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Post Construction Stormwater Management Plan Narrative

Atlantic Sunrise Project

Permanent Access Roads
South Annville and Union Townships
Lebanon County
Pennsylvania

Prepared For:

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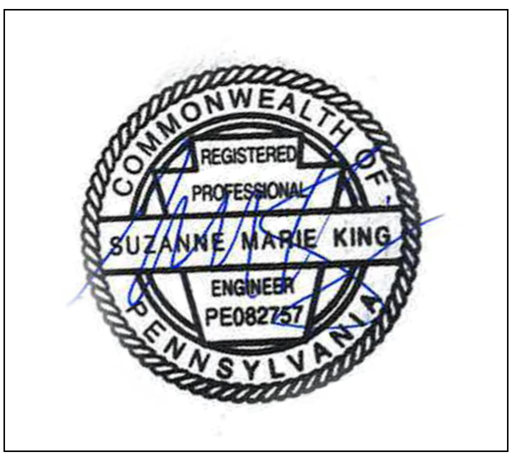

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* Road-specific Appendix letters correspond to the road-specific Appendix included in the **E&SC Narrative for Lebanon County included in Section 2 of the ESCGP-2 NOI**. Supporting calculations are provided for permanent access roads only in this narrative.

GENERAL INFORMATION

Project Description

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

References

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

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

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

Permanent Access Road Table

The following permanent access roads that will provide access to an MLV are proposed to be constructed in Lebanon 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
LE-037.2	MP 42.6	Susquehanna	Gingrich Run	None	TSF, MF	Agriculture (Suspended Solids); Source Unknown (Pathogens); Urban Runoff/Storm Sewers (Organic Enrichment/Low D.O.)	TMDL, 2012 (Siltation)
LE-050.1.1	MP 56.8	Susquehanna	Forge Creek	None	WWF, MF	Agriculture (Siltation and Flow Alterations)	None

1.0 COMMON INFORMATION

1.1 Topographic Features

See **Appendices G and Q** 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 Lebanon County, Pennsylvania and the Soil Association Maps prepared by Wood Group Mustang Inc. are included in Appendix C of the **E&SC Narrative for Lebanon County included in Section 2 of the ESCGP-2 NOI.** County-specific soil type and use limitations are presented in Table 1.2.1 below.

Table 1.2.1

Soil Type and Use Limitations for Lebanon 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
CkB	Clarksburg Silt Loam	3-8%	X	C/S		X		X	X	X	X	X	X	X	X	X		X
HaB	Hagerstown silt loam	3-8%	X	S		X		X	X	X	X	X	X	X	X	X		
HbC	Hagerstown Silty Clay Loam	8-15%	X	S		X		X	X	X	X	X	X	X	X	X		
Ls	Lindside Silt loam	Nearly Level	X	S			X	X	X	X	X	X		X		X		X
MagB	Manor silt loam	3-8%	X	C/S	X			X		X	X		X	X				X
ThA	Thorndale Silt Loam	0-3%	X	C/S				X	X	X	X	X	X	X	X	X		X
WeB	Weikert Channery Silt Loam	3-8%	X	C/S	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 roads are located in areas of woodland, agricultural and meadow lands. Portions of the roads are located along existing dirt, gravel, or paved roads. The proposed land use is for permanent access roads intended to provide a means of ingress/egress to/ 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 Lebanon 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 filter sock diversion, respectively. (See the road-specific appendices of the **E&SC Narrative for Lebanon 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 design storm and the change in peak rate of runoff for the *1-year,* 2-year, 5-year, 10-year, 25-year, 50-year and 100-year 24-hour design storms for pre-construction and post construction conditions, along with the supporting calculations, are provided for each permanent access road in the road-specific narratives appended to this narrative.

Permanent access roads (PAR) have been designed to decrease peak rate of stormwater runoff from each location for all storm events. An analysis was also completed to assure that the stormwater velocities leaving the PAR's are appropriate for the land cover that receives the discharges, therefore there are no anticipated impacts to downstream properties.

Act 167 Consistency Verification:

The proposed permanent access roads located in Lebanon 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 roads are shown on the PCSM Plans (**Section 3 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 Lebanon County included in Section 2 of the NOI** and shown on the E&SC Plans (**Section 2 of the ESCGP-2 NOI**) and the Best Management Practices and Quantities Plan.

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

PCSM BMPs

- <u>Stone Valve Site Void Storage</u>: 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.
- <u>Permanent Vegetative Stabilization</u>: Upon reaching final grades, and upon cessation of earth disturbance activities, disturbed areas will receive topsoil, seed, and mulch to establish permanent vegetative stabilization.

1.7 BMP Installation Sequence Narrative

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

1.8 Supporting Calculations and Measurements

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

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

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

> ***(1) Predevelopment site characterization and assessment of soil and geology including appropriate infiltration and geotechnical studies that identify location and depths of test sites and methods used.***
>
> ***(2) Analysis demonstrating that the PCSM BMPs will meet the volume reduction and water quality requirements specified in an applicable Department approved and current Act 167 stormwater management watershed plan; or manage the net change for storms up to and including the 2-year/24-hour storm event when compared to preconstruction runoff volume and water quality. The analysis for the 2-year/24-hour storm event shall be conducted using the following minimum criteria:***
>
>> ***(i) Existing predevelopment nonforested pervious areas must be considered meadow in good condition or its equivalent except for repair, reconstruction or restoration of roadways or rail lines, or construction, repair, reconstruction or restoration of utility infrastructure when the site will be returned to existing condition.***
>>
>> ***(ii) When the existing project site contains impervious area, 20% of the existing impervious area to be disturbed must be considered meadow in good condition or better, except for repair, reconstruction or restoration of roadways or rail lines, or construction, repair, reconstruction, or restoration of utility infrastructure when the site will be returned to existing condition.***
>>
>> ***(iii) When the existing site contains impervious area and the existing site conditions have public health, safety or environmental limitations, the applicant may demonstrate to the Department that it is not practicable to satisfy the requirement in subparagraph (ii), but***

the stormwater volume reduction and water quality treatment will be maximized to the extent practicable to maintain and protect existing water quality and existing and designated uses.

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

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

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

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

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

1.9 Plan Drawings

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

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

1.10 Long Term Operation and Maintenance Schedule

E&SC BMPs shall be maintained properly throughout Project construction as described in the **E&SC Narrative for Lebanon 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 (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.

- <u>Stone Valve Site Void Storage</u>: MLV sites shall be inspected annually as follows:
    - Inspect and correct erosion problems, disruption to stone, and sediment and debris accumulation;

- o Inspect stone for erosion and formation of rills or gullies, correct as needed;
- o Inspect for pools of standing water; dewater and discharge to an approved location and restore to design grade; and
- o Remove litter.

Annual Records of Maintenance Procedures

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

1.11 Material Recycling and Disposal

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

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

1.12 Soil Conditions and Geologic Formations

AECOM conducted a review of the proposed CPL 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, as recommended by the Natural Resources Conservation Service (NRCS).

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 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 3 of the ESCGP-2 NOI**). Following completion of construction, disturbed areas shall be stabilized and the long-term maintenance of the PCSM BMPs will begin.

1.15 Riparian Buffer Waiver

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

1.16 Antidegradation Requirements

The permanent access roads have been designed to maintain pre-construction rates of runoff by detaining and infiltrating stormwater within the MLV site. 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 Lebanon 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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Tensar International Corporation warrants that at the time of delivery the product furnished hereunder shall conform to the specification stated herein. Any other warranty including merchantability and fitness for a particular purpose, are hereby executed. If the product does not meet specifications on this page and Tensar is notified prior to installation, Tensar will replace the product at no cost to the customer. **This product specification supersedes all prior specifications for the product described above and is not applicable to any products shipped prior to January 1, 2012.**

ROLLMAX™
ROLLED EROSION CONTROL

Specification Sheet – EroNet™ S75® Erosion Control Blanket

DESCRIPTION

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

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

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

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

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

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

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

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

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

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Specification Sheet – EroNet™ SC150® Erosion Control Blanket

DESCRIPTION

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

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

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

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

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

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

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

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

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

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Specification Sheet – BioNet® SC150BN™ Erosion Control Blanket

DESCRIPTION

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

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

Material Content

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

Standard Roll Sizes

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

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

Design Permissible Shear Stress

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

Slope Design Data: C Factors

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

Roughness Coefficients – Unveg.

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

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Specification Sheet – VMax® P550® Turf Reinforcement Mat

DESCRIPTION

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

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

Material Content		
Matrix	100% UV stable polypropylene fiber	0.5 lb/sy (0.27 kg/sm)
Netting	Top and Bottom, UV-Stabilized Polypropylene	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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ROLLMAX™
ROLLED EROSION CONTROL

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/cm³
Mass/Unit Area	ASTM 6566	16.13 oz/sy (548 g/sm)
UV Stability	ASTM D4355/ 1000 HR	100%
Porosity	ECTC Guidelines	99%
Stiffness	ASTM D1388	222.65 oz-in.
Light Penetration	ASTM D6567	4.1%
Tensile Strength – MD	ASTM D6818	709 lbs/ft (10.51 kN/m)
Elongation – MD	ASTM D6818	23.9%
Tensile Strength – TD	ASTM D6818	712 lbs/ft (10.56 kN/m)
Elongation – TD	ASTM D6818	36.9%
Biomass Improvement	ASTM D7322	441%

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

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

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

Tensar®

NORTH AMERICAN GREEN®

Tensar International Corporation
2500 Northwinds Parkway
Suite 500
Alpharetta, GA 30009
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tensarcorp.com

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)

Tensar
NORTH AMERICAN GREEN®

Tensar International Corporation
2500 Northwinds Parkway
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Alpharetta, GA 30009
800-TENSAR-1
tensarcorp.com

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

APPENDIX G

AR-LE-037.2 Specific Narrative and Calculations

G.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)

G.2 Location Map

G.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

G.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

G.5 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

G.6 Infiltration Information
- ***a. Field Observation Report***

G.7 Off-Site Discharge Analysis
- ***a. Adequacy of Off-Site Discharge***

G.8 Storage Volume Analysis
- ***a. Storage Volume Analysis***

G.9 Sediment Barrier Table
- ***a. E&S Worksheet 1***

G.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-LE-037.2***

ACT 167 PLAN: None

TMDL: 2012 (Siltation)

NARRATIVE:

AR-LE-037.2 is a proposed permanent access road (PAR) located in South Annville Township, Lebanon County Pennsylvania. The intent of this PAR is to provide permanent maintenance and operational access to the proposed Main Line Valve (MLV) 06 (CS-MLV-06) located on the proposed 42" Central Penn Line South Pipeline. The road begins at ***Horseshoe Pike*** and terminates at the MLV site at approximate mile post ***42.7***. The proposed road is approximately ***100*** feet long over relatively flat terrain. ***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.***

A temporary rock construction entrance ***with wash rack, compost filter sock, and driveway apron*** are proposed where the PAR meets Horseshoe Pike to allow access to the gas pipeline by construction vehicles. Upon completion of the construction activities, the temporary construction entrance ***with wash rack and apron*** will be removed and the 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 a ***south-westerly direction to a grassed area where it will then be directed to the proposed MLV site***. The MLV site will be constructed with a 6-inch thick layer of AASHTO #8 stone on top of nonwoven geotextile and a ***24-inch*** thick layer of AASHTO #57 stone. ***As summarized in the infiltration calculations added to the bottom of Worksheet #5, the detained water stored in the voids of the MLV stone pad will infiltrate to the surrounding ground over approximately 7 hours.***

Due to the size of the drainage area contributing runoff to the point of interest for the stormwater analysis, it was determined that the site should be analyzed only within the limits of disturbance. The MLV site is designed to treat and store the required volume of runoff determined from the water quality worksheets and to alleviate peak post-development discharge. All existing drainage patterns within the watershed will remain the same.

Water Quality Worksheet #4 was used to complete the Control Guidelines 1 (CG-1) volume analysis for the 2-year 24-hour storm. The storage volume provided by MLV-06 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-LE-037.2 is a proposed permanent access road for Main Line Valve 06. 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.

THERMAL IMPACT ANALYSIS:

Thermal impacts associated with AR-LE-037.2 will be avoided to the maximum extent practicable. The following measures have been implemented to minimize thermal impacts:

- ***AR- LE-037.2 is approximately 100 linear feet, minimizing the total length of necessary temporary construction and, therefore, minimizing thermal impact of the road.***

- ***This road is proposed in a location that minimizes tree removal. The ability to use this road without the removal of additional trees acts to minimize the thermal impact of this road.***

ACIDIC SOIL MANAGEMENT PLAN:

AR-LE-037.2 Soil Acidity Table		
Soil Map Symbol	Soil Name	PH
ThA	Thorndale silt loam, 0 to 3 percent slopes	6.3
CkB	Clarksburg silt loam, 3 to 8 percent slopes	5.8

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-LE-037.2

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

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

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

4. ***Survey crews locate and stake all special areas of concern (e.g., 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 and apron. 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 orange 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 MLV Site.

14. Begin grading and strip and stockpile topsoil; install E&SC BMPs around stockpiles. Soil stockpile areas to support the access roads shall be located within the area of minimum disturbance/reduced grading for the same access road that the topsoil was stripped, or within the pipeline ROW. Stockpiled soil shall not exceed 35 feet in height, have maximum side slopes of 2:1, and be surrounded by 12" compost filter sock or silt fence. All existing excavated material that is not to be reused in the work is to be immediately removed from the site and properly disposed of at an approved facility or permitted waste area.

15. The Compliance Manager shall provide PADEP at least three days' notice prior to placing the stone and geotextile fabric within the MLV pads.

16. 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.

17. 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.

18. 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.

19. 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 Site 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).

20. ***Once the temporary improvements to the permanent access road are no longer necessary; remove all gravel and geotextile fabric from outside of the permanent access road limits 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.***

21. ***Loosen and de-compact topsoil throughout the temporarily improved section of the permanent access road limits and grade the access road so finish grades and drainage patterns match preconstruction conditions. Immediately fertilize, seed and stabilize areas at finished grade. Maintain E&SC control devices until Site work is complete and uniform 70% perennial vegetative cover is established.***

22. ***Upon completion of all earth disturbance activities and permanent stabilization of all disturbed areas, the Owner and/or Operators shall contact the local CCD for an inspection prior to the removal of the E&SC BMPs. Vegetated areas must achieve a minimum uniform 70% perennial cover over the entire disturbed area to be considered stabilized. Roadways and parking areas should have at least a clean subbase in place to be considered stabilized.***

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

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

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

Pemanent Access Road Summary Sheet

Access Road Number:	AR-LE-037.2			
Watershed Name:	Swatara Creek, TSF, MF			
Act 167 Plan Name:			Date Adopted:	
Design Storm Frequency	2 year	Pre-construction	Post-construction	Net Change
Rainfall Amount	3.01 inches			
Impervious area (acres)		0.000	0.140	0.140
Volume of stormwater runoff (cf) without planned stormwater BMPs		2,656	3,584	928
Volume of stormwater runoff (cf) with planned stormwater BMPs			775	(1,881)

Pre- vs. Post-construction Peak Rate of Flow Summary

Stormwater discharge rate for the design frequency storm (cfs)	Pre-construction	Post-construction	Net Change
1) 1-Year/24-Hour	0.15	0.00	(0.15)
2) 2-Year/24-Hour	0.24	0.00	(0.24)
3) 5-Year/24-Hour	0.41	0.00	(0.41)
4) 10-Year/24-Hour	0.56	0.00	(0.56)
5) 25-Year/24-Hour	0.82	0.08	(0.74)
6) 50-Year/24-Hour	1.06	0.13	(0.93)
7) 100-Year/24-Hour	1.33	0.18	(1.15)

Summary Description of Restoration BMPs - Permanent Access Roads

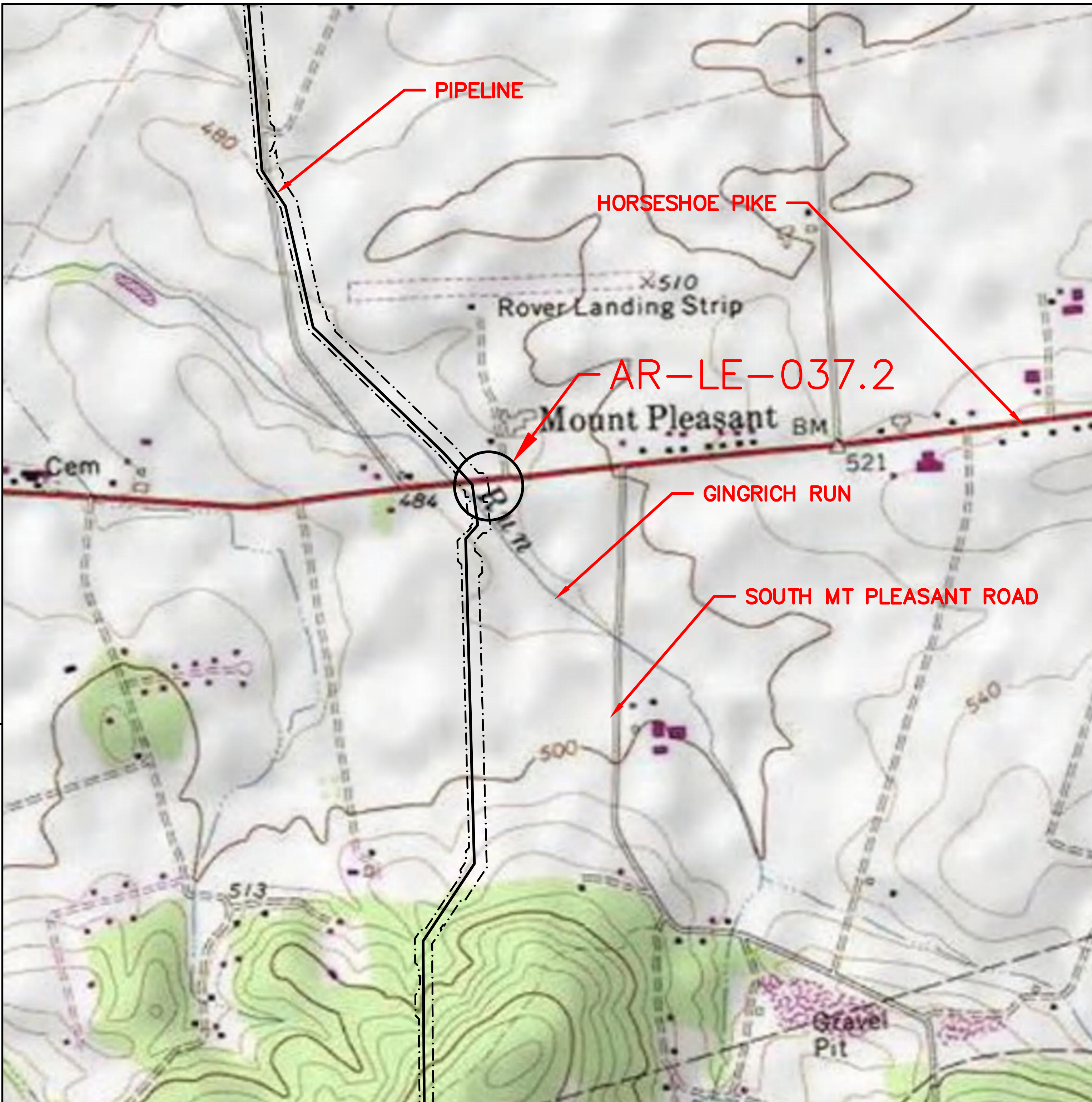
BMP	Function	Volume of stormwater treated (cf)	Acres treated
Natural area conservation: Pre-construction drainage pattern intact		0	0
Access road design: Ditches Culverts	Infiltration/ Recharge/Storage	0 Included in Ditches	0 Included in Ditches
Stormwater energy dissipaters: Riprap Aprons	Infiltration/ Recharge/Storage	0	0
Other: MLV Stone Pad Void Storage	Infiltration/ Recharge/Storage	2,809	0.23

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.

Infiltration Loading Ratio:	***Channel***	***MLV Pad***
Maximum Impervious Loading Ratio	***N/A***	***2.8 :1 (5:1 Max)***
Maximum Total Loading Ratio	***N/A***	***3.6 :1 (8:1 Max)***

Supporting Areas	***Channel***	***MLV Pad***	***Unit***
Impervious Drainage Area	***N/A***	***0.18***	***Acres***
Infiltration Area	***N/A***	***0.06***	***Acres***
Total Drainage Area	***N/A***	***0.23***	***Acres***

G.2 Location Map



PALMYRA 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-LE-037.2
SOUTH ANNVILLE TOWNSHIP
LEBANON COUNTY, PENNSYLVANIA

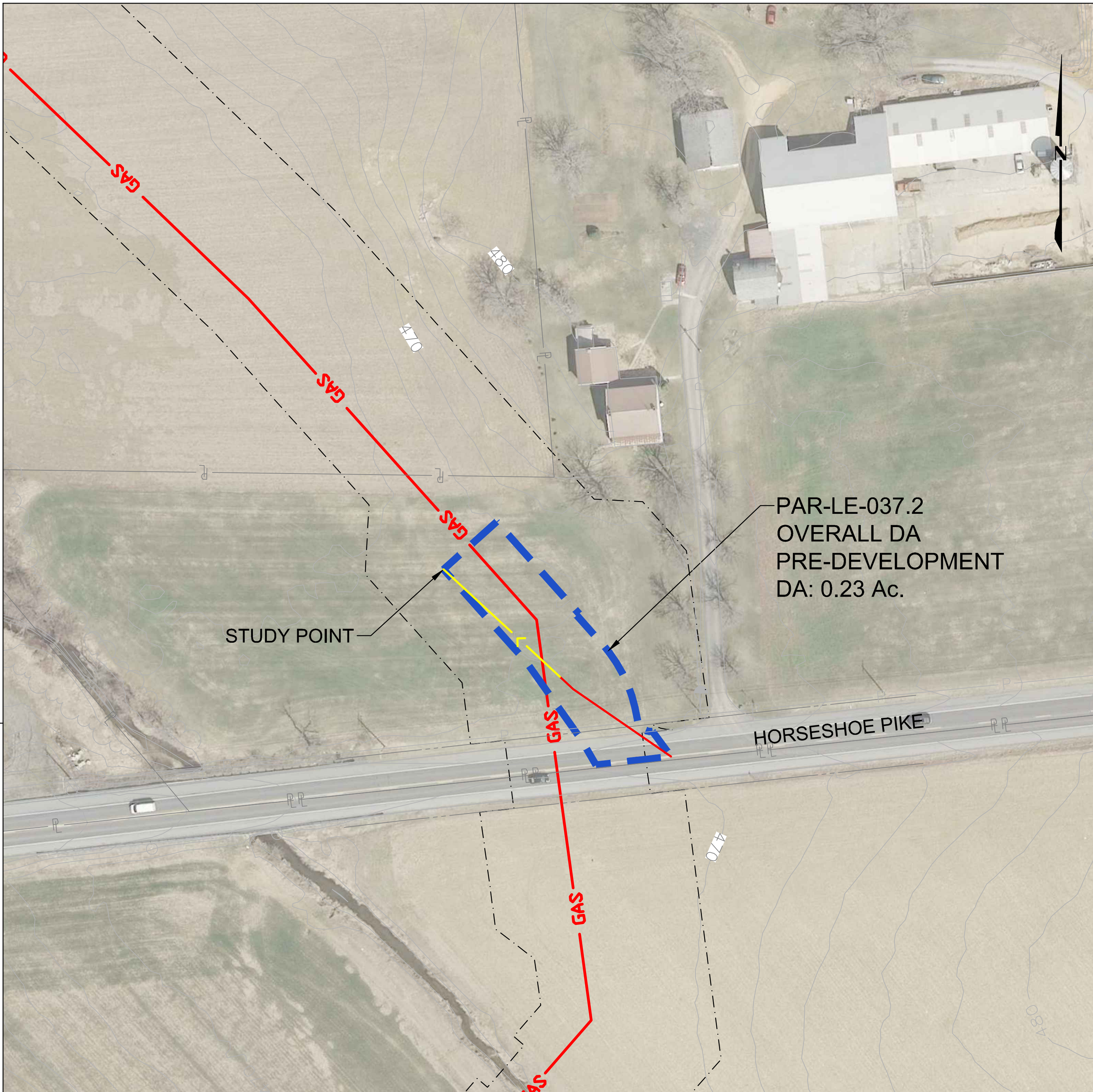
Williams

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-LE-037.2	SHEET 1 OF 1
WO: 1161481			

G.3 Predevelopment Calculations

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



PRE-DEVELOPMENT DRAINAGE AREA MAP

100 50 100
SCALE IN FEET

ISSUED FOR PERMITTING

ARCHITECTURE
ENGINEERING
ENVIRONMENTAL
LAND SURVEYING
BL Companies

LEGEND

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

ATLANTIC SUNRISE PROJECT -
CENTRAL PENN LINE SOUTH

PROPOSED 42" NATURAL GAS PIPELINE
ACCESS ROAD DRAINAGE AREA MAP
AR-LE-037.2 PRE
SOUTH ANNVILLE TOWNSHIP
LEBANON 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" = 100'
							CHECKED BY: BJP	DATE: 10/26/15	ISSUED FOR CONSTRUCTION:	
							APPROVED BY: BJP	DATE: 10/26/15	DRAWING NUMBER:	AR-LE-037.2 PRE
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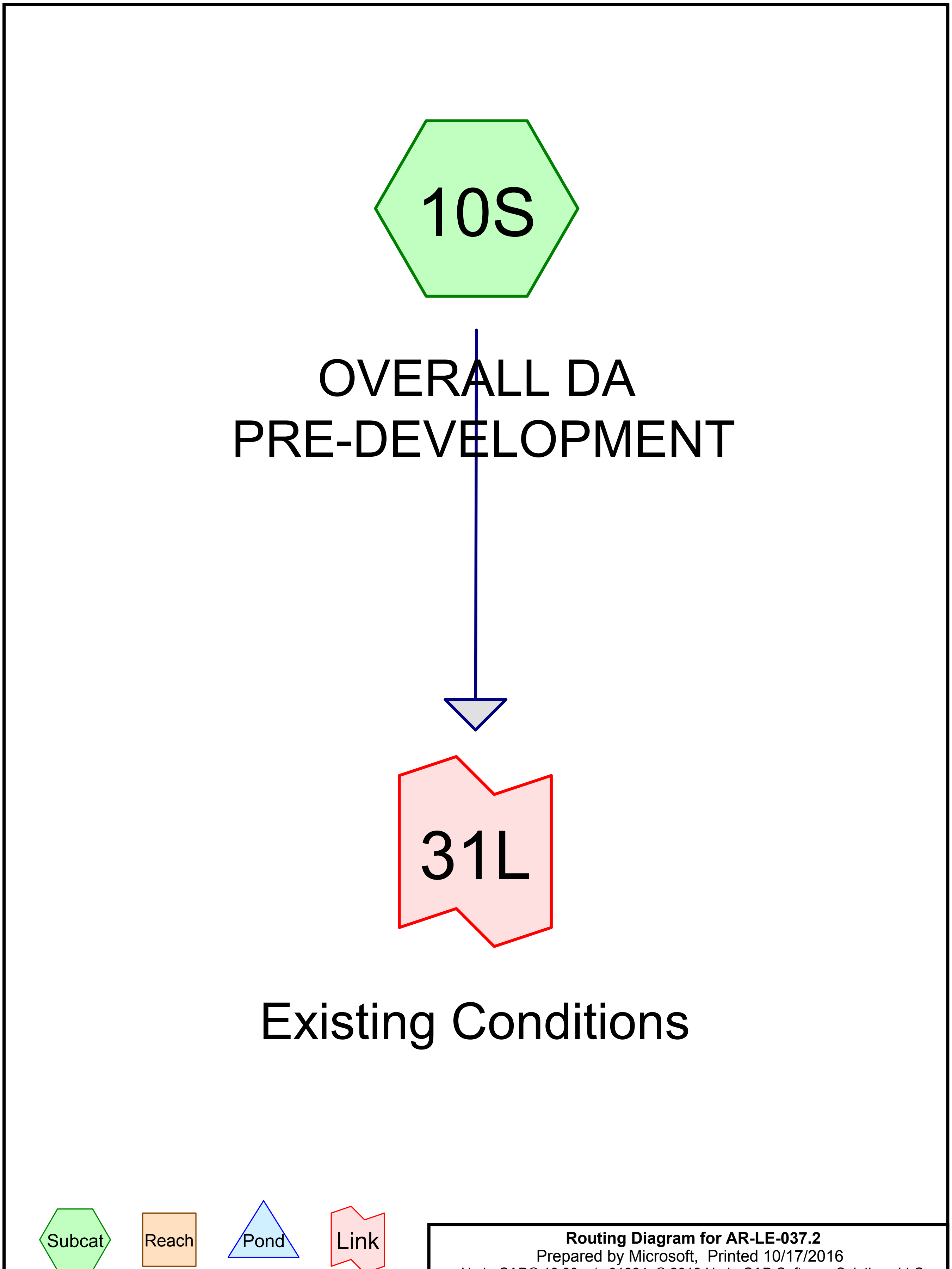


Routing Diagram for AR-LE-037.2
Prepared by Microsoft, Printed 10/17/2016
HydroCAD® 10.00 s/n 01334 © 2013 HydroCAD Software Solutions LLC

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.210	71	Meadow, non-grazed, HSG C (10S)
0.019	98	Paved parking, HSG C (10S)
0.230	**73**	**TOTAL AREA**

Soil Listing (selected nodes)

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

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 10S: OVERALL DA Runoff Area=9,999 sf 8.47% Impervious Runoff Depth=0.56"
Flow Length=215' Slope=0.0150 '/' Tc=15.1 min CN=73 Runoff=0.15 cfs 0.011 af

Link 31L: Existing Conditions Inflow=0.15 cfs 0.011 af
Primary=0.15 cfs 0.011 af

Total Runoff Area = 0.230 ac Runoff Volume = 0.011 af Average Runoff Depth = 0.56"
91.53% Pervious = 0.210 ac 8.47% Impervious = 0.019 ac

Summary for Subcatchment 10S: OVERALL DA PRE-DEVELOPMENT

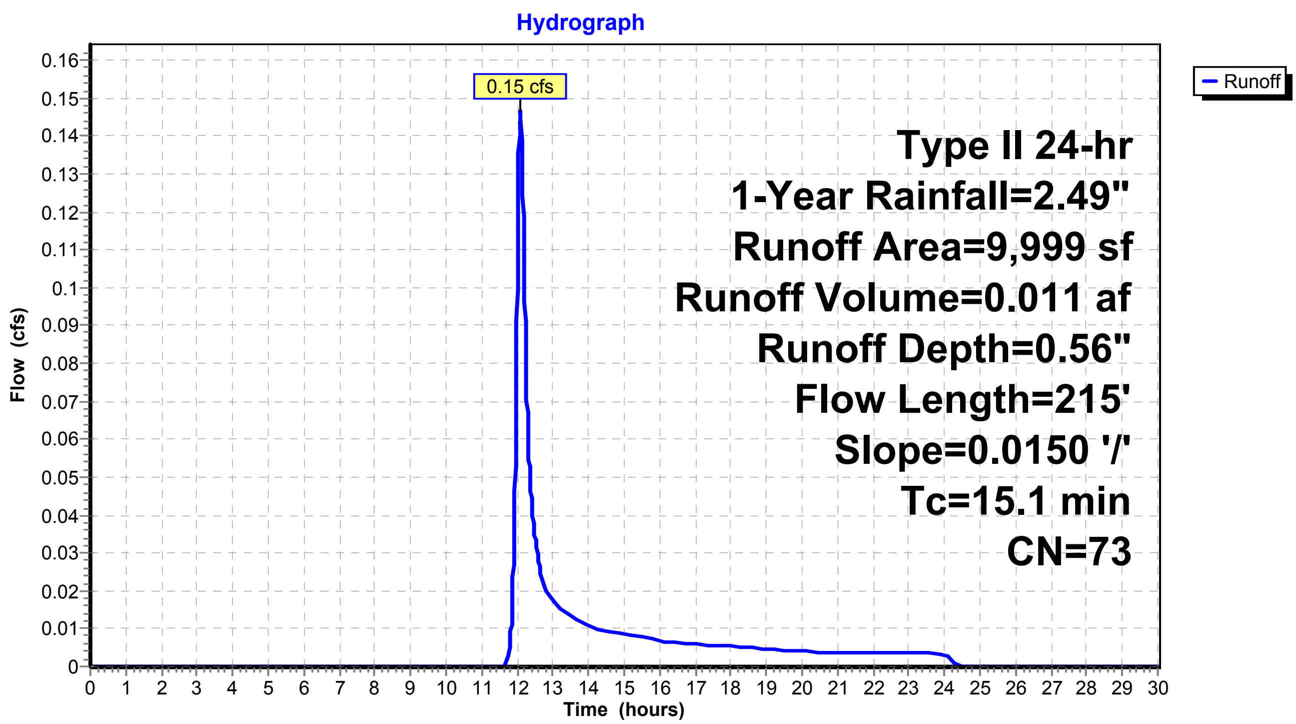
Runoff = 0.15 cfs @ 12.09 hrs, Volume= 0.011 af, Depth= 0.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type II 24-hr 1-Year Rainfall=2.49"

	Area (sf)	CN	Description
	847	98	Paved parking, HSG C
	0	89	Gravel roads, HSG C
*	0	98	Crushed Stone Pad, HSG C
	0	70	Woods, Good, HSG C
	9,152	71	Meadow, non-grazed, HSG C
	9,999	73	Weighted Average
	9,152		91.53% Pervious Area
	847		8.47% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	30	0.0150	0.93		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.01"
12.4	70	0.0150	0.09		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.01"
2.2	115	0.0150	0.86		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
15.1	215	Total			

Subcatchment 10S: OVERALL DA PRE-DEVELOPMENT

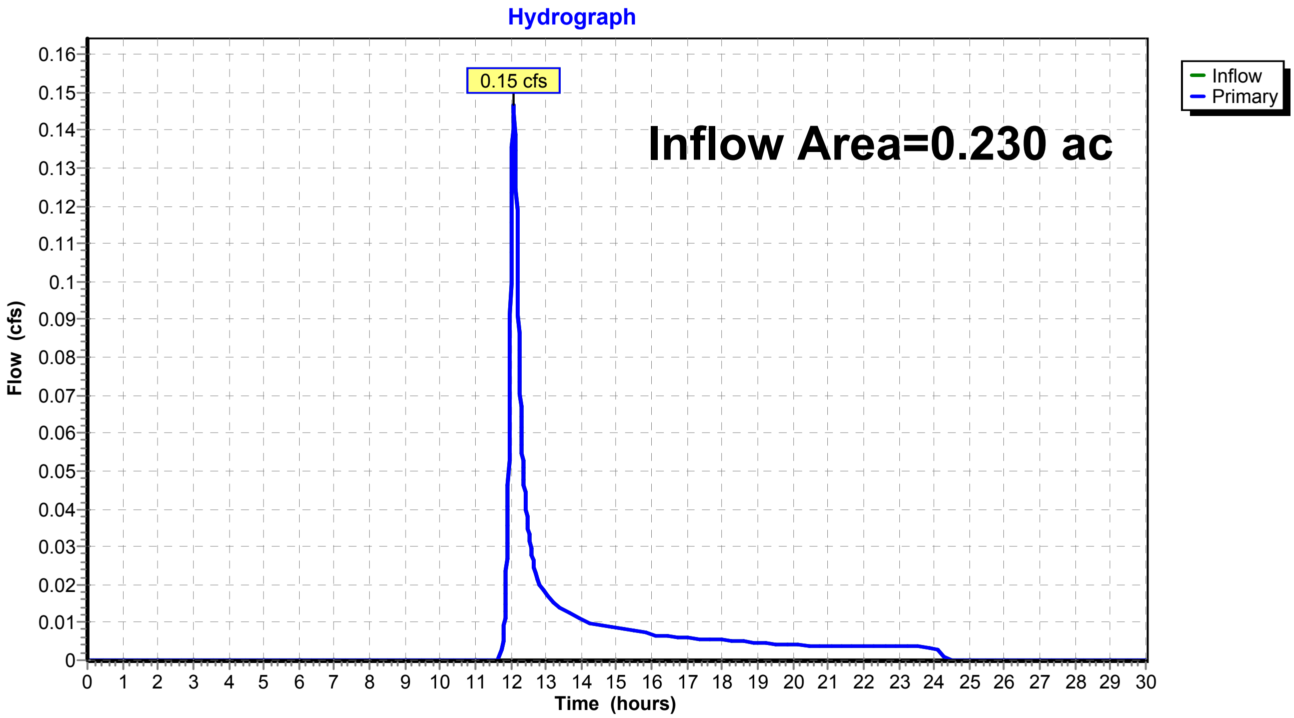


Summary for Link 31L: Existing Conditions

Inflow Area = 0.230 ac, 8.47% Impervious, Inflow Depth = 0.56" for 1-Year event
Inflow = 0.15 cfs @ 12.09 hrs, Volume= 0.011 af
Primary = 0.15 cfs @ 12.09 hrs, Volume= 0.011 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Link 31L: Existing Conditions



Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 10S: OVERALL DA Runoff Area=9,999 sf 8.47% Impervious Runoff Depth=0.86"
Flow Length=215' Slope=0.0150 '/' Tc=15.1 min CN=73 Runoff=0.24 cfs 0.017 af

Link 31L: Existing Conditions Inflow=0.24 cfs 0.017 af
Primary=0.24 cfs 0.017 af

Total Runoff Area = 0.230 ac Runoff Volume = 0.017 af Average Runoff Depth = 0.86"
91.53% Pervious = 0.210 ac 8.47% Impervious = 0.019 ac

Summary for Subcatchment 10S: OVERALL DA PRE-DEVELOPMENT

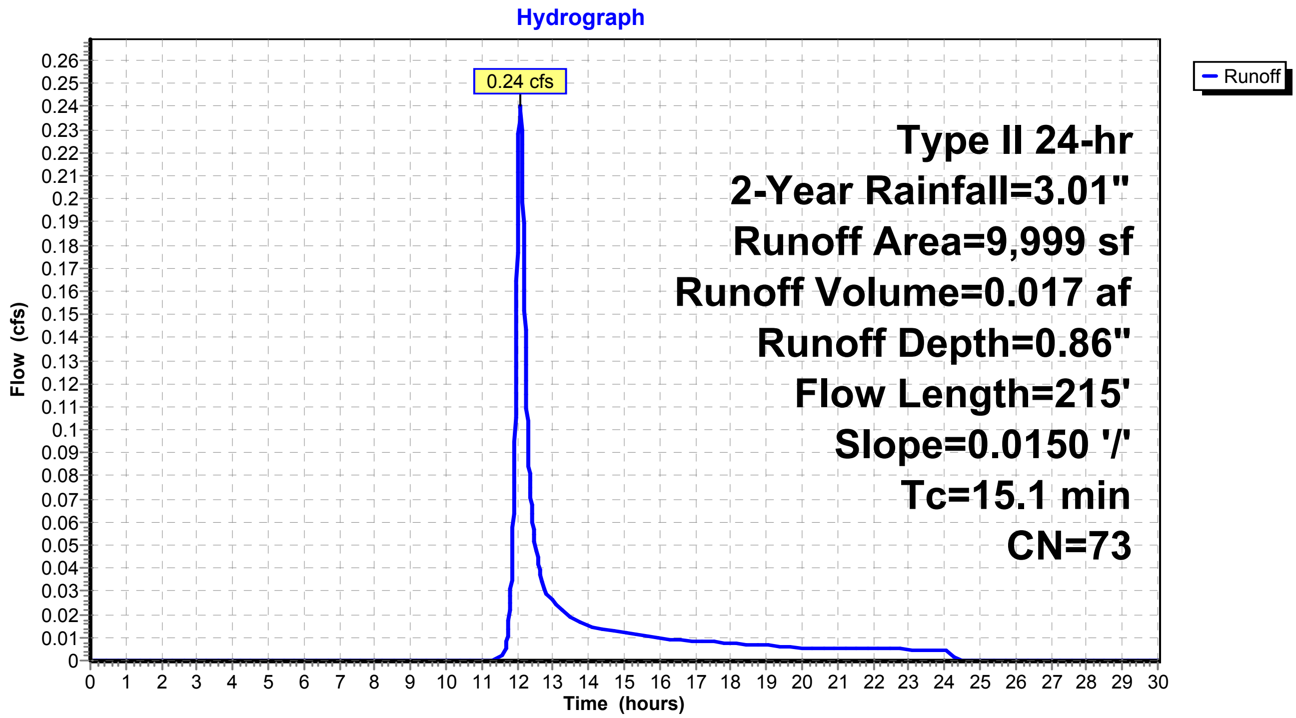
Runoff = 0.24 cfs @ 12.09 hrs, Volume= 0.017 af, Depth= 0.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type II 24-hr 2-Year Rainfall=3.01"

