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Post Construction Stormwater Management Plan Narrative

Atlantic Sunrise Project

Permanent Access Roads
Montour Township
Columbia County
Pennsylvania

Prepared For:

TRANSCONTINENTAL GAS PIPE LINE COMPANY, LLC

2800 Post Oak Blvd
Houston, TX, 77251

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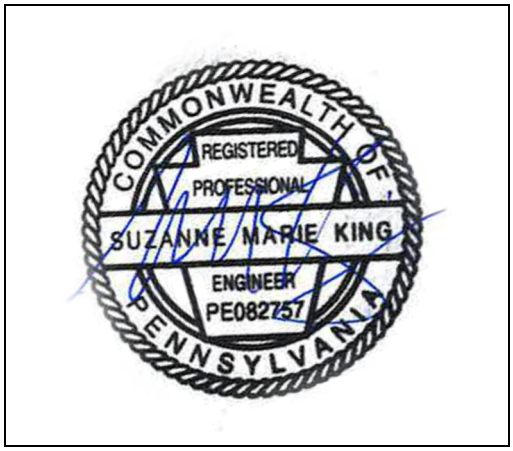
Prepared By:

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



Suzanne King, PE
P.E. 082757

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* Road-specific Appendix letters correspond to the road-specific Appendix included in the **E&SC Narrative for Columbia County included in Section 2 of the ESCGP-2 NOI**. Supporting calculations are provided for the permanent access road to the mainline valve site 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 Columbia 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 Columbia County, the main Project improvements that the temporary and permanent access roads will support include installation of a 42-inch-diameter greenfield pipeline referred to as the Central Penn Line (CPL) South 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 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.

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 road that will provide access to an MLV is proposed to be constructed in Columbia County to support the CPL South pipeline:

Access Road	Mile Post (MP)	Major River Basin	Receiving Water	Existing Use	Chapter 93 Designated Use	Impairment	Total Maximum Daily Load
CO-095.1.1.3	M-0423 MP 0.4	Susquehanna	UNT to Montour Run	None	CWF, MF	Crop Related Agric (Siltation)	TMDL, 2012 (Siltation)

1.0 COMMON INFORMATION

1.1 Topographic Features

See **Appendix K** 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 South pipeline. The NRCS Custom Soil Resource Report for Columbia County, Pennsylvania and the Soil Association Maps prepared by Wood Group Inc. are included in Appendix C of the **E&SC Narrative for Columbia County included in Section 2 of the ESCGP-2 NOI.** Soil type and use limitations for the permanent access road to the MLV site in Columbia County are presented in Table 1.2.1 below.

Table 1.2.1

Soil Type and Use Limitations for Columbia 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
HhD2	Hartleton Channery silt loam-Mod. eroded	20-35%	X	C	X					X	X	X	X	X				
WbB2	Watson silt loam, moderately eroded	3-8%	X	C/S	X			X	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 Columbia County included in Section 2 of the ESCGP-2 NOI**.

Characterization of Land Use

The characterization of land use within the proposed CPL South 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 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 Columbia 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 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.

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 located in Columbia county are located in watersheds that are not subject to an Act 167 Plan. Therefore, the PCSM BMPs for these roads have been designed to comply with section 25 Pa. Code §§ 102.8(g)(2) & 102.8(g)(3) and using 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 road is shown on the PCSM Plans (**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. Installation and maintenance guidelines, as well as E&SC BMP locations are described in the **E&SC**

Narrative for Columbia 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 road 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 drainage 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 **Appendix K**.

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 E&SC Plans have been provided under separate cover in Section 2 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 Columbia 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 stone 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 Berm: The infiltration berm shall be inspected annually and within 48 hours after every major storm event (> 1 inch rainfall depth) as follows:
  - Inspect slope and integrity of berm 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 berm;
- 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 Environmental Construction Plan (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 South 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 South 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 South 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 South 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 South 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 provides the locations of the acidic bedrock.

Acidic Soils

For the proposed CPL South 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 South 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 deemed to be a potential source of pollution (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 of 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:

- Minimize permanent changes in land cover to only that necessary to construct the required access roads;
- Limit removal of vegetation, especially tree cover, to only that necessary for construction;
- Minimize permanent impervious surfaces;
- Collect runoff from the permanent impervious areas and direct runoff to PCSM BMPs;
- Install a gravel surface for the permanent access roads rather than asphalt;
- Incorporate the use of stone at mainline valves and vegetated channels with earthen check dams to provide storage for stormwater runoff; and
- Minimize impacts to existing riparian corridors.

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 2 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

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

1.16 Antidegradation Requirements

AR-CO-095.1.1.3 has 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 Columbia 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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ROLLMAX™
ROLLED EROSION CONTROL

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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ROLLMAX™
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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	24 lb/1000 sf (11.7 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%	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

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NORTH AMERICAN GREEN®

Tensar International Corporation
2500 Northwinds Parkway
Suite 500
Alpharetta, GA 30009
800-TENSAR-1
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ROLLMAX™
ROLLED EROSION CONTROL

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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Tensar International Corporation
2500 Northwinds Parkway
Suite 500
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APPENDIX I-3

AR-CO-095.1.1.3 Specific Narrative and Calculations

I-3.1 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)

I-3.2 Location Map

I-3.3 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

I-3.4 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

I-3.5 Conveyance Calculations
- a. E&S Worksheet 11
- b. NAG Swale Lining Analysis
- c. Figure 9.3-Riprap Apron Design

I-3.6 PCSM BMP Calculations
- a. Check Dam Volume Calculations

I-3.7 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

I-3.8 Infiltration Information
- ***a. Field Observation Report***

I-3.9 Off-Site Discharge Analysis
- ***a. Adequacy of Off-Site Discharge***

I-3.10 Storage Volume Analysis
- ***a. Storage Volume Analysis***

I-3.1 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-CO-095.1.1.3

ACT 167 PLAN: None

TMDL: 2012 (Siltation)

NARRATIVE:

AR-CO-095.1.1.3 is a proposed permanent access road (PAR) located in Montour Township, Columbia County, Pennsylvania. The intent of this PAR is to provide permanent maintenance and operational access to the proposed Main Line Valve 11 (CS-MLV-11) located on the proposed 42" Central Penn Line South Pipeline. The road begins at Ridge Road (SR 4004) and terminates at the MLV site at approximate mile post M-0423 MP 0.4. The PAR is approximately 300 feet long and has an elevation change of approximately 5 feet. The road will be entirely located within the pipeline permanent right of way. During construction, the access road will have a temporary rock construction entrance and driveway apron sized for the anticipated vehicles and equipment using the road during construction. Upon completion of the construction activities, the temporary construction entrance and driveway apron will be removed and a permanent access road will be constructed. The proposed road will have a width of 14 feet and a cross slope of 2% directing runoff in the easterly direction into a vegetated channel for infiltration with check dams. 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 AASHTO #57 stone. An infiltration berm will be installed downgradient of the MLV site and vegetated channel for infiltration to provide additional stormwater detention to maintain pre-construction flow rates.

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.

Williams was not granted access permission to perform infiltration testing for the proposed vegetated channel for infiltration and MLV pad prior to the August 2016 PADEP submittal. As a placeholder, a conservative infiltration rate of 0.25 inches per hour has been used for the drawdown calculations. Prior to construction, infiltration testing will be completed for this road and the placeholder infiltration rate will be replaced with the actual road-specific infiltration rate. Using the assumed infiltration rate of 0.25 inches per hour in the infiltration calculations summary 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 72 hours and the water detained behind the check dams will infiltrate to the surrounding ground over approximately 48 hours. These dewatering time estimates will be updated to reflect the field tested infiltration rates after the field tests are complete.

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 the vegetated channel for infiltration, CS-MLV-11, and level spreader 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 Siltation TMDL. The rock construction entrance will include a wash rack due to this TMDL. The implementation of the wash rack will 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-CO-095.1.1.3 is a proposed permanent access road for Main Line Valve 11. All construction and operations traffic will utilize the proposed road. The permanent access road is situated completely within the permanent right of way of the pipeline reducing the area of impact. The roadway width has also been minimized 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-CO-095.1.1.3 will be avoided to the maximum extent practicable. The following measures have been implemented to minimize thermal impacts:

- 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 are proposed in the construction of the access road, allowing the runoff to be more easily directed away from the impervious roadway surface to the vegetated channel for infiltration.

- A vegetated channel for infiltration with check dams is proposed adjacent to the proposed permanent access road. The vegetated channel for infiltration 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-CO-095.1.1.3 Soil Acidity Table		
Soil Map Symbol	Soil Name	PH
HhD2	Hartleton channery silt loam, 20 to 35 percent slopes, moderately eroded	5.0
WbB2	Watson silt loam, 3 to 8 percent slopes	5.0

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-CO-095.1.1.3

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 pre-construction 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 and gravel driveway apron.

9. Remove brush to effectively install perimeter E&SC BMPs.

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

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

12. Proceed with major clearing and grubbing.

13. Begin construction staking for layout of access road.

14. Strip topsoil and stockpile within the pipeline right of way per Details TS.1, TS.2 or TS.3 provided in the Best Management Practices and Quantities Plan under separate cover. Grade the access road as shown on the E&SC Plans (Section 2 of the ESCGP-2 NOI). Excess material shall be removed from the Site

immediately and hauled off-site to a suitable disposal or recycling site in compliance with local, state, and federal regulations.

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

16. The Compliance Manager shall provide PADEP at least three days' notice prior to installing vegetated channel for infiltration with check dams and placing the stone and geotextile fabric within the MLV pads.

17. Install vegetated channel for infiltration with check dams where specified on the E&SC Plans (Section 2 of the ESCGP-2 NOI). 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. Note: this is a critical stage of PCSM plan to be observed by a licensed professional or designee.

    a. Rough grade the vegetated channel. Equipment shall avoid excessive compaction and/or land disturbance. Excavating equipment should operate from the side of the vegetated channel and never on the bottom. If excavation leads to substantial compaction of the subgrade, 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. The area should be disked prior to final grading of topsoil.

    b. Construct check dams.

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

    d. Seed, vegetate and install protective lining as per approved plans and according to final planting list. Plant the vegetated channel at a time of the year when successful establishment without irrigation is most likely. However, temporary irrigation may be needed in periods of little rain or drought. Vegetation should be established as soon as possible to prevent erosion and scour.

    e. Once all tributary areas are sufficiently stabilized, remove temporary erosion and sediment controls. It is very important that the vegetated channel be stabilized before receiving upland stormwater flow.

    f. 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 vegetated channel.

18. 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.

19. 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.

20. Place the stone and geotextile fabric within the MLV pad as specified on the E&SC Plans (Section 2 of the ESCGP-2 NOI). NOTE: This is a critical stage of PCSM Plan to be observed by a licensed professional or designee.

21. 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, the disturbed area 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).

22. Once the temporary access road is no longer necessary, remove all gravel and geotextile fabric from the Site and dispose of the materials at a suitable disposal or recycling site in compliance with local, state, and federal regulations. Restore pre-construction grades. Immediately seed and stabilize disturbed areas, including areas used to stockpile topsoil. E&SC BMPs will remain in place and functional.

23. Loosen and de-compact topsoil throughout the temporarily improved sections of the access road and grade the access to match preconstruction conditions. Immediately fertilize, seed and stabilize areas at finished grade. Maintain E&SC BMPs until Site work is complete and uniform 70% perennial vegetative cover is established.

24. 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. Roadway and MLV Site should have at least a clean subbase in place to be considered stabilized.

25. 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.

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

27. Upon completion of all earth disturbance activities, removal of all temporary 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-CO-095.1.1.3			
Watershed Name:	Fishing Creek, CWF, MF			
Act 167 Plan Name:	N/A		Date Adopted: --	
Design Storm Frequency	2 year	Pre-construction	Post-construction	Net Change
Rainfall Amount	2.84 inches			
Impervious area (acres)		0.000	0.202	0.202
Volume of stormwater runoff (cf) without planned stormwater BMPs		3,863	4,995	1,132
Volume of stormwater runoff (cf) with planned stormwater BMPs			(7,454)	(11,317)

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	2.39	1.47	(0.92)
2) 2-Year/24-Hour	4.03	2.48	(1.55)
3) 5-Year/24-Hour	6.78	4.18	(2.60)
4) 10-Year/24-Hour	9.41	5.79	(3.62)
5) 25-Year/24-Hour	13.92	8.58	(5.34)
6) 50-Year/24-Hour	18.34	11.30	(7.04)
7) 100-Year/24-Hour	23.73	20.40	(3.33)

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	1,328	1.37
Stormwater energy dissipaters: Infiltration Basin	Infiltration/ Recharge/Storage	9,735	0.20
Other: MLV Stone Pad Void Storage	Infiltration/ Recharge/Storage	1,386	0.12

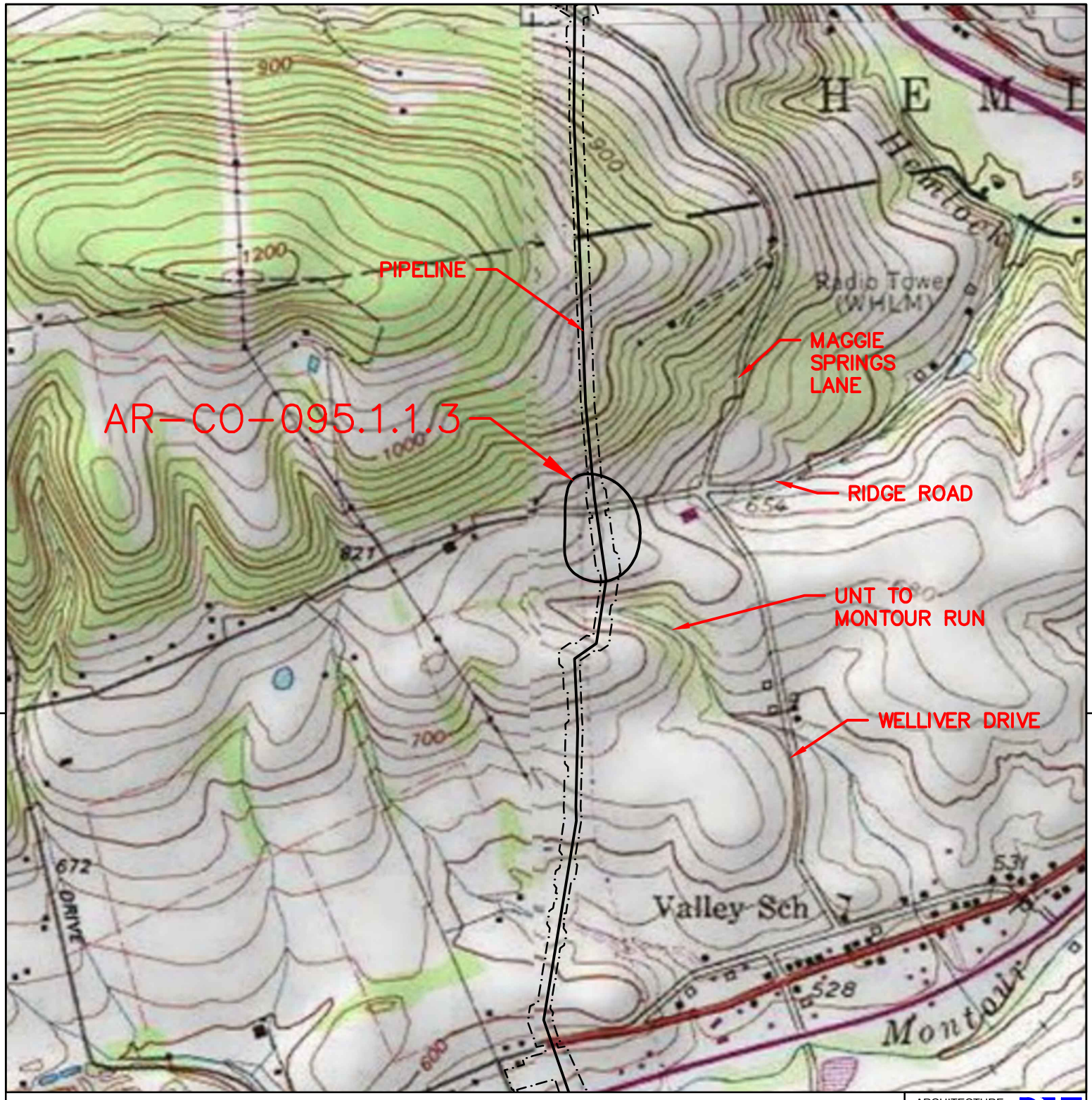
Off-site Discharge Analysis:

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/Basin***	***MLV Pad***
Maximum Impervious Loading Ratio	***0.8 :1 (5:1 Max)***	***1.0 :1 (5:1 Max)***
Maximum Total Loading Ratio	***7.3 :1* (8:1 Max)***	***1.1 :1 (8:1 Max)***

Supporting Areas	***Channel/Basin***	***MLV Pad***	***Unit***
Impervious Drainage Area	***0.17***	***0.11***	***Acres***
Infiltration Area	***0.22***	***0.11***	***Acres***
Total Drainage Area	***1.57***	***0.12***	***Acres***

I-3.2 Location Map



DANVILLE 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
PERMANENT AR-CO-095.1.1.3
MONTOUR TOWNSHIP
COLUMBIA COUNTY, PENNSYLVANIA

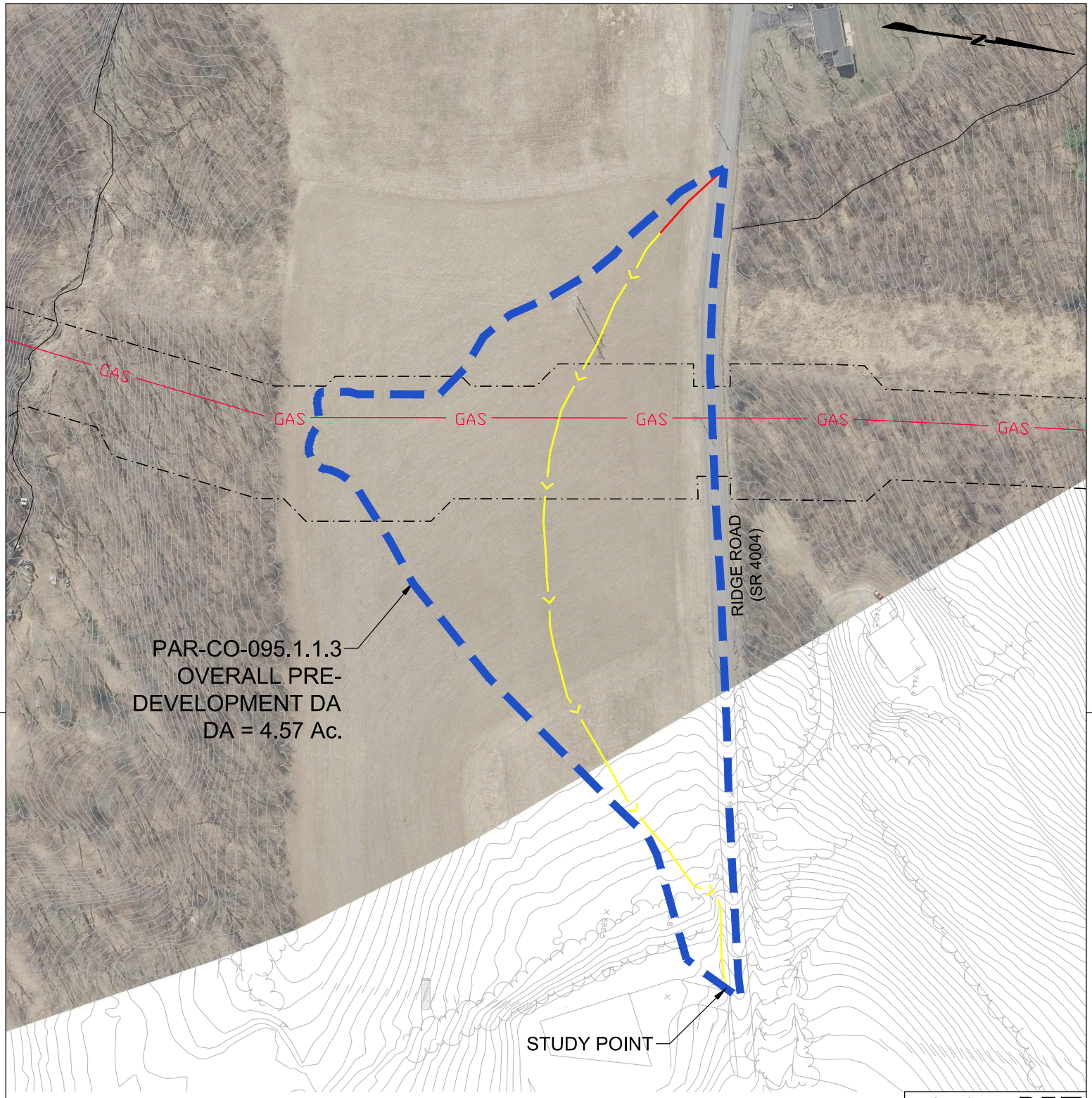
Williams

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: 24-1600-70-28-A/ LL113_9-AR-CO-095.1.1.3	SHEET 1 OF 1
WO: 1161481			

I-3.3 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 75 150

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 —

ATLANTIC SUNRISE PROJECT - CENTRAL PENN LINE SOUTH

PROPOSED 42" NATURAL GAS PIPELINE
ACCESS ROAD DRAINAGE AREA MAP
AR-CO-095.1.1.3 PRE
HEMLOCK TOWNSHIP
COLUMBIA COUNTY, PENNSYLVANIA

Williams

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

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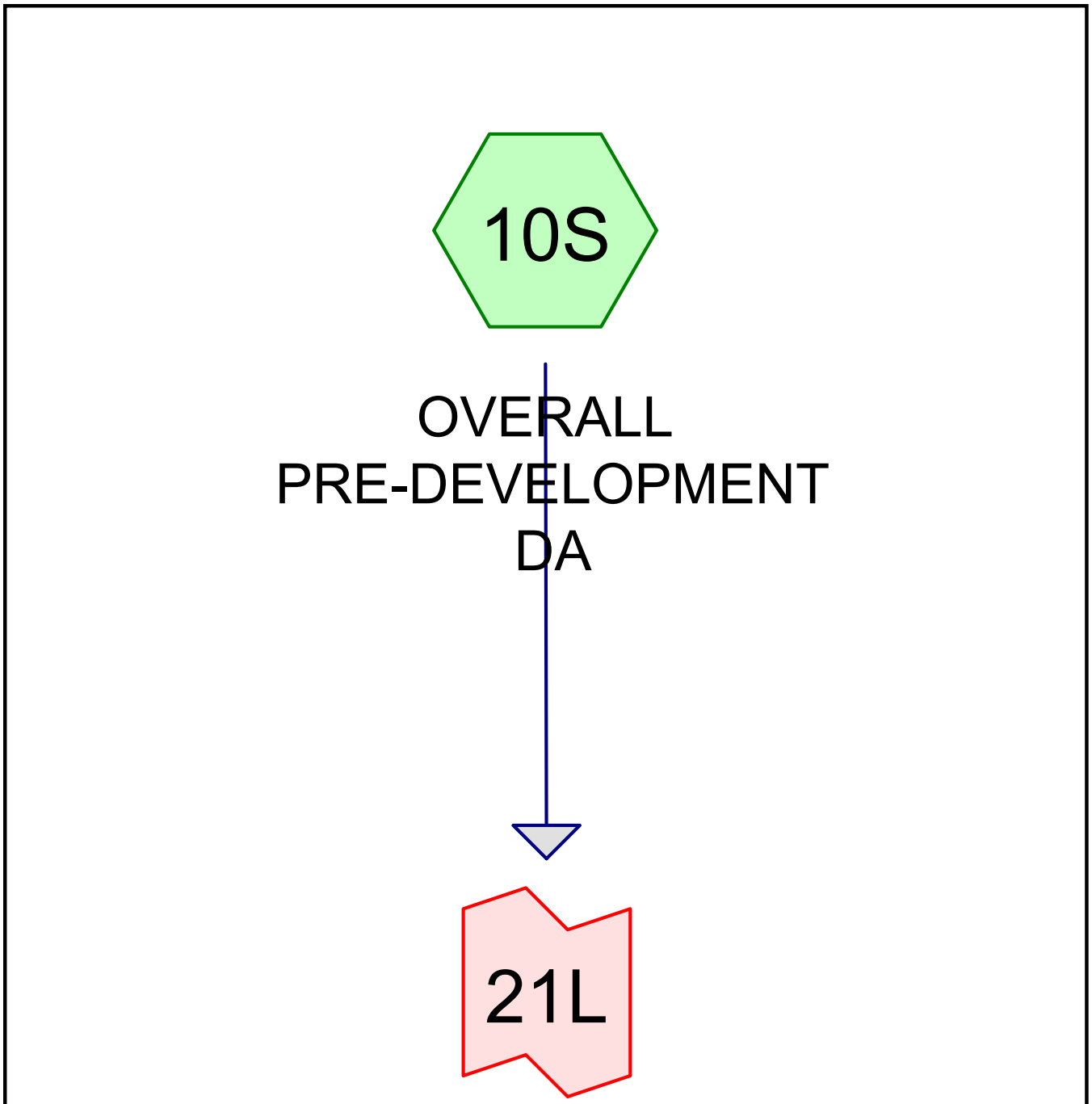
CHECKED BY: BJP	DATE: 10/26/15	ISSUED FOR CONSTRUCTION:	
APPROVED BY: BJP	DATE: 10/26/15	DRAWING NUMBER:	AR-CO-095.1.1.3 PRE
WO:			



Subcat Reach Pond Link

Routing Diagram for AR-CO-095.1.1.3
Prepared by Microsoft, Printed 10/18/2016
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Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
4.383	71	Meadow, non-grazed, HSG C (10S)
0.185	98	Paved parking, HSG C (10S)
4.567	**72**	**TOTAL AREA**

Soil Listing (selected nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
4.567	HSG C	10S
0.000	HSG D	
0.000	Other	
4.567		**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

Subcatchment10S: OVERALL Runoff Area=198,948 sf 4.04% Impervious Runoff Depth=0.46"
Flow Length=1,035' Tc=13.8 min CN=72 Runoff=2.39 cfs 0.176 af

Link 21L: Existing Conditions Inflow=2.39 cfs 0.176 af
Primary=2.39 cfs 0.176 af

Total Runoff Area = 4.567 ac Runoff Volume = 0.176 af Average Runoff Depth = 0.46"
95.96% Pervious = 4.383 ac 4.04% Impervious = 0.185 ac

Summary for Subcatchment 10S: OVERALL PRE-DEVELOPMENT DA

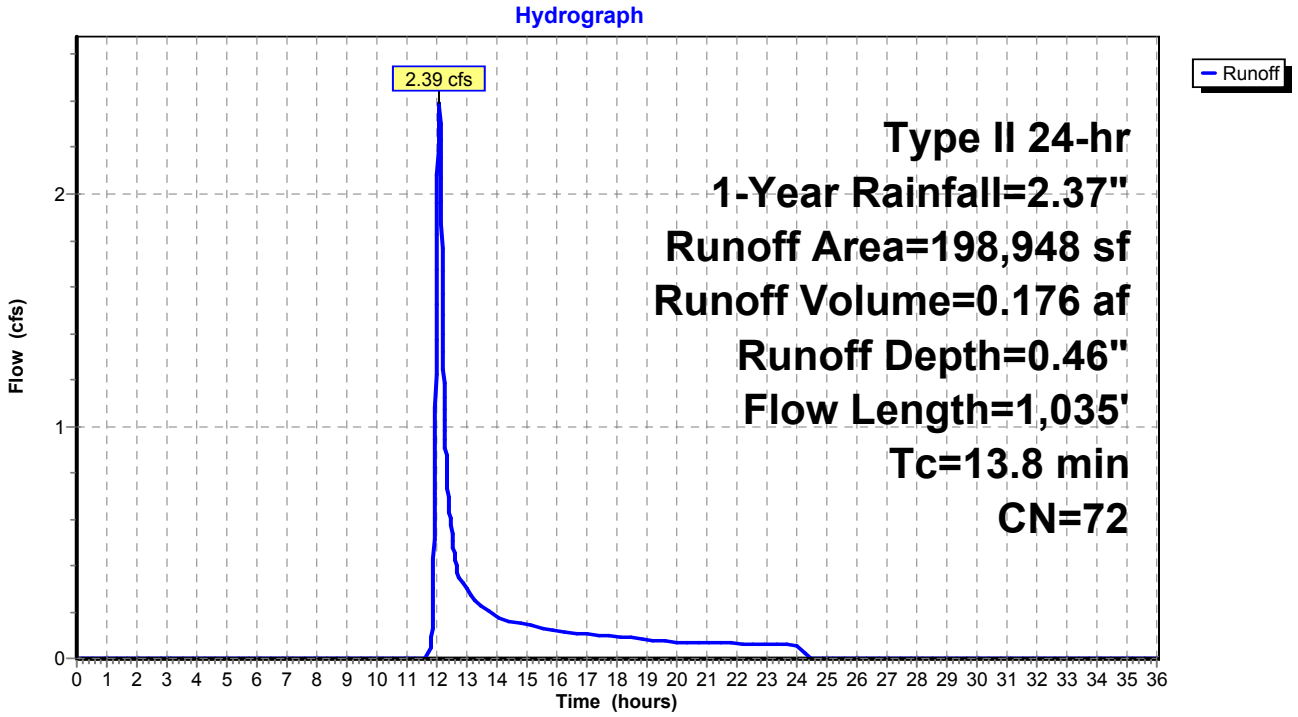
Runoff = 2.39 cfs @ 12.08 hrs, Volume= 0.176 af, Depth= 0.46"

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=2.37"

	Area (sf)	CN	Description
	8,044	98	Paved parking, HSG C
	0	89	Gravel roads, HSG C
*	0	98	Crushed Stone Pad, HSG C
	190,904	71	Meadow, non-grazed, HSG C
	198,948	72	Weighted Average
	190,904		95.96% Pervious Area
	8,044		4.04% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.3	15	0.0200	0.89		**Sheet Flow, Sheet** Smooth surfaces n= 0.011 P2= 2.84"
6.7	85	0.1100	0.21		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 2.84"
6.6	831	0.0900	2.10		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
0.2	104	0.0900	9.48	37.92	**Channel Flow, Existing Roadside Channel** Area= 4.0 sf Perim= 12.5' r= 0.32' n= 0.022 Earth, clean & straight
13.8	1,035	Total			

Subcatchment 10S: OVERALL PRE-DEVELOPMENT DA

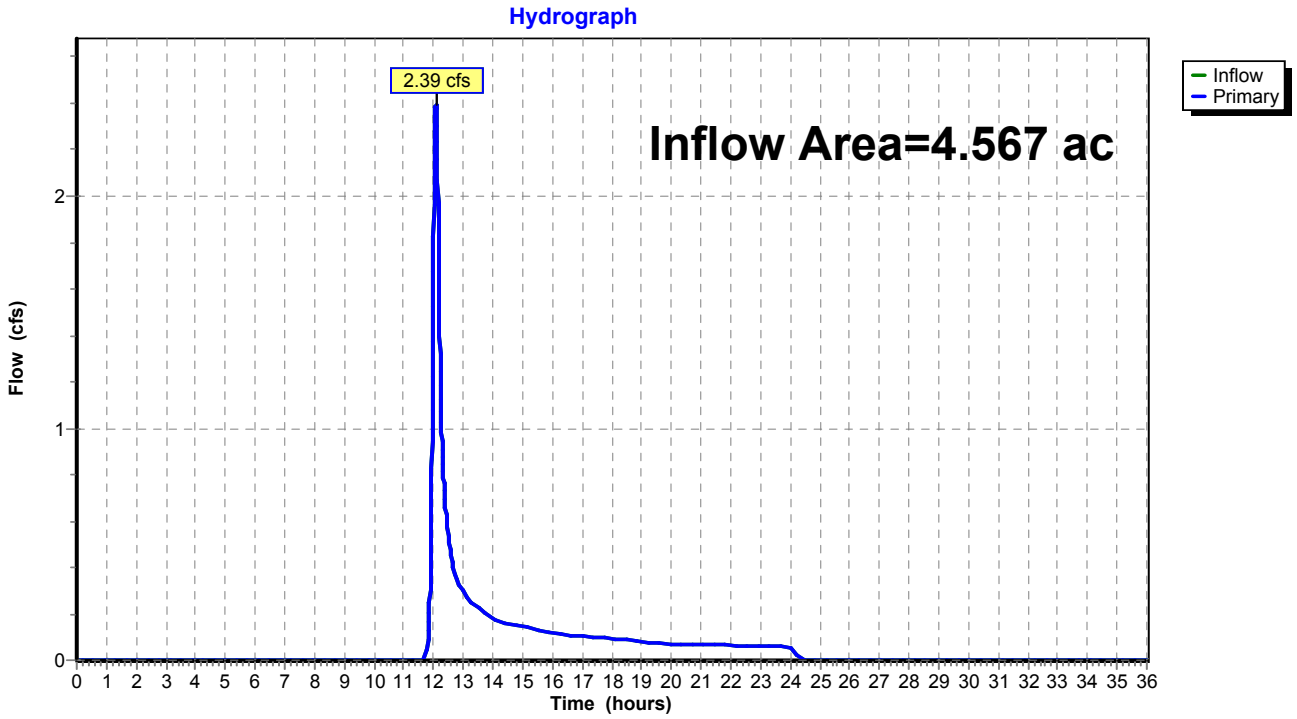


Summary for Link 21L: Existing Conditions

Inflow Area = 4.567 ac, 4.04% Impervious, Inflow Depth = 0.46" for 1-Year event
Inflow = 2.39 cfs @ 12.08 hrs, Volume= 0.176 af
Primary = 2.39 cfs @ 12.08 hrs, Volume= 0.176 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Link 21L: Existing Conditions



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

Subcatchment10S: OVERALL Runoff Area=198,948 sf 4.04% Impervious Runoff Depth=0.71"
Flow Length=1,035' Tc=13.8 min CN=72 Runoff=4.03 cfs 0.272 af

Link 21L: Existing Conditions Inflow=4.03 cfs 0.272 af
Primary=4.03 cfs 0.272 af

Total Runoff Area = 4.567 ac Runoff Volume = 0.272 af Average Runoff Depth = 0.71"
95.96% Pervious = 4.383 ac 4.04% Impervious = 0.185 ac

Summary for Subcatchment 10S: OVERALL PRE-DEVELOPMENT DA

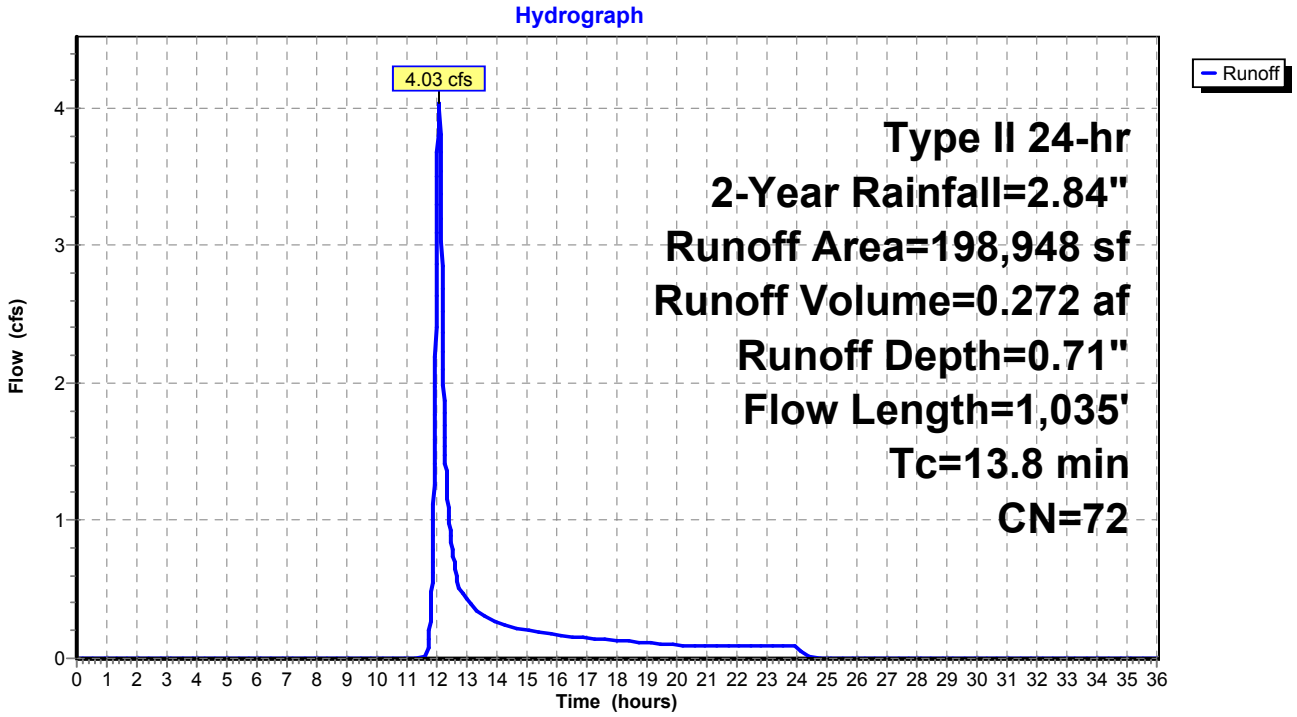
Runoff = 4.03 cfs @ 12.07 hrs, Volume= 0.272 af, Depth= 0.71"

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 2-Year Rainfall=2.84"

	Area (sf)	CN	Description
	8,044	98	Paved parking, HSG C
	0	89	Gravel roads, HSG C
*	0	98	Crushed Stone Pad, HSG C
	190,904	71	Meadow, non-grazed, HSG C
	198,948	72	Weighted Average
	190,904		95.96% Pervious Area
	8,044		4.04% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.3	15	0.0200	0.89		**Sheet Flow, Sheet** Smooth surfaces n= 0.011 P2= 2.84"
6.7	85	0.1100	0.21		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 2.84"
6.6	831	0.0900	2.10		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
0.2	104	0.0900	9.48	37.92	**Channel Flow, Existing Roadside Channel** Area= 4.0 sf Perim= 12.5' r= 0.32' n= 0.022 Earth, clean & straight
13.8	1,035	Total			

Subcatchment 10S: OVERALL PRE-DEVELOPMENT DA

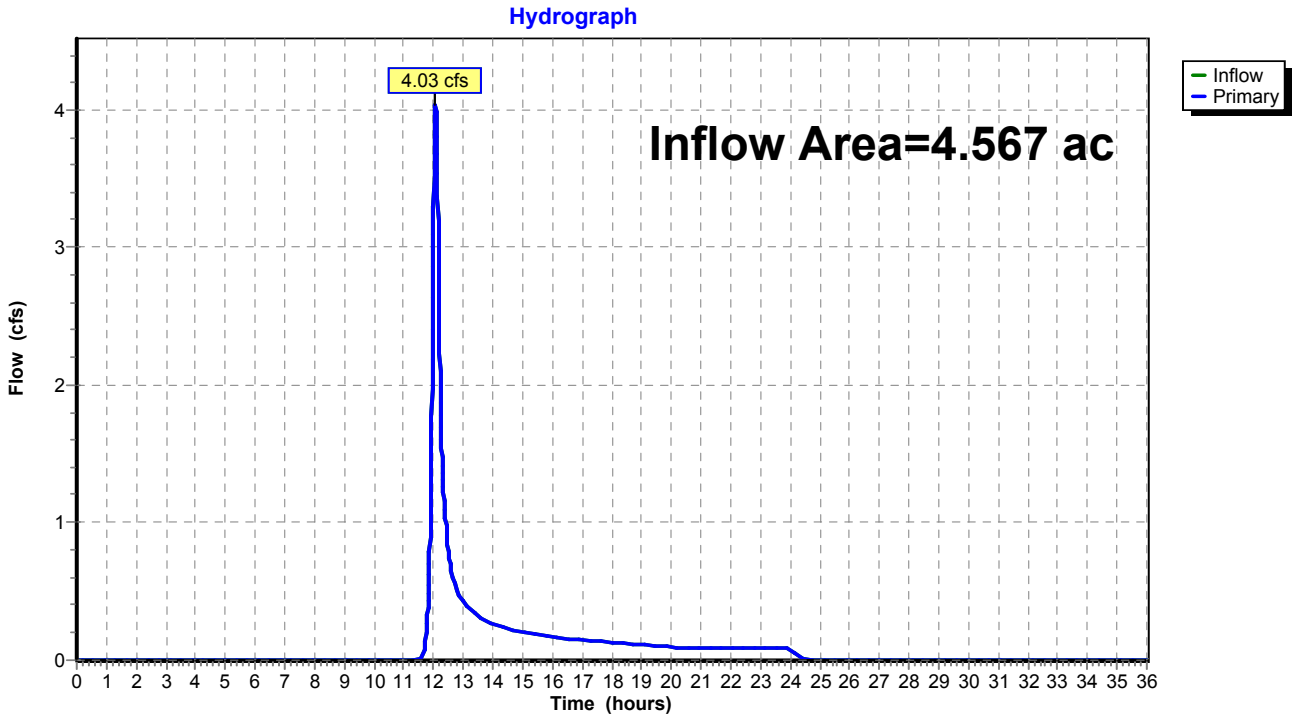


Summary for Link 21L: Existing Conditions

Inflow Area = 4.567 ac, 4.04% Impervious, Inflow Depth = 0.71" for 2-Year event
Inflow = 4.03 cfs @ 12.07 hrs, Volume= 0.272 af
Primary = 4.03 cfs @ 12.07 hrs, Volume= 0.272 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Link 21L: Existing Conditions



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

Subcatchment10S: OVERALL Runoff Area=198,948 sf 4.04% Impervious Runoff Depth=1.14"
Flow Length=1,035' Tc=13.8 min CN=72 Runoff=6.78 cfs 0.434 af

Link 21L: Existing Conditions Inflow=6.78 cfs 0.434 af
Primary=6.78 cfs 0.434 af

Total Runoff Area = 4.567 ac Runoff Volume = 0.434 af Average Runoff Depth = 1.14"
95.96% Pervious = 4.383 ac 4.04% Impervious = 0.185 ac

