



Technical Memorandum

Subject: Stormwater Drainage Report

PWB Project #s: W02229

Date: January 15, 2024

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Portland Water Bureau

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Emerio Project Number: 0596-003

City of Portland Permit Numbers: TBD

I hereby certify that this Stormwater Management Report for this project has been prepared by me or under my supervision and meets minimum standards of the Multnomah County Design and Construction Manual (MCDCM) and normal standards of engineering practice. I hereby acknowledge and agree that the jurisdiction does not and will not assume liability for the sufficiency, suitability, or performance of drainage facilities designed by me.

This report was prepared in support of the City of Portland Water Bureau’s Bull Run Filtration Facility Site Project land use applications in Multnomah County and reflects the current status of the project design, which is approximately 100% complete as of the date of this report. This design is subject to change and has been prepared for the specific purpose of addressing conformance of the project to the Multnomah County land use requirements as expressed in the Multnomah County Code.

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List of Abbreviations

BES	Bureau of Environmental Services
CAD	Computer-Aided Design
CN	Curve Number
COP	City of Portland
CSSWF	Columbia South Shore Wellfield
EPA	Environmental Protection Agency
GIS	Geographical Information System
MCDCM	Multnomah County Design and Construction Manual
NCRS	Natural Resources Conservation Service
NOAA	National Oceanic and Atmospheric Administration
O&M	Operations and Maintenance
OHA	Oregon Health Authority
PAC	Presumptive Approach Calculator
PDF	Portable document format
POD	Point of Discharge
PWB	Portland Water Bureau
RWP	Raw Water Pipe
SBUH	Santa Barbara Urban Hydrograph
SDFDM	City of Portland 2020 Sewer and Drainage Facilities Design Manual
SWMM	City of Portland 2020 Stormwater Management Manual
TR	Technical Report

References

Multnomah County, Design and Construction Manual

City of Portland, 2020 Stormwater Management Manual

City of Portland, 2020 Sewer and Drainage Facilities Design Manual

City of Portland, 2020 Source Control Manual

Oregon Department of Environmental Quality, Section 401 Water Quality Certification Post-Construction Stormwater Management Plan Submission Guidelines, January 2021.

Oregon 2018/2020 Integrated Report

2018/2020 Water Quality Report and List of Water Quality Limited Waters, dated April 2020 prepared by the Oregon Department of Environmental Quality.

Urban Hydrology for Small Watersheds TR-55, dated June 1986.

1.0 Introduction

1.1 Project Description

The water supply for the City of Portland includes two sources: the Bull Run Watershed and the Columbia South Shore Wellfield (CSSWF). In addition to the City of Portland, the Portland Water Bureau (PWB) provides potable water to 19 wholesale customers. The Bull Run Watershed, located east of Portland in the Mount Hood National Forest, is the primary source of water. This 102-square-mile protected watershed is managed by the U.S. Forest Service in cooperation with the PWB. Two dam structures within this watershed create two surface water reservoirs with a combined storage capacity of 16.5 billion gallons. This water is transported from the lower dam near the headworks site to the Portland Metro area via three large-diameter pipelines.

The Bull Run supply is currently an unfiltered water supply and has consistently met the filtration avoidance criteria under the Surface Water Treatment Rule for source water quality, watershed management, and disinfection. Before distribution, the supply is treated with free chlorine for primary disinfection, ammonia to form chloramines as a residual disinfectant, and sodium hydroxide for corrosion control. The PWB supplements the Bull Run source as needed with groundwater withdrawn from the CSSWF. The CSSWF is primarily used as an emergency backup. It is typically used during turbidity events in the Bull Run Watershed and for summer supply augmentation.

In 2006, the U.S. Environmental Protection Agency (EPA) required water utilities to treat for the pathogen *Cryptosporidium*. From 2012 to 2017, the Oregon Health Authority (OHA) issued a variance from this rule subject to a set of conditions that included exhibiting an exceptionally low concentration of *Cryptosporidium* in ongoing raw water sampling. However, on May 19, 2017, OHA issued an order revoking Portland's treatment variance. In August 2017, the Portland City Council voted to build the Bull Run Filtration Facility to meet the treatment requirements for *Cryptosporidium*. On December 18, 2017, OHA and the PWB signed a bilateral compliance agreement establishing a compliance schedule for meeting the EPA requirements.

The Bull Run Water Treatment Project was established to meet the compliance schedule and is a multi-year drinking water infrastructure program consisting of a new drinking water filtration facility and associated new raw and finished water pipelines. This report is developed for the Filtration Facility. The facility will have a capacity of 135 mgd. The facility location is a 95-acre site owned by the PWB, east of Gresham, Oregon.

1.2 Purpose of this Report

The purpose of this report is to evaluate the existing and proposed stormwater conditions for the Bull Run Filtration Facility including Carpenter Lane and the southern emergency access road. This report includes an analysis and discussion on the following:

- City of Portland's Infiltration and Discharge Hierarchy
- Site Specific Infiltration Testing and Rates
- Stormwater Quality Treatment
- Stormwater Flow Control
- Stormwater Conveyance
- Analysis of surface stormwater for both Run-On and Run-Off conditions
- Groundwater management including groundwater collected from sub-slab drainage pipes
- Stormwater management of Carpenter Lane
- Stormwater management of the emergency access road

1.3 Project Location

The proposed project is located south of SE Carpenter Lane, Multnomah County, Oregon. Currently, the existing site is a nursery crop production facility.

1.4 Property Zoning

This project area is zoned for Exclusive Farm and Forest Use.

1.5 Agency Stormwater Criteria

This project lies within two jurisdictions: Multnomah County and Clackamas County.

Multnomah County is the governing agency for the Bull Run Filtration Facility and Carpenter Lane. Both stormwater flow control and stormwater quality treatment are required and shall be designed in accordance with the Multnomah County Design and Construction Manual (MCDCM), Section 5. Drainage. The MCDCM follows the City of Portland 2020 Stormwater Management Manual (SWMM) for stormwater quality treatment (per MCDCM Section 5.1.3. Water Quality Design Standards). Stormwater flow control is designed per MCDCM Section 5.1.2. Water Quantity Design Standards which match the SWMM Section 2.5.3.2. Designing for Flow Control Requirements.

The emergency access road that runs from the southeast corner of the Facility site to SE Bluff Road is located within Clackamas County. Both stormwater treatment and stormwater quantity are required and are designed in accordance with the Stormwater Standards Clackamas County Service District No.1, July 1, 2013.

1.6 Site Specific Stormwater Design Requirements and Assumptions

Stormwater management requirements include infiltration, water quality treatment, and flow control. The following section includes design assumptions for the Bull Run Filtration Facility Improvements. Onsite stormwater management is required to the maximum extent possible depending on site-specific conditions. The following is a discussion of the site-specific parameters and design assumptions.

Hydromodification is the alteration of the natural flow of water, timing, frequency, and volume of runoff from the land surface as a result of urbanization. Hydromodification results in an increase in runoff energy and frequency in the receiving water bodies. This increase in energy leads to the degradation of the natural stream and wetland systems through incision, bank erosion, and sedimentation. The flow control requirements in this stormwater management report are designed to minimize these impacts in accordance with Section 1.3.5. Level 2 Separated Storm System Requirements of the City of Portland SWMM.

1.6.1 Infiltration and Discharge Hierarchy

The City of Portland has three Levels of hierarchy for the disposal and conveyance of stormwater. The city ranks the use of these systems for stormwater management in Section 1.3.3. Infiltration and Discharge Hierarchy and Table 1-2. Summary of Infiltration and Discharge Hierarchy Stormwater Management Requirements of the SWMM, as follows:

Level 1 – Full Onsite infiltration

Level 2 – Offsite Discharge to the Separate Stormwater System

Level 3 – Combined sewers that convey water to the wastewater treatment plant

Infiltration Rates

The Final Geotechnical Data Report Technical Memorandum Dated July 15, 2022 (prepared by McMillan Jacobs Associates), Attachment K Preliminary Geotechnical Data Report (prepared by Rhino One) discusses the field infiltration testing related to stormwater design. Per section 2.4 of the Preliminary Data Report prepared by Rhino One the infiltration rates are low, and infiltration is not feasible at this site. Table 1. Geotechnical Measured Infiltration Rates show extremely low infiltration rates. The measured infiltration rates range from 0.012 in/hr to 0.86 in/hr as noted in the boring logs and Table 4 of the Geotechnical Data Report prepared by Rhino One.

Table 1. Geotechnical Measured Infiltration Rates		
Boring Number	Infiltration Rate (in/hr)	Nearest Stormwater Pond
WTP-B-06	0.3	D
WTP-B-10	0.11	D
WTP-B-11	0.31	D
WTP-B-12	0.012	D
WTP-TP-02	0.86	A
WTP-TP-04	0.29	A
WTP-TP-06	0.18	C
WTP-TP-08	0.36	C
WTP-TP-09	0.41	C
WTP-TP-10	0.13	n/a
WTP-TP-11	0.32	n/a

Discharge Hierarchy

As the onsite infiltration measured rate is extremely low, it has been deemed not practical for this project.

This project is using Hierarchy Level 2 - Offsite Discharges to the Separated Stormwater System, Johnson Creek. The project is also assuming that there is no infiltration within the stormwater facilities due to the extremely low infiltration rates shown in the geotechnical data and engineering reports. The geotechnical evaluation did not recommend the use of infiltration-based facilities and is deemed not practical for this project as a stormwater management strategy.

1.6.2 Stormwater Facility Selection, Sizing, and Design

The City of Portland allows the use of three design approaches for stormwater facilities being:

- Simplified Approach
- Presumptive Approach
- Performance Approach

This project will use both the Presumptive Approach and the Performance Approach. The Presumptive Approach is used for sizing the stormwater planters and basins, while the Performance Approach is used for sizing the flow control ponds and grassy swales.

1.6.3 Stormwater Quality Treatment

Per Table 1-2. Summary of Infiltration and Discharge Hierarchy Stormwater Management Requirements of the SWMM this project is Hierarchy Level 2 in the discharge hierarchy as discussed above in Section 1.6.1. Therefore, the following stormwater quality treatment standards apply.

Pollution reduction required:

- Achieve 70% TSS removal from the runoff resulting from 90% of the average annual rainfall.
- Treat 80% of the average annual rainfall.
- Use a pollution reduction facility that will reduce pollutants of concern in watersheds with a TMDL or on DEQ's 303(d) list of impaired waters.

Per the Oregon 2018/2020 Integrated Report and the 2018/2020 Water Quality Report and List of Water Quality Limited Waters, dated April 2020, Johnson Creek has TMDL and 303(d) listed.

TMDLs:

- Bacteria
- Temperature
- DDT 4, 4'; DDD4, 4'; DDE 4,4'

303(d):

- Dissolved Oxygen
- Iron
- Endosulfan
- Chlordane
- Polychlorinated Biphenyls (PCBs)
- Polycyclic Aromatic Hydrocarbons (PAHs)

From the City of Portland SWMM Table 2-8. Summary of How Requirements are Met, both the Presumptive and Performance Approaches are allowed to be used with Hierarchy Level 2.

This project is proposing to use multiple facilities to achieve the water quality treatment requirement by installing Planters, Basins, Filter Strips, Grassy Swales, and an Ecoroof. These facilities are allowed per City of Portland SWMM Table 2-9. Summary of Generally Allowed Stormwater Facilities.

The proposed planters and basins are designed using the Presumptive Approach Calculator (PAC) and meet the requirements of Section 2.5.2. Presumptive Approach. Due to limited space between the buildings, paved access roads, and underground piping, these facilities will be designed for stormwater quality treatment only.

Basin 11A is sized using HydroCAD under the Performance Approach, rather than the PAC Calculator due to its unique geometry as a tiered facility with three levels divided by check dams, but with no longitudinal slope. This geometry is input into HydroCAD and analyzed using the site-specific water quality design storm described below.

Per DEQ Section 401 Water Quality Certification Post Construction Stormwater Management Plan Section E.1.1, the water quality storm event depth is the site's 2-year, 24-hour precipitation. Per Table 3 below the rainfall depth is 2.8 inches. The water quality design storm factor is 0.5 for this site, resulting in a water quality design storm depth of 1.4 inches. This is less than the rainfall depth that is used in the City of Portland's PAC, which is 1.61 per section A.2.1 Water Quality Treatment Volume goal in the SWMM.

The grassy swales are a rate-based facility and will be designed to meet the requirements of City of Portland SWMM Table 2-12. Water Quality Storm and Section 3.2.5.5. Grassy Swales.

Vegetated filter strips will be designed to meet the requirements of City of Portland SWMM Table 3-6.

The ecoroof will be designed to meet the requirements of City of Portland SWMM Section 3.2.1.1.

The proposed development will contribute runoff to Johnson Creek. As such, pollution reduction will be provided for all runoff from proposed impervious areas by routing the runoff through either basin, flow-through planter, or grassy swale facilities. The basins and flow-through planters will filter out the relevant pollutants via percolation of runoff through the vegetation, growing medium, and gravel within the facilities. The grassy swales will filter out the relevant pollutants by routing runoff through the densely vegetated surfaces of the facilities. The proposed vegetation will remove pollutants as runoff slowly flows to the downstream ends of the facilities.

1.6.4 Stormwater Flow Control

This project is proposing to use five Dry Detention Ponds, a sloped basin, and an Ecoroof to achieve the stormwater flow control requirements. These facilities are allowed per the City of Portland SWMM Table 2-9. Summary of Generally Allowed Stormwater Facilities.

The proposed ponds are designed using the Santa Barbara Urban Hydrograph Method (SBUH) with an NRCS Type IA synthetic rainfall distribution. The calculations were executed with the computer program HydroCAD. This method was used to generate site runoff hydrographs, determine peak flows, and perform pond routing analysis.

The ponds are designed using the Performance Approach meeting the requirements of the City of Portland SWMM Section 2.5.3. Performance Approach and Sub-section 2.5.3.2. Designing for Flow Control Requirements, per Table 2 below:

Table 2. Flow Control Requirements*		
Design Storm Event	24-hr Rainfall Depth (inches)**	Requirements by the Receiving System
2 Year	2.8	Limit 1/2 the 2-year post-development peak flow to 1/2 the 2-year pre-development peak flow
5 Year	3.4	Do not exceed pre-development peak flows
10 Year	3.8	Do not exceed pre-development peak flows
25 Year	4.5	Do not exceed pre-development peak flows

*Table 2 is a partial table taken from the SWMM Table 2-13.

**Rainfall depths are taken from Table 3 below.

Rainfall Data

The 24-hour rainfall depths used in the hydrographs to determine the peak stormwater runoff rates for this analysis were obtained from NOAA ATLAS 2, Volume X, Isopluvial Maps Figures 25 to 30 summarized in Table 3 below.

Design Storm Event	24-hr Rainfall Depth (inches)
2 Year	2.8
5 Year	3.4
10 Year	3.8
25 Year	4.5
50 Year	5.0
100 Year	5.5

These rainfall depths are based on the physical location of the project. As such, they do not match the City of Portland rainfall depths listed in Table A-9. 24-Hour Rainfall Depths at Portland Airport of the SWMM.

Existing Hydrologic Soil Groups

The existing soils on-site are as follows (Per NRCS Soil Maps in Attachment B):

- Cazadero Silty Clay Loam, Hydrologic Soil Group C
- Wollent Silt Loam, Hydrologic Soil Group C/D
- Borges Silty Clay Loam, Hydrologic Soil Group D
- Haplumbrepts, Hydrologic Soil Group B

The curve numbers discussed below are based on this hydrologic soil group.

Curve Numbers

The existing site landscape character is agricultural and has served as a nursery / tree farm for decades. Tree starts are planted tightly in rows and harvested as very young (estimated at 1/2-inch caliper/6-foot height average) bare root stock. The crop rows are oriented to drain as quickly as possible that results in surface runoff to the low points of the site. Much of the site does not have developed groundcover vegetation and has a significant amount of exposed soil.

The proposed landscape will include permanent native grassland seeding with some locations being populated by trees and understory plants appropriate for the surrounding context. This area will be mown infrequently, maybe two times a year as a management strategy. Inside the secure facility, the landscape will be more of a campus style development with maintained and irrigated landscape beds integrated with the proposed buildings and parking areas to meet development codes and provide a hospitable environment. The proposed landscape outside the secure area to the west, south and east of the facility will include the same permanent native grassland seeding with scattered groupings of native oaks and pines with associated understory plants. Some portions of this area will be replanted similar to adjacent forested areas which will include large native evergreen trees and native understory plantings.

Vegetated stormwater facilities will be integrated into the landscape design inside the secure area and outside it to connect to the lowest points of the site where stormwater eventually exits. The vegetated facility types include stormwater planters and basins, flow control ponds and planted swales to convey runoff to the low points in a controlled manner. Stormwater facilities will be planted in a manner that matches the visual character of the immediate surrounding landscape while introducing more significant permanent vegetation.

Pre-developed Curve Numbers

The existing site primarily consists of hydrologic soil group (HSG) of C.

Using the TR-55 Urban Hydrology for Small Watersheds, Table 2-2b. Runoff Curve Numbers for Cultivated Agricultural Lands, cover type of Row Crops, having a treatment of straight rows and crop residue cover in good condition, a curve number of 82 has been selected for the entire site. This land coverage is consistent across the entire site. This curve number is being used in the hydrologic flow calculations to determine the existing stormwater flows that occur on the site.

Developed Curve Numbers

During construction this site will experience significant disturbance, causing the existing soil profile to be altered and consolidated. Construction activities include mass grading and compaction, utility installation, building construction and roadway construction. This consolidation will also affect the existing soils infiltration rate. As a result of this disturbance, the developed curve numbers were selected using a HSG of D. This selection is based on TR-55 Urban Hydrology for Small Watersheds, Appendix A, Disturbed Soils Profiles.

Using the TR-55 Urban Hydrology for Small Watersheds, Table 2-2a. Runoff Curve Numbers for Urban Areas, with cover type of impervious paved parking lots, roofs, driveways, etc., a curve number of 98 has been selected. This CN has been applied for all impervious areas of the site.

Using the TR-55 Urban Hydrology for Small Watersheds, Table 2-2a. Runoff Curve Numbers for Urban Areas, Open Space (lawns, parks, golf courses, cemeteries, etc.), good condition (grass cover > 75%), a curve number of 80 was selected. This CN has been applied to the landscape areas within drainage basins A, B, C1, C2, D, E and F as well as the cross-property flows from subbasins 1A and 2A. Refer to Figure 2 Post Construction Stormwater Drainage Basin Map Cross-Property and Figure 3 Site Stormwater Drainage Basin Map Flow Control for locations.

These curve numbers are being used in the hydrologic flow calculations to determine the developed conditions stormwater flows that occur on the site.

1.6.5 Stormwater Conveyance

An onsite system of pipes and ditches will convey collected onsite flows to and from proposed treatment and detention facilities before routing flows to site discharge points.

The proposed pipes and ditches are designed using the Santa Barbara Urban Hydrograph Method (SBUH) with an NRCS Type IA synthetic rainfall distribution. HydroCAD is used to determine tributary basin flows and to analyze the capacity of proposed ditch geometries. Pipe capacity analysis is completed in a separate spreadsheet.

Standards outlined in the City of Portland 2020 Sewer and Drainage Facilities Design Manual (SDFDM) section 6.4.1 state that piped flows must be conveyed without surcharge during the 10-year design storm and with a minimum 6 inches of freeboard within the system during the 25-year design storm. The proposed onsite piped system is designed to convey the 25-year design storm without surcharging. The 25-year design storm is also used to size all conveyance ditches per Table 6-2 in the 2020 SDFDM.

Segments of the conveyance system managing pumped underdrain flows from Areas 33, 35, 37, and the overflow basins will be sized and analyzed using different assumptions as the rest of the conveyance system. Pumped flow rates from groundwater entering Pond C were determined by others and was forced through the relevant conveyance pipes as a base flow, rather than flows from a standard tributary basin.

The primary pump station just south of Area 40 pumps flows to the flow spreader at proposed Point of Discharge #2. It is assumed that this pump discharges flows from a modified 2-year design storm, while the overflow basins provide storage for larger storm events while the underdrain system empties. The conveyance system downstream of the pump station is designed to convey the 2-year design storm for the 30-minute period where the design storm flows peak. The flow forced through these pipes by the pump is approximately 4 cfs as this flow occurs approximately 15 minutes before 2-year flows reach a peak. It is assumed that all runoff from the pumped areas enter the underdrain system. To supplement for the conveyance system managing a lower storm event from the pumped areas, the overflow basins will be analyzed for their capacity to contain the 25-year design storm from all pumped areas assuming the pump station is not running.

All curve number and rainfall data assumptions stated in section 1.6.4 of this report will apply to design methods regarding the proposed onsite conveyance system.

2.0 Existing and Pre-Developed Stormwater Drainage Conditions

2.1 Description of Existing Stormwater Drainage Conditions

This site is an existing nursery crop production facility and contains no existing storm drainage infrastructure. This site is bounded by dirt access roads and several dirt access roads are located within the project's limits. This site is bisected by a ridge line where the majority of the property generally slopes to the west or southwest. There is a small portion from the ridge line that flows southeasterly. (See Figure 1 – Existing Stormwater Drainage Basin Map)

Subbasin 1 is located at the northwest corner of the property wedged between SE Carpenter Lane and a private gravel access road. The existing stormwater drains westerly across the property line at an angle onto the adjacent farmland. The flows are partially by sheet flow and partially by shallow concentrated flow. The shallow concentrated flows are collected by an existing 8" PVC culvert that crosses the gravel road at a low point. The culvert drains to the west and provides stormwater to an existing ditch as well as an unnamed tributary of Johnson Creek.

Subbasin 2 is the central basin encompassing the majority of the site. The basin extends from the east side of the property (being an existing gravel access road) to the west side of the site. The existing stormwater drains to a low point on the west property line. The flows are partially by sheet flow and partially by shallow concentrated flow. This low point is the same 8" PVC culvert described above.

Subbasin 3 is located at the southwest corner of the property wedged between the west and south property lines. The west and south property lines consist of a dirt access road. The existing stormwater drains across both the west and south property lines at an angle eventually draining to the headwaters of Johnson Creek. Johnson Creek is approximately 100 feet southwest of the basin, and flows are partially by sheet flow and partially by shallow concentrated flow.

Subbasin 4 is located on the south side of the property. The south property line consists of a dirt access road where the existing stormwater drains across the access road at an angle eventually draining to the headwaters of Johnson Creek. Johnson Creek is approximately 100 feet southwest of the basin, and flows are partially by sheet flow and partially by shallow concentrated flow.

Subbasin 5 is located at the southeast corner of the property wedged between the east and south property lines. The east and south property lines consist of a gravel access road. The existing stormwater drains easterly

to a low point on the east property line where it crosses the existing gravel road onto an adjacent property. The stormwater continues to flow east where it disperses into an existing forested area.

The cross-property stormwater flows are discussed in Section 4 Cross-Property Drainage.

2.2 Existing Stormwater Points of Discharge

The existing stormwater runoff occurs via sheet flow and shallow concentrated and/or drainage ditches. There are three points of discharge from the site, identified in Figure 1.

Existing Point of Discharge #1 is located on the west side of the site. It is a low-lying area where the shallow concentrated flows are collected by two existing 8" PVC culverts that crosses the gravel road at a low point to an existing drainage ditch. The culvert drains to the west and provides stormwater to the existing ditch as well as an unnamed tributary of Johnson Creek. These existing pipes are full of debris and need to be cleaned prior to connecting to them. Existing subbasins 1 and 2 drain to this point of discharge.

Existing Point of Discharge #2 is located along southwest portion of the site, draining southwesterly to a vegetated area at the headwaters of Johnson Creek. Existing subbasins 3 and 4 drain to this point of discharge.

Existing Point of Discharge #3 is located on the east side of the site. The existing stormwater drains easterly to a low-lying area where it crosses the existing gravel road onto an adjacent property. The stormwater continues to flow east where it disperses into an existing forested area. Existing subbasin 5 drains to this point of discharge.

SE Carpenter Lane slopes westerly to SE Cottrell Road. There are no defined drainage ditches or stormwater infrastructure within the right-of-way of SE Carpenter Lane. The existing runoff sheet flows into the adjacent farm fields.

This site consists of five existing subbasins. See Attachment A, Figure 1 Existing Stormwater Drainage Basin Map.

3.0 Proposed Post Construction Stormwater Drainage

3.1 Description of Proposed Stormwater Drainage Conditions

The proposed improvements include the construction of buildings, above-ground tanks, underground tanks, loading areas, and storage areas. These newly generated impervious surfaces will drain to trap-type catch basins, a piped conveyance system, grass-lined drainage ditches, and detention ponds.

The mitigated portion of the site provides stormwater quality and stormwater flow control prior to discharging off-site and one of three Points of Discharge. Most of these areas drain via surface flow to water quality facilities or directly into a conveyance system which routes all treated or directly collected flows to five dry detention ponds. Some mitigated areas drain via surface flow directly into the ponds. See Attachment A, Figures 3, 4, and 5 for maps of mitigated basin areas regarding the flow control, water quality, and conveyance systems, respectively.

The non-mitigated areas are areas where cross-property flows occur post construction, along the west property line and a portion of the south property line. These flows are not managed by flow control or a water quality facility. These areas do not contain impervious surface and consist of landscaping. See Attachment A, Figure 2 Post Construction Stormwater Drainage Basin Map Cross-Property, which is discussed below in section 4 Cross-Property Drainage.

Existing drainage patterns along Carpenter Lane will be maintained after development. Per conversations with Multnomah County, no new storm drainage infrastructure will be added along Carpenter Lane to intercept and collect flows from this drainage pattern.

A flow splitter controls the amount of stormwater that drains to the Point of Discharge #1. Flows will enter the flow splitter from Pond D and from unmitigated areas along the northwest portion of the site before being routed to either Point of Discharge #1 or Point of Discharge #2, where all other mitigated flows exit the site. See Section 3.4 Site Points of Discharge Locations discussing total flows discharging off site.

The emergency gravel access road (Road B) extends from the southeast corner of the facility site south to SE Bluff Road. Road B is bisected by a ridge line, as can be seen in Figures 3, 4, and 5. The north section of Road B drains north and utilizes the interface of the shoulder and existing farmland as a channel. The north section eventually drains to a grassy swale adjacent to Road B where flows will be treated for water quality. This grassy swale drains flows southwesterly to Pond C for flow control.

The south section of Road B (south of the ridge line) drains south within a new drainage way that utilizes the interface of the shoulder and existing farmland as the channel. Flows drain to Pond E, which contains a grassy swale at the bottom of the proposed pond volume.

3.2 On-Site Stormwater Quality Treatment

Treatment of stormwater runoff is proposed for the site's building and roadway impervious areas. Treatment will be provided by vegetated planters, stormwater basins, grassy swales, vegetated filter strips, and an ecoroof (See Figure 4. Site Stormwater Drainage Basin Map Water Quality). Proposed planters and grassy swales are sized water quality treatment only, while stormwater basin E1 and the ecoroof will additionally provide flow control. Flows exiting the treatment-only facilities will be conveyed to one of the five on-site dry detention ponds, as discussed below in Section 3.3. The treatment areas are delineated based on building downspout layouts and roadway grading. The treatment basins shown in Attachment A, Figure 4 are assumed to be 100% impervious. Table 4 below is a summary of the water quality treatment facility and stormwater flows treated in each catchment area.

The vegetated planters and stormwater basins have been designed using the City of Portland's Presumptive Approach Calculator (PAC). Grassy swales were designed using separate spreadsheets under Performance Approach standards. Basin 11A was sized using HydroCAD, with the results of the model showing that the water quality storm does not overtop any facility overflow structures. Vegetated filter strips have been designed using the minimum geometries outlined in Table 3-6 of the City of Portland SWMM. PAC and swale spreadsheet calculations are in Attachment D.

Table 4. Proposed Stormwater Quality Facility Summary						
Facility #	Contributing Impervious Area (sf)	Facility Type(ft)	Bottom Area (sf)	Blended Soil Depth (in)	Rock Storage Depth (in)	Overflow Depth (in)
11A	26,106	Basin	39	18	12	12
11B	35,031	Planter	656	18	12	12
11C	7,918	Planter	257	18	12	12
12A	8,535	Planter	206	18	12	12
12B	20,925	Planter	324	18	12	12
40A	93,777	Ecoroof	0	0	0	0
65A	10,752	Planter	508	18	12	12
70A	36,357	Planter	513	18	12	16
70B	18,015	Planter	314	18	12	12
81A	58,265	Planter	1,344	18	12	12
F1	48,779	Sloped Basin	1,260	12	12	18
E1	17,024	Sloped Basin	1,202	12	12	18
Total	381,484					
Grassy Swales						
Facility #	Treatment Area (sf)	Treatment Flow (cfs)	Length (ft)	Slope (%)	Flow Depth (in)	Velocity (ft/sec)
Area 12C	51,507	0.20	137	0.5	4	0.20
Area 51	28,769	0.11	144	1	4	0.10
Road A	22,489	0.09	251	1	4	0.08
Road B1	48,943	0.19	507	1	4	0.18
Road B2	36,099	0.14	158	1	4	0.13
Road F	8,475	0.03	76	1	4	0.03
Total	196,282					
Vegetated Filter Strips						
Facility #	Treatment Area (SF)		Width (ft)			
1	11,277		20			
2	20,813		20			
3	19,281		20			
4	5,291		20			
5	10,340		20			
Total	67,002					

3.3 On-Site Stormwater Flow Control

Five Dry Detention Ponds (being A, B, C, D and E), one sloped basin, and an Ecoroof will achieve stormwater flow control requirements for this project. These facilities are allowed per the City of Portland SWMM Table 2-9. Summary of Generally Allowed Stormwater Facilities. See Attachment A, Figure 3 for a map of the detention basins. Tables 6-10 below are summaries of the dry detention ponds’ performance. See Attachment E for plots of the pond flow control analysis.

Basin F, consisting of a section of Road E and adjacent landscaping drains to a sloped basin and will manage both water quality and flow control. The sloped basin will have check dams every 50 feet. The stormwater basin was designed using the PAC. A report of the PAC results can be found in Attachment D.

Sloped Basin E1 summary:

- 3 feet wide bottom
- 3:1 side slopes
- Check dams at 50’ o.c.
- 12” topsoil depth
- 12” storage rock depth, 3’ wide
- 1% running slope
- 400 feet in length

There is one ecoroof proposed in this project, located on Building 40. Per City of Portland’s SWMM Table 2-9. Summary of Generally Allowed Stormwater Facilities the ecoroof can provide both stormwater quality treatment and stormwater flow control. Per Table 2-10. Simplified Approach Sizing and Design the sizing factor is 1, meaning the required area of the ecoroof is 1 times the impervious (or roof) area.

Table 5. Area and Composite Curve Number Summary

Drainage Basin	Total Area (SF)	Impervious Area (SF)	Pervious Area (SF)	Ecoroof (SF)	CN	CNp	CNecoroof	Composite CN
A	349,468	176,142	173,326	-	98	80	61	89
B	294,211	160,056	134,155	-	98	80	61	90
C	754,337	82,047	672,290	-	98	80	61	82
D	485,197	135,356	256,064	-	98	80	61	85
E	580,537	36,209	544,328	-	98	80	61	81
F	103,464	17,069	86,395	-	98	80	61	83
G	93,777	-	-	93,777	98	80	61	61

Curve number selection is discussed in section 1.6.4.

3.3.1 Time of Concentration

Stormwater runoff travels through a watershed as sheet flow, shallow concentrated flow, open channel flow, or a combination of these flows. This project calculates the pre-developed time of concentration using sheet flow for the first 300 feet of travel and shallow concentrated flow for the remaining travel distance to one of the three existing points of discharge. The calculations are based on the methods and formulas described in TR-55-Chapter 3 Time of Concentration and Travel Time.

The minimum time of concentration for all the post development stormwater basins of 5 minutes was used in the calculations for determining the peak runoff rates, per City of Portland’s SWMM Section 1.3.5 Level 2: Separated Storm System Requirements.

3.3.2 Dry Detention Ponds

This site has five dry detention ponds (A, B, C, D, and E) that are described below. The stormwater is treated for water quality by separate features and is discussed in Section 3.2. On-Site Stormwater Quality Treatment.

- Pond A is located on the north side of the site adjacent to the Maintenance Building.
- Pond B is located on the east side of the site adjacent to the Wash-Water Clarification structure.
- Pond C is located on the south side of the site, east of the Overflow Basins.
- Pond D is located on the west side of the site, west of Building 16 North Electrical Complex.
- Pond E is located at the southeast corner of the site.

The dry detention ponds are designed with 1 foot of freeboard. The flow out of each pond will be controlled by a flow control manhole. The flow control manhole will have an overflow riser for larger storm events to bypass the pond.

Table 6. Pond ‘A’ Performance Summary

Storm Event (year)	Pre-Developed Flow Rate (cfs)	Developed Flow Rate (cfs)	Allowable Release Rate (cfs)	Actual Release Rate (cfs)	Pond Water Elev (ft)	Pond Storage (cf)
2	1.24	3.52	0.62	0.61	709.36	13,290
5	1.87	4.59	1.87	1.18	709.65	15,735
10	2.31	5.33	2.31	1.56	709.85	17,390
25	3.12	6.62	3.12	2.11	710.32	21,617

Lower orifice 2.6” dia, IE = 696.43

Upper orifice 3” h X 16” w, IE= 709.40

*The allowable release rate is limited to 50 percent of the 2-year pre-Developed flow rate.

Table 7. Pond ‘B’ Performance Summary

Storm Event (year)	Pre-Developed Flow (cfs)	Developed Flow (cfs)	Allowable Release Rate (cfs)	Actual Release Rate (cfs)	Pond Water Elev (ft)	Pond Storage (cf)
2	1.38	3.08	0.69	0.67	709.12	9,226
5	2.07	3.98	2.07	1.34	709.48	11,166
10	2.55	4.60	2.55	1.70	709.73	12,599
25	3.43	5.70	3.43	2.22	710.29	15,967

Lower orifice 3.5” dia, IE = 703.04

Upper orifice 3” h X 14” w, IE= 709.15

*The allowable release rate is limited to 50 percent of the 2-year pre-developed flow rate

Table 8. Pond 'C' Performance Summary

Storm Event (year)	Pre-Developed Flow (cfs)	Developed Flow (cfs)	Underdrain Pumps (cfs)	Total Inflow (cfs)	Allowable Release Rate (cfs)	Actual Release Rate (cfs)	Pond Water Elev (ft)	Pond Storage (cf)
2	4.04	4.78	0.8	5.58	2.02*	1.86	704.82	15,943
5	5.99	6.89	0.8	7.69	5.99	2.53	705.13	22,341
10	7.37	8.39	0.8	9.19	7.37	2.92	705.34	26,741
25	9.88	11.12	0.8	11.92	9.88	3.50	705.81	37,299

Lower orifice 5.1" dia, IE = 695.90

Upper orifice 3" h X 16" w, IE= 704.85

* The allowable release rate is limited to 50 percent of the 2-year pre-developed flow rate.

Table 9. Pond 'D' Performance Summary

Storm Event (year)	Pre-Developed Flow (cfs)	Developed Flow (cfs)	Allowable Release Rate (cfs)	Actual Release Rate (cfs)	Pond Water Elev (ft)	Pond Storage (cf)
2	1.90	3.35	0.95*	0.94	694.57	8,181
5	2.83	4.50	2.83	1.75	694.95	10,505
10	3.49	5.31	3.49	2.18	695.33	12,303
25	4.70	6.75	4.70	2.80	695.8	16,277

Lower orifice 4.3" dia, IE = 690.50

Upper orifice 3" h X 15" w, IE= 694.60

* The allowable release rate is limited to 50 percent of the 2-year pre-developed flow rate

Table 10. Pond 'E' Performance Summary

Storm Event (year)	Pre-Developed Flow (cfs)	Developed Flow (cfs)	Allowable Release Rate (cfs)	Actual Release Rate (cfs)	Pond Water Elev (ft)	Pond Storage (cf)
2	2.65	3.43	1.33*	1.30	713.96	8,316
5	3.97	5.04	3.97	2.22	714.27	11,384
10	4.90	6.18	4.90	2.71	714.50	13,759
25	6.60	8.27	6.60	3.45	714.98	18,886

Lower orifice 7.0" dia, IE = 711.00

Upper orifice 3" h X 16" w, IE= 713.95

* The allowable release rate is limited to 50 percent of the 2-year pre-developed flow rate.

3.4 Site Points of Discharge Locations

The site has three proposed Points of Discharge as described in Section 2.1 Description of Existing Stormwater Drainage Conditions above. See Figure 3 Site Stormwater Drainage Basin Map Flow Control for the following discussion.

The existing points of discharge will be maintained and utilized for this project as described below. The site's post developed stormwater flows are equal or less than the pre-developed stormwater flows, as shown in Table 11 below.

Most mitigated flows will route directly to Point of Discharge #2. Mitigated flows from Pond D and unmitigated flows from the northwest portion of the site will route through a flow splitter manhole, which routes discharges to both Point of Discharge #1 and Point of Discharge #2. An internal tee structure with a single orifice will control the routing of flows leaving the flow splitter. Most flows will route through the larger bypass pipe to Point of Discharge #2, while the rest will pass through the tee structure to Point of Discharge #1.

Proposed Point of Discharge #1 is located on the west side of the site. There are two existing 8" PVC culverts that cross the existing access road. Only one will be used for this project. This discharge location is not the primary discharge for the site. This discharge is to maintain and provide stormwater to the existing downstream storm system within the flow capacities of the existing culverts. This Point of Discharge receives stormwater from the site conveyance system by means of a flow splitter. The flow splitter will provide variable flow in the range of 0.47 to 0.66 cfs. See Table 11 for flow summary and Attachment G for plots of the flow splitter HydroCAD model.

The primary discharge location for this site is Proposed Point of Discharge #2, being Flow Spreader No. 1. It is located in the southwest corner of the site located between the sites Overflow Basins and the SEC Zone for water resources. The structure is a concrete channel with the downhill side lower than the uphill side. The structure has a bottom that will slope to a low point. This low point will have a drain with an 8" pipe to daylight, that will dewater the structure. The top of the facility is flat to provide uniform flow over the top of the structure, which flows to a layer of drain rock and a landscaped buffer area for erosion control. See Attachment H: Outfall Flow Spreader Calculations and Details. The structure is:

- 175 feet long
- Structure bottom running slope is 0.25%.
- Structure top is flat
- Design flow 16.82 cfs
- Flow depth is 0.10 feet
- Velocity of approximately 0.94 fps

Point of Discharge #2 has a greatly increased flow rate in the post-developed condition. However, with total onsite flows between all discharge points being reduced due to onsite detention, and the velocity of flows exiting the top of the flow spreader being less than 1 fps, increased erosion, or damage to downstream bodies of water are not anticipated.

The Proposed Point of Discharge #3 is located on the east side of the site adjacent to Pond E, utilizing the existing low area that exists. The pond with discharge on to the finished grade on the east side of the new emergency access road using a small bubbler consisting of a catch basin surrounded by a layer of drain rock. The mitigated stormwater runoff will continue to flow east in its current direction of travel.

Point of Discharge #1 receives stormwater from the on-site flow splitter.

Table 11. Point of Discharge Flow Summary				
Flows to Flow Splitter				
Storm Event (year)	Pond Actual Release Rate (cfs)	Intercepted Unmitigated Flows (cfs)	Cross-property Flow (cfs)	Total Flow at Flow Splitter (cfs)
2	4.24	0.90	1.26	6.40
5	7.27	1.37	1.95	10.59
10	9.02	1.71	2.46	13.19
25	11.42	2.32	3.39	17.13
Point of Discharge #1				
Storm Event (year)	Pre-Developed Flow (cfs)	Flow From Flow Splitter to POD (cfs)	Total Flow POD (cfs)	
2	7.34	0.47	0.47	
5	11.01	0.54	0.54	
10	13.62	0.60	0.60	
25	18.41	0.66	0.66	
Point of Discharge #2				
Storm Event (year)	Pre-Developed Flow (cfs)	Flow From Flow Splitter to POD (cfs)	Total Flow POD (cfs)	
2	4.60	0.91	9.33	
5	6.86	1.58	10.90	
10	8.46	2.23	13.09	
25	11.38	3.23	16.82	
Point of Discharge #3				
Storm Event (year)	Pre-Developed Flow (cfs)	Pond Actual Release Rate (cfs)	Total Flow POD #3 (cfs)	
2	2.65	1.30	1.30	
5	3.97	2.22	2.22	
10	4.90	2.71	2.71	
25	6.60	3.45	3.45	

3.5 Conveyance System

Onsite developed runoff will be collected and flowing overland to proposed catch basins, water quality treatment facilities, and detention facilities. After collection, flows will be routed to and from the various water quality and detention facilities and to the three points of discharge by a conveyance system made up of pipes and conveyance ditches. The proposed onsite storm conveyance system is a combination of 8", 10", 12", 15", 18", & 24" diameter storm pipes designed to convey the 25-year design storm without surcharge and conveyance ditch segments designed to convey the 25-year design storm under open channel flow conditions with adequate

freeboard. Maps of the tributary onsite basin areas and proposed conveyance system can be found in Attachment A, Figures 5 and 6, respectively.

Using the methods and assumptions outlined in section 1.6.5 of this report, both the piped conveyance system and conveyance ditch segments were analyzed for conveyance capacity. Along a series of pipes that experience the same flows, only the pipe with the lowest capacity was analyzed to determine the capacity of the series. The results of the system analysis show that all proposed pipes are adequately sized to convey the 25-year design storm under open channel flow conditions without any surcharging throughout the system. The analysis also shows that all conveyance ditches can adequately convey the 25-year design storm while maintaining more than the minimum required 0.5 ft of freeboard. Pipe and ditch segments managing pumped flows were determined to have sufficient capacity to convey the modified 2-year design storm from all pumped areas. Additionally, the Overflow basins were determined to have sufficient storage capacity for the 25-year design storm with a peak 25-year storage elevation of 685.19' and top of basin elevations at 693.00'. Table 12 below contains the results of the ditch analysis. See Attachment G for HydroCAD plots of the tributary basins and ditch segments, and the piped system calculation spreadsheet.

Table 12. Conveyance Ditch Performance Summary					
Facility #	Bottom Width (ft)	Longitudinal Slope (ft/ft)	Flow Rate (cfs)	Flow Depth (ft)	Freeboard (ft)
Ditch 1	2	0.019	1.86	0.25	0.5
Ditch 2	3	0.022	1.42	0.17	0.83
Ditch 3	2	0.008	2.46	0.37	0.63
Ditch 4	0	0.038	5.82	0.73	1.02
Ditch 5	3	0.005	4.50	0.49	0.51
Ditch 6	2	0.015	3.65	0.38	0.62

4.0 Cross-Property Drainage

The purpose of this section is to address how Oregon has adopted the civil law doctrine of drainage. Under this doctrine adjoining landowners are entitled to have the normal course of natural drainage maintained. The lower landowner must accept water which naturally comes to his land from above, but he is entitled not to have the normal drainage changed or substantially increased. The lower landowner may not obstruct the run-off from the upper land if the upper landowner is properly discharging the water.

4.1 Existing Surface Water Cross-Property Drainage

See Section 2.1 Description of Existing Stormwater Drainage Conditions.

4.2 Proposed Surface Water Cross-Property Drainage

Post-construction, the site will consist of four subbasins that will discharge offsite unmitigated. See Figure 2 Post Construction Stormwater Drainage Basin Map Cross-Property. This section does not discuss the discharge points, see Section 3.4 Site Discharge Locations.

The development of this site is reducing the stormwater flows crossing property lines by reducing the amount of area that crosses property lines, reducing the runoff curve number, or cutting off the drainage by installing drainage ditches along the property lines.

Subbasin 1A has been disconnected from cross-property flows due to the new drainage ditch along the west property line that extends from Carpenter Lane to the Point of Discharge No 1. These flows have been included in the point of discharge analysis in Section 3.4 Site Discharge Locations.

Subbasin 2A has been reduced in size due to the site development. It flows toward the Point of Discharge No. 1.

Subbasin 3A has been disconnected from cross-property flows due to the new drainage ditch along the west property line. The northern portion the subbasin 3 is captured by a drainage ditch, which is connected to the sites storm drainage system. The southern portion of the subbasin continues to flow across the property lines but has been significantly reduced. These flows have been included in the point of discharge analysis in Section 3.4 Site Discharge Locations.

Subbasin 4A has been reduced in size due to the site development. The subbasin continues to flow across the property lines but has been significantly reduced.

4.3 Existing and Proposed Cross-Property Hydrologic Analysis

The analysis was completed using the SBUH hydrological model with an NRCS Type 1A synthetic rainfall distribution. The 24-hour rainfall depths used for the analysis shown in Table 3 above were used in the calculations. Table 13 below is a summary of the pre-developed flows versus the post construction flows (or unmitigated flows) from newly landscaped areas. It shows that the cross-property flows have been reduced.

The pre-developed unmitigated flows consist of the upstream farmland, (See Figure 1 – Existing Stormwater Drainage Basin Map). The post construction flows (or unmitigated flows) are flows from the newly constructed landscape areas as can be seen in Figure 2 Post Construction Stormwater Drainage Basin Map Cross-Property. A curve number of 82 was used for the pre-developed flows (with no impervious surfaces included in the calculations) and a curve number of 80 was used for the post construction altered flows. The curve numbers are discussed above in section 1.6.4.

Table 13. Cross-Property Storm Drainage Flow Summary				
Subbasin	Design Storm (year)	Drainage Area (sf)	Pre-Developed Flow Farm Use (cfs)	Post Construction Landscaped Areas (cfs)
1A	2	100,222	0.42	0.39
	5		0.63	0.59
	10		0.77	0.73
	25		1.05	0.99
2A	2	57,233	0.30	0.24
	5		-	0.37
	10		-	0.57
	25		-	0.64
3A	2	33,843	0.20	0.18
	5		0.29	0.27
	10		0.35	0.33
	25		0.47	0.43
4A	2	440,630	1.67	1.37
	5		-	2.07
	10		-	2.58
	25		-	3.51

5.0 Groundwater Management and Subdrain System

5.1 Description of Proposed Post-Construction Groundwater Discharge

This project is proposing to collect groundwater using a sub-drain system under Buildings 30 and 40. The groundwater is included in the sizing of Pond C, being 300 gpm (0.8 cfs) for managing flow control. This groundwater in combination with the site’s mitigated surface stormwater flows will discharge to the site’s flow spreader, Point of Discharge #2.

No known contamination exists on site, and construction site management activities and post-construction stormwater management will implement stormwater facilities conforming to SWMM stormwater facility selection, sizing, and design criteria.

Table 13 summarizes the approximate distance from the pond bottom elevation to the approximate groundwater depth as shown in the Final Geotechnical Data Report Technical Memorandum Dated July 15, 2022 (prepared by McMillan Jacobs Associates), Attachment K Preliminary Geotechnical Data Report (prepared by Rhino One). Groundwater is not anticipated to affect the ponds capacity.

Table 14. Pond Bottom to Groundwater Depth

Pond	Approx. Exist. Grade at Pond (ft)	Measured Water Level BGS (ft) and Boring # **	Approx. Groundwater Elev (ft)*	Pond Bottom Elev (ft)*	Approx. Depth to Groundwater (ft)*
A	716	55.45 WTP-B-04	661	707.5	46.5
B	718	24.66 WTP-B-01	693	707	14
C	722	45.34 WTP-B-05	677	704	27
D	698	55.45 WTP-B-04	643	693	50
E	712	7.67 WTP-B-02	704	713	9

* Elevations have been rounded to the nearest foot and are approximate. The elevations and depths were estimated based on the nearest boring.

** Final Geotechnical Data Report Technical Memorandum Dated July 15, 2022 (prepared by McMillan Jacobs Associates), Attachment K Preliminary Geotechnical Data Report (prepared by Rhino One) Table 7 Groundwater Level Observations Summary. The measured groundwater depths were measured on April 15, 2021, the shallowest measure and listed in Table 7.

6.0 Summary

The Multnomah County Design and Construction Manual refers to the City of Portland Stormwater Management Manual for stormwater quantity and quality control and conveyance design standards. The design of the proposed site satisfies both stormwater quality treatment, stormwater flow control, and stormwater conveyance standards as outlined in the City of Portland SWMM.

The flow control implemented in this project exceeds what is required by the SWMM, which requires the post-development runoff rates to be less than or equal to the pre-development runoff rates for the 2-year through 25-year storm events. This project is providing flow control to the extent that the 2-year storm event is being detained while releasing one-half the total flow from the pre-developed 2-year storm event.

The site’s post-construction improvements meet local and state stormwater quality treatment and flow control requirements, minimizing hydromodification in accordance with Portland SWMM Section 1.3.5.

The conveyance system implemented in this project exceeds what is required by the SDFDM, which requires that the 10-year storm event pass through the system without surcharging.

Attachment A: Stormwater Drainage Basin Maps

Figure 1 – Existing Stormwater Drainage Basin Map

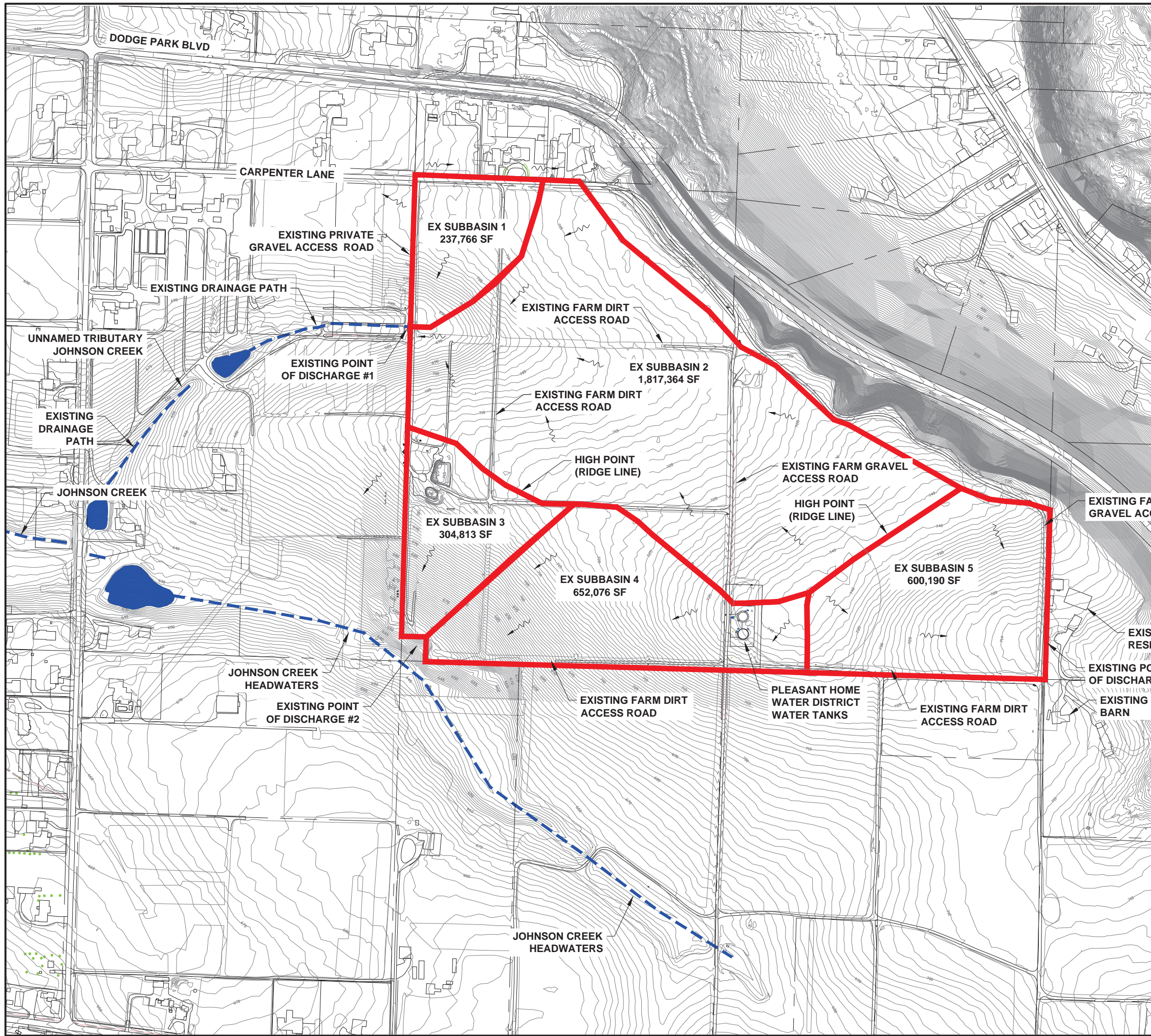
Figure 2 – Post Construction Stormwater Drainage Basin Map Cross-Property

Figure 3 – Site Stormwater Drainage Basin Map Flow Control

Figure 4 – Site Stormwater Drainage Basin Map Water Quality

Figure 5 – Site Stormwater Drainage Basin Map Conveyance

Figure 6 – Conveyance System Map



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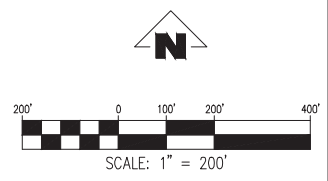
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- EXISTING CONTOUR MAJOR
- EXISTING CONTOUR MINOR
- PROPERTY LINE
- > DIRECTION OF SURFACE WATER FLOW

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EXISTING STORMWATER DRAINAGE BASIN MAP

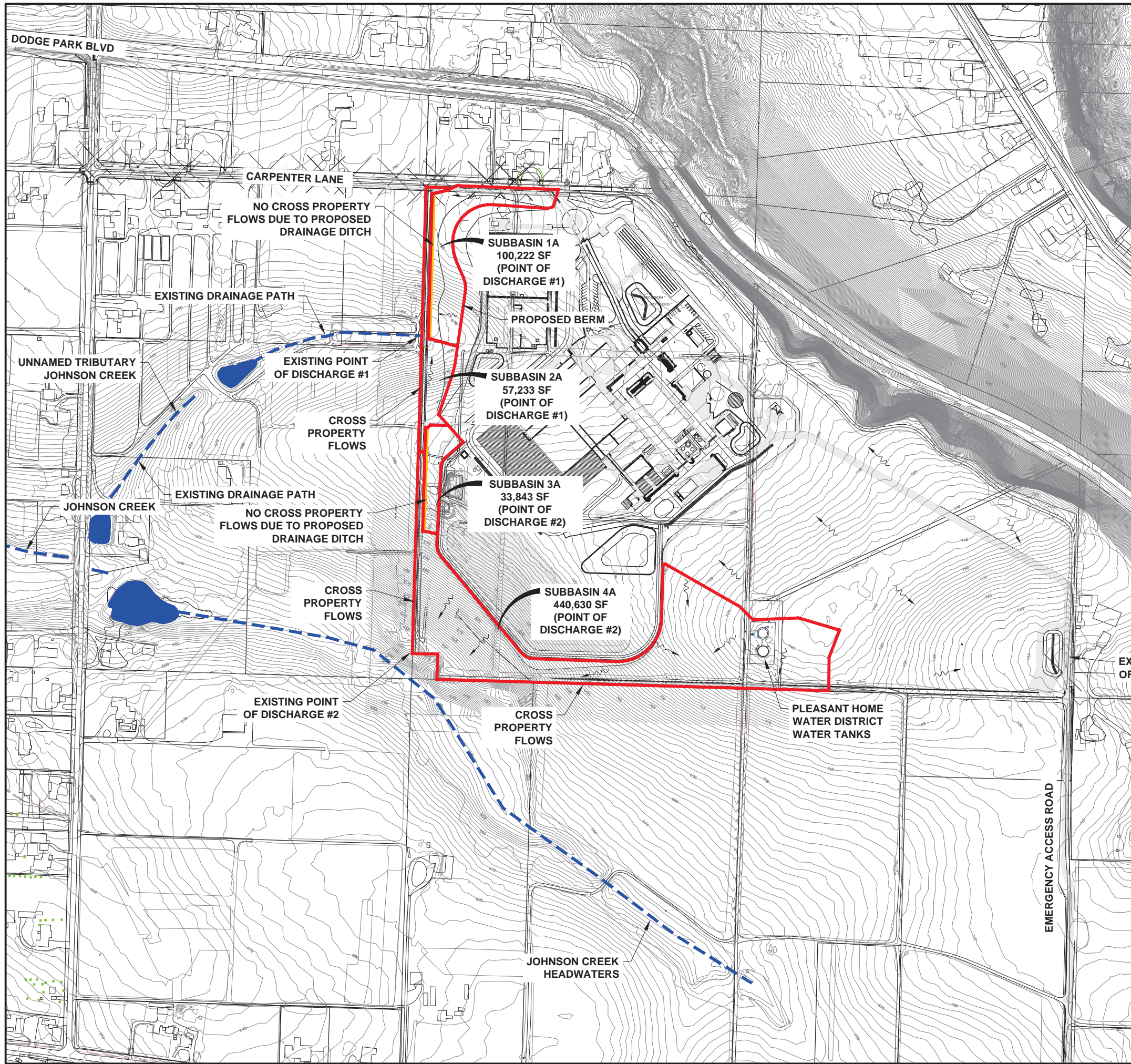
NO.	DATE	DESCRIPTION

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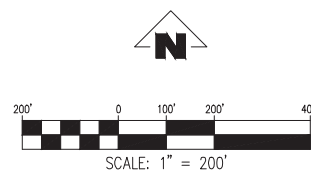
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FILE: P:\0596-003 Bull Run WTP Filtration Facility\docs\Civil\Stormwater\Site Storm Report\Figures\0596-003 Figure 1 Existing Storm Runoff Basin Map Layout Figure 1 Plot Date: 2/2/2023 9:25 AM, by: Josh Meyer



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	STORMWATER BASIN
	EXISTING CONTOUR MAJOR
	EXISTING CONTOUR MINOR
	PROPERTY LINE
	DIRECTION OF SURFACE WATER FLOW
	PROPOSED CONTOUR MAJOR
	PROPOSED CONTOUR MINOR
	PROPOSED DRAINAGE DITCH



BULL RUN FILTRATION FACILITY

MULTNOMAH COUNTY, OREGON

**POST CONSTRUCTION
STORMWATER DRAINAGE
BASIN MAP
CROSS-PROPERTY**

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FILE: P:\0596-003 Bull Run WTP Filtration Facility\docs\civil\Stormwater\Site Storm Report\Figures\0596-003 Figure 2 Proposed Storm Runoff Basin Map Layout Figure 2 Plot Date: 2/2/2023 9:22 AM, by: Josh Meyer

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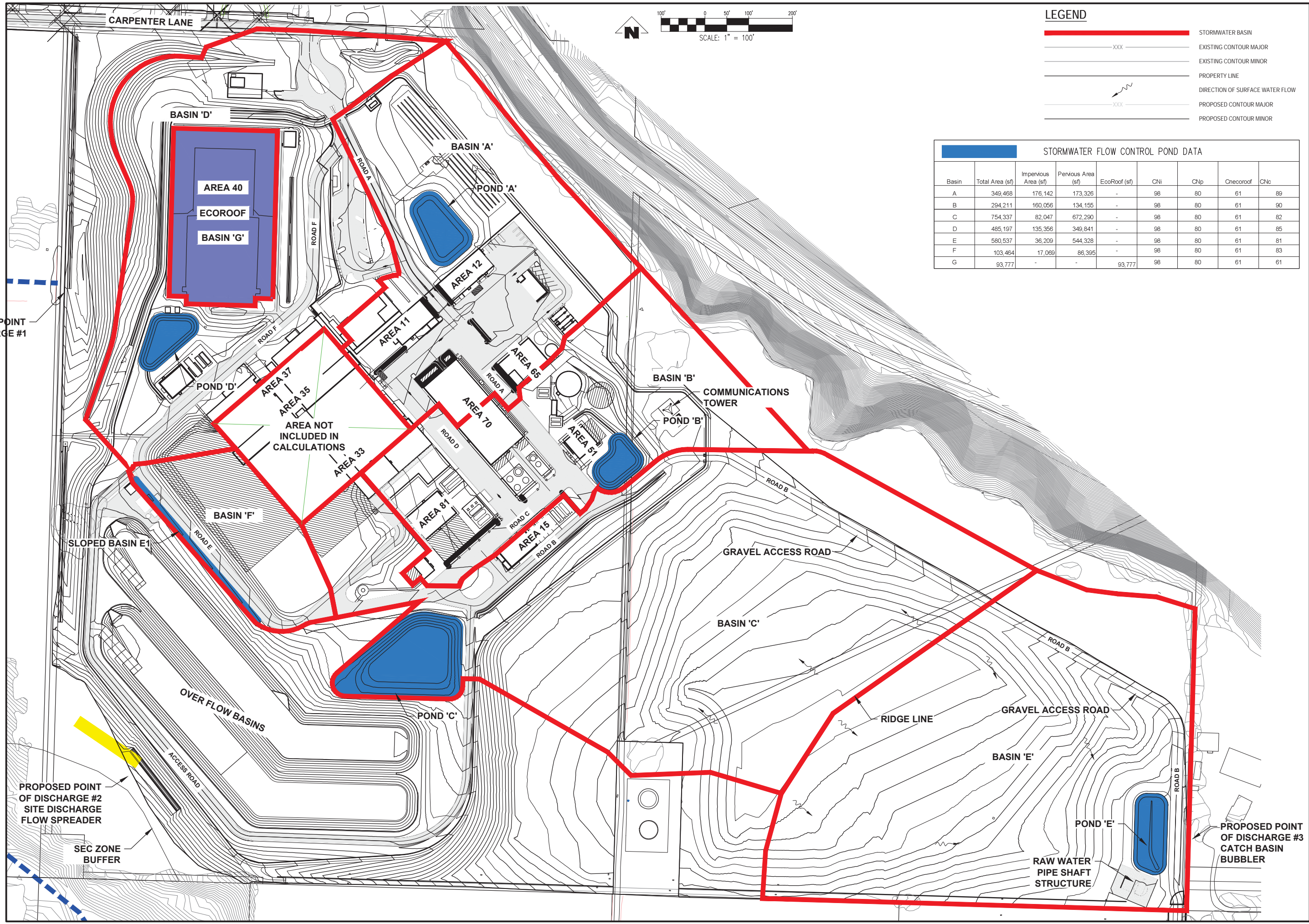


LEGEND

- STORMWATER BASIN
- XXX EXISTING CONTOUR MAJOR
- EXISTING CONTOUR MINOR
- PROPERTY LINE
- DIRECTION OF SURFACE WATER FLOW
- XXX PROPOSED CONTOUR MAJOR
- PROPOSED CONTOUR MINOR

STORMWATER FLOW CONTROL POND DATA								
Basin	Total Area (sf)	Impervious Area (sf)	Pervious Area (sf)	EcoRoof (sf)	CNI	CNp	Checroof	CNc
A	349,468	176,142	173,326	-	98	80	61	89
B	294,211	160,056	134,155	-	98	80	61	90
C	754,337	82,047	672,290	-	98	80	61	82
D	485,197	135,356	349,841	-	98	80	61	85
E	580,537	36,209	544,328	-	98	80	61	81
F	103,464	17,069	86,395	-	98	80	61	83
G	93,777	-	-	93,777	98	80	61	61

PROPOSED POINT OF DISCHARGE #1



AREA 40
ECOROOF
BASIN 'G'

AREA NOT INCLUDED IN CALCULATIONS

PROPOSED POINT OF DISCHARGE #2
SITE DISCHARGE FLOW SPREADER

SEC ZONE BUFFER

PROPOSED POINT OF DISCHARGE #3
CATCH BASIN BUBBLER

BULL RUN FILTRATION FACILITY
MULTNOMAH COUNTY, OREGON

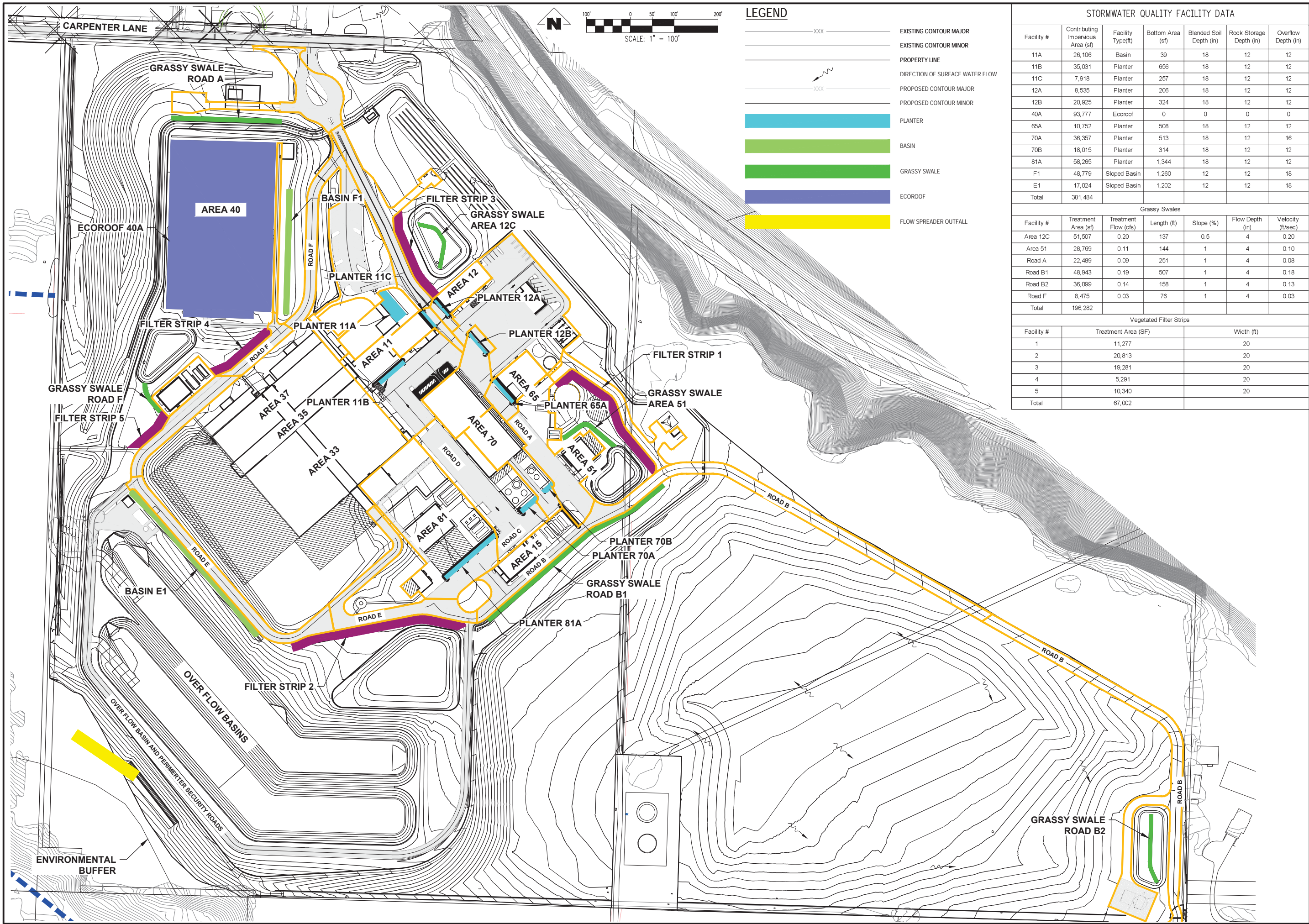
SITE STORMWATER DRAINAGE BASIN MAP FLOW CONTROL

NO.	DATE	DESCRIPTION

EMERIO
ENGINEERING - SURVEYING - DESIGN

6446 SW FALLBROOK PLACE, SUITE 100
BEAVERTON, OREGON 97008
TEL: (503) 748-8812
FAX: (503) 639-9592
www.emeriodesign.com

FILE: P:\0596-003 Bull Run WTP Filtration Facility\docs\Civil\Stormwater\Site Storm Report\Figures\0596-003 Figure 3-4 Proposed Storm Basin Map_Layout: Figure 3, Plot Date: 1/15/2024 2:03 PM, by: Josh Meyer



LEGEND

- XXX --- EXISTING CONTOUR MAJOR
- --- EXISTING CONTOUR MINOR
- --- PROPERTY LINE
- >--- DIRECTION OF SURFACE WATER FLOW
- XXX --- PROPOSED CONTOUR MAJOR
- --- PROPOSED CONTOUR MINOR
- █ PLANTER
- █ BASIN
- █ GRASSY SWALE
- █ ECOROOF
- █ FLOW SPREADER OUTFALL

STORMWATER QUALITY FACILITY DATA

Facility #	Contributing Impervious Area (sf)	Facility Type(ft)	Bottom Area (sf)	Blended Soil Depth (in)	Rock Storage Depth (in)	Overflow Depth (in)
11A	26,106	Basin	39	18	12	12
11B	35,031	Planter	656	18	12	12
11C	7,918	Planter	257	18	12	12
12A	8,535	Planter	206	18	12	12
12B	20,925	Planter	324	18	12	12
40A	93,777	Ecoroof	0	0	0	0
65A	10,752	Planter	508	18	12	12
70A	36,357	Planter	513	18	12	16
70B	18,015	Planter	314	18	12	12
81A	58,265	Planter	1,344	18	12	12
F1	48,779	Sloped Basin	1,260	12	12	18
E1	17,024	Sloped Basin	1,202	12	12	18
Total	381,484					

Grassy Swales						
Facility #	Treatment Area (sf)	Treatment Flow (cfs)	Length (ft)	Slope (%)	Flow Depth (in)	Velocity (ft/sec)
Area 12C	51,507	0.20	137	0.5	4	0.20
Area 51	28,769	0.11	144	1	4	0.10
Road A	22,489	0.09	251	1	4	0.08
Road B1	48,943	0.19	507	1	4	0.18
Road B2	36,099	0.14	158	1	4	0.13
Road F	8,475	0.03	76	1	4	0.03
Total	196,282					

Vegetated Filter Strips		
Facility #	Treatment Area (SF)	Width (ft)
1	11,277	20
2	20,813	20
3	19,281	20
4	5,291	20
5	10,340	20
Total	67,002	

BULL RUN FILTRATION FACILITY

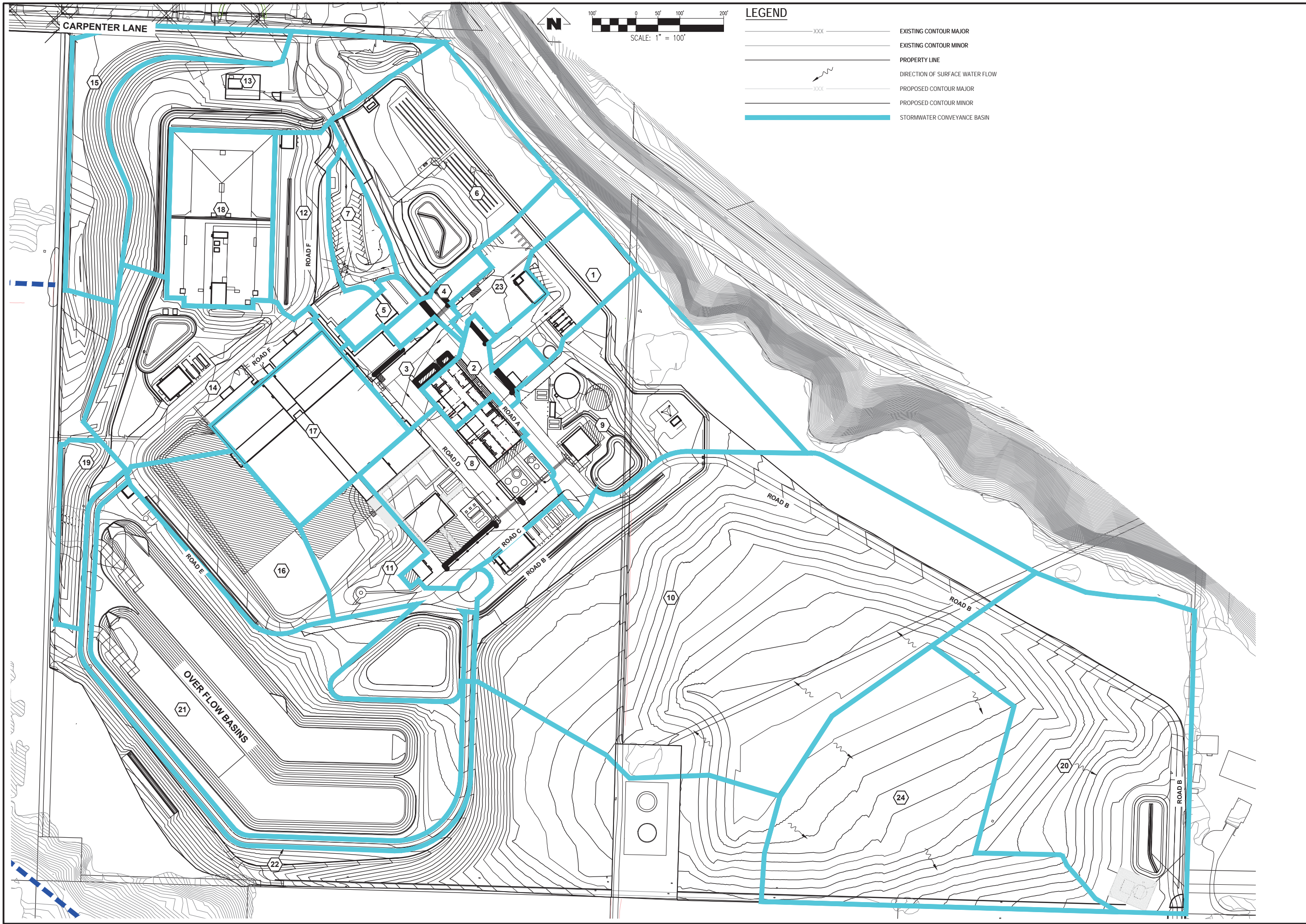
SITE STORMWATER DRAINAGE BASIN MAP WATER QUALITY

REVISIONS

NO.	DATE	DESCRIPTION

EMERIO
 ENGINEERING - SURVEYING - DESIGN
 6446 SW FALLBROOK PLACE, SUITE 100
 BEAVERTON, OREGON 97008
 TEL: (503) 748-8812
 FAX: (503) 639-8592
 www.emeriodesign.com

FILE: P:\0596-003 Bull Run WTP Filtration Facility\docs\civil\Stormwater\Site Storm Report\Figures\0596-003 Figure 3-4 Proposed Storm Basin Map, Layout: Figure 4, Plot Date: 1/15/2024 2:04 PM, by: Josh Meyer



CARPENTER LANE



LEGEND

- XXX— EXISTING CONTOUR MAJOR
- EXISTING CONTOUR MINOR
- PROPERTY LINE
- > DIRECTION OF SURFACE WATER FLOW
- XXX— PROPOSED CONTOUR MAJOR
- PROPOSED CONTOUR MINOR
- STORMWATER CONVEYANCE BASIN

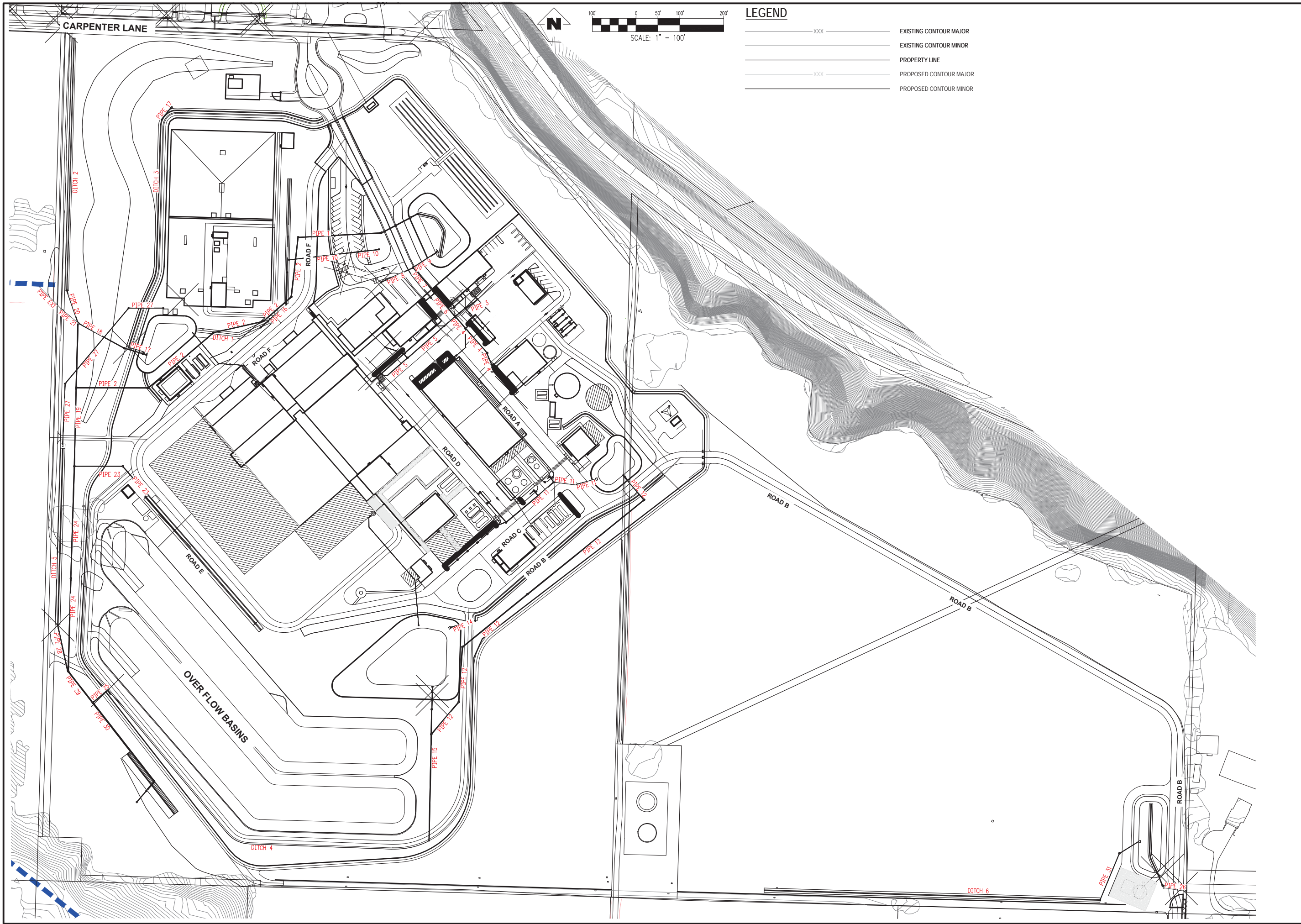
BULL RUN FILTRATION FACILITY
MULTNOMAH COUNTY, OREGON

SITE STORMWATER DRAINAGE BASIN MAP CONVEYANCE

NO.	DATE	DESCRIPTION

EMERIO
 ENGINEERING • SURVEYING • DESIGN
 6446 SW FALLBROOK PLACE, SUITE 100
 BEAVERTON, OREGON 97008
 TEL: (503) 748-8812
 FAX: (503) 639-8592
 www.emeriodesign.com

FILE: P:\0596-003 Bull Run WTP Filtration Facility\docs\Civil\Stormwater\Site Storm Report\Figures\0596-003 Figure 5 Conveyance, Layout: Figure 5, Plot Date: 1/15/2024 12:31 PM, by: Josh Meyer



LEGEND

- XXX— EXISTING CONTOUR MAJOR
- EXISTING CONTOUR MINOR
- PROPERTY LINE
- XXX— PROPOSED CONTOUR MAJOR
- PROPOSED CONTOUR MINOR

BULL RUN FILTRATION FACILITY
MULTNOMAH COUNTY, OREGON

**CONVEYANCE SYSTEM
 MAP**

REVISIONS	
NO.	DESCRIPTION

EMERIO
 ENGINEERING • SURVEYING • DESIGN
 6446 SW FALLBROOK PLACE SUITE 100
 BEAVERTON, OREGON 97008
 TEL: (503) 748-8812
 FAX: (503) 639-9592
 www.emeriodesign.com

SHEET
06
 OF
06

FILE: P:\0596-003 Bull Run WTP Filtration Facility\docs\Civil\Stormwater\Site Storm Report\Figures\0596-003 Figure 6 Conveyance System Layout: Figure 6, Plot Date: 1/15/2024 4:29 PM, by: Josh Meyer

Attachment B: NCRS Hydrologic Soil Group Information

Soil Map—Clackamas County Area, Oregon, and Multnomah County Area, Oregon
(On-Site)



Map Scale: 1:5,250 if printed on A landscape (11" x 8.5") sheet.




Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84



Soil Map—Clackamas County Area, Oregon, and Multnomah County Area, Oregon
(On-Site Soils Map)

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 1:20,000.

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: Clackamas County Area, Oregon
Survey Area Data: Version 18, Oct 27, 2021

Soil Survey Area: Multnomah County Area, Oregon
Survey Area Data: Version 20, Oct 27, 2021

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

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

Date(s) aerial images were photographed: Jul 2, 2015—Sep 21, 2016

MAP LEGEND

MAP INFORMATION

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
7B	Borges silty clay loam, 0 to 8 percent slopes	0.0	0.0%
15B	Cazadero silty clay loam, 0 to 7 percent slopes	0.1	0.1%
Subtotals for Soil Survey Area		0.1	0.1%
Totals for Area of Interest		100.0	100.0%

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
9B	Cazadero silty clay loam, 0 to 8 percent slopes	90.8	90.8%
9C	Cazadero silty clay loam, 8 to 15 percent slopes	0.7	0.7%
20F	Haplumbrepts, very steep	6.9	6.9%
57	Wollent silt loam	1.5	1.5%
Subtotals for Soil Survey Area		99.9	99.9%
Totals for Area of Interest		100.0	100.0%

Hydrologic Soil Group—Clackamas County Area, Oregon, and Multnomah County Area, Oregon
(On-Site)



Map Scale: 1:5,250 if printed on A landscape (11" x 8.5") sheet.




Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84



MAP LEGEND

Area of Interest (AOI)









 Area of Interest (AOI)

Soils

Soil Rating Polygons





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

Soil Rating Lines


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

Soil Rating Points






 A
 A/D
 B
 B/D

 C
 C/D
 D
 Not rated or not available


Water Features

 Streams and Canals

Transportation

 Rails
 Interstate Highways
 US Routes
 Major Roads
 Local Roads

Background

 Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

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: Clackamas County Area, Oregon
 Survey Area Data: Version 18, Oct 27, 2021

Soil Survey Area: Multnomah County Area, Oregon
 Survey Area Data: Version 20, Oct 27, 2021

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

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

Date(s) aerial images were photographed: Jul 2, 2015—Sep 21, 2016

MAP LEGEND

MAP INFORMATION

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
7B	Borges silty clay loam, 0 to 8 percent slopes	D	0.0	0.0%
15B	Cazadero silty clay loam, 0 to 7 percent slopes	C	0.1	0.1%
Subtotals for Soil Survey Area			0.1	0.1%
Totals for Area of Interest			100.0	100.0%

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
9B	Cazadero silty clay loam, 0 to 8 percent slopes	C	90.8	90.8%
9C	Cazadero silty clay loam, 8 to 15 percent slopes	C	0.7	0.7%
20F	Haplumbrepts, very steep	B	6.9	6.9%
57	Wollent silt loam	C/D	1.5	1.5%
Subtotals for Soil Survey Area			99.9	99.9%
Totals for Area of Interest			100.0	100.0%

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

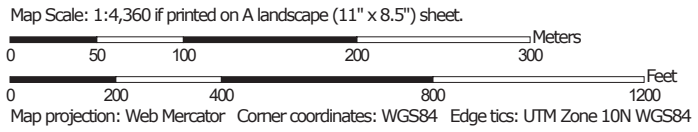
Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Soil Map—Multnomah County Area, Oregon
(Carpenter Lane)




Soil Map may not be valid at this scale.



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 1:20,000.

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: Multnomah County Area, Oregon

Survey Area Data: Version 20, Oct 27, 2021

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

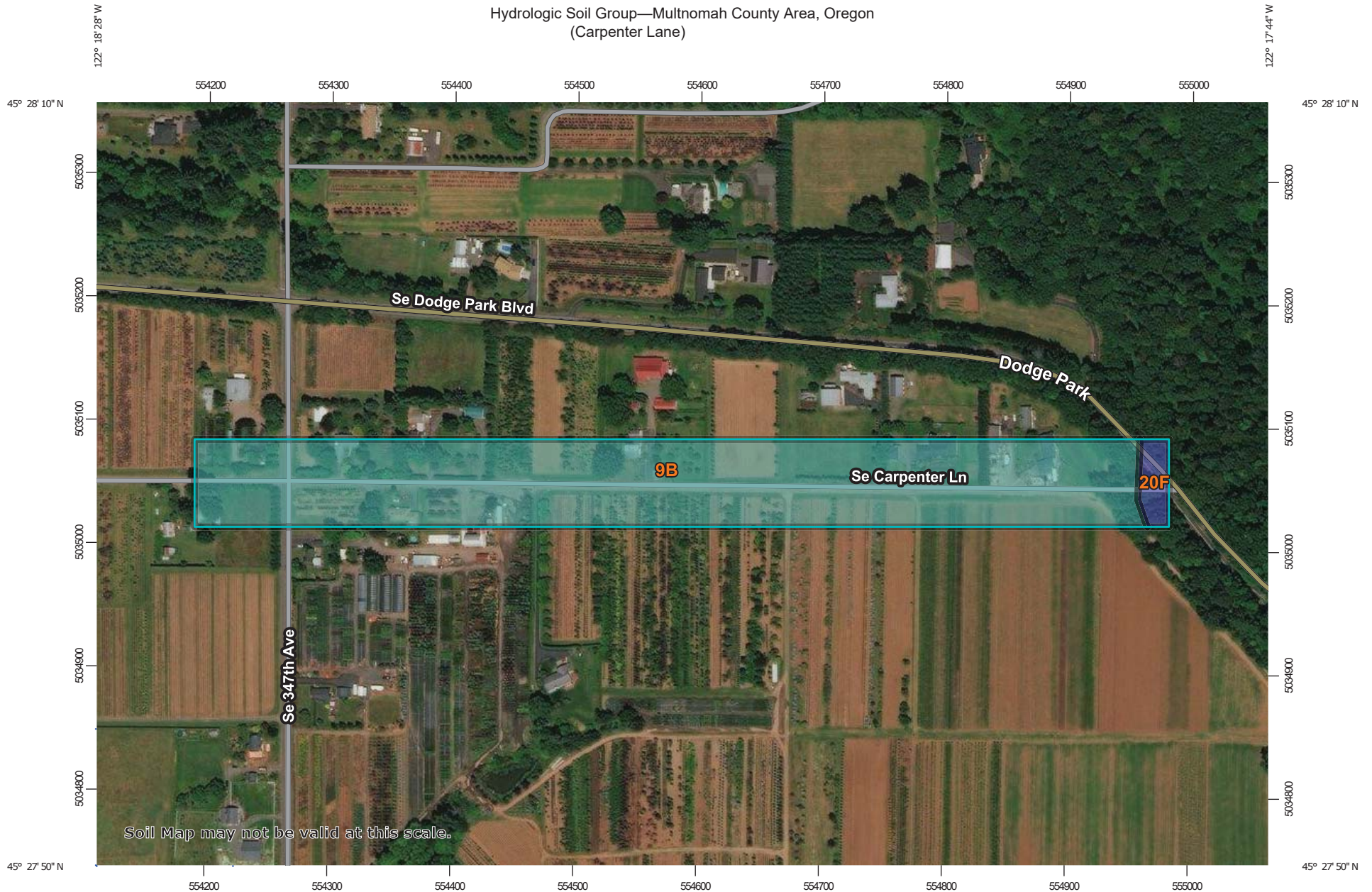
Date(s) aerial images were photographed: Jul 2, 2015—Sep 21, 2016

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.

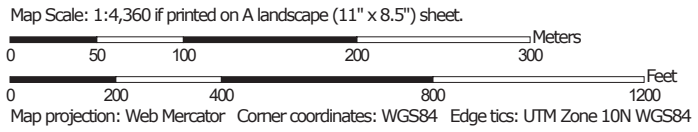
Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
9B	Cazadero silty clay loam, 0 to 8 percent slopes	13.6	97.0%
20F	Haplumbrepts, very steep	0.4	3.0%
Totals for Area of Interest		14.0	100.0%

Hydrologic Soil Group—Multnomah County Area, Oregon
(Carpenter Lane)




Soil Map may not be valid at this scale.



MAP LEGEND

Area of Interest (AOI)









 Area of Interest (AOI)

Soils

Soil Rating Polygons





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

Soil Rating Lines


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

Soil Rating Points






 A
 A/D
 B
 B/D

 C
 C/D
 D
 Not rated or not available

Water Features

 Streams and Canals

Transportation

 Rails
 Interstate Highways
 US Routes
 Major Roads
 Local Roads

Background

 Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

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

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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: Multnomah County Area, Oregon
 Survey Area Data: Version 20, Oct 27, 2021

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

Date(s) aerial images were photographed: Jul 2, 2015—Sep 21, 2016

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
9B	Cazadero silty clay loam, 0 to 8 percent slopes	C	13.6	97.0%
20F	Haplumbrepts, very steep	B	0.4	3.0%
Totals for Area of Interest			14.0	100.0%

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

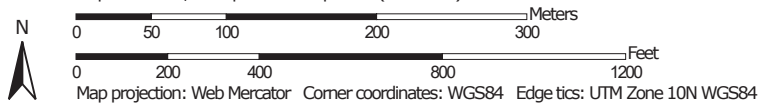
Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Soil Map—Clackamas County Area, Oregon, and Multnomah County Area, Oregon
(South Access)




Map Scale: 1:5,030 if printed on A portrait (8.5" x 11") sheet.



Soil Map—Clackamas County Area, Oregon, and Multnomah County Area, Oregon
(South Access)

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 1:20,000.

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: Clackamas County Area, Oregon
Survey Area Data: Version 18, Oct 27, 2021

Soil Survey Area: Multnomah County Area, Oregon
Survey Area Data: Version 20, Oct 27, 2021

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

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

Date(s) aerial images were photographed: Jul 2, 2015—Sep 21, 2016

MAP LEGEND

MAP INFORMATION

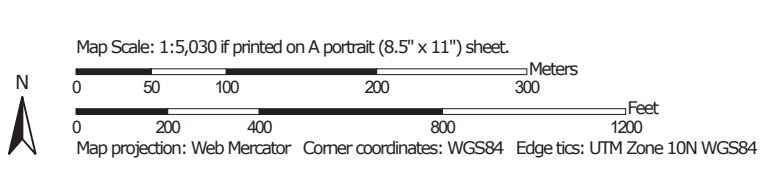
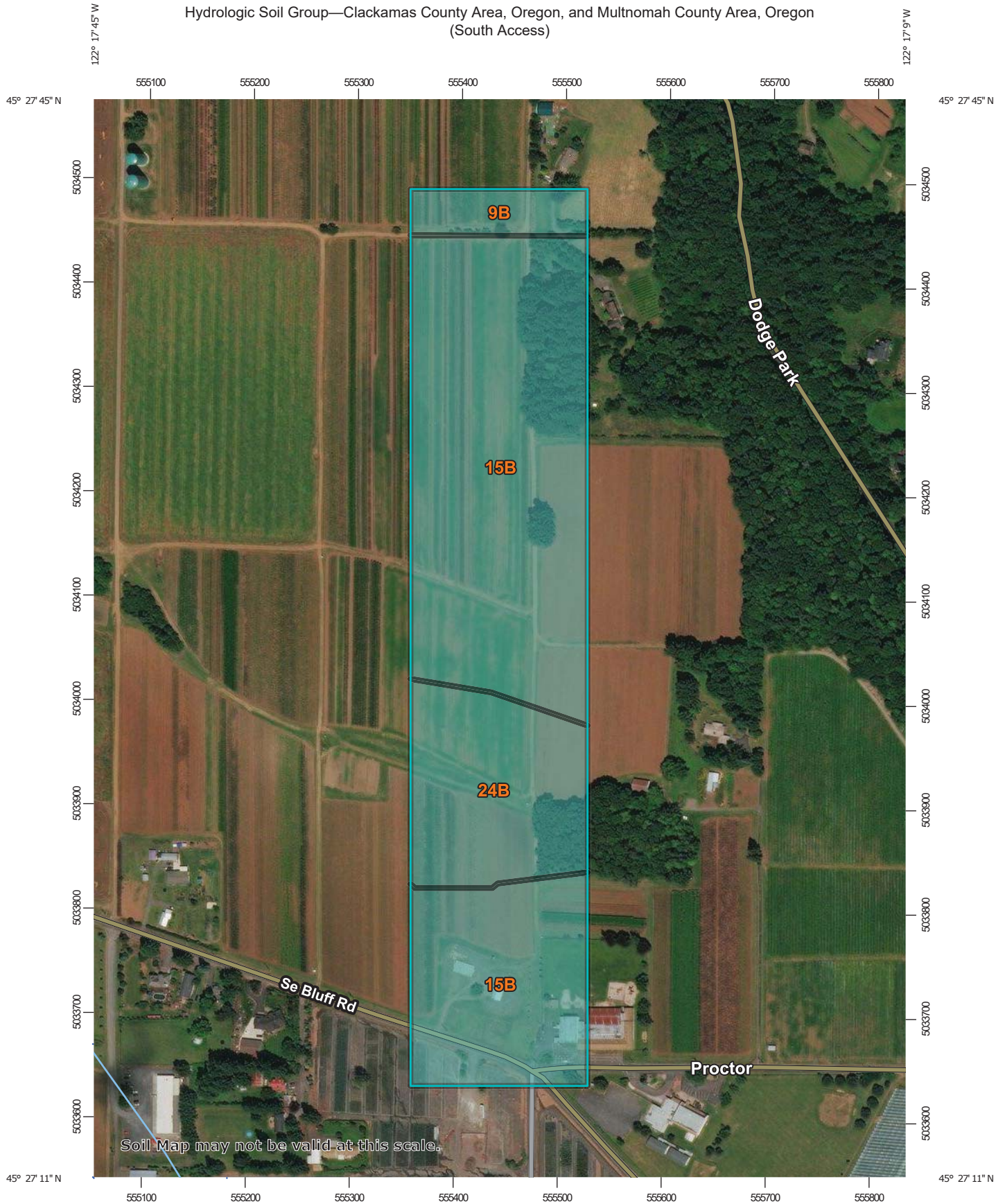
The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
15B	Cazadero silty clay loam, 0 to 7 percent slopes	26.9	74.2%
24B	Cottrell silty clay loam, 2 to 8 percent slopes	7.5	20.6%
Subtotals for Soil Survey Area		34.4	94.8%
Totals for Area of Interest		36.3	100.0%


Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
9B	Cazadero silty clay loam, 0 to 8 percent slopes	1.9	5.2%
Subtotals for Soil Survey Area		1.9	5.2%
Totals for Area of Interest		36.3	100.0%

Hydrologic Soil Group—Clackamas County Area, Oregon, and Multnomah County Area, Oregon
(South Access)



MAP LEGEND

Area of Interest (AOI)









 Area of Interest (AOI)

Soils

Soil Rating Polygons





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

Soil Rating Lines


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

Soil Rating Points






 A
 A/D
 B
 B/D

 C
 C/D
 D
 Not rated or not available

Water Features

 Streams and Canals

Transportation

 Rails
 Interstate Highways
 US Routes
 Major Roads
 Local Roads

Background

 Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

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: Clackamas County Area, Oregon
 Survey Area Data: Version 18, Oct 27, 2021

Soil Survey Area: Multnomah County Area, Oregon
 Survey Area Data: Version 20, Oct 27, 2021

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

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

Date(s) aerial images were photographed: Jul 2, 2015—Sep 21, 2016

MAP LEGEND

MAP INFORMATION

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
15B	Cazadero silty clay loam, 0 to 7 percent slopes	C	26.9	74.2%
24B	Cottrell silty clay loam, 2 to 8 percent slopes	C	7.5	20.6%
Subtotals for Soil Survey Area			34.4	94.8%
Totals for Area of Interest			36.3	100.0%

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
9B	Cazadero silty clay loam, 0 to 8 percent slopes	C	1.9	5.2%
Subtotals for Soil Survey Area			1.9	5.2%
Totals for Area of Interest			36.3	100.0%

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Table 2-2a Runoff curve numbers for urban areas ^{1/}

Cover description	Average percent impervious area ^{2/}	Curve numbers for hydrologic soil group			
		A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.) ^{3/}:					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only) ^{4/}		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas					
Newly graded areas					
(pervious areas only, no vegetation) ^{5/}		77	86	91	94
Idle lands (CN's are determined using cover types similar to those in table 2-2c).					

¹ Average runoff condition, and $I_a = 0.2S$.² The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 2-3 or 2-4.³ CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.⁴ Composite CN's for natural desert landscaping should be computed using figures 2-3 or 2-4 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.⁵ Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 2-3 or 2-4 based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

Table 2-2b Runoff curve numbers for cultivated agricultural lands ^{1/}

Cover description			Curve numbers for hydrologic soil group			
Cover type	Treatment ^{2/}	Hydrologic condition ^{3/}	A	B	C	D
Fallow	Bare soil	—	77	86	91	94
	Crop residue cover (CR)	Poor	76	85	90	93
		Good	74	83	88	90
Row crops	Straight row (SR)	Poor	72	81	88	91
		Good	67	78	85	89
	SR + CR	Poor	71	80	87	90
		Good	64	75	82	85
	Contoured (C)	Poor	70	79	84	88
		Good	65	75	82	86
	C + CR	Poor	69	78	83	87
		Good	64	74	81	85
	Contoured & terraced (C&T)	Poor	66	74	80	82
		Good	62	71	78	81
C&T+ CR	Poor	65	73	79	81	
	Good	61	70	77	80	
Small grain	SR	Poor	65	76	84	88
		Good	63	75	83	87
	SR + CR	Poor	64	75	83	86
		Good	60	72	80	84
	C	Poor	63	74	82	85
		Good	61	73	81	84
	C + CR	Poor	62	73	81	84
		Good	60	72	80	83
	C&T	Poor	61	72	79	82
		Good	59	70	78	81
C&T+ CR	Poor	60	71	78	81	
	Good	58	69	77	80	
Close-seeded or broadcast legumes or rotation meadow	SR	Poor	66	77	85	89
		Good	58	72	81	85
	C	Poor	64	75	83	85
		Good	55	69	78	83
	C&T	Poor	63	73	80	83
		Good	51	67	76	80

¹ Average runoff condition, and $I_a = 0.2S$

² Crop residue cover applies only if residue is on at least 5% of the surface throughout the year.

³ Hydraulic condition is based on combination factors that affect infiltration and runoff, including (a) density and canopy of vegetative areas, (b) amount of year-round cover, (c) amount of grass or close-seeded legumes, (d) percent of residue cover on the land surface (good $\geq 20\%$), and (e) degree of surface roughness.

Poor: Factors impair infiltration and tend to increase runoff.

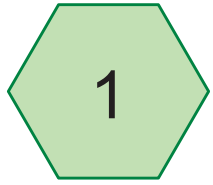
Good: Factors encourage average and better than average infiltration and tend to decrease runoff.

Table 2-2c Runoff curve numbers for other agricultural lands ^{1/}

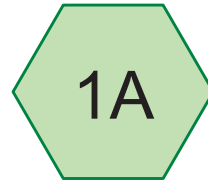
Cover type	Cover description	Hydrologic condition	Curve numbers for hydrologic soil group			
			A	B	C	D
Pasture, grassland, or range—continuous forage for grazing. ^{2/}		Poor	68	79	86	89
		Fair	49	69	79	84
		Good	39	61	74	80
Meadow—continuous grass, protected from grazing and generally mowed for hay.		—	30	58	71	78
Brush—brush-weed-grass mixture with brush the major element. ^{3/}		Poor	48	67	77	83
		Fair	35	56	70	77
		Good	30 ^{4/}	48	65	73
Woods—grass combination (orchard or tree farm). ^{5/}		Poor	57	73	82	86
		Fair	43	65	76	82
		Good	32	58	72	79
Woods. ^{6/}		Poor	45	66	77	83
		Fair	36	60	73	79
		Good	30 ^{4/}	55	70	77
Farmsteads—buildings, lanes, driveways, and surrounding lots.		—	59	74	82	86

¹ Average runoff condition, and $I_a = 0.2S$.² **Poor:** <50% ground cover or heavily grazed with no mulch.**Fair:** 50 to 75% ground cover and not heavily grazed.**Good:** >75% ground cover and lightly or only occasionally grazed.³ **Poor:** <50% ground cover.**Fair:** 50 to 75% ground cover.**Good:** >75% ground cover.⁴ Actual curve number is less than 30; use CN = 30 for runoff computations.⁵ CN's shown were computed for areas with 50% woods and 50% grass (pasture) cover. Other combinations of conditions may be computed from the CN's for woods and pasture.⁶ **Poor:** Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning.**Fair:** Woods are grazed but not burned, and some forest litter covers the soil.**Good:** Woods are protected from grazing, and litter and brush adequately cover the soil.

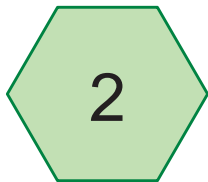
Attachment C: Hydrologic Analysis of Pre- and Post-Developed Conditions Cross-Property Flows



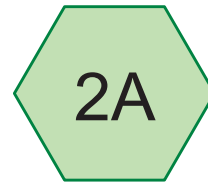
Existing Subbasin 1



Subbasin 1A



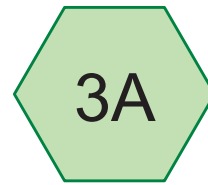
Existing Subbasin 2



Subbasin 2A



Existing Subbasin 3



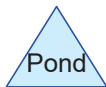
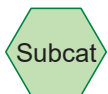
Subbasin 3A



Existing Subbasin 4



Subbasin 4A



Bull Run Filtration Post Cross Property

Type IA 24-hr 2-Year Rainfall=2.80"

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Page 2

Summary for Subcatchment 1: Existing Subbasin 1

Runoff = 0.42 cfs @ 8.06 hrs, Volume= 10,218 cf, Depth= 1.22"

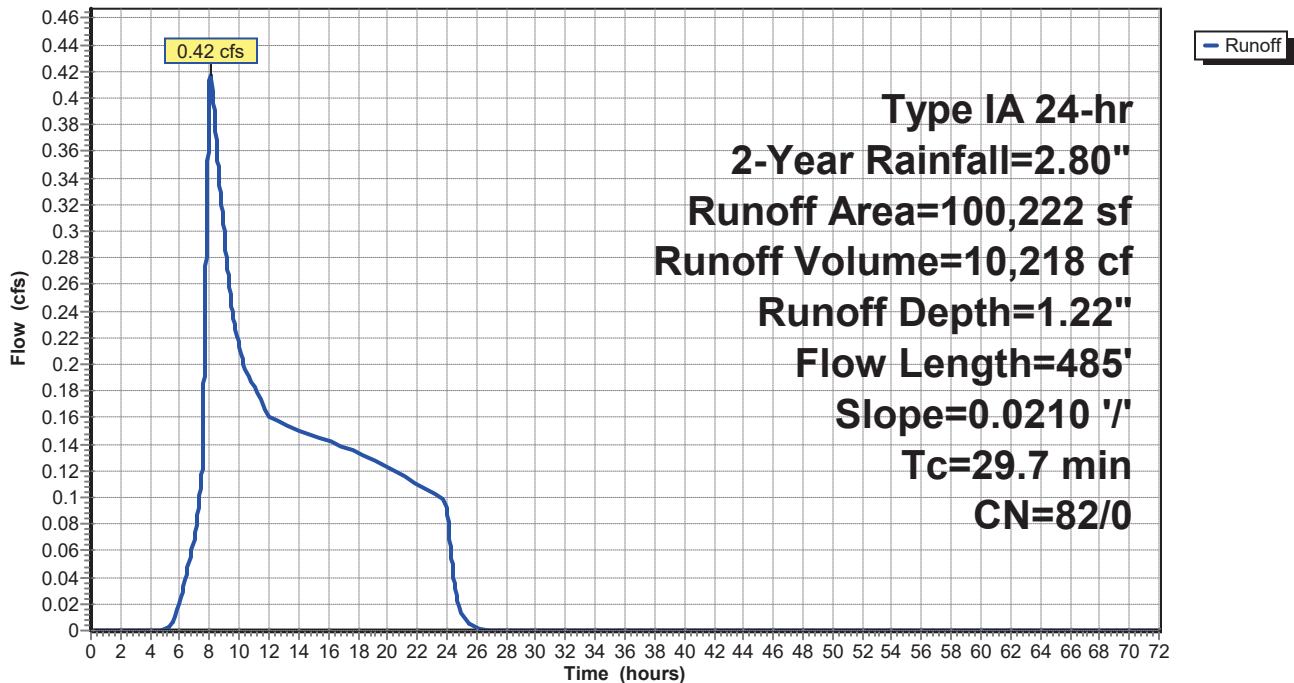
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-Year Rainfall=2.80"

Area (sf)	CN	Description
100,222	82	Row crops, SR + CR, Good, HSG C
100,222	82	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
27.3	300	0.0210	0.18		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 2.80"
2.4	185	0.0210	1.30		Shallow Concentrated Flow, Cultivated Straight Rows Kv= 9.0 fps
29.7	485	Total			

Subcatchment 1: Existing Subbasin 1

Hydrograph



Bull Run Filtration Post Cross Property

Type IA 24-hr 2-Year Rainfall=2.80"

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Summary for Subcatchment 1A: Subbasin 1A

Runoff = 0.39 cfs @ 8.07 hrs, Volume= 9,892 cf, Depth= 1.18"

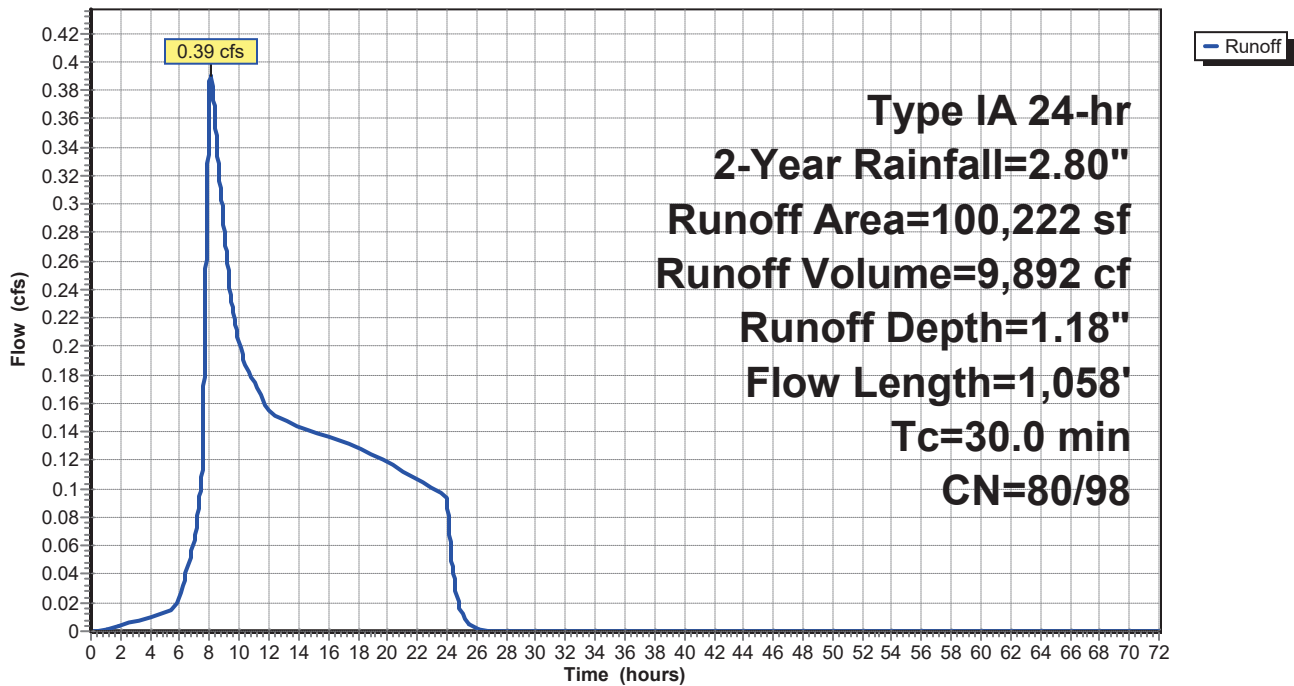
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-Year Rainfall=2.80"

Area (sf)	CN	Description
94,598	80	>75% Grass cover, Good, HSG D
* 5,624	98	Impervious
100,222	81	Weighted Average
94,598	80	94.39% Pervious Area
5,624	98	5.61% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
24.3	300	0.0220	0.21		Sheet Flow, Grass: Short n= 0.150 P2= 2.80"
2.9	182	0.0220	1.04		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
2.8	576	0.0222	3.38	20.28	Channel Flow, Area= 6.0 sf Perim= 9.0' r= 0.67' n= 0.050 Scattered brush, heavy weeds
30.0	1,058	Total			

Subcatchment 1A: Subbasin 1A

Hydrograph



Bull Run Filtration Post Cross Property

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Summary for Subcatchment 2: Existing Subbasin 2

Runoff = 0.30 cfs @ 8.00 hrs, Volume= 5,835 cf, Depth= 1.22"

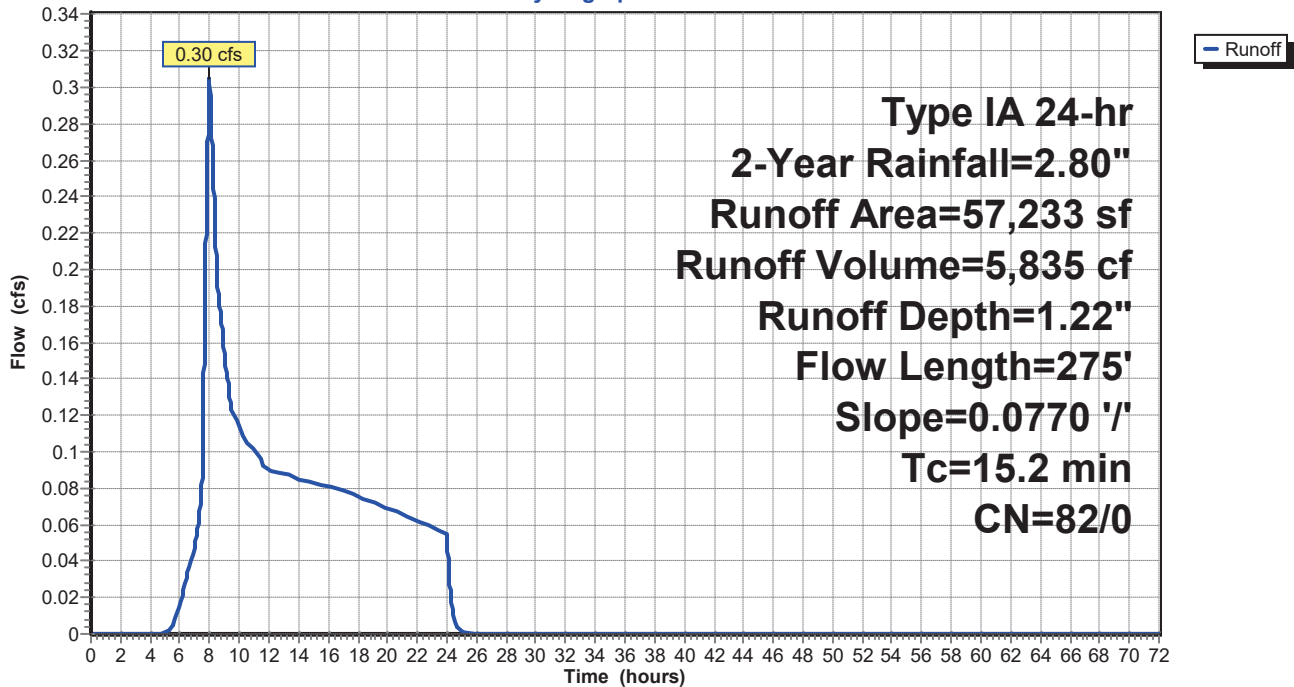
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-Year Rainfall=2.80"

Area (sf)	CN	Description
57,233	82	Row crops, SR + CR, Good, HSG C
57,233	82	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.2	275	0.0770	0.30		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 2.80"

Subcatchment 2: Existing Subbasin 2

Hydrograph



Bull Run Filtration Post Cross Property

Type IA 24-hr 2-Year Rainfall=2.80"

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Summary for Subcatchment 2A: Subbasin 2A

Runoff = 0.24 cfs @ 8.01 hrs, Volume= 5,374 cf, Depth= 1.13"

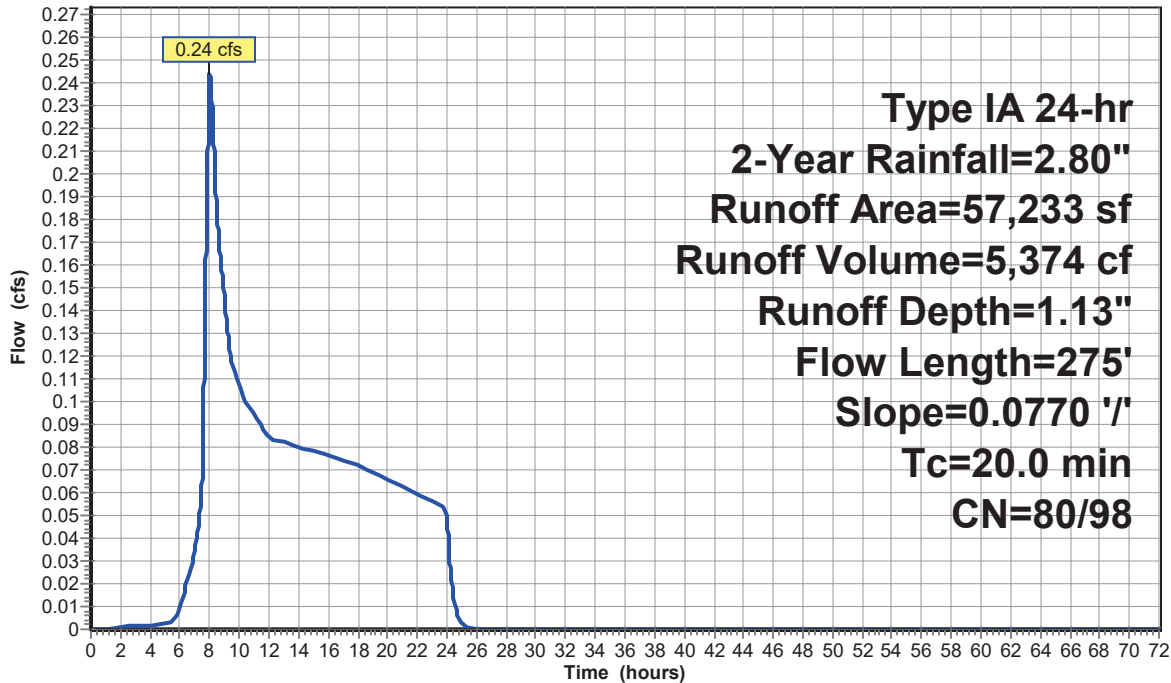
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-Year Rainfall=2.80"

Area (sf)	CN	Description
56,269	80	>75% Grass cover, Good, HSG D
* 964	98	Impervious
57,233	80	Weighted Average
56,269	80	98.32% Pervious Area
964	98	1.68% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0	275	0.0770	0.23		Sheet Flow, Grass: Dense n= 0.240 P2= 2.80"

Subcatchment 2A: Subbasin 2A

Hydrograph



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Summary for Subcatchment 3: Existing Subbasin 3

Runoff = 0.20 cfs @ 8.00 hrs, Volume= 3,450 cf, Depth= 1.22"

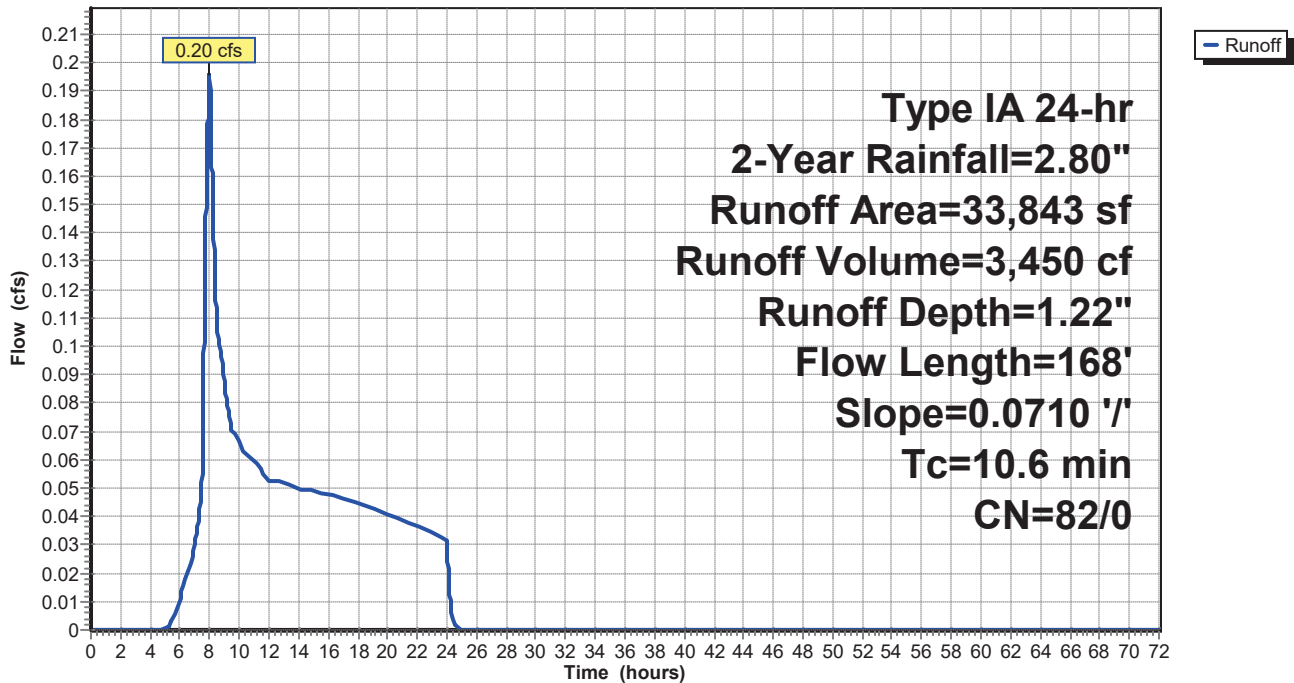
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-Year Rainfall=2.80"

Area (sf)	CN	Description
33,843	82	Row crops, SR + CR, Good, HSG C
33,843	82	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.6	168	0.0710	0.27		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 2.80"

Subcatchment 3: Existing Subbasin 3

Hydrograph



Bull Run Filtration Post Cross Property

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Summary for Subcatchment 3A: Subbasin 3A

Runoff = 0.18 cfs @ 8.01 hrs, Volume= 3,625 cf, Depth= 1.29"

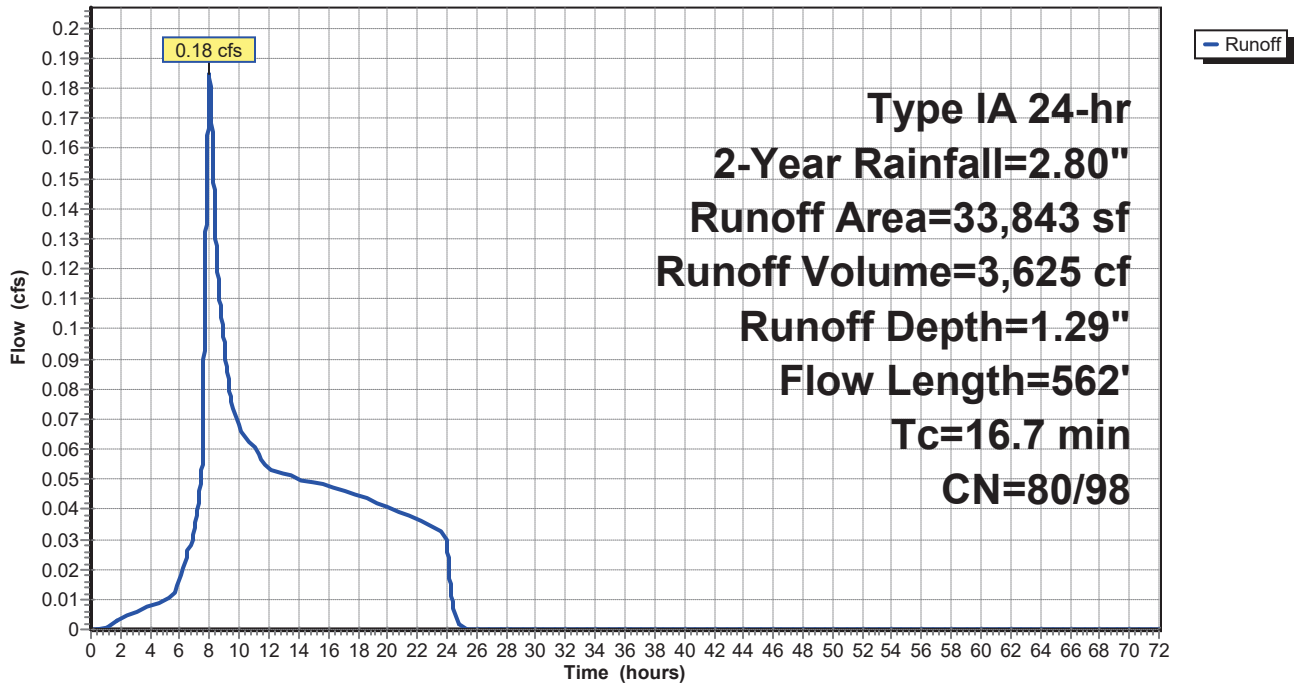
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-Year Rainfall=2.80"

Area (sf)	CN	Description
29,613	80	>75% Grass cover, Good, HSG D
* 4,230	98	Impervious Area
33,843	82	Weighted Average
29,613	80	87.50% Pervious Area
4,230	98	12.50% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.2	151	0.0790	0.21		Sheet Flow, Grass: Dense n= 0.240 P2= 2.80"
4.5	411	0.0046	1.54	9.23	Channel Flow, Area= 6.0 sf Perim= 9.0' r= 0.67' n= 0.050 Scattered brush, heavy weeds
16.7	562	Total			

Subcatchment 3A: Subbasin 3A

Hydrograph



Bull Run Filtration Post Cross Property

Type IA 24-hr 2-Year Rainfall=2.80"

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Summary for Subcatchment 4: Existing Subbasin 4

Runoff = 1.67 cfs @ 8.14 hrs, Volume= 44,924 cf, Depth= 1.22"

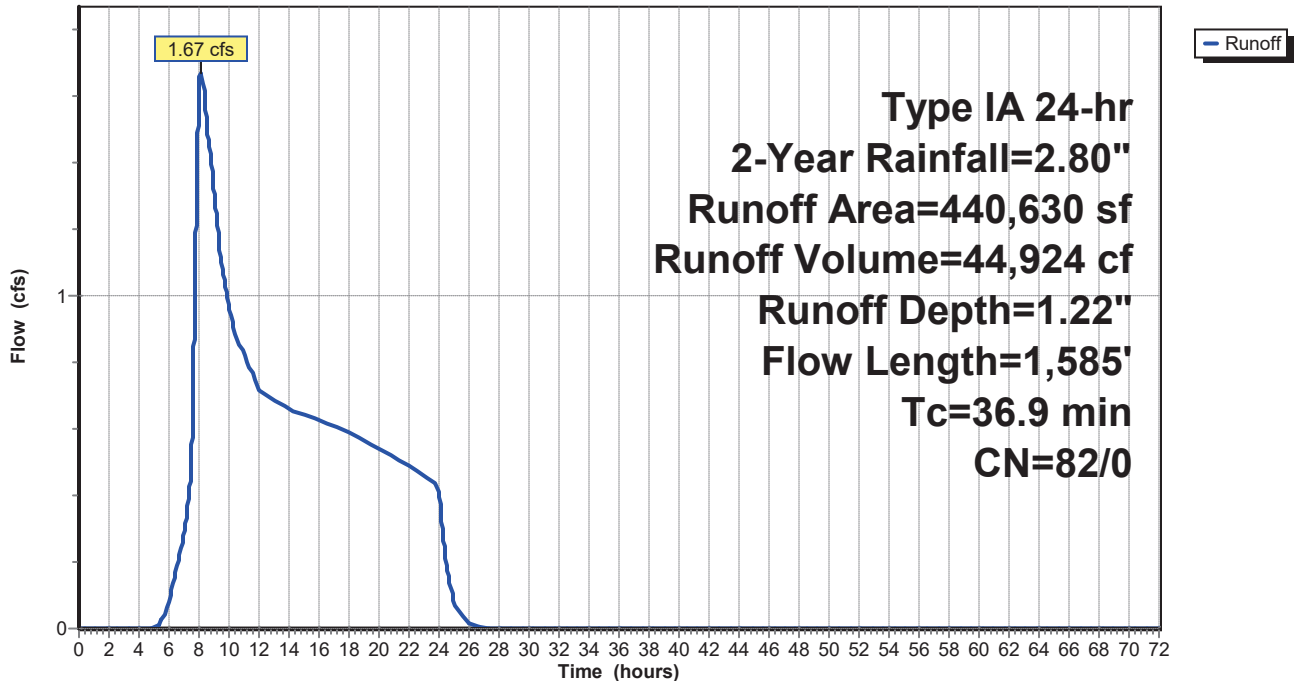
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-Year Rainfall=2.80"

Area (sf)	CN	Description
440,630	82	Row crops, SR + CR, Good, HSG C
440,630	82	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
27.9	300	0.0200	0.18		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 2.80"
9.0	1,285	0.0700	2.38		Shallow Concentrated Flow, Cultivated Straight Rows Kv= 9.0 fps
36.9	1,585	Total			

Subcatchment 4: Existing Subbasin 4

Hydrograph



Bull Run Filtration Post Cross Property

Type IA 24-hr 2-Year Rainfall=2.80"

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Summary for Subcatchment 4A: Subbasin 4A

Runoff = 1.37 cfs @ 8.24 hrs, Volume= 42,907 cf, Depth= 1.17"

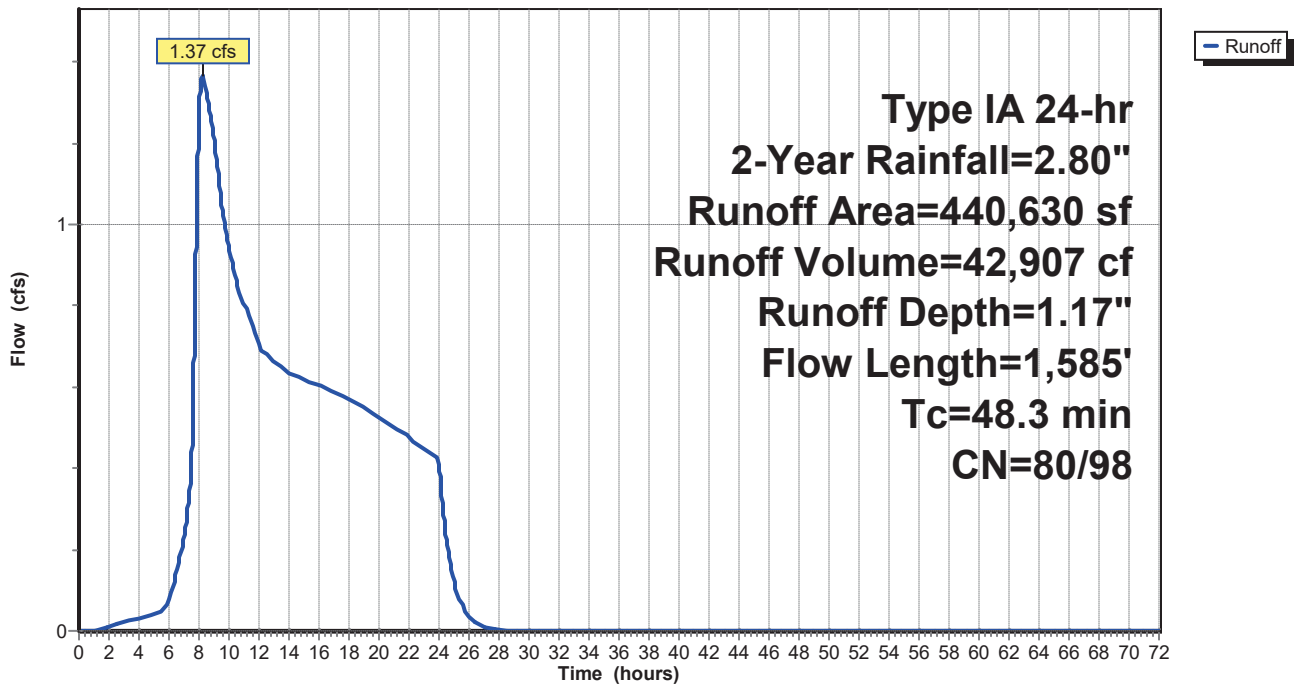
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-Year Rainfall=2.80"

Area (sf)	CN	Description
420,676	80	>75% Grass cover, Good, HSG D
* 19,954	98	Impervious
440,630	81	Weighted Average
420,676	80	95.47% Pervious Area
19,954	98	4.53% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
36.7	300	0.0200	0.14		Sheet Flow, Grass: Dense n= 0.240 P2= 2.80"
11.6	1,285	0.0700	1.85		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
48.3	1,585	Total			

Subcatchment 4A: Subbasin 4A

Hydrograph



Bull Run Filtration Post Cross Property

Type IA 24-hr 5-Year Rainfall=3.40"

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Summary for Subcatchment 1: Existing Subbasin 1

Runoff = 0.63 cfs @ 8.03 hrs, Volume= 14,201 cf, Depth= 1.70"

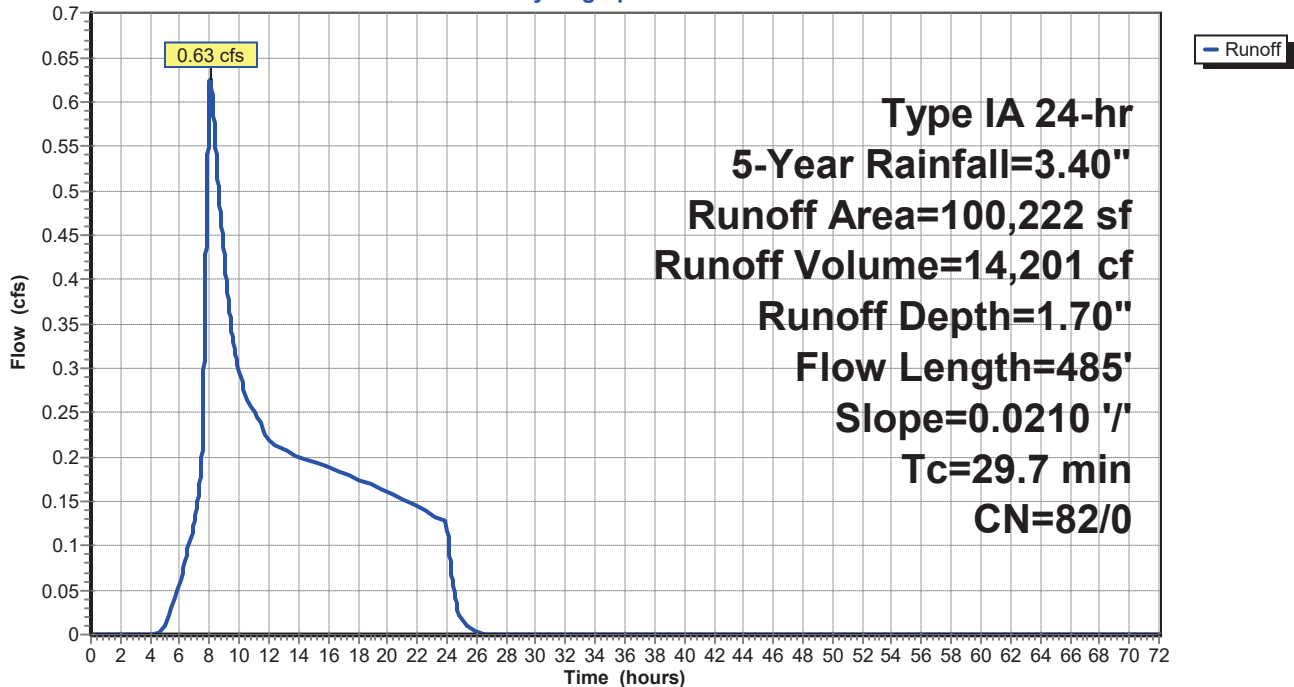
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 5-Year Rainfall=3.40"

Area (sf)	CN	Description
100,222	82	Row crops, SR + CR, Good, HSG C
100,222	82	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
27.3	300	0.0210	0.18		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 2.80"
2.4	185	0.0210	1.30		Shallow Concentrated Flow, Cultivated Straight Rows Kv= 9.0 fps
29.7	485	Total			

Subcatchment 1: Existing Subbasin 1

Hydrograph



Bull Run Filtration Post Cross Property

Type IA 24-hr 5-Year Rainfall=3.40"

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Summary for Subcatchment 1A: Subbasin 1A

Runoff = 0.59 cfs @ 8.04 hrs, Volume= 13,761 cf, Depth= 1.65"

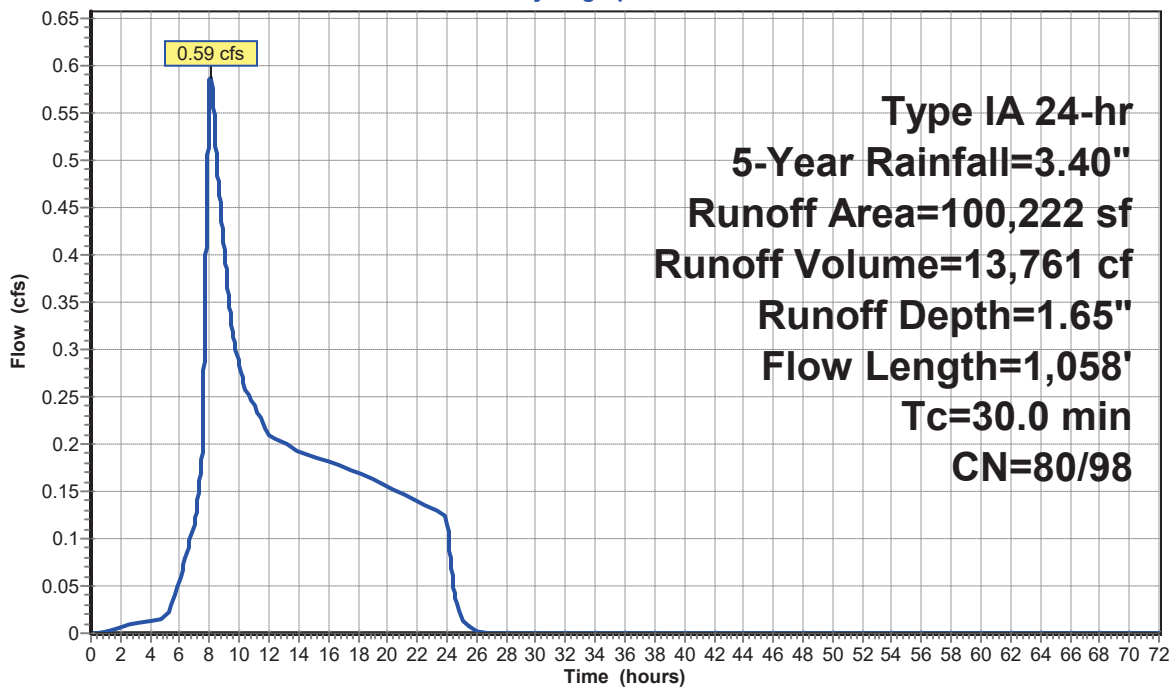
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 5-Year Rainfall=3.40"

Area (sf)	CN	Description
94,598	80	>75% Grass cover, Good, HSG D
* 5,624	98	Impervious
100,222	81	Weighted Average
94,598	80	94.39% Pervious Area
5,624	98	5.61% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
24.3	300	0.0220	0.21		Sheet Flow, Grass: Short n= 0.150 P2= 2.80"
2.9	182	0.0220	1.04		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
2.8	576	0.0222	3.38	20.28	Channel Flow, Area= 6.0 sf Perim= 9.0' r= 0.67' n= 0.050 Scattered brush, heavy weeds
30.0	1,058	Total			

Subcatchment 1A: Subbasin 1A

Hydrograph



Bull Run Filtration Post Cross Property

Type IA 24-hr 5-Year Rainfall=3.40"

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Summary for Subcatchment 2: Existing Subbasin 2

Runoff = 0.45 cfs @ 8.00 hrs, Volume= 8,110 cf, Depth= 1.70"

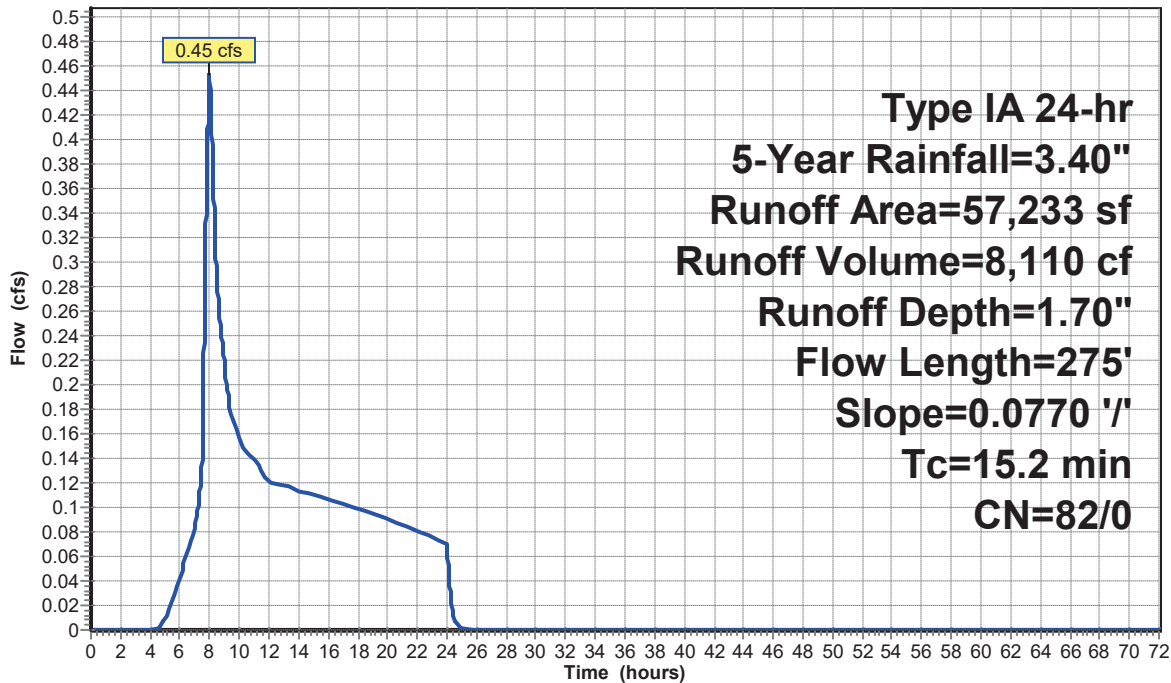
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 5-Year Rainfall=3.40"

Area (sf)	CN	Description
57,233	82	Row crops, SR + CR, Good, HSG C
57,233	82	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.2	275	0.0770	0.30		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 2.80"

Subcatchment 2: Existing Subbasin 2

Hydrograph



Bull Run Filtration Post Cross Property

Type IA 24-hr 5-Year Rainfall=3.40"

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Summary for Subcatchment 2A: Subbasin 2A

Runoff = 0.37 cfs @ 8.01 hrs, Volume= 7,557 cf, Depth= 1.58"

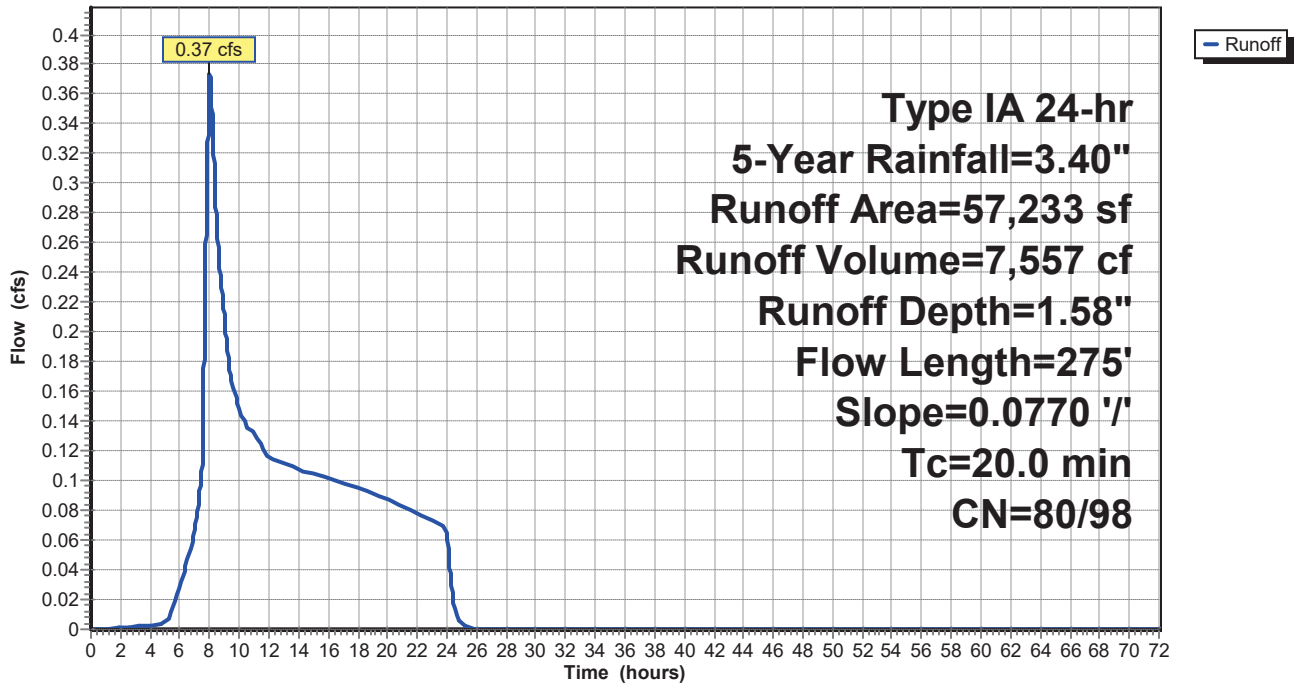
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 5-Year Rainfall=3.40"

Area (sf)	CN	Description
56,269	80	>75% Grass cover, Good, HSG D
* 964	98	Impervious
57,233	80	Weighted Average
56,269	80	98.32% Pervious Area
964	98	1.68% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0	275	0.0770	0.23		Sheet Flow, Grass: Dense n= 0.240 P2= 2.80"

Subcatchment 2A: Subbasin 2A

Hydrograph



Bull Run Filtration Post Cross Property

Type IA 24-hr 5-Year Rainfall=3.40"

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Summary for Subcatchment 3: Existing Subbasin 3

Runoff = 0.29 cfs @ 8.00 hrs, Volume= 4,796 cf, Depth= 1.70"

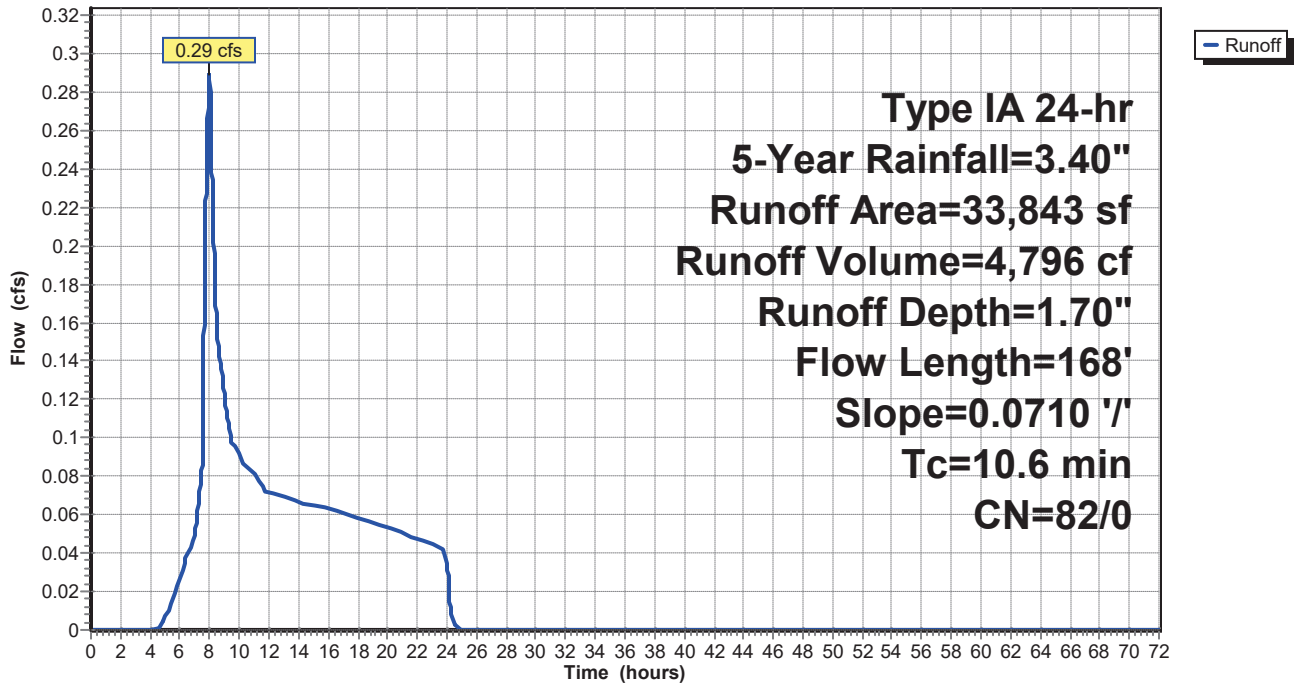
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 5-Year Rainfall=3.40"

Area (sf)	CN	Description
33,843	82	Row crops, SR + CR, Good, HSG C
33,843	82	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.6	168	0.0710	0.27		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 2.80"

Subcatchment 3: Existing Subbasin 3

Hydrograph



Bull Run Filtration Post Cross Property

Type IA 24-hr 5-Year Rainfall=3.40"

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Summary for Subcatchment 3A: Subbasin 3A

Runoff = 0.27 cfs @ 8.00 hrs, Volume= 4,960 cf, Depth= 1.76"

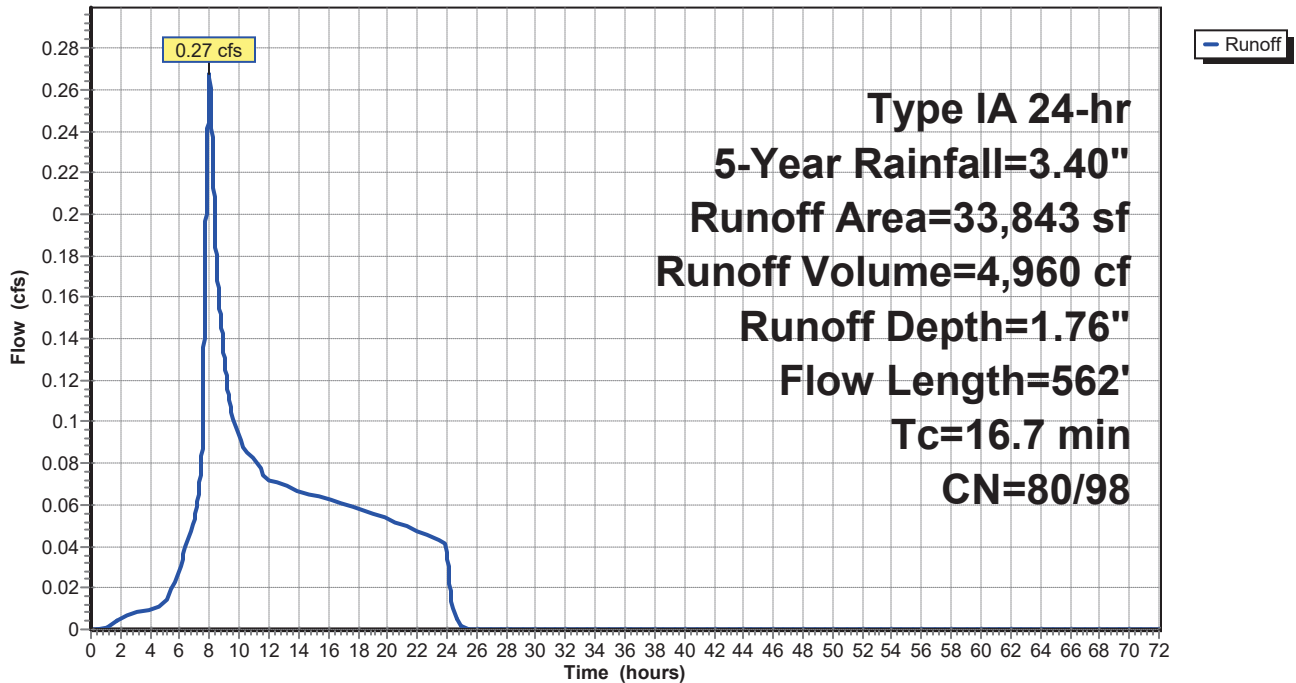
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 5-Year Rainfall=3.40"

Area (sf)	CN	Description
29,613	80	>75% Grass cover, Good, HSG D
* 4,230	98	Impervious Area
33,843	82	Weighted Average
29,613	80	87.50% Pervious Area
4,230	98	12.50% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.2	151	0.0790	0.21		Sheet Flow, Grass: Dense n= 0.240 P2= 2.80"
4.5	411	0.0046	1.54	9.23	Channel Flow, Area= 6.0 sf Perim= 9.0' r= 0.67' n= 0.050 Scattered brush, heavy weeds
16.7	562	Total			

Subcatchment 3A: Subbasin 3A

Hydrograph



Bull Run Filtration Post Cross Property

Type IA 24-hr 5-Year Rainfall=3.40"

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Summary for Subcatchment 4: Existing Subbasin 4

Runoff = 2.51 cfs @ 8.10 hrs, Volume= 62,437 cf, Depth= 1.70"

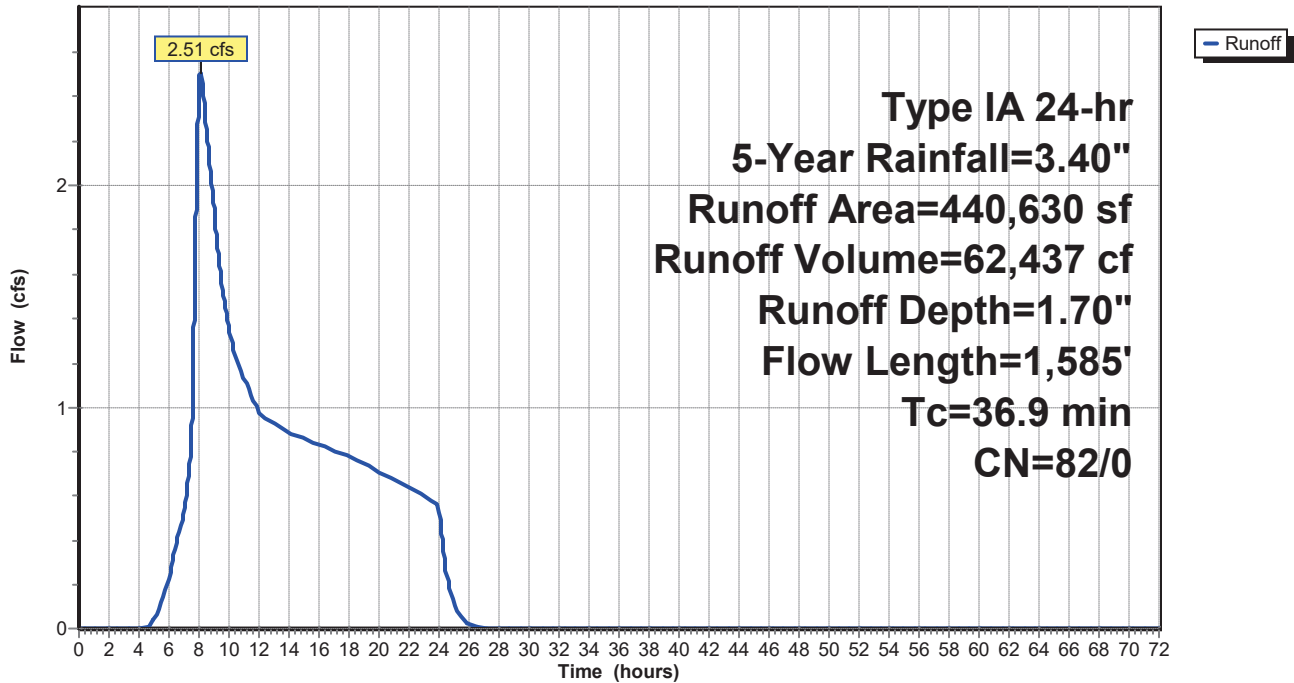
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 5-Year Rainfall=3.40"

Area (sf)	CN	Description
440,630	82	Row crops, SR + CR, Good, HSG C
440,630	82	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
27.9	300	0.0200	0.18		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 2.80"
9.0	1,285	0.0700	2.38		Shallow Concentrated Flow, Cultivated Straight Rows Kv= 9.0 fps
36.9	1,585	Total			

Subcatchment 4: Existing Subbasin 4

Hydrograph



Bull Run Filtration Post Cross Property

Type IA 24-hr 5-Year Rainfall=3.40"

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Summary for Subcatchment 4A: Subbasin 4A

Runoff = 2.07 cfs @ 8.20 hrs, Volume= 59,863 cf, Depth= 1.63"

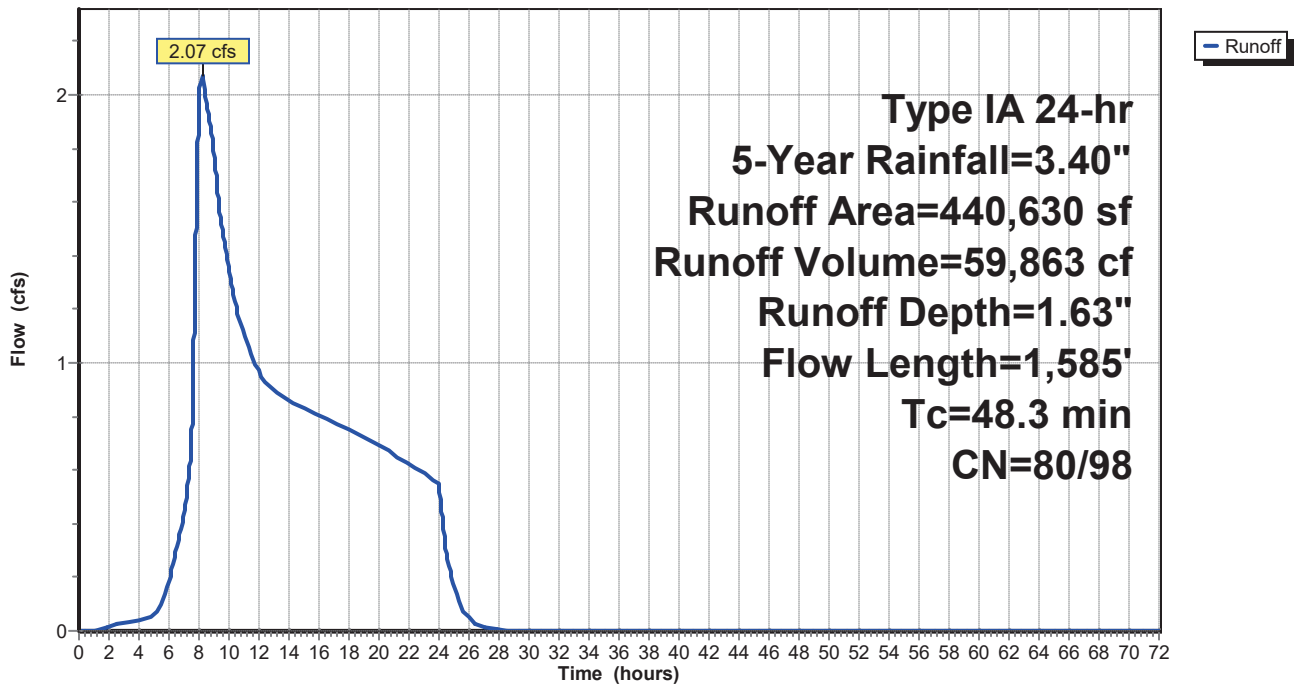
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 5-Year Rainfall=3.40"

Area (sf)	CN	Description
420,676	80	>75% Grass cover, Good, HSG D
* 19,954	98	Impervious
440,630	81	Weighted Average
420,676	80	95.47% Pervious Area
19,954	98	4.53% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
36.7	300	0.0200	0.14		Sheet Flow, Grass: Dense n= 0.240 P2= 2.80"
11.6	1,285	0.0700	1.85		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
48.3	1,585	Total			

Subcatchment 4A: Subbasin 4A

Hydrograph



Bull Run Filtration Post Cross Property

Type IA 24-hr 10-Year Rainfall=3.80"

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Summary for Subcatchment 1: Existing Subbasin 1

Runoff = 0.77 cfs @ 8.02 hrs, Volume= 16,980 cf, Depth= 2.03"

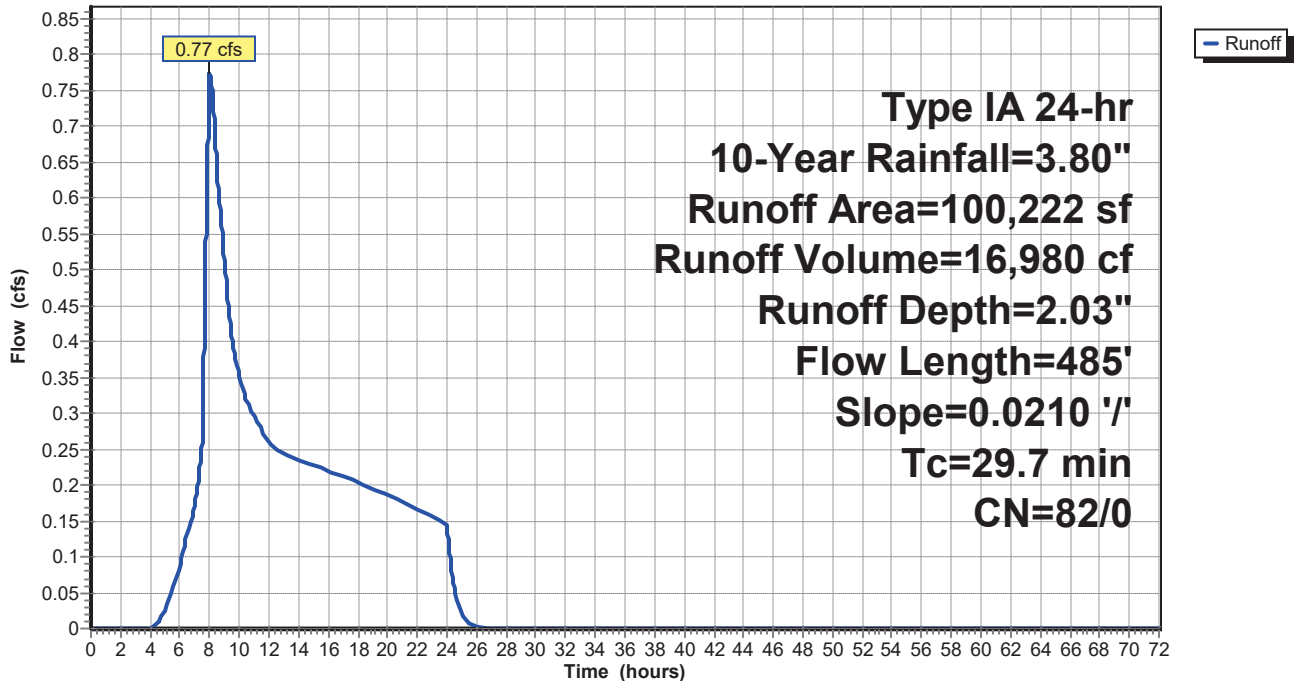
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Year Rainfall=3.80"

Area (sf)	CN	Description
100,222	82	Row crops, SR + CR, Good, HSG C
100,222	82	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
27.3	300	0.0210	0.18		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 2.80"
2.4	185	0.0210	1.30		Shallow Concentrated Flow, Cultivated Straight Rows Kv= 9.0 fps
29.7	485	Total			

Subcatchment 1: Existing Subbasin 1

Hydrograph



Bull Run Filtration Post Cross Property

Type IA 24-hr 10-Year Rainfall=3.80"

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Summary for Subcatchment 1A: Subbasin 1A

Runoff = 0.73 cfs @ 8.03 hrs, Volume= 16,472 cf, Depth= 1.97"

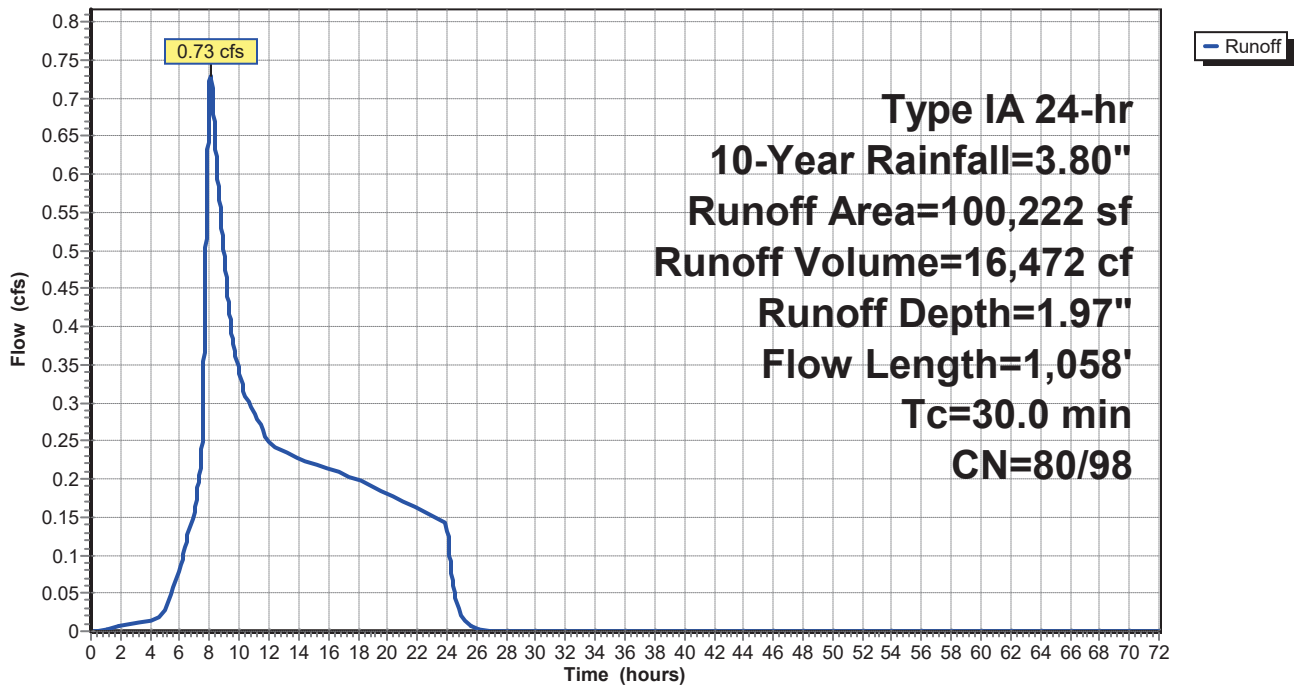
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Year Rainfall=3.80"

Area (sf)	CN	Description
94,598	80	>75% Grass cover, Good, HSG D
* 5,624	98	Impervious
100,222	81	Weighted Average
94,598	80	94.39% Pervious Area
5,624	98	5.61% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
24.3	300	0.0220	0.21		Sheet Flow, Grass: Short n= 0.150 P2= 2.80"
2.9	182	0.0220	1.04		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
2.8	576	0.0222	3.38	20.28	Channel Flow, Area= 6.0 sf Perim= 9.0' r= 0.67' n= 0.050 Scattered brush, heavy weeds
30.0	1,058	Total			

Subcatchment 1A: Subbasin 1A

Hydrograph



Bull Run Filtration Post Cross Property

Type IA 24-hr 10-Year Rainfall=3.80"

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Summary for Subcatchment 2: Existing Subbasin 2

Runoff = 0.56 cfs @ 8.00 hrs, Volume= 9,697 cf, Depth= 2.03"

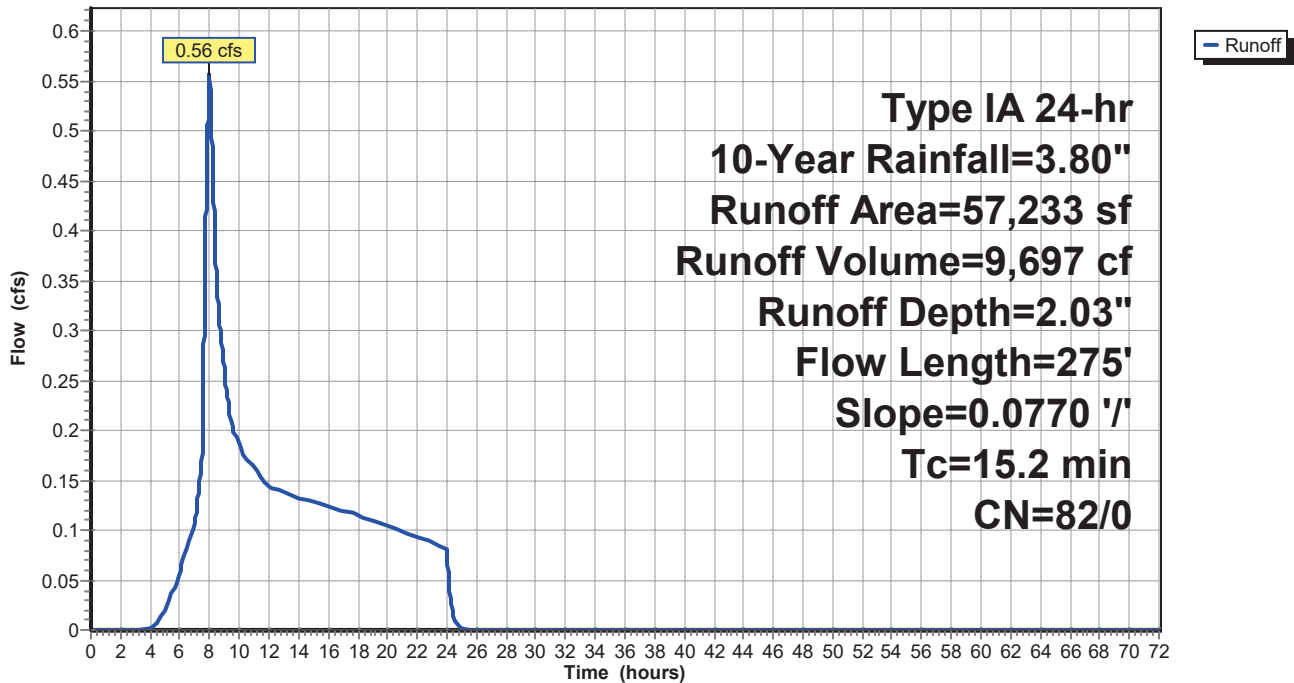
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Year Rainfall=3.80"

Area (sf)	CN	Description
57,233	82	Row crops, SR + CR, Good, HSG C
57,233	82	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.2	275	0.0770	0.30		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 2.80"

Subcatchment 2: Existing Subbasin 2

Hydrograph



Bull Run Filtration Post Cross Property

Type IA 24-hr 10-Year Rainfall=3.80"

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Summary for Subcatchment 2A: Subbasin 2A

Runoff = 0.47 cfs @ 8.01 hrs, Volume= 9,091 cf, Depth= 1.91"

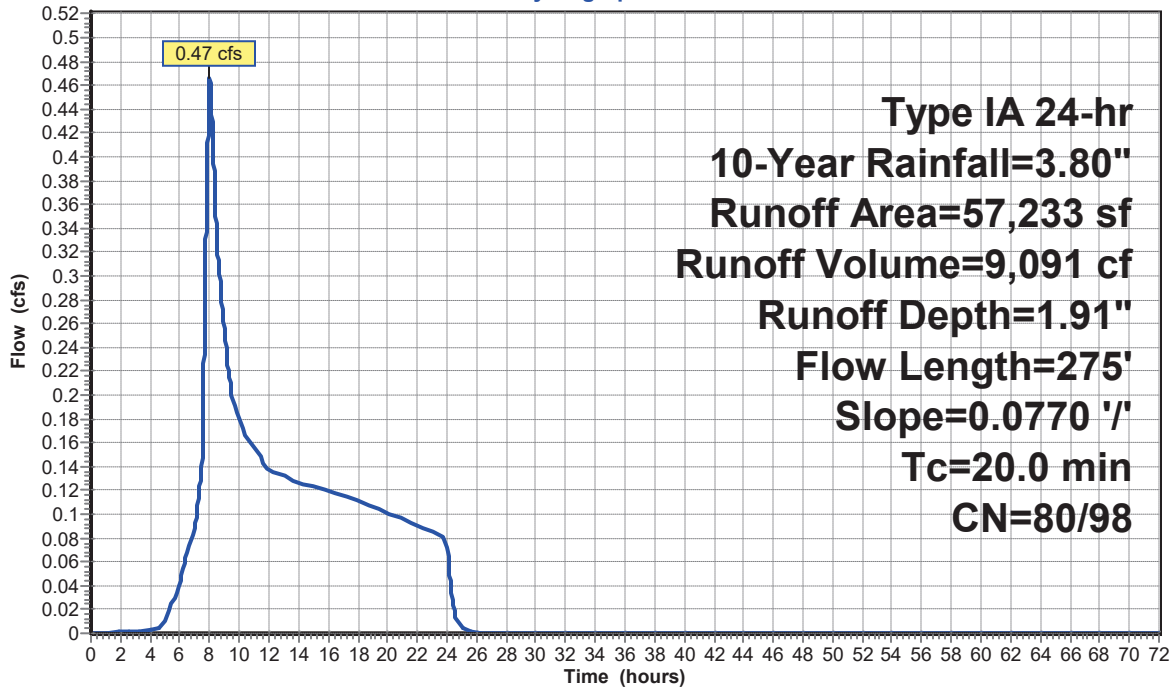
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Year Rainfall=3.80"

Area (sf)	CN	Description
56,269	80	>75% Grass cover, Good, HSG D
* 964	98	Impervious
57,233	80	Weighted Average
56,269	80	98.32% Pervious Area
964	98	1.68% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0	275	0.0770	0.23		Sheet Flow, Grass: Dense n= 0.240 P2= 2.80"

Subcatchment 2A: Subbasin 2A

Hydrograph



Bull Run Filtration Post Cross Property

Type IA 24-hr 10-Year Rainfall=3.80"

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Summary for Subcatchment 3: Existing Subbasin 3

Runoff = 0.35 cfs @ 8.00 hrs, Volume= 5,734 cf, Depth= 2.03"

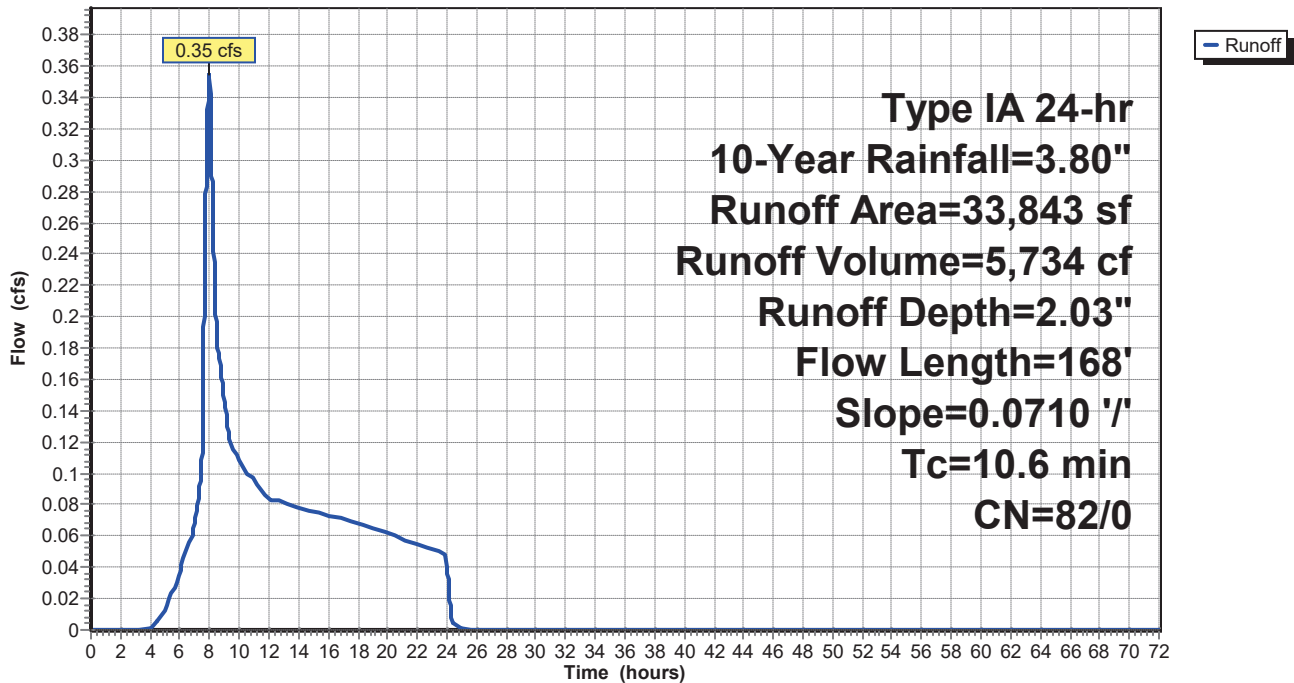
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Year Rainfall=3.80"

Area (sf)	CN	Description
33,843	82	Row crops, SR + CR, Good, HSG C
33,843	82	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.6	168	0.0710	0.27		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 2.80"

Subcatchment 3: Existing Subbasin 3

Hydrograph



Bull Run Filtration Post Cross Property

Type IA 24-hr 10-Year Rainfall=3.80"

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Summary for Subcatchment 3A: Subbasin 3A

Runoff = 0.33 cfs @ 8.00 hrs, Volume= 5,890 cf, Depth= 2.09"

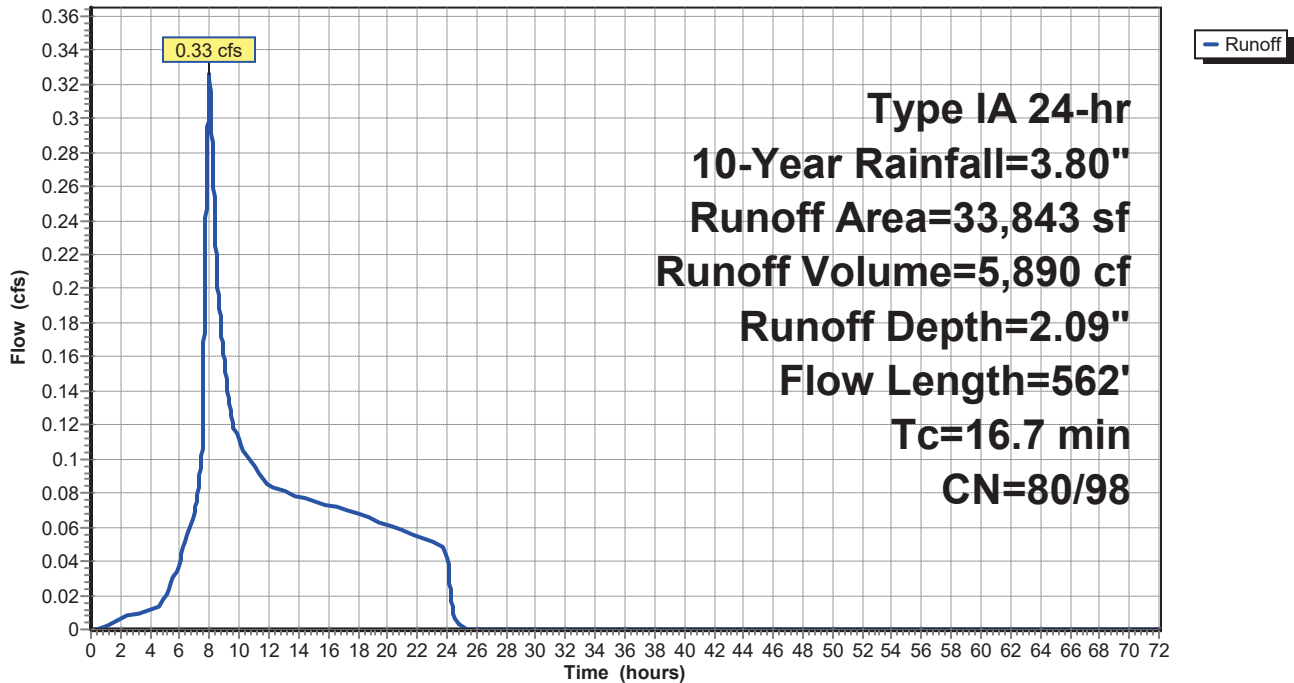
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Year Rainfall=3.80"

Area (sf)	CN	Description
29,613	80	>75% Grass cover, Good, HSG D
* 4,230	98	Impervious Area
33,843	82	Weighted Average
29,613	80	87.50% Pervious Area
4,230	98	12.50% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.2	151	0.0790	0.21		Sheet Flow, Grass: Dense n= 0.240 P2= 2.80"
4.5	411	0.0046	1.54	9.23	Channel Flow, Area= 6.0 sf Perim= 9.0' r= 0.67' n= 0.050 Scattered brush, heavy weeds
16.7	562	Total			

Subcatchment 3A: Subbasin 3A

Hydrograph



Bull Run Filtration Post Cross Property

Type IA 24-hr 10-Year Rainfall=3.80"

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Summary for Subcatchment 4: Existing Subbasin 4

Runoff = 3.10 cfs @ 8.09 hrs, Volume= 74,654 cf, Depth= 2.03"

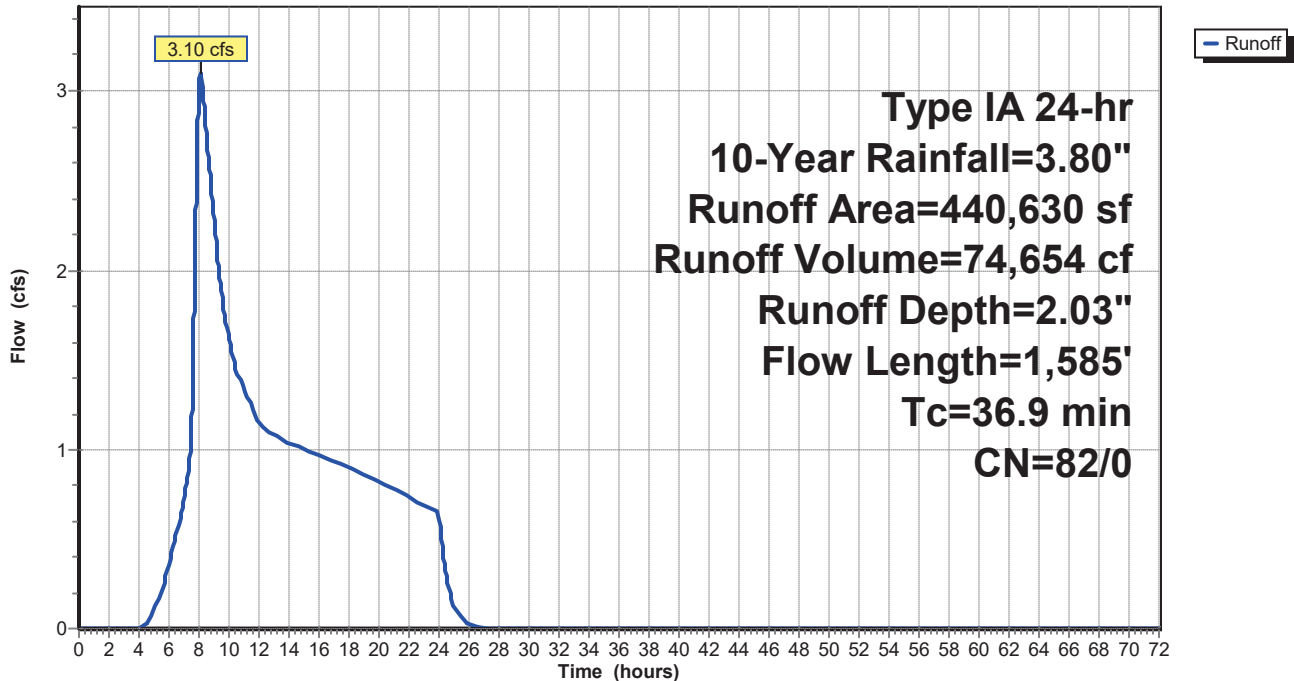
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Year Rainfall=3.80"

Area (sf)	CN	Description
440,630	82	Row crops, SR + CR, Good, HSG C
440,630	82	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
27.9	300	0.0200	0.18		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 2.80"
9.0	1,285	0.0700	2.38		Shallow Concentrated Flow, Cultivated Straight Rows Kv= 9.0 fps
36.9	1,585	Total			

Subcatchment 4: Existing Subbasin 4

Hydrograph



Bull Run Filtration Post Cross Property

Type IA 24-hr 10-Year Rainfall=3.80"

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Summary for Subcatchment 4A: Subbasin 4A

Runoff = 2.58 cfs @ 8.19 hrs, Volume= 71,750 cf, Depth= 1.95"

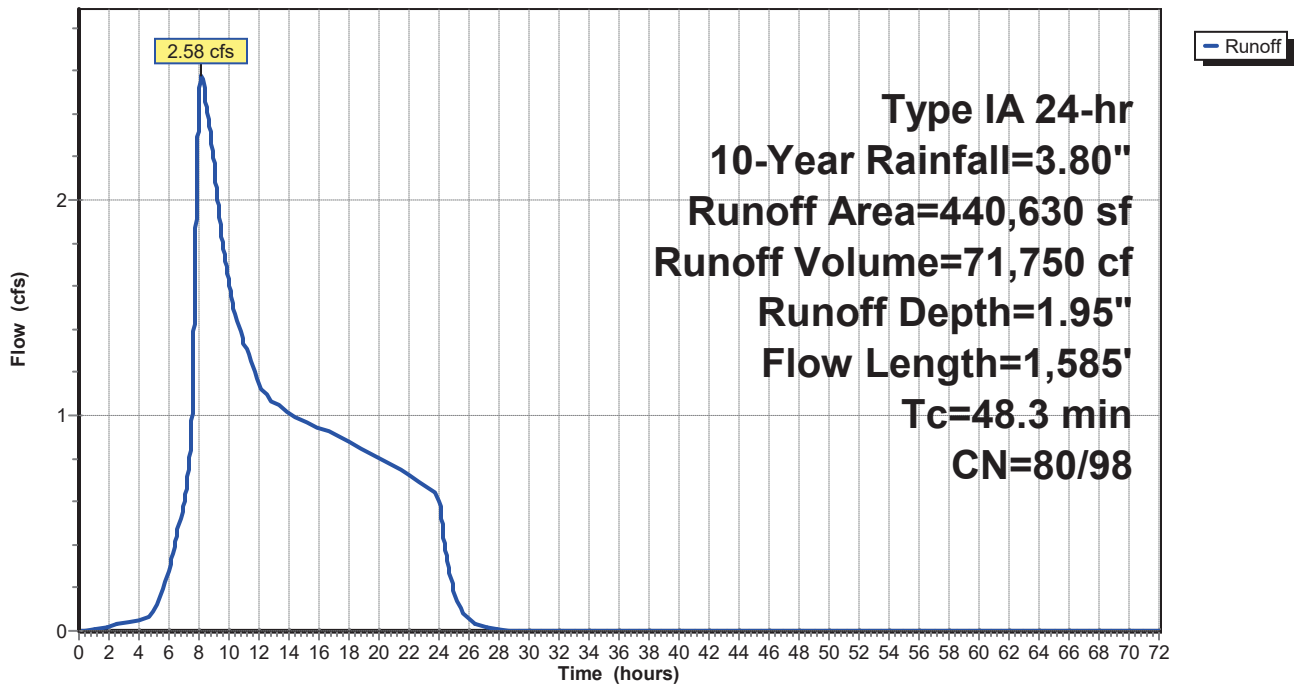
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Year Rainfall=3.80"

Area (sf)	CN	Description
420,676	80	>75% Grass cover, Good, HSG D
* 19,954	98	Impervious
440,630	81	Weighted Average
420,676	80	95.47% Pervious Area
19,954	98	4.53% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
36.7	300	0.0200	0.14		Sheet Flow, Grass: Dense n= 0.240 P2= 2.80"
11.6	1,285	0.0700	1.85		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
48.3	1,585	Total			

Subcatchment 4A: Subbasin 4A

Hydrograph



Bull Run Filtration Post Cross Property

Type IA 24-hr 25-Year Rainfall=4.50"

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Summary for Subcatchment 1: Existing Subbasin 1

Runoff = 1.05 cfs @ 8.01 hrs, Volume= 22,016 cf, Depth= 2.64"

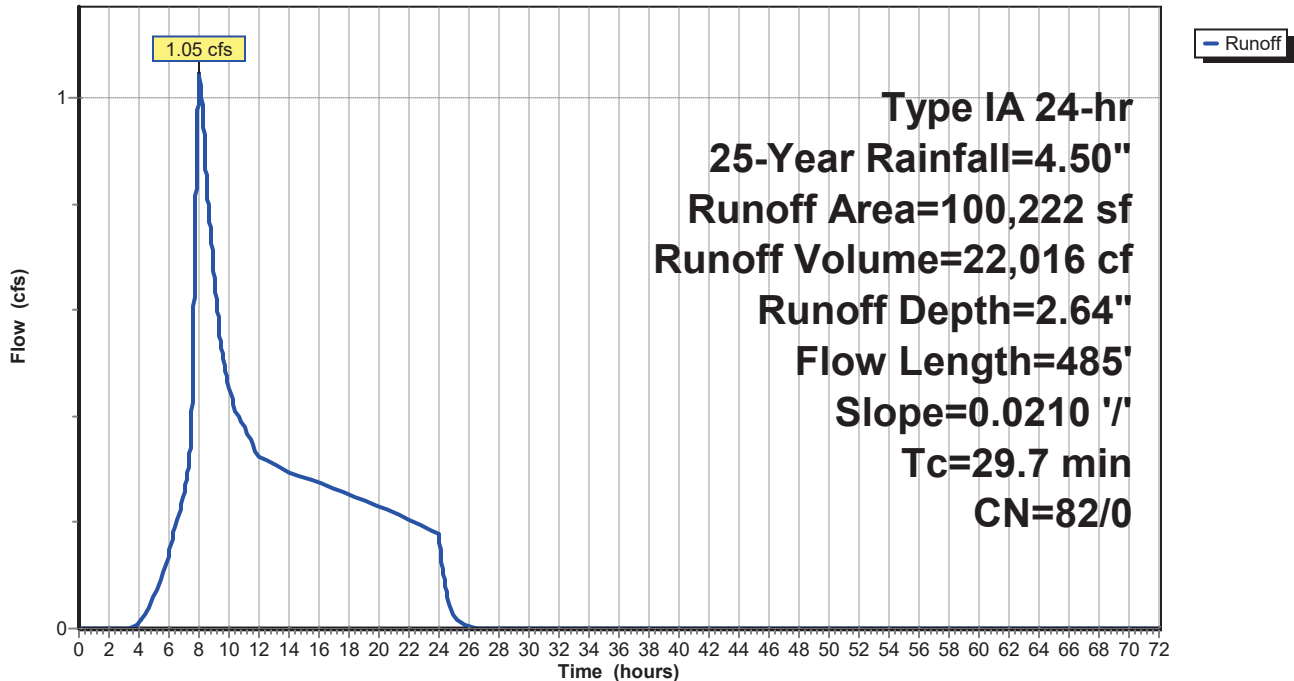
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=4.50"

Area (sf)	CN	Description
100,222	82	Row crops, SR + CR, Good, HSG C
100,222	82	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
27.3	300	0.0210	0.18		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 2.80"
2.4	185	0.0210	1.30		Shallow Concentrated Flow, Cultivated Straight Rows Kv= 9.0 fps
29.7	485	Total			

Subcatchment 1: Existing Subbasin 1

Hydrograph



Bull Run Filtration Post Cross Property

Type IA 24-hr 25-Year Rainfall=4.50"

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Summary for Subcatchment 1A: Subbasin 1A

Runoff = 0.99 cfs @ 8.01 hrs, Volume= 21,403 cf, Depth= 2.56"

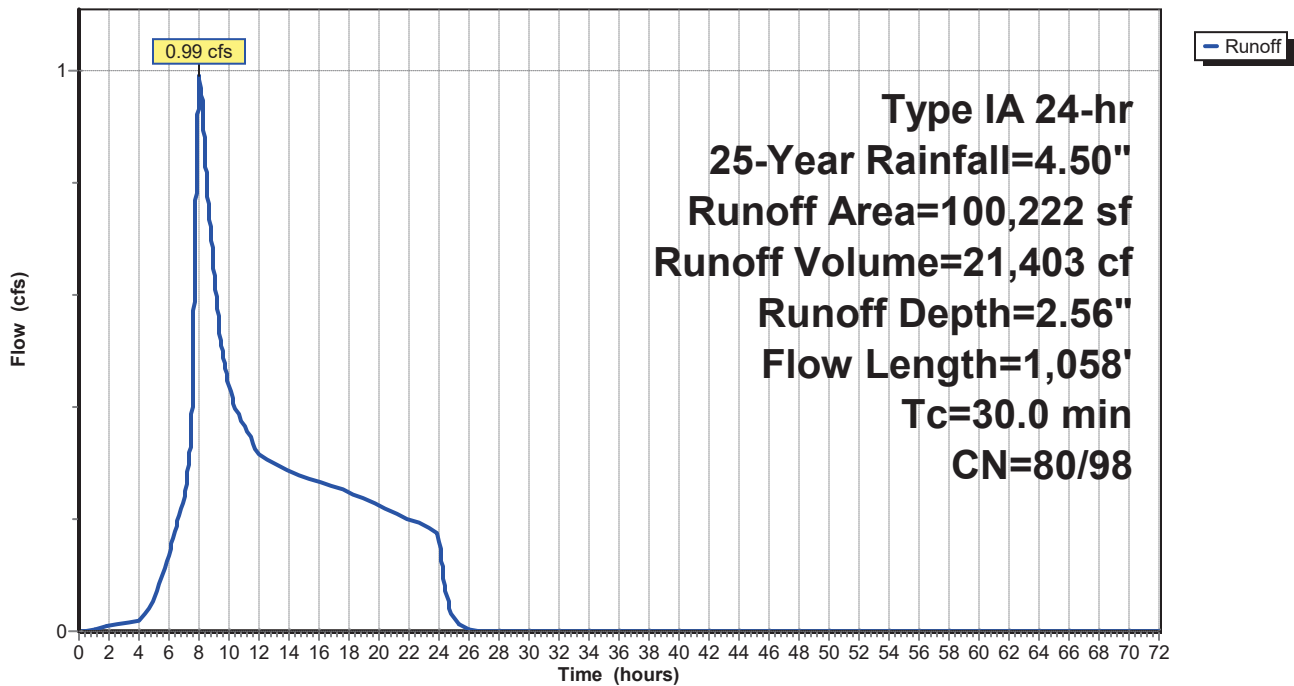
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=4.50"

Area (sf)	CN	Description
94,598	80	>75% Grass cover, Good, HSG D
* 5,624	98	Impervious
100,222	81	Weighted Average
94,598	80	94.39% Pervious Area
5,624	98	5.61% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
24.3	300	0.0220	0.21		Sheet Flow, Grass: Short n= 0.150 P2= 2.80"
2.9	182	0.0220	1.04		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
2.8	576	0.0222	3.38	20.28	Channel Flow, Area= 6.0 sf Perim= 9.0' r= 0.67' n= 0.050 Scattered brush, heavy weeds
30.0	1,058	Total			

Subcatchment 1A: Subbasin 1A

Hydrograph



Bull Run Filtration Post Cross Property

Type IA 24-hr 25-Year Rainfall=4.50"

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Summary for Subcatchment 2: Existing Subbasin 2

Runoff = 0.75 cfs @ 8.00 hrs, Volume= 12,573 cf, Depth= 2.64"