	Area (sf)	CN	Description
	847	98	Paved parking, HSG C
	0	89	Gravel roads, HSG C
*	0	98	Crushed Stone Pad, HSG C
	0	70	Woods, Good, HSG C
	9,152	71	Meadow, non-grazed, HSG C
	9,999	73	Weighted Average
	9,152		91.53% Pervious Area
	847		8.47% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	30	0.0150	0.93		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.01"
12.4	70	0.0150	0.09		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.01"
2.2	115	0.0150	0.86		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
15.1	215	Total			

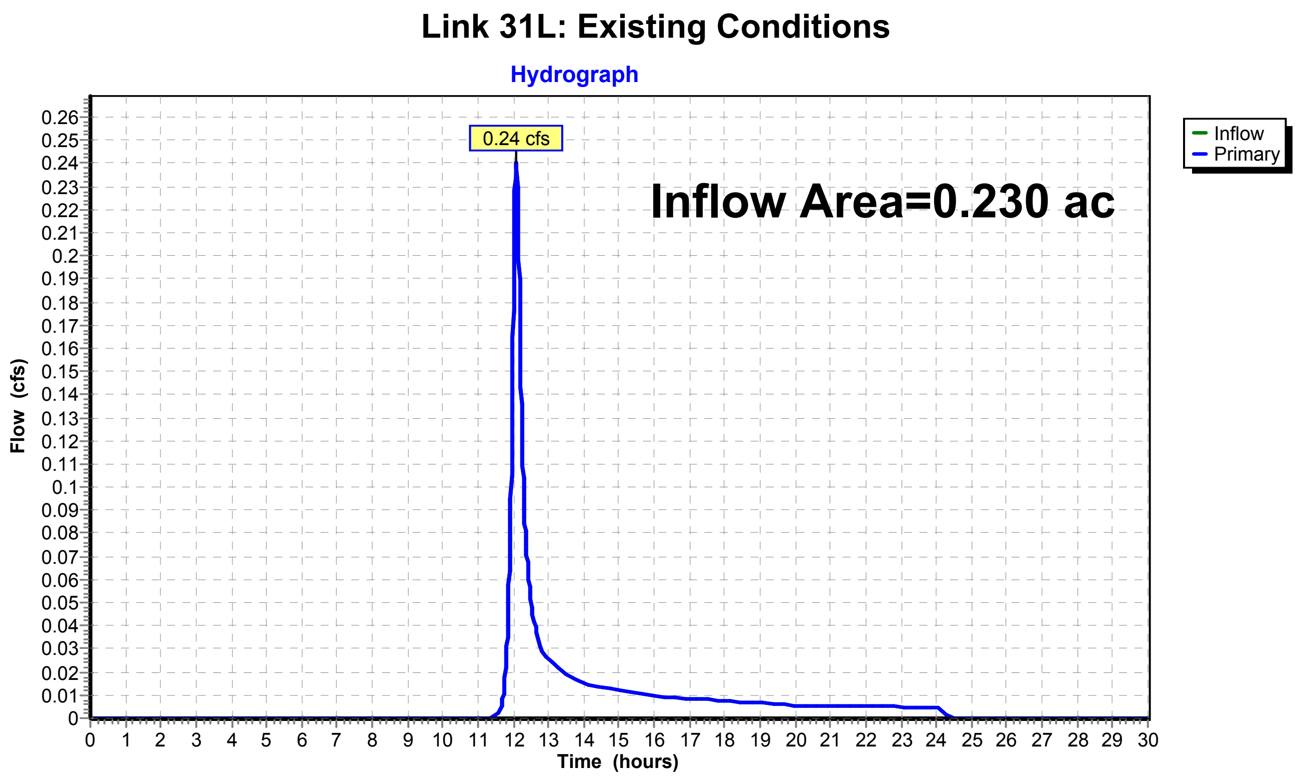
Subcatchment 10S: OVERALL DA PRE-DEVELOPMENT



Summary for Link 31L: Existing Conditions

Inflow Area = 0.230 ac, 8.47% Impervious, Inflow Depth = 0.86" for 2-Year event
Inflow = 0.24 cfs @ 12.09 hrs, Volume= 0.017 af
Primary = 0.24 cfs @ 12.09 hrs, Volume= 0.017 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs



Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 10S: OVERALL DA Runoff Area=9,999 sf 8.47% Impervious Runoff Depth=1.40"
Flow Length=215' Slope=0.0150 '/' Tc=15.1 min CN=73 Runoff=0.41 cfs 0.027 af

Link 31L: Existing Conditions Inflow=0.41 cfs 0.027 af
Primary=0.41 cfs 0.027 af

Total Runoff Area = 0.230 ac Runoff Volume = 0.027 af Average Runoff Depth = 1.40"
91.53% Pervious = 0.210 ac 8.47% Impervious = 0.019 ac

Summary for Subcatchment 10S: OVERALL DA PRE-DEVELOPMENT

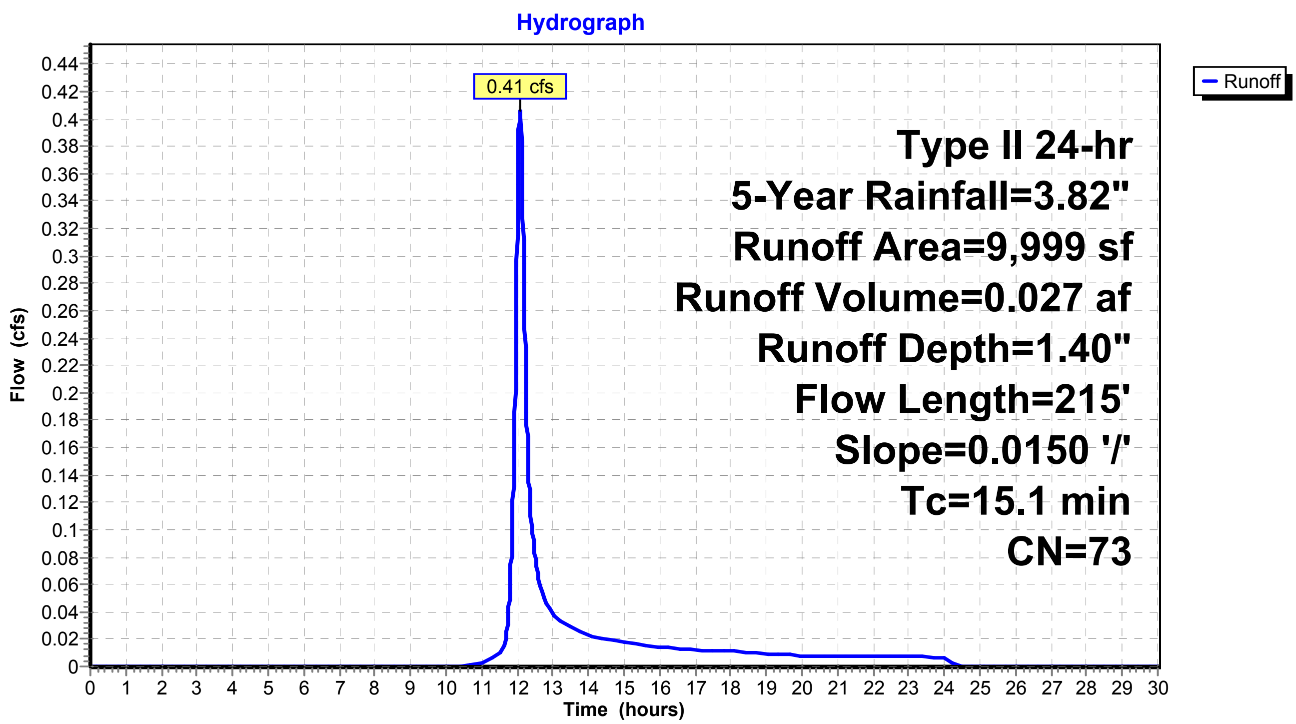
Runoff = 0.41 cfs @ 12.08 hrs, Volume= 0.027 af, Depth= 1.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type II 24-hr 5-Year Rainfall=3.82"

	Area (sf)	CN	Description
	847	98	Paved parking, HSG C
	0	89	Gravel roads, HSG C
*	0	98	Crushed Stone Pad, HSG C
	0	70	Woods, Good, HSG C
	9,152	71	Meadow, non-grazed, HSG C
	9,999	73	Weighted Average
	9,152		91.53% Pervious Area
	847		8.47% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	30	0.0150	0.93		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.01"
12.4	70	0.0150	0.09		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.01"
2.2	115	0.0150	0.86		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
15.1	215	Total			

Subcatchment 10S: OVERALL DA PRE-DEVELOPMENT

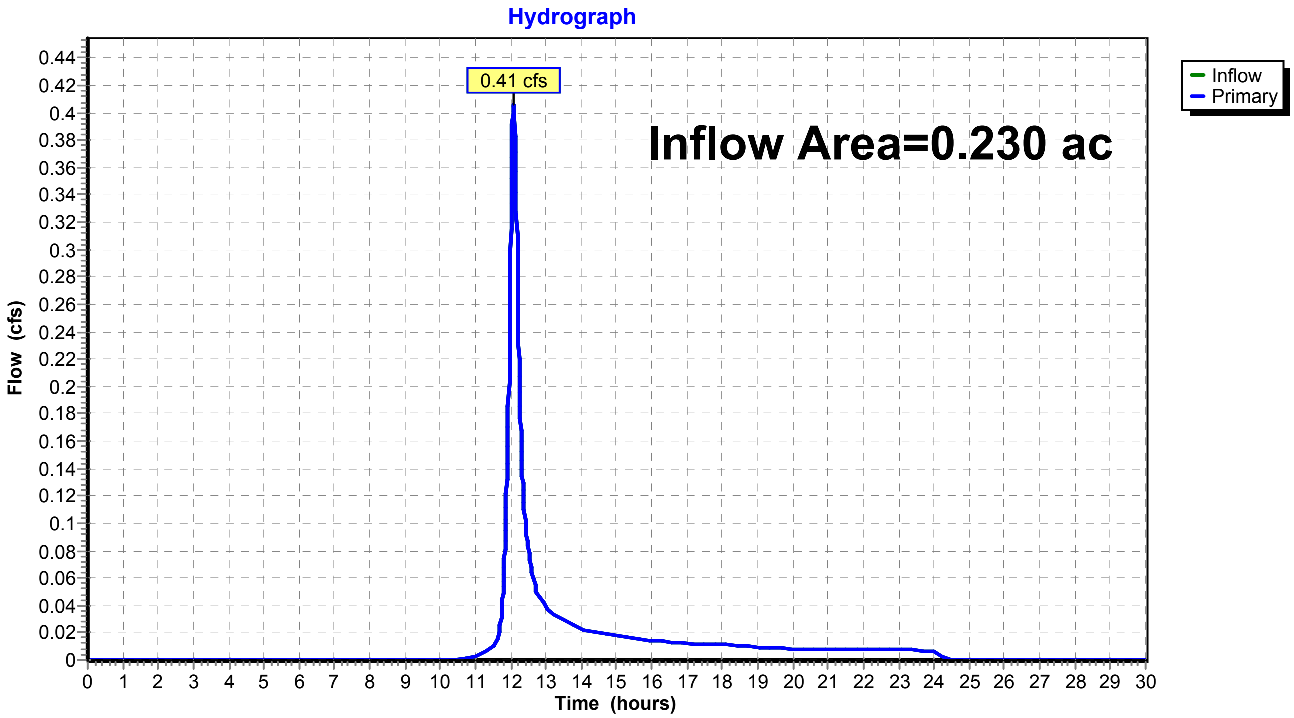


Summary for Link 31L: Existing Conditions

Inflow Area = 0.230 ac, 8.47% Impervious, Inflow Depth = 1.40" for 5-Year event
Inflow = 0.41 cfs @ 12.08 hrs, Volume= 0.027 af
Primary = 0.41 cfs @ 12.08 hrs, Volume= 0.027 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Link 31L: Existing Conditions



Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 10S: OVERALL DA Runoff Area=9,999 sf 8.47% Impervious Runoff Depth=1.92"
Flow Length=215' Slope=0.0150 '/' Tc=15.1 min CN=73 Runoff=0.56 cfs 0.037 af

Link 31L: Existing Conditions Inflow=0.56 cfs 0.037 af
Primary=0.56 cfs 0.037 af

Total Runoff Area = 0.230 ac Runoff Volume = 0.037 af Average Runoff Depth = 1.92"
91.53% Pervious = 0.210 ac 8.47% Impervious = 0.019 ac

Summary for Subcatchment 10S: OVERALL DA PRE-DEVELOPMENT

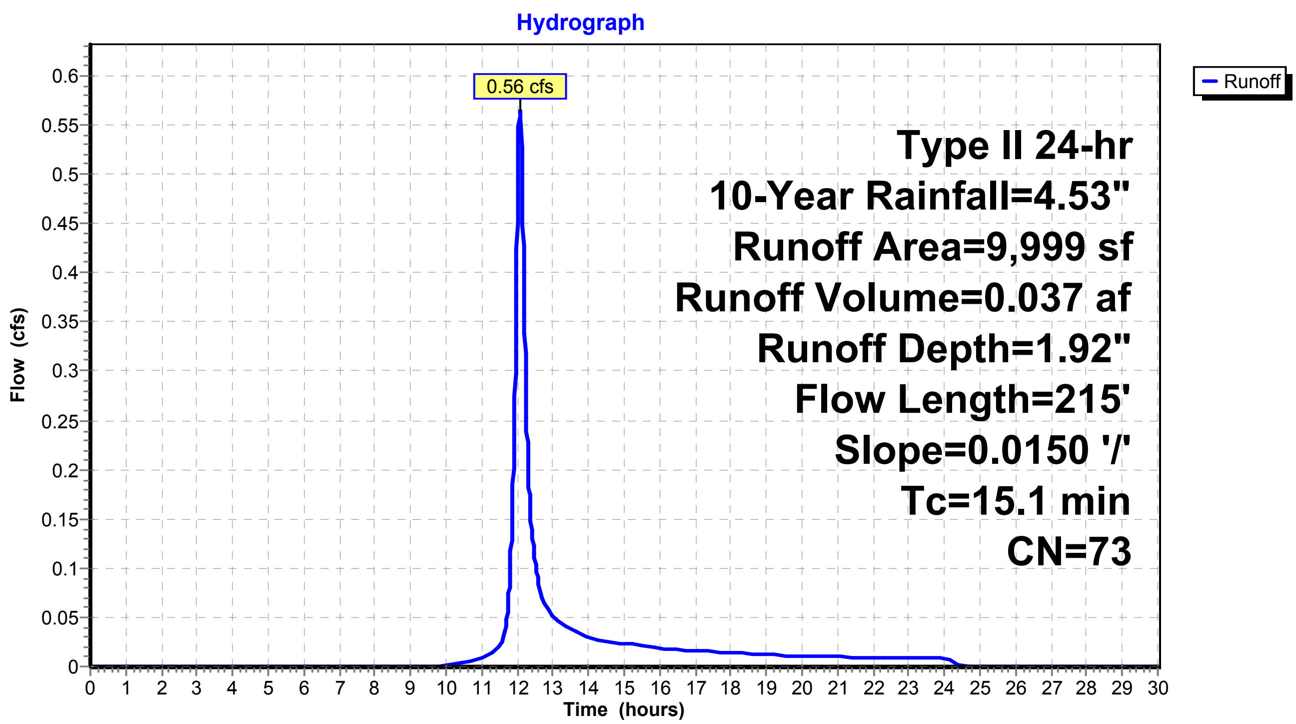
Runoff = 0.56 cfs @ 12.08 hrs, Volume= 0.037 af, Depth= 1.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type II 24-hr 10-Year Rainfall=4.53"

	Area (sf)	CN	Description
	847	98	Paved parking, HSG C
	0	89	Gravel roads, HSG C
*	0	98	Crushed Stone Pad, HSG C
	0	70	Woods, Good, HSG C
	9,152	71	Meadow, non-grazed, HSG C
	9,999	73	Weighted Average
	9,152		91.53% Pervious Area
	847		8.47% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	30	0.0150	0.93		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.01"
12.4	70	0.0150	0.09		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.01"
2.2	115	0.0150	0.86		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
15.1	215	Total			

Subcatchment 10S: OVERALL DA PRE-DEVELOPMENT

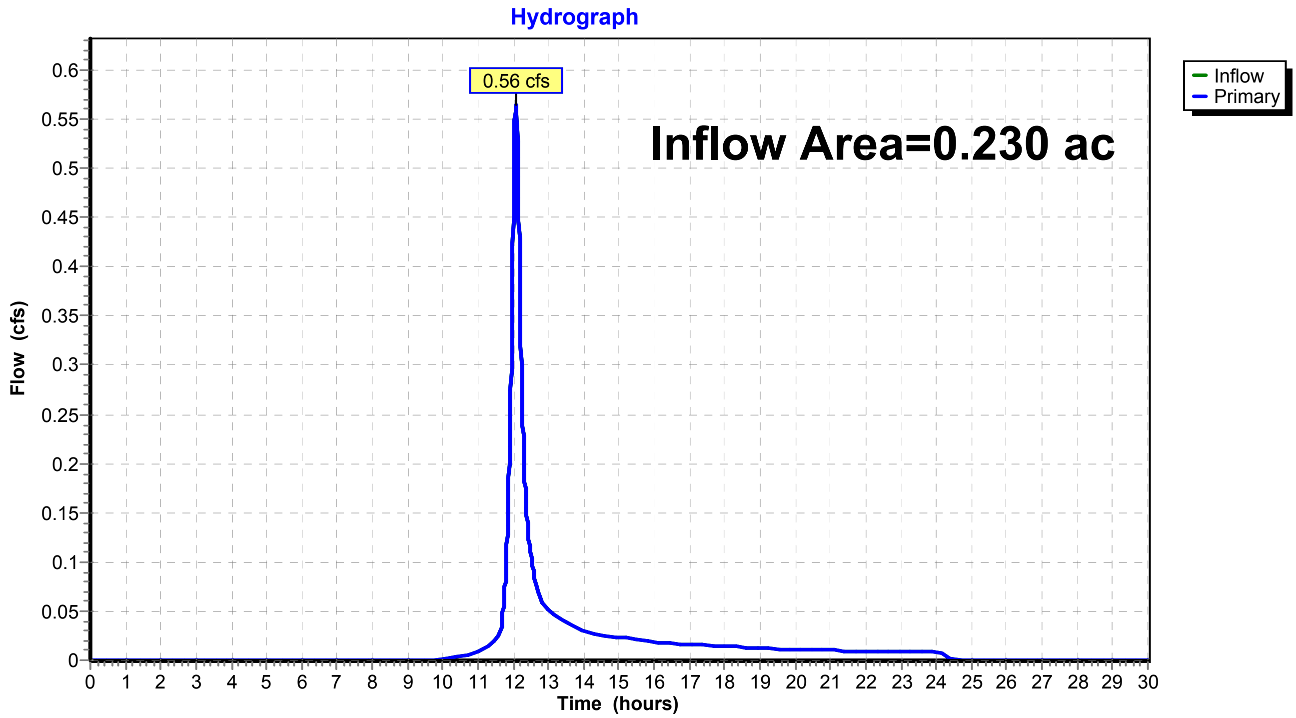


Summary for Link 31L: Existing Conditions

Inflow Area = 0.230 ac, 8.47% Impervious, Inflow Depth = 1.92" for 10-Year event
Inflow = 0.56 cfs @ 12.08 hrs, Volume= 0.037 af
Primary = 0.56 cfs @ 12.08 hrs, Volume= 0.037 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Link 31L: Existing Conditions



Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 10S: OVERALL DA Runoff Area=9,999 sf 8.47% Impervious Runoff Depth=2.78"
Flow Length=215' Slope=0.0150 '/' Tc=15.1 min CN=73 Runoff=0.82 cfs 0.053 af

Link 31L: Existing Conditions Inflow=0.82 cfs 0.053 af
Primary=0.82 cfs 0.053 af

Total Runoff Area = 0.230 ac Runoff Volume = 0.053 af Average Runoff Depth = 2.78"
91.53% Pervious = 0.210 ac 8.47% Impervious = 0.019 ac

Summary for Subcatchment 10S: OVERALL DA PRE-DEVELOPMENT

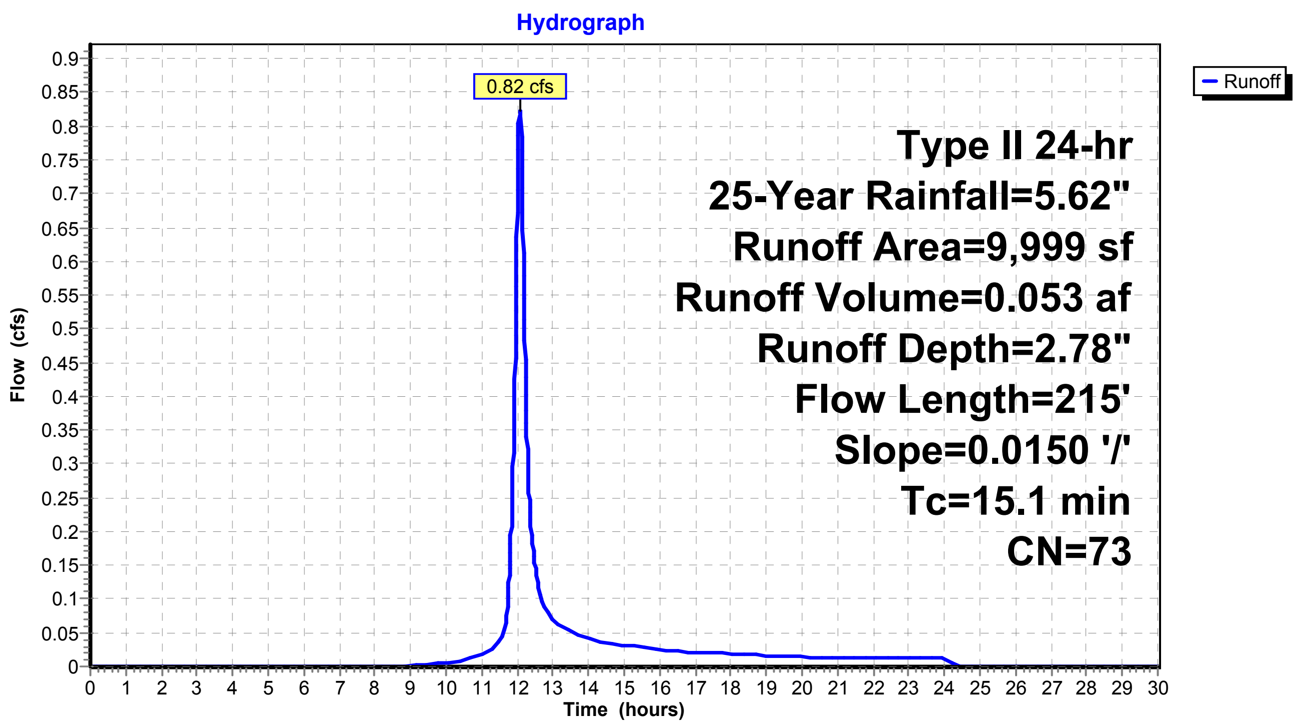
Runoff = 0.82 cfs @ 12.07 hrs, Volume= 0.053 af, Depth= 2.78"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=5.62"

	Area (sf)	CN	Description
	847	98	Paved parking, HSG C
	0	89	Gravel roads, HSG C
*	0	98	Crushed Stone Pad, HSG C
	0	70	Woods, Good, HSG C
	9,152	71	Meadow, non-grazed, HSG C
	9,999	73	Weighted Average
	9,152		91.53% Pervious Area
	847		8.47% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	30	0.0150	0.93		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.01"
12.4	70	0.0150	0.09		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.01"
2.2	115	0.0150	0.86		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
15.1	215	Total			

Subcatchment 10S: OVERALL DA PRE-DEVELOPMENT

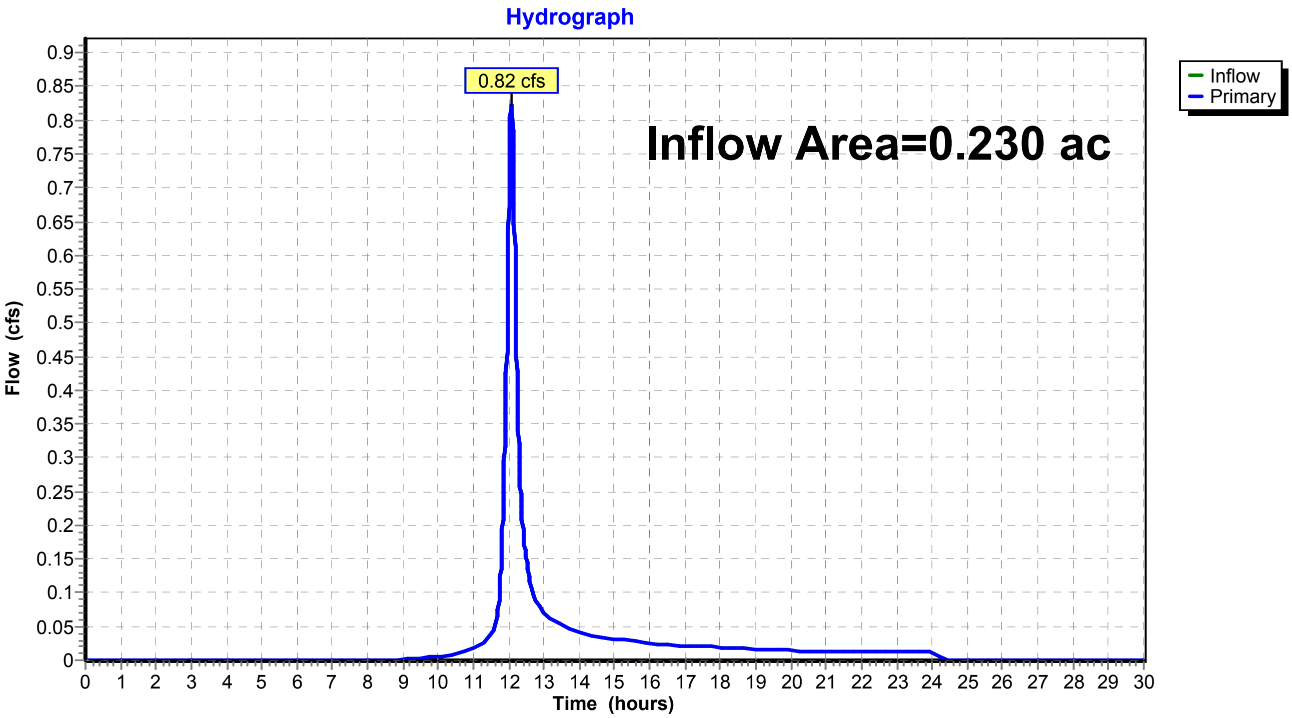


Summary for Link 31L: Existing Conditions

Inflow Area = 0.230 ac, 8.47% Impervious, Inflow Depth = 2.78" for 25-Year event
Inflow = 0.82 cfs @ 12.07 hrs, Volume= 0.053 af
Primary = 0.82 cfs @ 12.07 hrs, Volume= 0.053 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Link 31L: Existing Conditions



Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 10S: OVERALL DA Runoff Area=9,999 sf 8.47% Impervious Runoff Depth=3.57"
Flow Length=215' Slope=0.0150 '/' Tc=15.1 min CN=73 Runoff=1.06 cfs 0.068 af

Link 31L: Existing Conditions Inflow=1.06 cfs 0.068 af
Primary=1.06 cfs 0.068 af

Total Runoff Area = 0.230 ac Runoff Volume = 0.068 af Average Runoff Depth = 3.57"
91.53% Pervious = 0.210 ac 8.47% Impervious = 0.019 ac

Summary for Subcatchment 10S: OVERALL DA PRE-DEVELOPMENT

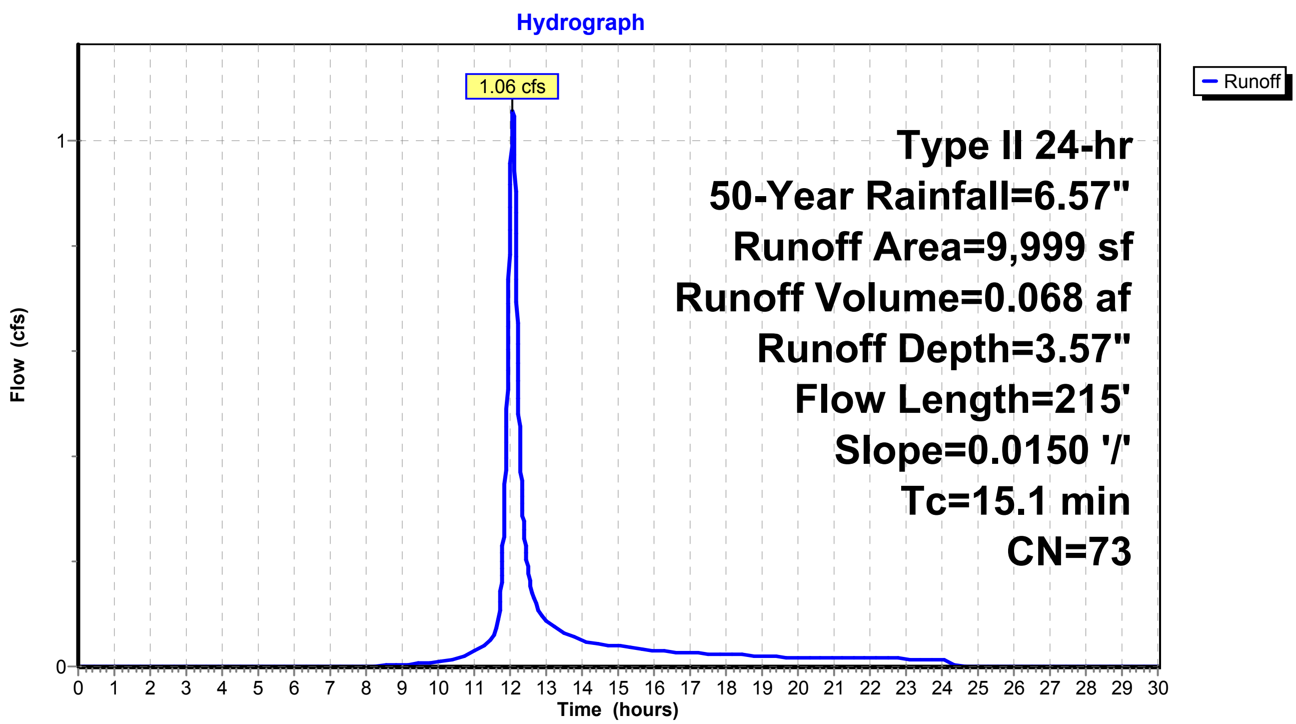
Runoff = 1.06 cfs @ 12.07 hrs, Volume= 0.068 af, Depth= 3.57"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type II 24-hr 50-Year Rainfall=6.57"

	Area (sf)	CN	Description
	847	98	Paved parking, HSG C
	0	89	Gravel roads, HSG C
*	0	98	Crushed Stone Pad, HSG C
	0	70	Woods, Good, HSG C
	9,152	71	Meadow, non-grazed, HSG C
	9,999	73	Weighted Average
	9,152		91.53% Pervious Area
	847		8.47% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	30	0.0150	0.93		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.01"
12.4	70	0.0150	0.09		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.01"
2.2	115	0.0150	0.86		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
15.1	215	Total			

Subcatchment 10S: OVERALL DA PRE-DEVELOPMENT

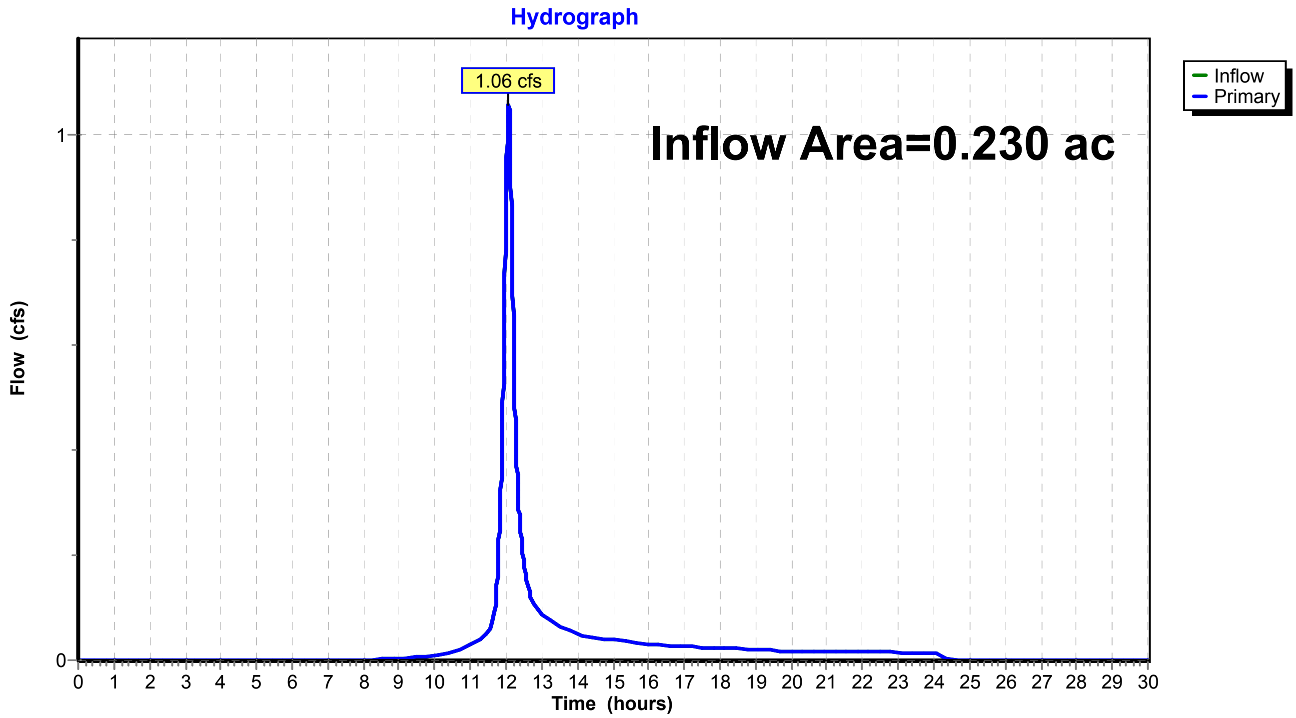


Summary for Link 31L: Existing Conditions

Inflow Area =	0.230 ac,	8.47% Impervious, Inflow Depth = 3.57"	for 50-Year event	
Inflow =	1.06 cfs @	12.07 hrs, Volume=	0.068 af	
Primary =	1.06 cfs @	12.07 hrs, Volume=	0.068 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Link 31L: Existing Conditions



Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 10S: OVERALL DA Runoff Area=9,999 sf 8.47% Impervious Runoff Depth=4.50"
Flow Length=215' Slope=0.0150 '/' Tc=15.1 min CN=73 Runoff=1.33 cfs 0.086 af

Link 31L: Existing Conditions Inflow=1.33 cfs 0.086 af
Primary=1.33 cfs 0.086 af

Total Runoff Area = 0.230 ac Runoff Volume = 0.086 af Average Runoff Depth = 4.50"
91.53% Pervious = 0.210 ac 8.47% Impervious = 0.019 ac

Summary for Subcatchment 10S: OVERALL DA PRE-DEVELOPMENT

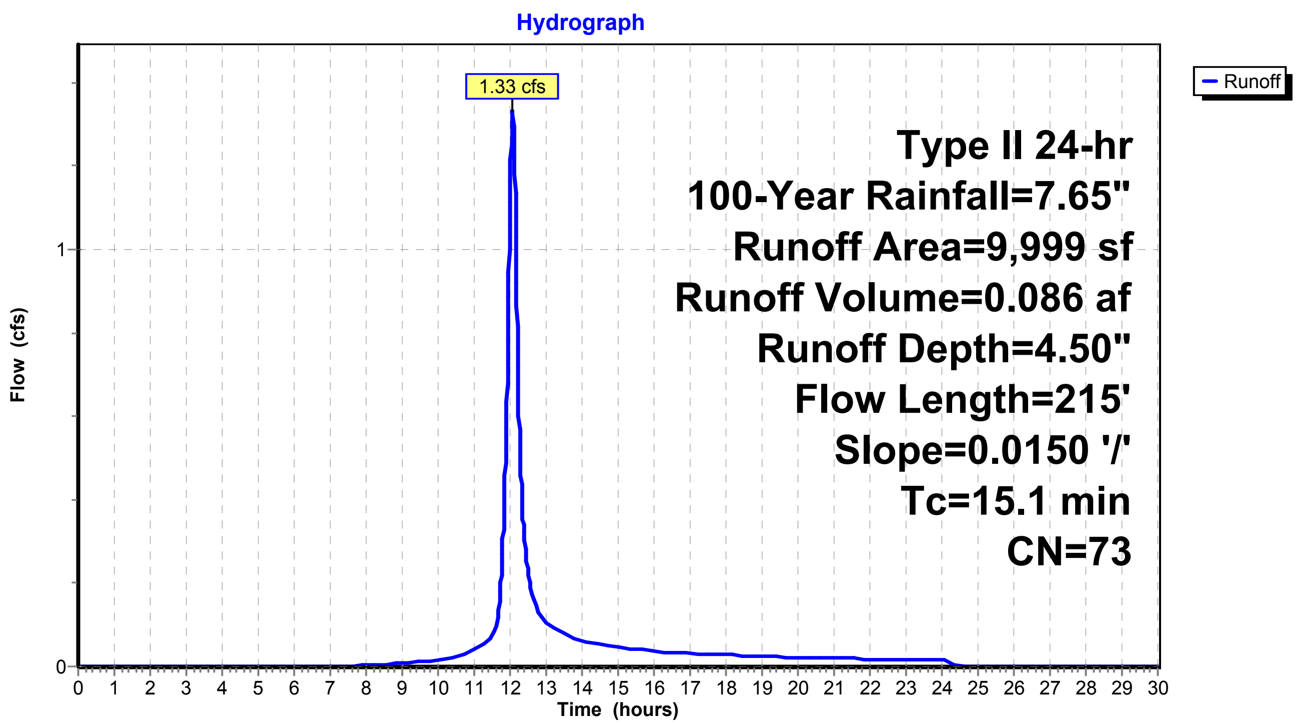
Runoff = 1.33 cfs @ 12.07 hrs, Volume= 0.086 af, Depth= 4.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Year Rainfall=7.65"

	Area (sf)	CN	Description
	847	98	Paved parking, HSG C
	0	89	Gravel roads, HSG C
*	0	98	Crushed Stone Pad, HSG C
	0	70	Woods, Good, HSG C
	9,152	71	Meadow, non-grazed, HSG C
	9,999	73	Weighted Average
	9,152		91.53% Pervious Area
	847		8.47% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	30	0.0150	0.93		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.01"
12.4	70	0.0150	0.09		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.01"
2.2	115	0.0150	0.86		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
15.1	215	Total			

