impervious, Inflow Depth = 6.41" for 100-Year event
Inflow = 4.94 cfs @ 12.09 hrs, Volume= 0.385 af
Outflow = 1.32 cfs @ 12.44 hrs, Volume= 0.385 af, Atten= 73%, Lag= 21.6 min
Primary = 1.32 cfs @ 12.44 hrs, Volume= 0.385 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 158.24' @ 12.44 hrs Surf.Area= 2,572 sf Storage= 6,916 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 199.9 min (968.1 - 768.2)

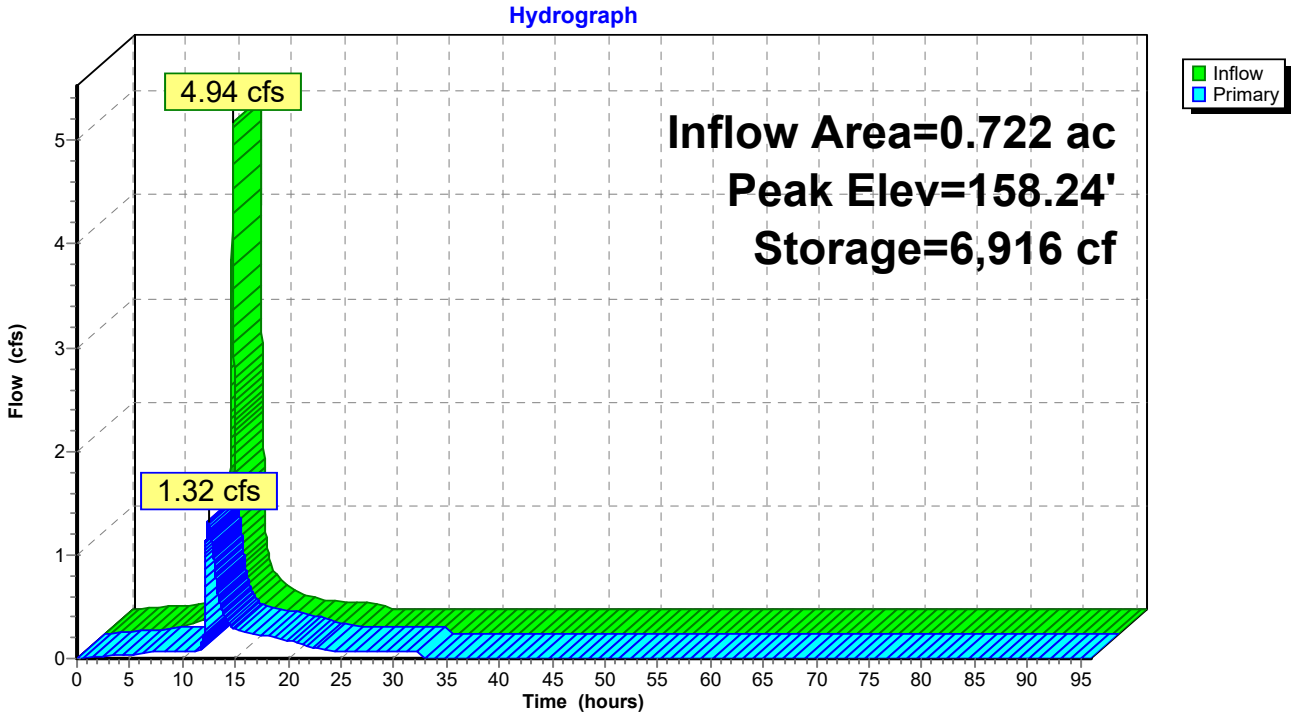
Volume	Invert	Avail.Storage	Storage Description
#1	155.00'	8,960 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
155.00	1,718	0	0
156.00	1,970	1,844	1,844
157.00	2,232	2,101	3,945
158.00	2,505	2,369	6,314
159.00	2,787	2,646	8,960

Device	Routing	Invert	Outlet Devices
#1	Primary	151.80'	**15.0" Round Culvert** L= 95.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 151.80' / 151.00' S= 0.0084 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Device 1	155.00'	**1.500 in/hr Exfiltration over Surface area**
#3	Device 1	156.00'	**2.5" Vert. Orifice/Grate** C= 0.600
#4	Device 1	157.30'	**6.0" W x 6.0" H Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=1.32 cfs @ 12.44 hrs HW=158.24' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Passes 1.32 cfs of 12.50 cfs potential flow)
  ├─**2=Exfiltration** (Exfiltration Controls 0.09 cfs)
  ├─**3=Orifice/Grate** (Orifice Controls 0.24 cfs @ 7.03 fps)
  └─**4=Orifice/Grate** (Orifice Controls 0.99 cfs @ 3.97 fps)

Pond Bio1: Bioretention Basin 1



Summary for Pond Bio2: Bioretention Basin 2

Inflow Area = 1.235 ac, 41.21% Impervious, Inflow Depth = 6.68" for 100-Year event
Inflow = 3.06 cfs @ 12.16 hrs, Volume= 0.688 af
Outflow = 0.65 cfs @ 13.47 hrs, Volume= 0.688 af, Atten= 79%, Lag= 78.4 min
Primary = 0.65 cfs @ 13.47 hrs, Volume= 0.688 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 158.23' @ 13.47 hrs Surf.Area= 5,071 sf Storage= 9,263 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 269.4 min (1,249.8 - 980.3)

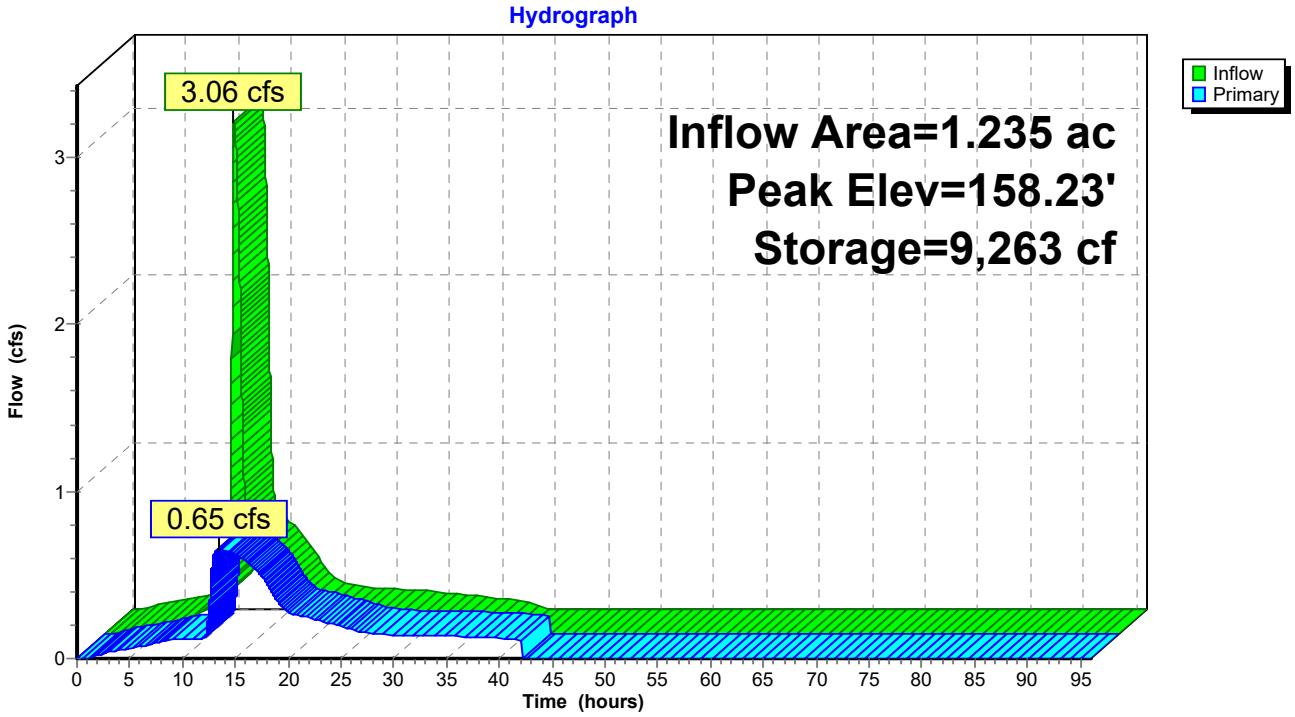
Volume	Invert	Avail.Storage	Storage Description
#1	156.00'	13,443 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
156.00	3,288	0	0
157.00	4,052	3,670	3,670
158.00	4,872	4,462	8,132
159.00	5,749	5,311	13,443

Device	Routing	Invert	Outlet Devices
#1	Primary	152.17'	**15.0" Round Culvert** L= 109.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 152.17' / 151.30' S= 0.0080 '/' Cc= 0.900 n= 0.012, Flow Area= 1.23 sf
#2	Device 1	156.00'	**1.500 in/hr Exfiltration over Surface area**
#3	Device 1	157.00'	**2.5" Vert. Orifice/Grate** C= 0.600
#4	Device 1	157.54'	**4.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.65 cfs @ 13.47 hrs HW=158.23' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Passes 0.65 cfs of 12.26 cfs potential flow)
  ├─**2=Exfiltration** (Exfiltration Controls 0.18 cfs)
  ├─**3=Orifice/Grate** (Orifice Controls 0.17 cfs @ 5.10 fps)
  └─**4=Orifice/Grate** (Orifice Controls 0.30 cfs @ 3.47 fps)

Pond Bio2: Bioretention Basin 2

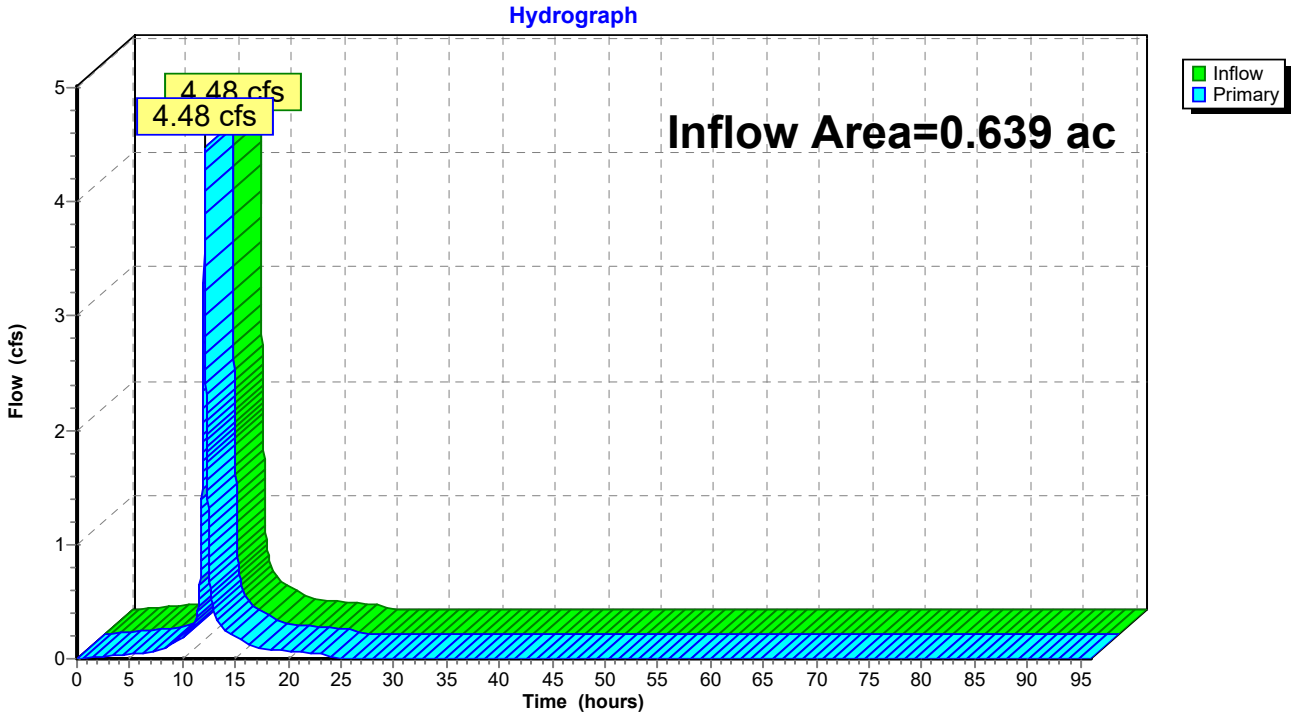


Summary for Link 1: Drainage Area 1

Inflow Area = 0.639 ac, 48.04% Impervious, Inflow Depth = 6.63" for 100-Year event
Inflow = 4.48 cfs @ 12.08 hrs, Volume= 0.353 af
Primary = 4.48 cfs @ 12.08 hrs, Volume= 0.353 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Link 1: Drainage Area 1

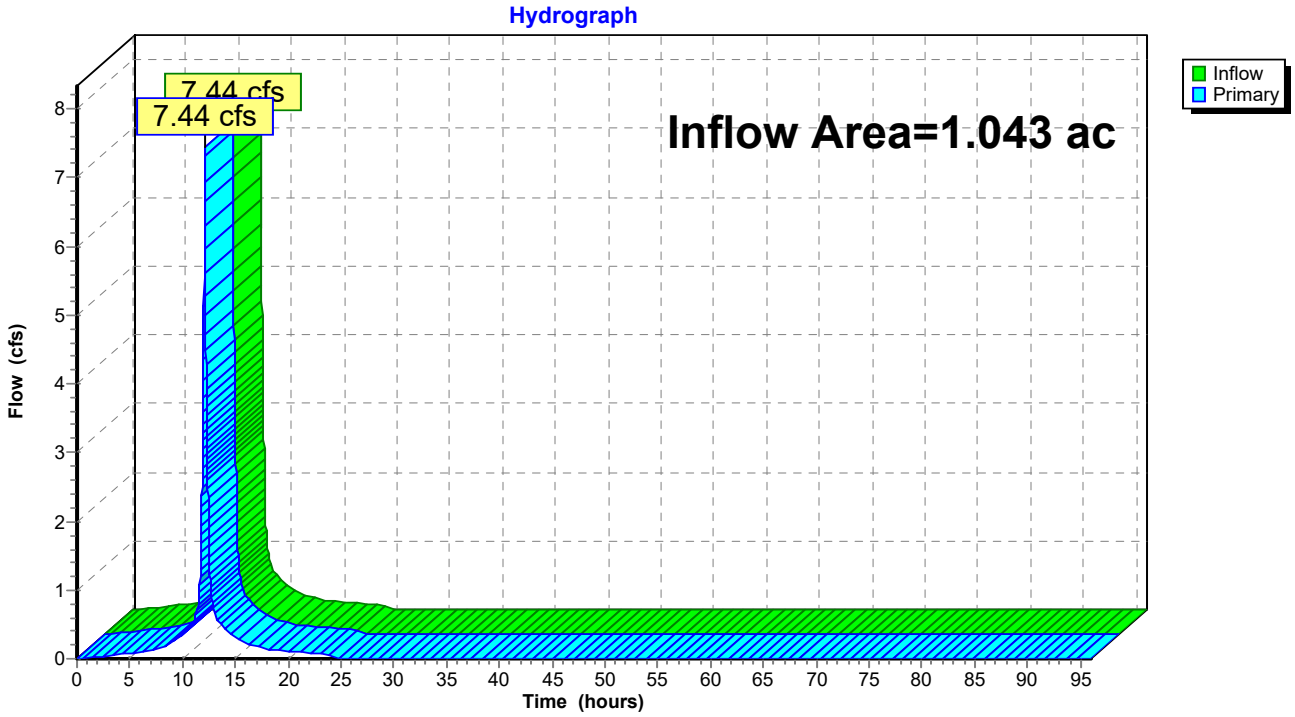


Summary for Link 2: Drainage Area 2

Inflow Area = 1.043 ac, 48.80% Impervious, Inflow Depth = 7.04" for 100-Year event
Inflow = 7.44 cfs @ 12.10 hrs, Volume= 0.612 af
Primary = 7.44 cfs @ 12.10 hrs, Volume= 0.612 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Link 2: Drainage Area 2

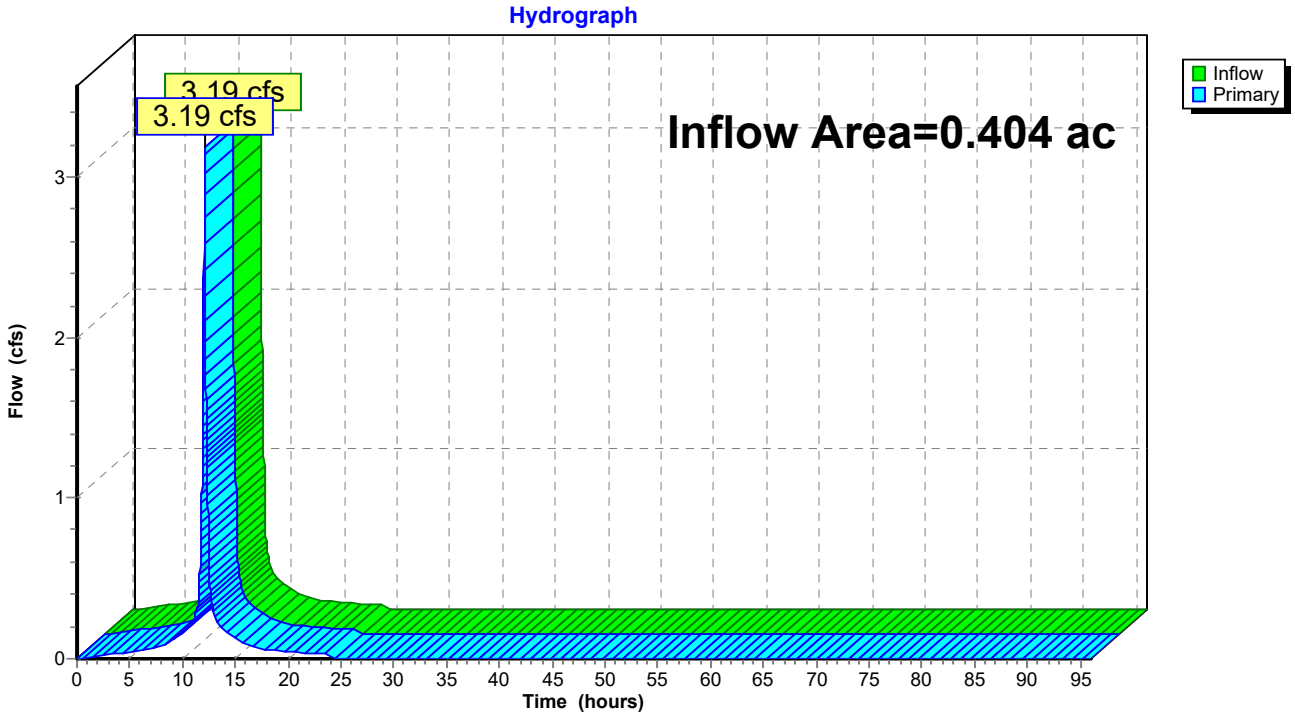


Summary for Link 3: Drainage Area 3

Inflow Area = 0.404 ac,100.00% Impervious, Inflow Depth = 7.79" for 100-Year event
Inflow = 3.19 cfs @ 12.08 hrs, Volume= 0.262 af
Primary = 3.19 cfs @ 12.08 hrs, Volume= 0.262 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Link 3: Drainage Area 3

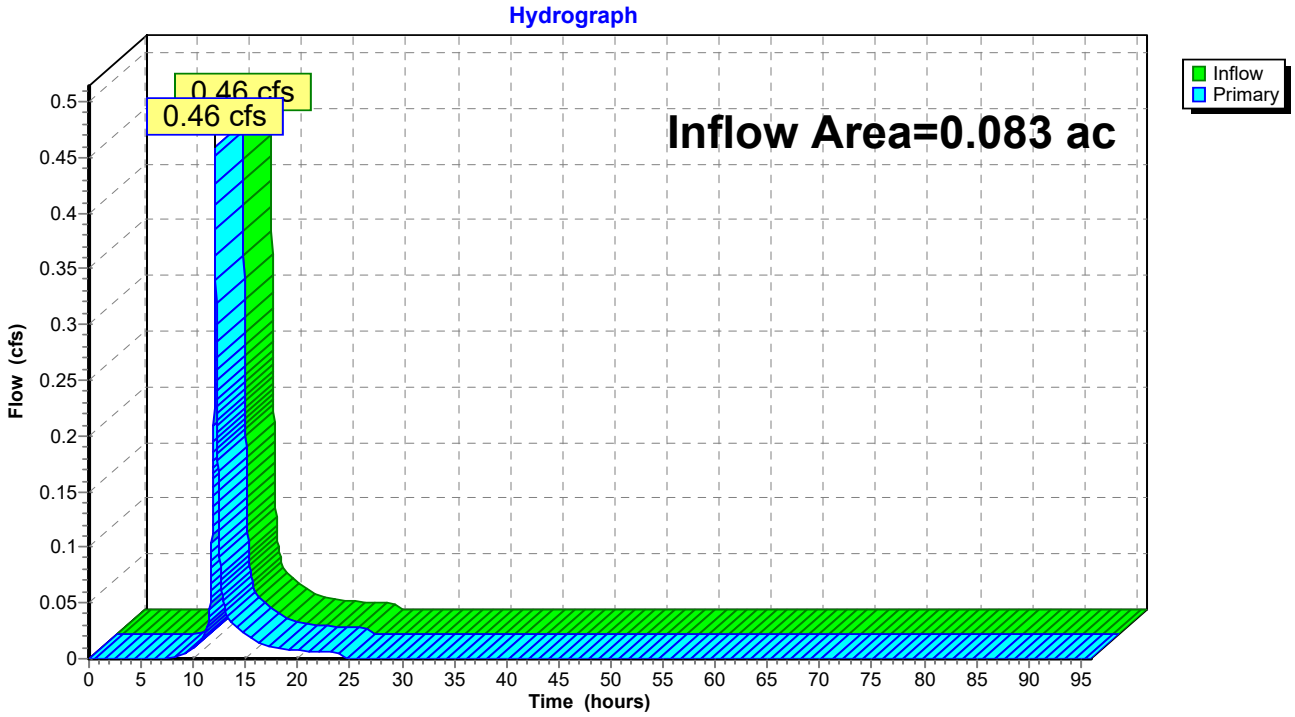


Summary for Link 4: Drainage Area 4

Inflow Area = 0.083 ac, 0.00% Impervious, Inflow Depth = 4.72" for 100-Year event
Inflow = 0.46 cfs @ 12.09 hrs, Volume= 0.033 af
Primary = 0.46 cfs @ 12.09 hrs, Volume= 0.033 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Link 4: Drainage Area 4

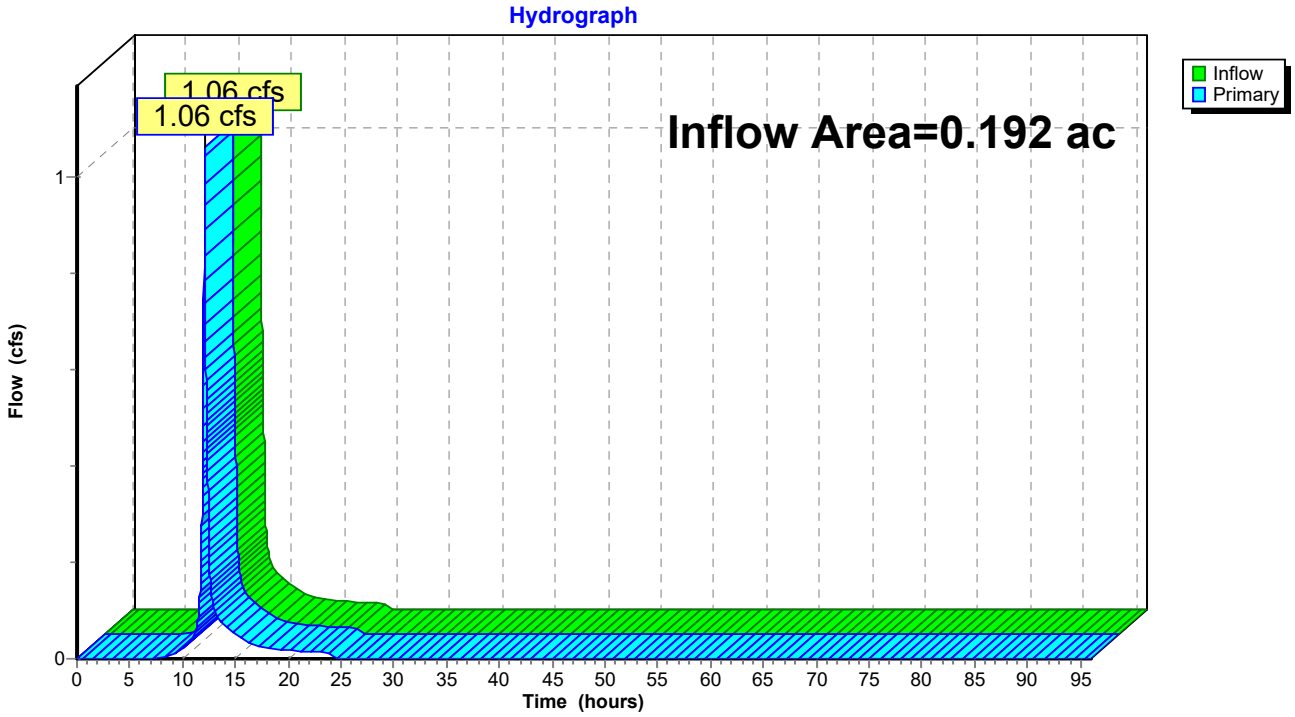


Summary for Link 5: Drainage Area 5

Inflow Area = 0.192 ac, 0.00% Impervious, Inflow Depth = 4.72" for 100-Year event
Inflow = 1.06 cfs @ 12.09 hrs, Volume= 0.076 af
Primary = 1.06 cfs @ 12.09 hrs, Volume= 0.076 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Link 5: Drainage Area 5

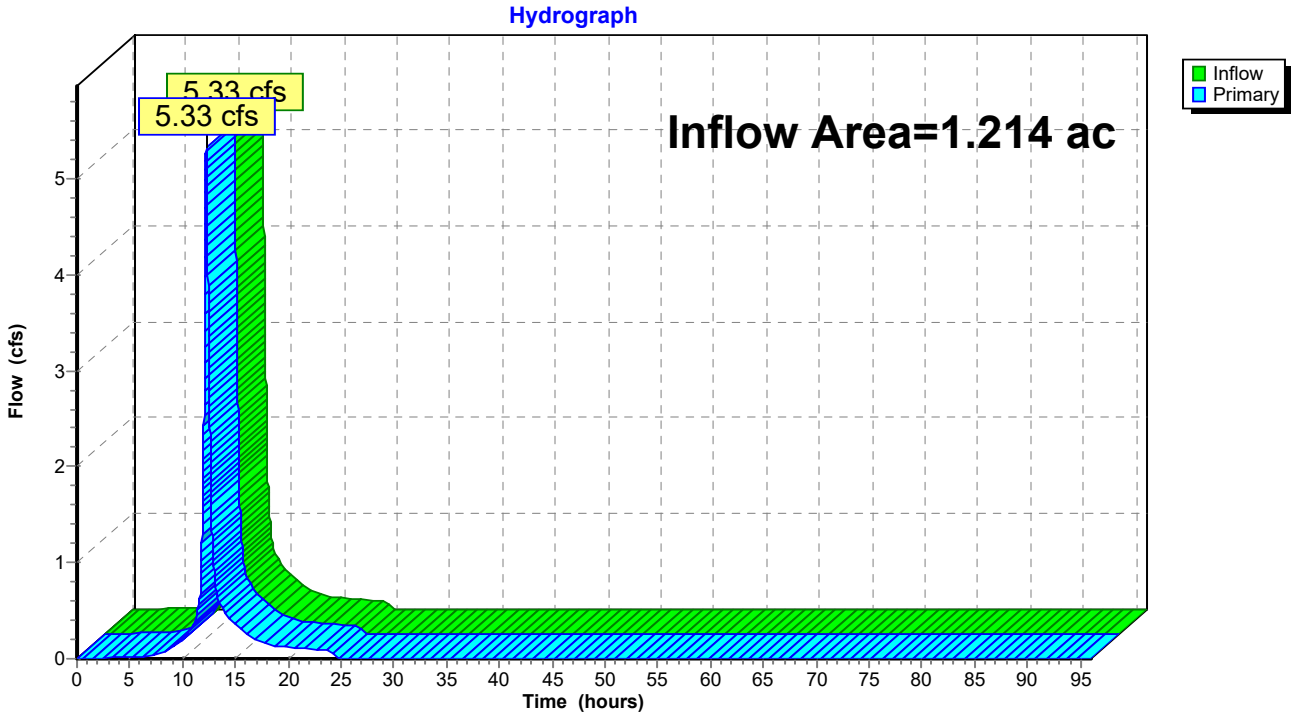


Summary for Link 6: Drainage Area 6

Inflow Area = 1.214 ac, 13.01% Impervious, Inflow Depth = 5.45" for 100-Year event
Inflow = 5.33 cfs @ 12.24 hrs, Volume= 0.552 af
Primary = 5.33 cfs @ 12.24 hrs, Volume= 0.552 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Link 6: Drainage Area 6

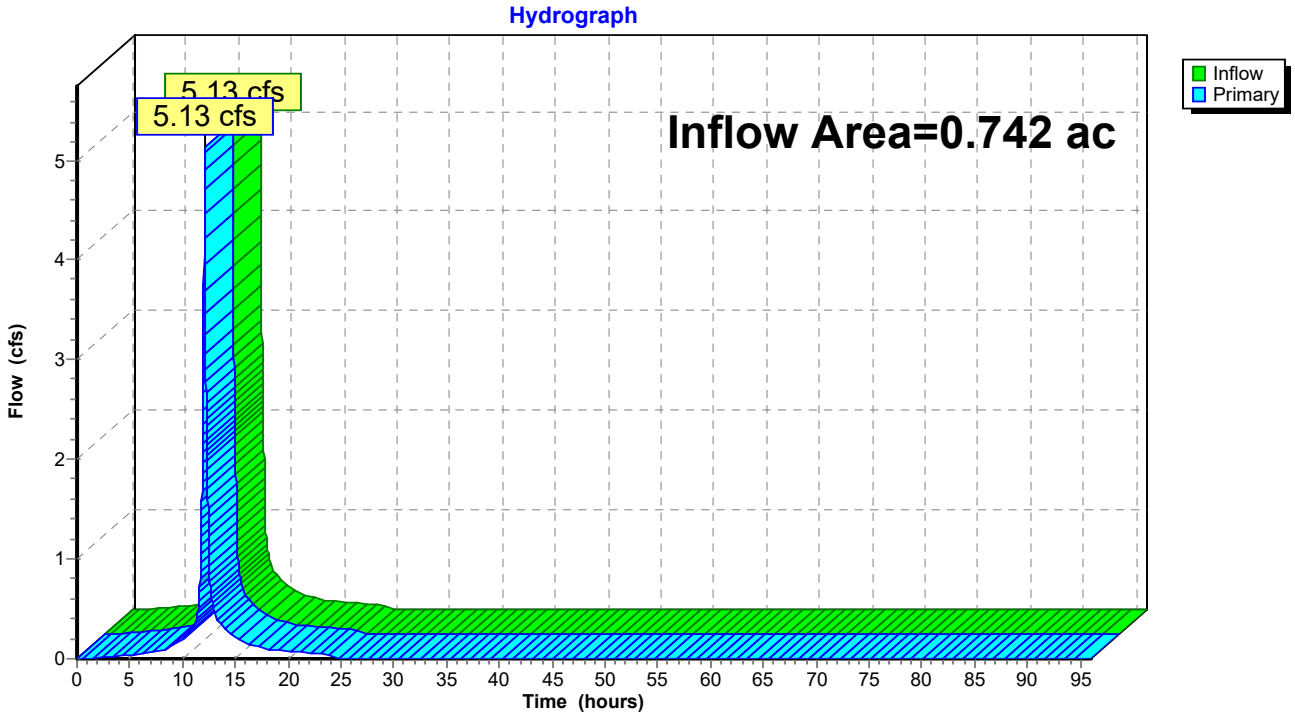


Summary for Link 7: Drainage Area 7

Inflow Area = 0.742 ac, 32.88% Impervious, Inflow Depth = 6.43" for 100-Year event
Inflow = 5.13 cfs @ 12.08 hrs, Volume= 0.398 af
Primary = 5.13 cfs @ 12.08 hrs, Volume= 0.398 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Link 7: Drainage Area 7

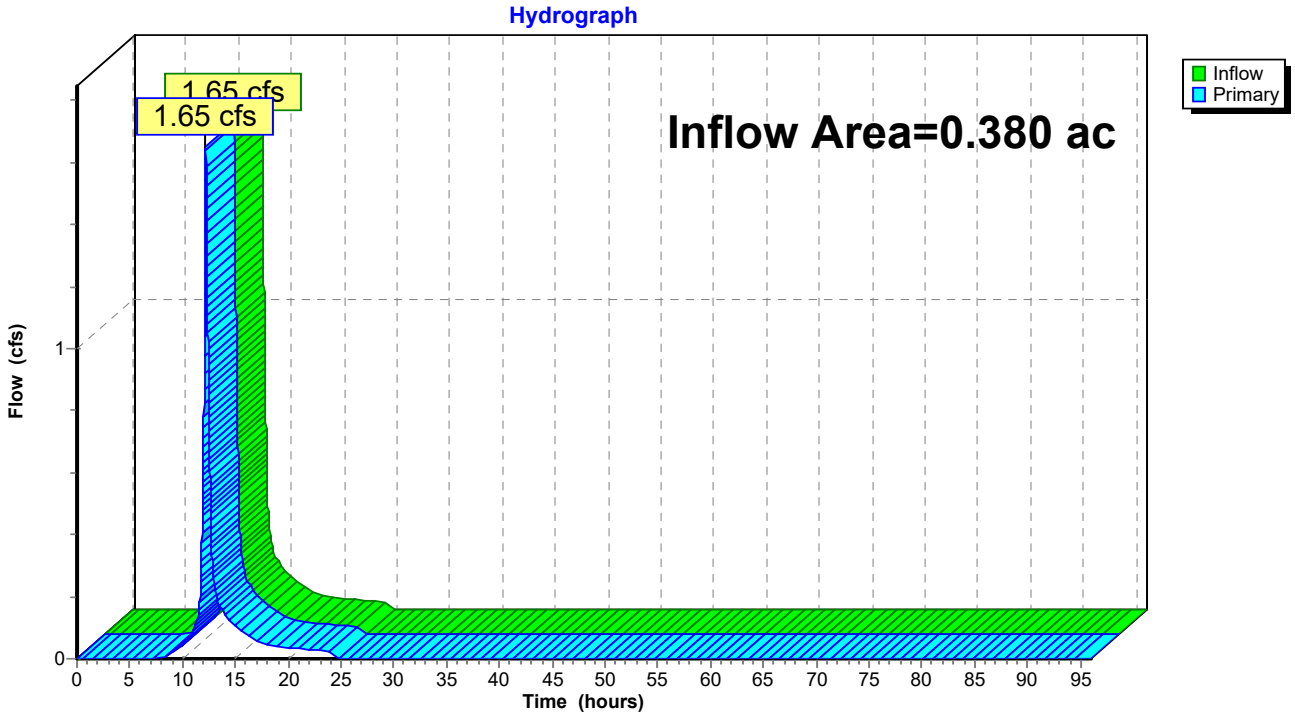


Summary for Link 8: Drainage Area 8

Inflow Area = 0.380 ac, 0.00% Impervious, Inflow Depth = 4.84" for 100-Year event
Inflow = 1.65 cfs @ 12.20 hrs, Volume= 0.153 af
Primary = 1.65 cfs @ 12.20 hrs, Volume= 0.153 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Link 8: Drainage Area 8

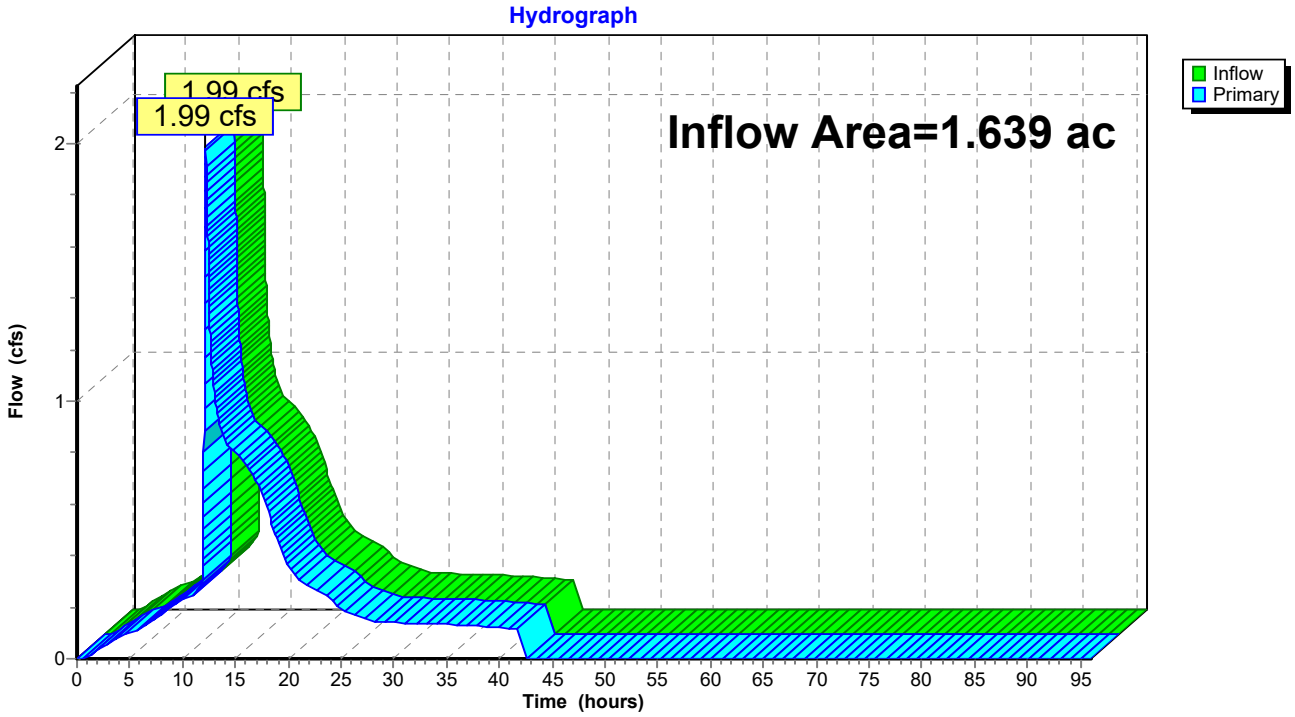


Summary for Link MH9: ST MH 9 Connector

Inflow Area = 1.639 ac, 55.70% Impervious, Inflow Depth = 6.95" for 100-Year event
Inflow = 1.99 cfs @ 12.19 hrs, Volume= 0.950 af
Primary = 1.99 cfs @ 12.19 hrs, Volume= 0.950 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Link MH9: ST MH 9 Connector

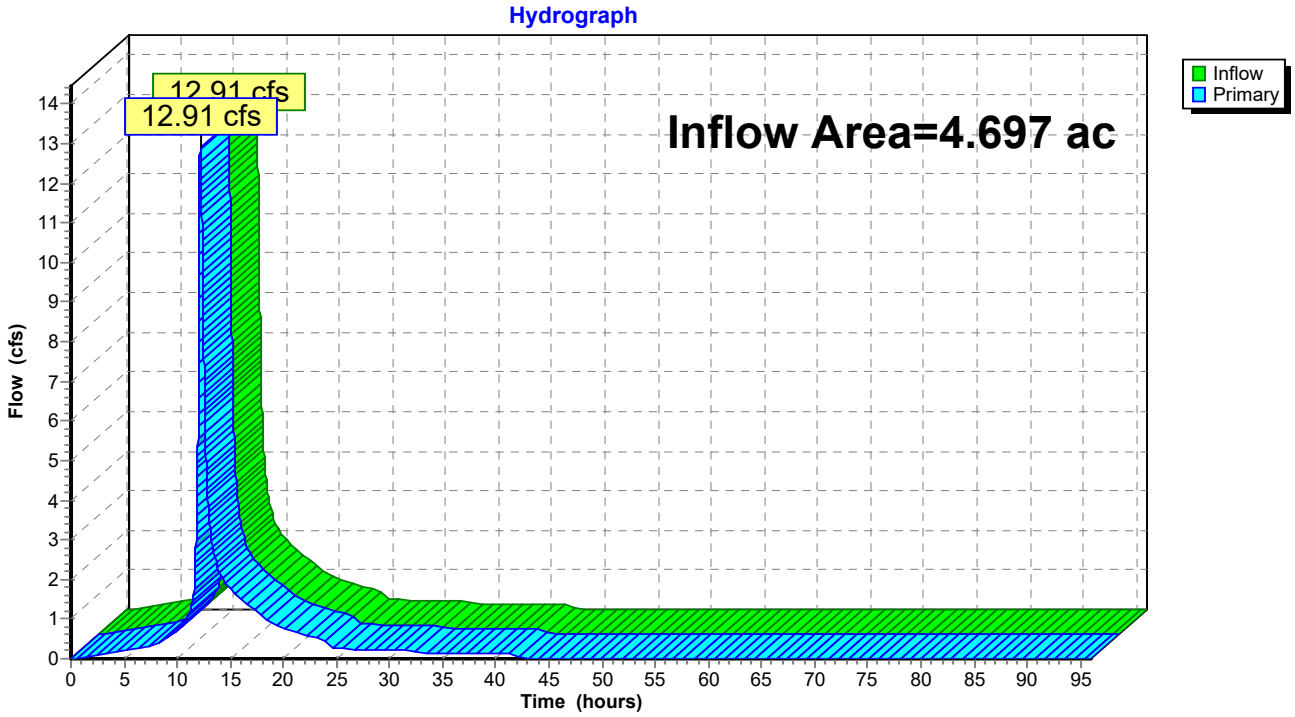


Summary for Link PE: Penn East Total Runoff

Inflow Area = 4.697 ac, 34.53% Impervious, Inflow Depth = 6.23" for 100-Year event
Inflow = 12.91 cfs @ 12.17 hrs, Volume= 2.438 af
Primary = 12.91 cfs @ 12.17 hrs, Volume= 2.438 af, Atten= 0%, Lag= 0.0 min

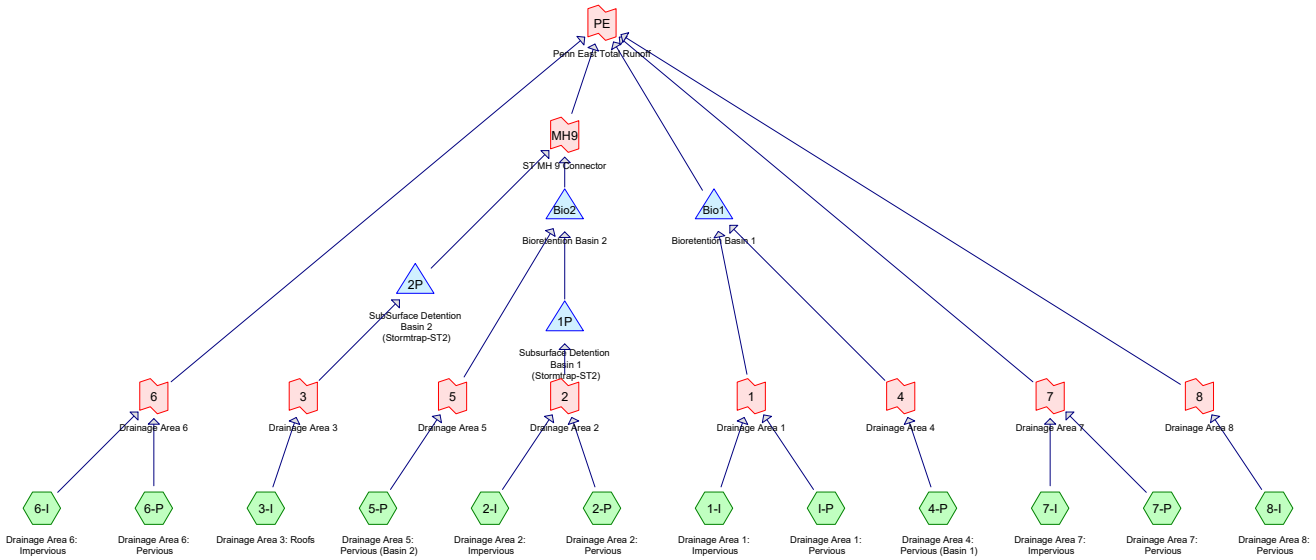
Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

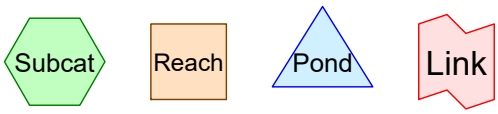
Link PE: Penn East Total Runoff



APPENDIX G

WATER QUALITY CALCULATIONS





Routing Diagram for 292931 - 2018-08-30 PR-DA
Prepared by TRC Environmental Corp, Printed 8/30/2018
HydroCAD® 10.00-22 s/n 02814 © 2018 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
1.846	74	>75% Grass cover, Good, HSG C (2-P, 6-P, 7-P, 8-I, I-P)
0.598	96	Gravel surface, HSG C (1-I, 2-I, 6-I, 7-I)
0.924	98	Paved parking, HSG C (1-I, 2-I, 7-I)
0.183	98	Unconnected pavement, HSG C (1-I, 2-I, 6-I)
0.515	98	Unconnected roofs, HSG C (3-I, 6-I, 7-I)
0.631	72	Woods/grass comb., Good, HSG C (2-P, 4-P, 5-P, 6-P, 8-I, I-P)
4.697	**85**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
4.697	HSG C	1-I, 2-I, 2-P, 3-I, 4-P, 5-P, 6-I, 6-P, 7-I, 7-P, 8-I, I-P
0.000	HSG D	
0.000	Other	
4.697		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	1.846	0.000	0.000	1.846	>75% Grass cover, Good	2-P, 6-P, 7-P, 8-I, I-P
0.000	0.000	0.598	0.000	0.000	0.598	Gravel surface	1-I, 2-I, 6-I, 7-I
0.000	0.000	0.924	0.000	0.000	0.924	Paved parking	1-I, 2-I, 7-I
0.000	0.000	0.183	0.000	0.000	0.183	Unconnected pavement	1-I, 2-I, 6-I
0.000	0.000	0.515	0.000	0.000	0.515	Unconnected roofs	3-I, 6-I, 7-I
0.000	0.000	0.631	0.000	0.000	0.631	Woods/grass comb., Good	2-P, 4-P, 5-P, 6-P, 8-I, I-P
0.000	**0.000**	**4.697**	**0.000**	**0.000**	**4.697**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	6-I	0.00	0.00	67.0	0.0780	0.012	16.0	0.0	0.0
2	8-I	0.00	0.00	40.0	0.0270	0.012	12.0	0.0	0.0
3	1P	156.33	156.00	50.0	0.0066	0.012	15.0	0.0	0.0
4	2P	157.33	151.13	245.0	0.0253	0.012	15.0	0.0	0.0
5	Bio1	151.80	151.00	95.0	0.0084	0.013	15.0	0.0	0.0
6	Bio2	152.17	151.30	109.0	0.0080	0.012	15.0	0.0	0.0

Time span=0.00-96.00 hrs, dt=0.01 hrs, 9601 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1-I: Drainage Area 1: Runoff Area=0.387 ac 79.33% Impervious Runoff Depth=1.03"
Flow Length=119' Tc=6.0 min CN=98 Runoff=1.13 cfs 0.033 af

Subcatchment 2-I: Drainage Area 2: Runoff Area=0.802 ac 63.47% Impervious Runoff Depth=0.94"
Flow Length=252' Tc=7.0 min CN=97 Runoff=2.15 cfs 0.063 af

Subcatchment 2-P: Drainage Area 2: Runoff Area=0.241 ac 0.00% Impervious Runoff Depth=0.07"
Tc=7.0 min CN=74 Runoff=0.03 cfs 0.001 af

Subcatchment 3-I: Drainage Area 3: Roofs Runoff Area=0.404 ac 100.00% Impervious Runoff Depth=1.03"
Tc=6.0 min CN=98 Runoff=1.18 cfs 0.035 af

Subcatchment 4-P: Drainage Area 4: Runoff Area=0.083 ac 0.00% Impervious Runoff Depth=0.05"
Tc=6.0 min CN=72 Runoff=0.01 cfs 0.000 af

Subcatchment 5-P: Drainage Area 5: Runoff Area=0.192 ac 0.00% Impervious Runoff Depth=0.05"
Tc=6.0 min CN=72 Runoff=0.02 cfs 0.001 af

Subcatchment 6-I: Drainage Area 6: Runoff Area=0.223 ac 70.85% Impervious Runoff Depth=0.94"
Flow Length=596' Tc=17.7 min CN=97 Runoff=0.42 cfs 0.018 af

Subcatchment 6-P: Drainage Area 6: Runoff Area=0.991 ac 0.00% Impervious Runoff Depth=0.07"
Tc=17.7 min CN=74 Runoff=0.10 cfs 0.006 af

Subcatchment 7-I: Drainage Area 7: Runoff Area=0.404 ac 60.40% Impervious Runoff Depth=0.94"
Tc=6.0 min CN=97 Runoff=1.11 cfs 0.032 af

Subcatchment 7-P: Drainage Area 7: Runoff Area=0.338 ac 0.00% Impervious Runoff Depth=0.07"
Tc=6.0 min CN=74 Runoff=0.05 cfs 0.002 af

Subcatchment 8-I: Drainage Area 8: Pervious Runoff Area=0.380 ac 0.00% Impervious Runoff Depth=0.06"
Flow Length=327' Tc=14.6 min CN=73 Runoff=0.03 cfs 0.002 af

Subcatchment I-P: Drainage Area 1: Pervious Runoff Area=0.252 ac 0.00% Impervious Runoff Depth=0.06"
Tc=6.0 min CN=73 Runoff=0.03 cfs 0.001 af

Pond 1P: Subsurface Detention Basin 1 Peak Elev=157.36' Storage=2,200 cf Inflow=2.16 cfs 0.064 af
Outflow=0.16 cfs 0.064 af

Pond 2P: SubSurface Detention Basin 2 Peak Elev=158.39' Storage=956 cf Inflow=1.18 cfs 0.035 af
Outflow=0.16 cfs 0.035 af

Pond Bio1: Bioretention Basin 1 Peak Elev=155.65' Storage=1,177 cf Inflow=1.14 cfs 0.035 af
Outflow=0.07 cfs 0.035 af

Pond Bio2: Bioretention Basin 2 Peak Elev=156.12' Storage=391 cf Inflow=0.17 cfs 0.065 af
Outflow=0.12 cfs 0.065 af

Link 1: Drainage Area 1 Inflow=1.14 cfs 0.035 af
Primary=1.14 cfs 0.035 af

Link 2: Drainage Area 2 Inflow=2.16 cfs 0.064 af
Primary=2.16 cfs 0.064 af

Link 3: Drainage Area 3 Inflow=1.18 cfs 0.035 af
Primary=1.18 cfs 0.035 af

Link 4: Drainage Area 4 Inflow=0.01 cfs 0.000 af
Primary=0.01 cfs 0.000 af

Link 5: Drainage Area 5 Inflow=0.02 cfs 0.001 af
Primary=0.02 cfs 0.001 af

Link 6: Drainage Area 6 Inflow=0.49 cfs 0.024 af
Primary=0.49 cfs 0.024 af

Link 7: Drainage Area 7 Inflow=1.14 cfs 0.034 af
Primary=1.14 cfs 0.034 af

Link 8: Drainage Area 8 Inflow=0.03 cfs 0.002 af
Primary=0.03 cfs 0.002 af

Link MH9: ST MH 9 Connector Inflow=0.28 cfs 0.100 af
Primary=0.28 cfs 0.100 af

Link PE: Penn East Total Runoff Inflow=1.73 cfs 0.195 af
Primary=1.73 cfs 0.195 af

Total Runoff Area = 4.697 ac Runoff Volume = 0.195 af Average Runoff Depth = 0.50"
65.47% Pervious = 3.075 ac 34.53% Impervious = 1.622 ac