Summary for Subcatchment 10S: OVERALL PRE-DEVELOPMENT DA

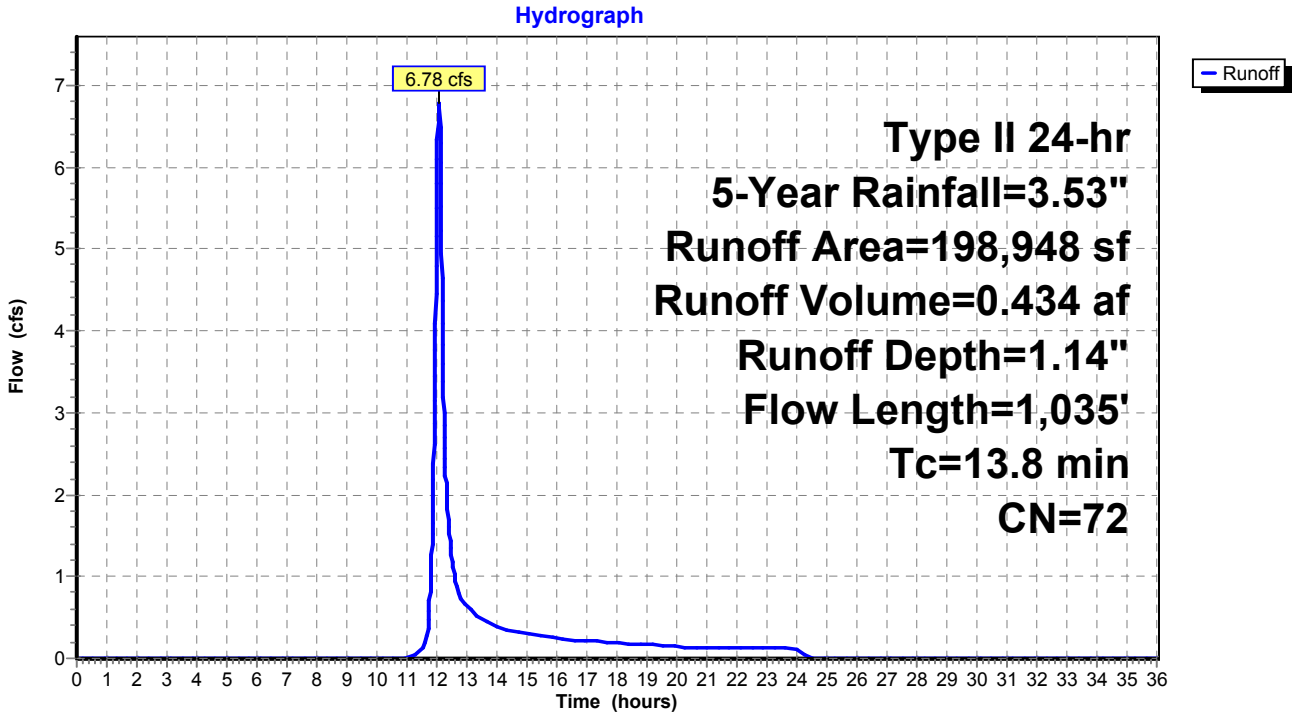
Runoff = 6.78 cfs @ 12.07 hrs, Volume= 0.434 af, Depth= 1.14"

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=3.53"

	Area (sf)	CN	Description
	8,044	98	Paved parking, HSG C
	0	89	Gravel roads, HSG C
*	0	98	Crushed Stone Pad, HSG C
	190,904	71	Meadow, non-grazed, HSG C
	198,948	72	Weighted Average
	190,904		95.96% Pervious Area
	8,044		4.04% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.3	15	0.0200	0.89		**Sheet Flow, Sheet** Smooth surfaces n= 0.011 P2= 2.84"
6.7	85	0.1100	0.21		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 2.84"
6.6	831	0.0900	2.10		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
0.2	104	0.0900	9.48	37.92	**Channel Flow, Existing Roadside Channel** Area= 4.0 sf Perim= 12.5' r= 0.32' n= 0.022 Earth, clean & straight
13.8	1,035	Total			

Subcatchment 10S: OVERALL PRE-DEVELOPMENT DA

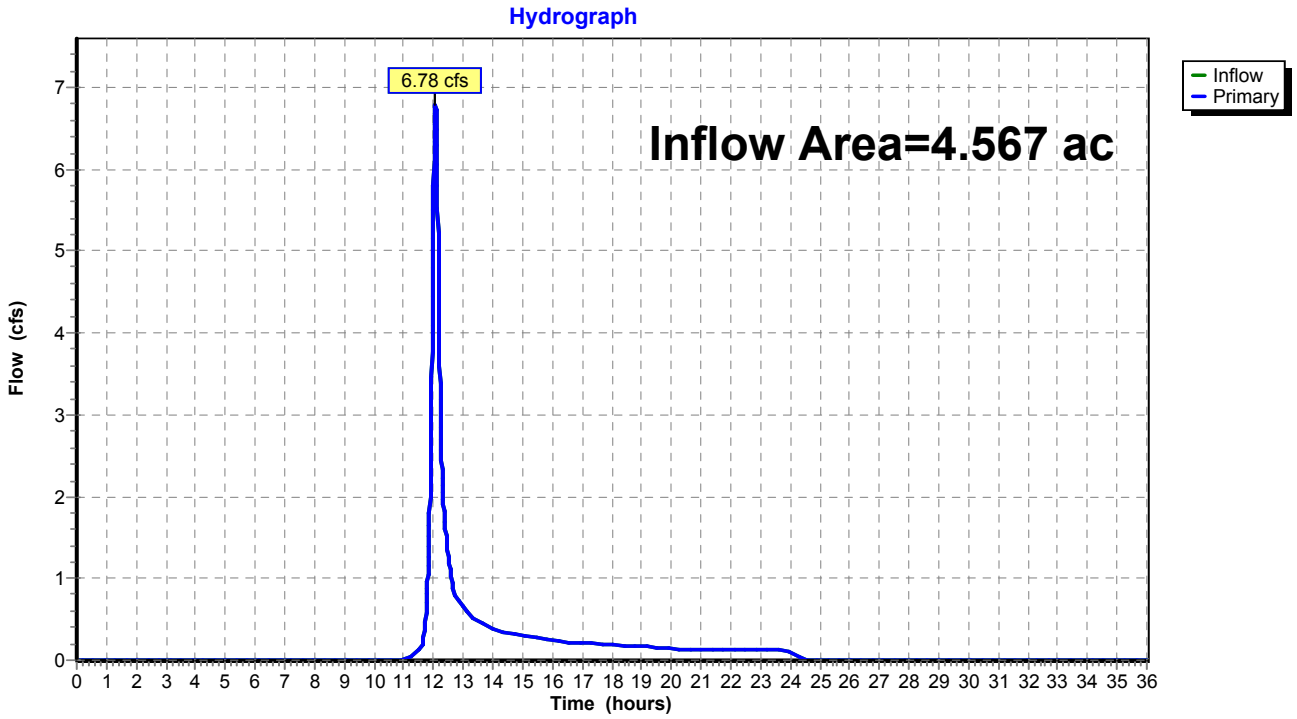


Summary for Link 21L: Existing Conditions

Inflow Area = 4.567 ac, 4.04% Impervious, Inflow Depth = 1.14" for 5-Year event
Inflow = 6.78 cfs @ 12.07 hrs, Volume= 0.434 af
Primary = 6.78 cfs @ 12.07 hrs, Volume= 0.434 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Link 21L: Existing Conditions



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

Subcatchment10S: OVERALL Runoff Area=198,948 sf 4.04% Impervious Runoff Depth=1.55"
Flow Length=1,035' Tc=13.8 min CN=72 Runoff=9.41 cfs 0.591 af

Link 21L: Existing Conditions Inflow=9.41 cfs 0.591 af
Primary=9.41 cfs 0.591 af

Total Runoff Area = 4.567 ac Runoff Volume = 0.591 af Average Runoff Depth = 1.55"
95.96% Pervious = 4.383 ac 4.04% Impervious = 0.185 ac

Summary for Subcatchment 10S: OVERALL PRE-DEVELOPMENT DA

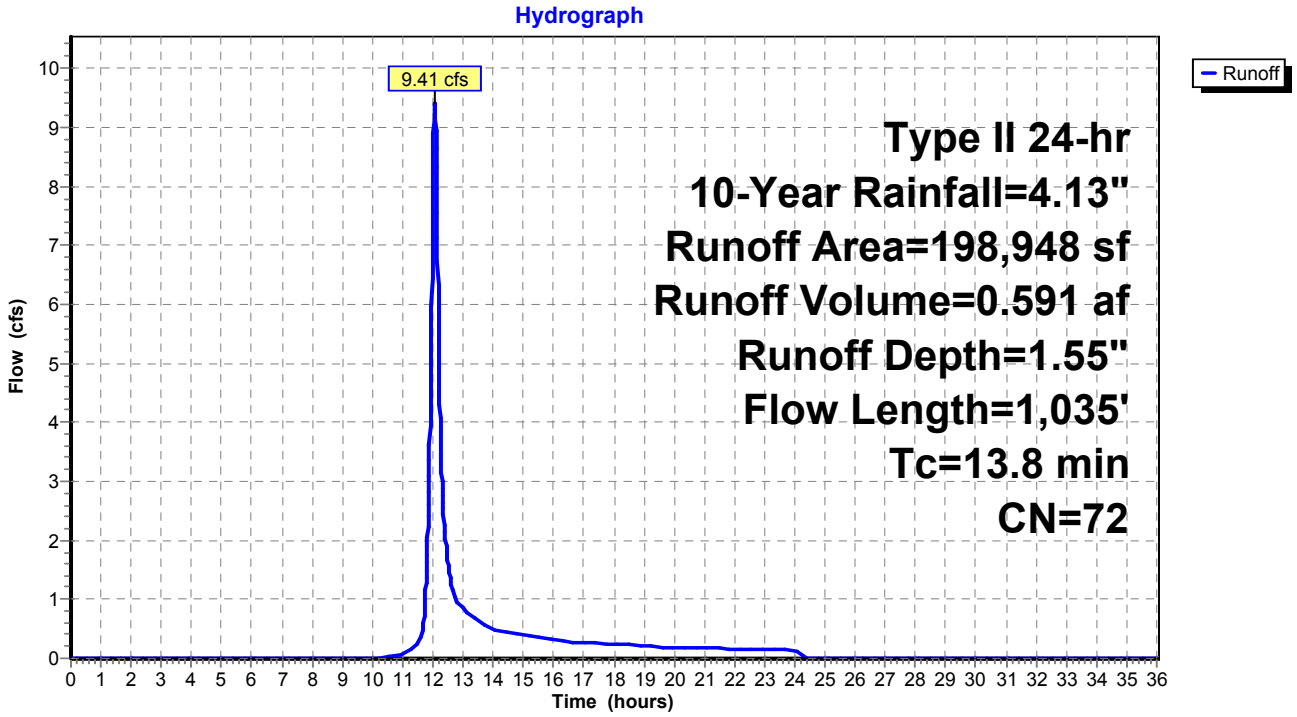
Runoff = 9.41 cfs @ 12.07 hrs, Volume= 0.591 af, Depth= 1.55"

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=4.13"

	Area (sf)	CN	Description
	8,044	98	Paved parking, HSG C
	0	89	Gravel roads, HSG C
*	0	98	Crushed Stone Pad, HSG C
	190,904	71	Meadow, non-grazed, HSG C
	198,948	72	Weighted Average
	190,904		95.96% Pervious Area
	8,044		4.04% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.3	15	0.0200	0.89		**Sheet Flow, Sheet** Smooth surfaces n= 0.011 P2= 2.84"
6.7	85	0.1100	0.21		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 2.84"
6.6	831	0.0900	2.10		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
0.2	104	0.0900	9.48	37.92	**Channel Flow, Existing Roadside Channel** Area= 4.0 sf Perim= 12.5' r= 0.32' n= 0.022 Earth, clean & straight
13.8	1,035	Total			

Subcatchment 10S: OVERALL PRE-DEVELOPMENT DA

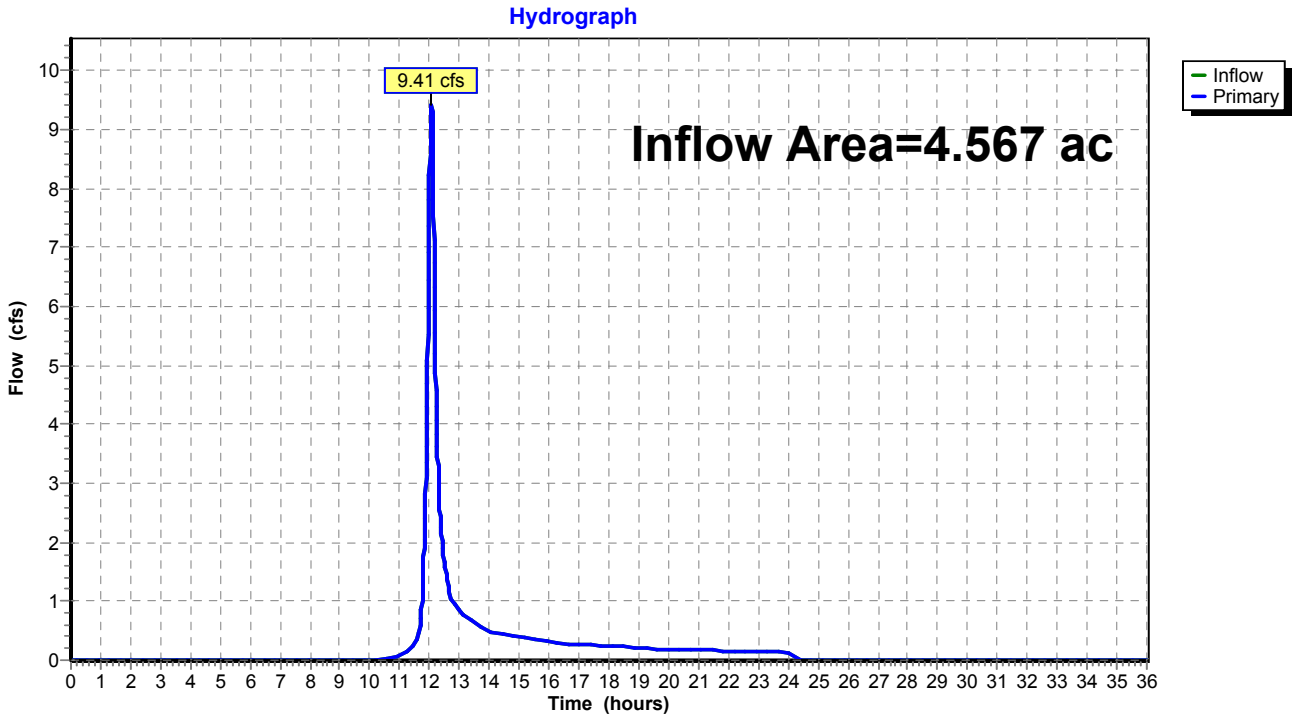


Summary for Link 21L: Existing Conditions

Inflow Area = 4.567 ac, 4.04% Impervious, Inflow Depth = 1.55" for 10-Year event
Inflow = 9.41 cfs @ 12.07 hrs, Volume= 0.591 af
Primary = 9.41 cfs @ 12.07 hrs, Volume= 0.591 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Link 21L: Existing Conditions



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

Subcatchment10S: OVERALL Runoff Area=198,948 sf 4.04% Impervious Runoff Depth=2.27"
Flow Length=1,035' Tc=13.8 min CN=72 Runoff=13.92 cfs 0.863 af

Link 21L: Existing Conditions Inflow=13.92 cfs 0.863 af
Primary=13.92 cfs 0.863 af

Total Runoff Area = 4.567 ac Runoff Volume = 0.863 af Average Runoff Depth = 2.27"
95.96% Pervious = 4.383 ac 4.04% Impervious = 0.185 ac

Summary for Subcatchment 10S: OVERALL PRE-DEVELOPMENT DA

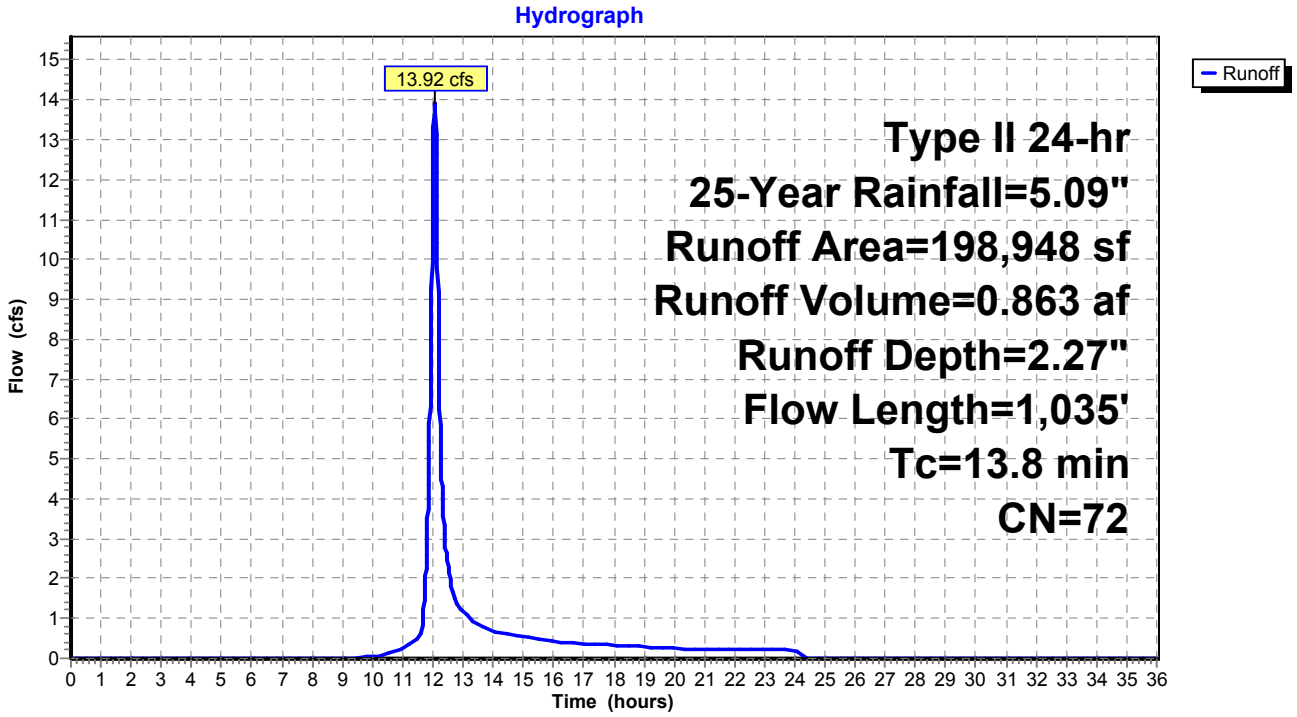
Runoff = 13.92 cfs @ 12.06 hrs, Volume= 0.863 af, Depth= 2.27"

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=5.09"

	Area (sf)	CN	Description
	8,044	98	Paved parking, HSG C
	0	89	Gravel roads, HSG C
*	0	98	Crushed Stone Pad, HSG C
	190,904	71	Meadow, non-grazed, HSG C
	198,948	72	Weighted Average
	190,904		95.96% Pervious Area
	8,044		4.04% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.3	15	0.0200	0.89		**Sheet Flow, Sheet** Smooth surfaces n= 0.011 P2= 2.84"
6.7	85	0.1100	0.21		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 2.84"
6.6	831	0.0900	2.10		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
0.2	104	0.0900	9.48	37.92	**Channel Flow, Existing Roadside Channel** Area= 4.0 sf Perim= 12.5' r= 0.32' n= 0.022 Earth, clean & straight
13.8	1,035	Total			

Subcatchment 10S: OVERALL PRE-DEVELOPMENT DA

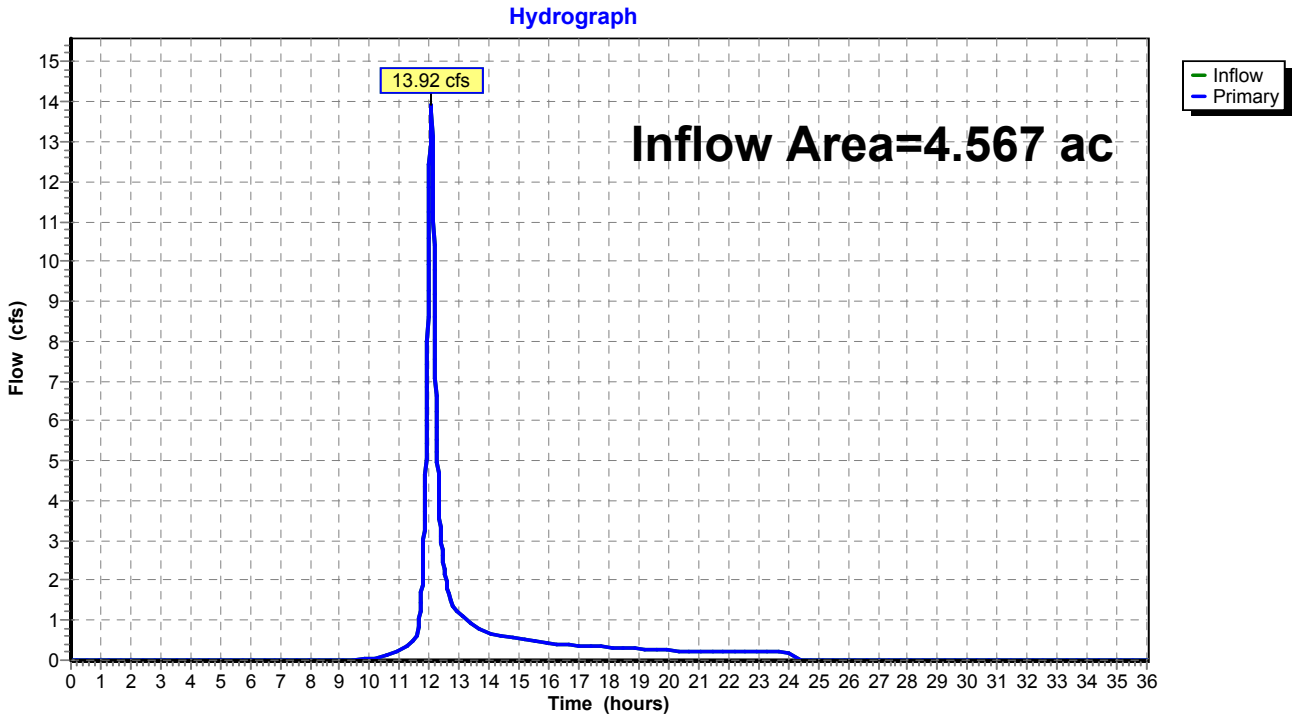


Summary for Link 21L: Existing Conditions

Inflow Area = 4.567 ac, 4.04% Impervious, Inflow Depth = 2.27" for 25-Year event
Inflow = 13.92 cfs @ 12.06 hrs, Volume= 0.863 af
Primary = 13.92 cfs @ 12.06 hrs, Volume= 0.863 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Link 21L: Existing Conditions



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

Subcatchment10S: OVERALL Runoff Area=198,948 sf 4.04% Impervious Runoff Depth=2.98"
Flow Length=1,035' Tc=13.8 min CN=72 Runoff=18.34 cfs 1.133 af

Link 21L: Existing Conditions Inflow=18.34 cfs 1.133 af
Primary=18.34 cfs 1.133 af

Total Runoff Area = 4.567 ac Runoff Volume = 1.133 af Average Runoff Depth = 2.98"
95.96% Pervious = 4.383 ac 4.04% Impervious = 0.185 ac

Summary for Subcatchment 10S: OVERALL PRE-DEVELOPMENT DA

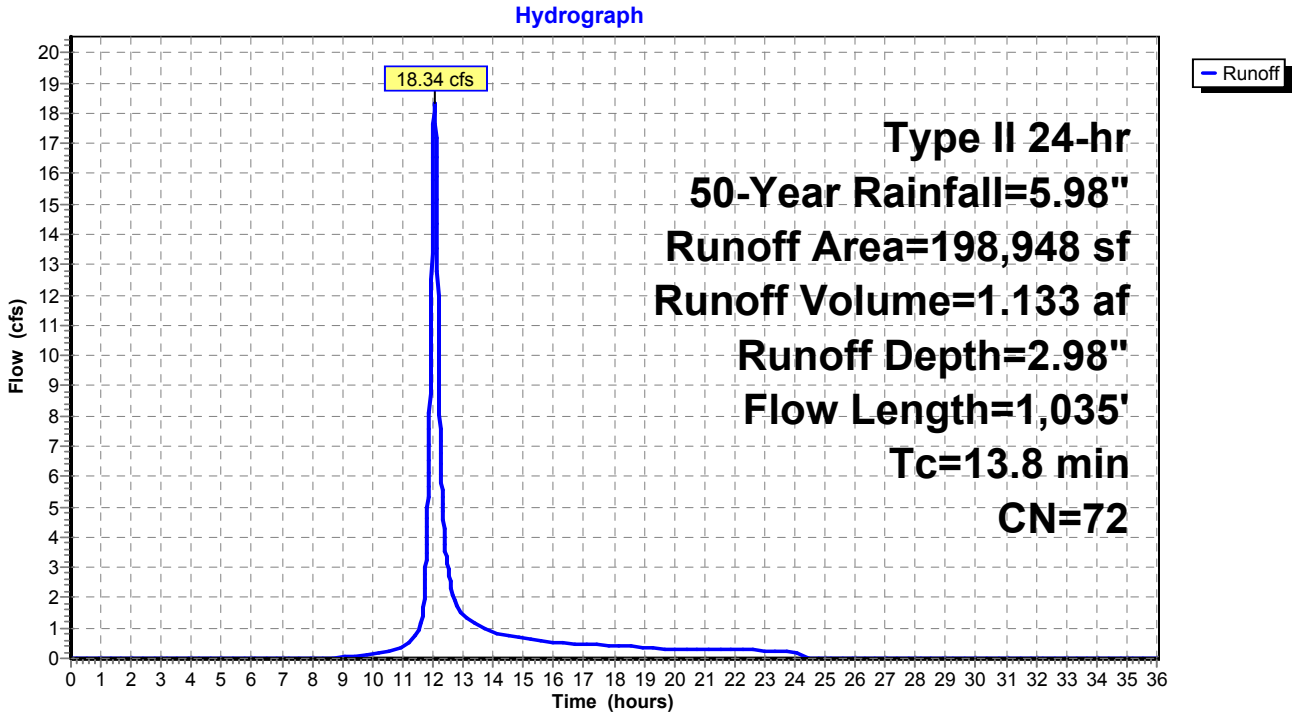
Runoff = 18.34 cfs @ 12.06 hrs, Volume= 1.133 af, Depth= 2.98"

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=5.98"

	Area (sf)	CN	Description
	8,044	98	Paved parking, HSG C
	0	89	Gravel roads, HSG C
*	0	98	Crushed Stone Pad, HSG C
	190,904	71	Meadow, non-grazed, HSG C
	198,948	72	Weighted Average
	190,904		95.96% Pervious Area
	8,044		4.04% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.3	15	0.0200	0.89		**Sheet Flow, Sheet** Smooth surfaces n= 0.011 P2= 2.84"
6.7	85	0.1100	0.21		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 2.84"
6.6	831	0.0900	2.10		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
0.2	104	0.0900	9.48	37.92	**Channel Flow, Existing Roadside Channel** Area= 4.0 sf Perim= 12.5' r= 0.32' n= 0.022 Earth, clean & straight
13.8	1,035	Total			

Subcatchment 10S: OVERALL PRE-DEVELOPMENT DA

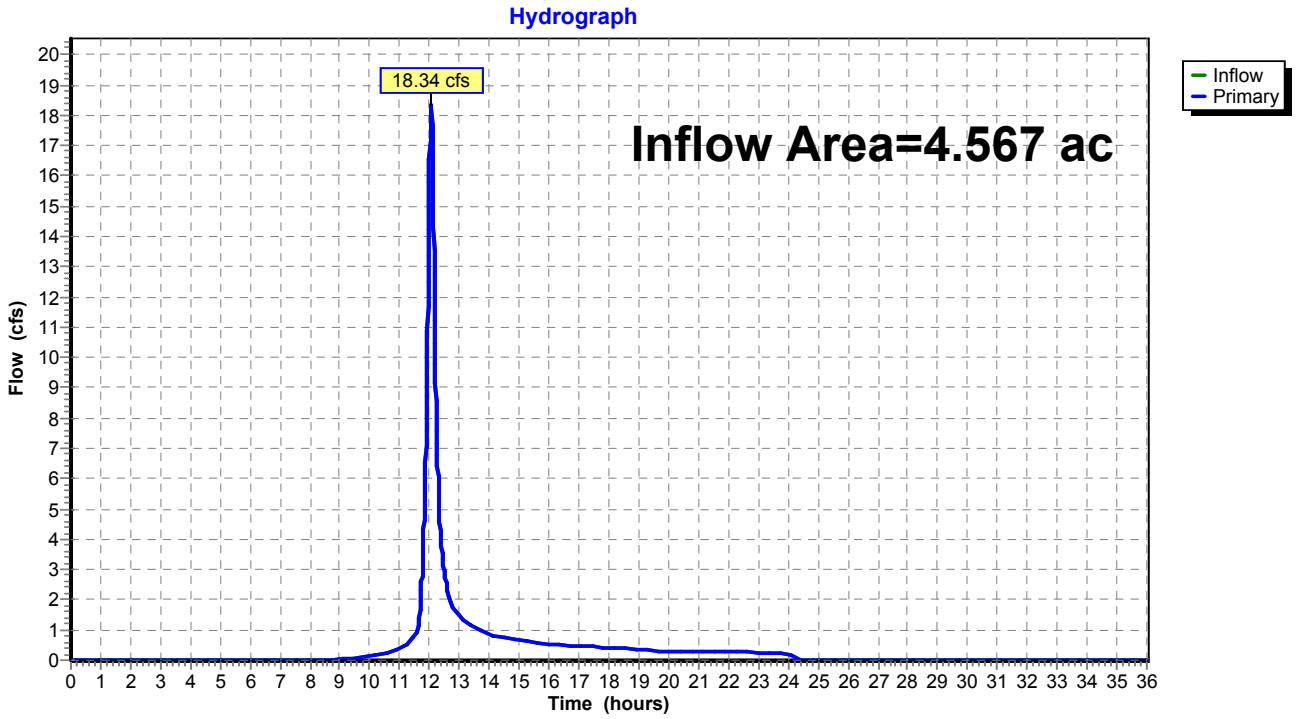


Summary for Link 21L: Existing Conditions

Inflow Area = 4.567 ac, 4.04% Impervious, Inflow Depth = 2.98" for 50-Year event
Inflow = 18.34 cfs @ 12.06 hrs, Volume= 1.133 af
Primary = 18.34 cfs @ 12.06 hrs, Volume= 1.133 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Link 21L: Existing Conditions



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

Subcatchment10S: OVERALL Runoff Area=198,948 sf 4.04% Impervious Runoff Depth=3.85"
Flow Length=1,035' Tc=13.8 min CN=72 Runoff=23.73 cfs 1.467 af

Link 21L: Existing Conditions Inflow=23.73 cfs 1.467 af
Primary=23.73 cfs 1.467 af

Total Runoff Area = 4.567 ac Runoff Volume = 1.467 af Average Runoff Depth = 3.85"
95.96% Pervious = 4.383 ac 4.04% Impervious = 0.185 ac

Summary for Subcatchment 10S: OVERALL PRE-DEVELOPMENT DA

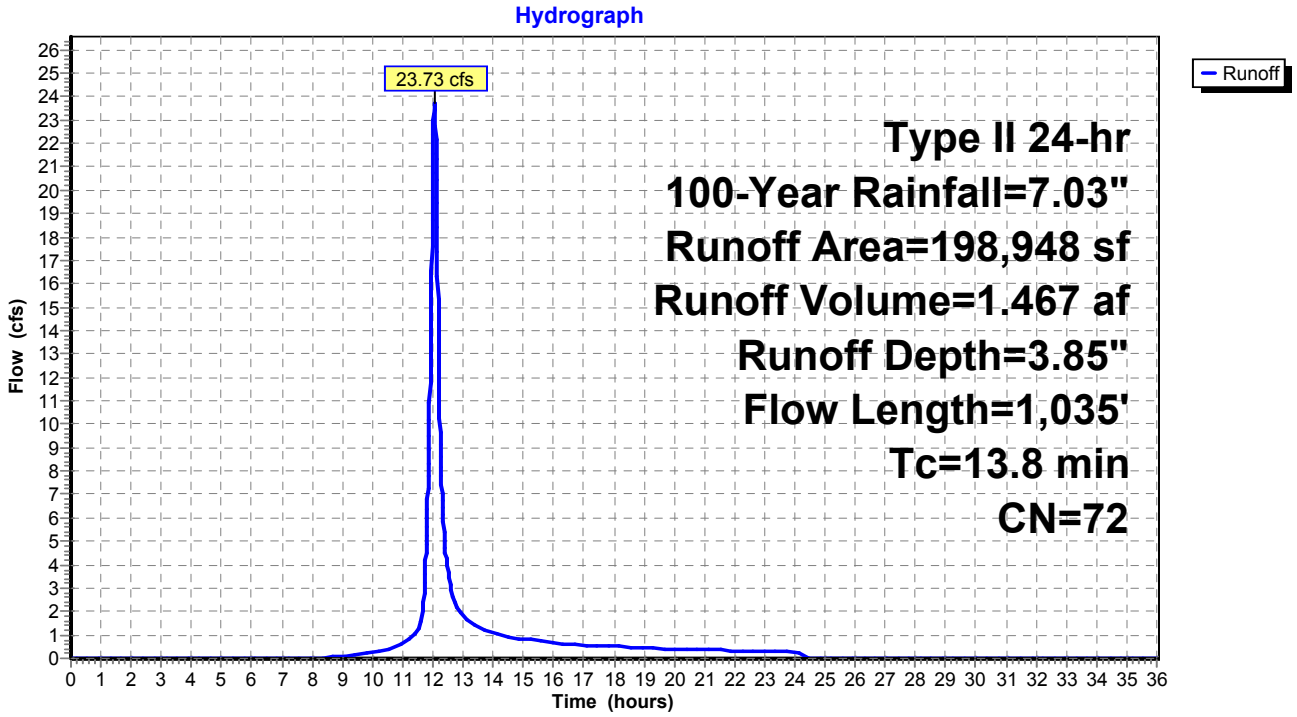
Runoff = 23.73 cfs @ 12.06 hrs, Volume= 1.467 af, Depth= 3.85"

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=7.03"

	Area (sf)	CN	Description
	8,044	98	Paved parking, HSG C
	0	89	Gravel roads, HSG C
*	0	98	Crushed Stone Pad, HSG C
	190,904	71	Meadow, non-grazed, HSG C
	198,948	72	Weighted Average
	190,904		95.96% Pervious Area
	8,044		4.04% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.3	15	0.0200	0.89		**Sheet Flow, Sheet** Smooth surfaces n= 0.011 P2= 2.84"
6.7	85	0.1100	0.21		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 2.84"
6.6	831	0.0900	2.10		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
0.2	104	0.0900	9.48	37.92	**Channel Flow, Existing Roadside Channel** Area= 4.0 sf Perim= 12.5' r= 0.32' n= 0.022 Earth, clean & straight
13.8	1,035	Total			

Subcatchment 10S: OVERALL PRE-DEVELOPMENT DA

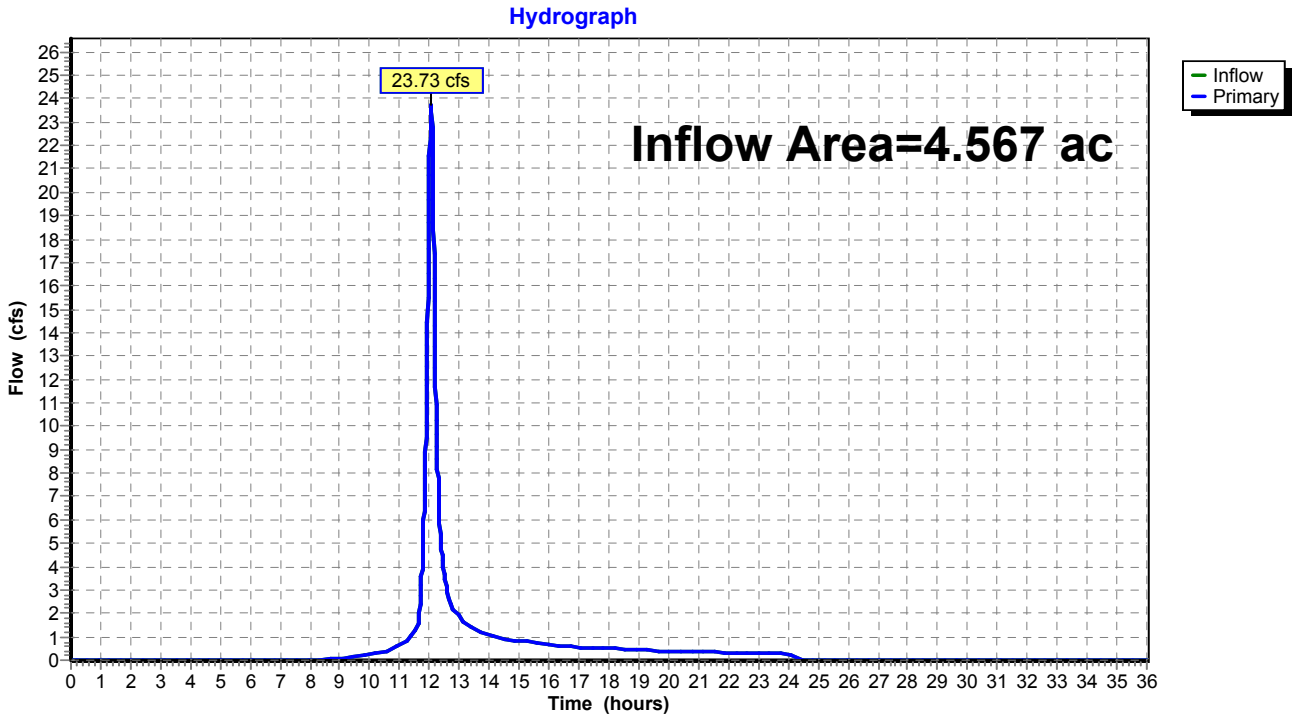


Summary for Link 21L: Existing Conditions

Inflow Area = 4.567 ac, 4.04% Impervious, Inflow Depth = 3.85" for 100-Year event
Inflow = 23.73 cfs @ 12.06 hrs, Volume= 1.467 af
Primary = 23.73 cfs @ 12.06 hrs, Volume= 1.467 af, Atten= 0%, Lag= 0.0 min

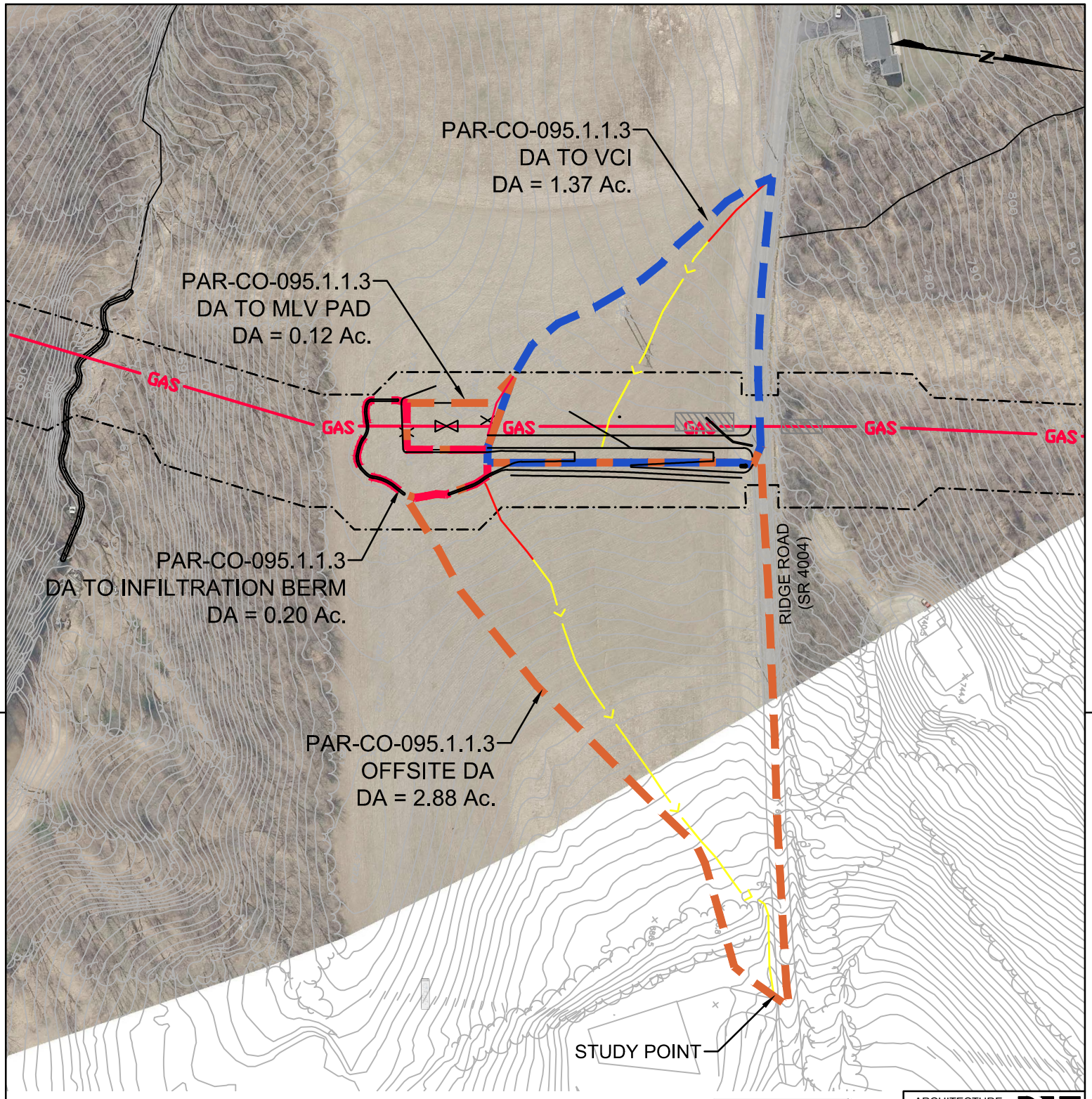
Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Link 21L: Existing Conditions