Subcatchment 10S: OVERALL DA PRE-DEVELOPMENT

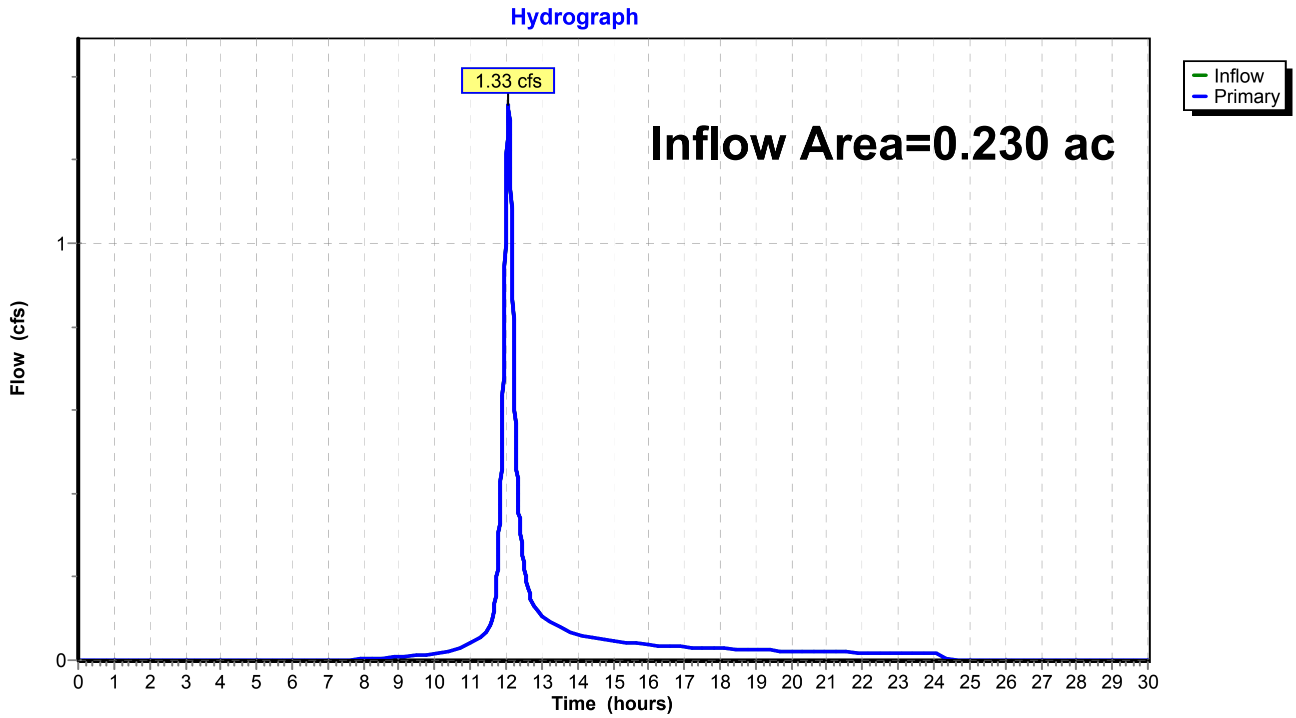


Summary for Link 31L: Existing Conditions

Inflow Area = 0.230 ac, 8.47% Impervious, Inflow Depth = 4.50" for 100-Year event
Inflow = 1.33 cfs @ 12.07 hrs, Volume= 0.086 af
Primary = 1.33 cfs @ 12.07 hrs, Volume= 0.086 af, Atten= 0%, Lag= 0.0 min

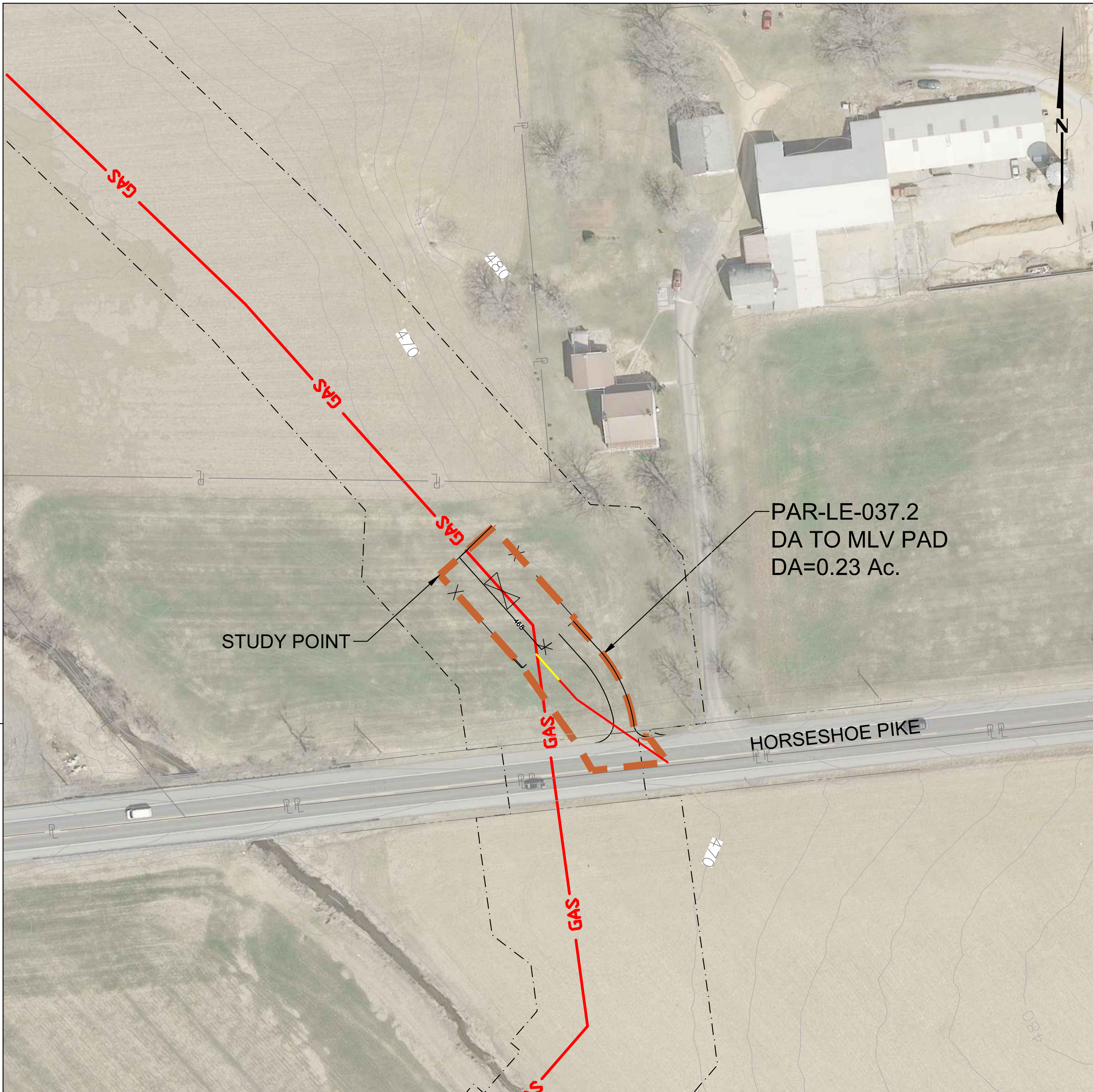
Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Link 31L: Existing Conditions



G.4 Post Development Calculations

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



POST-DEVELOPMENT DRAINAGE AREA MAP

100 50 100
SCALE IN FEET

ISSUED FOR PERMITTING

ARCHITECTURE
ENGINEERING
ENVIRONMENTAL
LAND SURVEYING
BL Companies

LEGEND

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

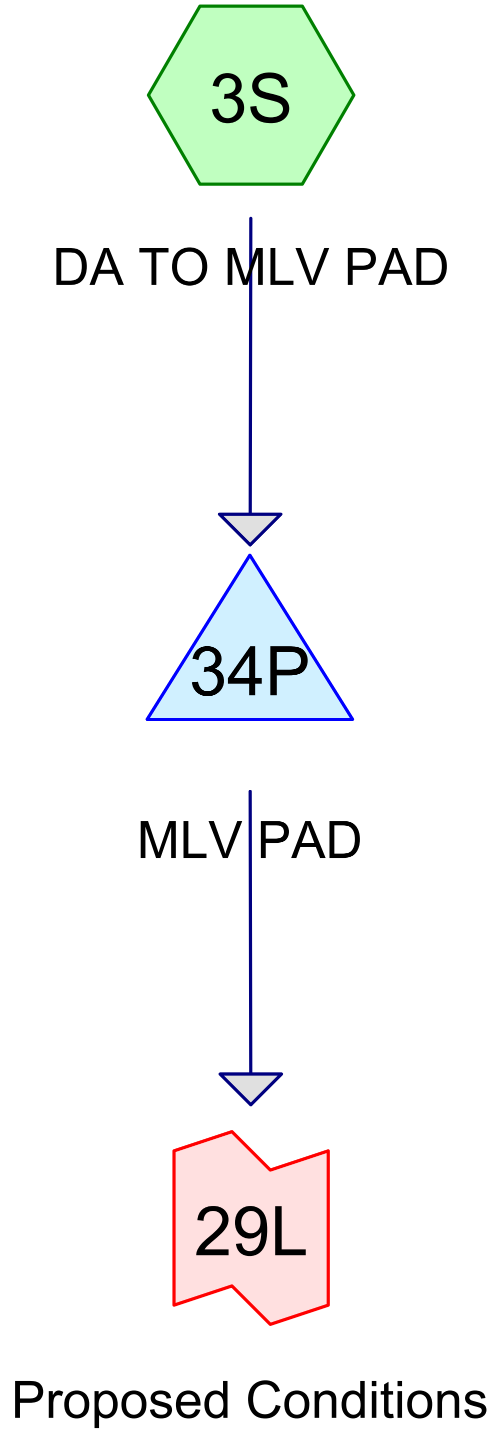
ATLANTIC SUNRISE PROJECT - CENTRAL PENN LINE SOUTH

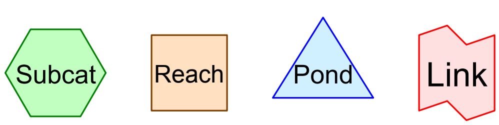
PROPOSED 42" NATURAL GAS PIPELINE
ACCESS ROAD DRAINAGE AREA MAP
AR-LE-037.2 POST
SOUTH ANNVILLE TOWNSHIP
LEBANON COUNTY, PENNSYLVANIA

Williams

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

DRAWN BY: OLC	DATE: 10/26/15	ISSUED FOR BID:	SCALE: 1" = 100'
CHECKED BY: BJP	DATE: 10/26/15	ISSUED FOR CONSTRUCTION:	
APPROVED BY: BJP	DATE: 10/26/15	DRAWING NUMBER: AR-LE-037.2 POST	
WO:			





Routing Diagram for AR-LE-037.2
Prepared by Microsoft, Printed 10/17/2016
HydroCAD® 10.00 s/n 01334 © 2013 HydroCAD Software Solutions LLC

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.107	98	Crushed Stone Pad, HSG C (3S)
0.029	89	Gravel roads, HSG C (3S)
0.066	71	Meadow, non-grazed, HSG C (3S)
0.027	98	Paved parking, HSG C (3S)
0.230	**89**	**TOTAL AREA**

Soil Listing (selected nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
0.230	HSG C	3S
0.000	HSG D	
0.000	Other	
0.230		**TOTAL AREA**

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment3S: DA TO MLV PAD Runoff Area=9,999 sf 58.72% Impervious Runoff Depth=1.45"
Flow Length=125' Slope=0.0150 '/' Tc=11.1 min CN=89 Runoff=0.49 cfs 0.028 af

Pond 34P: MLV PAD Peak Elev=466.86' Storage=1,205 cf Inflow=0.49 cfs 0.028 af
Outflow=0.00 cfs 0.000 af

Link 29L: Proposed Conditions Inflow=0.00 cfs 0.000 af
Primary=0.00 cfs 0.000 af

Total Runoff Area = 0.230 ac Runoff Volume = 0.028 af Average Runoff Depth = 1.45"
41.28% Pervious = 0.095 ac 58.72% Impervious = 0.135 ac

Summary for Subcatchment 3S: DA TO MLV PAD

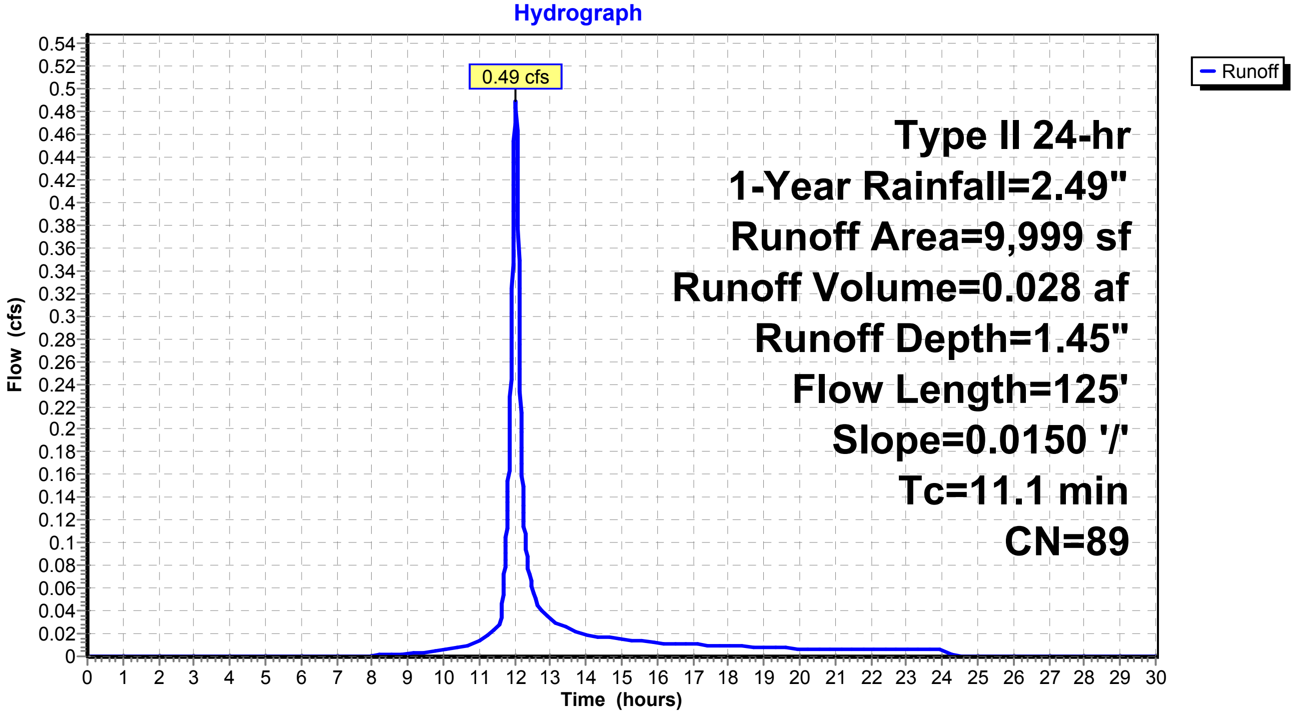
Runoff = 0.49 cfs @ 12.03 hrs, Volume= 0.028 af, Depth= 1.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type II 24-hr 1-Year Rainfall=2.49"

	Area (sf)	CN	Description
	1,191	98	Paved parking, HSG C
	1,271	89	Gravel roads, HSG C
*	4,680	98	Crushed Stone Pad, HSG C
	0	70	Woods, Good, HSG C
	2,857	71	Meadow, non-grazed, HSG C
	9,999	89	Weighted Average
	4,128		41.28% Pervious Area
	5,871		58.72% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	38	0.0150	0.98		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.01"
0.2	10	0.0150	0.75		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.01"
9.8	52	0.0150	0.09		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.01"
0.5	25	0.0150	0.86		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
11.1	125	Total			

Subcatchment 3S: DA TO MLV PAD



Summary for Pond 34P: MLV PAD

Inflow Area = 0.230 ac, 58.72% Impervious, Inflow Depth = 1.45" for 1-Year event
Inflow = 0.49 cfs @ 12.03 hrs, Volume= 0.028 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= 0.00-30.00 hrs, dt= 0.01 hrs / 6
Peak Elev= 466.86' @ 24.63 hrs Surf.Area= 0 sf Storage= 1,205 cf

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

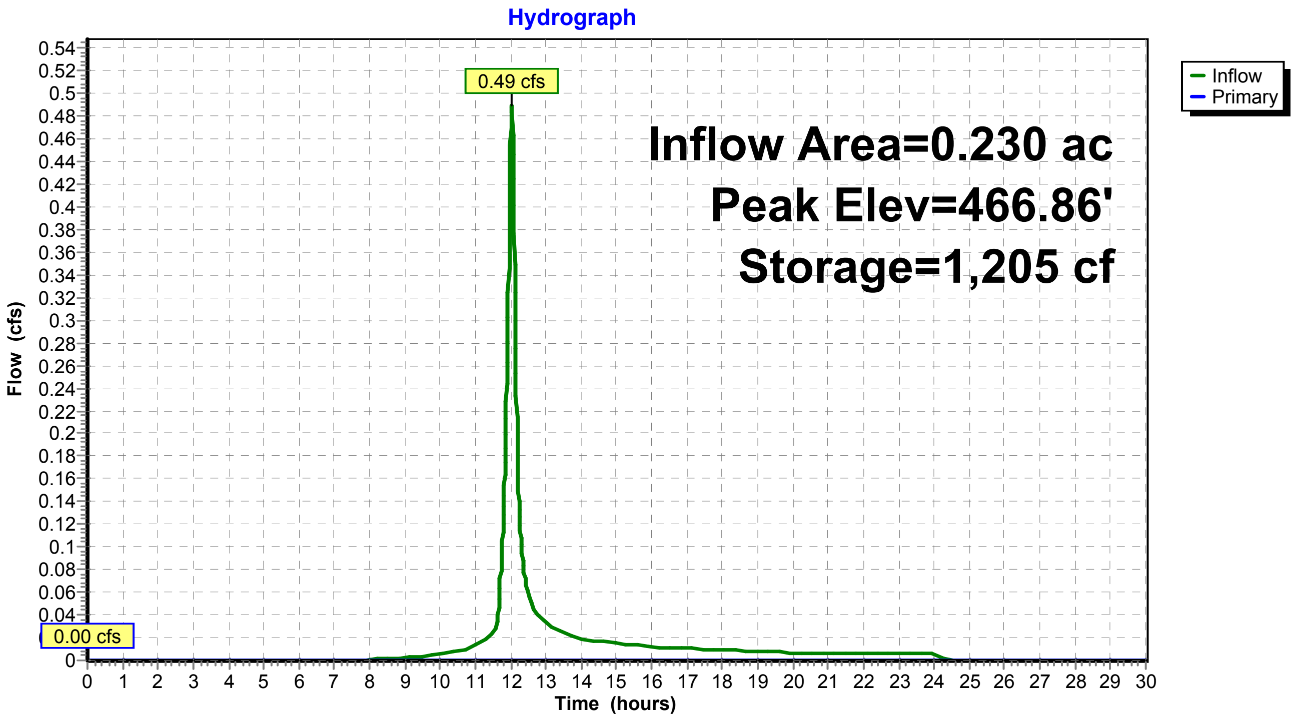
Volume	Invert	Avail.Storage	Storage Description
#1	466.00'	2,809 cf	**Stone Pad Void Storage** Listed below 7,022 cf Overall x 40.0% Voids

Elevation (feet)	Cum.Store (cubic-feet)
466.00	0
466.50	1,755
467.00	3,511
467.50	5,266
468.00	7,021
468.50	7,022

Device	Routing	Invert	Outlet Devices
#1	Primary	468.00'	**90.0' long x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=466.00' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

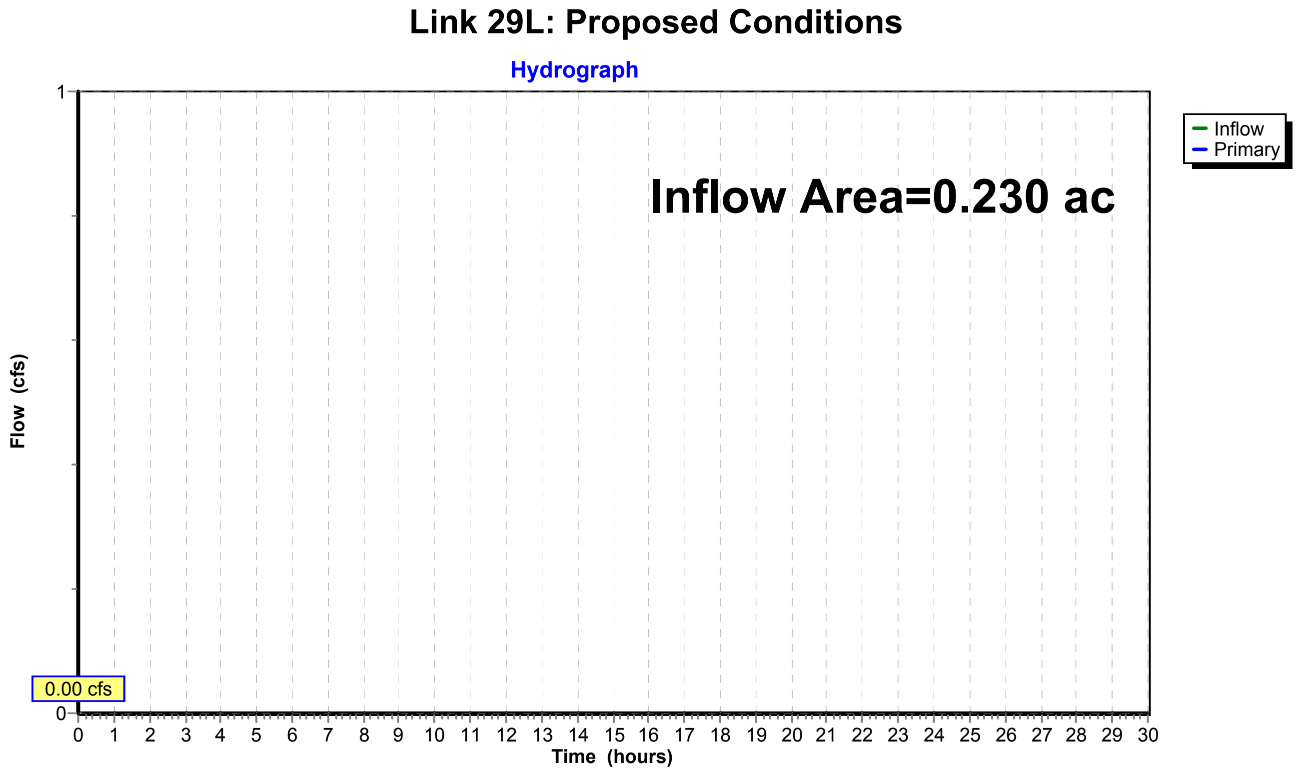
Pond 34P: MLV PAD



Summary for Link 29L: Proposed Conditions

Inflow Area = 0.230 ac, 58.72% Impervious, Inflow Depth = 0.00" for 1-Year event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs



Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 3S: DA TO MLV PAD Runoff Area=9,999 sf 58.72% Impervious Runoff Depth=1.91"
Flow Length=125' Slope=0.0150 '/' Tc=11.1 min CN=89 Runoff=0.64 cfs 0.037 af

Pond 34P: MLV PAD Peak Elev=467.13' Storage=1,591 cf Inflow=0.64 cfs 0.037 af
Outflow=0.00 cfs 0.000 af

Link 29L: Proposed Conditions Inflow=0.00 cfs 0.000 af
Primary=0.00 cfs 0.000 af

Total Runoff Area = 0.230 ac Runoff Volume = 0.037 af Average Runoff Depth = 1.91"
41.28% Pervious = 0.095 ac 58.72% Impervious = 0.135 ac

Summary for Subcatchment 3S: DA TO MLV PAD

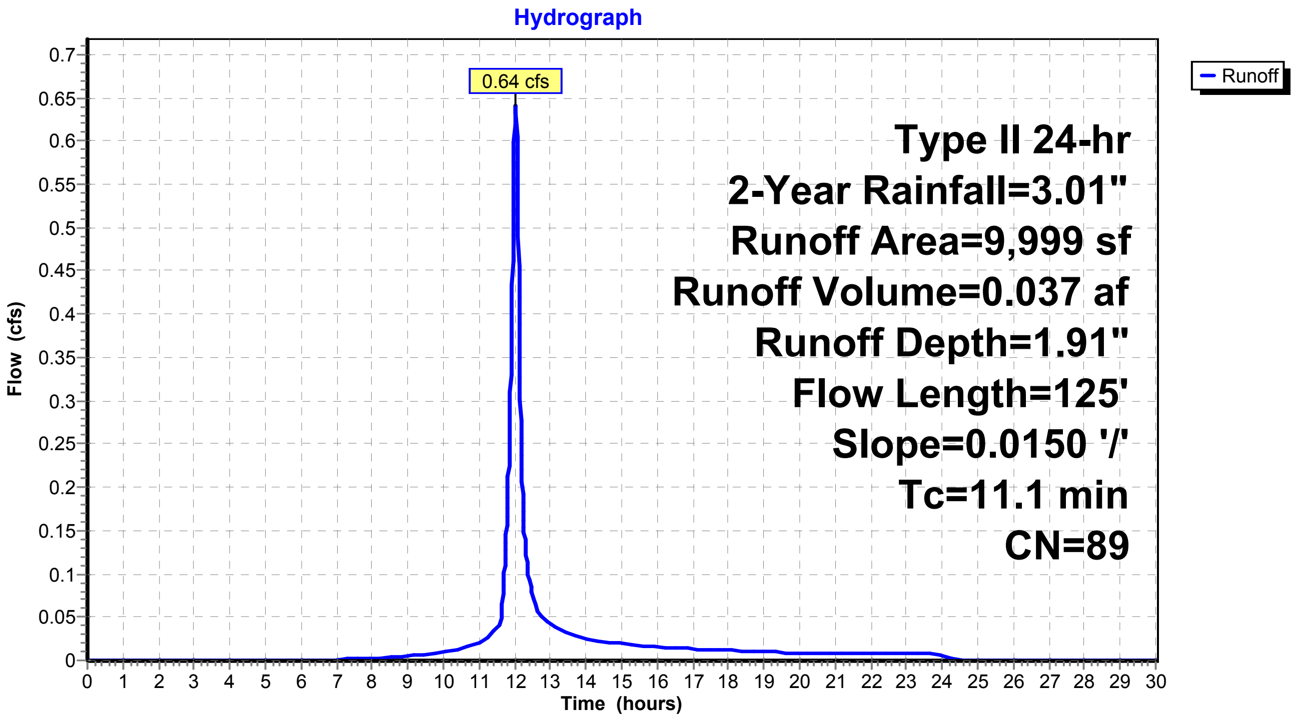
Runoff = 0.64 cfs @ 12.03 hrs, Volume= 0.037 af, Depth= 1.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type II 24-hr 2-Year Rainfall=3.01"

	Area (sf)	CN	Description
	1,191	98	Paved parking, HSG C
	1,271	89	Gravel roads, HSG C
*	4,680	98	Crushed Stone Pad, HSG C
	0	70	Woods, Good, HSG C
	2,857	71	Meadow, non-grazed, HSG C
	9,999	89	Weighted Average
	4,128		41.28% Pervious Area
	5,871		58.72% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	38	0.0150	0.98		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.01"
0.2	10	0.0150	0.75		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.01"
9.8	52	0.0150	0.09		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.01"
0.5	25	0.0150	0.86		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
11.1	125	Total			

Subcatchment 3S: DA TO MLV PAD



Summary for Pond 34P: MLV PAD

Inflow Area = 0.230 ac, 58.72% Impervious, Inflow Depth = 1.91" for 2-Year event
Inflow = 0.64 cfs @ 12.03 hrs, Volume= 0.037 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= 0.00-30.00 hrs, dt= 0.01 hrs / 6
Peak Elev= 467.13' @ 24.63 hrs Surf.Area= 0 sf Storage= 1,591 cf

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

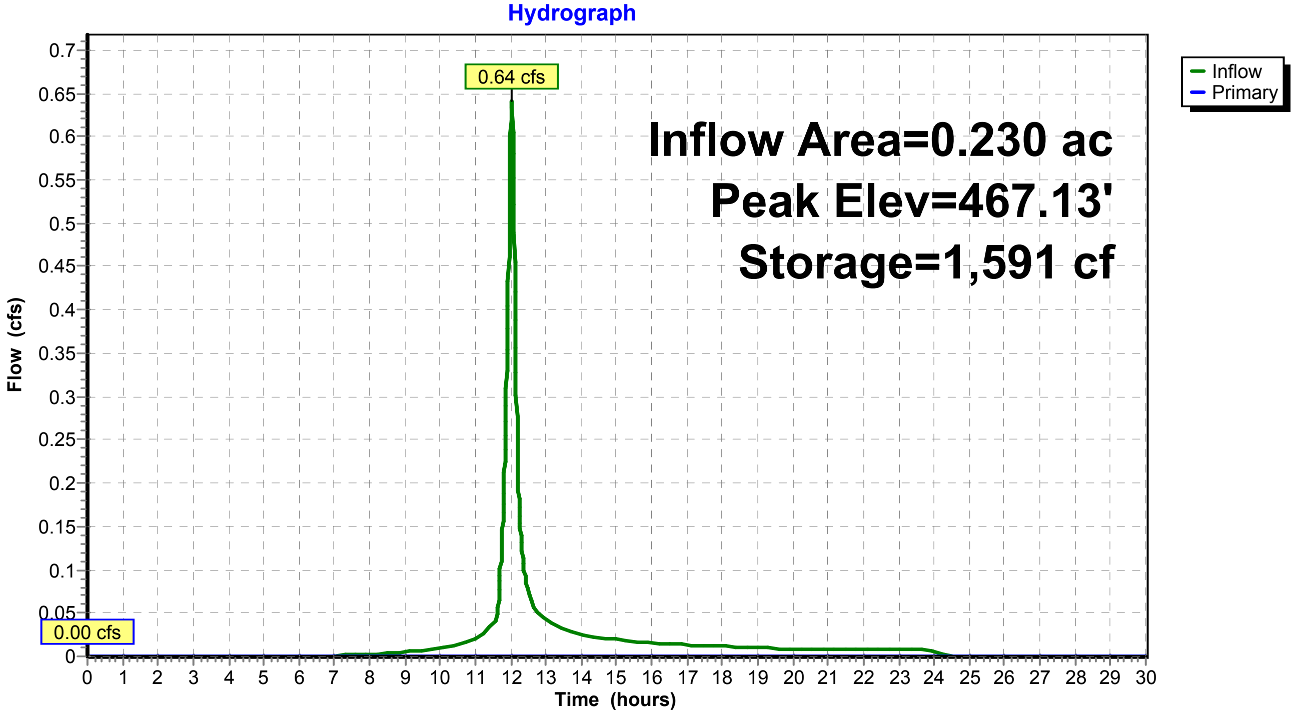
Volume	Invert	Avail.Storage	Storage Description
#1	466.00'	2,809 cf	**Stone Pad Void Storage** Listed below 7,022 cf Overall x 40.0% Voids

Elevation (feet)	Cum.Store (cubic-feet)
466.00	0
466.50	1,755
467.00	3,511
467.50	5,266
468.00	7,021
468.50	7,022

Device	Routing	Invert	Outlet Devices
#1	Primary	468.00'	**90.0' long x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=466.00' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 34P: MLV PAD

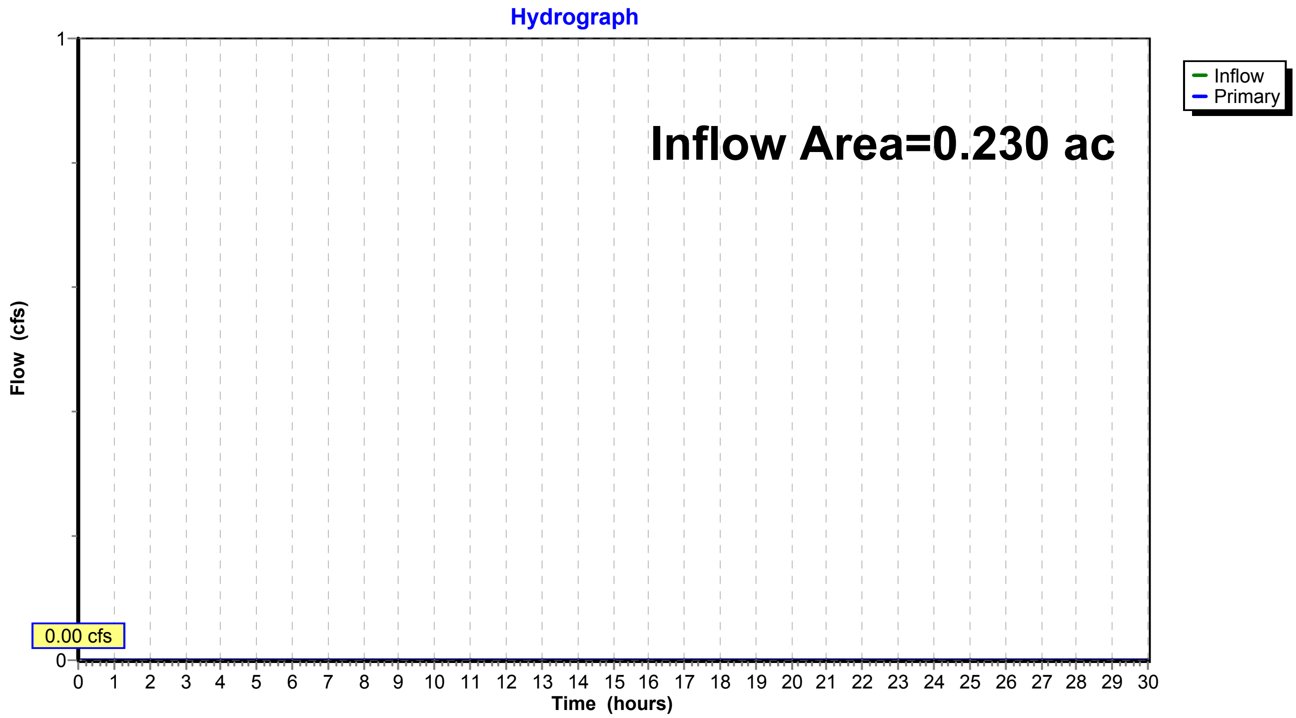


Summary for Link 29L: Proposed Conditions

Inflow Area =	0.230 ac,	58.72% Impervious,	Inflow Depth = 0.00"	for 2-Year event
Inflow =	0.00 cfs @	0.00 hrs, Volume=	0.000 af	
Primary =	0.00 cfs @	0.00 hrs, Volume=	0.000 af, Atten= 0%, Lag= 0.0 min	

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Link 29L: Proposed Conditions



Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment3S: DA TO MLV PAD Runoff Area=9,999 sf 58.72% Impervious Runoff Depth=2.65"
Flow Length=125' Slope=0.0150 '/' Tc=11.1 min CN=89 Runoff=0.88 cfs 0.051 af

Pond 34P: MLV PAD Peak Elev=467.58' Storage=2,212 cf Inflow=0.88 cfs 0.051 af
Outflow=0.00 cfs 0.000 af

Link 29L: Proposed Conditions Inflow=0.00 cfs 0.000 af
Primary=0.00 cfs 0.000 af

Total Runoff Area = 0.230 ac Runoff Volume = 0.051 af Average Runoff Depth = 2.65"
41.28% Pervious = 0.095 ac 58.72% Impervious = 0.135 ac

Summary for Subcatchment 3S: DA TO MLV PAD

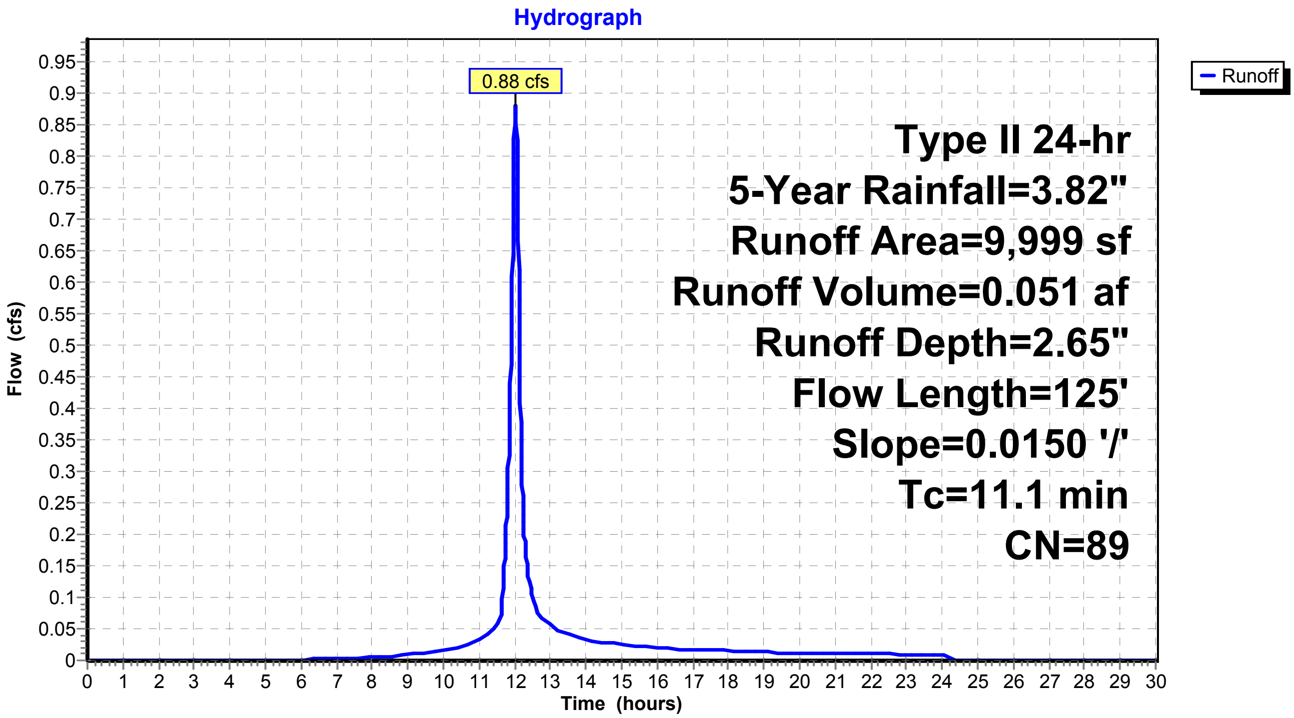
Runoff = 0.88 cfs @ 12.03 hrs, Volume= 0.051 af, Depth= 2.65"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type II 24-hr 5-Year Rainfall=3.82"

	Area (sf)	CN	Description
	1,191	98	Paved parking, HSG C
	1,271	89	Gravel roads, HSG C
*	4,680	98	Crushed Stone Pad, HSG C
	0	70	Woods, Good, HSG C
	2,857	71	Meadow, non-grazed, HSG C
	9,999	89	Weighted Average
	4,128		41.28% Pervious Area
	5,871		58.72% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	38	0.0150	0.98		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.01"
0.2	10	0.0150	0.75		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.01"
9.8	52	0.0150	0.09		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.01"
0.5	25	0.0150	0.86		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
11.1	125	Total			

Subcatchment 3S: DA TO MLV PAD



Summary for Pond 34P: MLV PAD

Inflow Area = 0.230 ac, 58.72% Impervious, Inflow Depth = 2.65" for 5-Year event
Inflow = 0.88 cfs @ 12.03 hrs, Volume= 0.051 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= 0.00-30.00 hrs, dt= 0.01 hrs / 6
Peak Elev= 467.58' @ 24.63 hrs Surf.Area= 0 sf Storage= 2,212 cf