Summary for Subcatchment 1-I: Drainage Area 1: Impervious

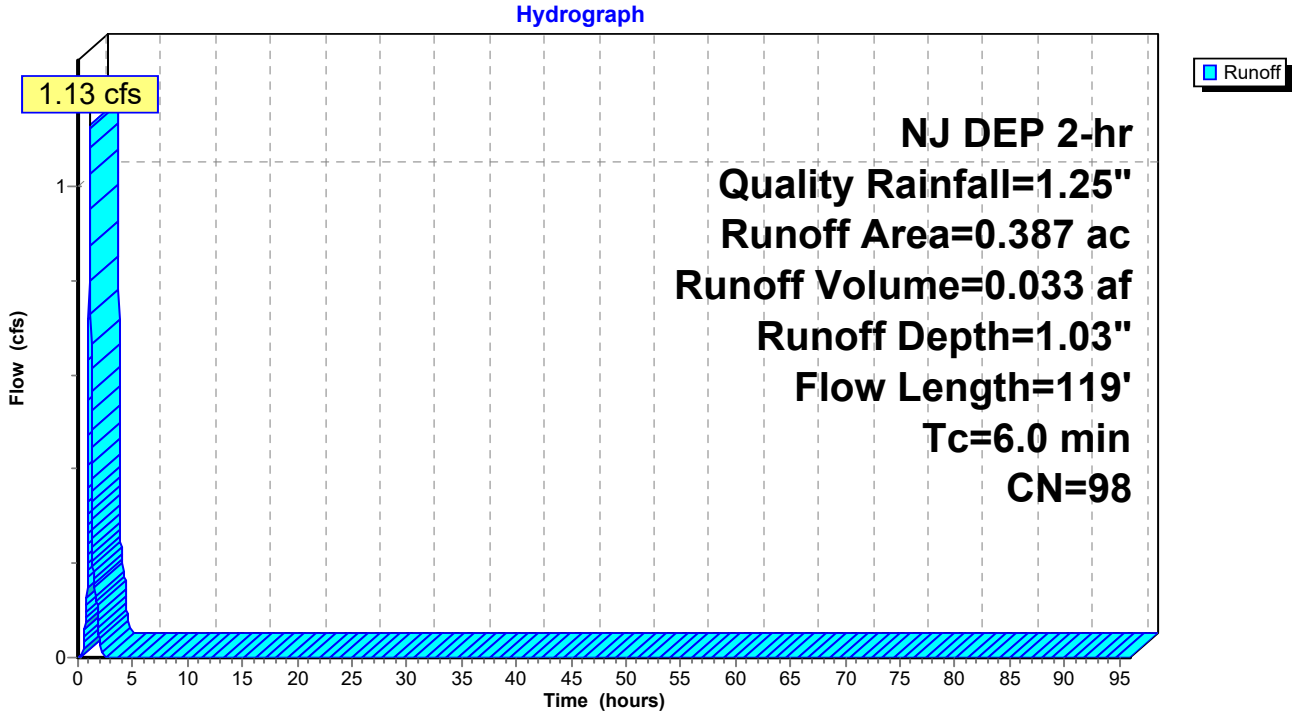
Runoff = 1.13 cfs @ 1.11 hrs, Volume= 0.033 af, Depth= 1.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
NJ DEP 2-hr Quality Rainfall=1.25"

Area (ac)	CN	Description
0.080	96	Gravel surface, HSG C
0.015	98	Unconnected pavement, HSG C
0.292	98	Paved parking, HSG C
0.387	98	Weighted Average
0.080		20.67% Pervious Area
0.307		79.33% Impervious Area
0.015		4.89% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	119		0.33		**Direct Entry, Direct**

Subcatchment 1-I: Drainage Area 1: Impervious



Summary for Subcatchment 2-I: Drainage Area 2: Impervious

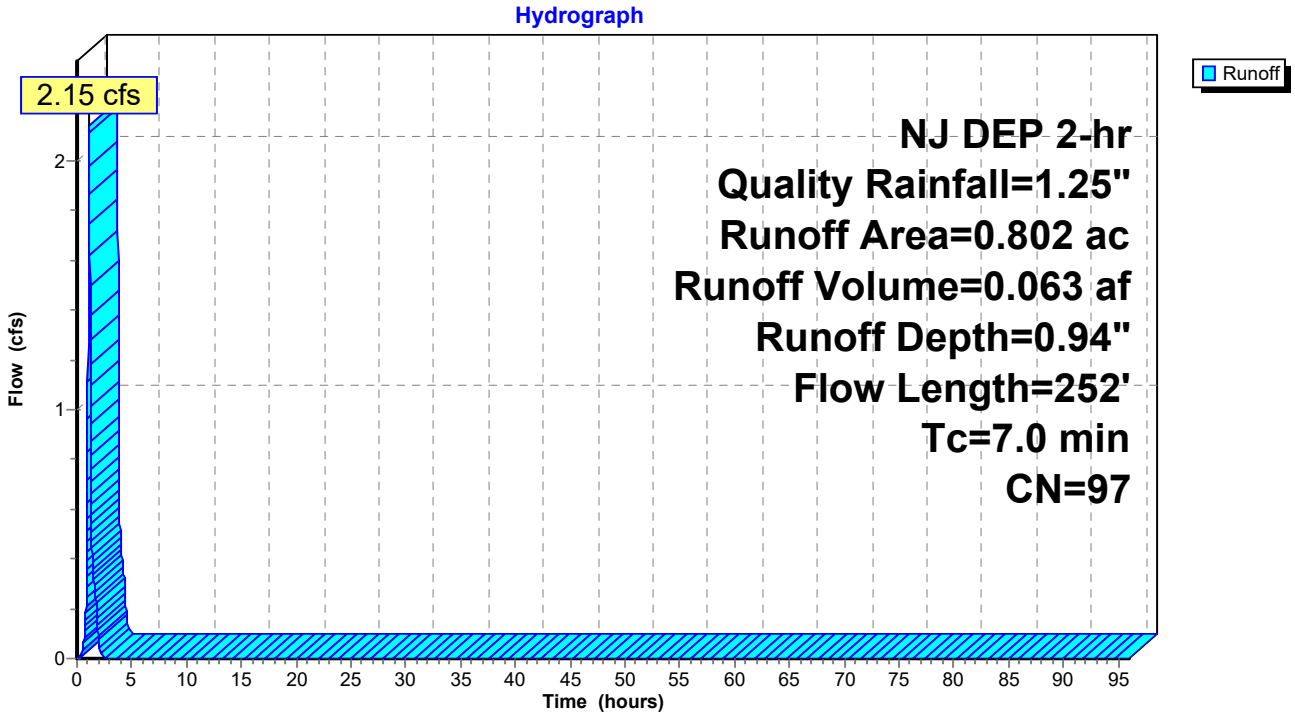
Runoff = 2.15 cfs @ 1.12 hrs, Volume= 0.063 af, Depth= 0.94"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
NJ DEP 2-hr Quality Rainfall=1.25"

Area (ac)	CN	Description
0.293	96	Gravel surface, HSG C
0.497	98	Paved parking, HSG C
0.012	98	Unconnected pavement, HSG C
0.802	97	Weighted Average
0.293		36.53% Pervious Area
0.509		63.47% Impervious Area
0.012		2.36% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.1	44	0.0840	0.18		**Sheet Flow, Grass: Dense** Grass: Dense n= 0.240 P2= 3.38"
2.1	38	0.3310	0.30		**Sheet Flow, Grass: Dense** Grass: Dense n= 0.240 P2= 3.38"
0.2	18	0.0500	1.45		**Sheet Flow, Smooth Surfaces** Smooth surfaces n= 0.011 P2= 3.38"
0.6	152	0.0370	3.90		**Shallow Concentrated Flow, Paved** Paved Kv= 20.3 fps
7.0	252	Total			

Subcatchment 2-I: Drainage Area 2: Impervious



Summary for Subcatchment 2-P: Drainage Area 2: Pervious

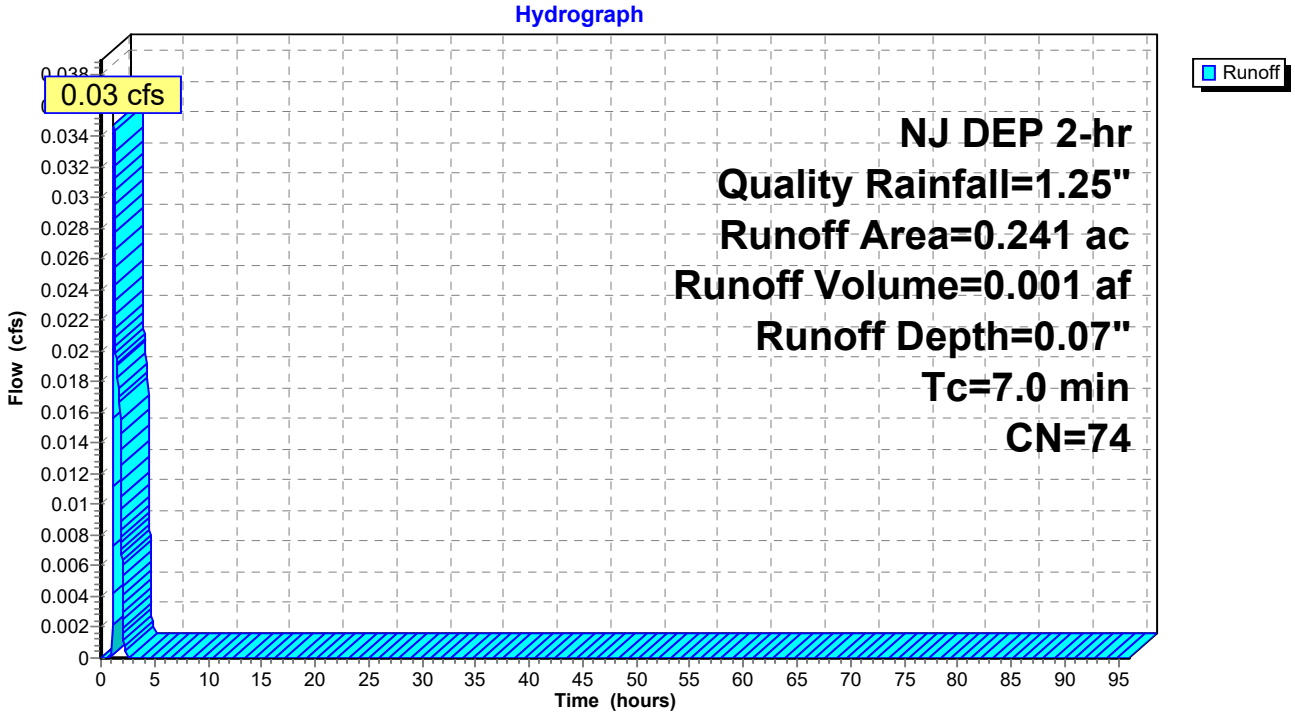
Runoff = 0.03 cfs @ 1.21 hrs, Volume= 0.001 af, Depth= 0.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
NJ DEP 2-hr Quality Rainfall=1.25"

Area (ac)	CN	Description
0.186	74	>75% Grass cover, Good, HSG C
0.055	72	Woods/grass comb., Good, HSG C
0.241	74	Weighted Average
0.241		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0					**Direct Entry, 2-I**

Subcatchment 2-P: Drainage Area 2: Pervious



Summary for Subcatchment 3-I: Drainage Area 3: Roofs

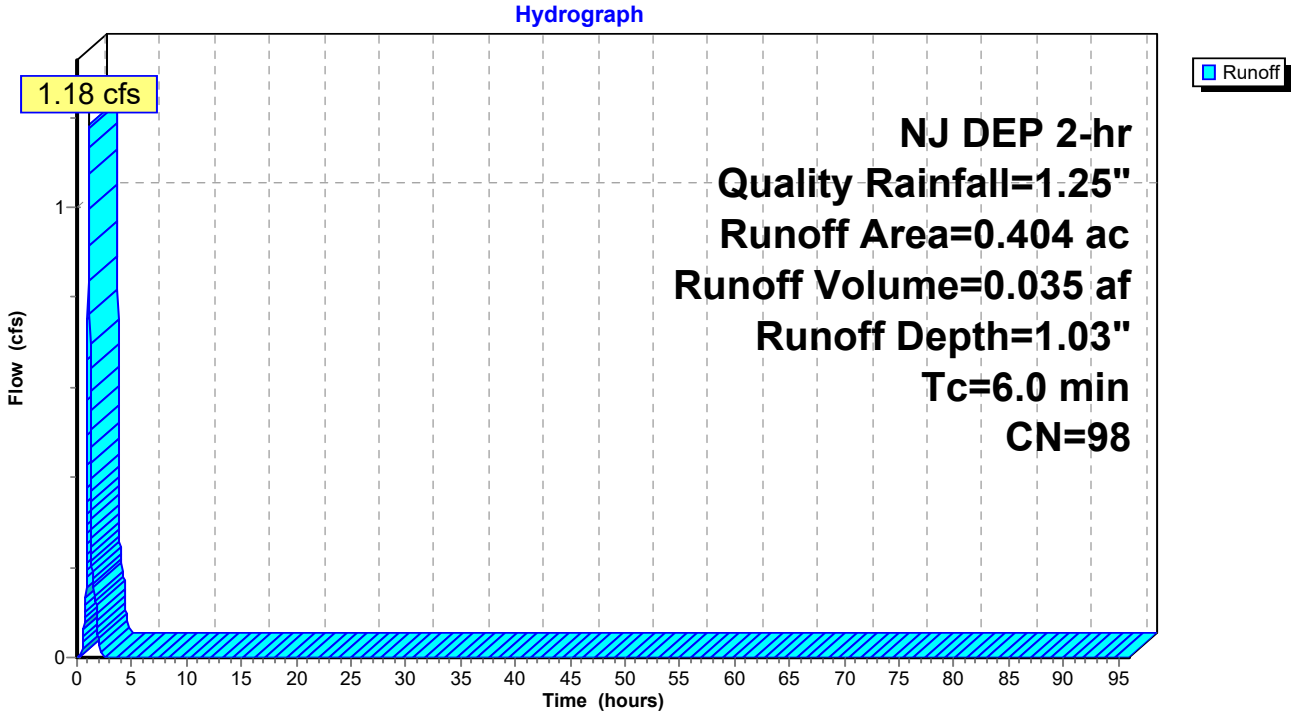
Runoff = 1.18 cfs @ 1.11 hrs, Volume= 0.035 af, Depth= 1.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
NJ DEP 2-hr Quality Rainfall=1.25"

Area (ac)	CN	Description
0.404	98	Unconnected roofs, HSG C
0.404		100.00% Impervious Area
0.404		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct C-1**

Subcatchment 3-I: Drainage Area 3: Roofs



Summary for Subcatchment 4-P: Drainage Area 4: Pervious (Basin 1)

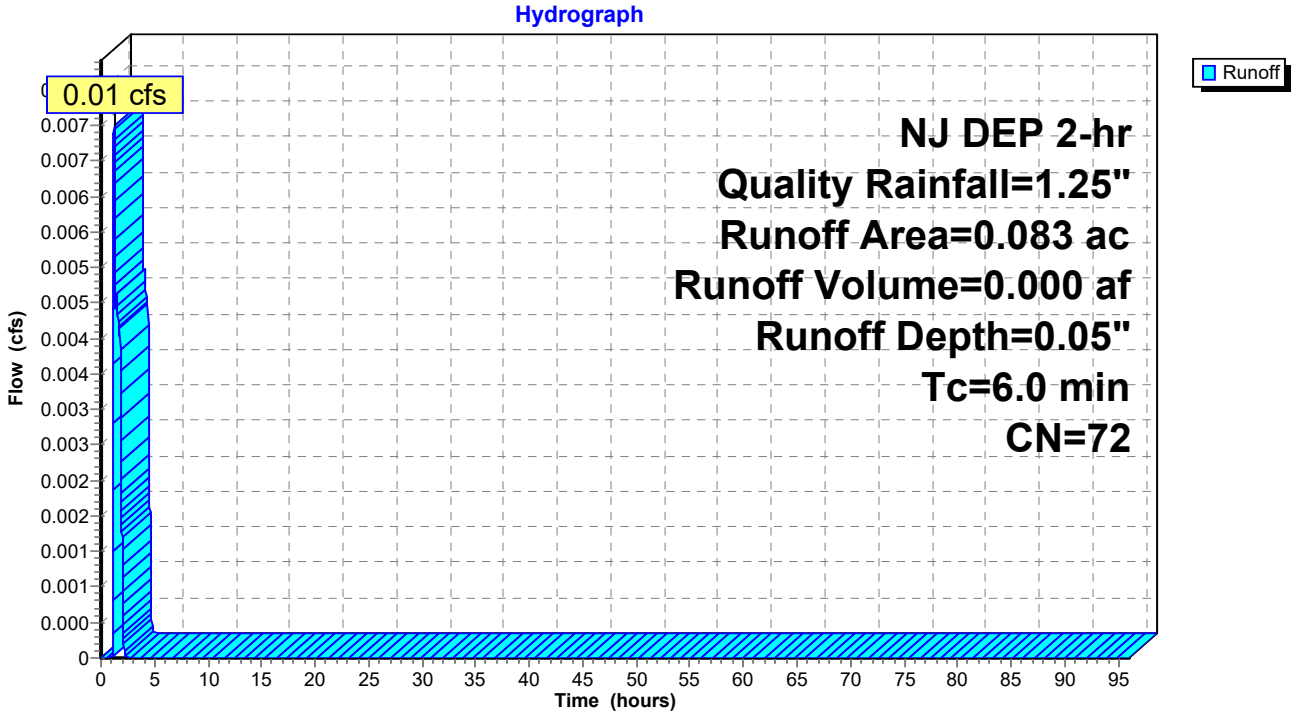
Runoff = 0.01 cfs @ 1.22 hrs, Volume= 0.000 af, Depth= 0.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
NJ DEP 2-hr Quality Rainfall=1.25"

Area (ac)	CN	Description
0.083	72	Woods/grass comb., Good, HSG C
0.083		100.00% Pervious Area

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

Subcatchment 4-P: Drainage Area 4: Pervious (Basin 1)



Summary for Subcatchment 5-P: Drainage Area 5: Pervious (Basin 2)

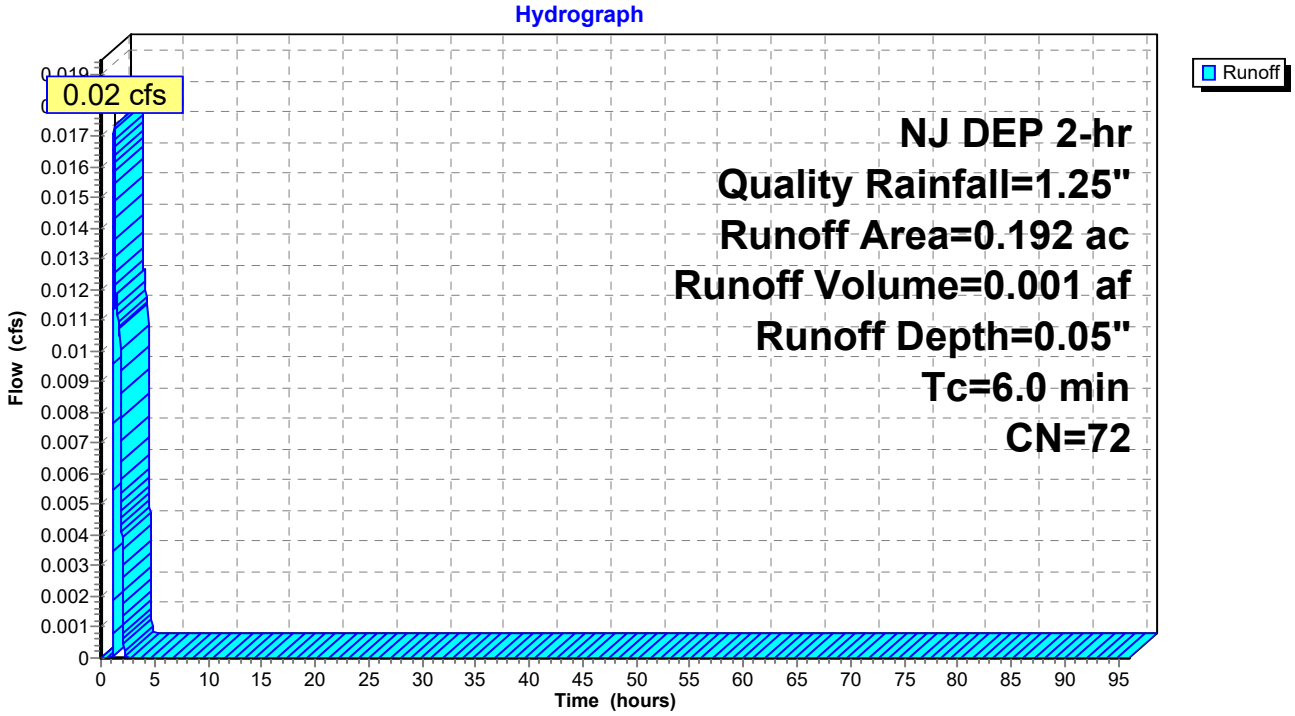
Runoff = 0.02 cfs @ 1.22 hrs, Volume= 0.001 af, Depth= 0.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
NJ DEP 2-hr Quality Rainfall=1.25"

Area (ac)	CN	Description
0.192	72	Woods/grass comb., Good, HSG C
0.192		100.00% Pervious Area

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

Subcatchment 5-P: Drainage Area 5: Pervious (Basin 2)



Summary for Subcatchment 6-I: Drainage Area 6: Impervious

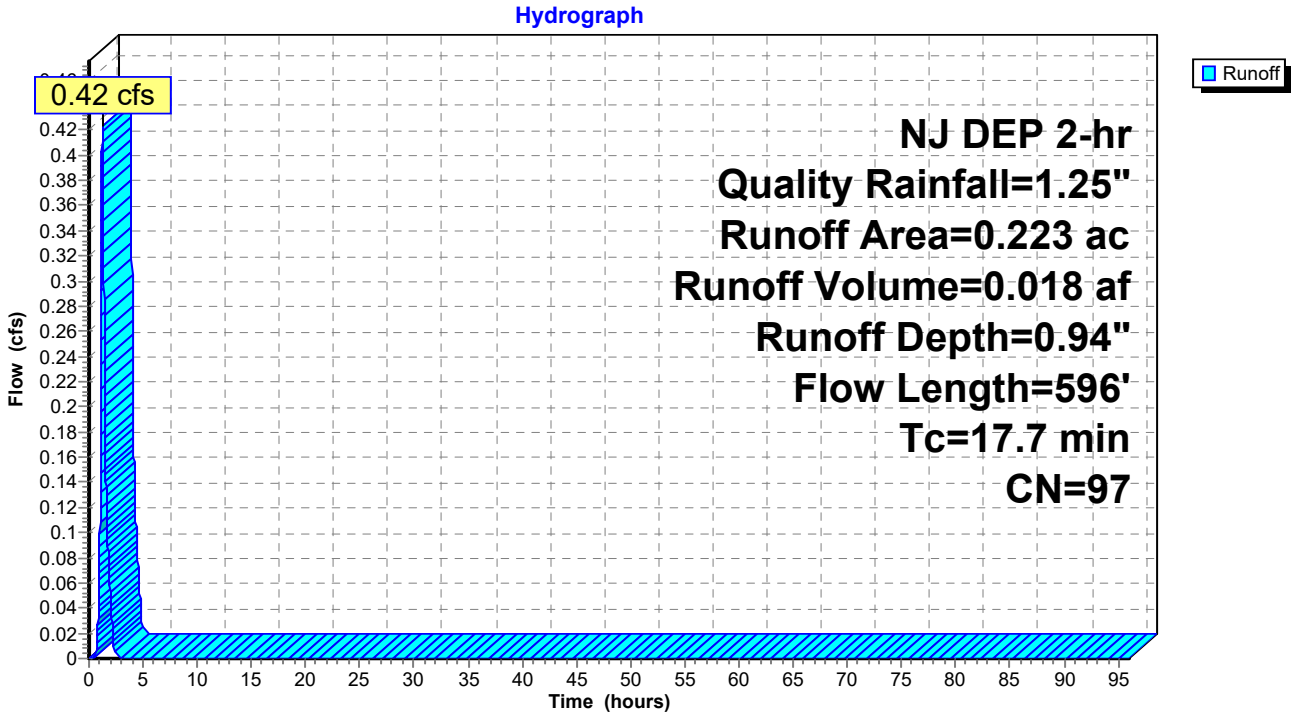
Runoff = 0.42 cfs @ 1.24 hrs, Volume= 0.018 af, Depth= 0.94"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
NJ DEP 2-hr Quality Rainfall=1.25"

Area (ac)	CN	Description
0.002	98	Unconnected roofs, HSG C
0.156	98	Unconnected pavement, HSG C
0.065	96	Gravel surface, HSG C
0.223	97	Weighted Average
0.065		29.15% Pervious Area
0.158		70.85% Impervious Area
0.158		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.6	40	0.1180	0.08		**Sheet Flow, SF1** Woods: Dense underbrush n= 0.800 P2= 3.38"
5.0	60	0.0923	0.20		**Sheet Flow, SF2** Grass: Dense n= 0.240 P2= 3.38"
0.7	86	0.0988	2.20		**Shallow Concentrated Flow, SCF1** Short Grass Pasture Kv= 7.0 fps
3.3	343	0.0499	1.75	1.75	**Channel Flow, CF1** Area= 1.0 sf Perim= 12.6' r= 0.08' n= 0.035 Earth, dense weeds
0.1	67	0.0780	16.63	23.22	**Pipe Channel, HDPE Pipe** 16.0" Round Area= 1.4 sf Perim= 4.2' r= 0.33' n= 0.012
17.7	596	Total			

Subcatchment 6-I: Drainage Area 6: Impervious



Summary for Subcatchment 6-P: Drainage Area 6: Pervious

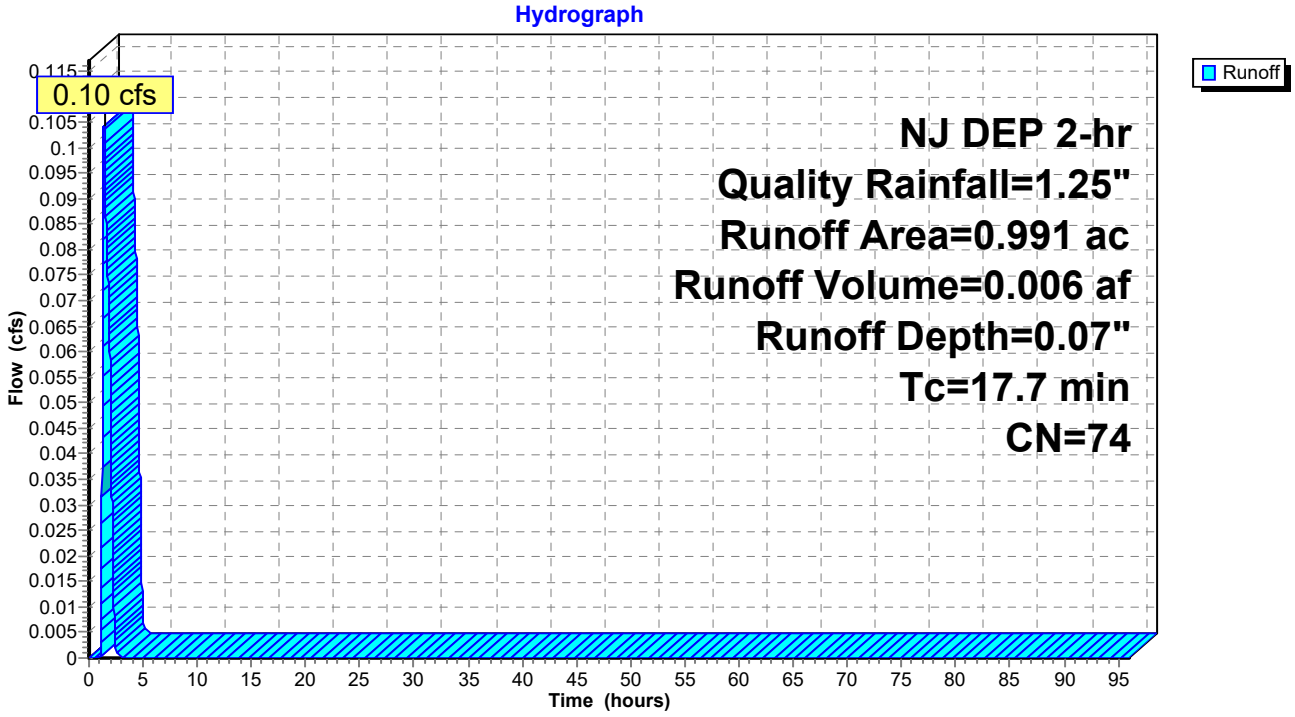
Runoff = 0.10 cfs @ 1.39 hrs, Volume= 0.006 af, Depth= 0.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
NJ DEP 2-hr Quality Rainfall=1.25"

Area (ac)	CN	Description
0.981	74	>75% Grass cover, Good, HSG C
0.010	72	Woods/grass comb., Good, HSG C
0.991	74	Weighted Average
0.991		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.7					**Direct Entry, Same as G1**

Subcatchment 6-P: Drainage Area 6: Pervious



Summary for Subcatchment 7-I: Drainage Area 7: Impervious

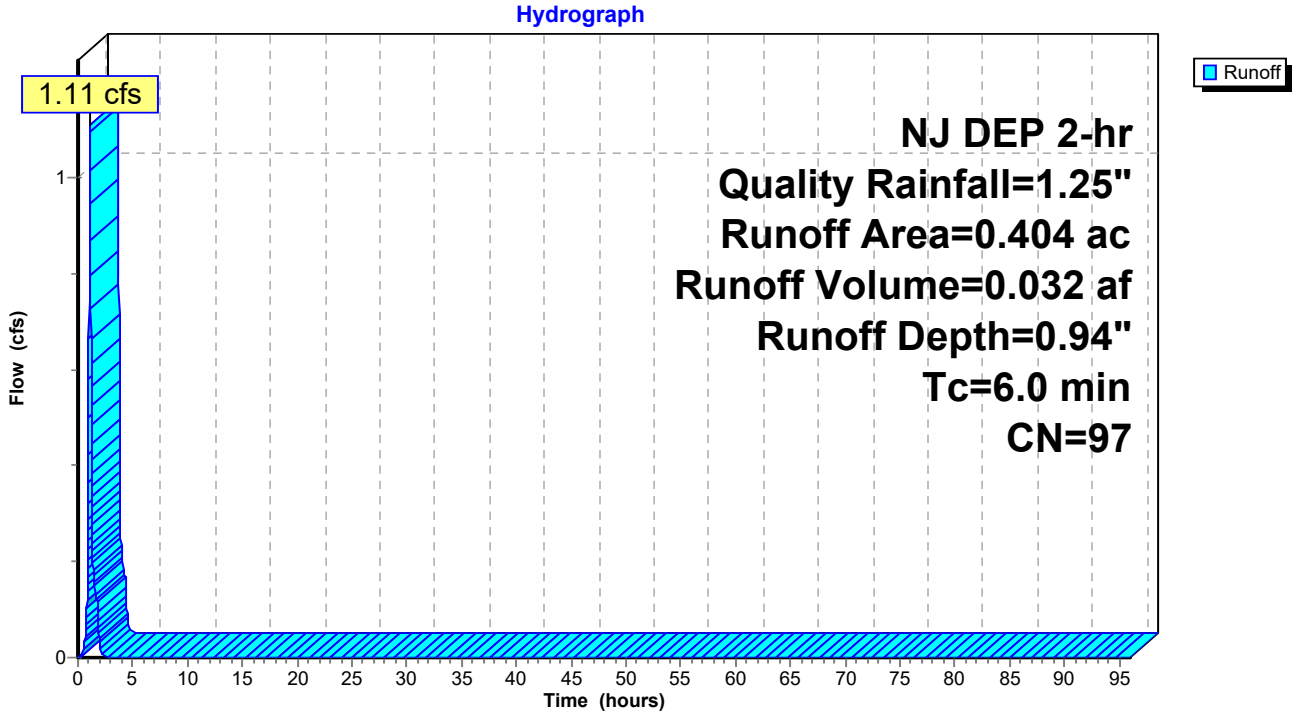
Runoff = 1.11 cfs @ 1.11 hrs, Volume= 0.032 af, Depth= 0.94"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
NJ DEP 2-hr Quality Rainfall=1.25"

Area (ac)	CN	Description
0.135	98	Paved parking, HSG C
0.160	96	Gravel surface, HSG C
0.109	98	Unconnected roofs, HSG C
0.404	97	Weighted Average
0.160		39.60% Pervious Area
0.244		60.40% Impervious Area
0.109		44.67% Unconnected

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

Subcatchment 7-I: Drainage Area 7: Impervious



Summary for Subcatchment 7-P: Drainage Area 7: Pervious

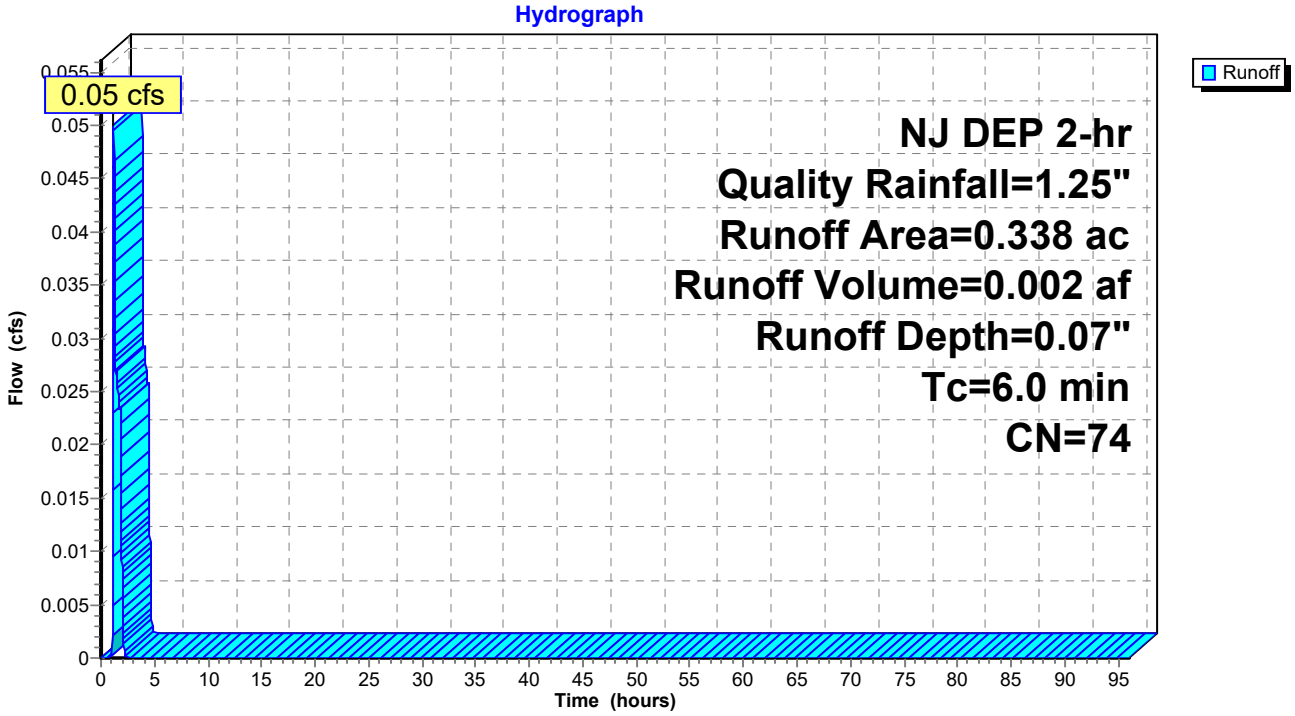
Runoff = 0.05 cfs @ 1.20 hrs, Volume= 0.002 af, Depth= 0.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
NJ DEP 2-hr Quality Rainfall=1.25"

Area (ac)	CN	Description
0.338	74	>75% Grass cover, Good, HSG C
0.338		100.00% Pervious Area

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

Subcatchment 7-P: Drainage Area 7: Pervious



Summary for Subcatchment 8-I: Drainage Area 8: Pervious

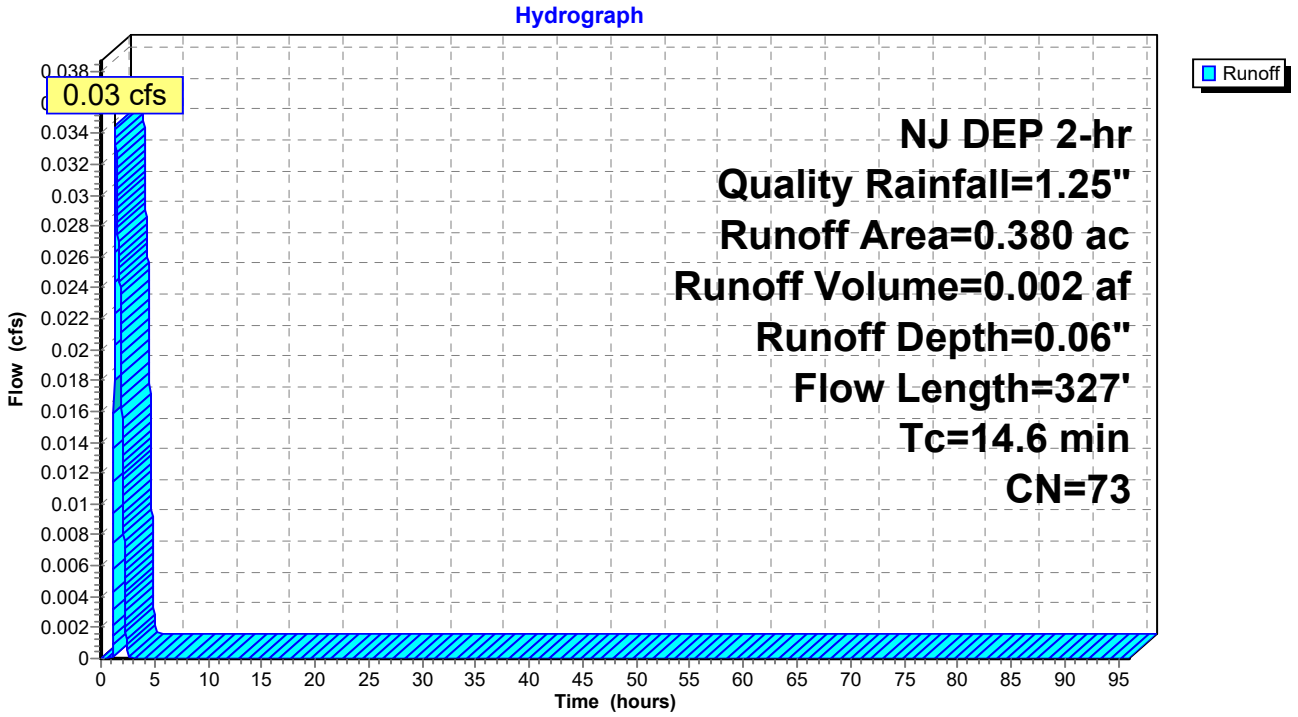
Runoff = 0.03 cfs @ 1.35 hrs, Volume= 0.002 af, Depth= 0.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
NJ DEP 2-hr Quality Rainfall=1.25"

Area (ac)	CN	Description
0.234	74	>75% Grass cover, Good, HSG C
0.146	72	Woods/grass comb., Good, HSG C
0.380	73	Weighted Average
0.380		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	16	0.1190	0.25		**Sheet Flow, Grass: Short** Grass: Short n= 0.150 P2= 3.38"
12.0	85	0.0580	0.12		**Sheet Flow, Woods: Light Underbrush** Woods: Light underbrush n= 0.400 P2= 3.38"
0.2	23	0.0850	2.04		**Shallow Concentrated Flow, Short Grass Pasture** Short Grass Pasture Kv= 7.0 fps
0.4	28	0.0480	1.10		**Shallow Concentrated Flow, Woodland** Woodland Kv= 5.0 fps
0.3	27	0.0650	1.78		**Shallow Concentrated Flow, Short Grass Pasture** Short Grass Pasture Kv= 7.0 fps
0.5	108	0.0130	3.54	3.54	**Parabolic Channel, Earth Clean and Straight** W=3.00' D=0.50' Area=1.0 sf Perim=3.2' n= 0.022 Earth, clean & straight
0.1	40	0.0270	8.08	6.34	**Pipe Channel, Pipe** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012
14.6	327	Total			

Subcatchment 8-I: Drainage Area 8: Pervious



Summary for Subcatchment I-P: Drainage Area 1: Pervious

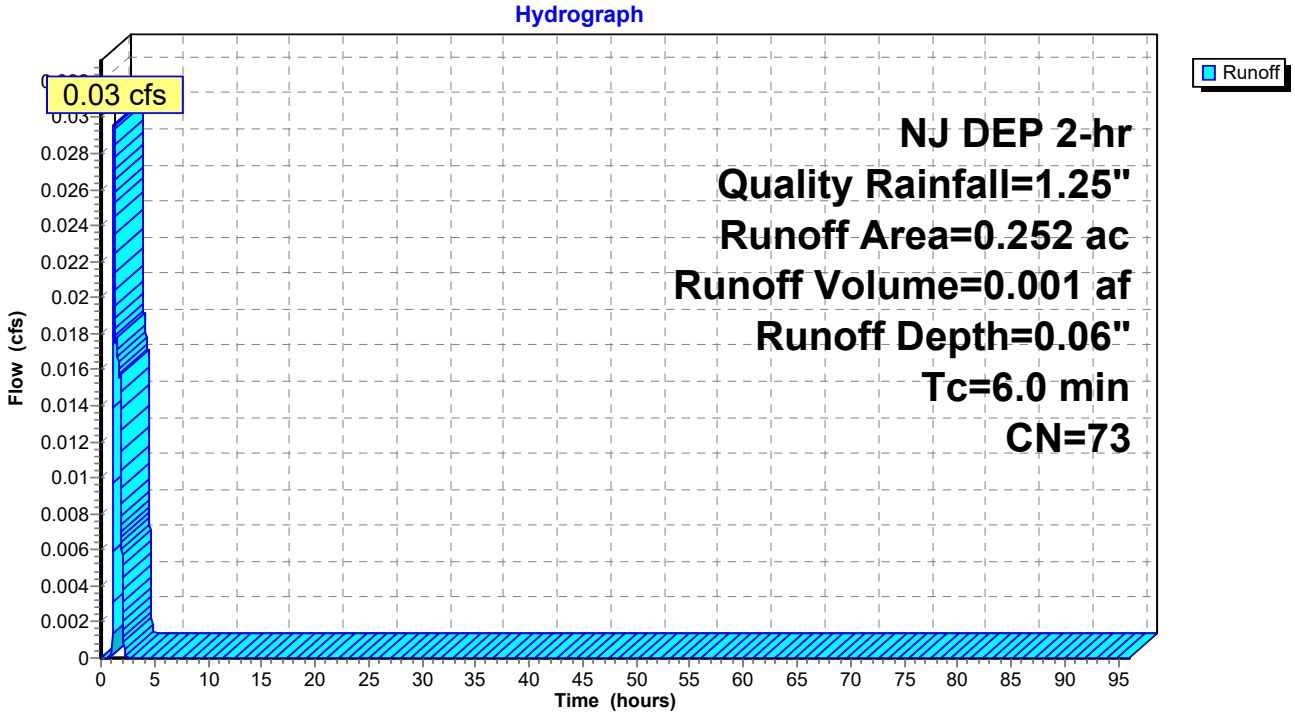
Runoff = 0.03 cfs @ 1.21 hrs, Volume= 0.001 af, Depth= 0.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
NJ DEP 2-hr Quality Rainfall=1.25"

Area (ac)	CN	Description
0.107	74	>75% Grass cover, Good, HSG C
0.145	72	Woods/grass comb., Good, HSG C
0.252	73	Weighted Average
0.252		100.00% Pervious Area

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

Subcatchment I-P: Drainage Area 1: Pervious



Summary for Pond 1P: Subsurface Detention Basin 1 (Stormtrap-ST2)

Inflow Area = 1.043 ac, 48.80% Impervious, Inflow Depth = 0.74" for Quality event
Inflow = 2.16 cfs @ 1.12 hrs, Volume= 0.064 af
Outflow = 0.16 cfs @ 1.86 hrs, Volume= 0.064 af, Atten= 93%, Lag= 44.2 min
Primary = 0.16 cfs @ 1.86 hrs, Volume= 0.064 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 157.36' @ 1.86 hrs Surf.Area= 4,273 sf Storage= 2,200 cf

Plug-Flow detention time= 147.2 min calculated for 0.064 af (100% of inflow)
Center-of-Mass det. time= 147.2 min (220.1 - 72.8)

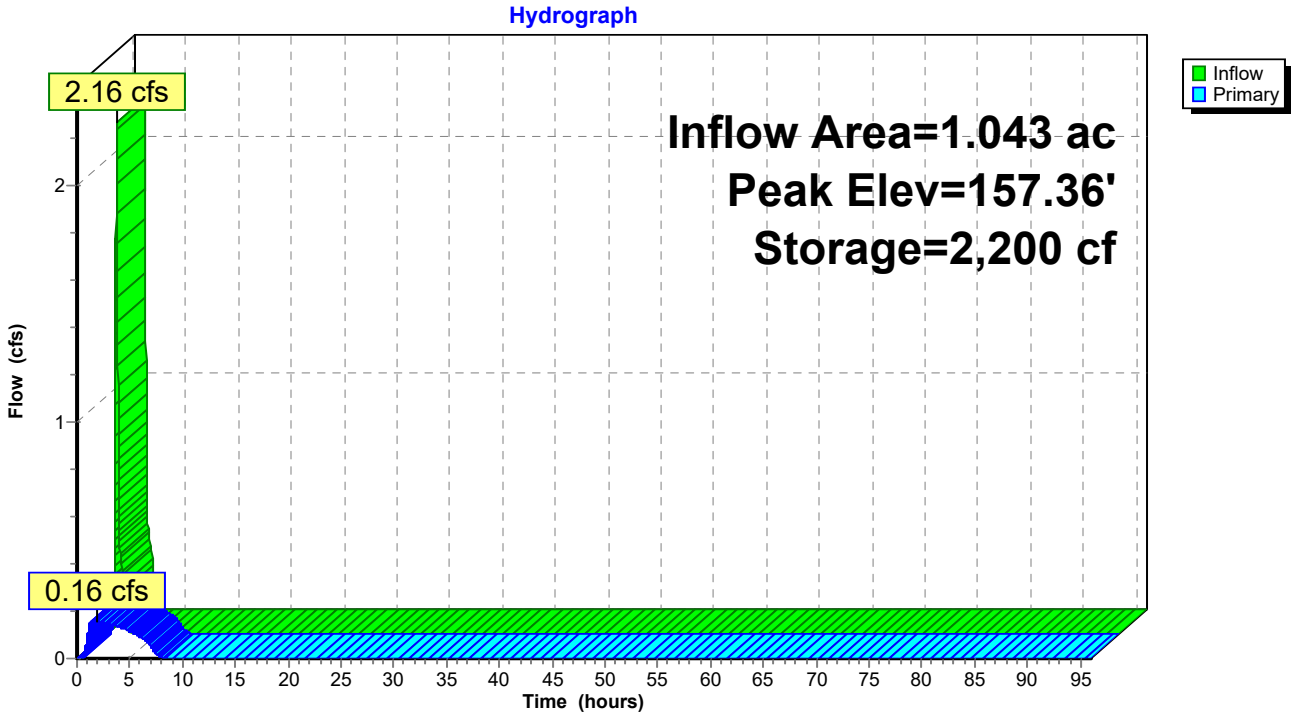
Volume	Invert	Avail.Storage	Storage Description
#1	156.33'	12,969 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
156.33	0	0	0
158.83	10,375	12,969	12,969

Device	Routing	Invert	Outlet Devices
#1	Primary	156.33'	**15.0" Round Culvert** L= 50.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 156.33' / 156.00' S= 0.0066 '/' Cc= 0.900 n= 0.012, Flow Area= 1.23 sf
#2	Device 1	156.33'	**2.5" Vert. Orifice/Grate** C= 0.600
#3	Device 1	157.83'	**18.0" W x 6.0" H Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.16 cfs @ 1.86 hrs HW=157.36' TW=156.04' (Dynamic Tailwater)
└─**1=Culvert** (Passes 0.16 cfs of 3.20 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.16 cfs @ 4.63 fps)
  └─**3=Orifice/Grate** (Controls 0.00 cfs)

Pond 1P: Subsurface Detention Basin 1 (Stormtrap-ST2)



Summary for Pond 2P: SubSurface Detention Basin 2 (Stormtrap-ST2)

Inflow Area = 0.404 ac,100.00% Impervious, Inflow Depth = 1.03" for Quality event
Inflow = 1.18 cfs @ 1.11 hrs, Volume= 0.035 af
Outflow = 0.16 cfs @ 1.46 hrs, Volume= 0.035 af, Atten= 86%, Lag= 21.4 min
Primary = 0.16 cfs @ 1.46 hrs, Volume= 0.035 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 158.39' @ 1.46 hrs Surf.Area= 1,799 sf Storage= 956 cf

Plug-Flow detention time= 65.4 min calculated for 0.035 af (100% of inflow)
Center-of-Mass det. time= 65.4 min (135.7 - 70.3)

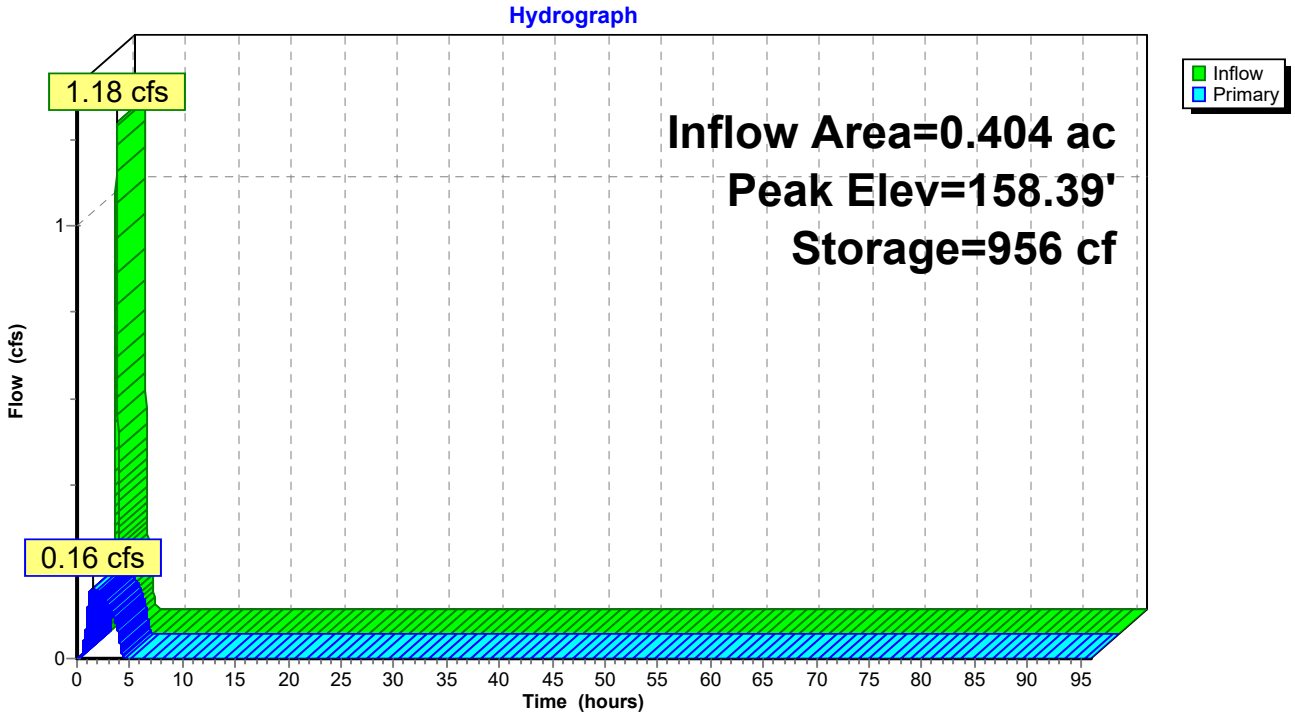
Volume	Invert	Avail.Storage	Storage Description
#1	157.33'	5,286 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
157.33	0	0	0
159.83	4,229	5,286	5,286

Device	Routing	Invert	Outlet Devices
#1	Primary	157.33'	**15.0" Round Culvert** L= 245.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 157.33' / 151.13' S= 0.0253 '/' Cc= 0.900 n= 0.012, Flow Area= 1.23 sf
#2	Device 1	157.33'	**2.5" Vert. Orifice/Grate** C= 0.600
#3	Device 1	158.70'	**18.0" W x 6.0" H Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.16 cfs @ 1.46 hrs HW=158.39' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Passes 0.16 cfs of 3.08 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.16 cfs @ 4.72 fps)
  └─**3=Orifice/Grate** (Controls 0.00 cfs)

Pond 2P: SubSurface Detention Basin 2 (Stormtrap-ST2)



Summary for Pond Bio1: Bioretention Basin 1

Inflow Area = 0.722 ac, 42.52% Impervious, Inflow Depth = 0.58" for Quality event
Inflow = 1.14 cfs @ 1.11 hrs, Volume= 0.035 af
Outflow = 0.07 cfs @ 1.87 hrs, Volume= 0.035 af, Atten= 94%, Lag= 45.6 min
Primary = 0.07 cfs @ 1.87 hrs, Volume= 0.035 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 155.65' @ 1.87 hrs Surf.Area= 1,883 sf Storage= 1,177 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 159.9 min (231.1 - 71.2) Drain time = 159.9 min < 72 hours, ok