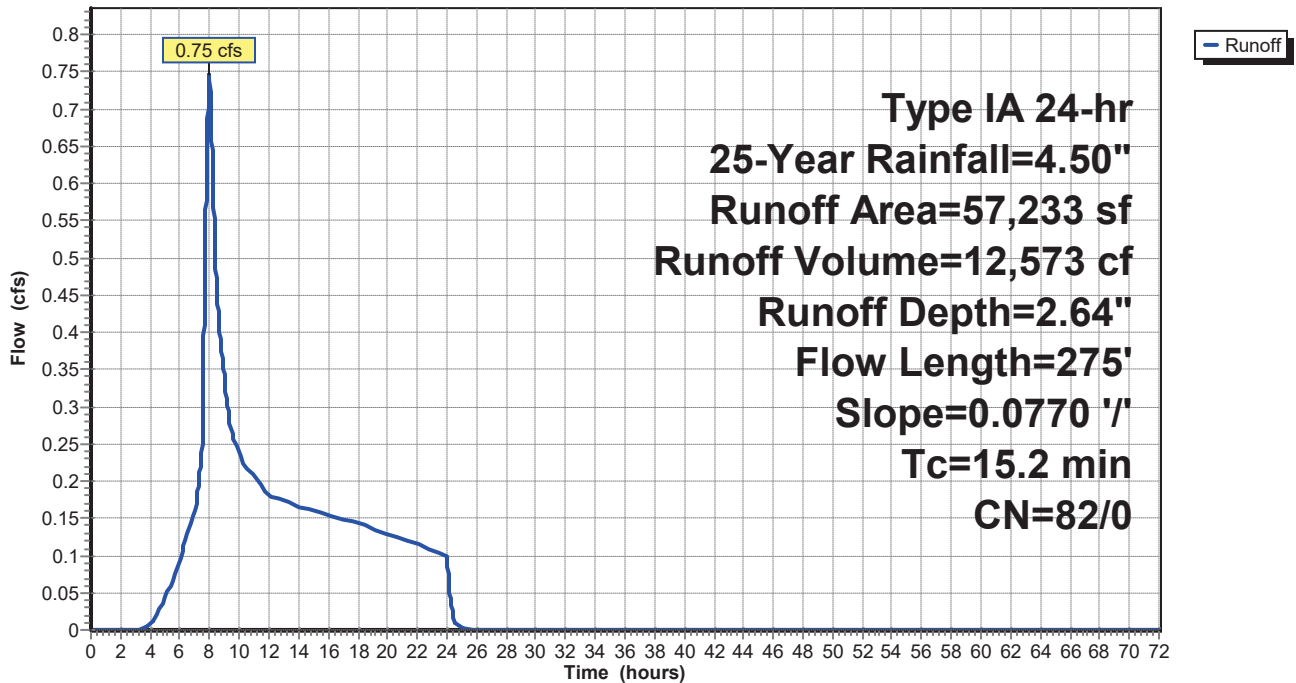
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=4.50"

Area (sf)	CN	Description
57,233	82	Row crops, SR + CR, Good, HSG C
57,233	82	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.2	275	0.0770	0.30		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 2.80"

Subcatchment 2: Existing Subbasin 2

Hydrograph



Bull Run Filtration Post Cross Property

Type IA 24-hr 25-Year Rainfall=4.50"

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Summary for Subcatchment 2A: Subbasin 2A

Runoff = 0.64 cfs @ 8.01 hrs, Volume= 11,885 cf, Depth= 2.49"

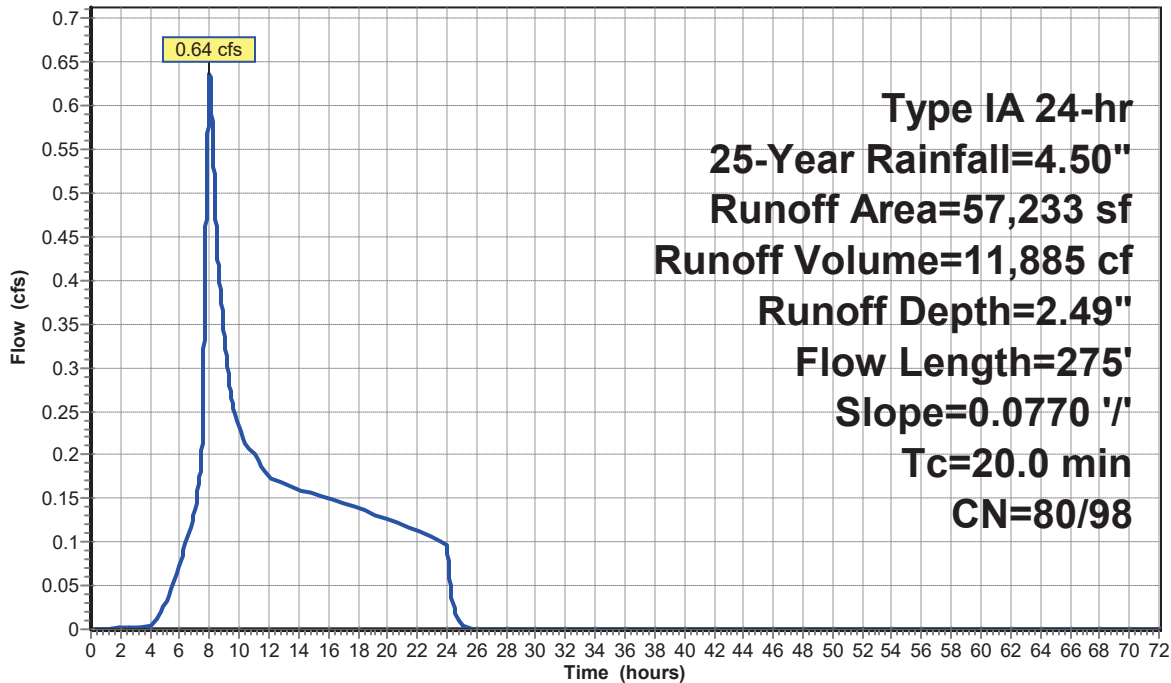
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=4.50"

Area (sf)	CN	Description
56,269	80	>75% Grass cover, Good, HSG D
* 964	98	Impervious
57,233	80	Weighted Average
56,269	80	98.32% Pervious Area
964	98	1.68% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0	275	0.0770	0.23		Sheet Flow, Grass: Dense n= 0.240 P2= 2.80"

Subcatchment 2A: Subbasin 2A

Hydrograph



Bull Run Filtration Post Cross Property

Type IA 24-hr 25-Year Rainfall=4.50"

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Summary for Subcatchment 3: Existing Subbasin 3

Runoff = 0.47 cfs @ 8.00 hrs, Volume= 7,434 cf, Depth= 2.64"

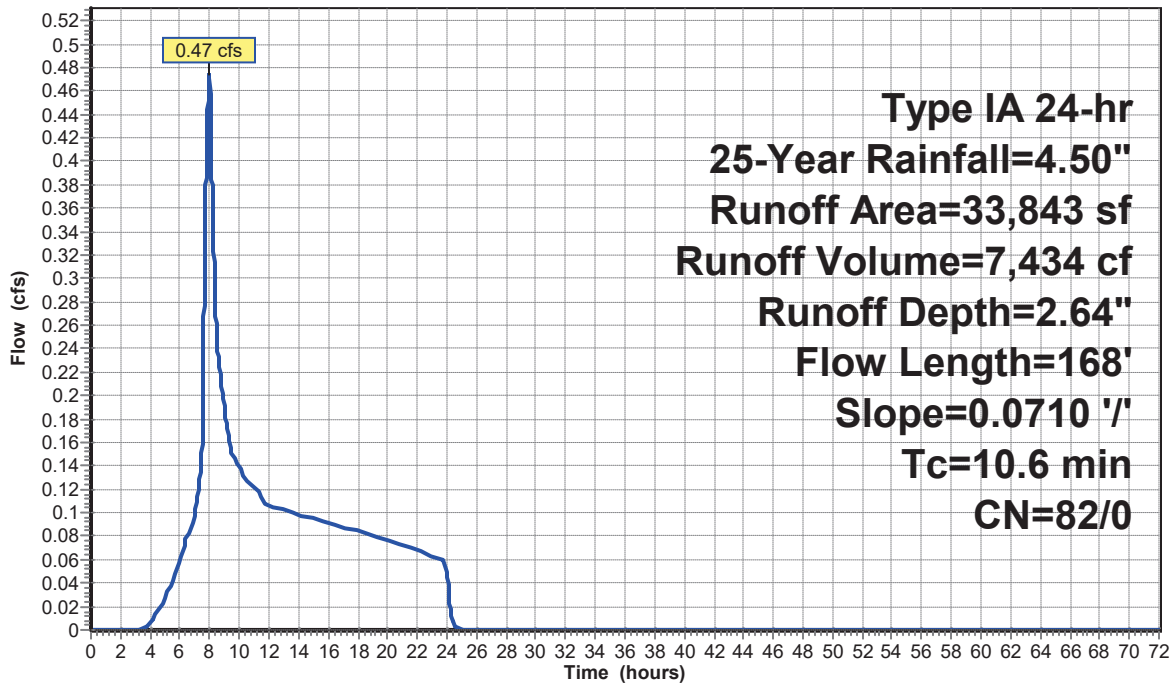
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=4.50"

Area (sf)	CN	Description
33,843	82	Row crops, SR + CR, Good, HSG C
33,843	82	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.6	168	0.0710	0.27		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 2.80"

Subcatchment 3: Existing Subbasin 3

Hydrograph



Bull Run Filtration Post Cross Property

Type IA 24-hr 25-Year Rainfall=4.50"

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Summary for Subcatchment 3A: Subbasin 3A

Runoff = 0.43 cfs @ 8.00 hrs, Volume= 7,578 cf, Depth= 2.69"

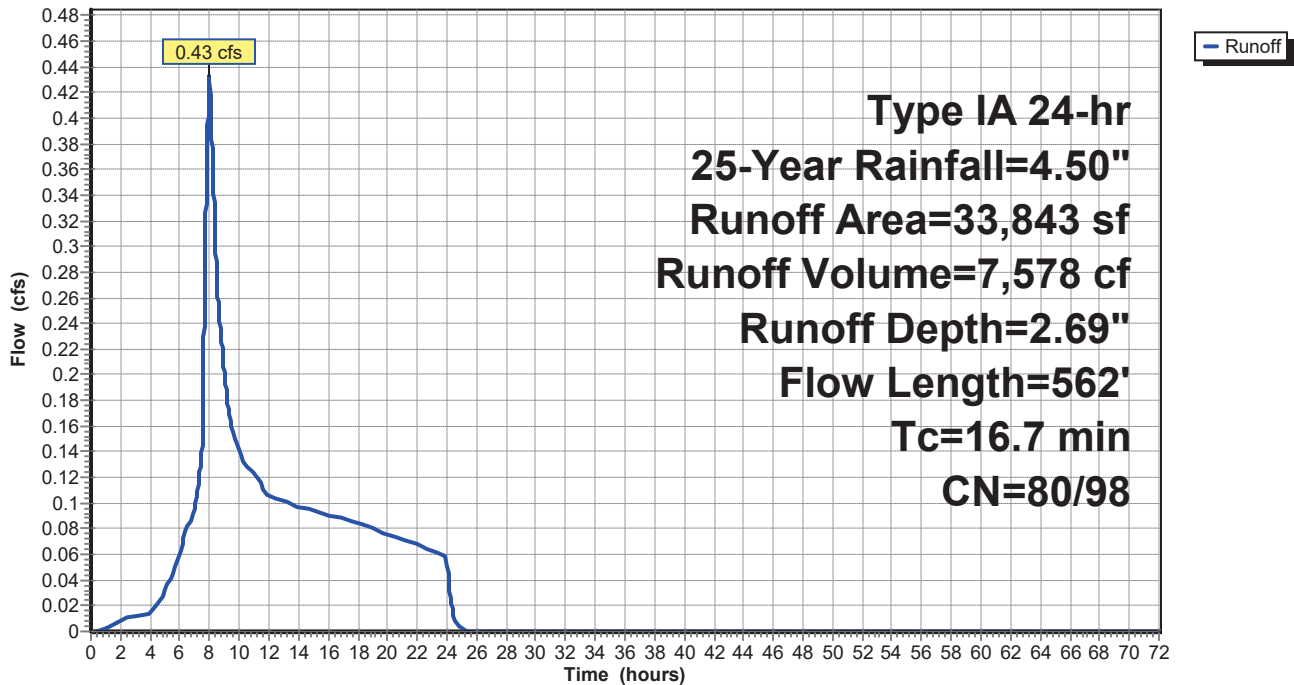
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=4.50"

Area (sf)	CN	Description
29,613	80	>75% Grass cover, Good, HSG D
* 4,230	98	Impervious Area
33,843	82	Weighted Average
29,613	80	87.50% Pervious Area
4,230	98	12.50% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.2	151	0.0790	0.21		Sheet Flow, Grass: Dense n= 0.240 P2= 2.80"
4.5	411	0.0046	1.54	9.23	Channel Flow, Area= 6.0 sf Perim= 9.0' r= 0.67' n= 0.050 Scattered brush, heavy weeds
16.7	562	Total			

Subcatchment 3A: Subbasin 3A

Hydrograph



Bull Run Filtration Post Cross Property

Type IA 24-hr 25-Year Rainfall=4.50"

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Summary for Subcatchment 4: Existing Subbasin 4

Runoff = 4.19 cfs @ 8.07 hrs, Volume= 96,794 cf, Depth= 2.64"

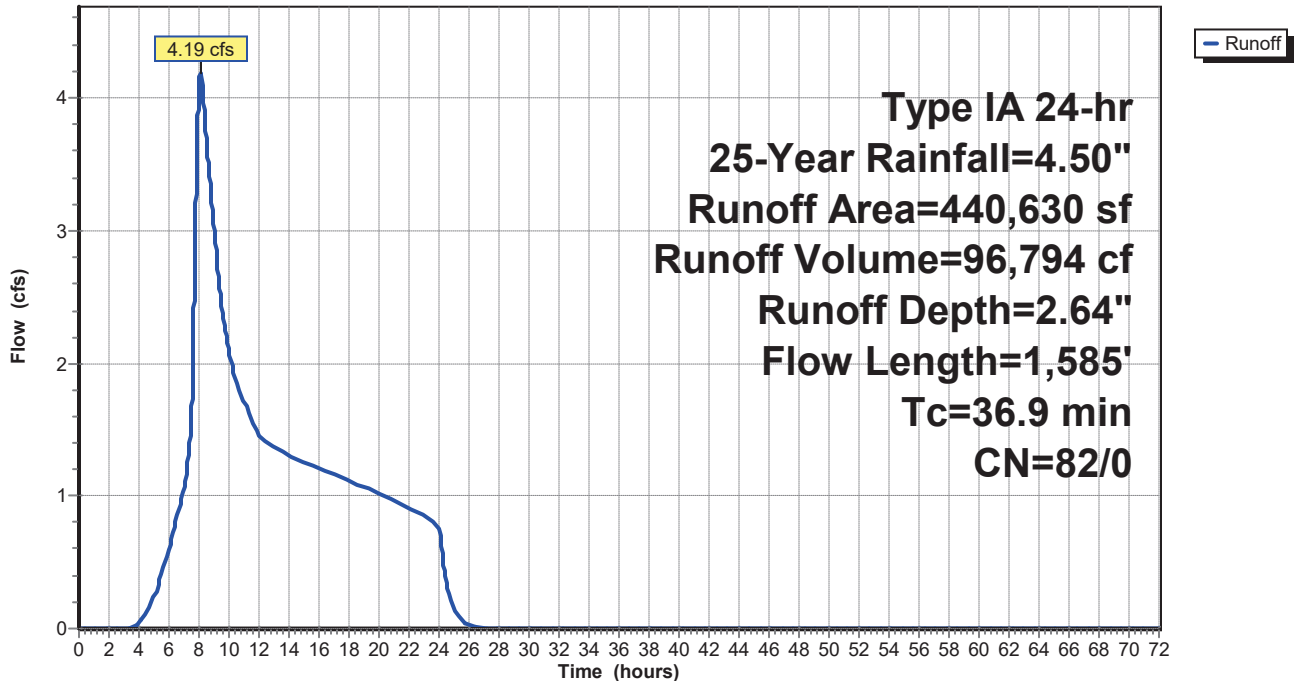
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=4.50"

Area (sf)	CN	Description
440,630	82	Row crops, SR + CR, Good, HSG C
440,630	82	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
27.9	300	0.0200	0.18		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 2.80"
9.0	1,285	0.0700	2.38		Shallow Concentrated Flow, Cultivated Straight Rows Kv= 9.0 fps
36.9	1,585	Total			

Subcatchment 4: Existing Subbasin 4

Hydrograph



Bull Run Filtration Post Cross Property

Type IA 24-hr 25-Year Rainfall=4.50"

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Summary for Subcatchment 4A: Subbasin 4A

Runoff = 3.51 cfs @ 8.16 hrs, Volume= 93,383 cf, Depth= 2.54"

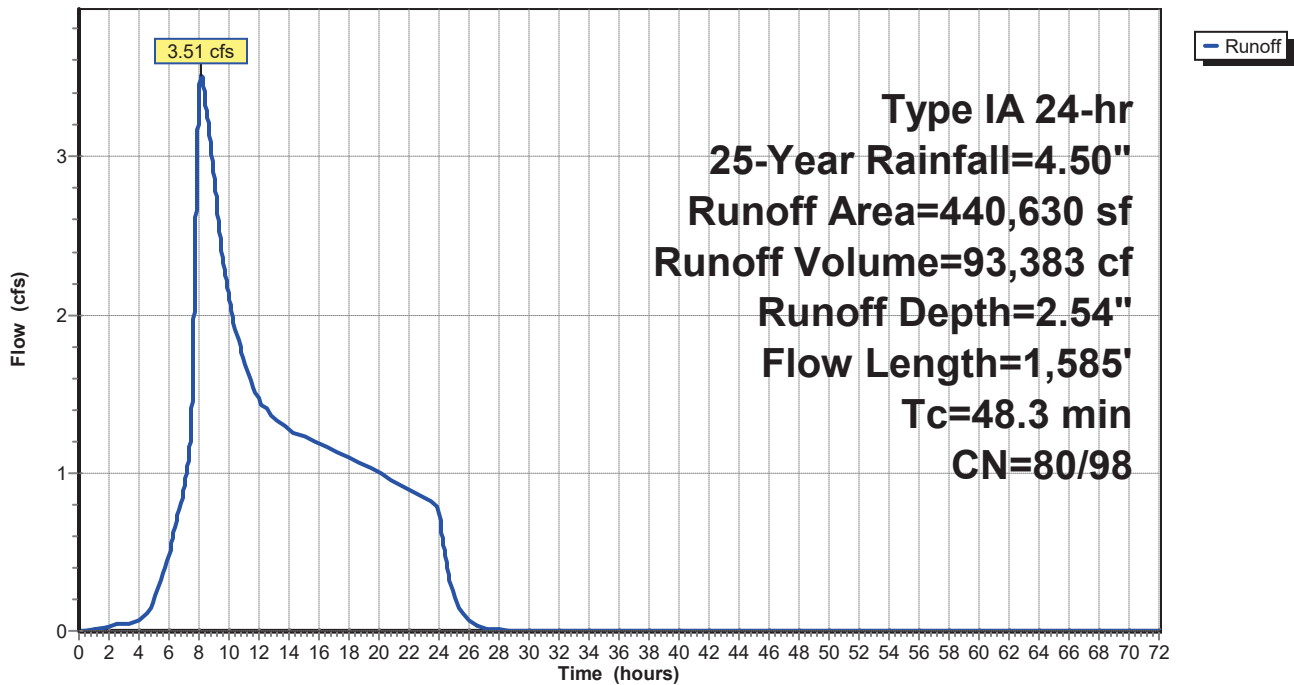
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=4.50"

Area (sf)	CN	Description
420,676	80	>75% Grass cover, Good, HSG D
* 19,954	98	Impervious
440,630	81	Weighted Average
420,676	80	95.47% Pervious Area
19,954	98	4.53% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
36.7	300	0.0200	0.14		Sheet Flow, Grass: Dense n= 0.240 P2= 2.80"
11.6	1,285	0.0700	1.85		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
48.3	1,585	Total			

Subcatchment 4A: Subbasin 4A

Hydrograph



Attachment D: Water Quality Treatment Calculations

PAC Report

Grassy Swale Calculations

Basin 11A HydroCAD Plots

PAC Report

Project Details

Project Name Bull Run Filtration Facility	Permit No TBD	Created 1/5/2023 4:47:46 PM
Project Address SE Carpenter Lane	Designer Emerio Design	Last Modified 4/27/2023 11:36:11 PM
	Company Emerio Design	Report Generated 4/27/2023 4:56:28 PM

Project Summary

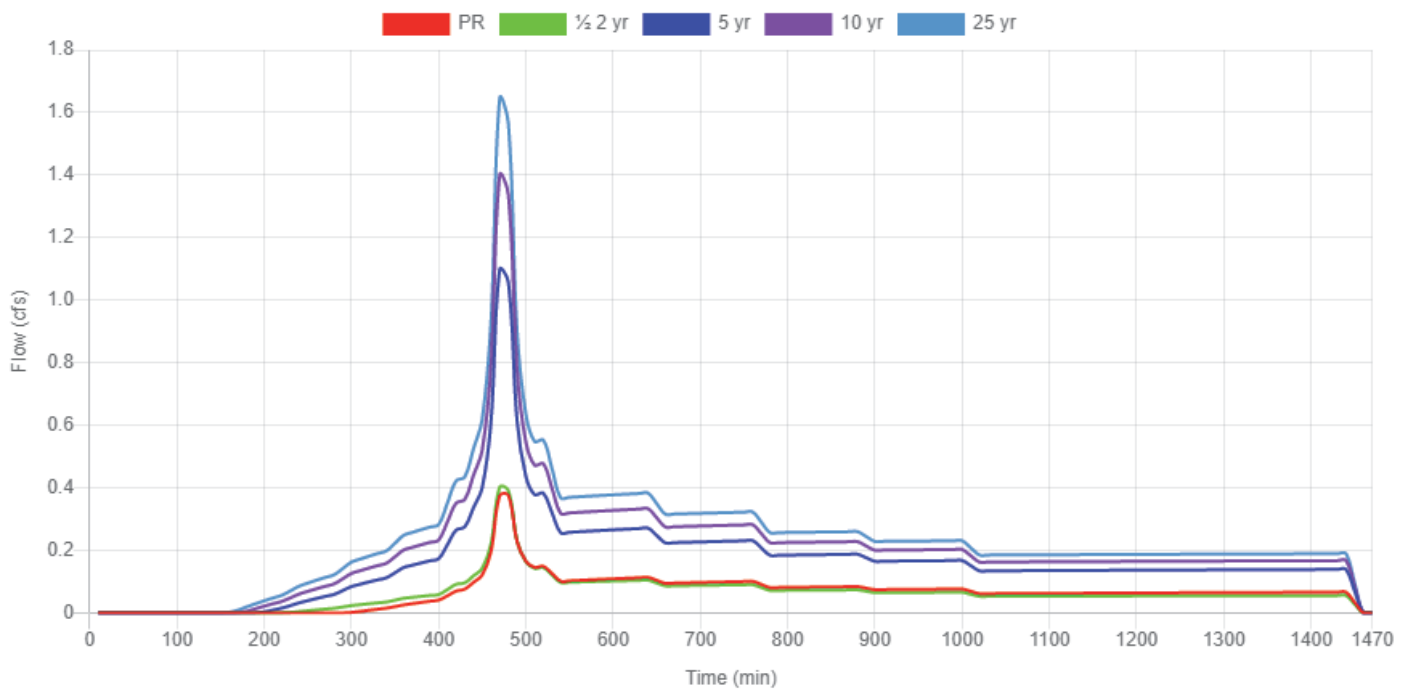
Catchment Name	Imper-vious Area (sq ft)	Native Soil Design Infiltration Rate (in/hr)	Level	Category	Config	Facility Area (excl. free board) (sq ft)	Facility Sizing Ratio (%)	PR Results	Infiltration Results	Flow Control Results
F1	96271	0	2B	SlopedFacility	D	2077.65	2.16	Pass	NA	Fail
81A	58265	0	2B	FlatPlanter	D	1344.00	2.31	Pass	NA	Fail
70B	18015	0	2B	FlatPlanter	D	315.00	1.75	Pass	NA	Fail
70A	36357	0	2B	FlatPlanter	D	522.00	1.44	Pass	NA	Fail
65A	10752	0	2B	FlatPlanter	D	508.00	4.72	Pass	NA	Fail
12B	20925	0	2B	FlatPlanter	D	324.00	1.55	Pass	NA	Fail
12A	8535	0	2B	FlatPlanter	D	206.00	2.41	Pass	NA	Fail
11C	7918	0	2B	FlatPlanter	D	257.00	3.25	Pass	NA	Fail
11B	35031	0	2B	FlatPlanter	D	656.00	1.87	Pass	NA	Fail
E1	103464	0	2B	SlopedFacility	D	2779.92	2.69	Pass	NA	Pass

F1

<p>Site Soils & Infiltration Testing</p>	<p>Infiltration Testing Procedure NA</p> <p>Tested Native Soil Infiltration Rate 0 in/hr</p>
<p>Correction Factor</p>	<p>CF test 2</p>
<p>Design Infiltration Rates</p>	<p>Native Soil 0 in/hr</p> <p>Imported Blended Soil 6 in/hr</p>
<p>Catchment Information</p>	<p>Hierarchy Level 2B</p> <p>Hierarchy Description Discharge to an overland storm drainage system, including streams, drainageways, and ditches, or to a storm-only pipe system that discharges to an overland storm drainage system.</p> <p>Pollution Reduction Requirement Filter the post-development stormwater runoff from the water quality storm event through the blended soil.</p> <p>Infiltration Requirement N/A</p> <p>Flow Control Requirement Limit the ½ the 2-yr, the 5-yr, and the 10-yr post-development peak flows to their respective pre-development peak flows. Unless the facility is a public facility (i.e., in the public right-of-way), also limit the 25-yr post-development peak flow to the 25-year pre-development peak flow.</p> <p>Impervious Area 96271 sq ft 2.21 acre</p> <p>Pre-Development Time of Concentration (T_{c pre}) 10 min</p> <p>Post-Development Time of Concentration (T_{c post}) 5 min</p> <p>Pre-Development Curve Number (CN_{pre}) 82</p> <p>Post-Development Curve Number (CN_{post}) 89</p>

SBUH Results

Post-Development Runoff



	Pre - Development Rate and Volume		Post - Development Rate and Volume	
	Peak Rate (cfs)	Total Volume (cf)	Peak Rate (cfs)	Total Volume (cf)
PR	0.1303	3268	0.3763	5733.5
½ 2-Year	0.2123	3711.4	0.4023	5486
5-Year	0.6451	10435.3	1.0982	14518.3
10-Year	0.8826	13641.5	1.4003	18170.5
25-Year	1.0815	16310.8	1.6455	21146.3

	Overflow		Underdrain Outflow		Infiltration	
	Peak Rate (cfs)	Total Volume (cf)	Peak Rate (cfs)	Total Volume (cf)	Peak Rate (cfs)	Total Volume (cf)
PR	0	0	0.229	5733.5	0	0
½ 2-Year	0	0	0.229	5486	0	0
5-Year	0.575	1177.5	0.229	13340.8	0	0
10-Year	1.108	3015	0.229	15155.5	0	0
25-Year	1.416	4833.7	0.229	16312.6	0	0

Sloped Facility

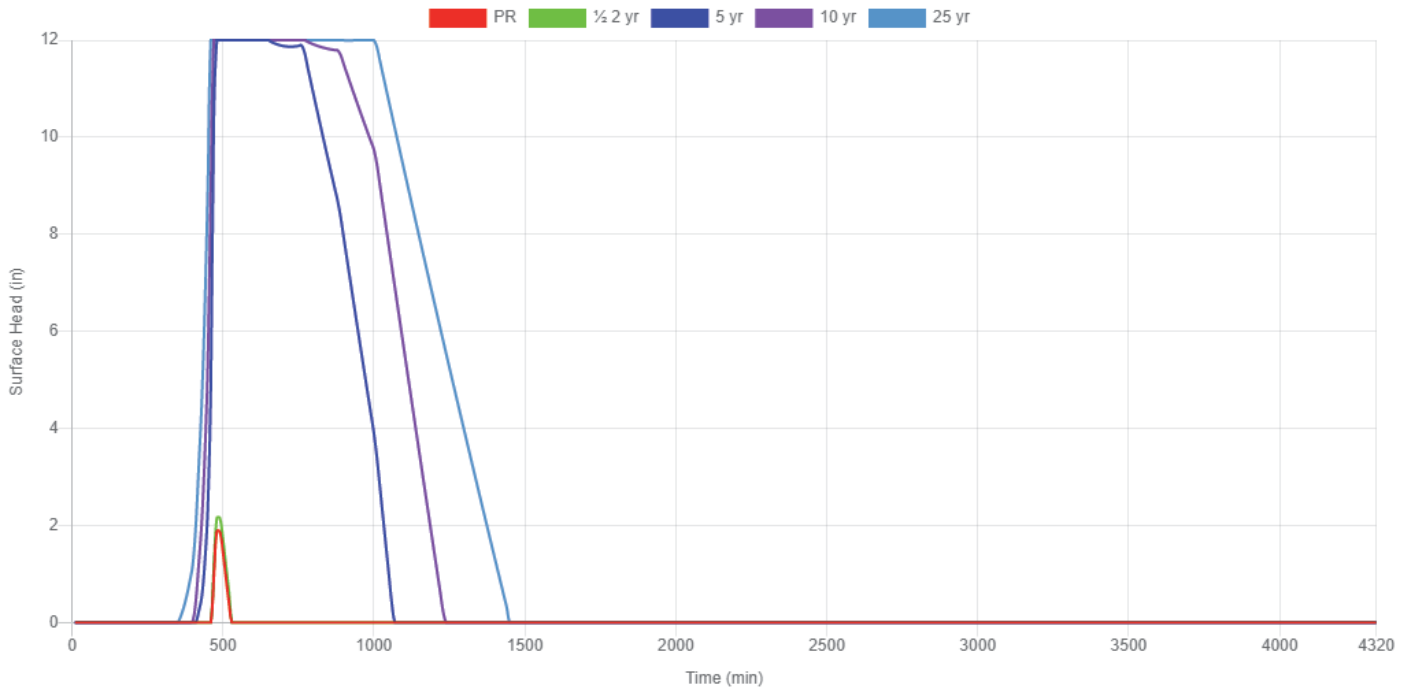
Site Soils & Infiltration Testing	<p>Category Sloped Facility</p> <p>Shape Null</p> <p>Location Parcel</p> <p>Configuration D: Lined Facility with RS and Ud</p> <p>Above Grade Storage Data</p> <p>Total Depth of Blended Soil plus Rock 24 in</p> <p>Surface Storage Capacity at Overflow 1117.87 cu ft</p> <p>Design Infiltration Rate to Soil Underlying the Facility 0.000 cfs</p> <p>Design Infiltration Rate for Imported Blended Soil in the Facility 0.229 cfs</p> <p>Below Grade Storage Data</p> <p>Catchment is too small for flow control? No</p> <p>Rock Area 854.00 sq ft</p> <p>Rock Width 3.00 ft</p> <p>Rock Storage Depth 12.0 in</p> <p>Rock Porosity 0.3</p> <p>Percent of Facility Base that Allows Infiltration 0 %</p> <p>Underdrain Height 4 in</p> <p>Orifice (Y/N)? No</p> <p>Why no orifice</p>
--	--

	Water-quality-only facility																				
Facility Facts	<p>Total Facility Area (excluding freeboard) 2077.65 sq ft</p> <p>Sizing Ratio 2.16 %</p> <p>Segments Total Length 287.50 ft</p>																				
Pollution Reduction Results	<p>Pollution Reduction Score Pass</p> <p>Overflow Volume 0.00 cf</p> <p>Surface Capacity Used 15.71 %</p>																				
Flow Control Results	<p>Flow Control Score Fail</p> <table border="1"> <thead> <tr> <th></th> <th>STORMWATER FACILITY OUTFLOW (CFS)</th> <th></th> <th>PRE-DEVELOPMENT RUNOFF (CFS)</th> </tr> </thead> <tbody> <tr> <td>½ the 2 year</td> <td>0.2292</td> <td><=</td> <td>0.2123</td> </tr> <tr> <td>5 year</td> <td>0.8045</td> <td><=</td> <td>0.6451</td> </tr> <tr> <td>10 year</td> <td>1.3368</td> <td><=</td> <td>0.8826</td> </tr> <tr> <td>25 year</td> <td>1.6455</td> <td><=</td> <td>1.0815</td> </tr> </tbody> </table>		STORMWATER FACILITY OUTFLOW (CFS)		PRE-DEVELOPMENT RUNOFF (CFS)	½ the 2 year	0.2292	<=	0.2123	5 year	0.8045	<=	0.6451	10 year	1.3368	<=	0.8826	25 year	1.6455	<=	1.0815
	STORMWATER FACILITY OUTFLOW (CFS)		PRE-DEVELOPMENT RUNOFF (CFS)																		
½ the 2 year	0.2292	<=	0.2123																		
5 year	0.8045	<=	0.6451																		
10 year	1.3368	<=	0.8826																		
25 year	1.6455	<=	1.0815																		

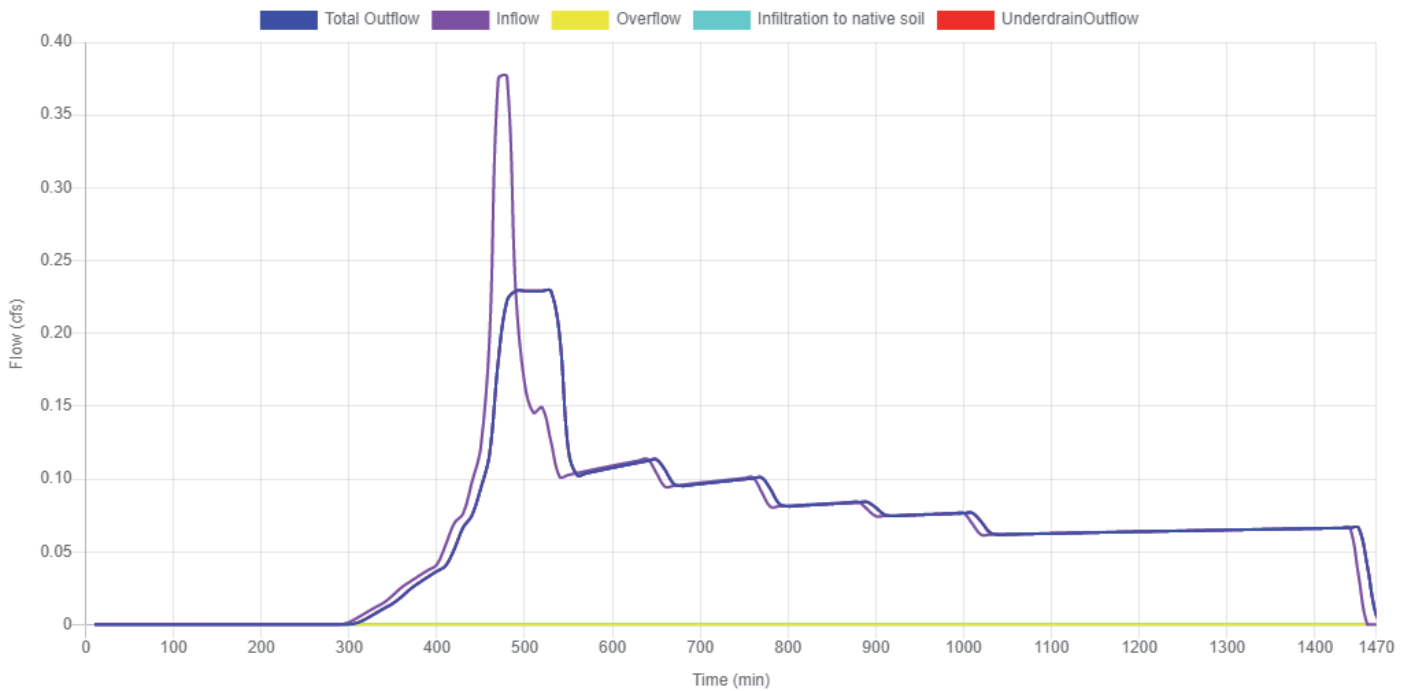
Sloped Facility Worksheet

Segment #	Check Dam Length (ft)	Check Dam Width (ft)	Slope, v/h (ft/ft)	Bottom Width (ft)	Right Side Slope (_h:1v)	Left Side Slope (_h:1v)	Down-gradient Depth (in)	Landscape Width (ft)	Adjusted Length (ft)	Up-gradient Depth (ft)	Surface Capacity Volume (cf)
0	57.00	0.5	0.01	3.00	3.0	3.0	12.0	9.0	57.00	0.43	223.57
1	57.00	0.5	0.01	3.00	3.0	3.0	12.0	9.0	57.00	0.43	223.57
2	57.00	0.5	0.01	3.00	3.0	3.0	12.0	9.0	57.00	0.43	223.57
3	57.00	0.5	0.01	3.00	3.0	3.0	12.0	9.0	57.00	0.43	223.57
4	57.00	0.5	0.01	3.00	3.0	3.0	12.0	9.0	57.00	0.43	223.57

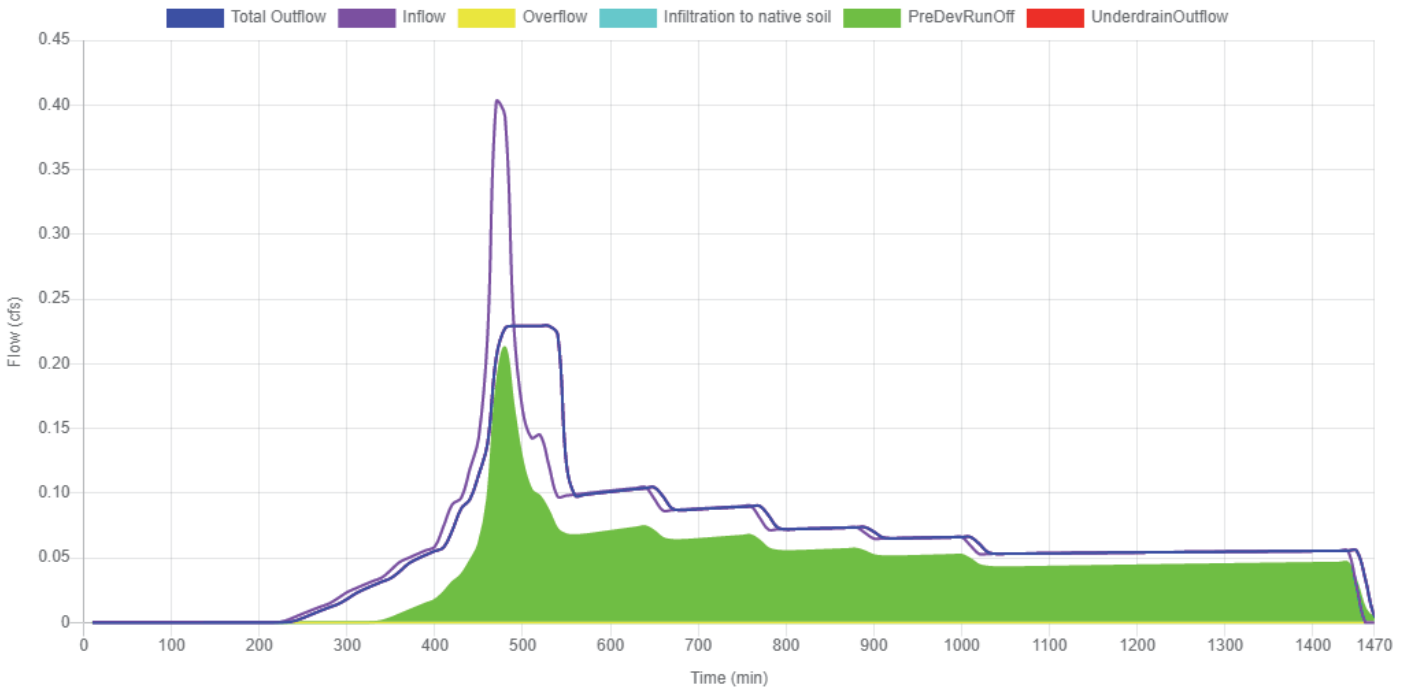
Surface Head



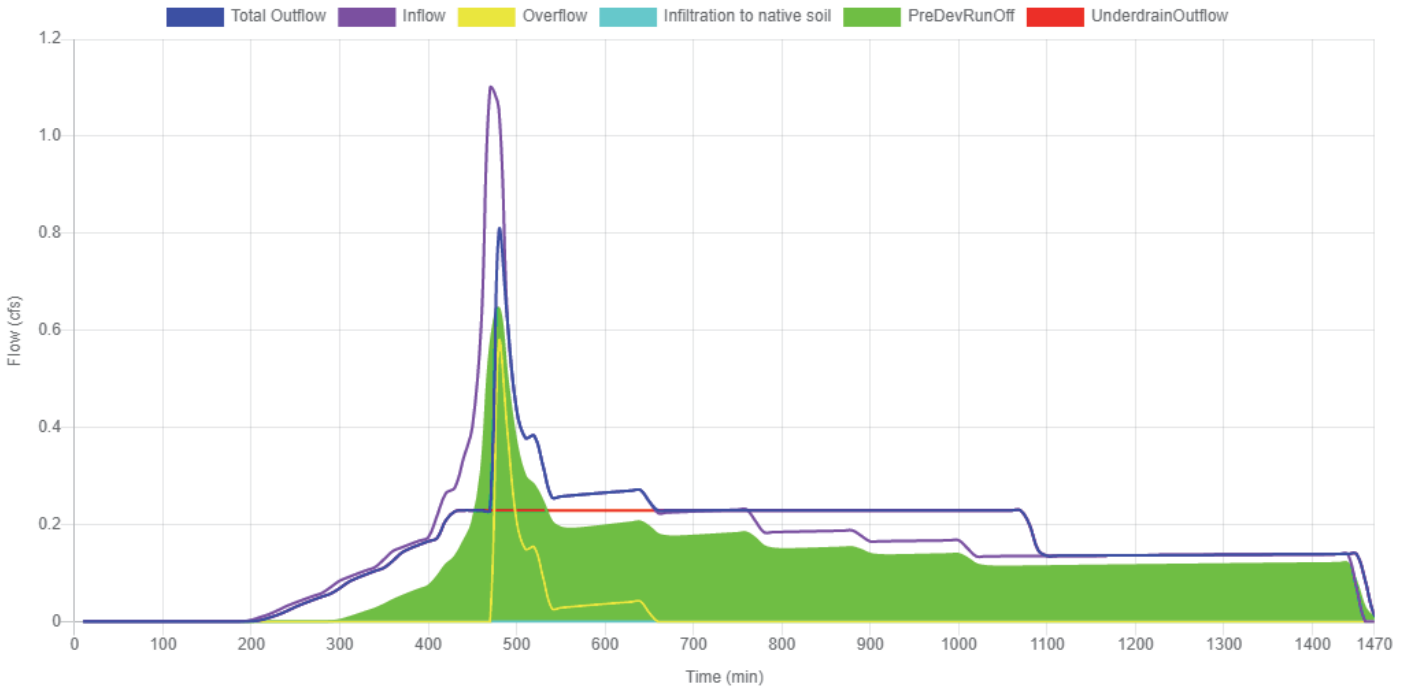
Water Quality



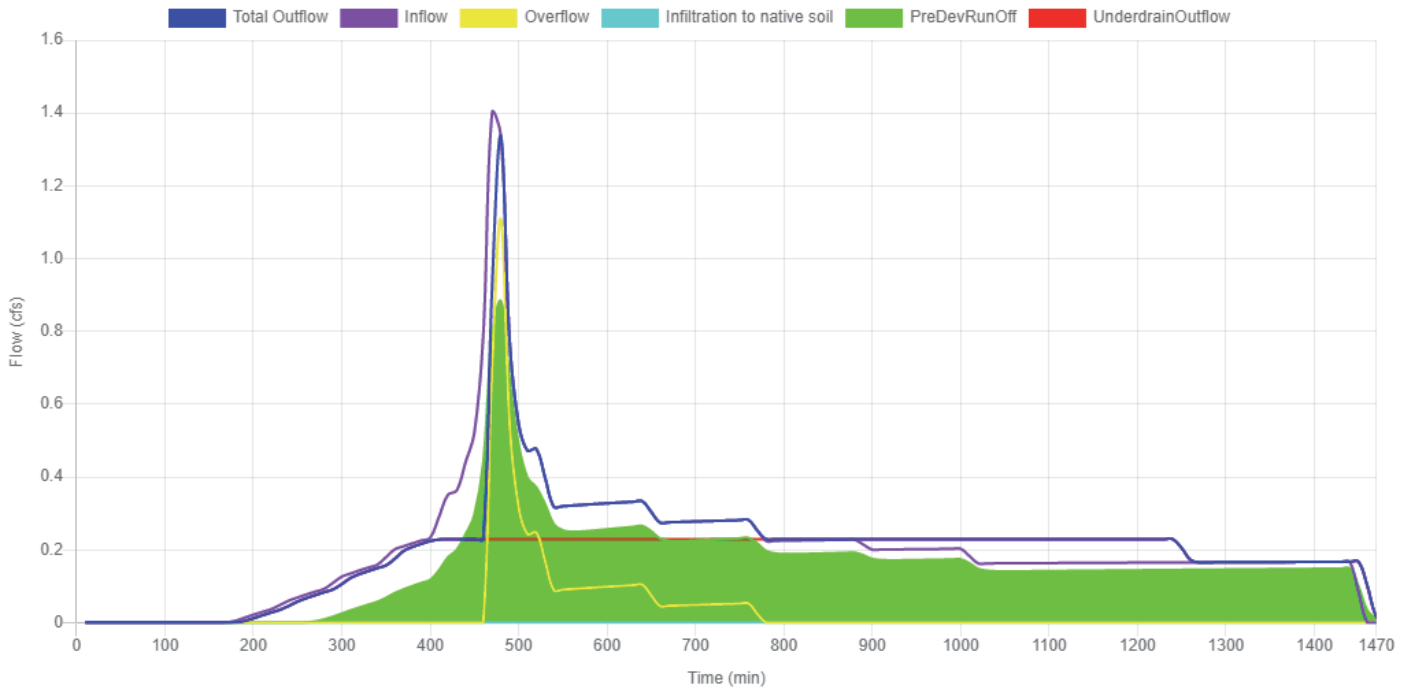
1/2 2-Year



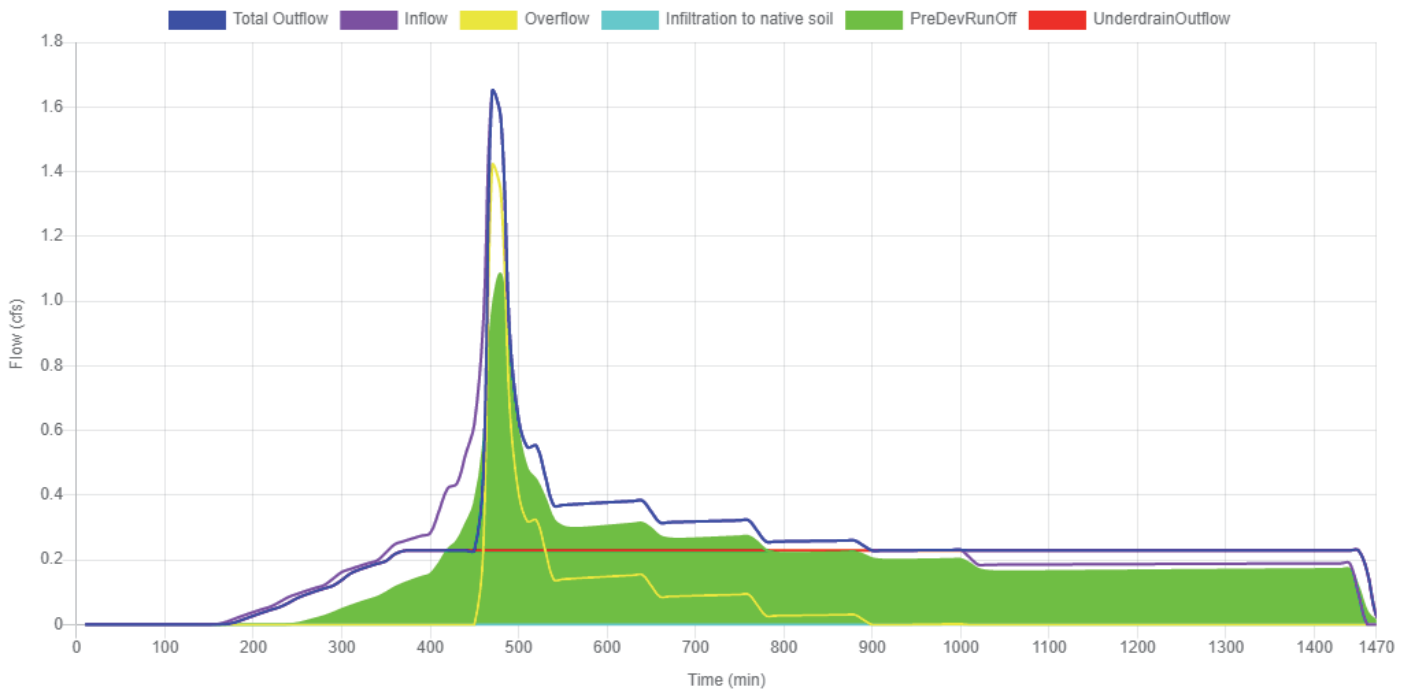
5-Year



10-Year



25-Year

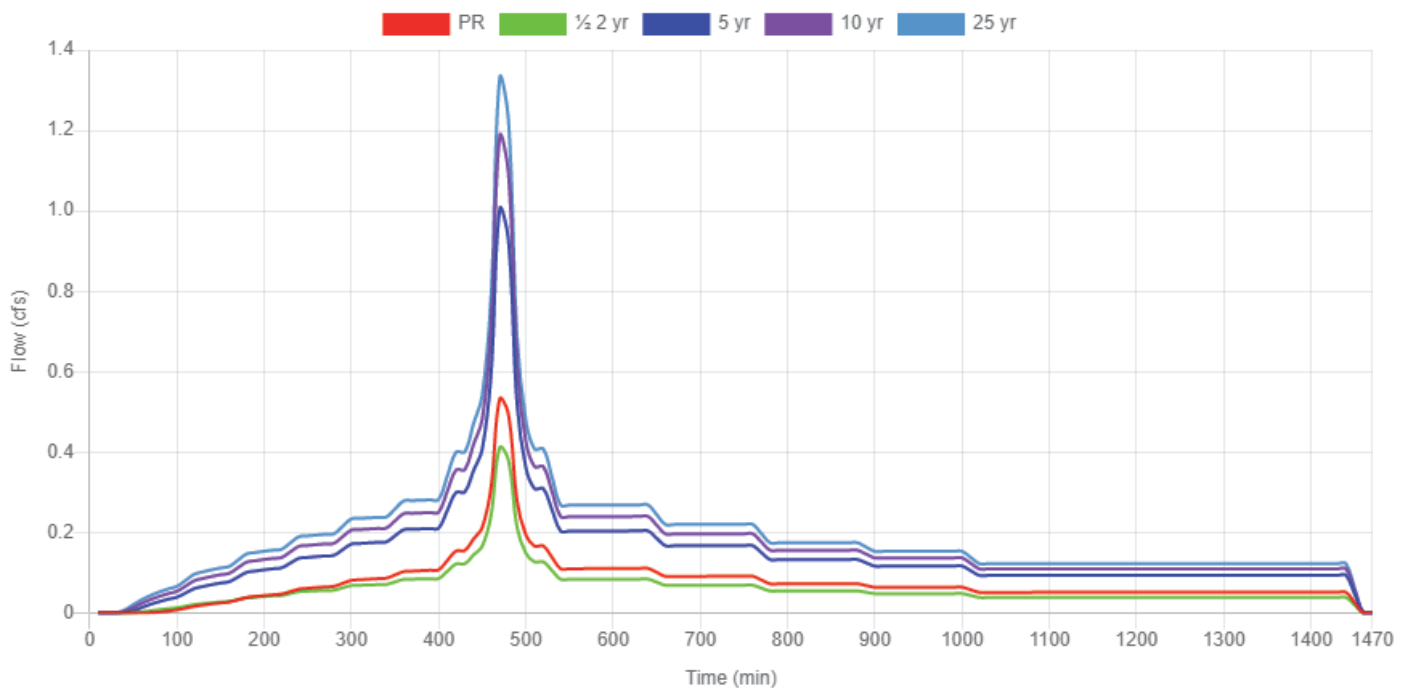


81A

<p>Site Soils & Infiltration Testing</p>	<p>Infiltration Testing Procedure NA</p> <p>Tested Native Soil Infiltration Rate 0 in/hr</p>
<p>Correction Factor</p>	<p>CF test 2</p>
<p>Design Infiltration Rates</p>	<p>Native Soil 0 in/hr</p> <p>Imported Blended Soil 6 in/hr</p>
<p>Catchment Information</p>	<p>Hierarchy Level 2B</p> <p>Hierarchy Description Discharge to an overland storm drainage system, including streams, drainageways, and ditches, or to a storm-only pipe system that discharges to an overland storm drainage system.</p> <p>Pollution Reduction Requirement Filter the post-development stormwater runoff from the water quality storm event through the blended soil.</p> <p>Infiltration Requirement N/A</p> <p>Flow Control Requirement Limit the ½ the 2-yr, the 5-yr, and the 10-yr post-development peak flows to their respective pre-development peak flows. Unless the facility is a public facility (i.e., in the public right-of-way), also limit the 25-yr post-development peak flow to the 25-year pre-development peak flow.</p> <p>Impervious Area 58265 sq ft 1.338 acre</p> <p>Pre-Development Time of Concentration (T_{c pre}) 10 min</p> <p>Post-Development Time of Concentration (T_{c post}) 5 min</p> <p>Pre-Development Curve Number (CN_{pre}) 82</p> <p>Post-Development Curve Number (CN_{post}) 98</p>

SBUH Results

Post-Development Runoff



	Pre - Development Rate and Volume		Post - Development Rate and Volume	
	Peak Rate (cfs)	Total Volume (cf)	Peak Rate (cfs)	Total Volume (cf)
PR	0.0788	1977.9	0.5322	6742.2
½ 2-Year	0.1285	2246.2	0.4113	5271.4
5-Year	0.3904	6315.7	1.0047	12957.6
10-Year	0.5342	8256.1	1.1859	15376.1
25-Year	0.6545	9871.6	1.3304	17312.5

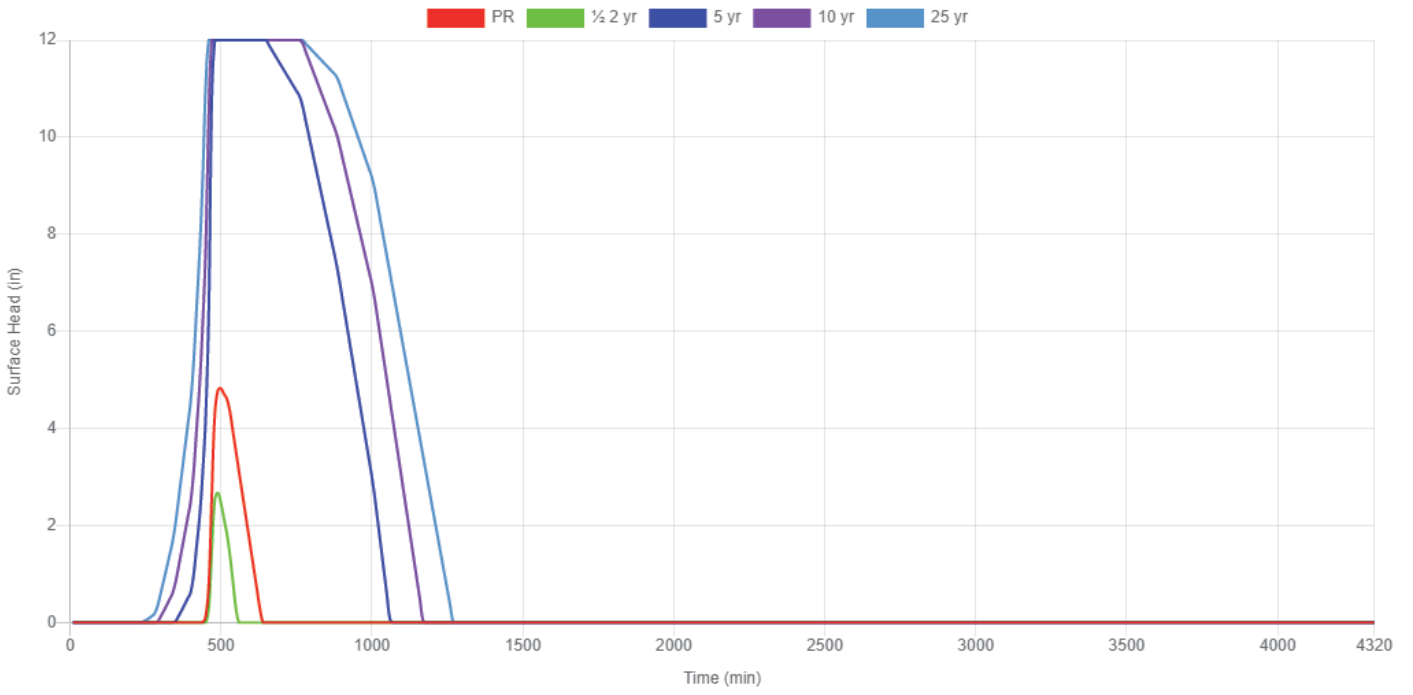
	Overflow		Underdrain Outflow		Infiltration	
	Peak Rate (cfs)	Total Volume (cf)	Peak Rate (cfs)	Total Volume (cf)	Peak Rate (cfs)	Total Volume (cf)
PR	0	0	0.187	6742.2	0	0
½ 2-Year	0	0	0.187	5271.4	0	0
5-Year	0.523	918.8	0.187	12038.8	0	0
10-Year	0.908	2089.7	0.187	13286.4	0	0
25-Year	1.144	3197	0.187	14115.5	0	0

Flat Planter

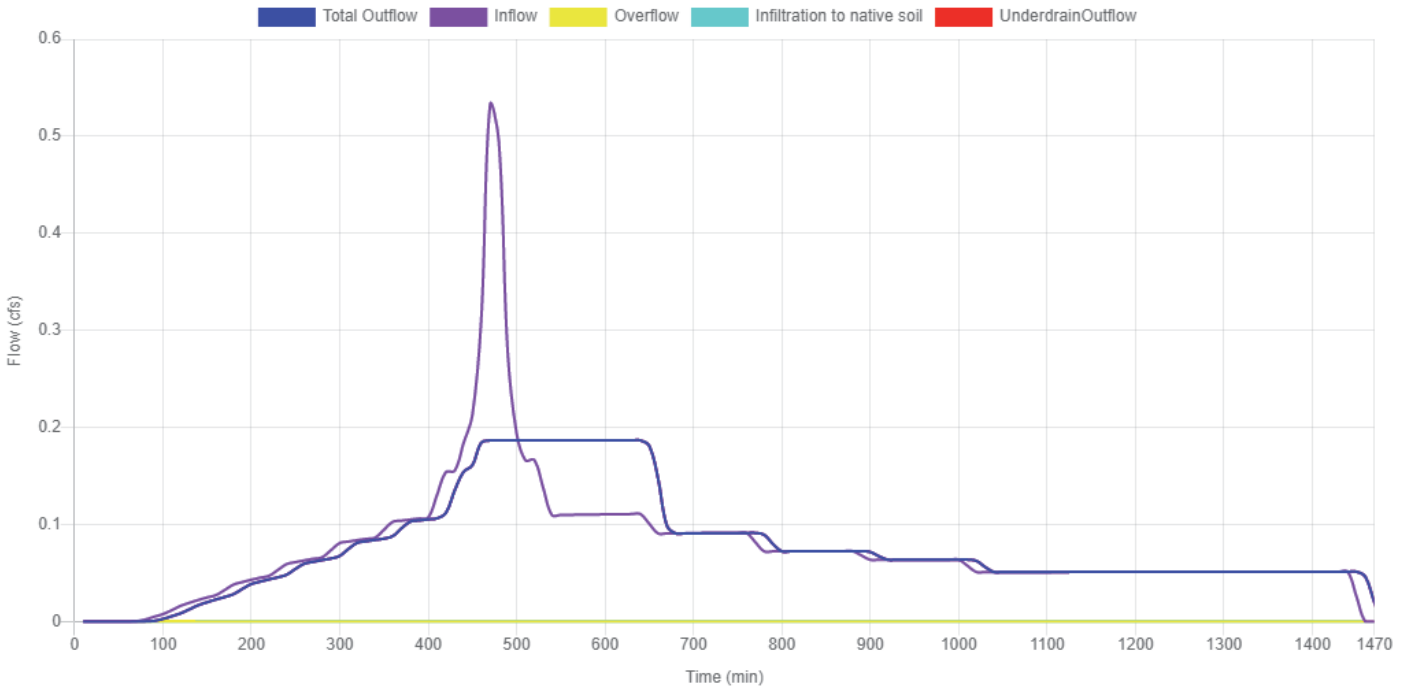
Site Soils & Infiltration Testing	Category
	Flat Planter
	Shape
	Null
	Location
	Parcel
	Configuration
	D: Lined Facility with RS and Ud
	Above Grade Storage Data
	Bottom Area
	1344 sq ft
	Bottom Width
	10 ft
	Overflow Height
	12 in
	Total Depth of Blended Soil plus Rock
	30 in
	Surface Storage Capacity at Overflow
	1344 cu ft
	Design Infiltration Rate to Soil Underlying the Facility
	0.000 cfs
Design Infiltration Rate for Imported Blended Soil in the Facility	
0.187 cfs	
Below Grade Storage Data	
Catchment is too small for flow control?	
No	
Rock Area	
450.00 sq ft	
Rock Width	
3.00 ft	
Rock Storage Depth	
12.0 in	
Rock Porosity	
0.3	
Underdrain Height	

	<p>4 in</p> <p>Percent of Facility Base that Allows Infiltration</p> <p>0 %</p> <p>Orifice (Y/N)?</p> <p>No</p> <p>Why no orifice</p> <p>Water-quality-only facility</p>																				
<p>Facility Facts</p>	<p>Total Facility Area (excluding freeboard)</p> <p>1344.00 sq ft</p> <p>Sizing Ratio</p> <p>2.31 %</p>																				
<p>Pollution Reduction Results</p>	<p>Pollution Reduction Score</p> <p>Pass</p> <p>Overflow Volume</p> <p>0.00 cf</p> <p>Surface Capacity Used</p> <p>40.22 %</p>																				
<p>Flow Control Results</p>	<p>Flow Control Score</p> <p>Fail</p> <table border="1" data-bbox="662 1160 1490 1554"> <thead> <tr> <th></th> <th>STORMWATER FACILITY OUTFLOW (CFS)</th> <th></th> <th>PRE-DEVELOPMENT RUNOFF (CFS)</th> </tr> </thead> <tbody> <tr> <td>½ the 2 year</td> <td>0.1867</td> <td><=</td> <td>0.1285</td> </tr> <tr> <td>5 year</td> <td>0.7096</td> <td><=</td> <td>0.3904</td> </tr> <tr> <td>10 year</td> <td>1.0946</td> <td><=</td> <td>0.5342</td> </tr> <tr> <td>25 year</td> <td>1.3304</td> <td><=</td> <td>0.6545</td> </tr> </tbody> </table>		STORMWATER FACILITY OUTFLOW (CFS)		PRE-DEVELOPMENT RUNOFF (CFS)	½ the 2 year	0.1867	<=	0.1285	5 year	0.7096	<=	0.3904	10 year	1.0946	<=	0.5342	25 year	1.3304	<=	0.6545
	STORMWATER FACILITY OUTFLOW (CFS)		PRE-DEVELOPMENT RUNOFF (CFS)																		
½ the 2 year	0.1867	<=	0.1285																		
5 year	0.7096	<=	0.3904																		
10 year	1.0946	<=	0.5342																		
25 year	1.3304	<=	0.6545																		

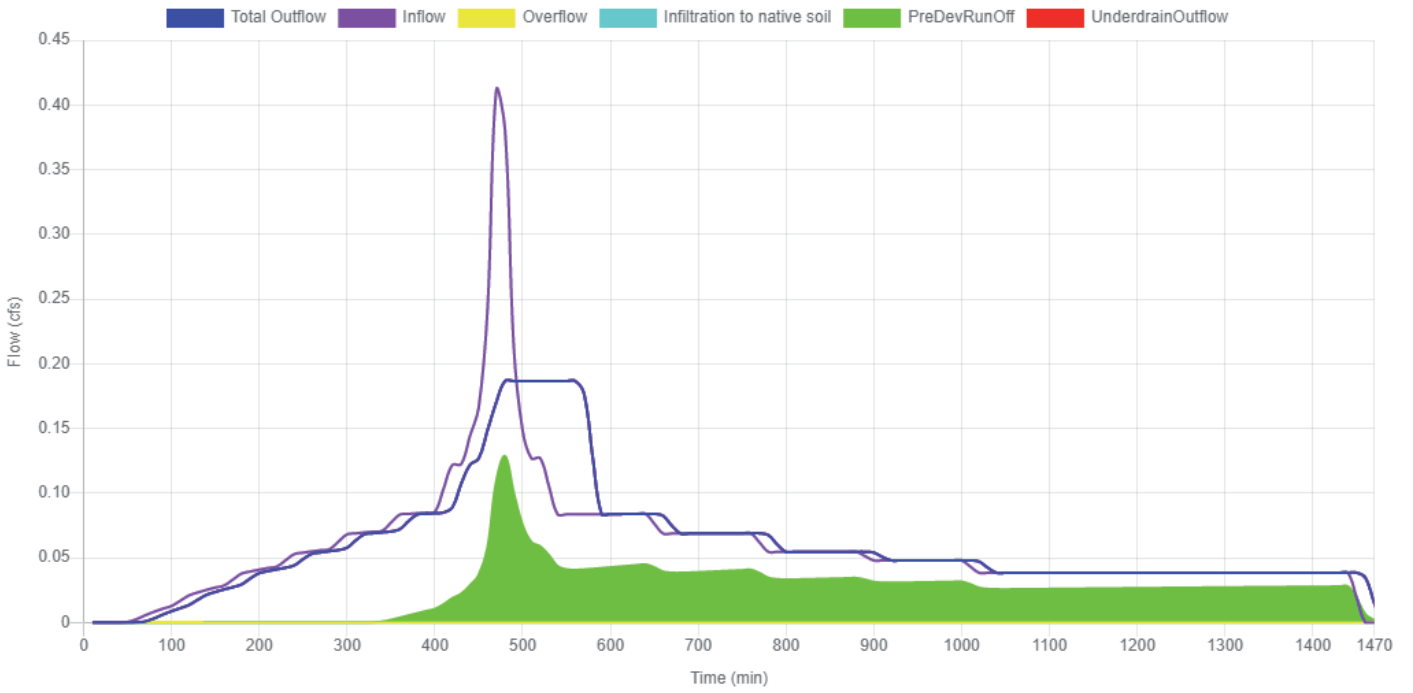
Surface Head



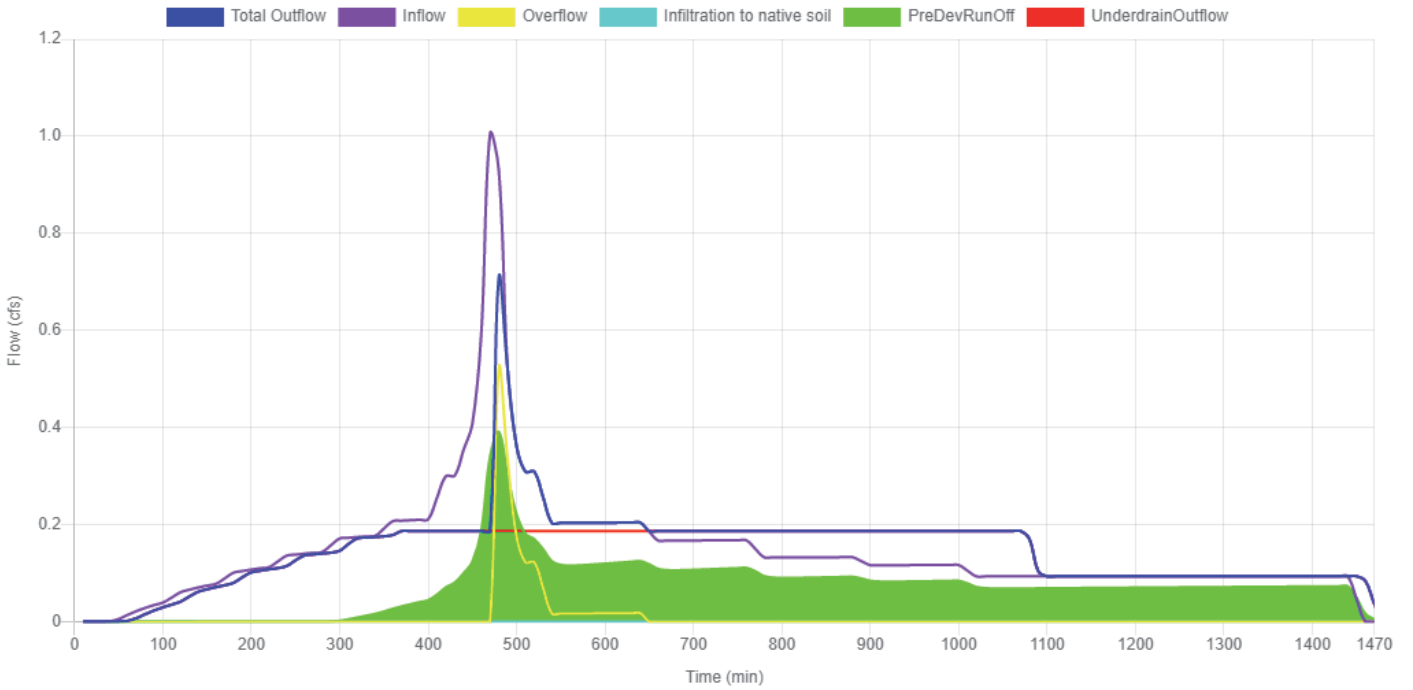
Water Quality



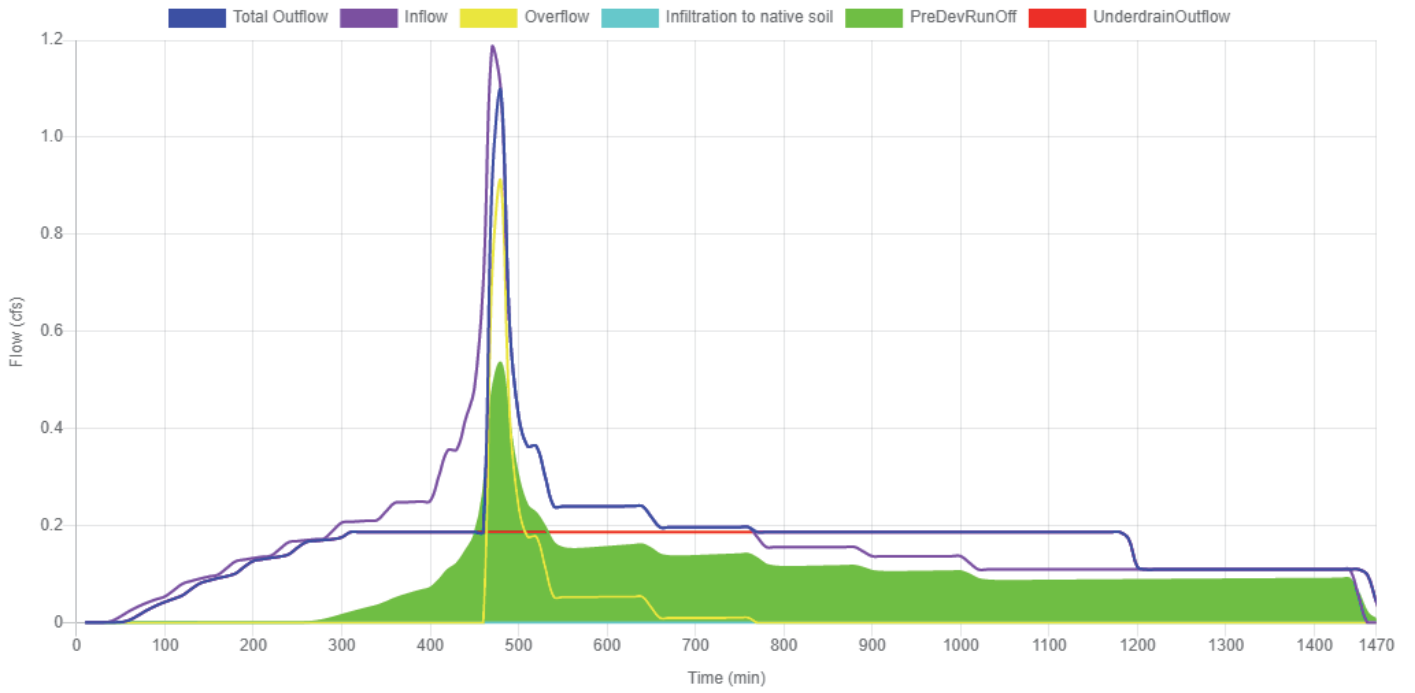
1/2 2-Year



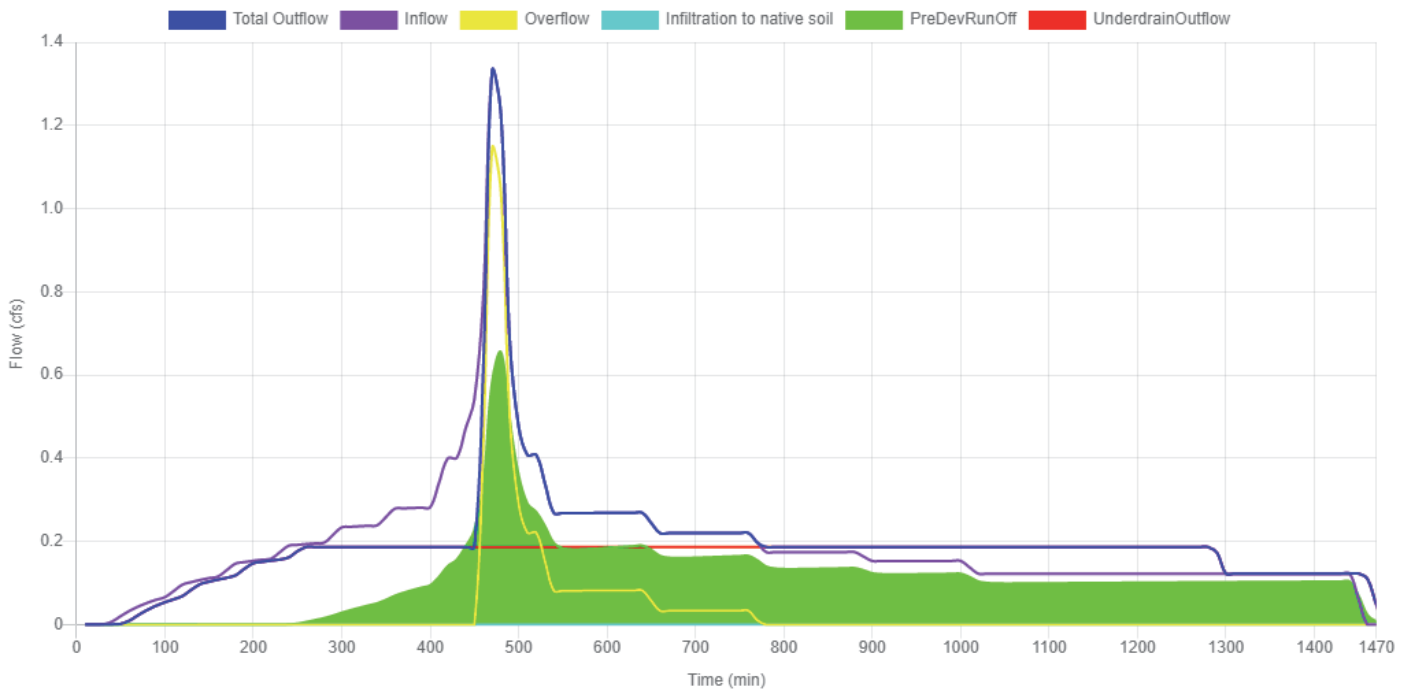
5-Year



10-Year



25-Year

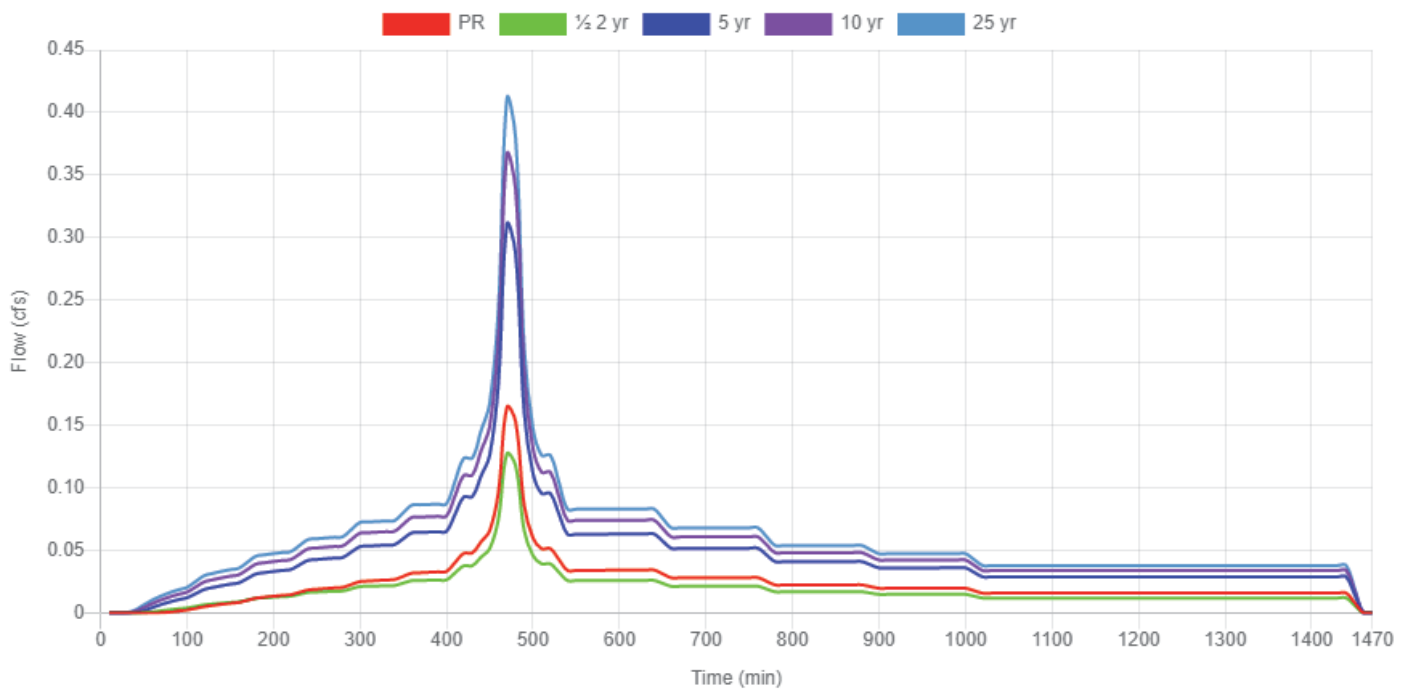


70B

Site Soils & Infiltration Testing	Infiltration Testing Procedure NA Tested Native Soil Infiltration Rate 0 in/hr
Correction Factor	CF test 2
Design Infiltration Rates	Native Soil 0 in/hr Imported Blended Soil 6 in/hr
Catchment Information	Hierarchy Level 2B Hierarchy Description Discharge to an overland storm drainage system, including streams, drainageways, and ditches, or to a storm-only pipe system that discharges to an overland storm drainage system. Pollution Reduction Requirement Filter the post-development stormwater runoff from the water quality storm event through the blended soil. Infiltration Requirement N/A Flow Control Requirement Limit the ½ the 2-yr, the 5-yr, and the 10-yr post-development peak flows to their respective pre-development peak flows. Unless the facility is a public facility (i.e., in the public right-of-way), also limit the 25-yr post-development peak flow to the 25-year pre-development peak flow. Impervious Area 18015 sq ft 0.414 acre Pre-Development Time of Concentration (T_{c pre}) 10 min Post-Development Time of Concentration (T_{c post}) 5 min Pre-Development Curve Number (CN_{pre}) 82 Post-Development Curve Number (CN_{post}) 98

SBUH Results

Post-Development Runoff



	Pre - Development Rate and Volume		Post - Development Rate and Volume	
	Peak Rate (cfs)	Total Volume (cf)	Peak Rate (cfs)	Total Volume (cf)
PR	0.0244	611.5	0.1646	2084.6
1/2 2-Year	0.0397	694.5	0.1272	1629.9
5-Year	0.1207	1952.7	0.3107	4006.4
10-Year	0.1652	2552.7	0.3667	4754.1
25-Year	0.2024	3052.2	0.4113	5352.9

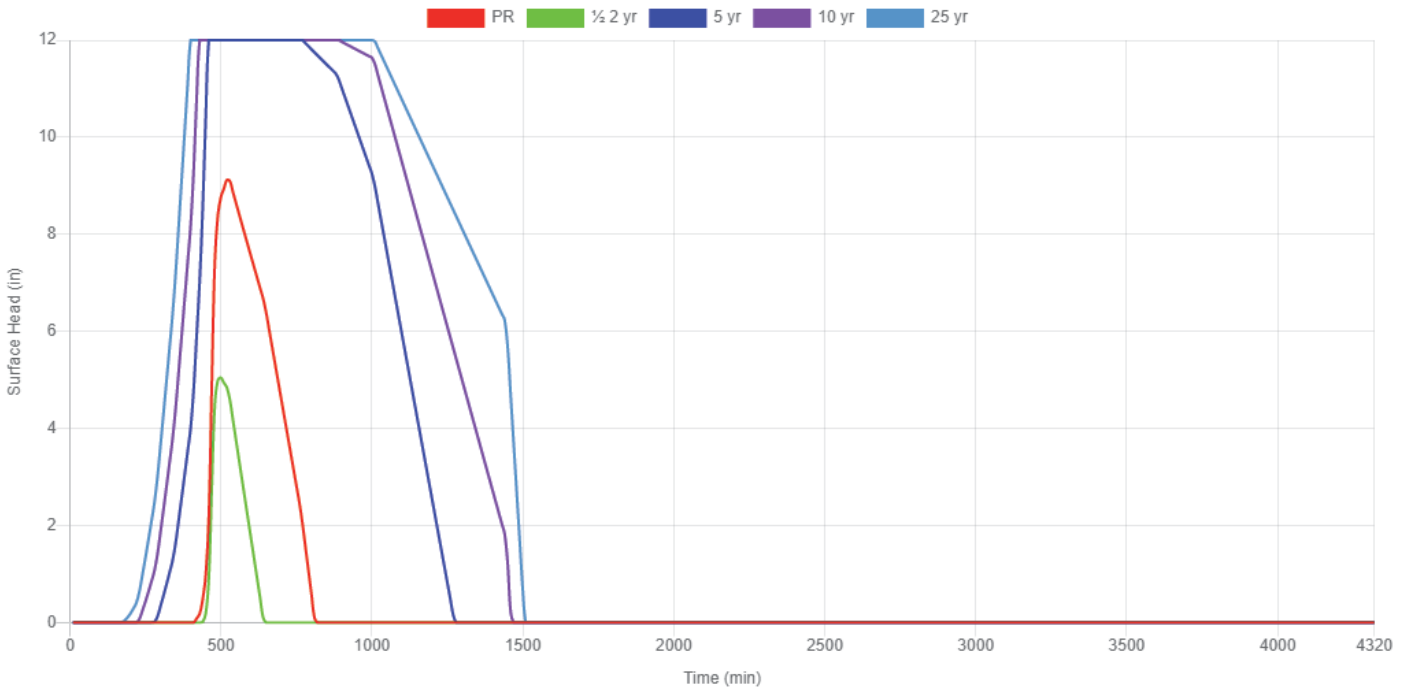
	Overflow		Underdrain Outflow		Infiltration	
	Peak Rate (cfs)	Total Volume (cf)	Peak Rate (cfs)	Total Volume (cf)	Peak Rate (cfs)	Total Volume (cf)
PR	0	0	0.044	2084.6	0	0
1/2 2-Year	0	0	0.044	1629.9	0	0
5-Year	0.267	732	0.044	3274.4	0	0
10-Year	0.323	1213.7	0.044	3540.5	0	0
25-Year	0.368	1653.3	0.044	3699.6	0	0

Flat Planter

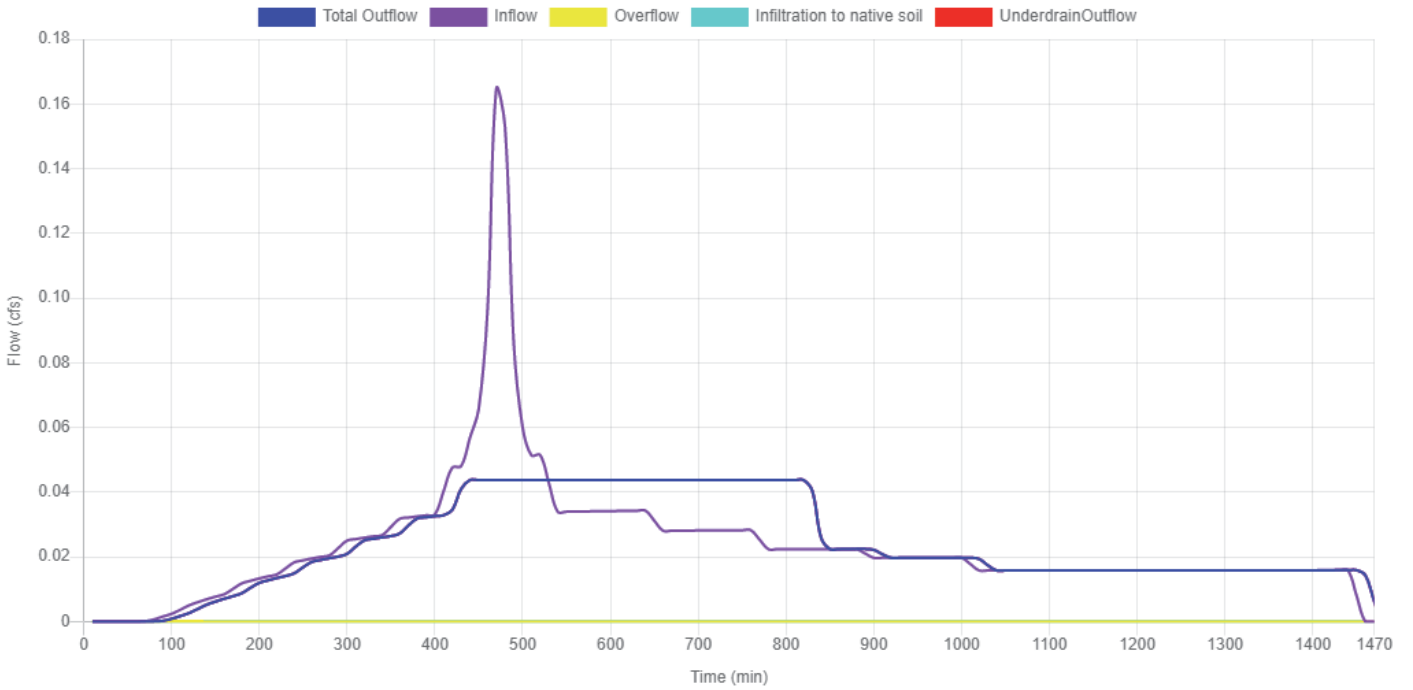
Site Soils & Infiltration Testing	Category
	Flat Planter
	Shape
	Null
	Location
	Parcel
	Configuration
	D: Lined Facility with RS and Ud
	Above Grade Storage Data
	Bottom Area
	315 sq ft
	Bottom Width
	11.00 ft
	Overflow Height
	12 in
	Total Depth of Blended Soil plus Rock
	30 in
	Surface Storage Capacity at Overflow
	315 cu ft
	Design Infiltration Rate to Soil Underlying the Facility
	0.000 cfs
Design Infiltration Rate for Imported Blended Soil in the Facility	
0.044 cfs	
Below Grade Storage Data	
Catchment is too small for flow control?	
No	
Rock Area	
94.50 sq ft	
Rock Width	
3.00 ft	
Rock Storage Depth	
12.0 in	
Rock Porosity	
0.3	
Underdrain Height	

	<p>4 in</p> <p>Percent of Facility Base that Allows Infiltration</p> <p>0 %</p> <p>Orifice (Y/N)?</p> <p>No</p> <p>Why no orifice</p> <p>Water-quality-only facility</p>																				
<p>Facility Facts</p>	<p>Total Facility Area (excluding freeboard)</p> <p>315.00 sq ft</p> <p>Sizing Ratio</p> <p>1.75 %</p>																				
<p>Pollution Reduction Results</p>	<p>Pollution Reduction Score</p> <p>Pass</p> <p>Overflow Volume</p> <p>0.00 cf</p> <p>Surface Capacity Used</p> <p>75.99 %</p>																				
<p>Flow Control Results</p>	<p>Flow Control Score</p> <p>Fail</p> <table border="1" data-bbox="662 1160 1489 1554"> <thead> <tr> <th></th> <th>STORMWATER FACILITY OUTFLOW (CFS)</th> <th></th> <th>PRE-DEVELOPMENT RUNOFF (CFS)</th> </tr> </thead> <tbody> <tr> <td>½ the 2 year</td> <td>0.0438</td> <td><=</td> <td>0.0397</td> </tr> <tr> <td>5 year</td> <td>0.3107</td> <td><=</td> <td>0.1207</td> </tr> <tr> <td>10 year</td> <td>0.3667</td> <td><=</td> <td>0.1652</td> </tr> <tr> <td>25 year</td> <td>0.4113</td> <td><=</td> <td>0.2024</td> </tr> </tbody> </table>		STORMWATER FACILITY OUTFLOW (CFS)		PRE-DEVELOPMENT RUNOFF (CFS)	½ the 2 year	0.0438	<=	0.0397	5 year	0.3107	<=	0.1207	10 year	0.3667	<=	0.1652	25 year	0.4113	<=	0.2024
	STORMWATER FACILITY OUTFLOW (CFS)		PRE-DEVELOPMENT RUNOFF (CFS)																		
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10 year	0.3667	<=	0.1652																		
25 year	0.4113	<=	0.2024																		

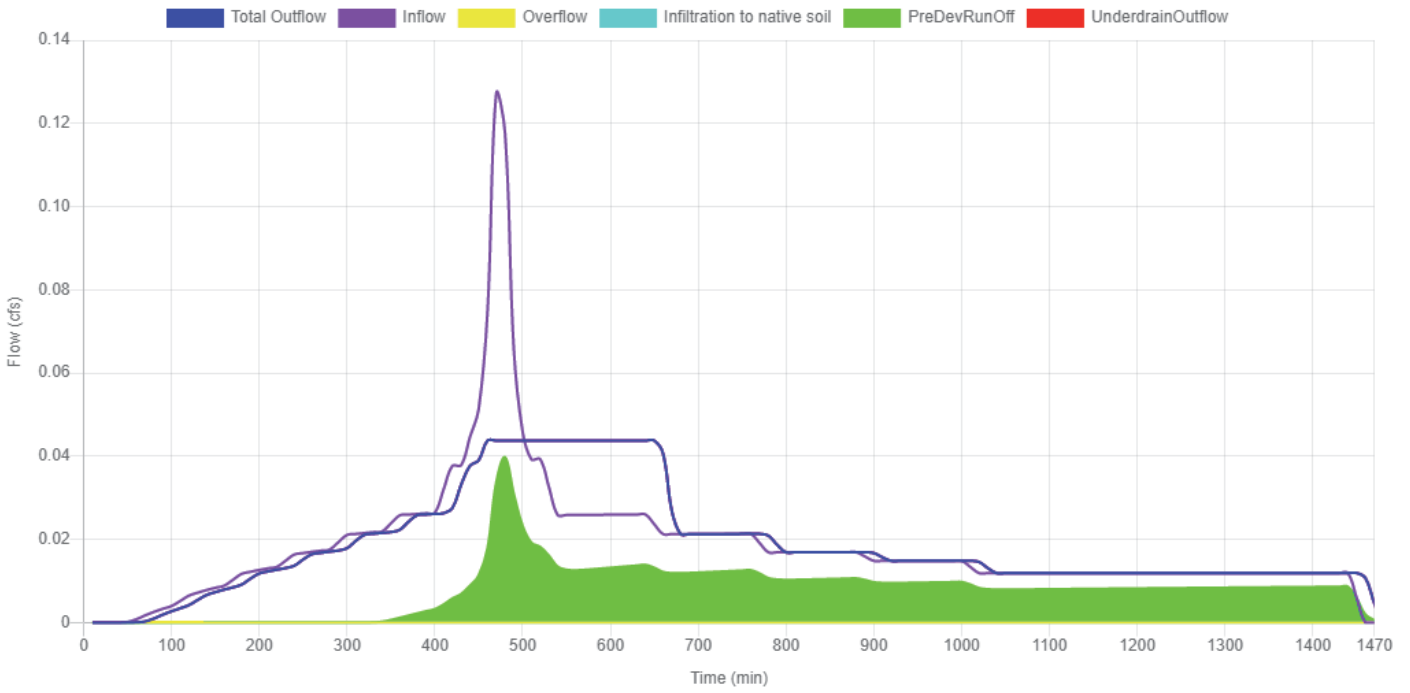
Surface Head



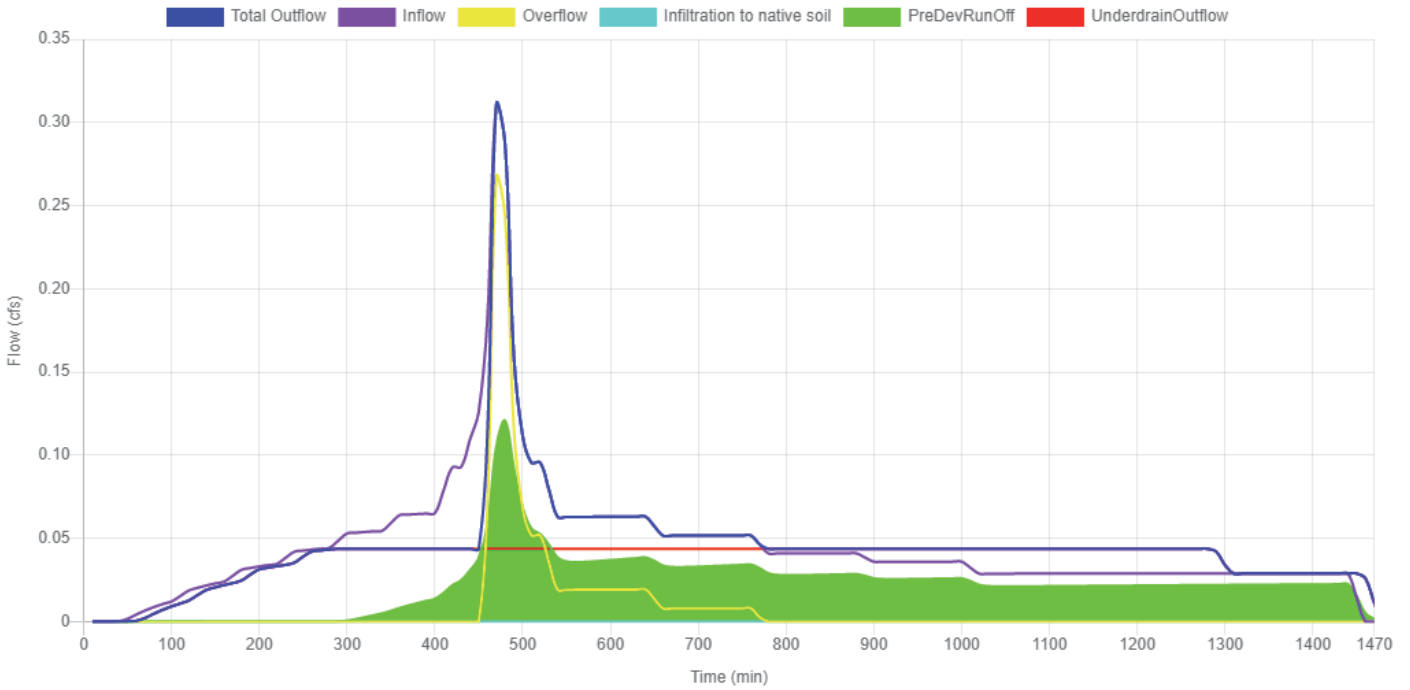
Water Quality



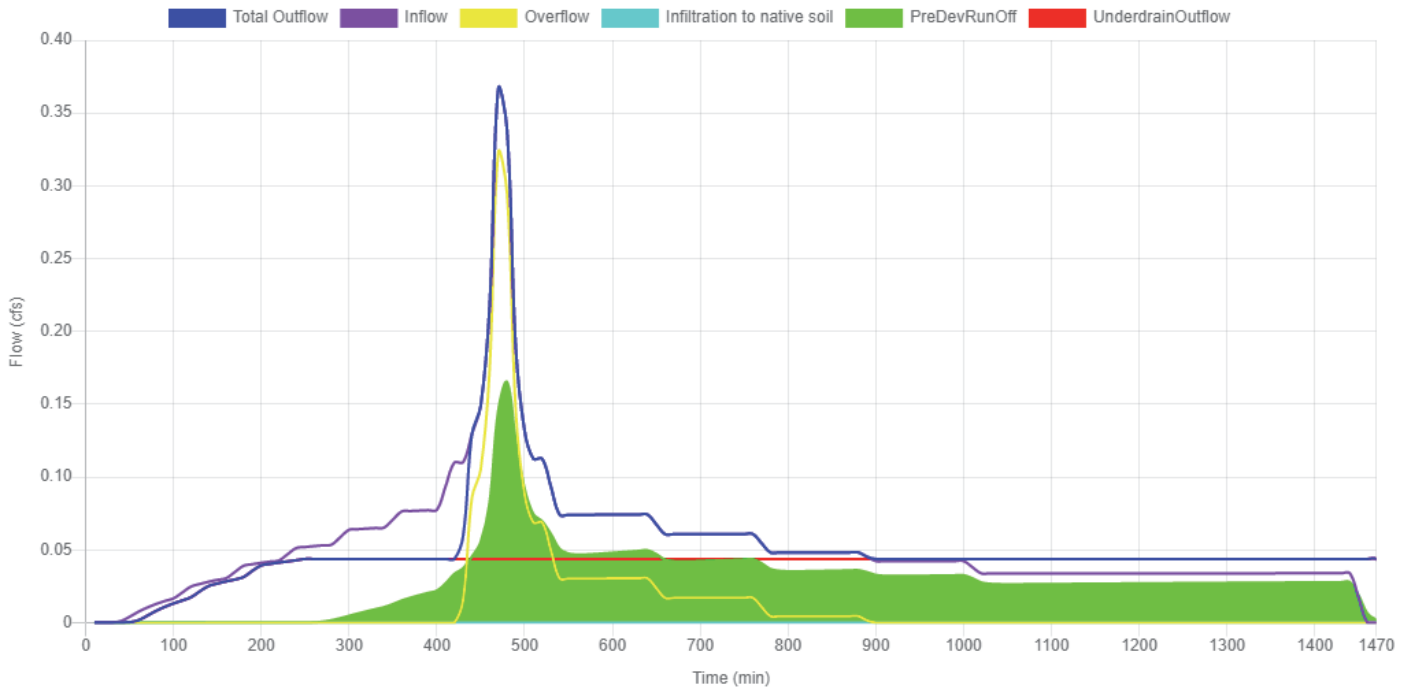
1/2 2-Year



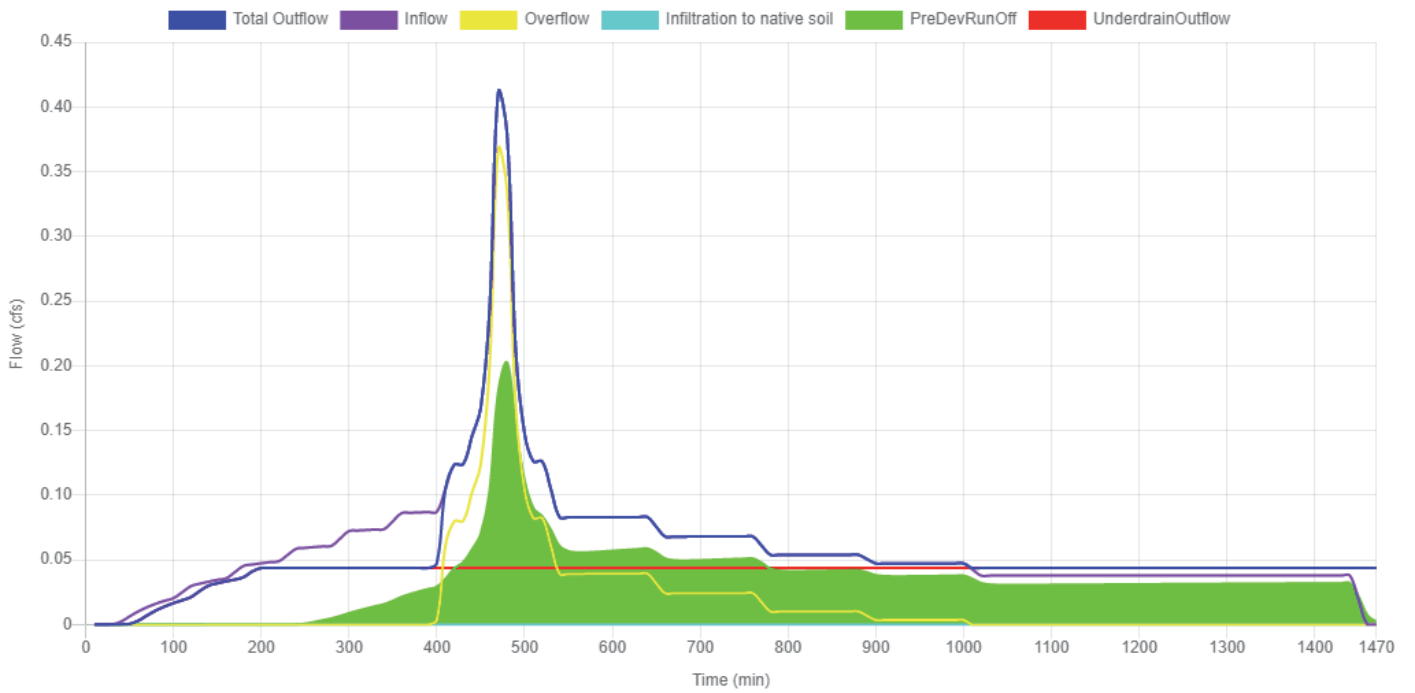
5-Year



10-Year



25-Year

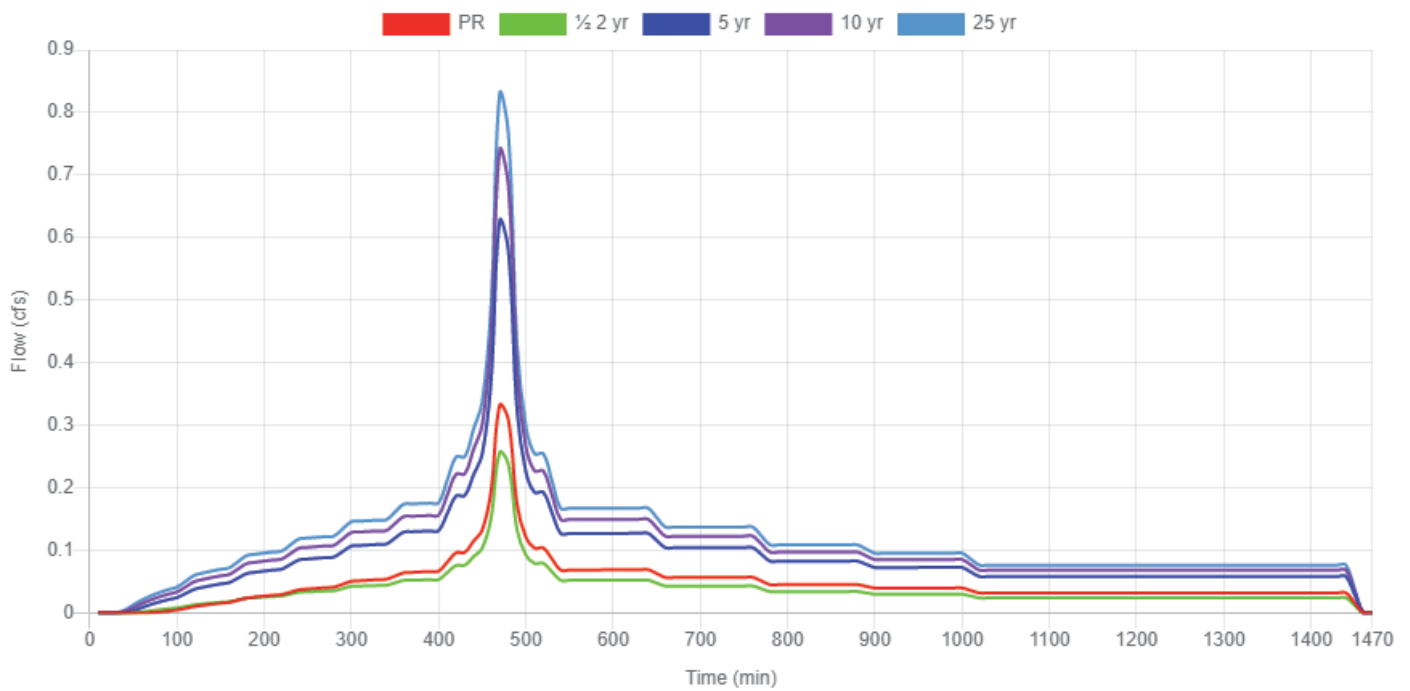


70A

<p>Site Soils & Infiltration Testing</p>	<p>Infiltration Testing Procedure NA</p> <p>Tested Native Soil Infiltration Rate 0 in/hr</p>
<p>Correction Factor</p>	<p>CF test 2</p>
<p>Design Infiltration Rates</p>	<p>Native Soil 0 in/hr</p> <p>Imported Blended Soil 6 in/hr</p>
<p>Catchment Information</p>	<p>Hierarchy Level 2B</p> <p>Hierarchy Description Discharge to an overland storm drainage system, including streams, drainageways, and ditches, or to a storm-only pipe system that discharges to an overland storm drainage system.</p> <p>Pollution Reduction Requirement Filter the post-development stormwater runoff from the water quality storm event through the blended soil.</p> <p>Infiltration Requirement N/A</p> <p>Flow Control Requirement Limit the ½ the 2-yr, the 5-yr, and the 10-yr post-development peak flows to their respective pre-development peak flows. Unless the facility is a public facility (i.e., in the public right-of-way), also limit the 25-yr post-development peak flow to the 25-year pre-development peak flow.</p> <p>Impervious Area 36357 sq ft 0.835 acre</p> <p>Pre-Development Time of Concentration (T_{c pre}) 10 min</p> <p>Post-Development Time of Concentration (T_{c post}) 5 min</p> <p>Pre-Development Curve Number (CN_{pre}) 82</p> <p>Post-Development Curve Number (CN_{post}) 98</p>

SBUH Results

Post-Development Runoff



	Pre - Development Rate and Volume		Post - Development Rate and Volume	
	Peak Rate (cfs)	Total Volume (cf)	Peak Rate (cfs)	Total Volume (cf)
PR	0.0492	1234.2	0.3321	4207.1
½ 2-Year	0.0802	1401.6	0.2567	3289.3
5-Year	0.2436	3940.9	0.6269	8085.5
10-Year	0.3333	5151.8	0.74	9594.6
25-Year	0.4084	6159.8	0.8302	10802.9

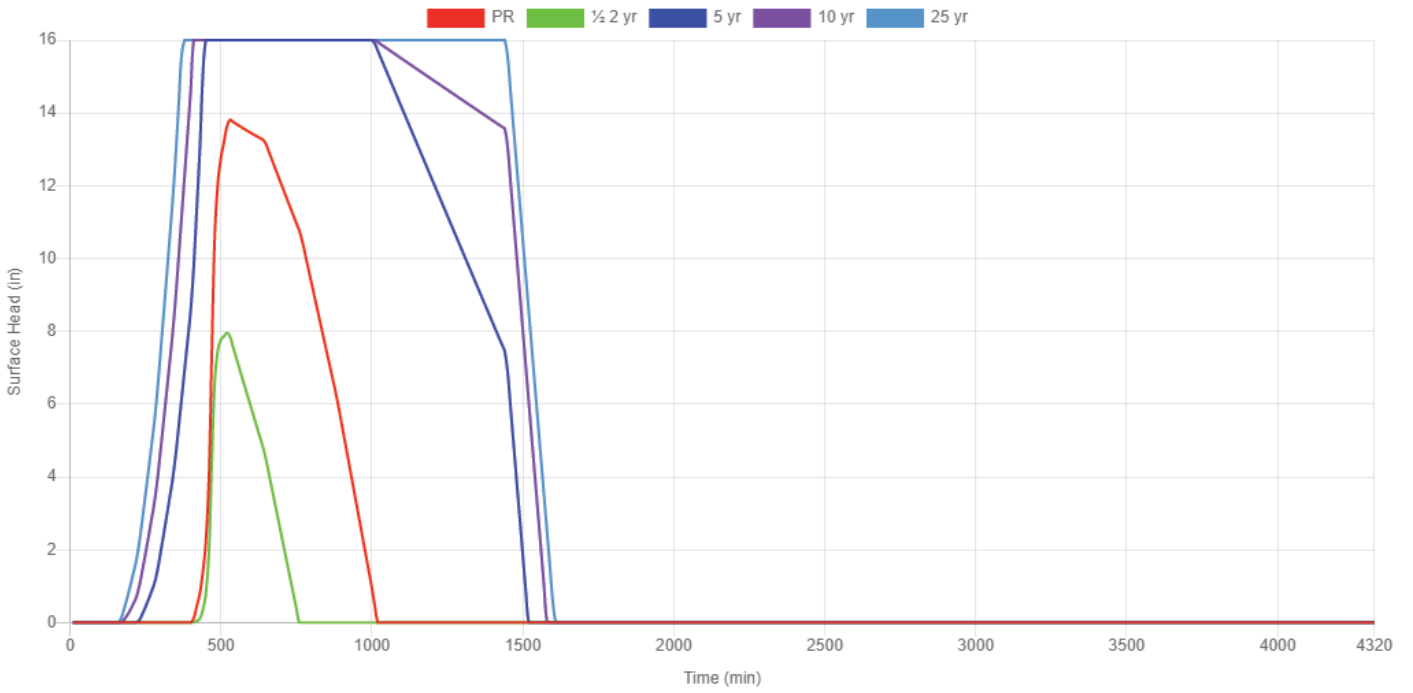
	Overflow		Underdrain Outflow		Infiltration	
	Peak Rate (cfs)	Total Volume (cf)	Peak Rate (cfs)	Total Volume (cf)	Peak Rate (cfs)	Total Volume (cf)
PR	0	0	0.072	4207.1	0	0
½ 2-Year	0	0	0.072	3289.3	0	0
5-Year	0.554	2000.3	0.072	6085.2	0	0
10-Year	0.667	3142.4	0.072	6452.2	0	0
25-Year	0.758	4180	0.072	6622.9	0	0

Flat Planter

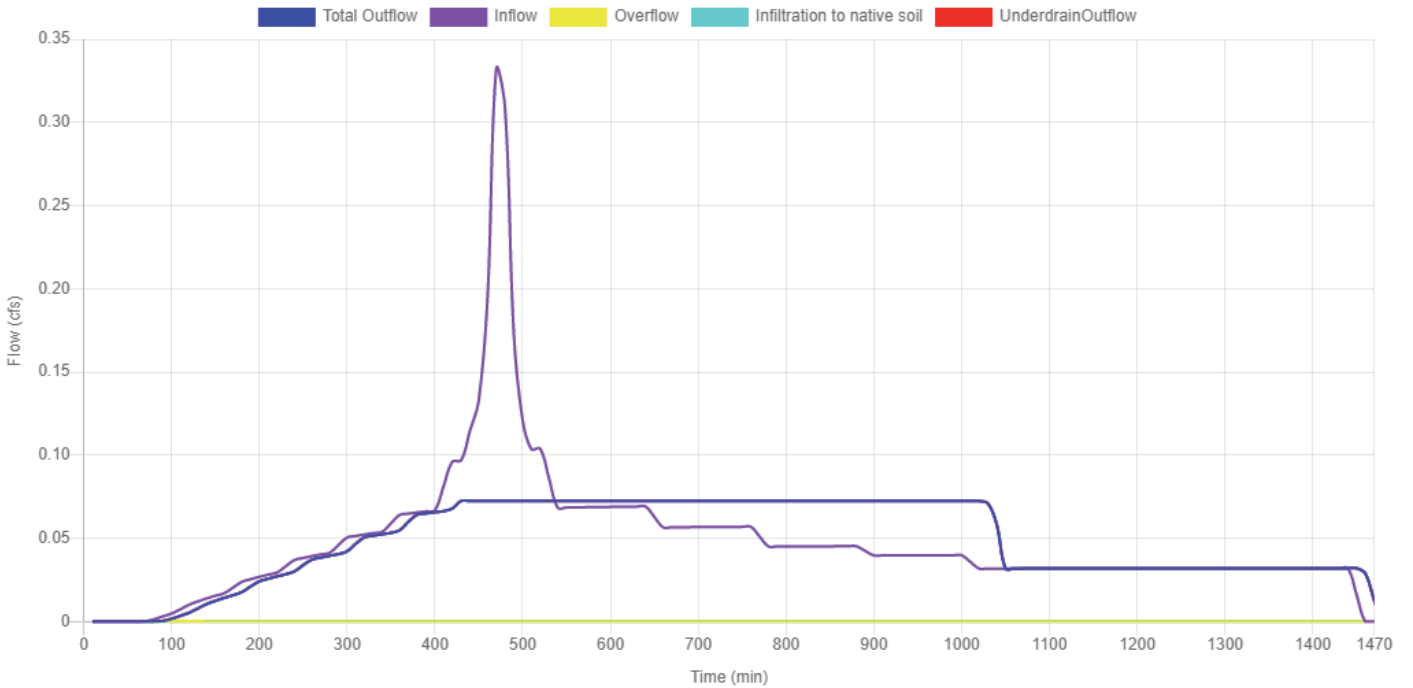
Site Soils & Infiltration Testing	Category
	Flat Planter
	Shape
	Null
	Location
	Parcel
	Configuration
	D: Lined Facility with RS and Ud
	Above Grade Storage Data
	Bottom Area
	522 sq ft
	Bottom Width
	11.00 ft
	Overflow Height
	16.0 in
	Total Depth of Blended Soil plus Rock
	30 in
	Surface Storage Capacity at Overflow
	696 cu ft
	Design Infiltration Rate to Soil Underlying the Facility
	0.000 cfs
Design Infiltration Rate for Imported Blended Soil in the Facility	
0.073 cfs	
Below Grade Storage Data	
Catchment is too small for flow control?	
No	
Rock Area	
150.00 sq ft	
Rock Width	
3.00 ft	
Rock Storage Depth	
12.0 in	
Rock Porosity	
0.3	
Underdrain Height	

	<p>4 in</p> <p>Percent of Facility Base that Allows Infiltration</p> <p>0 %</p> <p>Orifice (Y/N)?</p> <p>No</p> <p>Why no orifice</p> <p>Water-quality-only facility</p>																				
<p>Facility Facts</p>	<p>Total Facility Area (excluding freeboard)</p> <p>522.00 sq ft</p> <p>Sizing Ratio</p> <p>1.44 %</p>																				
<p>Pollution Reduction Results</p>	<p>Pollution Reduction Score</p> <p>Pass</p> <p>Overflow Volume</p> <p>0.00 cf</p> <p>Surface Capacity Used</p> <p>86.33 %</p>																				
<p>Flow Control Results</p>	<p>Flow Control Score</p> <p>Fail</p> <table border="1" data-bbox="662 1160 1489 1554"> <thead> <tr> <th></th> <th>STORMWATER FACILITY OUTFLOW (CFS)</th> <th></th> <th>PRE-DEVELOPMENT RUNOFF (CFS)</th> </tr> </thead> <tbody> <tr> <td>½ the 2 year</td> <td>0.0725</td> <td><=</td> <td>0.0802</td> </tr> <tr> <td>5 year</td> <td>0.6269</td> <td><=</td> <td>0.2436</td> </tr> <tr> <td>10 year</td> <td>0.7400</td> <td><=</td> <td>0.3333</td> </tr> <tr> <td>25 year</td> <td>0.8302</td> <td><=</td> <td>0.4084</td> </tr> </tbody> </table>		STORMWATER FACILITY OUTFLOW (CFS)		PRE-DEVELOPMENT RUNOFF (CFS)	½ the 2 year	0.0725	<=	0.0802	5 year	0.6269	<=	0.2436	10 year	0.7400	<=	0.3333	25 year	0.8302	<=	0.4084
	STORMWATER FACILITY OUTFLOW (CFS)		PRE-DEVELOPMENT RUNOFF (CFS)																		
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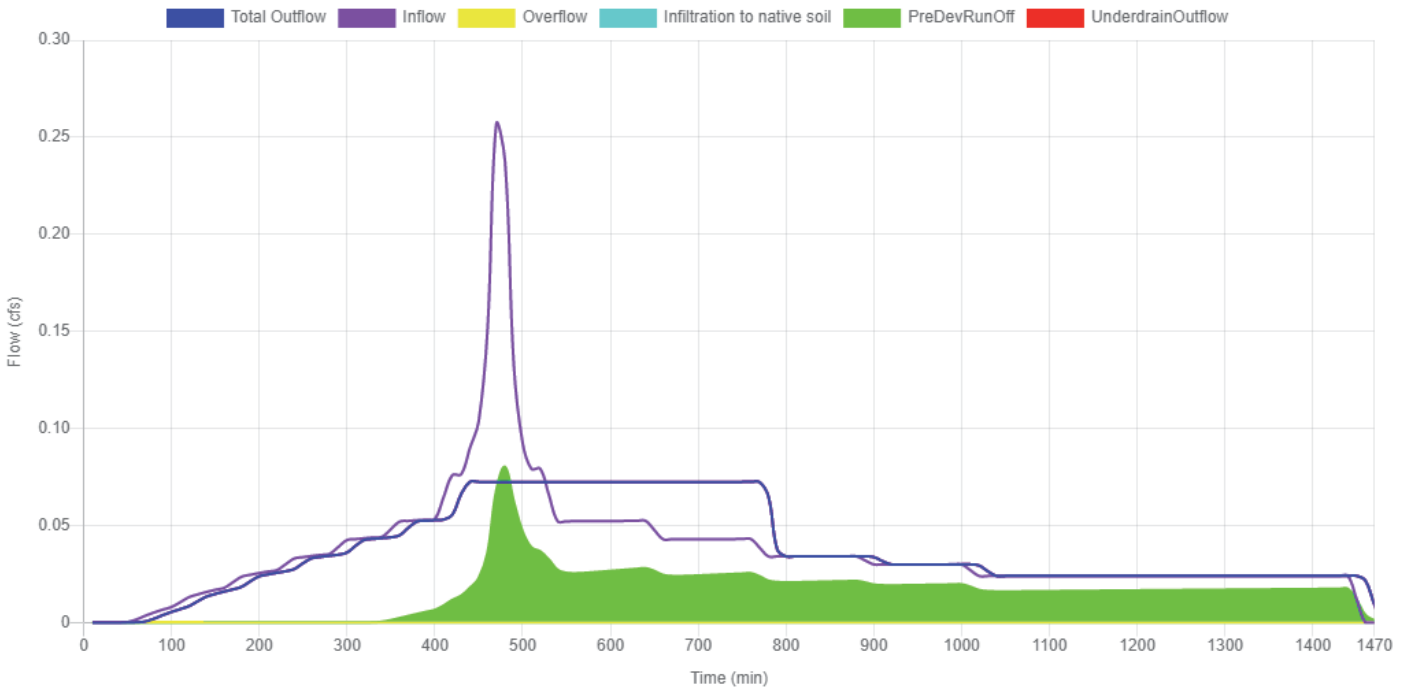
Surface Head



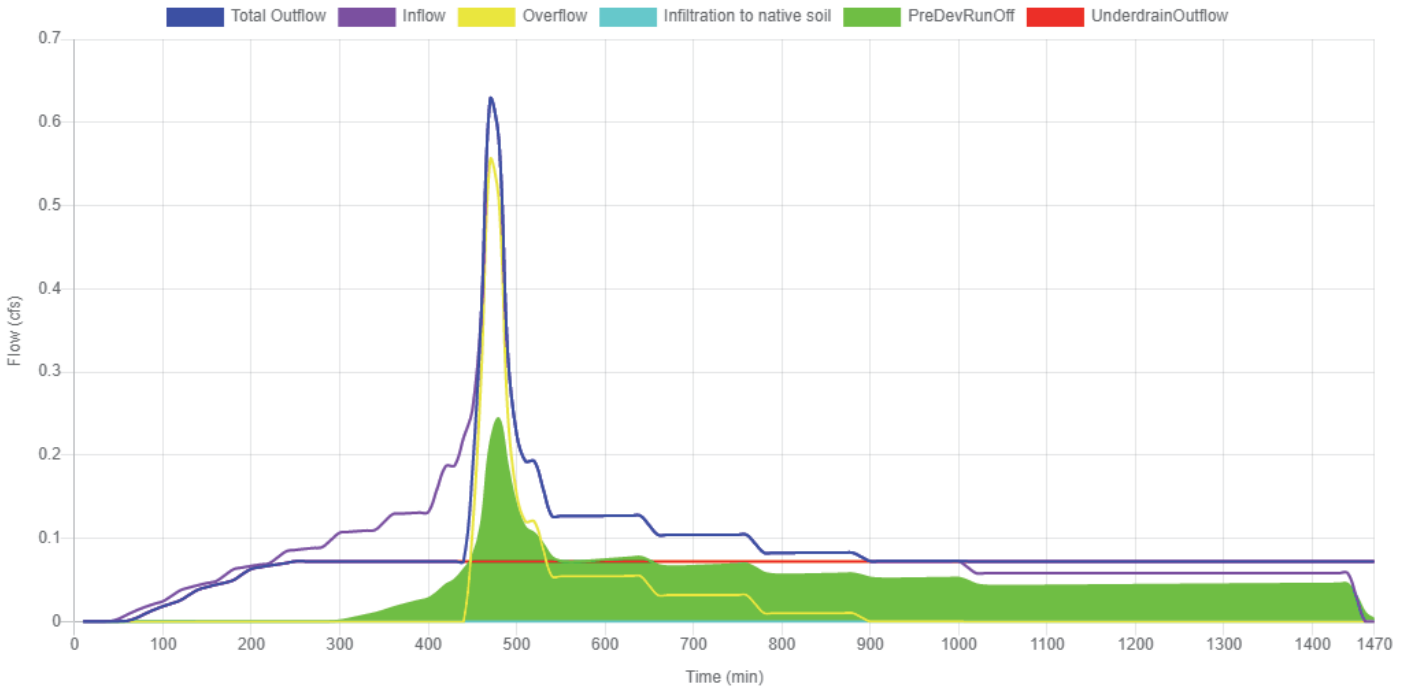
Water Quality



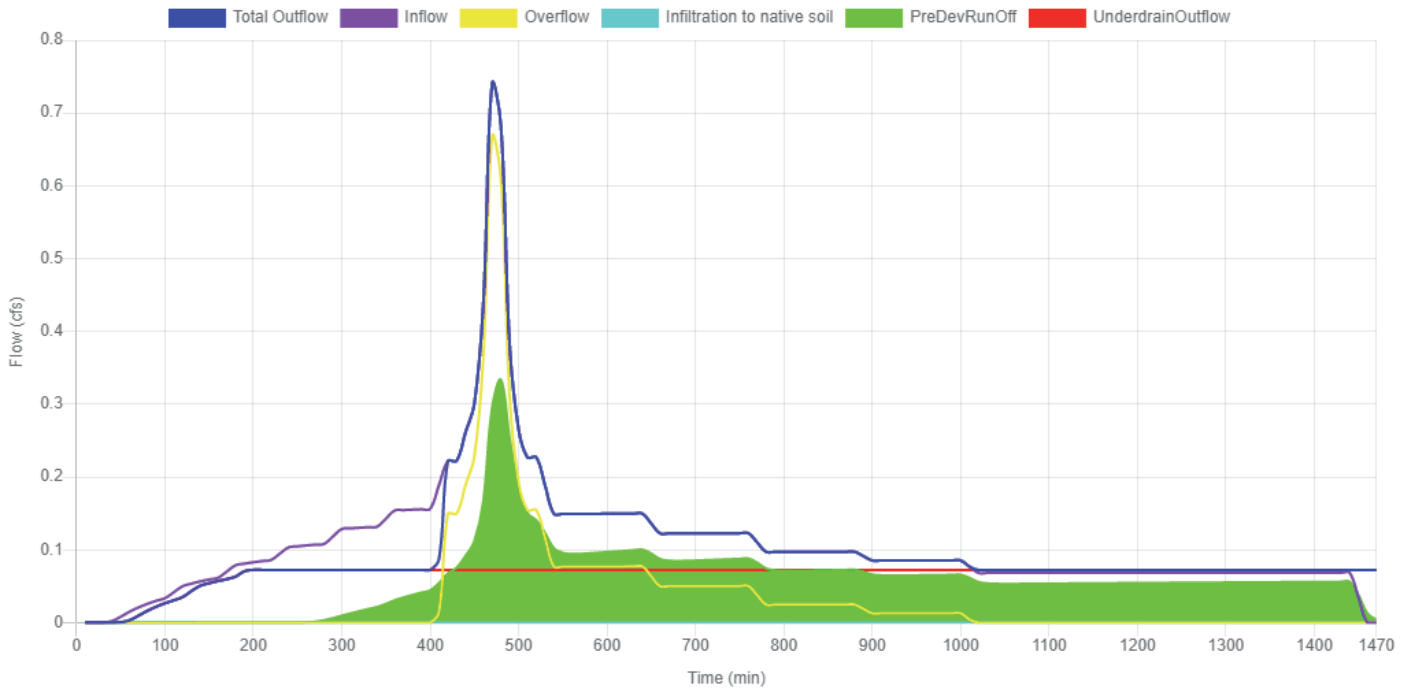
1/2 2-Year



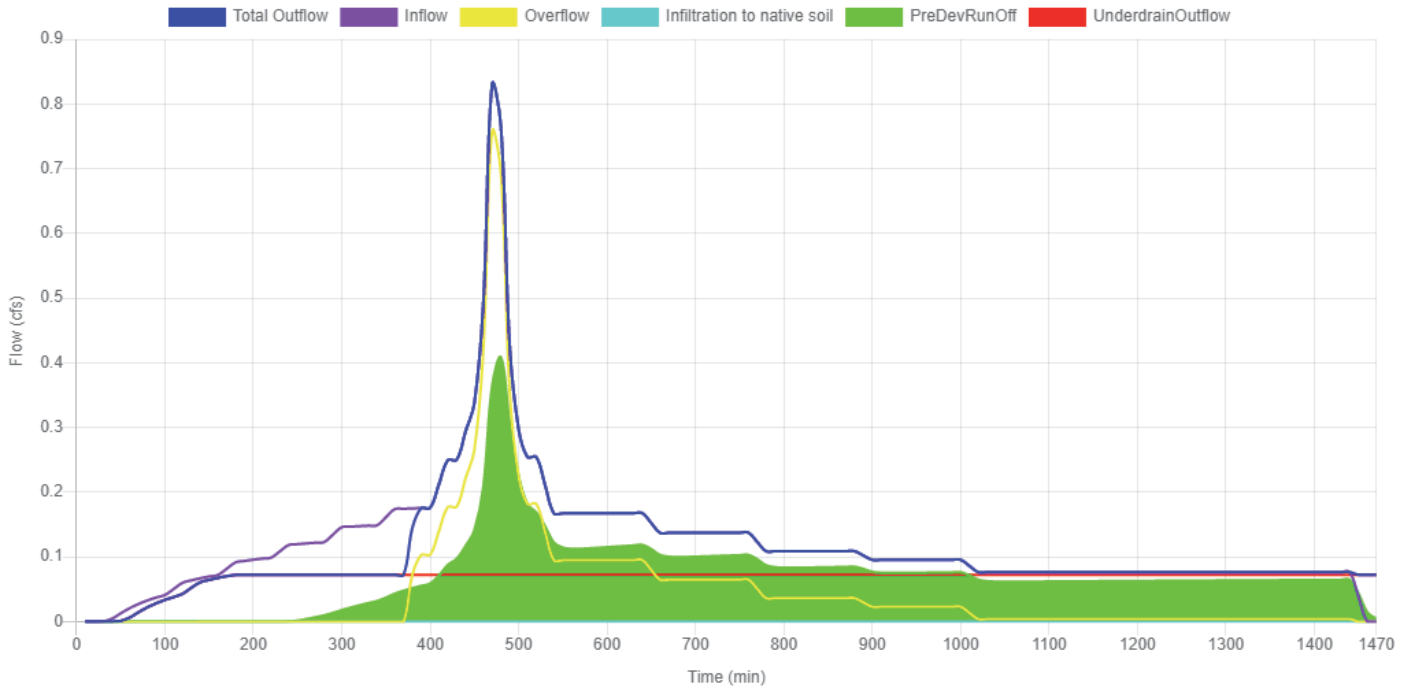
5-Year



10-Year



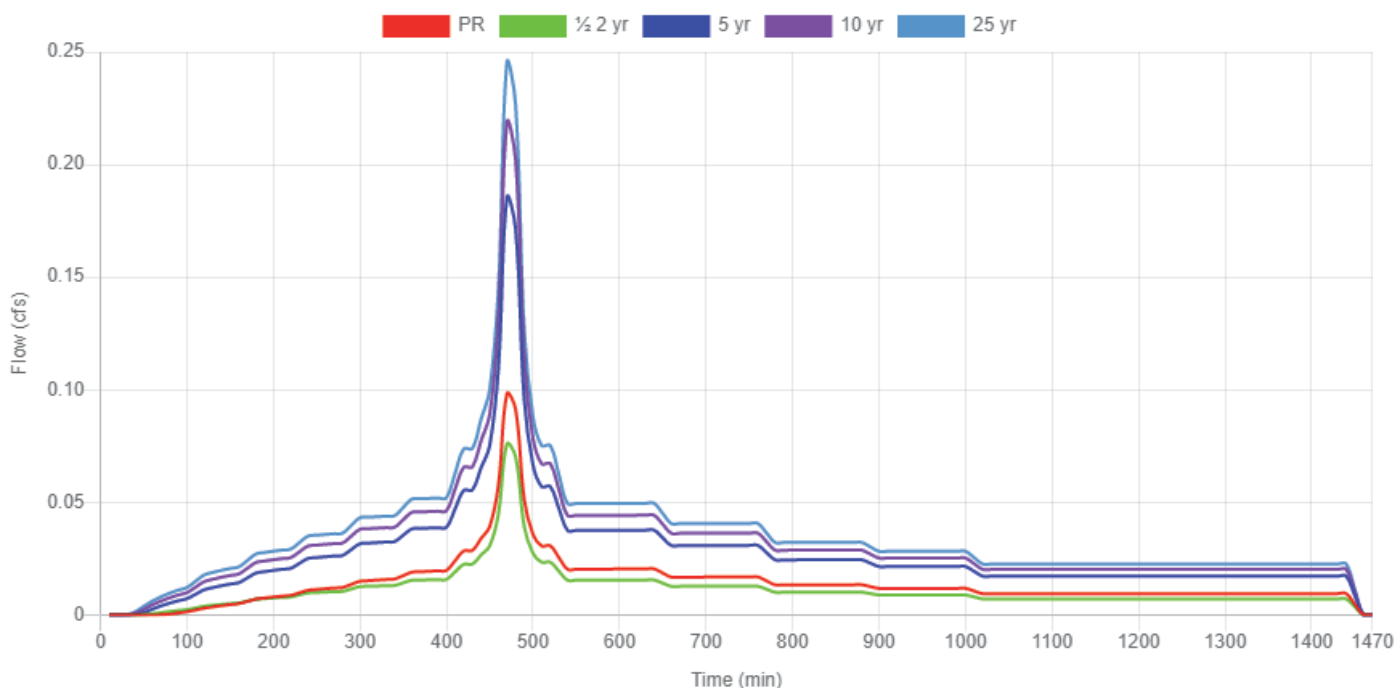
25-Year



Site Soils & Infiltration Testing	Infiltration Testing Procedure NA Tested Native Soil Infiltration Rate 0 in/hr
Correction Factor	CF test 2
Design Infiltration Rates	Native Soil 0 in/hr Imported Blended Soil 6 in/hr
Catchment Information	Hierarchy Level 2B Hierarchy Description Discharge to an overland storm drainage system, including streams, drainageways, and ditches, or to a storm-only pipe system that discharges to an overland storm drainage system. Pollution Reduction Requirement Filter the post-development stormwater runoff from the water quality storm event through the blended soil. Infiltration Requirement N/A Flow Control Requirement Limit the ½ the 2-yr, the 5-yr, and the 10-yr post-development peak flows to their respective pre-development peak flows. Unless the facility is a public facility (i.e., in the public right-of-way), also limit the 25-yr post-development peak flow to the 25-year pre-development peak flow. Impervious Area 10752 sq ft 0.247 acre Pre-Development Time of Concentration (T_{c pre}) 10 min Post-Development Time of Concentration (T_{c post}) 5 min Pre-Development Curve Number (CN_{pre}) 82 Post-Development Curve Number (CN_{post}) 98

SBUH Results

Post-Development Runoff



	Pre - Development Rate and Volume		Post - Development Rate and Volume	
	Peak Rate (cfs)	Total Volume (cf)	Peak Rate (cfs)	Total Volume (cf)
PR	0.0145	365	0.0982	1244.2
1/2 2-Year	0.0237	414.5	0.0759	972.8
5-Year	0.0721	1165.5	0.1854	2391.2
10-Year	0.0986	1523.5	0.2188	2837.4
25-Year	0.1208	1821.7	0.2455	3194.8

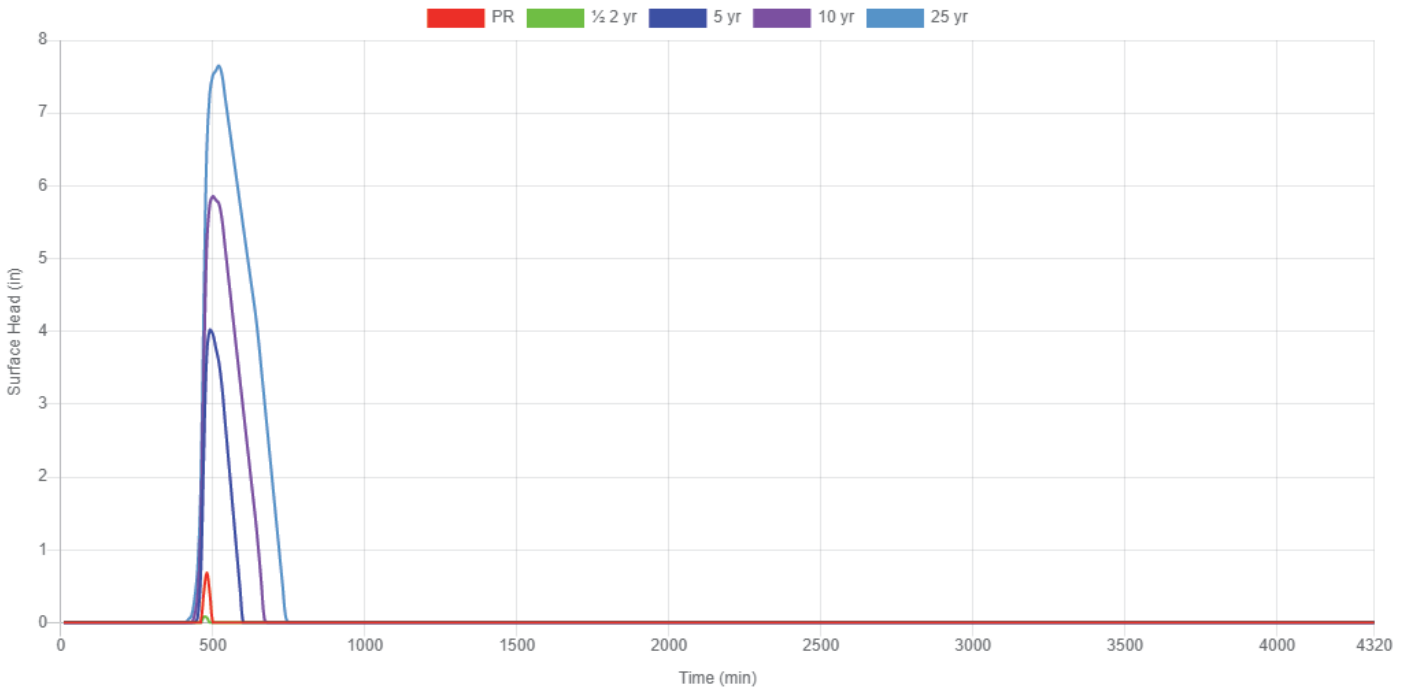
	Overflow		Underdrain Outflow		Infiltration	
	Peak Rate (cfs)	Total Volume (cf)	Peak Rate (cfs)	Total Volume (cf)	Peak Rate (cfs)	Total Volume (cf)
PR	0	0	0.071	1244.2	0	0
1/2 2-Year	0	0	0.071	972.8	0	0
5-Year	0	0	0.071	2391.2	0	0
10-Year	0	0	0.071	2837.4	0	0
25-Year	0	0	0.071	3194.8	0	0

Flat Planter

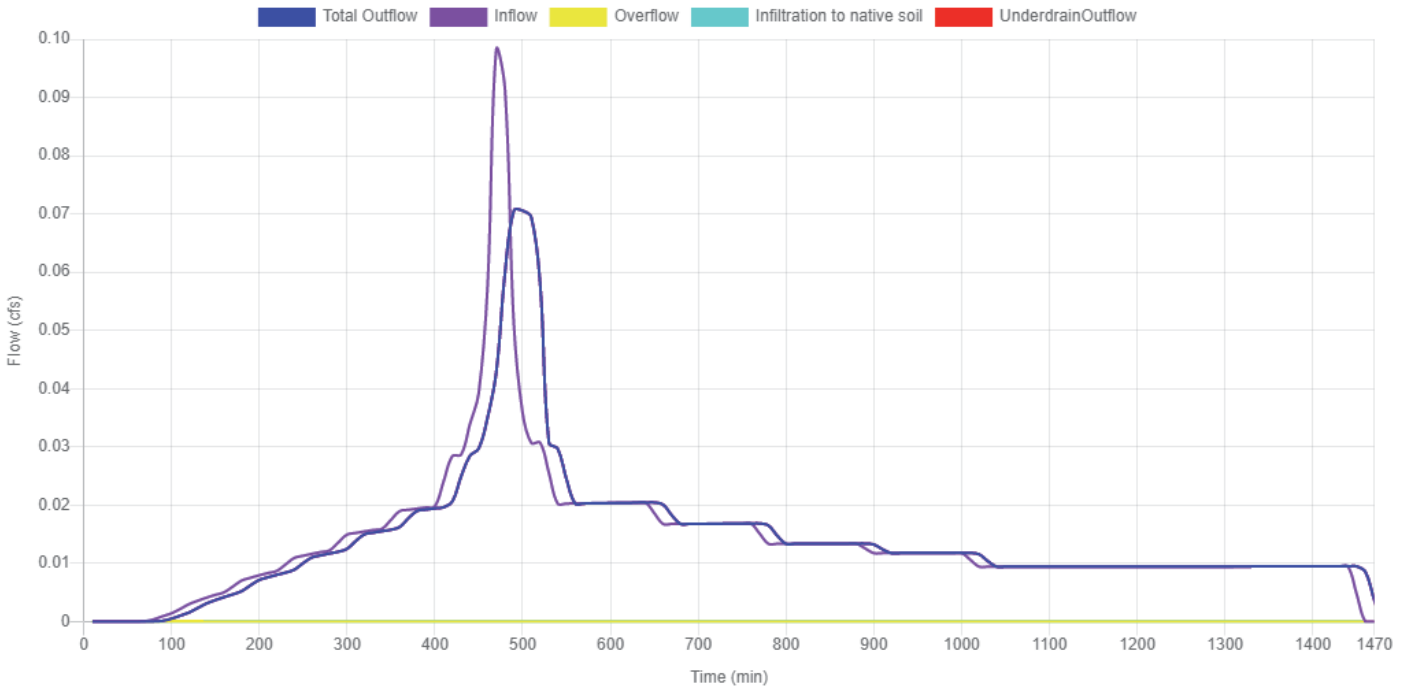
Site Soils & Infiltration Testing	Category
	Flat Planter
	Shape
	Null
	Location
	Parcel
	Configuration
	D: Lined Facility with RS and Ud
	Above Grade Storage Data
	Bottom Area
	508 sq ft
	Bottom Width
	7.50 ft
	Overflow Height
	12 in
	Total Depth of Blended Soil plus Rock
	30 in
	Surface Storage Capacity at Overflow
	508 cu ft
	Design Infiltration Rate to Soil Underlying the Facility
	0.000 cfs
Design Infiltration Rate for Imported Blended Soil in the Facility	
0.071 cfs	
Below Grade Storage Data	
Catchment is too small for flow control?	
No	
Rock Area	
204.00 sq ft	
Rock Width	
3.00 ft	
Rock Storage Depth	
12.0 in	
Rock Porosity	
0.3	
Underdrain Height	

	<p>4 in</p> <p>Percent of Facility Base that Allows Infiltration</p> <p>0 %</p> <p>Orifice (Y/N)?</p> <p>No</p> <p>Why no orifice</p> <p>Water-quality-only facility</p>																				
<p>Facility Facts</p>	<p>Total Facility Area (excluding freeboard)</p> <p>508.00 sq ft</p> <p>Sizing Ratio</p> <p>4.72 %</p>																				
<p>Pollution Reduction Results</p>	<p>Pollution Reduction Score</p> <p>Pass</p> <p>Overflow Volume</p> <p>0.00 cf</p> <p>Surface Capacity Used</p> <p>5.71 %</p>																				
<p>Flow Control Results</p>	<p>Flow Control Score</p> <p>Fail</p> <table border="1" data-bbox="662 1160 1489 1554"> <thead> <tr> <th></th> <th>STORMWATER FACILITY OUTFLOW (CFS)</th> <th></th> <th>PRE-DEVELOPMENT RUNOFF (CFS)</th> </tr> </thead> <tbody> <tr> <td>½ the 2 year</td> <td>0.0706</td> <td><=</td> <td>0.0237</td> </tr> <tr> <td>5 year</td> <td>0.0706</td> <td><=</td> <td>0.0721</td> </tr> <tr> <td>10 year</td> <td>0.0706</td> <td><=</td> <td>0.0986</td> </tr> <tr> <td>25 year</td> <td>0.0706</td> <td><=</td> <td>0.1208</td> </tr> </tbody> </table>		STORMWATER FACILITY OUTFLOW (CFS)		PRE-DEVELOPMENT RUNOFF (CFS)	½ the 2 year	0.0706	<=	0.0237	5 year	0.0706	<=	0.0721	10 year	0.0706	<=	0.0986	25 year	0.0706	<=	0.1208
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5 year	0.0706	<=	0.0721																		
10 year	0.0706	<=	0.0986																		
25 year	0.0706	<=	0.1208																		

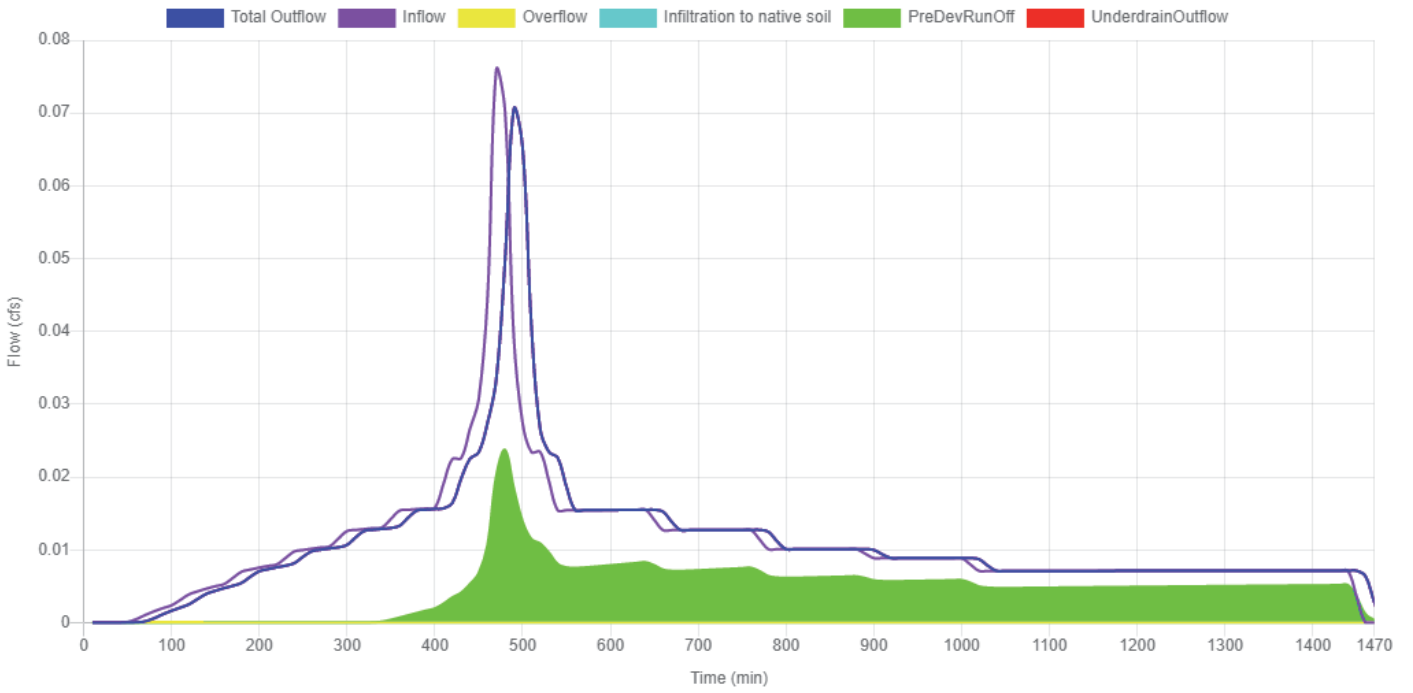
Surface Head



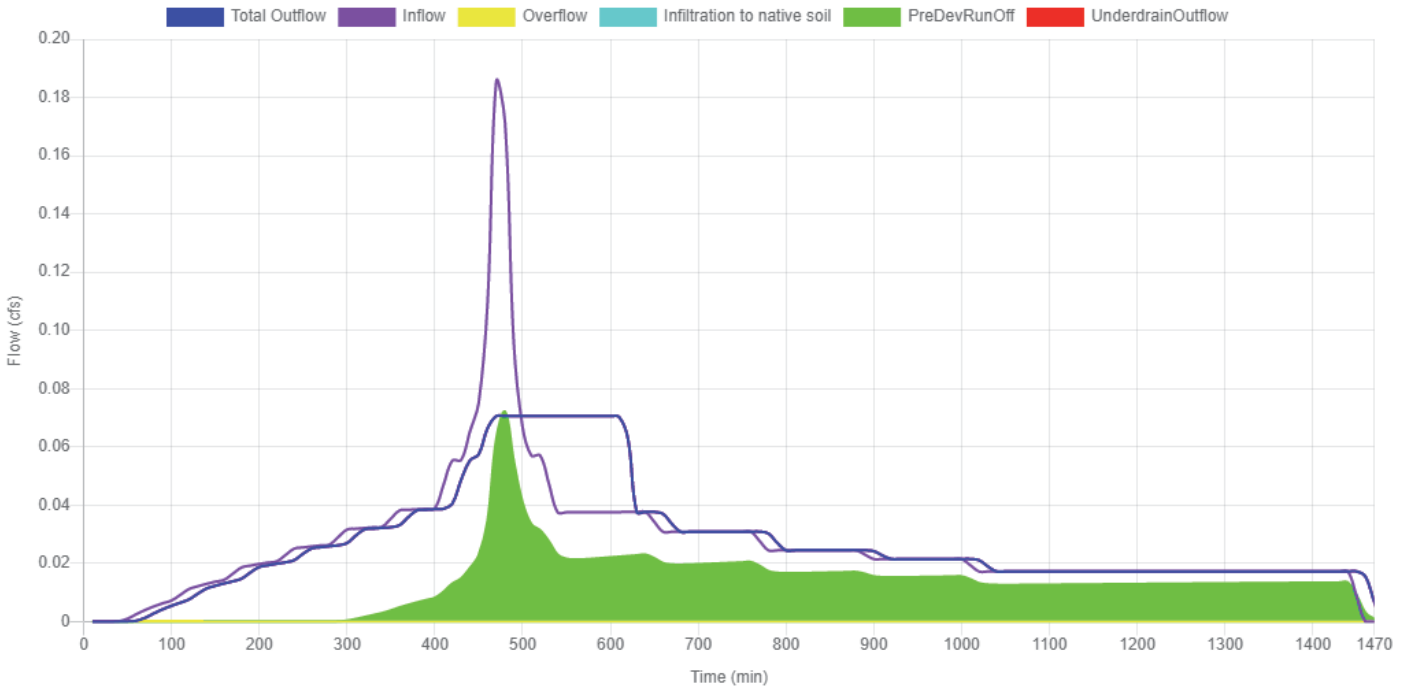
Water Quality



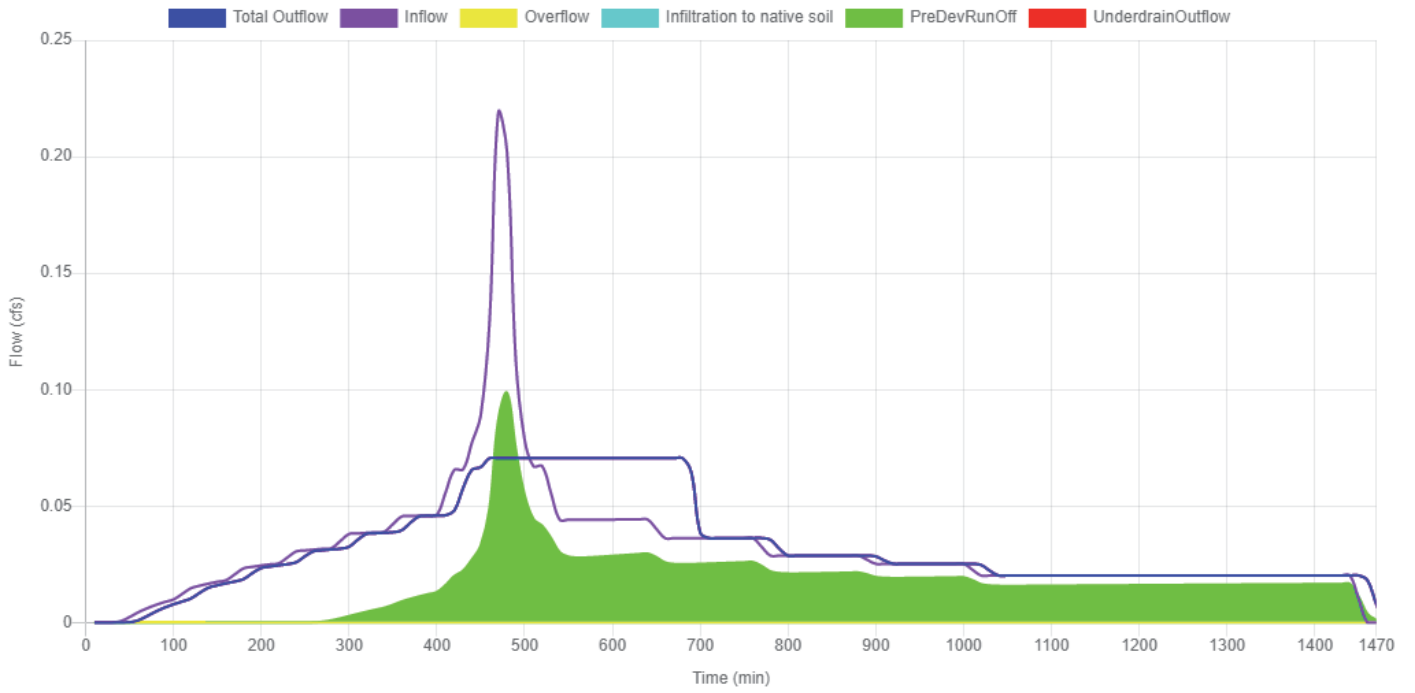
1/2 2-Year



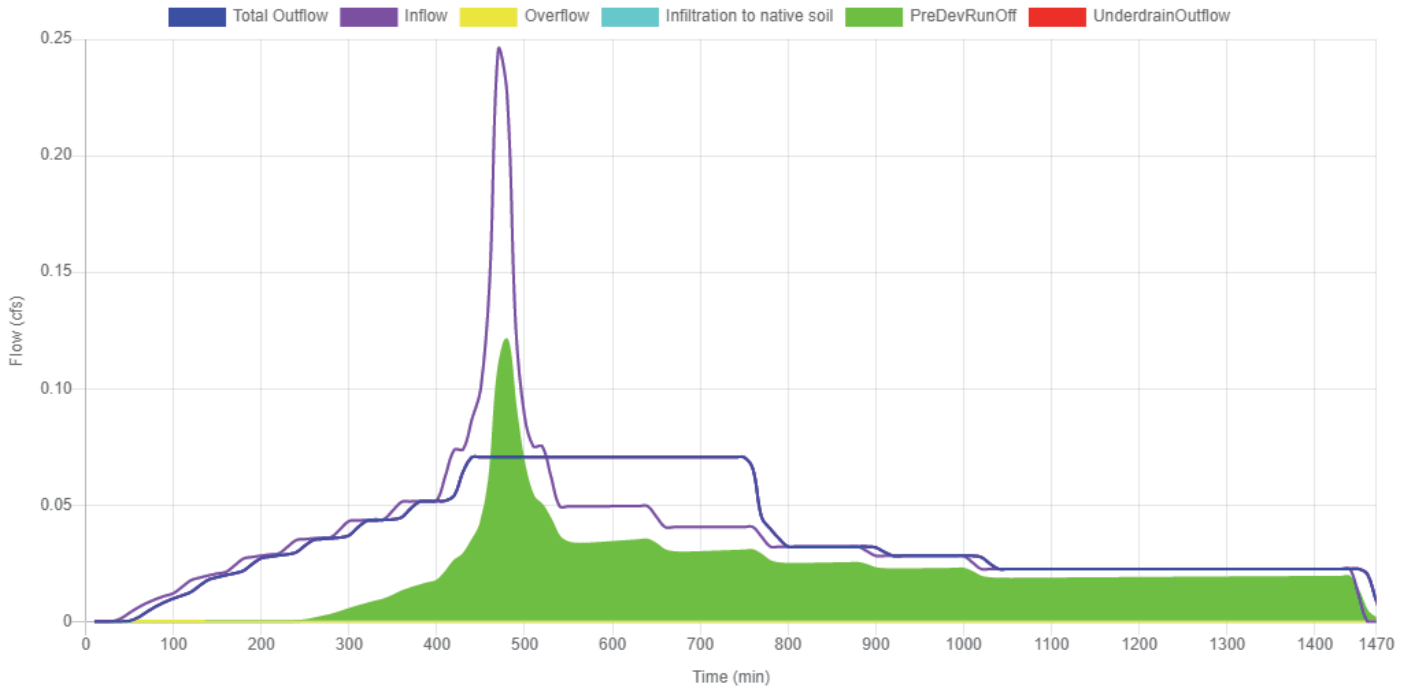
5-Year



10-Year



25-Year

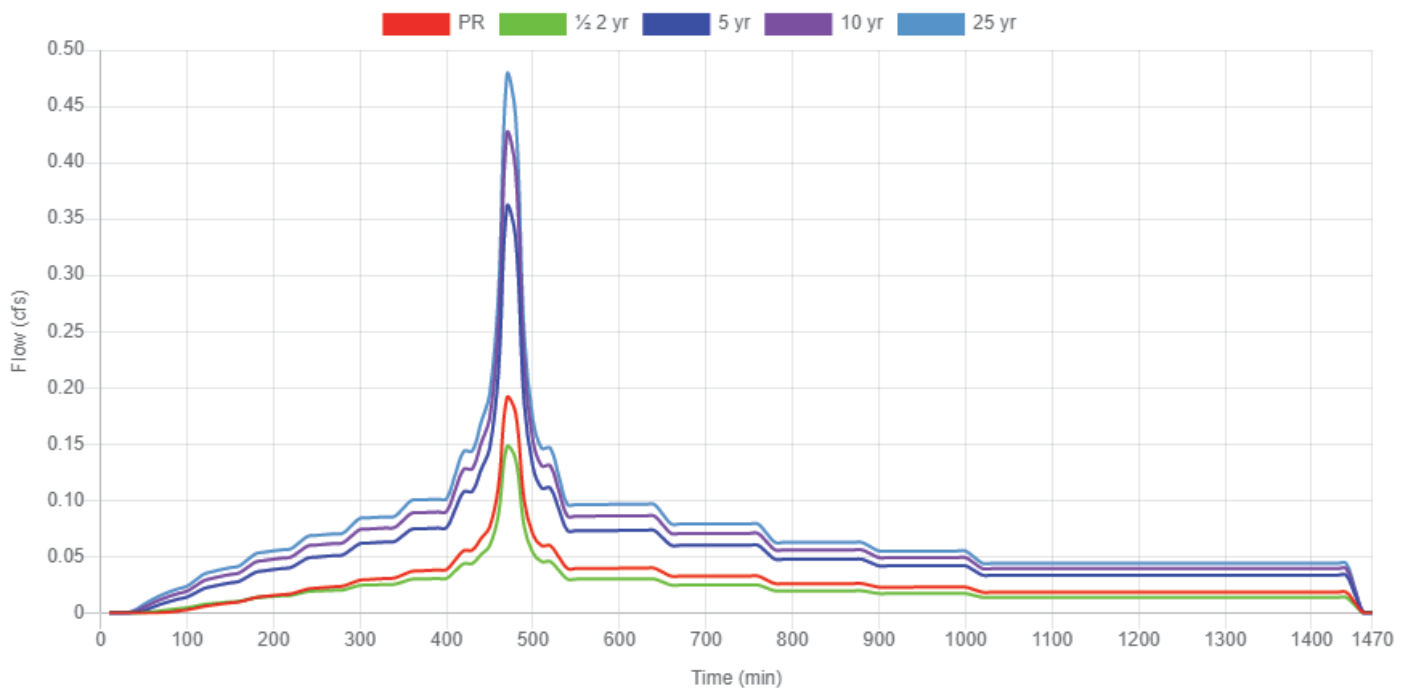


12B

<p>Site Soils & Infiltration Testing</p>	<p>Infiltration Testing Procedure NA</p> <p>Tested Native Soil Infiltration Rate 0 in/hr</p>
<p>Correction Factor</p>	<p>CF test 2</p>
<p>Design Infiltration Rates</p>	<p>Native Soil 0 in/hr</p> <p>Imported Blended Soil 6 in/hr</p>
<p>Catchment Information</p>	<p>Hierarchy Level 2B</p> <p>Hierarchy Description Discharge to an overland storm drainage system, including streams, drainageways, and ditches, or to a storm-only pipe system that discharges to an overland storm drainage system.</p> <p>Pollution Reduction Requirement Filter the post-development stormwater runoff from the water quality storm event through the blended soil.</p> <p>Infiltration Requirement N/A</p> <p>Flow Control Requirement Limit the ½ the 2-yr, the 5-yr, and the 10-yr post-development peak flows to their respective pre-development peak flows. Unless the facility is a public facility (i.e., in the public right-of-way), also limit the 25-yr post-development peak flow to the 25-year pre-development peak flow.</p> <p>Impervious Area 20925 sq ft 0.48 acre</p> <p>Pre-Development Time of Concentration (T_{c pre}) 10 min</p> <p>Post-Development Time of Concentration (T_{c post}) 5 min</p> <p>Pre-Development Curve Number (CN_{pre}) 82</p> <p>Post-Development Curve Number (CN_{post}) 98</p>

SBUH Results

Post-Development Runoff



	Pre - Development Rate and Volume		Post - Development Rate and Volume	
	Peak Rate (cfs)	Total Volume (cf)	Peak Rate (cfs)	Total Volume (cf)
PR	0.0283	710.3	0.1911	2421.4
½ 2-Year	0.0462	806.7	0.1477	1893.1
5-Year	0.1402	2268.2	0.3608	4653.5
10-Year	0.1918	2965.1	0.4259	5522.1
25-Year	0.2351	3545.2	0.4778	6217.5

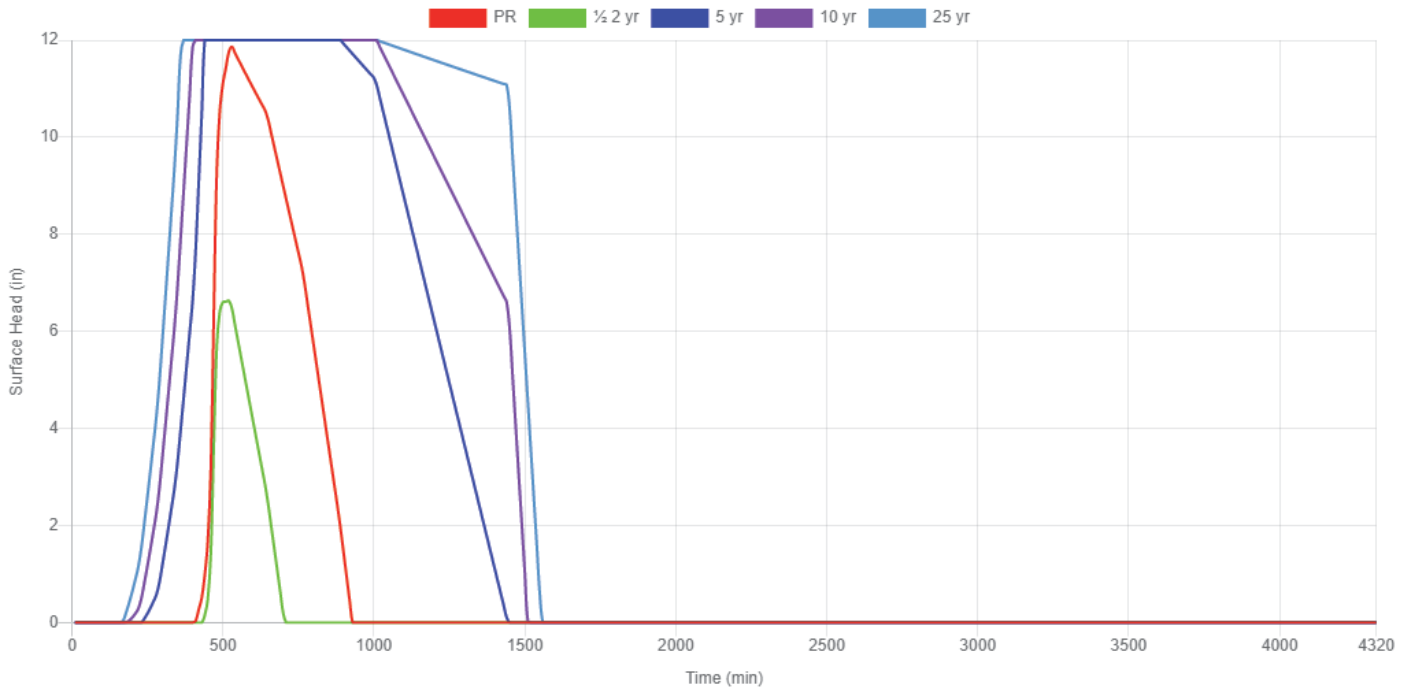
	Overflow		Underdrain Outflow		Infiltration	
	Peak Rate (cfs)	Total Volume (cf)	Peak Rate (cfs)	Total Volume (cf)	Peak Rate (cfs)	Total Volume (cf)
PR	0	0	0.045	2421.4	0	0
½ 2-Year	0	0	0.045	1893.1	0	0
5-Year	0.316	1095.8	0.045	3557.7	0	0
10-Year	0.381	1720.6	0.045	3801.5	0	0
25-Year	0.433	2255.9	0.045	3961.6	0	0

Flat Planter

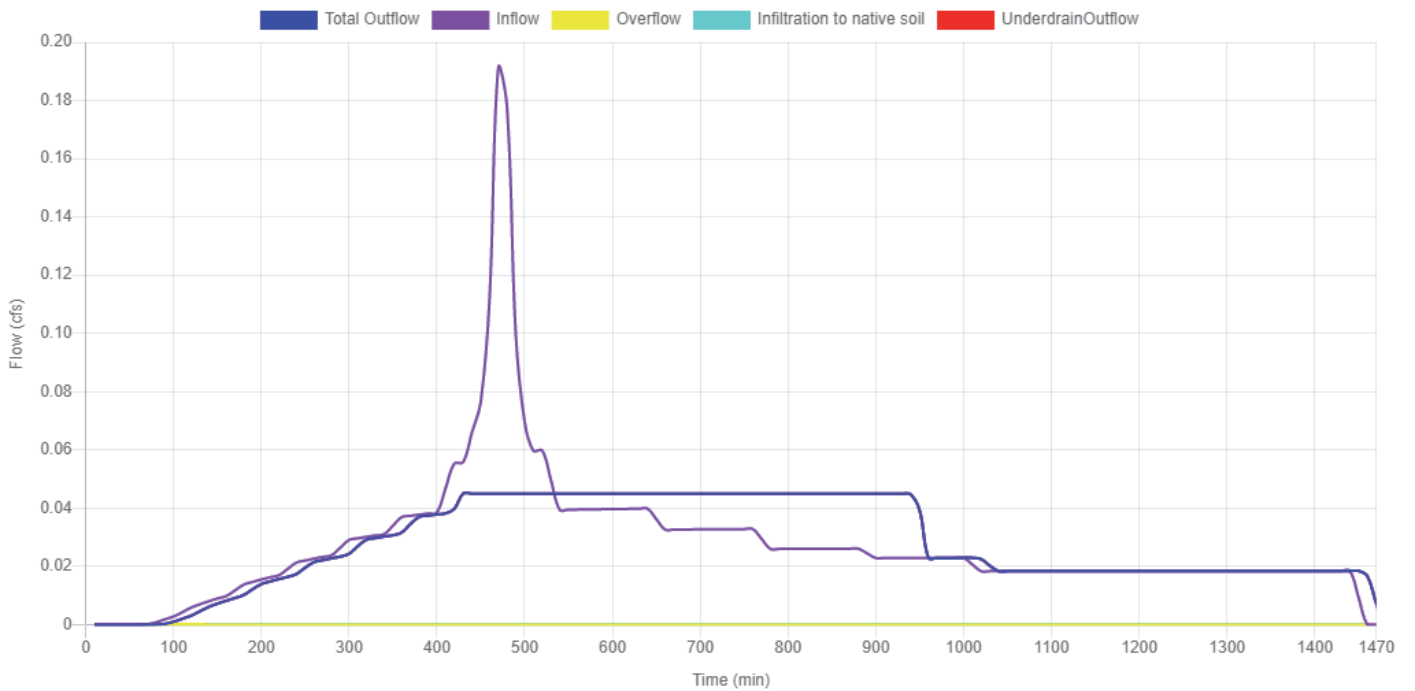
Site Soils & Infiltration Testing	Category	Flat Planter
	Shape	Null
	Location	Parcel
	Configuration	D: Lined Facility with RS and Ud
	Above Grade Storage Data	
	Bottom Area	324 sq ft
	Bottom Width	5.50 ft
	Overflow Height	12 in
	Total Depth of Blended Soil plus Rock	30 in
	Surface Storage Capacity at Overflow	324 cu ft
	Design Infiltration Rate to Soil Underlying the Facility	0.000 cfs
	Design Infiltration Rate for Imported Blended Soil in the Facility	0.045 cfs
	Below Grade Storage Data	
	Catchment is too small for flow control?	No
	Rock Area	177.00 sq ft
	Rock Width	3.00 ft
	Rock Storage Depth	12.0 in
	Rock Porosity	0.3
	Underdrain Height	

	<p>4 in</p> <p>Percent of Facility Base that Allows Infiltration</p> <p>0 %</p> <p>Orifice (Y/N)?</p> <p>No</p> <p>Why no orifice</p> <p>Water-quality-only facility</p>																				
<p>Facility Facts</p>	<p>Total Facility Area (excluding freeboard)</p> <p>324.00 sq ft</p> <p>Sizing Ratio</p> <p>1.55 %</p>																				
<p>Pollution Reduction Results</p>	<p>Pollution Reduction Score</p> <p>Pass</p> <p>Overflow Volume</p> <p>0.00 cf</p> <p>Surface Capacity Used</p> <p>98.86 %</p>																				
<p>Flow Control Results</p>	<p>Flow Control Score</p> <p>Fail</p> <table border="1" data-bbox="663 1160 1489 1552"> <thead> <tr> <th></th> <th>STORMWATER FACILITY OUTFLOW (CFS)</th> <th></th> <th>PRE-DEVELOPMENT RUNOFF (CFS)</th> </tr> </thead> <tbody> <tr> <td>½ the 2 year</td> <td>0.0450</td> <td><=</td> <td>0.0462</td> </tr> <tr> <td>5 year</td> <td>0.3608</td> <td><=</td> <td>0.1402</td> </tr> <tr> <td>10 year</td> <td>0.4259</td> <td><=</td> <td>0.1918</td> </tr> <tr> <td>25 year</td> <td>0.4778</td> <td><=</td> <td>0.2351</td> </tr> </tbody> </table>		STORMWATER FACILITY OUTFLOW (CFS)		PRE-DEVELOPMENT RUNOFF (CFS)	½ the 2 year	0.0450	<=	0.0462	5 year	0.3608	<=	0.1402	10 year	0.4259	<=	0.1918	25 year	0.4778	<=	0.2351
	STORMWATER FACILITY OUTFLOW (CFS)		PRE-DEVELOPMENT RUNOFF (CFS)																		
½ the 2 year	0.0450	<=	0.0462																		
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25 year	0.4778	<=	0.2351																		

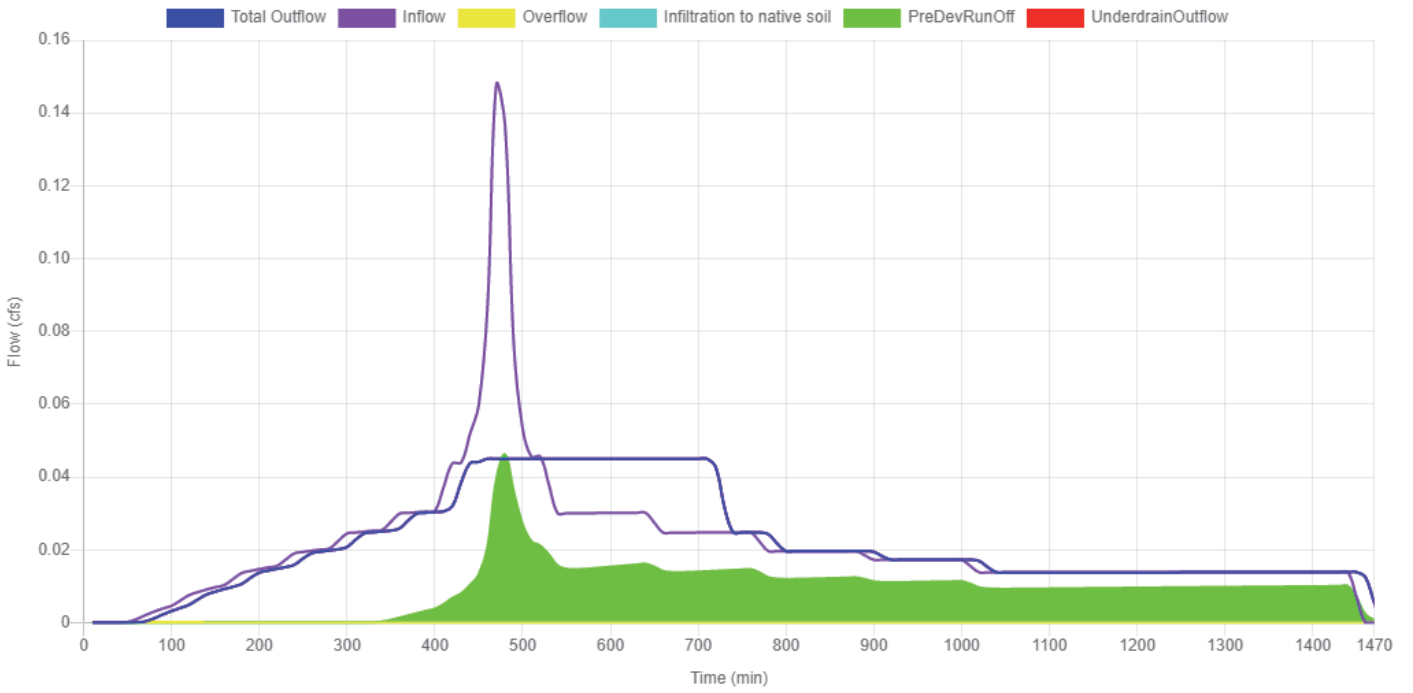
Surface Head



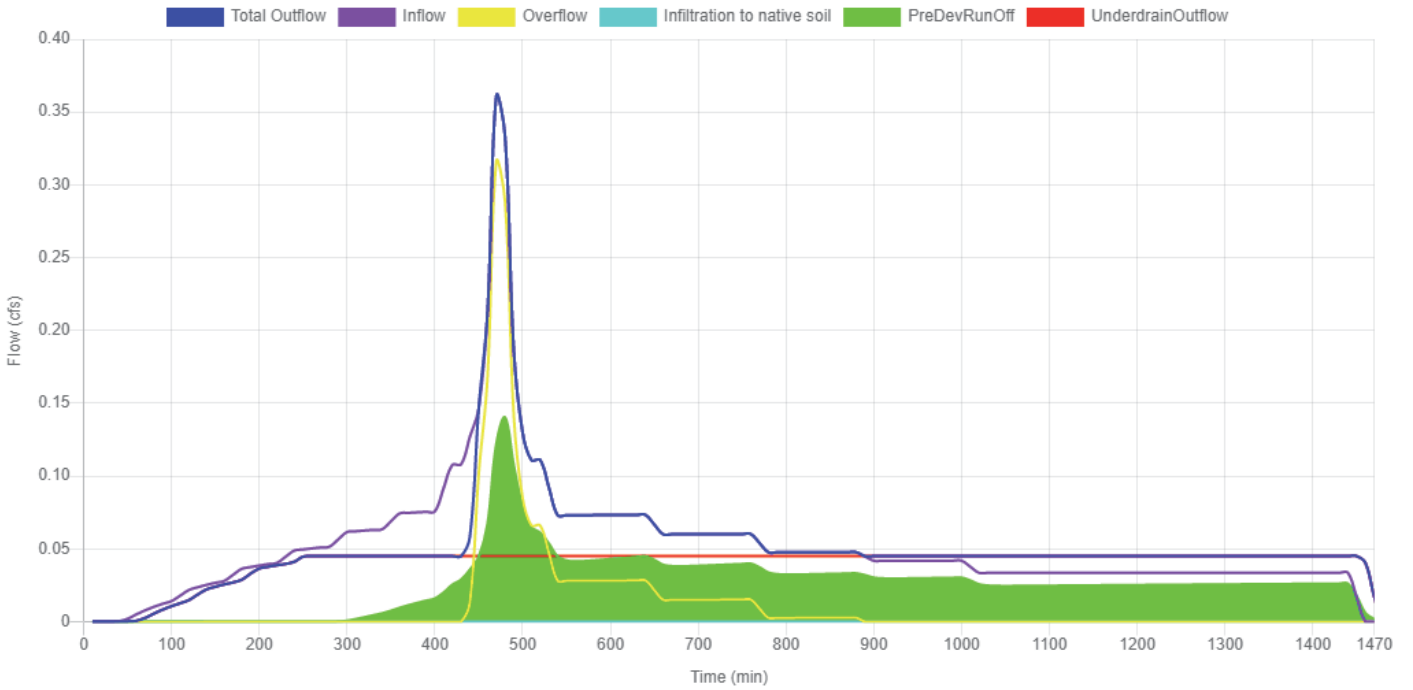
Water Quality



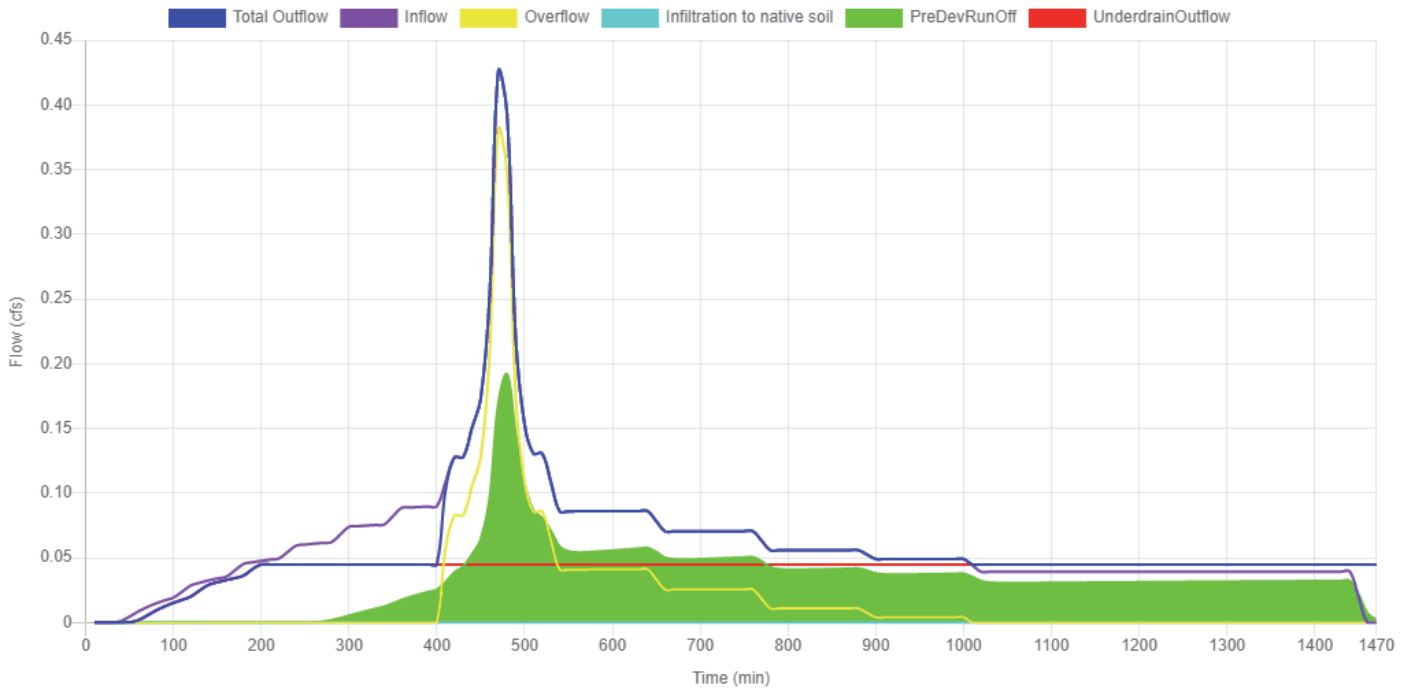
1/2 2-Year



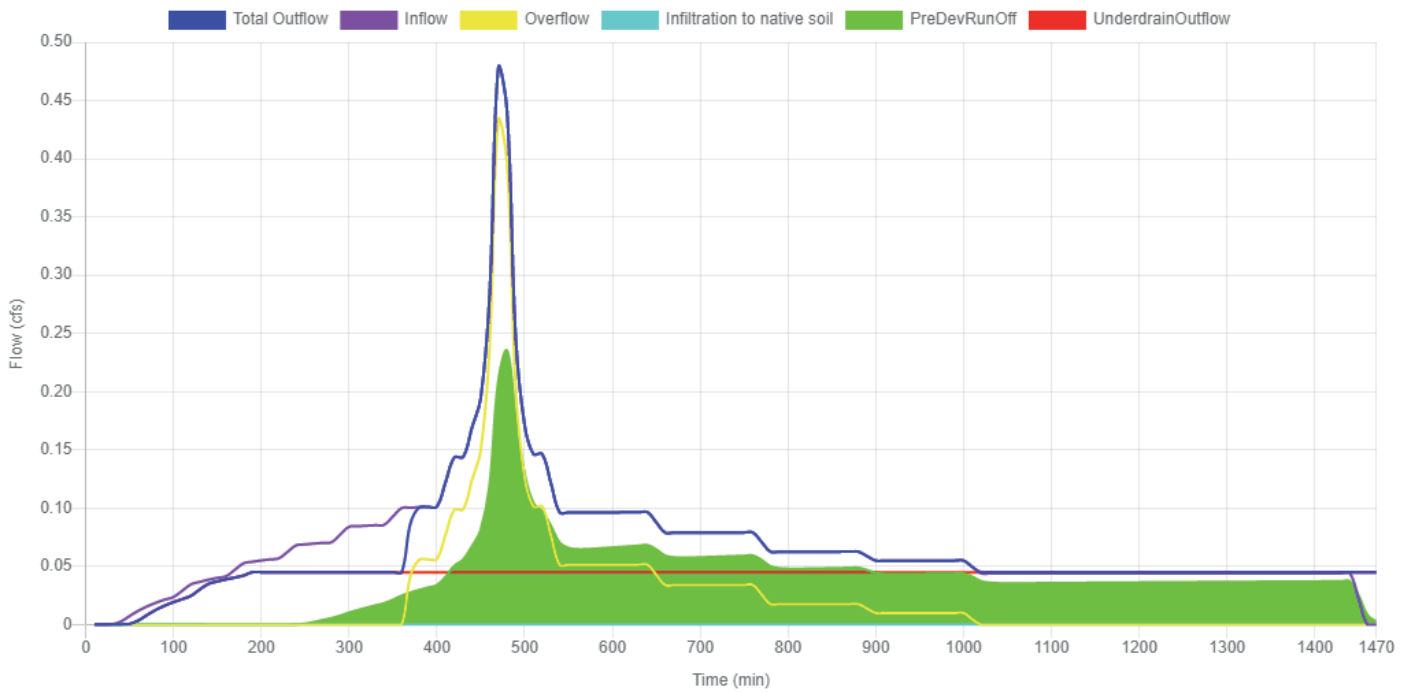
5-Year



10-Year



25-Year

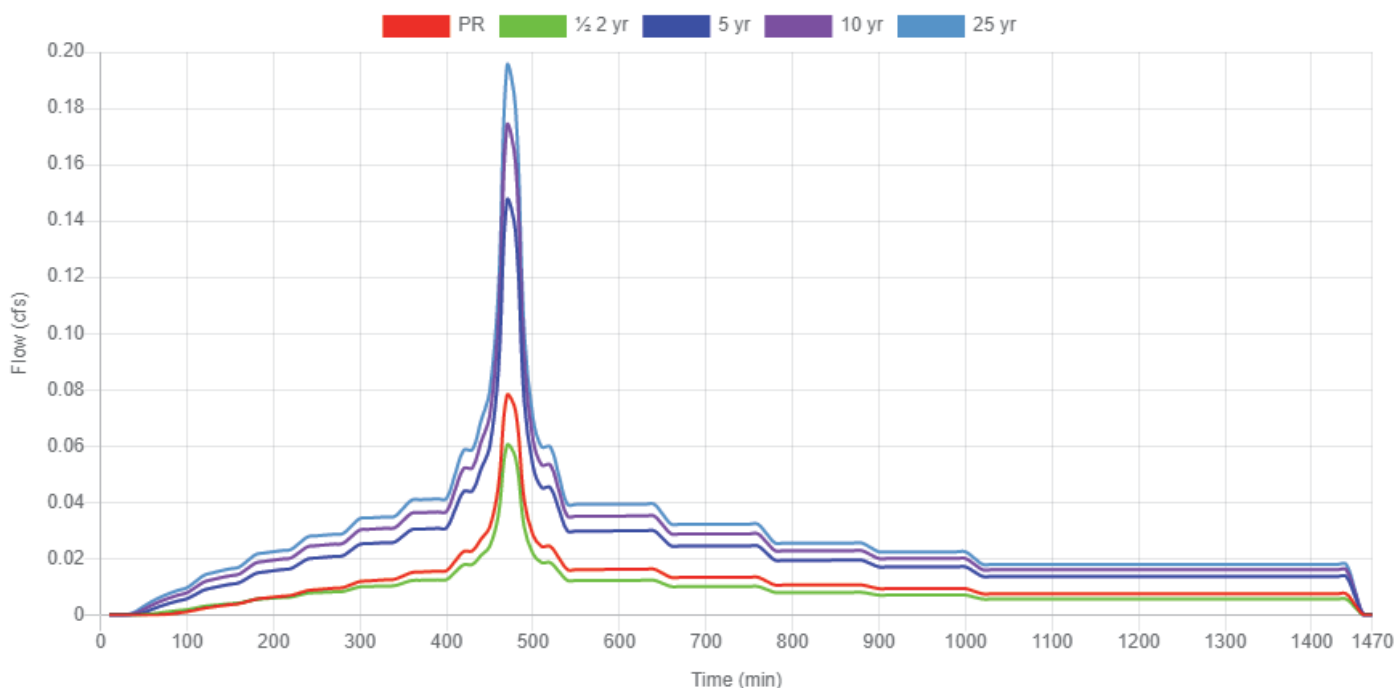


12A

<p>Site Soils & Infiltration Testing</p>	<p>Infiltration Testing Procedure NA</p> <p>Tested Native Soil Infiltration Rate 0 in/hr</p>
<p>Correction Factor</p>	<p>CF test 2</p>
<p>Design Infiltration Rates</p>	<p>Native Soil 0 in/hr</p> <p>Imported Blended Soil 6 in/hr</p>
<p>Catchment Information</p>	<p>Hierarchy Level 2B</p> <p>Hierarchy Description Discharge to an overland storm drainage system, including streams, drainageways, and ditches, or to a storm-only pipe system that discharges to an overland storm drainage system.</p> <p>Pollution Reduction Requirement Filter the post-development stormwater runoff from the water quality storm event through the blended soil.</p> <p>Infiltration Requirement N/A</p> <p>Flow Control Requirement Limit the ½ the 2-yr, the 5-yr, and the 10-yr post-development peak flows to their respective pre-development peak flows. Unless the facility is a public facility (i.e., in the public right-of-way), also limit the 25-yr post-development peak flow to the 25-year pre-development peak flow.</p> <p>Impervious Area 8535 sq ft 0.196 acre</p> <p>Pre-Development Time of Concentration (T_{c pre}) 10 min</p> <p>Post-Development Time of Concentration (T_{c post}) 5 min</p> <p>Pre-Development Curve Number (CN_{pre}) 82</p> <p>Post-Development Curve Number (CN_{post}) 98</p>

SBUH Results

Post-Development Runoff



	Pre - Development Rate and Volume		Post - Development Rate and Volume	
	Peak Rate (cfs)	Total Volume (cf)	Peak Rate (cfs)	Total Volume (cf)
PR	0.0115	289.7	0.078	987.6
1/2 2-Year	0.0188	329	0.0603	772.2
5-Year	0.0572	925.2	0.1472	1898.1
10-Year	0.0783	1209.4	0.1737	2252.4
25-Year	0.0959	1446	0.1949	2536

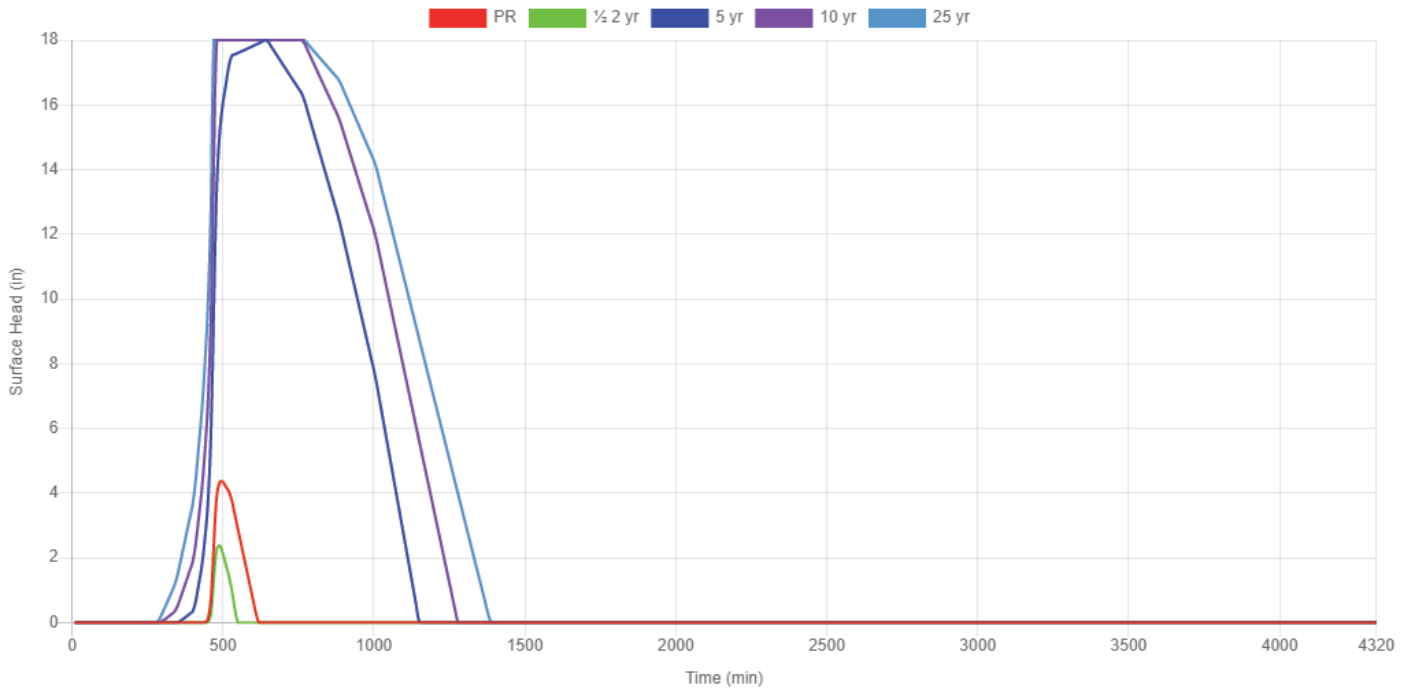
	Overflow		Underdrain Outflow		Infiltration	
	Peak Rate (cfs)	Total Volume (cf)	Peak Rate (cfs)	Total Volume (cf)	Peak Rate (cfs)	Total Volume (cf)
PR	0	0	0.029	987.6	0	0
1/2 2-Year	0	0	0.029	772.2	0	0
5-Year	0	0	0.029	1898.1	0	0
10-Year	0.061	158	0.029	2094.4	0	0
25-Year	0.151	316.1	0.029	2220	0	0