I-3.4 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

LEGEND

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

0 75 150

SCALE IN FEET

ISSUED FOR PERMITTING

ARCHITECTURE
ENGINEERING
ENVIRONMENTAL
LAND SURVEYING
BL Companies

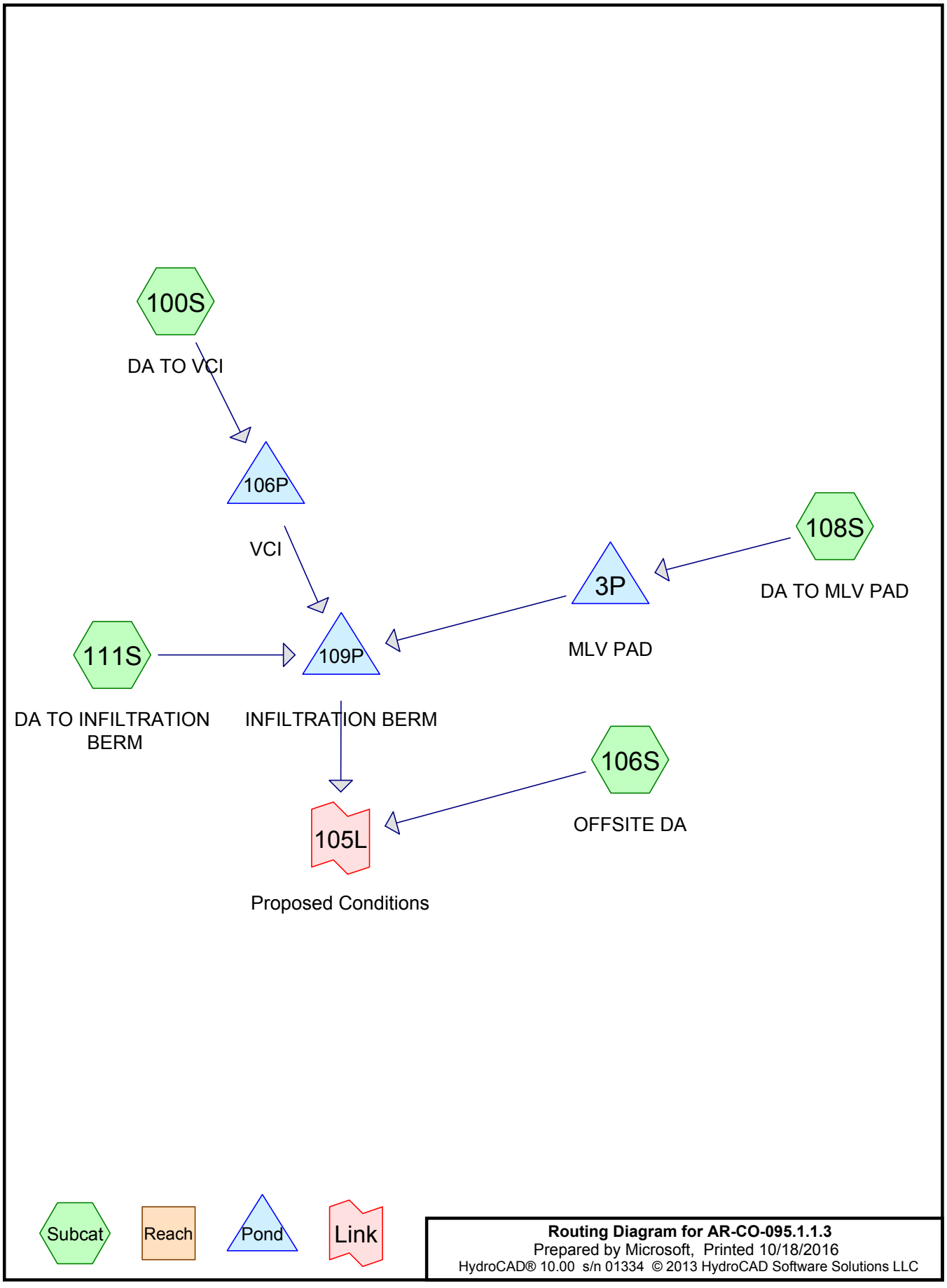
ATLANTIC SUNRISE PROJECT -
CENTRAL PENN LINE SOUTH

PROPOSED 42" NATURAL GAS PIPELINE
ACCESS ROAD DRAINAGE AREA MAP
AR-CO-095.1.1.3 POST
HEMLOCK TOWNSHIP
COLUMBIA COUNTY, PENNSYLVANIA

Williams

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

DRAWN BY: OLC	DATE: 10/26/15	ISSUED FOR BID:	SCALE: 1" = 150'		
CHECKED BY: BJP	DATE: 10/26/15	ISSUED FOR CONSTRUCTION:			
APPROVED BY: BJP	DATE: 10/26/15	DRAWING NUMBER:	AR-CO-095.1.1.3 POST		
WO:					



Routing Diagram for AR-CO-095.1.1.3
Prepared by Microsoft, Printed 10/18/2016
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Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.107	98	Crushed Stone Pad, HSG C (108S)
0.095	89	Gravel roads, HSG C (100S, 108S)
4.134	71	Meadow, non-grazed, HSG C (100S, 106S, 108S, 111S)
0.231	98	Paved Parking, HSG C (100S, 106S)
4.567	**73**	**TOTAL AREA**

Soil Listing (selected nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
4.567	HSG C	100S, 106S, 108S, 111S
0.000	HSG D	
0.000	Other	
4.567		**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

Subcatchment100S: DA TO VCI Runoff Area=59,820 sf 5.87% Impervious Runoff Depth=0.54"
Flow Length=361' Tc=8.9 min CN=74 Runoff=1.09 cfs 0.061 af

Subcatchment106S: OFFSITE DA Runoff Area=125,213 sf 5.23% Impervious Runoff Depth=0.46"
Flow Length=675' Tc=14.4 min CN=72 Runoff=1.47 cfs 0.111 af

Subcatchment108S: DA TO MLV PAD Runoff Area=5,380 sf 86.99% Impervious Runoff Depth=1.84"
Flow Length=240' Tc=10.5 min CN=95 Runoff=0.33 cfs 0.019 af

Subcatchment111S: DA TO INFILTRATION Runoff Area=8,535 sf 0.00% Impervious Runoff Depth=0.43"
Tc=5.0 min CN=71 Runoff=0.14 cfs 0.007 af

Pond 3P: MLV PAD Peak Elev=736.09' Storage=824 cf Inflow=0.33 cfs 0.019 af
Outflow=0.00 cfs 0.000 af

Pond 106P: VCI Peak Elev=736.02' Storage=1,327 cf Inflow=1.09 cfs 0.061 af
Outflow=0.09 cfs 0.031 af

Pond 109P: INFILTRATIONBERM Peak Elev=735.24' Storage=1,651 cf Inflow=0.14 cfs 0.038 af
Outflow=0.00 cfs 0.000 af

Link 105L: Proposed Conditions Inflow=1.47 cfs 0.111 af
Primary=1.47 cfs 0.111 af

Total Runoff Area = 4.567 ac Runoff Volume = 0.198 af Average Runoff Depth = 0.52"
92.59% Pervious = 4.229 ac 7.41% Impervious = 0.338 ac

Summary for Subcatchment 100S: DA TO VCI

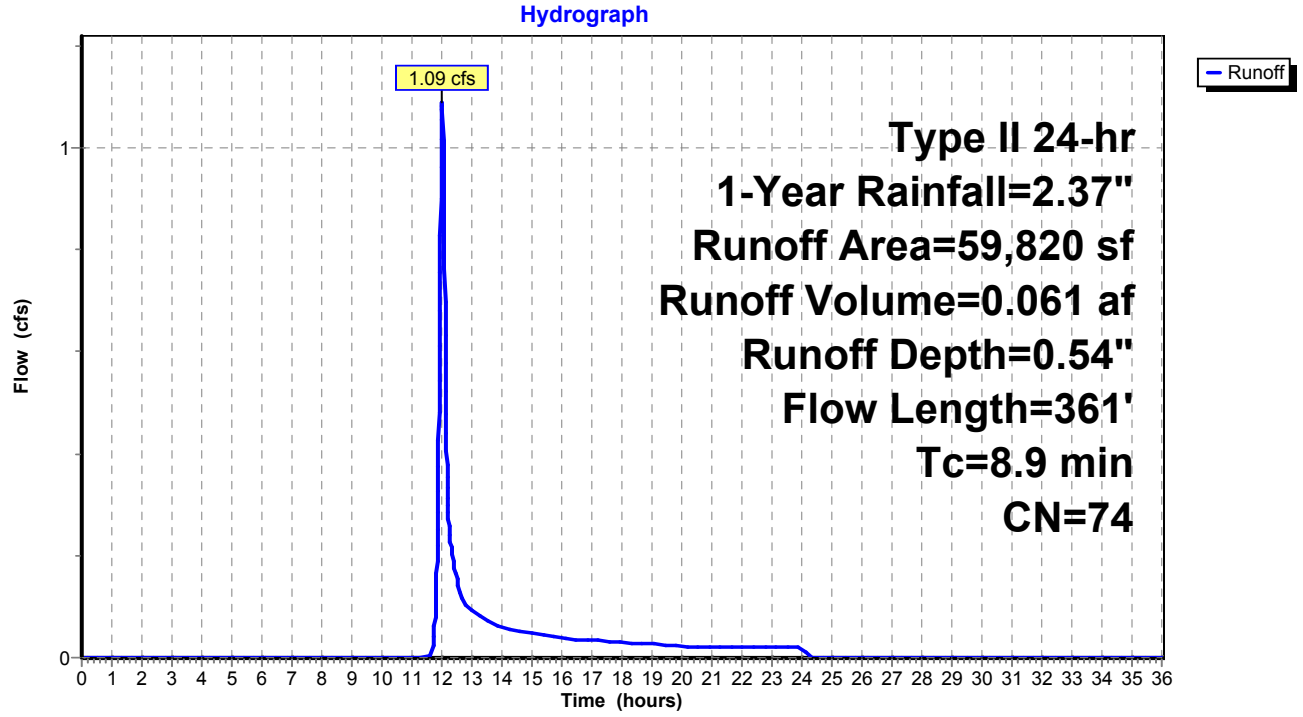
Runoff = 1.09 cfs @ 12.02 hrs, Volume= 0.061 af, Depth= 0.54"

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=2.37"

	Area (sf)	CN	Description
*	3,509	98	Paved Parking, HSG C
	4,122	89	Gravel roads, HSG C
*	0	98	Crushed Stone Pad, HSG C
	52,189	71	Meadow, non-grazed, HSG C
	59,820	74	Weighted Average
	56,311		94.13% Pervious Area
	3,509		5.87% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.3	15	0.0200	0.89		**Sheet Flow, Sheet** Smooth surfaces n= 0.011 P2= 2.84"
6.7	85	0.1100	0.21		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 2.84"
1.9	261	0.1100	2.32		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
8.9	361	Total			

Subcatchment 100S: DA TO VCI



Summary for Subcatchment 106S: OFFSITE DA

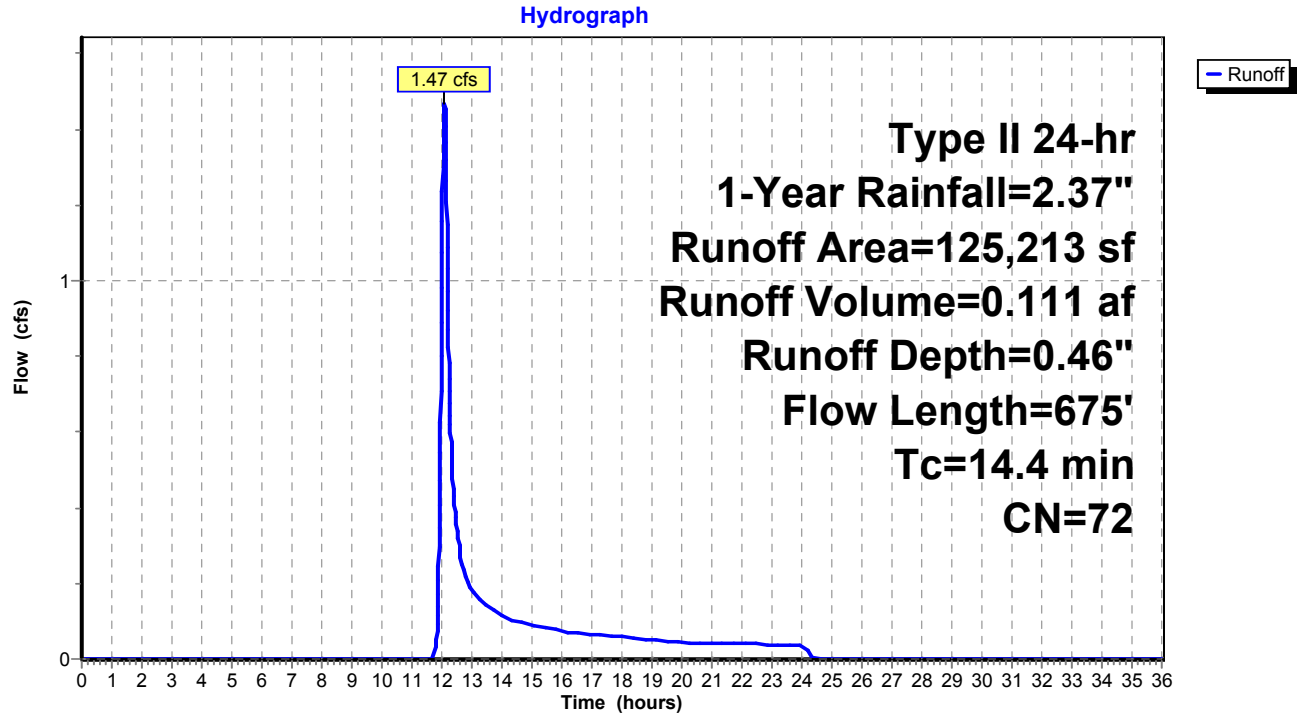
Runoff = 1.47 cfs @ 12.09 hrs, Volume= 0.111 af, Depth= 0.46"

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=2.37"

	Area (sf)	CN	Description
*	6,546	98	Paved Parking, HSG C
	0	89	Gravel roads, HSG C
*	0	98	Crushed Stone Pad, HSG C
	118,667	71	Meadow, non-grazed, HSG C
	125,213	72	Weighted Average
	118,667		94.77% Pervious Area
	6,546		5.23% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.5	100	0.0500	0.16		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 2.84"
3.7	471	0.0900	2.10		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
0.2	104	0.0900	9.48	37.92	**Channel Flow, Existing Roadside Channel** Area= 4.0 sf Perim= 12.5' r= 0.32' n= 0.022 Earth, clean & straight
14.4	675	Total			

Subcatchment 106S: OFFSITE DA



Summary for Subcatchment 108S: DA TO MLV PAD

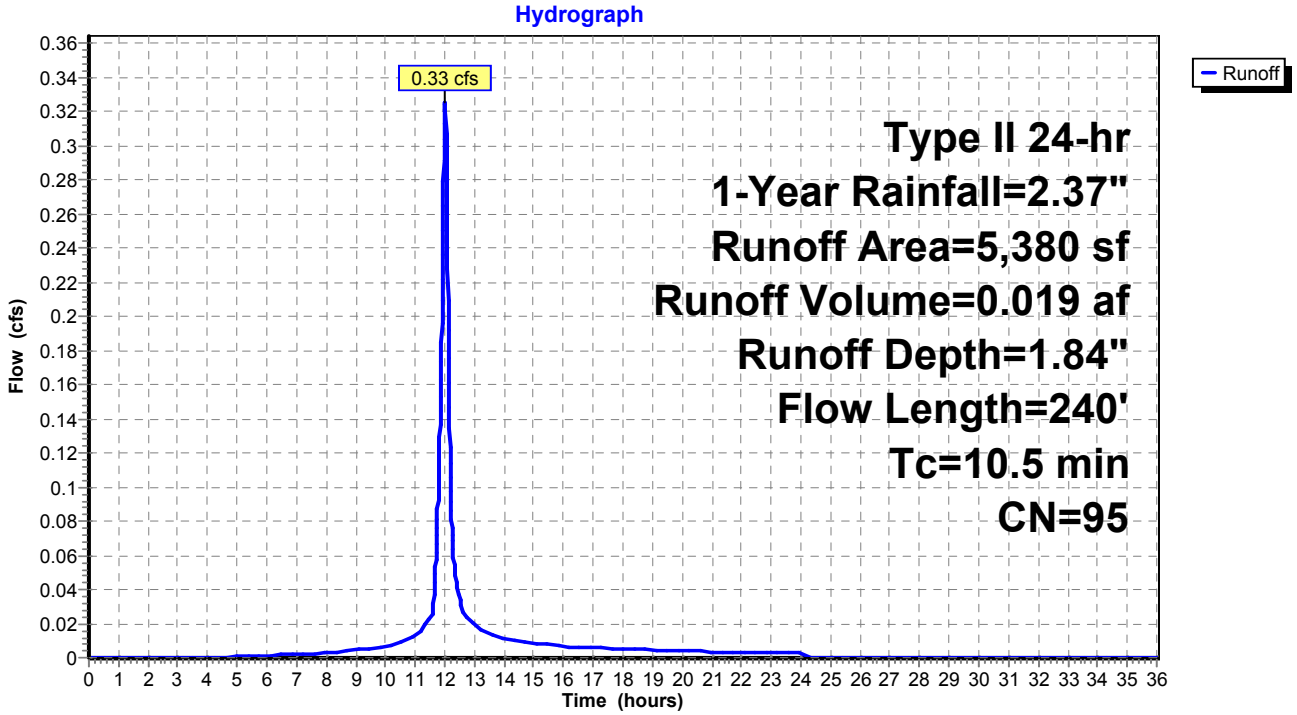
Runoff = 0.33 cfs @ 12.02 hrs, Volume= 0.019 af, Depth= 1.84"

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=2.37"

	Area (sf)	CN	Description
*	0	98	Paved Parking, HSG C
	32	89	Gravel roads, HSG C
*	4,680	98	Crushed Stone Pad, HSG C
	668	71	Meadow, non-grazed, HSG C
	5,380	95	Weighted Average
	700		13.01% Pervious Area
	4,680		86.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.9	100	0.0750	0.19		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 2.84"
1.6	140	0.0430	1.45		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
10.5	240	Total			

Subcatchment 108S: DA TO MLV PAD



Summary for Subcatchment 111S: DA TO INFILTRATION BERM

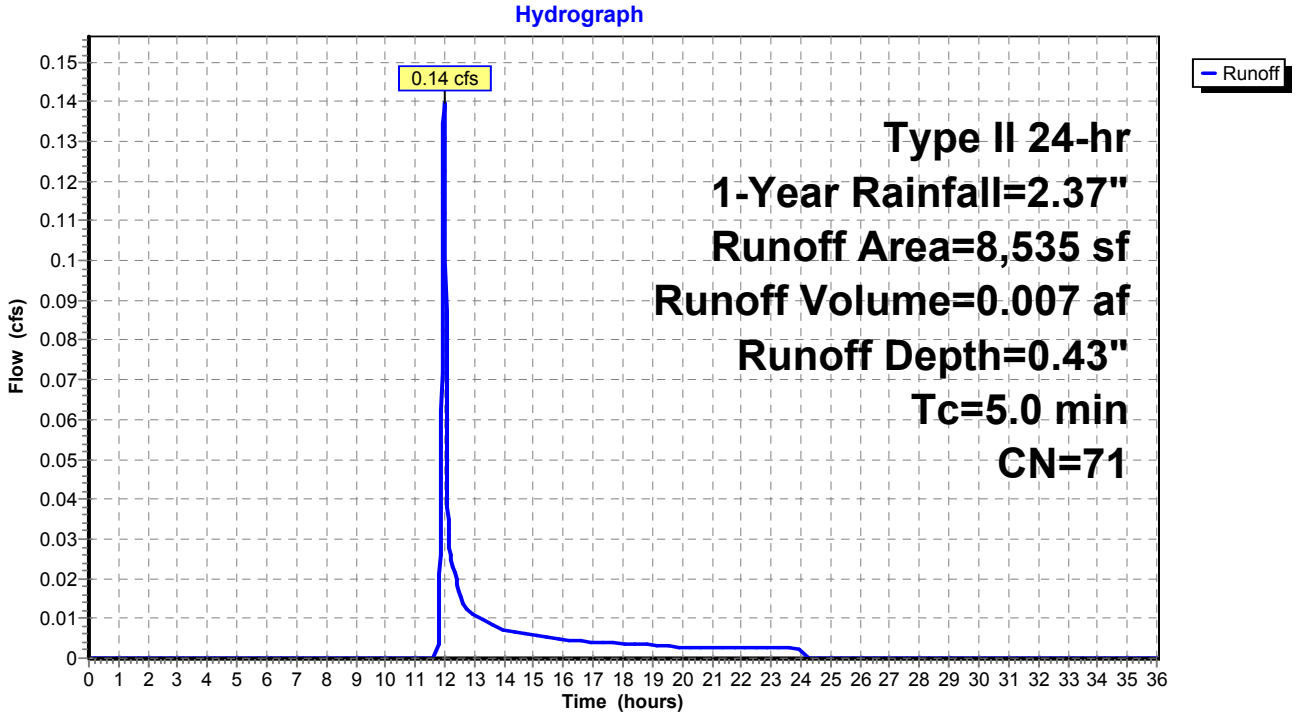
Runoff = 0.14 cfs @ 11.98 hrs, Volume= 0.007 af, Depth= 0.43"

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=2.37"

	Area (sf)	CN	Description
*	0	98	Paved Parking, HSG C
	0	89	Gravel roads, HSG C
*	0	98	Crushed Stone Pad, HSG C
	8,535	71	Meadow, non-grazed, HSG C
	8,535	71	Weighted Average
	8,535		100.00% Pervious Area

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

Subcatchment 111S: DA TO INFILTRATION BERM



Summary for Pond 3P: MLV PAD

Inflow Area = 0.124 ac, 86.99% Impervious, Inflow Depth = 1.84" for 1-Year event
Inflow = 0.33 cfs @ 12.02 hrs, Volume= 0.019 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 / 4
Peak Elev= 736.09' @ 24.60 hrs Surf.Area= 0 sf Storage= 824 cf

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

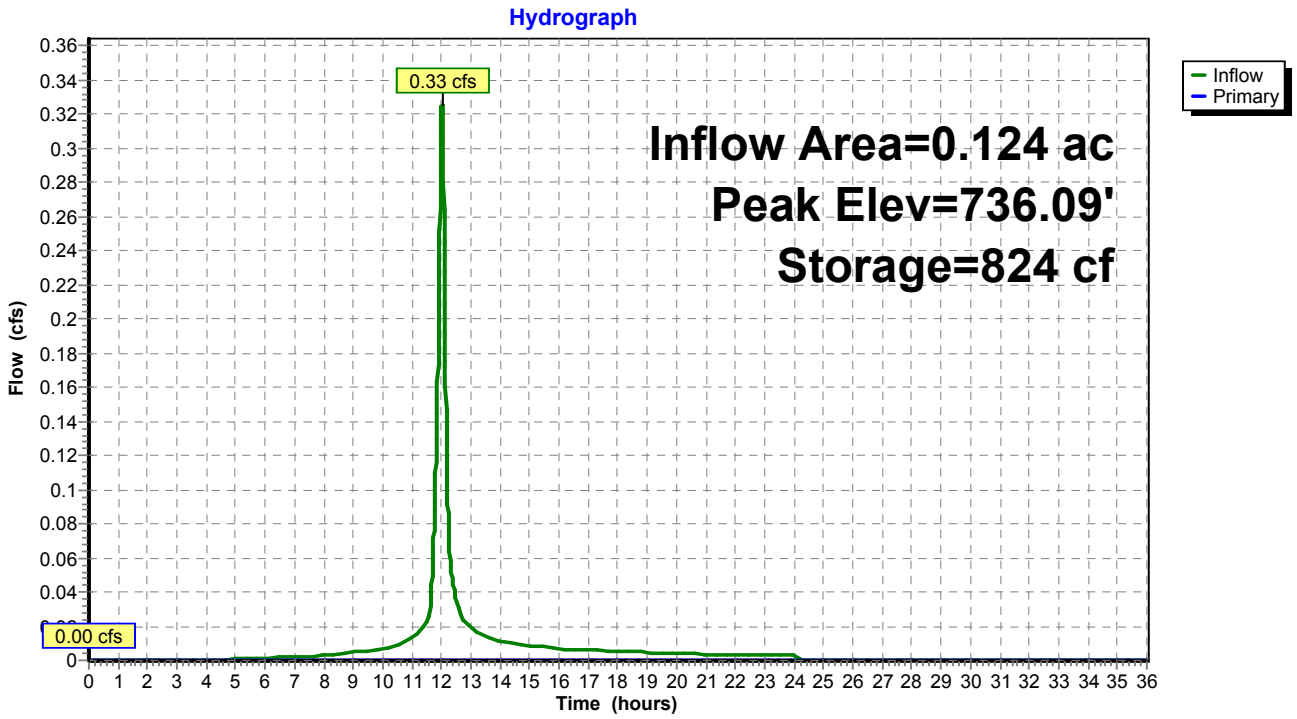
Volume	Invert	Avail.Storage	Storage Description
#1	735.50'	1,386 cf	**Stone Pad Void Storage** Listed below 3,464 cf Overall x 40.0% Voids

Elevation (feet)	Cum.Store (cubic-feet)
735.50	0
736.00	1,732
736.50	3,463
737.00	3,464

Device	Routing	Invert	Outlet Devices
#1	Primary	736.50'	**90.0' long x 3.0' breadth Broad-Crested 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=735.50' (Free Discharge)
↑—**1=Broad-Crested Weir** (Controls 0.00 cfs)

Pond 3P: MLV PAD



Summary for Pond 106P: VCI

Inflow Area = 1.373 ac, 5.87% Impervious, Inflow Depth = 0.54" for 1-Year event
Inflow = 1.09 cfs @ 12.02 hrs, Volume= 0.061 af
Outflow = 0.09 cfs @ 13.04 hrs, Volume= 0.031 af, Atten= 92%, Lag= 61.2 min
Primary = 0.09 cfs @ 13.04 hrs, Volume= 0.031 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 8
Peak Elev= 736.02' @ 13.04 hrs Surf.Area= 0 sf Storage= 1,327 cf

Plug-Flow detention time= 302.1 min calculated for 0.031 af (50% of inflow)
Center-of-Mass det. time= 150.4 min (1,034.0 - 883.6)

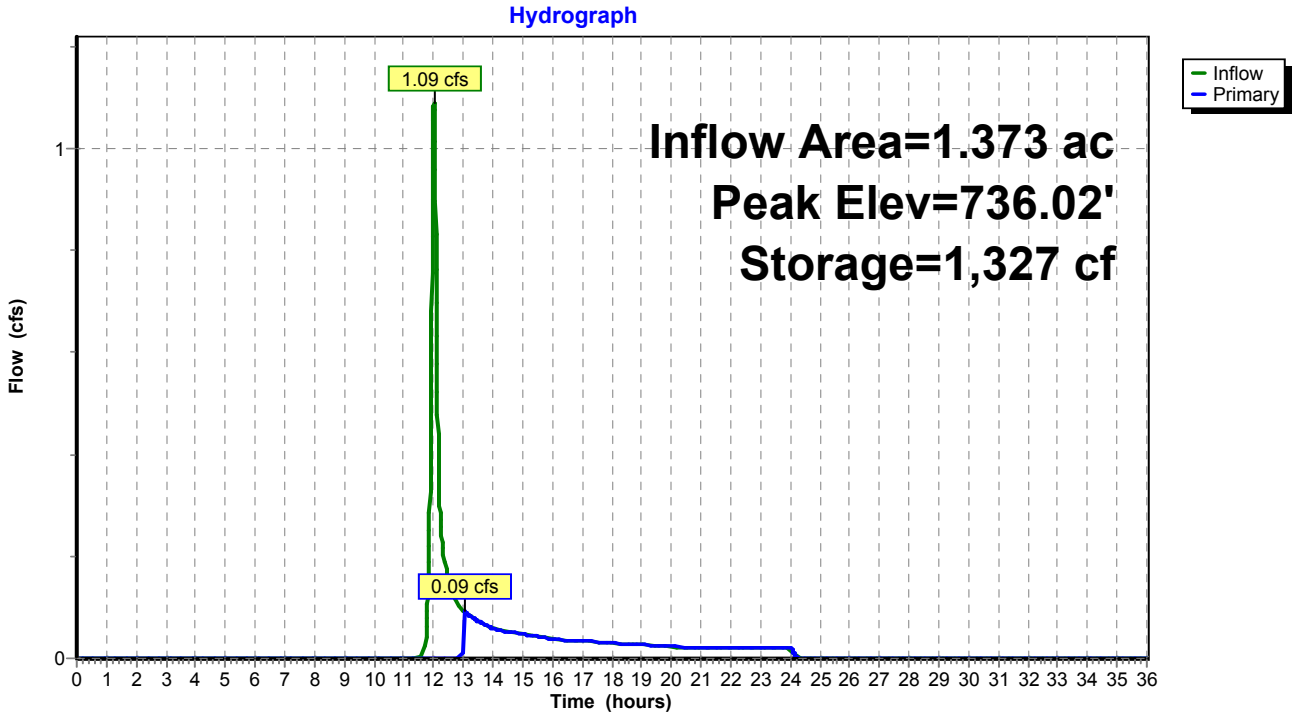
Volume	Invert	Avail.Storage	Storage Description
#1	735.00'	1,328 cf	**Custom Stage Data**Listed below

Elevation (feet)	Cum.Store (cubic-feet)
735.00	0
735.50	664
736.00	1,327
736.50	1,328

Device	Routing	Invert	Outlet Devices
#1	Primary	736.00'	**16.0' long x 2.0' 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 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Primary OutFlow Max=0.09 cfs @ 13.04 hrs HW=736.02' (Free Discharge)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 0.09 cfs @ 0.33 fps)

Pond 106P: VCI



Summary for Pond 109P: INFILTRATION BERM

Inflow Area = 1.693 ac, 11.11% Impervious, Inflow Depth = 0.27" for 1-Year event
Inflow = 0.14 cfs @ 11.98 hrs, Volume= 0.038 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= 735.24' @ 24.52 hrs Surf.Area= 7,049 sf Storage= 1,651 cf

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

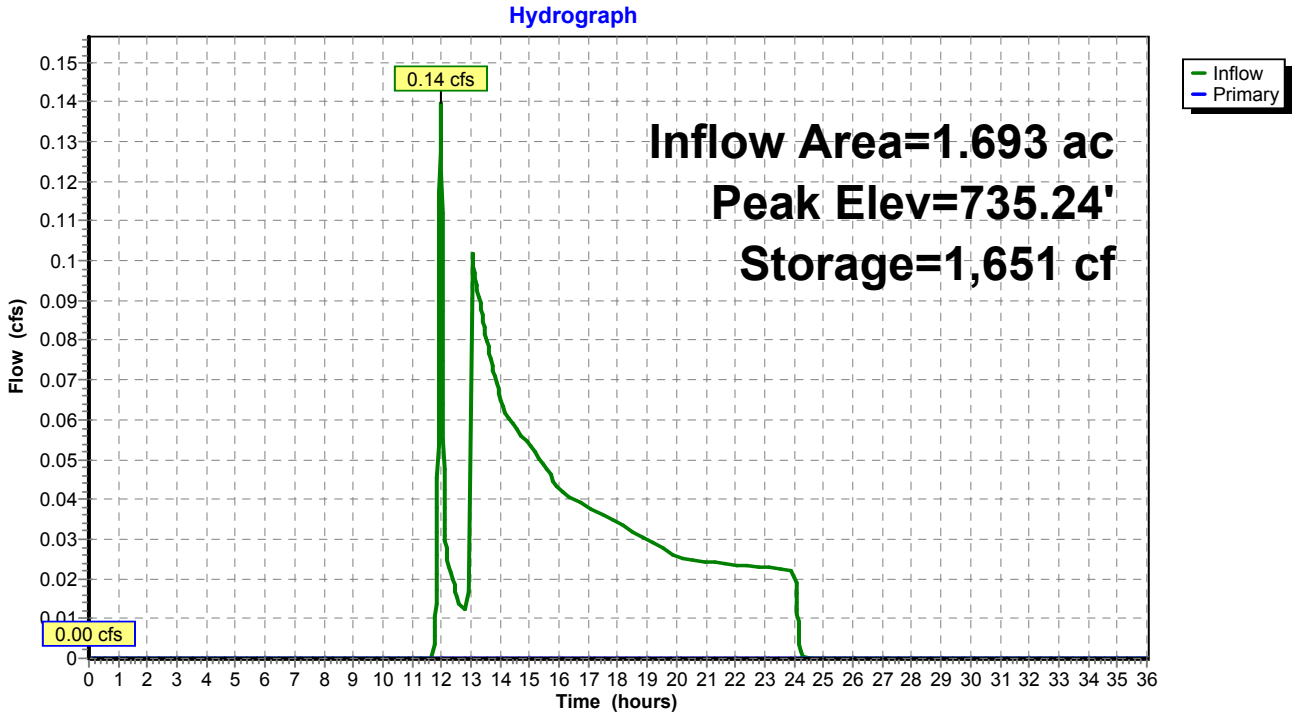
Volume	Invert	Avail.Storage	Storage Description
#1	735.00'	9,735 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
735.00	6,611	465.0	0	0	6,611
736.00	8,513	518.7	7,542	7,542	10,843
736.25	9,035	525.0	2,193	9,735	11,383

Device	Routing	Invert	Outlet Devices
#1	Primary	736.00'	**50.0' long x 2.0' 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 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=735.00' (Free Discharge)
↑**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 109P: INFILTRATION BERM

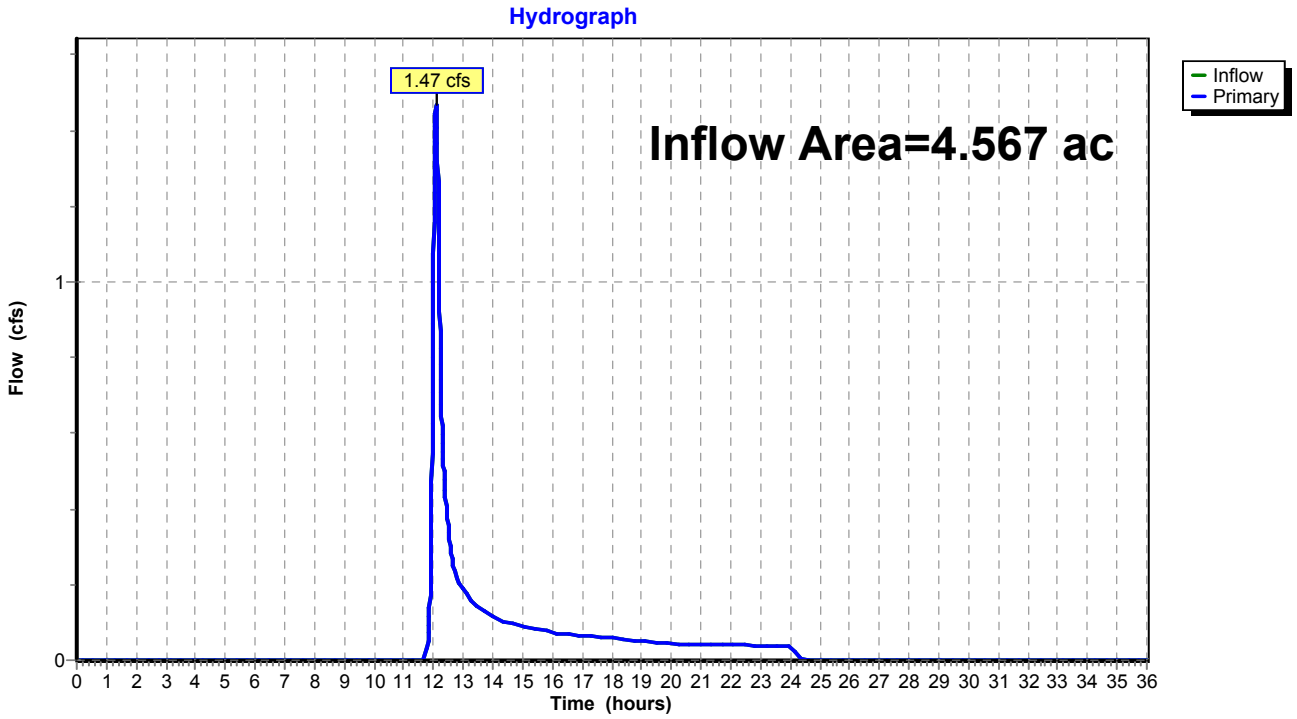


Summary for Link 105L: Proposed Conditions

Inflow Area = 4.567 ac, 7.41% Impervious, Inflow Depth = 0.29" for 1-Year event
Inflow = 1.47 cfs @ 12.09 hrs, Volume= 0.111 af
Primary = 1.47 cfs @ 12.09 hrs, Volume= 0.111 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Link 105L: Proposed Conditions



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

Subcatchment100S: DA TO VCI Runoff Area=59,820 sf 5.87% Impervious Runoff Depth=0.81"
Flow Length=361' Tc=8.9 min CN=74 Runoff=1.72 cfs 0.093 af

Subcatchment106S: OFFSITE DA Runoff Area=125,213 sf 5.23% Impervious Runoff Depth=0.71"
Flow Length=675' Tc=14.4 min CN=72 Runoff=2.48 cfs 0.171 af

Subcatchment108S: DA TO MLV PAD Runoff Area=5,380 sf 86.99% Impervious Runoff Depth=2.29"
Flow Length=240' Tc=10.5 min CN=95 Runoff=0.40 cfs 0.024 af

Subcatchment111S: DA TO INFILTRATION Runoff Area=8,535 sf 0.00% Impervious Runoff Depth=0.67"
Tc=5.0 min CN=71 Runoff=0.23 cfs 0.011 af

Pond 3P: MLV PAD Peak Elev=736.24' Storage=1,028 cf Inflow=0.40 cfs 0.024 af
Outflow=0.00 cfs 0.000 af

Pond 106P: VCI Peak Elev=736.08' Storage=1,327 cf Inflow=1.72 cfs 0.093 af
Outflow=0.91 cfs 0.062 af

Pond 109P: INFILTRATIONBERM Peak Elev=735.45' Storage=3,178 cf Inflow=0.96 cfs 0.073 af
Outflow=0.00 cfs 0.000 af

Link 105L: Proposed Conditions Inflow=2.48 cfs 0.171 af
Primary=2.48 cfs 0.171 af

Total Runoff Area = 4.567 ac Runoff Volume = 0.298 af Average Runoff Depth = 0.78"
92.59% Pervious = 4.229 ac 7.41% Impervious = 0.338 ac

Summary for Subcatchment 100S: DA TO VCI

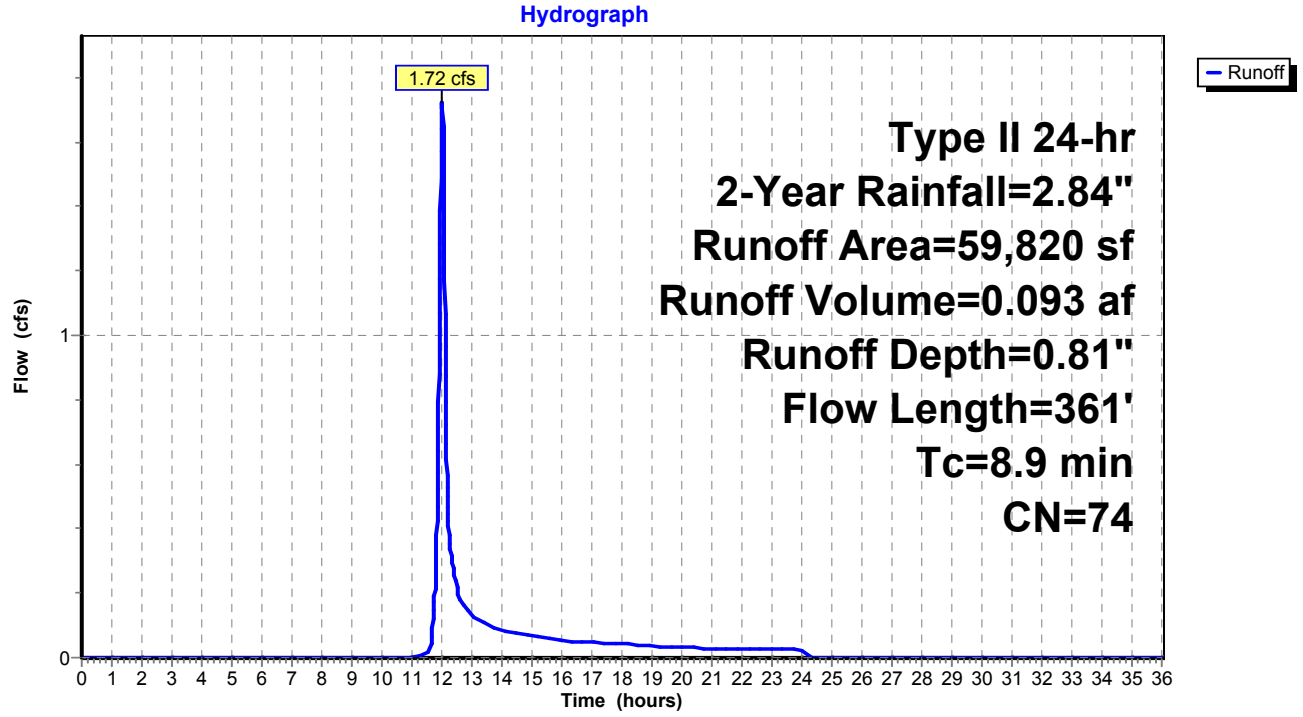
Runoff = 1.72 cfs @ 12.02 hrs, Volume= 0.093 af, Depth= 0.81"

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=2.84"

	Area (sf)	CN	Description
*	3,509	98	Paved Parking, HSG C
	4,122	89	Gravel roads, HSG C
*	0	98	Crushed Stone Pad, HSG C
	52,189	71	Meadow, non-grazed, HSG C
	59,820	74	Weighted Average
	56,311		94.13% Pervious Area
	3,509		5.87% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.3	15	0.0200	0.89		**Sheet Flow, Sheet** Smooth surfaces n= 0.011 P2= 2.84"
6.7	85	0.1100	0.21		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 2.84"
1.9	261	0.1100	2.32		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
8.9	361	Total			

Subcatchment 100S: DA TO VCI



Summary for Subcatchment 106S: OFFSITE DA

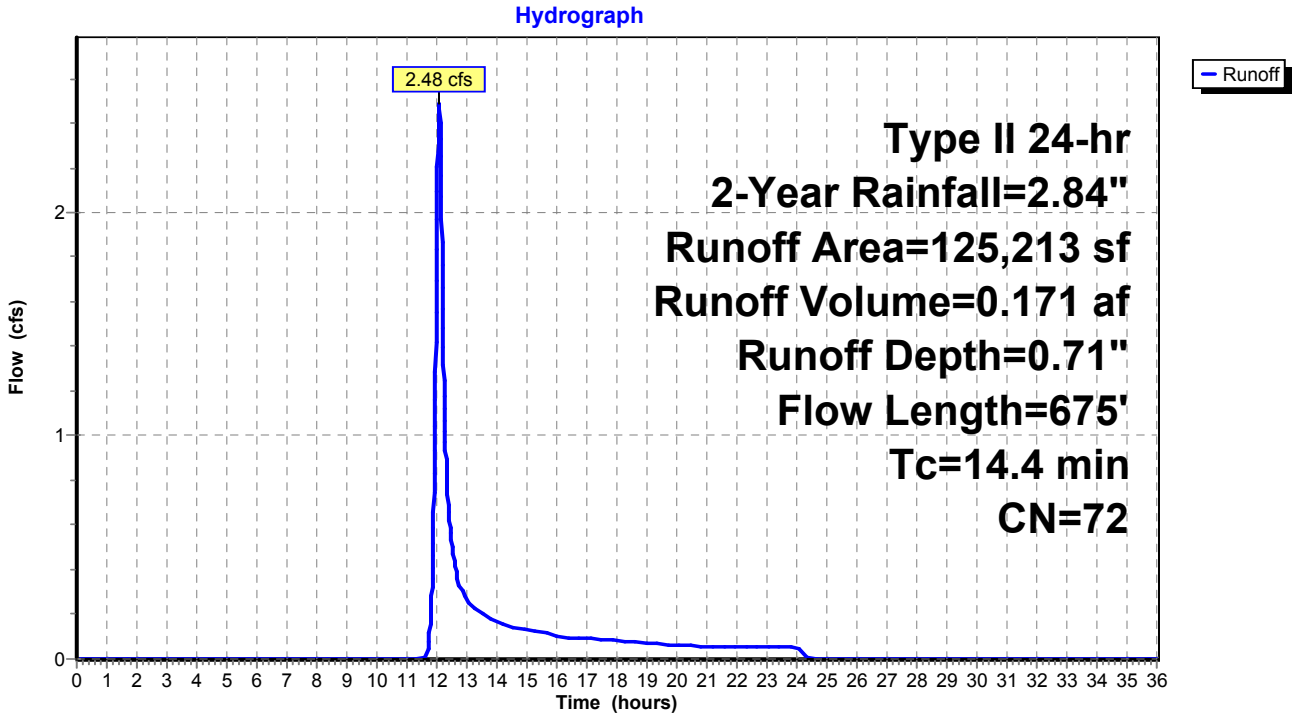
Runoff = 2.48 cfs @ 12.08 hrs, Volume= 0.171 af, Depth= 0.71"