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

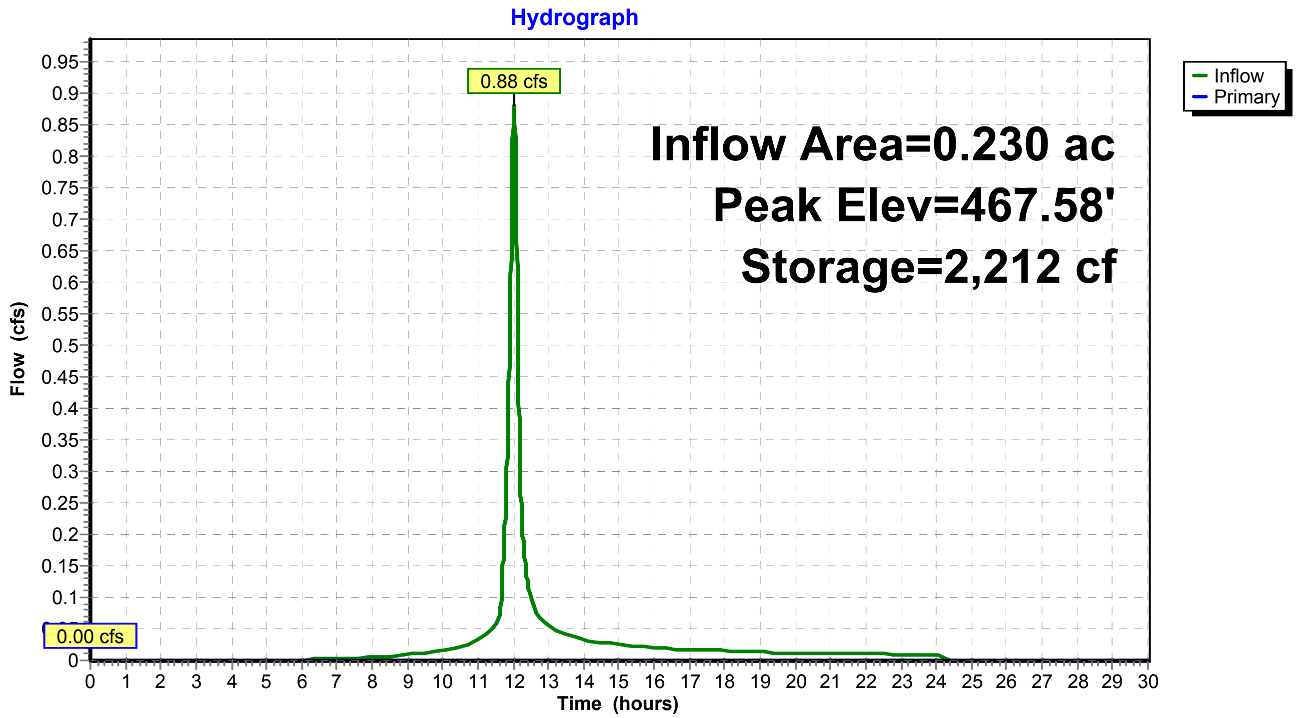
Volume	Invert	Avail.Storage	Storage Description
#1	466.00'	2,809 cf	**Stone Pad Void Storage** Listed below 7,022 cf Overall x 40.0% Voids

Elevation (feet)	Cum.Store (cubic-feet)
466.00	0
466.50	1,755
467.00	3,511
467.50	5,266
468.00	7,021
468.50	7,022

Device	Routing	Invert	Outlet Devices
#1	Primary	468.00'	**90.0' long x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=466.00' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 34P: MLV PAD

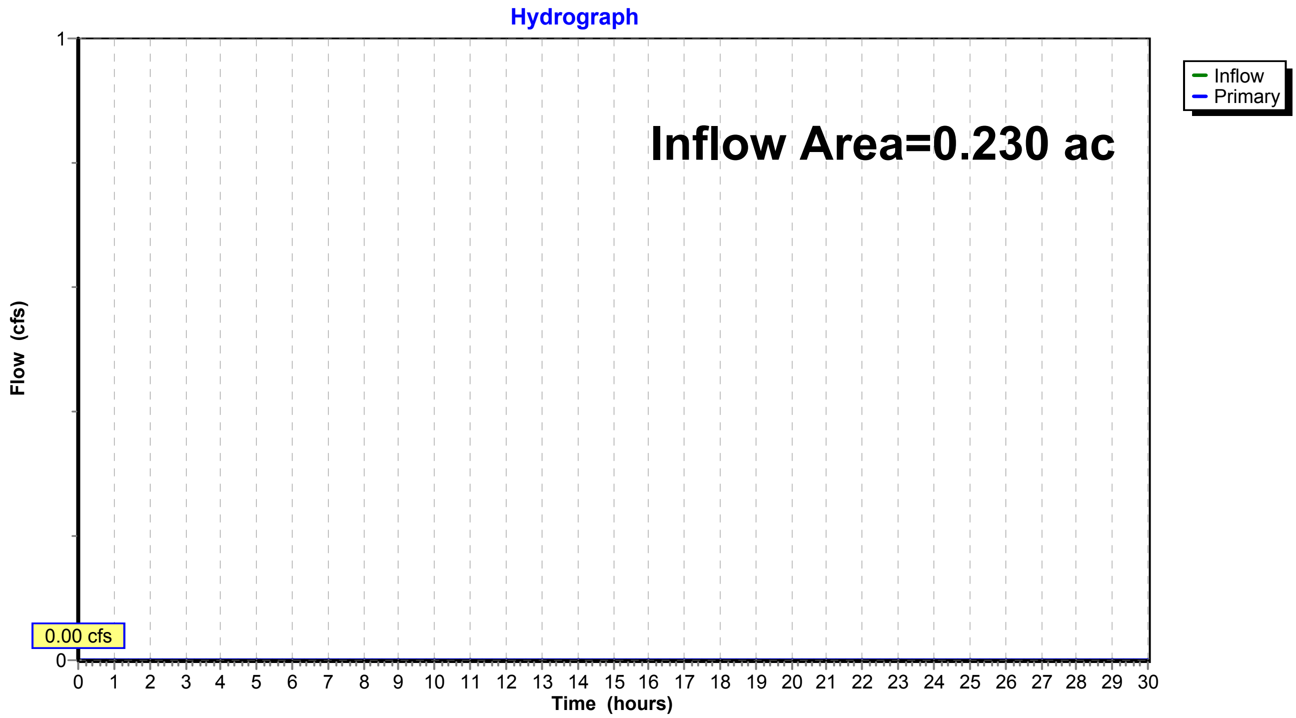


Summary for Link 29L: Proposed Conditions

Inflow Area = 0.230 ac, 58.72% Impervious, Inflow Depth = 0.00" for 5-Year event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Link 29L: Proposed Conditions



Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment3S: DA TO MLV PAD Runoff Area=9,999 sf 58.72% Impervious Runoff Depth=3.32"
Flow Length=125' Slope=0.0150 '/' Tc=11.1 min CN=89 Runoff=1.09 cfs 0.064 af

Pond 34P: MLV PAD Peak Elev=467.97' Storage=2,769 cf Inflow=1.09 cfs 0.064 af
Outflow=0.00 cfs 0.000 af

Link 29L: Proposed Conditions Inflow=0.00 cfs 0.000 af
Primary=0.00 cfs 0.000 af

Total Runoff Area = 0.230 ac Runoff Volume = 0.064 af Average Runoff Depth = 3.32"
41.28% Pervious = 0.095 ac 58.72% Impervious = 0.135 ac

Summary for Subcatchment 3S: DA TO MLV PAD

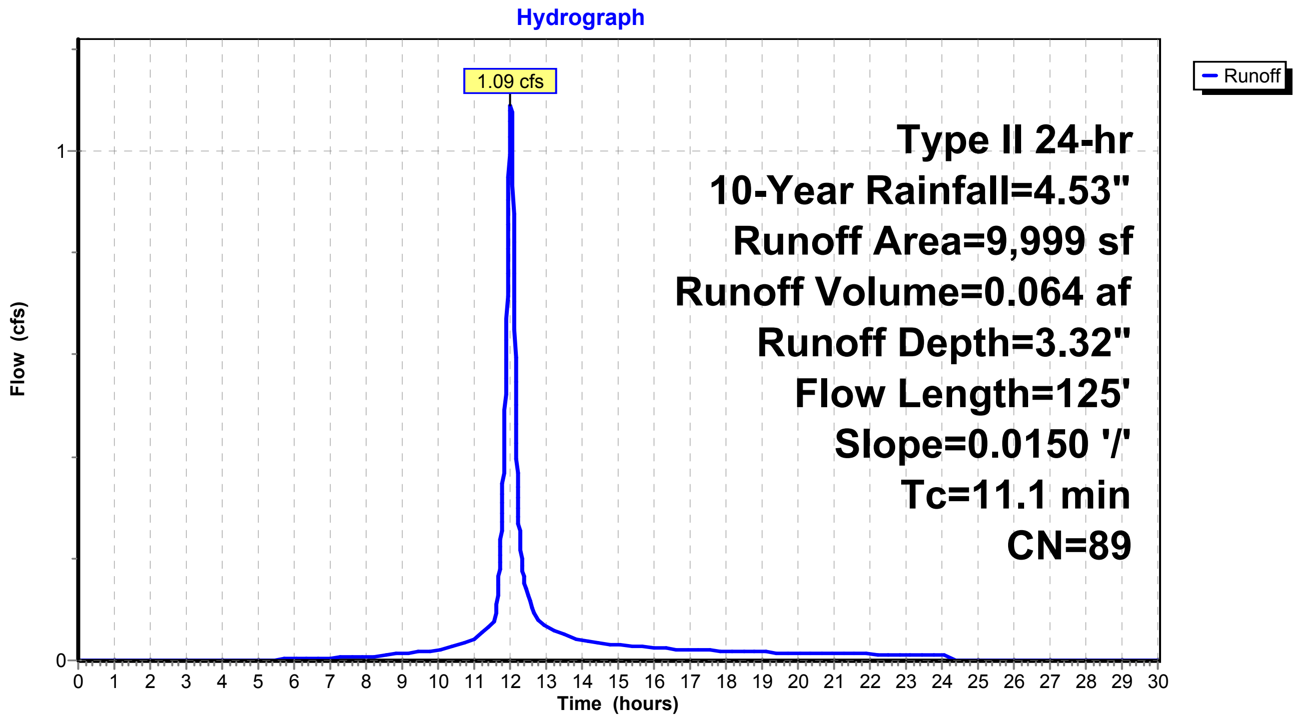
Runoff = 1.09 cfs @ 12.02 hrs, Volume= 0.064 af, Depth= 3.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type II 24-hr 10-Year Rainfall=4.53"

	Area (sf)	CN	Description
	1,191	98	Paved parking, HSG C
	1,271	89	Gravel roads, HSG C
*	4,680	98	Crushed Stone Pad, HSG C
	0	70	Woods, Good, HSG C
	2,857	71	Meadow, non-grazed, HSG C
	9,999	89	Weighted Average
	4,128		41.28% Pervious Area
	5,871		58.72% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	38	0.0150	0.98		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.01"
0.2	10	0.0150	0.75		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.01"
9.8	52	0.0150	0.09		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.01"
0.5	25	0.0150	0.86		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
11.1	125	Total			

Subcatchment 3S: DA TO MLV PAD



Summary for Pond 34P: MLV PAD

Inflow Area = 0.230 ac, 58.72% Impervious, Inflow Depth = 3.32" for 10-Year event
Inflow = 1.09 cfs @ 12.02 hrs, Volume= 0.064 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= 0.00-30.00 hrs, dt= 0.01 hrs / 6
Peak Elev= 467.97' @ 24.63 hrs Surf.Area= 0 sf Storage= 2,769 cf

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

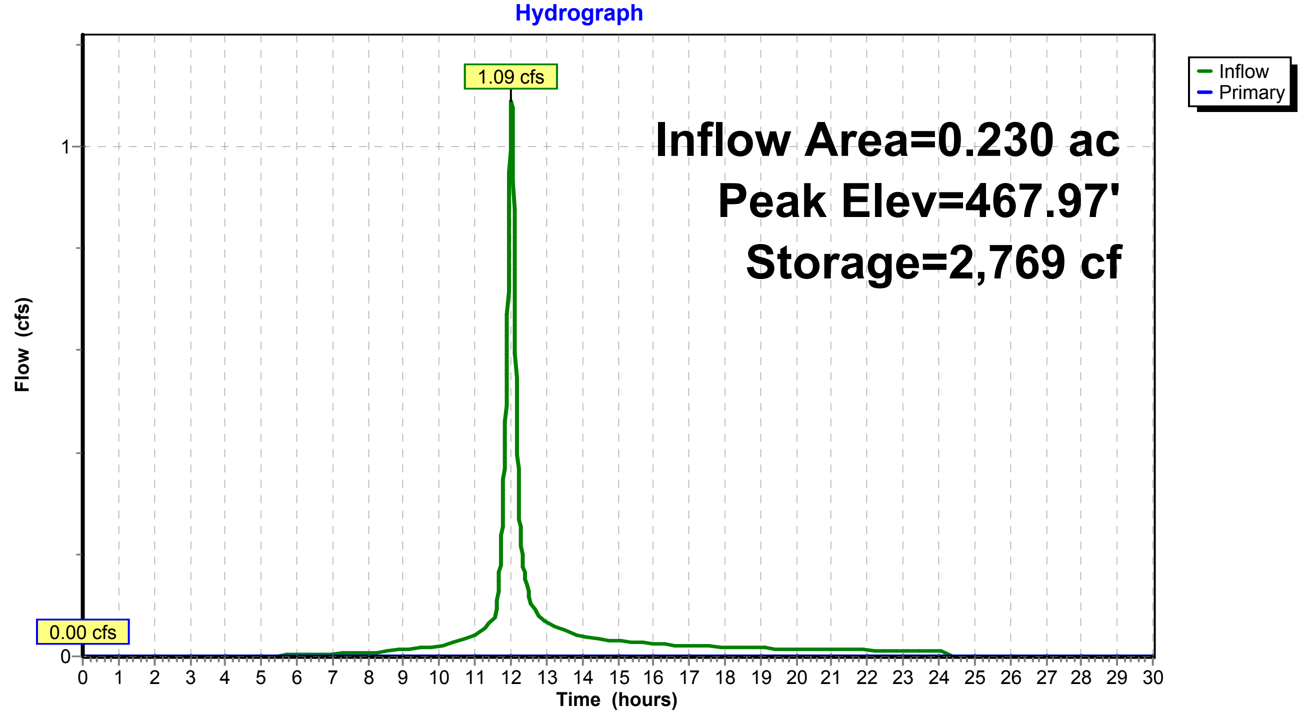
Volume	Invert	Avail.Storage	Storage Description
#1	466.00'	2,809 cf	**Stone Pad Void Storage** Listed below 7,022 cf Overall x 40.0% Voids

Elevation (feet)	Cum.Store (cubic-feet)
466.00	0
466.50	1,755
467.00	3,511
467.50	5,266
468.00	7,021
468.50	7,022

Device	Routing	Invert	Outlet Devices
#1	Primary	468.00'	**90.0' long x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=466.00' (Free Discharge)
1=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Pond 34P: MLV PAD

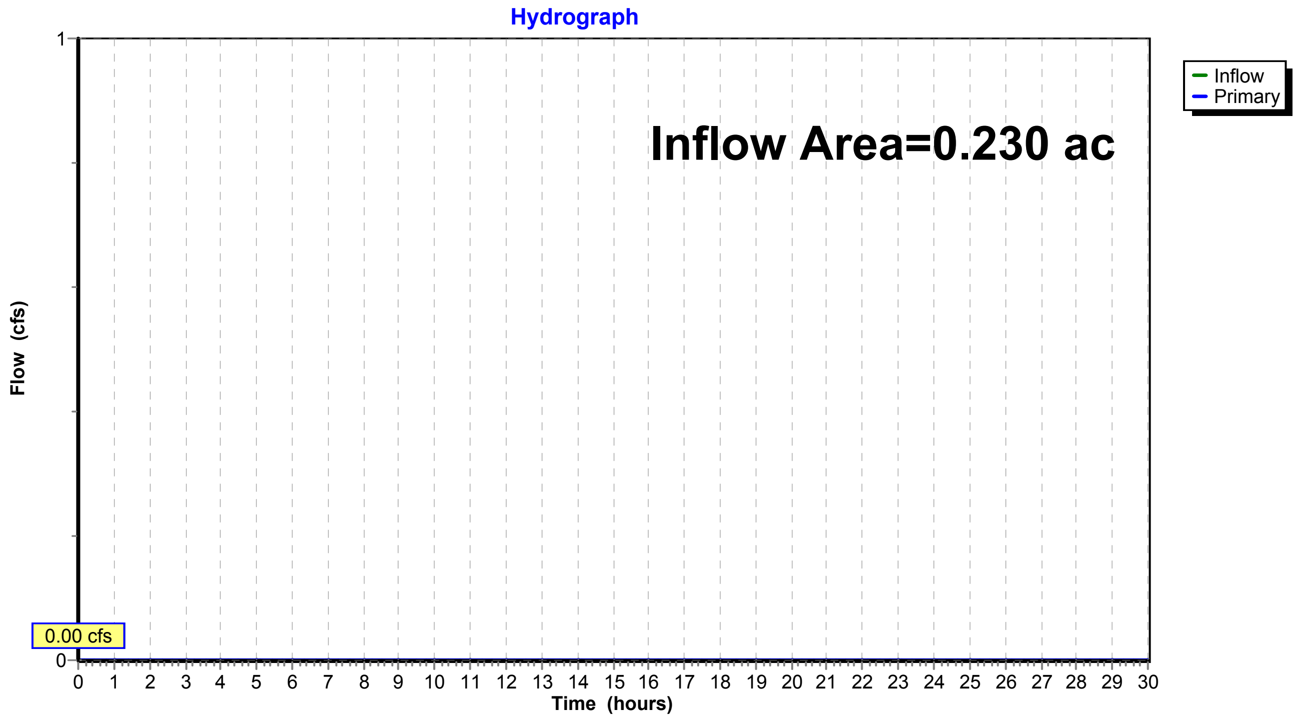


Summary for Link 29L: Proposed Conditions

Inflow Area = 0.230 ac, 58.72% Impervious, Inflow Depth = 0.00" for 10-Year event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Link 29L: Proposed Conditions



Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment3S: DA TO MLV PAD Runoff Area=9,999 sf 58.72% Impervious Runoff Depth=4.37"
Flow Length=125' Slope=0.0150 '/' Tc=11.1 min CN=89 Runoff=1.41 cfs 0.084 af

Pond 34P: MLV PAD Peak Elev=468.00' Storage=2,808 cf Inflow=1.41 cfs 0.084 af
Outflow=0.08 cfs 0.019 af

Link 29L: Proposed Conditions Inflow=0.08 cfs 0.019 af
Primary=0.08 cfs 0.019 af

Total Runoff Area = 0.230 ac Runoff Volume = 0.084 af Average Runoff Depth = 4.37"
41.28% Pervious = 0.095 ac 58.72% Impervious = 0.135 ac

Summary for Subcatchment 3S: DA TO MLV PAD

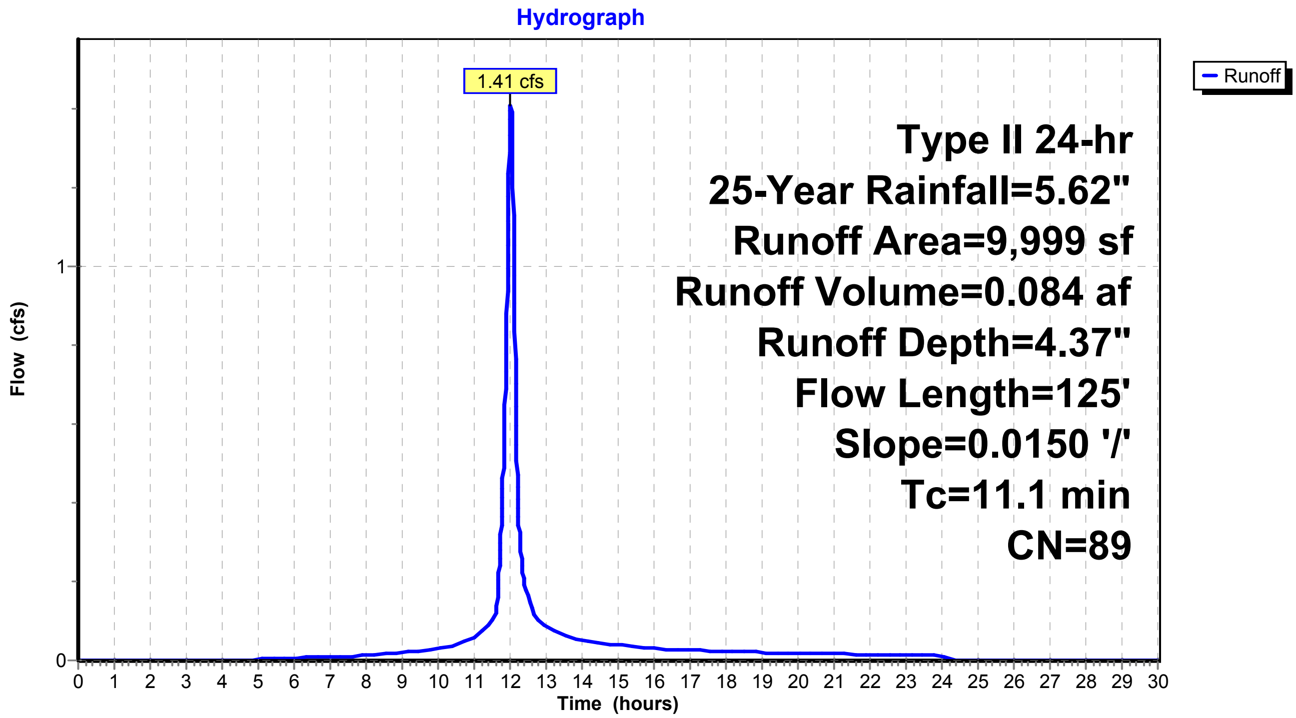
Runoff = 1.41 cfs @ 12.02 hrs, Volume= 0.084 af, Depth= 4.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=5.62"

	Area (sf)	CN	Description
	1,191	98	Paved parking, HSG C
	1,271	89	Gravel roads, HSG C
*	4,680	98	Crushed Stone Pad, HSG C
	0	70	Woods, Good, HSG C
	2,857	71	Meadow, non-grazed, HSG C
	9,999	89	Weighted Average
	4,128		41.28% Pervious Area
	5,871		58.72% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	38	0.0150	0.98		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.01"
0.2	10	0.0150	0.75		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.01"
9.8	52	0.0150	0.09		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.01"
0.5	25	0.0150	0.86		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
11.1	125	Total			

Subcatchment 3S: DA TO MLV PAD



Summary for Pond 34P: MLV PAD

Inflow Area = 0.230 ac, 58.72% Impervious, Inflow Depth = 4.37" for 25-Year event
Inflow = 1.41 cfs @ 12.02 hrs, Volume= 0.084 af
Outflow = 0.08 cfs @ 14.04 hrs, Volume= 0.019 af, Atten= 95%, Lag= 121.3 min
Primary = 0.08 cfs @ 14.04 hrs, Volume= 0.019 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 6
Peak Elev= 468.00' @ 14.04 hrs Surf.Area= 0 sf Storage= 2,808 cf

Plug-Flow detention time= 448.9 min calculated for 0.019 af (23% of inflow)
Center-of-Mass det. time= 287.2 min (1,079.0 - 791.9)

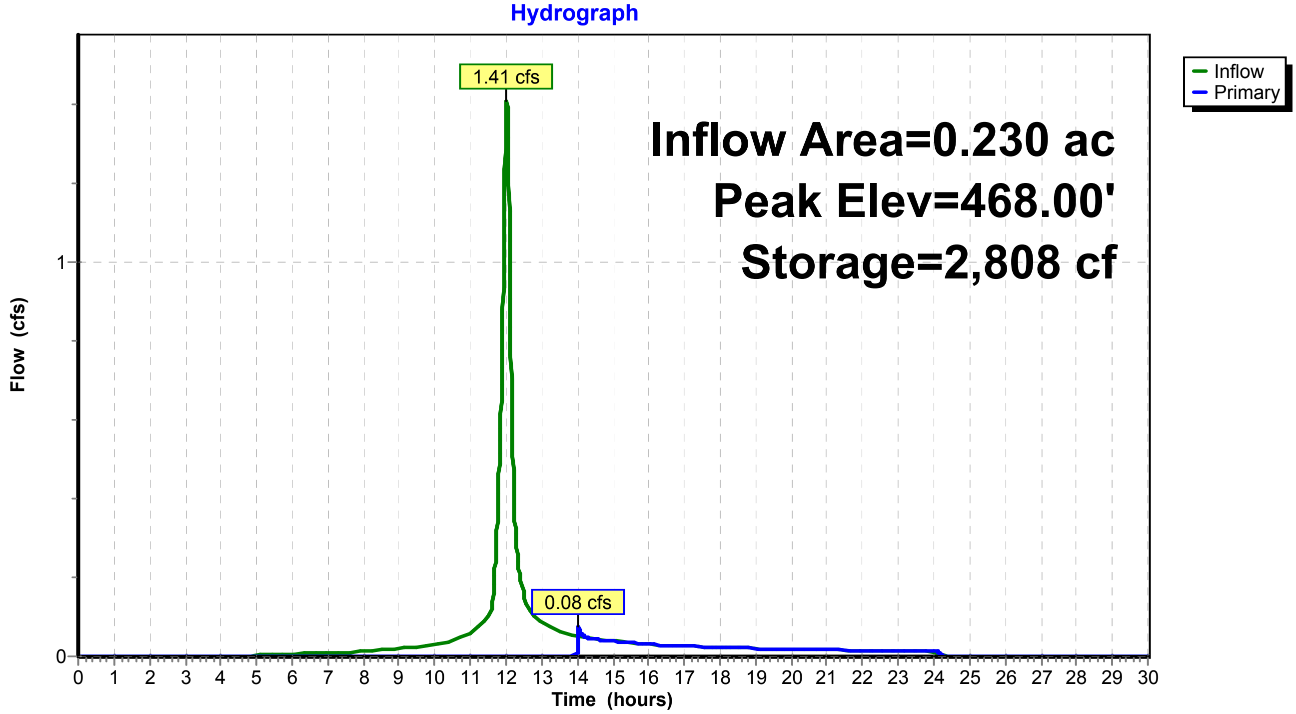
Volume	Invert	Avail.Storage	Storage Description
#1	466.00'	2,809 cf	**Stone Pad Void Storage** Listed below 7,022 cf Overall x 40.0% Voids

Elevation (feet)	Cum.Store (cubic-feet)
466.00	0
466.50	1,755
467.00	3,511
467.50	5,266
468.00	7,021
468.50	7,022

Device	Routing	Invert	Outlet Devices
#1	Primary	468.00'	**90.0' long x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=0.02 cfs @ 14.04 hrs HW=468.00' (Free Discharge)
1=Broad-Crested Rectangular Weir (Weir Controls 0.02 cfs @ 0.11 fps)

Pond 34P: MLV PAD

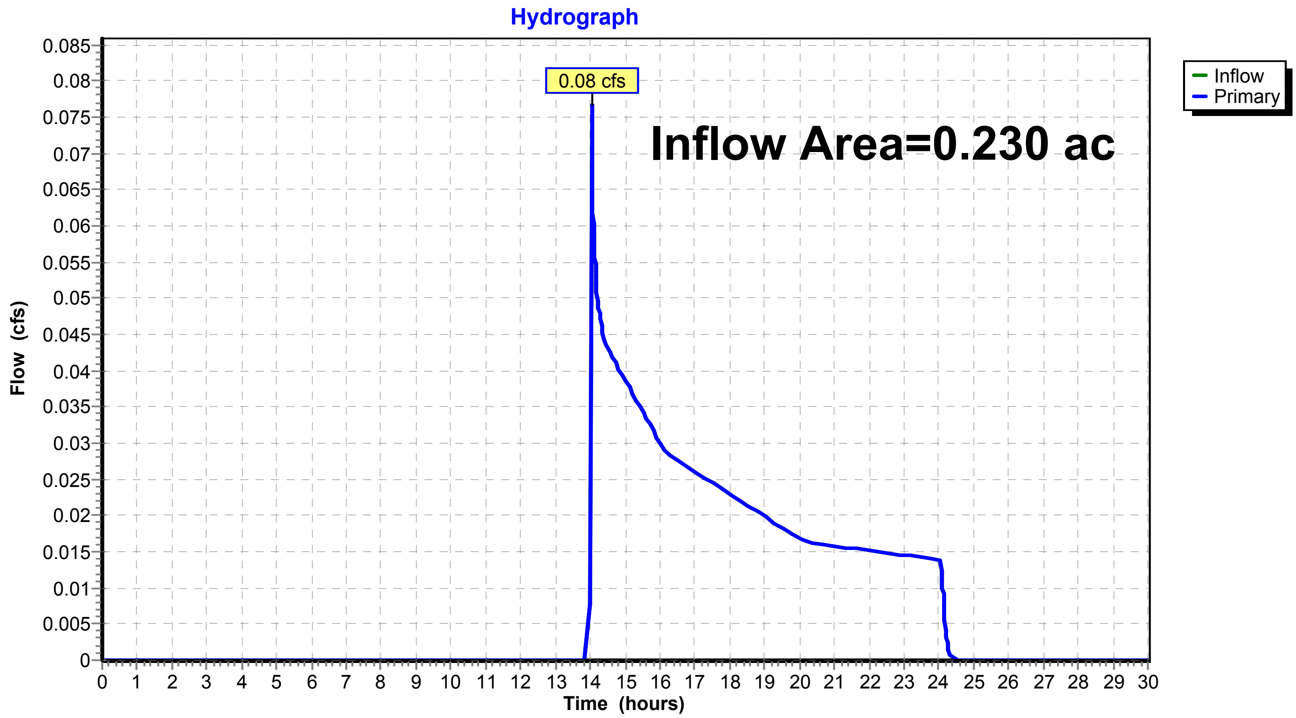


Summary for Link 29L: Proposed Conditions

Inflow Area =	0.230 ac,	58.72% Impervious,	Inflow Depth = 1.01"	for 25-Year event	
Inflow =	0.08 cfs @	14.04 hrs,	Volume=	0.019 af	
Primary =	0.08 cfs @	14.04 hrs,	Volume=	0.019 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Link 29L: Proposed Conditions



Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment3S: DA TO MLV PAD Runoff Area=9,999 sf 58.72% Impervious Runoff Depth=5.29"
Flow Length=125' Slope=0.0150 '/' Tc=11.1 min CN=89 Runoff=1.69 cfs 0.101 af

Pond 34P: MLV PAD Peak Elev=468.00' Storage=2,808 cf Inflow=1.69 cfs 0.101 af
Outflow=0.13 cfs 0.035 af

Link 29L: Proposed Conditions Inflow=0.13 cfs 0.035 af
Primary=0.13 cfs 0.035 af

Total Runoff Area = 0.230 ac Runoff Volume = 0.101 af Average Runoff Depth = 5.29"
41.28% Pervious = 0.095 ac 58.72% Impervious = 0.135 ac

Summary for Subcatchment 3S: DA TO MLV PAD

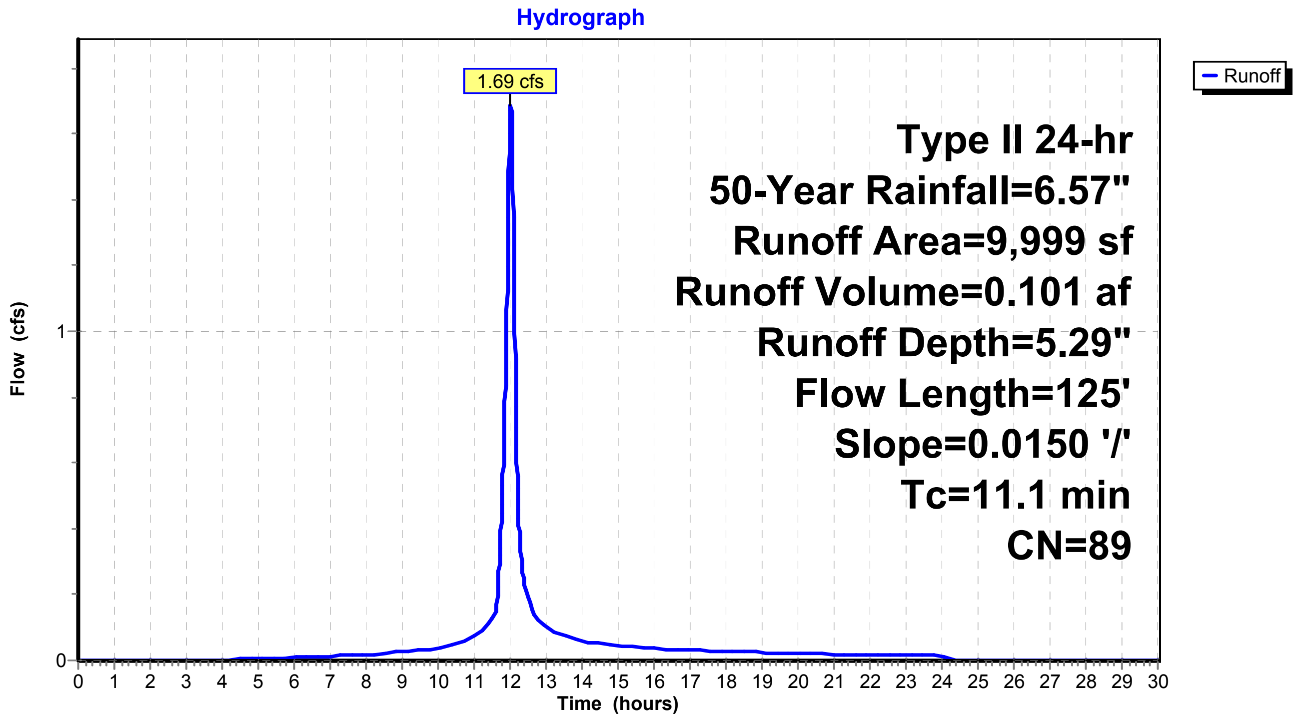
Runoff = 1.69 cfs @ 12.02 hrs, Volume= 0.101 af, Depth= 5.29"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type II 24-hr 50-Year Rainfall=6.57"

	Area (sf)	CN	Description
	1,191	98	Paved parking, HSG C
	1,271	89	Gravel roads, HSG C
*	4,680	98	Crushed Stone Pad, HSG C
	0	70	Woods, Good, HSG C
	2,857	71	Meadow, non-grazed, HSG C
	9,999	89	Weighted Average
	4,128		41.28% Pervious Area
	5,871		58.72% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	38	0.0150	0.98		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.01"
0.2	10	0.0150	0.75		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.01"
9.8	52	0.0150	0.09		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.01"
0.5	25	0.0150	0.86		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
11.1	125	Total			

Subcatchment 3S: DA TO MLV PAD



Summary for Pond 34P: MLV PAD

Inflow Area = 0.230 ac, 58.72% Impervious, Inflow Depth = 5.29" for 50-Year event
Inflow = 1.69 cfs @ 12.02 hrs, Volume= 0.101 af
Outflow = 0.13 cfs @ 12.52 hrs, Volume= 0.035 af, Atten= 92%, Lag= 30.0 min
Primary = 0.13 cfs @ 12.52 hrs, Volume= 0.035 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 6
Peak Elev= 468.00' @ 12.52 hrs Surf.Area= 0 sf Storage= 2,808 cf

Plug-Flow detention time= 324.5 min calculated for 0.035 af (35% of inflow)
Center-of-Mass det. time= 188.4 min (975.1 - 786.6)

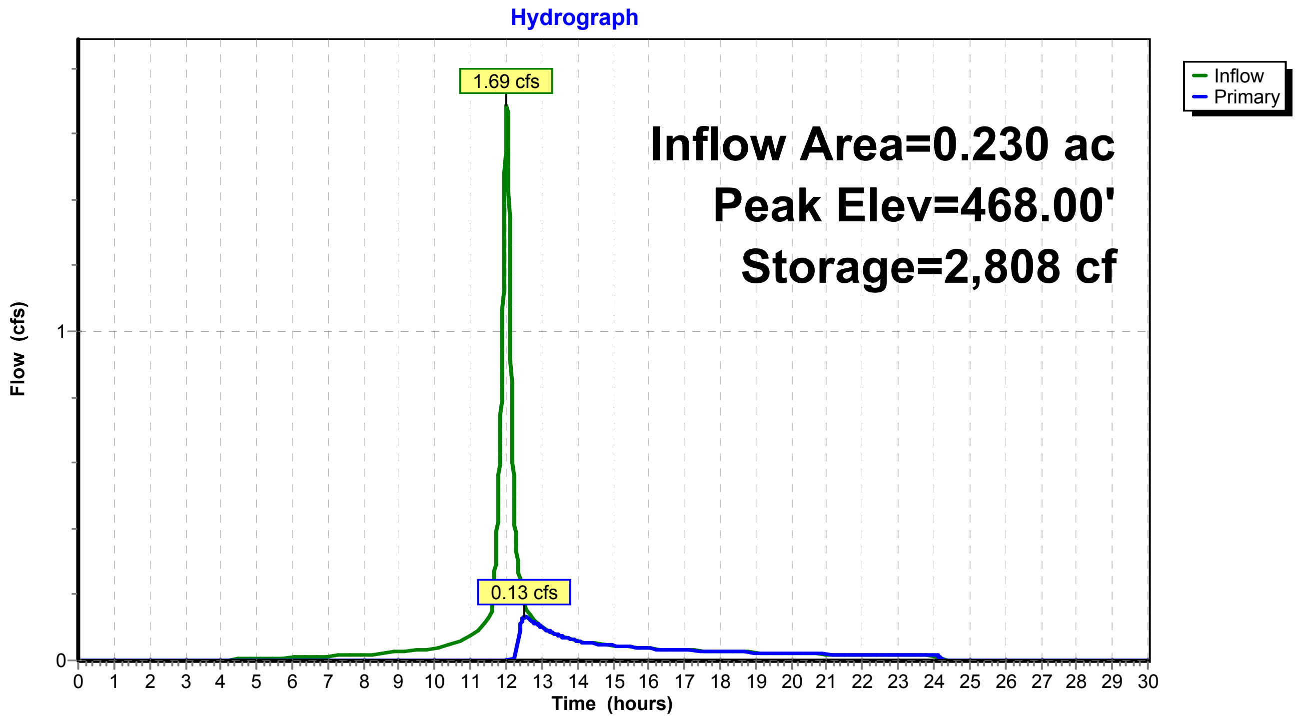
Volume	Invert	Avail.Storage	Storage Description
#1	466.00'	2,809 cf	**Stone Pad Void Storage** Listed below 7,022 cf Overall x 40.0% Voids

Elevation (feet)	Cum.Store (cubic-feet)
466.00	0
466.50	1,755
467.00	3,511
467.50	5,266
468.00	7,021
468.50	7,022

Device	Routing	Invert	Outlet Devices
#1	Primary	468.00'	**90.0' long x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=0.05 cfs @ 12.52 hrs HW=468.00' (Free Discharge)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 0.05 cfs @ 0.15 fps)