Flat Planter

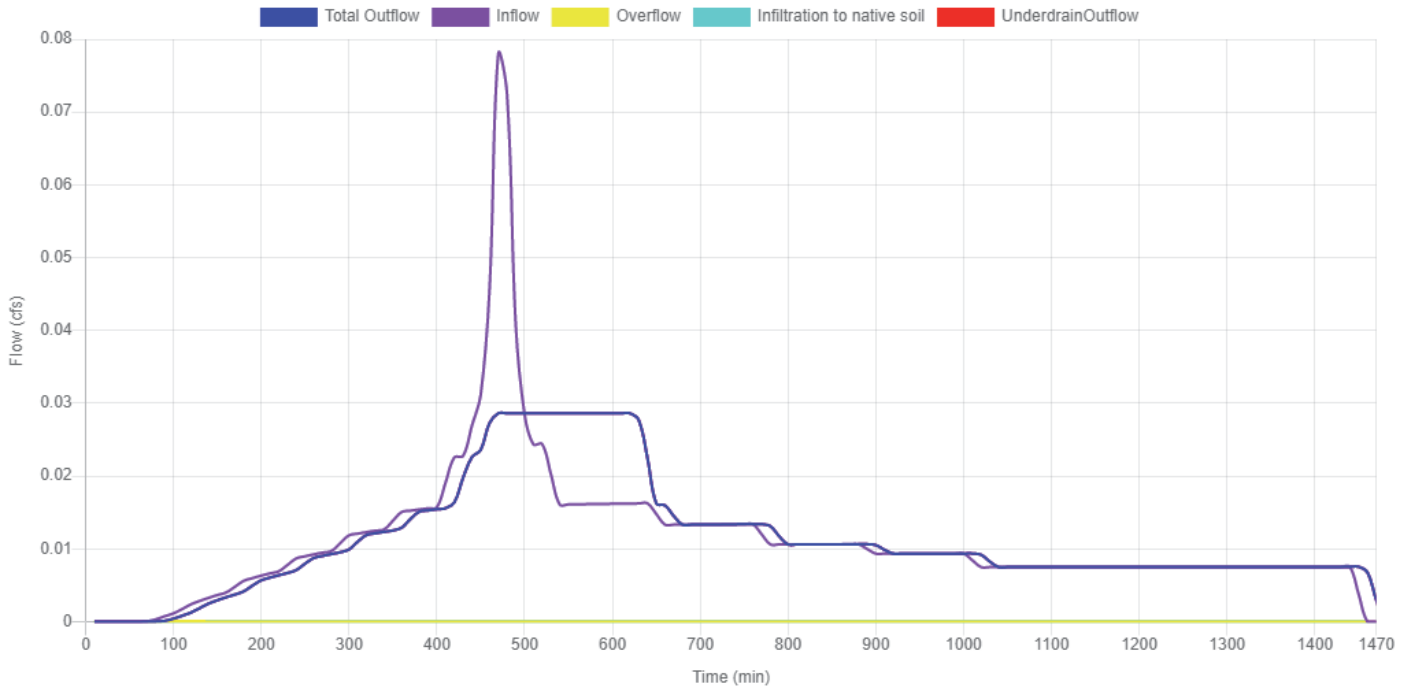
Site Soils & Infiltration Testing	Category
	Flat Planter
	Shape
	Null
	Location
	Parcel
	Configuration
	D: Lined Facility with RS and Ud
	Above Grade Storage Data
	Bottom Area
	206 sq ft
	Bottom Width
	4.50 ft
	Overflow Height
	18.0 in
	Total Depth of Blended Soil plus Rock
	30 in
	Surface Storage Capacity at Overflow
	309 cu ft
	Design Infiltration Rate to Soil Underlying the Facility
	0.000 cfs
Design Infiltration Rate for Imported Blended Soil in the Facility	
0.029 cfs	
Below Grade Storage Data	
Catchment is too small for flow control?	
No	
Rock Area	
138.00 sq ft	
Rock Width	
3.00 ft	
Rock Storage Depth	
12.0 in	
Rock Porosity	
0.3	
Underdrain Height	

	<p>4 in</p> <p>Percent of Facility Base that Allows Infiltration</p> <p>0 %</p> <p>Orifice (Y/N)?</p> <p>No</p> <p>Why no orifice</p> <p>Water-quality-only facility</p>																				
<p>Facility Facts</p>	<p>Total Facility Area (excluding freeboard)</p> <p>206.00 sq ft</p> <p>Sizing Ratio</p> <p>2.41 %</p>																				
<p>Pollution Reduction Results</p>	<p>Pollution Reduction Score</p> <p>Pass</p> <p>Overflow Volume</p> <p>0.00 cf</p> <p>Surface Capacity Used</p> <p>24.18 %</p>																				
<p>Flow Control Results</p>	<p>Flow Control Score</p> <p>Fail</p> <table border="1" data-bbox="662 1160 1489 1554"> <thead> <tr> <th></th> <th>STORMWATER FACILITY OUTFLOW (CFS)</th> <th></th> <th>PRE-DEVELOPMENT RUNOFF (CFS)</th> </tr> </thead> <tbody> <tr> <td>½ the 2 year</td> <td>0.0286</td> <td><=</td> <td>0.0188</td> </tr> <tr> <td>5 year</td> <td>0.0286</td> <td><=</td> <td>0.0572</td> </tr> <tr> <td>10 year</td> <td>0.0893</td> <td><=</td> <td>0.0783</td> </tr> <tr> <td>25 year</td> <td>0.1798</td> <td><=</td> <td>0.0959</td> </tr> </tbody> </table>		STORMWATER FACILITY OUTFLOW (CFS)		PRE-DEVELOPMENT RUNOFF (CFS)	½ the 2 year	0.0286	<=	0.0188	5 year	0.0286	<=	0.0572	10 year	0.0893	<=	0.0783	25 year	0.1798	<=	0.0959
	STORMWATER FACILITY OUTFLOW (CFS)		PRE-DEVELOPMENT RUNOFF (CFS)																		
½ the 2 year	0.0286	<=	0.0188																		
5 year	0.0286	<=	0.0572																		
10 year	0.0893	<=	0.0783																		
25 year	0.1798	<=	0.0959																		

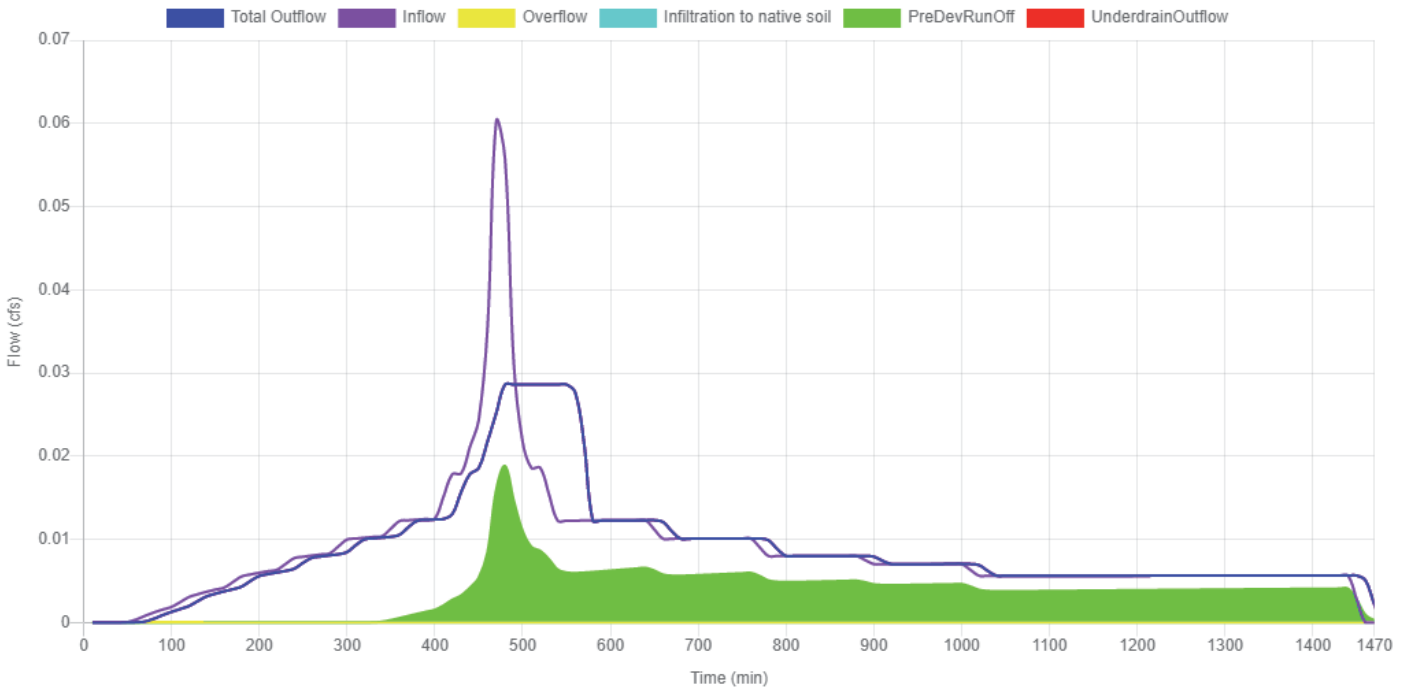
Surface Head



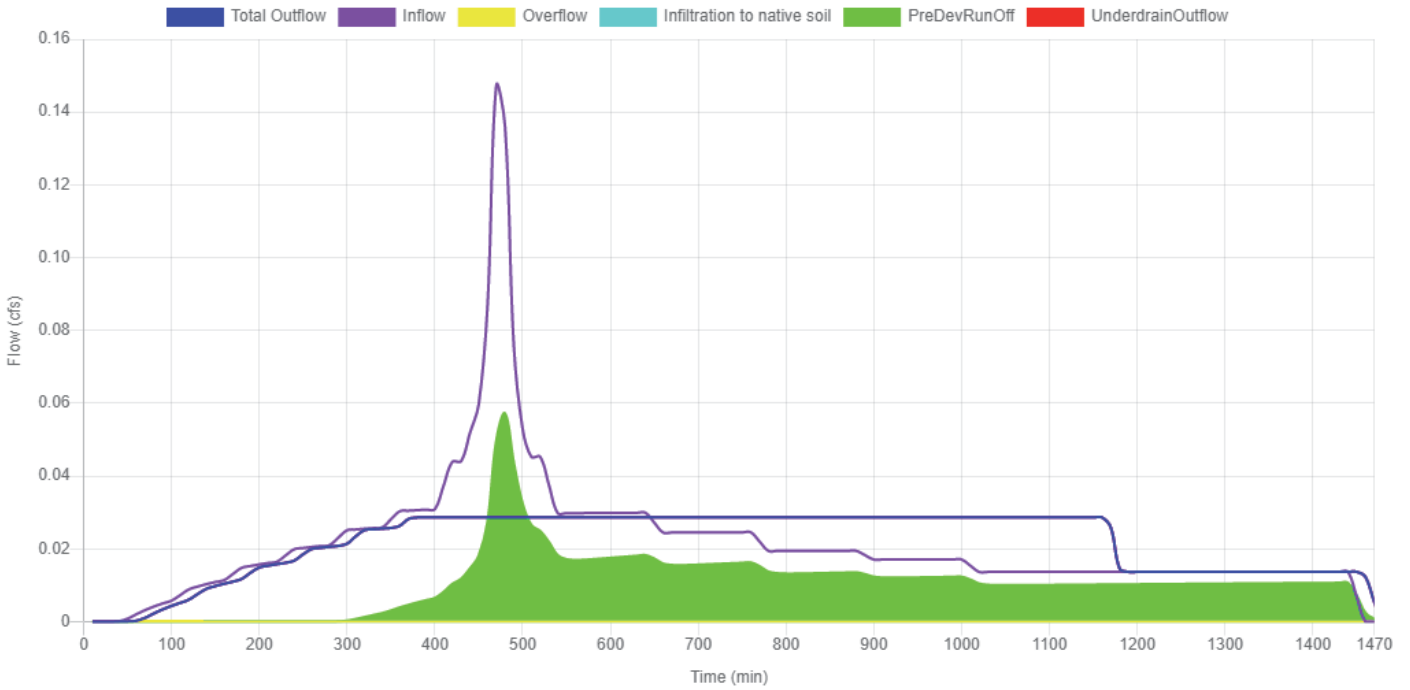
Water Quality



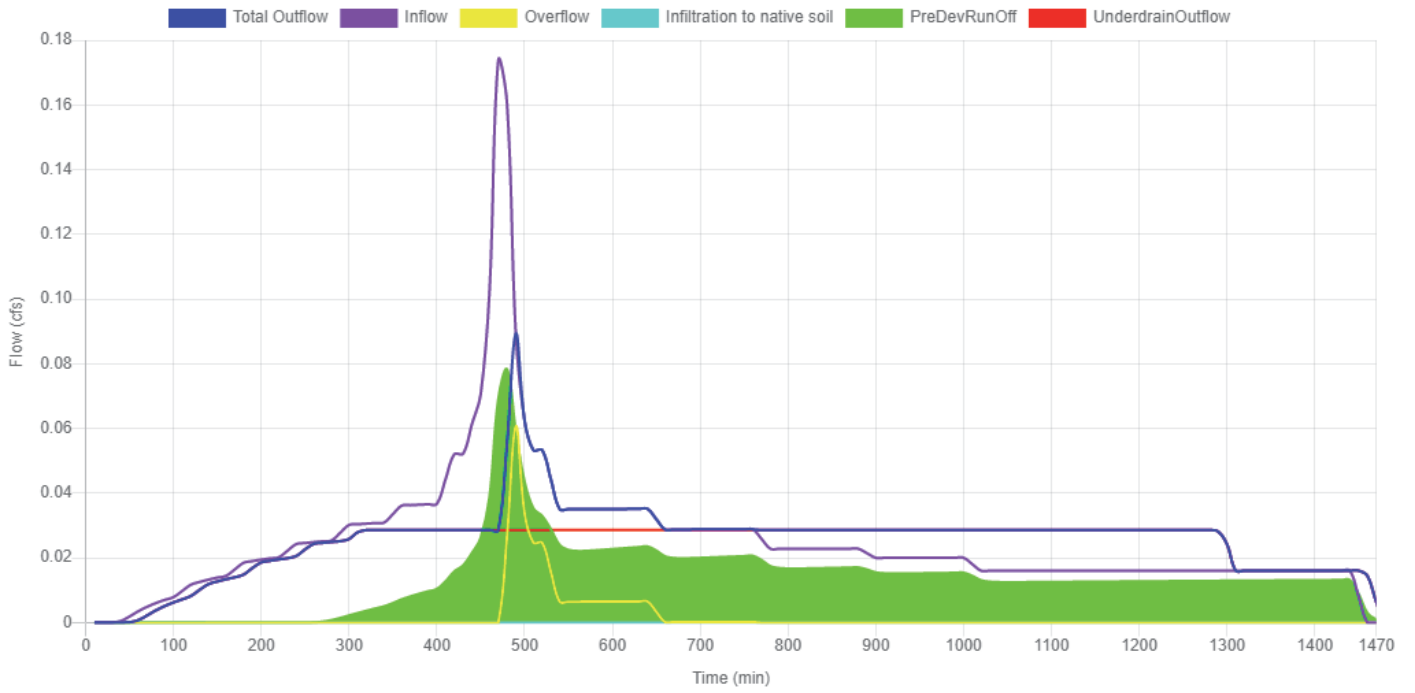
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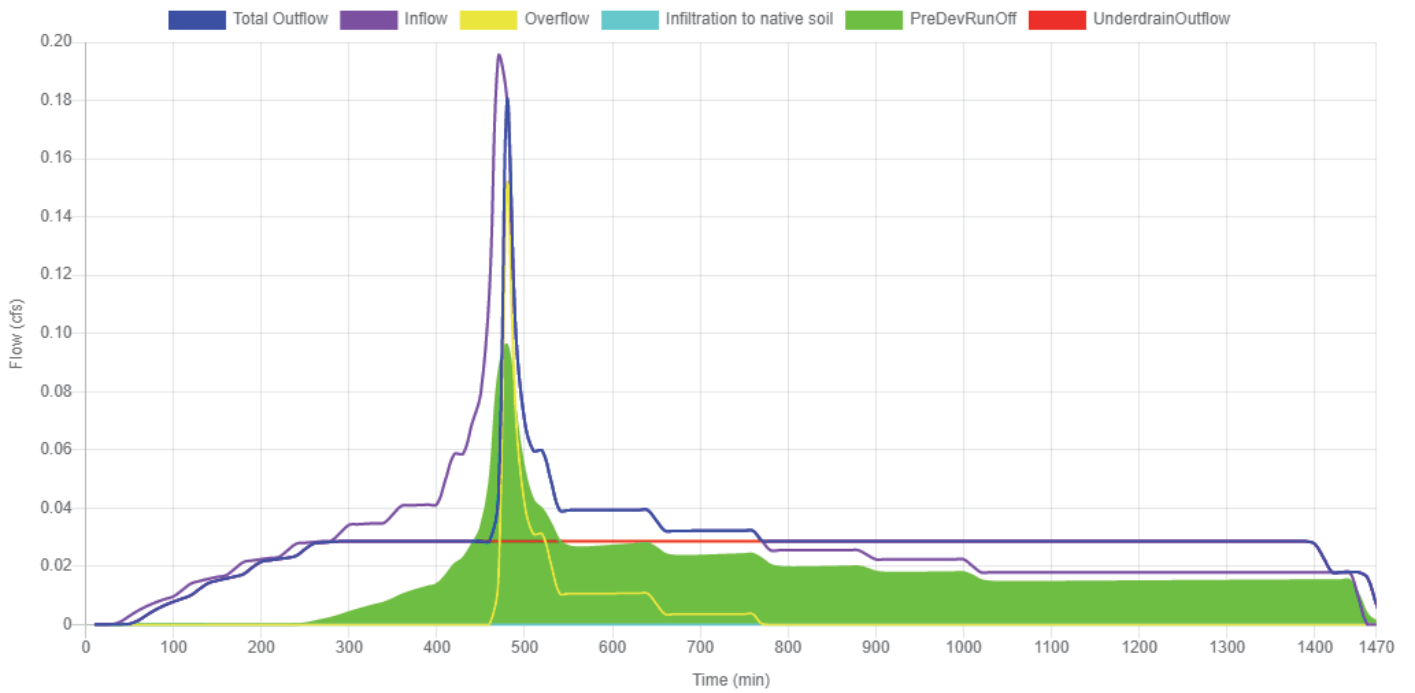
5-Year



10-Year



25-Year

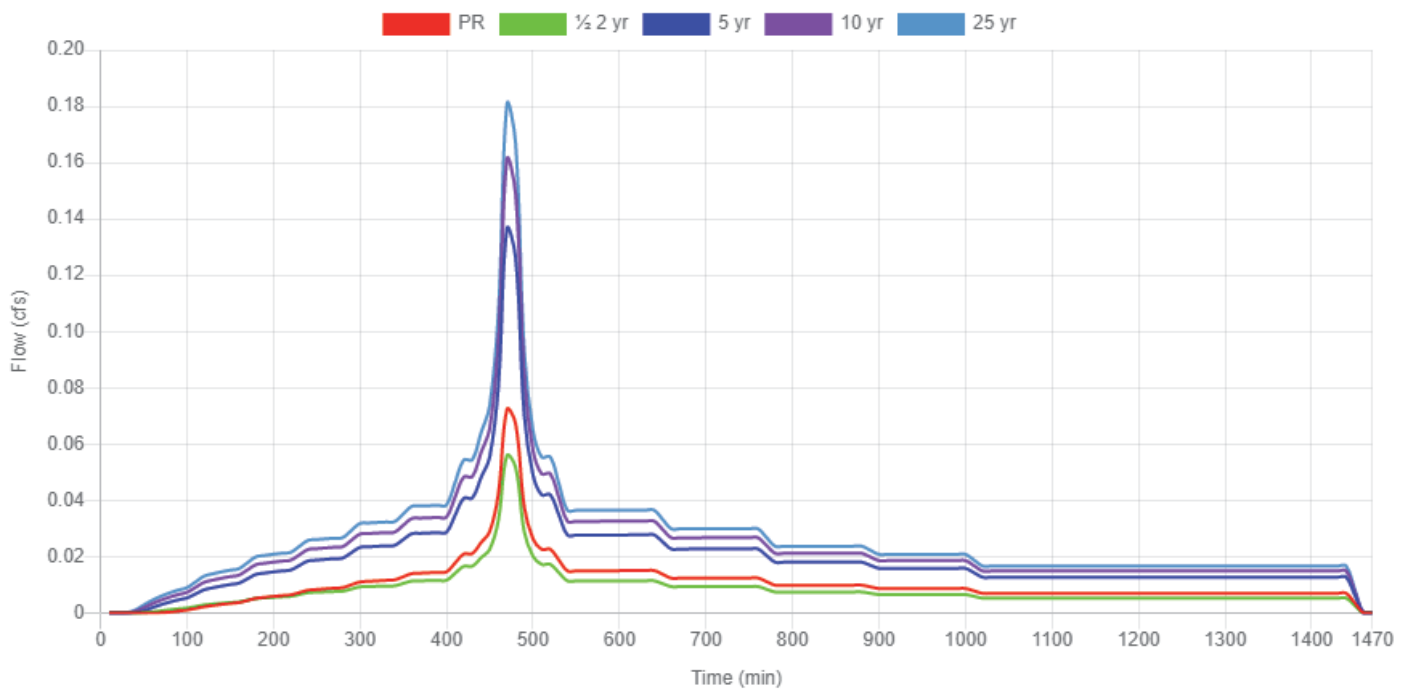


11C

<p>Site Soils & Infiltration Testing</p>	<p>Infiltration Testing Procedure NA</p> <p>Tested Native Soil Infiltration Rate 0 in/hr</p>
<p>Correction Factor</p>	<p>CF test 2</p>
<p>Design Infiltration Rates</p>	<p>Native Soil 0 in/hr</p> <p>Imported Blended Soil 6 in/hr</p>
<p>Catchment Information</p>	<p>Hierarchy Level 2B</p> <p>Hierarchy Description Discharge to an overland storm drainage system, including streams, drainageways, and ditches, or to a storm-only pipe system that discharges to an overland storm drainage system.</p> <p>Pollution Reduction Requirement Filter the post-development stormwater runoff from the water quality storm event through the blended soil.</p> <p>Infiltration Requirement N/A</p> <p>Flow Control Requirement Limit the ½ the 2-yr, the 5-yr, and the 10-yr post-development peak flows to their respective pre-development peak flows. Unless the facility is a public facility (i.e., in the public right-of-way), also limit the 25-yr post-development peak flow to the 25-year pre-development peak flow.</p> <p>Impervious Area 7918 sq ft 0.182 acre</p> <p>Pre-Development Time of Concentration (T_{c pre}) 10 min</p> <p>Post-Development Time of Concentration (T_{c post}) 5 min</p> <p>Pre-Development Curve Number (CN_{pre}) 82</p> <p>Post-Development Curve Number (CN_{post}) 98</p>

SBUH Results

Post-Development Runoff



	Pre - Development Rate and Volume		Post - Development Rate and Volume	
	Peak Rate (cfs)	Total Volume (cf)	Peak Rate (cfs)	Total Volume (cf)
PR	0.0107	268.8	0.0723	916.2
1/2 2-Year	0.0175	305.3	0.0559	716.4
5-Year	0.0531	858.3	0.1365	1760.9
10-Year	0.0726	1122	0.1612	2089.6
25-Year	0.0889	1341.5	0.1808	2352.7

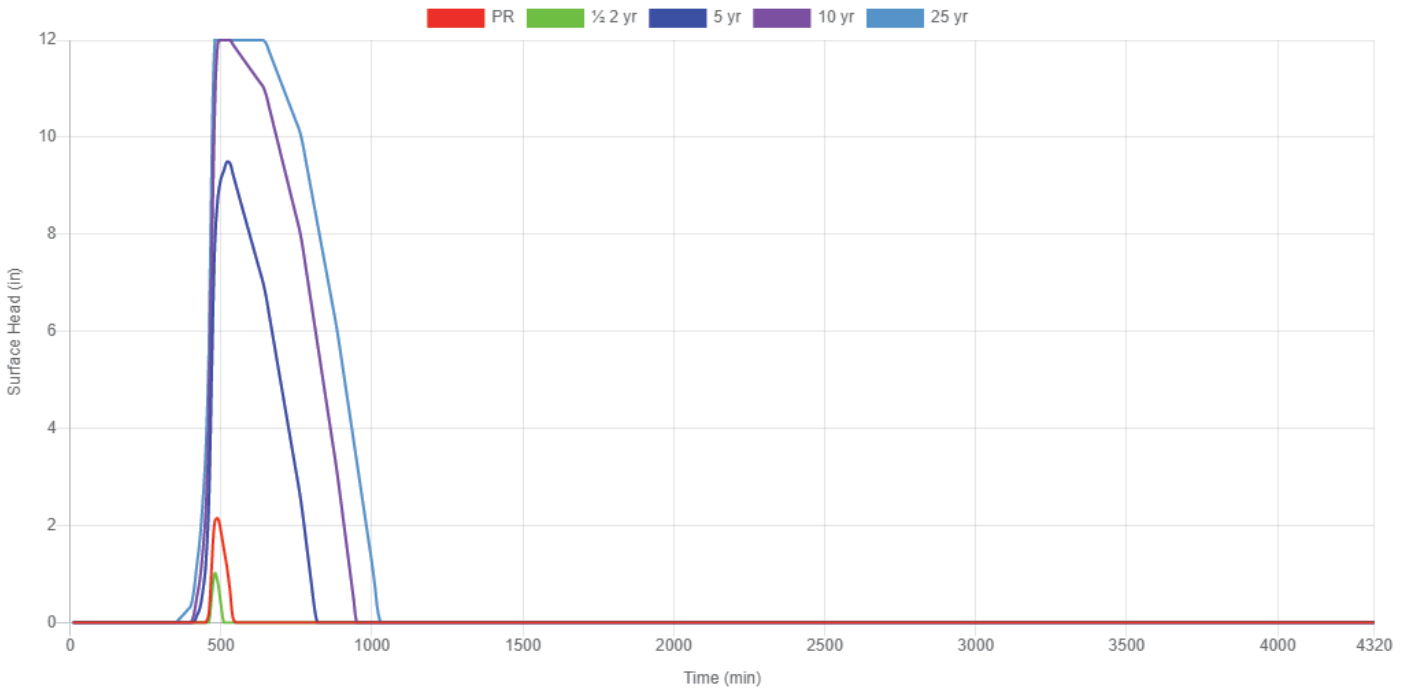
	Overflow		Underdrain Outflow		Infiltration	
	Peak Rate (cfs)	Total Volume (cf)	Peak Rate (cfs)	Total Volume (cf)	Peak Rate (cfs)	Total Volume (cf)
PR	0	0	0.036	916.2	0	0
1/2 2-Year	0	0	0.036	716.4	0	0
5-Year	0	0	0.036	1760.9	0	0
10-Year	0.02	32	0.036	2057.6	0	0
25-Year	0.057	113.6	0.036	2239.1	0	0

Flat Planter

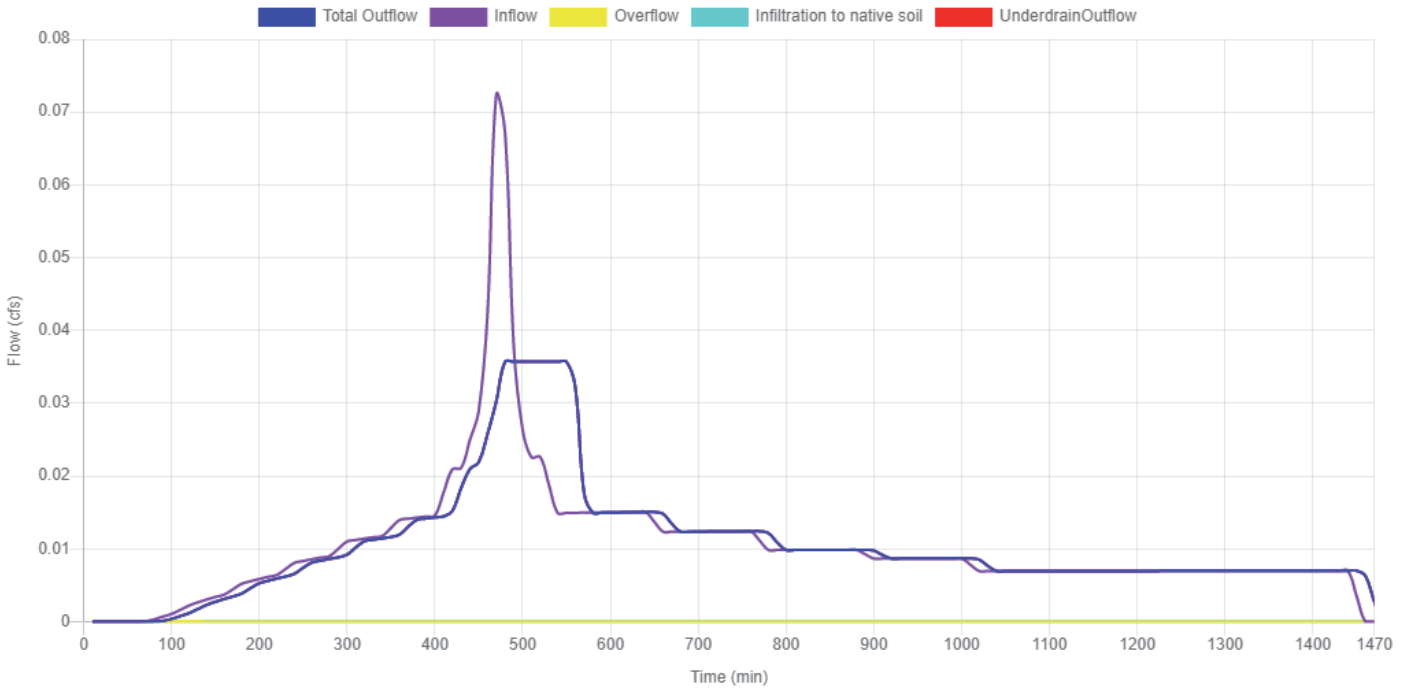
Site Soils & Infiltration Testing	Category
	Flat Planter
	Shape
	Null
	Location
	Parcel
	Configuration
	D: Lined Facility with RS and Ud
	Above Grade Storage Data
	Bottom Area
	257 sq ft
	Bottom Width
	5.50 ft
	Overflow Height
	12 in
	Total Depth of Blended Soil plus Rock
	30 in
	Surface Storage Capacity at Overflow
	257 cu ft
	Design Infiltration Rate to Soil Underlying the Facility
	0.000 cfs
Design Infiltration Rate for Imported Blended Soil in the Facility	
0.036 cfs	
Below Grade Storage Data	
Catchment is too small for flow control?	
No	
Rock Area	
140.00 sq ft	
Rock Width	
3.00 ft	
Rock Storage Depth	
12.0 in	
Rock Porosity	
0.3	
Underdrain Height	

	<p>4 in</p> <p>Percent of Facility Base that Allows Infiltration</p> <p>0 %</p> <p>Orifice (Y/N)?</p> <p>No</p> <p>Why no orifice</p> <p>Water-quality-only facility</p>																				
Facility Facts	<p>Total Facility Area (excluding freeboard)</p> <p>257.00 sq ft</p> <p>Sizing Ratio</p> <p>3.25 %</p>																				
Pollution Reduction Results	<p>Pollution Reduction Score</p> <p>Pass</p> <p>Overflow Volume</p> <p>0.00 cf</p> <p>Surface Capacity Used</p> <p>17.88 %</p>																				
Flow Control Results	<p>Flow Control Score</p> <p>Fail</p> <table border="1"> <thead> <tr> <th></th> <th>STORMWATER FACILITY OUTFLOW (CFS)</th> <th></th> <th>PRE-DEVELOPMENT RUNOFF (CFS)</th> </tr> </thead> <tbody> <tr> <td>½ the 2 year</td> <td>0.0357</td> <td><=</td> <td>0.0175</td> </tr> <tr> <td>5 year</td> <td>0.0357</td> <td><=</td> <td>0.0531</td> </tr> <tr> <td>10 year</td> <td>0.0561</td> <td><=</td> <td>0.0726</td> </tr> <tr> <td>25 year</td> <td>0.0929</td> <td><=</td> <td>0.0889</td> </tr> </tbody> </table>		STORMWATER FACILITY OUTFLOW (CFS)		PRE-DEVELOPMENT RUNOFF (CFS)	½ the 2 year	0.0357	<=	0.0175	5 year	0.0357	<=	0.0531	10 year	0.0561	<=	0.0726	25 year	0.0929	<=	0.0889
	STORMWATER FACILITY OUTFLOW (CFS)		PRE-DEVELOPMENT RUNOFF (CFS)																		
½ the 2 year	0.0357	<=	0.0175																		
5 year	0.0357	<=	0.0531																		
10 year	0.0561	<=	0.0726																		
25 year	0.0929	<=	0.0889																		

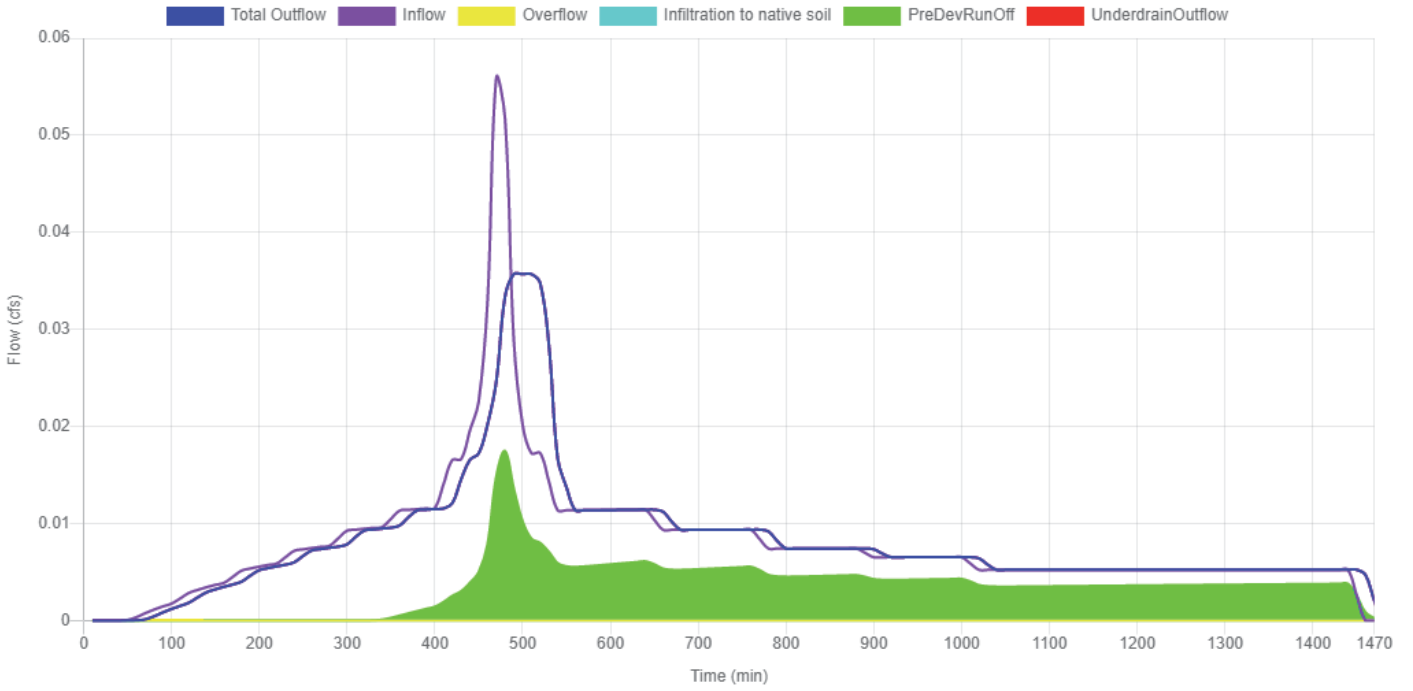
Surface Head



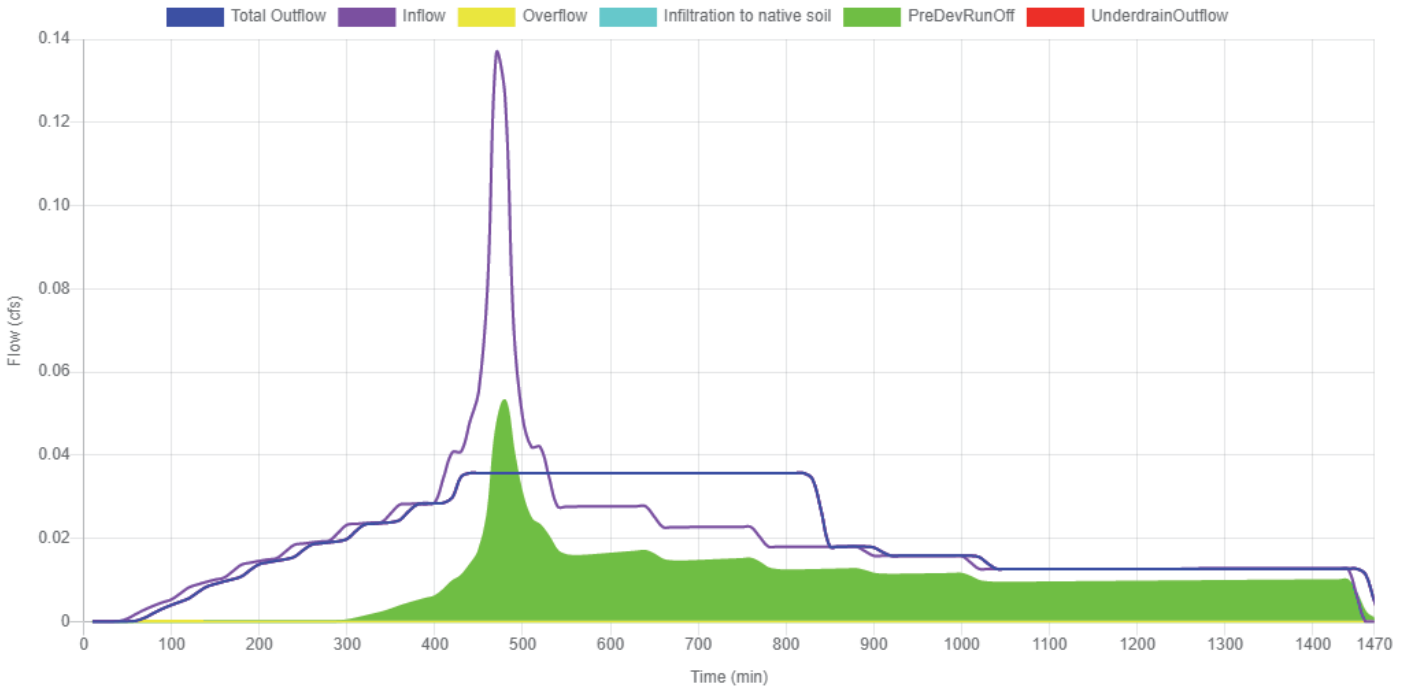
Water Quality



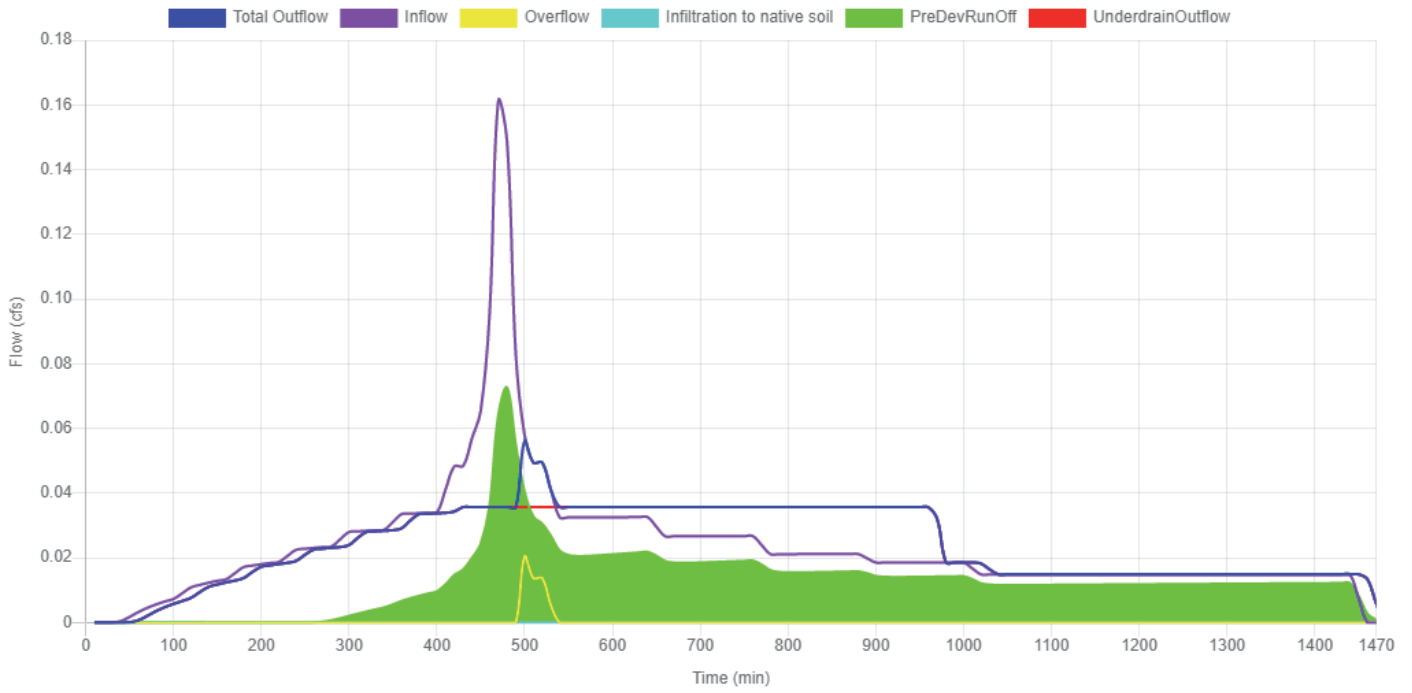
1/2 2-Year



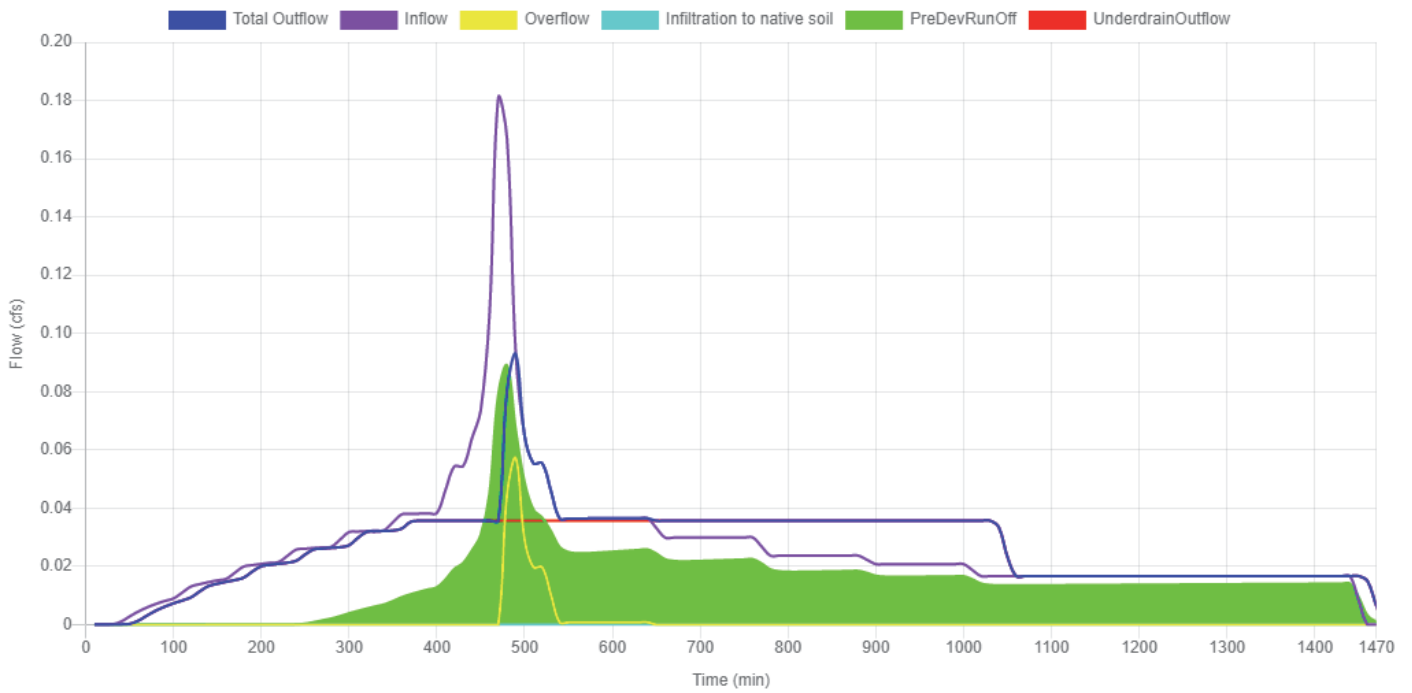
5-Year



10-Year



25-Year

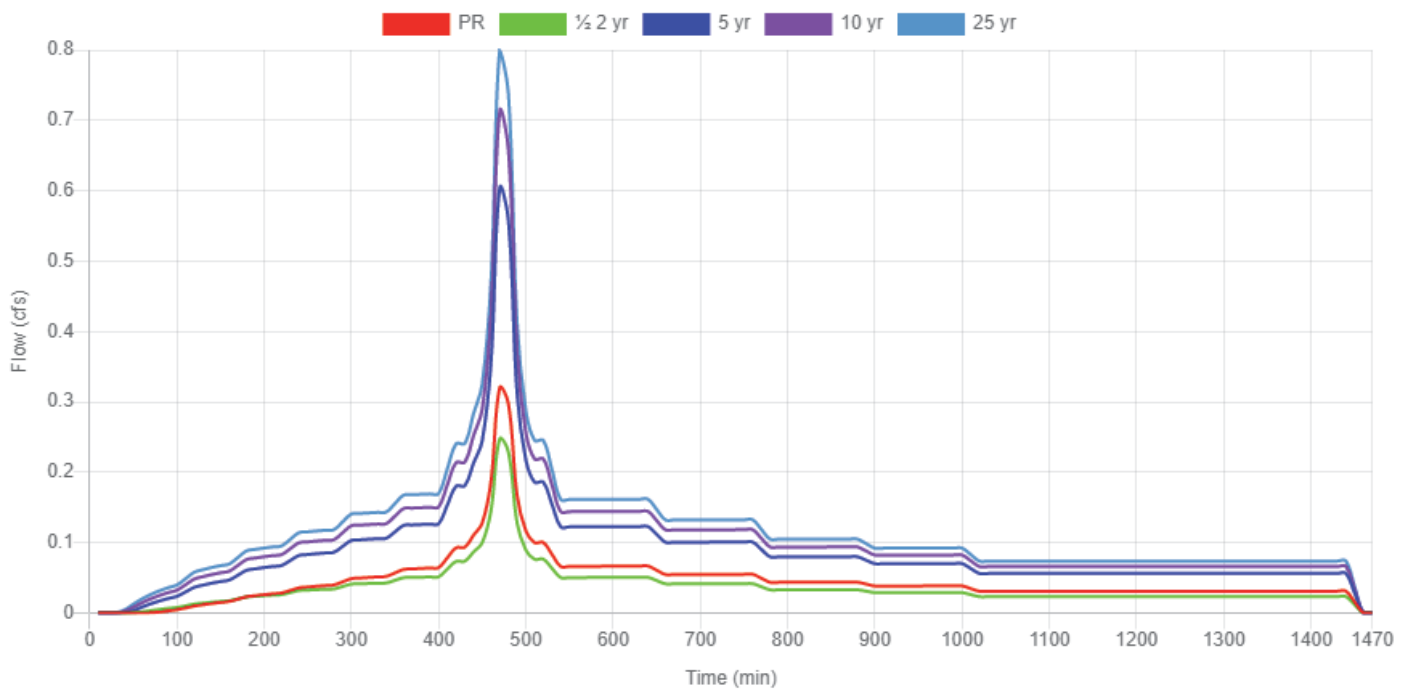


11B

<p>Site Soils & Infiltration Testing</p>	<p>Infiltration Testing Procedure NA</p> <p>Tested Native Soil Infiltration Rate 0 in/hr</p>
<p>Correction Factor</p>	<p>CF test 2</p>
<p>Design Infiltration Rates</p>	<p>Native Soil 0 in/hr</p> <p>Imported Blended Soil 6 in/hr</p>
<p>Catchment Information</p>	<p>Hierarchy Level 2B</p> <p>Hierarchy Description Discharge to an overland storm drainage system, including streams, drainageways, and ditches, or to a storm-only pipe system that discharges to an overland storm drainage system.</p> <p>Pollution Reduction Requirement Filter the post-development stormwater runoff from the water quality storm event through the blended soil.</p> <p>Infiltration Requirement N/A</p> <p>Flow Control Requirement Limit the ½ the 2-yr, the 5-yr, and the 10-yr post-development peak flows to their respective pre-development peak flows. Unless the facility is a public facility (i.e., in the public right-of-way), also limit the 25-yr post-development peak flow to the 25-year pre-development peak flow.</p> <p>Impervious Area 35031 sq ft 0.804 acre</p> <p>Pre-Development Time of Concentration (T_{c pre}) 10 min</p> <p>Post-Development Time of Concentration (T_{c post}) 5 min</p> <p>Pre-Development Curve Number (CN_{pre}) 82</p> <p>Post-Development Curve Number (CN_{post}) 98</p>

SBUH Results

Post-Development Runoff



	Pre - Development Rate and Volume		Post - Development Rate and Volume	
	Peak Rate (cfs)	Total Volume (cf)	Peak Rate (cfs)	Total Volume (cf)
PR	0.0474	1189.2	0.32	4053.6
1/2 2-Year	0.0773	1350.5	0.2473	3169.4
5-Year	0.2347	3797.2	0.6041	7790.6
10-Year	0.3212	4963.9	0.713	9244.7
25-Year	0.3935	5935.2	0.7999	10408.9

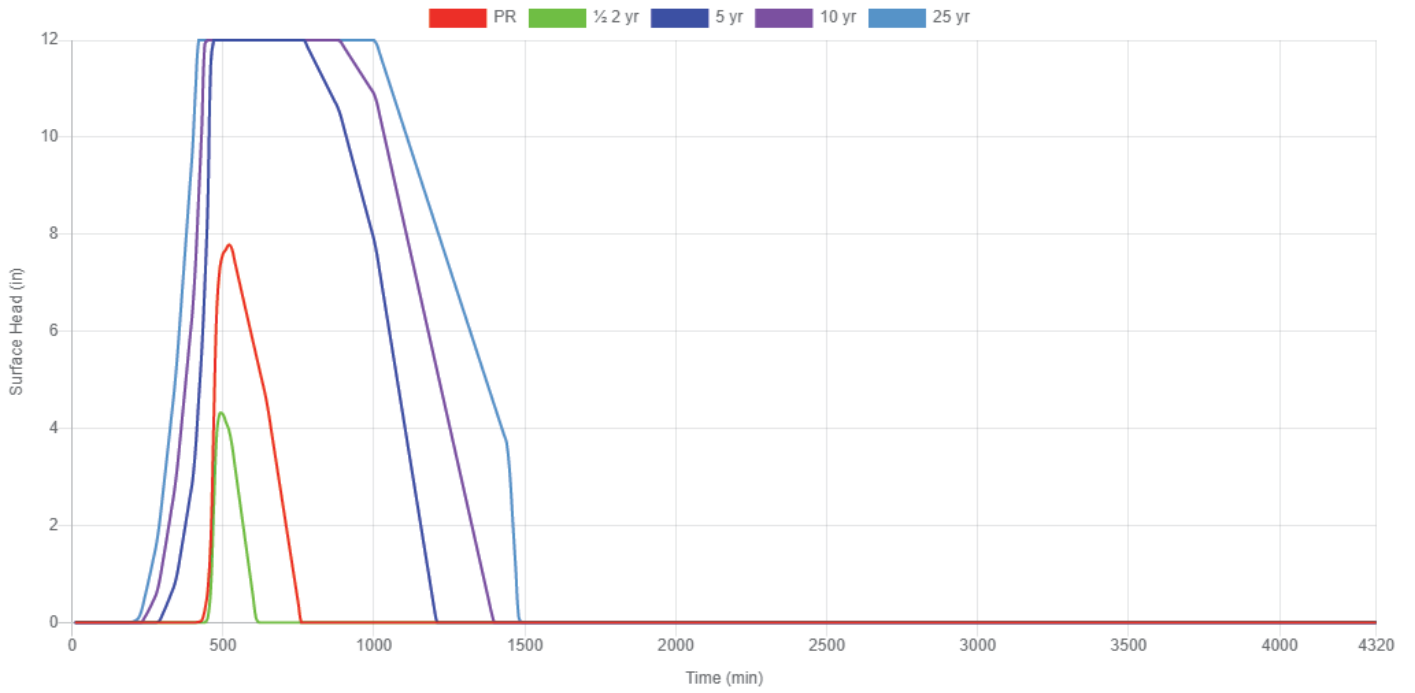
	Overflow		Underdrain Outflow		Infiltration	
	Peak Rate (cfs)	Total Volume (cf)	Peak Rate (cfs)	Total Volume (cf)	Peak Rate (cfs)	Total Volume (cf)
PR	0	0	0.091	4053.6	0	0
1/2 2-Year	0	0	0.091	3169.4	0	0
5-Year	0.468	1202.2	0.091	6588.4	0	0
10-Year	0.622	2075.7	0.091	7168.9	0	0
25-Year	0.709	2872.9	0.091	7536	0	0

Flat Planter

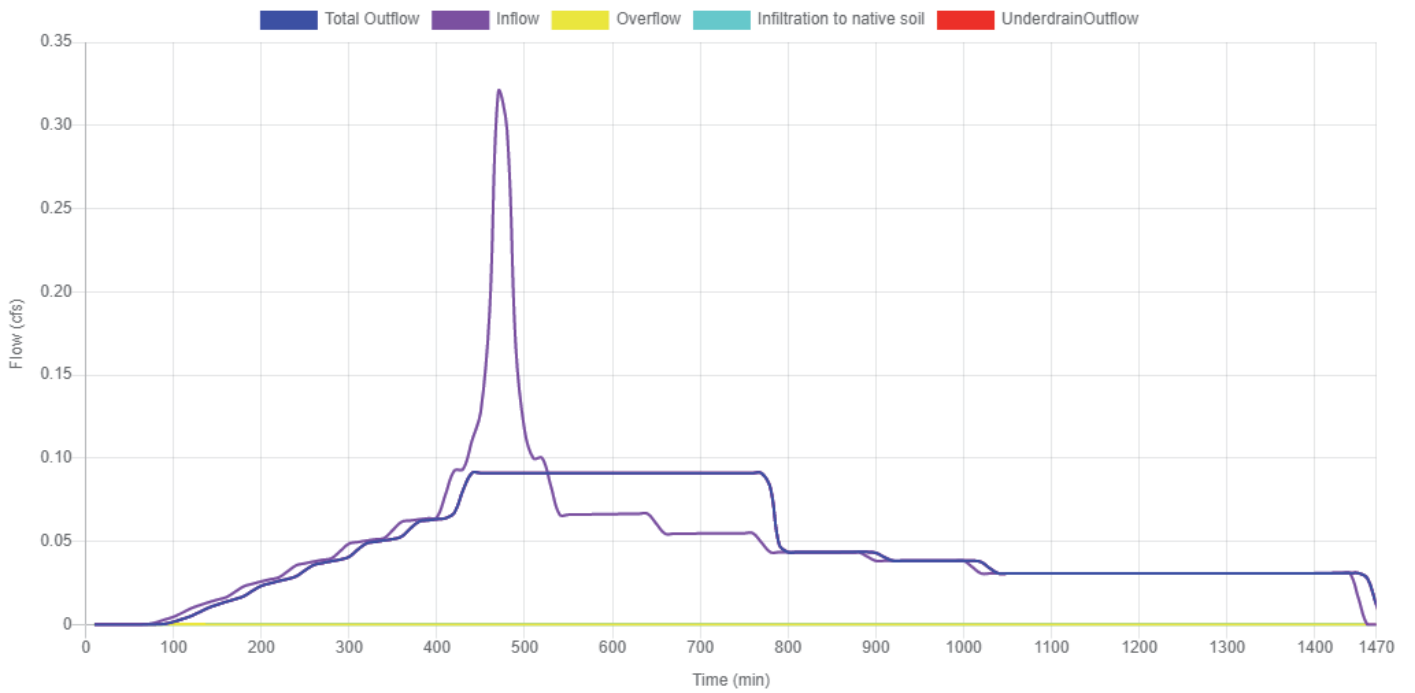
Site Soils & Infiltration Testing	Category
	Flat Planter
	Shape
	Null
	Location
	Parcel
	Configuration
	D: Lined Facility with RS and Ud
	Above Grade Storage Data
	Bottom Area
	656 sq ft
	Bottom Width
	9.00 ft
	Overflow Height
	12 in
	Total Depth of Blended Soil plus Rock
	30 in
	Surface Storage Capacity at Overflow
	656 cu ft
	Design Infiltration Rate to Soil Underlying the Facility
	0.000 cfs
Design Infiltration Rate for Imported Blended Soil in the Facility	
0.091 cfs	
Below Grade Storage Data	
Catchment is too small for flow control?	
No	
Rock Area	
219.00 sq ft	
Rock Width	
3.00 ft	
Rock Storage Depth	
12.0 in	
Rock Porosity	
0.3	
Underdrain Height	

	<p>4 in</p> <p>Percent of Facility Base that Allows Infiltration</p> <p>0 %</p> <p>Orifice (Y/N)?</p> <p>No</p> <p>Why no orifice</p> <p>Water-quality-only facility</p>																				
<p>Facility Facts</p>	<p>Total Facility Area (excluding freeboard)</p> <p>656.00 sq ft</p> <p>Sizing Ratio</p> <p>1.87 %</p>																				
<p>Pollution Reduction Results</p>	<p>Pollution Reduction Score</p> <p>Pass</p> <p>Overflow Volume</p> <p>0.00 cf</p> <p>Surface Capacity Used</p> <p>64.88 %</p>																				
<p>Flow Control Results</p>	<p>Flow Control Score</p> <p>Fail</p> <table border="1" data-bbox="662 1160 1489 1554"> <thead> <tr> <th></th> <th>STORMWATER FACILITY OUTFLOW (CFS)</th> <th></th> <th>PRE-DEVELOPMENT RUNOFF (CFS)</th> </tr> </thead> <tbody> <tr> <td>½ the 2 year</td> <td>0.0911</td> <td><=</td> <td>0.0773</td> </tr> <tr> <td>5 year</td> <td>0.5589</td> <td><=</td> <td>0.2347</td> </tr> <tr> <td>10 year</td> <td>0.7130</td> <td><=</td> <td>0.3212</td> </tr> <tr> <td>25 year</td> <td>0.7999</td> <td><=</td> <td>0.3935</td> </tr> </tbody> </table>		STORMWATER FACILITY OUTFLOW (CFS)		PRE-DEVELOPMENT RUNOFF (CFS)	½ the 2 year	0.0911	<=	0.0773	5 year	0.5589	<=	0.2347	10 year	0.7130	<=	0.3212	25 year	0.7999	<=	0.3935
	STORMWATER FACILITY OUTFLOW (CFS)		PRE-DEVELOPMENT RUNOFF (CFS)																		
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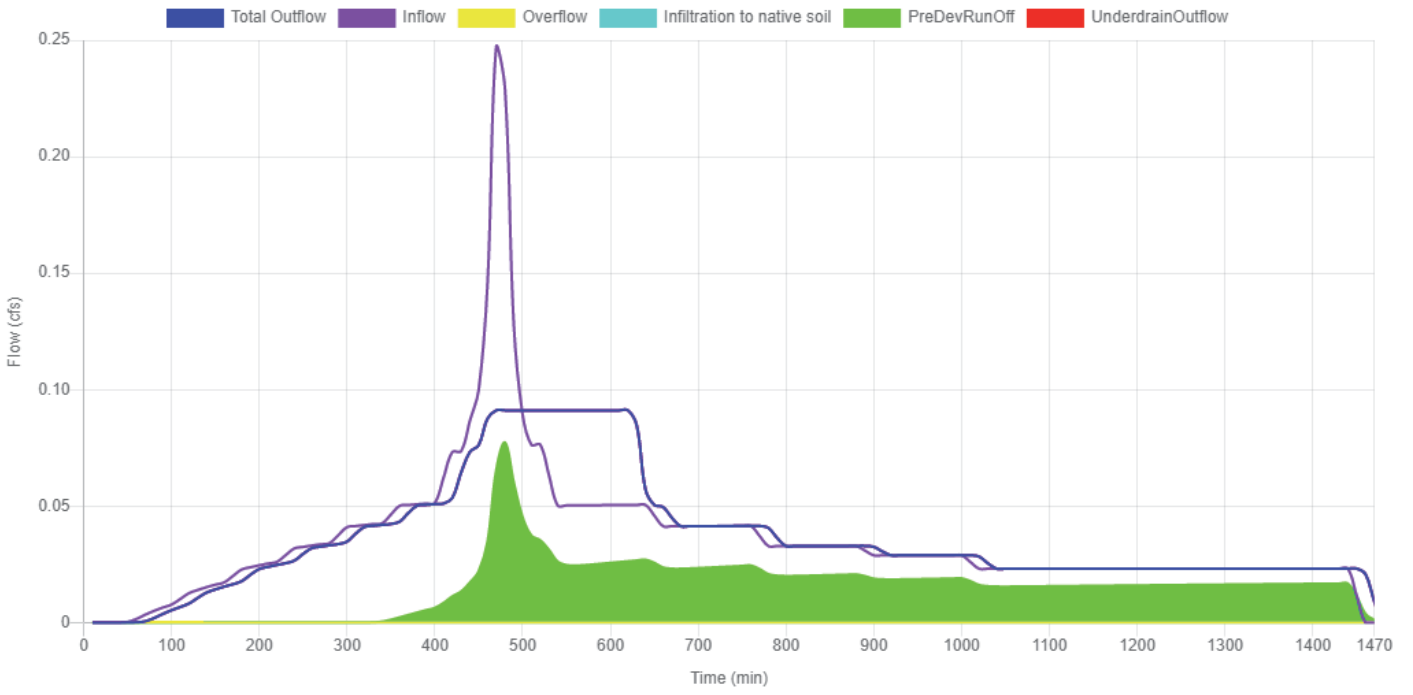
Surface Head



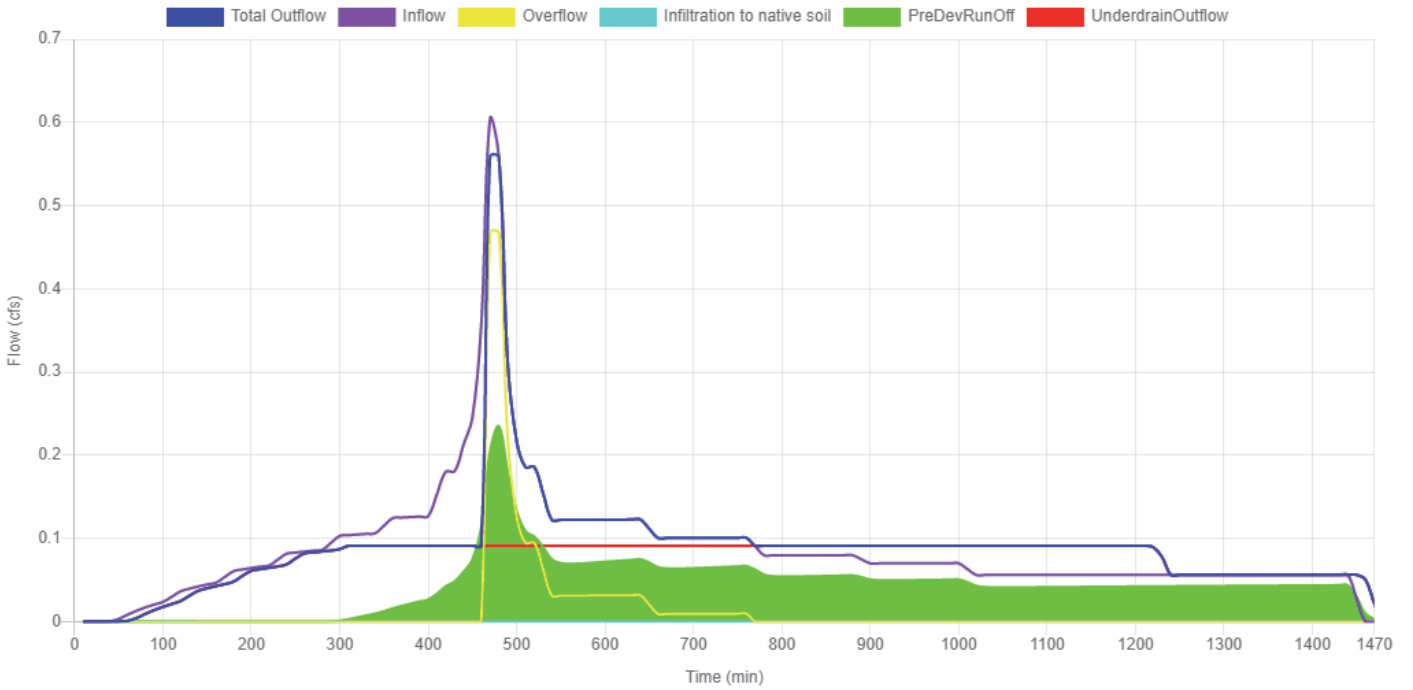
Water Quality



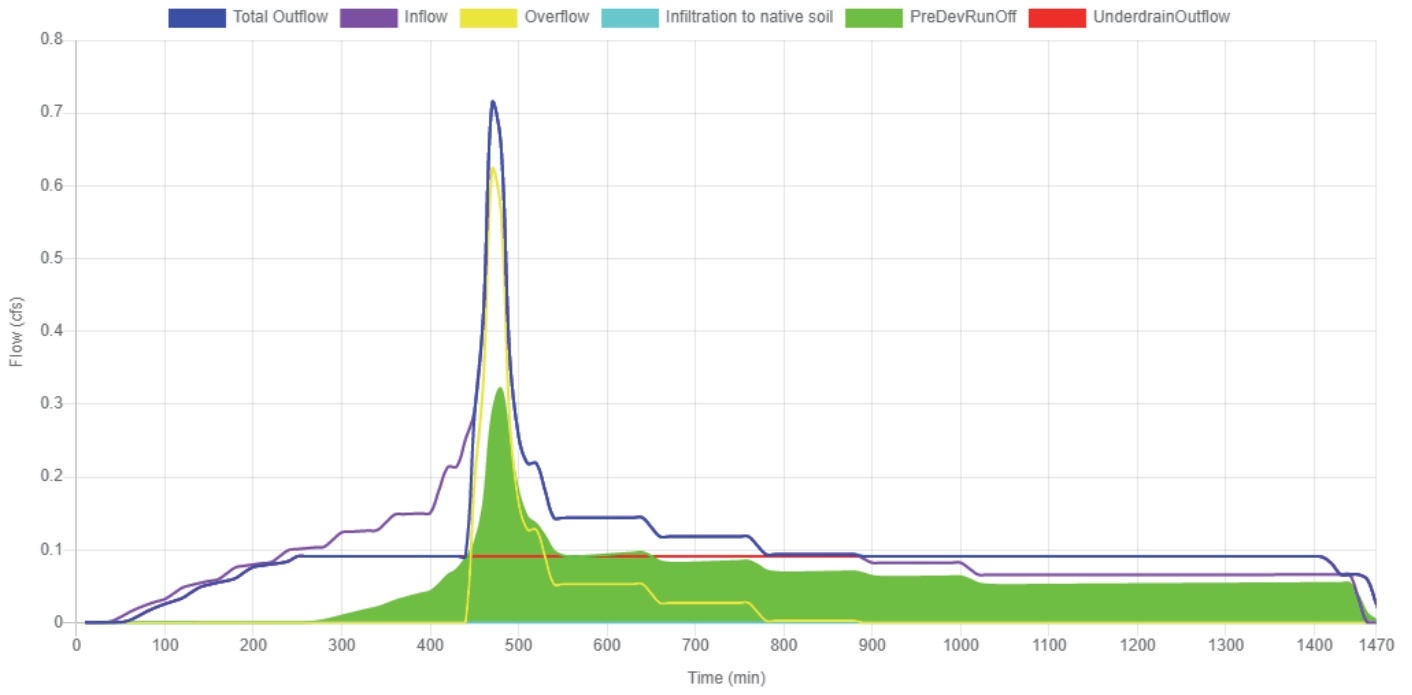
1/2 2-Year



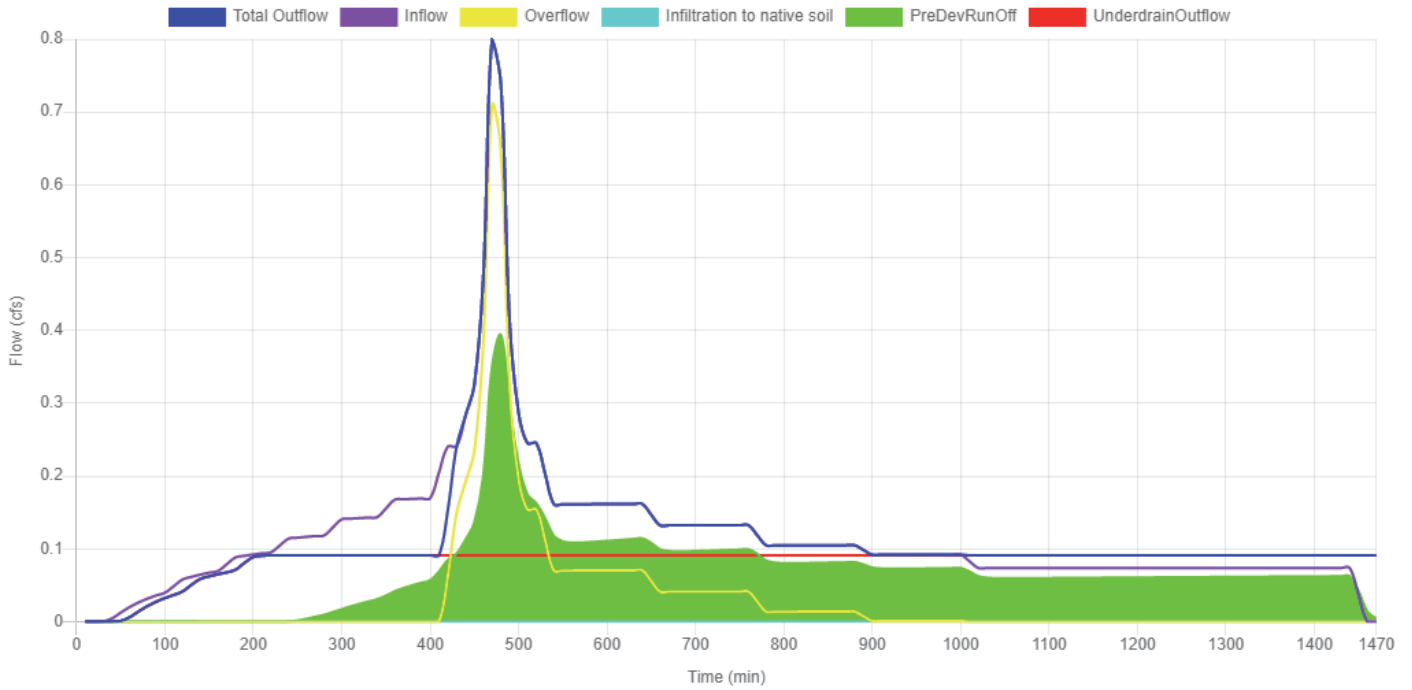
5-Year



10-Year



25-Year

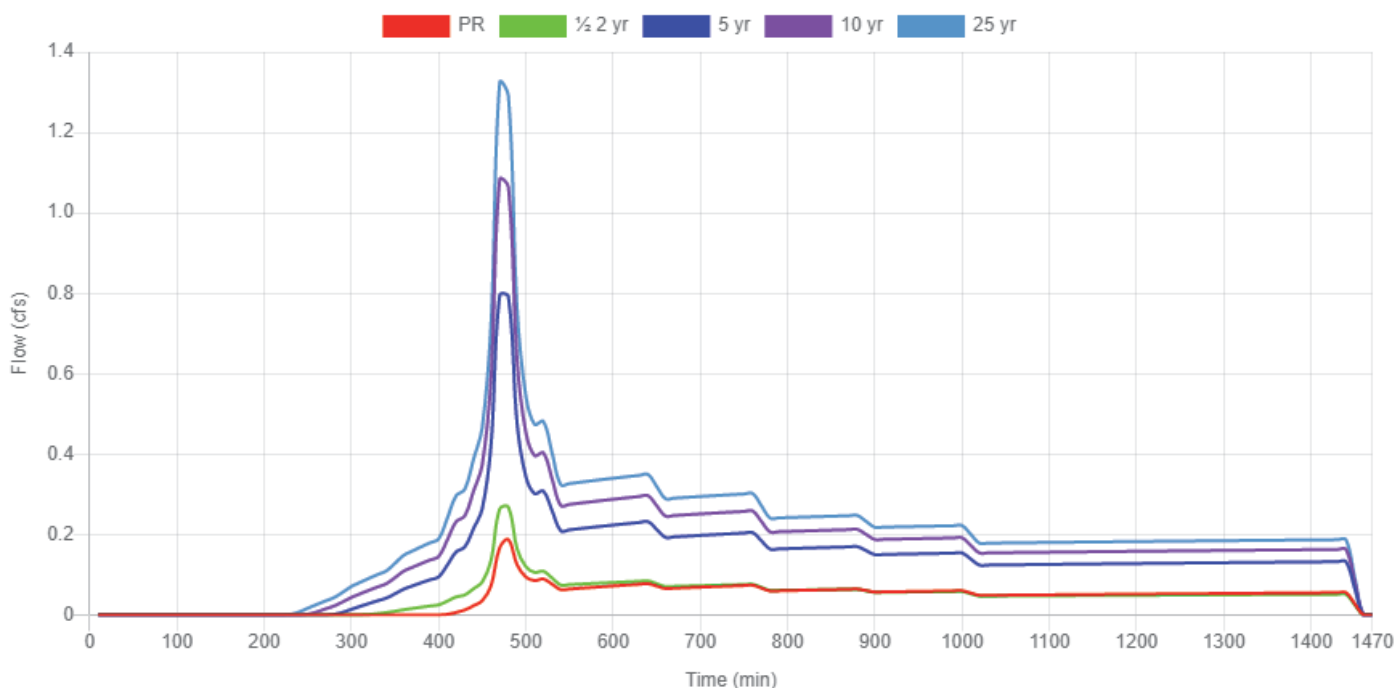


E1

<p>Site Soils & Infiltration Testing</p>	<p>Infiltration Testing Procedure NA</p> <p>Tested Native Soil Infiltration Rate 0 in/hr</p>
<p>Correction Factor</p>	<p>CF test 2</p>
<p>Design Infiltration Rates</p>	<p>Native Soil 0 in/hr</p> <p>Imported Blended Soil 6 in/hr</p>
<p>Catchment Information</p>	<p>Hierarchy Level 2B</p> <p>Hierarchy Description Discharge to an overland storm drainage system, including streams, drainageways, and ditches, or to a storm-only pipe system that discharges to an overland storm drainage system.</p> <p>Pollution Reduction Requirement Filter the post-development stormwater runoff from the water quality storm event through the blended soil.</p> <p>Infiltration Requirement N/A</p> <p>Flow Control Requirement Limit the ½ the 2-yr, the 5-yr, and the 10-yr post-development peak flows to their respective pre-development peak flows. Unless the facility is a public facility (i.e., in the public right-of-way), also limit the 25-yr post-development peak flow to the 25-year pre-development peak flow.</p> <p>Impervious Area 103464 sq ft 2.375 acre</p> <p>Pre-Development Time of Concentration (T_{c pre}) 10 min</p> <p>Post-Development Time of Concentration (T_{c post}) 5 min</p> <p>Pre-Development Curve Number (CN_{pre}) 82</p> <p>Post-Development Curve Number (CN_{post}) 83</p>

SBUH Results

Post-Development Runoff



	Pre - Development Rate and Volume		Post - Development Rate and Volume	
	Peak Rate (cfs)	Total Volume (cf)	Peak Rate (cfs)	Total Volume (cf)
PR	0.14	3512.2	0.1871	3824.2
1/2 2-Year	0.2282	3988.7	0.2678	4228.8
5-Year	0.6933	11215	0.7949	11781.9
10-Year	0.9486	14660.8	1.0831	15302
25-Year	1.1623	17529.5	1.3239	18222.9

	Overflow		Underdrain Outflow		Infiltration	
	Peak Rate (cfs)	Total Volume (cf)	Peak Rate (cfs)	Total Volume (cf)	Peak Rate (cfs)	Total Volume (cf)
PR	0	0	0.131	3701.5	0	0
1/2 2-Year	0	0	0.183	4106.1	0	0
5-Year	0	0	0.278	11659.2	0	0
10-Year	0.15	231.6	0.304	14947.8	0	0
25-Year	0.56	1252.9	0.304	16847.3	0	0

Sloped Facility

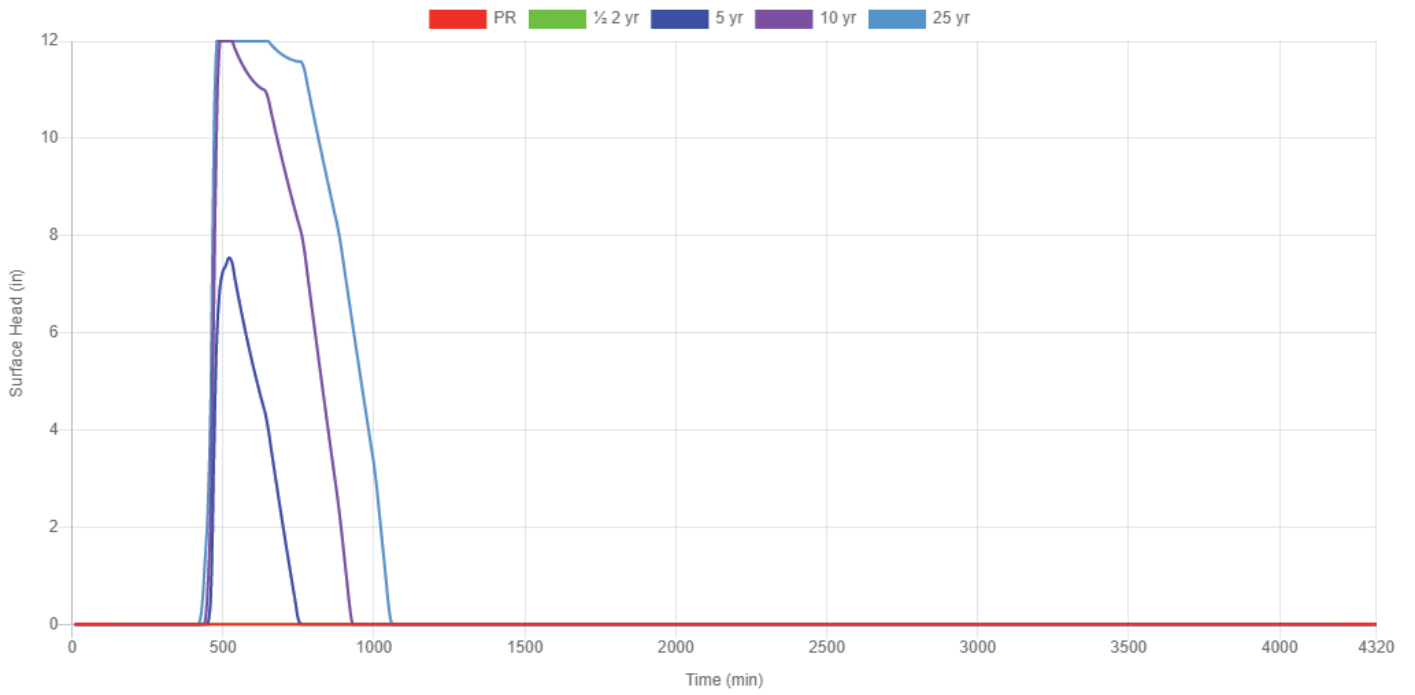
Site Soils & Infiltration Testing	Category
	Sloped Facility
	Shape
	Null
	Location
	Parcel
	Configuration
	D: Lined Facility with RS and Ud
	Above Grade Storage Data
	Total Depth of Blended Soil plus Rock
	24 in
	Surface Storage Capacity at Overflow
	1458.63 cu ft
	Design Infiltration Rate to Soil Underlying the Facility
	0.000 cfs
	Design Infiltration Rate for Imported Blended Soil in the Facility
	0.304 cfs
	Below Grade Storage Data
	Catchment is too small for flow control?
	No
	Rock Area
450.00 sq ft	
Rock Width	
3.00 ft	
Rock Storage Depth	
12.0 in	
Rock Porosity	
0.3	
Percent of Facility Base that Allows Infiltration	
0 %	
Underdrain Height	
4 in	
Orifice (Y/N)?	
Yes	
Orifice Diameter	

	3.000 in																				
Facility Facts	<p>Total Facility Area (excluding freeboard) 2779.92 sq ft</p> <p>Sizing Ratio 2.69 %</p> <p>Segments Total Length 399.00 ft</p>																				
Pollution Reduction Results	<p>Pollution Reduction Score Pass</p> <p>Overflow Volume 0.00 cf</p> <p>Surface Capacity Used 0.00 %</p>																				
Flow Control Results	<p>Flow Control Score Pass</p> <table border="1"> <thead> <tr> <th></th> <th>STORMWATER FACILITY OUTFLOW (CFS)</th> <th></th> <th>PRE-DEVELOPMENT RUNOFF (CFS)</th> </tr> </thead> <tbody> <tr> <td>½ the 2 year</td> <td>0.1828</td> <td><=</td> <td>0.2282</td> </tr> <tr> <td>5 year</td> <td>0.2780</td> <td><=</td> <td>0.6933</td> </tr> <tr> <td>10 year</td> <td>0.4540</td> <td><=</td> <td>0.9486</td> </tr> <tr> <td>25 year</td> <td>0.8616</td> <td><=</td> <td>1.1623</td> </tr> </tbody> </table>		STORMWATER FACILITY OUTFLOW (CFS)		PRE-DEVELOPMENT RUNOFF (CFS)	½ the 2 year	0.1828	<=	0.2282	5 year	0.2780	<=	0.6933	10 year	0.4540	<=	0.9486	25 year	0.8616	<=	1.1623
	STORMWATER FACILITY OUTFLOW (CFS)		PRE-DEVELOPMENT RUNOFF (CFS)																		
½ the 2 year	0.1828	<=	0.2282																		
5 year	0.2780	<=	0.6933																		
10 year	0.4540	<=	0.9486																		
25 year	0.8616	<=	1.1623																		

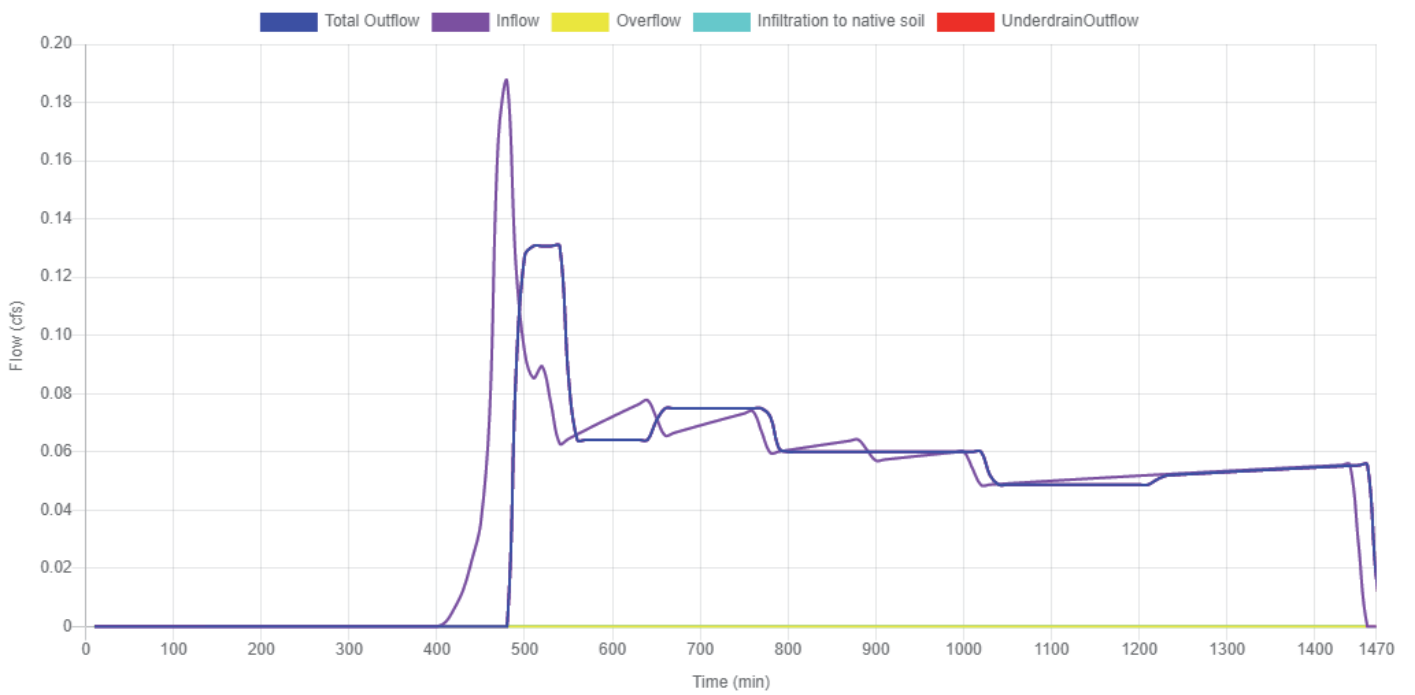
Sloped Facility Worksheet

Segment #	Check Dam Length (ft)	Check Dam Width (ft)	Slope, v/h (ft/ft)	Bottom Width (ft)	Right Side Slope (_h:1v)	Left Side Slope (_h:1v)	Down-gradient Depth (in)	Landscape Width (ft)	Adjusted Length (ft)	Up-gradient Depth (ft)	Surface Capacity Volume (cf)
0	66.00	0.5	0.01	3.00	3.0	3.0	12.0	9.0	66.00	0.34	243.10
1	66.00	0.5	0.01	3.00	3.0	3.0	12.0	9.0	66.00	0.34	243.10
2	66.00	0.5	0.01	3.00	3.0	3.0	12.0	9.0	66.00	0.34	243.10
3	66.00	0.5	0.01	3.00	3.0	3.0	12.0	9.0	66.00	0.34	243.10
4	66.00	0.5	0.01	3.00	3.0	3.0	12.0	9.0	66.00	0.34	243.10
5	66.00	0.5	0.01	3.00	3.0	3.0	12.0	9.0	66.00	0.34	243.10

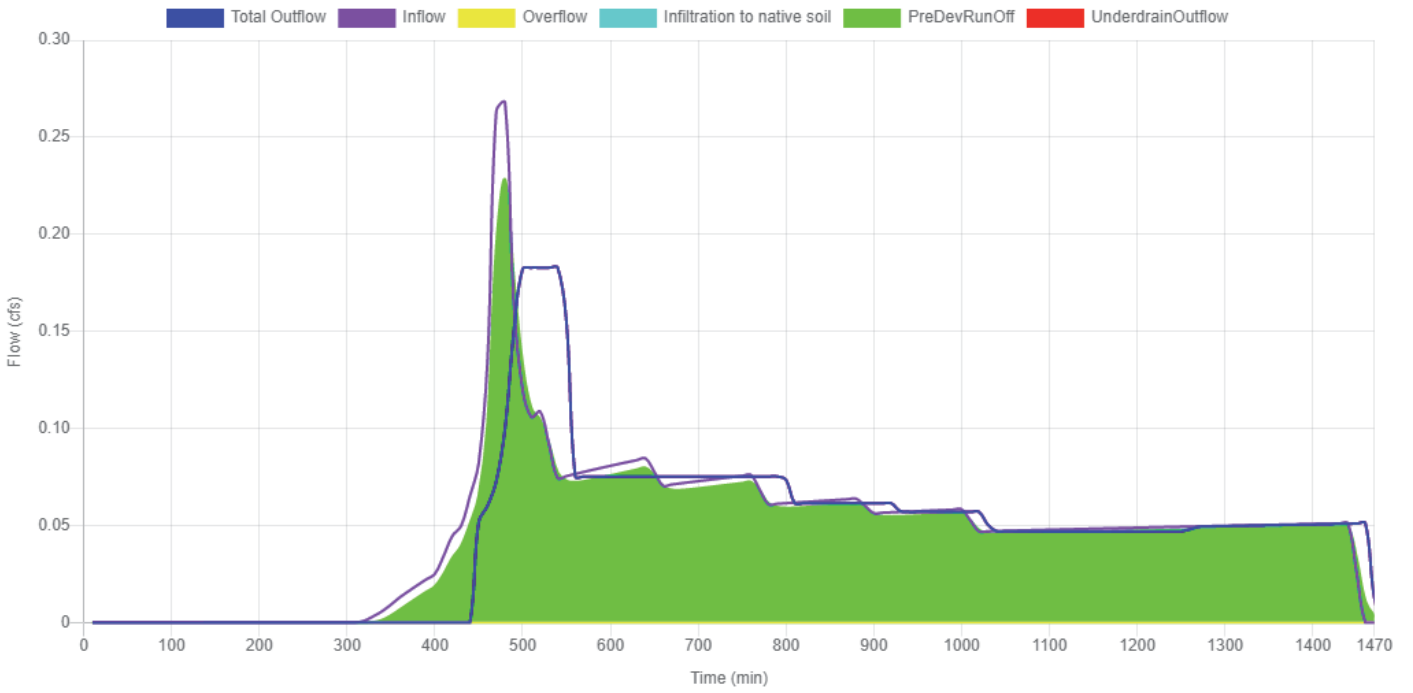
Surface Head



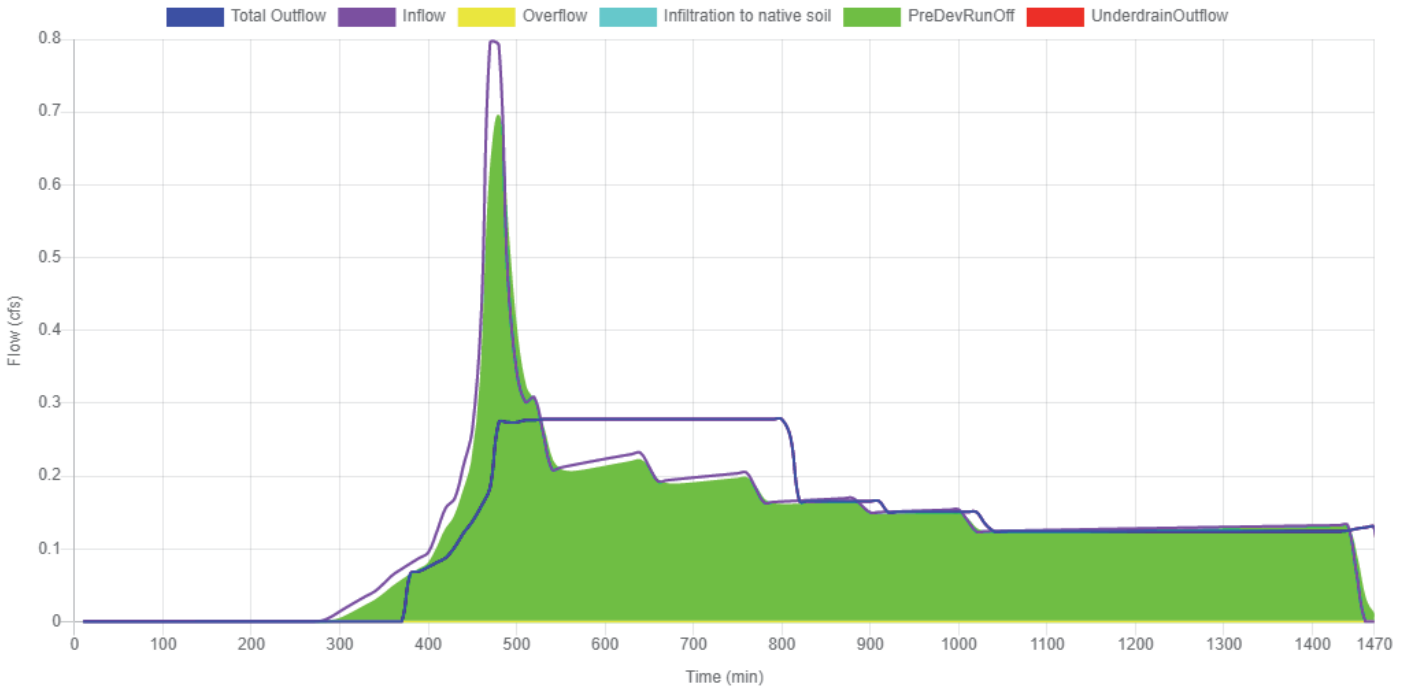
Water Quality



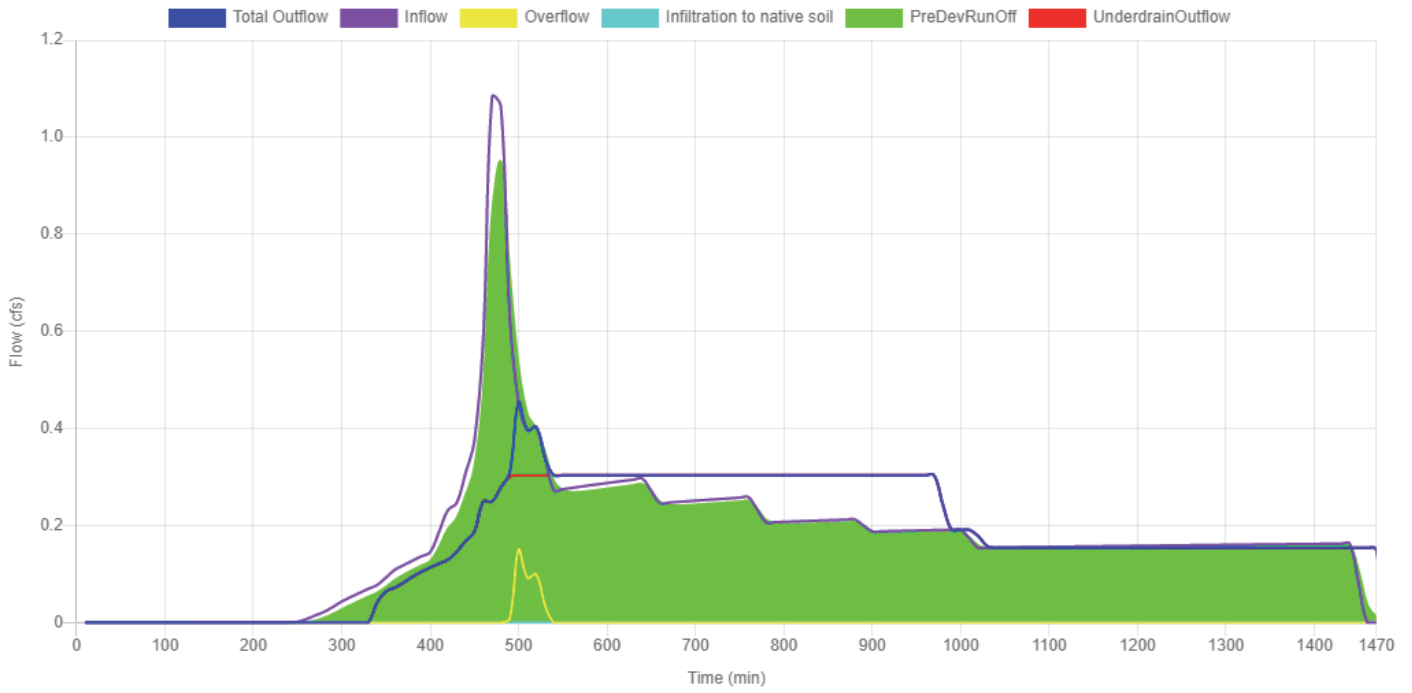
1/2 2-Year



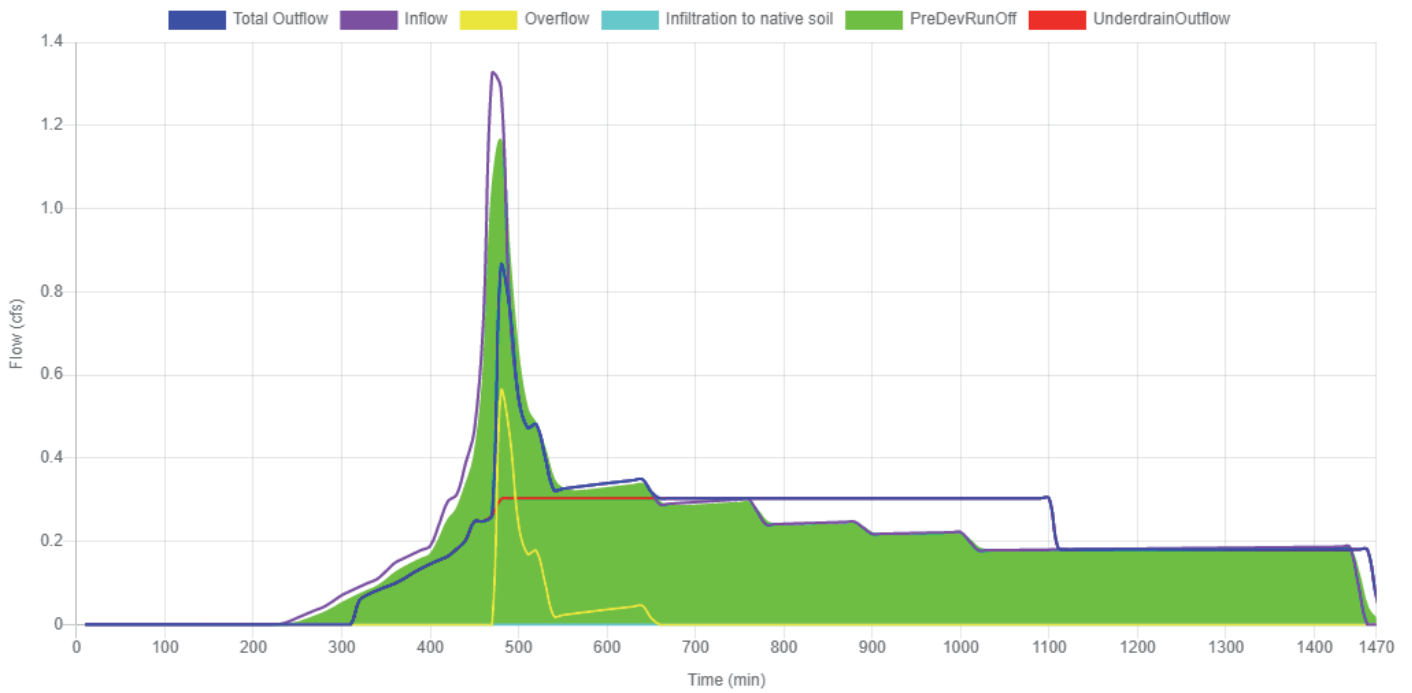
5-Year



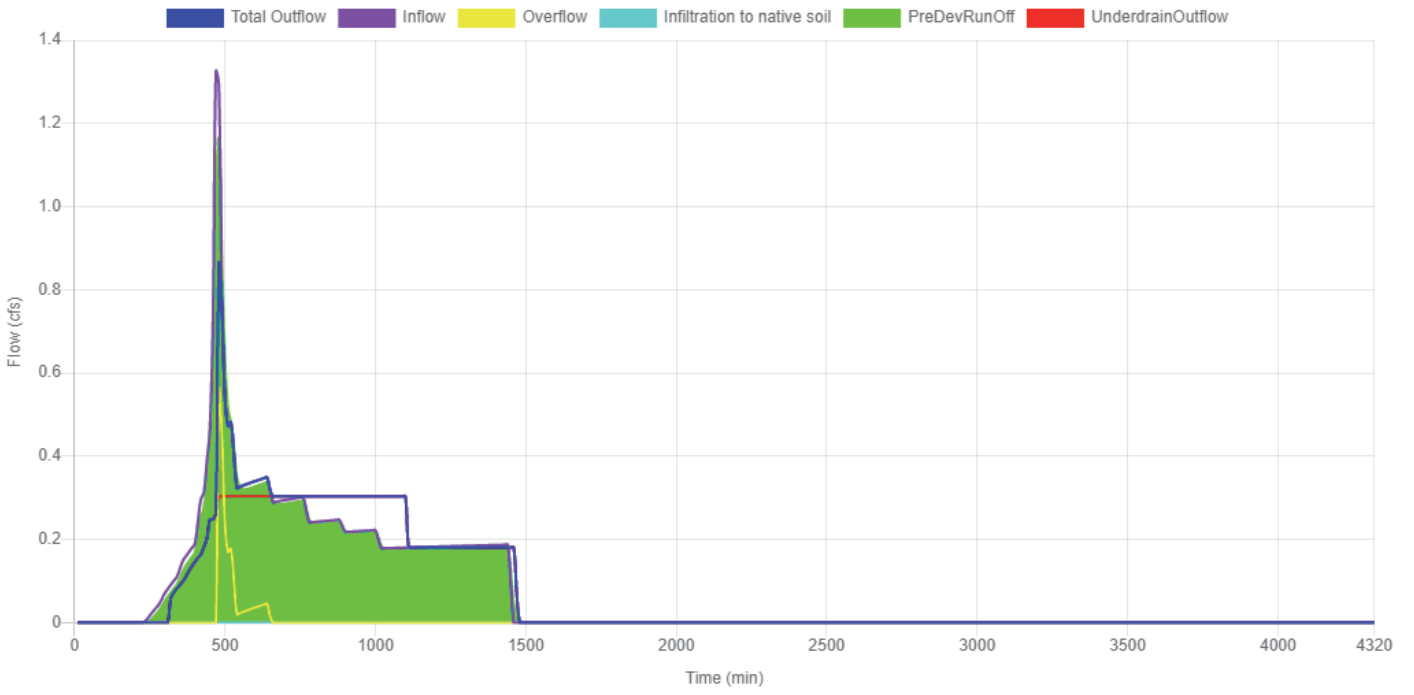
10-Year



25-Year



25-Year



BIO-SWALE DESIGN

Area 12C

Water Quality Flow:

A = 51,507 sf
I = 0.19 inches
WQF = 0.20 cfs

Bio-Swale Design Data:

Q = 0.202 Design flow rate (c.f.s.)
n = 0.25 manning's n
S = 0.5% longitudinal slope of swale (ft/ft)
b = 2.00 width of bottom (ft.)
Z = 3 side slope (ft/ft)
t = 9 Min Residence Time

Depth y (ft)	Area A (sf)	Wetted Perimeter P (ft)	Hydraulic Radius R (ft)	Top Width T (ft)	Velocity V (ft/s)	Length L (ft)
0.3300	0.9867	4.0871	0.2414	3.9800	0.20	110.66

Water Quality Design Velocity:

Q = 0.202
A = 0.99 sf
 $V=Q/A$
V = 0.20 ft/s

Bio-Swale Length

$L=(V)(t)(60)$
t = 9.00 min
V = 0.20 ft/s
L = 110.66 ft ok

BIO-SWALE DESIGN

Area 51

Water Quality Flow:

A = 28,769 sf
I = 0.19 inches
WQF = 0.11 cfs

Bio-Swale Design Data:

Q = 0.113 Design flow rate (c.f.s.)
n = 0.24 manning's n
S = 1.0% longitudinal slope of swale (ft/ft)
b = 2.00 width of bottom (ft.)
Z = 4 side slope (ft/ft)
t = 9 Min Residence Time

Depth y (ft)	Area A (sf)	Wetted Perimeter P (ft)	Hydraulic Radius R (ft)	Top Width T (ft)	Velocity V (ft/s)	Length L (ft)
0.3300	1.0956	4.7212	0.2321	4.6400	0.10	55.664

Water Quality Design Velocity:

Q = 0.113
A = 1.10 sf
 $V=Q/A$
V = 0.10 ft/s

Bio-Swale Length

$L=(V)(t)(60)$
t = 9.00 min
V = 0.10 ft/s
L = 55.66 Use Minimum Swale Length

BIO-SWALE DESIGN

Road A

Water Quality Flow:

A = 22,489 sf
I = 0.19 inches
WQF = 0.09 cfs

Bio-Swale Design Data:

Q = 0.088 Design flow rate (c.f.s.)
n = 0.24 manning's n
S = 1.0% longitudinal slope of swale (ft/ft)
b = 2.00 width of bottom (ft.)
Z = 4 side slope (ft/ft)
t = 9 Min Residence Time

Depth y (ft)	Area A (sf)	Wetted Perimeter P (ft)	Hydraulic Radius R (ft)	Top Width T (ft)	Velocity V (ft/s)	Length L (ft)
0.3300	1.0956	4.7212	0.2321	4.6400	0.08	43.513

Water Quality Design Velocity:

Q = 0.088
A = 1.10 sf
 $V=Q/A$
V = 0.08 ft/s

Bio-Swale Length

$L=(V)(t)(60)$
t = 9.00 min
V = 0.08 ft/s
L = 43.51 Use Minimum Swale Length

BIO-SWALE DESIGN

Road B1

Water Quality Flow:

A = 48,943 sf
I = 0.19 inches
WQF = 0.19 cfs

Bio-Swale Design Data:

Q = 0.192 Design flow rate (c.f.s.)
n = 0.24 manning's n
S = 1.0% longitudinal slope of swale (ft/ft)
b = 2.00 width of bottom (ft.)
Z = 4 side slope (ft/ft)
t = 9 Min Residence Time

Depth y (ft)	Area A (sf)	Wetted Perimeter P (ft)	Hydraulic Radius R (ft)	Top Width T (ft)	Velocity V (ft/s)	Length L (ft)
0.3300	1.0956	4.7212	0.2321	4.6400	0.18	94.698

Water Quality Design Velocity:

Q = 0.192
A = 1.10 sf
 $V=Q/A$
V = 0.18 ft/s

Bio-Swale Length

$L=(V)(t)(60)$
t = 9.00 min
V = 0.18 ft/s
L = 94.70 Use Minimum Swale Length

BIO-SWALE DESIGN

Road B2

Water Quality Flow:

A = 36,099 sf
I = 0.19 inches
WQF = 0.14 cfs

Bio-Swale Design Data:

Q = 0.142 Design flow rate (c.f.s.)
n = 0.24 manning's n
S = 1.0% longitudinal slope of swale (ft/ft)
b = 2.00 width of bottom (ft.)
Z = 4 side slope (ft/ft)
t = 9 Min Residence Time

Depth y (ft)	Area A (sf)	Wetted Perimeter P (ft)	Hydraulic Radius R (ft)	Top Width T (ft)	Velocity V (ft/s)	Length L (ft)
0.3300	1.0956	4.7212	0.2321	4.6400	0.13	69.847

Water Quality Design Velocity:

Q = 0.142
A = 1.10 sf
 $V=Q/A$
V = 0.13 ft/s

Bio-Swale Length

$L=(V)(t)(60)$
t = 9.00 min
V = 0.13 ft/s
L = 69.85 Use Minimum Swale Length

BIO-SWALE DESIGN

Road F

Water Quality Flow:

A = 8,475 sf
I = 0.19 inches
WQF = 0.03 cfs

Bio-Swale Design Data:

Q = 0.033 Design flow rate (c.f.s.)
n = 0.24 manning's n
S = 1.0% longitudinal slope of swale (ft/ft)
b = 2.00 width of bottom (ft.)
Z = 4 side slope (ft/ft)
t = 9 Min Residence Time

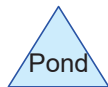
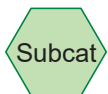
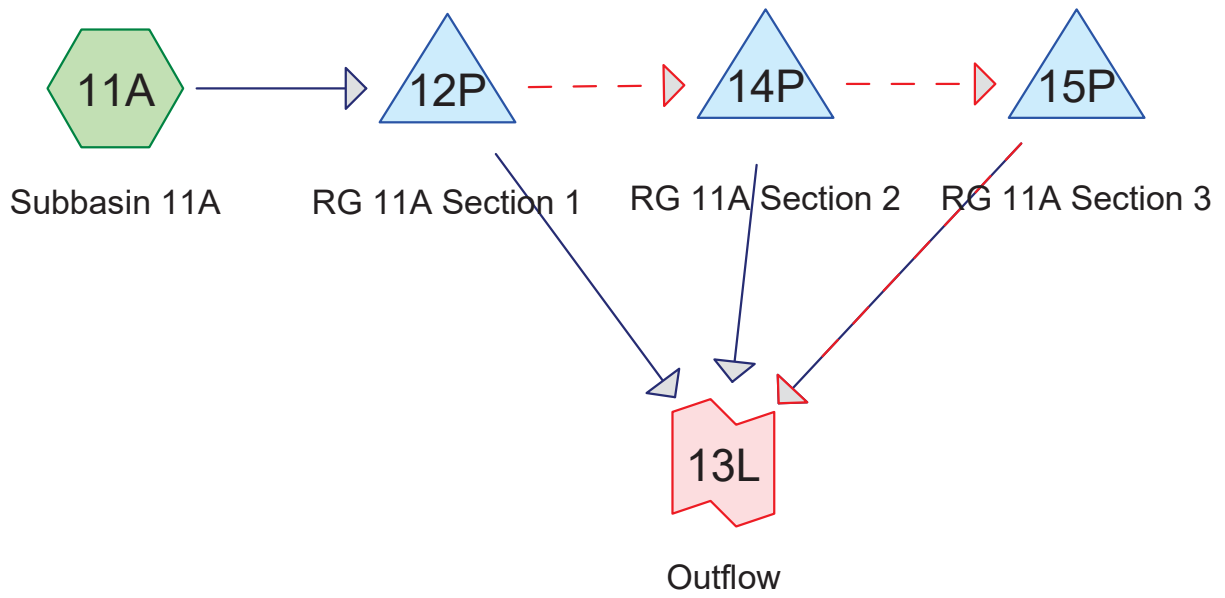
Depth y (ft)	Area A (sf)	Wetted Perimeter P (ft)	Hydraulic Radius R (ft)	Top Width T (ft)	Velocity V (ft/s)	Length L (ft)
0.3300	1.0956	4.7212	0.2321	4.6400	0.03	16.398

Water Quality Design Velocity:

Q = 0.033
A = 1.10 sf
 $V=Q/A$
V = 0.03 ft/s

Bio-Swale Length

$L=(V)(t)(60)$
t = 9.00 min
V = 0.03 ft/s
L = 16.40 Use Minimum Swale Length



Routing Diagram for Bull Run Filtration Rain Garden 11A
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Bull Run Filtration Rain Garden 11A

Type IA 24-hr WQ Rainfall=1.40"

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Summary for Subcatchment 11A: Subbasin 11A

Runoff = 0.09 cfs @ 7.89 hrs, Volume= 1,280 cf, Depth= 1.18"

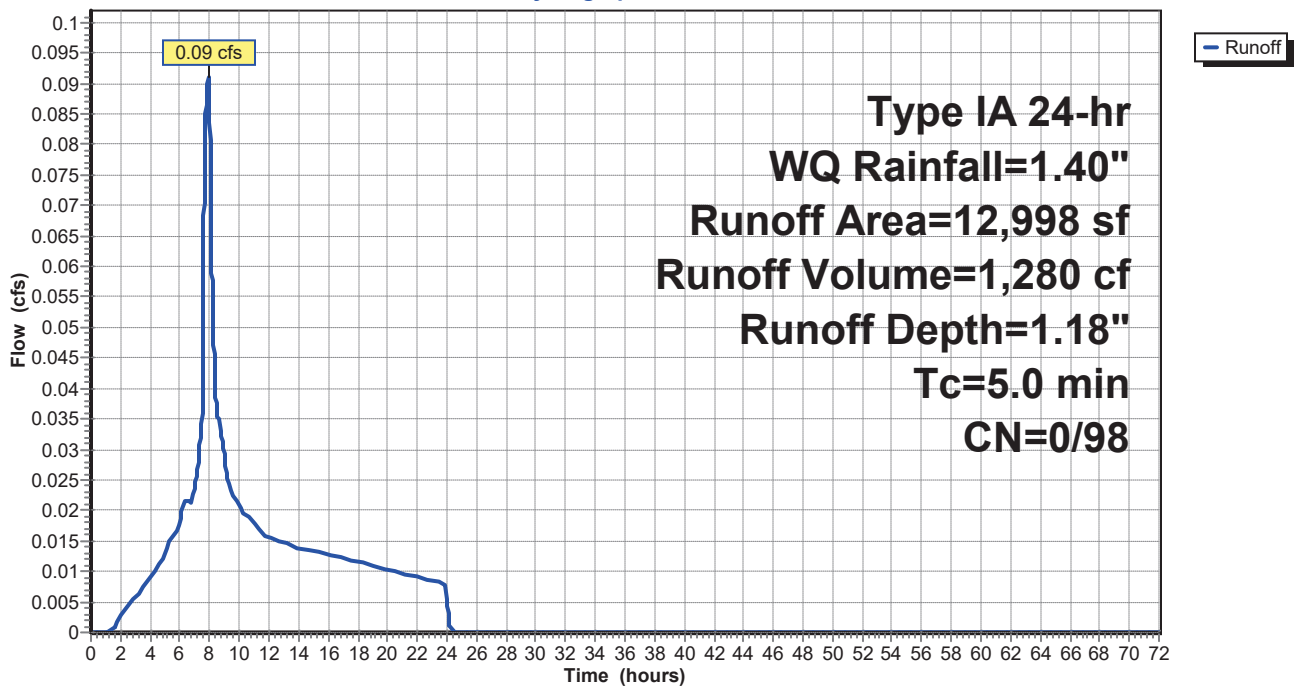
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr WQ Rainfall=1.40"

	Area (sf)	CN	Description
*	12,998	98	Impervious
	12,998	98	100.00% Impervious Area

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

Subcatchment 11A: Subbasin 11A

Hydrograph



Bull Run Filtration Rain Garden 11A

Type IA 24-hr WQ Rainfall=1.40"

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Summary for Pond 12P: RG 11A Section 1

Inflow Area = 12,998 sf, 100.00% Impervious, Inflow Depth = 1.18" for WQ event
 Inflow = 0.09 cfs @ 7.89 hrs, Volume= 1,280 cf
 Outflow = 0.09 cfs @ 7.89 hrs, Volume= 1,280 cf, Atten= 0%, Lag= 0.0 min
 Primary = 0.09 cfs @ 7.89 hrs, Volume= 1,280 cf
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Peak Elev= 710.60' @ 7.89 hrs Surf.Area= 11 sf Storage= 0 cf

Plug-Flow detention time= 0.0 min calculated for 1,280 cf (100% of inflow)
 Center-of-Mass det. time= 0.0 min (695.4 - 695.4)

Volume	Invert	Avail.Storage	Storage Description
#1	710.59'	1,148 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
710.59	9	0	0
713.59	756	1,148	1,148

Device	Routing	Invert	Outlet Devices
#1	Secondary	713.26'	1.0' long x 1.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32
#2	Primary	708.42'	4.0" Round Culvert L= 26.5' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 708.42' / 708.29' S= 0.0049 '/' Cc= 0.900 n= 0.013, Flow Area= 0.09 sf

Primary OutFlow Max=0.44 cfs @ 7.89 hrs HW=710.60' (Free Discharge)
 ↑**2=Culvert** (Barrel Controls 0.44 cfs @ 4.99 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=710.59' (Free Discharge)
 ↑**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Bull Run Filtration Rain Garden 11A

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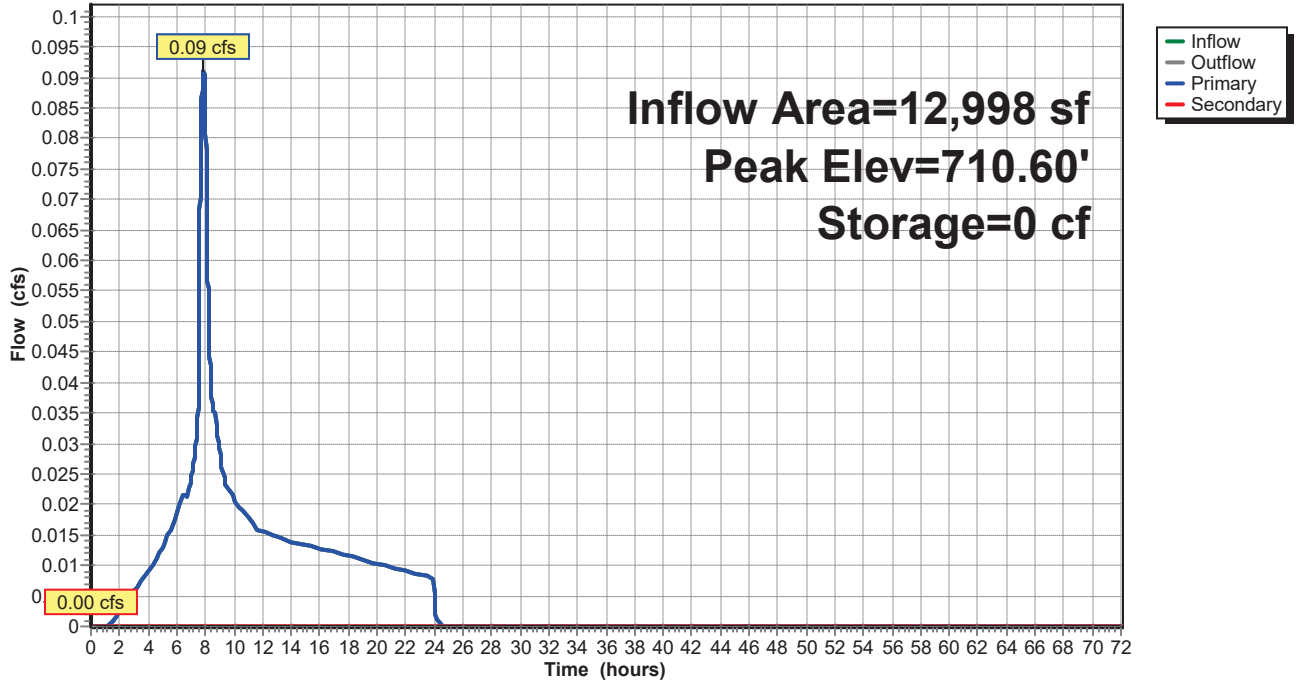
Type IA 24-hr WQ Rainfall=1.40"

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Pond 12P: RG 11A Section 1

Hydrograph



Bull Run Filtration Rain Garden 11A

Type IA 24-hr WQ Rainfall=1.40"

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Summary for Pond 14P: RG 11A Section 2

Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
 Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Peak Elev= 711.01' @ 0.00 hrs Surf.Area= 21 sf Storage= 0 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
 Center-of-Mass det. time= (not calculated: no inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	711.01'	988 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
711.01	21	0	0
713.51	769	988	988

Device	Routing	Invert	Outlet Devices
#1	Secondary	713.14'	1.0' long x 1.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32
#2	Primary	708.29'	4.0" Round Culvert L= 30.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 708.29' / 708.14' S= 0.0050 '/' Cc= 0.900 n= 0.013, Flow Area= 0.09 sf

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=711.01' (Free Discharge)

↑**2=Culvert** (Passes 0.00 cfs of 0.47 cfs potential flow)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=711.01' (Free Discharge)

↑**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Bull Run Filtration Rain Garden 11A

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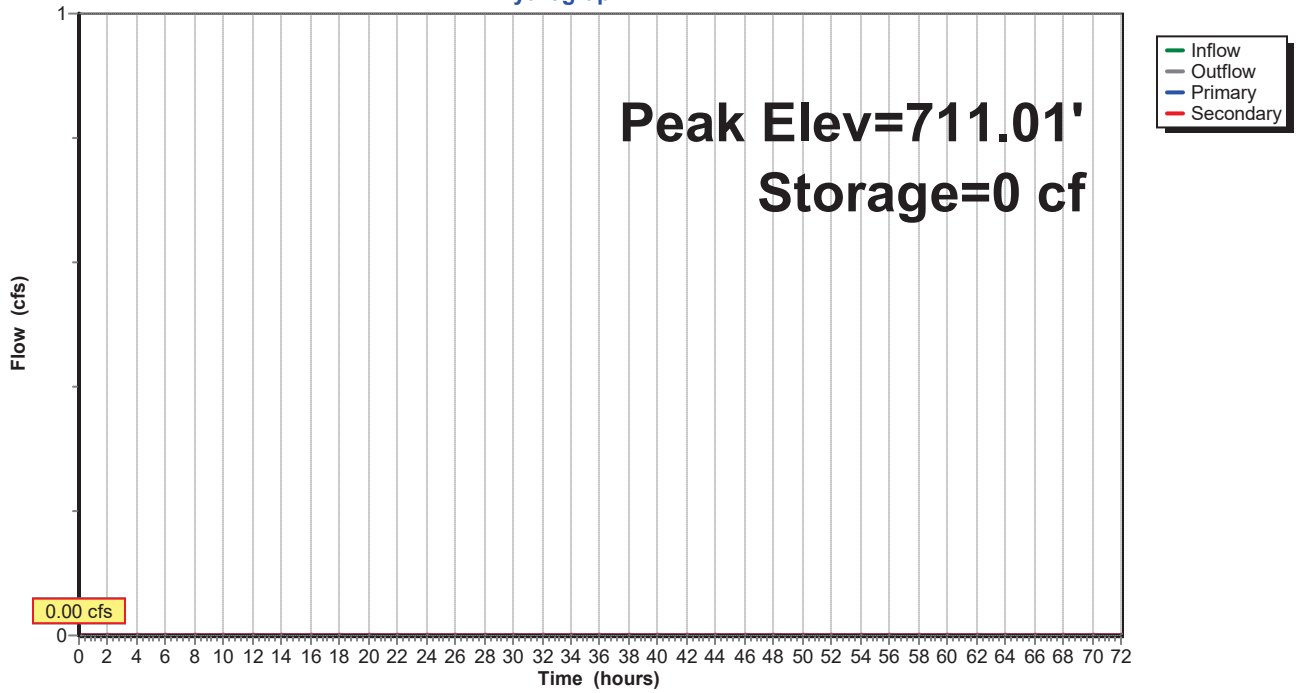
Type IA 24-hr WQ Rainfall=1.40"

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Pond 14P: RG 11A Section 2

Hydrograph



Bull Run Filtration Rain Garden 11A

Type IA 24-hr WQ Rainfall=1.40"

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Summary for Pond 15P: RG 11A Section 3

Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
 Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Peak Elev= 711.39' @ 0.00 hrs Surf.Area= 9 sf Storage= 0 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
 Center-of-Mass det. time= (not calculated: no inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	711.39'	324 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
711.39	9	0	0
713.39	315	324	324

Device	Routing	Invert	Outlet Devices
#1	Primary	708.14'	4.0" Round Culvert L= 13.5' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 708.14' / 708.07' S= 0.0052 '/' Cc= 0.900 n= 0.013, Flow Area= 0.09 sf
#2	Secondary	712.75'	18.0" Horiz. Beehive C= 0.620 Limited to weir flow at low heads

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=711.39' (Free Discharge)

↑**1=Culvert** (Passes 0.00 cfs of 0.66 cfs potential flow)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=711.39' (Free Discharge)

↑**2=Beehive** (Controls 0.00 cfs)

Bull Run Filtration Rain Garden 11A

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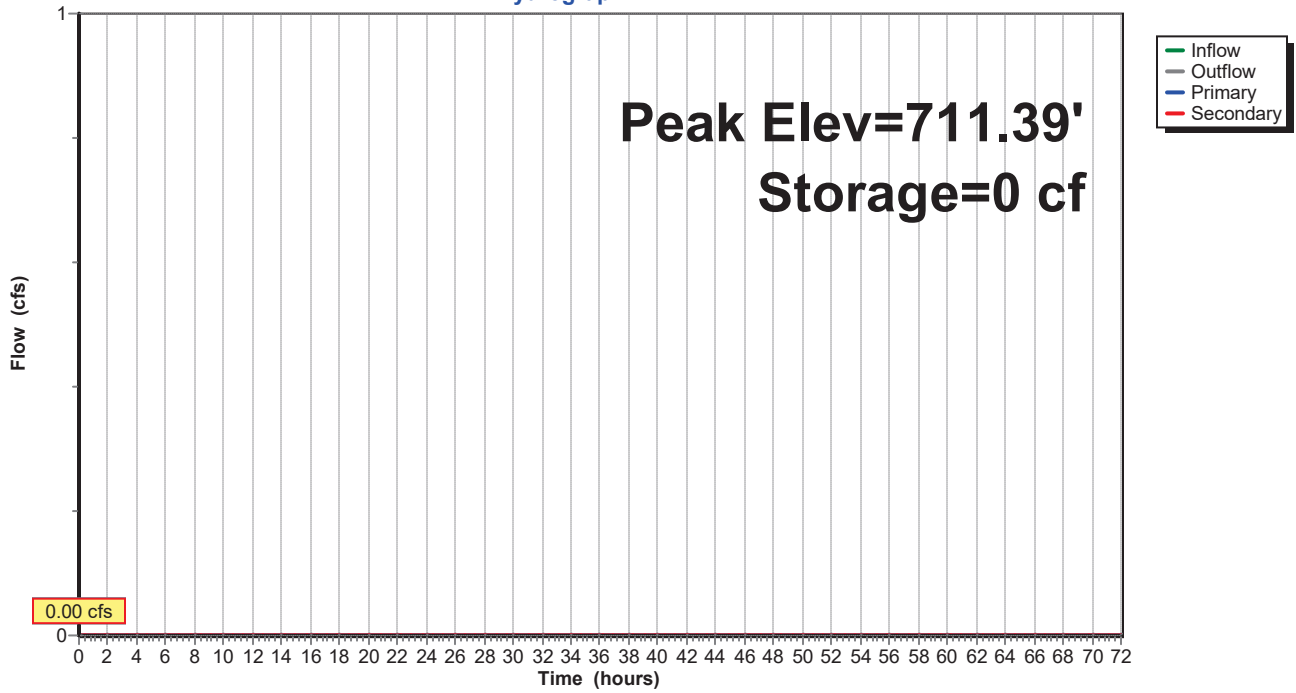
Type IA 24-hr WQ Rainfall=1.40"

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Pond 15P: RG 11A Section 3

Hydrograph



Bull Run Filtration Rain Garden 11A

Type IA 24-hr WQ Rainfall=1.40"

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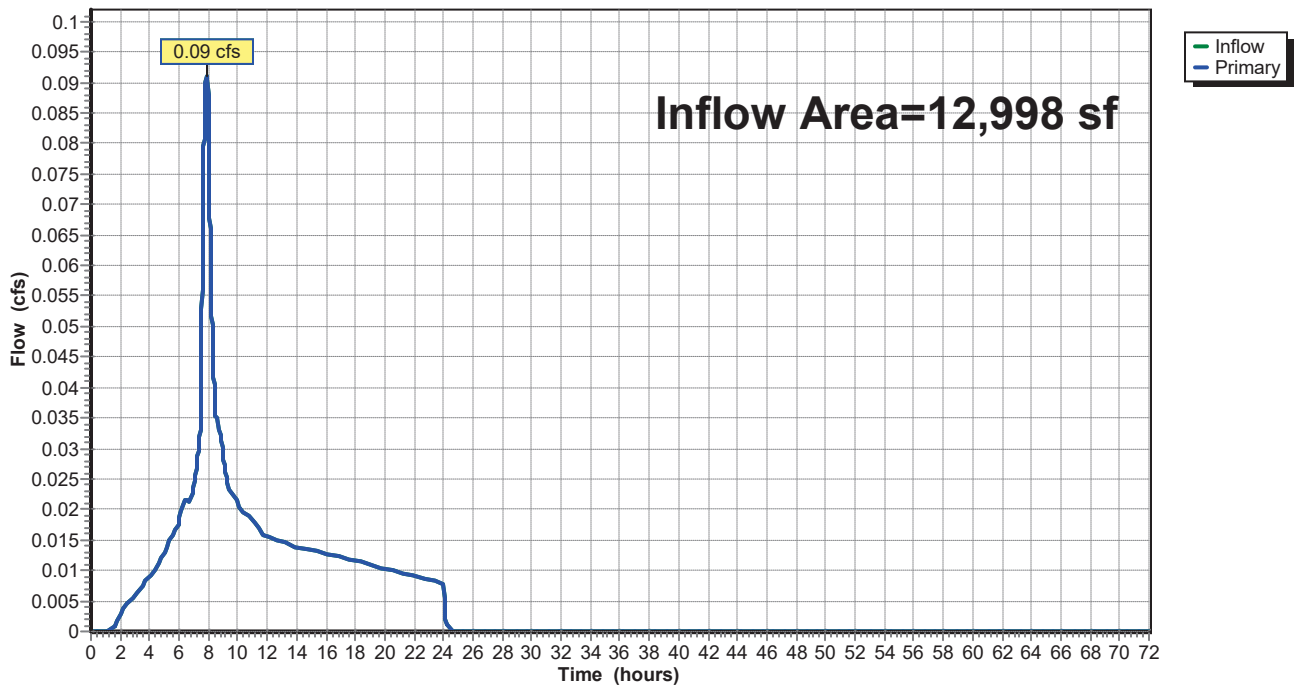
Summary for Link 13L: Outflow

Inflow Area = 12,998 sf, 100.00% Impervious, Inflow Depth = 1.18" for WQ event
Inflow = 0.09 cfs @ 7.89 hrs, Volume= 1,280 cf
Primary = 0.09 cfs @ 7.89 hrs, Volume= 1,280 cf, Atten= 0%, Lag= 0.0 min

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

Link 13L: Outflow

Hydrograph



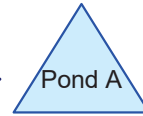
Attachment E: Hydrologic Analysis of Pre- and Post-Developed Conditions (For Flow Control)



Pre Dev Basin A



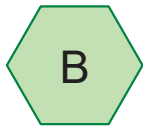
Post Basin A



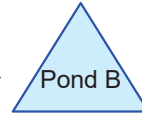
Pond A



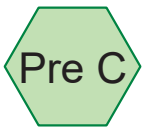
Pre Dev Basin B



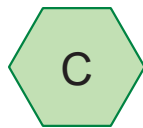
Post Basin B



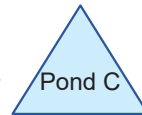
Pond B



Pre Dev Basin C



Post Basin C



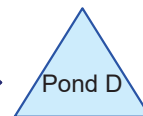
Pond C



Pre Dev Basin D



Post Basin D



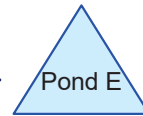
Pond D



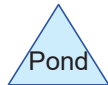
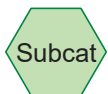
Pre Dev Basin E



Post Basin E



Pond E



Routing Diagram for Bull Run Filtration Detention Ponds
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Bull Run Filtration Detention Ponds

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Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
17,049	98	(E)
1,780,163	80	>75% Grass cover, Good, HSG D (A, B, C, D, E)
572,761	98	Impervious Area (A, B, C, D, E)
2,369,973	82	Row crops, SR + CR, Good, HSG C (Pre A, Pre B, Pre C, Pre D, Pre E)
4,739,946	83	TOTAL AREA

Bull Run Filtration Detention Ponds

Type IA 24-hr 2-Year Rainfall=2.80"

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Summary for Subcatchment A: Post Basin A

Runoff = 3.52 cfs @ 7.92 hrs, Volume= 53,630 cf, Depth= 1.84"

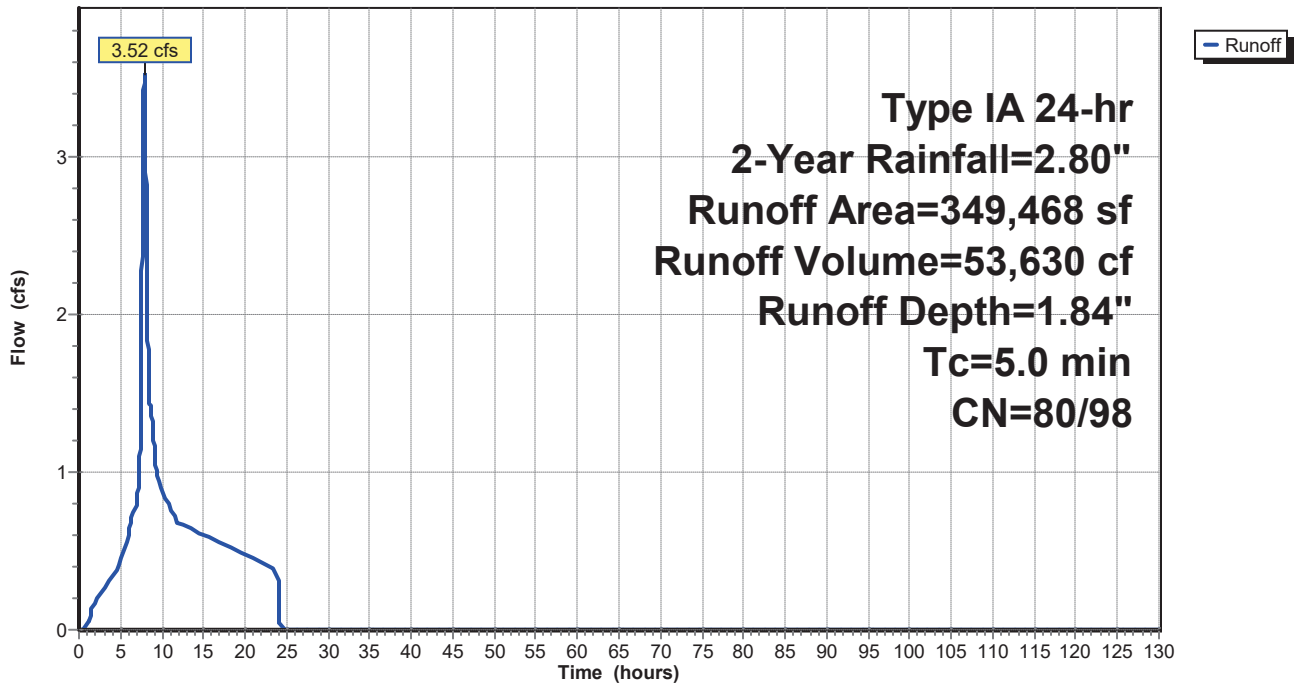
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-Year Rainfall=2.80"

	Area (sf)	CN	Description
*	176,142	98	Impervious Area
	173,326	80	>75% Grass cover, Good, HSG D
	349,468	89	Weighted Average
	173,326	80	49.60% Pervious Area
	176,142	98	50.40% Impervious Area

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

Subcatchment A: Post Basin A

Hydrograph



Bull Run Filtration Detention Ponds

Type IA 24-hr 2-Year Rainfall=2.80"

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Summary for Subcatchment B: Post Basin B

Runoff = 3.08 cfs @ 7.91 hrs, Volume= 46,588 cf, Depth= 1.90"

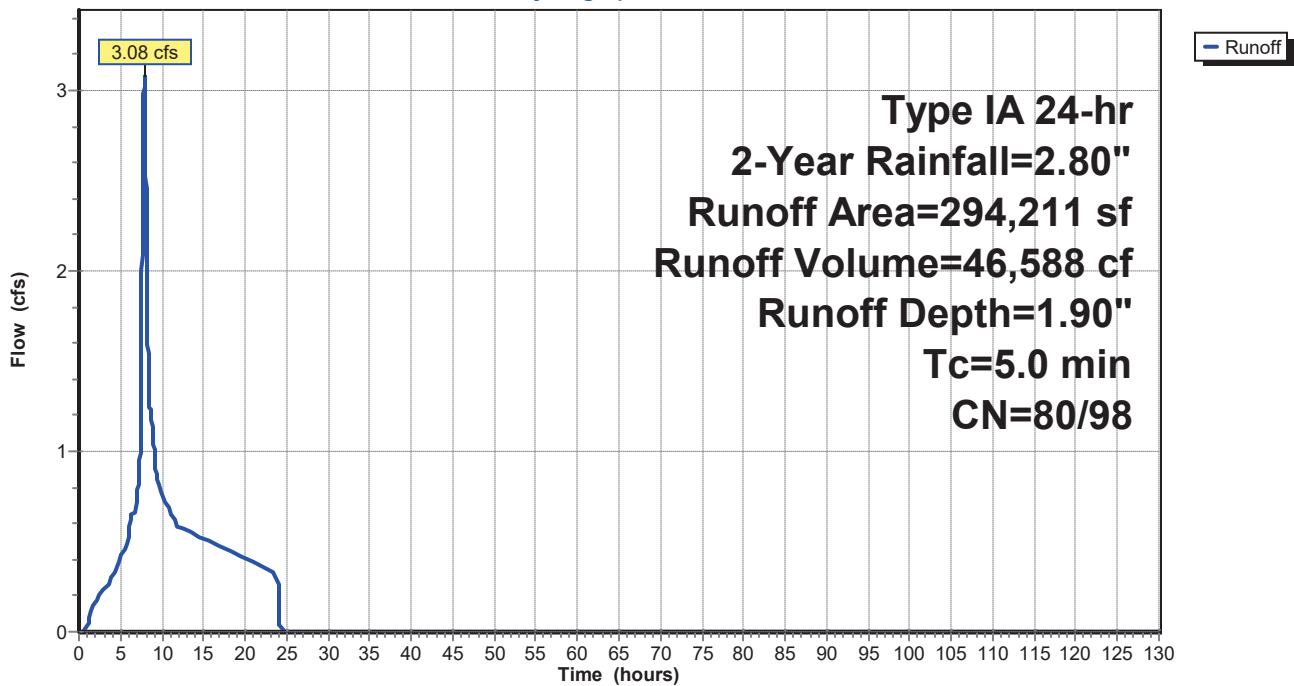
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-Year Rainfall=2.80"

	Area (sf)	CN	Description
*	160,056	98	Impervious Area
	134,155	80	>75% Grass cover, Good, HSG D
	294,211	90	Weighted Average
	134,155	80	45.60% Pervious Area
	160,056	98	54.40% Impervious Area

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

Subcatchment B: Post Basin B

Hydrograph



Bull Run Filtration Detention Ponds

Type IA 24-hr 2-Year Rainfall=2.80"

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Summary for Subcatchment C: Post Basin C

Runoff = 4.78 cfs @ 7.98 hrs, Volume= 79,309 cf, Depth= 1.26"

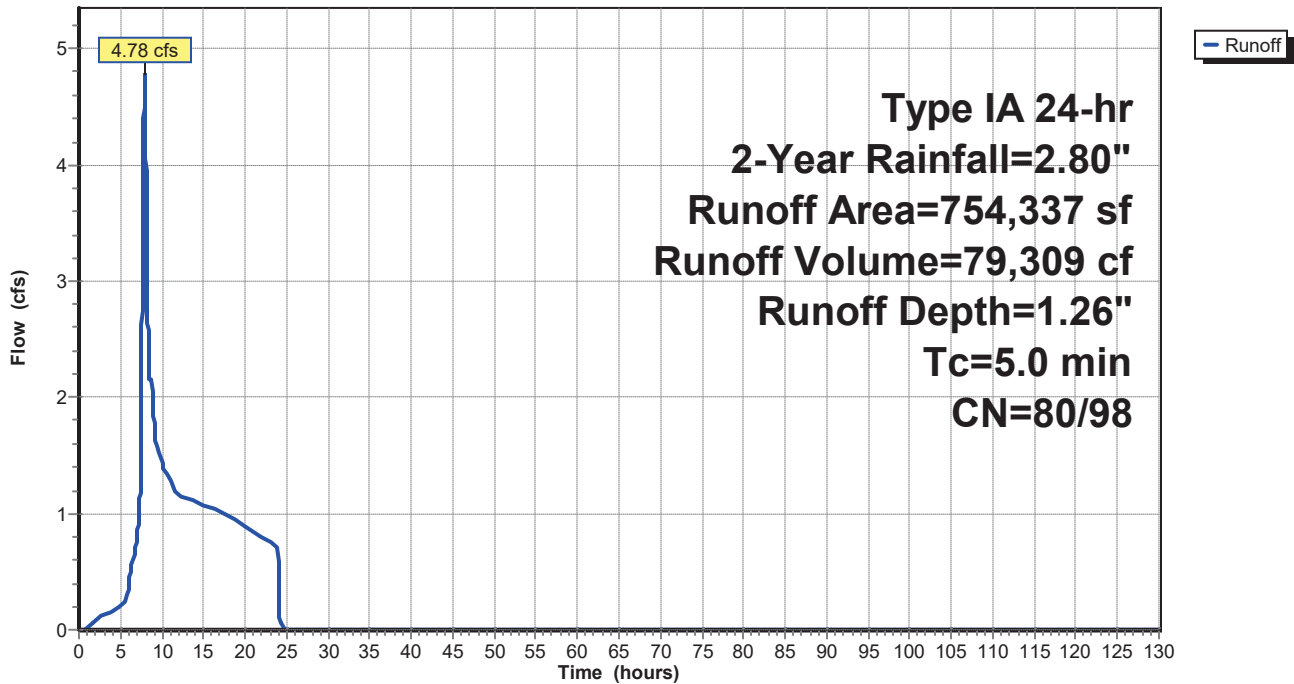
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-Year Rainfall=2.80"

	Area (sf)	CN	Description
*	82,047	98	Impervious Area
	672,290	80	>75% Grass cover, Good, HSG D
	754,337	82	Weighted Average
	672,290	80	89.12% Pervious Area
	82,047	98	10.88% Impervious Area

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

Subcatchment C: Post Basin C

Hydrograph



Bull Run Filtration Detention Ponds

Type IA 24-hr 2-Year Rainfall=2.80"

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Summary for Subcatchment D: Post Basin D

Runoff = 3.35 cfs @ 7.94 hrs, Volume= 52,496 cf, Depth= 1.61"

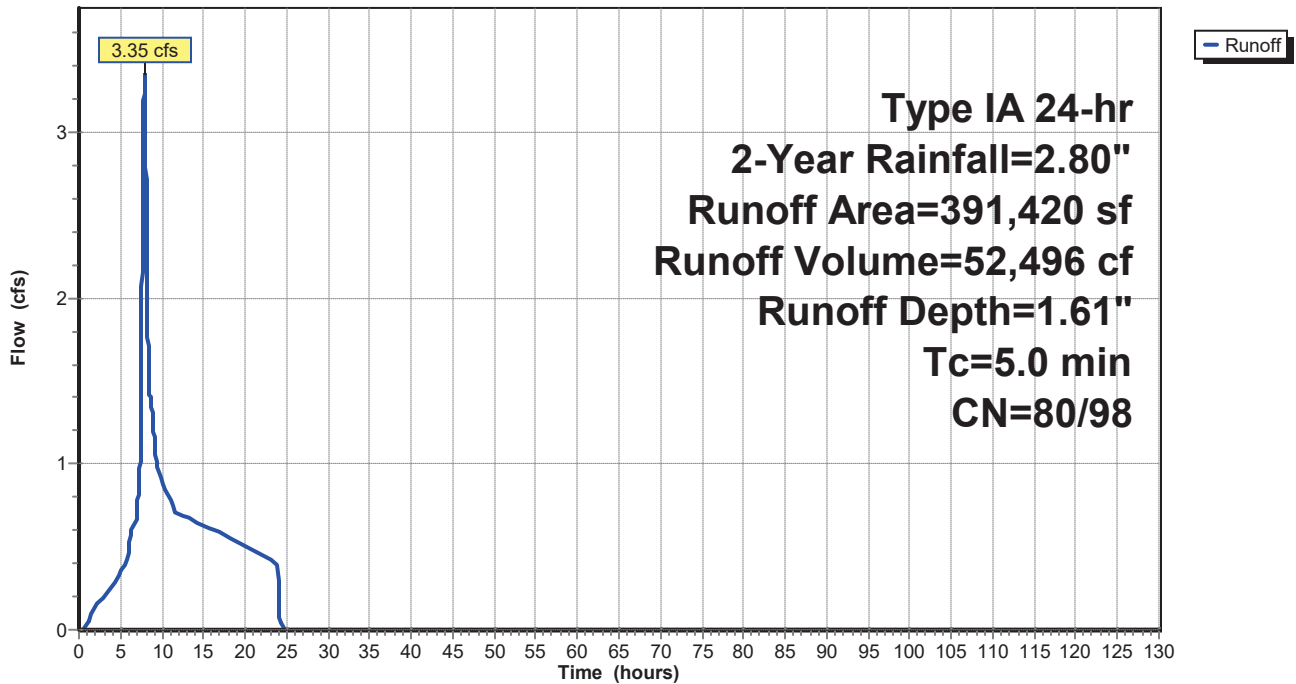
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-Year Rainfall=2.80"

	Area (sf)	CN	Description
*	135,356	98	Impervious Area
	256,064	80	>75% Grass cover, Good, HSG D
	391,420	86	Weighted Average
	256,064	80	65.42% Pervious Area
	135,356	98	34.58% Impervious Area

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

Subcatchment D: Post Basin D

Hydrograph



Bull Run Filtration Detention Ponds

Type IA 24-hr 2-Year Rainfall=2.80"

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Summary for Subcatchment E: Post Basin E

Runoff = 3.43 cfs @ 7.99 hrs, Volume= 57,743 cf, Depth= 1.19"

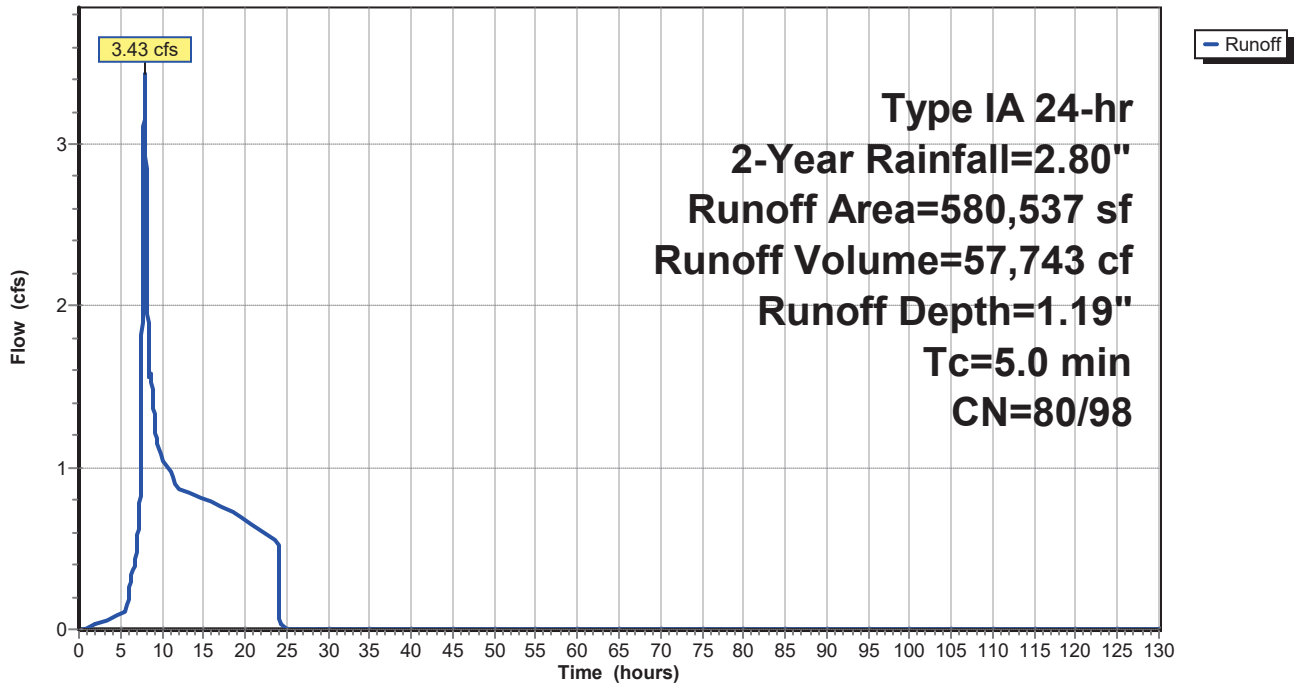
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-Year Rainfall=2.80"

	Area (sf)	CN	Description
*	19,160	98	Impervious Area
	544,328	80	>75% Grass cover, Good, HSG D
*	17,049	98	
	580,537	81	Weighted Average
	544,328	80	93.76% Pervious Area
	36,209	98	6.24% Impervious Area

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

Subcatchment E: Post Basin E

Hydrograph



Bull Run Filtration Detention Ponds

Type IA 24-hr 2-Year Rainfall=2.80"

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Summary for Subcatchment Pre A: Pre Dev Basin A

Runoff = 1.24 cfs @ 8.19 hrs, Volume= 35,630 cf, Depth= 1.22"

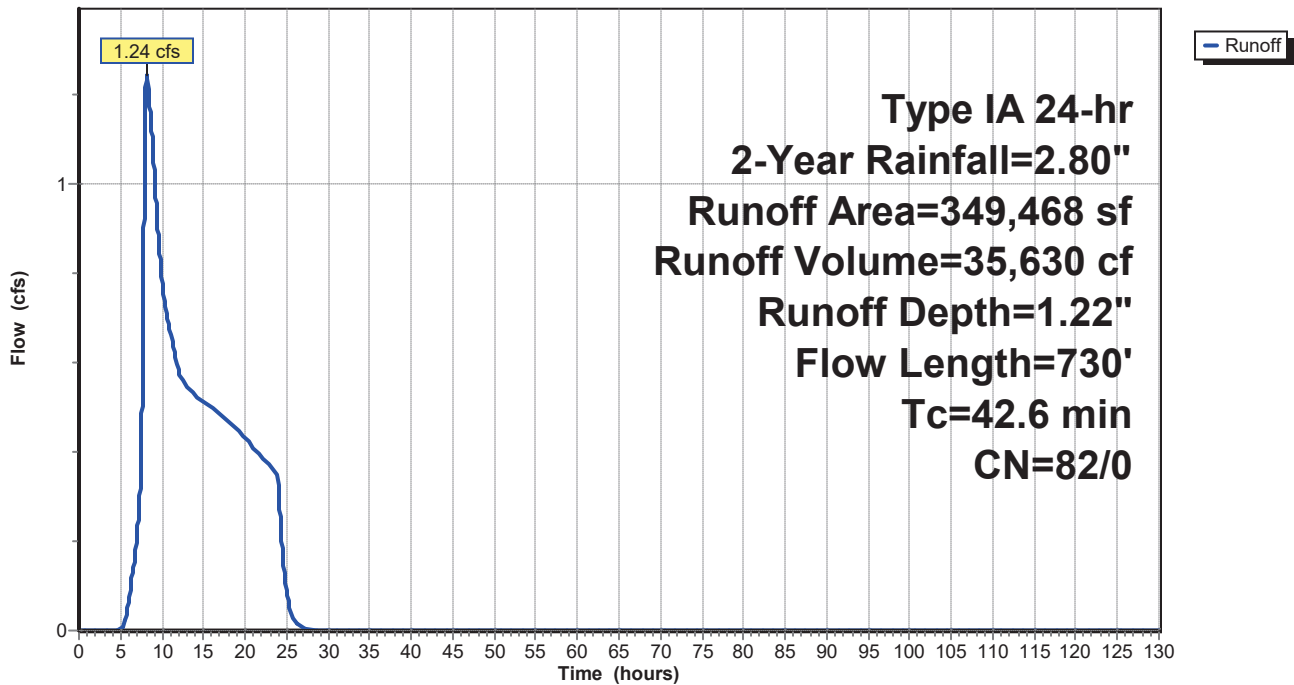
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-Year Rainfall=2.80"

Area (sf)	CN	Description
349,468	82	Row crops, SR + CR, Good, HSG C
349,468	82	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
36.8	300	0.0100	0.14		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 2.80"
5.8	430	0.0190	1.24		Shallow Concentrated Flow, Cultivated Straight Rows Kv= 9.0 fps
42.6	730	Total			

Subcatchment Pre A: Pre Dev Basin A

Hydrograph



Bull Run Filtration Detention Ponds

Type IA 24-hr 2-Year Rainfall=2.80"

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Summary for Subcatchment Pre B: Pre Dev Basin B

Runoff = 1.38 cfs @ 8.01 hrs, Volume= 29,996 cf, Depth= 1.22"

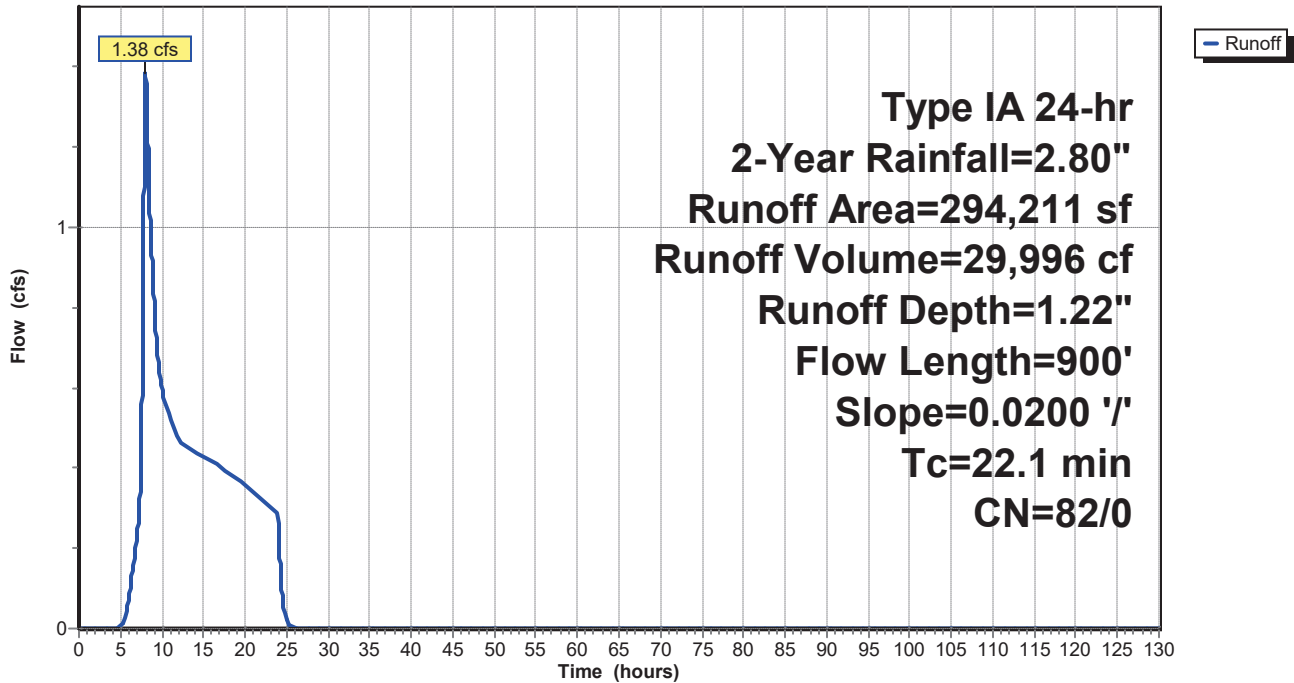
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-Year Rainfall=2.80"

Area (sf)	CN	Description
294,211	82	Row crops, SR + CR, Good, HSG C
294,211	82	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.6	100	0.0200	0.14		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 2.80"
10.5	800	0.0200	1.27		Shallow Concentrated Flow, Cultivated Straight Rows Kv= 9.0 fps
22.1	900	Total			

Subcatchment Pre B: Pre Dev Basin B

Hydrograph



Bull Run Filtration Detention Ponds

Type IA 24-hr 2-Year Rainfall=2.80"

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Summary for Subcatchment Pre C: Pre Dev Basin C

Runoff = 4.04 cfs @ 8.00 hrs, Volume= 76,908 cf, Depth= 1.22"

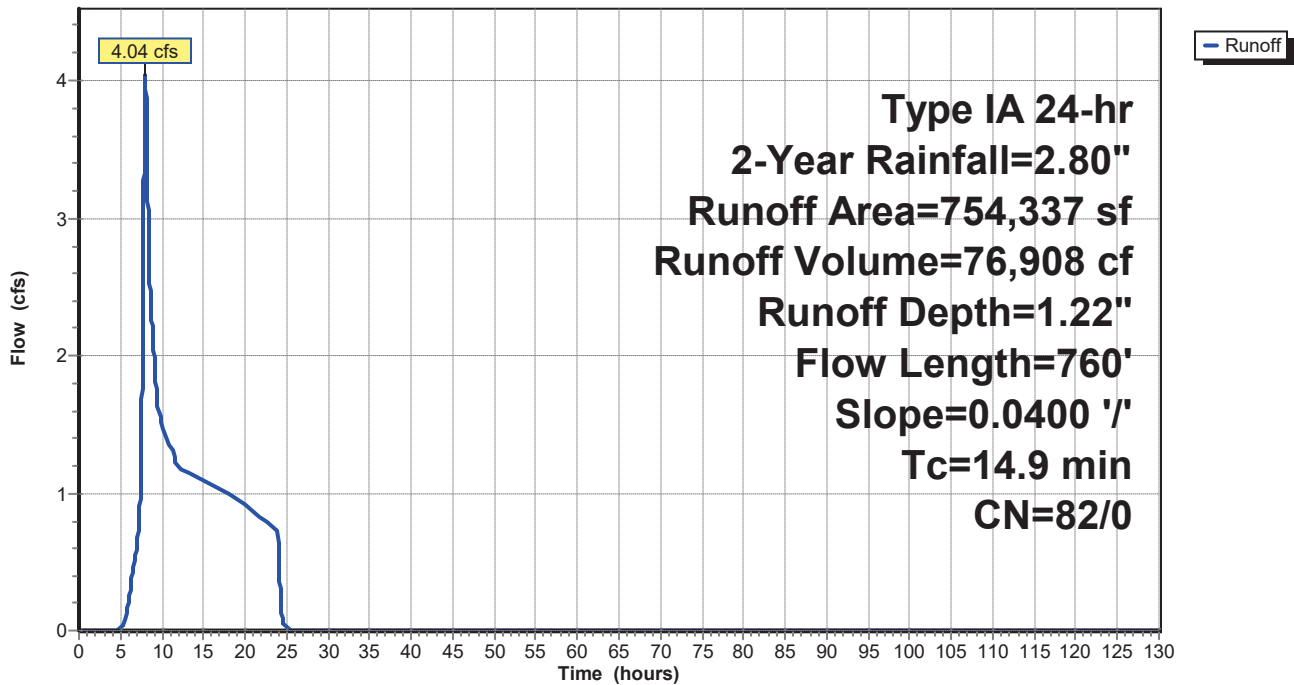
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-Year Rainfall=2.80"

Area (sf)	CN	Description
754,337	82	Row crops, SR + CR, Good, HSG C
754,337	82	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.8	100	0.0400	0.19		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 2.80"
6.1	660	0.0400	1.80		Shallow Concentrated Flow, Cultivated Straight Rows Kv= 9.0 fps
14.9	760	Total			

Subcatchment Pre C: Pre Dev Basin C

Hydrograph



Bull Run Filtration Detention Ponds

Type IA 24-hr 2-Year Rainfall=2.80"

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Summary for Subcatchment Pre D: Pre Dev Basin D

Runoff = 1.90 cfs @ 8.01 hrs, Volume= 39,907 cf, Depth= 1.22"

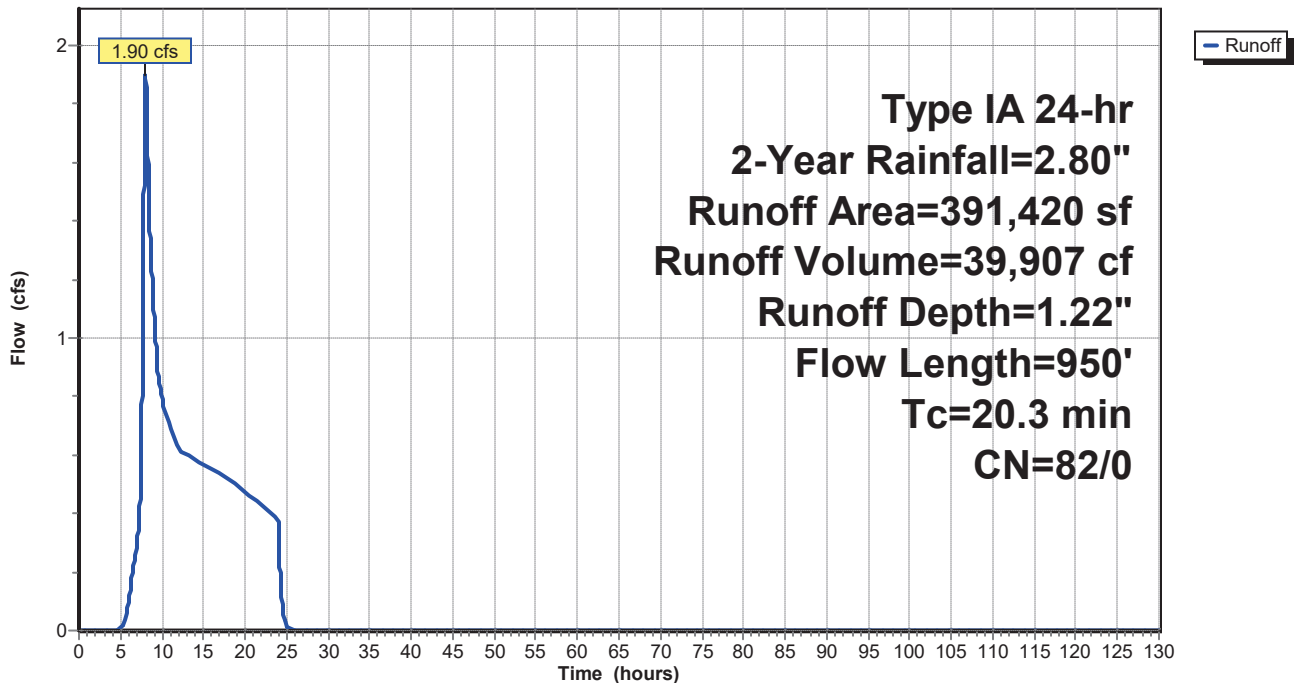
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-Year Rainfall=2.80"

Area (sf)	CN	Description
391,420	82	Row crops, SR + CR, Good, HSG C
391,420	82	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.6	100	0.0200	0.14		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 2.80"
8.7	850	0.0330	1.63		Shallow Concentrated Flow, Cultivated Straight Rows Kv= 9.0 fps
20.3	950	Total			

Subcatchment Pre D: Pre Dev Basin D

Hydrograph



Bull Run Filtration Detention Ponds

Type IA 24-hr 2-Year Rainfall=2.80"

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Summary for Subcatchment Pre E: Pre Dev Basin E

Runoff = 2.65 cfs @ 8.01 hrs, Volume= 59,189 cf, Depth= 1.22"

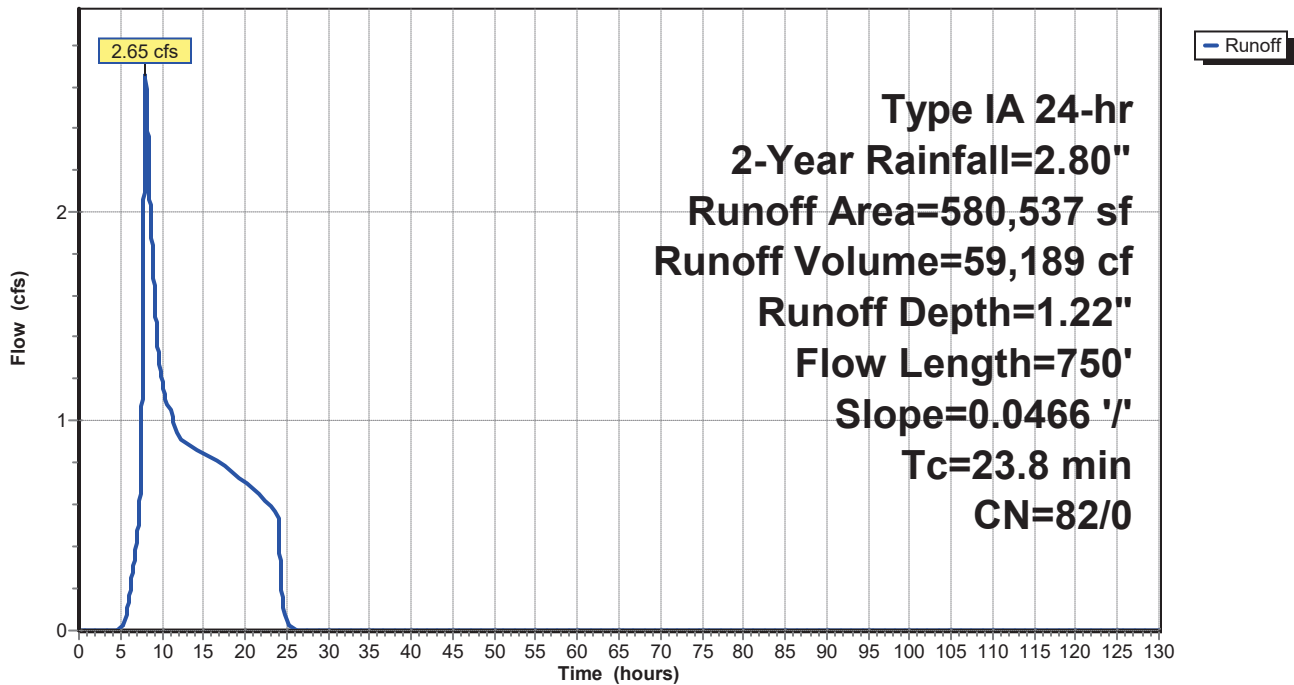
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-Year Rainfall=2.80"

Area (sf)	CN	Description
580,537	82	Row crops, SR + CR, Good, HSG C
580,537	82	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.9	300	0.0466	0.25		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 2.80"
3.9	450	0.0466	1.94		Shallow Concentrated Flow, Cultivated Straight Rows Kv= 9.0 fps
23.8	750	Total			

Subcatchment Pre E: Pre Dev Basin E

Hydrograph



Bull Run Filtration Detention Ponds

Type IA 24-hr 2-Year Rainfall=2.80"

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Summary for Pond Pond A: Pond A

Inflow Area = 349,468 sf, 50.40% Impervious, Inflow Depth = 1.84" for 2-Year event
 Inflow = 3.52 cfs @ 7.92 hrs, Volume= 53,630 cf
 Outflow = 0.61 cfs @ 14.82 hrs, Volume= 53,630 cf, Atten= 83%, Lag= 414.2 min
 Primary = 0.61 cfs @ 14.82 hrs, Volume= 53,630 cf

Routing by Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs / 3
 Peak Elev= 709.36' @ 14.82 hrs Surf.Area= 8,132 sf Storage= 13,290 cf

Plug-Flow detention time= 246.7 min calculated for 53,626 cf (100% of inflow)
 Center-of-Mass det. time= 246.7 min (965.4 - 718.7)

Volume	Invert	Avail.Storage	Storage Description
#1	707.50'	70,555 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
707.50	6,107	0	0
708.00	6,714	3,205	3,205
709.00	7,742	7,228	10,433
710.00	8,825	8,284	18,717
711.00	9,967	9,396	28,113
712.00	11,161	10,564	38,677
713.00	12,412	11,787	50,463
714.00	13,717	13,065	63,528
714.50	14,392	7,027	70,555

Device	Routing	Invert	Outlet Devices
#1	Primary	698.43'	18.0" Round Culvert L= 138.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 698.43' / 696.24' S= 0.0159 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf
#2	Device 1	696.43'	2.6" Horiz. Orifice/Grate C= 0.620 Limited to weir flow at low heads
#3	Device 1	709.40'	16.0" W x 3.0" H Vert. Orifice/Grate C= 0.620

Primary OutFlow Max=0.61 cfs @ 14.82 hrs HW=709.36' (Free Discharge)

- 1=Culvert (Passes 0.61 cfs of 24.10 cfs potential flow)
- 2=Orifice/Grate (Orifice Controls 0.61 cfs @ 16.45 fps)
- 3=Orifice/Grate (Controls 0.00 cfs)

Bull Run Filtration Detention Ponds

Type IA 24-hr 2-Year Rainfall=2.80"

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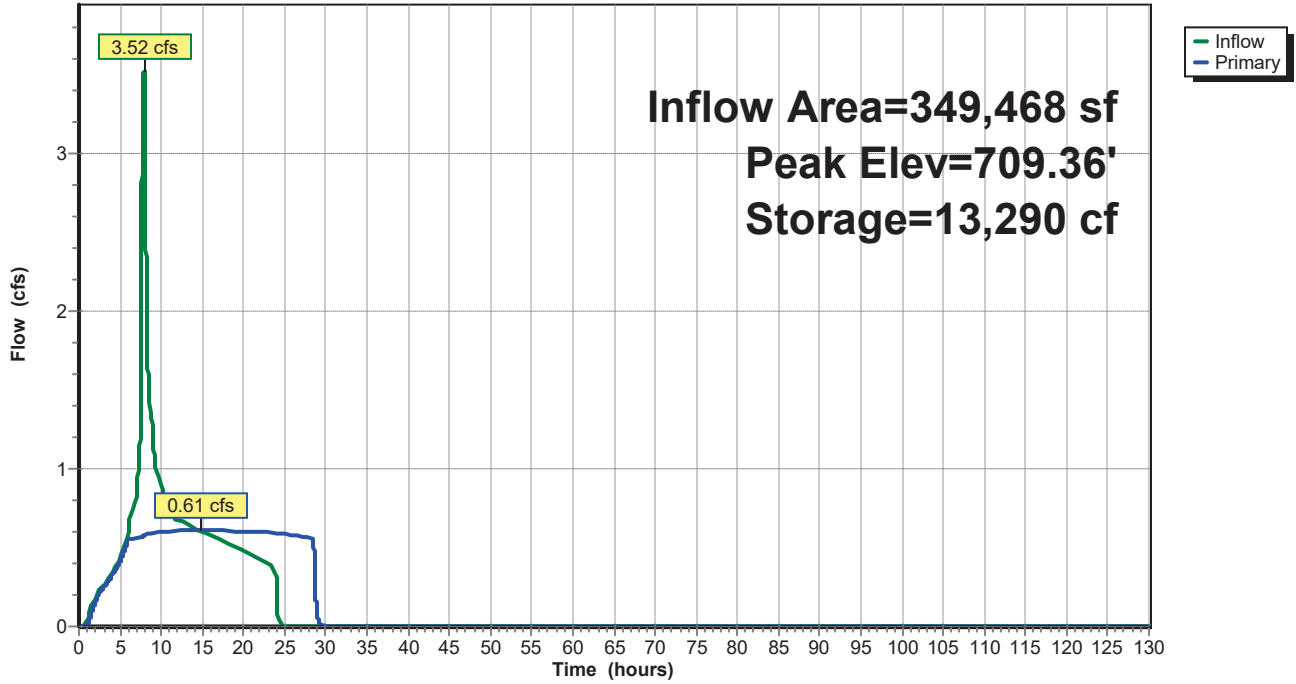
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Pond Pond A: Pond A

Hydrograph



Bull Run Filtration Detention Ponds

Type IA 24-hr 2-Year Rainfall=2.80"

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Summary for Pond Pond B: Pond B

Inflow Area = 294,211 sf, 54.40% Impervious, Inflow Depth = 1.90" for 2-Year event
 Inflow = 3.08 cfs @ 7.91 hrs, Volume= 46,588 cf
 Outflow = 0.67 cfs @ 11.01 hrs, Volume= 46,588 cf, Atten= 78%, Lag= 186.0 min
 Primary = 0.67 cfs @ 11.01 hrs, Volume= 46,588 cf

Routing by Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs / 3
 Peak Elev= 709.12' @ 11.01 hrs Surf.Area= 5,248 sf Storage= 9,226 cf

Plug-Flow detention time= 143.1 min calculated for 46,585 cf (100% of inflow)
 Center-of-Mass det. time= 143.1 min (856.4 - 713.3)

Volume	Invert	Avail.Storage	Storage Description
#1	707.00'	36,813 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
707.00	3,493	0	0
708.00	4,288	3,891	3,891
709.00	5,139	4,714	8,604
710.00	6,046	5,593	14,197
711.00	7,010	6,528	20,725
712.00	8,030	7,520	28,245
713.00	9,107	8,569	36,813

Device	Routing	Invert	Outlet Devices
#1	Primary	705.04'	18.0" Round Culvert L= 339.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 705.04' / 701.65' S= 0.0100 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf
#2	Device 1	703.04'	3.5" Horiz. Orifice/Grate C= 0.620 Limited to weir flow at low heads
#3	Device 1	709.15'	14.0" W x 3.0" H Vert. Orifice/Grate C= 0.620

Primary OutFlow Max=0.67 cfs @ 11.01 hrs HW=709.12' (Free Discharge)

- ↑ **1=Culvert** (Passes 0.67 cfs of 12.49 cfs potential flow)
- ↑ **2=Orifice/Grate** (Orifice Controls 0.67 cfs @ 10.05 fps)
- ↑ **3=Orifice/Grate** (Controls 0.00 cfs)

Bull Run Filtration Detention Ponds

Type IA 24-hr 2-Year Rainfall=2.80"

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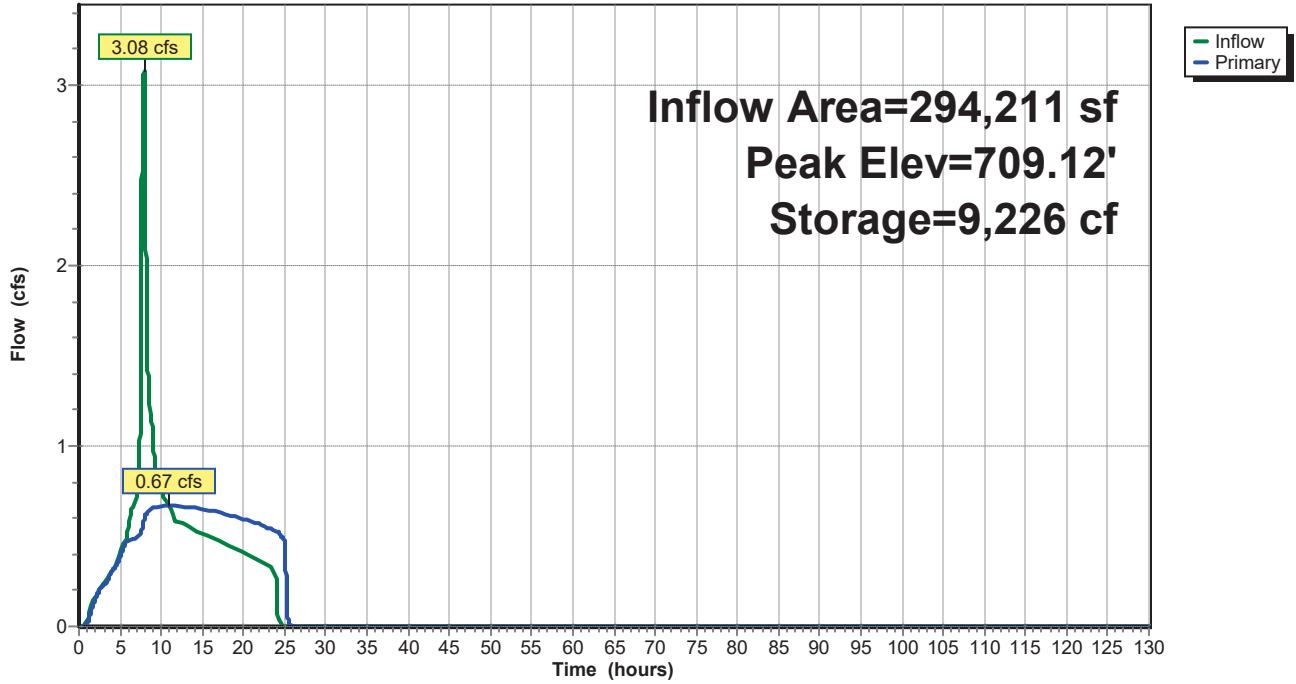
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Pond Pond B: Pond B

Hydrograph



Bull Run Filtration Detention Ponds

Type IA 24-hr 2-Year Rainfall=2.80"

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Summary for Pond Pond C: Pond C

Inflow Area = 754,337 sf, 10.88% Impervious, Inflow Depth > 7.22" for 2-Year event
 Inflow = 5.58 cfs @ 7.98 hrs, Volume= 453,738 cf, Incl. 0.80 cfs Base Flow
 Outflow = 1.86 cfs @ 15.66 hrs, Volume= 453,393 cf, Atten= 67%, Lag= 460.7 min
 Primary = 1.86 cfs @ 15.66 hrs, Volume= 453,393 cf

Routing by Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs / 3
 Peak Elev= 704.82' @ 15.66 hrs Surf.Area= 20,381 sf Storage= 15,943 cf

Plug-Flow detention time= 38.2 min calculated for 453,388 cf (100% of inflow)
 Center-of-Mass det. time= 34.8 min (3,392.8 - 3,358.0)

Volume	Invert	Avail.Storage	Storage Description
#1	704.00'	95,416 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
704.00	18,277	0	0
705.00	20,828	19,553	19,553
706.00	23,671	22,250	41,802
707.00	26,743	25,207	67,009
708.00	30,070	28,407	95,416

Device	Routing	Invert	Outlet Devices
#1	Primary	697.90'	12.0" Round Culvert L= 53.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 697.90' / 695.55' S= 0.0443 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	693.90'	5.1" Horiz. Orifice/Grate C= 0.620 Limited to weir flow at low heads
#3	Device 1	704.85'	16.0" W x 3.0" H Vert. Orifice/Grate C= 0.620

Primary OutFlow Max=1.86 cfs @ 15.66 hrs HW=704.82' (Free Discharge)

- ↑ **1=Culvert** (Passes 1.86 cfs of 9.59 cfs potential flow)
- ↑ **2=Orifice/Grate** (Orifice Controls 1.86 cfs @ 13.09 fps)
- ↑ **3=Orifice/Grate** (Controls 0.00 cfs)

Bull Run Filtration Detention Ponds

Type IA 24-hr 2-Year Rainfall=2.80"

Prepared by {enter your company name here}

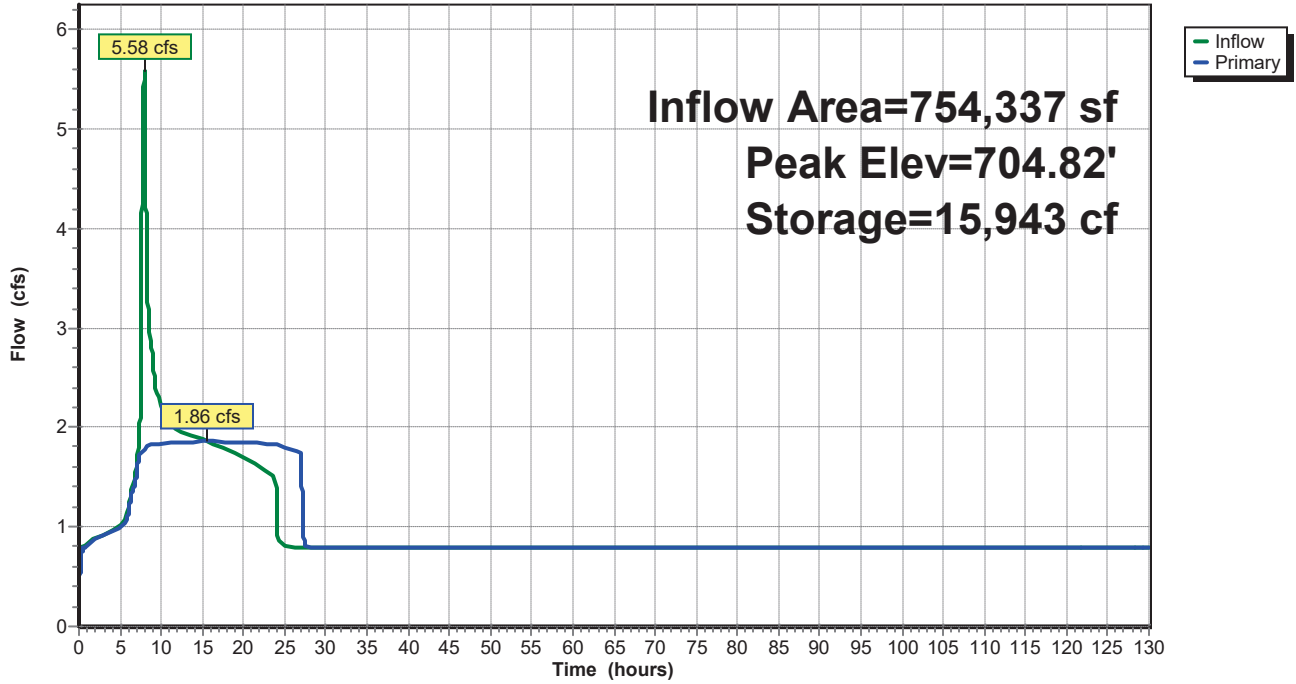
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Pond Pond C: Pond C

Hydrograph



Bull Run Filtration Detention Ponds

Type IA 24-hr 2-Year Rainfall=2.80"

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Summary for Pond Pond D: Pond D

Inflow Area = 391,420 sf, 34.58% Impervious, Inflow Depth = 1.61" for 2-Year event
 Inflow = 3.35 cfs @ 7.94 hrs, Volume= 52,496 cf
 Outflow = 0.94 cfs @ 9.75 hrs, Volume= 52,496 cf, Atten= 72%, Lag= 108.9 min
 Primary = 0.94 cfs @ 9.75 hrs, Volume= 52,496 cf

Routing by Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs / 3
 Peak Elev= 694.57' @ 9.75 hrs Surf.Area= 5,958 sf Storage= 8,181 cf

Plug-Flow detention time= 86.5 min calculated for 52,492 cf (100% of inflow)
 Center-of-Mass det. time= 86.5 min (830.5 - 744.0)

Volume	Invert	Avail.Storage	Storage Description
#1	693.00'	45,106 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
693.00	4,453	0	0
694.00	5,388	4,921	4,921
695.00	6,380	5,884	10,805
696.00	7,428	6,904	17,709
697.00	8,533	7,981	25,689
698.00	9,694	9,114	34,803
699.00	10,912	10,303	45,106

Device	Routing	Invert	Outlet Devices
#1	Primary	692.50'	12.0" Round Culvert L= 121.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 692.50' / 688.97' S= 0.0292 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	690.50'	4.9" Horiz. Orifice/Grate C= 0.620 Limited to weir flow at low heads
#3	Device 1	694.60'	15.0" W x 3.0" H Vert. Orifice/Grate C= 0.620

Primary OutFlow Max=0.94 cfs @ 9.75 hrs HW=694.57' (Free Discharge)

- ↑ **1=Culvert** (Passes 0.94 cfs of 4.75 cfs potential flow)
- ↑ **2=Orifice/Grate** (Orifice Controls 0.94 cfs @ 7.17 fps)
- ↑ **3=Orifice/Grate** (Controls 0.00 cfs)

Bull Run Filtration Detention Ponds

Type IA 24-hr 2-Year Rainfall=2.80"

Prepared by {enter your company name here}

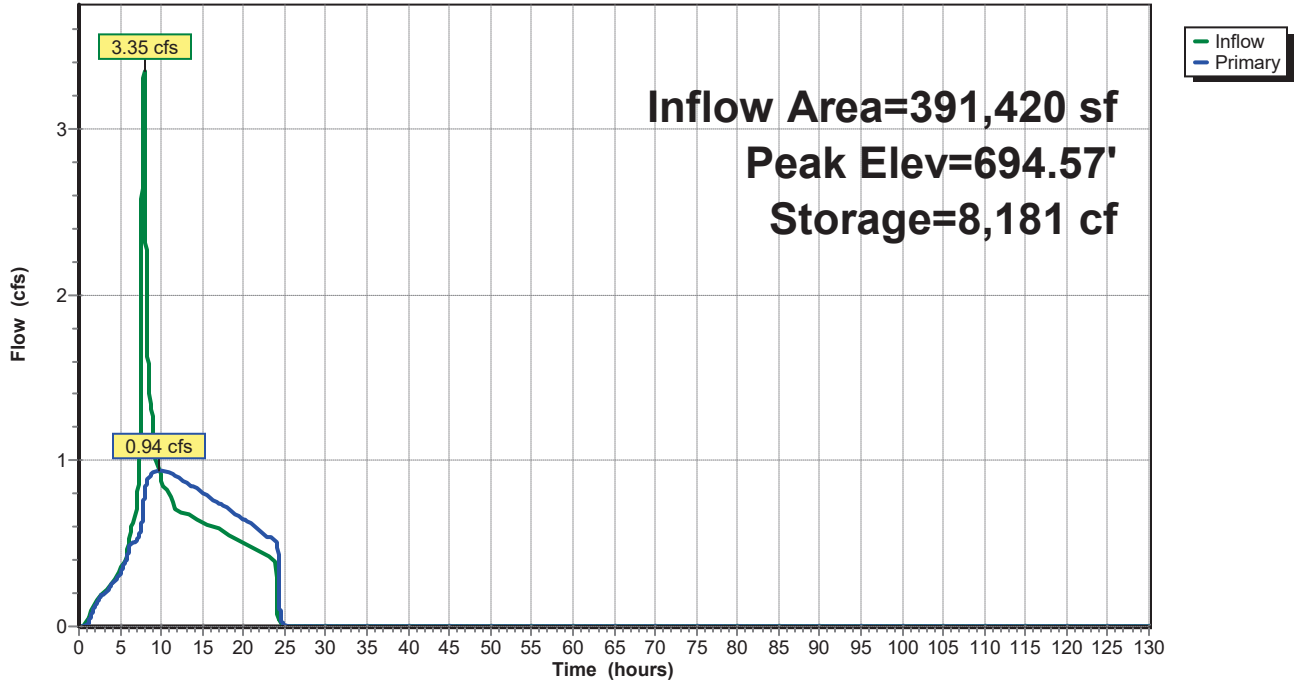
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Pond Pond D: Pond D

Hydrograph



Bull Run Filtration Detention Ponds

Type IA 24-hr 2-Year Rainfall=2.80"

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Summary for Pond Pond E: Pond E

Inflow Area = 580,537 sf, 6.24% Impervious, Inflow Depth = 1.19" for 2-Year event
 Inflow = 3.43 cfs @ 7.99 hrs, Volume= 57,743 cf
 Outflow = 1.30 cfs @ 9.08 hrs, Volume= 57,731 cf, Atten= 62%, Lag= 65.5 min
 Primary = 1.30 cfs @ 9.08 hrs, Volume= 57,731 cf

Routing by Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs / 3
 Peak Elev= 713.96' @ 9.08 hrs Surf.Area= 9,470 sf Storage= 8,316 cf

Plug-Flow detention time= 111.2 min calculated for 57,727 cf (100% of inflow)
 Center-of-Mass det. time= 111.5 min (925.4 - 813.9)

Volume	Invert	Avail.Storage	Storage Description
#1	713.00'	31,308 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
713.00	7,916	0	0
714.00	9,540	8,728	8,728
715.00	11,265	10,403	19,131
716.00	13,090	12,178	31,308

Device	Routing	Invert	Outlet Devices
#1	Primary	713.00'	15.0" Round Culvert L= 44.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 713.00' / 712.80' S= 0.0045 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Device 1	711.00'	7.0" Horiz. Orifice/Grate C= 0.620 Limited to weir flow at low heads
#3	Device 1	713.95'	16.0" W x 3.0" H Vert. Orifice/Grate C= 0.620

Primary OutFlow Max=1.30 cfs @ 9.08 hrs HW=713.96' (Free Discharge)

- ↑ **1=Culvert** (Passes 1.30 cfs of 2.49 cfs potential flow)
- ↑ **2=Orifice/Grate** (Orifice Controls 1.30 cfs @ 4.87 fps)
- ↑ **3=Orifice/Grate** (Orifice Controls 0.00 cfs @ 0.27 fps)

Bull Run Filtration Detention Ponds

Type IA 24-hr 2-Year Rainfall=2.80"

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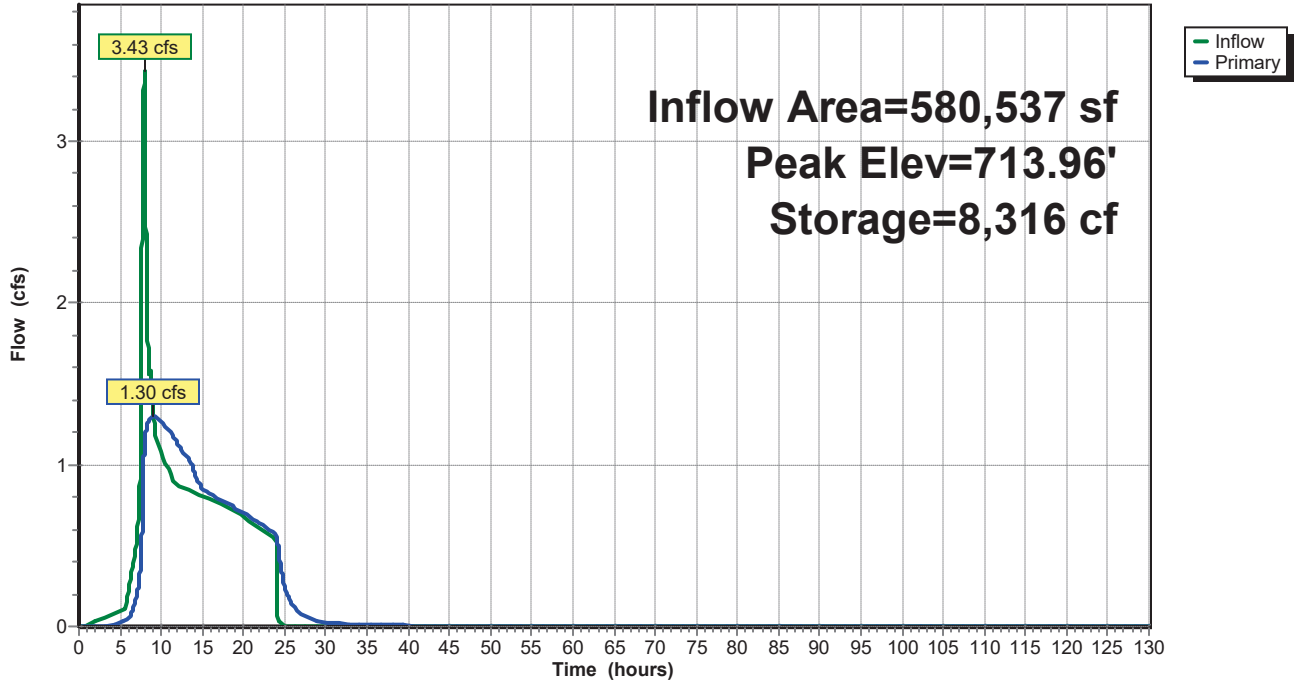
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Pond Pond E: Pond E

Hydrograph



Bull Run Filtration Detention Ponds

Type IA 24-hr 5-Year Rainfall=3.40"

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Summary for Subcatchment A: Post Basin A

Runoff = 4.59 cfs @ 7.91 hrs, Volume= 68,979 cf, Depth= 2.37"

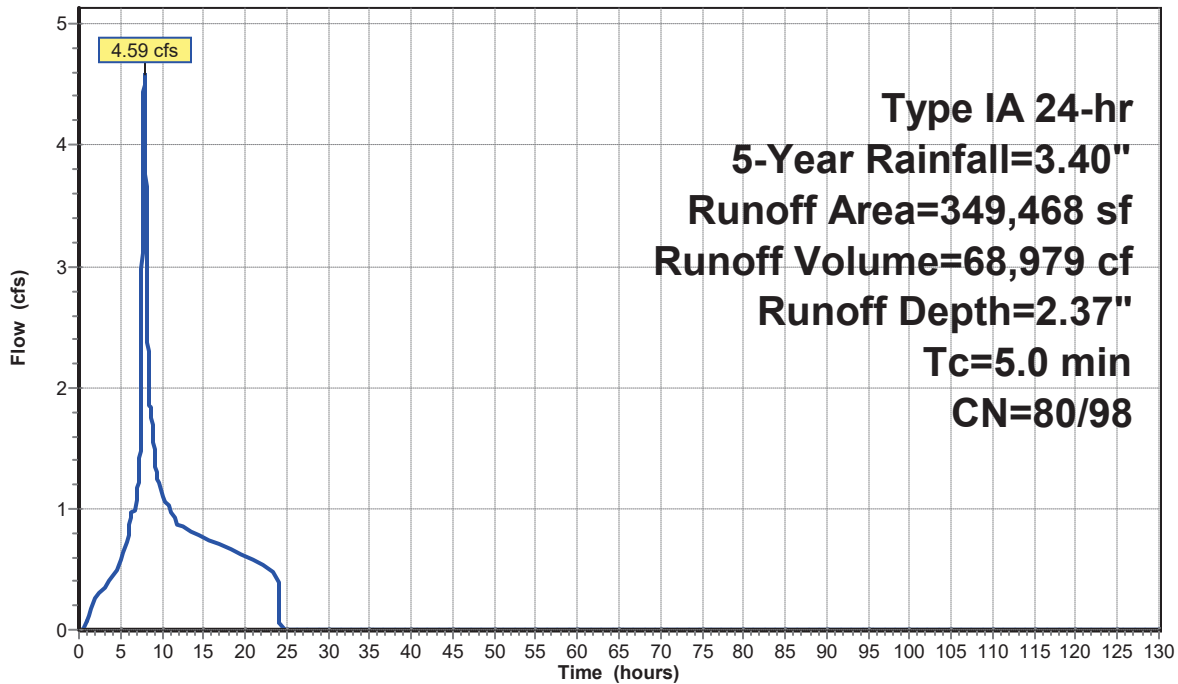
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 5-Year Rainfall=3.40"

	Area (sf)	CN	Description
*	176,142	98	Impervious Area
	173,326	80	>75% Grass cover, Good, HSG D
	349,468	89	Weighted Average
	173,326	80	49.60% Pervious Area
	176,142	98	50.40% Impervious Area

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

Subcatchment A: Post Basin A

Hydrograph



Bull Run Filtration Detention Ponds

Type IA 24-hr 5-Year Rainfall=3.40"

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Summary for Subcatchment B: Post Basin B

Runoff = 3.98 cfs @ 7.91 hrs, Volume= 59,650 cf, Depth= 2.43"