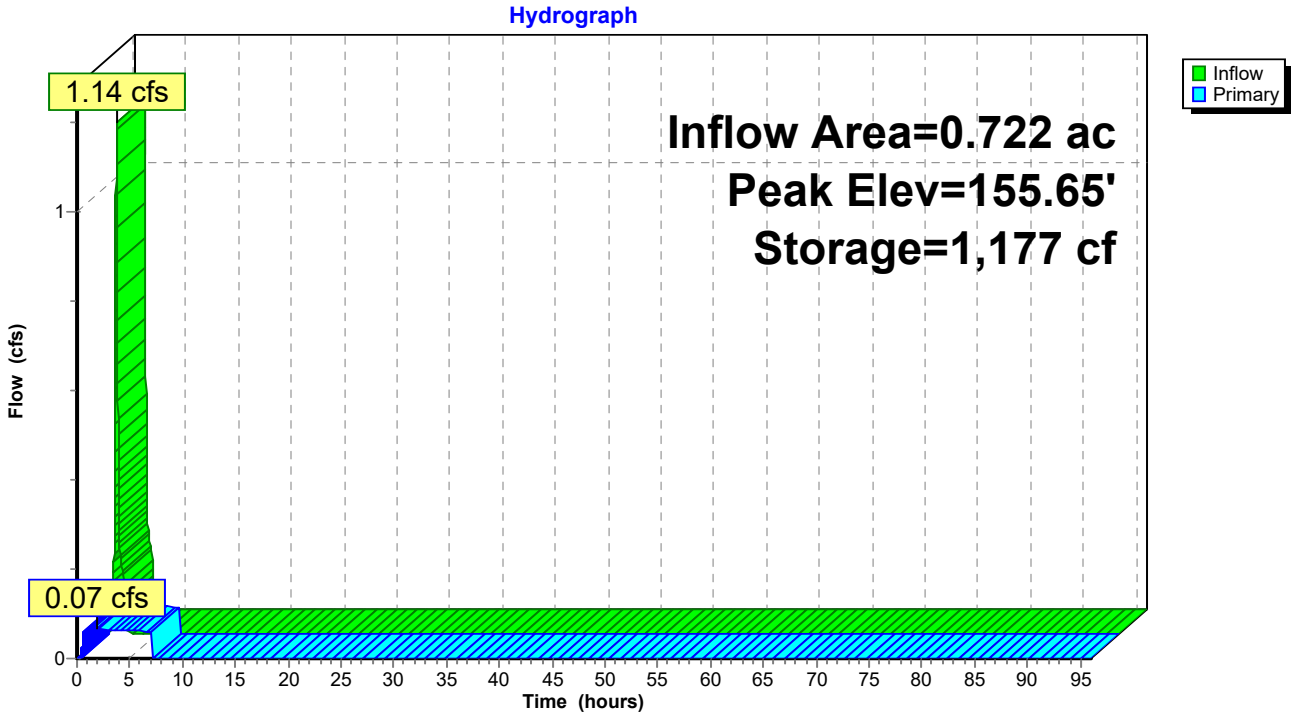
Volume	Invert	Avail.Storage	Storage Description
#1	155.00'	8,960 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
155.00	1,718	0	0
156.00	1,970	1,844	1,844
157.00	2,232	2,101	3,945
158.00	2,505	2,369	6,314
159.00	2,787	2,646	8,960

Device	Routing	Invert	Outlet Devices
#1	Primary	151.80'	**15.0" Round Culvert** L= 95.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 151.80' / 151.00' S= 0.0084 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Device 1	155.00'	**1.500 in/hr Exfiltration over Surface area** = 3.0 in/hr design x 0.5 Safety Factor
#3	Device 1	156.00'	**2.5" Vert. Orifice/Grate** C= 0.600
#4	Device 1	157.30'	**6.0" W x 6.0" H Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.07 cfs @ 1.87 hrs HW=155.65' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Passes 0.07 cfs of 9.43 cfs potential flow)
  ├─**2=Exfiltration** (Exfiltration Controls 0.07 cfs)
  ├─**3=Orifice/Grate** (Controls 0.00 cfs)
  └─**4=Orifice/Grate** (Controls 0.00 cfs)

Pond Bio1: Bioretention Basin 1



Summary for Pond Bio2: Bioretention Basin 2

[87] Warning: Oscillations may require smaller dt or Finer Routing (severity=56)

Inflow Area =	1.235 ac,	41.21% Impervious,	Inflow Depth =	0.63"	for Quality event
Inflow =	0.17 cfs @	1.77 hrs,	Volume=	0.065 af	
Outflow =	0.12 cfs @	4.83 hrs,	Volume=	0.065 af,	Atten= 30%, Lag= 183.7 min
Primary =	0.12 cfs @	4.83 hrs,	Volume=	0.065 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 156.12' @ 4.83 hrs Surf.Area= 3,378 sf Storage= 391 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 36.3 min (254.8 - 218.5) Drain time = 36.3 min < 72 hours, ok

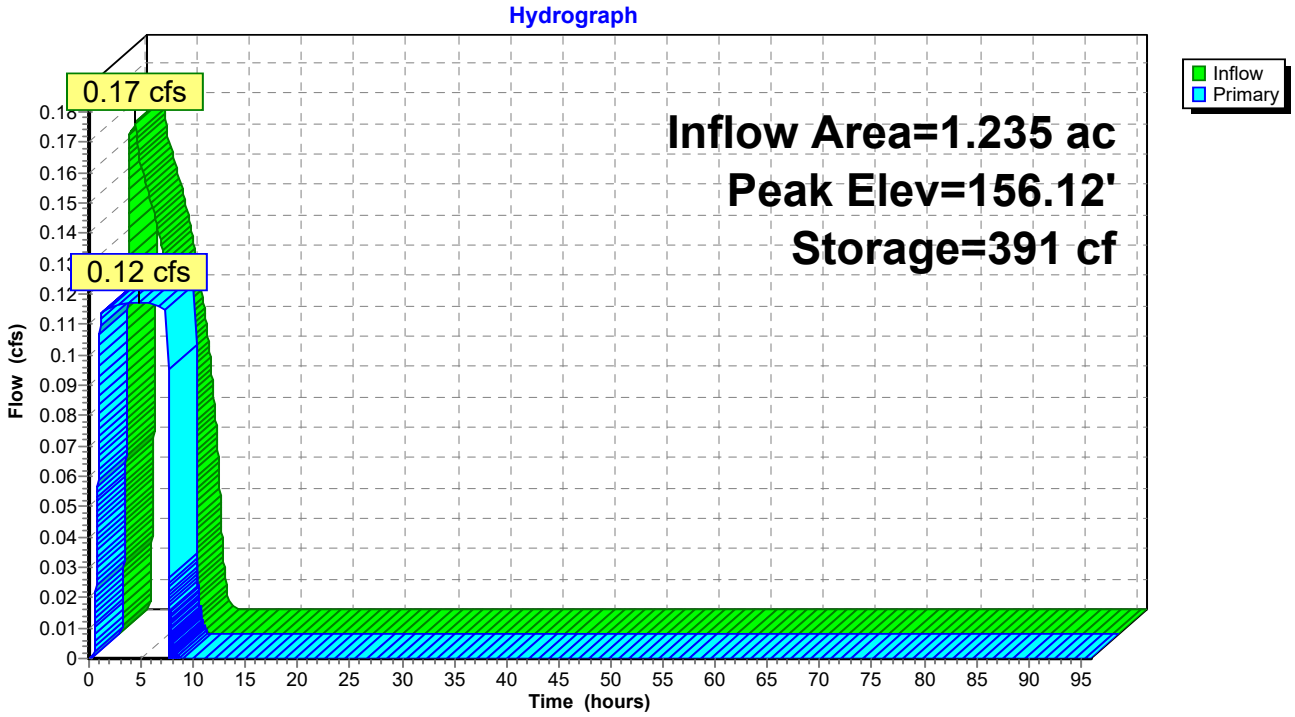
Volume	Invert	Avail.Storage	Storage Description
#1	156.00'	13,443 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
156.00	3,288	0	0
157.00	4,052	3,670	3,670
158.00	4,872	4,462	8,132
159.00	5,749	5,311	13,443

Device	Routing	Invert	Outlet Devices
#1	Primary	152.17'	**15.0" Round Culvert** L= 109.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 152.17' / 151.30' S= 0.0080 '/' Cc= 0.900 n= 0.012, Flow Area= 1.23 sf
#2	Device 1	156.00'	**1.500 in/hr Exfiltration over Surface area** = 3.0 in/hr design x 0.5 Safety Factor
#3	Device 1	157.00'	**2.5" Vert. Orifice/Grate** C= 0.600
#4	Device 1	157.54'	**4.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.12 cfs @ 4.83 hrs HW=156.12' TW=0.00' (Dynamic Tailwater)
- **1=Culvert** (Passes 0.12 cfs of 9.71 cfs potential flow)
  - **2=Exfiltration** (Exfiltration Controls 0.12 cfs)
  - **3=Orifice/Grate** (Controls 0.00 cfs)
  - **4=Orifice/Grate** (Controls 0.00 cfs)

Pond Bio2: Bioretention Basin 2

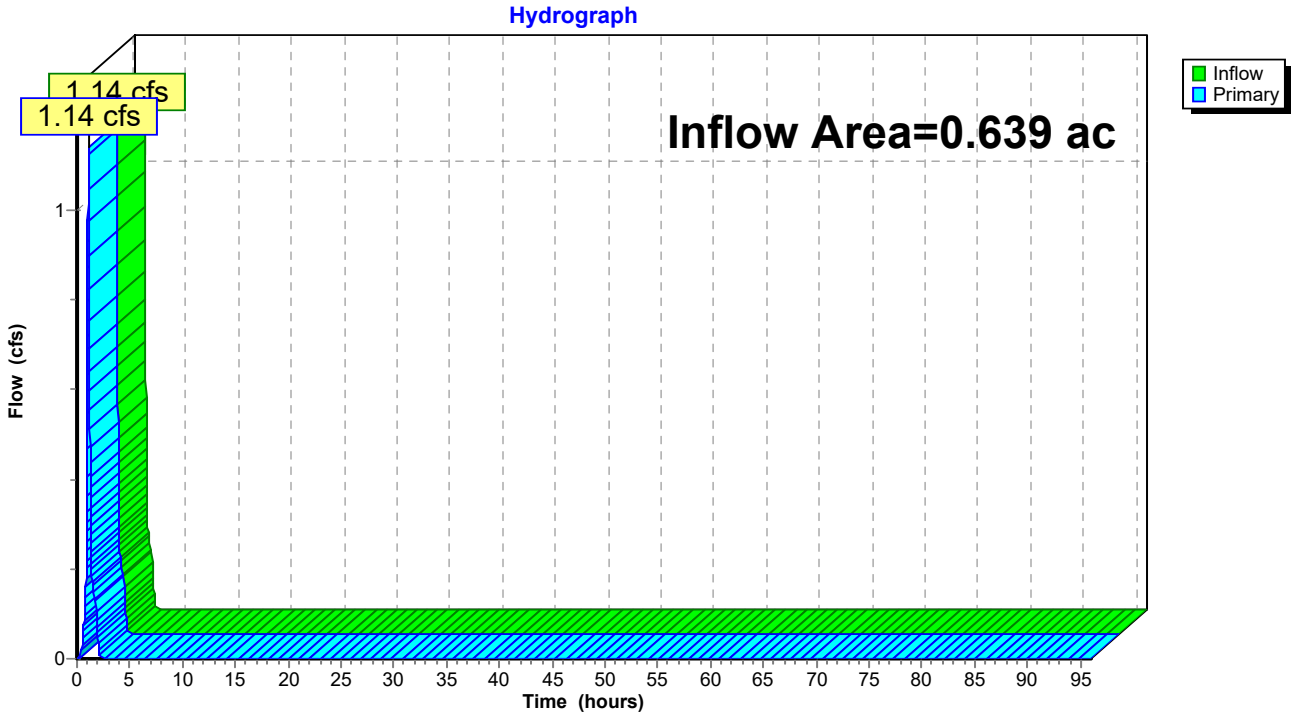


Summary for Link 1: Drainage Area 1

Inflow Area = 0.639 ac, 48.04% Impervious, Inflow Depth = 0.65" for Quality event
Inflow = 1.14 cfs @ 1.11 hrs, Volume= 0.035 af
Primary = 1.14 cfs @ 1.11 hrs, Volume= 0.035 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Link 1: Drainage Area 1

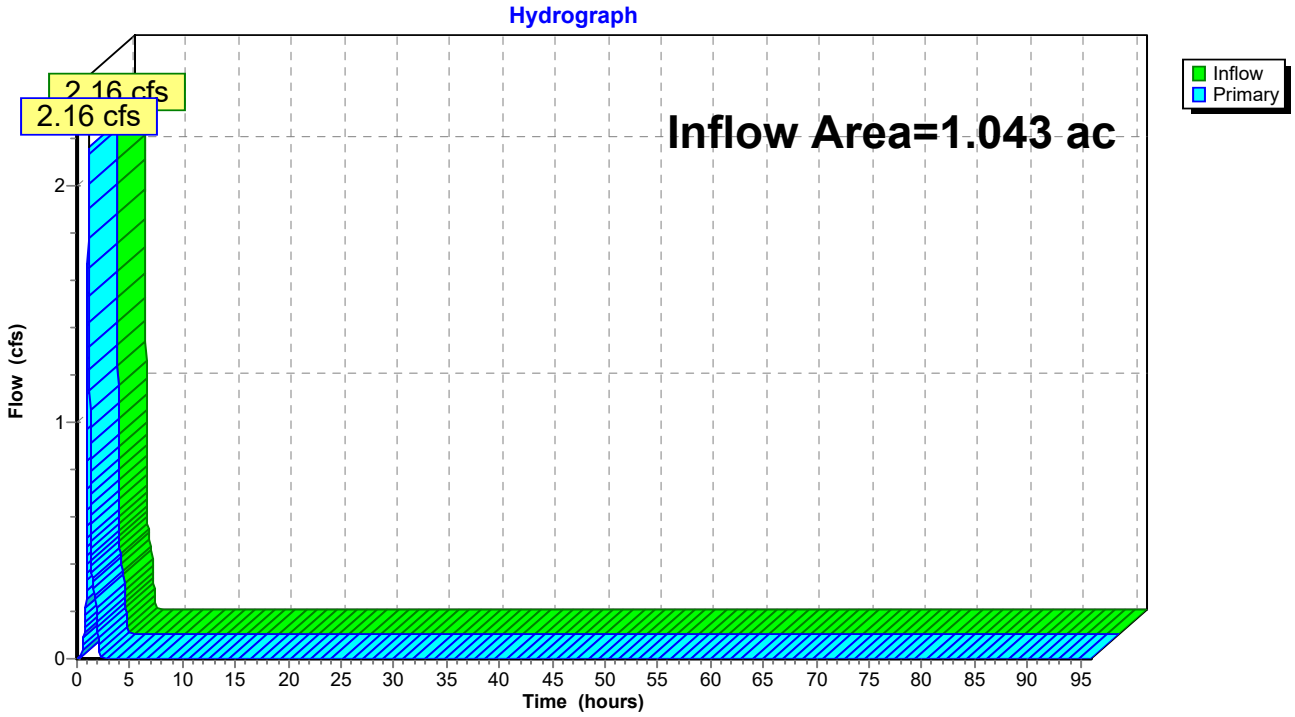


Summary for Link 2: Drainage Area 2

Inflow Area = 1.043 ac, 48.80% Impervious, Inflow Depth = 0.74" for Quality event
Inflow = 2.16 cfs @ 1.12 hrs, Volume= 0.064 af
Primary = 2.16 cfs @ 1.12 hrs, Volume= 0.064 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Link 2: Drainage Area 2

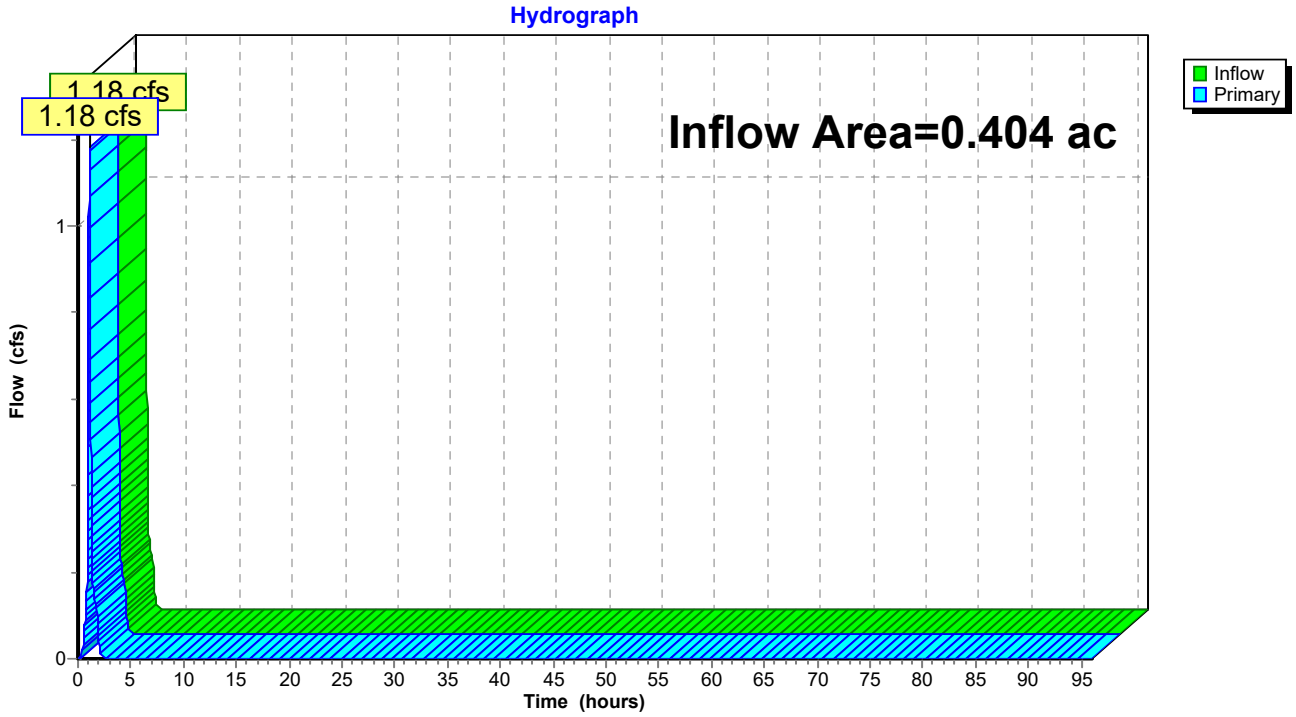


Summary for Link 3: Drainage Area 3

Inflow Area = 0.404 ac,100.00% Impervious, Inflow Depth = 1.03" for Quality event
Inflow = 1.18 cfs @ 1.11 hrs, Volume= 0.035 af
Primary = 1.18 cfs @ 1.11 hrs, Volume= 0.035 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Link 3: Drainage Area 3

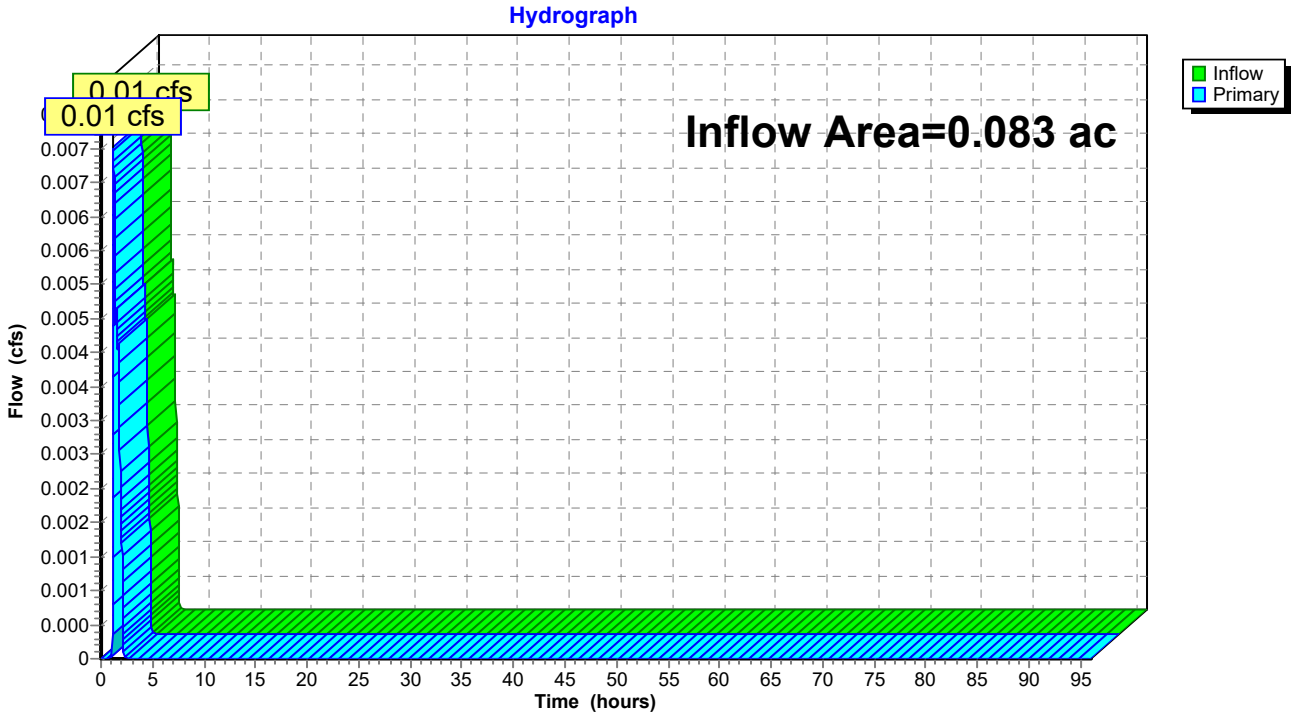


Summary for Link 4: Drainage Area 4

Inflow Area = 0.083 ac, 0.00% Impervious, Inflow Depth = 0.05" for Quality event
Inflow = 0.01 cfs @ 1.22 hrs, Volume= 0.000 af
Primary = 0.01 cfs @ 1.22 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Link 4: Drainage Area 4

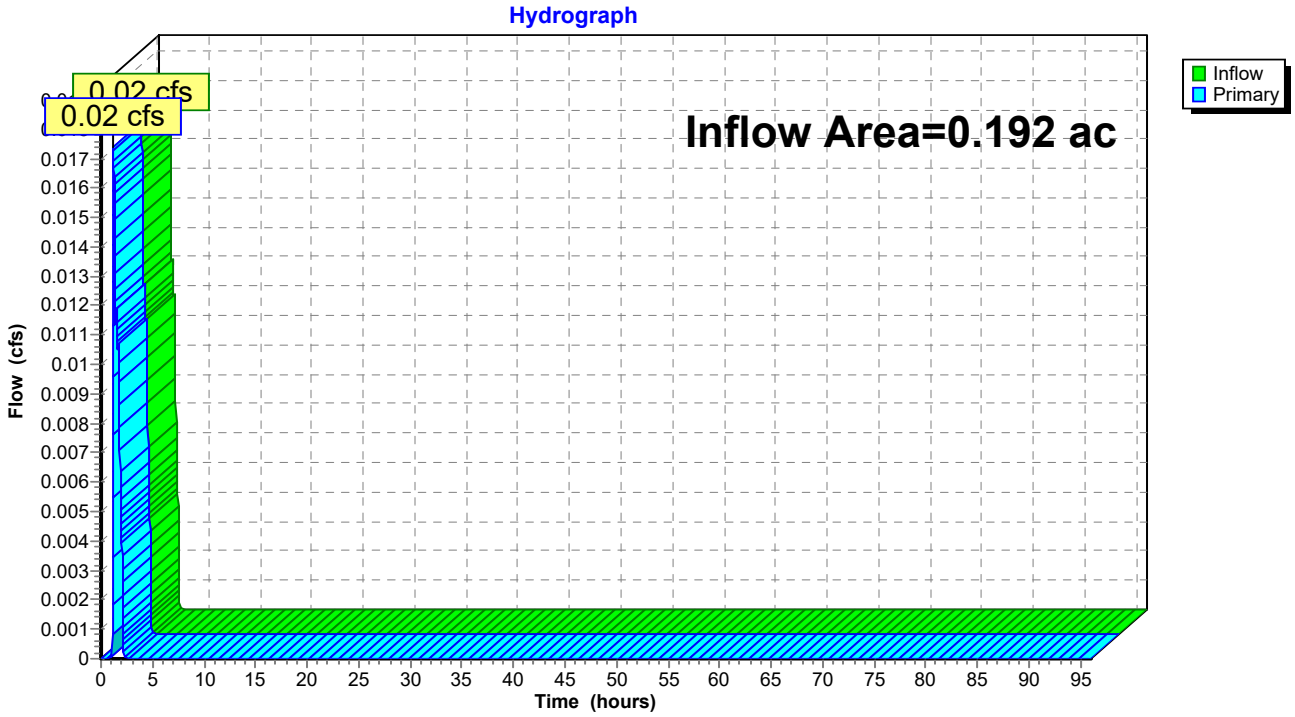


Summary for Link 5: Drainage Area 5

Inflow Area = 0.192 ac, 0.00% Impervious, Inflow Depth = 0.05" for Quality event
Inflow = 0.02 cfs @ 1.22 hrs, Volume= 0.001 af
Primary = 0.02 cfs @ 1.22 hrs, Volume= 0.001 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Link 5: Drainage Area 5

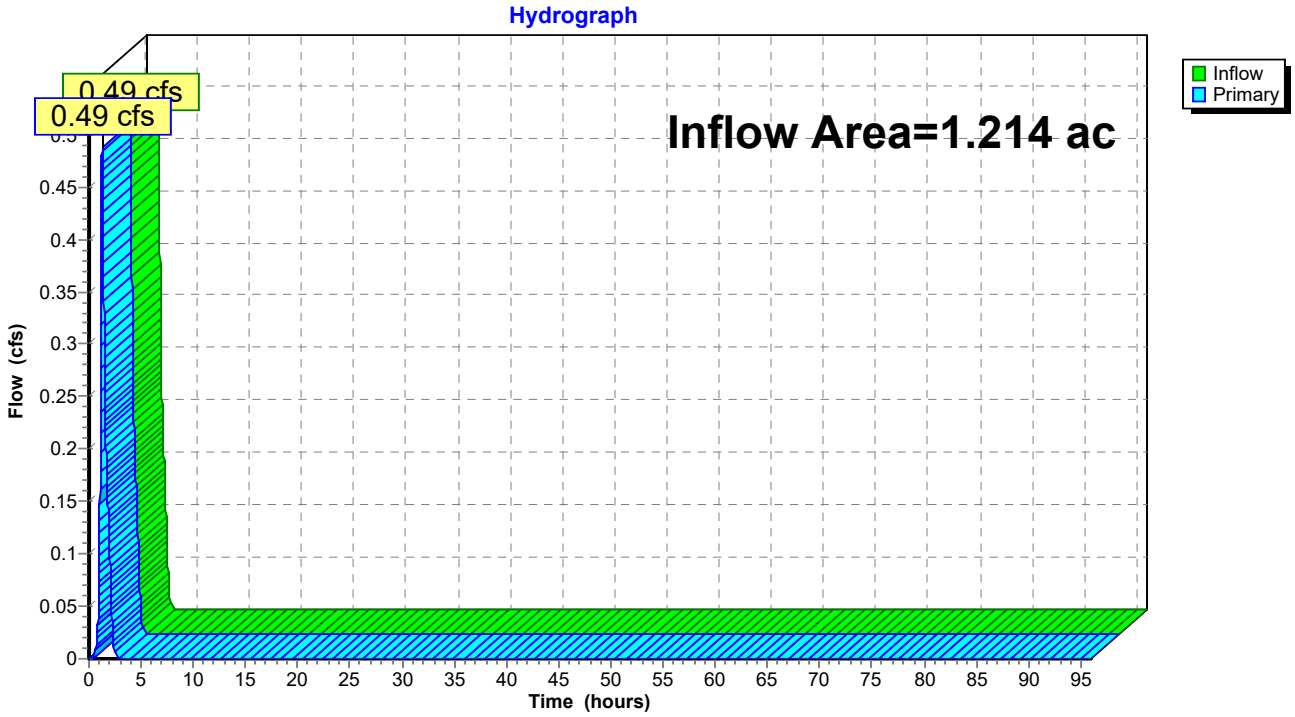


Summary for Link 6: Drainage Area 6

Inflow Area = 1.214 ac, 13.01% Impervious, Inflow Depth = 0.23" for Quality event
Inflow = 0.49 cfs @ 1.27 hrs, Volume= 0.024 af
Primary = 0.49 cfs @ 1.27 hrs, Volume= 0.024 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Link 6: Drainage Area 6

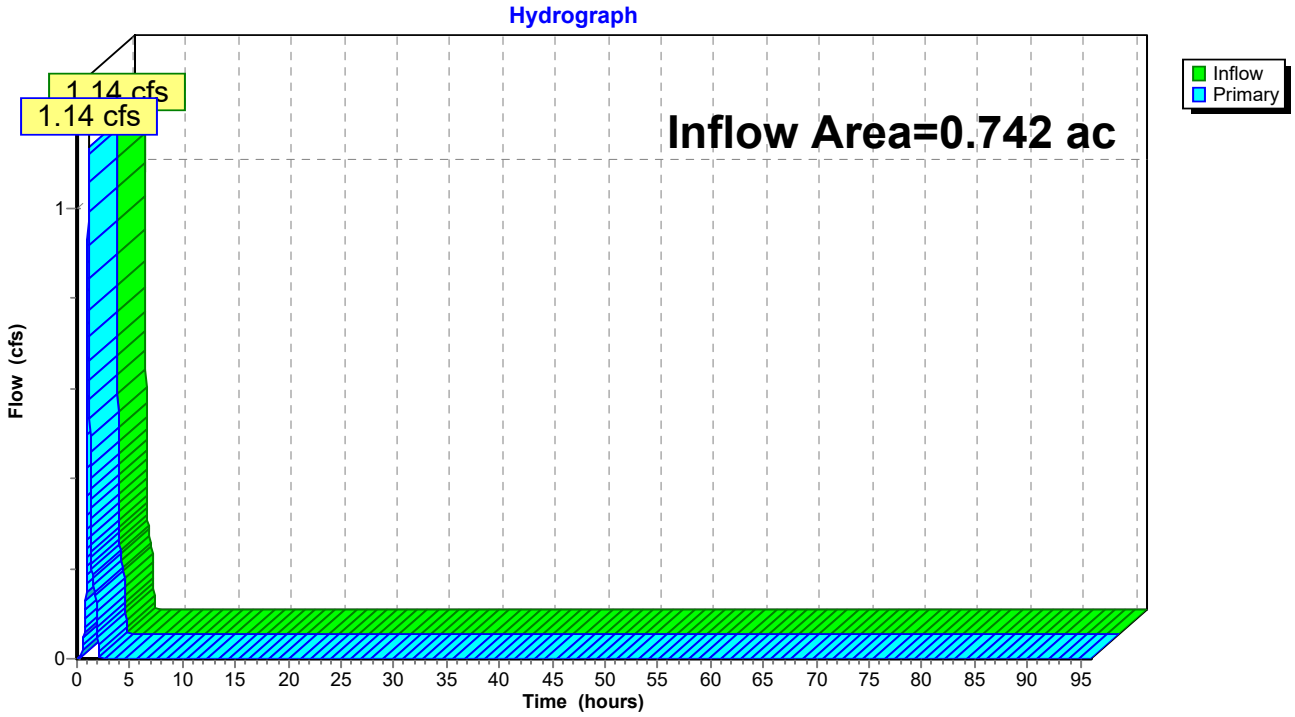


Summary for Link 7: Drainage Area 7

Inflow Area = 0.742 ac, 32.88% Impervious, Inflow Depth = 0.55" for Quality event
Inflow = 1.14 cfs @ 1.11 hrs, Volume= 0.034 af
Primary = 1.14 cfs @ 1.11 hrs, Volume= 0.034 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Link 7: Drainage Area 7

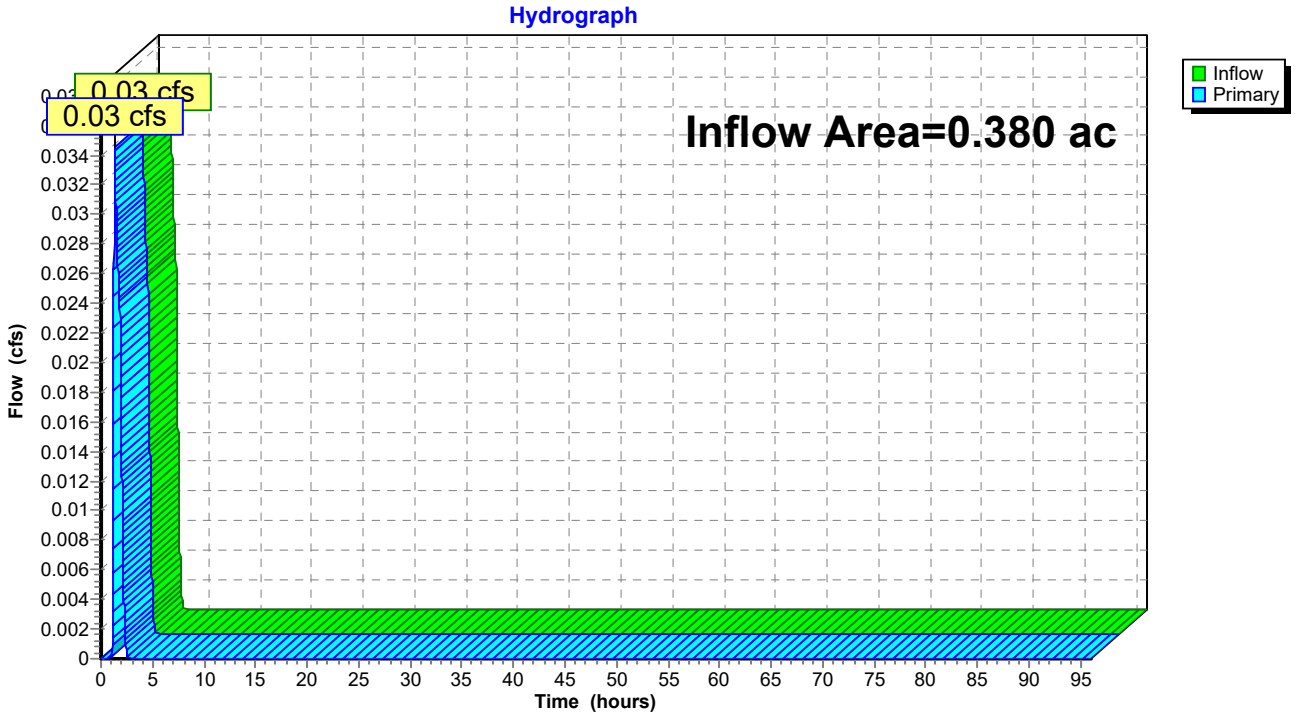


Summary for Link 8: Drainage Area 8

Inflow Area = 0.380 ac, 0.00% Impervious, Inflow Depth = 0.06" for Quality event
Inflow = 0.03 cfs @ 1.35 hrs, Volume= 0.002 af
Primary = 0.03 cfs @ 1.35 hrs, Volume= 0.002 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Link 8: Drainage Area 8

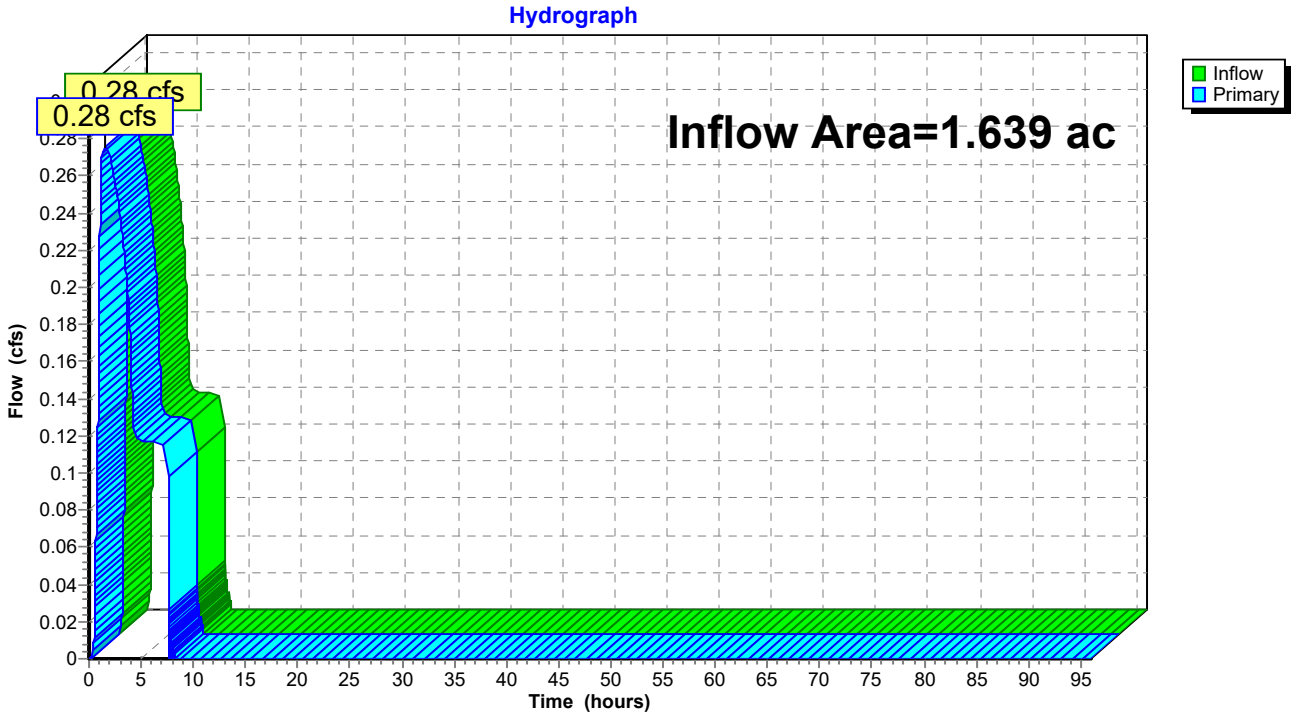


Summary for Link MH9: ST MH 9 Connector

Inflow Area = 1.639 ac, 55.70% Impervious, Inflow Depth = 0.73" for Quality event
Inflow = 0.28 cfs @ 1.55 hrs, Volume= 0.100 af
Primary = 0.28 cfs @ 1.55 hrs, Volume= 0.100 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Link MH9: ST MH 9 Connector

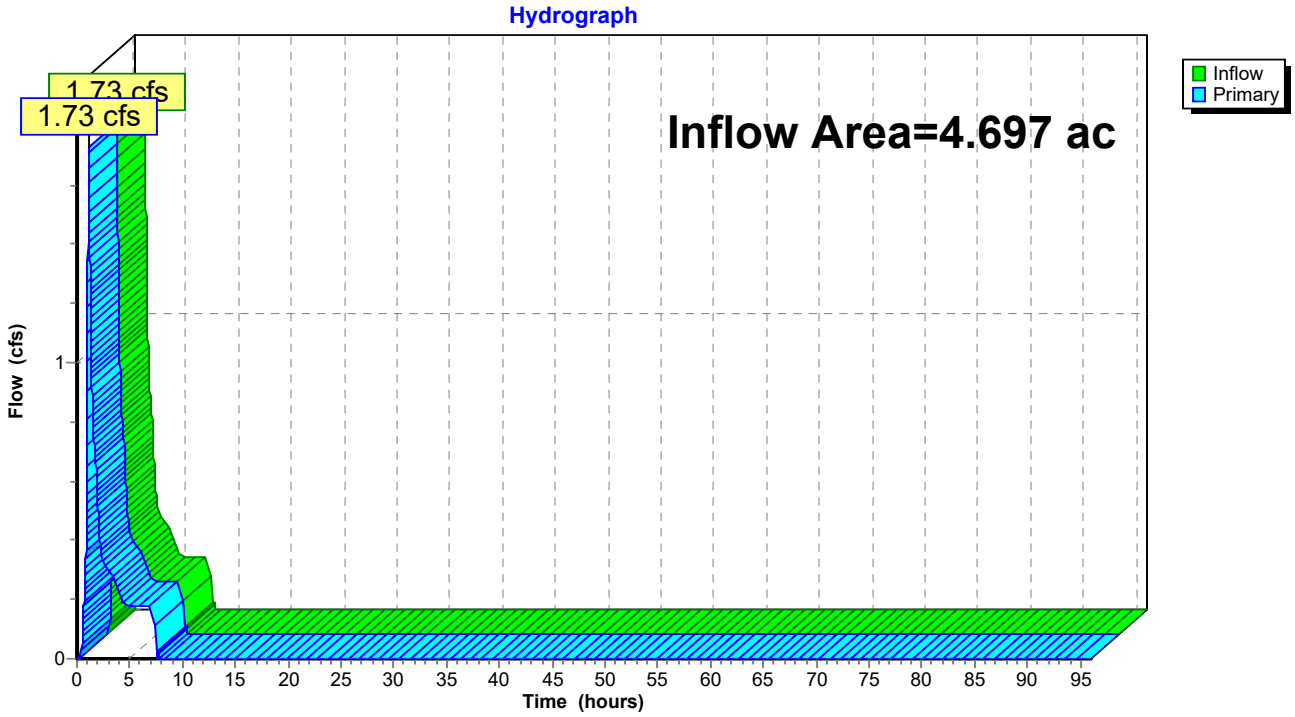


Summary for Link PE: Penn East Total Runoff

Inflow Area = 4.697 ac, 34.53% Impervious, Inflow Depth = 0.50" for Quality event
Inflow = 1.73 cfs @ 1.12 hrs, Volume= 0.195 af
Primary = 1.73 cfs @ 1.12 hrs, Volume= 0.195 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Link PE: Penn East Total Runoff



BIORETENTION BASIN UNDERDRAIN PIPE CAPACITY

Flow Capacity of 4" Underdrain Pipe

Project Description

Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data

Roughness Coefficient	0.012	
Channel Slope	0.00500	ft/ft
Normal Depth	0.33	ft
Diameter	0.33	ft
Discharge	0.15	ft³/s > 0.07 cfs (Basin 1 outflow) and 0.12 cfs (Basin 2 outflow)

Results

Discharge	0.15	ft³/s
Normal Depth	0.33	ft
Flow Area	0.09	ft²
Wetted Perimeter	1.05	ft
Hydraulic Radius	0.08	ft
Top Width	0.00	ft
Critical Depth	0.21	ft
Percent Full	100.0	%
Critical Slope	0.00897	ft/ft
Velocity	1.67	ft/s
Velocity Head	0.04	ft
Specific Energy	0.38	ft
Froude Number	0.00	
Maximum Discharge	0.16	ft³/s
Discharge Full	0.15	ft³/s
Slope Full	0.00500	ft/ft
Flow Type	SubCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

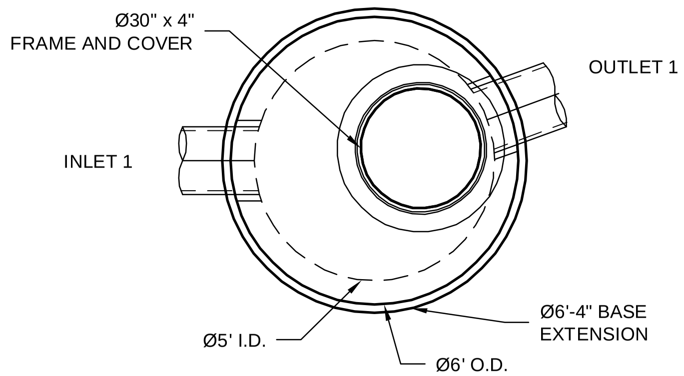
GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%

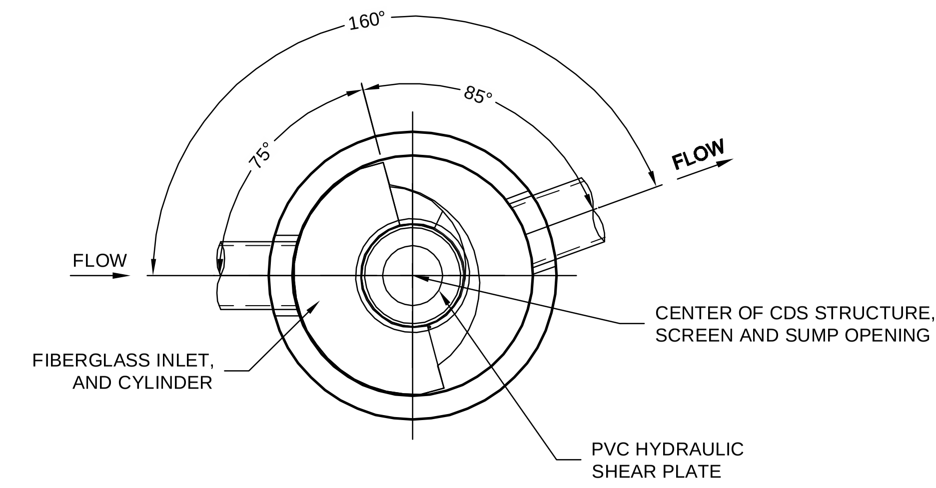
Flow Capacity of 4" Underdrain Pipe

GVF Output Data

Normal Depth Over Rise	100.00	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.33	ft
Critical Depth	0.21	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.00897	ft/ft



PLAN VIEW



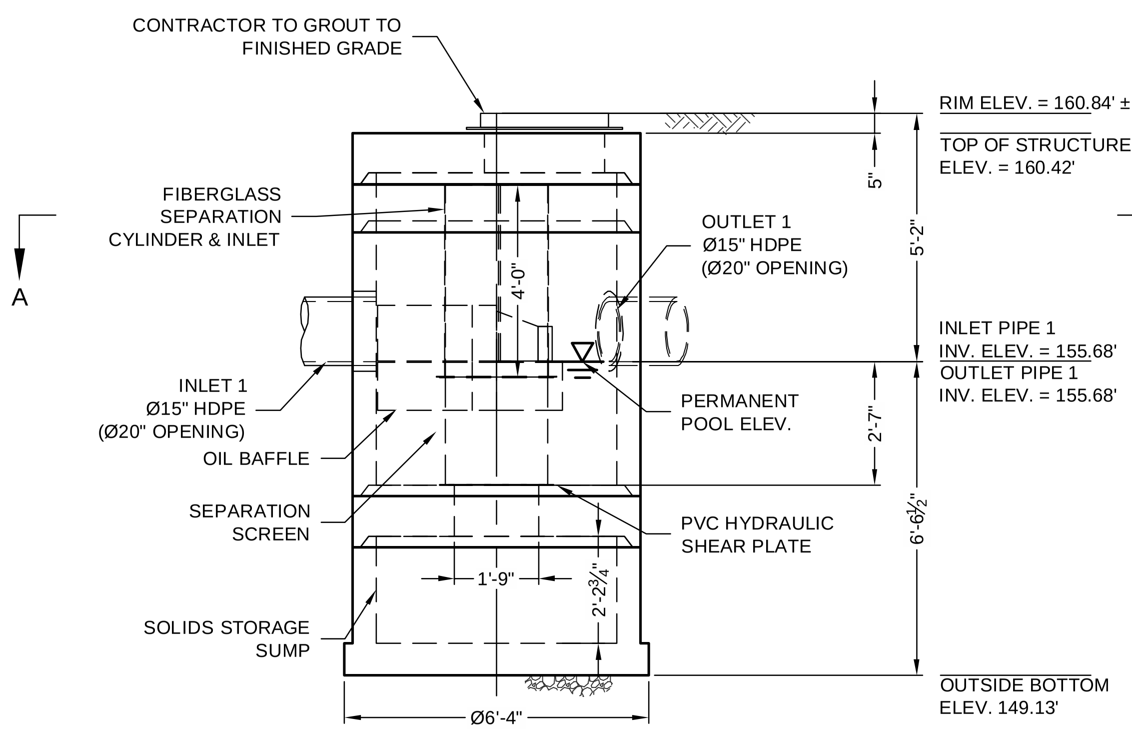
SECTION A-A

MATERIAL LIST (PROVIDED BY CONTECH)

COUNT	DESCRIPTION	INSTALLED BY
1	FIBERGLASS INLET AND CYLINDER	CONTECH
1	2400 micron, 2.5' O.D. x 2.25' SEP. SCREEN	CONTECH
1	SEALANT FOR JOINTS (BY PRECASTER)	CONTRACTOR
1	Ø30" x 4" FRAME & COVER, EJ#41600484, OR EQUIV.	CONTRACTOR

SITE DESIGN DATA

WATER QUALITY FLOW RATE	1.16 CFS
PEAK FLOW RATE	3.30 CFS
RETURN PERIOD OF PEAK FLOW	25 YRS



ELEVATION VIEW

GENERAL NOTES
1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. FOR FABRICATION DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHT, PLEASE CONTACT YOUR CONTECH ENGINEERED SOLUTIONS LLC REPRESENTATIVE. www.ContechES.com
3. CDS WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING. CONTRACTOR TO CONFIRM STRUCTURE MEETS REQUIREMENTS OF PROJECT.
4. STRUCTURE SHALL MEET AASHTO HS-20 LOAD RATING, ASSUMING EARTH COVER OF 0' - 2', AND GROUNDWATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION. CASTINGS SHALL MEET AASHTO M306 AND BE CAST WITH THE CONTECH LOGO.
5. IF REQUIRED, PVC HYDRAULIC SHEAR PLATE IS PLACED ON SHELF AT BOTTOM OF SCREEN CYLINDER. REMOVE AND REPLACE AS NECESSARY DURING MAINTENANCE CLEANING.
6. CDS STRUCTURE SHALL BE PRECAST CONCRETE CONFORMING TO ASTM C-478 AND AASHTO LOAD FACTOR DESIGN METHOD.

INSTALLATION NOTES
A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE CDS MANHOLE STRUCTURE.
C. CONTRACTOR TO INSTALL JOINT SEALANT BETWEEN ALL STRUCTURE SECTIONS AND ASSEMBLE STRUCTURE.
D. CONTRACTOR TO PROVIDE, INSTALL, AND GROUT INLET AND OUTLET PIPE(S). MATCH PIPE INVERTS WITH ELEVATIONS SHOWN. ALL PIPE CENTERLINES TO MATCH PIPE OPENING CENTERLINES.
E. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO ASSURE UNIT IS WATER TIGHT, HOLDING WATER TO FLOWLINE INVERT MINIMUM. IT IS SUGGESTED THAT ALL JOINTS BELOW PIPE INVERTS ARE GROUTED.

STRUCTURE WEIGHT
APPROXIMATE HEAVIEST PICK = 12500 LBS.
STRUCTURE IS DELIVERED IN 4 PIECES

MAX FOOTPRINT = Ø6'-4"

CONTECH
PROPOSAL
DRAWING

GILL
LAYOUT 1H
2520-5-FGIS
5798 / GILL10
9.55T

CDS2520-5-C - 596999-10
TEXAS EASTERN TRANSMISSION -
PENN EAST MODERNIZATION
WEST AMWELL, NJ
for SYSTEM: WQU-CDS-1

MARK	DATE	REVISION DESCRIPTION	BY

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CONTECH ENGINEERED SOLUTIONS LLC
www.ContechES.com
605 Global Way Suite 113, Linthicum, MD 21(

CDS®

THIS PRODUCT MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING U.S. PATENTS: 5,788,848; 6,641,720; 6,511,595; 6,581,783; RELATED FOREIGN PATENTS, OR OTHER PATENTS PENDING.

DATE: 08/23/18	SCALE: 1/4" = 1'-0"
DESIGNED: TKM	DRAWN: TKM
CHECKED: ###	APPROVED: ###
PROJECT No.: 596999	SEQUENCE No.: 10
SHEET: 1 OF 1	

I:\MERLIN\PROJECT\ACTIVE\596900\596999\596999-10-CDS\DRAWINGS\PRE-596999-10-CDS2520-5 CONFAB.DWG 8/23/2018 11:06 AM

CDS Design Summary

TEXAS EASTERN TRANSMISSION – PENN EAST MODERNIZATION (WQU-CDS-1)

WEST AMWELL, NJ

Information provided by Engineer (TRC):

- Water Quality Flow = 1.16 cfs
- 25-YR Storm Flow = 3.30 cfs
- Presiding agency = NJDEP
- Stormwater treatment system TSS removal required = 50%

Sizing Summary:

The CDS technology features a patented non-blocking, indirect screening technique developed to treat stormwater runoff. The unit is highly effective in the capture of suspended solids, fine sands and larger particles. Because of its non-blocking screening capacity, the CDS unit is un-matched in its ability to capture and retain gross pollutants such as trash and debris. The CDS system is NJCAT verified and as a result has received certification from the NJDEP for 50% TSS removal.

For this project the CDS system was designed to treat the water quality design storm. The peak water quality design storm runoff flow rate provided the engineer of record is **1.16 cfs**.

Water Quality Design Storm Peak Runoff Rate (cfs)	CDS-5 (CDS2520-5) NJDEP Approved Water Quality Treatment Flow Rate (cfs)
1.16	1.5

Maintenance:

Like any stormwater best management practice, the CDS system requires regular inspection and maintenance to ensure optimal performance. Maintenance frequency will be driven by site conditions. Quarterly visual inspections are recommended, at which time the accumulation of pollutants can be determined. On average, the CDS system requires annual removal of accumulated pollutants.

Thank you for the opportunity to present this information to you and your client.