Pond 34P: MLV PAD

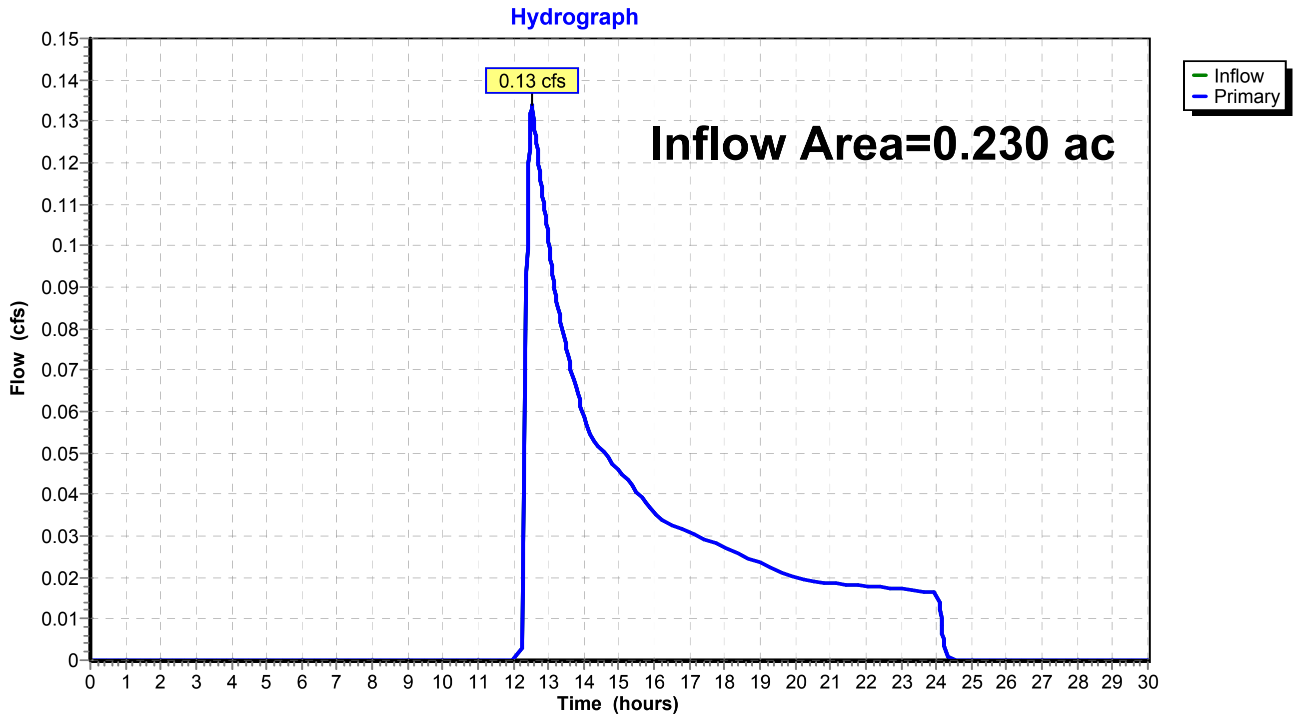


Summary for Link 29L: Proposed Conditions

Inflow Area = 0.230 ac, 58.72% Impervious, Inflow Depth = 1.84" for 50-Year event
Inflow = 0.13 cfs @ 12.52 hrs, Volume= 0.035 af
Primary = 0.13 cfs @ 12.52 hrs, Volume= 0.035 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Link 29L: Proposed Conditions



Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment3S: DA TO MLV PAD Runoff Area=9,999 sf 58.72% Impervious Runoff Depth=6.34"
Flow Length=125' Slope=0.0150 '/' Tc=11.1 min CN=89 Runoff=2.00 cfs 0.121 af

Pond 34P: MLV PAD Peak Elev=468.01' Storage=2,808 cf Inflow=2.00 cfs 0.121 af
Outflow=0.18 cfs 0.043 af

Link 29L: Proposed Conditions Inflow=0.18 cfs 0.043 af
Primary=0.18 cfs 0.043 af

Total Runoff Area = 0.230 ac Runoff Volume = 0.121 af Average Runoff Depth = 6.34"
41.28% Pervious = 0.095 ac 58.72% Impervious = 0.135 ac

Summary for Subcatchment 3S: DA TO MLV PAD

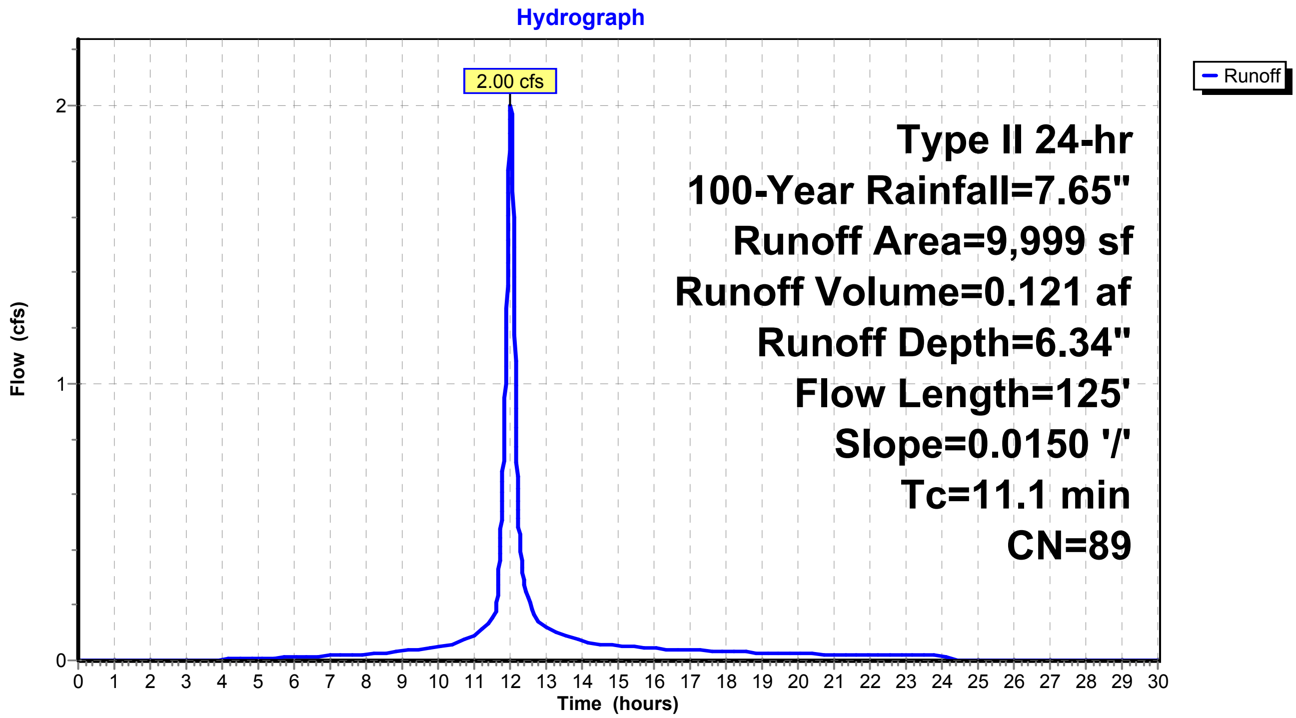
Runoff = 2.00 cfs @ 12.02 hrs, Volume= 0.121 af, Depth= 6.34"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Year Rainfall=7.65"

	Area (sf)	CN	Description
	1,191	98	Paved parking, HSG C
	1,271	89	Gravel roads, HSG C
*	4,680	98	Crushed Stone Pad, HSG C
	0	70	Woods, Good, HSG C
	2,857	71	Meadow, non-grazed, HSG C
	9,999	89	Weighted Average
	4,128		41.28% Pervious Area
	5,871		58.72% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	38	0.0150	0.98		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.01"
0.2	10	0.0150	0.75		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.01"
9.8	52	0.0150	0.09		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.01"
0.5	25	0.0150	0.86		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
11.1	125	Total			

Subcatchment 3S: DA TO MLV PAD



Summary for Pond 34P: MLV PAD

Inflow Area = 0.230 ac, 58.72% Impervious, Inflow Depth = 6.34" for 100-Year event
Inflow = 2.00 cfs @ 12.02 hrs, Volume= 0.121 af
Outflow = 0.18 cfs @ 12.47 hrs, Volume= 0.043 af, Atten= 91%, Lag= 26.9 min
Primary = 0.18 cfs @ 12.47 hrs, Volume= 0.043 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 6
Peak Elev= 468.01' @ 12.47 hrs Surf.Area= 0 sf Storage= 2,808 cf

Plug-Flow detention time= 321.2 min calculated for 0.043 af (36% of inflow)
Center-of-Mass det. time= 183.2 min (965.0 - 781.8)

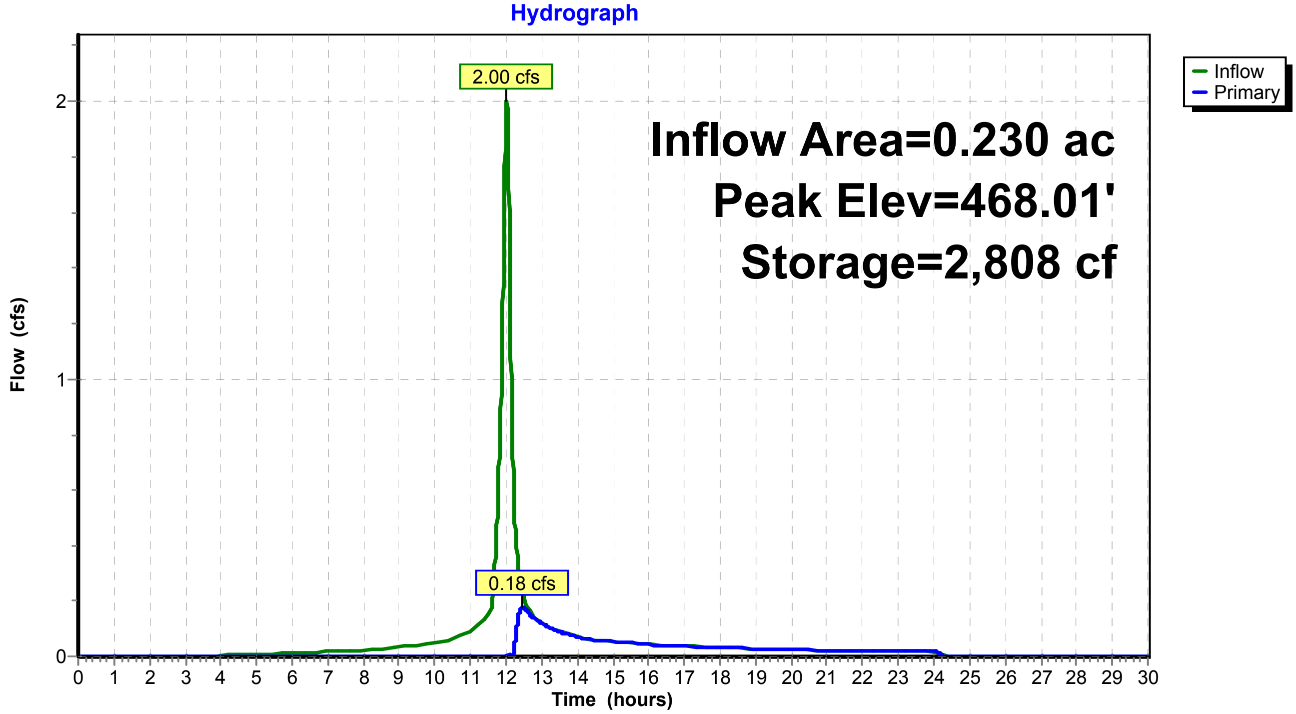
Volume	Invert	Avail.Storage	Storage Description
#1	466.00'	2,809 cf	**Stone Pad Void Storage** Listed below 7,022 cf Overall x 40.0% Voids

Elevation (feet)	Cum.Store (cubic-feet)
466.00	0
466.50	1,755
467.00	3,511
467.50	5,266
468.00	7,021
468.50	7,022

Device	Routing	Invert	Outlet Devices
#1	Primary	468.00'	**90.0' long x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=0.08 cfs @ 12.47 hrs HW=468.01' (Free Discharge)
1=Broad-Crested Rectangular Weir (Weir Controls 0.08 cfs @ 0.17 fps)

Pond 34P: MLV PAD

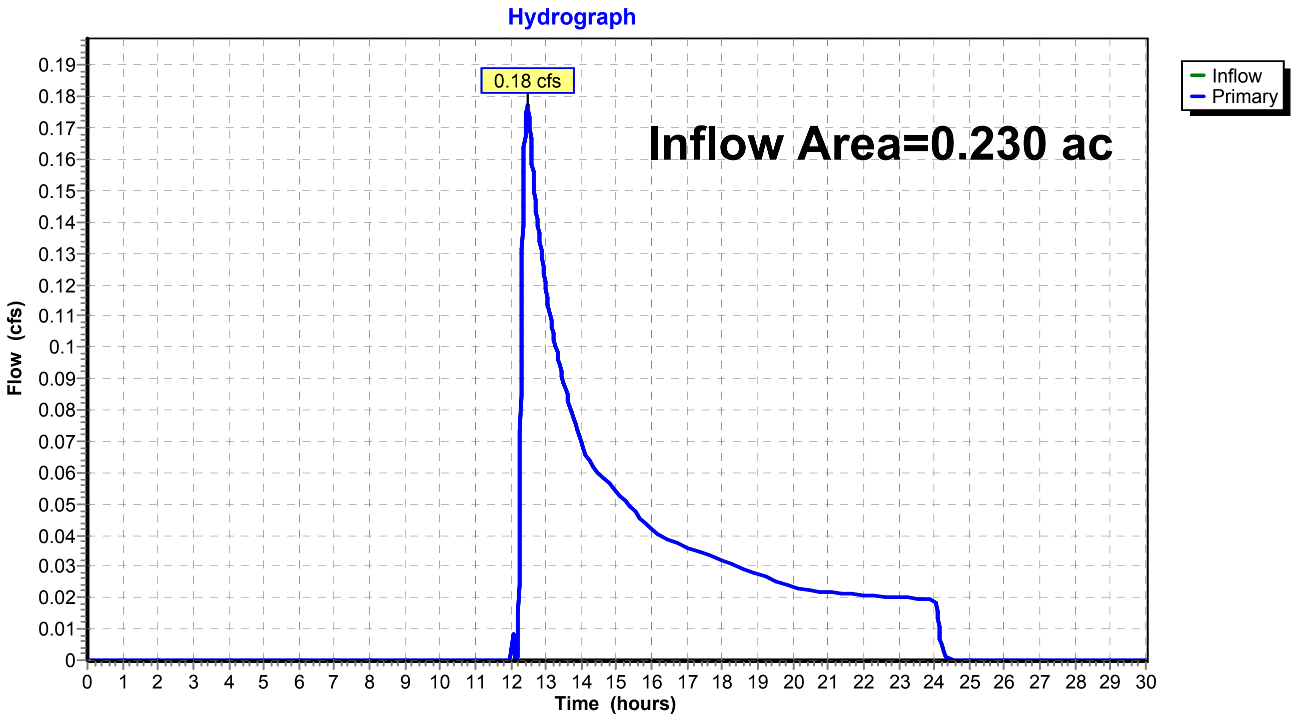


Summary for Link 29L: Proposed Conditions

Inflow Area = 0.230 ac, 58.72% Impervious, Inflow Depth = 2.25" for 100-Year event
Inflow = 0.18 cfs @ 12.47 hrs, Volume= 0.043 af
Primary = 0.18 cfs @ 12.47 hrs, Volume= 0.043 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

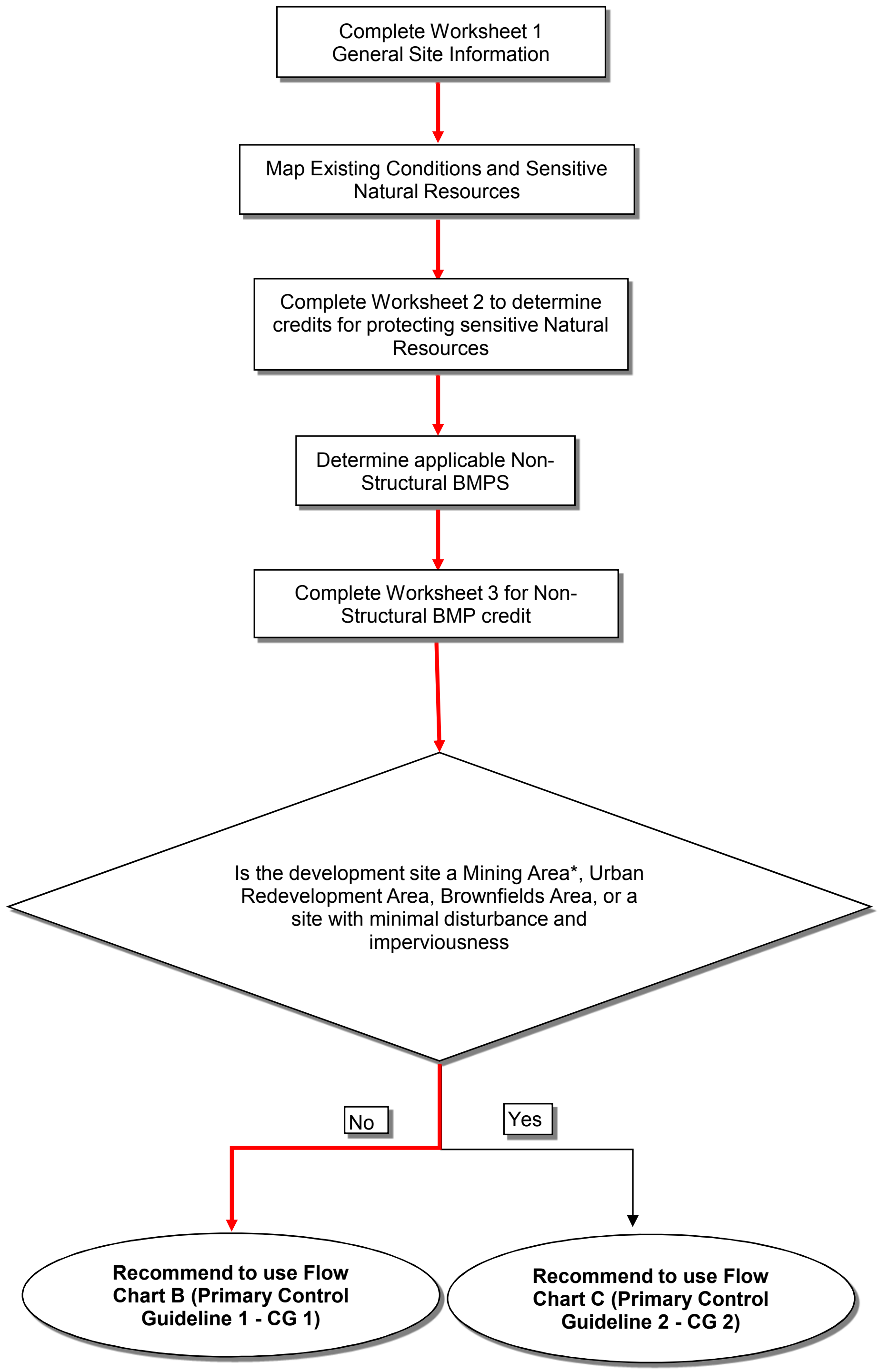
Link 29L: Proposed Conditions



G.5 Water Quality Worksheets

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

FLOW CHART A
Stormwater Calculation Process



Worksheet 1. General Site Information

INSTRUCTIONS: Fill out Worksheet 1 for each watershed

Date: 28-Mar-16

Project Name: Atlantic Sunrise Pipeline AR-LE-037.2

Municipality: South Annville Township

County: Lebanon

Total Area (acres): 0.96

Major River Basin: Susquehanna

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

Watershed: Swatara Creek

Sub-Basin: Lower Susquehanna

Nearest Surface Water(s) to Receive Runoff: Gingrich Run

Chapter 93 - Designated Water Use: TSF, MF

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

Impaired according to Chapter 303(d) List? Yes [X] No [ ]

http://www.dep.state.pa.us/dep/deputate/watermgt/wqp/wqstandards/303d-Report.htm

List Causes of Impairment: Agriculture (Suspended Solids); Source Unknown (Pathogens); Urban Runoff/Storm Sewers (Organic Enrichment/Low D.O.)

Is project subject to, or part of:

Municipal Separate Storm Sewer System (MS4) Requirements? Yes [ ] No [X]

http://www.dep.state.pa.us/dep/deputate/watermgt/wc/Subjects/StormwaterManagement/GeneralPermits/default.htm

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

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

Approved Act 167 Plan? Yes [ ] No [X]

http://www.dep.state.pa.us/dep/deputate/watermgt/wc/Subjects/StormwaterManagement/Approved_1.html

Existing River Conservation Plan? Yes [ ] No [X]

http://www.dcnr.state.pa.us/brc/rivers/riversconservation/planningprojects/

Worksheet 2. Sensitive Natural Resources

INSTRUCTIONS:

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

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

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

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

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

EXISTING NATURAL SENSITIVE RESOURCE	MAPPED? yes/no/n/a	TOTAL AREA (Ac.)	PROTECTED AREA (Ac.)
Waterbodies	N/A		
Floodplains	N/A		
Riparian Areas	N/A		
Wetlands	N/A		
Woodlands	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
0.96	-	0	=	0.96

This is the area that requires stormwater management

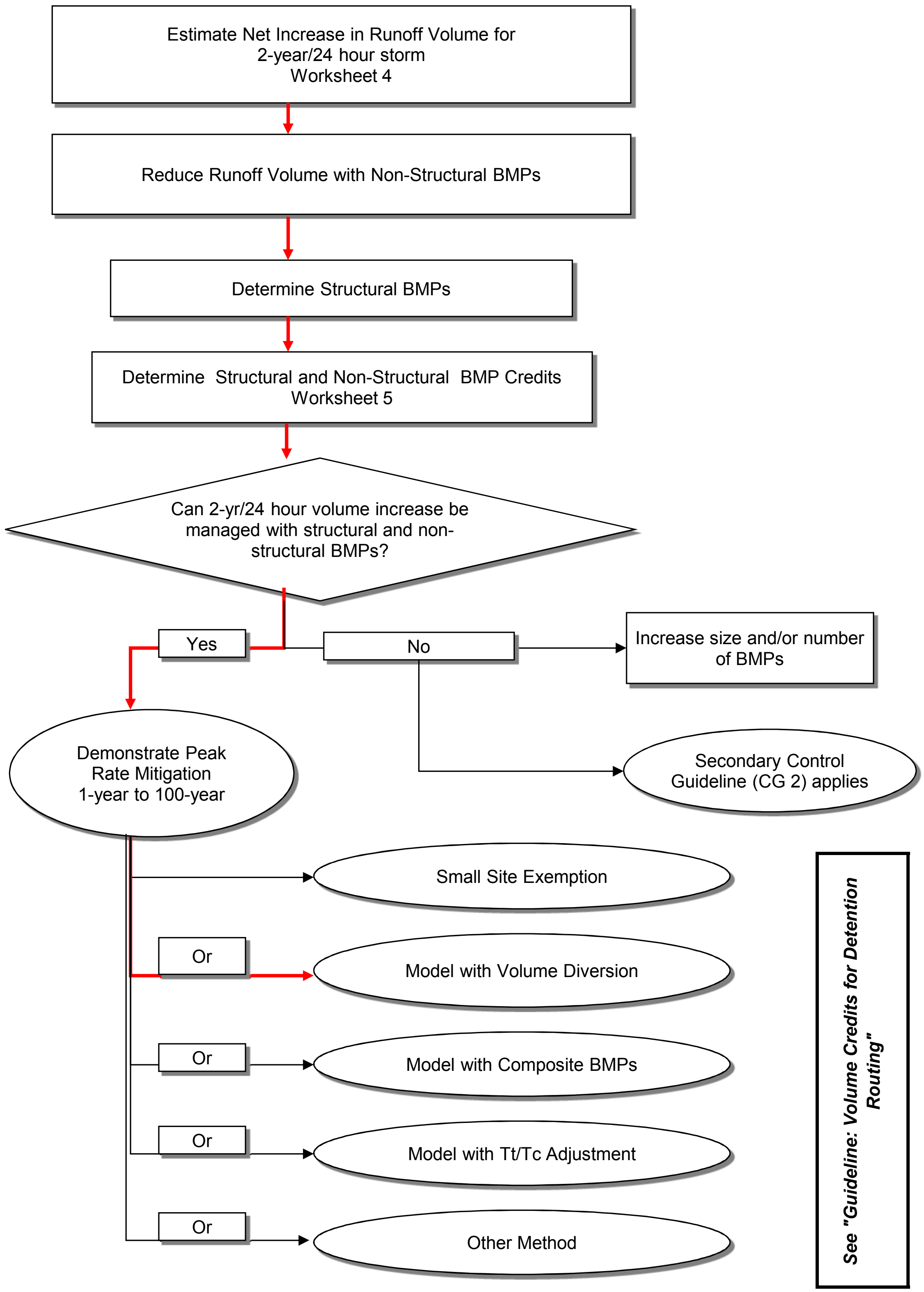
VOLUME CREDITS

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-LE-037.2**

2-Year Rainfall: 3.01 **in**

Total Site Area: 0.96 **acres**
Protected Site Area: 0 **acres**
Managed Area 0.96 **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	0	0.00	98	0.20	0.04	2.78	-
"Meadow"[3]	C	0	0.00	71	4.08	0.82	0.77	-
Meadow	C	41,603	0.96	71	4.08	0.82	0.77	2,656
TOTAL:		41,603	0.96					2,656

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	133	0.00	98	0.20	0.04	2.78	31
Gravel Rd	C	1,271	0.03	89	1.24	0.25	1.91	202
Stone	C	4,680	0.11	98	0.20	0.04	2.78	1,084
Meadow	C	35,519	0.82	71	4.08	0.82	0.77	2,268
TOTAL:		41,603	0.96					3,584

2-Year Volume Increase (ft^3)	**928**

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

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

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

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

3. Twenty (20) percent of existing impervious area, when present, shall be considered meadow (good condition) in the model for existing conditions for redevelopment per Volume Control Guideline 1.
(For Existing Condition: Impervious Area + "Meadow" = Total Impervious Area)

WORKSHEET 5. STRUCTURAL BMP VOLUME CREDITS

PROJECT: Atlantic Sunrise Pipeline AR-LE-037.2
SUB-BASIN: Lower Susquehanna

Required Control Volume (ft^3) - *from Worksheet 4* :		928
Non-structural Volume Credit (ft^3) - *from Worksheet 3* :	-	0
Structural Volume Reqmt (ft^3)		928
(Required Control Volume minus Non-structural Credit)		

	Proposed BMP	**Area (ft^2)**	**Volume Reduction Permanently Removed (ft^3)**
6.4.1	Porous Pavement		
6.4.2	Infiltration Basin		
6.4.3	Infiltration Bed		
6.4.4	Infiltration Trench		
6.4.5	Rain Garden/Bioretention		
6.4.6	Dry Well / Seepage Pit		
6.4.7	Constructed Filter		
6.4.8	Vegetated Swale		
6.4.9	Vegetated Filter Strip		
6.4.10	Berm		
6.5.1	Vegetated Roof		
6.5.2	Capture and Re-use		
6.6.1	Constructed Wetlands		
6.6.2	Wet Pond / Retention Basin		
6.6.3	Dry Extended Detention Basin		
6.6.4	Water Quality Filters		
6.7.1	Riparian Buffer Restoration		
6.7.2	Landscape Restoration / Reforestation		
6.7.3	Soil Amendment		
6.8.1	Level Spreader		
6.8.2	Special Storage Areas		
Other	Storage in 30" stone MLV pad		2,809

Total Structural Volume (ft^3):	2,809
Structural Volume Requirement (ft^3):	928
DIFFERENCE	1,881

MLV Pad Infiltration Calculations Summary		
Average Measured Infiltration Rate for MLV Pad	***8.63***	***in/hr***
Factor of Safety*	***2.00***	
Design Infiltration Rate	***4.32***	***in/hr***
Dewatering Time for top 6 inches of MLV Pad	***1.39***	***hours***
Depth of AASHTO #57 Section of MLV Pad	***24***	***inches***
Dewatering Time for AASHTO #57 Section of MLV Pad	***5.56***	***hours***
Total Dewatering Time for MLV Pad	***6.95***	***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		

G.6 Infiltration Information

a. Field Observation Report

Field Observation Report

Project Number: 14C4909 - A

Project Name: Atlantic Sunrise Project – **AR-LE-037.2**

Date of Field Visit: April 19, 2016

Weather Conditions: Sunny Temperature: Approx. 50-69°F

Prepared By: Krystal Bealing, APSS and Jonathan Libbon

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

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

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

Three soil pits were excavated by backhoe and described by an Associate Professional Soil Scientist (APSS) to varying depths utilizing the U.S. Department of Agriculture Natural Resources Conservation Service (USDA-NRCS) *Field Book for Describing and Sampling Soils, Version 3.0,* and *Keys to Soil Taxonomy, Twelfth Edition, 2014*. According to the Web Soil Survey, soils within the area of the pits are described by the USDA-NRCS as Thorndale silt loam, 0-3% slopes.

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

Infiltration testing was conducted within a level testing area at all test pit locations using the double ring infiltrometer method. An infiltrometer containing a 12-inch outer ring and a 6-inch inner ring was driven into the soil a minimum of two inches. Both rings were filled with water to

Field Observation Report

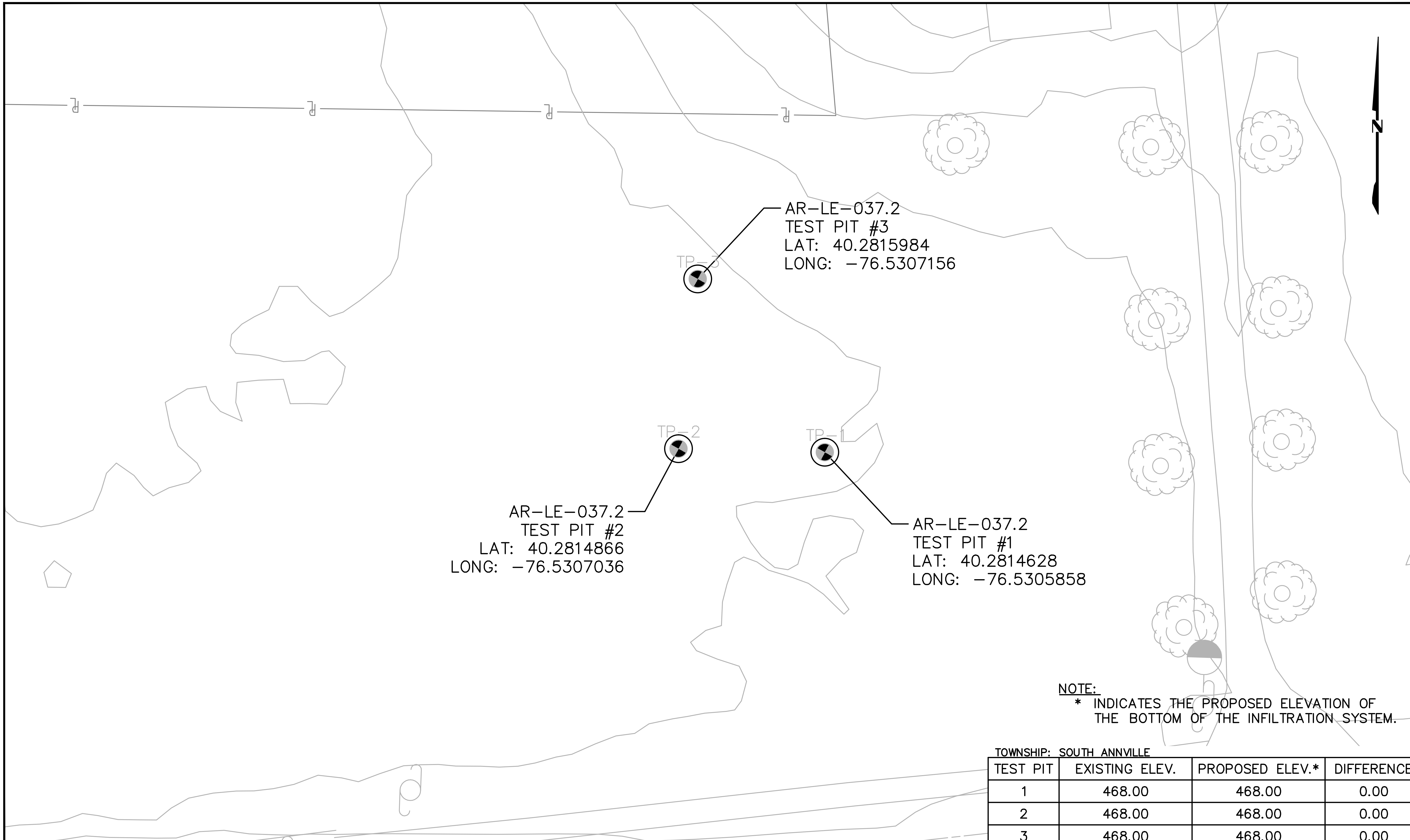
a marked line at 30 minute intervals for one hour. If the drop in water level, measured within the center ring, during the last 30 minutes of the presoak is 2 inches or more, measurements are taken in 10-minute intervals. If the water level drop is less than 2 inches, measurements are taken in 30-minute intervals. After each measurement, the rings were refilled to the marked line. Each measurement was taken at a fixed reference point. Measurements were taken until the rate of drop stabilized, or eight measurements were taken. A stabilized rate of drop is considered a difference of 0.25-inch or less between the highest and lowest measurements of four consecutive readings. An average of the stabilized rate (i.e., the last four measurements) or the average of eight total measurements if the rate of drop did not stabilize, expressed in inches per hour, represents the infiltration rate.

Pit Number	Pit Location (decimal degrees)	Observed Limiting Layer	Infiltration Test Depth (inches below the surface)	Infiltration Rate (inches/hour)
1	40.2814628, -76.5305858	32 inches, Fragipan	0	9.188
2	40.2814866, -76.5307036	45 inches, Fragipan	0	7.688
3	40.2815984, -76.5307156	38 inches, Fragipan	0	9.000

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

Pit Number	Pit Location (decimal degrees)	Observed Limiting Layer	Infiltration Test Depth (inches below the surface)	Infiltration Rate (inches/hour)
1	40.2814628, -76.5305858	Fragipan at 32 inches	0	9.188
2	40.2814866, -76.5307036	Fragipan at 45 inches	0	7.688
3	40.2815984, -76.5307156	Fragipan at 38 inches	0	9.000

The test pit location map, soil profile logs, infiltration worksheet, photographs, and USDA-NRCS Soil Survey information are attached.



NOTE:
* INDICATES THE PROPOSED ELEVATION OF THE BOTTOM OF THE INFILTRATION SYSTEM.

TOWNSHIP: SOUTH ANNVILLE

TEST PIT	EXISTING ELEV.	PROPOSED ELEV.*	DIFFERENCE
1	468.00	468.00	0.00
2	468.00	468.00	0.00
3	468.00	468.00	0.00

LANDOWNER: OBERHOLTZER

AR-LE-037.2 INFILTRATION TESTING LOCATIONS

GRAPHIC SCALE
40 20 0 40
SCALE IN FEET

Soil Profile Log

Project 14C4909-A Atlantic Sunrise Project - AR-LE-037.2
Test Pit # 1
Name Krystal Bealing, APSS
Date April 19, 2016
Weather Sunny, 50-69°F
Equipment Mini Excavator

Elevation 468.00 AMSL
Soil Type ThA - Thorndale silt loam, 0-3% slopes
Geology Antietam Formation
Landscape Position/Slope Toeslope, 0-5%
Land Use Mowed/Maintained lawn
Additional Notes

Horizon	Depth (inches)	Texture	Coarse Fragments	Matrix Color	Color Patterns	Redoximorphic Features	Structure and Grade	Consistency	Boundary Strike/Dip	Roots/ Pores	Depth to Bedrock	Depth to Water
Ap	0-14	Silt Loam	-	10YR 3/4	-	2% 5YR 4/6	Weak Granular	Friable	Clear, Smooth	>20% roots	-	-
Bt	14-32	Silt Loam	-	10YR 4/6	-	-	Weak Subangular Blocky	Firm	Clear, Irregular	<2% roots	-	-
Btx	32-58+	Silty Clay	15% Gravelly	10YR 4/6	-	10% 7.5YR 4/2	Weak Prismatic	Firm	-	-	-	-

Comments: Limiting layer observed at 32 inches due to the presence of a fragipan.

Soil Profile Log

Project 14C4909-A Atlantic Sunrise Project - AR-LE-037.2
Test Pit # 2
Name Krystal Bealing, APSS
Date April 19, 2016
Weather Sunny, 50-69°F
Equipment Mini Excavator

Elevation 468.00 AMSL
Soil Type ThA - Thorndale silt loam, 0-3% slopes
Geology Antietam Formation
Landscape Position/Slope Toeslope, 0-5%
Land Use Mowed/Maintained lawn
Additional Notes

Horizon	Depth (inches)	Texture	Coarse Fragments	Matrix Color	Color Patterns	Redoximorphic Features	Structure and Grade	Consistency	Boundary Strike/Dip	Roots/ Pores	Depth to Bedrock	Depth to Water
Ap	0-18	Silt Loam	-	10YR 3/3	-	-	Weak Granular	Friable	Diffuse, Irregular	>20% roots; Earthworm borrows present	-	-
Bw	18-45	Silt Loam	-	10YR 4/6	10YR 3/3*	-	Moderate Subangular Blocky	Friable	Gradual, Smooth	2-20% roots	-	-
C	45-59+	Silty Clay Loam	5% Gravelly	10YR 4/6	10YR 4/4	5% 5YR 5/8 5% 10YR 6/2	Weak Prismatic	Firm	-	-	-	-

Comments: Limiting layer observed at 45 inches due to the presence of a fragipan.
*Color pattern observed in the Bw horizon due to decaying roots.

Soil Profile Log

Project 14C4909-A Atlantic Sunrise Project - AR-LE-037.2
Test Pit # 3
Name Krystal Bealing, APSS
Date April 19, 2016
Weather Sunny, 50-69°F
Equipment Mini Excavator

Elevation 468.00 AMSL
Soil Type ThA - Thorndale silt loam, 0-3% slopes
Geology Antietam Formation
Landscape Position/Slope Toeslope, 0-5%
Land Use Mowed/Maintained lawn
Additional Notes

Horizon	Depth (inches)	Texture	Coarse Fragments	Matrix Color	Color Patterns	Redoximorphic Features	Structure and Grade	Consistency	Boundary Strike/Dip	Roots/ Pores	Depth to Bedrock	Depth to Water
Ap	0-16	Silt Loam	-	10YR 3/3	-	-	Weak Granular	Friable	Clear, Smooth	>20% roots	-	-
Bt	16-38	Silt Loam	-	10YR 4/6	-	-	Moderate Subangular Blocky	Friable	Diffuse, Smooth	<2% roots; Earthworm borrows present	-	-
Btx	38-55+	Silty Clay Loam	5% Gravelly	7.5YR 4/6	10% 10YR 2/1*	-	Weak Prismatic	Firm	-	-	-	-

Comments: Limiting layer observed at 38 inches due to the presence of a fragipan.
*Color pattern observed in the Bt horizon due to manganese.

ATLANTIC SUNRISE PROJECT - AR-LE-037.2

SOIL INFILTRATION WORKSHEET - DOUBLE RING INFILTROMETER METHOD

Hole Number	Drop >2 inches after 30 minute presoak?[1]	Reading Interval (minutes)	Reading 1 (Inches of Drop)	Reading 2 (Inches of Drop)	Reading 3 (Inches of Drop)	Reading 4 (Inches of Drop)	Reading 5 (Inches of Drop)	Reading 6 (Inches of Drop)	Reading 7 (Inches of Drop)	Reading 8 (Inches of Drop)	Average Stabilized Reading[2] (Inches of Drop)	Infiltration Rate[3] (in/hr)	Comments
1	Yes	10	1.625	1.500	1.625	1.375					1.531	9.188	50-69°F, sunny. Test done at surface.
2	Yes	10	1.500	1.375	1.375	1.125	1.250				1.281	7.688	50-69°F, sunny. Test done at surface.
3	Yes	10	1.875	1.625	1.500	1.500	1.375				1.500	9.000	50-69°F, sunny. Test done at surface.

[1] Inches of drop greater than 2 inches after the 30 minute presoak? Yes, use 10 minute interval; No, use 30 minute interval.

[2] Calculated as the average of the last four stabilized (less than 0.25-inch difference overall) readings, or an overall average in the case of eight unstabilized readings.

[3] Calculated as the average stabilized reading x 2 for 30 minute intervals; x 6 for 10 minute intervals.

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

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

Custom Soil Resource Report for Lebanon County, Pennsylvania

AR-LE-037.2

April 14, 2016

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (http://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Soil Map

Map Scale: 1:676 if printed on A landscape (11" x 8.5") sheet.