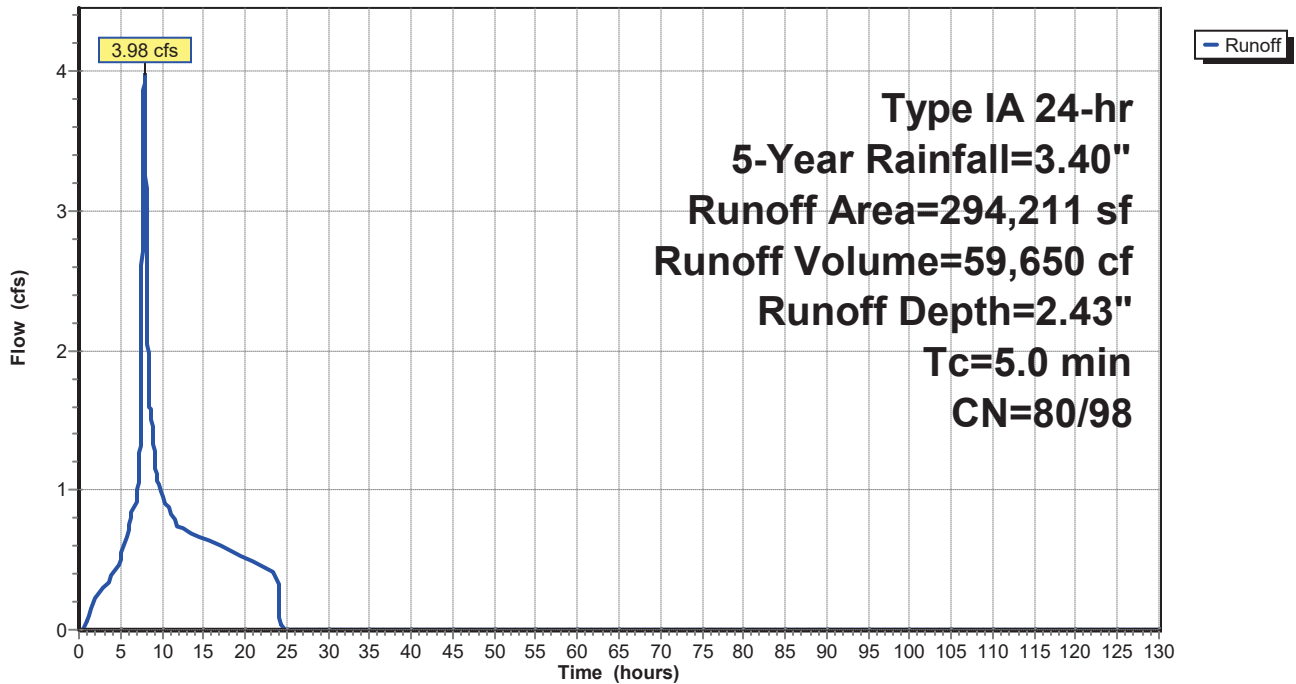
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 5-Year Rainfall=3.40"

	Area (sf)	CN	Description
*	160,056	98	Impervious Area
	134,155	80	>75% Grass cover, Good, HSG D
	294,211	90	Weighted Average
	134,155	80	45.60% Pervious Area
	160,056	98	54.40% Impervious Area

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

Subcatchment B: Post Basin B

Hydrograph



Bull Run Filtration Detention Ponds

Type IA 24-hr 5-Year Rainfall=3.40"

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Summary for Subcatchment C: Post Basin C

Runoff = 6.89 cfs @ 7.97 hrs, Volume= 108,905 cf, Depth= 1.73"

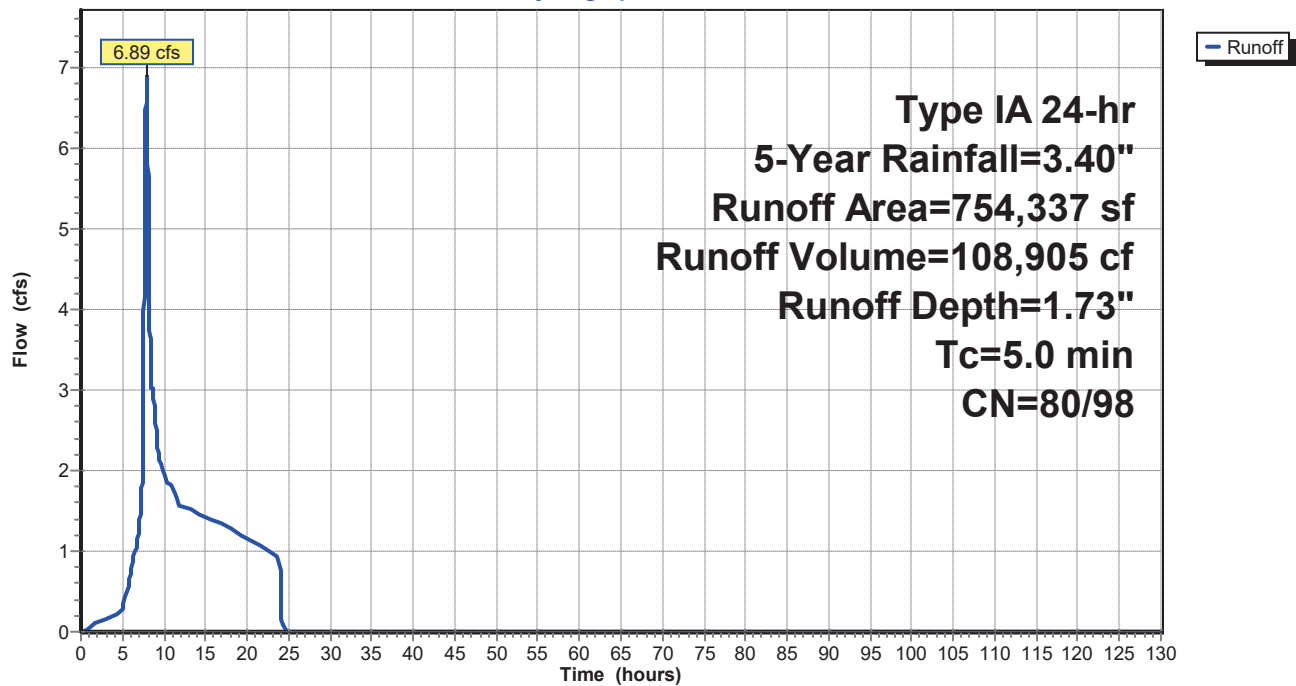
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 5-Year Rainfall=3.40"

	Area (sf)	CN	Description
*	82,047	98	Impervious Area
	672,290	80	>75% Grass cover, Good, HSG D
	754,337	82	Weighted Average
	672,290	80	89.12% Pervious Area
	82,047	98	10.88% Impervious Area

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

Subcatchment C: Post Basin C

Hydrograph



Bull Run Filtration Detention Ponds

Type IA 24-hr 5-Year Rainfall=3.40"

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Summary for Subcatchment D: Post Basin D

Runoff = 4.50 cfs @ 7.93 hrs, Volume= 68,953 cf, Depth= 2.11"

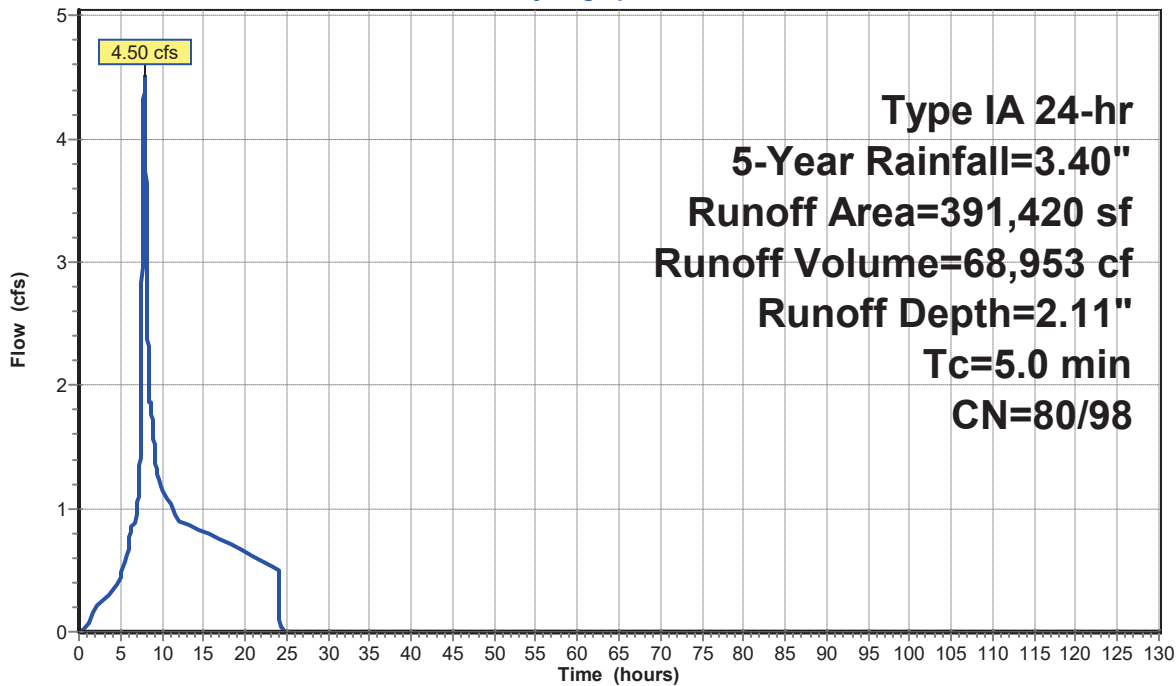
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 5-Year Rainfall=3.40"

	Area (sf)	CN	Description
*	135,356	98	Impervious Area
	256,064	80	>75% Grass cover, Good, HSG D
	391,420	86	Weighted Average
	256,064	80	65.42% Pervious Area
	135,356	98	34.58% Impervious Area

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

Subcatchment D: Post Basin D

Hydrograph



Bull Run Filtration Detention Ponds

Type IA 24-hr 5-Year Rainfall=3.40"

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Summary for Subcatchment E: Post Basin E

Runoff = 5.04 cfs @ 7.97 hrs, Volume= 80,201 cf, Depth= 1.66"

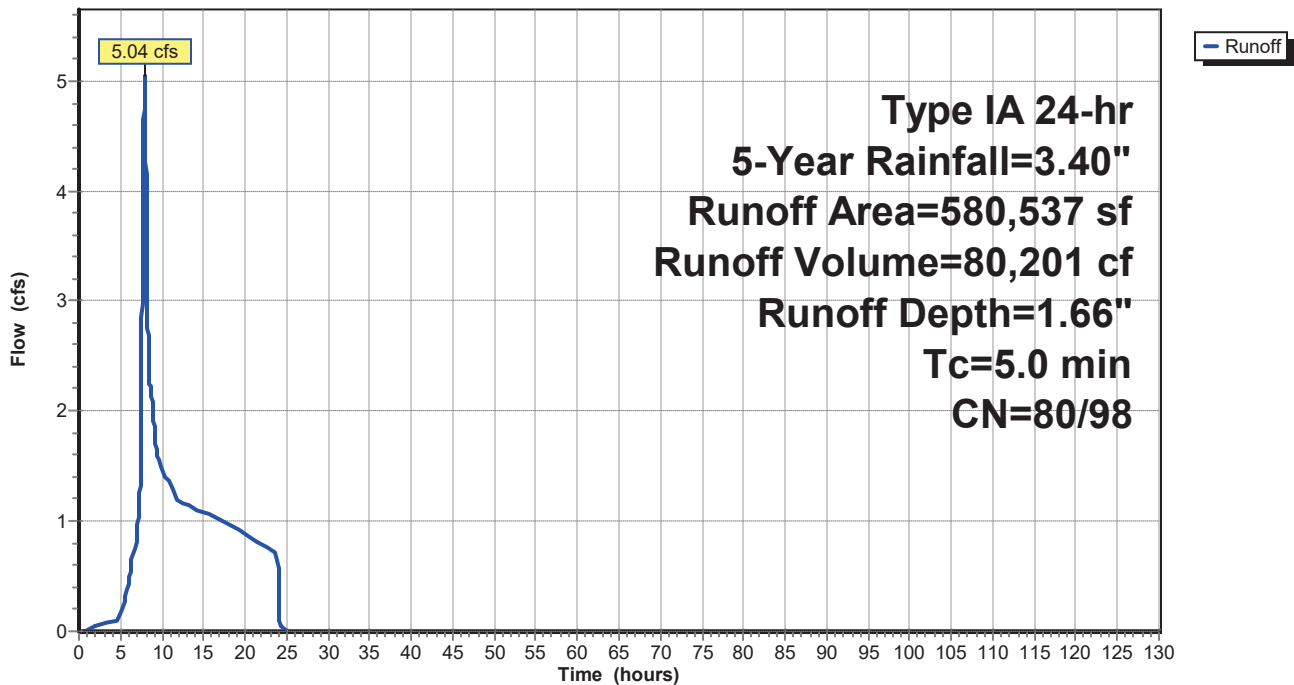
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 5-Year Rainfall=3.40"

	Area (sf)	CN	Description
*	19,160	98	Impervious Area
	544,328	80	>75% Grass cover, Good, HSG D
*	17,049	98	
	580,537	81	Weighted Average
	544,328	80	93.76% Pervious Area
	36,209	98	6.24% Impervious Area

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

Subcatchment E: Post Basin E

Hydrograph



Bull Run Filtration Detention Ponds

Type IA 24-hr 5-Year Rainfall=3.40"

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Summary for Subcatchment Pre A: Pre Dev Basin A

Runoff = 1.87 cfs @ 8.15 hrs, Volume= 49,519 cf, Depth= 1.70"

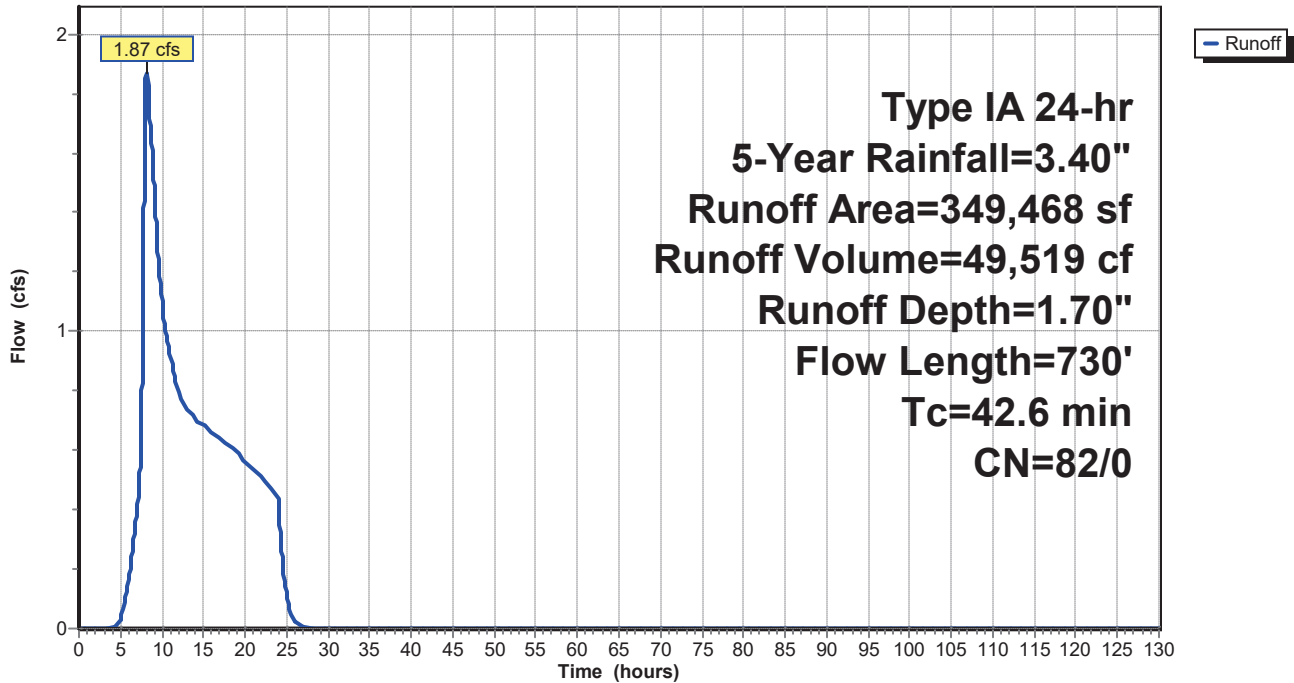
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 5-Year Rainfall=3.40"

Area (sf)	CN	Description
349,468	82	Row crops, SR + CR, Good, HSG C
349,468	82	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
36.8	300	0.0100	0.14		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 2.80"
5.8	430	0.0190	1.24		Shallow Concentrated Flow, Cultivated Straight Rows Kv= 9.0 fps
42.6	730	Total			

Subcatchment Pre A: Pre Dev Basin A

Hydrograph



Bull Run Filtration Detention Ponds

Type IA 24-hr 5-Year Rainfall=3.40"

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Summary for Subcatchment Pre B: Pre Dev Basin B

Runoff = 2.07 cfs @ 8.01 hrs, Volume= 41,689 cf, Depth= 1.70"

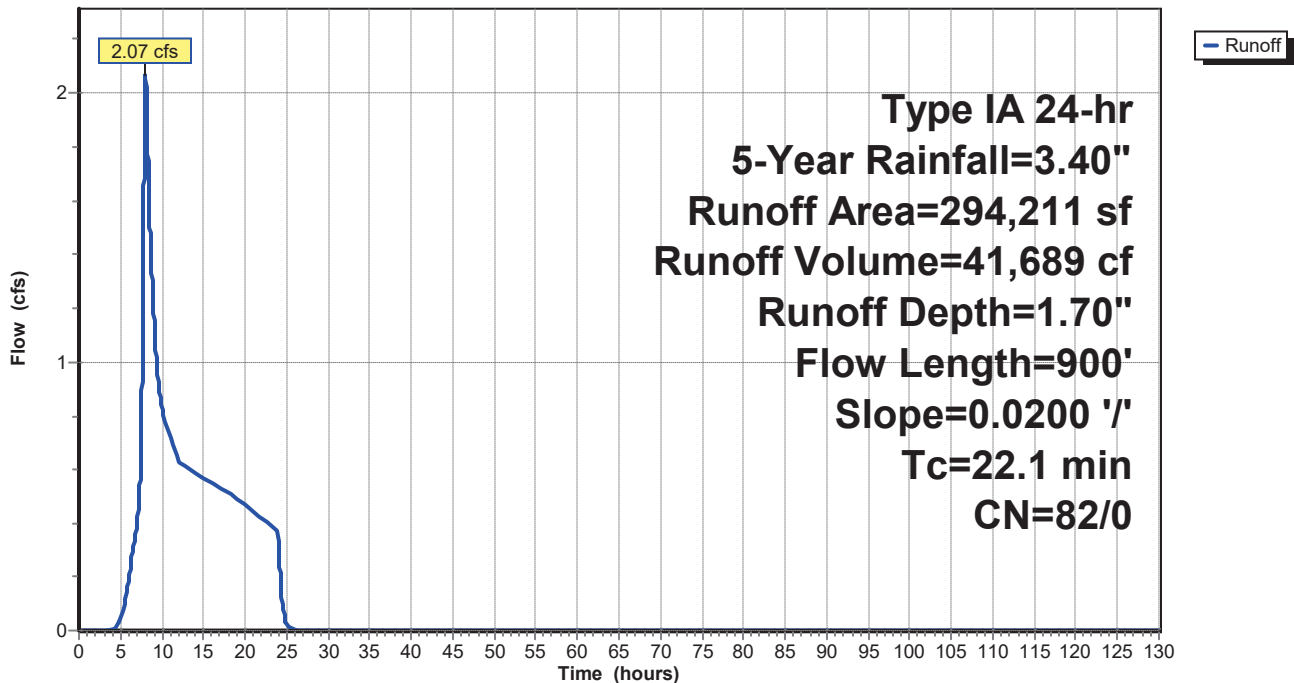
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 5-Year Rainfall=3.40"

Area (sf)	CN	Description
294,211	82	Row crops, SR + CR, Good, HSG C
294,211	82	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.6	100	0.0200	0.14		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 2.80"
10.5	800	0.0200	1.27		Shallow Concentrated Flow, Cultivated Straight Rows Kv= 9.0 fps
22.1	900	Total			

Subcatchment Pre B: Pre Dev Basin B

Hydrograph



Bull Run Filtration Detention Ponds

Type IA 24-hr 5-Year Rainfall=3.40"

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Summary for Subcatchment Pre C: Pre Dev Basin C

Runoff = 5.99 cfs @ 8.00 hrs, Volume= 106,889 cf, Depth= 1.70"

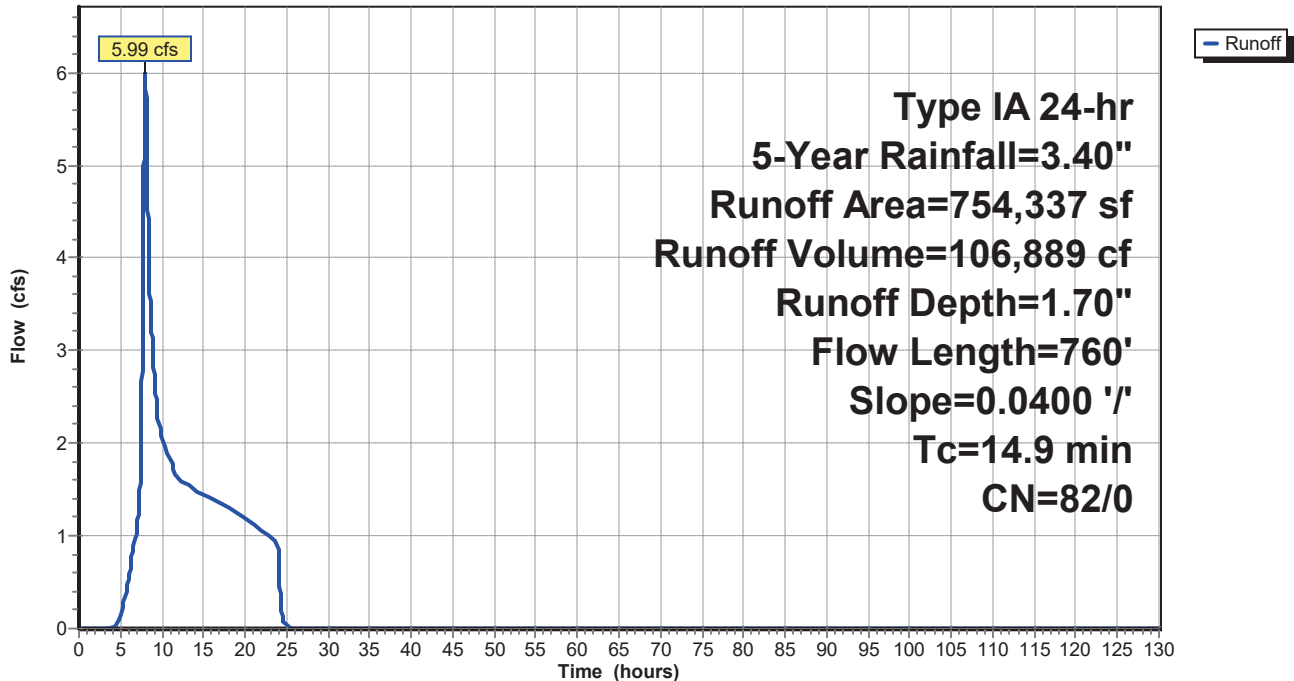
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 5-Year Rainfall=3.40"

Area (sf)	CN	Description
754,337	82	Row crops, SR + CR, Good, HSG C
754,337	82	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.8	100	0.0400	0.19		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 2.80"
6.1	660	0.0400	1.80		Shallow Concentrated Flow, Cultivated Straight Rows Kv= 9.0 fps
14.9	760	Total			

Subcatchment Pre C: Pre Dev Basin C

Hydrograph



Bull Run Filtration Detention Ponds

Type IA 24-hr 5-Year Rainfall=3.40"

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Summary for Subcatchment Pre D: Pre Dev Basin D

Runoff = 2.83 cfs @ 8.01 hrs, Volume= 55,464 cf, Depth= 1.70"

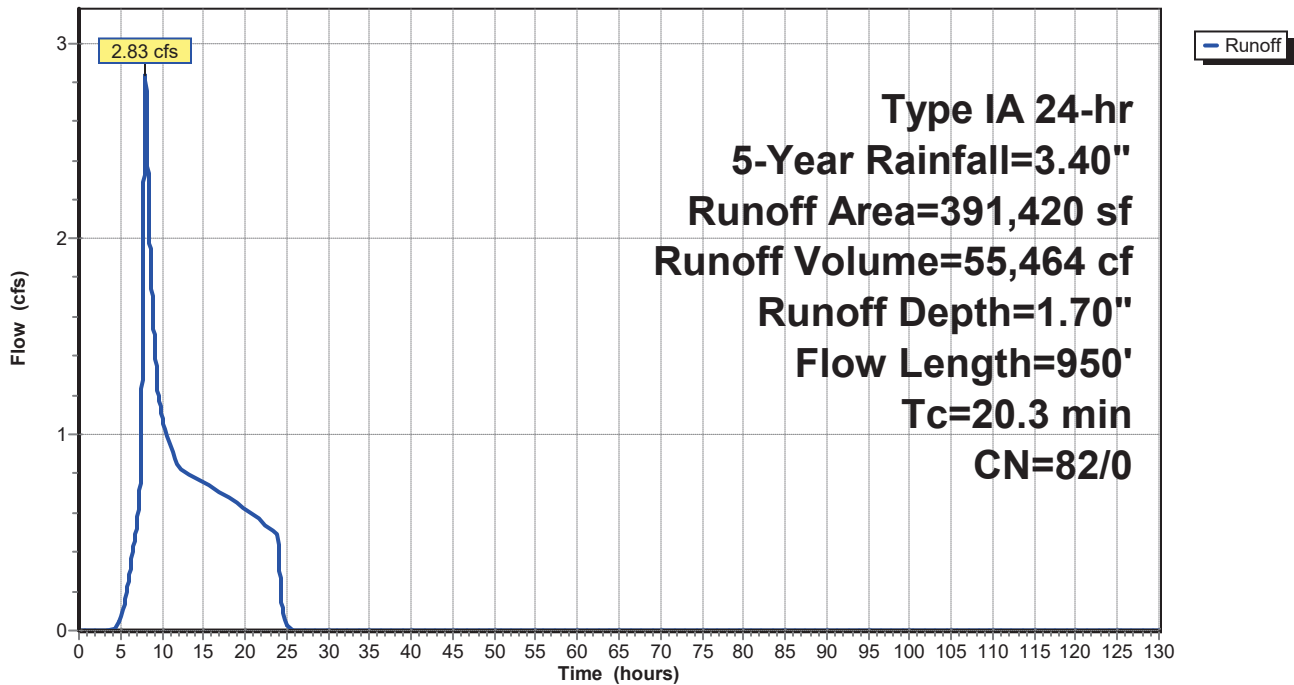
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 5-Year Rainfall=3.40"

Area (sf)	CN	Description
391,420	82	Row crops, SR + CR, Good, HSG C
391,420	82	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.6	100	0.0200	0.14		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 2.80"
8.7	850	0.0330	1.63		Shallow Concentrated Flow, Cultivated Straight Rows Kv= 9.0 fps
20.3	950	Total			

Subcatchment Pre D: Pre Dev Basin D

Hydrograph



Bull Run Filtration Detention Ponds

Type IA 24-hr 5-Year Rainfall=3.40"

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Summary for Subcatchment Pre E: Pre Dev Basin E

Runoff = 3.97 cfs @ 8.01 hrs, Volume= 82,262 cf, Depth= 1.70"

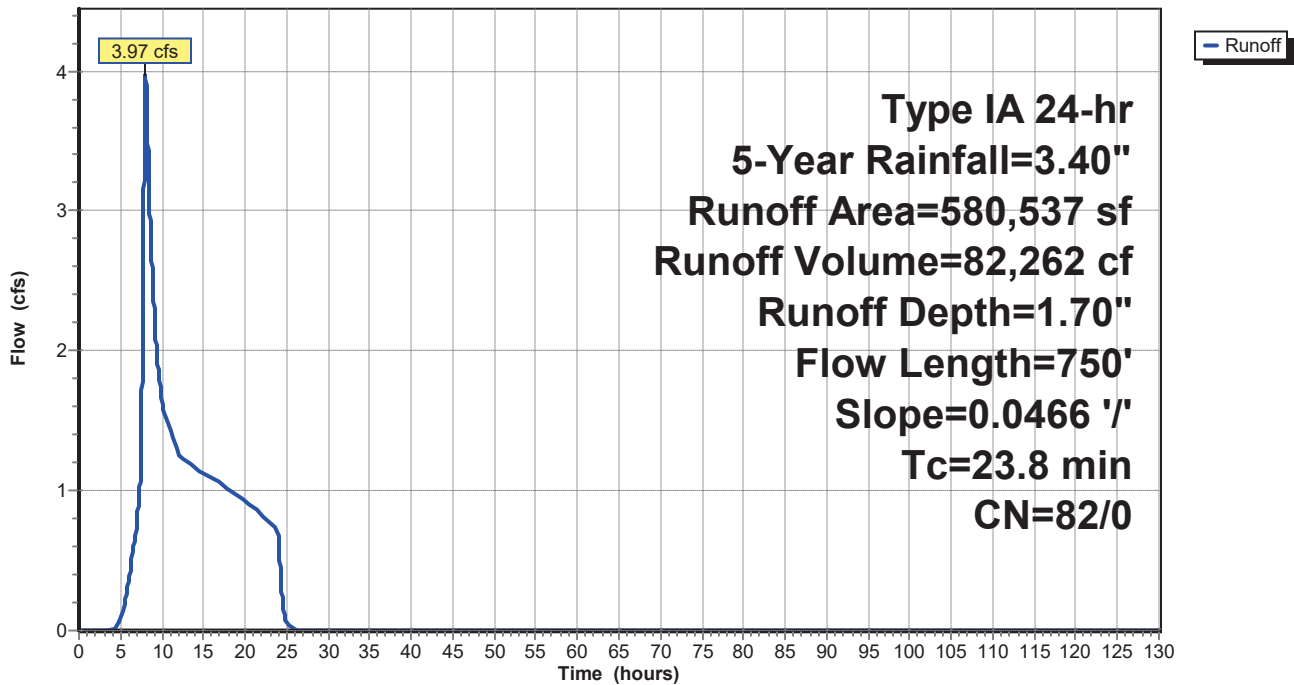
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 5-Year Rainfall=3.40"

Area (sf)	CN	Description
580,537	82	Row crops, SR + CR, Good, HSG C
580,537	82	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.9	300	0.0466	0.25		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 2.80"
3.9	450	0.0466	1.94		Shallow Concentrated Flow, Cultivated Straight Rows Kv= 9.0 fps
23.8	750	Total			

Subcatchment Pre E: Pre Dev Basin E

Hydrograph



Bull Run Filtration Detention Ponds

Type IA 24-hr 5-Year Rainfall=3.40"

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Summary for Pond Pond A: Pond A

Inflow Area = 349,468 sf, 50.40% Impervious, Inflow Depth = 2.37" for 5-Year event
 Inflow = 4.59 cfs @ 7.91 hrs, Volume= 68,979 cf
 Outflow = 1.18 cfs @ 9.84 hrs, Volume= 68,979 cf, Atten= 74%, Lag= 115.6 min
 Primary = 1.18 cfs @ 9.84 hrs, Volume= 68,979 cf

Routing by Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs / 3
 Peak Elev= 709.65' @ 9.84 hrs Surf.Area= 8,451 sf Storage= 15,735 cf

Plug-Flow detention time= 240.8 min calculated for 68,979 cf (100% of inflow)
 Center-of-Mass det. time= 240.8 min (953.5 - 712.7)

Volume	Invert	Avail.Storage	Storage Description
#1	707.50'	70,555 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
707.50	6,107	0	0
708.00	6,714	3,205	3,205
709.00	7,742	7,228	10,433
710.00	8,825	8,284	18,717
711.00	9,967	9,396	28,113
712.00	11,161	10,564	38,677
713.00	12,412	11,787	50,463
714.00	13,717	13,065	63,528
714.50	14,392	7,027	70,555

Device	Routing	Invert	Outlet Devices
#1	Primary	698.43'	18.0" Round Culvert L= 138.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 698.43' / 696.24' S= 0.0159 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf
#2	Device 1	696.43'	2.6" Horiz. Orifice/Grate C= 0.620 Limited to weir flow at low heads
#3	Device 1	709.40'	16.0" W x 3.0" H Vert. Orifice/Grate C= 0.620

Primary OutFlow Max=1.18 cfs @ 9.84 hrs HW=709.65' (Free Discharge)

- ↑ **1=Culvert** (Passes 1.18 cfs of 24.40 cfs potential flow)
- ↑ **2=Orifice/Grate** (Orifice Controls 0.61 cfs @ 16.67 fps)
- ↑ **3=Orifice/Grate** (Orifice Controls 0.57 cfs @ 1.70 fps)

Bull Run Filtration Detention Ponds

Type IA 24-hr 5-Year Rainfall=3.40"

Prepared by {enter your company name here}

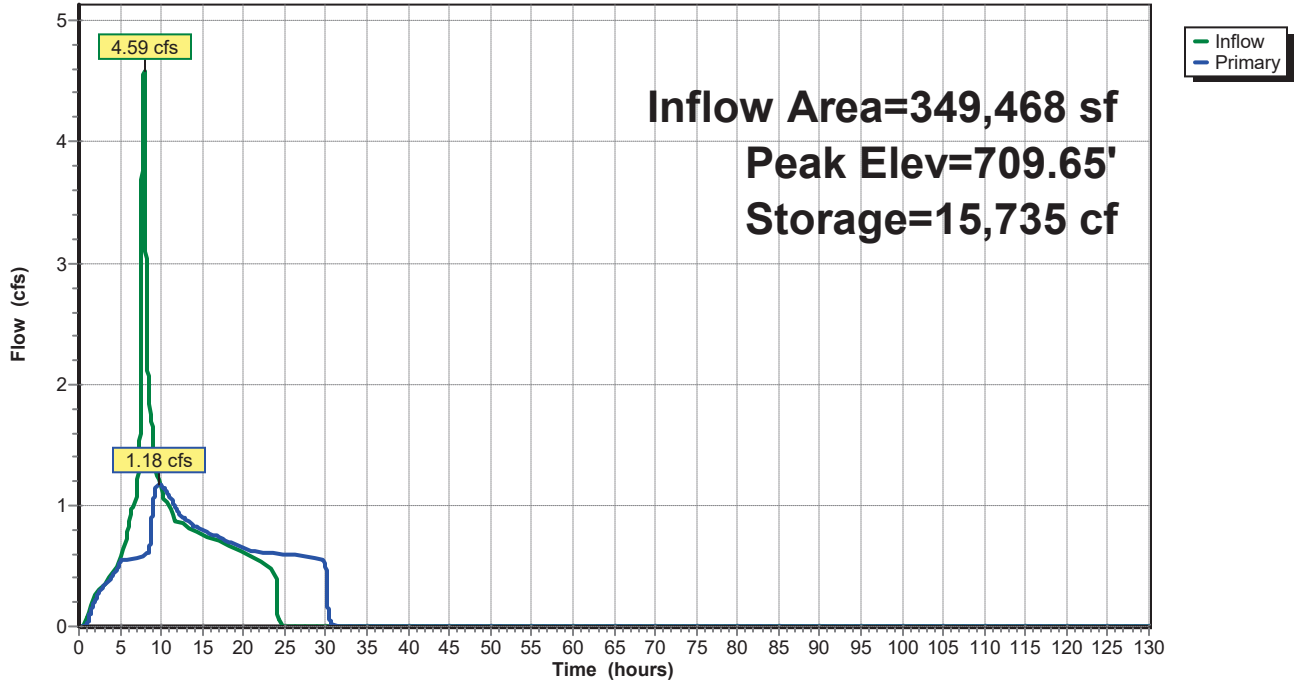
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Pond Pond A: Pond A

Hydrograph



Bull Run Filtration Detention Ponds

Type IA 24-hr 5-Year Rainfall=3.40"

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Summary for Pond Pond B: Pond B

Inflow Area = 294,211 sf, 54.40% Impervious, Inflow Depth = 2.43" for 5-Year event
 Inflow = 3.98 cfs @ 7.91 hrs, Volume= 59,650 cf
 Outflow = 1.34 cfs @ 8.97 hrs, Volume= 59,650 cf, Atten= 66%, Lag= 63.7 min
 Primary = 1.34 cfs @ 8.97 hrs, Volume= 59,650 cf

Routing by Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs / 3
 Peak Elev= 709.48' @ 8.97 hrs Surf.Area= 5,573 sf Storage= 11,166 cf

Plug-Flow detention time= 157.4 min calculated for 59,645 cf (100% of inflow)
 Center-of-Mass det. time= 157.4 min (864.9 - 707.5)

Volume	Invert	Avail.Storage	Storage Description
#1	707.00'	36,813 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
707.00	3,493	0	0
708.00	4,288	3,891	3,891
709.00	5,139	4,714	8,604
710.00	6,046	5,593	14,197
711.00	7,010	6,528	20,725
712.00	8,030	7,520	28,245
713.00	9,107	8,569	36,813

Device	Routing	Invert	Outlet Devices
#1	Primary	705.04'	18.0" Round Culvert L= 339.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 705.04' / 701.65' S= 0.0100 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf
#2	Device 1	703.04'	3.5" Horiz. Orifice/Grate C= 0.620 Limited to weir flow at low heads
#3	Device 1	709.15'	14.0" W x 3.0" H Vert. Orifice/Grate C= 0.620

Primary OutFlow Max=1.34 cfs @ 8.97 hrs HW=709.48' (Free Discharge)

- ↑ **1=Culvert** (Passes 1.34 cfs of 12.86 cfs potential flow)
- ↑ **2=Orifice/Grate** (Orifice Controls 0.70 cfs @ 10.48 fps)
- ↑ **3=Orifice/Grate** (Orifice Controls 0.64 cfs @ 2.21 fps)

Bull Run Filtration Detention Ponds

Type IA 24-hr 5-Year Rainfall=3.40"

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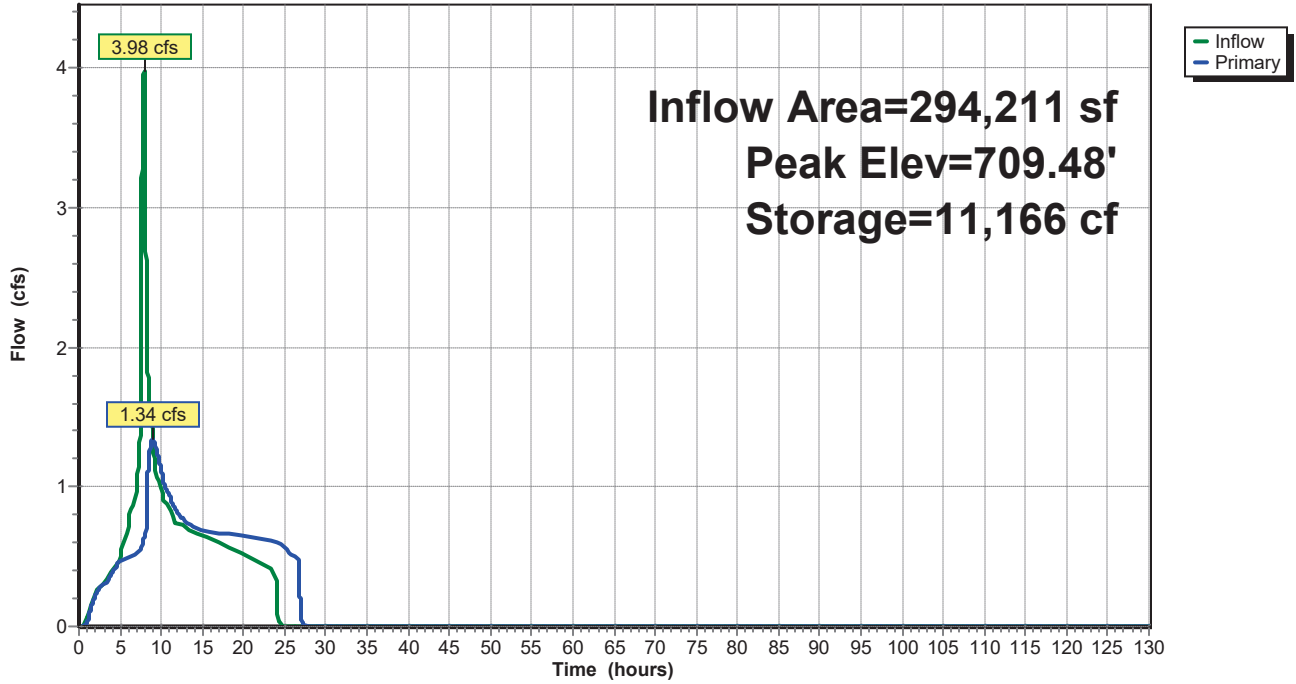
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Pond Pond B: Pond B

Hydrograph



Bull Run Filtration Detention Ponds

Type IA 24-hr 5-Year Rainfall=3.40"

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Summary for Pond Pond C: Pond C

Inflow Area = 754,337 sf, 10.88% Impervious, Inflow Depth > 7.69" for 5-Year event
 Inflow = 7.69 cfs @ 7.97 hrs, Volume= 483,333 cf, Incl. 0.80 cfs Base Flow
 Outflow = 2.53 cfs @ 11.16 hrs, Volume= 482,989 cf, Atten= 67%, Lag= 191.7 min
 Primary = 2.53 cfs @ 11.16 hrs, Volume= 482,989 cf

Routing by Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs / 3
 Peak Elev= 705.13' @ 11.16 hrs Surf.Area= 21,205 sf Storage= 22,341 cf

Plug-Flow detention time= 49.9 min calculated for 482,984 cf (100% of inflow)
 Center-of-Mass det. time= 46.5 min (3,244.5 - 3,198.0)

Volume	Invert	Avail.Storage	Storage Description
#1	704.00'	95,416 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
704.00	18,277	0	0
705.00	20,828	19,553	19,553
706.00	23,671	22,250	41,802
707.00	26,743	25,207	67,009
708.00	30,070	28,407	95,416

Device	Routing	Invert	Outlet Devices
#1	Primary	697.90'	12.0" Round Culvert L= 53.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 697.90' / 695.55' S= 0.0443 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	693.90'	5.1" Horiz. Orifice/Grate C= 0.620 Limited to weir flow at low heads
#3	Device 1	704.85'	16.0" W x 3.0" H Vert. Orifice/Grate C= 0.620

Primary OutFlow Max=2.54 cfs @ 11.16 hrs HW=705.13' (Free Discharge)

- ↑ **1=Culvert** (Passes 2.54 cfs of 9.81 cfs potential flow)
- ↑ **2=Orifice/Grate** (Orifice Controls 1.90 cfs @ 13.38 fps)
- ↑ **3=Orifice/Grate** (Orifice Controls 0.64 cfs @ 1.92 fps)

Bull Run Filtration Detention Ponds

Type IA 24-hr 5-Year Rainfall=3.40"

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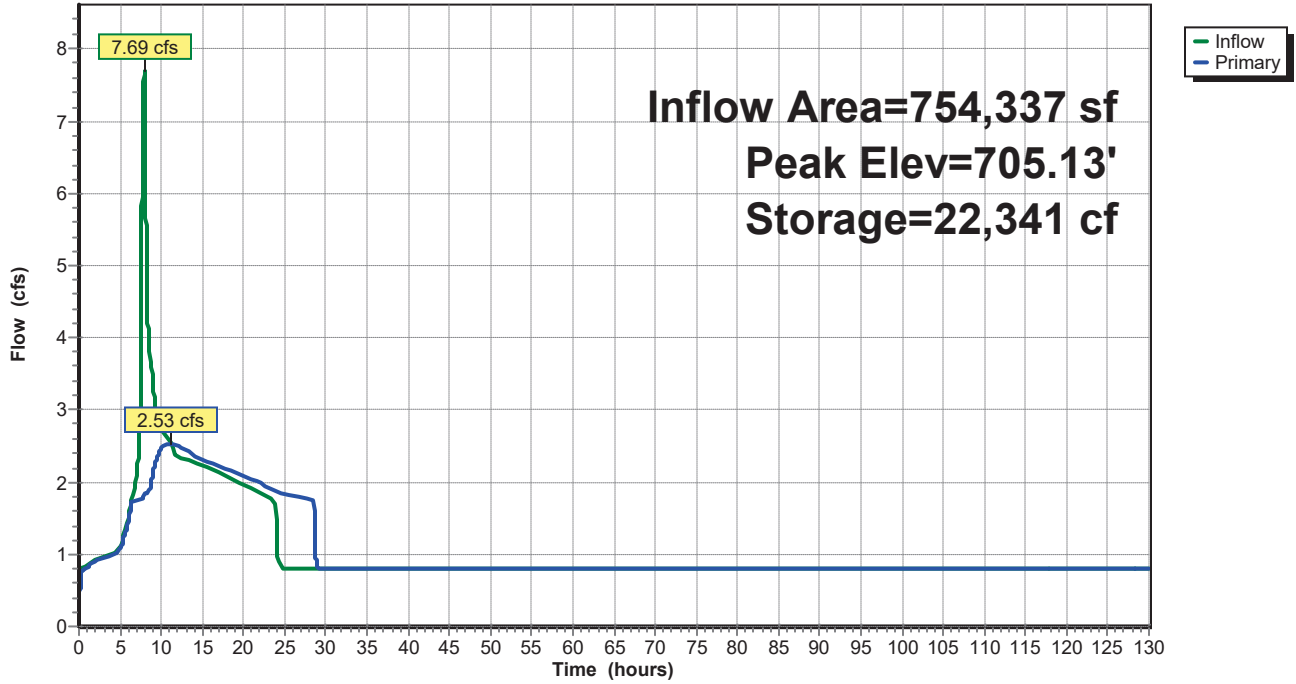
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Pond Pond C: Pond C

Hydrograph



Bull Run Filtration Detention Ponds

Type IA 24-hr 5-Year Rainfall=3.40"

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Summary for Pond Pond D: Pond D

Inflow Area = 391,420 sf, 34.58% Impervious, Inflow Depth = 2.11" for 5-Year event
 Inflow = 4.50 cfs @ 7.93 hrs, Volume= 68,953 cf
 Outflow = 1.75 cfs @ 8.79 hrs, Volume= 68,953 cf, Atten= 61%, Lag= 51.7 min
 Primary = 1.75 cfs @ 8.79 hrs, Volume= 68,953 cf

Routing by Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs / 3
 Peak Elev= 694.95' @ 8.79 hrs Surf.Area= 6,333 sf Storage= 10,505 cf

Plug-Flow detention time= 103.0 min calculated for 68,948 cf (100% of inflow)
 Center-of-Mass det. time= 103.0 min (839.2 - 736.1)

Volume	Invert	Avail.Storage	Storage Description
#1	693.00'	45,106 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
693.00	4,453	0	0
694.00	5,388	4,921	4,921
695.00	6,380	5,884	10,805
696.00	7,428	6,904	17,709
697.00	8,533	7,981	25,689
698.00	9,694	9,114	34,803
699.00	10,912	10,303	45,106

Device	Routing	Invert	Outlet Devices
#1	Primary	692.50'	12.0" Round Culvert L= 121.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 692.50' / 688.97' S= 0.0292 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	690.50'	4.9" Horiz. Orifice/Grate C= 0.620 Limited to weir flow at low heads
#3	Device 1	694.60'	15.0" W x 3.0" H Vert. Orifice/Grate C= 0.620

Primary OutFlow Max=1.75 cfs @ 8.79 hrs HW=694.95' (Free Discharge)

- ↑ **1=Culvert** (Passes 1.75 cfs of 5.28 cfs potential flow)
- ↑ **2=Orifice/Grate** (Orifice Controls 1.02 cfs @ 7.79 fps)
- ↑ **3=Orifice/Grate** (Orifice Controls 0.73 cfs @ 2.34 fps)

Bull Run Filtration Detention Ponds

Type IA 24-hr 5-Year Rainfall=3.40"

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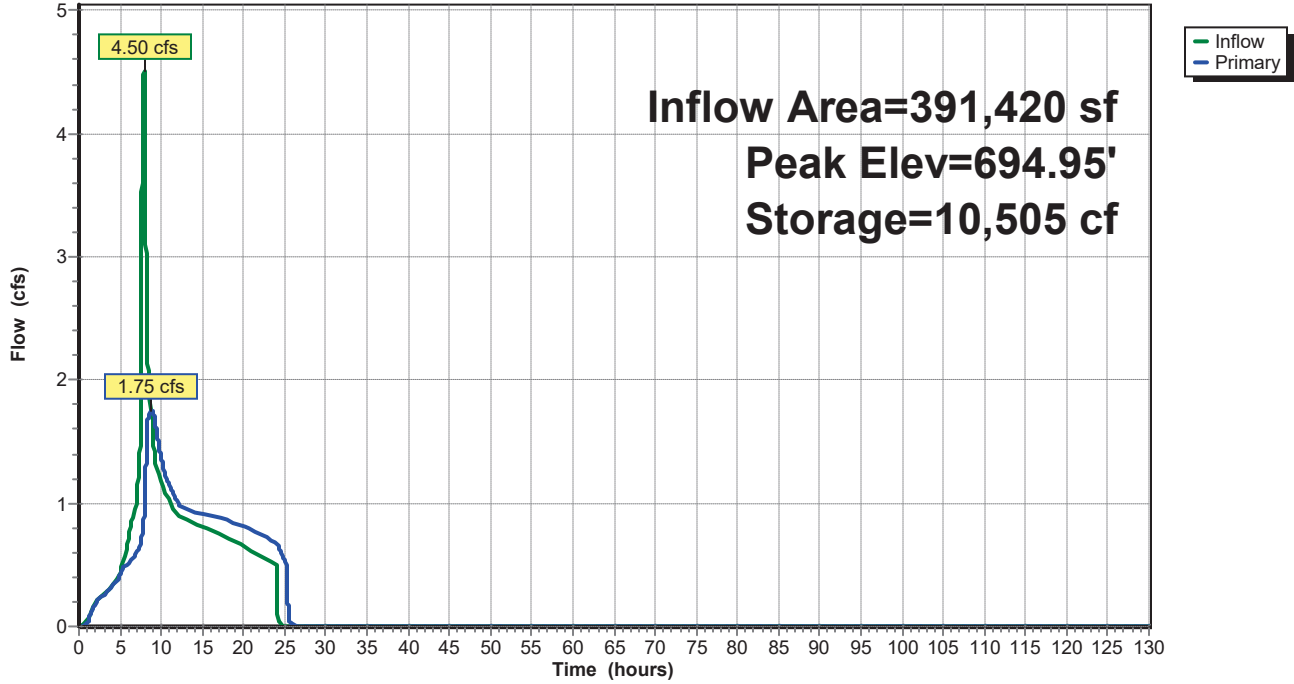
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Pond Pond D: Pond D

Hydrograph



Bull Run Filtration Detention Ponds

Type IA 24-hr 5-Year Rainfall=3.40"

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Summary for Pond Pond E: Pond E

Inflow Area = 580,537 sf, 6.24% Impervious, Inflow Depth = 1.66" for 5-Year event
 Inflow = 5.04 cfs @ 7.97 hrs, Volume= 80,201 cf
 Outflow = 2.22 cfs @ 8.69 hrs, Volume= 80,188 cf, Atten= 56%, Lag= 42.8 min
 Primary = 2.22 cfs @ 8.69 hrs, Volume= 80,188 cf

Routing by Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs / 3
 Peak Elev= 714.27' @ 8.69 hrs Surf.Area= 10,009 sf Storage= 11,384 cf

Plug-Flow detention time= 105.7 min calculated for 80,182 cf (100% of inflow)
 Center-of-Mass det. time= 106.1 min (902.3 - 796.2)

Volume	Invert	Avail.Storage	Storage Description
#1	713.00'	31,308 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
713.00	7,916	0	0
714.00	9,540	8,728	8,728
715.00	11,265	10,403	19,131
716.00	13,090	12,178	31,308

Device	Routing	Invert	Outlet Devices
#1	Primary	713.00'	15.0" Round Culvert L= 44.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 713.00' / 712.80' S= 0.0045 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Device 1	711.00'	7.0" Horiz. Orifice/Grate C= 0.620 Limited to weir flow at low heads
#3	Device 1	713.95'	16.0" W x 3.0" H Vert. Orifice/Grate C= 0.620

Primary OutFlow Max=2.22 cfs @ 8.69 hrs HW=714.27' (Free Discharge)

- ↑ **1=Culvert** (Passes 2.22 cfs of 3.83 cfs potential flow)
- ↑ **2=Orifice/Grate** (Orifice Controls 1.50 cfs @ 5.61 fps)
- ↑ **3=Orifice/Grate** (Orifice Controls 0.72 cfs @ 2.17 fps)

Bull Run Filtration Detention Ponds

Type IA 24-hr 5-Year Rainfall=3.40"

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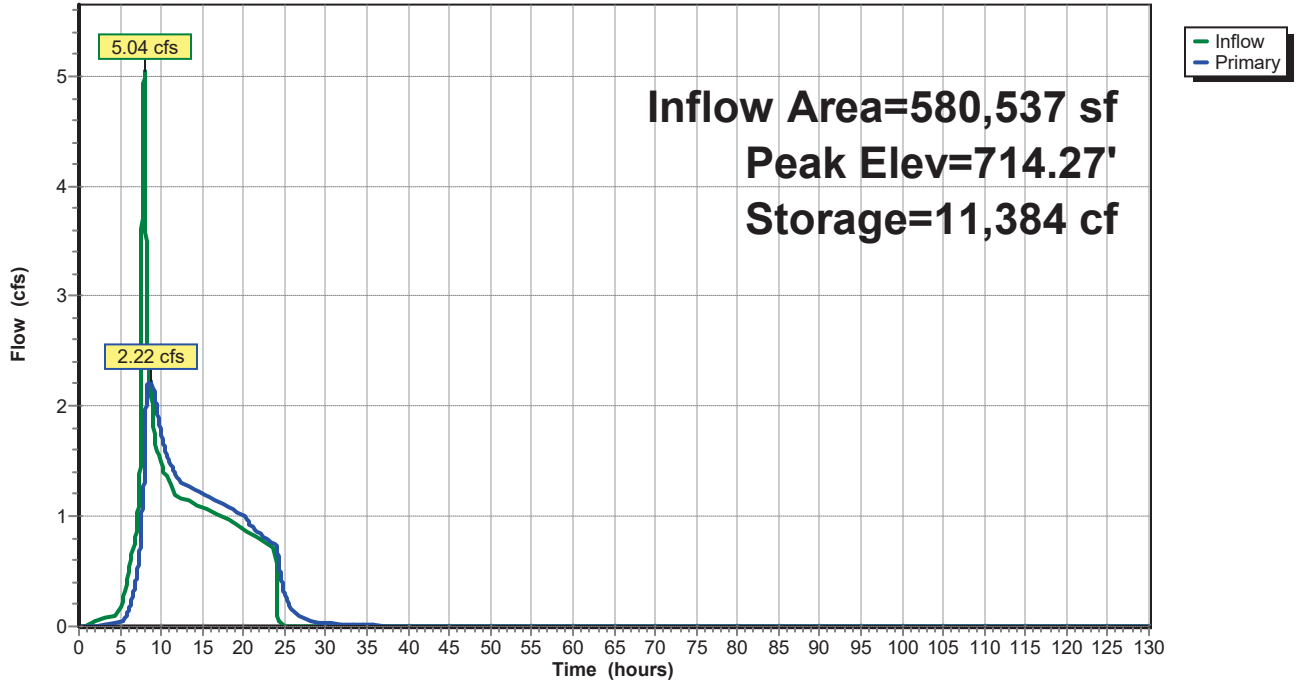
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Pond Pond E: Pond E

Hydrograph



Bull Run Filtration Detention Ponds

Type IA 24-hr 10-Year Rainfall=3.80"

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Summary for Subcatchment A: Post Basin A

Runoff = 5.32 cfs @ 7.91 hrs, Volume= 79,457 cf, Depth= 2.73"

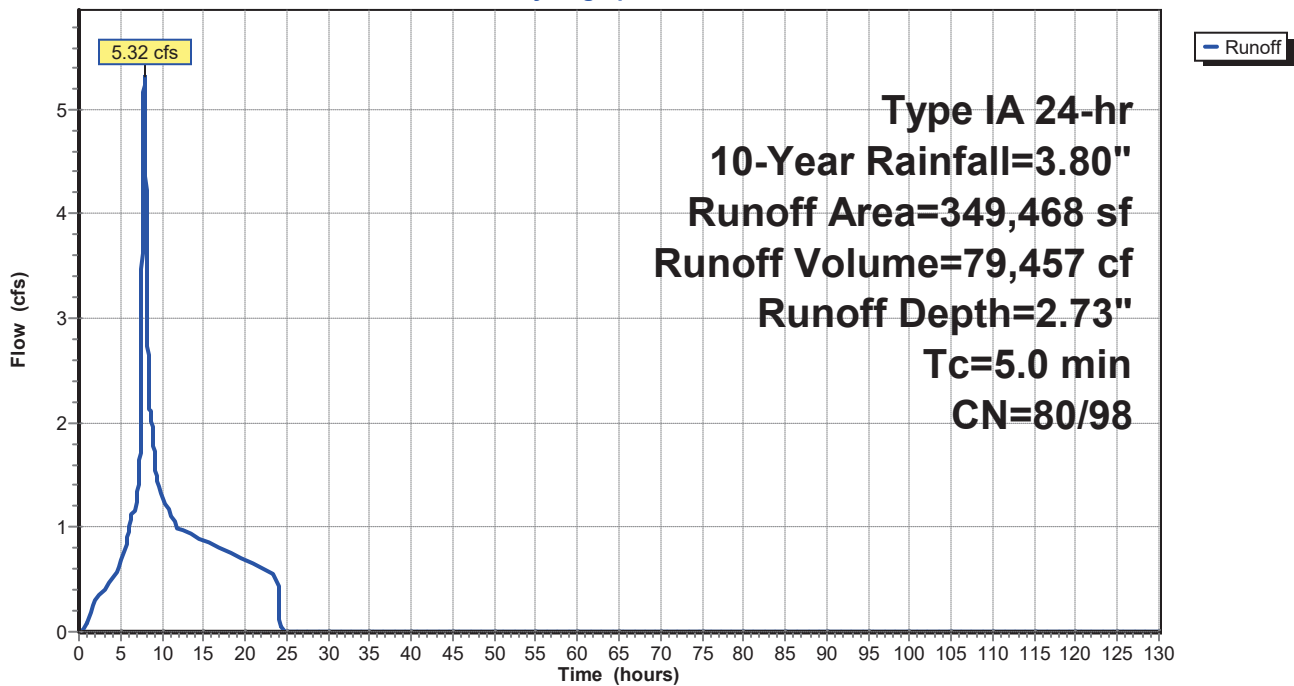
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Year Rainfall=3.80"

	Area (sf)	CN	Description
*	176,142	98	Impervious Area
	173,326	80	>75% Grass cover, Good, HSG D
	349,468	89	Weighted Average
	173,326	80	49.60% Pervious Area
	176,142	98	50.40% Impervious Area

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

Subcatchment A: Post Basin A

Hydrograph



Bull Run Filtration Detention Ponds

Type IA 24-hr 10-Year Rainfall=3.80"

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Summary for Subcatchment B: Post Basin B

Runoff = 4.60 cfs @ 7.91 hrs, Volume= 68,549 cf, Depth= 2.80"

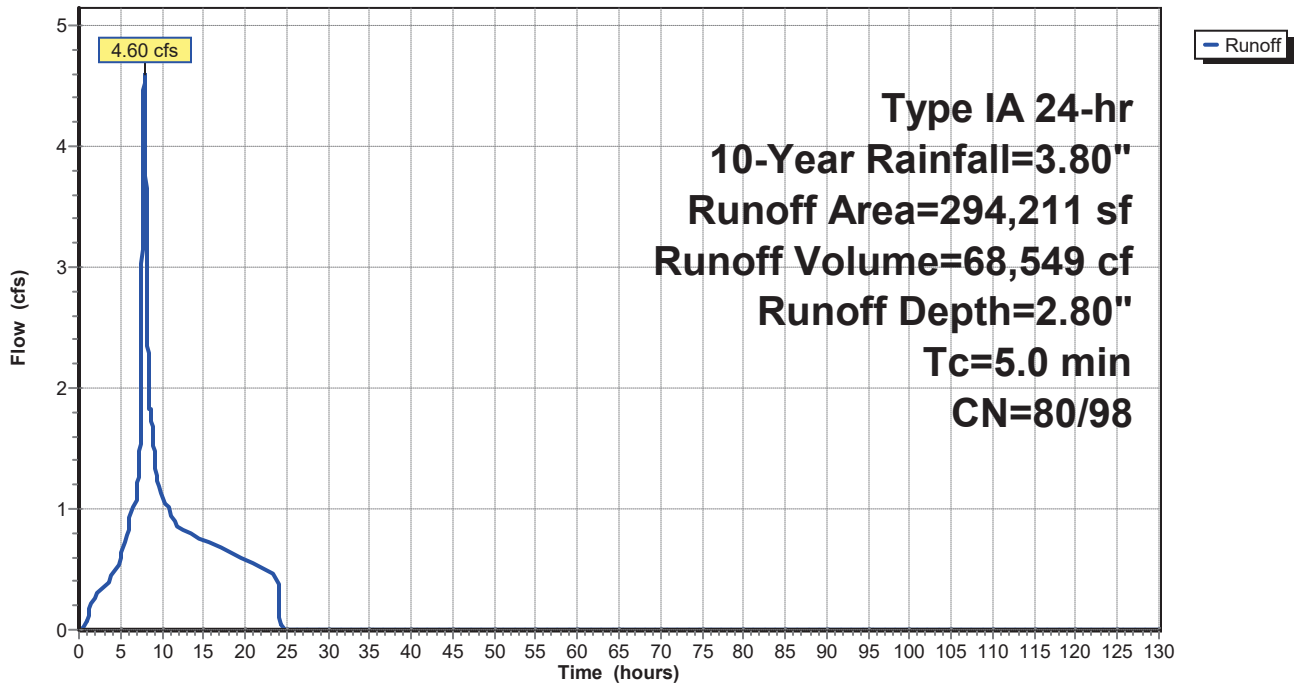
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Year Rainfall=3.80"

	Area (sf)	CN	Description
*	160,056	98	Impervious Area
	134,155	80	>75% Grass cover, Good, HSG D
	294,211	90	Weighted Average
	134,155	80	45.60% Pervious Area
	160,056	98	54.40% Impervious Area

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

Subcatchment B: Post Basin B

Hydrograph



Bull Run Filtration Detention Ponds

Type IA 24-hr 10-Year Rainfall=3.80"

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Summary for Subcatchment C: Post Basin C

Runoff = 8.39 cfs @ 7.96 hrs, Volume= 129,569 cf, Depth= 2.06"

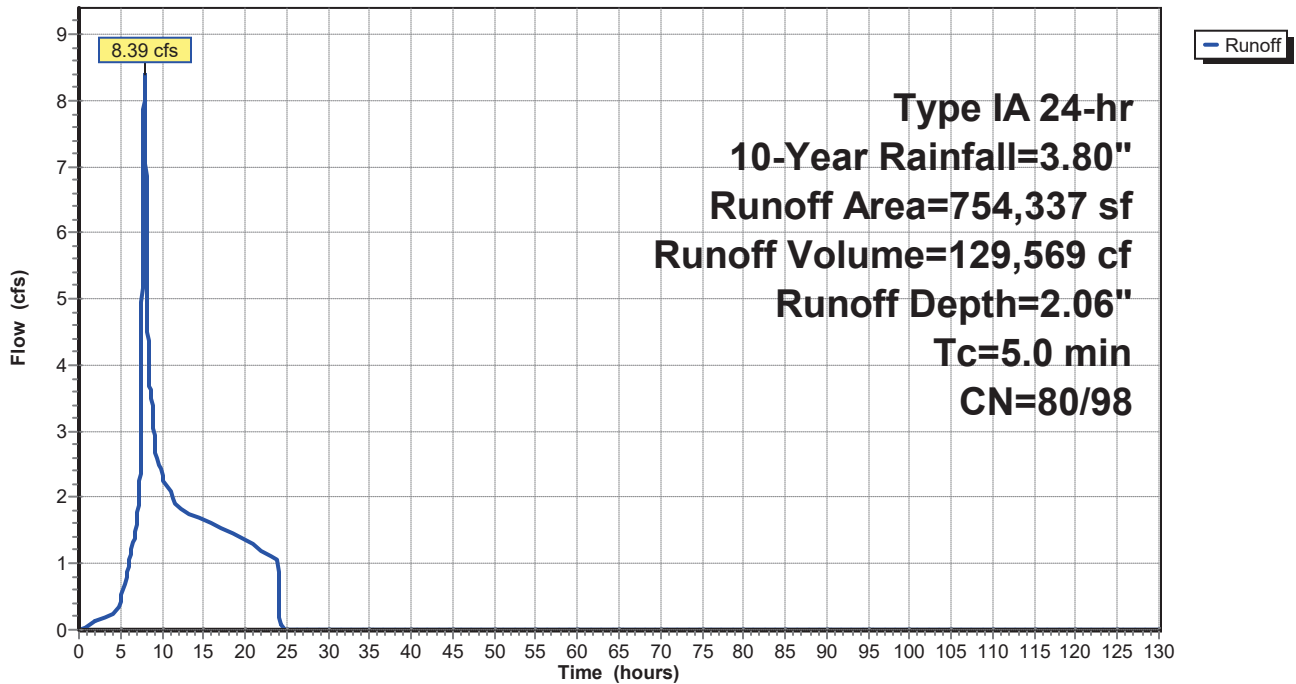
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Year Rainfall=3.80"

	Area (sf)	CN	Description
*	82,047	98	Impervious Area
	672,290	80	>75% Grass cover, Good, HSG D
	754,337	82	Weighted Average
	672,290	80	89.12% Pervious Area
	82,047	98	10.88% Impervious Area

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

Subcatchment C: Post Basin C

Hydrograph



Bull Run Filtration Detention Ponds

Type IA 24-hr 10-Year Rainfall=3.80"

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Summary for Subcatchment D: Post Basin D

Runoff = 5.31 cfs @ 7.93 hrs, Volume= 80,284 cf, Depth= 2.46"

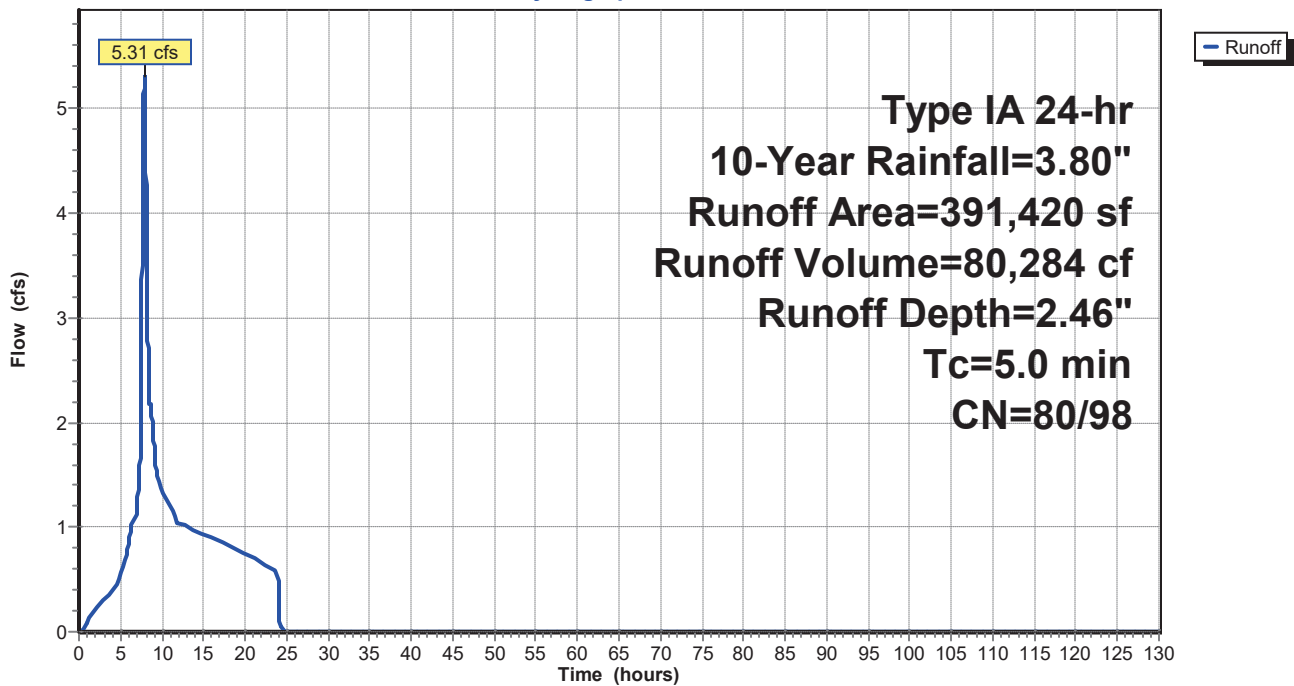
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Year Rainfall=3.80"

	Area (sf)	CN	Description
*	135,356	98	Impervious Area
	256,064	80	>75% Grass cover, Good, HSG D
	391,420	86	Weighted Average
	256,064	80	65.42% Pervious Area
	135,356	98	34.58% Impervious Area

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

Subcatchment D: Post Basin D

Hydrograph



Bull Run Filtration Detention Ponds

Type IA 24-hr 10-Year Rainfall=3.80"

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Summary for Subcatchment E: Post Basin E

Runoff = 6.18 cfs @ 7.96 hrs, Volume= 95,927 cf, Depth= 1.98"

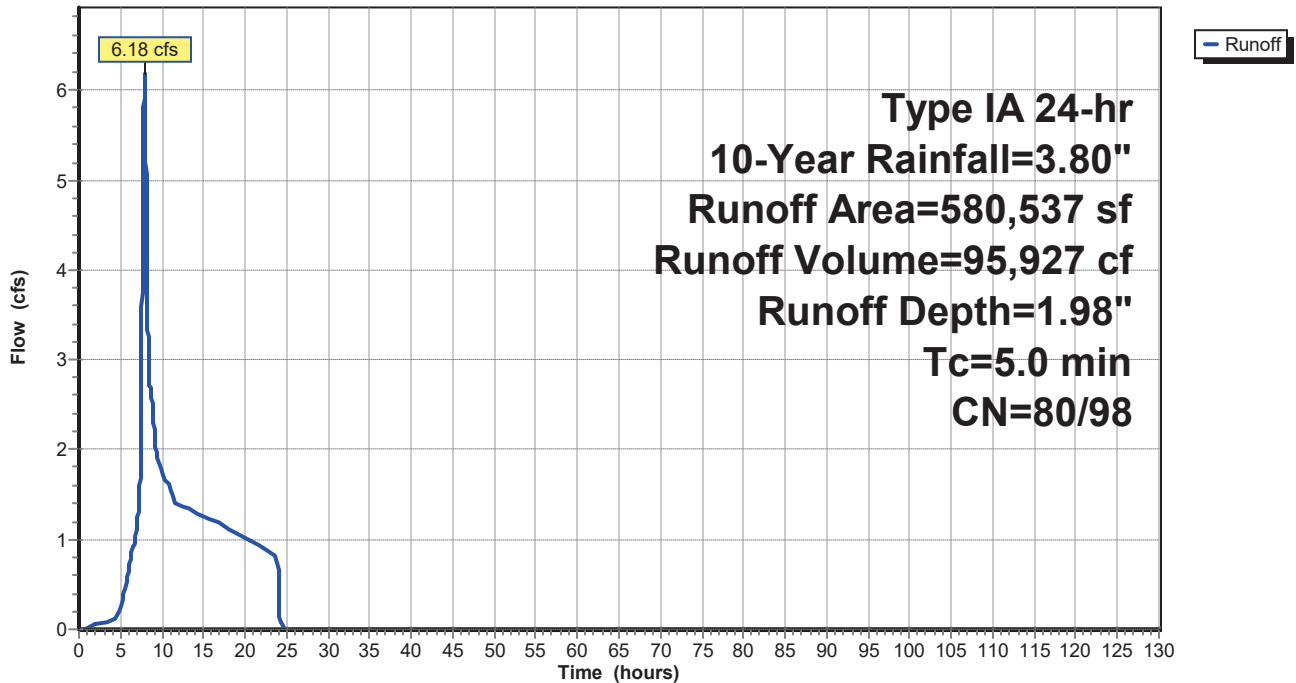
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Year Rainfall=3.80"

	Area (sf)	CN	Description
*	19,160	98	Impervious Area
	544,328	80	>75% Grass cover, Good, HSG D
*	17,049	98	
<hr/>			
	580,537	81	Weighted Average
	544,328	80	93.76% Pervious Area
	36,209	98	6.24% Impervious Area

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

Subcatchment E: Post Basin E

Hydrograph



Bull Run Filtration Detention Ponds

Type IA 24-hr 10-Year Rainfall=3.80"

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Summary for Subcatchment Pre A: Pre Dev Basin A

Runoff = 2.31 cfs @ 8.14 hrs, Volume= 59,209 cf, Depth= 2.03"

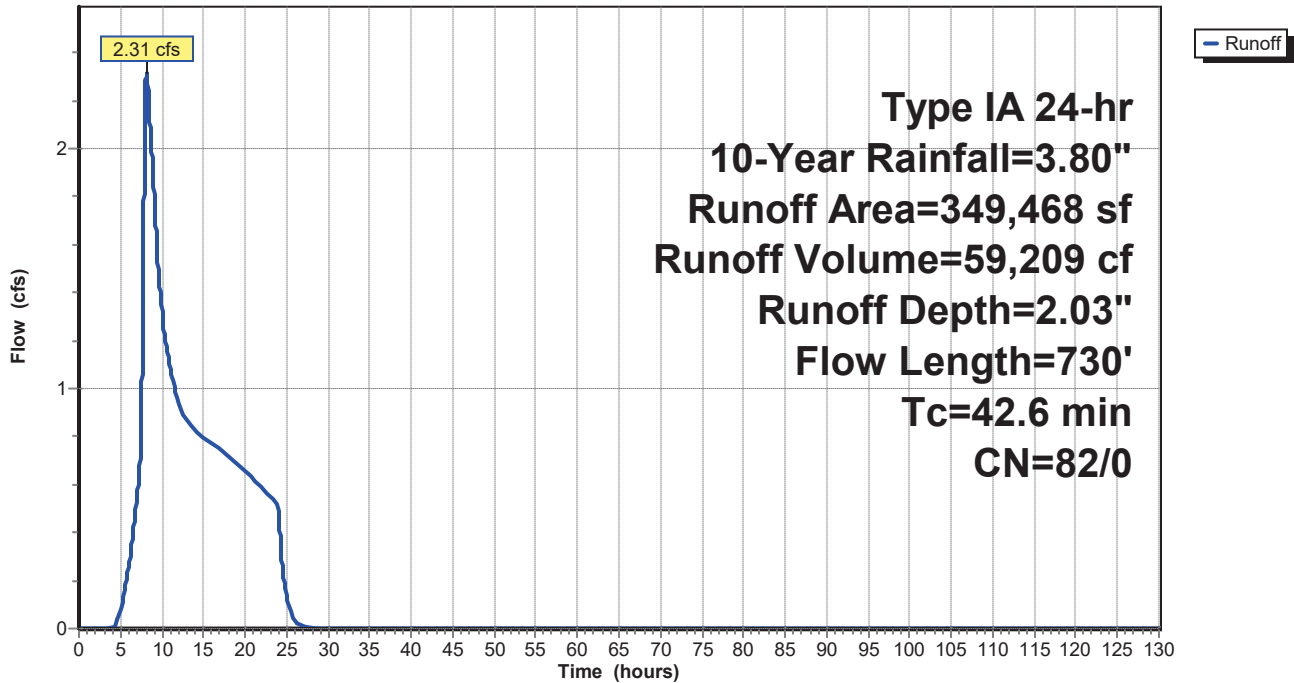
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Year Rainfall=3.80"

Area (sf)	CN	Description
349,468	82	Row crops, SR + CR, Good, HSG C
349,468	82	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
36.8	300	0.0100	0.14		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 2.80"
5.8	430	0.0190	1.24		Shallow Concentrated Flow, Cultivated Straight Rows Kv= 9.0 fps
42.6	730	Total			

Subcatchment Pre A: Pre Dev Basin A

Hydrograph



Bull Run Filtration Detention Ponds

Type IA 24-hr 10-Year Rainfall=3.80"

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Summary for Subcatchment Pre B: Pre Dev Basin B

Runoff = 2.55 cfs @ 8.01 hrs, Volume= 49,847 cf, Depth= 2.03"

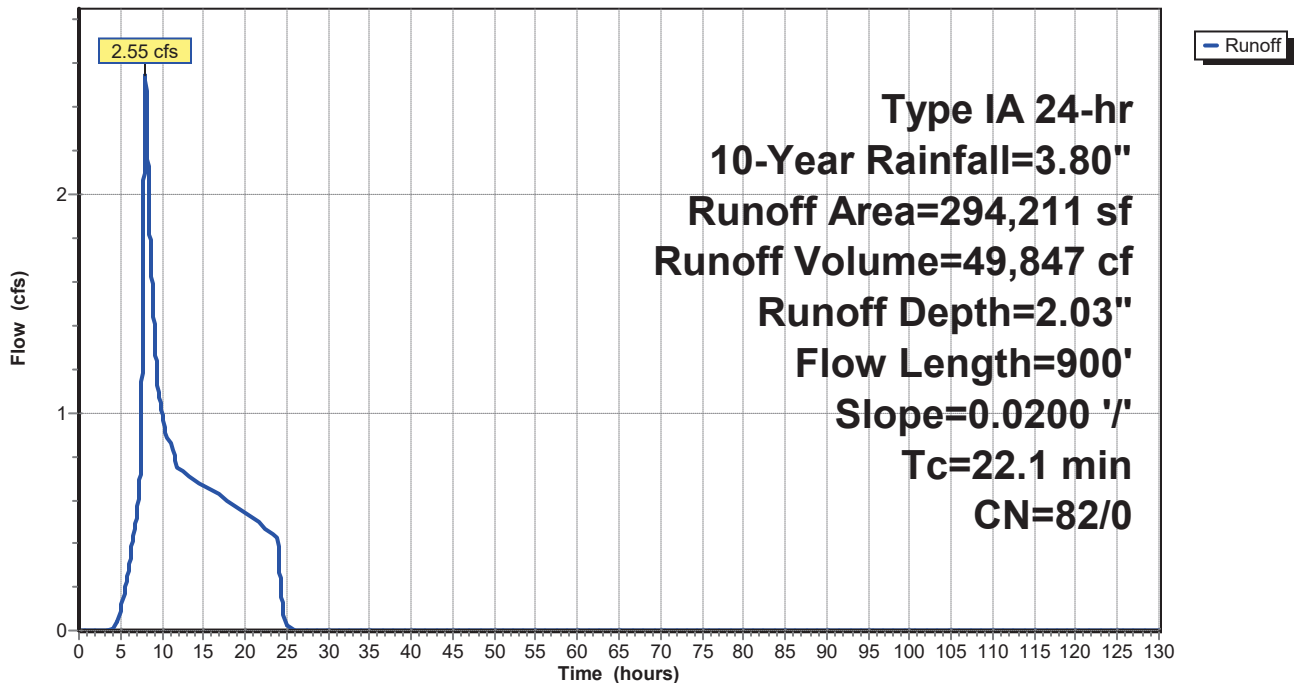
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Year Rainfall=3.80"

Area (sf)	CN	Description
294,211	82	Row crops, SR + CR, Good, HSG C
294,211	82	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.6	100	0.0200	0.14		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 2.80"
10.5	800	0.0200	1.27		Shallow Concentrated Flow, Cultivated Straight Rows Kv= 9.0 fps
22.1	900	Total			

Subcatchment Pre B: Pre Dev Basin B

Hydrograph



Bull Run Filtration Detention Ponds

Type IA 24-hr 10-Year Rainfall=3.80"

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Summary for Subcatchment Pre C: Pre Dev Basin C

Runoff = 7.37 cfs @ 8.00 hrs, Volume= 127,804 cf, Depth= 2.03"

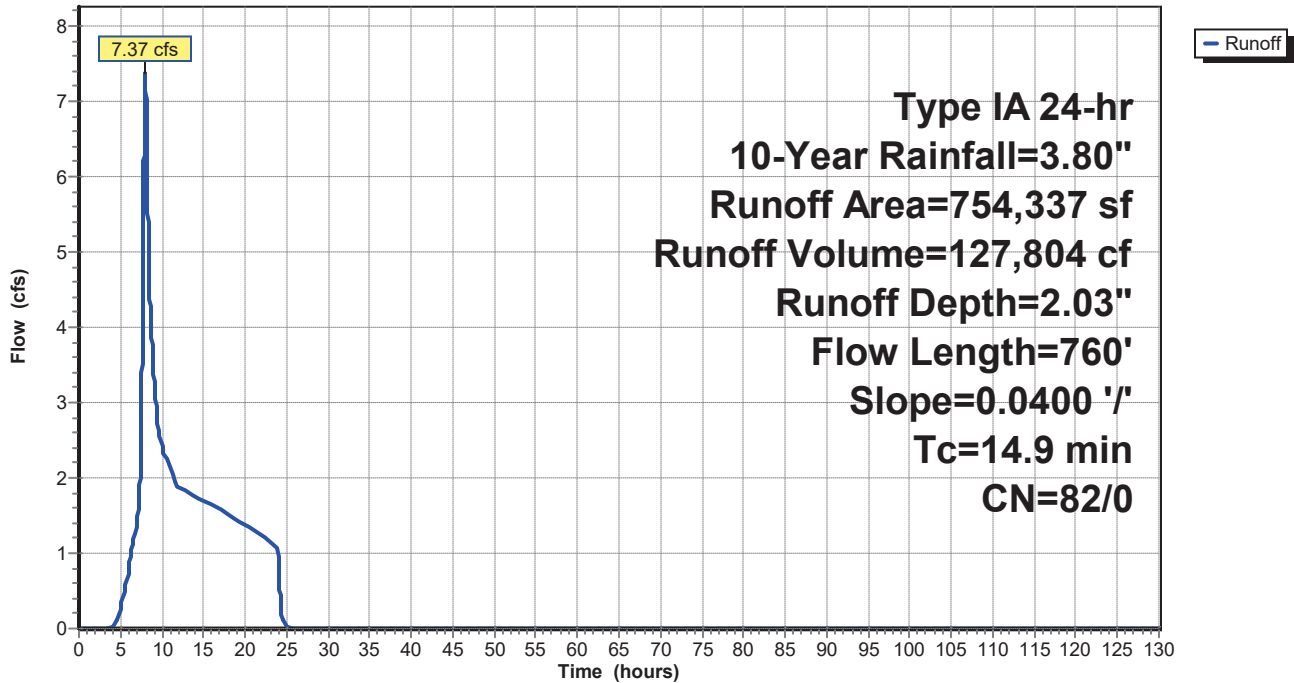
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Year Rainfall=3.80"

Area (sf)	CN	Description
754,337	82	Row crops, SR + CR, Good, HSG C
754,337	82	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.8	100	0.0400	0.19		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 2.80"
6.1	660	0.0400	1.80		Shallow Concentrated Flow, Cultivated Straight Rows Kv= 9.0 fps
14.9	760	Total			

Subcatchment Pre C: Pre Dev Basin C

Hydrograph



Bull Run Filtration Detention Ponds

Type IA 24-hr 10-Year Rainfall=3.80"

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Summary for Subcatchment Pre D: Pre Dev Basin D

Runoff = 3.49 cfs @ 8.01 hrs, Volume= 66,317 cf, Depth= 2.03"

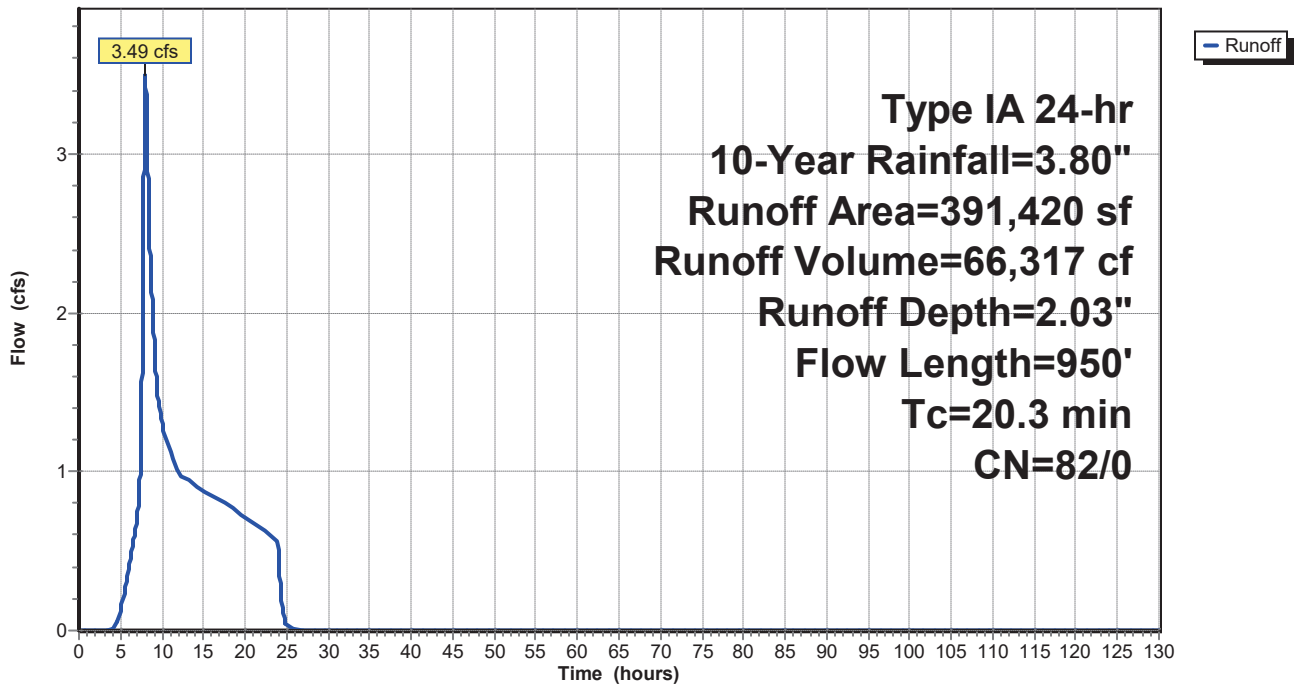
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Year Rainfall=3.80"

Area (sf)	CN	Description
391,420	82	Row crops, SR + CR, Good, HSG C
391,420	82	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.6	100	0.0200	0.14		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 2.80"
8.7	850	0.0330	1.63		Shallow Concentrated Flow, Cultivated Straight Rows Kv= 9.0 fps
20.3	950	Total			

Subcatchment Pre D: Pre Dev Basin D

Hydrograph



Bull Run Filtration Detention Ponds

Type IA 24-hr 10-Year Rainfall=3.80"

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Summary for Subcatchment Pre E: Pre Dev Basin E

Runoff = 4.90 cfs @ 8.01 hrs, Volume= 98,358 cf, Depth= 2.03"

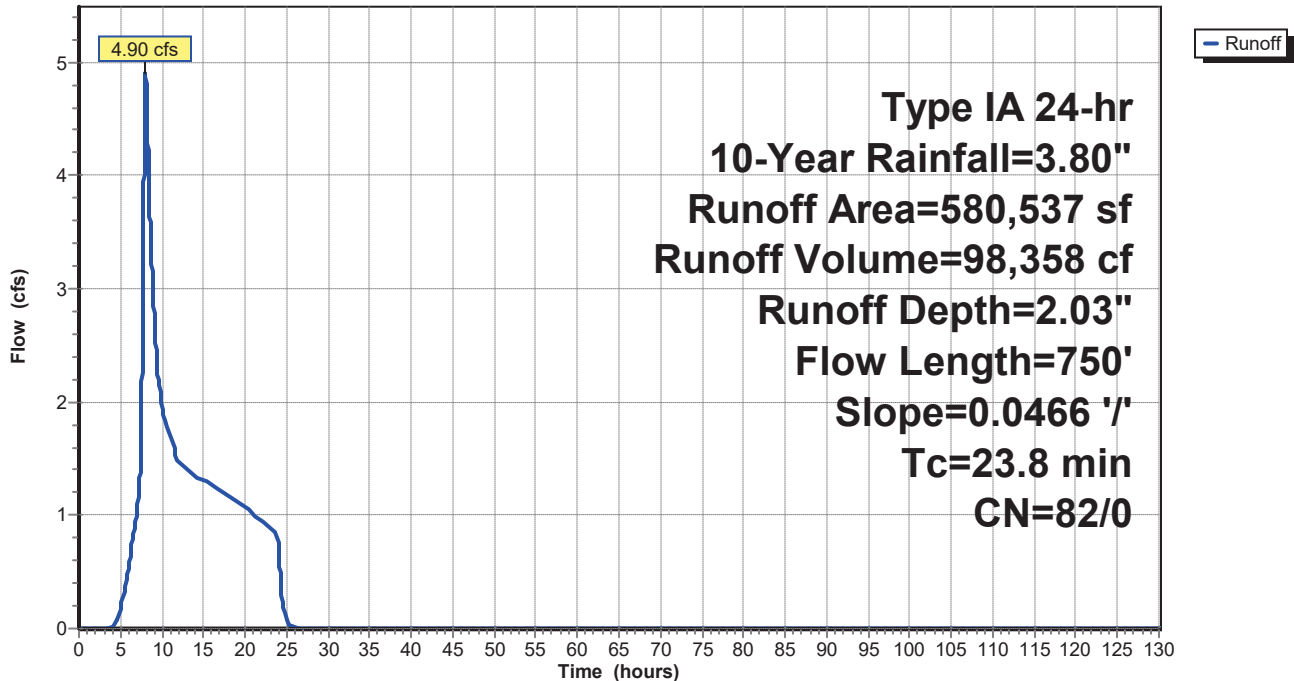
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Year Rainfall=3.80"

Area (sf)	CN	Description
580,537	82	Row crops, SR + CR, Good, HSG C
580,537	82	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.9	300	0.0466	0.25		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 2.80"
3.9	450	0.0466	1.94		Shallow Concentrated Flow, Cultivated Straight Rows Kv= 9.0 fps
23.8	750	Total			

Subcatchment Pre E: Pre Dev Basin E

Hydrograph



Bull Run Filtration Detention Ponds

Type IA 24-hr 10-Year Rainfall=3.80"

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Summary for Pond Pond A: Pond A

Inflow Area = 349,468 sf, 50.40% Impervious, Inflow Depth = 2.73" for 10-Year event
 Inflow = 5.32 cfs @ 7.91 hrs, Volume= 79,457 cf
 Outflow = 1.56 cfs @ 9.22 hrs, Volume= 79,457 cf, Atten= 71%, Lag= 78.7 min
 Primary = 1.56 cfs @ 9.22 hrs, Volume= 79,457 cf

Routing by Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs / 3
 Peak Elev= 709.85' @ 9.22 hrs Surf.Area= 8,661 sf Storage= 17,390 cf

Plug-Flow detention time= 223.3 min calculated for 79,451 cf (100% of inflow)
 Center-of-Mass det. time= 223.3 min (932.4 - 709.1)

Volume	Invert	Avail.Storage	Storage Description
#1	707.50'	70,555 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
707.50	6,107	0	0
708.00	6,714	3,205	3,205
709.00	7,742	7,228	10,433
710.00	8,825	8,284	18,717
711.00	9,967	9,396	28,113
712.00	11,161	10,564	38,677
713.00	12,412	11,787	50,463
714.00	13,717	13,065	63,528
714.50	14,392	7,027	70,555

Device	Routing	Invert	Outlet Devices
#1	Primary	698.43'	18.0" Round Culvert L= 138.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 698.43' / 696.24' S= 0.0159 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf
#2	Device 1	696.43'	2.6" Horiz. Orifice/Grate C= 0.620 Limited to weir flow at low heads
#3	Device 1	709.40'	16.0" W x 3.0" H Vert. Orifice/Grate C= 0.620

Primary OutFlow Max=1.56 cfs @ 9.22 hrs HW=709.85' (Free Discharge)

- ↑ **1=Culvert** (Passes 1.56 cfs of 24.60 cfs potential flow)
- ↑ **2=Orifice/Grate** (Orifice Controls 0.62 cfs @ 16.81 fps)
- ↑ **3=Orifice/Grate** (Orifice Controls 0.94 cfs @ 2.81 fps)

Bull Run Filtration Detention Ponds

Type IA 24-hr 10-Year Rainfall=3.80"

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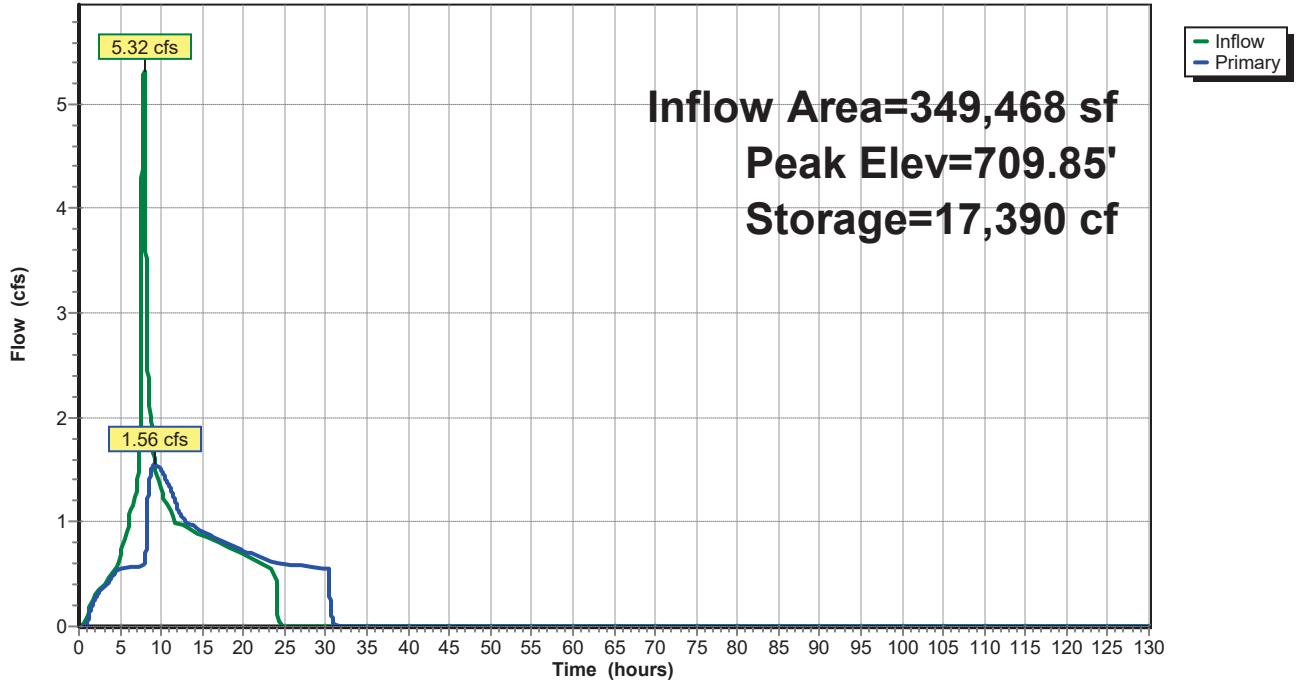
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Pond Pond A: Pond A

Hydrograph



Bull Run Filtration Detention Ponds

Type IA 24-hr 10-Year Rainfall=3.80"

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Summary for Pond Pond B: Pond B

Inflow Area = 294,211 sf, 54.40% Impervious, Inflow Depth = 2.80" for 10-Year event
 Inflow = 4.60 cfs @ 7.91 hrs, Volume= 68,549 cf
 Outflow = 1.70 cfs @ 8.80 hrs, Volume= 68,549 cf, Atten= 63%, Lag= 53.7 min
 Primary = 1.70 cfs @ 8.80 hrs, Volume= 68,549 cf

Routing by Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs / 3
 Peak Elev= 709.73' @ 8.80 hrs Surf.Area= 5,801 sf Storage= 12,599 cf

Plug-Flow detention time= 154.7 min calculated for 68,549 cf (100% of inflow)
 Center-of-Mass det. time= 154.7 min (858.9 - 704.2)

Volume	Invert	Avail.Storage	Storage Description
#1	707.00'	36,813 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
707.00	3,493	0	0
708.00	4,288	3,891	3,891
709.00	5,139	4,714	8,604
710.00	6,046	5,593	14,197
711.00	7,010	6,528	20,725
712.00	8,030	7,520	28,245
713.00	9,107	8,569	36,813

Device	Routing	Invert	Outlet Devices
#1	Primary	705.04'	18.0" Round Culvert L= 339.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 705.04' / 701.65' S= 0.0100 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf
#2	Device 1	703.04'	3.5" Horiz. Orifice/Grate C= 0.620 Limited to weir flow at low heads
#3	Device 1	709.15'	14.0" W x 3.0" H Vert. Orifice/Grate C= 0.620

Primary OutFlow Max=1.70 cfs @ 8.80 hrs HW=709.73' (Free Discharge)

- ↑ **1=Culvert** (Passes 1.70 cfs of 13.11 cfs potential flow)
- ↑ **2=Orifice/Grate** (Orifice Controls 0.72 cfs @ 10.78 fps)
- ↑ **3=Orifice/Grate** (Orifice Controls 0.98 cfs @ 3.35 fps)

Bull Run Filtration Detention Ponds

Type IA 24-hr 10-Year Rainfall=3.80"

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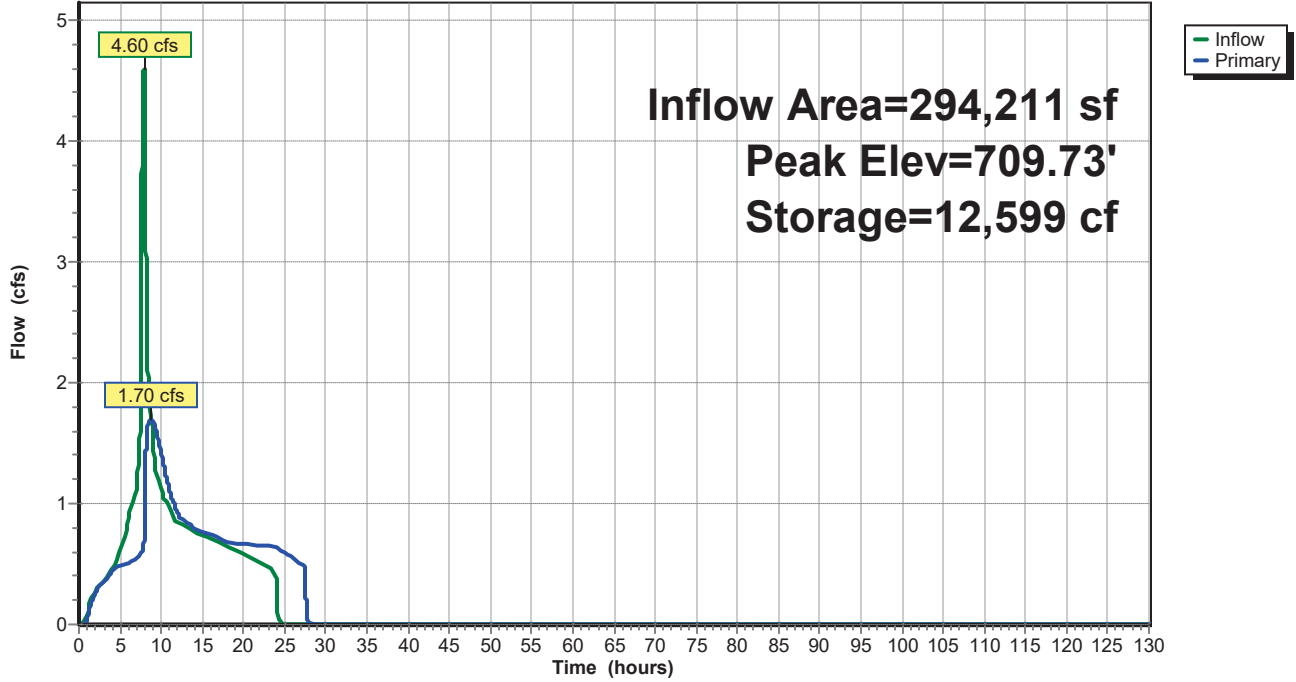
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Pond Pond B: Pond B

Hydrograph



Bull Run Filtration Detention Ponds

Type IA 24-hr 10-Year Rainfall=3.80"

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Summary for Pond Pond C: Pond C

Inflow Area = 754,337 sf, 10.88% Impervious, Inflow Depth > 8.02" for 10-Year event
 Inflow = 9.19 cfs @ 7.96 hrs, Volume= 503,998 cf, Incl. 0.80 cfs Base Flow
 Outflow = 2.92 cfs @ 10.92 hrs, Volume= 503,653 cf, Atten= 68%, Lag= 177.7 min
 Primary = 2.92 cfs @ 10.92 hrs, Volume= 503,653 cf

Routing by Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs / 3
 Peak Elev= 705.34' @ 10.92 hrs Surf.Area= 21,787 sf Storage= 26,741 cf

Plug-Flow detention time= 54.2 min calculated for 503,648 cf (100% of inflow)
 Center-of-Mass det. time= 50.9 min (3,147.8 - 3,096.8)

Volume	Invert	Avail.Storage	Storage Description
#1	704.00'	95,416 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
704.00	18,277	0	0
705.00	20,828	19,553	19,553
706.00	23,671	22,250	41,802
707.00	26,743	25,207	67,009
708.00	30,070	28,407	95,416

Device	Routing	Invert	Outlet Devices
#1	Primary	697.90'	12.0" Round Culvert L= 53.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 697.90' / 695.55' S= 0.0443 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	693.90'	5.1" Horiz. Orifice/Grate C= 0.620 Limited to weir flow at low heads
#3	Device 1	704.85'	16.0" W x 3.0" H Vert. Orifice/Grate C= 0.620

Primary OutFlow Max=2.92 cfs @ 10.92 hrs HW=705.34' (Free Discharge)

- ↑ **1=Culvert** (Passes 2.92 cfs of 9.96 cfs potential flow)
- ↑ **2=Orifice/Grate** (Orifice Controls 1.92 cfs @ 13.57 fps)
- ↑ **3=Orifice/Grate** (Orifice Controls 0.99 cfs @ 2.98 fps)

Bull Run Filtration Detention Ponds

Type IA 24-hr 10-Year Rainfall=3.80"

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Pond Pond C: Pond C

Hydrograph



Bull Run Filtration Detention Ponds

Type IA 24-hr 10-Year Rainfall=3.80"

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Summary for Pond Pond D: Pond D

Inflow Area = 391,420 sf, 34.58% Impervious, Inflow Depth = 2.46" for 10-Year event
 Inflow = 5.31 cfs @ 7.93 hrs, Volume= 80,284 cf
 Outflow = 2.18 cfs @ 8.65 hrs, Volume= 80,284 cf, Atten= 59%, Lag= 43.4 min
 Primary = 2.18 cfs @ 8.65 hrs, Volume= 80,284 cf

Routing by Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs / 3
 Peak Elev= 695.23' @ 8.65 hrs Surf.Area= 6,622 sf Storage= 12,303 cf

Plug-Flow detention time= 106.7 min calculated for 80,284 cf (100% of inflow)
 Center-of-Mass det. time= 106.7 min (838.2 - 731.5)

Volume	Invert	Avail.Storage	Storage Description
#1	693.00'	45,106 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
693.00	4,453	0	0
694.00	5,388	4,921	4,921
695.00	6,380	5,884	10,805
696.00	7,428	6,904	17,709
697.00	8,533	7,981	25,689
698.00	9,694	9,114	34,803
699.00	10,912	10,303	45,106

Device	Routing	Invert	Outlet Devices
#1	Primary	692.50'	12.0" Round Culvert L= 121.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 692.50' / 688.97' S= 0.0292 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	690.50'	4.9" Horiz. Orifice/Grate C= 0.620 Limited to weir flow at low heads
#3	Device 1	694.60'	15.0" W x 3.0" H Vert. Orifice/Grate C= 0.620

Primary OutFlow Max=2.18 cfs @ 8.65 hrs HW=695.23' (Free Discharge)

- ↑ **1=Culvert** (Passes 2.18 cfs of 5.65 cfs potential flow)
- ↑ **2=Orifice/Grate** (Orifice Controls 1.08 cfs @ 8.22 fps)
- ↑ **3=Orifice/Grate** (Orifice Controls 1.10 cfs @ 3.53 fps)

Bull Run Filtration Detention Ponds

Type IA 24-hr 10-Year Rainfall=3.80"

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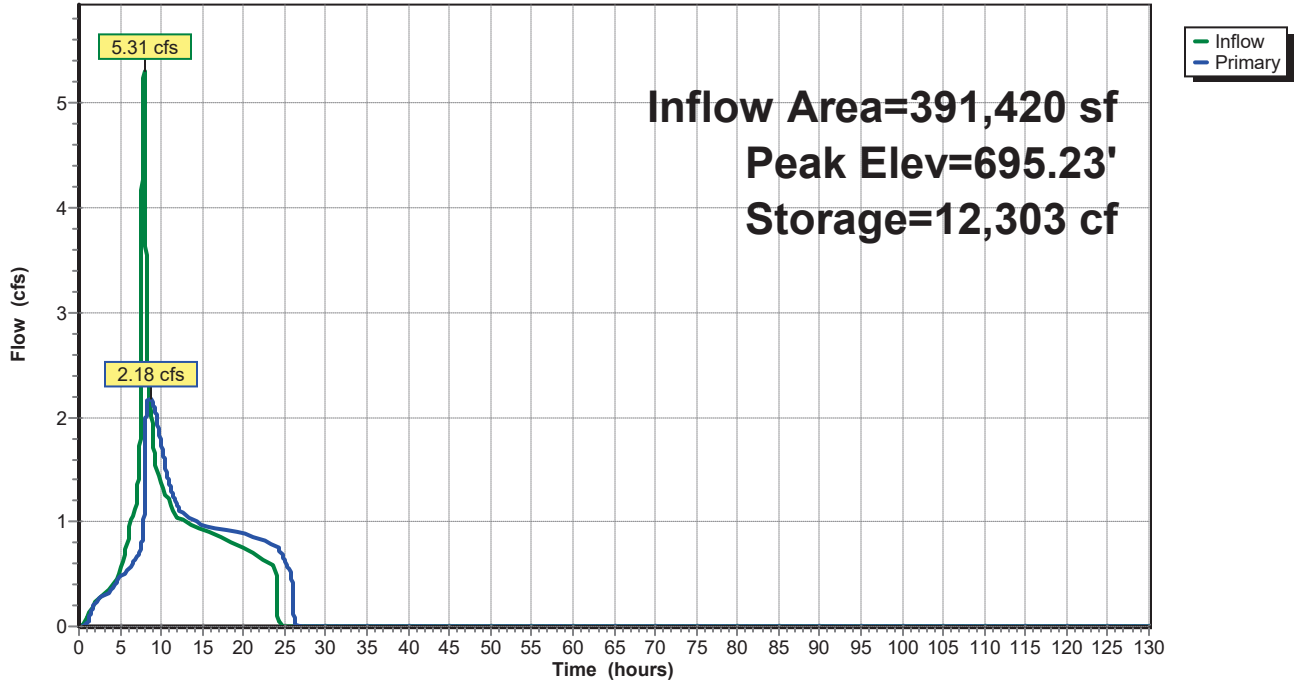
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Pond Pond D: Pond D

Hydrograph



Bull Run Filtration Detention Ponds

Type IA 24-hr 10-Year Rainfall=3.80"

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Summary for Pond Pond E: Pond E

Inflow Area = 580,537 sf, 6.24% Impervious, Inflow Depth = 1.98" for 10-Year event
 Inflow = 6.18 cfs @ 7.96 hrs, Volume= 95,927 cf
 Outflow = 2.71 cfs @ 8.48 hrs, Volume= 95,915 cf, Atten= 56%, Lag= 31.0 min
 Primary = 2.71 cfs @ 8.48 hrs, Volume= 95,915 cf

Routing by Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs / 3
 Peak Elev= 714.50' @ 8.48 hrs Surf.Area= 10,410 sf Storage= 13,759 cf

Plug-Flow detention time= 105.0 min calculated for 95,915 cf (100% of inflow)
 Center-of-Mass det. time= 104.9 min (891.5 - 786.6)

Volume	Invert	Avail.Storage	Storage Description
#1	713.00'	31,308 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
713.00	7,916	0	0
714.00	9,540	8,728	8,728
715.00	11,265	10,403	19,131
716.00	13,090	12,178	31,308

Device	Routing	Invert	Outlet Devices
#1	Primary	713.00'	15.0" Round Culvert L= 44.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 713.00' / 712.80' S= 0.0045 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Device 1	711.00'	7.0" Horiz. Orifice/Grate C= 0.620 Limited to weir flow at low heads
#3	Device 1	713.95'	16.0" W x 3.0" H Vert. Orifice/Grate C= 0.620

Primary OutFlow Max=2.71 cfs @ 8.48 hrs HW=714.50' (Free Discharge)

- 1=Culvert (Passes 2.71 cfs of 4.67 cfs potential flow)
- 2=Orifice/Grate (Orifice Controls 1.63 cfs @ 6.10 fps)
- 3=Orifice/Grate (Orifice Controls 1.08 cfs @ 3.25 fps)

Bull Run Filtration Detention Ponds

Type IA 24-hr 10-Year Rainfall=3.80"

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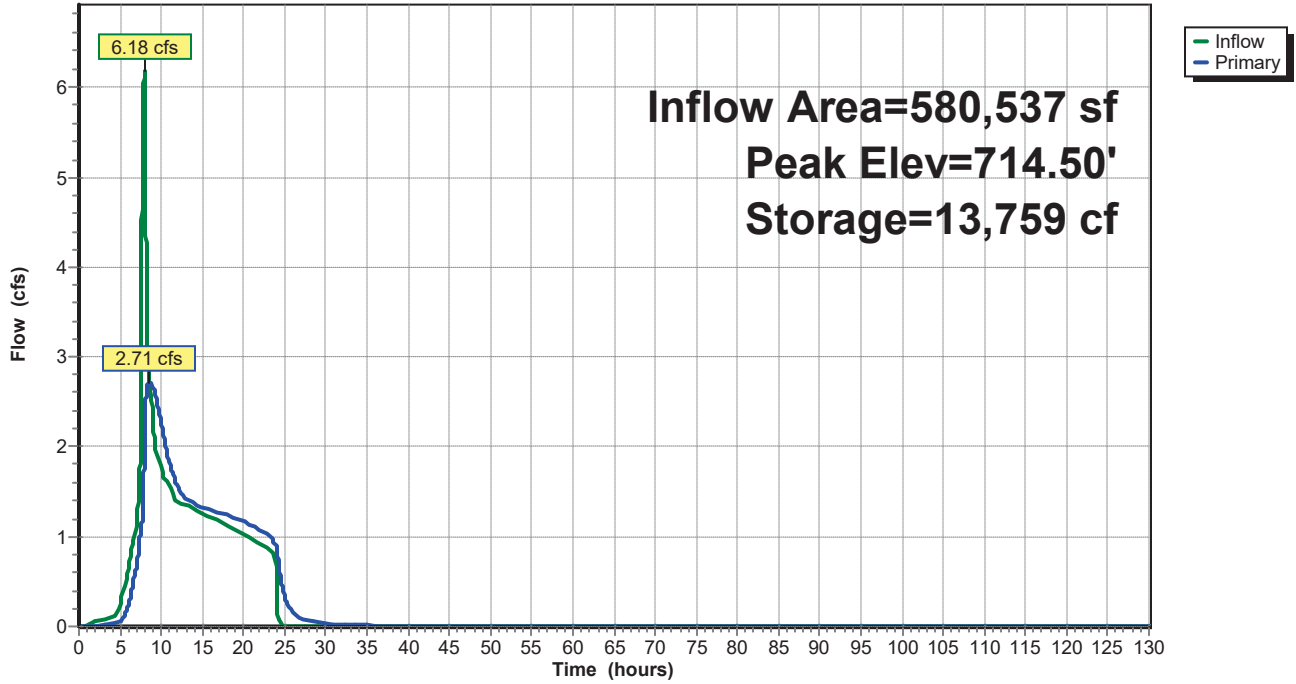
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Pond Pond E: Pond E

Hydrograph



Bull Run Filtration Detention Ponds

Type IA 24-hr 25-Year Rainfall=4.50"

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Summary for Subcatchment A: Post Basin A

Runoff = 6.62 cfs @ 7.91 hrs, Volume= 98,144 cf, Depth= 3.37"

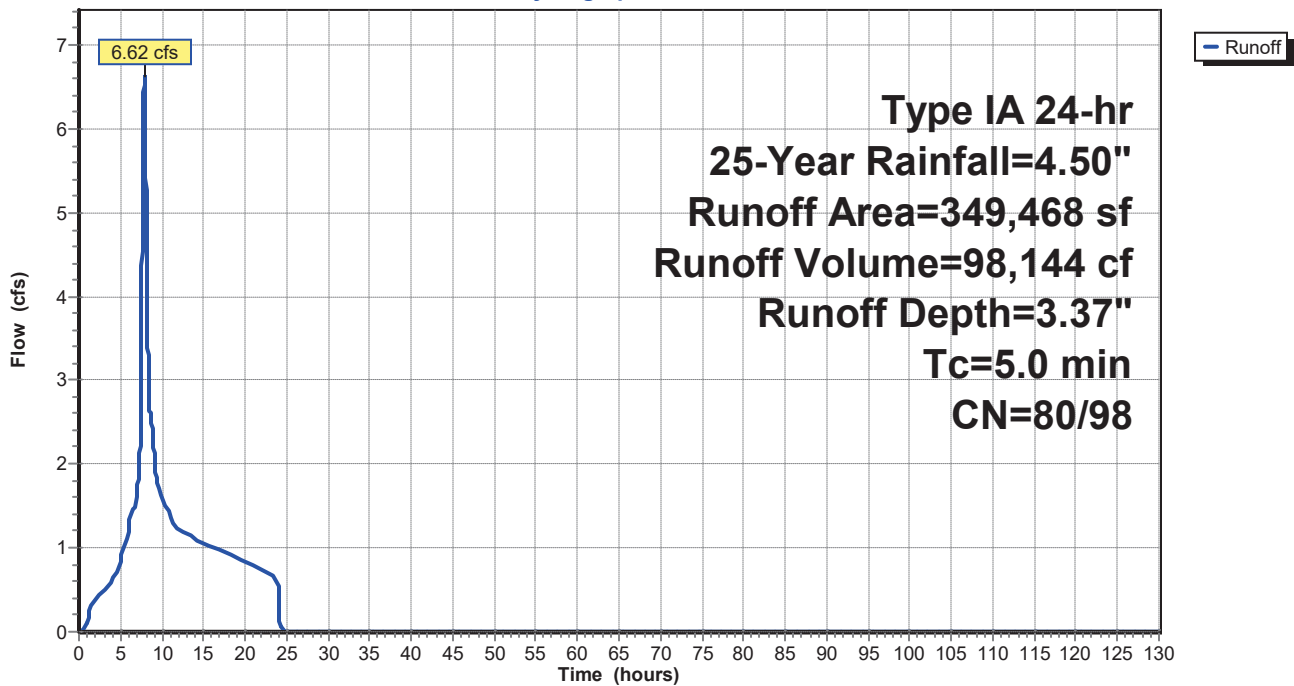
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=4.50"

	Area (sf)	CN	Description
*	176,142	98	Impervious Area
	173,326	80	>75% Grass cover, Good, HSG D
	349,468	89	Weighted Average
	173,326	80	49.60% Pervious Area
	176,142	98	50.40% Impervious Area

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

Subcatchment A: Post Basin A

Hydrograph



Bull Run Filtration Detention Ponds

Type IA 24-hr 25-Year Rainfall=4.50"

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Summary for Subcatchment B: Post Basin B

Runoff = 5.70 cfs @ 7.90 hrs, Volume= 84,393 cf, Depth= 3.44"

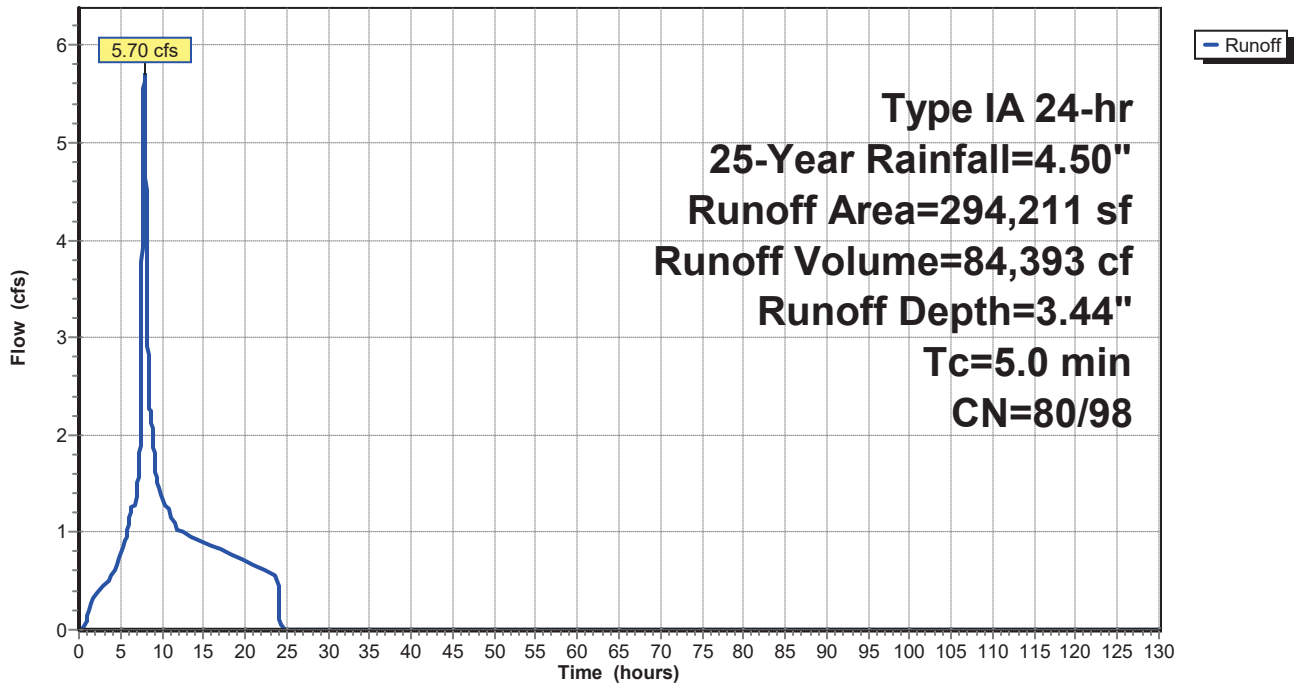
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=4.50"

	Area (sf)	CN	Description
*	160,056	98	Impervious Area
	134,155	80	>75% Grass cover, Good, HSG D
	294,211	90	Weighted Average
	134,155	80	45.60% Pervious Area
	160,056	98	54.40% Impervious Area

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

Subcatchment B: Post Basin B

Hydrograph



Bull Run Filtration Detention Ponds

Type IA 24-hr 25-Year Rainfall=4.50"

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Summary for Subcatchment C: Post Basin C

Runoff = 11.12 cfs @ 7.94 hrs, Volume= 167,060 cf, Depth= 2.66"

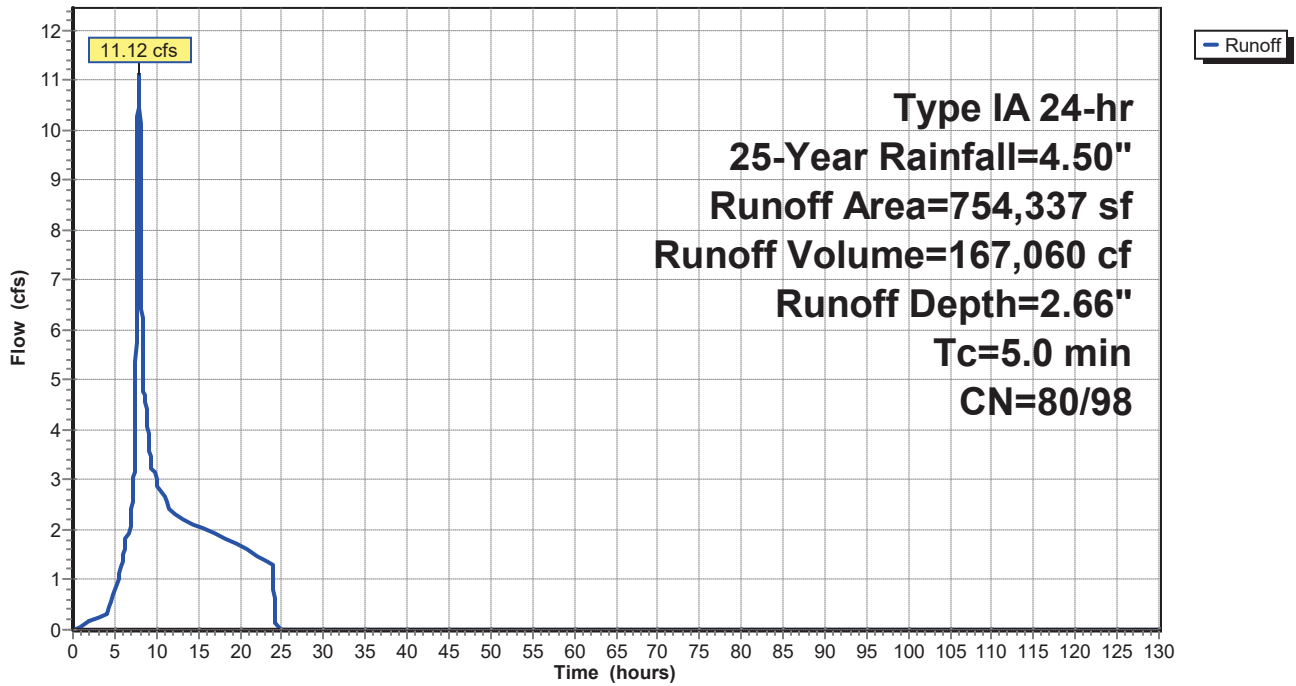
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=4.50"

	Area (sf)	CN	Description
*	82,047	98	Impervious Area
	672,290	80	>75% Grass cover, Good, HSG D
	754,337	82	Weighted Average
	672,290	80	89.12% Pervious Area
	82,047	98	10.88% Impervious Area

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

Subcatchment C: Post Basin C

Hydrograph



Bull Run Filtration Detention Ponds

Type IA 24-hr 25-Year Rainfall=4.50"

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Summary for Subcatchment D: Post Basin D

Runoff = 6.75 cfs @ 7.92 hrs, Volume= 100,623 cf, Depth= 3.08"

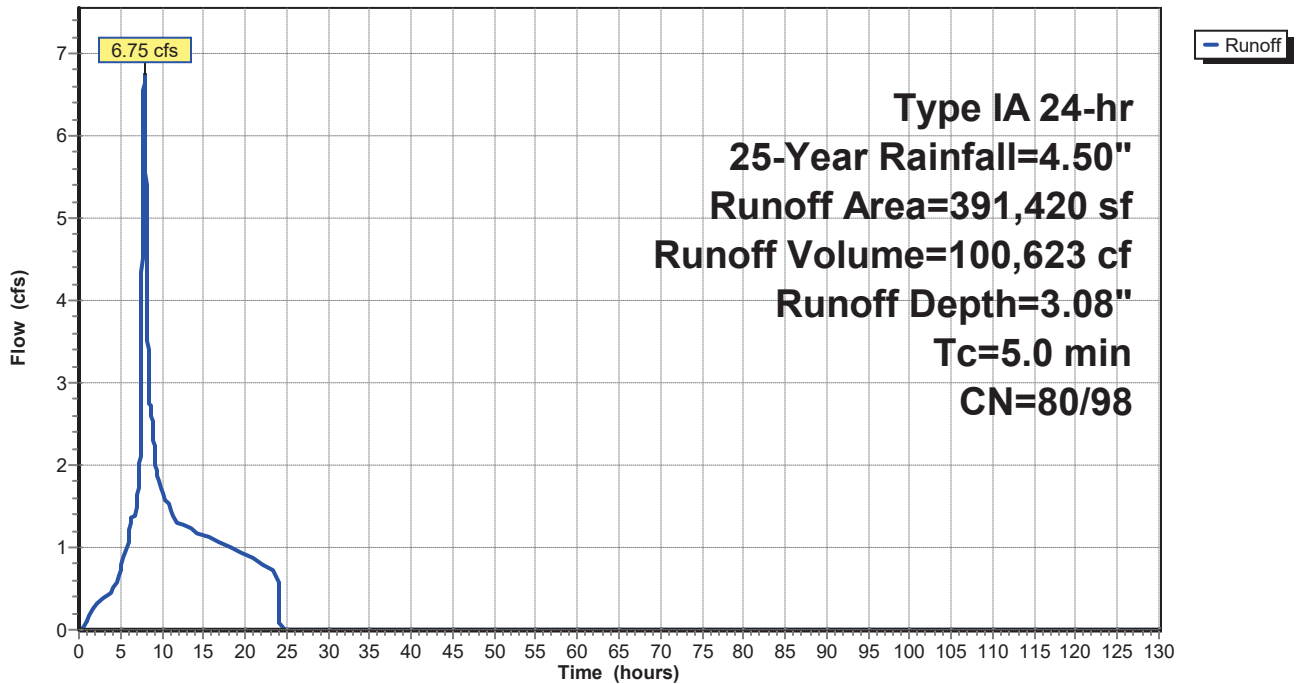
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=4.50"

	Area (sf)	CN	Description
*	135,356	98	Impervious Area
	256,064	80	>75% Grass cover, Good, HSG D
	391,420	86	Weighted Average
	256,064	80	65.42% Pervious Area
	135,356	98	34.58% Impervious Area

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

Subcatchment D: Post Basin D

Hydrograph



Bull Run Filtration Detention Ponds

Type IA 24-hr 25-Year Rainfall=4.50"

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Summary for Subcatchment E: Post Basin E

Runoff = 8.27 cfs @ 7.95 hrs, Volume= 124,523 cf, Depth= 2.57"

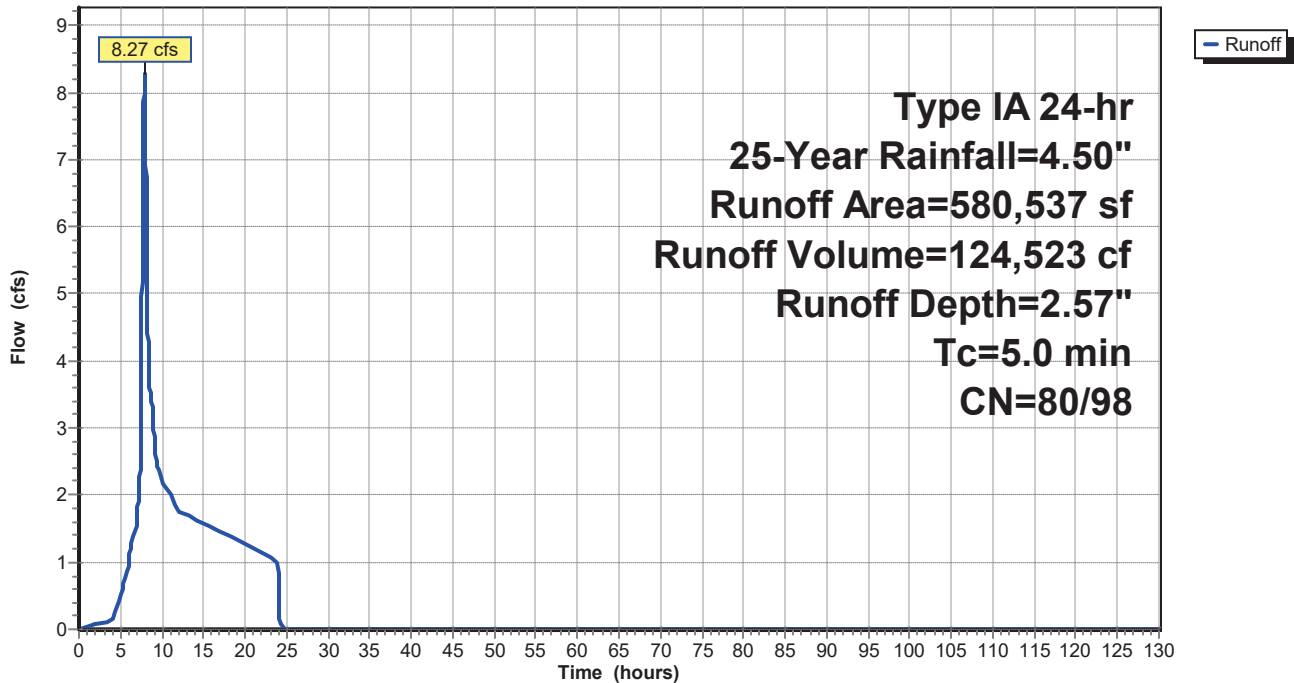
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=4.50"

	Area (sf)	CN	Description
*	19,160	98	Impervious Area
	544,328	80	>75% Grass cover, Good, HSG D
*	17,049	98	
<hr/>			
	580,537	81	Weighted Average
	544,328	80	93.76% Pervious Area
	36,209	98	6.24% Impervious Area

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

Subcatchment E: Post Basin E

Hydrograph



Bull Run Filtration Detention Ponds

Type IA 24-hr 25-Year Rainfall=4.50"

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Summary for Subcatchment Pre A: Pre Dev Basin A

Runoff = 3.12 cfs @ 8.11 hrs, Volume= 76,769 cf, Depth= 2.64"

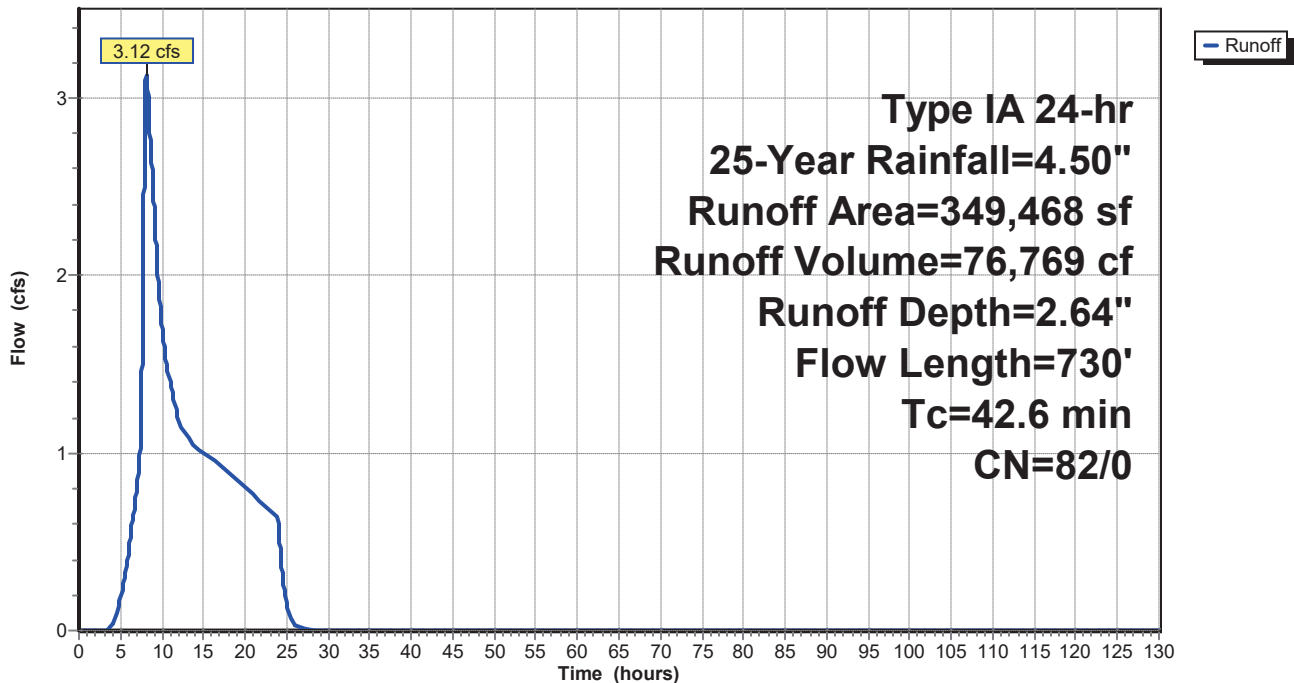
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=4.50"

Area (sf)	CN	Description
349,468	82	Row crops, SR + CR, Good, HSG C
349,468	82	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
36.8	300	0.0100	0.14		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 2.80"
5.8	430	0.0190	1.24		Shallow Concentrated Flow, Cultivated Straight Rows Kv= 9.0 fps
42.6	730	Total			

Subcatchment Pre A: Pre Dev Basin A

Hydrograph



Bull Run Filtration Detention Ponds

Type IA 24-hr 25-Year Rainfall=4.50"

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Summary for Subcatchment Pre B: Pre Dev Basin B

Runoff = 3.43 cfs @ 8.01 hrs, Volume= 64,630 cf, Depth= 2.64"

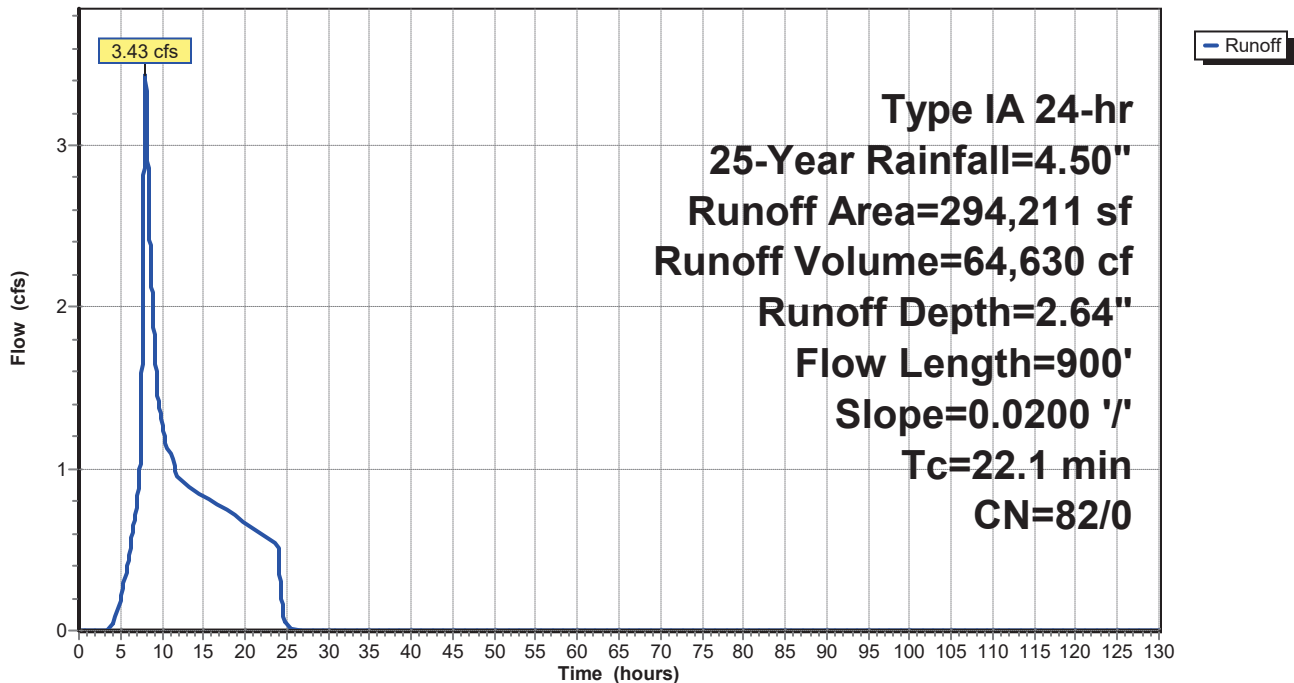
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=4.50"

Area (sf)	CN	Description
294,211	82	Row crops, SR + CR, Good, HSG C
294,211	82	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.6	100	0.0200	0.14		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 2.80"
10.5	800	0.0200	1.27		Shallow Concentrated Flow, Cultivated Straight Rows Kv= 9.0 fps
22.1	900	Total			

Subcatchment Pre B: Pre Dev Basin B

Hydrograph



Bull Run Filtration Detention Ponds

Type IA 24-hr 25-Year Rainfall=4.50"

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Summary for Subcatchment Pre C: Pre Dev Basin C

Runoff = 9.88 cfs @ 8.00 hrs, Volume= 165,707 cf, Depth= 2.64"

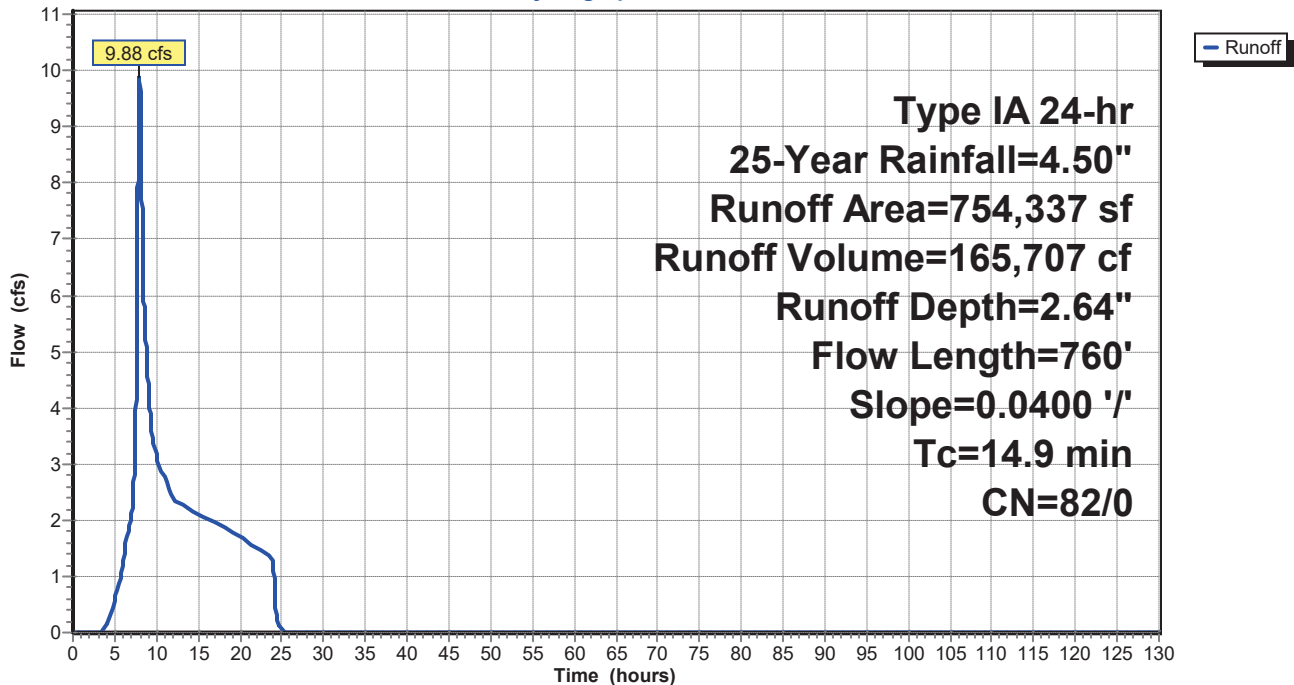
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=4.50"

Area (sf)	CN	Description
754,337	82	Row crops, SR + CR, Good, HSG C
754,337	82	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.8	100	0.0400	0.19		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 2.80"
6.1	660	0.0400	1.80		Shallow Concentrated Flow, Cultivated Straight Rows Kv= 9.0 fps
14.9	760	Total			

Subcatchment Pre C: Pre Dev Basin C

Hydrograph



Bull Run Filtration Detention Ponds

Type IA 24-hr 25-Year Rainfall=4.50"

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Summary for Subcatchment Pre D: Pre Dev Basin D

Runoff = 4.70 cfs @ 8.01 hrs, Volume= 85,984 cf, Depth= 2.64"

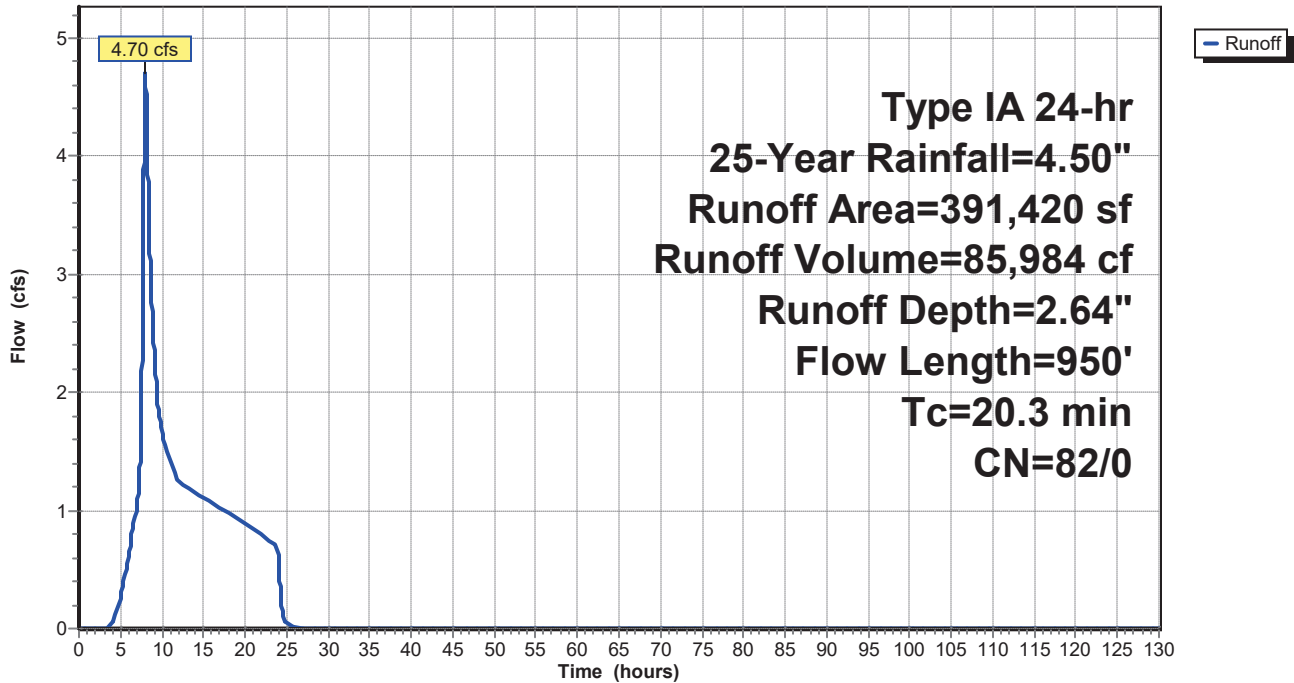
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=4.50"

Area (sf)	CN	Description
391,420	82	Row crops, SR + CR, Good, HSG C
391,420	82	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.6	100	0.0200	0.14		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 2.80"
8.7	850	0.0330	1.63		Shallow Concentrated Flow, Cultivated Straight Rows Kv= 9.0 fps
20.3	950	Total			

Subcatchment Pre D: Pre Dev Basin D

Hydrograph



Bull Run Filtration Detention Ponds

Type IA 24-hr 25-Year Rainfall=4.50"

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Summary for Subcatchment Pre E: Pre Dev Basin E

Runoff = 6.60 cfs @ 8.01 hrs, Volume= 127,528 cf, Depth= 2.64"

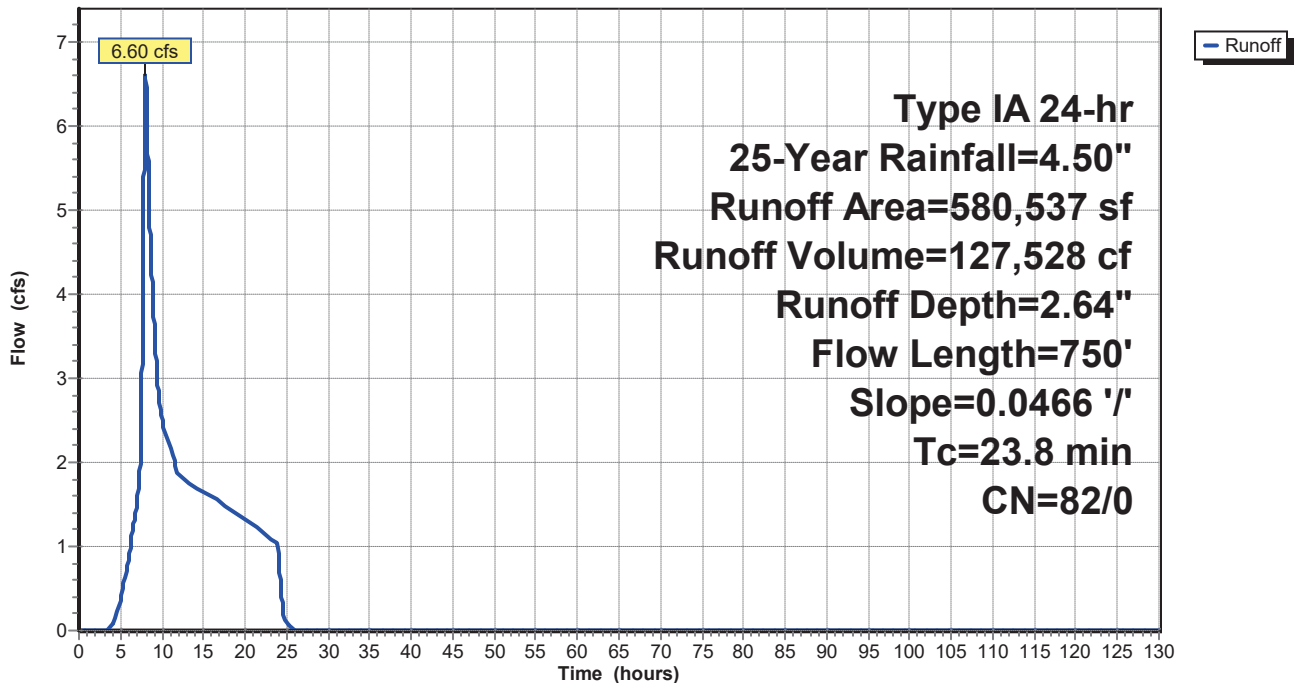
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=4.50"

Area (sf)	CN	Description
580,537	82	Row crops, SR + CR, Good, HSG C
580,537	82	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.9	300	0.0466	0.25		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 2.80"
3.9	450	0.0466	1.94		Shallow Concentrated Flow, Cultivated Straight Rows Kv= 9.0 fps
23.8	750	Total			

Subcatchment Pre E: Pre Dev Basin E

Hydrograph



Bull Run Filtration Detention Ponds

Type IA 24-hr 25-Year Rainfall=4.50"

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Summary for Pond Pond A: Pond A

Inflow Area = 349,468 sf, 50.40% Impervious, Inflow Depth = 3.37" for 25-Year event
 Inflow = 6.62 cfs @ 7.91 hrs, Volume= 98,144 cf
 Outflow = 2.11 cfs @ 9.05 hrs, Volume= 98,144 cf, Atten= 68%, Lag= 68.5 min
 Primary = 2.11 cfs @ 9.05 hrs, Volume= 98,144 cf

Routing by Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs / 3
 Peak Elev= 710.32' @ 9.05 hrs Surf.Area= 9,193 sf Storage= 21,617 cf

Plug-Flow detention time= 200.9 min calculated for 98,144 cf (100% of inflow)
 Center-of-Mass det. time= 200.9 min (904.6 - 703.7)

Volume	Invert	Avail.Storage	Storage Description
#1	707.50'	70,555 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
707.50	6,107	0	0
708.00	6,714	3,205	3,205
709.00	7,742	7,228	10,433
710.00	8,825	8,284	18,717
711.00	9,967	9,396	28,113
712.00	11,161	10,564	38,677
713.00	12,412	11,787	50,463
714.00	13,717	13,065	63,528
714.50	14,392	7,027	70,555

Device	Routing	Invert	Outlet Devices
#1	Primary	698.43'	18.0" Round Culvert L= 138.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 698.43' / 696.24' S= 0.0159 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf
#2	Device 1	696.43'	2.6" Horiz. Orifice/Grate C= 0.620 Limited to weir flow at low heads
#3	Device 1	709.40'	16.0" W x 3.0" H Vert. Orifice/Grate C= 0.620

Primary OutFlow Max=2.11 cfs @ 9.05 hrs HW=710.32' (Free Discharge)

- 1=Culvert (Passes 2.11 cfs of 25.08 cfs potential flow)
- 2=Orifice/Grate (Orifice Controls 0.63 cfs @ 17.16 fps)
- 3=Orifice/Grate (Orifice Controls 1.48 cfs @ 4.44 fps)

Bull Run Filtration Detention Ponds

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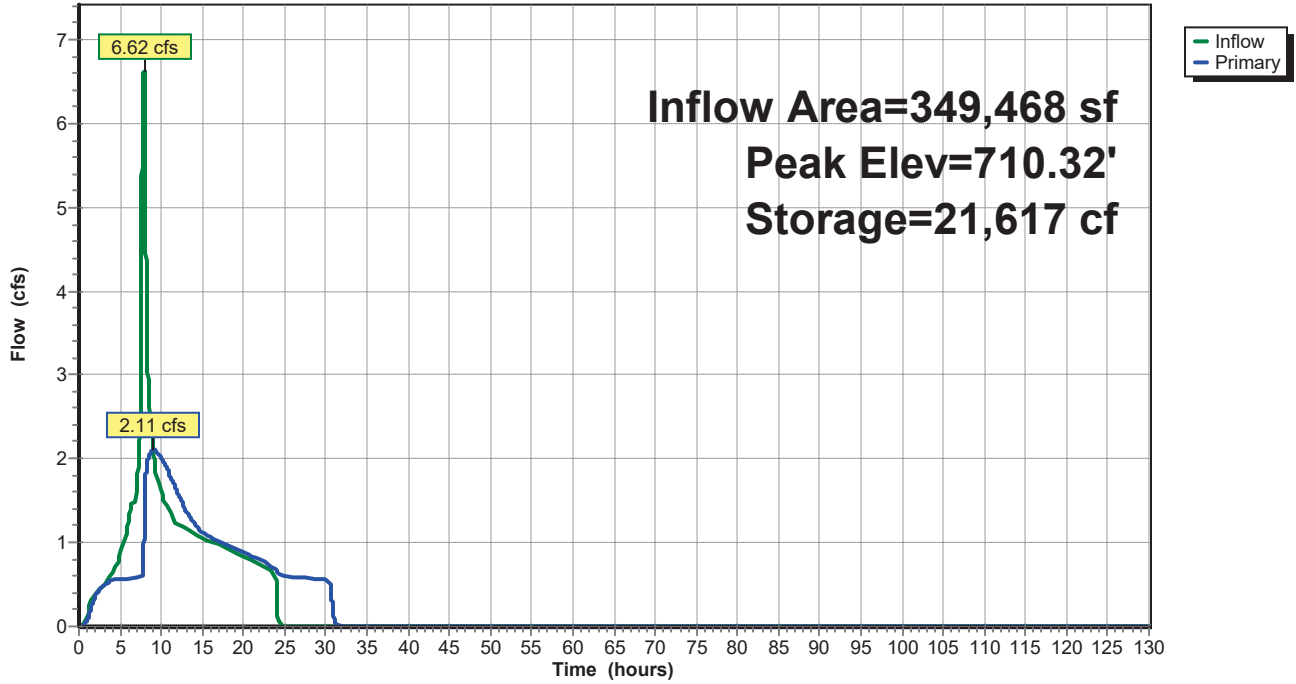
Type IA 24-hr 25-Year Rainfall=4.50"

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Pond Pond A: Pond A

Hydrograph



Bull Run Filtration Detention Ponds

Type IA 24-hr 25-Year Rainfall=4.50"

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Summary for Pond Pond B: Pond B

Inflow Area = 294,211 sf, 54.40% Impervious, Inflow Depth = 3.44" for 25-Year event
 Inflow = 5.70 cfs @ 7.90 hrs, Volume= 84,393 cf
 Outflow = 2.22 cfs @ 8.68 hrs, Volume= 84,393 cf, Atten= 61%, Lag= 46.5 min
 Primary = 2.22 cfs @ 8.68 hrs, Volume= 84,393 cf

Routing by Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs / 3
 Peak Elev= 710.29' @ 8.68 hrs Surf.Area= 6,322 sf Storage= 15,967 cf

Plug-Flow detention time= 146.4 min calculated for 84,393 cf (100% of inflow)
 Center-of-Mass det. time= 146.4 min (845.4 - 699.0)

Volume	Invert	Avail.Storage	Storage Description
#1	707.00'	36,813 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
707.00	3,493	0	0
708.00	4,288	3,891	3,891
709.00	5,139	4,714	8,604
710.00	6,046	5,593	14,197
711.00	7,010	6,528	20,725
712.00	8,030	7,520	28,245
713.00	9,107	8,569	36,813

Device	Routing	Invert	Outlet Devices
#1	Primary	705.04'	18.0" Round Culvert L= 339.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 705.04' / 701.65' S= 0.0100 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf
#2	Device 1	703.04'	3.5" Horiz. Orifice/Grate C= 0.620 Limited to weir flow at low heads
#3	Device 1	709.15'	14.0" W x 3.0" H Vert. Orifice/Grate C= 0.620

Primary OutFlow Max=2.22 cfs @ 8.68 hrs HW=710.29' (Free Discharge)

- ↑ **1=Culvert** (Passes 2.22 cfs of 13.65 cfs potential flow)
- ↑ **2=Orifice/Grate** (Orifice Controls 0.76 cfs @ 11.40 fps)
- ↑ **3=Orifice/Grate** (Orifice Controls 1.46 cfs @ 5.00 fps)

Bull Run Filtration Detention Ponds

Type IA 24-hr 25-Year Rainfall=4.50"

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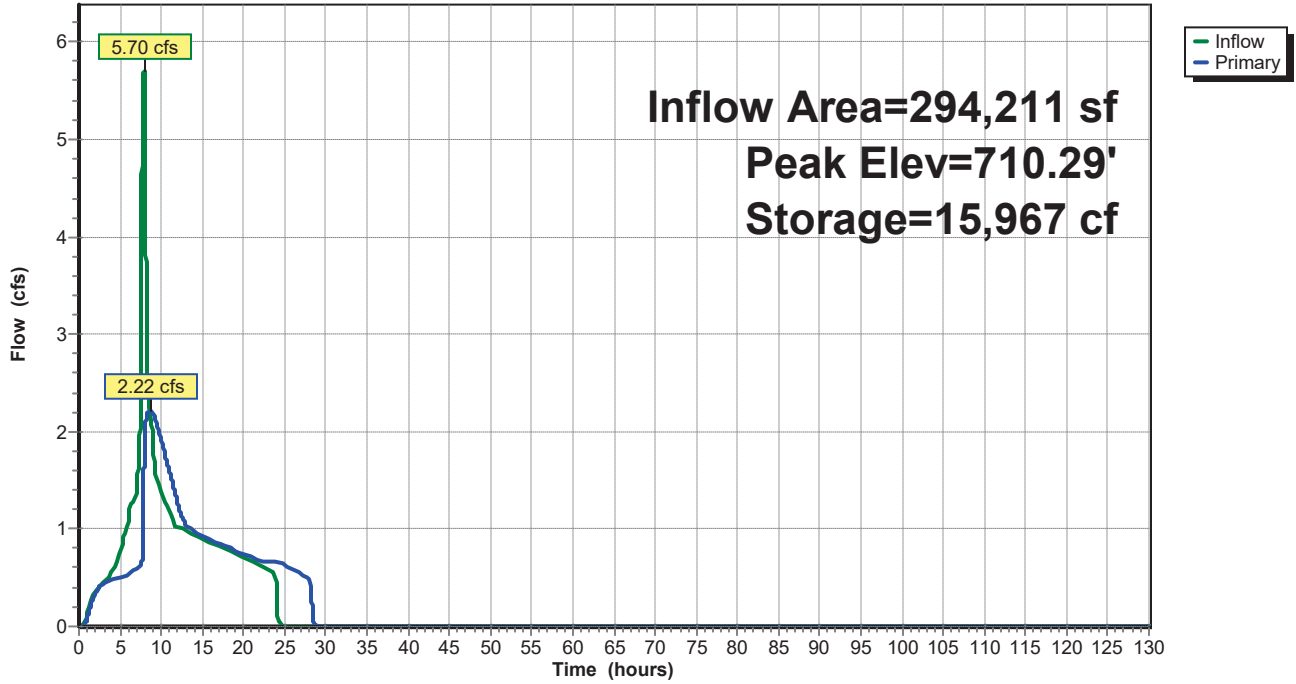
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Pond Pond B: Pond B

Hydrograph



Bull Run Filtration Detention Ponds

Type IA 24-hr 25-Year Rainfall=4.50"

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Summary for Pond Pond C: Pond C

Inflow Area = 754,337 sf, 10.88% Impervious, Inflow Depth > 8.61" for 25-Year event
 Inflow = 11.92 cfs @ 7.94 hrs, Volume= 541,489 cf, Incl. 0.80 cfs Base Flow
 Outflow = 3.50 cfs @ 10.90 hrs, Volume= 541,144 cf, Atten= 71%, Lag= 177.5 min
 Primary = 3.50 cfs @ 10.90 hrs, Volume= 541,144 cf

Routing by Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs / 3
 Peak Elev= 705.81' @ 10.90 hrs Surf.Area= 23,124 sf Storage= 37,299 cf

Plug-Flow detention time= 65.5 min calculated for 541,139 cf (100% of inflow)
 Center-of-Mass det. time= 62.3 min (2,994.7 - 2,932.3)

Volume	Invert	Avail.Storage	Storage Description
#1	704.00'	95,416 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
704.00	18,277	0	0
705.00	20,828	19,553	19,553
706.00	23,671	22,250	41,802
707.00	26,743	25,207	67,009
708.00	30,070	28,407	95,416

Device	Routing	Invert	Outlet Devices
#1	Primary	697.90'	12.0" Round Culvert L= 53.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 697.90' / 695.55' S= 0.0443 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	693.90'	5.1" Horiz. Orifice/Grate C= 0.620 Limited to weir flow at low heads
#3	Device 1	704.85'	16.0" W x 3.0" H Vert. Orifice/Grate C= 0.620

Primary OutFlow Max=3.50 cfs @ 10.90 hrs HW=705.81' (Free Discharge)

- ↑ **1=Culvert** (Passes 3.50 cfs of 10.29 cfs potential flow)
- ↑ **2=Orifice/Grate** (Orifice Controls 1.98 cfs @ 13.99 fps)
- ↑ **3=Orifice/Grate** (Orifice Controls 1.51 cfs @ 4.54 fps)

Bull Run Filtration Detention Ponds

Type IA 24-hr 25-Year Rainfall=4.50"

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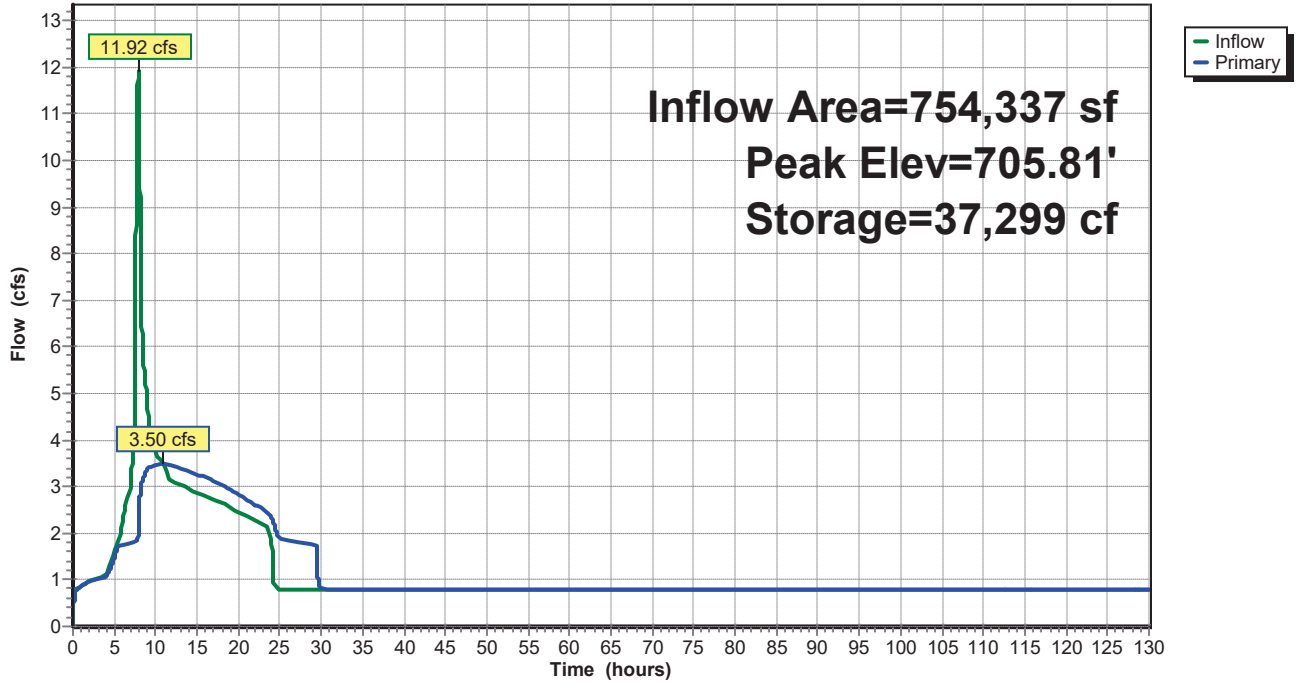
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Pond Pond C: Pond C

Hydrograph



Bull Run Filtration Detention Ponds

Type IA 24-hr 25-Year Rainfall=4.50"

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Summary for Pond Pond D: Pond D

Inflow Area = 391,420 sf, 34.58% Impervious, Inflow Depth = 3.08" for 25-Year event
 Inflow = 6.75 cfs @ 7.92 hrs, Volume= 100,623 cf
 Outflow = 2.80 cfs @ 8.47 hrs, Volume= 100,623 cf, Atten= 59%, Lag= 33.1 min
 Primary = 2.80 cfs @ 8.47 hrs, Volume= 100,623 cf

Routing by Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs / 3
 Peak Elev= 695.80' @ 8.47 hrs Surf.Area= 7,223 sf Storage= 16,277 cf

Plug-Flow detention time= 106.2 min calculated for 100,615 cf (100% of inflow)
 Center-of-Mass det. time= 106.2 min (830.6 - 724.3)

Volume	Invert	Avail.Storage	Storage Description
#1	693.00'	45,106 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
693.00	4,453	0	0
694.00	5,388	4,921	4,921
695.00	6,380	5,884	10,805
696.00	7,428	6,904	17,709
697.00	8,533	7,981	25,689
698.00	9,694	9,114	34,803
699.00	10,912	10,303	45,106

Device	Routing	Invert	Outlet Devices
#1	Primary	692.50'	12.0" Round Culvert L= 121.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 692.50' / 688.97' S= 0.0292 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	690.50'	4.9" Horiz. Orifice/Grate C= 0.620 Limited to weir flow at low heads
#3	Device 1	694.60'	15.0" W x 3.0" H Vert. Orifice/Grate C= 0.620

Primary OutFlow Max=2.80 cfs @ 8.47 hrs HW=695.80' (Free Discharge)

- ↑ **1=Culvert** (Passes 2.80 cfs of 6.33 cfs potential flow)
- ↑ **2=Orifice/Grate** (Orifice Controls 1.18 cfs @ 9.04 fps)
- ↑ **3=Orifice/Grate** (Orifice Controls 1.61 cfs @ 5.17 fps)

Bull Run Filtration Detention Ponds

Type IA 24-hr 25-Year Rainfall=4.50"

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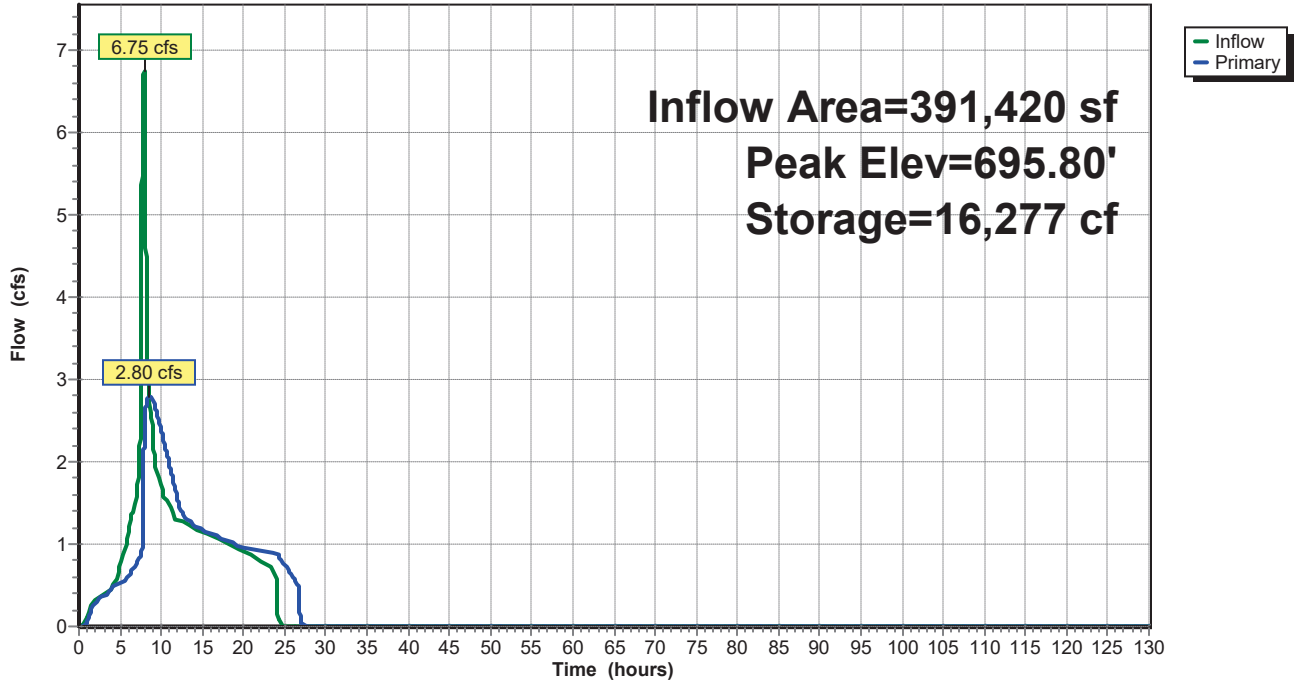
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Pond Pond D: Pond D

Hydrograph



Bull Run Filtration Detention Ponds

Type IA 24-hr 25-Year Rainfall=4.50"

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Summary for Pond Pond E: Pond E

Inflow Area = 580,537 sf, 6.24% Impervious, Inflow Depth = 2.57" for 25-Year event
 Inflow = 8.27 cfs @ 7.95 hrs, Volume= 124,523 cf
 Outflow = 3.45 cfs @ 8.72 hrs, Volume= 124,511 cf, Atten= 58%, Lag= 46.1 min
 Primary = 3.45 cfs @ 8.72 hrs, Volume= 124,511 cf

Routing by Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs / 3
 Peak Elev= 714.98' @ 8.72 hrs Surf.Area= 11,227 sf Storage= 18,886 cf

Plug-Flow detention time= 102.6 min calculated for 124,511 cf (100% of inflow)
 Center-of-Mass det. time= 102.5 min (875.2 - 772.7)

Volume	Invert	Avail.Storage	Storage Description
#1	713.00'	31,308 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
713.00	7,916	0	0
714.00	9,540	8,728	8,728
715.00	11,265	10,403	19,131
716.00	13,090	12,178	31,308

Device	Routing	Invert	Outlet Devices
#1	Primary	713.00'	15.0" Round Culvert L= 44.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 713.00' / 712.80' S= 0.0045 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Device 1	711.00'	7.0" Horiz. Orifice/Grate C= 0.620 Limited to weir flow at low heads
#3	Device 1	713.95'	16.0" W x 3.0" H Vert. Orifice/Grate C= 0.620

Primary OutFlow Max=3.45 cfs @ 8.72 hrs HW=714.98' (Free Discharge)

- ↑ **1=Culvert** (Passes 3.45 cfs of 5.97 cfs potential flow)
- ↑ **2=Orifice/Grate** (Orifice Controls 1.87 cfs @ 7.00 fps)
- ↑ **3=Orifice/Grate** (Orifice Controls 1.57 cfs @ 4.72 fps)

Bull Run Filtration Detention Ponds

Type IA 24-hr 25-Year Rainfall=4.50"

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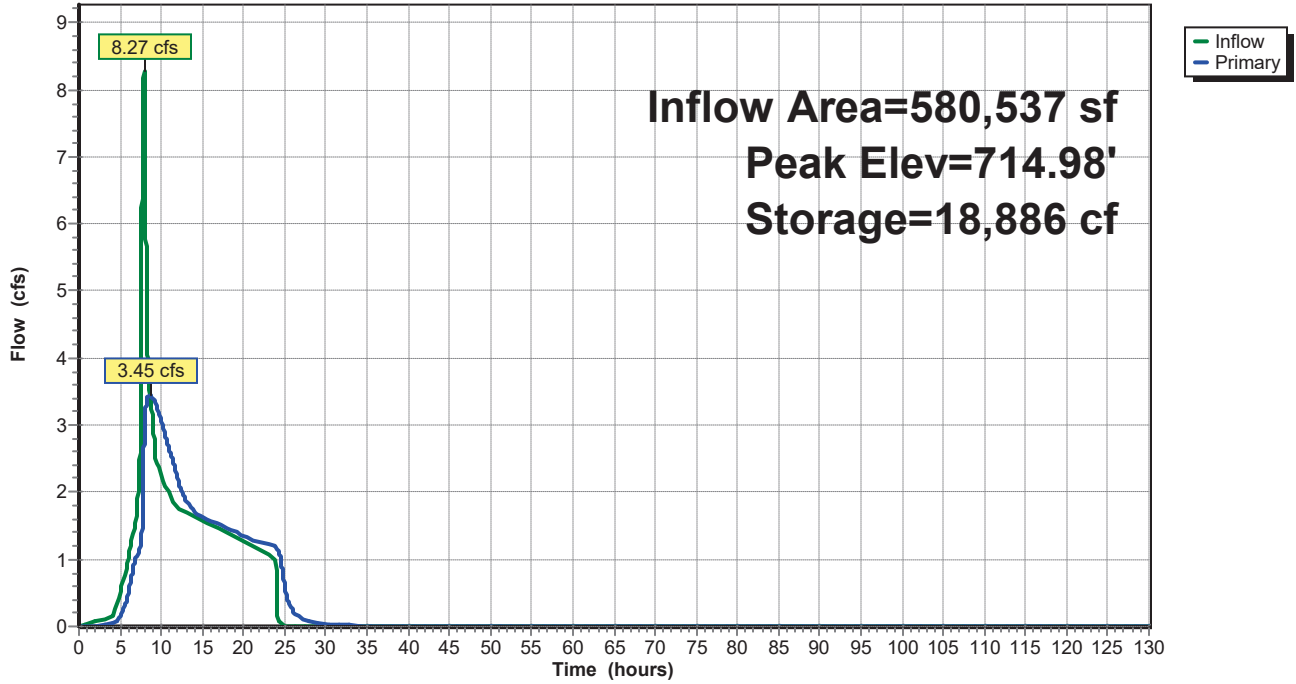
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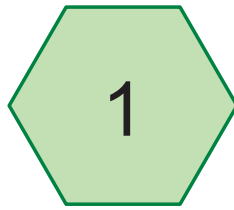
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Pond Pond E: Pond E

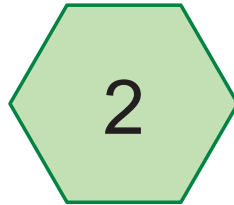
Hydrograph



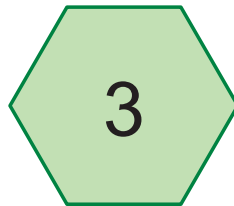
Attachment F: Hydrologic Analysis of Pre-Developed Points of Discharge Calculations



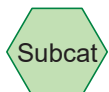
Exist Point of Discharge
#1



Exist Point of Discharge
#2



Exist Point of Discharge
#3



Bull Run Filtration Existing Points of Discharge

Type IA 24-hr 2-Year Rainfall=2.80"

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Summary for Subcatchment 1: Exist Point of Discharge #1

Runoff = 7.34 cfs @ 8.19 hrs, Volume= 209,531 cf, Depth= 1.22"

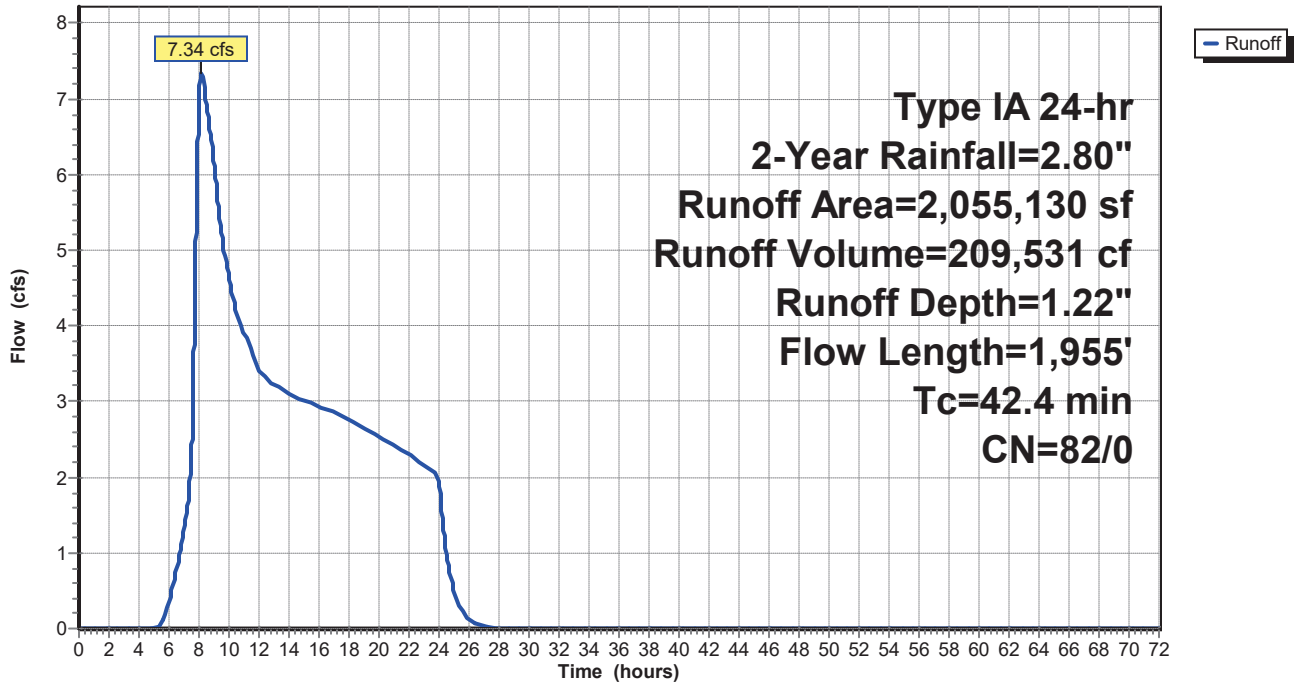
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-Year Rainfall=2.80"

Area (sf)	CN	Description
2,055,130	82	Row crops, SR + CR, Good, HSG C
2,055,130	82	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
23.7	300	0.0300	0.21		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 2.80"
18.7	1,655	0.0270	1.48		Shallow Concentrated Flow, Cultivated Straight Rows Kv= 9.0 fps
42.4	1,955	Total			

Subcatchment 1: Exist Point of Discharge #1

Hydrograph



Bull Run Filtration Existing Points of Discharge

Type IA 24-hr 2-Year Rainfall=2.80"

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Summary for Subcatchment 2: Exist Point of Discharge #2

Runoff = 4.60 cfs @ 8.01 hrs, Volume= 97,560 cf, Depth= 1.22"

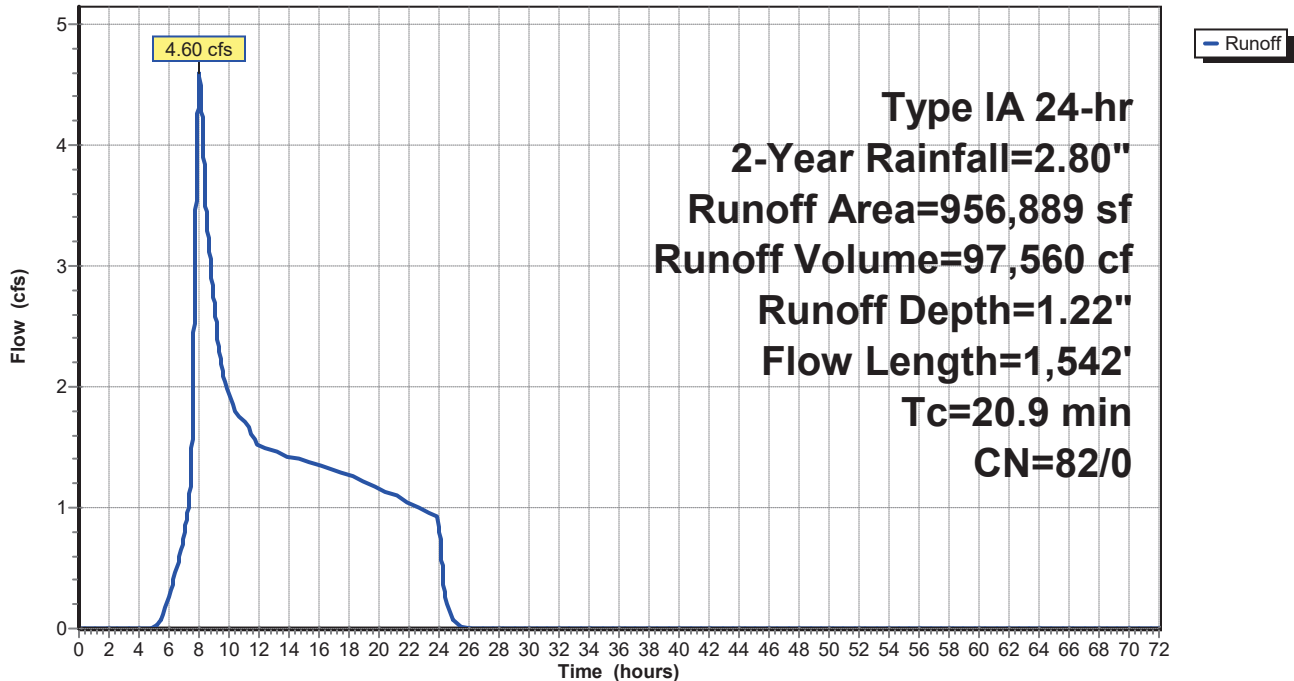
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-Year Rainfall=2.80"

Area (sf)	CN	Description
956,889	82	Row crops, SR + CR, Good, HSG C
956,889	82	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.9	300	0.1670	0.42		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 2.80"
9.0	1,242	0.0660	2.31		Shallow Concentrated Flow, Cultivated Straight Rows Kv= 9.0 fps
20.9	1,542	Total			

Subcatchment 2: Exist Point of Discharge #2

Hydrograph



Bull Run Filtration Existing Points of Discharge

Type IA 24-hr 2-Year Rainfall=2.80"

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Summary for Subcatchment 3: Exist Point of Discharge #3

Runoff = 2.74 cfs @ 8.01 hrs, Volume= 61,192 cf, Depth= 1.22"

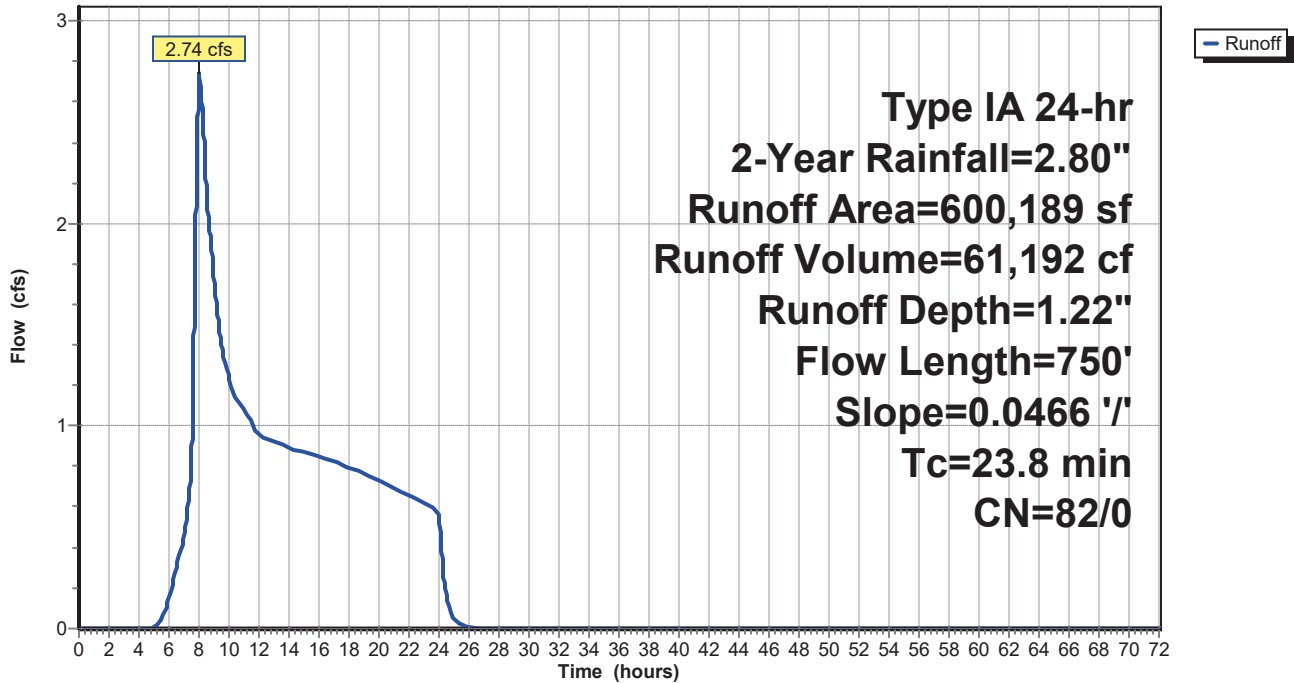
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-Year Rainfall=2.80"

Area (sf)	CN	Description
600,189	82	Row crops, SR + CR, Good, HSG C
600,189	82	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.9	300	0.0466	0.25		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 2.80"
3.9	450	0.0466	1.94		Shallow Concentrated Flow, Cultivated Straight Rows Kv= 9.0 fps
23.8	750	Total			

Subcatchment 3: Exist Point of Discharge #3

Hydrograph



Bull Run Filtration Existing Points of Discharge

Type IA 24-hr 5-Year Rainfall=3.40"

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Summary for Subcatchment 1: Exist Point of Discharge #1

Runoff = 11.01 cfs @ 8.15 hrs, Volume= 291,210 cf, Depth= 1.70"

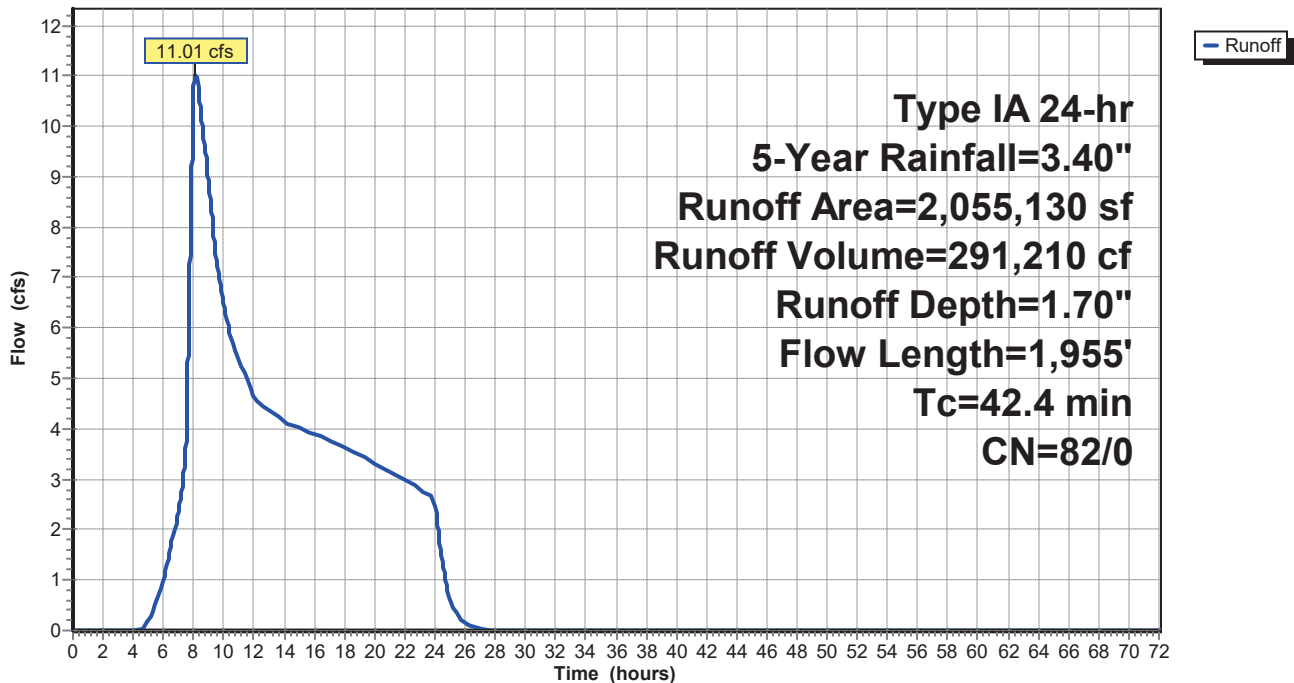
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 5-Year Rainfall=3.40"

Area (sf)	CN	Description
2,055,130	82	Row crops, SR + CR, Good, HSG C
2,055,130	82	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
23.7	300	0.0300	0.21		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 2.80"
18.7	1,655	0.0270	1.48		Shallow Concentrated Flow, Cultivated Straight Rows Kv= 9.0 fps
42.4	1,955	Total			

Subcatchment 1: Exist Point of Discharge #1

Hydrograph



Bull Run Filtration Existing Points of Discharge

Type IA 24-hr 5-Year Rainfall=3.40"

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Summary for Subcatchment 2: Exist Point of Discharge #2

Runoff = 6.86 cfs @ 8.01 hrs, Volume= 135,590 cf, Depth= 1.70"

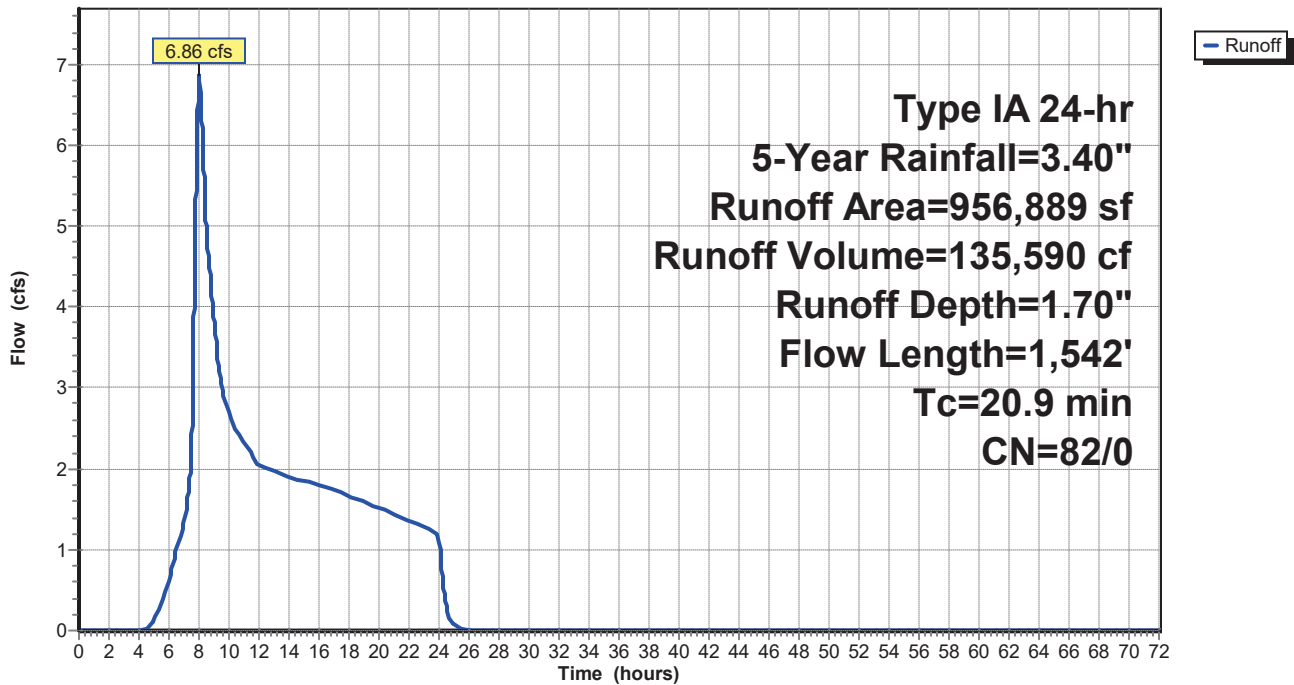
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 5-Year Rainfall=3.40"

Area (sf)	CN	Description
956,889	82	Row crops, SR + CR, Good, HSG C
956,889	82	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.9	300	0.1670	0.42		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 2.80"
9.0	1,242	0.0660	2.31		Shallow Concentrated Flow, Cultivated Straight Rows Kv= 9.0 fps
20.9	1,542	Total			

Subcatchment 2: Exist Point of Discharge #2

Hydrograph



Bull Run Filtration Existing Points of Discharge

Type IA 24-hr 5-Year Rainfall=3.40"

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Summary for Subcatchment 3: Exist Point of Discharge #3

Runoff = 4.10 cfs @ 8.01 hrs, Volume= 85,046 cf, Depth= 1.70"

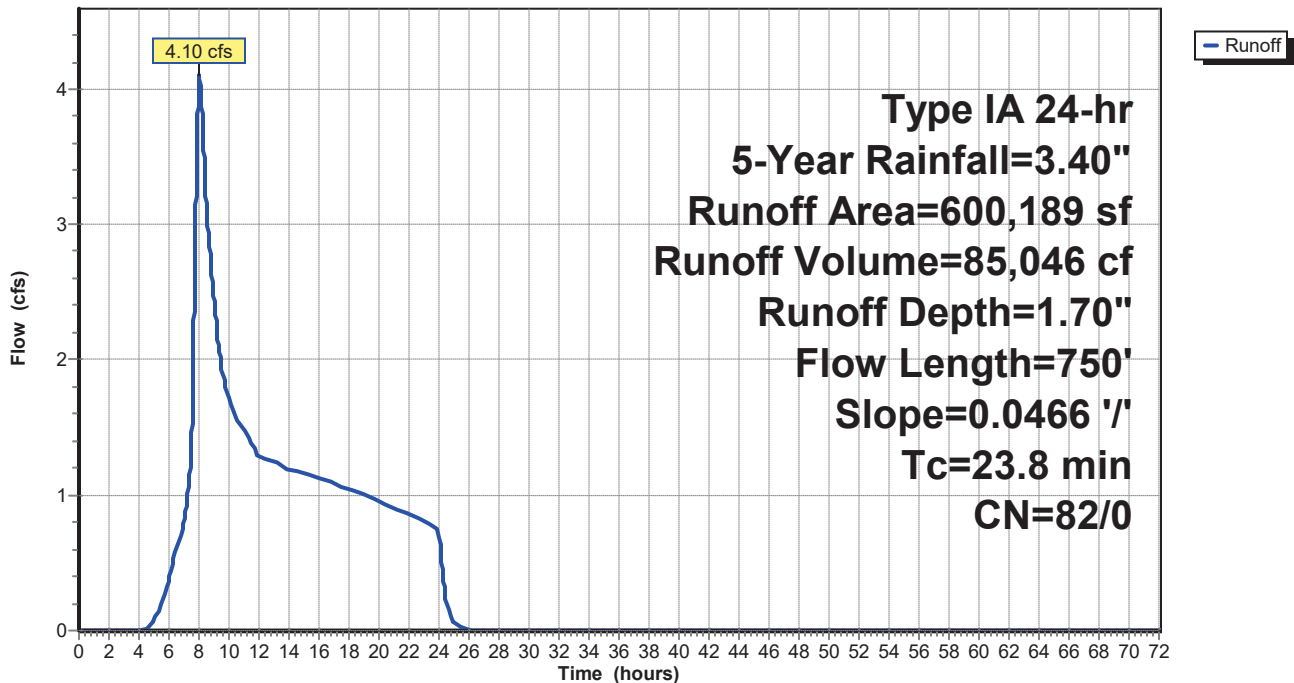
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 5-Year Rainfall=3.40"

