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Post Construction Stormwater Management Plan Narrative

Atlantic Sunrise Project

Permanent Access Roads
Falls Township
Wyoming County
Pennsylvania

Prepared For:

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* Road-specific Appendix letters correspond to the road-specific Appendix included in the **E&SC Narrative for Wyoming County included in Section 2 of the ESCGP-2 NOI**. Supporting calculations are provided for permanent access roads only in this narrative.

GENERAL INFORMATION

Project Description

The following post construction stormwater management (PCSM) narrative describes the PCSM designs for the permanent access roads to mainline valves (MLVs) to be constructed within Wyoming County (County), Pennsylvania as part of the Transcontinental Gas Pipe Line Company, LLC (Transco) Atlantic Sunrise Project (“Project”). This narrative supplements the Erosion & Sediment Control (E&SC) Plan and Site Restoration (SR) Plan Narrative included in **Section 2 of the Erosion and Sediment Control General Permit 2 (ESCGP-2) Notice of Intent (NOI)**.

The Project includes modifications to the existing Transco Mainline system to reverse the direction of flow, enabling new north-to-south capabilities (bi-directional flow) to transport this new source of natural gas to existing markets. In Wyoming County, the main Project improvements that the temporary and permanent access roads will support include installation of a 30-inch-diameter greenfield pipeline referred to as the Central Penn Line (CPL) North pipeline.

Where possible, existing public and private roads will be utilized to provide access to the pipeline ROW during and after construction. During construction, E&SC BMPs will be installed along all access roads as shown on the road-specific Soil Erosion Control Plans included in the Erosion & Sediment Control and Layout Plans for Access Roads in **Section 2 of the ESCGP-2 NOI**.

Permanent gravel access roads will be installed, and maintained by Transco, to provide access to MLVs and select portions of the pipeline right of way (ROW) for pipeline maintenance and inspections in accordance with applicable regulatory guidelines. The increase in impervious area for the permanent access roads that provide access to the MLVs is permanent. However, the proposed increase in impervious area for the permanent access roads to the pipeline ROW is temporary. Similar to temporary access roads, upon construction completion, the proposed road materials will be removed and the impacted areas will be restored to pre-construction conditions. Transco operations will use the restored road surface to access the ROW as necessary in the future. Typically, pickup trucks will be used to perform routine maintenance and inspections and the trucks are capable of driving over grassy areas similar to the pipeline ROW. The permanent access roads to be restored to pre-construction conditions are not included in this PCSM Narrative. Only the access roads to MLV sites with permanent improvements are included in this PCSM Narrative.

References

E&SC Best Management Practices (E&SC BMPs), in accordance with the standards and specifications in the Pennsylvania Department of Environmental Protection's (PADEP's) "Erosion and Sediment Pollution Control Program Manual," Technical Guidance No. 363-2134-008, as amended and updated (E&SC Manual) will be used during the construction phase of the project. The proposed practices are designed to achieve the regulatory standard of minimizing the potential for accelerated erosion and sedimentation associated with temporary earth disturbance activities. The E&SC BMPs will remain in place until the surrounding area has reached final stabilization. An area shall be considered to have achieved final stabilization when it has a minimum uniform 70% perennial vegetative cover or other permanent non-vegetative cover with a density sufficient to resist accelerated surface erosion and subsurface characteristic sufficient to resist sliding and other movements.

PCSM BMPs, in accordance with the PADEP's "Pennsylvania Stormwater Best Management Practices Manual," Technical Guidance No. 363-0300-002, as amended and updated (PCSM Manual), will be used for site restoration and post construction stormwater management measures.

Impacts to wetlands, streams or waterbodies will be avoided to the maximum extent practicable. Refer to the Wetland Delineation Report provided as **Section 5 of the ESCGP-2 NOI** for information supporting wetland mapping shown on the E&SC Plans (**Section 2 of the ESCGP-2 NOI**).

Permanent Access Roads

The following permanent access roads that will provide access to an MLV are proposed to be constructed in Wyoming County to support the CPL North pipeline:

Access Road	Mile Post (MP)	Major River Basin	Receiving Water	Existing Use	Chapter 93 Designated Use	Impairment	Total Maximum Daily Load
WY-028	MP 35.8	Susquehanna River	UNT to Susquehanna River	None	CWF, MF	None	None
WY-029	MP 35.2	Susquehanna River	Susquehanna River	None	WWF, MF	Source Unknown (PCB); Source Unknown (Mercury)	TMDL, 1999 (PCBs) TMDL, 2009 (metals)

1.0 COMMON INFORMATION

1.1 Topographic Features

See **Appendices K and L-1** for road-specific United States Geological Survey mapping.

1.2 Soil Characteristics

AECOM prepared the United States Department of Agriculture Natural Resources Conservation Service (NRCS) Custom Soil Resource Report for the counties crossed by the CPL North pipeline. The NRCS Custom Soil Resource Report for Wyoming County, Pennsylvania and the Soil Association Maps prepared by Wood Group Mustang Inc. are included in Appendix C of the **E&SC Narrative for Wyoming County included in Section 2 of the ESCGP-2 NOI.** Soil type and use limitations for the permanent access roads to the MLV sites are presented in Table 1.2.1 below.

Table 1.2.1

Soil Type and Use Limitations for Wyoming County

Map Symbol	Soil Name	Slope	Cut Banks Cave	Corrosive to Concrete or Steel	Droughty	Easily Erodible	Flooding	High Water Table	Hydric/Hydric Inclusions	Low Strength	Slow Percolation	Piping	Poor Source of Topsoil	Frost Action	Shrink-Swell	Potential Sinkhole	Ponding	Wetness
McB	Mardin channery silt loam:	3-8%	X	S	X	X		X	X	X	X	X		X				X
OYE	Oquaga and Lordstown extremely stony loam	steep	X	C	X	X			X	X	X	X		X				
Pp	Pope soils, rarely flooded		X	C/S		X	X		X	X	X	X	X	X				
SxD	Swartswood extremely stony loam	8-25%	X	C	X	X		X		X	X	X	X					
UnB UnC	Unadilla silt loam	3-8% 8-15%	X	C		X			X	X	X	X		X				

Source: Appendix E, Table E-1, PADEP, *Erosion and Sediment Pollution Control Program Manual*, Technical Guidance Number 363-2134-008.

Table 1.2.2

Soil Use Limitations Resolutions

Limitation	Resolution
Slopes	Excavations should be stabilized to prevent erosion and contractor should employ proper construction techniques to ensure safety on steep slope areas.
Cut Banks Cave	Excavations will be properly supported by sheeting and shoring to prevent caves.
Corrosive to Concrete or Steel	No concrete or steel piping is proposed without appropriate coatings and protection.
Droughty	Existing suitable topsoil and soil amendments will be used during construction as necessary.
Easily Erodible	Temporary and permanent E&SC BMPs will be employed throughout the construction and operation of the access roads.
Flooding	Ensure that the access roads have has proper drainage and no obstructions within floodway/floodplain.
High Water Table	A geotechnical investigation was conducted to minimize conflicts with saturated zones.
Hydric/Hydric Inclusions	A wetland investigation was completed. Impacts to wetlands have been minimized by modifying the access road alignment to avoid wetlands and/or protecting wetlands with E&SC BMPs where existing roads are adjacent to wetlands.
Low Strength	A maximum of 3:1 slopes area proposed.
Slow Percolation	A field investigation of percolation rates at the infiltration areas will be performed to verify the soils percolation capacity.
Piping	Watertight pipe, antiseep collars, clay cores through basin berms, and concrete endwalls will be used to minimize water movement via pipe bedding.
Poor Source of Topsoil	Existing topsoil, which has proven to be suitable, will be reused on the site.
Frost Action	Gravel specified in lieu of pavement to minimize frost effects.
Shrink-Swell	Gravel specified in lieu of pavement.
Potential Sinkhole	Geotechnical Engineer of record recommendations will be followed for any potential occurrences.
Ponding	Surface grading and drainage facilities will be provided to minimize ponding affects.
Wetness	Wet weather construction recommendations, per the Geotechnical Engineer's recommendations, will be employed to minimize the effects of wetness during construction, surface grading. Surface grading and drainage will be provided to minimize wetness affects after construction.

1.3 Earth Disturbance Activity

The proposed permanent access road is located in agricultural lands. The proposed land use is for a permanent access road intended to provide a means of ingress/egress to/from the MLV site for operations. The proposed alteration of the land includes modifying the existing access road ROW to accommodate a 14 foot wide gravel access road. Installing the access road requires grading activity to construct the new road. See the **E&SC Plans for Wyoming County included in Section 2 of the ESCGP-2 NOI**.

Characterization of Land Use

The characterization of land use within the proposed CPL North project areas is based on interpretation of aerial photographs taken in the spring of 2014 and information gathered from field surveys conducted during 2014 and 2015. Transco classified land uses within the proposed Project areas into the following eight broad types:

1. Agricultural Land – land associated with active cultivation of ROW and field crops; areas of grasses planted for livestock grazing or for the production of hay crops; orchards; and specialty crops, including vineyards, Christmas trees, and fruits and vegetables.
2. Upland Forest/Woodland – includes upland deciduous forest, evergreen forest, and mixed (deciduous and evergreen) forest, but does not include forested wetlands.
3. Industrial/Commercial Land – land used for mines or quarries and associated processing plants; manufacturing or other industrial facilities; and land developed for commercial or retail uses, including malls, strip plazas, business parks, and medical facilities.
4. Transportation Land – land used for transportation purposes, including interstate highways; state, county, and local highways and roads; and railroad lines.
5. Residential Land – residential areas, including yards of individual residences.
6. Open Land – non-forested and undeveloped land not classified for another use, including land maintained as utility ROWs for overhead and underground electric transmission, natural gas transmission, and oil transmission facilities.
7. Wetlands – includes wetlands covered with emergent, scrub-shrub, and forested vegetation.
8. Open Water – include rivers, streams, creeks, canals, and other linear waterbodies, as well as lakes, ponds, and other non-flowing waterbodies.

Area Types

The access road construction ROW is comprised of the following area types:

- Limit of Disturbance (LOD) Area – The LOD area is the construction ROW for the access roads. For most roads, this area is 50 feet wide and centered on the centerline of the access road. In areas where grading and/or E&SC BMPs require more room, the LOD has been expanded to encompass the proposed improvement area.
- ESCGP-2 Permit Boundary/Site Area – The ESCGP-2 Permit Boundary/Site Area is the area to be permitted for improvements with the Chapter 102 Application. This area is slightly larger than the LOD area. The limit of the ESCGP-2 Permit Boundary/Site Area is typically offset 5 feet from the LOD limit for access roads.

  Future changes made to the LOD area that are still within the ESCGP-2 Permit Boundary/ Site Area would likely be considered a minor modification to the Project's Chapter 102 Permit. However, future changes to the LOD area that are outside the ESCGP-2 Permit Boundary/Site Area may require a major modification to the Permit.
- Area of Minimum Disturbance/Reduced Grading – The Area of Minimum Disturbance/Reduced Grading is the area within the LOD area that is outside the proposed grading area. Disturbances within the Area of Minimum Disturbance/Reduced Grading will be minimal.
- LOD Area within Floodway/Floodplain – The LOD Area within Floodway/Floodplain is the area within the LOD that is within a FEMA (Federal Emergency Management Agency) designated Floodplain or an assumed floodway that extends approximately 50 feet from the top of bank of a stream landward. The LOD Area within Floodway/Floodplain have been coordinated with the Chapter 105 Permit application. For most of the access roads, where the LOD crosses a floodway/floodplain, the LOD area has been minimized and the existing road will be used. Where the existing road cannot support the intended traffic loads, timber matting will be installed to provide an adequate driving surface.
- Stormwater Management Area – The Stormwater Management Area is calculated using Worksheet #3. For the permanent access roads, the Stormwater Management Area is equal to the LOD Area because no credit is taken for protected areas. The LOD is minimized at wetlands and streams to mimimize impacts. Where the LOD crosses a floodway/floodplain, the existing road will be used with matting, as necessary.

- Area Controlled by BMPs – The Area Controlled by BMPs is the drainage area that discharges to either the vegetated channel or MLV pad. The pre- and post-construction cover types for the Area Controlled by BMPs are summarized in Worksheet #4.

1.4 Project Site Runoff

The E&SC BMPs for the access roads are sized using E&SC Worksheets 1 and 11 of the PADEP E&SC Manual. These worksheets take into consideration the slope length above the sediment barrier and the drainage area contributing to the channel, respectively. (See the road-specific appendices of the **E&SC Narrative for Wyoming County included in Section 2 of the ESCGP-2 NOI** for road-specific worksheets.)

For temporary access roads and permanent access roads that provide access to the pipeline ROW only, no permanent change in cover is proposed. Disturbed areas will be restored to pre-construction conditions. Therefore, no change in runoff rate or volume is anticipated.

For permanent access roads that provide access to MLVs, a summary table presenting the change in runoff volume for the 2-year 24-hour design storm and the change in peak rate of runoff for the 1-year, 2-year, 5-year, 10-year, 25-year, 50-year and 100-year 24-hour design storms for pre-construction and post construction conditions, along with the supporting calculations, are provided for each permanent access road in the road-specific narratives appended to this narrative.

Act 167 Summary

Where applicable, Act 167 Plan names and adoption dates for each access road watershed are included in the road-specific narratives appended to this narrative.

The proposed permanent access roads are located in the Bowman Creek Act 167 Stormwater Management Plan for Wyoming County. However, this Act 167 Plan was not approved after 2005. Therefore, the Site was designed to comply with section 25 Pa. Code §§ 102.8(g)(2) & 102.8(g)(3) and the recommended Control Guideline – 1 (CG-1) form

1.5 Surface Water Classification

The locations and Chapter 93 designation of the streams and wetlands near the LOD for the permanent access roads are shown on the PCSM Plans (**Section 2 of the ESCGP-2 NOI**).

1.6 BMP Description Narrative

E&SC BMPs, consistent with the PADEP E&SC Manual, are planned to be used along the temporary and permanent access roads before, during, and after earth disturbance activities. E&SC BMPs will be installed prior to disturbance of tributary areas. Installation and maintenance guidelines, as well as E&SC BMP locations are described in the **E&SC Narrative for Wyoming County included in Section 2 of the NOI** and shown on the E&SC Plans (**Section 2 of the ESCGP-2 NOI**) and the Best Management Practices and Quantities Plan.

For permanent access roads that require an increase in impervious area, additional PCSM BMPs will be installed to manage the additional runoff created by the change in pre- and post-development conditions. The PCSM BMPs that will be used for the permanent access roads include the following:

PCSM BMPs

- Vegetated Channel: Vegetated Channels shall be installed to collect and attentuate runoff volume from adjacent impervious areas, allowing some pollutants to settle out in the process. Permanent Check Dams are used to enhance attenuation and pollutant removal.
- Check Dams: Check Dams will be installed as shown on the Plans and Detail Sheets. Check Dams dissipate energy from the concentrated flow in roadside ditches and channels to prevent erosion of the channel and at the outlet.The Check Dams will be earthen check dams with a height of 12 inches, typically.
- Stone Valve Site Void Storage: Runoff from the proposed permanent access roads may be detained in the void space between the stone at the MLV sites (mainline valves) to attenuate the peak rate of runoff for up to the 100-year design storm event. The valve sites will be comprised of 6 inches of AASHTO #8 aggregate over a heavy nonwoven geotextile over 12 inches to 30 inches of AASHTO #57 aggregate. The depth of the AASHTO #57 aggregate varies based on the detention volume needed to attenuate the volume of runoff for the 100-year storm. Dewatering calculations for the valve sites are included in the road-specific narratives appended to this narrative.
- Riprap Aprons/Outlet Protection: Riprap Aprons shall be installed to dissipate energy from flow concentrated at culverts and vegetated channels. Permanent Riprap Aprons will remain in place and be part of the final PCSM design.
- Permanent Vegetative Stabilization: Upon reaching final grades, and upon cessation of earth disturbance activities, disturbed areas will receive topsoil, seed, and mulch to establish permanent vegetative stabilization.

1.7 BMP Installation Sequence Narrative

Refer to the E&SC Plans (**Section 2 of the ESCGP-2 NOI**) for the location of the proposed work and the associated E&SC and PCSM BMPs. A road-specific construction sequence is provided in **Appendices K and L-1**.

1.8 Supporting Calculations and Measurements

Supporting calculations for each permanent access road design are provided in the road-specific narratives appended to this narrative.

The access roads have been designed to meet the requirements of 25 Pa. Code§§ 102.8, including sections 102.8(g)(2) & 102.8(g)(3) as reproduced below:

(g) PCSM Plan stormwater analysis. Except for regulated activities that require site restoration or reclamation, and small earth disturbance activities identified in subsection (n), PCSM Plans for proposed activities requiring a permit under this chapter require the following additional information:

> ***(1) Predevelopment site characterization and assessment of soil and geology including appropriate infiltration and geotechnical studies that identify location and depths of test sites and methods used.***
>
> ***(2) Analysis demonstrating that the PCSM BMPs will meet the volume reduction and water quality requirements specified in an applicable Department approved and current Act 167 stormwater management watershed plan; or manage the net change for storms up to and including the 2-year/24-hour storm event when compared to preconstruction runoff volume and water quality. The analysis for the 2-year/24-hour storm event shall be conducted using the following minimum criteria:***
>
> > ***(i) Existing predevelopment nonforested pervious areas must be considered meadow in good condition or its equivalent except for repair, reconstruction or restoration of roadways or rail lines, or construction, repair, reconstruction or restoration of utility infrastructure when the site will be returned to existing condition.***
> >
> > ***(ii) When the existing project site contains impervious area, 20% of the existing impervious area to be disturbed must be considered meadow in good condition or better, except for repair, reconstruction or restoration of roadways or rail lines, or construction, repair,***

reconstruction, or restoration of utility infrastructure when the site will be returned to existing condition.

(iii) When the existing site contains impervious area and the existing site conditions have public health, safety or environmental limitations, the applicant may demonstrate to the Department that it is not practicable to satisfy the requirement in subparagraph (ii), but the stormwater volume reduction and water quality treatment will be maximized to the extent practicable to maintain and protect existing water quality and existing and designated uses.

(iv) Approaches other than that required under paragraph (2) may be proposed by the applicant when the applicant demonstrates to the Department that the alternative will either be more protective than required under paragraph (2) or will maintain and protect existing water quality and existing and designated uses by maintaining the site hydrology, water quality, and erosive impacts of the conditions prior to initiation of any earth disturbance activities.

(3) Analysis demonstrating that the PCSM BMPs will meet the rate requirements specified in an applicable Department approved and current Act 167 stormwater management watershed plan; or manage the net change in peak rate for the 2-, 10-, 50-, and 100-year/24-hour storm events in a manner not to exceed preconstruction rates.

(i) Hydrologic computations or a routing analysis are required to demonstrate that this requirement has been met.

(ii) Exempt from this requirement are Department- approved direct discharges to tidal areas or Department-approved no detention areas.

(iii) Approaches other than that required under paragraph (3) may be proposed by the applicant when the applicant demonstrates to the Department that the alternative will either be more protective than required under paragraph (3) or will maintain and protect existing water quality and existing and designated uses by maintaining the preconstruction site hydrologic impact.

1.9 Plan Drawings

Full size copies of the permanent access road PCSM Plans have been provided under separate cover in **Section 3 of the ESCGP-2 NOI**.

Preparer Qualifications are included in **Appendix D**.

1.10 Long Term Operation and Maintenance Schedule

E&SC BMPs shall be maintained properly throughout Project construction as described in the **E&SC Narrative for Wyoming County included in Section 2 of the NOI**. Until an access road is stabilized, the associated E&SC BMPs shall be maintained properly. Maintenance shall include inspections of E&SC BMPs after each runoff event and on a weekly basis. Preventative and remedial maintenance work, including clean out, repair, replacement, re-grading, reseeding, and re-mulching must be initiated immediately. If the E&SC BMPs fail to perform as expected, replacement E&SC BMPs, or modifications of those installed will be required.

After project completion, the PCSM BMPs will be monitored and maintained as described below:

Monitoring

Transco's personnel (Operations) will perform visual inspections on an annual basis after permit closure to ascertain that the PCSM BMPs are functioning and operating effectively to ensure the MLV sites and associated permanent access roads are causing no undue burden on the property owner or adjacent owners. Repairs of deficiencies will be initiated within ten business days of discovery.

Maintenance

The Contractor will be responsible for the maintenance of the PCSM BMPs during construction. After construction, the PCSM BMPs will be owned and maintained by Transco.

Maintenance of the PCSM BMPs after acceptance by the Owner will consist of routine cleaning of accumulated sediment and debris. The specific maintenance steps and schedule are listed below:

PCSM BMPs Inspection

PCSM BMPs (vegetated channels and rock within the MLV site) are to be inspected annually for sediment, build-up and erosion debris. The sediment, debris, trash and any other waste material removed from the PCSM BMPs shall be disposed of at a suitable disposal or recycling site and in compliance with local, state and federal waste regulations.

- Vegetated Channel and Check Dams: Vegetated channels shall be inspected annually and within 48 hours after every major storm event (> 1 inch rainfall depth) as follows:
  - Inspect and correct erosion problems, damage to vegetation, and sediment and debris accumulation (address when > 3 inches at any spot or covering vegetation);
  - Inspect vegetation on side slopes for erosion and formation of rills or gullies, correct as needed;
  - Inspect for pools of standing water; dewater and discharge to an approved location and restore to design grade;
  - Mow and trim vegetation to ensure safety, aesthetics, proper vegetated channel operation, or to suppress weeds and invasive vegetation; dispose of cuttings in a local composting facility; mow only when vegetated channel is dry to avoid rutting;
  - Inspect for litter; remove prior to mowing;
  - Inspect for uniformity in cross-section and longitudinal slope, correct as needed; and
  - Inspect vegetated channel inlet and outlet for signs of erosion or blockage, correct as needed.

  Maintenance activities to be done as needed:

  - Plant alternative grass species in the event of unsuccessful establishment;
  - Reseed bare areas; install appropriate erosion control measures when native soil is exposed or erosion channels are forming;
  - Rototill and replant vegetated channel if draw down time is more than 48 hours;
  - Inspect and correct check dams when signs of altered water flow (channelization, obstructions, erosion, etc.) are identified; and
  - Water during dry periods, fertilize, and apply pesticide only when absolutely necessary.
- Infiltration Basin: The infiltration basin shall be inspected annually and within 48 hours after every major storm event (> 1 inch rainfall depth) as follows:

  - Inspect slope and integrity of basin to ensure proper functionality;
  - Inspect for pools of standing water; dewater and discharge to an approved location and restore to design grade;
  - Mow and trim vegetation to ensure safety, aesthetics, or to suppress weeds and invasive vegetation; dispose of cuttings in a local composting facility;
  - Avoid running heavy equipment over the infiltration area at the base of the basin;
  - Remove accumulated trash and debris; and
  - Inspect for signs of flow channelization; restore level gradient immediately after deficiencies are observed.
- Stone Valve Site Void Storage: MLV sites shall be inspected annually as follows:
  - Inspect and correct erosion problems, disruption to stone, and sediment and debris accumulation;
  - Inspect stone for erosion and formation of rills or gullies, correct as needed;
  - Inspect for pools of standing water; dewater and discharge to an approved location and restore to design grade; and
  - Remove litter.

Annual Records of Maintenance Procedures

The Owner shall maintain a checklist whenever the PCSM BMPs are inspected and cleaned. An annual list of inspections and major cleaning operations and repairs shall be maintained. Upon request, the local CCD or enforcement officials shall have access to those records. The Owner shall ensure compliance with ESCGP-2 Permit requirements by meeting all ongoing recordkeeping maintenance, and other applicable ESCGP-2 and PADEP permit conditions.

1.11 Material Recycling and Disposal

Maintenance of the permanent access roads that provide access to the MLV sites will require the removal of materials (i.e., sediment, debris, and litter). The materials shall be dispose of at suitable disposal or recycling sites in compliance with local, state and federal regulations.

Transco has prepared a Spill Plan for Oil and Hazardous Materials to assist in prevention of any spills that may occur at the MLV site and to respond to any spills that do occur. The Spill Plan for Oil and Hazardous Materials is included as Attachment 9 to the ECP provided as **Section 4 of the ESCGP-2 NOI**.

1.12 Soil Conditions and Geologic Formations

AECOM conducted a review of the proposed CPL North pipeline for the potential of geologic formation which may cause pollution if disturbed or exposed during construction.

Karst Bedrock Formations

As identified by AECOM, naturally–occurring bedrock formations and soils types that may cause pollution are present along portions of the CPL North construction ROW. Bedrock formations that may cause pollution are associated with karst or acid-forming conditions include the following:

- Conestoga Formation
- Vintage Formation
- Buffalo Springs Formation
- Ledger Formation
- Zooks Corner Formation
- Snitz Creek Formation
- Millbach Formation
- Stonehenge Formation
- Epler Formation
- Richenbach Formation
- Ontelaunee Formation
- Annville Formation
- Hershey-Myerstown Formation
- Keyser-Tonoloway Formation

There are two bedrock formations that do not form significant karst terrain along the proposed CPL North pipelines, which include Hamburg Sequence/limestone unit and Hamilton Group/Tully limestone unit.

Acid-Producing Sulfide Bedrock Formations

In the review of the NRCS data for the proposed CPL North pipeline route, several acid-producing sulfide bedrock formations are located along the proposed route. These formations are as follows:

- Pottsville Formation (anthracite coal-bearing)
- Llewelyn Formation (anthracite coal bearing)

Formations containing variable amounts of pyrite or other sulfide minerals that may only locally be acid-producing are found along the proposed CPL North pipeline. These formations can be determined only by site-specific acid-drainage investigation, and are identified as follows:

- Octoraro schist
- Conestoga phyllite
- Antietam-Harpers schist
- Kinzers shale

- Cocalico shale
- Hamburg/Martinsburg shale

Table 6 in the Best Management Practices and Quantities Plan Set provides the locations of the acidic bedrock.

Acidic Soils

For the proposed CPL North pipeline, based on review of the attached NRCS Custom Soil Resource Report provided in **Appendix C**, acidity levels of the soils found along the proposed CPL North route do not fall within the pH range that is considered to be a potential source of pollution that must be mitigated. Should acidic soils with a pH of 4.0 or lower be encountered during the construction of the temporary and permanent access roads, the following Acid Producing Soils and Bedrock Control Plan shall be implemented. Table 5 in the Best Management Practices and Quantities Plan provides the locations of soils and their respective acidity levels. A road specific Soil Acidity Table is included for each road in the road specific appendices attached to this document.

Acid Producing Soils and Bedrock Control Plan

The following acid producing soils control plan was developed to identify BMPs and procedures for minimizing the potential for pollution associated with the disturbance of the areas associated with the construction of the temporary and permanent access roads that contain acid-producing soils with a pH less than 4.0.

1. Contractor shall limit the excavation area and exposure time when high acid-producing soils are encountered. Locations where acidic soils are anticipated to be present along the access roads are provided in the road specific narratives included in this document and on the E&SC plans included in Section 2 of the ESCGP-2 NOI.

2. Contractor shall separately store topsoil stripped from the site away from temporarily stockpiled high acid-producing soils and bedrock.

3. Contractor shall stockpile high acid-producing soils and bedrock material on level ground to minimize its movement, especially when these materials have a high clay content.

4. Contractor shall cover temporarily stockpiled high acid-producing soil and bedrock material to be exposed more than 7 days with properly anchored, heavy-grate sheets of polyethylene, where possible. If not possible, stockpiles shall be covered with a minimum of three to six inches of wood chips to minimize erosion of the stockpile. In addition, the contractor shall install silt fence at the toe of the

stockpile slope to contain movement of material. Contractor shall not apply topsoil to the high acid-producing soil or bedrock stockpiles to prevent topsoil contamination.

5. Contractor shall ultimately dispose of high acid-producing soils or bedrock with a pH of four or less, or containing iron sulfide (including borrow from cuts) by placing the material combined with limestone at the rate of 6 tons per acre (or 275 pounds per 1,000 square feet of surface area) and covering the mixture with a minimum of 12 inches of settled soils with a pH of five or more except as follows:

    a. In the areas where trees or shrubs are to be planted, the contractor shall cover the limestone/soil mixture with a minimum of 24 inches of soils with a pH of five or more.

    b. Contractor shall not locate any disposal area within 24 inches of any surface of a slope or bank, such as berms, stream banks, ditches, and other surface waters to prevent potential lateral leaching damages.

6. At the end of each day, contractor shall clean all equipment used to handle high acid-producing soils or bedrock to prevent spreading of high-acid materials to other parts of the proposed right-of-way, into streams, or stormwater conveyances, and to protect machinery from accelerated corrosion.

7. Contractor shall provide and install non-vegetative erosion controls (stone tracking pads, strategically-place limestone check dams, silt fences, wood chips) to limit the movement of high acid-producing soils from, around, or off areas disturbed for access road construction.

8. Following the burial or removal of high acid-producing soils and bedrock, top soiling, and seeding of the areas restored after the removal of the temporary access roads and permanent access roads that provide access to the pipeline right-of-way, Transco shall monitor the site for approximately six to 12 months to assure there is adequate stabilization and that no high-acid soil or bedrock problems emerge. Contractor shall correct any problems that are discovered within this time period.

9. If problems occur where high acid-producing soils or bedrock have been placed or buried, the applicant shall monitor these areas for at least two years to assure there is no migration of potential acid leachate.

1.13 Thermal Impacts

Thermal impacts associated with access roads will be avoided to the maximum extent practicable by implementing the following measures:

- Limit removal of vegetation, especially tree cover, to only that necessary for construction;
- Minimize permanent impervious surfaces;
- Install a gravel surface for the access roads rather than asphalt; and
- Incorporate the use of stone at mainline valves and vegetated vegetated channels with earthen check dams to provide storage for stormwater runoff.

See the road-specific narratives for a road-specific discussion on thermal impacts.

1.14 E&SC Plan and PCSM Plan Consistency

The E&SC Plans (**Section 2 of the ESCGP-2 NOI**), the E&SC Narrative, and this PCSM Narrative have been designed and will be constructed to be consistent with the PCSM Plans (**Section 3 of the ESCGP-2 NOI**). Following completion of construction, disturbed areas shall be stabilized and the long-term maintenance of the PCSM BMPs will begin.

1.15 Riparian Buffer Waiver

A comprehensive Riparian Buffer narrative is provided in the “Erosion and Sediment Control Plan Narrative” for the portion of the CPL North pipeline located in Wyoming County (**Section 2 of the ESCGP-2 NOI**).

No access roads within Wyoming County require a riparian buffer waiver.

1.16 Antidegradation Requirements

The permanent access roads have been designed to maintain pre-construction rates of runoff by detaining and infiltrating stormwater within the MLV site and vegetated channels. There are no opportunities for non-discharge alternatives such as connecting to a sewer system or capturing stormwater in rain barrels for reuse as irrigation.

1.17 TMDL

Road-specific Total Maximum Daily Load (TMDL) discussions are provided in the road-specific narratives.

APPENDIX A

Intentionally Omitted by Applicant

APPENDIX B

Intentionally Omitted by Applicant

APPENDIX C

United States Department of Agriculture Natural Resources Conservation Service Custom Soil Resource Report

Included under separate cover in Appendix C of the E&SC Narrative for Wyoming County included in Section 2 of the ESCGP-2 NOI

APPENDIX D

Supporting Information

Appendix D.1 – Preparer Qualifications
Appendix D.2 – North American Green Product Data

Appendix D.1 – Preparer Qualifications

NAME OF PLAN PREPARER: Suzanne Marie King, PE

FORMAL EDUCATION:

Name of College or Technical Institute: Roger Williams University / Stanford University

Curriculum or Program: General Engineering / Structural Engineering

Dates of Attendance: **From:** RWU: 9/1998 / SU: 9/2002 **To:** RWU: 5/2002 / SU: 5/2003

Degree Received RWU: Bachelor of Science - General Engineering
SU: Masters of Science - Structural Engineering

OTHER TRAINING:

Name of Training:

Presented By:

Date:

EMPLOYMENT HISTORY:

Current Employer: BL Companies

Telephone: 781-619-9500

Former Employer: Woodard & Curran BKF Engineers

Telephone: 401-273-1007 650-482-6300

RECENT PERMANENT STORMWATER FACILITY PLANS PREPARED:

Name of Project:	Treasure Island Redevelopment	Canal Street Improvements	Beechwood Museum
County:	San Francisco	Essex	Newport
Municipality:	San Francisco, CA	Salem, MA	Newport, RI
Permit Number:	N/A	N/A	N/A
Approving Agency:	Treasure Island Development Authority (TIDA)	City of Salem & Massachusetts Emergency Management Agency	City of Newport & Coastal Resources Management Council

Appendix D.2 – North American Green Product Data

ROLLMAX™
ROLLED EROSION CONTROL

Specification Sheet – EroNet™ DS75™ Erosion Control Blanket

DESCRIPTION

The ultra short-term single net erosion control blanket shall be a machine-produced mat of 100% agricultural straw with a functional longevity of up to 45 days. (NOTE: functional longevity may vary depending upon climatic conditions, soil, geographical location, and elevation). The blanket shall be of consistent thickness with the straw evenly distributed over the entire area of the mat. The blanket shall be covered on the top side with a polypropylene netting having an approximate 0.50 x 0.50 (1.27 x 1.27 cm) mesh with photodegradable accelerators to provide breakdown of the netting within approximately 45 days, depending upon geographical location and elevation. The blanket shall be sewn together on 1.50 inch (3.81 cm) centers with degradable thread. The blanket shall be manufactured with a colored thread stitched along both outer edges (approximately 2-5 inches [5-12.5 cm] from the edge) as an overlap guide for adjacent mats.

The DS75 shall meet Type 1.C specification requirements established by the Erosion Control Technology Council (ECTC) and Federal Highway Administration's (FHWA) FP-03 Section 713.17

Material Content		
Matrix	100% Straw Fiber	0.5 lbs/sq yd (0.27 kg/sm)
Netting	Top side only, lightweight photodegradable with photo accelerators	1.5 lb/1000 sq ft (0.73 g/sm)
Thread	Degradable	

Standard Roll Sizes			
Width	6.67 (2.03 m)	8.0 ft (2.4 m)	16 ft (4.87 m)
Length	108 ft (32.92 m)	112 ft (34.14 m)	108 ft (32.92 m)
Weight ± 10%	40 lbs (18.14 kg)	50 lbs (22.68 kg)	96 lbs (43.54 kg)
Area	80 sq yd (66.9 sm)	100 sq yd (83.61 sm)	192 sq yd (165.5 sm)

Index Property	Test Method	Typical
Thickness	ASTM D6525	0.45 in. (11.43 mm)
Resiliency	ECTC Guidelines	78.8%
Water Absorbency	ASTM D1117	375%
Mass/Unit Area	ASTM 6475	8.57 oz/sy (291 g/sm)
Swell	ECTC Guidelines	15%
Smolder Resistance	ECTC Guidelines	Yes
Stiffness	ASTM D1388	6.31 oz-in
Light Penetration	ASTM D6567	10%
Tensile Strength - MD	ASTM D6818	105.6 lbs/ft (1.57 kN/m)
Elongation - MD	ASTM D6818	34%
Tensile Strength - TD	ASTM D6818	42.0 lbs/ft (0.62 kN/m)
Elongation - TD	ASTM D6818	25.2%
Biomass Improvement	ASTM D7322	286%

Design Permissible Shear Stress	
Unvegetated Shear Stress	1.55 psf (74 Pa)
Unvegetated Velocity	5.00 fps (1.52 m/s)

Slope Design Data: C Factors			
	Slope Gradients (S)		
Slope Length (L)	≤ 3:1	3:1 – 2:1	≥ 2:1
≤ 20 ft (6 m)	0.029	N/A	N/A
20-50 ft	0.11	N/A	N/A
≥ 50 ft (15.2 m)	0.19	N/A	N/A

Roughness Coefficients – Unveg.	
Flow Depth	Manning's n
≤ 0.50 ft (0.15 m)	0.055
0.50 – 2.0 ft	0.055-0.021
≥ 2.0 ft (0.60 m)	0.021

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Specification Sheet – EroNet™ C125® Erosion Control Blanket

DESCRIPTION

The long-term double net erosion control blanket shall be a machine-produced mat of 100% coconut fiber with a functional longevity of up to 36 months. (NOTE: functional longevity may vary depending upon climatic conditions, soil, geographical location, and elevation). The blanket shall be of consistent thickness with the coconut evenly distributed over the entire area of the mat. The blanket shall be covered on the top and bottom sides with a heavyweight photodegradable polypropylene netting having ultraviolet additives to delay breakdown and an approximate 0.63 x 0.63 in (1.59 x 1.59 cm) mesh. The blanket shall be sewn together on 1.50 inch (3.81 cm) centers with degradable thread. The blanket shall be manufactured with a colored thread stitched along both outer edges (approximately 2-5 inches [5-12.5 cm] from the edge) as an overlap guide for adjacent mats.

The C125 shall meet Type 4 specification requirements established by the Erosion Control Technology Council (ECTC) and Federal Highway Administration's (FHWA) FP-03 Section 713.17

Material Content

Matrix	100% Coconut Fiber	0.5 lbs/sq yd (0.27 kg/sm)
Netting	Heavyweight photodegradable with UV additives	3 lbs/1000 sq ft (1.47 g/sm)
Thread	Black polypropylene	

Standard Roll Sizes

Width	6.67 (2.03 m)	8 ft (2.44 m)
Length	108 ft (32.92 m)	112 ft (35.14 m)
Weight ± 10%	44 lbs (19.95 kg)	56.25 (25.5 kg)
Area	80 sq yd (66.9 sm)	100 sq yd (83.61 sm)

Index Property	Test Method	Typical
Thickness	ASTM D6525	0.22 in. (5.59 mm)
Resiliency	ECTC Guidelines	82%
Water Absorbency	ASTM D1117	167%
Mass/Unit Area	ASTM 6475	7.73 oz/sy (262.8 g/sm)
Swell	ECTC Guidelines	13%
Smolder Resistance	ECTC Guidelines	Yes
Stiffness	ASTM D1388	0.75 oz-in
Light Penetration	ASTM D6567	16.6%
Tensile Strength - MD	ASTM D6818	472.8 lbs/ft (7.01 kN/m)
Elongation - MD	ASTM D6818	25.6%
Tensile Strength - TD	ASTM D6818	225.6 lbs/ft (3.35 kN/m)
Elongation - TD	ASTM D6818	33.9%
Biomass Improvement	ASTM 7322	257%

Design Permissible Shear Stress

Unvegetated Shear Stress	2.25 psf (108 Pa)
Unvegetated Velocity	10.0 fps (3.05 m/s)

Slope Design Data: C Factors

	Slope Gradients (S)		
Slope Length (L)	≤ 3:1	3:1 – 2:1	≥ 2:1
≤ 20 ft (6 m)	0.001	0.029	0.082
20-50 ft	0.036	0.060	0.096
≥ 50 ft (15.2 m)	0.070	0.090	0.110

Roughness Coefficients – Unveg.

Flow Depth	Manning's n
≤ 0.50 ft (0.15 m)	0.022
0.50 – 2.0 ft	0.022-0.014
≥ 2.0 ft (0.60 m)	0.014

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Specification Sheet – EroNet™ S75® Erosion Control Blanket

DESCRIPTION

The short-term single net erosion control blanket shall be a machine-produced mat of 100% agricultural straw with a functional longevity of up to 12 months. (NOTE: functional longevity may vary depending upon climatic conditions, soil, geographical location, and elevation). The blanket shall be of consistent thickness with the straw evenly distributed over the entire area of the mat. The blanket shall be covered on the top side with a lightweight photodegradable polypropylene netting having an approximate 0.50 x 0.50 in. (1.27 x 1.27 cm) mesh. The blanket shall be sewn together on 1.50 inch (3.81 cm) centers with degradable thread. The blanket shall be manufactured with a colored thread stitched along both outer edges (approximately 2-5 inches [5-12.5 cm] from the edge) as an overlap guide for adjacent mats.

The S75 shall meet Type 2.C specification requirements established by the Erosion Control Technology Council (ECTC) and Federal Highway Administration's (FHWA) FP-03 Section 713.17

Material Content		
Matrix	100% Straw Fiber	0.5 lbs/sq yd (0.27 kg/sm)
Netting	Top side only, lightweight photodegradable	1.5 lb/1000 sq ft (0.73 kg/100 sm)
Thread	Degradable	

Standard Roll Sizes			
Width	6.67 ft (2.03 m)	8.0 ft (2.4 m)	16 ft (4.87 m)
Length	108 ft (32.92 m)	112 ft (34.14 m)	108 ft (32.92 m)
Weight ± 10%	40 lbs (18.14 kg)	50 lbs (22.68 kg)	96 lbs (43.54 kg)
Area	80 sq yd (66.9 sm)	100 sq yd (83.61 sm)	192 sq yd (165.5 sm)

Index Property	Test Method	Typical
Thickness	ASTM D6525	0.50 in. (12.7 mm)
Resiliency	ECTC Guidelines	78.8%
Water Absorbency	ASTM D1117	301%
Mass/Unit Area	ASTM D6475	9.76 oz/sy (332 g/sm)
Swell	ECTC Guidelines	15%
Smolder Resistance	ECTC Guidelines	Yes
Stiffness	ASTM D1388	6.31 oz-in
Light Penetration	ASTM D6567	6.0%
Tensile Strength - MD	ASTM D6818	122.4 lbs/ft (1.81 kN/m)
Elongation - MD	ASTM D6818	36.1%
Tensile Strength - TD	ASTM D6818	79.2 lbs/ft (1.17 kN/m)
Elongation - TD	ASTM D6818	26.8%
Biomass Improvement	ASTM D7322	301%

Design Permissible Shear Stress	
Unvegetated Shear Stress	1.55 psf (74 Pa)
Unvegetated Velocity	5.00 fps (1.52 m/s)

Slope Design Data: C Factors			
	Slope Gradients (S)		
Slope Length (L)	≤ 3:1	3:1 – 2:1	≥ 2:1
≤ 20 ft (6 m)	0.029	N/A	N/A
20-50 ft	0.11	N/A	N/A
≥ 50 ft (15.2 m)	0.19	N/A	N/A

NTPEP Large-Scale Slope Testing
ASTM D6459 - C-factor = 0.012

Roughness Coefficients – Unveg.	
Flow Depth	Manning's n
≤ 0.50 ft (0.15 m)	0.055
0.50 – 2.0 ft	0.055-0.021
≥ 2.0 ft (0.60 m)	0.021

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Specification Sheet – EroNet™ SC150® Erosion Control Blanket

DESCRIPTION

The extended-term double net erosion control blanket shall be a machine-produced mat of 70% agricultural straw and 30% coconut fiber with a functional longevity of up to 24 months. (NOTE: functional longevity may vary depending upon climatic conditions, soil, geographical location, and elevation). The blanket shall be of consistent thickness with the straw and coconut evenly distributed over the entire area of the mat. The blanket shall be covered on the top side with a heavyweight photodegradable polypropylene netting having ultraviolet additives to delay breakdown and an approximate 0.63 x 0.63 in (1.59 x 1.59 cm) mesh, and on the bottom side with a lightweight photodegradable polypropylene netting with an approximate 0.50 x 0.50 (1.27 x 1.27 cm) mesh. The blanket shall be sewn together on 1.50 inch (3.81 cm) centers with degradable thread. The blanket shall be manufactured with a colored thread stitched along both outer edges (approximately 2-5 inches [5-12.5 cm] from the edge) as an overlap guide for adjacent mats.

The SC150 shall meet Type 3.B specification requirements established by the Erosion Control Technology Council (ECTC) and Federal Highway Administration's (FHWA) FP-03 Section 713.17

Material Content

Matrix	70% Straw Fiber 30% Coconut Fiber	0.35 lbs/sq yd (0.19 kg/sm) 0.15 lbs/sq yd (0.08 kg/sm)
Netting	Top: Heavyweight photodegradable with UV additives	3 lbs/1000 sq ft (1.47 kg/100 sm)
	Bottom: lighweight photodegradable	1.5 lb/1000 sq ft (0.73 kg/100 sm)
Thread	Degradable	

Standard Roll Sizes

Width	6.67 ft (2.03 m)	8 ft (2.4 m)	16.0 ft (4.87 m)
Length	108 ft (32.92 m)	112 ft (34.14 m)	108 ft (32.92 m)
Weight ± 10%	44 lbs (19.95 kg)	55 lbs (24.95 kg)	105.6 lbs (47.9 kg)
Area	80 sq yd (66.9 sm)	100 sq yd (83.61 sm)	192 sq yd (165.6 sm)

Index Property	Test Method	Typical
Thickness	ASTM D6525	0.35 in. (8.89 mm)
Resiliency	ECTC Guidelines	75%
Water Absorbency	ASTM D1117	342%
Mass/Unit Area	ASTM D6475	7.87 oz/sy (267.6 g/sm)
Swell	ECTC Guidelines	30%
Smolder Resistance	ECTC Guidelines	Yes
Stiffness	ASTM D1388	1.11 oz-in
Light Penetration	ASTM D6567	6.2%
Tensile Strength - MD	ASTM D6818	362.4 lbs/ft (5.37 kN/m)
Elongation - MD	ASTM D6818	29.4%
Tensile Strength - TD	ASTM D6818	136.8 lbs/ft (2.03 kN/m)
Elongation - TD	ASTM D6818	27.6%
Biomass Improvement	ASTM D7322	481%

Design Permissible Shear Stress

Unvegetated Shear Stress	2.00 psf (96 Pa)
Unvegetated Velocity	8.0 fps (2.44 m/s)

Slope Design Data: C Factors

	Slope Gradients (S)		
Slope Length (L)	≤ 3:1	3:1 – 2:1	≥ 2:1
≤ 20 ft (6 m)	0.001	0.048	0.100
20-50 ft	0.051	0.079	0.145
≥ 50 ft (15.2 m)	0.10	0.110	0.190

NTPEP Large-Scale Slope
ASTM D6459 - C-factor = 0.031

Roughness Coefficients – Unveg.

Flow Depth	Manning's n
≤ 0.50 ft (0.15 m)	0.050
0.50 – 2.0 ft	0.050-0.018
≥ 2.0 ft (0.60 m)	0.018

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Specification Sheet – BioNet® SC150BN™ Erosion Control Blanket

DESCRIPTION

The extended-term double net erosion control blanket shall be a machine-produced mat of 70% agricultural straw and 30% coconut fiber with a functional longevity of up to 18 months. (NOTE: functional longevity may vary depending upon climatic conditions, soil, geographical location, and elevation). The blanket shall be of consistent thickness with the straw and coconut evenly distributed over the entire area of the mat. The blanket shall be covered on the top and bottom sides with a 100% biodegradable woven natural organic fiber netting. The netting shall consist of machine directional strands formed from two intertwined yarns with cross directional strands interwoven through the twisted machine strands (commonly referred to as Leno weave) to form an approximate 0.50 x 1.0 in. (1.27 x 2.54 cm) mesh. The blanket shall be sewn together on 1.50 inch (3.81 cm) centers with degradable thread. The blanket shall be manufactured with a colored thread stitched along both outer edges (approximately 2-5 inches [5-12.5 cm] from the edge) as an overlap guide for adjacent mats.

The SC150BN shall meet Type 3.B specification requirements established by the Erosion Control Technology Council (ECTC) and Federal Highway Administration's (FHWA) FP-03 Section 713.17

Material Content		
Matrix	70% Straw Fiber	0.35 lbs/sq yd (0.19 kg/sm)
	30% Coconut Fiber	0.15 lbs/sq yd (0.08 kg/sm)
Netting	Top: Leno woven 100% biodegradable jute	9.35 lb/1000 sq ft (4.5 kg/100 sm)
	Bottom: 100% biodegradable organic jute	7.7 lb/1000 sq ft (3.76 kg/100 sm)
Thread	Biodegradable	

Standard Roll Sizes			
Width	6.67 ft (2.03 m)	8.0 ft (2.4 m)	15.5 ft (4.72 m)
Length	108 ft (32.92 m)	112 ft (34.14 m)	90 ft (27.43 m)
Weight ± 10%	52.22 lbs (23.69 kg)	65.28 lbs (29.61 kg)	101.2 lbs (45.9 kg)
Area	80 sq yd (66.9 sm)	100 sq yd (83.61 sm)	155 sq yd (129.6 sm)
	Leno weave top only	Leno top and bottom	Leno top and bottom

Index Property	Test Method	Typical
Thickness	ASTM D6525	0.25 in. (6.35 mm)
Resiliency	ECTC Guidelines	86%
Water Absorbency	ASTM D1117	311%
Mass/Unit Area	ASTM D6475	8.32 oz/sy (282.9 g/sm)
Swell	ECTC Guidelines	46%
Smolder Resistance	ECTC Guidelines	Yes
Stiffness	ASTM D1388	0.42 oz-in
Light Penetration	ASTM D6567	7.6%
Tensile Strength - MD	ASTM D6818	201.6 lbs/ft (2.99 kN/m)
Elongation - MD	ASTM D6818	13.4%
Tensile Strength - TD	ASTM D6818	164.4 lbs/ft (2.44 kN/m)
Elongation - TD	ASTM D6818	14.2%
Biomass Improvement	ASTM D7322	641 %

Design Permissible Shear Stress	
Unvegetated Shear Stress	2.10 psf (100 Pa)
Unvegetated Velocity	8.00 fps (2.44 m/s)

Slope Design Data: C Factors			
	Slope Gradients (S)		
Slope Length (L)	≤ 3:1	3:1 – 2:1	≥ 2:1
≤ 20 ft (6 m)	0.001	0.029	0.063
20-50 ft	0.051	0.055	0.092
≥ 50 ft (15.2 m)	0.10	0.080	0.120

Roughness Coefficients – Unveg.	
Flow Depth	Manning's n
≤ 0.50 ft (0.15 m)	0.050
0.50 – 2.0 ft	0.050-0.018
≥ 2.0 ft (0.60 m)	0.018

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Specification Sheet – VMax® P550® Turf Reinforcement Mat

DESCRIPTION

The composite turf reinforcement mat (C-TRM) shall be a machine-produced mat of 100% UV stable polypropylene fiber matrix incorporated into permanent three-dimensional turf reinforcement matting. The matrix shall be evenly distributed across the entire width of the matting and stitch bonded between a ultra heavy duty UV stabilized nettings with 0.50 x 0.50 inch (1.27 x 1.27 cm) openings, an ultra heavy UV stabilized, dramatically corrugated (crimped) intermediate netting with 0.5 x 0.5 inch (1.27 x 1.27 cm) openings, and covered by an ultra heavy duty UV stabilized nettings with 0.50 x 0.50 inch (1.27 x 1.27 cm) openings. The middle corrugated netting shall form prominent closely spaced ridges across the entire width of the mat. The three nettings shall be stitched together on 1.50 inch (3.81cm) centers with UV stabilized polypropylene thread to form permanent three-dimensional turf reinforcement matting. All mats shall be manufactured with a colored thread stitched along both outer edges as an overlap guide for adjacent mats.

The P550 shall meet Type 5A, 5B, and 5C specification requirements established by the Erosion Control Technology Council (ECTC) and Federal Highway Administration's (FHWA) FP-03 Section 713.18

Material Content		
Matrix	100% UV stable polypropylene fiber	0.5 lb/sy (0.27 kg/sm)
Netting	Top and Bottom, UV-Stabilized Polypropylene Middle, Corrugated UV-Stabilized Polypropylene	24 lb/1000 sf (11.7 kg/100 sm) 24 lb/1000 sf (11.7 kg/100 sm)
Thread	Polypropylene, UV Stable	

Standard Roll Sizes	
Width	6.5 ft (2.0 m)
Length	55.5 ft (16.9 m)
Weight ± 10%	52 lbs (23.59 kg)
Area	40 sy (33.4 sm)

Index Property	Test Method	Typical
Thickness	ASTM D6525	0.72 in. (18.29 mm)
Resiliency	ASTM 6524	95%
Density	ASTM D792	0.892 g/cm^3
Mass/Unit Area	ASTM 6566	21.25 oz/sy (723 g/sm)
UV Stability	ASTM D4355/ 1000 HR	100%
Porosity	ECTC Guidelines	96%
Stiffness	ASTM D1388	366.3 oz-in.
Light Penetration	ASTM D6567	16.5%
Tensile Strength – MD	ASTM D6818	1421 lbs/ft (21.07 kN/m)
Elongation – MD	ASTM D6818	40.5%
Tensile Strength – TD	ASTM D6818	1191.6 lbs/ft (17.67 kN/m)
Elongation – TD	ASTM D6818	28.8%
Biomass Improvement	ASTM D7322	378%

Design Permissible Shear Stress		
	Short Duration	**Long Duration**
Phase 1: Unvegetated	4.0 psf (191 Pa)	3.25 psf (156 Pa)
Phase 2: Partially Veg.	12.0 psf (576 Pa)	12.0 psf (576 Pa)
Phase 3: Fully Veg.	14.0 psf (672 Pa)	12.0 psf (576 Pa)
Unvegetated Velocity	12.5 fps (3.8 m/s)	
Vegetated Velocity	25 fps (7.6 m/s)	

NTPEP ASTM D6460 Large Scale Channel	
Vegetated Shear Stress	>13.2 psf (632 Pa)
Vegetated Velocity	>24.5 fps (7.47 m/s)

Slope Design Data: C Factors

	Slope Gradients (S)		
Slope Length (L)	≤ 3:1	3:1 – 2.1	≥ 2:1
≤ 20 ft (6 m)	0.0005	0.015	0.043
20-50 ft	0.0173	0.031	0.050
≥ 50 ft (15.2 m)	0.035	0.047	0.057

Roughness Coefficients – Unveg.

Flow Depth	Manning's n
≤ 0.50 ft (0.15 m)	0.041
0.50 – 2.0 ft	0.040-0.013
≥ 2.0 ft (0.60 m)	0.013

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Specification Sheet – VMax® SC250® Turf Reinforcement Mat

DESCRIPTION

The composite turf reinforcement mat (C-TRM) shall be a machine-produced mat of 70% straw and 30% coconut fiber matrix incorporated into permanent three-dimensional turf reinforcement matting. The matrix shall be evenly distributed across the entire width of the matting and stitch bonded between a heavy duty UV stabilized nettings with 0.50 x 0.50 inch (1.27 x 1.27 cm) openings, an ultra heavy UV stabilized, dramatically corrugated (crimped) intermediate netting with 0.5 x 0.5 inch (1.27 x 1.27 cm) openings, and covered by an heavy duty UV stabilized nettings with 0.50 x 0.50 inch (1.27 x 1.27 cm) openings. The middle corrugated netting shall form prominent closely spaced ridges across the entire width of the mat. The three nettings shall be stitched together on 1.50 inch (3.81cm) centers with UV stabilized polypropylene thread to form permanent three-dimensional turf reinforcement matting. All mats shall be manufactured with a colored thread stitched along both outer edges as an overlap guide for adjacent mats.

The SC250 shall meet Type 5A, 5B, and 5C specification requirements established by the Erosion Control Technology Council (ECTC) and Federal Highway Administration's (FHWA) FP-03 Section 713.18

Material Content		
Matrix	70% Straw Fiber	0.35 lb/sq yd (0.19 kg/sm)
	30% Coconut Fiber	0.15 lbs/sq yd (0.08 kg/sm)
Netting	Top and Bottom, UV-Stabilized Polypropylene	5 lb/1000 sq ft (2.44 kg/100 sm)
	Middle, Corrugated UV-Stabilized Polypropylene	24 lb/1000 sf (11.7 kg/100 sm)
Thread	Polypropylene, UV Stable	

Standard Roll Sizes	
Width	6.5 ft (2.0 m)
Length	55.5 ft (16.9 m)
Weight ± 10%	34 lbs (15.42 kg)
Area	40 sq yd (33.4 sm)

Index Property	Test Method	Typical
Thickness	ASTM D6525	0.62 in. (15.75 mm)
Resiliency	ASTM 6524	95.2%
Density	ASTM D792	0.891 g/cm^3
Mass/Unit Area	ASTM 6566	16.13 oz/sy (548 g/sm)
UV Stability	ASTM D4355/ 1000 HR	100%
Porosity	ECTC Guidelines	99%
Stiffness	ASTM D1388	222.65 oz-in.
Light Penetration	ASTM D6567	4.1%
Tensile Strength – MD	ASTM D6818	709 lbs/ft (10.51 kN/m)
Elongation – MD	ASTM D6818	23.9%
Tensile Strength – TD	ASTM D6818	712 lbs/ft (10.56 kN/m)
Elongation – TD	ASTM D6818	36.9%
Biomass Improvement	ASTM D7322	441%

Design Permissible Shear Stress		
	Short Duration	Long Duration
Phase 1: Unvegetated	3.0 psf (144 Pa)	2.5 psf (120 Pa)
Phase 2: Partially Veg.	8.0 psf (383 Pa)	8.0 psf (383 Pa)
Phase 3: Fully Veg.	10.0 psf (480 Pa)	8.0 psf (383 Pa)
Unvegetated Velocity	9.5 fps (2.9 m/s)	
Vegetated Velocity	15 fps (4.6 m/s)	

Slope Design Data: C Factors			
	Slope Gradients (S)		
Slope Length (L)	≤ 3:1	3:1 – 2.1	≥ 2:1
≤ 20 ft (6 m)	0.0010	0.0209	0.0507
20-50 ft	0.0081	0.0266	0.0574
≥ 50 ft (15.2 m)	0.0455	0.0555	0.081

Roughness Coefficients – Unveg.	
Flow Depth	Manning's n
≤ 0.50 ft (0.15 m)	0.040
0.50 – 2.0 ft	0.040-0.012
≥ 2.0 ft (0.60 m)	0.011

Tensar
NORTH AMERICAN GREEN®

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Tensar International Corporation warrants that at the time of delivery the product furnished hereunder shall conform to the specification stated herein. Any other warranty including merchantability and fitness for a particular purpose, are hereby executed. If the product does not meet specifications on this page and Tensar is notified prior to installation, Tensar will replace the product at no cost to the customer. **This product specification supersedes all prior specifications for the product described above and is not applicable to any products shipped prior to January 1, 2012.**

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ROLLMAX™
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Specification Sheet – VMax® W3000™ High-Performance Turf Reinforcement Mat

DESCRIPTION

The VMax® W3000™ high performance turf reinforcement mat (HPTRM) is a machine-produced mat of 100% UV-stabilized high denier poly yarns woven into permanent, high strength three-dimensional turf reinforcement matting. The mat consists of a woven bottom layer integrally interlaced into a woven corrugated middle layer, with poly tendons on the top side spanning the entire machine direction. The mat is designed to provide sufficient thickness, optimum open area and three-dimensionality for effective erosion control and vegetation reinforcement against high flow induced shear forces. The mat has high tensile strength providing excellent damage resistance and increased bearing capacity of vegetated soils subject to heavy loads from maintenance equipment and other vehicular traffic. The corrugated structure provides a highly frictional surface to prevent sod slippage when sod is installed over the mat. When used as surface protection without sod overlay, the corrugated structure encapsulates the seed and soil in place while promoting self-soil infilling of the system.

Material Content		
Bottom	100% UV stable poly fiber weave	Black/Green
Corrugated Middle	100% UV stable poly fiber weave	Black/Green
Top	100% UV stable Poly Tendons	Green

Standard Roll Sizes	
Width	10 ft (3.05 m)
Length	90 ft (27.4 m)
Weight ± 10%	90 lbs (41.0 kg)
Area	100 sy (83.6 sm)

Index Property	Test Method	Typical
Thickness	ASTM D6525	0.40 in. (10.2 mm)
Resiliency	ASTM D6524	98%
Mass/Unit Area	ASTM 6566	14.7oz/sy (495 g/m2)
Tensile Strength - MD	ASTM D6818	3600 lbs/ft (52.6 kN/m)
Elongation - MD	ASTM D6818	35%*
Tensile Strength - TD	ASTM D6818	3800 lbs/ft (55.5 kN/m)
Elongation - TD	ASTM D6818	20%*
Light Penetration	ASTM D6567	12%
UV Stability	ASTM D4355	>80% @3000 hrs

** Measured on fabric prior to corrugation for true measurement of base fabric elongation*

Design Permissible Shear Stress*	
Vegetated Shear Stress	16 psf (766 Pa)
Vegetated Velocity	25 fps (7.6 m/s)

**Values extrapolated through ASTM D6460 testing*

ASTM D6460 Large Scale Channel	
Vegetated Shear Stress	>13.2 psf (632 Pa)
Vegetated Velocity	>24.5 fps (7.47 m/s)

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APPENDIX K

AR-WY-028 Specific Narrative and Calculations

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  a. Narrative
  b. TMDL Discussion
  c. Minimized Soil Compaction
  d. Thermal Impact Analysis
  e. Acidic Soil Management Plan
  f. Road Specific Construction Sequence
  g. Permanent Access Road Summary Sheet (NOI PCSM Table)
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K.3 Predevelopment Calculations
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K.6 PCSM BMP Calculations
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  c. Worksheet 2. Sensitive Natural Resources
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  e. Flow Chart B – Control Guideline 1 Process
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  a. E&S Worksheet 1
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- *a. Adequacy of Off-Site Discharge*

K.11 Storage Volume Analysis

- *a. Storage Volume Analysis*

K.1 Site Specific Narrative

a. Narrative
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d. Thermal Impact Analysis
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f. Road Specific Construction Sequence
g. Permanent Access Road Summary Sheet (NOI PCSM Table)

ACCESS ROAD: AR-WY-028

ACT 167 PLAN: None

TMDL: None

NARRATIVE:

AR-WY-028 is a proposed permanent access road (PAR) located in Falls Township, Wyoming County Pennsylvania. The intent of this road is to provide permanent maintenance and operational access to the Main Line Valve - 04 (MLV-04) located on the proposed 30” Central Penn Line North Pipeline. The road begins at Whites Ferry Road and terminates at the MLV site at approximate mile post 35.8. The proposed road will follow the path of an existing ***dirt/vegetative*** road and is approximately ***470*** feet long over relatively hilly terrain. A temporary driveway apron and rock construction entrance ***with compost filter sock*** is proposed to allow access to the gas pipeline by construction vehicles. Temporary compost filter socks are proposed to ***filter*** runoff from construction activities. ***Within the pipeline right of way, the proposed temporary sediment barriers are included in the Pipeline E&S Plan and shown in grey on the Access Road Plan for coordination purposes.*** Broad based dips are also proposed ***to*** divert ***runoff*** to the perimeter E&SC BMPs. Upon completion of the construction activities, the temporary construction entrance, driveway apron, compost filter socks, and broad based dip will be removed and a permanent access road will be constructed. The proposed road will have a cross slope of 2% directing runoff in a northerly direction into a proposed vegetated channel for infiltration with check dams. The check dams will dewater within 26 hours.

A portion of the road will direct runoff to the proposed MLV site. The MLV site will be constructed with a 6-inch thick layer of AASHTO #8 stone on top of nonwoven geotextile and a 12-inch thick layer of AASHTO #57 stone. ***As summarized in the infiltration calculations added to the bottom of Worksheet #5, the detained water stored in the voids of the MLV stone pad will infiltrate to the surrounding ground over approximately 43 hours and the water detained behind the check dams will infiltrate to the surrounding ground over approximately 26 hours.***

Water Quality Worksheet #4 was used to complete the CG-1 volume analysis for the 2 year storm. The storage volume provided by the check dams in the swale and the voids in the MLV site is greater than the required volume per Worksheet #4.

Pre-development and post-development runoff hydrographs were developed for the 1, 2, 5, 10, 25, 50 and 100 year ***24-hour*** storm events using the SCS TR-20 method. Directing runoff from the proposed new gravel road to the swale with check dams and MLV site mitigates the potential impact from the proposed development.

TMDL DISCUSSION:

The nearest surface waters to receive runoff from this road are not subject to any TMDL restrictions.

MINIMIZED SOIL COMPACTION:

The Project seeks to minimize soils compaction impacts associated with access roads to the maximum extent practicable. AR-WY-028 is a proposed permanent access road for Main Line Valve 04. All construction and operations traffic will utilize the proposed road. The permanent access road will follow the path of an existing road path throughout the majority of its length. Soil compaction impact have been minimized by using the existing road path and minimizing the road width to 14 feet. Additionally, infiltration and evaporation are encouraged in the MLV site pad and in the swales proposed in the permanent road construction.

THERMAL IMPACT ANALYSIS:

Thermal impacts associated with AR-WY-028 will be avoided to the maximum extent practicable. The following measures have been implemented to minimize thermal impacts:

- ***AR-WY-028 is a permanent access road constructed of a gravel surface. This roadway surface minimizes the thermal impact because it allows for runoff to flow unimpeded through the roadway surface to the proposed perimeter E&SC BMPs such as the compost filter sock, vegetated channel for infiltration and MLV pad.***

- ***Broad based dips are proposed in the construction of the access road, directing runoff from the gravel roadway surface to proposed perimeter E&SC BMPs such as the compost filter socks and vegetated channels for infiltration.***

- ***During the construction phase of this project compost filter socks will be placed downgradient of the proposed access road. The compost filter socks will promote infiltration of runoff from the proposed temporary impervious surfaces. Infiltration of runoff prior to entering receiving waters allows for runoff to assimilate to ground water temperatures which are minimally influenced by seasonal temperature changes, minimizing the thermal impact of this road.***

- ***A vegetated channel for infiltration with check dams is proposed adjacent to the proposed permanent access road. The swale and check dams***

promote infiltration of the runoff from the proposed gravel road. Infiltration allows the runoff to assimilate to ground water temperatures which are minimally influenced by seasonal temperature changes, minimizing the thermal impact of this road.

ACIDIC SOIL MANAGEMENT PLAN:

AR-WY-028 Soil Acidity Table		
Soil Map Symbol	Soil Name	PH
UnB	Unadilla silt loam, 3 to 8 percent slopes	5.7

An Acid Producing Soils Control Plan is included as part of this application. The plan identifies the measures to be used to control pollution associated with construction of access roads that contain acid-producing soils. The plan requires that these measures be applied only for soils with a pH less than 4.0, as recommended by the Natural Resources Conservation Service (NRCS). The table above depicts the soil types present on this road as well as the acidity of the soils. The pH of the soils on this road are outside the threshold established by the Acid Producing Soils Control Plan. Therefore, the measures prescribed in the plan do not need to be implemented for this road.

ROAD SPECIFIC CONSTRUCTION SEQUENCE:
ACCESS ROAD: AR-WY-028

1. ***At least 7 days prior to starting any earth disturbance activities, including clearing and grubbing, the owner and/or operator shall invite all contractors, Environmental Inspectors, the landowner, appropriate municipal officials, the E&S plan preparer, the PCSM plan preparer, the licensed professional responsible for oversight of critical stages of implementation of the PCSM plan, and a representative from the local conservation district to an on-site preconstruction meeting.***

2. ***At least 3 days prior to starting any earth disturbance activities, or expanding into an area previously unmarked, the Pennsylvania One Call System Inc. shall be notified at 1-800-242-1776 for the location of existing underground utilities.***

3. ***Hold pre-construction conference with the Environmental Inspectors, local County Conservation District (CCD), PADEP and Design Engineer.***

4. ***Survey crews locate and stake all special areas of concern (i.e., wetlands, streams, culverts, other utilities, etc.), edge of proposed access road, and field locate the limit of disturbance.***

5. ***Install orange construction fence around areas to be preserved.***

6. ***Locate staging areas and access points including the rock construction entrance with wash rack. Install E&SC BMPs down slope of these areas.***

7. ***Perform tree cutting where required. (Areas with tree cutting shall be restored to meadow in good condition.)***

8. ***Install rock construction entrance with gravel driveway apron.***

9. ***Remove brush to effectively install perimeter E&SC BMPs and level side cuts to grant access for vehicles and workers to safely perform the installation of sediment barriers on the Site as shown on the construction drawings.***

10. ***Install perimeter E&SC BMPs as depicted on the E&SC Plan.***

11. ***The Compliance Manager shall provide PADEP at least three days' notice prior to bulk earth disturbance and upon completed installation of perimeter erosion controls.***

12. ***If applicable, install security fence. The necessity of a security fence will be at the discretion of the Contractor.***

13. ***Proceed with major clearing and grubbing.***

14. ***Begin construction staking for layout of access road.***

15. ***Grade the access road as shown on the E&SC Plans.***

16. ***Install vegetated channels for infiltration with check dams and infiltration berm where specified on the E&SC & PCSM plans. Note: this is a critical stage of PCSM plan to be observed by a licensed professional or designee. Begin vegetated channel construction only when the upgradient temporary erosion and sediment control measures are in place. Vegetated channels should be constructed and stabilized early in the construction schedule, preferably before mass earthwork and paving increase the rate and volume of runoff. (Erosion and sediment control methods shall adhere to the Pennsylvania Department of Environmental Protection's Erosion and Sediment Pollution Control Program Manual, March 2000 or latest edition.)***

17. ***Rough grade the vegetated channel. Equipment shall avoid excessive compaction and/or land disturbance. Excavating equipment should operate from the side of the channel and never on the bottom. If excavation leads to substantial compaction of the subgrade (where an infiltration trench is not proposed), 18 inches shall be removed and replaced with a blend of topsoil and sand to promote infiltration and biological growth. At the very least, topsoil shall be thoroughly deep plowed into the subgrade in order to penetrate the compacted zone and promote aeration and the formation of macropores. Following this, the area should be disked prior to final grading of topsoil.***

18. ***Construct check dams.***

19. ***Fine grade the vegetated channel. Accurate grading is crucial for channels. Even the smallest nonconformities may compromise flow conditions.***

20. ***Seed, vegetate and install protective lining as per approved plans and according to final planting list. Vegetation should be established as soon as possible to prevent erosion and scour. Seed mix and season of planting are provided under separate cover in the Best Management Practices and Quantities Plan Set.***

21. ***Once all tributary areas are sufficiently stabilized, remove temporary erosion and sediment controls. It is very important that the channel be stabilized before receiving upland stormwater flow. NOTE: If a vegetated channel is used for runoff conveyance during construction, it should be***

regraded and reseeded immediately after construction and stabilization has occurred. Any damaged areas should be fully restored to ensure future functionality of the channel.

22. ***Rough grade the MLV pad. Equipment shall avoid excessive compaction and/or land disturbance. If excavation leads to substantial compaction of the subgrade (where an infiltration trench is not proposed), 18 inches shall be removed and replaced with a blend of topsoil and sand to promote infiltration and biological growth. At the very least, topsoil shall be thoroughly deep plowed into the subgrade in order to penetrate the compacted zone and promote aeration and the formation of macropores. Following this, the area should be disked prior to final grading.***

23. ***Caution shall be observed when excavating above the recently installed gas pipeline. Prior to excavation over the gas pipeline, confirm the depth of cover over the pipe. Decompact the pipe trench backfill as described in the previous Step.***

24. ***Place the stone and geotextile fabric within the MLV pad as specified on the E&SC & PCSM Plans. NOTE: This is a critical stage of PCSM Plan to be observed by a licensed professional or designee.***

25. ***Immediately stabilize the access road with geotextile and gravel surfacing where indicated in the E&SC Plans.***

26. ***Upon temporary cessation of an earth disturbance activity or any stage of an activity where the cessation of earth disturbance activities will exceed four days, disturbed areas shall be immediately seeded, mulched, or otherwise protected from accelerated erosion and sedimentation pending future earth disturbance activities. For an earth disturbance activity or any stage of an activity to be considered temporarily stabilized, the disturbed areas shall be covered with one of the following: a minimum uniform coverage of mulch and seed, with a density capable of resisting accelerated erosion and sedimentation, or an acceptable E&SC BMPs, which temporarily minimizes accelerated erosion and sedimentation. Temporary stabilization will not occur on active vehicular travel ways within the right of way. The on-site environmental inspector will log daily activity within the limits of disturbance and notify the Contractor of areas requiring temporary stabilization (i.e., areas where work has ceased for at least four days).***

27. ***Upon completion of all earth disturbance activities and permanent stabilization of all disturbed areas, the Owner shall contact the local CCD for an inspection prior to the removal of the E&SC BMPs. Vegetated areas must achieve a minimum uniform 70% perennial cover over the entire***

disturbed area to be considered stabilized. Roadways and parking areas should have at least a clean subbase in place to be considered stabilized.

28. ***Upon local CCD and Transco approval of stabilization and re-vegetation, remove temporary E&SC BMPs and stabilize areas disturbed by removal including the perimeter sediment barrier and temporary diversions. Properly dispose/recycle E&SC BMPs. Remove orange construction fencing and security fence.***

29. ***Complete access road limit of disturbance stabilization, including soil treatment, seed application and mulching in areas disturbed by E&SC BMP removal.***

30. ***Upon completion of all earth disturbance activities, removal of all temporary BMPs, and permanent stabilization of all disturbed areas, the Owner and/or Operators shall contact the local CCD for a final inspection.***

Permanent Access Road Summary Sheet

Access Road Number:	AR-WY-028			
Watershed Name:	Susquehanna River, CWF, MF			
Act 167 Plan Name:			Date Adopted:	
Design Storm Frequency	2 year	Pre-construction	Post-construction	Net Change
Rainfall Amount	2.51 inches			
Impervious area (acres)		0.009	0.287	0.278
Volume of stormwater runoff (cf) without planned stormwater BMPs		3,540	4,521	981
Volume of stormwater runoff (cf) with planned stormwater BMPs			2,442	(1,098)

Pre- vs. Post-construction Peak Rate of Flow Summary			
Stormwater discharge rate for the design frequency storm (cfs)	Pre-construction	Post-construction	Net Change
1) 1-Year/24-Hour	0.60	0.28	(0.32)
2) 2-Year/24-Hour	1.09	0.60	(0.49)
3) 5-Year/24-Hour	1.90	1.18	(0.72)
4) 10-Year/24-Hour	2.70	1.54	(1.16)
5) 25-Year/24-Hour	4.04	3.23	(0.81)
6) 50-Year/24-Hour	5.33	4.61	(0.72)
7) 100-Year/24-Hour	6.88	5.98	(0.90)

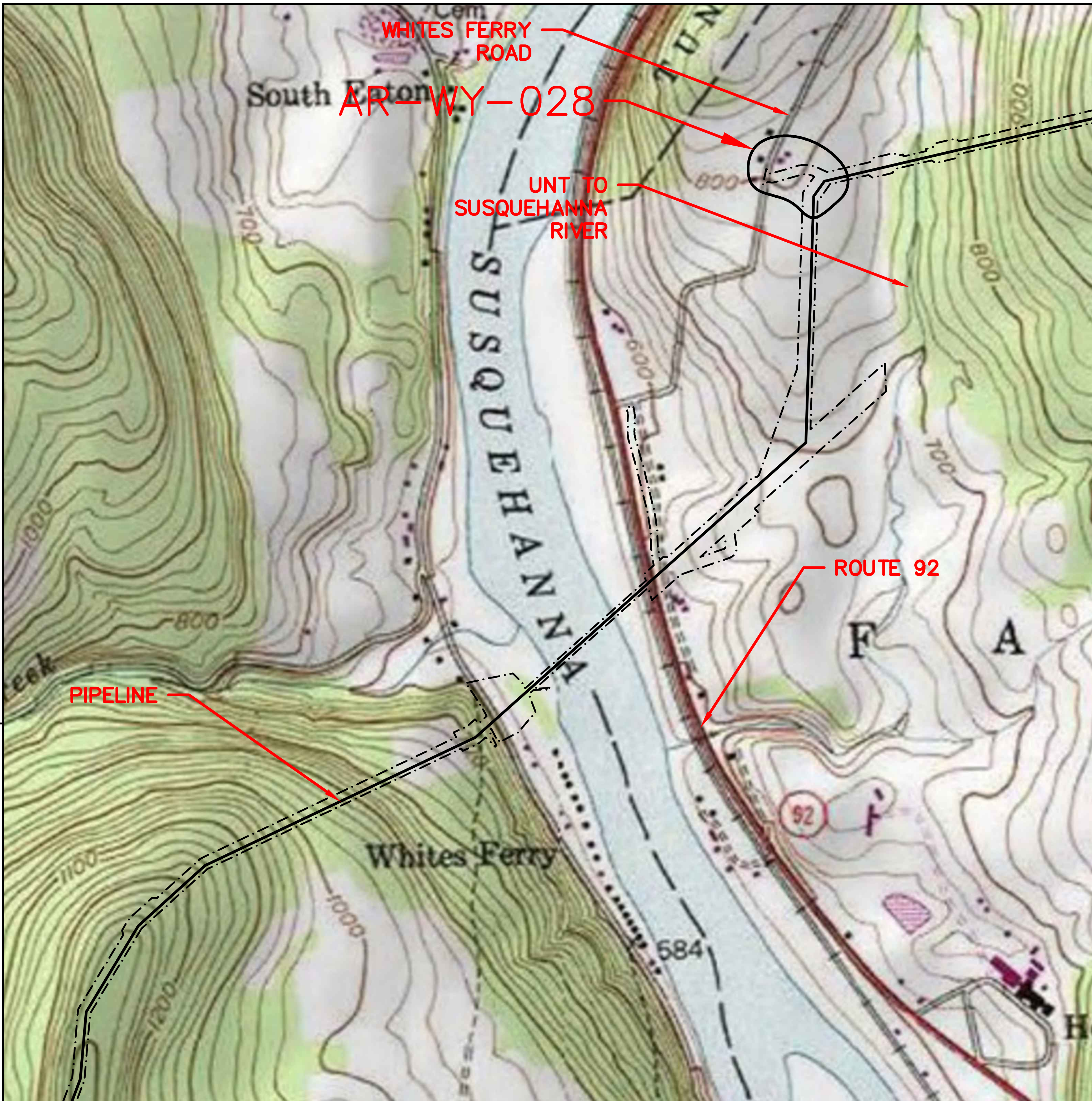
Summary Description of Restoration BMPs - Permanent Access Roads			
BMP	Function	Volume of stormwater treated (cf)	Acres treated
Natural area conservation: Pre-construction drainage pattern intact		0	0
Access road design: Ditches Culverts	Infiltration/ Recharge/Storage	1,610	0.40
Stormwater energy dissipaters: Riprap Aprons	Infiltration/ Recharge/Storage	0	0
Other: MLV Stone Pad Void Storage	Infiltration/ Recharge/Storage	469	0.11

Off-site Discharge Analysis:
The point of interest (POI) for the access road stormwater design is the downstream point where the access road watershed currently discharges off-site. As shown in the tables above, there is no increase in volume or peak rate of runoff at the POI. Therefore, the existing drainage pattern will be unchanged and erosion, damage, or nuisance to off-site properties is not anticipated to be caused by the Project improvements.

Loading Ratio:	***Channel***		***MLV Pad***	
Maximum Impervious Loading Ratio	***3.6 :1***	***(5:1 Max)***	***1.0 :1***	***(5:1 Max)***
Maximum Total Loading Ratio	***7.8 :1***	***(8:1 Max)***	***1.0 :1***	***(8:1 Max)***

Supporting Areas	***Channel***	***MLV Pad***	***Unit***
Impervious Drainage Area	***0.18***	***0.11***	***Acres***
Infiltration Area	***0.05***	***0.11***	***Acres***
Total Drainage Area	***0.40***	***0.11***	***Acres***

K.2 Location Map



ARCHITECTURE
ENGINEERING
ENVIRONMENTAL
LAND SURVEYING

BL Companies

N

GRAPHIC SCALE

1,000 500 0 1,000

SCALE IN FEET

ATLANTIC SUNRISE
PROPOSED 30" NATURAL GAS PIPELINE

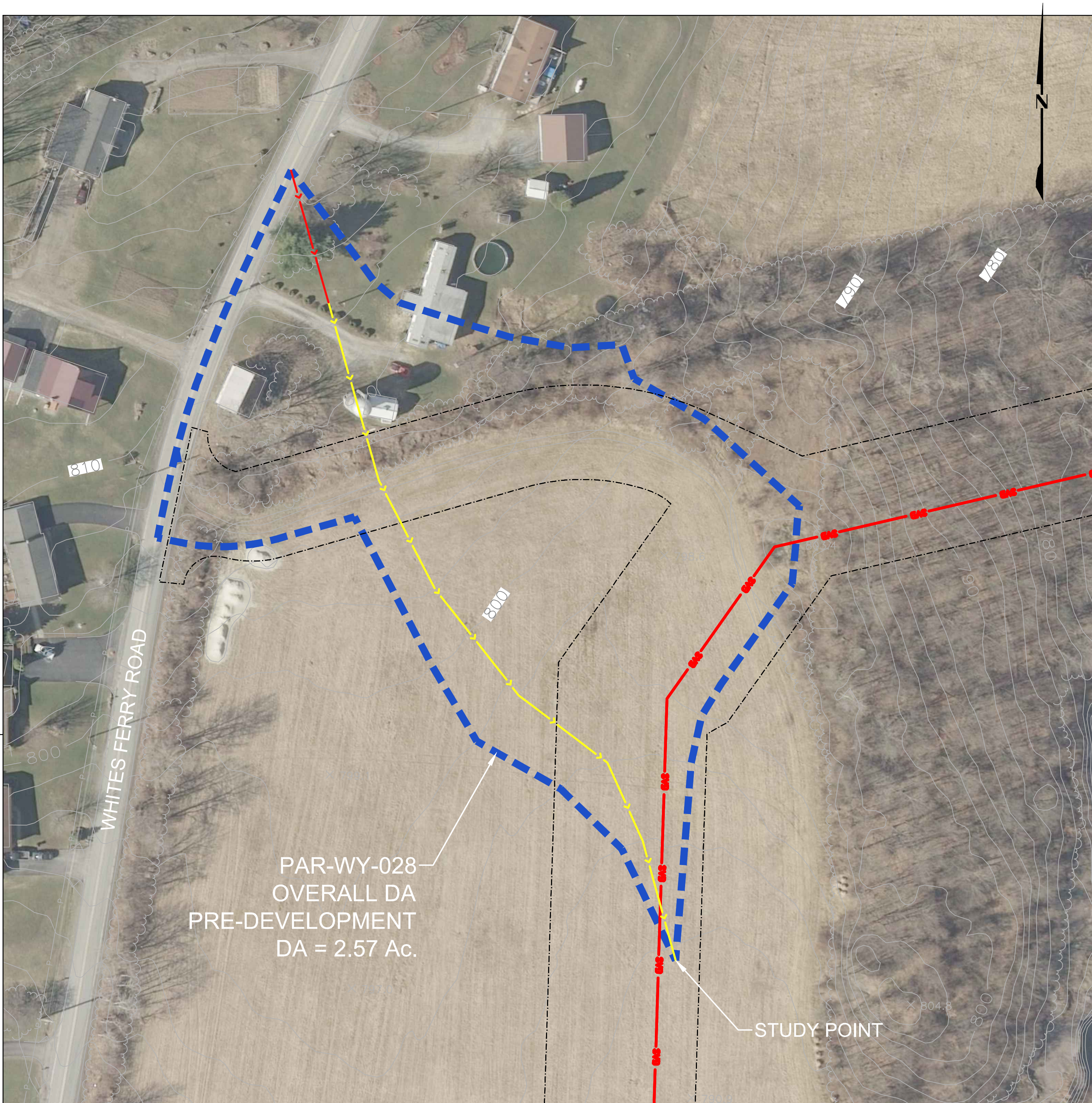
USGS LOCATION MAP
TEMPORARY AR-WY-028
EATON TOWNSHIP
WYOMING COUNTY, PENNSYLVANIA

Williams

NO.	DATE	BY	REVISION DESCRIPTION	W.O. NO.	CHK.	APP.	DRAWN BY: CLM	DATE: 11/11/15	ISSUED FOR BID:	SCALE: 1"=1,000'
				1161481			CHECKED BY:	DATE:	ISSUED FOR CONSTRUCTION:	
							APPROVED BY:	DATE:	DRAWING NUMBER: 24-1601-70-28-A/ 1683_3-AR-WY-028	SHEET 1 OF 1
							WO: 1161481			

K.3 Predevelopment Calculations

a. Predevelopment Drainage Area Map
b. 1-Year Rainfall Event
c. 2-Year Rainfall Event
d. 5-Year Rainfall Event
e. 10-Year Rainfall Event
f. 25-Year Rainfall Event
g. 50-year Rainfall Event
h. 100-Year Rainfall Event



PRE-DEVELOPMENT DRAINAGE AREA MAP

0 50 100
SCALE IN FEET

ISSUED FOR PERMITTING

ARCHITECTURE
ENGINEERING
ENVIRONMENTAL
LAND SURVEYING
BL Companies

LEGEND

TIME OF CONCENTRATION-SHEET FLOW	
TIME OF CONCENTRATION-SHALLOW CONCENTRATED FLOW	
DRAINAGE AREA	
PROPOSED GAS PIPELINE	GAS GAS

ATLANTIC SUNRISE PROJECT -
CENTRAL PENN LINE NORTH

PROPOSED 30" NATURAL GAS PIPELINE
ACCESS ROAD DRAINAGE AREA MAP
AR–WY–028 PRE
EATON TOWNSHIP
WYOMING COUNTY, PENNSYLVANIA

Williams

NO.	DATE	BY	REVISION DESCRIPTION	W.O. NO.	CHK.	APP.

DRAWN BY: OLC	DATE: 11/11/15	ISSUED FOR BID:	SCALE: 1" = 100'
CHECKED BY: BJP	DATE: 11/11/15	ISSUED FOR CONSTRUCTION:	
APPROVED BY: BJP	DATE: 11/11/15	DRAWING NUMBER: AR–WY–028 PRE	
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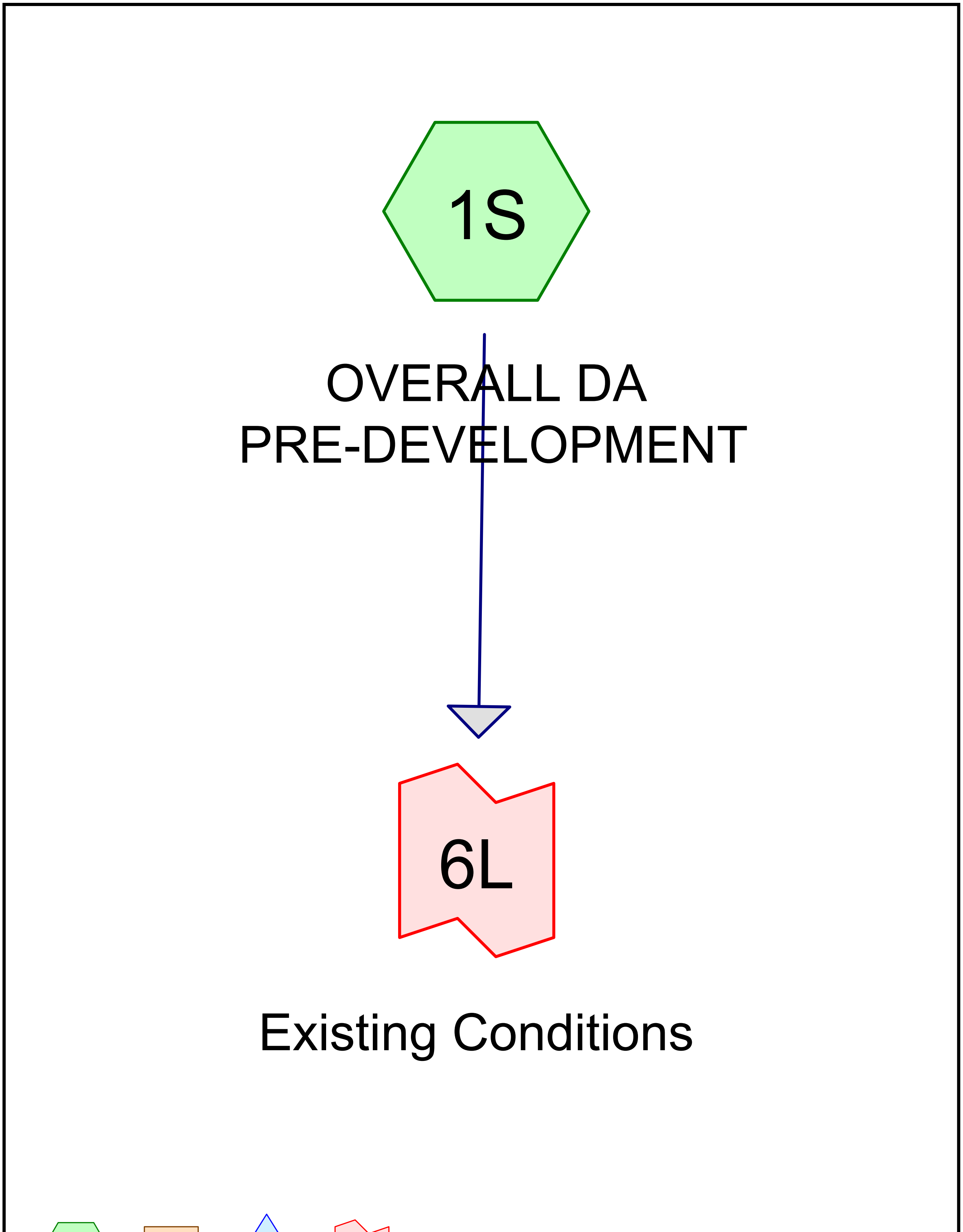


Routing Diagram for WY-028
Prepared by Microsoft, Printed 10/10/2016
HydroCAD® 10.00 s/n 01334 © 2013 HydroCAD Software Solutions LLC

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.074	87	Dirt roads, HSG C (1S)
2.024	71	Meadow, non-grazed, HSG C (1S)
0.139	98	Paved parking, HSG C (1S)
0.331	70	Woods, Good, HSG C (1S)
2.569	**73**	**TOTAL AREA**

Soil Listing (selected nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
2.569	HSG C	1S
0.000	HSG D	
0.000	Other	
2.569		**TOTAL AREA**

Time span=0.00-200.00 hrs, dt=0.01 hrs, 20001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: OVERALL DA Runoff Area=111,914 sf 5.42% Impervious Runoff Depth=0.36"
Flow Length=656' Tc=28.9 min CN=73 Runoff=0.60 cfs 0.077 af

Link 6L: Existing Conditions Inflow=0.60 cfs 0.077 af
Primary=0.60 cfs 0.077 af

Total Runoff Area = 2.569 ac Runoff Volume = 0.077 af Average Runoff Depth = 0.36"
94.58% Pervious = 2.430 ac 5.42% Impervious = 0.139 ac

Summary for Subcatchment 1S: OVERALL DA PRE-DEVELOPMENT

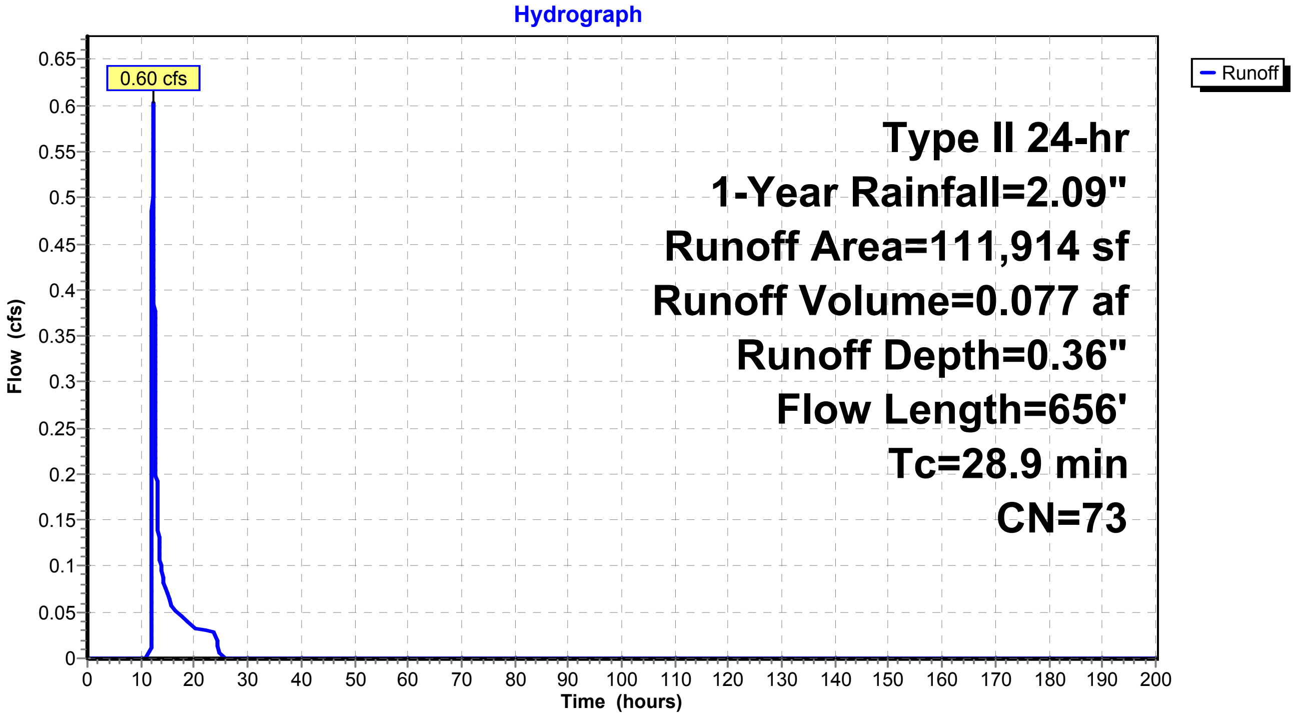
Runoff = 0.60 cfs @ 12.30 hrs, Volume= 0.077 af, Depth= 0.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs
Type II 24-hr 1-Year Rainfall=2.09"

	Area (sf)	CN	Description
	6,070	98	Paved parking, HSG C
	0	89	Gravel roads, HSG C
*	0	98	Crushed Stone Pad, HSG C
	14,434	70	Woods, Good, HSG C
	88,181	71	Meadow, non-grazed, HSG C
	3,229	87	Dirt roads, HSG C
	111,914	73	Weighted Average
	105,844		94.58% Pervious Area
	6,070		5.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	17	0.0450	1.18		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.51"
1.5	8	0.0450	0.09		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.51"
15.5	43	0.0450	0.05		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.51"
4.9	32	0.0400	0.11		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.51"
0.2	17	0.0540	1.63		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
0.1	40	0.0540	4.72		**Shallow Concentrated Flow, SC2** Paved Kv= 20.3 fps
0.5	51	0.0540	1.63		**Shallow Concentrated Flow, SC3** Short Grass Pasture Kv= 7.0 fps
0.3	18	0.0540	1.16		**Shallow Concentrated Flow, SC4** Woodland Kv= 5.0 fps
0.1	10	0.0540	1.63		**Shallow Concentrated Flow, SC5** Short Grass Pasture Kv= 7.0 fps
0.0	6	0.0540	3.74		**Shallow Concentrated Flow, SC6** Unpaved Kv= 16.1 fps
5.6	414	0.0310	1.23		**Shallow Concentrated Flow, SC7** Short Grass Pasture Kv= 7.0 fps
28.9	656	Total			

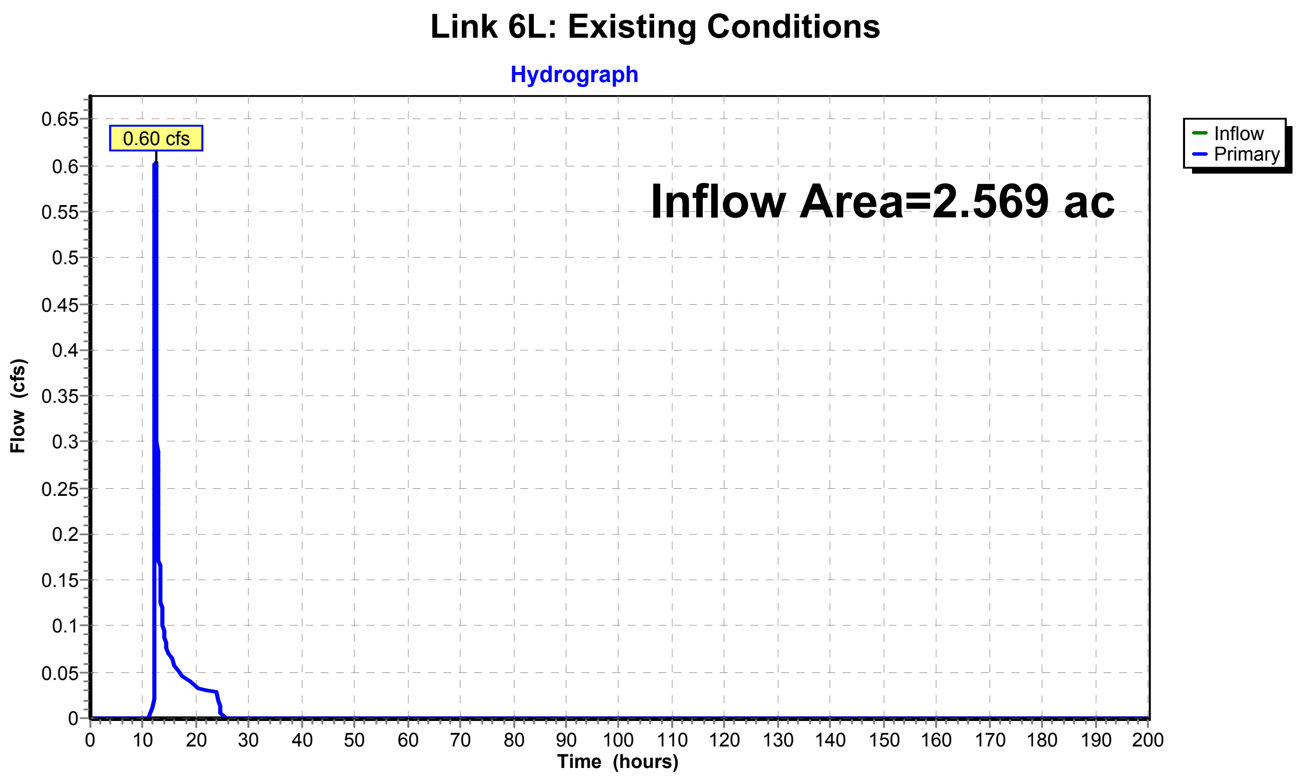
Subcatchment 1S: OVERALL DA PRE-DEVELOPMENT



Summary for Link 6L: Existing Conditions

Inflow Area =	2.569 ac,	5.42% Impervious,	Inflow Depth = 0.36"	for 1-Year event	
Inflow =	0.60 cfs @	12.30 hrs, Volume=	0.077 af		
Primary =	0.60 cfs @	12.30 hrs, Volume=	0.077 af,	Atten= 0%,	Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs



Time span=0.00-200.00 hrs, dt=0.01 hrs, 20001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: OVERALLDA Runoff Area=111,914 sf 5.42% Impervious Runoff Depth=0.57"
Flow Length=656' Tc=28.9 min CN=73 Runoff=1.09 cfs 0.123 af

Link 6L: Existing Conditions Inflow=1.09 cfs 0.123 af
Primary=1.09 cfs 0.123 af

Total Runoff Area = 2.569 ac Runoff Volume = 0.123 af Average Runoff Depth = 0.57"
94.58% Pervious = 2.430 ac 5.42% Impervious = 0.139 ac

Summary for Subcatchment 1S: OVERALL DA PRE-DEVELOPMENT

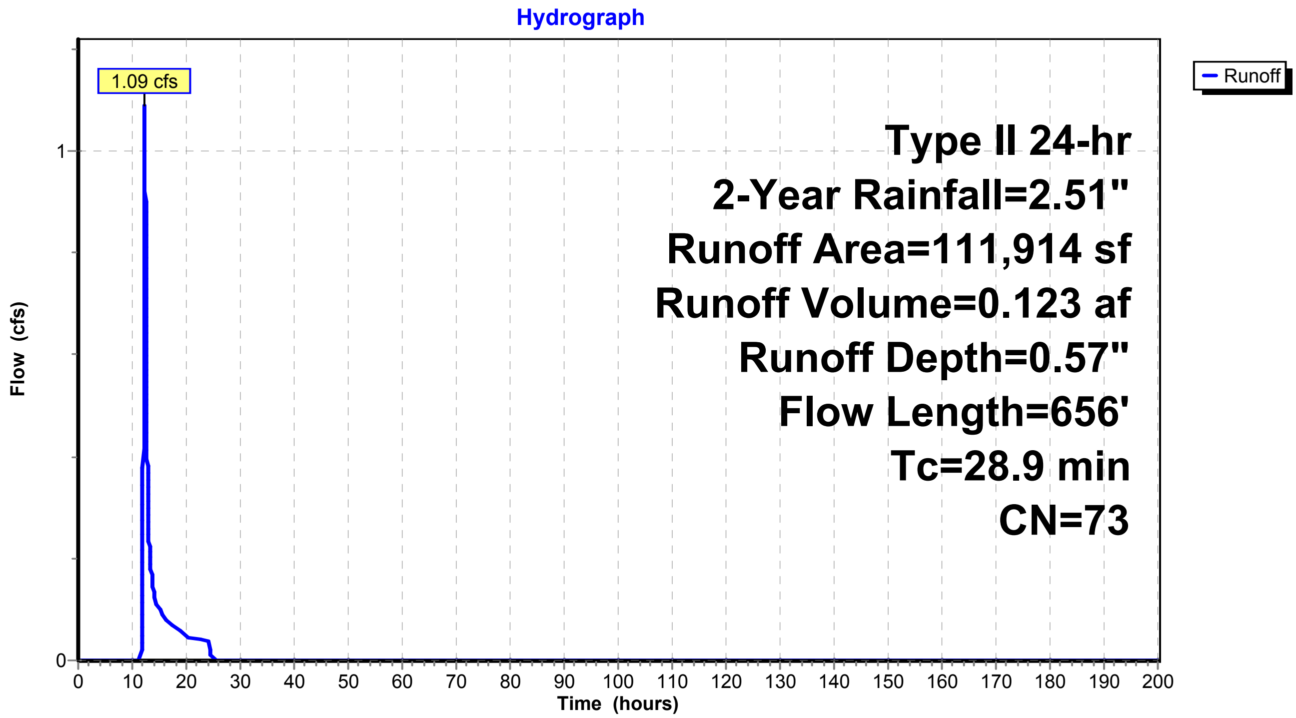
Runoff = 1.09 cfs @ 12.27 hrs, Volume= 0.123 af, Depth= 0.57"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs
Type II 24-hr 2-Year Rainfall=2.51"

	Area (sf)	CN	Description
	6,070	98	Paved parking, HSG C
	0	89	Gravel roads, HSG C
*	0	98	Crushed Stone Pad, HSG C
	14,434	70	Woods, Good, HSG C
	88,181	71	Meadow, non-grazed, HSG C
	3,229	87	Dirt roads, HSG C
	111,914	73	Weighted Average
	105,844		94.58% Pervious Area
	6,070		5.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	17	0.0450	1.18		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.51"
1.5	8	0.0450	0.09		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.51"
15.5	43	0.0450	0.05		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.51"
4.9	32	0.0400	0.11		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.51"
0.2	17	0.0540	1.63		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
0.1	40	0.0540	4.72		**Shallow Concentrated Flow, SC2** Paved Kv= 20.3 fps
0.5	51	0.0540	1.63		**Shallow Concentrated Flow, SC3** Short Grass Pasture Kv= 7.0 fps
0.3	18	0.0540	1.16		**Shallow Concentrated Flow, SC4** Woodland Kv= 5.0 fps
0.1	10	0.0540	1.63		**Shallow Concentrated Flow, SC5** Short Grass Pasture Kv= 7.0 fps
0.0	6	0.0540	3.74		**Shallow Concentrated Flow, SC6** Unpaved Kv= 16.1 fps
5.6	414	0.0310	1.23		**Shallow Concentrated Flow, SC7** Short Grass Pasture Kv= 7.0 fps
28.9	656	Total			

Subcatchment 1S: OVERALL DA PRE-DEVELOPMENT

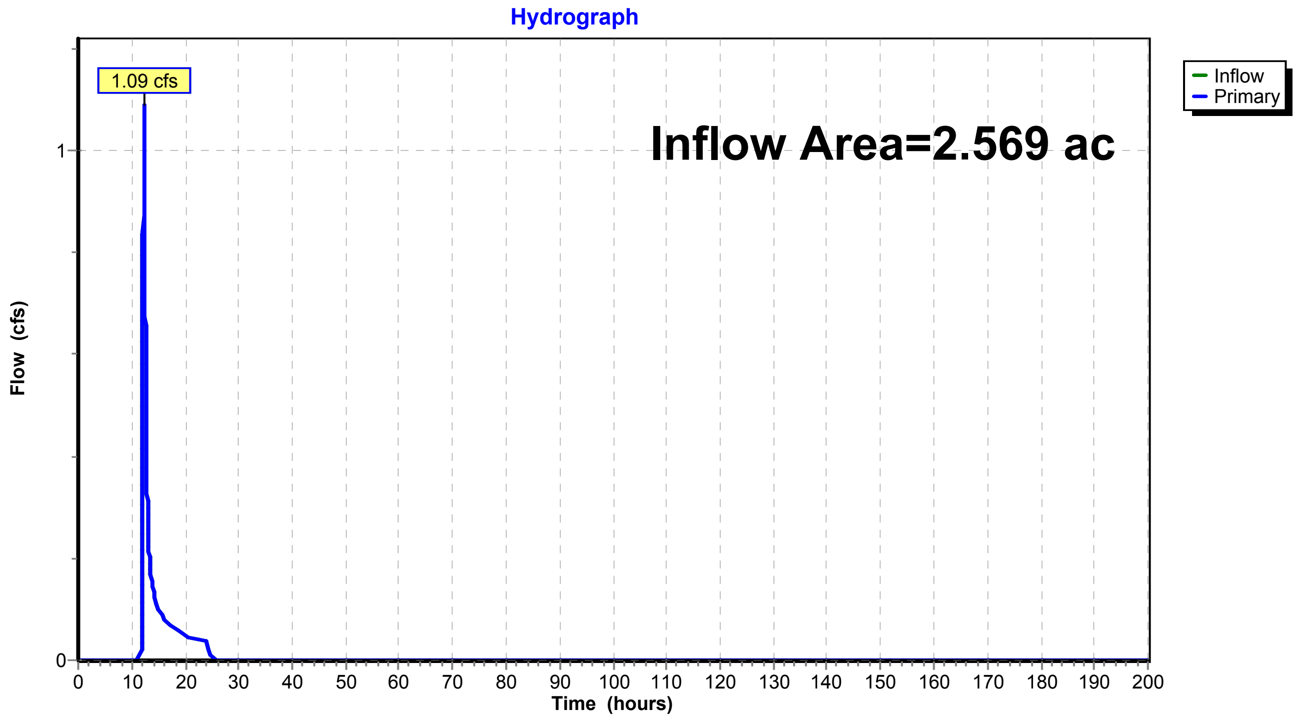


Summary for Link 6L: Existing Conditions

Inflow Area = 2.569 ac, 5.42% Impervious, Inflow Depth = 0.57" for 2-Year event
Inflow = 1.09 cfs @ 12.27 hrs, Volume= 0.123 af
Primary = 1.09 cfs @ 12.27 hrs, Volume= 0.123 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs

Link 6L: Existing Conditions



Time span=0.00-200.00 hrs, dt=0.01 hrs, 20001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: OVERALL DA Runoff Area=111,914 sf 5.42% Impervious Runoff Depth=0.91"
Flow Length=656' Tc=28.9 min CN=73 Runoff=1.90 cfs 0.196 af

Link 6L: Existing Conditions Inflow=1.90 cfs 0.196 af
Primary=1.90 cfs 0.196 af

Total Runoff Area = 2.569 ac Runoff Volume = 0.196 af Average Runoff Depth = 0.91"
94.58% Pervious = 2.430 ac 5.42% Impervious = 0.139 ac

Summary for Subcatchment 1S: OVERALL DA PRE-DEVELOPMENT

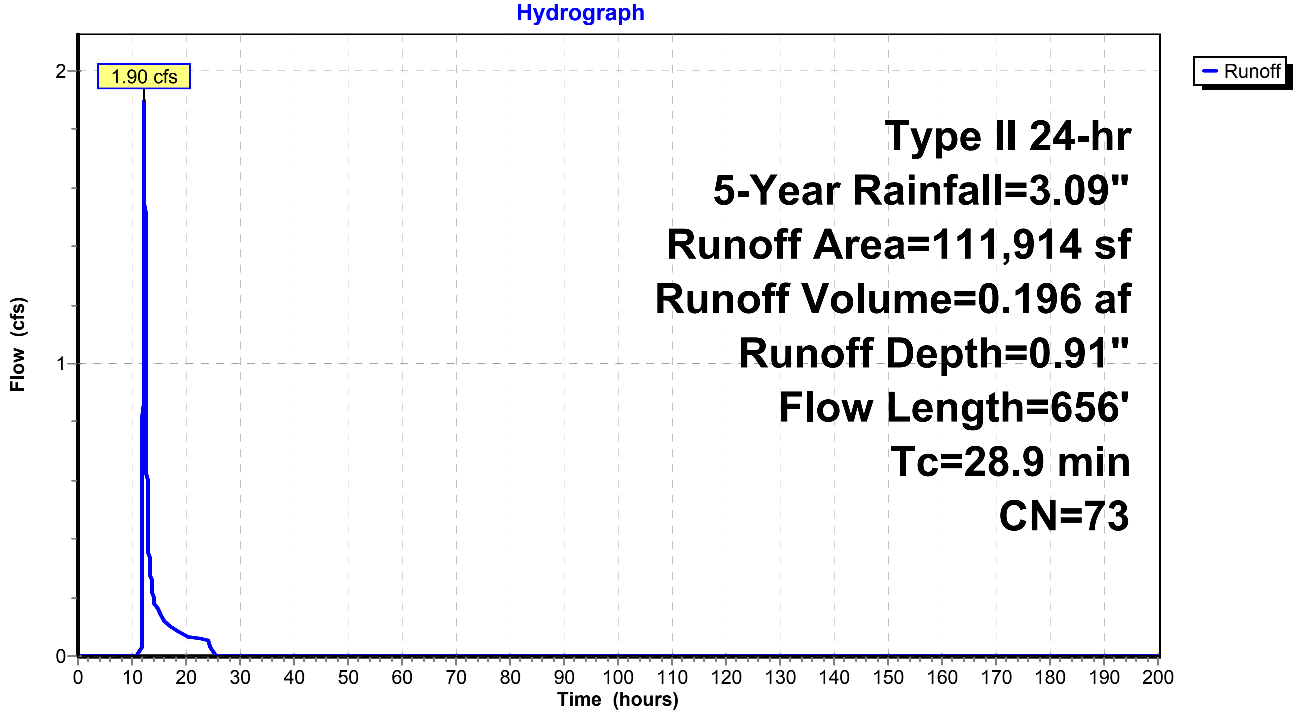
Runoff = 1.90 cfs @ 12.24 hrs, Volume= 0.196 af, Depth= 0.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs
Type II 24-hr 5-Year Rainfall=3.09"