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 2-Year Rainfall=2.84"

	Area (sf)	CN	Description
*	6,546	98	Paved Parking, HSG C
	0	89	Gravel roads, HSG C
*	0	98	Crushed Stone Pad, HSG C
	118,667	71	Meadow, non-grazed, HSG C
	125,213	72	Weighted Average
	118,667		94.77% Pervious Area
	6,546		5.23% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.5	100	0.0500	0.16		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 2.84"
3.7	471	0.0900	2.10		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
0.2	104	0.0900	9.48	37.92	**Channel Flow, Existing Roadside Channel** Area= 4.0 sf Perim= 12.5' r= 0.32' n= 0.022 Earth, clean & straight
14.4	675	Total			

Subcatchment 106S: OFFSITE DA



Summary for Subcatchment 108S: DA TO MLV PAD

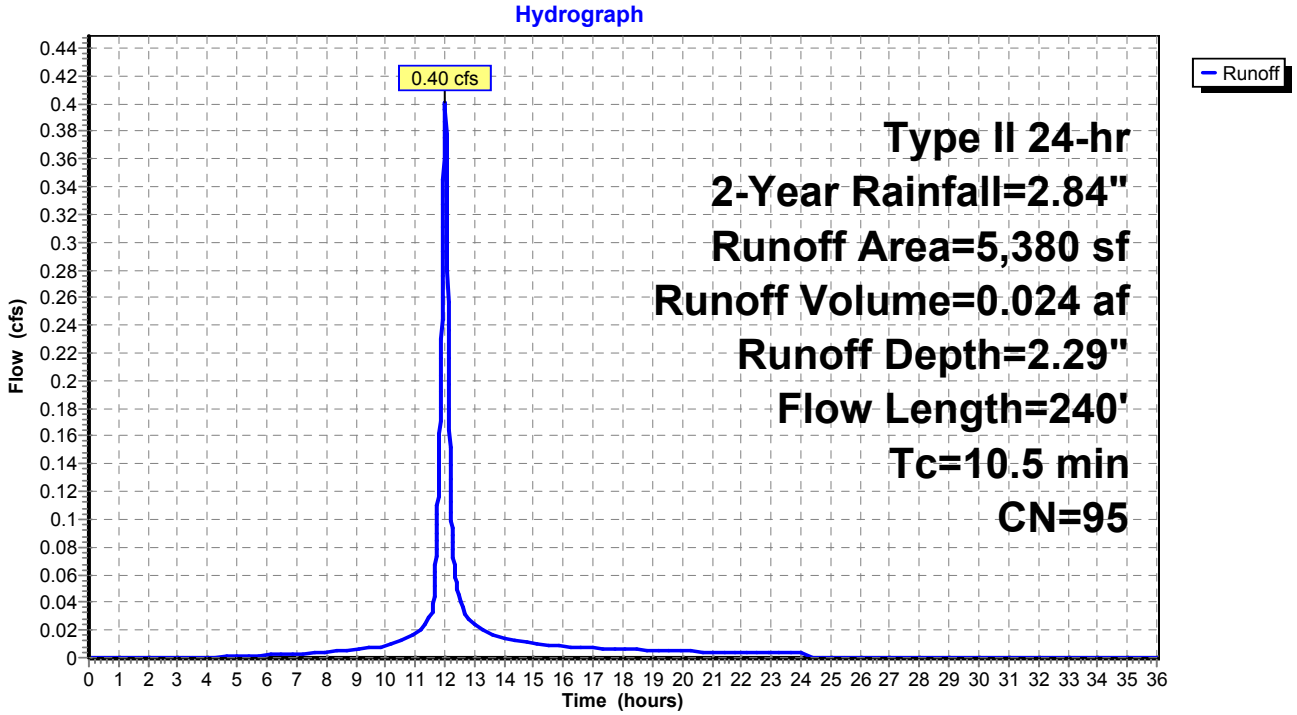
Runoff = 0.40 cfs @ 12.02 hrs, Volume= 0.024 af, Depth= 2.29"

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 2-Year Rainfall=2.84"

	Area (sf)	CN	Description
*	0	98	Paved Parking, HSG C
	32	89	Gravel roads, HSG C
*	4,680	98	Crushed Stone Pad, HSG C
	668	71	Meadow, non-grazed, HSG C
	5,380	95	Weighted Average
	700		13.01% Pervious Area
	4,680		86.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.9	100	0.0750	0.19		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 2.84"
1.6	140	0.0430	1.45		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
10.5	240	Total			

Subcatchment 108S: DA TO MLV PAD



Summary for Subcatchment 111S: DA TO INFILTRATION BERM

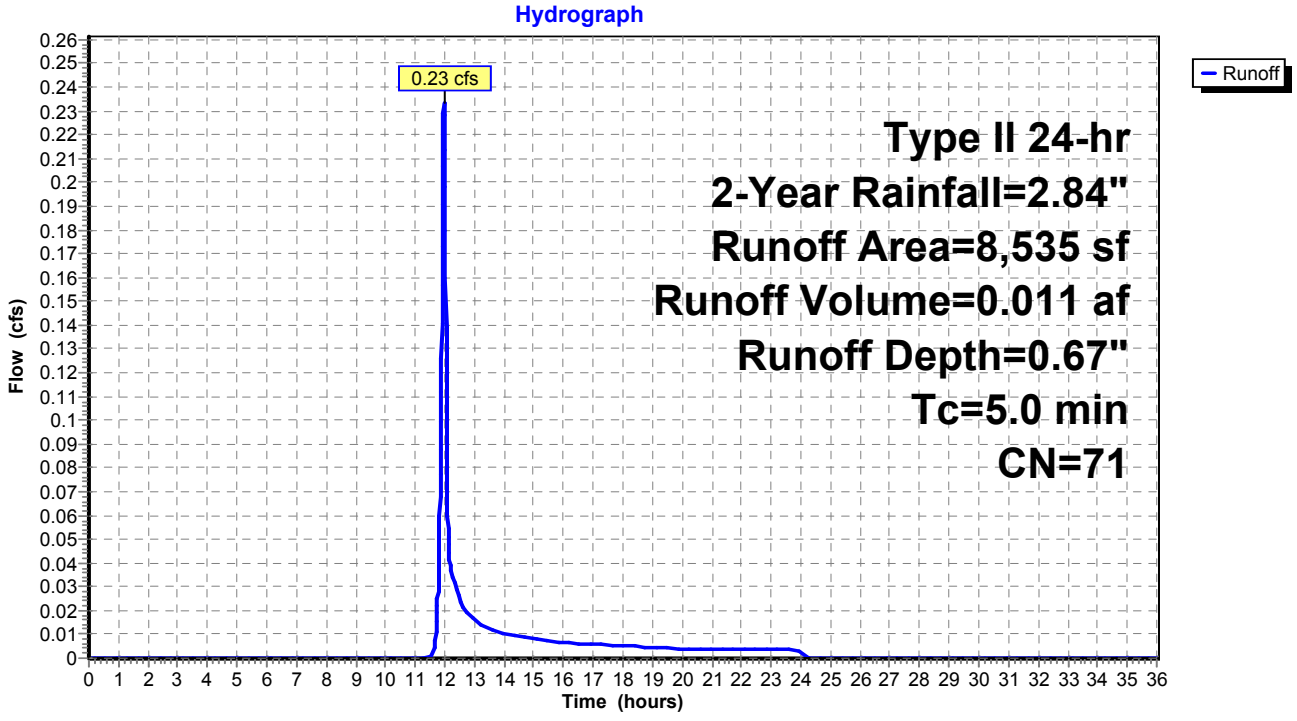
Runoff = 0.23 cfs @ 11.97 hrs, Volume= 0.011 af, Depth= 0.67"

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=2.84"

	Area (sf)	CN	Description
*	0	98	Paved Parking, HSG C
	0	89	Gravel roads, HSG C
*	0	98	Crushed Stone Pad, HSG C
	8,535	71	Meadow, non-grazed, HSG C
	8,535	71	Weighted Average
	8,535		100.00% Pervious Area

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

Subcatchment 111S: DA TO INFILTRATION BERM



Summary for Pond 3P: MLV PAD

Inflow Area = 0.124 ac, 86.99% Impervious, Inflow Depth = 2.29" for 2-Year event
Inflow = 0.40 cfs @ 12.02 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 / 4
Peak Elev= 736.24' @ 24.60 hrs Surf.Area= 0 sf Storage= 1,028 cf

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

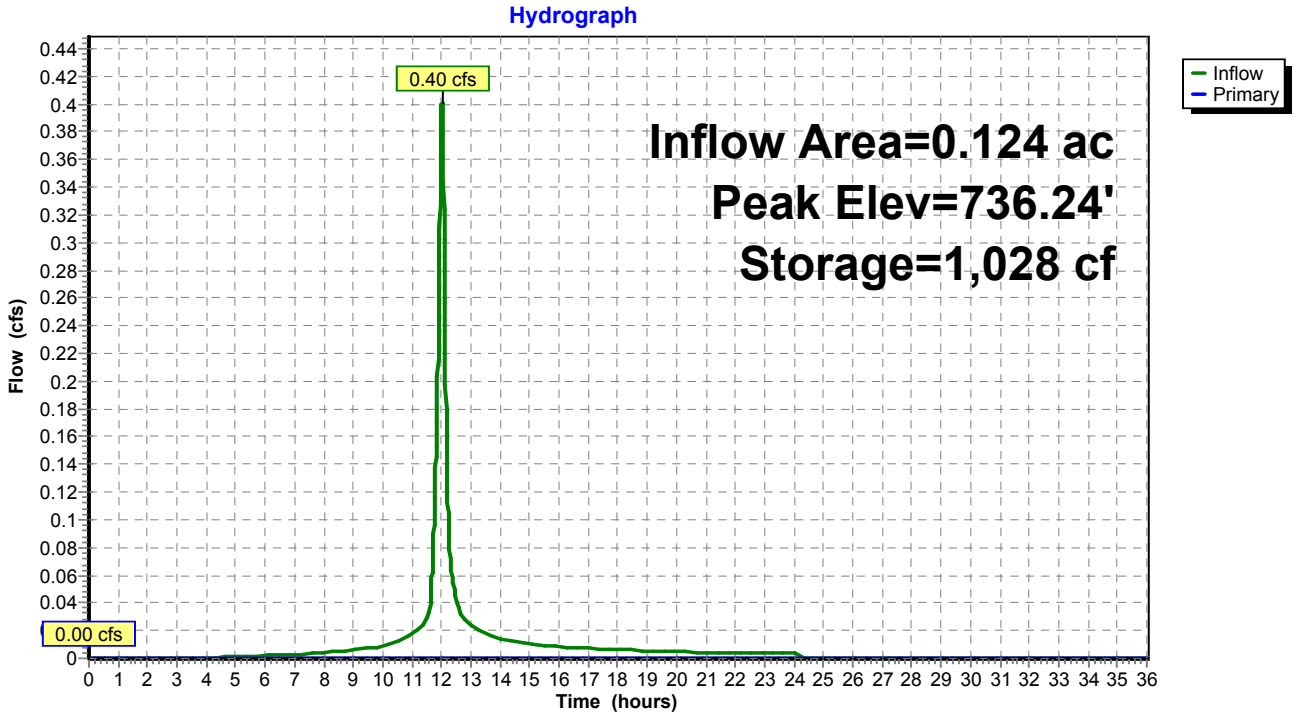
Volume	Invert	Avail.Storage	Storage Description
#1	735.50'	1,386 cf	**Stone Pad Void Storage** Listed below 3,464 cf Overall x 40.0% Voids

Elevation (feet)	Cum.Store (cubic-feet)
735.50	0
736.00	1,732
736.50	3,463
737.00	3,464

Device	Routing	Invert	Outlet Devices
#1	Primary	736.50'	**90.0' long x 3.0' breadth Broad-Crested 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=735.50' (Free Discharge)
↑—**1=Broad-Crested Weir** (Controls 0.00 cfs)

Pond 3P: MLV PAD



Summary for Pond 106P: VCI

Inflow Area = 1.373 ac, 5.87% Impervious, Inflow Depth = 0.81" for 2-Year event
Inflow = 1.72 cfs @ 12.02 hrs, Volume= 0.093 af
Outflow = 0.91 cfs @ 12.12 hrs, Volume= 0.062 af, Atten= 47%, Lag= 6.6 min
Primary = 0.91 cfs @ 12.12 hrs, Volume= 0.062 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 8
Peak Elev= 736.08' @ 12.12 hrs Surf.Area= 0 sf Storage= 1,327 cf

Plug-Flow detention time= 195.5 min calculated for 0.062 af (67% of inflow)
Center-of-Mass det. time= 74.4 min (943.9 - 869.4)

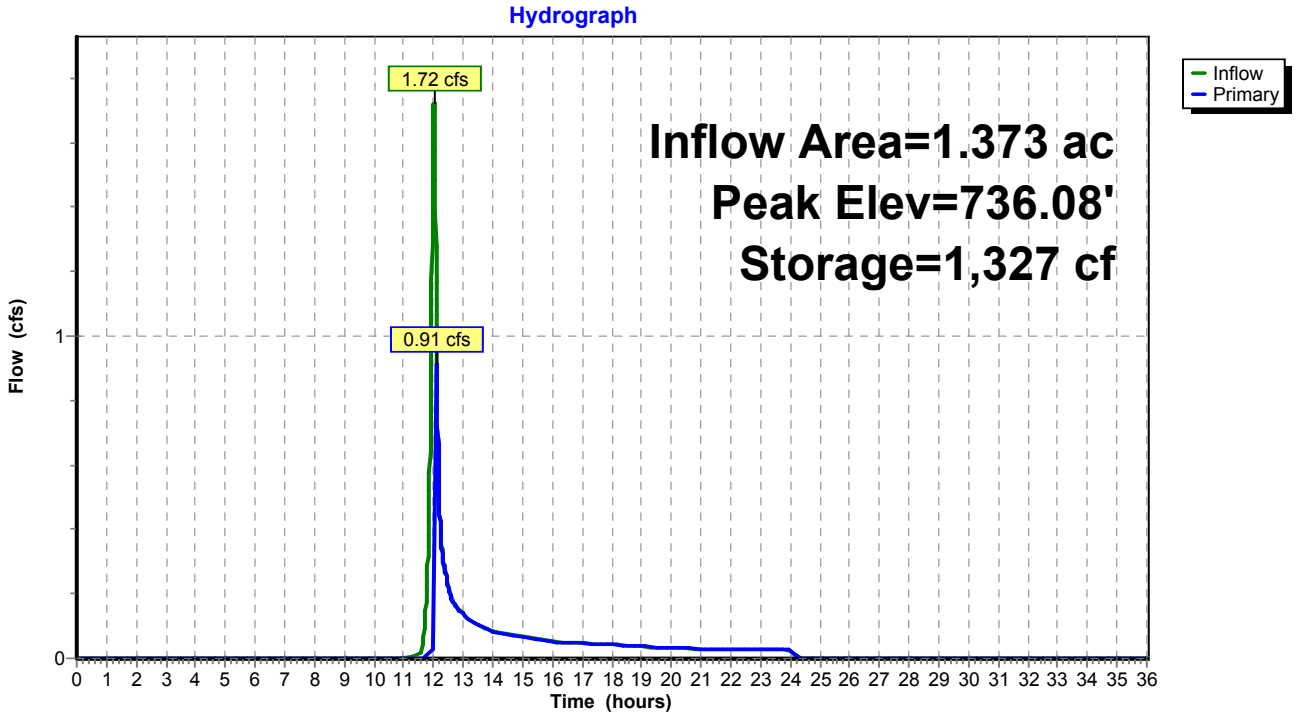
Volume	Invert	Avail.Storage	Storage Description
#1	735.00'	1,328 cf	**Custom Stage Data**Listed below

Elevation (feet)	Cum.Store (cubic-feet)
735.00	0
735.50	664
736.00	1,327
736.50	1,328

Device	Routing	Invert	Outlet Devices
#1	Primary	736.00'	**16.0' long x 2.0' 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 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Primary OutFlow Max=0.80 cfs @ 12.12 hrs HW=736.07' (Free Discharge)
↑**1=Broad-Crested Rectangular Weir** (Weir Controls 0.80 cfs @ 0.69 fps)

Pond 106P: VCI



Summary for Pond 109P: INFILTRATION BERM

Inflow Area = 1.693 ac, 11.11% Impervious, Inflow Depth = 0.52" for 2-Year event
Inflow = 0.96 cfs @ 12.12 hrs, Volume= 0.073 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= 735.45' @ 24.52 hrs Surf.Area= 7,442 sf Storage= 3,178 cf

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

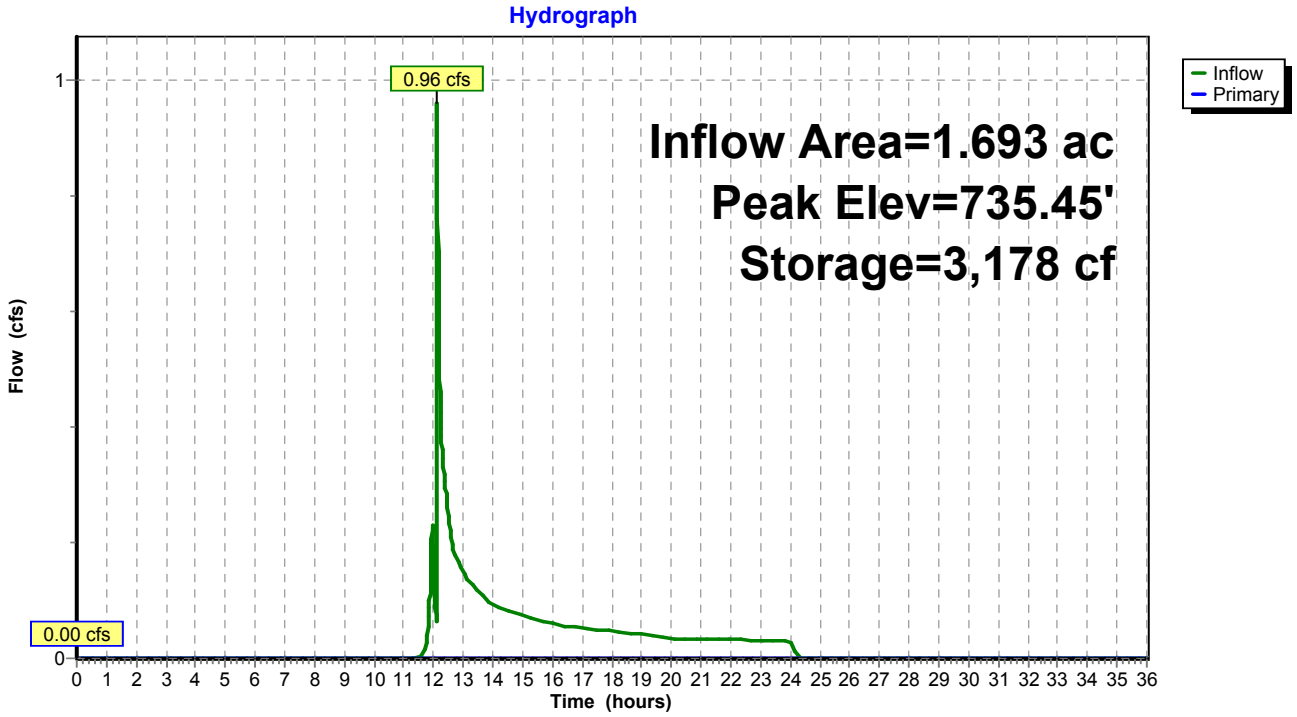
Volume	Invert	Avail.Storage	Storage Description
#1	735.00'	9,735 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
735.00	6,611	465.0	0	0	6,611
736.00	8,513	518.7	7,542	7,542	10,843
736.25	9,035	525.0	2,193	9,735	11,383

Device	Routing	Invert	Outlet Devices
#1	Primary	736.00'	**50.0' long x 2.0' 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 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=735.00' (Free Discharge)
↑**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 109P: INFILTRATION BERM

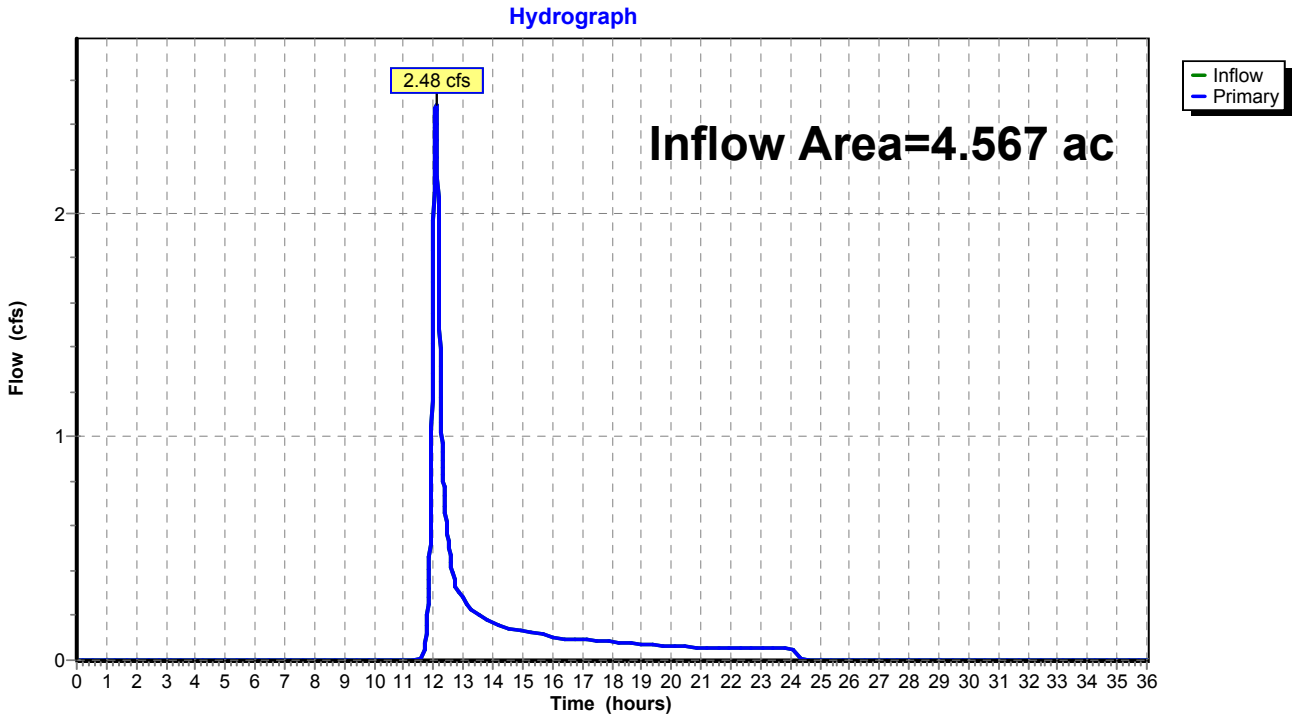


Summary for Link 105L: Proposed Conditions

Inflow Area = 4.567 ac, 7.41% Impervious, Inflow Depth = 0.45" for 2-Year event
Inflow = 2.48 cfs @ 12.08 hrs, Volume= 0.171 af
Primary = 2.48 cfs @ 12.08 hrs, Volume= 0.171 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Link 105L: Proposed Conditions



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

Subcatchment100S: DA TO VCI Runoff Area=59,820 sf 5.87% Impervious Runoff Depth=1.26"
Flow Length=361' Tc=8.9 min CN=74 Runoff=2.75 cfs 0.144 af

Subcatchment106S: OFFSITE DA Runoff Area=125,213 sf 5.23% Impervious Runoff Depth=1.14"
Flow Length=675' Tc=14.4 min CN=72 Runoff=4.18 cfs 0.273 af

Subcatchment108S: DA TO MLV PAD Runoff Area=5,380 sf 86.99% Impervious Runoff Depth=2.97"
Flow Length=240' Tc=10.5 min CN=95 Runoff=0.51 cfs 0.031 af

Subcatchment111S: DA TO INFILTRATION Runoff Area=8,535 sf 0.00% Impervious Runoff Depth=1.08"
Tc=5.0 min CN=71 Runoff=0.39 cfs 0.018 af

Pond 3P: MLV PAD Peak Elev=736.46' Storage=1,331 cf Inflow=0.51 cfs 0.031 af
Outflow=0.00 cfs 0.000 af

Pond 106P: VCI Peak Elev=736.21' Storage=1,327 cf Inflow=2.75 cfs 0.144 af
Outflow=3.58 cfs 0.114 af

Pond 109P: INFILTRATIONBERM Peak Elev=735.78' Storage=5,730 cf Inflow=3.92 cfs 0.132 af
Outflow=0.00 cfs 0.000 af

Link 105L: Proposed Conditions Inflow=4.18 cfs 0.273 af
Primary=4.18 cfs 0.273 af

Total Runoff Area = 4.567 ac Runoff Volume = 0.466 af Average Runoff Depth = 1.22"
92.59% Pervious = 4.229 ac 7.41% Impervious = 0.338 ac

Summary for Subcatchment 100S: DA TO VCI

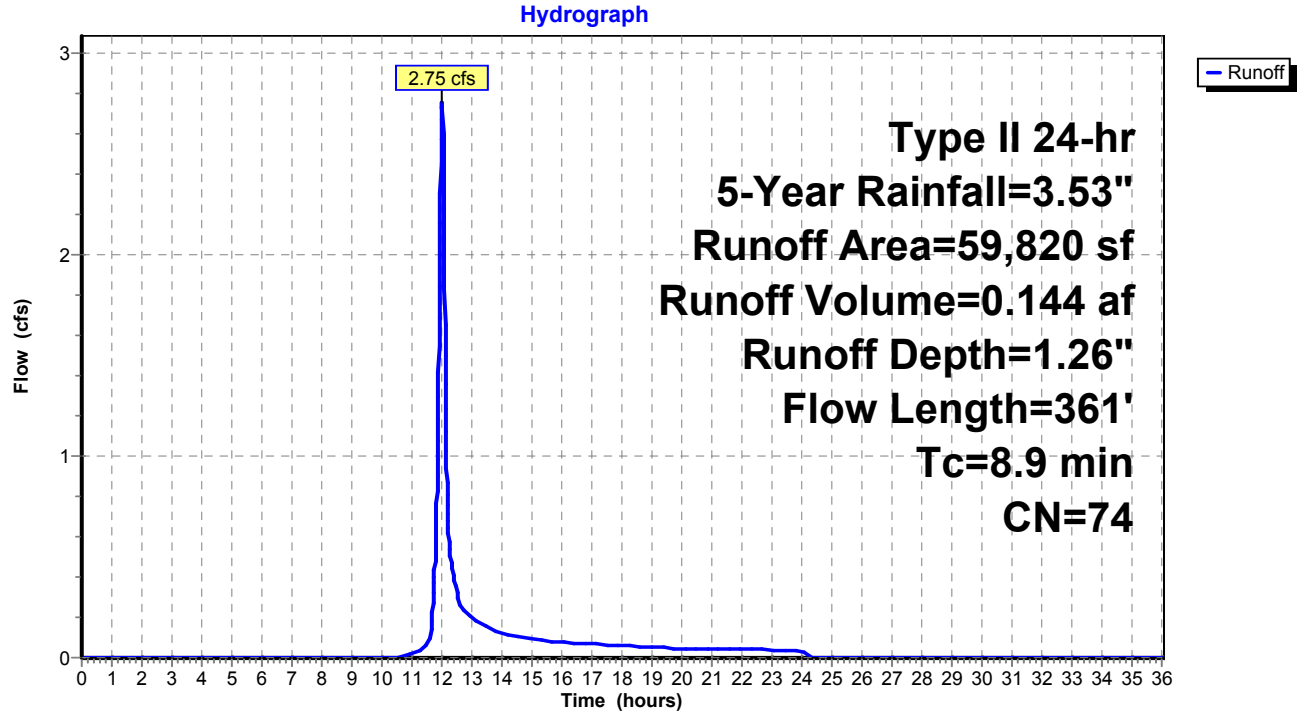
Runoff = 2.75 cfs @ 12.01 hrs, Volume= 0.144 af, Depth= 1.26"

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=3.53"

	Area (sf)	CN	Description
*	3,509	98	Paved Parking, HSG C
	4,122	89	Gravel roads, HSG C
*	0	98	Crushed Stone Pad, HSG C
	52,189	71	Meadow, non-grazed, HSG C
	59,820	74	Weighted Average
	56,311		94.13% Pervious Area
	3,509		5.87% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.3	15	0.0200	0.89		**Sheet Flow, Sheet** Smooth surfaces n= 0.011 P2= 2.84"
6.7	85	0.1100	0.21		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 2.84"
1.9	261	0.1100	2.32		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
8.9	361	Total			

Subcatchment 100S: DA TO VCI



Summary for Subcatchment 106S: OFFSITE DA

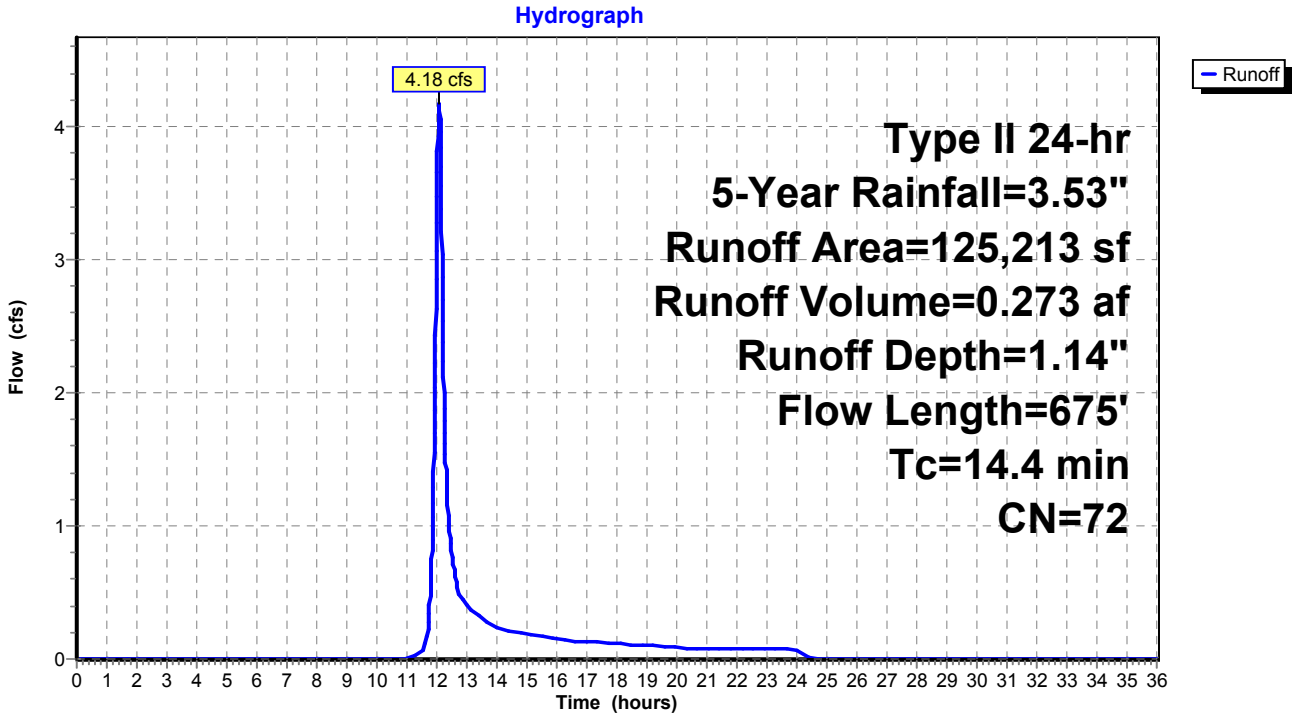
Runoff = 4.18 cfs @ 12.08 hrs, Volume= 0.273 af, Depth= 1.14"

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=3.53"

	Area (sf)	CN	Description
*	6,546	98	Paved Parking, HSG C
	0	89	Gravel roads, HSG C
*	0	98	Crushed Stone Pad, HSG C
	118,667	71	Meadow, non-grazed, HSG C
	125,213	72	Weighted Average
	118,667		94.77% Pervious Area
	6,546		5.23% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.5	100	0.0500	0.16		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 2.84"
3.7	471	0.0900	2.10		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
0.2	104	0.0900	9.48	37.92	**Channel Flow, Existing Roadside Channel** Area= 4.0 sf Perim= 12.5' r= 0.32' n= 0.022 Earth, clean & straight
14.4	675	Total			

Subcatchment 106S: OFFSITE DA



Summary for Subcatchment 108S: DA TO MLV PAD

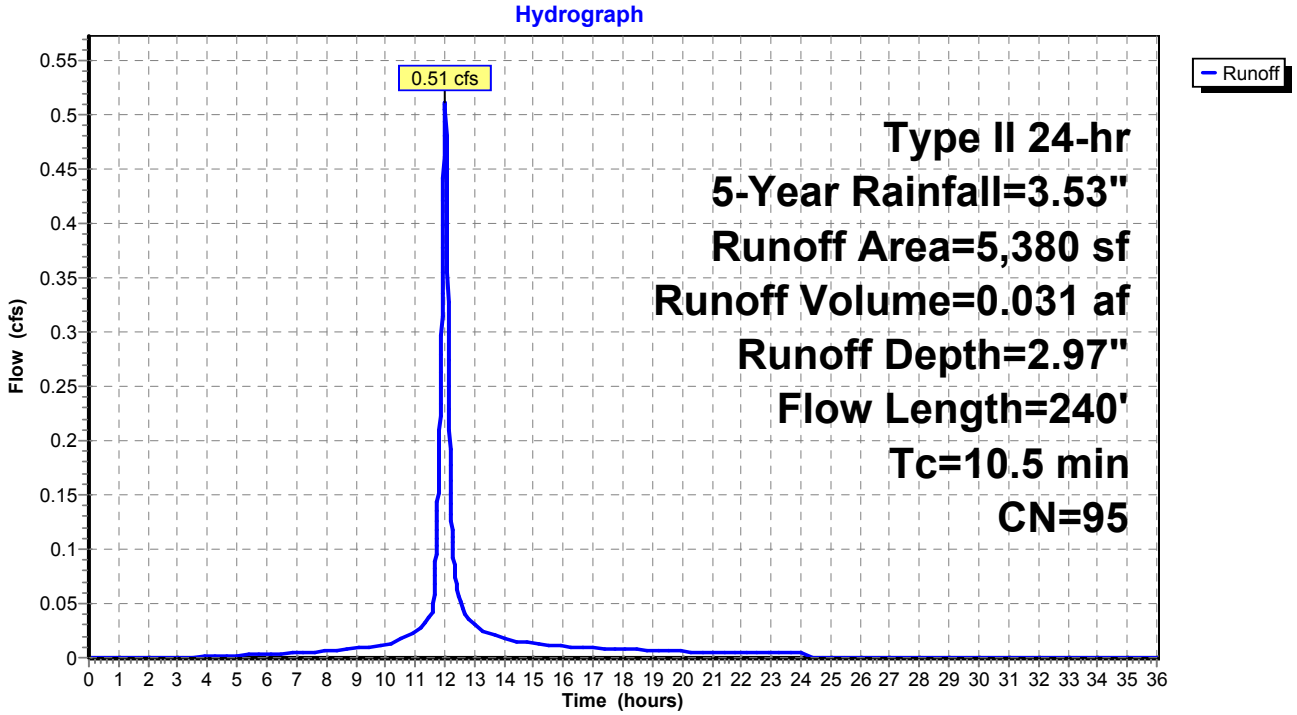
Runoff = 0.51 cfs @ 12.02 hrs, Volume= 0.031 af, Depth= 2.97"

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=3.53"

	Area (sf)	CN	Description
*	0	98	Paved Parking, HSG C
	32	89	Gravel roads, HSG C
*	4,680	98	Crushed Stone Pad, HSG C
	668	71	Meadow, non-grazed, HSG C
	5,380	95	Weighted Average
	700		13.01% Pervious Area
	4,680		86.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.9	100	0.0750	0.19		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 2.84"
1.6	140	0.0430	1.45		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
10.5	240	Total			

Subcatchment 108S: DA TO MLV PAD



Summary for Subcatchment 111S: DA TO INFILTRATION BERM

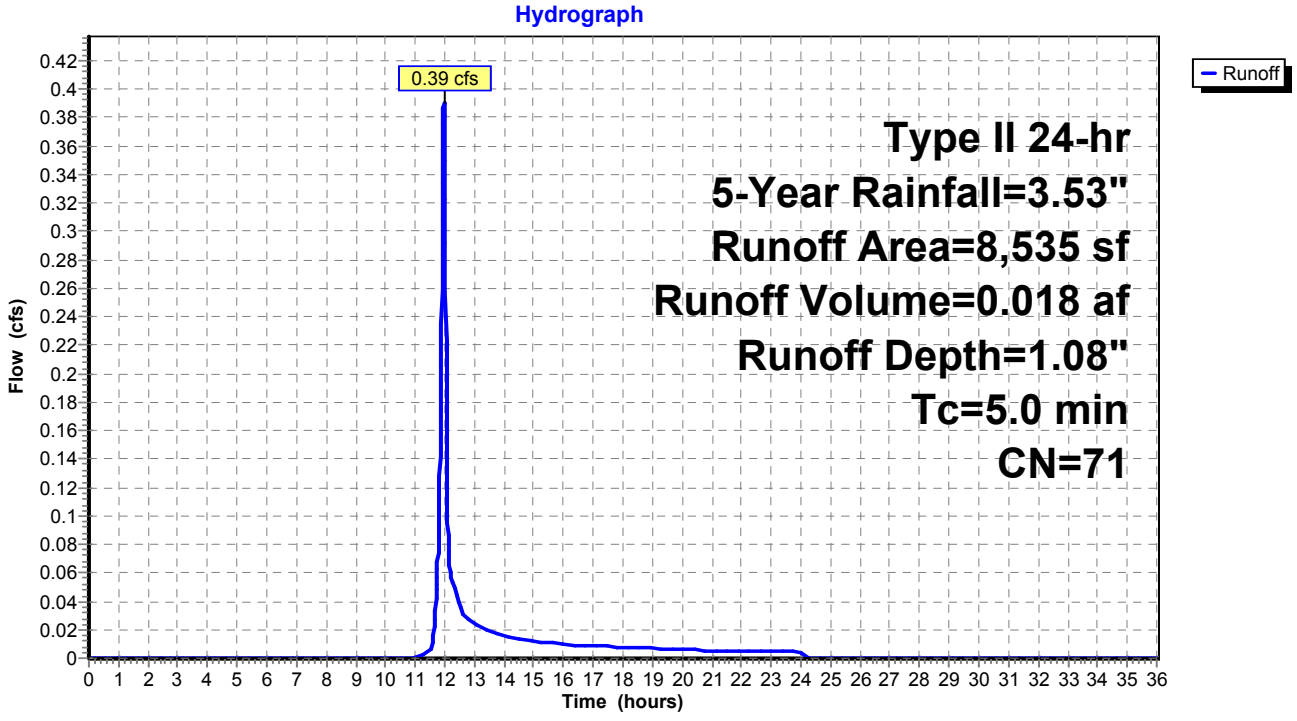
Runoff = 0.39 cfs @ 11.97 hrs, Volume= 0.018 af, Depth= 1.08"

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=3.53"

	Area (sf)	CN	Description
*	0	98	Paved Parking, HSG C
	0	89	Gravel roads, HSG C
*	0	98	Crushed Stone Pad, HSG C
	8,535	71	Meadow, non-grazed, HSG C
	8,535	71	Weighted Average
	8,535		100.00% Pervious Area

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

Subcatchment 111S: DA TO INFILTRATION BERM



Summary for Pond 3P: MLV PAD

Inflow Area = 0.124 ac, 86.99% Impervious, Inflow Depth = 2.97" for 5-Year event
Inflow = 0.51 cfs @ 12.02 hrs, Volume= 0.031 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 / 4
Peak Elev= 736.46' @ 24.60 hrs Surf.Area= 0 sf Storage= 1,331 cf