Area (sf)	CN	Description
600,189	82	Row crops, SR + CR, Good, HSG C
600,189	82	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.9	300	0.0466	0.25		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 2.80"
3.9	450	0.0466	1.94		Shallow Concentrated Flow, Cultivated Straight Rows Kv= 9.0 fps
23.8	750	Total			

Subcatchment 3: Exist Point of Discharge #3

Hydrograph



Bull Run Filtration Existing Points of Discharge

Type IA 24-hr 10-Year Rainfall=3.80"

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Summary for Subcatchment 1: Exist Point of Discharge #1

Runoff = 13.62 cfs @ 8.13 hrs, Volume= 348,192 cf, Depth= 2.03"

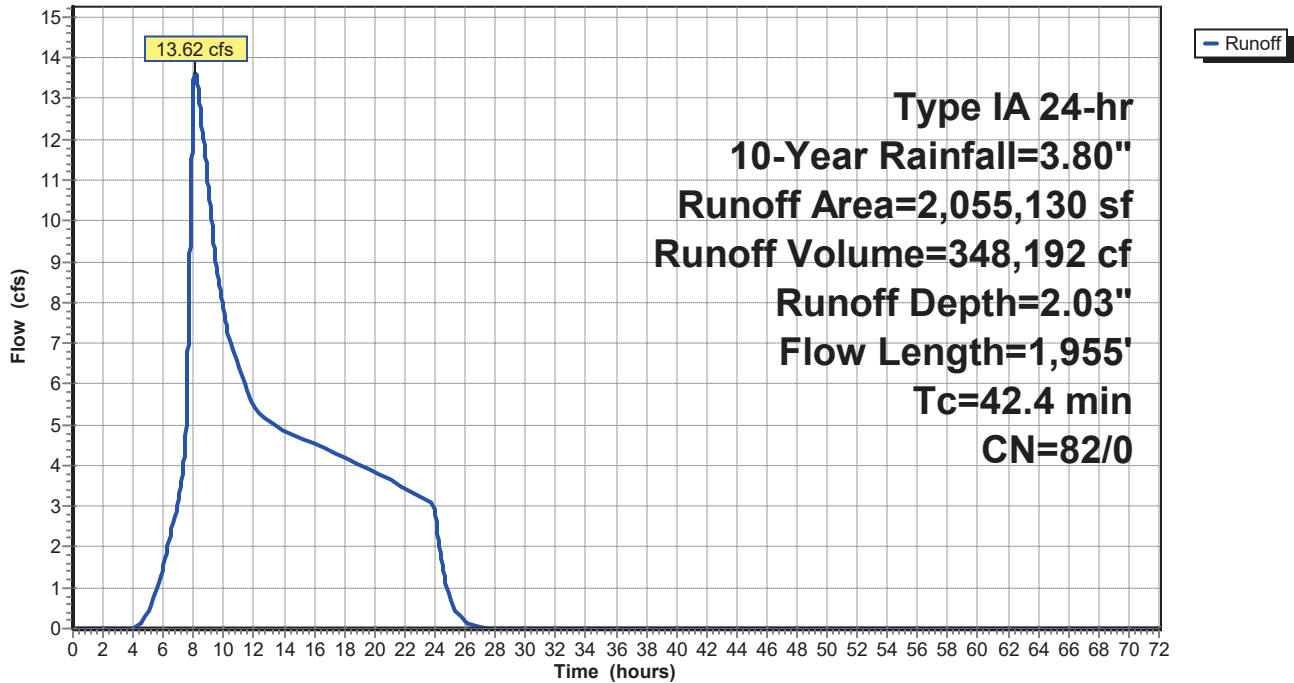
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Year Rainfall=3.80"

Area (sf)	CN	Description
2,055,130	82	Row crops, SR + CR, Good, HSG C
2,055,130	82	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
23.7	300	0.0300	0.21		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 2.80"
18.7	1,655	0.0270	1.48		Shallow Concentrated Flow, Cultivated Straight Rows Kv= 9.0 fps
42.4	1,955	Total			

Subcatchment 1: Exist Point of Discharge #1

Hydrograph



Bull Run Filtration Existing Points of Discharge

Type IA 24-hr 10-Year Rainfall=3.80"

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Summary for Subcatchment 2: Exist Point of Discharge #2

Runoff = 8.46 cfs @ 8.01 hrs, Volume= 162,122 cf, Depth= 2.03"

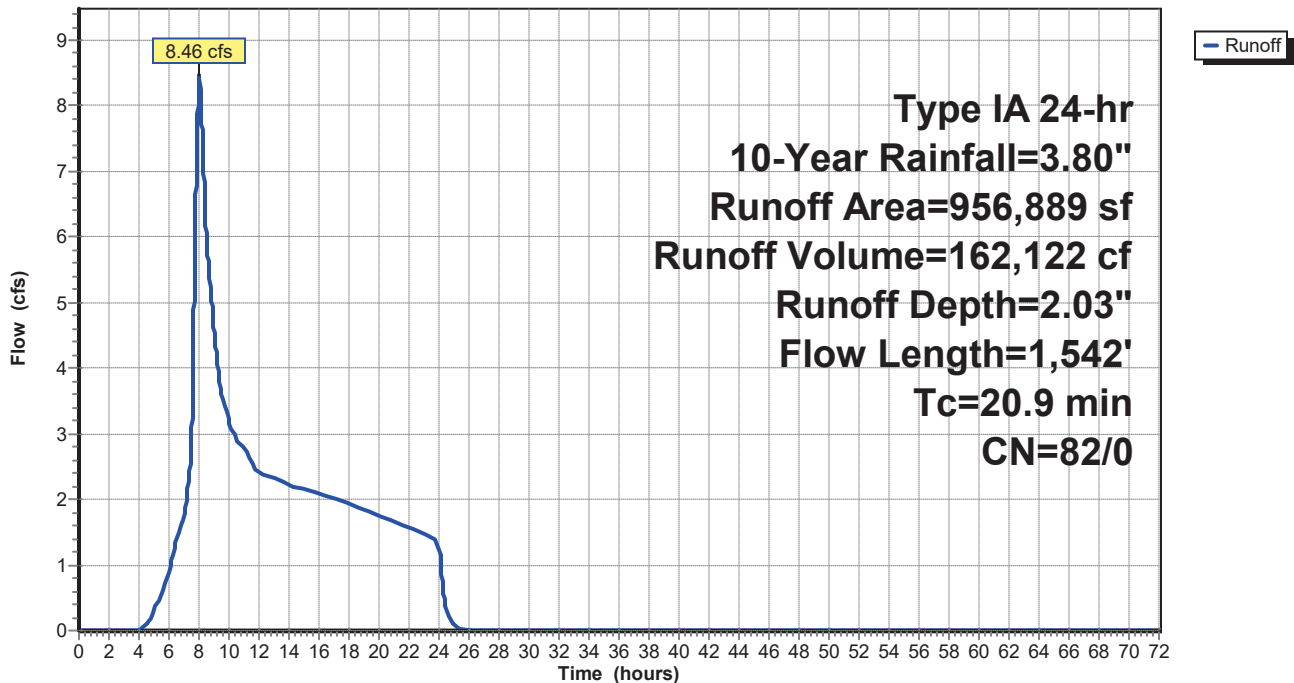
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Year Rainfall=3.80"

Area (sf)	CN	Description
956,889	82	Row crops, SR + CR, Good, HSG C
956,889	82	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.9	300	0.1670	0.42		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 2.80"
9.0	1,242	0.0660	2.31		Shallow Concentrated Flow, Cultivated Straight Rows Kv= 9.0 fps
20.9	1,542	Total			

Subcatchment 2: Exist Point of Discharge #2

Hydrograph



Bull Run Filtration Existing Points of Discharge

Type IA 24-hr 10-Year Rainfall=3.80"

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Summary for Subcatchment 3: Exist Point of Discharge #3

Runoff = 5.07 cfs @ 8.01 hrs, Volume= 101,688 cf, Depth= 2.03"

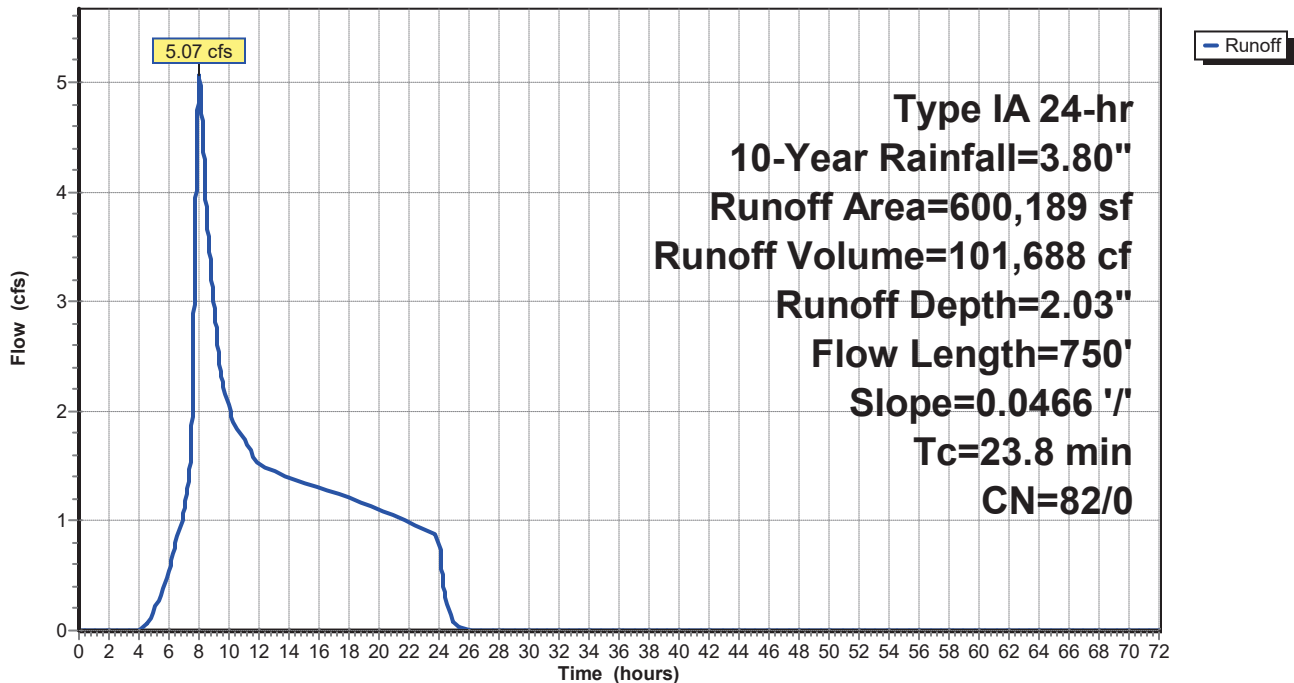
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Year Rainfall=3.80"

Area (sf)	CN	Description
600,189	82	Row crops, SR + CR, Good, HSG C
600,189	82	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.9	300	0.0466	0.25		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 2.80"
3.9	450	0.0466	1.94		Shallow Concentrated Flow, Cultivated Straight Rows Kv= 9.0 fps
23.8	750	Total			

Subcatchment 3: Exist Point of Discharge #3

Hydrograph



Bull Run Filtration Existing Points of Discharge

Type IA 24-hr 25-Year Rainfall=4.50"

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Summary for Subcatchment 1: Exist Point of Discharge #1

Runoff = 18.41 cfs @ 8.11 hrs, Volume= 451,456 cf, Depth= 2.64"

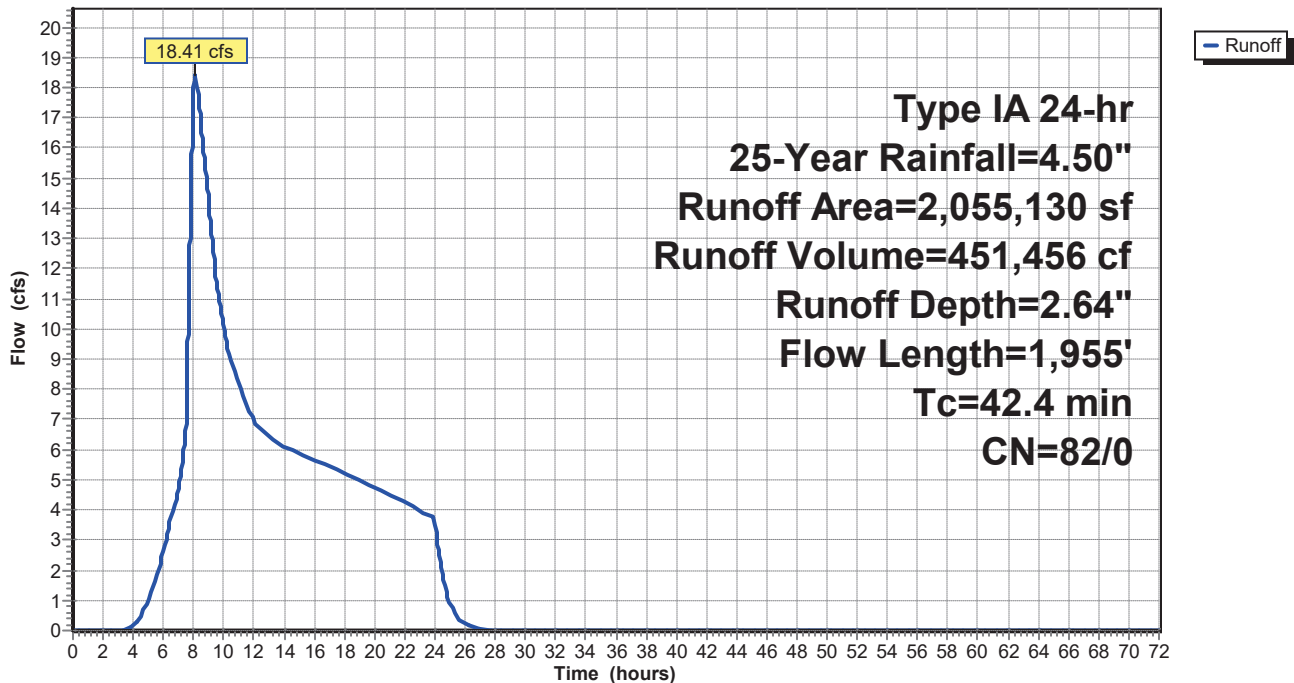
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=4.50"

Area (sf)	CN	Description
2,055,130	82	Row crops, SR + CR, Good, HSG C
2,055,130	82	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
23.7	300	0.0300	0.21		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 2.80"
18.7	1,655	0.0270	1.48		Shallow Concentrated Flow, Cultivated Straight Rows Kv= 9.0 fps
42.4	1,955	Total			

Subcatchment 1: Exist Point of Discharge #1

Hydrograph



Bull Run Filtration Existing Points of Discharge

Type IA 24-hr 25-Year Rainfall=4.50"

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Summary for Subcatchment 2: Exist Point of Discharge #2

Runoff = 11.38 cfs @ 8.01 hrs, Volume= 210,202 cf, Depth= 2.64"

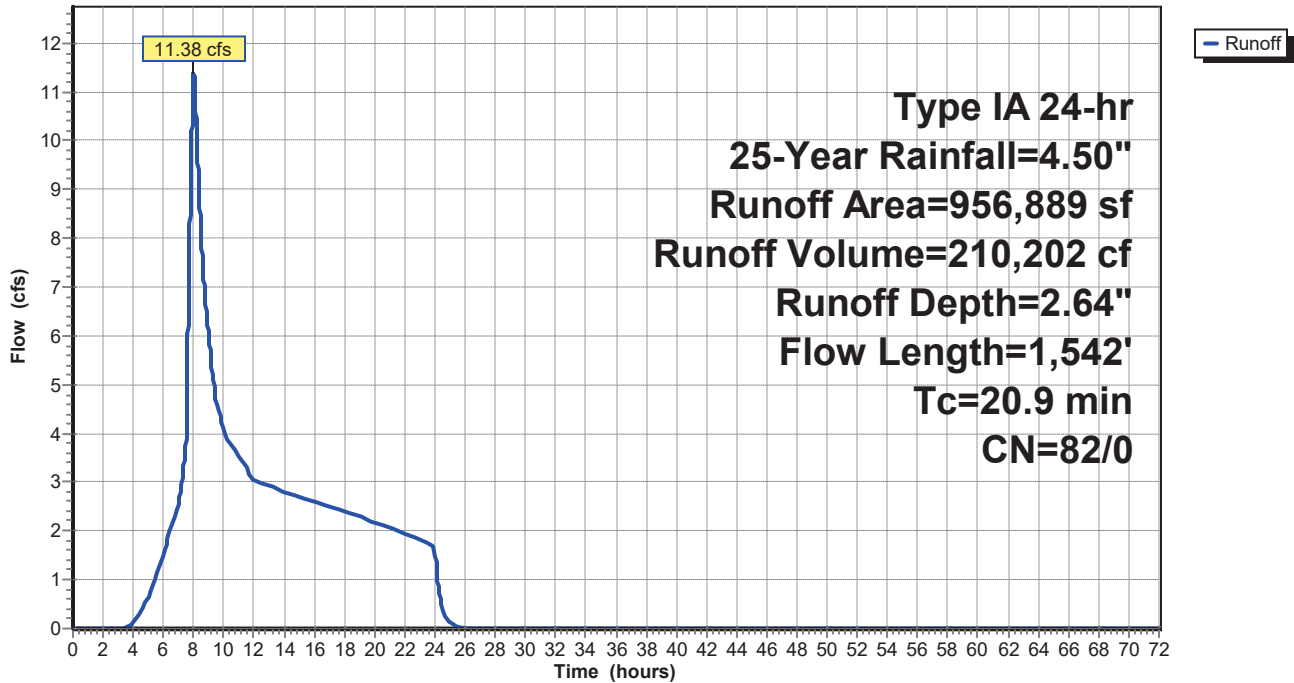
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=4.50"

Area (sf)	CN	Description
956,889	82	Row crops, SR + CR, Good, HSG C
956,889	82	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.9	300	0.1670	0.42		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 2.80"
9.0	1,242	0.0660	2.31		Shallow Concentrated Flow, Cultivated Straight Rows Kv= 9.0 fps
20.9	1,542	Total			

Subcatchment 2: Exist Point of Discharge #2

Hydrograph



Bull Run Filtration Existing Points of Discharge

Type IA 24-hr 25-Year Rainfall=4.50"

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Summary for Subcatchment 3: Exist Point of Discharge #3

Runoff = 6.82 cfs @ 8.01 hrs, Volume= 131,845 cf, Depth= 2.64"

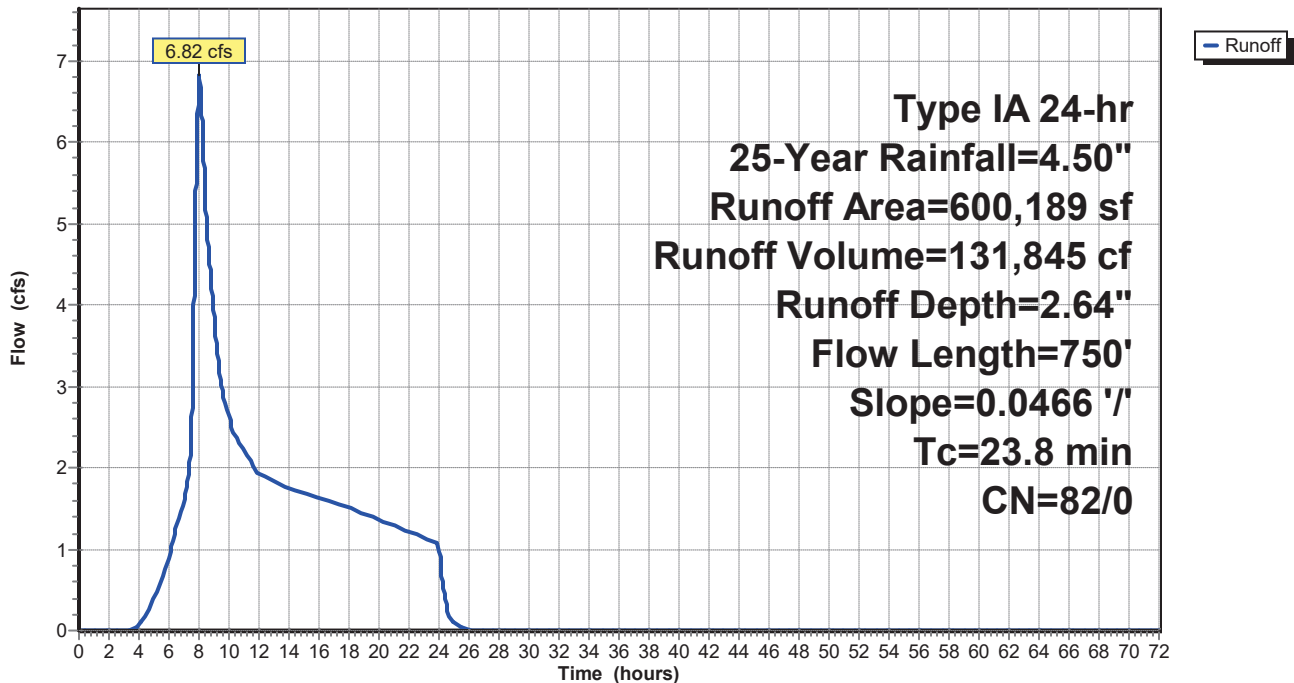
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=4.50"

Area (sf)	CN	Description
600,189	82	Row crops, SR + CR, Good, HSG C
600,189	82	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.9	300	0.0466	0.25		Sheet Flow, Cultivated: Residue>20% n= 0.170 P2= 2.80"
3.9	450	0.0466	1.94		Shallow Concentrated Flow, Cultivated Straight Rows Kv= 9.0 fps
23.8	750	Total			

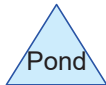
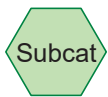
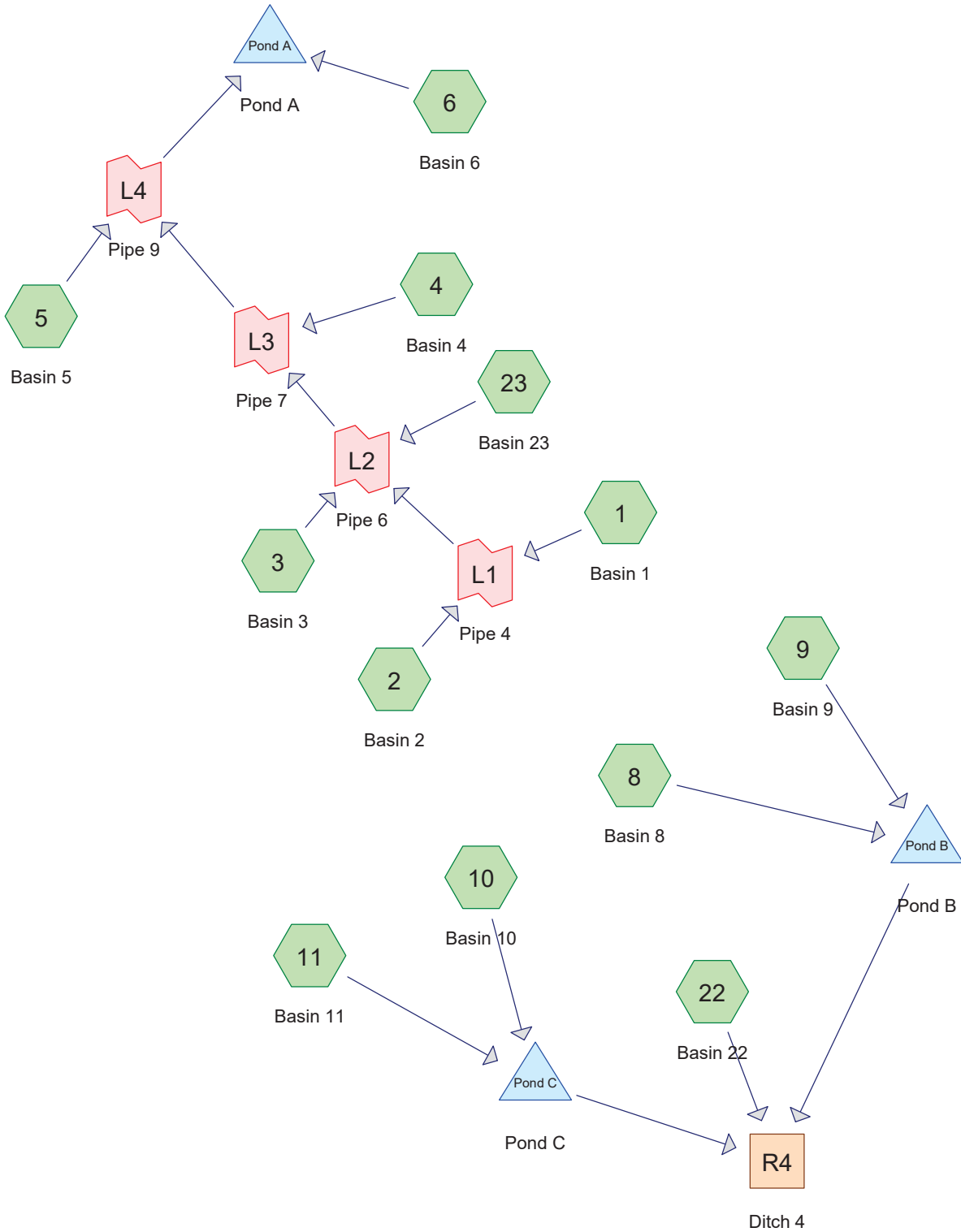
Subcatchment 3: Exist Point of Discharge #3

Hydrograph



Attachment G: Conveyance System Calculations

HydroCAD Plots (Tributary Basins, Conveyance Ditches, Flow Splitter Manhole)
Piped System Calculation Spreadsheet



Routing Diagram for Bull Run Conveyance
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Bull Run Conveyance

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Type IA 24-hr 2-Year Rainfall=2.80"

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Page 2

Summary for Subcatchment 1: Basin 1

Runoff = 0.51 cfs @ 7.92 hrs, Volume= 7,811 cf, Depth= 1.78"

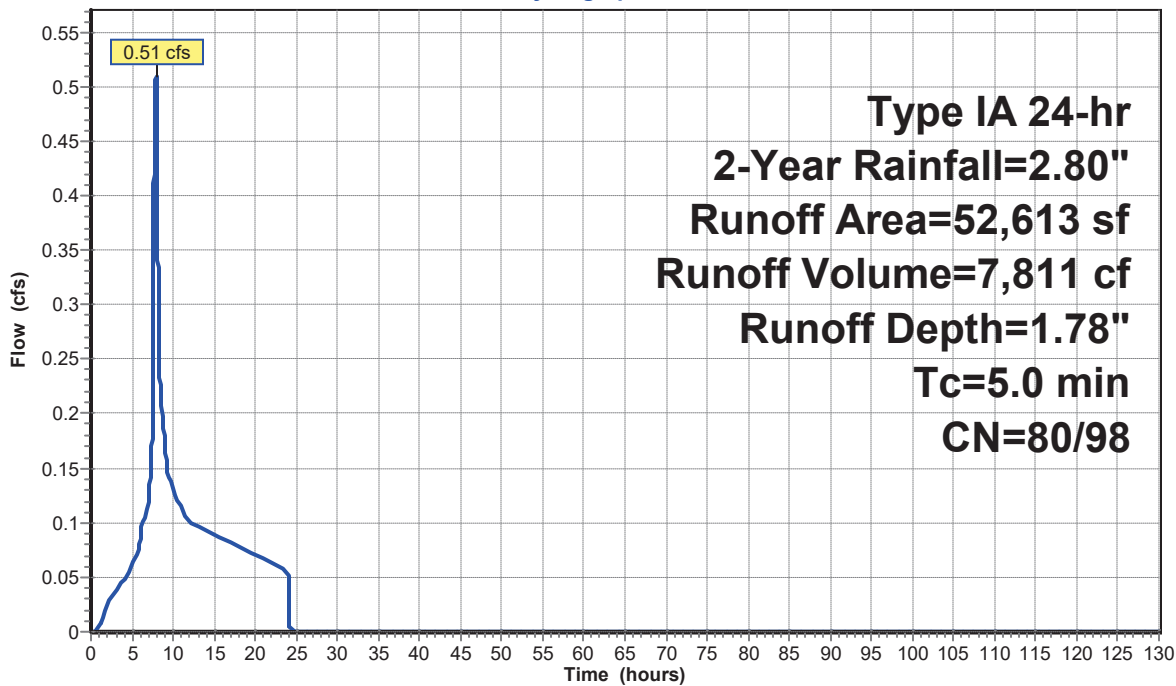
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-Year Rainfall=2.80"

	Area (sf)	CN	Description
*	24,364	98	Impervious Area
*	28,249	80	Pervious
	52,613	88	Weighted Average
	28,249	80	53.69% Pervious Area
	24,364	98	46.31% Impervious Area

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

Subcatchment 1: Basin 1

Hydrograph



Bull Run Conveyance

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Page 3

Summary for Subcatchment 2: Basin 2

Runoff = 0.47 cfs @ 7.88 hrs, Volume= 6,774 cf, Depth= 2.57"

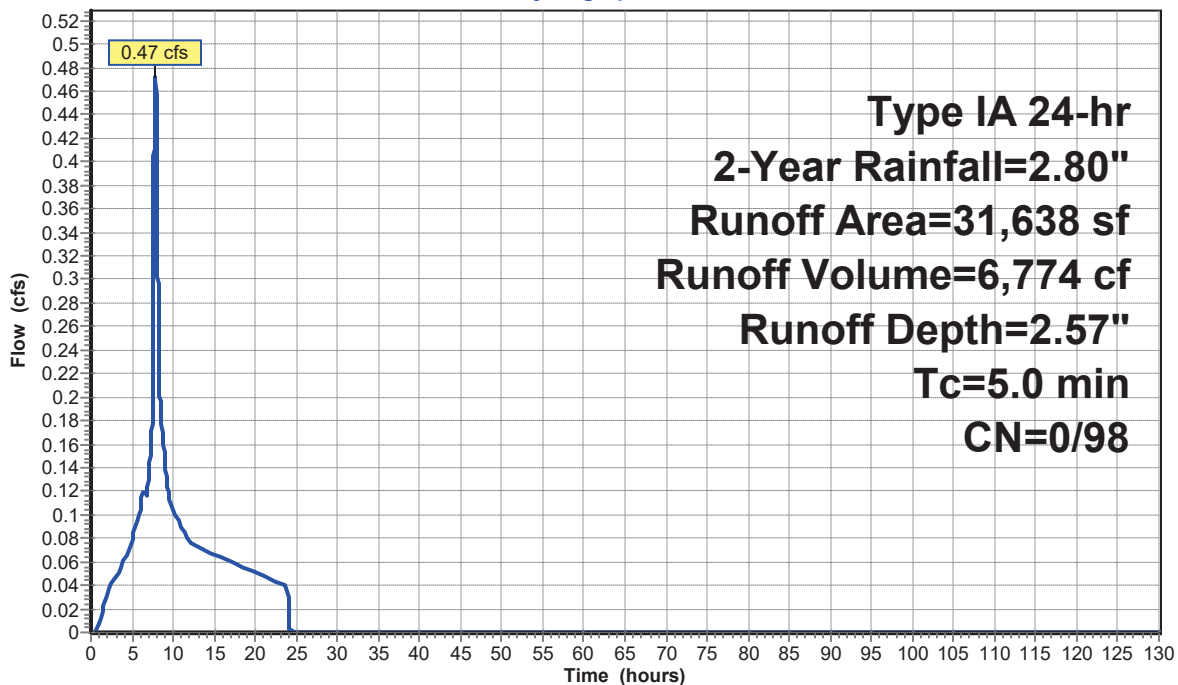
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-Year Rainfall=2.80"

	Area (sf)	CN	Description
*	31,638	98	Impervious Area
	31,638	98	100.00% Impervious Area

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

Subcatchment 2: Basin 2

Hydrograph



Bull Run Conveyance

Type IA 24-hr 2-Year Rainfall=2.80"

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Summary for Subcatchment 3: Basin 3

Runoff = 0.52 cfs @ 7.88 hrs, Volume= 7,517 cf, Depth= 2.57"

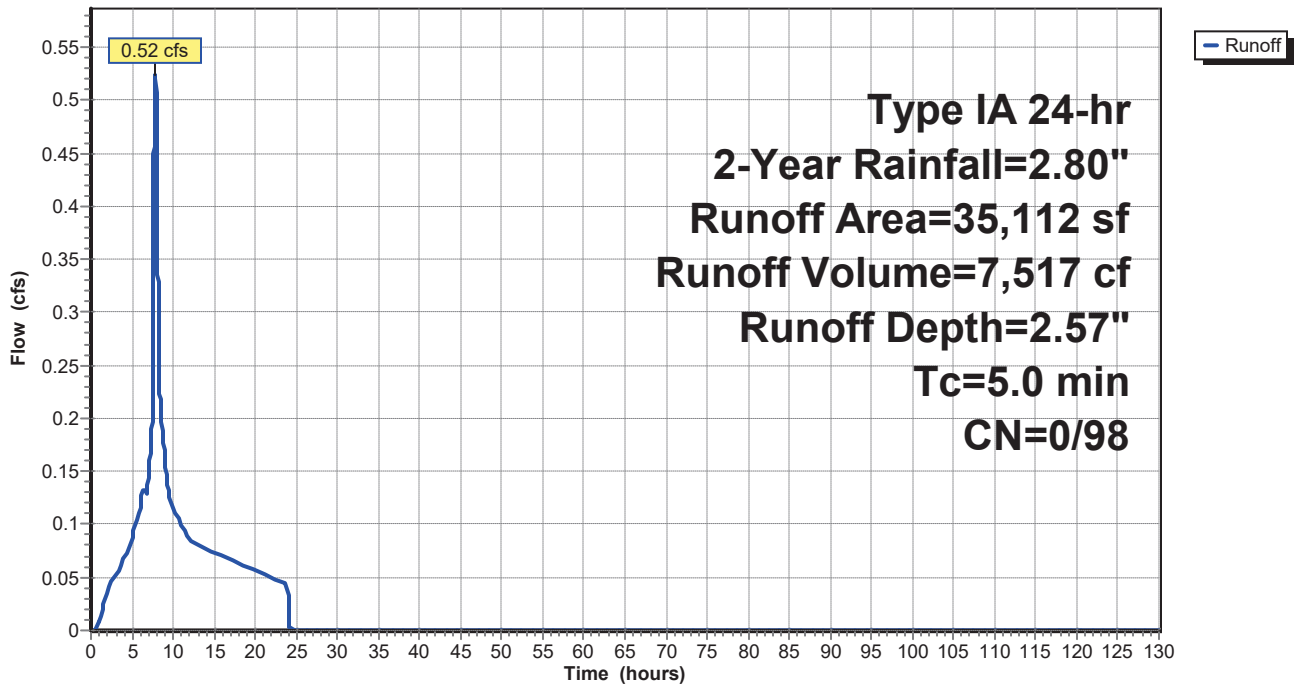
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-Year Rainfall=2.80"

	Area (sf)	CN	Description
*	35,112	98	Impervious Area
	35,112	98	100.00% Impervious Area

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

Subcatchment 3: Basin 3

Hydrograph



Bull Run Conveyance

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Type IA 24-hr 2-Year Rainfall=2.80"

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Summary for Subcatchment 4: Basin 4

Runoff = 0.25 cfs @ 7.88 hrs, Volume= 3,525 cf, Depth= 2.57"

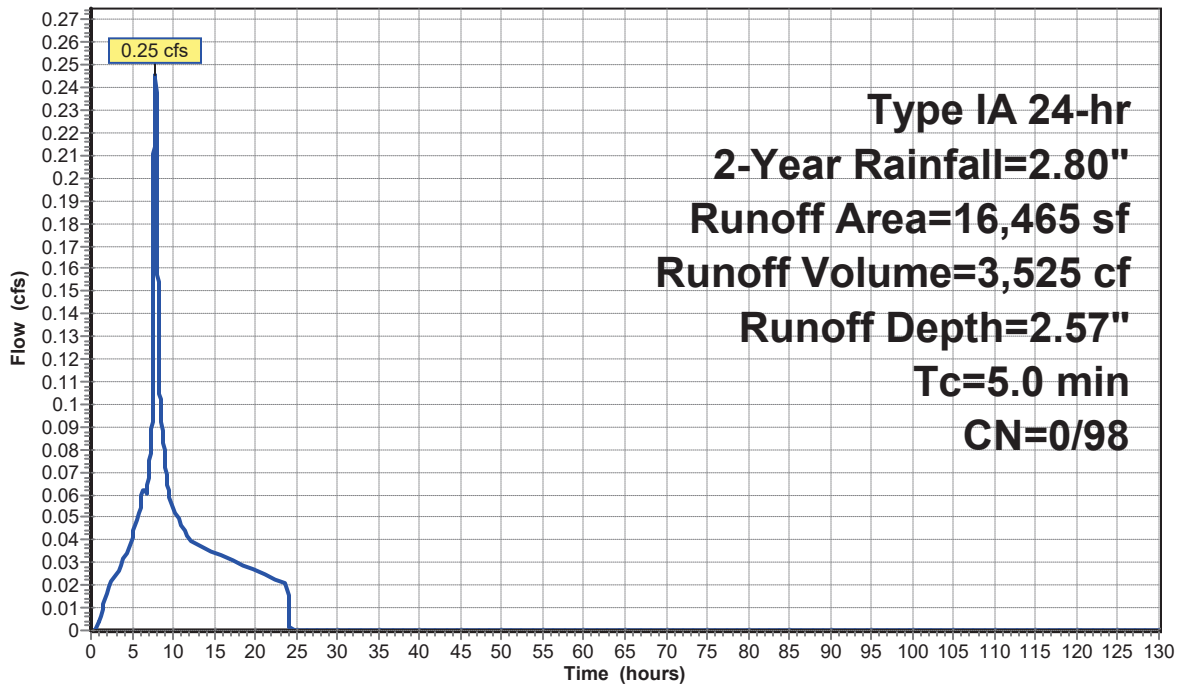
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-Year Rainfall=2.80"

	Area (sf)	CN	Description
*	16,465	98	Impervious Area
	16,465	98	100.00% Impervious Area

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

Subcatchment 4: Basin 4

Hydrograph



Bull Run Conveyance

Type IA 24-hr 2-Year Rainfall=2.80"

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Summary for Subcatchment 5: Basin 5

Runoff = 0.19 cfs @ 7.88 hrs, Volume= 2,785 cf, Depth= 2.57"

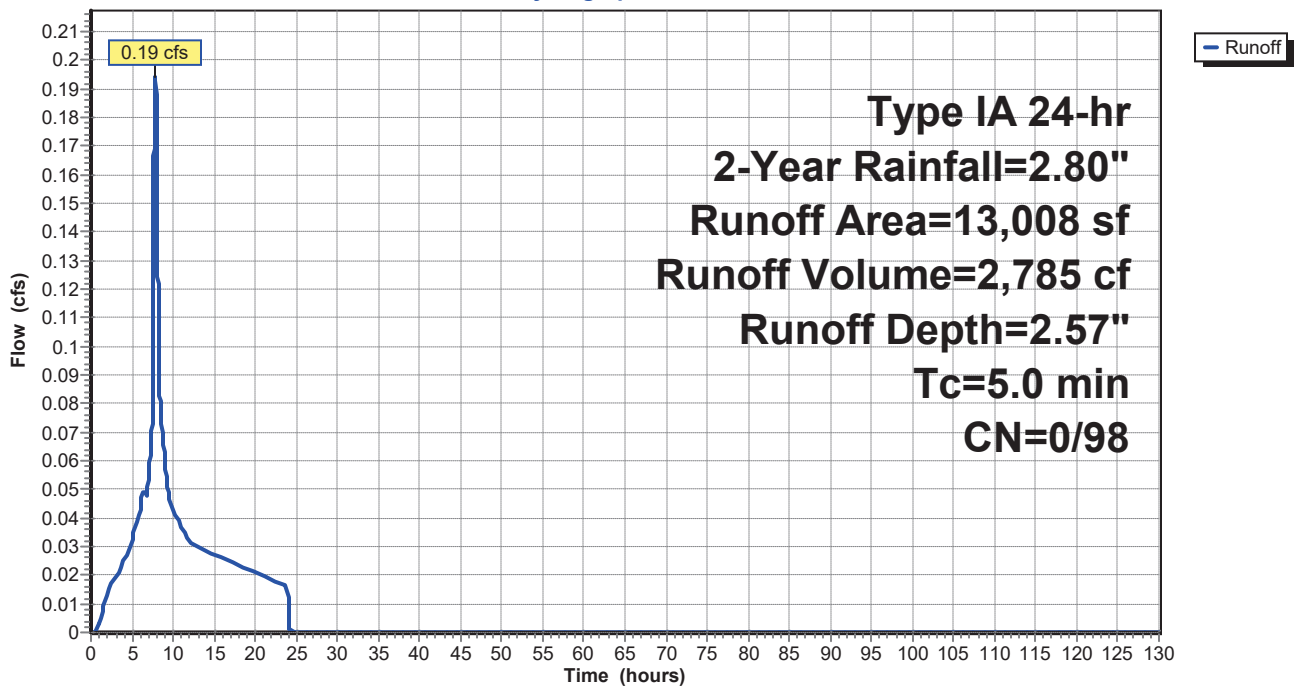
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-Year Rainfall=2.80"

	Area (sf)	CN	Description
*	13,008	98	Impervious Area
	13,008	98	100.00% Impervious Area

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

Subcatchment 5: Basin 5

Hydrograph



Bull Run Conveyance

Type IA 24-hr 2-Year Rainfall=2.80"

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Summary for Subcatchment 6: Basin 6

Runoff = 1.09 cfs @ 7.97 hrs, Volume= 17,748 cf, Depth= 1.34"

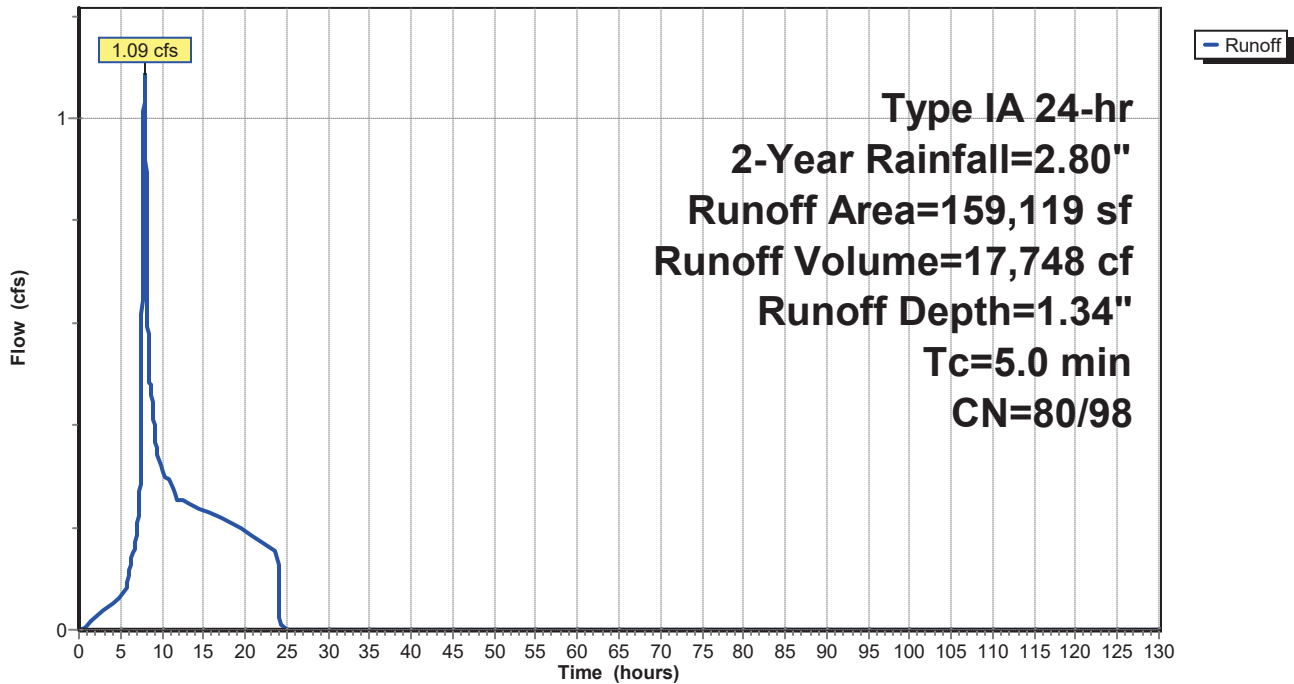
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-Year Rainfall=2.80"

	Area (sf)	CN	Description
*	133,479	80	Pervious
*	25,640	98	Impervious
	159,119	83	Weighted Average
	133,479	80	83.89% Pervious Area
	25,640	98	16.11% Impervious Area

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

Subcatchment 6: Basin 6

Hydrograph



Bull Run Conveyance

Type IA 24-hr 2-Year Rainfall=2.80"

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Summary for Subcatchment 8: Basin 8

Runoff = 1.72 cfs @ 7.88 hrs, Volume= 24,651 cf, Depth= 2.57"

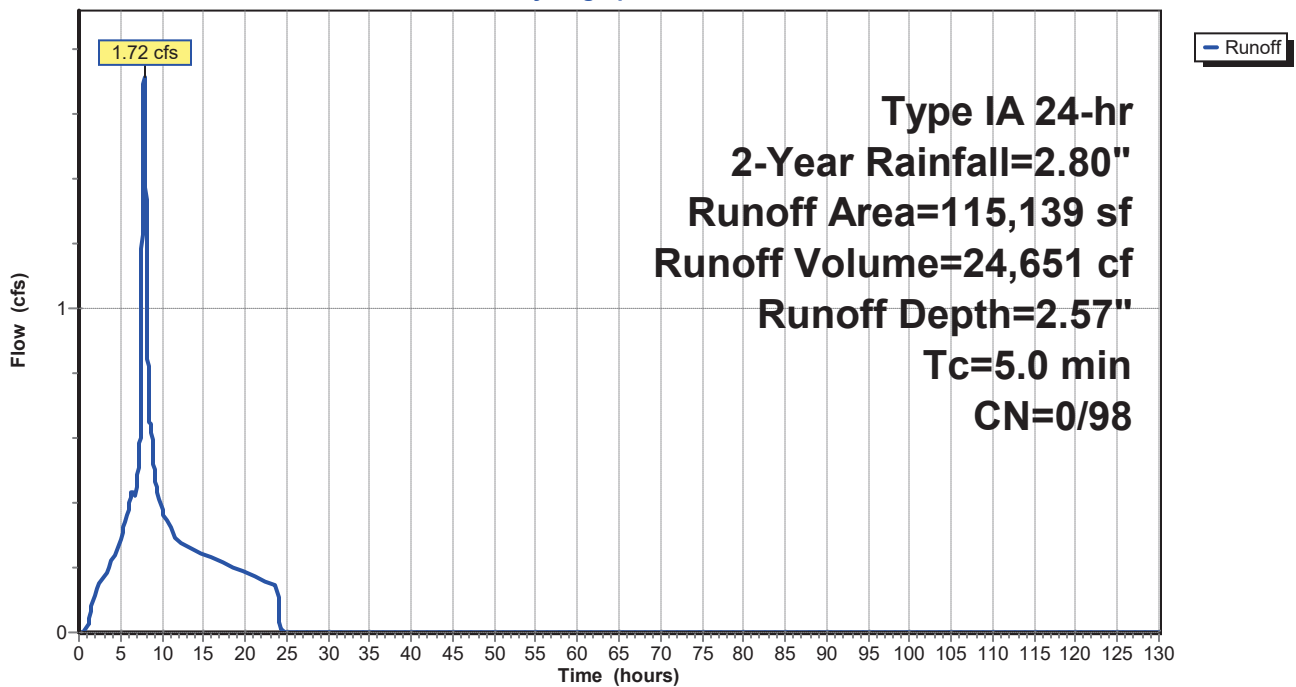
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
 Type IA 24-hr 2-Year Rainfall=2.80"

Area (sf)	CN	Description
* 115,139	98	Impervious Area
115,139	98	100.00% Impervious Area

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

Subcatchment 8: Basin 8

Hydrograph



Bull Run Conveyance

Type IA 24-hr 2-Year Rainfall=2.80"

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Summary for Subcatchment 9: Basin 9

Runoff = 1.37 cfs @ 7.95 hrs, Volume= 21,940 cf, Depth= 1.47"

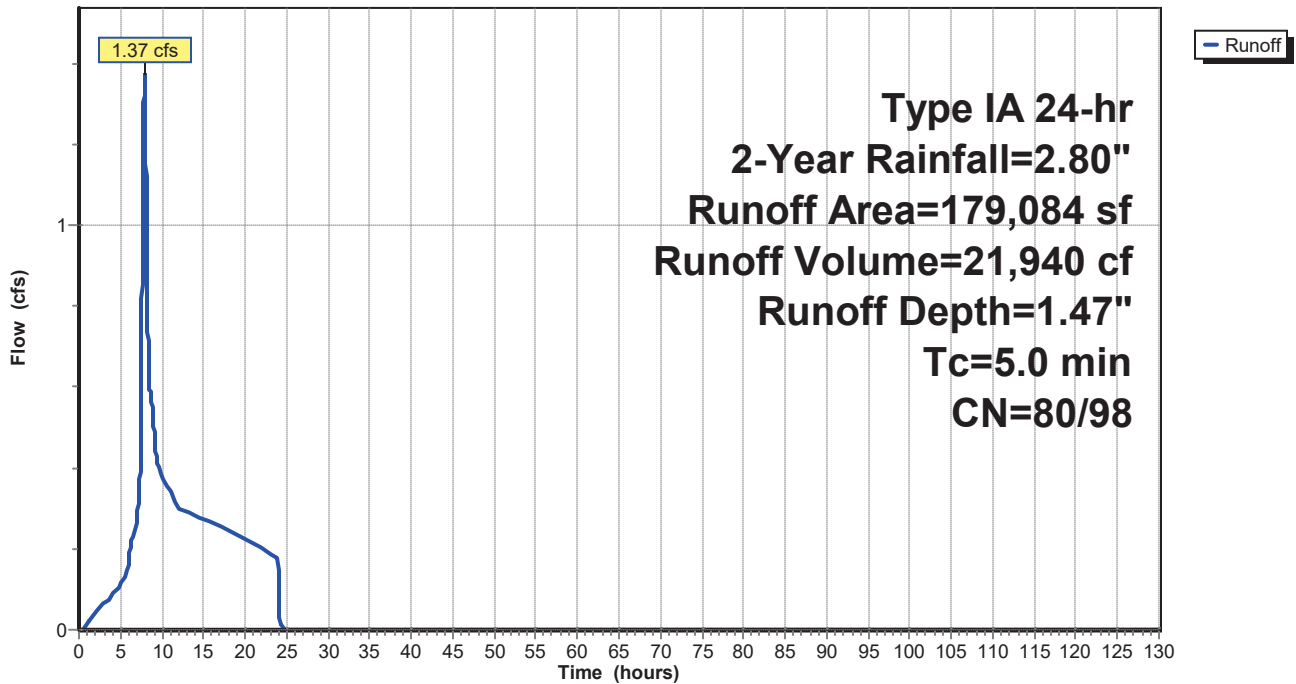
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-Year Rainfall=2.80"

	Area (sf)	CN	Description
*	44,929	98	Impervious Area
*	134,155	80	Landscape Areas
	179,084	85	Weighted Average
	134,155	80	74.91% Pervious Area
	44,929	98	25.09% Impervious Area

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

Subcatchment 9: Basin 9

Hydrograph



Bull Run Conveyance

Type IA 24-hr 2-Year Rainfall=2.80"

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Summary for Subcatchment 10: Basin 10

Runoff = 3.81 cfs @ 7.99 hrs, Volume= 63,741 cf, Depth= 1.22"

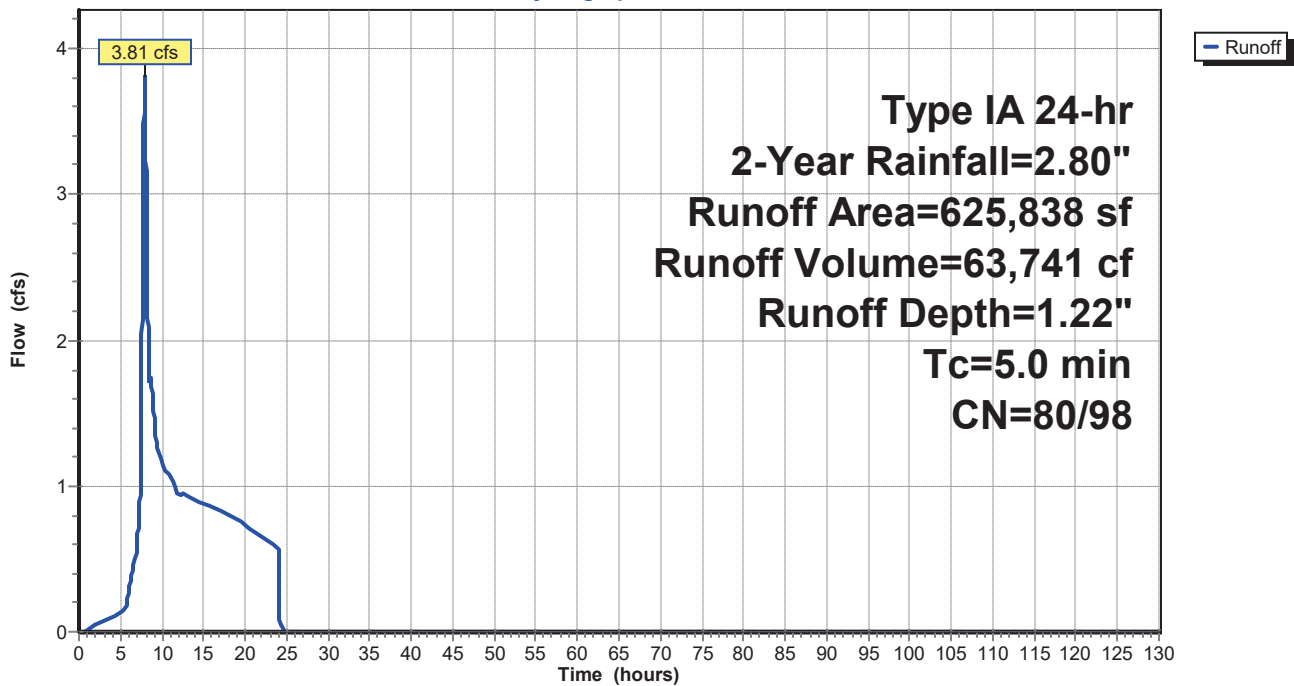
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-Year Rainfall=2.80"

	Area (sf)	CN	Description
*	51,234	98	Impervious Area
*	574,604	80	Pervious
	625,838	81	Weighted Average
	574,604	80	91.81% Pervious Area
	51,234	98	8.19% Impervious Area

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

Subcatchment 10: Basin 10

Hydrograph



Bull Run Conveyance

Type IA 24-hr 2-Year Rainfall=2.80"

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Summary for Subcatchment 11: Basin 11

Runoff = 0.82 cfs @ 7.97 hrs, Volume= 13,427 cf, Depth= 1.36"

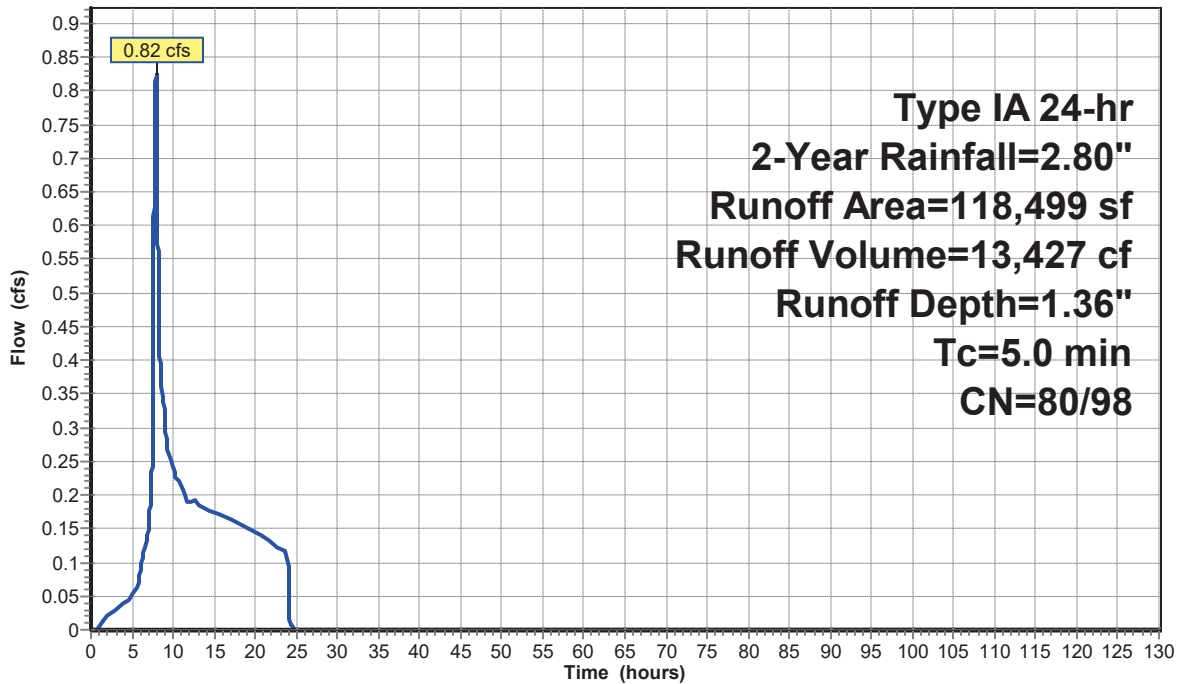
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-Year Rainfall=2.80"

	Area (sf)	CN	Description
*	20,813	98	Impervious Area
*	97,686	80	Pervious
	118,499	83	Weighted Average
	97,686	80	82.44% Pervious Area
	20,813	98	17.56% Impervious Area

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

Subcatchment 11: Basin 11

Hydrograph



Bull Run Conveyance

Type IA 24-hr 2-Year Rainfall=2.80"

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Summary for Subcatchment 22: Basin 22

Runoff = 0.62 cfs @ 7.88 hrs, Volume= 8,945 cf, Depth= 2.57"

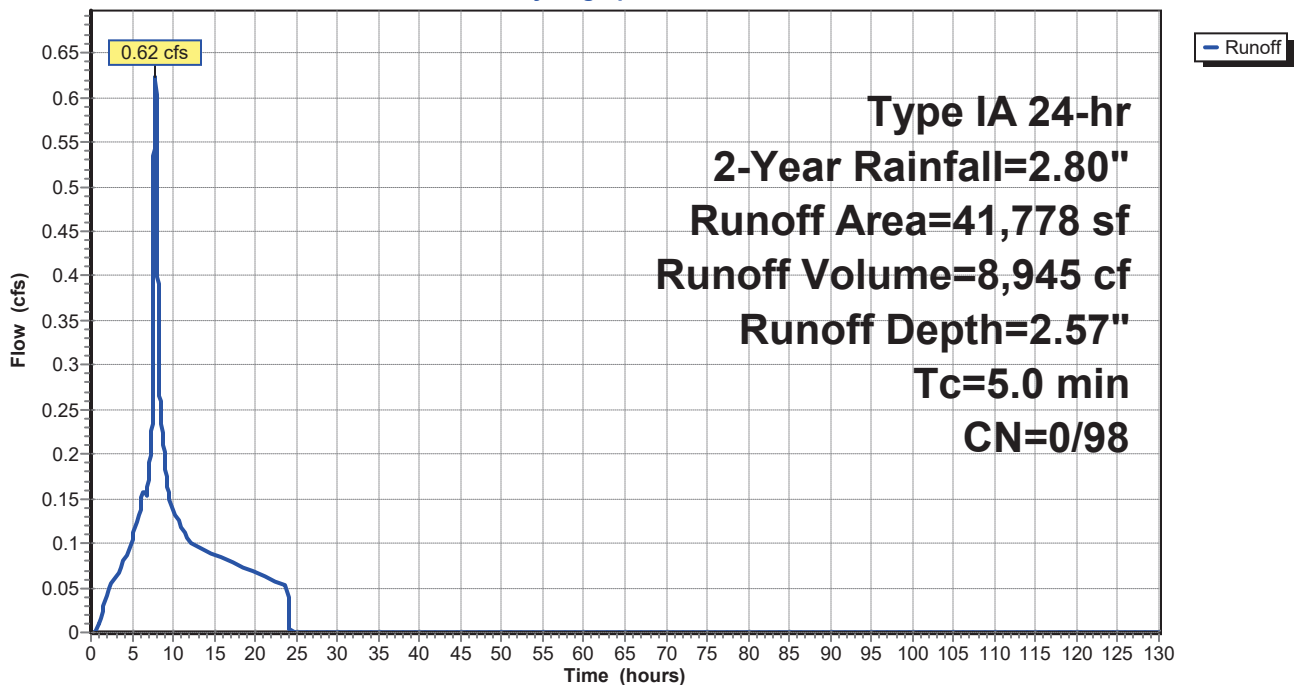
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-Year Rainfall=2.80"

	Area (sf)	CN	Description
*	41,778	98	Impervious Area
	41,778	98	100.00% Impervious Area

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

Subcatchment 22: Basin 22

Hydrograph



Bull Run Conveyance

Type IA 24-hr 2-Year Rainfall=2.80"

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Summary for Subcatchment 23: Basin 23

Runoff = 0.51 cfs @ 7.90 hrs, Volume= 7,474 cf, Depth= 2.16"

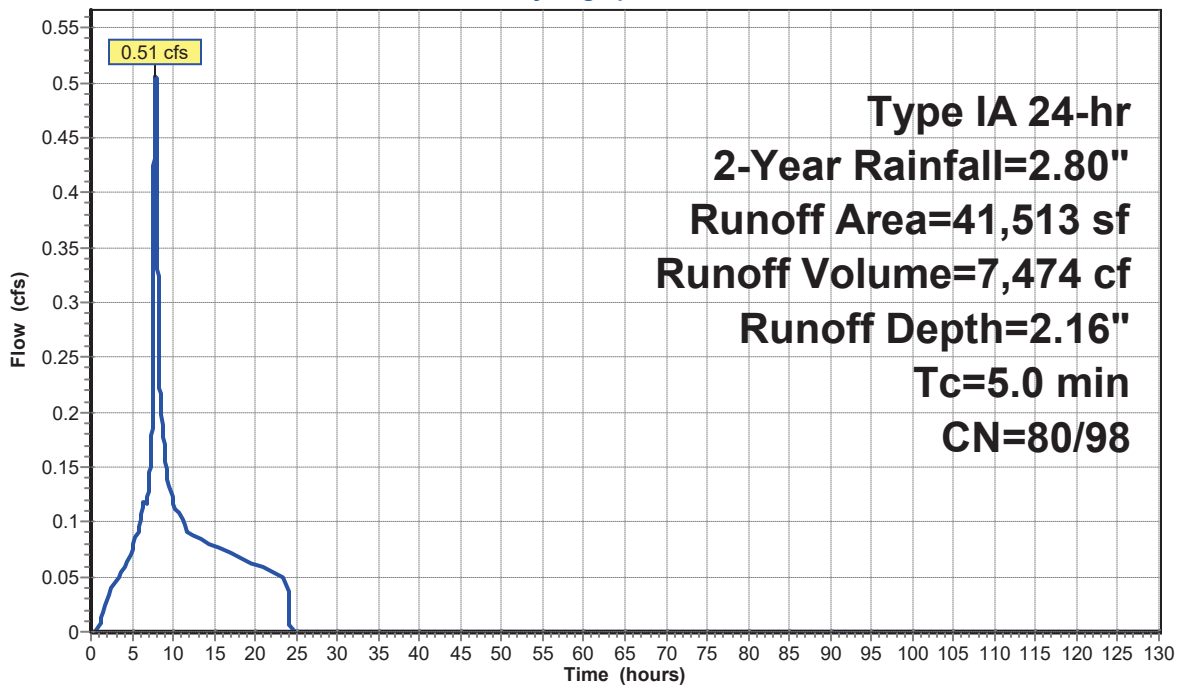
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-Year Rainfall=2.80"

	Area (sf)	CN	Description
*	29,948	98	Impervious Area
*	11,565	80	Pervious
	41,513	93	Weighted Average
	11,565	80	27.86% Pervious Area
	29,948	98	72.14% Impervious Area

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

Subcatchment 23: Basin 23

Hydrograph



Bull Run Conveyance

Type IA 24-hr 2-Year Rainfall=2.80"

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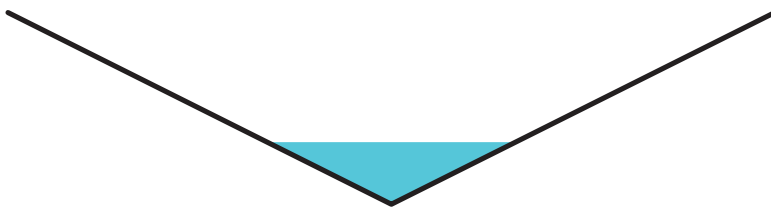
Summary for Reach R4: Ditch 4

Inflow Area = 1,080,338 sf, 25.35% Impervious, Inflow Depth > 5.63" for 2-Year event
Inflow = 2.99 cfs @ 7.97 hrs, Volume= 506,788 cf
Outflow = 2.99 cfs @ 7.97 hrs, Volume= 506,763 cf, Atten= 0%, Lag= 0.3 min

Routing by Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.65 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 3.53 fps, Avg. Travel Time= 0.5 min

Peak Storage= 64 cf @ 7.97 hrs
Average Depth at Peak Storage= 0.57'
Bank-Full Depth= 1.75' Flow Area= 6.1 sf, Capacity= 60.27 cfs

Custom cross-section, Length= 100.0' Slope= 0.0380 '/'
Constant n= 0.025 Earth, clean & straight
Inlet Invert= 694.00', Outlet Invert= 690.20'



Offset (feet)	Elevation (feet)	Chan.Depth (feet)
-3.50	1.75	0.00
0.00	0.00	1.75
3.50	1.75	0.00

Depth (feet)	End Area (sq-ft)	Perim. (feet)	Storage (cubic-feet)	Discharge (cfs)
0.00	0.0	0.0	0	0.00
1.75	6.1	7.8	613	60.27

Bull Run Conveyance

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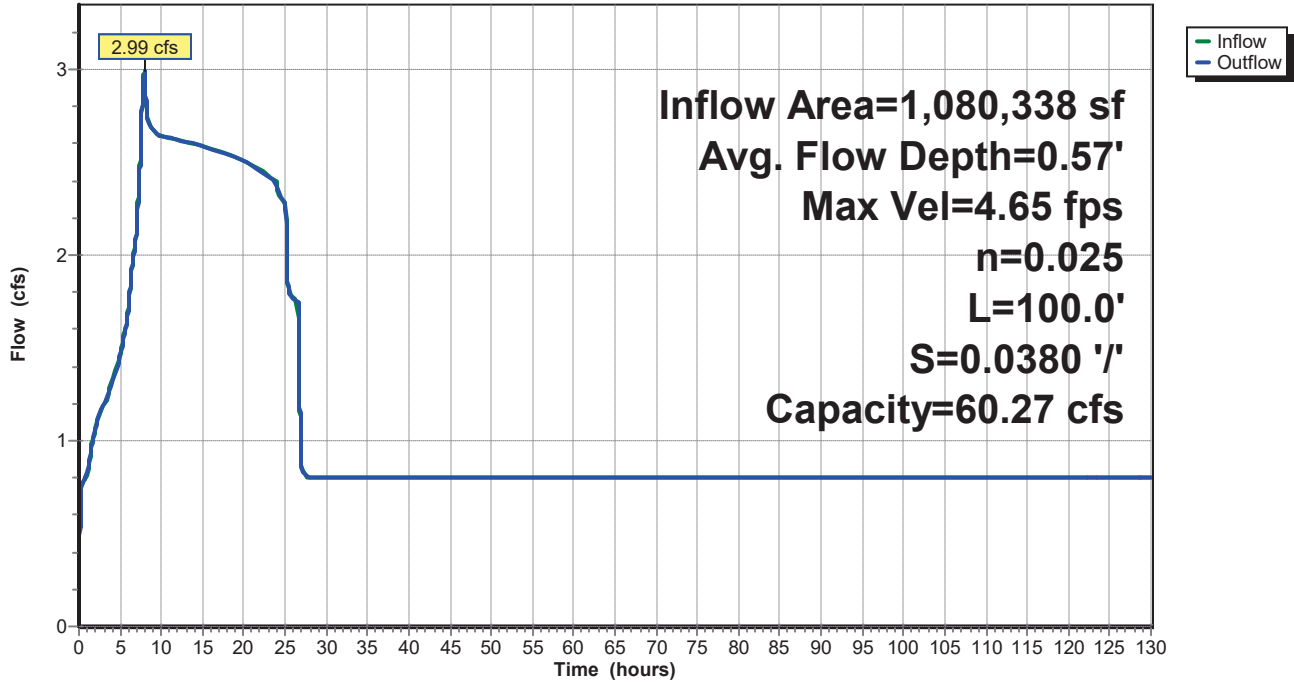
Type IA 24-hr 2-Year Rainfall=2.80"

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Reach R4: Ditch 4

Hydrograph



Bull Run Conveyance

Type IA 24-hr 2-Year Rainfall=2.80"

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Summary for Pond Pond A: Pond A

Inflow Area = 349,468 sf, 50.41% Impervious, Inflow Depth = 1.84" for 2-Year event
 Inflow = 3.52 cfs @ 7.92 hrs, Volume= 53,634 cf
 Outflow = 0.61 cfs @ 14.82 hrs, Volume= 53,634 cf, Atten= 83%, Lag= 414.3 min
 Primary = 0.61 cfs @ 14.82 hrs, Volume= 53,634 cf

Routing by Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs / 3
 Peak Elev= 709.36' @ 14.82 hrs Surf.Area= 8,132 sf Storage= 13,293 cf

Plug-Flow detention time= 246.7 min calculated for 53,630 cf (100% of inflow)
 Center-of-Mass det. time= 246.8 min (965.4 - 718.7)

Volume	Invert	Avail.Storage	Storage Description
#1	707.50'	70,555 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
707.50	6,107	0	0
708.00	6,714	3,205	3,205
709.00	7,742	7,228	10,433
710.00	8,825	8,284	18,717
711.00	9,967	9,396	28,113
712.00	11,161	10,564	38,677
713.00	12,412	11,787	50,463
714.00	13,717	13,065	63,528
714.50	14,392	7,027	70,555

Device	Routing	Invert	Outlet Devices
#1	Primary	698.43'	18.0" Round Culvert L= 138.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 698.43' / 696.24' S= 0.0159 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf
#2	Device 1	696.43'	2.6" Horiz. Orifice/Grate C= 0.620 Limited to weir flow at low heads
#3	Device 1	709.40'	16.0" W x 3.0" H Vert. Orifice/Grate C= 0.620

Primary OutFlow Max=0.61 cfs @ 14.82 hrs HW=709.36' (Free Discharge)

- 1=Culvert (Passes 0.61 cfs of 24.10 cfs potential flow)
- 2=Orifice/Grate (Orifice Controls 0.61 cfs @ 16.45 fps)
- 3=Orifice/Grate (Controls 0.00 cfs)

Bull Run Conveyance

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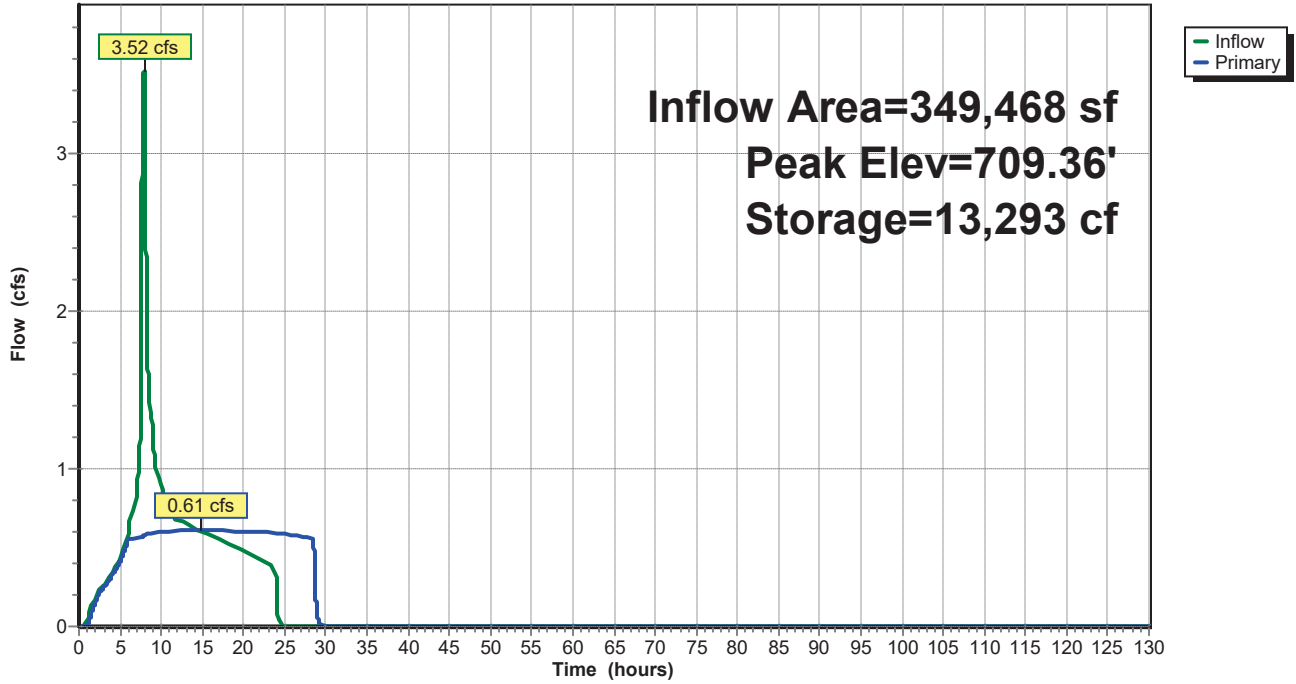
Type IA 24-hr 2-Year Rainfall=2.80"

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Pond Pond A: Pond A

Hydrograph



Bull Run Conveyance

Type IA 24-hr 2-Year Rainfall=2.80"

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Summary for Pond Pond B: Pond B

Inflow Area = 294,223 sf, 54.40% Impervious, Inflow Depth = 1.90" for 2-Year event
 Inflow = 3.08 cfs @ 7.91 hrs, Volume= 46,591 cf
 Outflow = 0.67 cfs @ 11.01 hrs, Volume= 46,591 cf, Atten= 78%, Lag= 186.0 min
 Primary = 0.67 cfs @ 11.01 hrs, Volume= 46,591 cf

Routing by Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs / 3
 Peak Elev= 709.12' @ 11.01 hrs Surf.Area= 5,248 sf Storage= 9,227 cf

Plug-Flow detention time= 143.1 min calculated for 46,587 cf (100% of inflow)
 Center-of-Mass det. time= 143.1 min (856.4 - 713.3)

Volume	Invert	Avail.Storage	Storage Description
#1	707.00'	36,813 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
707.00	3,493	0	0
708.00	4,288	3,891	3,891
709.00	5,139	4,714	8,604
710.00	6,046	5,593	14,197
711.00	7,010	6,528	20,725
712.00	8,030	7,520	28,245
713.00	9,107	8,569	36,813

Device	Routing	Invert	Outlet Devices
#1	Primary	705.04'	18.0" Round Culvert L= 339.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 705.04' / 701.65' S= 0.0100 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf
#2	Device 1	703.04'	3.5" Horiz. Orifice/Grate C= 0.620 Limited to weir flow at low heads
#3	Device 1	709.15'	14.0" W x 3.0" H Vert. Orifice/Grate C= 0.620

Primary OutFlow Max=0.67 cfs @ 11.01 hrs HW=709.12' (Free Discharge)

- ↑ **1=Culvert** (Passes 0.67 cfs of 12.49 cfs potential flow)
- ↑ **2=Orifice/Grate** (Orifice Controls 0.67 cfs @ 10.05 fps)
- ↑ **3=Orifice/Grate** (Controls 0.00 cfs)

Bull Run Conveyance

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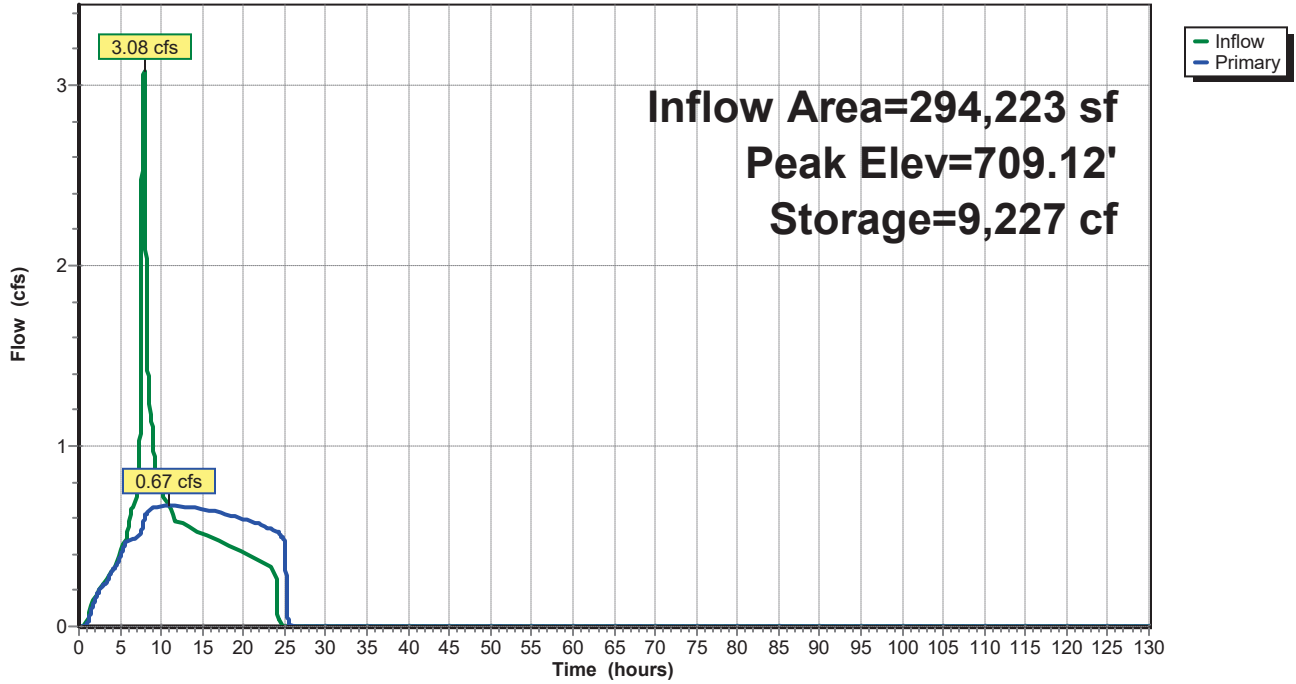
Type IA 24-hr 2-Year Rainfall=2.80"

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Pond Pond B: Pond B

Hydrograph



Bull Run Conveyance

Type IA 24-hr 2-Year Rainfall=2.80"

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Summary for Pond Pond C: Pond C

Inflow Area = 744,337 sf, 9.68% Impervious, Inflow Depth > 7.28" for 2-Year event
 Inflow = 5.43 cfs @ 7.98 hrs, Volume= 451,597 cf, Incl. 0.80 cfs Base Flow
 Outflow = 1.85 cfs @ 15.18 hrs, Volume= 451,252 cf, Atten= 66%, Lag= 431.7 min
 Primary = 1.85 cfs @ 15.18 hrs, Volume= 451,252 cf

Routing by Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs / 3
 Peak Elev= 704.77' @ 15.18 hrs Surf.Area= 20,253 sf Storage= 14,924 cf

Plug-Flow detention time= 35.8 min calculated for 451,247 cf (100% of inflow)
 Center-of-Mass det. time= 32.3 min (3,403.1 - 3,370.8)

Volume	Invert	Avail.Storage	Storage Description
#1	704.00'	95,416 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
704.00	18,277	0	0
705.00	20,828	19,553	19,553
706.00	23,671	22,250	41,802
707.00	26,743	25,207	67,009
708.00	30,070	28,407	95,416

Device	Routing	Invert	Outlet Devices
#1	Primary	697.90'	12.0" Round Culvert L= 53.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 697.90' / 695.55' S= 0.0443 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	693.90'	5.1" Horiz. Orifice/Grate C= 0.620 Limited to weir flow at low heads
#3	Device 1	704.85'	16.0" W x 3.0" H Vert. Orifice/Grate C= 0.620

Primary OutFlow Max=1.85 cfs @ 15.18 hrs HW=704.77' (Free Discharge)

- ↑ **1=Culvert** (Passes 1.85 cfs of 9.55 cfs potential flow)
- ↑ **2=Orifice/Grate** (Orifice Controls 1.85 cfs @ 13.05 fps)
- ↑ **3=Orifice/Grate** (Controls 0.00 cfs)

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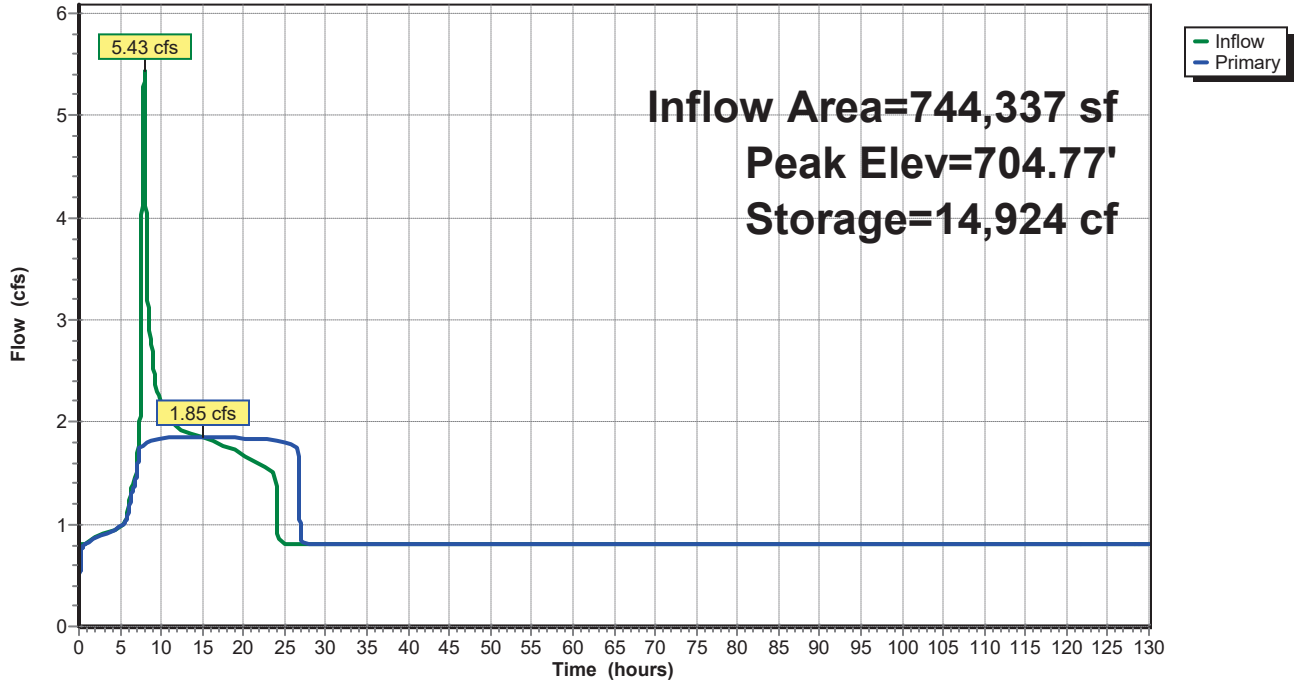
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Pond Pond C: Pond C

Hydrograph



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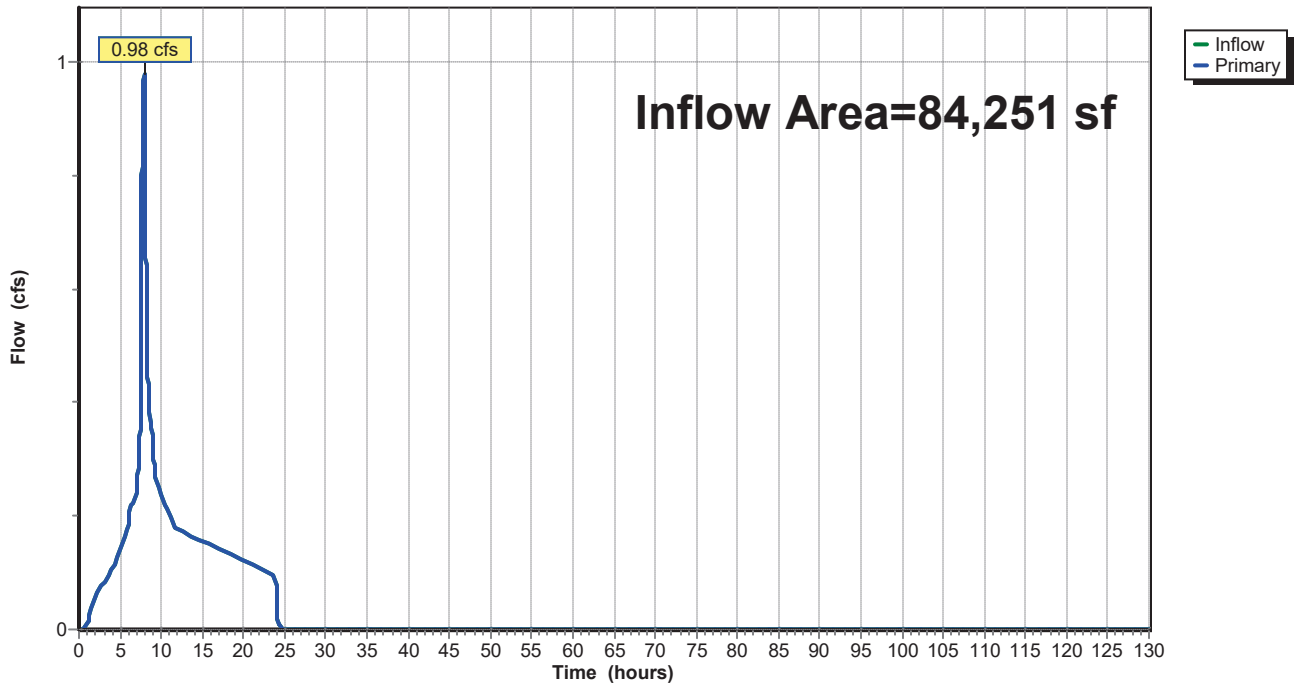
Summary for Link L1: Pipe 4

Inflow Area = 84,251 sf, 66.47% Impervious, Inflow Depth = 2.08" for 2-Year event
Inflow = 0.98 cfs @ 7.90 hrs, Volume= 14,584 cf
Primary = 0.98 cfs @ 7.90 hrs, Volume= 14,584 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs

Link L1: Pipe 4

Hydrograph



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Type IA 24-hr 2-Year Rainfall=2.80"

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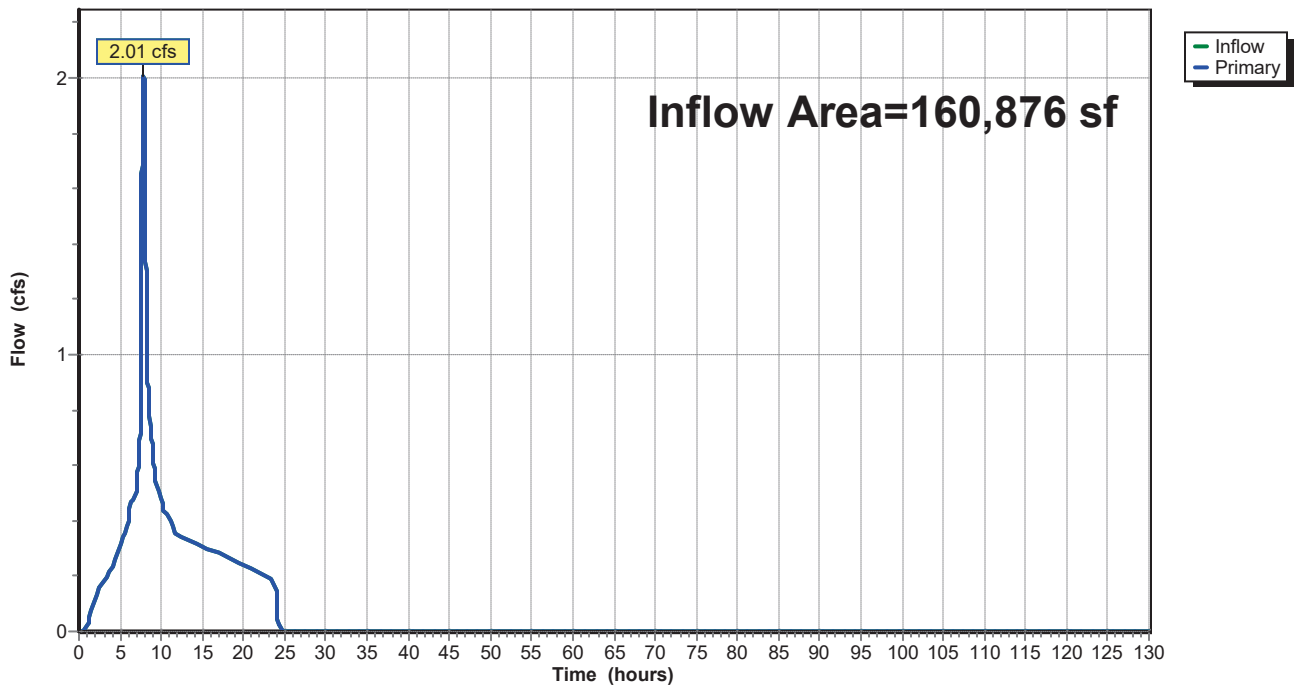
Summary for Link L2: Pipe 6

Inflow Area = 160,876 sf, 75.25% Impervious, Inflow Depth = 2.21" for 2-Year event
Inflow = 2.01 cfs @ 7.90 hrs, Volume= 29,575 cf
Primary = 2.01 cfs @ 7.90 hrs, Volume= 29,575 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs

Link L2: Pipe 6

Hydrograph



Bull Run Conveyance

Type IA 24-hr 2-Year Rainfall=2.80"

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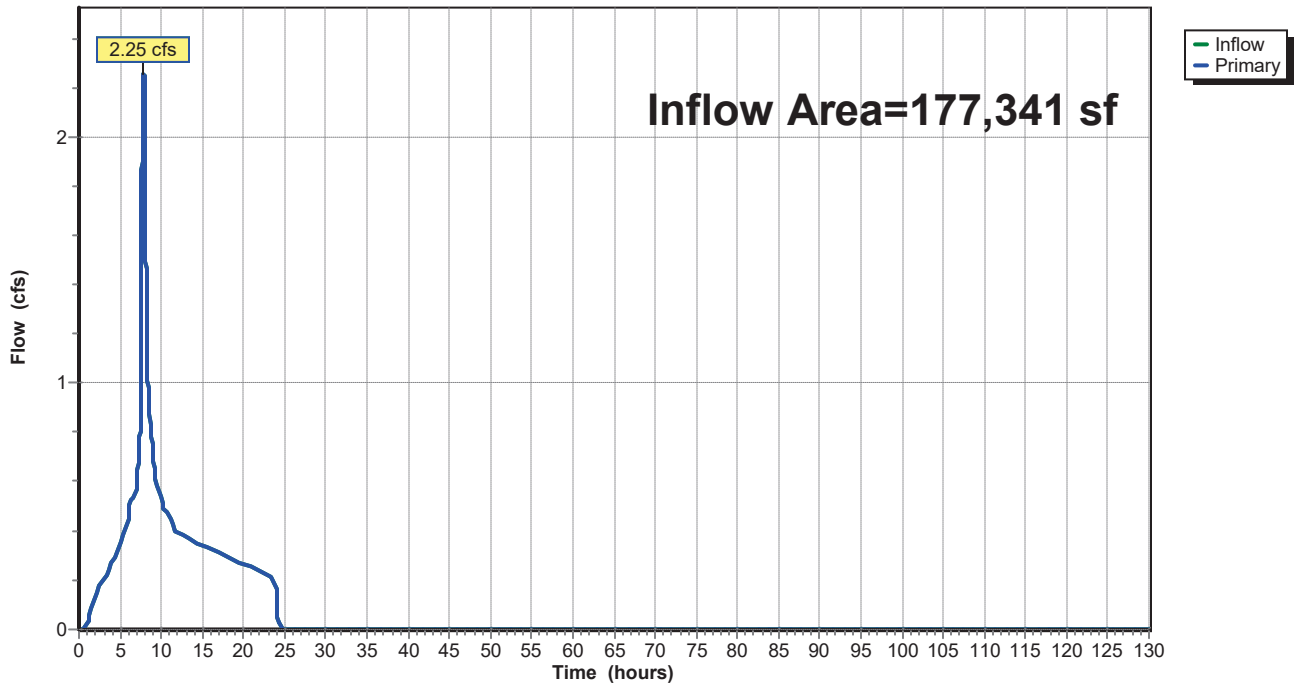
Summary for Link L3: Pipe 7

Inflow Area = 177,341 sf, 77.55% Impervious, Inflow Depth = 2.24" for 2-Year event
Inflow = 2.25 cfs @ 7.89 hrs, Volume= 33,101 cf
Primary = 2.25 cfs @ 7.89 hrs, Volume= 33,101 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs

Link L3: Pipe 7

Hydrograph



Bull Run Conveyance

Type IA 24-hr 2-Year Rainfall=2.80"

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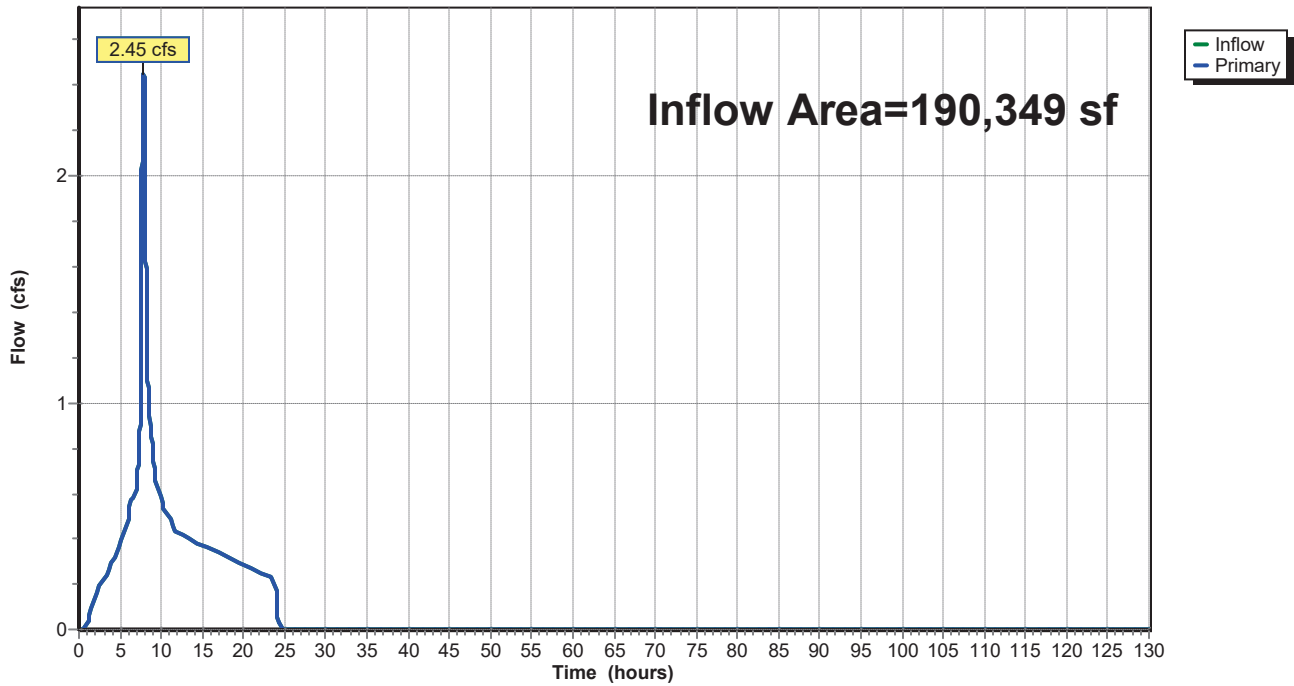
Summary for Link L4: Pipe 9

Inflow Area = 190,349 sf, 79.08% Impervious, Inflow Depth = 2.26" for 2-Year event
Inflow = 2.45 cfs @ 7.89 hrs, Volume= 35,886 cf
Primary = 2.45 cfs @ 7.89 hrs, Volume= 35,886 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs

Link L4: Pipe 9

Hydrograph



Bull Run Conveyance

Type IA 24-hr 5-Year Rainfall=3.40"

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Summary for Subcatchment 1: Basin 1

Runoff = 0.67 cfs @ 7.92 hrs, Volume= 10,096 cf, Depth= 2.30"

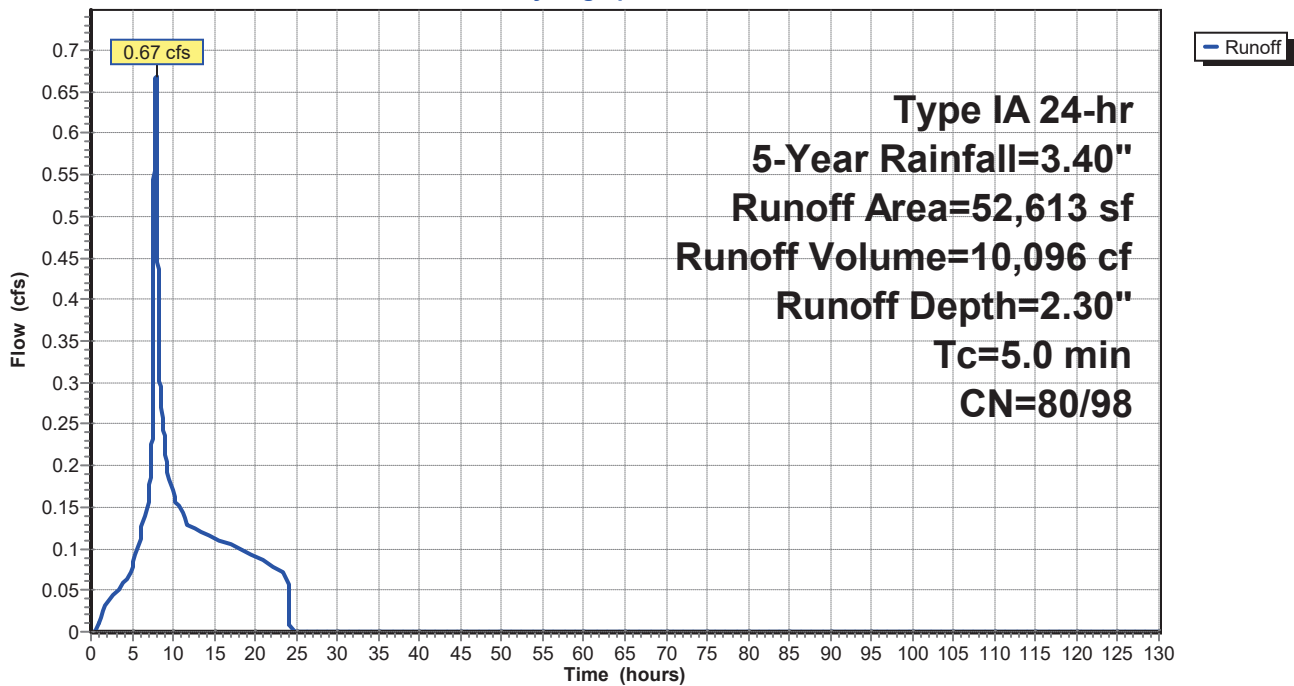
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 5-Year Rainfall=3.40"

	Area (sf)	CN	Description
*	24,364	98	Impervious Area
*	28,249	80	Pervious
	52,613	88	Weighted Average
	28,249	80	53.69% Pervious Area
	24,364	98	46.31% Impervious Area

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

Subcatchment 1: Basin 1

Hydrograph



Bull Run Conveyance

Type IA 24-hr 5-Year Rainfall=3.40"

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Summary for Subcatchment 2: Basin 2

Runoff = 0.58 cfs @ 7.88 hrs, Volume= 8,349 cf, Depth= 3.17"

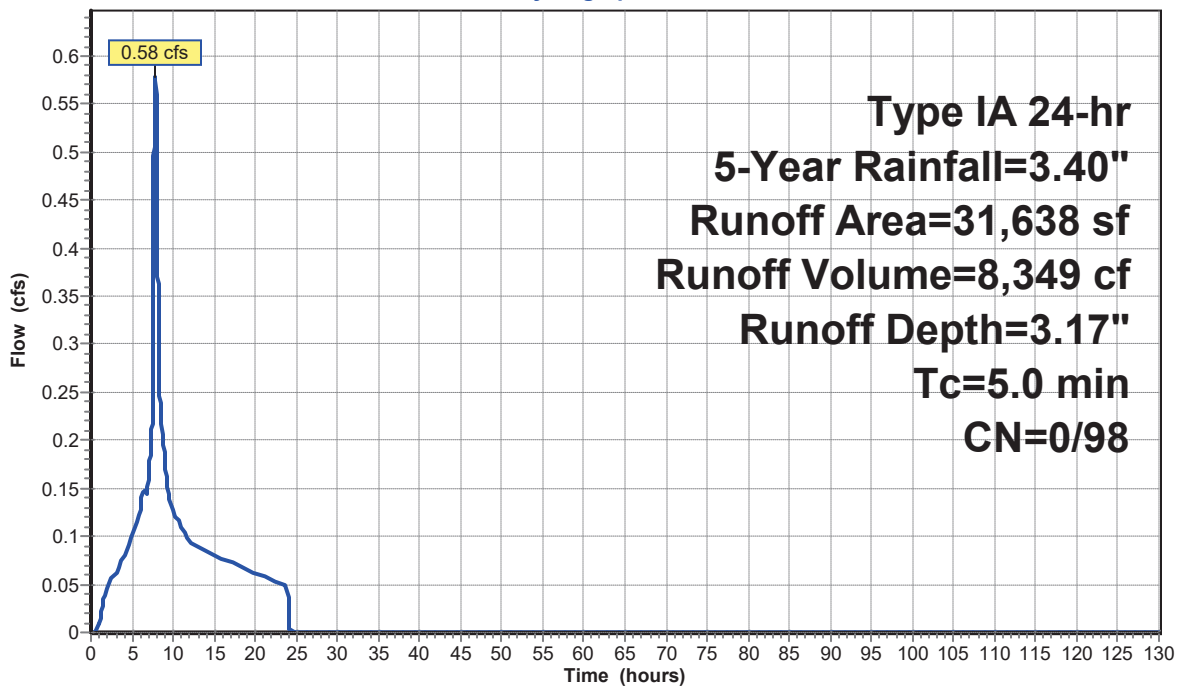
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 5-Year Rainfall=3.40"

	Area (sf)	CN	Description
*	31,638	98	Impervious Area
	31,638	98	100.00% Impervious Area

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

Subcatchment 2: Basin 2

Hydrograph



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Type IA 24-hr 5-Year Rainfall=3.40"

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Summary for Subcatchment 3: Basin 3

Runoff = 0.64 cfs @ 7.88 hrs, Volume= 9,266 cf, Depth= 3.17"

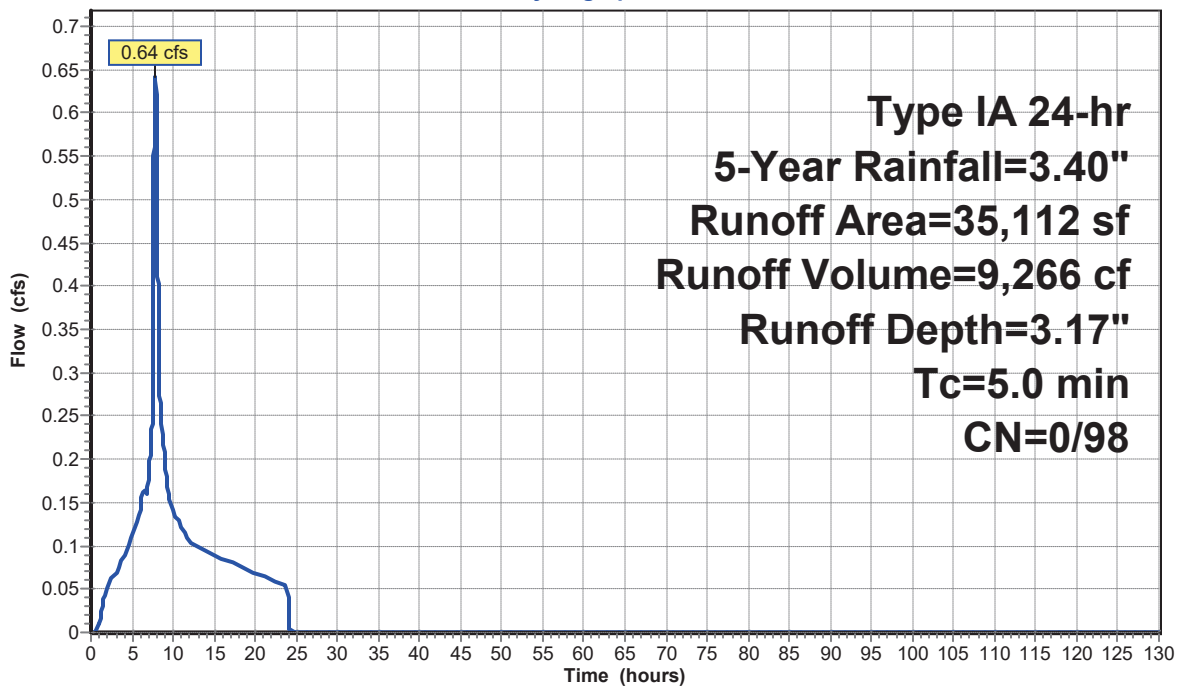
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 5-Year Rainfall=3.40"

	Area (sf)	CN	Description
*	35,112	98	Impervious Area
	35,112	98	100.00% Impervious Area

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

Subcatchment 3: Basin 3

Hydrograph



Bull Run Conveyance

Type IA 24-hr 5-Year Rainfall=3.40"

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Summary for Subcatchment 4: Basin 4

Runoff = 0.30 cfs @ 7.88 hrs, Volume= 4,345 cf, Depth= 3.17"

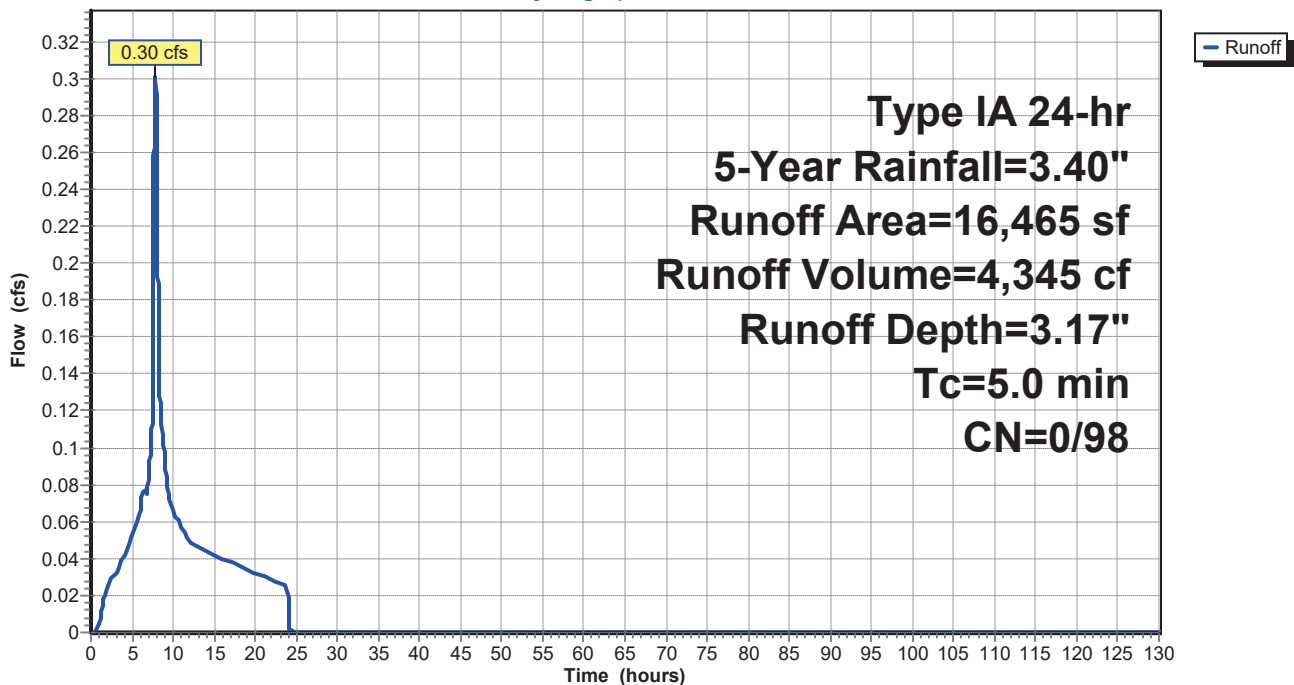
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 5-Year Rainfall=3.40"

	Area (sf)	CN	Description
*	16,465	98	Impervious Area
	16,465	98	100.00% Impervious Area

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

Subcatchment 4: Basin 4

Hydrograph



Bull Run Conveyance

Type IA 24-hr 5-Year Rainfall=3.40"

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Summary for Subcatchment 5: Basin 5

Runoff = 0.24 cfs @ 7.88 hrs, Volume= 3,433 cf, Depth= 3.17"

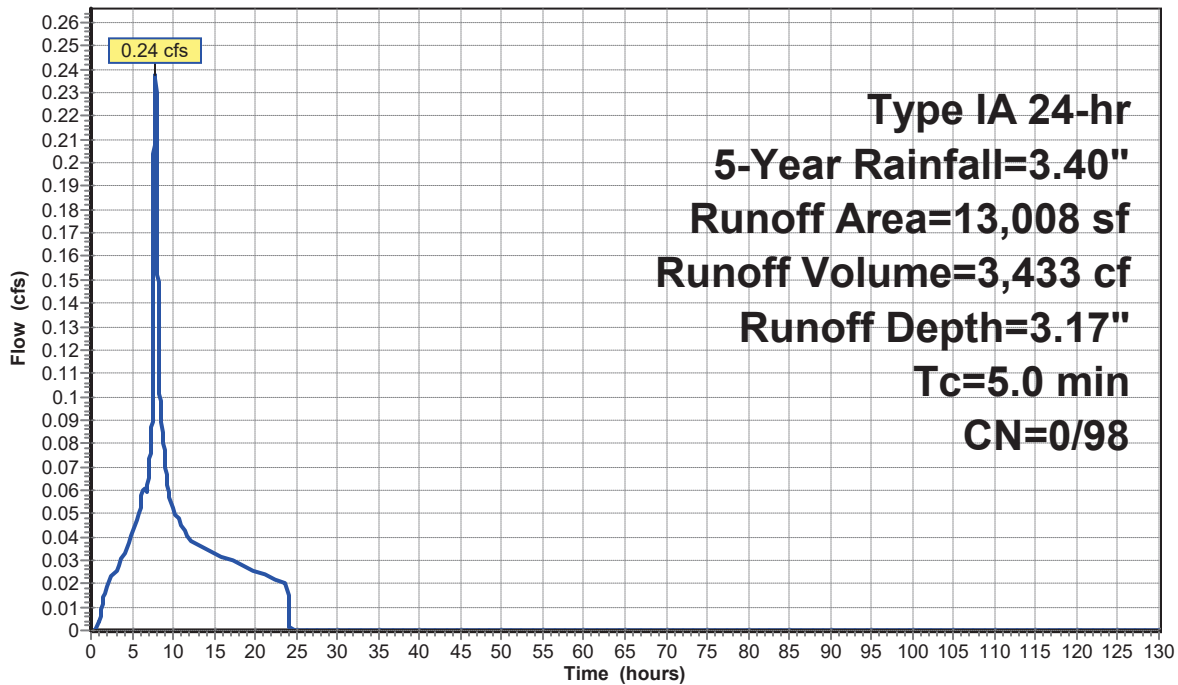
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 5-Year Rainfall=3.40"

	Area (sf)	CN	Description
*	13,008	98	Impervious Area
	13,008	98	100.00% Impervious Area

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

Subcatchment 5: Basin 5

Hydrograph



Bull Run Conveyance

Type IA 24-hr 5-Year Rainfall=3.40"

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Summary for Subcatchment 6: Basin 6

Runoff = 1.54 cfs @ 7.96 hrs, Volume= 24,090 cf, Depth= 1.82"

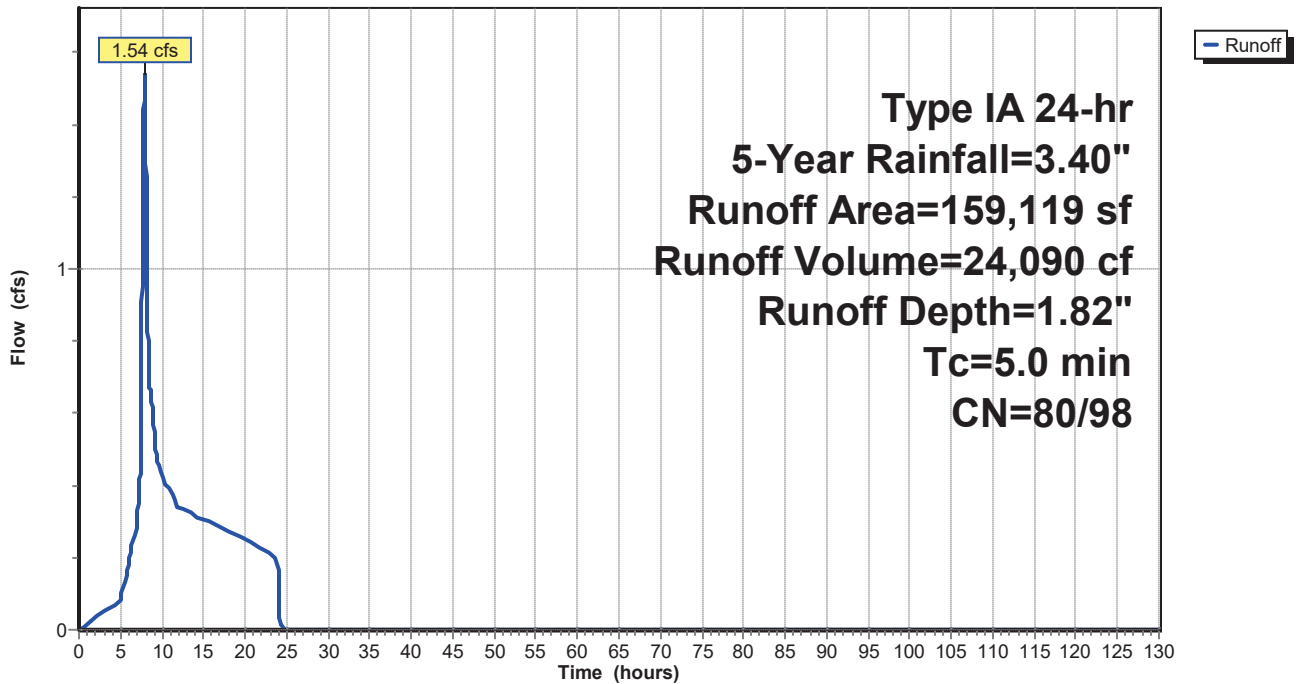
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
 Type IA 24-hr 5-Year Rainfall=3.40"

	Area (sf)	CN	Description
*	133,479	80	Pervious
*	25,640	98	Impervious
	159,119	83	Weighted Average
	133,479	80	83.89% Pervious Area
	25,640	98	16.11% Impervious Area

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

Subcatchment 6: Basin 6

Hydrograph



Bull Run Conveyance

Type IA 24-hr 5-Year Rainfall=3.40"

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Summary for Subcatchment 8: Basin 8

Runoff = 2.10 cfs @ 7.88 hrs, Volume= 30,385 cf, Depth= 3.17"

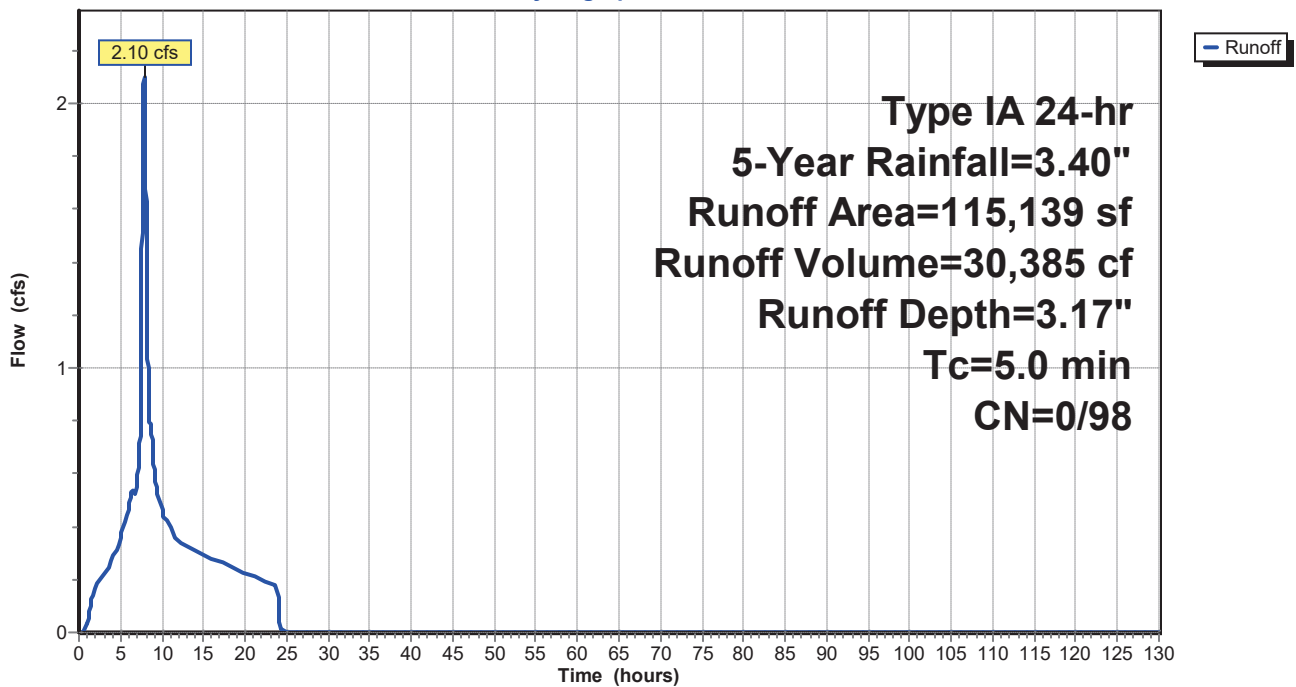
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 5-Year Rainfall=3.40"

Area (sf)	CN	Description
* 115,139	98	Impervious Area
115,139	98	100.00% Impervious Area

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

Subcatchment 8: Basin 8

Hydrograph



Bull Run Conveyance

Type IA 24-hr 5-Year Rainfall=3.40"

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Summary for Subcatchment 9: Basin 9

Runoff = 1.89 cfs @ 7.94 hrs, Volume= 29,268 cf, Depth= 1.96"

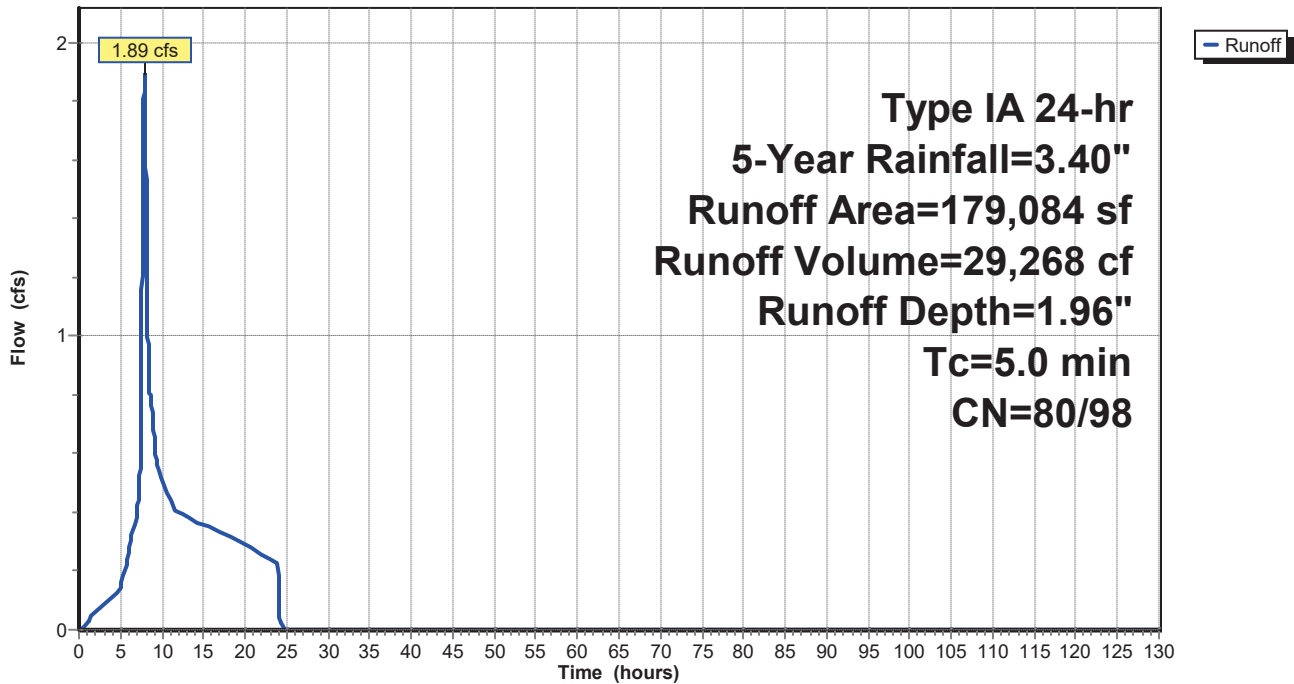
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
 Type IA 24-hr 5-Year Rainfall=3.40"

	Area (sf)	CN	Description
*	44,929	98	Impervious Area
*	134,155	80	Landscape Areas
	179,084	85	Weighted Average
	134,155	80	74.91% Pervious Area
	44,929	98	25.09% Impervious Area

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

Subcatchment 9: Basin 9

Hydrograph



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Type IA 24-hr 5-Year Rainfall=3.40"

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Summary for Subcatchment 10: Basin 10

Runoff = 5.55 cfs @ 7.97 hrs, Volume= 88,095 cf, Depth= 1.69"

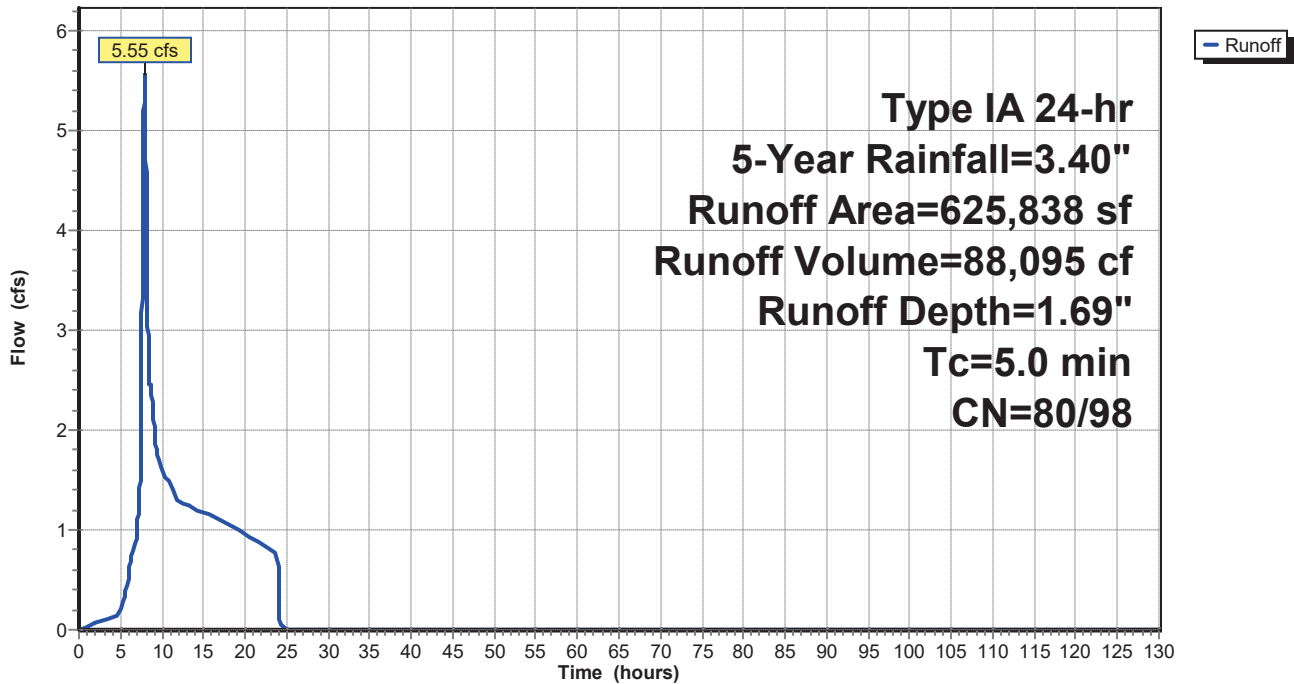
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 5-Year Rainfall=3.40"

	Area (sf)	CN	Description
*	51,234	98	Impervious Area
*	574,604	80	Pervious
	625,838	81	Weighted Average
	574,604	80	91.81% Pervious Area
	51,234	98	8.19% Impervious Area

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

Subcatchment 10: Basin 10

Hydrograph



Bull Run Conveyance

Type IA 24-hr 5-Year Rainfall=3.40"

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Summary for Subcatchment 11: Basin 11

Runoff = 1.16 cfs @ 7.95 hrs, Volume= 18,171 cf, Depth= 1.84"

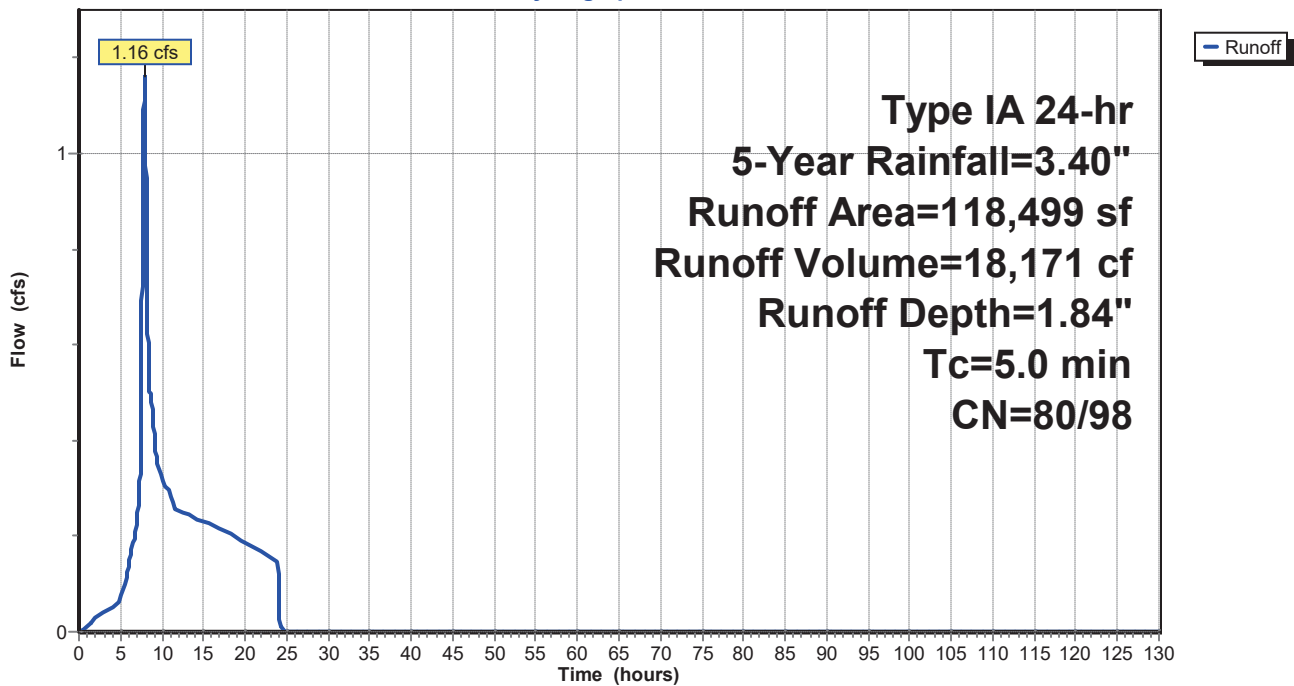
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
 Type IA 24-hr 5-Year Rainfall=3.40"

	Area (sf)	CN	Description
*	20,813	98	Impervious Area
*	97,686	80	Pervious
	118,499	83	Weighted Average
	97,686	80	82.44% Pervious Area
	20,813	98	17.56% Impervious Area

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

Subcatchment 11: Basin 11

Hydrograph



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Type IA 24-hr 5-Year Rainfall=3.40"

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Summary for Subcatchment 22: Basin 22

Runoff = 0.76 cfs @ 7.88 hrs, Volume= 11,025 cf, Depth= 3.17"

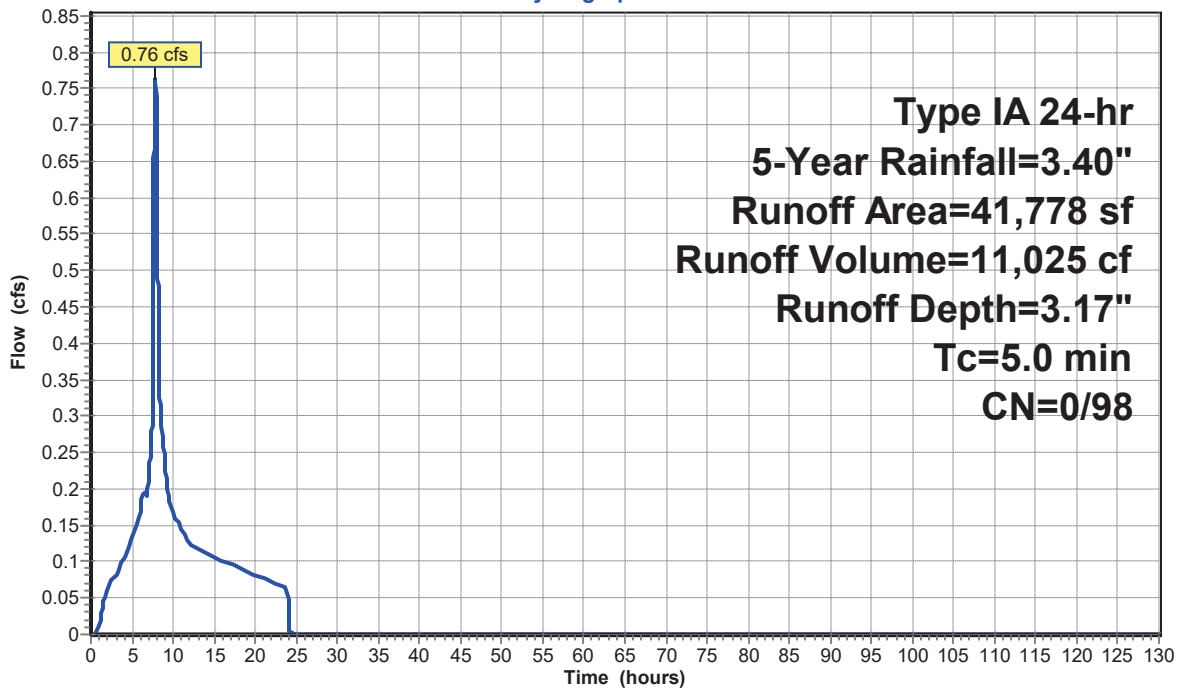
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 5-Year Rainfall=3.40"

	Area (sf)	CN	Description
*	41,778	98	Impervious Area
	41,778	98	100.00% Impervious Area

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

Subcatchment 22: Basin 22

Hydrograph



Bull Run Conveyance

Type IA 24-hr 5-Year Rainfall=3.40"

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Summary for Subcatchment 23: Basin 23

Runoff = 0.64 cfs @ 7.89 hrs, Volume= 9,404 cf, Depth= 2.72"

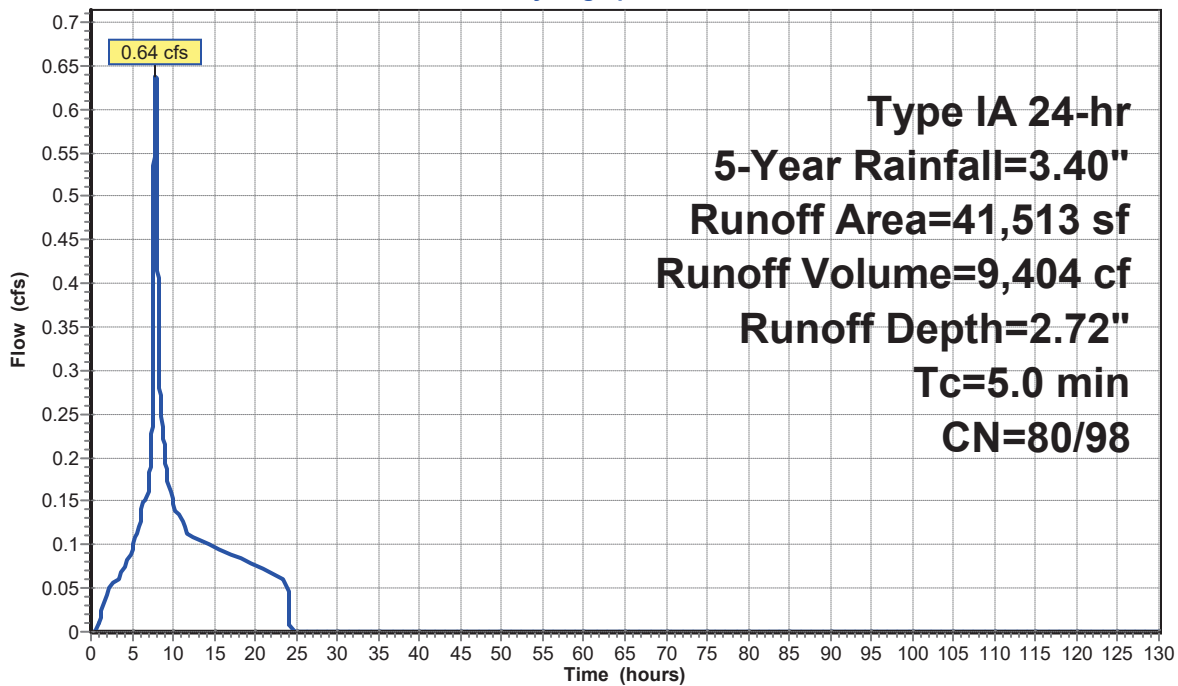
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
 Type IA 24-hr 5-Year Rainfall=3.40"

	Area (sf)	CN	Description
*	29,948	98	Impervious Area
*	11,565	80	Pervious
	41,513	93	Weighted Average
	11,565	80	27.86% Pervious Area
	29,948	98	72.14% Impervious Area

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

Subcatchment 23: Basin 23

Hydrograph



Bull Run Conveyance

Type IA 24-hr 5-Year Rainfall=3.40"

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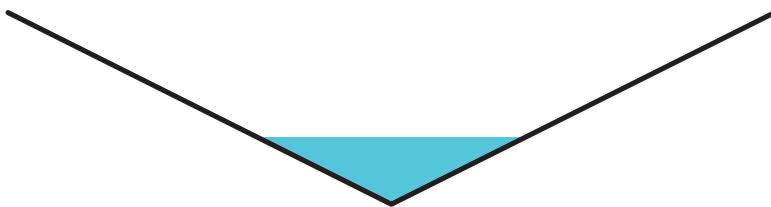
Summary for Reach R4: Ditch 4

Inflow Area = 1,080,338 sf, 25.35% Impervious, Inflow Depth > 6.12" for 5-Year event
 Inflow = 3.69 cfs @ 9.77 hrs, Volume= 551,028 cf
 Outflow = 3.69 cfs @ 9.77 hrs, Volume= 551,003 cf, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
 Max. Velocity= 4.90 fps, Min. Travel Time= 0.3 min
 Avg. Velocity = 3.57 fps, Avg. Travel Time= 0.5 min

Peak Storage= 75 cf @ 9.77 hrs
 Average Depth at Peak Storage= 0.61'
 Bank-Full Depth= 1.75' Flow Area= 6.1 sf, Capacity= 60.27 cfs

Custom cross-section, Length= 100.0' Slope= 0.0380 '/'
 Constant n= 0.025 Earth, clean & straight
 Inlet Invert= 694.00', Outlet Invert= 690.20'



Offset (feet)	Elevation (feet)	Chan.Depth (feet)
-3.50	1.75	0.00
0.00	0.00	1.75
3.50	1.75	0.00

Depth (feet)	End Area (sq-ft)	Perim. (feet)	Storage (cubic-feet)	Discharge (cfs)
0.00	0.0	0.0	0	0.00
1.75	6.1	7.8	613	60.27

Bull Run Conveyance

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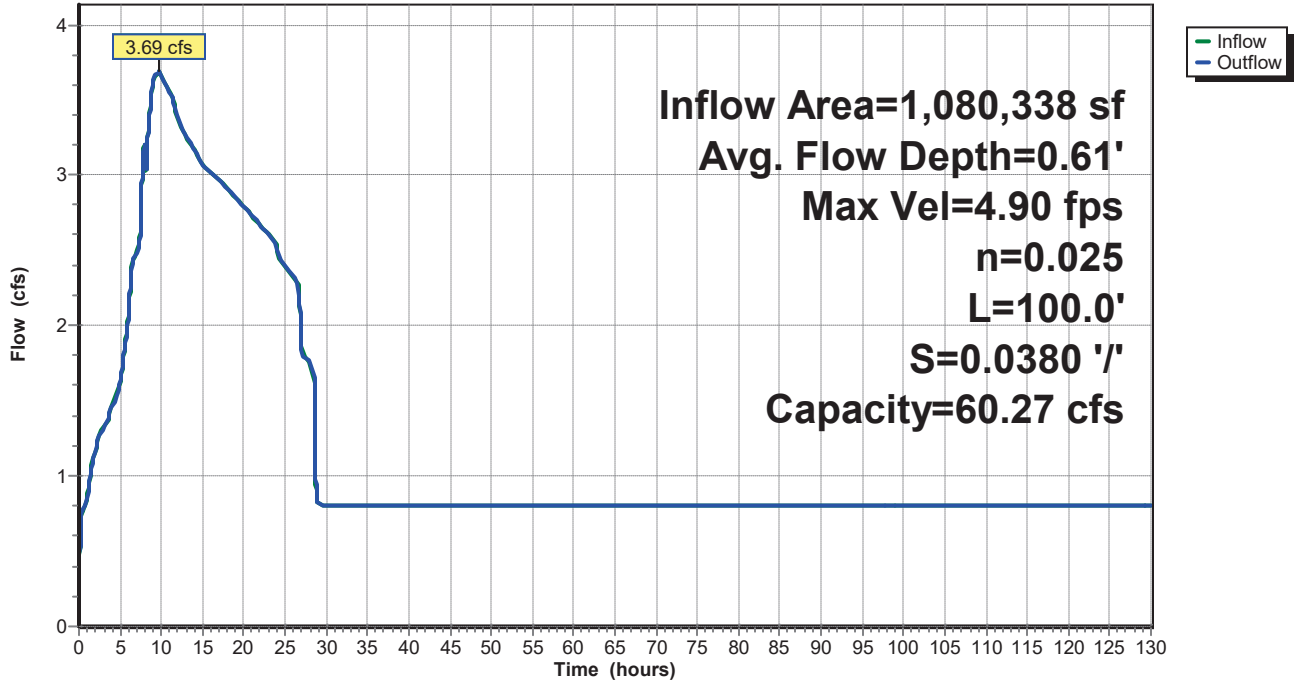
Type IA 24-hr 5-Year Rainfall=3.40"

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Reach R4: Ditch 4

Hydrograph



Bull Run Conveyance

Type IA 24-hr 5-Year Rainfall=3.40"

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Summary for Pond Pond A: Pond A

Inflow Area = 349,468 sf, 50.41% Impervious, Inflow Depth = 2.37" for 5-Year event
 Inflow = 4.59 cfs @ 7.91 hrs, Volume= 68,983 cf
 Outflow = 1.18 cfs @ 9.84 hrs, Volume= 68,983 cf, Atten= 74%, Lag= 115.6 min
 Primary = 1.18 cfs @ 9.84 hrs, Volume= 68,983 cf

Routing by Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs / 3
 Peak Elev= 709.65' @ 9.84 hrs Surf.Area= 8,451 sf Storage= 15,736 cf

Plug-Flow detention time= 240.8 min calculated for 68,983 cf (100% of inflow)
 Center-of-Mass det. time= 240.8 min (953.4 - 712.7)

Volume	Invert	Avail.Storage	Storage Description
#1	707.50'	70,555 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
707.50	6,107	0	0
708.00	6,714	3,205	3,205
709.00	7,742	7,228	10,433
710.00	8,825	8,284	18,717
711.00	9,967	9,396	28,113
712.00	11,161	10,564	38,677
713.00	12,412	11,787	50,463
714.00	13,717	13,065	63,528
714.50	14,392	7,027	70,555

Device	Routing	Invert	Outlet Devices
#1	Primary	698.43'	18.0" Round Culvert L= 138.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 698.43' / 696.24' S= 0.0159 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf
#2	Device 1	696.43'	2.6" Horiz. Orifice/Grate C= 0.620 Limited to weir flow at low heads
#3	Device 1	709.40'	16.0" W x 3.0" H Vert. Orifice/Grate C= 0.620

Primary OutFlow Max=1.18 cfs @ 9.84 hrs HW=709.65' (Free Discharge)

- ↑ **1=Culvert** (Passes 1.18 cfs of 24.40 cfs potential flow)
- ↑ **2=Orifice/Grate** (Orifice Controls 0.61 cfs @ 16.67 fps)
- ↑ **3=Orifice/Grate** (Orifice Controls 0.57 cfs @ 1.70 fps)

Bull Run Conveyance

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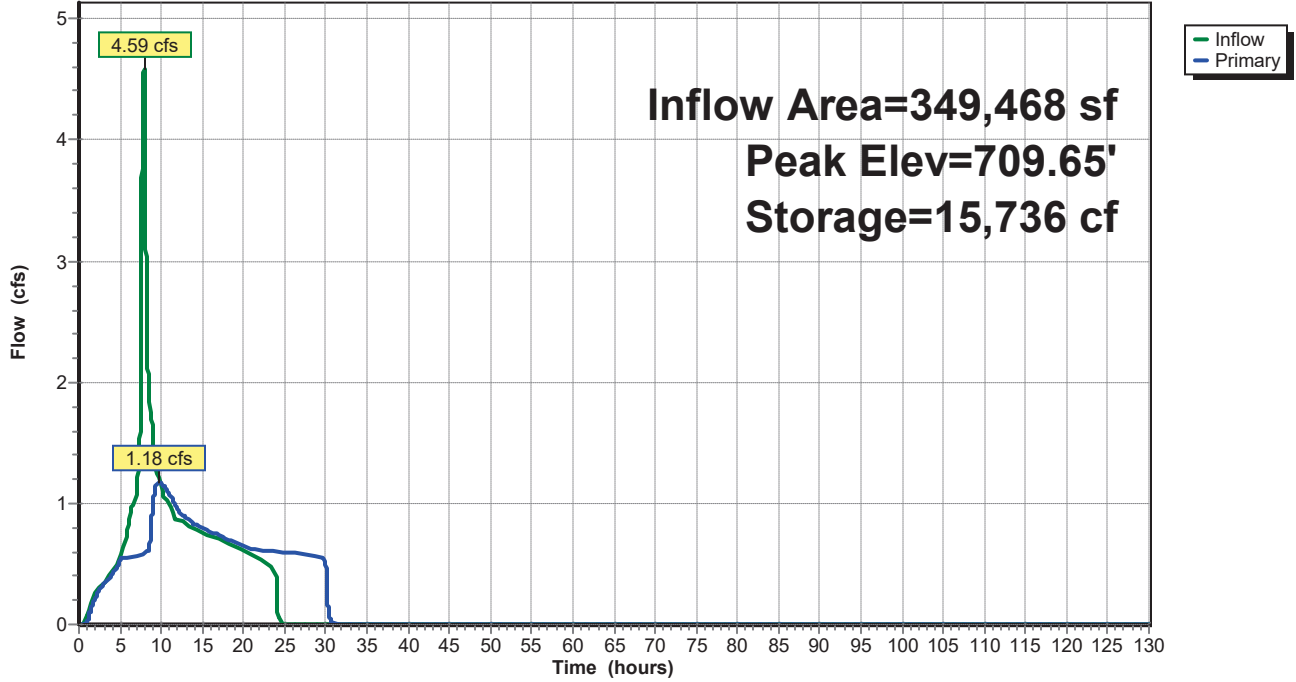
Type IA 24-hr 5-Year Rainfall=3.40"

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Pond Pond A: Pond A

Hydrograph



Bull Run Conveyance

Type IA 24-hr 5-Year Rainfall=3.40"

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Summary for Pond Pond B: Pond B

Inflow Area = 294,223 sf, 54.40% Impervious, Inflow Depth = 2.43" for 5-Year event
 Inflow = 3.98 cfs @ 7.91 hrs, Volume= 59,653 cf
 Outflow = 1.34 cfs @ 8.97 hrs, Volume= 59,653 cf, Atten= 66%, Lag= 63.7 min
 Primary = 1.34 cfs @ 8.97 hrs, Volume= 59,653 cf

Routing by Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs / 3
 Peak Elev= 709.48' @ 8.97 hrs Surf.Area= 5,573 sf Storage= 11,166 cf

Plug-Flow detention time= 157.4 min calculated for 59,648 cf (100% of inflow)
 Center-of-Mass det. time= 157.4 min (864.9 - 707.5)

Volume	Invert	Avail.Storage	Storage Description
#1	707.00'	36,813 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
707.00	3,493	0	0
708.00	4,288	3,891	3,891
709.00	5,139	4,714	8,604
710.00	6,046	5,593	14,197
711.00	7,010	6,528	20,725
712.00	8,030	7,520	28,245
713.00	9,107	8,569	36,813

Device	Routing	Invert	Outlet Devices
#1	Primary	705.04'	18.0" Round Culvert L= 339.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 705.04' / 701.65' S= 0.0100 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf
#2	Device 1	703.04'	3.5" Horiz. Orifice/Grate C= 0.620 Limited to weir flow at low heads
#3	Device 1	709.15'	14.0" W x 3.0" H Vert. Orifice/Grate C= 0.620

Primary OutFlow Max=1.34 cfs @ 8.97 hrs HW=709.48' (Free Discharge)

- ↑ **1=Culvert** (Passes 1.34 cfs of 12.86 cfs potential flow)
- ↑ **2=Orifice/Grate** (Orifice Controls 0.70 cfs @ 10.48 fps)
- ↑ **3=Orifice/Grate** (Orifice Controls 0.64 cfs @ 2.21 fps)

Bull Run Conveyance

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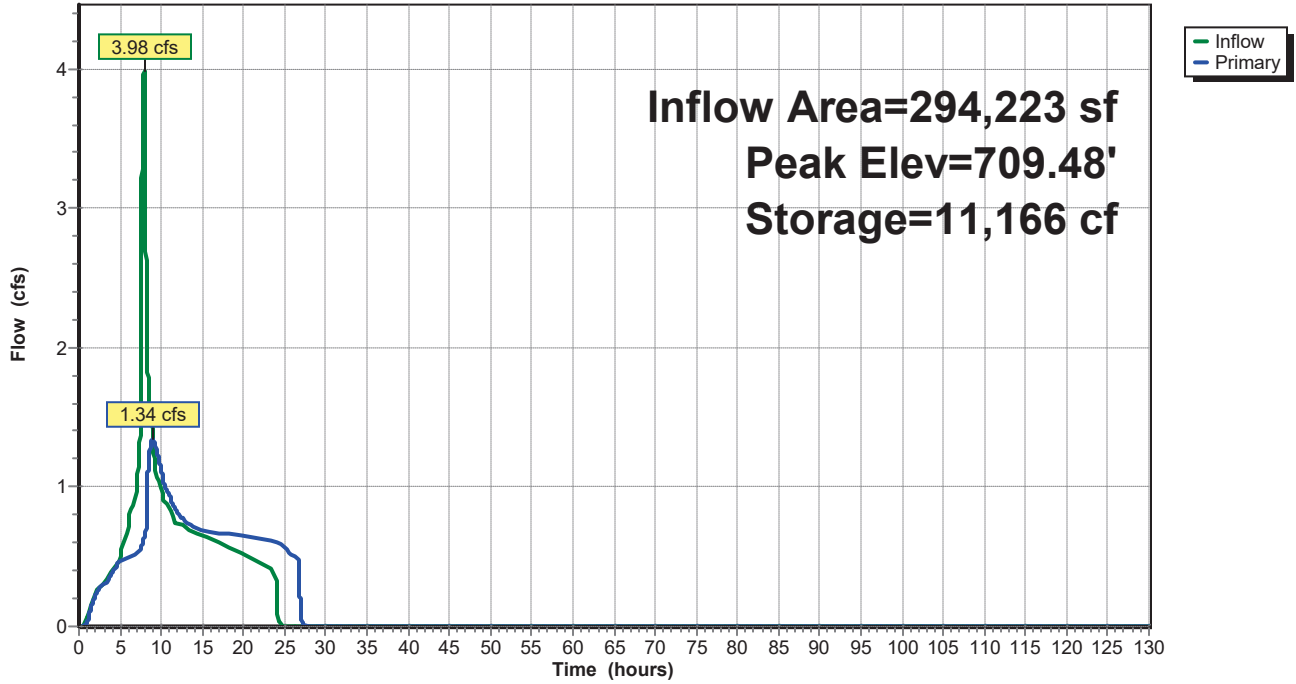
Type IA 24-hr 5-Year Rainfall=3.40"

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Pond Pond B: Pond B

Hydrograph



Bull Run Conveyance

Type IA 24-hr 5-Year Rainfall=3.40"

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Summary for Pond Pond C: Pond C

Inflow Area = 744,337 sf, 9.68% Impervious, Inflow Depth > 7.75" for 5-Year event
 Inflow = 7.52 cfs @ 7.97 hrs, Volume= 480,694 cf, Incl. 0.80 cfs Base Flow
 Outflow = 2.48 cfs @ 11.23 hrs, Volume= 480,349 cf, Atten= 67%, Lag= 195.8 min
 Primary = 2.48 cfs @ 11.23 hrs, Volume= 480,349 cf

Routing by Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs / 3
 Peak Elev= 705.11' @ 11.23 hrs Surf.Area= 21,150 sf Storage= 21,926 cf

Plug-Flow detention time= 49.4 min calculated for 480,345 cf (100% of inflow)
 Center-of-Mass det. time= 46.1 min (3,257.9 - 3,211.9)

Volume	Invert	Avail.Storage	Storage Description
#1	704.00'	95,416 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
704.00	18,277	0	0
705.00	20,828	19,553	19,553
706.00	23,671	22,250	41,802
707.00	26,743	25,207	67,009
708.00	30,070	28,407	95,416

Device	Routing	Invert	Outlet Devices
#1	Primary	697.90'	12.0" Round Culvert L= 53.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 697.90' / 695.55' S= 0.0443 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	693.90'	5.1" Horiz. Orifice/Grate C= 0.620 Limited to weir flow at low heads
#3	Device 1	704.85'	16.0" W x 3.0" H Vert. Orifice/Grate C= 0.620

Primary OutFlow Max=2.49 cfs @ 11.23 hrs HW=705.11' (Free Discharge)

- ↑ **1=Culvert** (Passes 2.49 cfs of 9.80 cfs potential flow)
- ↑ **2=Orifice/Grate** (Orifice Controls 1.90 cfs @ 13.36 fps)
- ↑ **3=Orifice/Grate** (Orifice Controls 0.59 cfs @ 1.77 fps)

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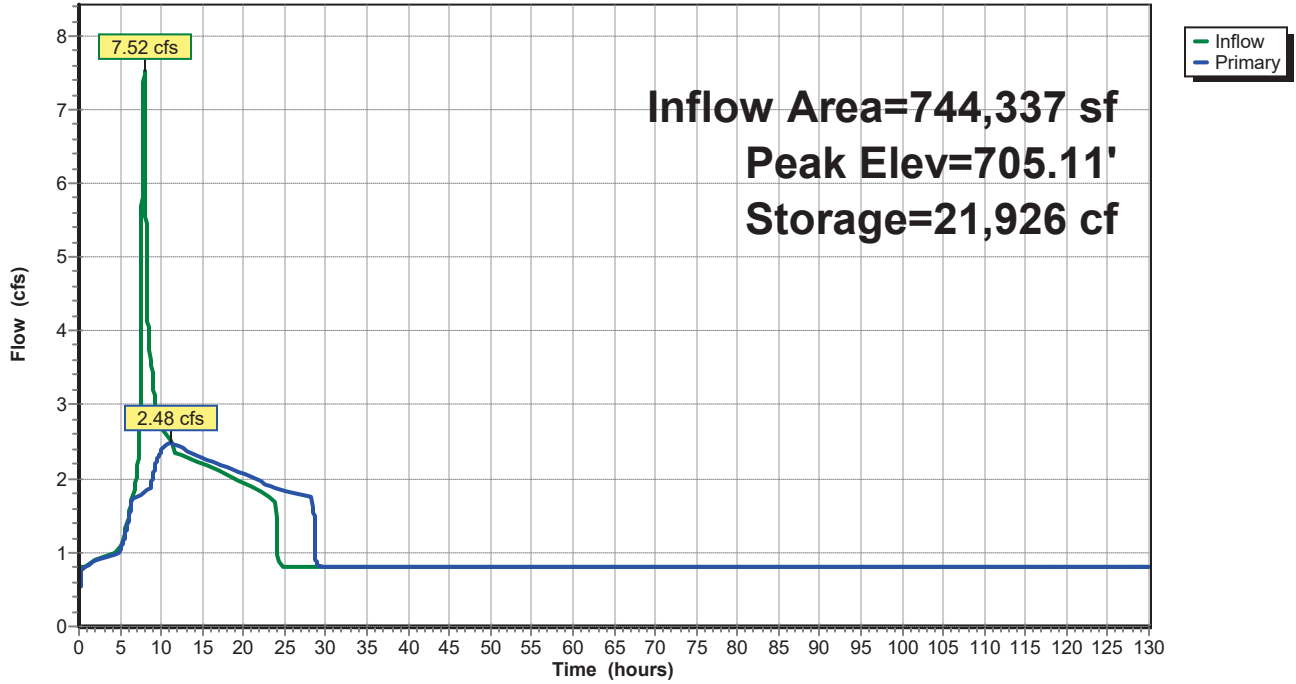
Type IA 24-hr 5-Year Rainfall=3.40"

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Pond Pond C: Pond C

Hydrograph



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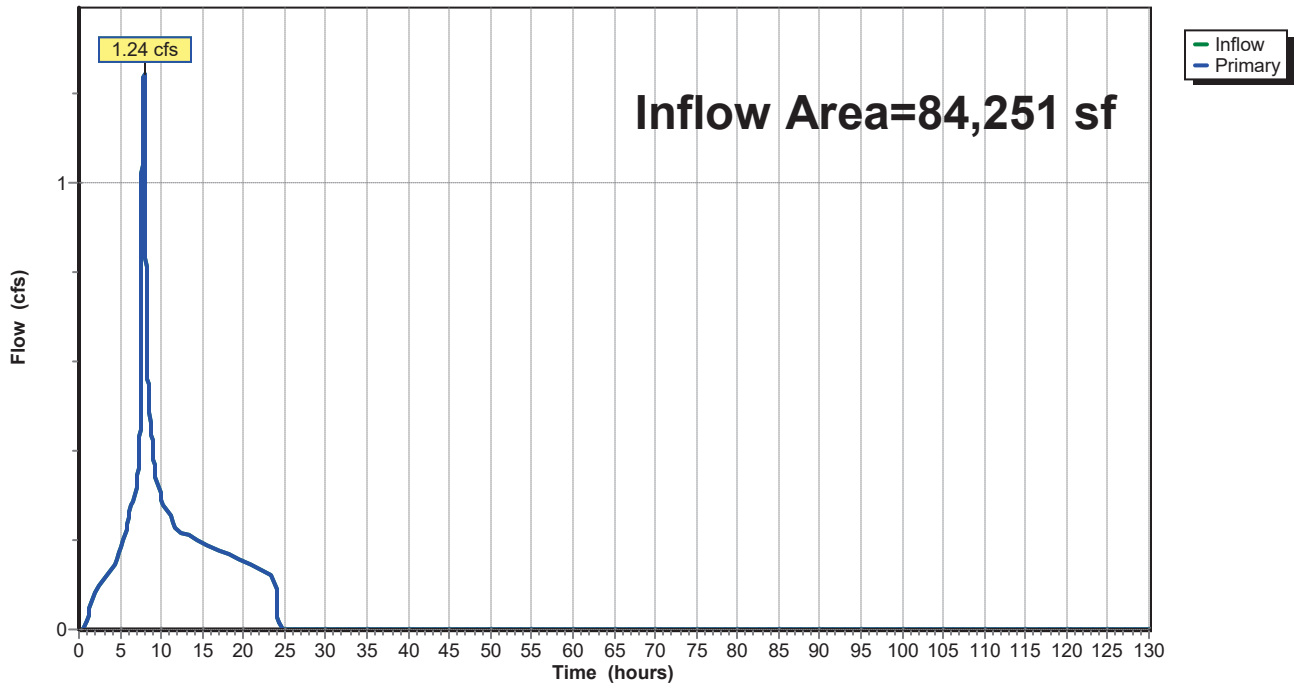
Summary for Link L1: Pipe 4

Inflow Area = 84,251 sf, 66.47% Impervious, Inflow Depth = 2.63" for 5-Year event
Inflow = 1.24 cfs @ 7.90 hrs, Volume= 18,445 cf
Primary = 1.24 cfs @ 7.90 hrs, Volume= 18,445 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs

Link L1: Pipe 4

Hydrograph



Bull Run Conveyance

Type IA 24-hr 5-Year Rainfall=3.40"

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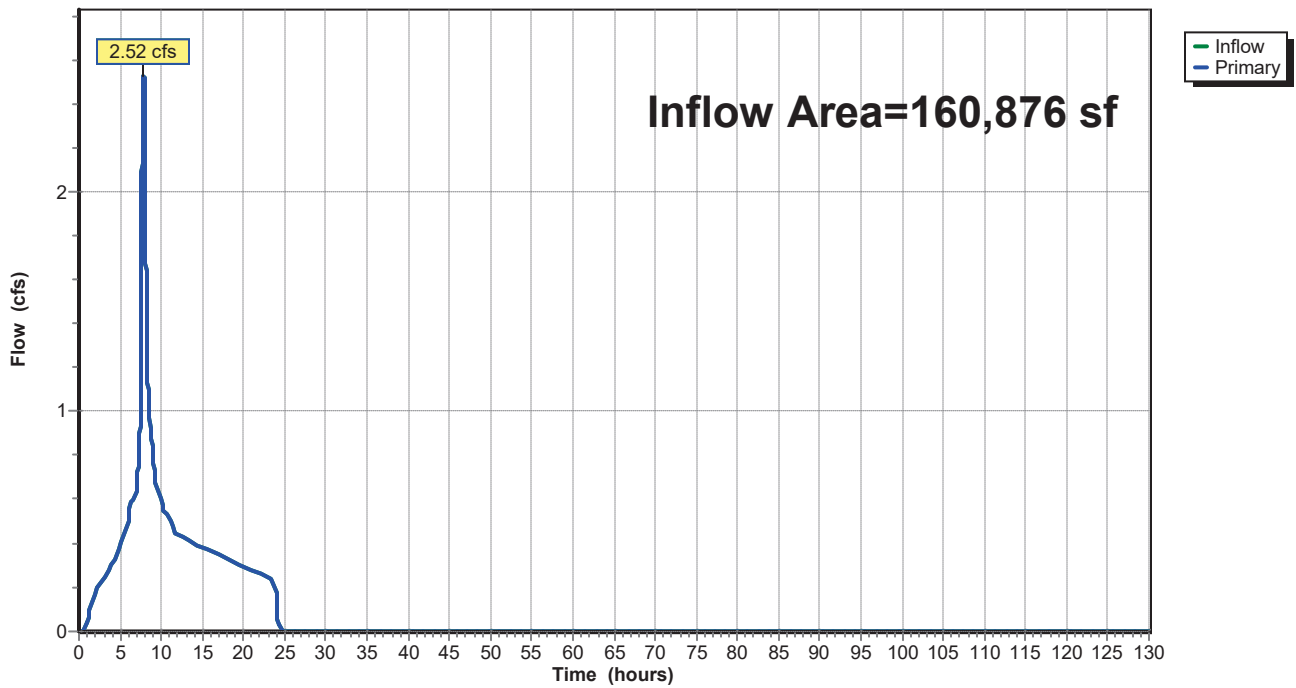
Summary for Link L2: Pipe 6

Inflow Area = 160,876 sf, 75.25% Impervious, Inflow Depth = 2.77" for 5-Year event
Inflow = 2.52 cfs @ 7.89 hrs, Volume= 37,115 cf
Primary = 2.52 cfs @ 7.89 hrs, Volume= 37,115 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs

Link L2: Pipe 6

Hydrograph



Bull Run Conveyance

Type IA 24-hr 5-Year Rainfall=3.40"

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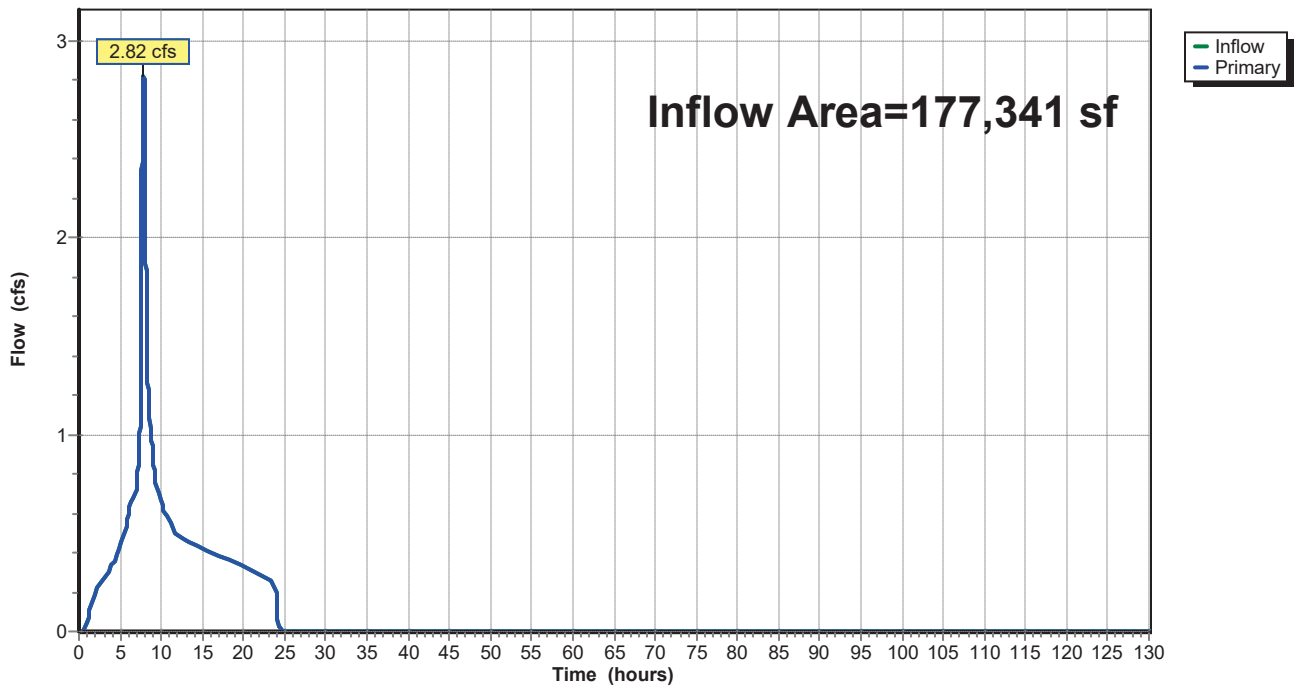
Summary for Link L3: Pipe 7

Inflow Area = 177,341 sf, 77.55% Impervious, Inflow Depth = 2.81" for 5-Year event
Inflow = 2.82 cfs @ 7.89 hrs, Volume= 41,460 cf
Primary = 2.82 cfs @ 7.89 hrs, Volume= 41,460 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs

Link L3: Pipe 7

Hydrograph



Bull Run Conveyance

Type IA 24-hr 5-Year Rainfall=3.40"

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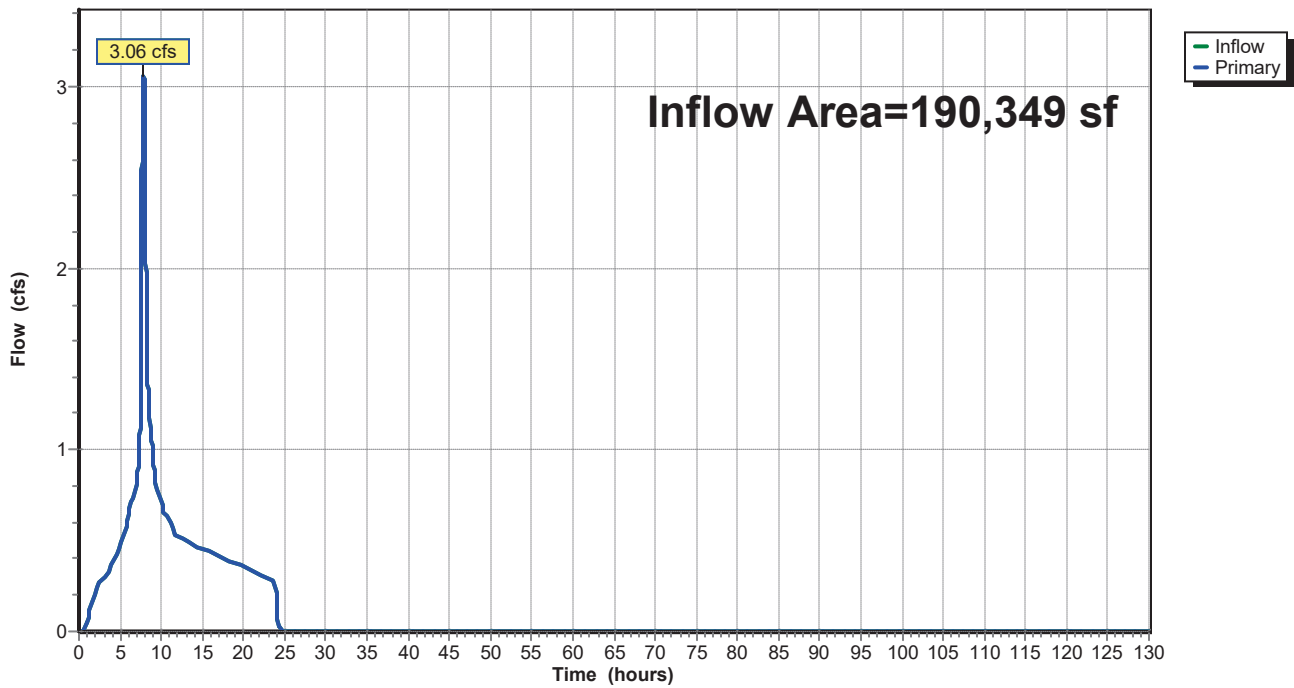
Summary for Link L4: Pipe 9

Inflow Area = 190,349 sf, 79.08% Impervious, Inflow Depth = 2.83" for 5-Year event
Inflow = 3.06 cfs @ 7.89 hrs, Volume= 44,893 cf
Primary = 3.06 cfs @ 7.89 hrs, Volume= 44,893 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs

Link L4: Pipe 9

Hydrograph



Bull Run Conveyance

Type IA 24-hr 10-Year Rainfall=3.80"

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Summary for Subcatchment 1: Basin 1

Runoff = 0.78 cfs @ 7.91 hrs, Volume= 11,659 cf, Depth= 2.66"

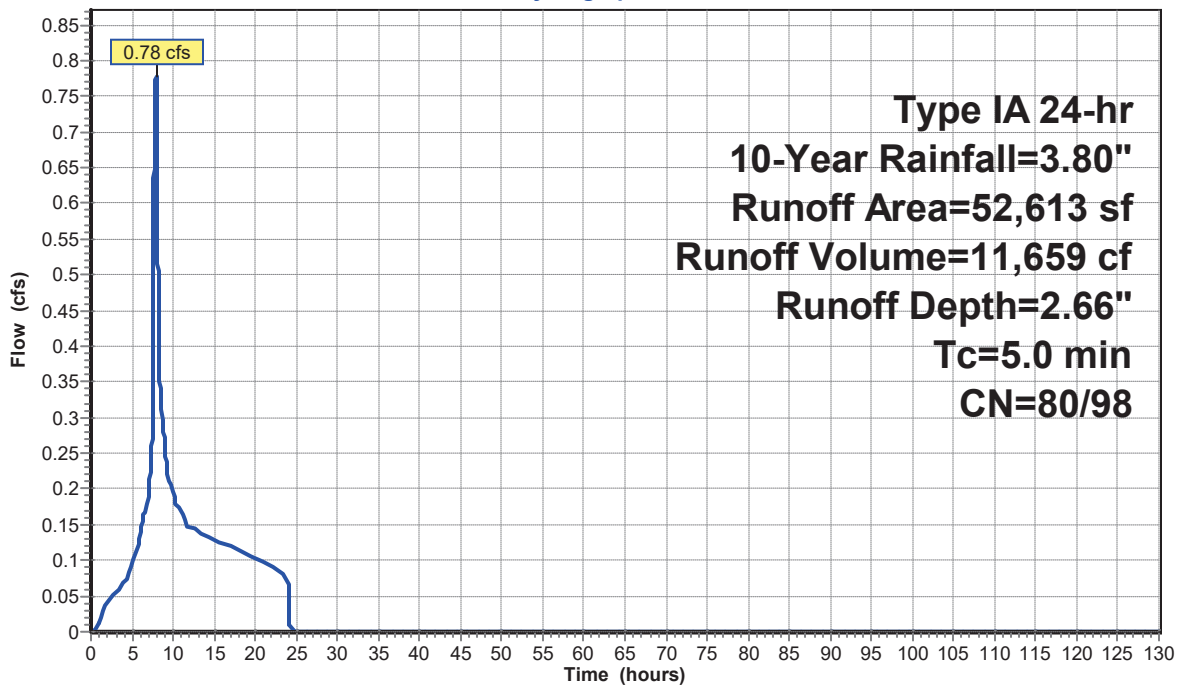
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Year Rainfall=3.80"

	Area (sf)	CN	Description
*	24,364	98	Impervious Area
*	28,249	80	Pervious
	52,613	88	Weighted Average
	28,249	80	53.69% Pervious Area
	24,364	98	46.31% Impervious Area

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

Subcatchment 1: Basin 1

Hydrograph



Bull Run Conveyance

Type IA 24-hr 10-Year Rainfall=3.80"

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Summary for Subcatchment 2: Basin 2

Runoff = 0.65 cfs @ 7.88 hrs, Volume= 9,401 cf, Depth= 3.57"

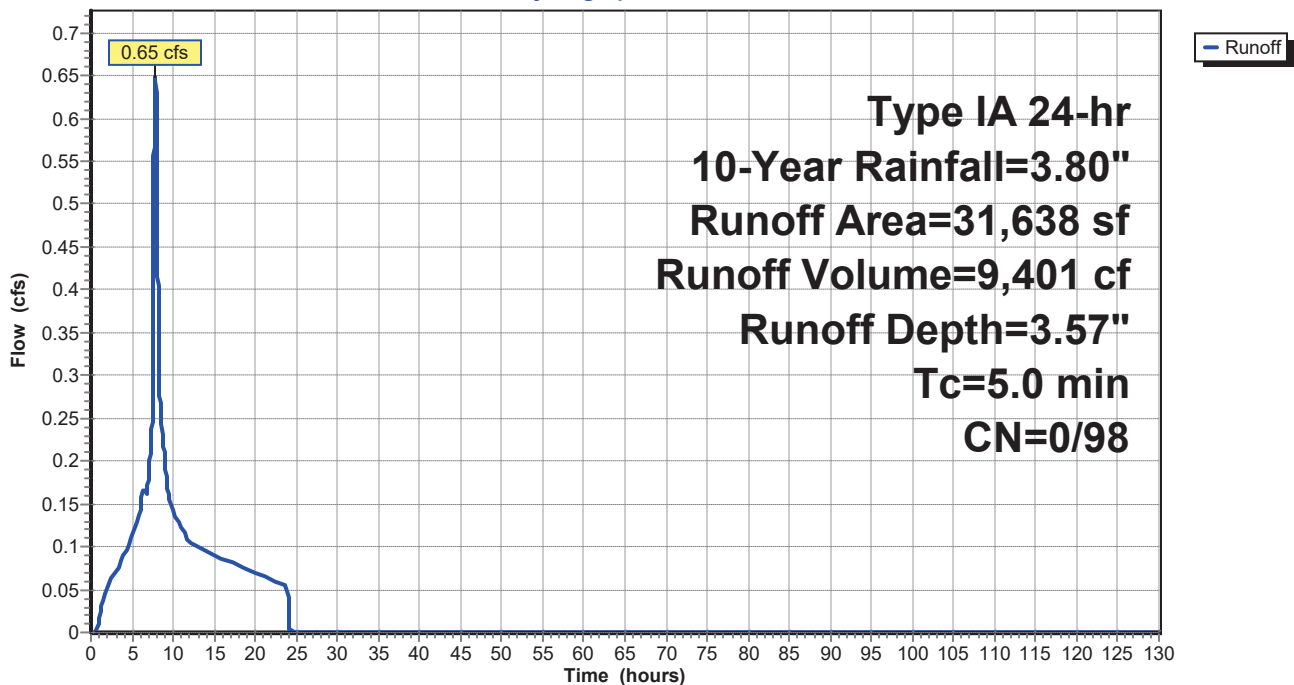
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Year Rainfall=3.80"

	Area (sf)	CN	Description
*	31,638	98	Impervious Area
	31,638	98	100.00% Impervious Area

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

Subcatchment 2: Basin 2

Hydrograph



Bull Run Conveyance

Type IA 24-hr 10-Year Rainfall=3.80"

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Summary for Subcatchment 3: Basin 3

Runoff = 0.72 cfs @ 7.88 hrs, Volume= 10,433 cf, Depth= 3.57"

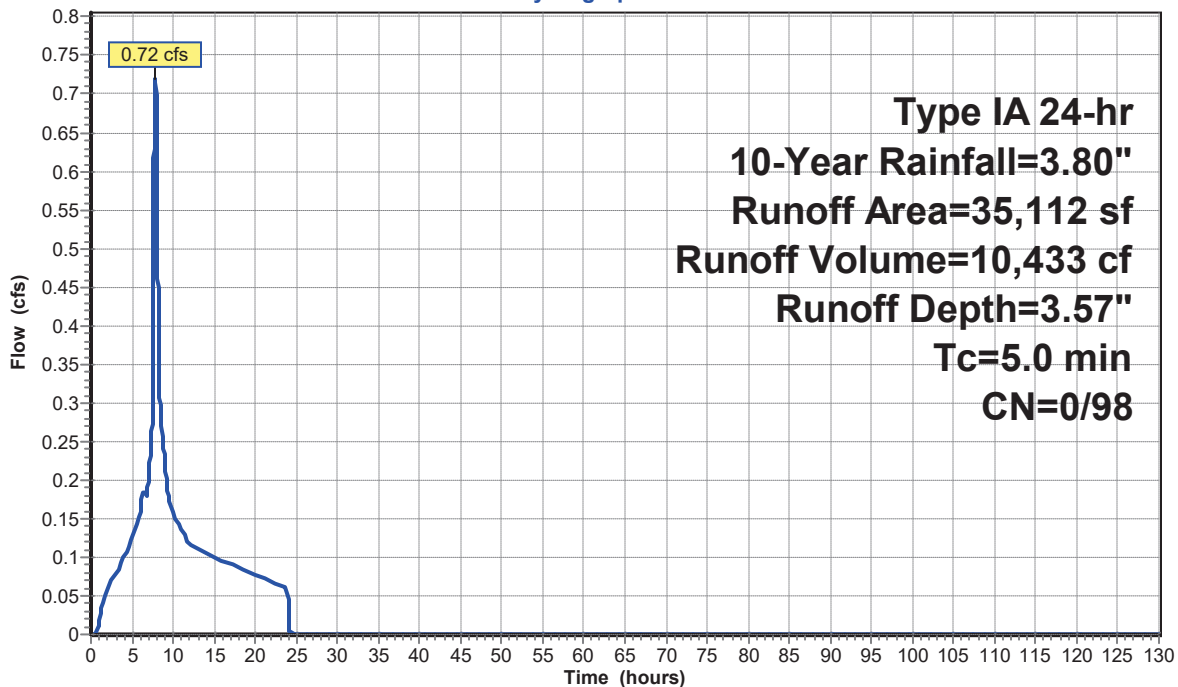
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Year Rainfall=3.80"

	Area (sf)	CN	Description
*	35,112	98	Impervious Area
	35,112	98	100.00% Impervious Area

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

Subcatchment 3: Basin 3

Hydrograph



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Type IA 24-hr 10-Year Rainfall=3.80"

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Summary for Subcatchment 4: Basin 4

Runoff = 0.34 cfs @ 7.88 hrs, Volume= 4,892 cf, Depth= 3.57"

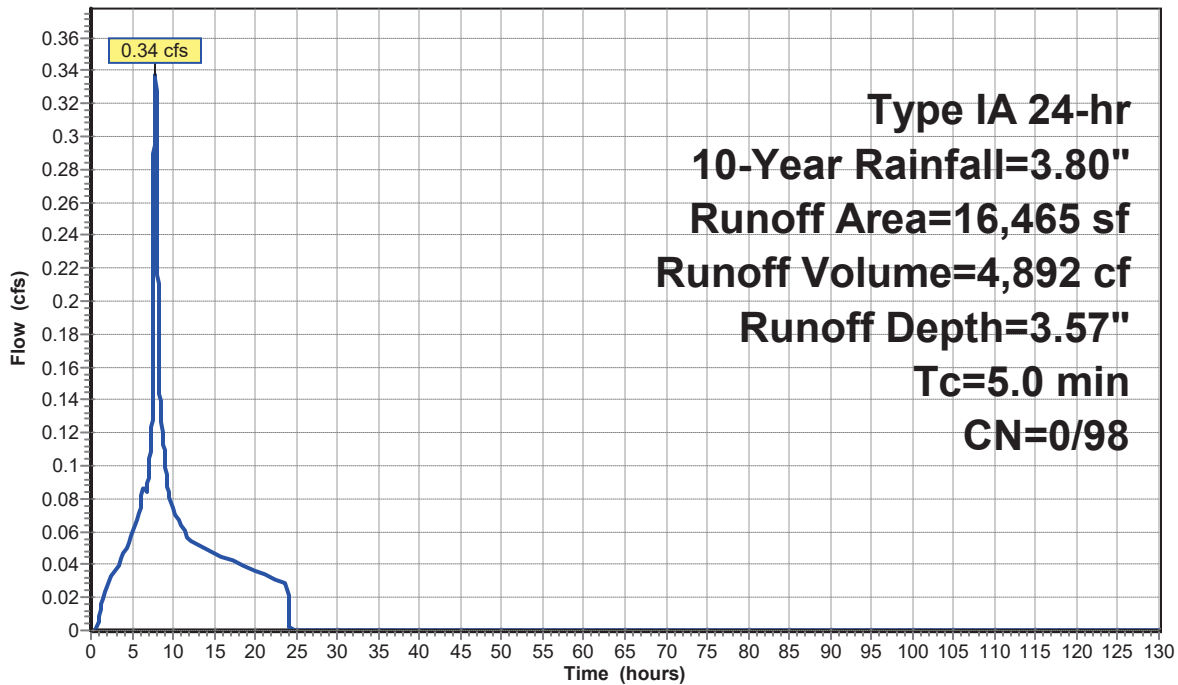
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Year Rainfall=3.80"

	Area (sf)	CN	Description
*	16,465	98	Impervious Area
	16,465	98	100.00% Impervious Area

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

Subcatchment 4: Basin 4

Hydrograph



Bull Run Conveyance

Type IA 24-hr 10-Year Rainfall=3.80"

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Summary for Subcatchment 5: Basin 5

Runoff = 0.27 cfs @ 7.88 hrs, Volume= 3,865 cf, Depth= 3.57"

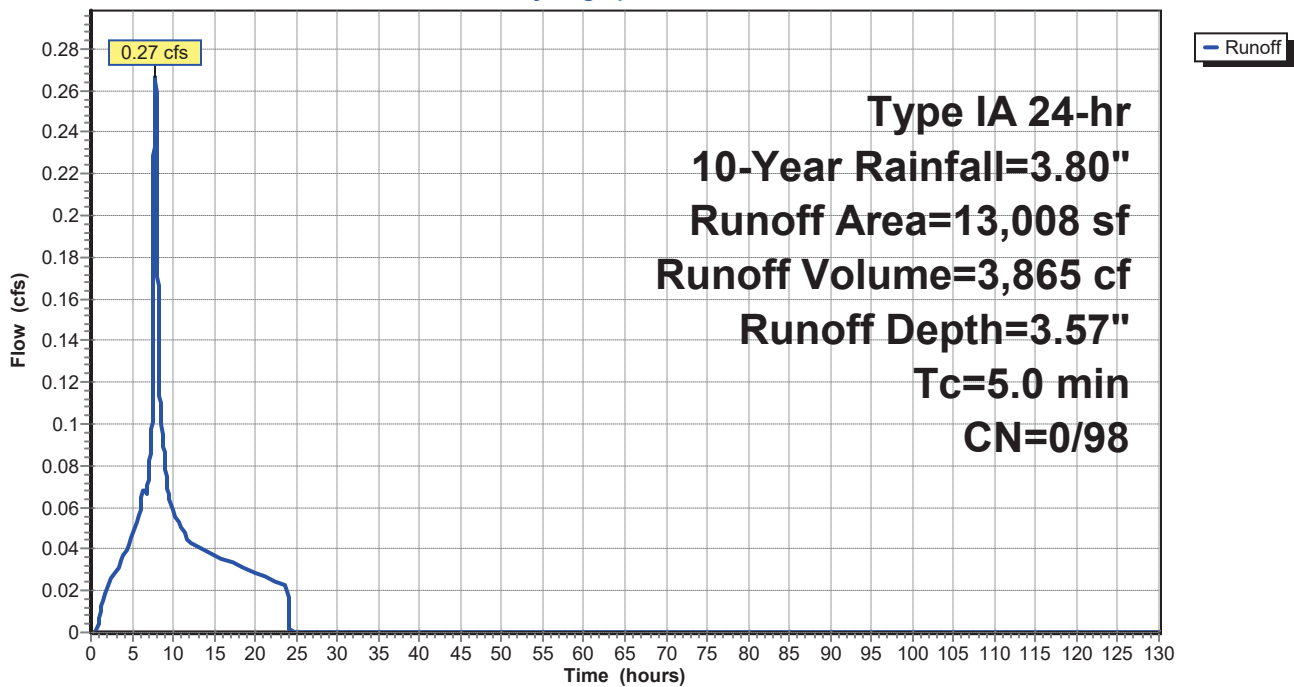
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Year Rainfall=3.80"

	Area (sf)	CN	Description
*	13,008	98	Impervious Area
	13,008	98	100.00% Impervious Area

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

Subcatchment 5: Basin 5

Hydrograph



Bull Run Conveyance

Type IA 24-hr 10-Year Rainfall=3.80"

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Summary for Subcatchment 6: Basin 6

Runoff = 1.85 cfs @ 7.95 hrs, Volume= 28,503 cf, Depth= 2.15"

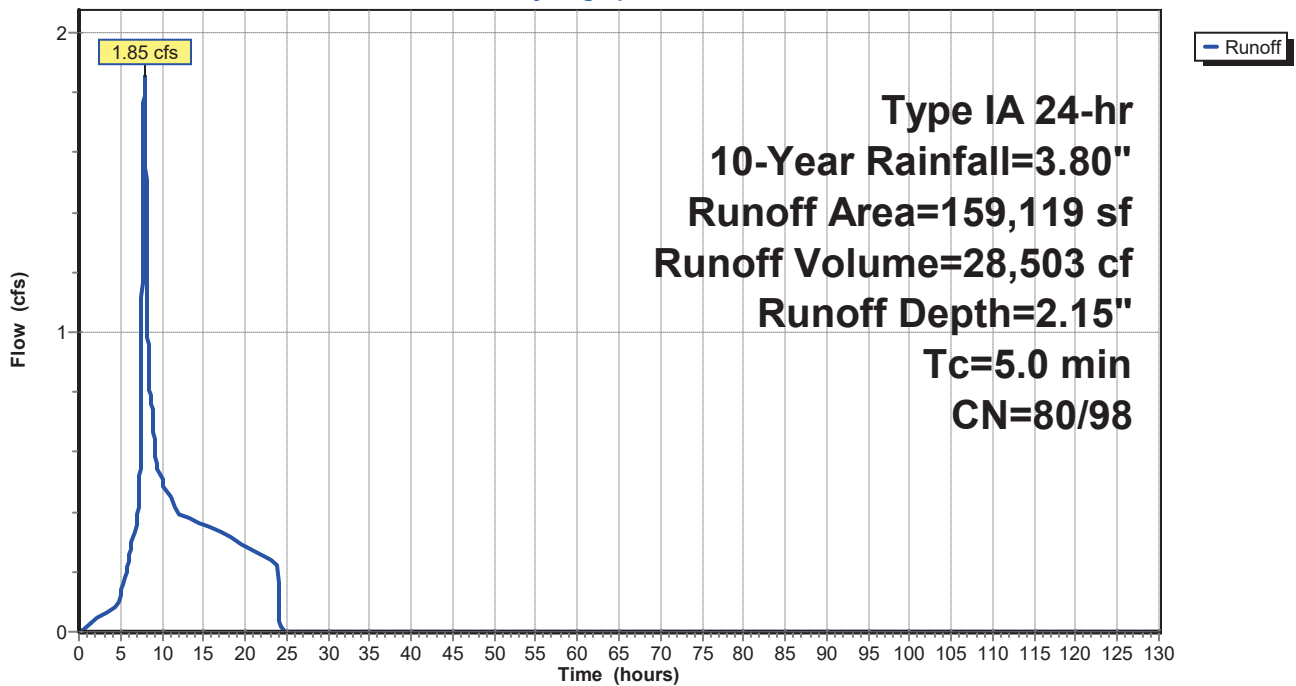
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Year Rainfall=3.80"

	Area (sf)	CN	Description
*	133,479	80	Pervious
*	25,640	98	Impervious
	159,119	83	Weighted Average
	133,479	80	83.89% Pervious Area
	25,640	98	16.11% Impervious Area

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

Subcatchment 6: Basin 6

Hydrograph



Bull Run Conveyance

Type IA 24-hr 10-Year Rainfall=3.80"

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Summary for Subcatchment 8: Basin 8

Runoff = 2.36 cfs @ 7.88 hrs, Volume= 34,212 cf, Depth= 3.57"

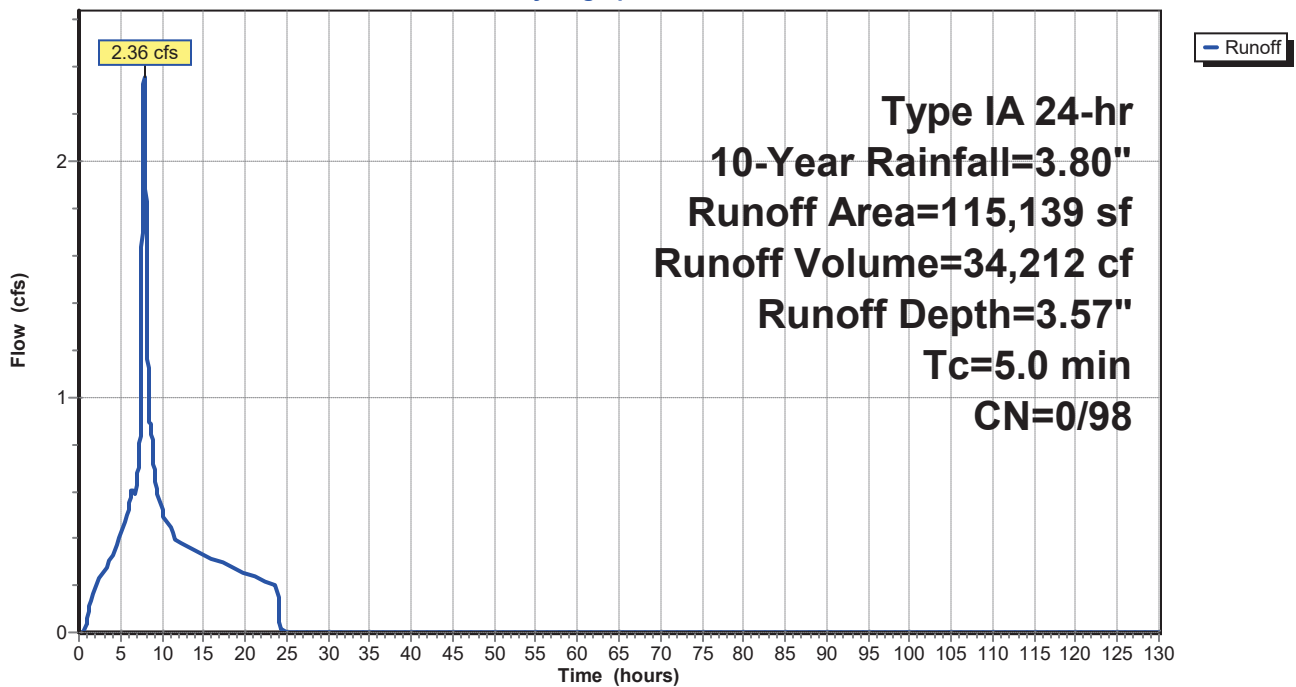
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Year Rainfall=3.80"

Area (sf)	CN	Description
* 115,139	98	Impervious Area
115,139	98	100.00% Impervious Area

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

Subcatchment 8: Basin 8

Hydrograph



Bull Run Conveyance

Type IA 24-hr 10-Year Rainfall=3.80"

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Summary for Subcatchment 9: Basin 9

Runoff = 2.25 cfs @ 7.94 hrs, Volume= 34,341 cf, Depth= 2.30"