	Area (sf)	CN	Description
	6,070	98	Paved parking, HSG C
	0	89	Gravel roads, HSG C
*	0	98	Crushed Stone Pad, HSG C
	14,434	70	Woods, Good, HSG C
	88,181	71	Meadow, non-grazed, HSG C
	3,229	87	Dirt roads, HSG C
	111,914	73	Weighted Average
	105,844		94.58% Pervious Area
	6,070		5.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	17	0.0450	1.18		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.51"
1.5	8	0.0450	0.09		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.51"
15.5	43	0.0450	0.05		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.51"
4.9	32	0.0400	0.11		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.51"
0.2	17	0.0540	1.63		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
0.1	40	0.0540	4.72		**Shallow Concentrated Flow, SC2** Paved Kv= 20.3 fps
0.5	51	0.0540	1.63		**Shallow Concentrated Flow, SC3** Short Grass Pasture Kv= 7.0 fps
0.3	18	0.0540	1.16		**Shallow Concentrated Flow, SC4** Woodland Kv= 5.0 fps
0.1	10	0.0540	1.63		**Shallow Concentrated Flow, SC5** Short Grass Pasture Kv= 7.0 fps
0.0	6	0.0540	3.74		**Shallow Concentrated Flow, SC6** Unpaved Kv= 16.1 fps
5.6	414	0.0310	1.23		**Shallow Concentrated Flow, SC7** Short Grass Pasture Kv= 7.0 fps
28.9	656	Total			

Subcatchment 1S: OVERALL DA PRE-DEVELOPMENT

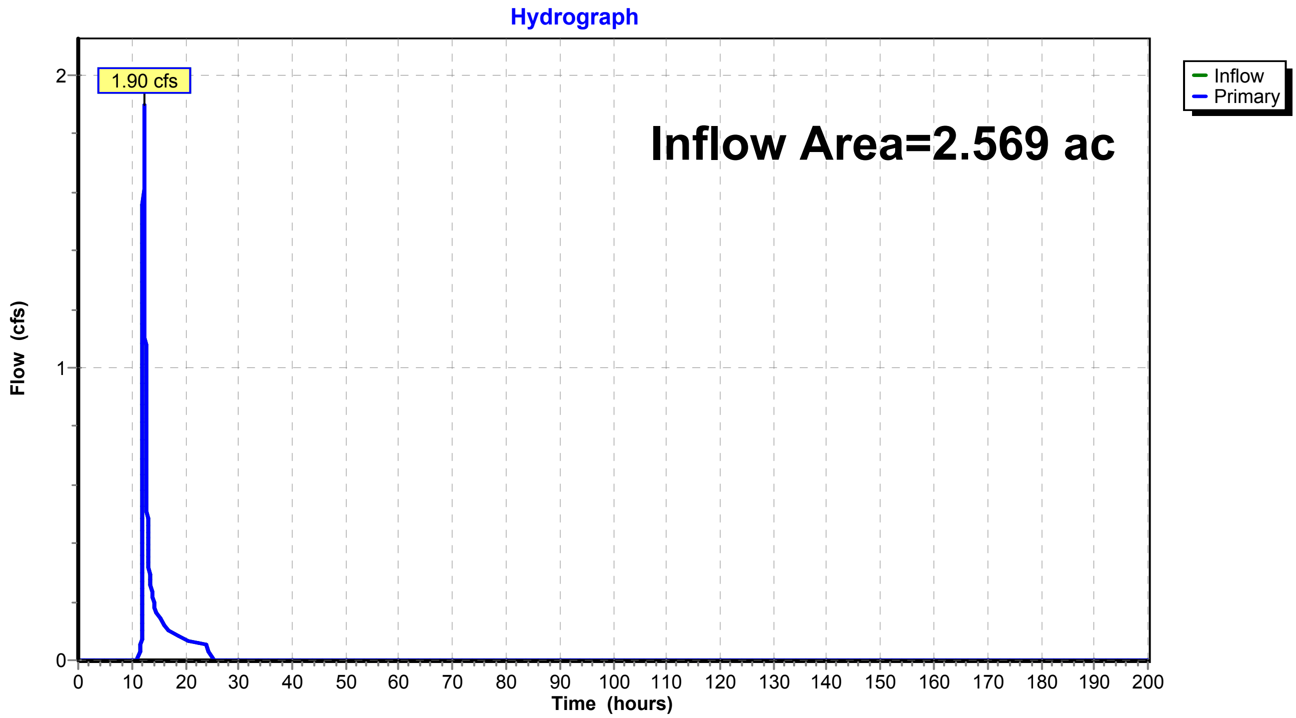


Summary for Link 6L: Existing Conditions

Inflow Area = 2.569 ac, 5.42% Impervious, Inflow Depth = 0.91" for 5-Year event
Inflow = 1.90 cfs @ 12.24 hrs, Volume= 0.196 af
Primary = 1.90 cfs @ 12.24 hrs, Volume= 0.196 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs

Link 6L: Existing Conditions



Time span=0.00-200.00 hrs, dt=0.01 hrs, 20001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: OVERALL DA Runoff Area=111,914 sf 5.42% Impervious Runoff Depth=1.25"
Flow Length=656' Tc=28.9 min CN=73 Runoff=2.70 cfs 0.267 af

Link 6L: Existing Conditions Inflow=2.70 cfs 0.267 af
Primary=2.70 cfs 0.267 af

Total Runoff Area = 2.569 ac Runoff Volume = 0.267 af Average Runoff Depth = 1.25"
94.58% Pervious = 2.430 ac 5.42% Impervious = 0.139 ac

Summary for Subcatchment 1S: OVERALL DA PRE-DEVELOPMENT

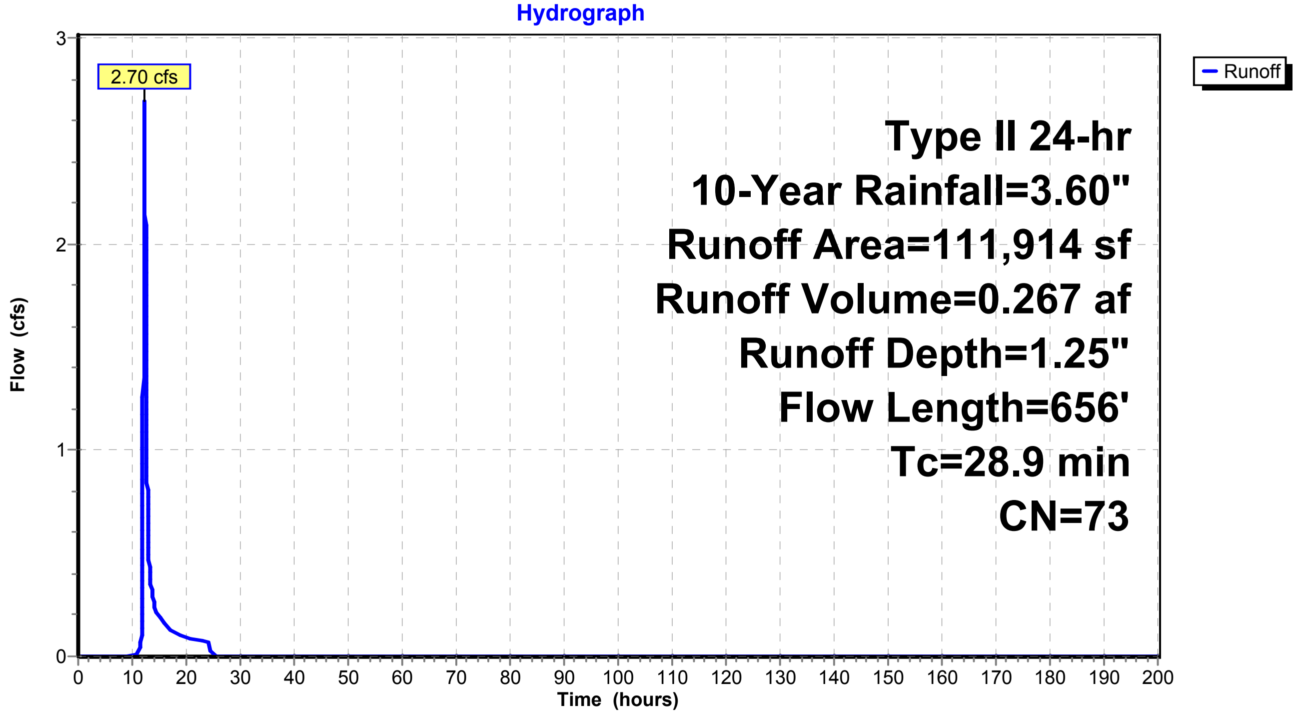
Runoff = 2.70 cfs @ 12.24 hrs, Volume= 0.267 af, Depth= 1.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs
Type II 24-hr 10-Year Rainfall=3.60"

	Area (sf)	CN	Description
	6,070	98	Paved parking, HSG C
	0	89	Gravel roads, HSG C
*	0	98	Crushed Stone Pad, HSG C
	14,434	70	Woods, Good, HSG C
	88,181	71	Meadow, non-grazed, HSG C
	3,229	87	Dirt roads, HSG C
	111,914	73	Weighted Average
	105,844		94.58% Pervious Area
	6,070		5.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	17	0.0450	1.18		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.51"
1.5	8	0.0450	0.09		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.51"
15.5	43	0.0450	0.05		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.51"
4.9	32	0.0400	0.11		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.51"
0.2	17	0.0540	1.63		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
0.1	40	0.0540	4.72		**Shallow Concentrated Flow, SC2** Paved Kv= 20.3 fps
0.5	51	0.0540	1.63		**Shallow Concentrated Flow, SC3** Short Grass Pasture Kv= 7.0 fps
0.3	18	0.0540	1.16		**Shallow Concentrated Flow, SC4** Woodland Kv= 5.0 fps
0.1	10	0.0540	1.63		**Shallow Concentrated Flow, SC5** Short Grass Pasture Kv= 7.0 fps
0.0	6	0.0540	3.74		**Shallow Concentrated Flow, SC6** Unpaved Kv= 16.1 fps
5.6	414	0.0310	1.23		**Shallow Concentrated Flow, SC7** Short Grass Pasture Kv= 7.0 fps
28.9	656	Total			

Subcatchment 1S: OVERALL DA PRE-DEVELOPMENT

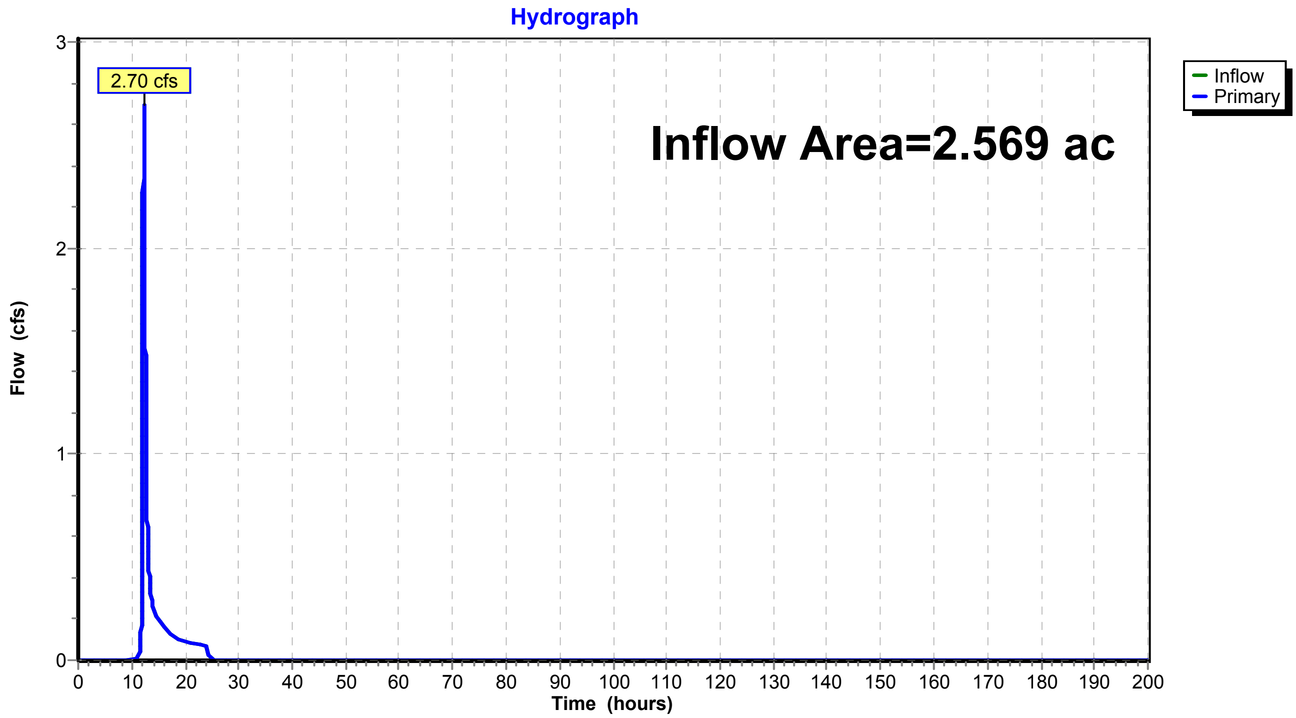


Summary for Link 6L: Existing Conditions

Inflow Area =	2.569 ac,	5.42% Impervious,	Inflow Depth = 1.25"	for 10-Year event	
Inflow =	2.70 cfs @	12.24 hrs,	Volume=	0.267 af	
Primary =	2.70 cfs @	12.24 hrs,	Volume=	0.267 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs

Link 6L: Existing Conditions



Time span=0.00-200.00 hrs, dt=0.01 hrs, 20001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: OVERALL DA Runoff Area=111,914 sf 5.42% Impervious Runoff Depth=1.81"
Flow Length=656' Tc=28.9 min CN=73 Runoff=4.04 cfs 0.388 af

Link 6L: Existing Conditions Inflow=4.04 cfs 0.388 af
Primary=4.04 cfs 0.388 af

Total Runoff Area = 2.569 ac Runoff Volume = 0.388 af Average Runoff Depth = 1.81"
94.58% Pervious = 2.430 ac 5.42% Impervious = 0.139 ac

Summary for Subcatchment 1S: OVERALL DA PRE-DEVELOPMENT

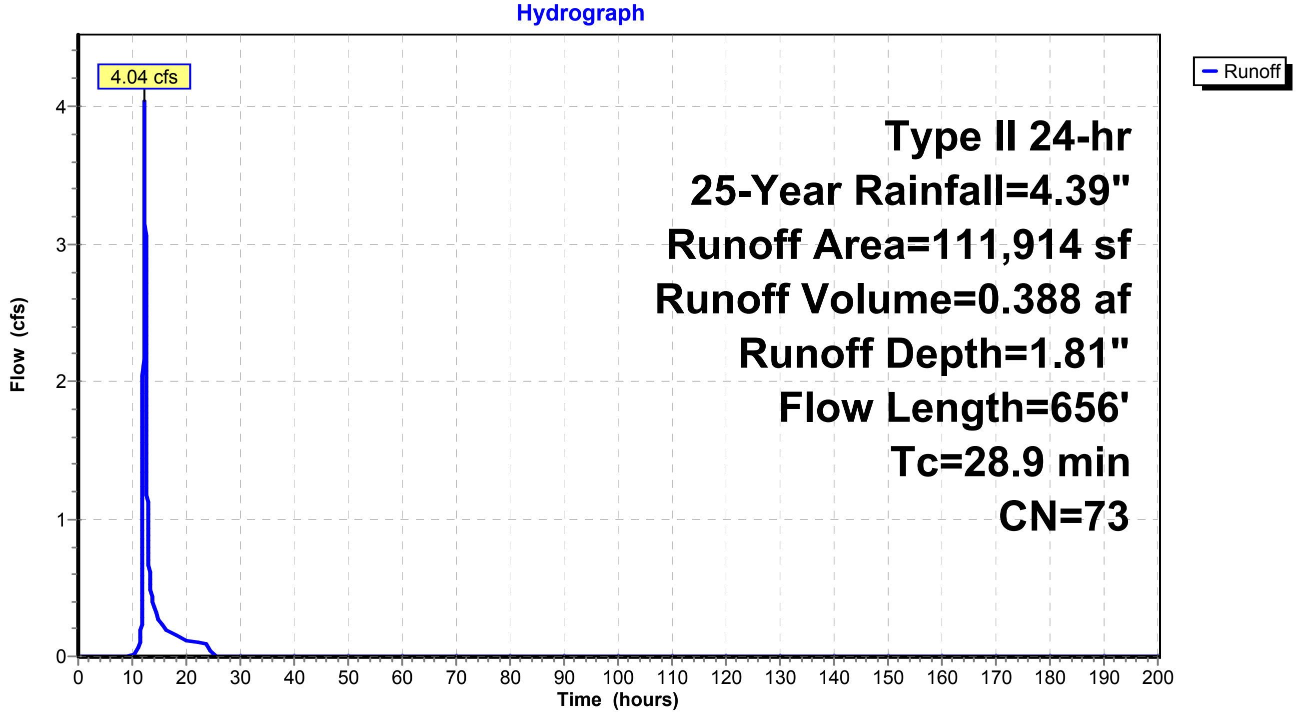
Runoff = 4.04 cfs @ 12.24 hrs, Volume= 0.388 af, Depth= 1.81"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=4.39"

	Area (sf)	CN	Description
	6,070	98	Paved parking, HSG C
	0	89	Gravel roads, HSG C
*	0	98	Crushed Stone Pad, HSG C
	14,434	70	Woods, Good, HSG C
	88,181	71	Meadow, non-grazed, HSG C
	3,229	87	Dirt roads, HSG C
	111,914	73	Weighted Average
	105,844		94.58% Pervious Area
	6,070		5.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	17	0.0450	1.18		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.51"
1.5	8	0.0450	0.09		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.51"
15.5	43	0.0450	0.05		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.51"
4.9	32	0.0400	0.11		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.51"
0.2	17	0.0540	1.63		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
0.1	40	0.0540	4.72		**Shallow Concentrated Flow, SC2** Paved Kv= 20.3 fps
0.5	51	0.0540	1.63		**Shallow Concentrated Flow, SC3** Short Grass Pasture Kv= 7.0 fps
0.3	18	0.0540	1.16		**Shallow Concentrated Flow, SC4** Woodland Kv= 5.0 fps
0.1	10	0.0540	1.63		**Shallow Concentrated Flow, SC5** Short Grass Pasture Kv= 7.0 fps
0.0	6	0.0540	3.74		**Shallow Concentrated Flow, SC6** Unpaved Kv= 16.1 fps
5.6	414	0.0310	1.23		**Shallow Concentrated Flow, SC7** Short Grass Pasture Kv= 7.0 fps
28.9	656	Total			

Subcatchment 1S: OVERALL DA PRE-DEVELOPMENT

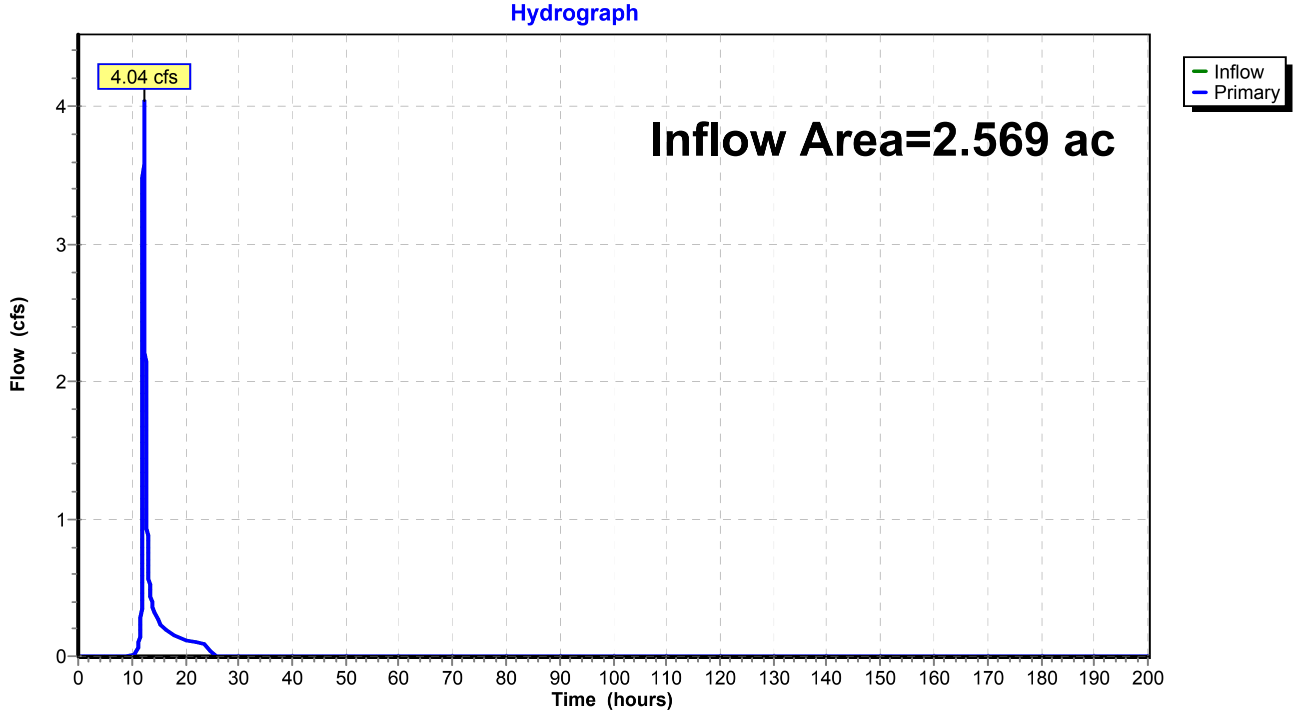


Summary for Link 6L: Existing Conditions

Inflow Area = 2.569 ac, 5.42% Impervious, Inflow Depth = 1.81" for 25-Year event
Inflow = 4.04 cfs @ 12.24 hrs, Volume= 0.388 af
Primary = 4.04 cfs @ 12.24 hrs, Volume= 0.388 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs

Link 6L: Existing Conditions



Time span=0.00-200.00 hrs, dt=0.01 hrs, 20001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: OVERALL DA Runoff Area=111,914 sf 5.42% Impervious Runoff Depth=2.36"
Flow Length=656' Tc=28.9 min CN=73 Runoff=5.33 cfs 0.505 af

Link 6L: Existing Conditions Inflow=5.33 cfs 0.505 af
Primary=5.33 cfs 0.505 af

Total Runoff Area = 2.569 ac Runoff Volume = 0.505 af Average Runoff Depth = 2.36"
94.58% Pervious = 2.430 ac 5.42% Impervious = 0.139 ac

Summary for Subcatchment 1S: OVERALL DA PRE-DEVELOPMENT

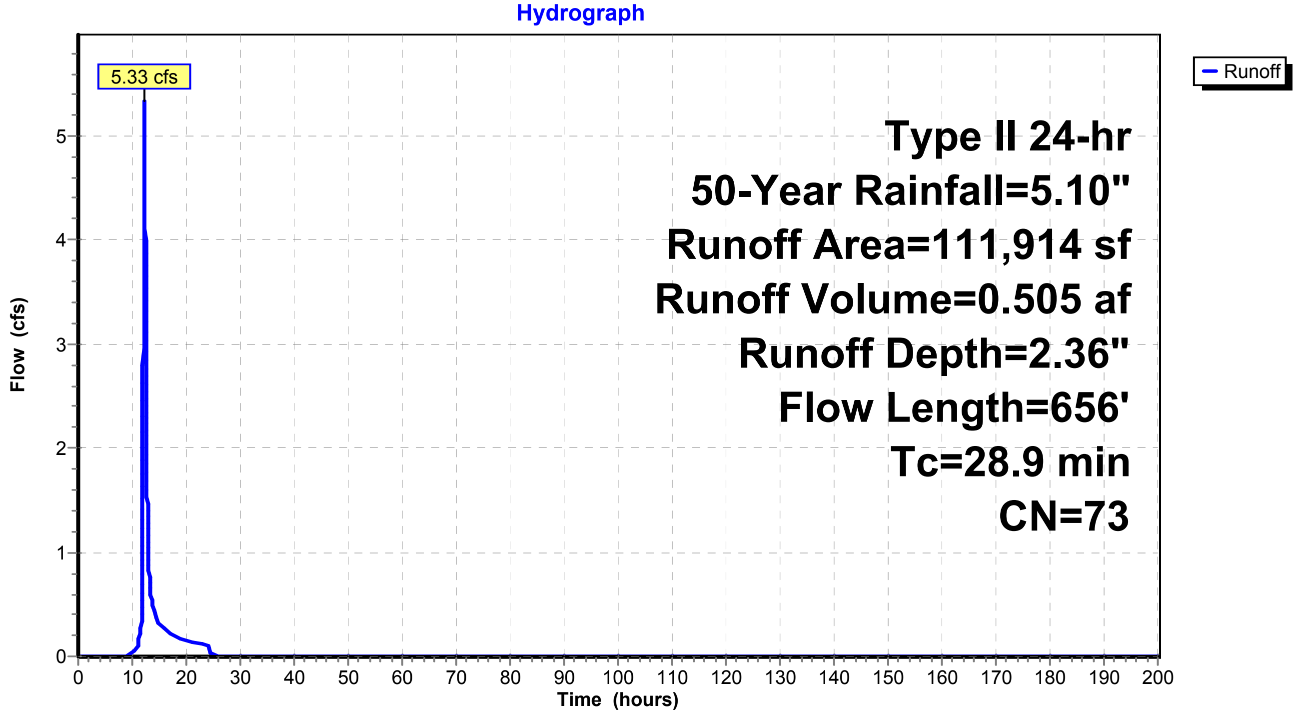
Runoff = 5.33 cfs @ 12.23 hrs, Volume= 0.505 af, Depth= 2.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs
Type II 24-hr 50-Year Rainfall=5.10"

	Area (sf)	CN	Description
	6,070	98	Paved parking, HSG C
	0	89	Gravel roads, HSG C
*	0	98	Crushed Stone Pad, HSG C
	14,434	70	Woods, Good, HSG C
	88,181	71	Meadow, non-grazed, HSG C
	3,229	87	Dirt roads, HSG C
	111,914	73	Weighted Average
	105,844		94.58% Pervious Area
	6,070		5.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	17	0.0450	1.18		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.51"
1.5	8	0.0450	0.09		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.51"
15.5	43	0.0450	0.05		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.51"
4.9	32	0.0400	0.11		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.51"
0.2	17	0.0540	1.63		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
0.1	40	0.0540	4.72		**Shallow Concentrated Flow, SC2** Paved Kv= 20.3 fps
0.5	51	0.0540	1.63		**Shallow Concentrated Flow, SC3** Short Grass Pasture Kv= 7.0 fps
0.3	18	0.0540	1.16		**Shallow Concentrated Flow, SC4** Woodland Kv= 5.0 fps
0.1	10	0.0540	1.63		**Shallow Concentrated Flow, SC5** Short Grass Pasture Kv= 7.0 fps
0.0	6	0.0540	3.74		**Shallow Concentrated Flow, SC6** Unpaved Kv= 16.1 fps
5.6	414	0.0310	1.23		**Shallow Concentrated Flow, SC7** Short Grass Pasture Kv= 7.0 fps
28.9	656	Total			

Subcatchment 1S: OVERALL DA PRE-DEVELOPMENT

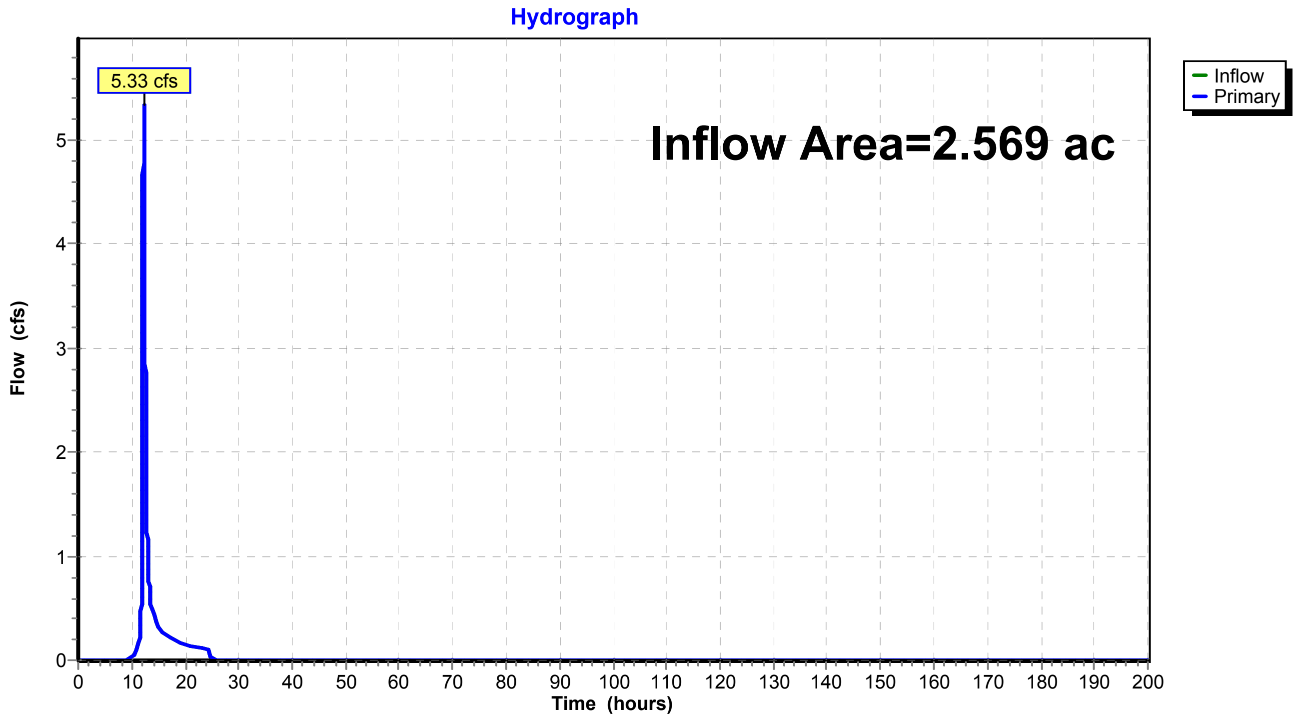


Summary for Link 6L: Existing Conditions

Inflow Area =	2.569 ac,	5.42% Impervious,	Inflow Depth = 2.36"	for 50-Year event	
Inflow =	5.33 cfs @	12.23 hrs,	Volume=	0.505 af	
Primary =	5.33 cfs @	12.23 hrs,	Volume=	0.505 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs

Link 6L: Existing Conditions



Time span=0.00-200.00 hrs, dt=0.01 hrs, 20001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: OVERALLDA Runoff Area=111,914 sf 5.42% Impervious Runoff Depth=3.02"
Flow Length=656' Tc=28.9 min CN=73 Runoff=6.88 cfs 0.647 af

Link 6L: Existing Conditions Inflow=6.88 cfs 0.647 af
Primary=6.88 cfs 0.647 af

Total Runoff Area = 2.569 ac Runoff Volume = 0.647 af Average Runoff Depth = 3.02"
94.58% Pervious = 2.430 ac 5.42% Impervious = 0.139 ac

Summary for Subcatchment 1S: OVERALL DA PRE-DEVELOPMENT

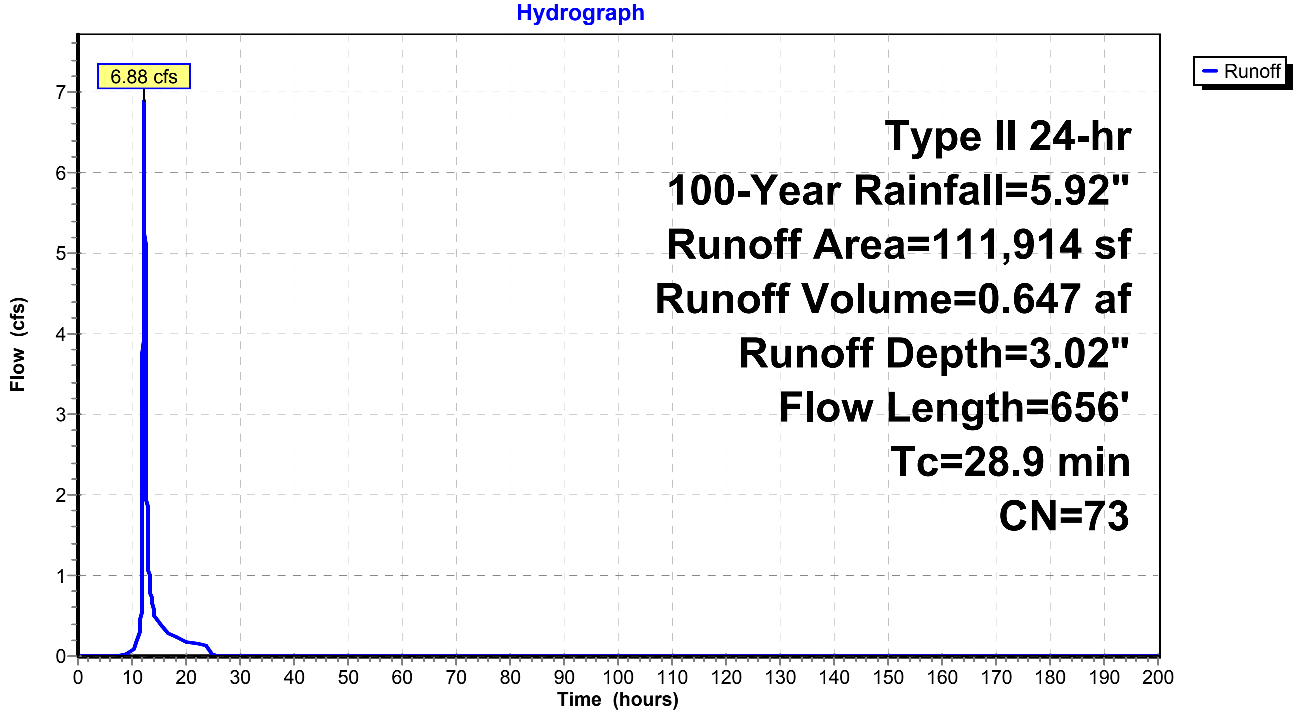
Runoff = 6.88 cfs @ 12.23 hrs, Volume= 0.647 af, Depth= 3.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Year Rainfall=5.92"

	Area (sf)	CN	Description
	6,070	98	Paved parking, HSG C
	0	89	Gravel roads, HSG C
*	0	98	Crushed Stone Pad, HSG C
	14,434	70	Woods, Good, HSG C
	88,181	71	Meadow, non-grazed, HSG C
	3,229	87	Dirt roads, HSG C
	111,914	73	Weighted Average
	105,844		94.58% Pervious Area
	6,070		5.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	17	0.0450	1.18		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.51"
1.5	8	0.0450	0.09		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.51"
15.5	43	0.0450	0.05		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.51"
4.9	32	0.0400	0.11		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.51"
0.2	17	0.0540	1.63		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
0.1	40	0.0540	4.72		**Shallow Concentrated Flow, SC2** Paved Kv= 20.3 fps
0.5	51	0.0540	1.63		**Shallow Concentrated Flow, SC3** Short Grass Pasture Kv= 7.0 fps
0.3	18	0.0540	1.16		**Shallow Concentrated Flow, SC4** Woodland Kv= 5.0 fps
0.1	10	0.0540	1.63		**Shallow Concentrated Flow, SC5** Short Grass Pasture Kv= 7.0 fps
0.0	6	0.0540	3.74		**Shallow Concentrated Flow, SC6** Unpaved Kv= 16.1 fps
5.6	414	0.0310	1.23		**Shallow Concentrated Flow, SC7** Short Grass Pasture Kv= 7.0 fps
28.9	656	Total			

Subcatchment 1S: OVERALL DA PRE-DEVELOPMENT

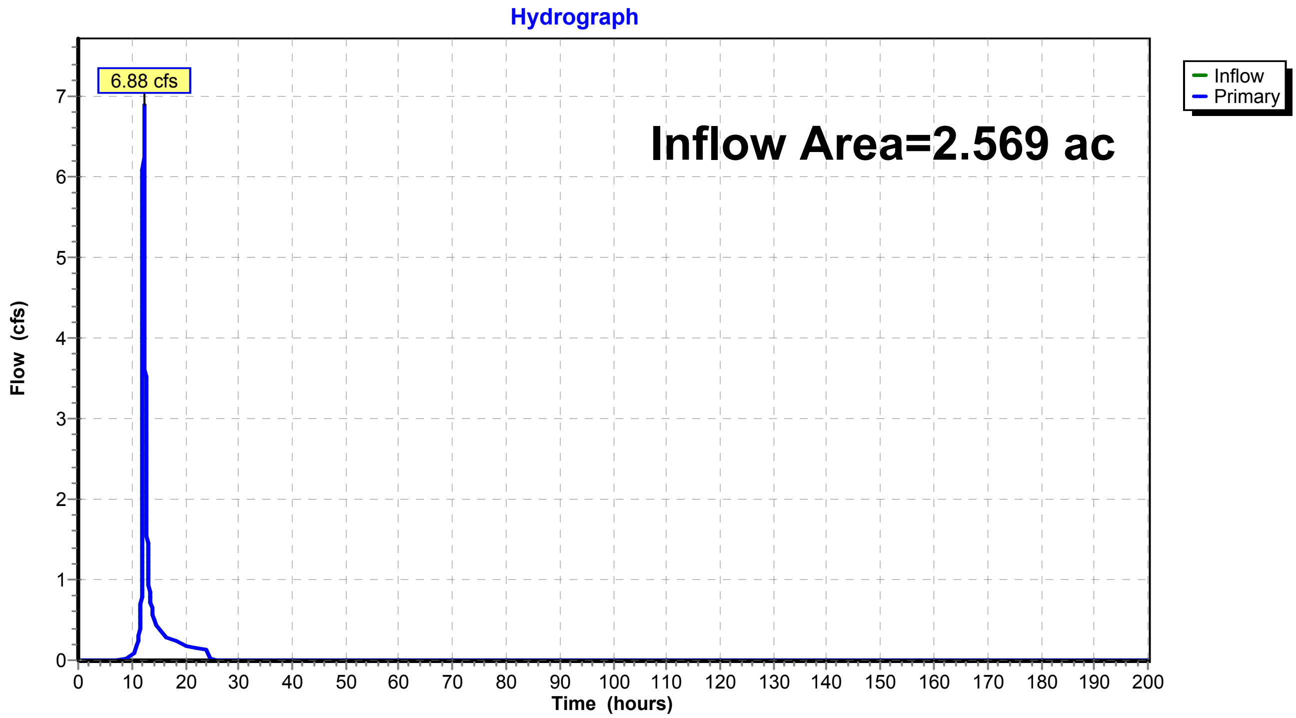


Summary for Link 6L: Existing Conditions

Inflow Area =	2.569 ac,	5.42% Impervious,	Inflow Depth =	3.02"	for 100-Year event
Inflow =	6.88 cfs @	12.23 hrs,	Volume=	0.647 af	
Primary =	6.88 cfs @	12.23 hrs,	Volume=	0.647 af,	Atten= 0%, Lag= 0.0 min

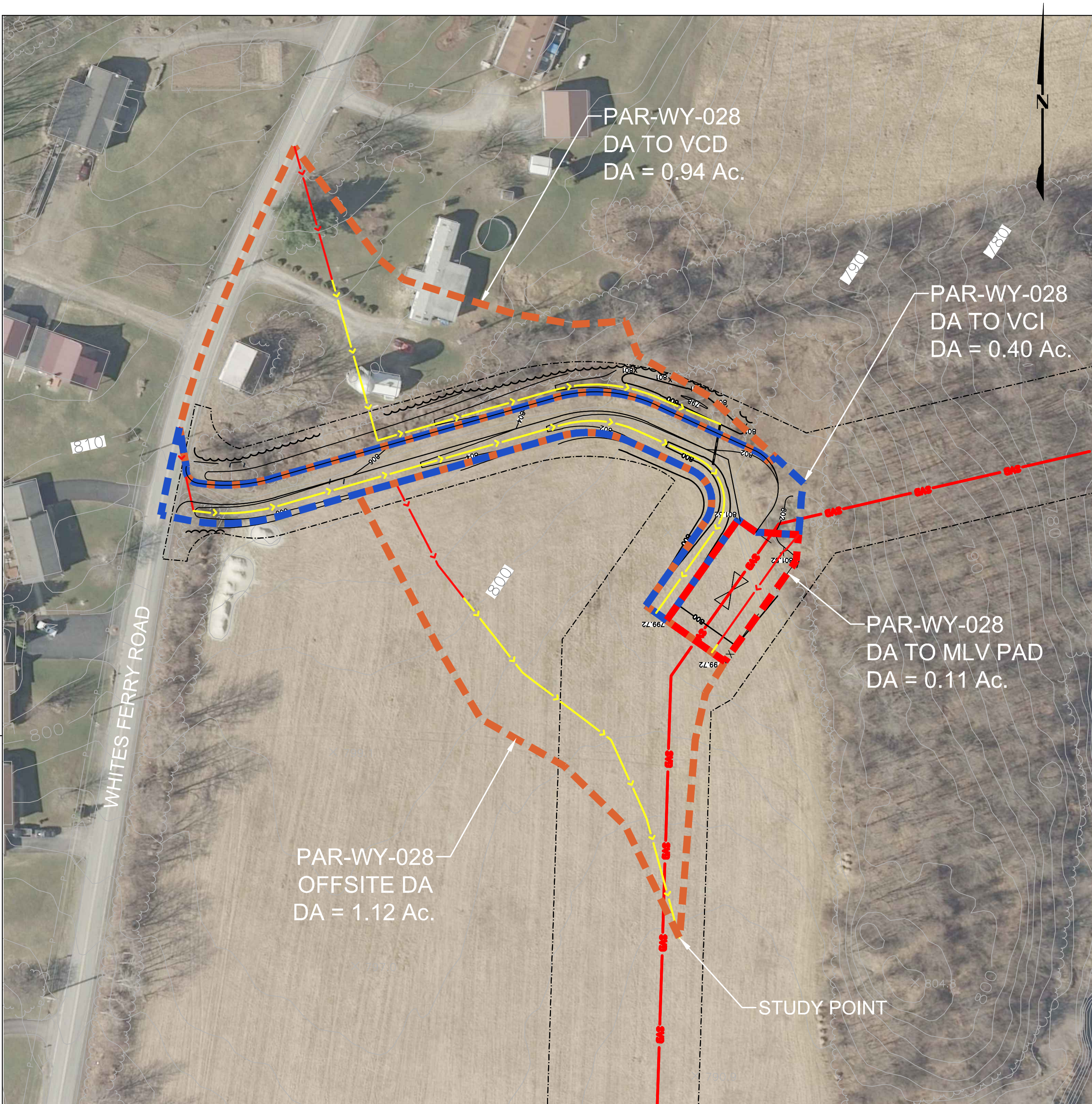
Primary outflow = Inflow, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs

Link 6L: Existing Conditions



K.4 Post Development Calculations

a. Post Development Drainage Area Map
b. 1-Year Rainfall Event
c. 2-Year Rainfall Event
d. 5-Year Rainfall Event
e. 10-Year Rainfall Event
f. 25-Year Rainfall Event
g. 50-year Rainfall Event
h. 100-Year Rainfall Event



POST-DEVELOPMENT DRAINAGE AREA MAP

0 50 100
SCALE IN FEET

ISSUED FOR PERMITTING

ARCHITECTURE
ENGINEERING
ENVIRONMENTAL
LAND SURVEYING
BL Companies

LEGEND

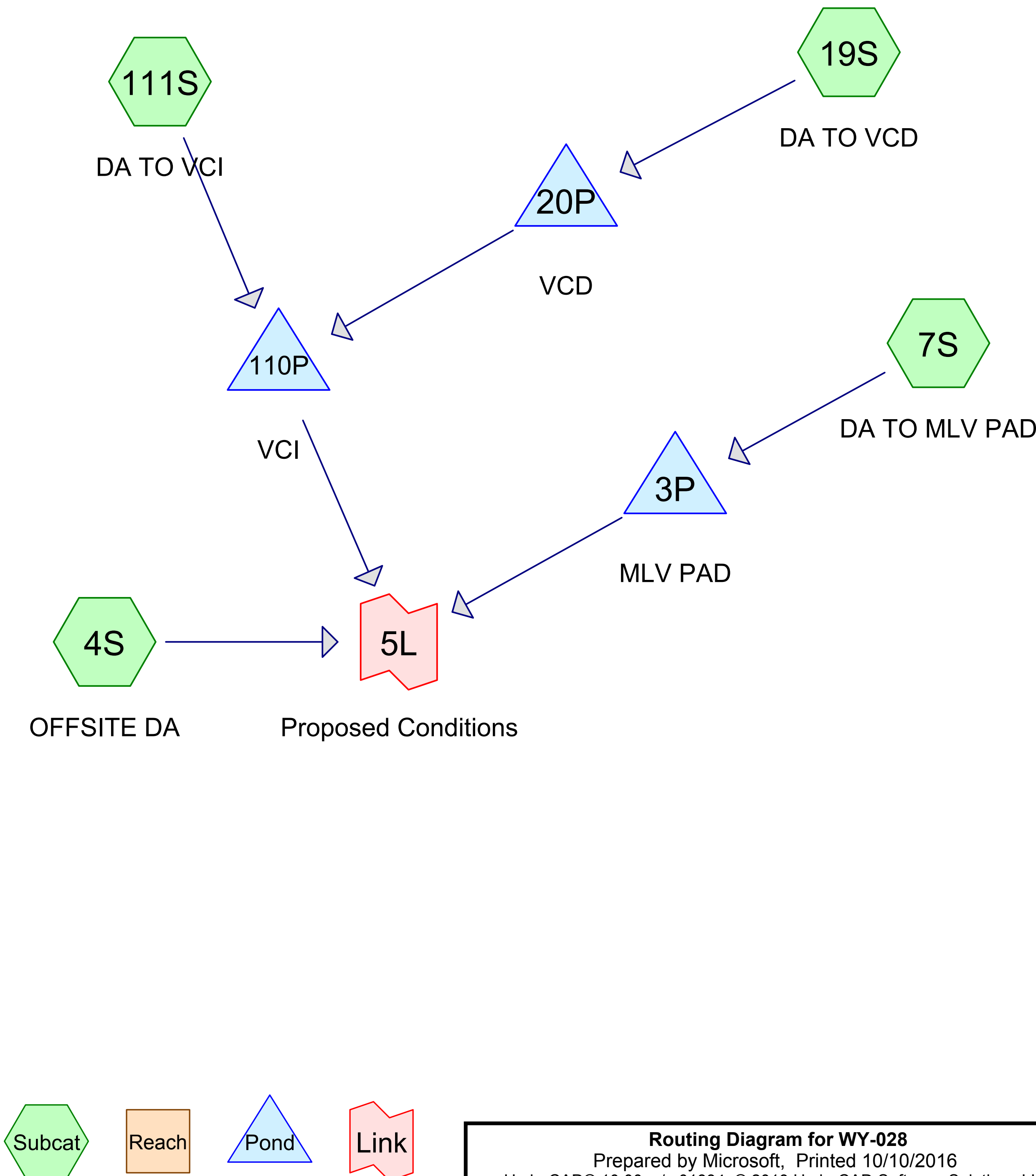
TIME OF CONCENTRATION-SHEET FLOW	
TIME OF CONCENTRATION-SHALLOW CONCENTRATED FLOW	
DRAINAGE AREA	
PROPOSED GAS PIPELINE	GAS GAS

ATLANTIC SUNRISE PROJECT - CENTRAL PENN LINE NORTH

PROPOSED 30" NATURAL GAS PIPELINE
ACCESS ROAD DRAINAGE AREA MAP
AR-WY-028 POST
EATON TOWNSHIP
WYOMING COUNTY, PENNSYLVANIA

Williams

NO.	DATE	BY	REVISION DESCRIPTION	W.O. NO.	CHK.	APP.	DRAWN BY: OLC	DATE: 11/11/15	ISSUED FOR BID:	SCALE: 1" = 100'
							CHECKED BY: BJP	DATE: 11/11/15	ISSUED FOR CONSTRUCTION:	
							APPROVED BY: BJP	DATE: 11/11/15	DRAWING NUMBER: AR-WY-028 POST	
							WO:			



Routing Diagram for WY-028
Prepared by Microsoft, Printed 10/10/2016
HydroCAD® 10.00 s/n 01334 © 2013 HydroCAD Software Solutions LLC

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.107	98	Crushed Stone Pad, HSG C (7S)
0.171	89	Gravel roads, HSG C (111S)
1.894	71	Meadow, non-grazed, HSG C (4S, 7S, 19S, 111S)
0.174	98	Paved parking, HSG C (19S, 111S)
0.222	70	Woods, Good, HSG C (19S)
2.569	**75**	**TOTAL AREA**

Soil Listing (selected nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
2.569	HSG C	4S, 7S, 19S, 111S
0.000	HSG D	
0.000	Other	
2.569		**TOTAL AREA**

Pipe Listing (selected nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	20P	800.00	799.70	30.0	0.0100	0.011	12.0	0.0	0.0

Time span=0.00-200.00 hrs, dt=0.01 hrs, 20001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment4S: OFFSITE DA Runoff Area=48,633 sf 0.00% Impervious Runoff Depth=0.30"
Flow Length=403' Slope=0.0310 '/' Tc=17.6 min CN=71 Runoff=0.28 cfs 0.028 af

Subcatchment7S: DA TO MLV PAD Runoff Area=4,976 sf 94.05% Impervious Runoff Depth=1.66"
Flow Length=107' Tc=5.0 min CN=96 Runoff=0.32 cfs 0.016 af

Subcatchment19S: DA TO VCD Runoff Area=40,871 sf 17.17% Impervious Runoff Depth=0.43"
Flow Length=483' Tc=25.5 min CN=75 Runoff=0.31 cfs 0.033 af

Subcatchment111S: DA TO VCI Runoff Area=17,434 sf 3.28% Impervious Runoff Depth=0.62"
Flow Length=577' Tc=6.0 min CN=80 Runoff=0.44 cfs 0.021 af

Pond 3P: MLV PAD Peak Elev=799.22' Storage=468 cf Inflow=0.32 cfs 0.016 af
Outflow=0.04 cfs 0.005 af

Pond 20P: VCD Peak Elev=799.74' Storage=1,451 cf Inflow=0.31 cfs 0.033 af
12.0" Round Culvert n=0.011 L=30.0' S=0.0100 '/' Outflow=0.00 cfs 0.000 af

Pond 110P: VCI Peak Elev=798.56' Storage=898 cf Inflow=0.44 cfs 0.021 af
Outflow=0.00 cfs 0.000 af

Link 5L: Proposed Conditions Inflow=0.28 cfs 0.033 af
Primary=0.28 cfs 0.033 af

Total Runoff Area = 2.569 ac Runoff Volume = 0.098 af Average Runoff Depth = 0.46"
89.04% Pervious = 2.288 ac 10.96% Impervious = 0.282 ac

Summary for Subcatchment 4S: OFFSITE DA

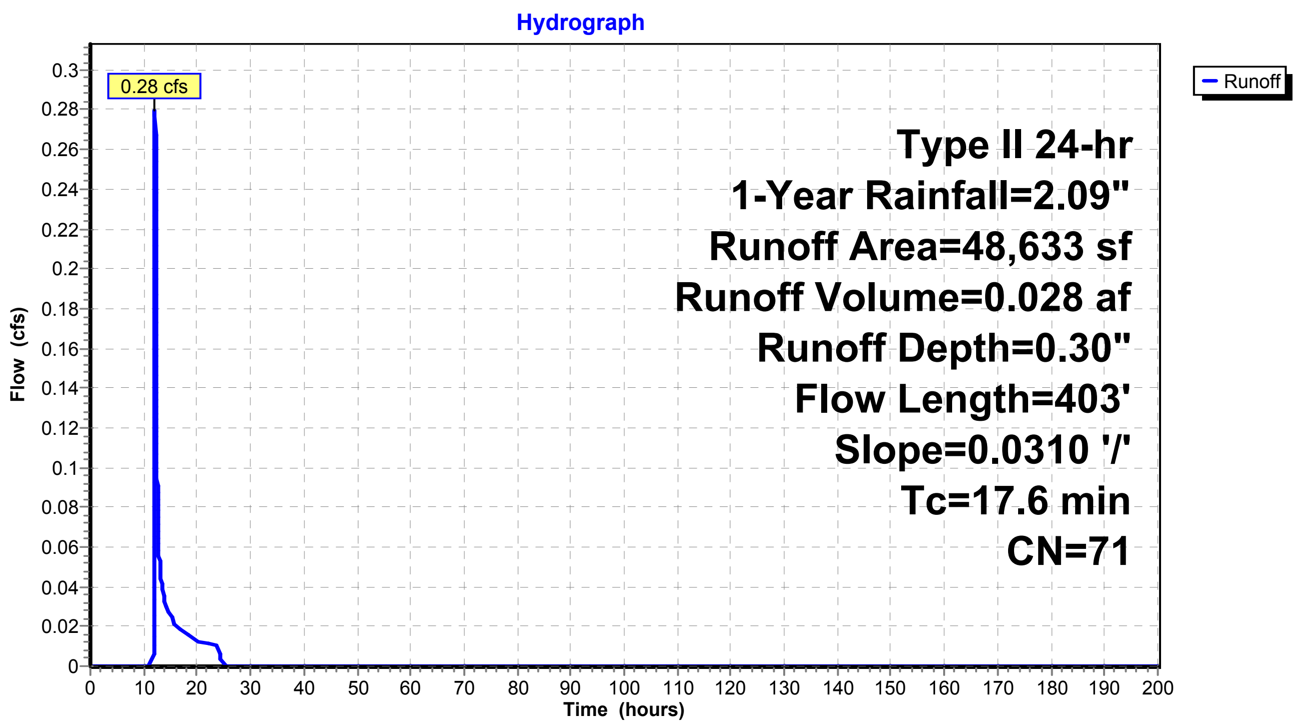
Runoff = 0.28 cfs @ 12.14 hrs, Volume= 0.028 af, Depth= 0.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs
Type II 24-hr 1-Year Rainfall=2.09"

	Area (sf)	CN	Description
	0	98	Paved parking, HSG C
	0	89	Gravel roads, HSG C
*	0	98	Crushed Stone Pad, HSG C
	0	70	Woods, Good, HSG C
	48,633	71	Meadow, non-grazed, HSG C
	48,633	71	Weighted Average
	48,633		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	100	0.0310	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.51"
4.1	303	0.0310	1.23		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
17.6	403	Total			

Subcatchment 4S: OFFSITE DA



Summary for Subcatchment 7S: DA TO MLV PAD

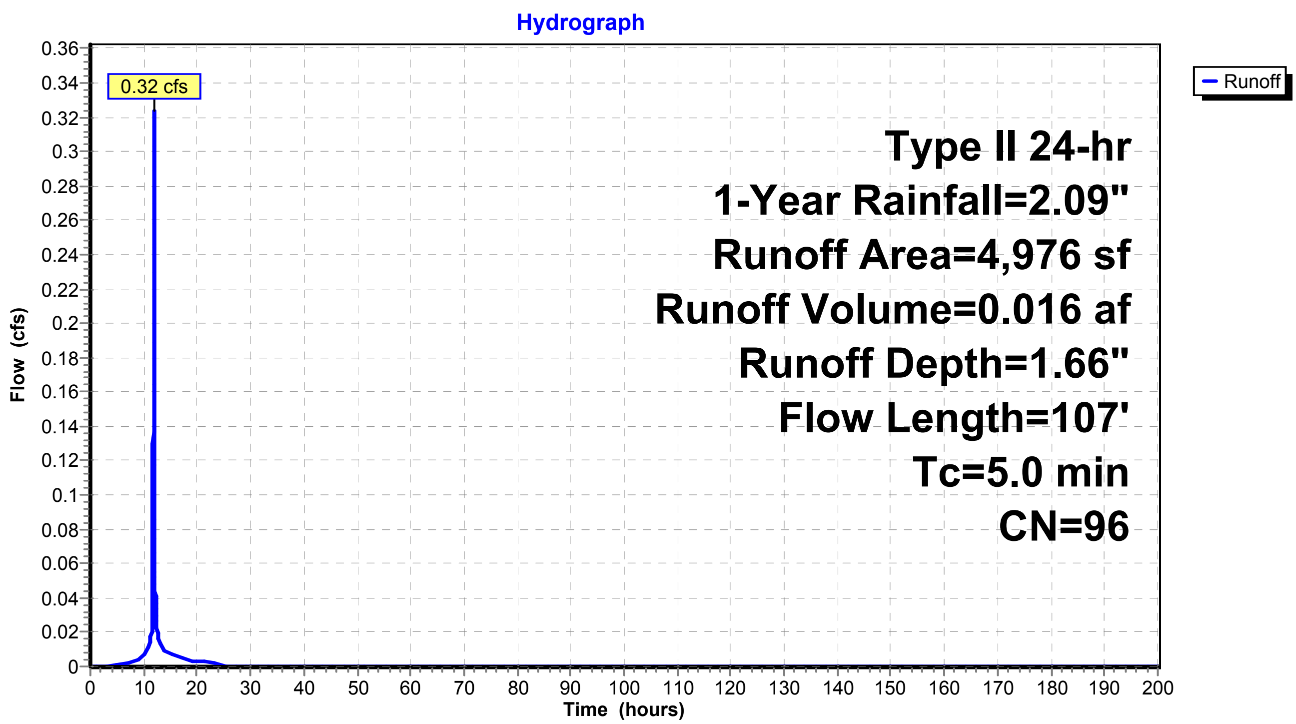
Runoff = 0.32 cfs @ 11.96 hrs, Volume= 0.016 af, Depth= 1.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs
Type II 24-hr 1-Year Rainfall=2.09"

	Area (sf)	CN	Description
	0	98	Paved parking, HSG C
	0	89	Gravel roads, HSG C
*	4,680	98	Crushed Stone Pad, HSG C
	0	70	Woods, Good, HSG C
	296	71	Meadow, non-grazed, HSG C
	4,976	96	Weighted Average
	296		5.95% Pervious Area
	4,680		94.05% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.2	17	0.0870	0.13		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.51"
1.2	83	0.0200	1.17		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.51"
0.1	7	0.0200	2.28		**Shallow Concentrated Flow, SC1** Unpaved Kv= 16.1 fps
3.5	107	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 7S: DA TO MLV PAD



Summary for Subcatchment 19S: DA TO VCD

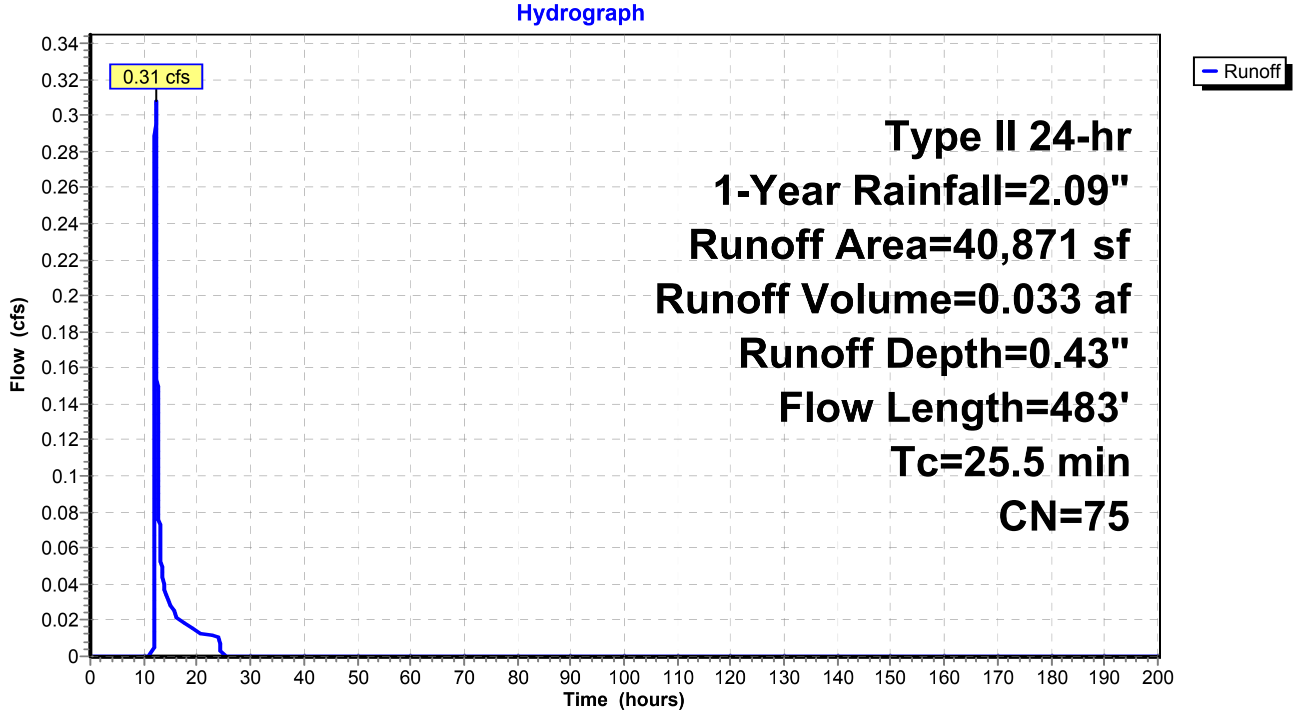
Runoff = 0.31 cfs @ 12.22 hrs, Volume= 0.033 af, Depth= 0.43"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs
Type II 24-hr 1-Year Rainfall=2.09"

	Area (sf)	CN	Description
	7,017	98	Paved parking, HSG C
	0	89	Gravel roads, HSG C
*	0	98	Crushed Stone Pad, HSG C
	9,681	70	Woods, Good, HSG C
	24,173	71	Meadow, non-grazed, HSG C
	40,871	75	Weighted Average
	33,854		82.83% Pervious Area
	7,017		17.17% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	17	0.0450	1.18		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.51"
1.5	8	0.0450	0.09		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.51"
15.5	43	0.0450	0.05		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.51"
4.9	32	0.0400	0.11		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.51"
0.2	17	0.0540	1.63		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
0.1	40	0.0540	4.72		**Shallow Concentrated Flow, SC2** Paved Kv= 20.3 fps
0.7	65	0.0540	1.63		**Shallow Concentrated Flow, SC3** Short Grass Pasture Kv= 7.0 fps
1.2	167	0.0250	2.37		**Shallow Concentrated Flow, SC4** Grassed Waterway Kv= 15.0 fps
1.2	94	0.0075	1.30		**Shallow Concentrated Flow, SC5** Grassed Waterway Kv= 15.0 fps
25.5	483	Total			

Subcatchment 19S: DA TO VCD



Summary for Subcatchment 111S: DA TO VCI

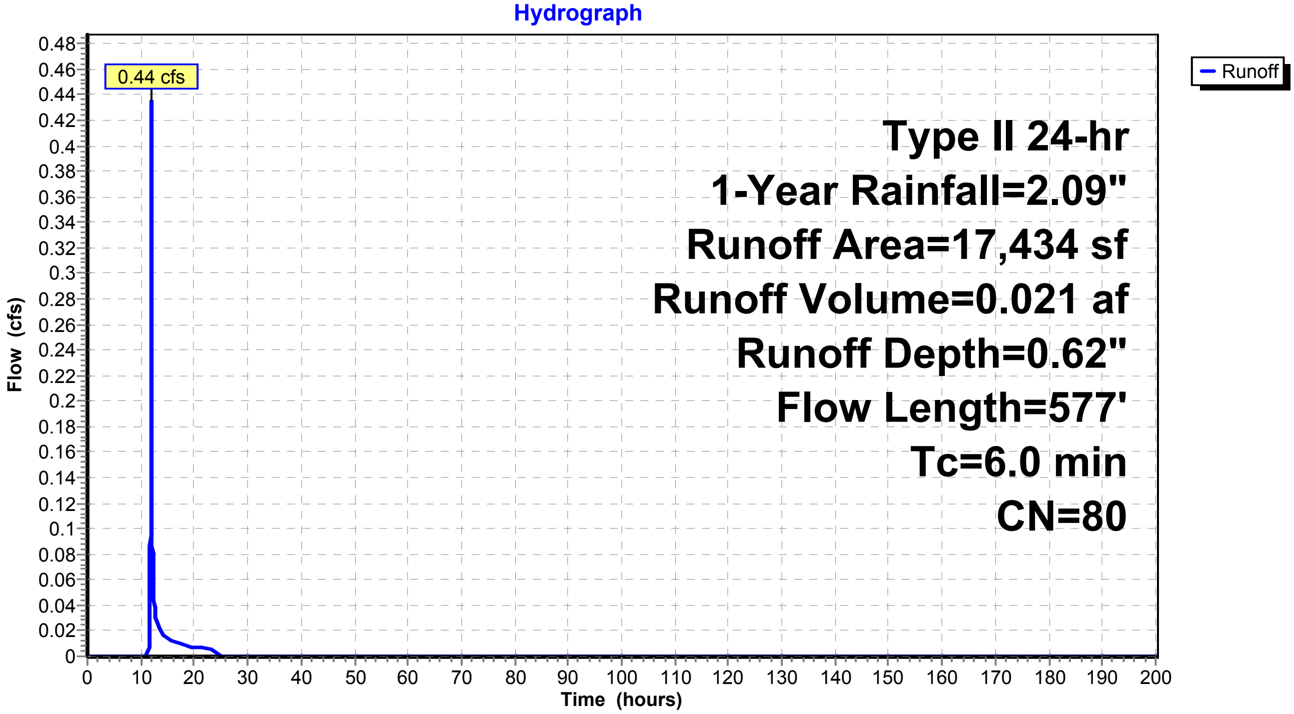
Runoff = 0.44 cfs @ 11.98 hrs, Volume= 0.021 af, Depth= 0.62"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs
Type II 24-hr 1-Year Rainfall=2.09"

	Area (sf)	CN	Description
	571	98	Paved parking, HSG C
	7,463	89	Gravel roads, HSG C
*	0	98	Crushed Stone Pad, HSG C
	0	70	Woods, Good, HSG C
	9,400	71	Meadow, non-grazed, HSG C
	17,434	80	Weighted Average
	16,863		96.72% Pervious Area
	571		3.28% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	55	0.0320	1.30		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.51"
0.5	5	0.3300	0.17		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.51"
2.0	158	0.0075	1.30		**Shallow Concentrated Flow, SC1** Grassed Waterway Kv= 15.0 fps
1.0	145	0.0250	2.37		**Shallow Concentrated Flow, SC2** Grassed Waterway Kv= 15.0 fps
1.8	214	0.0180	2.01		**Shallow Concentrated Flow, SC3** Grassed Waterway Kv= 15.0 fps
6.0	577	Total			

Subcatchment 111S: DA TO VCI



Summary for Pond 3P: MLV PAD

Inflow Area = 0.114 ac, 94.05% Impervious, Inflow Depth = 1.66" for 1-Year event
Inflow = 0.32 cfs @ 11.96 hrs, Volume= 0.016 af
Outflow = 0.04 cfs @ 12.59 hrs, Volume= 0.005 af, Atten= 89%, Lag= 38.2 min
Primary = 0.04 cfs @ 12.59 hrs, Volume= 0.005 af

Routing by Stor-Ind method, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs / 6
Peak Elev= 799.22' @ 12.59 hrs Surf.Area= 0 sf Storage= 468 cf

Plug-Flow detention time= 346.3 min calculated for 0.005 af (32% of inflow)
Center-of-Mass det. time= 206.6 min (989.5 - 782.9)

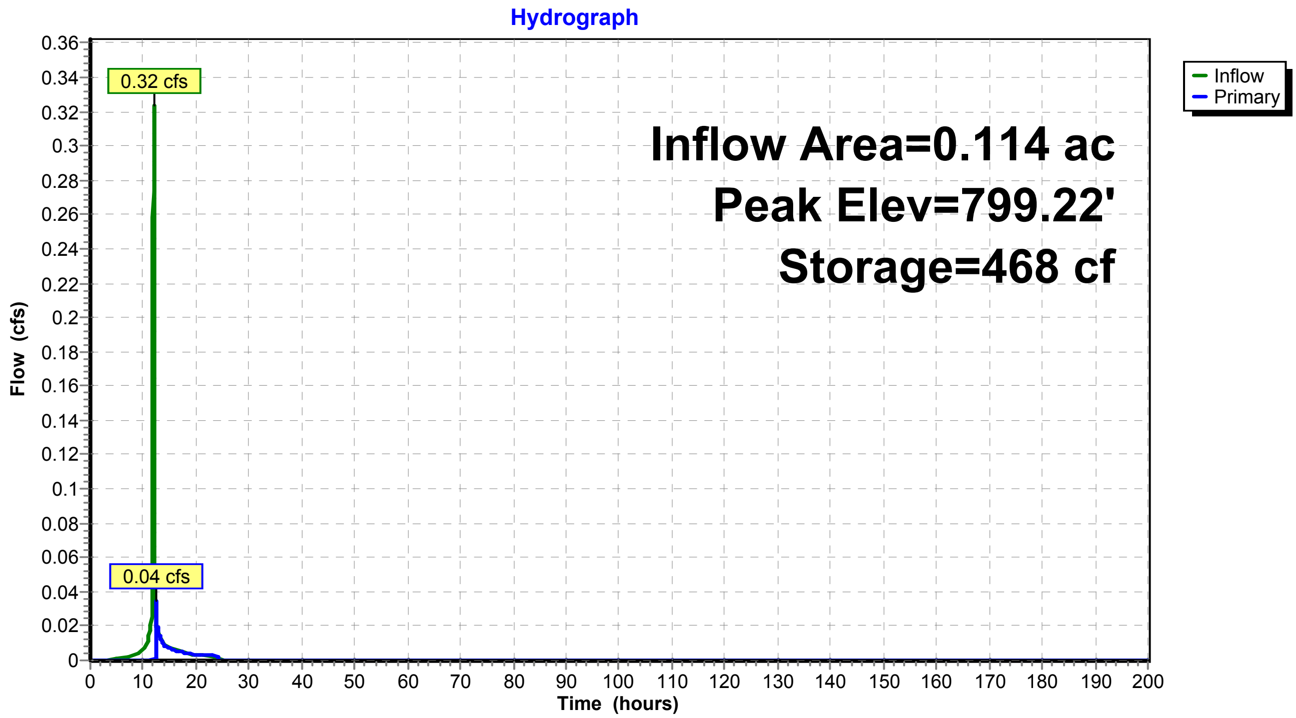
Volume	Invert	Avail.Storage	Storage Description
#1	798.22'	469 cf	**Stone Pad Void Storage**Listed below 1,172 cf Overall x 40.0% Voids

Elevation (feet)	Cum.Store (cubic-feet)
798.22	0
798.72	586
799.22	1,171
799.50	1,172

Device	Routing	Invert	Outlet Devices
#1	Primary	799.22'	**52.0' long x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=0.01 cfs @ 12.59 hrs HW=799.22' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir**(Weir Controls 0.01 cfs @ 0.12 fps)

Pond 3P: MLV PAD



Summary for Pond 20P: VCD

Inflow Area = 0.938 ac, 17.17% Impervious, Inflow Depth = 0.43" for 1-Year event
Inflow = 0.31 cfs @ 12.22 hrs, Volume= 0.033 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs / 8
Peak Elev= 799.74' @ 25.45 hrs Surf.Area= 0 sf Storage= 1,451 cf

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

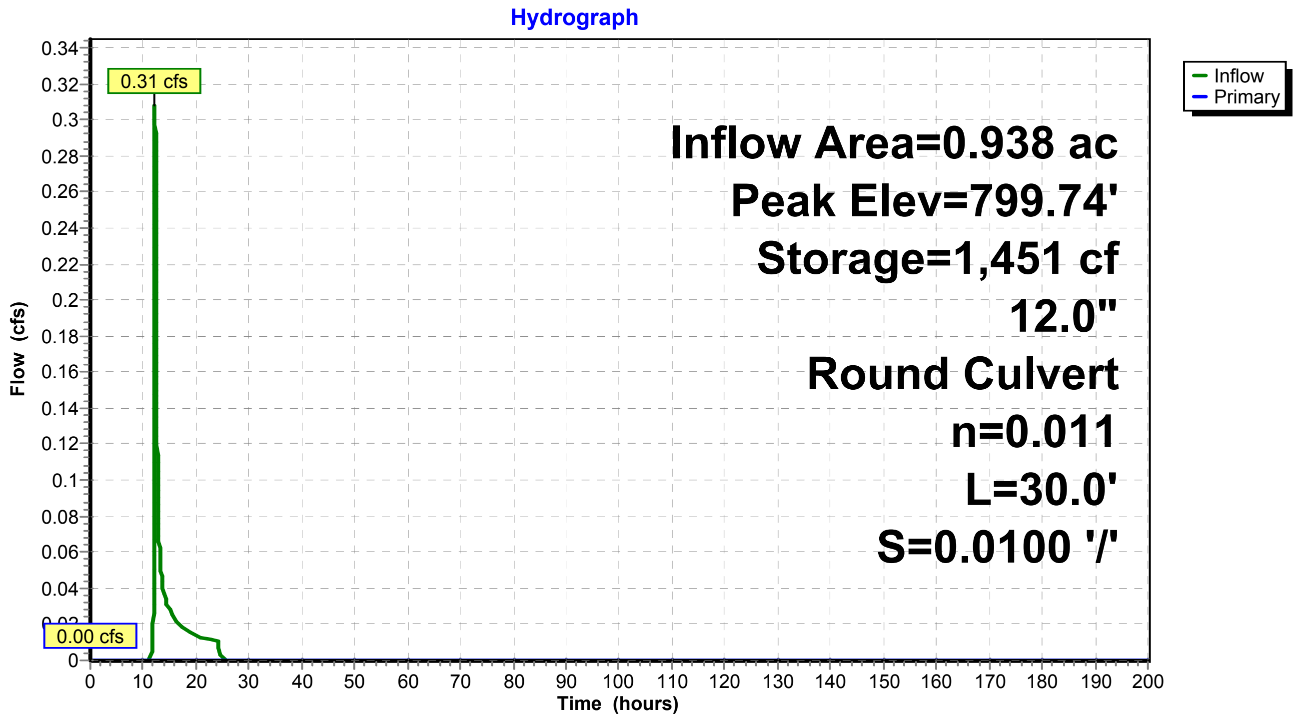
Volume	Invert	Avail.Storage	Storage Description
#1	799.00'	2,943 cf	**Custom Stage Data**Listed below

Elevation (feet)	Cum.Store (cubic-feet)
799.00	0
799.50	981
800.00	1,961
800.50	2,942
801.00	2,943

Device	Routing	Invert	Outlet Devices
#1	Primary	800.00'	**12.0" Round RCP_Round 12"** L= 30.0' RCP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 800.00' / 799.70' S= 0.0100 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=799.00' (Free Discharge)
└─**1=RCP_Round 12"** (Controls 0.00 cfs)

Pond 20P: VCD


Hydrograph
0.31 cfs
0.00 cfs
Inflow Area=0.938 ac
Peak Elev=799.74'
Storage=1,451 cf
12.0"
Round Culvert
n=0.011
L=30.0'
S=0.0100 '/'
Inflow
Primary
Flow (cfs)
Time (hours)
0.34
0.32
0.3
0.28
0.26
0.24
0.22
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200

Summary for Pond 110P: VCI

Inflow Area = 1.338 ac, 13.01% Impervious, Inflow Depth = 0.18" for 1-Year event
Inflow = 0.44 cfs @ 11.98 hrs, Volume= 0.021 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs / 8
Peak Elev= 798.56' @ 24.34 hrs Surf.Area= 0 sf Storage= 898 cf

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

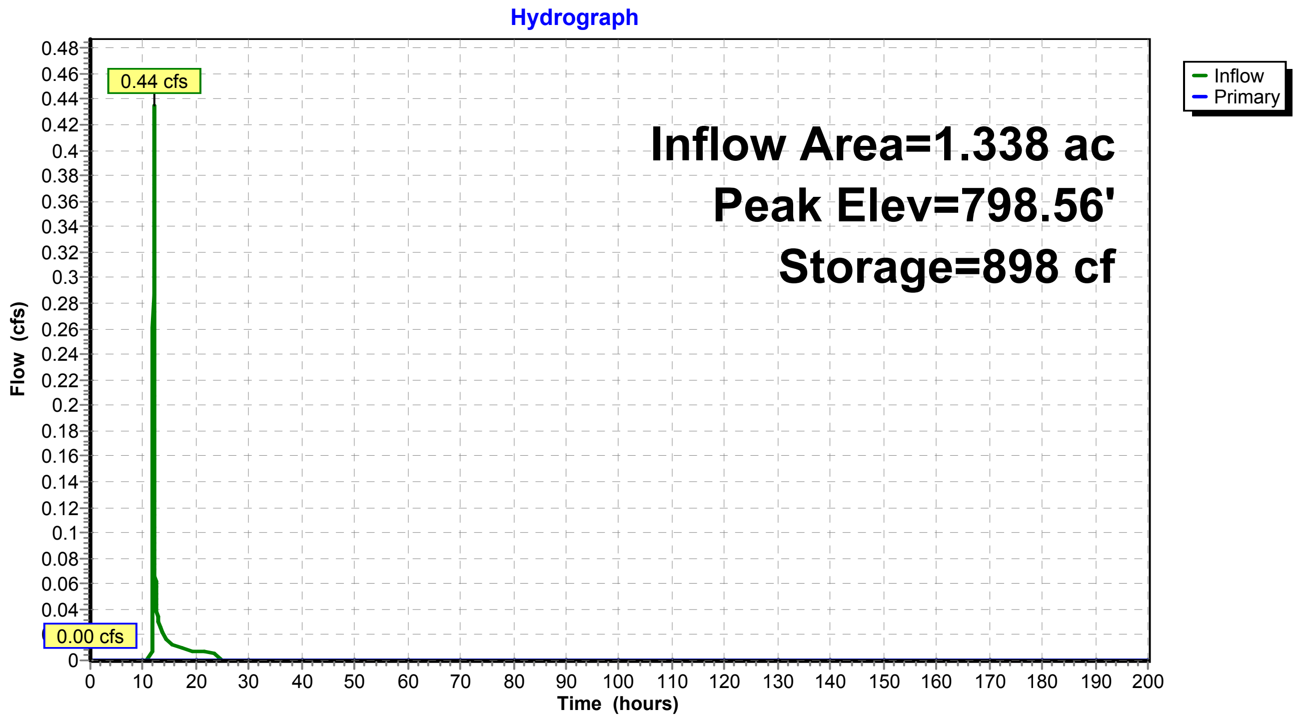
Volume	Invert	Avail.Storage	Storage Description
#1	798.00'	1,611 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
798.00	0
798.50	805
799.00	1,610
799.50	1,611

Device	Routing	Invert	Outlet Devices
#1	Primary	799.00'	**8.0' long x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=798.00' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 110P: VCI

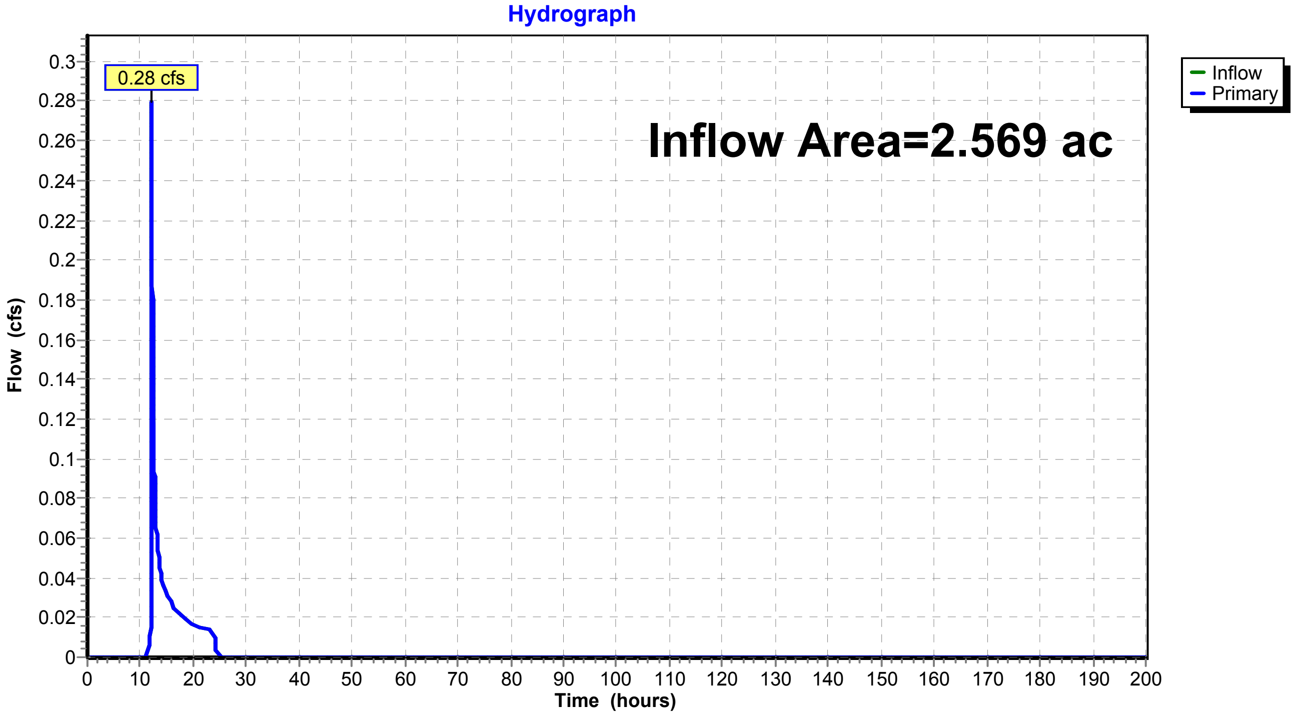


Summary for Link 5L: Proposed Conditions

Inflow Area = 2.569 ac, 10.96% Impervious, Inflow Depth = 0.16" for 1-Year event
Inflow = 0.28 cfs @ 12.14 hrs, Volume= 0.033 af
Primary = 0.28 cfs @ 12.14 hrs, Volume= 0.033 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs

Link 5L: Proposed Conditions



Time span=0.00-200.00 hrs, dt=0.01 hrs, 20001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment4S: OFFSITE DA Runoff Area=48,633 sf 0.00% Impervious Runoff Depth=0.50"
Flow Length=403' Slope=0.0310 '/' Tc=17.6 min CN=71 Runoff=0.54 cfs 0.046 af

Subcatchment7S: DA TO MLV PAD Runoff Area=4,976 sf 94.05% Impervious Runoff Depth=2.07"
Flow Length=107' Tc=5.0 min CN=96 Runoff=0.40 cfs 0.020 af

Subcatchment19S: DA TO VCD Runoff Area=40,871 sf 17.17% Impervious Runoff Depth=0.66"
Flow Length=483' Tc=25.5 min CN=75 Runoff=0.53 cfs 0.051 af

Subcatchment111S: DA TO VCI Runoff Area=17,434 sf 3.28% Impervious Runoff Depth=0.90"
Flow Length=577' Tc=6.0 min CN=80 Runoff=0.64 cfs 0.030 af

Pond 3P: MLV PAD Peak Elev=799.23' Storage=468 cf Inflow=0.40 cfs 0.020 af
Outflow=0.08 cfs 0.008 af

Pond 20P: VCD Peak Elev=800.06' Storage=2,081 cf Inflow=0.53 cfs 0.051 af
12.0" Round Culvert n=0.011 L=30.0' S=0.0100 '/' Outflow=0.01 cfs 0.006 af

Pond 110P: VCI Peak Elev=798.98' Storage=1,576 cf Inflow=0.64 cfs 0.036 af
Outflow=0.00 cfs 0.000 af

Link 5L: Proposed Conditions Inflow=0.60 cfs 0.054 af
Primary=0.60 cfs 0.054 af

Total Runoff Area = 2.569 ac Runoff Volume = 0.147 af Average Runoff Depth = 0.69"
89.04% Pervious = 2.288 ac 10.96% Impervious = 0.282 ac

Summary for Subcatchment 4S: OFFSITE DA

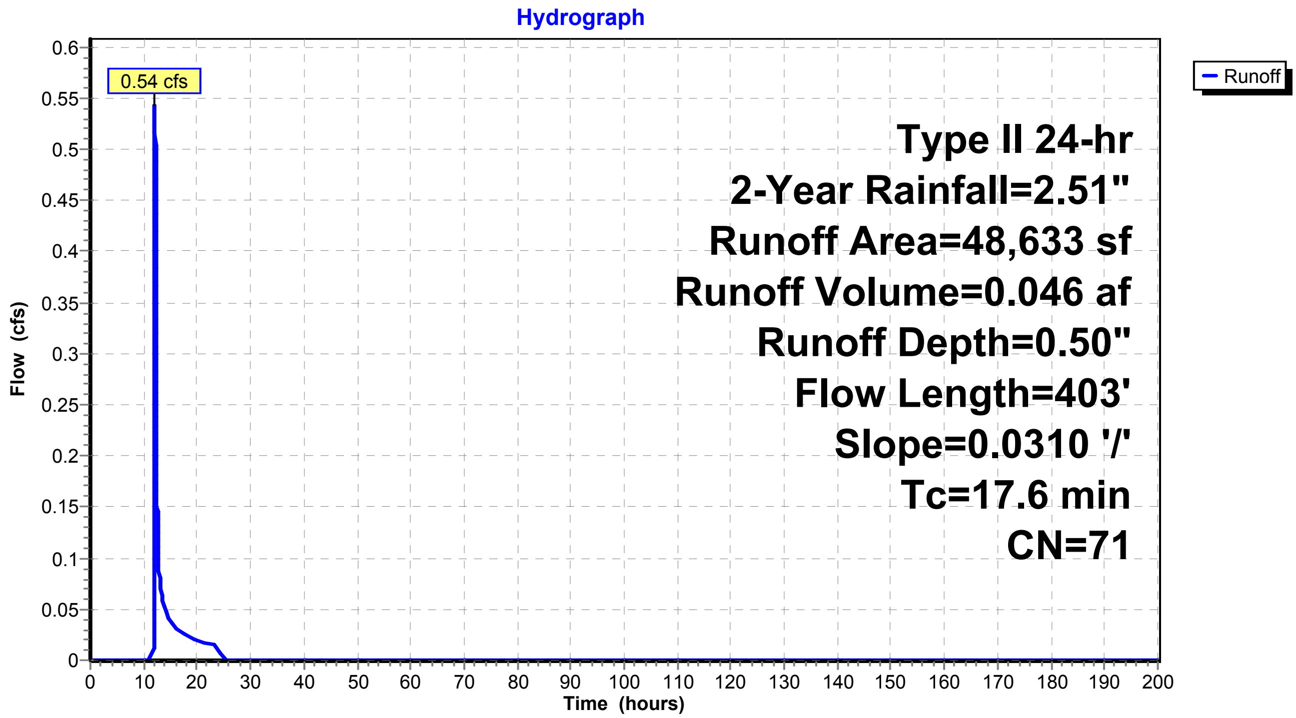
Runoff = 0.54 cfs @ 12.13 hrs, Volume= 0.046 af, Depth= 0.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs
Type II 24-hr 2-Year Rainfall=2.51"

	Area (sf)	CN	Description
	0	98	Paved parking, HSG C
	0	89	Gravel roads, HSG C
*	0	98	Crushed Stone Pad, HSG C
	0	70	Woods, Good, HSG C
	48,633	71	Meadow, non-grazed, HSG C
	48,633	71	Weighted Average
	48,633		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	100	0.0310	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.51"
4.1	303	0.0310	1.23		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
17.6	403	Total			

Subcatchment 4S: OFFSITE DA



Summary for Subcatchment 7S: DA TO MLV PAD

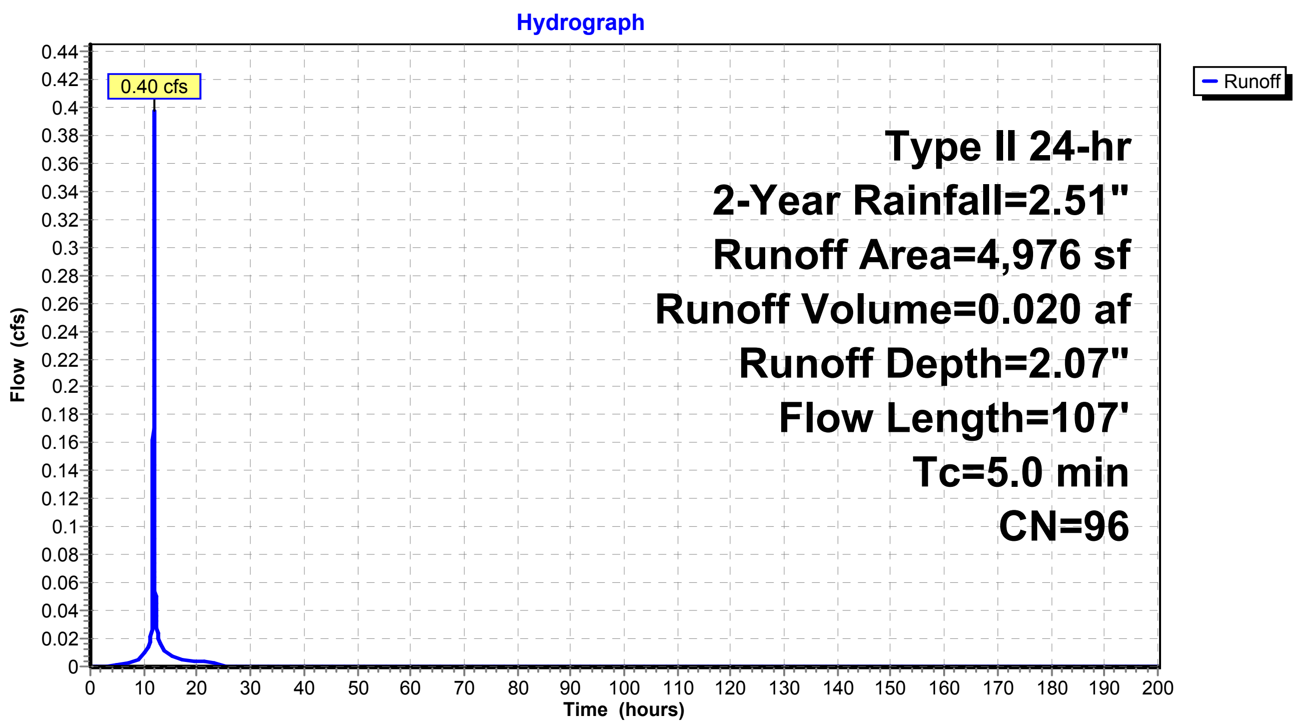
Runoff = 0.40 cfs @ 11.96 hrs, Volume= 0.020 af, Depth= 2.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs
Type II 24-hr 2-Year Rainfall=2.51"

	Area (sf)	CN	Description
	0	98	Paved parking, HSG C
	0	89	Gravel roads, HSG C
*	4,680	98	Crushed Stone Pad, HSG C
	0	70	Woods, Good, HSG C
	296	71	Meadow, non-grazed, HSG C
	4,976	96	Weighted Average
	296		5.95% Pervious Area
	4,680		94.05% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.2	17	0.0870	0.13		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.51"
1.2	83	0.0200	1.17		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.51"
0.1	7	0.0200	2.28		**Shallow Concentrated Flow, SC1** Unpaved Kv= 16.1 fps
3.5	107	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 7S: DA TO MLV PAD



Summary for Subcatchment 19S: DA TO VCD

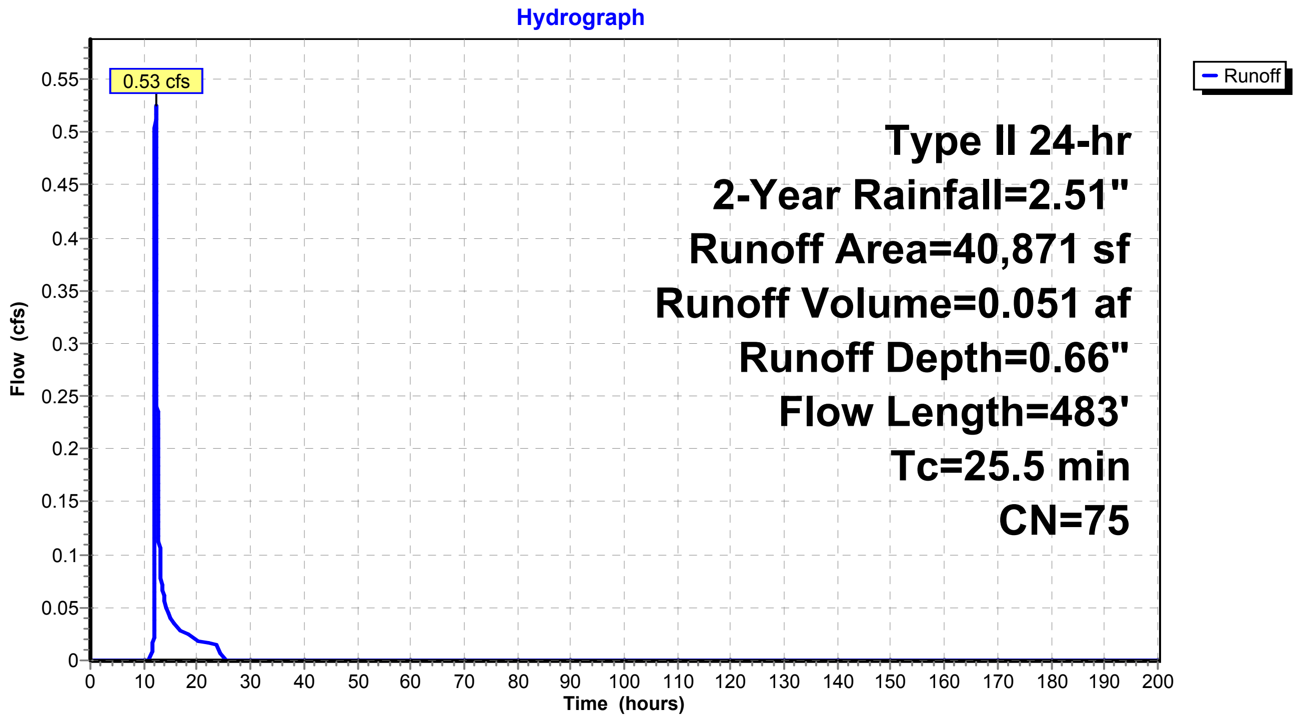
Runoff = 0.53 cfs @ 12.21 hrs, Volume= 0.051 af, Depth= 0.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs
Type II 24-hr 2-Year Rainfall=2.51"

	Area (sf)	CN	Description
	7,017	98	Paved parking, HSG C
	0	89	Gravel roads, HSG C
*	0	98	Crushed Stone Pad, HSG C
	9,681	70	Woods, Good, HSG C
	24,173	71	Meadow, non-grazed, HSG C
	40,871	75	Weighted Average
	33,854		82.83% Pervious Area
	7,017		17.17% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	17	0.0450	1.18		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.51"
1.5	8	0.0450	0.09		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.51"
15.5	43	0.0450	0.05		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.51"
4.9	32	0.0400	0.11		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.51"
0.2	17	0.0540	1.63		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
0.1	40	0.0540	4.72		**Shallow Concentrated Flow, SC2** Paved Kv= 20.3 fps
0.7	65	0.0540	1.63		**Shallow Concentrated Flow, SC3** Short Grass Pasture Kv= 7.0 fps
1.2	167	0.0250	2.37		**Shallow Concentrated Flow, SC4** Grassed Waterway Kv= 15.0 fps
1.2	94	0.0075	1.30		**Shallow Concentrated Flow, SC5** Grassed Waterway Kv= 15.0 fps
25.5	483	Total			

Subcatchment 19S: DA TO VCD



Summary for Subcatchment 111S: DA TO VCI

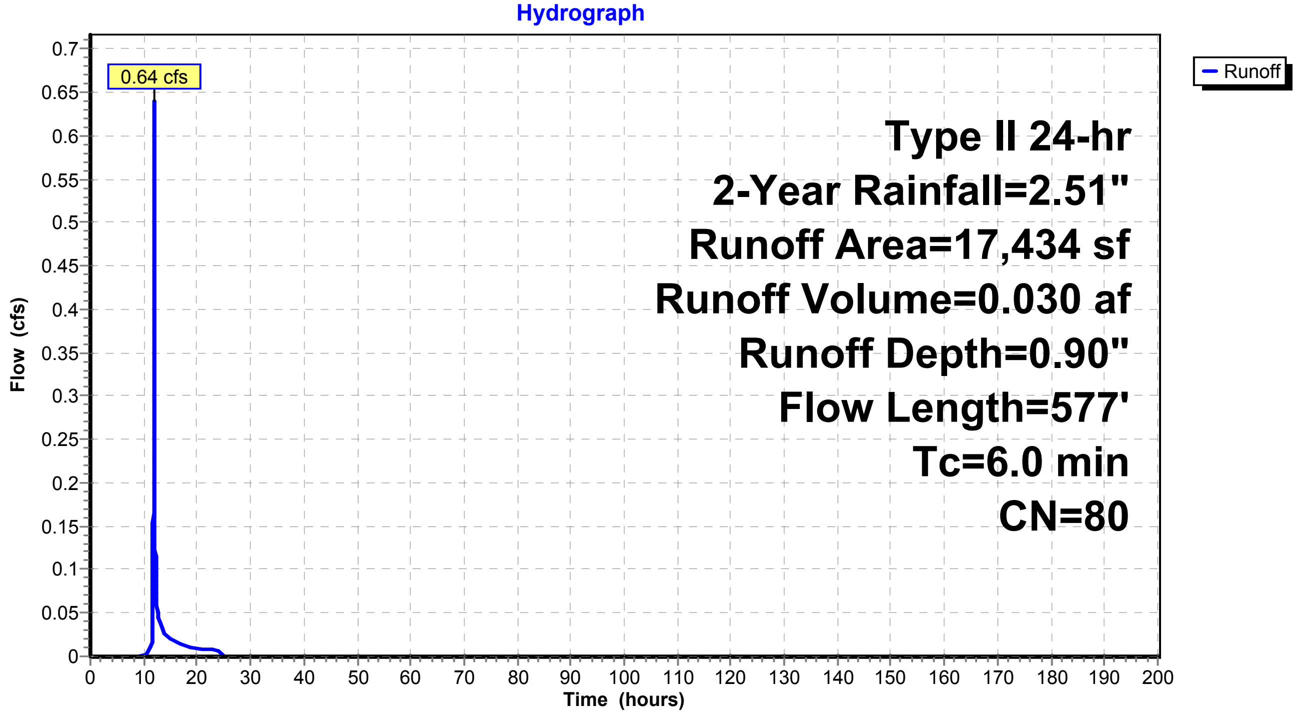
Runoff = 0.64 cfs @ 11.98 hrs, Volume= 0.030 af, Depth= 0.90"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs
Type II 24-hr 2-Year Rainfall=2.51"

	Area (sf)	CN	Description
	571	98	Paved parking, HSG C
	7,463	89	Gravel roads, HSG C
*	0	98	Crushed Stone Pad, HSG C
	0	70	Woods, Good, HSG C
	9,400	71	Meadow, non-grazed, HSG C
	17,434	80	Weighted Average
	16,863		96.72% Pervious Area
	571		3.28% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	55	0.0320	1.30		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.51"
0.5	5	0.3300	0.17		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.51"
2.0	158	0.0075	1.30		**Shallow Concentrated Flow, SC1** Grassed Waterway Kv= 15.0 fps
1.0	145	0.0250	2.37		**Shallow Concentrated Flow, SC2** Grassed Waterway Kv= 15.0 fps
1.8	214	0.0180	2.01		**Shallow Concentrated Flow, SC3** Grassed Waterway Kv= 15.0 fps
6.0	577	Total			

Subcatchment 111S: DA TO VCI



Summary for Pond 3P: MLV PAD

Inflow Area = 0.114 ac, 94.05% Impervious, Inflow Depth = 2.07" for 2-Year event
Inflow = 0.40 cfs @ 11.96 hrs, Volume= 0.020 af
Outflow = 0.08 cfs @ 12.05 hrs, Volume= 0.008 af, Atten= 81%, Lag= 5.6 min
Primary = 0.08 cfs @ 12.05 hrs, Volume= 0.008 af

Routing by Stor-Ind method, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs / 6
Peak Elev= 799.23' @ 12.05 hrs Surf.Area= 0 sf Storage= 468 cf

Plug-Flow detention time= 274.0 min calculated for 0.008 af (42% of inflow)
Center-of-Mass det. time= 148.3 min (925.3 - 777.0)

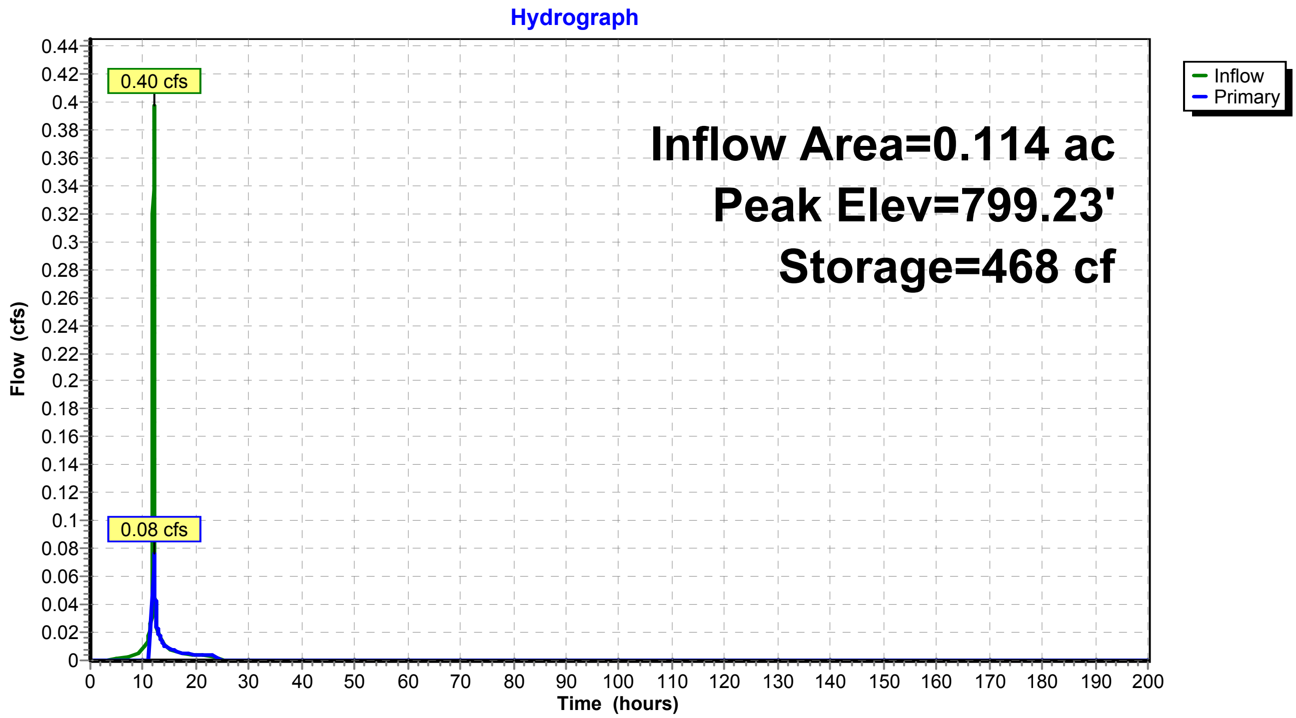
Volume	Invert	Avail.Storage	Storage Description
#1	798.22'	469 cf	**Stone Pad Void Storage**Listed below 1,172 cf Overall x 40.0% Voids

Elevation (feet)	Cum.Store (cubic-feet)
798.22	0
798.72	586
799.22	1,171
799.50	1,172

Device	Routing	Invert	Outlet Devices
#1	Primary	799.22'	**52.0' long x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=0.05 cfs @ 12.05 hrs HW=799.23' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir**(Weir Controls 0.05 cfs @ 0.18 fps)

Pond 3P: MLV PAD



Summary for Pond 20P: VCD

Inflow Area = 0.938 ac, 17.17% Impervious, Inflow Depth = 0.66" for 2-Year event
Inflow = 0.53 cfs @ 12.21 hrs, Volume= 0.051 af
Outflow = 0.01 cfs @ 24.14 hrs, Volume= 0.006 af, Atten= 97%, Lag= 715.4 min
Primary = 0.01 cfs @ 24.14 hrs, Volume= 0.006 af

Routing by Stor-Ind method, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs / 8
Peak Elev= 800.06' @ 24.14 hrs Surf.Area= 0 sf Storage= 2,081 cf

Plug-Flow detention time= 812.4 min calculated for 0.006 af (12% of inflow)
Center-of-Mass det. time= 646.0 min (1,536.0 - 890.0)

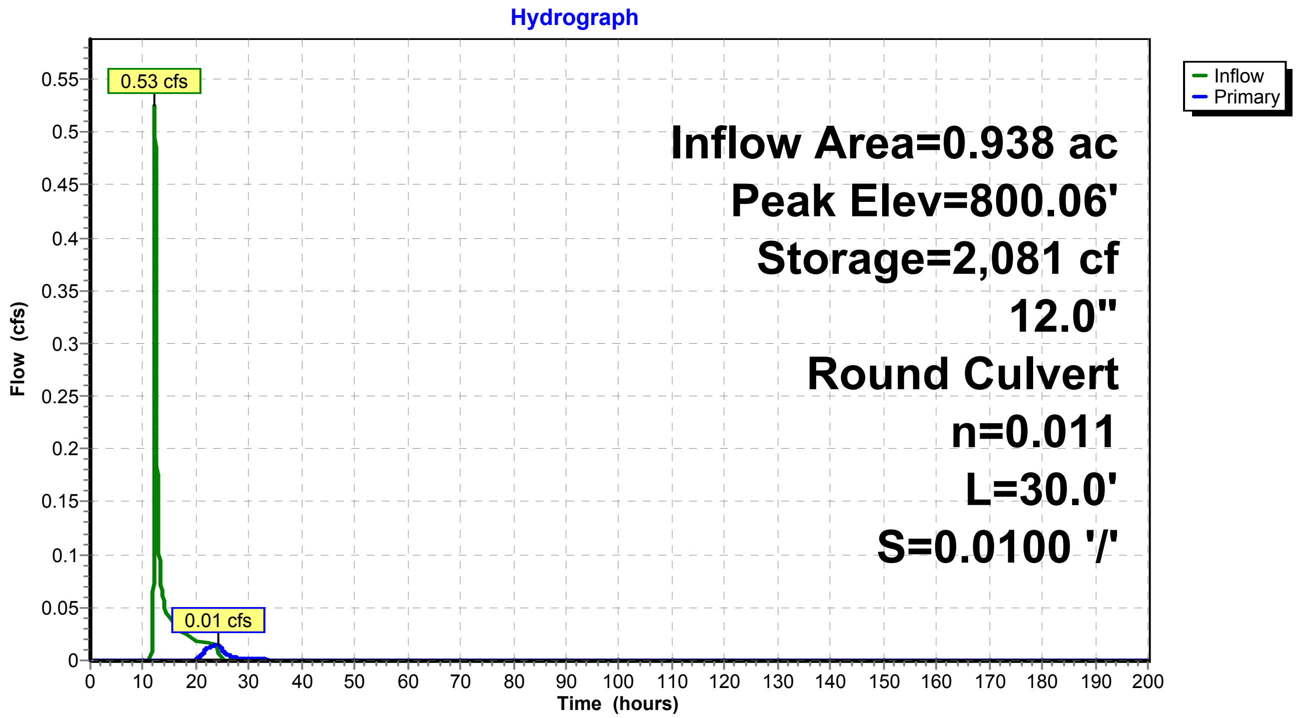
Volume	Invert	Avail.Storage	Storage Description
#1	799.00'	2,943 cf	**Custom Stage Data**Listed below

Elevation (feet)	Cum.Store (cubic-feet)
799.00	0
799.50	981
800.00	1,961
800.50	2,942
801.00	2,943

Device	Routing	Invert	Outlet Devices
#1	Primary	800.00'	**12.0" Round RCP_Round 12"** L= 30.0' RCP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 800.00' / 799.70' S= 0.0100 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Primary OutFlow Max=0.01 cfs @ 24.14 hrs HW=800.06' (Free Discharge)
↑—**1=RCP_Round 12"** (Inlet Controls 0.01 cfs @ 0.74 fps)

Pond 20P: VCD


Hydrograph
0.53 cfs
0.01 cfs
Inflow
Primary
Inflow Area=0.938 ac
Peak Elev=800.06'
Storage=2,081 cf
12.0"
Round Culvert
n=0.011
L=30.0'
S=0.0100 '/'
Flow (cfs)
Time (hours)
0.55
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200

Summary for Pond 110P: VCI

Inflow Area = 1.338 ac, 13.01% Impervious, Inflow Depth = 0.32" for 2-Year event
Inflow = 0.64 cfs @ 11.98 hrs, Volume= 0.036 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs / 8
Peak Elev= 798.98' @ 199.82 hrs Surf.Area= 0 sf Storage= 1,576 cf

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

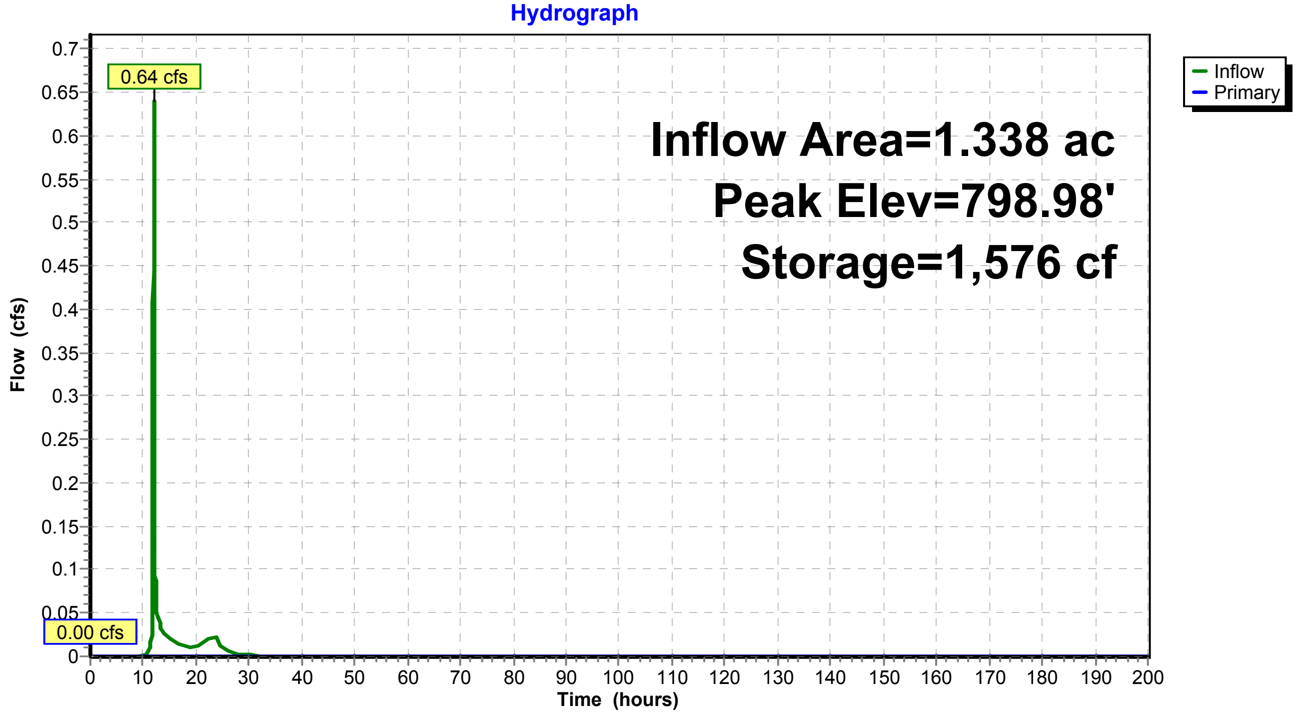
Volume	Invert	Avail.Storage	Storage Description
#1	798.00'	1,611 cf	**Custom Stage Data**Listed below