Sincerely,

Taylor Murdock
Contech Engineered Solutions LLC

7037 Ridge Road, Suite 350 | Hanover, MD 21076
Office: 443.457.1500 Fax: 410.740.8492

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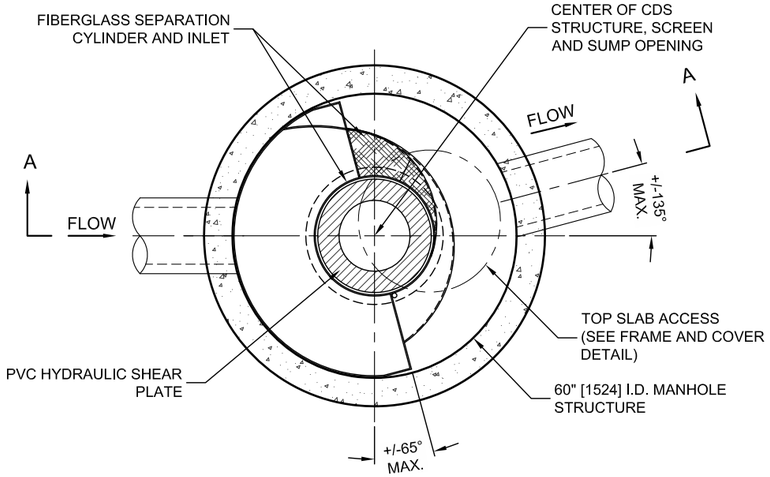
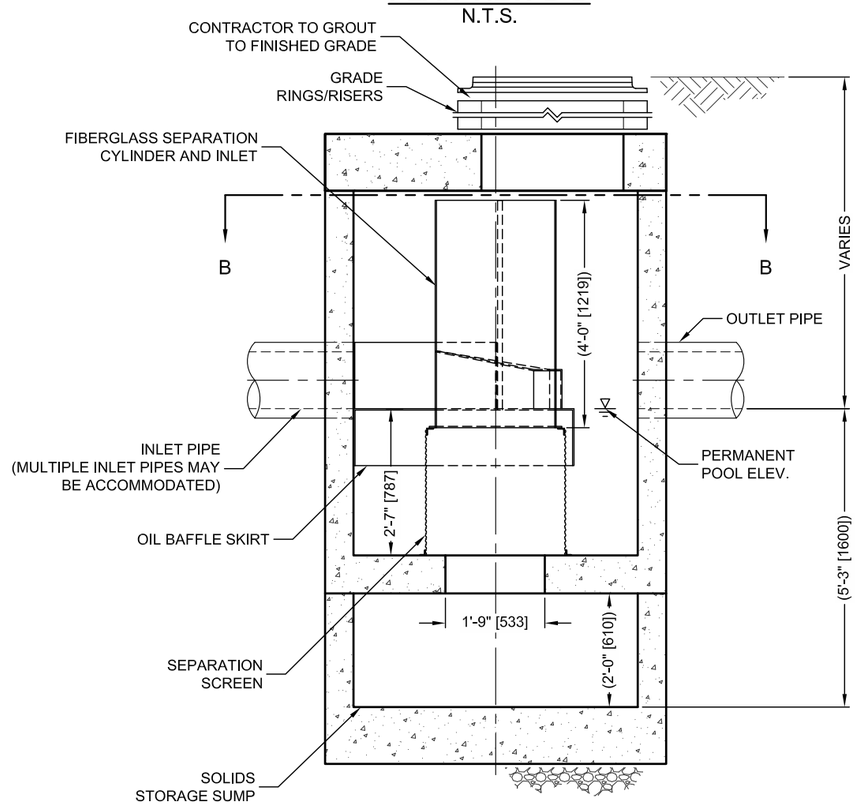


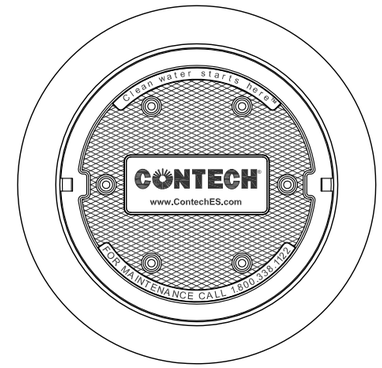
PLAN VIEW B-B
N.T.S.



ELEVATION A-A
N.T.S.

CDS-5-C (CDS2520) DESIGN NOTES

CDS-5-C (CDS2520) RATED TREATMENT CAPACITY IS 1.50 CFS. IF THE SITE CONDITIONS EXCEED MAXIMUM HYDRAULIC INTERNAL BYPASS CAPACITY, AN UPSTREAM BYPASS STRUCTURE IS REQUIRED.
CDS-5-C (CDS2520) HAS A MINIMUM OIL STORAGE CAPACITY OF 99 GALLONS AND A MINIMUM SUMP CAPACITY OF 1.5 CUBIC YARDS.



FRAME AND COVER
(DIAMETER VARIES)
N.T.S.

SITE SPECIFIC DATA REQUIREMENTS

STRUCTURE ID			
WATER QUALITY FLOW RATE (CFS OR L/s)			*
PEAK FLOW RATE (CFS OR L/s)			*
RETURN PERIOD OF PEAK FLOW (YRS)			*
SCREEN APERTURE (2400 OR 4700)			*
PIPE DATA:	I.E.	MATERIAL	DIAMETER
INLET PIPE 1	*	*	*
INLET PIPE 2	*	*	*
OUTLET PIPE	*	*	*
RIM ELEVATION			*
ANTI-FLOTATION BALLAST	WIDTH	HEIGHT	
	*	*	

NOTES/SPECIAL REQUIREMENTS:

* PER ENGINEER OF RECORD

GENERAL NOTES
1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. DIMENSIONS MARKED WITH ( ) ARE REFERENCE DIMENSIONS. ACTUAL DIMENSIONS MAY VARY.
3. FOR FABRICATION DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHTS, PLEASE CONTACT YOUR CONTECH ENGINEERED SOLUTIONS LLC REPRESENTATIVE. www.ContechES.com
4. CDS WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING.
5. STRUCTURE SHALL MEET AASHTO HS20 LOAD RATING, ASSUMING GROUNDWATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION. CASTINGS SHALL MEET HS20 (AASHTO M 306) AND BE CAST WITH THE CONTECH LOGO.
6. IF REQUIRED, PVC HYDRAULIC SHEAR PLATE IS PLACED ON SHELF AT BOTTOM OF SCREEN CYLINDER. REMOVE AND REPLACE AS NECESSARY DURING MAINTENANCE CLEANING.

INSTALLATION NOTES
A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE CDS MANHOLE STRUCTURE (LIFTING CLUTCHES PROVIDED).
C. CONTRACTOR TO ADD JOINT SEALANT BETWEEN ALL STRUCTURE SECTIONS, AND ASSEMBLE STRUCTURE.
D. CONTRACTOR TO PROVIDE, INSTALL, AND GROUT PIPES. MATCH PIPE INVERTS WITH ELEVATIONS SHOWN.
E. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO ASSURE UNIT IS WATER TIGHT, HOLDING WATER TO FLOWLINE INVERT MINIMUM. IT IS SUGGESTED THAT ALL JOINTS BELOW PIPE INVERTS ARE GROUTED.

THIS PRODUCT MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING U.S. PATENTS: 5,788,848; 6,641,720; 6,511,993; 6,581,783; RELATED FOREIGN PATENTS, OR OTHER PATENTS PENDING.

CONTECH ENGINEERED SOLUTIONS LLC
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9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

CDS-5-C (CDS2520)
ONLINE CDS
STANDARD DETAIL

C:\USERS\ABROWN\DOCUMENTS\RESOURCES\NEW JERSEY RESOURCES\PRODUCTS\TREATMENT\CDS\CDS SIZING\CDS NJ STANDARD DETAILS\CDS-5-C DTL.DWG 8/29/2017 5:05 PM

State of New Jersey

DEPARTMENT OF ENVIRONMENTAL PROTECTION
Bureau of Nonpoint Pollution Control
Division of Water Quality
401-02B
Post Office Box 420
Trenton, New Jersey 08625-0420
609-633-7021 Fax: 609-777-0432
http://www.state.nj.us/dep/dwq/bnpc_home.htm

CHRIS CHRISTIE
Governor

KIM GUADAGNO
Lt. Governor

BOB MARTIN
Commissioner

March 21, 2017

Derek M. Berg
Contech Engineered Solutions, LLC
71 US Route 1, Suite F
Scarborough, ME 04074

Re: Revised MTD Lab Certification
Continuous Deflective Separator (CDS®) Stormwater Treatment Device by Contech Engineered Solutions, LLC
On-line Installation

TSS Removal Rate 50%

Dear Mr. Berg:

This revised certification letter supersedes the Department's prior certification dated January 9, 2015. This revision was completed to reflect the updated Manufactured Treatment Device (MTD) scaling methodology as agreed upon by the manufacturers' working group on September 19, 2016. In part, the updated scaling for hydrodynamic MTDs is based on the depth of the reference (tested) MTD from the top of the false floor utilized during removal efficiency testing, not from the physical bottom of the unit. Based on the above decision, Table A-2 of the NJCAT Technology Verification report located at http://www.njcat.org/uploads/newDocs/CDSVerificationReportFinal1.pdf has been revised, and Table 1 noted below has been added.

The Stormwater Management rules under N.J.A.C. 7:8-5.5(b) and 5.7 (c) allow the use of manufactured treatment devices (MTDs) for compliance with the design and performance standards at N.J.A.C. 7:8-5 if the pollutant removal rates have been verified by the New Jersey Corporation for Advanced Technology (NJCAT) and have been certified by the New Jersey Department of Environmental Protection (NJDEP). Contech Engineered Solutions, LLC has requested an MTD Laboratory Certification for the CDS® Stormwater Treatment Device.

The verification is subject to the "Procedure for Obtaining Verification of a Stormwater Manufactured Treatment Device from New Jersey Corporation for Advance Technology" dated January 25, 2013. The applicable protocol is the "New Jersey Laboratory Testing Protocol to Assess Total Suspended Solids Removal by a Hydrodynamic Sedimentation Manufactured Treatment Device" dated January 25, 2013.

NJCAT verification documents submitted to the NJDEP indicate that the requirements of the aforementioned protocol have been met or exceeded. The NJCAT letter also included a recommended certification TSS removal rate and the required maintenance plan. The NJCAT Verification Report with the Verification

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Appendix dated September 2014 (Revised January 2017) for this device is published online at http://www.njcat.org/verification-process/technology-verification-database.html.

The NJDEP certifies the use of the CDS® Stormwater Treatment Device by Contech Engineered Solutions, LLC at a TSS removal rate of 50% when designed, operated, and maintained in accordance with the information provided in the Verification Appendix and the following conditions:

1. The maximum treatment flow rate (MTFR) for the manufactured treatment device (MTD) is calculated using the New Jersey Water Quality Design Storm (1.25 inches in 2 hrs) in N.J.A.C. 7:8-5.5.

2. The CDS® Stormwater Treatment Device shall be installed using the same configuration reviewed by NJCAT and shall be sized in accordance with the criteria specified in item 6 below.

3. This CDS® Stormwater Treatment Device cannot be used in series with another MTD or a media filter (such as a sand filter) to achieve an enhanced removal rate for total suspended solids (TSS) removal under N.J.A.C. 7:8-5.5.

4. Additional design criteria for MTDs can be found in Chapter 9.6 of the New Jersey Stormwater Best Management Practices (NJ Stormwater BMP) Manual which can be found on-line at www.njstormwater.org.

5. The maintenance plan for a site using this device shall incorporate, at a minimum, the maintenance requirements for the CDS® Stormwater Treatment Device. A copy of the maintenance plan is attached to this certification. However, it is recommended to review the maintenance website at http://www.conteches.com/products/stormwater-management/treatment/cds.aspx#1822141-technical-info for any changes to the maintenance requirements.

6. Sizing Requirements:

   The example below demonstrates the sizing procedure for the CDS®:

   Example: A 0.25-acre impervious site is to be treated to 50% TSS removal using a CDS®. The impervious site runoff (Q) based on the New Jersey Water Quality Design Storm was determined to be 0.79 cfs.

   Maximum Treatment Flow Rate (MTFR) Evaluation:

   The site runoff (Q) was based on the following:
   time of concentration = 10 minutes
   i=3.2 in/hr (page 5-8, Fig. 5-3 of the NJ Stormwater BMP Manual)
   c=0.99 (runoff coefficient for impervious)
   Q=ciA=0.99x3.2x0.25=0.79 cfs

   Given the site runoff is 0.79 cfs and based on Table 1 below, the CDS® Model CDS-4 with an MTFR of 0.93 cfs would be the smallest model approved that could be used for this site that could remove 50% of the TSS from the impervious area without exceeding the MTFR.

The sizing table corresponding to the available system models is noted below. Additional specifications regarding each model can be found in the Verification Appendix under Table A-1 and A-2.

Table 1 CDS Models

CDS Model	Manhole Diameter (ft.)	Treatment Chamber Depth (ft.)	MTFR (cfs)
CDS-3	3	3.50	0.52
CDS-4	4	3.50	0.93
CDS-5	5	3.75	1.5
CDS-6	6	4.50	2.1
CDS-7	7	5.25	2.8
CDS-8	8	6.00	3.7
CDS-10	10	7.50	5.8
CDS-12	12	9.00	8.4

- Treatment Chamber Depth is defined as the depth below the invert to the top of the false floor installed at 50% sediment depth.

A detailed maintenance plan is mandatory for any project with a Stormwater BMP subject to the Stormwater Management Rules, N.J.A.C. 7:8. The plan must include all of the items identified in the Stormwater Management Rules, N.J.A.C. 7:8-5.8. Such items include, but are not limited to, the list of inspection and maintenance equipment and tools, specific corrective and preventative maintenance tasks, indication of problems in the system, and training of maintenance personnel. Additional information can be found in Chapter 8: Maintenance and Retrofit of Stormwater Management Measures.

If you have any questions regarding the above information, please contact Mr. Shashi Nayak of my office at (609) 633-7021.

Sincerely,

James J. Murphy, Chief
Bureau of Nonpoint Pollution Control

Attachment: Maintenance Plan

c: Chron File
Richard Magee, NJCAT
Vince Mazzei, NJDEP - DLUR
Ravi Patraju, NJDEP - BES
Gabriel Mahon, NJDEP - BNPC
Shashi Nayak, NJDEP – BNPC

CONTECH®
ENGINEERED SOLUTIONS

CDS® Inspection and Maintenance Guide

CDS TECHNOLOGIES

Maintenance

The CDS system should be inspected at regular intervals and maintained when necessary to ensure optimum performance. The rate at which the system collects pollutants will depend more heavily on site activities than the size of the unit. For example, unstable soils or heavy winter sanding will cause the grit chamber to fill more quickly but regular sweeping of paved surfaces will slow accumulation.

Inspection

Inspection is the key to effective maintenance and is easily performed. Pollutant transport and deposition may vary from year to year and regular inspections will help ensure that the system is cleaned out at the appropriate time. At a minimum, inspections should be performed twice per year (e.g. spring and fall) however more frequent inspections may be necessary in climates where winter sanding operations may lead to rapid accumulations, or in equipment washdown areas. Installations should also be inspected more frequently where excessive amounts of trash are expected.

The visual inspection should ascertain that the system components are in working order and that there are no blockages or obstructions in the inlet and separation screen. The inspection should also quantify the accumulation of hydrocarbons, trash, and sediment in the system. Measuring pollutant accumulation can be done with a calibrated dipstick, tape measure or other measuring instrument. If absorbent material is used for enhanced removal of hydrocarbons, the level of discoloration of the sorbent material should also be identified during inspection. It is useful and often required as part of an operating permit to keep a record of each inspection. A simple form for doing so is provided.

Access to the CDS unit is typically achieved through two manhole access covers. One opening allows for inspection and cleanout of the separation chamber (cylinder and screen) and isolated sump. The other allows for inspection and cleanout of sediment captured and retained outside the screen. For deep units, a single manhole access point would allows both sump cleanout and access outside the screen.

The CDS system should be cleaned when the level of sediment has reached 75% of capacity in the isolated sump or when an appreciable level of hydrocarbons and trash has accumulated. If absorbent material is used, it should be replaced when significant discoloration has occurred. Performance will not be impacted until 100% of the sump capacity is exceeded however it is recommended that the system be cleaned prior to that for easier removal of sediment. The level of sediment is easily determined by measuring from finished grade down to the top of the sediment pile. To avoid underestimating the level of sediment in the chamber, the measuring device must be lowered to the top of the sediment pile carefully. Particles at the top of the pile typically offer less resistance to the end of the rod than consolidated particles toward the bottom of the pile. Once this measurement is recorded, it should be compared to the as-built drawing for the unit to determine weather the height of the sediment pile off the bottom of the sump floor exceeds 75% of the total height of isolated sump.

Cleaning

Cleaning of a CDS systems should be done during dry weather conditions when no flow is entering the system. The use of a vacuum truck is generally the most effective and convenient method of removing pollutants from the system. Simply remove the manhole covers and insert the vacuum hose into the sump. The system should be completely drained down and the sump fully evacuated of sediment. The area outside the screen should also be cleaned out if pollutant build-up exists in this area.

In installations where the risk of petroleum spills is small, liquid contaminants may not accumulate as quickly as sediment. However, the system should be cleaned out immediately in the event of an oil or gasoline spill should be cleaned out immediately. Motor oil and other hydrocarbons that accumulate on a more routine basis should be removed when an appreciable layer has been captured. To remove these pollutants, it may be preferable to use absorbent pads since they are usually less expensive to dispose than the oil/water emulsion that may be created by vacuuming the oily layer. Trash and debris can be netted out to separate it from the other pollutants. The screen should be power washed to ensure it is free of trash and debris.

Manhole covers should be securely seated following cleaning activities to prevent leakage of runoff into the system from above and also to ensure that proper safety precautions have been followed. Confined space entry procedures need to be followed if physical access is required. Disposal of all material removed from the CDS system should be done in accordance with local regulations. In many jurisdictions, disposal of the sediments may be handled in the same manner as the disposal of sediments removed from catch basins or deep sump manholes.

CDS Model	Diameter		Distance from Water Surface to Top of Sediment Pile		Sediment Storage Capacity	
	ft	m	ft	m	yd3	m3
CDS2015-4	4	1.2	3.0	0.9	0.9	0.7
CDS2015	5	1.5	3.0	0.9	1.3	1.0
CDS2020	5	1.5	3.5	1.1	1.3	1.0
CDS2025	5	1.5	4.0	1.2	1.3	1.0
CDS3020	6	1.8	4.0	1.2	2.1	1.6
CDS3030	6	1.8	4.6	1.4	2.1	1.6
CDS3035	6	1.8	5.0	1.5	2.1	1.6
CDS4030	8	2.4	4.6	1.4	5.6	4.3
CDS4040	8	2.4	5.7	1.7	5.6	4.3
CDS4045	8	2.4	6.2	1.9	5.6	4.3
CDS5640	10	3.0	6.3	1.9	8.7	6.7
CDS5653	10	3.0	7.7	2.3	8.7	6.7
CDS5668	10	3.0	9.3	2.8	8.7	6.7
CDS5678	10	3.0	10.3	3.1	8.7	6.7

Table 1: CDS Maintenance Indicators and Sediment Storage Capacities

Support

- Drawings and specifications are available at www.contechstormwater.com.
- Site-specific design support is available from our engineers.

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CONTECH ENGINEERED SOLUTIONS
800.925.5240
www.ContechES.com

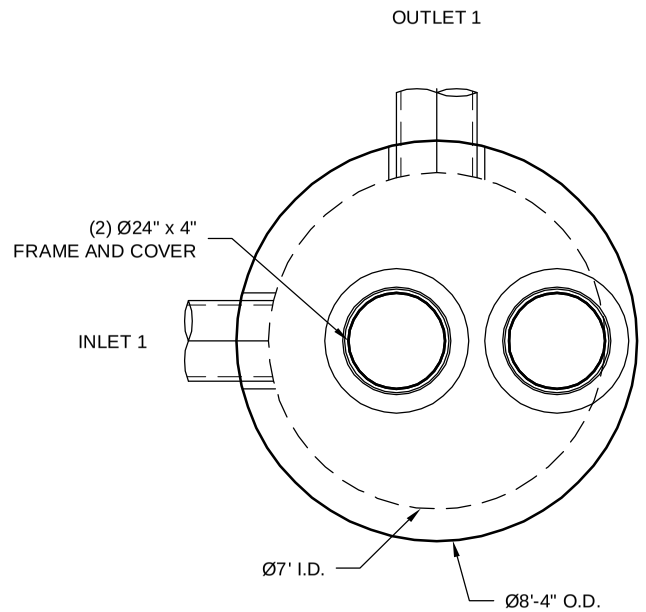
CDS Inspection & Maintenance Log

CDS Model: _____ Location: _____

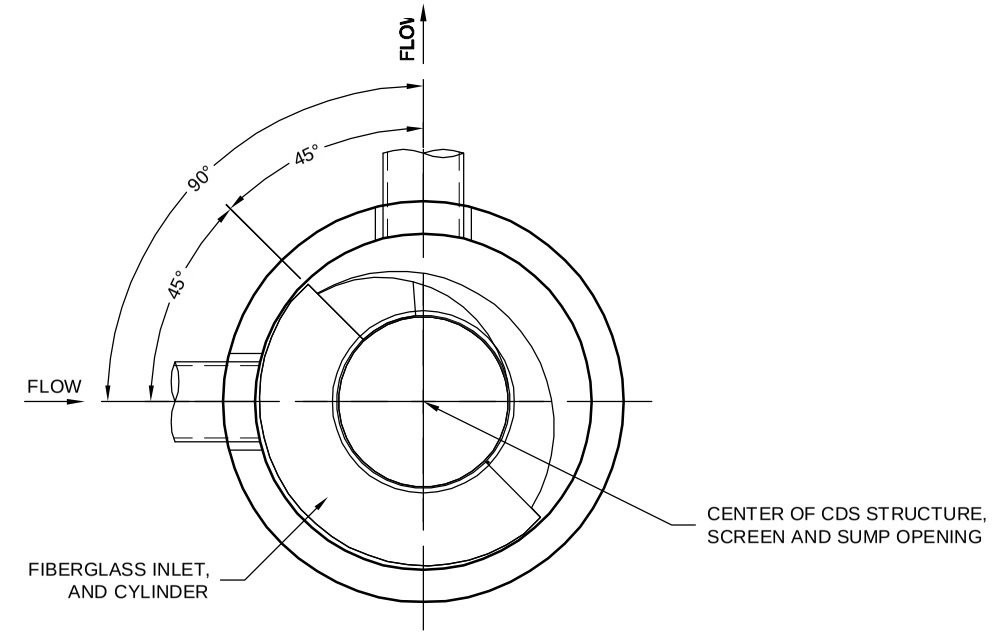
Date	Water depth to sediment[1]	Floatable Layer Thickness[2]	Describe Maintenance Performed	Maintenance Personnel	Comments

1. The water depth to sediment is determined by taking two measurements with a stadia rod: one measurement from the manhole opening to the top of the sediment pile and the other from the manhole opening to the water surface. If the difference between these measurements is less than the values listed in table 1 the system should be cleaned out. **Note: to avoid underestimating the volume of sediment in the chamber, the measuring device must be carefully lowered to the top of the sediment pile.**

2. For optimum performance, the system should be cleaned out when the floating hydrocarbon layer accumulates to an appreciable thickness. In the event of an oil spill, the system should be cleaned immediately.



PLAN VIEW



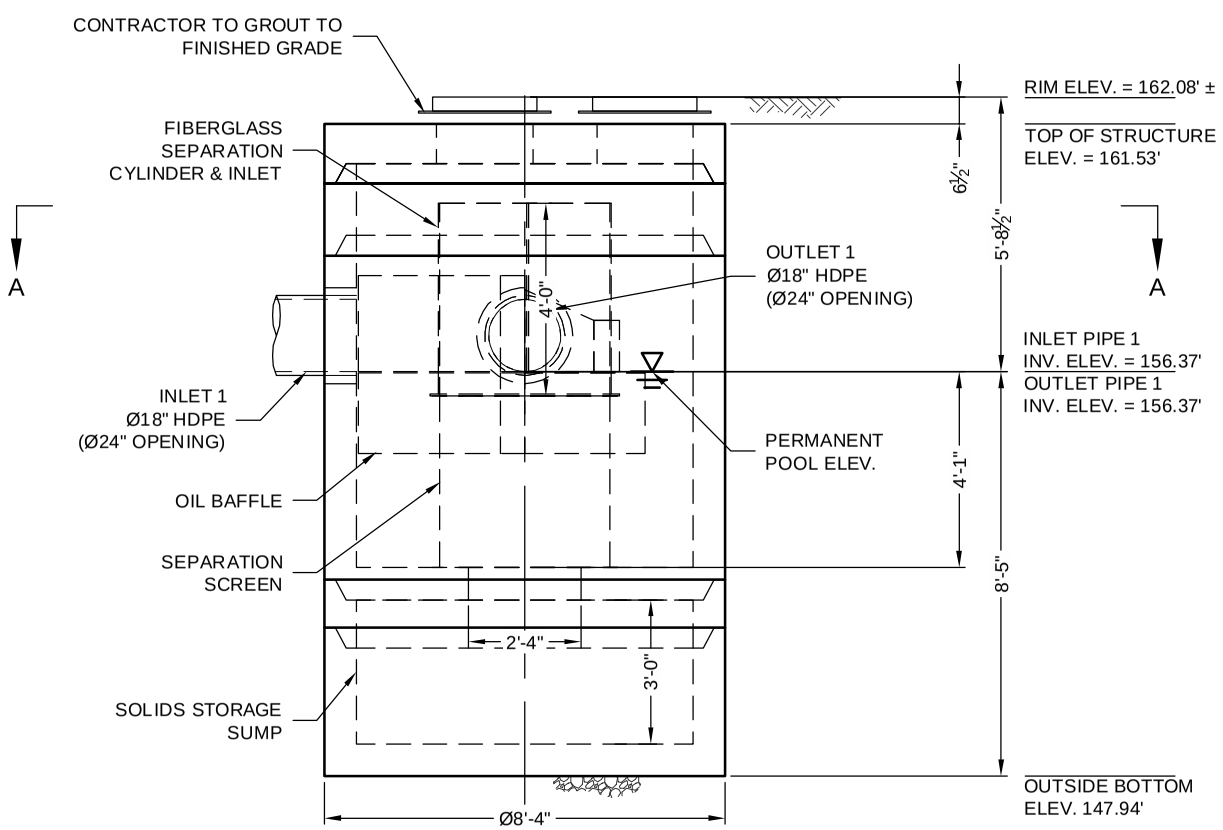
SECTION A-A

MATERIAL LIST (PROVIDED BY CONTECH)

COUNT	DESCRIPTION	INSTALLED BY
1	FIBERGLASS INLET AND CYLINDER	CONTECH
1	2400 micron, 3.5' O.D. x 3.58' SEP. SCREEN	CONTECH
1	SEALANT FOR JOINTS (BY PRECASTER)	CONTRACTOR
2	Ø24" x 4" FRAME & COVER, EJ#41600389, OR EQUIV.	CONTRACTOR

SITE DESIGN DATA

WATER QUALITY FLOW RATE	2.16 CFS
PEAK FLOW RATE	5.49 CFS
RETURN PERIOD OF PEAK FLOW	25 YRS



ELEVATION VIEW

GENERAL NOTES
1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. FOR FABRICATION DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHT, PLEASE CONTACT YOUR CONTECH ENGINEERED SOLUTIONS LLC REPRESENTATIVE. www.ContechES.com
3. CDS WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING. CONTRACTOR TO CONFIRM STRUCTURE MEETS REQUIREMENTS OF PROJECT.
4. STRUCTURE SHALL MEET AASHTO HS-20 LOAD RATING, ASSUMING EARTH COVER OF 0' - 2', AND GROUNDWATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION. CASTINGS SHALL MEET AASHTO M306 AND BE CAST WITH THE CONTECH LOGO.
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D. CONTRACTOR TO PROVIDE, INSTALL, AND GROUT INLET AND OUTLET PIPE(S). MATCH PIPE INVERTS WITH ELEVATIONS SHOWN. ALL PIPE CENTERLINES TO MATCH PIPE OPENING CENTERLINES.
E. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO ASSURE UNIT IS WATER TIGHT, HOLDING WATER TO FLOWLINE INVERT MINIMUM. IT IS SUGGESTED THAT ALL JOINTS BELOW PIPE INVERTS ARE GROUTED.

STRUCTURE WEIGHT
APPROXIMATE HEAVIEST PICK = 23000 LBS.
STRUCTURE IS DELIVERED IN 5 PIECES

MAX FOOTPRINT = Ø8'-4"

CONTECH
PROPOSAL
DRAWING

COAS
LAYOUT 1E
3535-7-FGIS
5767 / COAS11
17.17T

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MARK	DATE	REVISION DESCRIPTION	BY

CDS3535-7-C - 596999-20
TEXAS EASTERN TRANSMISSION - PENN EAST MODERNIZATION
WEST AMWELL, NJ
for SYSTEM: WQU-CDS-2

CONTECH ENGINEERED SOLUTIONS LLC
www.ContechES.com
605 Global Way Suite 113, Linthicum, MD 21.

THIS PROJECT MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING U.S. PATENTS: 5,566,518; 5,725,751; 6,811,696; 6,817,126; 6,827,000; 7,008,538; 7,011,763; 7,029,586; 7,033,511; 7,037,426; 7,051,878; 7,078,000.

DATE: 08/21/18	SCALE: 1/4" = 1'-0"
DESIGNED: TKM	DRAWN: TKM
CHECKED: ###	APPROVED: ###
PROJECT No.: 596999	SEQUENCE No.: 20
SHEET: 1 OF 1	

I:\MERLIN\PROJECT\ACTIVE\596900\596999\596999-20-CDS\DRAWINGS\PRE-596999-20-CDS3535-7 CONFAB.DWG 8/21/2018 10:37 AM

CDS Design Summary

TEXAS EASTERN TRANSMISSION – PENN EAST MODERNIZATION (WQU-CDS-2)

WEST AMWELL, NJ

Information provided by Engineer (TRC):

- Water Quality Flow = 2.16 cfs
- 25-YR Storm Flow = 5.49 cfs
- Presiding agency = NJDEP
- Stormwater treatment system TSS removal required = 50%

Sizing Summary:

The CDS technology features a patented non-blocking, indirect screening technique developed to treat stormwater runoff. The unit is highly effective in the capture of suspended solids, fine sands and larger particles. Because of its non-blocking screening capacity, the CDS unit is un-matched in its ability to capture and retain gross pollutants such as trash and debris. The CDS system is NJCAT verified and as a result has received certification from the NJDEP for 50% TSS removal.

For this project the CDS system was designed to treat the water quality design storm. The peak water quality design storm runoff flow rate provided the engineer of record is **2.16 cfs**.

Water Quality Design Storm Peak Runoff Rate (cfs)	CDS-7 (CDS3535-7) NJDEP Approved Water Quality Treatment Flow Rate (cfs)
2.16	2.8

Maintenance:

Like any stormwater best management practice, the CDS system requires regular inspection and maintenance to ensure optimal performance. Maintenance frequency will be driven by site conditions. Quarterly visual inspections are recommended, at which time the accumulation of pollutants can be determined. On average, the CDS system requires annual removal of accumulated pollutants.

Thank you for the opportunity to present this information to you and your client.

Sincerely,

Taylor Murdock
Contech Engineered Solutions LLC

7037 Ridge Road, Suite 350 | Hanover, MD 21076
Office: 443.457.1500 Fax: 410.740.8492

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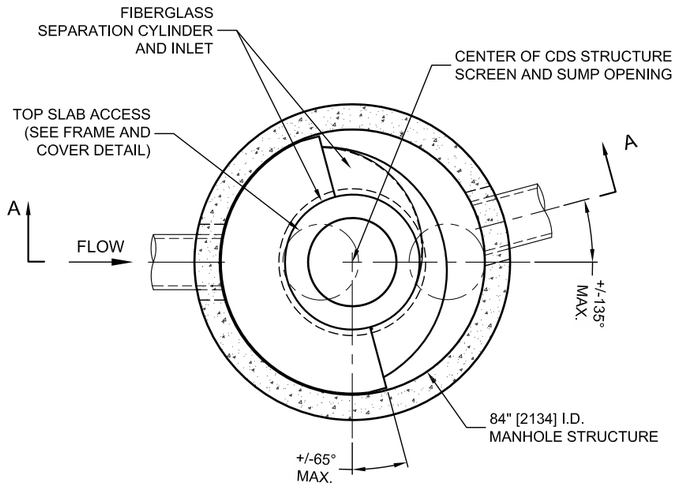
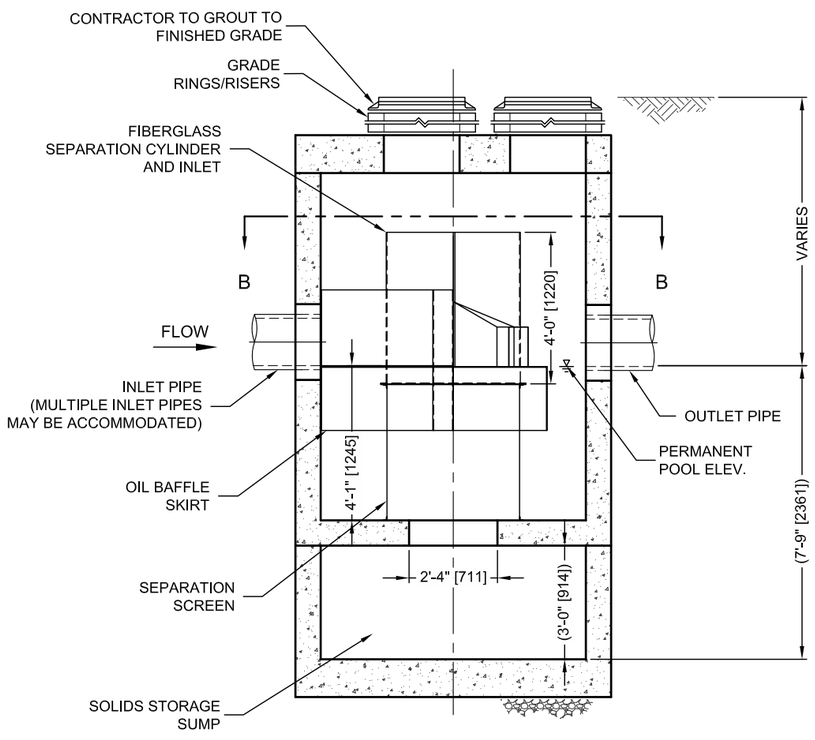
CDS-7-C (CDS3535) DESIGN NOTES

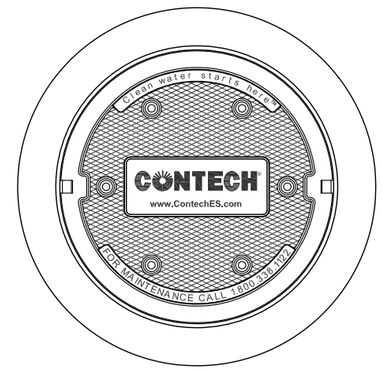
CDS-7-C (CDS3535) RATED TREATMENT CAPACITY IS 2.8 CFS. IF THE SITE CONDITIONS EXCEED MAXIMUM HYDRAULIC INTERNAL BYPASS CAPACITY, AN UPSTREAM BYPASS STRUCTURE IS REQUIRED.
CDS-7-C (CDS3535) HAS A MINIMUM OIL STORAGE CAPACITY OF 377 GALLONS AND A MINIMUM SUMP CAPACITY OF 2.9 CUBIC YARDS.



PLAN VIEW B-B
N.T.S.



ELEVATION A-A
N.T.S.



FRAME AND COVER
(DIAMETER VARIES)
N.T.S.

SITE SPECIFIC DATA REQUIREMENTS

STRUCTURE ID			
WATER QUALITY FLOW RATE (CFS OR L/s)			*
PEAK FLOW RATE (CFS OR L/s)			*
RETURN PERIOD OF PEAK FLOW (YRS)			*
SCREEN APERTURE (2400)			*
PIPE DATA:	I.E.	MATERIAL	DIAMETER
INLET PIPE 1	*	*	*
INLET PIPE 2	*	*	*
OUTLET PIPE	*	*	*
RIM ELEVATION			*
ANTI-FLOTATION BALLAST	WIDTH	HEIGHT	
	*	*	

NOTES/SPECIAL REQUIREMENTS:

* PER ENGINEER OF RECORD

GENERAL NOTES
1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. DIMENSIONS MARKED WITH ( ) ARE REFERENCE DIMENSIONS. ACTUAL DIMENSIONS MAY VARY.
3. FOR FABRICATION DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHTS, PLEASE CONTACT YOUR CONTECH ENGINEERED SOLUTIONS LLC REPRESENTATIVE. www.ContechES.com
4. CDS WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING.
5. STRUCTURE SHALL MEET AASHTO HS20 LOAD RATING, ASSUMING GROUNDWATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION. CASTINGS SHALL MEET HS20 (AASHTO M 306) AND BE CAST WITH THE CONTECH LOGO.
6. IF REQUIRED, PVC HYDRAULIC SHEAR PLATE IS PLACED ON SHELF AT BOTTOM OF SCREEN CYLINDER. REMOVE AND REPLACE AS NECESSARY DURING MAINTENANCE CLEANING.

INSTALLATION NOTES
A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE CDS MANHOLE STRUCTURE (LIFTING CLUTCHES PROVIDED).
C. CONTRACTOR TO ADD JOINT SEALANT BETWEEN ALL STRUCTURE SECTIONS, AND ASSEMBLE STRUCTURE.
D. CONTRACTOR TO PROVIDE, INSTALL, AND GROUT PIPES. MATCH PIPE INVERTS WITH ELEVATIONS SHOWN.
E. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO ASSURE UNIT IS WATER TIGHT, HOLDING WATER TO FLOWLINE INVERT MINIMUM. IT IS SUGGESTED THAT ALL JOINTS BELOW PIPE INVERTS ARE GROUTED.

THIS PRODUCT MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING U.S. PATENTS: 5,788,848; 6,641,720; 6,511,590; 6,581,783; RELATED FOREIGN PATENTS, OR OTHER PATENTS PENDING.

CONTECH ENGINEERED SOLUTIONS LLC
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9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

CDS-7-C (CDS3535)
ONLINE CDS
STANDARD DETAIL

C:\USERS\ABROWN\DOCUMENTS\RESOURCES\NEW JERSEY RESOURCES\PRODUCTS\TREATMENT\CDS\CDS SIZING\CDS NJ STANDARD DETAILS\CDS-7-C DTL.DWG 8/31/2017 11:22 AM

State of New Jersey

DEPARTMENT OF ENVIRONMENTAL PROTECTION
Bureau of Nonpoint Pollution Control
Division of Water Quality
401-02B
Post Office Box 420
Trenton, New Jersey 08625-0420
609-633-7021 Fax: 609-777-0432
http://www.state.nj.us/dep/dwq/bnpc_home.htm

CHRIS CHRISTIE
Governor

KIM GUADAGNO
Lt. Governor

BOB MARTIN
Commissioner

March 21, 2017

Derek M. Berg
Contech Engineered Solutions, LLC
71 US Route 1, Suite F
Scarborough, ME 04074

Re: Revised MTD Lab Certification
Continuous Deflective Separator (CDS®) Stormwater Treatment Device by Contech Engineered Solutions, LLC
On-line Installation

TSS Removal Rate 50%

Dear Mr. Berg:

This revised certification letter supersedes the Department's prior certification dated January 9, 2015. This revision was completed to reflect the updated Manufactured Treatment Device (MTD) scaling methodology as agreed upon by the manufacturers' working group on September 19, 2016. In part, the updated scaling for hydrodynamic MTDs is based on the depth of the reference (tested) MTD from the top of the false floor utilized during removal efficiency testing, not from the physical bottom of the unit. Based on the above decision, Table A-2 of the NJCAT Technology Verification report located at http://www.njcat.org/uploads/newDocs/CDSVerificationReportFinal1.pdf has been revised, and Table 1 noted below has been added.

The Stormwater Management rules under N.J.A.C. 7:8-5.5(b) and 5.7 (c) allow the use of manufactured treatment devices (MTDs) for compliance with the design and performance standards at N.J.A.C. 7:8-5 if the pollutant removal rates have been verified by the New Jersey Corporation for Advanced Technology (NJCAT) and have been certified by the New Jersey Department of Environmental Protection (NJDEP). Contech Engineered Solutions, LLC has requested an MTD Laboratory Certification for the CDS® Stormwater Treatment Device.

The verification is subject to the "Procedure for Obtaining Verification of a Stormwater Manufactured Treatment Device from New Jersey Corporation for Advance Technology" dated January 25, 2013. The applicable protocol is the "New Jersey Laboratory Testing Protocol to Assess Total Suspended Solids Removal by a Hydrodynamic Sedimentation Manufactured Treatment Device" dated January 25, 2013.

NJCAT verification documents submitted to the NJDEP indicate that the requirements of the aforementioned protocol have been met or exceeded. The NJCAT letter also included a recommended certification TSS removal rate and the required maintenance plan. The NJCAT Verification Report with the Verification

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Appendix dated September 2014 (Revised January 2017) for this device is published online at http://www.njcat.org/verification-process/technology-verification-database.html.

The NJDEP certifies the use of the CDS® Stormwater Treatment Device by Contech Engineered Solutions, LLC at a TSS removal rate of 50% when designed, operated, and maintained in accordance with the information provided in the Verification Appendix and the following conditions:

1. The maximum treatment flow rate (MTFR) for the manufactured treatment device (MTD) is calculated using the New Jersey Water Quality Design Storm (1.25 inches in 2 hrs) in N.J.A.C. 7:8-5.5.

2. The CDS® Stormwater Treatment Device shall be installed using the same configuration reviewed by NJCAT and shall be sized in accordance with the criteria specified in item 6 below.

3. This CDS® Stormwater Treatment Device cannot be used in series with another MTD or a media filter (such as a sand filter) to achieve an enhanced removal rate for total suspended solids (TSS) removal under N.J.A.C. 7:8-5.5.

4. Additional design criteria for MTDs can be found in Chapter 9.6 of the New Jersey Stormwater Best Management Practices (NJ Stormwater BMP) Manual which can be found on-line at www.njstormwater.org.

5. The maintenance plan for a site using this device shall incorporate, at a minimum, the maintenance requirements for the CDS® Stormwater Treatment Device. A copy of the maintenance plan is attached to this certification. However, it is recommended to review the maintenance website at http://www.conteches.com/products/stormwater-management/treatment/cds.aspx#1822141-technical-info for any changes to the maintenance requirements.

6. Sizing Requirements:

   The example below demonstrates the sizing procedure for the CDS®:

   Example: A 0.25-acre impervious site is to be treated to 50% TSS removal using a CDS®. The impervious site runoff (Q) based on the New Jersey Water Quality Design Storm was determined to be 0.79 cfs.

   Maximum Treatment Flow Rate (MTFR) Evaluation:

   The site runoff (Q) was based on the following:
   time of concentration = 10 minutes
   i=3.2 in/hr (page 5-8, Fig. 5-3 of the NJ Stormwater BMP Manual)
   c=0.99 (runoff coefficient for impervious)
   Q=ciA=0.99x3.2x0.25=0.79 cfs

   Given the site runoff is 0.79 cfs and based on Table 1 below, the CDS® Model CDS-4 with an MTFR of 0.93 cfs would be the smallest model approved that could be used for this site that could remove 50% of the TSS from the impervious area without exceeding the MTFR.

The sizing table corresponding to the available system models is noted below. Additional specifications regarding each model can be found in the Verification Appendix under Table A-1 and A-2.

Table 1 CDS Models

CDS Model	Manhole Diameter (ft.)	Treatment Chamber Depth (ft.)	MTFR (cfs)
CDS-3	3	3.50	0.52
CDS-4	4	3.50	0.93
CDS-5	5	3.75	1.5
CDS-6	6	4.50	2.1
CDS-7	7	5.25	2.8
CDS-8	8	6.00	3.7
CDS-10	10	7.50	5.8
CDS-12	12	9.00	8.4

- Treatment Chamber Depth is defined as the depth below the invert to the top of the false floor installed at 50% sediment depth.

A detailed maintenance plan is mandatory for any project with a Stormwater BMP subject to the Stormwater Management Rules, N.J.A.C. 7:8. The plan must include all of the items identified in the Stormwater Management Rules, N.J.A.C. 7:8-5.8. Such items include, but are not limited to, the list of inspection and maintenance equipment and tools, specific corrective and preventative maintenance tasks, indication of problems in the system, and training of maintenance personnel. Additional information can be found in Chapter 8: Maintenance and Retrofit of Stormwater Management Measures.

If you have any questions regarding the above information, please contact Mr. Shashi Nayak of my office at (609) 633-7021.

Sincerely,

James J. Murphy, Chief
Bureau of Nonpoint Pollution Control

Attachment: Maintenance Plan

c: Chron File
Richard Magee, NJCAT
Vince Mazzei, NJDEP - DLUR
Ravi Patraju, NJDEP - BES
Gabriel Mahon, NJDEP - BNPC
Shashi Nayak, NJDEP – BNPC

CONTECH®
ENGINEERED SOLUTIONS

CDS® Inspection and Maintenance Guide

CDS TECHNOLOGIES

Maintenance

The CDS system should be inspected at regular intervals and maintained when necessary to ensure optimum performance. The rate at which the system collects pollutants will depend more heavily on site activities than the size of the unit. For example, unstable soils or heavy winter sanding will cause the grit chamber to fill more quickly but regular sweeping of paved surfaces will slow accumulation.

Inspection

Inspection is the key to effective maintenance and is easily performed. Pollutant transport and deposition may vary from year to year and regular inspections will help ensure that the system is cleaned out at the appropriate time. At a minimum, inspections should be performed twice per year (e.g. spring and fall) however more frequent inspections may be necessary in climates where winter sanding operations may lead to rapid accumulations, or in equipment washdown areas. Installations should also be inspected more frequently where excessive amounts of trash are expected.

The visual inspection should ascertain that the system components are in working order and that there are no blockages or obstructions in the inlet and separation screen. The inspection should also quantify the accumulation of hydrocarbons, trash, and sediment in the system. Measuring pollutant accumulation can be done with a calibrated dipstick, tape measure or other measuring instrument. If absorbent material is used for enhanced removal of hydrocarbons, the level of discoloration of the sorbent material should also be identified during inspection. It is useful and often required as part of an operating permit to keep a record of each inspection. A simple form for doing so is provided.

Access to the CDS unit is typically achieved through two manhole access covers. One opening allows for inspection and cleanout of the separation chamber (cylinder and screen) and isolated sump. The other allows for inspection and cleanout of sediment captured and retained outside the screen. For deep units, a single manhole access point would allows both sump cleanout and access outside the screen.

The CDS system should be cleaned when the level of sediment has reached 75% of capacity in the isolated sump or when an appreciable level of hydrocarbons and trash has accumulated. If absorbent material is used, it should be replaced when significant discoloration has occurred. Performance will not be impacted until 100% of the sump capacity is exceeded however it is recommended that the system be cleaned prior to that for easier removal of sediment. The level of sediment is easily determined by measuring from finished grade down to the top of the sediment pile. To avoid underestimating the level of sediment in the chamber, the measuring device must be lowered to the top of the sediment pile carefully. Particles at the top of the pile typically offer less resistance to the end of the rod than consolidated particles toward the bottom of the pile. Once this measurement is recorded, it should be compared to the as-built drawing for the unit to determine weather the height of the sediment pile off the bottom of the sump floor exceeds 75% of the total height of isolated sump.

Cleaning

Cleaning of a CDS systems should be done during dry weather conditions when no flow is entering the system. The use of a vacuum truck is generally the most effective and convenient method of removing pollutants from the system. Simply remove the manhole covers and insert the vacuum hose into the sump. The system should be completely drained down and the sump fully evacuated of sediment. The area outside the screen should also be cleaned out if pollutant build-up exists in this area.

In installations where the risk of petroleum spills is small, liquid contaminants may not accumulate as quickly as sediment. However, the system should be cleaned out immediately in the event of an oil or gasoline spill should be cleaned out immediately. Motor oil and other hydrocarbons that accumulate on a more routine basis should be removed when an appreciable layer has been captured. To remove these pollutants, it may be preferable to use absorbent pads since they are usually less expensive to dispose than the oil/water emulsion that may be created by vacuuming the oily layer. Trash and debris can be netted out to separate it from the other pollutants. The screen should be power washed to ensure it is free of trash and debris.

Manhole covers should be securely seated following cleaning activities to prevent leakage of runoff into the system from above and also to ensure that proper safety precautions have been followed. Confined space entry procedures need to be followed if physical access is required. Disposal of all material removed from the CDS system should be done in accordance with local regulations. In many jurisdictions, disposal of the sediments may be handled in the same manner as the disposal of sediments removed from catch basins or deep sump manholes.

CDS Model	Diameter		Distance from Water Surface to Top of Sediment Pile		Sediment Storage Capacity	
	ft	m	ft	m	yd3	m3
CDS2015-4	4	1.2	3.0	0.9	0.9	0.7
CDS2015	5	1.5	3.0	0.9	1.3	1.0
CDS2020	5	1.5	3.5	1.1	1.3	1.0
CDS2025	5	1.5	4.0	1.2	1.3	1.0
CDS3020	6	1.8	4.0	1.2	2.1	1.6
CDS3030	6	1.8	4.6	1.4	2.1	1.6
CDS3035	6	1.8	5.0	1.5	2.1	1.6
CDS4030	8	2.4	4.6	1.4	5.6	4.3
CDS4040	8	2.4	5.7	1.7	5.6	4.3
CDS4045	8	2.4	6.2	1.9	5.6	4.3
CDS5640	10	3.0	6.3	1.9	8.7	6.7
CDS5653	10	3.0	7.7	2.3	8.7	6.7
CDS5668	10	3.0	9.3	2.8	8.7	6.7
CDS5678	10	3.0	10.3	3.1	8.7	6.7

Table 1: CDS Maintenance Indicators and Sediment Storage Capacities

Support

- Drawings and specifications are available at www.contechstormwater.com.
- Site-specific design support is available from our engineers.

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CONTECH ENGINEERED SOLUTIONS
800.925.5240
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CDS Inspection & Maintenance Log

CDS Model: _____ Location: _____

Date	Water depth to sediment[1]	Floatable Layer Thickness[2]	Describe Maintenance Performed	Maintenance Personnel	Comments

1. The water depth to sediment is determined by taking two measurements with a stadia rod: one measurement from the manhole opening to the top of the sediment pile and the other from the manhole opening to the water surface. If the difference between these measurements is less than the values listed in table 1 the system should be cleaned out. **Note: to avoid underestimating the volume of sediment in the chamber, the measuring device must be carefully lowered to the top of the sediment pile.**

2. For optimum performance, the system should be cleaned out when the floating hydrocarbon layer accumulates to an appreciable thickness. In the event of an oil spill, the system should be cleaned immediately.