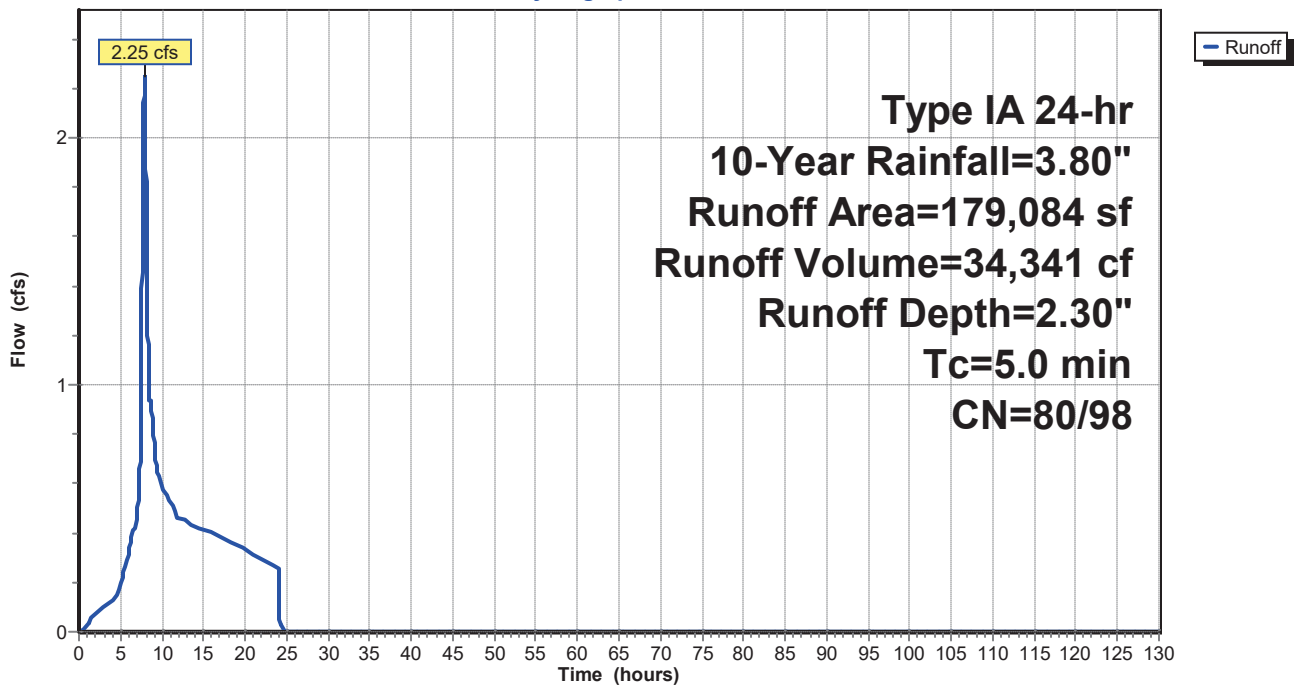
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Year Rainfall=3.80"

	Area (sf)	CN	Description
*	44,929	98	Impervious Area
*	134,155	80	Landscape Areas
	179,084	85	Weighted Average
	134,155	80	74.91% Pervious Area
	44,929	98	25.09% Impervious Area

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

Subcatchment 9: Basin 9

Hydrograph



Bull Run Conveyance

Type IA 24-hr 10-Year Rainfall=3.80"

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Summary for Subcatchment 10: Basin 10

Runoff = 6.79 cfs @ 7.96 hrs, Volume= 105,129 cf, Depth= 2.02"

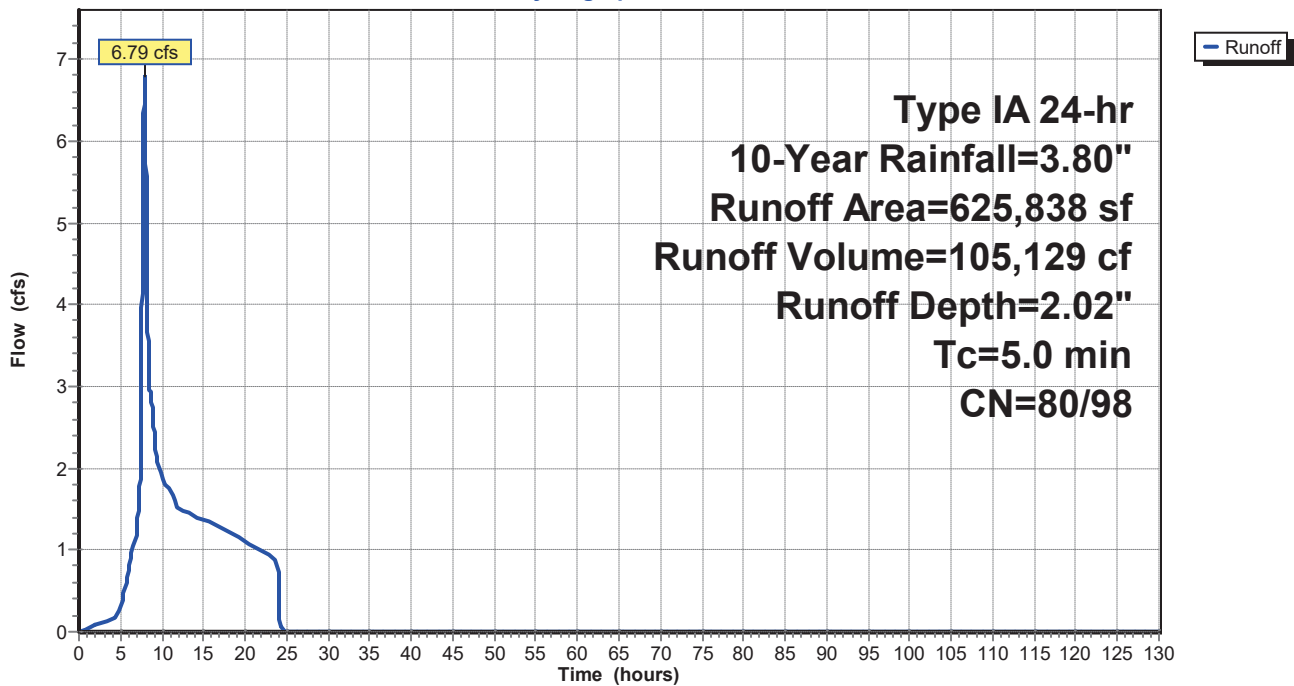
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Year Rainfall=3.80"

	Area (sf)	CN	Description
*	51,234	98	Impervious Area
*	574,604	80	Pervious
	625,838	81	Weighted Average
	574,604	80	91.81% Pervious Area
	51,234	98	8.19% Impervious Area

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

Subcatchment 10: Basin 10

Hydrograph



Bull Run Conveyance

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Type IA 24-hr 10-Year Rainfall=3.80"

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Summary for Subcatchment 11: Basin 11

Runoff = 1.40 cfs @ 7.95 hrs, Volume= 21,469 cf, Depth= 2.17"

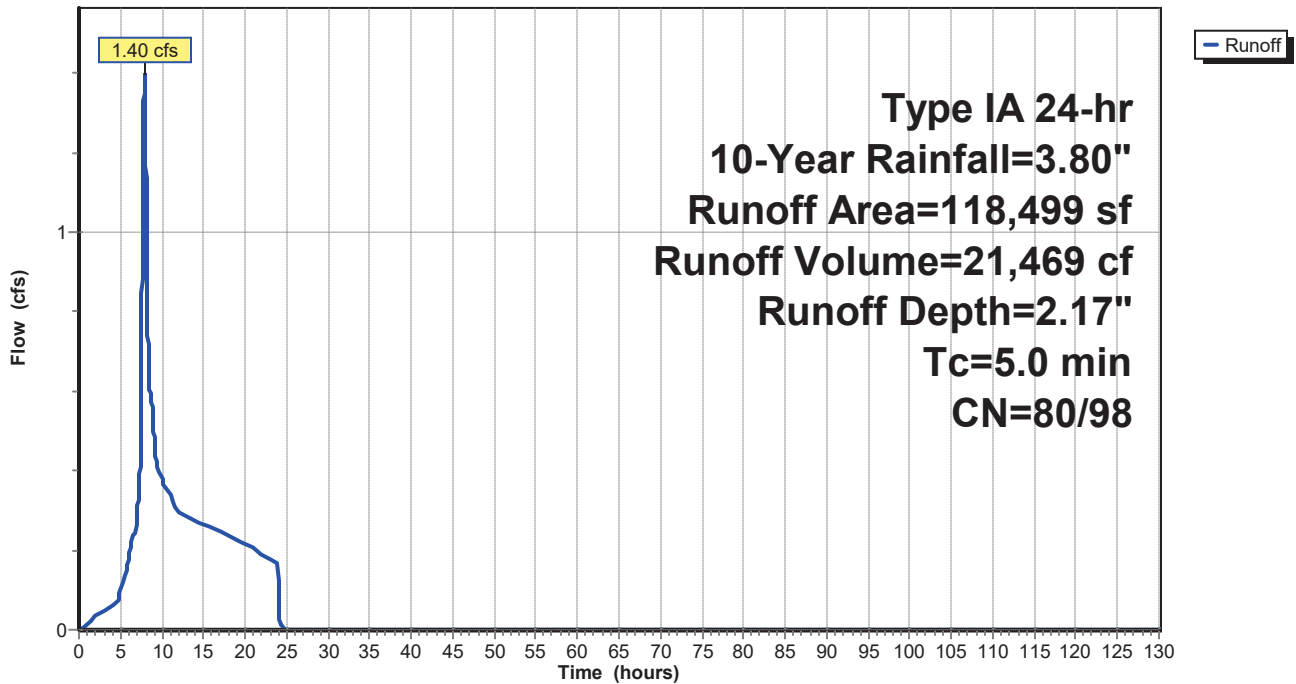
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Year Rainfall=3.80"

	Area (sf)	CN	Description
*	20,813	98	Impervious Area
*	97,686	80	Pervious
	118,499	83	Weighted Average
	97,686	80	82.44% Pervious Area
	20,813	98	17.56% Impervious Area

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

Subcatchment 11: Basin 11

Hydrograph



Bull Run Conveyance

Type IA 24-hr 10-Year Rainfall=3.80"

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Summary for Subcatchment 22: Basin 22

Runoff = 0.86 cfs @ 7.88 hrs, Volume= 12,414 cf, Depth= 3.57"

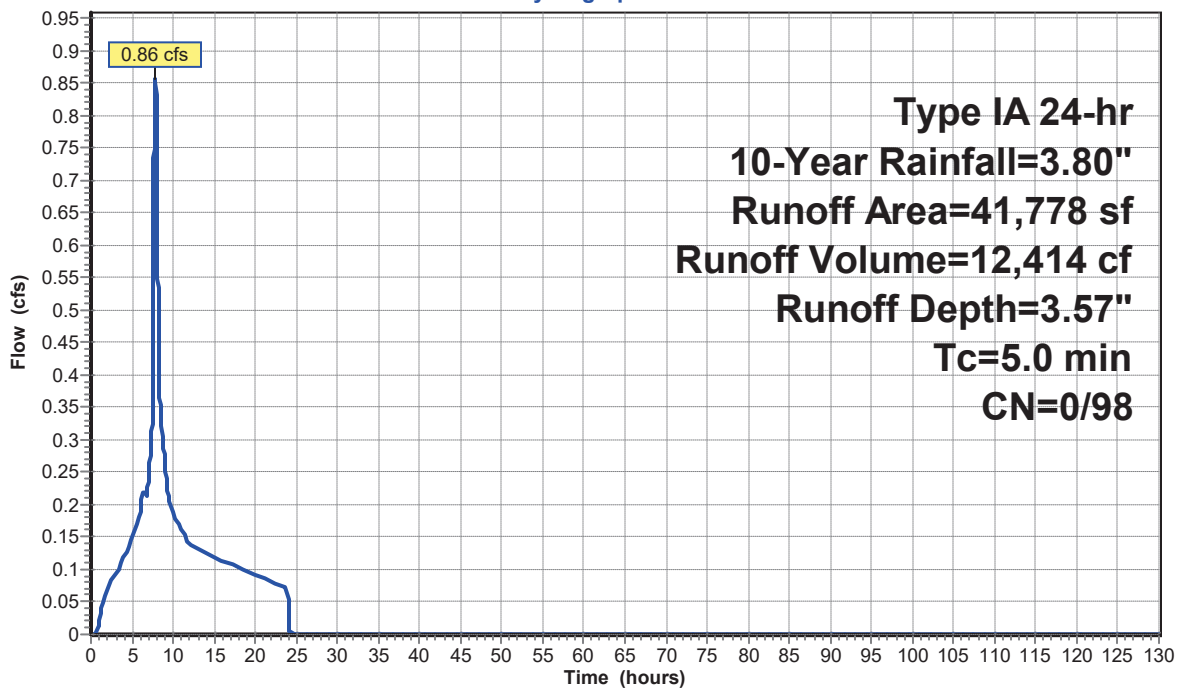
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Year Rainfall=3.80"

	Area (sf)	CN	Description
*	41,778	98	Impervious Area
	41,778	98	100.00% Impervious Area

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

Subcatchment 22: Basin 22

Hydrograph



Bull Run Conveyance

Type IA 24-hr 10-Year Rainfall=3.80"

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Summary for Subcatchment 23: Basin 23

Runoff = 0.73 cfs @ 7.89 hrs, Volume= 10,708 cf, Depth= 3.10"

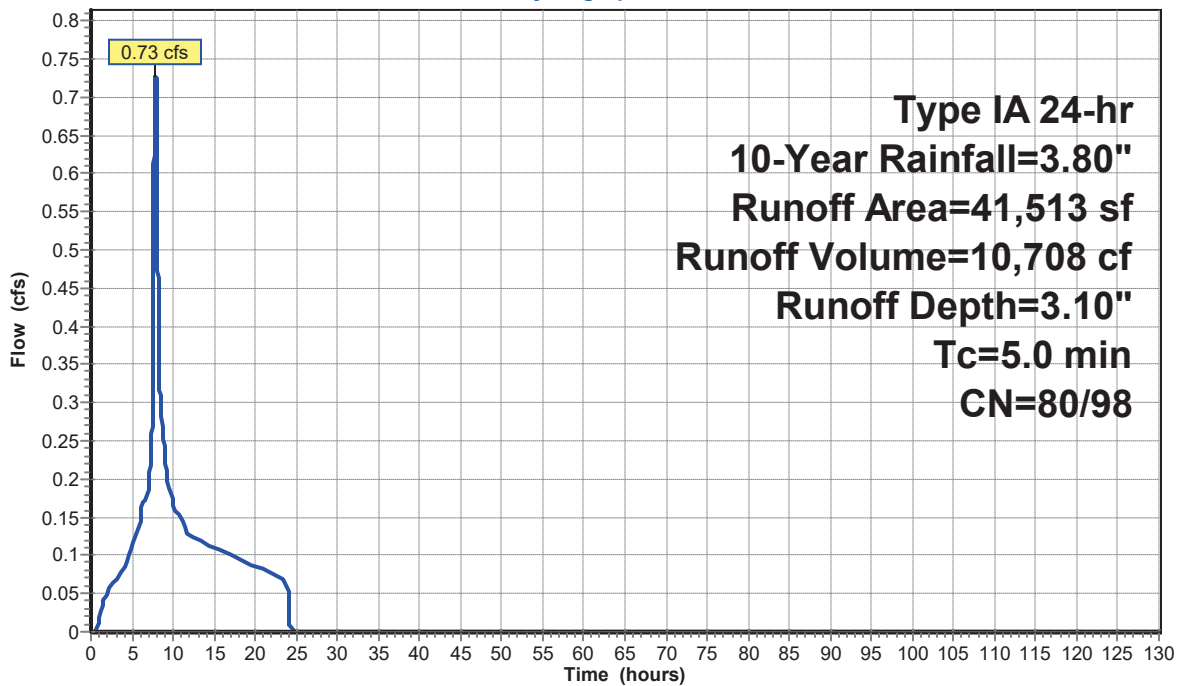
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Year Rainfall=3.80"

	Area (sf)	CN	Description
*	29,948	98	Impervious Area
*	11,565	80	Pervious
	41,513	93	Weighted Average
	11,565	80	27.86% Pervious Area
	29,948	98	72.14% Impervious Area

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

Subcatchment 23: Basin 23

Hydrograph



Bull Run Conveyance

Type IA 24-hr 10-Year Rainfall=3.80"

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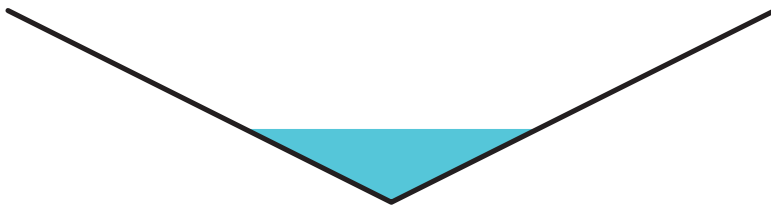
Summary for Reach R4: Ditch 4

Inflow Area = 1,080,338 sf, 25.35% Impervious, Inflow Depth > 6.46" for 10-Year event
Inflow = 4.63 cfs @ 9.05 hrs, Volume= 581,648 cf
Outflow = 4.63 cfs @ 9.06 hrs, Volume= 581,624 cf, Atten= 0%, Lag= 0.2 min

Routing by Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Max. Velocity= 5.18 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 3.60 fps, Avg. Travel Time= 0.5 min

Peak Storage= 89 cf @ 9.06 hrs
Average Depth at Peak Storage= 0.67'
Bank-Full Depth= 1.75' Flow Area= 6.1 sf, Capacity= 60.27 cfs

Custom cross-section, Length= 100.0' Slope= 0.0380 '/'
Constant n= 0.025 Earth, clean & straight
Inlet Invert= 694.00', Outlet Invert= 690.20'



Offset (feet)	Elevation (feet)	Chan.Depth (feet)
-3.50	1.75	0.00
0.00	0.00	1.75
3.50	1.75	0.00

Depth (feet)	End Area (sq-ft)	Perim. (feet)	Storage (cubic-feet)	Discharge (cfs)
0.00	0.0	0.0	0	0.00
1.75	6.1	7.8	613	60.27

Bull Run Conveyance

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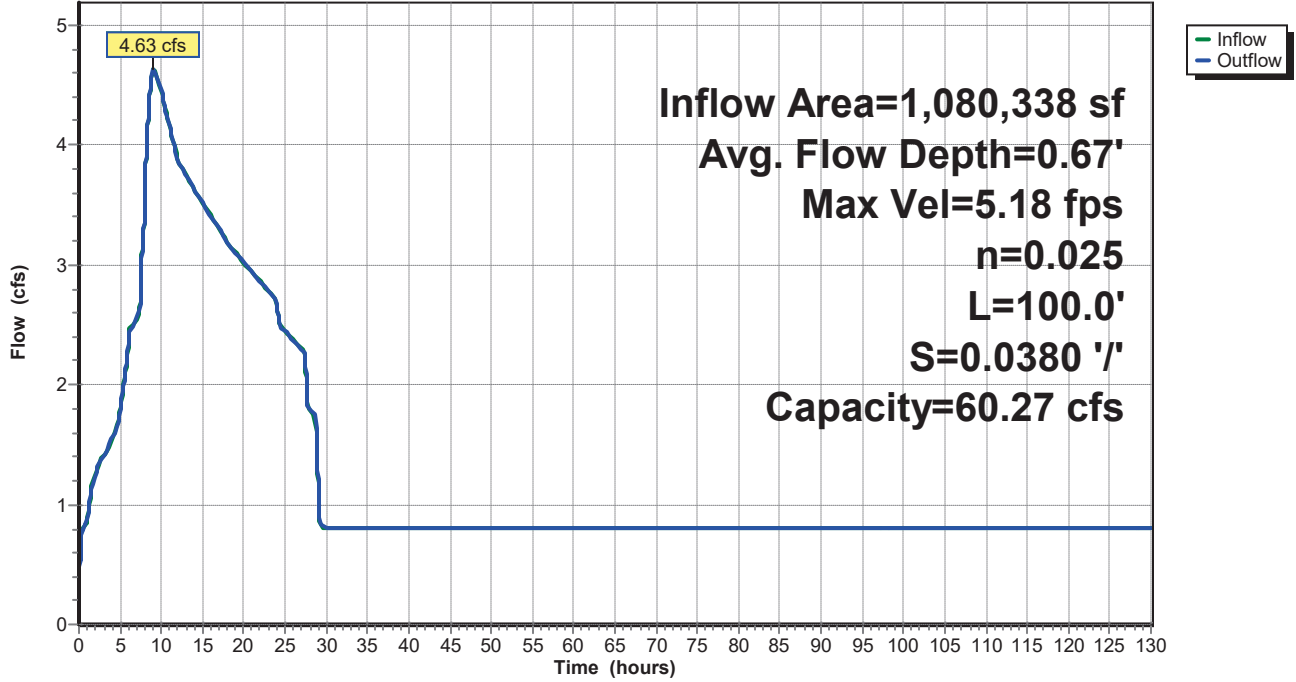
Type IA 24-hr 10-Year Rainfall=3.80"

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Reach R4: Ditch 4

Hydrograph



Bull Run Conveyance

Type IA 24-hr 10-Year Rainfall=3.80"

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Summary for Pond Pond A: Pond A

Inflow Area = 349,468 sf, 50.41% Impervious, Inflow Depth = 2.73" for 10-Year event
 Inflow = 5.32 cfs @ 7.91 hrs, Volume= 79,462 cf
 Outflow = 1.56 cfs @ 9.22 hrs, Volume= 79,462 cf, Atten= 71%, Lag= 78.7 min
 Primary = 1.56 cfs @ 9.22 hrs, Volume= 79,462 cf

Routing by Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs / 3
 Peak Elev= 709.85' @ 9.22 hrs Surf.Area= 8,661 sf Storage= 17,391 cf

Plug-Flow detention time= 223.3 min calculated for 79,456 cf (100% of inflow)
 Center-of-Mass det. time= 223.3 min (932.4 - 709.1)

Volume	Invert	Avail.Storage	Storage Description
#1	707.50'	70,555 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
707.50	6,107	0	0
708.00	6,714	3,205	3,205
709.00	7,742	7,228	10,433
710.00	8,825	8,284	18,717
711.00	9,967	9,396	28,113
712.00	11,161	10,564	38,677
713.00	12,412	11,787	50,463
714.00	13,717	13,065	63,528
714.50	14,392	7,027	70,555

Device	Routing	Invert	Outlet Devices
#1	Primary	698.43'	18.0" Round Culvert L= 138.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 698.43' / 696.24' S= 0.0159 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf
#2	Device 1	696.43'	2.6" Horiz. Orifice/Grate C= 0.620 Limited to weir flow at low heads
#3	Device 1	709.40'	16.0" W x 3.0" H Vert. Orifice/Grate C= 0.620

Primary OutFlow Max=1.56 cfs @ 9.22 hrs HW=709.85' (Free Discharge)

- 1=Culvert (Passes 1.56 cfs of 24.60 cfs potential flow)
- 2=Orifice/Grate (Orifice Controls 0.62 cfs @ 16.81 fps)
- 3=Orifice/Grate (Orifice Controls 0.94 cfs @ 2.81 fps)

Bull Run Conveyance

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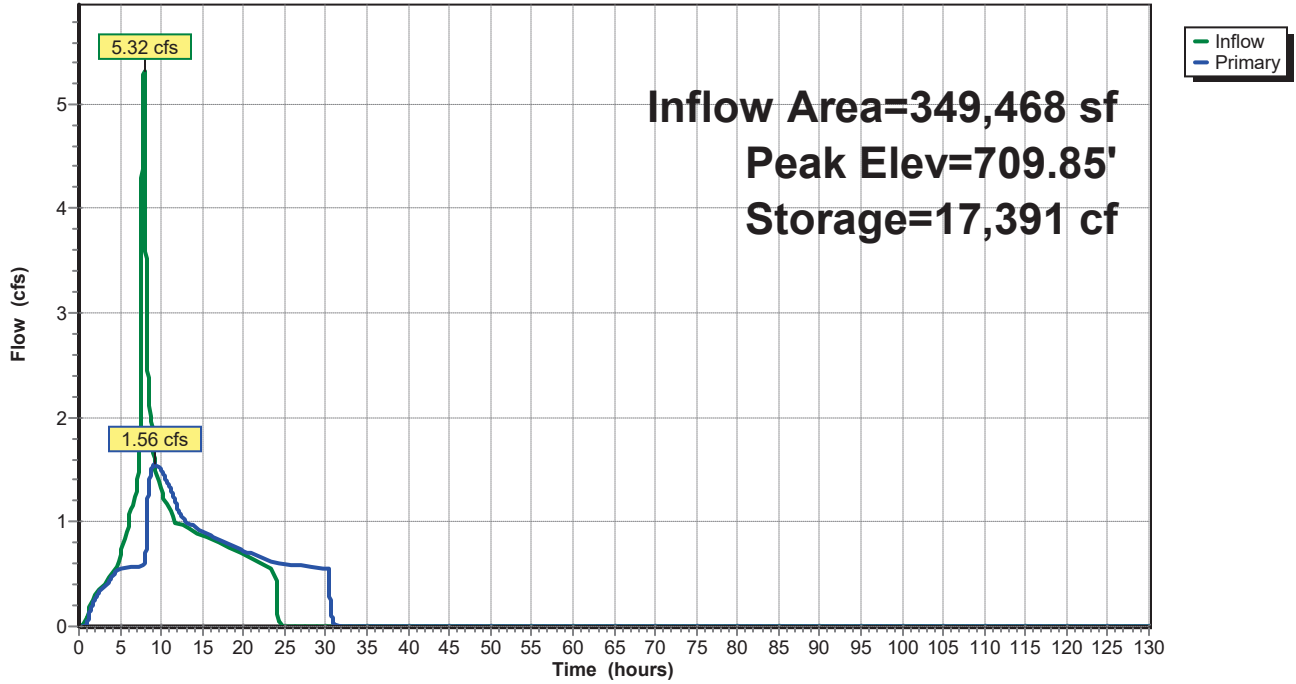
Type IA 24-hr 10-Year Rainfall=3.80"

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Pond Pond A: Pond A

Hydrograph



Bull Run Conveyance

Type IA 24-hr 10-Year Rainfall=3.80"

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Summary for Pond Pond B: Pond B

Inflow Area = 294,223 sf, 54.40% Impervious, Inflow Depth = 2.80" for 10-Year event
Inflow = 4.60 cfs @ 7.91 hrs, Volume= 68,552 cf
Outflow = 1.70 cfs @ 8.80 hrs, Volume= 68,552 cf, Atten= 63%, Lag= 53.7 min
Primary = 1.70 cfs @ 8.80 hrs, Volume= 68,552 cf

Routing by Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 709.73' @ 8.80 hrs Surf.Area= 5,802 sf Storage= 12,600 cf

Plug-Flow detention time= 154.7 min calculated for 68,552 cf (100% of inflow)
Center-of-Mass det. time= 154.7 min (858.9 - 704.2)

Volume	Invert	Avail.Storage	Storage Description
#1	707.00'	36,813 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
707.00	3,493	0	0
708.00	4,288	3,891	3,891
709.00	5,139	4,714	8,604
710.00	6,046	5,593	14,197
711.00	7,010	6,528	20,725
712.00	8,030	7,520	28,245
713.00	9,107	8,569	36,813

Device	Routing	Invert	Outlet Devices
#1	Primary	705.04'	18.0" Round Culvert L= 339.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 705.04' / 701.65' S= 0.0100 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf
#2	Device 1	703.04'	3.5" Horiz. Orifice/Grate C= 0.620 Limited to weir flow at low heads
#3	Device 1	709.15'	14.0" W x 3.0" H Vert. Orifice/Grate C= 0.620

Primary OutFlow Max=1.70 cfs @ 8.80 hrs HW=709.73' (Free Discharge)

- ↑ **1=Culvert** (Passes 1.70 cfs of 13.11 cfs potential flow)
- ↑ **2=Orifice/Grate** (Orifice Controls 0.72 cfs @ 10.78 fps)
- ↑ **3=Orifice/Grate** (Orifice Controls 0.98 cfs @ 3.35 fps)

Bull Run Conveyance

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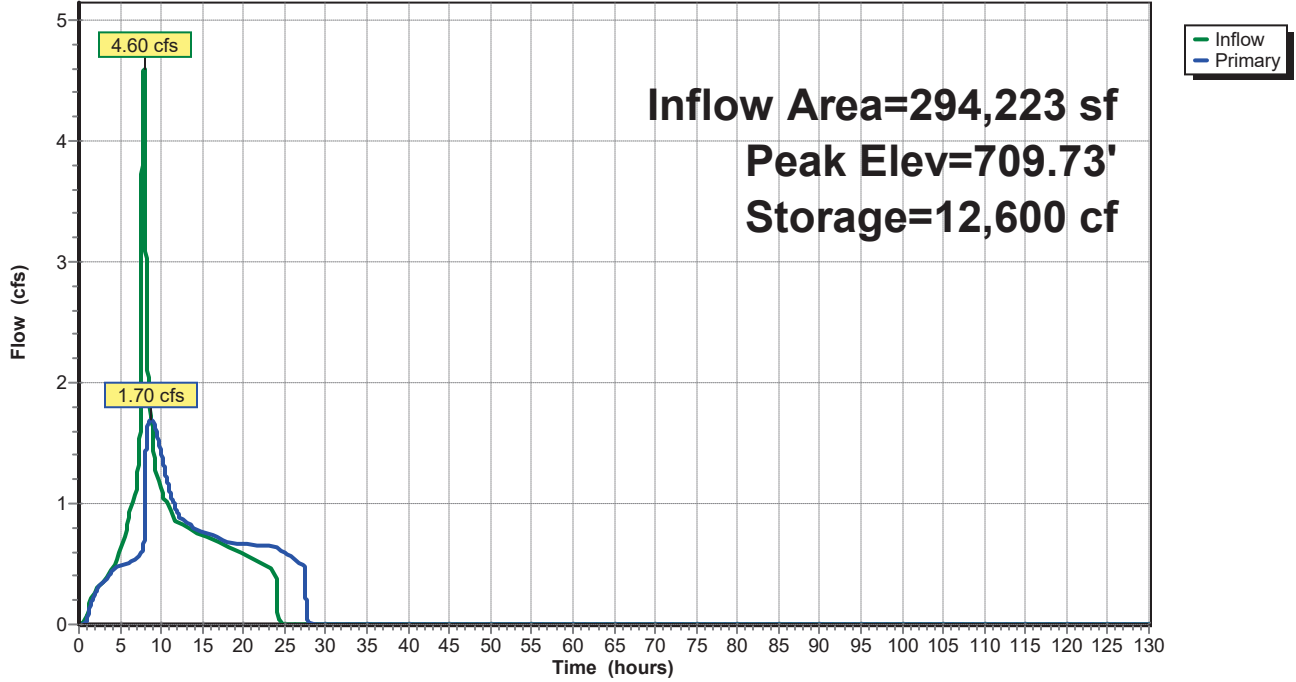
Type IA 24-hr 10-Year Rainfall=3.80"

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Pond Pond B: Pond B

Hydrograph



Bull Run Conveyance

Type IA 24-hr 10-Year Rainfall=3.80"

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Summary for Pond Pond C: Pond C

Inflow Area = 744,337 sf, 9.68% Impervious, Inflow Depth > 8.08" for 10-Year event
 Inflow = 8.99 cfs @ 7.96 hrs, Volume= 501,027 cf, Incl. 0.80 cfs Base Flow
 Outflow = 2.87 cfs @ 10.95 hrs, Volume= 500,682 cf, Atten= 68%, Lag= 179.2 min
 Primary = 2.87 cfs @ 10.95 hrs, Volume= 500,682 cf

Routing by Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs / 3
 Peak Elev= 705.31' @ 10.95 hrs Surf.Area= 21,701 sf Storage= 26,080 cf

Plug-Flow detention time= 53.6 min calculated for 500,677 cf (100% of inflow)
 Center-of-Mass det. time= 50.3 min (3,161.6 - 3,111.3)

Volume	Invert	Avail.Storage	Storage Description
#1	704.00'	95,416 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
704.00	18,277	0	0
705.00	20,828	19,553	19,553
706.00	23,671	22,250	41,802
707.00	26,743	25,207	67,009
708.00	30,070	28,407	95,416

Device	Routing	Invert	Outlet Devices
#1	Primary	697.90'	12.0" Round Culvert L= 53.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 697.90' / 695.55' S= 0.0443 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	693.90'	5.1" Horiz. Orifice/Grate C= 0.620 Limited to weir flow at low heads
#3	Device 1	704.85'	16.0" W x 3.0" H Vert. Orifice/Grate C= 0.620

Primary OutFlow Max=2.87 cfs @ 10.95 hrs HW=705.31' (Free Discharge)

- ↑ **1=Culvert** (Passes 2.87 cfs of 9.94 cfs potential flow)
- ↑ **2=Orifice/Grate** (Orifice Controls 1.92 cfs @ 13.54 fps)
- ↑ **3=Orifice/Grate** (Orifice Controls 0.95 cfs @ 2.85 fps)

Bull Run Conveyance

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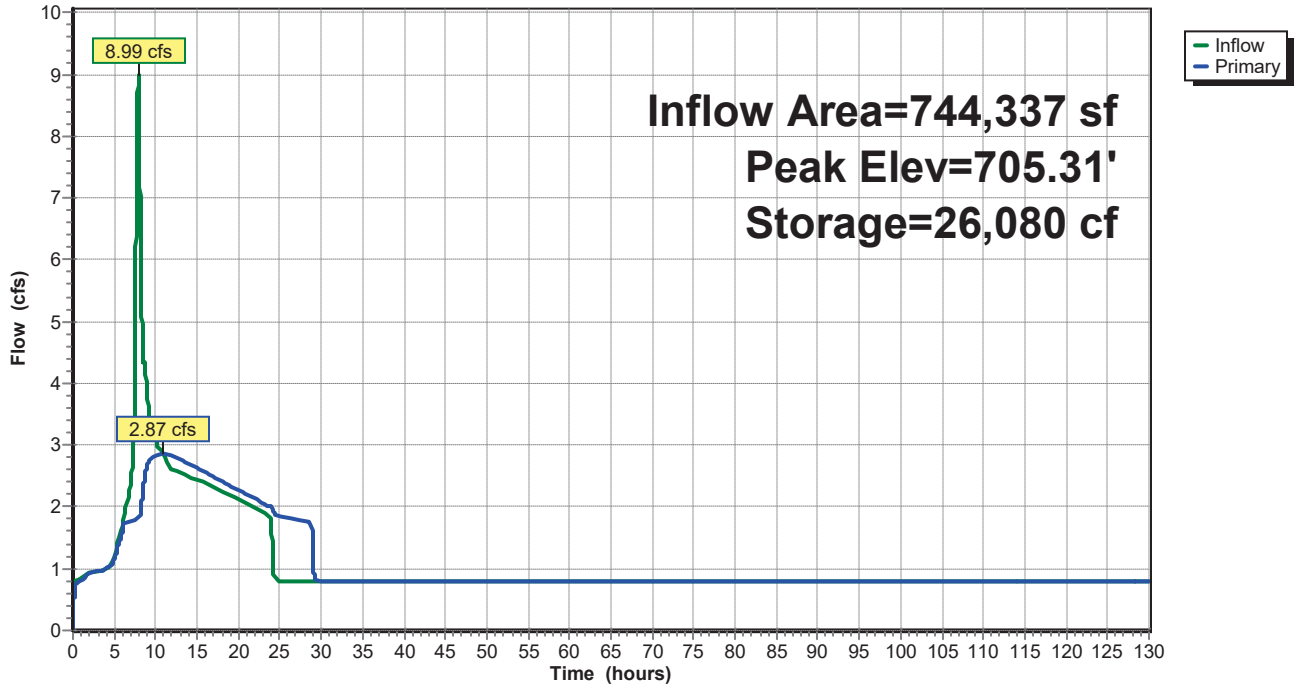
Type IA 24-hr 10-Year Rainfall=3.80"

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Pond Pond C: Pond C

Hydrograph



Bull Run Conveyance

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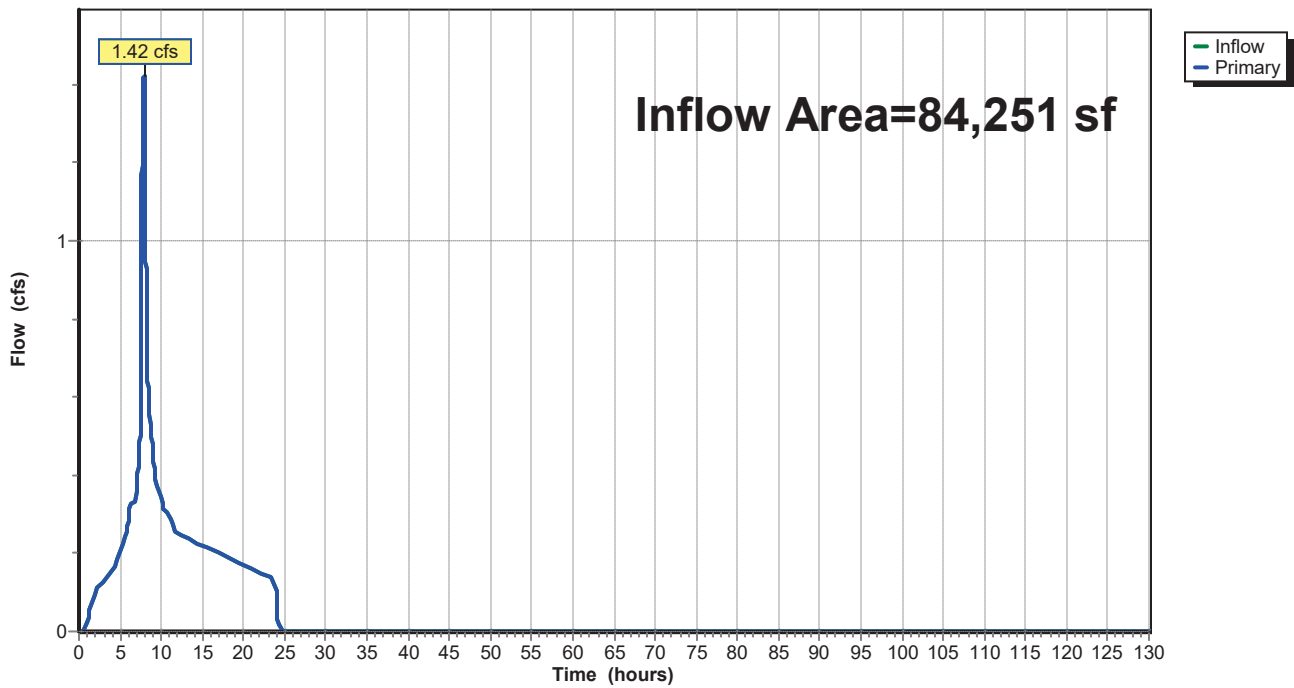
Summary for Link L1: Pipe 4

Inflow Area = 84,251 sf, 66.47% Impervious, Inflow Depth = 3.00" for 10-Year event
Inflow = 1.42 cfs @ 7.90 hrs, Volume= 21,060 cf
Primary = 1.42 cfs @ 7.90 hrs, Volume= 21,060 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs

Link L1: Pipe 4

Hydrograph



Bull Run Conveyance

Type IA 24-hr 10-Year Rainfall=3.80"

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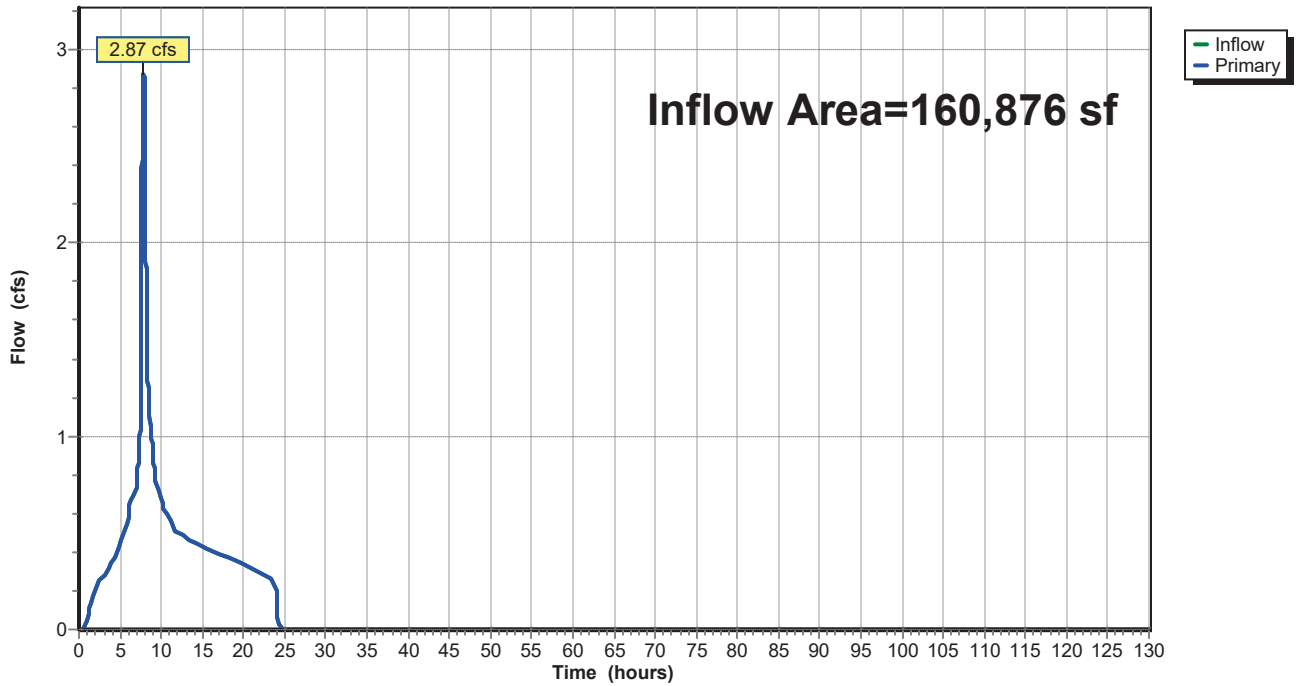
Summary for Link L2: Pipe 6

Inflow Area = 160,876 sf, 75.25% Impervious, Inflow Depth = 3.15" for 10-Year event
Inflow = 2.87 cfs @ 7.89 hrs, Volume= 42,201 cf
Primary = 2.87 cfs @ 7.89 hrs, Volume= 42,201 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs

Link L2: Pipe 6

Hydrograph



Bull Run Conveyance

Type IA 24-hr 10-Year Rainfall=3.80"

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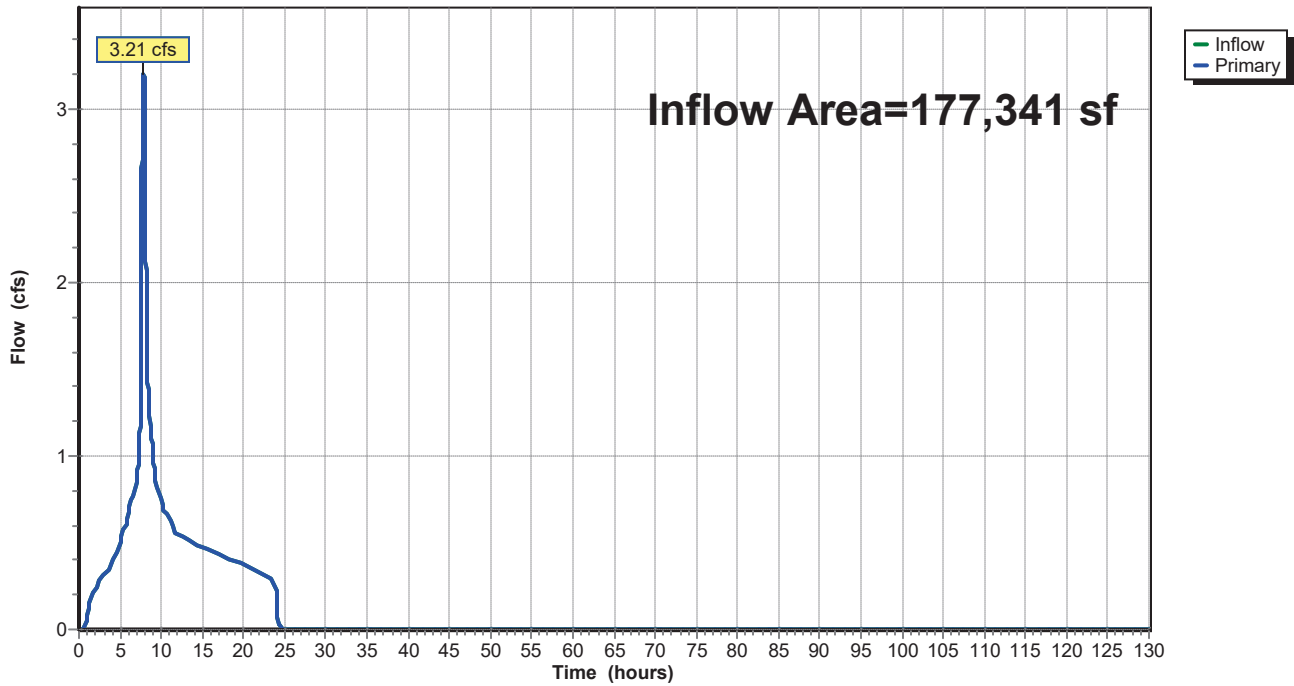
Summary for Link L3: Pipe 7

Inflow Area = 177,341 sf, 77.55% Impervious, Inflow Depth = 3.19" for 10-Year event
Inflow = 3.21 cfs @ 7.89 hrs, Volume= 47,093 cf
Primary = 3.21 cfs @ 7.89 hrs, Volume= 47,093 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs

Link L3: Pipe 7

Hydrograph



Bull Run Conveyance

Type IA 24-hr 10-Year Rainfall=3.80"

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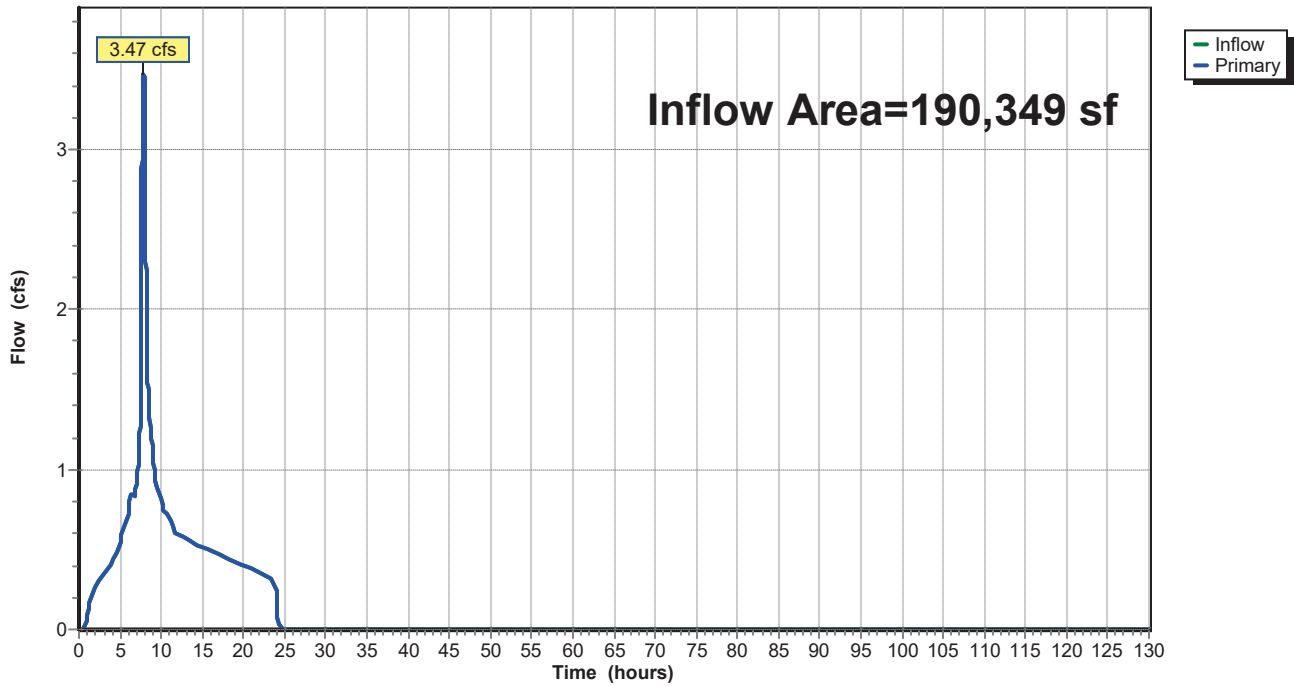
Summary for Link L4: Pipe 9

Inflow Area = 190,349 sf, 79.08% Impervious, Inflow Depth = 3.21" for 10-Year event
Inflow = 3.47 cfs @ 7.89 hrs, Volume= 50,959 cf
Primary = 3.47 cfs @ 7.89 hrs, Volume= 50,959 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs

Link L4: Pipe 9

Hydrograph



Bull Run Conveyance

Type IA 24-hr 25-Year Rainfall=4.50"

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Summary for Subcatchment 1: Basin 1

Runoff = 0.97 cfs @ 7.91 hrs, Volume= 14,452 cf, Depth= 3.30"

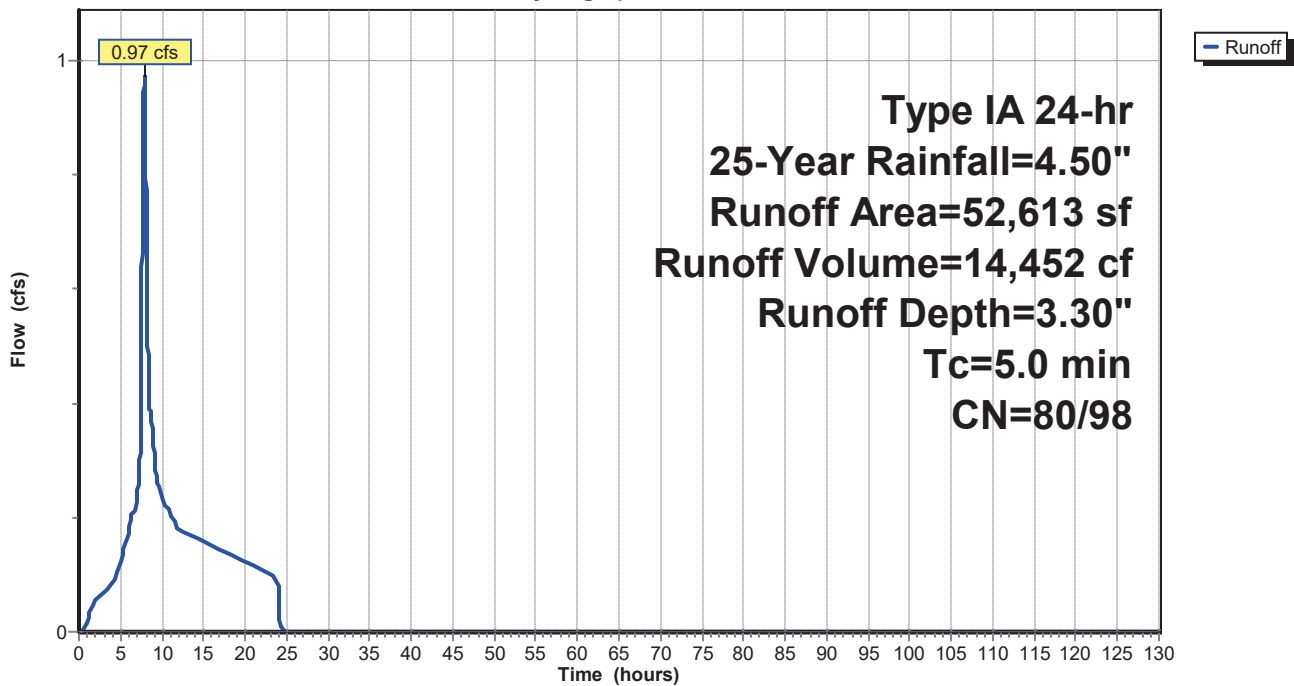
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=4.50"

	Area (sf)	CN	Description
*	24,364	98	Impervious Area
*	28,249	80	Pervious
	52,613	88	Weighted Average
	28,249	80	53.69% Pervious Area
	24,364	98	46.31% Impervious Area

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

Subcatchment 1: Basin 1

Hydrograph



Bull Run Conveyance

Type IA 24-hr 25-Year Rainfall=4.50"

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Summary for Subcatchment 2: Basin 2

Runoff = 0.77 cfs @ 7.88 hrs, Volume= 11,242 cf, Depth= 4.26"

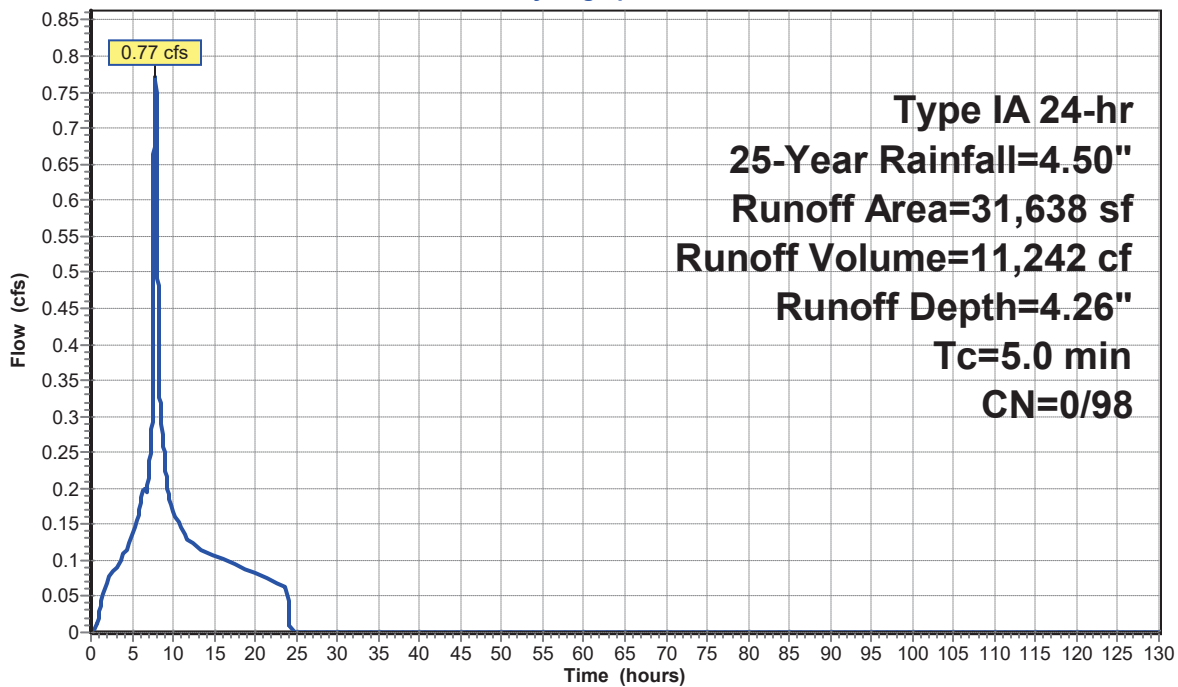
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=4.50"

	Area (sf)	CN	Description
*	31,638	98	Impervious Area
	31,638	98	100.00% Impervious Area

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

Subcatchment 2: Basin 2

Hydrograph



Bull Run Conveyance

Type IA 24-hr 25-Year Rainfall=4.50"

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Summary for Subcatchment 3: Basin 3

Runoff = 0.86 cfs @ 7.88 hrs, Volume= 12,477 cf, Depth= 4.26"

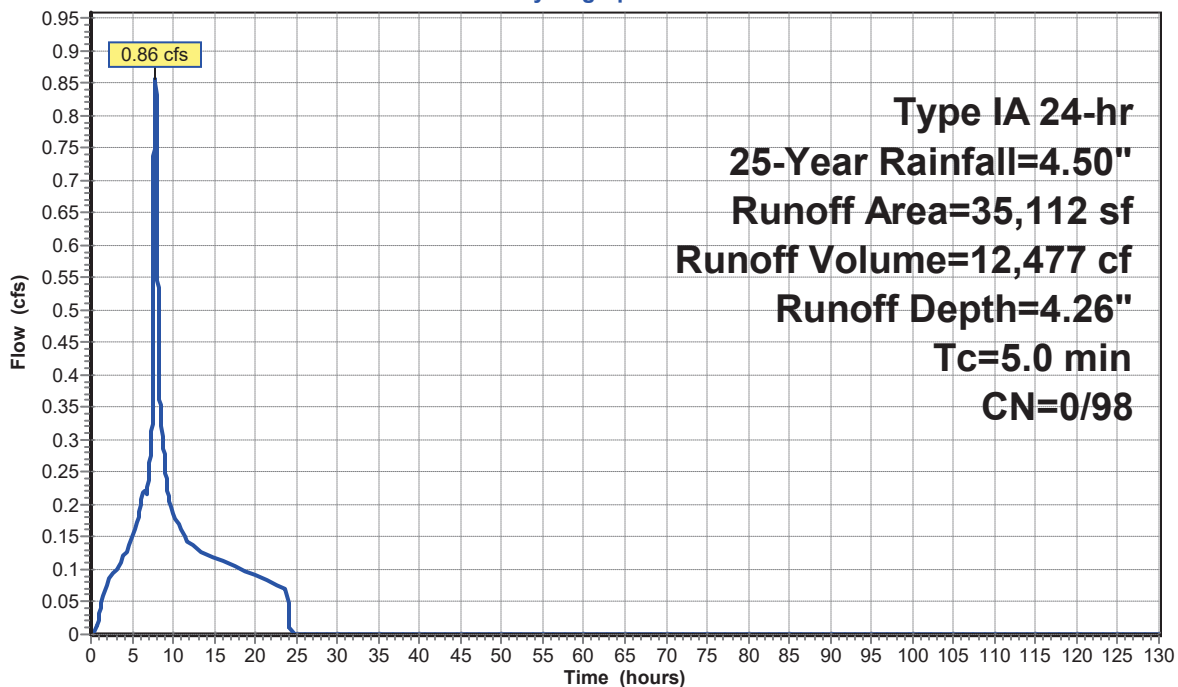
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
 Type IA 24-hr 25-Year Rainfall=4.50"

	Area (sf)	CN	Description
*	35,112	98	Impervious Area
	35,112	98	100.00% Impervious Area

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

Subcatchment 3: Basin 3

Hydrograph



Runoff

Bull Run Conveyance

Type IA 24-hr 25-Year Rainfall=4.50"

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Summary for Subcatchment 4: Basin 4

Runoff = 0.40 cfs @ 7.88 hrs, Volume= 5,851 cf, Depth= 4.26"

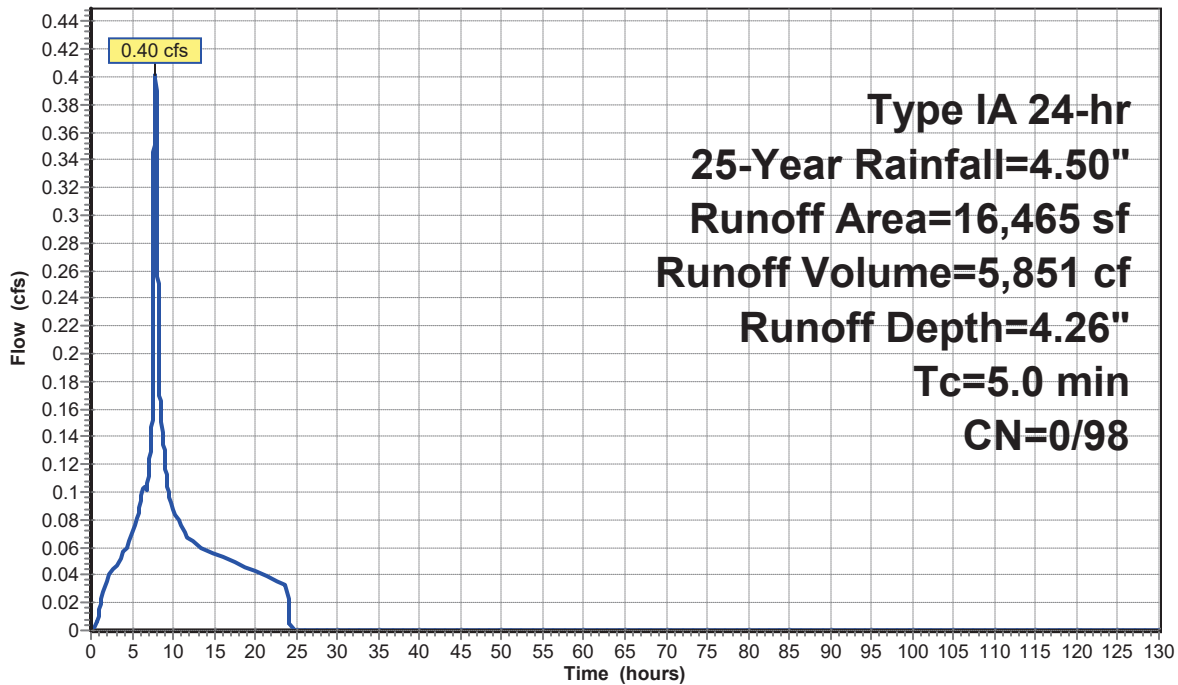
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=4.50"

	Area (sf)	CN	Description
*	16,465	98	Impervious Area
	16,465	98	100.00% Impervious Area

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

Subcatchment 4: Basin 4

Hydrograph



Bull Run Conveyance

Type IA 24-hr 25-Year Rainfall=4.50"

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Summary for Subcatchment 5: Basin 5

Runoff = 0.32 cfs @ 7.88 hrs, Volume= 4,622 cf, Depth= 4.26"

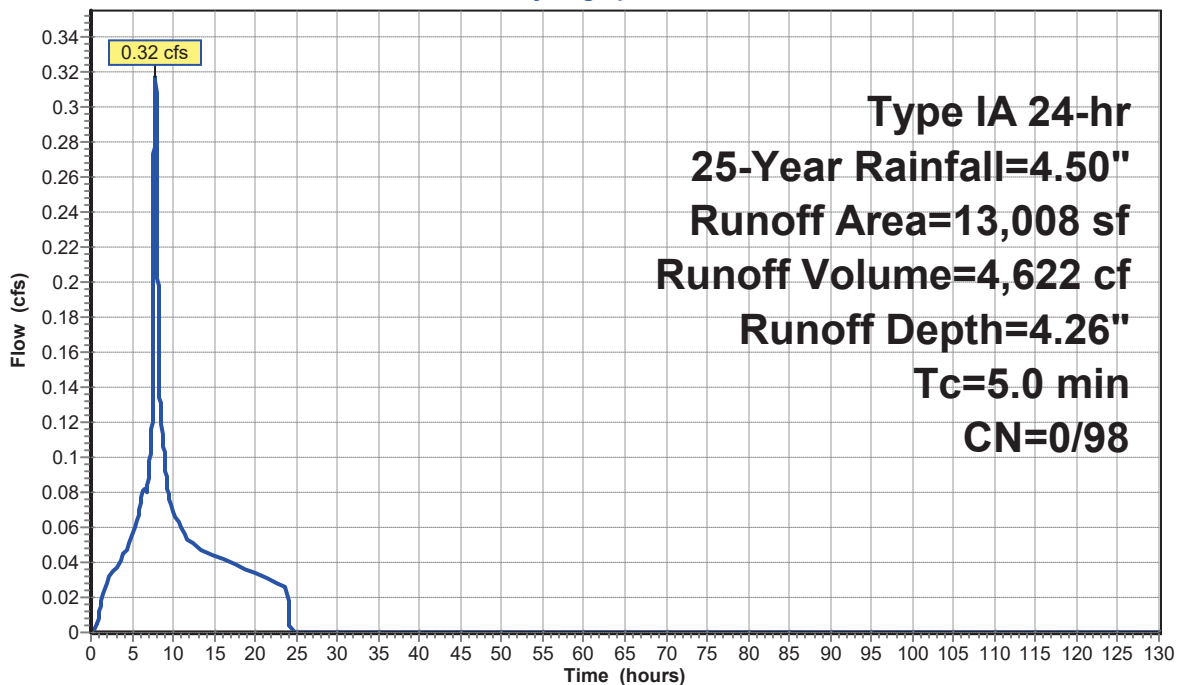
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=4.50"

	Area (sf)	CN	Description
*	13,008	98	Impervious Area
	13,008	98	100.00% Impervious Area

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

Subcatchment 5: Basin 5

Hydrograph



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Type IA 24-hr 25-Year Rainfall=4.50"

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Summary for Subcatchment 6: Basin 6

Runoff = 2.43 cfs @ 7.94 hrs, Volume= 36,491 cf, Depth= 2.75"

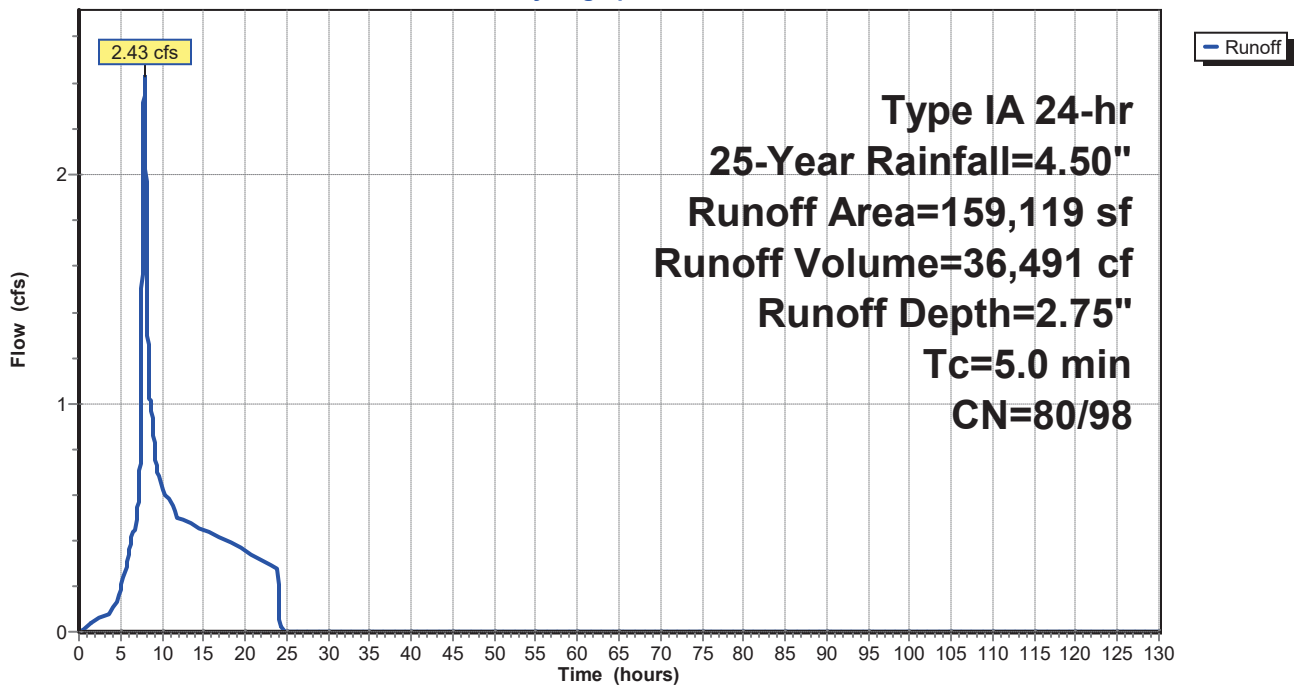
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=4.50"

	Area (sf)	CN	Description
*	133,479	80	Pervious
*	25,640	98	Impervious
	159,119	83	Weighted Average
	133,479	80	83.89% Pervious Area
	25,640	98	16.11% Impervious Area

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

Subcatchment 6: Basin 6

Hydrograph



Bull Run Conveyance

Type IA 24-hr 25-Year Rainfall=4.50"

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Summary for Subcatchment 8: Basin 8

Runoff = 2.81 cfs @ 7.88 hrs, Volume= 40,913 cf, Depth= 4.26"

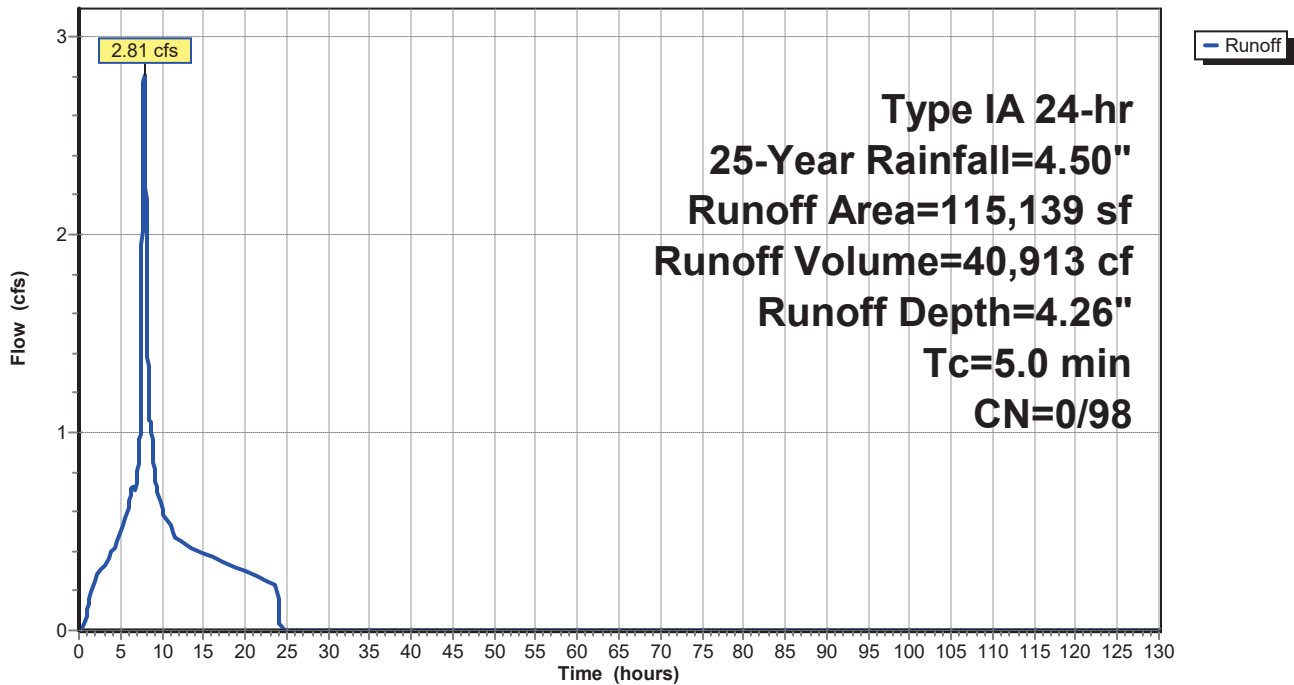
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=4.50"

Area (sf)	CN	Description
* 115,139	98	Impervious Area
115,139	98	100.00% Impervious Area

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

Subcatchment 8: Basin 8

Hydrograph



Bull Run Conveyance

Type IA 24-hr 25-Year Rainfall=4.50"

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Summary for Subcatchment 9: Basin 9

Runoff = 2.91 cfs @ 7.93 hrs, Volume= 43,484 cf, Depth= 2.91"

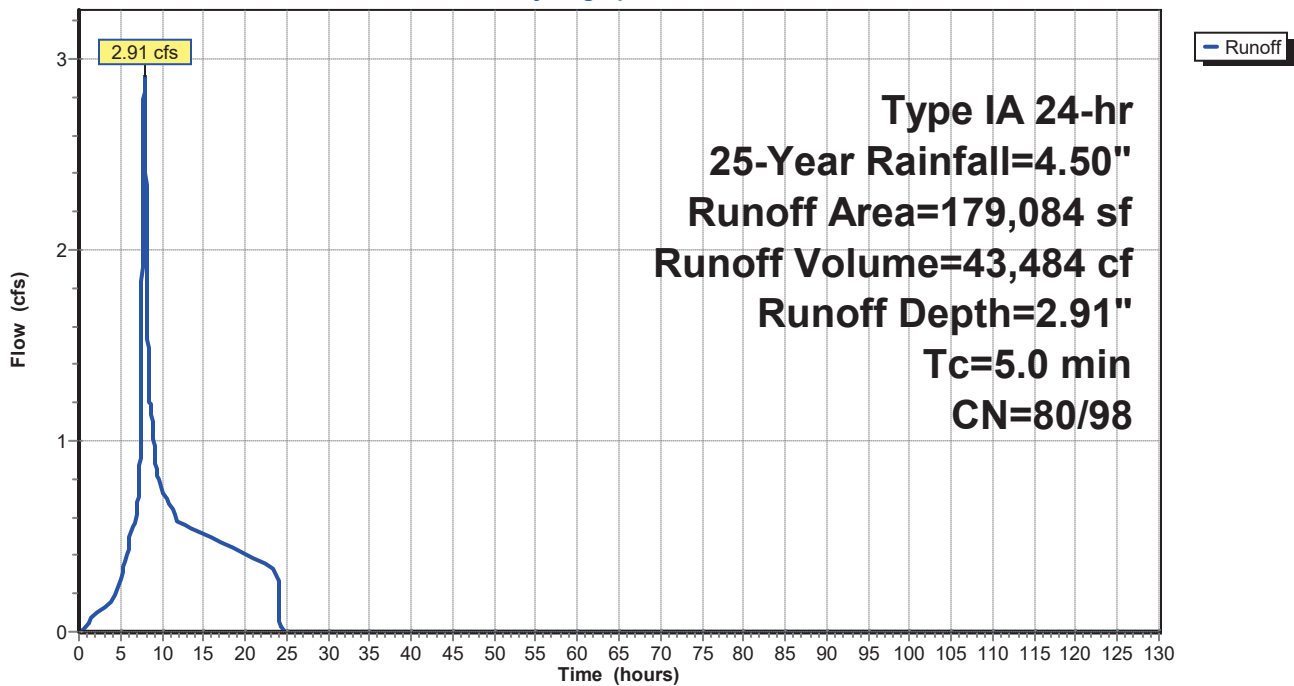
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=4.50"

	Area (sf)	CN	Description
*	44,929	98	Impervious Area
*	134,155	80	Landscape Areas
	179,084	85	Weighted Average
	134,155	80	74.91% Pervious Area
	44,929	98	25.09% Impervious Area

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

Subcatchment 9: Basin 9

Hydrograph



Bull Run Conveyance

Type IA 24-hr 25-Year Rainfall=4.50"

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Summary for Subcatchment 10: Basin 10

Runoff = 9.05 cfs @ 7.95 hrs, Volume= 136,073 cf, Depth= 2.61"

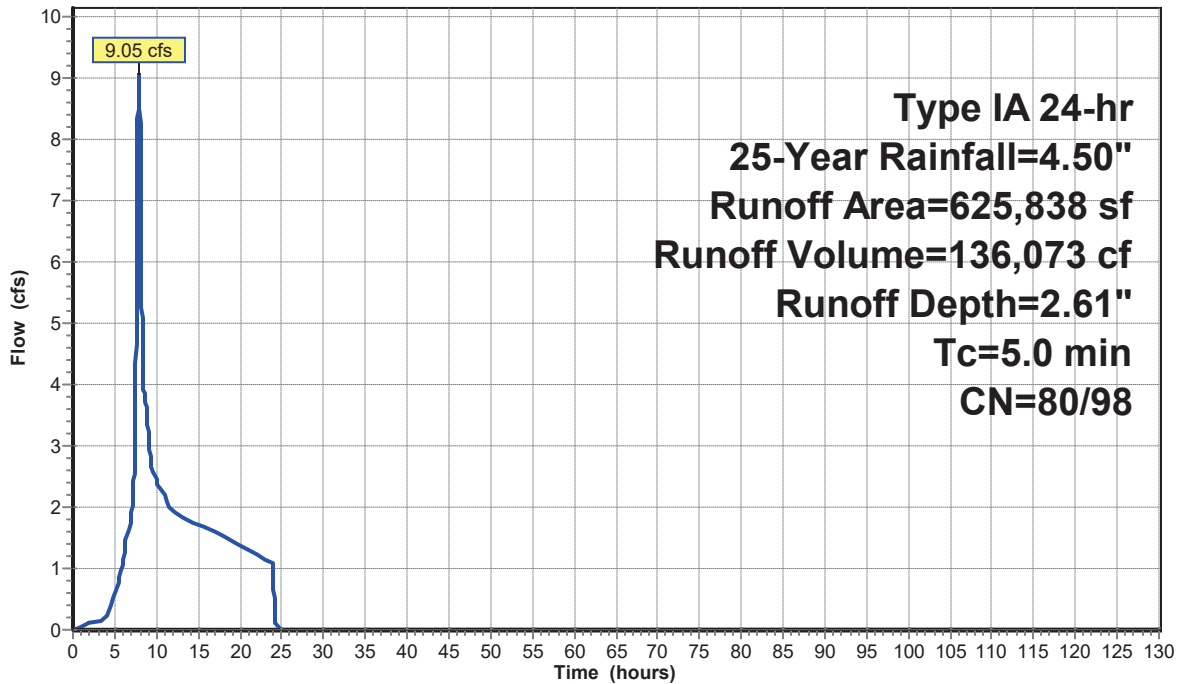
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=4.50"

	Area (sf)	CN	Description
*	51,234	98	Impervious Area
*	574,604	80	Pervious
	625,838	81	Weighted Average
	574,604	80	91.81% Pervious Area
	51,234	98	8.19% Impervious Area

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

Subcatchment 10: Basin 10

Hydrograph



Bull Run Conveyance

Type IA 24-hr 25-Year Rainfall=4.50"

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Summary for Subcatchment 11: Basin 11

Runoff = 1.83 cfs @ 7.94 hrs, Volume= 27,434 cf, Depth= 2.78"

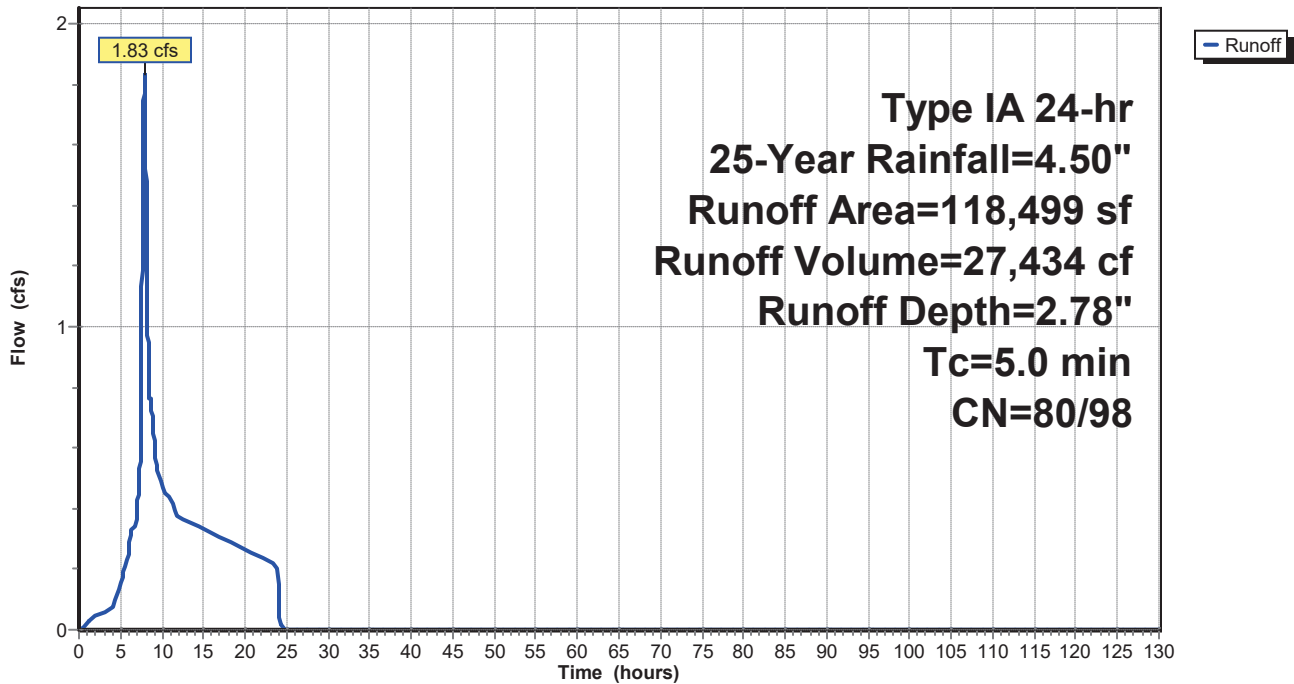
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
 Type IA 24-hr 25-Year Rainfall=4.50"

	Area (sf)	CN	Description
*	20,813	98	Impervious Area
*	97,686	80	Pervious
	118,499	83	Weighted Average
	97,686	80	82.44% Pervious Area
	20,813	98	17.56% Impervious Area

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

Subcatchment 11: Basin 11

Hydrograph



Bull Run Conveyance

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Type IA 24-hr 25-Year Rainfall=4.50"

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Summary for Subcatchment 22: Basin 22

Runoff = 1.02 cfs @ 7.88 hrs, Volume= 14,845 cf, Depth= 4.26"

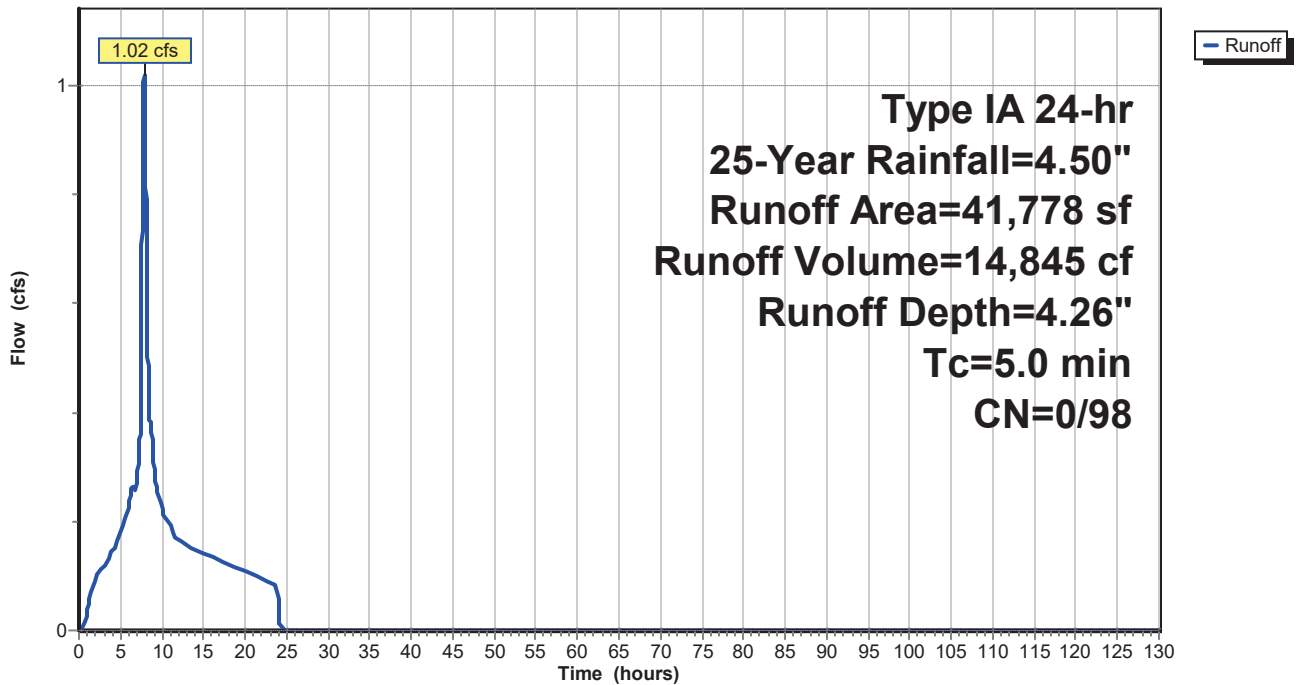
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=4.50"

Area (sf)	CN	Description
* 41,778	98	Impervious Area
41,778	98	100.00% Impervious Area

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

Subcatchment 22: Basin 22

Hydrograph



Bull Run Conveyance

Type IA 24-hr 25-Year Rainfall=4.50"

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Summary for Subcatchment 23: Basin 23

Runoff = 0.88 cfs @ 7.89 hrs, Volume= 13,014 cf, Depth= 3.76"

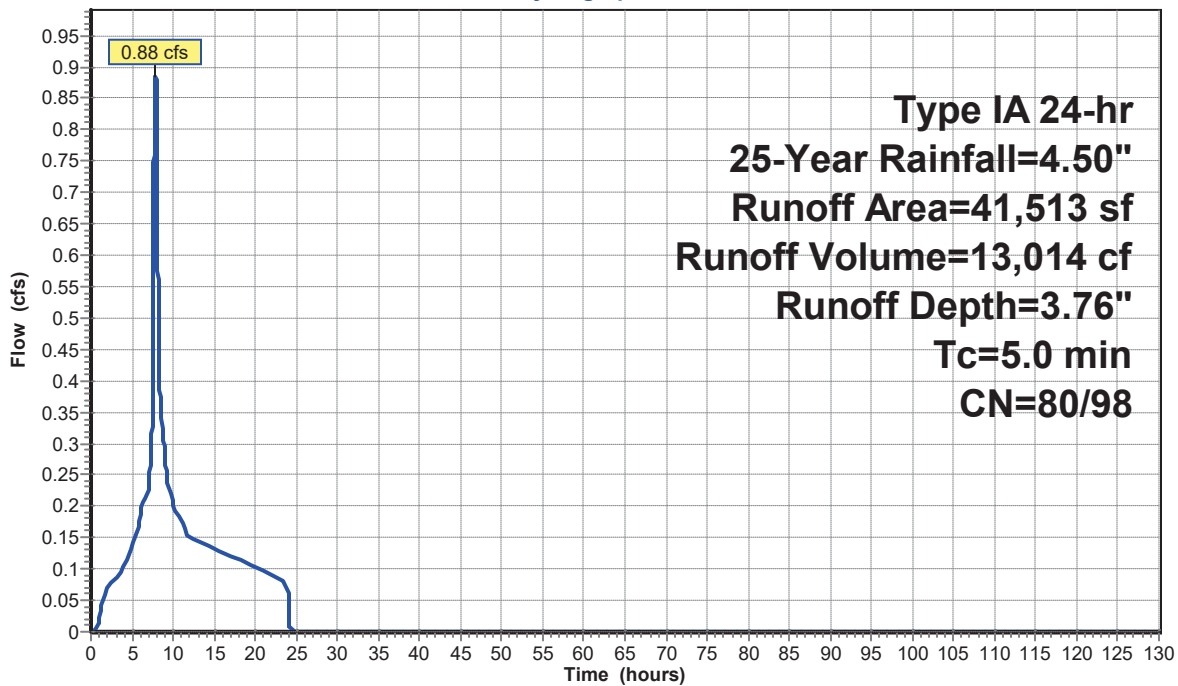
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=4.50"

	Area (sf)	CN	Description
*	29,948	98	Impervious Area
*	11,565	80	Pervious
	41,513	93	Weighted Average
	11,565	80	27.86% Pervious Area
	29,948	98	72.14% Impervious Area

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

Subcatchment 23: Basin 23

Hydrograph



Bull Run Conveyance

Type IA 24-hr 25-Year Rainfall=4.50"

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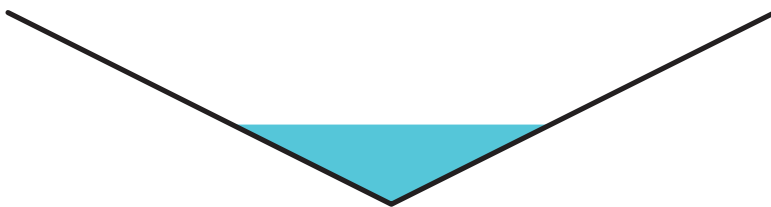
Summary for Reach R4: Ditch 4

Inflow Area = 1,080,338 sf, 25.35% Impervious, Inflow Depth > 7.07" for 25-Year event
Inflow = 5.83 cfs @ 8.89 hrs, Volume= 636,832 cf
Outflow = 5.83 cfs @ 8.89 hrs, Volume= 636,808 cf, Atten= 0%, Lag= 0.2 min

Routing by Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Max. Velocity= 5.49 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 3.64 fps, Avg. Travel Time= 0.5 min

Peak Storage= 106 cf @ 8.89 hrs
Average Depth at Peak Storage= 0.73'
Bank-Full Depth= 1.75' Flow Area= 6.1 sf, Capacity= 60.27 cfs

Custom cross-section, Length= 100.0' Slope= 0.0380 '/'
Constant n= 0.025 Earth, clean & straight
Inlet Invert= 694.00', Outlet Invert= 690.20'



Offset (feet)	Elevation (feet)	Chan.Depth (feet)
-3.50	1.75	0.00
0.00	0.00	1.75
3.50	1.75	0.00

Depth (feet)	End Area (sq-ft)	Perim. (feet)	Storage (cubic-feet)	Discharge (cfs)
0.00	0.0	0.0	0	0.00
1.75	6.1	7.8	613	60.27

Bull Run Conveyance

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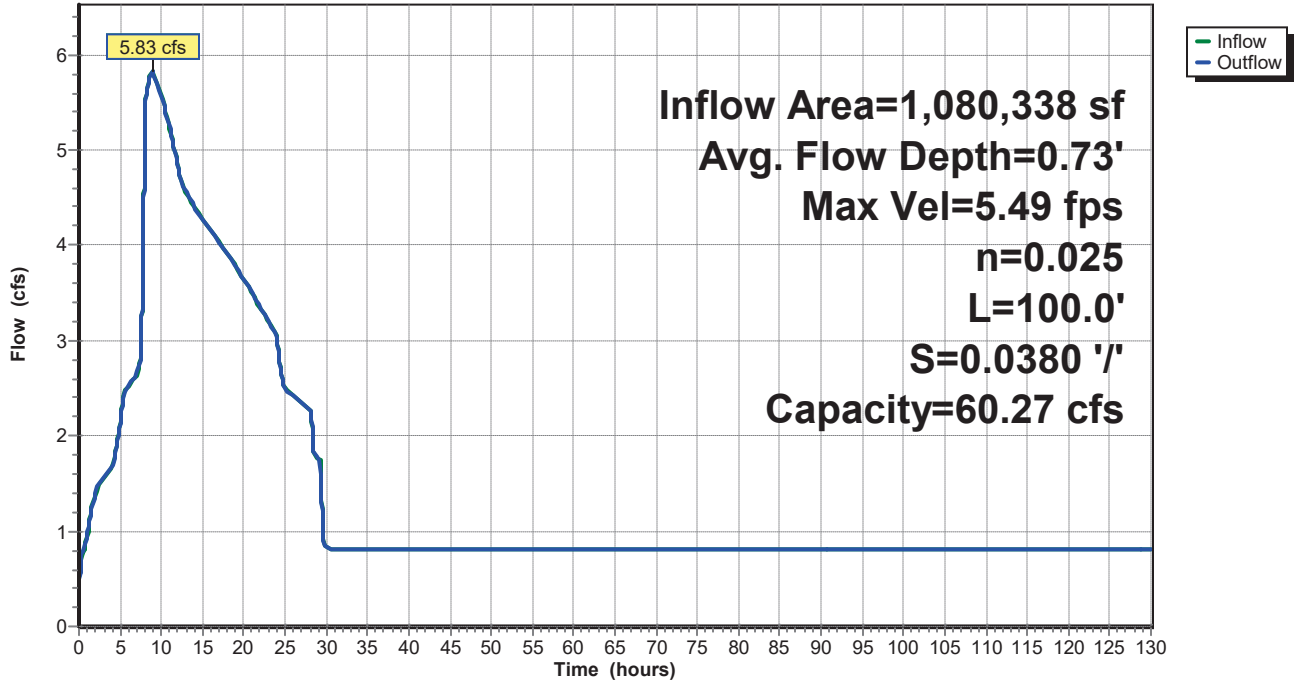
Type IA 24-hr 25-Year Rainfall=4.50"

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Reach R4: Ditch 4

Hydrograph



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Type IA 24-hr 25-Year Rainfall=4.50"

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Summary for Pond Pond A: Pond A

Inflow Area = 349,468 sf, 50.41% Impervious, Inflow Depth = 3.37" for 25-Year event
 Inflow = 6.62 cfs @ 7.91 hrs, Volume= 98,149 cf
 Outflow = 2.11 cfs @ 9.05 hrs, Volume= 98,149 cf, Atten= 68%, Lag= 68.5 min
 Primary = 2.11 cfs @ 9.05 hrs, Volume= 98,149 cf

Routing by Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs / 3
 Peak Elev= 710.32' @ 9.05 hrs Surf.Area= 9,193 sf Storage= 21,619 cf

Plug-Flow detention time= 200.9 min calculated for 98,141 cf (100% of inflow)
 Center-of-Mass det. time= 200.9 min (904.6 - 703.7)

Volume	Invert	Avail.Storage	Storage Description
#1	707.50'	70,555 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
707.50	6,107	0	0
708.00	6,714	3,205	3,205
709.00	7,742	7,228	10,433
710.00	8,825	8,284	18,717
711.00	9,967	9,396	28,113
712.00	11,161	10,564	38,677
713.00	12,412	11,787	50,463
714.00	13,717	13,065	63,528
714.50	14,392	7,027	70,555

Device	Routing	Invert	Outlet Devices
#1	Primary	698.43'	18.0" Round Culvert L= 138.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 698.43' / 696.24' S= 0.0159 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf
#2	Device 1	696.43'	2.6" Horiz. Orifice/Grate C= 0.620 Limited to weir flow at low heads
#3	Device 1	709.40'	16.0" W x 3.0" H Vert. Orifice/Grate C= 0.620

Primary OutFlow Max=2.11 cfs @ 9.05 hrs HW=710.32' (Free Discharge)

- 1=Culvert (Passes 2.11 cfs of 25.08 cfs potential flow)
- 2=Orifice/Grate (Orifice Controls 0.63 cfs @ 17.16 fps)
- 3=Orifice/Grate (Orifice Controls 1.48 cfs @ 4.44 fps)

Bull Run Conveyance

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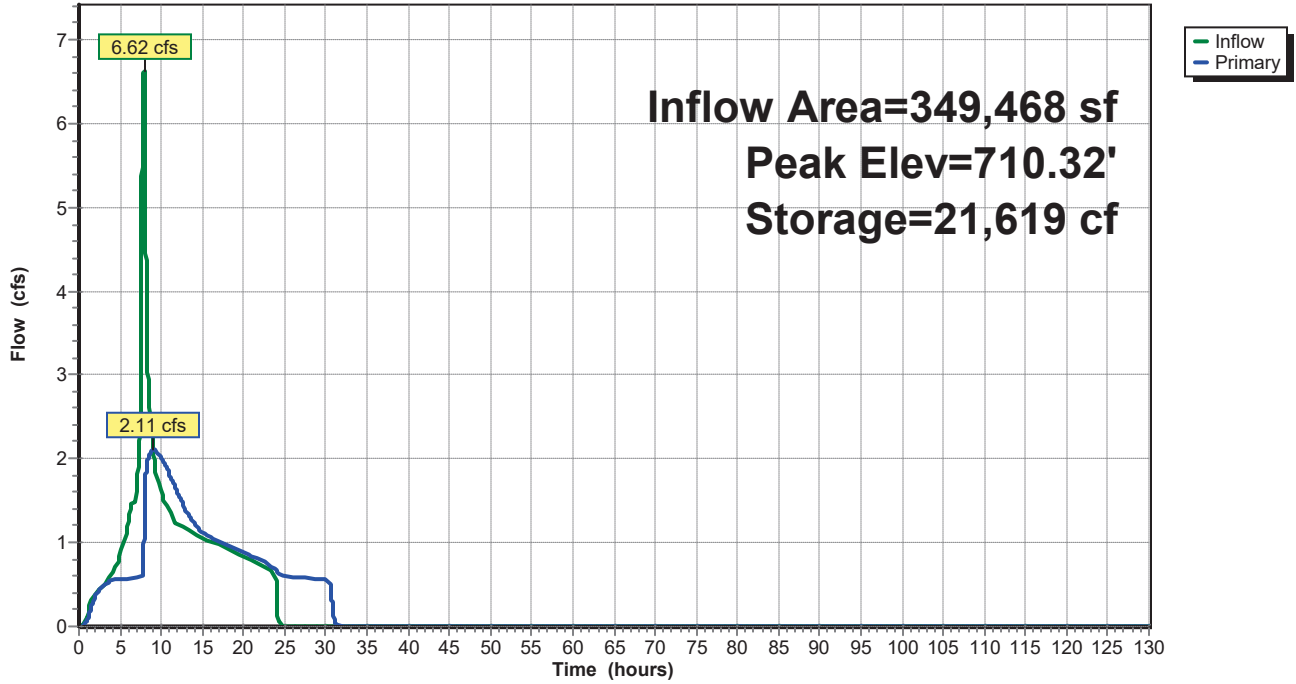
Type IA 24-hr 25-Year Rainfall=4.50"

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Pond Pond A: Pond A

Hydrograph



Bull Run Conveyance

Type IA 24-hr 25-Year Rainfall=4.50"

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Summary for Pond Pond B: Pond B

Inflow Area = 294,223 sf, 54.40% Impervious, Inflow Depth = 3.44" for 25-Year event
 Inflow = 5.70 cfs @ 7.90 hrs, Volume= 84,397 cf
 Outflow = 2.22 cfs @ 8.68 hrs, Volume= 84,397 cf, Atten= 61%, Lag= 46.5 min
 Primary = 2.22 cfs @ 8.68 hrs, Volume= 84,397 cf

Routing by Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs / 3
 Peak Elev= 710.29' @ 8.68 hrs Surf.Area= 6,322 sf Storage= 15,968 cf

Plug-Flow detention time= 146.4 min calculated for 84,397 cf (100% of inflow)
 Center-of-Mass det. time= 146.4 min (845.4 - 699.0)

Volume	Invert	Avail.Storage	Storage Description
#1	707.00'	36,813 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
707.00	3,493	0	0
708.00	4,288	3,891	3,891
709.00	5,139	4,714	8,604
710.00	6,046	5,593	14,197
711.00	7,010	6,528	20,725
712.00	8,030	7,520	28,245
713.00	9,107	8,569	36,813

Device	Routing	Invert	Outlet Devices
#1	Primary	705.04'	18.0" Round Culvert L= 339.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 705.04' / 701.65' S= 0.0100 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf
#2	Device 1	703.04'	3.5" Horiz. Orifice/Grate C= 0.620 Limited to weir flow at low heads
#3	Device 1	709.15'	14.0" W x 3.0" H Vert. Orifice/Grate C= 0.620

Primary OutFlow Max=2.22 cfs @ 8.68 hrs HW=710.29' (Free Discharge)

- ↑ **1=Culvert** (Passes 2.22 cfs of 13.65 cfs potential flow)
- ↑ **2=Orifice/Grate** (Orifice Controls 0.76 cfs @ 11.40 fps)
- ↑ **3=Orifice/Grate** (Orifice Controls 1.46 cfs @ 5.00 fps)

Bull Run Conveyance

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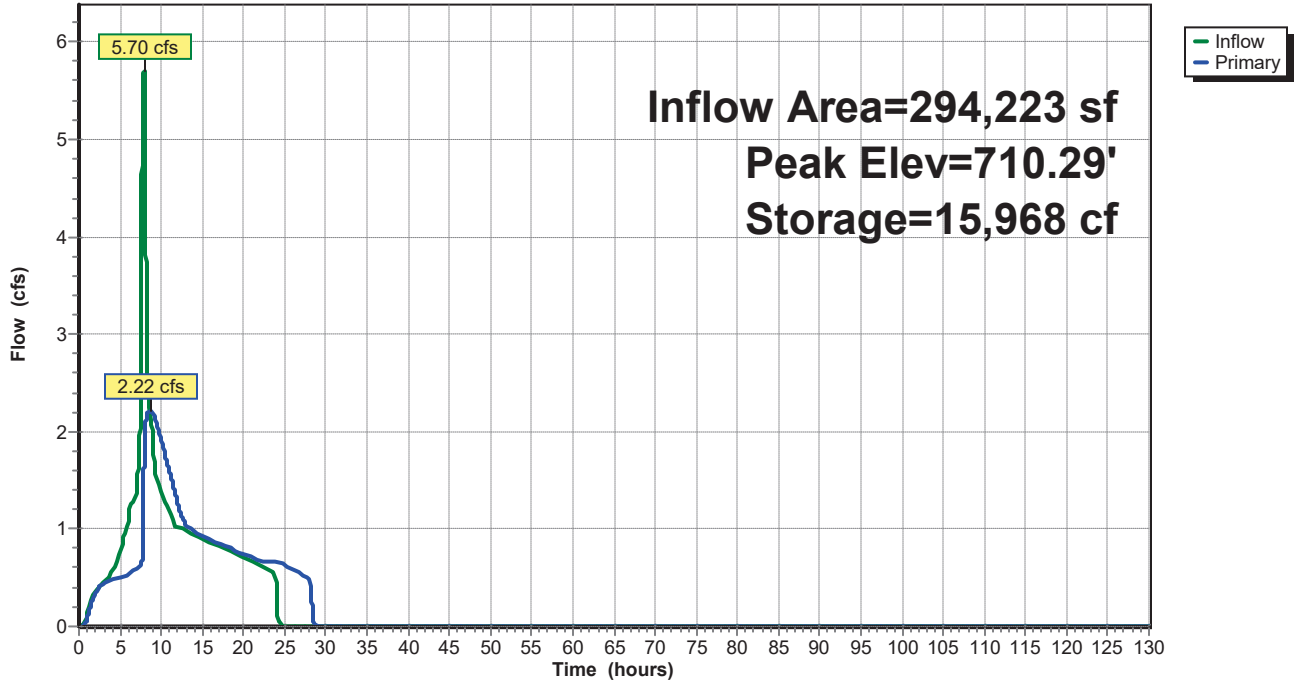
Type IA 24-hr 25-Year Rainfall=4.50"

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Pond Pond B: Pond B

Hydrograph



Bull Run Conveyance

Type IA 24-hr 25-Year Rainfall=4.50"

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Summary for Pond Pond C: Pond C

Inflow Area = 744,337 sf, 9.68% Impervious, Inflow Depth > 8.67" for 25-Year event
 Inflow = 11.68 cfs @ 7.95 hrs, Volume= 537,935 cf, Incl. 0.80 cfs Base Flow
 Outflow = 3.45 cfs @ 10.90 hrs, Volume= 537,590 cf, Atten= 70%, Lag= 177.5 min
 Primary = 3.45 cfs @ 10.90 hrs, Volume= 537,590 cf

Routing by Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs / 3
 Peak Elev= 705.76' @ 10.90 hrs Surf.Area= 22,994 sf Storage= 36,249 cf

Plug-Flow detention time= 64.3 min calculated for 537,586 cf (100% of inflow)
 Center-of-Mass det. time= 61.1 min (3,008.5 - 2,947.4)

Volume	Invert	Avail.Storage	Storage Description
#1	704.00'	95,416 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
704.00	18,277	0	0
705.00	20,828	19,553	19,553
706.00	23,671	22,250	41,802
707.00	26,743	25,207	67,009
708.00	30,070	28,407	95,416

Device	Routing	Invert	Outlet Devices
#1	Primary	697.90'	12.0" Round Culvert L= 53.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 697.90' / 695.55' S= 0.0443 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	693.90'	5.1" Horiz. Orifice/Grate C= 0.620 Limited to weir flow at low heads
#3	Device 1	704.85'	16.0" W x 3.0" H Vert. Orifice/Grate C= 0.620

Primary OutFlow Max=3.45 cfs @ 10.90 hrs HW=705.76' (Free Discharge)

- ↑ **1=Culvert** (Passes 3.45 cfs of 10.26 cfs potential flow)
- ↑ **2=Orifice/Grate** (Orifice Controls 1.98 cfs @ 13.95 fps)
- ↑ **3=Orifice/Grate** (Orifice Controls 1.47 cfs @ 4.41 fps)

Bull Run Conveyance

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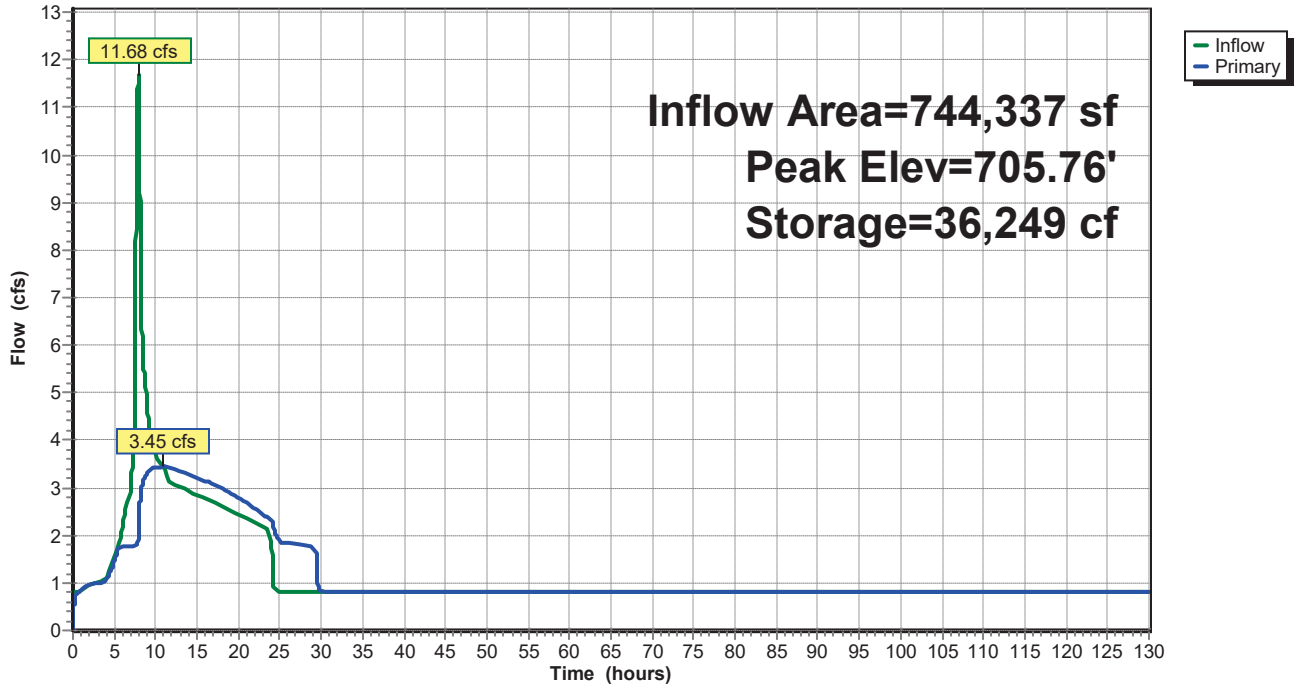
Type IA 24-hr 25-Year Rainfall=4.50"

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Pond Pond C: Pond C

Hydrograph



Bull Run Conveyance

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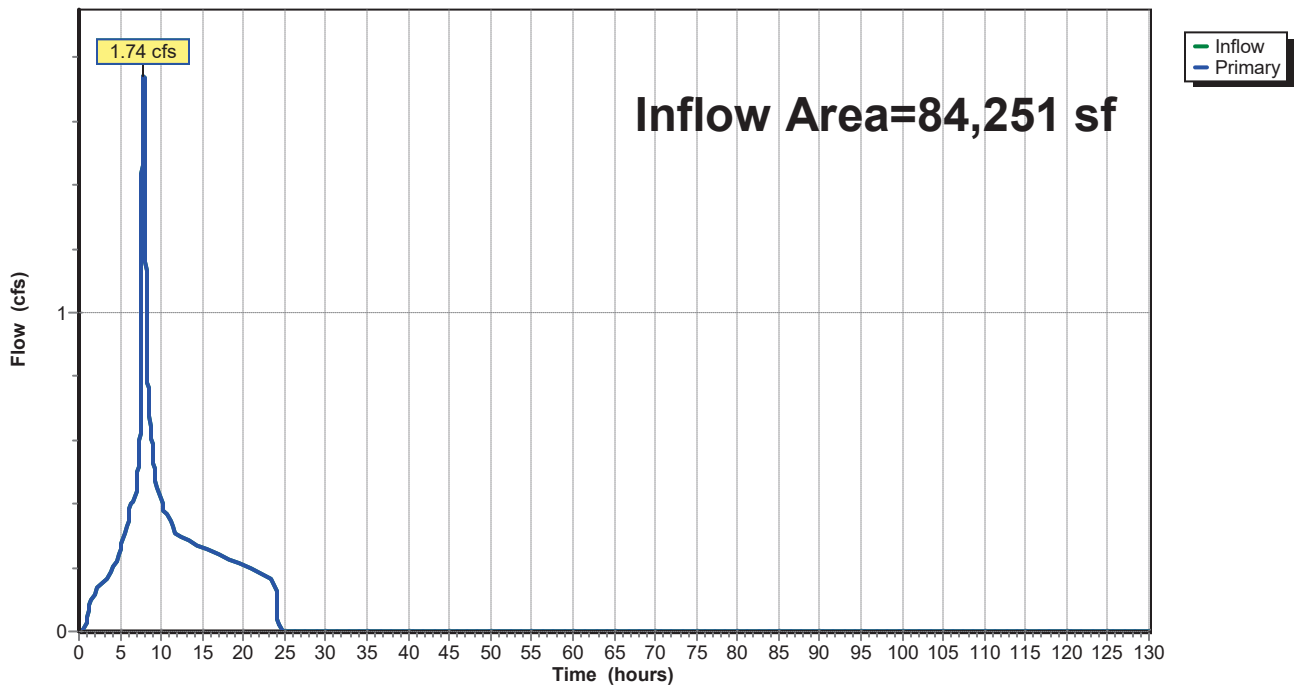
Summary for Link L1: Pipe 4

Inflow Area = 84,251 sf, 66.47% Impervious, Inflow Depth = 3.66" for 25-Year event
Inflow = 1.74 cfs @ 7.89 hrs, Volume= 25,694 cf
Primary = 1.74 cfs @ 7.89 hrs, Volume= 25,694 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs

Link L1: Pipe 4

Hydrograph



Bull Run Conveyance

Type IA 24-hr 25-Year Rainfall=4.50"

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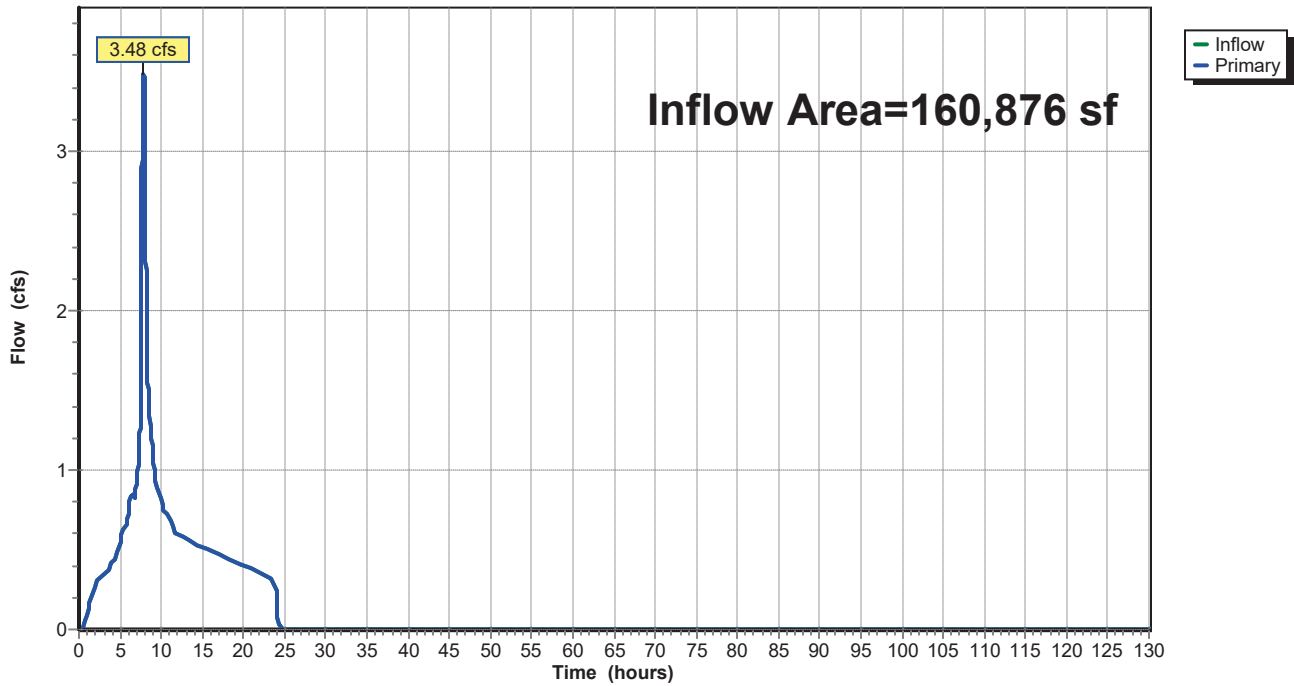
Summary for Link L2: Pipe 6

Inflow Area = 160,876 sf, 75.25% Impervious, Inflow Depth = 3.82" for 25-Year event
Inflow = 3.48 cfs @ 7.89 hrs, Volume= 51,185 cf
Primary = 3.48 cfs @ 7.89 hrs, Volume= 51,185 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs

Link L2: Pipe 6

Hydrograph



Bull Run Conveyance

Type IA 24-hr 25-Year Rainfall=4.50"

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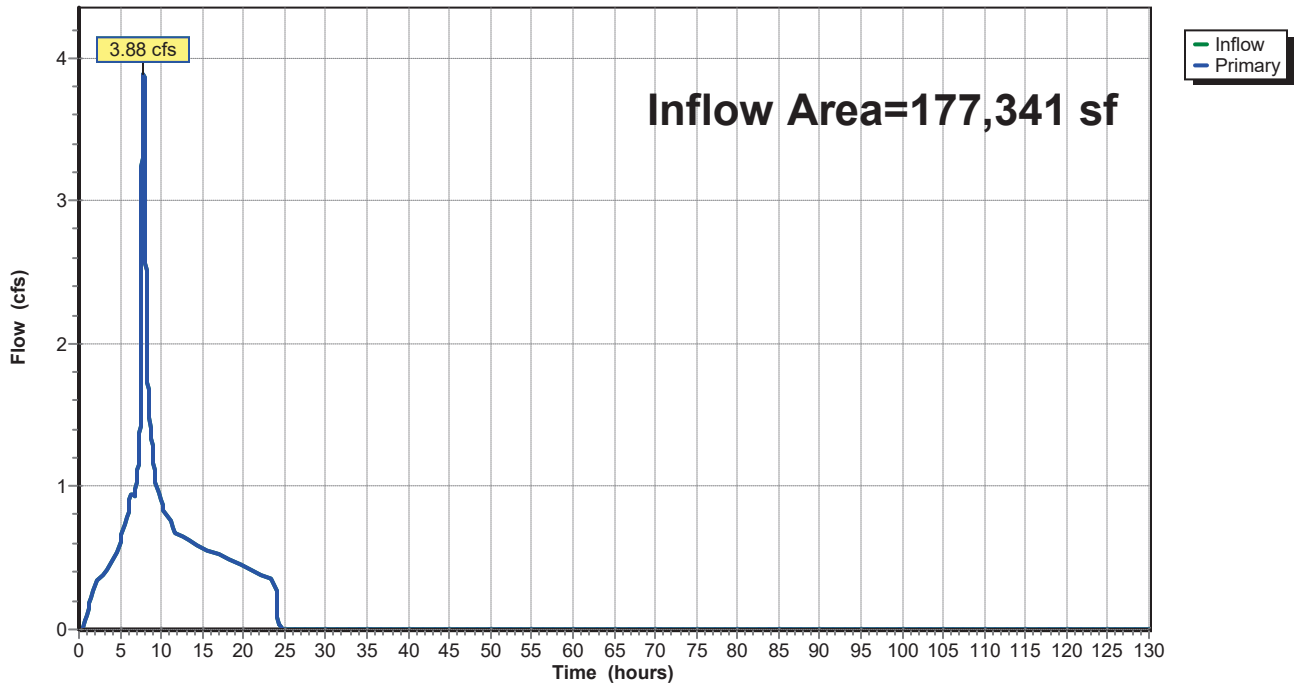
Summary for Link L3: Pipe 7

Inflow Area = 177,341 sf, 77.55% Impervious, Inflow Depth = 3.86" for 25-Year event
Inflow = 3.88 cfs @ 7.89 hrs, Volume= 57,035 cf
Primary = 3.88 cfs @ 7.89 hrs, Volume= 57,035 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs

Link L3: Pipe 7

Hydrograph



Bull Run Conveyance

Type IA 24-hr 25-Year Rainfall=4.50"

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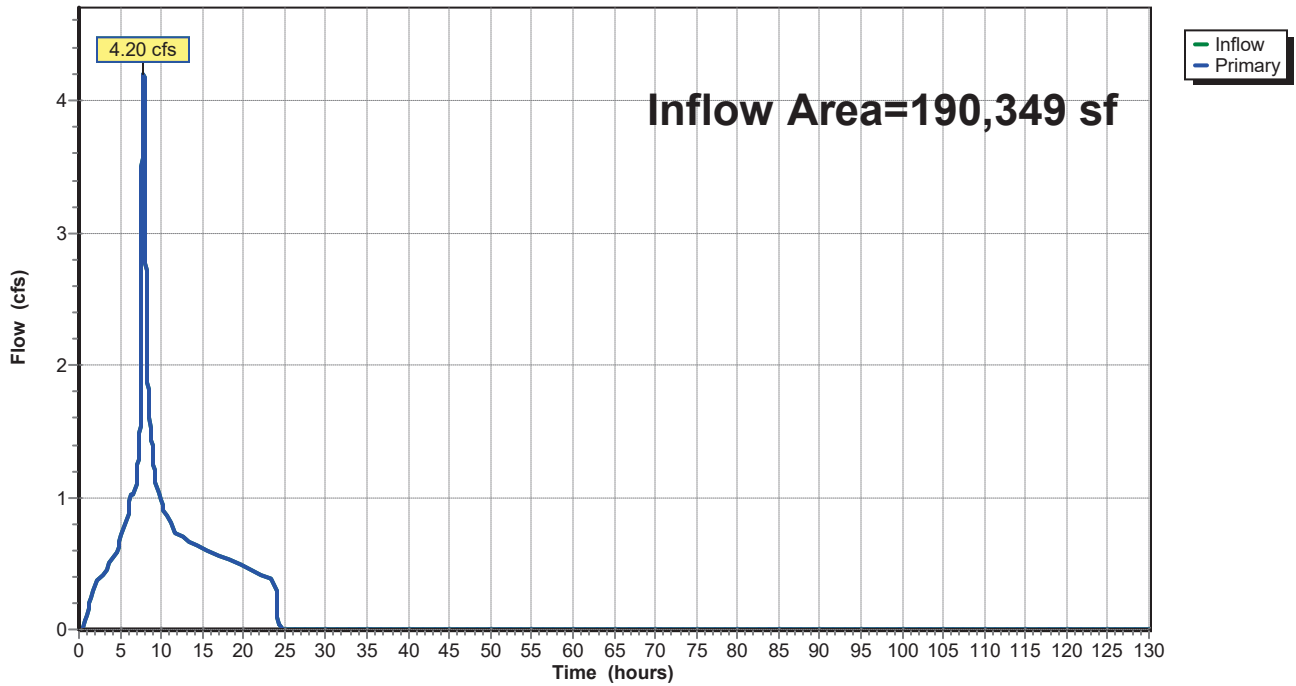
Summary for Link L4: Pipe 9

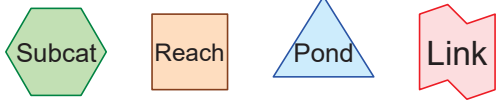
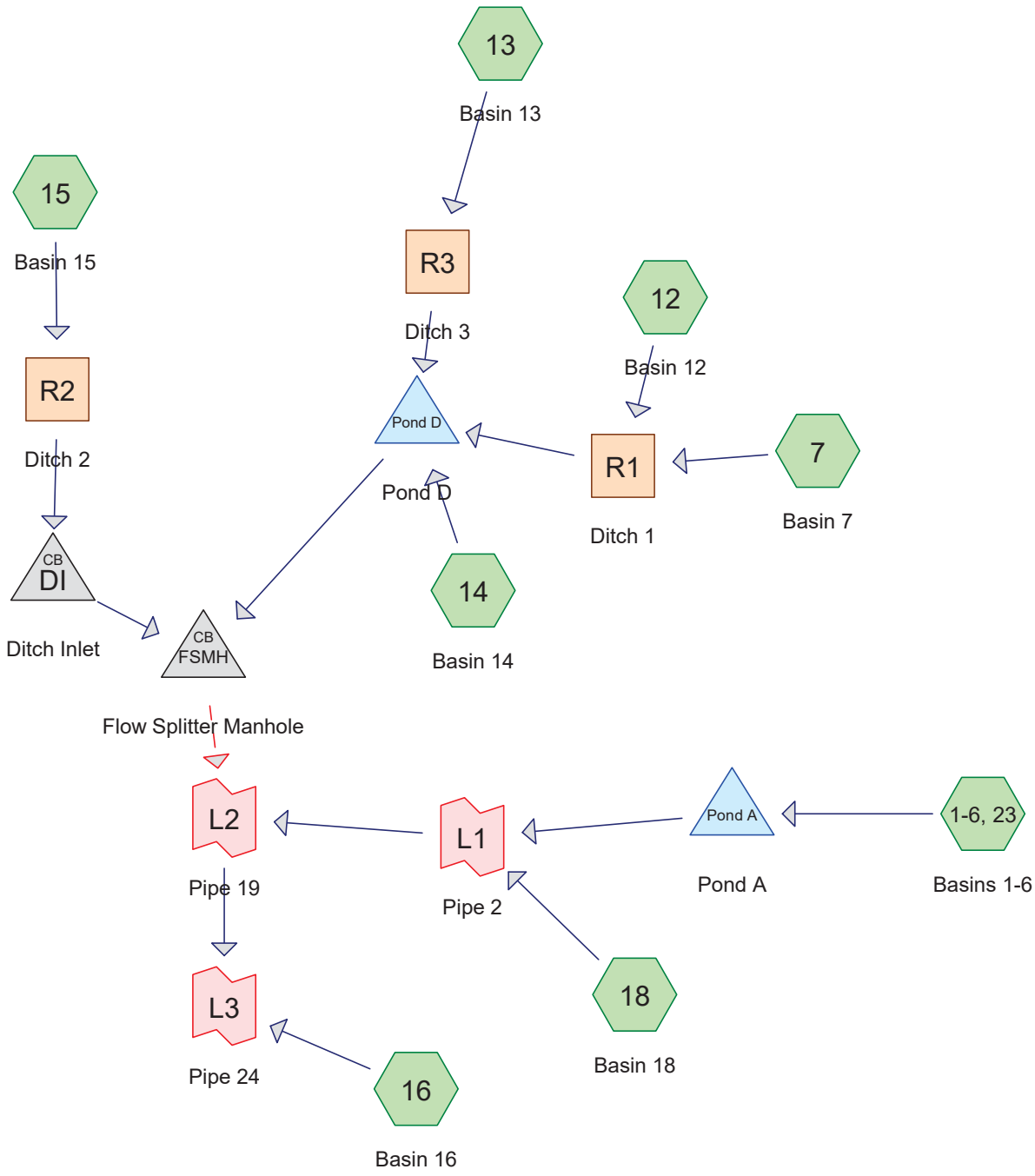
Inflow Area = 190,349 sf, 79.08% Impervious, Inflow Depth = 3.89" for 25-Year event
Inflow = 4.20 cfs @ 7.89 hrs, Volume= 61,657 cf
Primary = 4.20 cfs @ 7.89 hrs, Volume= 61,657 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs

Link L4: Pipe 9

Hydrograph





Routing Diagram for Bull Run Conveyance 2
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Bull Run Conveyance 2

Type IA 24-hr 2-Year Rainfall=2.80"

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Page 2

Summary for Subcatchment 1-6, 23: Basins 1-6

Runoff = 3.52 cfs @ 7.92 hrs, Volume= 53,630 cf, Depth= 1.84"

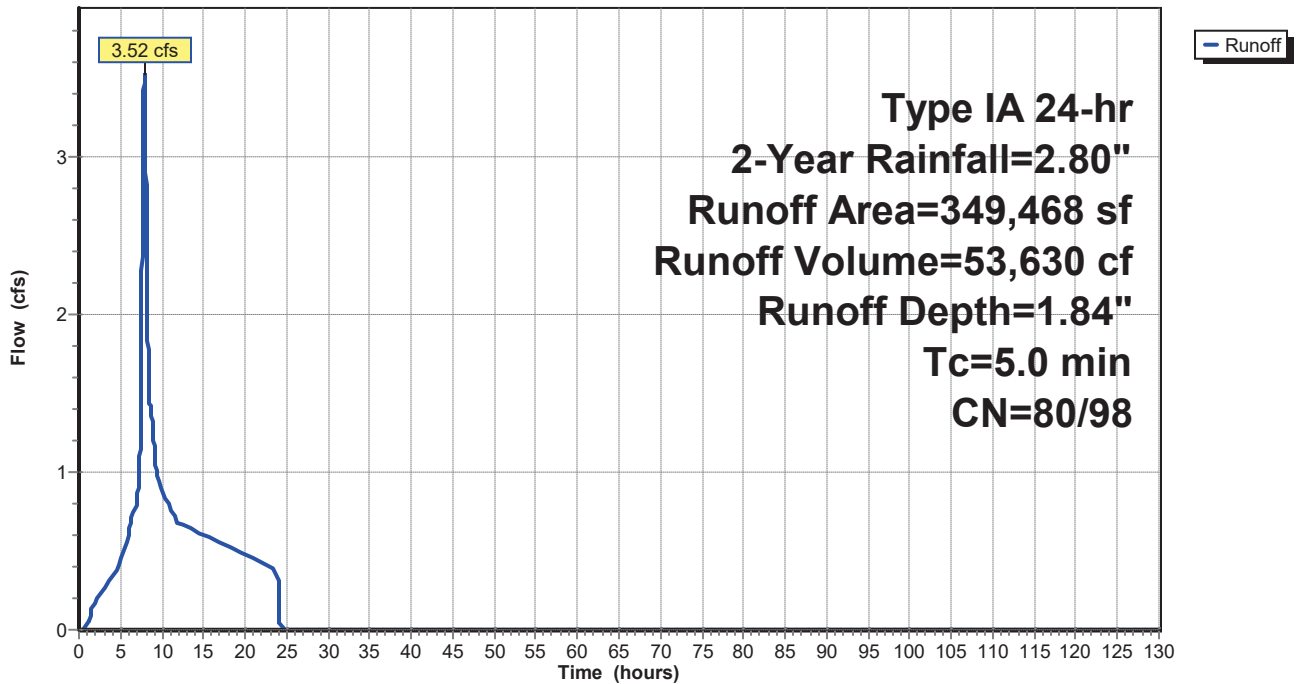
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-Year Rainfall=2.80"

	Area (sf)	CN	Description
*	176,142	98	Impervious Area
	173,326	80	>75% Grass cover, Good, HSG D
	349,468	89	Weighted Average
	173,326	80	49.60% Pervious Area
	176,142	98	50.40% Impervious Area

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

Subcatchment 1-6, 23: Basins 1-6

Hydrograph



Bull Run Conveyance 2

Type IA 24-hr 2-Year Rainfall=2.80"

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Page 3

Summary for Subcatchment 7: Basin 7

Runoff = 0.47 cfs @ 7.88 hrs, Volume= 6,699 cf, Depth= 2.57"

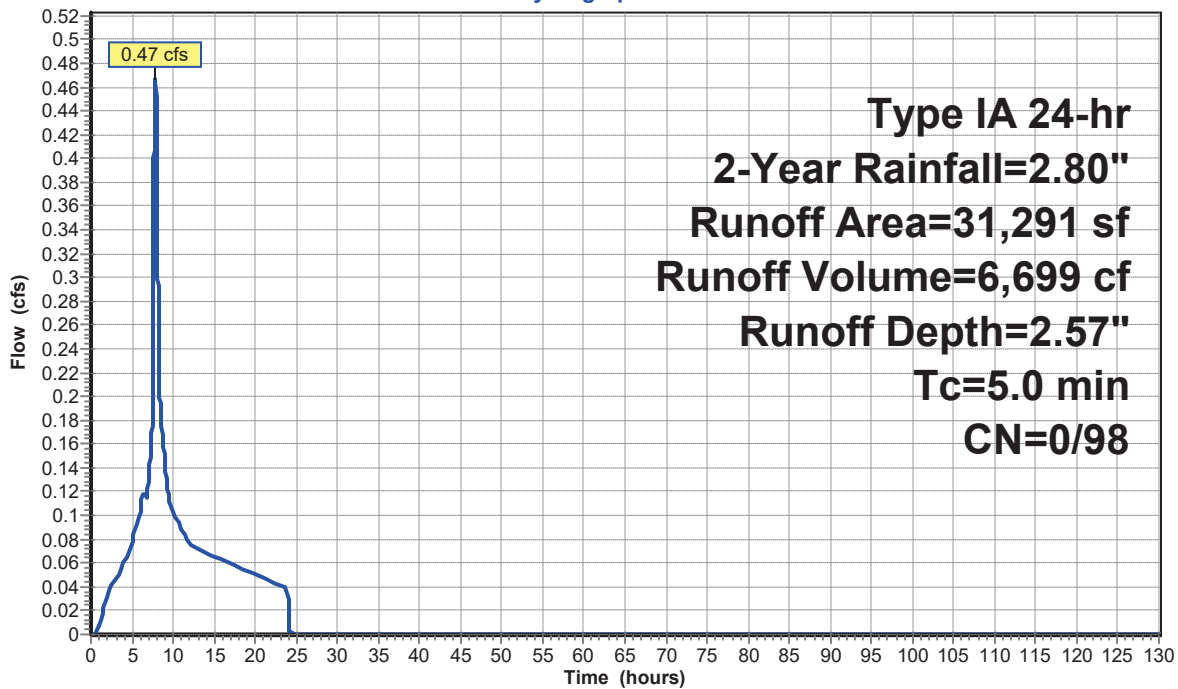
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-Year Rainfall=2.80"

	Area (sf)	CN	Description
*	31,291	98	Impervious Area
	31,291	98	100.00% Impervious Area

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

Subcatchment 7: Basin 7

Hydrograph



Bull Run Conveyance 2

Type IA 24-hr 2-Year Rainfall=2.80"

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Summary for Subcatchment 12: Basin 12

Runoff = 0.54 cfs @ 7.94 hrs, Volume= 8,458 cf, Depth= 1.56"

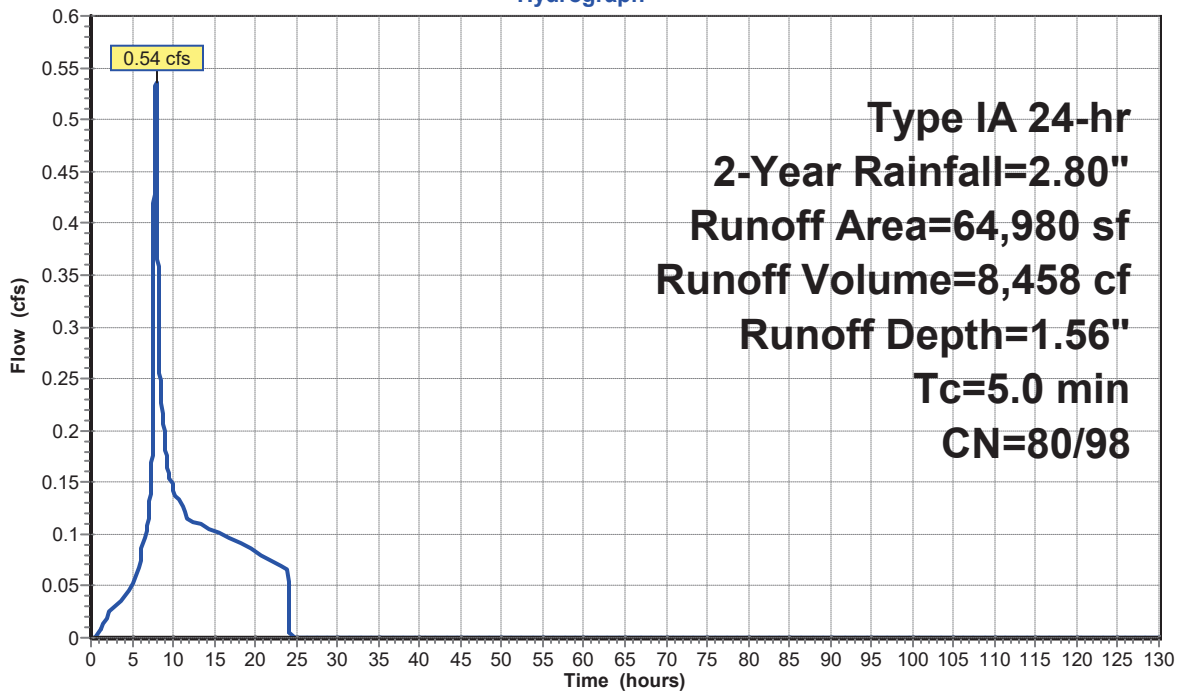
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-Year Rainfall=2.80"

	Area (sf)	CN	Description
*	20,370	98	Impervious Area
*	44,610	80	Pervious
	64,980	86	Weighted Average
	44,610	80	68.65% Pervious Area
	20,370	98	31.35% Impervious Area

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

Subcatchment 12: Basin 12

Hydrograph



Bull Run Conveyance 2

Type IA 24-hr 2-Year Rainfall=2.80"

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Summary for Subcatchment 13: Basin 13

Runoff = 1.13 cfs @ 7.96 hrs, Volume= 18,253 cf, Depth= 1.41"

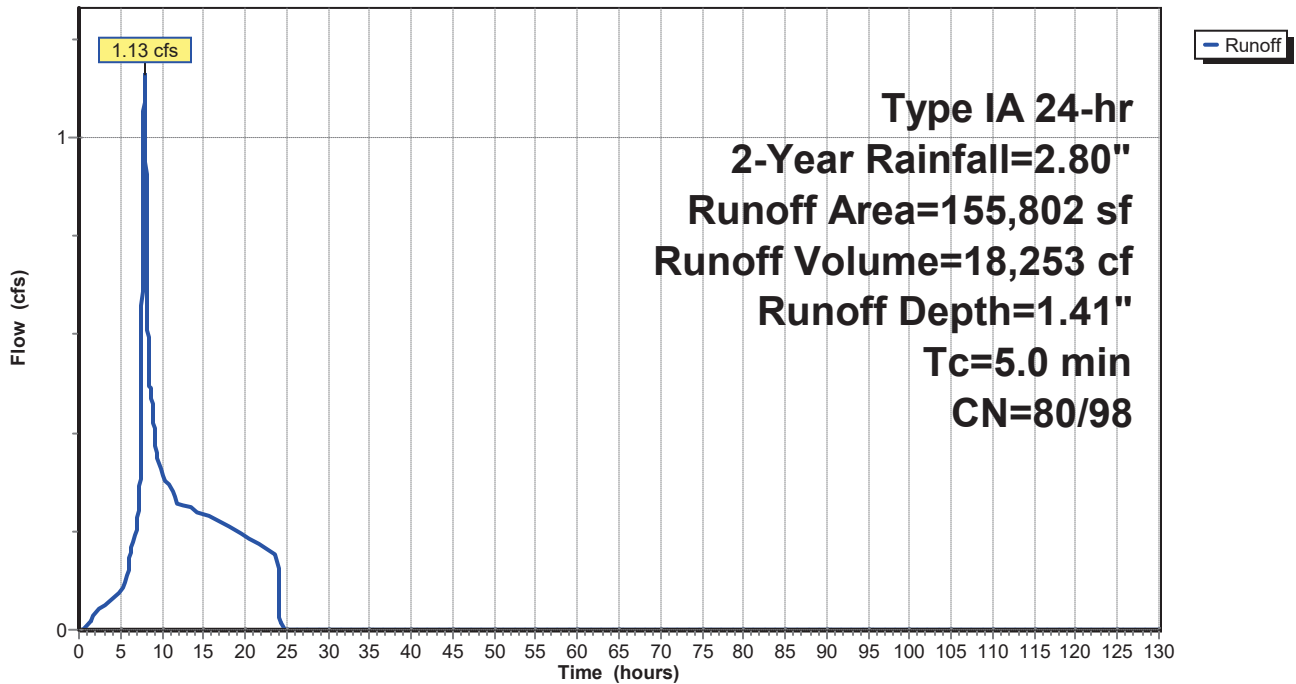
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
 Type IA 24-hr 2-Year Rainfall=2.80"

	Area (sf)	CN	Description
*	32,262	98	Impervious Area
*	123,540	80	Pervious
	155,802	84	Weighted Average
	123,540	80	79.29% Pervious Area
	32,262	98	20.71% Impervious Area

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

Subcatchment 13: Basin 13

Hydrograph



Bull Run Conveyance 2

Type IA 24-hr 2-Year Rainfall=2.80"

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Summary for Subcatchment 14: Basin 14

Runoff = 1.23 cfs @ 7.94 hrs, Volume= 19,119 cf, Depth= 1.64"

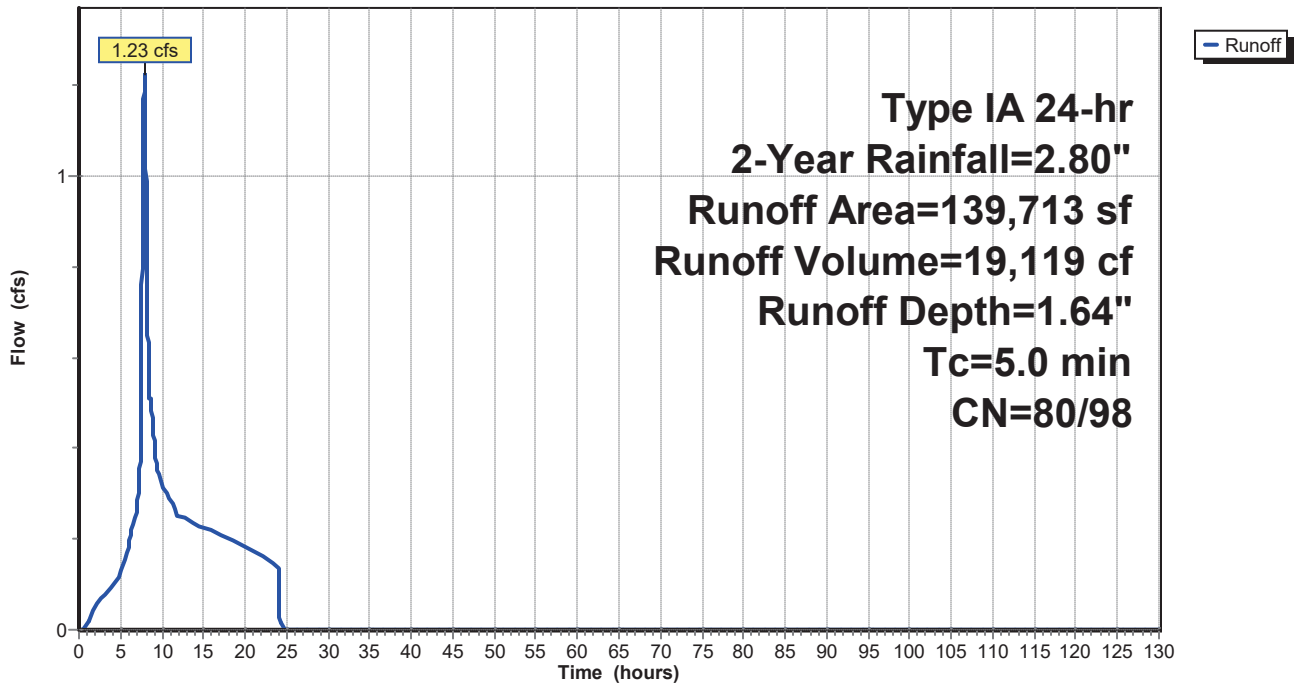
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
 Type IA 24-hr 2-Year Rainfall=2.80"

	Area (sf)	CN	Description
*	51,434	98	Impervious Area
*	88,279	80	Pervious Area
	139,713	87	Weighted Average
	88,279	80	63.19% Pervious Area
	51,434	98	36.81% Impervious Area

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

Subcatchment 14: Basin 14

Hydrograph



Bull Run Conveyance 2

Type IA 24-hr 2-Year Rainfall=2.80"

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Summary for Subcatchment 15: Basin 15

Runoff = 0.59 cfs @ 7.99 hrs, Volume= 9,892 cf, Depth= 1.18"

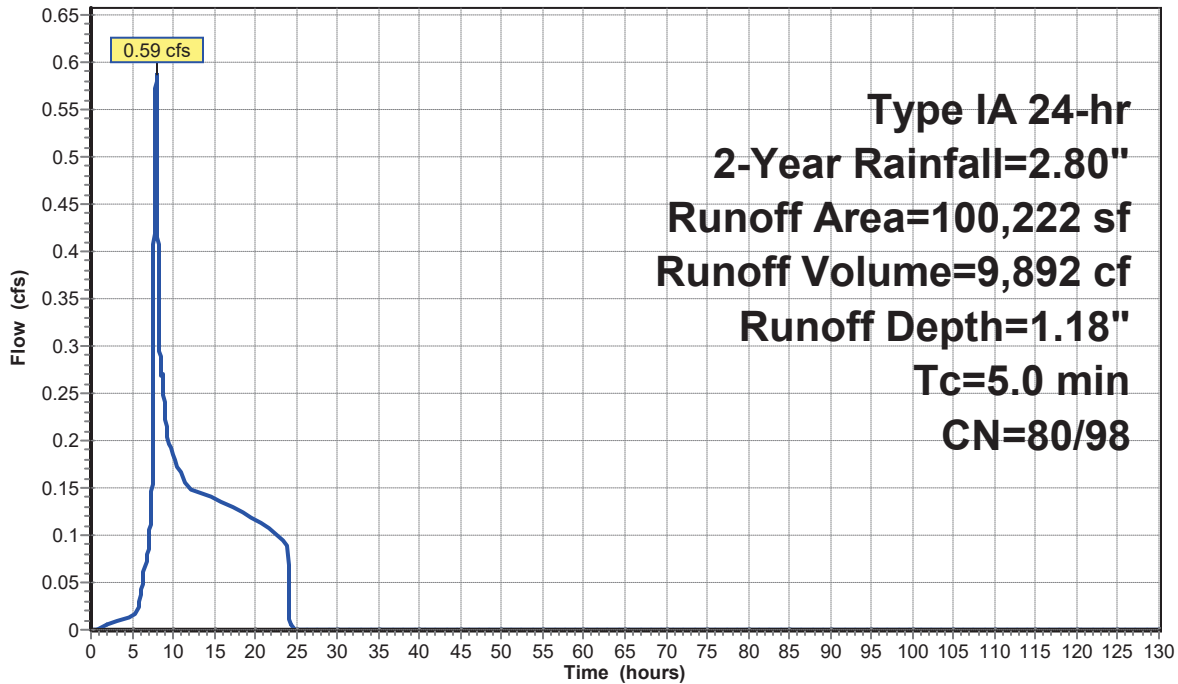
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-Year Rainfall=2.80"

	Area (sf)	CN	Description
*	5,624	98	Impervious Area
*	94,598	80	Pervious
	100,222	81	Weighted Average
	94,598	80	94.39% Pervious Area
	5,624	98	5.61% Impervious Area

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

Subcatchment 15: Basin 15

Hydrograph



Bull Run Conveyance 2

Type IA 24-hr 2-Year Rainfall=2.80"

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Summary for Subcatchment 16: Basin 16

Runoff = 0.64 cfs @ 7.99 hrs, Volume= 10,549 cf, Depth= 1.22"

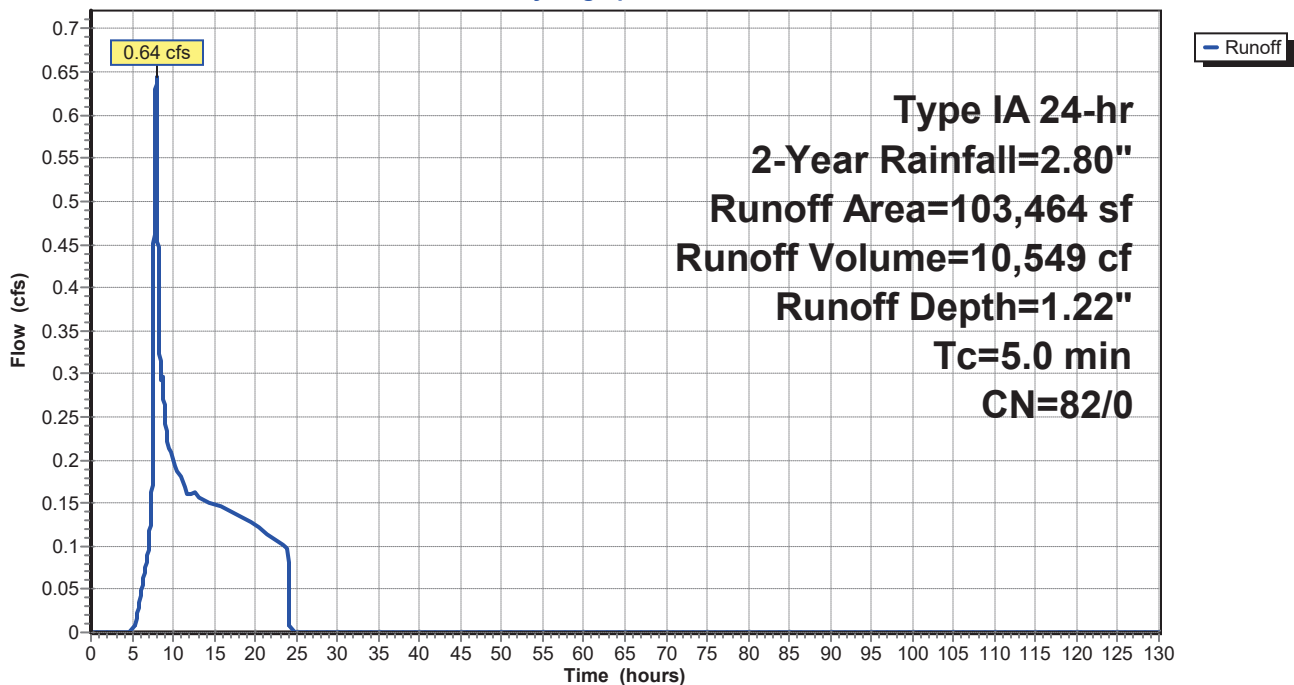
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-Year Rainfall=2.80"

	Area (sf)	CN	Description
*	103,464	82	Pervious
	103,464	82	100.00% Pervious Area

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

Subcatchment 16: Basin 16

Hydrograph



Bull Run Conveyance 2

Type IA 24-hr 2-Year Rainfall=2.80"

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Summary for Subcatchment 18: Basin 18

Runoff = 0.05 cfs @ 18.05 hrs, Volume= 2,285 cf, Depth= 0.29"

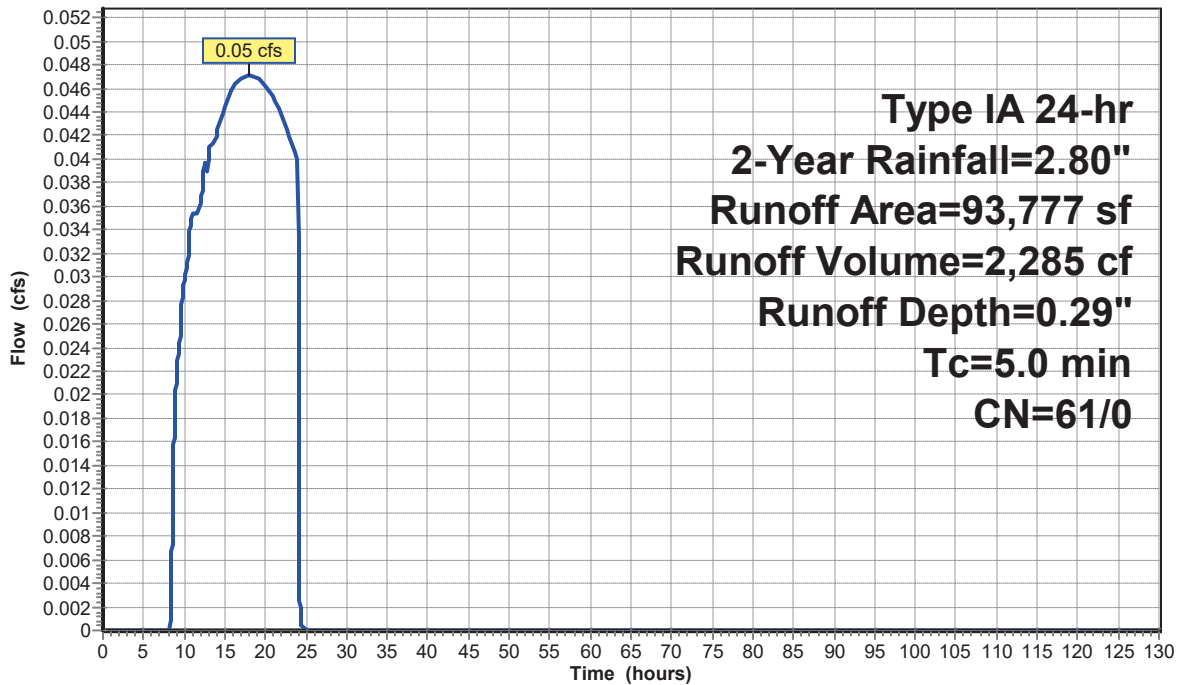
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-Year Rainfall=2.80"

	Area (sf)	CN	Description
*	93,777	61	Ecoroof
	93,777	61	100.00% Pervious Area

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

Subcatchment 18: Basin 18

Hydrograph



Bull Run Conveyance 2

Type IA 24-hr 2-Year Rainfall=2.80"

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Summary for Reach R1: Ditch 1

Inflow Area = 96,271 sf, 53.66% Impervious, Inflow Depth = 1.89" for 2-Year event
Inflow = 1.00 cfs @ 7.91 hrs, Volume= 15,157 cf
Outflow = 1.00 cfs @ 7.93 hrs, Volume= 15,157 cf, Atten= 0%, Lag= 0.9 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.23 fps, Min. Travel Time= 1.3 min
Avg. Velocity = 1.15 fps, Avg. Travel Time= 2.6 min

Peak Storage= 79 cf @ 7.93 hrs
Average Depth at Peak Storage= 0.18'
Bank-Full Depth= 0.75' Flow Area= 3.2 sf, Capacity= 15.74 cfs

Custom cross-section, Length= 176.0' Slope= 0.0187 '/'
Constant n= 0.025 Earth, clean & straight
Inlet Invert= 702.30', Outlet Invert= 699.00'



Offset (feet)	Elevation (feet)	Chan.Depth (feet)
-3.25	0.75	0.00
-1.00	0.00	0.75
1.00	0.00	0.75
3.25	0.75	0.00

Depth (feet)	End Area (sq-ft)	Perim. (feet)	Storage (cubic-feet)	Discharge (cfs)
0.00	0.0	2.0	0	0.00
0.75	3.2	6.7	561	15.74

Bull Run Conveyance 2

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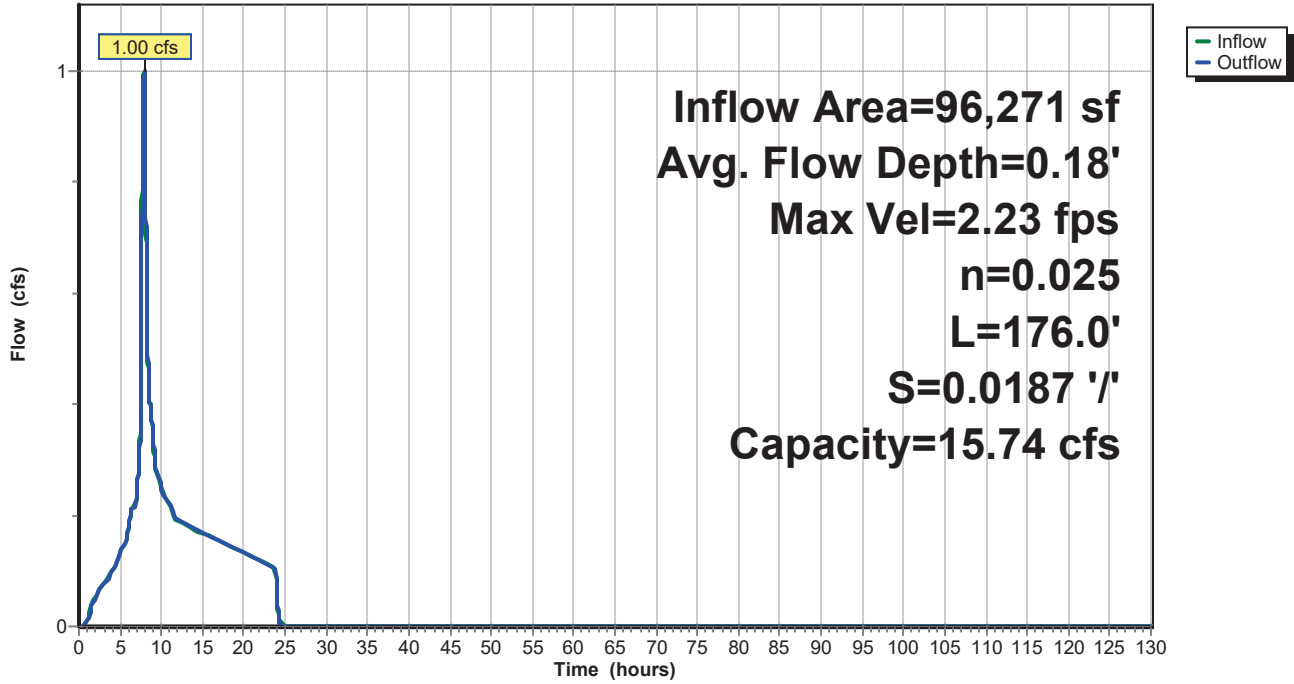
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Reach R1: Ditch 1

Hydrograph



Bull Run Conveyance 2

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Summary for Reach R2: Ditch 2

Inflow Area = 100,222 sf, 5.61% Impervious, Inflow Depth = 1.18" for 2-Year event
Inflow = 0.59 cfs @ 7.99 hrs, Volume= 9,892 cf
Outflow = 0.58 cfs @ 8.01 hrs, Volume= 9,892 cf, Atten= 2%, Lag= 0.9 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.77 fps, Min. Travel Time= 5.4 min
Avg. Velocity = 0.86 fps, Avg. Travel Time= 11.1 min

Peak Storage= 187 cf @ 8.01 hrs
Average Depth at Peak Storage= 0.10'
Bank-Full Depth= 1.00' Flow Area= 6.0 sf, Capacity= 39.58 cfs

Custom cross-section, Length= 576.0' Slope= 0.0222 '/'
Constant n= 0.025 Earth, clean & straight
Inlet Invert= 703.59', Outlet Invert= 690.82'



Offset (feet)	Elevation (feet)	Chan.Depth (feet)
-4.50	1.00	0.00
-1.50	0.00	1.00
1.50	0.00	1.00
4.50	1.00	0.00

Depth (feet)	End Area (sq-ft)	Perim. (feet)	Storage (cubic-feet)	Discharge (cfs)
0.00	0.0	3.0	0	0.00
1.00	6.0	9.3	3,456	39.58

Bull Run Conveyance 2

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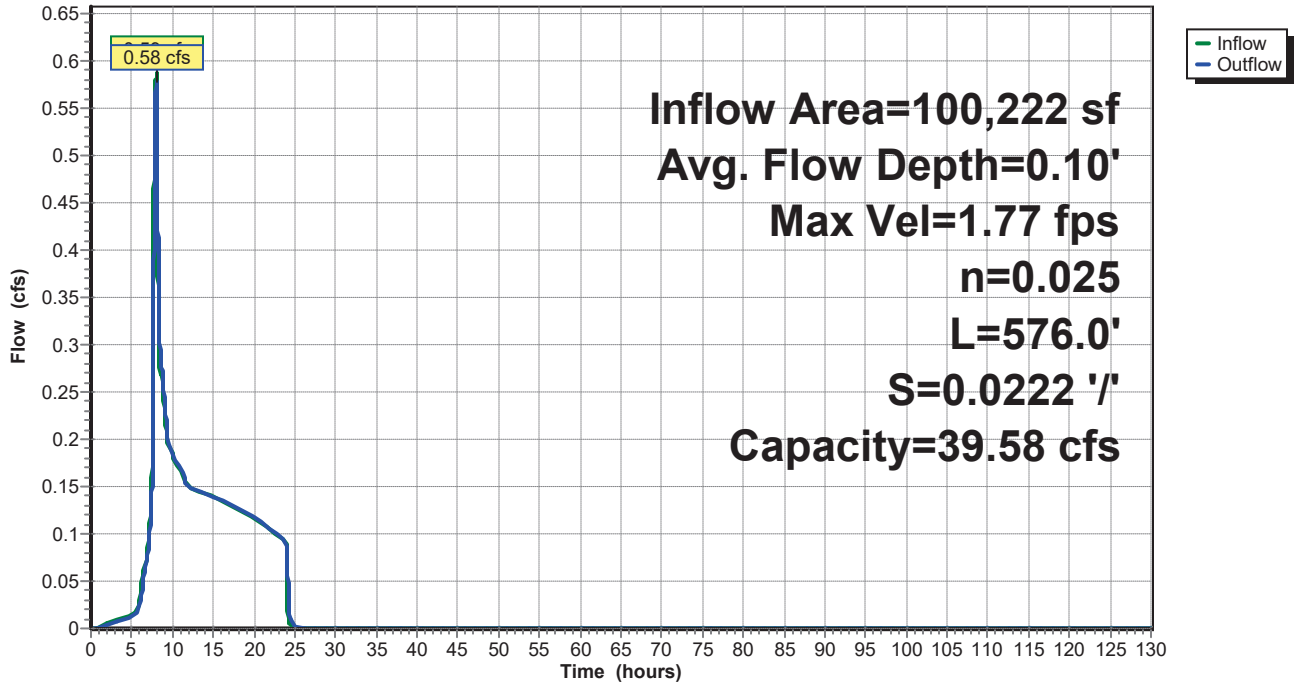
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Reach R2: Ditch 2

Hydrograph



Bull Run Conveyance 2

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Summary for Reach R3: Ditch 3

Inflow Area = 155,802 sf, 20.71% Impervious, Inflow Depth = 1.41" for 2-Year event
 Inflow = 1.13 cfs @ 7.96 hrs, Volume= 18,253 cf
 Outflow = 1.12 cfs @ 8.00 hrs, Volume= 18,253 cf, Atten= 1%, Lag= 2.5 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
 Max. Velocity= 1.70 fps, Min. Travel Time= 5.2 min
 Avg. Velocity = 0.84 fps, Avg. Travel Time= 10.5 min

Peak Storage= 347 cf @ 8.00 hrs
 Average Depth at Peak Storage= 0.24'
 Bank-Full Depth= 1.00' Flow Area= 5.0 sf, Capacity= 18.61 cfs

Custom cross-section, Length= 530.0' Slope= 0.0077 '/'
 Constant n= 0.025 Earth, clean & straight
 Inlet Invert= 707.64', Outlet Invert= 703.54'



Offset (feet)	Elevation (feet)	Chan.Depth (feet)
-4.00	1.00	0.00
-1.00	0.00	1.00
1.00	0.00	1.00
4.00	1.00	0.00

Depth (feet)	End Area (sq-ft)	Perim. (feet)	Storage (cubic-feet)	Discharge (cfs)
0.00	0.0	2.0	0	0.00
1.00	5.0	8.3	2,650	18.61

Bull Run Conveyance 2

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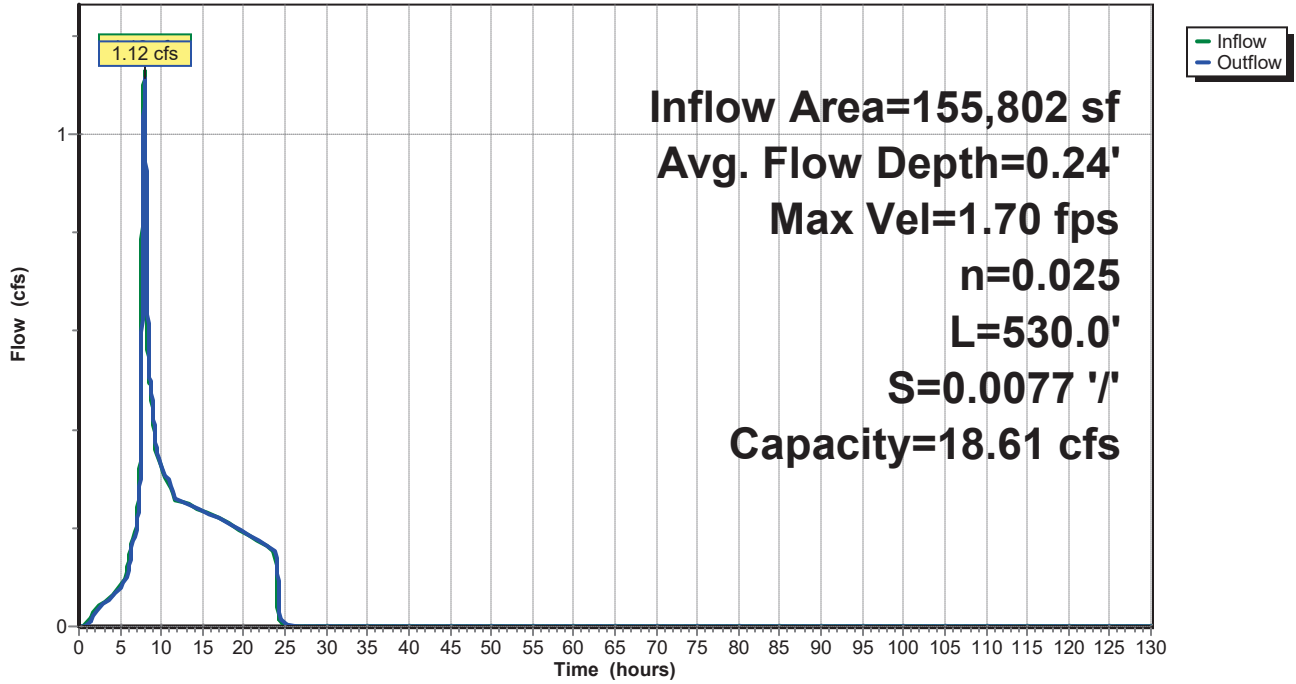
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Reach R3: Ditch 3

Hydrograph



Bull Run Conveyance 2

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Summary for Pond DI: Ditch Inlet

Inflow Area = 100,222 sf, 5.61% Impervious, Inflow Depth = 1.18" for 2-Year event
 Inflow = 0.58 cfs @ 8.01 hrs, Volume= 9,892 cf
 Outflow = 0.58 cfs @ 8.01 hrs, Volume= 9,892 cf, Atten= 0%, Lag= 0.0 min
 Primary = 0.58 cfs @ 8.01 hrs, Volume= 9,892 cf

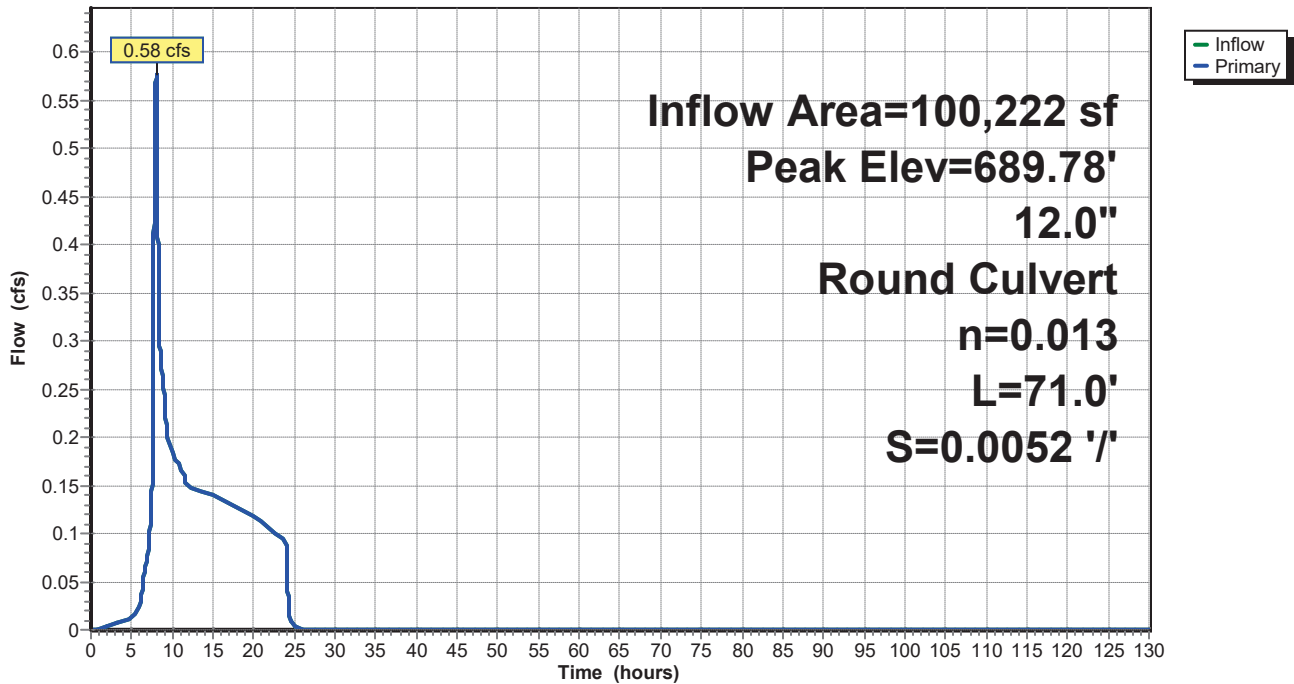
Routing by Dyn-Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
 Peak Elev= 689.78' @ 8.01 hrs

Device #	Routing	Invert	Outlet Devices
1	Primary	689.33'	12.0" Round From Ditch Inlet L= 71.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 689.33' / 688.96' S= 0.0052 '/ Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=0.58 cfs @ 8.01 hrs HW=689.78' TW=689.34' (Dynamic Tailwater)
 ←1=From Ditch Inlet (Outlet Controls 0.58 cfs @ 2.45 fps)

Pond DI: Ditch Inlet

Hydrograph



Bull Run Conveyance 2

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Summary for Pond FSMH: Flow Splitter Manhole

Inflow Area = 492,008 sf, 28.65% Impervious, Inflow Depth = 1.52" for 2-Year event
Inflow = 1.37 cfs @ 8.03 hrs, Volume= 62,427 cf
Outflow = 1.37 cfs @ 8.03 hrs, Volume= 62,427 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.47 cfs @ 8.03 hrs, Volume= 22,531 cf
Secondary = 0.90 cfs @ 8.03 hrs, Volume= 39,897 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Peak Elev= 689.34' @ 8.03 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	688.86'	8.0" Round To Existing Culvert L= 38.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 688.86' / 688.65' S= 0.0055 '/' Cc= 0.900 n= 0.013, Flow Area= 0.35 sf
#2	Device 1	687.36'	5.0" Horiz. Orifice C= 0.620 Limited to weir flow at low heads
#3	Secondary	688.86'	18.0" Round Bypassed Flow L= 148.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 688.86' / 688.11' S= 0.0051 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf

Primary OutFlow Max=0.47 cfs @ 8.03 hrs HW=689.34' (Free Discharge)

↑ **1=To Existing Culvert** (Passes 0.47 cfs of 0.48 cfs potential flow)

↑ **2=Orifice** (Orifice Controls 0.47 cfs @ 3.44 fps)

Secondary OutFlow Max=0.90 cfs @ 8.03 hrs HW=689.34' TW=0.00' (Dynamic Tailwater)

↑ **3=Bypassed Flow** (Barrel Controls 0.90 cfs @ 2.77 fps)

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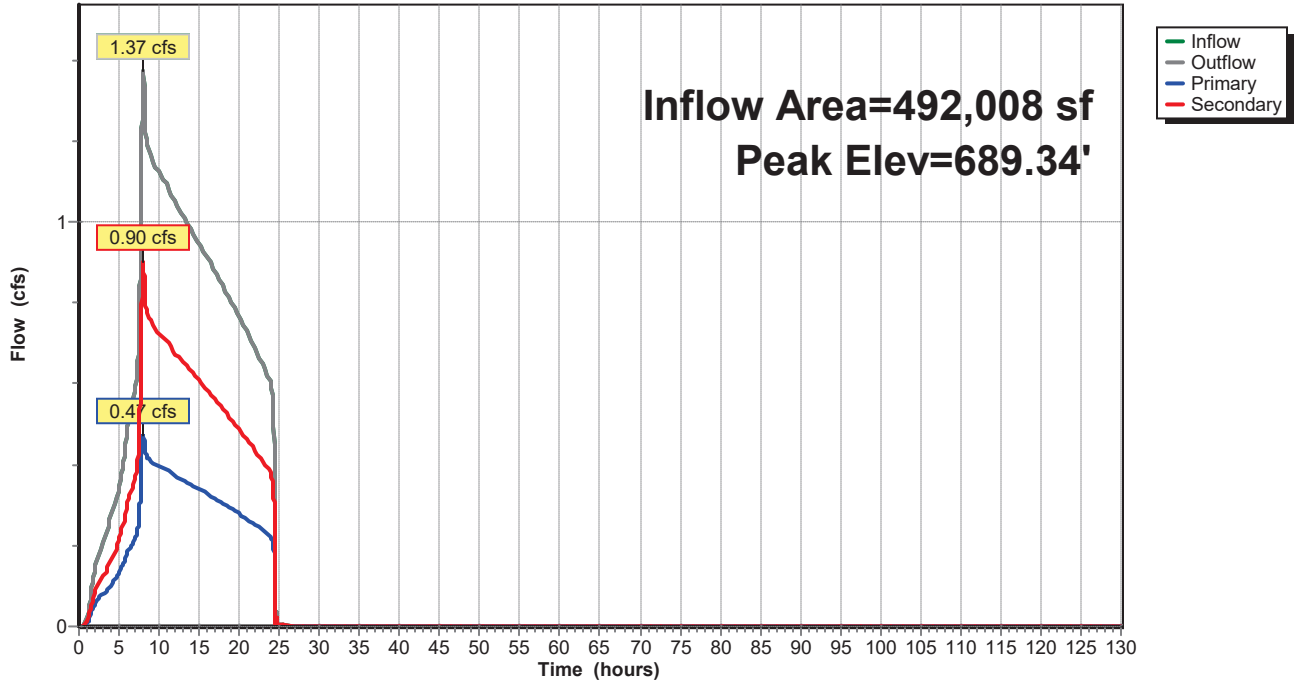
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Pond FSMH: Flow Splitter Manhole

Hydrograph



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Summary for Pond Pond A: Pond A

Inflow Area = 349,468 sf, 50.40% Impervious, Inflow Depth = 1.84" for 2-Year event
 Inflow = 3.52 cfs @ 7.92 hrs, Volume= 53,630 cf
 Outflow = 0.61 cfs @ 14.88 hrs, Volume= 53,638 cf, Atten= 83%, Lag= 417.7 min
 Primary = 0.61 cfs @ 14.88 hrs, Volume= 53,638 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
 Peak Elev= 709.31' @ 14.88 hrs Surf.Area= 8,083 sf Storage= 12,925 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
 Center-of-Mass det. time= 236.5 min (955.2 - 718.7)

Volume	Invert	Avail.Storage	Storage Description
#1	707.50'	70,555 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
707.50	6,107	0	0
708.00	6,714	3,205	3,205
709.00	7,742	7,228	10,433
710.00	8,825	8,284	18,717
711.00	9,967	9,396	28,113
712.00	11,161	10,564	38,677
713.00	12,412	11,787	50,463
714.00	13,717	13,065	63,528
714.50	14,392	7,027	70,555

Device	Routing	Invert	Outlet Devices
#1	Primary	698.43'	18.0" Round Culvert L= 138.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 698.43' / 696.24' S= 0.0159 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf
#2	Device 1	696.43'	2.6" Horiz. Orifice/Grate C= 0.620 Limited to weir flow at low heads
#3	Device 1	709.40'	16.0" W x 3.0" H Vert. Orifice/Grate C= 0.620

Primary OutFlow Max=0.61 cfs @ 14.88 hrs HW=709.31' TW=0.00' (Dynamic Tailwater)

- 1=Culvert (Passes 0.61 cfs of 24.05 cfs potential flow)
- 2=Orifice/Grate (Orifice Controls 0.61 cfs @ 16.42 fps)
- 3=Orifice/Grate (Controls 0.00 cfs)

Bull Run Conveyance 2

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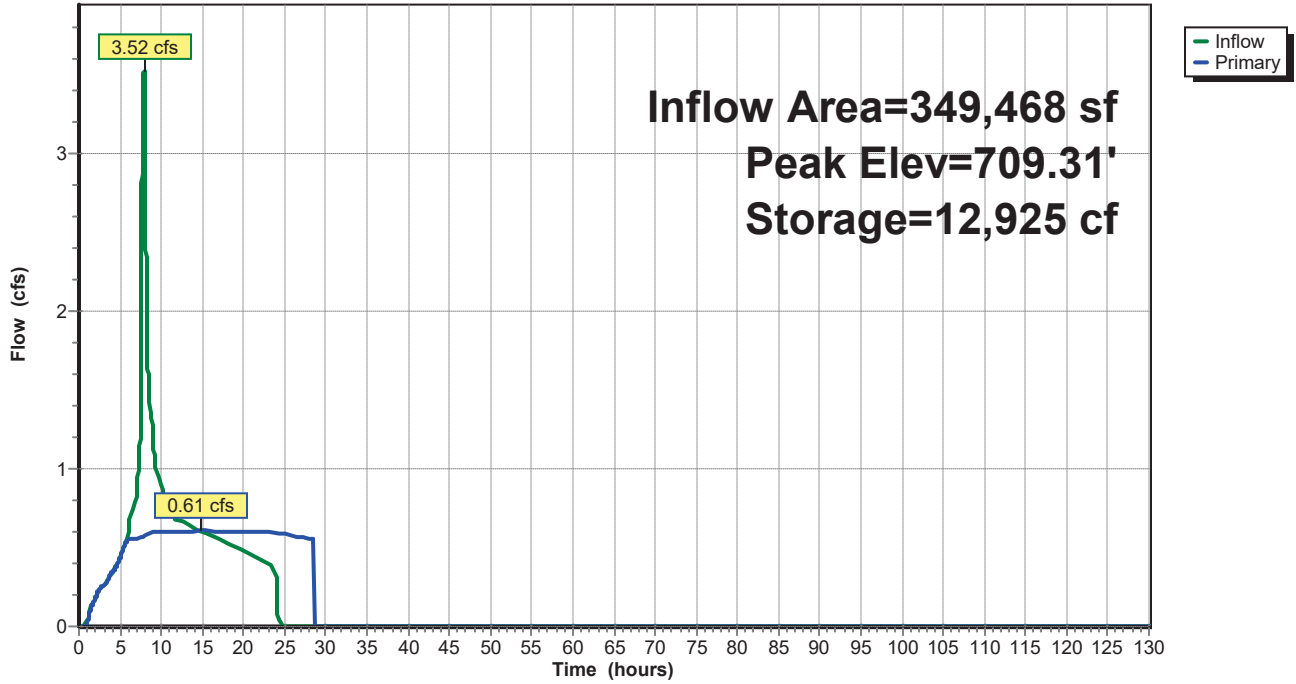
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Pond Pond A: Pond A

Hydrograph



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Summary for Pond Pond D: Pond D

Inflow Area = 391,786 sf, 34.55% Impervious, Inflow Depth = 1.61" for 2-Year event
 Inflow = 3.33 cfs @ 7.96 hrs, Volume= 52,530 cf
 Outflow = 0.93 cfs @ 9.82 hrs, Volume= 52,535 cf, Atten= 72%, Lag= 111.3 min
 Primary = 0.93 cfs @ 9.82 hrs, Volume= 52,535 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
 Peak Elev= 694.55' @ 9.82 hrs Surf.Area= 5,938 sf Storage= 8,059 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
 Center-of-Mass det. time= 84.5 min (832.1 - 747.6)

Volume	Invert	Avail.Storage	Storage Description
#1	693.00'	45,106 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
693.00	4,453	0	0
694.00	5,388	4,921	4,921
695.00	6,380	5,884	10,805
696.00	7,428	6,904	17,709
697.00	8,533	7,981	25,689
698.00	9,694	9,114	34,803
699.00	10,912	10,303	45,106

Device	Routing	Invert	Outlet Devices
#1	Primary	692.50'	12.0" Round Culvert L= 121.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 692.50' / 688.97' S= 0.0292 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	690.50'	4.9" Horiz. Orifice/Grate C= 0.620 Limited to weir flow at low heads
#3	Device 1	694.60'	15.0" W x 3.0" H Vert. Orifice/Grate C= 0.620

Primary OutFlow Max=0.93 cfs @ 9.82 hrs HW=694.55' TW=689.29' (Dynamic Tailwater)

- ↑ **1=Culvert** (Passes 0.93 cfs of 4.71 cfs potential flow)
- ↑ **2=Orifice/Grate** (Orifice Controls 0.93 cfs @ 7.13 fps)
- ↑ **3=Orifice/Grate** (Controls 0.00 cfs)

Bull Run Conveyance 2

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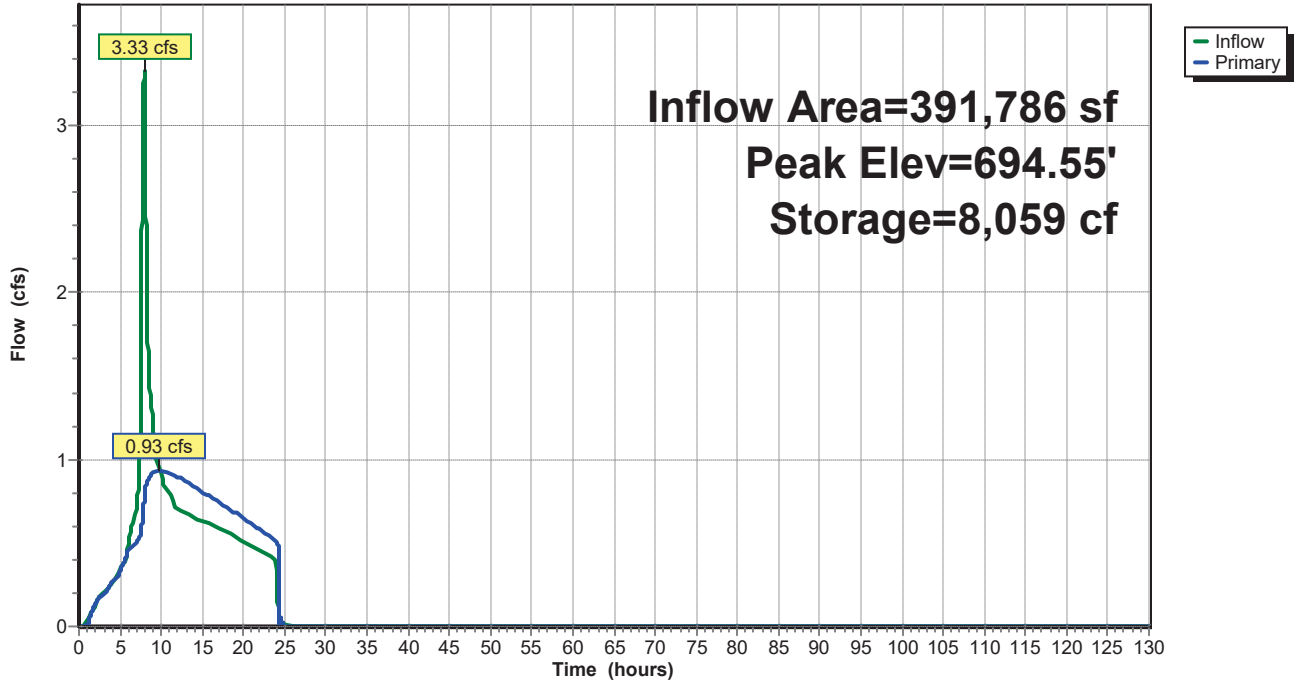
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Pond Pond D: Pond D

Hydrograph



Bull Run Conveyance 2

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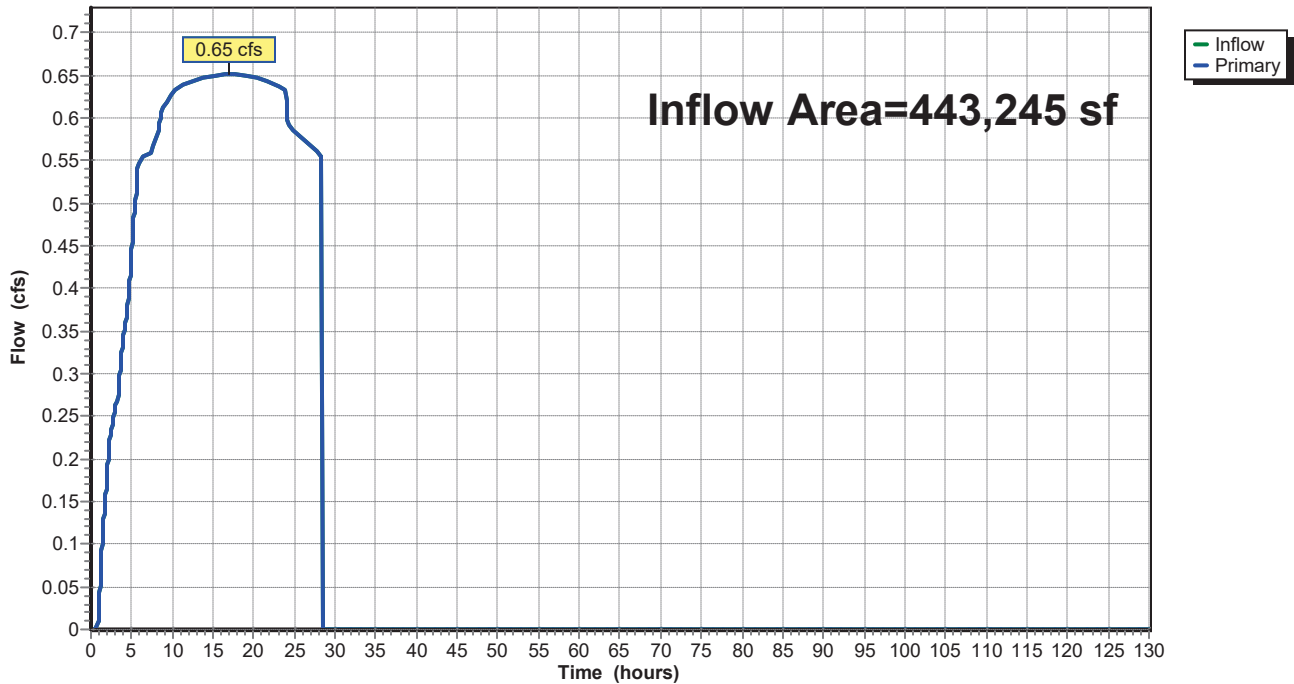
Summary for Link L1: Pipe 2

Inflow Area = 443,245 sf, 39.74% Impervious, Inflow Depth = 1.51" for 2-Year event
Inflow = 0.65 cfs @ 16.95 hrs, Volume= 55,923 cf
Primary = 0.65 cfs @ 16.95 hrs, Volume= 55,923 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs

Link L1: Pipe 2

Hydrograph



Bull Run Conveyance 2

Type IA 24-hr 2-Year Rainfall=2.80"

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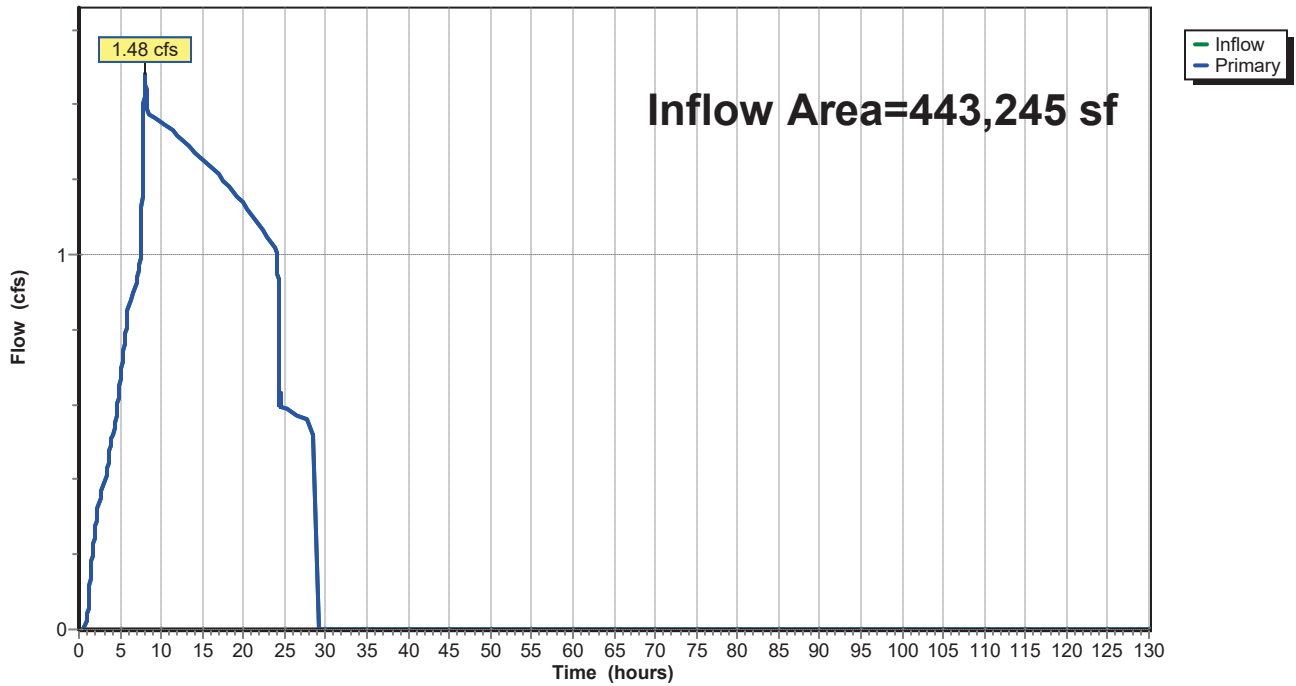
Summary for Link L2: Pipe 19

Inflow Area = 443,245 sf, 39.74% Impervious, Inflow Depth = 2.59" for 2-Year event
Inflow = 1.48 cfs @ 8.03 hrs, Volume= 95,820 cf
Primary = 1.48 cfs @ 8.03 hrs, Volume= 95,820 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs

Link L2: Pipe 19

Hydrograph



Bull Run Conveyance 2

Type IA 24-hr 2-Year Rainfall=2.80"

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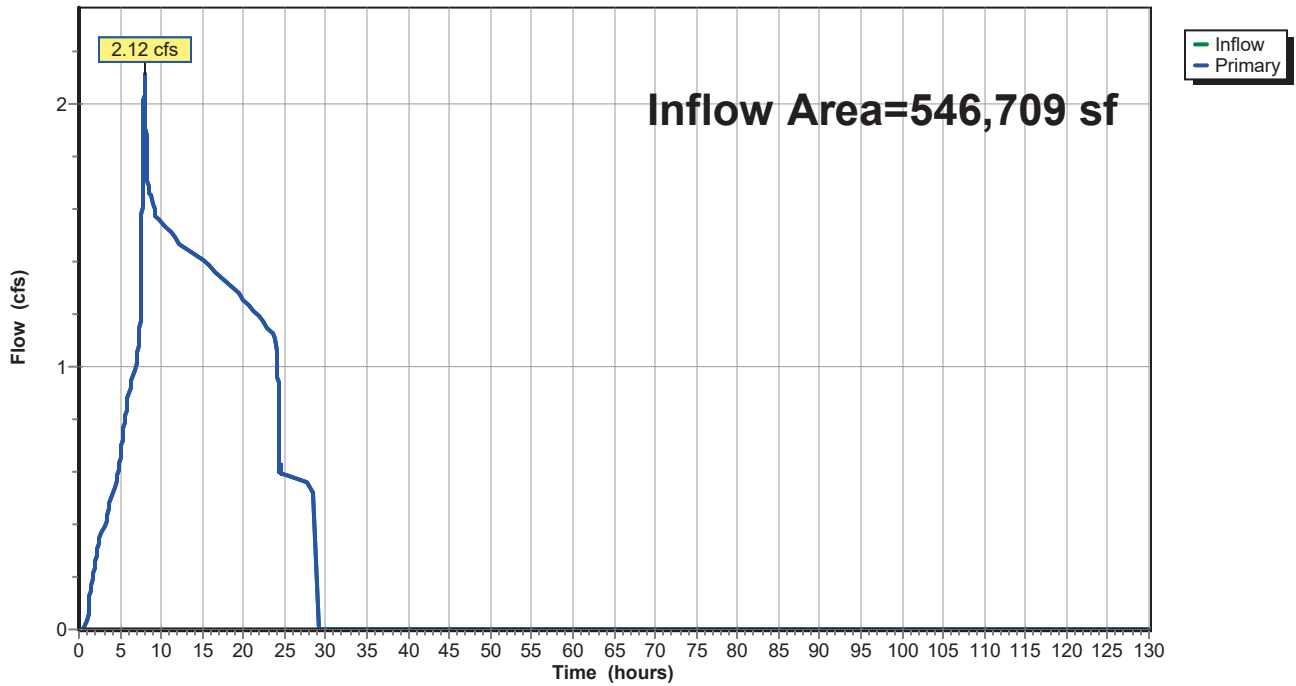
Summary for Link L3: Pipe 24

Inflow Area = 546,709 sf, 32.22% Impervious, Inflow Depth = 2.33" for 2-Year event
Inflow = 2.12 cfs @ 8.00 hrs, Volume= 106,369 cf
Primary = 2.12 cfs @ 8.00 hrs, Volume= 106,369 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs

Link L3: Pipe 24

Hydrograph



Bull Run Conveyance 2

Type IA 24-hr 5-Year Rainfall=3.40"

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Summary for Subcatchment 1-6, 23: Basins 1-6

Runoff = 4.59 cfs @ 7.91 hrs, Volume= 68,979 cf, Depth= 2.37"

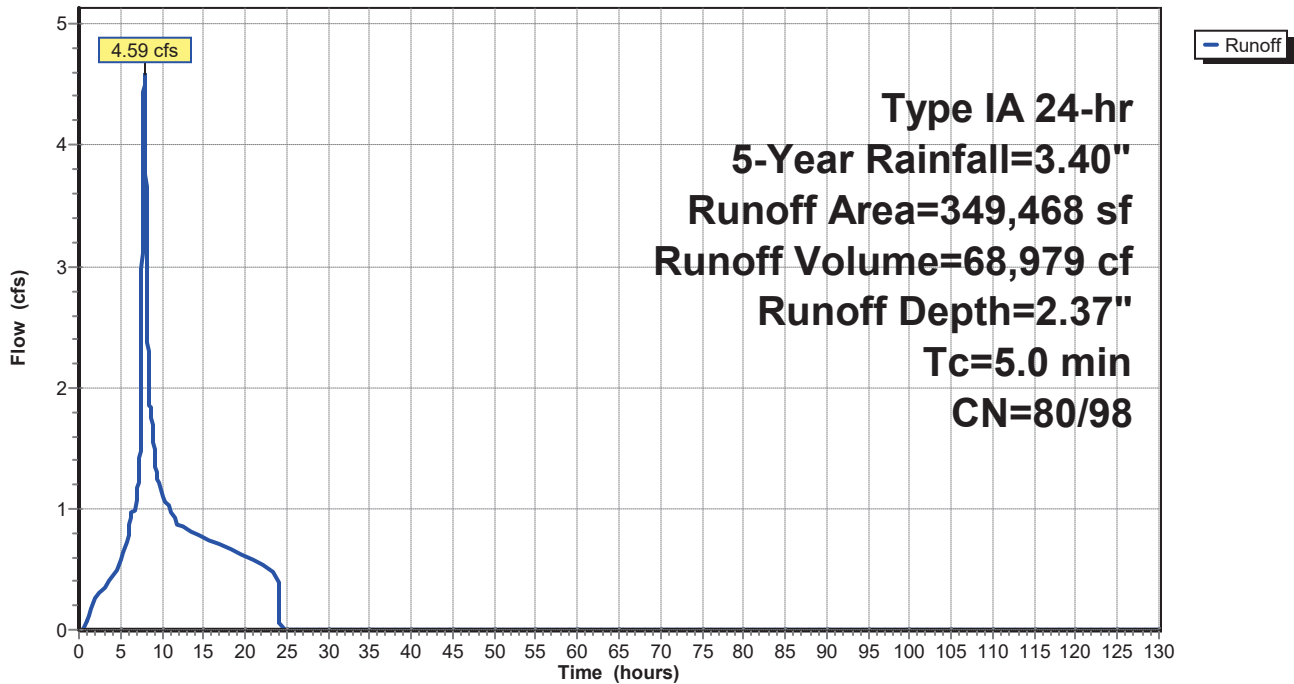
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 5-Year Rainfall=3.40"

	Area (sf)	CN	Description
*	176,142	98	Impervious Area
	173,326	80	>75% Grass cover, Good, HSG D
	349,468	89	Weighted Average
	173,326	80	49.60% Pervious Area
	176,142	98	50.40% Impervious Area