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

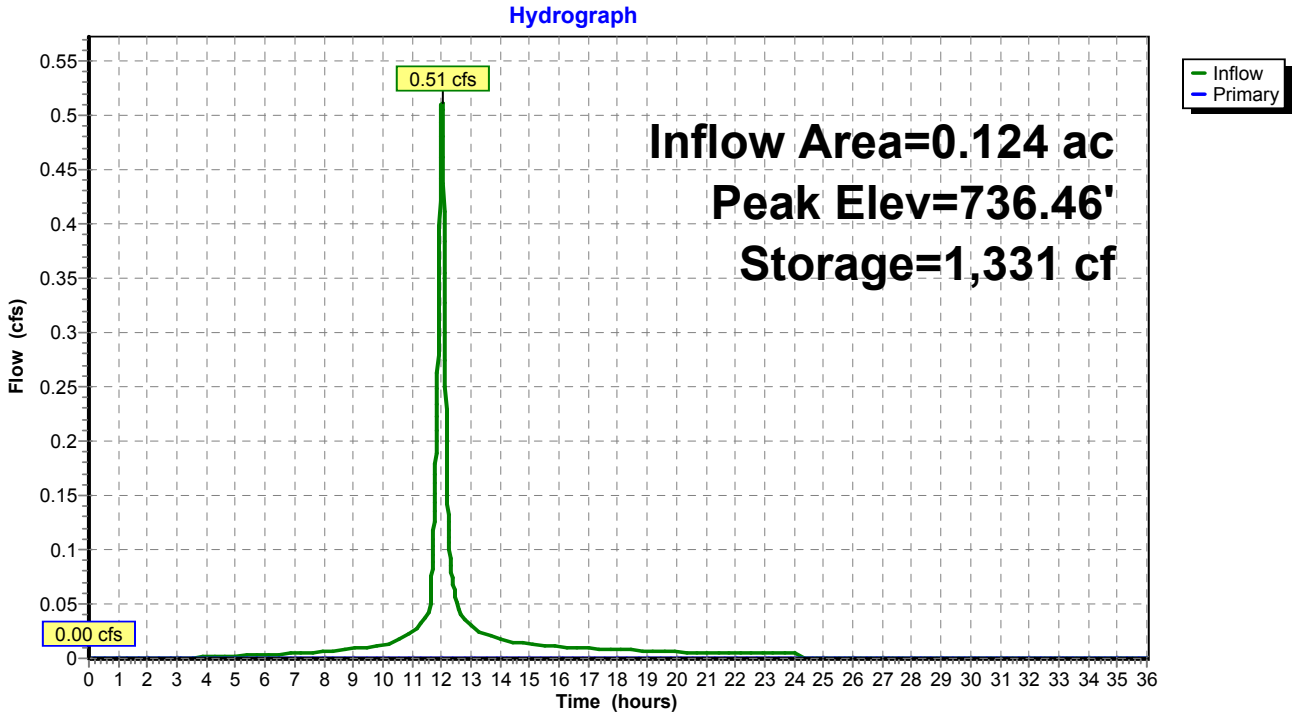
Volume	Invert	Avail.Storage	Storage Description
#1	735.50'	1,386 cf	**Stone Pad Void Storage** Listed below 3,464 cf Overall x 40.0% Voids

Elevation (feet)	Cum.Store (cubic-feet)
735.50	0
736.00	1,732
736.50	3,463
737.00	3,464

Device	Routing	Invert	Outlet Devices
#1	Primary	736.50'	**90.0' long x 3.0' breadth Broad-Crested 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=735.50' (Free Discharge)
↑—**1=Broad-Crested Weir** (Controls 0.00 cfs)

Pond 3P: MLV PAD



Summary for Pond 106P: VCI

Inflow Area = 1.373 ac, 5.87% Impervious, Inflow Depth = 1.26" for 5-Year event
Inflow = 2.75 cfs @ 12.01 hrs, Volume= 0.144 af
Outflow = 3.58 cfs @ 12.00 hrs, Volume= 0.114 af, Atten= 0%, Lag= 0.0 min
Primary = 3.58 cfs @ 12.00 hrs, Volume= 0.114 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 8
Peak Elev= 736.21' @ 12.00 hrs Surf.Area= 0 sf Storage= 1,327 cf

Plug-Flow detention time= 128.8 min calculated for 0.114 af (79% of inflow)
Center-of-Mass det. time= 38.7 min (894.1 - 855.4)

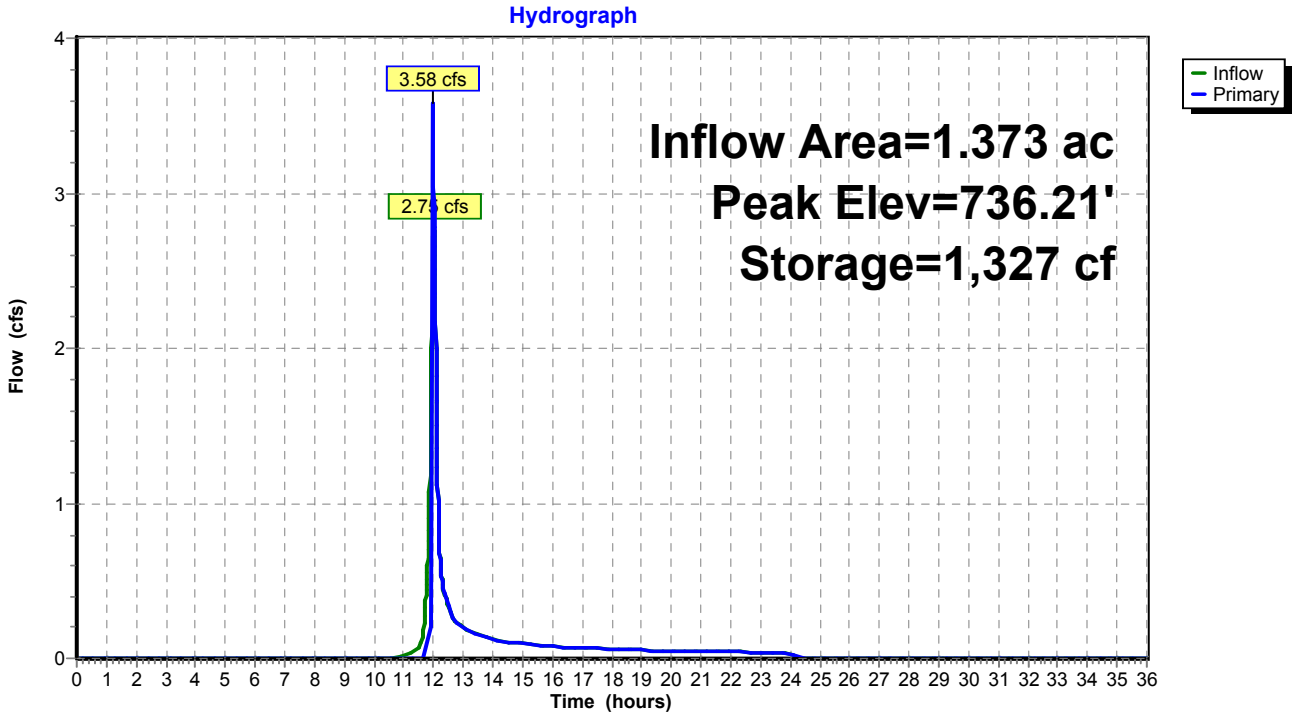
Volume	Invert	Avail.Storage	Storage Description
#1	735.00'	1,328 cf	**Custom Stage Data**Listed below

Elevation (feet)	Cum.Store (cubic-feet)
735.00	0
735.50	664
736.00	1,327
736.50	1,328

Device	Routing	Invert	Outlet Devices
#1	Primary	736.00'	**16.0' long x 2.0' 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 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Primary OutFlow Max=3.16 cfs @ 12.00 hrs HW=736.18' (Free Discharge)
↑**1=Broad-Crested Rectangular Weir** (Weir Controls 3.16 cfs @ 1.08 fps)

Pond 106P: VCI



Summary for Pond 109P: INFILTRATION BERM

Inflow Area = 1.693 ac, 11.11% Impervious, Inflow Depth = 0.93" for 5-Year event
Inflow = 3.92 cfs @ 12.00 hrs, Volume= 0.132 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= 735.78' @ 24.52 hrs Surf.Area= 8,077 sf Storage= 5,730 cf

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

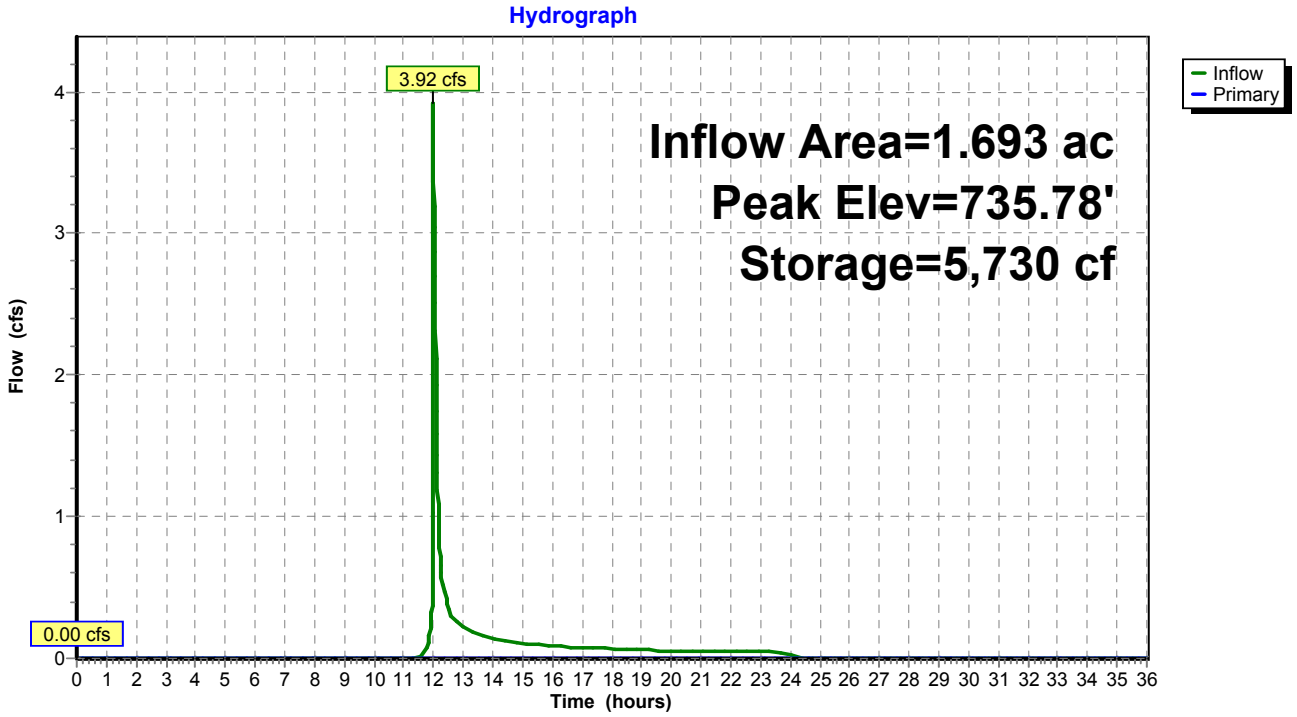
Volume	Invert	Avail.Storage	Storage Description
#1	735.00'	9,735 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
735.00	6,611	465.0	0	0	6,611
736.00	8,513	518.7	7,542	7,542	10,843
736.25	9,035	525.0	2,193	9,735	11,383

Device	Routing	Invert	Outlet Devices
#1	Primary	736.00'	**50.0' long x 2.0' 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 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=735.00' (Free Discharge)
1=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Pond 109P: INFILTRATION BERM

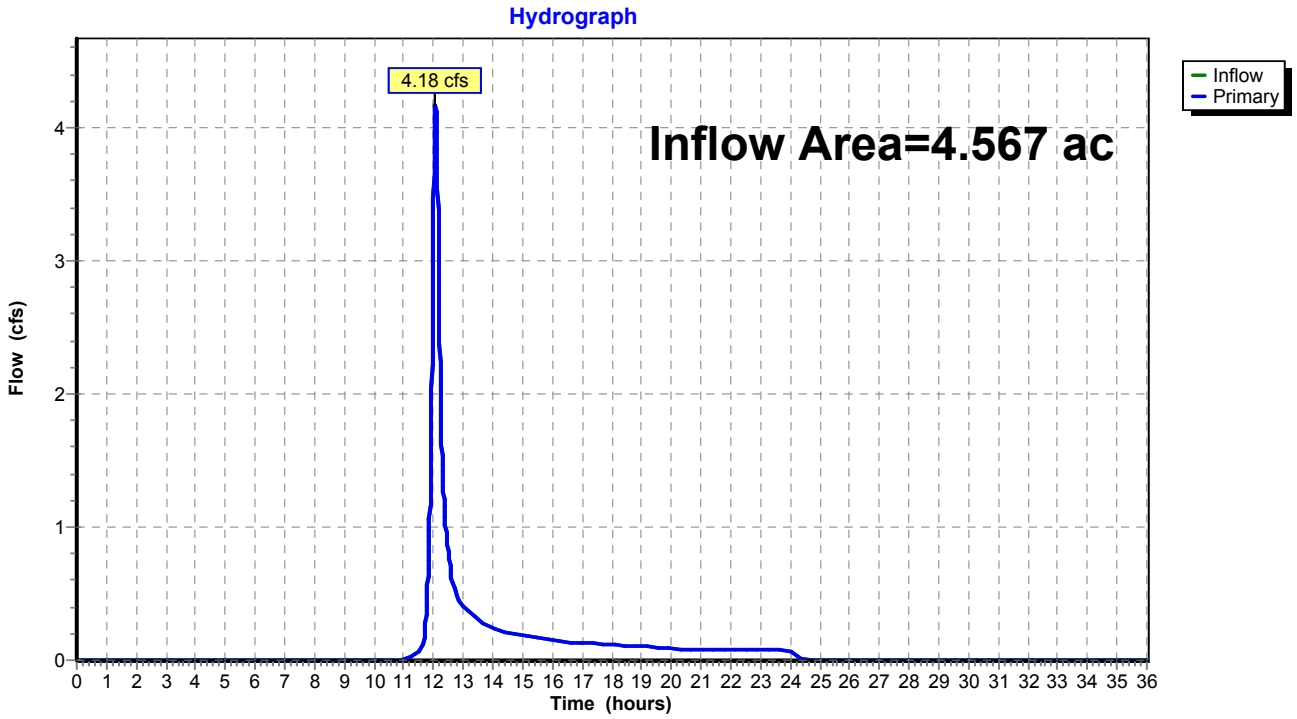


Summary for Link 105L: Proposed Conditions

Inflow Area = 4.567 ac, 7.41% Impervious, Inflow Depth = 0.72" for 5-Year event
Inflow = 4.18 cfs @ 12.08 hrs, Volume= 0.273 af
Primary = 4.18 cfs @ 12.08 hrs, Volume= 0.273 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Link 105L: Proposed Conditions



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

Subcatchment100S: DA TO VCI Runoff Area=59,820 sf 5.87% Impervious Runoff Depth=1.69"
Flow Length=361' Tc=8.9 min CN=74 Runoff=3.73 cfs 0.194 af

Subcatchment106S: OFFSITE DA Runoff Area=125,213 sf 5.23% Impervious Runoff Depth=1.55"
Flow Length=675' Tc=14.4 min CN=72 Runoff=5.79 cfs 0.372 af

Subcatchment108S: DA TO MLV PAD Runoff Area=5,380 sf 86.99% Impervious Runoff Depth=3.56"
Flow Length=240' Tc=10.5 min CN=95 Runoff=0.61 cfs 0.037 af

Subcatchment111S: DA TO INFILTRATION Runoff Area=8,535 sf 0.00% Impervious Runoff Depth=1.48"
Tc=5.0 min CN=71 Runoff=0.54 cfs 0.024 af

Pond 3P: MLV PAD Peak Elev=736.50' Storage=1,385 cf Inflow=0.61 cfs 0.037 af
Outflow=0.01 cfs 0.005 af

Pond 106P: VCI Peak Elev=736.20' Storage=1,327 cf Inflow=3.73 cfs 0.194 af
Outflow=3.70 cfs 0.160 af

Pond 109P: INFILTRATIONBERM Peak Elev=736.00' Storage=7,580 cf Inflow=4.15 cfs 0.189 af
Outflow=0.06 cfs 0.016 af

Link 105L: Proposed Conditions Inflow=5.79 cfs 0.388 af
Primary=5.79 cfs 0.388 af

Total Runoff Area = 4.567 ac Runoff Volume = 0.626 af Average Runoff Depth = 1.65"
92.59% Pervious = 4.229 ac 7.41% Impervious = 0.338 ac

Summary for Subcatchment 100S: DA TO VCI

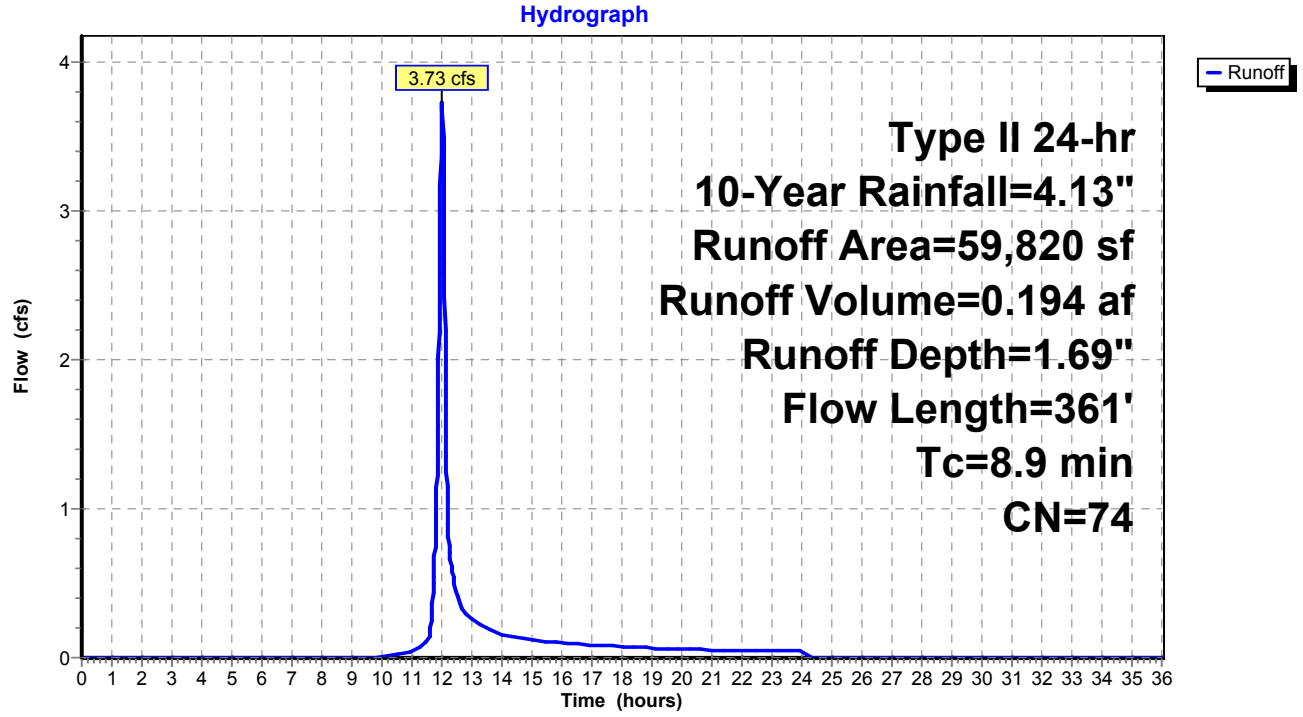
Runoff = 3.73 cfs @ 12.01 hrs, Volume= 0.194 af, Depth= 1.69"

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=4.13"

	Area (sf)	CN	Description
*	3,509	98	Paved Parking, HSG C
	4,122	89	Gravel roads, HSG C
*	0	98	Crushed Stone Pad, HSG C
	52,189	71	Meadow, non-grazed, HSG C
	59,820	74	Weighted Average
	56,311		94.13% Pervious Area
	3,509		5.87% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.3	15	0.0200	0.89		**Sheet Flow, Sheet** Smooth surfaces n= 0.011 P2= 2.84"
6.7	85	0.1100	0.21		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 2.84"
1.9	261	0.1100	2.32		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
8.9	361	Total			

Subcatchment 100S: DA TO VCI



Summary for Subcatchment 106S: OFFSITE DA

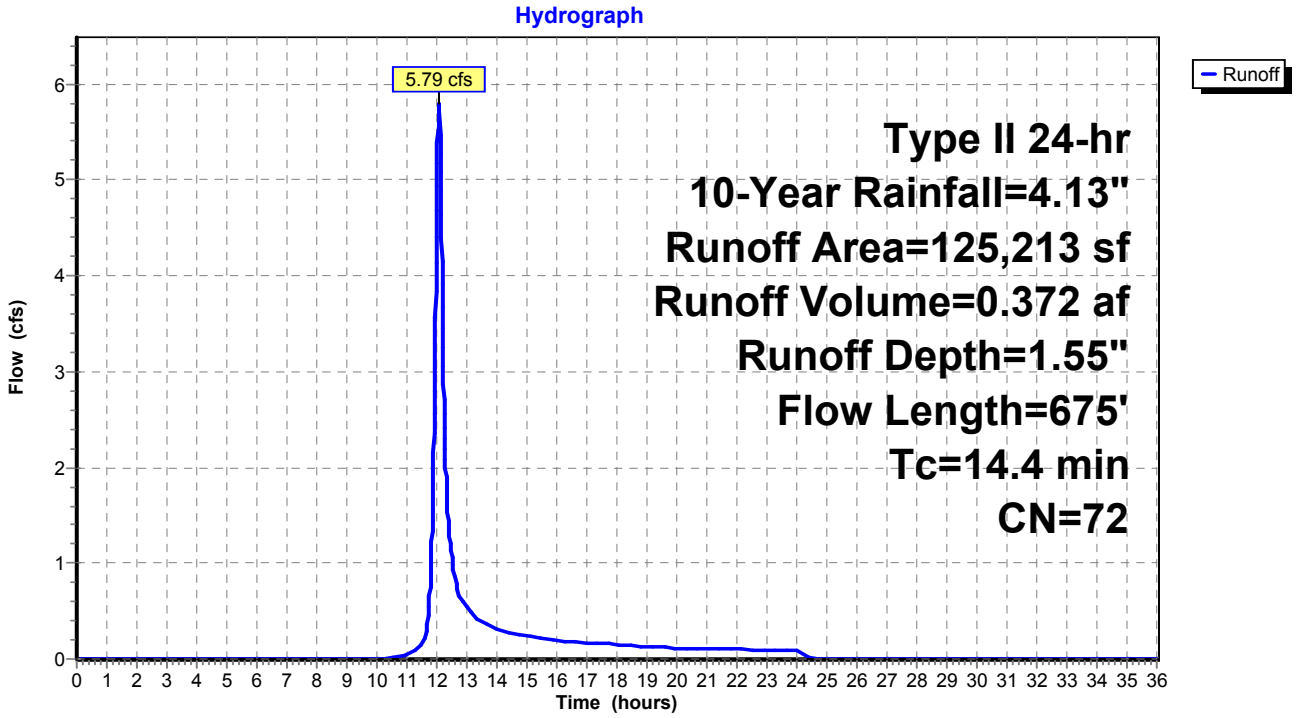
Runoff = 5.79 cfs @ 12.07 hrs, Volume= 0.372 af, Depth= 1.55"

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=4.13"

	Area (sf)	CN	Description
*	6,546	98	Paved Parking, HSG C
	0	89	Gravel roads, HSG C
*	0	98	Crushed Stone Pad, HSG C
	118,667	71	Meadow, non-grazed, HSG C
	125,213	72	Weighted Average
	118,667		94.77% Pervious Area
	6,546		5.23% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.5	100	0.0500	0.16		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 2.84"
3.7	471	0.0900	2.10		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
0.2	104	0.0900	9.48	37.92	**Channel Flow, Existing Roadside Channel** Area= 4.0 sf Perim= 12.5' r= 0.32' n= 0.022 Earth, clean & straight
14.4	675	Total			

Subcatchment 106S: OFFSITE DA



Summary for Subcatchment 108S: DA TO MLV PAD

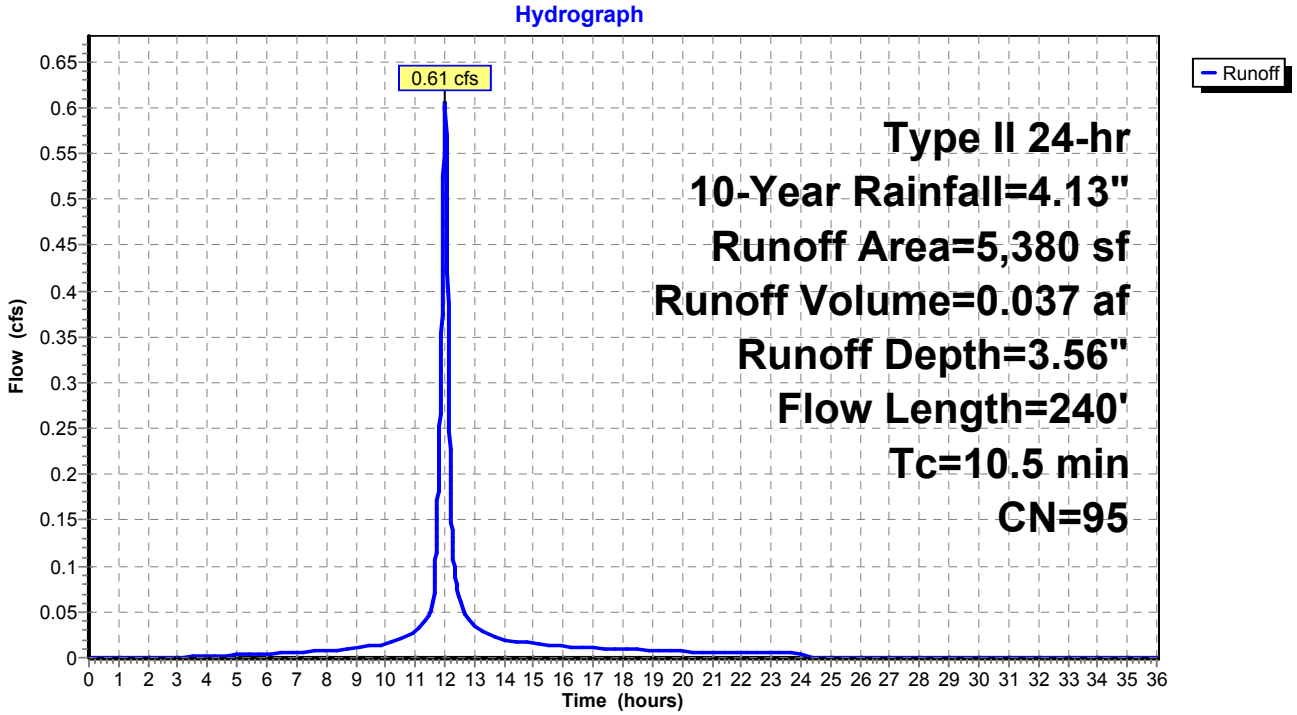
Runoff = 0.61 cfs @ 12.02 hrs, Volume= 0.037 af, Depth= 3.56"

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=4.13"

	Area (sf)	CN	Description
*	0	98	Paved Parking, HSG C
	32	89	Gravel roads, HSG C
*	4,680	98	Crushed Stone Pad, HSG C
	668	71	Meadow, non-grazed, HSG C
	5,380	95	Weighted Average
	700		13.01% Pervious Area
	4,680		86.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.9	100	0.0750	0.19		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 2.84"
1.6	140	0.0430	1.45		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
10.5	240	Total			

Subcatchment 108S: DA TO MLV PAD



Summary for Subcatchment 111S: DA TO INFILTRATION BERM

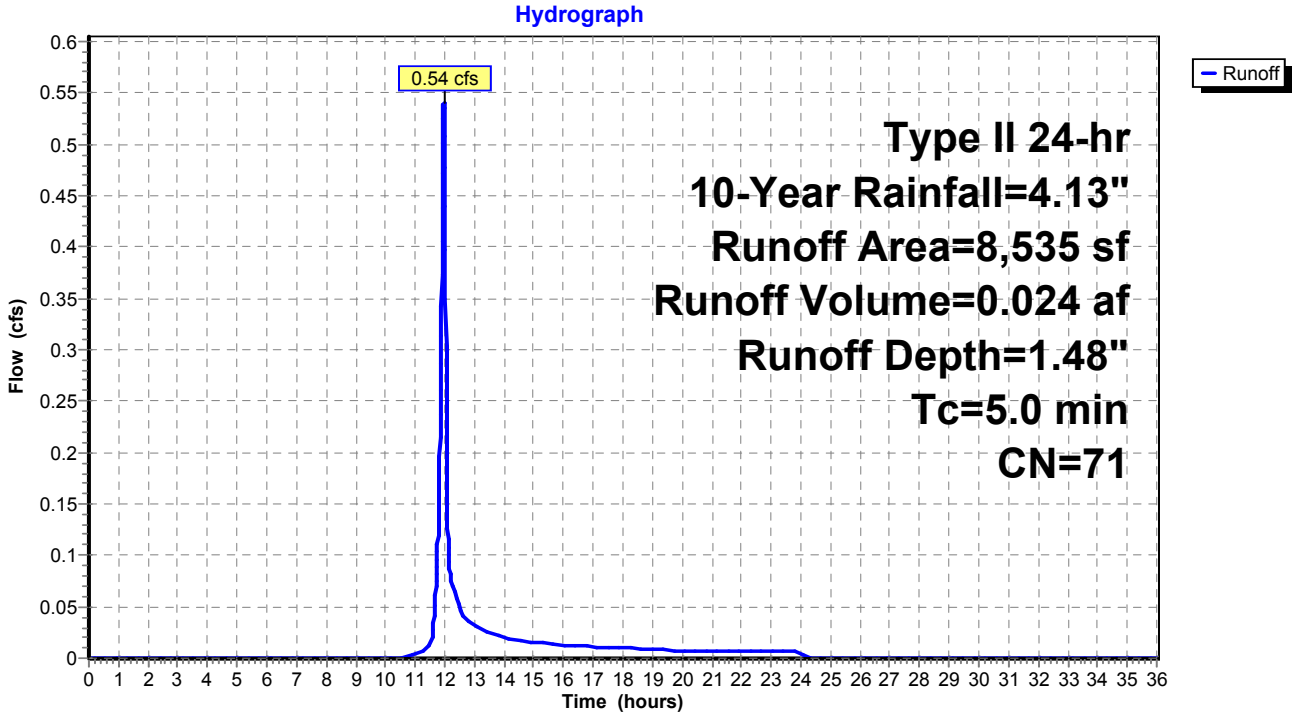
Runoff = 0.54 cfs @ 11.97 hrs, Volume= 0.024 af, Depth= 1.48"

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=4.13"

	Area (sf)	CN	Description
*	0	98	Paved Parking, HSG C
	0	89	Gravel roads, HSG C
*	0	98	Crushed Stone Pad, HSG C
	8,535	71	Meadow, non-grazed, HSG C
	8,535	71	Weighted Average
	8,535		100.00% Pervious Area

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

Subcatchment 111S: DA TO INFILTRATION BERM



Summary for Pond 3P: MLV PAD

Inflow Area = 0.124 ac, 86.99% Impervious, Inflow Depth = 3.56" for 10-Year event
Inflow = 0.61 cfs @ 12.02 hrs, Volume= 0.037 af
Outflow = 0.01 cfs @ 16.37 hrs, Volume= 0.005 af, Atten= 98%, Lag= 261.3 min
Primary = 0.01 cfs @ 16.37 hrs, Volume= 0.005 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 4
Peak Elev= 736.50' @ 16.37 hrs Surf.Area= 0 sf Storage= 1,385 cf

Plug-Flow detention time= 671.4 min calculated for 0.005 af (13% of inflow)
Center-of-Mass det. time= 410.5 min (1,184.6 - 774.1)

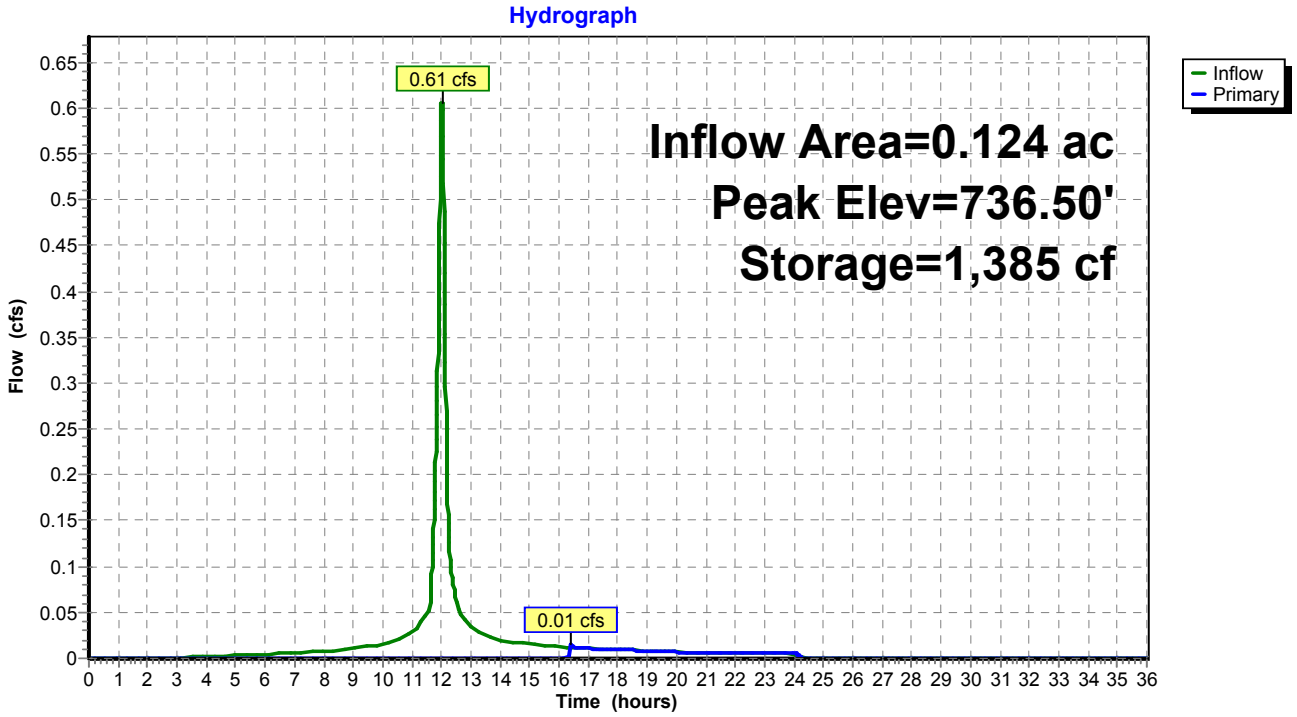
Volume	Invert	Avail.Storage	Storage Description
#1	735.50'	1,386 cf	**Stone Pad Void Storage** Listed below 3,464 cf Overall x 40.0% Voids

Elevation (feet)	Cum.Store (cubic-feet)
735.50	0
736.00	1,732
736.50	3,463
737.00	3,464

Device	Routing	Invert	Outlet Devices
#1	Primary	736.50'	**90.0' long x 3.0' breadth Broad-Crested 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 @ 16.37 hrs HW=736.50' (Free Discharge)
↑**1=Broad-Crested Weir** (Weir Controls 0.01 cfs @ 0.08 fps)

Pond 3P: MLV PAD



Summary for Pond 106P: VCI

Inflow Area = 1.373 ac, 5.87% Impervious, Inflow Depth = 1.69" for 10-Year event
Inflow = 3.73 cfs @ 12.01 hrs, Volume= 0.194 af
Outflow = 3.70 cfs @ 12.01 hrs, Volume= 0.160 af, Atten= 1%, Lag= 0.1 min
Primary = 3.70 cfs @ 12.01 hrs, Volume= 0.160 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 8
Peak Elev= 736.20' @ 12.01 hrs Surf.Area= 0 sf Storage= 1,327 cf

Plug-Flow detention time= 107.2 min calculated for 0.160 af (83% of inflow)
Center-of-Mass det. time= 29.7 min (876.3 - 846.6)

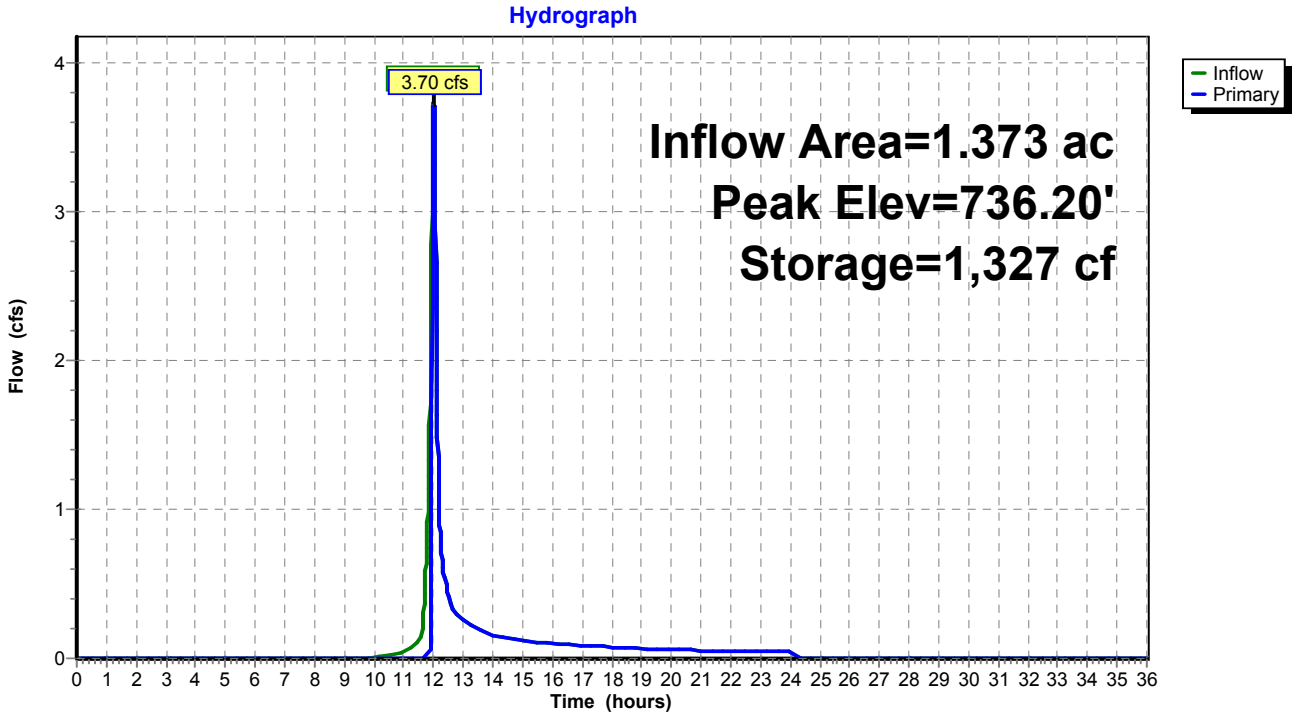
Volume	Invert	Avail.Storage	Storage Description
#1	735.00'	1,328 cf	**Custom Stage Data**Listed below

Elevation (feet)	Cum.Store (cubic-feet)
735.00	0
735.50	664
736.00	1,327
736.50	1,328

Device	Routing	Invert	Outlet Devices
#1	Primary	736.00'	**16.0' long x 2.0' 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 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Primary OutFlow Max=3.70 cfs @ 12.01 hrs HW=736.20' (Free Discharge)
↑**1=Broad-Crested Rectangular Weir** (Weir Controls 3.70 cfs @ 1.14 fps)

Pond 106P: VCI



Summary for Pond 109P: INFILTRATION BERM

Inflow Area = 1.693 ac, 11.11% Impervious, Inflow Depth = 1.34" for 10-Year event
Inflow = 4.15 cfs @ 12.01 hrs, Volume= 0.189 af
Outflow = 0.06 cfs @ 21.82 hrs, Volume= 0.016 af, Atten= 98%, Lag= 588.9 min
Primary = 0.06 cfs @ 21.82 hrs, Volume= 0.016 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 736.00' @ 21.82 hrs Surf.Area= 8,522 sf Storage= 7,580 cf

Plug-Flow detention time= 646.8 min calculated for 0.016 af (9% of inflow)
Center-of-Mass det. time= 480.0 min (1,361.0 - 881.1)

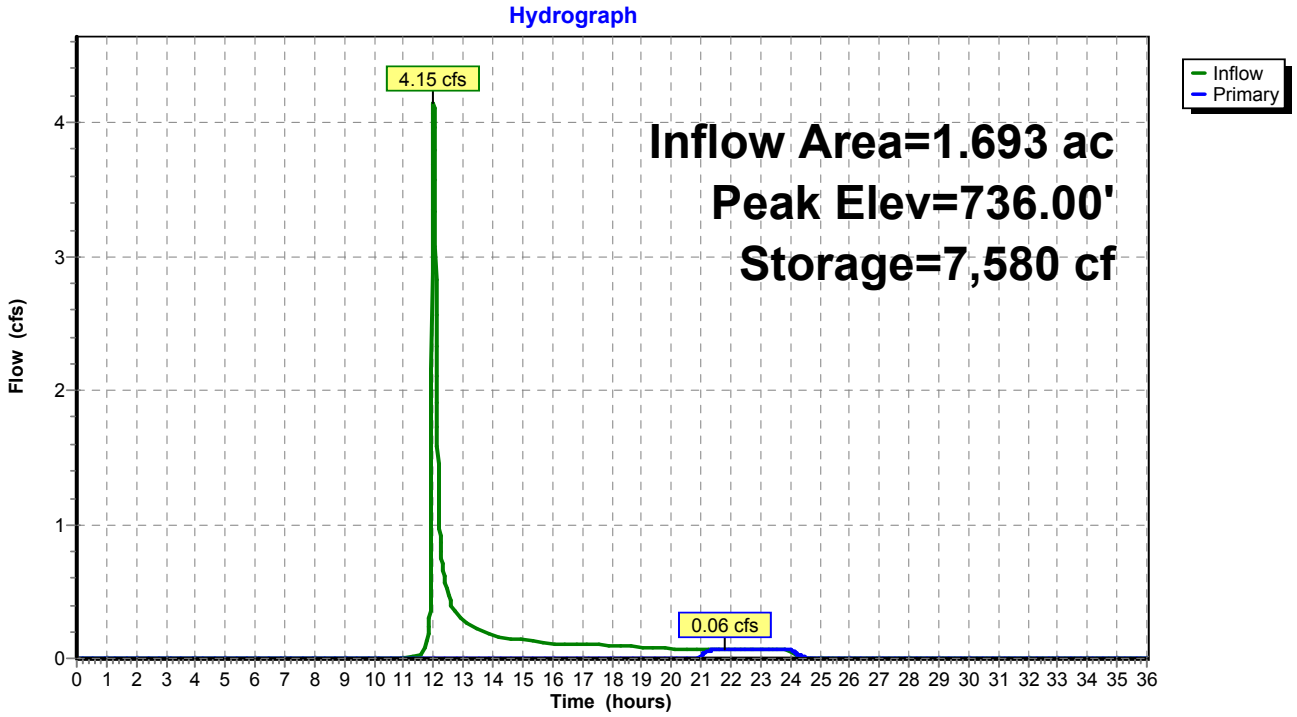
Volume	Invert	Avail.Storage	Storage Description
#1	735.00'	9,735 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
735.00	6,611	465.0	0	0	6,611
736.00	8,513	518.7	7,542	7,542	10,843
736.25	9,035	525.0	2,193	9,735	11,383

Device	Routing	Invert	Outlet Devices
#1	Primary	736.00'	**50.0' long x 2.0' 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 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Primary OutFlow Max=0.04 cfs @ 21.82 hrs HW=736.00' (Free Discharge)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 0.04 cfs @ 0.17 fps)