APPENDIX H

STORMWATER CONVEYANCE SYSTEM DESIGN

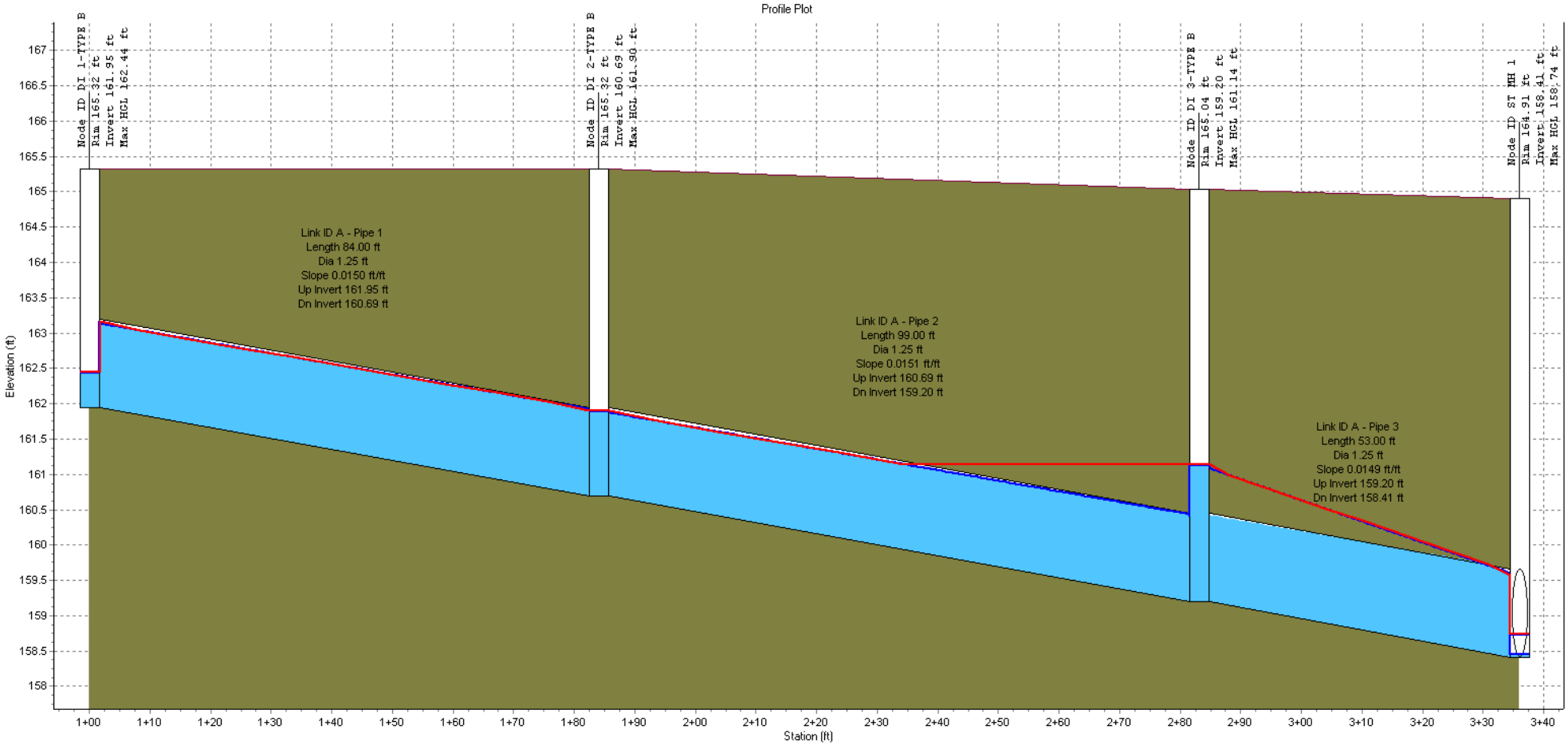
25 Year Storm Analysis

Stormwater Conveyance System Design - 25 Year Storm											
From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Pipe Shape	Pipe Diameter (inches)	Manning's Roughness	Peak Flow (cfs)	Max Flow Velocity (ft/sec)	Design Flow Capacity (cfs)
DI 1-TYPE B	DI 2-TYPE B	84.0	161.95	160.69	1.50	CIRCULAR	15.0	0.0120	0.46	5.02	8.57
DI 2-TYPE B	DI 3-TYPE B	99.0	160.69	159.20	1.51	CIRCULAR	15.0	0.0120	0.77	4.38	8.59
DI 3-TYPE B	ST MH 1	53.0	159.20	158.41	1.49	CIRCULAR	15.0	0.0120	1.30	5.04	8.54
ST MH 1	DI 4-TYPE B	91.0	158.41	157.04	1.51	CIRCULAR	15.0	0.0120	1.29	5.07	8.59
DI 4-TYPE B	ST MH 2	97.0	157.04	156.07	1.00	CIRCULAR	15.0	0.0120	1.97	4.93	7.00
TD-1	ST MH 2	28.0	157.61	155.93	6.00	CIRCULAR	15.0	0.0120	1.26	8.19	17.14
ST MH 2	WQU-CDS-1	25.0	155.91	155.68	0.92	CIRCULAR	15.0	0.0120	3.15	5.56	7.00
WQU-CDS-1	Wall 1	19.0	155.68	155.00	3.58	CIRCULAR	15.0	0.0120	3.15	8.85	13.24
DI 5-TYPE B	DI 6-TYPE B	87.0	158.29	157.85	0.51	CIRCULAR	15.0	0.0120	0.78	4.14	4.98
DI 6-TYPE B	ST MH 3	44.0	157.85	157.55	0.68	CIRCULAR	15.0	0.0120	1.42	3.91	5.78
DI 7-TYPE E	ST MH 3	60.0	156.81	156.51	0.50	CIRCULAR	15.0	0.0120	4.68	5.20	4.95
ST MH 3	WQU-CDS-2	28.0	156.51	156.37	0.50	CIRCULAR	18.0	0.0120	5.94	4.99	8.05
WQU-CDS-2	SSDB 1	7.0	156.37	156.33	0.57	CIRCULAR	18.0	0.0120	5.94	5.25	8.60
ST CO 1	ST CO 2	102.0	159.80	159.29	0.50	CIRCULAR	6.0	0.0120	0.30	3.93	0.43
ST CO 2	ST CO 6	182.0	159.29	158.38	0.50	CIRCULAR	10.0	0.0120	1.43	3.60	1.68
ST CO 3	ST CO 4	95.0	163.35	162.50	0.89	CIRCULAR	6.0	0.0120	0.30	4.61	0.57
ST CO 4	ST CO 5	180.0	162.50	161.00	0.83	CIRCULAR	10.0	0.0120	1.45	4.36	2.17
ST CO 5	ST CO 6	95.0	161.00	160.53	0.49	CIRCULAR	10.0	0.0120	1.43	3.52	1.68
ST CO 6	ST MH 5	62.0	158.38	158.07	0.50	CIRCULAR	15.0	0.0120	2.85	4.19	4.95
ST MH 5	SSDB 2	14.0	158.07	157.33	5.29	CIRCULAR	15.0	0.0120	2.85	9.88	16.09
ST MH 8	ST MH 9	32.0	151.89	150.69	3.75	CIRCULAR	15.0	0.0120	0.41	4.98	13.55
ST MH 9	ST MH 10	74.0	147.00	142.66	5.86	CIRCULAR	15.0	0.0120	1.50	8.53	16.95
ST MH 10	ST MH 11	80.0	142.66	142.26	0.50	CIRCULAR	15.0	0.0120	1.50	3.53	4.95
ST MH 11	HW 3	53.0	142.26	142.02	0.45	CIRCULAR	15.0	0.0120	1.50	3.53	4.95
ST MH 7	ST MH 9	49.0	151.86	148.34	7.18	CIRCULAR	15.0	0.0120	1.09	8.46	19.18
OCS 1	HW 1	95.0	151.80	151.34	0.48	CIRCULAR	15.0	0.0120	0.93	3.09	4.95
SDB 1	ST MH 4	10.0	156.33	156.28	0.50	CIRCULAR	15.0	0.0120	1.63	3.61	4.95
ST MH 4	HW 2	40.0	156.28	156.00	0.70	CIRCULAR	15.0	0.0120	1.63	4.09	5.86
OCS 2	ST MH 8	11.0	152.17	151.89	2.55	CIRCULAR	15.0	0.0120	0.41	4.33	11.17
SDB 2	ST MH 6	23.0	157.33	156.45	3.83	CIRCULAR	15.0	0.0120	1.09	6.68	13.69
ST MH 6	ST MH 7	61.0	156.45	152.02	7.26	CIRCULAR	15.0	0.0120	1.09	8.36	18.86

Design Software: AutoDesk Storm and Sanitary Analysis 2018

PENNEAST PIPELINE PROJECT - LAMBERTVILLE INTERCONNECT

Profile Plot

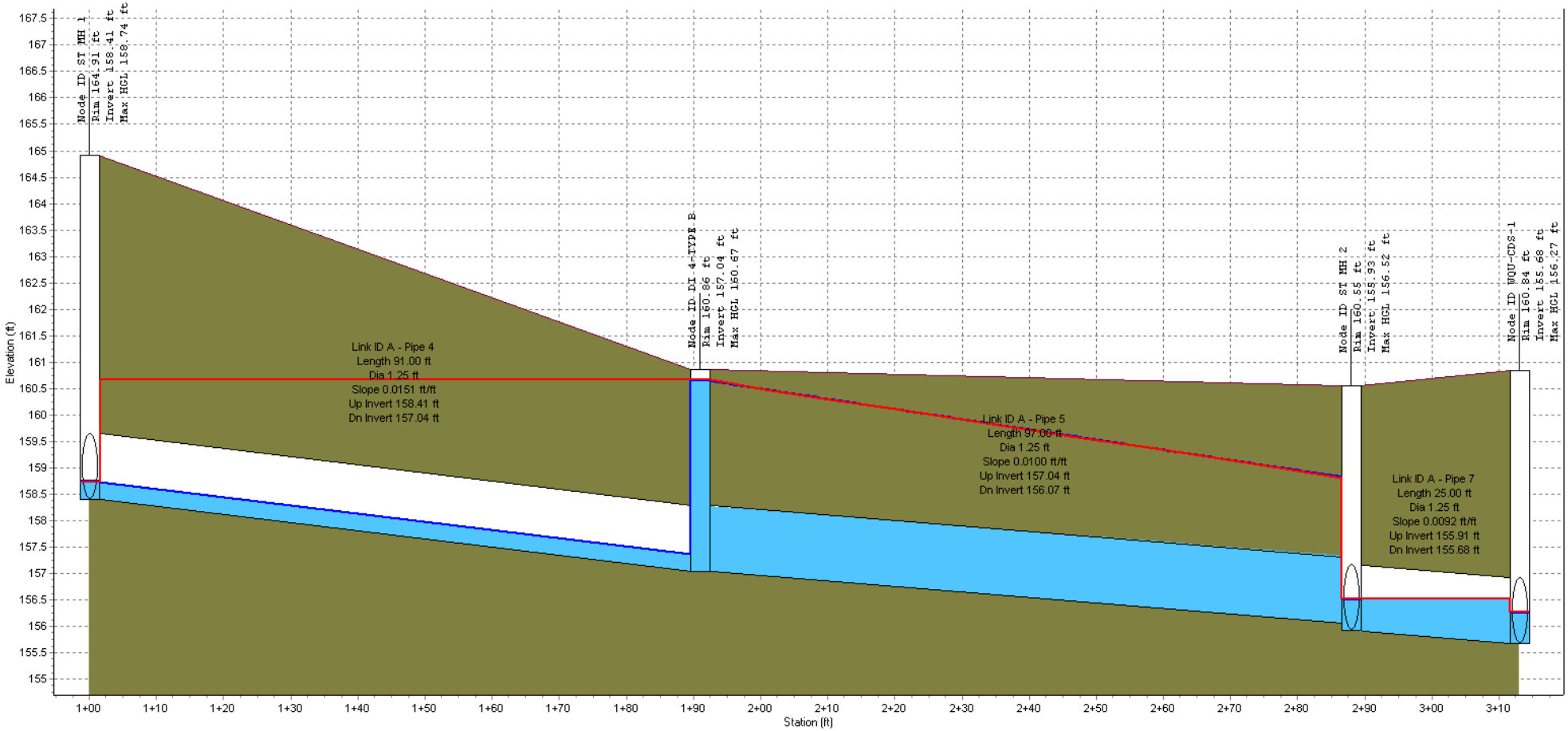


Node ID:	DI 1-TYPE B	DI 2-TYPE B	DI 3-TYPE B	ST MH 1
Rim (ft):	165.32	165.32	165.04	164.91
Invert (ft):	161.95	160.69	159.20	158.41
Min Pipe Cover (ft):				5.25
Max HGL (ft):	162.44	161.90	161.14	158.74

Link ID:	A - Pipe 1	A - Pipe 2	A - Pipe 3
Length (ft):	84.00	99.00	53.00
Dia (ft):	1.25	1.25	1.25
Slope (ft/ft):	0.0150	0.0151	0.0149
Up Invert (ft):	161.95	160.69	159.20
Dn Invert (ft):	160.69	159.20	158.41
Max Q (cfs):	0.46	0.77	1.30
Max Vel (ft/s):	5.02	4.38	5.04
Max Depth (ft):	0.20	0.25	0.33

PENNEAST PIPELINE PROJECT - LAMBERTVILLE INTERCONNECT

Profile Plot

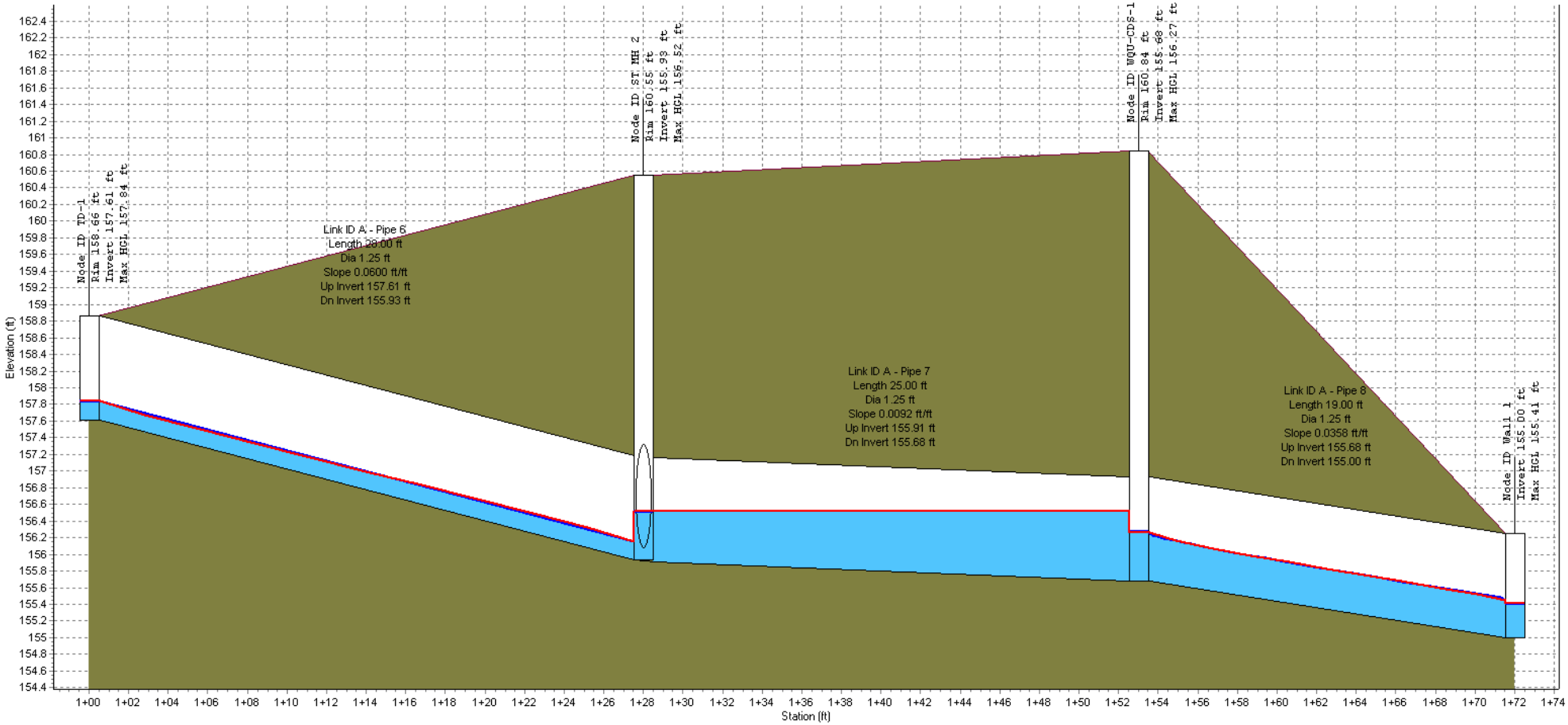


Node ID:	ST MH 1	DI 4-TYPE B	ST MH 2	WQU-CDS-1
Rim (ft):	164.91	160.86	160.55	160.84
Invert (ft):	158.41	157.04	155.93	155.68
Min Pipe Cover (ft):	5.25		3.23	3.91
Max HGL (ft):	158.74	160.67	156.52	156.27

Link ID:	A - Pipe 4	A - Pipe 5	A - Pipe 7
Length (ft):	91.00	97.00	25.00
Dia (ft):	1.25	1.25	1.25
Slope (ft/ft):	0.0151	0.0100	0.0092
Up Invert (ft):	158.41	157.04	155.91
Dn Invert (ft):	157.04	156.07	155.68
Max Q (cfs):	1.29	1.97	3.15
Max Vel (ft/s):	5.07	4.93	5.56
Max Depth (ft):	0.33	0.45	0.59

PENNEAST PIPELINE PROJECT - LAMBERTVILLE INTERCONNECT

Profile Plot

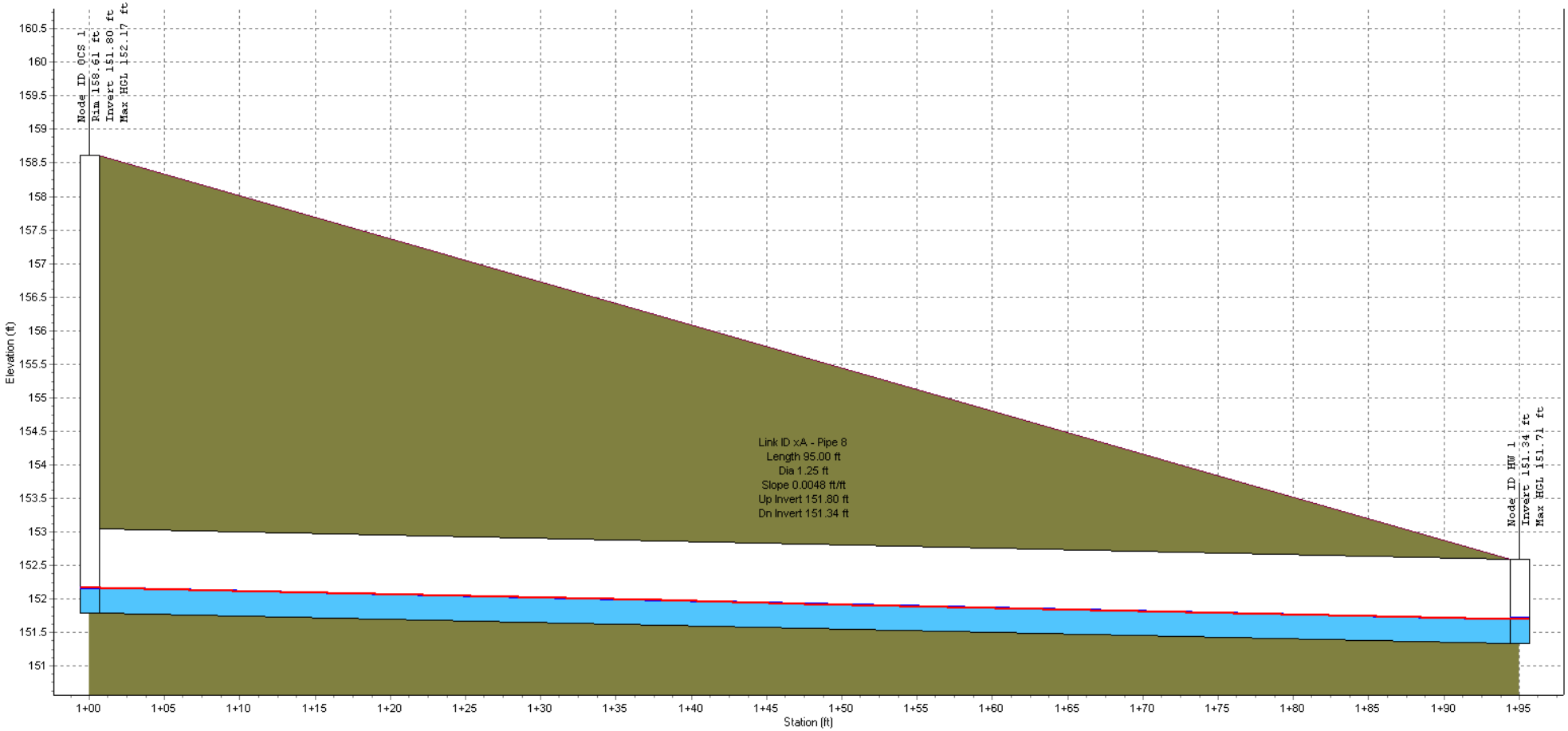


Node ID:	TD-1	ST MH 2	WQU-CDS-1	Wall 1
Rim (ft):	158.66	160.55	160.84	
Invert (ft):	157.61	155.93	155.68	155.00
Min Pipe Cover (ft):		3.23	3.91	
Max HGL (ft):	157.84	156.52	156.27	155.41

Link ID:	A - Pipe 6	A - Pipe 7	A - Pipe 8
Length (ft):	28.00	25.00	19.00
Dia (ft):	1.25	1.25	1.25
Slope (ft/ft):	0.0600	0.0092	0.0358
Up Invert (ft):	157.61	155.91	155.68
Dn Invert (ft):	155.93	155.68	155.00
Max Q (cfs):	1.26	3.15	3.15
Max Vel (ft/s):	8.19	5.56	8.85
Max Depth (ft):	0.23	0.59	0.41

PENNEAST PIPELINE PROJECT - LAMBERTVILLE INTERCONNECT

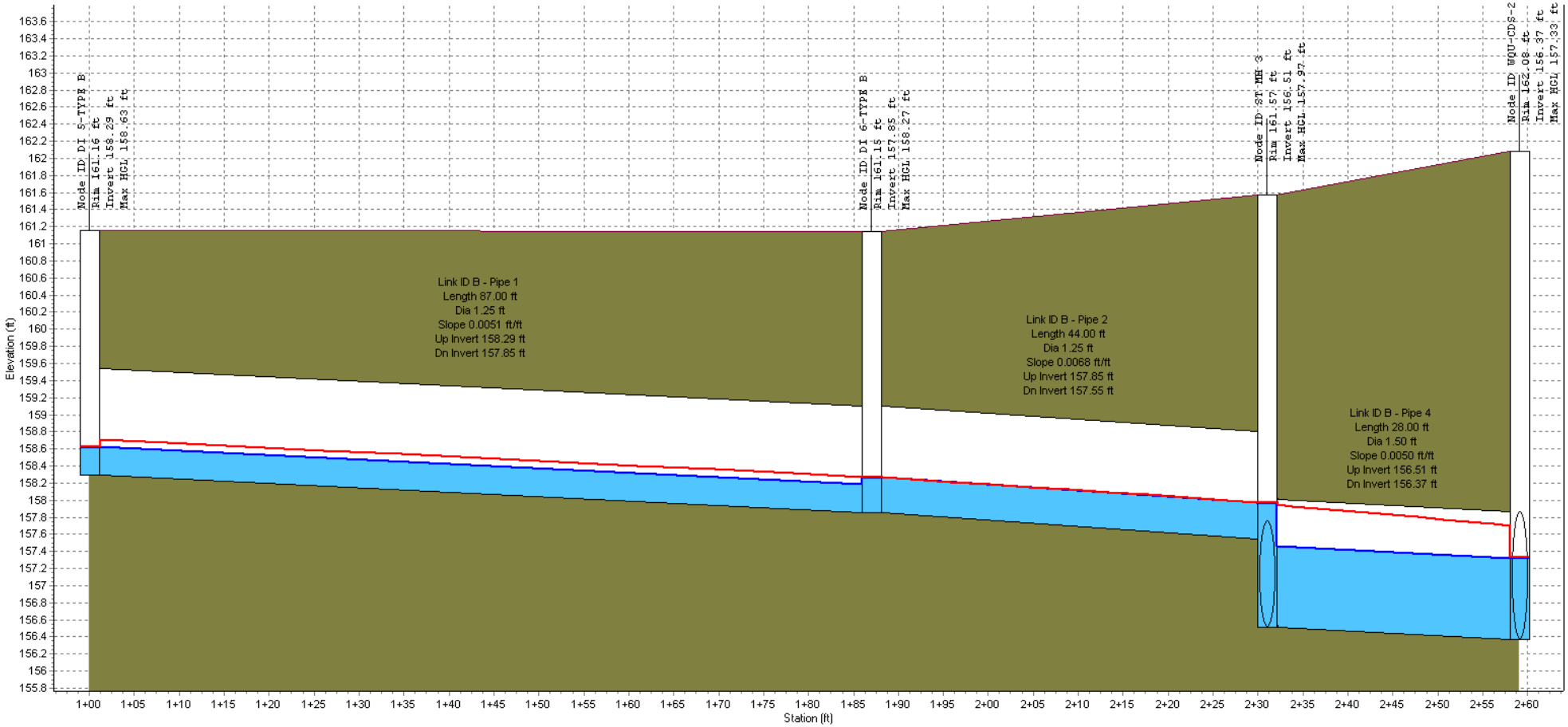
Profile Plot



Node ID:	OCS 1		HW 1
Rim (ft):	158.61		
Invert (ft):	151.80		151.34
Min Pipe Cover (ft):	5.56		
Max HGL (ft):	152.17		151.71
Link ID:		xA - Pipe 8	
Length (ft):		95.00	
Dia (ft):		1.25	
Slope (ft/ft):		0.0048	
Up Invert (ft):		151.80	
Dn Invert (ft):		151.34	
Max Q (cfs):		0.93	
Max Vel (ft/s):		3.09	
Max Depth (ft):		0.37	

PENNEAST PIPELINE PROJECT - LAMBERTVILLE INTERCONNECT

Profile Plot

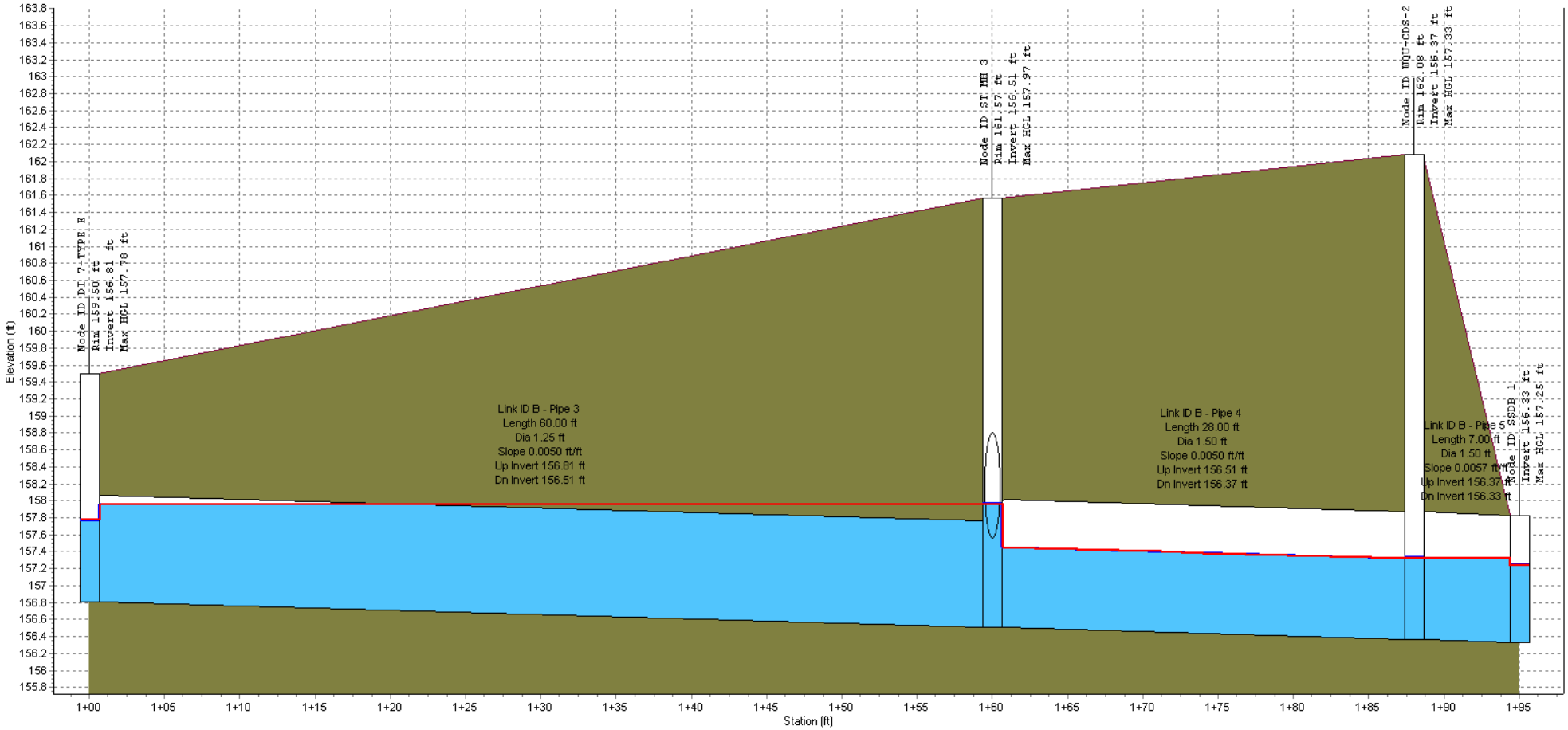


Node ID:	DI 5-TYPE B	DI 6-TYPE B	ST MH 3	WQU-CDS-2
Rim (ft):	161.16	161.15	161.57	162.08
Invert (ft):	158.29	157.85	156.51	156.37
Min Pipe Cover (ft):			2.77	4.21
Max HGL (ft):	158.63	158.27	157.97	157.33

Link ID:	B - Pipe 1	B - Pipe 2	B - Pipe 4
Length (ft):	87.00	44.00	28.00
Dia (ft):	1.25	1.25	1.50
Slope (ft/ft):	0.0051	0.0068	0.0050
Up Invert (ft):	158.29	157.85	156.51
Dn Invert (ft):	157.85	157.55	156.37
Max Q (cfs):	0.78	1.42	5.94
Max Vel (ft/s):	4.14	3.91	4.99
Max Depth (ft):	0.33	0.42	0.96

PENNEAST PIPELINE PROJECT - LAMBERTVILLE INTERCONNECT

Profile Plot

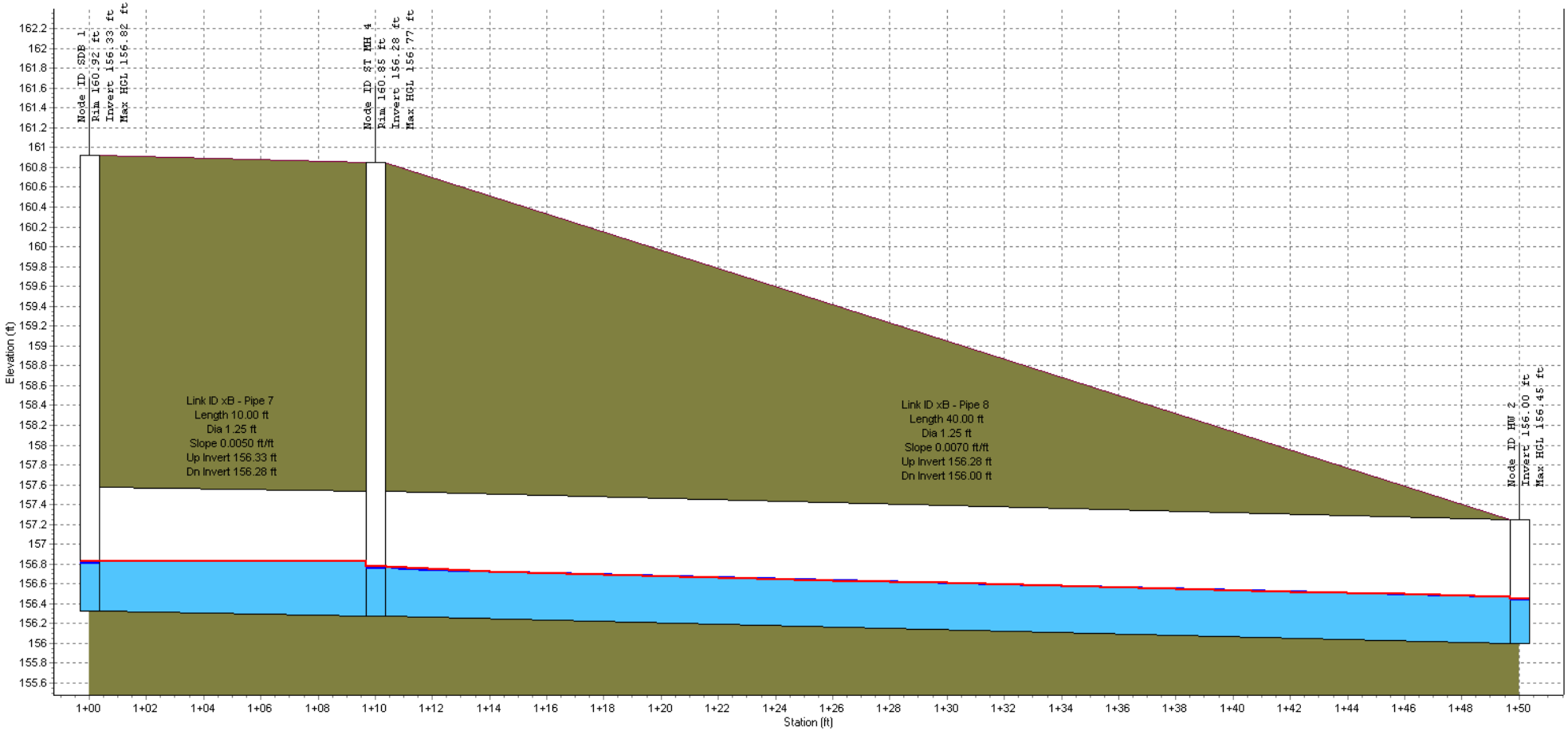


Node ID:	DI 7-TYPE E	ST MH 3	WQU-CDS-2	SSDB 1
Rim (ft):	159.50	161.57	162.08	
Invert (ft):	156.81	156.51	156.37	156.33
Min Pipe Cover (ft):		2.77	4.21	
Max HGL (ft):	157.78	157.97	157.33	157.25

Link ID:	B - Pipe 3	B - Pipe 4	B - Pipe 5
Length (ft):	60.00	28.00	7.00
Dia (ft):	1.25	1.50	1.50
Slope (ft/ft):	0.0050	0.0050	0.0057
Up Invert (ft):	156.81	156.51	156.37
Dn Invert (ft):	156.51	156.37	156.33
Max Q (cfs):	4.68	5.94	5.94
Max Vel (ft/s):	5.20	4.99	5.25
Max Depth (ft):	0.97	0.96	0.92

PENNEAST PIPELINE PROJECT - LAMBERTVILLE INTERCONNECT

Profile Plot

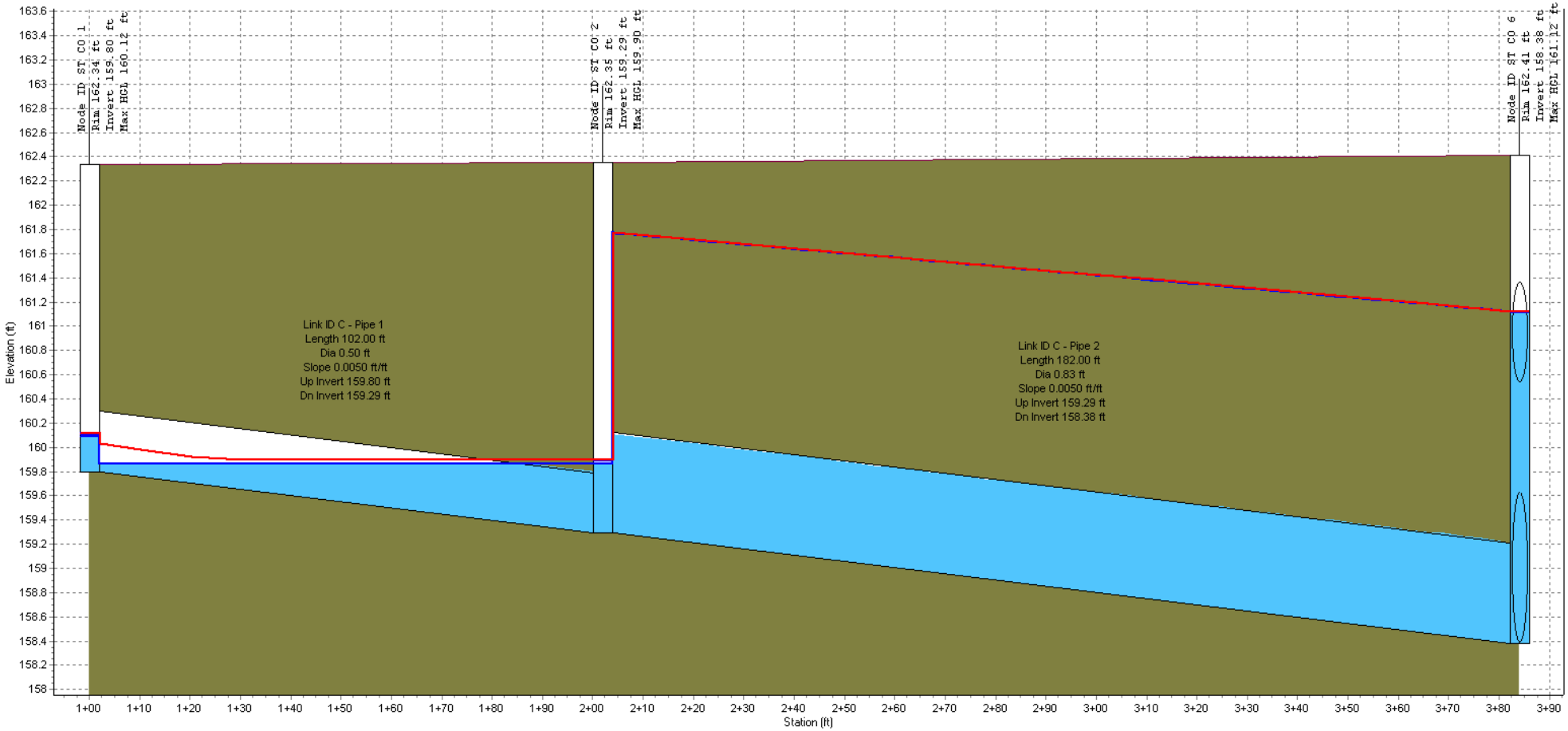


Node ID:	SDB 1	ST MH 4	HW 2
Rim (ft):	160.92	160.85	
Invert (ft):	156.33	156.28	156.00
Min Pipe Cover (ft):	3.34	3.32	
Max HGL (ft):	156.82	156.77	156.45

Link ID:	xB - Pipe 7	xB - Pipe 8
Length (ft):	10.00	40.00
Dia (ft):	1.25	1.25
Slope (ft/ft):	0.0050	0.0070
Up Invert (ft):	156.33	156.28
Dn Invert (ft):	156.28	156.00
Max Q (cfs):	1.63	1.63
Max Vel (ft/s):	3.61	4.09
Max Depth (ft):	0.49	0.45

PENNEAST PIPELINE PROJECT - LAMBERTVILLE INTERCONNECT

Profile Plot

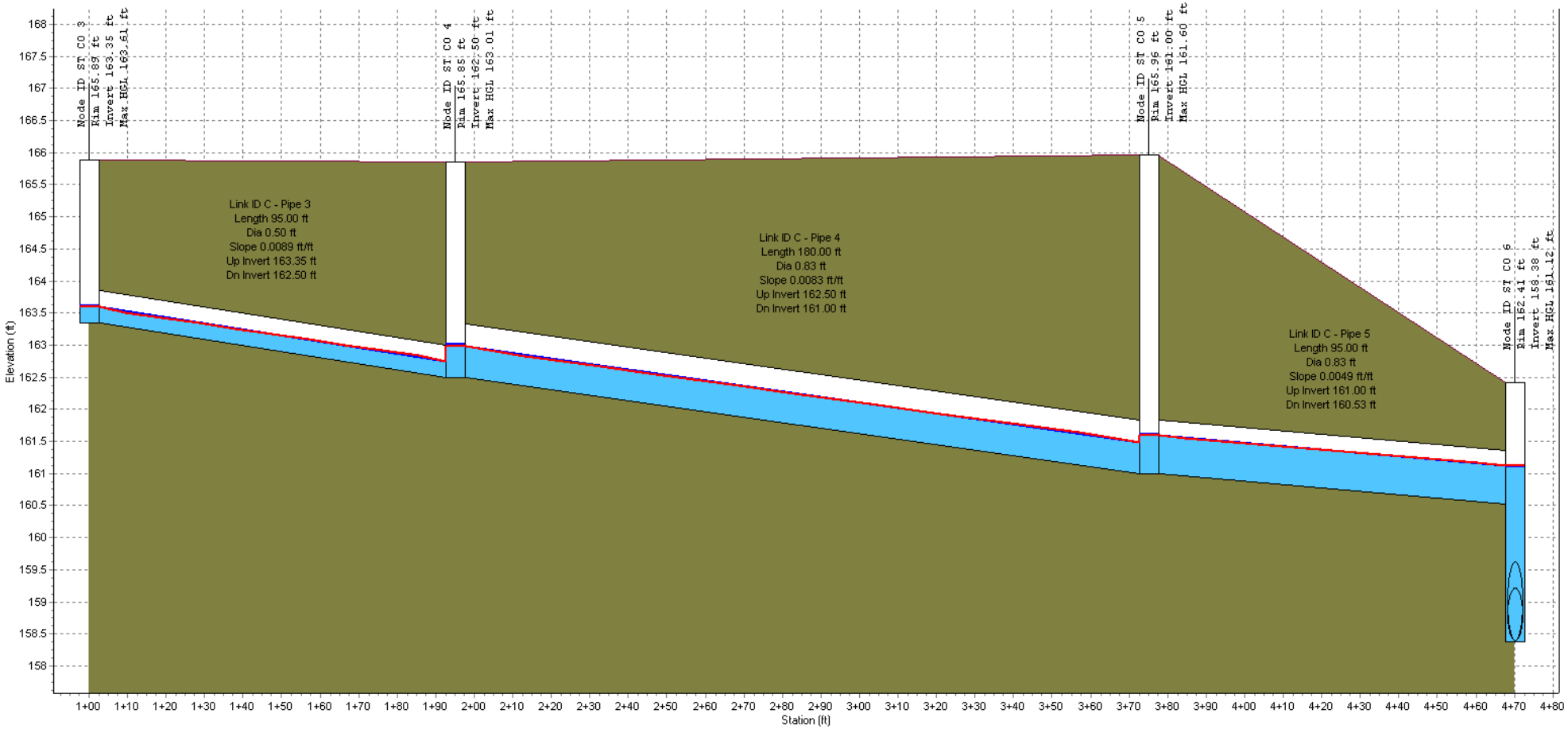


Node ID:	ST CO 1	ST CO 2	ST CO 6
Rim (ft):	162.34	162.35	162.41
Invert (ft):	159.80	159.29	158.38
Min Pipe Cover (ft):	2.04	2.23	1.05
Max HGL (ft):	160.12	159.90	161.12

Link ID:	C - Pipe 1	C - Pipe 2
Length (ft):	102.00	182.00
Dia (ft):	0.50	0.83
Slope (ft/ft):	0.0050	0.0050
Up Invert (ft):	159.80	159.29
Dn Invert (ft):	159.29	158.38
Max Q (cfs):	0.30	1.43
Max Vel (ft/s):	3.93	3.60
Max Depth (ft):	0.31	0.59

PENNEAST PIPELINE PROJECT - LAMBERTVILLE INTERCONNECT

Profile Plot

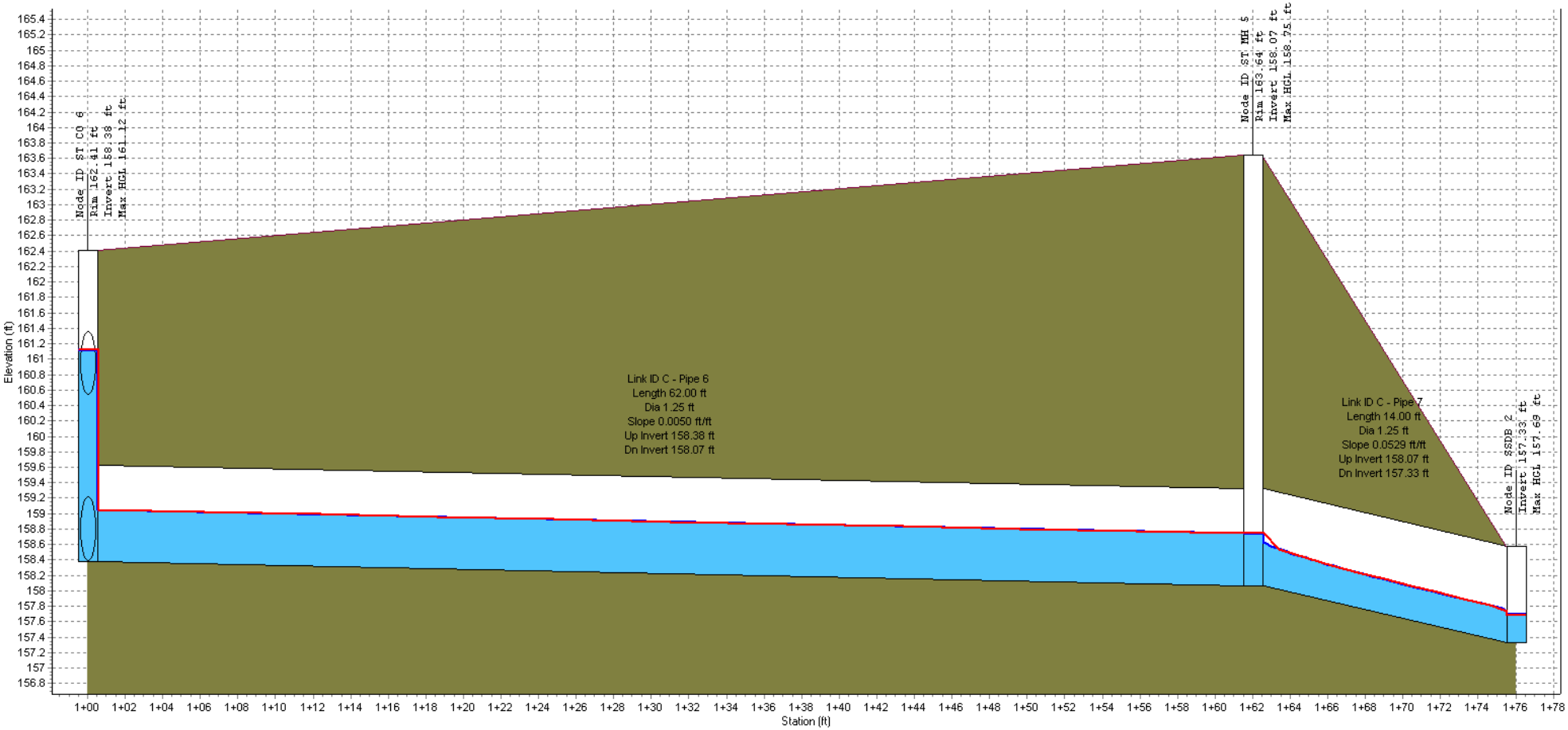


Node ID:	ST CO 3	ST CO 4	ST CO 5	ST CO 6
Rim (ft):	165.89	165.85	165.96	162.41
Invert (ft):	163.35	162.50	161.00	158.38
Min Pipe Cover (ft):	2.04	2.52	4.13	1.05
Max HGL (ft):	163.61	163.01	161.60	161.12

Link ID:	C - Pipe 3	C - Pipe 4	C - Pipe 5
Length (ft):	95.00	180.00	95.00
Dia (ft):	0.50	0.83	0.83
Slope (ft/ft):	0.0089	0.0083	0.0049
Up Invert (ft):	163.35	162.50	161.00
Dn Invert (ft):	162.50	161.00	160.53
Max Q (cfs):	0.30	1.45	1.43
Max Vel (ft/s):	4.61	4.36	3.52
Max Depth (ft):	0.26	0.50	0.59

PENNEAST PIPELINE PROJECT - LAMBERTVILLE INTERCONNECT

Profile Plot

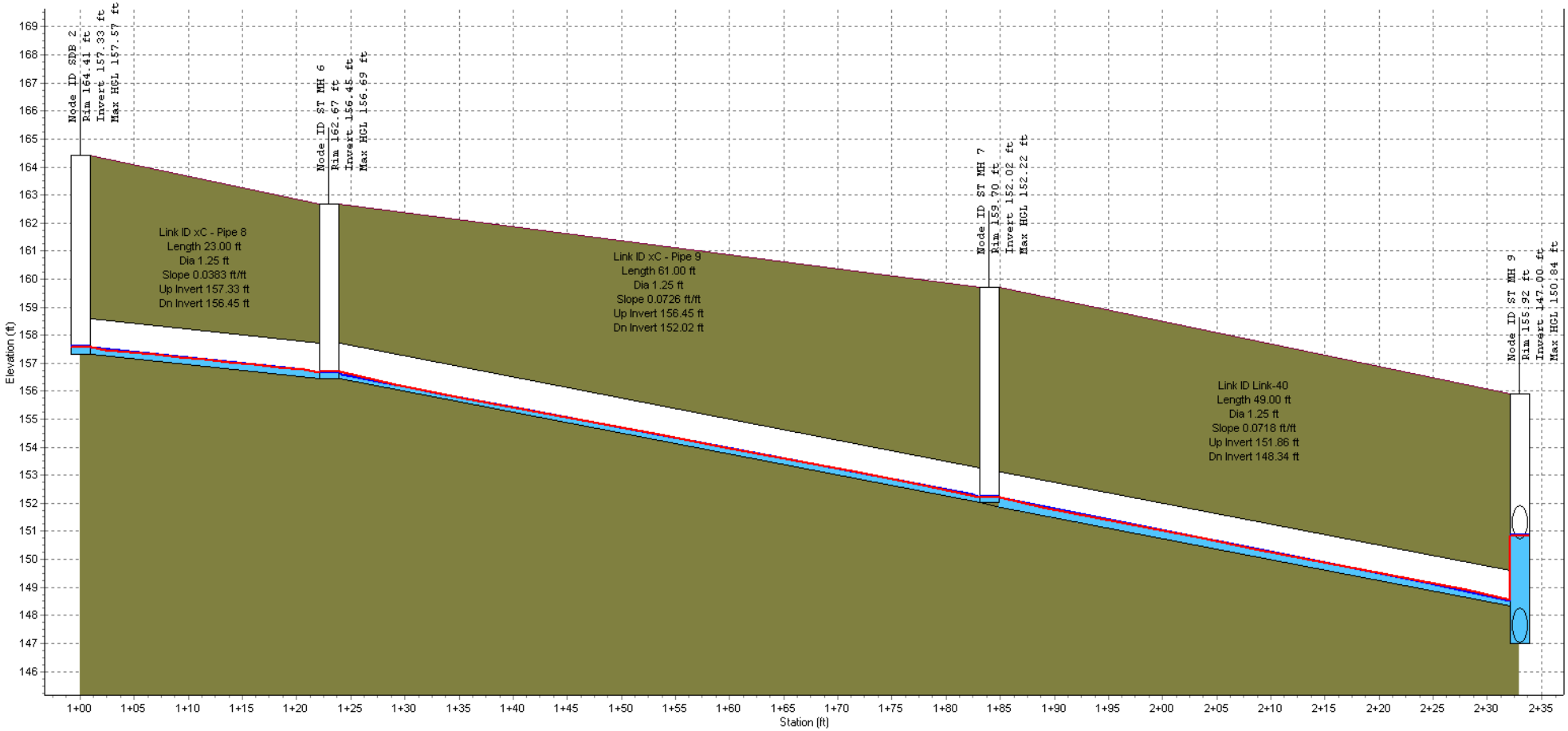


Node ID:	ST CO 6	ST MH 5	SSDB 2
Rim (ft):	162.41	163.64	
Invert (ft):	158.38	158.07	157.33
Min Pipe Cover (ft):	1.05	4.32	
Max HGL (ft):	161.12	158.75	157.69

Link ID:	C - Pipe 6	C - Pipe 7
Length (ft):	62.00	14.00
Dia (ft):	1.25	1.25
Slope (ft/ft):	0.0050	0.0529
Up Invert (ft):	158.38	158.07
Dn Invert (ft):	158.07	157.33
Max Q (cfs):	2.85	2.85
Max Vel (ft/s):	4.19	9.88
Max Depth (ft):	0.68	0.36

PENNEAST PIPELINE PROJECT - LAMBERTVILLE INTERCONNECT

Profile Plot

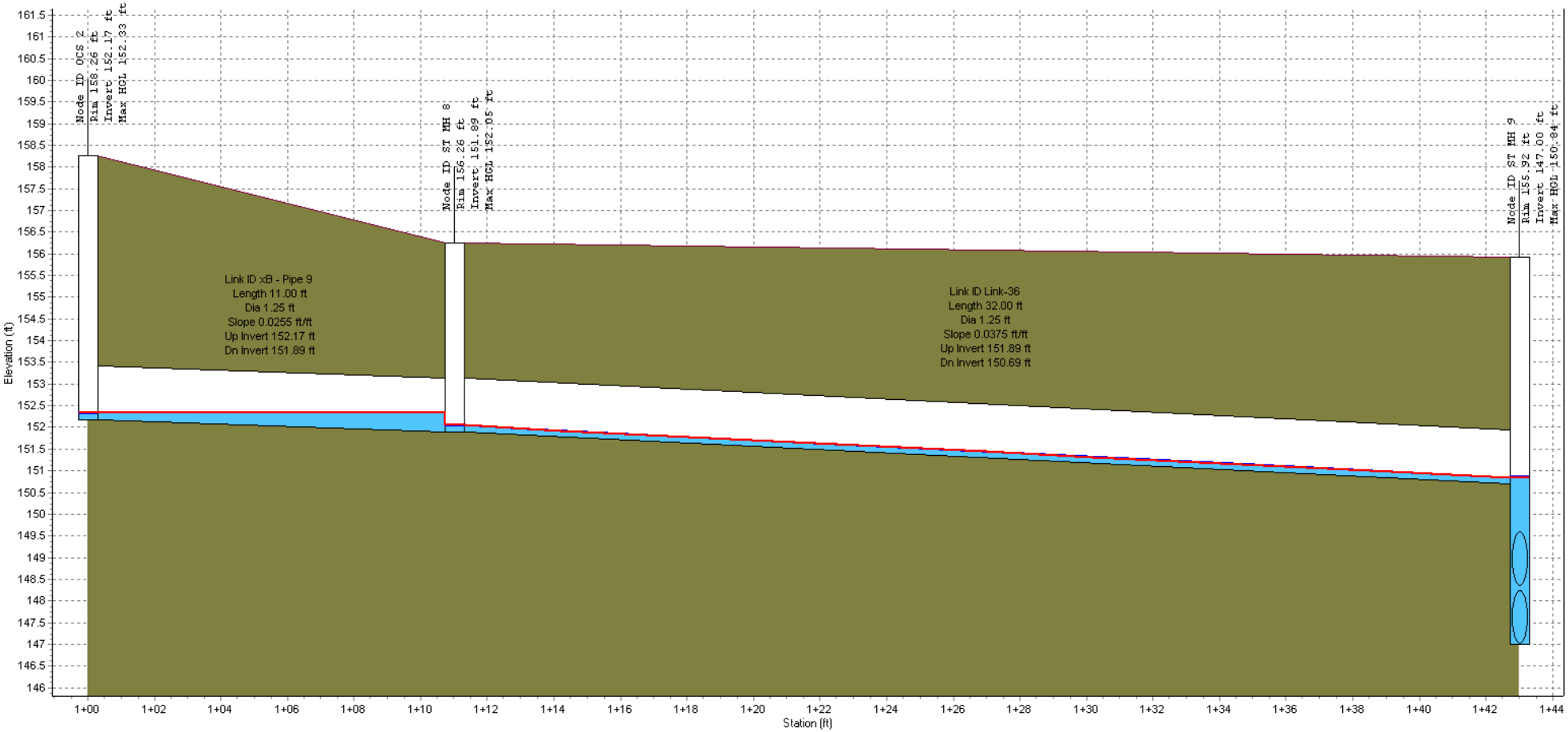


Node ID:	SDB 2	ST MH 6	ST MH 7	ST MH 9
Rim (ft):	164.41	162.67	159.70	155.92
Invert (ft):	157.33	156.45	152.02	147.00
Min Pipe Cover (ft):	5.83	4.97	6.43	3.98
Max HGL (ft):	157.57	156.69	152.22	150.84