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

Subcatchment 1-6, 23: Basins 1-6

Hydrograph



Bull Run Conveyance 2

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Type IA 24-hr 5-Year Rainfall=3.40"

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Summary for Subcatchment 7: Basin 7

Runoff = 0.57 cfs @ 7.88 hrs, Volume= 8,258 cf, Depth= 3.17"

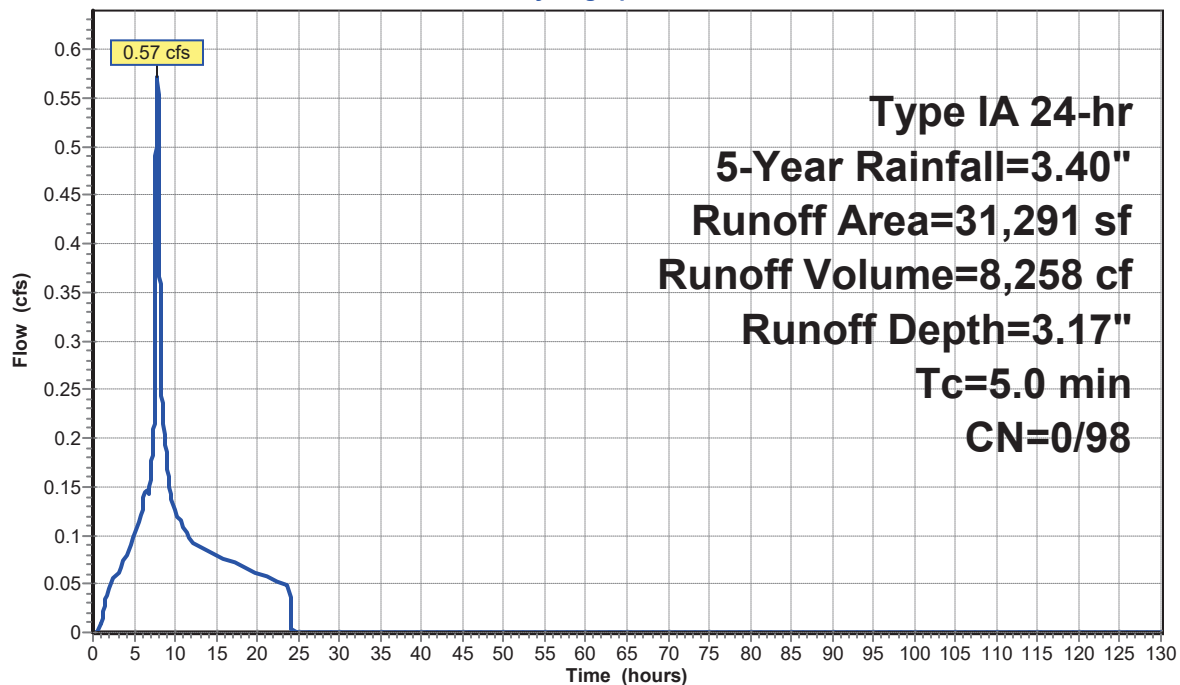
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 5-Year Rainfall=3.40"

	Area (sf)	CN	Description
*	31,291	98	Impervious Area
	31,291	98	100.00% Impervious Area

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

Subcatchment 7: Basin 7

Hydrograph



Bull Run Conveyance 2

Type IA 24-hr 5-Year Rainfall=3.40"

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Summary for Subcatchment 12: Basin 12

Runoff = 0.73 cfs @ 7.93 hrs, Volume= 11,165 cf, Depth= 2.06"

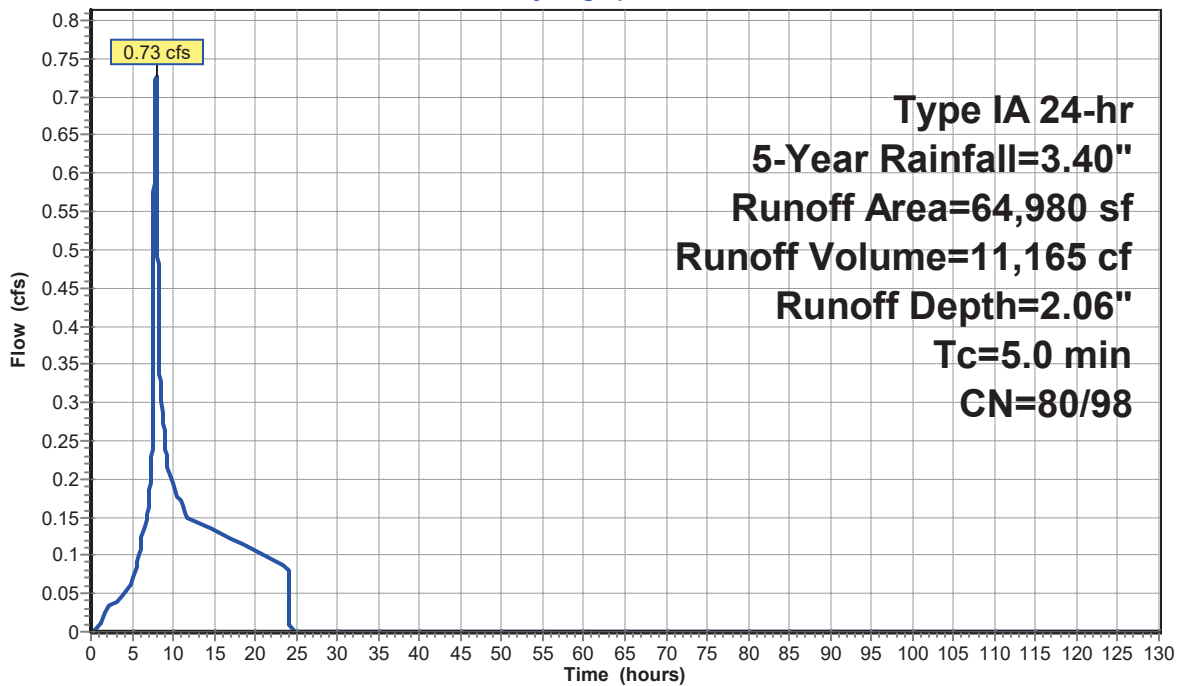
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 5-Year Rainfall=3.40"

	Area (sf)	CN	Description
*	20,370	98	Impervious Area
*	44,610	80	Pervious
	64,980	86	Weighted Average
	44,610	80	68.65% Pervious Area
	20,370	98	31.35% Impervious Area

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

Subcatchment 12: Basin 12

Hydrograph



Bull Run Conveyance 2

Type IA 24-hr 5-Year Rainfall=3.40"

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Summary for Subcatchment 13: Basin 13

Runoff = 1.58 cfs @ 7.95 hrs, Volume= 24,547 cf, Depth= 1.89"

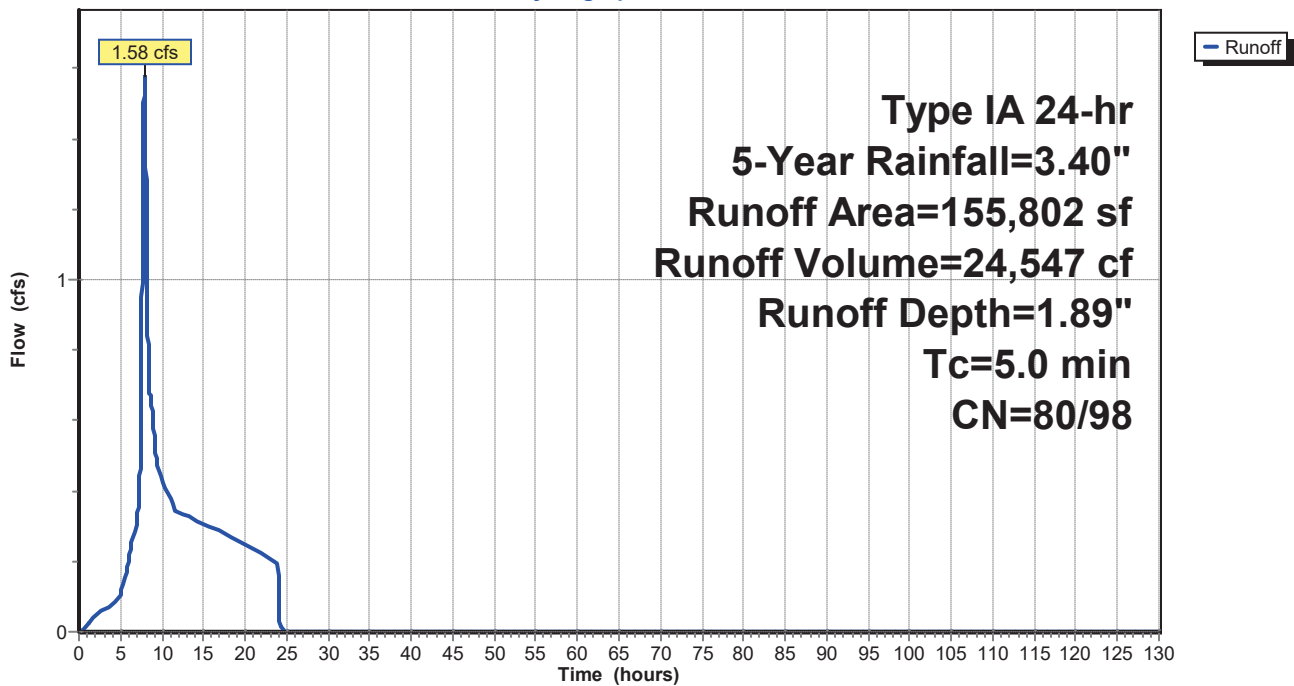
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 5-Year Rainfall=3.40"

	Area (sf)	CN	Description
*	32,262	98	Impervious Area
*	123,540	80	Pervious
	155,802	84	Weighted Average
	123,540	80	79.29% Pervious Area
	32,262	98	20.71% Impervious Area

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

Subcatchment 13: Basin 13

Hydrograph



Bull Run Conveyance 2

Type IA 24-hr 5-Year Rainfall=3.40"

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Summary for Subcatchment 14: Basin 14

Runoff = 1.64 cfs @ 7.93 hrs, Volume= 25,031 cf, Depth= 2.15"

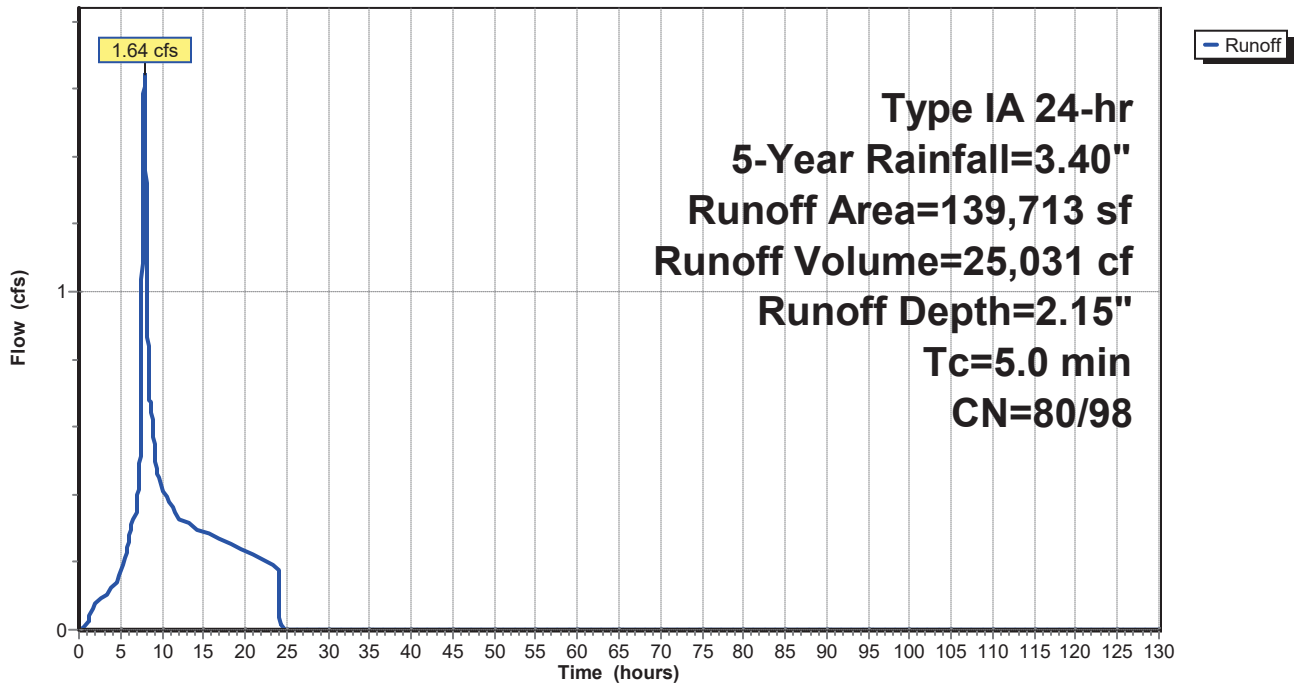
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
 Type IA 24-hr 5-Year Rainfall=3.40"

	Area (sf)	CN	Description
*	51,434	98	Impervious Area
*	88,279	80	Pervious Area
	139,713	87	Weighted Average
	88,279	80	63.19% Pervious Area
	51,434	98	36.81% Impervious Area

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

Subcatchment 14: Basin 14

Hydrograph



Bull Run Conveyance 2

Type IA 24-hr 5-Year Rainfall=3.40"

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Summary for Subcatchment 15: Basin 15

Runoff = 0.86 cfs @ 7.97 hrs, Volume= 13,761 cf, Depth= 1.65"

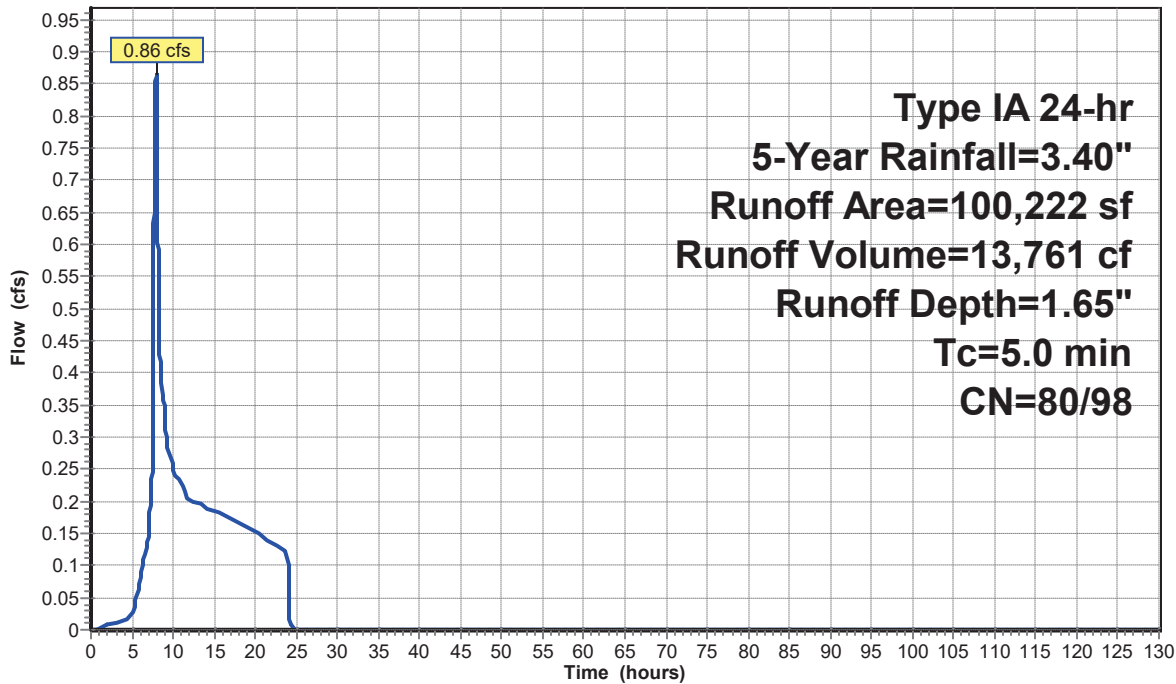
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
 Type IA 24-hr 5-Year Rainfall=3.40"

	Area (sf)	CN	Description
*	5,624	98	Impervious Area
*	94,598	80	Pervious
	100,222	81	Weighted Average
	94,598	80	94.39% Pervious Area
	5,624	98	5.61% Impervious Area

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

Subcatchment 15: Basin 15

Hydrograph



Bull Run Conveyance 2

Type IA 24-hr 5-Year Rainfall=3.40"

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Summary for Subcatchment 16: Basin 16

Runoff = 0.94 cfs @ 7.97 hrs, Volume= 14,661 cf, Depth= 1.70"

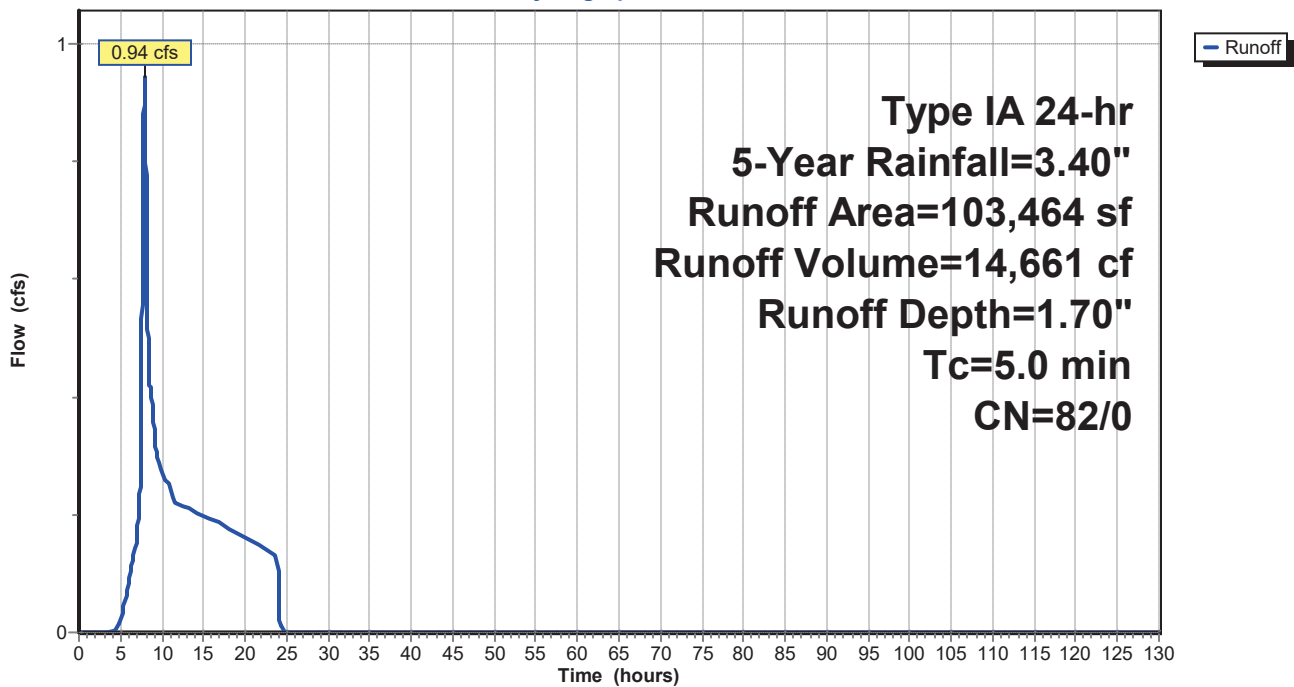
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 5-Year Rainfall=3.40"

Area (sf)	CN	Description
* 103,464	82	Pervious
103,464	82	100.00% Pervious Area

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

Subcatchment 16: Basin 16

Hydrograph



Bull Run Conveyance 2

Type IA 24-hr 5-Year Rainfall=3.40"

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Summary for Subcatchment 18: Basin 18

Runoff = 0.08 cfs @ 16.53 hrs, Volume= 4,130 cf, Depth= 0.53"

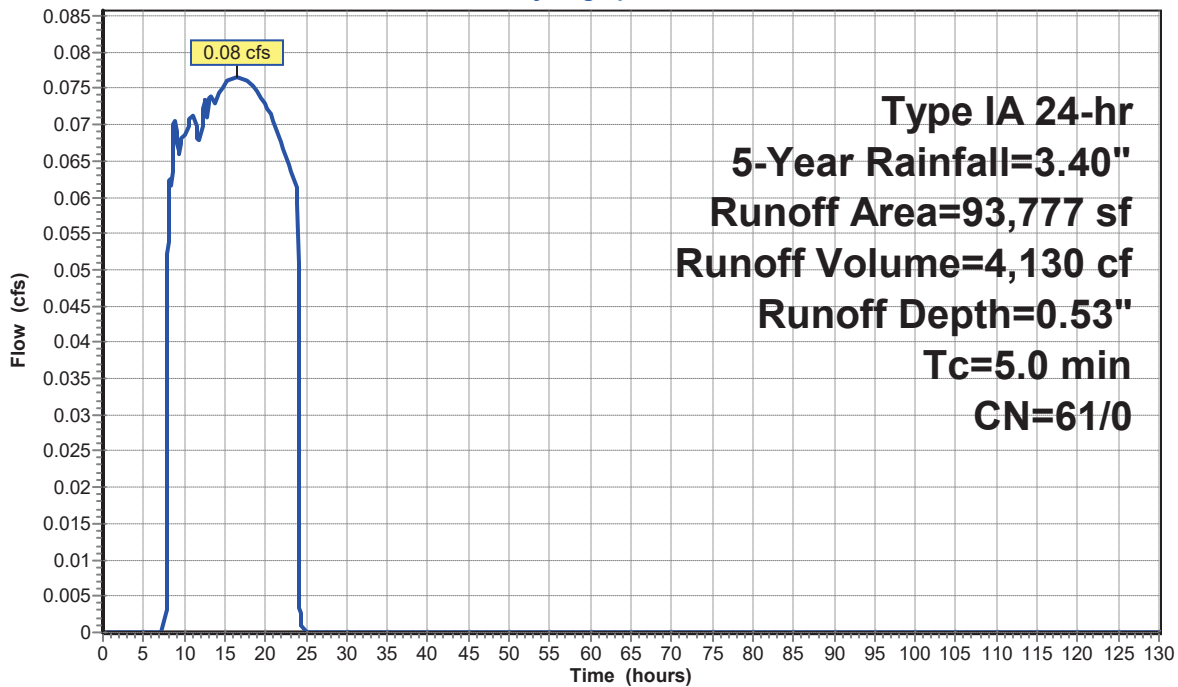
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 5-Year Rainfall=3.40"

	Area (sf)	CN	Description
*	93,777	61	Ecoroof
	93,777	61	100.00% Pervious Area

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

Subcatchment 18: Basin 18

Hydrograph



Bull Run Conveyance 2

Type IA 24-hr 5-Year Rainfall=3.40"

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Summary for Reach R1: Ditch 1

Inflow Area = 96,271 sf, 53.66% Impervious, Inflow Depth = 2.42" for 5-Year event
 Inflow = 1.30 cfs @ 7.91 hrs, Volume= 19,423 cf
 Outflow = 1.29 cfs @ 7.92 hrs, Volume= 19,423 cf, Atten= 0%, Lag= 0.8 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
 Max. Velocity= 2.42 fps, Min. Travel Time= 1.2 min
 Avg. Velocity = 1.25 fps, Avg. Travel Time= 2.3 min

Peak Storage= 94 cf @ 7.92 hrs
 Average Depth at Peak Storage= 0.20'
 Bank-Full Depth= 0.75' Flow Area= 3.2 sf, Capacity= 15.74 cfs

Custom cross-section, Length= 176.0' Slope= 0.0187 '/'
 Constant n= 0.025 Earth, clean & straight
 Inlet Invert= 702.30', Outlet Invert= 699.00'



Offset (feet)	Elevation (feet)	Chan.Depth (feet)
-3.25	0.75	0.00
-1.00	0.00	0.75
1.00	0.00	0.75
3.25	0.75	0.00

Depth (feet)	End Area (sq-ft)	Perim. (feet)	Storage (cubic-feet)	Discharge (cfs)
0.00	0.0	2.0	0	0.00
0.75	3.2	6.7	561	15.74

Bull Run Conveyance 2

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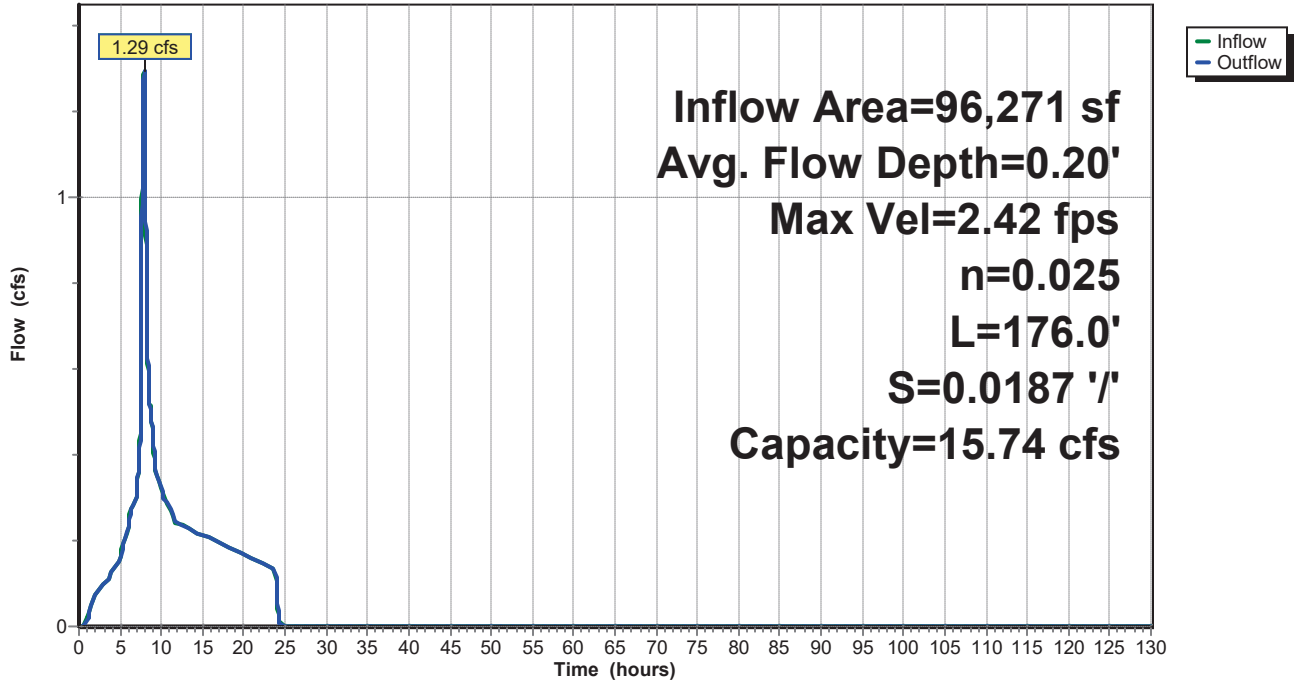
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Reach R1: Ditch 1

Hydrograph



Bull Run Conveyance 2

Type IA 24-hr 5-Year Rainfall=3.40"

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Summary for Reach R2: Ditch 2

Inflow Area = 100,222 sf, 5.61% Impervious, Inflow Depth = 1.65" for 5-Year event
 Inflow = 0.86 cfs @ 7.97 hrs, Volume= 13,761 cf
 Outflow = 0.86 cfs @ 8.00 hrs, Volume= 13,761 cf, Atten= 1%, Lag= 1.8 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
 Max. Velocity= 2.04 fps, Min. Travel Time= 4.7 min
 Avg. Velocity = 0.96 fps, Avg. Travel Time= 10.0 min

Peak Storage= 242 cf @ 8.00 hrs
 Average Depth at Peak Storage= 0.12'
 Bank-Full Depth= 1.00' Flow Area= 6.0 sf, Capacity= 39.58 cfs

Custom cross-section, Length= 576.0' Slope= 0.0222 '/'
 Constant n= 0.025 Earth, clean & straight
 Inlet Invert= 703.59', Outlet Invert= 690.82'



‡

Offset (feet)	Elevation (feet)	Chan.Depth (feet)	Depth (feet)	End Area (sq-ft)	Perim. (feet)	Storage (cubic-feet)	Discharge (cfs)
-4.50	1.00	0.00	0.00	0.0	3.0	0	0.00
-1.50	0.00	1.00	1.00	6.0	9.3	3,456	39.58
1.50	0.00	1.00					
4.50	1.00	0.00					

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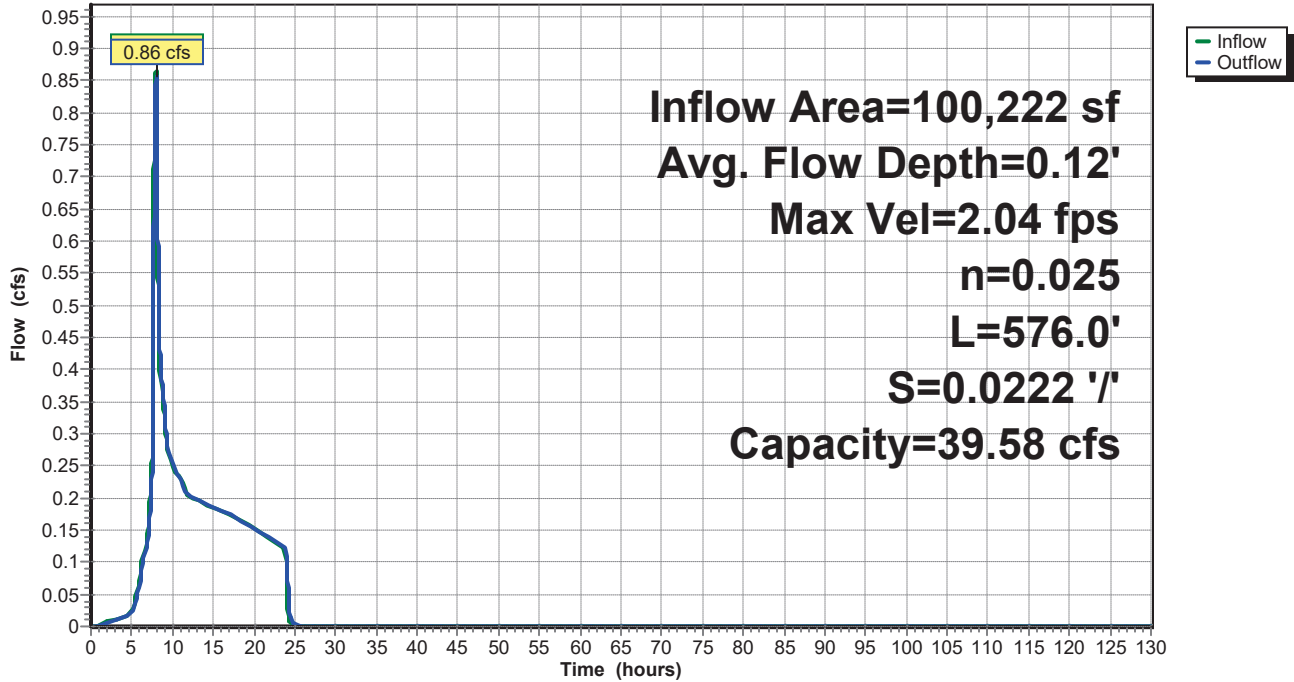
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Reach R2: Ditch 2

Hydrograph



Bull Run Conveyance 2

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Summary for Reach R3: Ditch 3

Inflow Area = 155,802 sf, 20.71% Impervious, Inflow Depth = 1.89" for 5-Year event
 Inflow = 1.58 cfs @ 7.95 hrs, Volume= 24,547 cf
 Outflow = 1.56 cfs @ 8.00 hrs, Volume= 24,547 cf, Atten= 1%, Lag= 2.9 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
 Max. Velocity= 1.89 fps, Min. Travel Time= 4.7 min
 Avg. Velocity = 0.92 fps, Avg. Travel Time= 9.6 min

Peak Storage= 439 cf @ 8.00 hrs
 Average Depth at Peak Storage= 0.29'
 Bank-Full Depth= 1.00' Flow Area= 5.0 sf, Capacity= 18.61 cfs

Custom cross-section, Length= 530.0' Slope= 0.0077 '/'
 Constant n= 0.025 Earth, clean & straight
 Inlet Invert= 707.64', Outlet Invert= 703.54'



Offset (feet)	Elevation (feet)	Chan.Depth (feet)	Depth (feet)	End Area (sq-ft)	Perim. (feet)	Storage (cubic-feet)	Discharge (cfs)
-4.00	1.00	0.00	0.00	0.0	2.0	0	0.00
-1.00	0.00	1.00	1.00	5.0	8.3	2,650	18.61
1.00	0.00	1.00					
4.00	1.00	0.00					

Bull Run Conveyance 2

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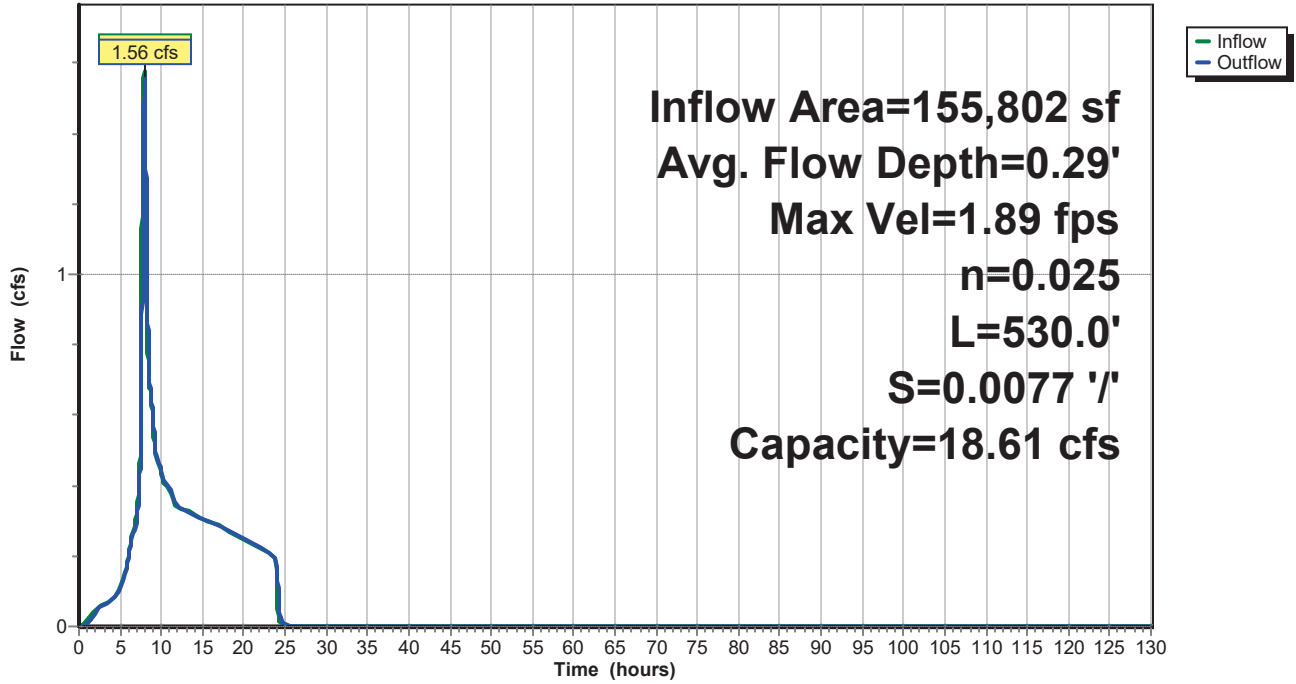
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Reach R3: Ditch 3

Hydrograph



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Summary for Pond DI: Ditch Inlet

Inflow Area = 100,222 sf, 5.61% Impervious, Inflow Depth = 1.65" for 5-Year event
 Inflow = 0.86 cfs @ 8.00 hrs, Volume= 13,761 cf
 Outflow = 0.86 cfs @ 8.00 hrs, Volume= 13,761 cf, Atten= 0%, Lag= 0.0 min
 Primary = 0.86 cfs @ 8.00 hrs, Volume= 13,761 cf

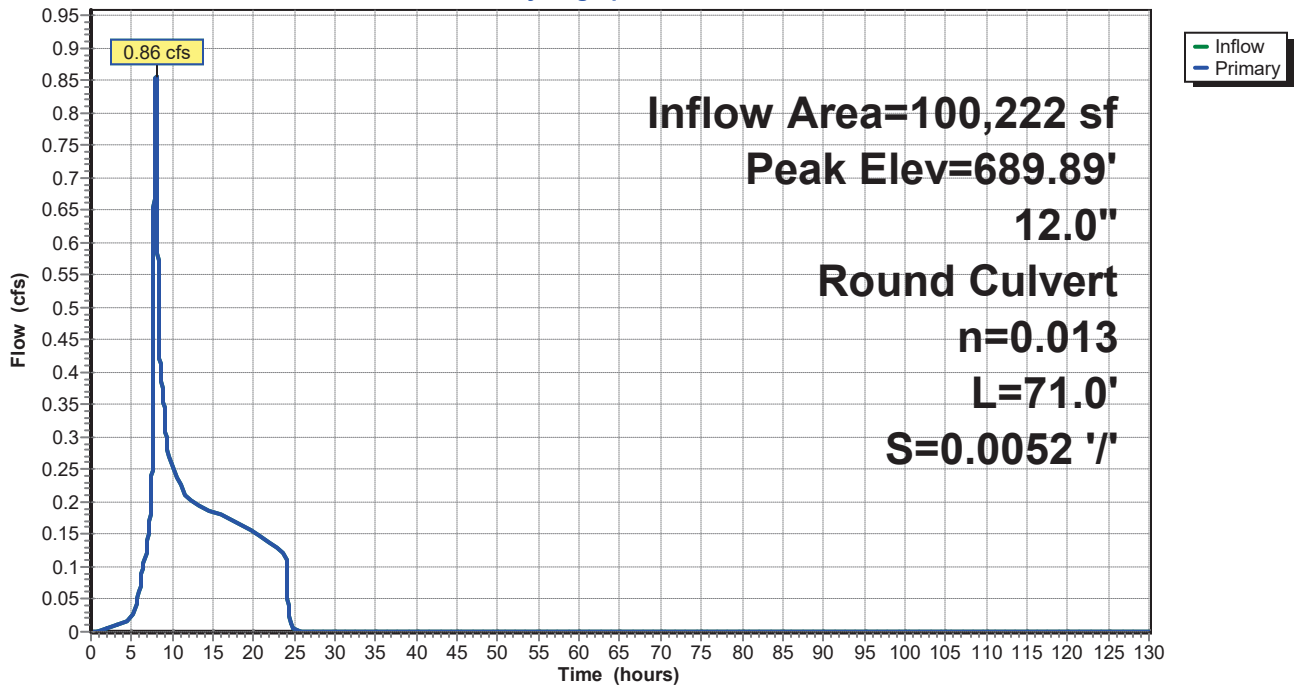
Routing by Dyn-Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
 Peak Elev= 689.89' @ 8.01 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	689.33'	12.0" Round From Ditch Inlet L= 71.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 689.33' / 688.96' S= 0.0052 '/ Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=0.86 cfs @ 8.00 hrs HW=689.89' TW=689.43' (Dynamic Tailwater)
 ↳1=From Ditch Inlet (Outlet Controls 0.86 cfs @ 2.70 fps)

Pond DI: Ditch Inlet

Hydrograph



Bull Run Conveyance 2

Type IA 24-hr 5-Year Rainfall=3.40"

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Summary for Pond FSMH: Flow Splitter Manhole

Inflow Area = 492,008 sf, 28.65% Impervious, Inflow Depth = 2.02" for 5-Year event
Inflow = 2.11 cfs @ 8.73 hrs, Volume= 82,763 cf
Outflow = 2.11 cfs @ 8.73 hrs, Volume= 82,763 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.54 cfs @ 8.73 hrs, Volume= 28,233 cf
Secondary = 1.57 cfs @ 8.73 hrs, Volume= 54,530 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Peak Elev= 689.50' @ 8.73 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	688.86'	8.0" Round To Existing Culvert L= 38.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 688.86' / 688.65' S= 0.0055 '/' Cc= 0.900 n= 0.013, Flow Area= 0.35 sf
#2	Device 1	687.36'	5.0" Horiz. Orifice C= 0.620 Limited to weir flow at low heads
#3	Secondary	688.86'	18.0" Round Bypassed Flow L= 148.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 688.86' / 688.11' S= 0.0051 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf

Primary OutFlow Max=0.54 cfs @ 8.73 hrs HW=689.50' (Free Discharge)

↑ **1=To Existing Culvert** (Passes 0.54 cfs of 0.75 cfs potential flow)

↑ **2=Orifice** (Orifice Controls 0.54 cfs @ 3.98 fps)

Secondary OutFlow Max=1.57 cfs @ 8.73 hrs HW=689.50' TW=0.00' (Dynamic Tailwater)

↑ **3=Bypassed Flow** (Barrel Controls 1.57 cfs @ 3.21 fps)

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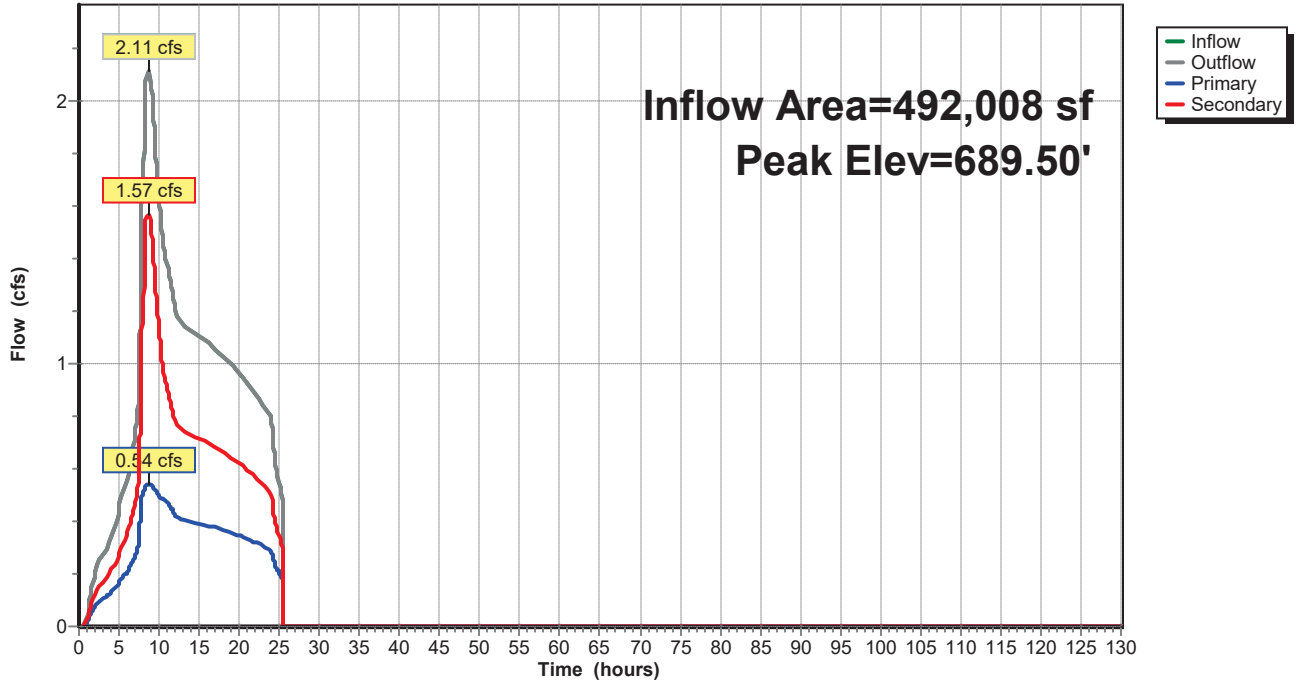
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Pond FSMH: Flow Splitter Manhole

Hydrograph



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Summary for Pond Pond A: Pond A

Inflow Area = 349,468 sf, 50.40% Impervious, Inflow Depth = 2.37" for 5-Year event
 Inflow = 4.59 cfs @ 7.91 hrs, Volume= 68,979 cf
 Outflow = 1.15 cfs @ 9.95 hrs, Volume= 68,985 cf, Atten= 75%, Lag= 122.5 min
 Primary = 1.15 cfs @ 9.95 hrs, Volume= 68,985 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
 Peak Elev= 709.64' @ 9.95 hrs Surf.Area= 8,441 sf Storage= 15,652 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
 Center-of-Mass det. time= 238.9 min (951.6 - 712.7)

Volume	Invert	Avail.Storage	Storage Description
#1	707.50'	70,555 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
707.50	6,107	0	0
708.00	6,714	3,205	3,205
709.00	7,742	7,228	10,433
710.00	8,825	8,284	18,717
711.00	9,967	9,396	28,113
712.00	11,161	10,564	38,677
713.00	12,412	11,787	50,463
714.00	13,717	13,065	63,528
714.50	14,392	7,027	70,555

Device	Routing	Invert	Outlet Devices
#1	Primary	698.43'	18.0" Round Culvert L= 138.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 698.43' / 696.24' S= 0.0159 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf
#2	Device 1	696.43'	2.6" Horiz. Orifice/Grate C= 0.620 Limited to weir flow at low heads
#3	Device 1	709.40'	16.0" W x 3.0" H Vert. Orifice/Grate C= 0.620

Primary OutFlow Max=1.15 cfs @ 9.95 hrs HW=709.64' TW=0.00' (Dynamic Tailwater)

- 1=Culvert (Passes 1.15 cfs of 24.39 cfs potential flow)
- 2=Orifice/Grate (Orifice Controls 0.61 cfs @ 16.66 fps)
- 3=Orifice/Grate (Orifice Controls 0.54 cfs @ 1.64 fps)

Bull Run Conveyance 2

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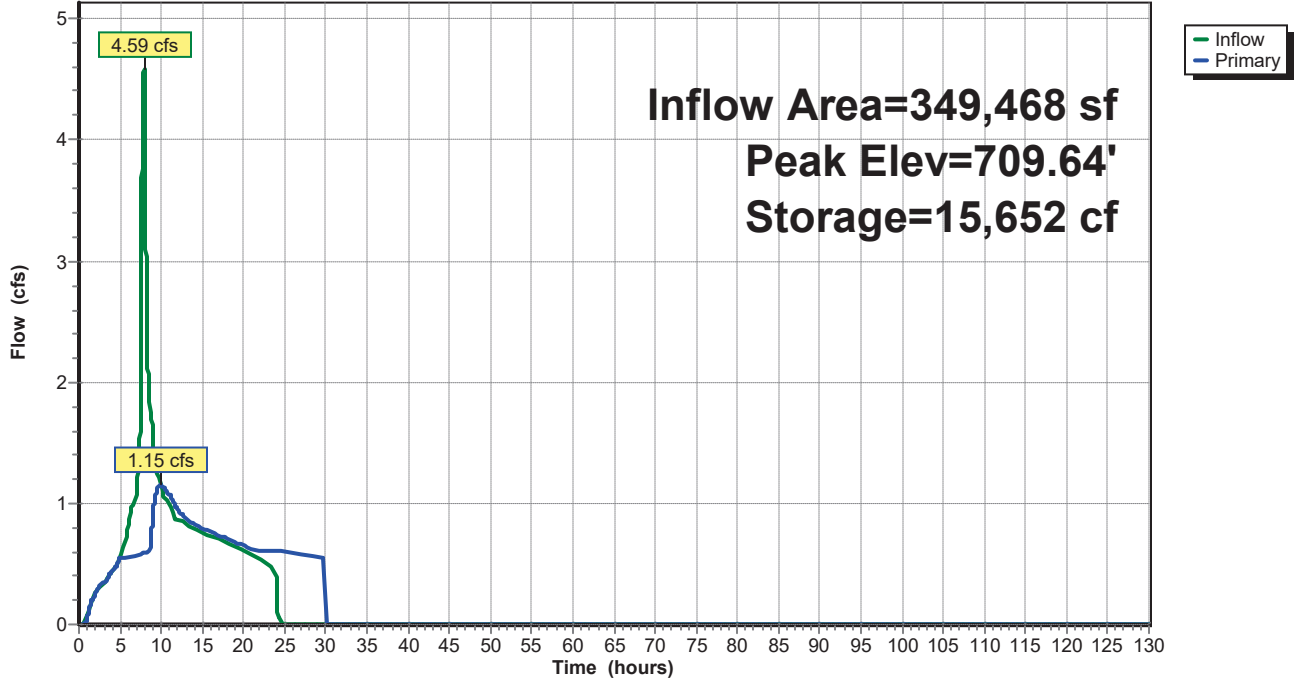
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Pond Pond A: Pond A

Hydrograph



Bull Run Conveyance 2

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Summary for Pond Pond D: Pond D

Inflow Area = 391,786 sf, 34.55% Impervious, Inflow Depth = 2.11" for 5-Year event
 Inflow = 4.48 cfs @ 7.96 hrs, Volume= 69,001 cf
 Outflow = 1.74 cfs @ 8.84 hrs, Volume= 69,001 cf, Atten= 61%, Lag= 52.9 min
 Primary = 1.74 cfs @ 8.84 hrs, Volume= 69,001 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
 Peak Elev= 694.94' @ 8.84 hrs Surf.Area= 6,325 sf Storage= 10,452 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
 Center-of-Mass det. time= 102.2 min (841.7 - 739.5)

Volume	Invert	Avail.Storage	Storage Description
#1	693.00'	45,106 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
693.00	4,453	0	0
694.00	5,388	4,921	4,921
695.00	6,380	5,884	10,805
696.00	7,428	6,904	17,709
697.00	8,533	7,981	25,689
698.00	9,694	9,114	34,803
699.00	10,912	10,303	45,106

Device	Routing	Invert	Outlet Devices
#1	Primary	692.50'	12.0" Round Culvert L= 121.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 692.50' / 688.97' S= 0.0292 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	690.50'	4.9" Horiz. Orifice/Grate C= 0.620 Limited to weir flow at low heads
#3	Device 1	694.60'	15.0" W x 3.0" H Vert. Orifice/Grate C= 0.620

Primary OutFlow Max=1.74 cfs @ 8.84 hrs HW=694.94' TW=689.50' (Dynamic Tailwater)

- ↑ **1=Culvert** (Passes 1.74 cfs of 5.27 cfs potential flow)
- ↑ **2=Orifice/Grate** (Orifice Controls 1.02 cfs @ 7.78 fps)
- ↑ **3=Orifice/Grate** (Orifice Controls 0.72 cfs @ 2.30 fps)

Bull Run Conveyance 2

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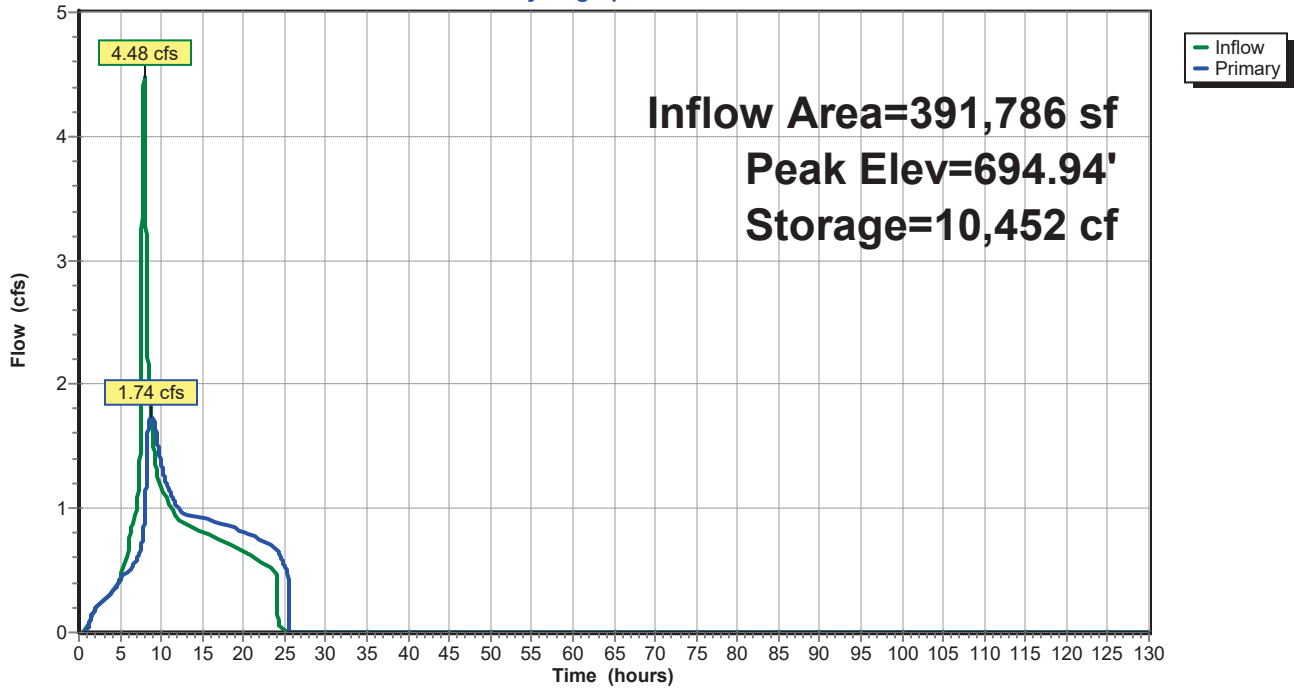
Type IA 24-hr 5-Year Rainfall=3.40"

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Pond Pond D: Pond D

Hydrograph



Bull Run Conveyance 2

Type IA 24-hr 5-Year Rainfall=3.40"

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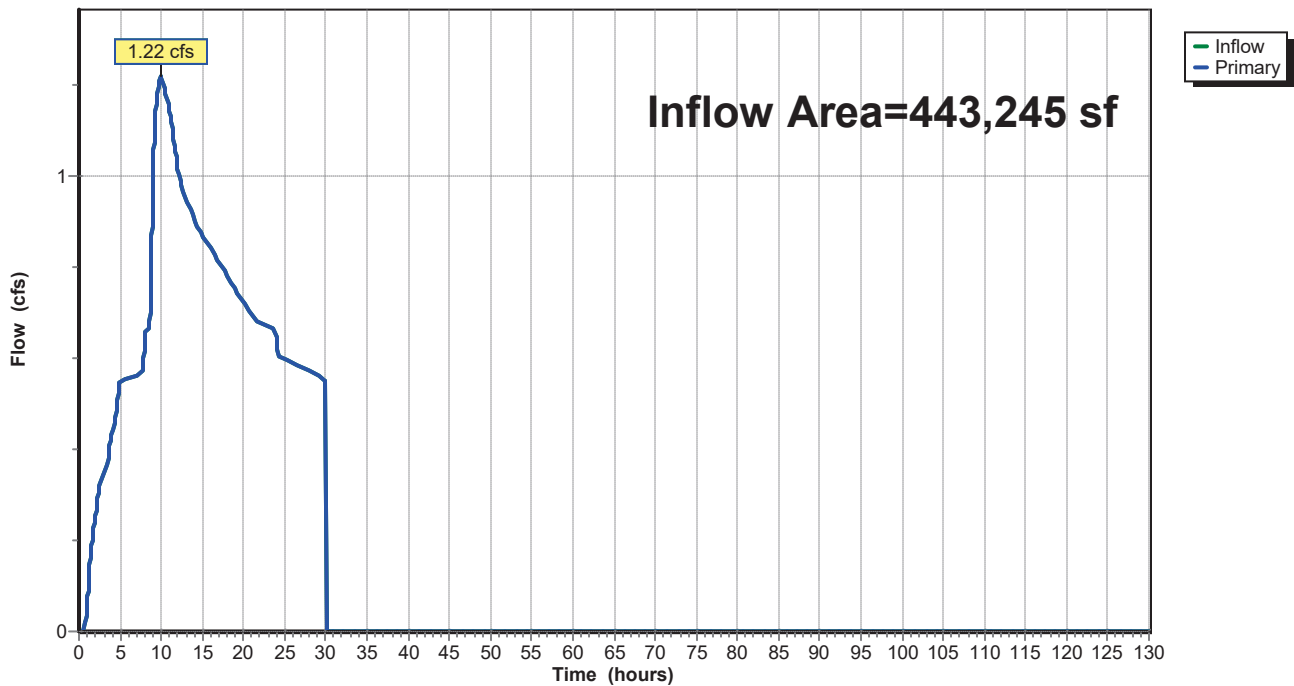
Summary for Link L1: Pipe 2

Inflow Area = 443,245 sf, 39.74% Impervious, Inflow Depth = 1.98" for 5-Year event
Inflow = 1.22 cfs @ 9.96 hrs, Volume= 73,115 cf
Primary = 1.22 cfs @ 9.96 hrs, Volume= 73,115 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs

Link L1: Pipe 2

Hydrograph



Bull Run Conveyance 2

Type IA 24-hr 5-Year Rainfall=3.40"

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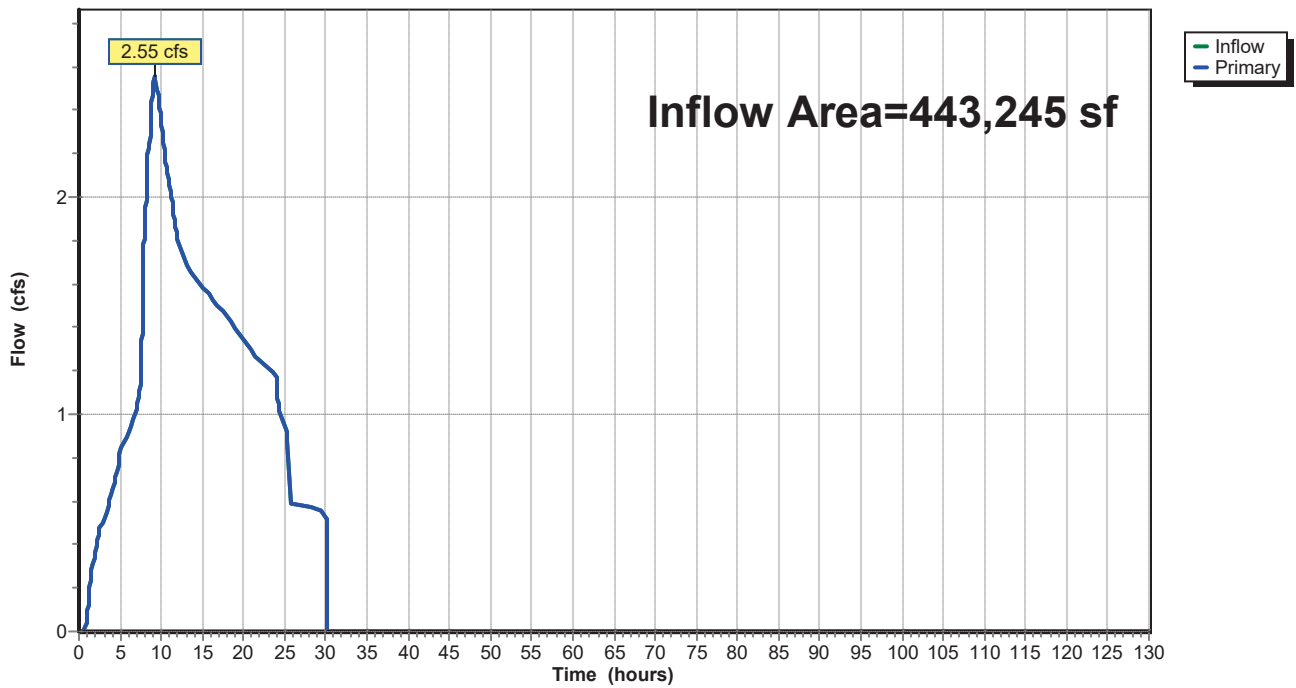
Summary for Link L2: Pipe 19

Inflow Area = 443,245 sf, 39.74% Impervious, Inflow Depth = 3.46" for 5-Year event
Inflow = 2.55 cfs @ 9.21 hrs, Volume= 127,645 cf
Primary = 2.55 cfs @ 9.21 hrs, Volume= 127,645 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs

Link L2: Pipe 19

Hydrograph



Bull Run Conveyance 2

Type IA 24-hr 5-Year Rainfall=3.40"

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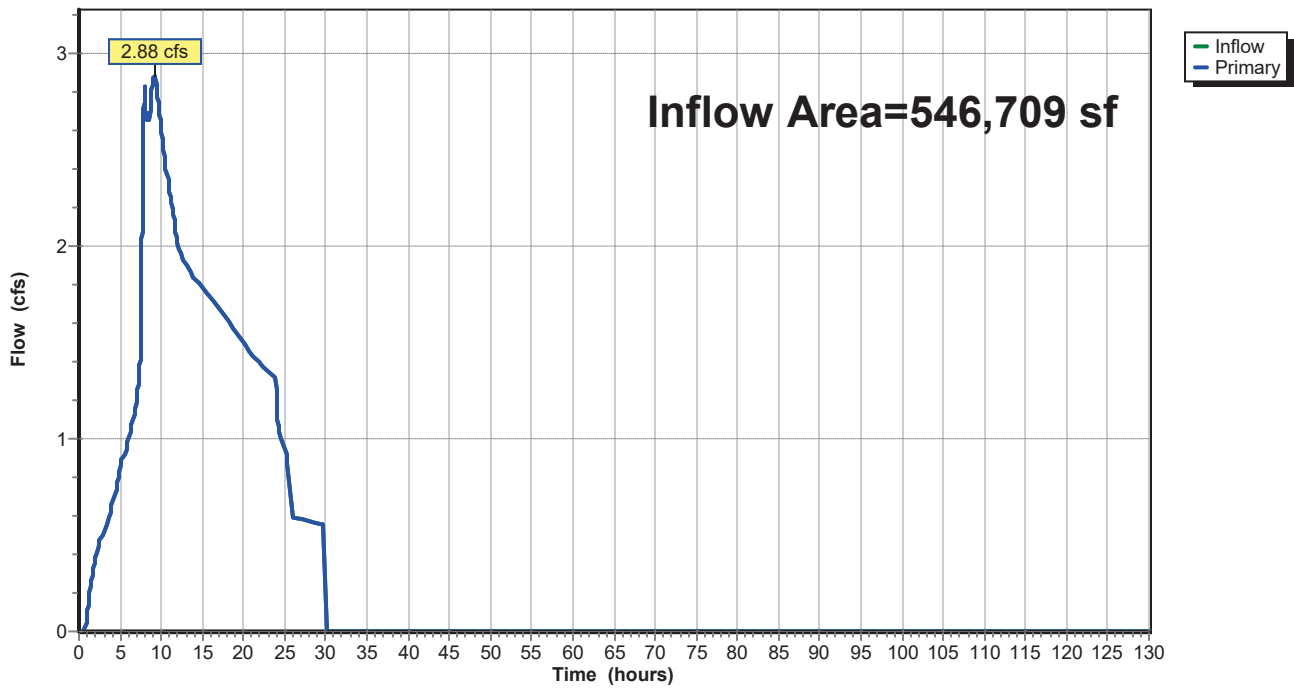
Summary for Link L3: Pipe 24

Inflow Area = 546,709 sf, 32.22% Impervious, Inflow Depth = 3.12" for 5-Year event
Inflow = 2.88 cfs @ 9.11 hrs, Volume= 142,306 cf
Primary = 2.88 cfs @ 9.11 hrs, Volume= 142,306 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs

Link L3: Pipe 24

Hydrograph



Bull Run Conveyance 2

Type IA 24-hr 10-Year Rainfall=3.80"

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Summary for Subcatchment 1-6, 23: Basins 1-6

Runoff = 5.32 cfs @ 7.91 hrs, Volume= 79,457 cf, Depth= 2.73"

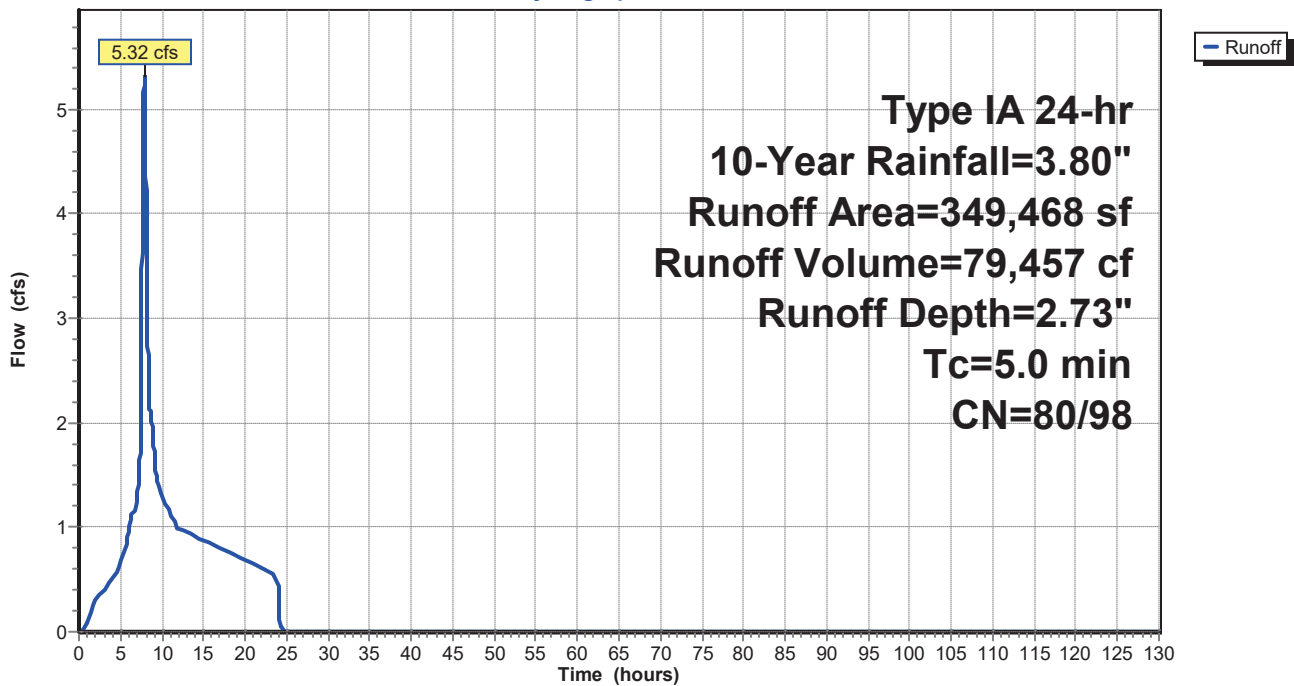
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Year Rainfall=3.80"

	Area (sf)	CN	Description
*	176,142	98	Impervious Area
	173,326	80	>75% Grass cover, Good, HSG D
	349,468	89	Weighted Average
	173,326	80	49.60% Pervious Area
	176,142	98	50.40% Impervious Area

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

Subcatchment 1-6, 23: Basins 1-6

Hydrograph



Bull Run Conveyance 2

Type IA 24-hr 10-Year Rainfall=3.80"

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Summary for Subcatchment 7: Basin 7

Runoff = 0.64 cfs @ 7.88 hrs, Volume= 9,298 cf, Depth= 3.57"

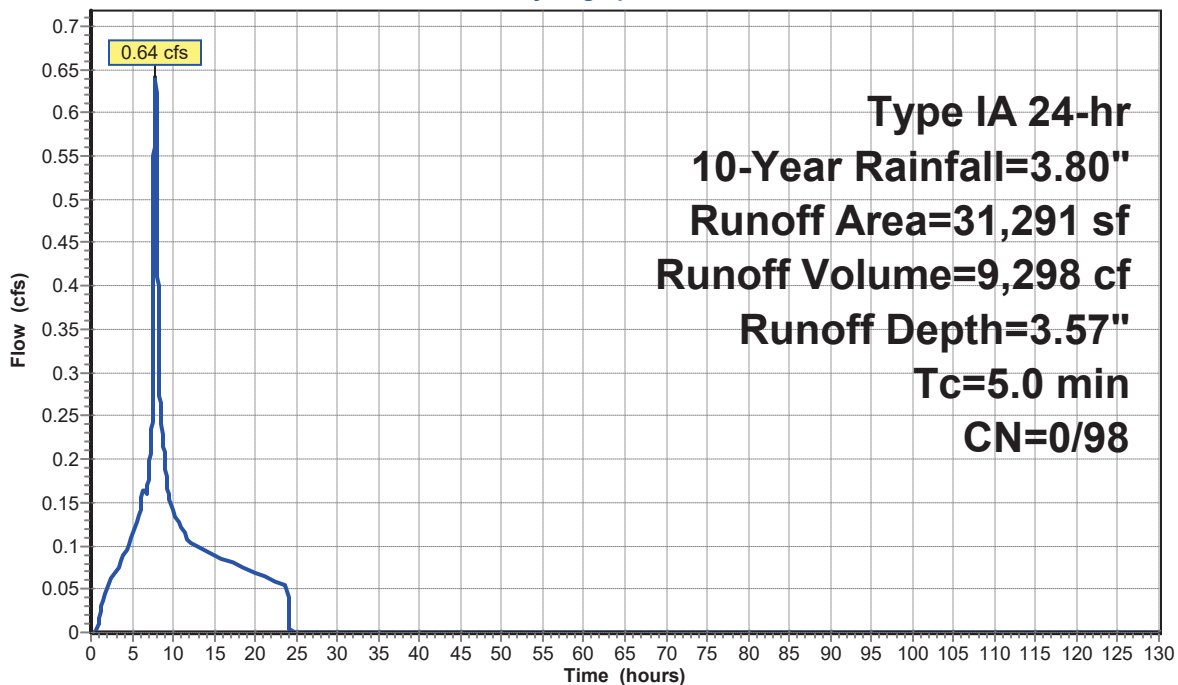
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Year Rainfall=3.80"

	Area (sf)	CN	Description
*	31,291	98	Impervious Area
	31,291	98	100.00% Impervious Area

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

Subcatchment 7: Basin 7

Hydrograph



Bull Run Conveyance 2

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Summary for Subcatchment 12: Basin 12

Runoff = 0.86 cfs @ 7.93 hrs, Volume= 13,033 cf, Depth= 2.41"

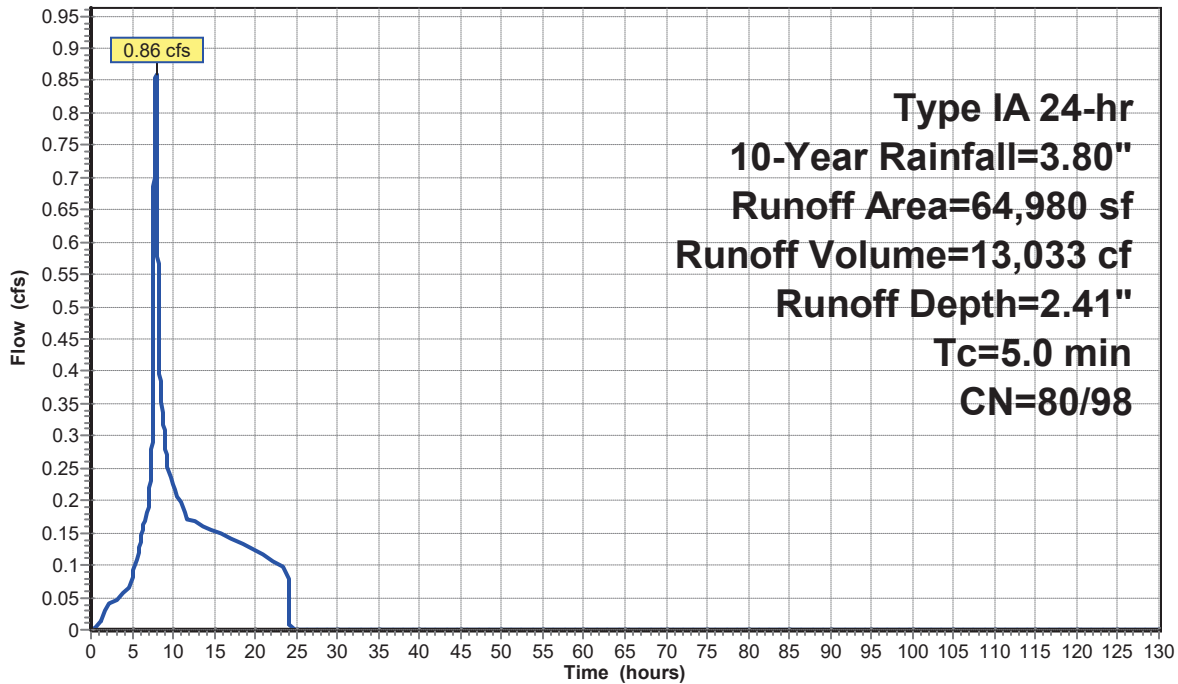
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Year Rainfall=3.80"

	Area (sf)	CN	Description
*	20,370	98	Impervious Area
*	44,610	80	Pervious
	64,980	86	Weighted Average
	44,610	80	68.65% Pervious Area
	20,370	98	31.35% Impervious Area

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

Subcatchment 12: Basin 12

Hydrograph



Bull Run Conveyance 2

Type IA 24-hr 10-Year Rainfall=3.80"

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Summary for Subcatchment 13: Basin 13

Runoff = 1.89 cfs @ 7.94 hrs, Volume= 28,916 cf, Depth= 2.23"

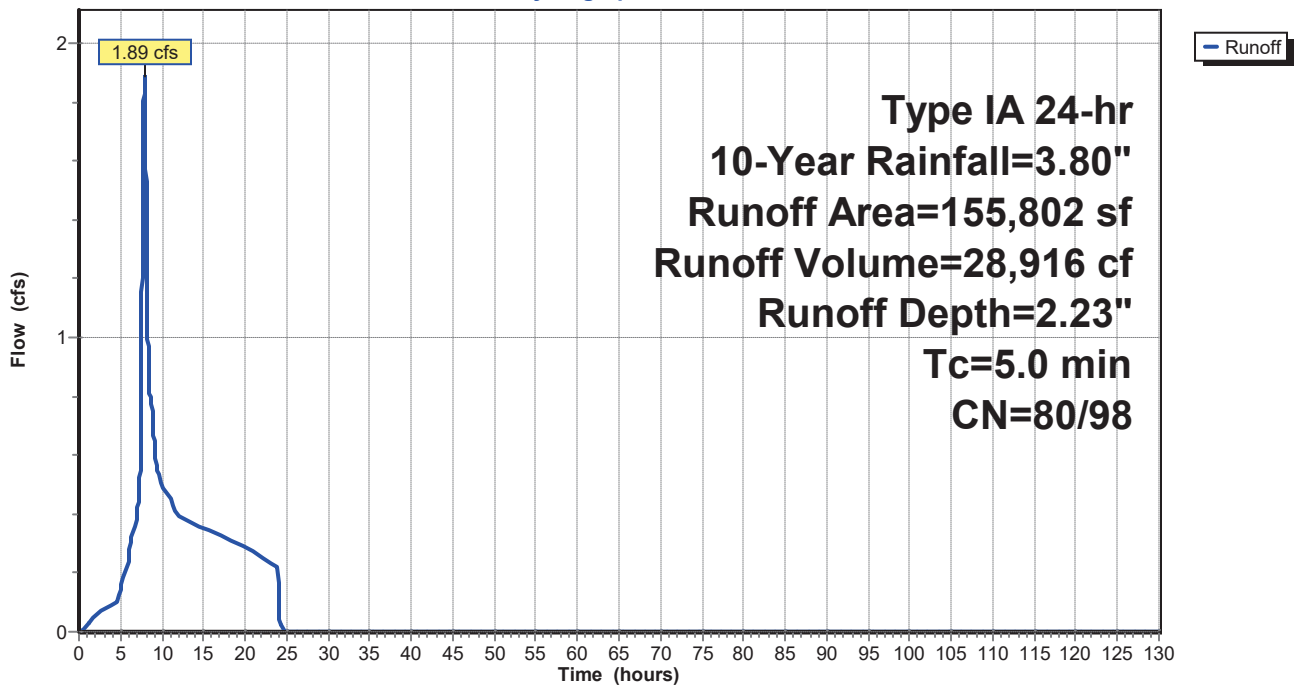
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
 Type IA 24-hr 10-Year Rainfall=3.80"

	Area (sf)	CN	Description
*	32,262	98	Impervious Area
*	123,540	80	Pervious
	155,802	84	Weighted Average
	123,540	80	79.29% Pervious Area
	32,262	98	20.71% Impervious Area

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

Subcatchment 13: Basin 13

Hydrograph



Bull Run Conveyance 2

Type IA 24-hr 10-Year Rainfall=3.80"

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Summary for Subcatchment 14: Basin 14

Runoff = 1.93 cfs @ 7.92 hrs, Volume= 29,095 cf, Depth= 2.50"

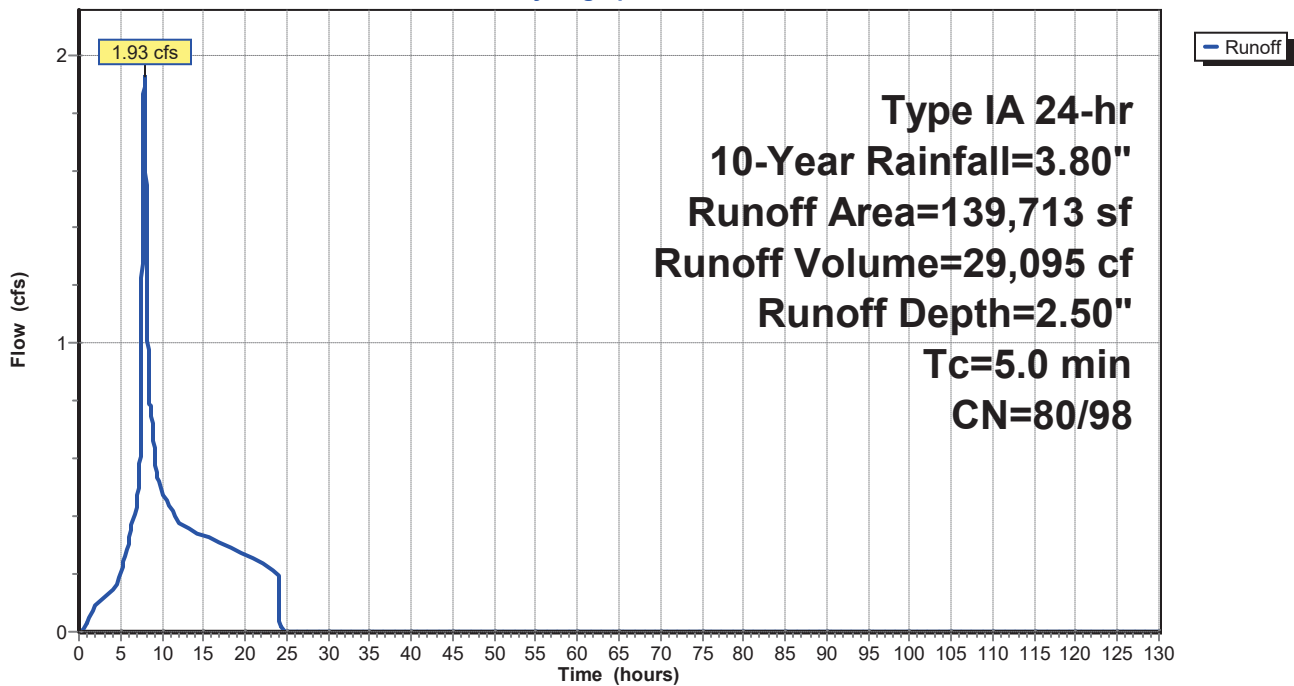
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Year Rainfall=3.80"

	Area (sf)	CN	Description
*	51,434	98	Impervious Area
*	88,279	80	Pervious Area
	139,713	87	Weighted Average
	88,279	80	63.19% Pervious Area
	51,434	98	36.81% Impervious Area

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

Subcatchment 14: Basin 14

Hydrograph



Bull Run Conveyance 2

Type IA 24-hr 10-Year Rainfall=3.80"

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Summary for Subcatchment 15: Basin 15

Runoff = 1.06 cfs @ 7.96 hrs, Volume= 16,472 cf, Depth= 1.97"

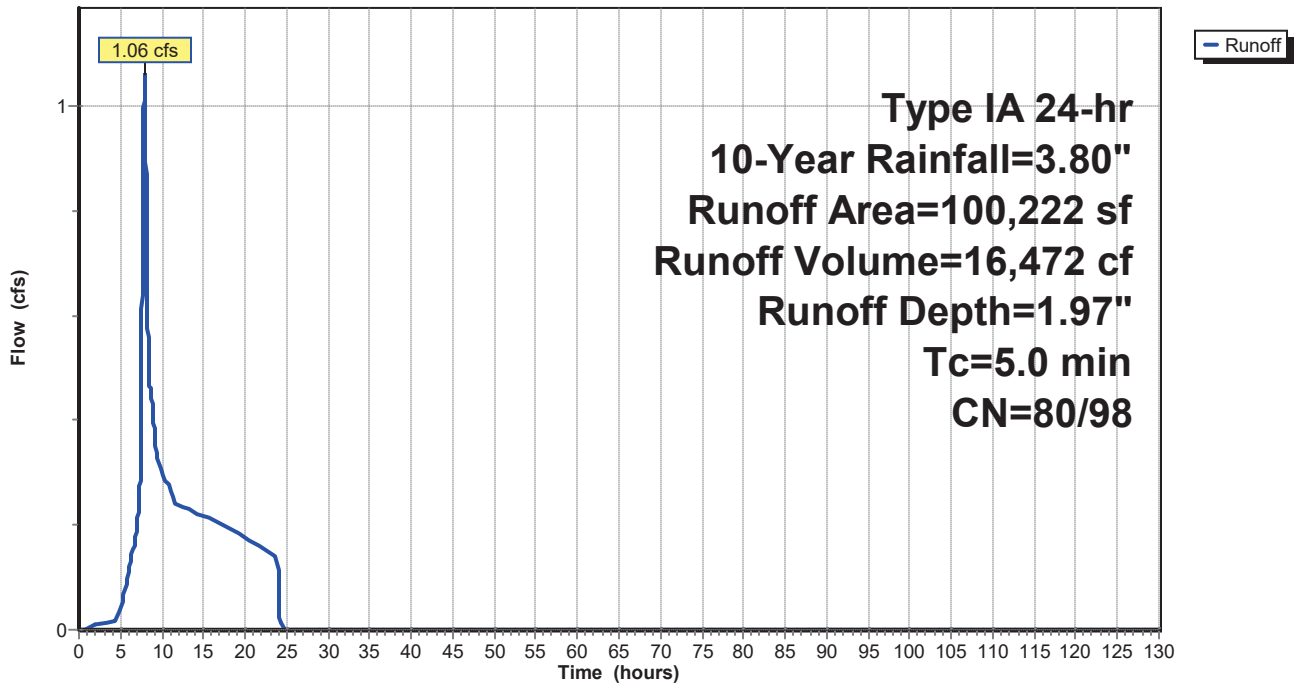
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
 Type IA 24-hr 10-Year Rainfall=3.80"

	Area (sf)	CN	Description
*	5,624	98	Impervious Area
*	94,598	80	Pervious
	100,222	81	Weighted Average
	94,598	80	94.39% Pervious Area
	5,624	98	5.61% Impervious Area

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

Subcatchment 15: Basin 15

Hydrograph



Bull Run Conveyance 2

Type IA 24-hr 10-Year Rainfall=3.80"

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Summary for Subcatchment 16: Basin 16

Runoff = 1.15 cfs @ 7.96 hrs, Volume= 17,529 cf, Depth= 2.03"

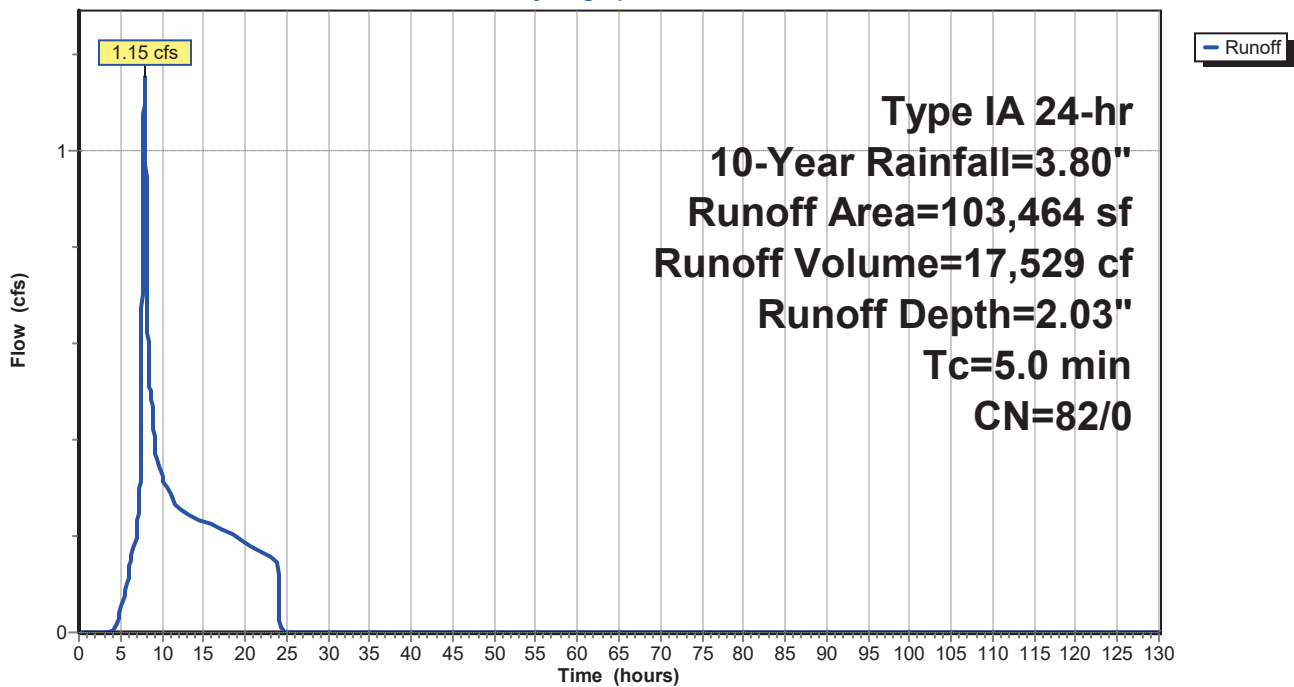
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Year Rainfall=3.80"

Area (sf)	CN	Description
* 103,464	82	Pervious
103,464	82	100.00% Pervious Area

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

Subcatchment 16: Basin 16

Hydrograph



Bull Run Conveyance 2

Type IA 24-hr 10-Year Rainfall=3.80"

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Summary for Subcatchment 18: Basin 18

Runoff = 0.14 cfs @ 8.01 hrs, Volume= 5,573 cf, Depth= 0.71"

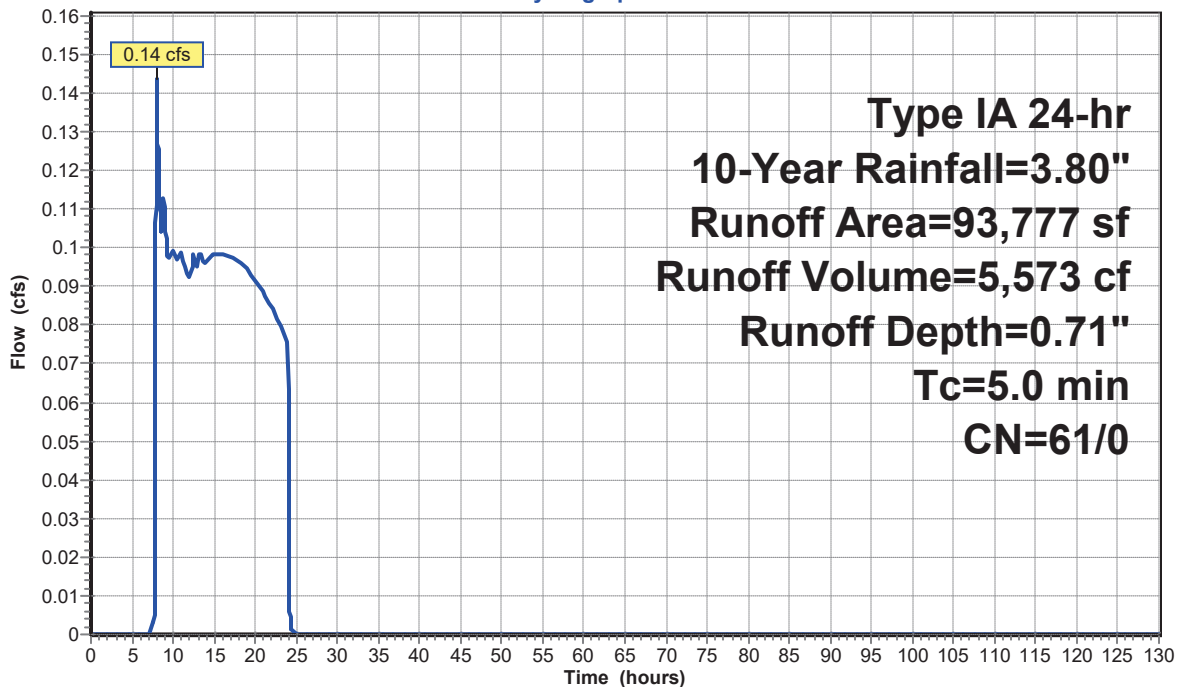
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Year Rainfall=3.80"

Area (sf)	CN	Description
93,777	61	Ecoroof
93,777	61	100.00% Pervious Area

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

Subcatchment 18: Basin 18

Hydrograph



Bull Run Conveyance 2

Type IA 24-hr 10-Year Rainfall=3.80"

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Summary for Reach R1: Ditch 1

Inflow Area = 96,271 sf, 53.66% Impervious, Inflow Depth = 2.78" for 10-Year event
 Inflow = 1.50 cfs @ 7.91 hrs, Volume= 22,330 cf
 Outflow = 1.50 cfs @ 7.92 hrs, Volume= 22,330 cf, Atten= 0%, Lag= 0.8 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
 Max. Velocity= 2.53 fps, Min. Travel Time= 1.2 min
 Avg. Velocity = 1.31 fps, Avg. Travel Time= 2.2 min

Peak Storage= 104 cf @ 7.92 hrs
 Average Depth at Peak Storage= 0.22'
 Bank-Full Depth= 0.75' Flow Area= 3.2 sf, Capacity= 15.74 cfs

Custom cross-section, Length= 176.0' Slope= 0.0187 '/'
 Constant n= 0.025 Earth, clean & straight
 Inlet Invert= 702.30', Outlet Invert= 699.00'



Offset (feet)	Elevation (feet)	Chan.Depth (feet)	Depth (feet)	End Area (sq-ft)	Perim. (feet)	Storage (cubic-feet)	Discharge (cfs)
-3.25	0.75	0.00	0.00	0.0	2.0	0	0.00
-1.00	0.00	0.75	0.75	3.2	6.7	561	15.74
1.00	0.00	0.75	0.75	3.2	6.7	561	15.74
3.25	0.75	0.00	0.00	0.0	2.0	0	0.00

Bull Run Conveyance 2

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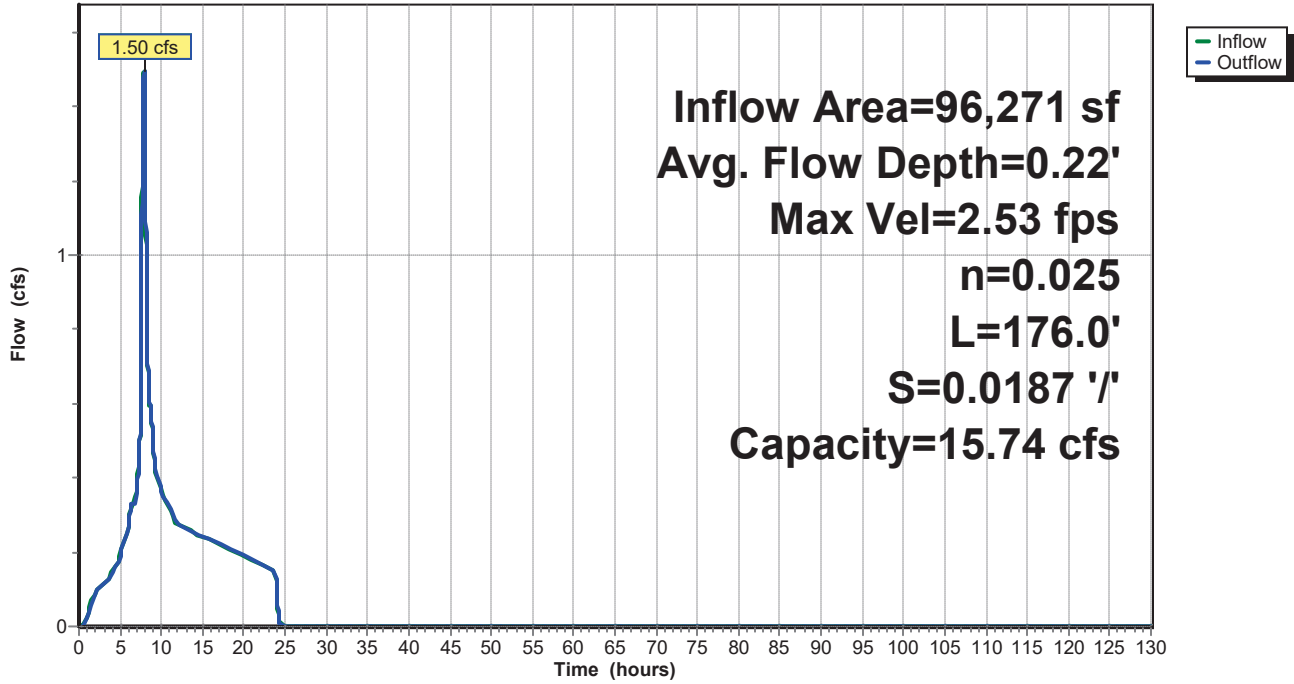
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Reach R1: Ditch 1

Hydrograph



Bull Run Conveyance 2

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Summary for Reach R2: Ditch 2

Inflow Area = 100,222 sf, 5.61% Impervious, Inflow Depth = 1.97" for 10-Year event
 Inflow = 1.06 cfs @ 7.96 hrs, Volume= 16,472 cf
 Outflow = 1.05 cfs @ 8.00 hrs, Volume= 16,472 cf, Atten= 1%, Lag= 2.1 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
 Max. Velocity= 2.19 fps, Min. Travel Time= 4.4 min
 Avg. Velocity = 1.02 fps, Avg. Travel Time= 9.4 min

Peak Storage= 277 cf @ 8.00 hrs
 Average Depth at Peak Storage= 0.14'
 Bank-Full Depth= 1.00' Flow Area= 6.0 sf, Capacity= 39.58 cfs

Custom cross-section, Length= 576.0' Slope= 0.0222 '/'
 Constant n= 0.025 Earth, clean & straight
 Inlet Invert= 703.59', Outlet Invert= 690.82'



Offset (feet)	Elevation (feet)	Chan.Depth (feet)
-4.50	1.00	0.00
-1.50	0.00	1.00
1.50	0.00	1.00
4.50	1.00	0.00

Depth (feet)	End Area (sq-ft)	Perim. (feet)	Storage (cubic-feet)	Discharge (cfs)
0.00	0.0	3.0	0	0.00
1.00	6.0	9.3	3,456	39.58

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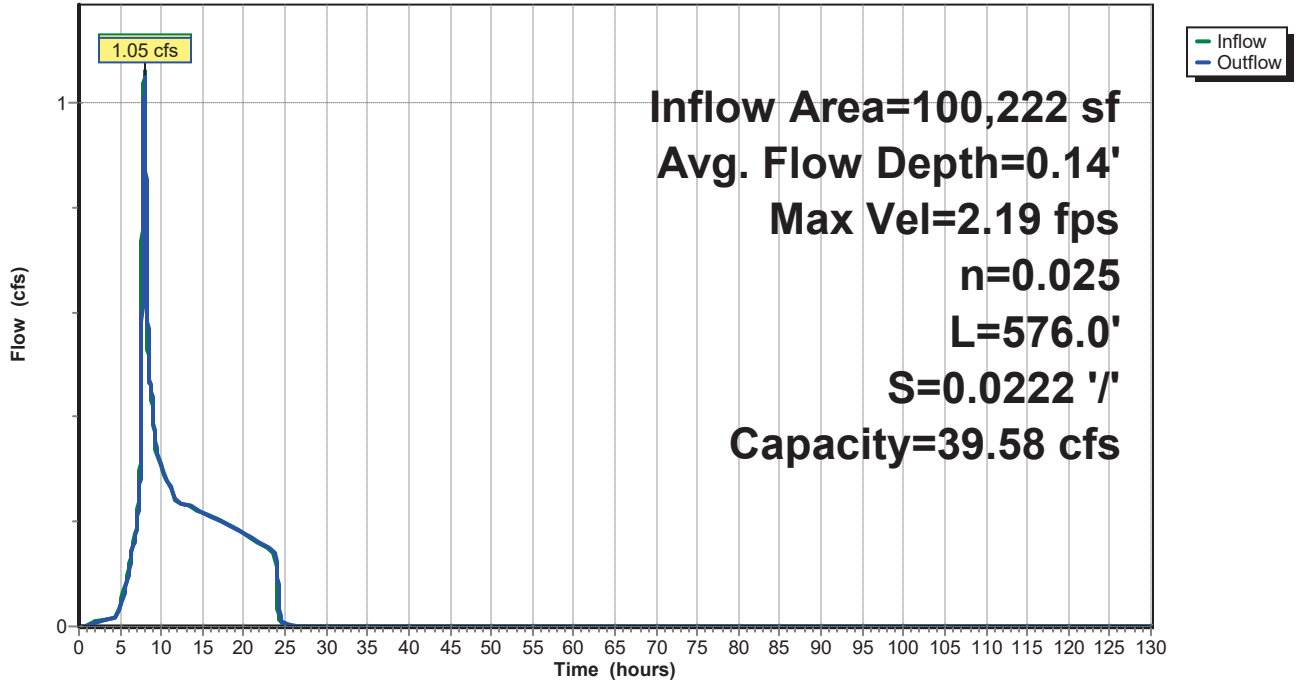
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Reach R2: Ditch 2

Hydrograph



Bull Run Conveyance 2

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Summary for Reach R3: Ditch 3

Inflow Area = 155,802 sf, 20.71% Impervious, Inflow Depth = 2.23" for 10-Year event
Inflow = 1.89 cfs @ 7.94 hrs, Volume= 28,916 cf
Outflow = 1.87 cfs @ 8.00 hrs, Volume= 28,916 cf, Atten= 1%, Lag= 3.1 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.99 fps, Min. Travel Time= 4.4 min
Avg. Velocity = 0.97 fps, Avg. Travel Time= 9.1 min

Peak Storage= 500 cf @ 8.00 hrs
Average Depth at Peak Storage= 0.32'
Bank-Full Depth= 1.00' Flow Area= 5.0 sf, Capacity= 18.61 cfs

Custom cross-section, Length= 530.0' Slope= 0.0077 '/'
Constant n= 0.025 Earth, clean & straight
Inlet Invert= 707.64', Outlet Invert= 703.54'



Offset (feet)	Elevation (feet)	Chan.Depth (feet)
-4.00	1.00	0.00
-1.00	0.00	1.00
1.00	0.00	1.00
4.00	1.00	0.00

Depth (feet)	End Area (sq-ft)	Perim. (feet)	Storage (cubic-feet)	Discharge (cfs)
0.00	0.0	2.0	0	0.00
1.00	5.0	8.3	2,650	18.61

Bull Run Conveyance 2

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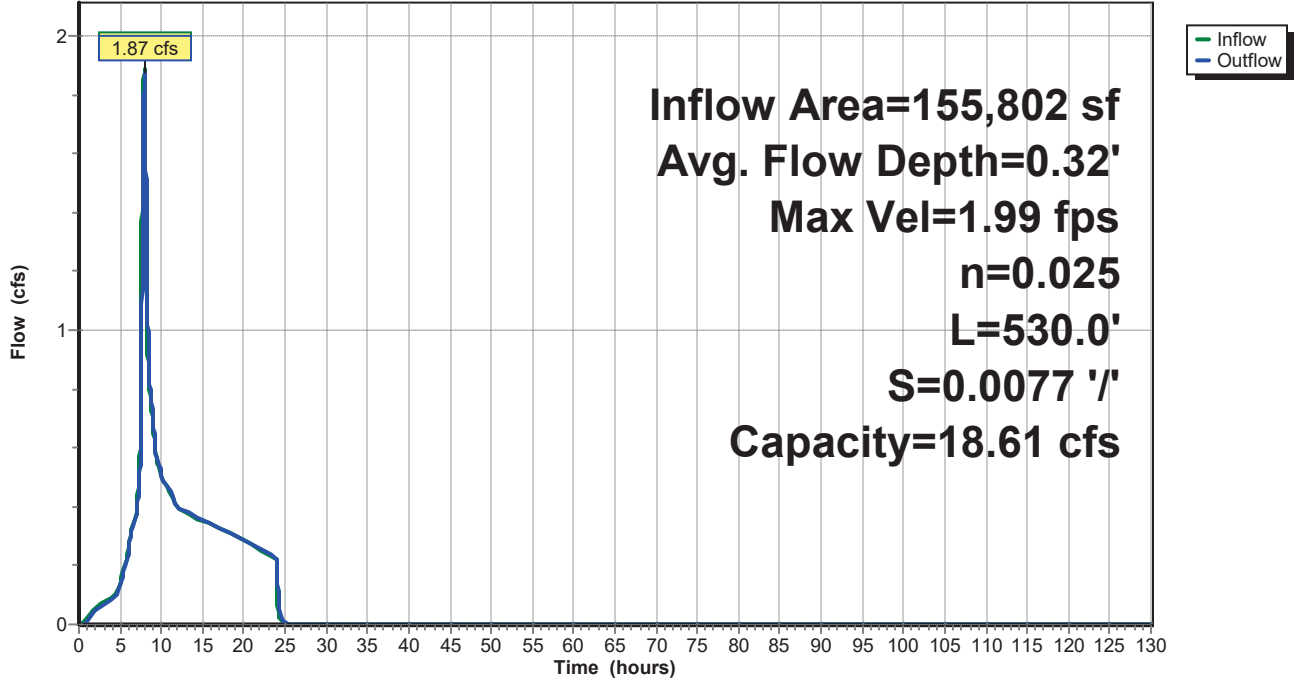
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Reach R3: Ditch 3

Hydrograph



Bull Run Conveyance 2

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Summary for Pond DI: Ditch Inlet

Inflow Area = 100,222 sf, 5.61% Impervious, Inflow Depth = 1.97" for 10-Year event
Inflow = 1.05 cfs @ 8.00 hrs, Volume= 16,472 cf
Outflow = 1.05 cfs @ 8.00 hrs, Volume= 16,472 cf, Atten= 0%, Lag= 0.0 min
Primary = 1.05 cfs @ 8.00 hrs, Volume= 16,472 cf

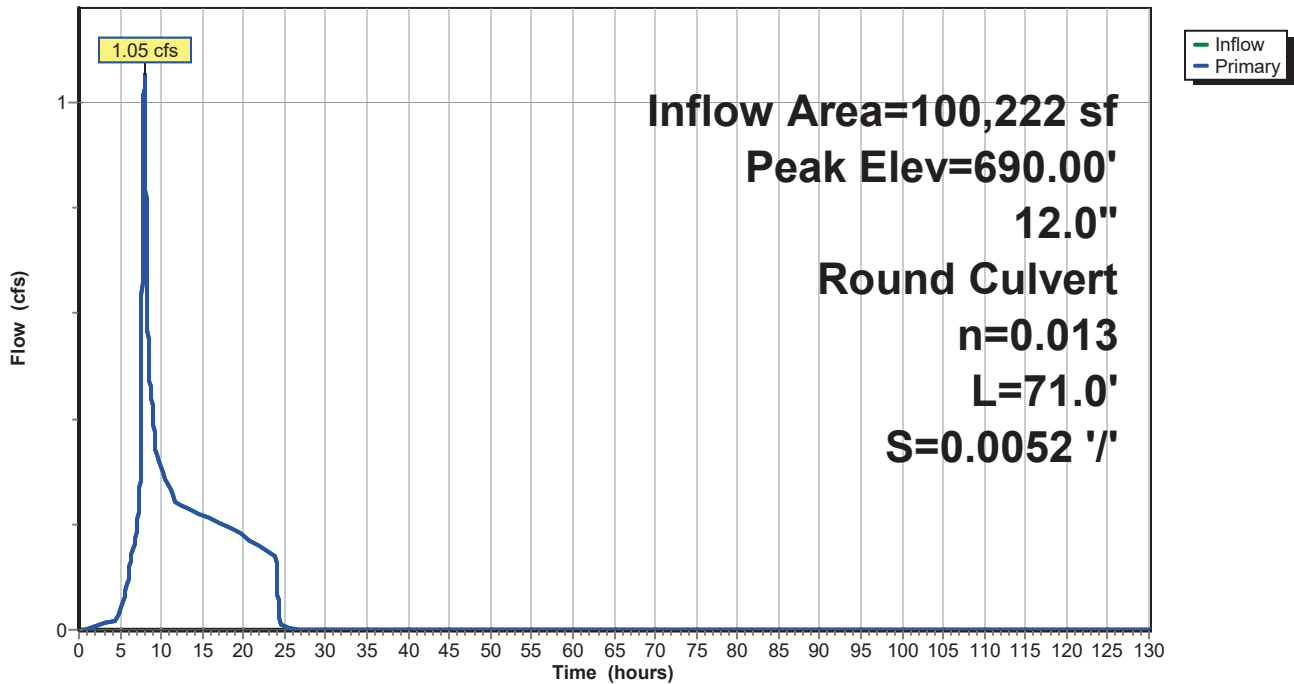
Routing by Dyn-Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Peak Elev= 690.00' @ 8.03 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	689.33'	12.0" Round From Ditch Inlet L= 71.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 689.33' / 688.96' S= 0.0052 '/ Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=1.04 cfs @ 8.00 hrs HW=689.99' TW=689.58' (Dynamic Tailwater)
↑1=From Ditch Inlet (Outlet Controls 1.04 cfs @ 2.66 fps)

Pond DI: Ditch Inlet

Hydrograph



Bull Run Conveyance 2

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Summary for Pond FSMH: Flow Splitter Manhole

Inflow Area = 492,008 sf, 28.65% Impervious, Inflow Depth = 2.36" for 10-Year event
Inflow = 2.77 cfs @ 8.13 hrs, Volume= 96,821 cf
Outflow = 2.77 cfs @ 8.13 hrs, Volume= 96,821 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.59 cfs @ 8.13 hrs, Volume= 31,451 cf
Secondary = 2.18 cfs @ 8.13 hrs, Volume= 65,371 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs

Peak Elev= 689.63' @ 8.13 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	688.86'	8.0" Round To Existing Culvert L= 38.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 688.86' / 688.65' S= 0.0055 '/' Cc= 0.900 n= 0.013, Flow Area= 0.35 sf
#2	Device 1	687.36'	5.0" Horiz. Orifice C= 0.620 Limited to weir flow at low heads
#3	Secondary	688.86'	18.0" Round Bypassed Flow L= 148.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 688.86' / 688.11' S= 0.0051 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf

Primary OutFlow Max=0.59 cfs @ 8.13 hrs HW=689.63' (Free Discharge)

↑**1=To Existing Culvert** (Passes 0.59 cfs of 0.93 cfs potential flow)

↑**2=Orifice** (Orifice Controls 0.59 cfs @ 4.36 fps)

Secondary OutFlow Max=2.18 cfs @ 8.13 hrs HW=689.63' TW=0.00' (Dynamic Tailwater)

↑**3=Bypassed Flow** (Barrel Controls 2.18 cfs @ 3.49 fps)

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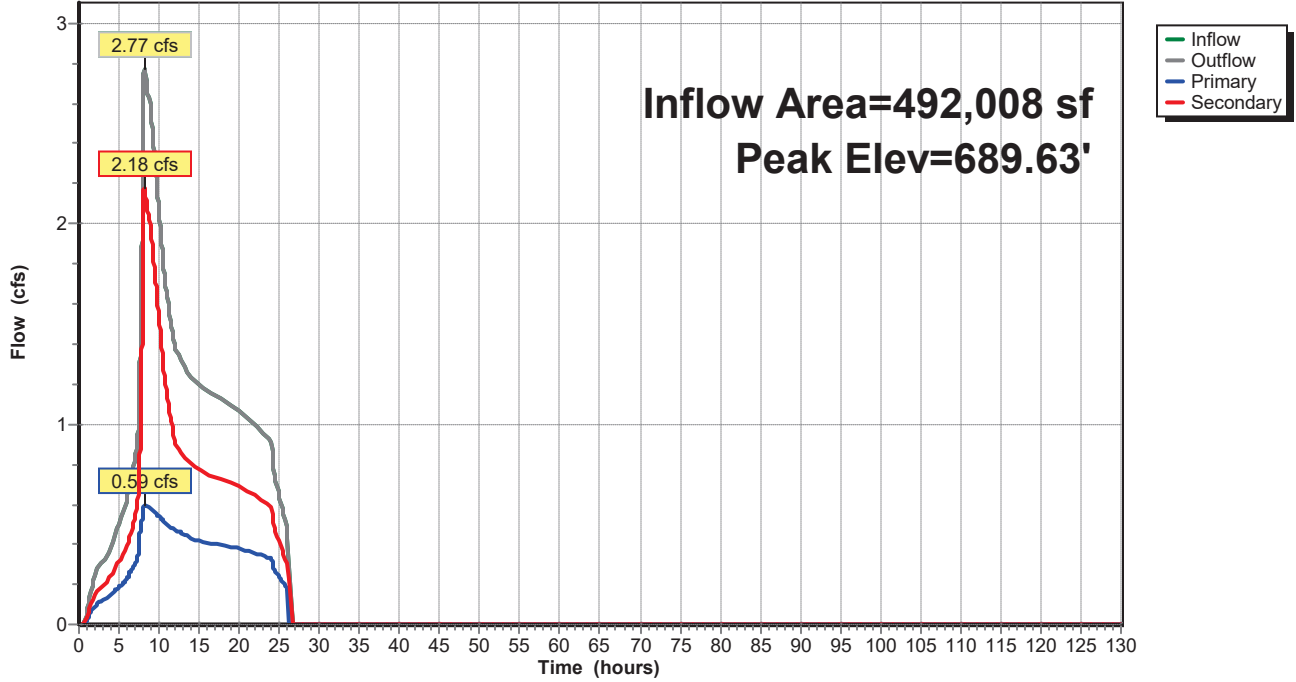
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Pond FSMH: Flow Splitter Manhole

Hydrograph



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Summary for Pond Pond A: Pond A

Inflow Area = 349,468 sf, 50.40% Impervious, Inflow Depth = 2.73" for 10-Year event
 Inflow = 5.32 cfs @ 7.91 hrs, Volume= 79,457 cf
 Outflow = 1.53 cfs @ 9.26 hrs, Volume= 79,464 cf, Atten= 71%, Lag= 80.8 min
 Primary = 1.53 cfs @ 9.26 hrs, Volume= 79,464 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
 Peak Elev= 709.83' @ 9.26 hrs Surf.Area= 8,641 sf Storage= 17,232 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
 Center-of-Mass det. time= 221.5 min (930.6 - 709.1)

Volume	Invert	Avail.Storage	Storage Description
#1	707.50'	70,555 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
707.50	6,107	0	0
708.00	6,714	3,205	3,205
709.00	7,742	7,228	10,433
710.00	8,825	8,284	18,717
711.00	9,967	9,396	28,113
712.00	11,161	10,564	38,677
713.00	12,412	11,787	50,463
714.00	13,717	13,065	63,528
714.50	14,392	7,027	70,555

Device	Routing	Invert	Outlet Devices
#1	Primary	698.43'	18.0" Round Culvert L= 138.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 698.43' / 696.24' S= 0.0159 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf
#2	Device 1	696.43'	2.6" Horiz. Orifice/Grate C= 0.620 Limited to weir flow at low heads
#3	Device 1	709.40'	16.0" W x 3.0" H Vert. Orifice/Grate C= 0.620

Primary OutFlow Max=1.53 cfs @ 9.26 hrs HW=709.83' TW=0.00' (Dynamic Tailwater)

- 1=Culvert (Passes 1.53 cfs of 24.58 cfs potential flow)
- 2=Orifice/Grate (Orifice Controls 0.62 cfs @ 16.80 fps)
- 3=Orifice/Grate (Orifice Controls 0.91 cfs @ 2.73 fps)

Bull Run Conveyance 2

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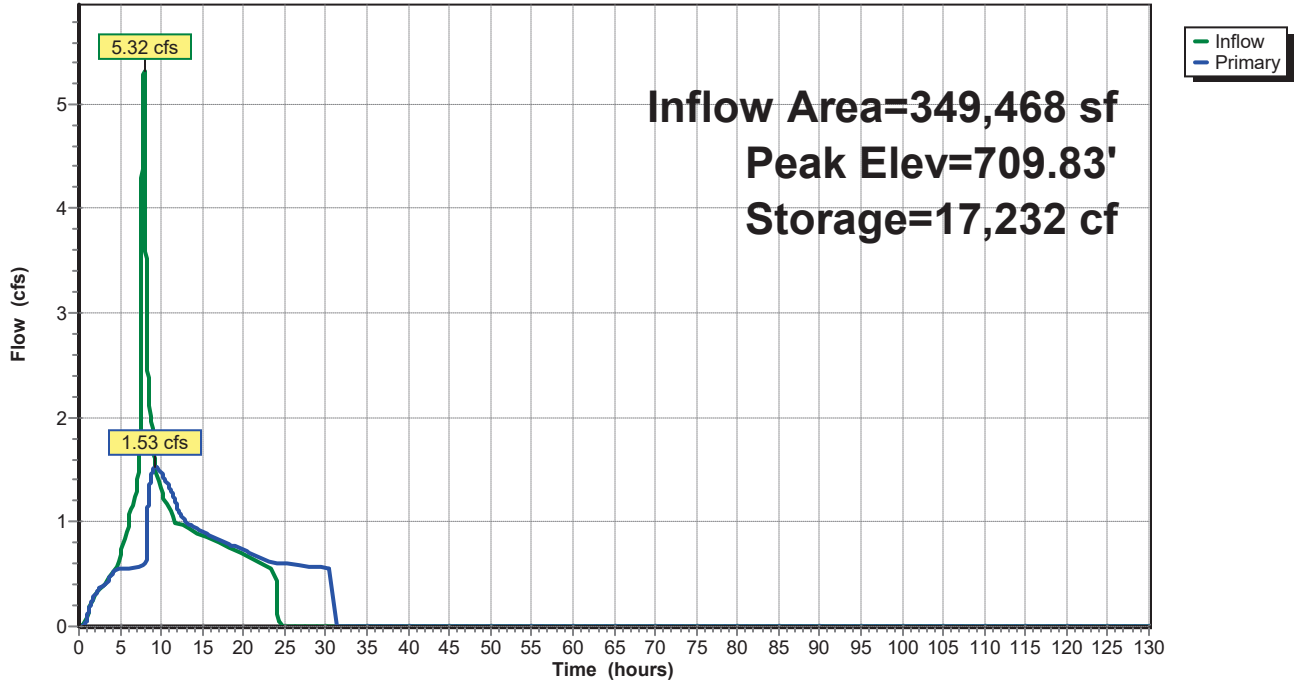
Type IA 24-hr 10-Year Rainfall=3.80"

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Pond Pond A: Pond A

Hydrograph



Bull Run Conveyance 2

Type IA 24-hr 10-Year Rainfall=3.80"

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Summary for Pond Pond D: Pond D

Inflow Area = 391,786 sf, 34.55% Impervious, Inflow Depth = 2.46" for 10-Year event
 Inflow = 5.28 cfs @ 7.95 hrs, Volume= 80,341 cf
 Outflow = 2.16 cfs @ 8.69 hrs, Volume= 80,349 cf, Atten= 59%, Lag= 44.4 min
 Primary = 2.16 cfs @ 8.69 hrs, Volume= 80,349 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
 Peak Elev= 695.22' @ 8.69 hrs Surf.Area= 6,610 sf Storage= 12,230 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
 Center-of-Mass det. time= 106.0 min (840.7 - 734.7)

Volume	Invert	Avail.Storage	Storage Description
#1	693.00'	45,106 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
693.00	4,453	0	0
694.00	5,388	4,921	4,921
695.00	6,380	5,884	10,805
696.00	7,428	6,904	17,709
697.00	8,533	7,981	25,689
698.00	9,694	9,114	34,803
699.00	10,912	10,303	45,106

Device	Routing	Invert	Outlet Devices
#1	Primary	692.50'	12.0" Round Culvert L= 121.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 692.50' / 688.97' S= 0.0292 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	690.50'	4.9" Horiz. Orifice/Grate C= 0.620 Limited to weir flow at low heads
#3	Device 1	694.60'	15.0" W x 3.0" H Vert. Orifice/Grate C= 0.620

Primary OutFlow Max=2.16 cfs @ 8.69 hrs HW=695.22' TW=689.60' (Dynamic Tailwater)

- ↑ **1=Culvert** (Passes 2.16 cfs of 5.63 cfs potential flow)
- ↑ **2=Orifice/Grate** (Orifice Controls 1.07 cfs @ 8.20 fps)
- ↑ **3=Orifice/Grate** (Orifice Controls 1.09 cfs @ 3.49 fps)

Bull Run Conveyance 2

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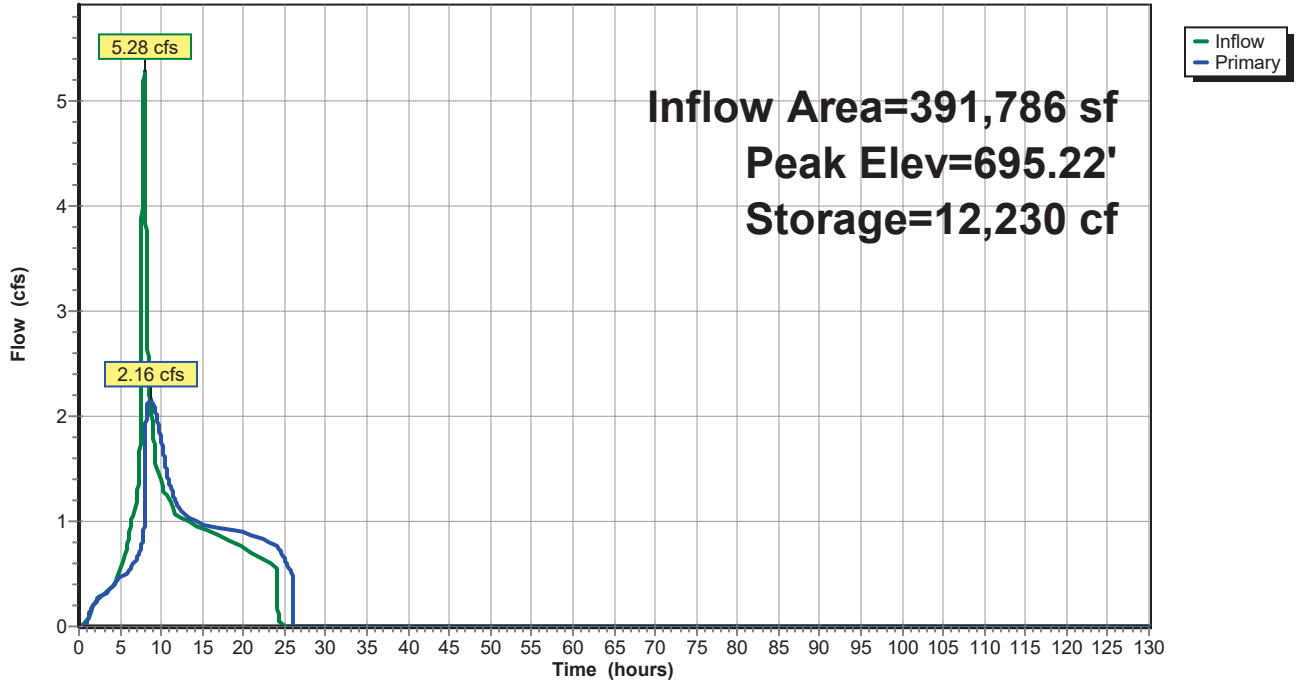
Type IA 24-hr 10-Year Rainfall=3.80"

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Pond Pond D: Pond D

Hydrograph



Bull Run Conveyance 2

Type IA 24-hr 10-Year Rainfall=3.80"

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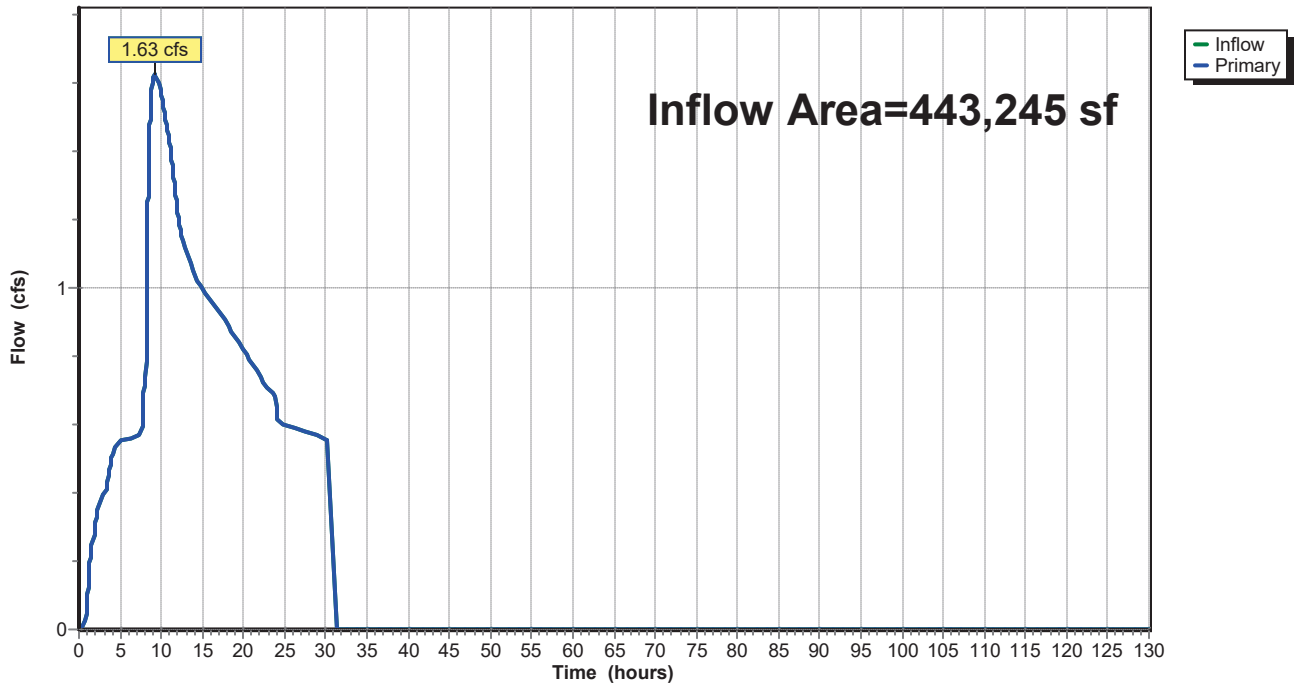
Summary for Link L1: Pipe 2

Inflow Area = 443,245 sf, 39.74% Impervious, Inflow Depth = 2.30" for 10-Year event
Inflow = 1.63 cfs @ 9.21 hrs, Volume= 85,036 cf
Primary = 1.63 cfs @ 9.21 hrs, Volume= 85,036 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs

Link L1: Pipe 2

Hydrograph



Bull Run Conveyance 2

Type IA 24-hr 10-Year Rainfall=3.80"

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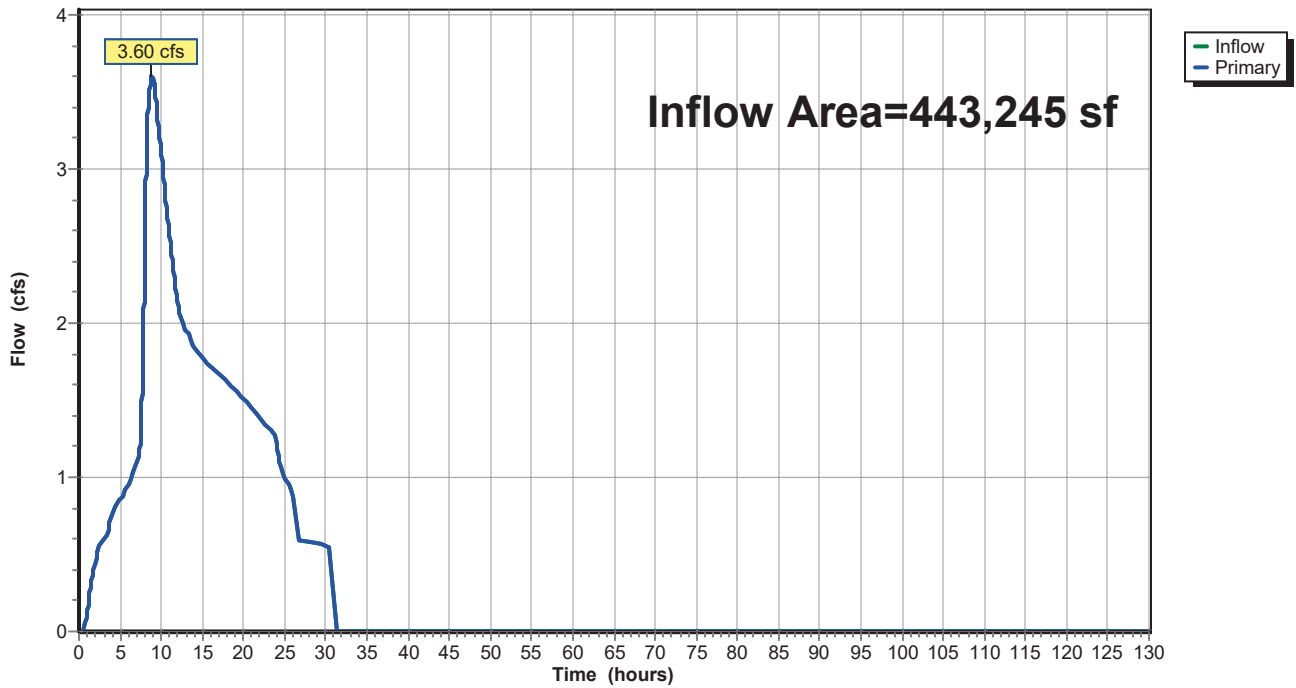
Summary for Link L2: Pipe 19

Inflow Area = 443,245 sf, 39.74% Impervious, Inflow Depth = 4.07" for 10-Year event
Inflow = 3.60 cfs @ 8.86 hrs, Volume= 150,407 cf
Primary = 3.60 cfs @ 8.86 hrs, Volume= 150,407 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs

Link L2: Pipe 19

Hydrograph



Bull Run Conveyance 2

Type IA 24-hr 10-Year Rainfall=3.80"

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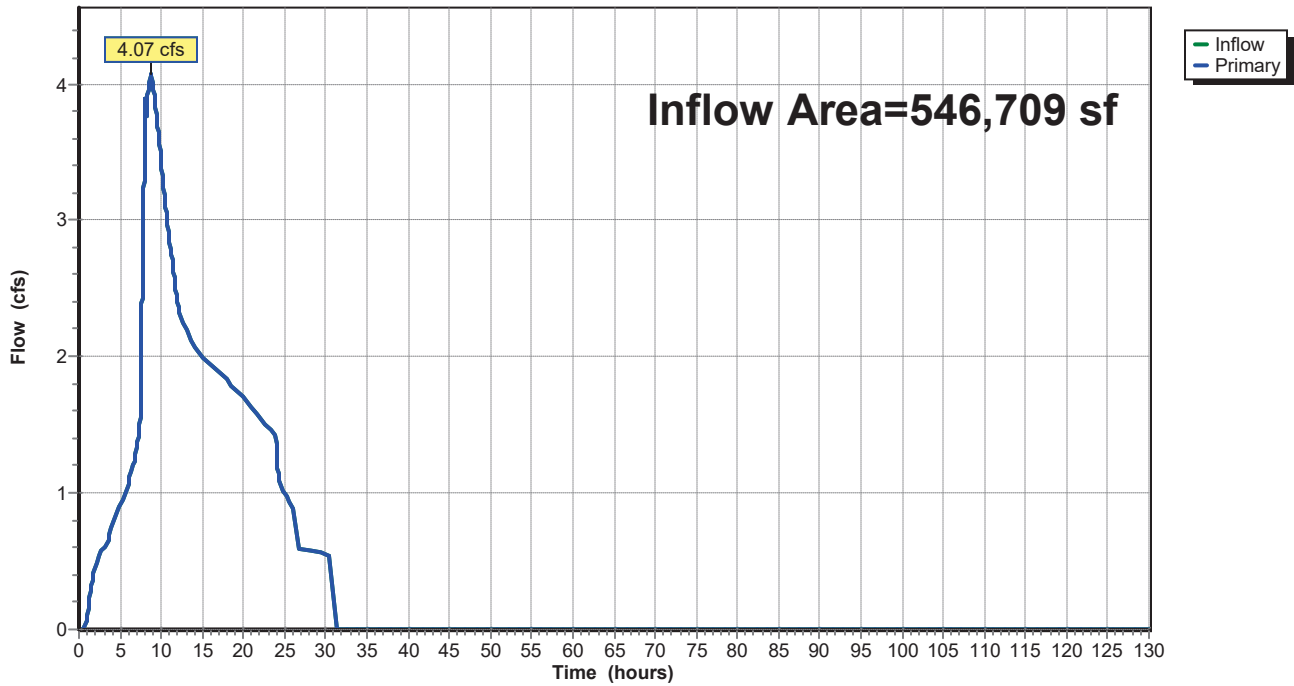
Summary for Link L3: Pipe 24

Inflow Area = 546,709 sf, 32.22% Impervious, Inflow Depth = 3.69" for 10-Year event
Inflow = 4.07 cfs @ 8.76 hrs, Volume= 167,937 cf
Primary = 4.07 cfs @ 8.76 hrs, Volume= 167,937 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs

Link L3: Pipe 24

Hydrograph



Bull Run Conveyance 2

Type IA 24-hr 25-Year Rainfall=4.50"

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Summary for Subcatchment 1-6, 23: Basins 1-6

Runoff = 6.62 cfs @ 7.91 hrs, Volume= 98,144 cf, Depth= 3.37"

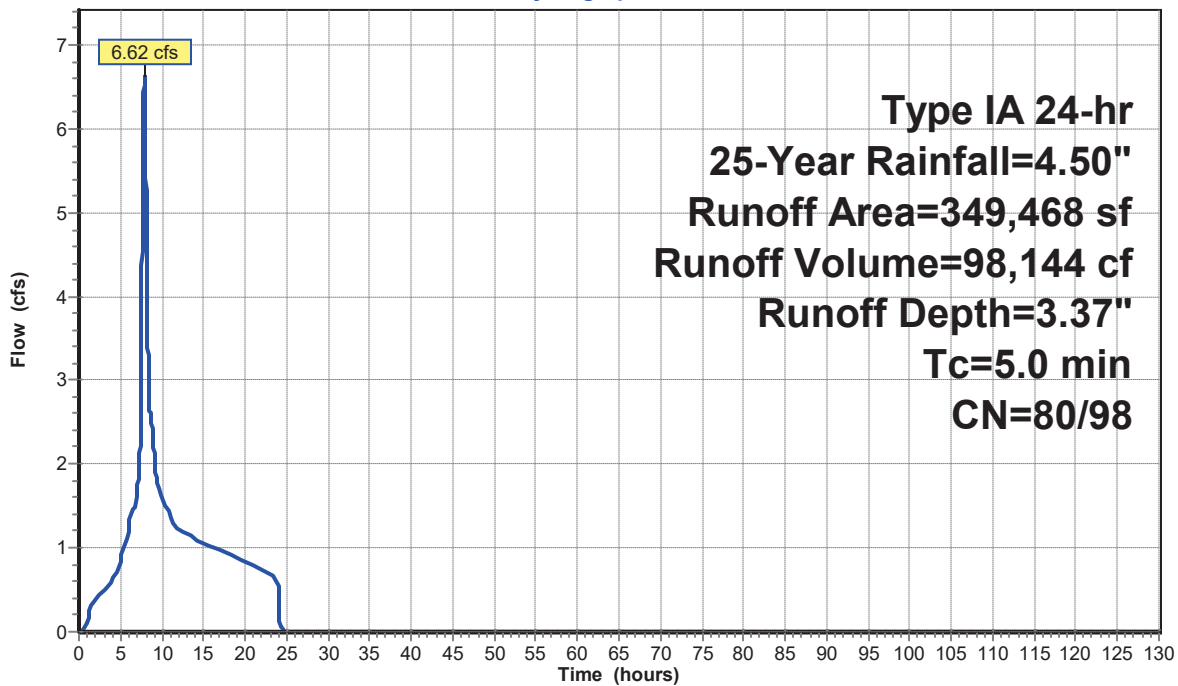
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=4.50"

	Area (sf)	CN	Description
*	176,142	98	Impervious Area
	173,326	80	>75% Grass cover, Good, HSG D
	349,468	89	Weighted Average
	173,326	80	49.60% Pervious Area
	176,142	98	50.40% Impervious Area

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

Subcatchment 1-6, 23: Basins 1-6

Hydrograph



Bull Run Conveyance 2

Type IA 24-hr 25-Year Rainfall=4.50"

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Summary for Subcatchment 7: Basin 7

Runoff = 0.76 cfs @ 7.88 hrs, Volume= 11,119 cf, Depth= 4.26"

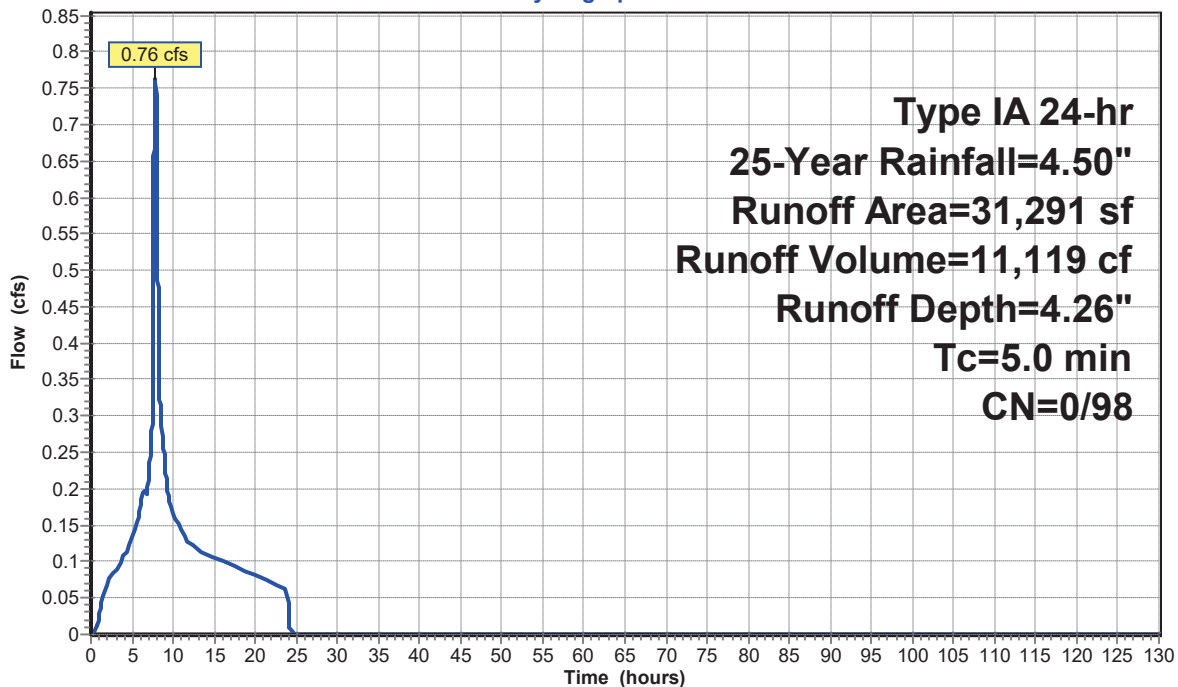
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=4.50"

	Area (sf)	CN	Description
*	31,291	98	Impervious Area
	31,291	98	100.00% Impervious Area

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

Subcatchment 7: Basin 7

Hydrograph



Bull Run Conveyance 2

Type IA 24-hr 25-Year Rainfall=4.50"

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Summary for Subcatchment 12: Basin 12

Runoff = 1.10 cfs @ 7.92 hrs, Volume= 16,389 cf, Depth= 3.03"

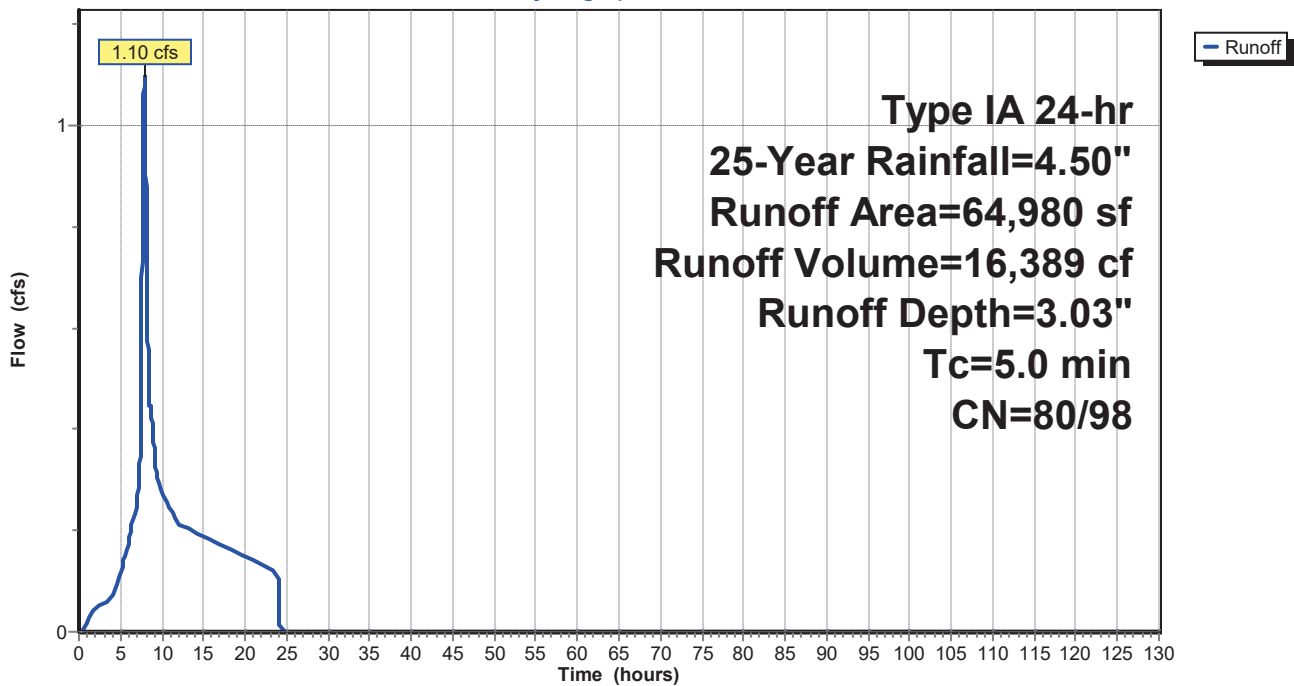
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=4.50"

	Area (sf)	CN	Description
*	20,370	98	Impervious Area
*	44,610	80	Pervious
	64,980	86	Weighted Average
	44,610	80	68.65% Pervious Area
	20,370	98	31.35% Impervious Area

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

Subcatchment 12: Basin 12

Hydrograph



Bull Run Conveyance 2

Type IA 24-hr 25-Year Rainfall=4.50"

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Summary for Subcatchment 13: Basin 13

Runoff = 2.46 cfs @ 7.93 hrs, Volume= 36,805 cf, Depth= 2.83"

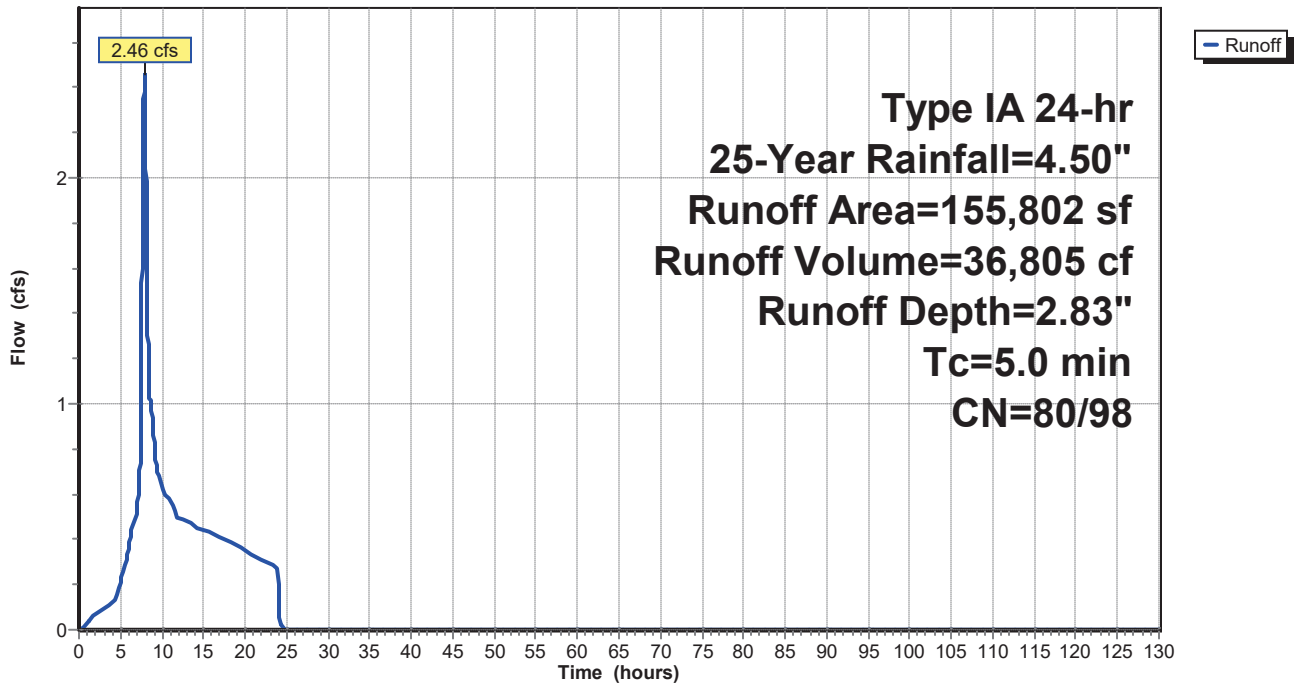
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=4.50"

	Area (sf)	CN	Description
*	32,262	98	Impervious Area
*	123,540	80	Pervious
	155,802	84	Weighted Average
	123,540	80	79.29% Pervious Area
	32,262	98	20.71% Impervious Area

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

Subcatchment 13: Basin 13

Hydrograph



Bull Run Conveyance 2

Type IA 24-hr 25-Year Rainfall=4.50"

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Summary for Subcatchment 14: Basin 14

Runoff = 2.44 cfs @ 7.92 hrs, Volume= 36,385 cf, Depth= 3.13"

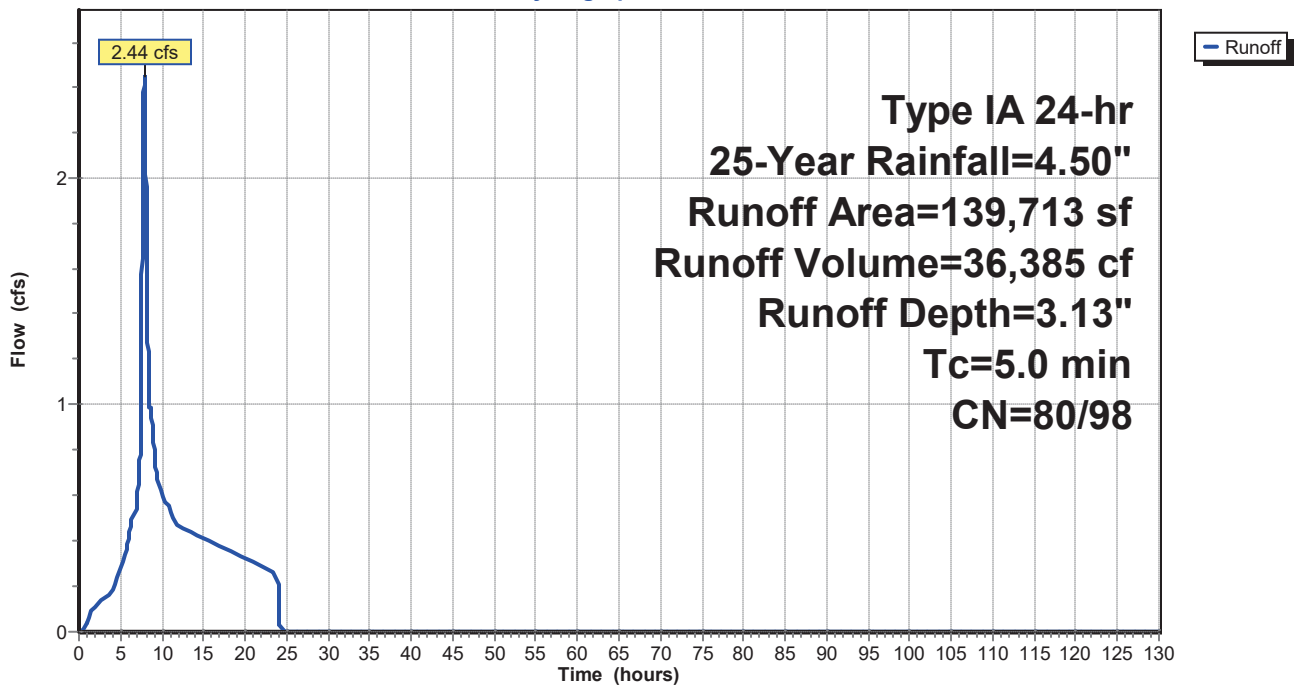
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
 Type IA 24-hr 25-Year Rainfall=4.50"

	Area (sf)	CN	Description
*	51,434	98	Impervious Area
*	88,279	80	Pervious Area
	139,713	87	Weighted Average
	88,279	80	63.19% Pervious Area
	51,434	98	36.81% Impervious Area

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

Subcatchment 14: Basin 14

Hydrograph



Bull Run Conveyance 2

Type IA 24-hr 25-Year Rainfall=4.50"

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Summary for Subcatchment 15: Basin 15

Runoff = 1.42 cfs @ 7.95 hrs, Volume= 21,403 cf, Depth= 2.56"

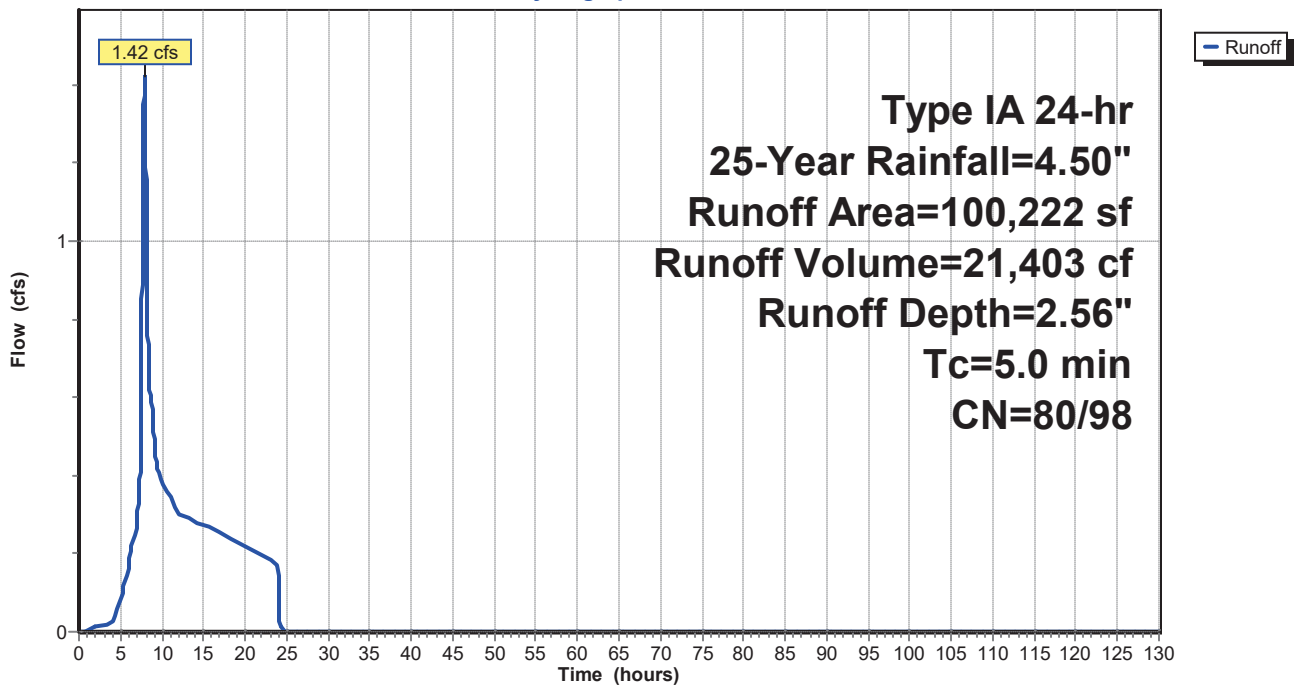
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=4.50"

	Area (sf)	CN	Description
*	5,624	98	Impervious Area
*	94,598	80	Pervious
	100,222	81	Weighted Average
	94,598	80	94.39% Pervious Area
	5,624	98	5.61% Impervious Area

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

Subcatchment 15: Basin 15

Hydrograph



Bull Run Conveyance 2

Type IA 24-hr 25-Year Rainfall=4.50"

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Summary for Subcatchment 16: Basin 16

Runoff = 1.54 cfs @ 7.95 hrs, Volume= 22,728 cf, Depth= 2.64"

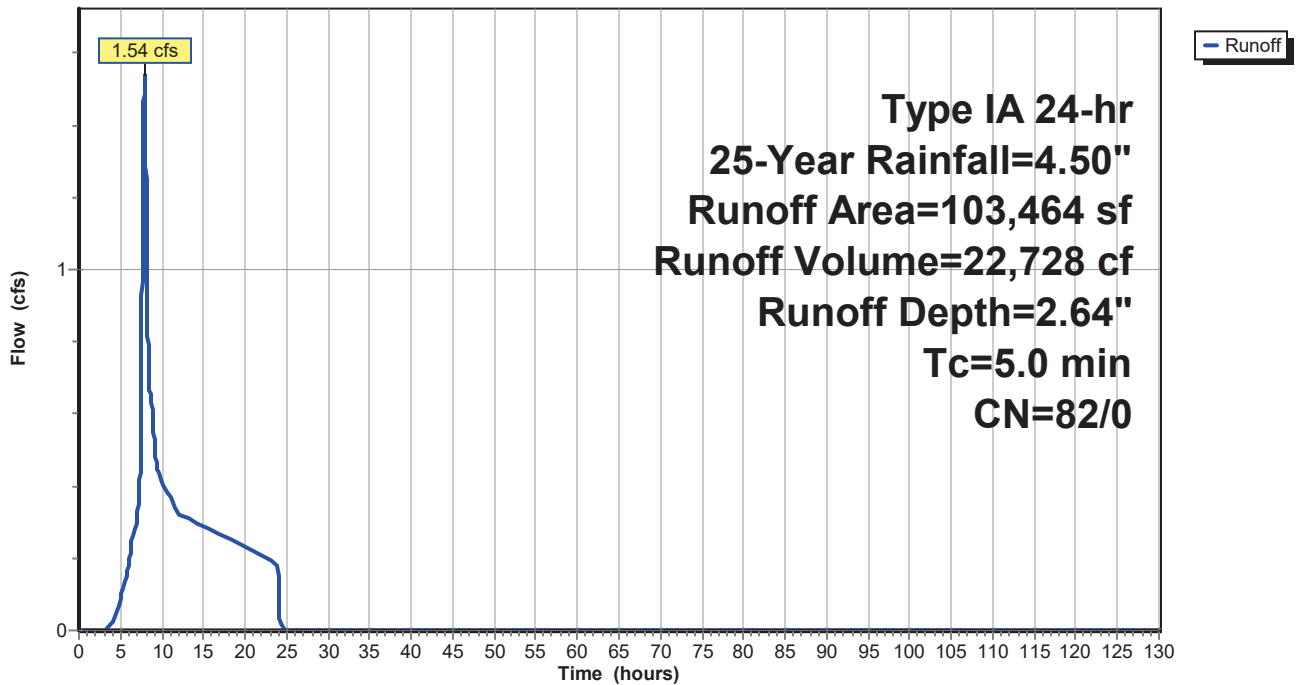
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=4.50"

Area (sf)	CN	Description
* 103,464	82	Pervious
103,464	82	100.00% Pervious Area

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

Subcatchment 16: Basin 16

Hydrograph



Bull Run Conveyance 2

Type IA 24-hr 25-Year Rainfall=4.50"

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Summary for Subcatchment 18: Basin 18

Runoff = 0.33 cfs @ 8.00 hrs, Volume= 8,434 cf, Depth= 1.08"

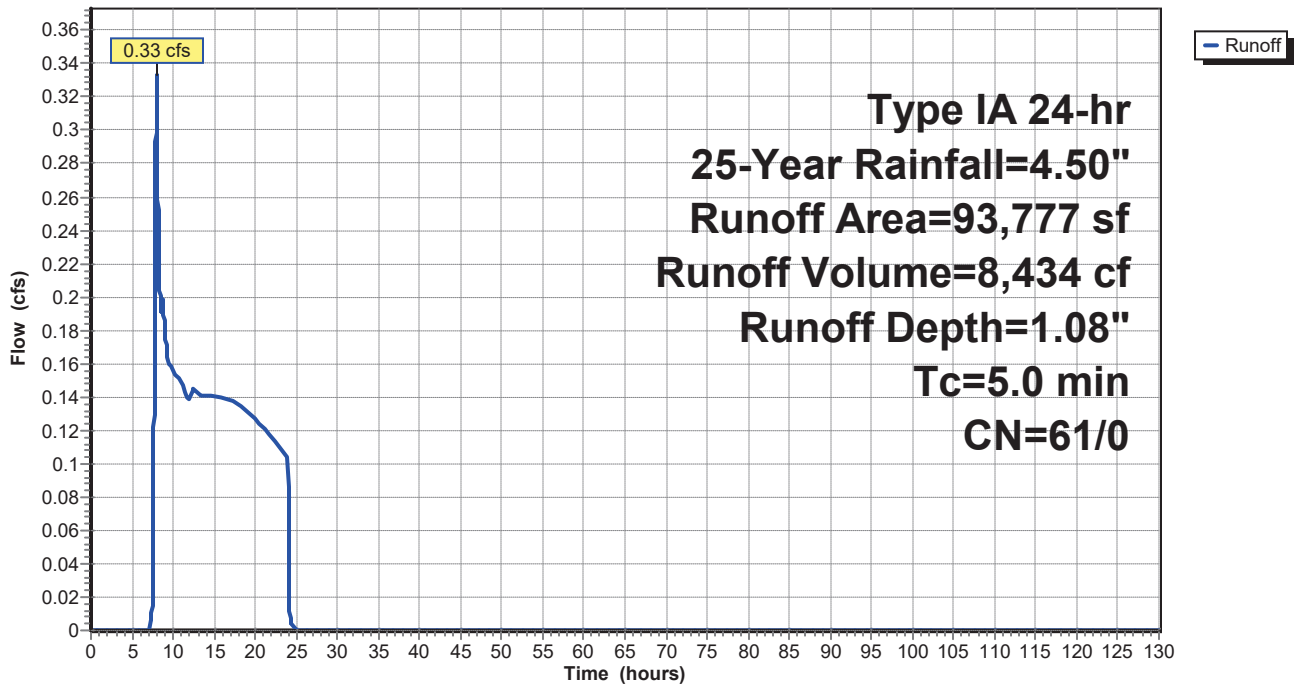
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=4.50"

Area (sf)	CN	Description
* 93,777	61	Ecoroof
93,777	61	100.00% Pervious Area

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

Subcatchment 18: Basin 18

Hydrograph



Bull Run Conveyance 2

Type IA 24-hr 25-Year Rainfall=4.50"

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Summary for Reach R1: Ditch 1

Inflow Area = 96,271 sf, 53.66% Impervious, Inflow Depth = 3.43" for 25-Year event
 Inflow = 1.86 cfs @ 7.90 hrs, Volume= 27,508 cf
 Outflow = 1.86 cfs @ 7.92 hrs, Volume= 27,508 cf, Atten= 0%, Lag= 0.8 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
 Max. Velocity= 2.71 fps, Min. Travel Time= 1.1 min
 Avg. Velocity = 1.40 fps, Avg. Travel Time= 2.1 min

Peak Storage= 121 cf @ 7.92 hrs
 Average Depth at Peak Storage= 0.25'
 Bank-Full Depth= 0.75' Flow Area= 3.2 sf, Capacity= 15.74 cfs

Custom cross-section, Length= 176.0' Slope= 0.0187 '/'
 Constant n= 0.025 Earth, clean & straight
 Inlet Invert= 702.30', Outlet Invert= 699.00'



Offset (feet)	Elevation (feet)	Chan.Depth (feet)	Depth (feet)	End Area (sq-ft)	Perim. (feet)	Storage (cubic-feet)	Discharge (cfs)
-3.25	0.75	0.00	0.00	0.0	2.0	0	0.00
-1.00	0.00	0.75	0.75	3.2	6.7	561	15.74
1.00	0.00	0.75	0.75	3.2	6.7	561	15.74
3.25	0.75	0.00	0.00	0.0	2.0	0	0.00

Bull Run Conveyance 2

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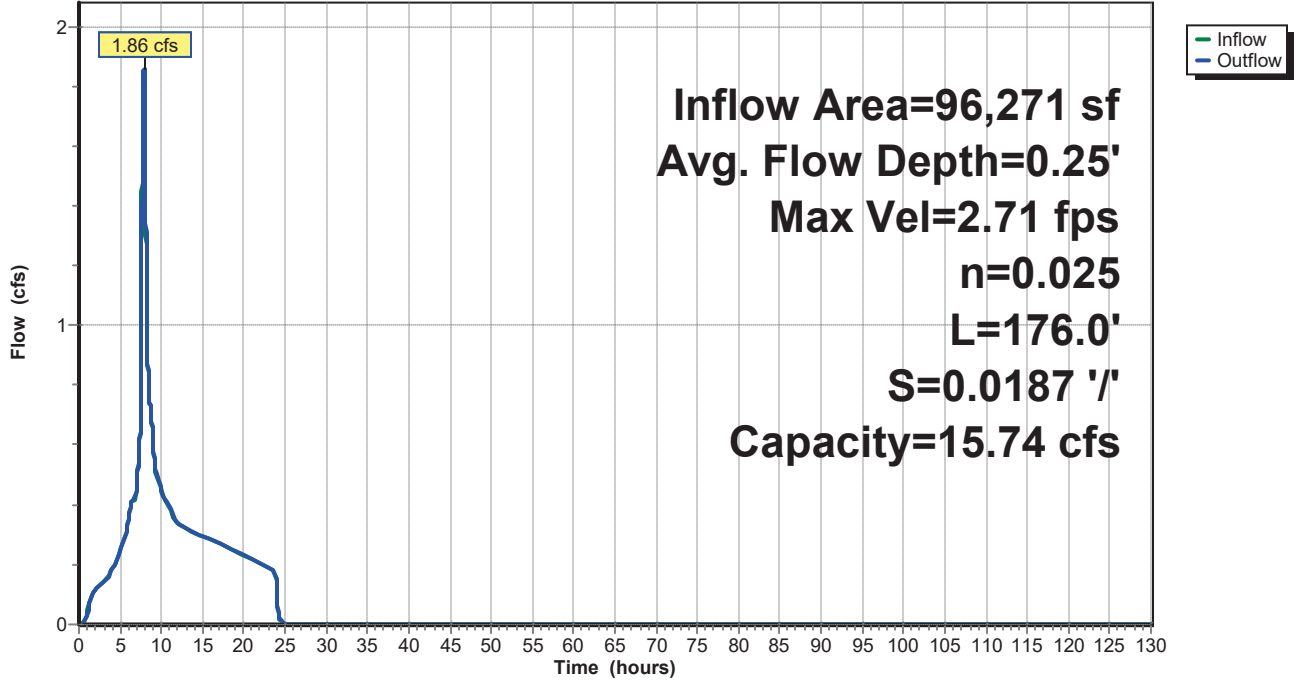
Type IA 24-hr 25-Year Rainfall=4.50"

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Reach R1: Ditch 1

Hydrograph



Bull Run Conveyance 2

Type IA 24-hr 25-Year Rainfall=4.50"

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Summary for Reach R2: Ditch 2

Inflow Area = 100,222 sf, 5.61% Impervious, Inflow Depth = 2.56" for 25-Year event
Inflow = 1.42 cfs @ 7.95 hrs, Volume= 21,403 cf
Outflow = 1.41 cfs @ 7.99 hrs, Volume= 21,403 cf, Atten= 1%, Lag= 2.6 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.43 fps, Min. Travel Time= 4.0 min
Avg. Velocity = 1.12 fps, Avg. Travel Time= 8.6 min

Peak Storage= 335 cf @ 7.99 hrs
Average Depth at Peak Storage= 0.17'
Bank-Full Depth= 1.00' Flow Area= 6.0 sf, Capacity= 39.58 cfs

Custom cross-section, Length= 576.0' Slope= 0.0222 '/'
Constant n= 0.025 Earth, clean & straight
Inlet Invert= 703.59', Outlet Invert= 690.82'



Offset (feet)	Elevation (feet)	Chan.Depth (feet)
-4.50	1.00	0.00
-1.50	0.00	1.00
1.50	0.00	1.00
4.50	1.00	0.00

Depth (feet)	End Area (sq-ft)	Perim. (feet)	Storage (cubic-feet)	Discharge (cfs)
0.00	0.0	3.0	0	0.00
1.00	6.0	9.3	3,456	39.58

Bull Run Conveyance 2

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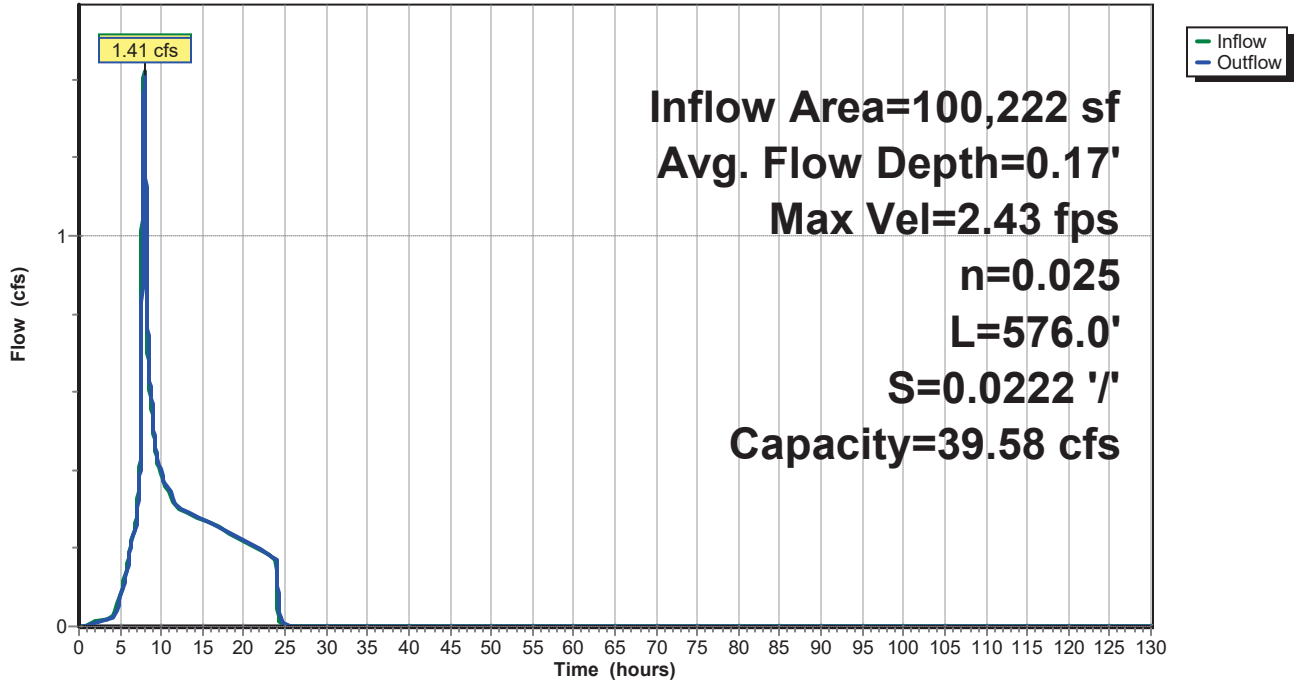
Type IA 24-hr 25-Year Rainfall=4.50"

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Reach R2: Ditch 2

Hydrograph



Bull Run Conveyance 2

Type IA 24-hr 25-Year Rainfall=4.50"

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Summary for Reach R3: Ditch 3

Inflow Area = 155,802 sf, 20.71% Impervious, Inflow Depth = 2.83" for 25-Year event
 Inflow = 2.46 cfs @ 7.93 hrs, Volume= 36,805 cf
 Outflow = 2.44 cfs @ 7.98 hrs, Volume= 36,805 cf, Atten= 1%, Lag= 3.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
 Max. Velocity= 2.15 fps, Min. Travel Time= 4.1 min
 Avg. Velocity = 1.04 fps, Avg. Travel Time= 8.5 min

Peak Storage= 603 cf @ 7.98 hrs
 Average Depth at Peak Storage= 0.37'
 Bank-Full Depth= 1.00' Flow Area= 5.0 sf, Capacity= 18.61 cfs

Custom cross-section, Length= 530.0' Slope= 0.0077 '/'
 Constant n= 0.025 Earth, clean & straight
 Inlet Invert= 707.64', Outlet Invert= 703.54'



Offset (feet)	Elevation (feet)	Chan.Depth (feet)	Depth (feet)	End Area (sq-ft)	Perim. (feet)	Storage (cubic-feet)	Discharge (cfs)
-4.00	1.00	0.00	0.00	0.0	2.0	0	0.00
-1.00	0.00	1.00	1.00	5.0	8.3	2,650	18.61
1.00	0.00	1.00					
4.00	1.00	0.00					

Bull Run Conveyance 2

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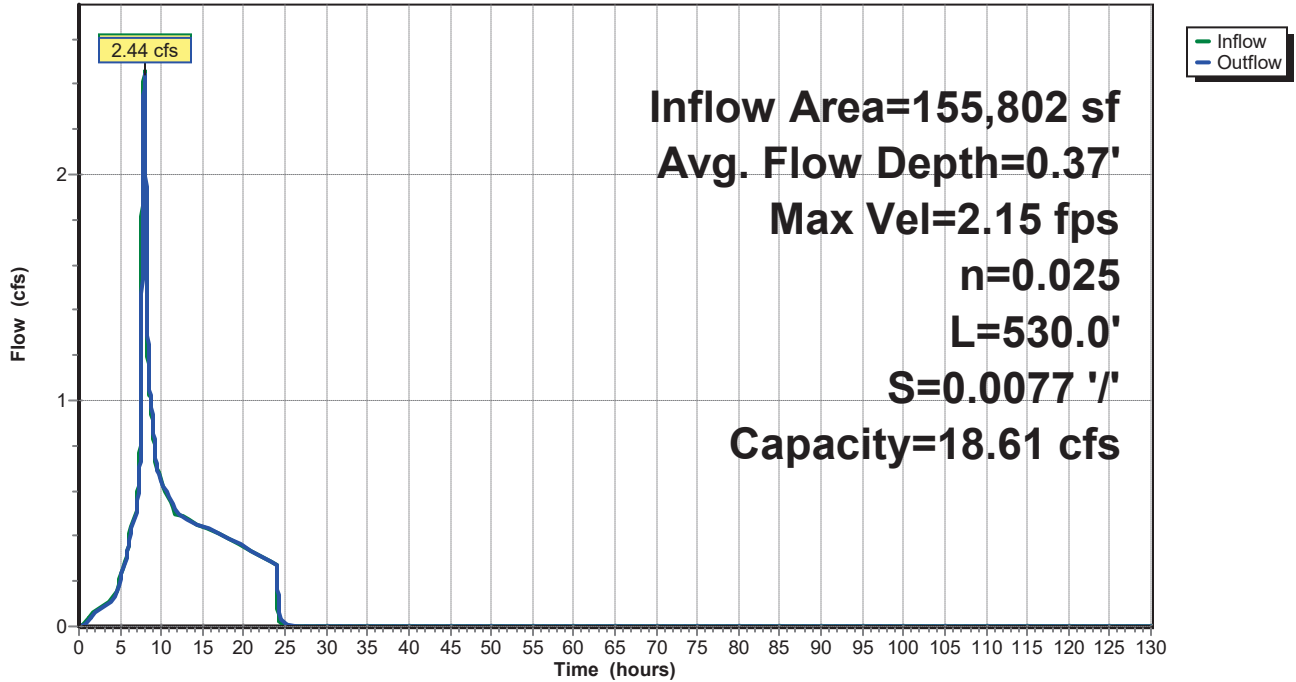
Type IA 24-hr 25-Year Rainfall=4.50"

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Reach R3: Ditch 3

Hydrograph



Bull Run Conveyance 2

Type IA 24-hr 25-Year Rainfall=4.50"

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Summary for Pond DI: Ditch Inlet

Inflow Area = 100,222 sf, 5.61% Impervious, Inflow Depth = 2.56" for 25-Year event
Inflow = 1.41 cfs @ 7.99 hrs, Volume= 21,403 cf
Outflow = 1.41 cfs @ 7.99 hrs, Volume= 21,403 cf, Atten= 0%, Lag= 0.0 min
Primary = 1.41 cfs @ 7.99 hrs, Volume= 21,403 cf

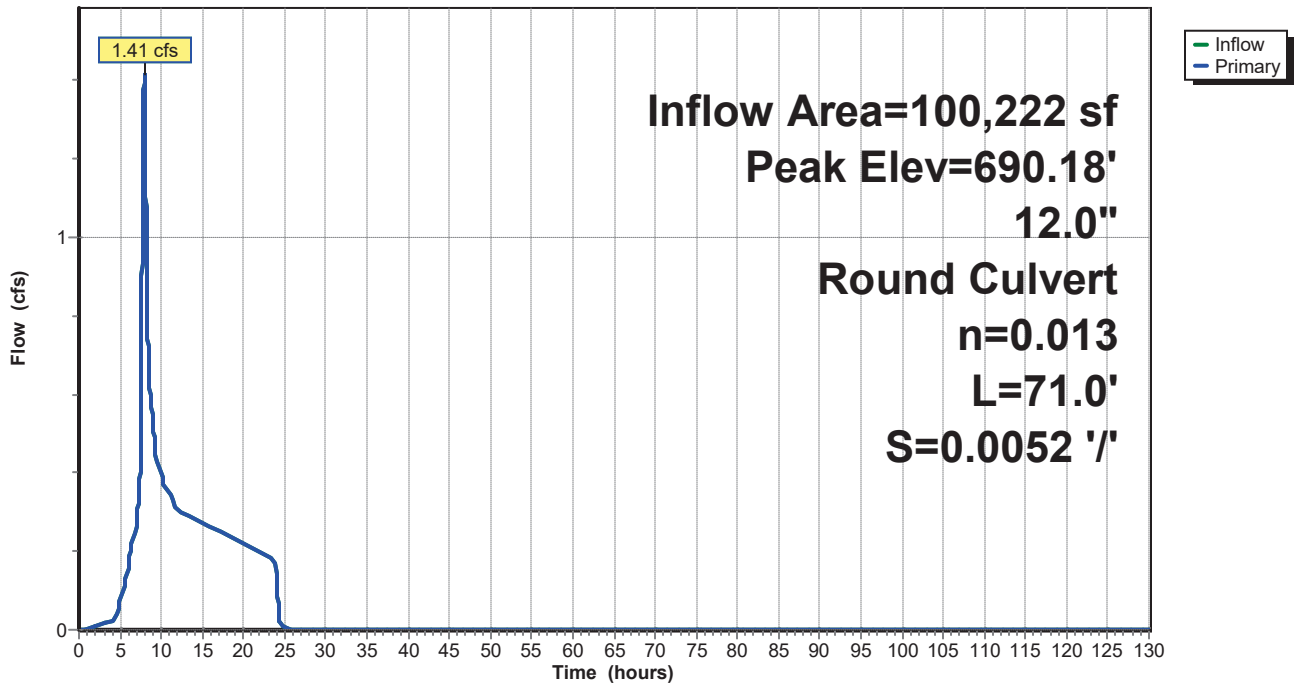
Routing by Dyn-Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Peak Elev= 690.18' @ 8.01 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	689.33'	12.0" Round From Ditch Inlet L= 71.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 689.33' / 688.96' S= 0.0052 '/ Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=1.41 cfs @ 7.99 hrs HW=690.18' TW=689.80' (Dynamic Tailwater)
↳ 1=From Ditch Inlet (Outlet Controls 1.41 cfs @ 2.68 fps)

Pond DI: Ditch Inlet

Hydrograph



Bull Run Conveyance 2

Type IA 24-hr 25-Year Rainfall=4.50"

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Summary for Pond FSMH: Flow Splitter Manhole

Inflow Area = 492,008 sf, 28.65% Impervious, Inflow Depth = 2.98" for 25-Year event
Inflow = 3.84 cfs @ 8.03 hrs, Volume= 122,101 cf
Outflow = 3.84 cfs @ 8.03 hrs, Volume= 122,101 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.66 cfs @ 8.03 hrs, Volume= 36,262 cf
Secondary = 3.18 cfs @ 8.03 hrs, Volume= 85,840 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs

Peak Elev= 689.81' @ 8.03 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	688.86'	8.0" Round To Existing Culvert L= 38.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 688.86' / 688.65' S= 0.0055 '/' Cc= 0.900 n= 0.013, Flow Area= 0.35 sf
#2	Device 1	687.36'	5.0" Horiz. Orifice C= 0.620 Limited to weir flow at low heads
#3	Secondary	688.86'	18.0" Round Bypassed Flow L= 148.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 688.86' / 688.11' S= 0.0051 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf

Primary OutFlow Max=0.66 cfs @ 8.03 hrs HW=689.81' (Free Discharge)

↑**1=To Existing Culvert** (Passes 0.66 cfs of 1.05 cfs potential flow)

↑**2=Orifice** (Orifice Controls 0.66 cfs @ 4.85 fps)

Secondary OutFlow Max=3.18 cfs @ 8.03 hrs HW=689.81' TW=0.00' (Dynamic Tailwater)

↑**3=Bypassed Flow** (Barrel Controls 3.18 cfs @ 3.83 fps)

Bull Run Conveyance 2

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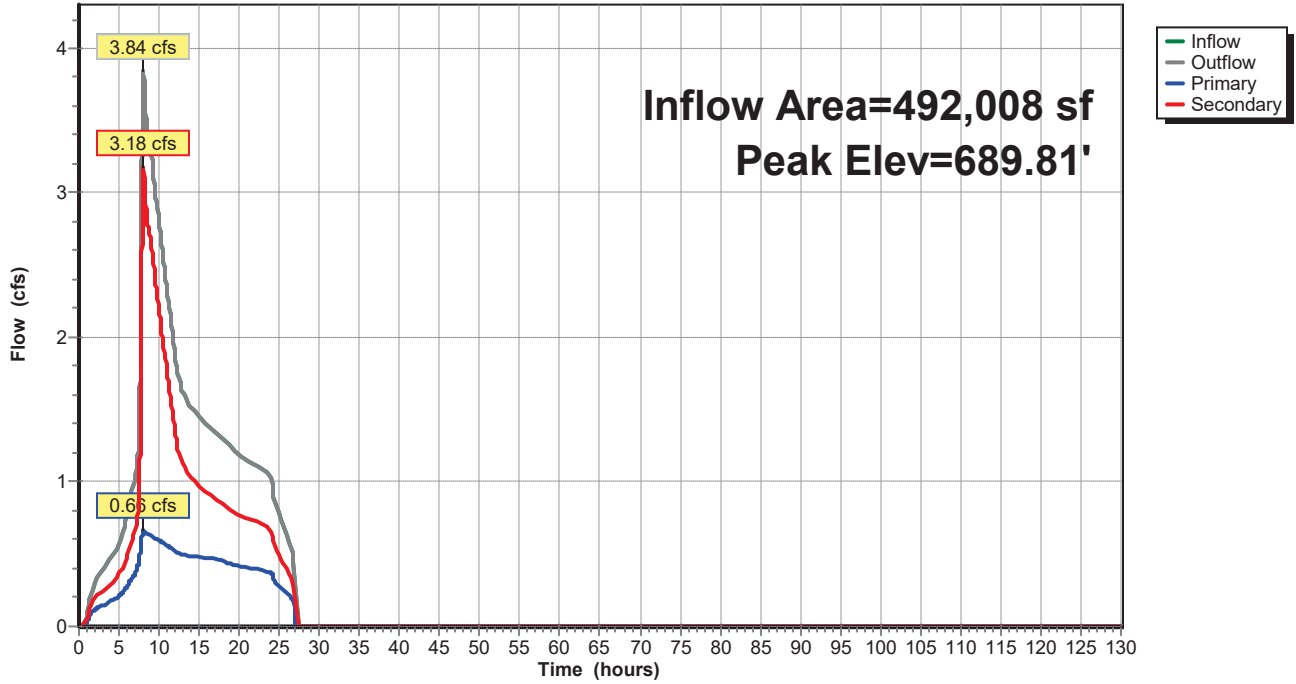
Type IA 24-hr 25-Year Rainfall=4.50"

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Pond FSMH: Flow Splitter Manhole

Hydrograph



Bull Run Conveyance 2

Type IA 24-hr 25-Year Rainfall=4.50"

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Summary for Pond Pond A: Pond A

Inflow Area = 349,468 sf, 50.40% Impervious, Inflow Depth = 3.37" for 25-Year event
 Inflow = 6.62 cfs @ 7.91 hrs, Volume= 98,144 cf
 Outflow = 2.09 cfs @ 9.07 hrs, Volume= 98,147 cf, Atten= 68%, Lag= 69.5 min
 Primary = 2.09 cfs @ 9.07 hrs, Volume= 98,147 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
 Peak Elev= 710.30' @ 9.07 hrs Surf.Area= 9,166 sf Storage= 21,406 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
 Center-of-Mass det. time= 199.1 min (902.8 - 703.7)

Volume	Invert	Avail.Storage	Storage Description
#1	707.50'	70,555 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
707.50	6,107	0	0
708.00	6,714	3,205	3,205
709.00	7,742	7,228	10,433
710.00	8,825	8,284	18,717
711.00	9,967	9,396	28,113
712.00	11,161	10,564	38,677
713.00	12,412	11,787	50,463
714.00	13,717	13,065	63,528
714.50	14,392	7,027	70,555

Device	Routing	Invert	Outlet Devices
#1	Primary	698.43'	18.0" Round Culvert L= 138.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 698.43' / 696.24' S= 0.0159 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf
#2	Device 1	696.43'	2.6" Horiz. Orifice/Grate C= 0.620 Limited to weir flow at low heads
#3	Device 1	709.40'	16.0" W x 3.0" H Vert. Orifice/Grate C= 0.620

Primary OutFlow Max=2.09 cfs @ 9.07 hrs HW=710.30' TW=0.00' (Dynamic Tailwater)

- 1=Culvert (Passes 2.09 cfs of 25.05 cfs potential flow)
- 2=Orifice/Grate (Orifice Controls 0.63 cfs @ 17.14 fps)
- 3=Orifice/Grate (Orifice Controls 1.46 cfs @ 4.37 fps)

Bull Run Conveyance 2

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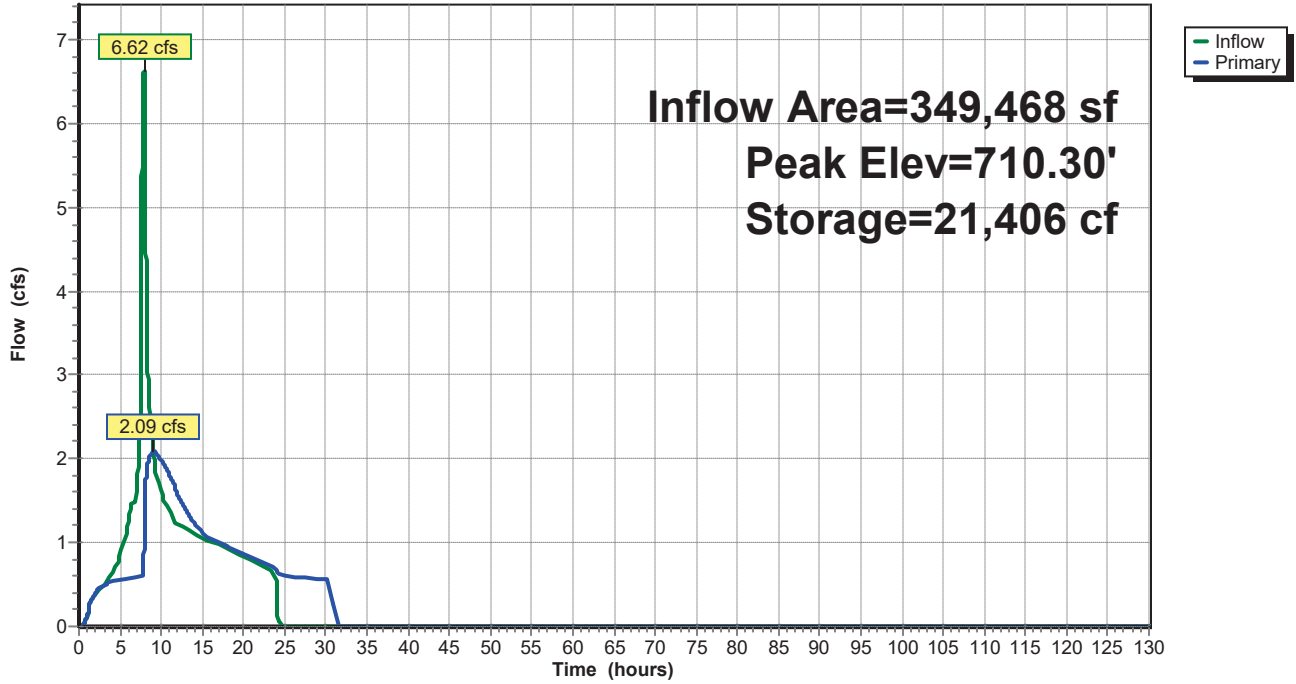
Type IA 24-hr 25-Year Rainfall=4.50"

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Pond Pond A: Pond A

Hydrograph



Bull Run Conveyance 2

Type IA 24-hr 25-Year Rainfall=4.50"

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Summary for Pond Pond D: Pond D

Inflow Area = 391,786 sf, 34.55% Impervious, Inflow Depth = 3.08" for 25-Year event
 Inflow = 6.72 cfs @ 7.94 hrs, Volume= 100,698 cf
 Outflow = 2.79 cfs @ 8.51 hrs, Volume= 100,698 cf, Atten= 59%, Lag= 34.2 min
 Primary = 2.79 cfs @ 8.51 hrs, Volume= 100,698 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
 Peak Elev= 695.79' @ 8.51 hrs Surf.Area= 7,209 sf Storage= 16,179 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
 Center-of-Mass det. time= 105.6 min (832.9 - 727.3)

Volume	Invert	Avail.Storage	Storage Description
#1	693.00'	45,106 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
693.00	4,453	0	0
694.00	5,388	4,921	4,921
695.00	6,380	5,884	10,805
696.00	7,428	6,904	17,709
697.00	8,533	7,981	25,689
698.00	9,694	9,114	34,803
699.00	10,912	10,303	45,106

Device	Routing	Invert	Outlet Devices
#1	Primary	692.50'	12.0" Round Culvert L= 121.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 692.50' / 688.97' S= 0.0292 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	690.50'	4.9" Horiz. Orifice/Grate C= 0.620 Limited to weir flow at low heads
#3	Device 1	694.60'	15.0" W x 3.0" H Vert. Orifice/Grate C= 0.620

Primary OutFlow Max=2.79 cfs @ 8.51 hrs HW=695.79' TW=689.74' (Dynamic Tailwater)

- ↑ **1=Culvert** (Passes 2.79 cfs of 6.32 cfs potential flow)
- ↑ **2=Orifice/Grate** (Orifice Controls 1.18 cfs @ 9.03 fps)
- ↑ **3=Orifice/Grate** (Orifice Controls 1.60 cfs @ 5.13 fps)

Bull Run Conveyance 2

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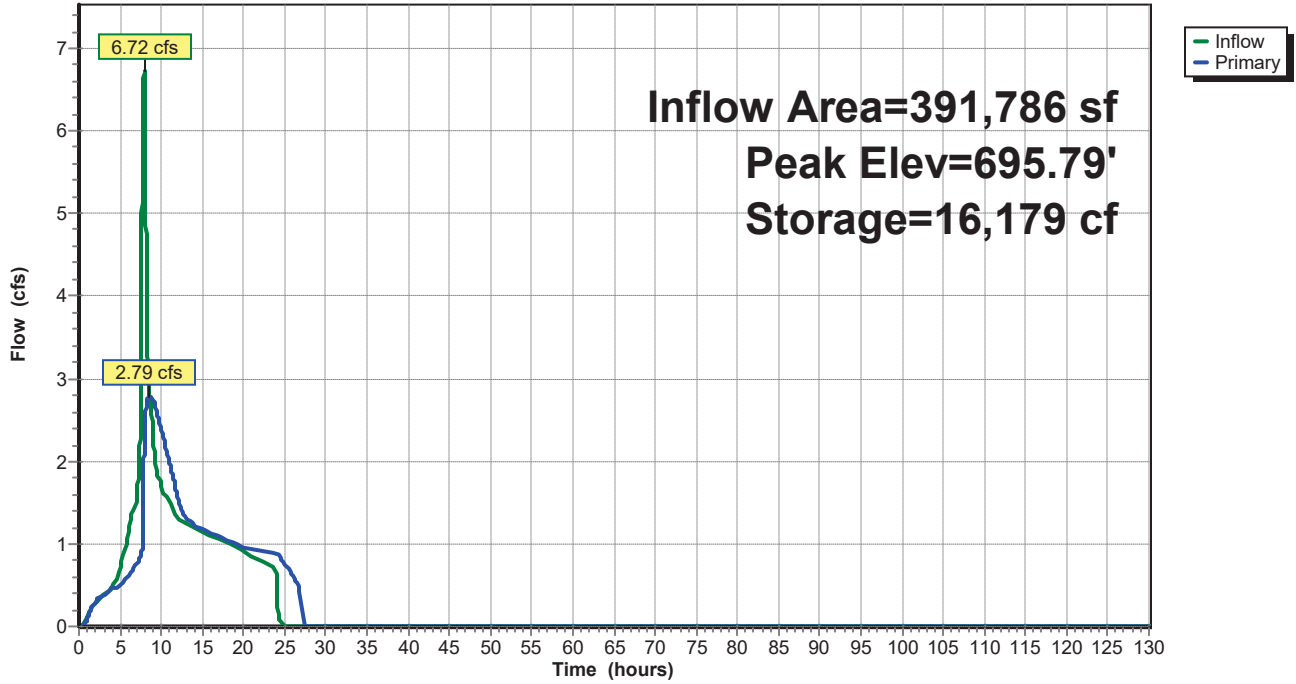
Type IA 24-hr 25-Year Rainfall=4.50"

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Pond Pond D: Pond D

Hydrograph



Bull Run Conveyance 2

Type IA 24-hr 25-Year Rainfall=4.50"

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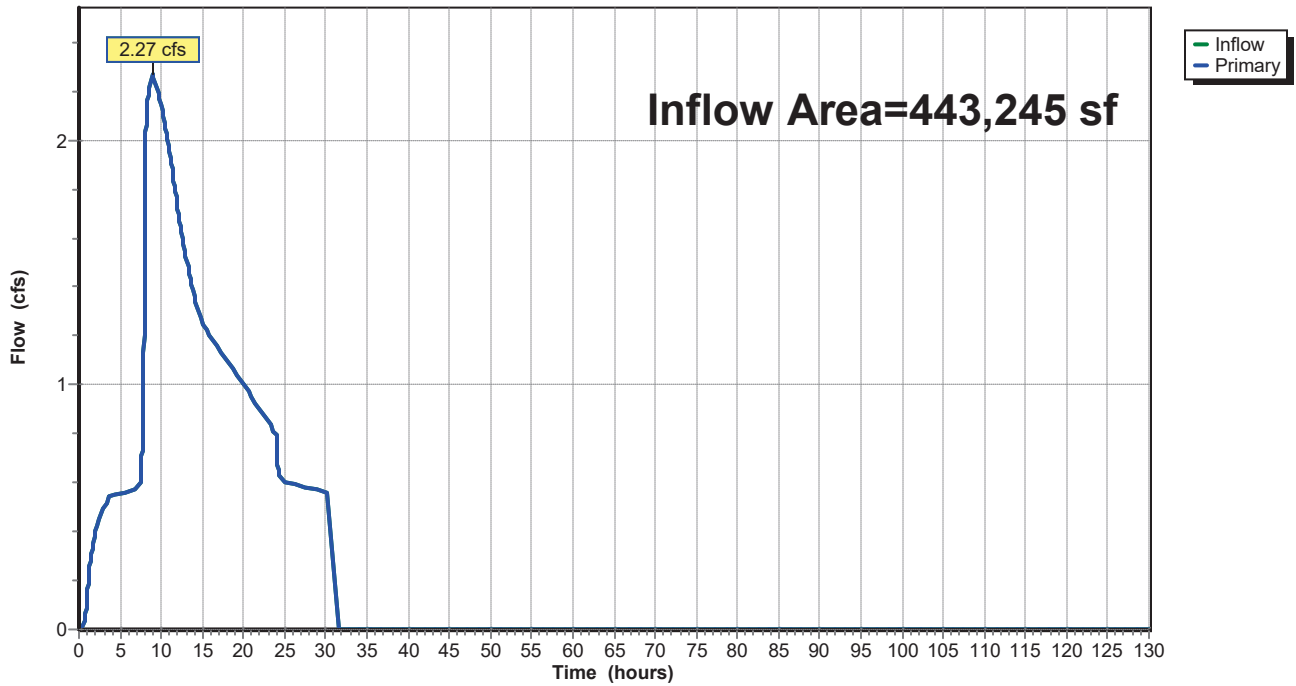
Summary for Link L1: Pipe 2

Inflow Area = 443,245 sf, 39.74% Impervious, Inflow Depth = 2.89" for 25-Year event
Inflow = 2.27 cfs @ 8.94 hrs, Volume= 106,582 cf
Primary = 2.27 cfs @ 8.94 hrs, Volume= 106,582 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs

Link L1: Pipe 2

Hydrograph



Bull Run Conveyance 2

Type IA 24-hr 25-Year Rainfall=4.50"

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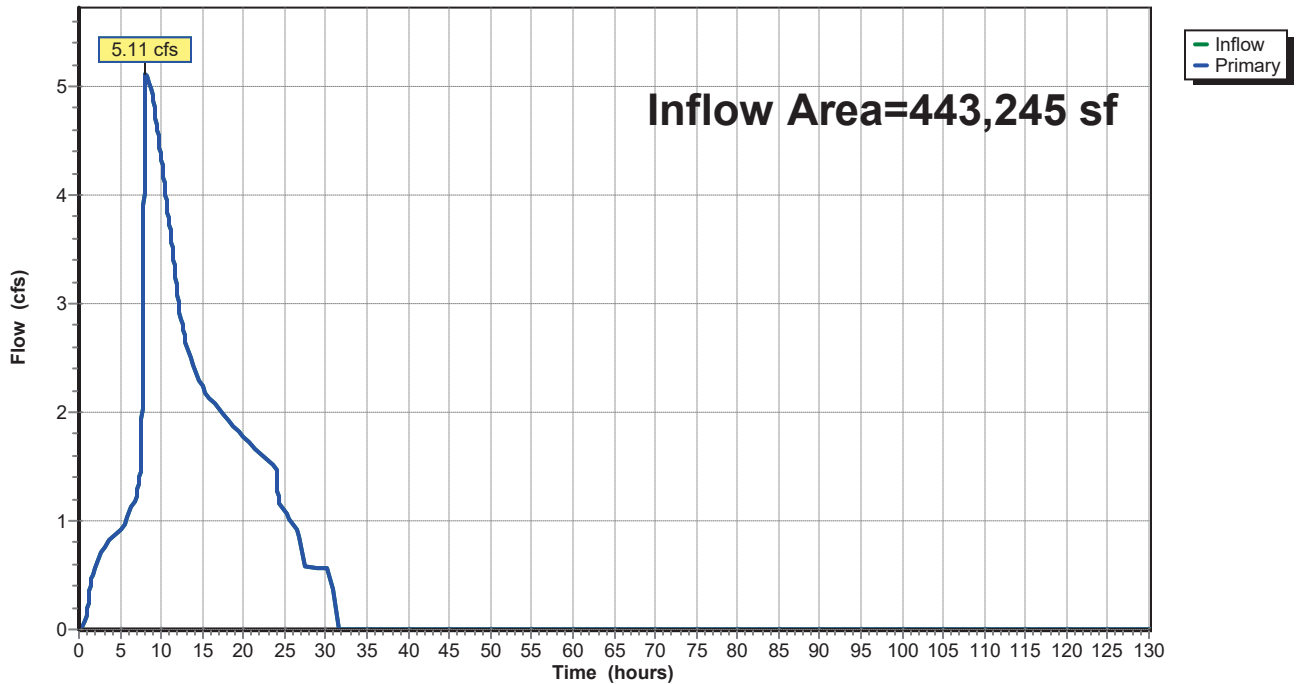
Summary for Link L2: Pipe 19