Elevation (feet)	Cum.Store (cubic-feet)
798.00	0
798.50	805
799.00	1,610
799.50	1,611

Device	Routing	Invert	Outlet Devices
#1	Primary	799.00'	**8.0' long x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=798.00' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 110P: VCI

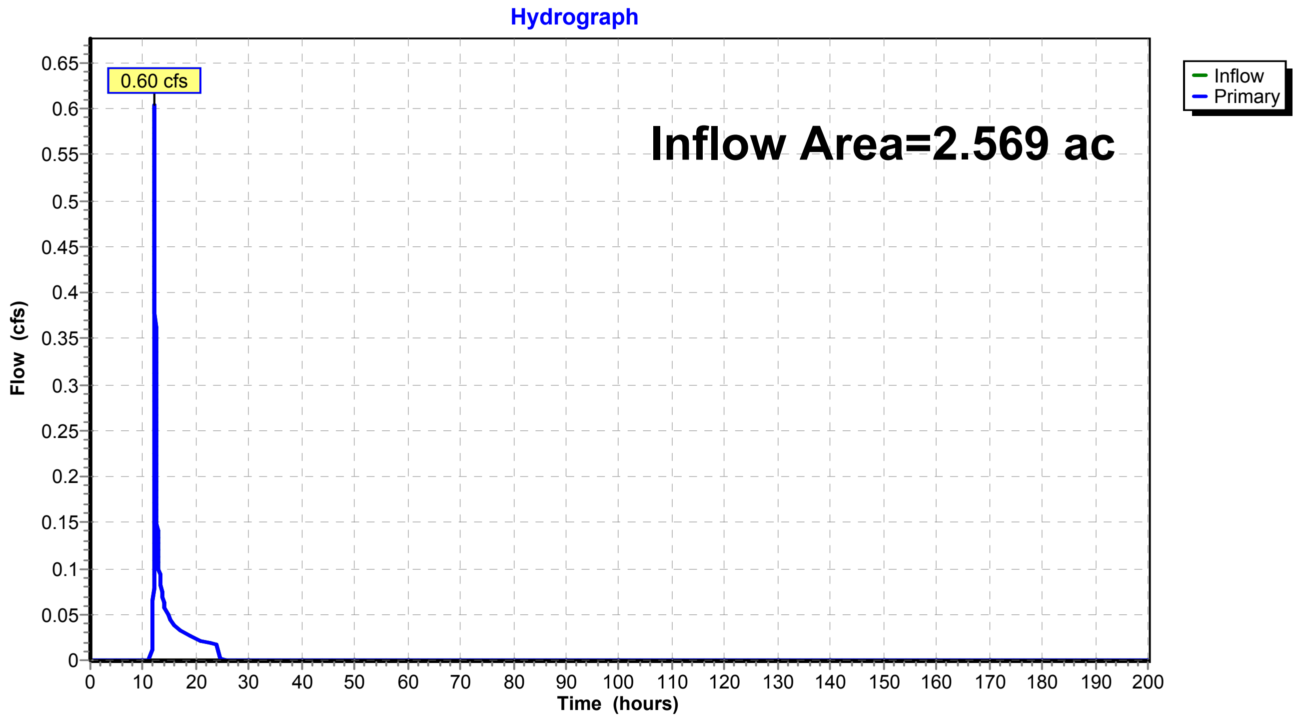


Summary for Link 5L: Proposed Conditions

Inflow Area = 2.569 ac, 10.96% Impervious, Inflow Depth = 0.25" for 2-Year event
Inflow = 0.60 cfs @ 12.12 hrs, Volume= 0.054 af
Primary = 0.60 cfs @ 12.12 hrs, Volume= 0.054 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs

Link 5L: Proposed Conditions



Time span=0.00-200.00 hrs, dt=0.01 hrs, 20001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment4S: OFFSITE DA Runoff Area=48,633 sf 0.00% Impervious Runoff Depth=0.81"
Flow Length=403' Slope=0.0310 '/' Tc=17.6 min CN=71 Runoff=0.98 cfs 0.076 af

Subcatchment7S: DA TO MLV PAD Runoff Area=4,976 sf 94.05% Impervious Runoff Depth=2.64"
Flow Length=107' Tc=5.0 min CN=96 Runoff=0.50 cfs 0.025 af

Subcatchment19S: DA TO VCD Runoff Area=40,871 sf 17.17% Impervious Runoff Depth=1.02"
Flow Length=483' Tc=25.5 min CN=75 Runoff=0.87 cfs 0.080 af

Subcatchment111S: DA TO VCI Runoff Area=17,434 sf 3.28% Impervious Runoff Depth=1.32"
Flow Length=577' Tc=6.0 min CN=80 Runoff=0.95 cfs 0.044 af

Pond 3P: MLV PAD Peak Elev=799.26' Storage=468 cf Inflow=0.50 cfs 0.025 af
Outflow=0.97 cfs 0.016 af

Pond 20P: VCD Peak Elev=800.12' Storage=2,199 cf Inflow=0.87 cfs 0.080 af
12.0" Round Culvert n=0.011 L=30.0' S=0.0100 '/' Outflow=0.06 cfs 0.035 af

Pond 110P: VCI Peak Elev=799.03' Storage=1,610 cf Inflow=0.95 cfs 0.079 af
Outflow=0.10 cfs 0.042 af

Link 5L: Proposed Conditions Inflow=1.18 cfs 0.134 af
Primary=1.18 cfs 0.134 af

Total Runoff Area = 2.569 ac Runoff Volume = 0.224 af Average Runoff Depth = 1.05"
89.04% Pervious = 2.288 ac 10.96% Impervious = 0.282 ac

Summary for Subcatchment 4S: OFFSITE DA

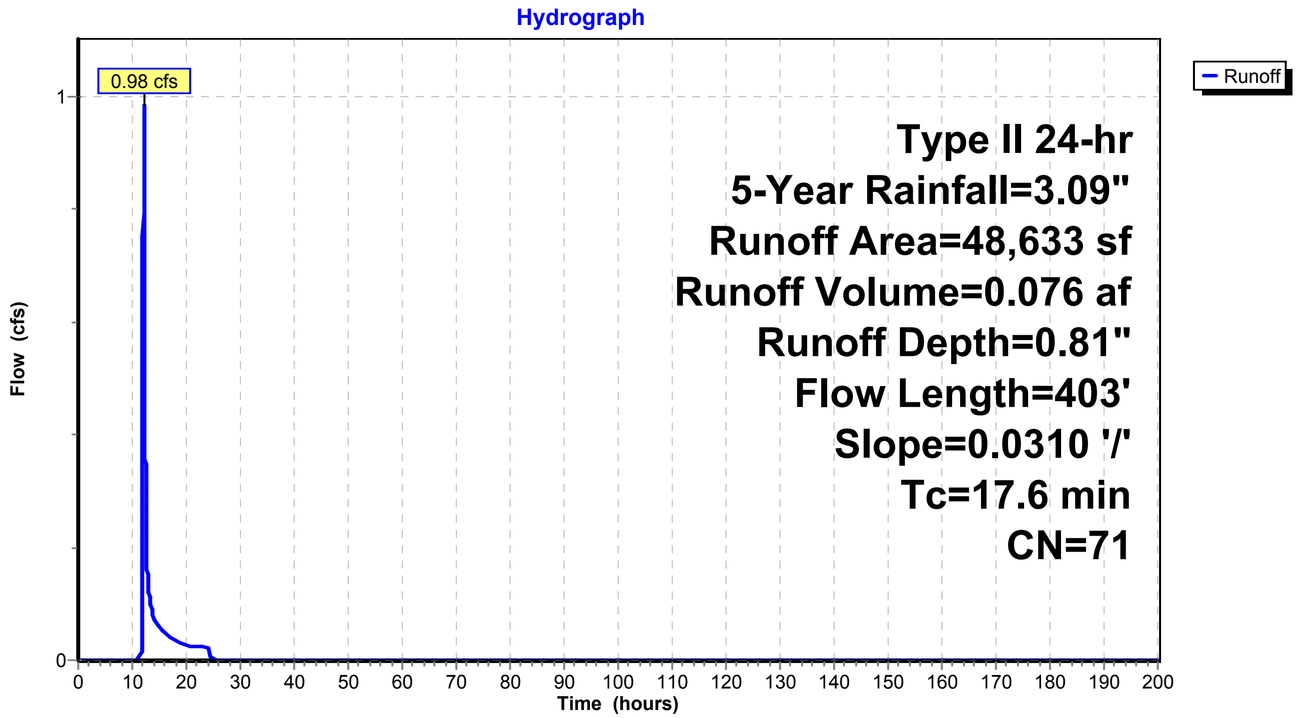
Runoff = 0.98 cfs @ 12.12 hrs, Volume= 0.076 af, Depth= 0.81"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs
Type II 24-hr 5-Year Rainfall=3.09"

	Area (sf)	CN	Description
	0	98	Paved parking, HSG C
	0	89	Gravel roads, HSG C
*	0	98	Crushed Stone Pad, HSG C
	0	70	Woods, Good, HSG C
	48,633	71	Meadow, non-grazed, HSG C
	48,633	71	Weighted Average
	48,633		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	100	0.0310	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.51"
4.1	303	0.0310	1.23		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
17.6	403	Total			

Subcatchment 4S: OFFSITE DA



Summary for Subcatchment 7S: DA TO MLV PAD

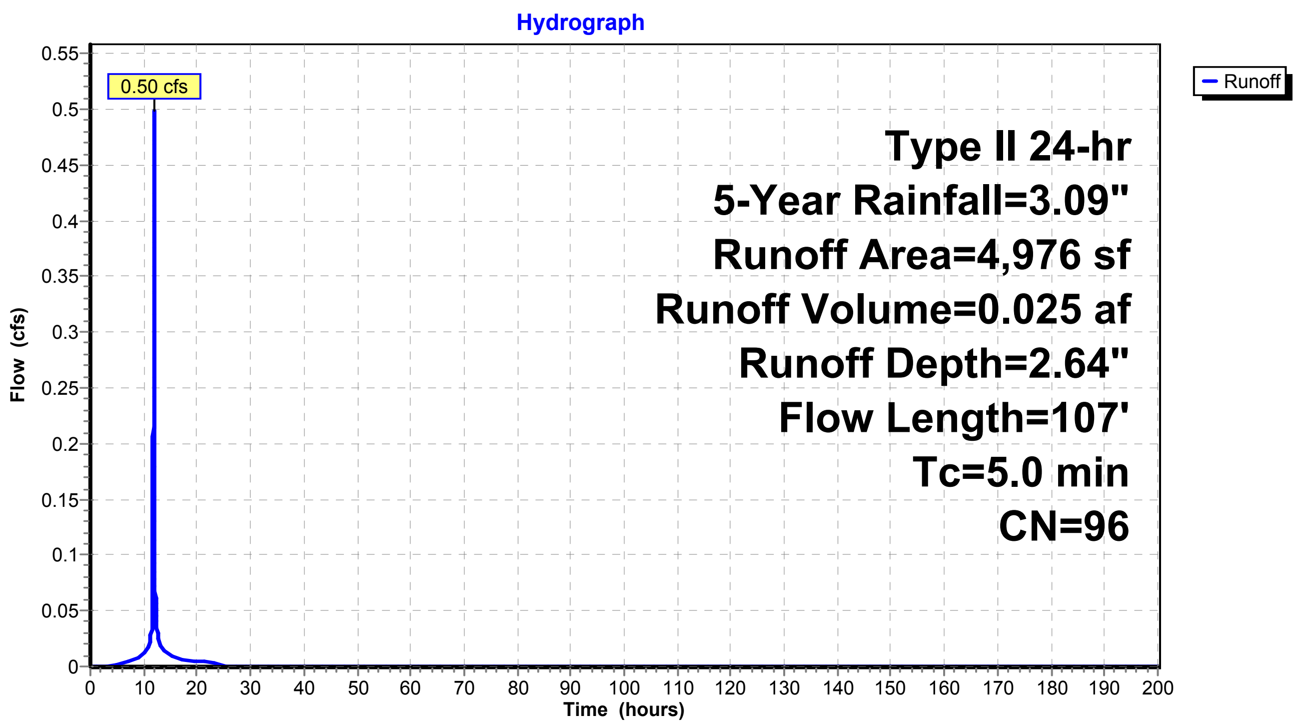
Runoff = 0.50 cfs @ 11.96 hrs, Volume= 0.025 af, Depth= 2.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs
Type II 24-hr 5-Year Rainfall=3.09"

	Area (sf)	CN	Description
	0	98	Paved parking, HSG C
	0	89	Gravel roads, HSG C
*	4,680	98	Crushed Stone Pad, HSG C
	0	70	Woods, Good, HSG C
	296	71	Meadow, non-grazed, HSG C
	4,976	96	Weighted Average
	296		5.95% Pervious Area
	4,680		94.05% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.2	17	0.0870	0.13		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.51"
1.2	83	0.0200	1.17		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.51"
0.1	7	0.0200	2.28		**Shallow Concentrated Flow, SC1** Unpaved Kv= 16.1 fps
3.5	107	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 7S: DA TO MLV PAD



Summary for Subcatchment 19S: DA TO VCD

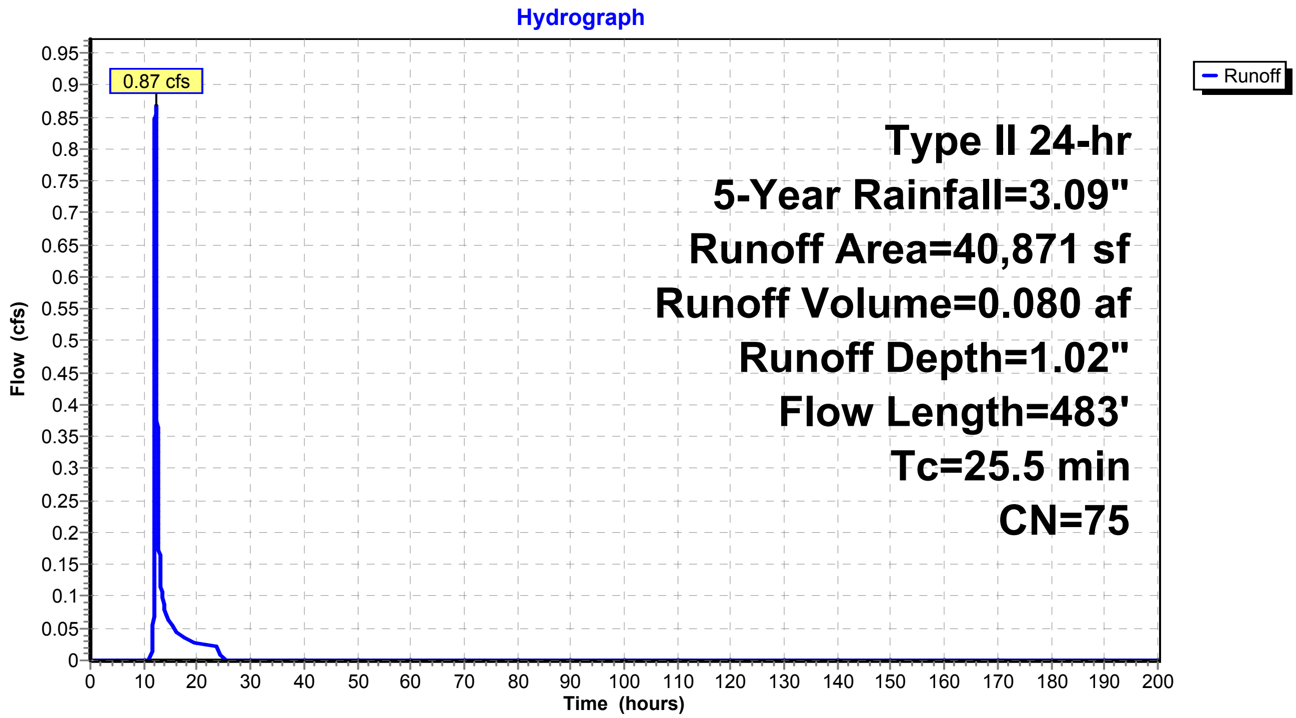
Runoff = 0.87 cfs @ 12.21 hrs, Volume= 0.080 af, Depth= 1.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs
Type II 24-hr 5-Year Rainfall=3.09"

	Area (sf)	CN	Description
	7,017	98	Paved parking, HSG C
	0	89	Gravel roads, HSG C
*	0	98	Crushed Stone Pad, HSG C
	9,681	70	Woods, Good, HSG C
	24,173	71	Meadow, non-grazed, HSG C
	40,871	75	Weighted Average
	33,854		82.83% Pervious Area
	7,017		17.17% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	17	0.0450	1.18		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.51"
1.5	8	0.0450	0.09		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.51"
15.5	43	0.0450	0.05		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.51"
4.9	32	0.0400	0.11		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.51"
0.2	17	0.0540	1.63		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
0.1	40	0.0540	4.72		**Shallow Concentrated Flow, SC2** Paved Kv= 20.3 fps
0.7	65	0.0540	1.63		**Shallow Concentrated Flow, SC3** Short Grass Pasture Kv= 7.0 fps
1.2	167	0.0250	2.37		**Shallow Concentrated Flow, SC4** Grassed Waterway Kv= 15.0 fps
1.2	94	0.0075	1.30		**Shallow Concentrated Flow, SC5** Grassed Waterway Kv= 15.0 fps
25.5	483	Total			

Subcatchment 19S: DA TO VCD



Summary for Subcatchment 111S: DA TO VCI

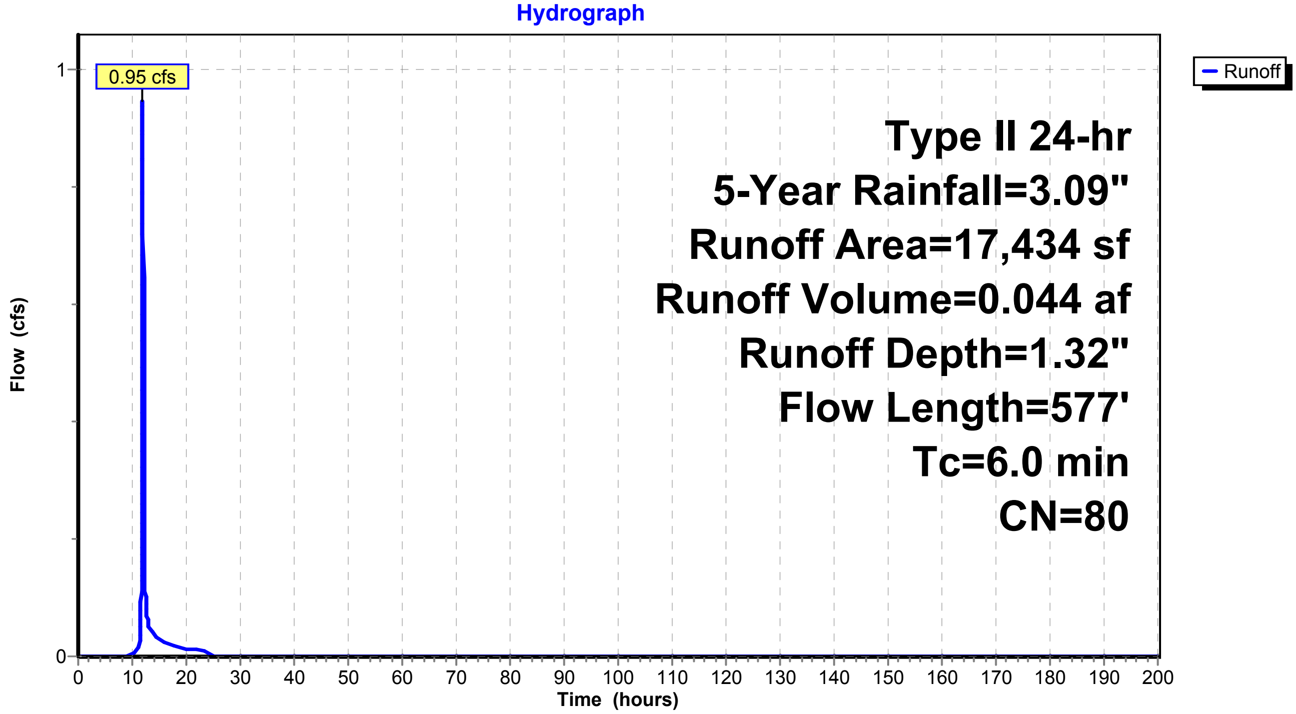
Runoff = 0.95 cfs @ 11.98 hrs, Volume= 0.044 af, Depth= 1.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs
Type II 24-hr 5-Year Rainfall=3.09"

	Area (sf)	CN	Description
	571	98	Paved parking, HSG C
	7,463	89	Gravel roads, HSG C
*	0	98	Crushed Stone Pad, HSG C
	0	70	Woods, Good, HSG C
	9,400	71	Meadow, non-grazed, HSG C
	17,434	80	Weighted Average
	16,863		96.72% Pervious Area
	571		3.28% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	55	0.0320	1.30		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.51"
0.5	5	0.3300	0.17		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.51"
2.0	158	0.0075	1.30		**Shallow Concentrated Flow, SC1** Grassed Waterway Kv= 15.0 fps
1.0	145	0.0250	2.37		**Shallow Concentrated Flow, SC2** Grassed Waterway Kv= 15.0 fps
1.8	214	0.0180	2.01		**Shallow Concentrated Flow, SC3** Grassed Waterway Kv= 15.0 fps
6.0	577	Total			

Subcatchment 111S: DA TO VCI



Summary for Pond 3P: MLV PAD

Inflow Area = 0.114 ac, 94.05% Impervious, Inflow Depth = 2.64" for 5-Year event
Inflow = 0.50 cfs @ 11.96 hrs, Volume= 0.025 af
Outflow = 0.97 cfs @ 11.93 hrs, Volume= 0.016 af, Atten= 0%, Lag= 0.0 min
Primary = 0.97 cfs @ 11.93 hrs, Volume= 0.016 af

Routing by Stor-Ind method, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs / 6
Peak Elev= 799.26' @ 11.93 hrs Surf.Area= 0 sf Storage= 468 cf

Plug-Flow detention time= 178.6 min calculated for 0.016 af (65% of inflow)
Center-of-Mass det. time= 77.8 min (848.4 - 770.6)

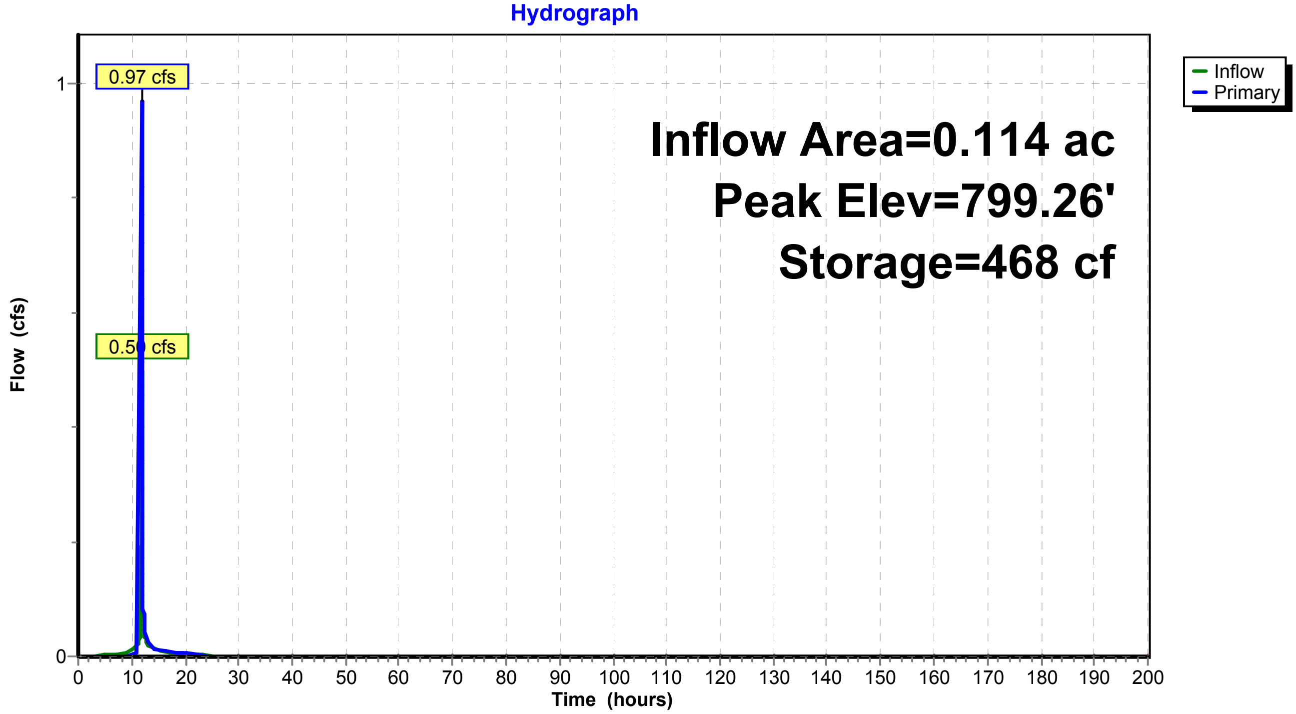
Volume	Invert	Avail.Storage	Storage Description
#1	798.22'	469 cf	**Stone Pad Void Storage**Listed below 1,172 cf Overall x 40.0% Voids

Elevation (feet)	Cum.Store (cubic-feet)
798.22	0
798.72	586
799.22	1,171
799.50	1,172

Device	Routing	Invert	Outlet Devices
#1	Primary	799.22'	**52.0' long x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=0.85 cfs @ 11.93 hrs HW=799.26' (Free Discharge)
↑—**1=Broad-Crested Rectangular Weir**(Weir Controls 0.85 cfs @ 0.46 fps)

Pond 3P: MLV PAD



Summary for Pond 20P: VCD

Inflow Area = 0.938 ac, 17.17% Impervious, Inflow Depth = 1.02" for 5-Year event
Inflow = 0.87 cfs @ 12.21 hrs, Volume= 0.080 af
Outflow = 0.06 cfs @ 15.07 hrs, Volume= 0.035 af, Atten= 93%, Lag= 171.7 min
Primary = 0.06 cfs @ 15.07 hrs, Volume= 0.035 af

Routing by Stor-Ind method, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs / 8
Peak Elev= 800.12' @ 15.07 hrs Surf.Area= 0 sf Storage= 2,199 cf

Plug-Flow detention time= 418.1 min calculated for 0.035 af (44% of inflow)
Center-of-Mass det. time= 275.9 min (1,151.6 - 875.7)

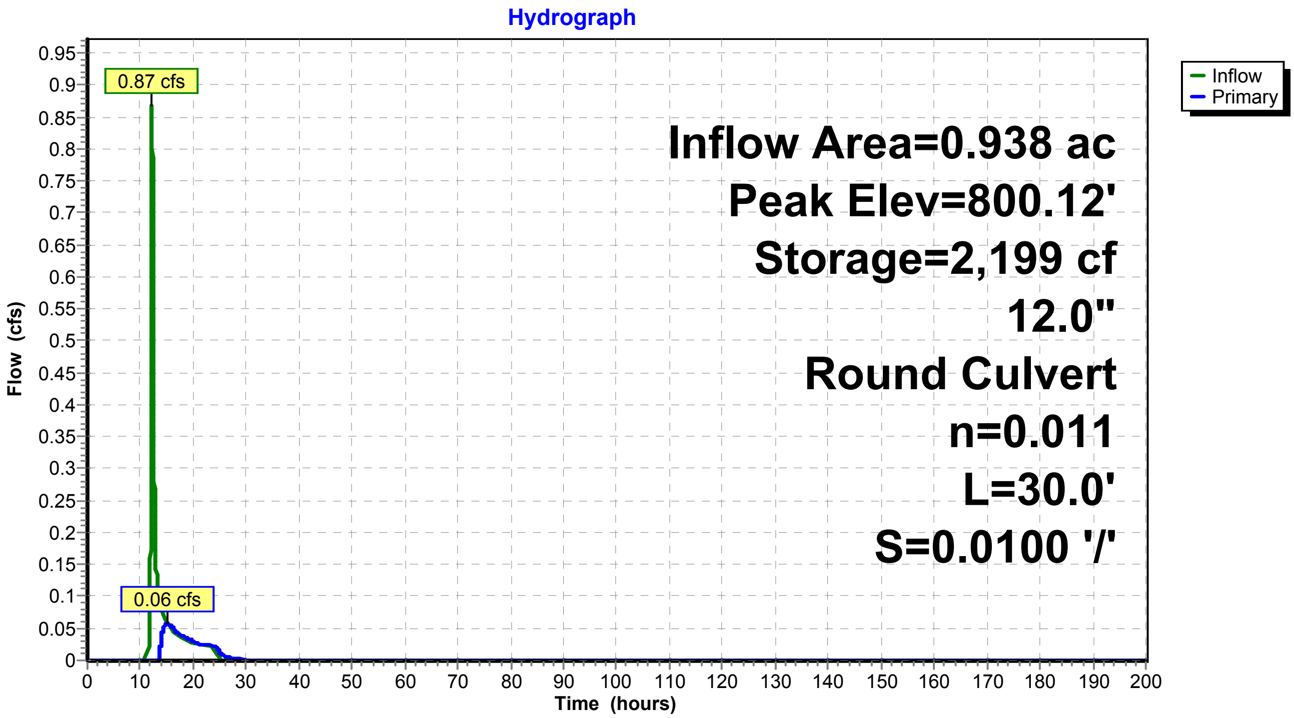
Volume	Invert	Avail.Storage	Storage Description
#1	799.00'	2,943 cf	**Custom Stage Data**Listed below

Elevation (feet)	Cum.Store (cubic-feet)
799.00	0
799.50	981
800.00	1,961
800.50	2,942
801.00	2,943

Device	Routing	Invert	Outlet Devices
#1	Primary	800.00'	**12.0" Round RCP_Round 12"** L= 30.0' RCP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 800.00' / 799.70' S= 0.0100 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Primary OutFlow Max=0.06 cfs @ 15.07 hrs HW=800.12' (Free Discharge)
└─**1=RCP_Round 12"** (Inlet Controls 0.06 cfs @ 1.05 fps)

Pond 20P: VCD


Hydrograph
0.87 cfs
0.06 cfs
Inflow
Primary
Inflow Area=0.938 ac
Peak Elev=800.12'
Storage=2,199 cf
12.0"
Round Culvert
n=0.011
L=30.0'
S=0.0100 '/'
Flow (cfs)
Time (hours)
0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
0.55
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200

Summary for Pond 110P: VCI

Inflow Area = 1.338 ac, 13.01% Impervious, Inflow Depth = 0.71" for 5-Year event
Inflow = 0.95 cfs @ 11.98 hrs, Volume= 0.079 af
Outflow = 0.10 cfs @ 14.91 hrs, Volume= 0.042 af, Atten= 89%, Lag= 176.3 min
Primary = 0.10 cfs @ 14.91 hrs, Volume= 0.042 af

Routing by Stor-Ind method, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs / 8
Peak Elev= 799.03' @ 14.91 hrs Surf.Area= 0 sf Storage= 1,610 cf

Plug-Flow detention time= 401.9 min calculated for 0.042 af (53% of inflow)
Center-of-Mass det. time= 197.3 min (1,175.5 - 978.3)

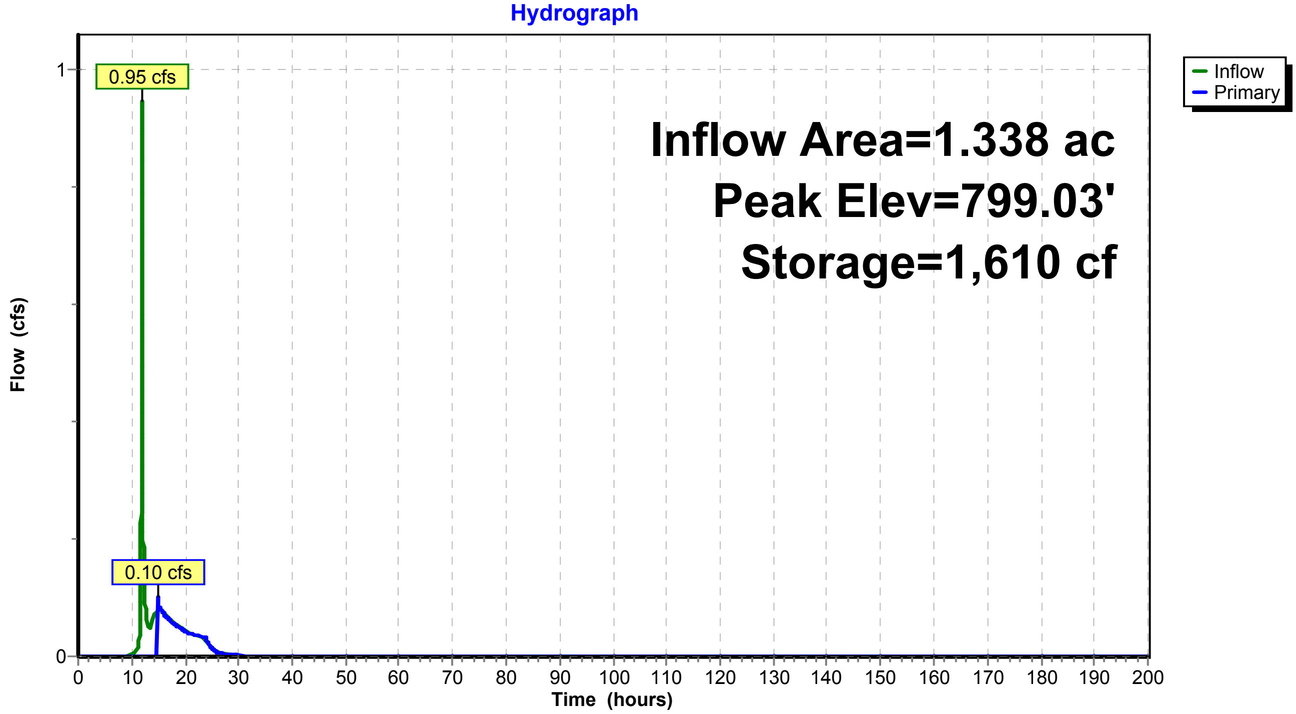
Volume	Invert	Avail.Storage	Storage Description
#1	798.00'	1,611 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
798.00	0
798.50	805
799.00	1,610
799.50	1,611

Device	Routing	Invert	Outlet Devices
#1	Primary	799.00'	**8.0' long x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=0.09 cfs @ 14.91 hrs HW=799.03' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Weir Controls 0.09 cfs @ 0.40 fps)

Pond 110P: VCI

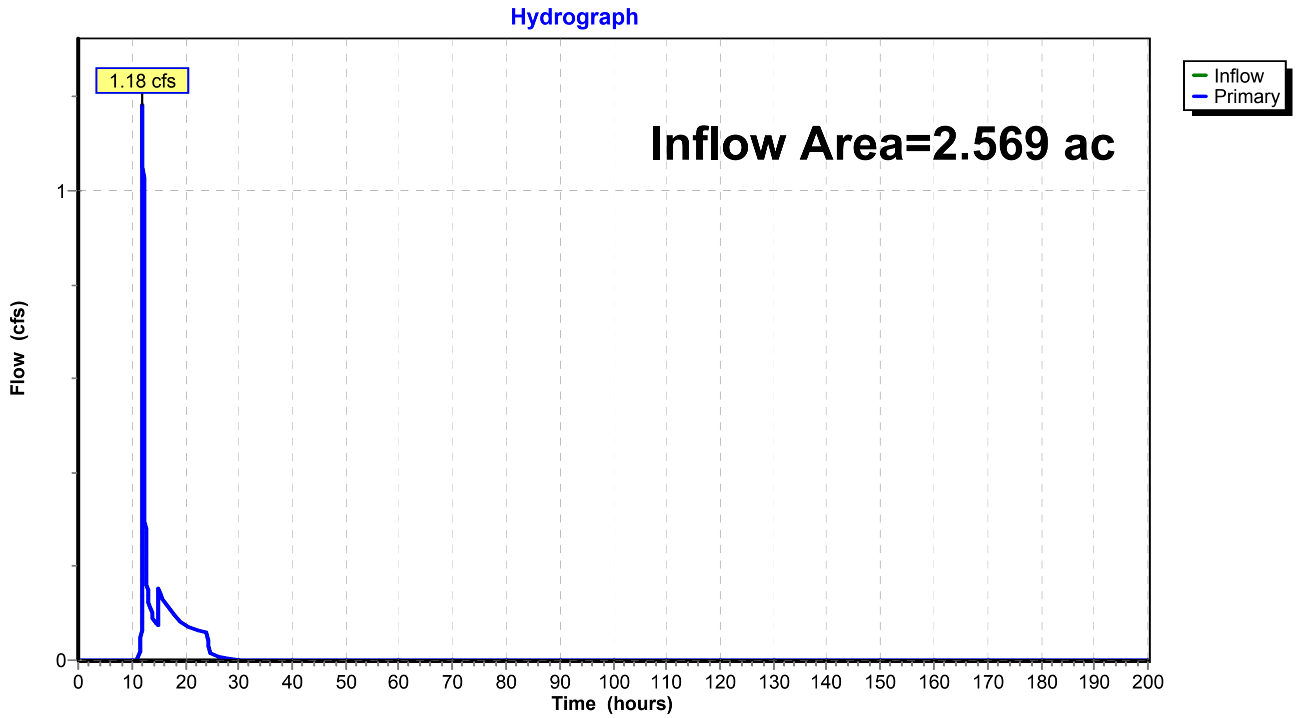


Summary for Link 5L: Proposed Conditions

Inflow Area = 2.569 ac, 10.96% Impervious, Inflow Depth = 0.62" for 5-Year event
Inflow = 1.18 cfs @ 11.93 hrs, Volume= 0.134 af
Primary = 1.18 cfs @ 11.93 hrs, Volume= 0.134 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs

Link 5L: Proposed Conditions



Time span=0.00-200.00 hrs, dt=0.01 hrs, 20001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment4S: OFFSITE DA Runoff Area=48,633 sf 0.00% Impervious Runoff Depth=1.13"
Flow Length=403' Slope=0.0310 '/' Tc=17.6 min CN=71 Runoff=1.43 cfs 0.105 af

Subcatchment7S: DA TO MLV PAD Runoff Area=4,976 sf 94.05% Impervious Runoff Depth=3.14"
Flow Length=107' Tc=5.0 min CN=96 Runoff=0.59 cfs 0.030 af

Subcatchment19S: DA TO VCD Runoff Area=40,871 sf 17.17% Impervious Runoff Depth=1.37"
Flow Length=483' Tc=25.5 min CN=75 Runoff=1.20 cfs 0.107 af

Subcatchment111S: DA TO VCI Runoff Area=17,434 sf 3.28% Impervious Runoff Depth=1.72"
Flow Length=577' Tc=6.0 min CN=80 Runoff=1.23 cfs 0.057 af

Pond 3P: MLV PAD Peak Elev=799.25' Storage=468 cf Inflow=0.59 cfs 0.030 af
Outflow=0.58 cfs 0.019 af

Pond 20P: VCD Peak Elev=800.22' Storage=2,383 cf Inflow=1.20 cfs 0.107 af
12.0" Round Culvert n=0.011 L=30.0' S=0.0100 '/' Outflow=0.17 cfs 0.062 af

Pond 110P: VCI Peak Elev=799.05' Storage=1,610 cf Inflow=1.23 cfs 0.120 af
Outflow=0.24 cfs 0.083 af

Link 5L: Proposed Conditions Inflow=1.54 cfs 0.207 af
Primary=1.54 cfs 0.207 af

Total Runoff Area = 2.569 ac Runoff Volume = 0.299 af Average Runoff Depth = 1.40"
89.04% Pervious = 2.288 ac 10.96% Impervious = 0.282 ac

Summary for Subcatchment 4S: OFFSITE DA

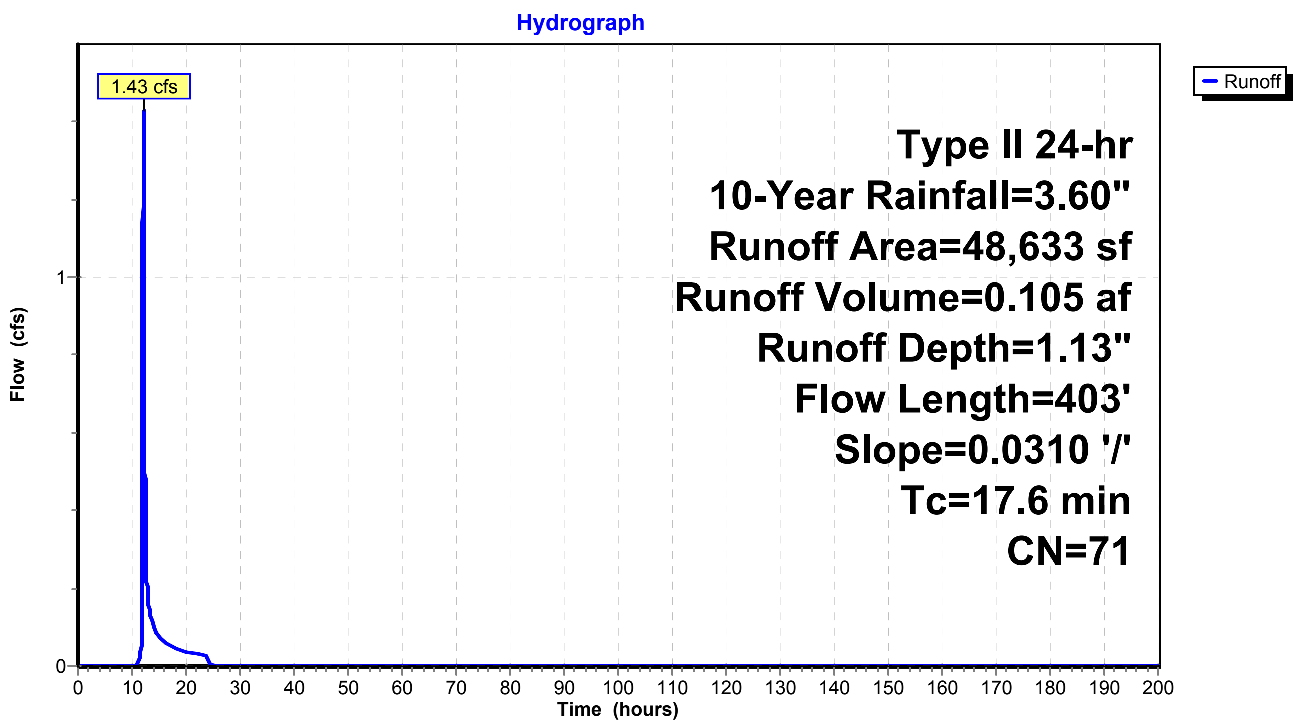
Runoff = 1.43 cfs @ 12.11 hrs, Volume= 0.105 af, Depth= 1.13"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs
Type II 24-hr 10-Year Rainfall=3.60"

	Area (sf)	CN	Description
	0	98	Paved parking, HSG C
	0	89	Gravel roads, HSG C
*	0	98	Crushed Stone Pad, HSG C
	0	70	Woods, Good, HSG C
	48,633	71	Meadow, non-grazed, HSG C
	48,633	71	Weighted Average
	48,633		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	100	0.0310	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.51"
4.1	303	0.0310	1.23		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
17.6	403	Total			

Subcatchment 4S: OFFSITE DA



Summary for Subcatchment 7S: DA TO MLV PAD

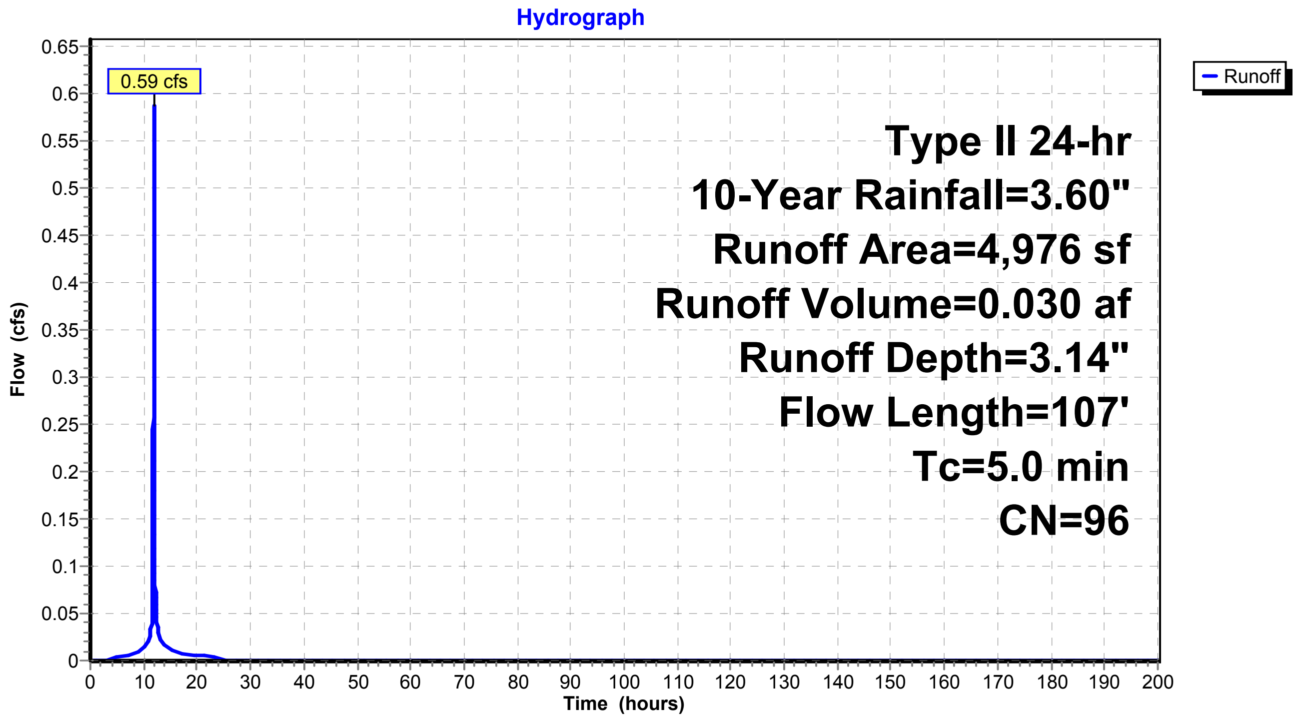
Runoff = 0.59 cfs @ 11.96 hrs, Volume= 0.030 af, Depth= 3.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs
Type II 24-hr 10-Year Rainfall=3.60"

	Area (sf)	CN	Description
	0	98	Paved parking, HSG C
	0	89	Gravel roads, HSG C
*	4,680	98	Crushed Stone Pad, HSG C
	0	70	Woods, Good, HSG C
	296	71	Meadow, non-grazed, HSG C
	4,976	96	Weighted Average
	296		5.95% Pervious Area
	4,680		94.05% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.2	17	0.0870	0.13		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.51"
1.2	83	0.0200	1.17		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.51"
0.1	7	0.0200	2.28		**Shallow Concentrated Flow, SC1** Unpaved Kv= 16.1 fps
3.5	107	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 7S: DA TO MLV PAD



Summary for Subcatchment 19S: DA TO VCD

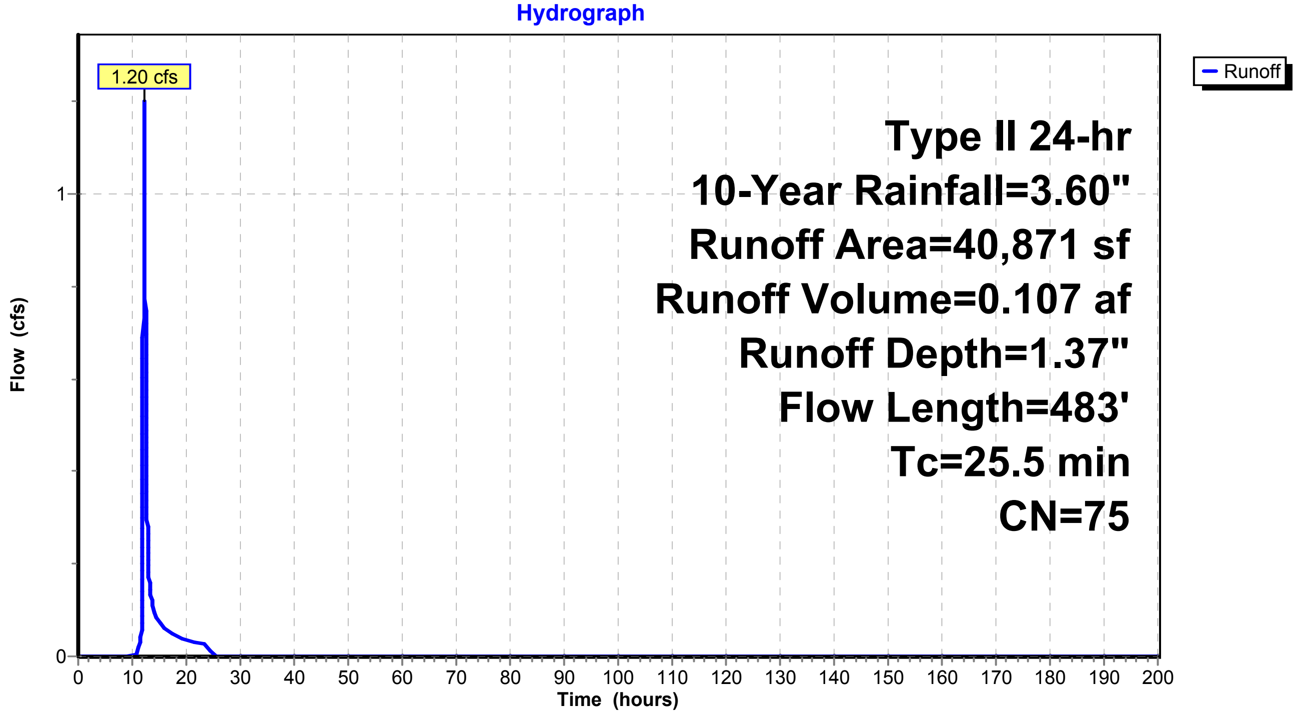
Runoff = 1.20 cfs @ 12.21 hrs, Volume= 0.107 af, Depth= 1.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs
Type II 24-hr 10-Year Rainfall=3.60"

	Area (sf)	CN	Description
	7,017	98	Paved parking, HSG C
	0	89	Gravel roads, HSG C
*	0	98	Crushed Stone Pad, HSG C
	9,681	70	Woods, Good, HSG C
	24,173	71	Meadow, non-grazed, HSG C
	40,871	75	Weighted Average
	33,854		82.83% Pervious Area
	7,017		17.17% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	17	0.0450	1.18		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.51"
1.5	8	0.0450	0.09		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.51"
15.5	43	0.0450	0.05		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.51"
4.9	32	0.0400	0.11		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.51"
0.2	17	0.0540	1.63		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
0.1	40	0.0540	4.72		**Shallow Concentrated Flow, SC2** Paved Kv= 20.3 fps
0.7	65	0.0540	1.63		**Shallow Concentrated Flow, SC3** Short Grass Pasture Kv= 7.0 fps
1.2	167	0.0250	2.37		**Shallow Concentrated Flow, SC4** Grassed Waterway Kv= 15.0 fps
1.2	94	0.0075	1.30		**Shallow Concentrated Flow, SC5** Grassed Waterway Kv= 15.0 fps
25.5	483	Total			

Subcatchment 19S: DA TO VCD



Summary for Subcatchment 111S: DA TO VCI

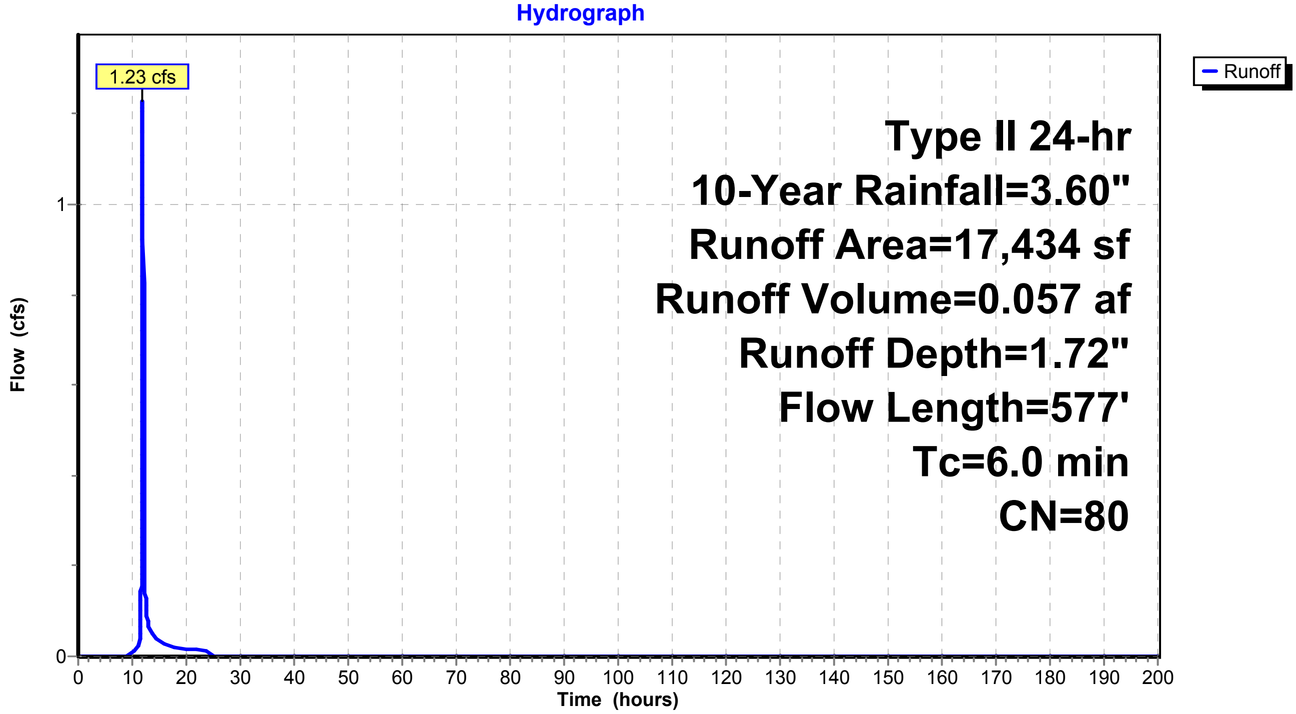
Runoff = 1.23 cfs @ 11.97 hrs, Volume= 0.057 af, Depth= 1.72"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs
Type II 24-hr 10-Year Rainfall=3.60"

	Area (sf)	CN	Description
	571	98	Paved parking, HSG C
	7,463	89	Gravel roads, HSG C
*	0	98	Crushed Stone Pad, HSG C
	0	70	Woods, Good, HSG C
	9,400	71	Meadow, non-grazed, HSG C
	17,434	80	Weighted Average
	16,863		96.72% Pervious Area
	571		3.28% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	55	0.0320	1.30		**Sheet Flow,**
					Smooth surfaces n= 0.011 P2= 2.51"
0.5	5	0.3300	0.17		**Sheet Flow,**
					Grass: Dense n= 0.240 P2= 2.51"
2.0	158	0.0075	1.30		**Shallow Concentrated Flow, SC1**
					Grassed Waterway Kv= 15.0 fps
1.0	145	0.0250	2.37		**Shallow Concentrated Flow, SC2**
					Grassed Waterway Kv= 15.0 fps
1.8	214	0.0180	2.01		**Shallow Concentrated Flow, SC3**
					Grassed Waterway Kv= 15.0 fps
6.0	577	Total			

Subcatchment 111S: DA TO VCI



Summary for Pond 3P: MLV PAD

Inflow Area = 0.114 ac, 94.05% Impervious, Inflow Depth = 3.14" for 10-Year event
Inflow = 0.59 cfs @ 11.96 hrs, Volume= 0.030 af
Outflow = 0.58 cfs @ 11.96 hrs, Volume= 0.019 af, Atten= 2%, Lag= 0.1 min
Primary = 0.58 cfs @ 11.96 hrs, Volume= 0.019 af

Routing by Stor-Ind method, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs / 6
Peak Elev= 799.25' @ 11.96 hrs Surf.Area= 0 sf Storage= 468 cf

Plug-Flow detention time= 183.9 min calculated for 0.019 af (64% of inflow)
Center-of-Mass det. time= 81.7 min (848.0 - 766.3)

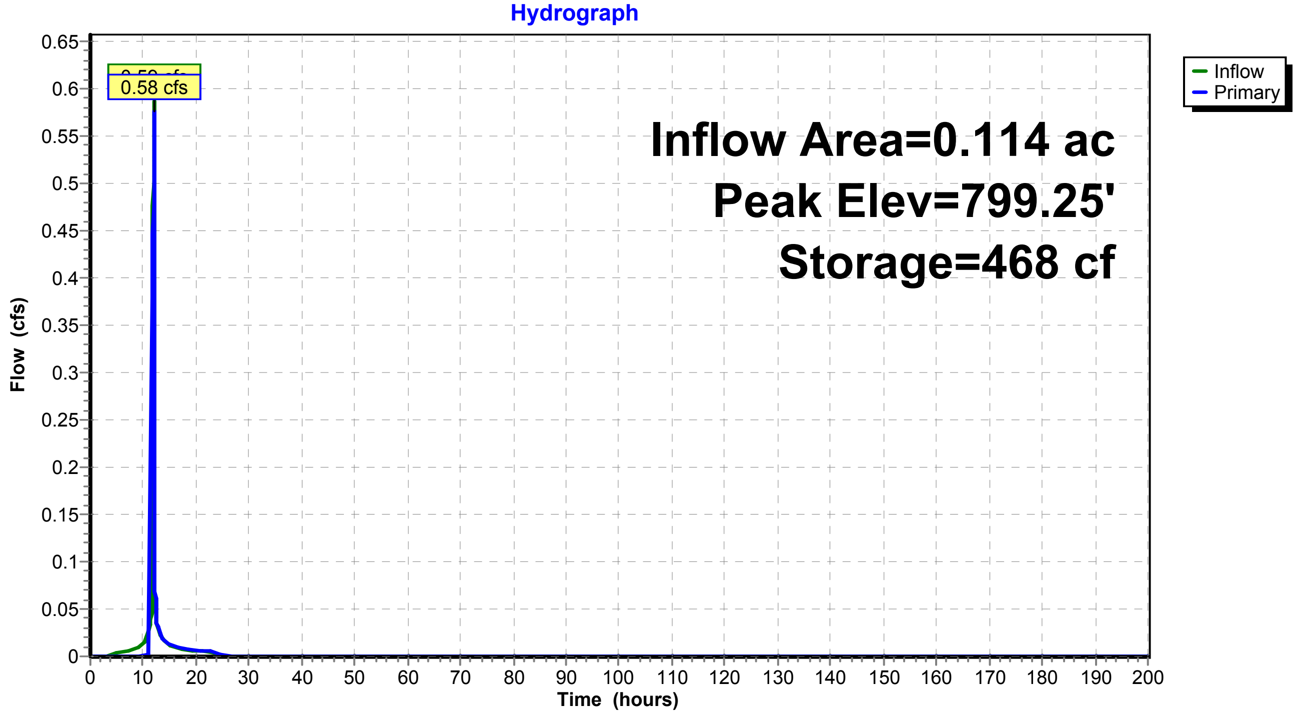
Volume	Invert	Avail.Storage	Storage Description
#1	798.22'	469 cf	**Stone Pad Void Storage** Listed below 1,172 cf Overall x 40.0% Voids

Elevation (feet)	Cum.Store (cubic-feet)
798.22	0
798.72	586
799.22	1,171
799.50	1,172

Device	Routing	Invert	Outlet Devices
#1	Primary	799.22'	**52.0' long x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=0.57 cfs @ 11.96 hrs HW=799.25' (Free Discharge)
1=Broad-Crested Rectangular Weir (Weir Controls 0.57 cfs @ 0.40 fps)

Pond 3P: MLV PAD



Summary for Pond 20P: VCD

Inflow Area = 0.938 ac, 17.17% Impervious, Inflow Depth = 1.37" for 10-Year event
Inflow = 1.20 cfs @ 12.21 hrs, Volume= 0.107 af
Outflow = 0.17 cfs @ 13.10 hrs, Volume= 0.062 af, Atten= 86%, Lag= 53.8 min
Primary = 0.17 cfs @ 13.10 hrs, Volume= 0.062 af

Routing by Stor-Ind method, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs / 8
Peak Elev= 800.22' @ 13.10 hrs Surf.Area= 0 sf Storage= 2,383 cf

Plug-Flow detention time= 301.0 min calculated for 0.062 af (58% of inflow)
Center-of-Mass det. time= 174.7 min (1,041.4 - 866.6)

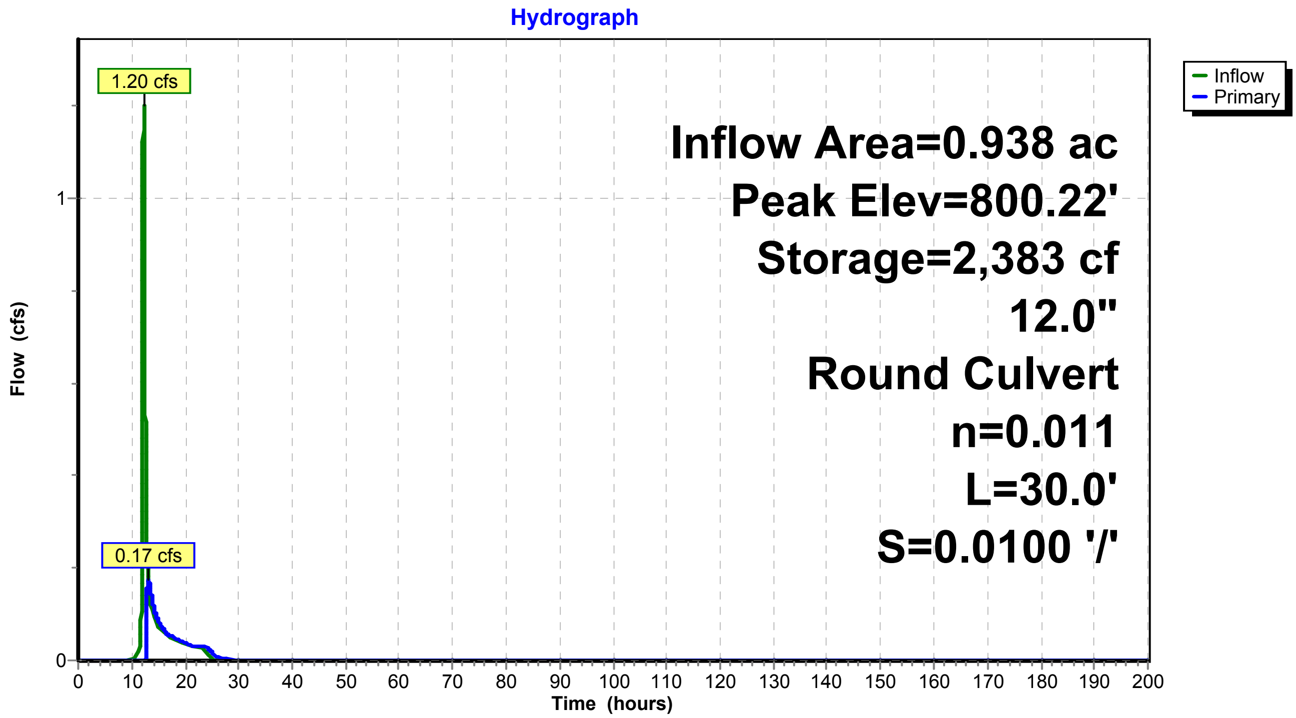
Volume	Invert	Avail.Storage	Storage Description
#1	799.00'	2,943 cf	**Custom Stage Data**Listed below

Elevation (feet)	Cum.Store (cubic-feet)
799.00	0
799.50	981
800.00	1,961
800.50	2,942
801.00	2,943

Device	Routing	Invert	Outlet Devices
#1	Primary	800.00'	**12.0" Round RCP_Round 12"** L= 30.0' RCP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 800.00' / 799.70' S= 0.0100 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Primary OutFlow Max=0.17 cfs @ 13.10 hrs HW=800.22' (Free Discharge)
└─**1=RCP_Round 12"** (Inlet Controls 0.17 cfs @ 1.39 fps)

Pond 20P: VCD


Hydrograph
1.20 cfs
0.17 cfs
Inflow
Primary
Inflow Area=0.938 ac
Peak Elev=800.22'
Storage=2,383 cf
12.0"
Round Culvert
n=0.011
L=30.0'
S=0.0100 '/'
Flow (cfs)
Time (hours)
0
1
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200

Summary for Pond 110P: VCI

Inflow Area = 1.338 ac, 13.01% Impervious, Inflow Depth = 1.07" for 10-Year event
Inflow = 1.23 cfs @ 11.97 hrs, Volume= 0.120 af
Outflow = 0.24 cfs @ 13.02 hrs, Volume= 0.083 af, Atten= 81%, Lag= 62.8 min
Primary = 0.24 cfs @ 13.02 hrs, Volume= 0.083 af

Routing by Stor-Ind method, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs / 8
Peak Elev= 799.05' @ 13.02 hrs Surf.Area= 0 sf Storage= 1,610 cf

Plug-Flow detention time= 241.0 min calculated for 0.083 af (69% of inflow)
Center-of-Mass det. time= 99.7 min (1,041.7 - 941.9)

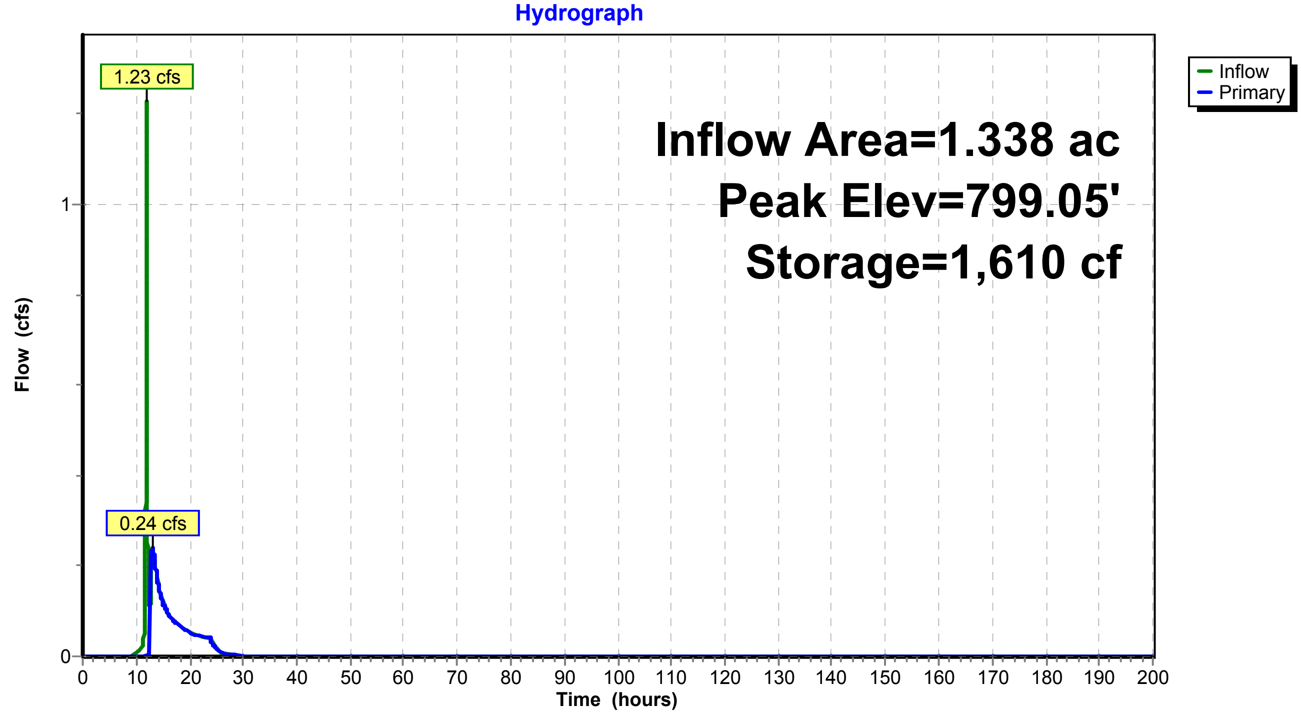
Volume	Invert	Avail.Storage	Storage Description
#1	798.00'	1,611 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
798.00	0
798.50	805
799.00	1,610
799.50	1,611

Device	Routing	Invert	Outlet Devices
#1	Primary	799.00'	**8.0' long x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=0.24 cfs @ 13.02 hrs HW=799.05' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Weir Controls 0.24 cfs @ 0.56 fps)

Pond 110P: VCI

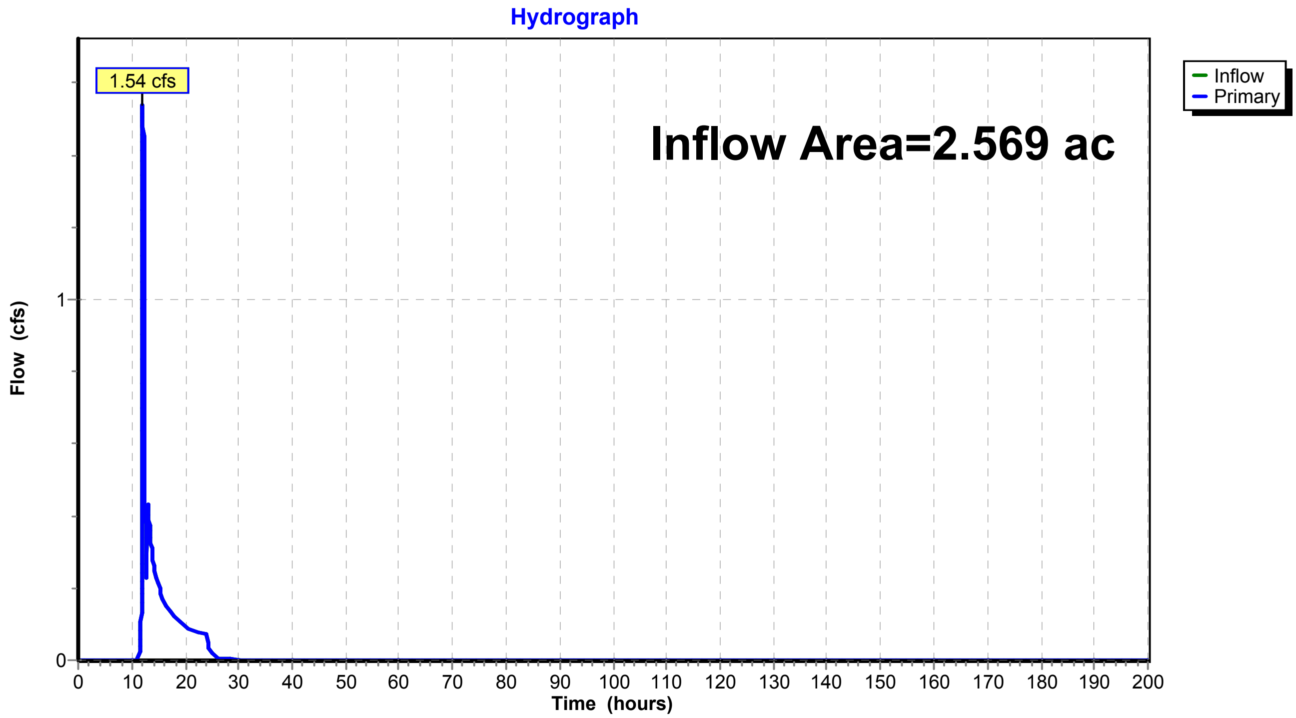


Summary for Link 5L: Proposed Conditions

Inflow Area =	2.569 ac, 10.96% Impervious, Inflow Depth = 0.96" for 10-Year event		
Inflow =	1.54 cfs @ 12.10 hrs, Volume=	0.207 af	
Primary =	1.54 cfs @ 12.10 hrs, Volume=	0.207 af, Atten= 0%, Lag= 0.0 min	

Primary outflow = Inflow, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs

Link 5L: Proposed Conditions



Time span=0.00-200.00 hrs, dt=0.01 hrs, 20001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment4S: OFFSITE DA Runoff Area=48,633 sf 0.00% Impervious Runoff Depth=1.67"
Flow Length=403' Slope=0.0310 '/' Tc=17.6 min CN=71 Runoff=2.17 cfs 0.155 af

Subcatchment7S: DA TO MLV PAD Runoff Area=4,976 sf 94.05% Impervious Runoff Depth=3.93"
Flow Length=107' Tc=5.0 min CN=96 Runoff=0.72 cfs 0.037 af

Subcatchment19S: DA TO VCD Runoff Area=40,871 sf 17.17% Impervious Runoff Depth=1.96"
Flow Length=483' Tc=25.5 min CN=75 Runoff=1.75 cfs 0.154 af

Subcatchment111S: DA TO VCI Runoff Area=17,434 sf 3.28% Impervious Runoff Depth=2.37"
Flow Length=577' Tc=6.0 min CN=80 Runoff=1.69 cfs 0.079 af

Pond 3P: MLV PAD Peak Elev=799.25' Storage=468 cf Inflow=0.72 cfs 0.037 af
Outflow=0.72 cfs 0.026 af

Pond 20P: VCD Peak Elev=800.43' Storage=2,795 cf Inflow=1.75 cfs 0.154 af
12.0" Round Culvert n=0.011 L=30.0' S=0.0100 '/' Outflow=0.62 cfs 0.109 af

Pond 110P: VCI Peak Elev=799.14' Storage=1,610 cf Inflow=1.69 cfs 0.188 af
Outflow=0.93 cfs 0.151 af

Link 5L: Proposed Conditions Inflow=3.23 cfs 0.332 af
Primary=3.23 cfs 0.332 af

Total Runoff Area = 2.569 ac Runoff Volume = 0.425 af Average Runoff Depth = 1.99"
89.04% Pervious = 2.288 ac 10.96% Impervious = 0.282 ac

Summary for Subcatchment 4S: OFFSITE DA

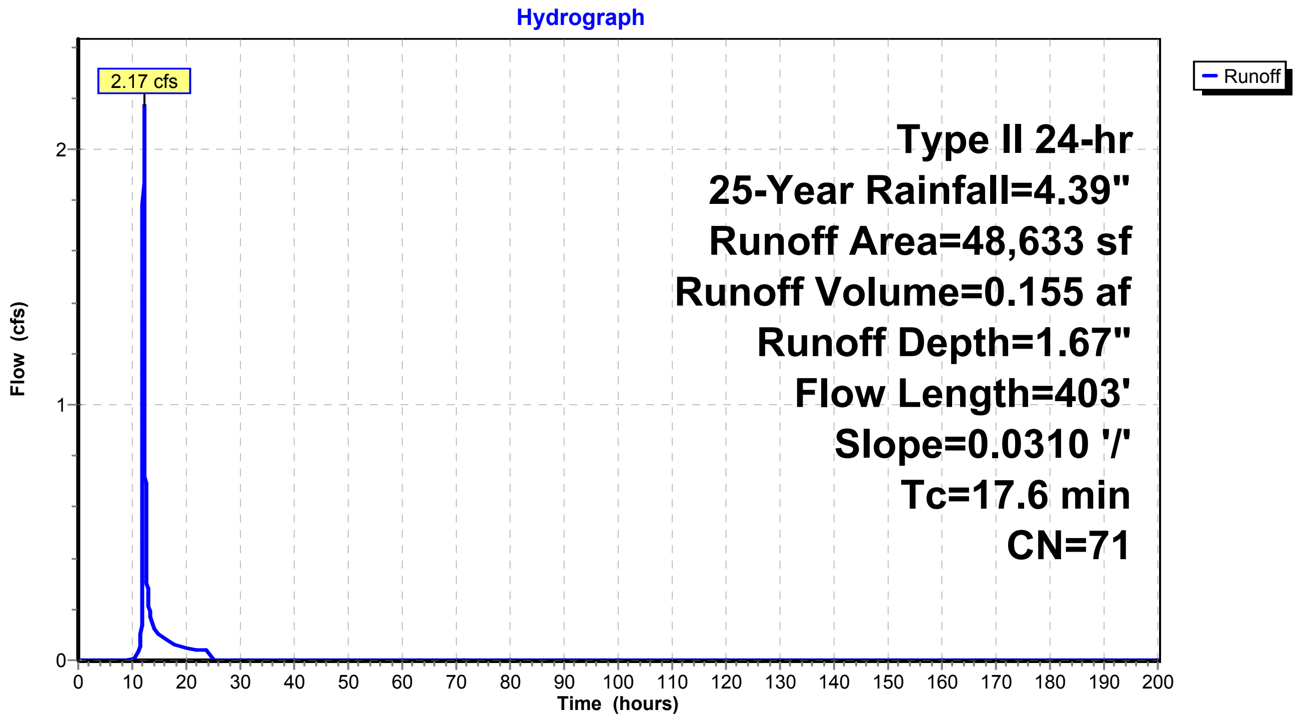
Runoff = 2.17 cfs @ 12.11 hrs, Volume= 0.155 af, Depth= 1.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=4.39"

	Area (sf)	CN	Description
	0	98	Paved parking, HSG C
	0	89	Gravel roads, HSG C
*	0	98	Crushed Stone Pad, HSG C
	0	70	Woods, Good, HSG C
	48,633	71	Meadow, non-grazed, HSG C
	48,633	71	Weighted Average
	48,633		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	100	0.0310	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.51"
4.1	303	0.0310	1.23		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
17.6	403	Total			

Subcatchment 4S: OFFSITE DA



Summary for Subcatchment 7S: DA TO MLV PAD

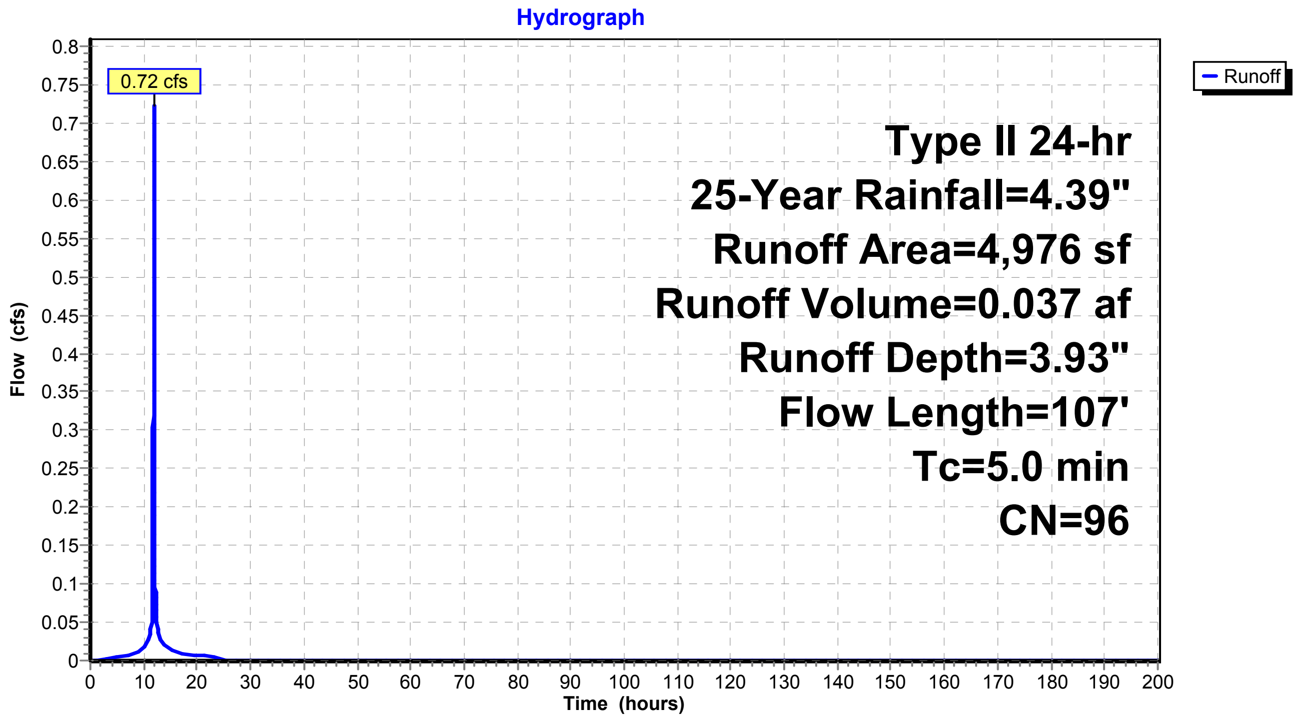
Runoff = 0.72 cfs @ 11.96 hrs, Volume= 0.037 af, Depth= 3.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=4.39"

	Area (sf)	CN	Description
	0	98	Paved parking, HSG C
	0	89	Gravel roads, HSG C
*	4,680	98	Crushed Stone Pad, HSG C
	0	70	Woods, Good, HSG C
	296	71	Meadow, non-grazed, HSG C
	4,976	96	Weighted Average
	296		5.95% Pervious Area
	4,680		94.05% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.2	17	0.0870	0.13		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.51"
1.2	83	0.0200	1.17		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.51"
0.1	7	0.0200	2.28		**Shallow Concentrated Flow, SC1** Unpaved Kv= 16.1 fps
3.5	107	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 7S: DA TO MLV PAD



Summary for Subcatchment 19S: DA TO VCD

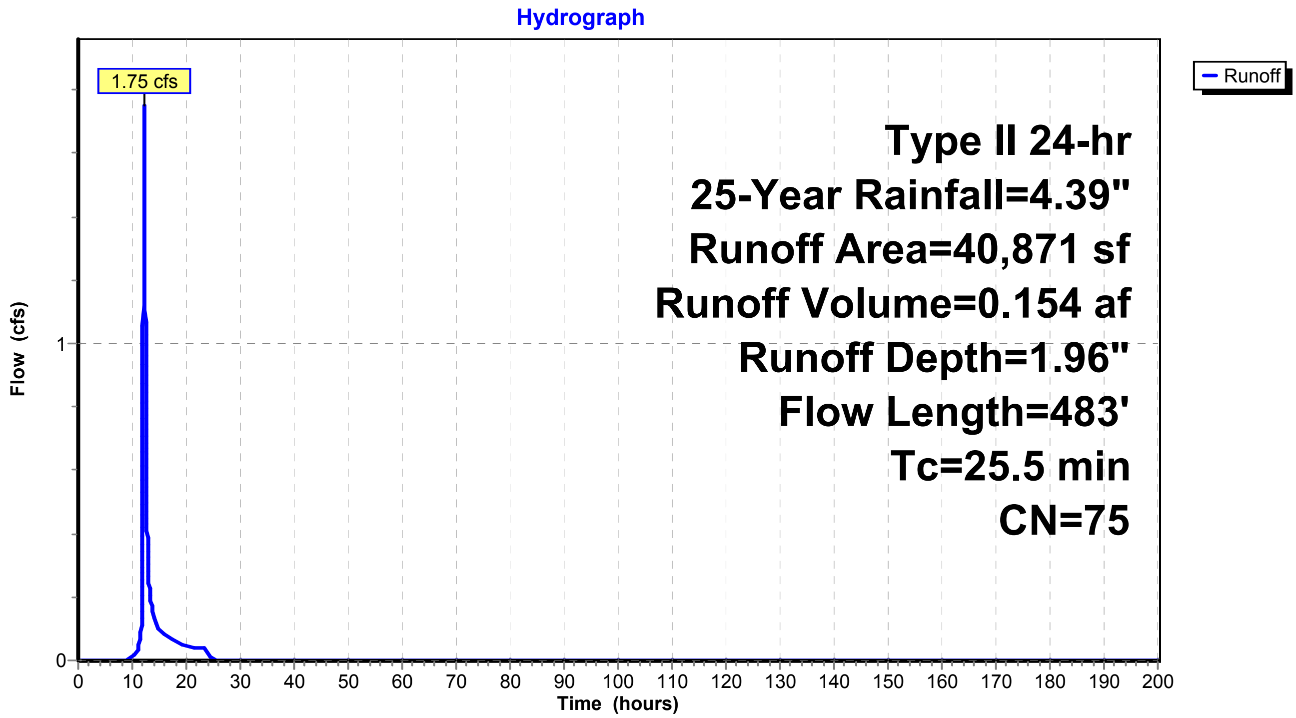
Runoff = 1.75 cfs @ 12.21 hrs, Volume= 0.154 af, Depth= 1.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=4.39"

	Area (sf)	CN	Description
	7,017	98	Paved parking, HSG C
	0	89	Gravel roads, HSG C
*	0	98	Crushed Stone Pad, HSG C
	9,681	70	Woods, Good, HSG C
	24,173	71	Meadow, non-grazed, HSG C
	40,871	75	Weighted Average
	33,854		82.83% Pervious Area
	7,017		17.17% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	17	0.0450	1.18		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.51"
1.5	8	0.0450	0.09		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.51"
15.5	43	0.0450	0.05		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.51"
4.9	32	0.0400	0.11		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.51"
0.2	17	0.0540	1.63		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
0.1	40	0.0540	4.72		**Shallow Concentrated Flow, SC2** Paved Kv= 20.3 fps
0.7	65	0.0540	1.63		**Shallow Concentrated Flow, SC3** Short Grass Pasture Kv= 7.0 fps
1.2	167	0.0250	2.37		**Shallow Concentrated Flow, SC4** Grassed Waterway Kv= 15.0 fps
1.2	94	0.0075	1.30		**Shallow Concentrated Flow, SC5** Grassed Waterway Kv= 15.0 fps
25.5	483	Total			

Subcatchment 19S: DA TO VCD



Summary for Subcatchment 111S: DA TO VCI

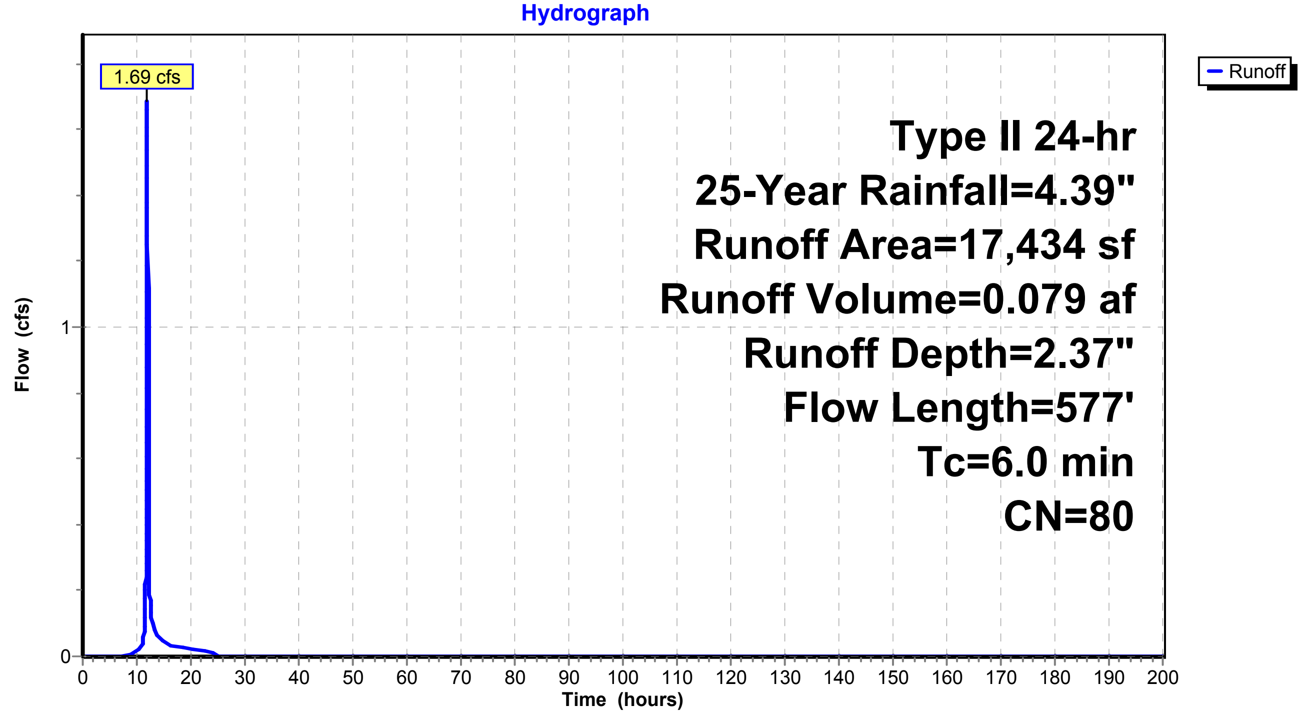
Runoff = 1.69 cfs @ 11.97 hrs, Volume= 0.079 af, Depth= 2.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=4.39"

	Area (sf)	CN	Description
	571	98	Paved parking, HSG C
	7,463	89	Gravel roads, HSG C
*	0	98	Crushed Stone Pad, HSG C
	0	70	Woods, Good, HSG C
	9,400	71	Meadow, non-grazed, HSG C
	17,434	80	Weighted Average
	16,863		96.72% Pervious Area
	571		3.28% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	55	0.0320	1.30		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.51"
0.5	5	0.3300	0.17		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.51"
2.0	158	0.0075	1.30		**Shallow Concentrated Flow, SC1** Grassed Waterway Kv= 15.0 fps
1.0	145	0.0250	2.37		**Shallow Concentrated Flow, SC2** Grassed Waterway Kv= 15.0 fps
1.8	214	0.0180	2.01		**Shallow Concentrated Flow, SC3** Grassed Waterway Kv= 15.0 fps
6.0	577	Total			

Subcatchment 111S: DA TO VCI



Summary for Pond 3P: MLV PAD

Inflow Area = 0.114 ac, 94.05% Impervious, Inflow Depth = 3.93" for 25-Year event
Inflow = 0.72 cfs @ 11.96 hrs, Volume= 0.037 af
Outflow = 0.72 cfs @ 11.96 hrs, Volume= 0.026 af, Atten= 1%, Lag= 0.0 min
Primary = 0.72 cfs @ 11.96 hrs, Volume= 0.026 af

Routing by Stor-Ind method, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs / 6
Peak Elev= 799.25' @ 11.96 hrs Surf.Area= 0 sf Storage= 468 cf

Plug-Flow detention time= 169.2 min calculated for 0.026 af (70% of inflow)
Center-of-Mass det. time= 73.0 min (833.9 - 761.0)

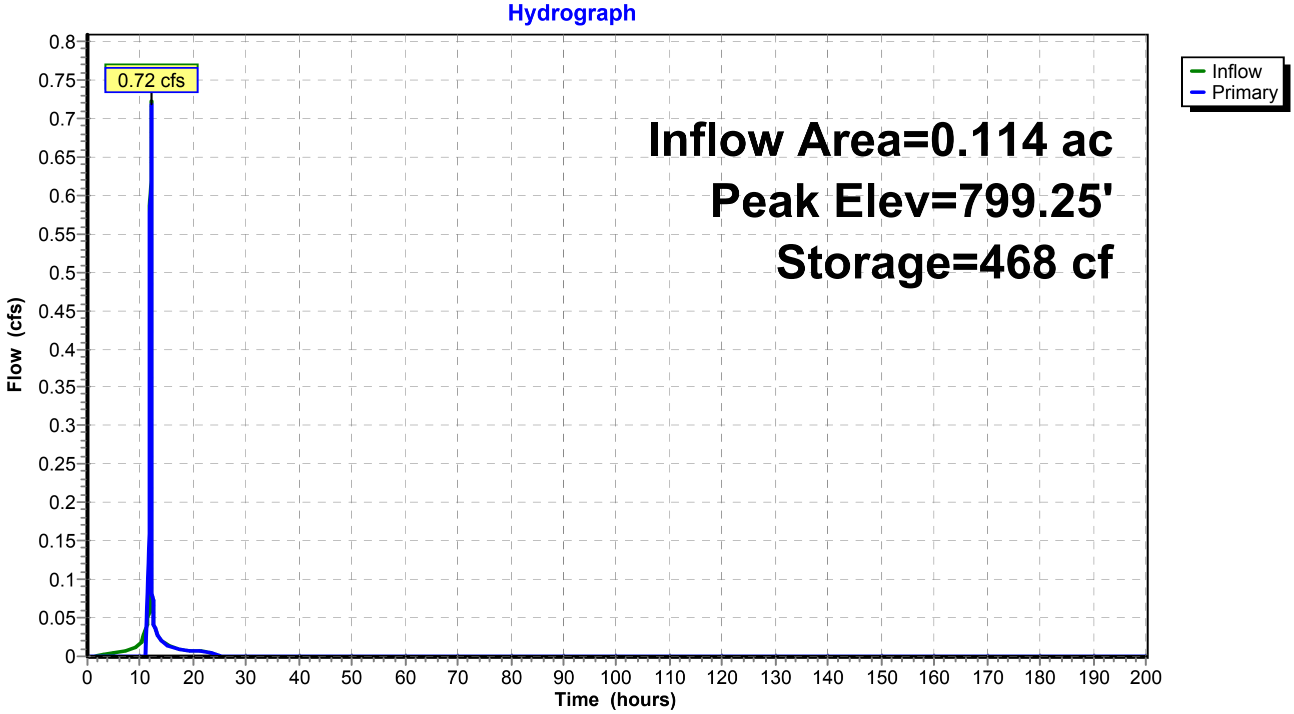
Volume	Invert	Avail.Storage	Storage Description
#1	798.22'	469 cf	**Stone Pad Void Storage** Listed below 1,172 cf Overall x 40.0% Voids

Elevation (feet)	Cum.Store (cubic-feet)
798.22	0
798.72	586
799.22	1,171
799.50	1,172

Device	Routing	Invert	Outlet Devices
#1	Primary	799.22'	**52.0' long x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=0.71 cfs @ 11.96 hrs HW=799.25' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Weir Controls 0.71 cfs @ 0.43 fps)

Pond 3P: MLV PAD



Summary for Pond 20P: VCD

Inflow Area = 0.938 ac, 17.17% Impervious, Inflow Depth = 1.96" for 25-Year event
Inflow = 1.75 cfs @ 12.21 hrs, Volume= 0.154 af
Outflow = 0.62 cfs @ 12.59 hrs, Volume= 0.109 af, Atten= 64%, Lag= 22.5 min
Primary = 0.62 cfs @ 12.59 hrs, Volume= 0.109 af

Routing by Stor-Ind method, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs / 8
Peak Elev= 800.43' @ 12.59 hrs Surf.Area= 0 sf Storage= 2,795 cf

Plug-Flow detention time= 217.3 min calculated for 0.109 af (71% of inflow)
Center-of-Mass det. time= 111.3 min (967.4 - 856.1)

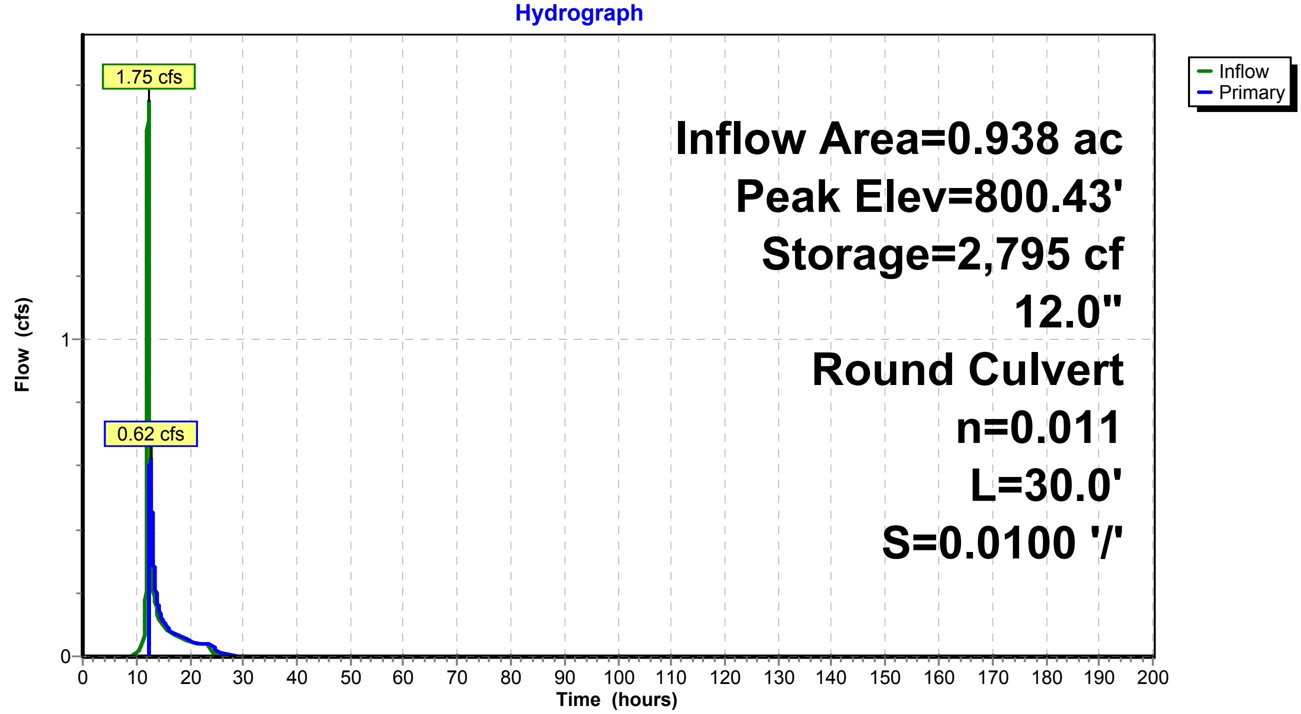
Volume	Invert	Avail.Storage	Storage Description
#1	799.00'	2,943 cf	**Custom Stage Data**Listed below

Elevation (feet)	Cum.Store (cubic-feet)
799.00	0
799.50	981
800.00	1,961
800.50	2,942
801.00	2,943

Device	Routing	Invert	Outlet Devices
#1	Primary	800.00'	**12.0" Round RCP_Round 12"** L= 30.0' RCP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 800.00' / 799.70' S= 0.0100 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Primary OutFlow Max=0.62 cfs @ 12.59 hrs HW=800.42' (Free Discharge)
1=RCP_Round 12" (Inlet Controls 0.62 cfs @ 1.96 fps)

Pond 20P: VCD


Hydrograph
1.75 cfs
0.62 cfs
Inflow
Primary
Inflow Area=0.938 ac
Peak Elev=800.43'
Storage=2,795 cf
12.0"
Round Culvert
n=0.011
L=30.0'
S=0.0100 '/'
Flow (cfs)
Time (hours)
0
1
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200

Summary for Pond 110P: VCI

Inflow Area = 1.338 ac, 13.01% Impervious, Inflow Depth = 1.68" for 25-Year event
Inflow = 1.69 cfs @ 11.97 hrs, Volume= 0.188 af
Outflow = 0.93 cfs @ 12.07 hrs, Volume= 0.151 af, Atten= 45%, Lag= 6.0 min
Primary = 0.93 cfs @ 12.07 hrs, Volume= 0.151 af

Routing by Stor-Ind method, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs / 8
Peak Elev= 799.14' @ 12.07 hrs Surf.Area= 0 sf Storage= 1,610 cf

Plug-Flow detention time= 148.2 min calculated for 0.151 af (80% of inflow)
Center-of-Mass det. time= 49.8 min (957.0 - 907.2)

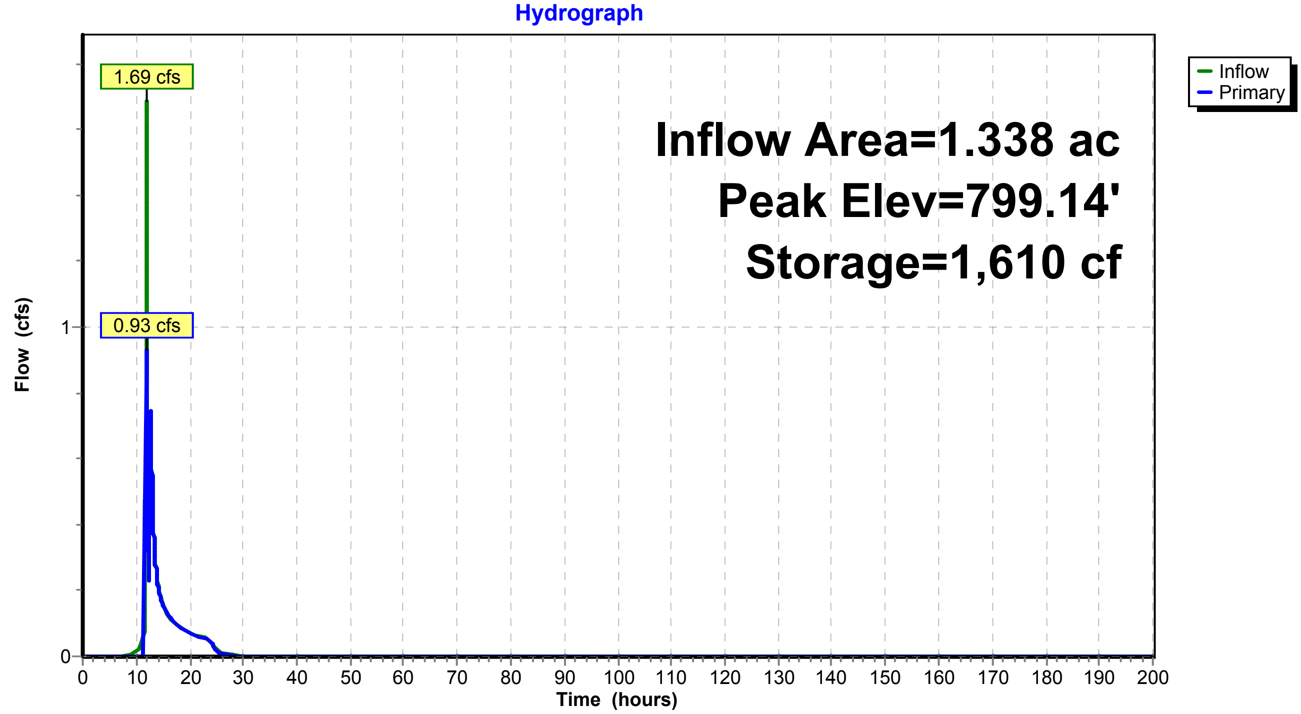
Volume	Invert	Avail.Storage	Storage Description
#1	798.00'	1,611 cf	**Custom Stage Data**Listed below

Elevation (feet)	Cum.Store (cubic-feet)
798.00	0
798.50	805
799.00	1,610
799.50	1,611

Device	Routing	Invert	Outlet Devices
#1	Primary	799.00'	**8.0' long x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=0.81 cfs @ 12.07 hrs HW=799.12' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir**(Weir Controls 0.81 cfs @ 0.84 fps)

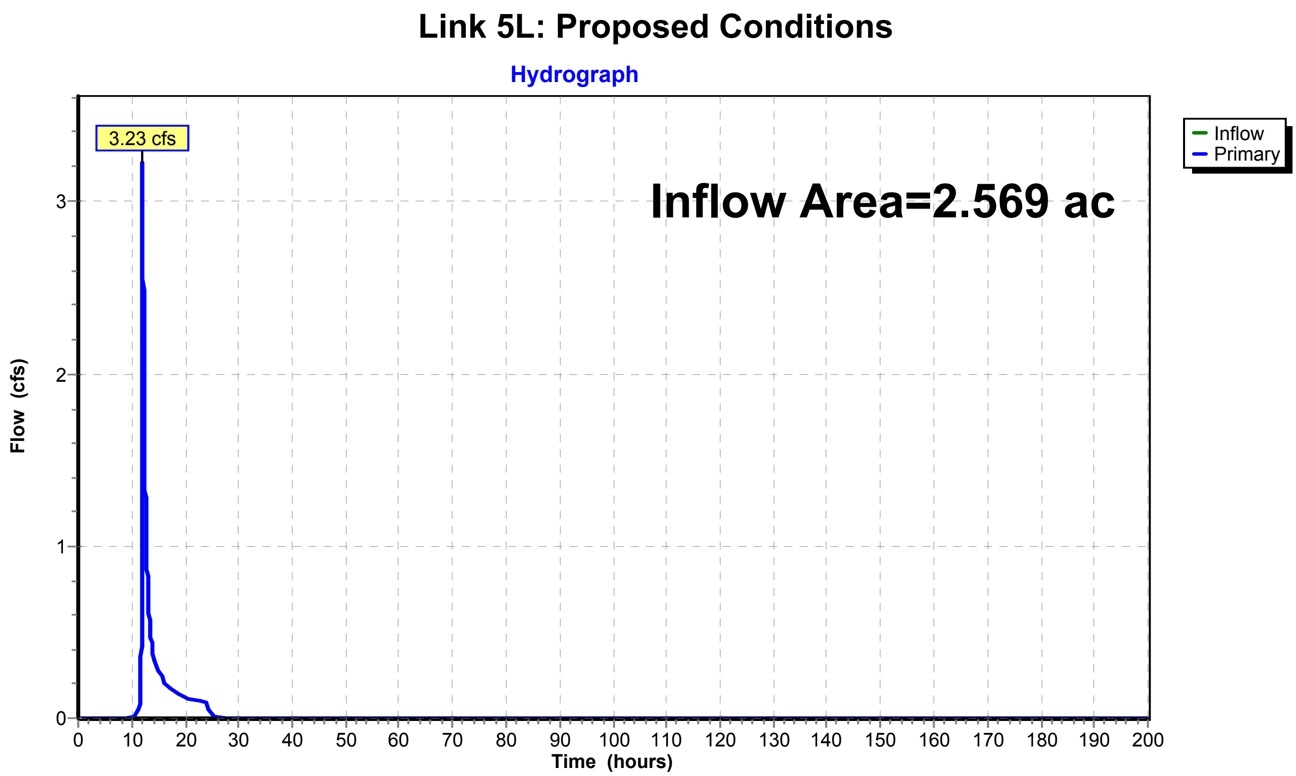
Pond 110P: VCI



Summary for Link 5L: Proposed Conditions

Inflow Area = 2.569 ac, 10.96% Impervious, Inflow Depth = 1.55" for 25-Year event
Inflow = 3.23 cfs @ 12.07 hrs, Volume= 0.332 af
Primary = 3.23 cfs @ 12.07 hrs, Volume= 0.332 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs



Time span=0.00-200.00 hrs, dt=0.01 hrs, 20001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment4S: OFFSITE DA Runoff Area=48,633 sf 0.00% Impervious Runoff Depth=2.19"
Flow Length=403' Slope=0.0310 '/' Tc=17.6 min CN=71 Runoff=2.90 cfs 0.204 af

Subcatchment7S: DA TO MLV PAD Runoff Area=4,976 sf 94.05% Impervious Runoff Depth=4.63"
Flow Length=107' Tc=5.0 min CN=96 Runoff=0.84 cfs 0.044 af

Subcatchment19S: DA TO VCD Runoff Area=40,871 sf 17.17% Impervious Runoff Depth=2.53"
Flow Length=483' Tc=25.5 min CN=75 Runoff=2.27 cfs 0.198 af

Subcatchment111S: DA TO VCI Runoff Area=17,434 sf 3.28% Impervious Runoff Depth=2.98"
Flow Length=577' Tc=6.0 min CN=80 Runoff=2.10 cfs 0.099 af

Pond 3P: MLV PAD Peak Elev=799.26' Storage=468 cf Inflow=0.84 cfs 0.044 af
Outflow=0.84 cfs 0.033 af

Pond 20P: VCD Peak Elev=800.85' Storage=2,943 cf Inflow=2.27 cfs 0.198 af
12.0" Round Culvert n=0.011 L=30.0' S=0.0100 '/' Outflow=1.96 cfs 0.152 af

Pond 110P: VCI Peak Elev=799.23' Storage=1,610 cf Inflow=2.10 cfs 0.252 af
Outflow=2.20 cfs 0.214 af

Link 5L: Proposed Conditions Inflow=4.61 cfs 0.452 af
Primary=4.61 cfs 0.452 af

Total Runoff Area = 2.569 ac Runoff Volume = 0.545 af Average Runoff Depth = 2.55"
89.04% Pervious = 2.288 ac 10.96% Impervious = 0.282 ac

Summary for Subcatchment 4S: OFFSITE DA

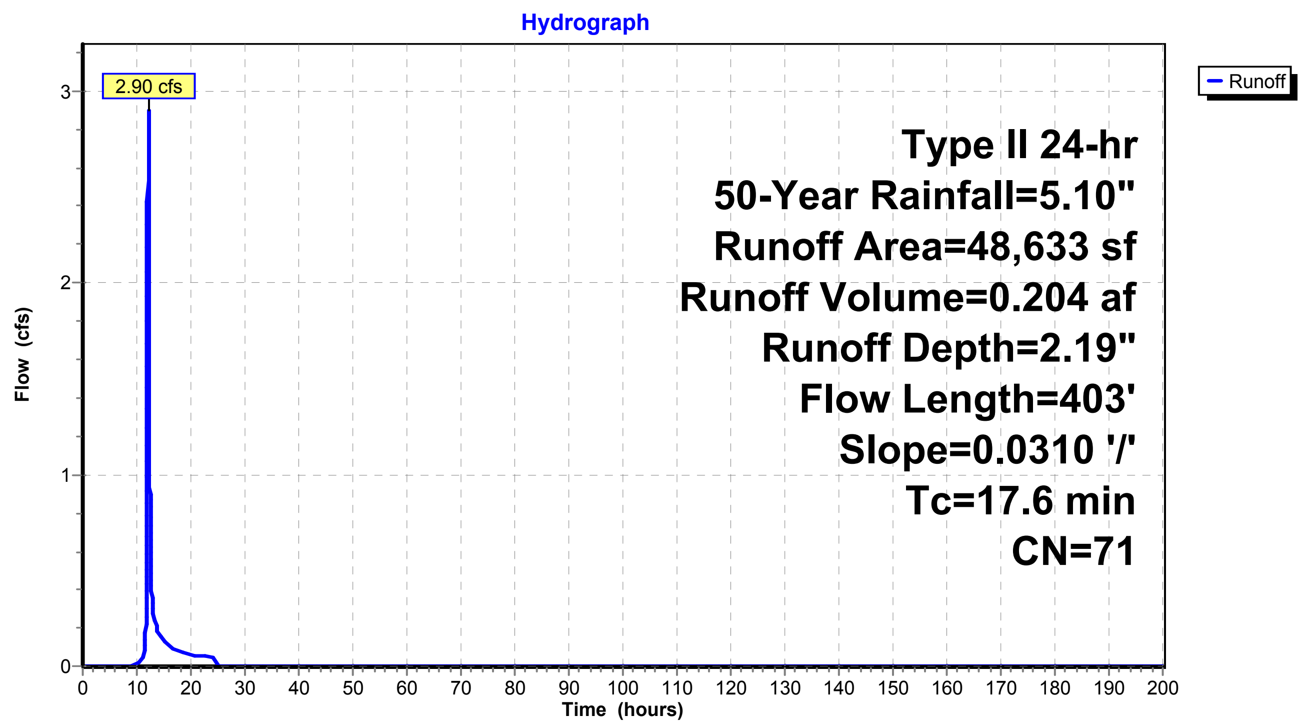
Runoff = 2.90 cfs @ 12.10 hrs, Volume= 0.204 af, Depth= 2.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs
Type II 24-hr 50-Year Rainfall=5.10"