Pond 109P: INFILTRATION BERM

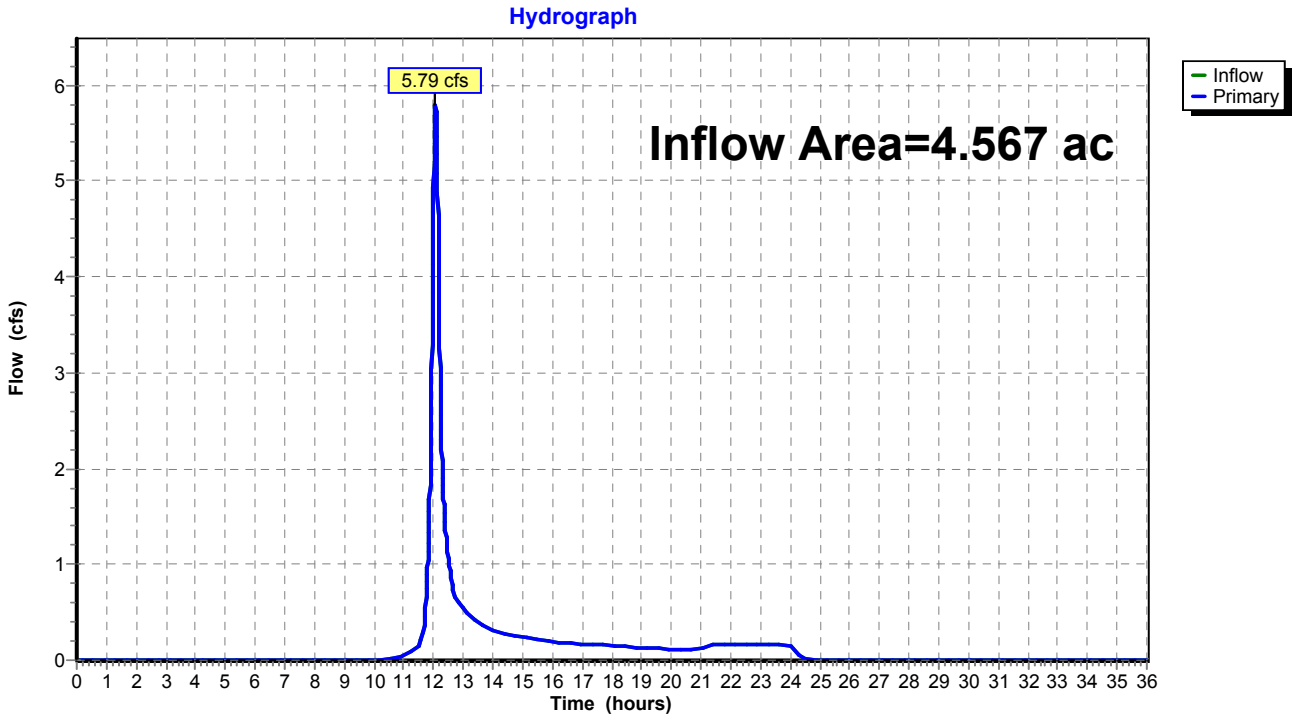


Summary for Link 105L: Proposed Conditions

Inflow Area = 4.567 ac, 7.41% Impervious, Inflow Depth = 1.02" for 10-Year event
Inflow = 5.79 cfs @ 12.07 hrs, Volume= 0.388 af
Primary = 5.79 cfs @ 12.07 hrs, Volume= 0.388 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Link 105L: Proposed Conditions



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

Subcatchment100S: DA TO VCI Runoff Area=59,820 sf 5.87% Impervious Runoff Depth=2.44"
Flow Length=361' Tc=8.9 min CN=74 Runoff=5.38 cfs 0.279 af

Subcatchment106S: OFFSITE DA Runoff Area=125,213 sf 5.23% Impervious Runoff Depth=2.27"
Flow Length=675' Tc=14.4 min CN=72 Runoff=8.58 cfs 0.543 af

Subcatchment108S: DA TO MLV PAD Runoff Area=5,380 sf 86.99% Impervious Runoff Depth=4.51"
Flow Length=240' Tc=10.5 min CN=95 Runoff=0.76 cfs 0.046 af

Subcatchment111S: DA TO INFILTRATION Runoff Area=8,535 sf 0.00% Impervious Runoff Depth=2.18"
Tc=5.0 min CN=71 Runoff=0.80 cfs 0.036 af

Pond 3P: MLV PAD Peak Elev=736.50' Storage=1,385 cf Inflow=0.76 cfs 0.046 af
Outflow=0.05 cfs 0.014 af

Pond 106P: VCI Peak Elev=736.26' Storage=1,328 cf Inflow=5.38 cfs 0.279 af
Outflow=5.38 cfs 0.250 af

Pond 109P: INFILTRATIONBERM Peak Elev=736.02' Storage=7,699 cf Inflow=6.05 cfs 0.300 af
Outflow=0.33 cfs 0.127 af

Link 105L: Proposed Conditions Inflow=8.58 cfs 0.670 af
Primary=8.58 cfs 0.670 af

Total Runoff Area = 4.567 ac Runoff Volume = 0.904 af Average Runoff Depth = 2.38"
92.59% Pervious = 4.229 ac 7.41% Impervious = 0.338 ac

Summary for Subcatchment 100S: DA TO VCI

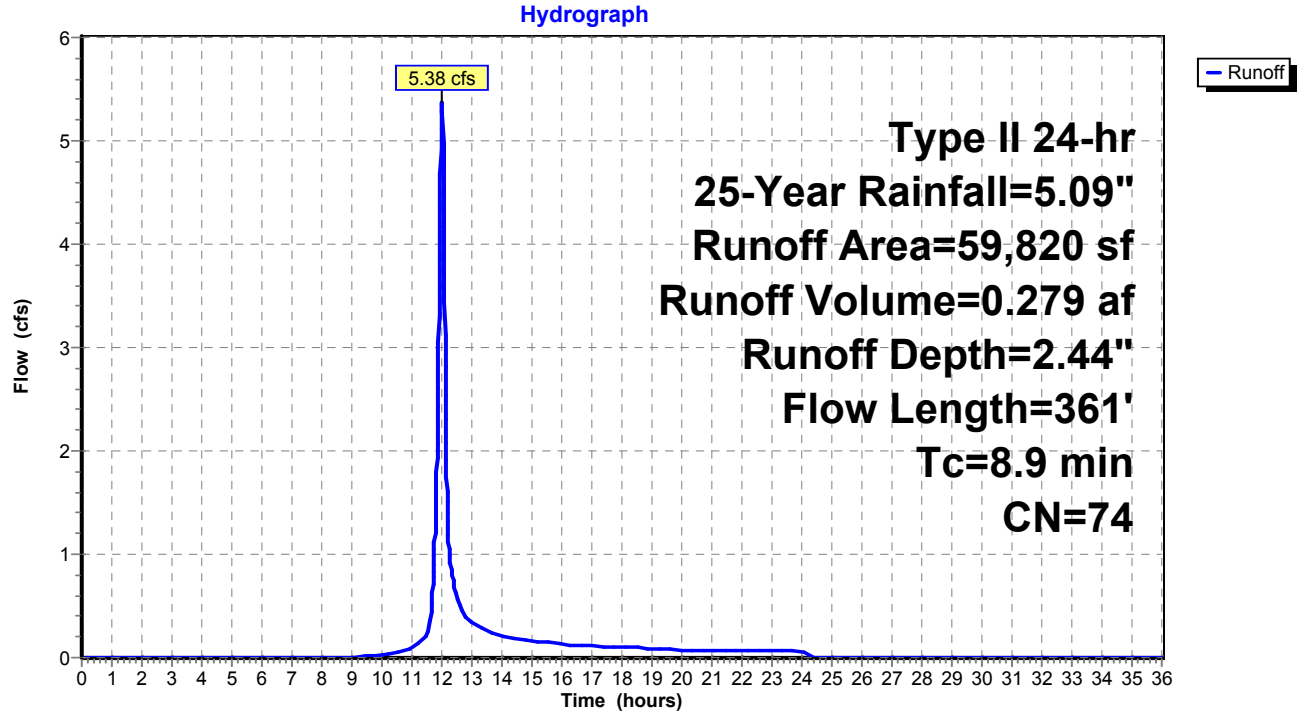
Runoff = 5.38 cfs @ 12.01 hrs, Volume= 0.279 af, Depth= 2.44"

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=5.09"

	Area (sf)	CN	Description
*	3,509	98	Paved Parking, HSG C
	4,122	89	Gravel roads, HSG C
*	0	98	Crushed Stone Pad, HSG C
	52,189	71	Meadow, non-grazed, HSG C
	59,820	74	Weighted Average
	56,311		94.13% Pervious Area
	3,509		5.87% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.3	15	0.0200	0.89		**Sheet Flow, Sheet** Smooth surfaces n= 0.011 P2= 2.84"
6.7	85	0.1100	0.21		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 2.84"
1.9	261	0.1100	2.32		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
8.9	361	Total			

Subcatchment 100S: DA TO VCI



Summary for Subcatchment 106S: OFFSITE DA

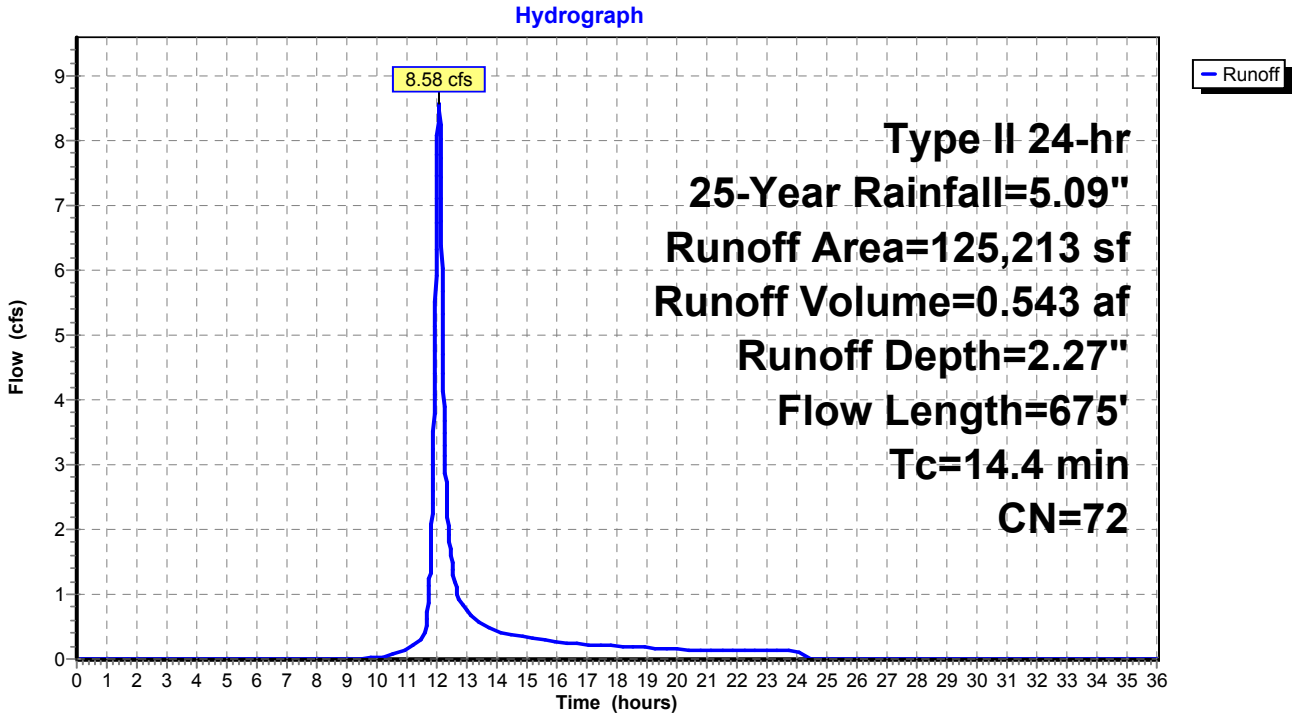
Runoff = 8.58 cfs @ 12.07 hrs, Volume= 0.543 af, Depth= 2.27"

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=5.09"

	Area (sf)	CN	Description
*	6,546	98	Paved Parking, HSG C
	0	89	Gravel roads, HSG C
*	0	98	Crushed Stone Pad, HSG C
	118,667	71	Meadow, non-grazed, HSG C
	125,213	72	Weighted Average
	118,667		94.77% Pervious Area
	6,546		5.23% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.5	100	0.0500	0.16		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 2.84"
3.7	471	0.0900	2.10		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
0.2	104	0.0900	9.48	37.92	**Channel Flow, Existing Roadside Channel** Area= 4.0 sf Perim= 12.5' r= 0.32' n= 0.022 Earth, clean & straight
14.4	675	Total			

Subcatchment 106S: OFFSITE DA



Summary for Subcatchment 108S: DA TO MLV PAD

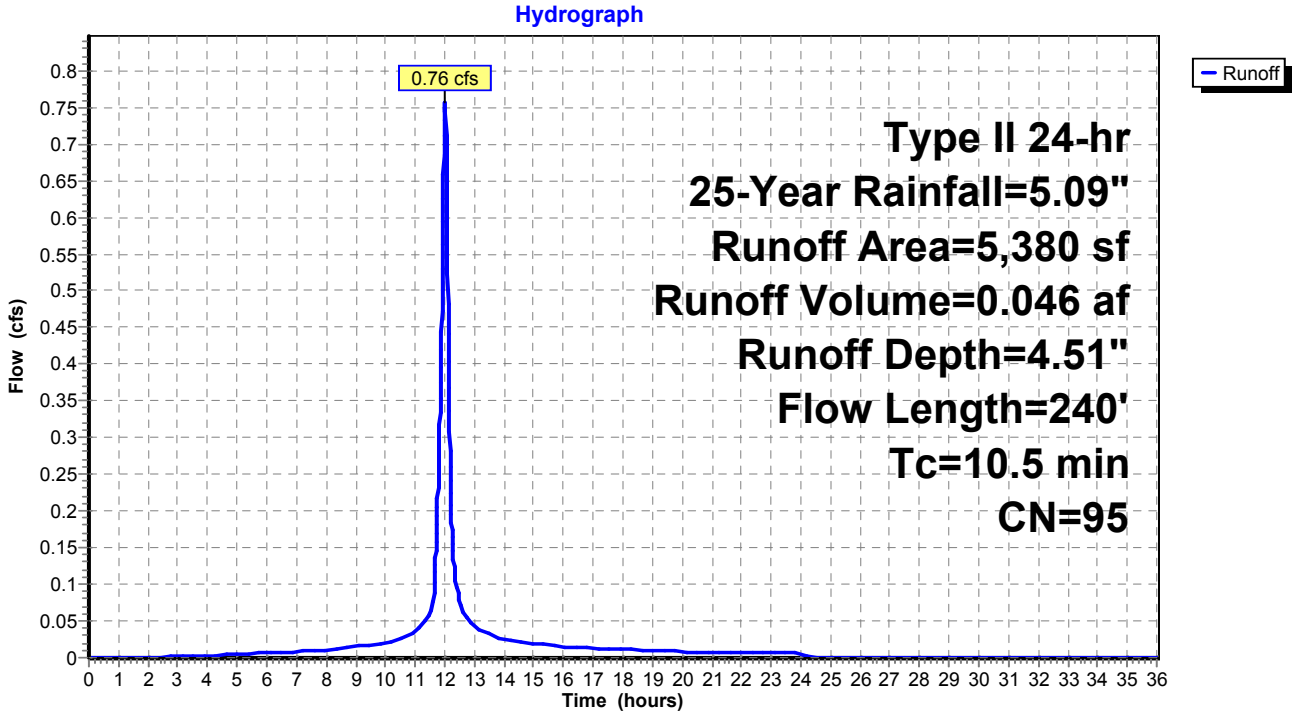
Runoff = 0.76 cfs @ 12.01 hrs, Volume= 0.046 af, Depth= 4.51"

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=5.09"

	Area (sf)	CN	Description
*	0	98	Paved Parking, HSG C
	32	89	Gravel roads, HSG C
*	4,680	98	Crushed Stone Pad, HSG C
	668	71	Meadow, non-grazed, HSG C
	5,380	95	Weighted Average
	700		13.01% Pervious Area
	4,680		86.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.9	100	0.0750	0.19		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 2.84"
1.6	140	0.0430	1.45		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
10.5	240	Total			

Subcatchment 108S: DA TO MLV PAD



Summary for Subcatchment 111S: DA TO INFILTRATION BERM

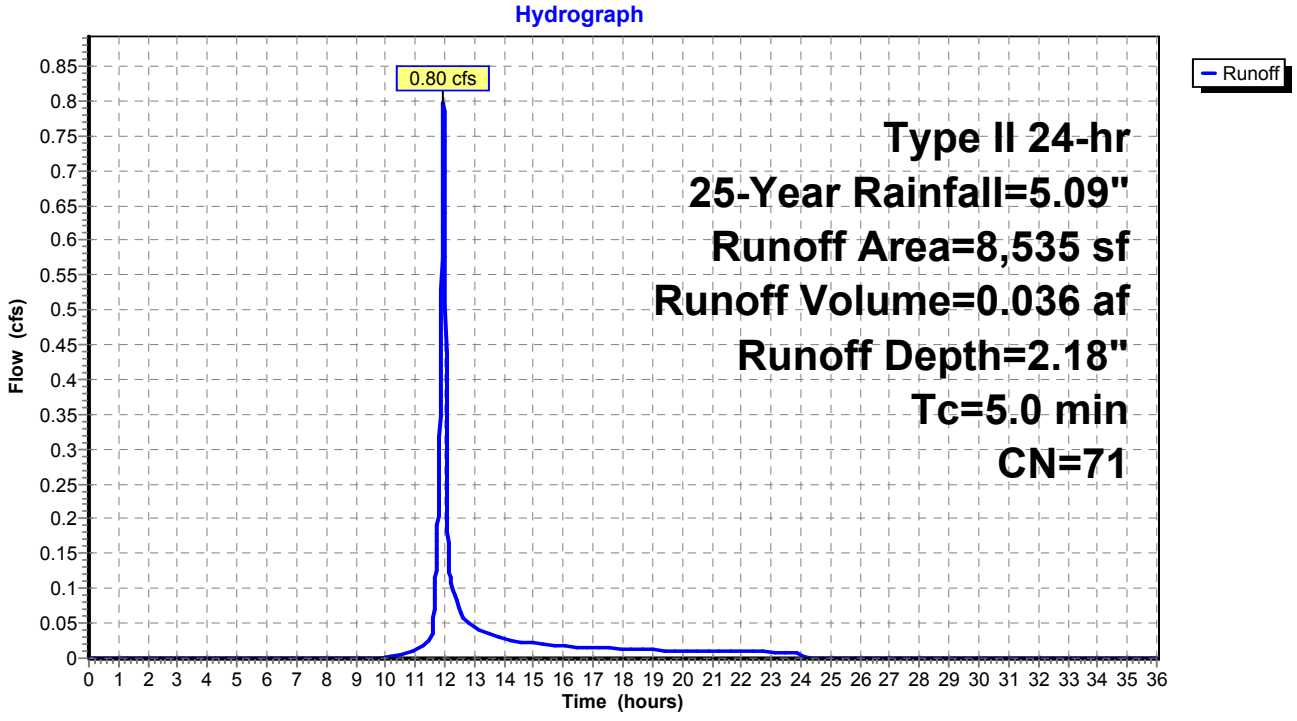
Runoff = 0.80 cfs @ 11.96 hrs, Volume= 0.036 af, Depth= 2.18"

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=5.09"

	Area (sf)	CN	Description
*	0	98	Paved Parking, HSG C
	0	89	Gravel roads, HSG C
*	0	98	Crushed Stone Pad, HSG C
	8,535	71	Meadow, non-grazed, HSG C
	8,535	71	Weighted Average
	8,535		100.00% Pervious Area

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

Subcatchment 111S: DA TO INFILTRATION BERM



Summary for Pond 3P: MLV PAD

Inflow Area = 0.124 ac, 86.99% Impervious, Inflow Depth = 4.51" for 25-Year event
Inflow = 0.76 cfs @ 12.01 hrs, Volume= 0.046 af
Outflow = 0.05 cfs @ 12.80 hrs, Volume= 0.014 af, Atten= 94%, Lag= 47.1 min
Primary = 0.05 cfs @ 12.80 hrs, Volume= 0.014 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 4
Peak Elev= 736.50' @ 12.80 hrs Surf.Area= 0 sf Storage= 1,385 cf

Plug-Flow detention time= 385.2 min calculated for 0.014 af (30% of inflow)
Center-of-Mass det. time= 220.5 min (988.8 - 768.3)

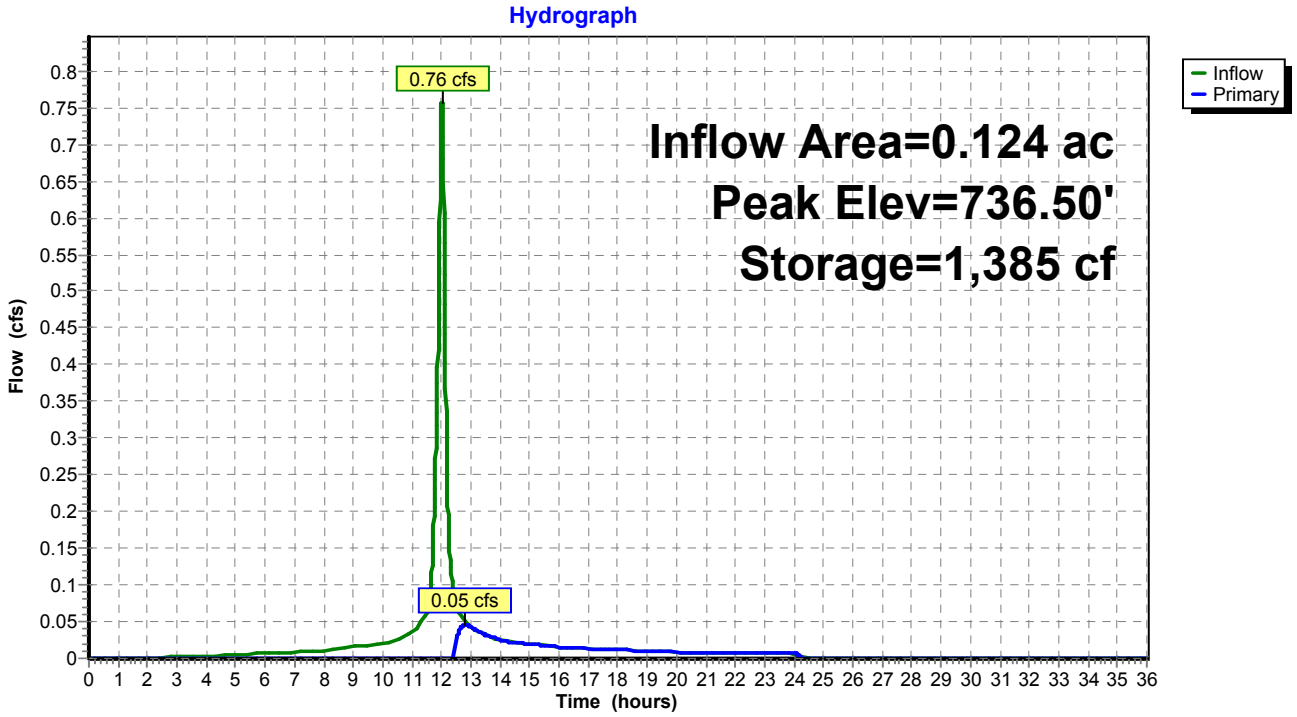
Volume	Invert	Avail.Storage	Storage Description
#1	735.50'	1,386 cf	**Stone Pad Void Storage** Listed below 3,464 cf Overall x 40.0% Voids

Elevation (feet)	Cum.Store (cubic-feet)
735.50	0
736.00	1,732
736.50	3,463
737.00	3,464

Device	Routing	Invert	Outlet Devices
#1	Primary	736.50'	**90.0' long x 3.0' breadth Broad-Crested 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=0.04 cfs @ 12.80 hrs HW=736.50' (Free Discharge)
1=Broad-Crested Weir (Weir Controls 0.04 cfs @ 0.13 fps)

Pond 3P: MLV PAD



Summary for Pond 106P: VCI

Inflow Area = 1.373 ac, 5.87% Impervious, Inflow Depth = 2.44" for 25-Year event
Inflow = 5.38 cfs @ 12.01 hrs, Volume= 0.279 af
Outflow = 5.38 cfs @ 12.01 hrs, Volume= 0.250 af, Atten= 0%, Lag= 0.0 min
Primary = 5.38 cfs @ 12.01 hrs, Volume= 0.250 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 8
Peak Elev= 736.26' @ 12.01 hrs Surf.Area= 0 sf Storage= 1,328 cf

Plug-Flow detention time= 69.8 min calculated for 0.250 af (90% of inflow)
Center-of-Mass det. time= 17.7 min (853.7 - 836.0)

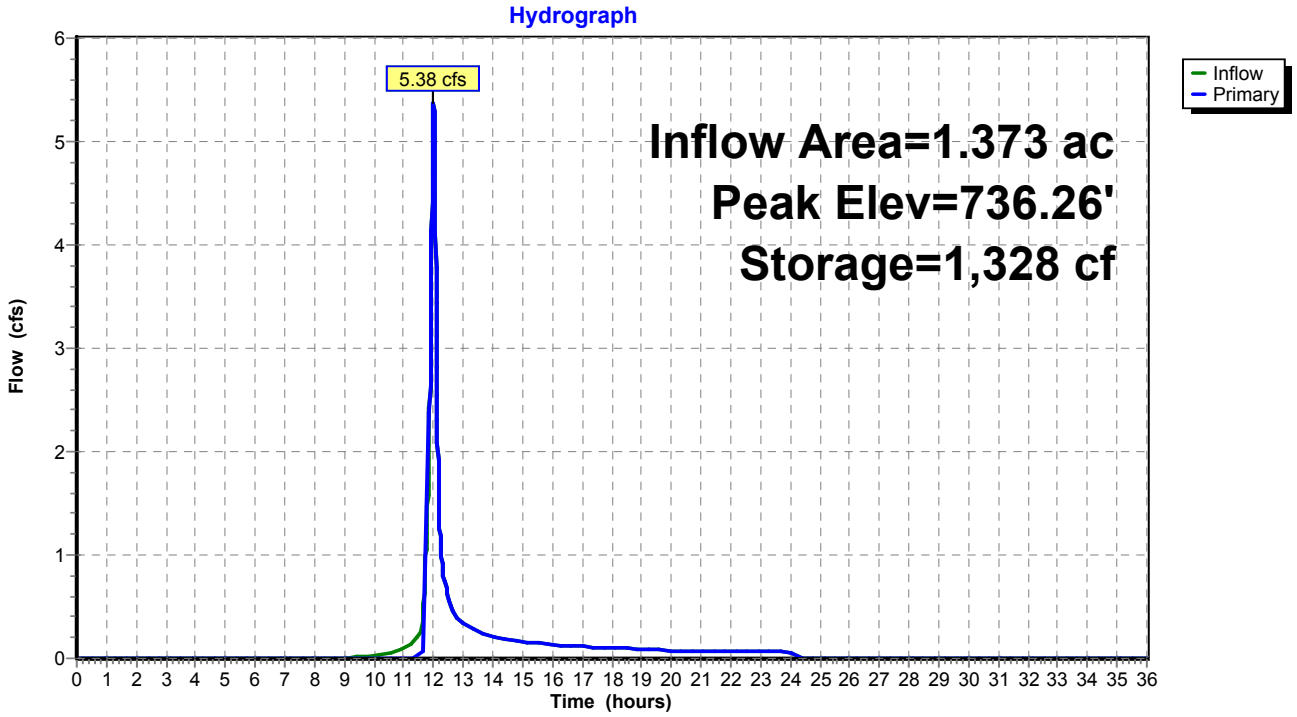
Volume	Invert	Avail.Storage	Storage Description
#1	735.00'	1,328 cf	**Custom Stage Data**Listed below

Elevation (feet)	Cum.Store (cubic-feet)
735.00	0
735.50	664
736.00	1,327
736.50	1,328

Device	Routing	Invert	Outlet Devices
#1	Primary	736.00'	**16.0' long x 2.0' 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 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Primary OutFlow Max=5.37 cfs @ 12.01 hrs HW=736.26' (Free Discharge)
↑**1=Broad-Crested Rectangular Weir** (Weir Controls 5.37 cfs @ 1.30 fps)

Pond 106P: VCI



Summary for Pond 109P: INFILTRATION BERM

Inflow Area = 1.693 ac, 11.11% Impervious, Inflow Depth = 2.13" for 25-Year event
Inflow = 6.05 cfs @ 12.00 hrs, Volume= 0.300 af
Outflow = 0.33 cfs @ 13.50 hrs, Volume= 0.127 af, Atten= 95%, Lag= 89.9 min
Primary = 0.33 cfs @ 13.50 hrs, Volume= 0.127 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 736.02' @ 13.50 hrs Surf.Area= 8,551 sf Storage= 7,699 cf

Plug-Flow detention time= 324.5 min calculated for 0.127 af (42% of inflow)
Center-of-Mass det. time= 185.6 min (1,044.0 - 858.4)

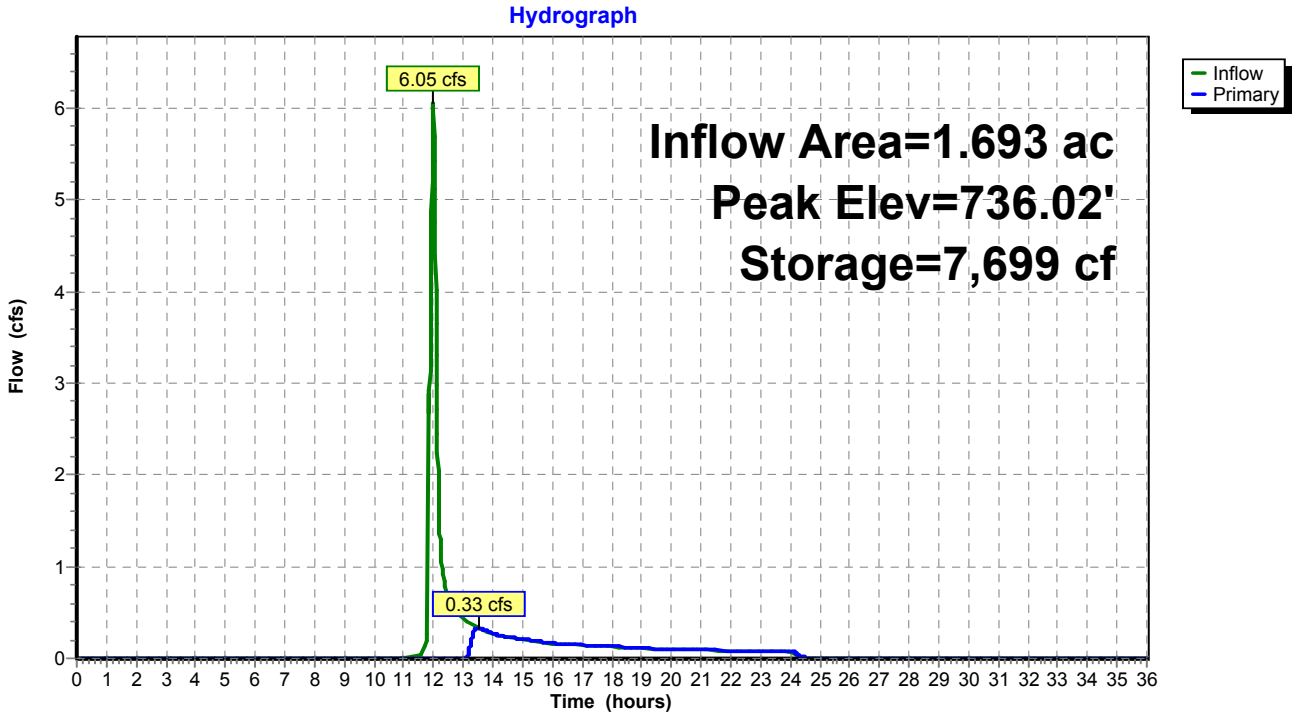
Volume	Invert	Avail.Storage	Storage Description
#1	735.00'	9,735 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
735.00	6,611	465.0	0	0	6,611
736.00	8,513	518.7	7,542	7,542	10,843
736.25	9,035	525.0	2,193	9,735	11,383

Device	Routing	Invert	Outlet Devices
#1	Primary	736.00'	**50.0' long x 2.0' 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 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Primary OutFlow Max=0.32 cfs @ 13.50 hrs HW=736.02' (Free Discharge)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 0.32 cfs @ 0.34 fps)

Pond 109P: INFILTRATION BERM

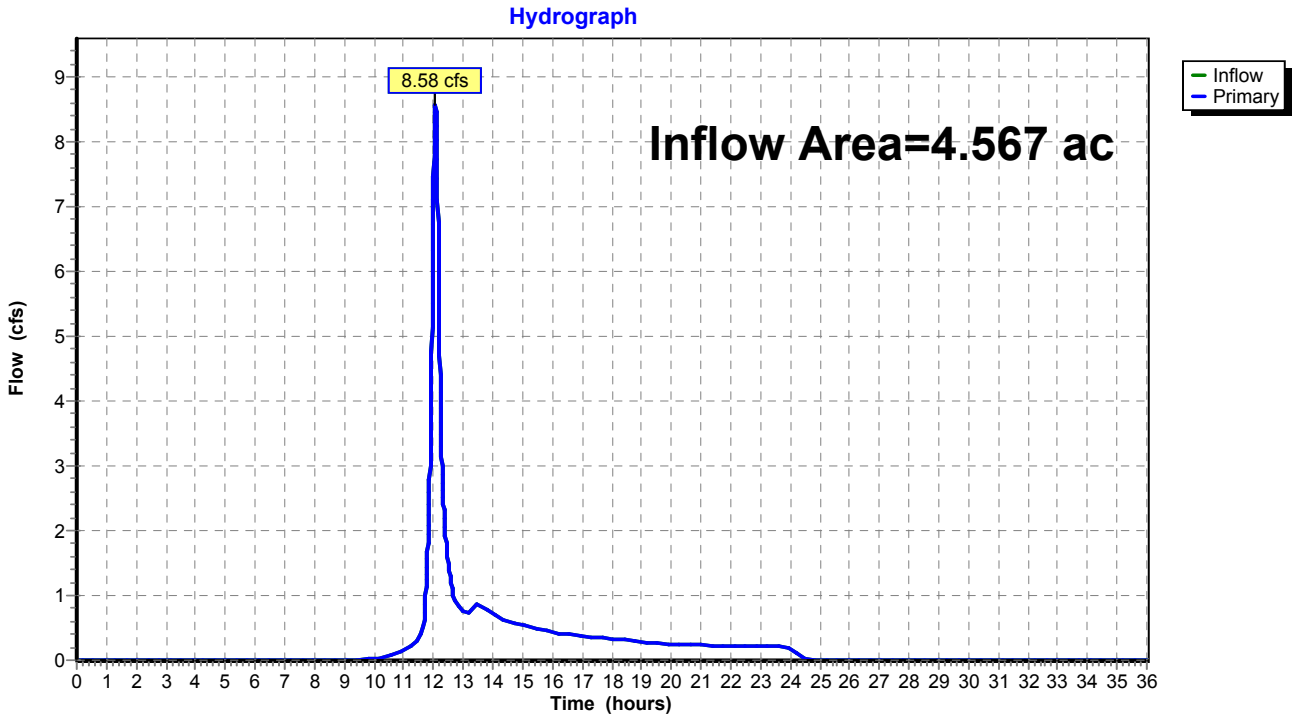


Summary for Link 105L: Proposed Conditions

Inflow Area = 4.567 ac, 7.41% Impervious, Inflow Depth = 1.76" for 25-Year event
Inflow = 8.58 cfs @ 12.07 hrs, Volume= 0.670 af
Primary = 8.58 cfs @ 12.07 hrs, Volume= 0.670 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Link 105L: Proposed Conditions



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

Subcatchment100S: DA TO VCI Runoff Area=59,820 sf 5.87% Impervious Runoff Depth=3.17"
Flow Length=361' Tc=8.9 min CN=74 Runoff=6.97 cfs 0.363 af

Subcatchment106S: OFFSITE DA Runoff Area=125,213 sf 5.23% Impervious Runoff Depth=2.98"
Flow Length=675' Tc=14.4 min CN=72 Runoff=11.30 cfs 0.713 af

Subcatchment108S: DA TO MLV PAD Runoff Area=5,380 sf 86.99% Impervious Runoff Depth=5.39"
Flow Length=240' Tc=10.5 min CN=95 Runoff=0.90 cfs 0.055 af

Subcatchment111S: DA TO INFILTRATION Runoff Area=8,535 sf 0.00% Impervious Runoff Depth=2.88"
Tc=5.0 min CN=71 Runoff=1.05 cfs 0.047 af

Pond 3P: MLV PAD Peak Elev=736.52' Storage=1,385 cf Inflow=0.90 cfs 0.055 af
Outflow=0.69 cfs 0.026 af

Pond 106P: VCI Peak Elev=736.31' Storage=1,328 cf Inflow=6.97 cfs 0.363 af
Outflow=6.97 cfs 0.332 af

Pond 109P: INFILTRATIONBERM Peak Elev=736.05' Storage=7,978 cf Inflow=7.86 cfs 0.405 af
Outflow=1.46 cfs 0.232 af

Link 105L: Proposed Conditions Inflow=11.30 cfs 0.945 af
Primary=11.30 cfs 0.945 af

Total Runoff Area = 4.567 ac Runoff Volume = 1.178 af Average Runoff Depth = 3.10"
92.59% Pervious = 4.229 ac 7.41% Impervious = 0.338 ac

Summary for Subcatchment 100S: DA TO VCI

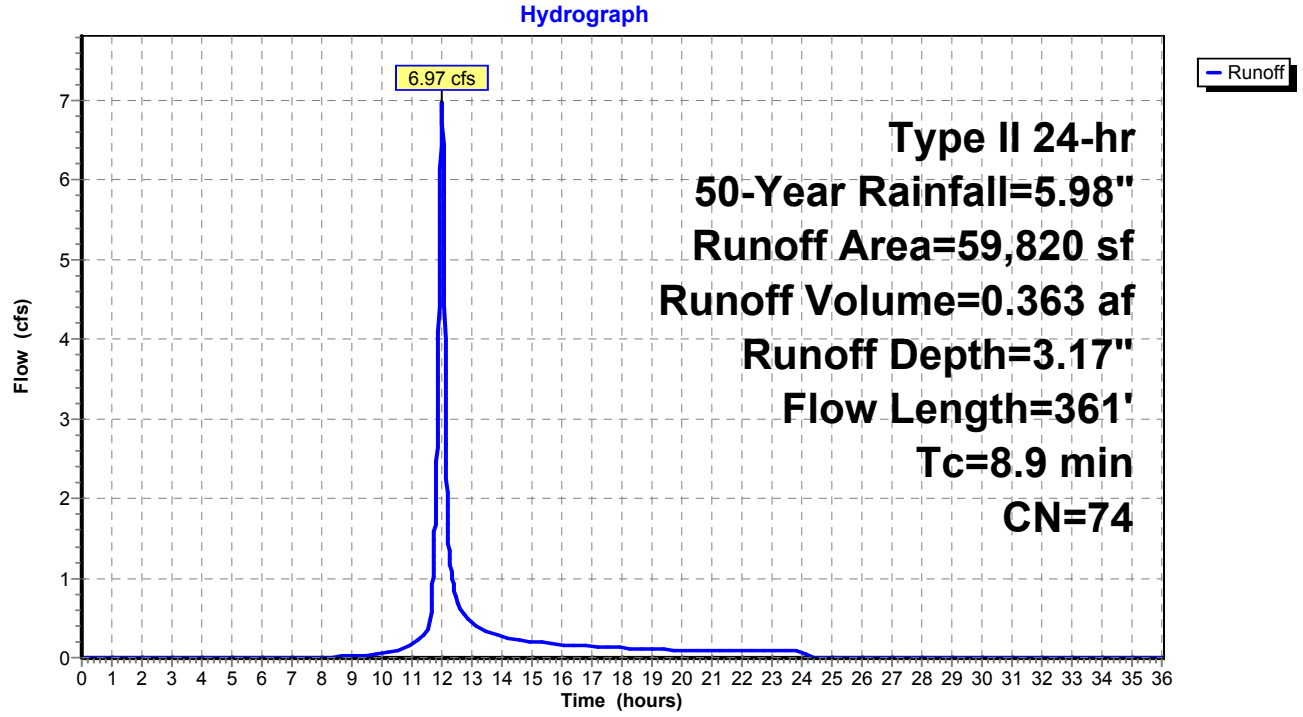
Runoff = 6.97 cfs @ 12.01 hrs, Volume= 0.363 af, Depth= 3.17"

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 50-Year Rainfall=5.98"

	Area (sf)	CN	Description
*	3,509	98	Paved Parking, HSG C
	4,122	89	Gravel roads, HSG C
*	0	98	Crushed Stone Pad, HSG C
	52,189	71	Meadow, non-grazed, HSG C
	59,820	74	Weighted Average
	56,311		94.13% Pervious Area
	3,509		5.87% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.3	15	0.0200	0.89		**Sheet Flow, Sheet** Smooth surfaces n= 0.011 P2= 2.84"
6.7	85	0.1100	0.21		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 2.84"
1.9	261	0.1100	2.32		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
8.9	361	Total			

Subcatchment 100S: DA TO VCI



Summary for Subcatchment 106S: OFFSITE DA

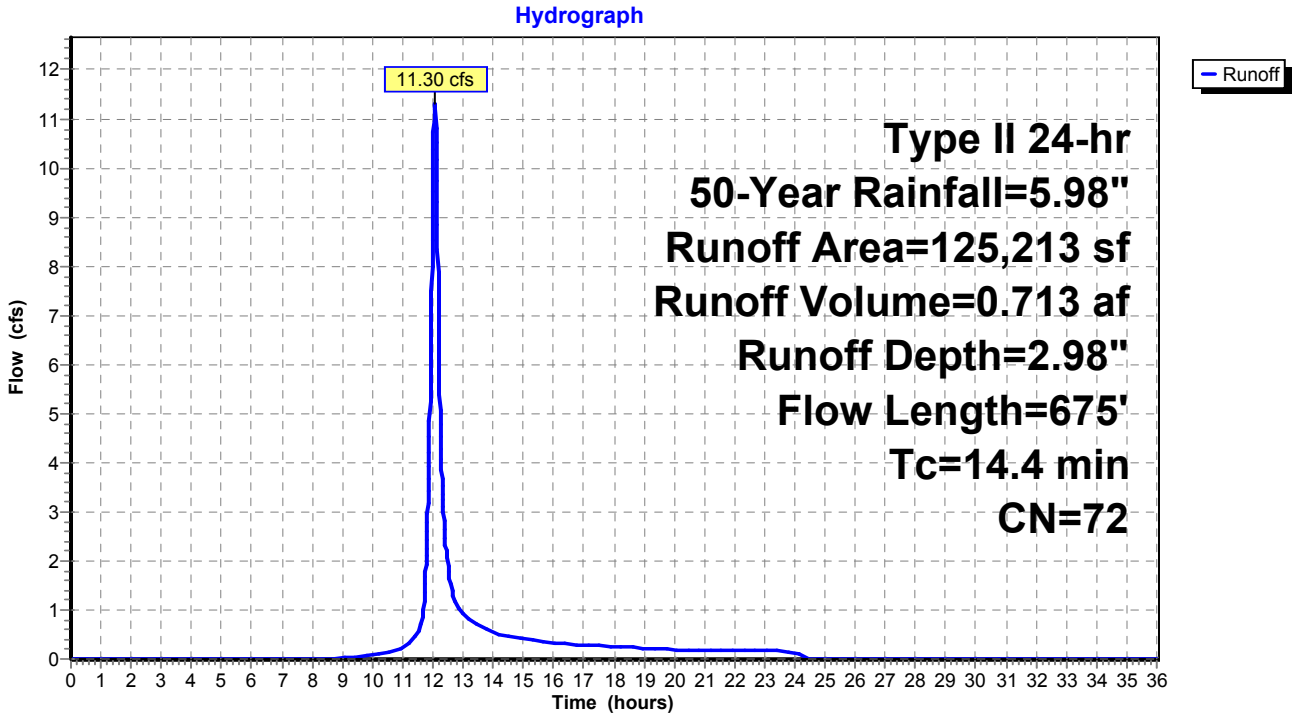
Runoff = 11.30 cfs @ 12.07 hrs, Volume= 0.713 af, Depth= 2.98"