Link ID:	xC - Pipe 8	xC - Pipe 9	Link-40
Length (ft):	23.00	61.00	49.00
Dia (ft):	1.25	1.25	1.25
Slope (ft/ft):	0.0383	0.0726	0.0718
Up Invert (ft):	157.33	156.45	151.86
Dn Invert (ft):	156.45	152.02	148.34
Max Q (cfs):	1.09	1.09	1.09
Max Vel (ft/s):	6.68	8.36	8.46
Max Depth (ft):	0.24	0.20	0.20

PENNEAST PIPELINE PROJECT - LAMBERTVILLE INTERCONNECT

Profile Plot

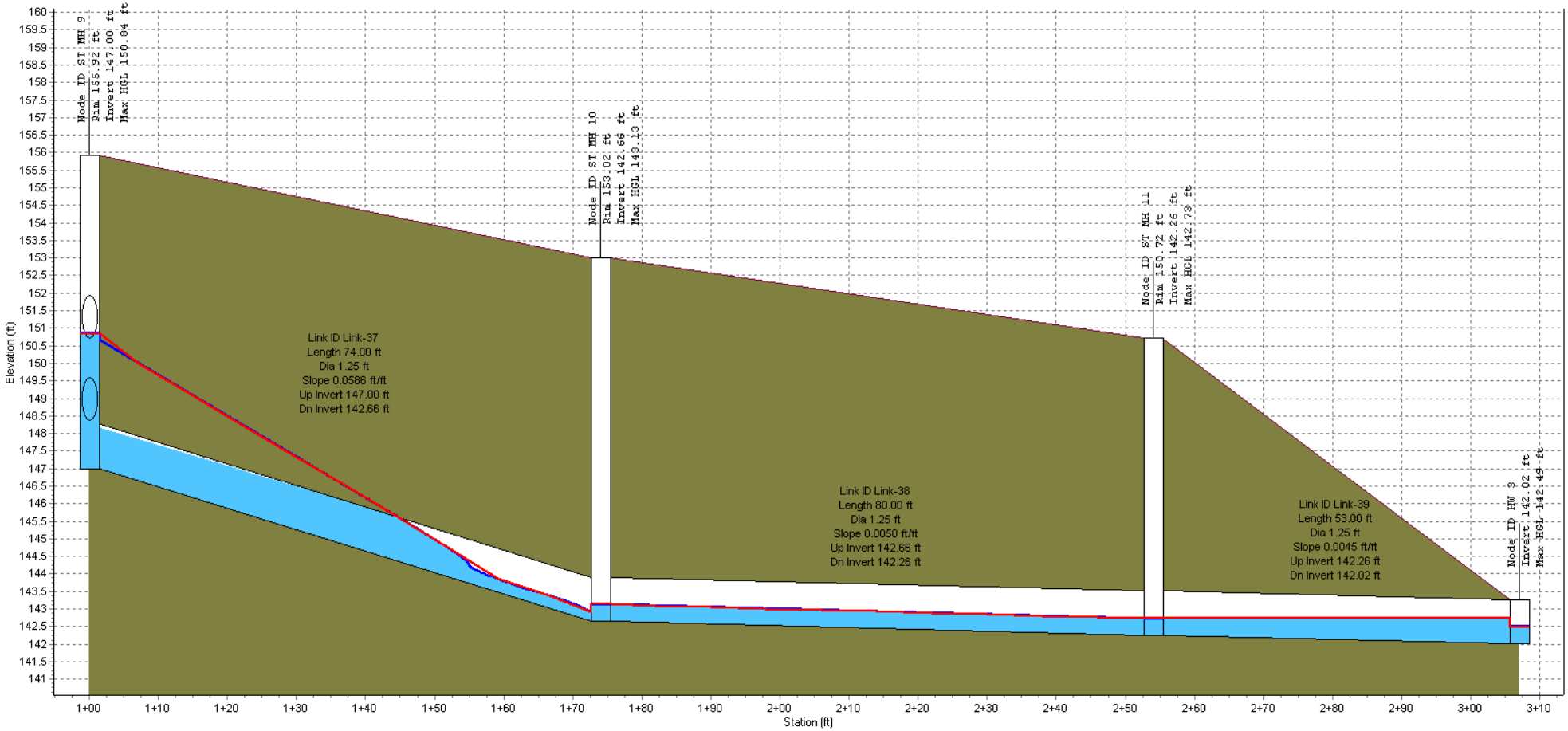


Node ID:	OCS 2	ST MH 8	ST MH 9
Rim (ft):	158.26	156.26	155.92
Invert (ft):	152.17	151.89	147.00
Min Pipe Cover (ft):	4.84	3.12	3.98
Max HGL (ft):	152.33	152.05	150.84

Link ID:	xB - Pipe 9	Link-36
Length (ft):	11.00	32.00
Dia (ft):	1.25	1.25
Slope (ft/ft):	0.0255	0.0375
Up Invert (ft):	152.17	151.89
Dn Invert (ft):	151.89	150.69
Max Q (cfs):	0.41	0.41
Max Vel (ft/s):	4.33	4.98
Max Depth (ft):	0.16	0.15

PENNEAST PIPELINE PROJECT - LAMBERTVILLE INTERCONNECT

Profile Plot

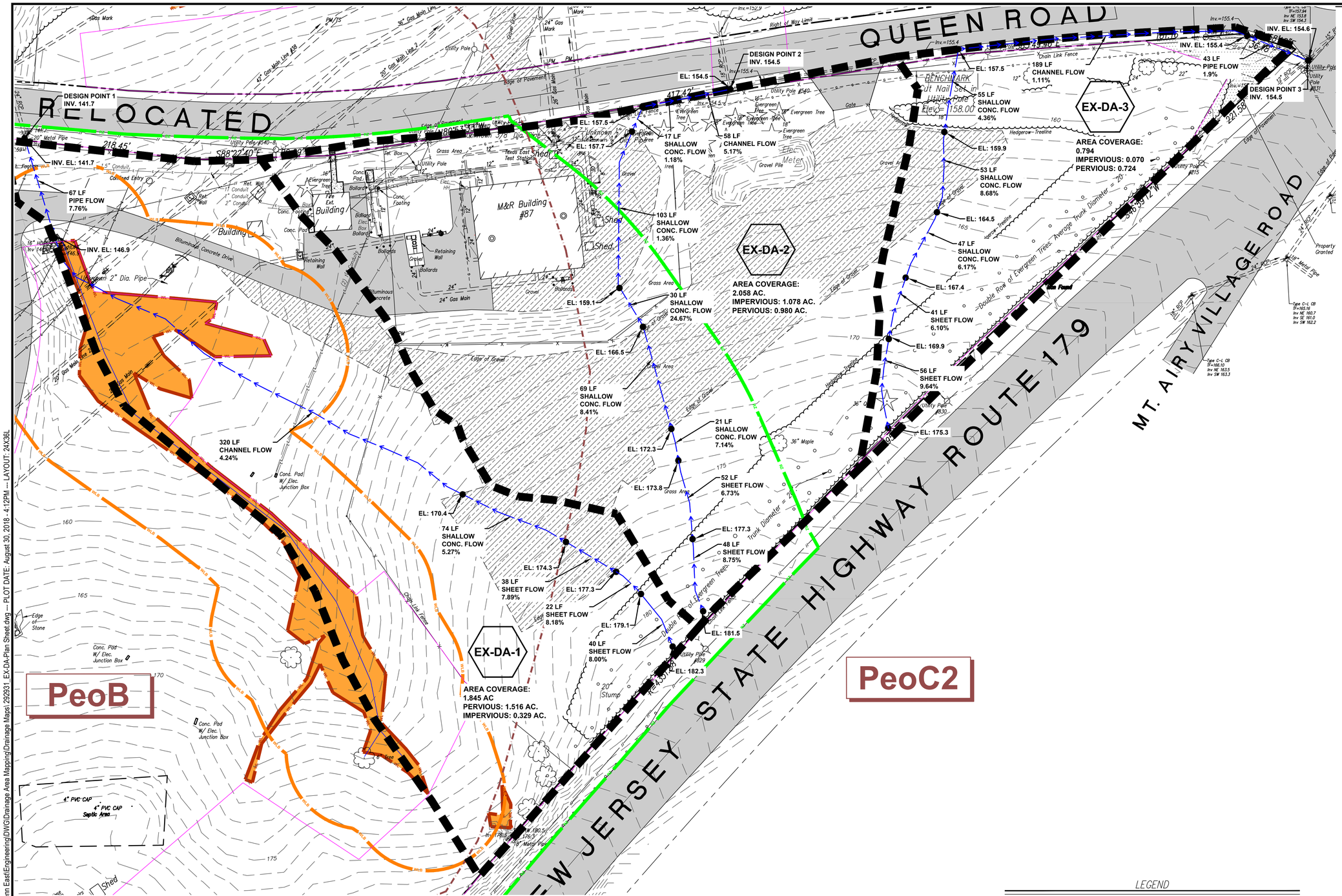


Node ID:	ST MH 9	ST MH 10	ST MH 11	HW 3
Rim (ft):	155.92	153.02	150.72	
Invert (ft):	147.00	142.66	142.26	142.02
Min Pipe Cover (ft):	3.98	9.11	7.21	
Max HGL (ft):	150.84	143.13	142.73	142.49

Link ID:	Link-37	Link-38	Link-39
Length (ft):	74.00	80.00	53.00
Dia (ft):	1.25	1.25	1.25
Slope (ft/ft):	0.0586	0.0050	0.0045
Up Invert (ft):	147.00	142.66	142.26
Dn Invert (ft):	142.66	142.26	142.02
Max Q (cfs):	1.50	1.50	1.50
Max Vel (ft/s):	8.53	3.53	3.53
Max Depth (ft):	0.25	0.47	0.47

APPENDIX I

PRE-AND POST-DEVELOPMENT DRAINAGE MAPS



RUNOFF QUANTITY SUMMARY

Existing Conditions		
STORM EVENT	VOLUME (AF)	PEAK FLOW (CFS)
2 Year Storm	0.599	6.43
10 Year Storm	1.112	12.11
100 Year Storm	2.169	23.47

TIME OF CONCENTRATION

Existing Drainage Area Time of Concentrations	
Drainage Area	Time of Concentration (min)
EX-DA-1	15
EX-DA-2	11.8
EX-DA-3	12.1

SOILS DATA

Symbol	Description
PeoB	Penn channery silt loam, 2 to 6 percent slopes
PeoC2	Penn channery silt loam, 6 to 12 percent slopes, eroded

DRAINAGE AREA SUMMARY

Drainage Area 1 - Existing Conditions			
Type	Area		CN
	Square Feet	Acres	
Grass Group C	64,136.02	1.472	72
Woods/Grass Group C	1,917.60	0.044	76
Gravel Group C	9,775.81	0.225	89
Impervious (Asphalt)	4,425.63	0.102	98
Impervious (Buildings)	96.54	0.002	98
Total:	**80,351.59**	**1.845**	**75.63**

Drainage Area 2 - Existing Conditions			
Type	Area		CN
	Square Feet	Acres	
Grass Group C	36,437.64	0.837	74
Woods/Grass Group C	6,245.89	0.143	72
Gravel Group C	36,328.33	0.834	89
Impervious (Asphalt)	5,889.19	0.135	98
Impervious (Buildings)	4,754.84	0.109	98
Total:	**89,655.88**	**2.058**	**82.79**

Drainage Area 3 - Existing Conditions			
Type	Area		CN
	Square Feet	Acres	
Grass Group C	19,223.58	0.441	74
Woods/Grass Group C	12,312.07	0.283	72
Gravel Group C	3,066.32	0.070	89
Impervious (Asphalt)	0.57	0.000	98
Total:	**34,602.55**	**0.794**	**74.62**

Total (Areas 1-3)			
Type	Area		CN
	Square Feet	Acres	
Total Pervious:	140,272.79	3.220	
Total Impervious:	64,337.23	1.477	
Total:	**204,610.02**	**4.697**	**78.59**

NOTES:

1. COORDINATES ARE REFERENCED TO THE NORTH AMERICAN DATUM (NAD) OF 1983 PROJECTED ONTO THE NEW JERSEY STATE PLANE COORDINATE SYSTEM.
2. ELEVATIONS DEPICTED ARE REFERENCED TO THE NORTH AMERICAN VERTICAL DATUM (NAVD) OF 1988 (NGVD29=NAVD88+0.90 FEET).
3. SURVEY PERFORMED BY LRC GROUP, INC.
4. FRESHWATER WETLANDS/WATERS BOUNDARY LINE AS VERIFIED BY NJDEP (FRESHWATER WETLANDS LETTER OF INTERPRETATION: LINE VERIFICATION FILE NO. 1026-02-0003.1) FOR BLOCK 5, LOT 6 ONLY.
5. WETLANDS AND WATERS BOUNDARY LINE(S) FOR BLOCK 5, LOT 6 ONLY AS SHOWN ON THE MAP ENTITLED: "NJDEP LETTER OF INTERPRETATION, LINE VERIFICATION – ENTIRE SITE, MARCELLUS TO MARKET PROJECT, LAMBERTVILLE COMPRESSOR STATION, HUNTERDON COUNTY, NEW JERSEY", CONSISTING OF THREE SHEETS, DATED OCTOBER 2016, LAST REVISED JANUARY 20, 2017, AND PREPARED BY BARRY A. GLEISSNER, P.L.S. OF AECOM.
6. WETLANDS AND WATERS BOUNDARY LINES DEPICTED ON BLOCK 5, LOT 5 DELINEATED BY TRC ENVIRONMENTAL CORPORATION ON AUGUST 11, 2017.
7. SOIL BOUNDARY INFORMATION OBTAINED FROM UNITED STATES GEOLOGICAL SURVEY (USGS) WEB SOIL SURVEY.

LEGEND

202	EXISTING TOPOGRAPHY
X	FENCELINE
	TREELINE
	EXISTING PAVEMENT
	EXISTING GRAVEL
	DECIDUOUS TREE
	CONIFER TREE
	UTILITY POLE
	FLOW PATH
EX-DA-1	DRAINAGE AREA LABEL
	DRAINAGE AREA BOUNDARY
	SOIL TYPE BOUNDARY
KkoD	SOIL TYPE LABEL
	STATE OPEN WATER
RZ	RIPARIAN ZONE (300 FT)
	WETLAND AREA
WL	WETLANDS AREA
WLB	WETLANDS TRANSITION AREA
FHA	FLOOD HAZARD AREA

PROJECT:
PENNEAST PIPELINE COMPANY, LLC
LAMBERTVILLE INTERCONNECT
WEST AMWELL TOWNSHIP, HUNTERDON COUNTY, NEW JERSEY

TITLE:
EXISTING DRAINAGE MAP

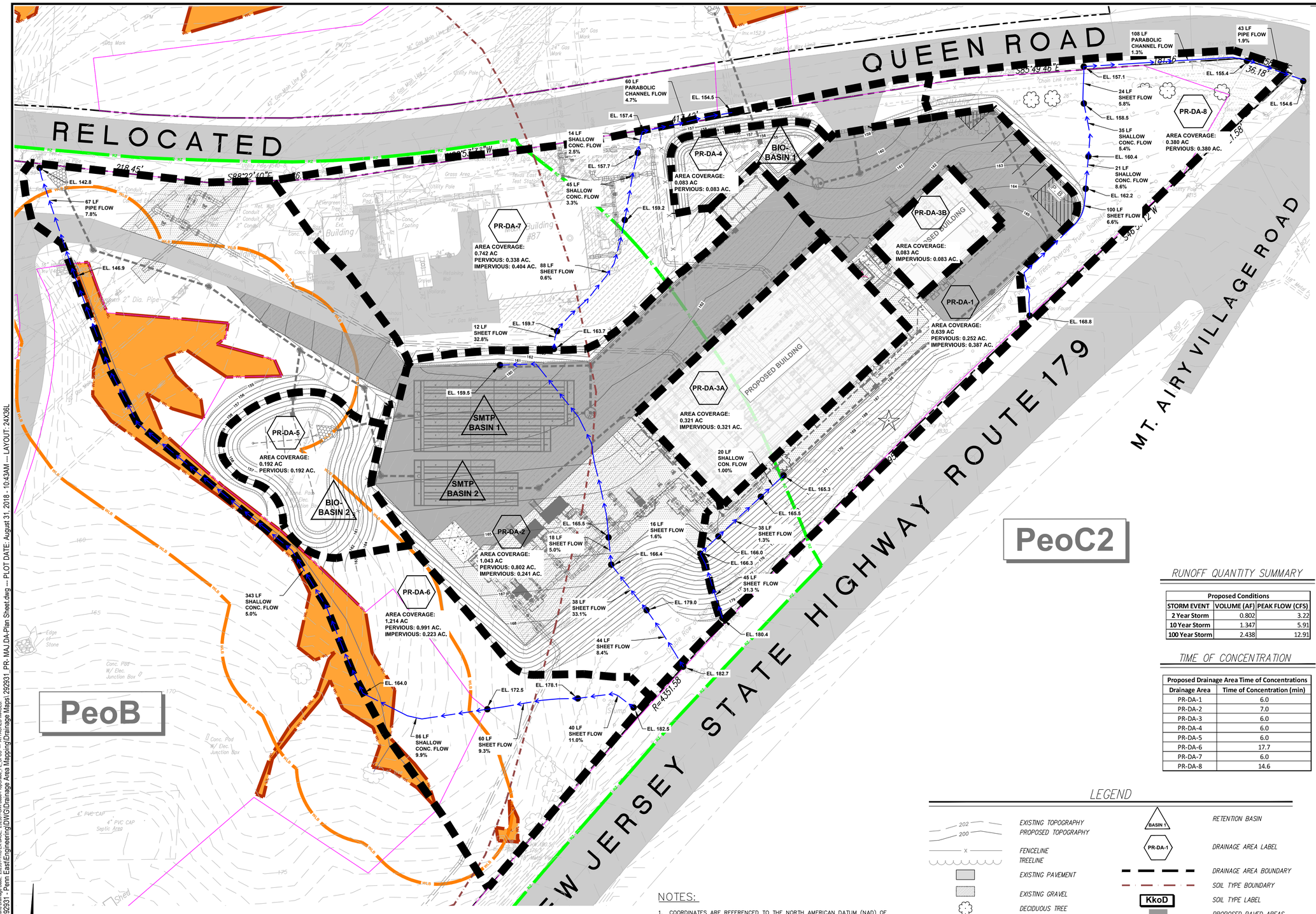
DRAWN BY:	AH	PROJ. NO.:	292931
CHECKED BY:	SB		
APPROVED BY:	BS		1
DATE:	AUGUST 2018		

TRC
41 Spring Street
Suite 102
New Providence, NJ 07974
Phone: 908.988.1700

FILE NO. 292931_EX-DA-Plan Sheet.dwg

24X36 --- ATTACHED XREF'S: 292931-TRC EX BASE --- ATTACHED IMAGES:
DRAWING NAME: W:\Vision Project Folders\292931 - Penn East\Engineering\DWG\Drainage Area Mapping\Drainage Maps\292931_EX-DA-Plan Sheet.dwg --- PLOT DATE: August 30, 2018 - 4:12PM --- LAYOUT: 24X36L

Version: 2017-03-09



SOILS DATA

Symbol	Description
PeoB	Penn channery silt loam, 2 to 6 percent slopes
PeoC2	Penn channery silt loam, 6 to 12 percent slopes, eroded

DRAINAGE AREA SUMMARY

Drainage Area 1 Proposed Conditions			
Type	Area		CN
	Square Feet	Acres	
Grass Group C	4,628.27	0.107	74
Woods/Grass Group C	6,324.41	0.145	72
Gravel Group C	3,480.02	0.080	89
Impervious (Asphalt)	12,736.86	0.292	98
Impervious (Concrete)	632.34	0.015	98
Total:	**27,801.89**	**0.638**	**86.96**

Drainage Area 2 Proposed Conditions			
Type	Area		CN
	Square Feet	Acres	
Grass Group C	8,111.77	0.186	74
Woods/Grass Group C	2,379.40	0.055	72
Gravel Group C	12,744.36	0.293	96
Impervious (Asphalt)	21,636.76	0.497	98
Impervious (Concrete)	542.47	0.012	98
Total:	**45,414.76**	**1.043**	**91.79**

Drainage Area 3 Proposed Conditions			
Type	Area		CN
	Square Feet	Acres	
Impervious (Buildings)	17,610.12	0.404	98
Total:	**17,610.12**	**0.404**	**98.00**

Drainage Area 4 Proposed Conditions			
Type	Area		CN
	Square Feet	Acres	
Woods/Grass Group C	3,625.58	0.083	72
Total:	**3,625.58**	**0.083**	**72.00**

Drainage Area 5 Proposed Conditions			
Type	Area		CN
	Square Feet	Acres	
Woods/Grass Group C	8,369.86	0.192	72
Total:	**8,369.86**	**0.192**	**72.00**

Drainage Area 6 Proposed Conditions			
Type	Area		CN
	Square Feet	Acres	
Grass Group C	42,732.36	0.981	74
Woods/Grass Group C	449.62	0.010	72
Gravel Group C	2,809.62	0.065	96
Impervious (Asphalt)	6,774.49	0.156	98
Impervious (Buildings)	96.54	0.002	98
Total:	**52,862.64**	**1.214**	**77.66**

Drainage Area 7 Proposed Conditions			
Type	Area		CN
	Square Feet	Acres	
Grass Group C	14,731.06	0.338	74
Gravel Group C	6,985.86	0.160	96
Impervious (Asphalt)	5,889.78	0.135	98
Impervious (Buildings)	4,754.84	0.109	98
Total:	**32,361.53**	**0.742**	**86.64**

Drainage Area 8 Proposed Conditions			
Type	Area		CN
	Square Feet	Acres	
Grass Group C	10,189.82	0.234	74
Woods/Grass Group C	6,366.94	0.146	72
Total:	**16,556.76**	**0.380**	**45.54**

Total (Areas 1-8)		
Type	Area	
	Square Feet	Acres
Total Pervious:	107,909.08	2.478
Total Impervious:	96,694.05	2.219
Total:	**204,603.13**	**4.697**

RUNOFF QUANTITY SUMMARY

Proposed Conditions		
STORM EVENT	VOLUME (AF)	PEAK FLOW (CFS)
2 Year Storm	0.802	3.22
10 Year Storm	1.347	5.91
100 Year Storm	2.438	12.91

TIME OF CONCENTRATION

Proposed Drainage Area Time of Concentrations	
Drainage Area	Time of Concentration (min)
PR-DA-1	6.0
PR-DA-2	7.0
PR-DA-3	6.0
PR-DA-4	6.0
PR-DA-5	6.0
PR-DA-6	17.7
PR-DA-7	6.0
PR-DA-8	14.6

LEGEND

- EXISTING TOPOGRAPHY (202)
- PROPOSED TOPOGRAPHY (200)
- FENCELINE
- TREELINE
- EXISTING PAVEMENT
- EXISTING GRAVEL
- DECIDUOUS TREE
- CONIFER TREE
- UTILITY POLE
- FLOW PATH
- WETLAND AREA
- WETLANDS AREA (WL)
- WETLANDS TRANSITION AREA (WLB)
- FLOOD HAZARD AREA (FHA)
- RETENTION BASIN (BASIN 1)
- DRAINAGE AREA LABEL (PR-DA-1)
- DRAINAGE AREA BOUNDARY
- SOIL TYPE BOUNDARY
- SOIL TYPE LABEL (KkoD)
- PROPOSED PAVED AREAS
- PROPOSED GRAVEL AREAS
- RIPARIAN AREA (RZ)
- PROPOSED MANHOLE
- PROPOSED PIPE
- PROPOSED INLET
- PROPOSED WATER QUALITY UNIT (WQ)
- PROJECT SITE

NOTES:

1. COORDINATES ARE REFERENCED TO THE NORTH AMERICAN DATUM (NAD) OF 1983 PROJECTED ONTO THE NEW JERSEY STATE PLANE COORDINATE SYSTEM.
2. ELEVATIONS DEPICTED ARE REFERENCED TO THE NORTH AMERICAN VERTICAL DATUM (NAVD) OF 1988 (NGVD29=NAVD88+0.90 FEET).
3. GRADING, ROAD, PAVEMENT AND FENCE DESIGN PERFORMED BY EN ENGINEERING, INC.
4. SURVEY PERFORMED BY LRC GROUP, INC.
5. FRESHWATER WETLANDS/WATERS BOUNDARY LINE AS VERIFIED BY NJDEP (FRESHWATER WETLANDS LETTER OF INTERPRETATION: LINE VERIFICATION FILE NO. 1026-02-0003.1) FOR BLOCK 5, LOT 6 ONLY.
6. WETLANDS AND WATERS BOUNDARY LINE(S) FOR BLOCK 5, LOT 6 ONLY AS SHOWN ON THE MAP ENTITLED: 'NJDEP LETTER OF INTERPRETATION, LINE VERIFICATION – ENTIRE SITE, MARCELLUS TO MARKET PROJECT, LAMBERTVILLE COMPRESSOR STATION, HUNTERDON COUNTY, NEW JERSEY', CONSISTING OF THREE SHEETS, DATED OCTOBER 2016, LAST REVISED JANUARY 20, 2017, AND PREPARED BY BARRY A. GLEISSNER, P.L.S. OF AECOM.
7. WETLANDS AND WATERS BOUNDARY LINES DEPICTED ON BLOCK 5, LOT 5 DELINEATED BY TRC ENVIRONMENTAL CORPORATION ON AUGUST 11, 2017.
8. SOIL BOUNDARY INFORMATION OBTAINED FROM UNITED STATES GEOLOGICAL SURVEY (USGS) WEB SOIL SURVEY.

PROJECT:
PENNEAST PIPELINE COMPANY, LLC
LAMBERTVILLE INTERCONNECT
WEST AMWELL TOWNSHIP, HUNTERDON COUNTY, NEW JERSEY

TITLE:
PROPOSED DRAINAGE MAP

DRAWN BY:	JH	PROJ NO.:	292931
CHECKED BY:	SB		2
APPROVED BY:	BS		
DATE:	AUGUST 2018		

TRC
41 Spring Street
Suite 102
New Providence, NJ 07974
Phone: 908.988.1700

FILE NO.: 292931_PR- MAJ.DA-Plan Sheet.dwg

24x36 -- ATTACHED XREFS: 292931_PR.DA-Proposed Grading and Drainage Base; 292931-TRC EX BASE; 292931-Civil Base-ProgCrade_PE_SPCS -- ATTACHED IMAGES:
DRAWING NAME: W:\Vision Project Folders\292931 - Penn East\Engineering\DWG\Drainage Area Mapping\Drainage Maps\292931_PR- MAJ.DA-Plan Sheet.dwg -- PLOT DATE: August 31, 2018 - 10:43AM -- LAYOUT: 24X36L
Version: 2017-03-03

APPENDIX J

SOIL EROSION AND SEDIMENT CONTROL CALCULATIONS

Conduit Outlet Protections Calculations

TRC

Project:	**Penn East Lambertville Interconnect**	**Project No.:**	**292931**
Subject:	**Conduit Outlet Protection Basin 1 Entrance**	**Date:**	**8/14/18**
Reference:	**Standards for Soil Erosion and Sediment Control in New Jersey**	**Comp. By:**	**SB**
		Chckd. By:	**BS**

1. Maximum Inside Culvert Height, D_o		ft	1.25
2. Maximum Inside Culvert Width, W_o		ft	1.25
3. Design Storm, Q		cfs	3.54
4. Unit Discharge, q	$q = \frac{Q}{W_o}$	cfs/ft	2.83
5. Tailwater, TW	$TW = 0.2D_o$	ft	0.25

A. Apron Dimensions - Unconfined Outlet

IF TW < 1/2 Do

6. Length of Apron	$L_a = 1.8\left(\frac{q}{D_o^{0.5}}\right) + 7D_o$	ft	13.31
7. Width of Apron	$W_a = 3W_o + L_a$	ft	17.06

IF TW > 1/2 Do

8. Length of Apron	$L_a = 3\left(\frac{q}{D_o^{0.5}}\right)$	ft	
9. Width of Apron	$W_a = 3W_o + 0.4L_a$	ft	

B. RipRap Sizing - Unconfined Outlet

10. Medium Stone Diameter, d_{50}	$d_{50} = \frac{0.02}{TW} q^{1.33}$	ft	0.32
11. Mannings Roughness Coefficient	$n = 0.0395(d_{50})^{\frac{1}{6}}$		0.033

C. Thickness of Rip-rap Lining

14. Rip-rap thickness if a filter layer is not used		in	11.50
15. Rip-rap thickness if a filter layer is used		in	7.67

TRC

Project:	**Penn East Lambertville Interconnect**	**Project No.:**	**292931**
Subject:	**Conduit Outlet Protection Basin 1 Exit - HW 1**	**Date:**	**8/14/18**
Reference:	**Standards for Soil Erosion and Sediment Control in New Jersey** **Silt Loam - Vmax = 3 ft/sec**	**Comp. By:**	**SB**
		Chckd. By:	**BS**

1. Maximum Inside Culvert Height, D_o		ft	1.25
2. Maximum Inside Culvert Width, W_o		ft	1.25
3. Design Storm, Q		cfs	0.58
4. Unit Discharge, q	$q = \frac{Q}{W_o}$	cfs/ft	0.46
5. Tailwater, TW	$TW = 0.2D_o$	ft	0.25

A. Apron Dimensions - Unconfined Outlet

IF TW < 1/2 Do

6. Length of Apron	$L_a = 1.8\left(\frac{q}{D_o^{0.5}}\right) + 7D_o$	ft	9.50
7. Width of Apron	$W_a = 3W_o + L_a$	ft	13.25

IF TW > 1/2 Do

8. Length of Apron	$L_a = 3\left(\frac{q}{D_o^{0.5}}\right)$	ft	
9. Width of Apron	$W_a = 3W_o + 0.4L_a$	ft	

B. RipRap Sizing - Unconfined Outlet

10. Medium Stone Diameter, d_{50}	$d_{50} = \frac{0.02}{TW} q^{1.33}$	ft	0.03
11. Mannings Roughness Coefficient	$n = 0.0395(d_{50})^{\frac{1}{6}}$		0.022

C. Thickness of Rip-rap Lining

14. Rip-rap thickness if a filter layer is not used		in	1.04
15. Rip-rap thickness if a filter layer is used		in	0.69

TRC

Project:	**Penn East Lambertville Interconnect**	**Project No.:**	**292931**
Subject:	**Conduit Outlet Protection Basin 2 Entrance - HW 2**	**Date:**	**8/14/18**
Reference:	**Standards for Soil Erosion and Sediment Control in New Jersey**	**Comp. By:**	**SB**
		Chckd. By:	**BS**

1. Maximum Inside Culvert Height, D_o		ft	1.25
2. Maximum Inside Culvert Width, W_o		ft	1.25
3. Design Storm, Q		cfs	1.87
4. Unit Discharge, q	$q = \frac{Q}{W_o}$	cfs/ft	0.10
5. Tailwater, TW	$TW = 0.2D_o$	ft	0.25

A. Apron Dimensions - Unconfined Outlet

IF TW < 1/2 Do

6. Length of Apron	$L_a = 1.8\left(\frac{q}{D_o^{0.5}}\right) + 7D_o$	ft	8.91
7. Width of Apron	$W_a = 3W_o + L_a$	ft	12.66

IF TW > 1/2 Do

8. Length of Apron	$L_a = 3\left(\frac{q}{D_o^{0.5}}\right)$	ft	
9. Width of Apron	$W_a = 3W_o + 0.4L_a$	ft	

B. RipRap Sizing - Unconfined Outlet

10. Medium Stone Diameter, d_{50}	$d_{50} = \frac{0.02}{TW} q^{1.33}$	ft	0.0037
11. Mannings Roughness Coefficient	$n = 0.0395(d_{50})^{\frac{1}{6}}$	ft	0.016

C. Thickness of Rip-rap Lining

14. Rip-rap thickness if a filter layer is not used		in	0.13
15. Rip-rap thickness if a filter layer is used		in	0.09

TRC

Project:	**Penn East Lambertville Interconnect**	**Project No.:**	**292931**
Subject:	**Conduit Outlet Protection Basin 2 - HW 3**	**Date:**	**8/14/18**
Reference:	**Standards for Soil Erosion and Sediment Control in New Jersey**	**Comp. By:**	**SB**
		Chckd. By:	**BS**

1. Maximum Inside Culvert Height, D_o		ft	1.25
2. Maximum Inside Culvert Width, W_o		ft	1.25
3. Design Storm, Q_{25}		cfs	0.38
4. Unit Discharge, q	$q = \frac{Q}{W_o}$	cfs/ft	0.30
5. Tailwater, TW	$TW = 0.2D_o$	ft	0.25

A. Apron Dimensions - Unconfined Outlet

IF TW < 1/2 Do

6. Length of Apron	$L_a = 1.8\left(\frac{q}{D_o^{0.5}}\right) + 7D_o$	ft	9.24
7. Width of Apron	$W_a = 3W_o + L_a$	ft	12.99

IF TW > 1/2 Do

8. Length of Apron	$L_a = 3\left(\frac{q}{D_o^{0.5}}\right)$	ft	
9. Width of Apron	$W_a = 3W_o + 0.4L_a$	ft	

B. RipRap Sizing - Unconfined Outlet

10. Medium Stone Diameter, d_{50}	$d_{50} = \frac{0.02}{TW} q^{1.33}$	ft	0.02
11. Mannings Roughness Coefficient	$n = 0.0395(d_{50})^{\frac{1}{6}}$		0.020

C. Thickness of Rip-rap Lining

14. Rip-rap thickness if a filter layer is not used		in	0.59
15. Rip-rap thickness if a filter layer is used		in	0.39

Basin Summary Forms

STATE SOIL CONSERVATION COMMITTEE
HYDRAULIC AND HYDROLOGIC DATABASE SUMMARY FORM FOR
STORMWATER MANAGEMENT BASINS

Pursuant to N.J.S.A. 4:29-39 et. seq. and as required for Application for Soil Erosion and Sediment Control Plan Certification the following hydraulic and hydrologic information regarding the proposed project is provided for Detention, Retention and Infiltration basins. A separate form must be completed for each basin. (See Guidelines to complete form on last page)

1. Name of Project: Penneast Pipeline Project- Lambertville Interconnect
   1a. Date of Submission: _

2. Municipality: West Amwell

3. County: Hunterdon

4. As built/Design (Circle) 5. Date: _____

6. Basin is in Block: 6_____Lot: 5

7. Height of Dam: _____ Top width of Dam: _____

8. Dam Classification: _____

9. Type of Basin (Circle): Detention/Retention/Infiltration

10. Name of Creek, Stream, or area into which the Basin discharges: Alexauken Creek

Basin outlet location (NJSPC feet, NAD83): N_____378662_____E_____571647_____

For District Use Only
File Name:
County:
Watershed:
Subwatershed

Basin Outlet Design Data: Proposed Bioretention Basin 1

11 Type of Outlet	12 Orifice Size or Weir Length (in.)	12 Elevation (USGS)	14 Discharge Coefficient	15 Exponent
Round culvert	15	151.80	0.900	N/A
Exfiltration	Surface Area	155.00	N/A	N/A
Vertical Orifice	2.5”	156.00	0.60	0.5
Vertical Orifice	6”x6”	157.30	0.60	1.5
Horizontal Grate	18” x 30”	158.24	0.60	1.5

Bioretention Basin 1 Stage-Discharge Data

16 Elevation (USGS Feet)	17 Storage (Acre-Ft)	18 Total Outlet Structure Discharge (cfs)
159.00	0.206	1.82
158.00	0.145	1.11
157.00	0.091	0.23
156.00	0.042	0.70
155.00	0.000	0.000

Post Development Watershed Data (Submit copy of USGS Map, GIS shape file or CADD file showing the site footprint)[1]:

19 Drainage Area Name	20 Drainage Area (sq miles)	21 Post-Development CN#	22 Percent Impervious	23 Time of Concentration (hrs)
1-I	0.0006	98	79.33	0.1000
1-P	0.0003	75	0.00	0.100
5-P	0.0001	74	0.00	0.100

1. GIS shape or CADD file should be in NJSPC feet, NAD83

Project Area Soil Type by Block and Lot Numbers:

24 Block	25 Lot	26 Soil Type	24 Block	25 Lot	26 Soil Type
5	6	PeoB			

27. Name of responsible parties that will maintain this basin:

Name: William Brett of ENBRIDGE Street Address: 890 Winter Street, Suite 300
Municipality: Waltham State: MA Zip Code: 02451
Phone Number: (617)-560-1371

Basin Outlet Design Data: Proposed Bioretention Basin 2

11 Type of Outlet	12 Orifice Size or Weir	12 Elevation (USGS)	14 Discharge Coefficient	15 Exponent
Round Culvert	15	152.17	0.90	N/A
Exfiltration	Surface Area	156.0	N/A	N/A
Vertical Orifice	2.5	157.0	0.60	.5
Vertical Orifice	4.0	157.54	0.60	1.5
Horizontal Grate	18 x 24	158.23	0.60	1.5

Basin Stage-Discharge Data

16 Elevation (USGS Feet)	17 Storage (Acre-Ft)	18 Total Outlet Structure Discharge (cfs)
156.00	0.00	0.00
157.00	0.08	0.14
158.00	0.18	0.55
159.00	0.31	0.91

Post Development Watershed Data (Submit copy of USGS Map, GIS shape file or CADD file showing the site footprint)[1]:

19 Drainage Area Name	20 Drainage Area (sq miles)	21 Post-Development CN#	22 Percent Impervious	23 Time of Concentration (hrs)
2-I	.001	97	63.47	0.12
2-P	.0003	74	0.00	0.12
4-P	.0003	74	0.00	0.10

1. GIS shape or CADD file should be in NJSPC feet, NAD83

Project Area Soil Type by Block and Lot Numbers:

24 Block	25 Lot	26 Soil Type	24 Block	25 Lot	26 Soil Type
5	6	PeoC			

28. Name of responsible parties that will maintain this basin:

Name: William Brett of ENBRIDGE Street Address: 890 Winter Street, Suite 300
Municipality: Waltham State: MA Phone Number: (617)-560-1371

APPENDIX L

STORMWATER MANAGEMENT SYSTEM OPERATION AND MAINTENANCE MANUAL

Lambertville Interconnect

Stormwater Management System Operation and Maintenance Manual

PennEast Pipeline Project
West Amwell Township, Hunterdon County, NJ

Prepared by:

TRC Engineers, Inc.
Attn: Barry J. Sutherland, PE, PP
41 Spring Street, Suite 102
New Providence, NJ 07974

June 28, 2019

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I. INTRODUCTION

In accordance with the requirements of the New Jersey Department of Environmental Protection ("NJDEP") Stormwater Management Rules at N.J.A.C. 7:8, a stormwater management system will be installed to meet local and state regulatory requirements and minimize environmental impacts from stormwater at the LAMBERTVILLE Interconnect Project site, located at 1325 Route 179 along the Alexauken River in Lambertville, Hunterdon County, New Jersey. The system consists of several structural "Best Management Practices" (BMPs), which have been designed in accordance with N.J.A.C. 7:8 and the NJDEP Stormwater Best Management Practices. The specific structural BMP's design for this site are as follows:

SYSTEM 1:

- **CDS Unit 1 - Hydrodynamic Separator** - NJDEP certified manufactured treatment device providing 50 percent TSS removal pretreatment upstream of Bioretention Basin 1;

- **Bioretention Basin 1 (Online System)** - Designed to provide 90 percent Total Suspended Solids (TSS) removal and a portion of the required quantity control volume using a multistage outflow control structure. This treatment train provides the required 95 percent TSS removal.

  Bioretention Basin 1 is lined with impermeable PVC liner to prevent potential source materials from infiltrating into groundwater. Bioretention Basin 1 is also equipped with an underdrain system above the liner to allow basin soils to drain within 72 hours.

SYSTEM 2:

- **CDS Unit 2 - Hydrodynamic Separator** - NJDEP certified manufactured treatment device providing 50 percent TSS removal pretreatment upstream of Bioretention Basin 2;

- **Subsurface Detention Basin 1** - Consists of StormTrap® SingleTrap® precast concrete underground chambers with built-in multistage outflow control structure to provide a portion of the required quantity control storage volume;

- **Bioretention Basin 2 (Online System)** - Designed to provide 90 percent Total Suspended Solids (TSS) removal and a portion of the required quantity control volume using a multistage outflow control structure. This treatment train provides the required 95 percent TSS removal.

  Subsurface Detention Basin 2 and Bioretention Basin 2 are lined with impermeable

PVC liner to prevent potential source materials from infiltrating into groundwater. Bioretention Basin 2 is also equipped with an underdrain system above the liner to allow basin soils to drain within 72 hours.

SYSTEM 3:

- **Subsurface Detention Basin 2** - Consists of StormTrap® SingleTrap® precast concrete underground chambers with built-in multistage outflow control structure to provide a portion of the required quantity control storage volume for roof drainage areas only. Since NJDEP does not require quality treatment for areas draining from rooftops, no quality control treatment is required for this runoff;

Regular maintenance of stormwater BMPs is necessary for the systems to perform reliably and effectively. If not maintained, they could retain more water for longer periods of time than required, heightening the potential for increased mosquito breeding and unsafe or unhealthy conditions.

This document was prepared to serve as a guide for the property owner, ensuring long-term effectiveness and functioning of the stormwater BMPs at the site. This plan provides guidance on specific preventive and corrective maintenance tasks, necessary equipment, and recommendations on facilitate inspections and minimizing maintenance costs.

II. BMP DESCRIPTIONS

As described in Section I, three (3) separate stormwater BMP systems will be installed on the Project site.

System 1 consists of two different categories of BMP's installed in series. Upstream manufactured treatment device with 50 percent TSS treated effluent flowing into a downstream online bioretention basin for further 90 percent TSS treatment and quantity control, for a combined total of 95 percent TSS removal and quantity control;

System 2 consists of three different categories of BMP's installed in series: upstream manufactured treatment device with 50 percent TSS treated effluent flowing into a downstream StormTrap® precast vault system downstream that provides quantity control, followed by an online 90 percent TSS treatment bioretention basin that also provides quantity control, for a total of 95 percent TSS removal and quantity control.

System 3 consists of one type of BMP, StormTrap® precast vault system providing quantity control for roof runoff only.

These systems combined provide 95 percent TSS removal, as required for the Project site. These systems meet the required stormwater quantity control and pollutant removal efficiencies.

The following descriptions detail the function and role of each BMP. A site plan with the BMP designs is included in Appendix A. Key items specific to the function of the system are indicated.

A. CDS® Hydrodynamic Separators

The NJDEP currently certifies the use of the CDS® Stormwater Treatment Device by Contech Engineered Solutions, LLC at a TSS removal rate of 50 percent when designed, operated, and maintained in accordance with its NJDEP Revised Lab Certification Letter dated March 21, 2017. These CDS units, installed upstream of each Bioretention Basin described in Section B below, will combine with the 90 percent TSS removal rates of the Bioretention Basins to provide 95 percent TSS removal levels required for this project.

CDS Unit 1 will be installed upstream of Bioretention Basin 1. CDS Unit 2 will be installed upstream of Subsurface Basin 1 and Bioretention Basin 2.

The CDS hydrodynamic separator uses swirl concentration and continuous deflective separation to screen, separate and trap trash, debris, sediment, and hydrocarbons from stormwater runoff. CDS captures and retains 100 percent of floatables and neutrally buoyant debris 2.4mm or larger, effectively removes sediment, and is the only non-blocking screening technology available in a

stormwater treatment device.

CDS retains all captured pollutants, even at high flow rates, and provides easy access for maintenance.

- Stormwater enters the CDS through one or multiple inlets and/or a grate inlet.

- The inlet flume guides the treatment flow into the separation chamber where water velocities within the chamber create a swirling vortex.

- Water velocities in the swirl chamber continually shear debris off the treatment screen, making it the only non-blocking screening technology available in a hydrodynamic separation system.

- The combination of swirl concentration and indirect screening force floatables and solids to the center of the separation chamber trapping 100 percent of floatables and neutrally buoyant debris larger than the screen aperture.

- Sediment settles into an isolated sump while floatables and neutrally buoyant pollutants are captured in the separation cylinder. All pollutants remain in these sections of the unit until they are removed during maintenance.

- Stormwater then moves under the hydrocarbon baffle, and the treated water exits the system. The baffle acts as a wall for hydrocarbon containment. It contains previously captured hydrocarbons and prevents the agitation of hydrocarbons when high-flows spill over the diversion weir.

- During high-intensity events, the internal diversion weir directs a portion of flows greater than the design storm around the treatment chamber and over an internal bypass weir.

- Treated stormwater exits the CDS via the outlet pipe and into the Bioretention Basins for additional TSS removal.

B. Bioretention Basins

The bioretention basins are stormwater management facilities used to address stormwater quality and quantity impacts of the project. The system typically consists of a soil bed planted with vegetation with underdrains. Pollutants are treated through the process of settling and uptake and filtration by the vegetation. Pollutants are also treated within the soil bed through infiltration. The total suspended solids (TSS) removal rate is 90 percent, based upon the depth of soil

and type of vegetation selected. The CDS units described in Section A provide pretreatment, and the underdrain system collects treated runoff and discharges it downstream.

Bioretention Basin 1, located along Queen Road in the norther area of the Site, is designed as online system with underdrains which provides treatment for the water quality design storm, and storage and attenuation of larger storm events.

Bioretention Basin 2, located along the western area of the Project site bordering SOW-B, is also designed as online system with underdrains which provides treatment for the water quality design storm, and storage and attenuation of larger storm events.

The soil bed for both bioretention basis is 24 inches in depth, following by a six-inch sand layer, and a gravel layer containing perforated underdrain pipes which have the capacity to allow the basin to drain within 72 hours. The basin is planted with terrestrial forested community vegetation in accordance with the NJDEP BMP manual, to provide 90 percent TSS removal.

Both basins have a multi-stage outlet structure with trash racks to allow storage and attenuation of the 2, 10 and 100-year storms.

C. Subsurface Detention Systems

The subsurface detention systems consist of StormTrap® SingleTrap® precast concrete underground chambers with an interior vault height of 2’-8”. A built-in multistage outflow control structure is included in each system to provide a portion of the required quantity control storage volume. The systems are placed on a bed of stone, covered by an impermeable PVC liner.

III. MAINTENANCE

Effective BMP system performance requires regular and effective maintenance. The following section provides information and requirements necessary to keep the systems at the development functioning properly.

A. Responsibilities

The following individual or organization is responsible for maintenance of the stormwater BMPs at the site:

William Brett
Supervisor
Environmental Construction Permitting
ENBRIDGE
890 Winter Street, Suite 300
Waltham, MA 02451

B. Schedules

Maintenance should be completed on a routine basis along with required inspections as outlined later in this manual. Specific tasks have been outlined in the following sections and should be closely followed to ensure the effectiveness and longevity of the BMP systems and avoid costly repairs.

C. Access

All the BMPs must be accessible for inspection and maintenance. Access routes have been provided in the overall design of the site, and these areas need to be kept clear and free of obstructions so that equipment and personnel can complete necessary work in a timely fashion. No physical structures should be placed in the access easements, and all trees, shrubs, and underbrush must be pruned or trimmed as necessary to maintain this access.

D. Safety

Standard safety precautions should be taken when maintaining the stormwater facilities. The primary concern for these systems is related to standing water remaining in the systems for more than 48 hours. While the parts of the system are designed to hold no more than one foot of standing water, extreme caution should be used when entering any areas of standing water.

E. Equipment, Tools, and Supplies

Bioretention Basins

Typical landscaping maintenance equipment, tools and supplies are needed to maintain the Bioretention BMPs. Care must be taken to avoid having large equipment operate from the basin floor causing compaction and reducing the effectiveness of infiltration areas. All work done by machinery should be completed from the perimeter of the basin.

CDS Units

A vacuum truck is required for cleaning the CDS units. The use of a vacuum truck is generally the most effective and convenient method of removing pollutants from the system. Cleaning of the CDS units should be done during dry weather when no flow is entering the system.

StormTrap® Subsurface Detention Systems

Maintenance is typically performed using a vacuum truck, with access via the system manholes. The systems are not designed to hold permanent pools of water, and therefore the dry detention system cleaning method, as recommended by the manufacturer, should be used. Sediment should be flushed towards a vacuum hose and removed through the opposite end manhole via suction. Since StormTrap® systems are constructed in rows, each row should be cleaned separately in this manner.

F. Cleaning of Inlet and Outfall Structures

Regular removal of sediment and debris accumulated in basin inlet and outlet structures is the best method to preventing damage and avoiding costly repairs. Sediment removal should take place when the basin bottoms is thoroughly dry. Disposal of debris and trash should be done at suitable disposal/recycling sites and in compliance with all applicable local, state, and federal waste regulations.

G. Landscape Care

Maintenance of the property should emphasize the following landscape conservation and maintenance techniques to prolong the longevity and effectiveness of the BMP systems.

1. Mowing

Mowing and/or trimming of vegetation must be performed on a regular schedule based on specific site conditions. Grass should be mowed at least once a year.

Care must be taken when mowing within bioretention basins, to avoid having large equipment operate from the basin floor causing compaction and reducing the effectiveness of infiltration areas. Vegetated areas must be inspected at least annually for erosion and scour. Vegetated areas should also be inspected at least annually for unwanted growth, which should be removed with minimum disruption to the remaining vegetation.

When establishing or restoring vegetation, biweekly inspections of vegetation health should be performed during the first growing season or until the vegetation is established. Once established, inspections of vegetation health, density, and diversity should be performed at least twice annually during both the growing and non-growing seasons. The vegetative cover should be maintained at 85 percent. If vegetation has greater than 50 percent damage, the area should be reestablished in accordance with the original specifications and the inspection requirements presented above.

The types and distribution of the dominant plants must also be assessed during the semi-annual BMP inspections described above. This assessment should be based on the health and relative extent of both the original species remaining and all volunteer species that have subsequently grown in the wetland. Appropriate steps must be taken to achieve and maintain an acceptable balance of original and volunteer species in accordance with the intent of the wetland's original design. All use of fertilizers, mechanical treatments, pesticides and other means to assure optimum vegetation health should not compromise the intended purpose of the constructed stormwater wetland. All vegetation deficiencies should be addressed without the use of fertilizers and pesticides whenever possible.

2. Removal of Invasive Vegetation

If inspection deems that invasive vegetation has become established, removal of the invasive vegetation by weeding or herbicide application shall be conducted. Several invasive plant species can become established in these systems. Of these species, some need to be removed entirely from the site, while others need to be closely monitored and, if they become a nuisance, removed or cut back. Those species that should be removed as soon as they appear include: purple loosestrife, phragmites, Japanese knotweed, multiflora rose, tree-of-heaven, and honeysuckle. Establishment of invasive species such as reed canary grass and cattail (See Attachment B for plant identification sheets) needs to be closely monitored and removed from the basin if they colonize and cover an area larger than 100 square feet (approximately 10 ft. x 10 ft. in area).

It is recommended that invasive plant species be removed by hand weeding if possible. If sufficient manual labor cannot be employed or is not successful

after initial efforts, an herbicide application can be used. An appropriate herbicide for treating invasive exotics in this type of environment is Rodeo, manufactured by Monsanto. The herbicide must be applied by a licensed applicator, per the manufacturer's specifications and local rules and regulations.

3. Replacement of Vegetation

The Contractor should provide a guarantee on all vegetation for a minimum of one year after installation. If any vegetation needs to be replaced during this period, the Contractor will be responsible for its replacement. After this period regular inspections should note any plant loss, and replacement should occur as needed. A minimum of 100 percent vegetative coverage is required after two years. If 100 percent coverage is not achieved, vegetation shall be installed using recommended species from the list provided in Attachment C, under the direction of a Landscape Architect. Unless substitute vegetation is approved by a landscape architect, only vegetation from this list shall be used for replacement.

4. General Herbaceous Care

The herbaceous vegetation is planted to achieve between 80-100 percent coverage within a two-year period. Apart from the removal of invasive vegetation as discussed above, regular maintenance of the herbaceous vegetation is not required.

5. General Shrub Care

Proper maintenance is important for most shrubs and will result in beautiful plants year after year. General maintenance considerations include watering thoroughly during the first year, if necessary, and inspecting shrubs closely to discover and control pests or diseases in their early stages. The only other maintenance requirement is occasional pruning. The Contractor will be responsible for watering all vegetation during construction. After construction, rainfall and the associated ponding in the bioretention basin will supply water for the shrubs.