	Area (sf)	CN	Description
	0	98	Paved parking, HSG C
	0	89	Gravel roads, HSG C
*	0	98	Crushed Stone Pad, HSG C
	0	70	Woods, Good, HSG C
	48,633	71	Meadow, non-grazed, HSG C
	48,633	71	Weighted Average
	48,633		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	100	0.0310	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.51"
4.1	303	0.0310	1.23		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
17.6	403	Total			

Subcatchment 4S: OFFSITE DA



Summary for Subcatchment 7S: DA TO MLV PAD

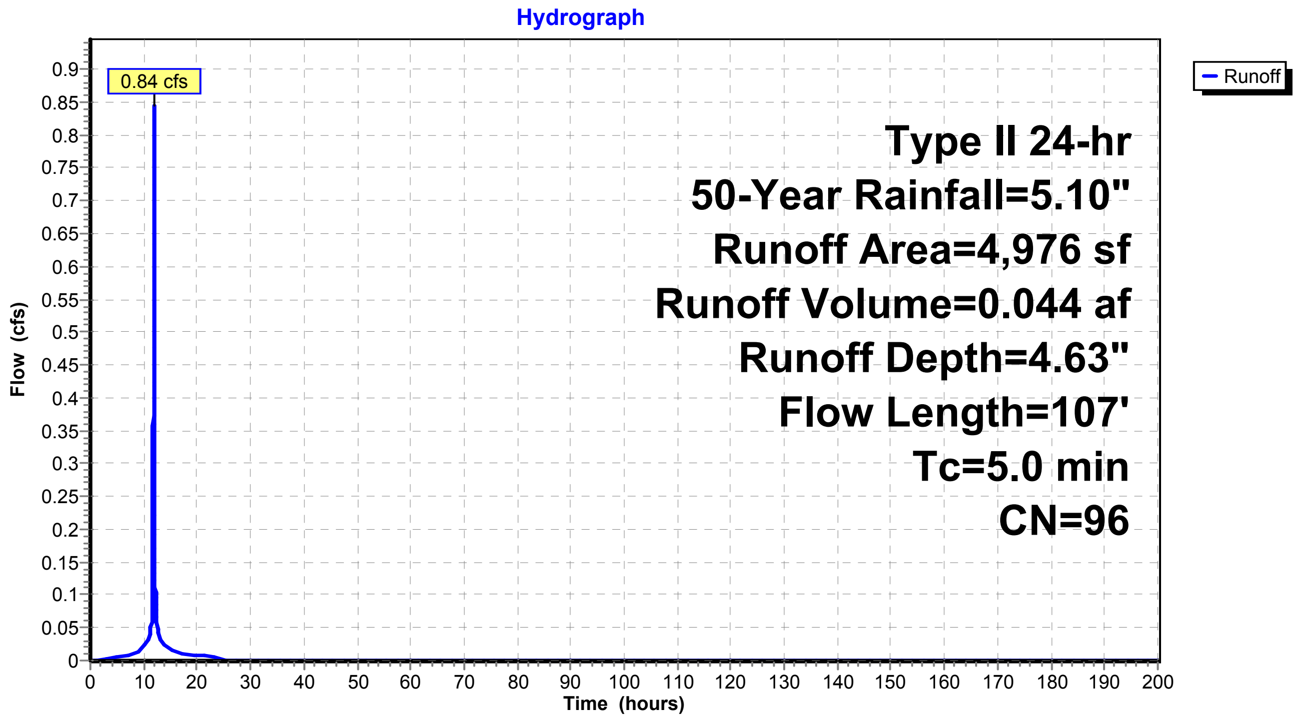
Runoff = 0.84 cfs @ 11.96 hrs, Volume= 0.044 af, Depth= 4.63"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs
Type II 24-hr 50-Year Rainfall=5.10"

	Area (sf)	CN	Description
	0	98	Paved parking, HSG C
	0	89	Gravel roads, HSG C
*	4,680	98	Crushed Stone Pad, HSG C
	0	70	Woods, Good, HSG C
	296	71	Meadow, non-grazed, HSG C
	4,976	96	Weighted Average
	296		5.95% Pervious Area
	4,680		94.05% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.2	17	0.0870	0.13		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.51"
1.2	83	0.0200	1.17		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.51"
0.1	7	0.0200	2.28		**Shallow Concentrated Flow, SC1** Unpaved Kv= 16.1 fps
3.5	107	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 7S: DA TO MLV PAD



Summary for Subcatchment 19S: DA TO VCD

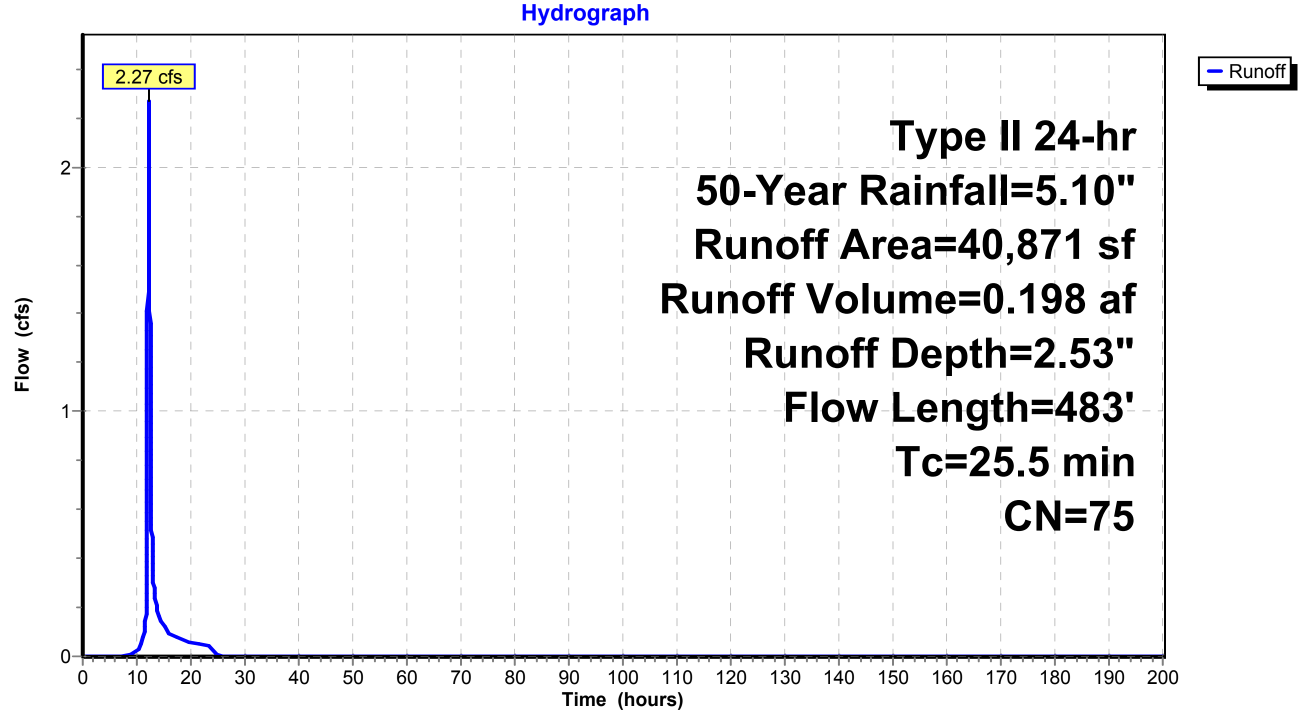
Runoff = 2.27 cfs @ 12.19 hrs, Volume= 0.198 af, Depth= 2.53"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs
Type II 24-hr 50-Year Rainfall=5.10"

	Area (sf)	CN	Description
	7,017	98	Paved parking, HSG C
	0	89	Gravel roads, HSG C
*	0	98	Crushed Stone Pad, HSG C
	9,681	70	Woods, Good, HSG C
	24,173	71	Meadow, non-grazed, HSG C
	40,871	75	Weighted Average
	33,854		82.83% Pervious Area
	7,017		17.17% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	17	0.0450	1.18		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.51"
1.5	8	0.0450	0.09		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.51"
15.5	43	0.0450	0.05		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.51"
4.9	32	0.0400	0.11		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.51"
0.2	17	0.0540	1.63		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
0.1	40	0.0540	4.72		**Shallow Concentrated Flow, SC2** Paved Kv= 20.3 fps
0.7	65	0.0540	1.63		**Shallow Concentrated Flow, SC3** Short Grass Pasture Kv= 7.0 fps
1.2	167	0.0250	2.37		**Shallow Concentrated Flow, SC4** Grassed Waterway Kv= 15.0 fps
1.2	94	0.0075	1.30		**Shallow Concentrated Flow, SC5** Grassed Waterway Kv= 15.0 fps
25.5	483	Total			

Subcatchment 19S: DA TO VCD



Summary for Subcatchment 111S: DA TO VCI

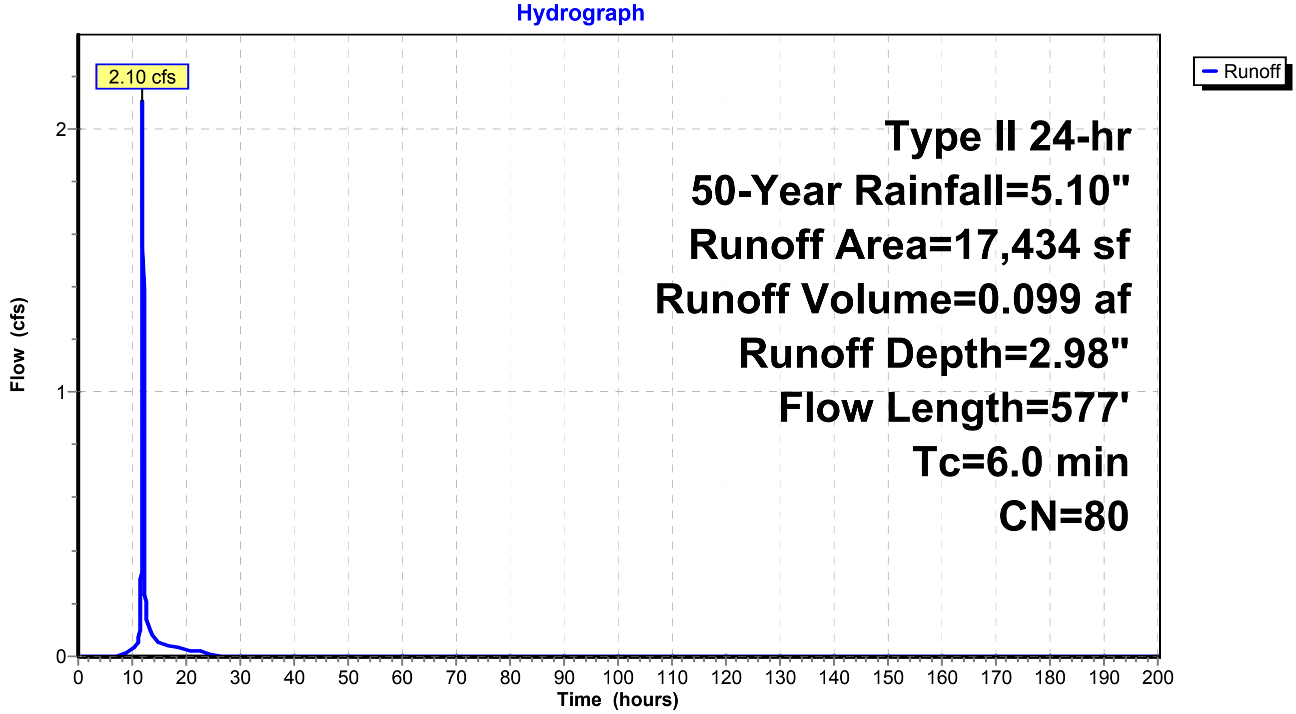
Runoff = 2.10 cfs @ 11.97 hrs, Volume= 0.099 af, Depth= 2.98"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs
Type II 24-hr 50-Year Rainfall=5.10"

	Area (sf)	CN	Description
	571	98	Paved parking, HSG C
	7,463	89	Gravel roads, HSG C
*	0	98	Crushed Stone Pad, HSG C
	0	70	Woods, Good, HSG C
	9,400	71	Meadow, non-grazed, HSG C
	17,434	80	Weighted Average
	16,863		96.72% Pervious Area
	571		3.28% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	55	0.0320	1.30		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.51"
0.5	5	0.3300	0.17		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.51"
2.0	158	0.0075	1.30		**Shallow Concentrated Flow, SC1** Grassed Waterway Kv= 15.0 fps
1.0	145	0.0250	2.37		**Shallow Concentrated Flow, SC2** Grassed Waterway Kv= 15.0 fps
1.8	214	0.0180	2.01		**Shallow Concentrated Flow, SC3** Grassed Waterway Kv= 15.0 fps
6.0	577	Total			

Subcatchment 111S: DA TO VCI



Summary for Pond 3P: MLV PAD

Inflow Area = 0.114 ac, 94.05% Impervious, Inflow Depth = 4.63" for 50-Year event
Inflow = 0.84 cfs @ 11.96 hrs, Volume= 0.044 af
Outflow = 0.84 cfs @ 11.96 hrs, Volume= 0.033 af, Atten= 0%, Lag= 0.0 min
Primary = 0.84 cfs @ 11.96 hrs, Volume= 0.033 af

Routing by Stor-Ind method, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs / 6
Peak Elev= 799.26' @ 11.96 hrs Surf.Area= 0 sf Storage= 468 cf

Plug-Flow detention time= 152.9 min calculated for 0.033 af (76% of inflow)
Center-of-Mass det. time= 64.8 min (822.0 - 757.2)

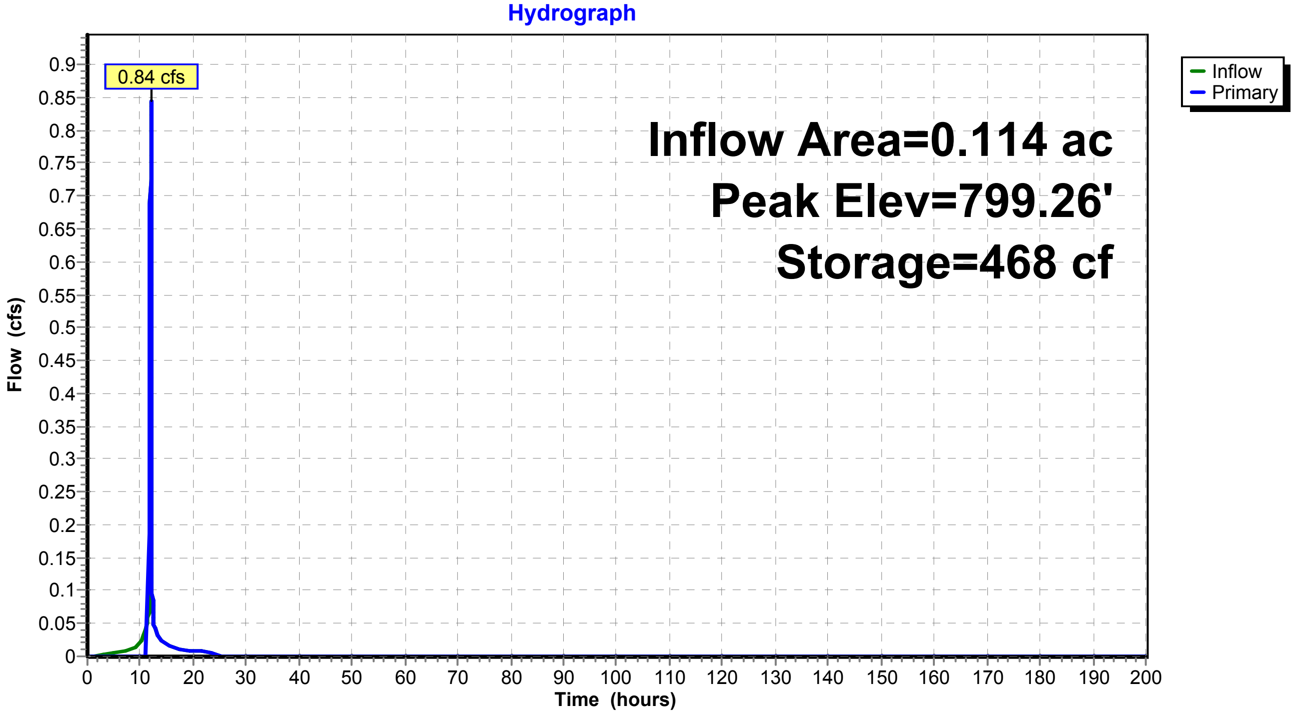
Volume	Invert	Avail.Storage	Storage Description
#1	798.22'	469 cf	**Stone Pad Void Storage**Listed below 1,172 cf Overall x 40.0% Voids

Elevation (feet)	Cum.Store (cubic-feet)
798.22	0
798.72	586
799.22	1,171
799.50	1,172

Device	Routing	Invert	Outlet Devices
#1	Primary	799.22'	**52.0' long x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=0.84 cfs @ 11.96 hrs HW=799.26' (Free Discharge)
└**1=Broad-Crested Rectangular Weir**(Weir Controls 0.84 cfs @ 0.46 fps)

Pond 3P: MLV PAD



Summary for Pond 20P: VCD

Inflow Area = 0.938 ac, 17.17% Impervious, Inflow Depth = 2.53" for 50-Year event
Inflow = 2.27 cfs @ 12.19 hrs, Volume= 0.198 af
Outflow = 1.96 cfs @ 12.32 hrs, Volume= 0.152 af, Atten= 14%, Lag= 7.8 min
Primary = 1.96 cfs @ 12.32 hrs, Volume= 0.152 af

Routing by Stor-Ind method, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs / 8
Peak Elev= 800.85' @ 12.32 hrs Surf.Area= 0 sf Storage= 2,943 cf

Plug-Flow detention time= 176.7 min calculated for 0.152 af (77% of inflow)
Center-of-Mass det. time= 85.3 min (934.1 - 848.8)

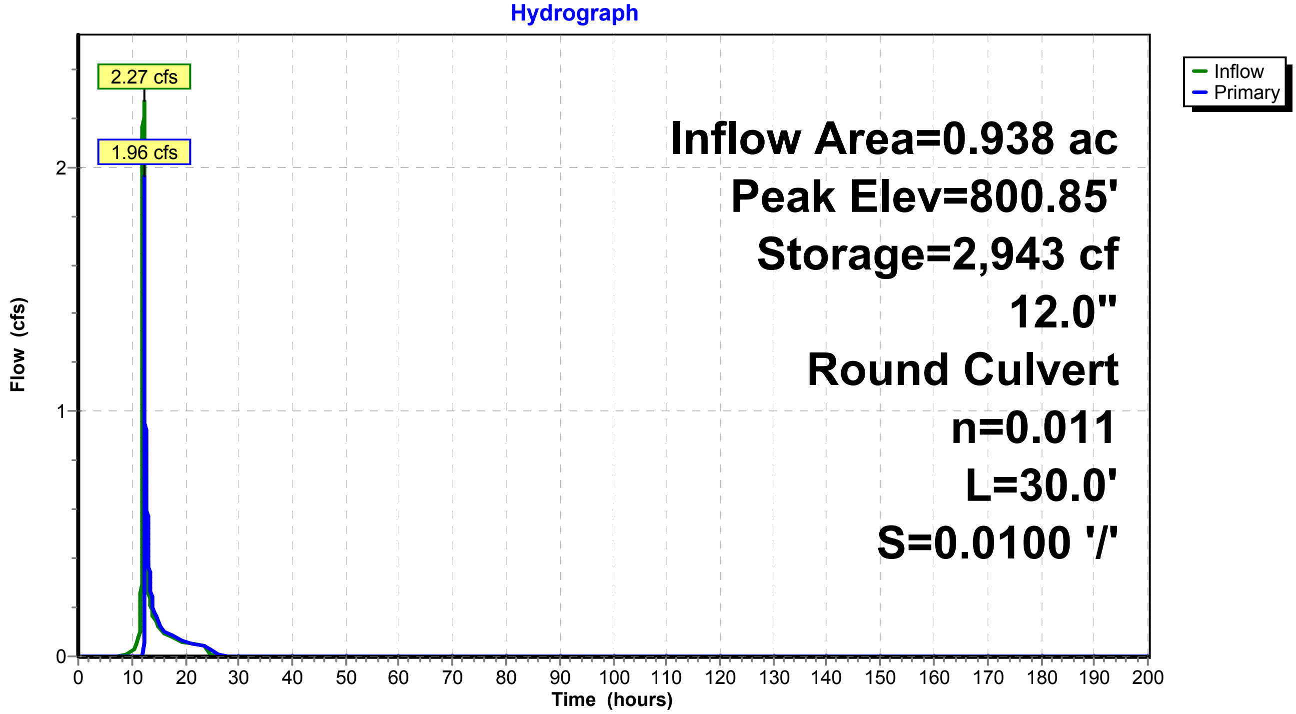
Volume	Invert	Avail.Storage	Storage Description
#1	799.00'	2,943 cf	**Custom Stage Data**Listed below

Elevation (feet)	Cum.Store (cubic-feet)
799.00	0
799.50	981
800.00	1,961
800.50	2,942
801.00	2,943

Device	Routing	Invert	Outlet Devices
#1	Primary	800.00'	**12.0" Round RCP_Round 12"** L= 30.0' RCP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 800.00' / 799.70' S= 0.0100 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Primary OutFlow Max=1.83 cfs @ 12.32 hrs HW=800.81' (Free Discharge)
└—**1=RCP_Round 12"** (Inlet Controls 1.83 cfs @ 2.70 fps)

Pond 20P: VCD


Hydrograph
2.27 cfs
1.96 cfs
Inflow
Primary
Inflow Area=0.938 ac
Peak Elev=800.85'
Storage=2,943 cf
12.0"
Round Culvert
n=0.011
L=30.0'
S=0.0100 '/'
Flow (cfs)
0
1
2
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200
Time (hours)

Summary for Pond 110P: VCI

Inflow Area = 1.338 ac, 13.01% Impervious, Inflow Depth = 2.26" for 50-Year event
Inflow = 2.10 cfs @ 11.97 hrs, Volume= 0.252 af
Outflow = 2.20 cfs @ 12.32 hrs, Volume= 0.214 af, Atten= 0%, Lag= 21.1 min
Primary = 2.20 cfs @ 12.32 hrs, Volume= 0.214 af

Routing by Stor-Ind method, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs / 8
Peak Elev= 799.23' @ 12.32 hrs Surf.Area= 0 sf Storage= 1,610 cf

Plug-Flow detention time= 112.8 min calculated for 0.214 af (85% of inflow)
Center-of-Mass det. time= 34.0 min (922.3 - 888.2)

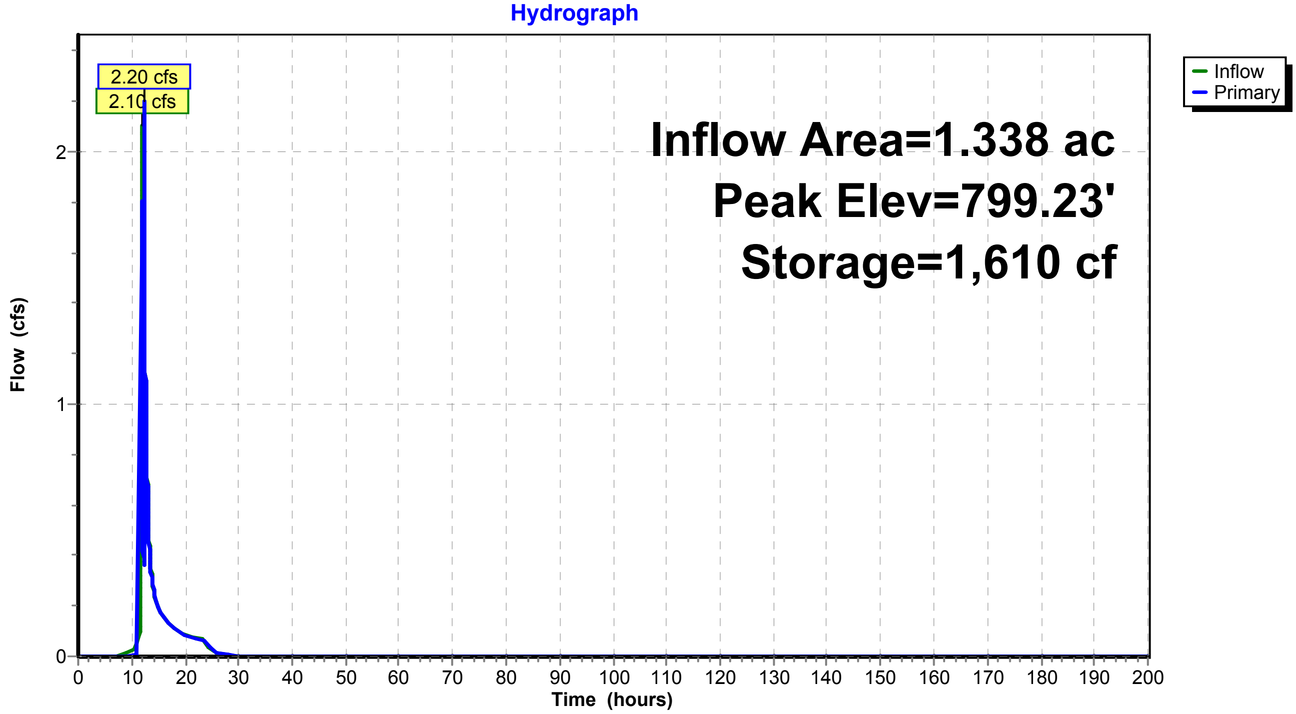
Volume	Invert	Avail.Storage	Storage Description
#1	798.00'	1,611 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
798.00	0
798.50	805
799.00	1,610
799.50	1,611

Device	Routing	Invert	Outlet Devices
#1	Primary	799.00'	**8.0' long x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=2.07 cfs @ 12.32 hrs HW=799.22' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Weir Controls 2.07 cfs @ 1.16 fps)

Pond 110P: VCI

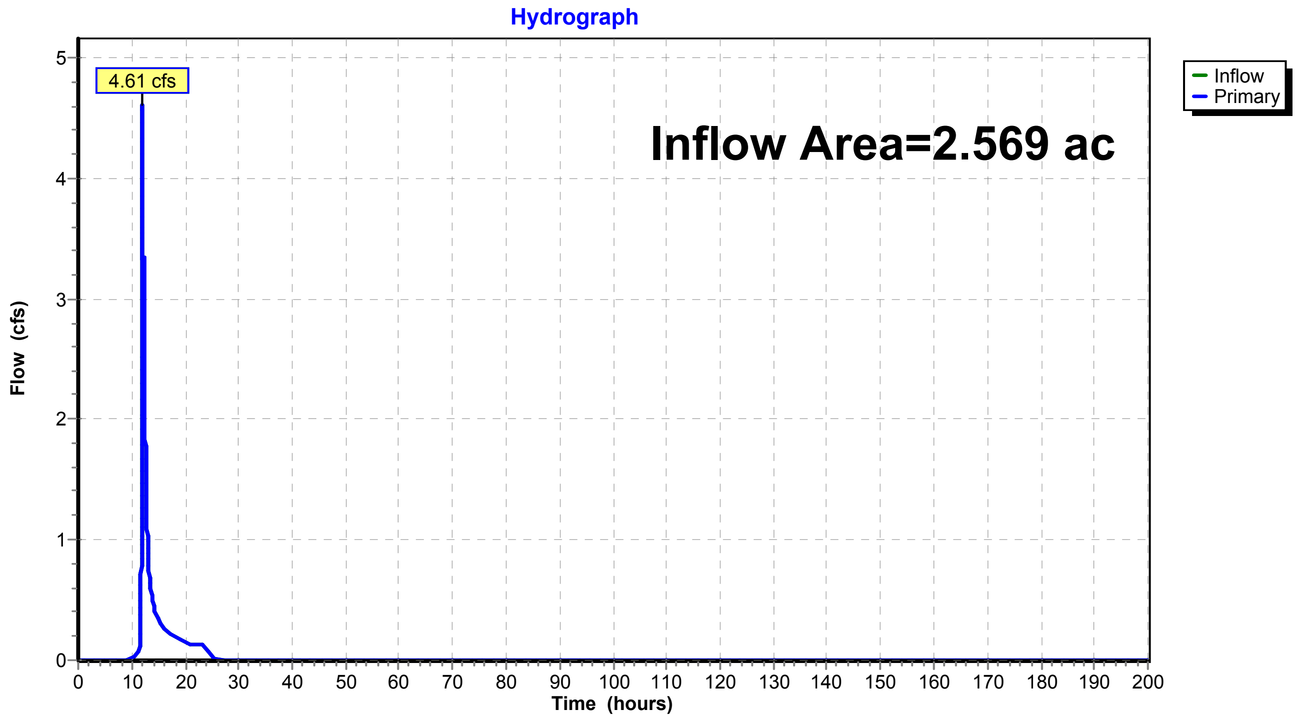


Summary for Link 5L: Proposed Conditions

Inflow Area = 2.569 ac, 10.96% Impervious, Inflow Depth = 2.11" for 50-Year event
Inflow = 4.61 cfs @ 12.01 hrs, Volume= 0.452 af
Primary = 4.61 cfs @ 12.01 hrs, Volume= 0.452 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs

Link 5L: Proposed Conditions



Time span=0.00-200.00 hrs, dt=0.01 hrs, 20001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment4S: OFFSITE DA Runoff Area=48,633 sf 0.00% Impervious Runoff Depth=2.83"
Flow Length=403' Slope=0.0310 '/' Tc=17.6 min CN=71 Runoff=3.77 cfs 0.264 af

Subcatchment7S: DA TO MLV PAD Runoff Area=4,976 sf 94.05% Impervious Runoff Depth=5.45"
Flow Length=107' Tc=5.0 min CN=96 Runoff=0.98 cfs 0.052 af

Subcatchment19S: DA TO VCD Runoff Area=40,871 sf 17.17% Impervious Runoff Depth=3.21"
Flow Length=483' Tc=25.5 min CN=75 Runoff=2.90 cfs 0.251 af

Subcatchment111S: DA TO VCI Runoff Area=17,434 sf 3.28% Impervious Runoff Depth=3.71"
Flow Length=577' Tc=6.0 min CN=80 Runoff=2.60 cfs 0.124 af

Pond 3P: MLV PAD Peak Elev=799.26' Storage=468 cf Inflow=0.98 cfs 0.052 af
Outflow=0.98 cfs 0.041 af

Pond 20P: VCD Peak Elev=801.00' Storage=2,943 cf Inflow=2.90 cfs 0.251 af
12.0" Round Culvert n=0.011 L=30.0' S=0.0100 '/' Outflow=2.36 cfs 0.203 af

Pond 110P: VCI Peak Elev=799.27' Storage=1,611 cf Inflow=2.72 cfs 0.327 af
Outflow=2.72 cfs 0.290 af

Link 5L: Proposed Conditions Inflow=5.98 cfs 0.594 af
Primary=5.98 cfs 0.594 af

Total Runoff Area = 2.569 ac Runoff Volume = 0.691 af Average Runoff Depth = 3.23"
89.04% Pervious = 2.288 ac 10.96% Impervious = 0.282 ac

Summary for Subcatchment 4S: OFFSITE DA

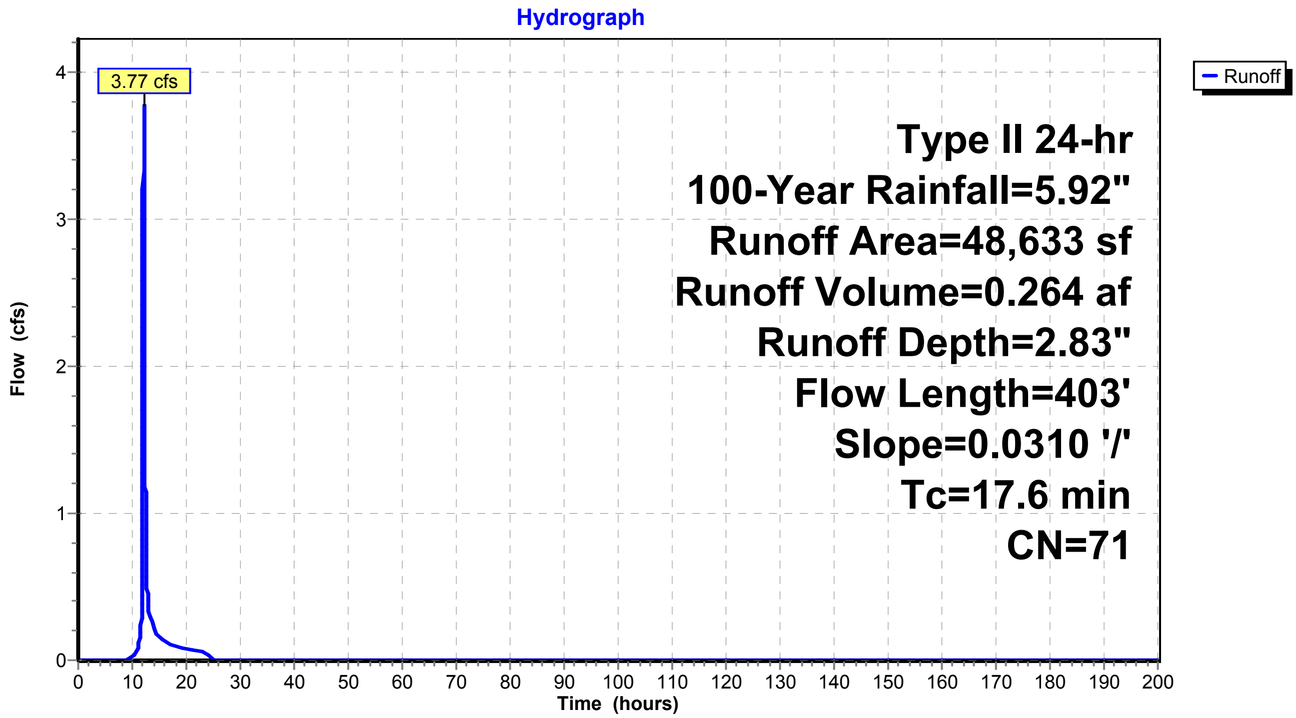
Runoff = 3.77 cfs @ 12.10 hrs, Volume= 0.264 af, Depth= 2.83"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Year Rainfall=5.92"

	Area (sf)	CN	Description
	0	98	Paved parking, HSG C
	0	89	Gravel roads, HSG C
*	0	98	Crushed Stone Pad, HSG C
	0	70	Woods, Good, HSG C
	48,633	71	Meadow, non-grazed, HSG C
	48,633	71	Weighted Average
	48,633		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	100	0.0310	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.51"
4.1	303	0.0310	1.23		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
17.6	403	Total			

Subcatchment 4S: OFFSITE DA



Summary for Subcatchment 7S: DA TO MLV PAD

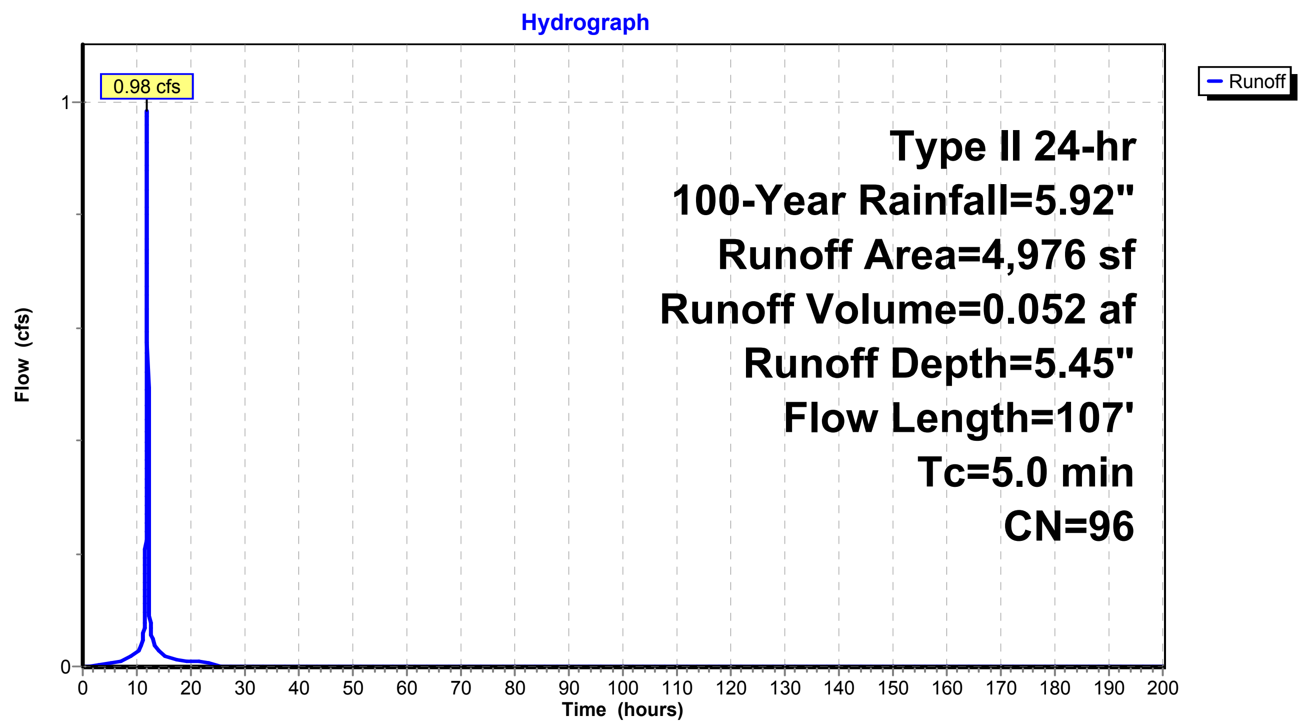
Runoff = 0.98 cfs @ 11.96 hrs, Volume= 0.052 af, Depth= 5.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Year Rainfall=5.92"

	Area (sf)	CN	Description
	0	98	Paved parking, HSG C
	0	89	Gravel roads, HSG C
*	4,680	98	Crushed Stone Pad, HSG C
	0	70	Woods, Good, HSG C
	296	71	Meadow, non-grazed, HSG C
	4,976	96	Weighted Average
	296		5.95% Pervious Area
	4,680		94.05% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.2	17	0.0870	0.13		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.51"
1.2	83	0.0200	1.17		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.51"
0.1	7	0.0200	2.28		**Shallow Concentrated Flow, SC1** Unpaved Kv= 16.1 fps
3.5	107	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 7S: DA TO MLV PAD



Summary for Subcatchment 19S: DA TO VCD

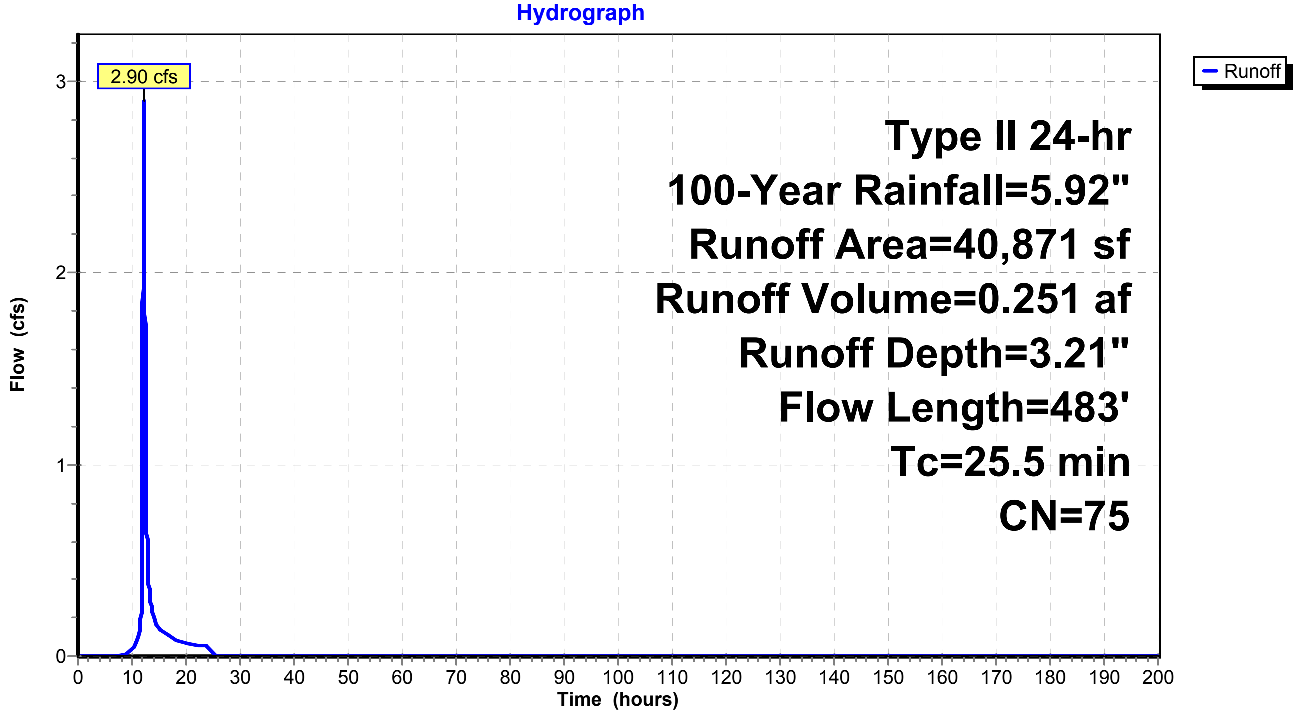
Runoff = 2.90 cfs @ 12.19 hrs, Volume= 0.251 af, Depth= 3.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Year Rainfall=5.92"

	Area (sf)	CN	Description
	7,017	98	Paved parking, HSG C
	0	89	Gravel roads, HSG C
*	0	98	Crushed Stone Pad, HSG C
	9,681	70	Woods, Good, HSG C
	24,173	71	Meadow, non-grazed, HSG C
	40,871	75	Weighted Average
	33,854		82.83% Pervious Area
	7,017		17.17% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	17	0.0450	1.18		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.51"
1.5	8	0.0450	0.09		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.51"
15.5	43	0.0450	0.05		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.51"
4.9	32	0.0400	0.11		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.51"
0.2	17	0.0540	1.63		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
0.1	40	0.0540	4.72		**Shallow Concentrated Flow, SC2** Paved Kv= 20.3 fps
0.7	65	0.0540	1.63		**Shallow Concentrated Flow, SC3** Short Grass Pasture Kv= 7.0 fps
1.2	167	0.0250	2.37		**Shallow Concentrated Flow, SC4** Grassed Waterway Kv= 15.0 fps
1.2	94	0.0075	1.30		**Shallow Concentrated Flow, SC5** Grassed Waterway Kv= 15.0 fps
25.5	483	Total			

Subcatchment 19S: DA TO VCD



Summary for Subcatchment 111S: DA TO VCI

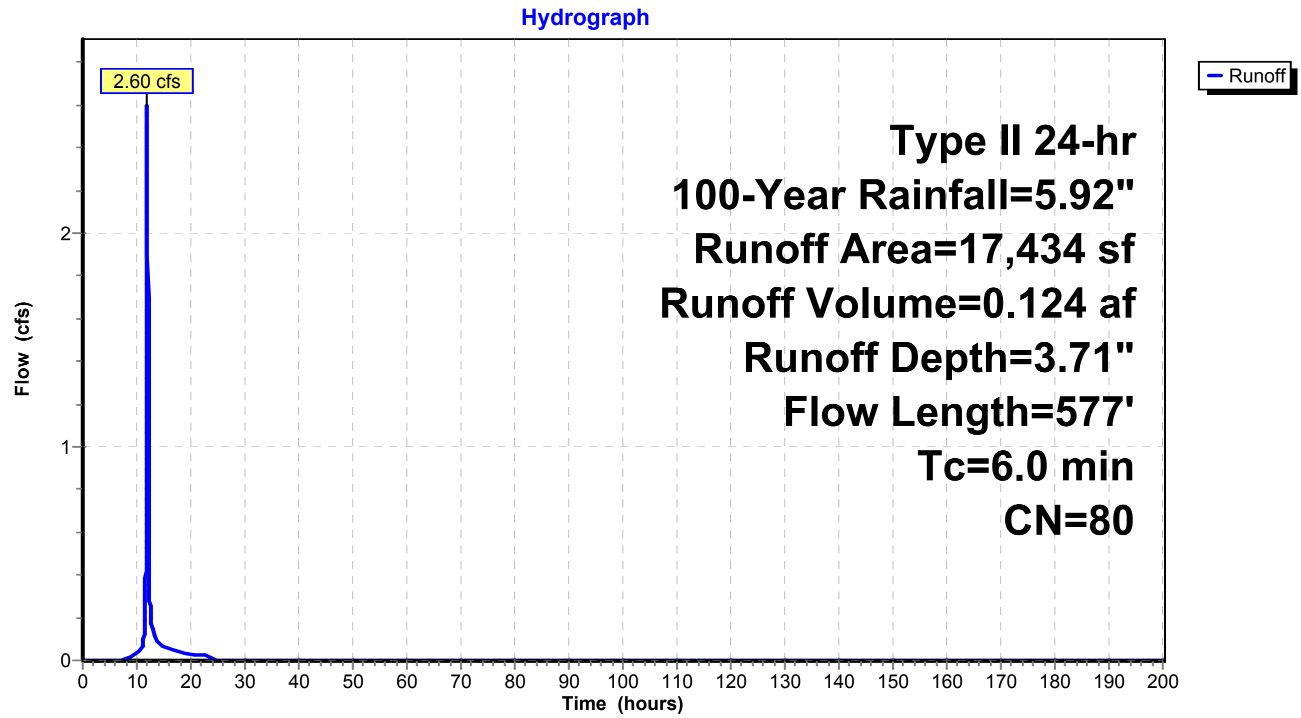
Runoff = 2.60 cfs @ 11.97 hrs, Volume= 0.124 af, Depth= 3.71"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Year Rainfall=5.92"

	Area (sf)	CN	Description
	571	98	Paved parking, HSG C
	7,463	89	Gravel roads, HSG C
*	0	98	Crushed Stone Pad, HSG C
	0	70	Woods, Good, HSG C
	9,400	71	Meadow, non-grazed, HSG C
	17,434	80	Weighted Average
	16,863		96.72% Pervious Area
	571		3.28% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	55	0.0320	1.30		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.51"
0.5	5	0.3300	0.17		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.51"
2.0	158	0.0075	1.30		**Shallow Concentrated Flow, SC1** Grassed Waterway Kv= 15.0 fps
1.0	145	0.0250	2.37		**Shallow Concentrated Flow, SC2** Grassed Waterway Kv= 15.0 fps
1.8	214	0.0180	2.01		**Shallow Concentrated Flow, SC3** Grassed Waterway Kv= 15.0 fps
6.0	577	Total			

Subcatchment 111S: DA TO VCI



Summary for Pond 3P: MLV PAD

Inflow Area = 0.114 ac, 94.05% Impervious, Inflow Depth = 5.45" for 100-Year event
Inflow = 0.98 cfs @ 11.96 hrs, Volume= 0.052 af
Outflow = 0.98 cfs @ 11.96 hrs, Volume= 0.041 af, Atten= 0%, Lag= 0.0 min
Primary = 0.98 cfs @ 11.96 hrs, Volume= 0.041 af

Routing by Stor-Ind method, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs / 6
Peak Elev= 799.26' @ 11.96 hrs Surf.Area= 0 sf Storage= 468 cf

Plug-Flow detention time= 143.5 min calculated for 0.041 af (79% of inflow)
Center-of-Mass det. time= 61.3 min (815.0 - 753.7)

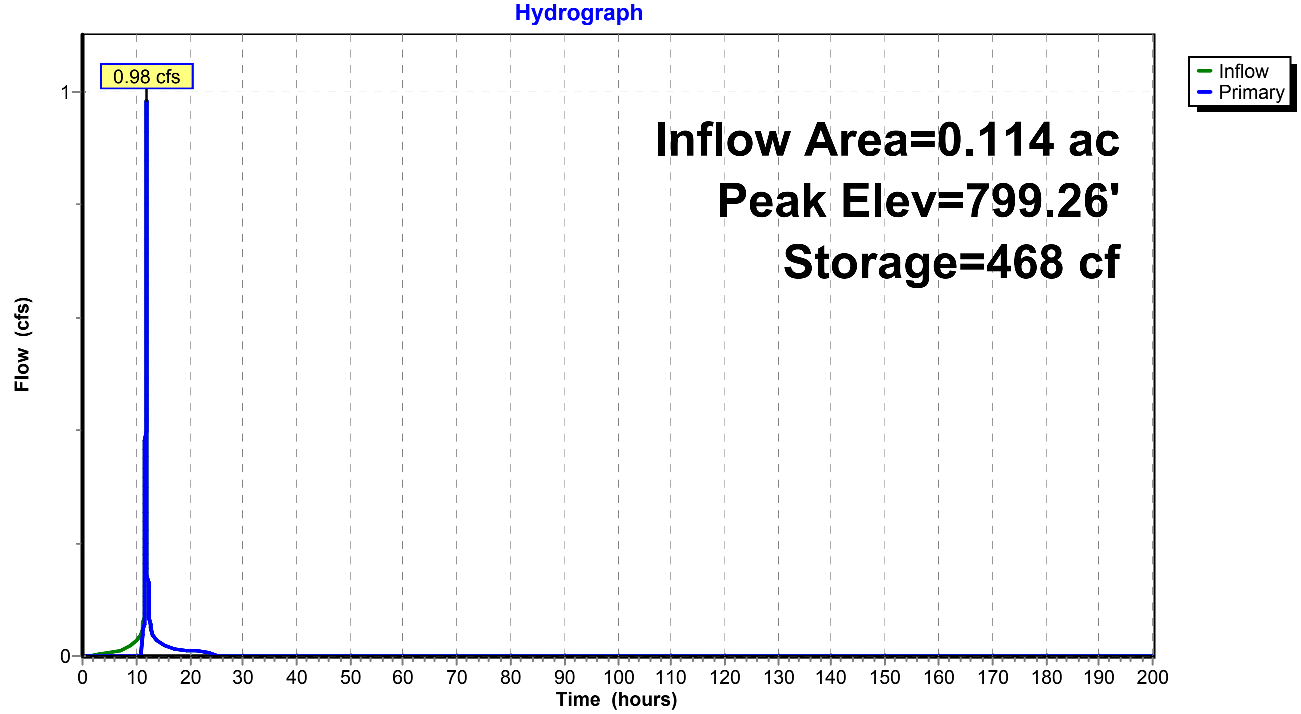
Volume	Invert	Avail.Storage	Storage Description
#1	798.22'	469 cf	**Stone Pad Void Storage** Listed below 1,172 cf Overall x 40.0% Voids

Elevation (feet)	Cum.Store (cubic-feet)
798.22	0
798.72	586
799.22	1,171
799.50	1,172

Device	Routing	Invert	Outlet Devices
#1	Primary	799.22'	**52.0' long x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=0.98 cfs @ 11.96 hrs HW=799.26' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Weir Controls 0.98 cfs @ 0.48 fps)

Pond 3P: MLV PAD



Summary for Pond 20P: VCD

Inflow Area = 0.938 ac, 17.17% Impervious, Inflow Depth = 3.21" for 100-Year event
Inflow = 2.90 cfs @ 12.19 hrs, Volume= 0.251 af
Outflow = 2.36 cfs @ 12.21 hrs, Volume= 0.203 af, Atten= 19%, Lag= 1.2 min
Primary = 2.36 cfs @ 12.21 hrs, Volume= 0.203 af

Routing by Stor-Ind method, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs / 8
Peak Elev= 801.00' @ 12.21 hrs Surf.Area= 0 sf Storage= 2,943 cf

Plug-Flow detention time= 152.4 min calculated for 0.203 af (81% of inflow)
Center-of-Mass det. time= 70.5 min (912.4 - 842.0)

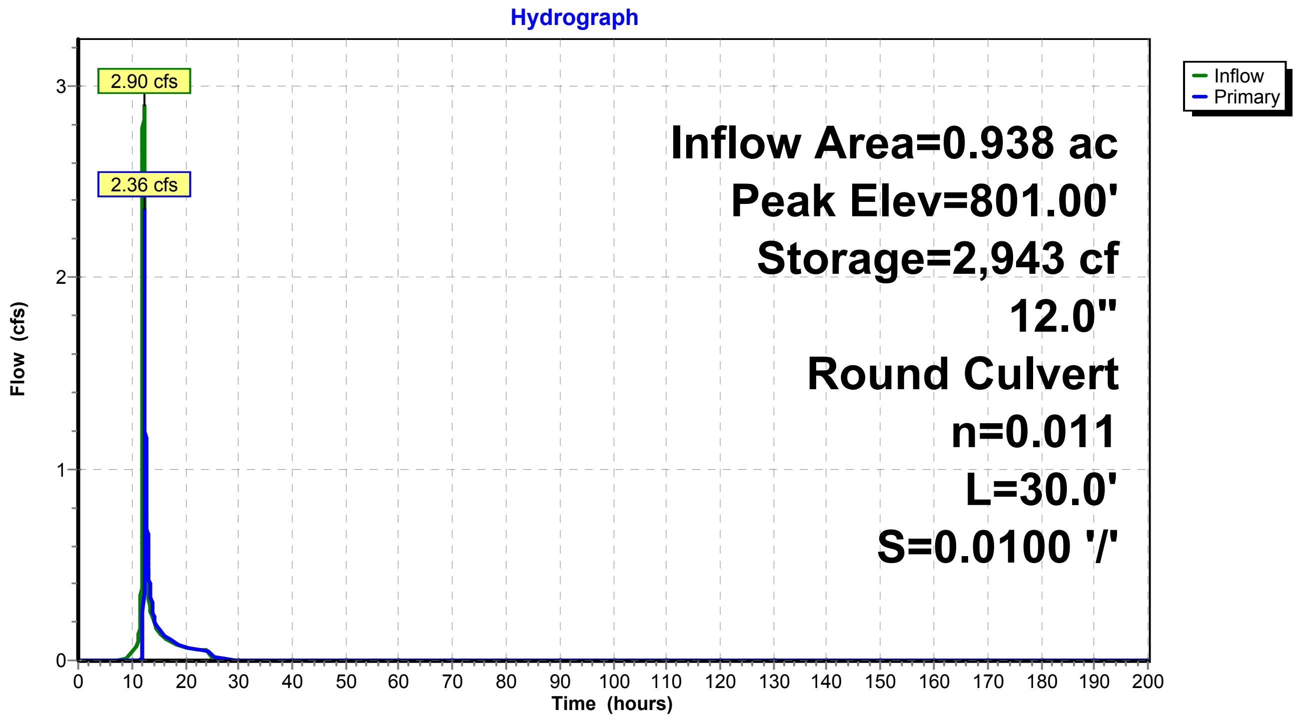
Volume	Invert	Avail.Storage	Storage Description
#1	799.00'	2,943 cf	**Custom Stage Data**Listed below

Elevation (feet)	Cum.Store (cubic-feet)
799.00	0
799.50	981
800.00	1,961
800.50	2,942
801.00	2,943

Device	Routing	Invert	Outlet Devices
#1	Primary	800.00'	**12.0" Round RCP_Round 12"** L= 30.0' RCP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 800.00' / 799.70' S= 0.0100 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Primary OutFlow Max=2.36 cfs @ 12.21 hrs HW=801.00' (Free Discharge)
└─**1=RCP_Round 12"** (Inlet Controls 2.36 cfs @ 3.00 fps)

Pond 20P: VCD


Hydrograph
2.90 cfs
2.36 cfs
Inflow
Primary
Inflow Area=0.938 ac
Peak Elev=801.00'
Storage=2,943 cf
12.0"
Round Culvert
n=0.011
L=30.0'
S=0.0100 '/'
Flow (cfs)
Time (hours)
0
1
2
3
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200

Summary for Pond 110P: VCI

Inflow Area = 1.338 ac, 13.01% Impervious, Inflow Depth = 2.93" for 100-Year event
Inflow = 2.72 cfs @ 12.21 hrs, Volume= 0.327 af
Outflow = 2.72 cfs @ 12.21 hrs, Volume= 0.290 af, Atten= 0%, Lag= 0.0 min
Primary = 2.72 cfs @ 12.21 hrs, Volume= 0.290 af

Routing by Stor-Ind method, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs / 8
Peak Elev= 799.27' @ 12.21 hrs Surf.Area= 0 sf Storage= 1,611 cf

Plug-Flow detention time= 87.6 min calculated for 0.290 af (89% of inflow)
Center-of-Mass det. time= 24.6 min (898.9 - 874.2)

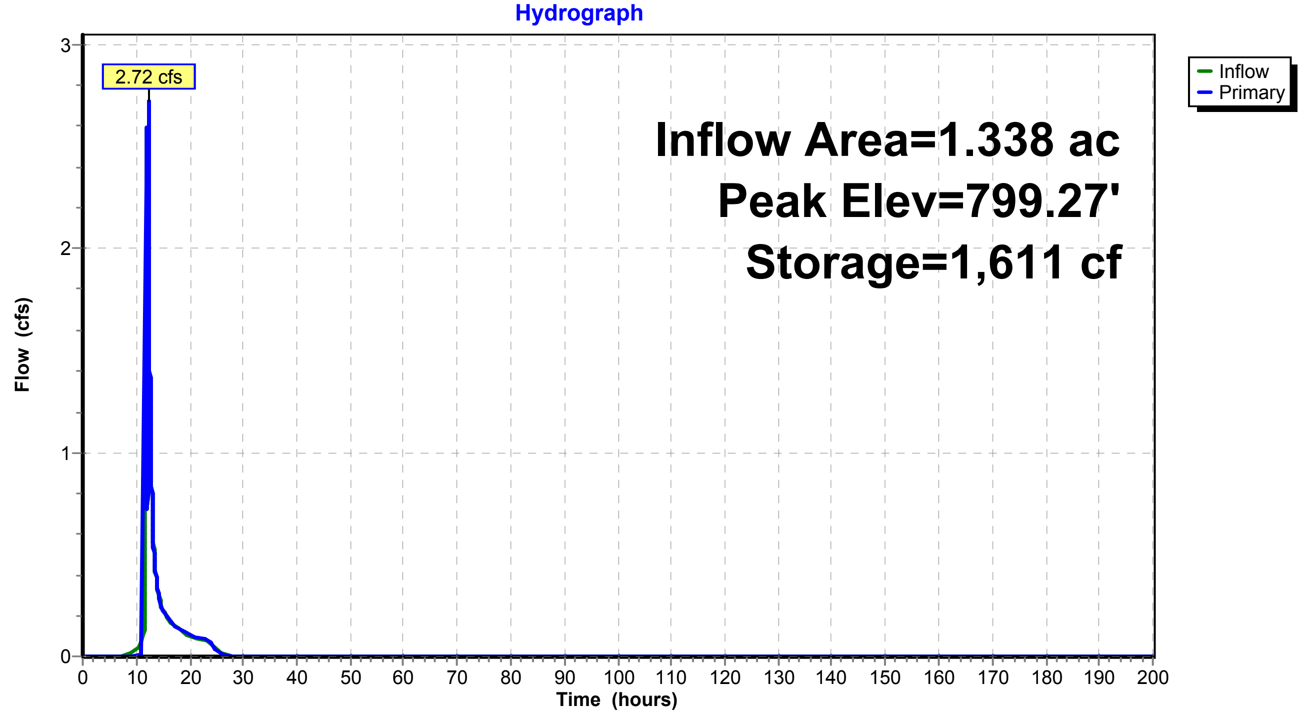
Volume	Invert	Avail.Storage	Storage Description
#1	798.00'	1,611 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
798.00	0
798.50	805
799.00	1,610
799.50	1,611

Device	Routing	Invert	Outlet Devices
#1	Primary	799.00'	**8.0' long x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=2.72 cfs @ 12.21 hrs HW=799.27' (Free Discharge)
└—**1=Broad-Crested Rectangular Weir** (Weir Controls 2.72 cfs @ 1.28 fps)

Pond 110P: VCI

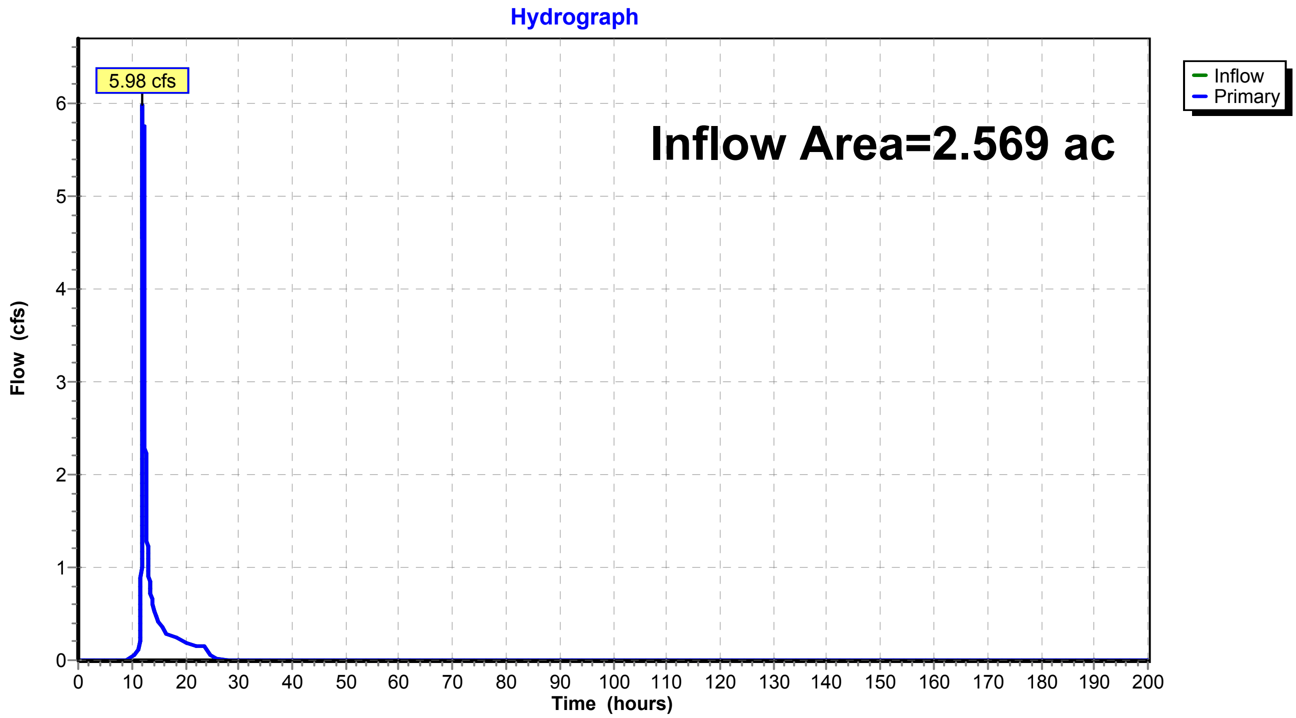


Summary for Link 5L: Proposed Conditions

Inflow Area =	2.569 ac, 10.96% Impervious, Inflow Depth = 2.78"		for 100-Year event
Inflow =	5.98 cfs @ 11.99 hrs, Volume=	0.594 af	
Primary =	5.98 cfs @ 11.99 hrs, Volume=	0.594 af, Atten= 0%, Lag= 0.0 min	

Primary outflow = Inflow, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs

Link 5L: Proposed Conditions



K.5 Conveyance Calculations

a. E&S Worksheet 11
b. NAG Swale Lining Analysis
c. Figure 9.3-Riprap Apron Design

E&S WORKSHEET # 11
Channel Design Data

PROJECT NAME: Atlantic Sunrise Project - Central Penn Line North

LOCATION: AR-WY-028-Vegetated Channel for Infiltration (VCI)

PREPARED BY: JMS ***REVISED BY: JMS*** DATE: 9/28/15 ***REV 09/29/16***

CHECKED BY: BJP ***CHECKED BY: SK*** DATE: 9/28/15 ***REV 09/29/16***

CHANNEL OR CHANNEL SECTION		AR-WY-028 VCI	AR-WY-028 VCI
TEMPORARY OR PERMANENT?	(T OR P)	P	P
DESIGN STORM	(2, 5, OR 10 YR)	10	10
ACRES	(AC)	0.4	0.4
MULTIPLIER[1]	(1.6, 2.25, or 2.75)[1]	N/A	N/A
Qr (REQUIRED CAPACITY)	(CFS)	1.23	1.23
Q (CALCULATED AT FLOW DEPTH d)	(CFS)	1.20	1.23
PROTECTIVE LINING[2]		SC250	SC250 REINFORCED VEGETATION
n (MANNING'S COEFFICIENT)[2]		0.04	0.21
Va (ALLOWABLE VELOCITY)	(FPS)	N/A	N/A
V (CALCULATED AT FLOW DEPTH d)	(FPS)	1.46	0.48
τa (MAX ALLOWABLE SHEAR STRESS)	(LB/FT^2)	2.50	8.00
τd (CALC'D SHEAR STRESS AT FLOW DEPTH d)	(LB/FT^2)	0.20	0.53
CHANNEL BOTTOM WIDTH	(FT)	4	4
CHANNEL SIDE SLOPES	(H:V)	3	3
D (TOTAL DEPTH)	(FT)	1.5	1.5
CHANNEL TOP WIDTH @ D	(FT)	13	13
d (CALCULATED FLOW DEPTH)	(FT)	0.18	0.47
CHANNEL TOP WIDTH @ FLOW DEPTH d	(FT)	5.08	6.82
BOTTOM WIDTH: FLOW DEPTH RATIO	(12:1 MAX)	22.22	8.51
d50 STONE SIZE	(IN)	N/A	N/A
A (CROSS-SECTIONAL AREA)	(SQ. FT.)	0.82	2.54
R (HYDRAULIC RADIUS)		0.16	0.36
S (BED SLOPE)[3]	(FT/FT)	0.018	0.018
Sc (CRITICAL SLOPE)	(FT/FT)	0.043	0.919
.7Sc	(FT/FT)	0.030	0.643
1.3Sc	(FT/FT)	0.057	1.194
STABLE FLOW?	(Y/N)	Y	Y
FREEBOARD BASED ON UNSTABLE FLOW	(FT)	0.02	0.0
FREEBOARD BASED ON STABLE FLOW	(FT)	0.50	0.5
MINIMUM REQUIRED FREEBOARD[4]	(FT)	0.50	0.5
DESIGN METHOD FOR PROTECTIVE LINING [5] PERMISSIBLE VELOCITY (V) OR SHEAR STRESS	(S)	S	S

EQUIVALENT PIPE CALCULATION:

Q	n	s (ft/ft)	D (ft.)	D (in)	Round up to:
1.23	0.013	0.018	0.601	7.206	**12" pipe**

D = ((Q*n/(S^(1/2)*Pi*0.1478))^3/8)

Pipe Equivalence Calculation for Sizing Rip Rap Apron:
Use Manning's Equation
Q = (1.49/n)*A*(R^2/3)*(S^1/2)

Q = Flow Rate from Worksheet 11 (cfs)
n = Manning's Constant for Smooth Plastic Pipe = 0.013 (unitless)
A = Area of Pipe (ft) = 0.25 * Pi * D^2
D = Diameter of Pipe (ft)
R = Hydraulic Radius = A / P = (0.25 * Pi * D^2) / (Pi * D) = 0.25 * D
P = Perimeter of Pipe (ft) = Pi * D
S = Slope of channel from Worksheet 11 (ft/ft)

Solve Manning's Equation for Diameter of Pipe:
Q = (1.49/n)*A*(R^2/3)*(S^1/2)
Q = (1.49/n)*(0.25*Pi*D^2)*((0.25*D)^2/3)*(S^1/2)
Q*n*/(1.49*S^(1/2))=(0.25*Pi*D^2)*((0.25*D)^2/3)
Q*n*/(1.49*S^(1/2)*0.25*(0.25^2/3))=(Pi*D^2)*(D^2/3)
Q*n*/(S^(1/2)*Pi*0.1478)=(D^2)*(D^2/3)
Q*n*/(S^(1/2)*Pi*0.1478)=(D^8/3)
(Q*n*/(S^(1/2)*Pi*0.1478))^3/8=D

Multiply by 12 to convert feet to inches:
D = ((Q*n/(S^(1/2)*Pi*0.1478))^3/8) * 12

1. Use 1.6 for Temporary Channels; 2.25 for Temporary Channels in Special Protection (HQ or EV) Watersheds; 2.75 for Permanent Channels. For Rational Method, enter "N/A" and attach E&S Worksheets 9 and 10. For TR-55 enter "N/A" and attach appropriate Worksheets.
2. Adjust "n" value for changes in channel liner and flow depth. For vegetated channels, provide data for manufactured linings without vegetation and with vegetation in separate columns.
3. Slopes may not be averaged.
4. Minimum Freeboard is 0.5 ft. or ¼ Total Channel Depth, whichever is greater
5. Permissible velocity lining design method is not acceptable for channels with a bed slope of 10% or greater. Shear stress lining design method is required for channels with a bed slope of 10% or greater. Shear stress lining design method may be used for any channel bed slope.

Source: 363-2134-008 / March 31, 2012 / Page 382

E&S WORKSHEET # 11
Channel Design Data

PROJECT NAME: Atlantic Sunrise Project - Central Penn Line North

LOCATION: AR-WY-028-Vegetated Channel for Diversion Purposes (VCD)

PREPARED BY: JMS ***REVISED BY: JMS*** DATE: 9/28/15 ***REV 09/29/16***

CHECKED BY: BJP ***CHECKED BY: SK*** DATE: 9/28/15 ***REV 09/29/16***

CHANNEL OR CHANNEL SECTION		AR-WY-028 VCD	AR-WY-028 VCD
TEMPORARY OR PERMANENT?	(T OR P)	P	P
DESIGN STORM	(2, 5, OR 10 YR)	10	10
ACRES	(AC)	0.94	0.94
MULTIPLIER[1]	(1.6, 2.25, or 2.75)[1]	N/A	N/A
Qr (REQUIRED CAPACITY)	(CFS)	1.20	1.20
Q (CALCULATED AT FLOW DEPTH d)	(CFS)	1.18	1.20
PROTECTIVE LINING[2]		SC250	SC250 REINFORCED VEGETATION
n (MANNING'S COEFFICIENT)[2]		0.04	0.232
Va (ALLOWABLE VELOCITY)	(FPS)	N/A	N/A
V (CALCULATED AT FLOW DEPTH d)	(FPS)	1.09	0.33
τa (MAX ALLOWABLE SHEAR STRESS)	(LB/FT^2)	2.50	8.00
τd (CALC'D SHEAR STRESS AT FLOW DEPTH d)	(LB/FT^2)	0.11	0.29
CHANNEL BOTTOM WIDTH	(FT)	4	4
CHANNEL SIDE SLOPES	(H:V)	3	3
D (TOTAL DEPTH)	(FT)	1.5	1.5
CHANNEL TOP WIDTH @ D	(FT)	13	13
d (CALCULATED FLOW DEPTH)	(FT)	0.23	0.62
CHANNEL TOP WIDTH @ FLOW DEPTH d	(FT)	5.38	7.72
BOTTOM WIDTH: FLOW DEPTH RATIO	(12:1 MAX)	17.39	6.45
d50 STONE SIZE	(IN)	N/A	N/A
A (CROSS-SECTIONAL AREA)	(SQ. FT.)	1.08	3.63
R (HYDRAULIC RADIUS)		0.20	0.46
S (BED SLOPE)[3]	(FT/FT)	0.0075	0.0075
Sc (CRITICAL SLOPE)	(FT/FT)	0.041	1.043
.7Sc	(FT/FT)	0.028	0.730
1.3Sc	(FT/FT)	0.053	1.355
STABLE FLOW?	(Y/N)	Y	Y
FREEBOARD BASED ON UNSTABLE FLOW	(FT)	0.02	0.0
FREEBOARD BASED ON STABLE FLOW	(FT)	0.50	0.5
MINIMUM REQUIRED FREEBOARD[4]	(FT)	0.50	0.5
DESIGN METHOD FOR PROTECTIVE LINING [5] PERMISSIBLE VELOCITY (V) OR SHEAR STRESS	(S)	S	S

EQUIVALENT PIPE CALCULATION:

Q	n	s (ft/ft)	D (ft.)	D (in)	Round up to:
1.20	0.013	0.0075	0.701	8.413	**12" pipe**

D = ((Q*n/(S^(1/2)*Pi*0.1478))^3/8)

Pipe Equivalence Calculation for Sizing Rip Rap Apron:
Use Manning's Equation
Q = (1.49/n)*A*(R^2/3)*(S^1/2)

Q = Flow Rate from Worksheet 11 (cfs)
n = Manning's Constant for Smooth Plastic Pipe = 0.013 (unitless)
A = Area of Pipe (ft) = 0.25 * Pi * D^2
D = Diameter of Pipe (ft)
R = Hydraulic Radius = A / P = (0.25 * Pi * D^2) / (Pi * D) = 0.25 * D
P = Perimeter of Pipe (ft) = Pi * D
S = Slope of channel from Worksheet 11 (ft/ft)

Solve Manning's Equation for Diameter of Pipe:
Q = (1.49/n)*A*(R^2/3)*(S^1/2)
Q = (1.49/n)*(0.25*Pi*D^2)*((0.25*D)^2/3)*(S^1/2)
Q*n*/(1.49*S^(1/2))=(0.25*Pi*D^2)*((0.25*D)^2/3)
Q*n*/(1.49*S^(1/2)*0.25*(0.25^2/3))=(Pi*D^2)*(D^2/3)
Q*n*/(S^(1/2)*Pi*0.1478)=(D^2)*(D^2/3)
Q*n*/(S^(1/2)*Pi*0.1478)=(D^8/3)
(Q*n*/(S^(1/2)*Pi*0.1478))^3/8=D

Multiply by 12 to convert feet to inches:
D = ((Q*n/(S^(1/2)*Pi*0.1478))^3/8) * 12

1. Use 1.6 for Temporary Channels; 2.25 for Temporary Channels in Special Protection (HQ or EV) Watersheds; 2.75 for Permanent Channels. For Rational Method, enter "N/A" and attach E&S Worksheets 9 and 10. For TR-55 enter "N/A" and attach appropriate Worksheets.
2. Adjust "n" value for changes in channel liner and flow depth. For vegetated channels, provide data for manufactured linings without vegetation and with vegetation in separate columns.
3. Slopes may not be averaged.
4. Minimum Freeboard is 0.5 ft. or ¼ Total Channel Depth, whichever is greater
5. Permissible velocity lining design method is not acceptable for channels with a bed slope of 10% or greater. Shear stress lining design method is required for channels with a bed slope of 10% or greater. Shear stress lining design method may be used for any channel bed slope.

Tensar International Corporation
5401 St. Wendel-Cynthiana Road
Poseyville, Indiana 47633
Tel. 800.772.2040
Fax 812.867.0247
www.nagreen.com

Erosion Control Materials Design Software
Version 5.0

Project Name: ASR Access Roads
Project Number: 63544
Channel Name: AR-WY-028-VCI

Discharge	1.23
Peak Flow Period	24
Channel Slope	0.018
Channel Bottom Width	4
Left Side Slope	3
Right Side Slope	3
Low Flow Liner	
Retardance Class	C
Vegtation Type	Mix (Sod & Bunch)
Vegetation Density	Good 75-95%
Soil Type	Silt Loam

SC250 - Class C - Mix (Sod & Bunch) - Good 75-95%

Phase	Reach	Discharge	Velocity	Normal Depth	Mannings N	Permissible Shear Stress	Calculated Shear Stress	Safety Factor	Remarks	Staple Pattern
SC250 Unvegetated	Straight	1.23 cfs	1.48 ft/s	0.18 ft	0.04	2.5 lbs/ft2	0.21 lbs/ft2	12.16	STABLE	E
SC250 Reinforced Vegetation	Straight	1.23 cfs	0.48 ft/s	0.47 ft	0.21	8 lbs/ft2	0.53 lbs/ft2	15.15	STABLE	E
Underlying Substrate	Straight	1.23 cfs	0.48 ft/s	0.47 ft	--	0.8 lbs/ft2	0.005 lbs/ft2	167.67	STABLE	--

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Version 5.0

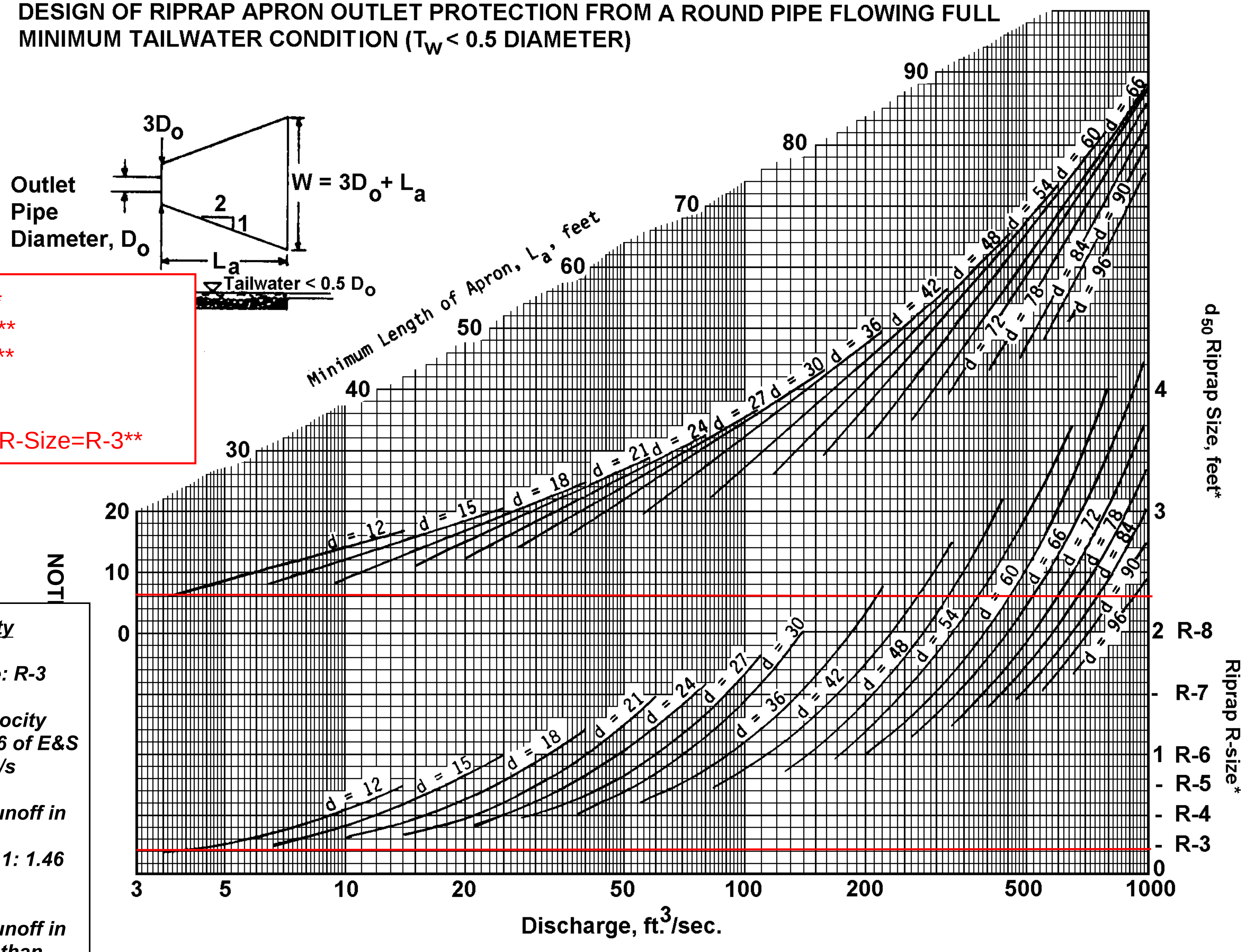
Project Name: ASR Access Roads
Project Number: 63544
Channel Name: AR-WY-028-VCD

Discharge	1.20
Peak Flow Period	24
Channel Slope	0.0075
Channel Bottom Width	4
Left Side Slope	3
Right Side Slope	3
Low Flow Liner	
Retardance Class	C
Vegtation Type	Mix (Sod & Bunch)
Vegetation Density	Good 75-95%
Soil Type	Silt Loam

SC250 - Class C - Mix (Sod & Bunch) - Good 75-95%

Phase	Reach	Discharge	Velocity	Normal Depth	Mannings N	Permissible Shear Stress	Calculated Shear Stress	Safety Factor	Remarks	Staple Pattern
SC250 Unvegetated	Straight	1.2 cfs	1.1 ft/s	0.23 ft	0.04	2.5 lbs/ft2	0.11 lbs/ft2	22.98	STABLE	E
SC250 Reinforced Vegetation	Straight	1.2 cfs	0.33 ft/s	0.62 ft	0.232	8 lbs/ft2	0.29 lbs/ft2	27.52	STABLE	E
Underlying Substrate	Straight	1.2 cfs	0.33 ft/s	0.62 ft	--	0.8 lbs/ft2	0.002 lbs/ft2	419.54	STABLE	--

FIGURE 9.3
Riprap Apron Design, Minimum Tailwater Condition



Do=1'**
3Do=3'**
La=6' ***
W=9'**
Rt=9"**
Riprap R-Size=R-3**

Adapted from USDA - NRCS

NOTE: ...ed for Box Cu...

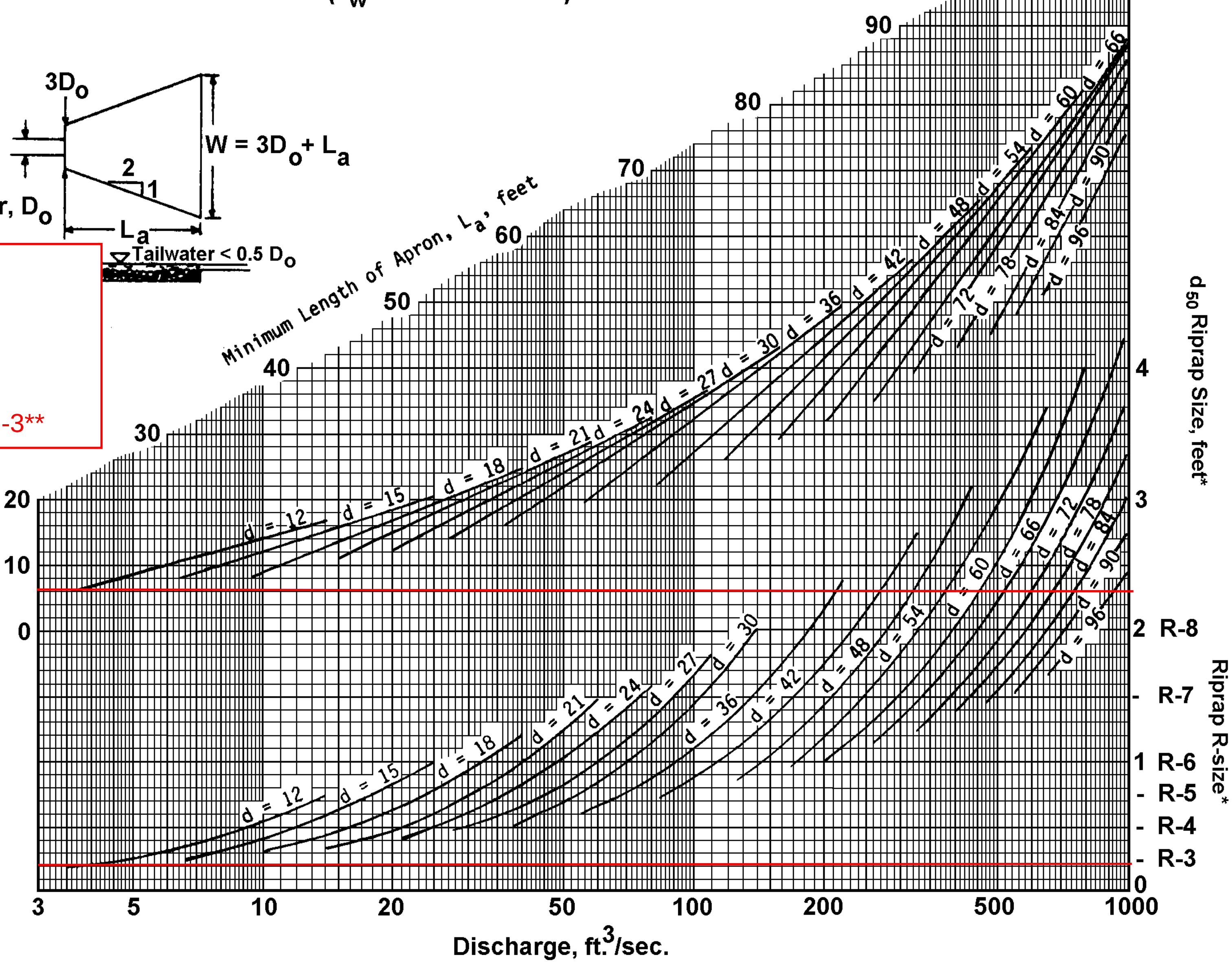
* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.
**DIMENSIONS BASED ON MINIMUM SIZING CRITERIA FROM CHART

Check Velocity
Riprap R-Size: R-3
Maximum Velocity from Table 6.6 of E&S Manual: 6.5 ft/s
Velocity of Runoff in Channel from Worksheet #11: 1.46 ft/s
Velocity of Runoff in Channel less than Maximum? Yes

PAR-WY-028 VCD
Q(10)=1.20 cfs, 12" pipe

FIGURE 9.3
Riprap Apron Design, Minimum Tailwater Condition

DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL MINIMUM TAILWATER CONDITION (T_W < 0.5 DIAMETER)



Do=1'**
3Do=3'**
La=6' ***
W=9'**
Rt=9"**
Riprap R-Size=R-3**

Adapted from USDA - NRCS

NOT

d for Box Cu

* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.
**DIMENSIONS BASED ON MINIMUM SIZING CRITERIA FROM CHART

Check Velocity

Riprap R-Size: R-3

Maximum Velocity from Table 6.6 of E&S Manual: 6.5 ft/s

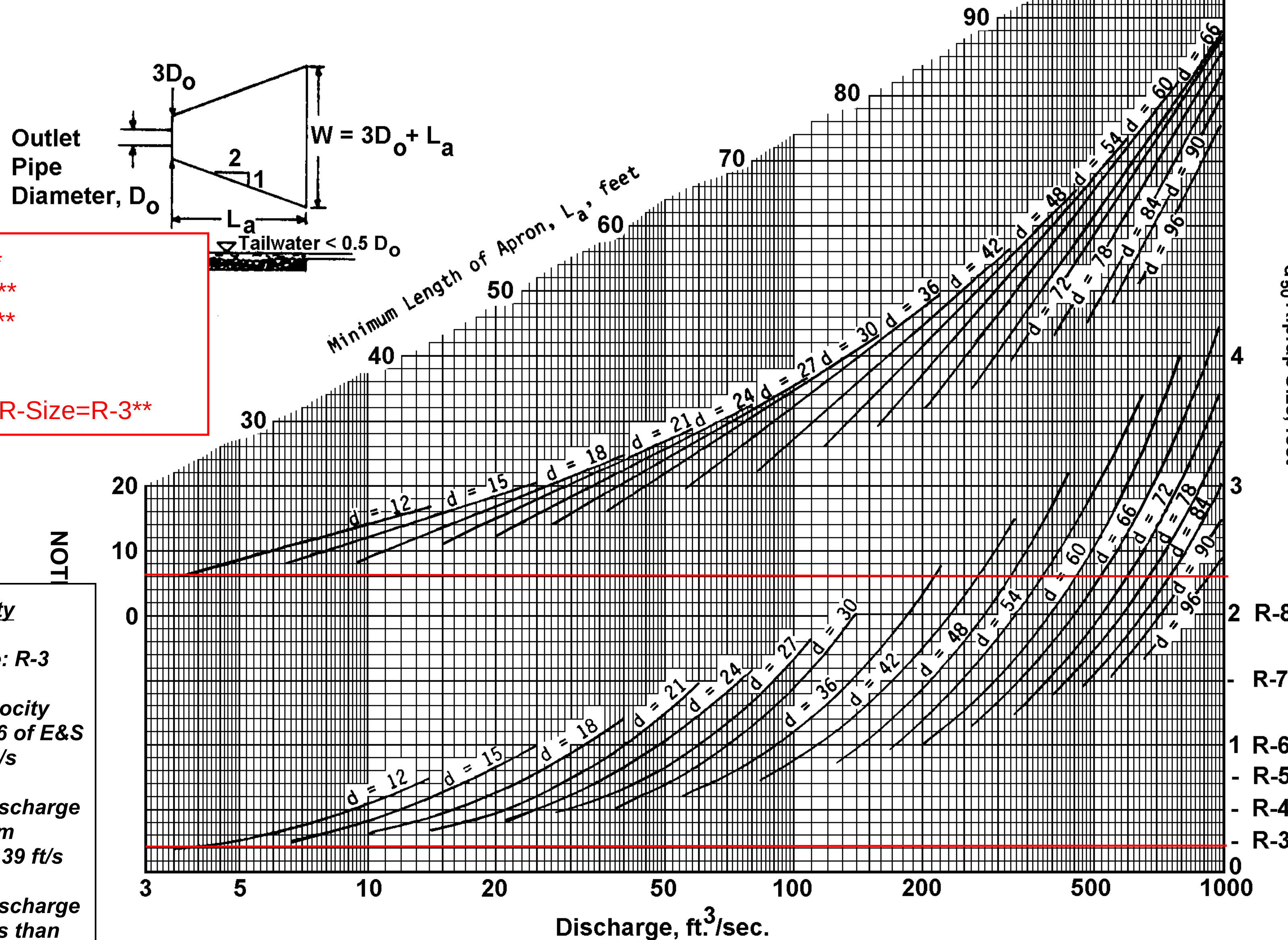
Velocity of Runoff in Channel from Worksheet #11: 1.09 ft/s

Velocity of Runoff in Channel less than Maximum? Yes

PAR-WY-028 CULVERT
Q(10)=0.17 cfs, 12" pipe

FIGURE 9.3
Riprap Apron Design, Minimum Tailwater Condition

DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
MINIMUM TAILWATER CONDITION (T_W < 0.5 DIAMETER)



Adapted from USDA - NRCS

Do=1'**
3Do=3'**
La=6' ***
W=9'**
Rt=9"**
Riprap R-Size=R-3**

NOT[illegible]

[illegible]d for Box Cu[illegible]

Check Velocity

Riprap R-Size: R-3

Maximum Velocity from Table 6.6 of E&S Manual: 6.5 ft/s

Velocity of Discharge at Culvert from HydroCAD: 1.39 ft/s

Velocity of Discharge at Culvert less than Maximum? Yes

* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.
**DIMENSIONS BASED ON MINIMUM SIZING CRITERIA FROM CHART

K.6 PCSM BMP Calculations

a. Check Dam Volume Calculations

ATLANTIC SUNRISE NATURAL GAS PIPELINE PROJECT
(ACCESS ROAD) VEGETATED CHANNEL CHECKDAM VOLUME
PAR WY-028-Vegetated Channel for Infiltration

9/28/2016

TOTAL REACH VOLUME = 1610 CF Width (W_B): 4 FT. Depth (H): 1 FT.

<u>**VEGETATED CHANNEL PAR-WY-028**</u>		<u>**VEGETATED CHANNEL PAR-WY-028**</u>		<u>**VEGETATED CHANNEL PAR-WY-028**</u>	
ROAD STA 0+50 to 2+71		ROAD STA 2+71 to 4+59		ROAD STA 4+59 to 6+00	
Input data		**Input data**		**Input data**	
S =	0.018 ft/ft	S =	0.025 ft/ft	S =	0.008 ft/ft
H =	1 ft	H =	1 ft	H =	1 ft
W_B =	4	W_B =	4	W_B =	4
z_1 =	3	z_1 =	3	z_1 =	3
z_2 =	3	z_2 =	3	z_2 =	3
Output data		**Output data**		**Output data**	
$L_{storage}$=	56 ft	$L_{storage}$=	40 ft	$L_{storage}$=	133 ft
W_T =	10 ft	W_T =	10 ft	W_T =	10 ft
$W_T + W_B$ =	14 ft	$W_T + W_B$ =	14 ft	$W_T + W_B$ =	14 ft
V =	194 cf	V =	140 cf	V =	467 cf
$L_{spacing}$ =	60 ft	$L_{spacing}$ =	45 ft	$L_{spacing}$ =	138 ft
No. of rock filters =	3	No. of rock filters =	4	No. of rock filters =	1
Subreach Volume =	583 CF	Subreach Volume =	560 CF	Subreach Volume =	467 CF
<u>Infiltration(Q_i)</u>		<u>Infiltration(Q_i)</u>		<u>Infiltration(Q_i)</u>	
Infiltration Depth =	12 in	Infiltration Depth =	12 in	Infiltration Depth =	12 in
Field Q_i =	0.922 in/hr	Field Q_i =	0.922 in/hr	Field Q_i =	0.922 in/hr
Factor of Safety =	2.0	Factor of Safety =	2.0	Factor of Safety =	2.0
Reduced Q_i =	0.5 in/hr	Reduced Q_i =	0.5 in/hr	Reduced Q_i =	0.5 in/hr
Dewatering Time =	26 hr	Dewatering Time =	26 hr	Dewatering Time =	26.03 hr
Less than 72 hours?	YES	Less than 72 hours?	YES	Less than 72 hours?	YES

ATLANTIC SUNRISE NATURAL GAS PIPELINE PROJECT
(ACCESS ROAD) VEGETATED CHANNEL CHECKDAM VOLUME
PAR WY-028-Vegetated Channel for Diversion

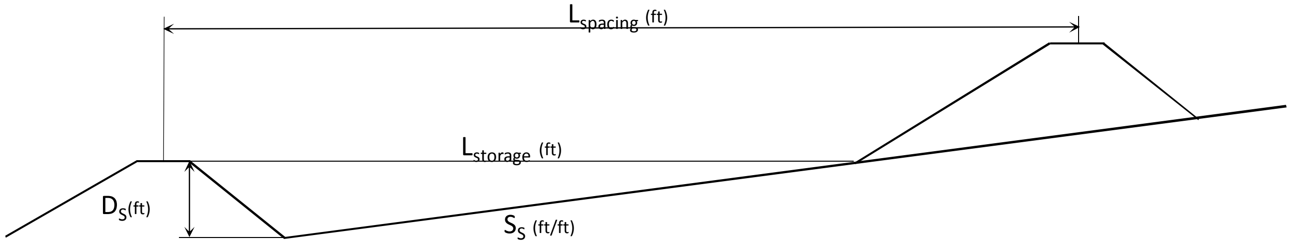
9/28/2016

TOTAL REACH VOLUME = 887 CF Width (W_B): 4 FT. Depth (H): 1 FT.

<u>**VEGETATED CHANNEL PAR-WY-028**</u>			<u>**VEGETATED CHANNEL PAR-WY-028**</u>		
ROAD STA 3+00 to 4+31			ROAD STA 4+31 to 6+00		
Input data			**Input data**		
S =	0.025	ft/ft	S =	0.008	ft/ft
H =	1	ft	H =	1	ft
W_B =	4		W_B =	4	
z_1 =	3		z_1 =	3	
z_2 =	3		z_2 =	3	
Output data			**Output data**		
$L_{storage}$=	40	ft	$L_{storage}$=	133	ft
W_T =	10	ft	W_T =	10	ft
$W_T + W_B$ =	14	ft	$W_T + W_B$ =	14	ft
V =	140	cf	V =	467	cf
$L_{spacing}$ =	45	ft	$L_{spacing}$ =	138	ft
No. of rock filters =	3		No. of rock filters =	1	
Subreach Volume =	420	CF	Subreach Volume =	467	CF
<u>Infiltration(Q_i)</u>			<u>Infiltration(Q_i)</u>		
Infiltration Depth =	12	in	Infiltration Depth =	12	in
Field Q_i =	0.922	in/hr	Field Q_i =	0.922	in/hr
Factor of Safety =	2.0		Factor of Safety =	2.0	
Reduced Q_i =	0.5	in/hr	Reduced Q_i =	0.5	in/hr
Dewatering Time =	26	hr	Dewatering Time =	26	hr
Less than 72 hours?	YES		Less than 72 hours?	YES	

EARTHEN CHECK DAM INFILTRATION VOLUME AND SPACING

Per the Pennsylvania Stormwater BMP Manual (pg 94), the minimum spacing ($L_{spacing}$) of check dams is determined by the length of the storage volume ($L_{storage}$) and the length to the check dam center line. The length of the storage volume is calculated by dividing the height of the rock filter (D_S) by the slope of the channel (S_S):



$L_{storage} = D_S/S_S$

Where: $L_{storage}$ = Storage Length

S_S = Channel slope

D_S = Height of the check dam

$L_{spacing} = L_{storage}+[(D_S+1)/(-S_S+0.5)]$

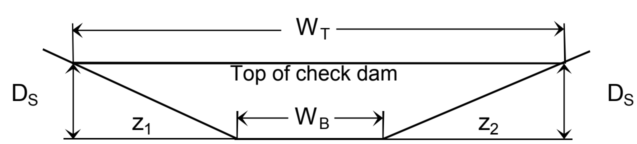
Where: $L_{spacing}$ = Check Dam Spacing

$L_{storage}$ = Storage Length

S_S = Channel slope

D_S = Height of the check dam

The volume of runoff that will be stored upstream of a check dam is dependent on the height of the check dam, the slope of the upstream channel and the dimensions of the upstream channel. The storage volume (V_S) can be calculated with:



$V_S = 0.25 \times L_{storage} \times D_S \times (W_T + W_B)$

Where:

$L_{storage}$ = Storage Length

D_S = Height of check dam

W_T = check dam top width

W_B = check dam bottom width

The check dam top width (W_T) is given by:

$W_T = W_B + z_1 + z_2$

Where: W_B = check dam bottom width

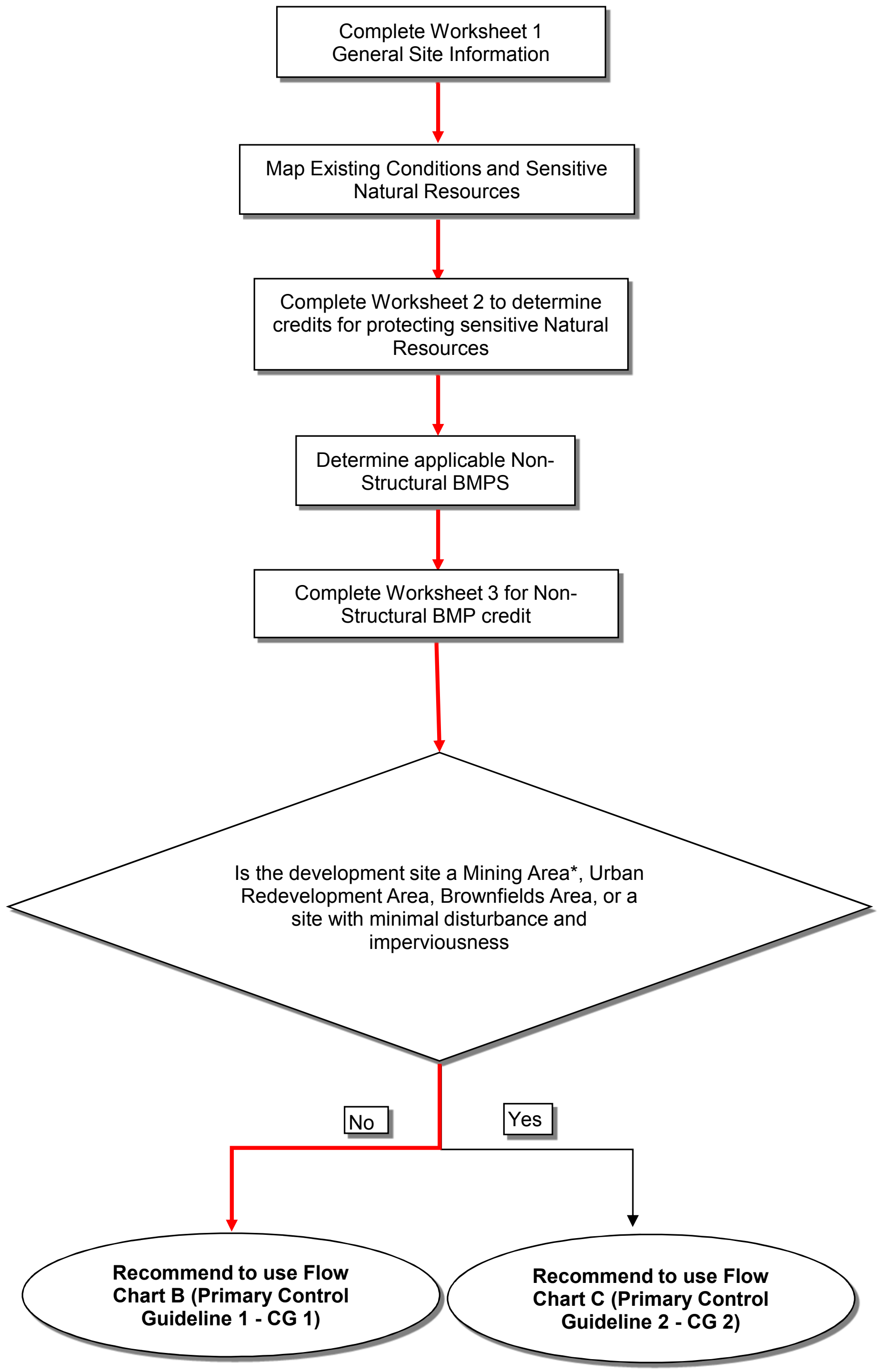
z_1 = side slope

z_2 = side slope

K.7 Water Quality Worksheets

a. Flow Chart A – Stormwater Calculation Process
b. Worksheet 1. General Site Information
c. Worksheet 2. Sensitive Natural Resources
d. Worksheet 3. Nonstructural BMP Credits
e. Flow Chart B – Control Guideline 1 Process
f. Worksheet 4. Change in Runoff Volume for 2-Yr Storm Event
g. Worksheet 5. Structural BMP Volume Credits
h. Worksheet 10. Water Quality Compliance for Nitrate

FLOW CHART A
Stormwater Calculation Process



Worksheet 1. General Site Information

INSTRUCTIONS: Fill out Worksheet 1 for each watershed

Date:	29-Sep-16
Project Name:	Atlantic Sunrise Pipeline AR-WY-028
Municipality:	Falls Township
County:	Wyoming
Total Area (acres):	1.19
Major River Basin:	Susquehanna River

http://www.dep.state.pa.us/dep/depupdate/watermgt/wc/default.htm#newtopics

Watershed:	Susquehanna River
Sub-Basin:	Upper Susquehanna River
Nearest Surface Water(s) to Receive Runoff:	UNT to Susquehanna River
Chapter 93 - Designated Water Use:	CWF,MF

http://www.pacode.com/secure/data/025/chapter93/chap93toc.html

Impaired according to Chapter 303(d) List? Yes [ ] No [X]
http://www.dep.state.pa.us/dep/deputate/watermgt/wqp/wqstandards/303d-Report.htm

List Causes of Impairment: ______

Is project subject to, or part of:

Municipal Separate Storm Sewer System (MS4) Requirements? Yes [ ] No [X]
http://www.dep.state.pa.us/dep/deputate/watermgt/wc/Subjects/StormwaterManagement/GeneralPermits/default.htm

Existing or planned drinking water supply? Yes [ ] No [X]

If yes, distance from proposed discharge (miles): ______

Approved Act 167 Plan? Yes [ ] No [X]
http://www.dep.state.pa.us/dep/deputate/watermgt/wc/Subjects/StormwaterManagement/Approved_1.html

Existing River Conservation Plan? Yes [X] No [ ]
http://www.dcnr.state.pa.us/brc/rivers/riversconservation/planningprojects/

Worksheet 2. Sensitive Natural Resources

INSTRUCTIONS:

1. Provide Sensitive Resources Map according to non-structural BMP 5.4.1 in Chapter 5. This map should identify wetlands, woodlands, natural drainage ways, steep slopes, and other sensitive natural areas.

*Note: Sensitive areas are shown on the Soil Erosion Control Plans.

2. Summarize the existing extent of each sensitive resource in the Existing Sensitive Resources Table (below, using Acres). If none present, insert 0.

3. Summarize Total Protected Area as defined under BMPs in Chapter 5.

4. Do not count any area twice. For example, an area that is both a floodplain and a wetland may only be considered once.

EXISTING NATURAL SENSITIVE RESOURCE	MAPPED? yes/no/n/a	TOTAL AREA (Ac.)	PROTECTED AREA (Ac.)
Waterbodies	N/A		
Floodplains	N/A		
Riparian Areas	N/A		
Wetlands	N/A		
Woodlands	N/A		
Natural Drainage Ways	N/A		
Steep Slopes, 15% - 25%	N/A		
Steep Slopes, over 25%	N/A		
Other:			
Other:			
TOTAL EXISTING:		0.00	0.00

Worksheet 3. Nonstructural BMP Credits

PROTECTED AREA

1.1 Area of Protected Sensitive/Special Value Features (see WS 2)	**-**	**Ac.**
1.2 Area of Riparian Forest Buffer Protection	**-**	**Ac.**
3.1 Area of Minimum Disturbance/Reduced Grading	**-**	**Ac.**
TOTAL	**-**	**Ac.**

Site Area	*minus*	Protected Area	=	Stormwater Management Area
1.19	-	-	=	1.19

This is the area that requires stormwater management

VOLUME CREDITS

3.1 Minimum Soil Compaction

Lawn	____ ft^2	x 1/4"	x 1/12	=	**-**	**ft^3**
Meadow	____ ft^2	x 1/3"	x 1/12	=	**-**	**ft^3**

3.3 Protect Existing Trees

For Trees within 100 feet of impervious area:

Tree Canopy	____ ft^2	x 1/2"	x 1/12	=	**-**	**ft^3**

For Trees within 20 feet of impervious area:

Tree Canopy	____ ft^2	x 1"	x 1/12	=	**-**	**ft^3**

5.1 Disconnect Roof Leaders to Vegetated Areas

For Runoff directed to areas protected under 5.8.1 and 5.8.2

Roof Area	____ ft^2	x 1/3"	x 1/12	=	**-**	**ft^3**

For all other disconnected roof areas

Roof Area	____ ft^2	x 1/4"	x 1/12	=	**-**	**ft^3**

5.2 Disconnect Non-Roof impervious to Vegetated Areas

For Runoff directed to areas protected under 5.8.1 and 5.8.2

Impervious Area	____ ft^2	x 1/3"	x 1/12	=	**-**	**ft^3**

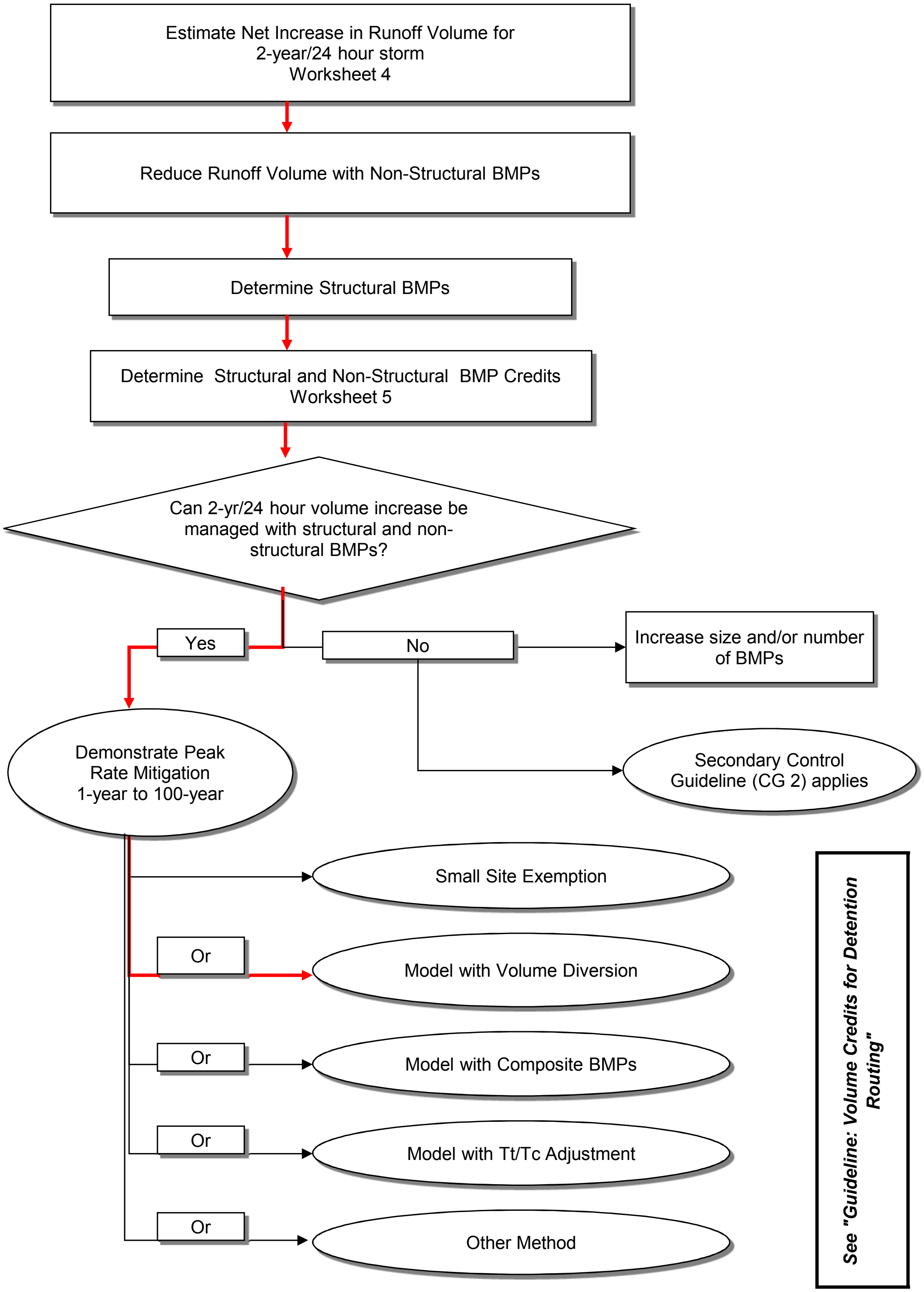
For all other disconnected non-roof areas

Impervious Area	____ ft^2	x 1/4"	x 1/12	=	**-**	**ft^3**

TOTAL NON-STRUCTURAL VOLUME CREDIT* - **ft^3**

** For use on Worksheet 5*

FLOW CHART B
Control Guideline 1 Process



WORKSHEET 4 . CHANGE IN RUNOFF VOLUME FOR 2-YR STORM EVENT

PROJECT: **Atlantic Sunrise Pipeline AR-WY-028**

2-Year Rainfall: 2.51 **in**

Total Site Area: 1.19 **acres**
Protected Site Area: 0 **acres**
Managed Area 1.19 **acres**

Existing Conditions:

Cover Type	Soil Type	Area (sf)	Area (ac)	CN	S	Ia (0.2*S)	Q Runoff[1] (in)	Runoff Volume[2] (ft^3)
Impervious[3]	C	303	0.01	98	0.20	0.04	2.28	58
"Meadow"[3]	C	76	0.00	71	4.08	0.82	0.50	3
Dirt Rd	C	3,229	0.07	87	1.49	0.30	1.32	355
Stone	C	0	0.00	98	0.20	0.04	2.28	-
Woods	C	7,990	0.18	70	4.29	0.86	0.46	306
Pasture	C	40,055	0.92	79	2.66	0.53	0.84	2,818
TOTAL:		51,653	1.19					3,540

Developed Conditions:

Cover Type	Soil Type	Area (sf)	Area (ac)	CN	S	Ia (0.2*S)	Q Runoff[1] (in)	Runoff Volume2 (ft3)
Impervious	C	379	0.01	98	0.20	0.04	2.28	72
Gravel Rd	C	7,464	0.17	89	1.24	0.25	1.46	910
Stone	C	4,680	0.11	98	0.20	0.04	2.28	889
Woods	C	3,237	0.07	70	4.29	0.86	0.46	124
Pasture	C	35,893	0.82	79	2.66	0.53	0.84	2,525
TOTAL:		51,653	1.19					4,521

2-Year Volume Increase (ft^3)	**981**

2-Year Volume Increase = Developed Conditions Runoff Volume - Existing Conditions Runoff Volume

1. Runoff (in) = Q = $(P - 0.2S)^2 / (P + 0.8S)$ where
   P = 2-Year Rainfall (in)
   S = (1000/ CN)-10

2. Runoff Volume (CF) = Q x Area x 1/12
   Q = Runoff (in)
   Area = Land use area (sq. ft.)

Note: Runoff Volume must be calculated for EACH land use type/condition and HSGI.
The use of a weighted CN value for volume calculations is not acceptable.