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

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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

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

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

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

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

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

Soil Survey Area: Lebanon County, Pennsylvania
Survey Area Data: Version 10, Nov 16, 2015

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

Date(s) aerial images were photographed: Mar 29, 2011—Apr 14, 2011

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

Map Unit Legend

Lebanon County, Pennsylvania (PA075)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
CkB	Clarksburg silt loam, 3 to 8 percent slopes	0.3	13.2%
HbC	Hagerstown silty clay loam, 8 to 15 percent slopes	0.3	14.9%
Ls	Lindside silt loam	0.0	2.4%
ThA	Thorndale silt loam, 0 to 3 percent slopes	1.4	69.5%
Totals for Area of Interest		**2.0**	**100.0%**

Map Unit Descriptions

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

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

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

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

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

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

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

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

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

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

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

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

Lebanon County, Pennsylvania

CkB—Clarksburg silt loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: l57s
Elevation: 200 to 1,500 feet
Mean annual precipitation: 32 to 48 inches
Mean annual air temperature: 48 to 57 degrees F
Frost-free period: 120 to 200 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Clarksburg and similar soils: 90 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Clarksburg

Setting

Landform: Valley flats
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear, concave
Across-slope shape: Concave, linear
Parent material: Residuum weathered from limestone

Typical profile

Ap - 0 to 8 inches: silt loam
Bt - 8 to 27 inches: silt loam
Btx - 27 to 51 inches: silt loam
C - 51 to 84 inches: silt loam

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 20 to 36 inches to fragipan; 60 to 99 inches to
Natural drainage class: Moderately well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.60 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C

Minor Components

Thorndale

Percent of map unit: 5 percent
Landform: Depressions
Landform position (two-dimensional): Footslope

Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Linear, concave

HbC—Hagerstown silty clay loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2tb0g
Elevation: 600 to 1,750 feet
Mean annual precipitation: 37 to 45 inches
Mean annual air temperature: 46 to 54 degrees F
Frost-free period: 155 to 181 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Hagerstown and similar soils: 80 percent
Opequon and similar soils: 10 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hagerstown

Setting

Landform: Hills
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Side slope, base slope
Down-slope shape: Linear, concave
Across-slope shape: Linear, concave
Parent material: Clayey residuum weathered from limestone

Typical profile

Ap - 0 to 8 inches: silty clay loam
Bt1 - 8 to 19 inches: silty clay loam
Bt2 - 19 to 31 inches: silty clay
C - 31 to 59 inches: silty clay
R - 59 to 69 inches: bedrock

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: 40 to 79 inches to lithic bedrock
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: High (about 9.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Other vegetative classification: Moist Loams (ML2)

Description of Opequon

Setting

Landform: Hills
Landform position (two-dimensional): Shoulder, summit, backslope
Landform position (three-dimensional): Nose slope, side slope, crest
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Clayey residuum weathered from limestone and dolomite

Typical profile

Ap - 0 to 5 inches: silty clay loam
Bt1 - 5 to 13 inches: silty clay
Bt2 - 13 to 16 inches: silty clay
R - 16 to 26 inches: bedrock

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: 12 to 20 inches to lithic bedrock
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline (0.0 to 0.2 mmhos/cm)
Available water storage in profile: Very low (about 1.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: D

Minor Components

Carbo

Percent of map unit: 10 percent
Landform: Hills
Landform position (two-dimensional): Summit, backslope, shoulder
Landform position (three-dimensional): Crest, side slope
Down-slope shape: Linear, convex
Across-slope shape: Linear, convex

Ls—Lindside silt loam

Map Unit Setting

National map unit symbol: l58n
Elevation: 300 to 1,500 feet
Mean annual precipitation: 34 to 50 inches
Mean annual air temperature: 46 to 57 degrees F
Frost-free period: 120 to 200 days
Farmland classification: All areas are prime farmland

Map Unit Composition

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

Description of Lindside

Setting

Landform: Flood plains
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Alluvium derived from sedimentary rock

Typical profile

H1 - 0 to 13 inches: silt loam
H2 - 13 to 46 inches: silty clay loam
H3 - 46 to 65 inches: gravelly sandy loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 2.00 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Available water storage in profile: High (about 11.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: C

Minor Components

Monongahela

Percent of map unit: 5 percent

Clarksburg

Percent of map unit: 5 percent

Melvin

Percent of map unit: 5 percent
Landform: Flood plains
Down-slope shape: Concave
Across-slope shape: Concave

ThA—Thorndale silt loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: l599
Elevation: 200 to 1,000 feet
Mean annual precipitation: 32 to 48 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 120 to 200 days
Farmland classification: Not prime farmland

Map Unit Composition

Thorndale and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Thorndale

Setting

Landform: Drainageways, depressions, valleys
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Head slope, side slope
Down-slope shape: Linear, concave
Across-slope shape: Concave
Parent material: Colluvium derived from calcareous shale and/or colluvium derived from limestone and siltstone

Typical profile

Ap - 0 to 9 inches: silt loam
Btg - 9 to 27 inches: silty clay loam
Bxg - 27 to 36 inches: silt loam
C - 36 to 60 inches: silt loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: 20 to 36 inches to fragipan; 60 to 99 inches to lithic bedrock
Natural drainage class: Poorly drained
Runoff class: Very high

Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: C/D

References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

National Research Council. 1995. Wetlands: Characteristics and boundaries.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577

Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580

Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.

United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374

United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf

G.7 Off-Site Discharge Analysis

a. Adequacy of Off-Site Discharge

ACCESS ROAD: AR-LE-037.2- Adequacy of Off-Site Discharge

AR-LE-037.2 is a proposed permanent access road (PAR) located in South Annville Township, Lebanon County Pennsylvania. The intent of this PAR is to provide permanent maintenance and operational access to the proposed Main Line Valve (MLV) 06 (CS-MLV-06) located on the proposed 42" Central Penn Line South Pipeline. The road begins at Horseshoe Pike and terminates at the MLV site at approximate mile post 42.7. The proposed road is approximately 100 feet long over relatively flat terrain, surround by existing pasture on all sides. 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 proposed permanent access road and the MLV site has been designed to reduce overall disturbance to the maximum extent practicable. The PAR and MLV site has been constructed with stone rather than pavement to further help with keeping with the existing conditions. The proposed access road will maintain a minimal width of only 14 feet wide. The MLV site has also been design to minimum the footprint to the maximum extent practical for the operation and maintenance requirements.

As for any development, the road and MLV site has been designed to match or reduce peak stormwater runoff from the design areas to an off-site discharge point where stormwater runoff is conveyed. (See the enclosed Pre and Post drainage area maps and calculations in Appendix G.3 and G.4 for details). In the case of this design, we were able to achieve a reduced peek runoff for all storm events, as shown in the Pre-vs. Post- Construction Peak Rate of Flow Summary for The Study Point chart below. The reduction was achieved by utilizing the MLV pad as a retention area. This Stormwater BMP measures is used to slow down the stormwater runoff, infiltrate and release at a slower and reduced rate to existing land.

Pre- vs. Post-construction Peak Rate of Flow Summary			
Stormwater discharge rate for the design frequency storm (cfs)	Pre-construction	Post-construction	Net Change
1) 1-Year/24-Hour	0.15	0.00	(0.15)
2) 2-Year/24-Hour	0.24	0.00	(0.24)
3) 5-Year/24-Hour	0.41	0.00	(0.41)
4) 10-Year/24-Hour	0.56	0.00	(0.56)
5) 25-Year/24-Hour	0.82	0.08	(0.74)
6) 50-Year/24-Hour	1.06	0.13	(0.93)
7) 100-Year/24-Hour	1.33	0.18	(1.15)

The MLV pad is used as an infiltration area to slow down peak stormwater runnoff. The pad is a flat area constructed of a top layer of 6" of AASHTO #8 aggregate, on a non-woven geotextile fabric, and a bottom layer of 24" AASHTO #57 stone. This 24-inch-deep area will detain and infiltrate the foot print of the MLV pad, plus areas of the road and agricultural land around the pad to the north.

After being conveyed through the stormwater PCSM BMP's above, the runoff of the post-construction site matches the pre-construction flow. From the MLV site, the runoff flows approximately 410 feet west until it outlets into Gingrich Run (WW-T64-5001).

The flow path from the MLV site crosses the following soil types:
- Ls – Lindside silt loam.
- ThA – Thorndale silt loam, 0 to 3 percent slopes.

The PADEP E&S Manual defines erosion resistant soils as soils having an erodibility "K" factor less than or equal to 0.37. The K factor for the soil types, according to the National Resources Conservation Service (NRCS) website http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx, crossed by the flow path are summarized below:
- Ls – 0.37
- ThA – 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 MLV pad has reduced the proposed stormwater velocity as it leaves the design points. The velocities at both points are such that they are slower than 2 fps, as see in the Stormwater Velocity Rate Chart. Based on Table G.1 in the Pennsylvania DEP erosion and Sediment Pollution Control Program 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 that we are discharging too.

Stormwater Velocity Rate Chart for the design frequency storm (fps)	MLV Pad Velocities (fps)
1) 1-Year/24-Hour	0.00
2) 2-Year/24-Hour	0.00
3) 5-Year/24-Hour	0.00
4) 10-Year/24-Hour	0.00
5) 25-Year/24-Hour	0.11
6) 50-Year/24-Hour	0.15
7) 100-Year/24-Hour	0.17

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 PDEP E&S PCPM)

In conclusion, based on the designed measures discussed above, and the soil and velocity data provided for this MLV site and access road, there are no anticipated impacts or changes to downhill properties as a result of construction the MLV site.

Down Slope Property Owners:

- Unknown Property Owner (PA-LE-051.110)
- Unknown Property Owner (PA-LE-051.120)

G.8 Storage Volume Analysis

a. Storage Volume Analysis

ACCESS ROAD: LE-037.2 – Storage Volume Analysis

Stormwater detention is provided 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.

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-LE-037.2 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 in the void space of the MLV pad rock is provided at the bottom of Worksheet #5 included in Appendix G.5.

G.9 Sediment Barrier Table

a. E&S Worksheet 1

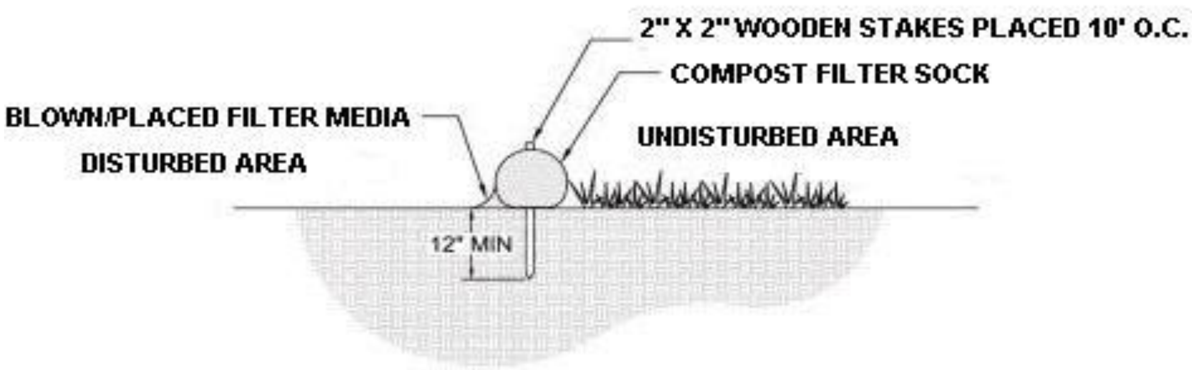
E&S WORKSHEET #1
Compost Filter Sock

PROJECT NAME: Atlantic Sunrise

LOCATION: AR-LE-037.2

PREPARED BY: EAW DATE: 10/31/16

CHECKED BY: BJP DATE: 10/31/16



SOCK NO.	Dia. In.	LOCATION	SLOPE PERCENT	SLOPE LENGTH ABOVE BARRIER (FT)	SOCK LENGTH
STOCKPILE					
SP 1	12	STA 0+50 to STA 1+75	N/A	N/A	375

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

APPENDIX Q

AR-LE-050.1.1 Specific Narrative and Calculations

Q.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)

Q.2 Location Map

Q.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

Q.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

Q.5 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

Q.6 Infiltration Information
   a. Field Observation Report

Q.7 Off-Site Discharge Analysis
   a. Adequacy of Off-Site Discharge

Q.8 Storage Volume Analysis
   a. Storage Volume Analysis

Q.9 Sediment Barrier Table
   a. E&S Worksheet 1

Q.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-LE-050.1.1

ACT 167 PLAN: None

TMDL: None

NARRATIVE:

AR-LE-050.1.1 is a proposed permanent access road (PAR) located in Union Township, Lebanon County, Pennsylvania. The intent of this PAR is to provide permanent maintenance and operational access to the proposed Main Line Valve 07 (CS-MLV-07) located on the proposed 42" Central Penn Line South Pipeline. The road begins at Fort Swatara Drive and terminates at the MLV site at approximate mile post 56.8. The PAR is approximately 90 feet long and has an elevation change of approximately 2 feet. The road will be entirely located within the pipeline permanent right of way. ***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.***

During construction, the access road will have a temporary rock construction entrance ***with wash rack and driveway apron*** sized for the anticipated vehicles and equipment using the road during construction. ***The wash rack is proposed due to the watershed siltation impairment.*** Upon completion of the construction activities, the temporary construction entrance 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 westerly direction. ***A portion of the road will direct runoff to the proposed MLV site.***

The MLV site will be constructed with a 6-inch thick layer of AASHTO #8 stone on top of nonwoven geotextile and a 15-inch thick layer of AASHTO #57 stone. The pad will dewater within the first 72 hours.

Water Quality Worksheet #4 was used to complete the ***Control Guideline* 1(**CG-1) volume analysis for the 2-year ***24-hour*** storm. The storage volume provided the MLV site 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. Storing runoff in the proposed MLV site mitigates the potential impact from the proposed development.

TMDL DISCUSSION:

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

MINIMIZED SOIL COMPACTION:

The Project seeks to minimize soils compaction impacts associated with access roads to the maximum extent practicable. AR-LE-050.1.1 is a proposed permanent access road for Main Line Valve 07. 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.

THERMAL IMPACT ANALYSIS:

Thermal impacts associated with AR-LE-050.1.1 will be avoided to the maximum extent practicable. The following measures have been implemented to minimize thermal impacts:

- ***AR-LE-050.1.1 is approximately 90 linear feet, minimizing the total length of necessary temporary construction and, therefore, minimizing thermal impact of the road.***

- ***This road is proposed in a location that minimizes tree removal. The ability to use this road without the removal of additional trees acts to minimize the thermal impact of this road.***

ACIDIC SOIL MANAGEMENT PLAN:

AR-LE-050.1.1 Soil Acidity Table		
Soil Map Symbol	Soil Name	PH
MagB	Markes silt loam, 3 to 8 percent slopes	5.7

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

ROAD SPECIFIC CONSTRUCTION SEQUENCE:

ACCESS ROAD: AR-LE-050.1.1

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

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

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

4. ***Survey crews locate and stake all special areas of concern (e.g., 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 orange 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 MLV Site.

14. Begin grading and strip and haul off excess topsoil at the MLV site. All existing excavated material is to be immediately removed from the site and properly disposed of at an approved facility or permitted waste area.

15. The Compliance Manager shall provide PADEP at least three days' notice prior to placing the stone and geotextile fabric within the MLV pads.

16. 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.

17. 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.

18. 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.

19. 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 Site 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).

20. Once the temporary improvements to the permanent access road are no longer necessary; remove all gravel and geotextile fabric from the areas outside of the permanent access road areas 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.

21. ***Loosen and de-compact topsoil throughout the areas outside of the permanent access road limits and grade the access road so finish grades and drainage patterns match preconstruction conditions. Immediately fertilize, seed and stabilize areas at finished grade. Maintain E&SC control devices until Site work is complete and uniform 70% perennial vegetative cover is established.***

22. ***Upon completion of all earth disturbance activities and permanent stabilization of all disturbed areas, the Owner and/or Operators shall contact the local CCD for an inspection prior to the removal of the E&SC BMPs. Vegetated areas must achieve a minimum uniform 70% perennial cover over the entire disturbed area to be considered stabilized. Roadways and parking areas should have at least a clean subbase in place to be considered stabilized.***

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

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

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

Permanent Access Road Summary Sheet

Access Road Number:	AR-LE-50.1.1			
Watershed Name:	Swatara Creek, WWF, MF			
Act 167 Plan Name:	N/A		Date Adopted: --	
Design Storm Frequency	2 year	Pre-construction	Post-construction	Net Change
Rainfall Amount	3.09 inches			
Impervious area (acres)		0	0.137	0.137
Volume of stormwater runoff (cf) without planned stormwater BMPs		2,129	3,264	1,135
Volume of stormwater runoff (cf) with planned stormwater BMPs			534	(1,595)

Pre- vs. Post-construction Peak Rate of Flow Summary			
Stormwater discharge rate for the design frequency storm (cfs)	Pre-construction	Post-construction	Net Change
1) 1-Year/24-Hour	0.26	0.22	(0.04)
2) 2-Year/24-Hour	0.43	0.36	(0.07)
3) 5-Year/24-Hour	0.72	0.60	(0.12)
4) 10-Year/24-Hour	1.00	0.82	(0.18)
5) 25-Year/24-Hour	1.46	1.18	(0.28)
6) 50-Year/24-Hour	1.90	1.52	(0.38)
7) 100-Year/24-Hour	2.41	1.92	(0.49)

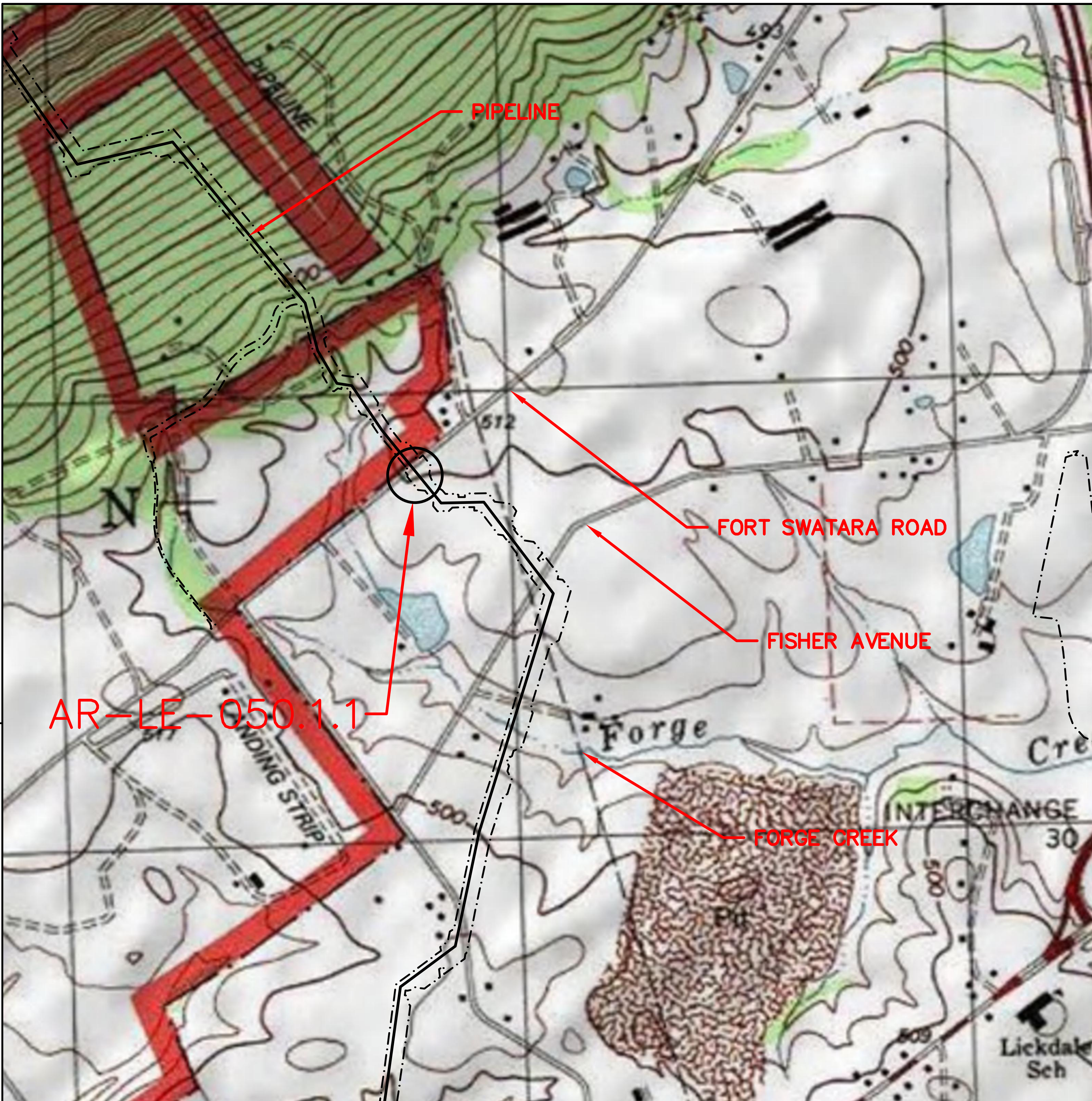
Summary Description of Restoration BMPs - Permanent Access Roads			
BMP	Function	Volume of stormwater treated (cf)	Acres treated
Natural area conservation: Pre-construction drainage pattern intact		0	0
Access road design: Ditches Culverts	Infiltration/ Recharge/Storage	0 Included in Ditches	0 Included in Ditches
Stormwater energy dissipaters: Riprap Aprons	Infiltration/ Recharge/Storage	0	0
Other: MLV Stone Pad Void Storage	Infiltration/ Recharge/Storage	2,730	0.19

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

Loading Ratio:	***Channel***	***MLV Pad***
Maximum Impervious Loading Ratio	***N/A***	***1.3 :1 (5:1 Max)***
Maximum Total Loading Ratio	***N/A***	***1.7 :1 (8:1 Max)***

Supporting Areas	***Channel***	***MLV Pad***	***Unit***
Impervious Drainage Area	***N/A***	***0.14***	***Acres***
Infiltration Area	***N/A***	***0.11***	***Acres***
Total Drainage Area	***N/A***	***0.19***	***Acres***

Q.2 Location Map



INDIANTOWN GAP 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-LE-050.1.1
UNION TOWNSHIP
LEBANON COUNTY, PENNSYLVANIA

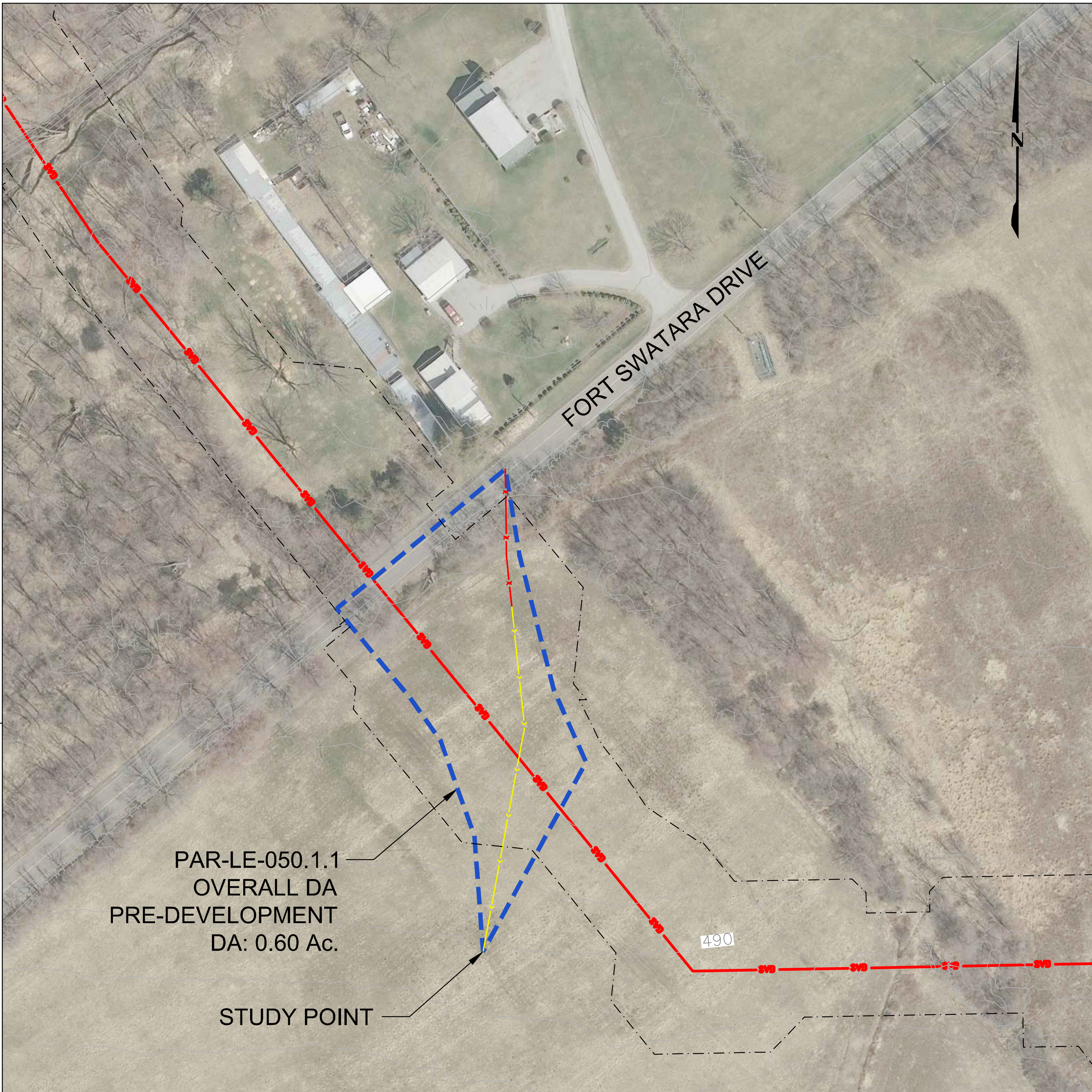
Williams

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-LE-050.1.1	SHEET 1 OF 1
WO: 1161481			

Q.3 Predevelopment Calculations

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



PRE-DEVELOPMENT DRAINAGE AREA MAP

0 50 100
SCALE IN FEET

ISSUED FOR PERMITTING

ARCHITECTURE
ENGINEERING
ENVIRONMENTAL
LAND SURVEYING
BL Companies

LEGEND

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

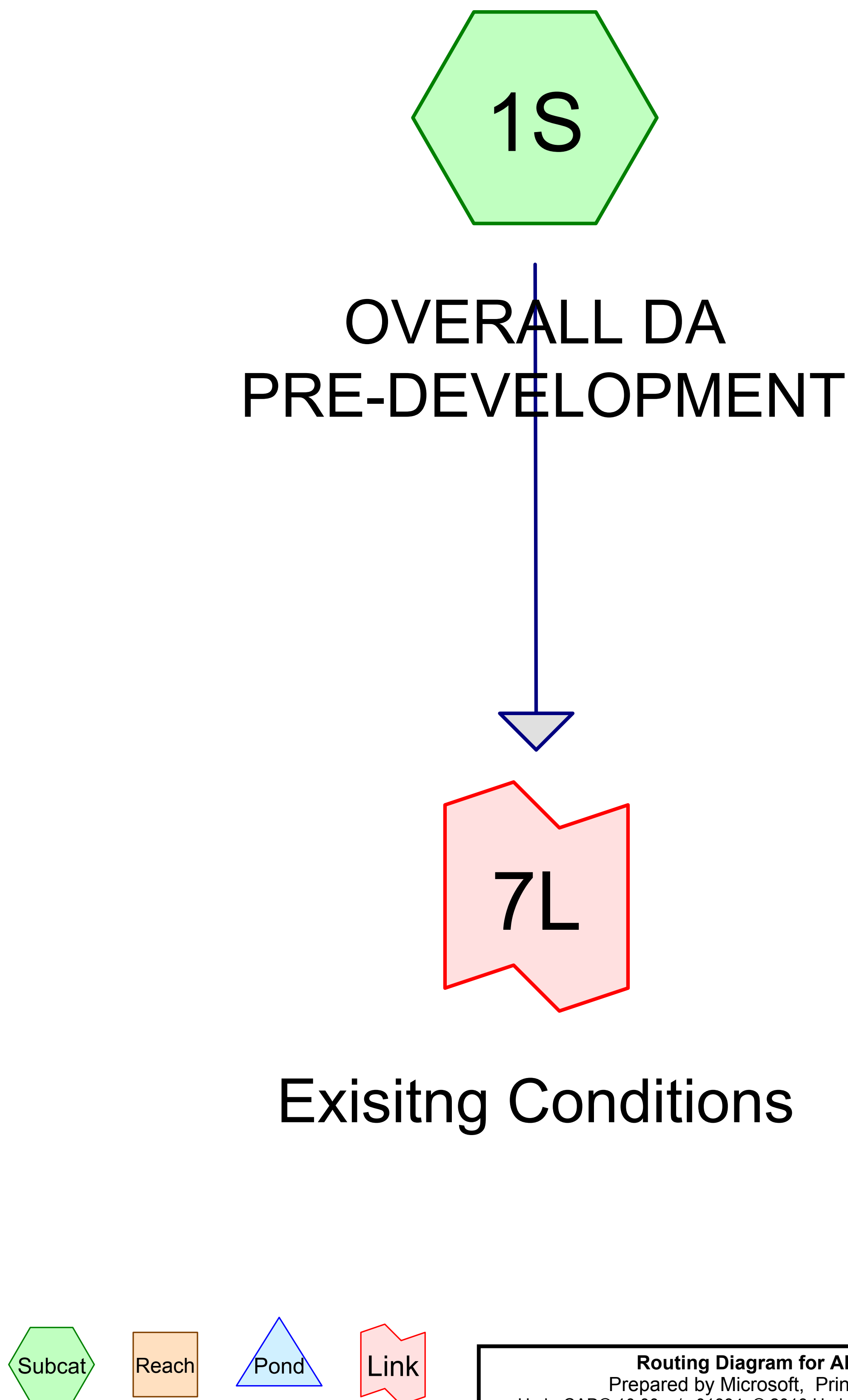
ATLANTIC SUNRISE PROJECT - CENTRAL PENN LINE SOUTH

PROPOSED 42" NATURAL GAS PIPELINE
ACCESS ROAD DRAINAGE AREA MAP
AR–LE–050.1.1 PRE
UNION TOWNSHIP
LEBANON 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" = 100'
CHECKED BY: BJP	DATE: 10/26/15	ISSUED FOR CONSTRUCTION:	
APPROVED BY: BJP	DATE: 10/26/15	DRAWING NUMBER: AR–LE–050.1.1 PRE	
WO:			



Routing Diagram for AR-LE-050.1.1
Prepared by Microsoft, Printed 10/17/2016
HydroCAD® 10.00 s/n 01334 © 2013 HydroCAD Software Solutions LLC

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.512	71	Meadow, non-grazed, HSG C (1S)
0.031	98	Paved Road, HSG C (1S)
0.063	70	Woods, Good, HSG C (1S)
0.606	**72**	**TOTAL AREA**

Soil Listing (selected nodes)

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

Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: OVERALL DA PRE-DEVELOPMENT Runoff Area=26,390 sf Runoff Depth=0.57"
Flow Length=355' Tc=27.9 min CN=72 Runoff=0.26 cfs 0.029 af

Link 7L: Exisitng Conditions Inflow=0.26 cfs 0.029 af
Primary=0.26 cfs 0.029 af

Total Runoff Area = 0.606 ac Runoff Volume = 0.029 af Average Runoff Depth = 0.57"

Summary for Subcatchment 1S: OVERALL DA PRE-DEVELOPMENT

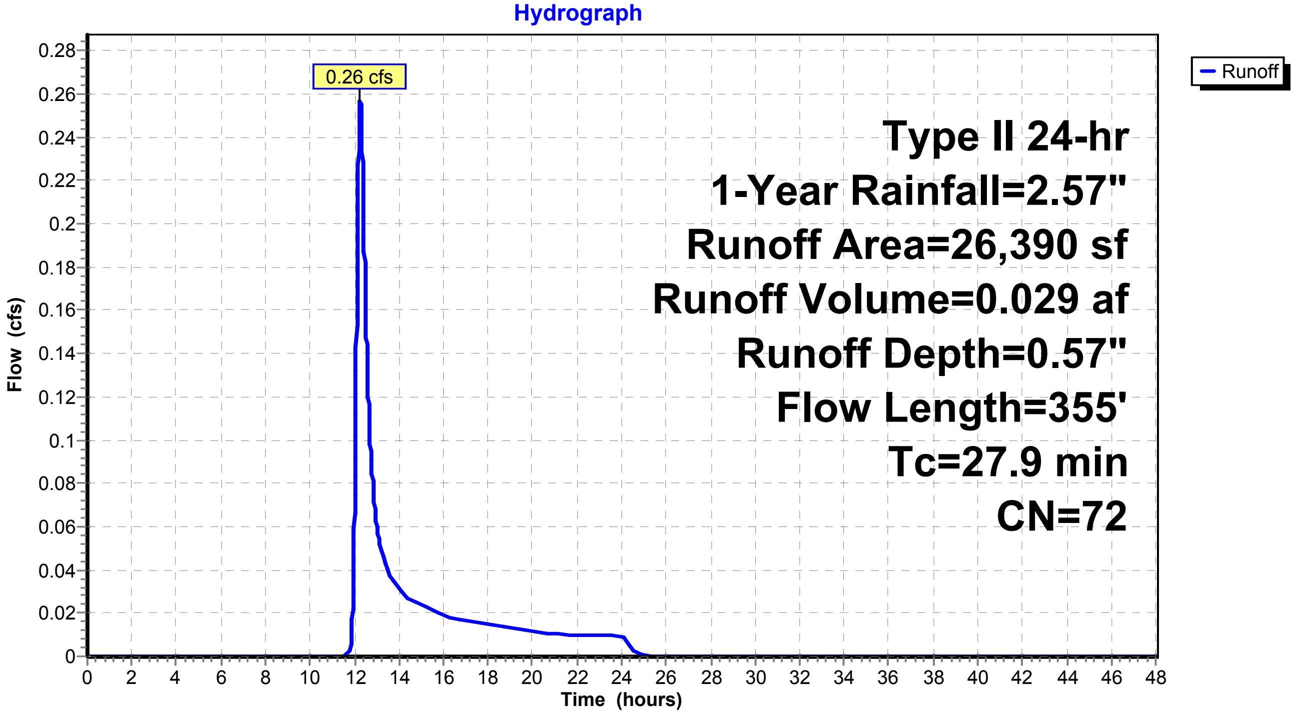
Runoff = 0.26 cfs @ 12.25 hrs, Volume= 0.029 af, Depth= 0.57"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 1-Year Rainfall=2.57"

	Area (sf)	CN	Description
*	1,355	98	Paved Road, HSG C
	2,727	70	Woods, Good, HSG C
	22,308	71	Meadow, non-grazed, HSG C
	26,390	72	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	15	0.0500	1.3		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.09"
1.5	8	0.0400	0.1		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.09"
11.3	31	0.0400	0.0		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 3.09"
10.3	46	0.0100	0.1		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.09"
3.2	134	0.0100	0.7		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
1.4	121	0.0400	1.4		**Shallow Concentrated Flow, SC2** Short Grass Pasture Kv= 7.0 fps
27.9	355	Total			

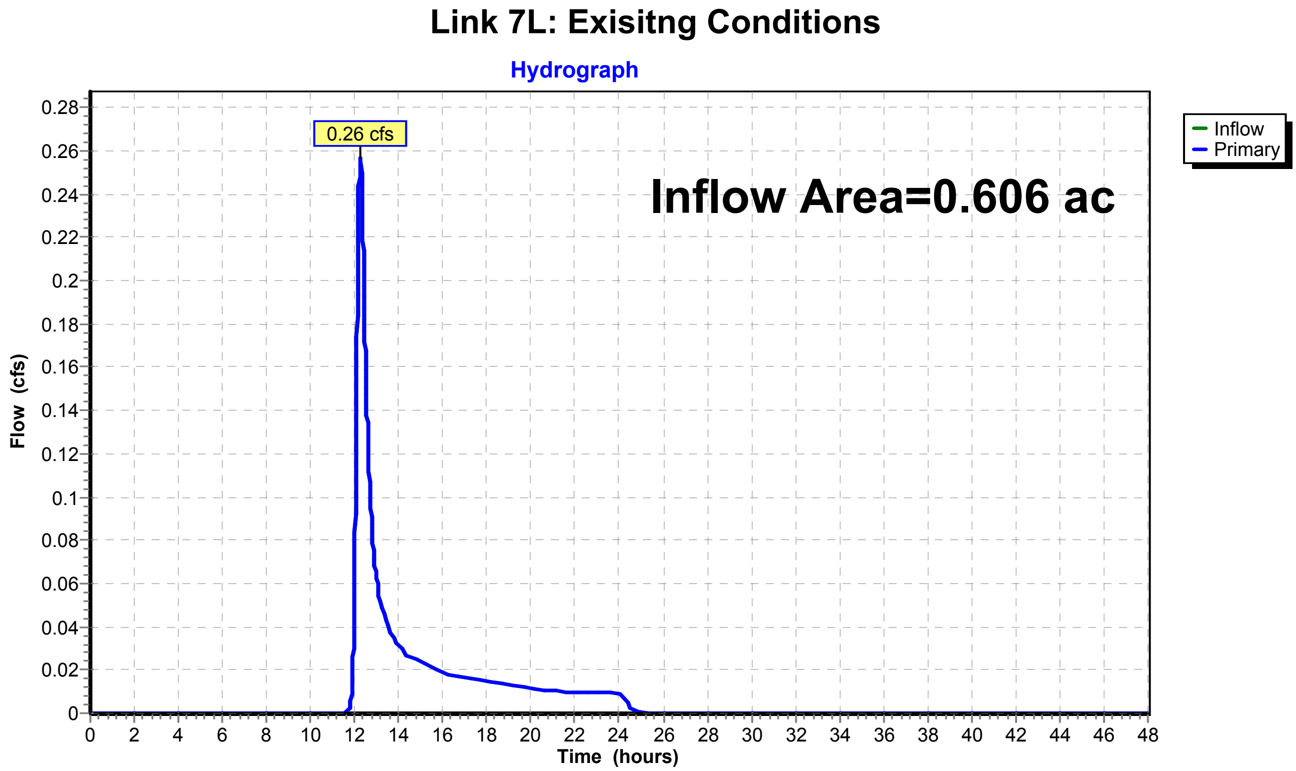
Subcatchment 1S: OVERALL DA PRE-DEVELOPMENT



Summary for Link 7L: Exisitng Conditions

Inflow Area = 0.606 ac, Inflow Depth = 0.57" for 1-Year event
Inflow = 0.26 cfs @ 12.25 hrs, Volume= 0.029 af
Primary = 0.26 cfs @ 12.25 hrs, Volume= 0.029 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs



Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: OVERALL DA PRE-DEVELOPMENT Runoff Area=26,390 sf Runoff Depth=0.86"
Flow Length=355' Tc=27.9 min CN=72 Runoff=0.43 cfs 0.044 af

Link 7L: Exisitng Conditions Inflow=0.43 cfs 0.044 af
Primary=0.43 cfs 0.044 af

Total Runoff Area = 0.606 ac Runoff Volume = 0.044 af Average Runoff Depth = 0.86"