No fertilization is necessary. The topsoil specifications provide enough organic material to adequately supply nutrients from natural cycling. The primary function of the bioretention system is to improve water quality. Adding fertilizers defeats or, at a minimum, impedes this goal. If shrubs are climatically adapted to the area in which they are planted, they rarely need protection from weather extremes. Since all shrubs specified for this project are native and should be purchased from local nurseries, climate protection will not be required for any of these shrubs. Guidelines for pruning and care specific to shrubs are outlined

in Attachment D.

6. General Tree Care

Trees require virtually the same maintenance as shrubs (i.e., watering, pruning, and inspecting for diseases). One additional maintenance procedure is staking. During installation, the Contractor will stake all trees. The stakes shall be removed as soon as the trees are able to stand on their own. Stakes are usually only needed through the first season. Guidelines for pruning and care specific to trees are outlined in Attachment D.

7. On-Site Fertilizer and Pesticide Use

Providing nutrients is essential to maintaining a healthy landscape. Most native trees and shrubs do not require fertilizer to thrive. Over fertilizing and exceeding application rates may promote excessive top growth and a shallow root system to plants and can become a major source of pollution in nearby streams. Fertilizer shall be applied with care to keep fertilizer off parking and driveway areas where it can wash into the storm drainage system. Applications that could carry nutrients away before they are absorbed into the soil should not be done when severe weather is imminent.

Pesticides should be used with care and only applied to address specific problems. Again, avoid spraying pesticide onto paved surfaces where it could be washed into the storm drainage system. No excess liquids should be dumped down storm drains, and applications during wet or rainy conditions should be avoided.

8. Wildlife Management

A low-maintenance landscape that minimizes mowing and allows for taller grasses and herbaceous plant materials will discourage waterfowl, especially non-migratory Canada Geese. During the establishment period, these unwanted waterfowl may take up temporary residence in these areas and damage young plantings. If this occurs, several scare tactics can be employed to deter waterfowl from continuing to use the site for refuge or food supply. See Attachment E for sample products.

IV. INSPECTIONS

The BMP's will require a moderate amount of routine maintenance to ensure that the systems function as designed, and that the basins maintain an aesthetic appeal. To ensure that maintenance is completed and that the systems are functioning properly, regular inspections of the BMPs are required. Standard inspection forms have been provided in Attachment G for use at these facilities. Copies of the completed inspection forms are to be kept in the Inspection Log found in Attachment I. When concerns or issues are noted during inspection, immediate action should be taken to prevent any permanent damage or costly repairs to the system. A detailed, written log of all preventive and corrective measures performed at the BMPs must be kept, including a copy of maintenance-related work orders.

Some problems that may occur include erosion or wash out of areas near inlet structures, ponding for extended periods of time, plant fatality, and debris collecting near the inlet or outlet structures. Loss of vegetation may also be a problem due to local wildlife (i.e. goose damage), extreme storm events, or extended periods of drought.

Special attention should be given to the removal of floating debris (leaves, paper, trash, branches, etc.), which can clog outlet structures. Debris removal on a routine basis is critical to:

- Reduce the chance of clogging outlet structures
- Prevent damage to vegetation
- Reduce potential mosquito-breeding habitat areas
- Improve aesthetic appearance

All components expected to receive and/or trap debris and sediment must be inspected for clogging and excessive debris and sediment accumulation at least four times annually, as well as after every storm exceeding 1 inch of rainfall. Such components may include trash racks, outlet structures, riprap aprons, and inlets.

A. Responsibilities

The following individual or organization is responsible for inspections of the stormwater BMPs at the site:

William Brett
Supervisor
Environmental Construction Permitting
ENBRIDGE
890 Winter Street, Suite 300
Waltham, MA 02451

B. Schedules

During the site construction, and for one year following the completion of all construction, all systems shall be inspected monthly, after each rainfall event (i.e., events of one inch of rainfall per 24 hours or greater), and during an extended period of drought.

Following the one-year establishment period, inspections shall occur quarterly and after each substantial rainfall event (i.e., storms producing one inch or more rainfall in 24 hours).

C. Inspection List

Erosion and Sedimentation: Avoiding erosion during the establishment period and beyond is critical to ensuring integrity of the visible banks, slopes, and basin floors. Healthy herbaceous vegetation must be maintained on all soil areas. Any bare areas should be reseeded and stabilized as quickly as possible. Seeding, along with the use of an erosion control blanket, may be necessary on slopes or embankments. Specific details on vegetation care and maintenance are outlined in this manual.

Sediment removal should take place when the basin is thoroughly dry. Disposal of debris and trash should be done at suitable disposal/recycling sites and in compliance with all applicable local, state, and federal waste regulations.

Structural Components: The inlet and outlet structures shall be inspected quarterly and cleaned and maintained as necessary, based on these inspections. All structural components should be inspected for subsidence, erosion, and

deterioration. Sediment deposited in CDS units will need to be removed via vacuum truck after it has accumulated in sufficient quantities in accordance with manufacturer's recommendations. Disposal of debris and trash should be done at suitable disposal/recycling sites and in compliance with all applicable local, state,

and federal waste regulations.

If standing water remains in the systems for more than 48 hours, this is a sign that outlets may be clogged, and cleaning of the structures may be needed, or that the soil bed or underdrain system has become clogged. If inspection deems this to be the case, immediate action should be taken, as ponded water in the basins will damage the vegetation and could provide mosquito-breeding habitat. Regular removal of sediment and debris accumulated in the systems is the best method of preventing this from happening and avoiding costly repairs. If significant increases or decreases in the normal drain time are observed, or if the 72-hour maximum is exceeded, a qualified designer/engineer familiar with BMPs should be consulted to evaluate the system's soil, and both groundwater and tailwater levels, and to test permeability rates and identify appropriate corrective measures to restore the functions of the system.

Vegetation: Vegetated areas should be checked for the following invasive vegetation: purple loosestrife, reed canary grass, phragmites, water primrose, and cattails (See Attachment B for plant identification sheets). If any of these species are noted, they must be removed.

After the Contractor guarantee period, regular inspections should note any plant loss and replacement should occur as needed. Vegetation shall be installed using recommended species from the list provided in Attachment C, under the direction of a Landscape Architect.

D. Emergency Plan

If the basins do not drain within 72 hours, immediate steps should be taken to remove all standing water. If standing water remains in the system, the water should be drained so that vegetation is not destroyed, and an assessment of the system can be completed.

V. REFERENCES AND RESOURCES

Schueler, T.R., P.A. Kumble and M. Heraty, A Current Assessment of Urban Best Management Practices. Metropolitan Washington Council of Governments. Washington, D.C. March 1992.

Claytor, Richard A. and Thomas R. Schueler, The Center for Watershed Protection - Design of Stormwater Filtering Systems, 1996.

2000 Maryland Stormwater Design Manual, Volumes I & II, Center for Watershed Protection and the Maryland Department of the Environment, 1999.

Design Manual for Use of Bioretention in Stormwater Management - Prince George's County Maryland, Engineering Technologies Associates, Inc., 1993.

Engineering Report, Volume 1 for Waterford, Montgomery Township, Somerset County, New Jersey, Van Note-Harvey Associates, P.C., revised July 18, 2003.

The Maintenance of Residential Stormwater Management Areas, USDA NRCS, January 2000.

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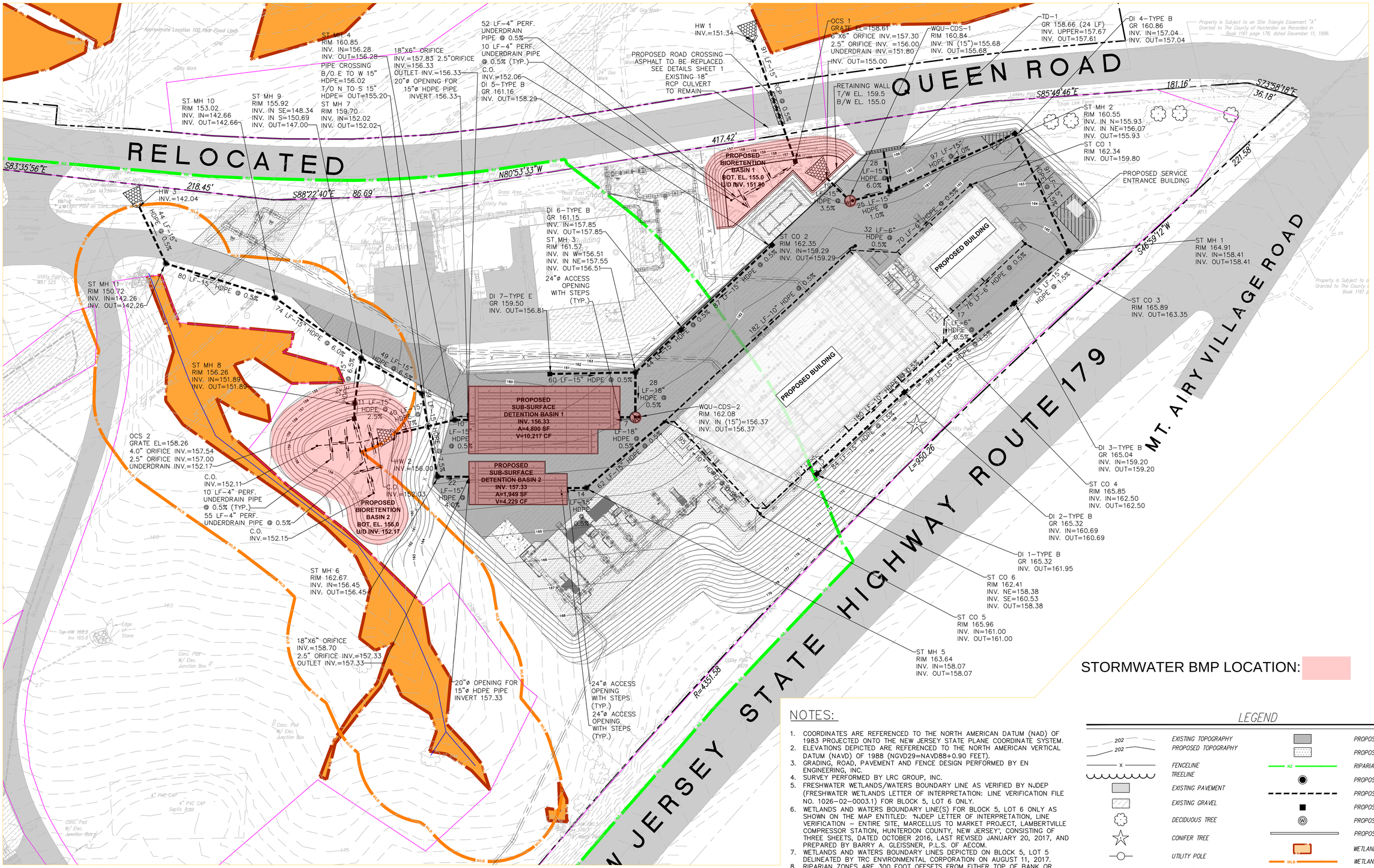
Operation, Maintenance, and Management of Stormwater Management Systems, Watershed Management Institute, Inc. and USEPA, August 1997.

ATTACHMENT A

Site Plan Showing BMP Locations



STORMWATER BMP LOCATION:

NOTES:

1. COORDINATES ARE REFERENCED TO THE NORTH AMERICAN DATUM (NAD) OF 1983 PROJECTED ONTO THE NEW JERSEY STATE PLANE COORDINATE SYSTEM.
2. ELEVATIONS DEPICTED ARE REFERENCED TO THE NORTH AMERICAN VERTICAL DATUM (NAVD) OF 1988 (NGVD29=NAVD88+0.90 FEET).
3. GRADING, ROAD, PAVEMENT AND FENCE DESIGN PERFORMED BY EN ENGINEERING, INC.
4. SURVEY PERFORMED BY LRC GROUP, INC.
5. FRESHWATER WETLANDS/WATERS BOUNDARY LINE AS VERIFIED BY NJDEP (FRESHWATER WETLANDS LETTER OF INTERPRETATION: LINE VERIFICATION FILE NO. 1026-02-0003.1) FOR BLOCK 5, LOT 6 ONLY.
6. WETLANDS AND WATERS BOUNDARY LINE(S) FOR BLOCK 5, LOT 6 ONLY AS SHOWN ON THE MAP ENTITLED: "NJDEP LETTER OF INTERPRETATION, LINE VERIFICATION – ENTIRE SITE, MARCELLUS TO MARKET PROJECT, LAMBERTVILLE COMPRESSOR STATION, HUNTERDON COUNTY, NEW JERSEY", CONSISTING OF THREE SHEETS, DATED OCTOBER 2016, LAST REVISED JANUARY 20, 2017, AND PREPARED BY BARRY A. GLEISSNER, P.L.S. OF AECOM.
7. WETLANDS AND WATERS BOUNDARY LINES DEPICTED ON BLOCK 5, LOT 5 DELINEATED BY TRC ENVIRONMENTAL CORPORATION ON AUGUST 11, 2017.
8. RIPARIAN ZONES ARE 300 FOOT OFFSETS FROM EITHER TOP OF BANK OR STREAM CENTERLINES, AS APPROPRIATE.

LEGEND

202 EXISTING TOPOGRAPHY	PROPOSED PAVED AREAS
202 PROPOSED TOPOGRAPHY	PROPOSED GRAVEL AREAS
x FENCELINE	RZ RIPARIAN ZONE (300 FT)
TREELINE	PROPOSED MANHOLE
EXISTING PAVEMENT	PROPOSED PIPE
EXISTING GRAVEL	PROPOSED INLET
DECIDUOUS TREE	W PROPOSED WATER QUALITY UNIT
CONIFER TREE	PROPOSED CURB
UTILITY POLE	WETLAND AREA
LOT LINE	WLB WETLANDS BUFFER (50 FT)
STATE OPEN WATER	PROJECT SITE

0 30 60 Feet

Drawing: W:\Vision Project Folders\392931 – Penn East\Engineering\DWG\Drainage Area Mapping\392931_PR-Proposed Grade Plan.DWG
Time: 1/9/2018 3:15:26 PM
Model:
Username: JHARRINS

TRC Engineers, Inc.

ENGINEER IN RESPONSIBLE CHARGE OF THE WORK SHOWN ON THIS DRAWING

DATE: 8/31/18 SIGNATURE

PROFESSIONAL ENGINEER: BARRY J. SUTHERLAND
LIC. # 24GE02913500

NO.	BY	DATE	REVISION	APP'D.
0	SB	8/31/18	ISSUED FOR PERMITTING	BS

TRC Engineers, Inc.
41 Spring Street, Suite 102
New Providence, New Jersey 07974
Phone No. 908-988-1700
Certificate of Authorization #24GA28047100

PENNEAST PIPELINE PROJECT
LAMBERTVILLE INTERCONNECT
PROPOSED STORMWATER MANAGEMENT PLAN

LOC. WEST AMWELL TOWNSHIP, HUNTERDON COUNTY, NEW JERSEY

PennEast PIPELINE

YEAR: 2020 | W.B.S CE.000147.001 | SCALE: 1:30 | DWG. C-102 | REV. 0

IG.#

ATTACHMENT B

Invasive Plant Identification Sheets

Common Invasive Species

• *Ailanthus altissima*	**Tree of Heaven**
• *Typha latifolia**	**Cattail***
• *Alliaria petiolata*	**Garlic Mustard**
• *Berberis thunbergii*	**Japanese barberry**
• *Polygonum cuspidatum*	**Japanese knotweed**
• *Lonicera japonica*	**Japanese Honeysuckle**
• *Lythrum salicaria*	**Purple Loosestrife**
• *Phalaris arundinacea**	**Reed Canary Grass***
• *Rosa multiflora*	**Multiflora Rose**
• *Acer platanoides*	**Norway Maple**
• *Phragmites australis*	**Common Reed**
• *	**Water Primrose***
• *Euonymous alata*	**Winged Euonymous (Burning Bush).**

***Monitor; if coverage reaches 100 ft^2 (a ten ft by ten ft area), remove.**

Lythrum salicaria

Purple loosestrife, Spike lythrum, Salicaire, Bouquet violet

CAUTION: Considered Invasive

Characteristics

Herbaceous / Perennial / Persistent

GROWTH

Rate of spread: rapid; over 1 ft. per yr. in unconsolidated sediment

Method of vegetative reproduction: new shoots from adventitious buds where damaged

PLANTING

Suggested spacing:

For uniform ground cover	plant at
in 1 yr.	2 ft. OC
in 2 yrs.	4 ft. OC
in 3 yrs.	6 ft. OC

Forms available: bare root plant

HABITAT

Community: fresh tidal marshes
nontidal marshes
wet meadows
river and lake borders

Distribution: Quebec and New England to Michigan, south to Virginia

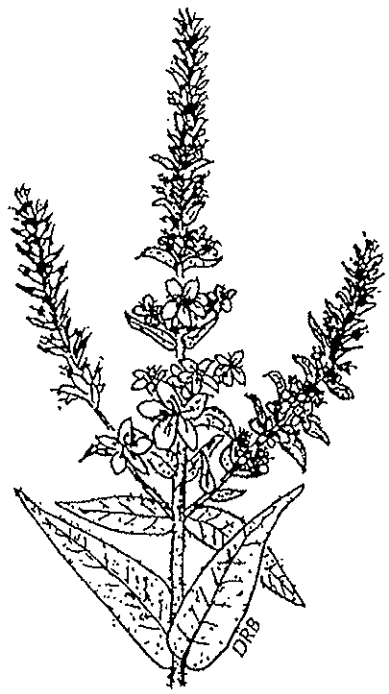
Shade: tolerates partial shade

NOTES

Legislation exists to prevent sale of Purple loosestrife, many land-managers advocate its ban

Re-seeds prolifically

Not native to North America



Appearance

Height: up to 4 ft

Flower color: purple (in spikes)

Flowering period: June through September

Wildlife Benefits

Potential Benefits and Species Served

Low wildlife value

Hydrology

Indicator status: Facultative wetland

Salinity: fresh water, less than 0.5 ppt

Tidal zone: upper portion of intertidal zone and above to upland elevations

Nontidal regime: irregularly, seasonally, regularly or permanently inundated up to 0.5 ft or saturated (up to approximately 100% of the growing season)

Phalaris arundinacea

Reed canary grass

CAUTION: Possibly Invasive

Characteristics

Herbaceous / Perennial / Persistent

GROWTH

Rate of spread: rapid; over 1 ft. per yr. in unconsolidated sediment

Method of vegetative reproduction: rhizome

PLANTING

Suggested spacing:

For uniform ground cover	plant at
in 1 yr.	2 ft. OC
in 2 yrs.	4 ft. OC
in 3 yrs.	6 ft. OC

Forms available: seed, bare root plant

HABITAT

Community: fresh tidal marshes
nontidal marshes
stream banks
lake shores
moist woods

Distribution: Newfoundland to southern Alaska, south to North Carolina, Kansas, and southern California

Shade: requires full sun

NOTES

Tolerates drought

Soil stabilizer

Should not be used in soil stabilization for temporarily exposed pond bottoms or where open water habitat is desired. Upon flooding, may form floating aquatic mats. (Lefor 1987)

Appearance

Height: up to 5 ft.

Flowering period: June through August

Wildlife Benefits

Potential Benefits and Species Served

Food, Cover: prairie vole, birds

Nesting: marsh wren, red-winged blackbird

Brood cover: wood duck

Hydrology

Indicator status: facultative wetland

Salinity: fresh water (less than 0.5 ppt)

Tidal zone:

Nontidal regime: seasonally to regularly inundated (up to 1 ft.) permanently inundated (up to 0.5 ft.) or saturated (approximately 13 to 100% of the growing season)

Phragmites australis

Common reed, Wild reed

CAUTION: Considered Invasive

Characteristics

Herbaceous / Perennial / Persistent

GROWTH

Rate of spread: rapid; over 1 ft. per yr. in unconsolidated sediment (can spread up to 30 ft. in one yr.)

Method of vegetative reproduction: rhizome

PLANTING

Suggested spacing:

For uniform ground cover	plant at
in 1 yr.	2 ft. OC
in 2 yrs.	4 ft. OC
in 3 yrs.	6 ft. OC

Forms available: bare root plant

HABITAT

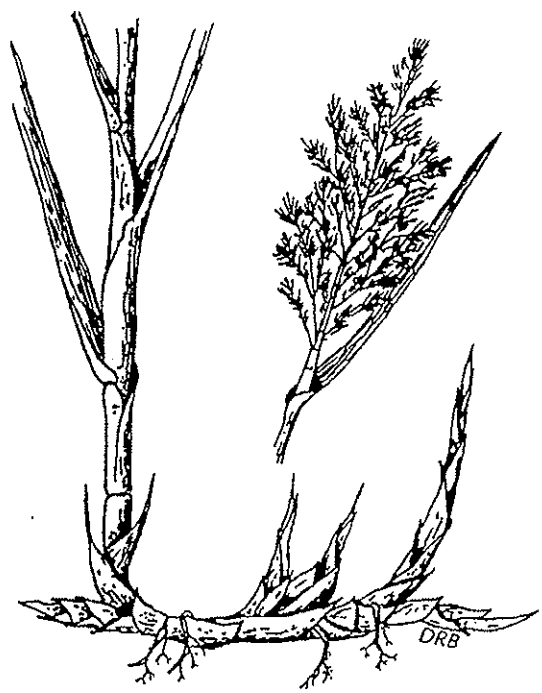
Community: fresh and brackish tidal marshes
nontidal marshes
swamps
wet shores
ditches and disturbed areas

Distribution: Nova Scotia and Quebec to British Columbia, south to Florida, Texas, and California

Shade: requires full sun

NOTES

Highly invasive; considered a pest species in many states
Good sediment stabilizer for extreme cases of erosion
pH preference = 3.7 – 9.0
Has shown some allelopathic characteristics



Appearance

Height: up to 10 ft.
Flowering period: June into September

Wildlife Benefits

Potential Benefits and Species Served

Cover: upland gamebirds, songbirds, marshbirds, shorebirds, aquatic furbearers, terrestrial furbearers

Low food value

Hydrology

Indicator status: Facultative wetland

Salinity: fresh to brackish water, up to 20 ppt

Tidal zone: in salt marsh, above mean high water to spring tide elevation; in fresh marsh, upper 50% of intertidal zone

Nontidal regime: seasonally, regularly, or permanently inundated up to 2 ft. or saturated (approximately 13 to 100% of the growing season)

Invasive Alien Plant Species

Multiflora Rose (*Rosa multiflora* Thunberg)

Description

Multiflora rose is a perennial, thorny shrub of medium height. Its arching or trailing stems can root at the tip, forming dense thickets. The compound leaves alternate along the stems; each leaf has 5-11 oval leaflets, the edges of which are toothed. In late spring, multiflora rose blooms in tapering clusters of white flowers. As in other rose species, the fruits are small, red hips. The seeds found in the hips of multiflora rose are sought after by many different bird species during winter.

Habitat

Usually found in fields, pastures and along roadsides, multiflora rose can also appear in dense forest where fallen trees have opened a gap in the forest canopy. It is adaptable to a wide range of environments but is not found in standing water or in extremely dry habitats.

Distribution

Multiflora rose is native to Asia and was brought to the United States from Japan in the 1880s by horticulturists. Later, wildlife managers planted it for wildlife food and cover. Once used for control of soil erosion and on highway medians to reduce headlight glare, multiflora rose is now found throughout most of the United States. It has established itself in all but a dozen counties of Virginia. The Virginia Department of Agriculture and Consumer Services has listed this plant as a noxious weed.

Threats

Multiflora rose forms dense thickets which can choke out native plant species. These thickets act as living fences, impenetrable by man or large animals. Results from studies done on multiflora rose suggest it is highly competitive for soil nutrients.

Control

Lightly infested areas may be cleared with a shovel or grubbing hoe provided the entire root is removed. Severe infestations of multiflora rose are effectively controlled by mowing or cutting. However, this treatment must be repeated 3-6 times a year for 2-4 years. Applying a glyphosate herbicide directly to freshly cut stumps helps insure kill of the root system. This method is most effective if done late in the growing season. Foliar application of a glyphosate herbicide will also kill multiflora rose. Glyphosate herbicides are recommended because they are biodegradable. However, glyphosate is a nonselective, systemic herbicide and will affect all

*Multiflora Rose (*Rosa multiflora *Thunberg)*

For more information, contact the Department of Conservation and Recreation or the Virginia Native Plant Society.

DCR
Department of Conservation & Recreation
CONSERVING VIRGINIA'S NATURAL AND RECREATIONAL RESOURCES
217 Governor Street, Richmond, VA 23219
(804) 786-7951; *http://www.state.va.us/~dcr/vaher.html*

Virginia Native Plant Society
Blandy Experimental Farm
400 Blandy Farm Lane, Unit 2
Boyce, VA 22620
(540) 837-1600
http://www.vnps.org

Jim Gilmore, Governor • John Paul Woodley, Jr., Secretary of Natural Resources • David G. Brickley, Director, Department of Conservation and Recreation

Invasive Alien Plant Species

Multiflora Rose (*Rosa multiflora* Thunberg)

green vegetation. To be safe and effective, herbicide use requires careful knowledge of the chemicals, appropriate concentrations, and the effective method and timing of application. Consult a natural resource specialist or agricultural extension agent for more information before attempting any herbicide control program.

In some situations, a prescribed burn during the early growing season may be an appropriate method for controlling severe infestations of multiflora rose. As with mechanical control methods, follow-up burn treatments may be necessary for several years to remove plants sprouting from stems or seed. Seek the advice of an agricultural extension agent or natural resource specialist before implementing this control method.

Suggested Alternatives

Some native shrubs with attractive flowers and/or fruit production useful to wildlife include Carolina rose (*Rosa carolina*), high-bush blueberry (*Vaccinium corymbosum*), black haw (*Viburnum prunifolia*), winterberry (*Ilex verticillata*) and American holly (*Ilex opaca*) (dioecious, female plant for fruit). These species should be available at most large nurseries and garden centers.

References

Evans, J. and N. Ekhardt. 1987. Element Stewardship Abstract: Rosa multiflora. The Nature Conservancy, Minneapolis.

Szafoni, R. 1990. Vegetation Management Circular: Multiflora rose. Illinois Nature Preserves Commission, Charleston.

Harvill, A., et al. 1992. Atlas of Virginia Flora. Virginia Botanical Association, Burkesville.

Illustration by Donna Smith

5/99

For more information, contact the Department of Conservation and Recreation or the Virginia Native Plant Society.

DCR
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Jim Gilmore, Governor • John Paul Woodley, Jr., Secretary of Natural Resources • David G. Brickley, Director, Department of Conservation and Recreation

Invasive Alien Plant Species

Japanese Knotweed (*Polygonum cuspidatum*)

Description

Japanese knotweed is a herbaceous perennial in the buckwheat family. It can grow three to nine and a half feet in height. It is sometimes called Mexican bamboo because of its stout, round, hollow stems and formations of dense clumps. It forms rhizomes which can reach forty-five to sixty feet in length. The leaves are two to six inches long and two to five inches wide, flattened at the base, and taper to a point at the end. The greenish-white flowers occur in clusters along the stem. Flowers bloom from August to September. The three-sided seeds are shiny black-brown. Its primary mean of reproduction appears to be vegetative. Rhizome fragments readily give rise to new plants. Japanese knotweed closely resembles giant knotweed, another member of the buckwheat family. Giant knotweed is taller and has larger leaves with a rounded leaf base. Consult a field guide or natural resource specialist for accurate identification.

Habitat

Japanese knotweed is found in moist open habitats. It has been reported from riverbanks and islands, wetlands, along roadways, hillsides, and disturbed areas in a variety of soil types. It does poorly in a forested understory.

Distribution

Native to Asia, Japanese knotweed came to the United States as an ornamental via England about a century ago. It has since spread in the wild and is now found from Nova Scotia to North Carolina. Japanese knotweed is widely scattered in Virginia.

Threats

Japanese knotweed emerges in early spring and grows rapidly to heights of six to nine feet. It forms dense, nearly pure stands which crowd out native plants. It reproduces almost solely from rhizomes. The rhizomes can regenerate from very small fragments. Fragments are transported to new sites by water and by humans moving soil as fill dirt. The deep roots enable it to outcompete other plants for water and nutrients. Once established, Japanese knotweed is very difficult to eradicate.

Control

Although not yet a serious pest in Virginia natural habitats, the presence of Japanese knotweed is of great concern. Experience in other states where it is a serious pest suggests that the best control method is prevention of establishment. The plant should be eradicated as early as possible upon its appearance. Cutting the stalks as often as three times during the growing season will offset growth of the rhizomes. Cutting followed immediately by application of a glyphosate herbicide has been found to be most effective. This should be done in late August through September when plants are translocating material to their root system for the winter. Several years of treatments may be needed to ensure that the rhizomes have been exterminated.

Japanese Knotweed (*Polygonum cuspidatum*)

Illustration from *Newcomb's Wildflower Guide*, by Lawrence Newcomb, Little, Brown and Company. Used with permission.

12/97

For more information, contact the Department of Conservation and Recreation or the Virginia Native Plant Society.

DCR
Department of Conservation & Recreation
CONSERVING VIRGINIA'S NATURAL AND RECREATIONAL RESOURCES

217 Governor Street, Richmond, Virginia 23219
(804) 786-7951
http://www.state.va.us/~dcr/vaher.html

Virginia Native Plant Society
Blandy Experimental Farm
400 Blandy Lane, Unit 2
Boyce, Virginia 22620
(540) 837-1600
http://www.vnps.org

Invasive Alien Plant Species

Tree-of-Heaven (*Ailanthus altissima* (Miller) Swingle)

Description

Tree-of-heaven is a small to medium-sized tree in the mostly tropical Quassia family. It has smooth gray bark. Leaves are compound, alternate, odd-pinnate, with 11-25 lanceolate leaflets. Most leaflets have one to three course teeth near their base. Tree-of-heaven leaves may be confused with those of sumac or black walnut. Flowers occur in panicles at the ends of branches; male flowers produce a strong odor which has been described as "the smell of burnt peanut butter." The leaves when crushed also produce this distinctive, offensive odor. Seeds are centered in a papery sheath called a samara. The samaras are slightly twisted or curled, and twirl as they fall to the ground. They can be borne on the wind great distances from the parent plant.

Tree-of-Heaven *(Ailanthus altissima)*

Habitat

Tree-of-heaven establishes itself readily on disturbed sites. These include vacant lots of the inner city, railroad embankments, highway medians, fence rows and roadsides. In naturally forested areas, disturbance created by severe storms or insect infestations can open the way for tree-of-heaven infestation.

Distribution

Tree-of-heaven is native to a region extending from China south to Australia. It was imported into the United States in 1784 by a Philadelphia gardener. In the western states it was brought over by Chinese immigrants who use it for medicinal purposes. Due to its rapid growth and prolific seed production, it quickly escaped from cultivation.

Threats

One tree-of-heaven can produce up to 350,000 seeds in a year. Seedlings establish a taproot three months from germination. Thus they quickly outrace many native plant species in competition for sunlight and space. Tree-of-heaven also produces a toxin in its bark and leaves. As these accumulate in the soil, the toxin inhibits the growth of other plants. This toxin is so effective it is being studied as a possible source for a natural herbicide. These factors combine to make tree-of-heaven a very aggressive invasive plant able to displace native tree and herb species. Furthermore, the root system is capable of doing damage to sewers and foundations.

Control

Tree-of-heaven is very difficult to remove once it has established a taproot. It has persisted in certain areas despite cutting, burning and herbiciding. Therefore, seedlings should be removed by hand as early as possible, preferably when the soil is moist to insure removal of the entire taproot. Larger plants should be cut; two cuttings a year may be necessary, once in the early growing season and once in the late growing season. Initially, this will not kill the plant; it will vigorously resprout from the roots, but seed production will be prevented and the plants will be lowered in stature. If continued over a period of several years, cutting during the growing season stresses the plants and may eventually kill them.

A glyphosate herbicide, either sprayed onto the leaves or painted onto a freshly cut stump will kill the plant. However, to insure the herbicide gets into the root system, it is best to apply this herbicide in the late

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growing season while the plant is translocating nutrients to its roots. Glyphosate herbicides are recommended because they are biodegradable, breaking down into harmless components on contact with the soil. However, glyphosate is a nonselective, systemic and will affect all green vegetation. To be safe and effective, herbicide use requires careful knowledge of the chemicals, appropriate concentrations, and the effective method and timing of their application. Consult a natural resource specialist or agricultural extension agent for more information before attempting herbicide control of tree-of-heaven.

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Invasive Alien Plant Species

Bush Honeysuckles: Belle's honeysuckle (*Lonicera x bella* Zabel), Fragrant honeysuckle (*L. fragrantissima* Lindley & Pax), Amur honeysuckle (*L. mackii* (Rupr.) Maxim), Morrow's honeysuckle (*L. morrowi* A. Gray), Tatarian honeysuckle (*L. tatarica* L.), European fly honeysuckle (*L. xylosteum* L.)

Description

Bush honeysuckles are upright, generally deciduous shrubs that range from 6 to 16 feet in height. The opposite, simple leaves are usually oval to oblong in shape and range in length from 1 to 2.5 inches. Flowering occurs from May to June (February to April for fragrant honeysuckle) with the fragrant, tubular flowers borne in pairs. Flower color ranges from creamy-white in most species to pink or crimson in varieties of Tatarian honeysuckle. Whitish flowers become yellow with age. The fruit is a many-seeded, red to orange berry. Exotic bush honeysuckles can be confused with our Virginia native fly honeysuckle (*Lonicera canadensis*), but this seldom-seen species is restricted to high elevation mountainous terrain. Consult an appropriate guidebook or a natural resource expert for proper identification.

Habitat

In Virginia bush honeysuckles occur most often along roadsides and in forest edges, pastures and abandoned fields. Grazed and disturbed woodlots may also be invaded by some bush honeysuckle species. Although bush honeysuckles are most common in upland habitats, Morrow's honeysuckle is known to invade fens, bogs and lakeshores in portions of the northeastern United States.

Distribution

The invasive bush honeysuckles in Virginia are natives of Europe, eastern Asia or Japan. Most species have been cultivated as ornamentals in the eastern United States since the mid-1800s. Also, some varieties were developed and planted widely for wildlife food source. At present, bush honeysuckles are distributed locally in Virginia, particularly in northern and central regions, although their ranges appear to be expanding.

Threats

Bush honeysuckles can rapidly invade and overtake a site, forming a dense shrub layer that interferes with the life cycles of many native woody and herbaceous plants. Exotic bush honeysuckles can alter habitats they invade by decreasing light availability and depleting soil moisture and nutrients. Some species may also release chemicals into the soil that inhibit the growth of other plant species. The fruit of bush honeysuckles is fed upon by many kinds of

Morrow's honeysuckle *(L. morrowi)*

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birds. The birds then spread the seed throughout the landscape.

Control

Light infestations may be cleared by hand with a shovel or grubbing hoe provided the entire root is removed. Severe infestations may be controlled by repeated treatments of cutting, burning or applying herbicide.

Brush cutting plants should be done during the growing season. Generally two cuts per year are recommended, one in early spring followed by one in the late summer or early autumn. Cuts made in the winter while the plant is dormant will only encourage vigorous resprouting.

The application of an herbicide is also an effective control method. Glyphosate herbicides are recommended because they are biodegradable. They will begin to break down into harmless components on contact with the soil. A glyphosate herbicide may be applied to the leaves or freshly cut stumps late in the growing season. Timing is important to insure effectiveness. Application near the end of the growing season when the plant is transporting nutrients to its roots will result in the highest rate of kill.

In some areas, prescribed burning may be used to control bush honeysuckles. Burns conducted during the growing season will top-kill shrubs and inhibit new shoot production. These burns will favor warm-season grasses and perennial forbs increasing species diversity and productivity.

Treatment of any severely infested areas usually requires management for a period of three to five years to inhibit growth of new shoots and eradicate target plants. Consult a natural resource specialist or an agricultural extension agent for more information on these control methods.

Written by Dr. Charles E. Williams, Department of Biology, Clarion University

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Ludwigia hexapetala
Water Primrose

Home Back

The Western Aquatic Plant Management Society

Description and Variation

Water Primrose is a perennial herb that can be found creeping along the shoreline, floating on the water surface, or growing upright. It is a robust plant with bright yellow, showy flowers and willow-like leaves. It is a non-native species originally from South America and the southern United States and has been introduced into Europe and northern North America.

Because of its showy yellow flowers, this plant is being sold as an ornamental species. Lake residents are strongly discouraged from planting water primrose in lakes, private ponds with an outlet or in a flood zone, or in natural waterbodies. These plants are very invasive and aggressive and will form very dense mats of vegetation.

Growth Habit

Water primrose grows in dense mats along shorelines and out into the water. It favors the margins of lakes, ponds, ditches, and streams. It blooms throughout the summer. This photograph shows water primrose growing along a ditch bank in Longview, Washington. It reproduces by seeds and by plant fragments.

Management

Methods such as mechanical removal, cutting, covering with opaque materials, and using the aquatic herbicide Rodeo® may be effective. It is not likely that grass carp would find water primrose to be palatable.

Identification

Water primrose can be identified by its sprawling growth habit and showy yellow flowers. Look for the following characteristics:

- Forms a vegetative mat sprawling across the water surface, rooted in the mud, witl flowering stems held above the water.
- Stem glabrous to sparsely pubescent, grows horizontally on water or mud. At flowering the stems lengthen and grow upright. Flowering stems can rise to 3 ft. above the water surface.
- Feathery roots at the nodes often dangle in the water, also often has white, spong aerenchymous roots at the nodes.
- Leaves are alternate. Each growth consists of rosette-like clusters of rounded (suborbicular to spatulate) leaves on the water surface. At flowering they lengthen to lanceolate or elliptic shaped (willow like).
- Flowers are bright yellow, 5 or 6 petals, arise from leaf axils on peduncles 2-3 cm long. Petals 15 to 30 mm, sepals are persistant, 8-19 mm long.
- Fruit is a cylindrical capsule.

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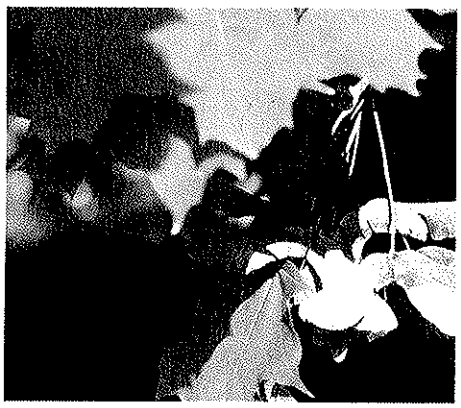
This page was last updated 03/12/2003

Norway maple
Acer platanoides L.
Maple Family (Aceraceae)



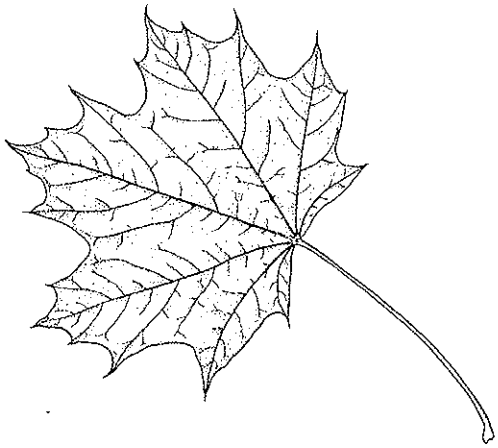
DESCRIPTION

Norway maple is a large, deciduous tree with a broad, rounded crown. It can readily be distinguished from other maples because the leaves and twigs ooze milky sap when cut or torn. Norway maple is the only large maple in our range that has that characteristic; however, late in the season it may be hard to detect.

Height - Norway maple can be 60–65 feet in height with a trunk diameter of as much as 6–7 feet, and a branch spread of 70 feet when growing in the open.

Stem - The bark is smooth and gray-brown; twigs are stout, brown with green buds with overlapping bud scales. The leaf scars are crescent-shaped with 3 distinct bundle scars, the pairs of leaf scars join around the stem to form a sharp angle.

Leaves - Norway maple has dark green leaves that are about 6 inches wide and 4–5 inches long, with 5–7 lobes. The fact that the leaves are wider than they are long is a good distinguishing characteristic; sugar maple leaves are generally longer than wide. Norway maple leaves are the last to change color in the fall; they remain green until early November then turn bright yellow. Late fall is the best time to survey for Norway maples as they are very conspicuous at that time.



Flowers - The yellowish-green flowers of Norway maple appear in stalked clusters in mid- to late April as the leaves are expanding; they are insect pollinated.

Fruit and seed - Like all the maples the fruit of the Norway maple is a double samara; its wings diverge at nearly 180°. The seeds, which mature in September, are wind dispersed.

Roots - Norway maple has shallow roots that are frequently exposed at the soil surface.

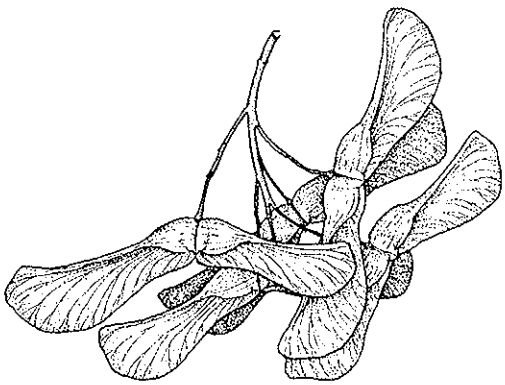
DISTRIBUTION AND HABITAT

Norway maple is the most widespread maple in Europe where it occurs from Norway and Sweden to the Caucasus Mountains, Turkey, and northern Iran. It was originally introduced into North America by John Bartram of Philadelphia who received seedlings from Philip Miller of

London in 1756. Soon after, Bartram began offering the plant through his nursery business operated in West Philadelphia. George Washington ordered 2 Norway maples from the Bartram in 1792 for his garden at Mount Vernon. Norway maple subsequently became one of the most popular trees for city plantings; many cultivars have been developed including purple-leaved and columnar forms. Over the years Norway maple has naturalized throughout most of Pennsylvania, although it is more common in the southern half of the state.

EFFECTS OF INVASION

Like many potentially invasive, non-native plants, Norway maple did not emerge as a problem until many years after its initial introduction. It wasn't until the early 1900s that plant identification manuals began to include it with the notation "occasionally escaped." Today Norway maple is a frequent invader of urban and suburban forests. Its extreme shade tolerance, especially when young, has allowed it to penetrate beneath an intact forest canopy. Research has recently shown that forests, which have been invaded by Norway maple, suffer losses in diversity of native forest wildflowers compared with forests in which the canopy is dominated by native species such as sugar maple. This is at least in part due to the dense shade cast by Norway maples, and the shallow roots, which compete with other vegetation.



REPRODUCTION AND DISPERSAL

Norway maple reproduces by seed, which it produces in large amounts. The winged fruits (samaras) are distributed by the wind; the seeds germinate readily, even in dense shade, and grow quickly when young. The ability of this species to grow in deep shade makes it particularly threatening to native forest habitats.

CONTROL

Mechanical - Use of the weed wrench to pull young trees out of the ground is effective. Girdling the trunk will also kill Norway maples.

Chemical - Cutting followed by treatment of the cut stem with triclopyr is recommended. Trees up to 4 inches in diameter can be controlled by an application of triclopyr in oil to the bark for a distance of 12–18 inches at the base of the trunk. This treatment is most effective between February 15 and March 31 or from June 1 to September 30.

Biological - No biological control options are currently known.

NATIVE ALTERNATIVES FOR LANDSCAPE USE

The following native trees are recommended as alternatives to Norway maple for landscape use: red maple (*Acer rubrum*), sugar maple (*Acer saccharum*), American basswood (*Tilia americana*), red oak (*Quercus rubra*), white ash (*Fraxinus americana*), tuliptree (*Liriodendron tulipifera*).

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Invasive species fact sheet prepared by:
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April 2002

ATTACHMENT C

List of Appropriate Vegetation

TRC

850 Bear Tavern Road, Suite 104
Trenton, NJ 08628
Phone: 609.882.7704
Fax: 609.882.7775

RESTORATION PLANT LIST
Flood Plain / Riparian / Wetland Sites

Aquatic/Emergent Species

Botanical Name	*Common Name*
Aster puniceus	purple stemmed aster
Calamagrostis canadensis	blue-joint grass
Carex crinita	fringed sedge
Carex stricta	tussock sedge
Carex vulpinoidea	fox sedge
Iris versicolor	blueflag iris
Pontederia cordata	pickerelweed
Sagittaria latifolia	duck-potato
Saururus cernus	lizard tail
Scirpus atrovirens	green bulrush
Sparganium americanum	lesser bur-reed

Herbaceous Species

Botanical Name	*Common Name*
Aesclepias incarnata	swamp milkweed
Aster novae-angliae	New England aster
Aster novi-belgi	New York aster
Carex lurida	shallow sedge
Chelone glabra	turtlehead
Eupatorium perfoliatum	boneset
Hibiscus moscheutos	swamp rose-mallow
Juncus effusus	soft rush
Lobelia cardinalis	cardinal flower
Lobelia siphilitica	blue lobelia
Onoclea sensibilis	sensitive fern
Osmunda cinnamomea	cinnamon fern
Osmunda regalis	royal fern
Vernonia noveboracensis	New York ironweed

Shrub Species

Botanical Name	*Common Name*
Alnus serrulata	smooth alder
Aronia melanocarpa	black chokeberry
Cephalanthus occidentalis	buttonbush
Clethra alnifolia	sweet pepperbush
Cornus amomum	silky dogwood
Cornus sericea	redosier dogwood
Ilex glabra	inkberry
Ilex verticillata	winterberry holly
Lindera benzoin	spicebush
Rhododendron viscosum	swamp azalea
Rosa palustris	swamp rose
Salix discolor	pussy willow
Vaccinium corymbosum	highbush blueberry
Viburnum dentatum	arrowwood viburnum
Viburnum trilobum	cranberrybush viburnum

Tree Species

Botanical Name	*Common Name*
Acer rubrum	red maple
Betula nigra	river birch
Fraxinus americana	white ash
Fraxinus pensylvanica	green ash
Nyssa sylvatica	black tupelo
Platanus occidentalis	sycamore
Quercus bicolor	swamp white oak
Quercus palustris	pin oak
Viburnum lentago	nannyberry viburnum
Viburnum prunifolium	blackhaw viburnum

ATTACHMENT D

Pruning Guidelines

PRUNING GUIDELINES AND SPECIFIC CARE FOR SHRUBS

A. Pruning

Pruning can be used to direct the growth of shrubs, to improve their health, and to increase their production of flowers and fruit. Pruning can direct a shrub's growth to balance unevenness, keep a shrub small and compact, and make it grow tall, or open up its form.

B. When to Prune

The following guidelines are provided for general knowledge should shrubs become unhealthy, undesirably large or a safety hazard. In general, pruning will not be necessary, but can be used to improve the appearance of shrubs in highly visible or highly trafficked areas. Pruning should be done only after consulting with the project landscape architect and/or property manager, with a clear understanding of the desired effect. Shrubs planted in the bioretention system are expected to spread over their life cycle, developing into a dense understory, providing pollutant removal and wildlife habitat.

Shrubs require pruning at different times of the year. Shrubs that are grown primarily y for their flowers require greater attention to timing than coniferous and broad-leafed evergreen shrubs. Flowering shrubs are divided into two groups: those that flower on old wood and those that flower on new wood. On this basis alone, you can determine when to prune your flowe ling shrubs.

To determine whether a shrub blooms on new or old wood, first distinguish between the two types of growth. New wood is new stem growth that is produced during the current growing season. It is usually light green or pinkish in color. Old wood has grown during a previous season. It is usually much darker in color than new wood and is much more brittle. While a plant blooms, take a close look to see where the flowers form. If you are uncertain about

whether the shrub blooms on old or new wood, wait a season to discover whether it blooms or not, and if it does, on what type of wood.

Once you know the type of wood on which a shrub flowers, pruning is easy. In early spring, old-wood-blooming shrubs should be pruned a week or two after the flowers drop. When pruned at the right time - in the spring or early summer - the plants have the rest of the season to produce more blossom buds for the following year.

Shrubs that blossom in late spring or in the summer produce flowers on new wood. The time to prune these shrubs is during the dormant season, or just before growth starts in very early spring. Pruning at these times encourages newer stem growth and more blossoms.

C. Types of Pruning

The two basic pruning methods are thinning and heading. Thinning, or thinning out, removes the entire branches back to a main trunk, or major branches to the ground. Heading, or heading back, removes only part of a branch.

The main difference between thinning and heading is the effect on plants. Thinning causes the shrubs energy to go to the remaining branches which then grow more. The long-term result of thinning a shrub is to give it an open, natural look. Thinned shrubs become larger than shrubs that are headed back.

Heading back a branch causes the plant to grow multiple branches in place of a single branch. Heading forces the dormant buds closest to a pruning cut to grow. Over the long term, heading results in a denser shrub that has more branches, but is smaller than a shrub that has been thinned. Heading is most often associated with formal shapes.

D. Pruning Cuts

Before leaves and new stems appear, growth buds form in small swellings on the stems and branches of a shrub. Inside these buds are tiny, undeveloped leaves, branches, and flowers. There are two types of buds: te1minal and lateral. Terminal buds grow at the tip of a shoot, and lateral buds appear at the side. These buds are the keys to making good pruning cuts. When pruning, always cut above a bud. To place the cut near a lateral bud, select a bud that is pointing outward so that the new branch will grow away from the main trunk rather than crisscrossing with interior branches. Cutting above an outward-pointing lateral bud will also open up the plant to light and air and promote orderly growth - important goals in pruning.

Cutting off lateral buds or side branches will direct the shrubs energy to the terminal buds, thus pushing the branches to grow in the directions they are alread y pointing. When making a pruning cut, hold the branch just below where the cut will be. Place the cutting blade of the hand pruners beneath the branch and cut at an upward angle. The slant of the cut should be in the direction you want the new branch to grow. Never leave a budless stub of wood behind. Stubs are unsightly and usually die and become an entry point for insects and diseases. Consider each cut carefully - no pruning cut should ever be made without a good reason and a clear understanding of what the results are likely to be.

E. Renewal Pruning

Renewal pruning is a special form of pruning that can keep deciduous shrubs, particularly y flowering varieties, young and vital no matter how old they are. Even though the plant itself may be over one hundred years old, this technique produces branches that never get more than three to five years old.

Every year or two, prune out a few of the oldest canes at ground level. Removing this old wood opens up the top to let light and air into the interior of

the shrub and encourages growth from the base, eventually renewing the top of the plant.

For those shrubs that do not produce shoots from their base, such as viburnums, deadheading the plant - removing the dead blooms - allows the vegetative buds of the plant to grow. In most of the Unites States, there are one to two periods of vegetative growth, followed by flower bud development in late July and August.

F. Three-Year Renewal

Each year, most deciduous shrubs produce shoots from their base or roots. Prune the shrub so that one third of the shoots will be one year old, one third will be two years old, and one third will be three years old. When you prune, remove crossing limbs or any dead or diseased branches. Next, cut out most of the three-year-old wood. This will induce new shoots to spring up, leaving the desired number to form the first-year shoots the following year.

The only other pruning necessary is done to reduce the total height of the shrub to keep it within the bounds you desire, while preserving its natural form. Removing the third-year wood every year after blooming guarantees that you always have young, healthy wood to produce the biggest and healthiest flowers. The three-year renewal system also results in healthier plants because older wood is more susceptible to insects and disease than young, strong shoots.

H. Specific Shrub Care

Arrowwood Viburnum *(Viburnum dentatum):* Many insects and diseases can attack viburnum, although these shrubs are usually untroubled if kept vigorous. Prune away any dead wood after flowering, and watch out for water sprouts - tall whips that shoot up from soil level, or low on the trunk. These can be cut down at the ground or cut back to a place where other shoots branch. They too will branch and blend in. Also, this will produce more branches on which flowers can develop.

Inkberry and Common Winterberry *(flex sp.)*: The Inkberry can reach six to eight feet in height by eight to I 0 feet in spread and develop a leggy openness. The Winterberry can grow 20 feet high but usually only reach six to nine feet with a similar spread. The Inkberry and Winterberry should be pruned heavily to renew leggy old plants.

Red and Black Chokeberry *(Aronia* sp.): Distinctly leggy, upright shrubs that grows six to I 0 feet high and three to five feet wide, these plants are best used in masses and large groups that serve to accentuate the fruit display and diminish their legginess. Adaptable and little troubled by pests, the Chokeberry is a carefree plant. The Chokeberry can be thinned or headed if needed.

Red-osier Dogwood (*Cornus stolonifera)*: Its loose, open, and very erect branches grow rapidly to a height of eight to I 0 feet, with lateral branching occurring only in the upper third of the shrub. Like most dogwoods, it is susceptible to many pests and diseases. Maintaining a vigorous plant is the best protection. In order to encourage vigorous new growth, each spring remove at least one third of the old wood - more if a compact plant is desired.

PRUNING GUIDELINES AND SPECIFIC CARE FOR TREES

A. Pruning

The following guidelines are provided for general knowledge should trees become unhealthy or a safety concern. In general, pruning will not be necessary, but can be used to improve the appearance of trees in highly visible or highly trafficked areas. Pruning should be done only after consulting with the project landscape architect and/or property manager, with a clear understanding of the desired effect. Trees planted in the bioretention system are expected to develop without the need for heavy pruning.

Pruning trees is slightly different than pruning shrubs. The best method of tree pruning is thinning, which involves removing a branch at its 0ligin or cutting back to another lateral branch. To be most effective, prune broadleaf trees in the following order: 1) prune away any dead, diseased, or crisscrossing branches, 2) prune for form, making the smallest cuts first and the largest ones last.