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=5.98"

	Area (sf)	CN	Description
*	6,546	98	Paved Parking, HSG C
	0	89	Gravel roads, HSG C
*	0	98	Crushed Stone Pad, HSG C
	118,667	71	Meadow, non-grazed, HSG C
	125,213	72	Weighted Average
	118,667		94.77% Pervious Area
	6,546		5.23% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.5	100	0.0500	0.16		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 2.84"
3.7	471	0.0900	2.10		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
0.2	104	0.0900	9.48	37.92	**Channel Flow, Existing Roadside Channel** Area= 4.0 sf Perim= 12.5' r= 0.32' n= 0.022 Earth, clean & straight
14.4	675	Total			

Subcatchment 106S: OFFSITE DA



Summary for Subcatchment 108S: DA TO MLV PAD

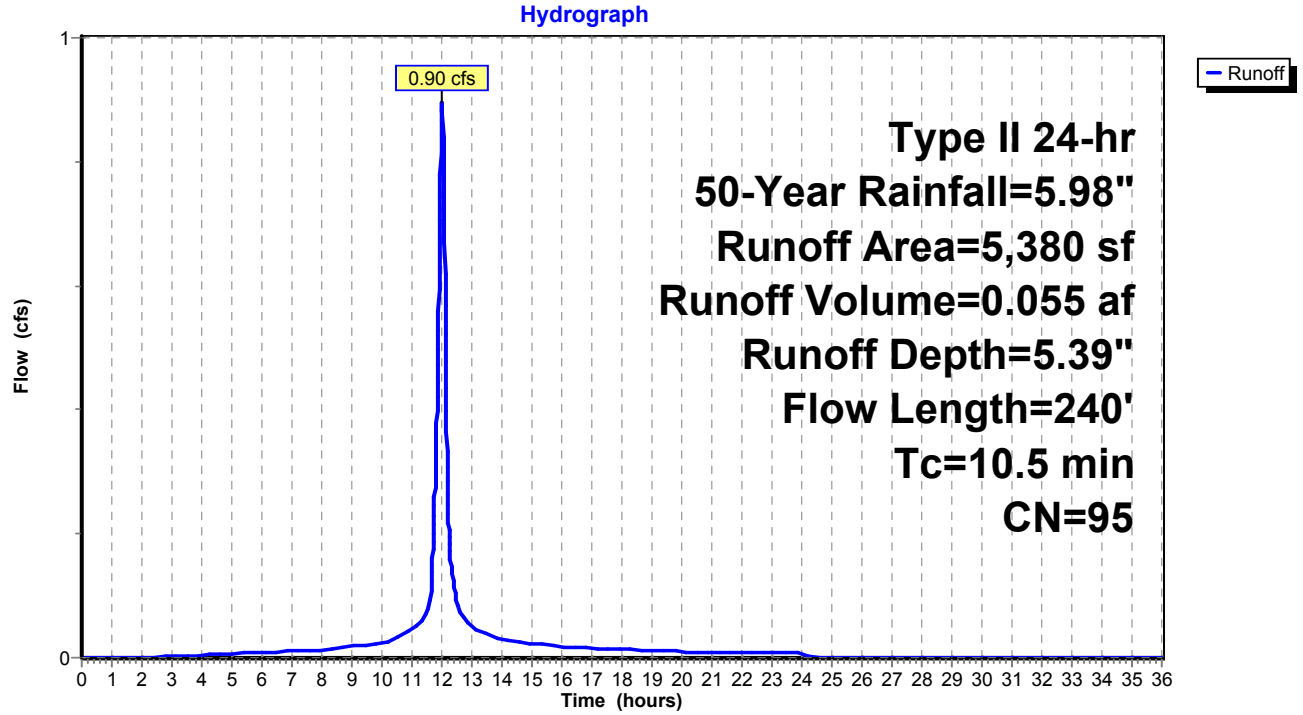
Runoff = 0.90 cfs @ 12.01 hrs, Volume= 0.055 af, Depth= 5.39"

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=5.98"

	Area (sf)	CN	Description
*	0	98	Paved Parking, HSG C
	32	89	Gravel roads, HSG C
*	4,680	98	Crushed Stone Pad, HSG C
	668	71	Meadow, non-grazed, HSG C
	5,380	95	Weighted Average
	700		13.01% Pervious Area
	4,680		86.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.9	100	0.0750	0.19		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 2.84"
1.6	140	0.0430	1.45		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
10.5	240	Total			

Subcatchment 108S: DA TO MLV PAD



Summary for Subcatchment 111S: DA TO INFILTRATION BERM

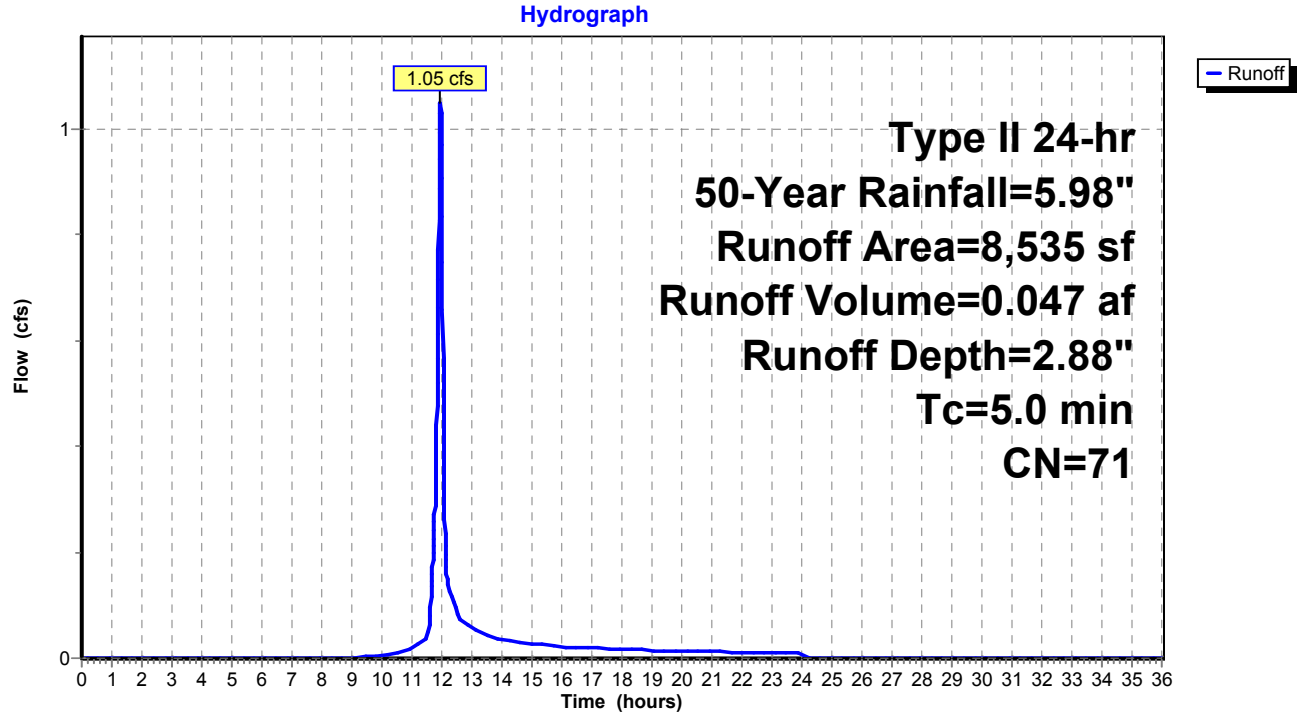
Runoff = 1.05 cfs @ 11.96 hrs, Volume= 0.047 af, Depth= 2.88"

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=5.98"

	Area (sf)	CN	Description
*	0	98	Paved Parking, HSG C
	0	89	Gravel roads, HSG C
*	0	98	Crushed Stone Pad, HSG C
	8,535	71	Meadow, non-grazed, HSG C
	8,535	71	Weighted Average
	8,535		100.00% Pervious Area

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

Subcatchment 111S: DA TO INFILTRATION BERM



Summary for Pond 3P: MLV PAD

Inflow Area = 0.124 ac, 86.99% Impervious, Inflow Depth = 5.39" for 50-Year event
Inflow = 0.90 cfs @ 12.01 hrs, Volume= 0.055 af
Outflow = 0.69 cfs @ 12.12 hrs, Volume= 0.026 af, Atten= 23%, Lag= 6.6 min
Primary = 0.69 cfs @ 12.12 hrs, Volume= 0.026 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 4
Peak Elev= 736.52' @ 12.12 hrs Surf.Area= 0 sf Storage= 1,385 cf

Plug-Flow detention time= 264.5 min calculated for 0.026 af (46% of inflow)
Center-of-Mass det. time= 136.4 min (900.5 - 764.1)

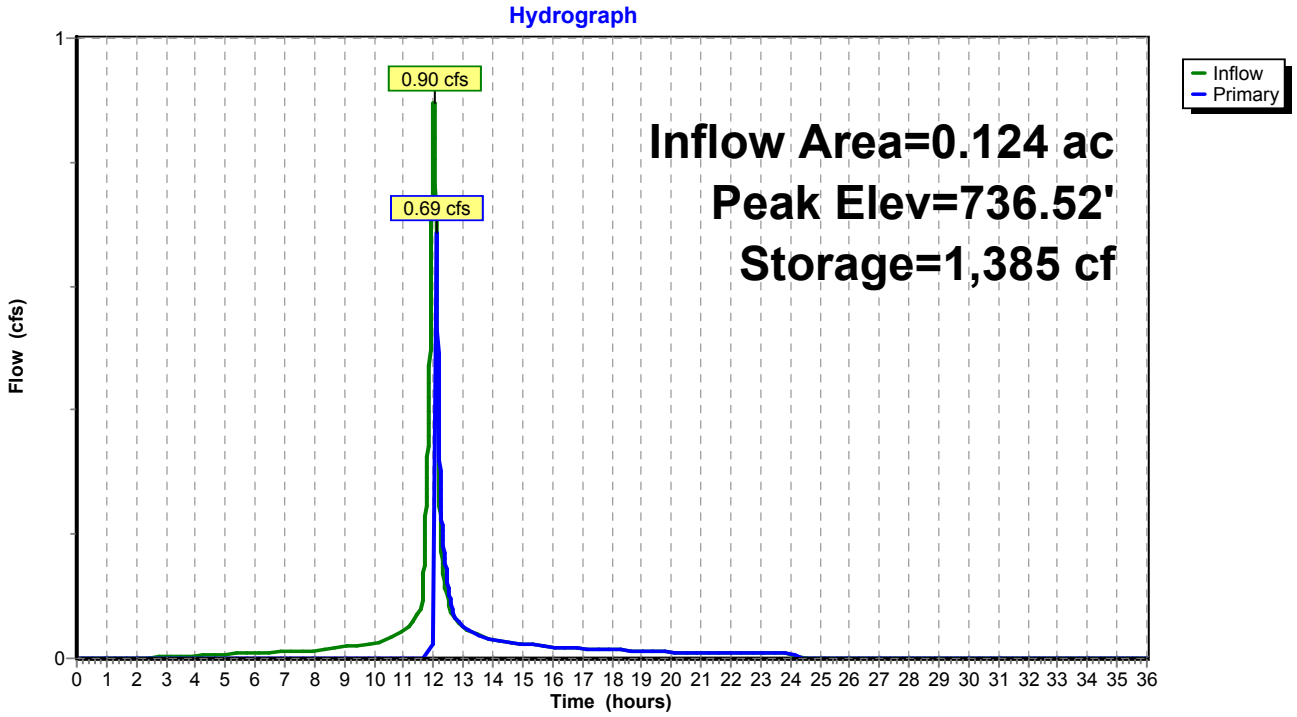
Volume	Invert	Avail.Storage	Storage Description
#1	735.50'	1,386 cf	**Stone Pad Void Storage** Listed below 3,464 cf Overall x 40.0% Voids

Elevation (feet)	Cum.Store (cubic-feet)
735.50	0
736.00	1,732
736.50	3,463
737.00	3,464

Device	Routing	Invert	Outlet Devices
#1	Primary	736.50'	**90.0' long x 3.0' breadth Broad-Crested 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=0.60 cfs @ 12.12 hrs HW=736.52' (Free Discharge)
1=Broad-Crested Weir (Weir Controls 0.60 cfs @ 0.34 fps)

Pond 3P: MLV PAD



Summary for Pond 106P: VCI

Inflow Area = 1.373 ac, 5.87% Impervious, Inflow Depth = 3.17" for 50-Year event
Inflow = 6.97 cfs @ 12.01 hrs, Volume= 0.363 af
Outflow = 6.97 cfs @ 12.01 hrs, Volume= 0.332 af, Atten= 0%, Lag= 0.0 min
Primary = 6.97 cfs @ 12.01 hrs, Volume= 0.332 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 8
Peak Elev= 736.31' @ 12.01 hrs Surf.Area= 0 sf Storage= 1,328 cf

Plug-Flow detention time= 59.4 min calculated for 0.332 af (92% of inflow)
Center-of-Mass det. time= 15.4 min (843.9 - 828.5)

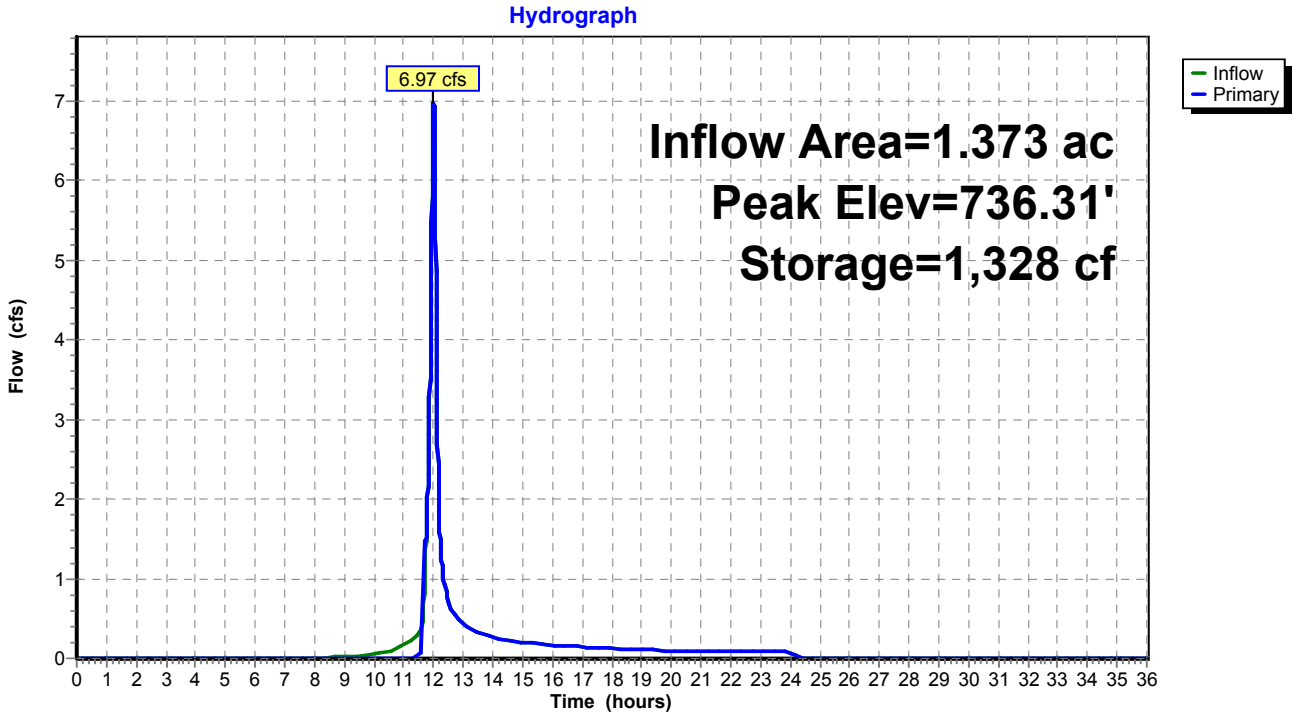
Volume	Invert	Avail.Storage	Storage Description
#1	735.00'	1,328 cf	**Custom Stage Data**Listed below

Elevation (feet)	Cum.Store (cubic-feet)
735.00	0
735.50	664
736.00	1,327
736.50	1,328

Device	Routing	Invert	Outlet Devices
#1	Primary	736.00'	**16.0' long x 2.0' 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 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Primary OutFlow Max=6.96 cfs @ 12.01 hrs HW=736.31' (Free Discharge)
1=Broad-Crested Rectangular Weir (Weir Controls 6.96 cfs @ 1.42 fps)

Pond 106P: VCI



Summary for Pond 109P: INFILTRATION BERM

Inflow Area = 1.693 ac, 11.11% Impervious, Inflow Depth = 2.87" for 50-Year event
Inflow = 7.86 cfs @ 12.00 hrs, Volume= 0.405 af
Outflow = 1.46 cfs @ 12.30 hrs, Volume= 0.232 af, Atten= 81%, Lag= 17.9 min
Primary = 1.46 cfs @ 12.30 hrs, Volume= 0.232 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 736.05' @ 12.30 hrs Surf.Area= 8,618 sf Storage= 7,978 cf

Plug-Flow detention time= 226.2 min calculated for 0.232 af (57% of inflow)
Center-of-Mass det. time= 104.4 min (950.5 - 846.1)

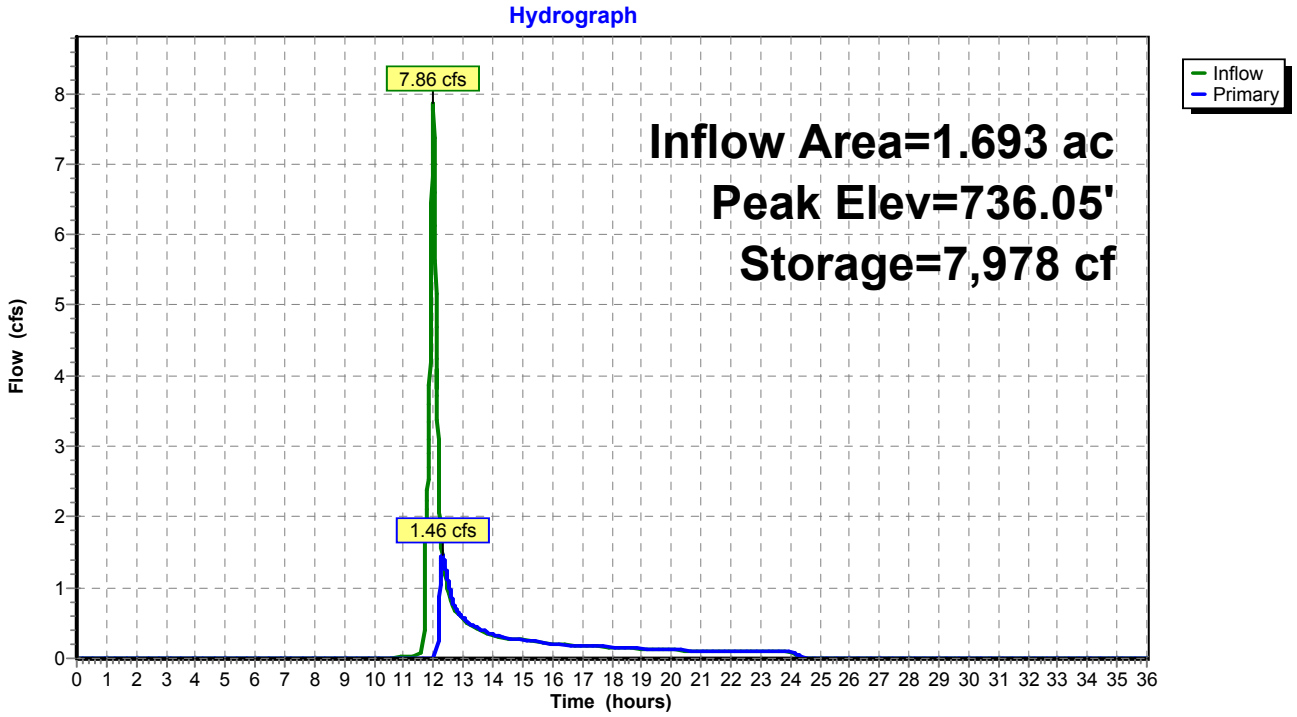
Volume	Invert	Avail.Storage	Storage Description
#1	735.00'	9,735 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
735.00	6,611	465.0	0	0	6,611
736.00	8,513	518.7	7,542	7,542	10,843
736.25	9,035	525.0	2,193	9,735	11,383

Device	Routing	Invert	Outlet Devices
#1	Primary	736.00'	**50.0' long x 2.0' 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 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Primary OutFlow Max=1.46 cfs @ 12.30 hrs HW=736.05' (Free Discharge)
1=Broad-Crested Rectangular Weir (Weir Controls 1.46 cfs @ 0.57 fps)

Pond 109P: INFILTRATION BERM

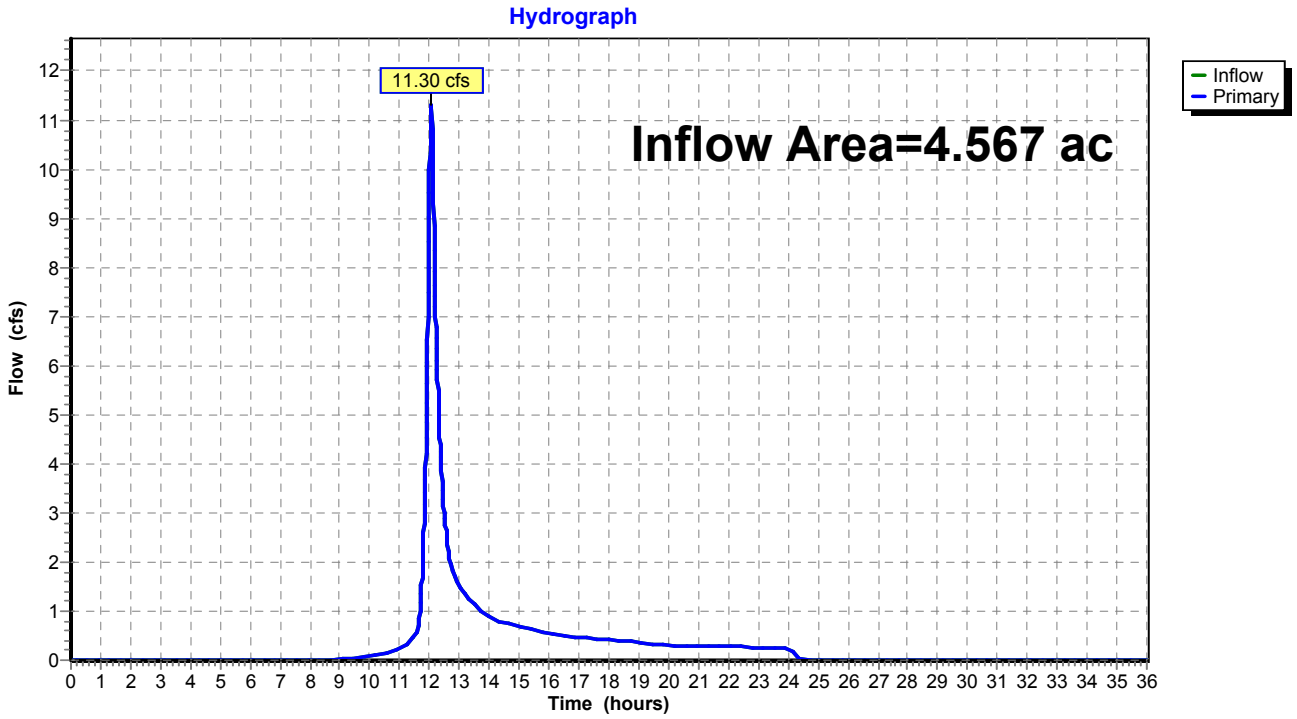


Summary for Link 105L: Proposed Conditions

Inflow Area = 4.567 ac, 7.41% Impervious, Inflow Depth = 2.48" for 50-Year event
Inflow = 11.30 cfs @ 12.07 hrs, Volume= 0.945 af
Primary = 11.30 cfs @ 12.07 hrs, Volume= 0.945 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Link 105L: Proposed Conditions



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

Subcatchment100S: DA TO VCI Runoff Area=59,820 sf 5.87% Impervious Runoff Depth=4.07"
Flow Length=361' Tc=8.9 min CN=74 Runoff=8.90 cfs 0.466 af

Subcatchment106S: OFFSITE DA Runoff Area=125,213 sf 5.23% Impervious Runoff Depth=3.85"
Flow Length=675' Tc=14.4 min CN=72 Runoff=14.63 cfs 0.923 af

Subcatchment108S: DA TO MLV PAD Runoff Area=5,380 sf 86.99% Impervious Runoff Depth=6.44"
Flow Length=240' Tc=10.5 min CN=95 Runoff=1.06 cfs 0.066 af

Subcatchment111S: DA TO INFILTRATION Runoff Area=8,535 sf 0.00% Impervious Runoff Depth=3.75"
Tc=5.0 min CN=71 Runoff=1.36 cfs 0.061 af

Pond 3P: MLV PAD Peak Elev=736.53' Storage=1,385 cf Inflow=1.06 cfs 0.066 af
Outflow=1.29 cfs 0.037 af

Pond 106P: VCI Peak Elev=736.36' Storage=1,328 cf Inflow=8.90 cfs 0.466 af
Outflow=8.90 cfs 0.435 af

Pond 109P: INFILTRATIONBERM Peak Elev=736.13' Storage=8,698 cf Inflow=10.53 cfs 0.533 af
Outflow=6.21 cfs 0.360 af

Link 105L: Proposed Conditions Inflow=20.40 cfs 1.283 af
Primary=20.40 cfs 1.283 af

Total Runoff Area = 4.567 ac Runoff Volume = 1.516 af Average Runoff Depth = 3.98"
92.59% Pervious = 4.229 ac 7.41% Impervious = 0.338 ac

Summary for Subcatchment 100S: DA TO VCI

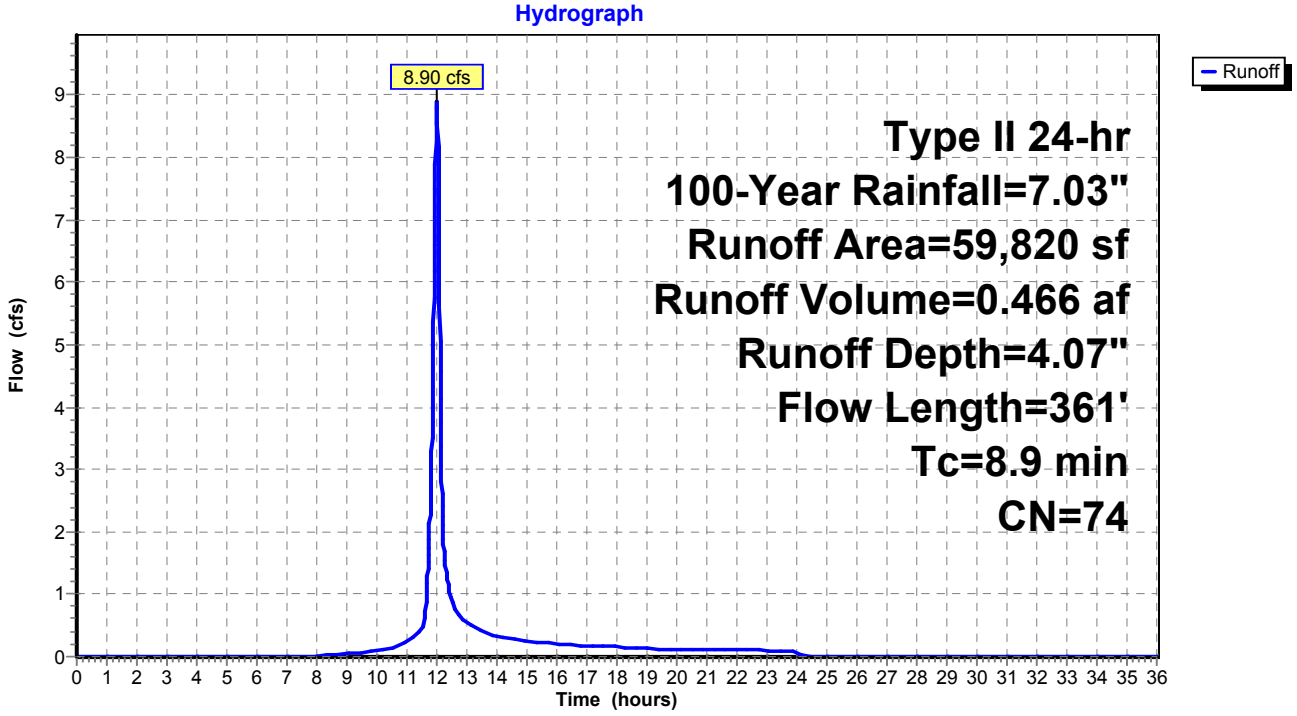
Runoff = 8.90 cfs @ 12.00 hrs, Volume= 0.466 af, Depth= 4.07"

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=7.03"

	Area (sf)	CN	Description
*	3,509	98	Paved Parking, HSG C
	4,122	89	Gravel roads, HSG C
*	0	98	Crushed Stone Pad, HSG C
	52,189	71	Meadow, non-grazed, HSG C
	59,820	74	Weighted Average
	56,311		94.13% Pervious Area
	3,509		5.87% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.3	15	0.0200	0.89		**Sheet Flow, Sheet** Smooth surfaces n= 0.011 P2= 2.84"
6.7	85	0.1100	0.21		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 2.84"
1.9	261	0.1100	2.32		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
8.9	361	Total			

Subcatchment 100S: DA TO VCI



Summary for Subcatchment 106S: OFFSITE DA

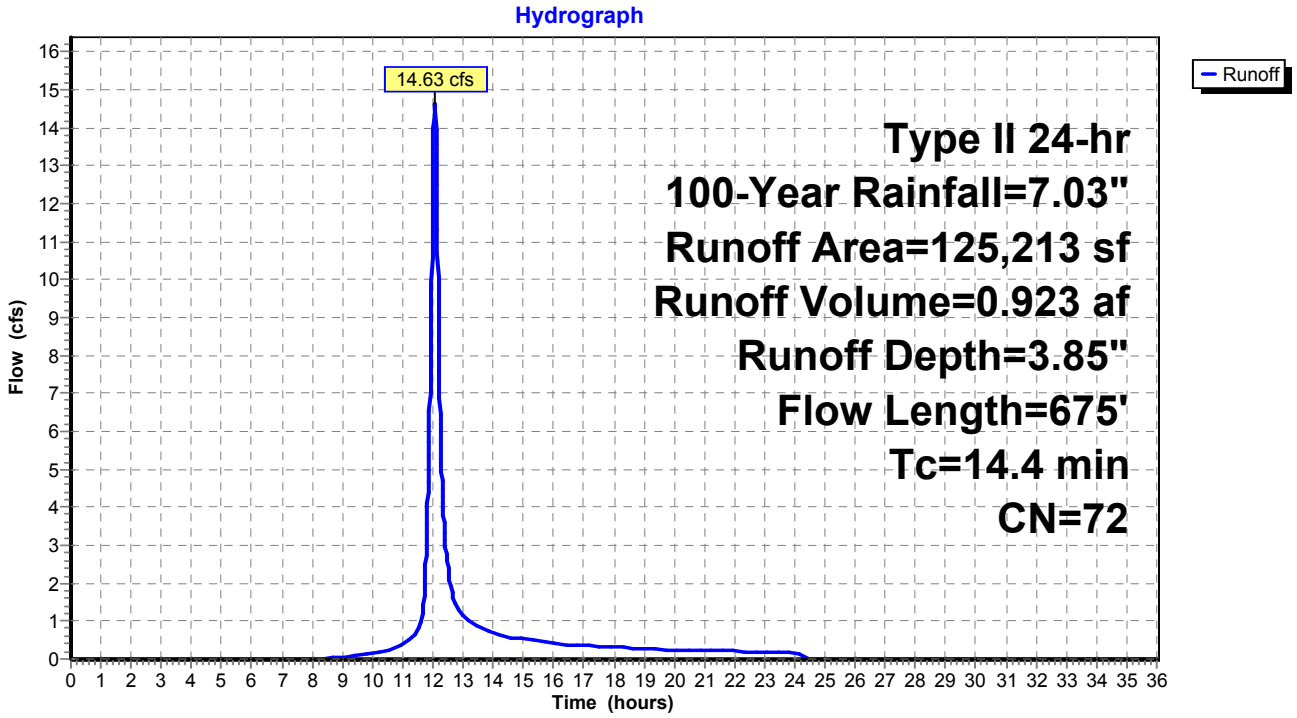
Runoff = 14.63 cfs @ 12.06 hrs, Volume= 0.923 af, Depth= 3.85"

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=7.03"

	Area (sf)	CN	Description
*	6,546	98	Paved Parking, HSG C
	0	89	Gravel roads, HSG C
*	0	98	Crushed Stone Pad, HSG C
	118,667	71	Meadow, non-grazed, HSG C
	125,213	72	Weighted Average
	118,667		94.77% Pervious Area
	6,546		5.23% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.5	100	0.0500	0.16		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 2.84"
3.7	471	0.0900	2.10		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
0.2	104	0.0900	9.48	37.92	**Channel Flow, Existing Roadside Channel** Area= 4.0 sf Perim= 12.5' r= 0.32' n= 0.022 Earth, clean & straight
14.4	675	Total			

Subcatchment 106S: OFFSITE DA



Summary for Subcatchment 108S: DA TO MLV PAD

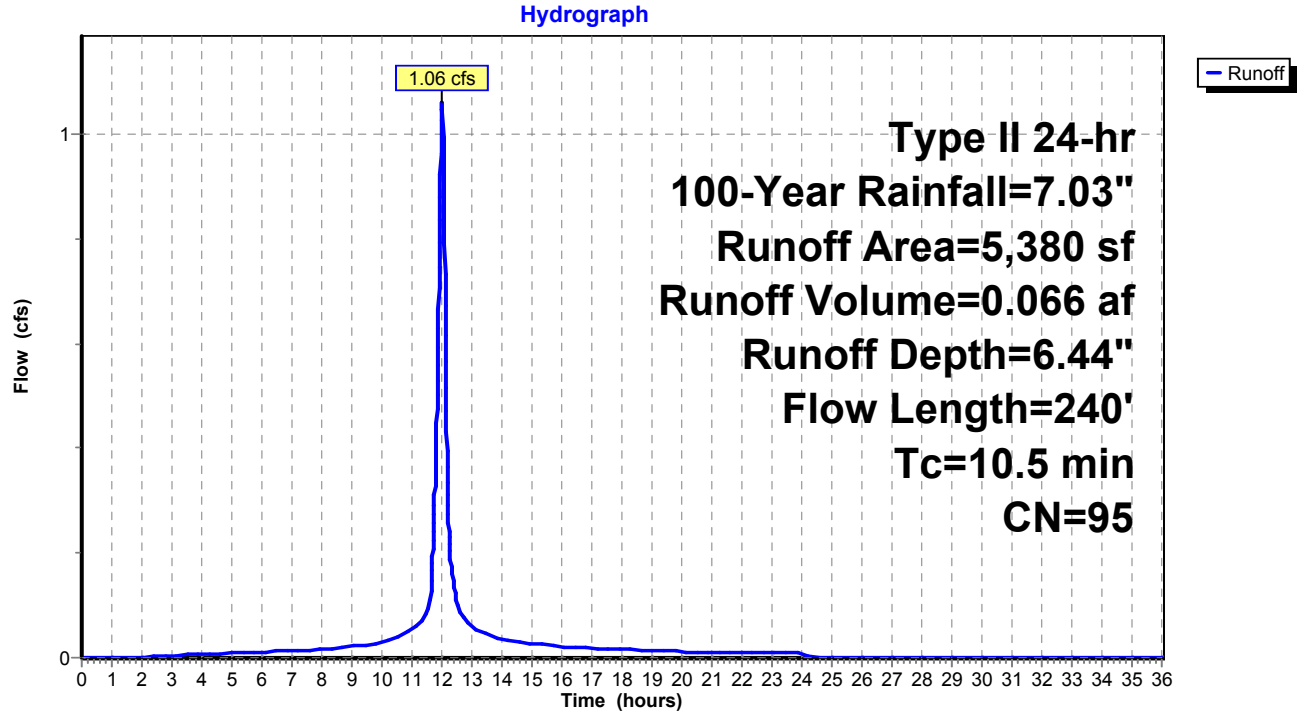
Runoff = 1.06 cfs @ 12.01 hrs, Volume= 0.066 af, Depth= 6.44"

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=7.03"

	Area (sf)	CN	Description
*	0	98	Paved Parking, HSG C
	32	89	Gravel roads, HSG C
*	4,680	98	Crushed Stone Pad, HSG C
	668	71	Meadow, non-grazed, HSG C
	5,380	95	Weighted Average
	700		13.01% Pervious Area
	4,680		86.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.9	100	0.0750	0.19		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 2.84"
1.6	140	0.0430	1.45		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
10.5	240	Total			

Subcatchment 108S: DA TO MLV PAD



Summary for Subcatchment 111S: DA TO INFILTRATION BERM

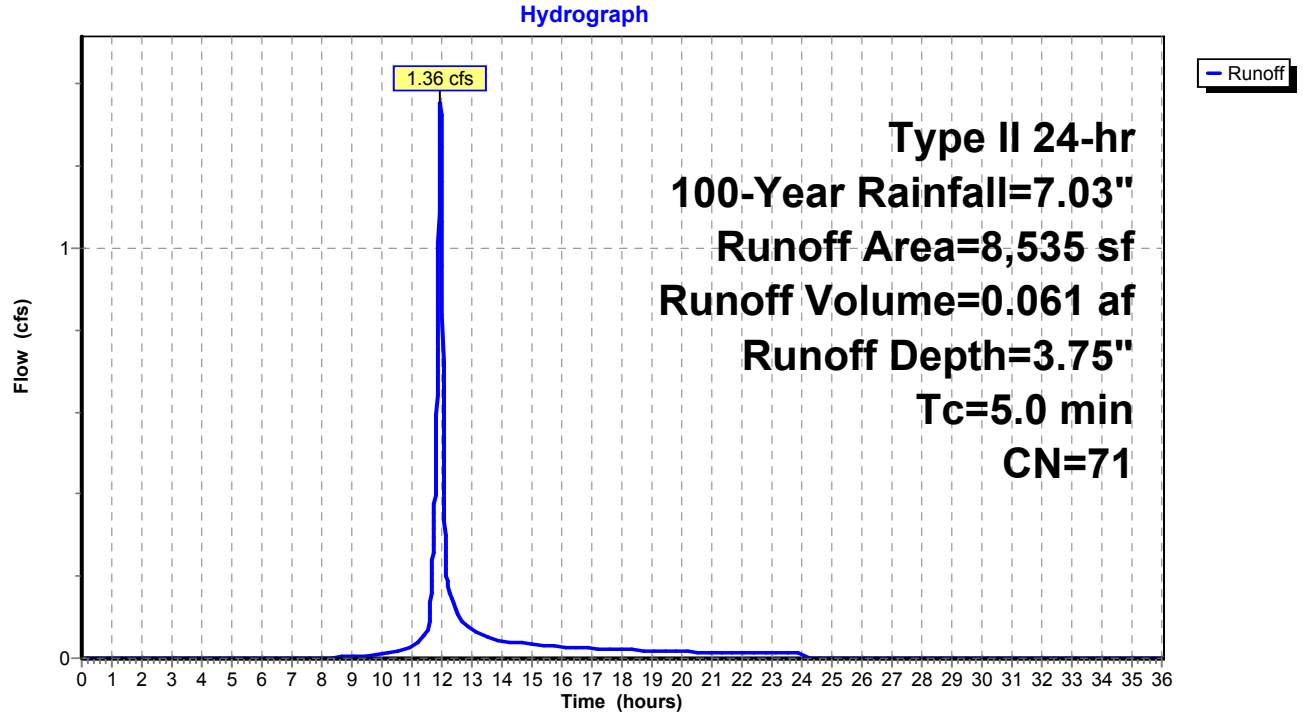
Runoff = 1.36 cfs @ 11.96 hrs, Volume= 0.061 af, Depth= 3.75"

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 100-Year Rainfall=7.03"

	Area (sf)	CN	Description
*	0	98	Paved Parking, HSG C
	0	89	Gravel roads, HSG C
*	0	98	Crushed Stone Pad, HSG C
	8,535	71	Meadow, non-grazed, HSG C
	8,535	71	Weighted Average
	8,535		100.00% Pervious Area

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

Subcatchment 111S: DA TO INFILTRATION BERM



Summary for Pond 3P: MLV PAD

Inflow Area = 0.124 ac, 86.99% Impervious, Inflow Depth = 6.44" for 100-Year event
Inflow = 1.06 cfs @ 12.01 hrs, Volume= 0.066 af
Outflow = 1.29 cfs @ 12.03 hrs, Volume= 0.037 af, Atten= 0%, Lag= 1.2 min
Primary = 1.29 cfs @ 12.03 hrs, Volume= 0.037 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 4
Peak Elev= 736.53' @ 12.03 hrs Surf.Area= 0 sf Storage= 1,385 cf

Plug-Flow detention time= 222.8 min calculated for 0.037 af (55% of inflow)
Center-of-Mass det. time= 108.2 min (868.5 - 760.3)