3. Twenty (20) percent of existing impervious area, when present, shall be considered meadow (good condition) in the model for existing conditions for redevelopment per Volume Control Guideline 1.

WORKSHEET 5. STRUCTURAL BMP VOLUME CREDITS

PROJECT: Atlantic Sunrise Pipeline AR-WY-028
SUB-BASIN: Upper Susquehanna River

Required Control Volume (ft^3) - *from Worksheet 4*:		981
Non-structural Volume Credit (ft^3) - *from Worksheet 3*:	-	0
Structural Volume Reqmt (ft^3)		981
(Required Control Volume minus Non-structural Credit)		

	Proposed BMP	**Area (ft^2)**	**Volume Reduction Permanently Removed (ft^3)**
6.4.1	Porous Pavement		
6.4.2	Infiltration Basin		
6.4.3	Infiltration Bed		
6.4.4	Infiltration Trench		
6.4.5	Rain Garden/Bioretention		
6.4.6	Dry Well / Seepage Pit		
6.4.7	Constructed Filter		
6.4.8	Vegetated Swale		
6.4.9	Vegetated Filter Strip		
6.4.10	Berm		
6.5.1	Vegetated Roof		
6.5.2	Capture and Re-use		
6.6.1	Constructed Wetlands		
6.6.2	Wet Pond / Retention Basin		
6.6.3	Dry Extended Detention Basin		
6.6.4	Water Quality Filters		
6.7.1	Riparian Buffer Restoration		
6.7.2	Landscape Restoration / Reforestation		
6.7.3	Soil Amendment		
6.8.1	Level Spreader		
6.8.2	Special Storage Areas		
Other	Check dams in Vegetated Channels		1,610
	Storage in 18" stone MLV Pad		469

Total Structural Volume (ft^3):	2,079
Structural Volume Requirement (ft^3):	981
DIFFERENCE	1,098

MLV Pad Infiltration Calculations Summary		
Average Measured Infiltration Rate for MLV Pad	0.78	in/hr
Factor of Safety	2.00	
Design Infiltration Rate	0.39	in/hr
Dewatering Time for top 6 inches of MLV Pad	15.38	hours
Depth of AASHTO #57 Section of MLV Pad	12	inches
Dewatering Time for AASHTO #57 Section of MLV Pad	30.77	hours
Total Dewatering Time for MLV Pad	46.15	hours

Check Dam Infiltration Calculations Summary		
Average Measured Infiltration Rate for Channel	0.94	in/hr
Factor of Safety	2.00	
Design Infiltration Rate	0.47	in/hr
Height of Check Dam	12	inches
Dewatering Time for Detained Water in Channel	25.53	hours

***A factor of safety of 2 is the minimal safety factor for design purposes per pager 19 of 21 of "Protocol 1, Site Evaluation and Soil Infiltration Testing, included as Appendix C of the Pennsylvania Stormwater BMP Manual.**

WORKSHEET 10. WATER QUALITY COMPLIANCE FOR NITRATE

Does the site design incorporate the following BMPs to address nitrate pollution? A summary "yes" rating is achieved if at least 2 Primary BMPs for nitrate are provided across the site or 4 secondary BMPs for nitrate are provided across the site (or the

PRIMARY BMPs FOR NITRATE:

	YES	NO
NS BMP 5.4.2 - Protect / Conserve / Enhance Riparian Buffers		X
NS BMP 5.5.4 - Cluster Uses at Each Site		X
NS BMP 5.6.1 - Minimize Total Disturbed Area	X	
NS BMP 5.6.3 - Re-Vegetate / Re-Forest Disturbed Areas (Native	X	
NS BMP 5.9.1 - Street Sweeping / Vacuuming		X
Structural BMP 6.7.1 - Riparian Buffer Restoration		X
Structural BMP 6.7.2 - Landscape Restoration		X

SECONDARY BMPs FOR NITRATE:

NS BMP 5.4.1 - Protect Sensitive / Special Value Features		
NS BMP 5.4.3 - Protect / Utilize Natural Drainage Features		
NS BMP 5.6.2 - Minimize Soil Compaction		
Structural BMP 6.4.5 - Rain Garden / Bioretention		
Structural BMP 6.4.8 - Vegetated Swale		
Structural BMP 6.4.9 - Vegetated Filter Strip		
Structural BMP 6.6.1 - Constructed Wetland		
Structural BMP 6.7.1 - Riparian Buffer Restoration		
Structural BMP 6.7.2 - Landscape Restoration		
Structural BMP 6.7.3 - Soils Amendment/Restoration		

K.8 Sediment Barrier Table

a. E&S Worksheet 1

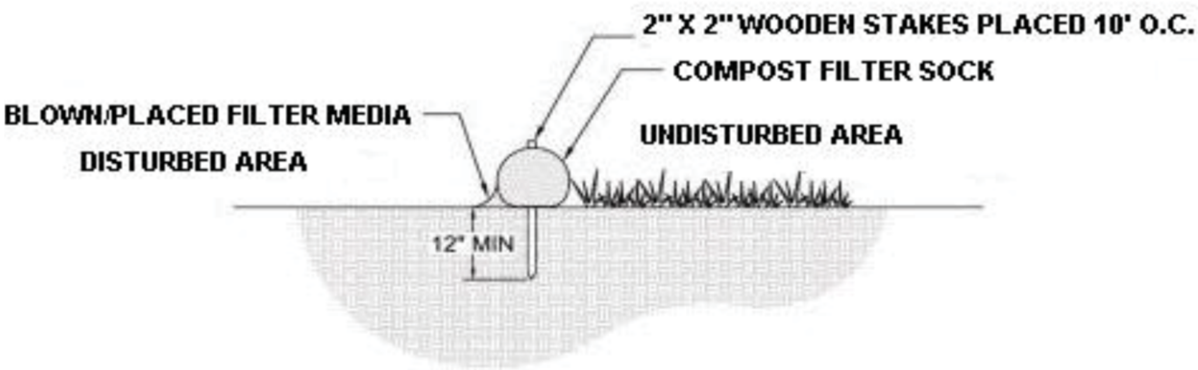
E&S WORKSHEET #1
Compost Filter Sock

PROJECT NAME: _Atlantic Sunrise_

LOCATION: _AR-WY-028_

PREPARED BY: _OLC_ DATE: _4/30/15 ***REV 9/16/2016***

CHECKED BY: _BJP_ DATE: _4/30/15 ***REV 9/16/2016***



SOCK NO.	Dia. In.	LOCATION	SLOPE PERCENT	SLOPE LENGTH ABOVE BARRIER (FT)	SOCK LENGTH
1-9	12	STA 2+10 to STA 6+00	33	10	*401*
STOCKPILE					
SP 1	*12*	*-*	*N/A*	*N/A*	*285*

SOURCE: Pennsylvania Erosion and Sediment Pollution Control Manual, Page 372

K.9 Infiltration Information

a. Field Observation Report

Field Observation Report

Project Number: 14C4909 - A

Project Name: Atlantic Sunrise Project – **AR-WY-028**

Date of Field Visit: October 26, 2015

Weather Conditions: Sunny Temperature: Approx. 45-55°F

Prepared By: Krystal Bealing, APSS and Joseph Kempf

Copies of Report Have Been Sent To: ☒ Client ☐ Contractor ☐ Other

Client:
Transcontinental Gas Pipe Line Company, LLC
2800 Post Oak Blvd
Houston, TX 77251

Contractor:
BL Companies
4242 Carlisle Pike, Suite 260
Camp Hill, PA 17011

Six soil pits were excavated by backhoe and described by an Associate Professional Soil Scientist (APSS) to varying depths utilizing the U.S. Department of Agriculture Natural Resources Conservation Service (USDA-NRCS) *Field Book for Describing and Sampling Soils, Version 3.0* and *Keys to Soil Taxonomy, Twelfth Edition, 2014*. According to the Web Soil Survey, soils within the area of the pits are described by the USDA-NRCS as Unadilla silt loam, 3-8% slopes and 8-15% slopes.

Test Pit #1, located at N41° 29’ 24.20”, W75° 53’ 58.68”, was observed to have three horizons, with a seasonal high water table observed at 34 inches.

Test Pit #2, located at N41° 29’ 24.68”, W75° 53’ 56.16”, was observed to have three horizons, with no observed limiting layer.

Test Pit #3, located at N41° 29’ 24.25”, W75° 53’ 53.69”, was observed to have two horizons, with bedrock observed at 19 inches.

Test Pit #4, located at N41° 29’ 23.95”, W75° 53’ 52.84”, was observed to have two horizons, with bedrock observed at 12 inches.

Test Pit #5 located at N41° 29’ 23.68”, W75° 53’ 53.16”, was observed to have two horizons, with bedrock observed at 10 inches.

Field Observation Report

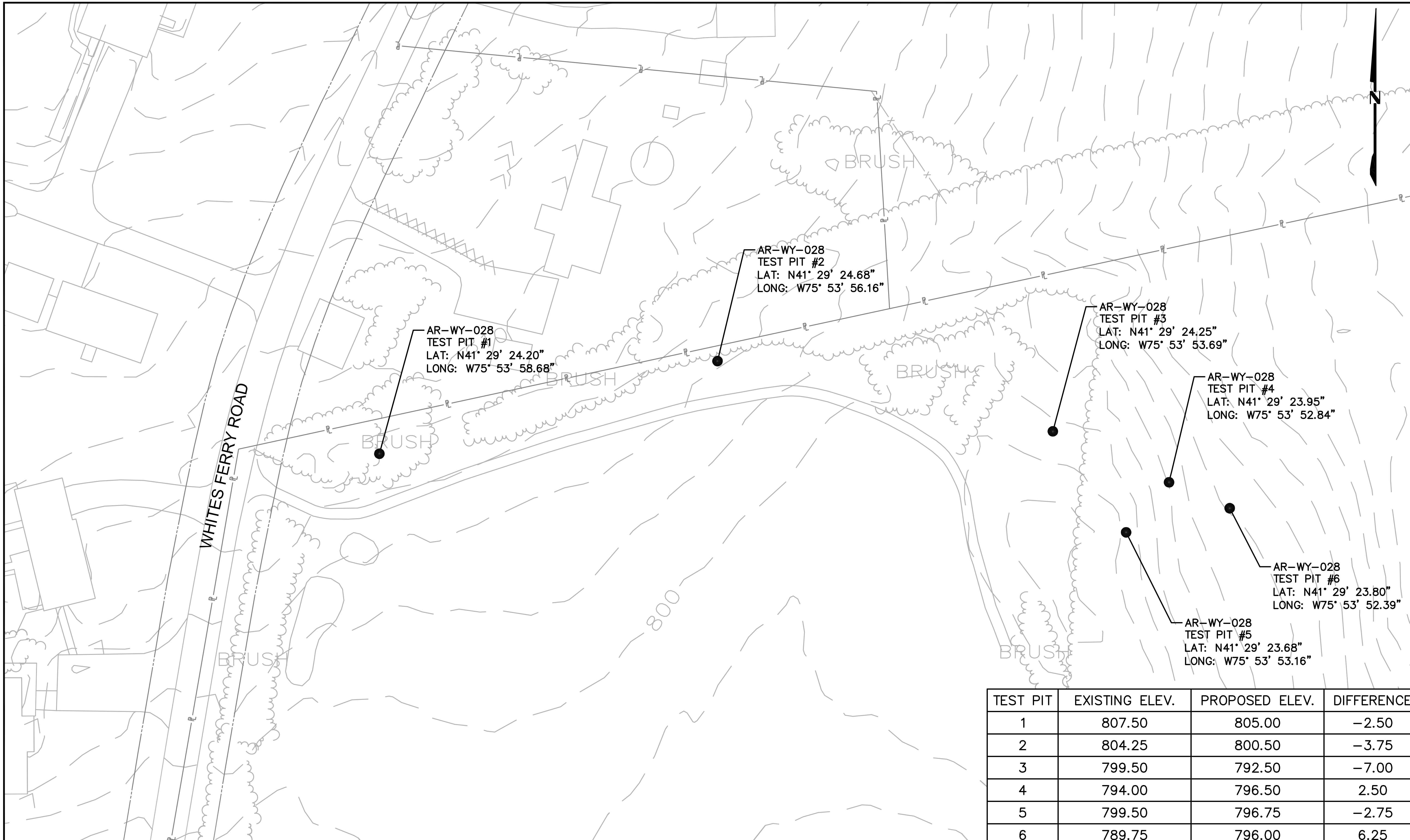
Test Pit #6 located at N41° 29' 23.80", W75° 53' 52.39", was observed to have five horizons, with bedrock observed at 30 inches.

Additionally, infiltration tests using the double ring infiltrometer method were conducted at each pit location, at depths ranging from the surface (0 inches) to 45 inches below surface. The elevations of the proposed improvements and the existing ground are provided on the infiltration testing location map. If the difference between the existing and proposed elevations is greater than zero, infiltration was performed at the existing elevation. If the difference between the existing and proposed elevation is between 0 and -5.00 feet, infiltration was conducted at the proposed elevation, or at two feet above the observed limiting layer, whichever was more shallow. If the difference between the existing and proposed elevations is greater than -5.00, infiltration was placed at 5 feet (60 inches) below the existing elevation to adhere to Occupational Safety and Health Administration (OSHA) standards for trenching and excavation safety.

Infiltration testing was conducted within a level testing area at all test pit locations using the double ring infiltrometer method. An infiltrometer containing a 12-inch outer ring and a 6-inch inner ring was driven into the soil a minimum of two inches. Both rings were filled with water to the rim at 30 minute intervals for one hour. If the drop in water level, measured within the center ring, during the last 30 minutes of the presoak is 2 inches or more, measurements are taken in 10-minute intervals. If the water level drop is less than 2 inches, measurements are taken in 30-minute intervals. After each measurement, the rings were refilled to the rim. Each measurement was taken at a fixed reference point. Measurements were taken until the rate of drop stabilized, or eight measurements were taken. A stabilized rate of drop is considered a difference of 0.25-inch or less between the highest and lowest measurements of four consecutive readings. An average of the stabilized rate (i.e., the last four measurements) or the average of eight total measurements if the rate of drop did not stabilize, expressed in inches per hour, represents the infiltration rate. Testing was completed at 6 inches below the surface at Test Pit #6, at 8 inches below the surface at Test Pit #1, at 45 inches below the surface at Test Pit #2, and at the surface for Test Pits #3, #4, and #5.

The infiltration rate at Test Pit #1 was observed to be 0.625 inches per hour.
The infiltration rate at Test Pit #2 was observed to be 1.219 inches per hour.
The infiltration rate at Test Pit #3 was observed to be 0.969 inches per hour.
The infiltration rate at Test Pit #4 was observed to be 1.125 inches per hour.
The infiltration rate at Test Pit #5 was observed to be 0.875 inches per hour.
The infiltration rate at Test Pit #6 was observed to be 0.344 inches per hour.

The soil profile descriptions, infiltration worksheet, photographs, infiltration testing location map, and USDA-NRCS Soil Survey information are attached.



TEST PIT	EXISTING ELEV.	PROPOSED ELEV.	DIFFERENCE
1	807.50	805.00	−2.50
2	804.25	800.50	−3.75
3	799.50	792.50	−7.00
4	794.00	796.50	2.50
5	799.50	796.75	−2.75
6	789.75	796.00	6.25

LANDOWNER: DOBRINSKI

AR-WY-028 INFILTRATION TESTING LOCATIONS

GRAPHIC SCALE
50 25 0 50
SCALE IN FEET

Soil Profile Log

Project 14C4909-A Atlantic Sunrise Project - AR-WY-028
Test Pit # 1
Name Joe Kempf and Kyrstal Bealing, APSS
Date October 26, 2015
Weather 45-55°F; Sunny
Equipment Mini Excavator

Elevation 807.5 AMSL
Soil Type Unadilla silt loam, 3-8% slopes
Geology Catskill Formation
Landscape Position/Slope Summit, 0-5%
Land Use Agriculture
Additional Comments

Horizon	Upper Boundary (inches)	Lower Boundary (inches)	Soil Textural Class	Type, Size, Coarse Fragments, etc.	Soil Matrix Color	Color Patterns	Pores, Roots, Structure	Depth to Bedrock	Depth to Water	Comments
Ap	0	9	SiL	-	10YR 3/3	-	Roots present; Weak, Subangular Blocky	-	-	Very Friable
Bw1	9	34	SiL	15-35% Channery	10YR 5/4	-	Weak, Subangular Blocky	-	-	Friable
Bw2	34	56+	SiL	15-35% Channery	10YR 5/4	15% 10YR 6/2, 5% 7.5YR 5/8	Weak, Subangular Blocky	-	-	Friable, Limiting Layer - Seasonal High Water Table, as indicated by the presence of redoximorphic features.

Note: Unless stated otherwise, horizon strike and dip was not observed to have a significant impact on water flow within the profile.

Soil Profile Log

Project 14C4909-A Atlantic Sunrise Project - AR-WY-028
Test Pit # 2
Name Joe Kempf and Kyrstal Bealing, APSS
Date October 26, 2015
Weather 45-55°F; Sunny
Equipment Mini Excavator

Elevation 804.25 AMSL
Soil Type Unadilla silt loam, 3-8% slopes
Geology Catskill Formation
Landscape Position/Slope Summit, 0-5%
Land Use Agriculture
Additional Comments

Horizon	Upper Boundary (inches)	Lower Boundary (inches)	Soil Textural Class	Type, Size, Coarse Fragments, etc.	Soil Matrix Color	Color Patterns	Pores, Roots, Structure	Depth to Bedrock	Depth to Water	Comments
Ap	0	11	SiL	-	10YR 3/3	-	Roots present; Weak, Granular	-	-	Very Friable
Bw	11	23	SiL	-	10YR 5/6	-	Roots present; Weak, Subangular Blocky	-	-	Friable
C	23	69+	SiL	35-60% Channery	5YR 4/3	-	Massive	-	-	Friable

Note: Unless stated otherwise, horizon strike and dip was not observed to have a significant impact on water flow within the profile.

Soil Profile Log

Project 14C4909-A Atlantic Sunrise Project - AR-WY-028
Test Pit # 3
Name Joe Kempf and Kyrstal Bealing, APSS
Date October 26, 2015
Weather 45-55°F; Sunny
Equipment Mini Excavator

Elevation 799.5 AMSL
Soil Type Unadilla silt loam, 3-8% slopes
Geology Catskill Formation
Landscape Position/Slope Summit, 0-5%
Land Use Agriculture
Additional Comments

Horizon	Upper Boundary (inches)	Lower Boundary (inches)	Soil Textural Class	Type, Size, Coarse Fragments, etc.	Soil Matrix Color	Color Patterns	Pores, Roots, Structure	Depth to Bedrock	Depth to Water	Comments
A	0	10	SiL	-	10YR 3/3	-	Roots present; Weak, Granular	-	-	Very Friable
Bw	10	19	SiL	-	10YR 5/4	-	Weak, Subangular Blocky	19	-	Friable, Observed excavator limit

Note: Unless stated otherwise, horizon strike and dip was not observed to have a significant impact on water flow within the profile.

Soil Profile Log

Project 14C4909-A Atlantic Sunrise Project - AR-WY-028
Test Pit # 4
Name Joe Kempf and Kyrstal Bealing, APSS
Date October 26, 2015
Weather 45-55°F; Sunny
Equipment Mini Excavator

Elevation 794 AMSL
Soil Type Unadilla silt loam, 3-8% slopes
Geology Catskill Formation
Landscape Position/Slope Side slope, 3-8%
Land Use Wooded
Additional Comments

Horizon	Upper Boundary (inches)	Lower Boundary (inches)	Soil Textural Class	Type, Size, Coarse Fragments, etc.	Soil Matrix Color	Color Patterns	Pores, Roots, Structure	Depth to Bedrock	Depth to Water	Comments
A	0	6	SiL	15-35% Channery	2.5Y 4/4	-	Roots present; Weak, Granular	-	-	Very Friable
Bw	6	12	SiL	15-35% Channery	10YR 6/6	-	Weak, Subangular Blocky	12	-	Friable, Observed excavator limit

Note: Unless stated otherwise, horizon strike and dip was not observed to have a significant impact on water flow within the profile.

Soil Profile Log

Project 14C4909-A Atlantic Sunrise Project - AR-WY-028
Test Pit # 5
Name Joe Kempf and Kyrstal Bealing, APSS
Date October 26, 2015
Weather 45-55°F; Sunny
Equipment Mini Excavator

Elevation 799.5 AMSL
Soil Type Unadilla silt loam, 3-8% slopes
Geology Catskill Formation
Landscape Position/Slope Side slope, 3-8%
Land Use Wooded
Additional Comments

Horizon	Upper Boundary (inches)	Lower Boundary (inches)	Soil Textural Class	Type, Size, Coarse Fragments, etc.	Soil Matrix Color	Color Patterns	Pores, Roots, Structure	Depth to Bedrock	Depth to Water	Comments
A	0	6	SiL	-	10YR 2/2	-	Roots present; Weak, Granular	-	-	Very Friable
Bw	6	10	SiL	15-35% Channery	10YR 3/4	-	Weak, Subangular Blocky	10	-	Friable, Observed excavator limit

Note: Unless stated otherwise, horizon strike and dip was not observed to have a significant impact on water flow within the profile.

Soil Profile Log

Project 14C4909-A Atlantic Sunrise Project - AR-WY-028
Test Pit # 6
Name Joe Kempf and Kyrstal Bealing, APSS
Date October 26, 2015
Weather 45-55°F; Sunny
Equipment Mini Excavator

Elevation 789.75 AMSL
Soil Type Unadilla silt loam, 8-15% slopes
Geology Catskill Formation
Landscape Position/Slope Sideslope, 3-8%
Land Use Wooded
Additional Comments

Horizon	Upper Boundary (inches)	Lower Boundary (inches)	Soil Textural Class	Type, Size, Coarse Fragments, etc.	Soil Matrix Color	Color Patterns	Pores, Roots, Structure	Depth to Bedrock	Depth to Water	Comments
A	0	6	SiL	-	2.5YR 4/4	-	Roots present; Weak, Granular	-	-	Very Friable
Bw1	6	10	SiL	-	10YR 6/6	-	Roots present; Moderate, Subangular Blocky	-	-	Friable
Bw2	10	26	SiL	-	10YR 5/6	-	Weak, Subangular Blocky	-	-	Friable
C	26	30	SL	-	5YR 4/3	-	Massive	30	-	Firm
R	30	35+	-	-	-	-	-	-	-	Observed excavator limit

Note: Unless stated otherwise, horizon strike and dip was not observed to have a significant impact on water flow within the profile.

ATLANTIC SUNRISE PROJECT - AR-WY-028

SOIL INFILTRATION WORKSHEET - DOUBLE RING INFILTROMETER METHOD

Hole Number	Drop >2 inches after 30 minute presoak?[1]	Reading Interval (minutes)	Reading 1 (Inches of Drop)	Reading 2 (Inches of Drop)	Reading 3 (Inches of Drop)	Reading 4 (Inches of Drop)	Reading 5 (Inches of Drop)	Reading 6 (Inches of Drop)	Reading 7 (Inches of Drop)	Reading 8 (Inches of Drop)	Average Stabilized Reading[2] (Inches of Drop)	Infiltration Rate[3] (in/hr)	Comments
1	No	30	0.375	0.375	0.125	0.375					0.313	0.625	45-55°F, sunny. Test done at 8 inches below the surface.
2	Yes	10	0.250	0.125	0.250	0.188					0.203	1.219	45-55°F, sunny. Test done at 45 inches below the surface.
3	No	30	1.000	0.375	0.500	0.563	0.500				0.484	0.969	45-55°F, sunny. Test done at surface.
4	No	30	0.625	0.625	0.500	0.500					0.563	1.125	45-55°F, sunny. Test done at surface.
5	No	30	0.375	0.375	0.500	0.500					0.438	0.875	45-55°F, sunny. Test done at surface.
6	No	30	0.188	0.125	0.125	0.250					0.172	0.344	45-55°F, sunny. Test done at 6 inches below the surface.

[1]Inches of drop greater than 2 inches after the 30 minute presoak? Yes, use 10 minute interval; No, use 30 minute interval.

[2]Calculated as the average of the last four stabilized (less than 0.25-inch difference overall) readings, or an overall average in the case of eight total readings.

[3]Calculated as the average stabilized reading x 2 for 30 minute intervals; x 6 for 10 minute intervals.


View of Pit #1.


View of Pit #2.


View of Pit #3.


View of Pit #4.


View of Pit #5.


View of Pit #6.

Wyoming County, Pennsylvania

UnB—Unadilla silt loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: b471
Elevation: 400 to 1,800 feet
Mean annual precipitation: 30 to 50 inches
Mean annual air temperature: 45 to 54 degrees F
Frost-free period: 110 to 180 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Unadilla and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Unadilla

Setting

Landform: Outwash terraces
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Outwash

Typical profile

H1 - 0 to 8 inches: silt loam
H2 - 8 to 42 inches: silt loam
H3 - 42 to 65 inches: very fine sandy loam

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 9.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: B

Minor Components

Wyoming

Percent of map unit: 5 percent

Data Source Information

Soil Survey Area: Wyoming County, Pennsylvania
Survey Area Data: Version 7, Sep 22, 2014

Wyoming County, Pennsylvania

UnC—Unadilla silt loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: b472
Elevation: 400 to 1,800 feet
Mean annual precipitation: 30 to 50 inches
Mean annual air temperature: 45 to 54 degrees F
Frost-free period: 110 to 180 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Unadilla and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Unadilla

Setting

Landform: Outwash terraces
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Outwash

Typical profile

H1 - 0 to 8 inches: silt loam
H2 - 8 to 42 inches: silt loam
H3 - 42 to 65 inches: very fine sandy loam

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 9.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B

Minor Components

Wyoming

Percent of map unit: 5 percent

Data Source Information

Soil Survey Area: Wyoming County, Pennsylvania
Survey Area Data: Version 7, Sep 22, 2014

K.10 Off-Site Discharge Analysis

a. Adequacy of Off-Site Discharge

ACCESS ROAD: AR-WY-028- Adequacy of Off-Site Discharge

AR-WY-028 is a proposed permanent access road (PAR) located in Falls Township, Wyoming County Pennsylvania. The intent of this road is to provide permanent maintenance and operational access to the Main Line Valve 04 (MLV-04) located on the proposed 30" Central Penn Line North Pipeline. The road begins at Whites Ferry Road and terminates at the MLV (Main Line Valve) site at approximate mile post 35.8. The proposed road will follow the path of an existing gravel road and is approximately 470 feet long over relatively hilly terrain surrounded by pasture to the south and west as depicted in the picture below and surrounded by wooded area to the north and east. The proposed improvements have been designed to have no anticipated impacts or changes to downhill properties as a result of the construction the MLV site.

The proposed permanent access road and the MLV site has been designed to reduce overall disturbance to the maximum extent practicable. The PAR and MLV site has been constructed with stone rather than pavement to further help with keeping with the existing conditions. As mentioned above, the road follows the existing path were practical and will maintain a new minimal width of only 14 feet wide. The road width is only slightly larger than the existing gravel travel way. The MLV site has been designed to minimize the footprint to the maximum extent practical for the operation and maintenance requirements.

The PAR and MLV site have been designed to match or reduce peak stormwater runoff from the design areas to an off-site discharge point where stormwater runoff is conveyed. (See the enclosed Pre and Post drainage area maps and calculations in Appendix K.3 and K.4 for details.) The reduced peak runoff for all storm events is summarized in the Pre-vs. Post- Construction Peak Rate of Flow Summary for The Study Point table below. The reduction was achieved by promoting infiltration through retention storage in the Vegetated Channel for Diversions (VCD), Vegetated Channel for Infiltration (VCI), and the MLV pad. Retaining and infiltrating runoff decreases the rate of stormwater runoff as well as recharging groundwater.

Pre- vs. Post-construction Peak Rate of Flow Summary			
Stormwater discharge rate for the design frequency storm (cfs)	Pre-construction	Post-construction	Net Change
1) 1-Year/24-Hour	0.60	0.28	(0.32)
2) 2-Year/24-Hour	1.09	0.60	(0.49)
3) 5-Year/24-Hour	1.90	1.18	(0.72)
4) 10-Year/24-Hour	2.70	1.54	(1.16)
5) 25-Year/24-Hour	4.04	3.23	(0.81)
6) 50-Year/24-Hour	5.33	4.61	(0.72)
7) 100-Year/24-Hour	6.88	5.98	(0.90)

The VCD is proposed to the north of the MLV site and access road. This VCD is 4-feet wide and 1-foot-deep and conveys flows from abutting properties to a proposed 12" Class V RCP stormwater culvert. The 12" Class V reinforced concrete pipe (RCP) discharges to the VCI. The VCD is equipped with multiple check dams to slow down flow and create small retention areas throughout the run in order to promote infiltration. These measures allow for the stormwater to pond during storm events and infiltrate into the ground, which reduces flows.

The VCI is located on the south side of the MLV site and access road. The VCI is also 4-feet wide and 1-foot deep and collects runoff from the access drive and areas between the drive and the existing pasture at the limit of disturbance. The VCI is equipped with multiple check dams to slow down flow and creates small retention areas throughout the channel to promote infiltration. A rip rap apron is proposed at the end of the channel to further slowdown stormwater runoff and dissipate energy.

The final measure used to ensure reduced peak stormwater runoff is the MLV pad itself. The pad is a gravel area constructed of a top layer of 6" of AASHTO #8 aggregate, on a non-woven geotextile fabric, and a bottom layer of 18" AASHTO #57 stone. This 18-inch-deep area will detain and infiltrate the footprint of the MLV pad, plus a small area around the pad to the East.

After being conveyed through one of the three stormwater PCSM BMP's above, the runoff flows south, until it converges with the pre-construction flows approximately 220 feet south of the MLV site. At this point the runoff follows pre-construction conditions until ultimately flowing into an unnamed tributary to the Susquehanna River (WW-T21-19002), approximately 880 feet southeast of the MLV Site.

The flow path from the MLV site crosses the following soil types:

- ASE – Arnot-Rock outcrop complex, steep.
- UnB – Unadilla silt loam, 3 to 8 percent slopes.
- UnC – Unadilla silt loam, 8 to 15 percent slopes.

The PADEP E&S Manual defines erosion resistant soils as soils having an erodibility "K" factor less than or equal to 0.37. The K factor for the soil types, according to the National Resources Conservation Service (NRCS) website http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx, crossed by the flow path are summarized below:

- ASE – No value specified by NRCS
- UnB – 0.37
- UnC – 0.37

All soils crossed by the flow path are considered erosion resistant soils.

In addition to the stormwater flow reduction and soil data above, the VCI, VCD and MLV pad has reduced the proposed stormwater velocity as it leaves the design points. The velocities at both points are slower than 2 fps, as summarized in the Stormwater Velocity Rate Summary table below. Based on Table G.1 in the PADEP E&S Manual, "Allowable Velocities for Downslope covers for Channeled Flows" (shown below), the maximum allowable velocity for mulch is 2 fps. The velocity of the runoff from the proposed improvements is less than the maximum allowable velocity.

Stormwater Velocity Rate Summary		
Design Frequency Storm	MLV Pad Velocity (fps)	VCI Velocity (fps)
1) 1-Year/24-Hour	0.12	0.00
2) 2-Year/24-Hour	0.18	0.00
3) 5-Year/24-Hour	0.46	0.40
4) 10-Year/24-Hour	0.40	0.56
5) 25-Year/24-Hour	0.43	0.84
6) 50-Year/24-Hour	0.46	1.16
7) 100-Year/24-Hour	0.48	1.28

Table G.1. Allowable Velocities for Downslope Covers for Channeled Flows

Ground Cover	Allowable Velocity
Grass*	4 fps
Gravel	5 fps
Mulch	1-2 fps

* See E&S Manual for more information on permissible velocities for grass and other cover types. Allowable velocities for grass can vary from 2.5 fps to as much as 8 fps. 4 fps has been selected as a conservative figure for design purposes.

(Table from the 2012 PADEP E&S Manual)

In conclusion, based on the designed measures discussed above, and the soil and velocity data provided for this MLV site and access road, there are no anticipated impacts or changes to downhill properties as a result of construction the MLV site.

Down Slope Property Owners:

- George P. Dobrinski & Leona A. Dobrinski (PA-WY-050.000)

K.11 Storage Volume Analysis

a. Storage Volume Analysis

ACCESS ROAD: WY-028 – Storage Volume Analysis

Stormwater detention is provided behind the check dams in the vegetated channel and in the void space between the AASHTO #57 stone layer at the MLV pad. The void space between the 6" AASHTO #8 stone at the surface of the pad is excluded from the detention, or storage volume, calculations. The required storage volume is calculated through an iterative process of increasing the storage volume in the HydroCAD model until the post-construction stormwater runoff rate is less than or equal to the pre-construction runoff rate.

Vegetated channel storage is created by installing check dams along the channel. The “Earthen Check Dam Infiltration Volume and Spacing” exhibit provided in Appendix K.6 describes how the storage volume behind each check dam is calculated. The number of check dams required is dependent on the channel cross-sectional dimensions, slope of channel, and required storage volume.

The void space between the AASHTO #57 stone provides the storage volume for the MLV pad. The void space between the 6" AASHTO #8 stone at the surface of the pad is excluded from the volume calculations.

The storage volume of the MLV pad is dependent on the slope of the MLV pad. If the pad were graded at 0% in all directions, the storage volume would simply be the area of the pad multiplied by the depth. However, due to site topography, a 0% grade would result in large quantities of earth movement, fill at the infiltration interface, or cut too close to the ground water table. Instead, the pad was designed to minimize these impacts by mimicking the existing grade. An actual storage volume was calculated based on the elevation of the low point of the pad (minus the 6" AASHTO #8 cover), since that is the highest runoff could be stored without overtopping the AASHTO #57 stone. Two scenarios apply to all of the main line valve pads on the project: low side pads and low corner pads. Since many of the volumes can only be obtained using calculus to determine the total storage the water surface elevation and base of the pad, AutoCAD Civil 3D was used to determine the storage volumes. To determine volumes in Civil 3D, surfaces representing the bottom of the pad and water surface elevation were built and combined into a volumetric surface; an earthwork analysis was run on the volumetric surface to determine the total volume between the two. The volume of low side pads can be checked using simple volumetric formulas for triangular (steeper grades, shallower pads) or trapezoidal (more gradual grades, deeper pads) prisms, with the cross sectional wetted area multiplied by the length of the low side of the pad. AR-WY-028 is a low-corner pad. Finally, the calculated storage volume was reduced by 60% to determine the available storage volume with 40% voids.

The detained stormwater will infiltrate the ground. The dewatering time for the stormwater detained behind the check dams is provided with the check dam volume calculations in Appendix K.6. The dewatering time for the stormwater detained in the void space of the MLV pad rock is provided at the bottom of Worksheet #5 included in Appendix K.7.

APPENDIX L

AR-WY-029 Specific Narrative and Calculations

L.1 Site Specific Narrative

a. Narrative
b. TMDL Discussion
c. Minimized Soil Compaction
d. Thermal Impact Analysis
e. Acidic Soil Management Plan
f. Road Specific Construction Sequence
g. Permanent Access Road Summary Sheet (NOI PCSM Table)

ACCESS ROAD: AR-WY-029

ACT 167 PLAN: None

TMDL: 1999 (PCBs), 2009 (metals)

NARRATIVE:

AR-WY-029 is a proposed ***permanent*** access road (PAR) located in Falls Township, Wyoming County, Pennsylvania. The intent of this road is to provide permanent maintenance and operational access to the proposed ***Main Line Valve 04.1 (CN-MLV-04.1) located on the proposed*** 30" Central Penn Line North Pipeline. ***The PAR is approximately 2,080 feet long in total with 1,780 feet of existing gravel road with the remainder of the PAR constructed over existing vegetated area. The road begins at Whites Ferry Road and terminates at the MLV Site at approximate mile post 35.3. During construction, the access road will have a temporary rock construction entrance with wash rack with compost filter sock at the point where the new road will be constructed. Temporary compost filter socks have been proposed to filter runoff leaving the area disturbed due to the road construction. Upon completion of the construction activities, the temporary construction entrance and compost filter sock will be removed. The permanent road will have a width of 14 feet and a cross slope of 2% directing runoff in the southerly direction into a vegetated channel for infiltration with check dams. The water quality channel for infiltration will convey runoff to a level spreader/pond.***

The MLV site will be constructed with a 6-inch thick layer of AASHTO #8 stone on top of nonwoven geotextile and a 12-inch thick layer of AASHTO #57 stone. As summarized in the infiltration calculations added to the bottom of Worksheet #5, the detained water stored in the voids of the MLV stone pad will infiltrate to the surrounding ground over approximately 32 hours and the water detained behind the check dams will infiltrate to the surrounding ground over approximately 16 hours.

Within the pipeline right of way, the proposed temporary sediment barriers are included in the Pipeline E&S Plan and shown in grey on the Access Road Plan for coordination purposes.

Water Quality Worksheet #4 was used to complete the Control Guidelines 1 (CG-1) volume analysis for the 2-year 24-hour storm. The storage volume provided by MLV-04.1 exceeds the required volume per Worksheet #4.

Pre-development and post-development runoff hydrographs were developed for the 1, 2, 5, 10, 25, 50 and 100 year 24-hour storm events using the SCS TR-20

method. Directing runoff from the proposed gravel road to the MLV pad mitigates the potential impact from the proposed development.

TMDL DISCUSSION:

Receiving surface waters in the location of this access road are subject to a PCB and Metals TMDL. The proposed erosion and sedimentation control measures to be implemented on this road are ABACT to minimize potential impacts from this road.

MINIMIZED SOIL COMPACTION:

The Project seeks to minimize soils compaction impacts associated with access roads to the maximum extent practicable. AR-WY-029 is a proposed permanent access road for Main Line Valve 04.1. All construction and operations traffic will utilize the proposed road. The permanent access road follows the path of an existing gravel road from Sta. 4+30 to its terminus at Sta. 21+74. Soil compaction impacts have been minimized by utilization of the existing road and minimizing the roadway width to 14 feet. Additionally, infiltration and evaporation are encouraged in the MLV site pad and in the vegetated channel for infiltration proposed in the permanent road construction.

THERMAL IMPACT ANALYSIS:

Thermal impacts associated with AR-WY-029 will be avoided to the maximum extent practicable. The following measures have been implemented to minimize thermal impacts:

- ***AR-WY-029 is approximately 2,080 linear feet; however, it follows an existing gravel road for approximately 1,780 linear feet. No improvements are necessary to use the existing gravel road. Utilizing the existing gravel road minimizes the potential thermal impact of this road.***

- ***This road is proposed in a location that minimizes tree removal. The ability to use this road without the removal of additional trees acts to minimize the thermal impact of this road.***

- ***Broad based dips and water deflectors are proposed in the construction of the access road, allowing the runoff to be more easily directed away from the gravel roadway surface to proposed perimeter BMPs such as the vegetated channel for infiltration.***

- ***A vegetated channel for infiltration with check dams is proposed adjacent to the proposed permanent access road. The channel and check dams promote infiltration of the runoff from the proposed impervious road.***

Infiltration allows the runoff to assimilate to ground water temperatures which are minimally influenced by seasonal temperature changes, minimizing the thermal impact of this road.

ACIDIC SOIL MANAGEMENT PLAN:

AR-WY-029 Soil Acidity Table		
Soil Map Symbol	Soil Name	PH
Need soil symbols on plans		

An Acid Producing Soils Control Plan is included as part of this application. The plan identifies the measures to be used to control pollution associated with construction of access roads that contain acid-producing soils. The plan requires that these measures be applied only for soils with a pH less than 4.0, as recommended by the Natural Resources Conservation Service (NRCS). The table above depicts the soil types present on this road as well as the acidity of the soils. The pH of the soils on this road are outside the threshold established by the Acid Producing Soils Control Plan. Therefore, the measures prescribed in the plan do not need to be implemented for this road.

ROAD SPECIFIC CONSTRUCTION SEQUENCE:
ACCESS ROAD: AR-WY-029

1. ***At least 7 days prior to starting any earth disturbance activities, including clearing and grubbing, the owner and/or operator shall invite all contractors, Environmental Inspectors, the landowner, appropriate municipal officials, the E&S plan preparer, the PCSM plan preparer, the licensed professional responsible for oversight of critical stages of implementation of the PCSM plan, and a representative from the local conservation district to an on-site preconstruction meeting.***

2. ***At least 3 days prior to starting any earth disturbance activities, or expanding into an area previously unmarked, the Pennsylvania One Call System Inc. shall be notified at 1-800-242-1776 for the location of existing underground utilities.***

3. ***Hold pre-construction conference with the Environmental Inspectors, local County Conservation District (CCD), PADEP and Design Engineer.***

4. ***Survey crews locate and stake all special areas of concern (i.e., wetlands, streams, culverts, other utilities, etc.), edge of proposed access road, and field locate the limit of disturbance.***

5. ***Install orange construction fence around areas to be preserved.***

6. ***Locate staging areas and access points including the rock construction entrance with wash rack. Install E&SC BMPs down slope of these areas.***

7. ***Perform tree cutting where required. (Areas with tree cutting shall be restored to meadow in good condition.)***

8. ***Install rock construction entrance with wash rack.***

9. ***Remove brush to effectively install perimeter E&SC BMPs and level side cuts to grant access for vehicles and workers to safely perform the installation of sediment barriers on the Site as shown on the construction drawings.***

10. ***Install perimeter E&SC BMPs as depicted on the E&SC Plans.***

11. ***The Compliance Manager shall provide PADEP at least three days' notice prior to bulk earth disturbance and upon completed installation of perimeter erosion controls.***

12. ***If applicable, install security fence. The necessity of a security fence will be at the discretion of the Contractor.***

13. ***Proceed with major clearing and grubbing.***

14. ***Begin construction staking for layout of access road.***

15. ***Grade the access road as shown on the E&SC Plans. Add AASHTO #57 stone to the portion of the existing road to remain in areas where existing gravel is thinning or bare to create a uniform travel surface. Continue adding AASHTO #57 stone to rutted or thinning areas as necessary during active use of the access road.***

16. ***Install vegetated channels for infiltration with check dams and infiltration berm where specified on the E&SC & PCSM plans. Note: this is a critical stage of PCSM plan to be observed by a licensed professional or designee. Begin vegetated channel construction only when the upgradient temporary erosion and sediment control measures are in place. Vegetated channels should be constructed and stabilized early in the construction schedule, preferably before mass earthwork and paving increase the rate and volume of runoff. (Erosion and sediment control methods shall adhere to the Pennsylvania Department of Environmental Protection's Erosion and Sediment Pollution Control Program Manual, March 2000 or latest edition.)***

17. ***Rough grade the vegetated channel. Equipment shall avoid excessive compaction and/or land disturbance. Excavating equipment should operate from the side of the channel and never on the bottom. If excavation leads to substantial compaction of the subgrade (where an infiltration trench is not proposed), 18 inches shall be removed and replaced with a blend of topsoil and sand to promote infiltration and biological growth. At the very least, topsoil shall be thoroughly deep plowed into the subgrade in order to penetrate the compacted zone and promote aeration and the formation of macropores. Following this, the area should be disked prior to final grading of topsoil.***

18. ***Construct check dams.***

19. ***Fine grade the vegetated channel. Accurate grading is crucial for channels. Even the smallest nonconformities may compromise flow conditions.***

20. ***Seed, vegetate and install protective lining as per approved plans and according to final planting list. Vegetation should be established as soon as possible to prevent erosion and scour. Seed mix and season of planting are provided under separate cover in the Best Management Practices and Quantities Plan Set.***

21. ***Once all tributary areas are sufficiently stabilized, remove temporary erosion and sediment controls. It is very important that the channel be***

stabilized before receiving upland stormwater flow. NOTE: If a vegetated channel is used for runoff conveyance during construction, it should be regraded and reseeded immediately after construction and stabilization has occurred. Any damaged areas should be fully restored to ensure future functionality of the channel.

22. ***Rough grade the MLV pad. Equipment shall avoid excessive compaction and/or land disturbance. If excavation leads to substantial compaction of the subgrade (where an infiltration trench is not proposed), 18 inches shall be removed and replaced with a blend of topsoil and sand to promote infiltration and biological growth. At the very least, topsoil shall be thoroughly deep plowed into the subgrade in order to penetrate the compacted zone and promote aeration and the formation of macropores. Following this, the area should be disked prior to final grading.***

23. ***Caution shall be observed when excavating above the recently installed gas pipeline. Prior to excavation over the gas pipeline, confirm the depth of cover over the pipe. Decompact the pipe trench backfill as described in the previous Step.***

24. ***Place the stone and geotextile fabric within the MLV pad as specified on the E&SC & PCSM Plans. NOTE: This is a critical stage of PCSM Plan to be observed by a licensed professional or designee.***

25. ***Immediately stabilize the access road with geotextile and gravel surfacing where indicated in the E&SC Plans. Install grass pavers on the access road as indicated on the plans and place seed or sod for stabilization.***

26. ***Upon temporary cessation of an earth disturbance activity or any stage of an activity where the cessation of earth disturbance activities will exceed four days, disturbed areas shall be immediately seeded, mulched, or otherwise protected from accelerated erosion and sedimentation pending future earth disturbance activities. For an earth disturbance activity or any stage of an activity to be considered temporarily stabilized, the disturbed areas shall be covered with one of the following: a minimum uniform coverage of mulch and seed, with a density capable of resisting accelerated erosion and sedimentation, or an acceptable E&SC BMPs, which temporarily minimizes accelerated erosion and sedimentation. Temporary stabilization will not occur on active vehicular travel ways within the right of way. The on-site environmental inspector will log daily activity within the limits of disturbance and notify the Contractor of areas requiring temporary stabilization (i.e., areas where work has ceased for at least four days).***

27. ***Upon completion of all earth disturbance activities and permanent stabilization of all disturbed areas, the Owner shall contact the local CCD for an inspection prior to the removal of the E&SC BMPs. Vegetated areas must achieve a minimum uniform 70% perennial cover over the entire disturbed area to be considered stabilized. Roadways and parking areas should have at least a clean subbase in place to be considered stabilized.***

28. ***Upon local CCD and Transco approval of stabilization and re-vegetation, remove temporary E&SC BMPs and stabilize areas disturbed by removal including the perimeter sediment barrier and temporary diversions. Properly dispose/recycle E&SC BMPs. Remove orange construction fencing and, if necessary, security fence.***

29. ***Complete access road limit of disturbance stabilization, including soil treatment, seed application and mulching in areas disturbed by E&SC BMP removal.***

30. ***Upon completion of all earth disturbance activities, removal of all temporary E&SC BMPs, and permanent stabilization of all disturbed areas, the Owner shall contact the local CCD for a final inspection.***

Permanent Access Road Summary Sheet

Access Road Number:	AR-WY-029			
Watershed Name:	Gingrich Run, TSF, MF			
Act 167 Plan Name:	N/A		Date Adopted: N/A	
Design Storm Frequency	2 year	Pre-construction	Post-construction	Net Change
Rainfall Amount	2.51 inches			
Impervious area (acres)		0.000	0.154	0.154
Volume of stormwater runoff (cf) without planned stormwater BMPs		9,801	10,689	888
Volume of stormwater runoff (cf) with planned stormwater BMPs			8,044	(1,757)

Pre- vs. Post-construction Peak Rate of Flow Summary			
Stormwater discharge rate for the design frequency storm (cfs)	Pre-construction	Post-construction	Net Change
1) 1-Year/24-Hour	0.82	0.00	(0.82)
2) 2-Year/24-Hour	1.57	1.37	(0.20)
3) 5-Year/24-Hour	2.89	2.52	(0.37)
4) 10-Year/24-Hour	4.18	3.74	(0.44)
5) 25-Year/24-Hour	6.41	5.66	(0.75)
6) 50-Year/24-Hour	8.54	7.60	(0.94)
7) 100-Year/24-Hour	11.15	9.85	(1.30)

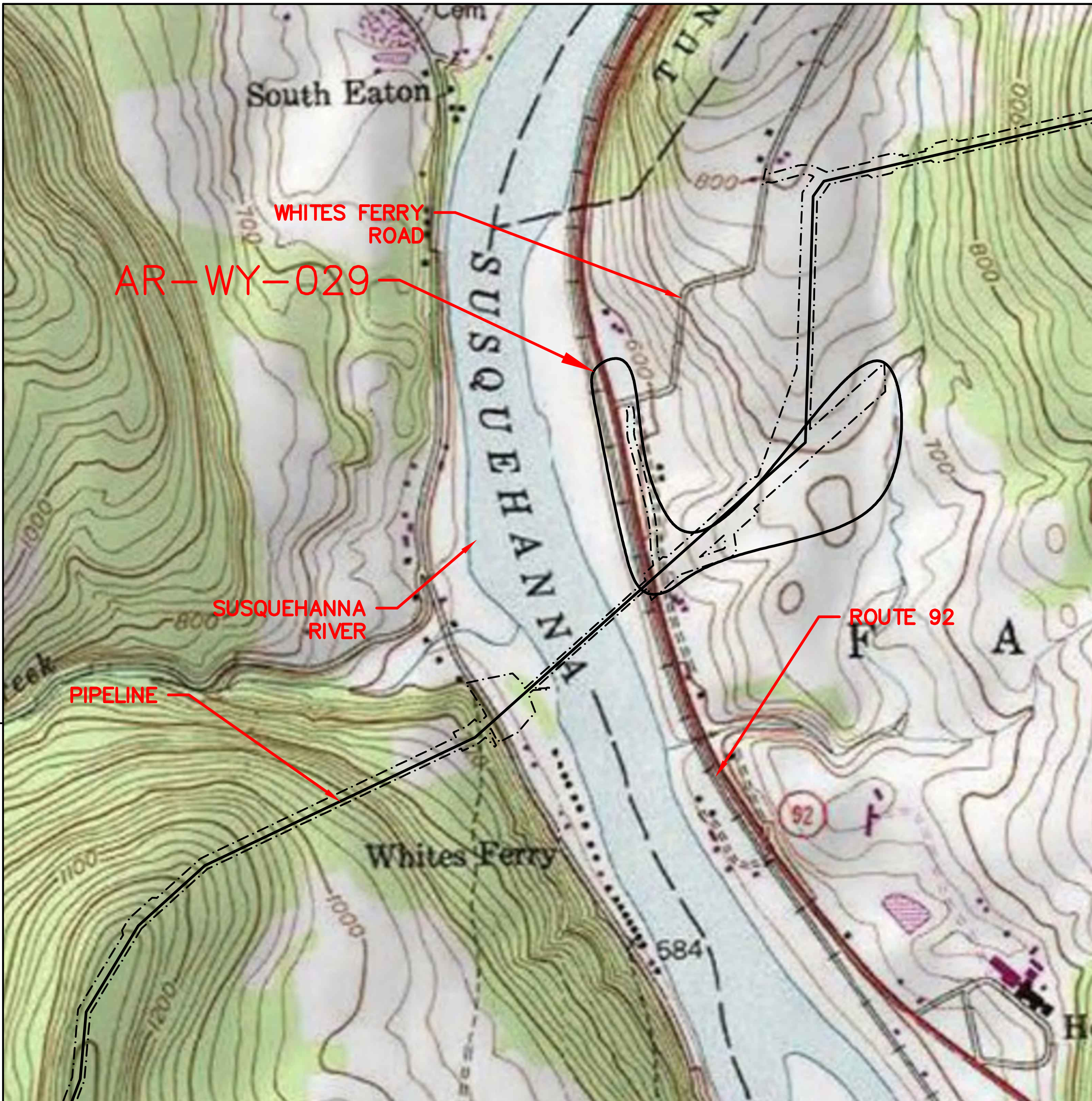
Summary Description of Restoration BMPs - Permanent Access Roads			
BMP	Function	Volume of stormwater treated (cf)	Acres treated
Natural area conservation: Pre-construction drainage pattern intact		0	0
Access road design: Ditches Culverts	Infiltration/ Recharge/Storage	1,746 Included in Ditches	0.54 Included in Ditches
Stormwater energy dissipaters: Level Spreader/Pond	Infiltration/ Recharge/Storage	0	0
Other: MLV Stone Pad Void Storage	Infiltration/ Recharge/Storage	899	0.12

Off-site Discharge Analysis:
The point of interest (POI) for the access road stormwater design is the downstream point where the access road watershed currently discharges off-site. As shown in the tables above, there is no increase in volume or peak rate of runoff at the POI. Therefore, the existing drainage pattern will be unchanged and erosion, damage, or nuisance to off-site properties is not anticipated to be caused by the Project improvements.

Loading Ratio:	***Channel***		***MLV Pad***
Maximum Impervious Loading Ratio	***2.7***	***:1 (5:1 Max)***	***1.9 :1 (5:1 Max)***
Maximum Total Loading Ratio	***7.7***	***:1* (8:1 Max)***	***1.9 :1 (8:1 Max)***

Supporting Areas	***Channel***	***MLV Pad***	***Unit***
Impervious Drainage Area	***0.19***	***0.12***	***Acres***
Infiltration Area	***0.07***	***0.06***	***Acres***
Total Drainage Area	***0.54***	***0.12***	***Acres***

L.2 Location Map



CENTER MORELAND QUADRANGLE

ARCHITECTURE
ENGINEERING
ENVIRONMENTAL
LAND SURVEYING
BL Companies

N

GRAPHIC SCALE
1,000 500 0 1,000
SCALE IN FEET

ATLANTIC SUNRISE
PROPOSED 30" NATURAL GAS PIPELINE
USGS LOCATION MAP
TEMPORARY AR-WY-029
EATON TOWNSHIP
WYOMING COUNTY, PENNSYLVANIA

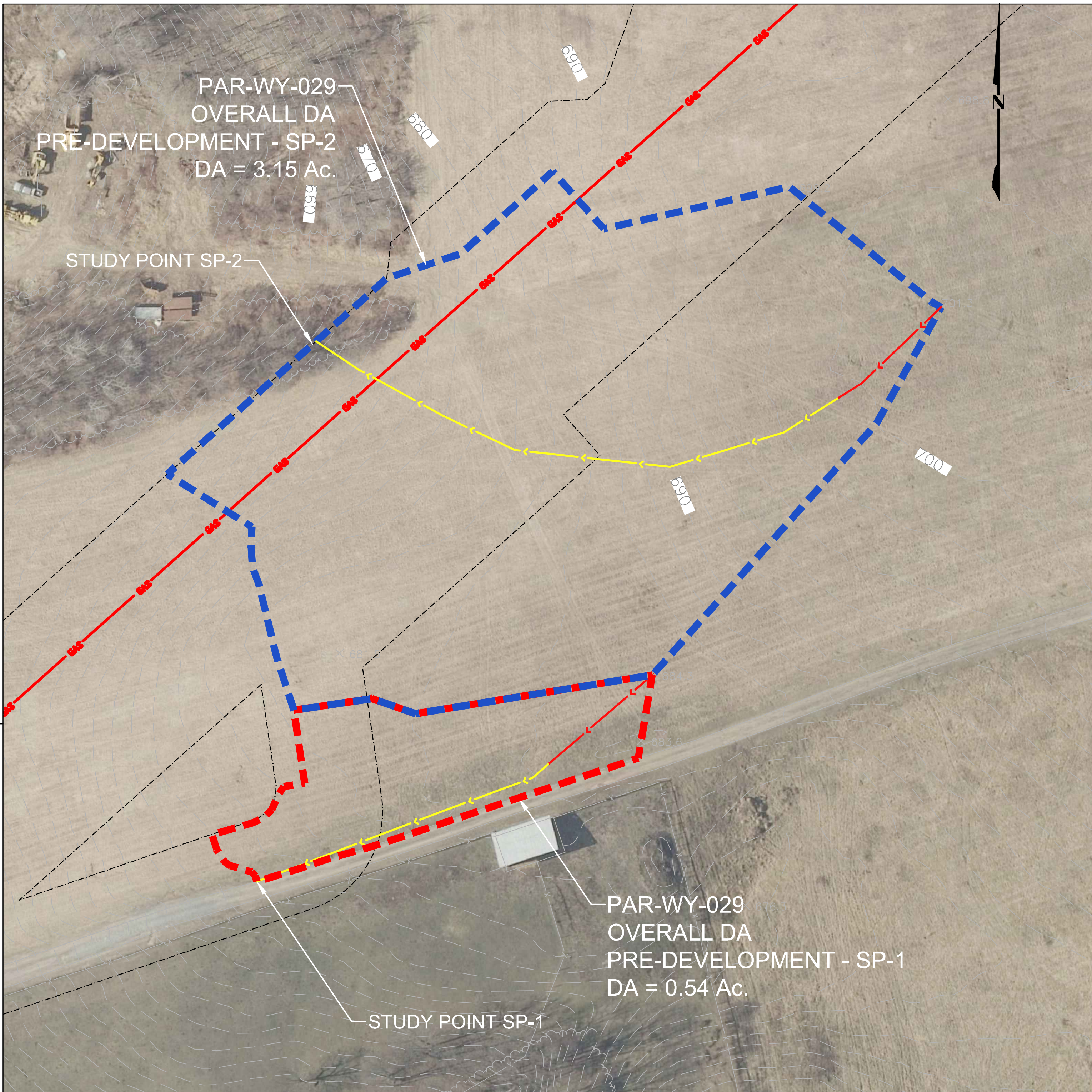
Williams

NO.	DATE	BY	REVISION DESCRIPTION	W.O. NO.	CHK.	APP.
				1161481		

DRAWN BY: CLM	DATE: 11/11/15	ISSUED FOR BID:	SCALE: 1"=1,000'
CHECKED BY:	DATE:	ISSUED FOR CONSTRUCTION:	
APPROVED BY:	DATE:	DRAWING NUMBER: 24-1601-70-28-A/ 1683_3-AR-WY-029	SHEET 1 OF 1
WO: 1161481			

L.3 Predevelopment Calculations

a. Predevelopment Drainage Area Map
b. 1-Year Rainfall Event
c. 2-Year Rainfall Event
d. 5-Year Rainfall Event
e. 10-Year Rainfall Event
f. 25-Year Rainfall Event
g. 50-year Rainfall Event
h. 100-Year Rainfall Event



PRE-DEVELOPMENT DRAINAGE AREA MAP

100 50 100
SCALE IN FEET

ISSUED FOR PERMITTING

ARCHITECTURE
ENGINEERING
ENVIRONMENTAL
LAND SURVEYING
BL Companies

LEGEND

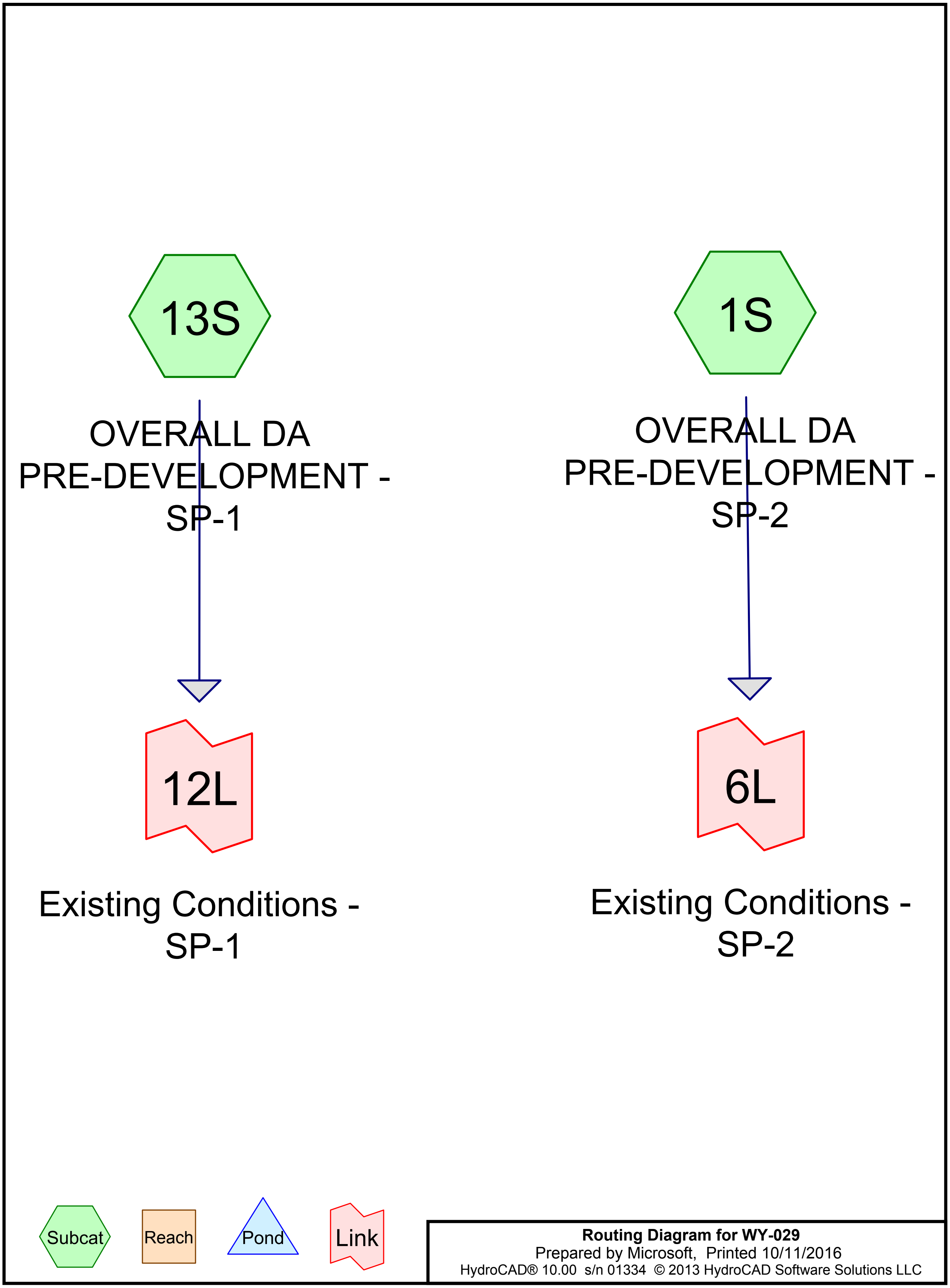
TIME OF CONCENTRATION-SHEET FLOW	
TIME OF CONCENTRATION-SHALLOW CONCENTRATED FLOW	
DRAINAGE AREA	
PROPOSED GAS PIPELINE	GAS GAS

ATLANTIC SUNRISE PROJECT -
CENTRAL PENN LINE NORTH

PROPOSED 30" NATURAL GAS PIPELINE
ACCESS ROAD DRAINAGE AREA MAP
AR-WY-029 PRE
FALLS TOWNSHIP
WYOMING COUNTY, PENNSYLVANIA

Williams

NO.	DATE	BY	REVISION DESCRIPTION	W.O. NO.	CHK.	APP.	DRAWN BY: OLC	DATE: 11/11/15	ISSUED FOR BID:	SCALE: 1" = 100'
							CHECKED BY: BJP	DATE: 11/11/15	ISSUED FOR CONSTRUCTION:	
							APPROVED BY: BJP	DATE: 11/11/15	DRAWING NUMBER: AR-WY-029 PRE	
							WO:			


13S
OVERALL DA PRE-DEVELOPMENT - SP-1
1S
OVERALL DA PRE-DEVELOPMENT - SP-2
12L
Existing Conditions - SP-1
6L
Existing Conditions - SP-2
Subcat
Reach
Pond
Link
Routing Diagram for WY-029
Prepared by Microsoft, Printed 10/11/2016
HydroCAD® 10.00 s/n 01334 © 2013 HydroCAD Software Solutions LLC

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
3.661	71	Meadow, non-grazed, HSG C (1S, 13S)
0.030	70	Woods, Good, HSG C (1S)
3.691	**71**	**TOTAL AREA**

Soil Listing (selected nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
3.691	HSG C	1S, 13S
0.000	HSG D	
0.000	Other	
3.691		**TOTAL AREA**

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: OVERALL DA Runoff Area=137,129 sf 0.00% Impervious Runoff Depth=0.31"
Flow Length=513' Tc=19.5 min CN=71 Runoff=0.75 cfs 0.080 af

Subcatchment13S: OVERALL DA Runoff Area=23,662 sf 0.00% Impervious Runoff Depth=0.31"
Flow Length=330' Tc=43.2 min CN=71 Runoff=0.07 cfs 0.014 af

Link 6L: Existing Conditions - SP-2 Inflow=0.75 cfs 0.080 af
Primary=0.75 cfs 0.080 af

Link 12L: Existing Conditions - SP-1 Inflow=0.07 cfs 0.014 af
Primary=0.07 cfs 0.014 af

Total Runoff Area = 3.691 ac Runoff Volume = 0.094 af Average Runoff Depth = 0.31"
100.00% Pervious = 3.691 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1S: OVERALL DA PRE-DEVELOPMENT - SP-2

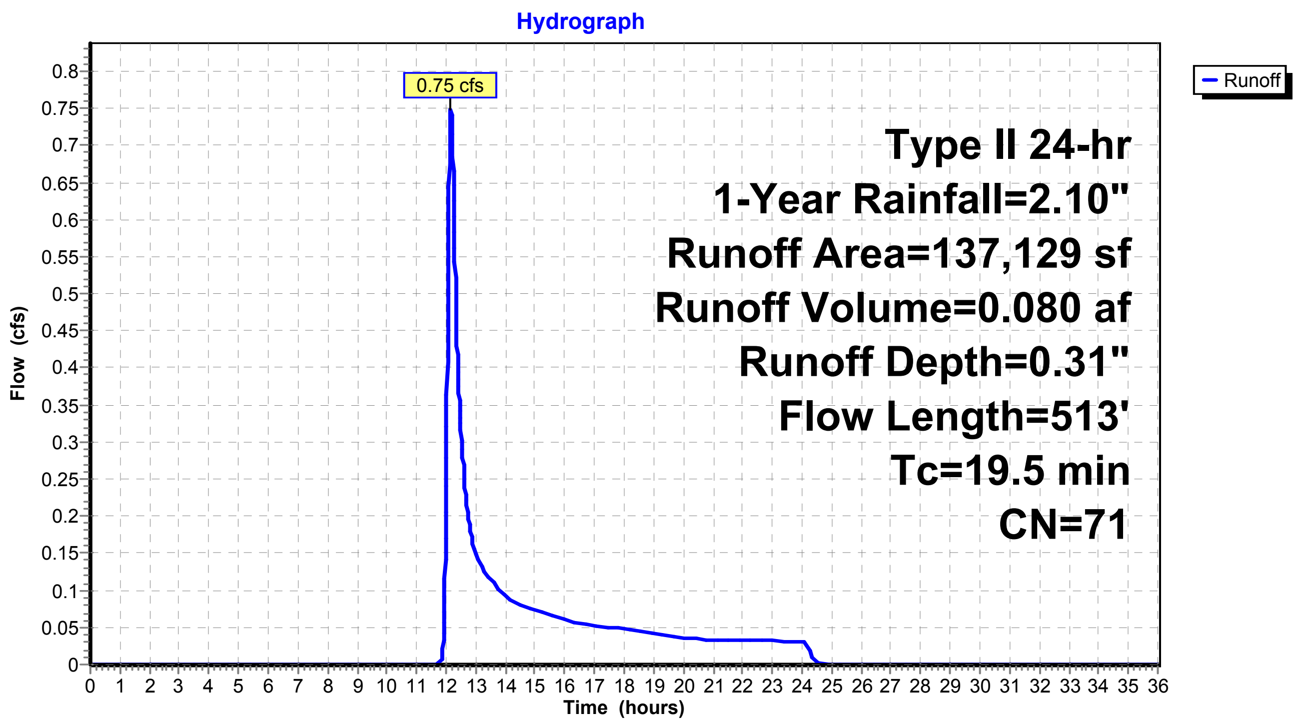
Runoff = 0.75 cfs @ 12.16 hrs, Volume= 0.080 af, Depth= 0.31"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 1-Year Rainfall=2.10"

Area (sf)	CN	Description
0	89	Gravel roads, HSG C
1,299	70	Woods, Good, HSG C
135,830	71	Meadow, non-grazed, HSG C
0	98	Paved parking, HSG C
137,129	71	Weighted Average
137,129		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.1	100	0.0200	0.10		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 2.51"
3.3	400	0.0840	2.03		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
0.1	13	0.0840	1.45		**Shallow Concentrated Flow, SC2** Woodland Kv= 5.0 fps
19.5	513	Total			

Subcatchment 1S: OVERALL DA PRE-DEVELOPMENT - SP-2



Summary for Subcatchment 13S: OVERALL DA PRE-DEVELOPMENT - SP-1

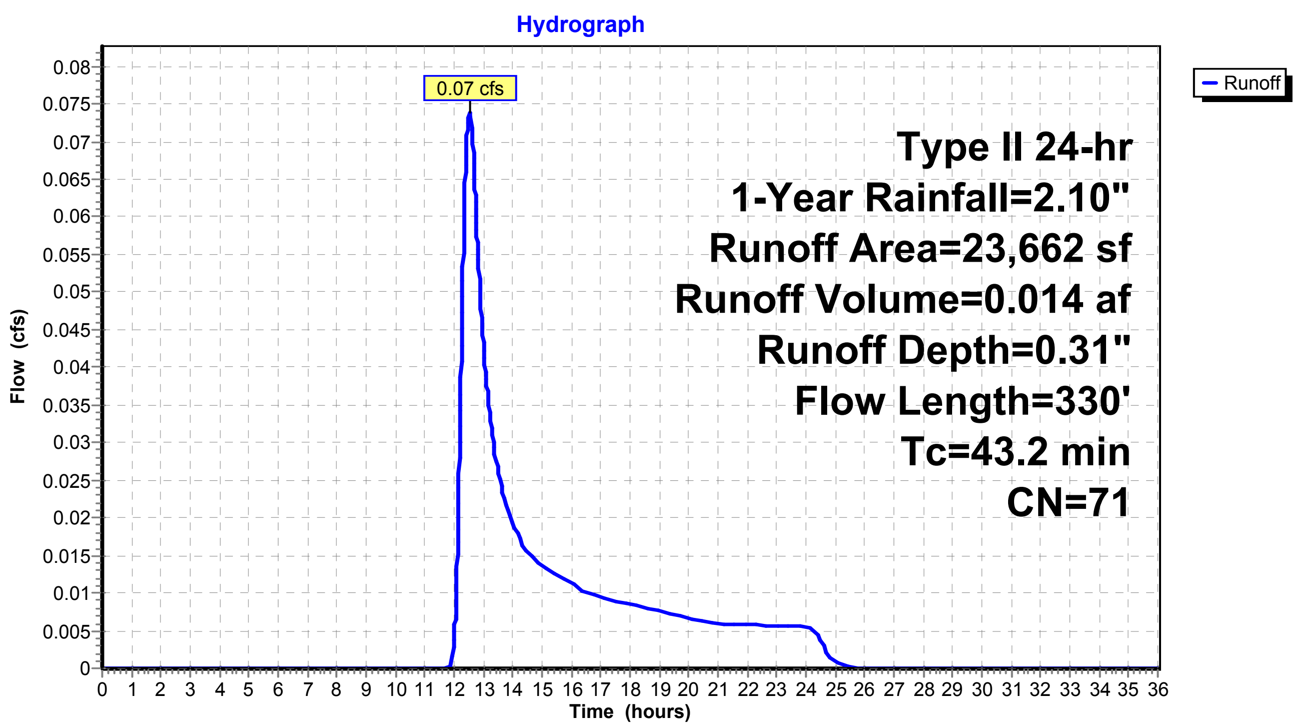
Runoff = 0.07 cfs @ 12.53 hrs, Volume= 0.014 af, Depth= 0.31"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 1-Year Rainfall=2.10"

Area (sf)	CN	Description
0	89	Gravel roads, HSG C
0	70	Woods, Good, HSG C
23,662	71	Meadow, non-grazed, HSG C
0	98	Paved parking, HSG C
23,662	71	Weighted Average
23,662		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
40.5	100	0.0020	0.04		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 2.51"
2.7	230	0.0400	1.40		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
43.2	330	Total			

Subcatchment 13S: OVERALL DA PRE-DEVELOPMENT - SP-1

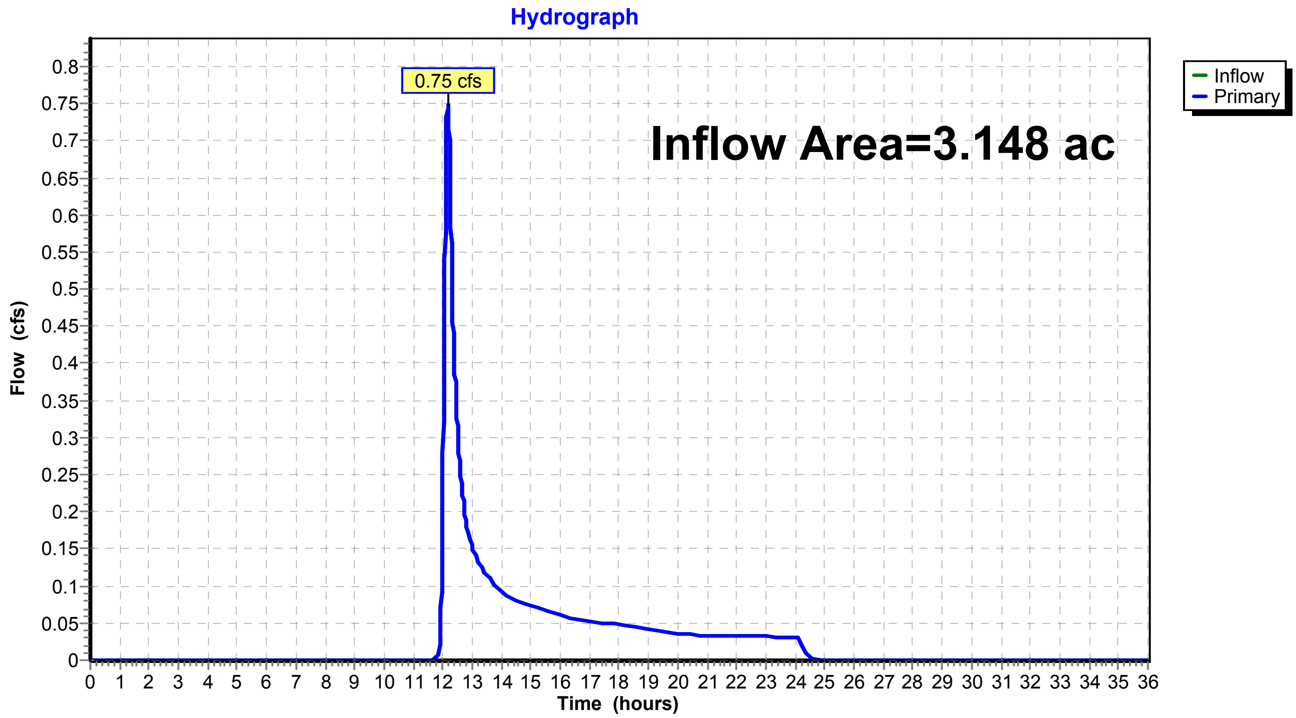


Summary for Link 6L: Existing Conditions - SP-2

Inflow Area =	3.148 ac,	0.00% Impervious, Inflow Depth = 0.31"	for 1-Year event	
Inflow =	0.75 cfs @	12.16 hrs, Volume=	0.080 af	
Primary =	0.75 cfs @	12.16 hrs, Volume=	0.080 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

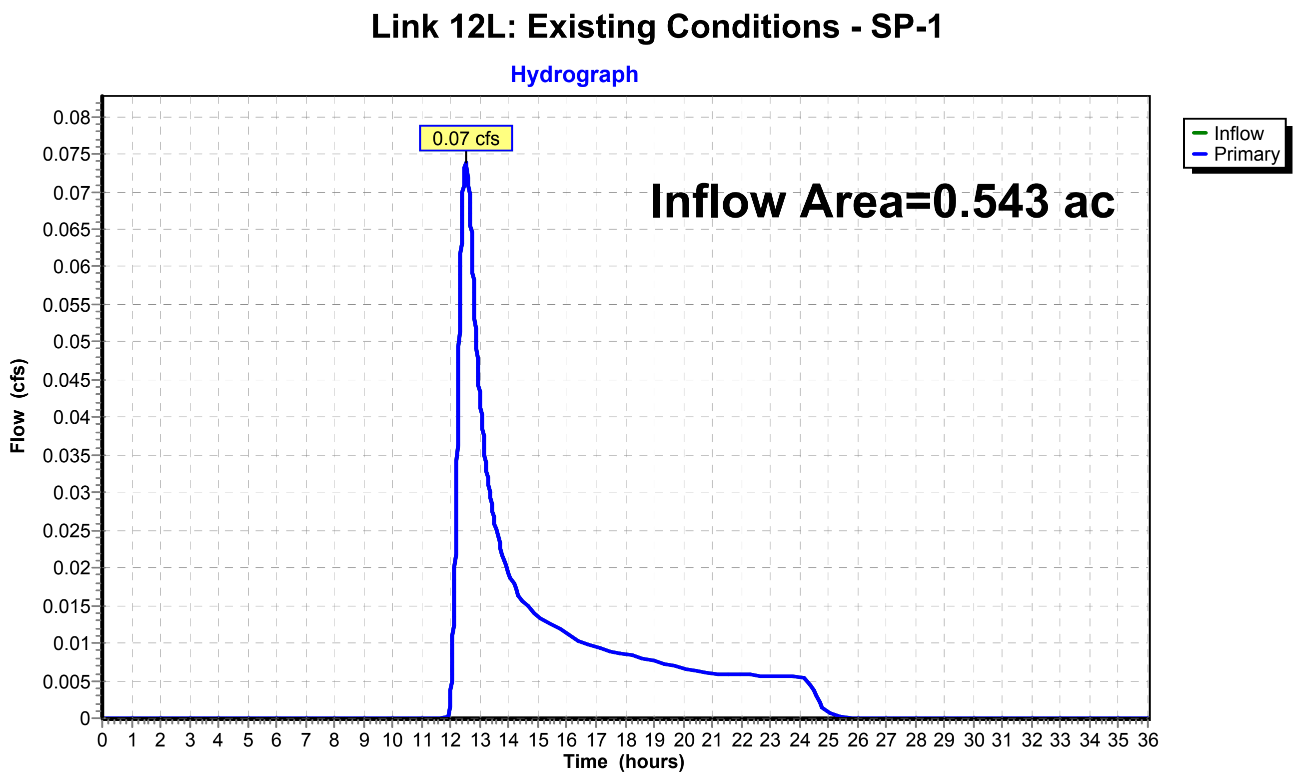
Link 6L: Existing Conditions - SP-2



Summary for Link 12L: Existing Conditions - SP-1

Inflow Area =	0.543 ac,	0.00% Impervious,	Inflow Depth = 0.31"	for 1-Year event	
Inflow =	0.07 cfs @	12.53 hrs,	Volume=	0.014 af	
Primary =	0.07 cfs @	12.53 hrs,	Volume=	0.014 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs



Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: OVERALL DA Runoff Area=137,129 sf 0.00% Impervious Runoff Depth=0.50"
Flow Length=513' Tc=19.5 min CN=71 Runoff=1.43 cfs 0.130 af

Subcatchment 13S: OVERALL DA Runoff Area=23,662 sf 0.00% Impervious Runoff Depth=0.50"
Flow Length=330' Tc=43.2 min CN=71 Runoff=0.14 cfs 0.022 af

Link 6L: Existing Conditions - SP-2 Inflow=1.43 cfs 0.130 af
Primary=1.43 cfs 0.130 af

Link 12L: Existing Conditions - SP-1 Inflow=0.14 cfs 0.022 af
Primary=0.14 cfs 0.022 af

Total Runoff Area = 3.691 ac Runoff Volume = 0.153 af Average Runoff Depth = 0.50"
100.00% Pervious = 3.691 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1S: OVERALL DA PRE-DEVELOPMENT - SP-2

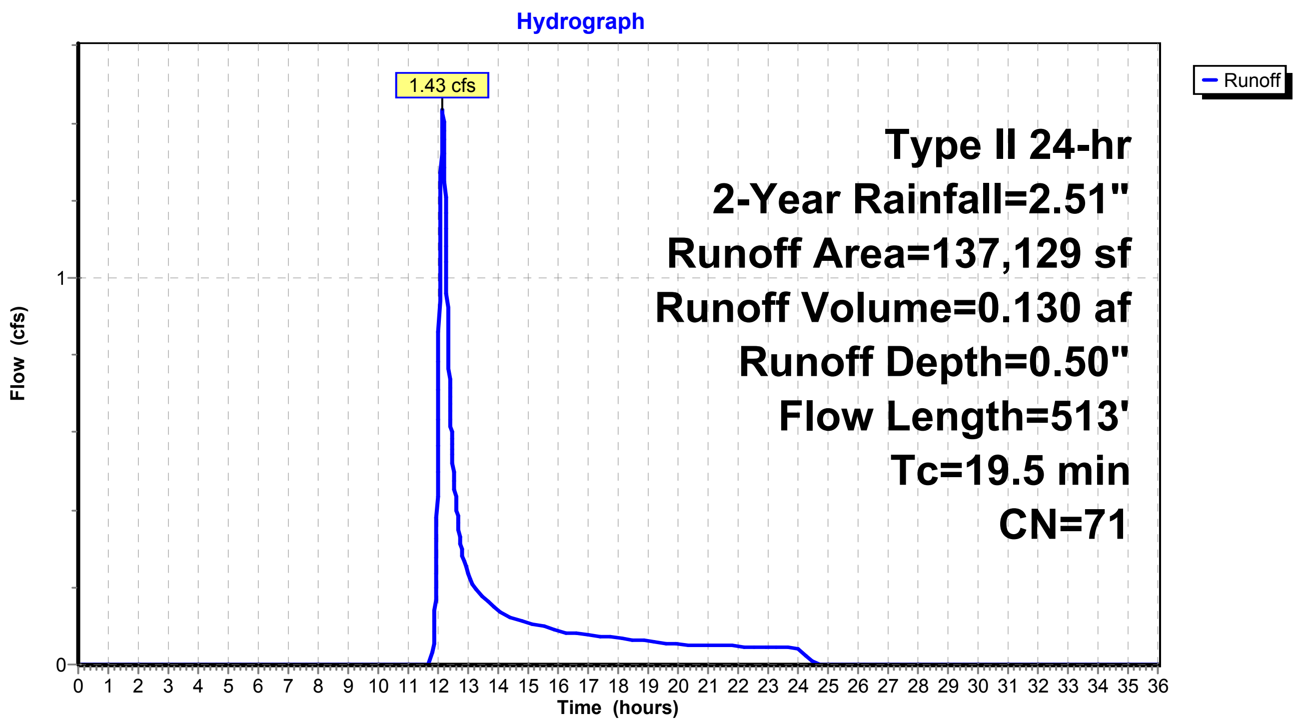
Runoff = 1.43 cfs @ 12.15 hrs, Volume= 0.130 af, Depth= 0.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 2-Year Rainfall=2.51"

Area (sf)	CN	Description
0	89	Gravel roads, HSG C
1,299	70	Woods, Good, HSG C
135,830	71	Meadow, non-grazed, HSG C
0	98	Paved parking, HSG C
137,129	71	Weighted Average
137,129		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.1	100	0.0200	0.10		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 2.51"
3.3	400	0.0840	2.03		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
0.1	13	0.0840	1.45		**Shallow Concentrated Flow, SC2** Woodland Kv= 5.0 fps
19.5	513	Total			

Subcatchment 1S: OVERALL DA PRE-DEVELOPMENT - SP-2



Summary for Subcatchment 13S: OVERALL DA PRE-DEVELOPMENT - SP-1

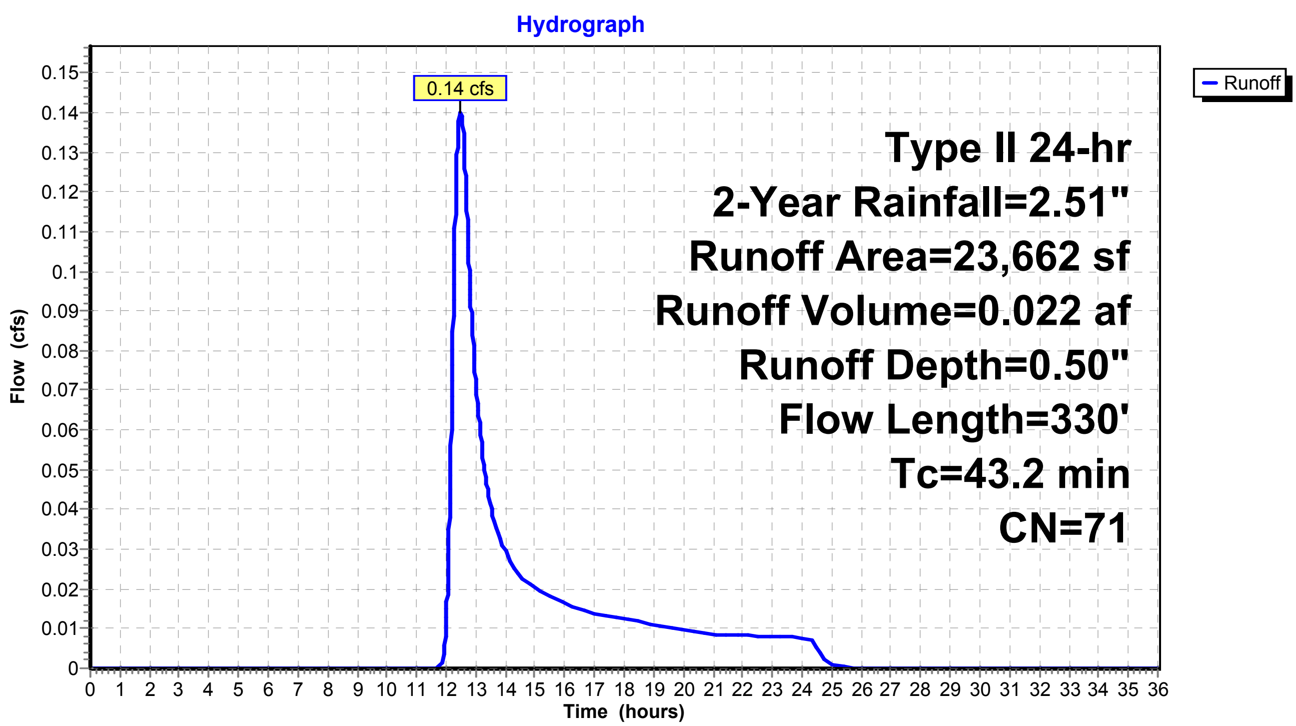
Runoff = 0.14 cfs @ 12.48 hrs, Volume= 0.022 af, Depth= 0.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 2-Year Rainfall=2.51"

Area (sf)	CN	Description
0	89	Gravel roads, HSG C
0	70	Woods, Good, HSG C
23,662	71	Meadow, non-grazed, HSG C
0	98	Paved parking, HSG C
23,662	71	Weighted Average
23,662		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
40.5	100	0.0020	0.04		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 2.51"
2.7	230	0.0400	1.40		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
43.2	330	Total			

Subcatchment 13S: OVERALL DA PRE-DEVELOPMENT - SP-1

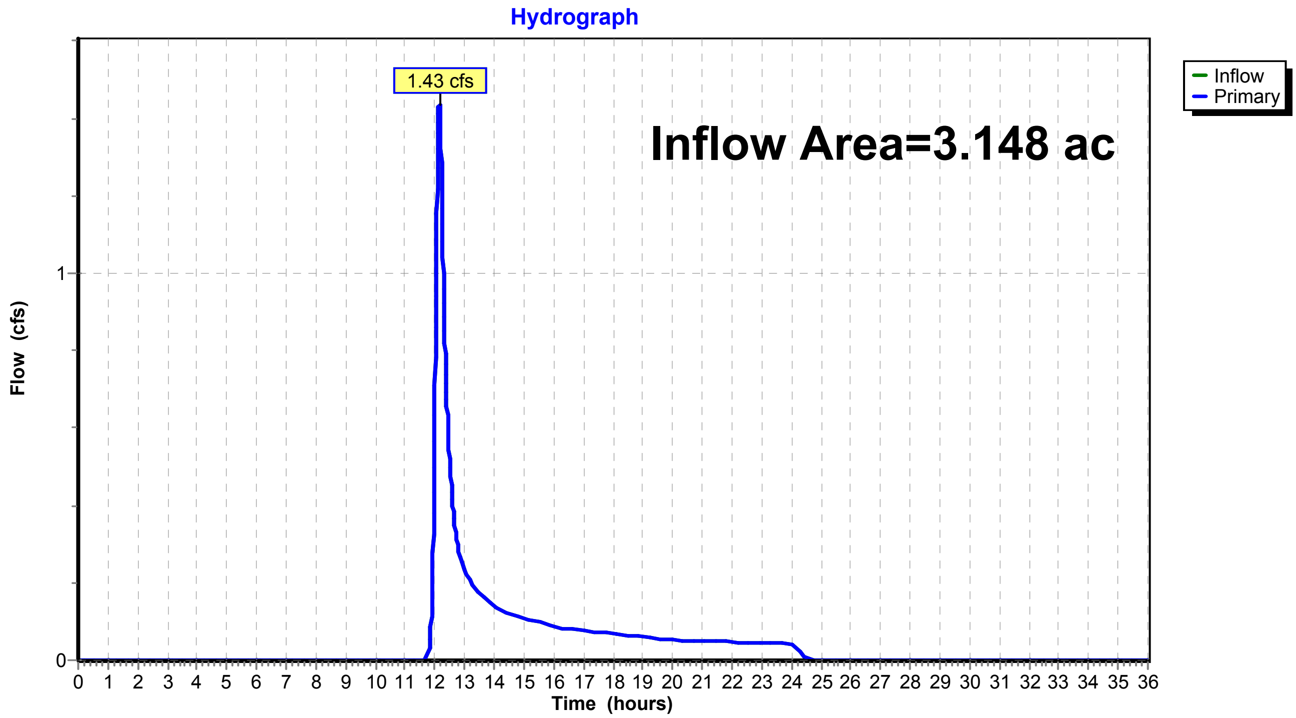


Summary for Link 6L: Existing Conditions - SP-2

Inflow Area =	3.148 ac,	0.00% Impervious, Inflow Depth = 0.50"	for 2-Year event	
Inflow =	1.43 cfs @	12.15 hrs, Volume=	0.130 af	
Primary =	1.43 cfs @	12.15 hrs, Volume=	0.130 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Link 6L: Existing Conditions - SP-2

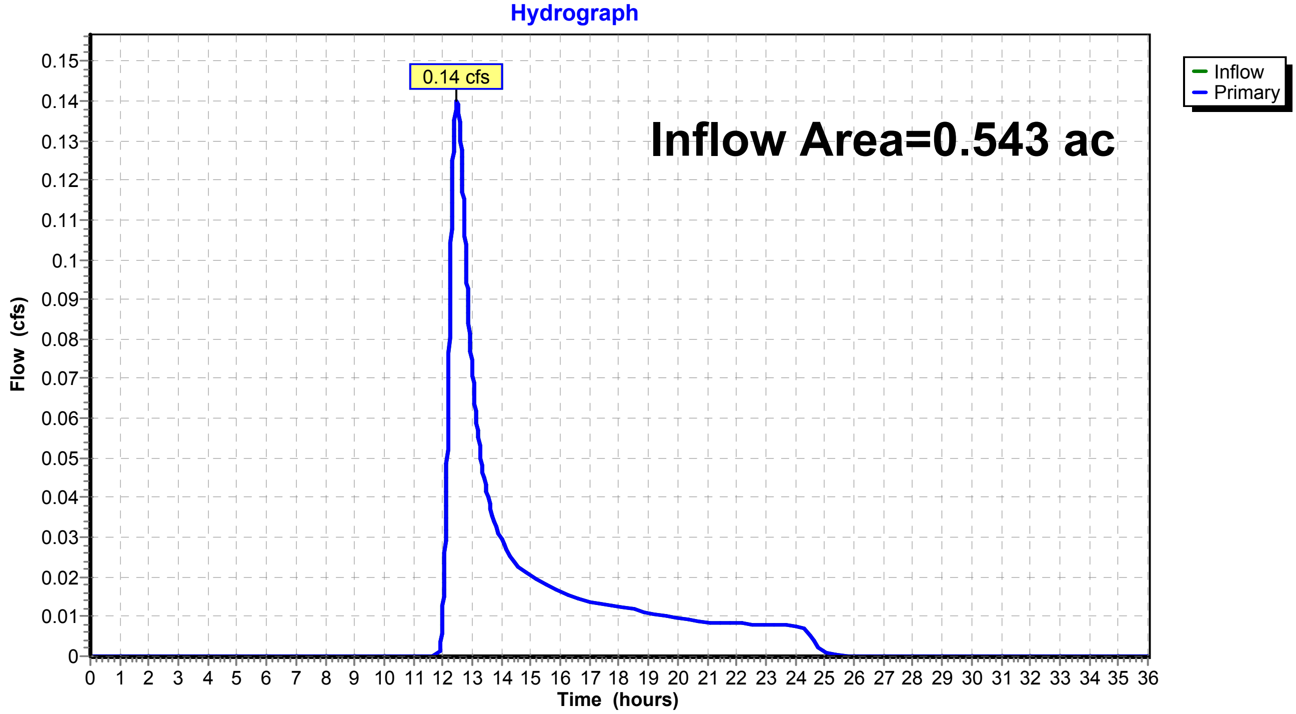


Summary for Link 12L: Existing Conditions - SP-1

Inflow Area =	0.543 ac,	0.00% Impervious, Inflow Depth = 0.50"	for 2-Year event	
Inflow =	0.14 cfs @	12.48 hrs, Volume=	0.022 af	
Primary =	0.14 cfs @	12.48 hrs, Volume=	0.022 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Link 12L: Existing Conditions - SP-1



Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: OVERALL DA Runoff Area=137,129 sf 0.00% Impervious Runoff Depth=0.82"
Flow Length=513' Tc=19.5 min CN=71 Runoff=2.63 cfs 0.215 af

Subcatchment13S: OVERALL DA Runoff Area=23,662 sf 0.00% Impervious Runoff Depth=0.82"
Flow Length=330' Tc=43.2 min CN=71 Runoff=0.26 cfs 0.037 af

Link 6L: Existing Conditions - SP-2 Inflow=2.63 cfs 0.215 af
Primary=2.63 cfs 0.215 af

Link 12L: Existing Conditions - SP-1 Inflow=0.26 cfs 0.037 af
Primary=0.26 cfs 0.037 af

Total Runoff Area = 3.691 ac Runoff Volume = 0.252 af Average Runoff Depth = 0.82"
100.00% Pervious = 3.691 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1S: OVERALL DA PRE-DEVELOPMENT - SP-2

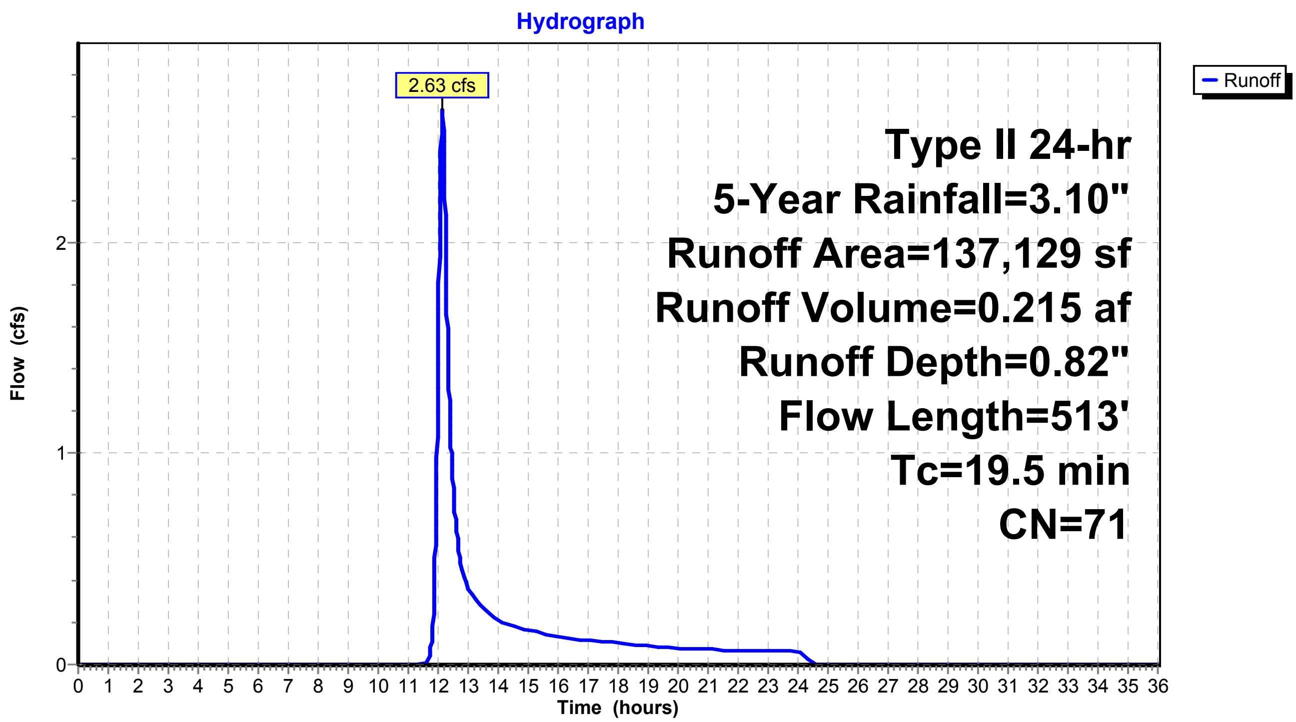
Runoff = 2.63 cfs @ 12.14 hrs, Volume= 0.215 af, Depth= 0.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 5-Year Rainfall=3.10"

Area (sf)	CN	Description
0	89	Gravel roads, HSG C
1,299	70	Woods, Good, HSG C
135,830	71	Meadow, non-grazed, HSG C
0	98	Paved parking, HSG C
137,129	71	Weighted Average
137,129		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.1	100	0.0200	0.10		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 2.51"
3.3	400	0.0840	2.03		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
0.1	13	0.0840	1.45		**Shallow Concentrated Flow, SC2** Woodland Kv= 5.0 fps
19.5	513	Total			

Subcatchment 1S: OVERALL DA PRE-DEVELOPMENT - SP-2



Summary for Subcatchment 13S: OVERALL DA PRE-DEVELOPMENT - SP-1

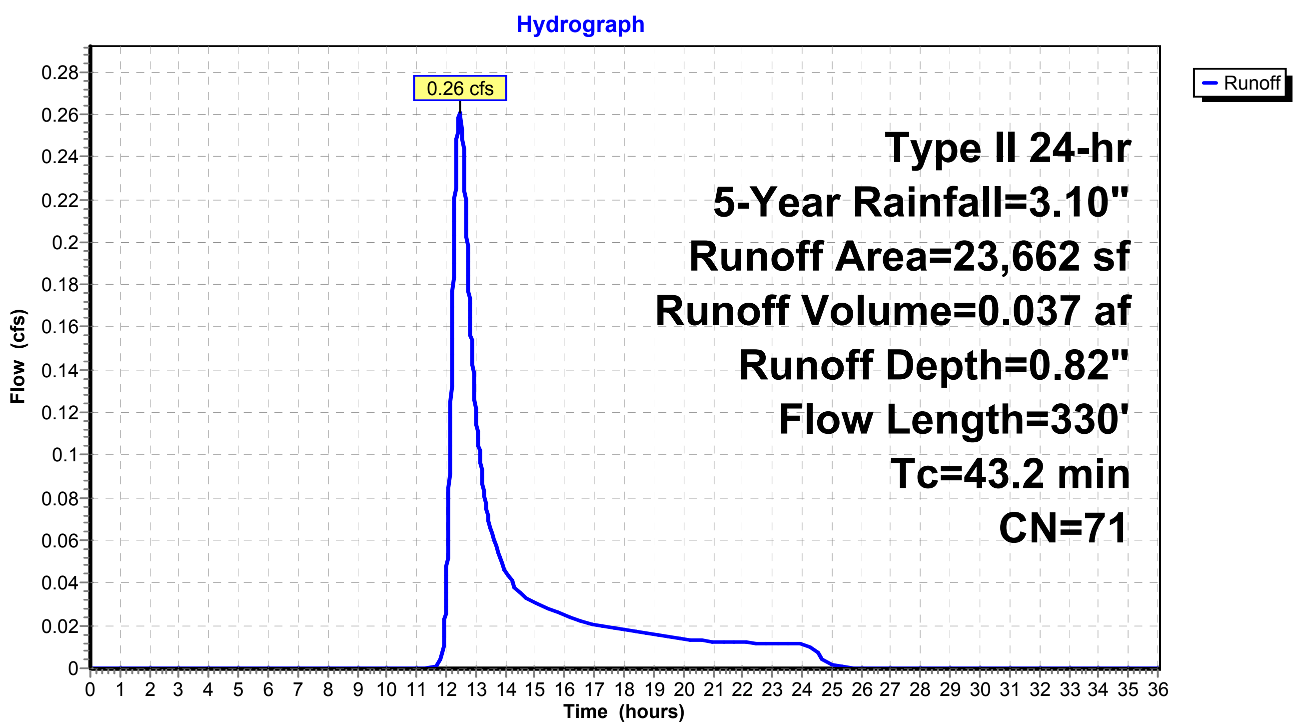
Runoff = 0.26 cfs @ 12.44 hrs, Volume= 0.037 af, Depth= 0.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 5-Year Rainfall=3.10"

Area (sf)	CN	Description
0	89	Gravel roads, HSG C
0	70	Woods, Good, HSG C
23,662	71	Meadow, non-grazed, HSG C
0	98	Paved parking, HSG C
23,662	71	Weighted Average
23,662		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
40.5	100	0.0020	0.04		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 2.51"
2.7	230	0.0400	1.40		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
43.2	330	Total			

Subcatchment 13S: OVERALL DA PRE-DEVELOPMENT - SP-1

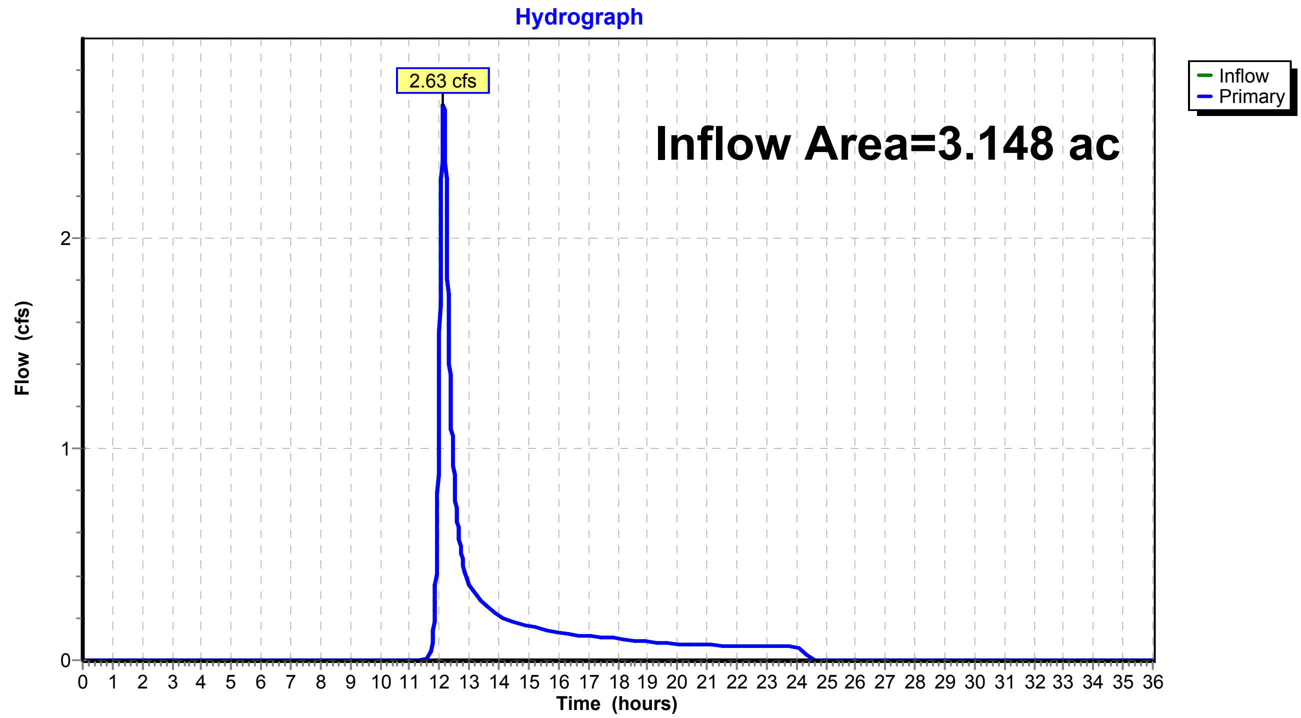


Summary for Link 6L: Existing Conditions - SP-2

Inflow Area =	3.148 ac,	0.00% Impervious,	Inflow Depth = 0.82"	for 5-Year event	
Inflow =	2.63 cfs @	12.14 hrs,	Volume=	0.215 af	
Primary =	2.63 cfs @	12.14 hrs,	Volume=	0.215 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Link 6L: Existing Conditions - SP-2

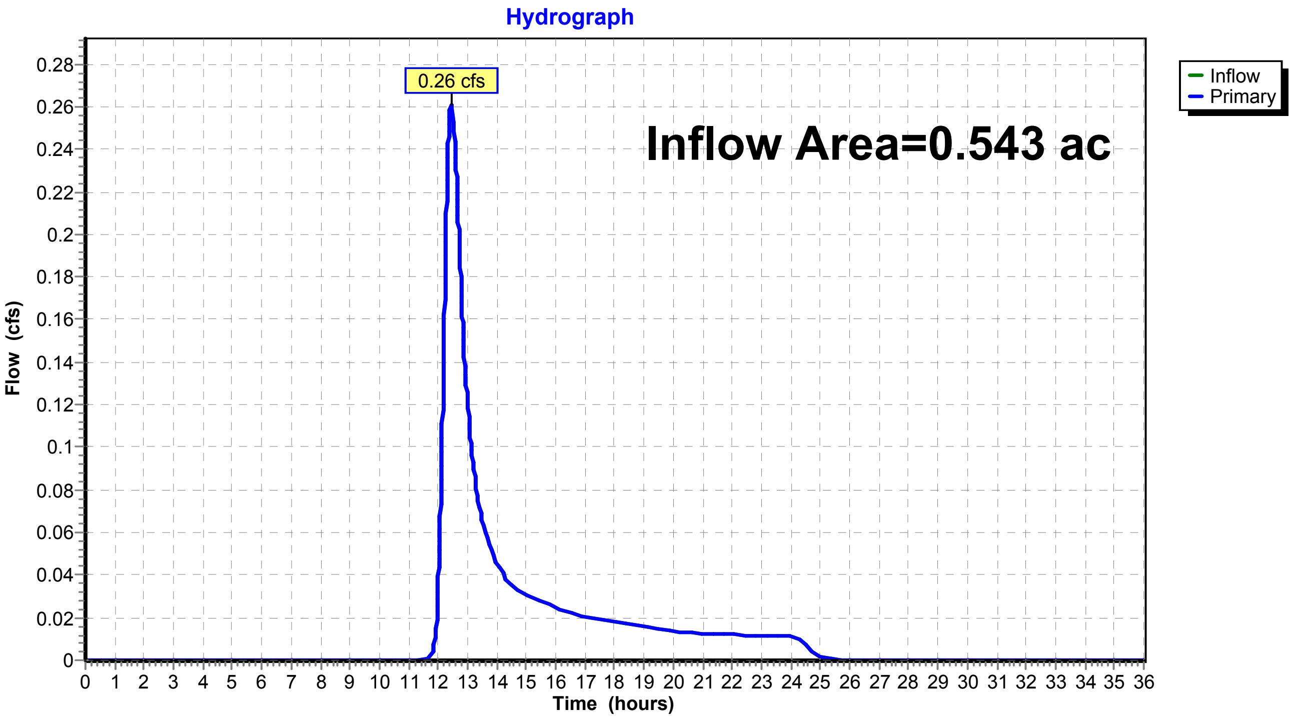


Summary for Link 12L: Existing Conditions - SP-1

Inflow Area =	0.543 ac,	0.00% Impervious, Inflow Depth = 0.82"	for 5-Year event
Inflow =	0.26 cfs @	12.44 hrs, Volume=	0.037 af
Primary =	0.26 cfs @	12.44 hrs, Volume=	0.037 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Link 12L: Existing Conditions - SP-1



Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: OVERALL DA Runoff Area=137,129 sf 0.00% Impervious Runoff Depth=1.13"
Flow Length=513' Tc=19.5 min CN=71 Runoff=3.80 cfs 0.298 af

Subcatchment 13S: OVERALL DA Runoff Area=23,662 sf 0.00% Impervious Runoff Depth=1.13"
Flow Length=330' Tc=43.2 min CN=71 Runoff=0.38 cfs 0.051 af

Link 6L: Existing Conditions - SP-2 Inflow=3.80 cfs 0.298 af
Primary=3.80 cfs 0.298 af

Link 12L: Existing Conditions - SP-1 Inflow=0.38 cfs 0.051 af
Primary=0.38 cfs 0.051 af

Total Runoff Area = 3.691 ac Runoff Volume = 0.349 af Average Runoff Depth = 1.13"
100.00% Pervious = 3.691 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1S: OVERALL DA PRE-DEVELOPMENT - SP-2