Summary for Subcatchment 1S: OVERALL DA PRE-DEVELOPMENT

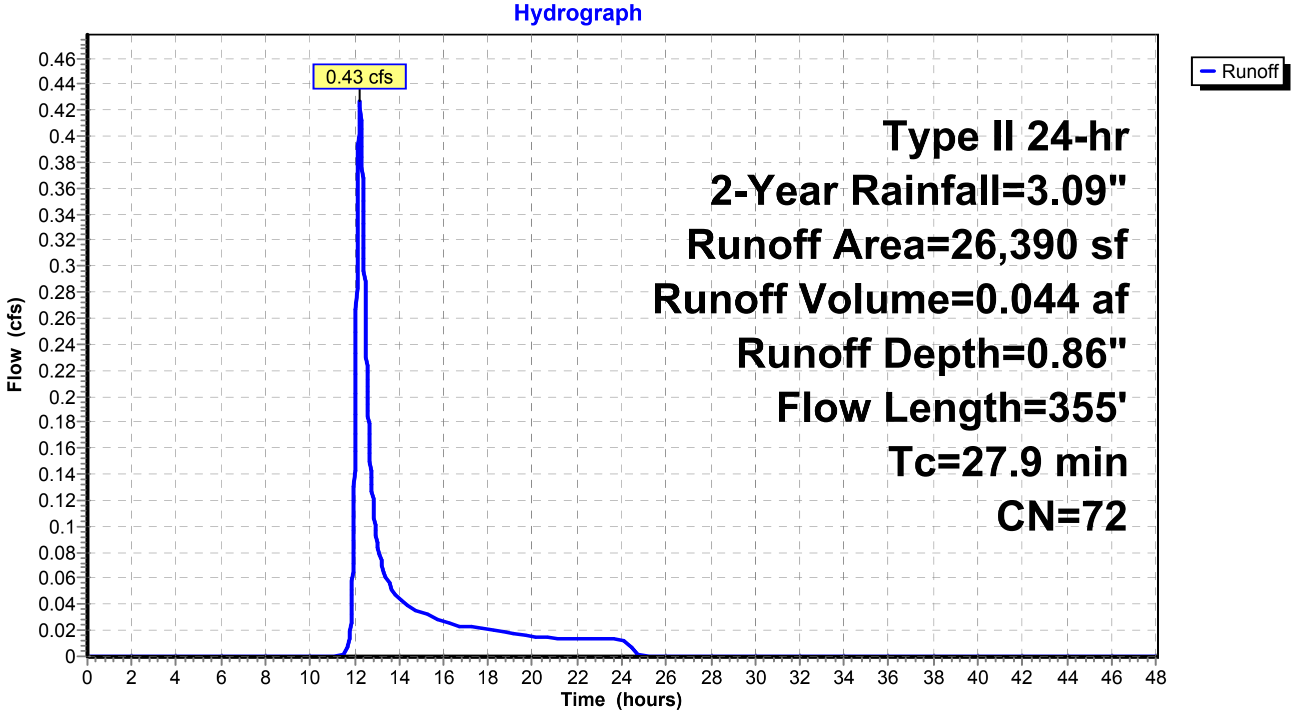
Runoff = 0.43 cfs @ 12.24 hrs, Volume= 0.044 af, Depth= 0.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 2-Year Rainfall=3.09"

	Area (sf)	CN	Description
*	1,355	98	Paved Road, HSG C
	2,727	70	Woods, Good, HSG C
	22,308	71	Meadow, non-grazed, HSG C
	26,390	72	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	15	0.0500	1.3		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.09"
1.5	8	0.0400	0.1		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.09"
11.3	31	0.0400	0.0		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 3.09"
10.3	46	0.0100	0.1		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.09"
3.2	134	0.0100	0.7		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
1.4	121	0.0400	1.4		**Shallow Concentrated Flow, SC2** Short Grass Pasture Kv= 7.0 fps
27.9	355	Total			

Subcatchment 1S: OVERALL DA PRE-DEVELOPMENT

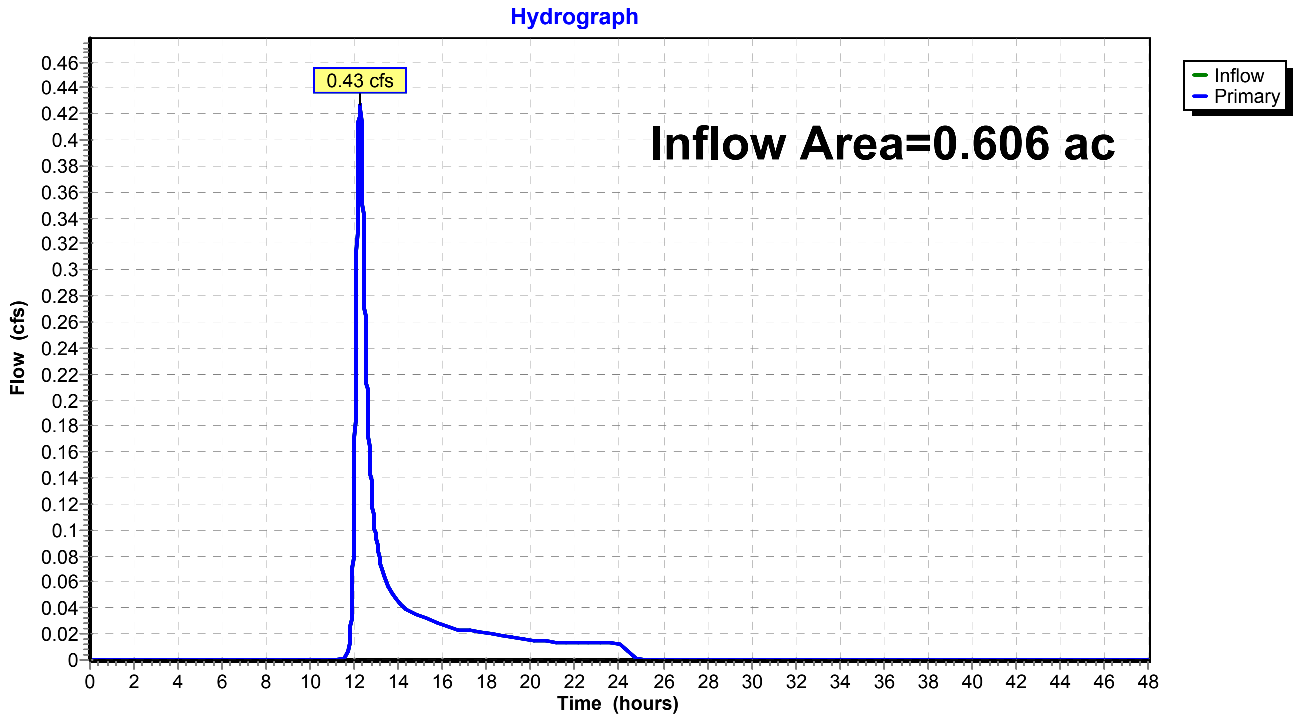


Summary for Link 7L: Exisitng Conditions

Inflow Area = 0.606 ac, Inflow Depth = 0.86" for 2-Year event
Inflow = 0.43 cfs @ 12.24 hrs, Volume= 0.044 af
Primary = 0.43 cfs @ 12.24 hrs, Volume= 0.044 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 7L: Exisitng Conditions



Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: OVERALL DA PRE-DEVELOPMENT Runoff Area=26,390 sf Runoff Depth=1.38"
Flow Length=355' Tc=27.9 min CN=72 Runoff=0.72 cfs 0.069 af

Link 7L: Exisitng Conditions Inflow=0.72 cfs 0.069 af
Primary=0.72 cfs 0.069 af

Total Runoff Area = 0.606 ac Runoff Volume = 0.069 af Average Runoff Depth = 1.38"

Summary for Subcatchment 1S: OVERALL DA PRE-DEVELOPMENT

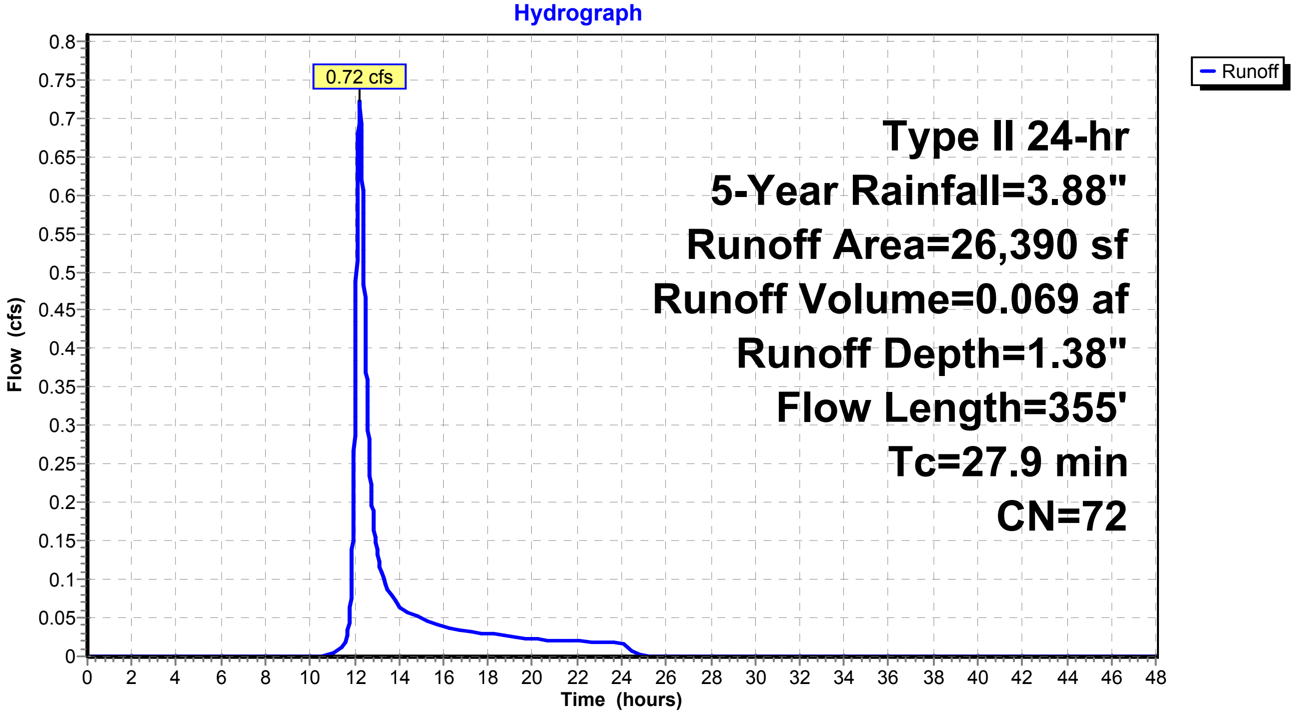
Runoff = 0.72 cfs @ 12.24 hrs, Volume= 0.069 af, Depth= 1.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 5-Year Rainfall=3.88"

	Area (sf)	CN	Description
*	1,355	98	Paved Road, HSG C
	2,727	70	Woods, Good, HSG C
	22,308	71	Meadow, non-grazed, HSG C
	26,390	72	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	15	0.0500	1.3		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.09"
1.5	8	0.0400	0.1		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.09"
11.3	31	0.0400	0.0		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 3.09"
10.3	46	0.0100	0.1		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.09"
3.2	134	0.0100	0.7		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
1.4	121	0.0400	1.4		**Shallow Concentrated Flow, SC2** Short Grass Pasture Kv= 7.0 fps
27.9	355	Total			

Subcatchment 1S: OVERALL DA PRE-DEVELOPMENT

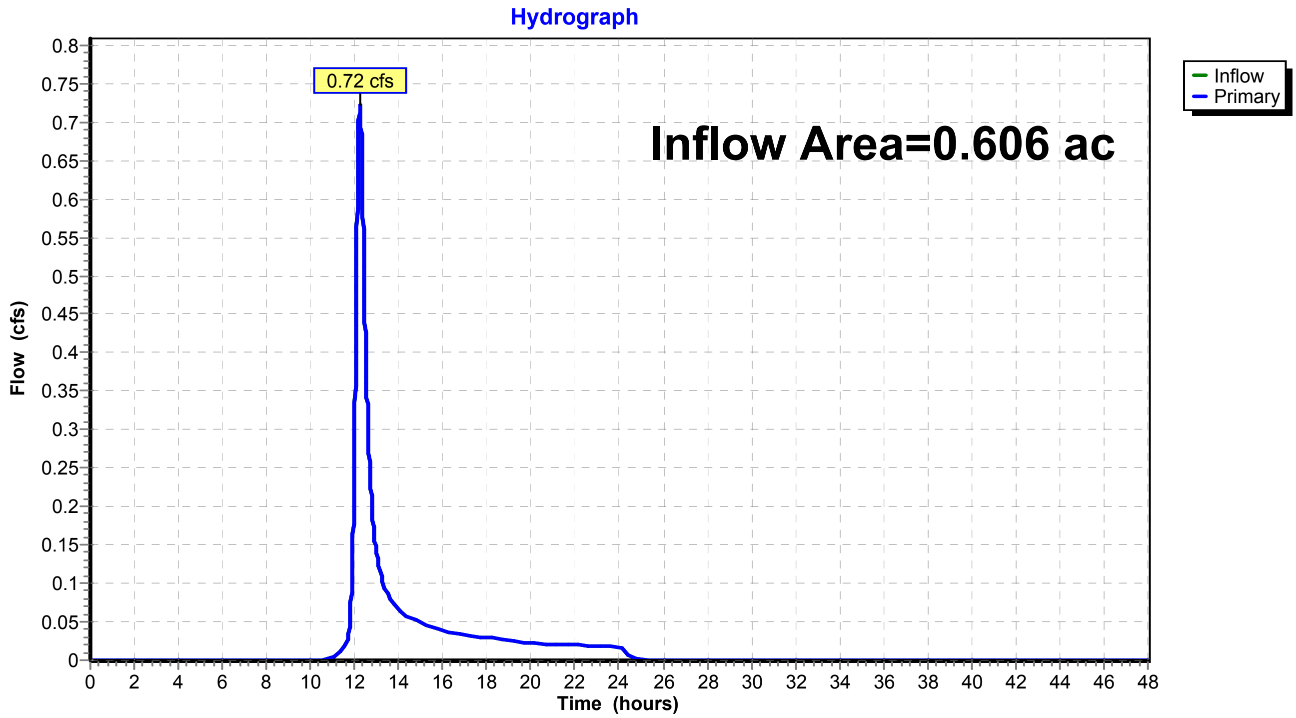


Summary for Link 7L: Exisitng Conditions

Inflow Area = 0.606 ac, Inflow Depth = 1.38" for 5-Year event
Inflow = 0.72 cfs @ 12.24 hrs, Volume= 0.069 af
Primary = 0.72 cfs @ 12.24 hrs, Volume= 0.069 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 7L: Exisitng Conditions



Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: OVERALL DA PRE-DEVELOPMENT Runoff Area=26,390 sf Runoff Depth=1.87"
Flow Length=355' Tc=27.9 min CN=72 Runoff=1.00 cfs 0.095 af

Link 7L: Exisitng Conditions Inflow=1.00 cfs 0.095 af
Primary=1.00 cfs 0.095 af

Total Runoff Area = 0.606 ac Runoff Volume = 0.095 af Average Runoff Depth = 1.87"

Summary for Subcatchment 1S: OVERALL DA PRE-DEVELOPMENT

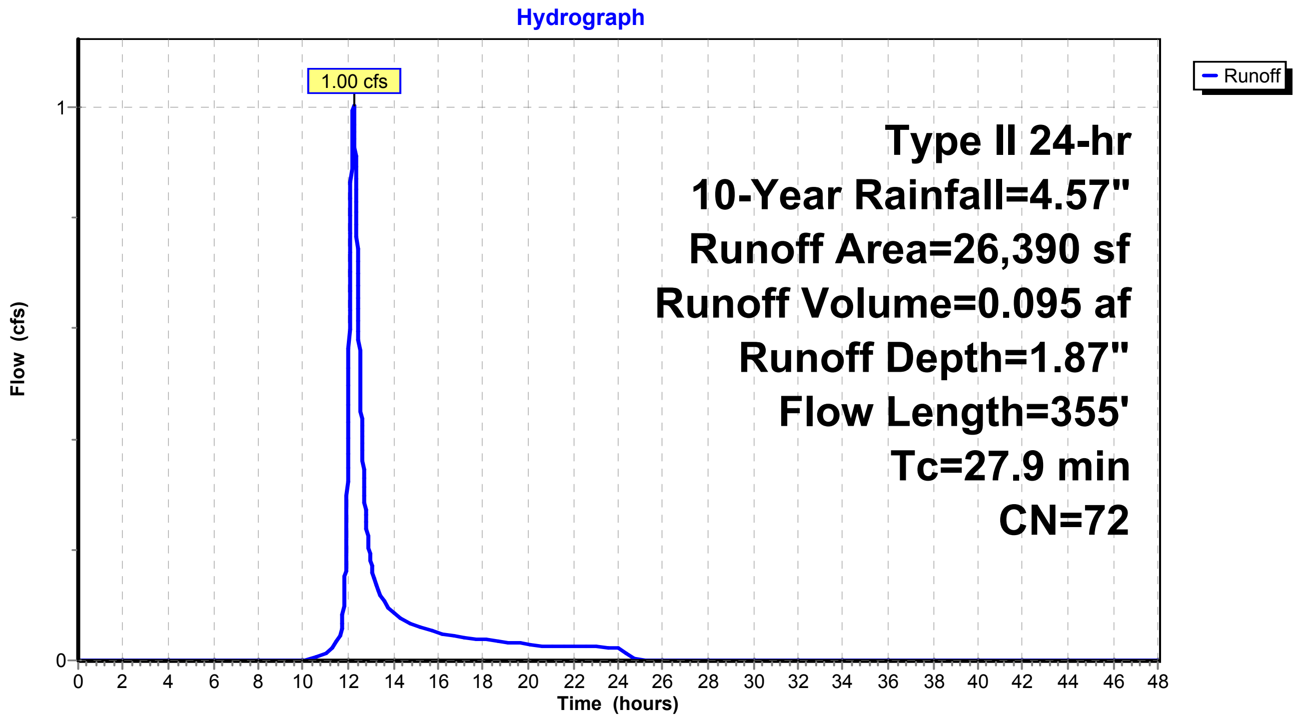
Runoff = 1.00 cfs @ 12.24 hrs, Volume= 0.095 af, Depth= 1.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 10-Year Rainfall=4.57"

	Area (sf)	CN	Description
*	1,355	98	Paved Road, HSG C
	2,727	70	Woods, Good, HSG C
	22,308	71	Meadow, non-grazed, HSG C
	26,390	72	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	15	0.0500	1.3		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.09"
1.5	8	0.0400	0.1		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.09"
11.3	31	0.0400	0.0		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 3.09"
10.3	46	0.0100	0.1		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.09"
3.2	134	0.0100	0.7		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
1.4	121	0.0400	1.4		**Shallow Concentrated Flow, SC2** Short Grass Pasture Kv= 7.0 fps
27.9	355	Total			

Subcatchment 1S: OVERALL DA PRE-DEVELOPMENT

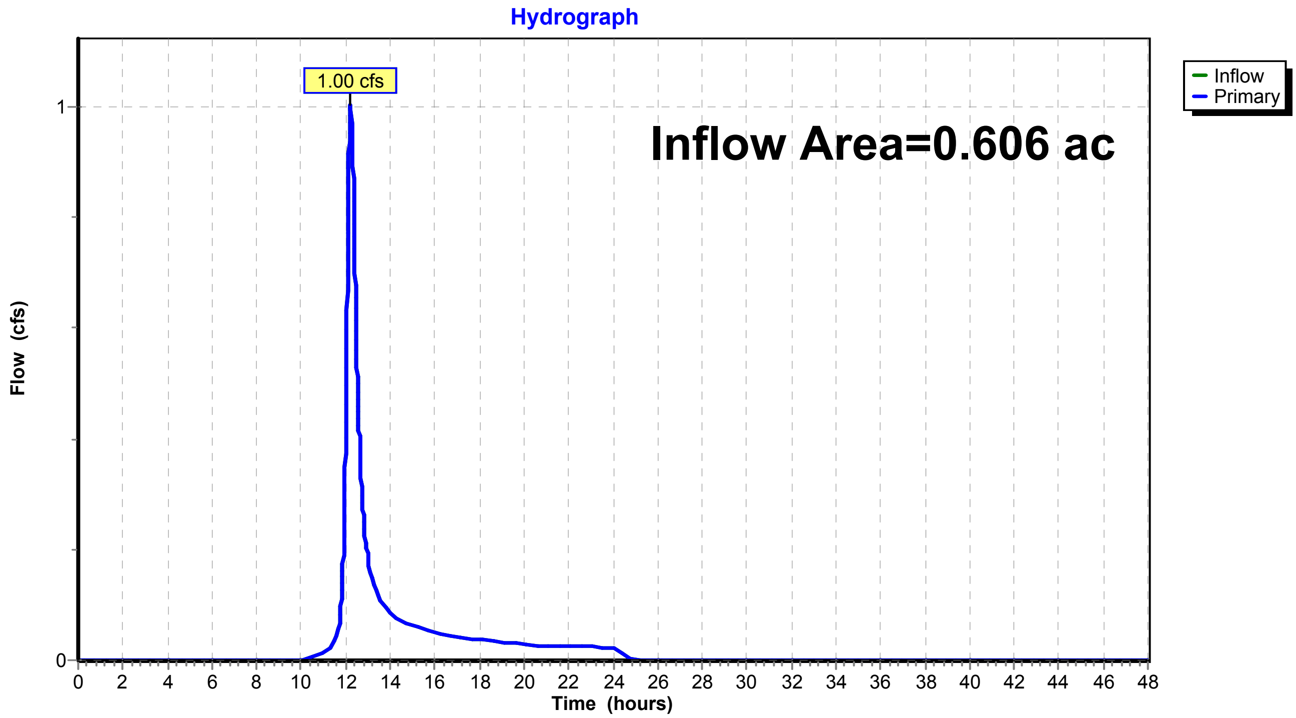


Summary for Link 7L: Exisitng Conditions

Inflow Area =	0.606 ac, Inflow Depth = 1.87" for 10-Year event	
Inflow =	1.00 cfs @ 12.24 hrs, Volume=	0.095 af
Primary =	1.00 cfs @ 12.24 hrs, Volume=	0.095 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 7L: Exisitng Conditions



Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: OVERALLDA PRE-DEVELOPMENT Runoff Area=26,390 sf Runoff Depth=2.69"
Flow Length=355' Tc=27.9 min CN=72 Runoff=1.46 cfs 0.136 af

Link 7L: Exisitng Conditions Inflow=1.46 cfs 0.136 af
Primary=1.46 cfs 0.136 af

Total Runoff Area = 0.606 ac Runoff Volume = 0.136 af Average Runoff Depth = 2.69"

Summary for Subcatchment 1S: OVERALL DA PRE-DEVELOPMENT

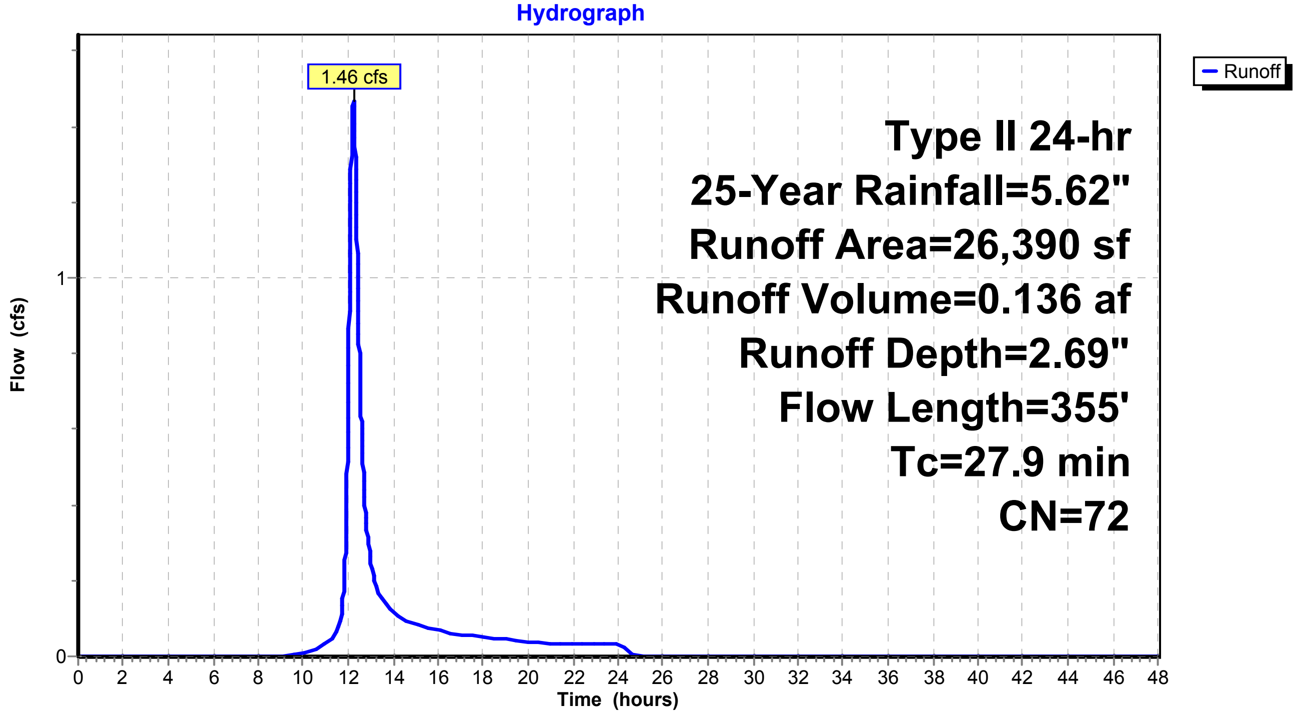
Runoff = 1.46 cfs @ 12.22 hrs, Volume= 0.136 af, Depth= 2.69"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=5.62"

	Area (sf)	CN	Description
*	1,355	98	Paved Road, HSG C
	2,727	70	Woods, Good, HSG C
	22,308	71	Meadow, non-grazed, HSG C
	26,390	72	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	15	0.0500	1.3		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.09"
1.5	8	0.0400	0.1		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.09"
11.3	31	0.0400	0.0		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 3.09"
10.3	46	0.0100	0.1		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.09"
3.2	134	0.0100	0.7		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
1.4	121	0.0400	1.4		**Shallow Concentrated Flow, SC2** Short Grass Pasture Kv= 7.0 fps
27.9	355	Total			

Subcatchment 1S: OVERALL DA PRE-DEVELOPMENT

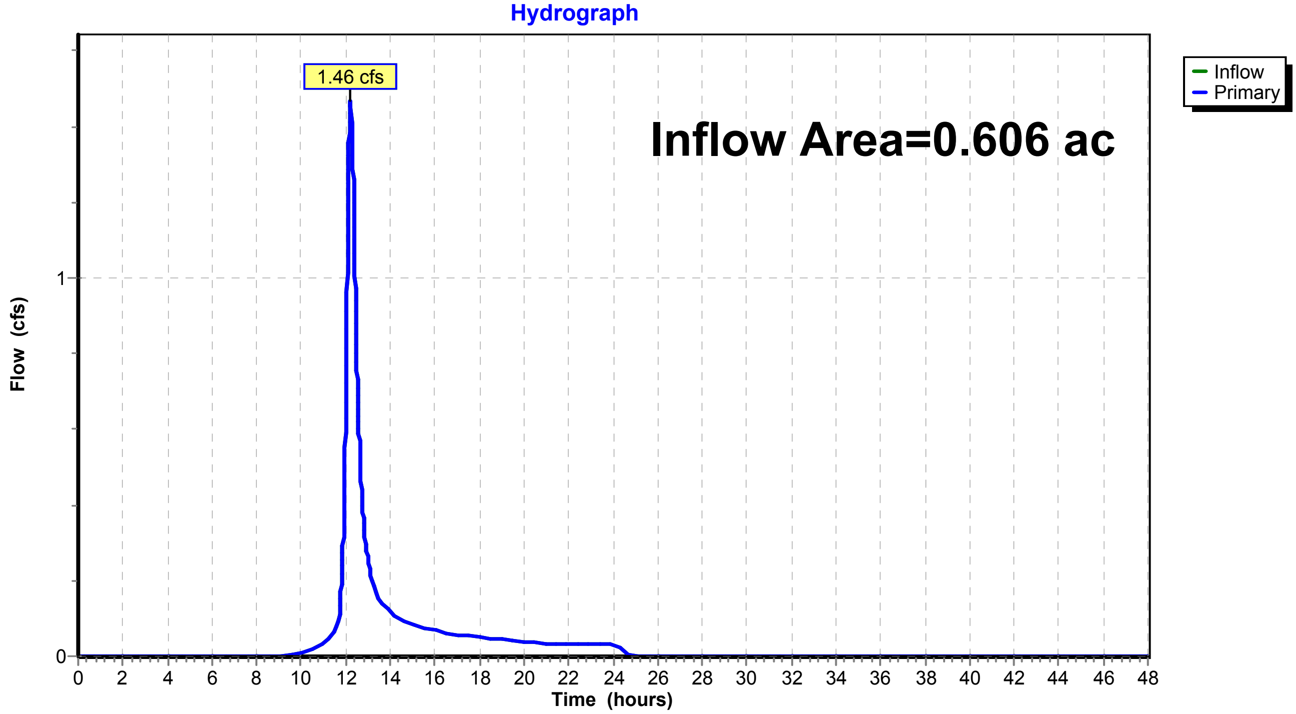


Summary for Link 7L: Exisitng Conditions

Inflow Area =	0.606 ac, Inflow Depth = 2.69" for 25-Year event	
Inflow =	1.46 cfs @ 12.22 hrs, Volume=	0.136 af
Primary =	1.46 cfs @ 12.22 hrs, Volume=	0.136 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 7L: Exisitng Conditions



Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: OVERALL DA PRE-DEVELOPMENT Runoff Area=26,390 sf Runoff Depth=3.46"
Flow Length=355' Tc=27.9 min CN=72 Runoff=1.90 cfs 0.175 af

Link 7L: Exisitng Conditions Inflow=1.90 cfs 0.175 af
Primary=1.90 cfs 0.175 af

Total Runoff Area = 0.606 ac Runoff Volume = 0.175 af Average Runoff Depth = 3.46"

Summary for Subcatchment 1S: OVERALL DA PRE-DEVELOPMENT

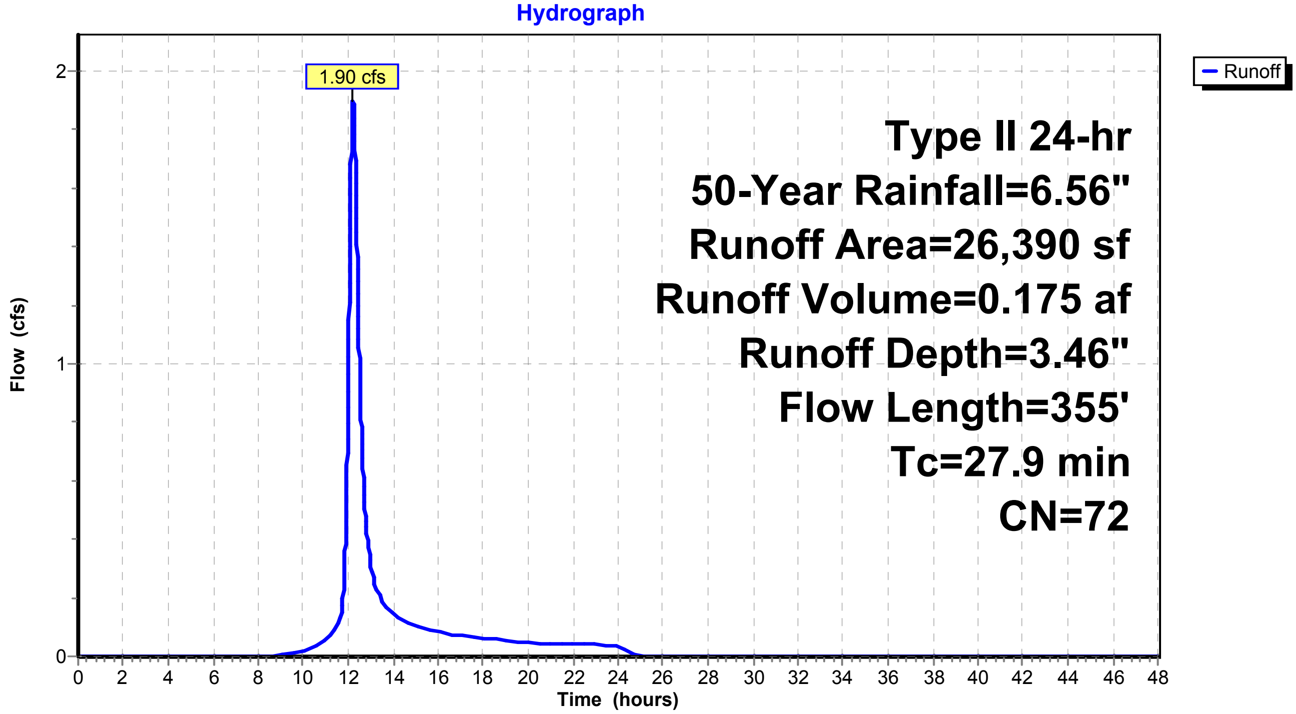
Runoff = 1.90 cfs @ 12.22 hrs, Volume= 0.175 af, Depth= 3.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 50-Year Rainfall=6.56"

	Area (sf)	CN	Description
*	1,355	98	Paved Road, HSG C
	2,727	70	Woods, Good, HSG C
	22,308	71	Meadow, non-grazed, HSG C
	26,390	72	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	15	0.0500	1.3		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.09"
1.5	8	0.0400	0.1		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.09"
11.3	31	0.0400	0.0		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 3.09"
10.3	46	0.0100	0.1		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.09"
3.2	134	0.0100	0.7		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
1.4	121	0.0400	1.4		**Shallow Concentrated Flow, SC2** Short Grass Pasture Kv= 7.0 fps
27.9	355	Total			

Subcatchment 1S: OVERALL DA PRE-DEVELOPMENT

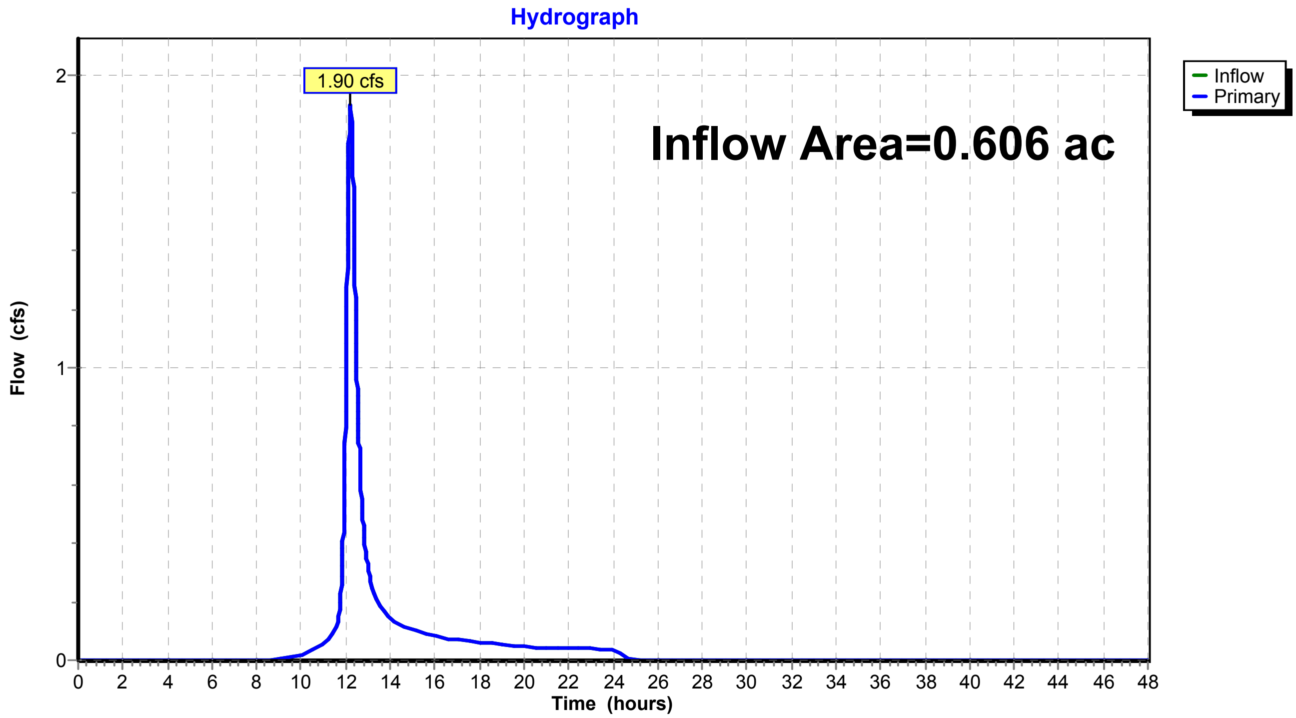


Summary for Link 7L: Exisitng Conditions

Inflow Area =	0.606 ac, Inflow Depth = 3.46"	for 50-Year event	
Inflow =	1.90 cfs @ 12.22 hrs, Volume=	0.175 af	
Primary =	1.90 cfs @ 12.22 hrs, Volume=	0.175 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 7L: Exisitng Conditions



Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: OVERALL DA PRE-DEVELOPMENT Runoff Area=26,390 sf Runoff Depth=4.37"
Flow Length=355' Tc=27.9 min CN=72 Runoff=2.41 cfs 0.221 af

Link 7L: Exisitng Conditions Inflow=2.41 cfs 0.221 af
Primary=2.41 cfs 0.221 af

Total Runoff Area = 0.606 ac Runoff Volume = 0.221 af Average Runoff Depth = 4.37"

Summary for Subcatchment 1S: OVERALL DA PRE-DEVELOPMENT

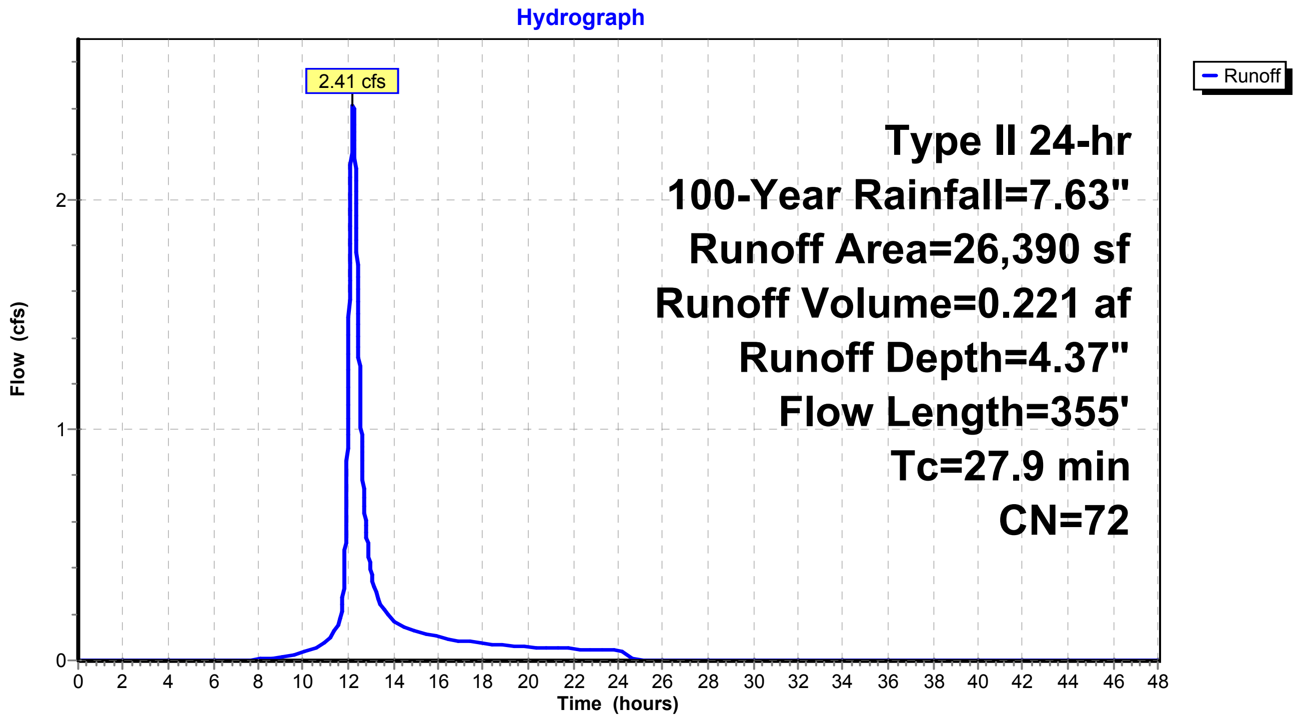
Runoff = 2.41 cfs @ 12.22 hrs, Volume= 0.221 af, Depth= 4.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Year Rainfall=7.63"