Pruning shears should be used when pruning small stems and shoots. Cut just above a healthy lateral bud to remove unwanted growth. Cut 3 inches above the bud from which you want a branch to grow - more will leave a dead stub, less may damage the bud. Place the shears so that the blade cuts upwards. Slant the cut upward toward the top of the bud, with the angle in the direction you want the new branch to grow.

Lopping shears should be used to prune small branches up to 3 inches thick. Again, cut upward; this makes cutting easier and reduces the danger of bark tearing as the limb falls. Cut small limbs, including suckers (vigorous sprouts that grow from the ground) and water sprouts (similar to suckers, but higher on the trunk) as close to the trunk or branch as possible.

A handsaw will work on branches thicker than 3 inches. If a branch is too heavy to support with your free hand, first make a rough cut about six inches from the trunk, and then cut off the six-inch stub next to the trunk. This method keeps

the bark from being stripped off the tree should the heavy branch slip from your hand while you are still cutting. The branch should be cut just outside the branch collar and not flush to the trunk. For this project, pruning may be performed on all trees to enhance the health and appearance of the trees.

B. Insects and Disease

Anthracnose: This term refers to several different fungi that can infest the leaves of maple, ash, sycamore, oak, and linden trees, among others. These fungi produce small brown spots that may coalesce. This gives a scorched appearance to the entire leaf, and affected leaves may drop off the tree. Usually young leaves and tender shoots are affected, particularly in a wet spring. A second crop of leaves and twigs will often fall prey to anthracnose as well.

Control: The best means of control is a thinned tree canopy that allows for better air circulation. Trees should also be well fertilized and growing vigorously. Anthracnose is generally not life threatening to the tree, and spray treatments with fungicides such as chlorothalonil, captan, or benomyl are recommended only in severe cases.

Beetles: There are many leaf eating beetles. Two of the most destructive are the elm leaf beetle and the Japanese beetle. The elm leaf beetles skeletonize leaves. The Japanese beetle is a Y2 inch long, metallic-green beetle with a coppery back.

Control: Spray with acephate, carbaryl, or diazinon when the damage is first noticed, and repeat as necessary.

Borers: Any tree - especially birch - that is in a weakened or stressed condition will attract borers. Drought, sunburn, frost cracks, poor soil, bark

injury, and air pollution are some of the major causes of stress and, consequently, of borer attack. Holes in the bark indicating the presence of borers may be very tiny or up to one inch in diameter; they may be oval or round.

Control: The best way to prevent borer infestation is to reduce tree stress. Wrapping the trunk of a tree can prevent a borer infestation. Insecticides such as Imane and chlorpyrifos will control some types of borers. Before applying insecticides, the borer type should be determined to ensure effective control.

Cankers: These are dead and diseased areas that develop on trees, usually on woody branches or trunks. A common symptom is die back staliing at branch tips and sunken lesions on the branches and twigs. Virtually all plants can be attacked by canker-forming diseases.

Control: Prune and discard infested branches. Paint pruning wounds with a disinfectant. When trunks are seriously invaded often the tree cannot be saved. Some cankers bleed (ooze). To best control this, restore the tree's health by supplying proper water and fertilizer. Control insects and prune in late winter when bleeding is reduced. Cut cankerous areas back to healthy bark so that callus tissue can from.

Caterpillars: Caterpillars, bagworms, and loopers (or cankerworms) are some of the most damaging leaf-eating pests.

Control: Use *Bacillus thuringiensis* (Bt), an organic, bacteria-based compound, to control caterpillars. Use insecticides such as acephate, carbaryl, diazinon, or malathion only where infestations are severe.

Honeydew: Some insects, such as asphids, that feed on trees by sucking their sap excrete honeydew, a sticky, clear, sugary material. Large number of ants, flies, and even honeybees, all of which are attracted to honeydew, are indicators of the presence of these pests. In time, a sooty mold may grow on the honeydew, blackening the leaves of infested plants. Soft scales and leafhoppers

are also common honeydew excreters. Though unsightly, the honeydew seldom does permanent damage.

Control: Use insecticidal soap to control these pests. These soaps can bum the tree, so follow label instructions carefully and test them first on an unimportant branch.

Powdery Mildew: This fungus disease causes an unsightly, grayish, powdery coating to form on young shoots, leaves, and flower buds. It thrives in shade and where air circulation is poor. This disease attacks many shade and flowering trees.

Control: In most cases, powdery mildew does not cause long-term damage. However, spraying with chlorothalonil, lime-sulfur, triforine, or benomyl may prevent this disease.

Scale: These are small, sucking insects. They are immobile except when in the crawler stage, which occurs after the eggs hatch, usually in the spring. If left unchecked, scales can build up large populations that can weaken or even cause the death of trees.

Control: A dormant oil spray applied in the late winter or early spring smothers scales or their eggs. Acephate, carbaryl, diazinon, or malathion can be used in summer when the crawlers appear.

C. Specific Tree Care

Red Maple *(Acer rubrum)*: It is fast growing to a height of 50-60 feet tall and 40-60 feet wide; symmetrical, spreading, pyramidal. Verticillium wilt can be a problem, and so can aphids and the honeydew they secrete. If desired, the lower branches may be pruned to allow passage under the canopy.

River Birch *(Betula nigra)*: It grows to 50-70 feet and is pyramidal in habit. This is a good tree to use a drought indicator, as it is among the first to show moisture

stress. It is prone to damage by aphids, borers, leafininers, and other insects and may be short lived. They also bleed profusely in the spring and should be pruned at other times.

Center for Urban Ecology Information Bulletin

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Bacterial Leaf Scorch of Landscape Trees

A newly described bacterium has been added to the host of factors that plague and weaken landscape trees. The bacterium *Xylella fastidiosa*, which clogs the water-conducting xylem cells, is associated with a leaf scorch of at least five tree species. Environmental factors such as drought, excessive salt, or root damage have long been known to cause leaf scorch. Not until 1978, however, were scientists able to culture *X. fastidiosa* and prove that this unique plant pathogen also causes leaf scorch.

Although the effects of the pathogen on a wide range of plants were known for some years, the connection with landscape trees is recent. This bulletin describes the symptoms for five trees: elm, oak, sycamore, mulberry, and maple. Familiarity with the distinctive symptoms illustrated here should assist in accurately diagnosing this widespread tree disease.

Bacterial leaf scorch affecting a young American elm on the National Mall

ELM

Leaf scorch symptoms begin to develop in mid- to late June and increase in severity through summer and early fall. Scorch appears as an irregular scalloped browning along the leaf margin bordered by a yellow halo. As browning spreads toward the midvein, leaves may curl and drop early. Symptom severity progresses from older to younger leaves on a branch; newest leaves at the tip sometimes remain unaffected. Symptoms recur each year and spread over the tree's crown. Reduction in growth and dieback are common in severely affected trees.

Bacterial leaf scorch can be confused with Dutch elm disease caused by the vascular wilt fungus *Ophiostoma ulmi*, but there are distinct differences. Dutch elm disease is usually noticed in early summer, while bacterial leaf scorch symptoms appear later. Dutch elm disease causes a true wilt, with leaves becoming flaccid or drooping before losing color and dying, while bacterial leaf scorch causes leaf browning, not wilt. Also, one characteristic of Dutch elm disease, brown streaking of the sap wood, does not occur with bacterial leaf scorch. Most significantly, Dutch elm disease is an acute disorder that usually kills a tree in one or two years. By

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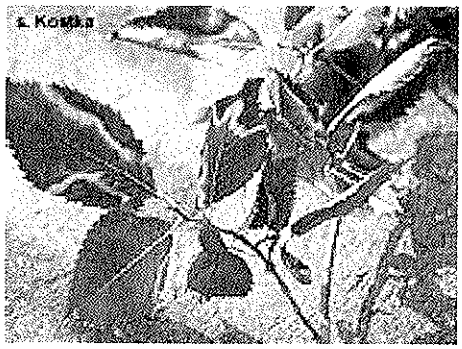
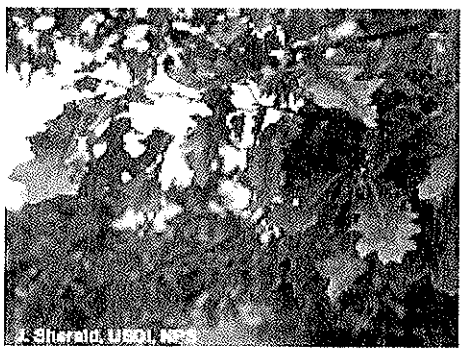


Elm leaf margins exhibit browning and yellow halo

contrast, bacterial leaf scorch causes slow decline over may years. Elms infected with *Xylella,* however, are weakened and therefore more attractive to bark beetles that transmit *O. ulmi.* Bacterial leaf scorch may therefore increase the probability of an elm contracting Dutch elm disease.

OAK

Bacterial leaf scorch affect several species in the red and black oak group including northern red oak, *Quercus rubra;* pin oak, *Q. palustirs;* scarlet oak, *Q. coccinea;* southern red oak, *Q. falcata;* laurel oak, *Q. laurifolia;* shingle oak, *Q. imbricaria;* and the water oak, *Q. nigra.* In midsummer leaves start to die along the edges. The leaf margin is usually composed of alternating reddish and light brown tissue. The leading edge (red-brown) shows a pale halo next to green tissues.



All leaves of this oak branch show disease symptoms

Because of the determinate growth pattern of oaks, all leaves on a branch share the same age and thus are affected at the same time in contrast to the symptoms in elm and sycamore. Each year, as is typical of chronic infections, leaf scorch, dieback, and crown reduction affect more of the tree. Severely scorched leaves commonly drop off early. Leaf scorch symptoms are obvious when a single limb is affected in an otherwise healthy oak, but in trees whose crowns are extensively affected, leaf scorch may be mistaken for stress.

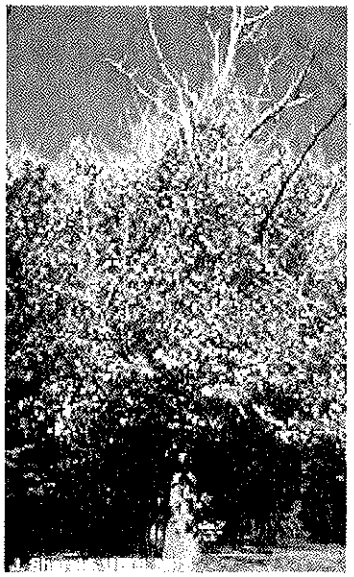
Bacterial leaf scorch may be mistakenly attributed to oak wilt caused by the fungus *Ceratocystis fagacearum* but, like Dutch elm disease, oak wilt results in distinctive vascular streaking and rapid death of the tree.

Dying area of sycamore leaf is tan, edged by red-brown

Sycamore branch with older leaves affected leaves

SYCAMORE

Symptoms appear in midsummer with leaves developing an olive drab discoloration that soon turns brown. Discoloration occurs along the leaf margin and between the veins. The leading edge of the dead tissue is often dark red-brown. As in elm, leaf scorch symptoms progress from older to younger leaves, with leaves at the tips of branches often remaining symptom-free. Scorched leaves curl upwards but stay attached.



Dieback marks final stage of severely affected sycamore

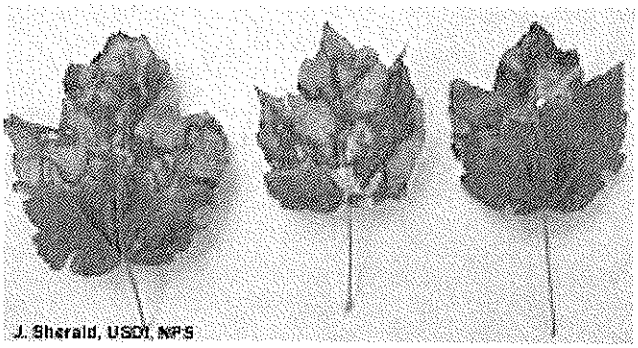
Symptoms appear first in a single branch or limb and spread throughout the canopy in later years. Affected trees linger for many years, developing a general decline characterized by progressive dieback, likely promoted by secondary factors.

Sometimes bacterial leaf scorch is misdiagnosed as sycamore anthracnose caused by the fungus *Apiognomonia veneta.* Anthracnose primarily affects new leaves in cool wet springs, whereas bacterial leaf scorch symptoms appear in midsummer.

MULBERRY and MAPLE

Mulberries are often affected but are not so severely debilitated by bacterial leaf scorch. In some cases, leaves dry up with only a slight change in color before curling upward. In other cases, leaf margins turn brown and have a distinctive yellow halo between dead and green tissue. As in elm and sycamore, symptoms progress from older to younger leaves. Leaves may fall early, leaving bare branches with tufts of green leaves at the tips.

Leaf scorch associated with *X. fastidiosa* has been observed in red maple. Maple leaves develop an irregular pattern of light and reddish brown tissue separated from green tissue by a yellow halo. Symptoms contrast sharply with the uniform marginal browning caused by drought and commonly seen in curbside plantings. As with other species, there is an annual progression of the symptoms of bacterial leaf scorch in the tree canopy.



Red maple leaf showing irregular pattern of light and reddish-brown tissue with yellow halo

DIAGNOSIS

Bacterial leaf scorch has been observed most often in the mid-Atlantic and southeastern states. However, oak leaf scorch has been seen as far north as New York; affected sycamores are common in Texas; and diseased mulberries have been seen as far west as Nebraska. These observations refer to managed landscapes- planted areas, park lands, or urban landscaping.

Once bacterial leaf scorch has been confirmed in a locale, the diagnosis can usually be based on symptoms alone. Note, however, that symptoms can be confused with other diseases, and infected trees may be suffering from other problems that mask the presence of *X. fastidiosa*. In some cases the bacterium's presence must be confirmed. The species name *"fastidiosa"* refers to the bacterium's exacting growth requirements. Because of its fastidious nature, confirming infections of trees by isolating the bacterium is difficult. A serological test has been developed to aid diagnosis. The test is an enzyme-linked immunosorbent assay (ELISA) called 'PATHOSCREEN Xf' (Agdia Inc., Elkhart, IN). Tissue samples of leaves, buds, and stems may be sent directly to the Agdia laboratory for analysis; or the test kit can be purchased from Agdia and used by diagnosticians.

TRANSMISSION

The bacterium has a wide host range including grasses and broad-leaved plants in some 30 families. Many infected plants show few symptoms. However, in addition to leaf scorch of landscape trees, *X. fastidiosa* causes several diseases that have economic consequences: Pierce's disease of grape, phony disease of peach, almond leaf scorch, plum leaf scald, and alfalfa dwarf. Xylem-feeding sharpshooter leafhoppers (*Cicadillinae*) and spittle bugs (*Cercopidae*) are known transmitters for these diseases. Insect transmission is just now being studied in landscape trees, but the same vectors are probably responsible. Also, since several vascular fungal pathogens are transmitted in elm and oak by root grafts, it is possible that *X. fastidiosa* can be transmitted by root grafts.

MANAGEMENT

Bacterial leaf scorch of landscape trees caused by *X. fastidiosa* is not a new disease but simply one that has been misdiagnosed or overlooked. Now that researchers recognize the disease and the pathogen that causes it, methods of prevention and treatment are being studied. Experimental antibiotic injections to the xylem have resulted in symptom remission, but no cure. Currently, there are no antibiotics or bactericides commercially available to treat bacterial leaf scorch. Management of insect vectors is not practical since leafhoppers are active throughout the growing season.

Pruning therapy is only now being tested. As with Dutch elm disease, surgical removal of an infected limb well below the last scorched leaf may cure early infections; however, surgery cannot benefit trees with widespread infection. Extra care to fertilize and irrigate may prolong the life of an infected tree, but trees with extensive leaf scorch and dieback should be removed.

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What is Goose Chase geese control? It's a biodegradable, food-grade taste aversion agent, made from a bitter tasting, smelly part of concord grapes (active ingredient methyl anthranilate). It renders food sources unpalatable and inedible to geese.

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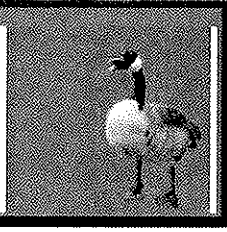

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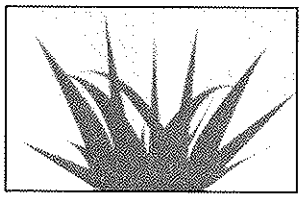
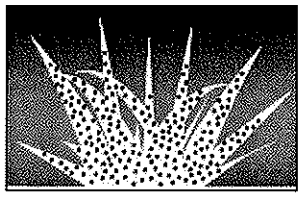
   Studies have shown that birds will refuse to eat food treated with the active ingredient in Flight*Control*® PLUS once they are conditioned.



Treated turf appears natural when viewed by humans.



Treated turf appears speckled when viewed by geese in the UV spectrum.

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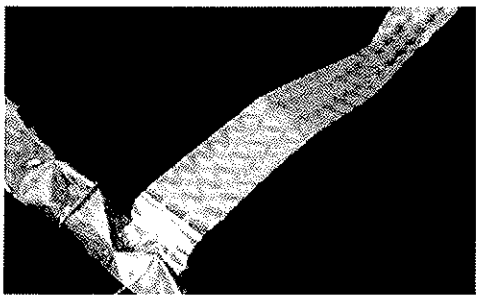

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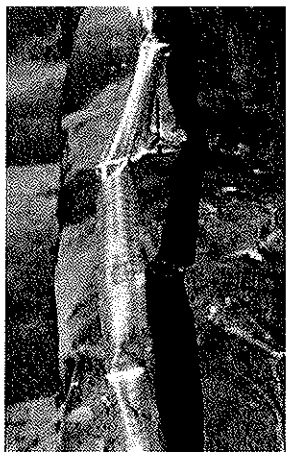

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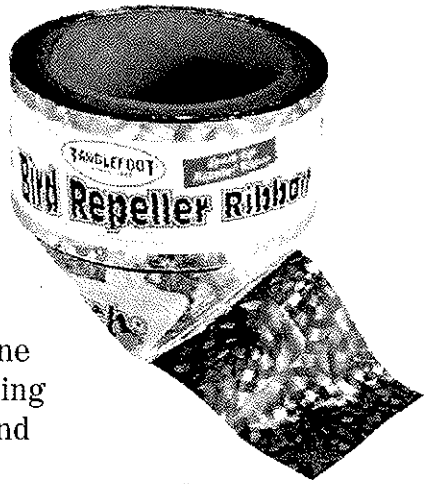
Repeller Ribbon



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Made from holographic Mylar foil, Repeller Ribbon provides spot control for nuisance birds by producing an optical, audible and physical discomfort zone.

The light reflected from its holographic surface is menacing to most pest birds. A light breeze will also provide move-ment and a metallic rattle which encourages the nuisance animals to keep their distance.

Application is easy; with scissors, cut several pieces of ribbon 2 to 3 foot long. Position the length of ribbon where nuisance birds and animals will see and hear it. Fasten them at one end to the desired locations using Velcro, string, twine, staples, etc. Make sure the length of ribbon can move freely with the wind.

When applied in a line fashion along a narrow ledge or on top of a fence, the ribbon can help deter bird roosting.

Repeller Ribbon is available from Nixalite in 25 foot and 100 foot long rolls. Contact Nixalite for more information on the Repeller Ribbon.

Applications:

- Gardens
- Orchards
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- Trees
- Garages
- Docks
- Gazebos
- Ponds
- Barns
- Many More!

Use with other spot controls:

- Bird Scare Predator Eyes
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The Bird Control 'X-perts'

BIRD-X

Pigeon Repellers Since 1964
***Environmentally Safe *Low Cost Repellers**
***Harmless to Pigeons *Easy to Install**

Controlling Pigeon Infestations Since 1964. Repelling Pigeons is our business.

Terror-Eyes

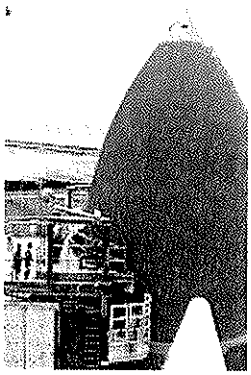
Repel pigeons with a vinyl inflatable predator frightens bird pests away!

Huge 2-foot hanging ball has menacing, moving eyes on front and back that strike fear in birds!

MILLIONS SOLD...TERROR-EYES WORKS AS A VERY EFFECTIVE PIGEON CONTROL DEVICE IN COMBINATION WITH SONIC ULTRASONIC OR ELECTRONIC BIRD REPELLERS!

Lenticular eyes produce holographic effects, constantly moving and changing as if they are "following" infesting birds. Made of brilliantly colored heavy duty vinyl; scientifically designed from extensive experience and research on predator and bird behavior.

Used in such places where there is pigeon problem and other bird infestation.



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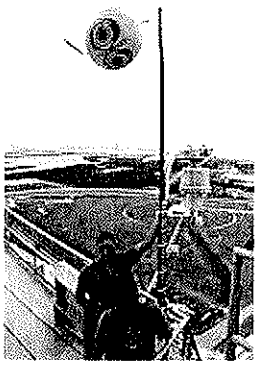

Goverment agencies such as NASA solved its pigeon infestation with Terror-Eyes bird repeller!!!

3-D EYES MOVE FORWARD AND SIDEWAYS FOLLOWING BIRD PESTS AS THEY FLY AWAY
Hanging spring and air currents do the rest... a totally realistic and scary visual deterrent!

"I would say that Terror-Eyes has helped to reduce bird activity here by about 90%," Becerra said. "Because this was the most effective solution we've tried, I ordered nine additional units. Whereas before we installed Terror-Eyes, hundreds of birds flocked here to fight over a popcorn kernel, maybe only a few birds can now be seen in the area because they seem afraid of the Terror-Eyes balloons."

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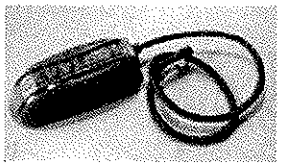

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ATTACHMENT F

Inspection Forms

Bioretention Basin Inspection & Maintenance Log

Basin Number:_____Location:_____

Date	Structural components[1]	Vegetation[2]	72-Hour Drain Time[3]	Describe Maintenance Performed	By	Comments

1. All structural components must be inspected at least once annually, for cracking, subsidence, spalling, erosion and deterioration. Components expected to receive and/or trap debris and sediment must be inspected for clogging at least 4 times annually, as well as after every storm exceeding 1 inch of rainfall.
2. Bi-weekly inspections are required when establishing/restoring vegetation. A minimum of one inspection during the growing season and one inspection during the non-growing season is required. Grasses within the basin should be maintained with light weight equipment to maintain system permeability.
3. Design drain time = 72 hours. The planting bed must be inspected at least twice annually to determine if the permeability of the bed has decreased. If the actual drain time is longer than the design drain time, the components must be evaluated and appropriate measures taken to return the bioretention system to the original tested as-built condition.

CDS Inspection & Maintenance Log

CDS Model: _____ Location: _____

Date	Water depth to sediment[1]	Floatable Layer Thickness[2]	Describe Maintenance Performed	Maintenance Personnel	Comments

1. The water depth to sediment is determined by taking two measurements with a stadia rod: one measurement from the manhole opening to the top of the sediment pile and the other from the manhole opening to the water surface. If the difference between these measurements is less than the values listed in table 1 the system should be cleaned out. **Note: to avoid underestimating the volume of sediment in the chamber, the measuring device must be carefully lowered to the top of the sediment pile.**

2. For optimum performance, the system should be cleaned out when the floating hydrocarbon layer accumulates to an appreciable thickness. In the event of an oil spill, the system should be cleaned immediately.

StormTrap Unit® Inspection & Maintenance Log

StormTrap Model:_____Location: _____

Date	Depth of Sediment	Accumulated Trash	Maintenance Performed	Maintenance Personnel	Comments

CONTECH®
ENGINEERED SOLUTIONS

CDS Guide
Operation, Design, Performance and Maintenance

CDS®

Using patented continuous deflective separation technology, the CDS system screens, separates and traps debris, sediment, and oil and grease from stormwater runoff. The indirect screening capability of the system allows for 100% removal of floatables and neutrally buoyant material without blinding. Flow and screening controls physically separate captured solids, and minimize the re-suspension and release of previously trapped pollutants. Inline units can treat up to 6 cfs, and internally bypass flows in excess of 50 cfs (1416 L/s). Available precast or cast-in-place, offline units can treat flows from 1 to 300 cfs (28.3 to 8495 L/s). The pollutant removal capacity of the CDS system has been proven in lab and field testing.

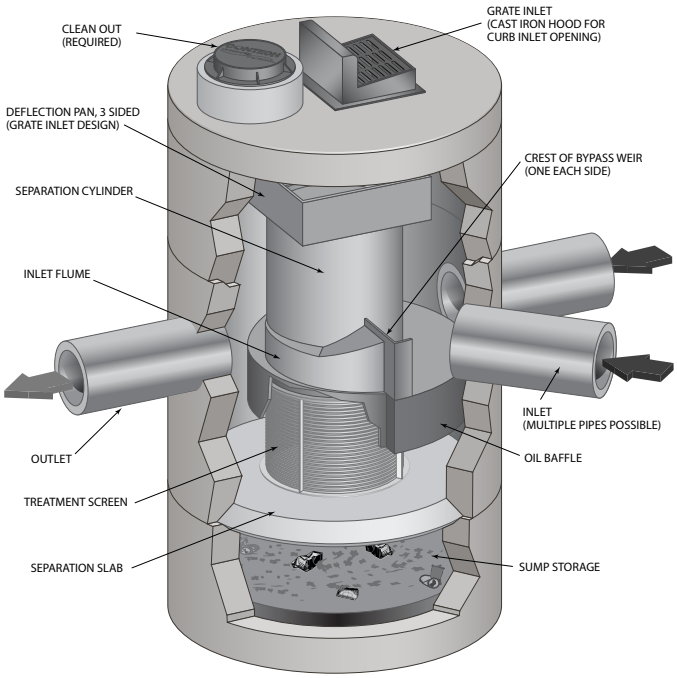
Operation Overview

Stormwater enters the diversion chamber where the diversion weir guides the flow into the unit's separation chamber and pollutants are removed from the flow. All flows up to the system's treatment design capacity enter the separation chamber and are treated.

Swirl concentration and screen deflection force floatables and solids to the center of the separation chamber where 100% of floatables and neutrally buoyant debris larger than the screen apertures are trapped.

Stormwater then moves through the separation screen, under the oil baffle and exits the system. The separation screen remains clog free due to continuous deflection.

During the flow events exceeding the treatment design capacity, the diversion weir bypasses excessive flows around the separation chamber, so captured pollutants are retained in the separation cylinder.



Design Basics

There are three primary methods of sizing a CDS system. The Water Quality Flow Rate Method determines which model size provides the desired removal efficiency at a given flow rate for a defined particle size. The Rational Rainfall Method™ or the and Probabilistic Method is used when a specific removal efficiency of the net annual sediment load is required.

Typically in the Unites States, CDS systems are designed to achieve an 80% annual solids load reduction based on lab generated performance curves for a gradation with an average particle size (d50) of 125 microns (μm). For some regulatory environments, CDS systems can also be designed to achieve an 80% annual solids load reduction based on an average particle size (d50) of 75 microns (μm) or 50 microns (μm).

Water Quality Flow Rate Method

In some cases, regulations require that a specific treatment rate, often referred to as the water quality design flow (WQQ), be treated. This WQQ represents the peak flow rate from either an event with a specific recurrence interval, e.g. the six-month storm, or a water quality depth, e.g. 1/2-inch (13 mm) of rainfall.

The CDS is designed to treat all flows up to the WQQ. At influent rates higher than the WQQ, the diversion weir will direct most flow exceeding the WQQ around the separation chamber. This allows removal efficiency to remain relatively constant in the separation chamber and eliminates the risk of washout during bypass flows regardless of influent flow rates.

Treatment flow rates are defined as the rate at which the CDS will remove a specific gradation of sediment at a specific removal efficiency. Therefore the treatment flow rate is variable, based on the gradation and removal efficiency specified by the design engineer.

Rational Rainfall Method™

Differences in local climate, topography and scale make every site hydraulically unique. It is important to take these factors into consideration when estimating the long-term performance of any stormwater treatment system. The Rational Rainfall Method combines site-specific information with laboratory generated performance data, and local historical precipitation records to estimate removal efficiencies as accurately as possible.

Short duration rain gauge records from across the United States and Canada were analyzed to determine the percent of the total annual rainfall that fell at a range of intensities. US stations' depths were totaled every 15 minutes, or hourly, and recorded in 0.01-inch increments. Depths were recorded hourly with 1-mm resolution at Canadian stations. One trend was consistent at all sites; the vast majority of precipitation fell at low intensities and high intensity storms contributed relatively little to the total annual depth.

These intensities, along with the total drainage area and runoff coefficient for each specific site, are translated into flow rates using the Rational Rainfall Method. Since most sites are relatively small and highly impervious, the Rational Rainfall Method is appropriate. Based on the runoff flow rates calculated for each intensity, operating rates within a proposed CDS system are

determined. Performance efficiency curve determined from full scale laboratory tests on defined sediment PSDs is applied to calculate solids removal efficiency. The relative removal efficiency at each operating rate is added to produce a net annual pollutant removal efficiency estimate.

Probabilistic Rational Method

The Probabilistic Rational Method is a sizing program Contech developed to estimate a net annual sediment load reduction for a particular CDS model based on site size, site runoff coefficient, regional rainfall intensity distribution, and anticipated pollutant characteristics.

The Probabilistic Method is an extension of the Rational Method used to estimate peak discharge rates generated by storm events of varying statistical return frequencies (e.g. 2-year storm event). Under the Rational Method, an adjustment factor is used to adjust the runoff coefficient estimated for the 10-year event, correlating a known hydrologic parameter with the target storm event. The rainfall intensities vary depending on the return frequency of the storm event under consideration. In general, these two frequency dependent parameters (rainfall intensity and runoff coefficient) increase as the return frequency increases while the drainage area remains constant.

These intensities, along with the total drainage area and runoff coefficient for each specific site, are translated into flow rates using the Rational Method. Since most sites are relatively small and highly impervious, the Rational Method is appropriate. Based on the runoff flow rates calculated for each intensity, operating rates within a proposed CDS are determined. Performance efficiency curve on defined sediment PSDs is applied to calculate solids removal efficiency. The relative removal efficiency at each operating rate is added to produce a net annual pollutant removal efficiency estimate.

Treatment Flow Rate

The inlet throat area is sized to ensure that the WQQ passes through the separation chamber at a water surface elevation equal to the crest of the diversion weir. The diversion weir bypasses excessive flows around the separation chamber, thus preventing re-suspension or re-entrainment of previously captured particles.

Hydraulic Capacity

The hydraulic capacity of a CDS system is determined by the length and height of the diversion weir and by the maximum allowable head in the system. Typical configurations allow hydraulic capacities of up to ten times the treatment flow rate. The crest of the diversion weir may be lowered and the inlet throat may be widened to increase the capacity of the system at a given water surface elevation. The unit is designed to meet project specific hydraulic requirements.

Performance

Full-Scale Laboratory Test Results

A full-scale CDS system (Model CDS2020-5B) was tested at the facility of University of Florida, Gainesville, FL. This CDS unit was evaluated under controlled laboratory conditions of influent flow rate and addition of sediment.

Two different gradations of silica sand material (UF Sediment & OK-110) were used in the CDS performance evaluation. The particle size distributions (PSDs) of the test materials were analyzed using standard method "Gradation ASTM D-422 "Standard Test Method for Particle-Size Analysis of Soils" by a certified laboratory.

UF Sediment is a mixture of three different products produced by the U.S. Silica Company: "Sil-Co-Sil 106", "#1 DRY" and "20/40 Oil Frac". Particle size distribution analysis shows that the UF Sediment has a very fine gradation (d50 = 20 to 30 μm) covering a wide size range (Coefficient of Uniformity, C averaged at 10.6). In comparison with the hypothetical TSS gradation specified in the NJDEP (New Jersey Department of Environmental Protection) and NJCAT (New Jersey Corporation for Advanced Technology) protocol for lab testing, the UF Sediment covers a similar range of particle size but with a finer d50 (d50 for NJDEP is approximately 50 μm) (NJDEP, 2003).

The OK-110 silica sand is a commercial product of U.S. Silica Sand. The particle size distribution analysis of this material, also included in Figure 1, shows that 99.9% of the OK-110 sand is finer than 250 microns, with a mean particle size (d50) of 106 microns. The PSDs for the test material are shown in Figure 1.

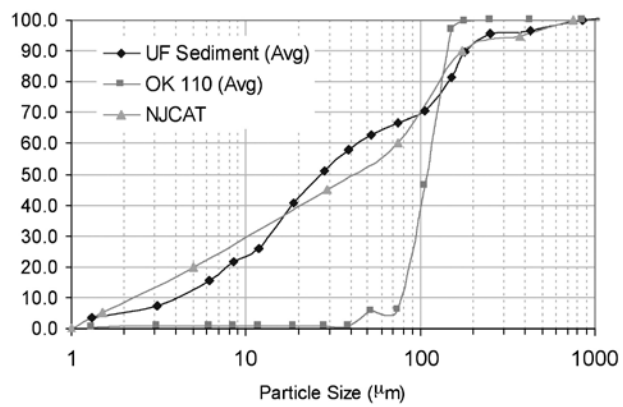


Figure 1. Particle size distributions

Tests were conducted to quantify the performance of a specific CDS unit (1.1 cfs (31.3-L/s) design capacity) at various flow rates, ranging from 1% up to 125% of the treatment design capacity of the unit, using the 2400 micron screen. All tests were conducted with controlled influent concentrations of approximately 200 mg/L. Effluent samples were taken at equal time intervals across the entire duration of each test run. These samples were then processed with a Dekaport Cone sample splitter to obtain representative sub-samples for Suspended Sediment Concentration (SSC) testing using ASTM D3977-97 "Standard Test Methods for Determining Sediment Concentration in Water Samples", and particle size distribution analysis.

Results and Modeling

Based on the data from the University of Florida, a performance model was developed for the CDS system. A regression analysis was used to develop a fitting curve representative of the scattered data points at various design flow rates. This model, which demonstrated good agreement with the laboratory data, can then be used to predict CDS system performance with respect

to SSC removal for any particle size gradation, assuming the particles are inorganic sandy-silt. Figure 2 shows CDS predictive performance for two typical particle size gradations (NJCAT gradation and OK-110 sand) as a function of operating rate.

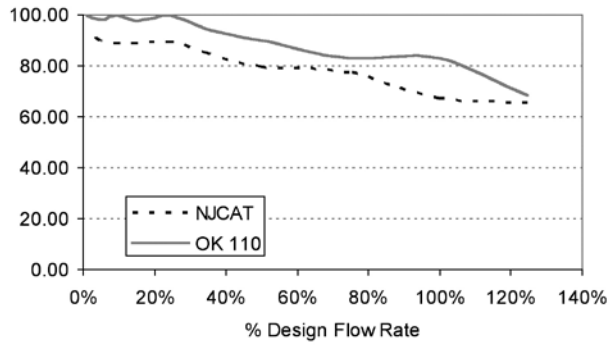


Figure 2. CDS stormwater treatment predictive performance for various particle gradations as a function of operating rate.

Many regulatory jurisdictions set a performance standard for hydrodynamic devices by stating that the devices shall be capable of achieving an 80% removal efficiency for particles having a mean particle size (d50) of 125 microns (e.g. Washington State Department of Ecology — WASDOE - 2008). The model can be used to calculate the expected performance of such a PSD (shown in Figure 3). The model indicates (Figure 4) that the CDS system with 2400 micron screen achieves approximately 80% removal at the design (100%) flow rate, for this particle size distribution (d50 = 125 μm).

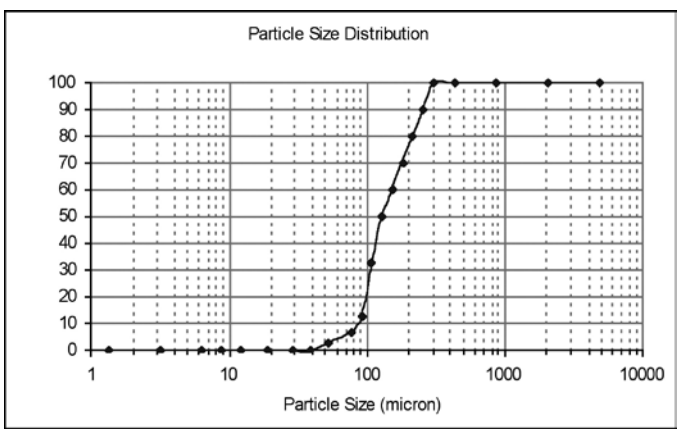


Figure 3. WASDOE PSD

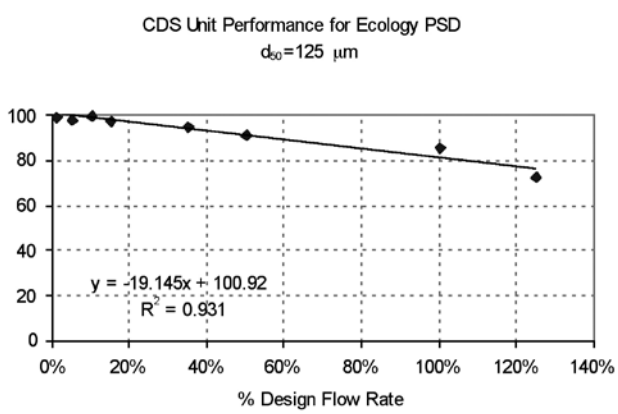


Figure 4. Modeled performance for WASDOE PSD.

Maintenance

The CDS system should be inspected at regular intervals and maintained when necessary to ensure optimum performance. The rate at which the system collects pollutants will depend more heavily on site activities than the size of the unit. For example, unstable soils or heavy winter sanding will cause the grit chamber to fill more quickly but regular sweeping of paved surfaces will slow accumulation.

Inspection

Inspection is the key to effective maintenance and is easily performed. Pollutant transport and deposition may vary from year to year and regular inspections will help ensure that the system is cleaned out at the appropriate time. At a minimum, inspections should be performed twice per year (e.g. spring and fall) however more frequent inspections may be necessary in climates where winter sanding operations may lead to rapid accumulations, or in equipment washdown areas. Installations should also be inspected more frequently where excessive amounts of trash are expected.

The visual inspection should ascertain that the system components are in working order and that there are no blockages or obstructions in the inlet and separation screen. The inspection should also quantify the accumulation of hydrocarbons, trash, and sediment in the system. Measuring pollutant accumulation can be done with a calibrated dipstick, tape measure or other measuring instrument. If absorbent material is used for enhanced removal of hydrocarbons, the level of discoloration of the sorbent material should also be identified

during inspection. It is useful and often required as part of an operating permit to keep a record of each inspection. A simple form for doing so is provided.

Access to the CDS unit is typically achieved through two manhole access covers. One opening allows for inspection and cleanout of the separation chamber (cylinder and screen) and isolated sump. The other allows for inspection and cleanout of sediment captured and retained outside the screen. For deep units, a single manhole access point would allows both sump cleanout and access outside the screen.

The CDS system should be cleaned when the level of sediment has reached 75% of capacity in the isolated sump or when an appreciable level of hydrocarbons and trash has accumulated. If absorbent material is used, it should be replaced when significant discoloration has occurred. Performance will not be impacted until 100% of the sump capacity is exceeded however it is recommended that the system be cleaned prior to that for easier removal of sediment. The level of sediment is easily determined by measuring from finished grade down to the top of the sediment pile. To avoid underestimating the level of sediment in the chamber, the measuring device must be lowered to the top of the sediment pile carefully. Particles at the top of the pile typically offer less resistance to the end of the rod than consolidated particles toward the bottom of the pile. Once this measurement is recorded, it should be compared to the as-built drawing for the unit to determine weather the height of the sediment pile off the bottom of the sump floor exceeds 75% of the total height of isolated sump.

Cleaning

Cleaning of a CDS systems should be done during dry weather conditions when no flow is entering the system. The use of a vacuum truck is generally the most effective and convenient method of removing pollutants from the system. Simply remove the manhole covers and insert the vacuum hose into the sump. The system should be completely drained down and the sump fully evacuated of sediment. The area outside the screen should also be cleaned out if pollutant build-up exists in this area.

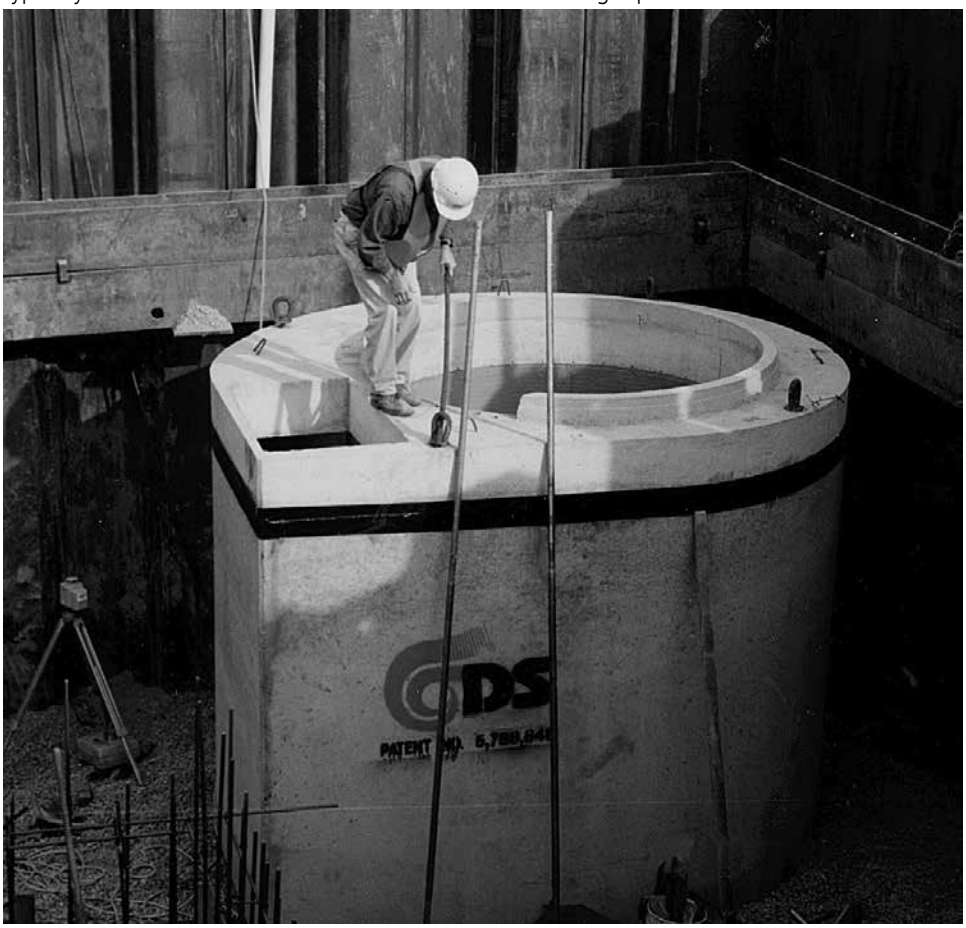
In installations where the risk of petroleum spills is small, liquid contaminants may not accumulate as quickly as sediment. However, the system should be cleaned out immediately in the event of an oil or gasoline spill. Motor oil and other hydrocarbons that accumulate on a more routine basis should be removed when an appreciable layer has been captured. To remove these pollutants, it may be preferable to use absorbent pads since they are usually less expensive to dispose than the oil/water emulsion that may be created by vacuuming the oily layer. Trash and debris can be netted out to separate it from the other pollutants. The screen should be cleaned to ensure it is free of trash and debris.

Manhole covers should be securely seated following cleaning activities to prevent leakage of runoff into the system from above and also to ensure that proper safety precautions have been followed. Confined space entry procedures need to be followed if physical access is required. Disposal of all material removed from the CDS system should be done in accordance with local regulations. In many jurisdictions, disposal of the sediments may be handled in the same manner as the disposal of sediments removed from catch basins or deep sump manholes. Check your local regulations for specific requirements on disposal.

CDS Model	Diameter		Distance from Water Surface to Top of Sediment Pile		Sediment Storage Capacity	
	ft	m	ft	m	y^3	m^3
CDS1515	3	0.9	3.0	0.9	0.5	0.4
CDS2015	4	1.2	3.0	0.9	0.9	0.7
CDS2015	5	1.5	3.0	0.9	1.3	1.0
CDS2020	5	1.5	3.5	1.1	1.3	1.0
CDS2025	5	1.5	4.0	1.2	1.3	1.0
CDS3020	6	1.8	4.0	1.2	2.1	1.6
CDS3025	6	1.8	4.0	1.2	2.1	1.6
CDS3030	6	1.8	4.6	1.4	2.1	1.6
CDS3035	6	1.8	5.0	1.5	2.1	1.6
CDS4030	8	2.4	4.6	1.4	5.6	4.3
CDS4040	8	2.4	5.7	1.7	5.6	4.3
CDS4045	8	2.4	6.2	1.9	5.6	4.3
CDS5640	10	3.0	6.3	1.9	8.7	6.7
CDS5653	10	3.0	7.7	2.3	8.7	6.7
CDS5668	10	3.0	9.3	2.8	8.7	6.7
CDS5678	10	3.0	10.3	3.1	8.7	6.7

Table 1: CDS Maintenance Indicators and Sediment Storage Capacities

Note: To avoid underestimating the volume of sediment in the chamber, carefully lower the measuring device to the top of the sediment pile. Finer silty particles at the top of the pile may be more difficult to feel with a measuring stick. These finer particles typically offer less resistance to the end of the rod than larger particles toward the bottom of the pile.



CDS Inspection & Maintenance Log

CDS Model: _____ Location: _____

Date	Water depth to sediment[1]	Floatable Layer Thickness[2]	Describe Maintenance Performed	Maintenance Personnel	Comments

1. The water depth to sediment is determined by taking two measurements with a stadia rod: one measurement from the manhole opening to the top of the sediment pile and the other from the manhole opening to the water surface. If the difference between these measurements is less than the values listed in table 1 the system should be cleaned out. **Note: to avoid underestimating the volume of sediment in the chamber, the measuring device must be carefully lowered to the top of the sediment pile**.

2. For optimum performance, the system should be cleaned out when the floating hydrocarbon layer accumulates to an appreciable thickness. In the event of an oil spill, the system should be cleaned immediately.

SUPPORT

- Drawings and specifications are available at www.ContechES.com.
- Site-specific design support is available from our engineers.

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cds_manual 3/17 PDF

RECYCLED PAPER

STORMTRAP MAINTENANCE MANUAL

1. Introduction

Regular inspections are recommended to ensure that the system is functioning as designed. Please call your Authorized StormTrap Representative if you have questions in regards to the inspection and maintenance of the StormTrap system. Prior to entry into any underground storm sewer or underground detention systems, appropriate OSHA and local safety regulations and guidelines should be followed.

2. Inspection Schedules for Municipalities

StormTrap Stormwater Management Systems are recommended for inspection whenever the upstream and downstream catch basins and stormwater pipes of the stormwater collection system are inspected or maintained. This will economize the cost of the inspection if it is done at the same time the Municipal crews are visiting the area.

3. Inspection Schedules for Private Development

StormTrap Stormwater Mangement Systems, for a private development, are recommended for inspection after each major storm water event. At a minimum, until a cleaning schedule can be established, an annual inspection is recommended. If inspected on an annual basis, the inspection should be conducted before the stormwater season begins to be sure that everything is functioning properly for the upcoming storm season.

4. Inspection Process

Inspections should be done such that at least 2-3 days has lapsed since the most recent rain event to allow for draining. Visually inspect the system at all manhole locations. Utilizing a sediment pole, measure and document the amount of silt at each manhole location (Figure 1). Inspect each pipe opening to ensure that the silt level or any foreign objects are not blocking the pipes. Be sure to inspect the outlet pipe(s) because this is typically the smallest

pipe in the system. It is common that most of the larger materials will be collected upstream of the system in catch basins, and it is therefore important at time of inspections to check these structures for large trash or blockages.

Remove any blockages if you can during the inspection process only if you can do so safely from the top of the system without entering into the system**. Do not go into the system under any circumstances** without proper ventilation equipment and training. Pass any information requiring action onto the appropriate maintenance personnel if you cannot remove the blockages from above during the inspection process. Be sure to describe the location of each manhole and the type of material that needs to be removed.

The sediment level of the system should also be measured and recorded during the inspection process. Recording the sediment level at each manhole is very important in order get a history of sediment that can be graphed over time (i.e. years) in order to estimate when the system will need to be maintained next. It is also important to keep these records to verify that the inspection process was actually performed if anyone asks for your records in the future.

The sediment level in the underground detention system can be determined from the outside of the system by opening up all the manholes and using a sediment pole to measure the amount of sediment at each location. Force the stick to the bottom of the system and then remove it and measure the amount of sediment at that location. Again, do not go into the system under any circumstances without proper ventilation equipment and training.

5. When to Clean the System

Any blockages should be safely removed as soon as practical so that the Stormwater detention system will fill and drain properly before the next stormwater event.

The Dry Detention System should be completely cleaned whenever the sediment occupies more than 10% to 15% of the originally designed system's volume. The Wet Detention System should be cleaned when the sediment occupies more than 30% or 1/3rd of the originally designed system's volume. NOTE: Check with your municipality in regards to

cleaning criteria, as the allowable sediment before cleaning may be more or less then described above.

6. How to Clean the StormTrap

The system should be completely cleaned back to 100% of the originally designed storage volume whenever the above sediment levels have been reached. Be sure to wait at least 3 days after a stormwater event to be sure that the system is completely drained (if it is a Dry Detention System), and all of the sediments have settled to the bottom of the system (if it is a Wet Detention System).

Do not enter the System unless you are properly trained, equipped, and qualified to enter a confined space as identified by local occupational safety and health regulations.

There are many maintenance companies that are in business to help you clean your underground stormwater detention systems and water quality units. Please call your StormTrap representative for referrals in your area.

A. Dry Detention System Cleaning

Maintenance is typically performed using a vacuum truck. Sediment should be flushed towards a vacuum hose for thorough removal. For a Dry Detention System, remove the manhole cover at the top of the system and lower a vacuum hose into one of the rows of the StormTrap system. Open up the manhole at the opposite end of the StormTrap and use sewer jetting equipment to force water in the same row from one end of the StormTrap row to the opposite side. The rows of the StormTrap are completely open in one contiguous channel from one end to the other for easy cleaning.

Place the vacuum hose and the sewer jetting equipment in the next row and repeat the process until all of the rows have been cleaned.

When finished, replace all covers that were removed and dispose of the collected material properly.

B. Wet Detention System Cleaning

If the system was designed to maintain a permanent pool of water, floatables and any oil should be removed in a separate procedure prior to the removal of all sediment.

The floatable trash is removed first by using a bucket strainer to capture and remove any floating debris.

The floatable oils are then removed off the top of the water by using the vacuum truck to suck off any floatable fluids and liquids.

The next step is to use the vacuum truck to gently remove the clarified water above the sediment layer.

The final step is to clean the sediment for each row as described above in the paragraph "A. Dry Detention System Cleaning". For smaller systems, the vacuum truck can remove all of the sediment in the basin without using the sewer jetting equipment because of the smaller space.

7. Inspection Reports

Proof of these inspections is the responsibility of the property owner. All inspection reports and data should be kept on site or at a location where they will be accessible for years in the future. Some municipalities require these inspection and cleaning reports to be forwarded to the proper governmental permitting agency on an annual basis.

Refer to your local and national regulations for any additional maintenance requirements and schedules not contained herein. Inspections should be a part of your standard operating procedure.

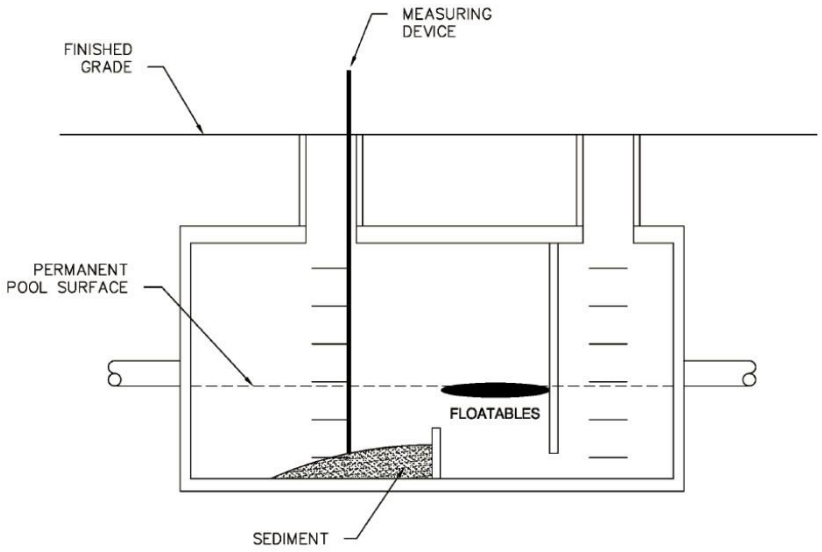

Figure 1. During inspection, measure the distance from finished grade to the top of the sediment inside the system.

Sample inspection and maintenance log

Date	Depth of Sediment	Accumulated Trash	Maintenance Performed	Maintenance Personnel	Comments
2/5/2012	3”	None	Sediment Removal/Vac	B. Johnson	

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ATTACHMENT G

Inspection Log

(Completed Inspection Checklists)

ATTACHMENT H

As Built Plans, Soil Test Results,

Permits, Certificates of Completion

(to be inserted when available)