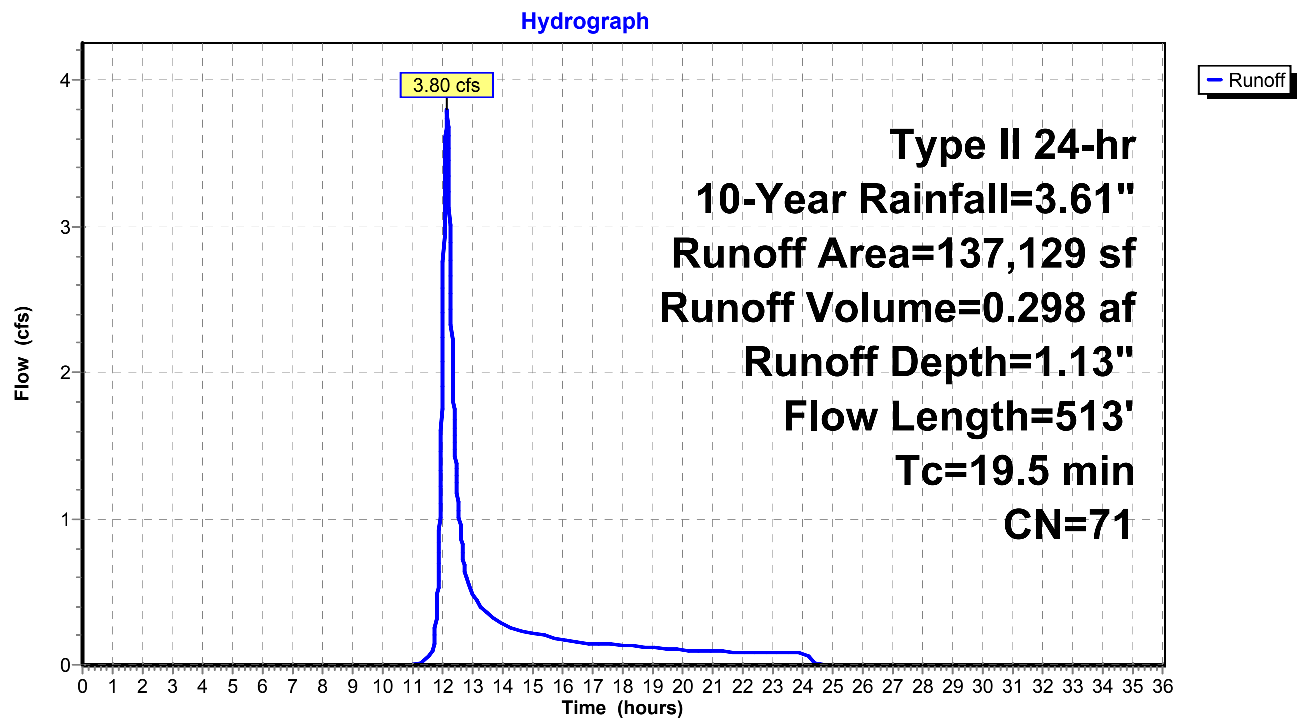
Runoff = 3.80 cfs @ 12.13 hrs, Volume= 0.298 af, Depth= 1.13"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 10-Year Rainfall=3.61"

Area (sf)	CN	Description
0	89	Gravel roads, HSG C
1,299	70	Woods, Good, HSG C
135,830	71	Meadow, non-grazed, HSG C
0	98	Paved parking, HSG C
137,129	71	Weighted Average
137,129		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.1	100	0.0200	0.10		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 2.51"
3.3	400	0.0840	2.03		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
0.1	13	0.0840	1.45		**Shallow Concentrated Flow, SC2** Woodland Kv= 5.0 fps
19.5	513	Total			

Subcatchment 1S: OVERALL DA PRE-DEVELOPMENT - SP-2



Summary for Subcatchment 13S: OVERALL DA PRE-DEVELOPMENT - SP-1

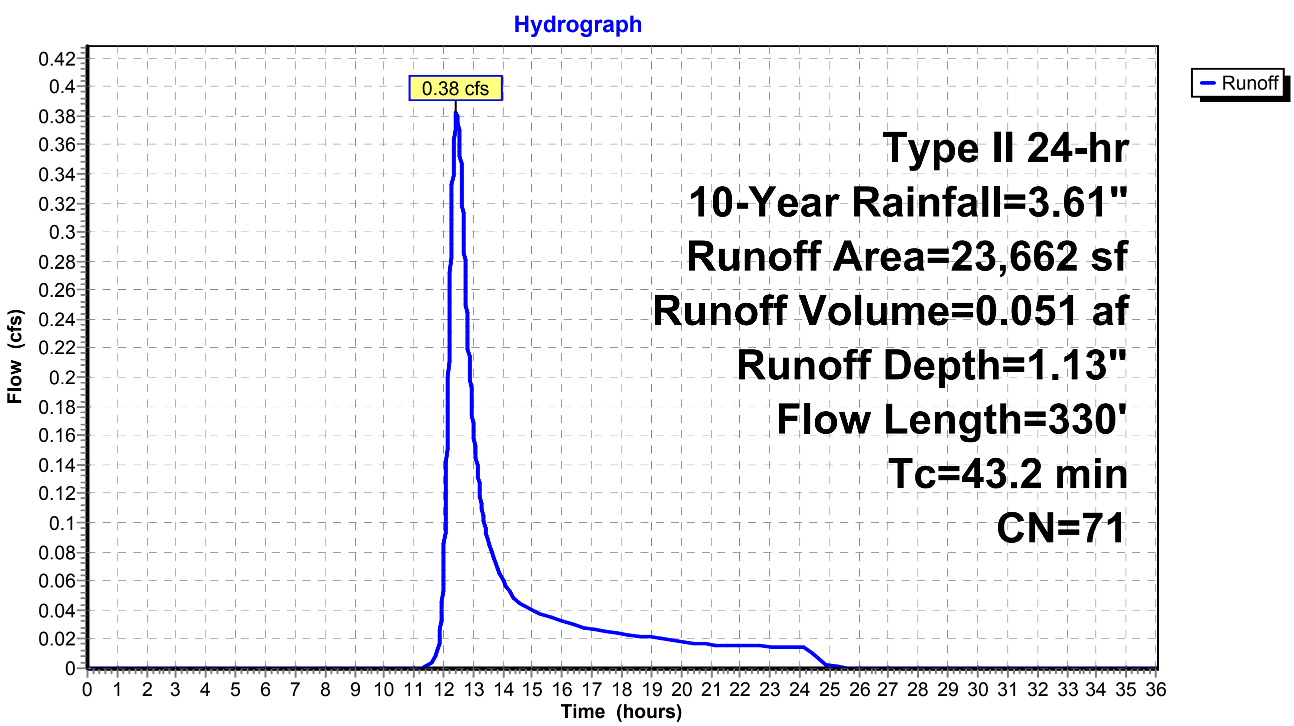
Runoff = 0.38 cfs @ 12.43 hrs, Volume= 0.051 af, Depth= 1.13"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 10-Year Rainfall=3.61"

Area (sf)	CN	Description
0	89	Gravel roads, HSG C
0	70	Woods, Good, HSG C
23,662	71	Meadow, non-grazed, HSG C
0	98	Paved parking, HSG C
23,662	71	Weighted Average
23,662		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
40.5	100	0.0020	0.04		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 2.51"
2.7	230	0.0400	1.40		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
43.2	330	Total			

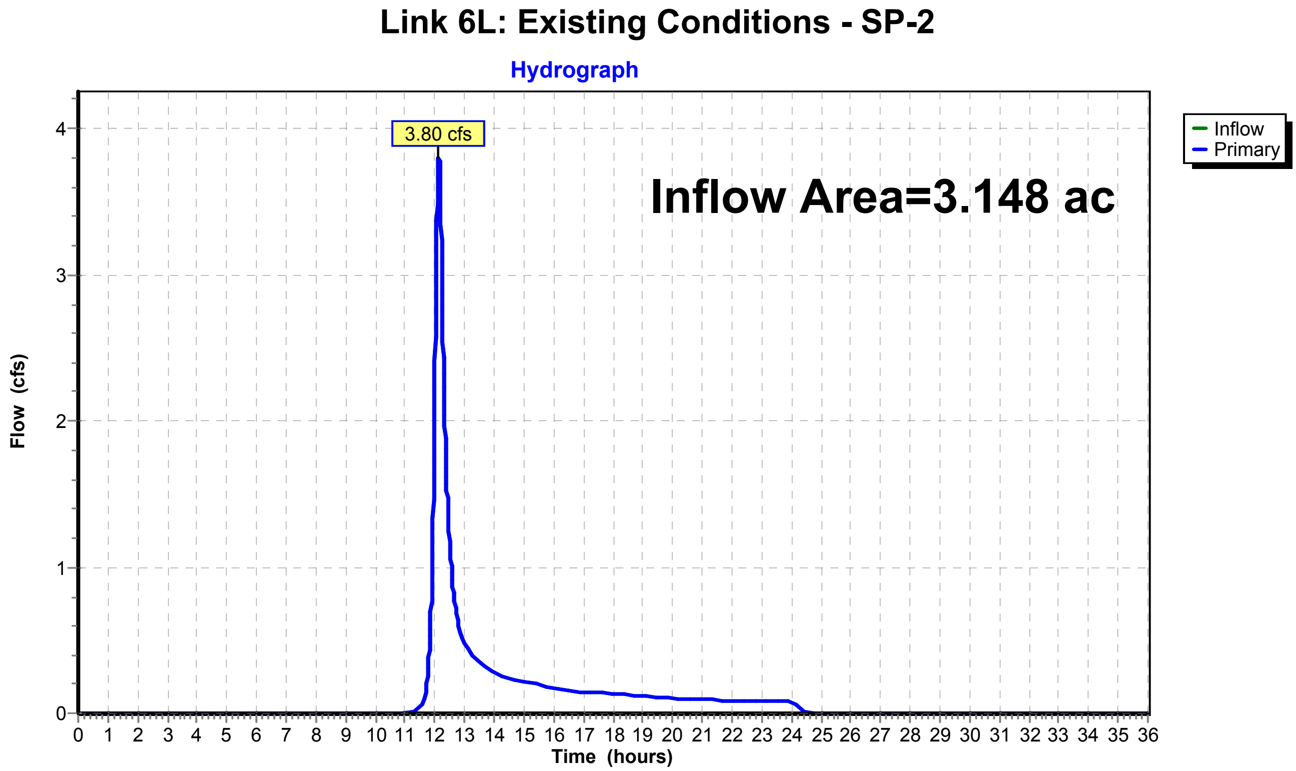
Subcatchment 13S: OVERALL DA PRE-DEVELOPMENT - SP-1



Summary for Link 6L: Existing Conditions - SP-2

Inflow Area =	3.148 ac,	0.00% Impervious,	Inflow Depth = 1.13"	for 10-Year event	
Inflow =	3.80 cfs @	12.13 hrs,	Volume=	0.298 af	
Primary =	3.80 cfs @	12.13 hrs,	Volume=	0.298 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

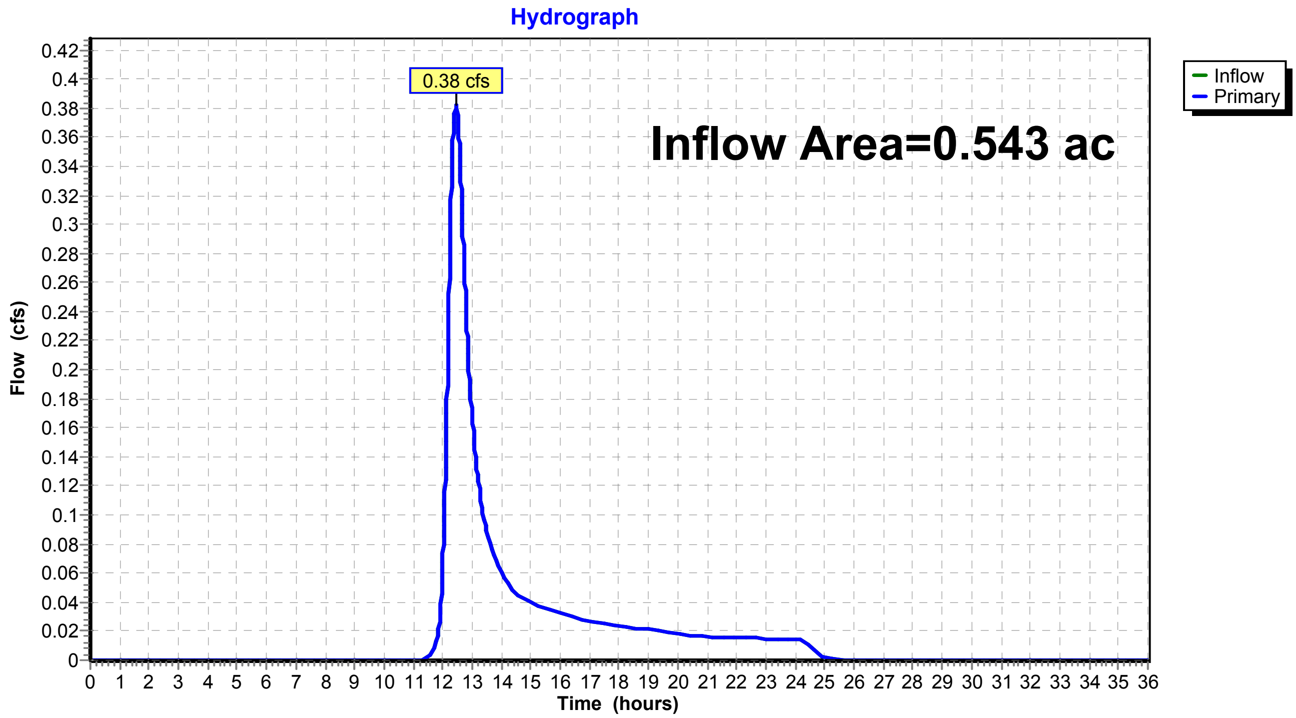


Summary for Link 12L: Existing Conditions - SP-1

Inflow Area =	0.543 ac,	0.00% Impervious, Inflow Depth = 1.13"	for 10-Year event	
Inflow =	0.38 cfs @	12.43 hrs, Volume=	0.051 af	
Primary =	0.38 cfs @	12.43 hrs, Volume=	0.051 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Link 12L: Existing Conditions - SP-1



Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: OVERALL DA Runoff Area=137,129 sf 0.00% Impervious Runoff Depth=1.68"
Flow Length=513' Tc=19.5 min CN=71 Runoff=5.82 cfs 0.441 af

Subcatchment 13S: OVERALL DA Runoff Area=23,662 sf 0.00% Impervious Runoff Depth=1.68"
Flow Length=330' Tc=43.2 min CN=71 Runoff=0.59 cfs 0.076 af

Link 6L: Existing Conditions - SP-2 Inflow=5.82 cfs 0.441 af
Primary=5.82 cfs 0.441 af

Link 12L: Existing Conditions - SP-1 Inflow=0.59 cfs 0.076 af
Primary=0.59 cfs 0.076 af

Total Runoff Area = 3.691 ac Runoff Volume = 0.517 af Average Runoff Depth = 1.68"
100.00% Pervious = 3.691 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1S: OVERALL DA PRE-DEVELOPMENT - SP-2

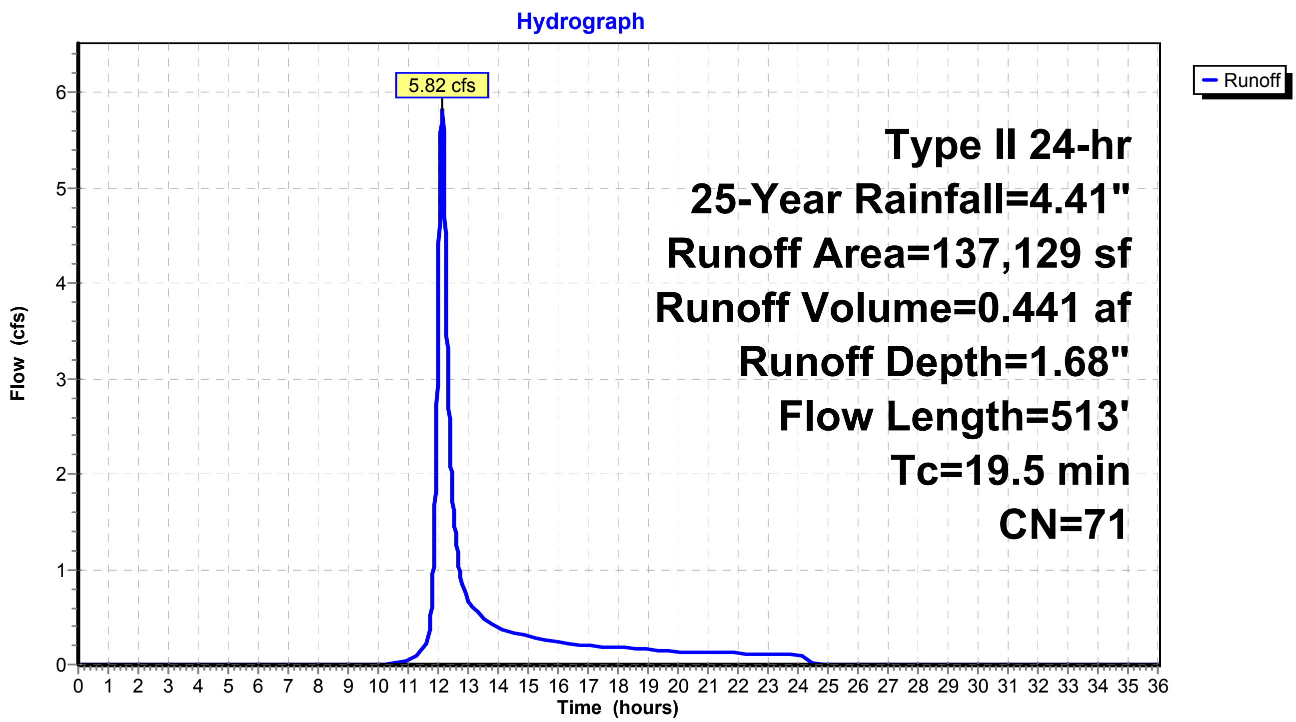
Runoff = 5.82 cfs @ 12.13 hrs, Volume= 0.441 af, Depth= 1.68"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=4.41"

Area (sf)	CN	Description
0	89	Gravel roads, HSG C
1,299	70	Woods, Good, HSG C
135,830	71	Meadow, non-grazed, HSG C
0	98	Paved parking, HSG C
137,129	71	Weighted Average
137,129		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.1	100	0.0200	0.10		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 2.51"
3.3	400	0.0840	2.03		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
0.1	13	0.0840	1.45		**Shallow Concentrated Flow, SC2** Woodland Kv= 5.0 fps
19.5	513	Total			

Subcatchment 1S: OVERALL DA PRE-DEVELOPMENT - SP-2



Summary for Subcatchment 13S: OVERALL DA PRE-DEVELOPMENT - SP-1

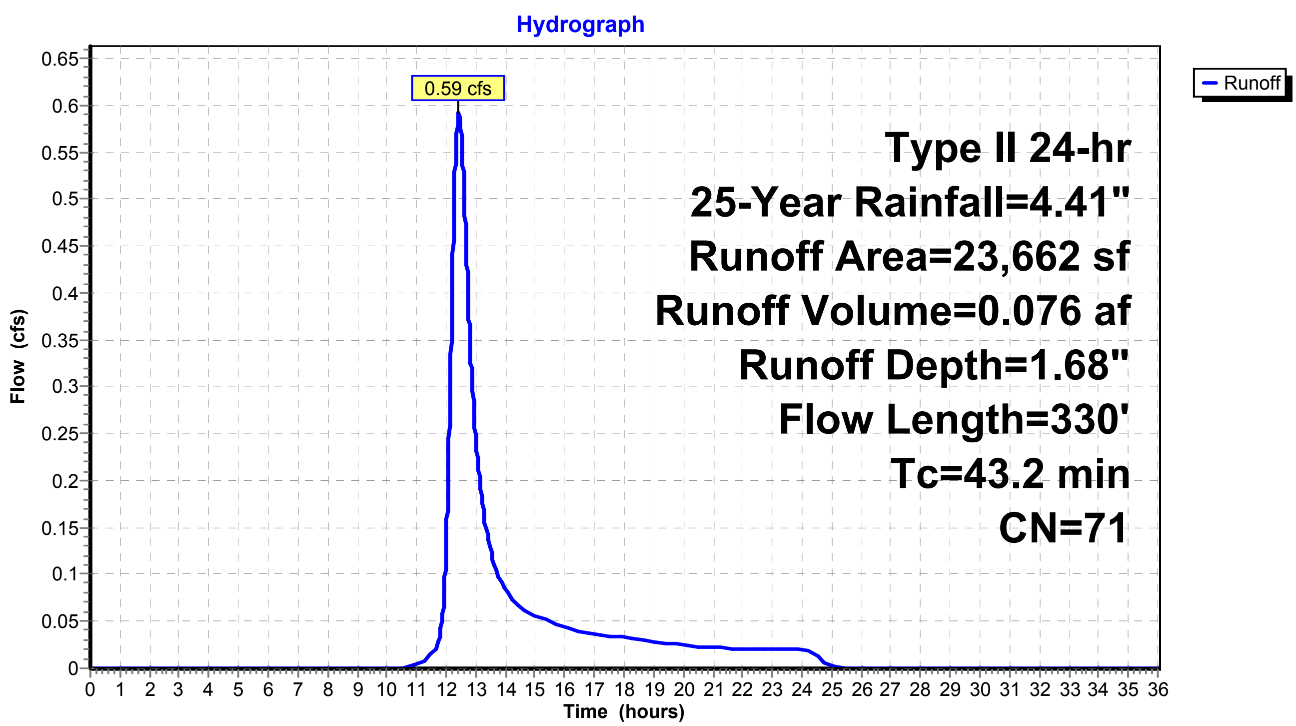
Runoff = 0.59 cfs @ 12.43 hrs, Volume= 0.076 af, Depth= 1.68"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=4.41"

Area (sf)	CN	Description
0	89	Gravel roads, HSG C
0	70	Woods, Good, HSG C
23,662	71	Meadow, non-grazed, HSG C
0	98	Paved parking, HSG C
23,662	71	Weighted Average
23,662		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
40.5	100	0.0020	0.04		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 2.51"
2.7	230	0.0400	1.40		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
43.2	330	Total			

Subcatchment 13S: OVERALL DA PRE-DEVELOPMENT - SP-1

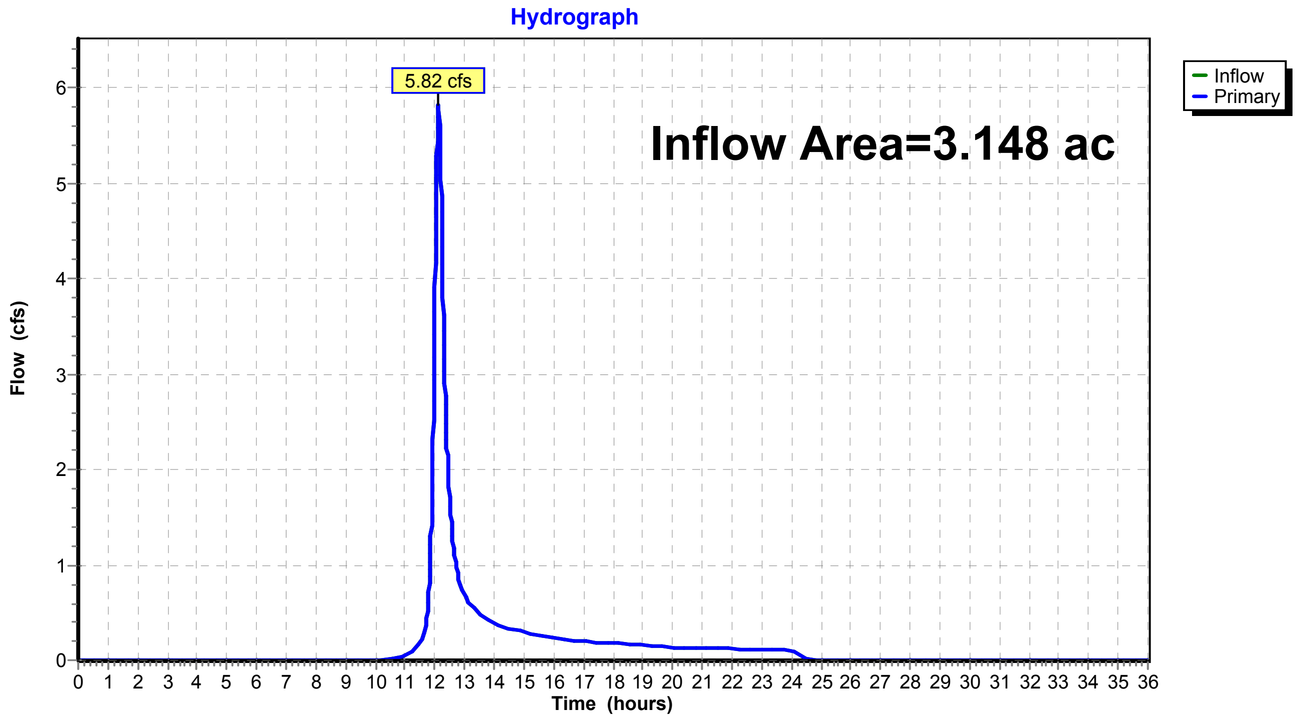


Summary for Link 6L: Existing Conditions - SP-2

Inflow Area =	3.148 ac,	0.00% Impervious, Inflow Depth = 1.68"	for 25-Year event	
Inflow =	5.82 cfs @	12.13 hrs, Volume=	0.441 af	
Primary =	5.82 cfs @	12.13 hrs, Volume=	0.441 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Link 6L: Existing Conditions - SP-2

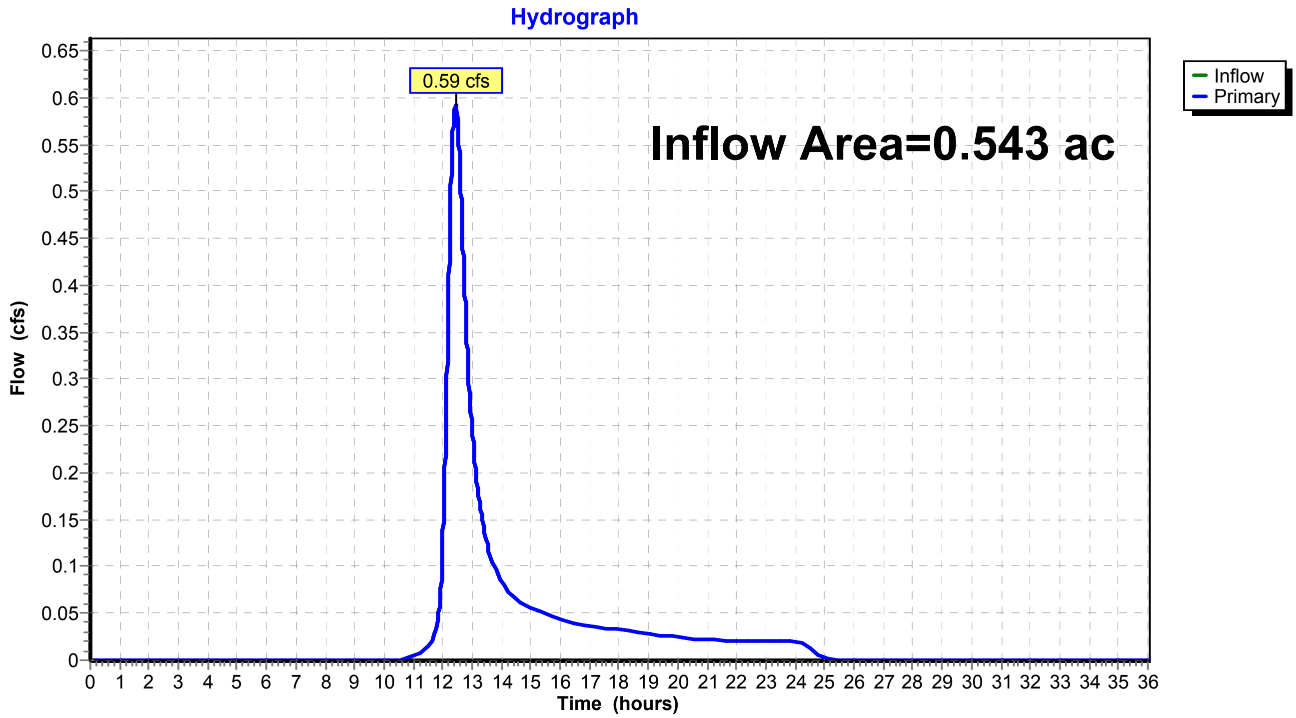


Summary for Link 12L: Existing Conditions - SP-1

Inflow Area =	0.543 ac,	0.00% Impervious,	Inflow Depth = 1.68"	for 25-Year event	
Inflow =	0.59 cfs @	12.43 hrs,	Volume=	0.076 af	
Primary =	0.59 cfs @	12.43 hrs,	Volume=	0.076 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Link 12L: Existing Conditions - SP-1



Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: OVERALL DA Runoff Area=137,129 sf 0.00% Impervious Runoff Depth=2.21"
Flow Length=513' Tc=19.5 min CN=71 Runoff=7.75 cfs 0.579 af

Subcatchment 13S: OVERALL DA Runoff Area=23,662 sf 0.00% Impervious Runoff Depth=2.21"
Flow Length=330' Tc=43.2 min CN=71 Runoff=0.79 cfs 0.100 af

Link 6L: Existing Conditions - SP-2 Inflow=7.75 cfs 0.579 af
Primary=7.75 cfs 0.579 af

Link 12L: Existing Conditions - SP-1 Inflow=0.79 cfs 0.100 af
Primary=0.79 cfs 0.100 af

Total Runoff Area = 3.691 ac Runoff Volume = 0.679 af Average Runoff Depth = 2.21"
100.00% Pervious = 3.691 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1S: OVERALL DA PRE-DEVELOPMENT - SP-2

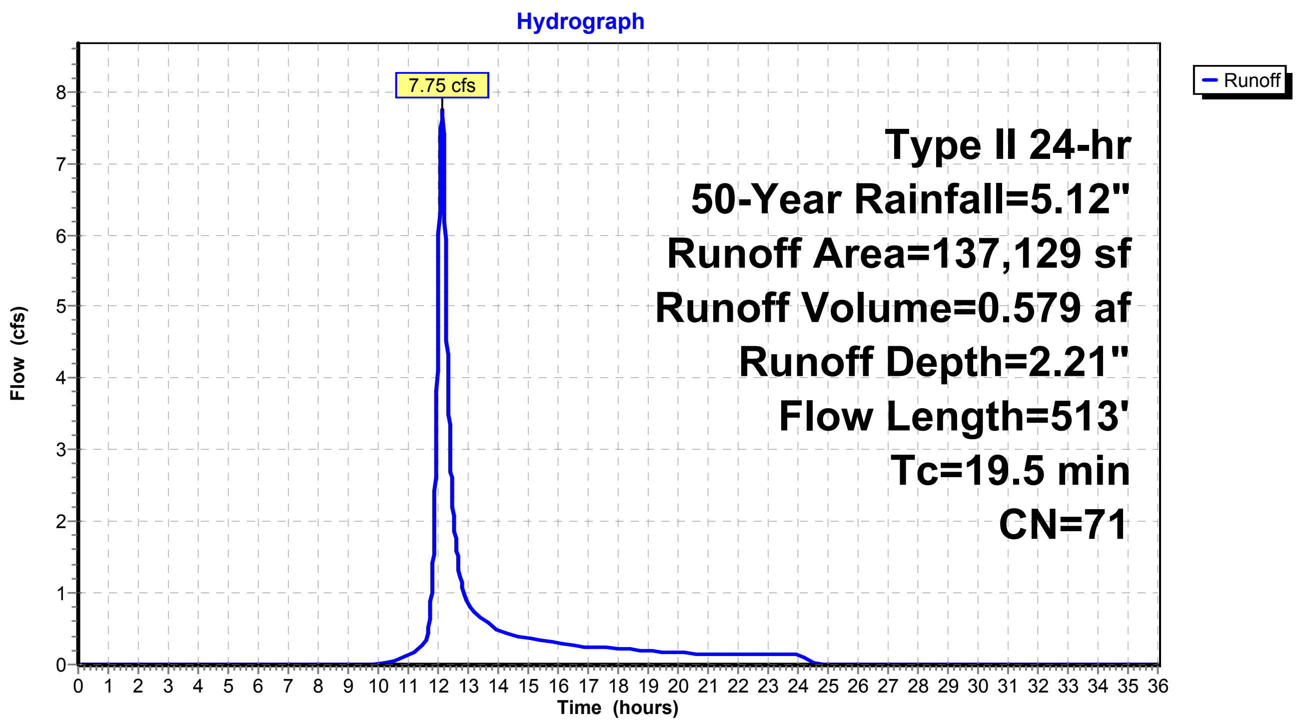
Runoff = 7.75 cfs @ 12.13 hrs, Volume= 0.579 af, Depth= 2.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 50-Year Rainfall=5.12"

Area (sf)	CN	Description
0	89	Gravel roads, HSG C
1,299	70	Woods, Good, HSG C
135,830	71	Meadow, non-grazed, HSG C
0	98	Paved parking, HSG C
137,129	71	Weighted Average
137,129		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.1	100	0.0200	0.10		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 2.51"
3.3	400	0.0840	2.03		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
0.1	13	0.0840	1.45		**Shallow Concentrated Flow, SC2** Woodland Kv= 5.0 fps
19.5	513	Total			

Subcatchment 1S: OVERALL DA PRE-DEVELOPMENT - SP-2



Summary for Subcatchment 13S: OVERALL DA PRE-DEVELOPMENT - SP-1

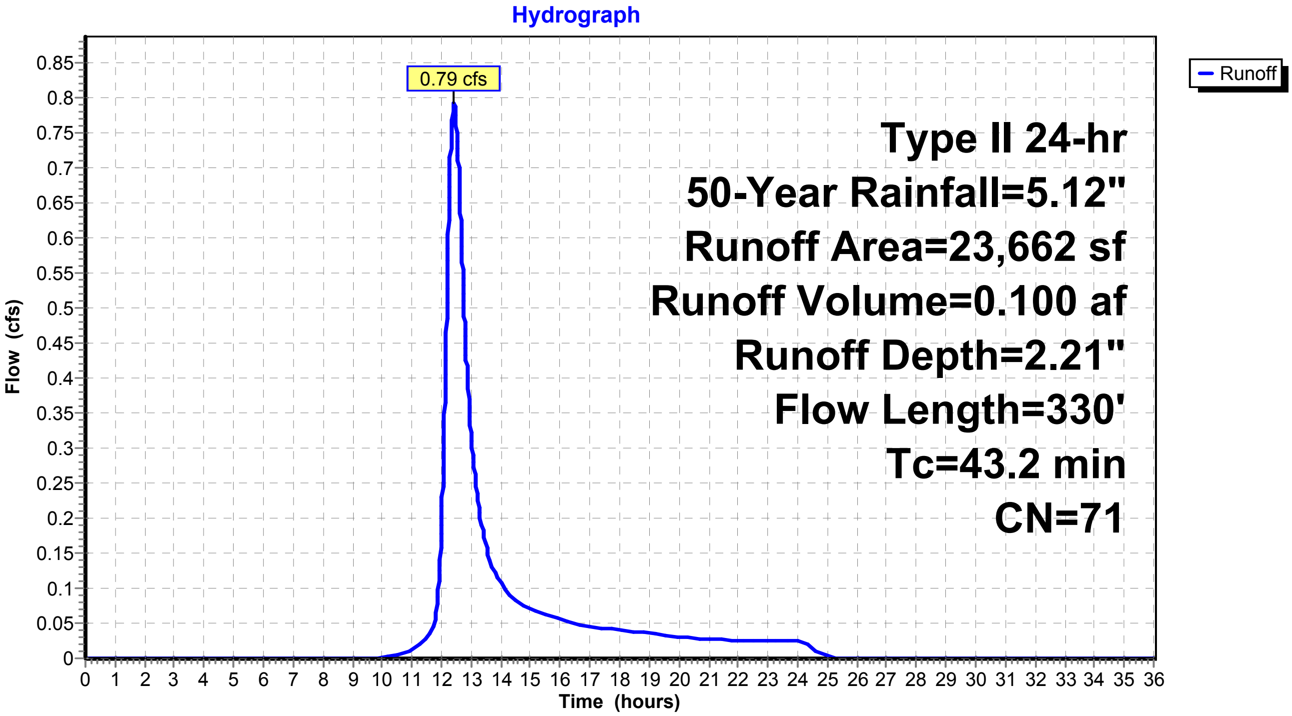
Runoff = 0.79 cfs @ 12.43 hrs, Volume= 0.100 af, Depth= 2.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 50-Year Rainfall=5.12"

Area (sf)	CN	Description
0	89	Gravel roads, HSG C
0	70	Woods, Good, HSG C
23,662	71	Meadow, non-grazed, HSG C
0	98	Paved parking, HSG C
23,662	71	Weighted Average
23,662		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
40.5	100	0.0020	0.04		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 2.51"
2.7	230	0.0400	1.40		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
43.2	330	Total			

Subcatchment 13S: OVERALL DA PRE-DEVELOPMENT - SP-1

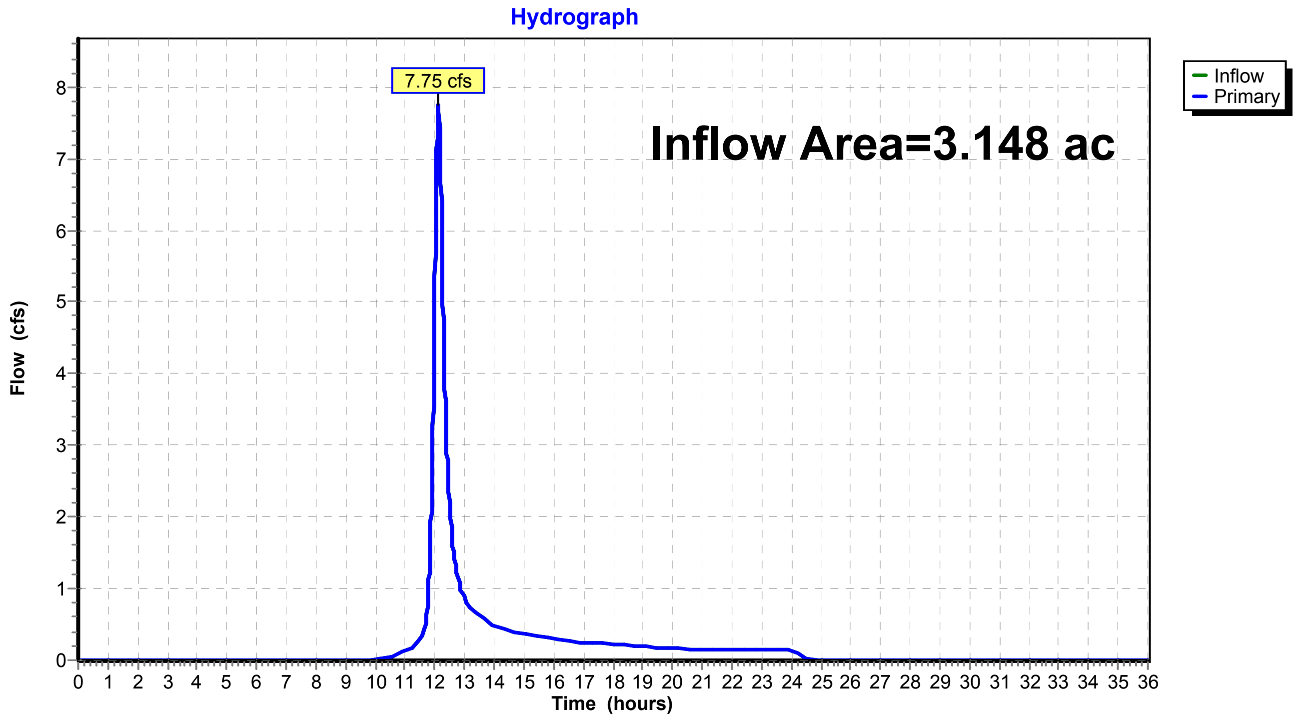


Summary for Link 6L: Existing Conditions - SP-2

Inflow Area = 3.148 ac, 0.00% Impervious, Inflow Depth = 2.21" for 50-Year event
Inflow = 7.75 cfs @ 12.13 hrs, Volume= 0.579 af
Primary = 7.75 cfs @ 12.13 hrs, Volume= 0.579 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Link 6L: Existing Conditions - SP-2

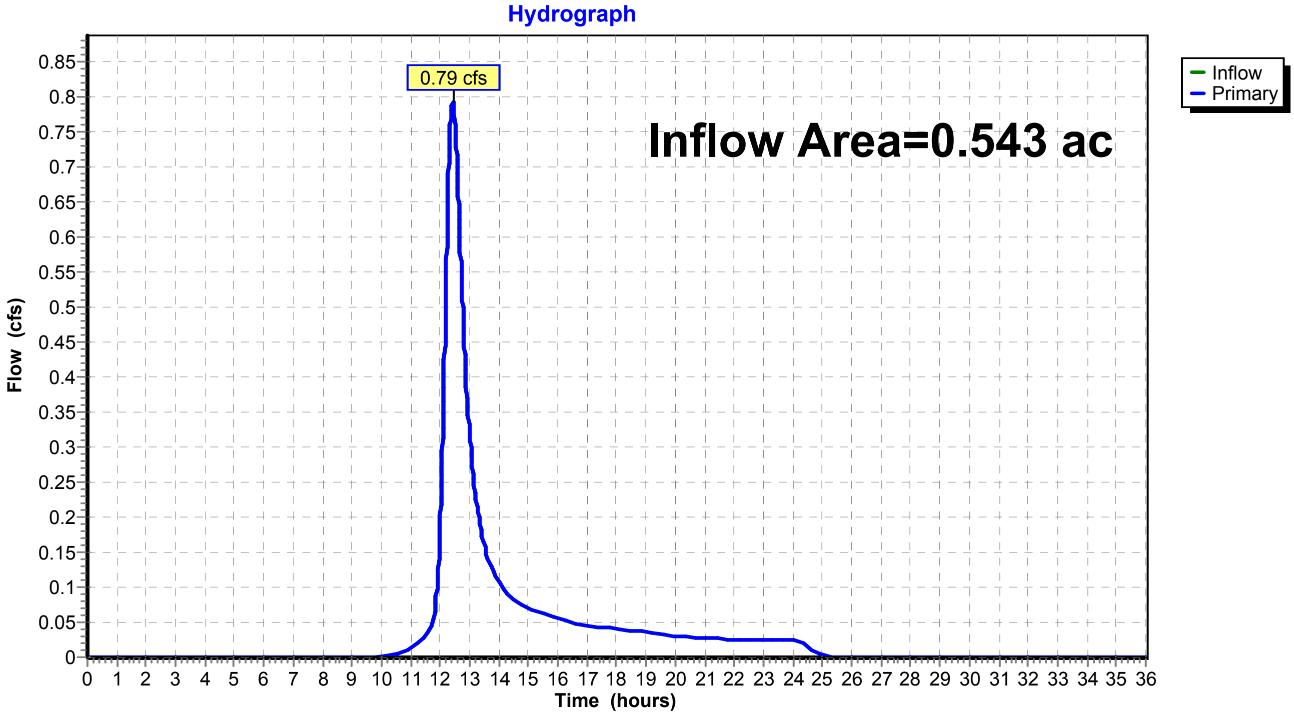


Summary for Link 12L: Existing Conditions - SP-1

Inflow Area =	0.543 ac,	0.00% Impervious,	Inflow Depth = 2.21"	for 50-Year event	
Inflow =	0.79 cfs @	12.43 hrs,	Volume=	0.100 af	
Primary =	0.79 cfs @	12.43 hrs,	Volume=	0.100 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Link 12L: Existing Conditions - SP-1



Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: OVERALL DA Runoff Area=137,129 sf 0.00% Impervious Runoff Depth=2.86"
Flow Length=513' Tc=19.5 min CN=71 Runoff=10.11 cfs 0.750 af

Subcatchment13S: OVERALL DA Runoff Area=23,662 sf 0.00% Impervious Runoff Depth=2.86"
Flow Length=330' Tc=43.2 min CN=71 Runoff=1.04 cfs 0.129 af

Link 6L: Existing Conditions - SP-2 Inflow=10.11 cfs 0.750 af
Primary=10.11 cfs 0.750 af

Link 12L: Existing Conditions - SP-1 Inflow=1.04 cfs 0.129 af
Primary=1.04 cfs 0.129 af

Total Runoff Area = 3.691 ac Runoff Volume = 0.879 af Average Runoff Depth = 2.86"
100.00% Pervious = 3.691 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1S: OVERALL DA PRE-DEVELOPMENT - SP-2

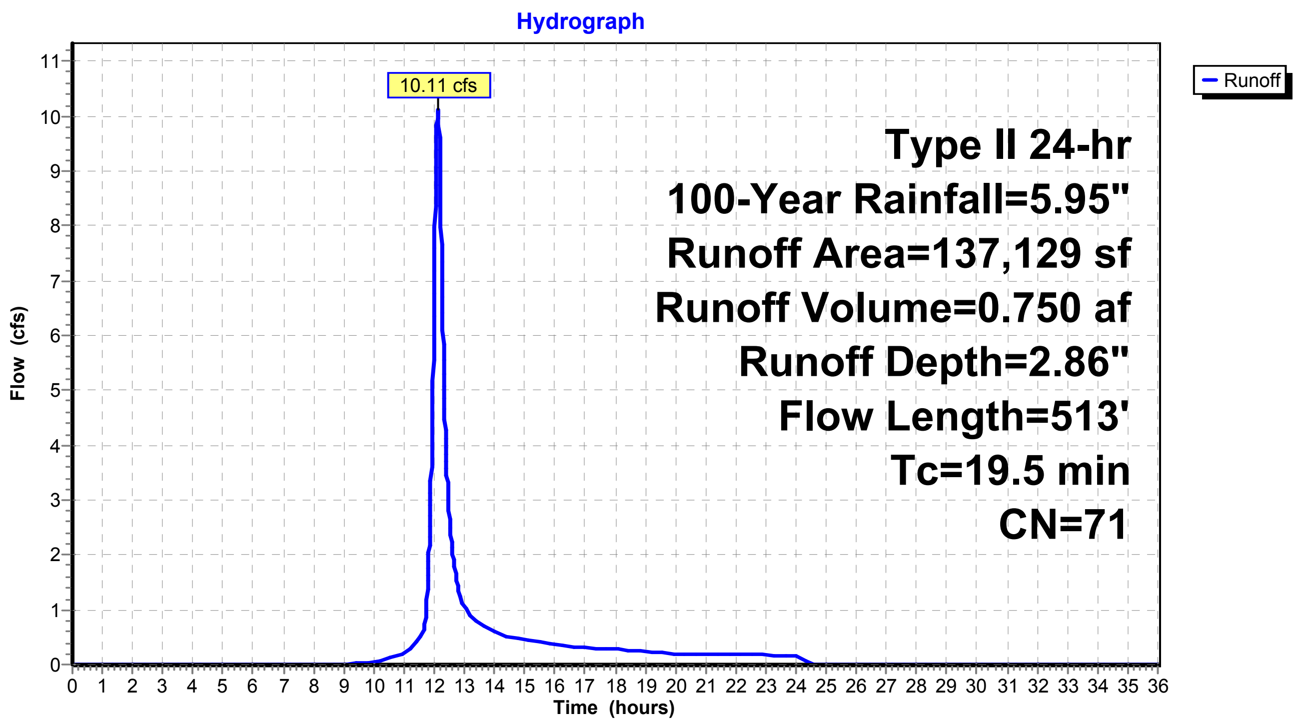
Runoff = 10.11 cfs @ 12.12 hrs, Volume= 0.750 af, Depth= 2.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Year Rainfall=5.95"

Area (sf)	CN	Description
0	89	Gravel roads, HSG C
1,299	70	Woods, Good, HSG C
135,830	71	Meadow, non-grazed, HSG C
0	98	Paved parking, HSG C
137,129	71	Weighted Average
137,129		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.1	100	0.0200	0.10		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 2.51"
3.3	400	0.0840	2.03		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
0.1	13	0.0840	1.45		**Shallow Concentrated Flow, SC2** Woodland Kv= 5.0 fps
19.5	513	Total			

Subcatchment 1S: OVERALL DA PRE-DEVELOPMENT - SP-2



Summary for Subcatchment 13S: OVERALL DA PRE-DEVELOPMENT - SP-1

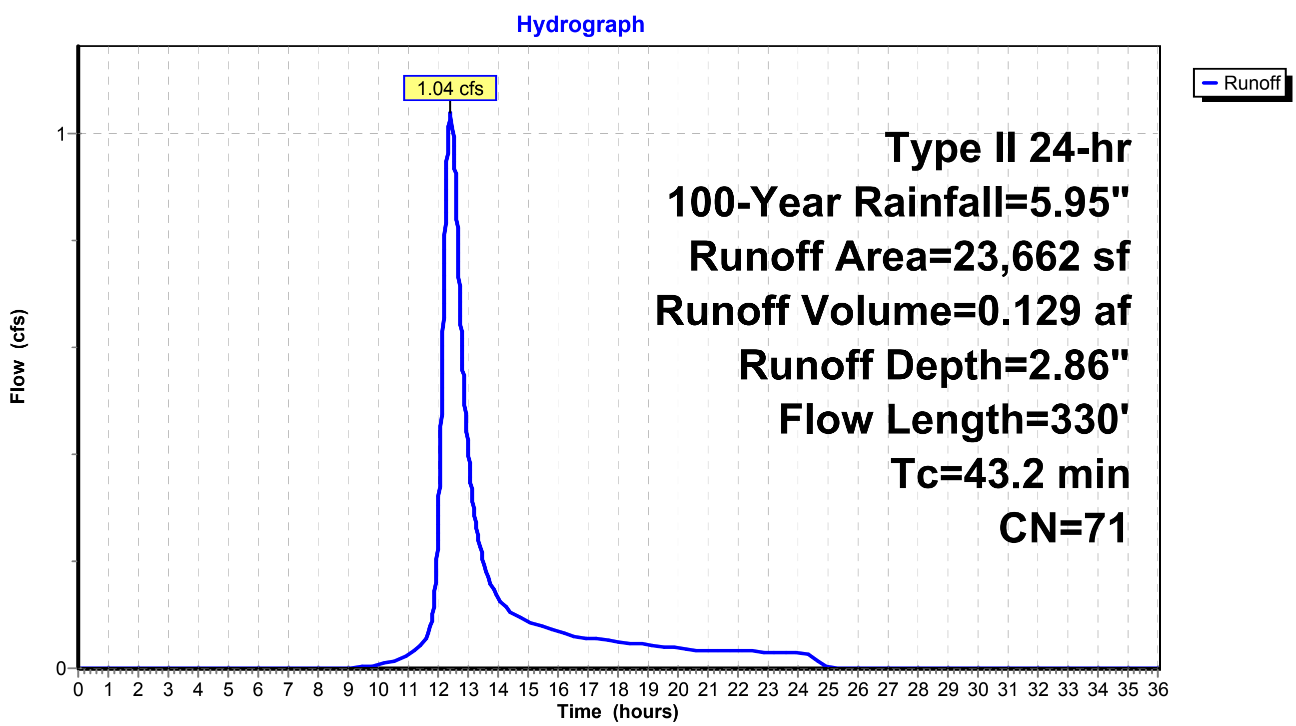
Runoff = 1.04 cfs @ 12.43 hrs, Volume= 0.129 af, Depth= 2.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Year Rainfall=5.95"

Area (sf)	CN	Description
0	89	Gravel roads, HSG C
0	70	Woods, Good, HSG C
23,662	71	Meadow, non-grazed, HSG C
0	98	Paved parking, HSG C
23,662	71	Weighted Average
23,662		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
40.5	100	0.0020	0.04		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 2.51"
2.7	230	0.0400	1.40		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
43.2	330	Total			

Subcatchment 13S: OVERALL DA PRE-DEVELOPMENT - SP-1

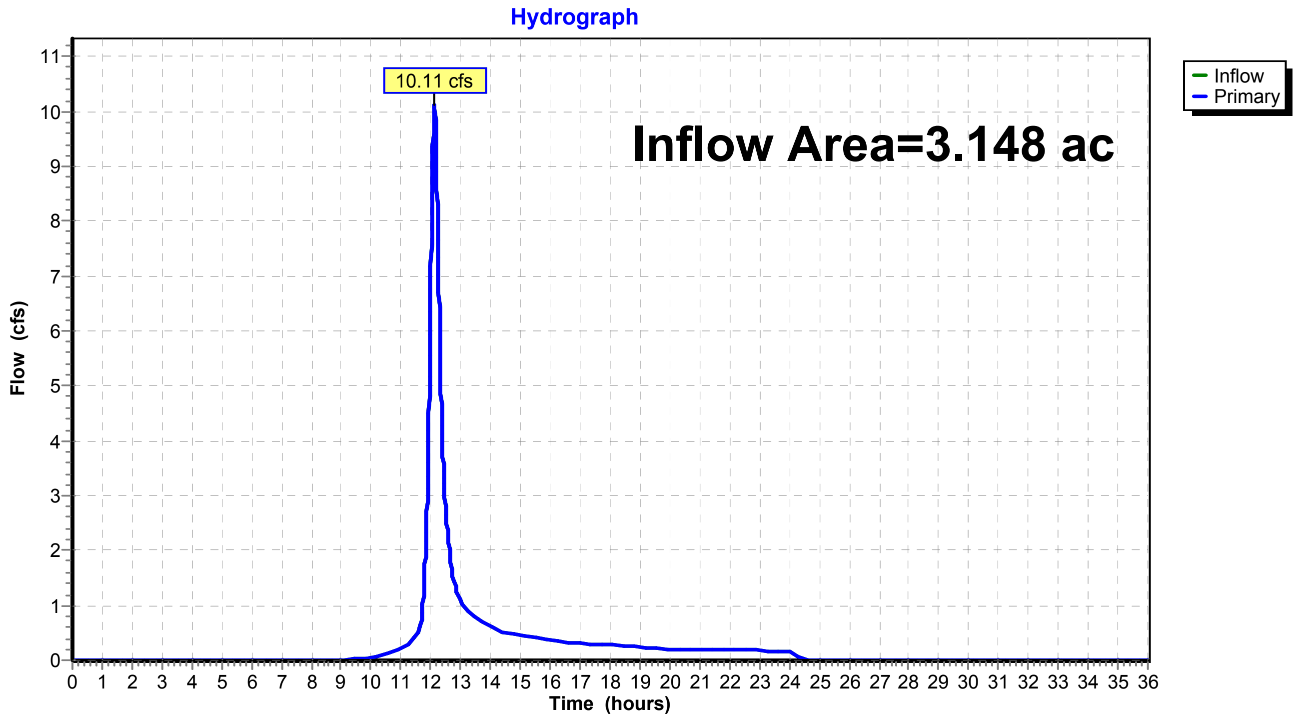


Summary for Link 6L: Existing Conditions - SP-2

Inflow Area = 3.148 ac, 0.00% Impervious, Inflow Depth = 2.86" for 100-Year event
Inflow = 10.11 cfs @ 12.12 hrs, Volume= 0.750 af
Primary = 10.11 cfs @ 12.12 hrs, Volume= 0.750 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Link 6L: Existing Conditions - SP-2

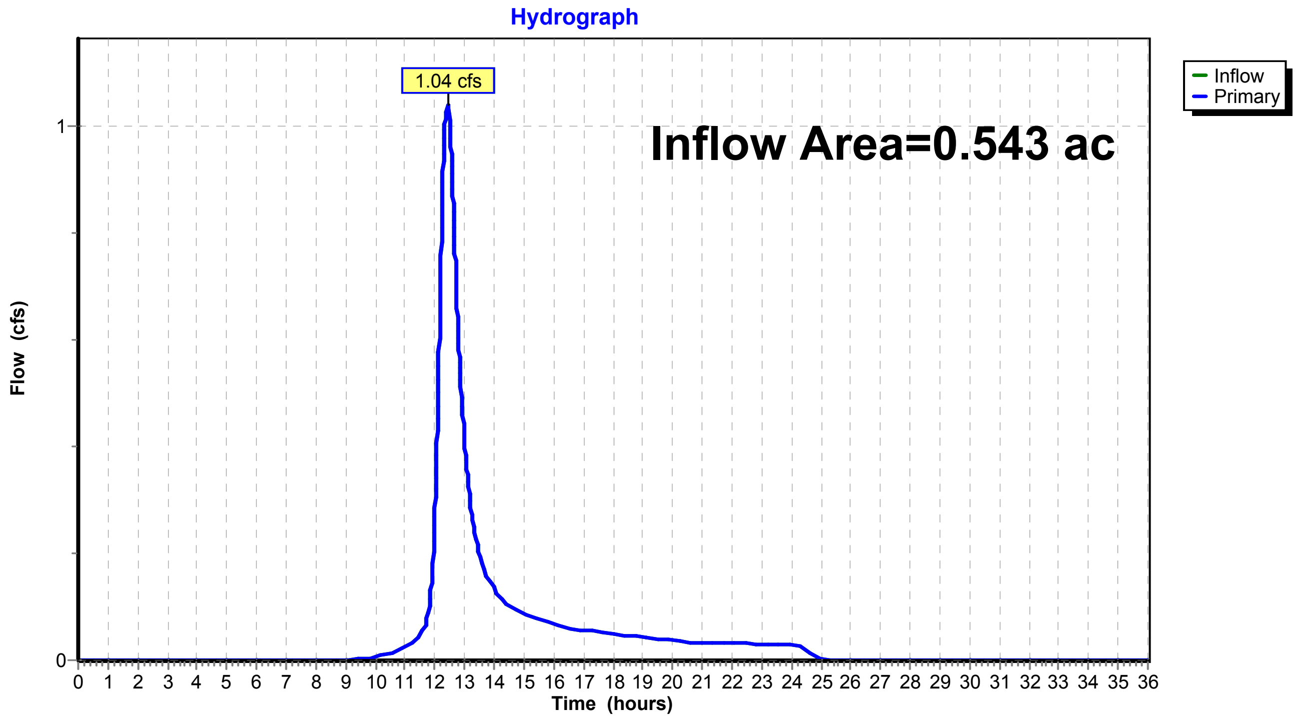


Summary for Link 12L: Existing Conditions - SP-1

Inflow Area = 0.543 ac, 0.00% Impervious, Inflow Depth = 2.86" for 100-Year event
Inflow = 1.04 cfs @ 12.43 hrs, Volume= 0.129 af
Primary = 1.04 cfs @ 12.43 hrs, Volume= 0.129 af, Atten= 0%, Lag= 0.0 min

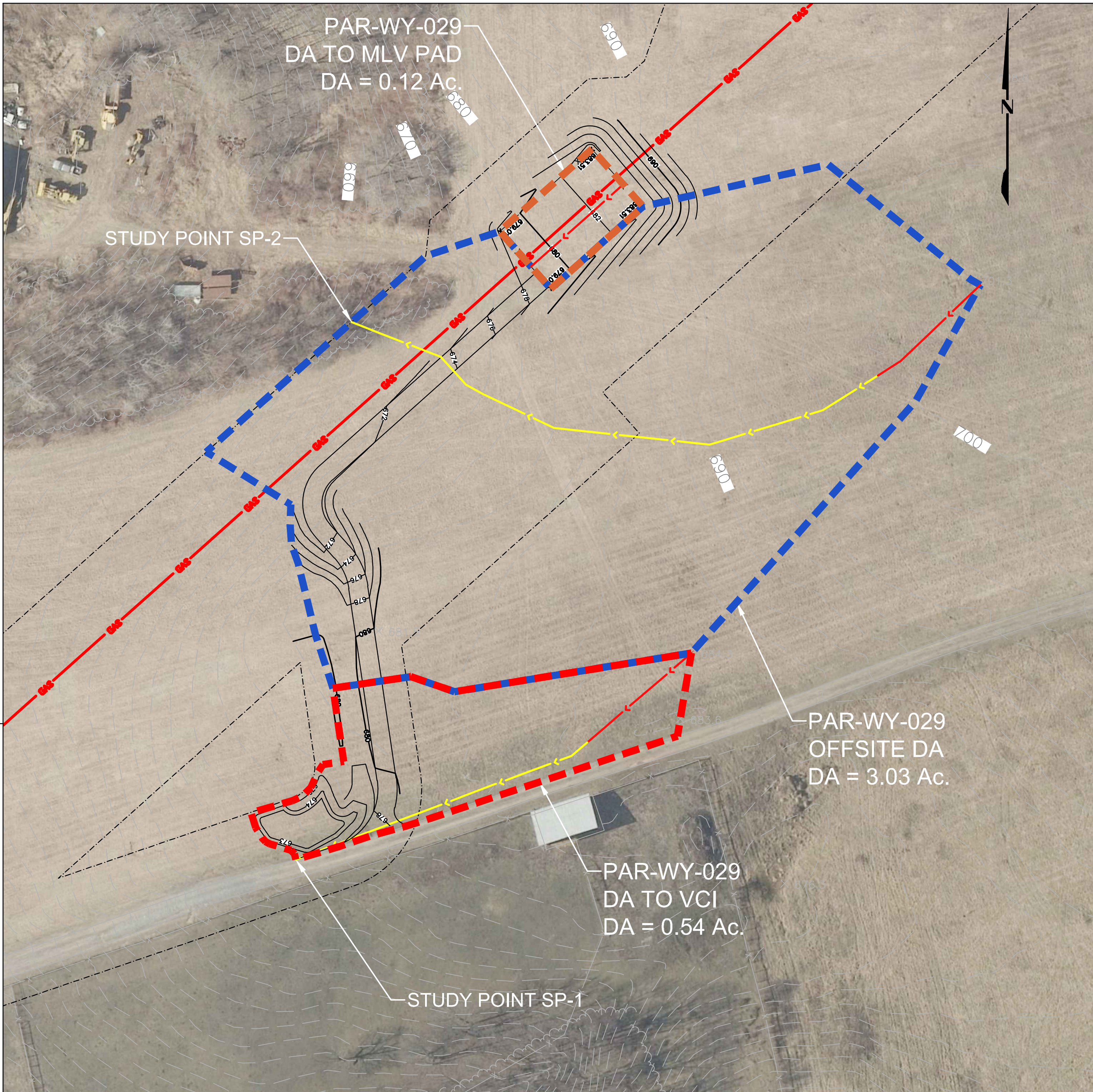
Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Link 12L: Existing Conditions - SP-1



L.4 Post Development Calculations

a. Post Development Drainage Area Map
b. 1-Year Rainfall Event
c. 2-Year Rainfall Event
d. 5-Year Rainfall Event
e. 10-Year Rainfall Event
f. 25-Year Rainfall Event
g. 50-year Rainfall Event
h. 100-Year Rainfall Event



POST-DEVELOPMENT DRAINAGE AREA MAP

100 50 100
SCALE IN FEET

ISSUED FOR PERMITTING

ARCHITECTURE
ENGINEERING
ENVIRONMENTAL
LAND SURVEYING
BL Companies

LEGEND

TIME OF CONCENTRATION-SHEET FLOW	
TIME OF CONCENTRATION-SHALLOW CONCENTRATED FLOW	
DRAINAGE AREA	
PROPOSED GAS PIPELINE	GAS GAS

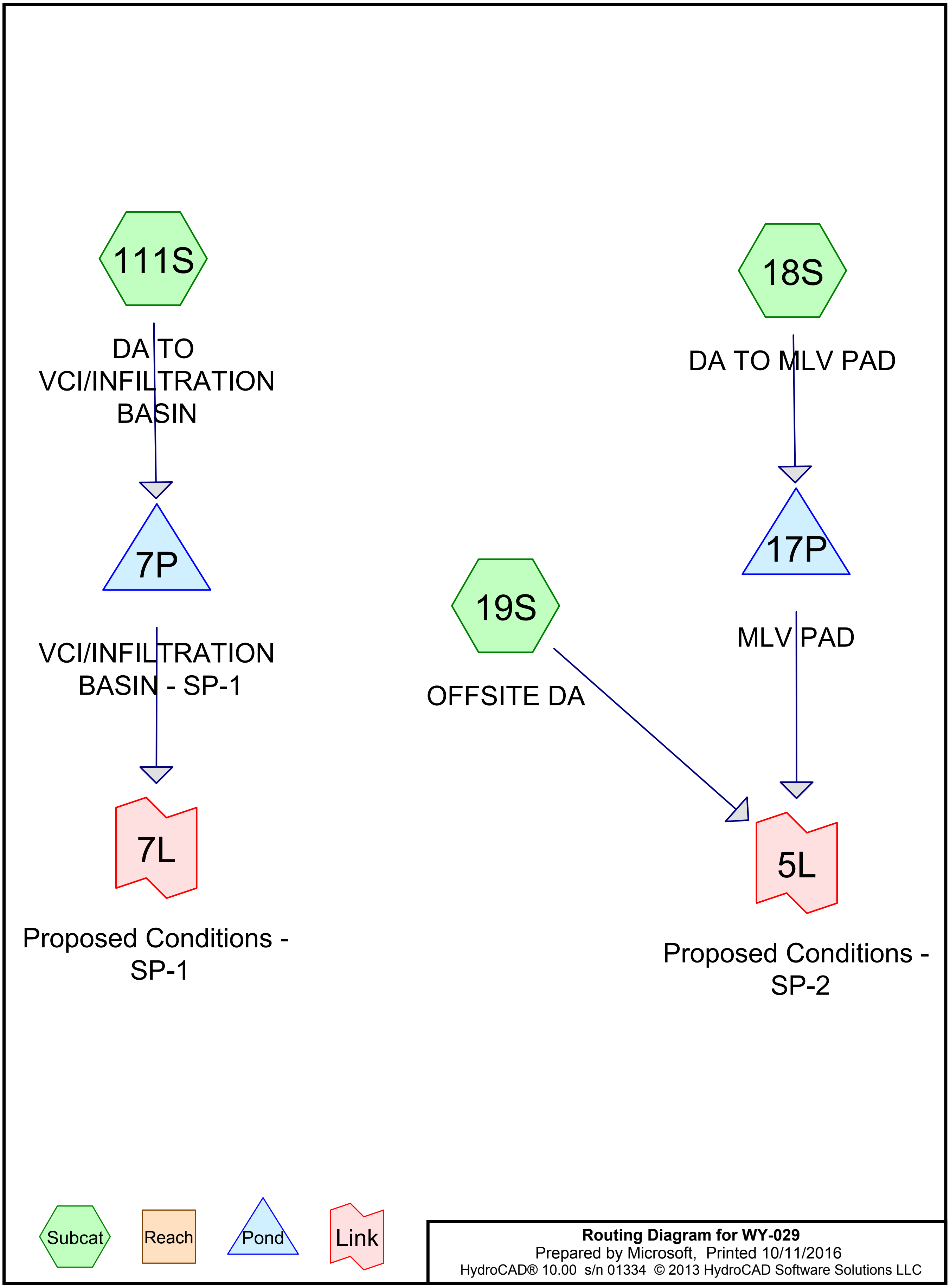
ATLANTIC SUNRISE PROJECT -
CENTRAL PENN LINE NORTH

PROPOSED 30" NATURAL GAS PIPELINE
ACCESS ROAD DRAINAGE AREA MAP
AR-WY-029 POST
EATON TOWNSHIP
WYOMING COUNTY, PENNSYLVANIA

Williams

NO.	DATE	BY	REVISION DESCRIPTION	W.O. NO.	CHK.	APP.

DRAWN BY: OLC	DATE: 11/11/15	ISSUED FOR BID:	SCALE: 1" = 100'
CHECKED BY: BJP	DATE: 11/11/15	ISSUED FOR CONSTRUCTION:	
APPROVED BY: BJP	DATE: 11/11/15	DRAWING NUMBER: AR-WY-029 POST	
WO:			


111S
DA TO VCI/INFILTRATION BASIN
7P
VCI/INFILTRATION BASIN - SP-1
7L
Proposed Conditions - SP-1
18S
DA TO MLV PAD
17P
MLV PAD
19S
OFFSITE DA
5L
Proposed Conditions - SP-2
Subcat
Reach
Pond
Link
Routing Diagram for WY-029
Prepared by Microsoft, Printed 10/11/2016
HydroCAD® 10.00 s/n 01334 © 2013 HydroCAD Software Solutions LLC

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.116	98	Crushed Stone Pad, HSG C (18S)
0.122	71	Grass Paver Roads, HSG C (19S)
0.038	89	Gravel roads, HSG C (111S)
3.416	71	Meadow, non-grazed, HSG C (19S, 111S)
3.691	**72**	**TOTAL AREA**

Soil Listing (selected nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
3.691	HSG C	18S, 19S, 111S
0.000	HSG D	
0.000	Other	
3.691		**TOTAL AREA**

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment18S: DA TO MLV PAD Runoff Area=5,040 sf 100.00% Impervious Runoff Depth=1.87"
Flow Length=90' Slope=0.0500 '/' Tc=5.0 min CN=98 Runoff=0.35 cfs 0.018 af

Subcatchment19S: OFFSITE DA Runoff Area=132,089 sf 0.00% Impervious Runoff Depth=0.31"
Flow Length=518' Tc=19.7 min CN=71 Runoff=0.71 cfs 0.078 af

Subcatchment111S: DA TO Runoff Area=23,662 sf 0.00% Impervious Runoff Depth=0.34"
Flow Length=330' Tc=43.1 min CN=72 Runoff=0.09 cfs 0.015 af

Pond 7P: VCI/INFILTRATIONBASIN - SP-1 Peak Elev=673.38' Storage=662 cf Inflow=0.09 cfs 0.015 af
Outflow=0.00 cfs 0.000 af

Pond 17P: MLV PAD Peak Elev=678.75' Storage=787 cf Inflow=0.35 cfs 0.018 af
Outflow=0.00 cfs 0.000 af

Link 5L: Proposed Conditions - SP-2 Inflow=0.71 cfs 0.078 af
Primary=0.71 cfs 0.078 af

Link 7L: Proposed Conditions - SP-1 Inflow=0.00 cfs 0.000 af
Primary=0.00 cfs 0.000 af

Total Runoff Area = 3.691 ac Runoff Volume = 0.111 af Average Runoff Depth = 0.36"
96.87% Pervious = 3.576 ac 3.13% Impervious = 0.116 ac

Summary for Subcatchment 18S: DA TO MLV PAD

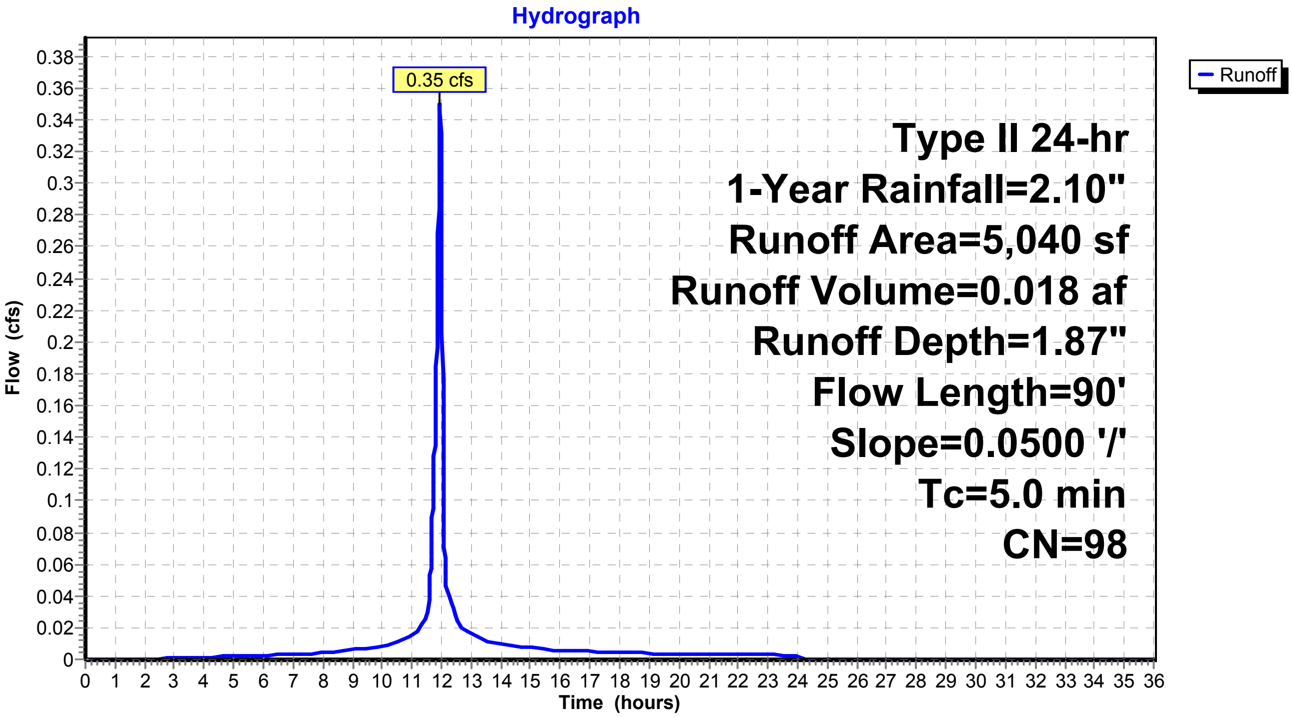
Runoff = 0.35 cfs @ 11.96 hrs, Volume= 0.018 af, Depth= 1.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 1-Year Rainfall=2.10"

	Area (sf)	CN	Description
*	5,040	98	Crushed Stone Pad, HSG C
	0	71	Meadow, non-grazed, HSG C
	5,040	98	Weighted Average
	5,040		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	90	0.0500	1.72		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.51"
0.9	90	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 18S: DA TO MLV PAD



Summary for Subcatchment 19S: OFFSITE DA

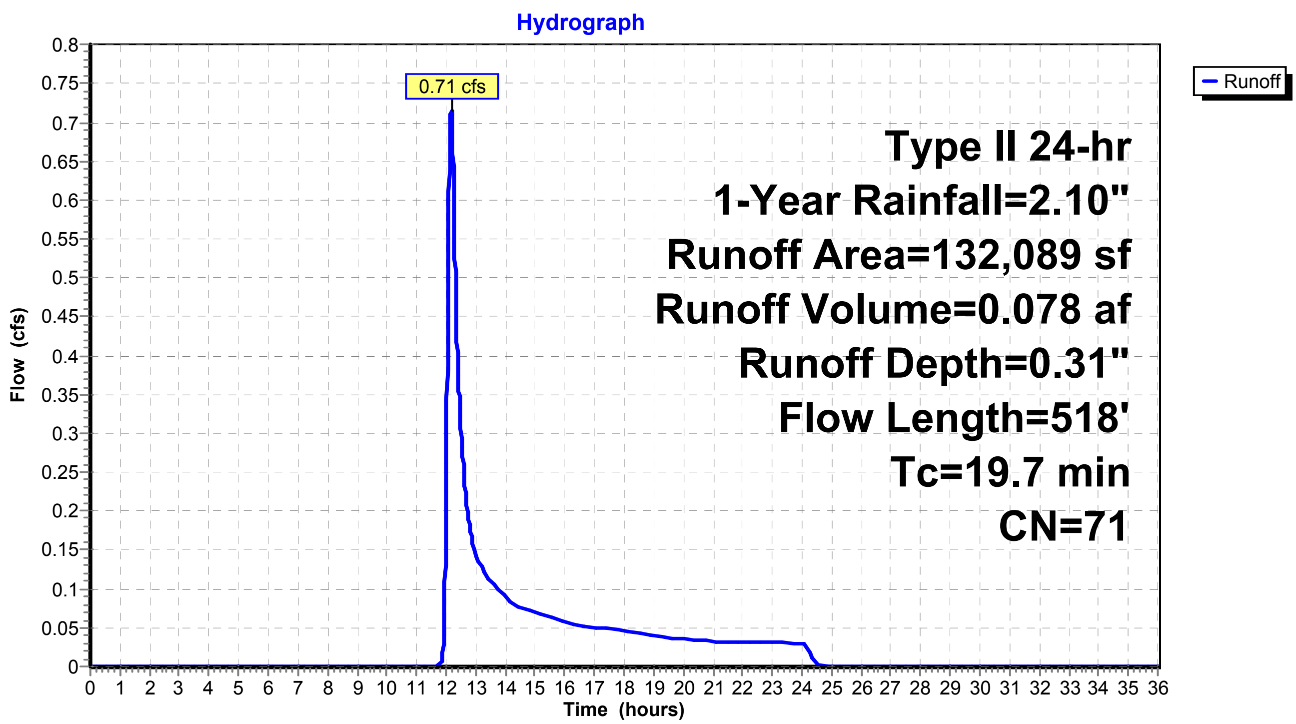
Runoff = 0.71 cfs @ 12.17 hrs, Volume= 0.078 af, Depth= 0.31"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 1-Year Rainfall=2.10"

	Area (sf)	CN	Description
*	5,293	71	Grass Paver Roads, HSG C
	0	70	Woods, Good, HSG C
	126,796	71	Meadow, non-grazed, HSG C
	0	98	Paved parking, HSG C
	132,089	71	Weighted Average
	132,089		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.1	100	0.0200	0.10		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 2.51"
2.7	333	0.0840	2.03		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
0.3	15	0.0150	0.86		**Shallow Concentrated Flow, SC2** Short Grass Pasture Kv= 7.0 fps
0.6	70	0.0840	2.03		**Shallow Concentrated Flow, SC3** Short Grass Pasture Kv= 7.0 fps
19.7	518	Total			

Subcatchment 19S: OFFSITE DA



Summary for Subcatchment 111S: DA TO VCI/INFILTRATION BASIN

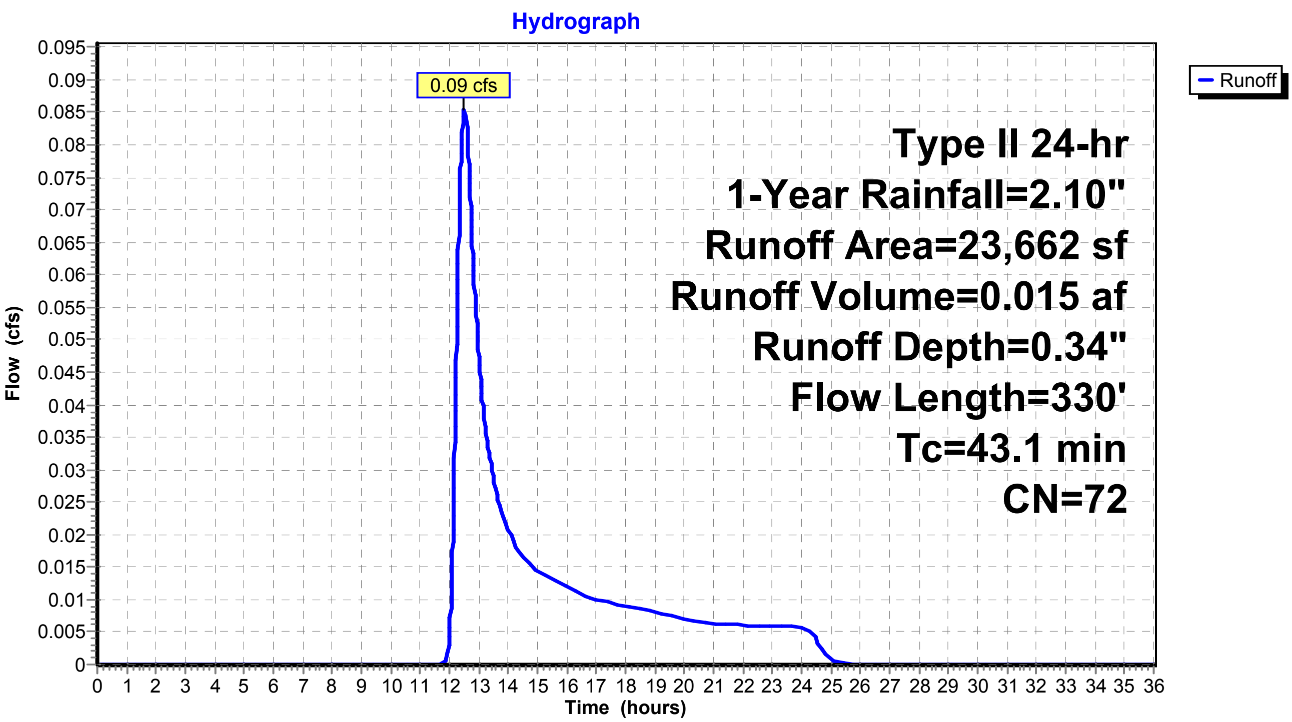
Runoff = 0.09 cfs @ 12.50 hrs, Volume= 0.015 af, Depth= 0.34"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 1-Year Rainfall=2.10"

Area (sf)	CN	Description
1,667	89	Gravel roads, HSG C
21,995	71	Meadow, non-grazed, HSG C
23,662	72	Weighted Average
23,662		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
40.5	100	0.0020	0.04		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 2.51"
1.9	158	0.0400	1.40		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
0.2	29	0.0400	3.22		**Shallow Concentrated Flow, SC2** Unpaved Kv= 16.1 fps
0.5	43	0.0400	1.40		**Shallow Concentrated Flow, SC3** Short Grass Pasture Kv= 7.0 fps
43.1	330	Total			

Subcatchment 111S: DA TO VCI/INFILTRATION BASIN



Summary for Pond 7P: VCI/INFILTRATION BASIN - SP-1

Inflow Area = 0.543 ac, 0.00% Impervious, Inflow Depth = 0.34" for 1-Year event
Inflow = 0.09 cfs @ 12.50 hrs, Volume= 0.015 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 673.38' @ 26.44 hrs Surf.Area= 0 sf Storage= 662 cf

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

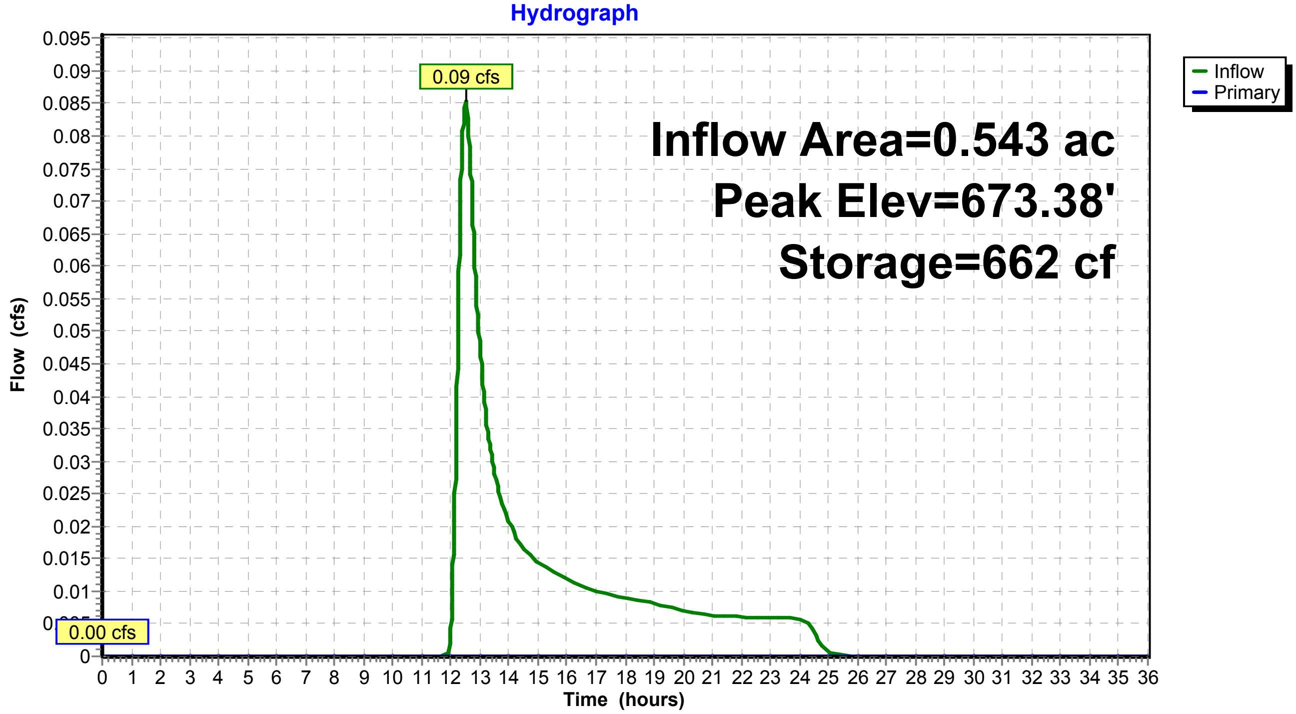
Volume	Invert	Avail.Storage	Storage Description
#1	673.00'	1,746 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
673.00	0
673.50	873
674.00	1,745
674.50	1,746

Device	Routing	Invert	Outlet Devices
#1	Primary	674.00'	**10.0' long x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=673.00' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 7P: VCI/INFILTRATION BASIN - SP-1



Summary for Pond 17P: MLV PAD

Inflow Area = 0.116 ac,100.00% Impervious, Inflow Depth = 1.87" for 1-Year event
Inflow = 0.35 cfs @ 11.96 hrs, Volume= 0.018 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 6
Peak Elev= 678.75' @ 24.29 hrs Surf.Area= 0 sf Storage= 787 cf

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

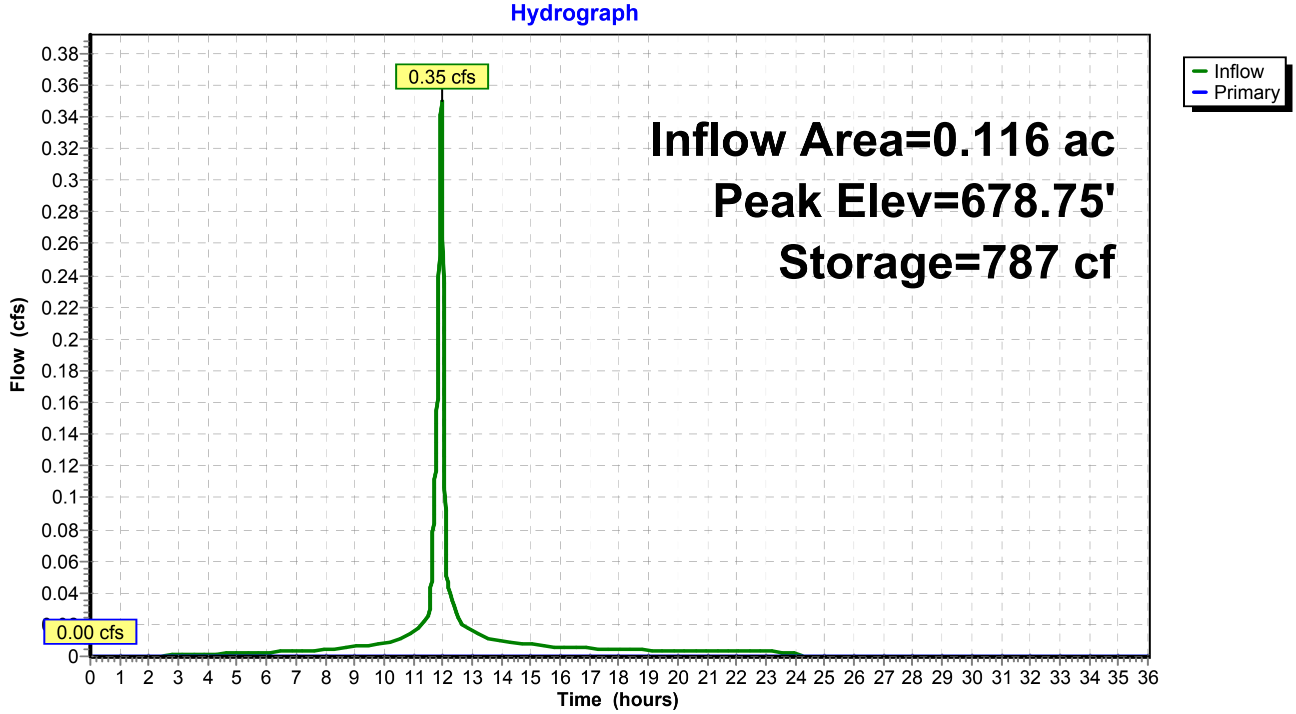
Volume	Invert	Avail.Storage	Storage Description
#1	677.00'	899 cf	**Stone Pad Void Storage** Listed below 2,247 cf Overall x 40.0% Voids

Elevation (feet)	Cum.Store (cubic-feet)
677.00	0
677.50	562
678.00	1,123
678.50	1,685
679.00	2,246
679.50	2,247

Device	Routing	Invert	Outlet Devices
#1	Primary	679.00'	**56.0' long x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=677.00' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 17P: MLV PAD

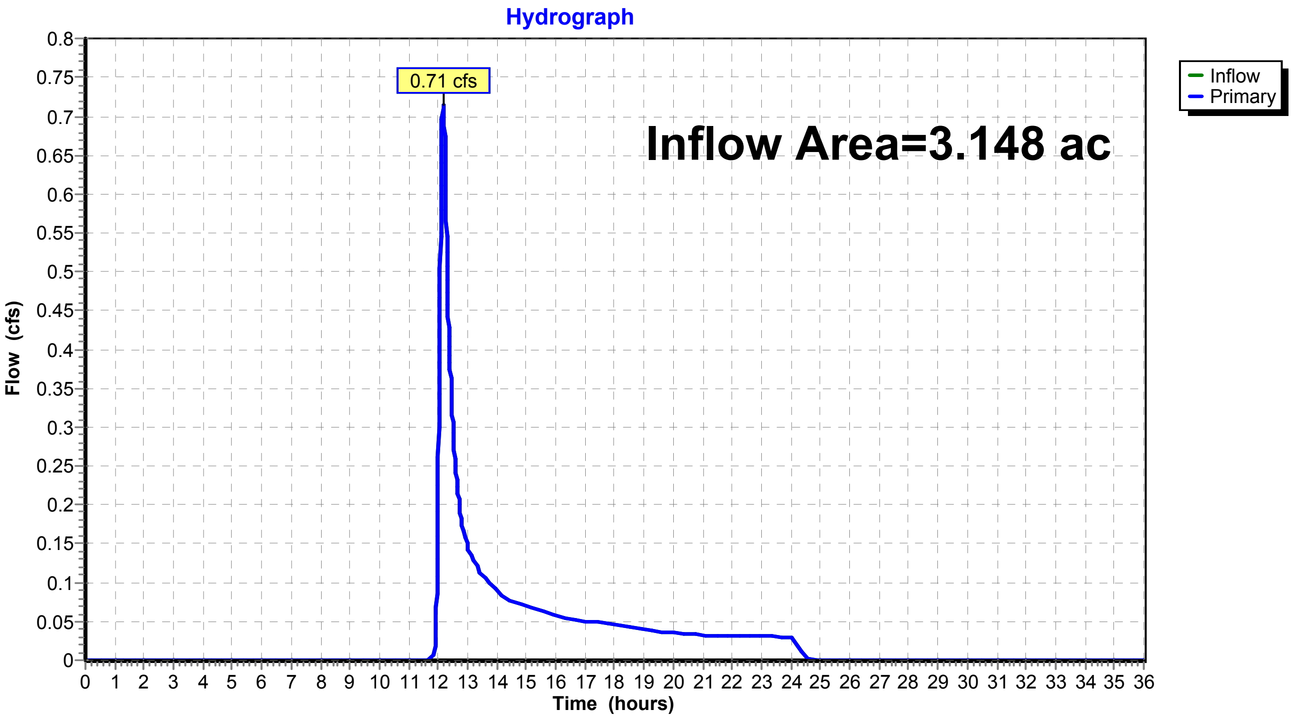


Summary for Link 5L: Proposed Conditions - SP-2

Inflow Area =	3.148 ac,	3.68% Impervious, Inflow Depth =	0.30"	for 1-Year event
Inflow =	0.71 cfs @	12.17 hrs, Volume=	0.078 af	
Primary =	0.71 cfs @	12.17 hrs, Volume=	0.078 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Link 5L: Proposed Conditions - SP-2

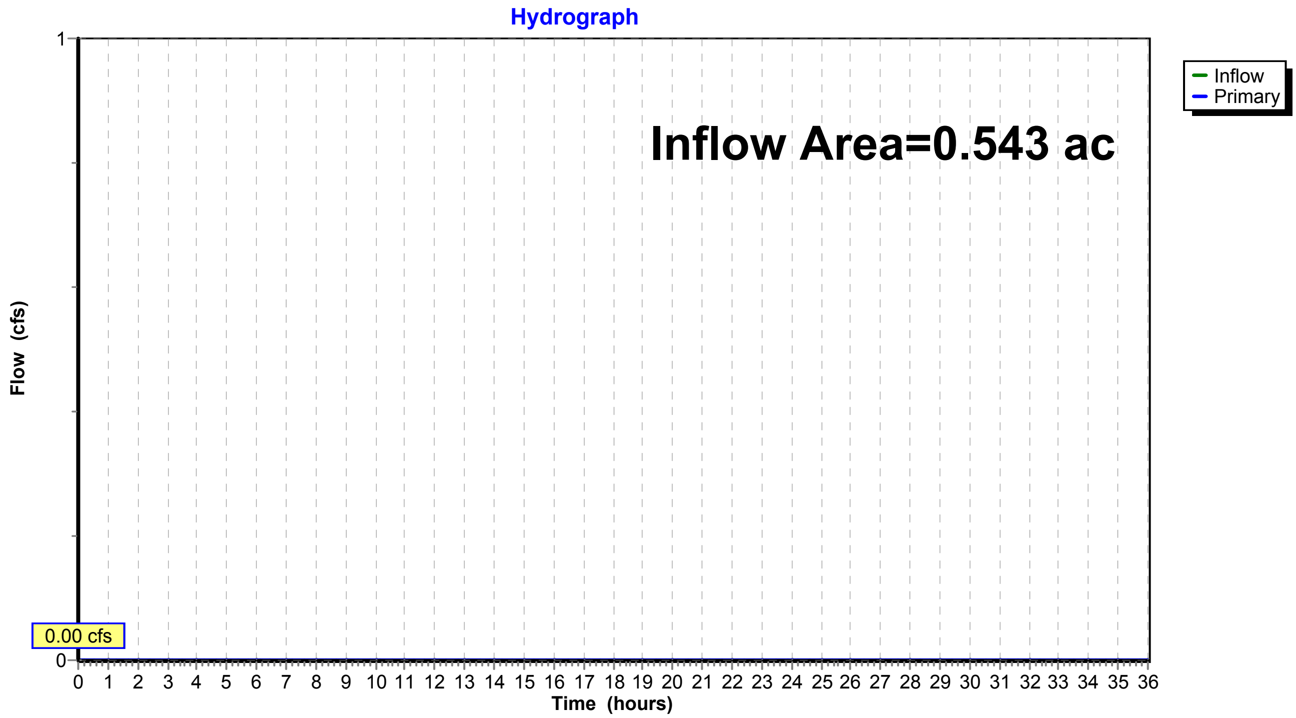


Summary for Link 7L: Proposed Conditions - SP-1

Inflow Area = 0.543 ac, 0.00% Impervious, Inflow Depth = 0.00" for 1-Year event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Link 7L: Proposed Conditions - SP-1



Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment18S: DA TO MLV PAD Runoff Area=5,040 sf 100.00% Impervious Runoff Depth=2.28"
Flow Length=90' Slope=0.0500 '/' Tc=5.0 min CN=98 Runoff=0.42 cfs 0.022 af

Subcatchment19S: OFFSITE DA Runoff Area=132,089 sf 0.00% Impervious Runoff Depth=0.50"
Flow Length=518' Tc=19.7 min CN=71 Runoff=1.37 cfs 0.125 af

Subcatchment111S: DA TO Runoff Area=23,662 sf 0.00% Impervious Runoff Depth=0.53"
Flow Length=330' Tc=43.1 min CN=72 Runoff=0.16 cfs 0.024 af

Pond 7P: VCI/INFILTRATIONBASIN - SP-1 Peak Elev=673.60' Storage=1,053 cf Inflow=0.16 cfs 0.024 af
Outflow=0.00 cfs 0.000 af

Pond 17P: MLV PAD Peak Elev=679.00' Storage=898 cf Inflow=0.42 cfs 0.022 af
Outflow=0.01 cfs 0.001 af

Link 5L: Proposed Conditions - SP-2 Inflow=1.37 cfs 0.127 af
Primary=1.37 cfs 0.127 af

Link 7L: Proposed Conditions - SP-1 Inflow=0.00 cfs 0.000 af
Primary=0.00 cfs 0.000 af

Total Runoff Area = 3.691 ac Runoff Volume = 0.172 af Average Runoff Depth = 0.56"
96.87% Pervious = 3.576 ac 3.13% Impervious = 0.116 ac

Summary for Subcatchment 18S: DA TO MLV PAD

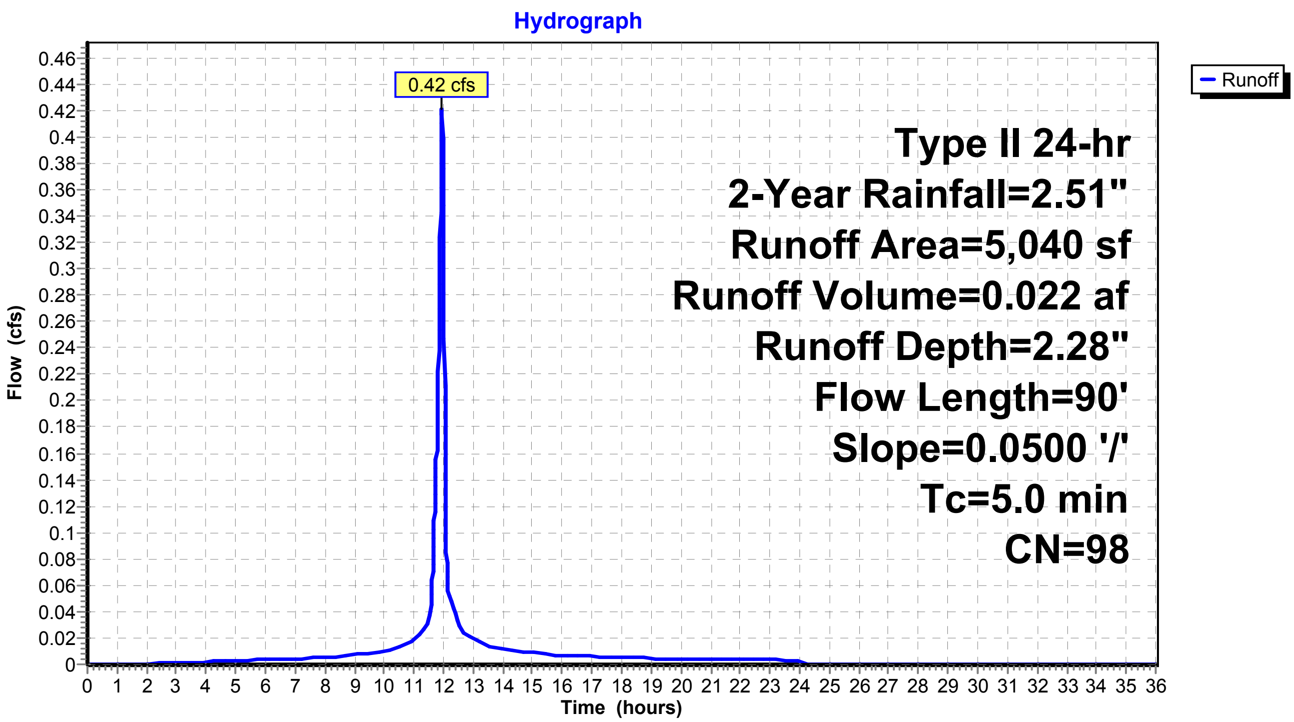
Runoff = 0.42 cfs @ 11.96 hrs, Volume= 0.022 af, Depth= 2.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 2-Year Rainfall=2.51"

	Area (sf)	CN	Description
*	5,040	98	Crushed Stone Pad, HSG C
	0	71	Meadow, non-grazed, HSG C
	5,040	98	Weighted Average
	5,040		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	90	0.0500	1.72		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.51"
0.9	90	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 18S: DA TO MLV PAD



Summary for Subcatchment 19S: OFFSITE DA

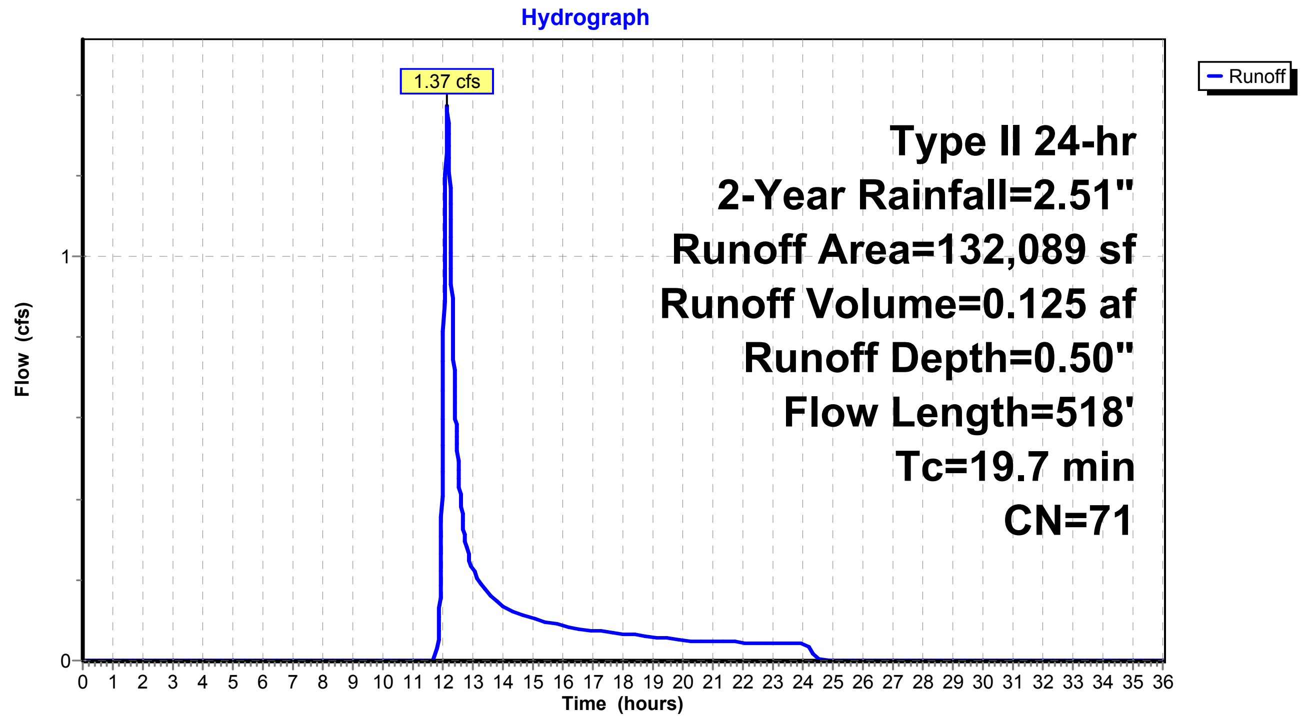
Runoff = 1.37 cfs @ 12.15 hrs, Volume= 0.125 af, Depth= 0.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 2-Year Rainfall=2.51"

	Area (sf)	CN	Description
*	5,293	71	Grass Paver Roads, HSG C
	0	70	Woods, Good, HSG C
	126,796	71	Meadow, non-grazed, HSG C
	0	98	Paved parking, HSG C
	132,089	71	Weighted Average
	132,089		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.1	100	0.0200	0.10		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 2.51"
2.7	333	0.0840	2.03		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
0.3	15	0.0150	0.86		**Shallow Concentrated Flow, SC2** Short Grass Pasture Kv= 7.0 fps
0.6	70	0.0840	2.03		**Shallow Concentrated Flow, SC3** Short Grass Pasture Kv= 7.0 fps
19.7	518	Total			

Subcatchment 19S: OFFSITE DA



Summary for Subcatchment 111S: DA TO VCI/INFILTRATION BASIN

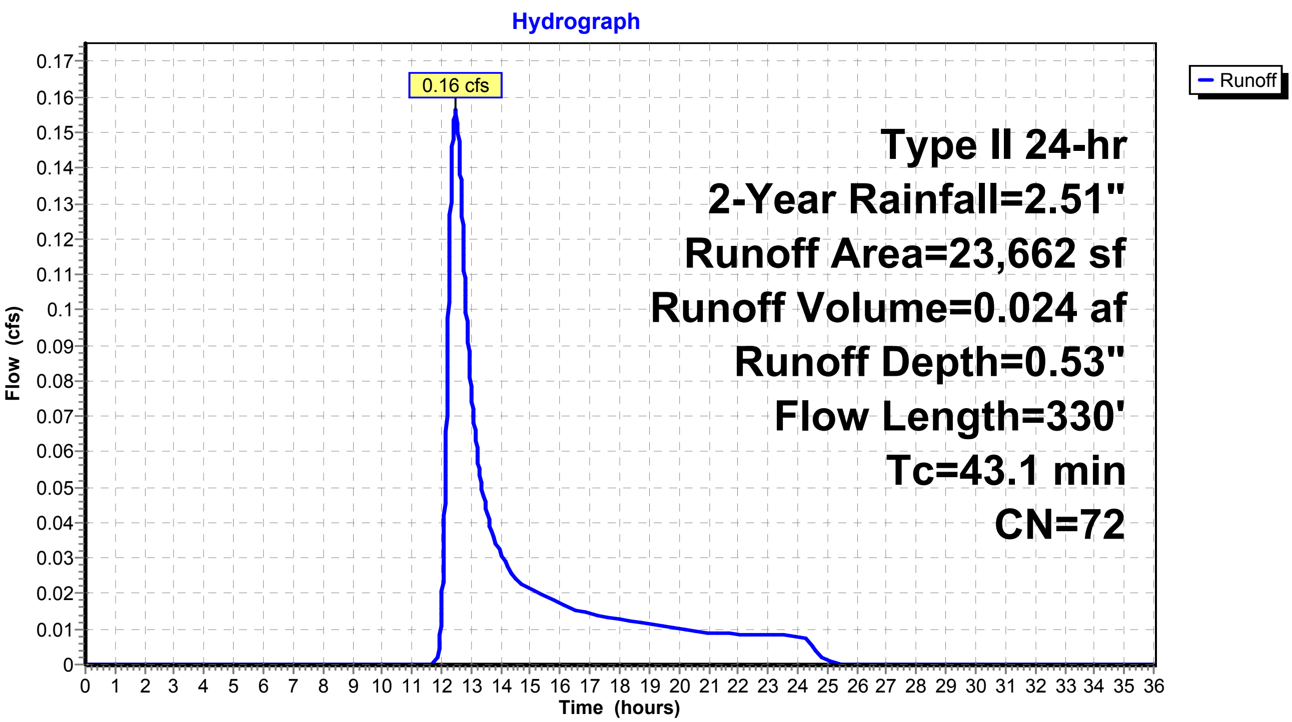
Runoff = 0.16 cfs @ 12.49 hrs, Volume= 0.024 af, Depth= 0.53"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 2-Year Rainfall=2.51"

Area (sf)	CN	Description
1,667	89	Gravel roads, HSG C
21,995	71	Meadow, non-grazed, HSG C
23,662	72	Weighted Average
23,662		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
40.5	100	0.0020	0.04		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 2.51"
1.9	158	0.0400	1.40		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
0.2	29	0.0400	3.22		**Shallow Concentrated Flow, SC2** Unpaved Kv= 16.1 fps
0.5	43	0.0400	1.40		**Shallow Concentrated Flow, SC3** Short Grass Pasture Kv= 7.0 fps
43.1	330	Total			

Subcatchment 111S: DA TO VCI/INFILTRATION BASIN



Summary for Pond 7P: VCI/INFILTRATION BASIN - SP-1

Inflow Area = 0.543 ac, 0.00% Impervious, Inflow Depth = 0.53" for 2-Year event
Inflow = 0.16 cfs @ 12.49 hrs, Volume= 0.024 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 673.60' @ 26.44 hrs Surf.Area= 0 sf Storage= 1,053 cf

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

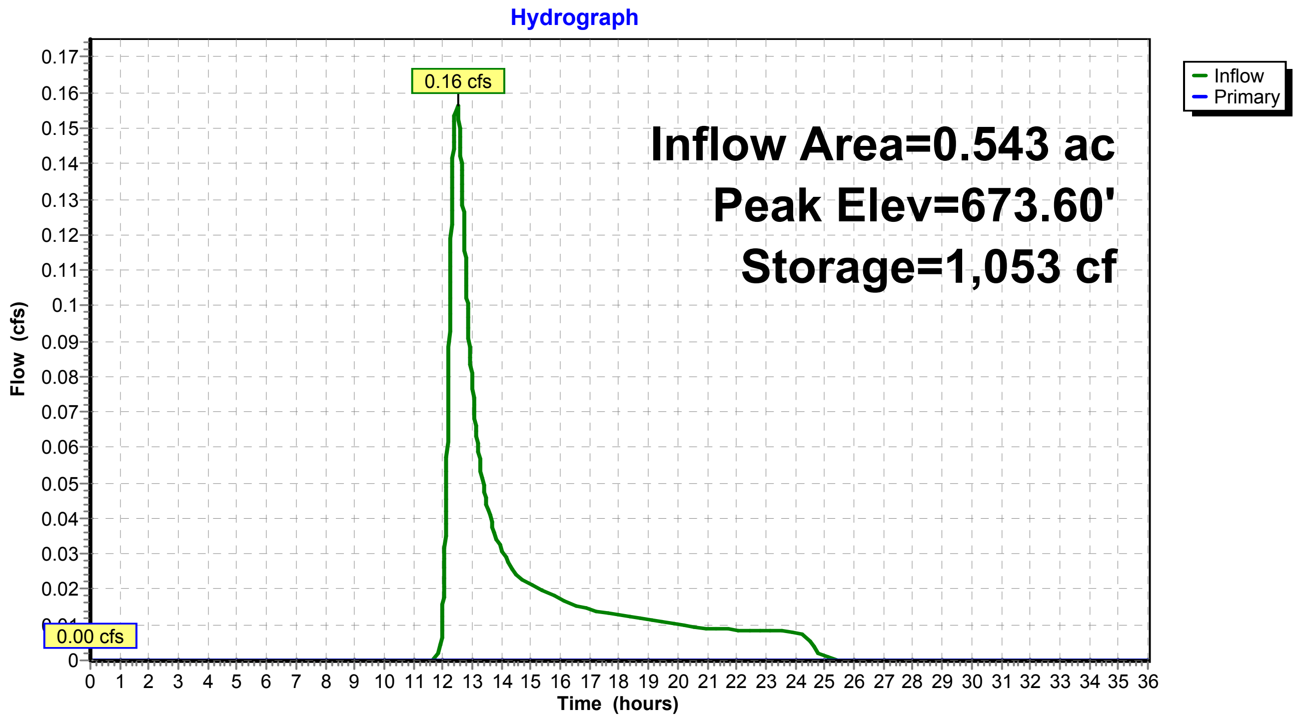
Volume	Invert	Avail.Storage	Storage Description
#1	673.00'	1,746 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
673.00	0
673.50	873
674.00	1,745
674.50	1,746

Device	Routing	Invert	Outlet Devices
#1	Primary	674.00'	**10.0' long x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=673.00' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 7P: VCI/INFILTRATION BASIN - SP-1