Inflow Area = 443,245 sf, 39.74% Impervious, Inflow Depth = 5.21" for 25-Year event
Inflow = 5.11 cfs @ 8.12 hrs, Volume= 192,421 cf
Primary = 5.11 cfs @ 8.12 hrs, Volume= 192,421 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs

Link L2: Pipe 19

Hydrograph



Bull Run Conveyance 2

Type IA 24-hr 25-Year Rainfall=4.50"

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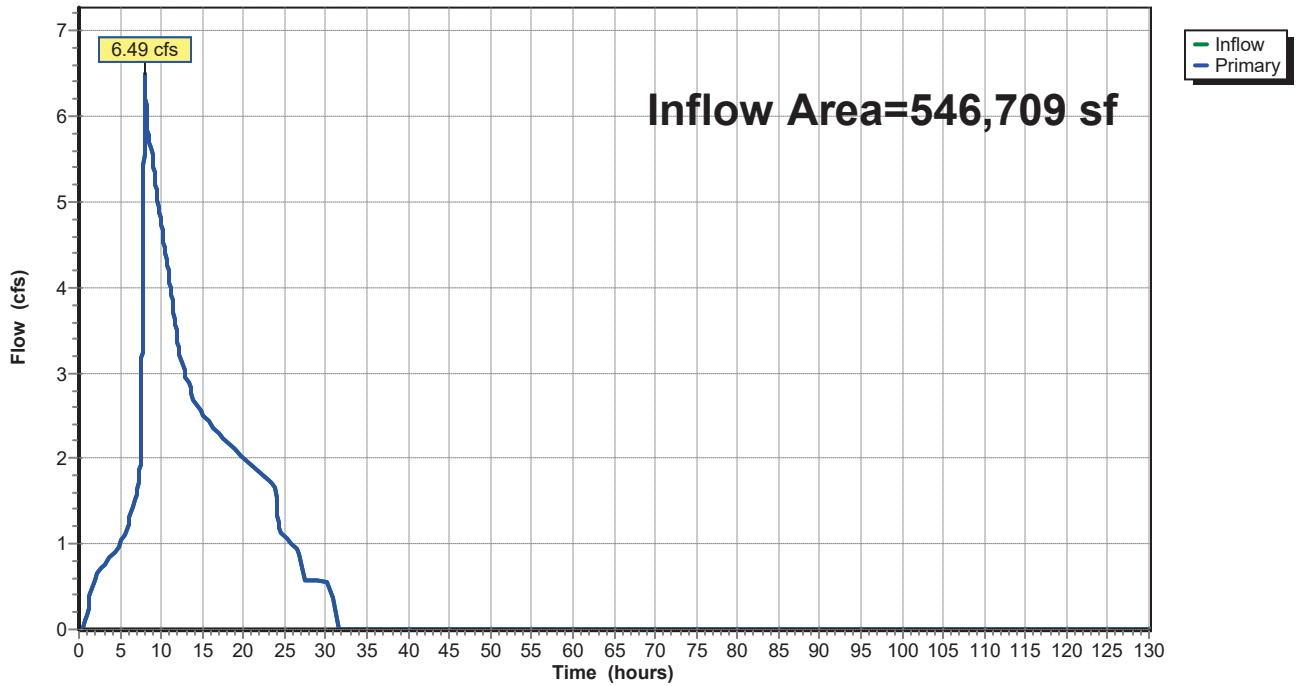
Summary for Link L3: Pipe 24

Inflow Area = 546,709 sf, 32.22% Impervious, Inflow Depth = 4.72" for 25-Year event
Inflow = 6.49 cfs @ 8.01 hrs, Volume= 215,150 cf
Primary = 6.49 cfs @ 8.01 hrs, Volume= 215,150 cf, Atten= 0%, Lag= 0.0 min

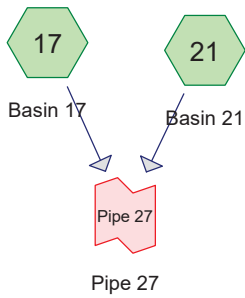
Primary outflow = Inflow, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs

Link L3: Pipe 24

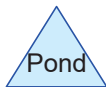
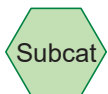
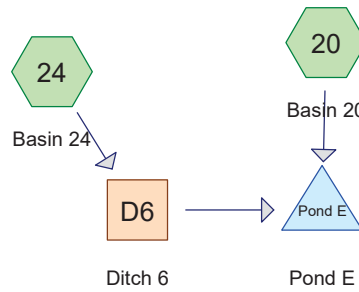
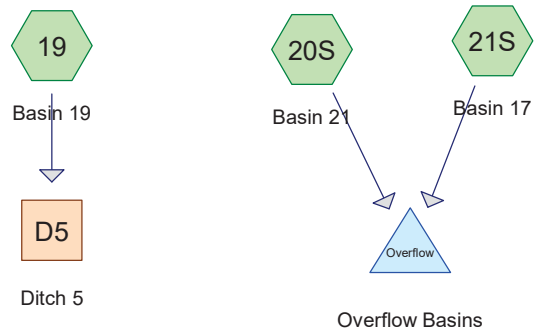
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Pumped Flows (2-yr Analysis)



25-yr Conveyance and Storage Capacity Analysis



Bull Run Conveyance 3

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Area Listing (selected nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
17,049	98	(20)
544,328	80	>75% Grass cover, Good, HSG D (20, 24)
701,982	98	Impervious Area (17, 19, 20, 20S, 21, 21S)
284,597	80	Pervious (19, 20S, 21)
1,547,956	88	TOTAL AREA

Bull Run Conveyance 3

Type IA 24-hr 2-Year Rainfall=2.80"

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Summary for Subcatchment 17: Basin 17

Runoff = 1.51 cfs @ 7.88 hrs, Volume= 21,693 cf, Depth= 2.57"

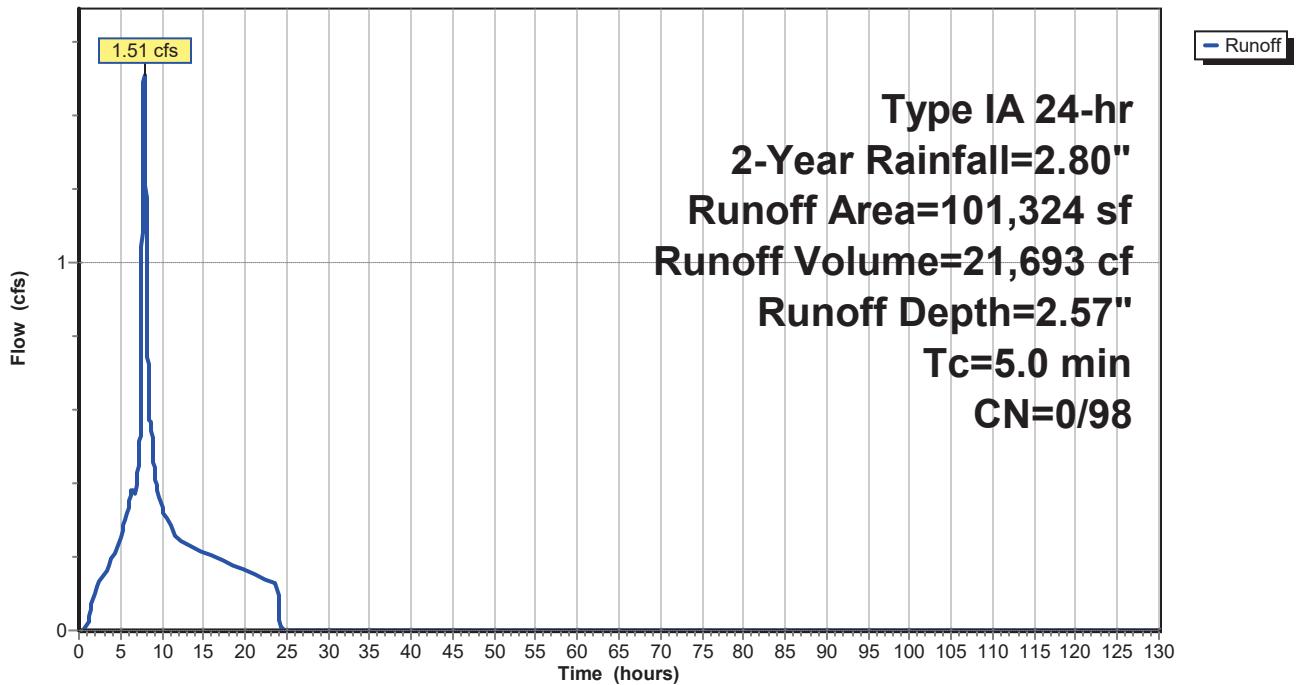
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-Year Rainfall=2.80"

	Area (sf)	CN	Description
*	101,324	98	Impervious Area
	101,324	98	100.00% Impervious Area

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

Subcatchment 17: Basin 17

Hydrograph



Bull Run Conveyance 3

Type IA 24-hr 2-Year Rainfall=2.80"

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Summary for Subcatchment 19: Basin 19

Runoff = 0.22 cfs @ 7.98 hrs, Volume= 3,625 cf, Depth= 1.29"

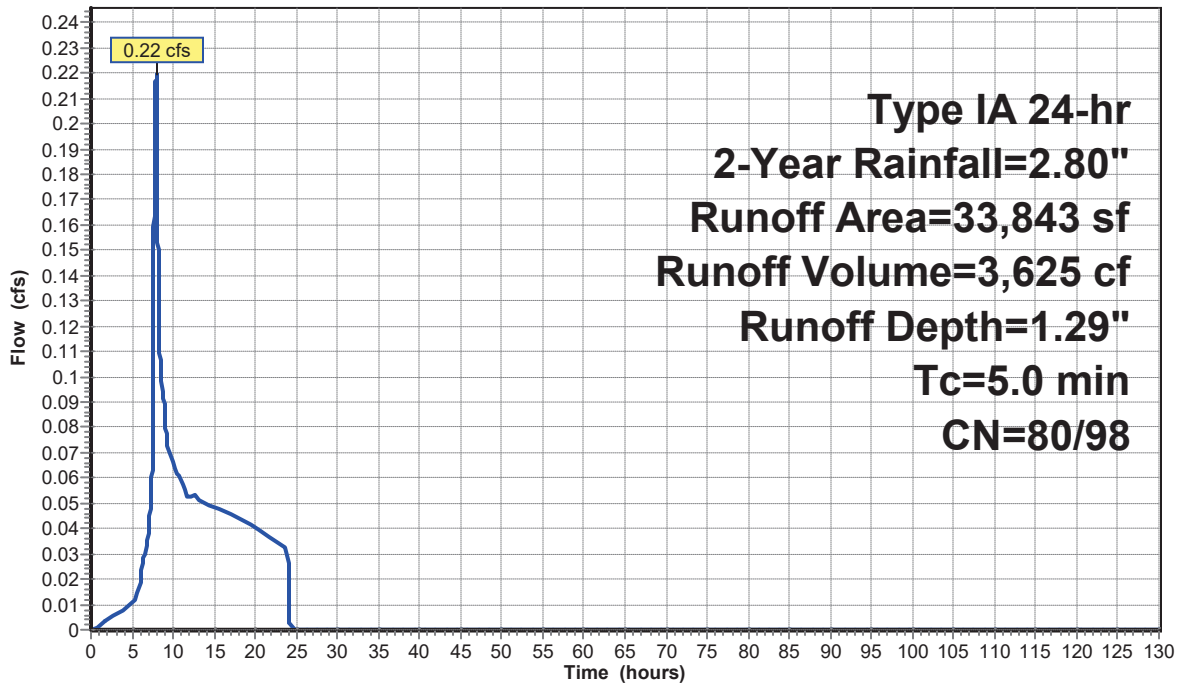
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-Year Rainfall=2.80"

	Area (sf)	CN	Description
*	4,230	98	Impervious Area
*	29,613	80	Pervious
	33,843	82	Weighted Average
	29,613	80	87.50% Pervious Area
	4,230	98	12.50% Impervious Area

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

Subcatchment 19: Basin 19

Hydrograph



Bull Run Conveyance 3

Type IA 24-hr 2-Year Rainfall=2.80"

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Summary for Subcatchment 20: Basin 20

Runoff = 2.00 cfs @ 7.98 hrs, Volume= 33,080 cf, Depth= 1.27"

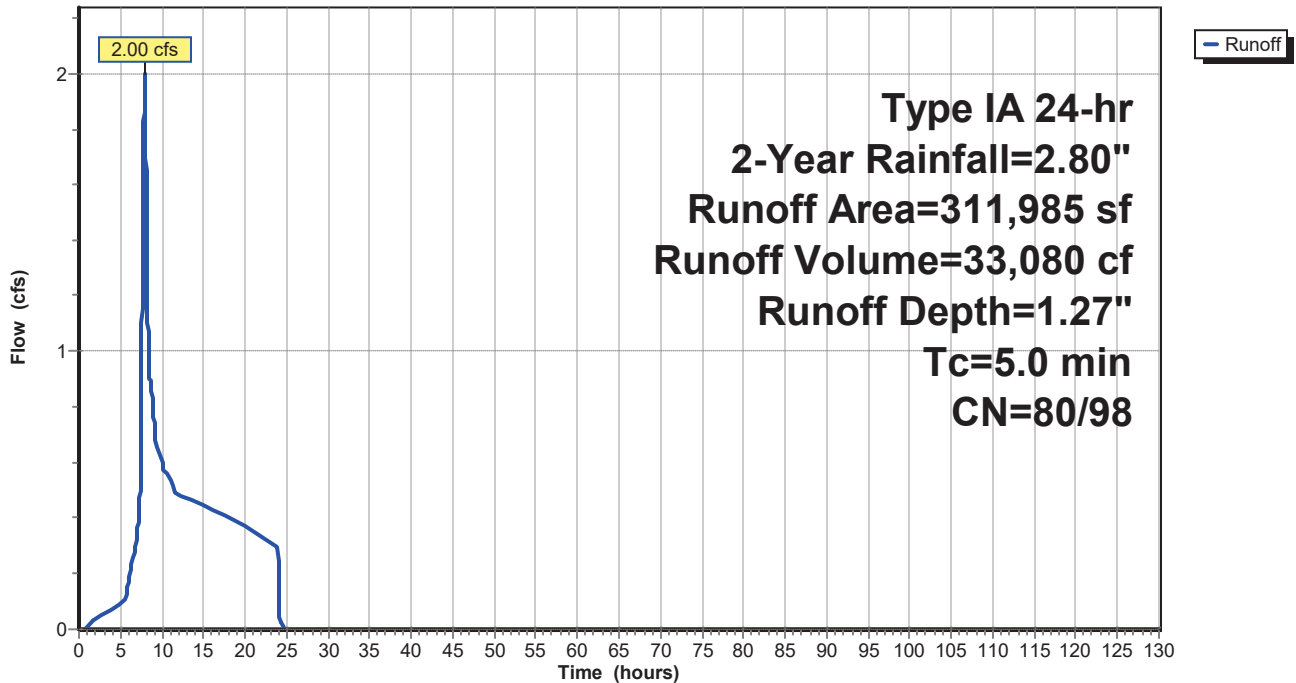
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-Year Rainfall=2.80"

	Area (sf)	CN	Description
*	19,160	98	Impervious Area
	275,776	80	>75% Grass cover, Good, HSG D
*	17,049	98	
	311,985	82	Weighted Average
	275,776	80	88.39% Pervious Area
	36,209	98	11.61% Impervious Area

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

Subcatchment 20: Basin 20

Hydrograph



Bull Run Conveyance 3

Type IA 24-hr 2-Year Rainfall=2.80"

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Summary for Subcatchment 20S: Basin 21

Runoff = 4.20 cfs @ 7.90 hrs, Volume= 62,658 cf, Depth= 2.06"

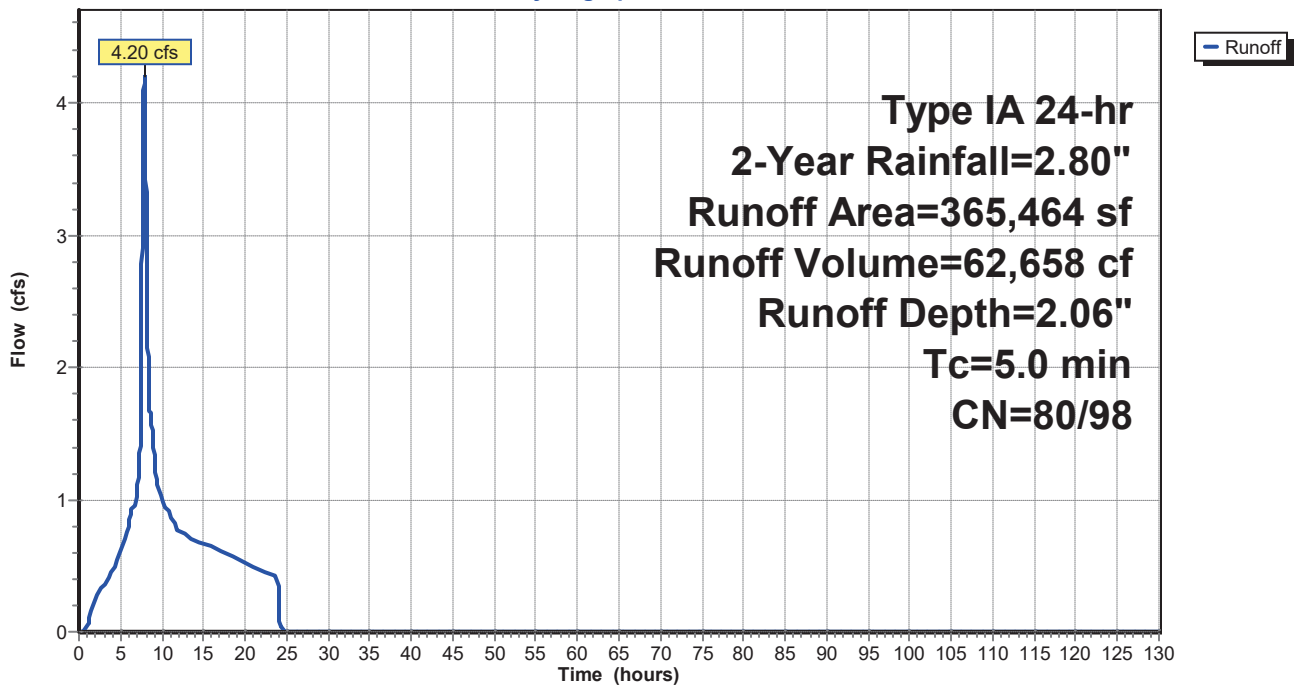
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-Year Rainfall=2.80"

	Area (sf)	CN	Description
*	237,972	98	Impervious Area
*	127,492	80	Pervious
	365,464	92	Weighted Average
	127,492	80	34.88% Pervious Area
	237,972	98	65.12% Impervious Area

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

Subcatchment 20S: Basin 21

Hydrograph



Bull Run Conveyance 3

Type IA 24-hr 2-Year Rainfall=2.80"

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Summary for Subcatchment 21: Basin 21

Runoff = 4.20 cfs @ 7.90 hrs, Volume= 62,658 cf, Depth= 2.06"

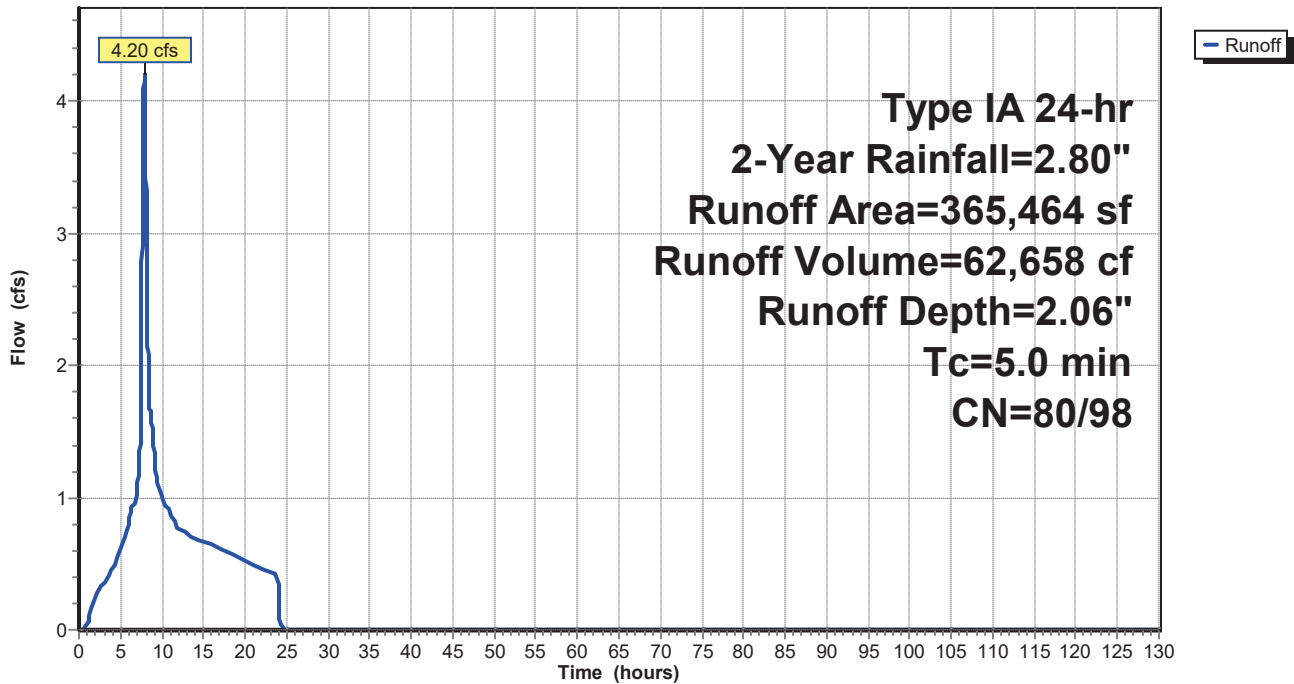
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-Year Rainfall=2.80"

	Area (sf)	CN	Description
*	237,972	98	Impervious Area
*	127,492	80	Pervious
	365,464	92	Weighted Average
	127,492	80	34.88% Pervious Area
	237,972	98	65.12% Impervious Area

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

Subcatchment 21: Basin 21

Hydrograph



Bull Run Conveyance 3

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Type IA 24-hr 2-Year Rainfall=2.80"

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Summary for Subcatchment 21S: Basin 17

Runoff = 1.51 cfs @ 7.88 hrs, Volume= 21,693 cf, Depth= 2.57"

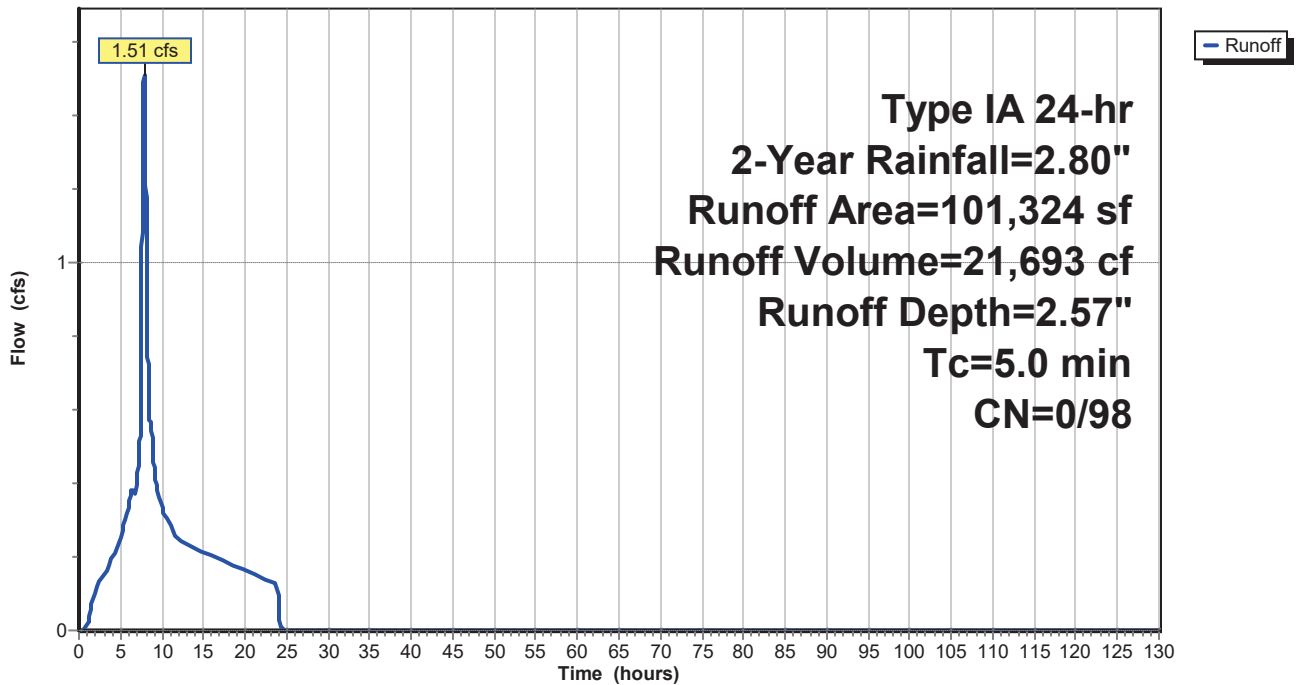
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-Year Rainfall=2.80"

	Area (sf)	CN	Description
*	101,324	98	Impervious Area
	101,324	98	100.00% Impervious Area

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

Subcatchment 21S: Basin 17

Hydrograph



Bull Run Conveyance 3

Type IA 24-hr 2-Year Rainfall=2.80"

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Summary for Subcatchment 24: Basin 24

Runoff = 1.44 cfs @ 8.00 hrs, Volume= 24,664 cf, Depth= 1.10"

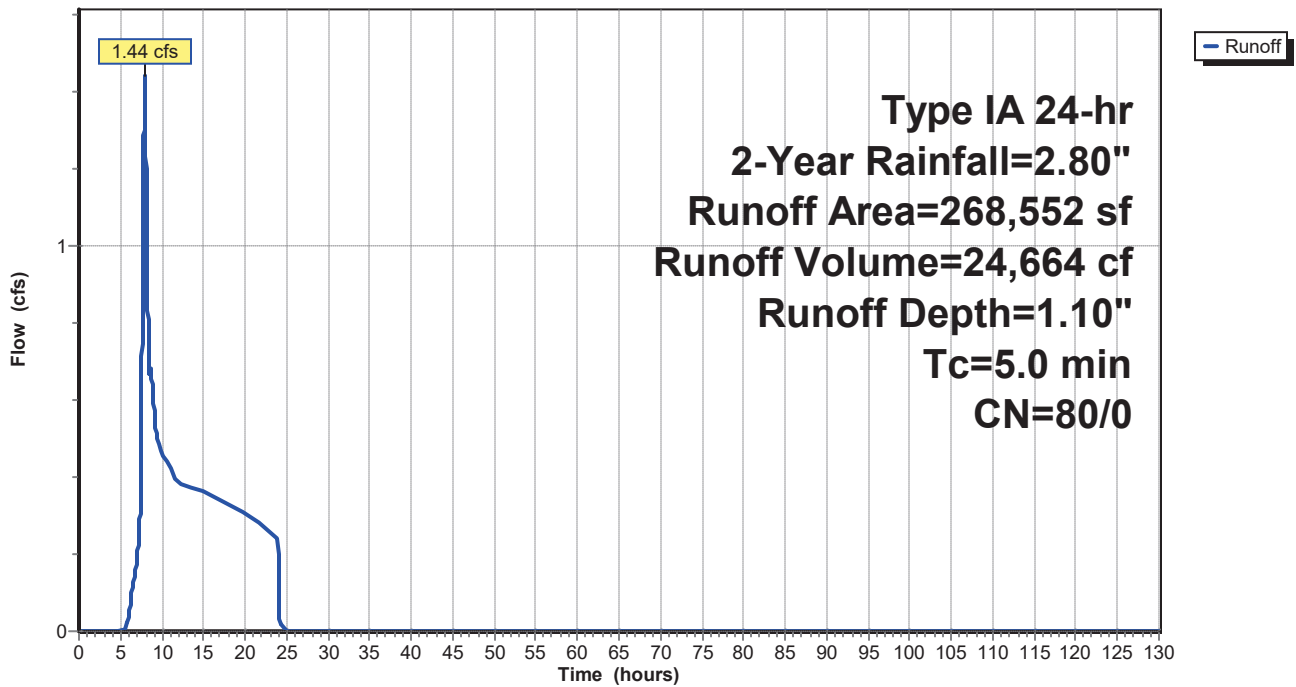
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-Year Rainfall=2.80"

Area (sf)	CN	Description
268,552	80	>75% Grass cover, Good, HSG D
* 0	98	Impervious
268,552	80	Weighted Average
268,552	80	100.00% Pervious Area

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

Subcatchment 24: Basin 24

Hydrograph



Bull Run Conveyance 3

Type IA 24-hr 2-Year Rainfall=2.80"

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Summary for Reach D5: Ditch 5

Inflow Area = 33,843 sf, 12.50% Impervious, Inflow Depth >665.11" for 2-Year event
 Inflow = 4.22 cfs @ 7.98 hrs, Volume= 1,875,769 cf, Incl. 4.00 cfs Base Flow
 Outflow = 4.22 cfs @ 8.00 hrs, Volume= 1,874,939 cf, Atten= 0%, Lag= 1.3 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
 Max. Velocity= 2.01 fps, Min. Travel Time= 3.4 min
 Avg. Velocity = 1.98 fps, Avg. Travel Time= 3.5 min

Peak Storage= 862 cf @ 8.00 hrs
 Average Depth at Peak Storage= 0.47'
 Bank-Full Depth= 1.00' Flow Area= 6.0 sf, Capacity= 18.12 cfs

Custom cross-section, Length= 411.0' Slope= 0.0046 '/'
 Constant n= 0.025 Earth, clean & straight
 Inlet Invert= 693.07', Outlet Invert= 691.16'



Offset (feet)	Elevation (feet)	Chan.Depth (feet)
-4.50	1.00	0.00
-1.50	0.00	1.00
1.50	0.00	1.00
4.50	1.00	0.00

Depth (feet)	End Area (sq-ft)	Perim. (feet)	Storage (cubic-feet)	Discharge (cfs)
0.00	0.0	3.0	0	0.00
1.00	6.0	9.3	2,466	18.12

Bull Run Conveyance 3

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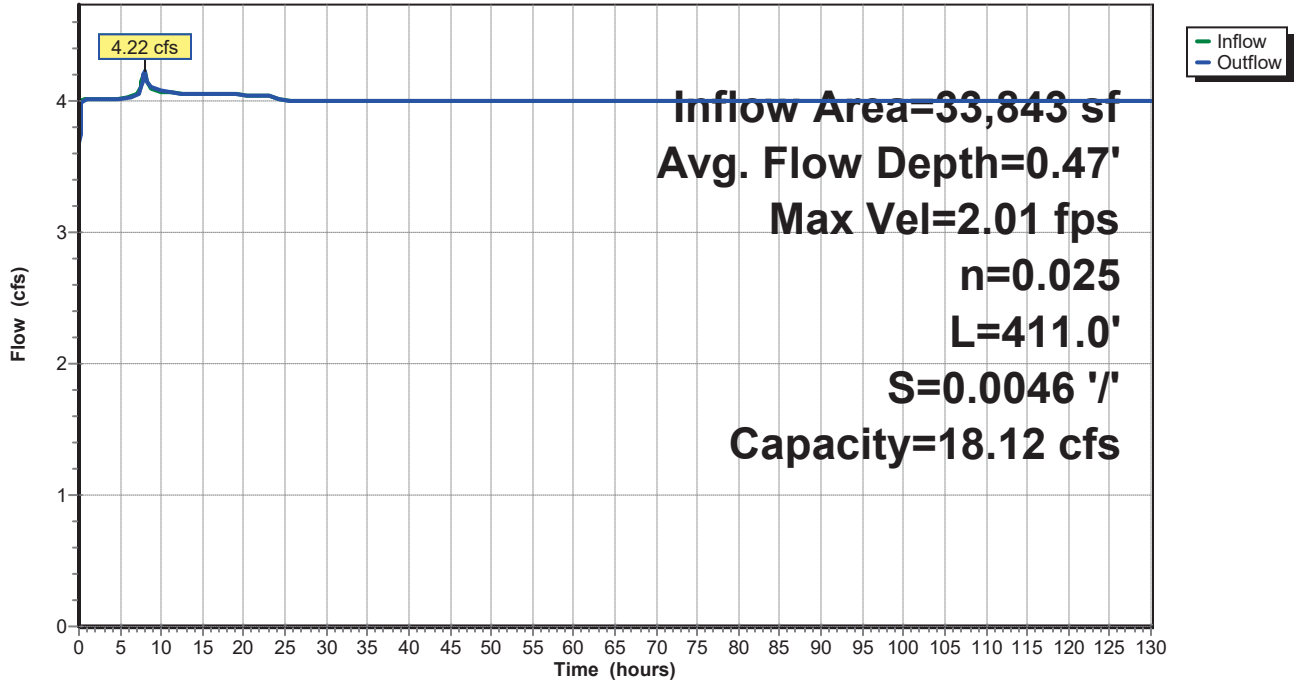
Type IA 24-hr 2-Year Rainfall=2.80"

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Reach D5: Ditch 5

Hydrograph



Bull Run Conveyance 3

Type IA 24-hr 2-Year Rainfall=2.80"

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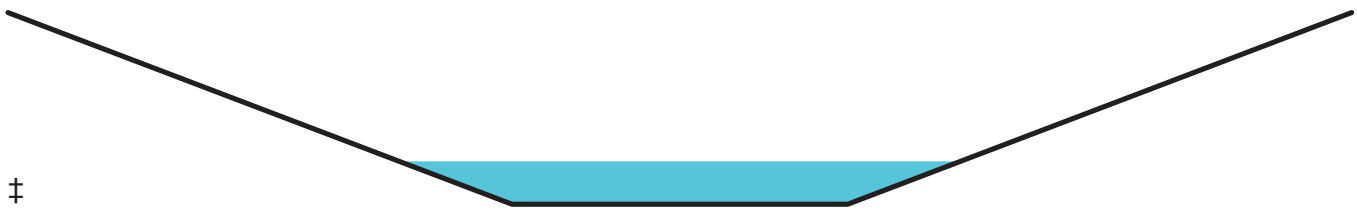
Summary for Reach D6: Ditch 6

Inflow Area = 268,552 sf, 0.00% Impervious, Inflow Depth = 1.10" for 2-Year event
 Inflow = 1.44 cfs @ 8.00 hrs, Volume= 24,664 cf
 Outflow = 1.36 cfs @ 8.02 hrs, Volume= 24,664 cf, Atten= 5%, Lag= 1.6 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
 Max. Velocity= 2.29 fps, Min. Travel Time= 8.0 min
 Avg. Velocity = 1.18 fps, Avg. Travel Time= 15.4 min

Peak Storage= 652 cf @ 8.02 hrs
 Average Depth at Peak Storage= 0.22'
 Bank-Full Depth= 1.00' Flow Area= 5.0 sf, Capacity= 26.07 cfs

Custom cross-section, Length= 1,095.0' Slope= 0.0152 '/'
 Constant n= 0.025 Earth, clean & straight
 Inlet Invert= 733.54', Outlet Invert= 716.92'



Offset (feet)	Elevation (feet)	Chan.Depth (feet)	Depth (feet)	End Area (sq-ft)	Perim. (feet)	Storage (cubic-feet)	Discharge (cfs)
-4.00	1.00	0.00	0.00	0.0	2.0	0	0.00
-1.00	0.00	1.00	1.00	5.0	8.3	5,475	26.07
1.00	0.00	1.00					
4.00	1.00	0.00					

Bull Run Conveyance 3

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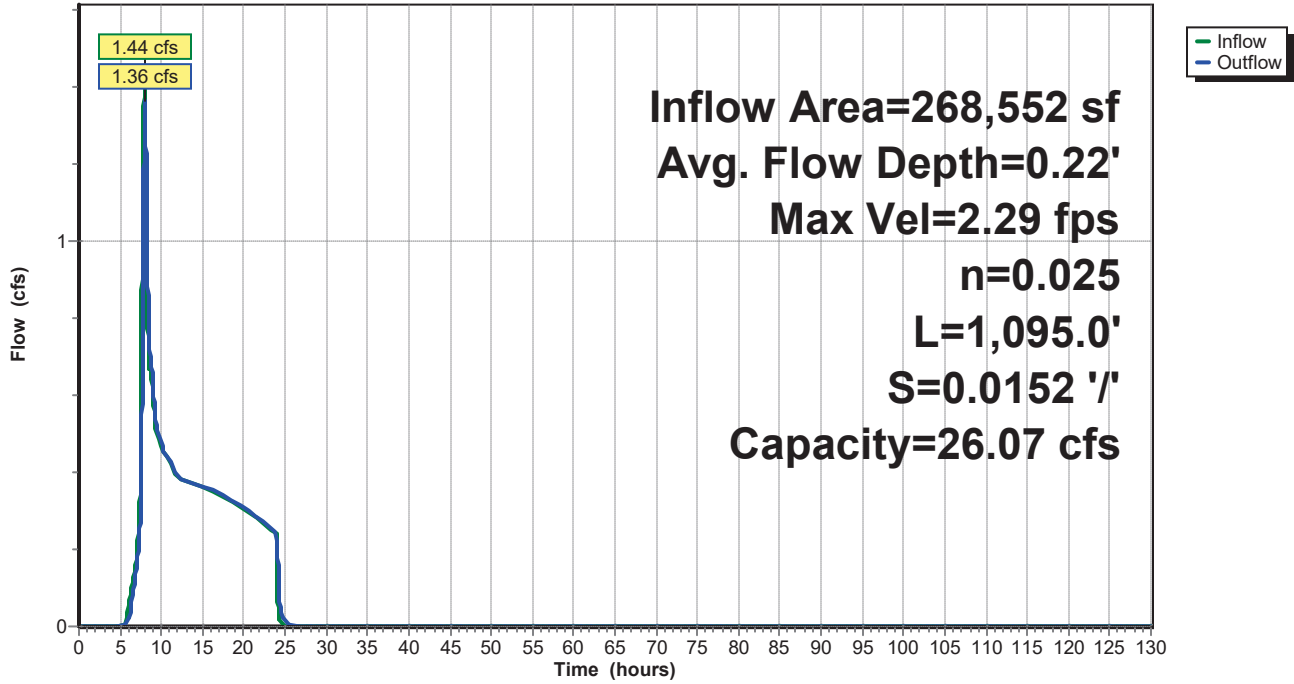
Type IA 24-hr 2-Year Rainfall=2.80"

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Reach D6: Ditch 6

Hydrograph



Bull Run Conveyance 3

Type IA 24-hr 2-Year Rainfall=2.80"

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Summary for Pond Overflow: Overflow Basins

Inflow Area = 466,788 sf, 72.69% Impervious, Inflow Depth = 2.17" for 2-Year event
 Inflow = 5.71 cfs @ 7.90 hrs, Volume= 84,351 cf
 Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 100%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
 Peak Elev= 684.74' @ 26.13 hrs Surf.Area= 130,029 sf Storage= 84,351 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
 Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	684.00'	760,666 cf	South Basin (Prismatic) Listed below (Recalc)
#2	684.00'	806,919 cf	North Basin (Prismatic) Listed below (Recalc)
		1,567,585 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
684.00	29,903	0	0
685.00	69,069	49,486	49,486
686.00	73,956	71,513	120,999
687.00	78,710	76,333	197,332
688.00	83,799	81,255	278,586
689.00	88,812	86,306	364,892
690.00	93,849	91,331	456,222
691.00	99,018	96,434	552,656
692.00	104,068	101,543	654,199
693.00	108,867	106,468	760,666

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
684.00	66,768	0	0
685.00	72,428	69,598	69,598
686.00	77,062	74,745	144,343
687.00	81,957	79,510	223,853
688.00	86,936	84,447	308,299
689.00	91,978	89,457	397,756
690.00	97,111	94,545	492,301
691.00	102,276	99,694	591,994
692.00	107,483	104,880	696,874
693.00	112,607	110,045	806,919

Bull Run Conveyance 3

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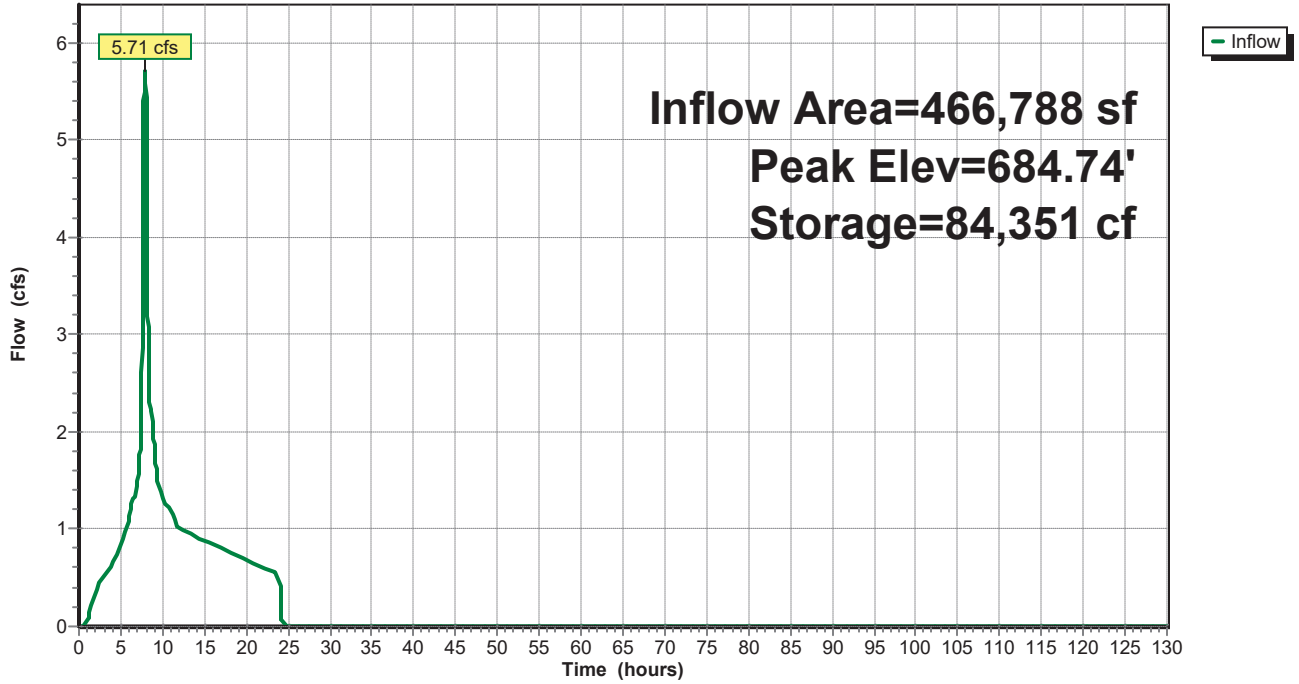
Type IA 24-hr 2-Year Rainfall=2.80"

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Pond Overflow: Overflow Basins

Hydrograph



Bull Run Conveyance 3

Type IA 24-hr 2-Year Rainfall=2.80"

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Summary for Pond Pond E: Pond E

Inflow Area = 580,537 sf, 6.24% Impervious, Inflow Depth = 1.19" for 2-Year event
 Inflow = 3.35 cfs @ 8.00 hrs, Volume= 57,743 cf
 Outflow = 1.29 cfs @ 9.15 hrs, Volume= 57,677 cf, Atten= 61%, Lag= 69.1 min
 Primary = 1.29 cfs @ 9.15 hrs, Volume= 57,677 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
 Peak Elev= 713.95' @ 9.15 hrs Surf.Area= 9,456 sf Storage= 8,235 cf

Plug-Flow detention time= 109.6 min calculated for 57,677 cf (100% of inflow)
 Center-of-Mass det. time= 108.8 min (927.7 - 819.0)

Volume	Invert	Avail.Storage	Storage Description
#1	713.00'	31,308 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
713.00	7,916	0	0
714.00	9,540	8,728	8,728
715.00	11,265	10,403	19,131
716.00	13,090	12,178	31,308

Device	Routing	Invert	Outlet Devices
#1	Primary	713.00'	15.0" Round Culvert L= 44.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 713.00' / 712.80' S= 0.0045 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Device 1	711.00'	7.0" Horiz. Orifice/Grate C= 0.620 Limited to weir flow at low heads
#3	Device 1	713.95'	16.0" W x 3.0" H Vert. Orifice/Grate C= 0.620

Primary OutFlow Max=1.29 cfs @ 9.15 hrs HW=713.95' (Free Discharge)

- ↑ **1=Culvert** (Passes 1.29 cfs of 2.45 cfs potential flow)
- ↑ **2=Orifice/Grate** (Orifice Controls 1.29 cfs @ 4.84 fps)
- ↑ **3=Orifice/Grate** (Controls 0.00 cfs)

Bull Run Conveyance 3

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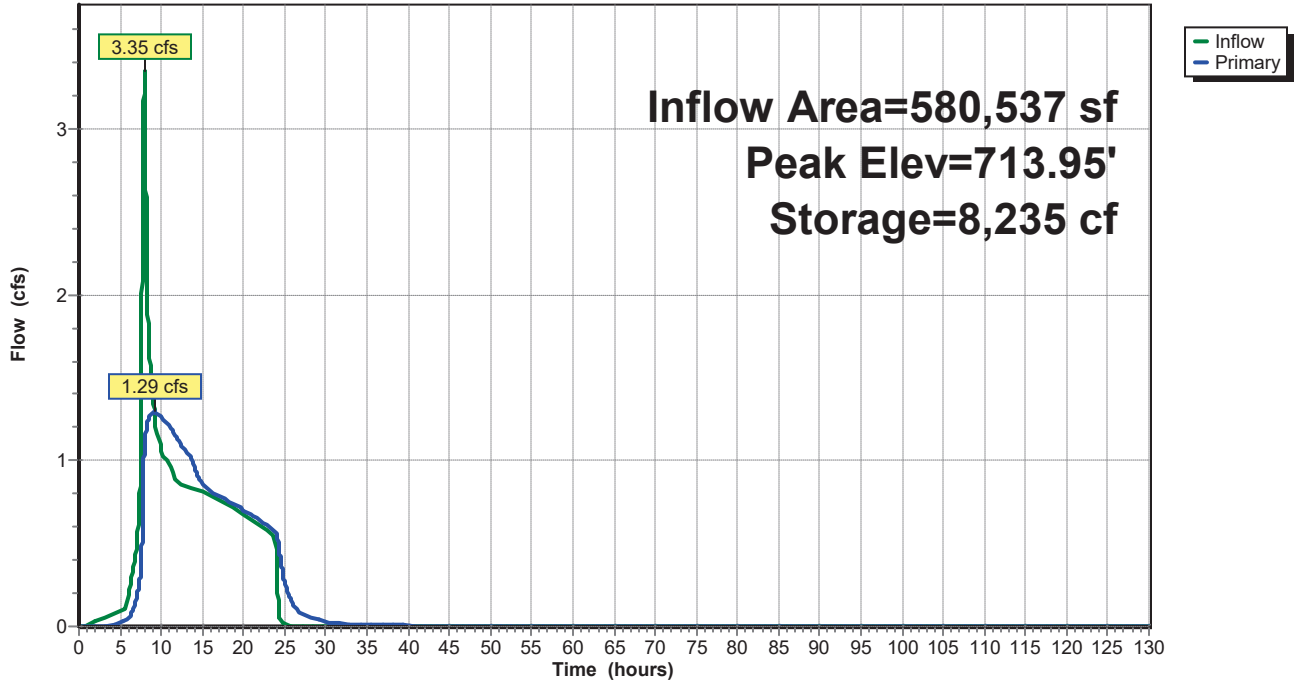
Type IA 24-hr 2-Year Rainfall=2.80"

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Pond Pond E: Pond E

Hydrograph



Bull Run Conveyance 3

Type IA 24-hr 2-Year Rainfall=2.80"

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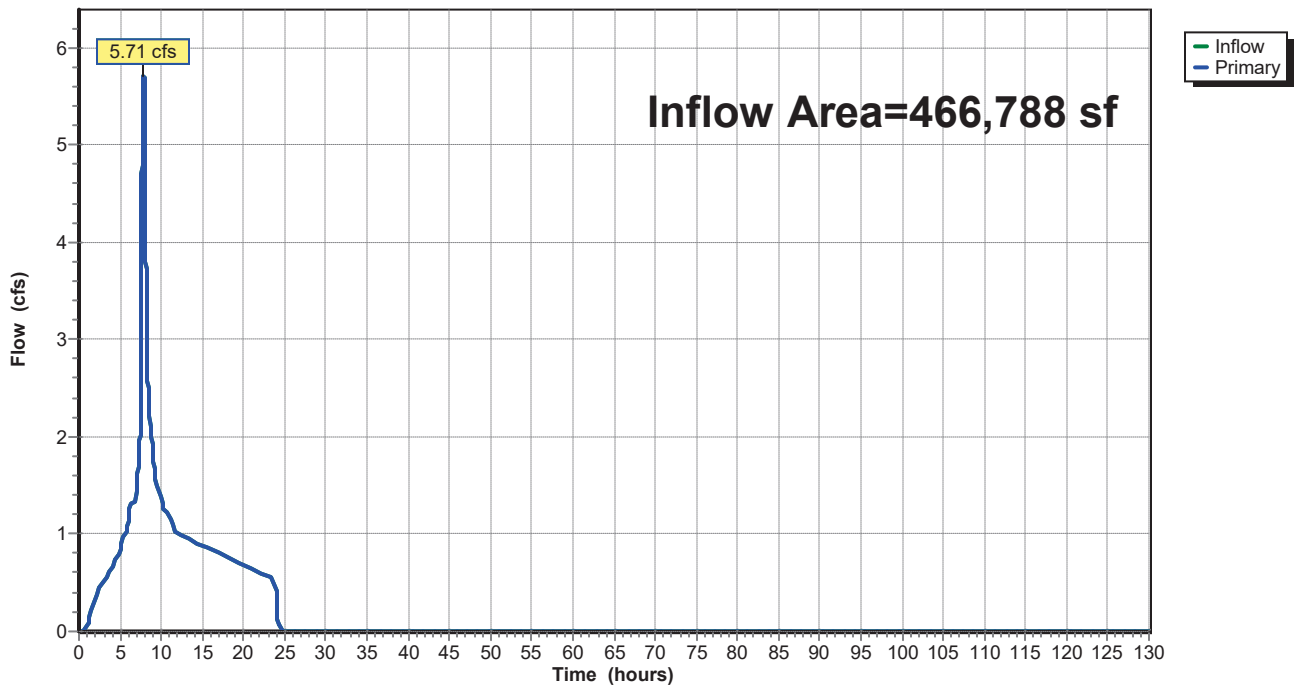
Summary for Link Pipe 27: Pipe 27

Inflow Area = 466,788 sf, 72.69% Impervious, Inflow Depth = 2.17" for 2-Year event
Inflow = 5.71 cfs @ 7.90 hrs, Volume= 84,351 cf
Primary = 5.71 cfs @ 7.90 hrs, Volume= 84,351 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs

Link Pipe 27: Pipe 27

Hydrograph



Bull Run Conveyance 3

Type IA 24-hr 5-Year Rainfall=3.40"

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Summary for Subcatchment 17: Basin 17

Runoff = 1.85 cfs @ 7.88 hrs, Volume= 26,739 cf, Depth= 3.17"

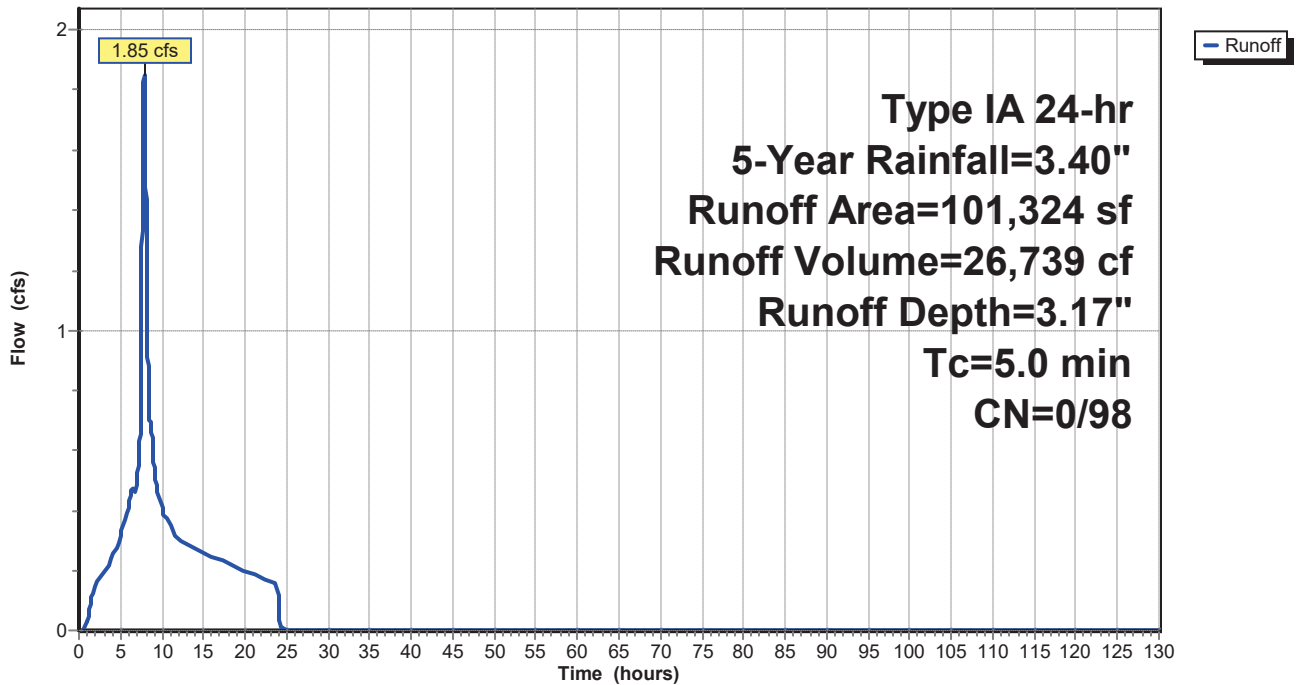
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 5-Year Rainfall=3.40"

	Area (sf)	CN	Description
*	101,324	98	Impervious Area
	101,324	98	100.00% Impervious Area

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

Subcatchment 17: Basin 17

Hydrograph



Bull Run Conveyance 3

Type IA 24-hr 5-Year Rainfall=3.40"

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Summary for Subcatchment 19: Basin 19

Runoff = 0.31 cfs @ 7.96 hrs, Volume= 4,960 cf, Depth= 1.76"

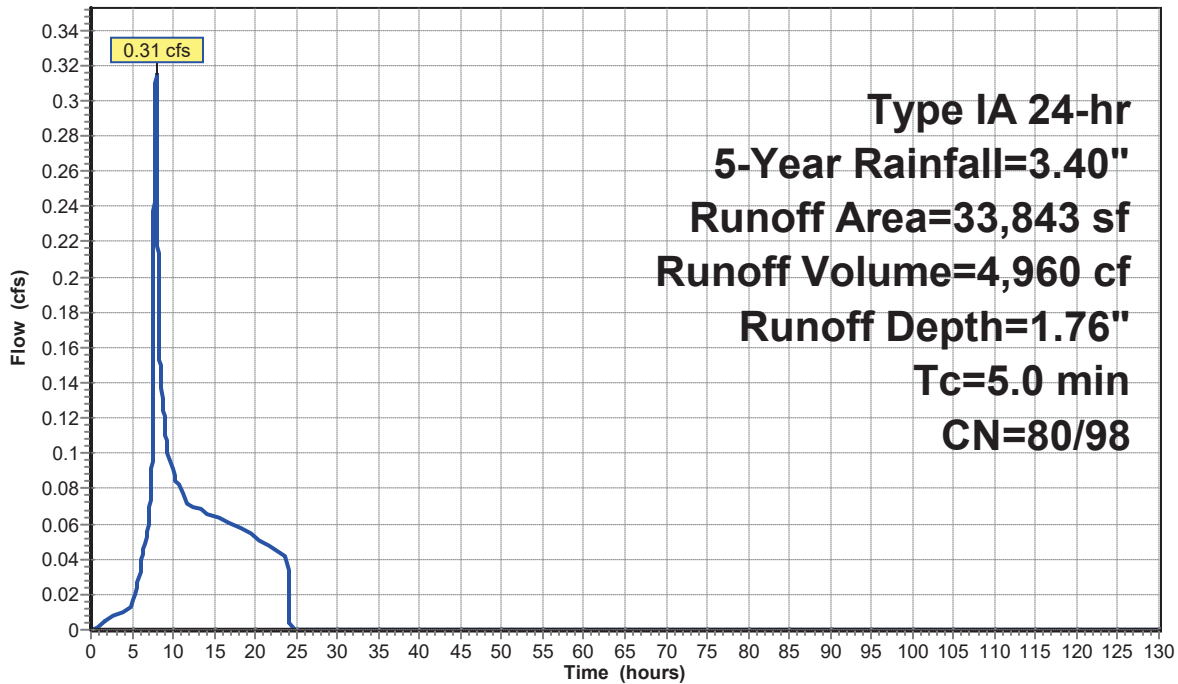
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 5-Year Rainfall=3.40"

	Area (sf)	CN	Description
*	4,230	98	Impervious Area
*	29,613	80	Pervious
	33,843	82	Weighted Average
	29,613	80	87.50% Pervious Area
	4,230	98	12.50% Impervious Area

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

Subcatchment 19: Basin 19

Hydrograph



Bull Run Conveyance 3

Type IA 24-hr 5-Year Rainfall=3.40"

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Summary for Subcatchment 20: Basin 20

Runoff = 2.87 cfs @ 7.96 hrs, Volume= 45,347 cf, Depth= 1.74"

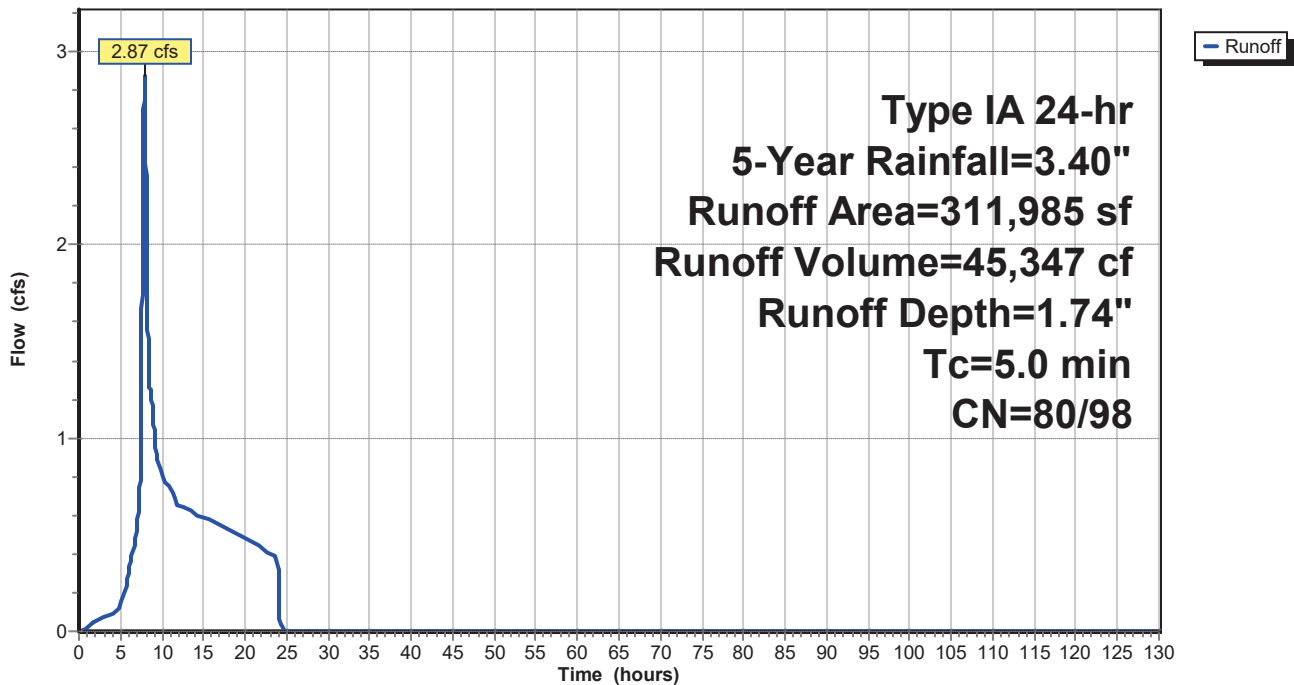
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 5-Year Rainfall=3.40"

	Area (sf)	CN	Description
*	19,160	98	Impervious Area
	275,776	80	>75% Grass cover, Good, HSG D
*	17,049	98	
	311,985	82	Weighted Average
	275,776	80	88.39% Pervious Area
	36,209	98	11.61% Impervious Area

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

Subcatchment 20: Basin 20

Hydrograph



Bull Run Conveyance 3

Type IA 24-hr 5-Year Rainfall=3.40"

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Summary for Subcatchment 20S: Basin 21

Runoff = 5.35 cfs @ 7.90 hrs, Volume= 79,347 cf, Depth= 2.61"

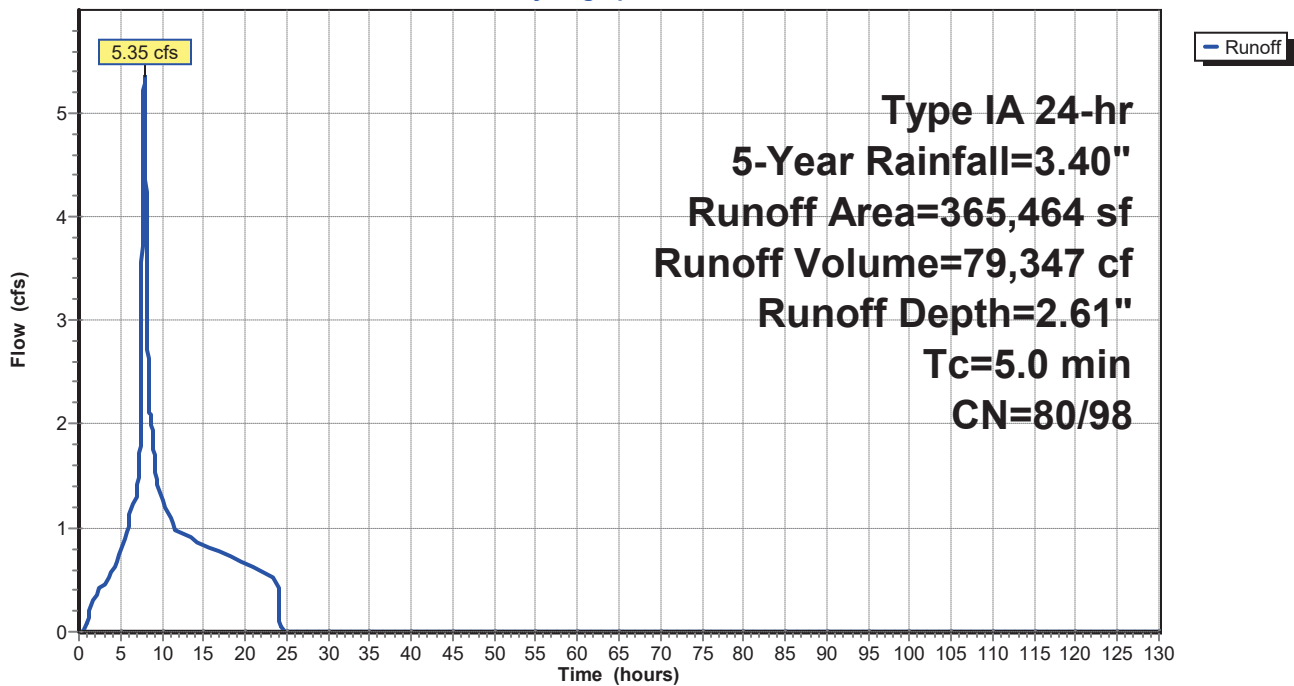
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 5-Year Rainfall=3.40"

	Area (sf)	CN	Description
*	237,972	98	Impervious Area
*	127,492	80	Pervious
	365,464	92	Weighted Average
	127,492	80	34.88% Pervious Area
	237,972	98	65.12% Impervious Area

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

Subcatchment 20S: Basin 21

Hydrograph



Bull Run Conveyance 3

Type IA 24-hr 5-Year Rainfall=3.40"

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Summary for Subcatchment 21: Basin 21

Runoff = 5.35 cfs @ 7.90 hrs, Volume= 79,347 cf, Depth= 2.61"

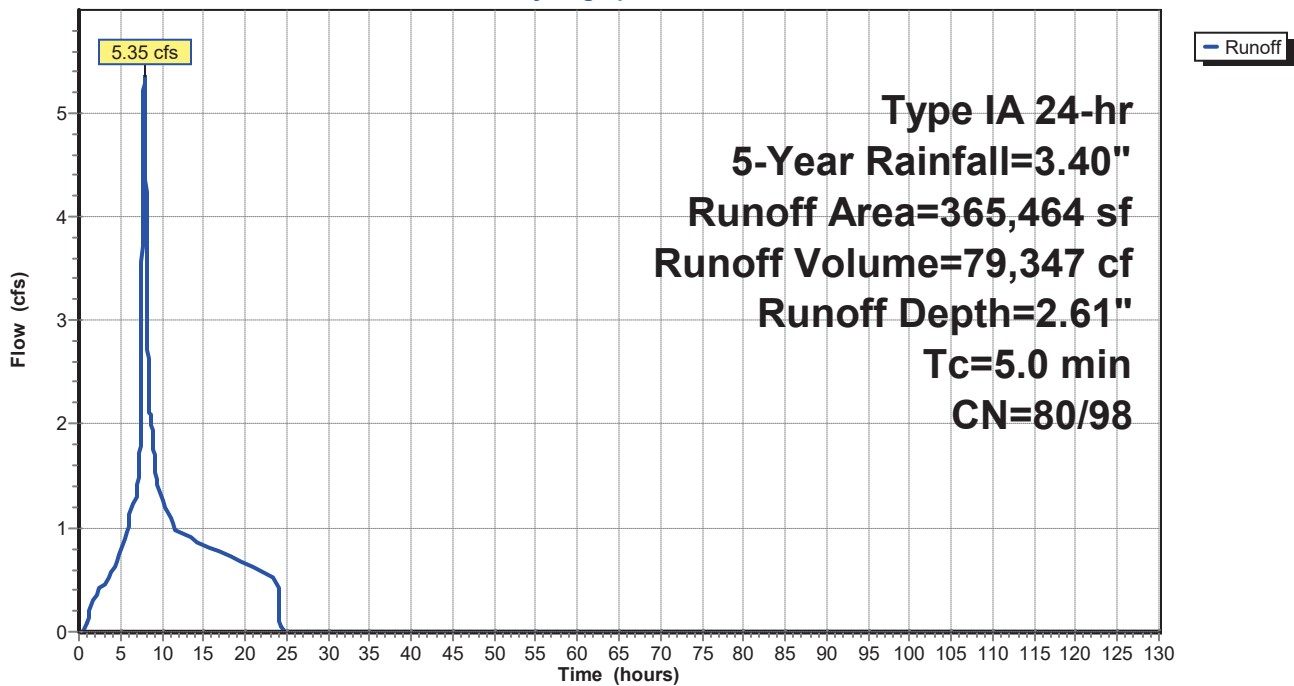
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 5-Year Rainfall=3.40"

	Area (sf)	CN	Description
*	237,972	98	Impervious Area
*	127,492	80	Pervious
	365,464	92	Weighted Average
	127,492	80	34.88% Pervious Area
	237,972	98	65.12% Impervious Area

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

Subcatchment 21: Basin 21

Hydrograph



Bull Run Conveyance 3

Type IA 24-hr 5-Year Rainfall=3.40"

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Summary for Subcatchment 21S: Basin 17

Runoff = 1.85 cfs @ 7.88 hrs, Volume= 26,739 cf, Depth= 3.17"

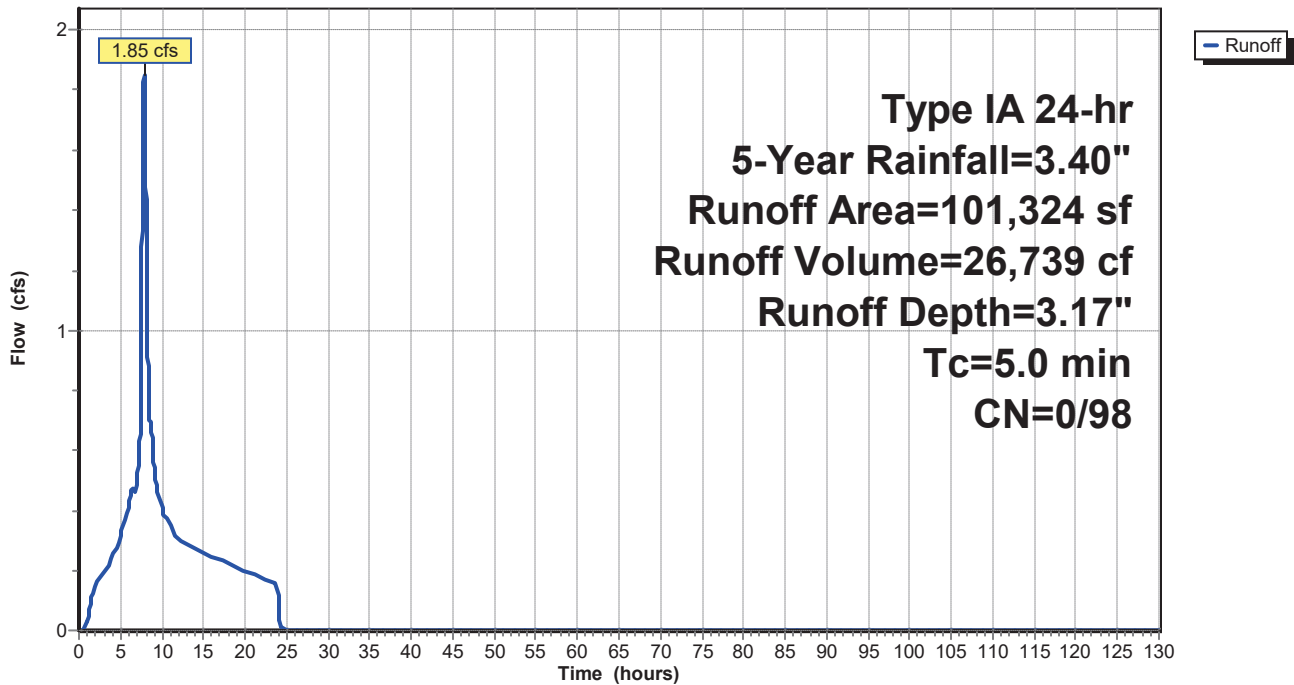
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
 Type IA 24-hr 5-Year Rainfall=3.40"

	Area (sf)	CN	Description
*	101,324	98	Impervious Area
	101,324	98	100.00% Impervious Area

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

Subcatchment 21S: Basin 17

Hydrograph



Bull Run Conveyance 3

Type IA 24-hr 5-Year Rainfall=3.40"

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Summary for Subcatchment 24: Basin 24

Runoff = 2.17 cfs @ 7.98 hrs, Volume= 34,854 cf, Depth= 1.56"

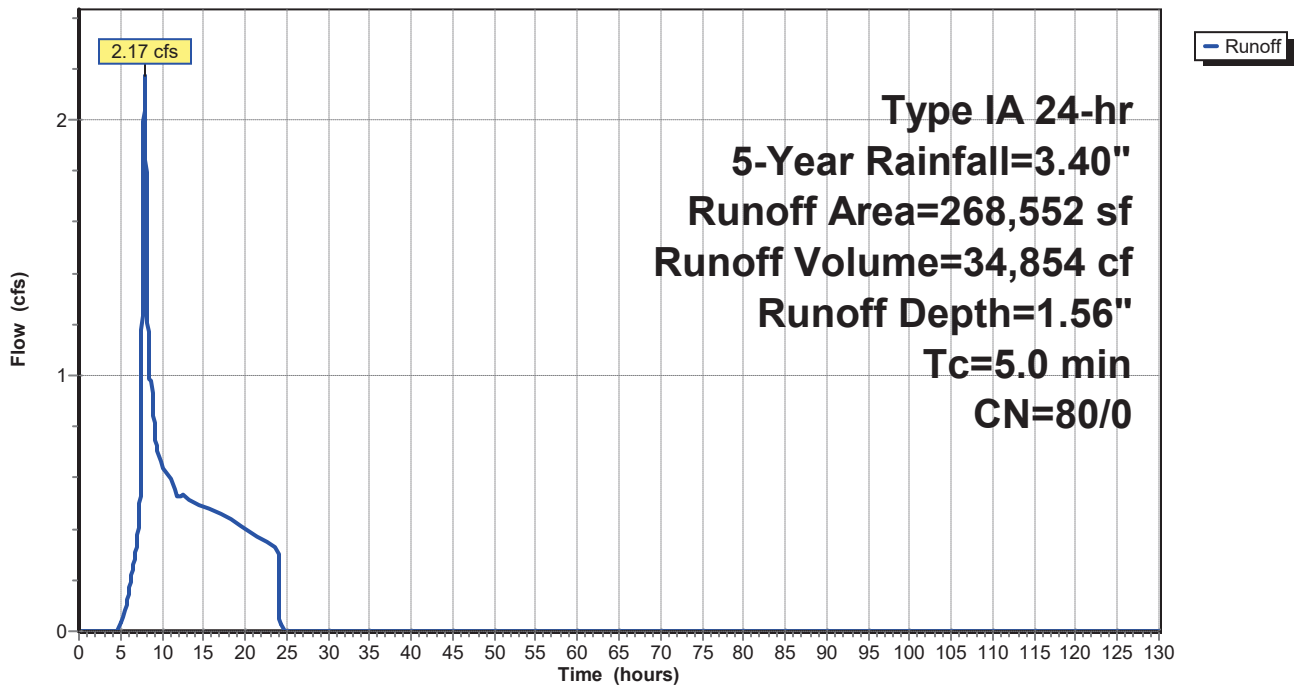
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 5-Year Rainfall=3.40"

Area (sf)	CN	Description
268,552	80	>75% Grass cover, Good, HSG D
* 0	98	Impervious
268,552	80	Weighted Average
268,552	80	100.00% Pervious Area

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

Subcatchment 24: Basin 24

Hydrograph



Bull Run Conveyance 3

Type IA 24-hr 5-Year Rainfall=3.40"

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Summary for Reach D5: Ditch 5

Inflow Area = 33,843 sf, 12.50% Impervious, Inflow Depth >665.58" for 5-Year event
 Inflow = 4.31 cfs @ 7.96 hrs, Volume= 1,877,104 cf, Incl. 4.00 cfs Base Flow
 Outflow = 4.31 cfs @ 8.00 hrs, Volume= 1,876,273 cf, Atten= 0%, Lag= 2.1 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
 Max. Velocity= 2.02 fps, Min. Travel Time= 3.4 min
 Avg. Velocity = 1.98 fps, Avg. Travel Time= 3.5 min

Peak Storage= 876 cf @ 8.00 hrs
 Average Depth at Peak Storage= 0.48'
 Bank-Full Depth= 1.00' Flow Area= 6.0 sf, Capacity= 18.12 cfs

Custom cross-section, Length= 411.0' Slope= 0.0046 '/'
 Constant n= 0.025 Earth, clean & straight
 Inlet Invert= 693.07', Outlet Invert= 691.16'



Offset (feet)	Elevation (feet)	Chan.Depth (feet)
-4.50	1.00	0.00
-1.50	0.00	1.00
1.50	0.00	1.00
4.50	1.00	0.00

Depth (feet)	End Area (sq-ft)	Perim. (feet)	Storage (cubic-feet)	Discharge (cfs)
0.00	0.0	3.0	0	0.00
1.00	6.0	9.3	2,466	18.12

Bull Run Conveyance 3

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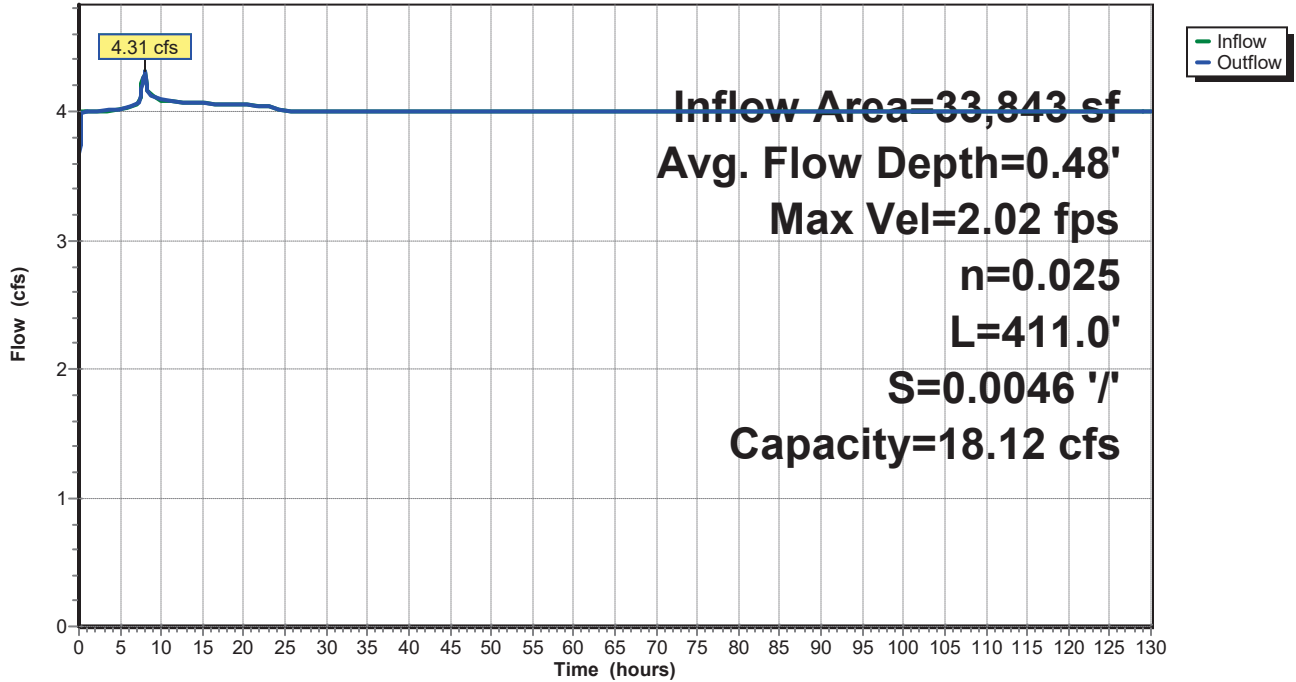
Type IA 24-hr 5-Year Rainfall=3.40"

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Reach D5: Ditch 5

Hydrograph



Bull Run Conveyance 3

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Summary for Reach D6: Ditch 6

Inflow Area = 268,552 sf, 0.00% Impervious, Inflow Depth = 1.56" for 5-Year event
 Inflow = 2.17 cfs @ 7.98 hrs, Volume= 34,854 cf
 Outflow = 2.10 cfs @ 8.01 hrs, Volume= 34,854 cf, Atten= 3%, Lag= 1.8 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
 Max. Velocity= 2.61 fps, Min. Travel Time= 7.0 min
 Avg. Velocity = 1.31 fps, Avg. Travel Time= 14.0 min

Peak Storage= 883 cf @ 8.01 hrs
 Average Depth at Peak Storage= 0.28'
 Bank-Full Depth= 1.00' Flow Area= 5.0 sf, Capacity= 26.07 cfs

Custom cross-section, Length= 1,095.0' Slope= 0.0152 '/'
 Constant n= 0.025 Earth, clean & straight
 Inlet Invert= 733.54', Outlet Invert= 716.92'



Offset (feet)	Elevation (feet)	Chan.Depth (feet)	Depth (feet)	End Area (sq-ft)	Perim. (feet)	Storage (cubic-feet)	Discharge (cfs)
-4.00	1.00	0.00	0.00	0.0	2.0	0	0.00
-1.00	0.00	1.00	1.00	5.0	8.3	5,475	26.07
1.00	0.00	1.00					
4.00	1.00	0.00					

Bull Run Conveyance 3

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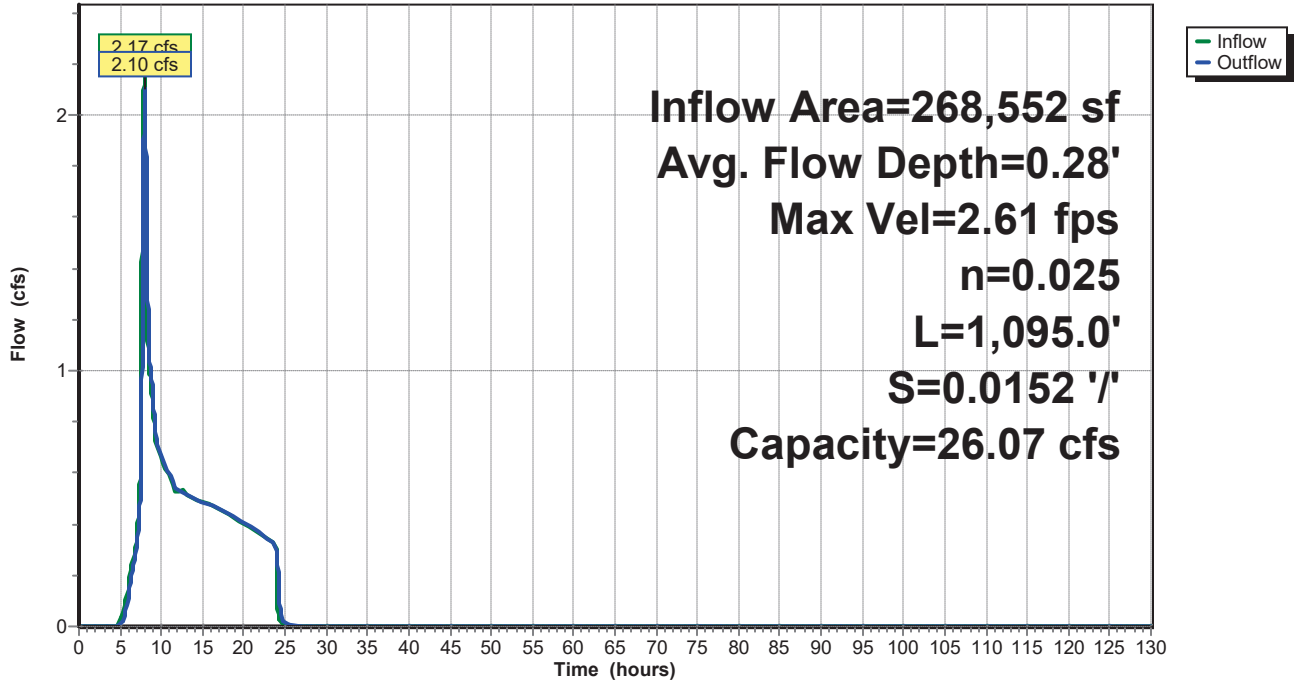
Type IA 24-hr 5-Year Rainfall=3.40"

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Reach D6: Ditch 6

Hydrograph



Bull Run Conveyance 3

Type IA 24-hr 5-Year Rainfall=3.40"

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Summary for Pond Overflow: Overflow Basins

Inflow Area = 466,788 sf, 72.69% Impervious, Inflow Depth = 2.73" for 5-Year event
 Inflow = 7.20 cfs @ 7.89 hrs, Volume= 106,086 cf
 Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 100%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
 Peak Elev= 684.91' @ 26.07 hrs Surf.Area= 137,318 sf Storage= 106,086 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
 Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	684.00'	760,666 cf	South Basin (Prismatic) Listed below (Recalc)
#2	684.00'	806,919 cf	North Basin (Prismatic) Listed below (Recalc)
		1,567,585 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
684.00	29,903	0	0
685.00	69,069	49,486	49,486
686.00	73,956	71,513	120,999
687.00	78,710	76,333	197,332
688.00	83,799	81,255	278,586
689.00	88,812	86,306	364,892
690.00	93,849	91,331	456,222
691.00	99,018	96,434	552,656
692.00	104,068	101,543	654,199
693.00	108,867	106,468	760,666

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
684.00	66,768	0	0
685.00	72,428	69,598	69,598
686.00	77,062	74,745	144,343
687.00	81,957	79,510	223,853
688.00	86,936	84,447	308,299
689.00	91,978	89,457	397,756
690.00	97,111	94,545	492,301
691.00	102,276	99,694	591,994
692.00	107,483	104,880	696,874
693.00	112,607	110,045	806,919

Bull Run Conveyance 3

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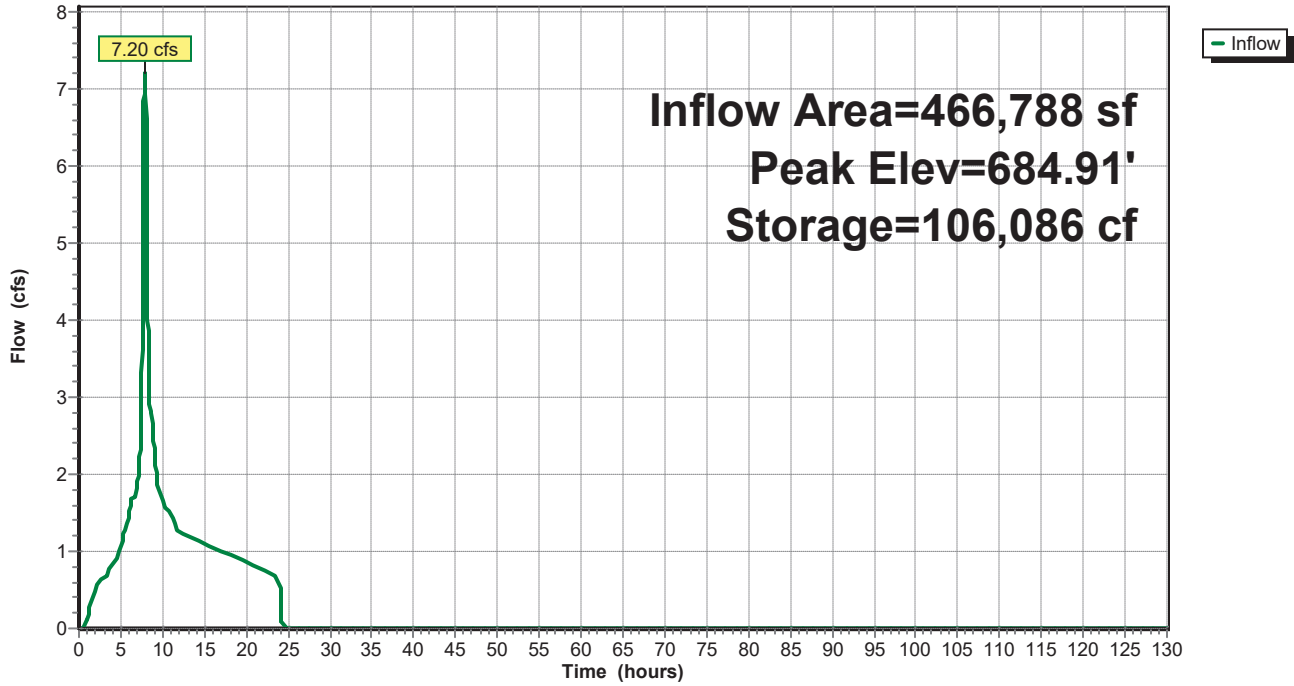
Type IA 24-hr 5-Year Rainfall=3.40"

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Pond Overflow: Overflow Basins

Hydrograph



Bull Run Conveyance 3

Type IA 24-hr 5-Year Rainfall=3.40"

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Summary for Pond Pond E: Pond E

Inflow Area = 580,537 sf, 6.24% Impervious, Inflow Depth = 1.66" for 5-Year event
 Inflow = 4.96 cfs @ 8.00 hrs, Volume= 80,201 cf
 Outflow = 2.21 cfs @ 8.73 hrs, Volume= 80,134 cf, Atten= 55%, Lag= 44.2 min
 Primary = 2.21 cfs @ 8.73 hrs, Volume= 80,134 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
 Peak Elev= 714.27' @ 8.73 hrs Surf.Area= 10,002 sf Storage= 11,343 cf

Plug-Flow detention time= 104.4 min calculated for 80,127 cf (100% of inflow)
 Center-of-Mass det. time= 104.2 min (905.1 - 800.9)

Volume	Invert	Avail.Storage	Storage Description
#1	713.00'	31,308 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
713.00	7,916	0	0
714.00	9,540	8,728	8,728
715.00	11,265	10,403	19,131
716.00	13,090	12,178	31,308

Device	Routing	Invert	Outlet Devices
#1	Primary	713.00'	15.0" Round Culvert L= 44.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 713.00' / 712.80' S= 0.0045 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Device 1	711.00'	7.0" Horiz. Orifice/Grate C= 0.620 Limited to weir flow at low heads
#3	Device 1	713.95'	16.0" W x 3.0" H Vert. Orifice/Grate C= 0.620

Primary OutFlow Max=2.21 cfs @ 8.73 hrs HW=714.27' (Free Discharge)

- ↑ **1=Culvert** (Passes 2.21 cfs of 3.81 cfs potential flow)
- ↑ **2=Orifice/Grate** (Orifice Controls 1.50 cfs @ 5.60 fps)
- ↑ **3=Orifice/Grate** (Orifice Controls 0.71 cfs @ 2.14 fps)

Bull Run Conveyance 3

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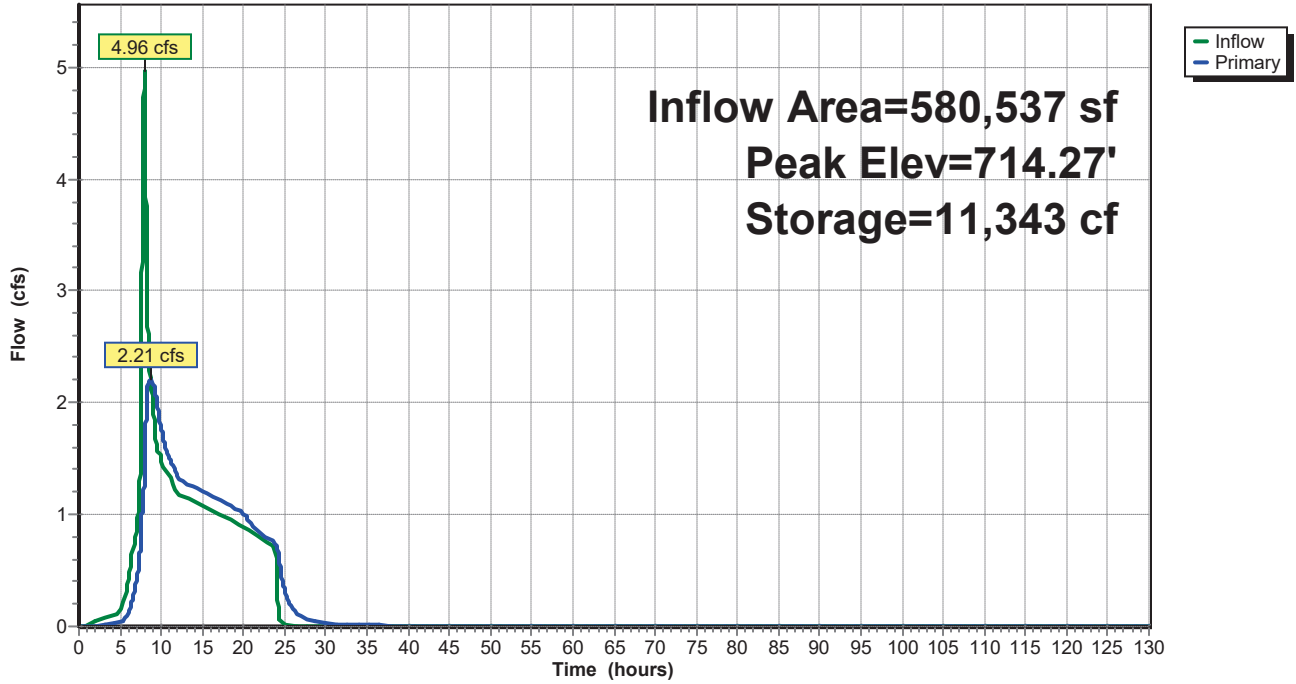
Type IA 24-hr 5-Year Rainfall=3.40"

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Pond Pond E: Pond E

Hydrograph



Bull Run Conveyance 3

Type IA 24-hr 5-Year Rainfall=3.40"

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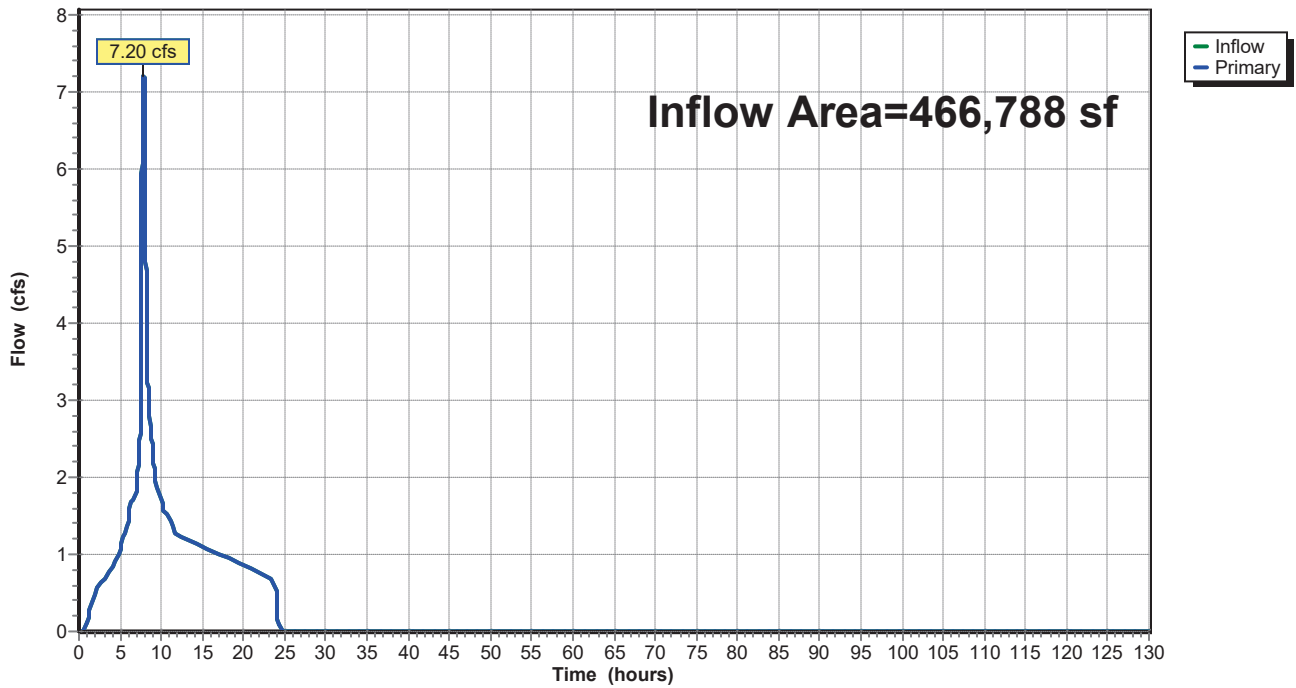
Summary for Link Pipe 27: Pipe 27

Inflow Area = 466,788 sf, 72.69% Impervious, Inflow Depth = 2.73" for 5-Year event
Inflow = 7.20 cfs @ 7.89 hrs, Volume= 106,086 cf
Primary = 7.20 cfs @ 7.89 hrs, Volume= 106,086 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs

Link Pipe 27: Pipe 27

Hydrograph



Bull Run Conveyance 3

Type IA 24-hr 10-Year Rainfall=3.80"

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Summary for Subcatchment 17: Basin 17

Runoff = 2.08 cfs @ 7.88 hrs, Volume= 30,107 cf, Depth= 3.57"

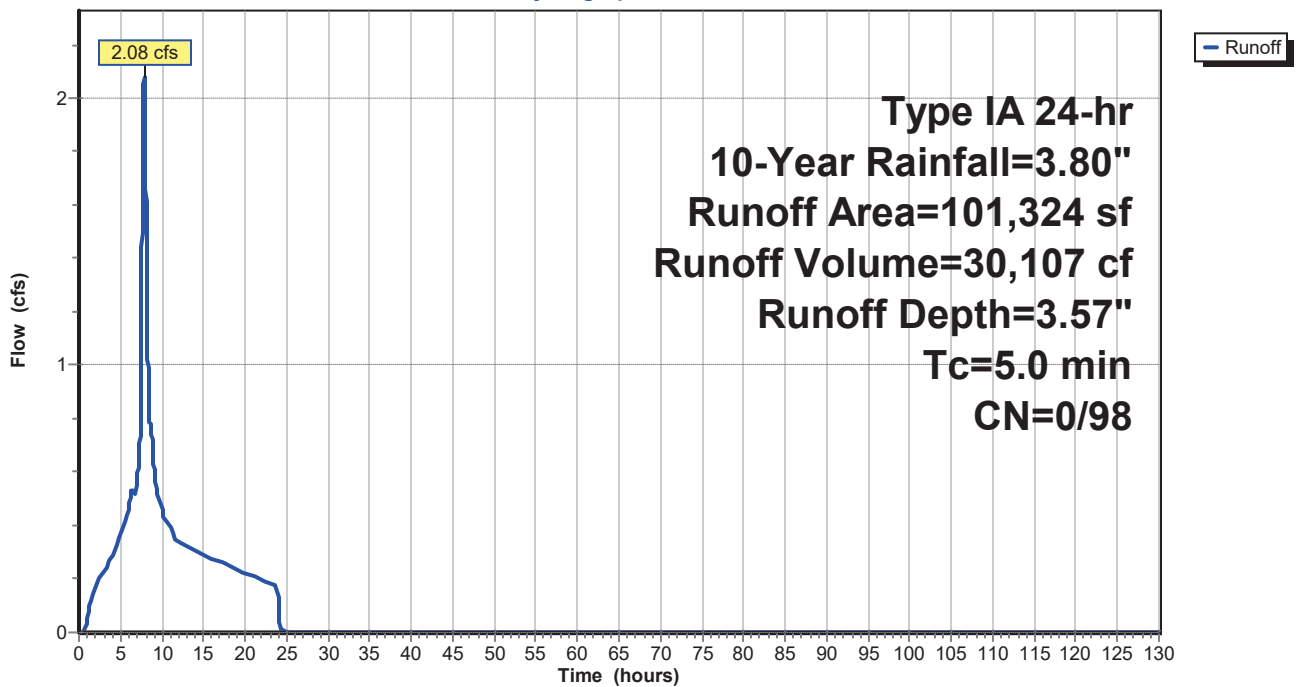
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
 Type IA 24-hr 10-Year Rainfall=3.80"

Area (sf)	CN	Description
* 101,324	98	Impervious Area
101,324	98	100.00% Impervious Area

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

Subcatchment 17: Basin 17

Hydrograph



Bull Run Conveyance 3

Type IA 24-hr 10-Year Rainfall=3.80"

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Summary for Subcatchment 19: Basin 19

Runoff = 0.38 cfs @ 7.95 hrs, Volume= 5,890 cf, Depth= 2.09"

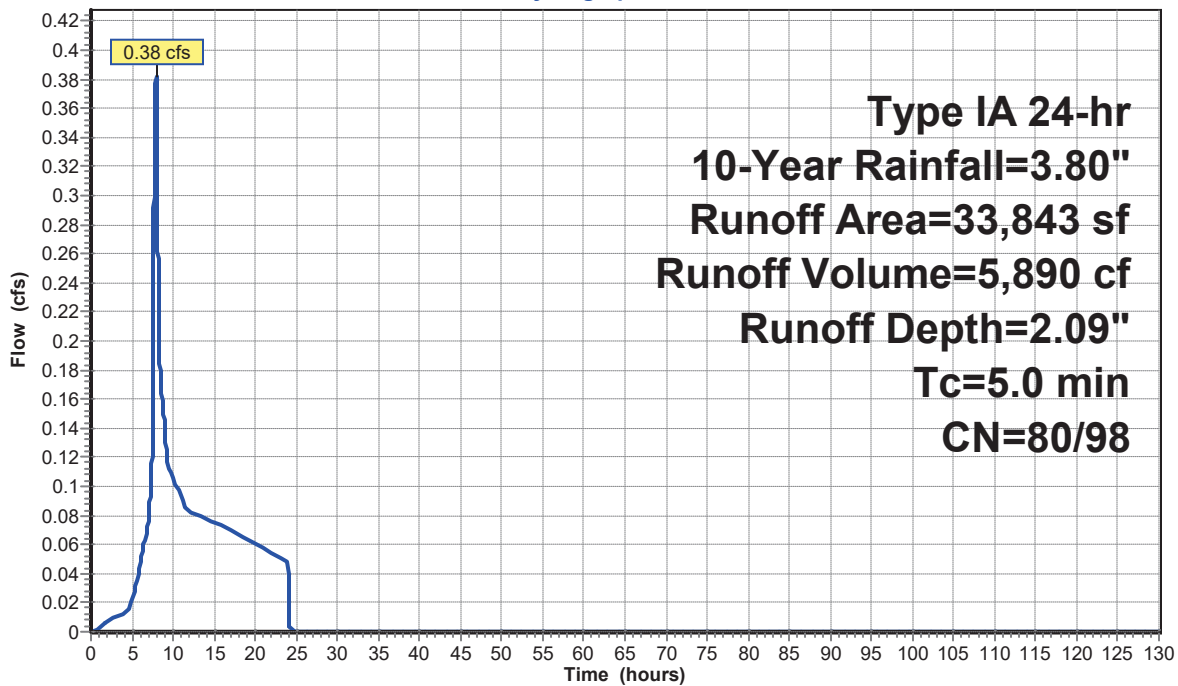
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Year Rainfall=3.80"

	Area (sf)	CN	Description
*	4,230	98	Impervious Area
*	29,613	80	Pervious
	33,843	82	Weighted Average
	29,613	80	87.50% Pervious Area
	4,230	98	12.50% Impervious Area

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

Subcatchment 19: Basin 19

Hydrograph



Bull Run Conveyance 3

Type IA 24-hr 10-Year Rainfall=3.80"

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Summary for Subcatchment 20: Basin 20

Runoff = 3.49 cfs @ 7.96 hrs, Volume= 53,908 cf, Depth= 2.07"

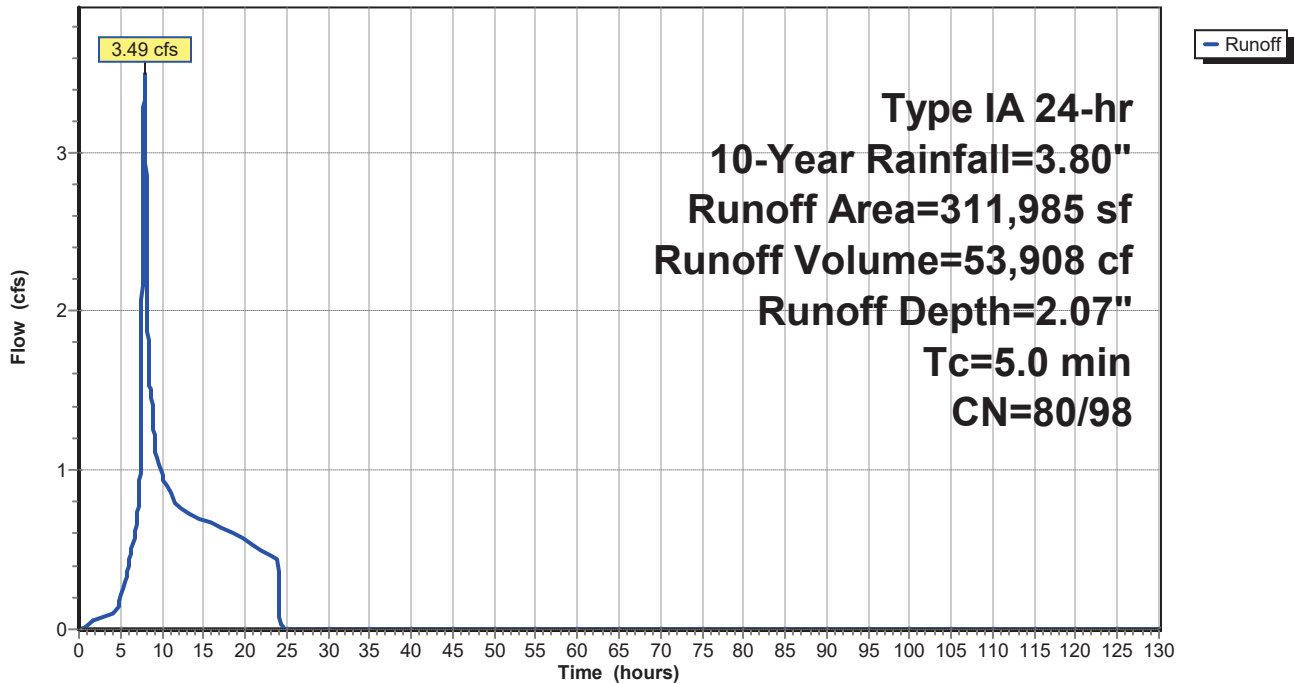
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Year Rainfall=3.80"

	Area (sf)	CN	Description
*	19,160	98	Impervious Area
	275,776	80	>75% Grass cover, Good, HSG D
*	17,049	98	
	311,985	82	Weighted Average
	275,776	80	88.39% Pervious Area
	36,209	98	11.61% Impervious Area

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

Subcatchment 20: Basin 20

Hydrograph



Bull Run Conveyance 3

Type IA 24-hr 10-Year Rainfall=3.80"

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Summary for Subcatchment 20S: Basin 21

Runoff = 6.13 cfs @ 7.90 hrs, Volume= 90,658 cf, Depth= 2.98"

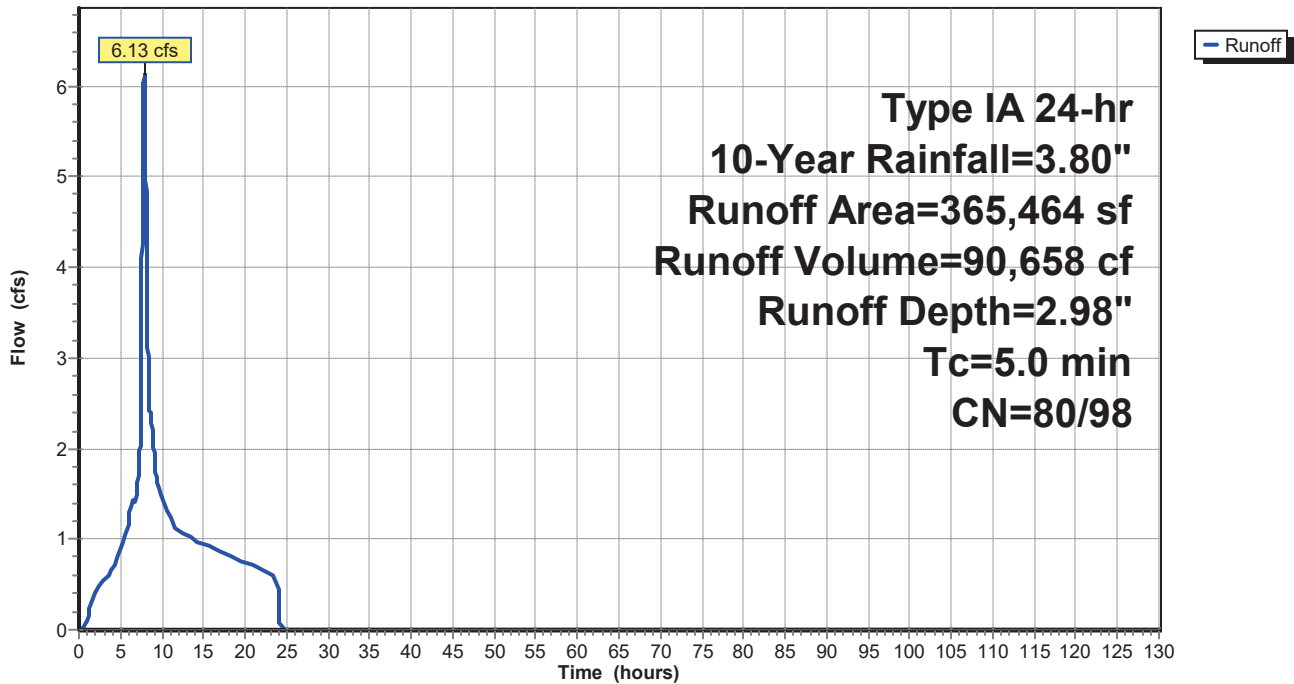
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Year Rainfall=3.80"

	Area (sf)	CN	Description
*	237,972	98	Impervious Area
*	127,492	80	Pervious
	365,464	92	Weighted Average
	127,492	80	34.88% Pervious Area
	237,972	98	65.12% Impervious Area

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

Subcatchment 20S: Basin 21

Hydrograph



Bull Run Conveyance 3

Type IA 24-hr 10-Year Rainfall=3.80"

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Summary for Subcatchment 21: Basin 21

Runoff = 6.13 cfs @ 7.90 hrs, Volume= 90,658 cf, Depth= 2.98"

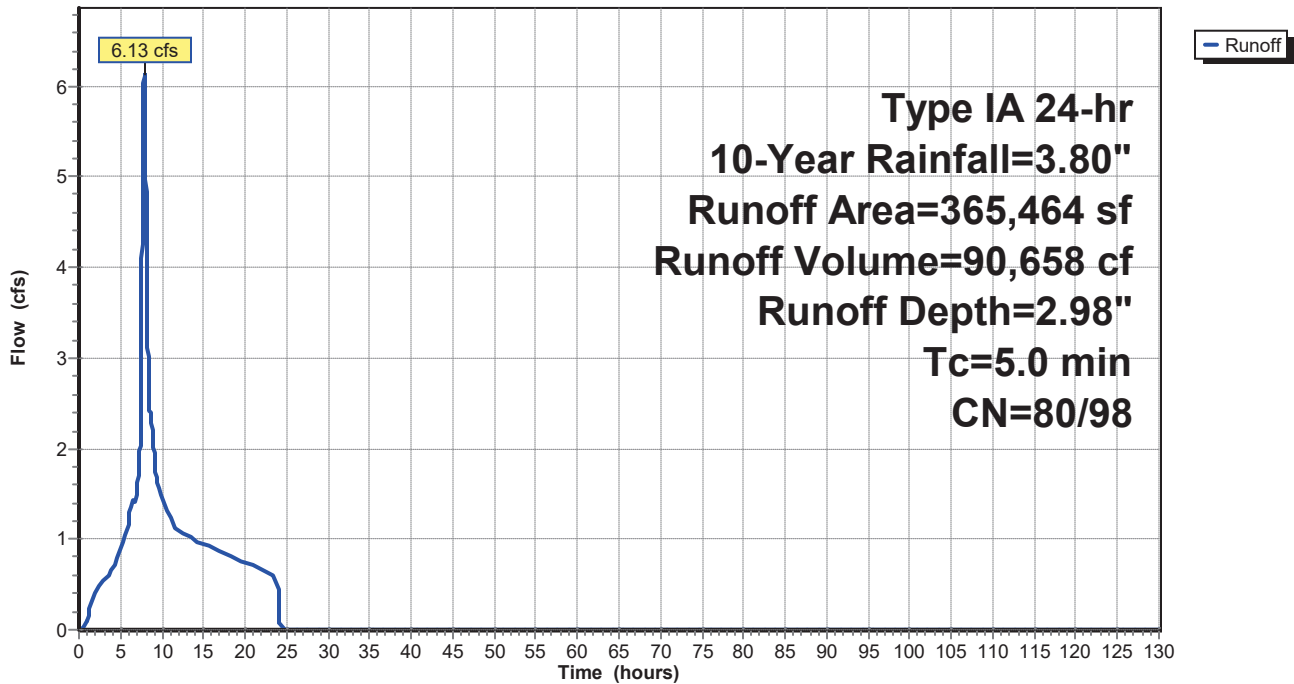
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Year Rainfall=3.80"

	Area (sf)	CN	Description
*	237,972	98	Impervious Area
*	127,492	80	Pervious
	365,464	92	Weighted Average
	127,492	80	34.88% Pervious Area
	237,972	98	65.12% Impervious Area

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

Subcatchment 21: Basin 21

Hydrograph



Bull Run Conveyance 3

Type IA 24-hr 10-Year Rainfall=3.80"

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Summary for Subcatchment 21S: Basin 17

Runoff = 2.08 cfs @ 7.88 hrs, Volume= 30,107 cf, Depth= 3.57"

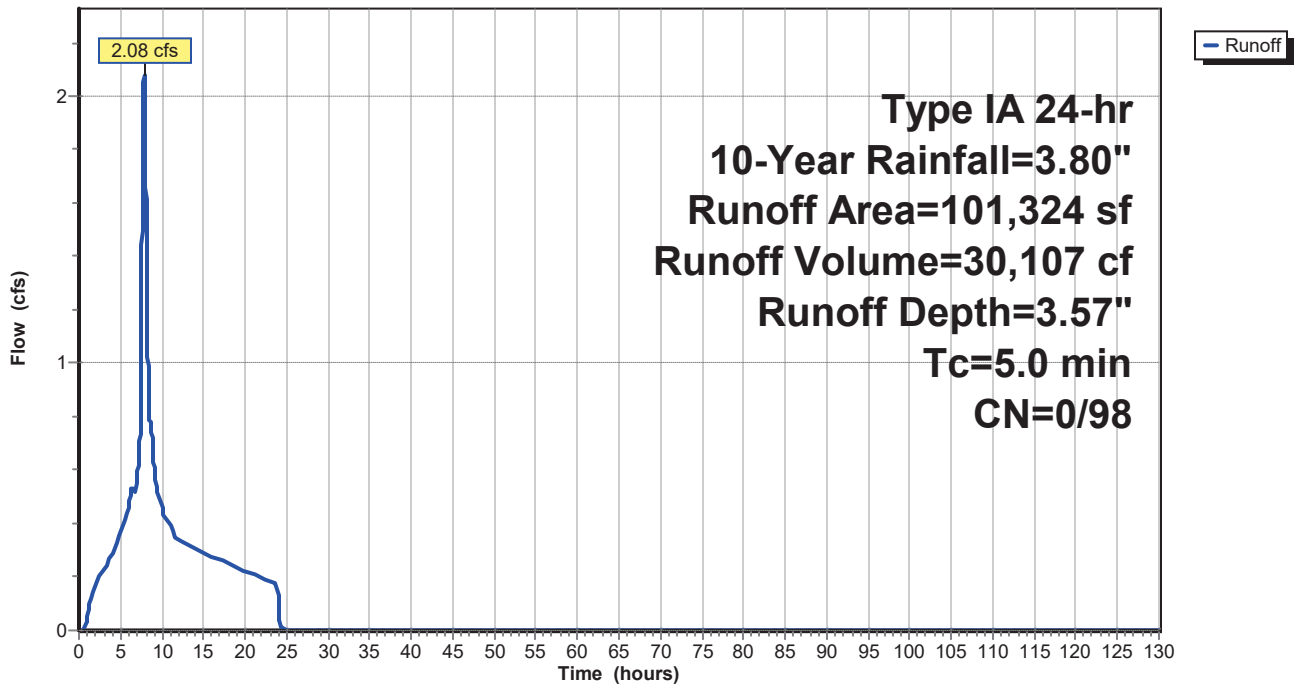
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Year Rainfall=3.80"

	Area (sf)	CN	Description
*	101,324	98	Impervious Area
	101,324	98	100.00% Impervious Area

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

Subcatchment 21S: Basin 17

Hydrograph



Bull Run Conveyance 3

Type IA 24-hr 10-Year Rainfall=3.80"

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Summary for Subcatchment 24: Basin 24

Runoff = 2.69 cfs @ 7.97 hrs, Volume= 42,019 cf, Depth= 1.88"

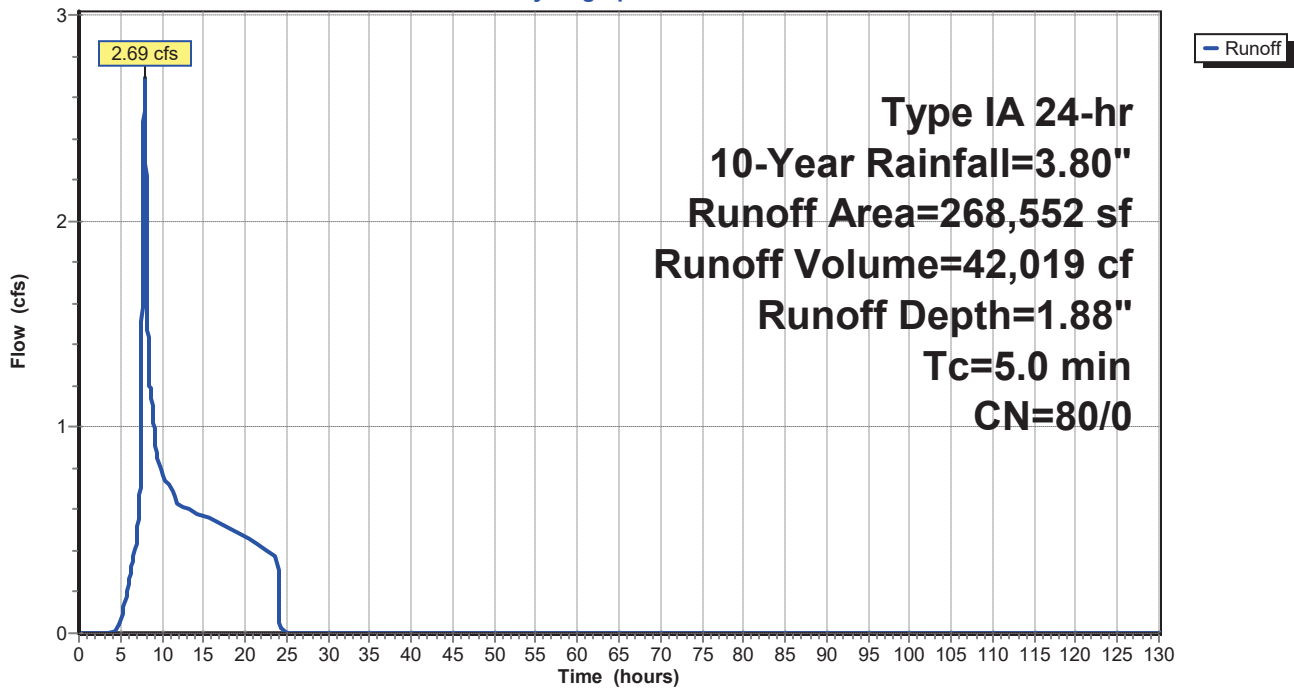
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Year Rainfall=3.80"

Area (sf)	CN	Description
268,552	80	>75% Grass cover, Good, HSG D
* 0	98	Impervious
268,552	80	Weighted Average
268,552	80	100.00% Pervious Area

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

Subcatchment 24: Basin 24

Hydrograph



Bull Run Conveyance 3

Type IA 24-hr 10-Year Rainfall=3.80"

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Summary for Reach D5: Ditch 5

Inflow Area = 33,843 sf, 12.50% Impervious, Inflow Depth >665.91" for 10-Year event
Inflow = 4.38 cfs @ 7.95 hrs, Volume= 1,878,034 cf, Incl. 4.00 cfs Base Flow
Outflow = 4.38 cfs @ 7.99 hrs, Volume= 1,877,204 cf, Atten= 0%, Lag= 2.4 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.03 fps, Min. Travel Time= 3.4 min
Avg. Velocity = 1.98 fps, Avg. Travel Time= 3.5 min

Peak Storage= 885 cf @ 7.99 hrs
Average Depth at Peak Storage= 0.48'
Bank-Full Depth= 1.00' Flow Area= 6.0 sf, Capacity= 18.12 cfs

Custom cross-section, Length= 411.0' Slope= 0.0046 '/'
Constant n= 0.025 Earth, clean & straight
Inlet Invert= 693.07', Outlet Invert= 691.16'



Offset (feet)	Elevation (feet)	Chan.Depth (feet)
-4.50	1.00	0.00
-1.50	0.00	1.00
1.50	0.00	1.00
4.50	1.00	0.00

Depth (feet)	End Area (sq-ft)	Perim. (feet)	Storage (cubic-feet)	Discharge (cfs)
0.00	0.0	3.0	0	0.00
1.00	6.0	9.3	2,466	18.12

Bull Run Conveyance 3

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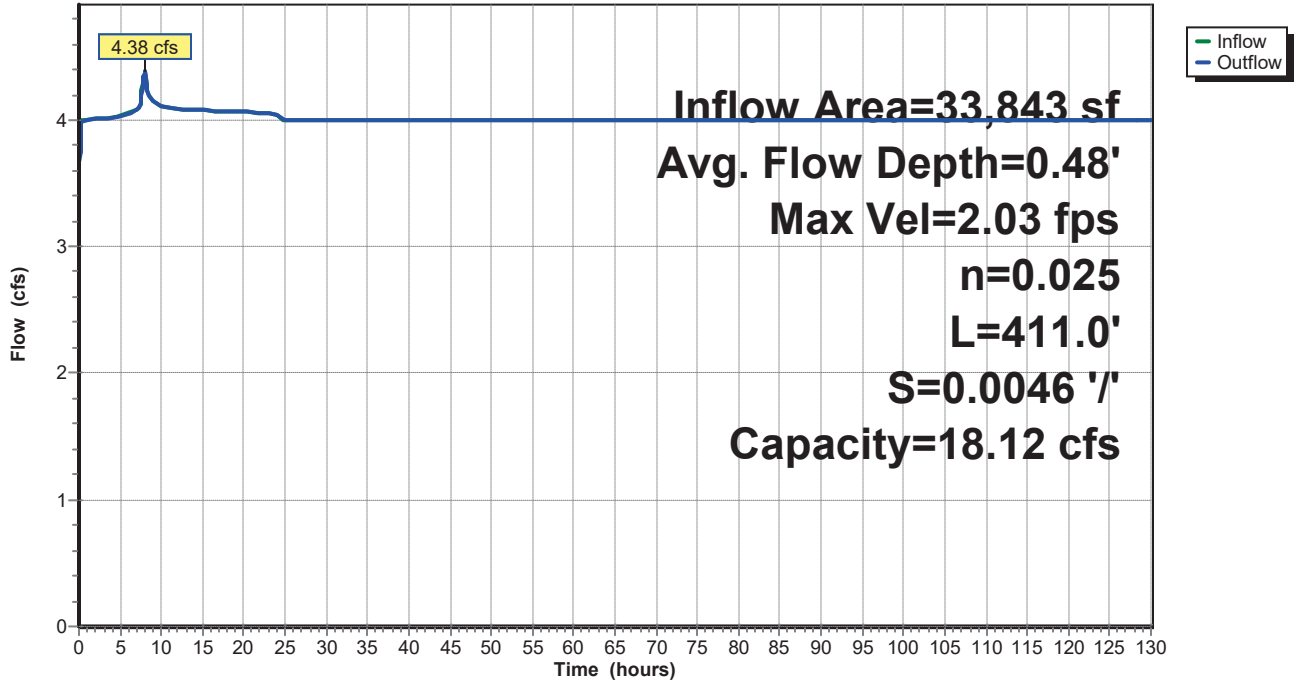
Type IA 24-hr 10-Year Rainfall=3.80"

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Reach D5: Ditch 5

Hydrograph



Bull Run Conveyance 3

Type IA 24-hr 10-Year Rainfall=3.80"

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Summary for Reach D6: Ditch 6

Inflow Area = 268,552 sf, 0.00% Impervious, Inflow Depth = 1.88" for 10-Year event
 Inflow = 2.69 cfs @ 7.97 hrs, Volume= 42,019 cf
 Outflow = 2.63 cfs @ 8.01 hrs, Volume= 42,019 cf, Atten= 2%, Lag= 2.3 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
 Max. Velocity= 2.79 fps, Min. Travel Time= 6.5 min
 Avg. Velocity = 1.38 fps, Avg. Travel Time= 13.3 min

Peak Storage= 1,033 cf @ 8.01 hrs
 Average Depth at Peak Storage= 0.32'
 Bank-Full Depth= 1.00' Flow Area= 5.0 sf, Capacity= 26.07 cfs

Custom cross-section, Length= 1,095.0' Slope= 0.0152 '/'
 Constant n= 0.025 Earth, clean & straight
 Inlet Invert= 733.54', Outlet Invert= 716.92'



Offset (feet)	Elevation (feet)	Chan.Depth (feet)	Depth (feet)	End Area (sq-ft)	Perim. (feet)	Storage (cubic-feet)	Discharge (cfs)
-4.00	1.00	0.00	0.00	0.0	2.0	0	0.00
-1.00	0.00	1.00	1.00	5.0	8.3	5,475	26.07
1.00	0.00	1.00					
4.00	1.00	0.00					

Bull Run Conveyance 3

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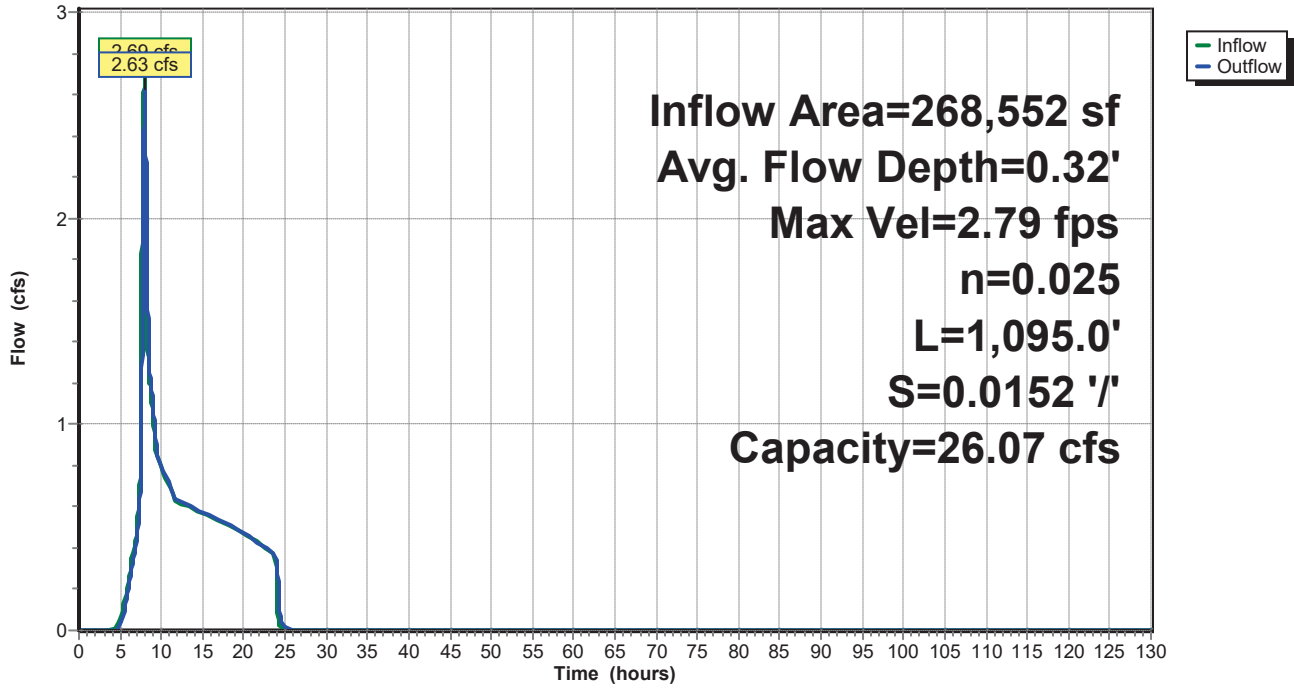
Type IA 24-hr 10-Year Rainfall=3.80"

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Reach D6: Ditch 6

Hydrograph



Bull Run Conveyance 3

Type IA 24-hr 10-Year Rainfall=3.80"

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Summary for Pond Overflow: Overflow Basins

Inflow Area = 466,788 sf, 72.69% Impervious, Inflow Depth = 3.10" for 10-Year event
 Inflow = 8.20 cfs @ 7.89 hrs, Volume= 120,765 cf
 Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 100%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
 Peak Elev= 685.01' @ 25.99 hrs Surf.Area= 141,610 sf Storage= 120,765 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
 Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	684.00'	760,666 cf	South Basin (Prismatic) Listed below (Recalc)
#2	684.00'	806,919 cf	North Basin (Prismatic) Listed below (Recalc)
		1,567,585 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
684.00	29,903	0	0
685.00	69,069	49,486	49,486
686.00	73,956	71,513	120,999
687.00	78,710	76,333	197,332
688.00	83,799	81,255	278,586
689.00	88,812	86,306	364,892
690.00	93,849	91,331	456,222
691.00	99,018	96,434	552,656
692.00	104,068	101,543	654,199
693.00	108,867	106,468	760,666

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
684.00	66,768	0	0
685.00	72,428	69,598	69,598
686.00	77,062	74,745	144,343
687.00	81,957	79,510	223,853
688.00	86,936	84,447	308,299
689.00	91,978	89,457	397,756
690.00	97,111	94,545	492,301
691.00	102,276	99,694	591,994
692.00	107,483	104,880	696,874
693.00	112,607	110,045	806,919

Bull Run Conveyance 3

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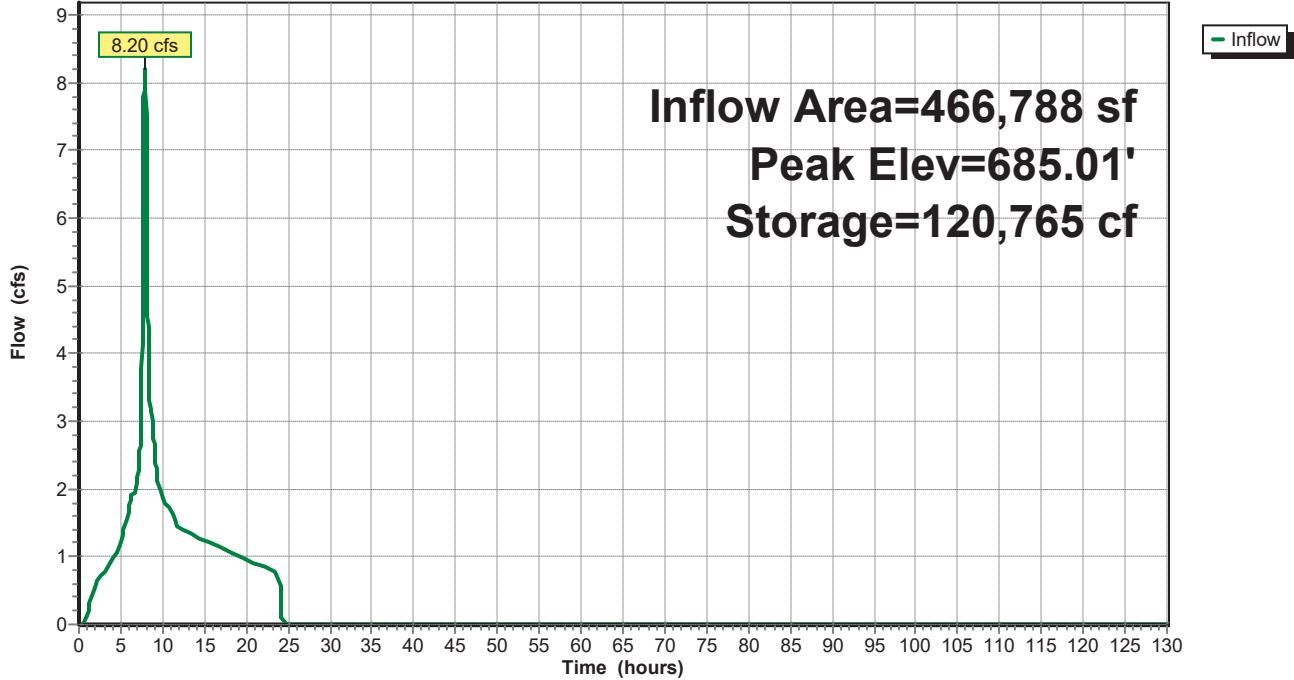
Type IA 24-hr 10-Year Rainfall=3.80"

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Pond Overflow: Overflow Basins

Hydrograph



Bull Run Conveyance 3

Type IA 24-hr 10-Year Rainfall=3.80"

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Summary for Pond Pond E: Pond E

Inflow Area = 580,537 sf, 6.24% Impervious, Inflow Depth = 1.98" for 10-Year event
 Inflow = 6.10 cfs @ 8.00 hrs, Volume= 95,927 cf
 Outflow = 2.70 cfs @ 8.69 hrs, Volume= 95,860 cf, Atten= 56%, Lag= 41.2 min
 Primary = 2.70 cfs @ 8.69 hrs, Volume= 95,860 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
 Peak Elev= 714.50' @ 8.69 hrs Surf.Area= 10,400 sf Storage= 13,700 cf

Plug-Flow detention time= 103.9 min calculated for 95,860 cf (100% of inflow)
 Center-of-Mass det. time= 103.4 min (894.4 - 791.0)

Volume	Invert	Avail.Storage	Storage Description
#1	713.00'	31,308 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
713.00	7,916	0	0
714.00	9,540	8,728	8,728
715.00	11,265	10,403	19,131
716.00	13,090	12,178	31,308

Device	Routing	Invert	Outlet Devices
#1	Primary	713.00'	15.0" Round Culvert L= 44.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 713.00' / 712.80' S= 0.0045 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Device 1	711.00'	7.0" Horiz. Orifice/Grate C= 0.620 Limited to weir flow at low heads
#3	Device 1	713.95'	16.0" W x 3.0" H Vert. Orifice/Grate C= 0.620

Primary OutFlow Max=2.70 cfs @ 8.69 hrs HW=714.50' (Free Discharge)

- ↑ **1=Culvert** (Passes 2.70 cfs of 4.65 cfs potential flow)
- ↑ **2=Orifice/Grate** (Orifice Controls 1.63 cfs @ 6.09 fps)
- ↑ **3=Orifice/Grate** (Orifice Controls 1.08 cfs @ 3.23 fps)

Bull Run Conveyance 3

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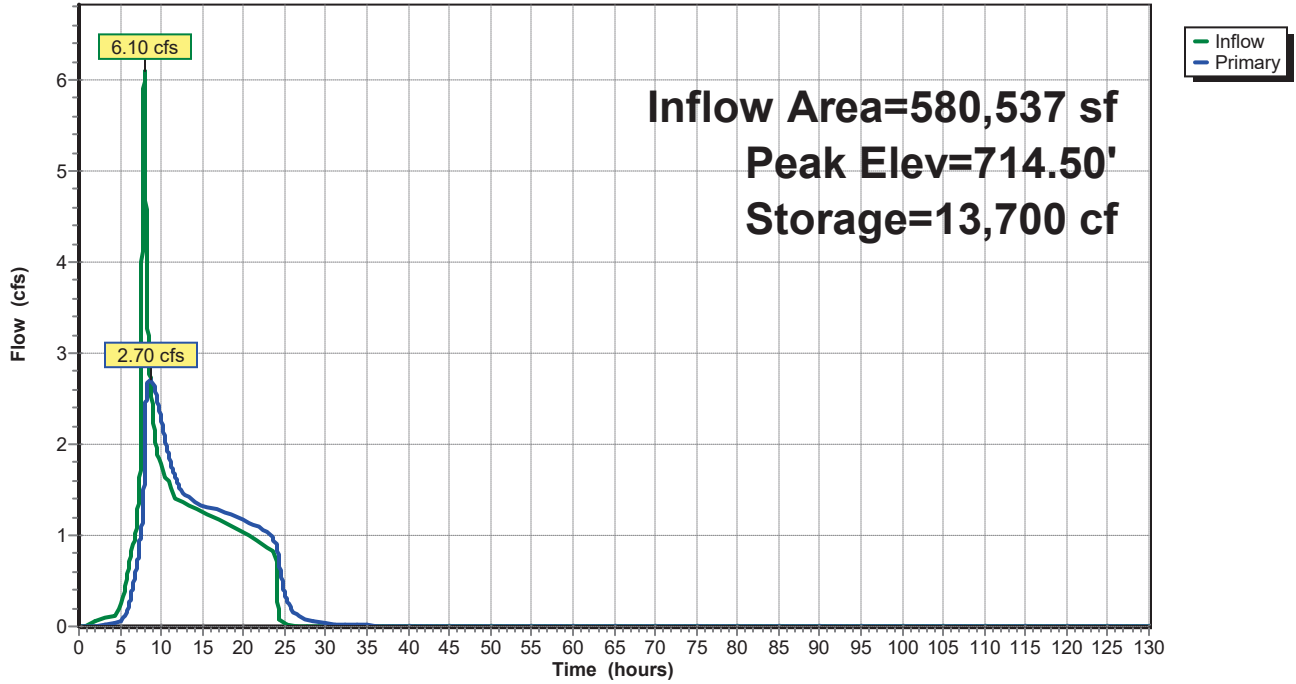
Type IA 24-hr 10-Year Rainfall=3.80"

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Pond Pond E: Pond E

Hydrograph



Bull Run Conveyance 3

Type IA 24-hr 10-Year Rainfall=3.80"

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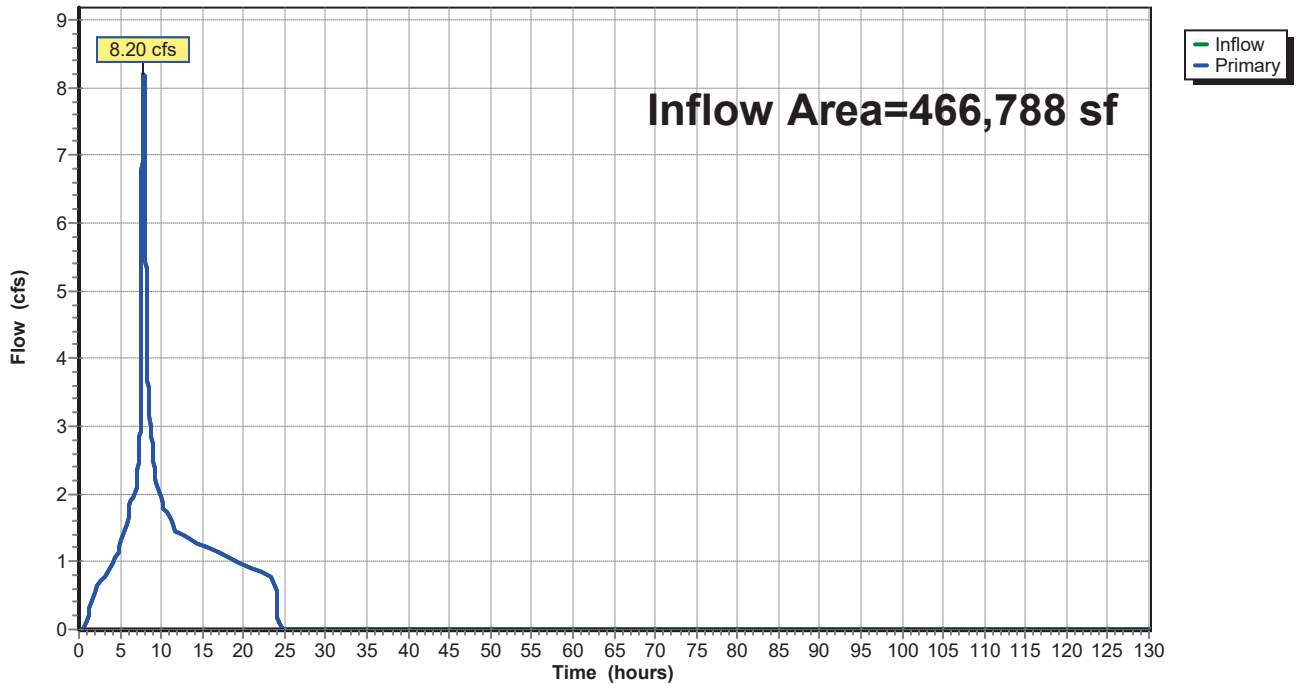
Summary for Link Pipe 27: Pipe 27

Inflow Area = 466,788 sf, 72.69% Impervious, Inflow Depth = 3.10" for 10-Year event
Inflow = 8.20 cfs @ 7.89 hrs, Volume= 120,765 cf
Primary = 8.20 cfs @ 7.89 hrs, Volume= 120,765 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs

Link Pipe 27: Pipe 27

Hydrograph



Bull Run Conveyance 3

Type IA 24-hr 25-Year Rainfall=4.50"

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Summary for Subcatchment 17: Basin 17

Runoff = 2.47 cfs @ 7.88 hrs, Volume= 36,004 cf, Depth= 4.26"

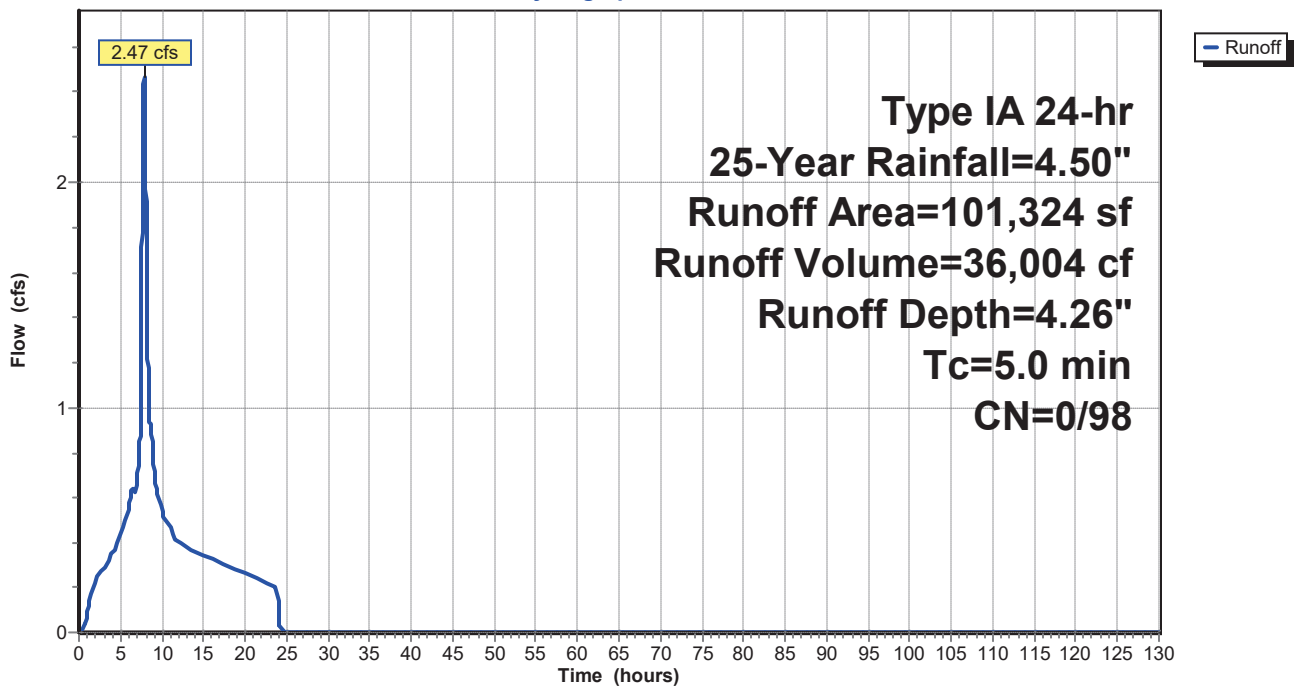
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=4.50"

	Area (sf)	CN	Description
*	101,324	98	Impervious Area
	101,324	98	100.00% Impervious Area

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

Subcatchment 17: Basin 17

Hydrograph



Bull Run Conveyance 3

Type IA 24-hr 25-Year Rainfall=4.50"

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Summary for Subcatchment 19: Basin 19

Runoff = 0.50 cfs @ 7.94 hrs, Volume= 7,578 cf, Depth= 2.69"

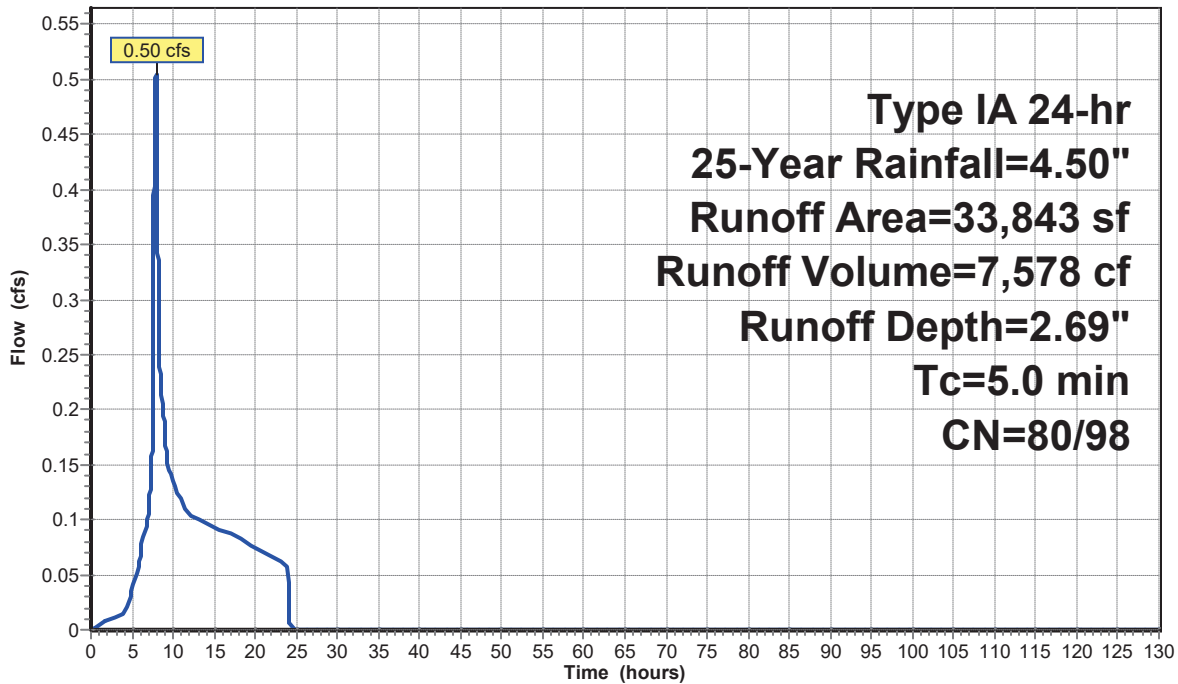
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=4.50"

	Area (sf)	CN	Description
*	4,230	98	Impervious Area
*	29,613	80	Pervious
	33,843	82	Weighted Average
	29,613	80	87.50% Pervious Area
	4,230	98	12.50% Impervious Area

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

Subcatchment 19: Basin 19

Hydrograph



Bull Run Conveyance 3

Type IA 24-hr 25-Year Rainfall=4.50"

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Summary for Subcatchment 20: Basin 20

Runoff = 4.62 cfs @ 7.94 hrs, Volume= 69,436 cf, Depth= 2.67"

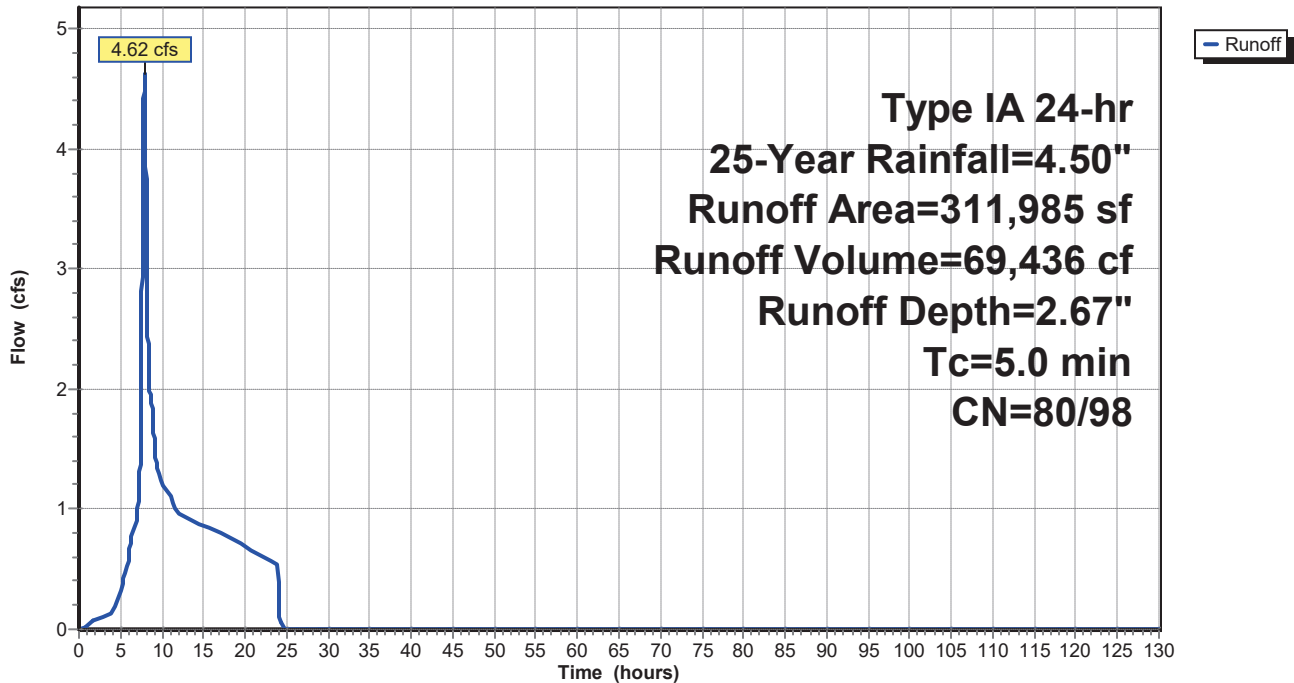
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=4.50"

	Area (sf)	CN	Description
*	19,160	98	Impervious Area
	275,776	80	>75% Grass cover, Good, HSG D
*	17,049	98	
	311,985	82	Weighted Average
	275,776	80	88.39% Pervious Area
	36,209	98	11.61% Impervious Area

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

Subcatchment 20: Basin 20

Hydrograph



Bull Run Conveyance 3

Type IA 24-hr 25-Year Rainfall=4.50"

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Summary for Subcatchment 20S: Basin 21

Runoff = 7.51 cfs @ 7.90 hrs, Volume= 110,712 cf, Depth= 3.64"

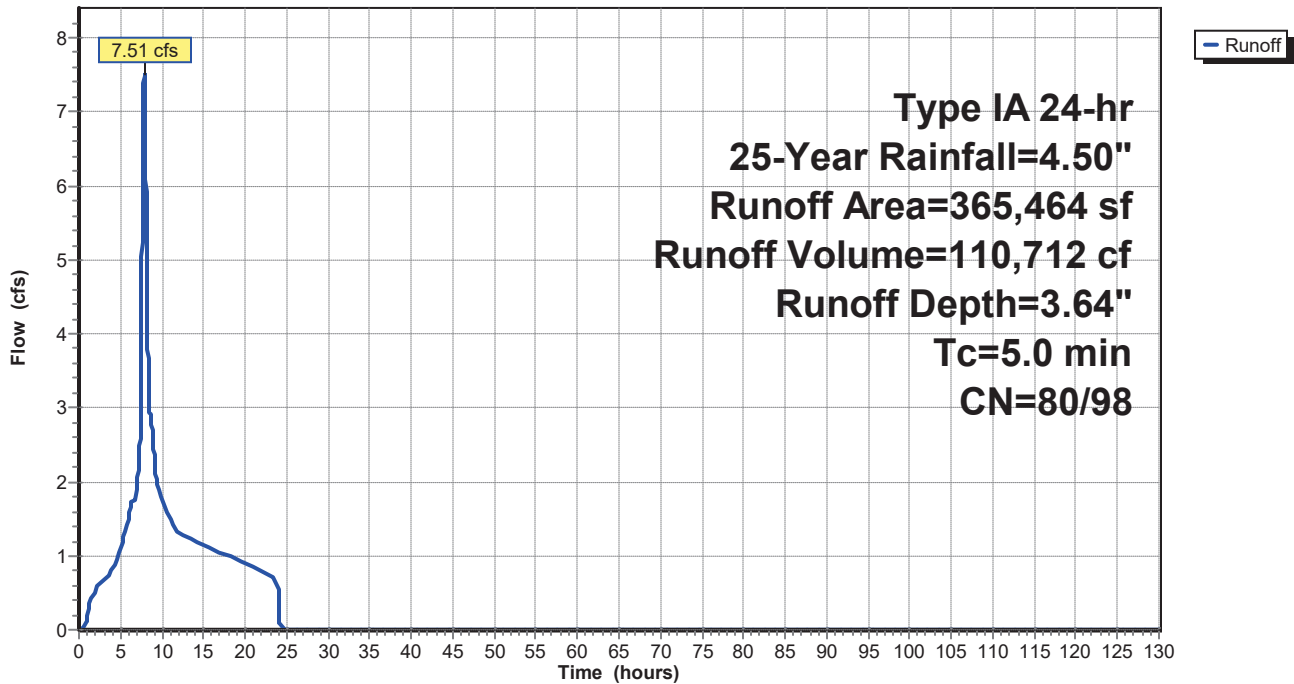
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=4.50"

	Area (sf)	CN	Description
*	237,972	98	Impervious Area
*	127,492	80	Pervious
	365,464	92	Weighted Average
	127,492	80	34.88% Pervious Area
	237,972	98	65.12% Impervious Area

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

Subcatchment 20S: Basin 21

Hydrograph



Bull Run Conveyance 3

Type IA 24-hr 25-Year Rainfall=4.50"

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Summary for Subcatchment 21: Basin 21

Runoff = 7.51 cfs @ 7.90 hrs, Volume= 110,712 cf, Depth= 3.64"

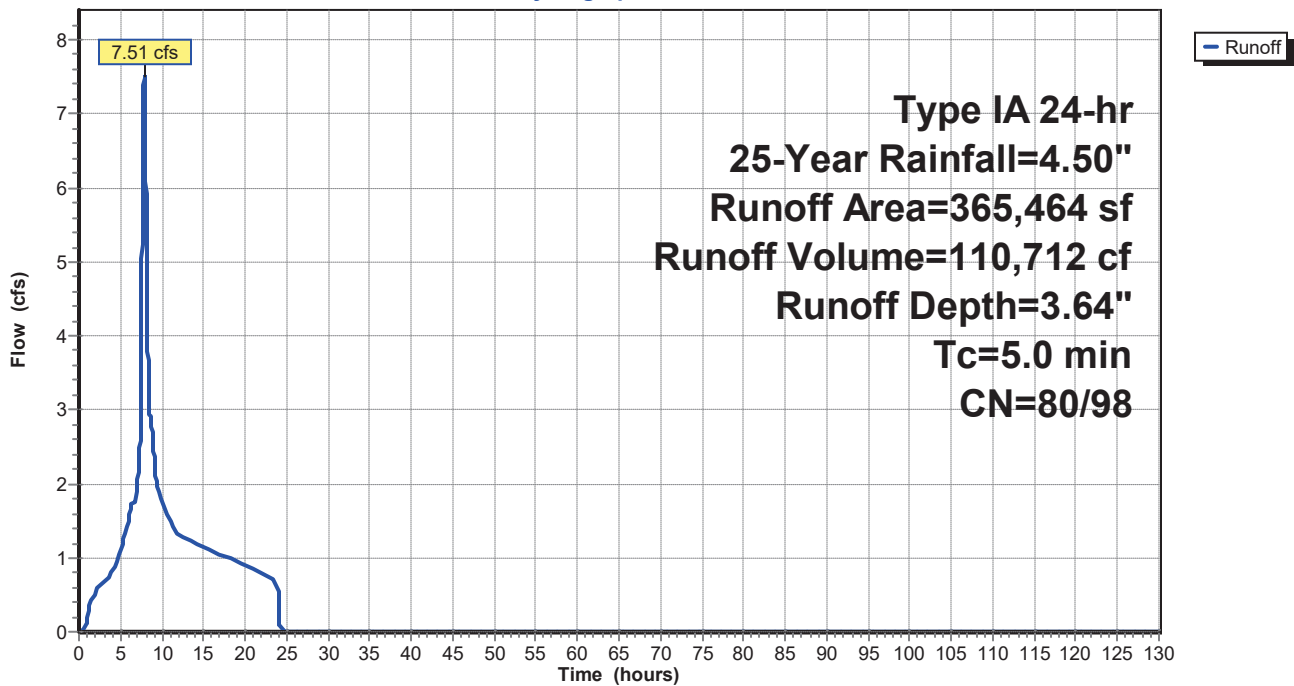
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=4.50"

	Area (sf)	CN	Description
*	237,972	98	Impervious Area
*	127,492	80	Pervious
	365,464	92	Weighted Average
	127,492	80	34.88% Pervious Area
	237,972	98	65.12% Impervious Area

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

Subcatchment 21: Basin 21

Hydrograph



Bull Run Conveyance 3

Type IA 24-hr 25-Year Rainfall=4.50"

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Summary for Subcatchment 21S: Basin 17

Runoff = 2.47 cfs @ 7.88 hrs, Volume= 36,004 cf, Depth= 4.26"

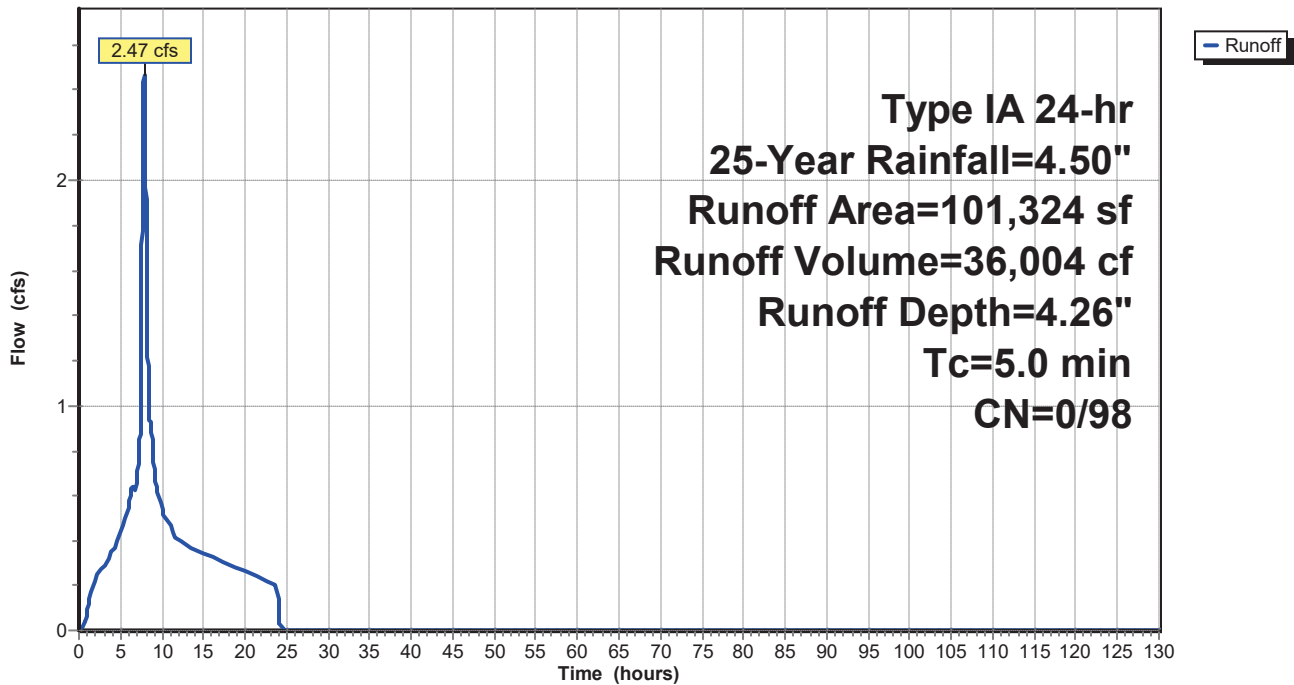
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=4.50"

	Area (sf)	CN	Description
*	101,324	98	Impervious Area
	101,324	98	100.00% Impervious Area

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

Subcatchment 21S: Basin 17

Hydrograph



Bull Run Conveyance 3

Type IA 24-hr 25-Year Rainfall=4.50"

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Summary for Subcatchment 24: Basin 24

Runoff = 3.65 cfs @ 7.96 hrs, Volume= 55,088 cf, Depth= 2.46"

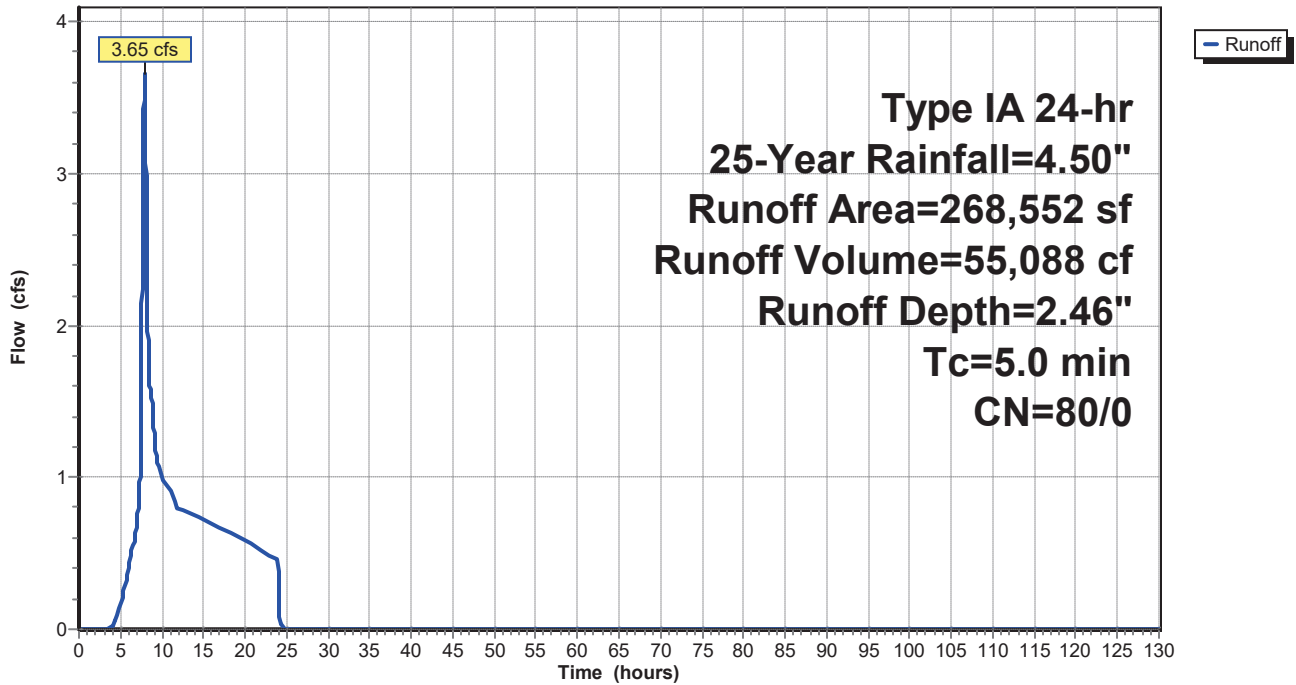
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=4.50"

Area (sf)	CN	Description
268,552	80	>75% Grass cover, Good, HSG D
* 0	98	Impervious
268,552	80	Weighted Average
268,552	80	100.00% Pervious Area

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

Subcatchment 24: Basin 24

Hydrograph



Bull Run Conveyance 3

Type IA 24-hr 25-Year Rainfall=4.50"

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Summary for Reach D5: Ditch 5

Inflow Area = 33,843 sf, 12.50% Impervious, Inflow Depth >666.51" for 25-Year event
Inflow = 4.50 cfs @ 7.94 hrs, Volume= 1,879,722 cf, Incl. 4.00 cfs Base Flow
Outflow = 4.50 cfs @ 7.98 hrs, Volume= 1,878,891 cf, Atten= 0%, Lag= 2.3 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.05 fps, Min. Travel Time= 3.3 min
Avg. Velocity = 1.98 fps, Avg. Travel Time= 3.5 min

Peak Storage= 903 cf @ 7.98 hrs
Average Depth at Peak Storage= 0.49'
Bank-Full Depth= 1.00' Flow Area= 6.0 sf, Capacity= 18.12 cfs

Custom cross-section, Length= 411.0' Slope= 0.0046 '/'
Constant n= 0.025 Earth, clean & straight
Inlet Invert= 693.07', Outlet Invert= 691.16'



‡

Offset (feet)	Elevation (feet)	Chan.Depth (feet)
-4.50	1.00	0.00
-1.50	0.00	1.00
1.50	0.00	1.00
4.50	1.00	0.00

Depth (feet)	End Area (sq-ft)	Perim. (feet)	Storage (cubic-feet)	Discharge (cfs)
0.00	0.0	3.0	0	0.00
1.00	6.0	9.3	2,466	18.12

Bull Run Conveyance 3

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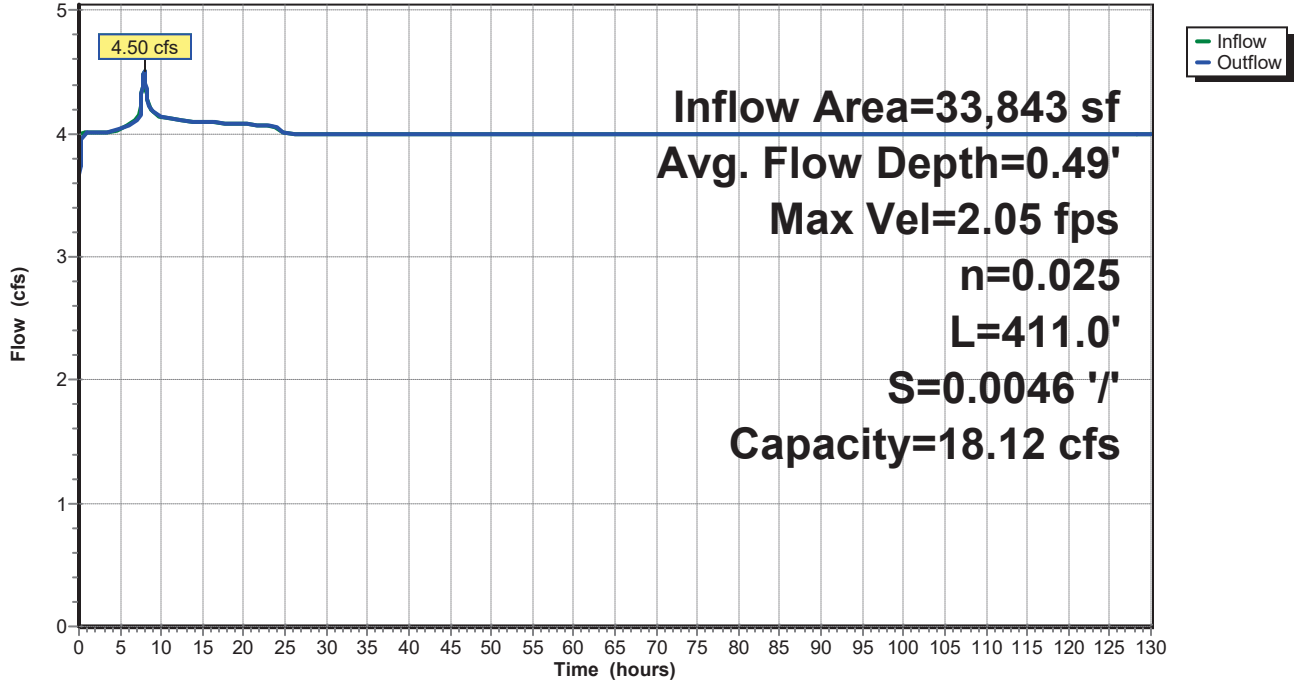
Type IA 24-hr 25-Year Rainfall=4.50"

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Reach D5: Ditch 5

Hydrograph



Bull Run Conveyance 3

Type IA 24-hr 25-Year Rainfall=4.50"

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Summary for Reach D6: Ditch 6

Inflow Area = 268,552 sf, 0.00% Impervious, Inflow Depth = 2.46" for 25-Year event
 Inflow = 3.65 cfs @ 7.96 hrs, Volume= 55,088 cf
 Outflow = 3.59 cfs @ 8.01 hrs, Volume= 55,088 cf, Atten= 2%, Lag= 2.9 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
 Max. Velocity= 3.05 fps, Min. Travel Time= 6.0 min
 Avg. Velocity = 1.48 fps, Avg. Travel Time= 12.3 min

Peak Storage= 1,290 cf @ 8.01 hrs
 Average Depth at Peak Storage= 0.38'
 Bank-Full Depth= 1.00' Flow Area= 5.0 sf, Capacity= 26.07 cfs

Custom cross-section, Length= 1,095.0' Slope= 0.0152 '/'
 Constant n= 0.025 Earth, clean & straight
 Inlet Invert= 733.54', Outlet Invert= 716.92'



Offset (feet)	Elevation (feet)	Chan.Depth (feet)	Depth (feet)	End Area (sq-ft)	Perim. (feet)	Storage (cubic-feet)	Discharge (cfs)
-4.00	1.00	0.00	0.00	0.0	2.0	0	0.00
-1.00	0.00	1.00	1.00	5.0	8.3	5,475	26.07
1.00	0.00	1.00					
4.00	1.00	0.00					

Bull Run Conveyance 3

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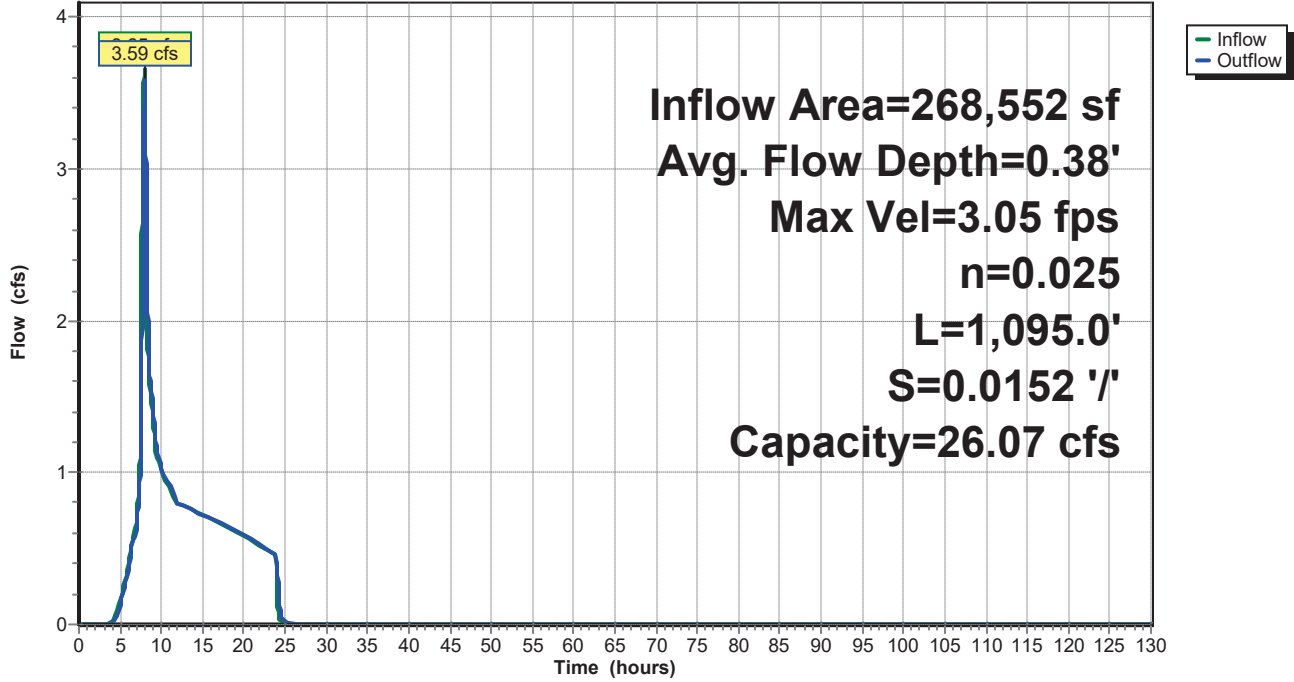
Type IA 24-hr 25-Year Rainfall=4.50"

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Reach D6: Ditch 6

Hydrograph



Bull Run Conveyance 3

Type IA 24-hr 25-Year Rainfall=4.50"

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Summary for Pond Overflow: Overflow Basins

Inflow Area = 466,788 sf, 72.69% Impervious, Inflow Depth = 3.77" for 25-Year event
 Inflow = 9.97 cfs @ 7.89 hrs, Volume= 146,716 cf
 Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 100%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
 Peak Elev= 685.19' @ 25.98 hrs Surf.Area= 143,344 sf Storage= 146,716 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
 Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	684.00'	760,666 cf	South Basin (Prismatic) Listed below (Recalc)
#2	684.00'	806,919 cf	North Basin (Prismatic) Listed below (Recalc)
		1,567,585 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
684.00	29,903	0	0
685.00	69,069	49,486	49,486
686.00	73,956	71,513	120,999
687.00	78,710	76,333	197,332
688.00	83,799	81,255	278,586
689.00	88,812	86,306	364,892
690.00	93,849	91,331	456,222
691.00	99,018	96,434	552,656
692.00	104,068	101,543	654,199
693.00	108,867	106,468	760,666

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
684.00	66,768	0	0
685.00	72,428	69,598	69,598
686.00	77,062	74,745	144,343
687.00	81,957	79,510	223,853
688.00	86,936	84,447	308,299
689.00	91,978	89,457	397,756
690.00	97,111	94,545	492,301
691.00	102,276	99,694	591,994
692.00	107,483	104,880	696,874
693.00	112,607	110,045	806,919

Bull Run Conveyance 3

Type IA 24-hr 25-Year Rainfall=4.50"

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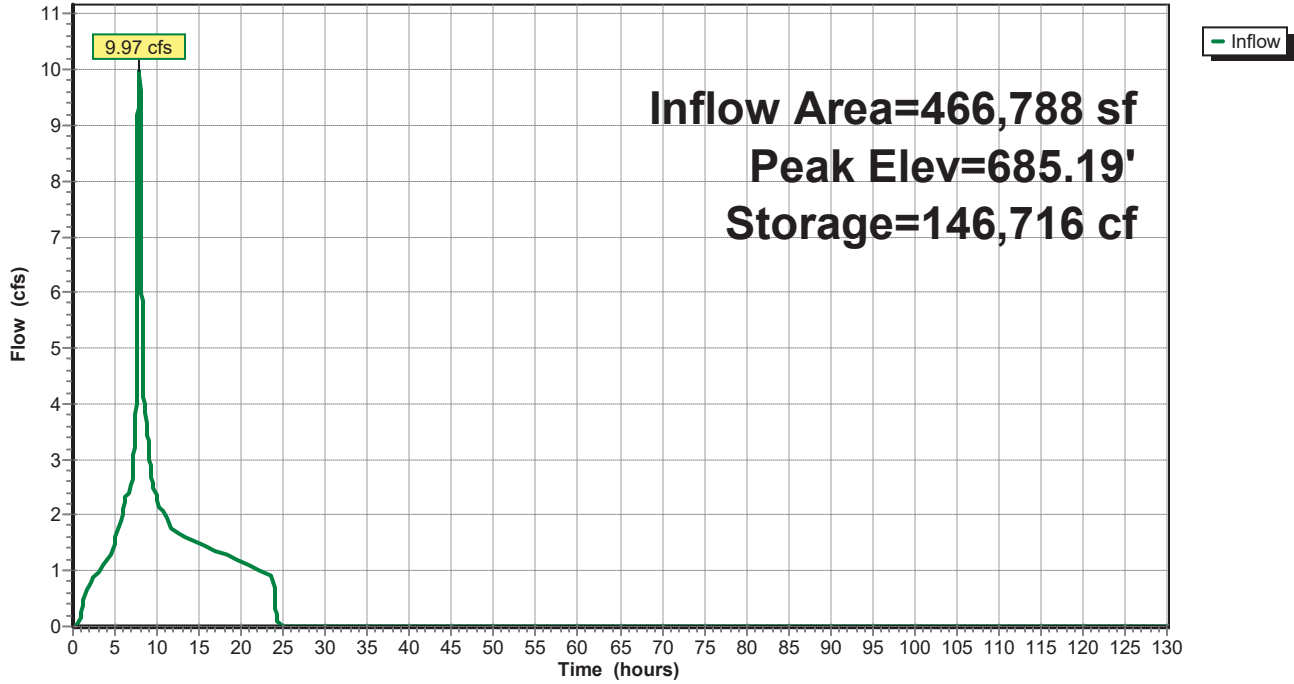
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Pond Overflow: Overflow Basins

Hydrograph



Bull Run Conveyance 3

Type IA 24-hr 25-Year Rainfall=4.50"

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Summary for Pond Pond E: Pond E

Inflow Area = 580,537 sf, 6.24% Impervious, Inflow Depth = 2.57" for 25-Year event
Inflow = 8.18 cfs @ 7.98 hrs, Volume= 124,523 cf
Outflow = 3.44 cfs @ 8.76 hrs, Volume= 124,456 cf, Atten= 58%, Lag= 46.4 min
Primary = 3.44 cfs @ 8.76 hrs, Volume= 124,456 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs
Peak Elev= 714.97' @ 8.76 hrs Surf.Area= 11,215 sf Storage= 18,803 cf

Plug-Flow detention time= 101.2 min calculated for 124,446 cf (100% of inflow)
Center-of-Mass det. time= 101.2 min (878.1 - 776.9)

Volume	Invert	Avail.Storage	Storage Description
#1	713.00'	31,308 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
713.00	7,916	0	0
714.00	9,540	8,728	8,728
715.00	11,265	10,403	19,131
716.00	13,090	12,178	31,308

Device	Routing	Invert	Outlet Devices
#1	Primary	713.00'	15.0" Round Culvert L= 44.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 713.00' / 712.80' S= 0.0045 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Device 1	711.00'	7.0" Horiz. Orifice/Grate C= 0.620 Limited to weir flow at low heads
#3	Device 1	713.95'	16.0" W x 3.0" H Vert. Orifice/Grate C= 0.620

Primary OutFlow Max=3.44 cfs @ 8.76 hrs HW=714.97' (Free Discharge)

- 1=Culvert (Passes 3.44 cfs of 5.95 cfs potential flow)
- 2=Orifice/Grate (Orifice Controls 1.87 cfs @ 6.98 fps)
- 3=Orifice/Grate (Orifice Controls 1.57 cfs @ 4.71 fps)

Bull Run Conveyance 3

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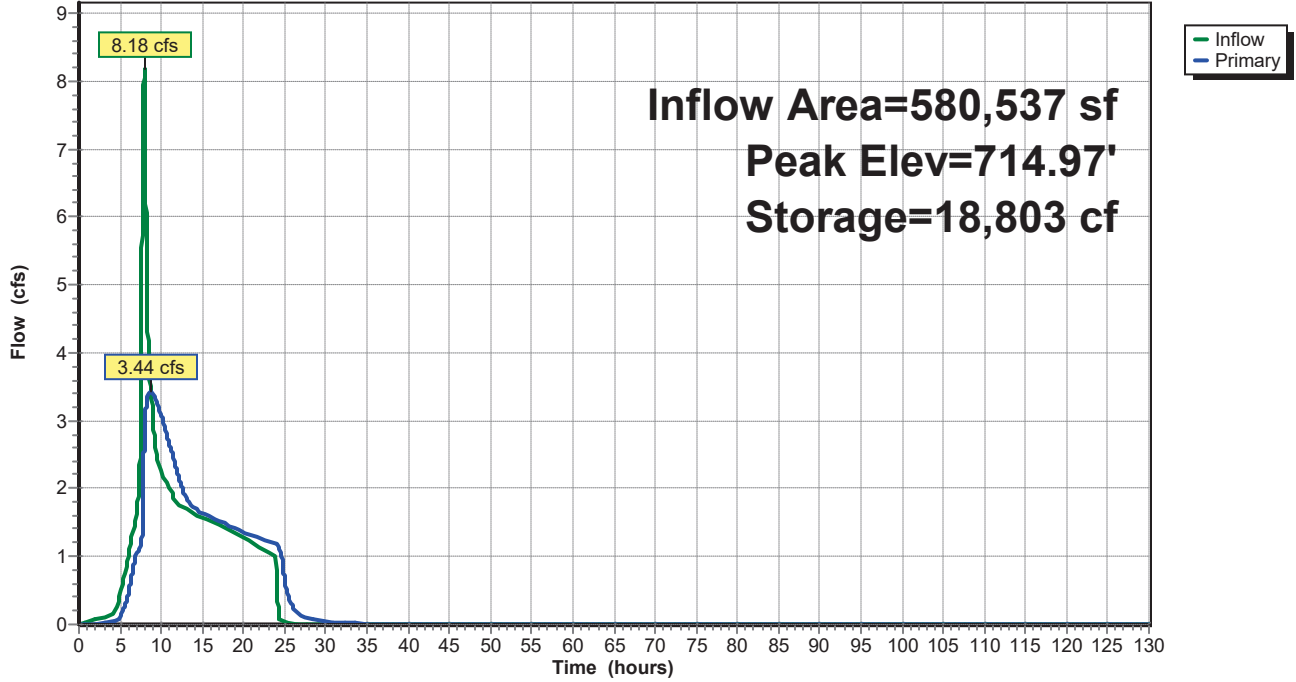
Type IA 24-hr 25-Year Rainfall=4.50"

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Pond Pond E: Pond E

Hydrograph



Bull Run Conveyance 3

Type IA 24-hr 25-Year Rainfall=4.50"

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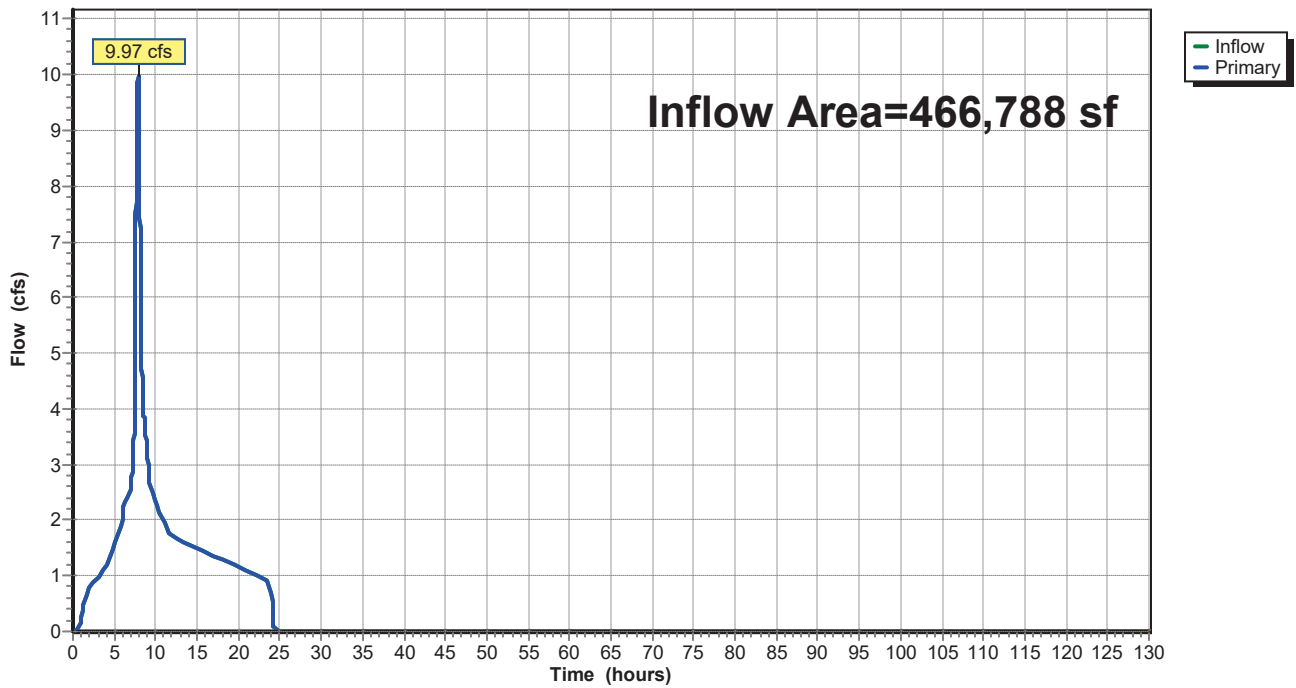
Summary for Link Pipe 27: Pipe 27

Inflow Area = 466,788 sf, 72.69% Impervious, Inflow Depth = 3.77" for 25-Year event
Inflow = 9.97 cfs @ 7.89 hrs, Volume= 146,716 cf
Primary = 9.97 cfs @ 7.89 hrs, Volume= 146,716 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-130.00 hrs, dt= 0.01 hrs

Link Pipe 27: Pipe 27

Hydrograph



Project: Bull Run Filtration Facility Piped Conveyance Analysis															
Date: 1/15/2024															
Calc'd By: Hankins															
Pipe Information and Calculations															
Pipe Number	Tributary Basins	Description	Q (Calc'd) "Q"	Pipe Dia. (inch) "D"	Pipe Dia. (ft) "D"	Manning's number "n"	Slope "S" %	Slope "S"	Area Full (Calc'd) "Af"	Wetted Perimeter (Calc'd) "WPF"	Hydraulic Radius (Calc'd) "Rf"	Velocity Full (Calc'd) "Vf"	Flow Rate Full (Calc'd) "Of"	% Pipe Capacity Used (Calc'd) "O/Of"	Velocity @ Q/Qf (Calc'd) "V"
Conveyance Analysis															
1	1-6, 23	From Pond A (Detained)	2.09	18	1.50	0.013	0.95	0.0095	1.767	4.712	0.375	5.809	10.266	20.4%	1.18
2	1-6, 18, 23		2.27	18	1.50	0.013	0.39	0.0039	1.767	4.712	0.375	3.722	6.578	34.5%	1.28
3	23		0.88	12	1.00	0.013	0.50	0.0050	0.785	3.142	0.250	3.216	2.526	34.8%	1.12
4	1, 2		1.74	12	1.00	0.013	0.53	0.0053	0.785	3.142	0.250	3.311	2.601	66.9%	2.22
5	3		0.86	10	0.83	0.013	0.63	0.0063	0.545	2.618	0.208	3.197	1.744	49.3%	1.58
6	1-3, 23		3.48	18	1.50	0.013	0.26	0.0026	1.767	4.712	0.375	3.039	5.371	64.8%	1.97
7	1-4, 23		3.88	18	1.50	0.013	0.26	0.0026	1.767	4.712	0.375	3.039	5.371	72.2%	2.20
8	5		0.32	10	0.83	0.013	0.56	0.0056	0.545	2.618	0.208	3.014	1.644	19.5%	0.59
9	1-5, 23		4.20	18	1.50	0.013	0.26	0.0026	1.767	4.712	0.375	3.039	5.371	78.2%	2.38
10	7		0.76	10	0.83	0.013	0.56	0.0056	0.545	2.618	0.208	3.014	1.644	46.2%	1.39
11	8		2.81	15	1.25	0.013	0.51	0.0051	1.227	3.927	0.313	3.769	4.626	60.7%	2.29
12	8, 9	From Pond B (Detained)	2.22	18	1.50	0.013	0.49	0.0049	1.767	4.712	0.375	4.172	7.373	30.1%	1.26
13	Pump		0.80	12	1.00	0.013	0.44	0.0044	0.785	3.142	0.250	3.017	2.370	33.8%	1.02
14	10		9.05	15	1.25	0.013	10.70	0.1070	1.227	3.927	0.313	17.265	21.187	42.7%	7.37
15	10, 11	From Pond C (Detained)	3.45	18	1.50	0.013	0.51	0.0051	1.767	4.712	0.375	4.256	7.522	45.9%	1.95
16	7, 12		1.86	10	0.83	0.013	1.00	0.0100	0.545	2.618	0.208	4.028	2.197	84.7%	3.41
17	13		2.46	12	1.00	0.013	0.50	0.0050	0.785	3.142	0.250	3.216	2.526	97.4%	3.13
18	7, 12-14	From Pond D (Detained)	2.79	12	1.00	0.013	1.69	0.0169	0.785	3.142	0.250	5.913	4.644	60.1%	3.55
19	1-7, 12-15, 18, 23		5.11	18	1.50	0.013	0.50	0.0050	1.767	4.712	0.375	4.215	7.448	68.6%	2.89
20	15		1.42	12	1.00	0.013	0.52	0.0052	0.785	3.142	0.250	3.280	2.576	55.1%	1.81
21	7, 12-15	From Flow Splitter	0.66	8	0.67	0.013	0.76	0.0076	0.349	2.094	0.167	3.026	1.056	62.5%	1.89
22	7, 12-15	From Flow Splitter	3.18	18	1.50	0.013	0.51	0.0051	1.767	4.712	0.375	4.256	7.522	42.3%	1.80
23	16		1.54	10	0.83	0.013	2.20	0.0220	0.545	2.618	0.208	5.974	3.259	47.3%	2.82
24	1-7, 12-16, 18, 23		6.49	18	1.50	0.013	0.50	0.0050	1.767	4.712	0.375	4.215	7.448	87.1%	3.67
25	8-11, 22		5.83	18	1.50	0.013	15.00	0.1500	1.767	4.712	0.375	23.084	40.793	14.3%	3.30
26	20, 24	From Pond E (Detained)	3.44	15	1.25	0.013	0.45	0.0045	1.227	3.927	0.313	3.541	4.345	79.2%	2.80
27	17, 21	From Pump Station	4.00	15	1.25	0.013	2.00	0.0200	1.227	3.927	0.313	7.464	9.160	43.7%	3.26
28	17, 19, 21		4.50	15	1.25	0.013	7.88	0.0788	1.227	3.927	0.313	14.816	18.182	24.7%	3.67
29	1-7, 12-19, 21, 23		10.99	24	2.00	0.013	0.41	0.0041	3.142	6.283	0.500	4.623	14.524	75.7%	3.50
30	1-19, 21-23		16.82	30	2.50	0.013	0.41	0.0041	4.909	7.854	0.625	5.365	26.334	63.9%	3.43
31	24		3.65	12	1.00	0.013	1.30	0.0130	0.785	3.142	0.250	5.186	4.073	89.6%	4.65
EX1	7, 12-15	Existing 8" Culvert	0.66	8	0.67	0.013	10.11	0.1011	0.349	2.094	0.167	11.037	3.853	17.1%	1.89

Attachment H: Outfall Flow Spreader Calculations and Details

Attachment H - Flow Spreader

Project Description	
Solve For	Crest Elevation
Input Data	
Discharge	16.82 cfs
Headwater Elevation	100.00 ft
Tailwater Elevation	99.90 ft
Crest Surface Type	Paved
Crest Breadth	1.00 ft
Crest Length	175.0 ft
Results	
Crest Elevation	99.90 ft
Headwater Height Above Crest	0.10 ft
Tailwater Height Above Crest	0.00 ft
Weir Coefficient	$2.93 \text{ ft}^{(1/2)}/\text{s}$
Submergence Factor	1.000
Adjusted Weir Coefficient	$2.93 \text{ ft}^{(1/2)}/\text{s}$
Flow Area	17.9 ft ²
Velocity	0.94 ft/s
Wetted Perimeter	175.2 ft
Top Width	175.00 ft

Attachment I: Stormwater Pond Cross Sections, Basins, Planters, Grassy Swale and Flow Control Manholes

See Land Use drawings under separate cover.