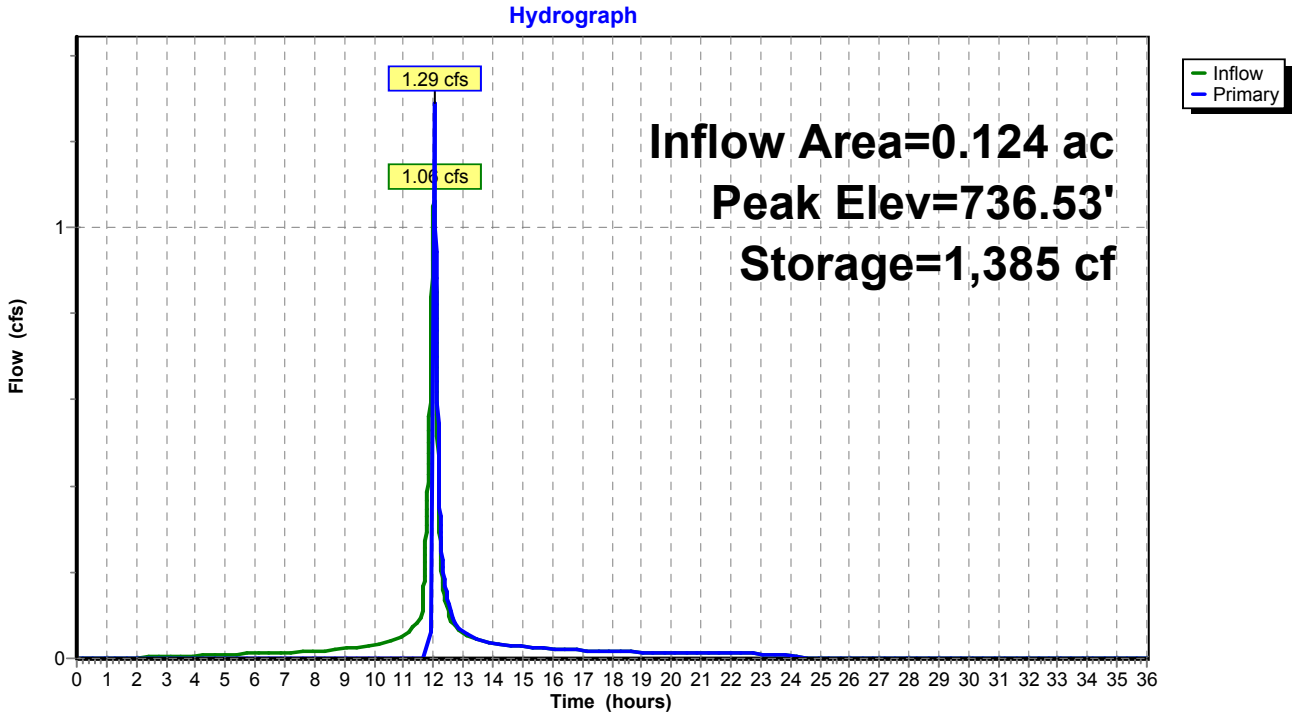
Volume	Invert	Avail.Storage	Storage Description
#1	735.50'	1,386 cf	**Stone Pad Void Storage** Listed below 3,464 cf Overall x 40.0% Voids

Elevation (feet)	Cum.Store (cubic-feet)
735.50	0
736.00	1,732
736.50	3,463
737.00	3,464

Device	Routing	Invert	Outlet Devices
#1	Primary	736.50'	**90.0' long x 3.0' breadth Broad-Crested 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=1.11 cfs @ 12.03 hrs HW=736.53' (Free Discharge)
↑—**1=Broad-Crested Weir** (Weir Controls 1.11 cfs @ 0.42 fps)

Pond 3P: MLV PAD



Summary for Pond 106P: VCI

Inflow Area = 1.373 ac, 5.87% Impervious, Inflow Depth = 4.07" for 100-Year event
Inflow = 8.90 cfs @ 12.00 hrs, Volume= 0.466 af
Outflow = 8.90 cfs @ 12.00 hrs, Volume= 0.435 af, Atten= 0%, Lag= 0.0 min
Primary = 8.90 cfs @ 12.00 hrs, Volume= 0.435 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 8
Peak Elev= 736.36' @ 12.00 hrs Surf.Area= 0 sf Storage= 1,328 cf

Plug-Flow detention time= 49.9 min calculated for 0.435 af (93% of inflow)
Center-of-Mass det. time= 13.8 min (835.2 - 821.4)

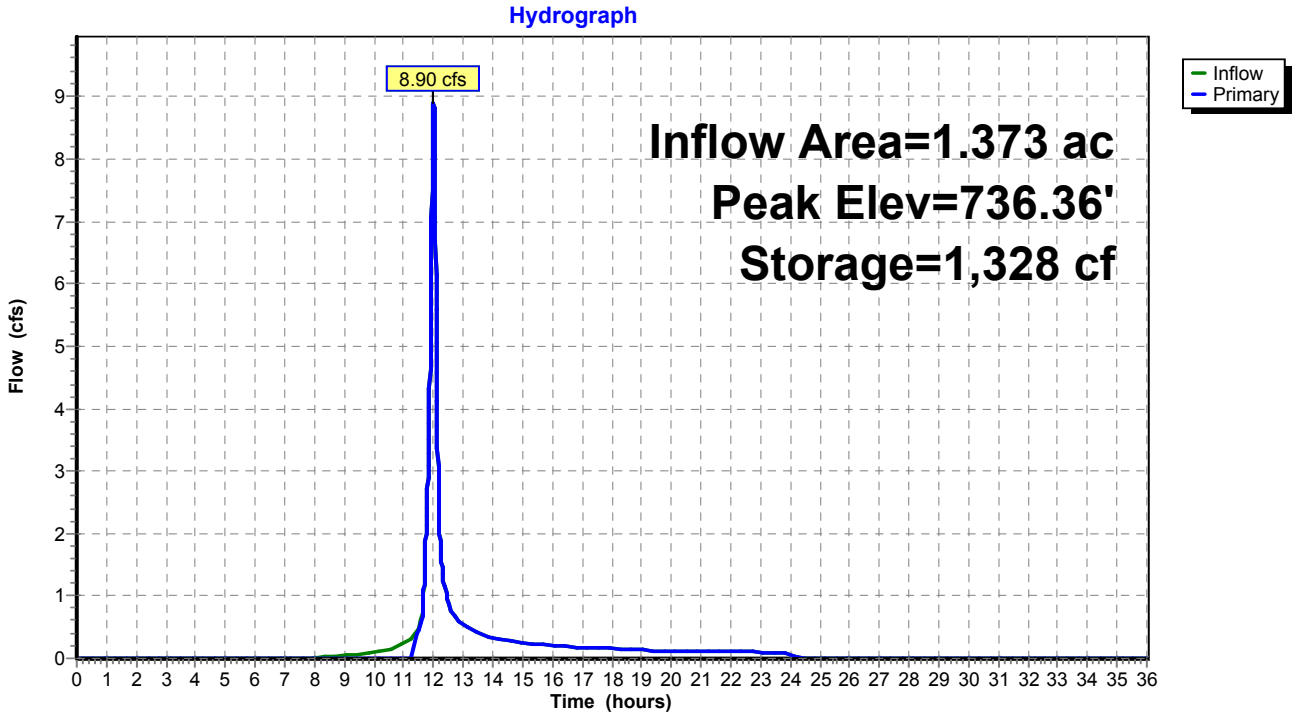
Volume	Invert	Avail.Storage	Storage Description
#1	735.00'	1,328 cf	**Custom Stage Data**Listed below

Elevation (feet)	Cum.Store (cubic-feet)
735.00	0
735.50	664
736.00	1,327
736.50	1,328

Device	Routing	Invert	Outlet Devices
#1	Primary	736.00'	**16.0' long x 2.0' 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 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Primary OutFlow Max=8.88 cfs @ 12.00 hrs HW=736.36' (Free Discharge)
↑**1=Broad-Crested Rectangular Weir** (Weir Controls 8.88 cfs @ 1.55 fps)

Pond 106P: VCI



Summary for Pond 109P: INFILTRATION BERM

Inflow Area = 1.693 ac, 11.11% Impervious, Inflow Depth = 3.78" for 100-Year event
Inflow = 10.53 cfs @ 12.03 hrs, Volume= 0.533 af
Outflow = 6.21 cfs @ 12.10 hrs, Volume= 0.360 af, Atten= 41%, Lag= 4.1 min
Primary = 6.21 cfs @ 12.10 hrs, Volume= 0.360 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 736.13' @ 12.10 hrs Surf.Area= 8,790 sf Storage= 8,698 cf

Plug-Flow detention time= 173.9 min calculated for 0.360 af (68% of inflow)
Center-of-Mass det. time= 67.0 min (903.2 - 836.2)

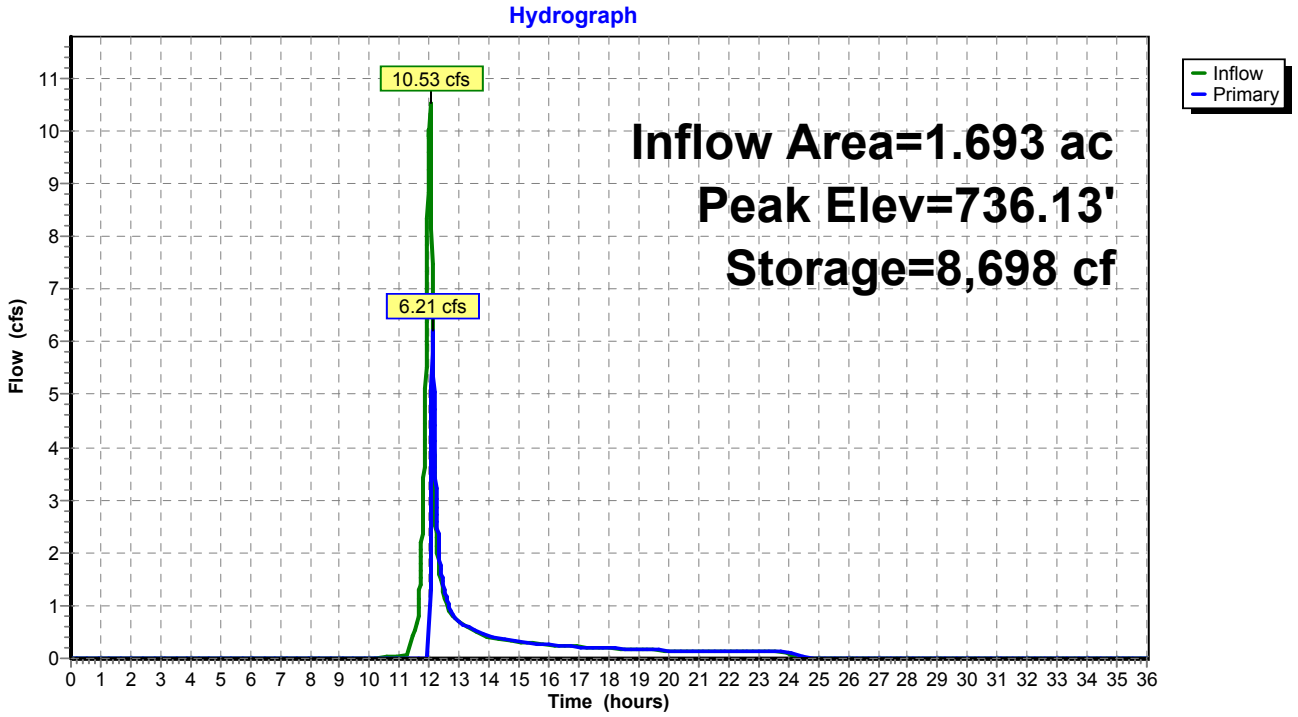
Volume	Invert	Avail.Storage	Storage Description
#1	735.00'	9,735 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
735.00	6,611	465.0	0	0	6,611
736.00	8,513	518.7	7,542	7,542	10,843
736.25	9,035	525.0	2,193	9,735	11,383

Device	Routing	Invert	Outlet Devices
#1	Primary	736.00'	**50.0' long x 2.0' 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 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Primary OutFlow Max=6.20 cfs @ 12.10 hrs HW=736.13' (Free Discharge)
1=Broad-Crested Rectangular Weir (Weir Controls 6.20 cfs @ 0.93 fps)

Pond 109P: INFILTRATION BERM

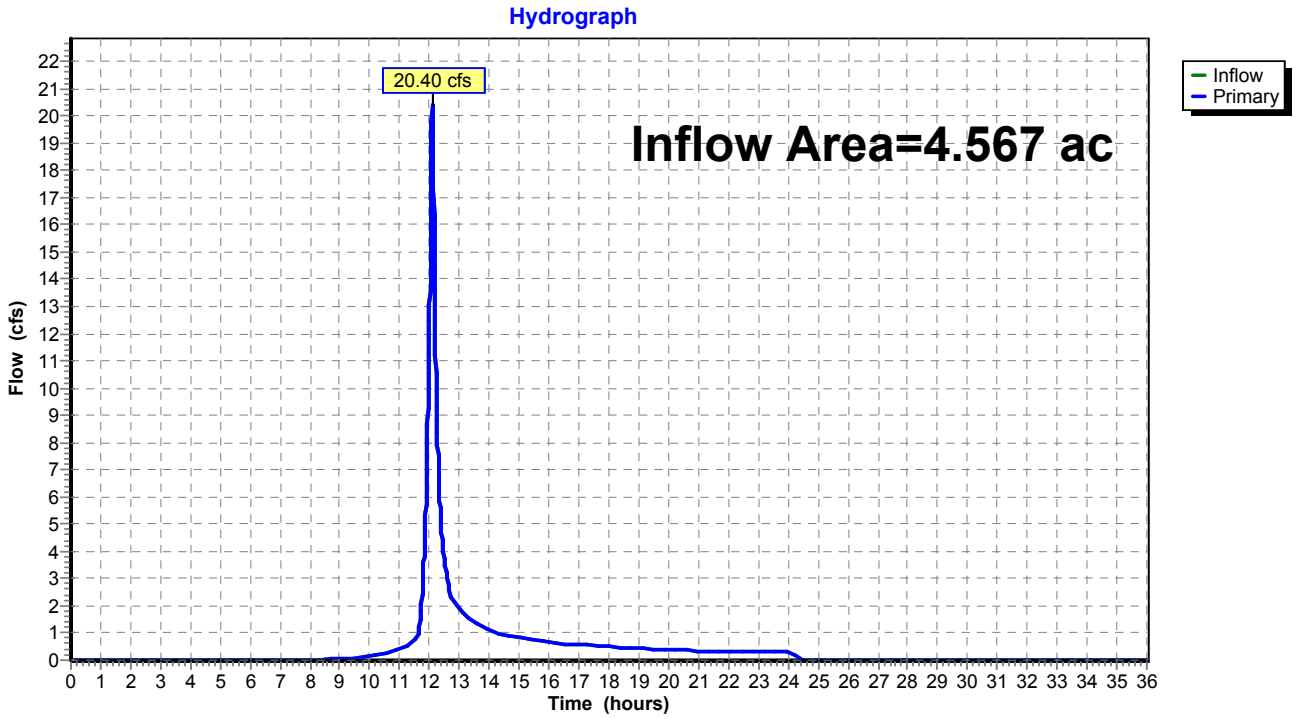


Summary for Link 105L: Proposed Conditions

Inflow Area = 4.567 ac, 7.41% Impervious, Inflow Depth = 3.37" for 100-Year event
Inflow = 20.40 cfs @ 12.09 hrs, Volume= 1.283 af
Primary = 20.40 cfs @ 12.09 hrs, Volume= 1.283 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Link 105L: Proposed Conditions



I-3.5 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-CO-95.1.1.3 Vegetated Channel for Infiltration (VCI)

PREPARED BY: JMS ***REVISED BY: JMS*** DATE: 9/28/15 ***REV 10/19/16***

CHECKED BY: BJP ***CHECKED BY: SK*** DATE: 9/28/15 ***REV 10/19/16***

CHANNEL OR CHANNEL SECTION		AR-CO-095.1.1.3 VCI	AR-CO-095.1.1.3 VCI
TEMPORARY OR PERMANENT?	(T OR P)	P	P
DESIGN STORM	(2, 5, OR 10 YR)	10	10
ACRES	(AC)	1.37	1.37
MULTIPLIER[1]	(1.6, 2.25, or 2.75)[1]	N/A	N/A
Qr (REQUIRED CAPACITY)	(CFS)	3.73	3.73
Q (CALCULATED AT FLOW DEPTH d)	(CFS)	3.61	3.73
PROTECTIVE LINING[2]		SC250	SC250 REINFORCED VEGETATION
n (MANNING'S COEFFICIENT)[2]		0.04	0.158
Va (ALLOWABLE VELOCITY)	(FPS)	N/A	N/A
V (CALCULATED AT FLOW DEPTH d)	(FPS)	1.62	0.68
τa (MAX ALLOWABLE SHEAR STRESS)	(LB/FT^2)	2.50	8.00
τd (CALC'D SHEAR STRESS AT FLOW DEPTH d)	(LB/FT^2)	0.22	0.49
CHANNEL BOTTOM WIDTH	(FT)	10	10
CHANNEL SIDE SLOPES	(H:V)	3	3
D (TOTAL DEPTH)	(FT)	2.0	2.0
CHANNEL TOP WIDTH @ D	(FT)	22	22
d (CALCULATED FLOW DEPTH)	(FT)	0.21	0.48
CHANNEL TOP WIDTH @ FLOW DEPTH d	(FT)	11.26	12.88
BOTTOM WIDTH: FLOW DEPTH RATIO	(12:1 MAX)	47.62	20.83
d50 STONE SIZE	(IN)	N/A	N/A
A (CROSS-SECTIONAL AREA)	(SQ. FT.)	2.23	5.49
R (HYDRAULIC RADIUS)		0.20	0.42
S (BED SLOPE)[3]	(FT/FT)	0.0165	0.0165
Sc (CRITICAL SLOPE)	(FT/FT)	0.040	0.491
.7Sc	(FT/FT)	0.028	0.344
1.3Sc	(FT/FT)	0.052	0.638
STABLE FLOW?	(Y/N)	Y	Y
FREEBOARD BASED ON UNSTABLE FLOW	(FT)	0.03	0.02
FREEBOARD BASED ON STABLE FLOW	(FT)	0.50	0.50
MINIMUM REQUIRED FREEBOARD[4]	(FT)	0.50	0.50
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:
3.73	0.013	0.0165	0.925	11.104	**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: PAR-CO-095.1.1.3-VCI

Discharge	3.73
Peak Flow Period	24
Channel Slope	0.0165
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

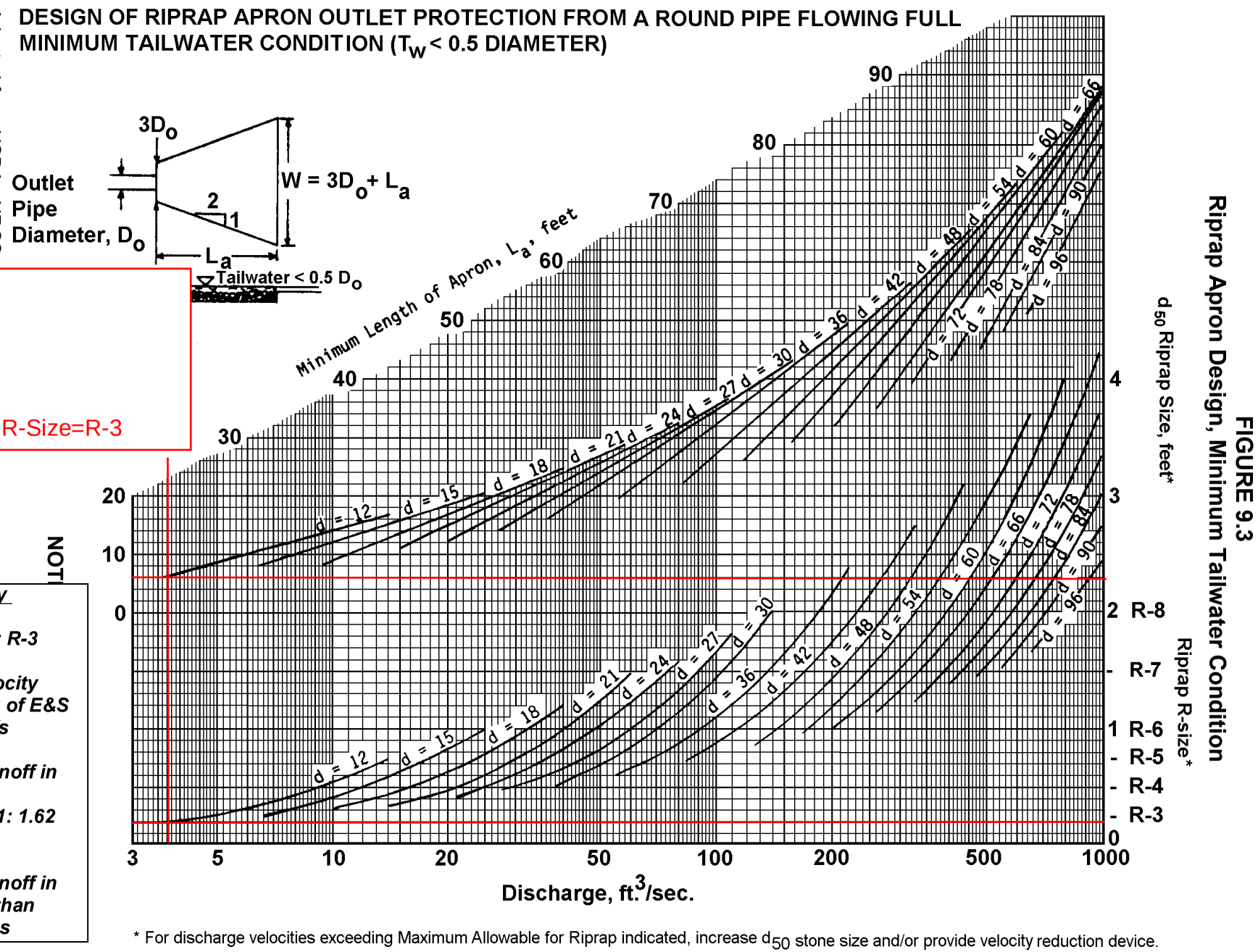
SC250 - Class C - Mix (Sod & Bunch) - Good 75-95%

Phase	Reach	Discharge	Velocity	Normal Depth	Mannings N	Permissible Shear Stress	Calculated Shear Stress	Safety Factor	Remarks	Staple Pattern
SC250 Unvegetated	Straight	3.73 cfs	1.64 ft/s	0.21 ft	0.04	2.5 lbs/ft2	0.22 lbs/ft2	11.33	STABLE	E
SC250 Reinforced Vegetation	Straight	3.73 cfs	0.68 ft/s	0.48 ft	0.158	8 lbs/ft2	0.49 lbs/ft2	16.17	STABLE	E
Underlying Substrate	Straight	3.73 cfs	0.68 ft/s	0.48 ft	--	0.8 lbs/ft2	0.008 lbs/ft2	101.1	STABLE	--

PAR-CO-095.1.1.3 VCI
Q(10)=3.73 cfs, 12" pipe

Adapted from USDA - NRCS

363-2134-008 / March 31, 2012



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

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: 1.62 ft/s

Velocity of Runoff in Channel less than Maximum? Yes

FIGURE 9.3
Riprap Apron Design, Minimum Tailwater Condition

* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

I-3.6 PCSM BMP Calculations

a. Check Dam Volume Calculations

ATLANTIC SUNRISE NATURAL GAS PIPELINE PROJECT
(ACCESS ROAD) VEGETATED CHANNEL CHECKDAM VOLUME
PAR CO-095.1.1.3-Vegetated Channel for Infiltration

10/18/2016

TOTAL REACH VOLUME = 1327 CF Width (W_B): 10 FT. Depth (H): 1 FT.

VEGETATED CHANNEL PAR-CO-095.1.1.3
ROAD STA 1+30 to 2+65
Input data

S =	0.005	ft/ft
H =	1	ft
W_B =	10	
z_1 =	3	
z_2 =	3	

Output data

$L_{storage}$ =	200	ft
W_T =	16	ft
$W_T + W_B$ =	26	ft
V =	1300	cf
$L_{spacing}$ =	200	ft
No. of Check Dams =	1	
Subreach Volume =	539*	CF

*Adjusted Volume for partial storage length

VEGETATED CHANNEL PAR-CO-095.1.1.3
ROAD STA 2+65 to 4+00
Input data

S =	0.017	ft/ft
H =	1	ft
W_B =	10	
z_1 =	3	
z_2 =	3	

Output data

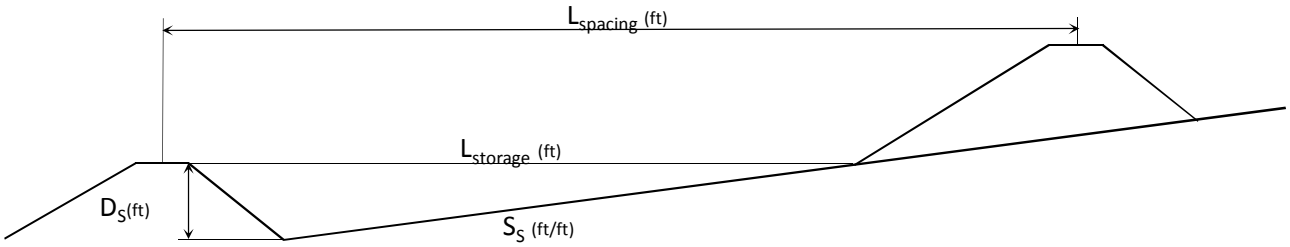
$L_{storage}$ =	61	ft
W_T =	16	ft
$W_T + W_B$ =	26	ft
V =	394	cf
$L_{spacing}$ =	65	ft
No. of Check Dams =	2	
Subreach Volume =	788	CF

Infiltration(Q_i)

Infiltration Depth =	12	in
Field Q_i =	0.500	in/hr
Factor of Safety =	2.0	
Reduced Q_i =	0.3	in/hr
Dewatering Time =	48	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):



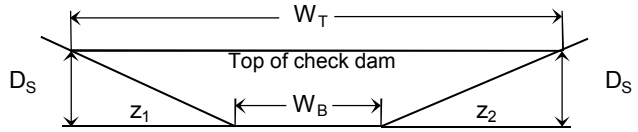
$L_{storage} = D_S / S_S$

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:

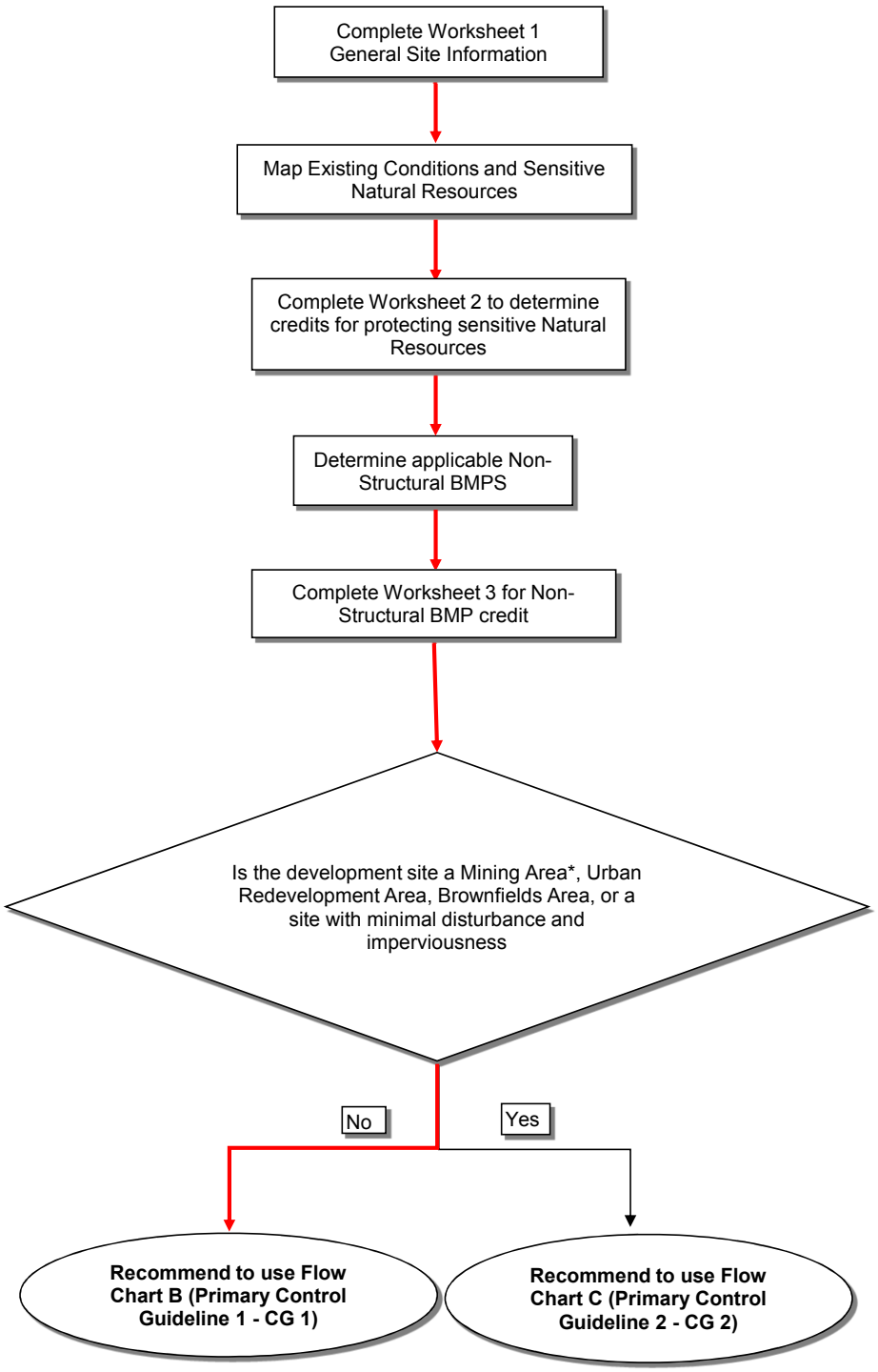
$W_T = W_B + z_1 + z_2$

Where: W_B = check dam bottom width
z_1 = side slope
z_2 = side slope

I-3.7 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: 4-Oct-16

Project Name: Atlantic Sunrise Pipeline AR-CO-095.1.1.3

Municipality: Montour Township

County: Columbia

Total Area (acres): 1.59

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

Watershed: Fishing Creek

Sub-Basin: Upper Central Susquehanna River

Nearest Surface Water(s) to Receive Runoff: UNT to Montour Run

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	X
http://www.dep.state.pa.us/dep/deputate/watermgt/wqp/wqstandards/303d-Report.htm	No	
List Causes of Impairment: Crop Related Agric (Siltation)		

Is project subject to, or part of:

Municipal Separate Storm Sewer System (MS4) Requirements?	Yes	
http://www.dep.state.pa.us/dep/deputate/watermgt/wc/Subjects/StormwaterManagement/GeneralPermits/default.htm	No	X
Existing or planned drinking water supply?	Yes	
	No	X

If yes, distance from proposed discharge (miles):

Approved Act 167 Plan?	Yes	
http://www.dep.state.pa.us/dep/deputate/watermgt/wc/Subjects/StormwaterManagement/Approved_1.html	No	X
Existing River Conservation Plan?	Yes	X
http://www.dcnr.state.pa.us/brc/rivers/riversconservation/planningprojects/	No	

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
1.59	-	0	=	1.59

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**

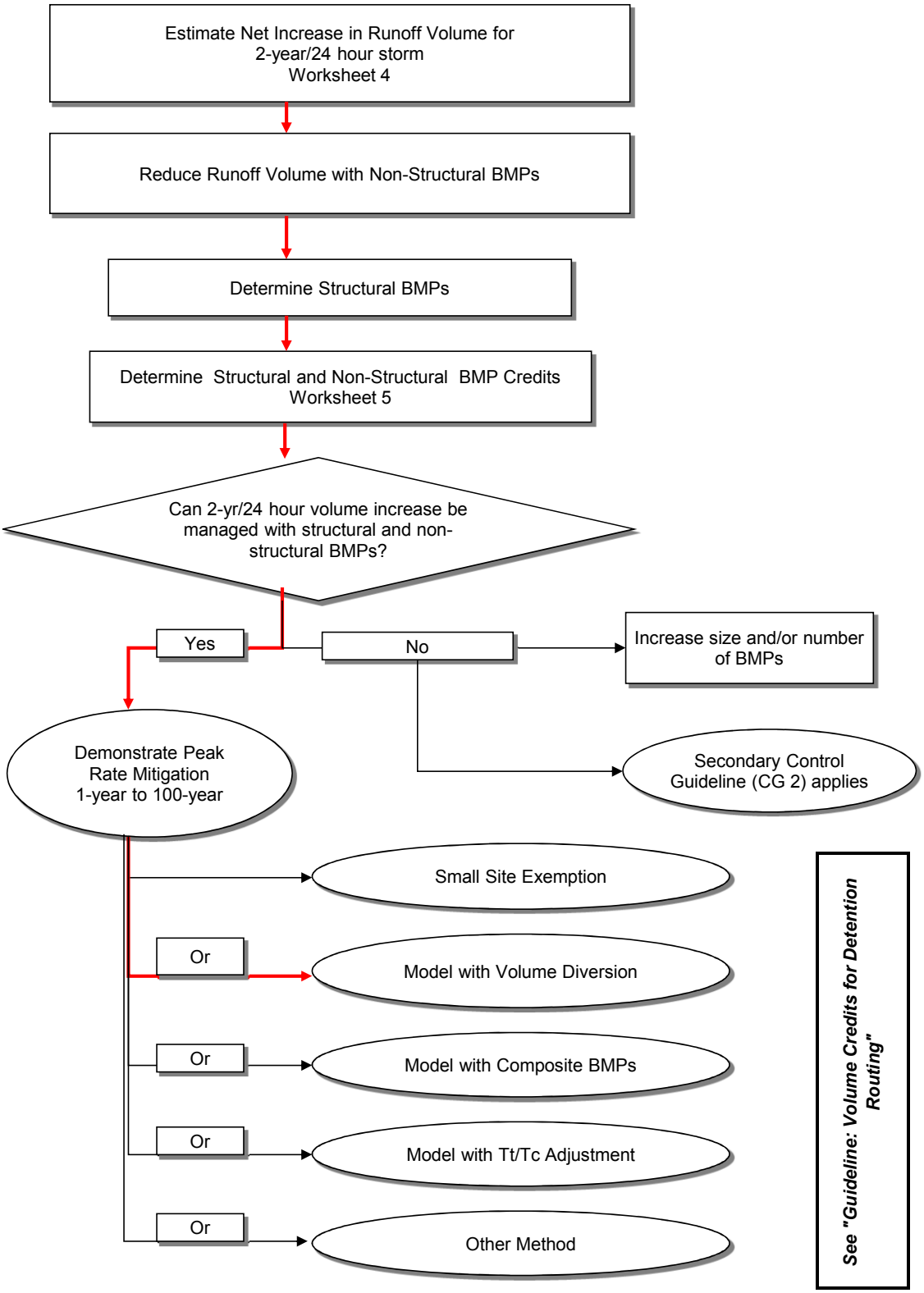
For all other disconnected non-roof areas

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-CO-095.1.1.3**

2-Year Rainfall: 2.84 **in**

Total Site Area:	1.59	**acres**
Protected Site Area:	0	**acres**
Managed Area	1.59	**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	-	-	98	0.20	0.04	2.61	-
"Meadow"[3]	C	-	-	71	4.08	0.82	0.67	-
Gravel Rd	C	-	-	89	1.24	0.25	-	-
Stone	C	-	-	98	0.20	0.04	-	-
Woods	C	-	-	70	4.29	0.86	0.63	-
Meadow	C	69,171	1.59	71	4.08	0.82	0.67	3,863
TOTAL:		69,171	1.59					3,863

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)
Impervious	C	-	0.00	98	0.20	0.04	2.61	-
Gravel Rd	C	4,154	0.10	89	1.24	0.25	1.76	608
Stone	C	4,680	0.11	98	0.20	0.04	2.61	1,017
Woods	C	-	-	70	4.29	0.86	0.63	-
Meadow	C	60,337	1.39	71	4.08	0.82	0.67	3,370
TOTAL:		69,171	1.59					4,995

2-Year Volume Increase (ft^3)	**1,132**

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 HSGl.
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-CO-095.1.1.3

SUB-BASIN: Upper Central Susquehanna River

Required Control Volume (ft^3) - *from Worksheet 4*:		1,132
Non-structural Volume Credit (ft^3) - *from Worksheet 3*:	-	0
Structural Volume Reqmt (ft^3)		1,132

(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		9,735
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 Channel		1,386
	Storage in 18" stone MLV Pad		1,328

Total Structural Volume (ft^3):	12,449
Structural Volume Requirement (ft^3):	1,132
DIFFERENCE	11,317

MLV Pad Infiltration Calculations Summary		
Average Measured Infiltration Rate for MLV Pad	***TBD***	***in/hr***
Factor of Safety	***2.00***	
Design Infiltration Rate	***0.25***	***in/hr***
Dewatering Time for top 6 inches of MLV Pad	***24.00***	***hours***
Depth of AASHTO #57 Section of MLV Pad	***12***	***inches***
Dewatering Time for AASHTO #57 Section of MLV Pad	***48.00***	***hours***
Total Dewatering Time for MLV Pad	***72.00***	***hours***

Check Dam Infiltration Calculations Summary		
Average Measured Infiltration Rate for Channel	***TBD***	***in/hr***
Factor of Safety	***2.00***	
Design Infiltration Rate	***0.25***	***in/hr***
Height of Check Dam	***12***	***inches***
Dewatering Time for Detained Water in Channel	***48.00***	***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		

I-3.8 Infiltration Information

a. Field Observation Report

NOTE: INFILTRATION TESTING HAS NOT BEEN COMPLETED FOR THIS ACCESS ROAD. TESTING WILL BE COMPLETED AFTER THE CONDEMNATION PROCESS HAS STARTED FOR THE PARCEL.

I-3.9 Off-Site Discharge Analysis

a. Adequacy of Off-Site Discharge

ACCESS ROAD: AR-CO-095.1.1.3- Adequacy of Off-Site Discharge

AR-CO-095.1.1.3 is a proposed permanent access road (PAR) located in Montour Township, Columbia County, Pennsylvania. The intent of this PAR is to provide permanent maintenance and operational access to the proposed Main Line Valve 11 (CS-MLV-11) located on the proposed 42" Central Penn Line South Pipeline. The road begins at Ridge Road (SR 4004) and terminates at the MLV site at approximate mile post M-0423 MP 0.4. The PAR is approximately 300 feet long and has an elevation change of approximately 5 feet. The access road is planned to be located on an existing pasture. The proposed road will have a width of 14 feet and a cross slope of 2% directing runoff in the easterly direction into a vegetated channel for infiltration (VCI) with check dams. 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 AASHTO #57 stone. An infiltration berm will be installed downgradient of the MLV site and vegetated channel for infiltration to provide additional stormwater detention to maintain pre-construction flow rates. The proposed improvements have been designed to have no anticipated impacts or changes to downhill properties as a result of constructing the MLV site.

The PAR and the MLV site have been designed to reduce overall disturbance to the maximum extent practicable. 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. (See the enclosed Pre and Post drainage area maps and calculations in Appendix I 3.3 and I 3.4 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 VCI, MLV pad and infiltration berm. Retaining and infiltrating runoff decreases the rate of stormwater runoff as well as recharging the 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	2.39	1.47	(0.92)
2) 2-Year/24-Hour	4.03	2.48	(1.55)
3) 5-Year/24-Hour	6.78	4.18	(2.60)
4) 10-Year/24-Hour	9.41	5.79	(3.62)
5) 25-Year/24-Hour	13.92	8.58	(5.34)
6) 50-Year/24-Hour	18.34	11.30	(7.04)
7) 100-Year/24-Hour	23.73	20.40	(3.33)

The VCI is located on the east side of the MLV site and access road. The VCI is 10-feet wide and 1.5-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 create small retention areas throughout the channel to promote infiltration. A rip rap apron is proposed at the end of the channel to further slow down stormwater runoff and dissipate energy.

The second measure used to ensure reduced peak stormwater runoff is the MLV pad itself. The pad is a flat area with a 1% cross-slope constructed with a top layer of 6" of AASHTO #8 aggregate, on a non-woven geotextile fabric, and a bottom layer of 12" AASHTO #57 stone. This 12-inch-deep area will detain and infiltrate the foot print of the MLV pad, plus a small area around the pad to the West.

The infiltrated berm is designed to further reduce peak stormwater runoff rates leaving the MLV site and PAR. The berm area is approximately 1.25' deep and is designed to also create a retention area promoting infiltration after flows travel through the MVL site and the VCI.

After being conveyed through one of these stormwater PCSM BMP's above, the runoff flows south until it outlets into an unnamed tributary to Montour Run (WW-RS-80012), approximately 380 feet south of the MLV site. A very small area to the east of the access driven generating additional flows that are impacted by the construction of the MLV site but not collected by the VCI will continue to flow east, before it converges with the pre-construction flows approximately 460 feet east of the MLV site. At this point the runoff follows pre-construction conditions until ultimately discharging to a watercourse, approximately 1590 feet east of the MLV site.

The flow path from the MLV site crosses the following soil types:

- BeC2 – Belmont silt loam, 12 to 20 percent slopes, moderately eroded.

- CdD2 – Calvin and Klinesville soils, neutral substrata, 20 to 35 percent slopes, moderately eroded.
- WbB2 – Watson silt loam, 3 to 8 percent slopes, moderately eroded.

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:

- BeC2 – 0.32
- CdD2 – 0.17
- WbB2 – 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, MLV pad, and the infiltration berm area have reduced the proposed stormwater velocity as it leaves the design points. The velocities at the final discharge point (infiltration berm area) are slower than 1 fps, as summarized in the Stormwater Velocity Rate 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 listed in the table, and is an allowable velocity for the area downhill of the proposed improvements. (Note: the infiltration berm represents the flows leaving all the design points prior to discharging to abutting property, the velocities for the MLV and VCI are shown for reference.)

Stormwater Velocity Rate Chart for the design frequency storm (fps)	MLV Pad Velocities (fps)	VCI Velocities (fps)	Infiltration Berm (fps)
1) 1-Year/24-Hour	0.00	0.33	0.00
2) 2-Year/24-Hour	0.00	0.69	0.00
3) 5-Year/24-Hour	0.00	1.08	0.00
4) 10-Year/24-Hour	0.08	1.14	0.17
5) 25-Year/24-Hour	0.13	1.30	0.34
6) 50-Year/24-Hour	0.34	1.42	0.57
7) 100-Year/24-Hour	0.42	1.55	0.93

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 Owner:

- Connie L. Giger (PA-CO-084.000)

I-3.10 Storage Volume Analysis

a. Storage Volume Analysis

ACCESS ROAD: CO-095.1.1.3 – 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 I-3.6 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-CO-095.1.1.3 is a low-side 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 I-3.6. 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 I-3.7.