Summary for Pond 17P: MLV PAD

Inflow Area = 0.116 ac,100.00% Impervious, Inflow Depth = 2.28" for 2-Year event
Inflow = 0.42 cfs @ 11.96 hrs, Volume= 0.022 af
Outflow = 0.01 cfs @ 19.45 hrs, Volume= 0.001 af, Atten= 99%, Lag= 449.9 min
Primary = 0.01 cfs @ 19.45 hrs, Volume= 0.001 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 6
Peak Elev= 679.00' @ 19.45 hrs Surf.Area= 0 sf Storage= 898 cf

Plug-Flow detention time= 949.2 min calculated for 0.001 af (6% of inflow)
Center-of-Mass det. time= 542.5 min (1,299.6 - 757.1)

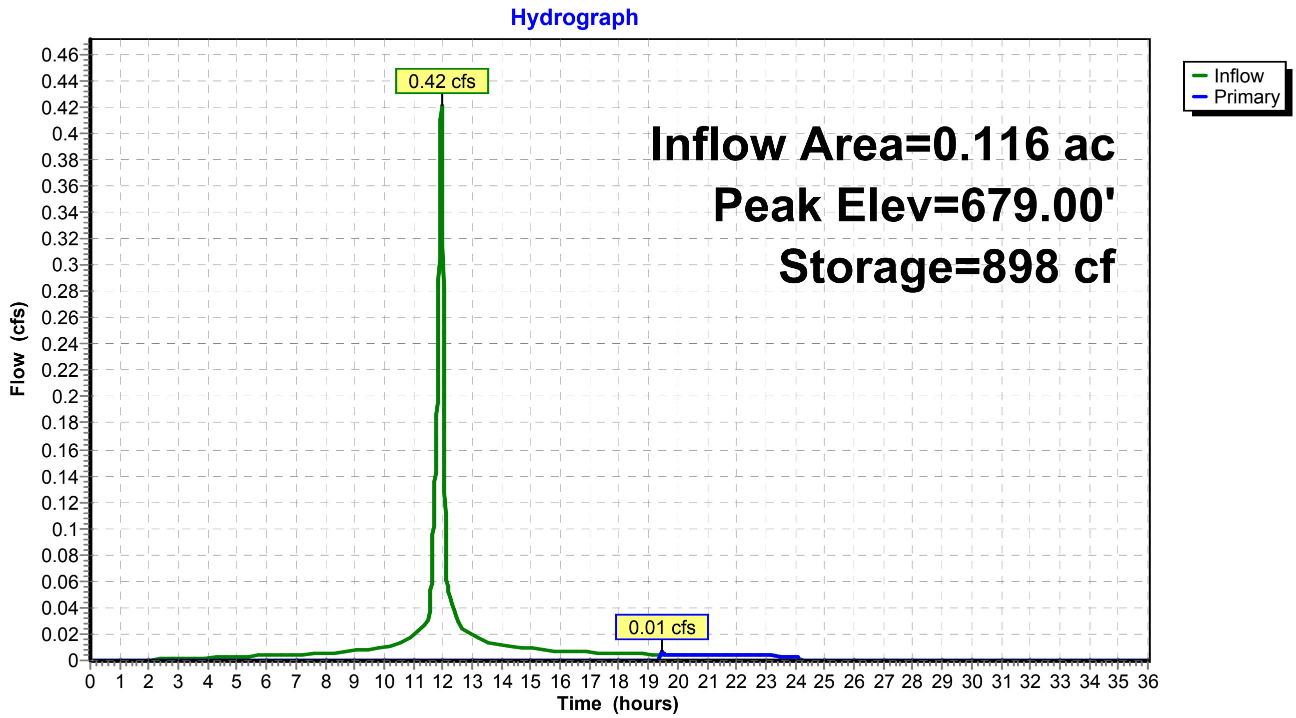
Volume	Invert	Avail.Storage	Storage Description
#1	677.00'	899 cf	**Stone Pad Void Storage** Listed below 2,247 cf Overall x 40.0% Voids

Elevation (feet)	Cum.Store (cubic-feet)
677.00	0
677.50	562
678.00	1,123
678.50	1,685
679.00	2,246
679.50	2,247

Device	Routing	Invert	Outlet Devices
#1	Primary	679.00'	**56.0' long x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=0.00 cfs @ 19.45 hrs HW=679.00' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Weir Controls 0.00 cfs @ 0.04 fps)

Pond 17P: MLV PAD

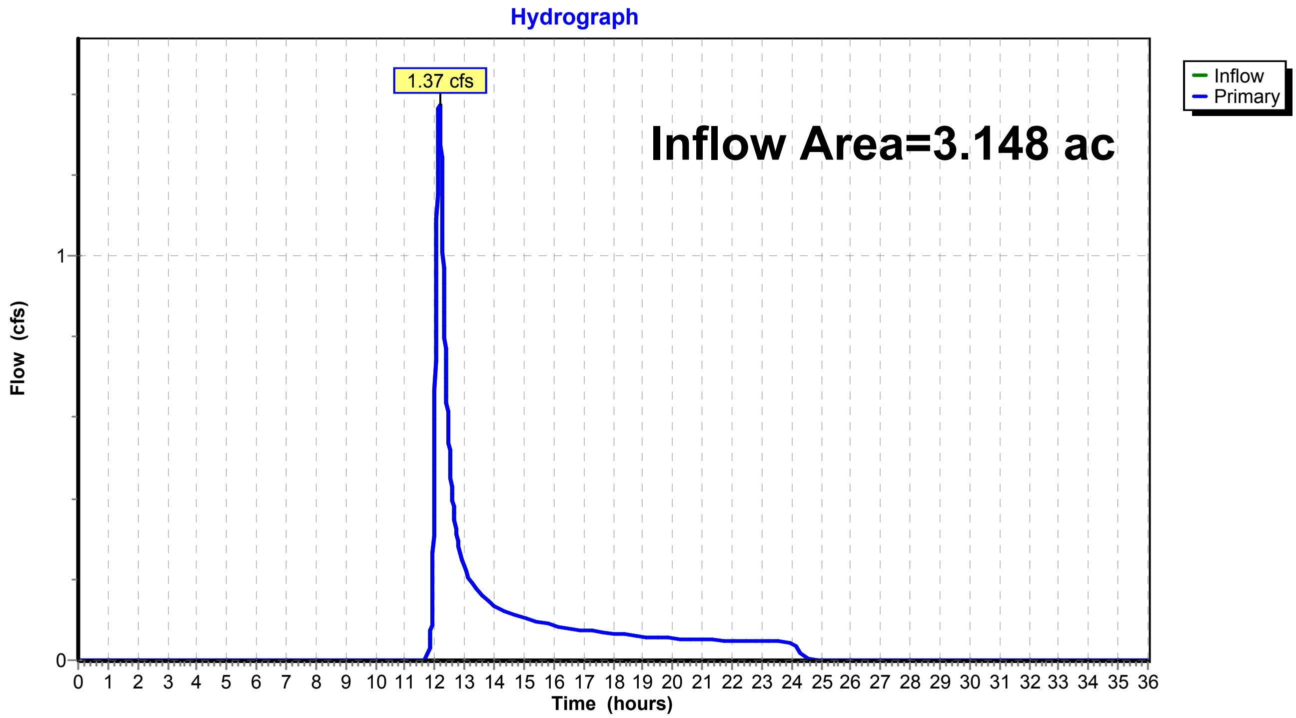


Summary for Link 5L: Proposed Conditions - SP-2

Inflow Area = 3.148 ac, 3.68% Impervious, Inflow Depth = 0.48" for 2-Year event
Inflow = 1.37 cfs @ 12.15 hrs, Volume= 0.127 af
Primary = 1.37 cfs @ 12.15 hrs, Volume= 0.127 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Link 5L: Proposed Conditions - SP-2

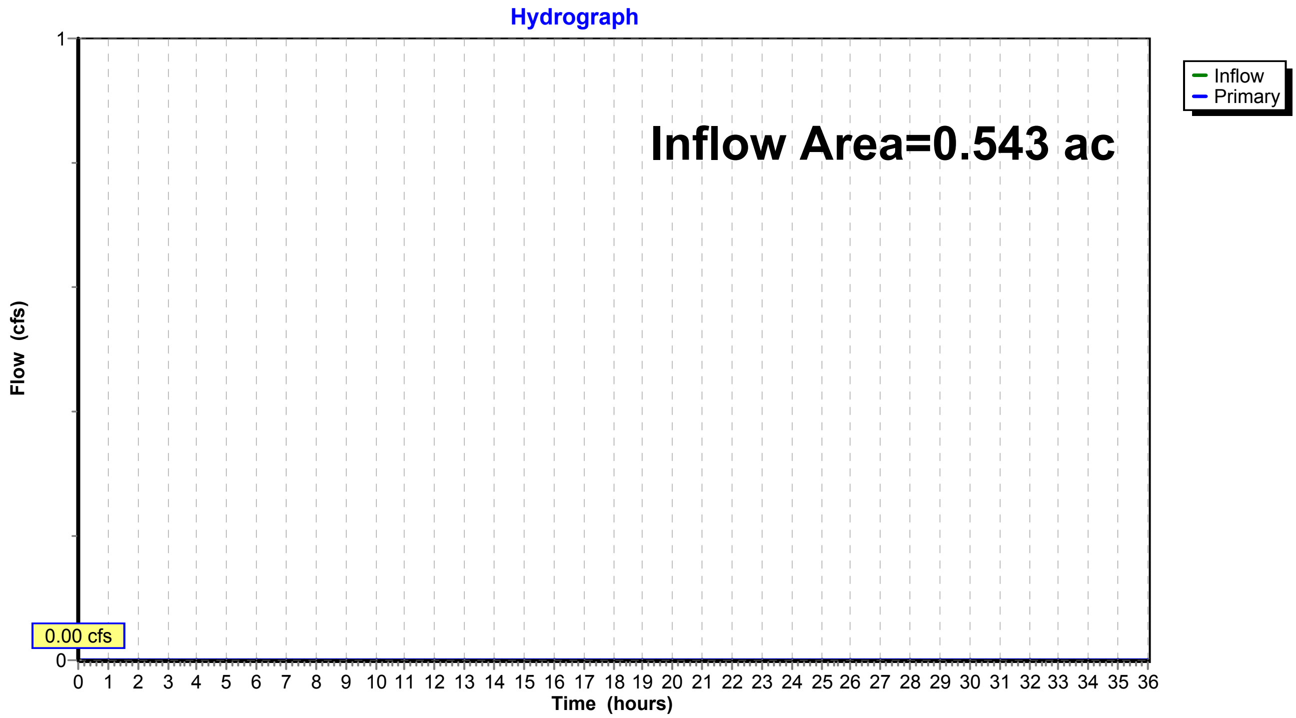


Summary for Link 7L: Proposed Conditions - SP-1

Inflow Area = 0.543 ac, 0.00% Impervious, Inflow Depth = 0.00" for 2-Year event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Link 7L: Proposed Conditions - SP-1



Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment18S: DA TO MLV PAD Runoff Area=5,040 sf 100.00% Impervious Runoff Depth=2.87"
Flow Length=90' Slope=0.0500 '/' Tc=5.0 min CN=98 Runoff=0.52 cfs 0.028 af

Subcatchment19S: OFFSITE DA Runoff Area=132,089 sf 0.00% Impervious Runoff Depth=0.82"
Flow Length=518' Tc=19.7 min CN=71 Runoff=2.52 cfs 0.207 af

Subcatchment111S: DA TO Runoff Area=23,662 sf 0.00% Impervious Runoff Depth=0.87"
Flow Length=330' Tc=43.1 min CN=72 Runoff=0.28 cfs 0.039 af

Pond 7P: VCI/INFILTRATIONBASIN - SP-1 Peak Elev=673.98' Storage=1,712 cf Inflow=0.28 cfs 0.039 af
Outflow=0.00 cfs 0.000 af

Pond 17P: MLV PAD Peak Elev=679.00' Storage=898 cf Inflow=0.52 cfs 0.028 af
Outflow=0.03 cfs 0.007 af

Link 5L: Proposed Conditions - SP-2 Inflow=2.52 cfs 0.214 af
Primary=2.52 cfs 0.214 af

Link 7L: Proposed Conditions - SP-1 Inflow=0.00 cfs 0.000 af
Primary=0.00 cfs 0.000 af

Total Runoff Area = 3.691 ac Runoff Volume = 0.274 af Average Runoff Depth = 0.89"
96.87% Pervious = 3.576 ac 3.13% Impervious = 0.116 ac

Summary for Subcatchment 18S: DA TO MLV PAD

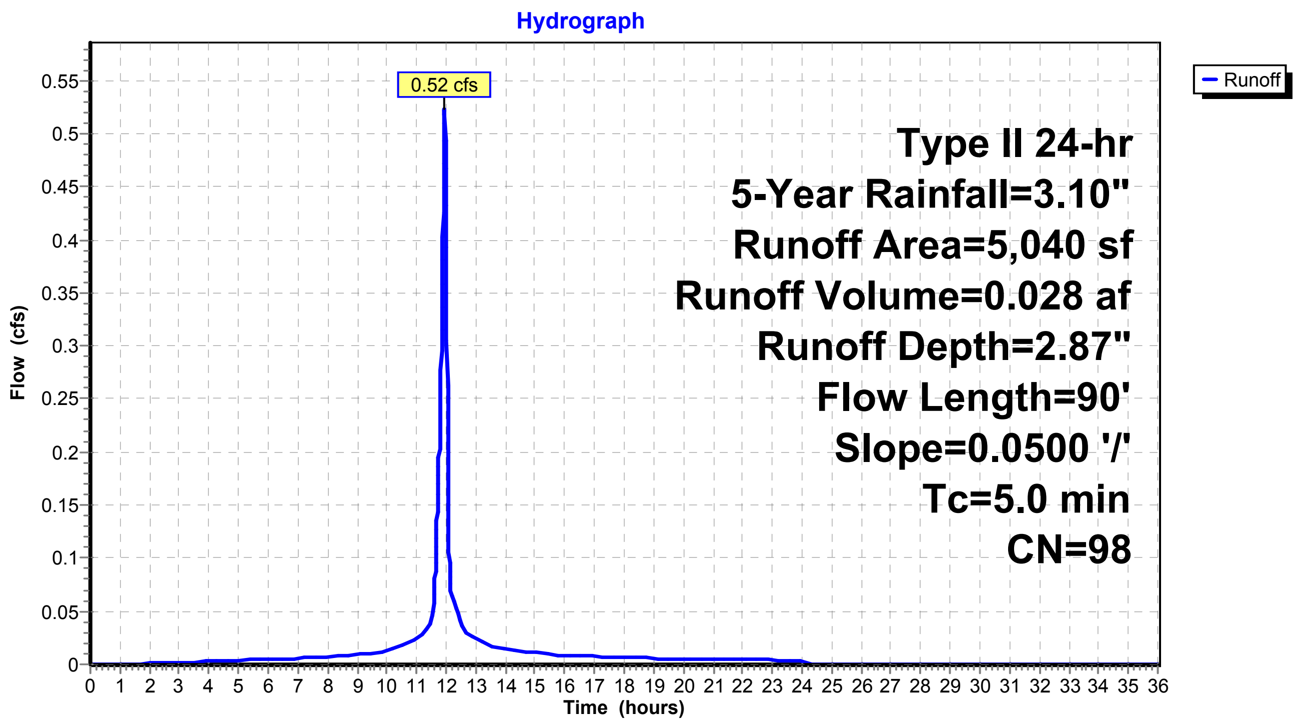
Runoff = 0.52 cfs @ 11.96 hrs, Volume= 0.028 af, Depth= 2.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 5-Year Rainfall=3.10"

	Area (sf)	CN	Description
*	5,040	98	Crushed Stone Pad, HSG C
	0	71	Meadow, non-grazed, HSG C
	5,040	98	Weighted Average
	5,040		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	90	0.0500	1.72		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.51"
0.9	90	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 18S: DA TO MLV PAD



Summary for Subcatchment 19S: OFFSITE DA

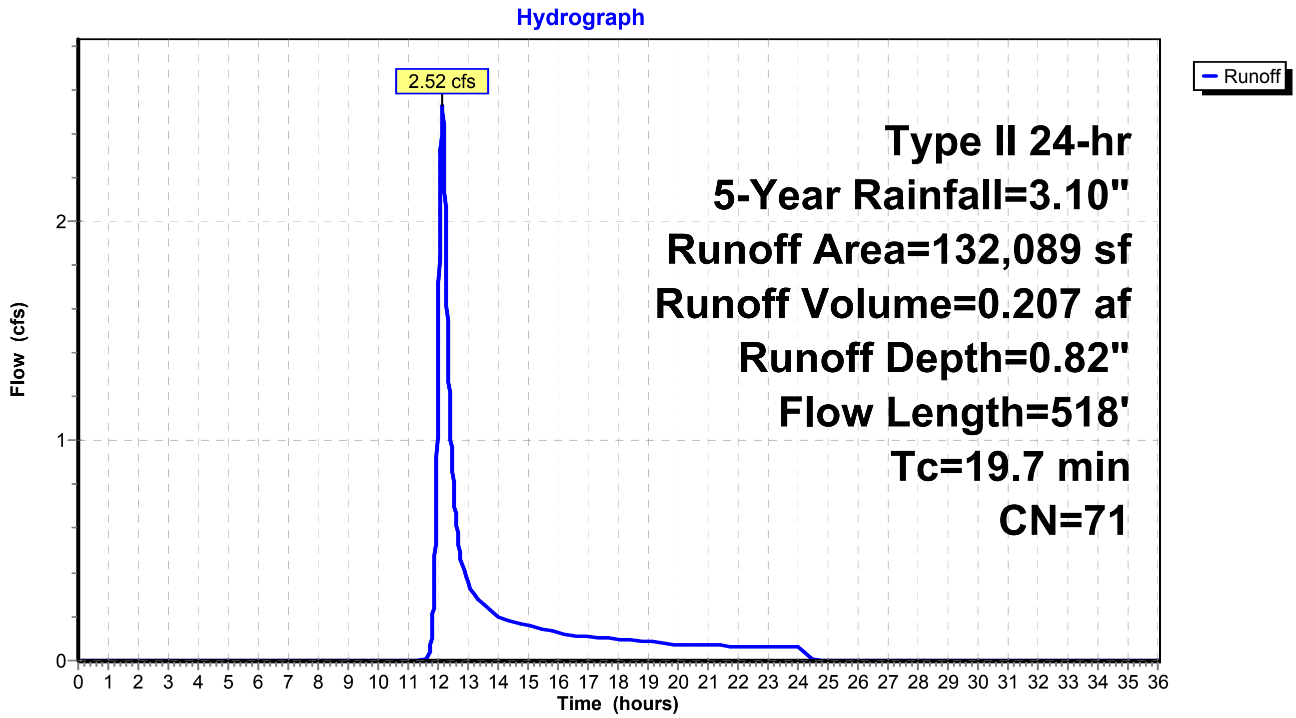
Runoff = 2.52 cfs @ 12.15 hrs, Volume= 0.207 af, Depth= 0.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 5-Year Rainfall=3.10"

	Area (sf)	CN	Description
*	5,293	71	Grass Paver Roads, HSG C
	0	70	Woods, Good, HSG C
	126,796	71	Meadow, non-grazed, HSG C
	0	98	Paved parking, HSG C
	132,089	71	Weighted Average
	132,089		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.1	100	0.0200	0.10		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 2.51"
2.7	333	0.0840	2.03		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
0.3	15	0.0150	0.86		**Shallow Concentrated Flow, SC2** Short Grass Pasture Kv= 7.0 fps
0.6	70	0.0840	2.03		**Shallow Concentrated Flow, SC3** Short Grass Pasture Kv= 7.0 fps
19.7	518	Total			

Subcatchment 19S: OFFSITE DA



Summary for Subcatchment 111S: DA TO VCI/INFILTRATION BASIN

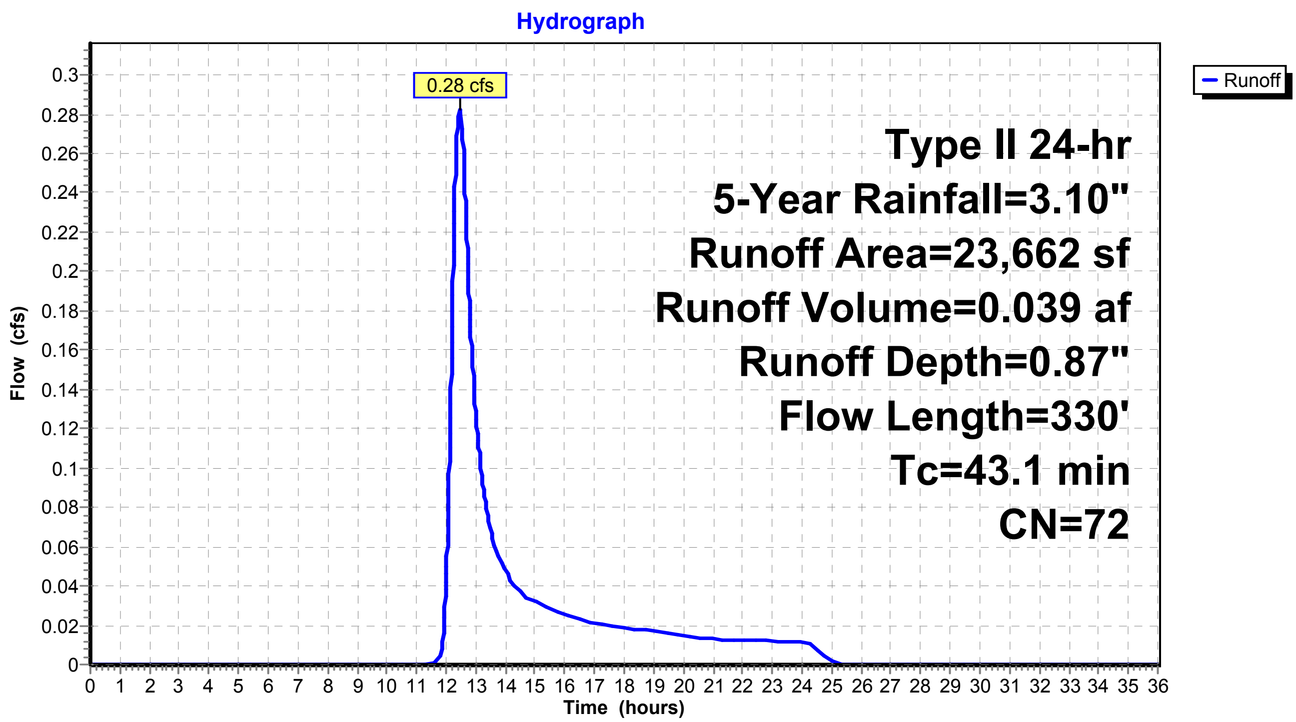
Runoff = 0.28 cfs @ 12.45 hrs, Volume= 0.039 af, Depth= 0.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 5-Year Rainfall=3.10"

Area (sf)	CN	Description
1,667	89	Gravel roads, HSG C
21,995	71	Meadow, non-grazed, HSG C
23,662	72	Weighted Average
23,662		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
40.5	100	0.0020	0.04		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 2.51"
1.9	158	0.0400	1.40		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
0.2	29	0.0400	3.22		**Shallow Concentrated Flow, SC2** Unpaved Kv= 16.1 fps
0.5	43	0.0400	1.40		**Shallow Concentrated Flow, SC3** Short Grass Pasture Kv= 7.0 fps
43.1	330	Total			

Subcatchment 111S: DA TO VCI/INFILTRATION BASIN



Summary for Pond 7P: VCI/INFILTRATION BASIN - SP-1

Inflow Area = 0.543 ac, 0.00% Impervious, Inflow Depth = 0.87" for 5-Year event
Inflow = 0.28 cfs @ 12.45 hrs, Volume= 0.039 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 673.98' @ 26.44 hrs Surf.Area= 0 sf Storage= 1,712 cf

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

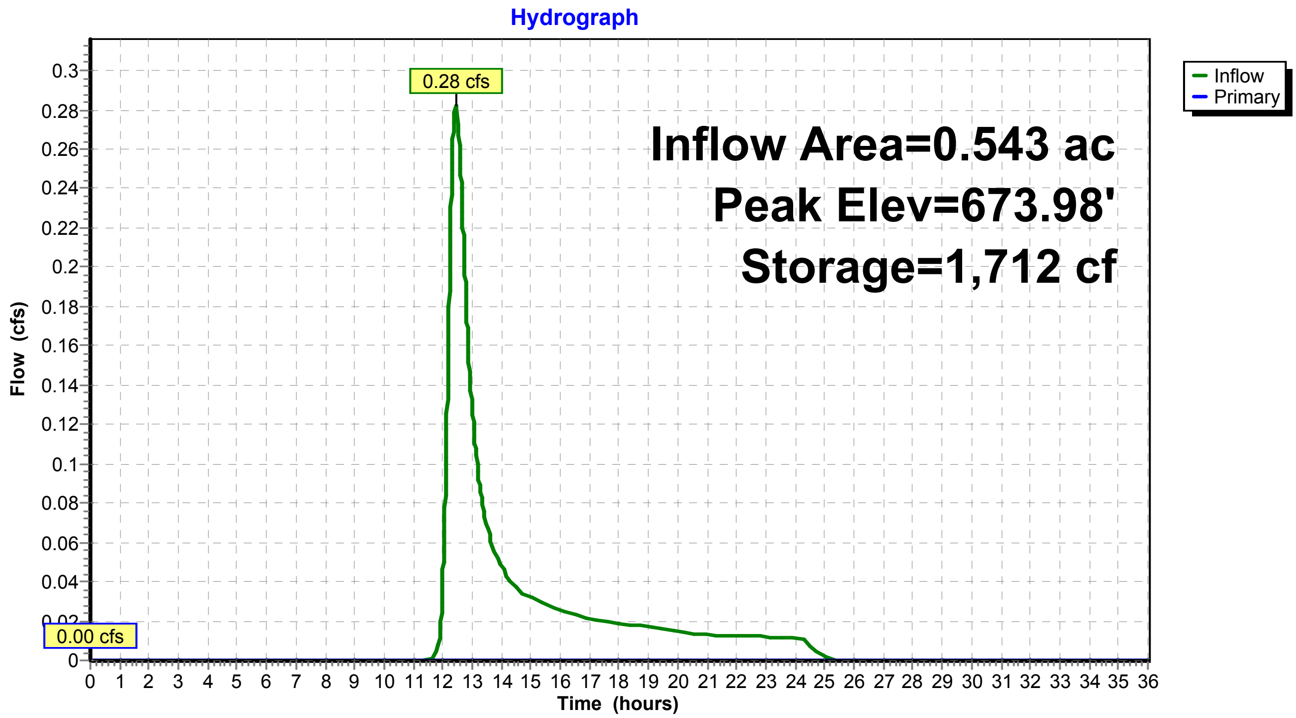
Volume	Invert	Avail.Storage	Storage Description
#1	673.00'	1,746 cf	**Custom Stage Data**Listed below

Elevation (feet)	Cum.Store (cubic-feet)
673.00	0
673.50	873
674.00	1,745
674.50	1,746

Device	Routing	Invert	Outlet Devices
#1	Primary	674.00'	**10.0' long x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=673.00' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 7P: VCI/INFILTRATION BASIN - SP-1



Summary for Pond 17P: MLV PAD

Inflow Area = 0.116 ac,100.00% Impervious, Inflow Depth = 2.87" for 5-Year event
Inflow = 0.52 cfs @ 11.96 hrs, Volume= 0.028 af
Outflow = 0.03 cfs @ 12.95 hrs, Volume= 0.007 af, Atten= 93%, Lag= 59.9 min
Primary = 0.03 cfs @ 12.95 hrs, Volume= 0.007 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 6
Peak Elev= 679.00' @ 12.95 hrs Surf.Area= 0 sf Storage= 898 cf

Plug-Flow detention time= 465.6 min calculated for 0.007 af (26% of inflow)
Center-of-Mass det. time= 262.7 min (1,015.0 - 752.3)

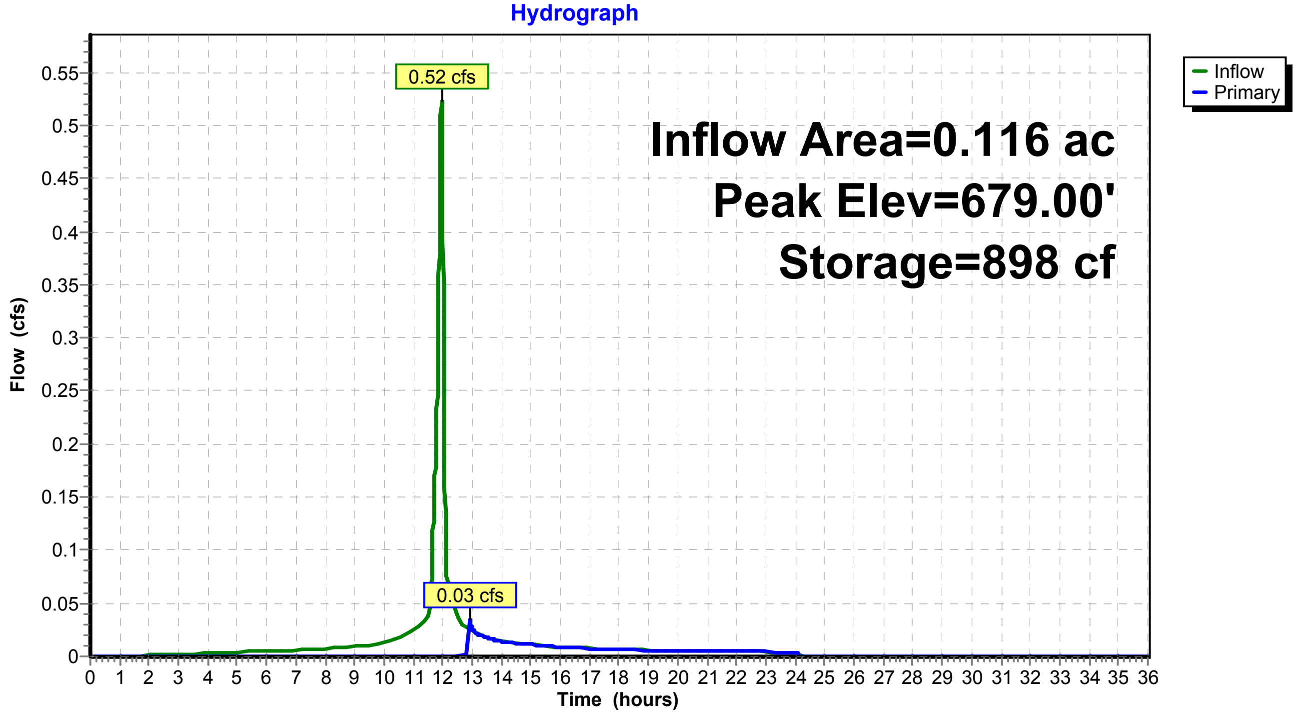
Volume	Invert	Avail.Storage	Storage Description
#1	677.00'	899 cf	**Stone Pad Void Storage** Listed below 2,247 cf Overall x 40.0% Voids

Elevation (feet)	Cum.Store (cubic-feet)
677.00	0
677.50	562
678.00	1,123
678.50	1,685
679.00	2,246
679.50	2,247

Device	Routing	Invert	Outlet Devices
#1	Primary	679.00'	**56.0' long x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=0.01 cfs @ 12.95 hrs HW=679.00' (Free Discharge)
└**1=Broad-Crested Rectangular Weir** (Weir Controls 0.01 cfs @ 0.09 fps)

Pond 17P: MLV PAD

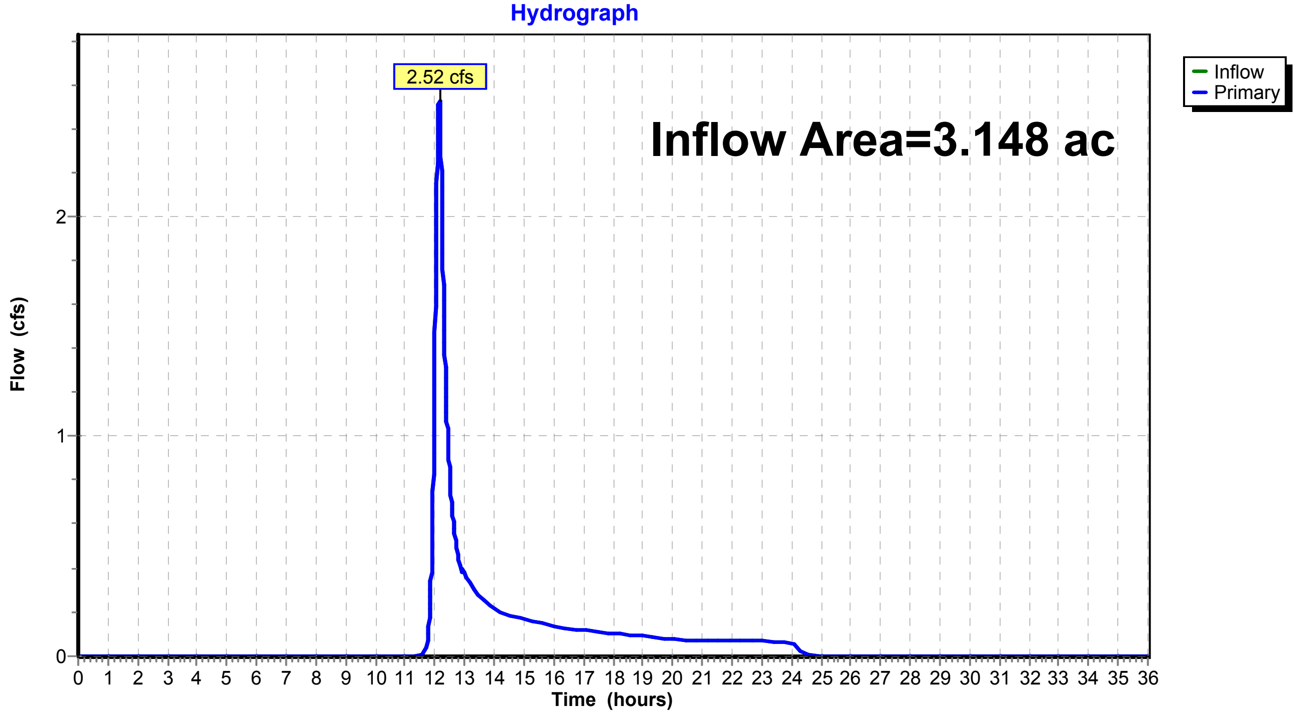


Summary for Link 5L: Proposed Conditions - SP-2

Inflow Area =	3.148 ac,	3.68% Impervious, Inflow Depth = 0.82"	for 5-Year event	
Inflow =	2.52 cfs @	12.15 hrs, Volume=	0.214 af	
Primary =	2.52 cfs @	12.15 hrs, Volume=	0.214 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

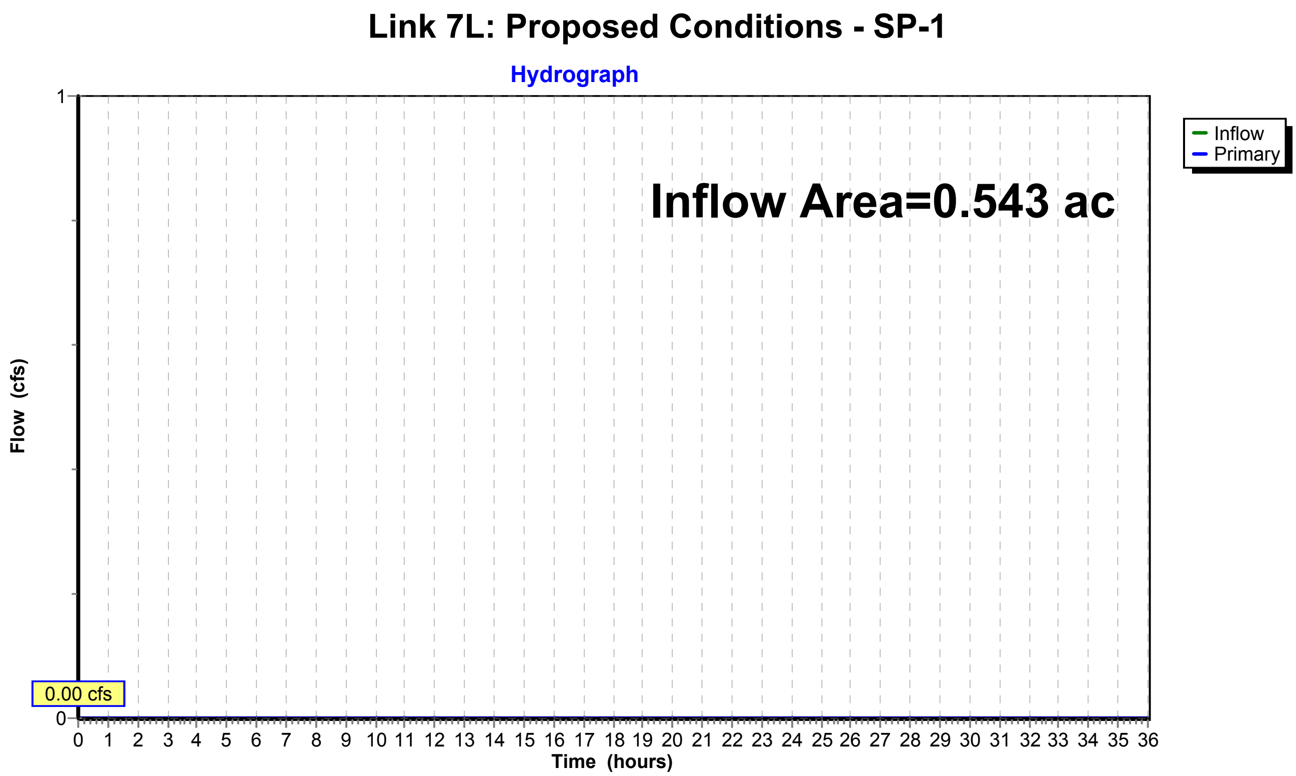
Link 5L: Proposed Conditions - SP-2



Summary for Link 7L: Proposed Conditions - SP-1

Inflow Area = 0.543 ac, 0.00% Impervious, Inflow Depth = 0.00" for 5-Year event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs



Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment18S: DA TO MLV PAD Runoff Area=5,040 sf 100.00% Impervious Runoff Depth=3.38"
Flow Length=90' Slope=0.0500 '/' Tc=5.0 min CN=98 Runoff=0.61 cfs 0.033 af

Subcatchment19S: OFFSITE DA Runoff Area=132,089 sf 0.00% Impervious Runoff Depth=1.13"
Flow Length=518' Tc=19.7 min CN=71 Runoff=3.64 cfs 0.287 af

Subcatchment111S: DA TO Runoff Area=23,662 sf 0.00% Impervious Runoff Depth=1.19"
Flow Length=330' Tc=43.1 min CN=72 Runoff=0.41 cfs 0.054 af

Pond 7P: VCI/INFILTRATIONBASIN - SP-1 Peak Elev=674.01' Storage=1,745 cf Inflow=0.41 cfs 0.054 af
Outflow=0.03 cfs 0.014 af

Pond 17P: MLV PAD Peak Elev=679.01' Storage=898 cf Inflow=0.61 cfs 0.033 af
Outflow=0.19 cfs 0.012 af

Link 5L: Proposed Conditions - SP-2 Inflow=3.74 cfs 0.299 af
Primary=3.74 cfs 0.299 af

Link 7L: Proposed Conditions - SP-1 Inflow=0.03 cfs 0.014 af
Primary=0.03 cfs 0.014 af

Total Runoff Area = 3.691 ac Runoff Volume = 0.373 af Average Runoff Depth = 1.21"
96.87% Pervious = 3.576 ac 3.13% Impervious = 0.116 ac

Summary for Subcatchment 18S: DA TO MLV PAD

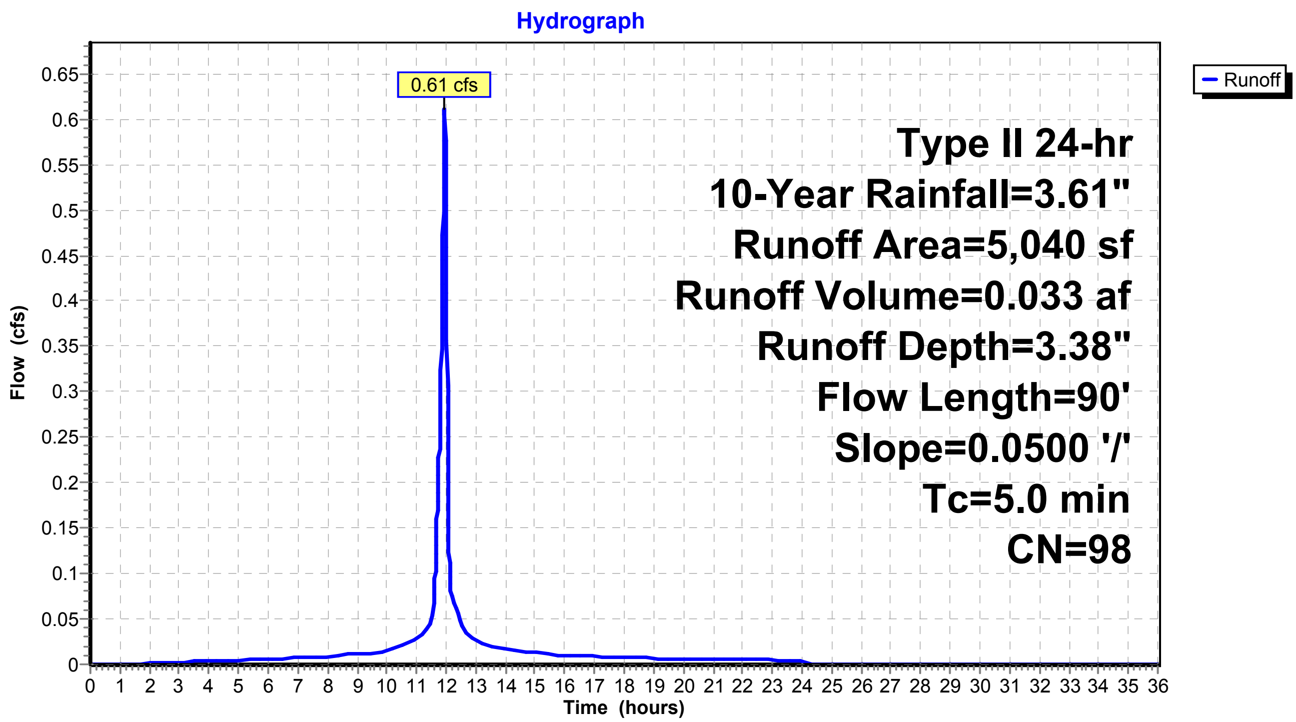
Runoff = 0.61 cfs @ 11.96 hrs, Volume= 0.033 af, Depth= 3.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 10-Year Rainfall=3.61"

	Area (sf)	CN	Description
*	5,040	98	Crushed Stone Pad, HSG C
	0	71	Meadow, non-grazed, HSG C
	5,040	98	Weighted Average
	5,040		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	90	0.0500	1.72		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.51"
0.9	90	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 18S: DA TO MLV PAD



Summary for Subcatchment 19S: OFFSITE DA

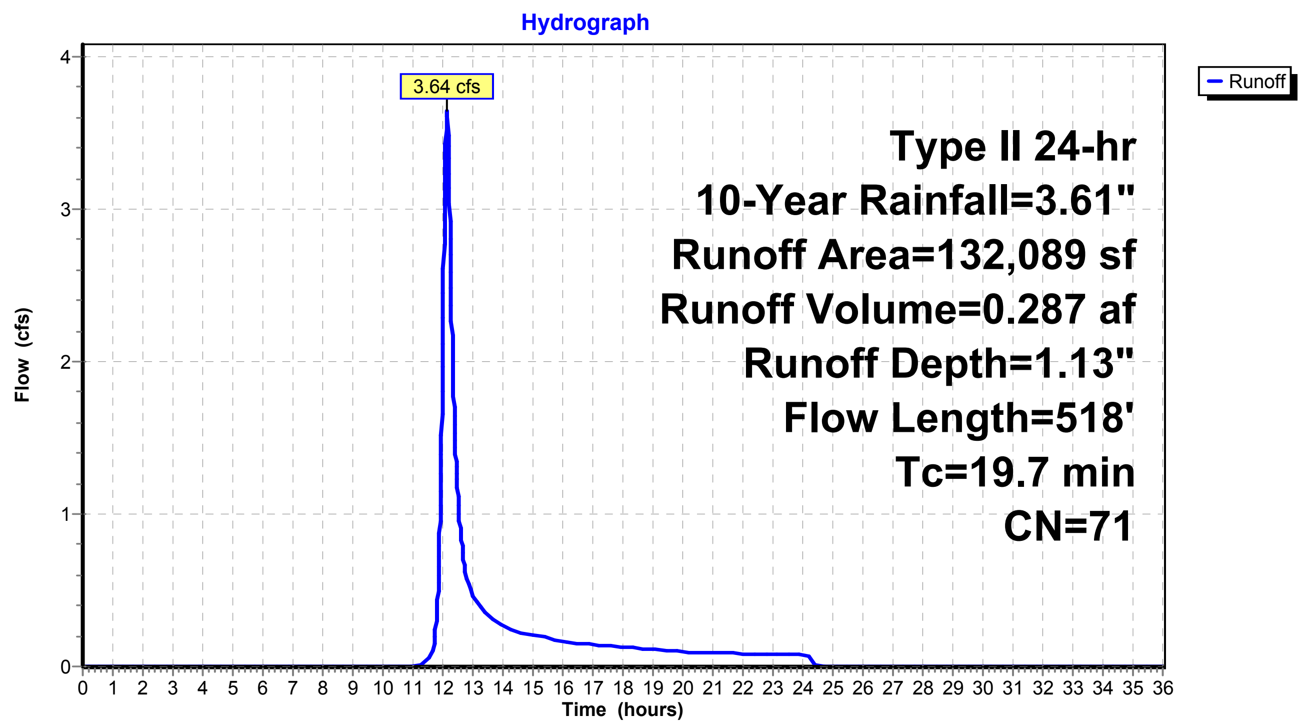
Runoff = 3.64 cfs @ 12.14 hrs, Volume= 0.287 af, Depth= 1.13"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 10-Year Rainfall=3.61"

	Area (sf)	CN	Description
*	5,293	71	Grass Paver Roads, HSG C
	0	70	Woods, Good, HSG C
	126,796	71	Meadow, non-grazed, HSG C
	0	98	Paved parking, HSG C
	132,089	71	Weighted Average
	132,089		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.1	100	0.0200	0.10		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 2.51"
2.7	333	0.0840	2.03		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
0.3	15	0.0150	0.86		**Shallow Concentrated Flow, SC2** Short Grass Pasture Kv= 7.0 fps
0.6	70	0.0840	2.03		**Shallow Concentrated Flow, SC3** Short Grass Pasture Kv= 7.0 fps
19.7	518	Total			

Subcatchment 19S: OFFSITE DA



Summary for Subcatchment 111S: DA TO VCI/INFILTRATION BASIN

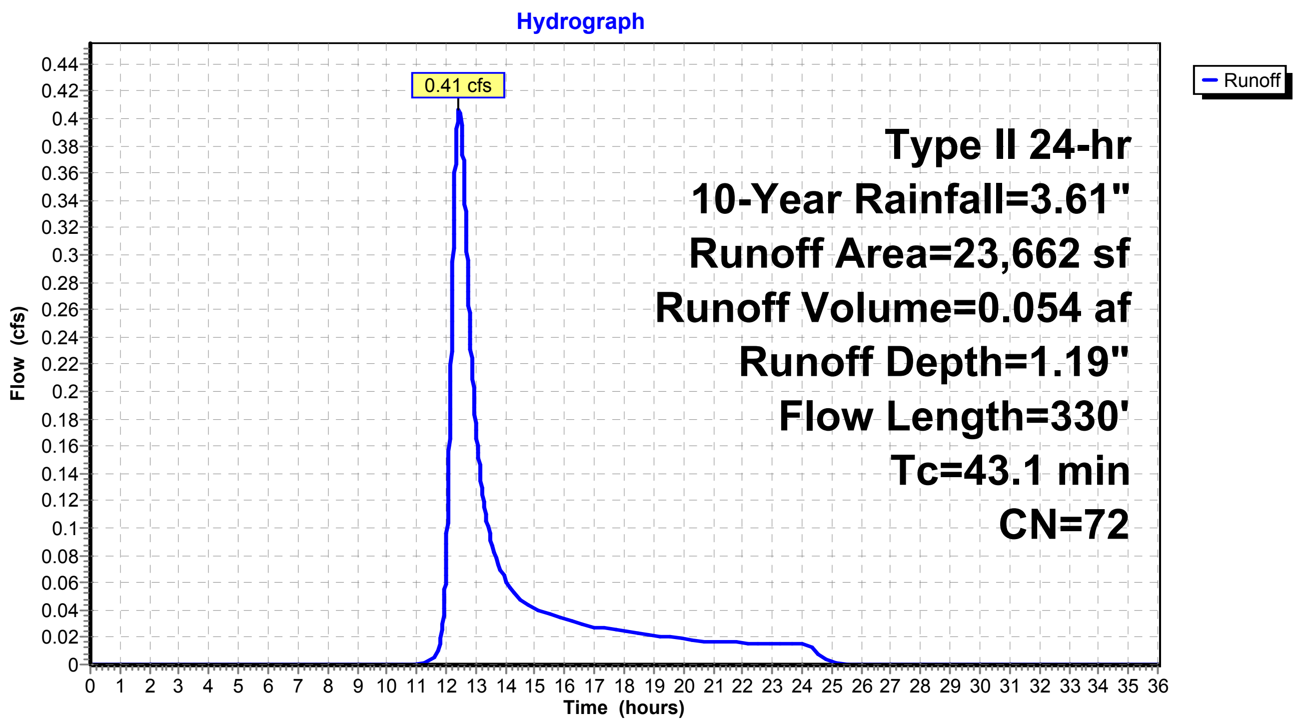
Runoff = 0.41 cfs @ 12.41 hrs, Volume= 0.054 af, Depth= 1.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 10-Year Rainfall=3.61"

Area (sf)	CN	Description
1,667	89	Gravel roads, HSG C
21,995	71	Meadow, non-grazed, HSG C
23,662	72	Weighted Average
23,662		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
40.5	100	0.0020	0.04		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 2.51"
1.9	158	0.0400	1.40		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
0.2	29	0.0400	3.22		**Shallow Concentrated Flow, SC2** Unpaved Kv= 16.1 fps
0.5	43	0.0400	1.40		**Shallow Concentrated Flow, SC3** Short Grass Pasture Kv= 7.0 fps
43.1	330	Total			

Subcatchment 111S: DA TO VCI/INFILTRATION BASIN



Summary for Pond 7P: VCI/INFILTRATION BASIN - SP-1

Inflow Area = 0.543 ac, 0.00% Impervious, Inflow Depth = 1.19" for 10-Year event
Inflow = 0.41 cfs @ 12.41 hrs, Volume= 0.054 af
Outflow = 0.03 cfs @ 16.33 hrs, Volume= 0.014 af, Atten= 92%, Lag= 235.2 min
Primary = 0.03 cfs @ 16.33 hrs, Volume= 0.014 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 674.01' @ 16.33 hrs Surf.Area= 0 sf Storage= 1,745 cf

Plug-Flow detention time= 453.1 min calculated for 0.014 af (26% of inflow)
Center-of-Mass det. time= 298.8 min (1,190.8 - 891.9)

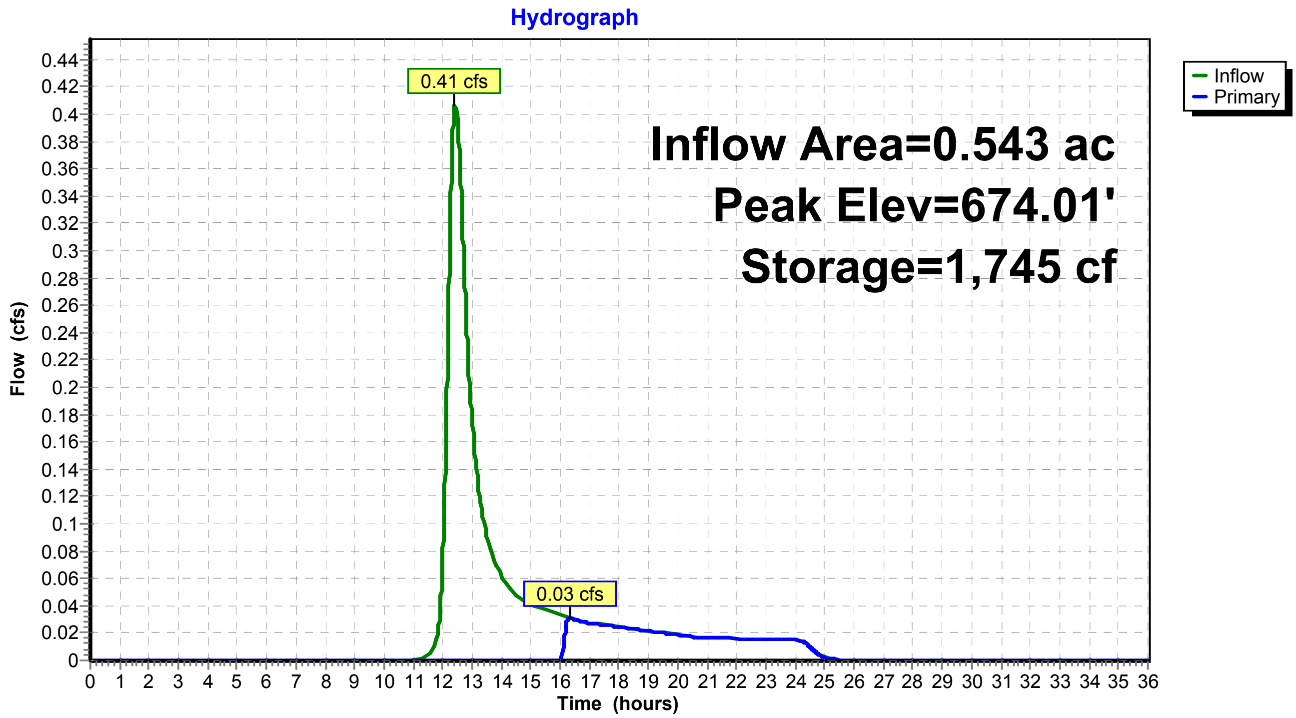
Volume	Invert	Avail.Storage	Storage Description
#1	673.00'	1,746 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
673.00	0
673.50	873
674.00	1,745
674.50	1,746

Device	Routing	Invert	Outlet Devices
#1	Primary	674.00'	**10.0' long x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=0.03 cfs @ 16.33 hrs HW=674.01' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Weir Controls 0.03 cfs @ 0.25 fps)

Pond 7P: VCI/INFILTRATION BASIN - SP-1



Summary for Pond 17P: MLV PAD

Inflow Area = 0.116 ac,100.00% Impervious, Inflow Depth = 3.38" for 10-Year event
Inflow = 0.61 cfs @ 11.96 hrs, Volume= 0.033 af
Outflow = 0.19 cfs @ 12.08 hrs, Volume= 0.012 af, Atten= 69%, Lag= 7.7 min
Primary = 0.19 cfs @ 12.08 hrs, Volume= 0.012 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 6
Peak Elev= 679.01' @ 12.08 hrs Surf.Area= 0 sf Storage= 898 cf

Plug-Flow detention time= 338.4 min calculated for 0.012 af (37% of inflow)
Center-of-Mass det. time= 180.5 min (929.6 - 749.1)

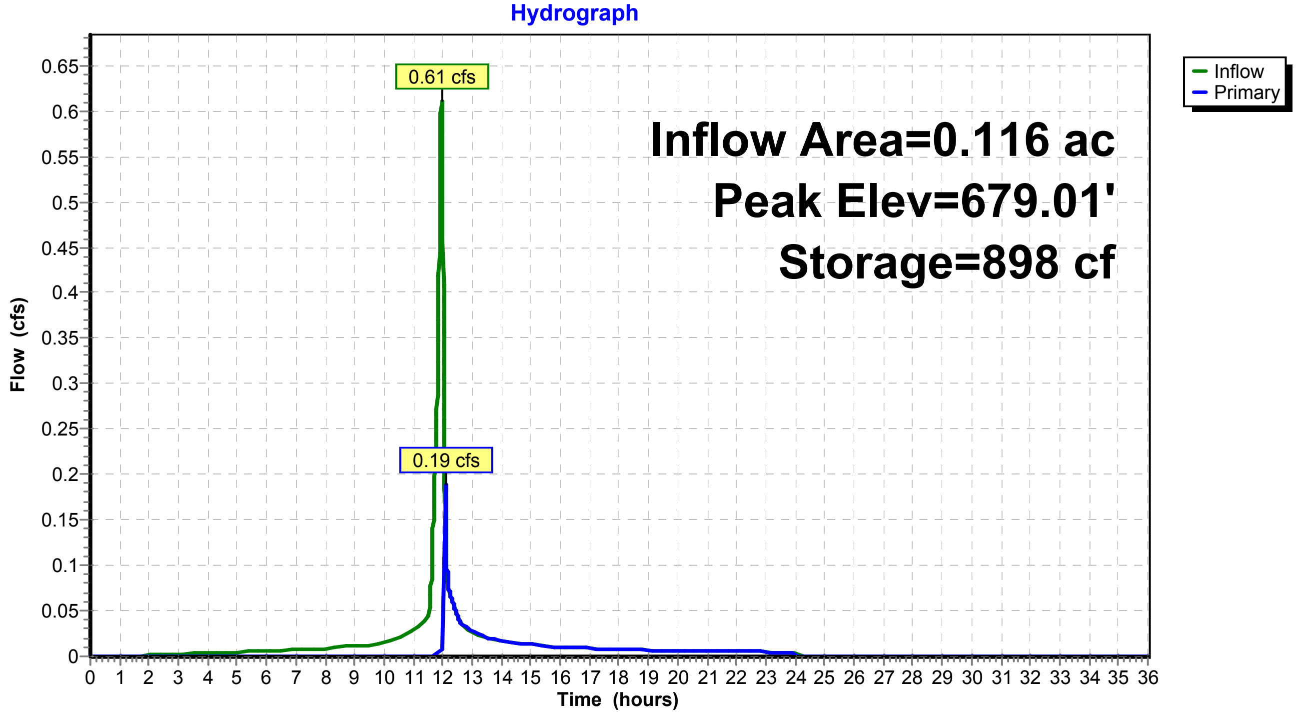
Volume	Invert	Avail.Storage	Storage Description
#1	677.00'	899 cf	**Stone Pad Void Storage** Listed below 2,247 cf Overall x 40.0% Voids

Elevation (feet)	Cum.Store (cubic-feet)
677.00	0
677.50	562
678.00	1,123
678.50	1,685
679.00	2,246
679.50	2,247

Device	Routing	Invert	Outlet Devices
#1	Primary	679.00'	**56.0' long x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=0.09 cfs @ 12.08 hrs HW=679.01' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Weir Controls 0.09 cfs @ 0.21 fps)

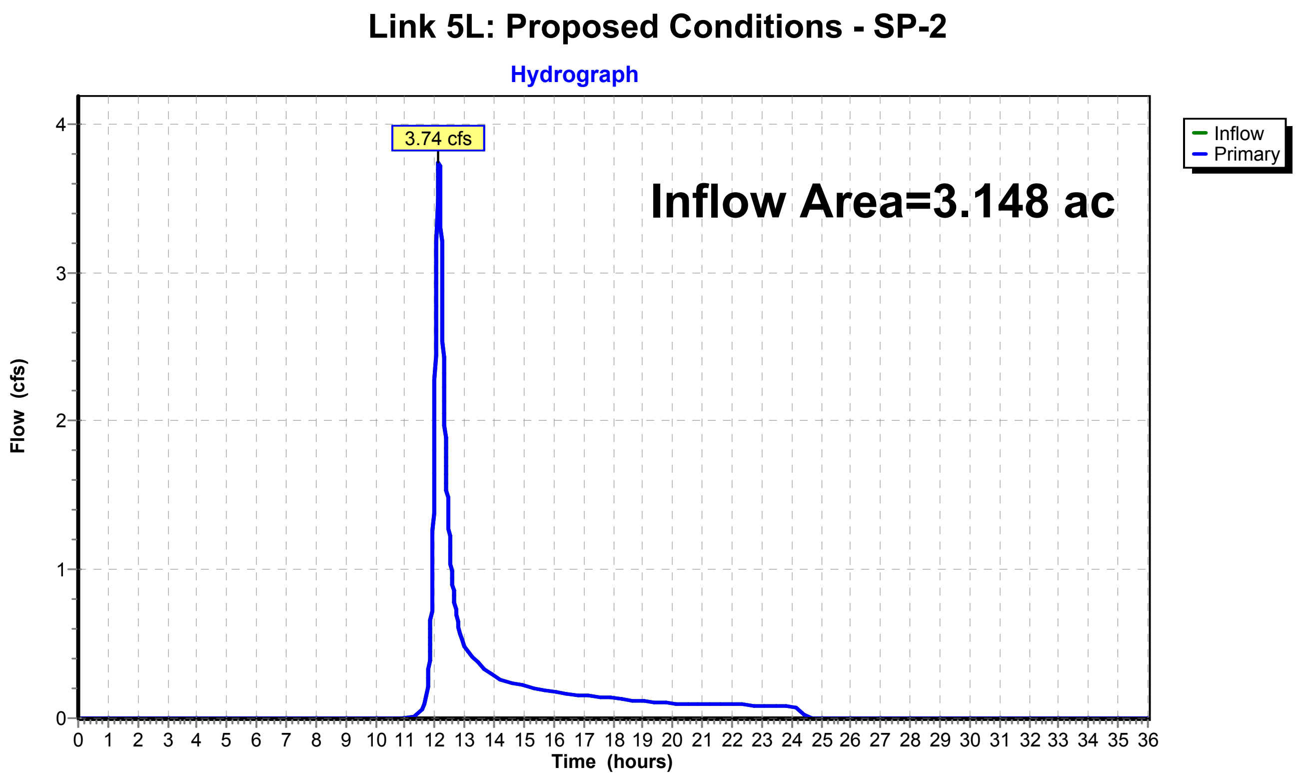
Pond 17P: MLV PAD



Summary for Link 5L: Proposed Conditions - SP-2

Inflow Area =	3.148 ac,	3.68% Impervious,	Inflow Depth = 1.14"	for 10-Year event	
Inflow =	3.74 cfs @	12.13 hrs,	Volume=	0.299 af	
Primary =	3.74 cfs @	12.13 hrs,	Volume=	0.299 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

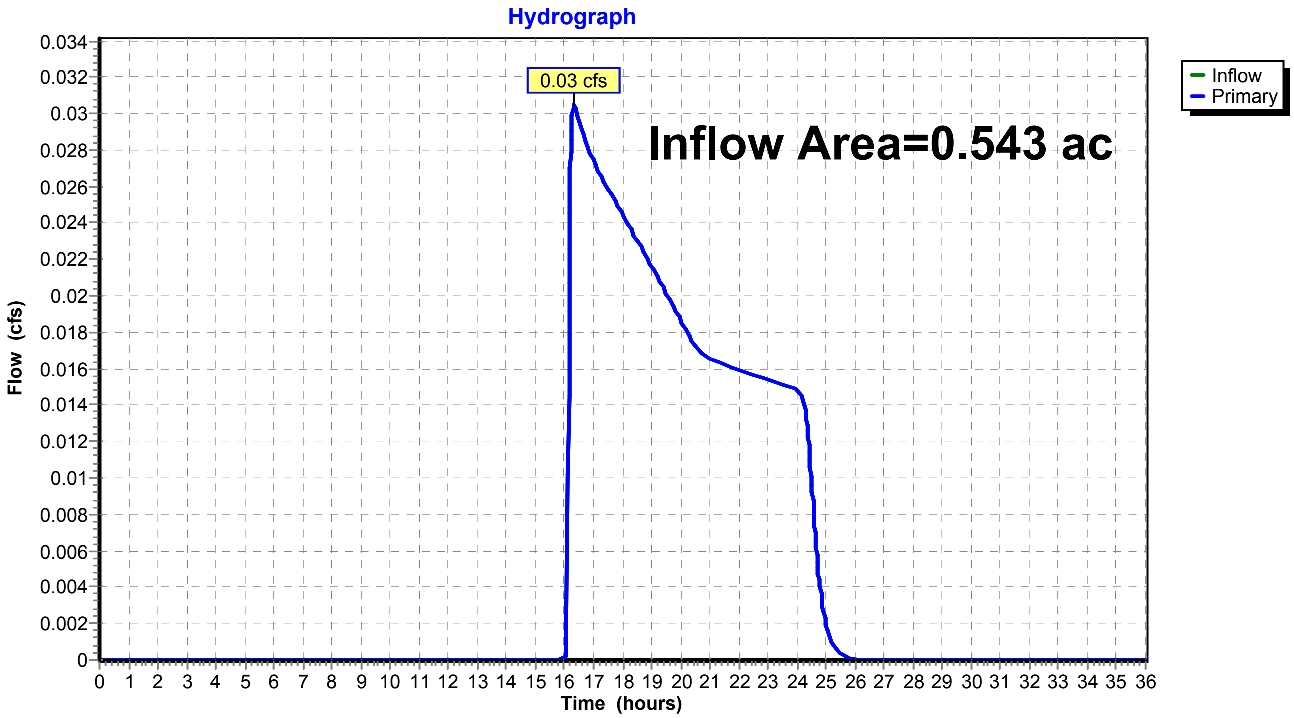


Summary for Link 7L: Proposed Conditions - SP-1

Inflow Area = 0.543 ac, 0.00% Impervious, Inflow Depth = 0.31" for 10-Year event
Inflow = 0.03 cfs @ 16.33 hrs, Volume= 0.014 af
Primary = 0.03 cfs @ 16.33 hrs, Volume= 0.014 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Link 7L: Proposed Conditions - SP-1



Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment18S: DA TO MLV PAD Runoff Area=5,040 sf 100.00% Impervious Runoff Depth=4.17"
Flow Length=90' Slope=0.0500 '/' Tc=5.0 min CN=98 Runoff=0.75 cfs 0.040 af

Subcatchment19S: OFFSITE DA Runoff Area=132,089 sf 0.00% Impervious Runoff Depth=1.68"
Flow Length=518' Tc=19.7 min CN=71 Runoff=5.58 cfs 0.425 af

Subcatchment111S: DA TO Runoff Area=23,662 sf 0.00% Impervious Runoff Depth=1.75"
Flow Length=330' Tc=43.1 min CN=72 Runoff=0.62 cfs 0.079 af

Pond 7P: VCI/INFILTRATIONBASIN - SP-1 Peak Elev=674.05' Storage=1,745 cf Inflow=0.62 cfs 0.079 af
Outflow=0.24 cfs 0.040 af

Pond 17P: MLV PAD Peak Elev=679.02' Storage=898 cf Inflow=0.75 cfs 0.040 af
Outflow=0.50 cfs 0.018 af

Link 5L: Proposed Conditions - SP-2 Inflow=5.66 cfs 0.443 af
Primary=5.66 cfs 0.443 af

Link 7L: Proposed Conditions - SP-1 Inflow=0.24 cfs 0.040 af
Primary=0.24 cfs 0.040 af

Total Runoff Area = 3.691 ac Runoff Volume = 0.545 af Average Runoff Depth = 1.77"
96.87% Pervious = 3.576 ac 3.13% Impervious = 0.116 ac

Summary for Subcatchment 18S: DA TO MLV PAD

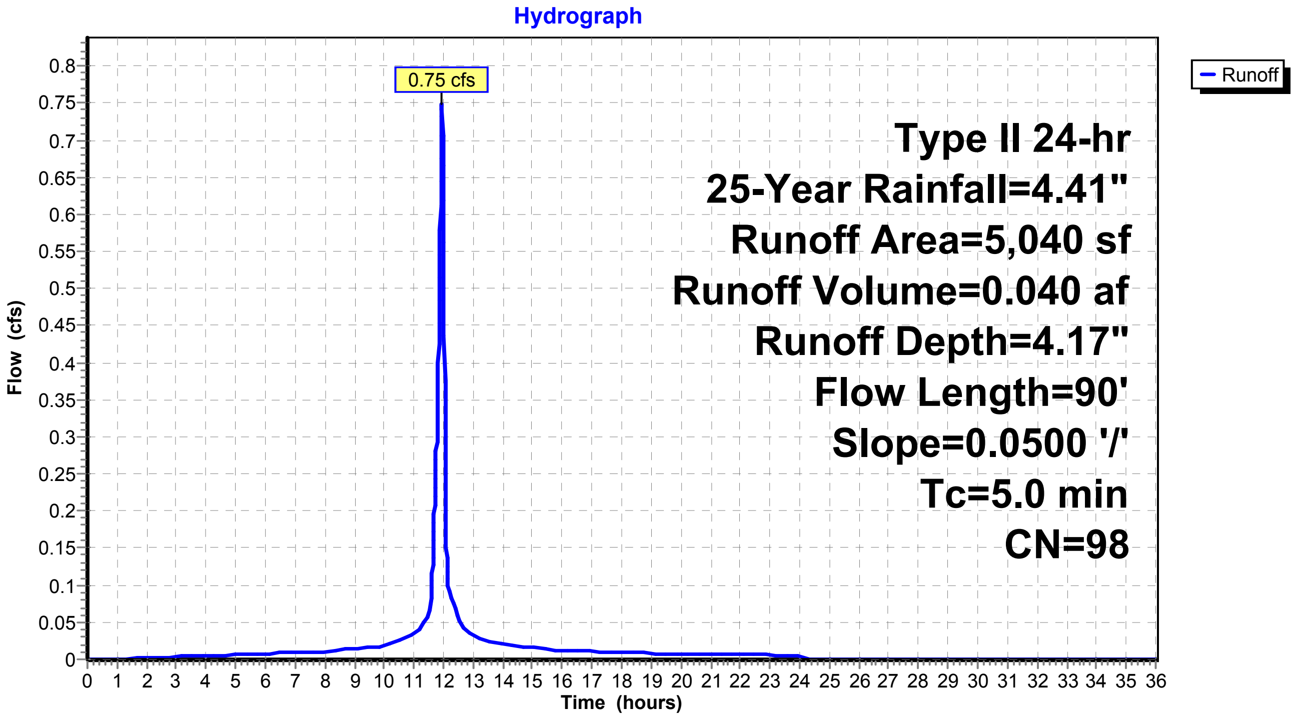
Runoff = 0.75 cfs @ 11.96 hrs, Volume= 0.040 af, Depth= 4.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=4.41"

	Area (sf)	CN	Description
*	5,040	98	Crushed Stone Pad, HSG C
	0	71	Meadow, non-grazed, HSG C
	5,040	98	Weighted Average
	5,040		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	90	0.0500	1.72		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.51"
0.9	90	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 18S: DA TO MLV PAD



Summary for Subcatchment 19S: OFFSITE DA

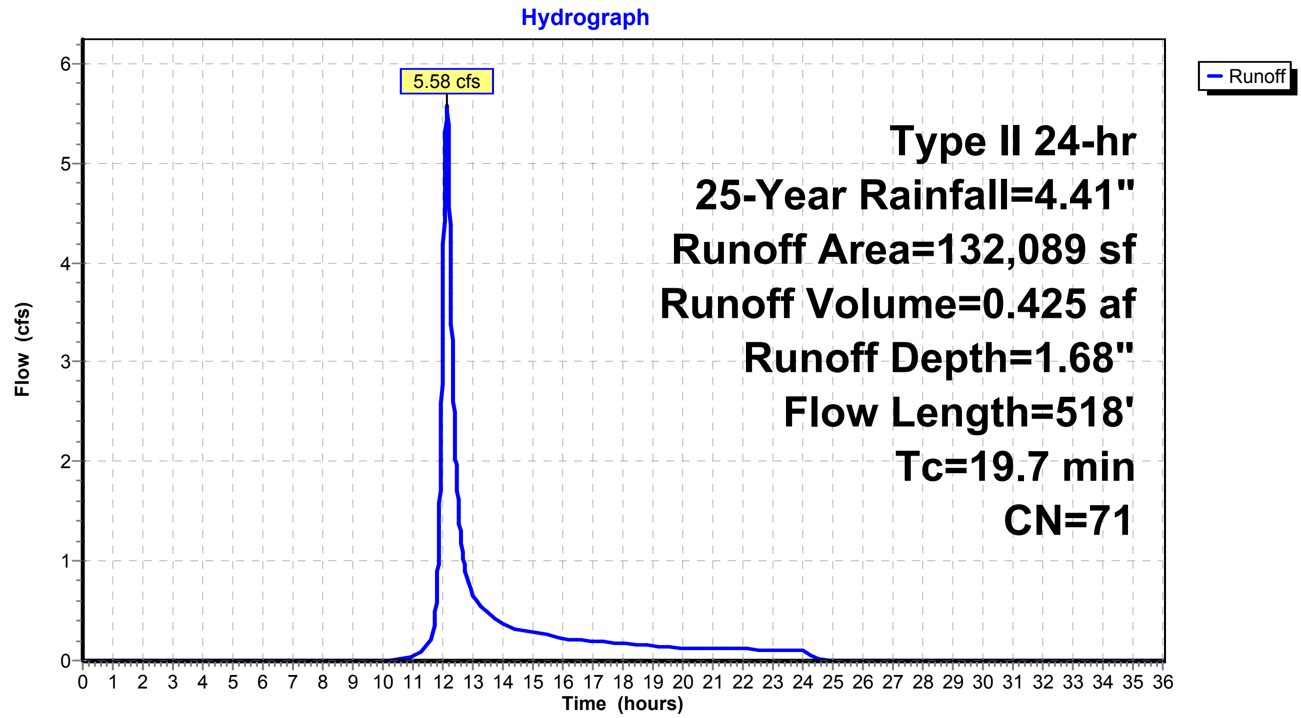
Runoff = 5.58 cfs @ 12.13 hrs, Volume= 0.425 af, Depth= 1.68"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=4.41"

	Area (sf)	CN	Description
*	5,293	71	Grass Paver Roads, HSG C
	0	70	Woods, Good, HSG C
	126,796	71	Meadow, non-grazed, HSG C
	0	98	Paved parking, HSG C
	132,089	71	Weighted Average
	132,089		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.1	100	0.0200	0.10		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 2.51"
2.7	333	0.0840	2.03		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
0.3	15	0.0150	0.86		**Shallow Concentrated Flow, SC2** Short Grass Pasture Kv= 7.0 fps
0.6	70	0.0840	2.03		**Shallow Concentrated Flow, SC3** Short Grass Pasture Kv= 7.0 fps
19.7	518	Total			

Subcatchment 19S: OFFSITE DA



Summary for Subcatchment 111S: DA TO VCI/INFILTRATION BASIN

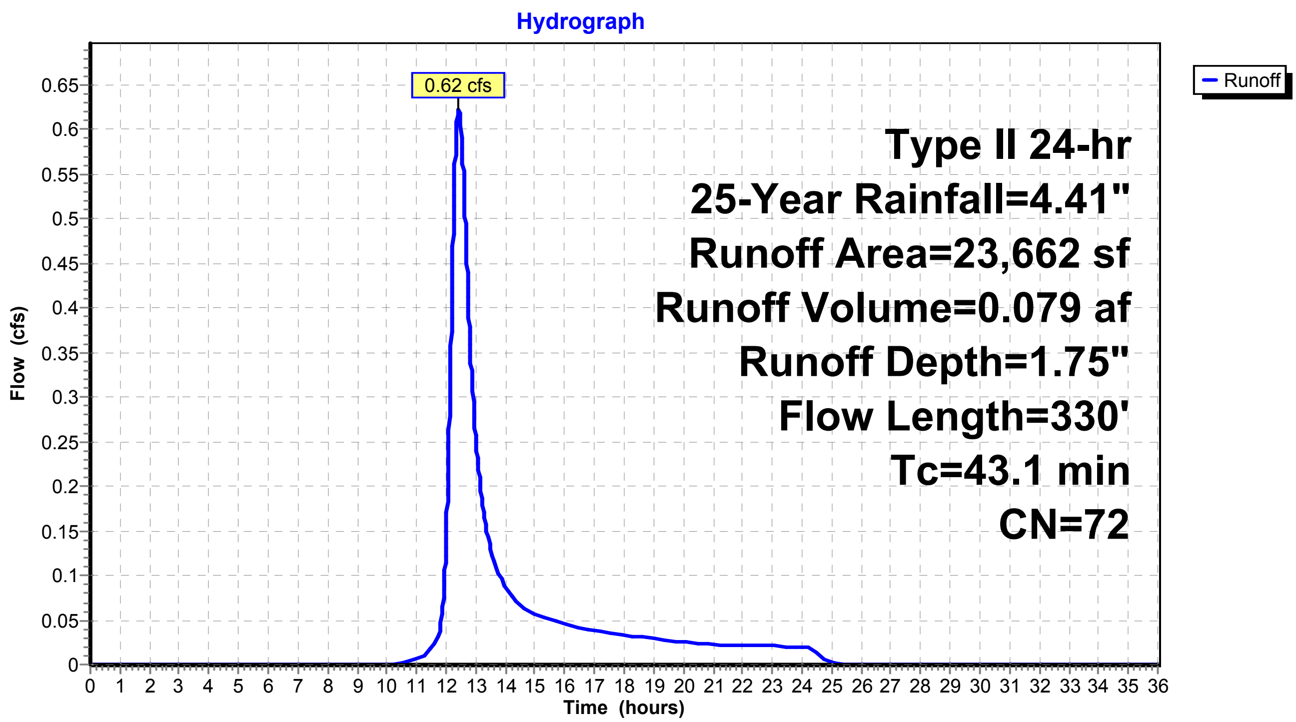
Runoff = 0.62 cfs @ 12.41 hrs, Volume= 0.079 af, Depth= 1.75"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=4.41"

Area (sf)	CN	Description
1,667	89	Gravel roads, HSG C
21,995	71	Meadow, non-grazed, HSG C
23,662	72	Weighted Average
23,662		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
40.5	100	0.0020	0.04		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 2.51"
1.9	158	0.0400	1.40		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
0.2	29	0.0400	3.22		**Shallow Concentrated Flow, SC2** Unpaved Kv= 16.1 fps
0.5	43	0.0400	1.40		**Shallow Concentrated Flow, SC3** Short Grass Pasture Kv= 7.0 fps
43.1	330	Total			

Subcatchment 111S: DA TO VCI/INFILTRATION BASIN



Summary for Pond 7P: VCI/INFILTRATION BASIN - SP-1

Inflow Area = 0.543 ac, 0.00% Impervious, Inflow Depth = 1.75" for 25-Year event
Inflow = 0.62 cfs @ 12.41 hrs, Volume= 0.079 af
Outflow = 0.24 cfs @ 13.09 hrs, Volume= 0.040 af, Atten= 62%, Lag= 40.8 min
Primary = 0.24 cfs @ 13.09 hrs, Volume= 0.040 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 674.05' @ 13.09 hrs Surf.Area= 0 sf Storage= 1,745 cf

Plug-Flow detention time= 265.8 min calculated for 0.040 af (50% of inflow)
Center-of-Mass det. time= 133.4 min (1,013.7 - 880.3)

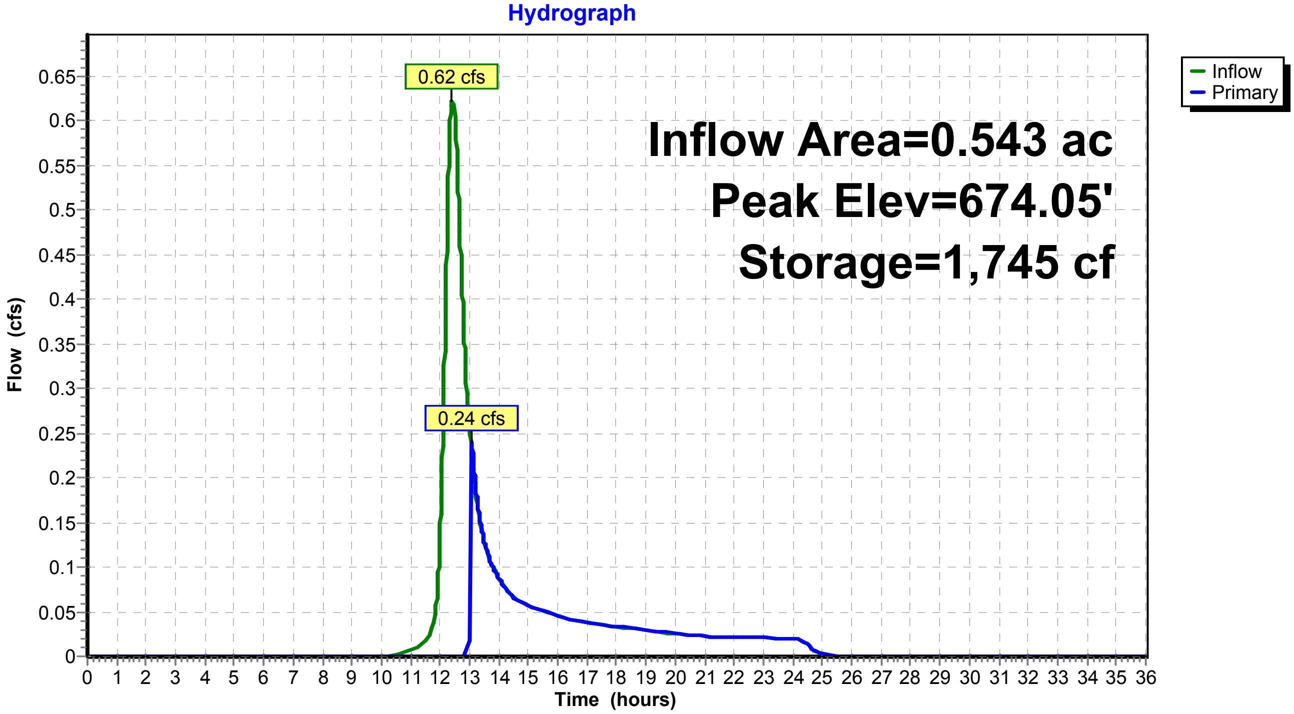
Volume	Invert	Avail.Storage	Storage Description
#1	673.00'	1,746 cf	**Custom Stage Data**Listed below

Elevation (feet)	Cum.Store (cubic-feet)
673.00	0
673.50	873
674.00	1,745
674.50	1,746

Device	Routing	Invert	Outlet Devices
#1	Primary	674.00'	**10.0' long x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=0.24 cfs @ 13.09 hrs HW=674.05' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir**(Weir Controls 0.24 cfs @ 0.52 fps)

Pond 7P: VCI/INFILTRATION BASIN - SP-1



Summary for Pond 17P: MLV PAD

Inflow Area = 0.116 ac,100.00% Impervious, Inflow Depth = 4.17" for 25-Year event
Inflow = 0.75 cfs @ 11.96 hrs, Volume= 0.040 af
Outflow = 0.50 cfs @ 11.97 hrs, Volume= 0.018 af, Atten= 34%, Lag= 0.9 min
Primary = 0.50 cfs @ 11.97 hrs, Volume= 0.018 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 6
Peak Elev= 679.02' @ 11.97 hrs Surf.Area= 0 sf Storage= 898 cf

Plug-Flow detention time= 288.9 min calculated for 0.018 af (44% of inflow)
Center-of-Mass det. time= 148.0 min (893.2 - 745.2)

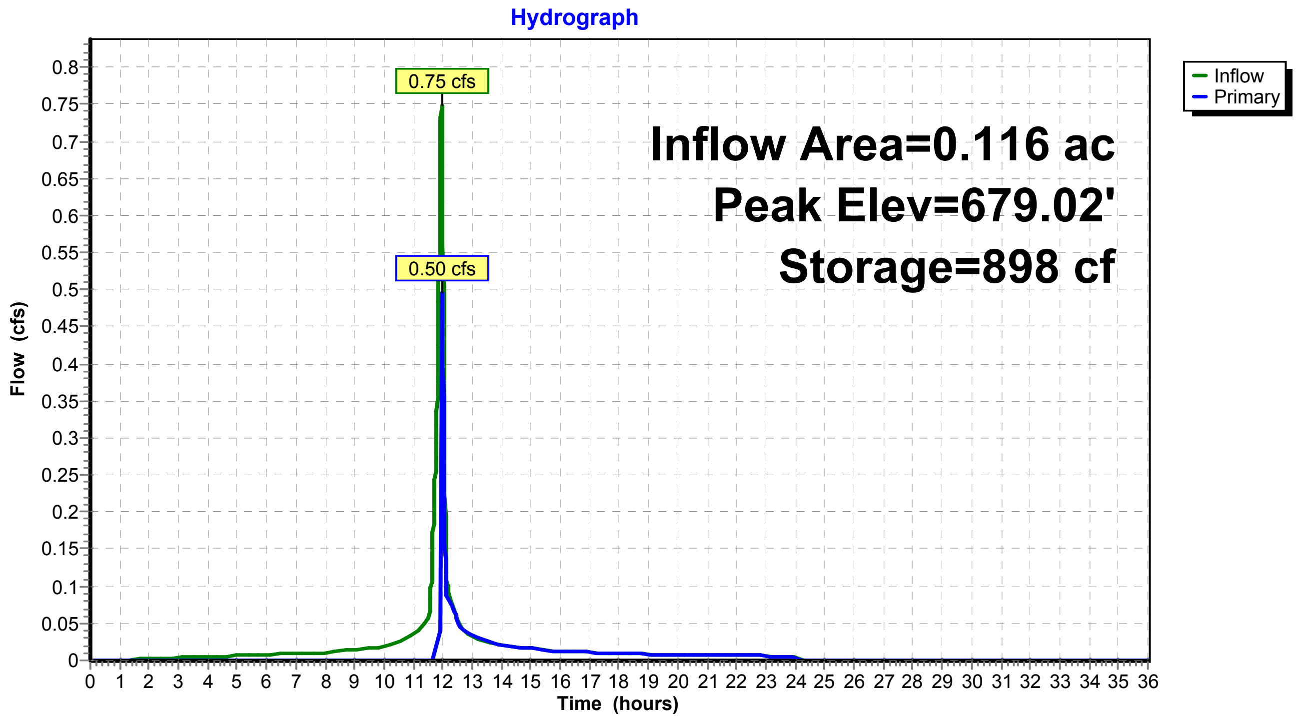
Volume	Invert	Avail.Storage	Storage Description
#1	677.00'	899 cf	**Stone Pad Void Storage**Listed below 2,247 cf Overall x 40.0% Voids

Elevation (feet)	Cum.Store (cubic-feet)
677.00	0
677.50	562
678.00	1,123
678.50	1,685
679.00	2,246
679.50	2,247

Device	Routing	Invert	Outlet Devices
#1	Primary	679.00'	**56.0' long x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=0.48 cfs @ 11.97 hrs HW=679.02' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir**(Weir Controls 0.48 cfs @ 0.37 fps)

Pond 17P: MLV PAD

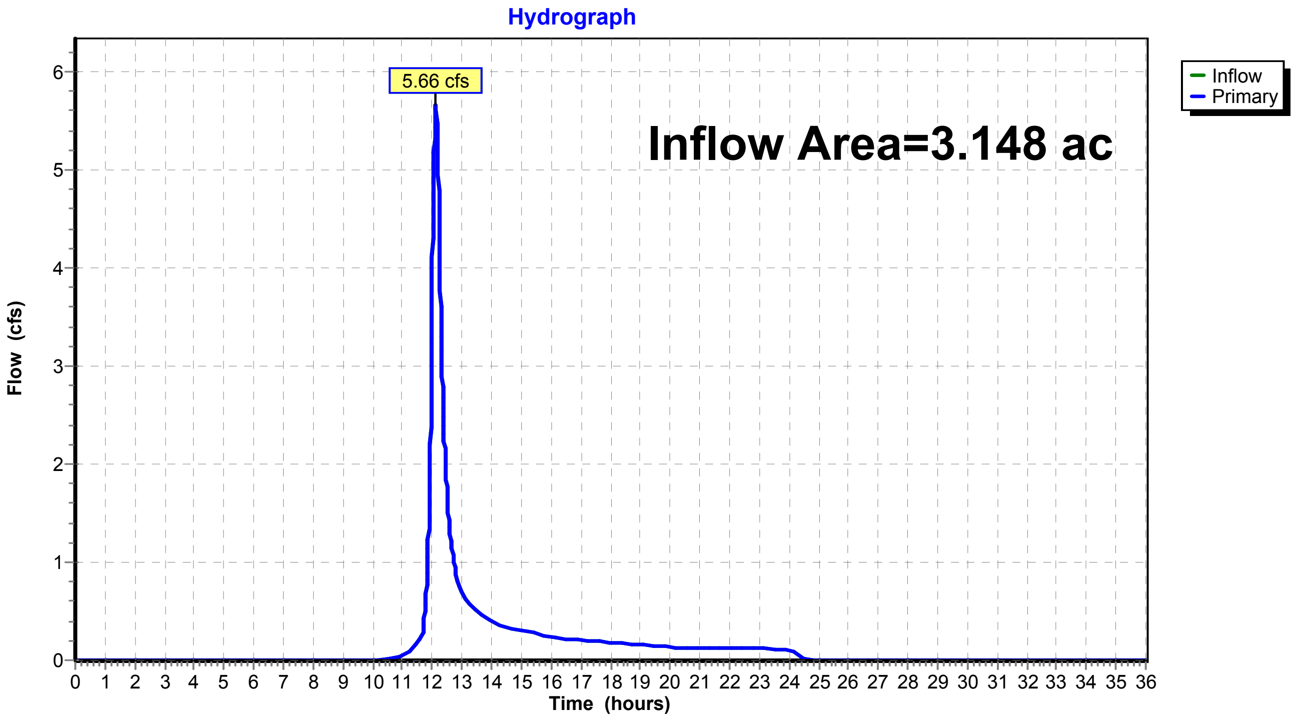


Summary for Link 5L: Proposed Conditions - SP-2

Inflow Area = 3.148 ac, 3.68% Impervious, Inflow Depth = 1.69" for 25-Year event
Inflow = 5.66 cfs @ 12.13 hrs, Volume= 0.443 af
Primary = 5.66 cfs @ 12.13 hrs, Volume= 0.443 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Link 5L: Proposed Conditions - SP-2

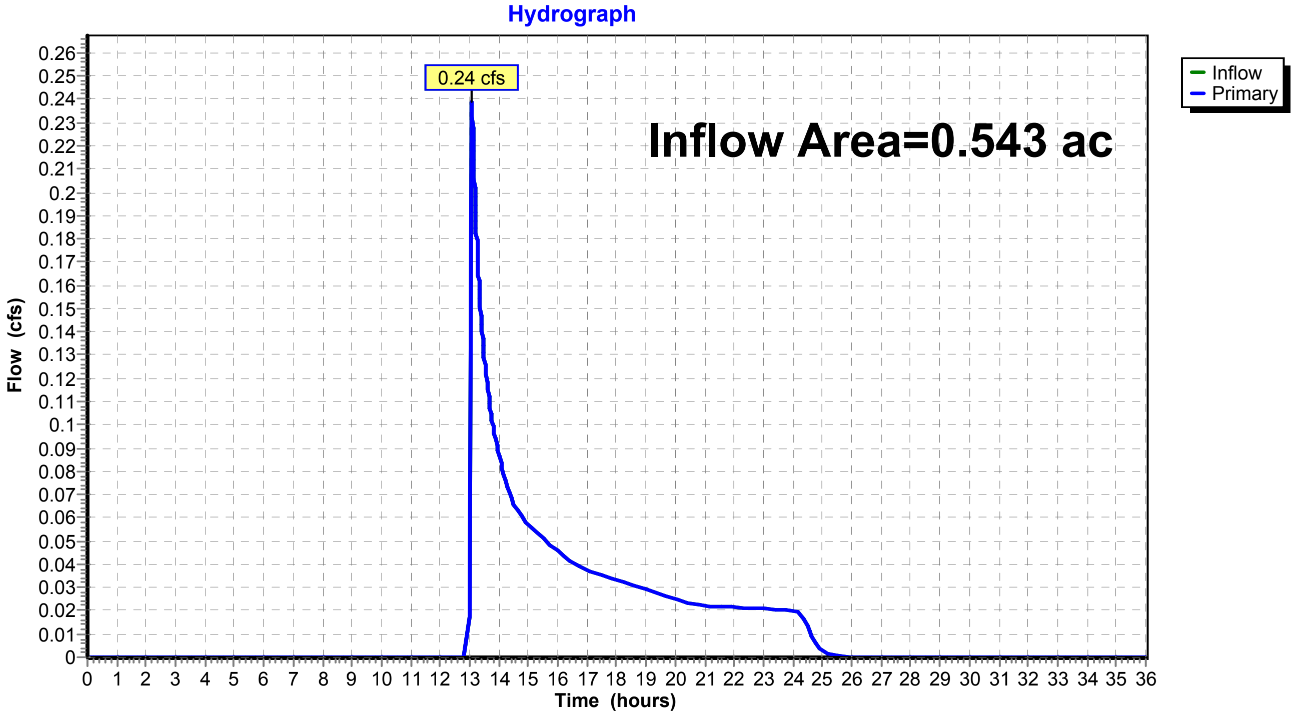


Summary for Link 7L: Proposed Conditions - SP-1

Inflow Area =	0.543 ac,	0.00% Impervious, Inflow Depth = 0.87"	for 25-Year event
Inflow =	0.24 cfs @	13.09 hrs, Volume=	0.040 af
Primary =	0.24 cfs @	13.09 hrs, Volume=	0.040 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Link 7L: Proposed Conditions - SP-1



Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment18S: DA TO MLV PAD Runoff Area=5,040 sf 100.00% Impervious Runoff Depth=4.88"
Flow Length=90' Slope=0.0500 '/' Tc=5.0 min CN=98 Runoff=0.87 cfs 0.047 af

Subcatchment19S: OFFSITE DA Runoff Area=132,089 sf 0.00% Impervious Runoff Depth=2.21"
Flow Length=518' Tc=19.7 min CN=71 Runoff=7.42 cfs 0.558 af

Subcatchment111S: DA TO Runoff Area=23,662 sf 0.00% Impervious Runoff Depth=2.29"
Flow Length=330' Tc=43.1 min CN=72 Runoff=0.83 cfs 0.104 af

Pond 7P: VCI/INFILTRATIONBASIN - SP-1 Peak Elev=674.09' Storage=1,745 cf Inflow=0.83 cfs 0.104 af
Outflow=0.76 cfs 0.064 af

Pond 17P: MLV PAD Peak Elev=679.04' Storage=898 cf Inflow=0.87 cfs 0.047 af
Outflow=1.27 cfs 0.031 af

Link 5L: Proposed Conditions - SP-2 Inflow=7.60 cfs 0.589 af
Primary=7.60 cfs 0.589 af

Link 7L: Proposed Conditions - SP-1 Inflow=0.76 cfs 0.064 af
Primary=0.76 cfs 0.064 af

Total Runoff Area = 3.691 ac Runoff Volume = 0.709 af Average Runoff Depth = 2.30"
96.87% Pervious = 3.576 ac 3.13% Impervious = 0.116 ac

Summary for Subcatchment 18S: DA TO MLV PAD

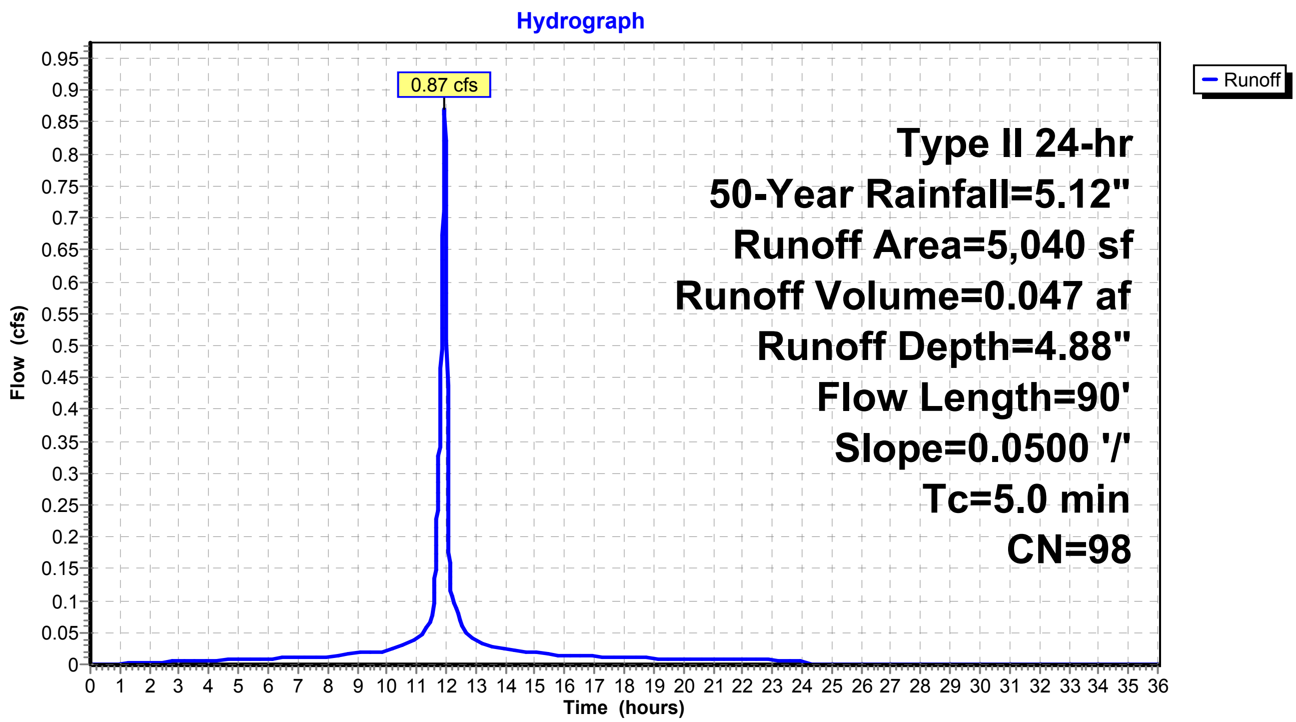
Runoff = 0.87 cfs @ 11.96 hrs, Volume= 0.047 af, Depth= 4.88"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 50-Year Rainfall=5.12"

	Area (sf)	CN	Description
*	5,040	98	Crushed Stone Pad, HSG C
	0	71	Meadow, non-grazed, HSG C
	5,040	98	Weighted Average
	5,040		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	90	0.0500	1.72		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.51"
0.9	90	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 18S: DA TO MLV PAD



Summary for Subcatchment 19S: OFFSITE DA

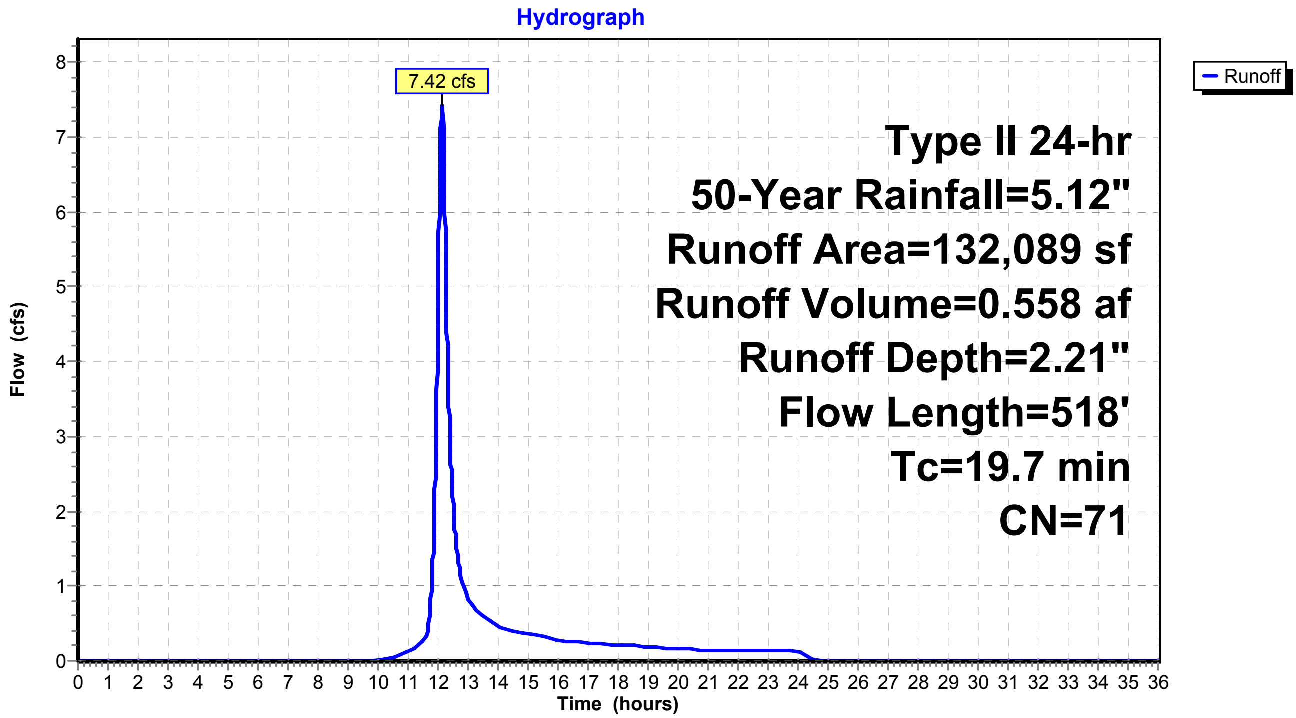
Runoff = 7.42 cfs @ 12.13 hrs, Volume= 0.558 af, Depth= 2.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 50-Year Rainfall=5.12"

	Area (sf)	CN	Description
*	5,293	71	Grass Paver Roads, HSG C
	0	70	Woods, Good, HSG C
	126,796	71	Meadow, non-grazed, HSG C
	0	98	Paved parking, HSG C
	132,089	71	Weighted Average
	132,089		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.1	100	0.0200	0.10		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 2.51"
2.7	333	0.0840	2.03		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
0.3	15	0.0150	0.86		**Shallow Concentrated Flow, SC2** Short Grass Pasture Kv= 7.0 fps
0.6	70	0.0840	2.03		**Shallow Concentrated Flow, SC3** Short Grass Pasture Kv= 7.0 fps
19.7	518	Total			

Subcatchment 19S: OFFSITE DA



Summary for Subcatchment 111S: DA TO VCI/INFILTRATION BASIN

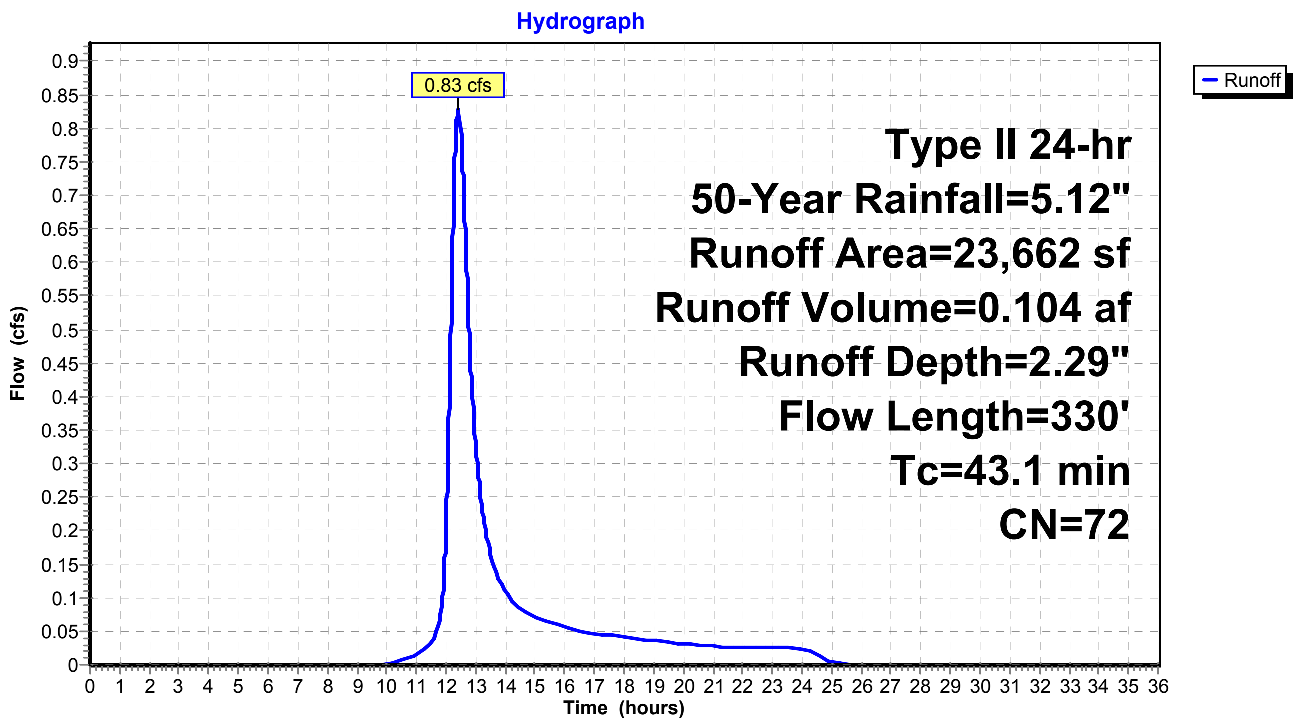
Runoff = 0.83 cfs @ 12.41 hrs, Volume= 0.104 af, Depth= 2.29"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 50-Year Rainfall=5.12"

Area (sf)	CN	Description
1,667	89	Gravel roads, HSG C
21,995	71	Meadow, non-grazed, HSG C
23,662	72	Weighted Average
23,662		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
40.5	100	0.0020	0.04		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 2.51"
1.9	158	0.0400	1.40		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
0.2	29	0.0400	3.22		**Shallow Concentrated Flow, SC2** Unpaved Kv= 16.1 fps
0.5	43	0.0400	1.40		**Shallow Concentrated Flow, SC3** Short Grass Pasture Kv= 7.0 fps
43.1	330	Total			

Subcatchment 111S: DA TO VCI/INFILTRATION BASIN



Summary for Pond 7P: VCI/INFILTRATION BASIN - SP-1

Inflow Area = 0.543 ac, 0.00% Impervious, Inflow Depth = 2.29" for 50-Year event
Inflow = 0.83 cfs @ 12.41 hrs, Volume= 0.104 af
Outflow = 0.76 cfs @ 12.68 hrs, Volume= 0.064 af, Atten= 8%, Lag= 16.7 min
Primary = 0.76 cfs @ 12.68 hrs, Volume= 0.064 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 674.09' @ 12.68 hrs Surf.Area= 0 sf Storage= 1,745 cf

Plug-Flow detention time= 201.5 min calculated for 0.064 af (62% of inflow)
Center-of-Mass det. time= 83.5 min (956.0 - 872.5)

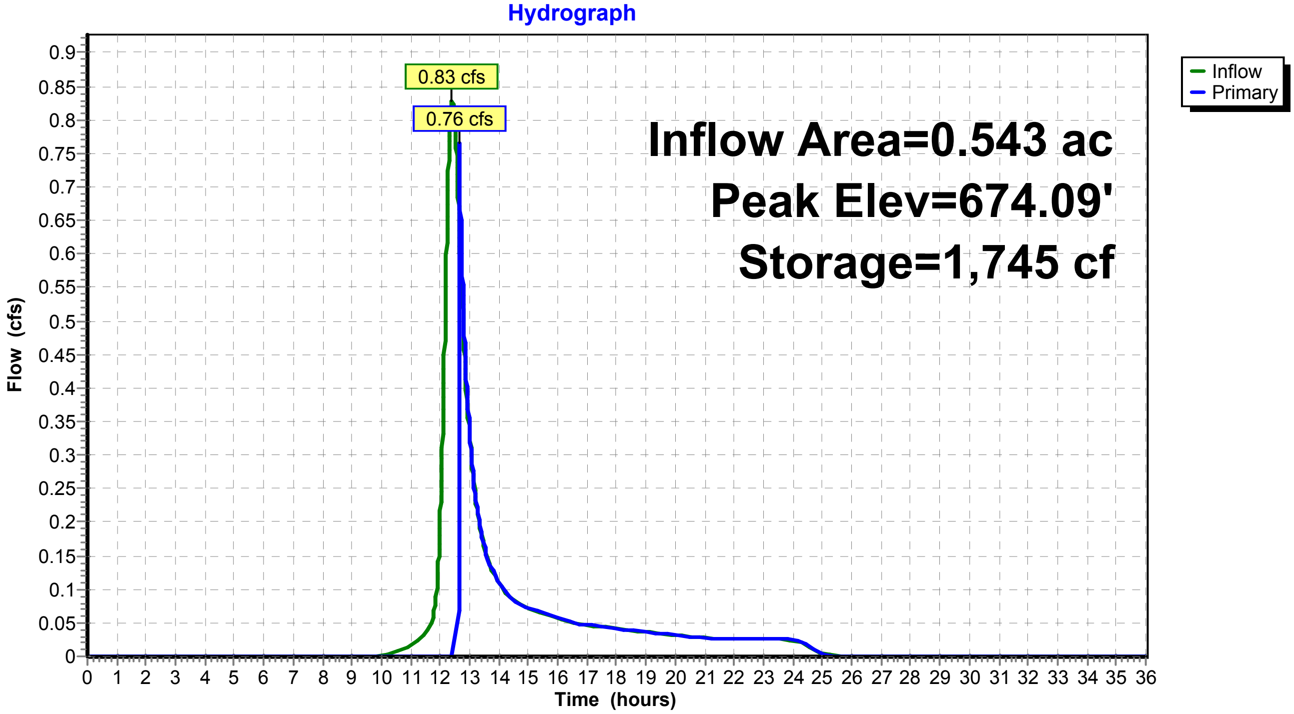
Volume	Invert	Avail.Storage	Storage Description
#1	673.00'	1,746 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
673.00	0
673.50	873
674.00	1,745
674.50	1,746

Device	Routing	Invert	Outlet Devices
#1	Primary	674.00'	**10.0' long x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=0.68 cfs @ 12.68 hrs HW=674.09' (Free Discharge)
└—**1=Broad-Crested Rectangular Weir** (Weir Controls 0.68 cfs @ 0.74 fps)

Pond 7P: VCI/INFILTRATION BASIN - SP-1



Summary for Pond 17P: MLV PAD

Inflow Area = 0.116 ac,100.00% Impervious, Inflow Depth = 4.88" for 50-Year event
Inflow = 0.87 cfs @ 11.96 hrs, Volume= 0.047 af
Outflow = 1.27 cfs @ 11.91 hrs, Volume= 0.031 af, Atten= 0%, Lag= 0.0 min
Primary = 1.27 cfs @ 11.91 hrs, Volume= 0.031 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 6
Peak Elev= 679.04' @ 11.91 hrs Surf.Area= 0 sf Storage= 898 cf

Plug-Flow detention time= 198.1 min calculated for 0.031 af (65% of inflow)
Center-of-Mass det. time= 93.7 min (836.3 - 742.6)

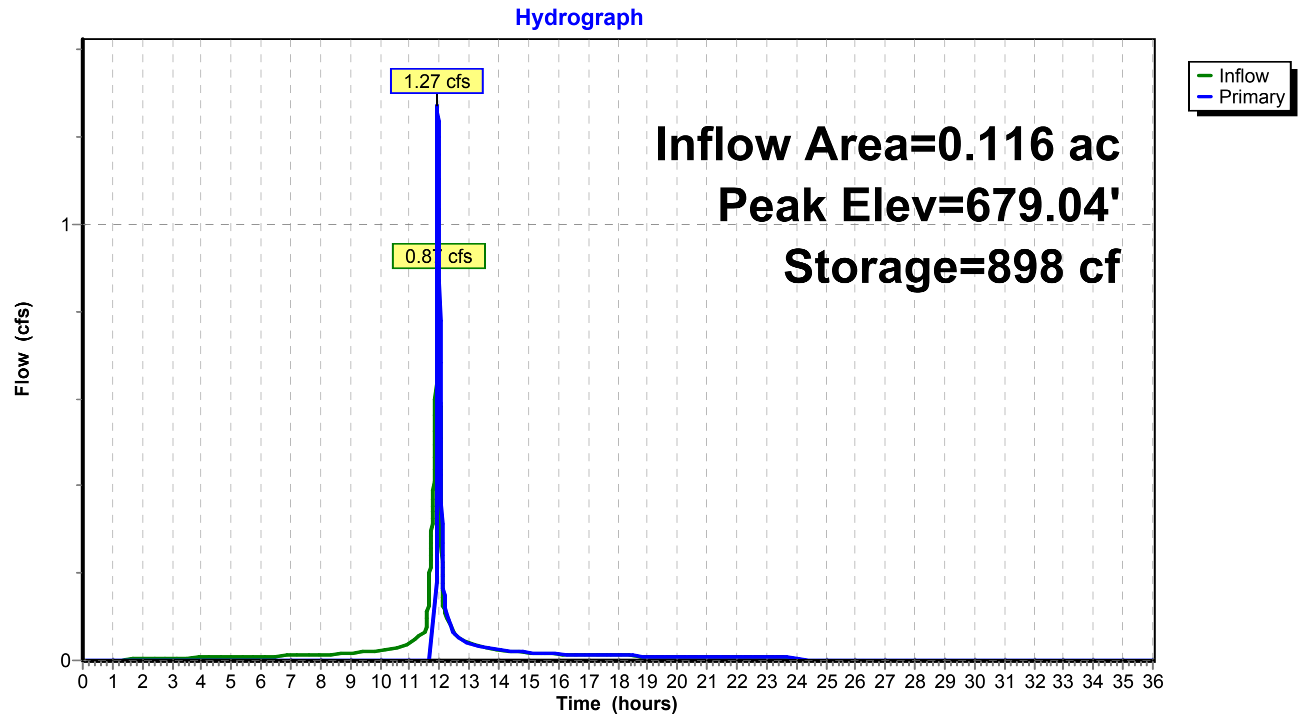
Volume	Invert	Avail.Storage	Storage Description
#1	677.00'	899 cf	**Stone Pad Void Storage** Listed below 2,247 cf Overall x 40.0% Voids

Elevation (feet)	Cum.Store (cubic-feet)
677.00	0
677.50	562
678.00	1,123
678.50	1,685
679.00	2,246
679.50	2,247

Device	Routing	Invert	Outlet Devices
#1	Primary	679.00'	**56.0' long x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=1.24 cfs @ 11.91 hrs HW=679.04' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Weir Controls 1.24 cfs @ 0.51 fps)

Pond 17P: MLV PAD

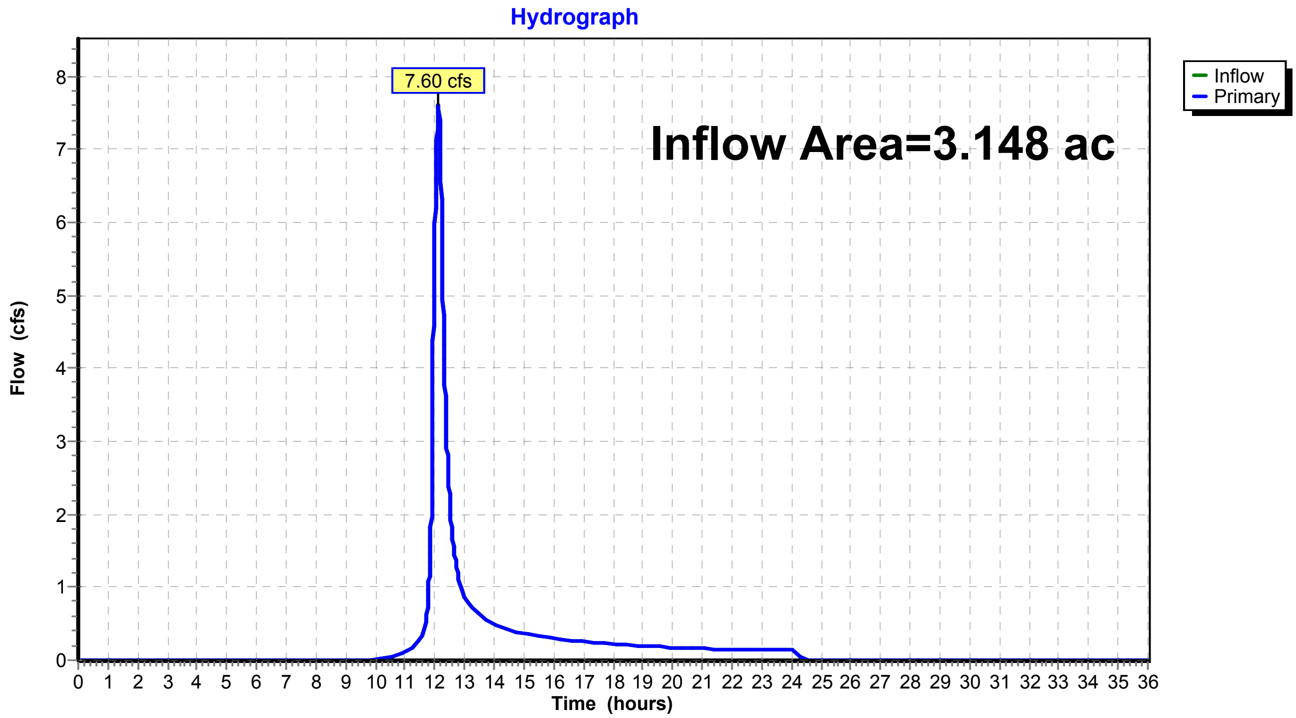


Summary for Link 5L: Proposed Conditions - SP-2

Inflow Area =	3.148 ac,	3.68% Impervious,	Inflow Depth = 2.24"	for 50-Year event	
Inflow =	7.60 cfs @	12.13 hrs,	Volume=	0.589 af	
Primary =	7.60 cfs @	12.13 hrs,	Volume=	0.589 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

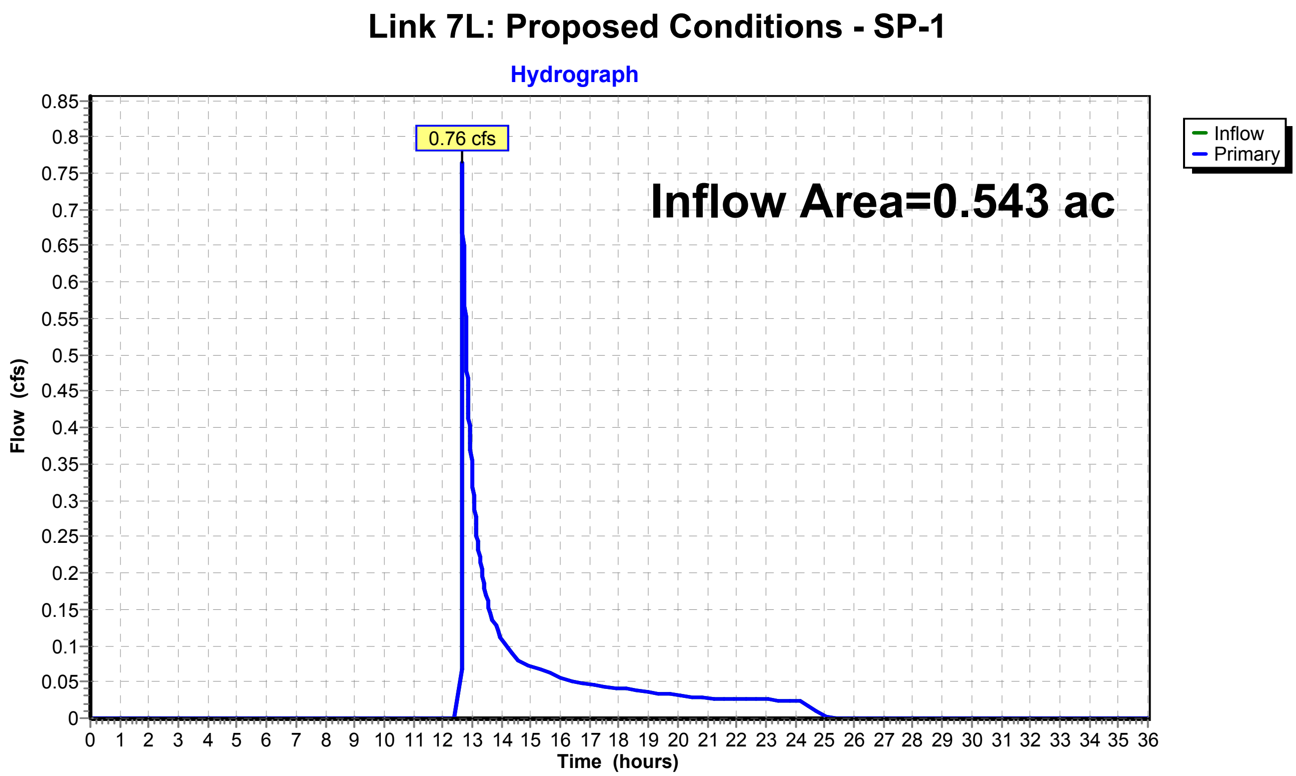
Link 5L: Proposed Conditions - SP-2



Summary for Link 7L: Proposed Conditions - SP-1

Inflow Area =	0.543 ac,	0.00% Impervious, Inflow Depth = 1.42"	for 50-Year event	
Inflow =	0.76 cfs @	12.68 hrs, Volume=	0.064 af	
Primary =	0.76 cfs @	12.68 hrs, Volume=	0.064 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs



Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment18S: DA TO MLV PAD Runoff Area=5,040 sf 100.00% Impervious Runoff Depth=5.71"
Flow Length=90' Slope=0.0500 '/' Tc=5.0 min CN=98 Runoff=1.01 cfs 0.055 af

Subcatchment19S: OFFSITE DA Runoff Area=132,089 sf 0.00% Impervious Runoff Depth=2.86"
Flow Length=518' Tc=19.7 min CN=71 Runoff=9.69 cfs 0.722 af

Subcatchment111S: DA TO Runoff Area=23,662 sf 0.00% Impervious Runoff Depth=2.95"
Flow Length=330' Tc=43.1 min CN=72 Runoff=1.08 cfs 0.134 af

Pond 7P: VCI/INFILTRATIONBASIN - SP-1 Peak Elev=674.12' Storage=1,745 cf Inflow=1.08 cfs 0.134 af
Outflow=0.98 cfs 0.093 af

Pond 17P: MLV PAD Peak Elev=679.04' Storage=898 cf Inflow=1.01 cfs 0.055 af
Outflow=1.04 cfs 0.035 af

Link 5L: Proposed Conditions - SP-2 Inflow=9.85 cfs 0.758 af
Primary=9.85 cfs 0.758 af

Link 7L: Proposed Conditions - SP-1 Inflow=0.98 cfs 0.093 af
Primary=0.98 cfs 0.093 af

Total Runoff Area = 3.691 ac Runoff Volume = 0.911 af Average Runoff Depth = 2.96"
96.87% Pervious = 3.576 ac 3.13% Impervious = 0.116 ac

Summary for Subcatchment 18S: DA TO MLV PAD

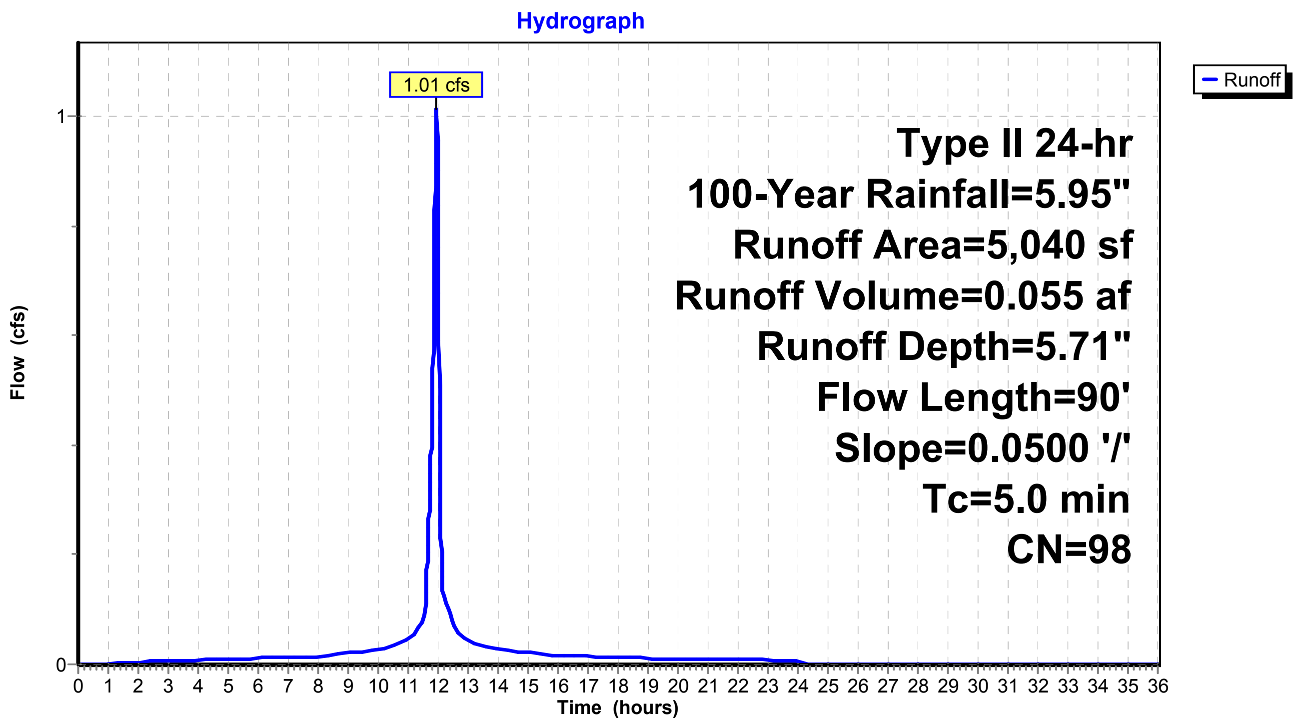
Runoff = 1.01 cfs @ 11.96 hrs, Volume= 0.055 af, Depth= 5.71"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Year Rainfall=5.95"

	Area (sf)	CN	Description
*	5,040	98	Crushed Stone Pad, HSG C
	0	71	Meadow, non-grazed, HSG C
	5,040	98	Weighted Average
	5,040		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	90	0.0500	1.72		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.51"
0.9	90	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 18S: DA TO MLV PAD



Summary for Subcatchment 19S: OFFSITE DA

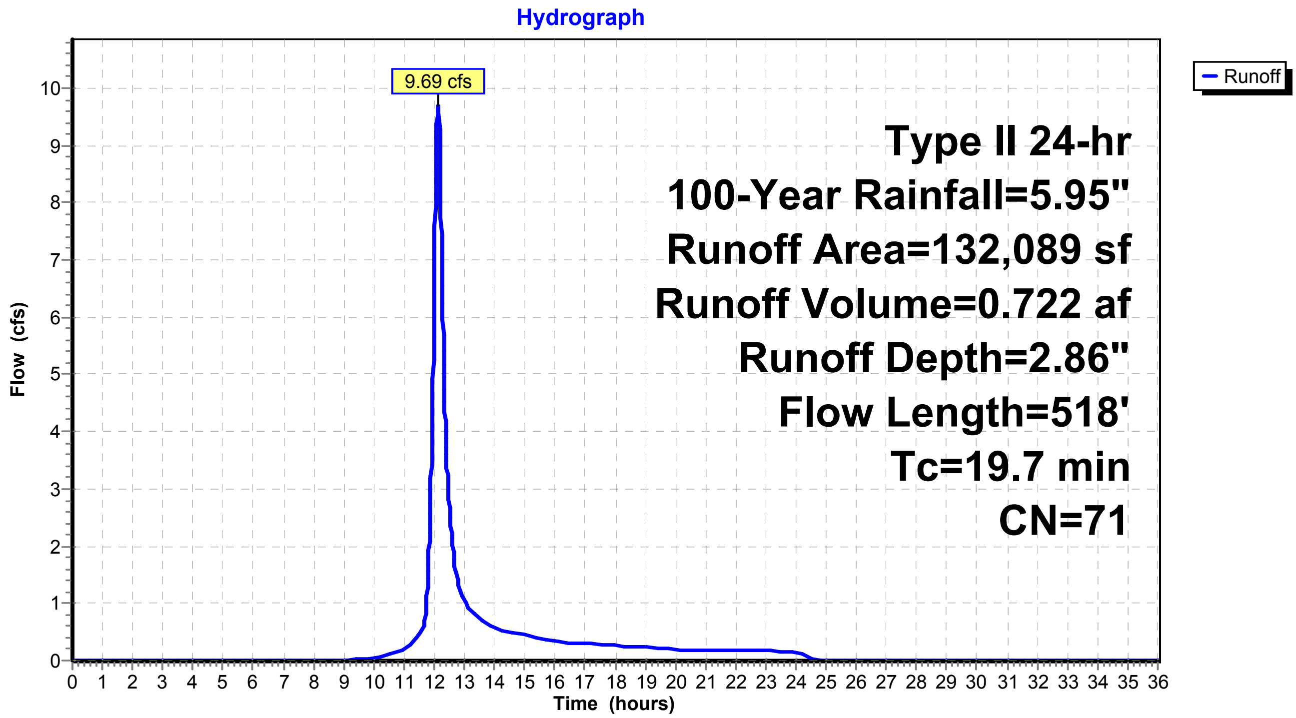
Runoff = 9.69 cfs @ 12.13 hrs, Volume= 0.722 af, Depth= 2.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Year Rainfall=5.95"

	Area (sf)	CN	Description
*	5,293	71	Grass Paver Roads, HSG C
	0	70	Woods, Good, HSG C
	126,796	71	Meadow, non-grazed, HSG C
	0	98	Paved parking, HSG C
	132,089	71	Weighted Average
	132,089		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.1	100	0.0200	0.10		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 2.51"
2.7	333	0.0840	2.03		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
0.3	15	0.0150	0.86		**Shallow Concentrated Flow, SC2** Short Grass Pasture Kv= 7.0 fps
0.6	70	0.0840	2.03		**Shallow Concentrated Flow, SC3** Short Grass Pasture Kv= 7.0 fps
19.7	518	Total			

Subcatchment 19S: OFFSITE DA



Summary for Subcatchment 111S: DA TO VCI/INFILTRATION BASIN

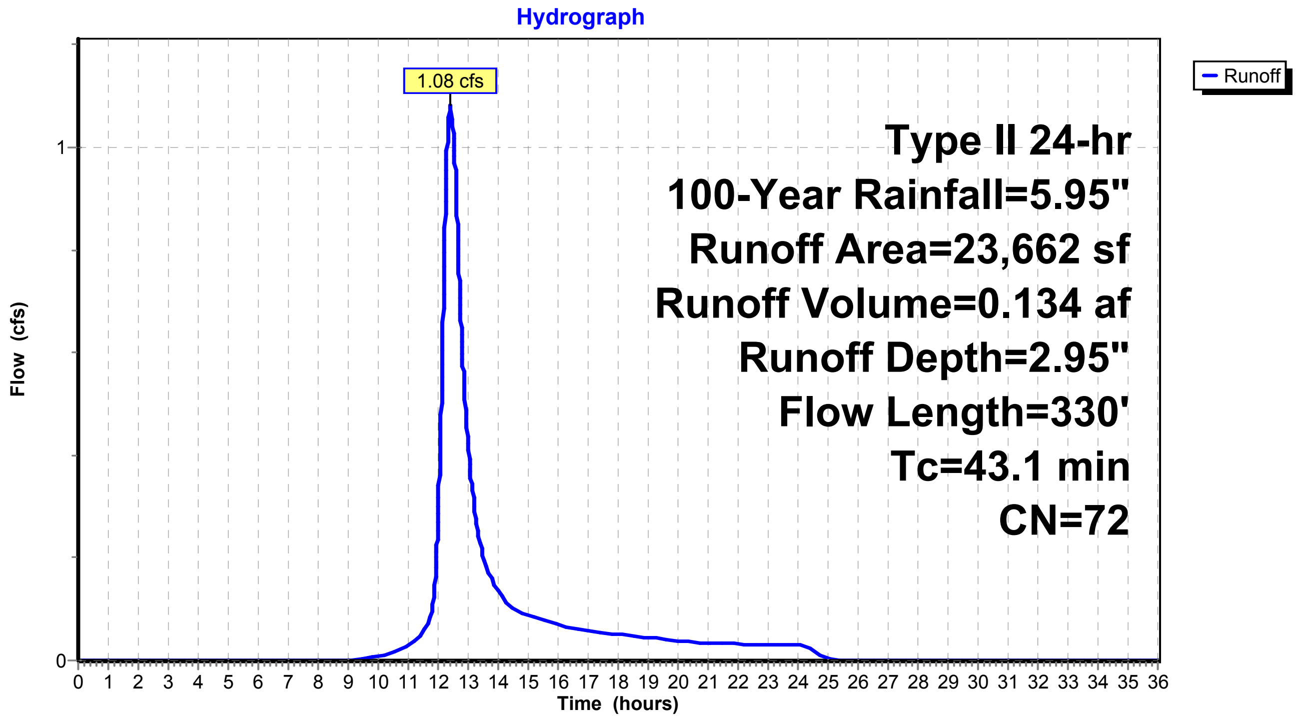
Runoff = 1.08 cfs @ 12.40 hrs, Volume= 0.134 af, Depth= 2.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Year Rainfall=5.95"

Area (sf)	CN	Description
1,667	89	Gravel roads, HSG C
21,995	71	Meadow, non-grazed, HSG C
23,662	72	Weighted Average
23,662		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
40.5	100	0.0020	0.04		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 2.51"
1.9	158	0.0400	1.40		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
0.2	29	0.0400	3.22		**Shallow Concentrated Flow, SC2** Unpaved Kv= 16.1 fps
0.5	43	0.0400	1.40		**Shallow Concentrated Flow, SC3** Short Grass Pasture Kv= 7.0 fps
43.1	330	Total			

Subcatchment 111S: DA TO VCI/INFILTRATION BASIN



Summary for Pond 7P: VCI/INFILTRATION BASIN - SP-1

Inflow Area = 0.543 ac, 0.00% Impervious, Inflow Depth = 2.95" for 100-Year event
Inflow = 1.08 cfs @ 12.40 hrs, Volume= 0.134 af
Outflow = 0.98 cfs @ 12.49 hrs, Volume= 0.093 af, Atten= 10%, Lag= 5.1 min
Primary = 0.98 cfs @ 12.49 hrs, Volume= 0.093 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 674.12' @ 12.49 hrs Surf.Area= 0 sf Storage= 1,745 cf

Plug-Flow detention time= 165.7 min calculated for 0.093 af (70% of inflow)
Center-of-Mass det. time= 60.2 min (925.3 - 865.1)

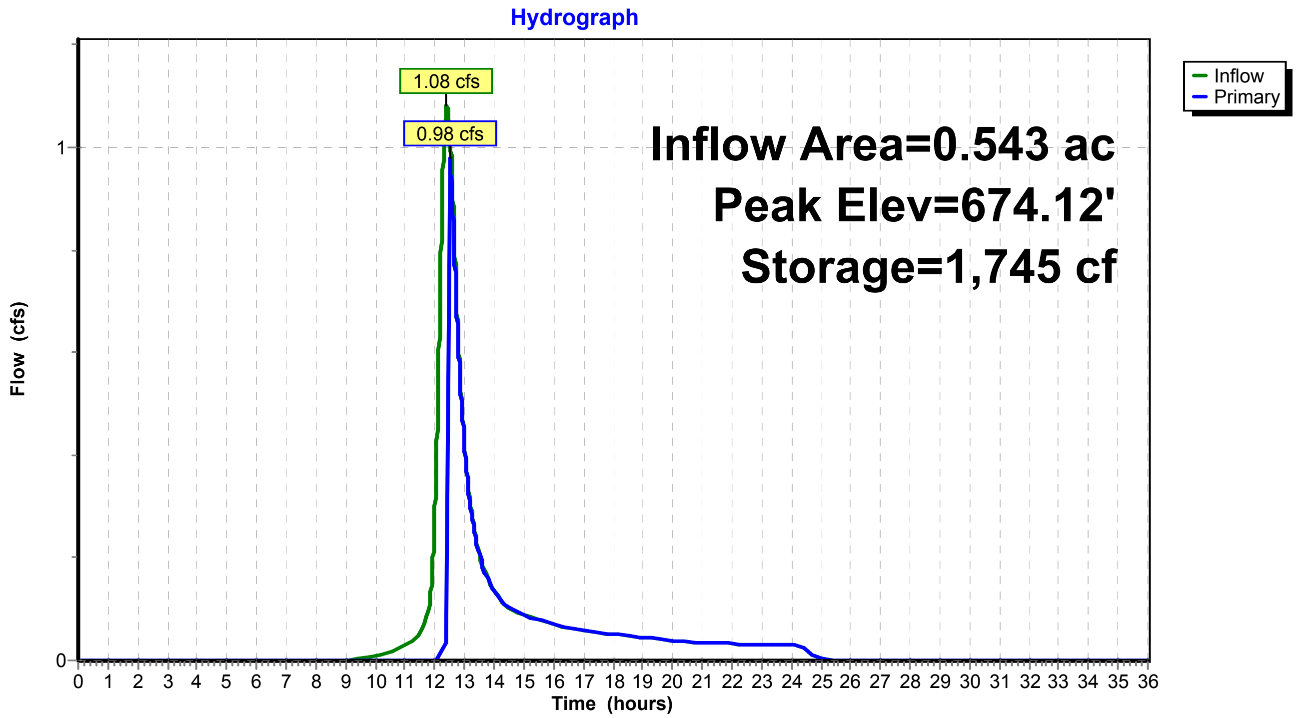
Volume	Invert	Avail.Storage	Storage Description
#1	673.00'	1,746 cf	**Custom Stage Data**Listed below

Elevation (feet)	Cum.Store (cubic-feet)
673.00	0
673.50	873
674.00	1,745
674.50	1,746

Device	Routing	Invert	Outlet Devices
#1	Primary	674.00'	**10.0' long x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=0.98 cfs @ 12.49 hrs HW=674.12' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir**(Weir Controls 0.98 cfs @ 0.83 fps)

Pond 7P: VCI/INFILTRATION BASIN - SP-1



Summary for Pond 17P: MLV PAD

Inflow Area = 0.116 ac,100.00% Impervious, Inflow Depth = 5.71" for 100-Year event
Inflow = 1.01 cfs @ 11.96 hrs, Volume= 0.055 af
Outflow = 1.04 cfs @ 11.95 hrs, Volume= 0.035 af, Atten= 0%, Lag= 0.0 min
Primary = 1.04 cfs @ 11.95 hrs, Volume= 0.035 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 6
Peak Elev= 679.04' @ 11.95 hrs Surf.Area= 0 sf Storage= 898 cf

Plug-Flow detention time= 202.5 min calculated for 0.035 af (64% of inflow)
Center-of-Mass det. time= 96.1 min (836.3 - 740.2)

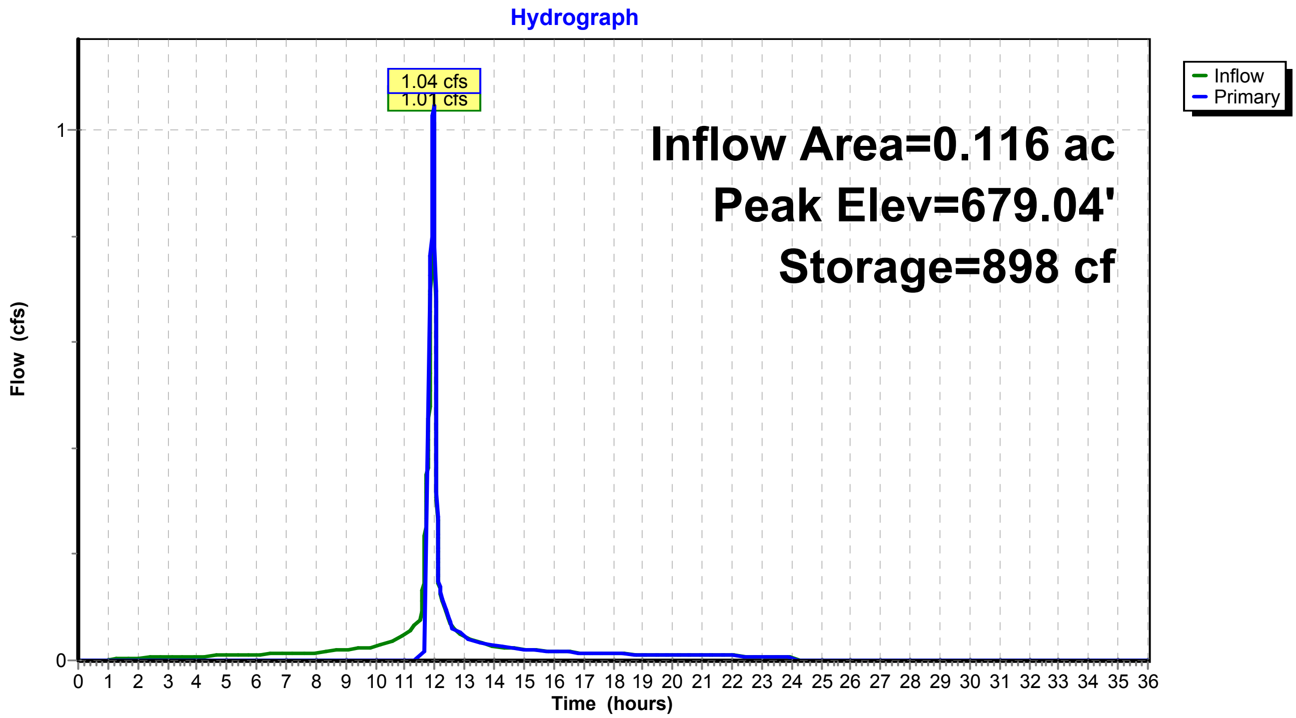
Volume	Invert	Avail.Storage	Storage Description
#1	677.00'	899 cf	**Stone Pad Void Storage** Listed below 2,247 cf Overall x 40.0% Voids

Elevation (feet)	Cum.Store (cubic-feet)
677.00	0
677.50	562
678.00	1,123
678.50	1,685
679.00	2,246
679.50	2,247

Device	Routing	Invert	Outlet Devices
#1	Primary	679.00'	**56.0' long x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=1.00 cfs @ 11.95 hrs HW=679.04' (Free Discharge)
1=Broad-Crested Rectangular Weir (Weir Controls 1.00 cfs @ 0.47 fps)

Pond 17P: MLV PAD

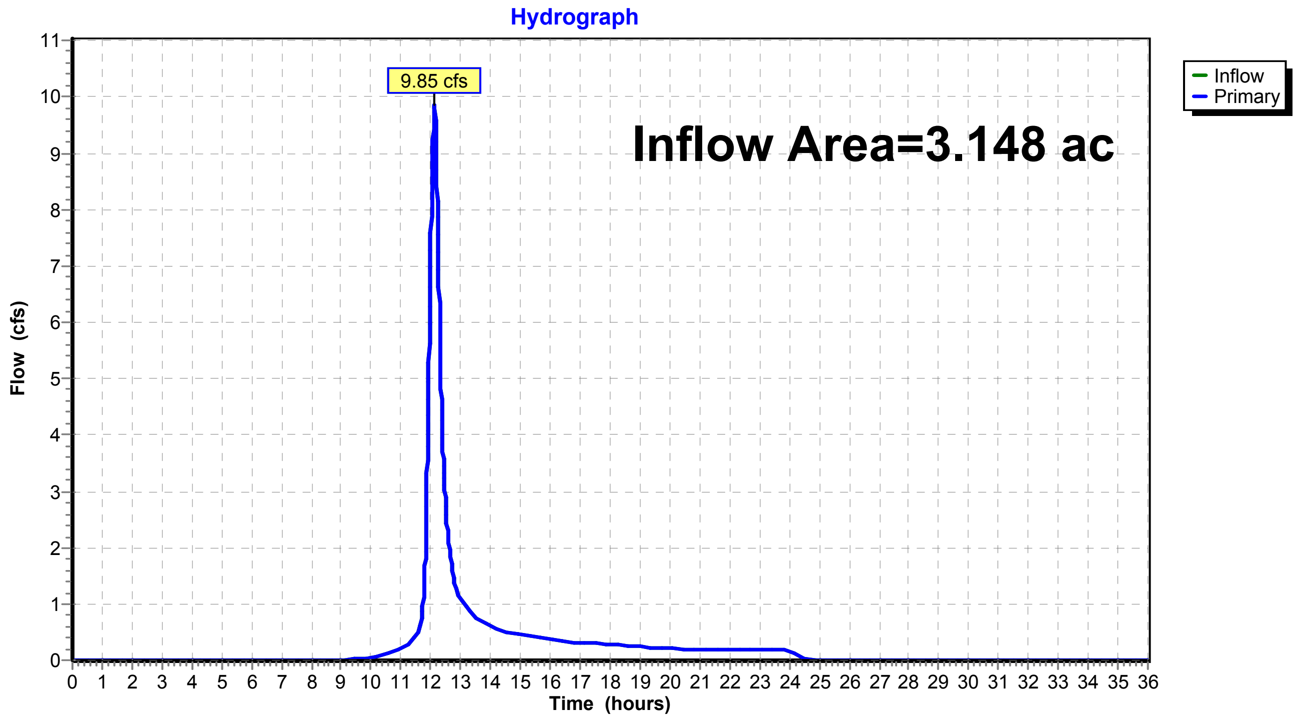


Summary for Link 5L: Proposed Conditions - SP-2

Inflow Area =	3.148 ac,	3.68% Impervious, Inflow Depth = 2.89"	for 100-Year event	
Inflow =	9.85 cfs @	12.13 hrs, Volume=	0.758 af	
Primary =	9.85 cfs @	12.13 hrs, Volume=	0.758 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

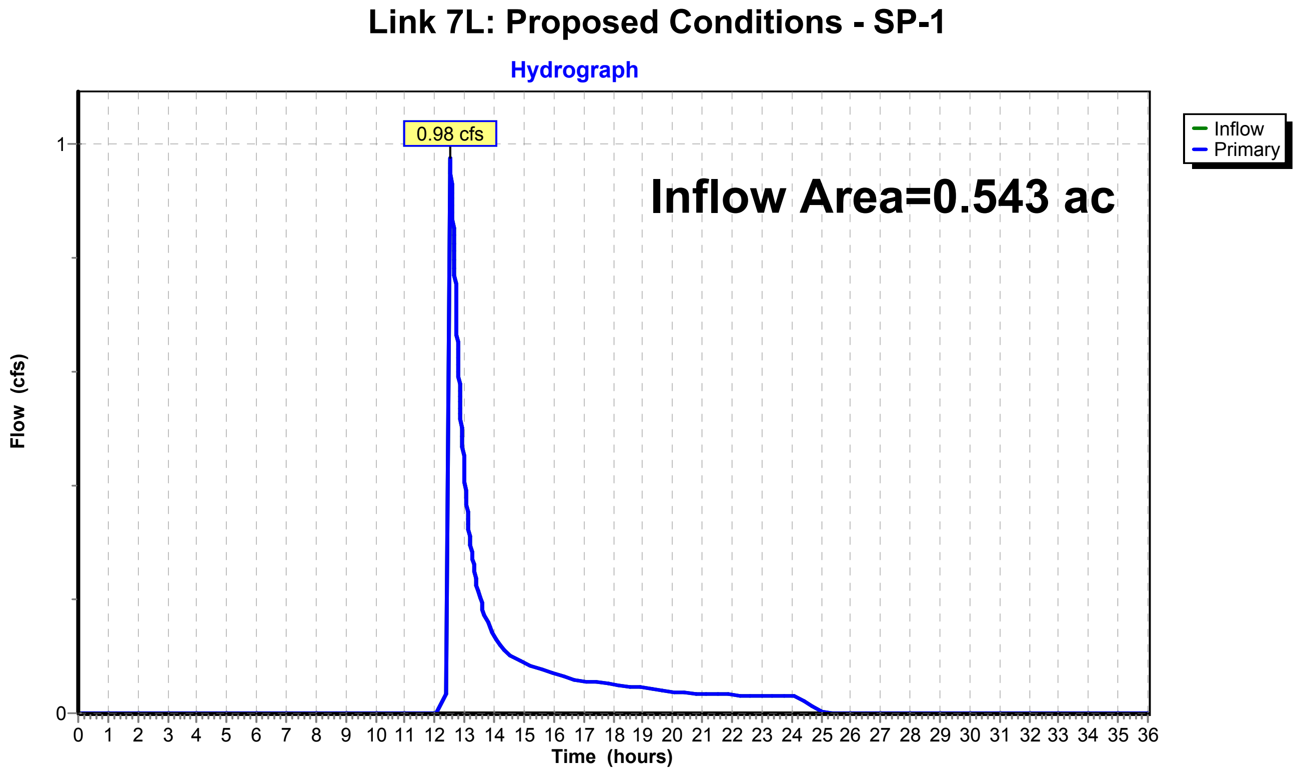
Link 5L: Proposed Conditions - SP-2



Summary for Link 7L: Proposed Conditions - SP-1

Inflow Area =	0.543 ac,	0.00% Impervious, Inflow Depth = 2.06"	for 100-Year event	
Inflow =	0.98 cfs @	12.49 hrs, Volume=	0.093 af	
Primary =	0.98 cfs @	12.49 hrs, Volume=	0.093 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs



L.5 Conveyance Calculations

a. E&S Worksheet 11
b. NAG Swale Lining Analysis
c. Figure 9.3-Riprap Apron Design

E&S WORKSHEET # 11
Channel Design Data

PROJECT NAME: Atlantic Sunrise
LOCATION: AR-WY-029 Vegetated Channel for Infiltration (VCI)
PREPARED BY: JMS REVISED BY: JMS DATE: 9/28/15 REV 09/30/16
CHECKED BY: BJP CHECKED BY: SK DATE: 9/28/15 REV 09/30/16

CHANNEL OR CHANNEL SECTION		AR-WY-029 VCI	AR-WY-029 VCI
TEMPORARY OR PERMANENT?	(T OR P)	P	P
DESIGN STORM	(2, 5, OR 10 YR)	10	10
ACRES	(AC)	0.54	0.54
MULTIPLIER[1]	(1.6, 2.25, or 2.75)[1]	N/A	N/A
Qr (REQUIRED CAPACITY)	(CFS)	0.41	0.41
Q (CALCULATED AT FLOW DEPTH d)	(CFS)	0.43	0.43
PROTECTIVE LINING[2]		SC250	SC250 REINFORCED VEGETATION
n (MANNING'S COEFFICIENT)[2]		0.04	0.25
Va (ALLOWABLE VELOCITY)	(FPS)	N/A	N/A
V (CALCULATED AT FLOW DEPTH d)	(FPS)	1.06	0.35
τa (MAX ALLOWABLE SHEAR STRESS)	(LB/FT^2)	2.50	8.00
τd (CALC'D SHEAR STRESS AT FLOW DEPTH d)	(LB/FT^2)	0.15	0.45
CHANNEL BOTTOM WIDTH	(FT)	10	10
CHANNEL SIDE SLOPES	(H:V)	3	3
D (TOTAL DEPTH)	(FT)	1.5	1.5
CHANNEL TOP WIDTH @ D	(FT)	19	19
d (CALCULATED FLOW DEPTH)	(FT)	0.04	0.12
CHANNEL TOP WIDTH @ FLOW DEPTH d	(FT)	10.24	10.72
BOTTOM WIDTH: FLOW DEPTH RATIO	(12:1 MAX)	250.00	83.33
d50 STONE SIZE	(IN)	N/A	N/A
A (CROSS-SECTIONAL AREA)	(SQ. FT.)	0.40	1.24
R (HYDRAULIC RADIUS)		0.04	0.12
S (BED SLOPE)[3]	(FT/FT)	0.06	0.06
Sc (CRITICAL SLOPE)	(FT/FT)	0.069	1.875
.7Sc	(FT/FT)	0.048	1.313
1.3Sc	(FT/FT)	0.089	2.438
STABLE FLOW?	(Y/N)	N	Y
FREEBOARD BASED ON UNSTABLE FLOW	(FT)	0.00	0.0
FREEBOARD BASED ON STABLE FLOW	(FT)	0.50	0.5
MINIMUM REQUIRED FREEBOARD[4]	(FT)	0.50	0.5
DESIGN METHOD FOR PROTECTIVE LINING [5] PERMISSIBLE VELOCITY (V) OR SHEAR STRESS	(S)	S	S

EQUIVALENT PIPE CALCULATION:

Q	n	s (ft/ft)	D (ft.)	D (in)	Round up to:
0.43	0.013	0.06	0.323	3.875	**12" pipe**

D = ((Q*n/(S^(1/2)*Pi*0.1478))^3/8)

Pipe Equivalence Calculation for Sizing Rip Rap Apron:
Use Manning's Equation
Q = (1.49/n)*A*(R^2/3)*(S^1/2)

Q = Flow Rate from Worksheet 11 (cfs)
n = Manning's Constant for Smooth Plastic Pipe = 0.013 (unitless)
A = Area of Pipe (ft) = 0.25 * Pi * D^2
D = Diameter of Pipe (ft)
R = Hydraulic Radius = A / P = (0.25 * Pi * D^2) / (Pi * D) = 0.25 * D
P = Perimeter of Pipe (ft) = Pi * D
S = Slope of channel from Worksheet 11 (ft/ft)

Solve Manning's Equation for Diameter of Pipe:
Q = (1.49/n)*A*(R^2/3)*(S^1/2)
Q = (1.49/n)*(0.25*Pi*D^2)*((0.25*D)^2/3)*(S^1/2)
Q*n*/(1.49*S^(1/2))=(0.25*Pi*D^2)*((0.25*D)^2/3)
Q*n*/(1.49*S^(1/2)*0.25*(0.25^2/3))=(Pi*D^2)*(D^2/3)
Q*n*/(S^(1/2)*Pi*0.1478)=(D^2)*(D^2/3)
Q*n*/(S^(1/2)*Pi*0.1478)=(D^8/3)
(Q*n*/(S^(1/2)*Pi*0.1478))^3/8=D

Multiply by 12 to convert feet to inches:
D = ((Q*n/(S^(1/2)*Pi*0.1478))^3/8) * 12

1. Use 1.6 for Temporary Channels; 2.25 for Temporary Channels in Special Protection (HQ or EV) Watersheds; 2.75 for Permanent Channels. For Rational Method, enter "N/A" and attach E&S Worksheets 9 and 10. For TR-55 enter "N/A" and attach appropriate Worksheets.
2. Adjust "n" value for changes in channel liner and flow depth. For vegetated channels, provide data for manufactured linings without vegetation and with vegetation in separate columns.
3. Slopes may not be averaged.
4. Minimum Freeboard is 0.5 ft. or ¼ Total Channel Depth, whichever is greater
5. Permissible velocity lining design method is not acceptable for channels with a bed slope of 10% or greater. Shear stress lining design method is required for channels with a bed slope of 10% or greater. Shear stress lining design method may be used for any channel bed slope.

Source: 363-2134-008 / March 31, 2012 / Page 382

Tensar International Corporation
5401 St. Wendel-Cynthiana Road
Poseyville, Indiana 47633
Tel. 800.772.2040
Fax 812.867.0247
www.nagreen.com

Erosion Control Materials Design Software
Version 5.0

Project Name: ASR Access Roads
Project Number: 63544
Channel Name: AR-WY-029-VCI

Discharge	0.41
Peak Flow Period	24
Channel Slope	0.06
Channel Bottom Width	10
Left Side Slope	3
Right Side Slope	3
Low Flow Liner	
Retardance Class	C
Vegtation Type	Mix (Sod & Bunch)
Vegetation Density	Good 75-95%
Soil Type	Silt Loam

SC250 - Class C - Mix (Sod & Bunch) - Good 75-95%

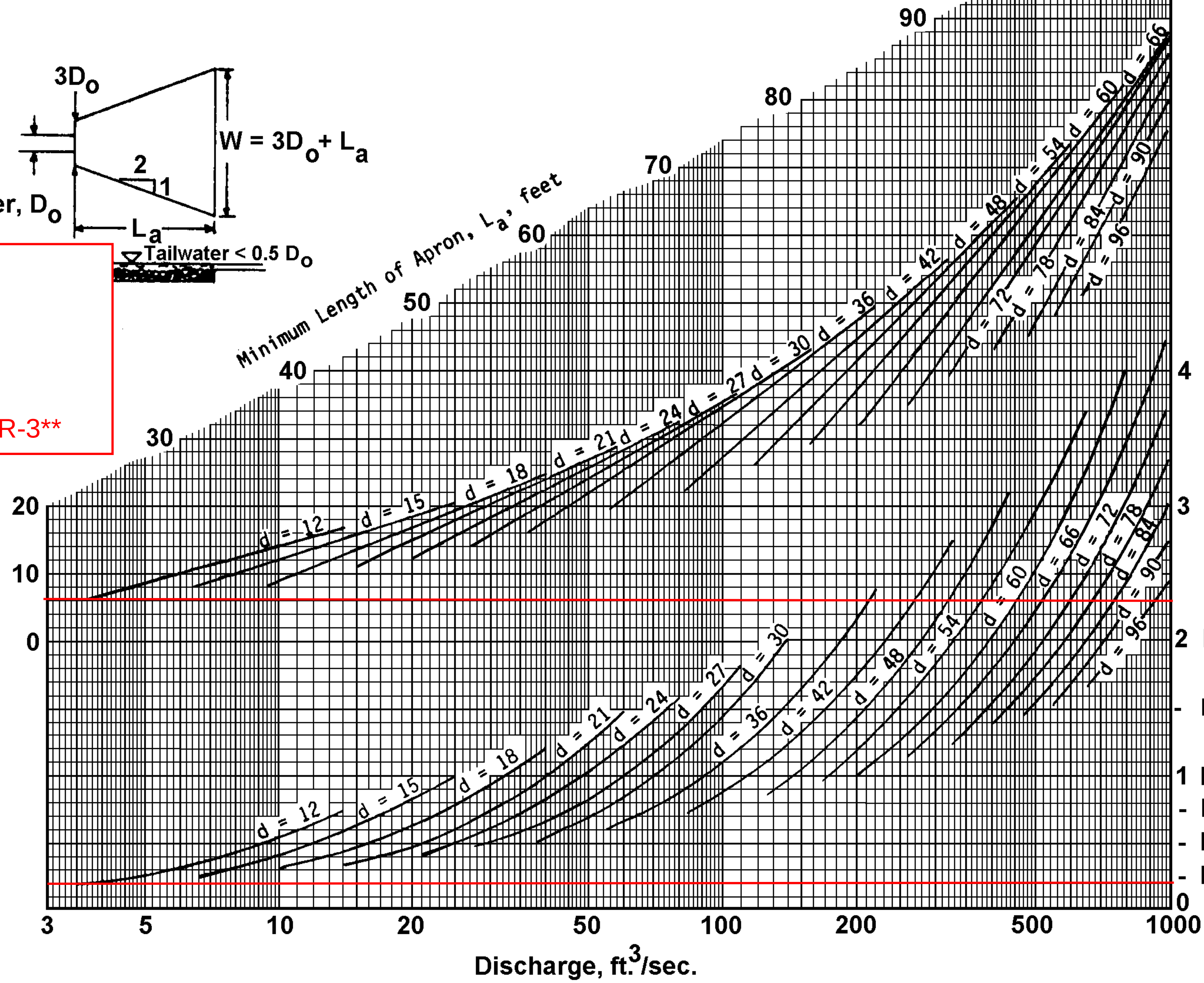
Phase	Reach	Discharge	Velocity	Normal Depth	Mannings N	Permissible Shear Stress	Calculated Shear Stress	Safety Factor	Remarks	Staple Pattern
SC250 Unvegetated	Straight	0.41 cfs	1.04 ft/s	0.04 ft	0.04	2.5 lbs/ft2	0.15 lbs/ft2	17.08	STABLE	E
SC250 Reinforced Vegetation	Straight	0.41 cfs	0.34 ft/s	0.12 ft	0.25	8 lbs/ft2	0.44 lbs/ft2	18.29	STABLE	E
Underlying Substrate	Straight	0.41 cfs	0.34 ft/s	0.12 ft	--	0.8 lbs/ft2	0.003 lbs/ft2	286.3	STABLE	--

PAR-WY-029 VCI
Q(10)=0.43 cfs, 12" pipe

FIGURE 9.3
Riprap Apron Design, Minimum Tailwater Condition

DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL MINIMUM TAILWATER CONDITION (T_W < 0.5 DIAMETER)

Adapted from USDA - NRCS



Do=1'**
3Do=3'**
La=6' ***
W=9'**
Rt=9"**
Riprap R-Size:=R-3**

NOT

d for Box Cu

Check Velocity

Riprap R-Size: R-3

Maximum Velocity from Table 6.6 of E&S Manual: 6.5 ft/s

Velocity of Runoff in Channel from Worksheet #11: 1.06 ft/s

Velocity of Runoff in Channel less than Maximum? Yes

* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

**DIMENSIONS BASED ON MINIMUM SIZING CRITERIA FROM CHART

L.6 PCSM BMP Calculations

a. Check Dam Volume Calculations

ATLANTIC SUNRISE NATURAL GAS PIPELINE PROJECT
(ACCESS ROAD) VEGETATED CHANNEL CHECKDAM VOLUME
PAR WY-029-Vegetated Channel for Infiltration

9/30/2016

TOTAL REACH VOLUME = 217 CF Width (W_B): 10 FT. Depth (H): 1 FT.

<u>VEGETATED CHANNEL PAR-WY-029.1</u>

ROAD STA 5+70 to 6+29

Input data

S =	0.060	ft/ft
H =	1	ft
W_B =	10	
z_1 =	3	
z_2 =	3	

Output data

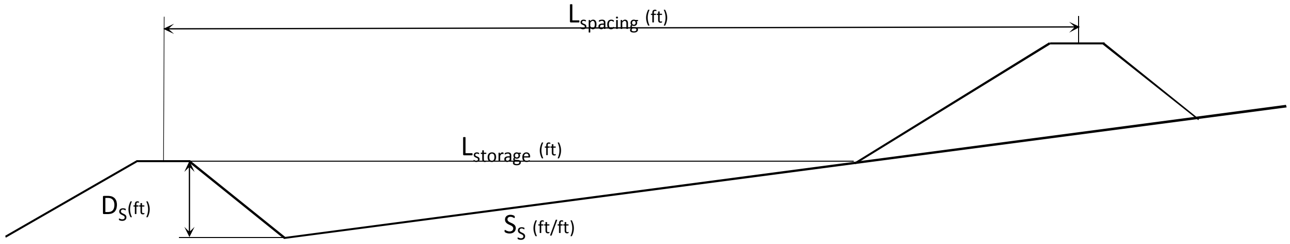
$L_{storage}$=	17	ft
W_T =	16	ft
$W_T + W_B$ =	26	ft
V =	108	cf
$L_{spacing}$=	22	
No. of Check Dams=	2	
Subreach Volume =	217	CF

<u>Infiltration(Q_i)</u>

Infiltration Depth =	12	in
Field Q_i =	2.320	in/hr
Factor of Safety =	2.0	
Reduced Q_i =	1.2	in/hr
Dewatering Time =	10.3	hr
Less than 72 hours?	YES	

EARTHEN CHECK DAM INFILTRATION VOLUME AND SPACING

Per the Pennsylvania Stormwater BMP Manual (pg 94), the minimum spacing ($L_{spacing}$) of check dams is determined by the length of the storage volume ($L_{storage}$) and the length to the check dam center line. The length of the storage volume is calculated by dividing the height of the rock filter (D_S) by the slope of the channel (S_S):



$L_{storage} = D_S/S_S$

Where: $L_{storage}$ = Storage Length

S_S = Channel slope

D_S = Height of the check dam

$L_{spacing} = L_{storage} + [(D_S+1)/(-S_S+0.5)]$

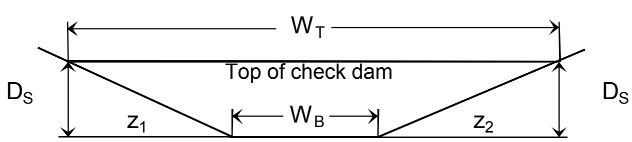
Where: $L_{spacing}$ = Check Dam Spacing

$L_{storage}$ = Storage Length

S_S = Channel slope

D_S = Height of the check dam

The volume of runoff that will be stored upstream of a check dam is dependent on the height of the check dam, the slope of the upstream channel and the dimensions of the upstream channel. The storage volume (V_S) can be calculated with:



$V_S = 0.25 \times L_{storage} \times D_S \times (W_T + W_B)$

Where:

$L_{storage}$ = Storage Length

D_S = Height of check dam

W_T = check dam top width

W_B = check dam bottom width

The check dam top width (W_T) is given by:

$W_T = W_B + z_1 + z_2$

Where: W_B = check dam bottom width

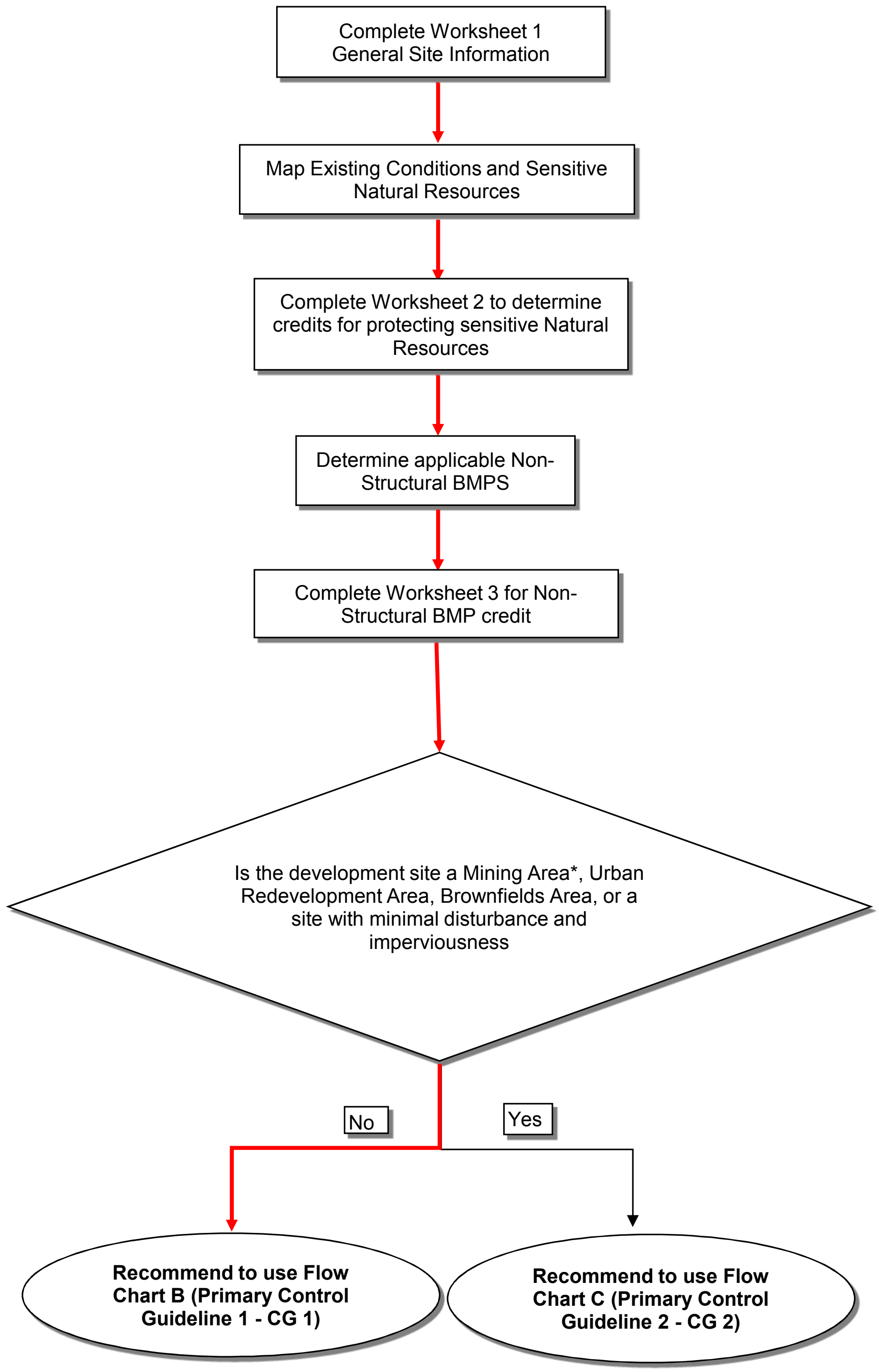
z_1 = side slope

z_2 = side slope

L.7 Water Quality Worksheets

a. Flow Chart A – Stormwater Calculation Process
b. Worksheet 1. General Site Information
c. Worksheet 2. Sensitive Natural Resources
d. Worksheet 3. Nonstructural BMP Credits
e. Flow Chart B – Control Guideline 1 Process
f. Worksheet 4. Change in Runoff Volume for 2-Yr Storm Event
g. Worksheet 5. Structural BMP Volume Credits
h. Worksheet 10. Water Quality Compliance for Nitrate

FLOW CHART A
Stormwater Calculation Process



Worksheet 1. General Site Information

INSTRUCTIONS: Fill out Worksheet 1 for each watershed

Date: 28-Mar-16

Project Name: Atlantic Sunrise Pipeline AR-WY-029

Municipality: Falls Township

County: Wyoming

Total Area (acres): 4.3

Major River Basin: Susquehanna River

http://www.dep.state.pa.us/dep/depupdate/watermgt/wc/default.htm#newtopics

Watershed: Susquehanna River

Sub-Basin: Upper Susquehanna River

Nearest Surface Water(s) to Receive Runoff: Susquehanna River

Chapter 93 - Designated Water Use: WWF,MF

http://www.pacode.com/secure/data/025/chapter93/chap93toc.html

Impaired according to Chapter 303(d) List? Yes [X] No [ ]

http://www.dep.state.pa.us/dep/deputate/watermgt/wqp/wqstandards/303d-Report.htm

List Causes of Impairment: Source Unknown (PCB); Source Unknown (Mercury)

Is project subject to, or part of:

Municipal Separate Storm Sewer System (MS4) Requirements? Yes [ ] No [X]

http://www.dep.state.pa.us/dep/deputate/watermgt/wc/Subjects/StormwaterManagement/GeneralPermits/default.htm

Existing or planned drinking water supply? Yes [ ] No [X]

If yes, distance from proposed discharge (miles): ____________

Approved Act 167 Plan? Yes [ ] No [X]

http://www.dep.state.pa.us/dep/deputate/watermgt/wc/Subjects/StormwaterManagement/Approved_1.html

Existing River Conservation Plan? Yes [ ] No [X]

http://www.dcnr.state.pa.us/brc/rivers/riversconservation/planningprojects/

Worksheet 2. Sensitive Natural Resources

INSTRUCTIONS:

1. Provide Sensitive Resources Map according to non-structural BMP 5.4.1 in Chapter 5. This map should identify wetlands, woodlands, natural drainage ways, steep slopes, and other sensitive natural areas.

*Note: Sensitive areas are shown on the Soil Erosion Control Plans.

2. Summarize the existing extent of each sensitive resource in the Existing Sensitive Resources Table (below, using Acres). If none present, insert 0.

3. Summarize Total Protected Area as defined under BMPs in Chapter 5.

4. Do not count any area twice. For example, an area that is both a floodplain and a wetland may only be considered once.

EXISTING NATURAL SENSITIVE RESOURCE	MAPPED? yes/no/n/a	TOTAL AREA (Ac.)	PROTECTED AREA (Ac.)
Waterbodies	N/A		
Floodplains	N/A		
Riparian Areas	N/A		
Wetlands	N/A		
Woodlands		0.04	0.00
Natural Drainage Ways	N/A		
Steep Slopes, 15% - 25%	N/A		
Steep Slopes, over 25%	N/A		
Other:			
Other:			
TOTAL EXISTING:		0.04	0.00

Worksheet 3. Nonstructural BMP Credits

PROTECTED AREA

1.1 Area of Protected Sensitive/Special Value Features (see WS 2)	**-**	**Ac.**
1.2 Area of Riparian Forest Buffer Protection	**-**	**Ac.**
3.1 Area of Minimum Disturbance/Reduced Grading	**-**	**Ac.**
TOTAL	**-**	**Ac.**

Site Area	*minus*	Protected Area	=	Stormwater Management Area
4.3	-	0	=	4.3

This is the area that requires stormwater management

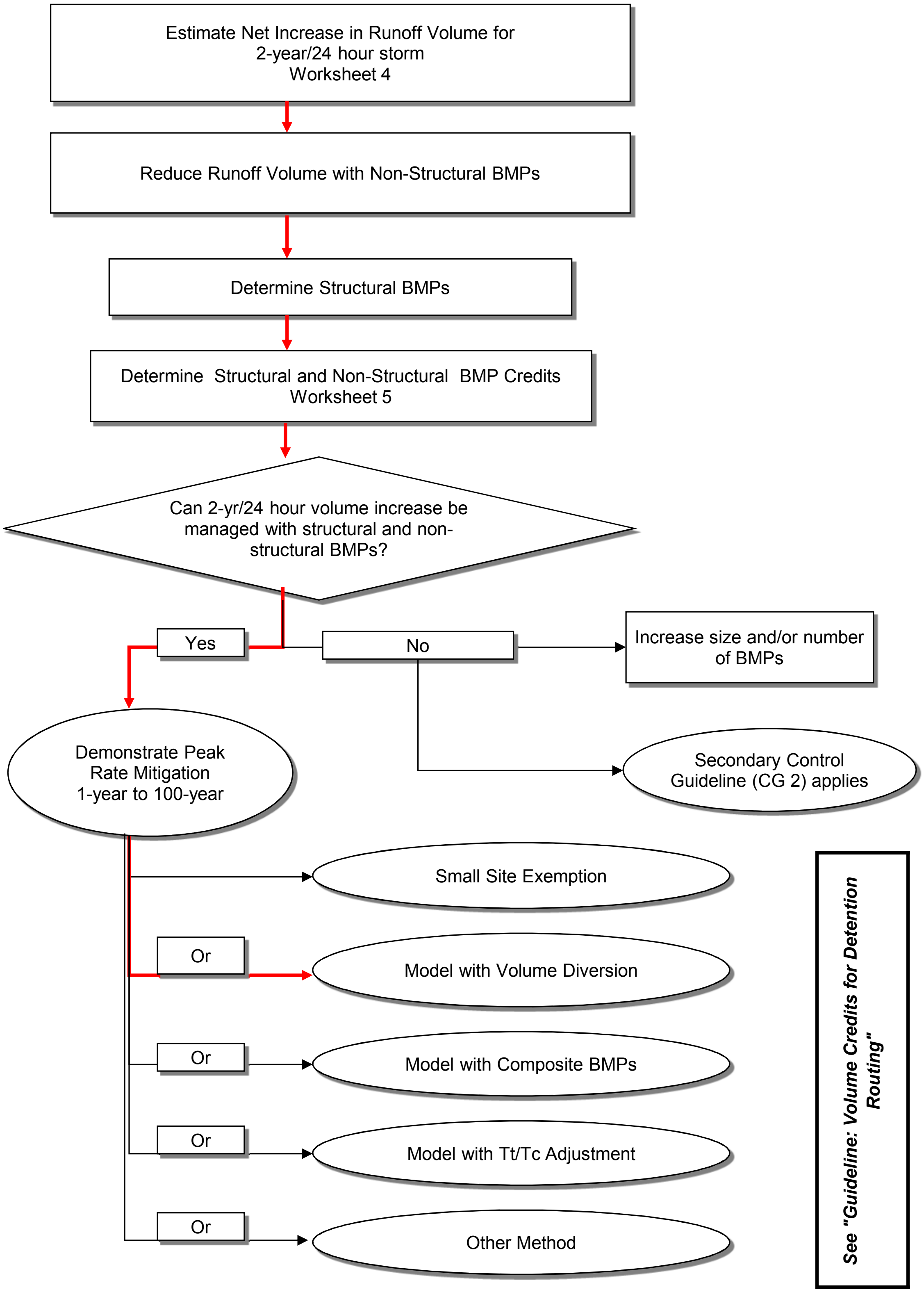
VOLUME CREDITS

3.1 Minimum Soil Compaction						
Lawn	ft^2	x 1/4"	x 1/12	=	**-**	ft^3
Meadow	ft^2	x 1/3"	x 1/12	=	**-**	ft^3
3.3 Protect Existing Trees						
For Trees within 100 feet of impervious area:						
Tree Canopy	ft^2	x 1/2"	x 1/12	=	**-**	ft^3
For Trees within 20 feet of impervious area:						
Tree Canopy	ft^2	x 1"	x 1/12	=	**-**	ft^3
5.1 Disconnect Roof Leaders to Vegetated Areas						
For Runoff directed to areas protected under 5.8.1 and 5.8.2						
Roof Area	ft^2	x 1/3"	x 1/12	=	**-**	ft^3
For all other disconnected roof areas						
Roof Area	ft^2	x 1/4"	x 1/12	=	**-**	ft^3
5.2 Disconnect Non-Roof impervious to Vegetated Areas						
For Runoff directed to areas protected under 5.8.1 and 5.8.2						
Impervious Area	ft^2	x 1/3"	x 1/12	=	**-**	ft^3
For all other disconnected non-roof areas						
Impervious Area	ft^2	x 1/4"	x 1/12	=	**-**	ft^3

TOTAL NON-STRUCTURAL VOLUME CREDIT* - ft^3

** For use on Worksheet 5*

FLOW CHART B
Control Guideline 1 Process



WORKSHEET 4 . CHANGE IN RUNOFF VOLUME FOR 2-YR STORM EVENT

PROJECT: **Atlantic Sunrise Pipeline AR-WY-029**

2-Year Rainfall: 2.51 **in**

Total Site Area: 4.3 **acres**
Protected Site Area: 0 **acres**
Managed Area 4.3 **acres**

Existing Conditions:

Cover Type	Soil Type	Area (sf)	Area (ac)	CN	S	Ia (0.2*S)	Q Runoff[1] (in)	Runoff Volume[2] (ft^3)
Meadow	C	160,634	3.688	71	4.08	0.82	0.50	6,642
Woods	C	1,299	0.030	70	4.29	0.86	0.46	50
Gravel Rd	C	25,498	0.585	89	1.24	0.25	1.46	3,110
Impervious[3]	C	0	0.000	98	0.20	0.04	2.28	-
"Meadow"[3]	C	0	0.000	71	4.08	0.82	0.50	-
TOTAL:		187,431	4.303					9,801

Developed Conditions:

Cover Type	Soil Type	Area (sf)	Area (ac)	CN	S	Ia (0.2*S)	Q Runoff[1] (in)	Runoff Volume[2] (ft^3)
Meadow	C	149,932	3.442	71	4.08	0.82	0.50	6,199
Woods	C	0	0.000	70	4.29	0.86	0.46	-
Paver Rd	C	5,293	0.122	71	4.08	0.82	0.50	219
Gravel Rd	C	27,166	0.624	89	1.24	0.25	1.46	3,313
Stone Pad	C	5,040	0.116	98	0.20	0.04	2.28	958
Impervious	C	0	0.000	98	0.20	0.04	2.28	-
TOTAL:		187,431	4.303					10,689

2-Year Volume Increase (ft^3)	**888**

2-Year Volume Increase = Developed Conditions Runoff Volume - Existing Conditions Runoff Volume

1. Runoff (in) = $Q = (P - 0.2S)^2 / (P + 0.8S)$ where
   P = 2-Year Rainfall (in)
   S = (1000/ CN)-10

2. Runoff Volume (CF) = Q x Area x 1/12
   Q = Runoff (in)
   Area = Land use area (sq. ft.)

Note: Runoff Volume must be calculated for EACH land use type/condition and HSGI.
The use of a weighted CN value for volume calculations is not acceptable.

3. Twenty (20) percent of existing impervious area, when present, shall be considered meadow (good condition) in the model for existing conditions for redevelopment per Volume Control Guideline 1.
(For Existing Condition: Impervious Area + "Meadow" = Total Impervious Area)

WORKSHEET 5. STRUCTURAL BMP VOLUME CREDITS

PROJECT: Atlantic Sunrise Pipeline AR-WY-029
SUB-BASIN: Upper Susquehanna River

Required Control Volume (ft^3) - *from Worksheet 4*:		888
Non-structural Volume Credit (ft^3) - *from Worksheet 3*:	-	0
Structural Volume Reqmt (ft^3)		888
(Required Control Volume minus Non-structural Credit)		

Proposed BMP		Area (ft^2)	Volume Reduction Permanently Removed (ft^3)
6.4.1	Porous Pavement		
6.4.2	Infiltration Basin		
6.4.3	Infiltration Bed		
6.4.4	Infiltration Trench		
6.4.5	Rain Garden/Bioretention		
6.4.6	Dry Well / Seepage Pit		
6.4.7	Constructed Filter		
6.4.8	Vegetated Swale		
6.4.9	Vegetated Filter Strip		
6.4.10	Berm		
6.5.1	Vegetated Roof		
6.5.2	Capture and Re-use		
6.6.1	Constructed Wetlands		
6.6.2	Wet Pond / Retention Basin		
6.6.3	Dry Extended Detention Basin		
6.6.4	Water Quality Filters		
6.7.1	Riparian Buffer Restoration		
6.7.2	Landscape Restoration / Reforestation		
6.7.3	Soil Amendment		
6.8.1	Level Spreader		
6.8.2	Special Storage Areas		
Other	Check dams in Vegetated Channels		1,746
	Storage in 30" stone MLV Pad		899

Total Structural Volume (ft^3):	2,645
Structural Volume Requirement (ft^3):	888
DIFFERENCE	1,757

MLV Pad Infiltration Calculations Summary		
Average Measured Infiltration Rate for MLV Pad	***1.13***	***in/hr***
Factor of Safety	***2.00***	
Design Infiltration Rate	***0.57***	***in/hr***
Dewatering Time for top 6 inches of MLV Pad	***10.62***	***hours***
Depth of AASHTO #57 Section of MLV Pad	***24***	***inches***
Dewatering Time for AASHTO #57 Section of MLV Pad	***42.48***	***hours***
Total Dewatering Time for MLV Pad	***53.10***	***hours***

Check Dam Infiltration Calculations Summary		
Average Measured Infiltration Rate for Channel	***2.32***	***in/hr***
Factor of Safety	***2.00***	
Design Infiltration Rate	***1.16***	***in/hr***
Height of Check Dam	***12***	***inches***
Dewatering Time for Detained Water in Channel	***10.34***	***hours***

A factor of safety of 2 is the minimal safety factor for design purposes per pager 19 of 21 of "Protocol 1, Site Evaluation and Soil Infiltration Testing, included as Appendix C of the Pennsylvania Stormwater BMP Manual.

WORKSHEET 10. WATER QUALITY COMPLIANCE FOR NITRATE

Does the site design incorporate the following BMPs to address nitrate pollution? A summary "yes" rating is achieved if at least 2 Primary BMPs for nitrate are provided across the site or 4 secondary BMPs for nitrate are provided across the site (or the

PRIMARY BMPs FOR NITRATE:

	YES	NO
NS BMP 5.4.2 - Protect / Conserve / Enhance Riparian Buffers		X
NS BMP 5.5.4 - Cluster Uses at Each Site		X
NS BMP 5.6.1 - Minimize Total Disturbed Area	X	
NS BMP 5.6.3 - Re-Vegetate / Re-Forest Disturbed Areas (Native	X	
NS BMP 5.9.1 - Street Sweeping / Vacuuming		X
Structural BMP 6.7.1 - Riparian Buffer Restoration		X
Structural BMP 6.7.2 - Landscape Restoration		X

SECONDARY BMPs FOR NITRATE:

	YES	NO
NS BMP 5.4.1 - Protect Sensitive / Special Value Features		
NS BMP 5.4.3 - Protect / Utilize Natural Drainage Features		
NS BMP 5.6.2 - Minimize Soil Compaction		
Structural BMP 6.4.5 - Rain Garden / Bioretention		
Structural BMP 6.4.8 - Vegetated Swale		
Structural BMP 6.4.9 - Vegetated Filter Strip		
Structural BMP 6.6.1 - Constructed Wetland		
Structural BMP 6.7.1 - Riparian Buffer Restoration		
Structural BMP 6.7.2 - Landscape Restoration		
Structural BMP 6.7.3 - Soils Amendment/Restoration		

L.8 Sediment Barrier Table

a. E&S Worksheet 1

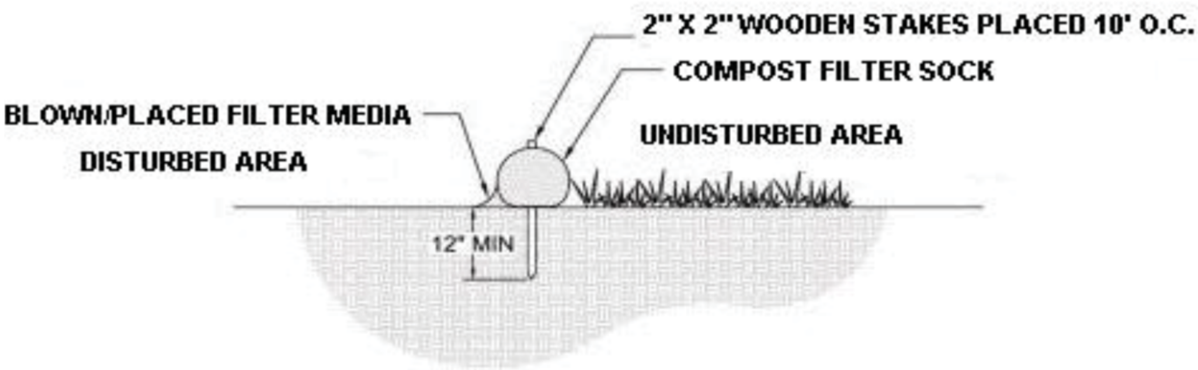
E&S WORKSHEET #1
Compost Filter Sock

PROJECT NAME: Atlantic Sunrise

LOCATION: AR-WY-029

PREPARED BY: JMS, ***RMR*** DATE: 9/04/16, ***Revised 11/10/16***

CHECKED BY: SMK DATE: 9/04/16 , ***Revised 11/10/16***



SOCK NO.	Dia. In.	LOCATION	SLOPE PERCENT	SLOPE LENGTH ABOVE BARRIER (FT)	SOCK LENGTH
1	12	STA 2+27 to STA 3+00	4	350	80
2-3	18	STA 3+00 to STA 4+50	4	285	100
4	24	STA 12+70 to STA 13+30	8	300	70
STOCKPILE					
SP 1	***12***	***STA 7+25 to STA 8+50***	***N/A***	***N/A***	***285***
SP2	***12***	***Pipeline ROW***	***N/A***	***N/A***	***320***

SOURCE: Pennsylvania Erosion and Sediment Pollution Control Manual, Page 372

L.9 Infiltration Information

a. Field Observation Report

Field Observation Report

Project Number: 14C4909 - A

Project Name: Atlantic Sunrise Project – **AR-WY-029.1**

Date of Field Visit: April 18, 2016

Weather Conditions: Sunny   Temperature: Approx. 60-78°F

Prepared By: Krystal Bealing, APSS and Jonathan Libbon

Copies of Report Have Been Sent To: ☒ Client ☐ Contractor ☐ Other

Client:
Transcontinental Gas Pipe Line Company, LLC
2800 Post Oak Blvd
Houston, TX 77251

Contractor:
BL Companies
4242 Carlisle Pike, Suite 260
Camp Hill, PA 17011

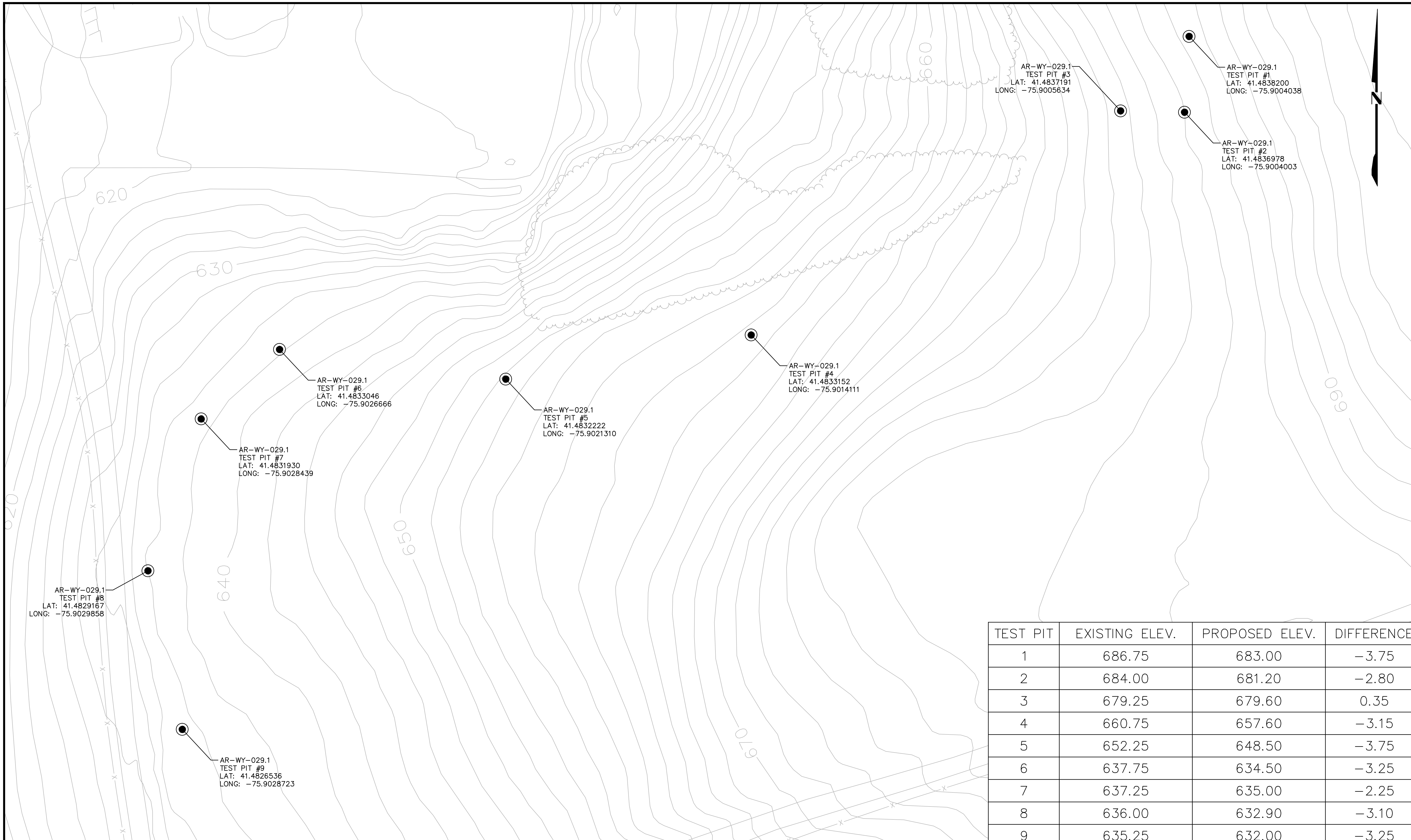
Nine soil pits were excavated by backhoe and described by an Associate Professional Soil Scientist (APSS) to varying depths utilizing the U.S. Department of Agriculture Natural Resources Conservation Service (USDA-NRCS) *Field Book for Describing and Sampling Soils, Version 3.0* and *Keys to Soil Taxonomy, Twelfth Edition, 2014*. According to the Web Soil Survey, soils within the area of the pits are described by the USDA-NRCS as Unadilla silt loam, 8-15% slopes.

Additionally, infiltration tests using the double ring infiltrometer method were conducted at each pit location, at depths ranging from the surface (0 inches) to 45 inches below surface. The elevations of the proposed improvements and the existing ground are provided on the infiltration testing location map. If the difference between the existing and proposed elevations is greater than zero, infiltration was performed at the existing elevation. If the difference between the existing and proposed elevation is between 0 and -5.00 feet, infiltration was conducted at the proposed elevation, or at two feet above the observed limiting layer, whichever was more shallow. If the difference between the existing and proposed elevations is greater than -5.00, infiltration was placed at 5 feet (60 inches) below the existing elevation to adhere to Occupational Safety and Health Administration (OSHA) standards for trenching and excavation safety.

Infiltration testing was conducted within a level testing area at all test pit locations using the double ring infiltrometer method. An infiltrometer containing a 12-inch outer ring and a 6-inch inner ring was driven into the soil a minimum of two inches. Both rings were filled with water to a marked line at 30 minute intervals for one hour. If the drop in water level, measured within the center ring, during the last 30 minutes of the presoak is 2 inches or more, measurements are taken in 10-minute intervals. If the water level drop is less than 2 inches, measurements are taken in 30-minute intervals. After each measurement, the rings were refilled to the marked line. Each measurement was taken at a fixed reference point. Measurements were taken until the rate of drop stabilized, or eight measurements were taken. A stabilized rate of drop is considered a difference of 0.25-inch or less between the highest and lowest measurements of four consecutive readings. An average of the stabilized rate (i.e., the last four measurements) or the average of eight total measurements if the rate of drop did not stabilize, expressed in inches per hour, represents the infiltration rate.

Pit Number	Pit Location (decimal degrees)	Observed Limiting Layer	Infiltration Test Depth (inches below the surface)	Infiltration Rate (inches/hour)
1	41.4838200, -75.9004038	None	45	0.063
2	41.4836978, -75.9004003	None	34	1.250
3	41.4837191, -75.9005634	None	0	2.063
4	41.4833152, -75.9014111	None	38	0.750
5	41.4832222, -75.9021310	None	33	3.313
6	41.4833046, -75.9026666	None	24	2.906
7	41.4831930, -75.9028439	None	21	6.750
8	41.4829167, -75.9029858	None	37	3.485
9	41.4826536, -75.9028723	None	39	0.875

The infiltration testing location map, soil profile logs, infiltration worksheet, photographs, and USDA-NRCS Soil Survey information are attached.



TEST PIT	EXISTING ELEV.	PROPOSED ELEV.	DIFFERENCE
1	686.75	683.00	-3.75
2	684.00	681.20	-2.80
3	679.25	679.60	0.35
4	660.75	657.60	-3.15
5	652.25	648.50	-3.75
6	637.75	634.50	-3.25
7	637.25	635.00	-2.25
8	636.00	632.90	-3.10
9	635.25	632.00	-3.25

LANDOWNER: DOBRINSKI

AR-WY-029.1 INFILTRATION TESTING LOCATIONS

GRAPHIC SCALE

50 25 0 50

Soil Profile Log

Project 14C4909-A Atlantic Sunrise Project - AR-WY-029.1
Test Pit # 1
Name Krystal Bealing, APSS
Date April 18, 2016
Weather Sunny, 60-78°F
Equipment Mini Excavator

Elevation 686.75 AMSL
Soil Type UnC - Unadilla silt loam, 8-15% slopes
Geology Catskill Formation (Devonian)
Landscape Position/Slope Sideslope, 3-8%
Land Use Agriculture
Additional Notes Field was recently plowed

Horizon	Depth (inches)	Texture	Coarse Fragments	Matrix Color	Color Patterns	Redoximorphic Features	Structure	Consistency	Boundary Strike/Dip	Roots/ Pores	Depth to Bedrock	Depth to Water
Ap	0-19	Silt Loam	15% Gravelly	10YR 3/3	-	-	Weak Granular	Very Friable	Abrupt, Slightly wavy	>20% roots	-	-
Bw	19-31	Silt Loam	15% Gravelly/ Flaggy	10YR 5/8	-	-	Weak Subangular Blocky	Friable	Gradual, Smooth	2-20% roots	-	-
C	31-60+	Very Fine Sandy Loam	35% Flaggy	10YR 4/3	-	-	Massive	Friable	-	-	-	-

Comments: No limiting layer observed.

Soil Profile Log

Project 14C4909-A Atlantic Sunrise Project - AR-WY-029.1
Test Pit # 2
Name Krystal Bealing, APSS
Date April 18, 2016
Weather Sunny, 60-78°F
Equipment Mini Excavator

Elevation 684.00 AMSL
Soil Type UnC - Unadilla silt loam, 8-15% slopes
Geology Catskill Formation (Devonian)
Landscape Position/Slope Sideslope, 3-8%
Land Use Agriculture
Additional Notes Field was recently plowed

Horizon	Depth (inches)	Texture	Coarse Fragments	Matrix Color	Color Patterns	Redoximorphic Features	Structure	Consistency	Boundary Strike/Dip	Roots/ Pores	Depth to Bedrock	Depth to Water
Ap	0-9	Silt Loam	15% Gravelly	10YR 3/3	-	-	Weak Subangular Blocky	Very Friable	Gradual, Smooth	>20% roots	-	-
Bw	9-20	Silt Loam	15% Gravelly/ Flaggy	10YR 4/4	-	-	Weak Subangular Blocky	Very Friable	Diffuse, Wavy	2-20% roots; Earthworm borrows present	-	-
C	20-60+	Sandy Loam	30% Flaggy	10YR 4/3	-	-	Massive	Very Friable	-	-	-	-

Comments: No limiting layer observed.

Soil Profile Log

Project 14C4909-A Atlantic Sunrise Project - AR-WY-029.1
Test Pit # 3
Name Krystal Bealing, APSS
Date April 18, 2016
Weather Sunny, 60-78°F
Equipment Mini Excavator

Elevation 679.25 AMSL
Soil Type UnC - Unadilla silt loam, 8-15% slopes
Geology Catskill Formation (Devonian)
Landscape Position/Slope Sideslope, 3-8%
Land Use Agriculture
Additional Notes Field was recently plowed

Horizon	Depth (inches)	Texture	Coarse Fragments	Matrix Color	Color Patterns	Redoximorphic Features	Structure	Consistency	Boundary Strike/Dip	Roots/ Pores	Depth to Bedrock	Depth to Water
Ap	0-10	Silt Loam	15% Gravelly	10YR 3/4	-	-	Weak Subangular Blocky	Very Friable	Diffuse, Wavy	>20% roots	-	-
Bw	10-24	Silt Loam	20% Gravelly/ Flaggy	10YR 4/6	-	-	Weak Subangular Blocky	Very Friable	Diffuse, Wavy	2-20% roots	-	-
C1	24-44	Sandy Loam	30% Flaggy	10YR 4/4	-	-	Massive	Very Friable	Diffuse, Wavy	-	-	-
C2	44-60+	Very Fine Sandy Loam	40% Flaggy	10YR 4/3	-	-	Massive	Friable	-	-	-	-

Comments: No limiting layer observed.

Soil Profile Log

Project 14C4909-A Atlantic Sunrise Project - AR-WY-029.1
Test Pit # 4
Name Krystal Bealing, APSS
Date April 18, 2016
Weather Sunny, 60-78°F
Equipment Mini Excavator

Elevation 660.75 AMSL
Soil Type UnC - Unadilla silt loam, 8-15% slopes
Geology Catskill Formation (Devonian)
Landscape Position/Slope Sideslope, 2-5%
Land Use Agriculture
Additional Notes Field was recently plowed

Horizon	Depth (inches)	Texture	Coarse Fragments	Matrix Color	Color Patterns	Redoximorphic Features	Structure	Consistency	Boundary Strike/Dip	Roots/ Pores	Depth to Bedrock	Depth to Water
Ap	0-13	Silt Loam	15% Gravelly	10YR 3/3	-	-	Weak Subangular Blocky	Very Friable	Diffuse, Wavy	>20% roots	-	-
Bw	13-25	Silt Loam	20% Gravelly/ Flaggy	10YR 4/3	-	-	Weak Subangular Blocky	Very Friable	Diffuse, Wavy	2-20% roots	-	-
C1	25-41	Sandy Loam	40% Flaggy	10YR 4/3	-	-	Massive	Very Friable	Diffuse, Wavy	-	-	-
C2	41-60+	Very Fine Sandy Loam	65% Flaggy	60% 10YR 4/3	40% 5YR 4/3	-	Massive	Friable	-	-	-	-

Comments: No limiting layer observed. Moved infiltration test to three inches above C2 horizon (38 inches) due to high coarse fragment content.

Soil Profile Log

Project 14C4909-A Atlantic Sunrise Project - AR-WY-029.1
Test Pit # 5
Name Krystal Bealing, APSS
Date April 18, 2016
Weather Sunny, 60-78°F
Equipment Mini Excavator

Elevation 652.25 AMSL
Soil Type UnC - Unadilla silt loam, 8-15% slopes
Geology Catskill Formation (Devonian)
Landscape Position/Slope Sideslope, 2-5%
Land Use Agriculture
Additional Notes Field was recently plowed

Horizon	Depth (inches)	Texture	Coarse Fragments	Matrix Color	Color Patterns	Redoximorphic Features	Structure	Consistency	Boundary Strike/Dip	Roots/ Pores	Depth to Bedrock	Depth to Water
Ap	0-15	Silt Loam	15% Channery	10YR 3/3	-	-	Weak Granular	Very Friable	Clear, Smooth	>20% roots	-	-
Bw	15-36	Silt Loam	30% Flaggy	7.5YR 4/4	-	-	Weak Granular	Firm	Gradual, Wavy	2-20% roots	-	-
C1	36-60+	Sandy Loam	65% Flaggy	7.5YR 4/3	-	-	Massive	Firm	-	-	-	-

Comments: No limiting layer observed. Moved infiltration test to three inches above C horizon (33 inches) due to high coarse fragment content.

Soil Profile Log

Project 14C4909-A Atlantic Sunrise Project - AR-WY-029.1
Test Pit # 6
Name Krystal Bealing, APSS
Date April 18, 2016
Weather Sunny, 60-78°F
Equipment Mini Excavator

Elevation 637.75 AMSL
Soil Type UnC - Unadilla silt loam, 8-15% slopes
Geology Catskill Formation (Devonian)
Landscape Position/Slope Sideslope, 0-5%
Land Use Agriculture
Additional Notes Field was recently plowed

Horizon	Depth (inches)	Texture	Coarse Fragments	Matrix Color	Color Patterns	Redoximorphic Features	Structure	Consistency	Boundary Strike/Dip	Roots/ Pores	Depth to Bedrock	Depth to Water
Ap	0-7	Silt Loam	15% Channery	10YR 3/3	-	-	Weak Granular	Very Friable	Clear, Smooth	>20% roots	-	-
Bw	7-27	Silt Loam	30% Channery	10YR 4/3	-	-	Weak Subangular Blocky	Very Friable	Clear, Irregular	2-20% roots	-	-
F	27-55+	Coarse Sand	30% Gravelly; 40% Flaggy	10YR 3/4	-	-	Single grain	Loose	-	-	-	-

Comments: No limiting layer observed. Moved infiltration test to three inches above fill horizon (24 inches) due to high coarse fragment content.

Soil Profile Log

Project 14C4909-A Atlantic Sunrise Project - AR-WY-029.1
Test Pit # 7
Name Krystal Bealing, APSS
Date April 18, 2016
Weather Sunny, 60-78°F
Equipment Mini Excavator

Elevation 637.25 AMSL
Soil Type UnC - Unadilla silt loam, 8-15% slopes
Geology Catskill Formation (Devonian)
Landscape Position/Slope Sideslope, 0-5%
Land Use Agriculture
Additional Notes Field was recently plowed

Horizon	Depth (inches)	Texture	Coarse Fragments	Matrix Color	Color Patterns	Redoximorphic Features	Structure	Consistency	Boundary Strike/Dip	Roots/ Pores	Depth to Bedrock	Depth to Water
Ap	0-14	Silt Loam	20% Flaggy	10YR 3/3	-	-	Weak Granular	Very Friable	Clear, Smooth	>20% roots	-	-
Bw	14-24	Silt Loam	35% Flaggy	10YR 4/4	-	-	Massive	Very Friable	Gradual, Irregular	2-20% roots	-	-
F	24-60+	Coarse Sand	30% Flaggy; 20% Channery; 10% Gravelly	10YR 3/4	-	-	Single grain	Loose	-	-	-	-

Comments: No limiting layer observed. Moved infiltration test to three inches above fill horizon (21 inches) due to high coarse fragment content.

Soil Profile Log

Project 14C4909-A Atlantic Sunrise Project - AR-WY-029.1
Test Pit # 8
Name Krystal Bealing, APSS
Date April 18, 2016
Weather Sunny, 60-78°F
Equipment Mini Excavator

Elevation 636.00 AMSL
Soil Type UnC - Unadilla silt loam, 8-15% slopes
Geology Catskill Formation (Devonian)
Landscape Position/Slope Sideslope, 3-8%
Land Use Agriculture
Additional Notes Field was recently plowed

Horizon	Depth (inches)	Texture	Coarse Fragments	Matrix Color	Color Patterns	Redoximorphic Features	Structure	Consistency	Boundary Strike/Dip	Roots/ Pores	Depth to Bedrock	Depth to Water
Ap	0-17	Silt Loam	20% Channery	10YR 3/2	-	-	Weak Granular	Very Friable	Clear, Irregular	>20% roots	-	-
Bw	17-35	Silt Loam	15% Channery	10YR 4/4+	-	-	Weak Subangular Blocky	Very Friable	Diffuse, Irregular	2-20% roots	-	-
C	35-60+	Sandy Loam	20% Channery	10YR 3/4	-	-	Massive	Loose	-	-	-	-

Comments: No limiting layer observed.

Soil Profile Log

Project 14C4909-A Atlantic Sunrise Project - AR-WY-029.1
Test Pit # 9
Name Krystal Bealing, APSS
Date April 18, 2016
Weather Sunny, 60-78°F
Equipment Mini Excavator

Elevation 636.25 AMSL
Soil Type UnC - Unadilla silt loam, 8-15% slopes
Geology Catskill Formation (Devonian)
Landscape Position/Slope Sideslope, 0-5%
Land Use Agriculture
Additional Notes Field was recently plowed

Horizon	Depth (inches)	Texture	Coarse Fragments	Matrix Color	Color Patterns	Redoximorphic Features	Structure	Consistency	Boundary Strike/Dip	Roots/ Pores	Depth to Bedrock	Depth to Water
Ap	0-17	Silt Loam	15% Gravelly	10YR 3/3	-	-	Weak Granular	Very Friable	Clear, Smooth	>20% roots	-	-
Bw	17-26	Silt Loam	20% Gravelly/ Flaggy	10YR 4/4+	-	-	Weak Subangular Blocky	Very Friable	Diffuse, Smooth	2-20% roots	-	-
BC	26-40	Sandy Loam	40% Flaggy	10YR 4/4	-	-	Massive	Loose	Diffuse, Smooth	-	-	-
C	40-60+	Very Fine Sandy Loam	20% Flaggy	10YR 4/4	15% 5YR 5/6	-	Massive	Firm	-	-	-	-

Comments: No limiting layer observed.

ATLANTIC SUNRISE PROJECT - AR-WY-029.1

SOIL INFILTRATION WORKSHEET - DOUBLE RING INFILTROMETER METHOD

Hole Number	Drop >2 inches after 30 minute presoak?[1]	Reading Interval (minutes)	Reading 1 (Inches of Drop)	Reading 2 (Inches of Drop)	Reading 3 (Inches of Drop)	Reading 4 (Inches of Drop)	Reading 5 (Inches of Drop)	Reading 6 (Inches of Drop)	Reading 7 (Inches of Drop)	Reading 8 (Inches of Drop)	Average Stabilized Reading[2] (Inches of Drop)	Infiltration Rate[3] (in/hr)	Comments
1	No	30	0.000	0.000	0.000	0.125					0.031	0.063	60-78°F, sunny. Test done at 45 inches below the surface.
2	No	30	0.750	1.000	0.750	0.250	0.500	0.625	0.625	0.750	0.625	1.250	60-78°F, sunny. Test done at 34 inches below the surface.
3	No	30	1.125	0.875	1.000	1.125					1.031	2.063	60-78°F, sunny. Test done at surface.
4	No	30	0.250	0.125	0.750	0.250	0.375	0.375	0.500		0.375	0.750	60-78°F, sunny. Test done at 38 inches below the surface due to high coarse fragments starting at 41 inches.
5	No	30	1.625	1.750	1.625	1.625					1.656	3.313	60-78°F, sunny. Test done at 33 inches below the surface due to high coarse fragments starting at 33 inches.
6	Yes	10	0.500	0.500	0.438	0.500					0.484	2.906	60-78°F, sunny. Test done at 24 inches below the surface due to high coarse fragments (fill) starting at 27 inches.
7	Yes	10	1.375	0.875	1.250	1.000	2.000	0.750	1.000	0.750	1.125	6.750	60-78°F, sunny. Test done at 21 inches below the surface due to high coarse fragments (fill) starting at 24 inches.

ATLANTIC SUNRISE PROJECT - AR-WY-029.1

SOIL INFILTRATION WORKSHEET - DOUBLE RING INFILTROMETER METHOD

8	No	30	1.750	1.625	1.845	1.750					1.743	3.485	60-78°F, sunny. Test done at 37 inches below the surface.
9	No	30	0.375	0.375	0.500	0.500					0.438	0.875	60-78°F, sunny. Test done at 39 inches below the surface.

[1]Inches of drop greater than 2 inches after the 30 minute presoak? Yes, use 10 minute interval; No, use 30 minute interval.

[2]Calculated as the average of the last four stabilized (less than 0.25-inch difference overall) readings, or an overall average in the case of eight unstabilized readings.

[3]Calculated as the average stabilized reading x 2 for 30 minute intervals; x 6 for 10 minute intervals.


View of Pit #1.


View of Pit #2.


View of Pit #3.


View of Pit #4.


View of Pit #5.


View of Pit #6.


View of Pit #7.


View of Pit #8.


View of Pit #9.

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

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

Custom Soil Resource Report for

Wyoming County, Pennsylvania

AR-WY-029.1

April 14, 2016

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (http://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.


75° 54' 14" W
75° 53' 57" W
41° 29' 3" N
41° 28' 55" N
424540
424580
424620
424660
424700
424740
424780
424820
424860
424900
4592920
4592880
4592840
4592800
4592760
4592720
4592680
UnB
UnC
UnB
92
N
Map Scale: 1:1,760 if printed on A landscape (11" x 8.5") sheet.
Meters
0 25 50 100 150
Feet
0 50 100 200 300
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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

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: http://websoilsurvey.nrcs.usda.gov
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: Wyoming County, Pennsylvania
Survey Area Data: Version 9, Nov 16, 2015

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

Date(s) aerial images were photographed: Data not available.

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

Wyoming County, Pennsylvania (PA131)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
UnB	Unadilla silt loam, 3 to 8 percent slopes	0.3	6.4%
UnC	Unadilla silt loam, 8 to 15 percent slopes	4.9	93.6%
Totals for Area of Interest		**5.2**	**100.0%**

Map Unit Descriptions

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

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

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

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

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

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

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

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

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

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

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

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

Wyoming County, Pennsylvania

UnB—Unadilla silt loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: b471
Elevation: 400 to 1,800 feet
Mean annual precipitation: 30 to 50 inches
Mean annual air temperature: 45 to 54 degrees F
Frost-free period: 110 to 180 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Unadilla and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Unadilla

Setting

Landform: Outwash terraces
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Outwash

Typical profile

H1 - 0 to 8 inches: silt loam
H2 - 8 to 42 inches: silt loam
H3 - 42 to 65 inches: very fine sandy loam

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 9.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: B

Minor Components

Wyoming

Percent of map unit: 5 percent

UnC—Unadilla silt loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: b472
Elevation: 400 to 1,800 feet
Mean annual precipitation: 30 to 50 inches
Mean annual air temperature: 45 to 54 degrees F
Frost-free period: 110 to 180 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Unadilla and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Unadilla

Setting

Landform: Outwash terraces
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Outwash

Typical profile

H1 - 0 to 8 inches: silt loam
H2 - 8 to 42 inches: silt loam
H3 - 42 to 65 inches: very fine sandy loam

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 9.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B

Minor Components

Wyoming

Percent of map unit: 5 percent

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L.10 Off-Site Discharge Analysis

a. Adequacy of Off-Site Discharge

ACCESS ROAD: AR-WY-029- Adequacy of Off-Site Discharge

AR-WY-029 is a proposed permanent access road (PAR) located in Falls Township, Wyoming County, Pennsylvania. The intent of this road is to provide permanent maintenance and operational access to the proposed Main Line Valve (MLV) site 04.1 (CN-MLV-04.1) located on the proposed 30” Central Penn Line North Pipeline. The PAR is approximately 2,080 feet long in total with 1,780 feet of existing gravel road with the remainder of the PAR constructed over existing vegetated area. The road begins at Whites Ferry Road and terminates at the MLV Site at approximate mile post 35.3.

The permanent road will be constructed of two materials. The lower portion of the road will be a gravel surface, and the upper portion of the access road will be grass pavers. The permanent access road will have a width of 14 feet and a cross slope of 2%.

The proposed access road and MLV site is surrounded by agricultural land on all four sides of the proposed area, with a small patch of woodlands to the west. The proposed improvements have been designed to match drainage patterns in this area. The improvement areas split into two drainage areas and is classified on the Pre and Post Drainage area maps as “Study Point SP-1 and Study Point SP-2” (See Appendix L.3 and L.4 for respective Maps and calculations).


(area looking north of the MLV Site)

SP-1 is located to the southwest of the MLV site. This area receives stormwater runoff from existing agricultural land and the proposed gravel access road. The flows are conveyed over land in a southwestern direction to a Vegetated Channel for Infiltration (VCI) located on the west side of the access road. The VCI is equipped with check dams and a rip rap apron to dissipate energy. Runoff that passes through the check dam and rip rap apron areas will discharge into an Infiltration Basin.

The second drainage area, SP-2, has portions in the easterly and westerly directions from the MLV site. The area consists of agricultural land, the proposed grass paver access road, a small wooded area and the MLV pad site. The proposed improvements have been designed to have no anticipated impacts or changes to downhill properties as a result of the construction the MLV site.

The proposed permanent access road and the MLV site have been designed to reduce overall disturbance to the maximum extent practicable. The PAR and MLV site have been constructed with stone and grass pavers rather than pavement to further help with keeping with the existing conditions. The MLV site has been designed to minimize the footprint to the maximum extent practical for the operation and maintenance requirements.

The PAR and MLV site have been designed to match or reduce peak stormwater runoff from the design areas to the two off-site discharge points. (See the enclosed Pre and Post drainage area maps and calculations in Appendix L1.3 and L1.4 for details.) The reduced peak runoff for all storm events is summarized in the Pre-vs. Post-Construction Peak Rate of Flow Summary for The Study Point table below. The reduction was achieved by promoting infiltration through retention storage in the Vegetated Channel for Infiltration (VCI), Infiltration Basin, Grass paver roads, and the MLV pad. Retaining and infiltrating runoff decreases the rate of stormwater runoff as well as recharging groundwater.

Pre- vs. Post-construction Peak Rate of Flow Summary for The Study Point SP-1			
Stormwater discharge rate for the design frequency storm (cfs)	Pre-construction	Post-construction	Net Change
1) 1-Year/24-Hour	0.07	0.00	(0.17)
2) 2-Year/24-Hour	0.14	0.00	(0.14)
3) 5-Year/24-Hour	0.26	0.00	(0.26)
4) 10-Year/24-Hour	0.38	0.03	(0.35)
5) 25-Year/24-Hour	0.59	0.24	(0.35)
6) 50-Year/24-Hour	0.79	0.76	(0.03)
7) 100-Year/24-Hour	1.04	0.98	(0.06)

Pre- vs. Post-construction Peak Rate of Flow Summary for The Study Point SP-2			
Stormwater discharge rate for the design frequency storm (cfs)	Pre-construction	Post-construction	Net Change
1) 1-Year/24-Hour	0.75	0.71	(0.04)
2) 2-Year/24-Hour	1.43	1.37	(0.06)
3) 5-Year/24-Hour	2.63	2.52	(0.11)
4) 10-Year/24-Hour	3.80	3.74	(0.06)
5) 25-Year/24-Hour	5.82	5.66	(0.16)
6) 50-Year/24-Hour	7.75	7.60	(0.15)
7) 100-Year/24-Hour	10.11	9.85	(0.26)

The VCI is located in SP-1 drainage area on the west side of the access road. The VCI is 4-feet wide and 1-foot deep and collects runoff from the access drive and agricultural land. The VCI is equipped with check dams to slow down flow and creates small retention areas throughout the channel to promote infiltration. A rip rap apron is proposed at the end of the channel to further slowdown stormwater runoff and dissipate energy.

The Infiltration Basin is also located in the SP-1 drainage area. The basin is a vegetated depression located to the west end of the PAR and was designed to retain and reduce runoff from the area. The basin is designed to infiltrate flows into the ground.

The smaller storm events will infiltrate the runoff back into the ground with no over flow from outlet, with the larger storm events release flows under pre-condition rates by way of a spillway weir outlet.

The grass pavers are located within the SP-2 drainage area and are used as a permanent measure within portions of the access road leading up to the MLV pad. The grass paver area is composed of several layers that will promote infiltration of stormwater within the paver area into the ground. The layers consist of two layers of gravel with a layer of soil and grass on top. The soil and seed area is lined with a “truegrid” plastic block system to provide armoring and maintain the vegetated cover. Using the paver system minimizes the new impervious area and is close to matching the existing ground cover type.

The final measure used to ensure reduced peak stormwater runoff is the MLV pad itself. The pad is a gravel area constructed of a top layer of 6” of AASHTO #8 aggregate, on a non-woven geotextile fabric, and a bottom layer of 24” AASHTO #57 stone. This 24-inch-deep area will detain and infiltrate the foot print of the MLV pad.

The flow path from the two drainage areas crosses the following soil types:

- Ph – Philo silt loam.
- Po – Pope soils.
- Pp – Pope soils, rarely flooded.
- UnB – Unadilla silt loam, 3 to 8 percent slopes.
- UnC – Unadilla silt loam, 8 to 15 percent slopes.

The PADEP E&S Manual defines erosion resistant soils as soils having an erodibility “K” factor less than or equal to 0.37. The K factor for the soil types, according to the National Resources Conservation Service (NRCS) website http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx, crossed by the flow path are summarized below:

- Ph – 0.37
- Po – 0.24
- Pp – 0.24
- UnB – 0.37
- UnC – 0.37

All soils crossed by the flow path are considered erosion resistant soils.

In addition to the stormwater flow reduction and soil data above, the VCI, Infiltration Basin and MLV pad has managed the proposed stormwater velocity as it leaves the design points. The velocities at both points are slower than 1 fps, as summarized in the Stormwater Velocity Rate Summary table below. Based on Table G.1 in the PADEP E&S Manual, “Allowable Velocities for Downslope covers for Channeled Flows” (shown below), the maximum allowable velocity for grass is 4 fps. The velocity of the runoff from the proposed improvements is less than the maximum allowable velocity listed in the table, and is an allowable velocity for the area that we are discharging too.

Stormwater Velocity Rate Summary		
Design Frequency Storm	VCI/Infiltration Basin Velocity (fps)	MLV Pad Velocity (fps)
1) 1-Year/24-Hour	0.00	0.00
2) 2-Year/24-Hour	0.00	0.04
3) 5-Year/24-Hour	0.00	0.09
4) 10-Year/24-Hour	0.25	0.21
5) 25-Year/24-Hour	0.52	0.37
6) 50-Year/24-Hour	0.74	0.51
7) 100-Year/24-Hour	0.83	0.47

Table G.1. Allowable Velocities for Downslope Covers for Channeled Flows

Ground Cover	Allowable Velocity
Grass*	4 fps
Gravel	5 fps
Mulch	1-2 fps

* See E&S Manual for more information on permissible velocities for grass and other cover types. Allowable velocities for grass can vary from 2.5 fps to as much as 8 fps. 4 fps has been selected as a conservative figure for design purposes.

(Table from the 2012 PADEP E&S Manual)

In conclusion, based on the designed measures discussed above, and the soil and velocity data provided for this MLV site and access road, there are no anticipated impacts or changes to downhill properties as a result of construction the MLV site.

Down Slope Property Owners:

- George P. Dobrinski & Leona A. Dobrinski (PA-WY-050.000)

L.11 Storage Volume Analysis

a. Storage Volume Analysis

ACCESS ROAD: WY-029 – Storage Volume Analysis

Stormwater detention is provided behind the check dams in the vegetated channel and in the void space between the AASHTO #57 stone layer at the MLV pad. The void space between the 6" AASHTO #8 stone at the surface of the pad is excluded from the detention, or storage volume, calculations. The required storage volume is calculated through an iterative process of increasing the storage volume in the HydroCAD model until the post-construction stormwater runoff rate is less than or equal to the pre-construction runoff rate.

Vegetated channel storage is created by installing check dams along the channel. The “Earthen Check Dam Infiltration Volume and Spacing” exhibit provided in Appendix L.6 describes how the storage volume behind each check dam is calculated. The number of check dams required is dependent on the channel cross-sectional dimensions, slope of channel, and required storage volume.

The void space between the AASHTO #57 stone provides the storage volume for the MLV pad. The void space between the 6" AASHTO #8 stone at the surface of the pad is excluded from the volume calculations.

The storage volume of the MLV pad is dependent on the slope of the MLV pad. If the pad were graded at 0% in all directions, the storage volume would simply be the area of the pad multiplied by the depth. However, due to site topography, a 0% grade would result in large quantities of earth movement, fill at the infiltration interface, or cut too close to the ground water table. Instead, the pad was designed to minimize these impacts by mimicking the existing grade. An actual storage volume was calculated based on the elevation of the low point of the pad (minus the 6" AASHTO #8 cover), since that is the highest runoff could be stored without overtopping the AASHTO #57 stone. Two scenarios apply to all of the main line valve pads on the project: low side pads and low corner pads. Since many of the volumes can only be obtained using calculus to determine the total storage the water surface elevation and base of the pad, AutoCAD Civil 3D was used to determine the storage volumes. To determine volumes in Civil 3D, surfaces representing the bottom of the pad and water surface elevation were built and combined into a volumetric surface; an earthwork analysis was run on the volumetric surface to determine the total volume between the two. The volume of low side pads can be checked using simple volumetric formulas for triangular (steeper grades, shallower pads) or trapezoidal (more gradual grades, deeper pads) prisms, with the cross sectional wetted area multiplied by the length of the low side of the pad. AR-WY-029 is a low-corner pad. Finally, the calculated storage volume was reduced by 60% to determine the available storage volume with 40% voids.

The detained stormwater will infiltrate the ground. The dewatering time for the stormwater detained behind the check dams is provided with the check dam volume calculations in Appendix L.6. The dewatering time for the stormwater detained in the void space of the MLV pad rock is provided at the bottom of Worksheet #5 included in Appendix L.7.