	Area (sf)	CN	Description
*	1,355	98	Paved Road, HSG C
	2,727	70	Woods, Good, HSG C
	22,308	71	Meadow, non-grazed, HSG C
	26,390	72	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	15	0.0500	1.3		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.09"
1.5	8	0.0400	0.1		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.09"
11.3	31	0.0400	0.0		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 3.09"
10.3	46	0.0100	0.1		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.09"
3.2	134	0.0100	0.7		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
1.4	121	0.0400	1.4		**Shallow Concentrated Flow, SC2** Short Grass Pasture Kv= 7.0 fps
27.9	355	Total			

Subcatchment 1S: OVERALL DA PRE-DEVELOPMENT

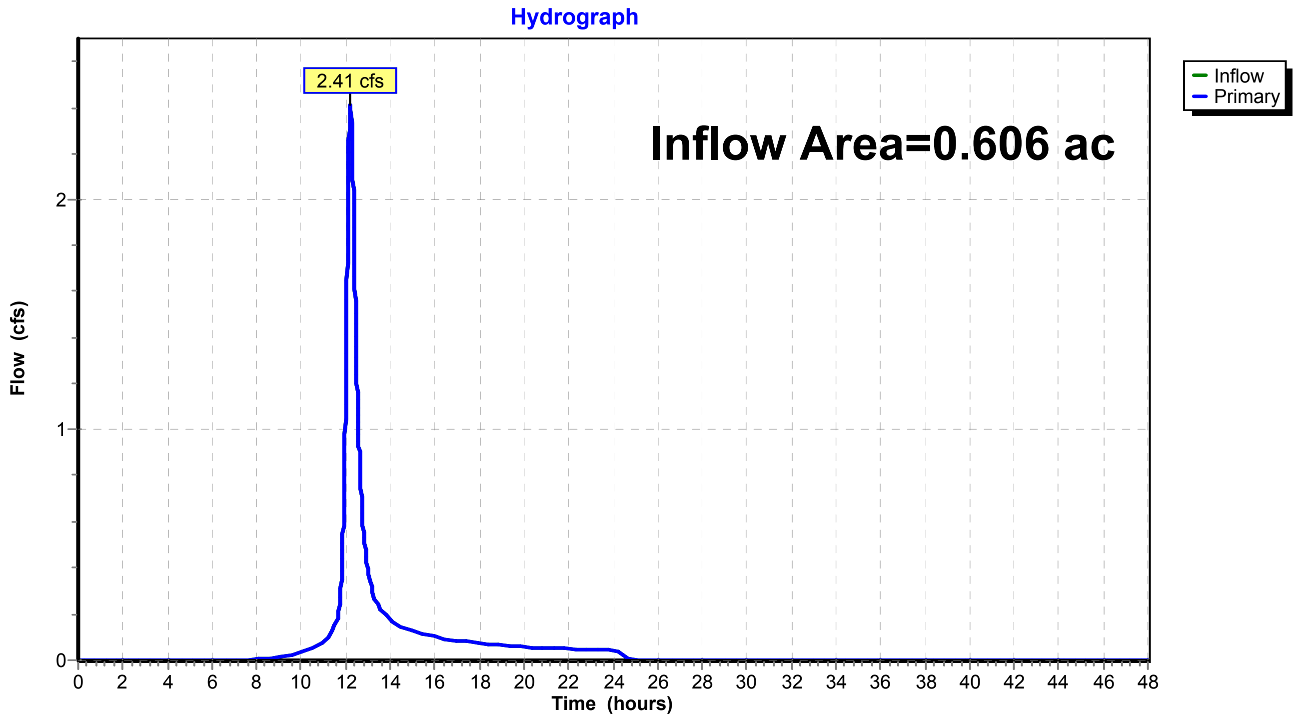


Summary for Link 7L: Exisitng Conditions

Inflow Area =	0.606 ac, Inflow Depth = 4.37" for 100-Year event	
Inflow =	2.41 cfs @ 12.22 hrs, Volume=	0.221 af
Primary =	2.41 cfs @ 12.22 hrs, Volume=	0.221 af, Atten= 0%, Lag= 0.0 min

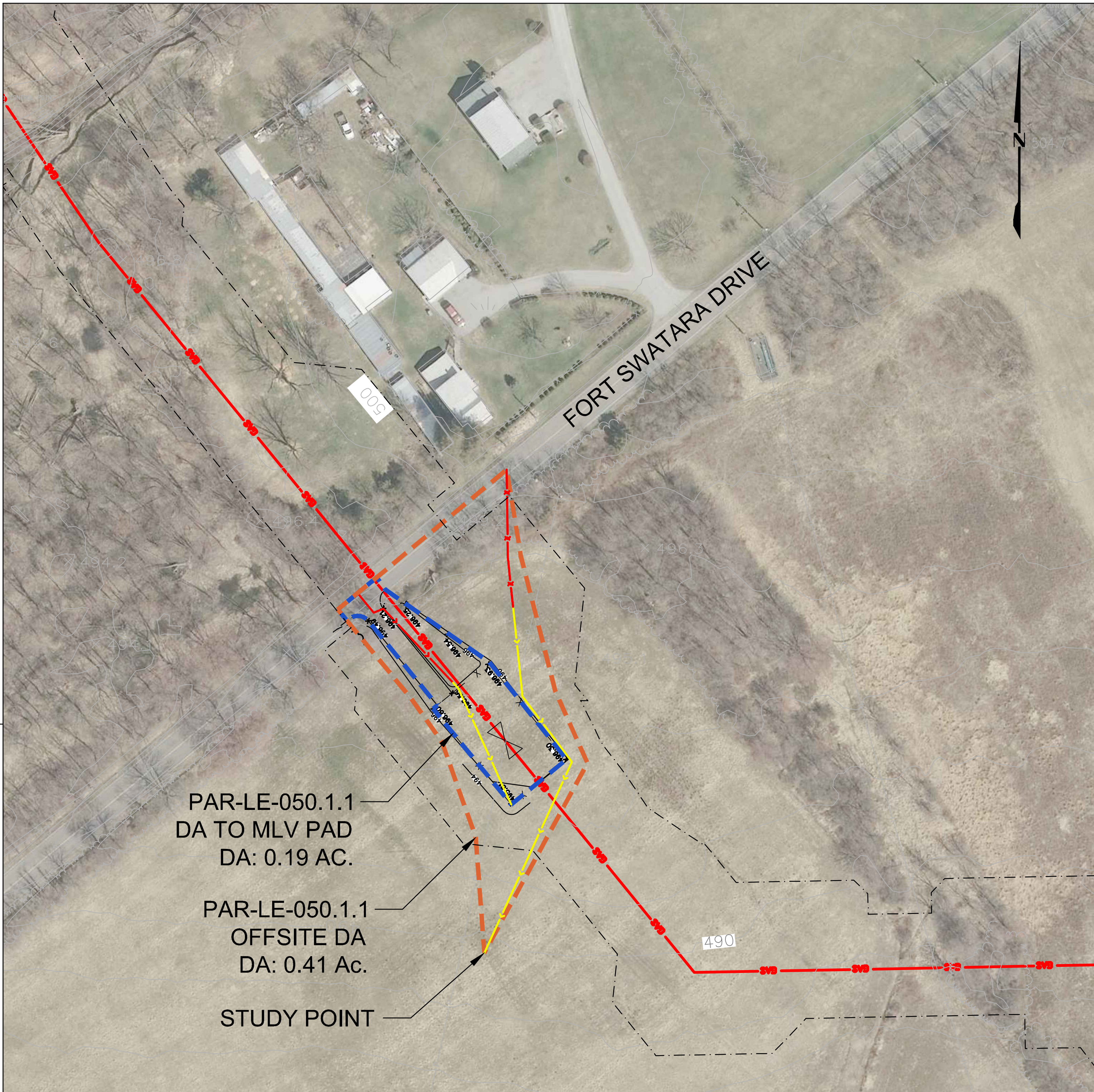
Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 7L: Exisitng Conditions



Q.4 Post Development Calculations

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



POST-DEVELOPMENT DRAINAGE AREA MAP

0 50 100
SCALE IN FEET

ISSUED FOR PERMITTING

ARCHITECTURE
ENGINEERING
ENVIRONMENTAL
LAND SURVEYING
BL Companies

LEGEND

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

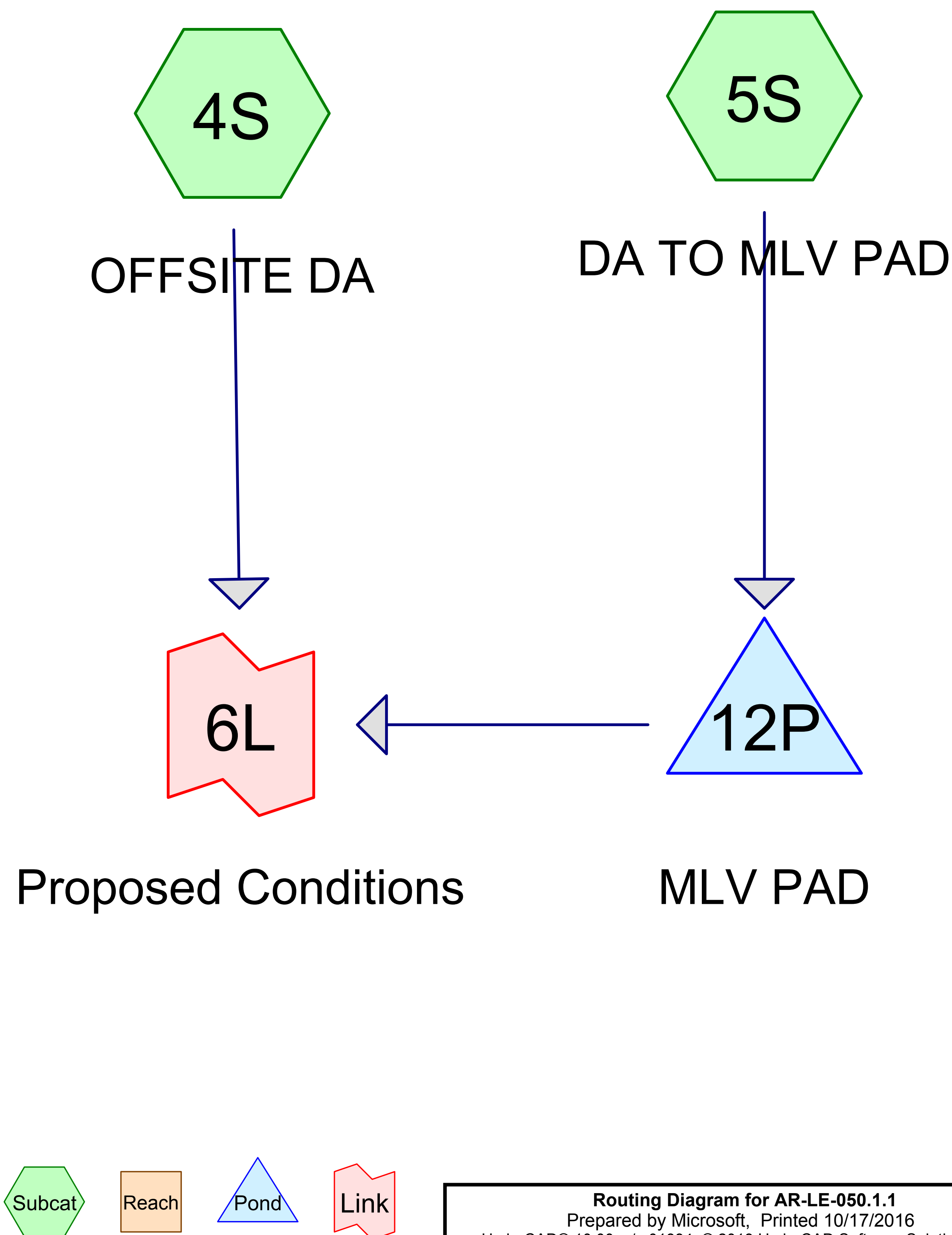
ATLANTIC SUNRISE PROJECT - CENTRAL PENN LINE SOUTH

PROPOSED 42" NATURAL GAS PIPELINE
ACCESS ROAD DRAINAGE AREA MAP
AR-LE-050.1.1 POST
UNION TOWNSHIP
LEBANON 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" = 100'
CHECKED BY: BJP	DATE: 10/26/15	ISSUED FOR CONSTRUCTION:	
APPROVED BY: BJP	DATE: 10/26/15	DRAWING NUMBER: AR-LE-050.1.1 POST	
WO:			



Routing Diagram for AR-LE-050.1.1
Prepared by Microsoft, Printed 10/17/2016
HydroCAD® 10.00 s/n 01334 © 2013 HydroCAD Software Solutions LLC

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.030	89	Gravel roads, HSG C (5S)
0.430	71	Meadow, non-grazed, HSG C (4S, 5S)
0.030	98	Paved Road, HSG C (4S)
0.009	98	Paved parking, HSG C (5S)
0.107	98	Stone Pad, HSG C (5S)
0.606	**78**	**TOTAL AREA**

Soil Listing (selected nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
0.606	HSG C	4S, 5S
0.000	HSG D	
0.000	Other	
0.606		**TOTAL AREA**

Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment4S: OFFSITE DA Runoff Area=17,975 sf Runoff Depth=0.61"
Flow Length=379' Tc=22.6 min CN=73 Runoff=0.22 cfs 0.021 af

Subcatchment5S: DA TO MLV PAD Runoff Area=8,415 sf Runoff Depth=1.59"
Flow Length=199' Tc=40.0 min CN=90 Runoff=0.22 cfs 0.026 af

Pond 12P: MLV PAD Peak Elev=495.45' Storage=1,118 cf Inflow=0.22 cfs 0.026 af
Outflow=0.00 cfs 0.000 af

Link 6L: Proposed Conditions Inflow=0.22 cfs 0.021 af
Primary=0.22 cfs 0.021 af

Total Runoff Area = 0.606 ac Runoff Volume = 0.046 af Average Runoff Depth = 0.92"

Summary for Subcatchment 4S: OFFSITE DA

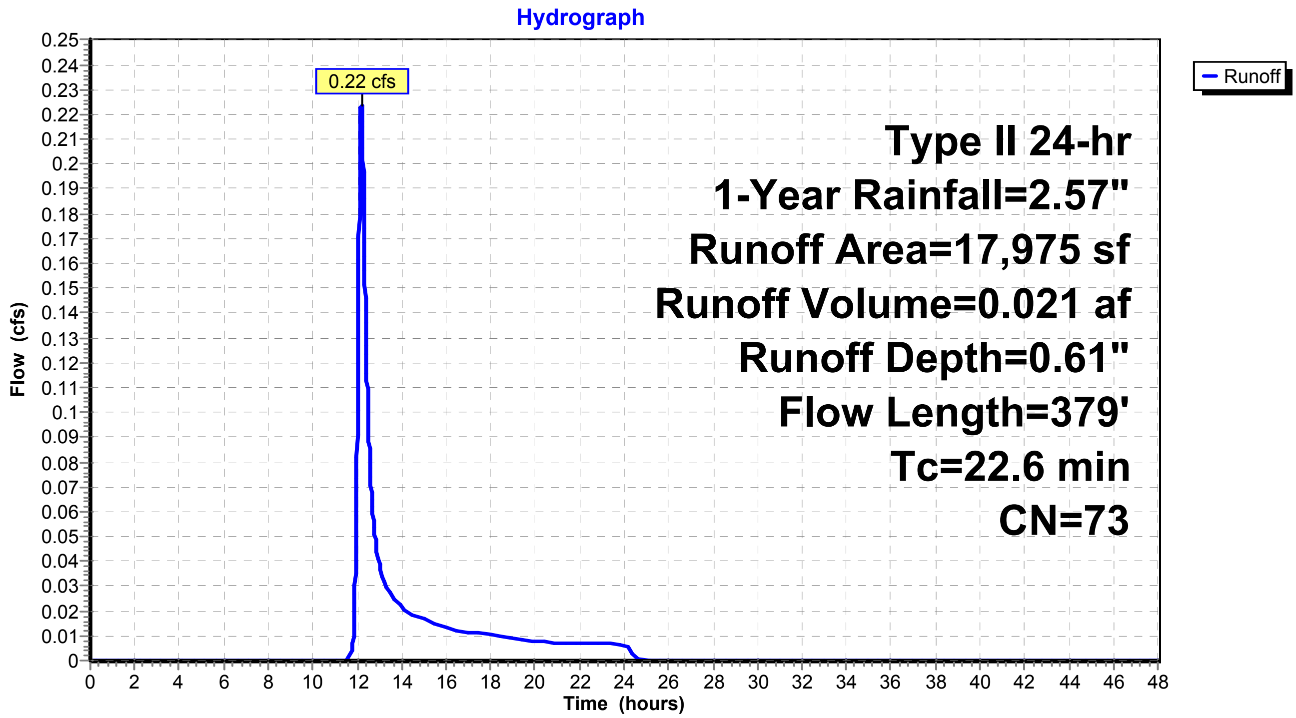
Runoff = 0.22 cfs @ 12.18 hrs, Volume= 0.021 af, Depth= 0.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 1-Year Rainfall=2.57"

	Area (sf)	CN	Description
*	1,308	98	Paved Road, HSG C
	16,667	71	Meadow, non-grazed, HSG C
	0	70	Woods, Good, HSG C
	17,975	73	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	15	0.0500	1.3		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.09"
5.2	39	0.0400	0.1		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.09"
10.3	46	0.0100	0.1		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.09"
5.6	166	0.0050	0.5		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
1.3	113	0.0400	1.4		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
22.6	379	Total			

Subcatchment 4S: OFFSITE DA



Summary for Subcatchment 5S: DA TO MLV PAD

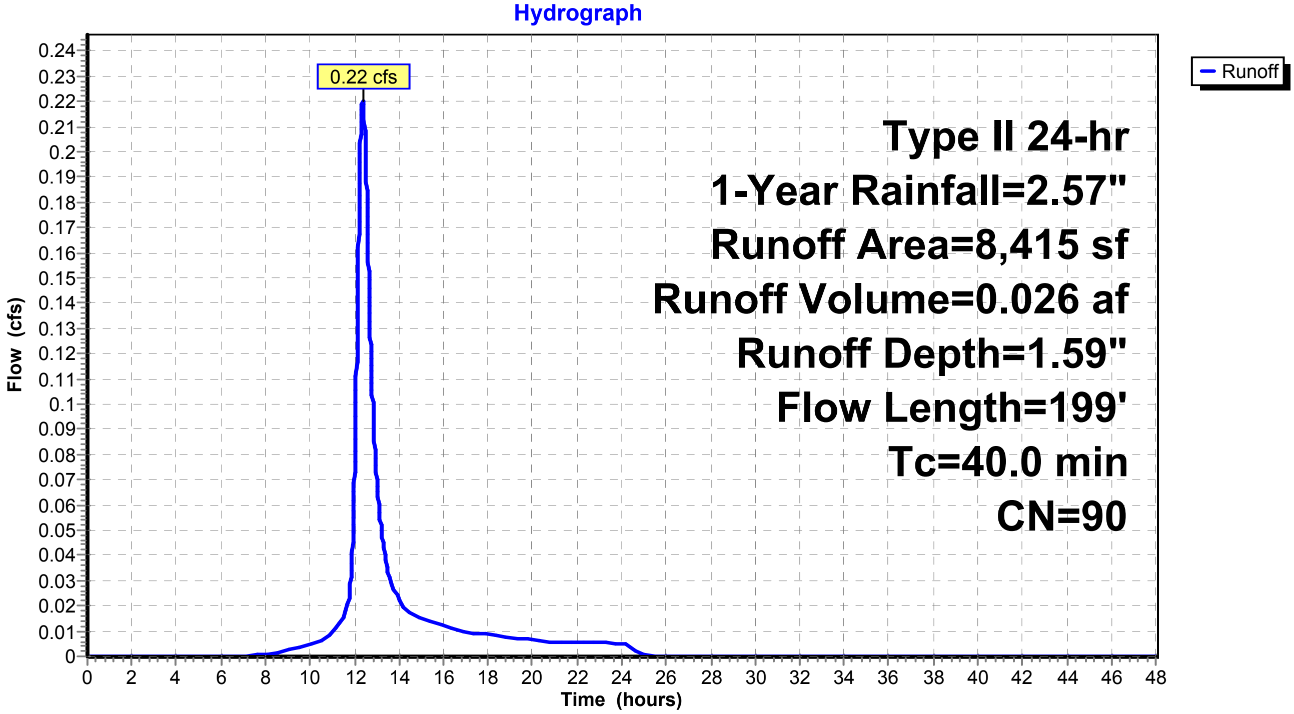
Runoff = 0.22 cfs @ 12.36 hrs, Volume= 0.026 af, Depth= 1.59"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 1-Year Rainfall=2.57"

	Area (sf)	CN	Description
*	4,680	98	Stone Pad, HSG C
	1,295	89	Gravel roads, HSG C
	2,054	71	Meadow, non-grazed, HSG C
	386	98	Paved parking, HSG C
	8,415	90	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	11	0.0200	0.9		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.09"
0.3	15	0.0200	0.9		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.09"
37.8	74	0.0010	0.0		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.09"
0.5	6	0.0010	0.2		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
1.2	93	0.0070	1.3		**Shallow Concentrated Flow, SC2** Unpaved Kv= 16.1 fps
40.0	199	Total			

Subcatchment 5S: DA TO MLV PAD



Summary for Pond 12P: MLV PAD

Inflow Area = 0.193 ac, Inflow Depth = 1.59" for 1-Year event
Inflow = 0.22 cfs @ 12.36 hrs, Volume= 0.026 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= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 495.45' @ 26.23 hrs Surf.Area= 4,629 sf Storage= 1,118 cf

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

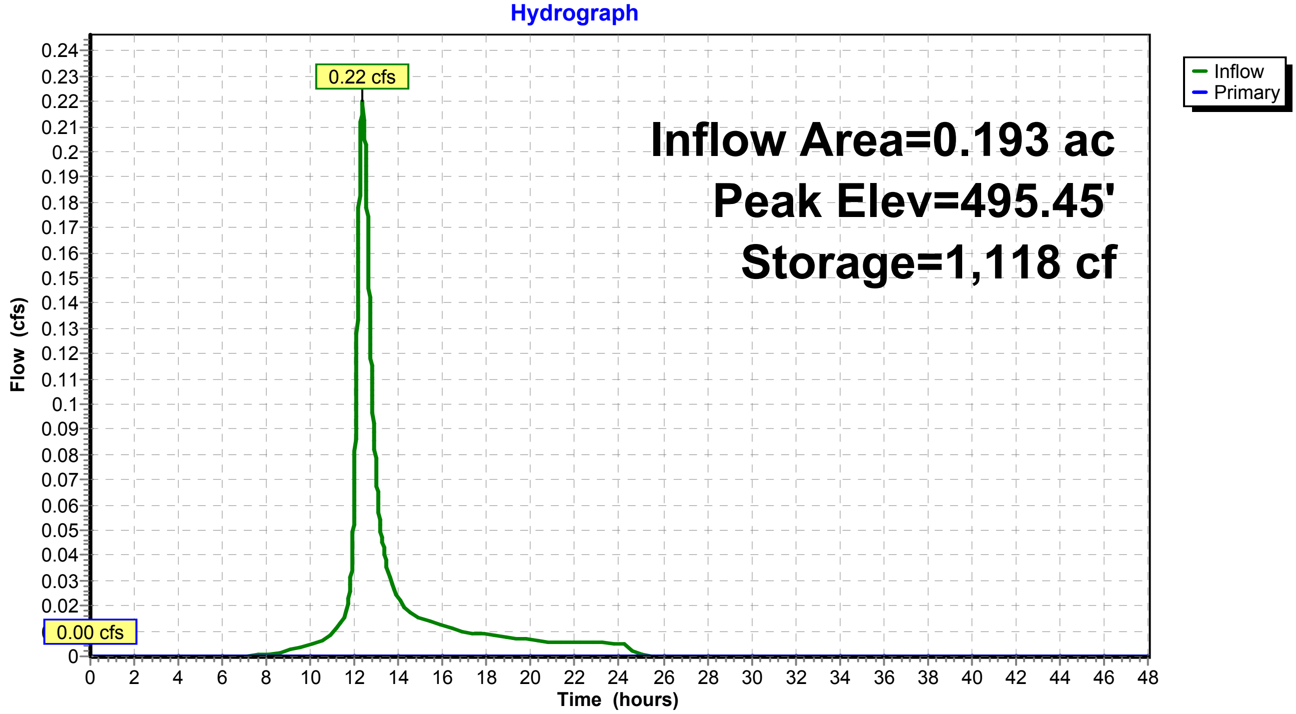
Volume	Invert	Avail.Storage	Storage Description
#1	494.31'	2,730 cf	**Stone Pad Void Storage (Prismatic)** Listed below 6,825 cf Overall x 40.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
494.31	0	0	0
494.81	2,020	505	505
495.31	4,610	1,658	2,163
495.81	4,680	2,323	4,485
496.31	4,680	2,340	6,825

Device	Routing	Invert	Outlet Devices
#1	Primary	495.81'	**90.0' long x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=494.31' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 12P: MLV PAD

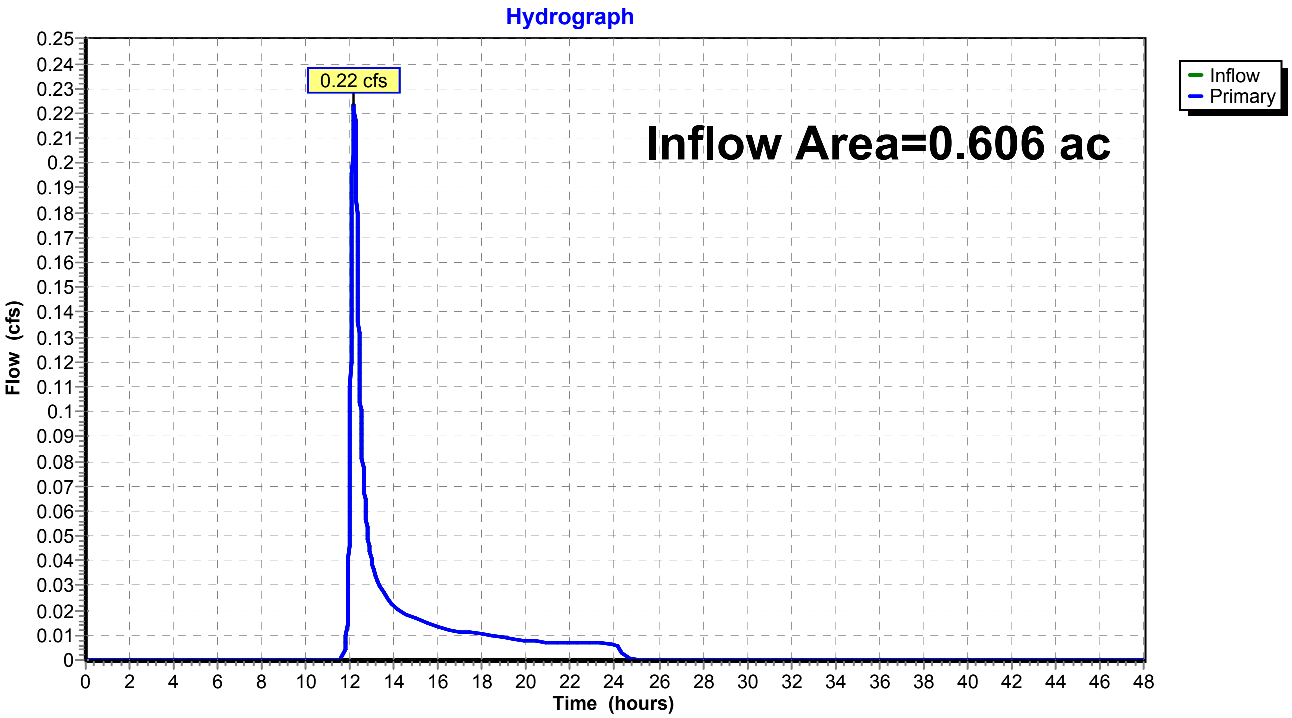


Summary for Link 6L: Proposed Conditions

Inflow Area = 0.606 ac, Inflow Depth = 0.41" for 1-Year event
Inflow = 0.22 cfs @ 12.18 hrs, Volume= 0.021 af
Primary = 0.22 cfs @ 12.18 hrs, Volume= 0.021 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 6L: Proposed Conditions



Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment4S: OFFSITE DA Runoff Area=17,975 sf Runoff Depth=0.91"
Flow Length=379' Tc=22.6 min CN=73 Runoff=0.36 cfs 0.031 af

Subcatchment5S: DA TO MLV PAD Runoff Area=8,415 sf Runoff Depth=2.07"
Flow Length=199' Tc=40.0 min CN=90 Runoff=0.28 cfs 0.033 af

Pond 12P: MLV PAD Peak Elev=495.62' Storage=1,449 cf Inflow=0.28 cfs 0.033 af
Outflow=0.00 cfs 0.000 af

Link 6L: Proposed Conditions Inflow=0.36 cfs 0.031 af
Primary=0.36 cfs 0.031 af

Total Runoff Area = 0.606 ac Runoff Volume = 0.065 af Average Runoff Depth = 1.28"

Summary for Subcatchment 4S: OFFSITE DA

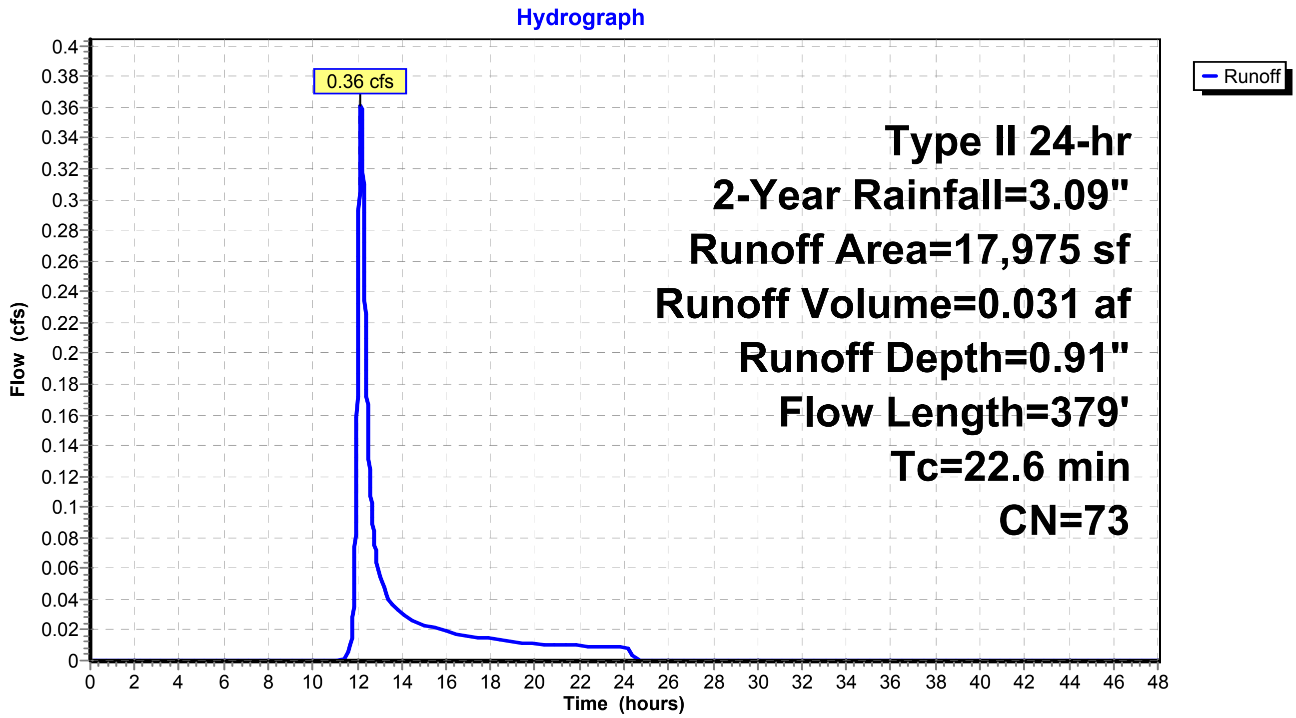
Runoff = 0.36 cfs @ 12.18 hrs, Volume= 0.031 af, Depth= 0.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 2-Year Rainfall=3.09"

	Area (sf)	CN	Description
*	1,308	98	Paved Road, HSG C
	16,667	71	Meadow, non-grazed, HSG C
	0	70	Woods, Good, HSG C
	17,975	73	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	15	0.0500	1.3		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.09"
5.2	39	0.0400	0.1		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.09"
10.3	46	0.0100	0.1		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.09"
5.6	166	0.0050	0.5		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
1.3	113	0.0400	1.4		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
22.6	379	Total			

Subcatchment 4S: OFFSITE DA



Summary for Subcatchment 5S: DA TO MLV PAD

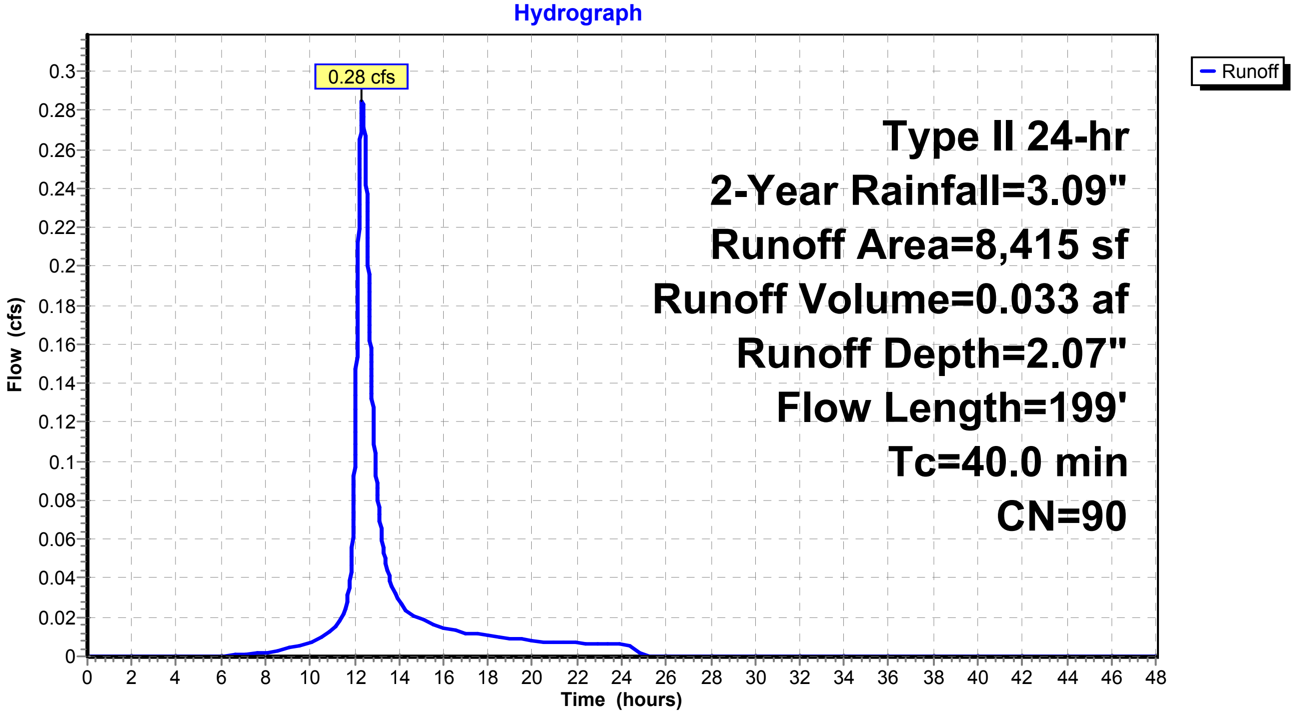
Runoff = 0.28 cfs @ 12.36 hrs, Volume= 0.033 af, Depth= 2.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 2-Year Rainfall=3.09"

	Area (sf)	CN	Description
*	4,680	98	Stone Pad, HSG C
	1,295	89	Gravel roads, HSG C
	2,054	71	Meadow, non-grazed, HSG C
	386	98	Paved parking, HSG C
	8,415	90	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	11	0.0200	0.9		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.09"
0.3	15	0.0200	0.9		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.09"
37.8	74	0.0010	0.0		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.09"
0.5	6	0.0010	0.2		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
1.2	93	0.0070	1.3		**Shallow Concentrated Flow, SC2** Unpaved Kv= 16.1 fps
40.0	199	Total			

Subcatchment 5S: DA TO MLV PAD



Summary for Pond 12P: MLV PAD

Inflow Area = 0.193 ac, Inflow Depth = 2.07" for 2-Year event
Inflow = 0.28 cfs @ 12.36 hrs, Volume= 0.033 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 495.62' @ 26.23 hrs Surf.Area= 4,654 sf Storage= 1,449 cf

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

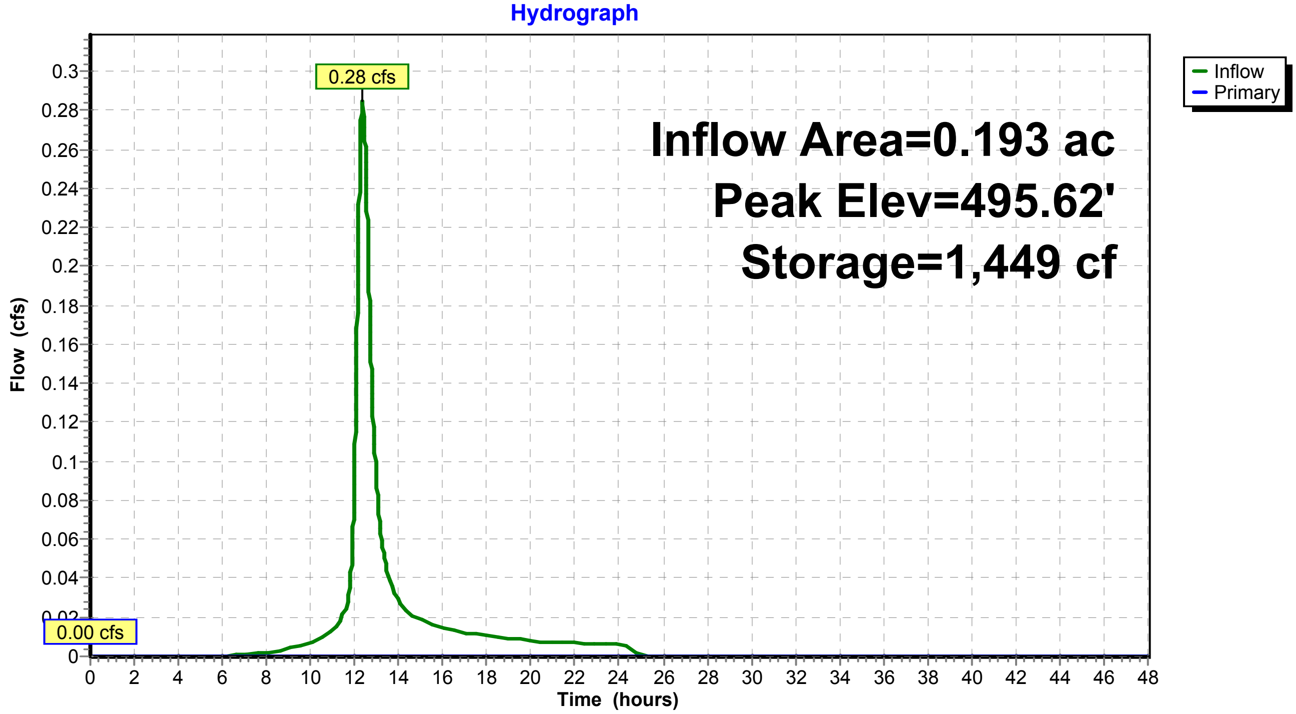
Volume	Invert	Avail.Storage	Storage Description
#1	494.31'	2,730 cf	**Stone Pad Void Storage (Prismatic)** Listed below 6,825 cf Overall x 40.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
494.31	0	0	0
494.81	2,020	505	505
495.31	4,610	1,658	2,163
495.81	4,680	2,323	4,485
496.31	4,680	2,340	6,825

Device	Routing	Invert	Outlet Devices
#1	Primary	495.81'	**90.0' long x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=494.31' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 12P: MLV PAD

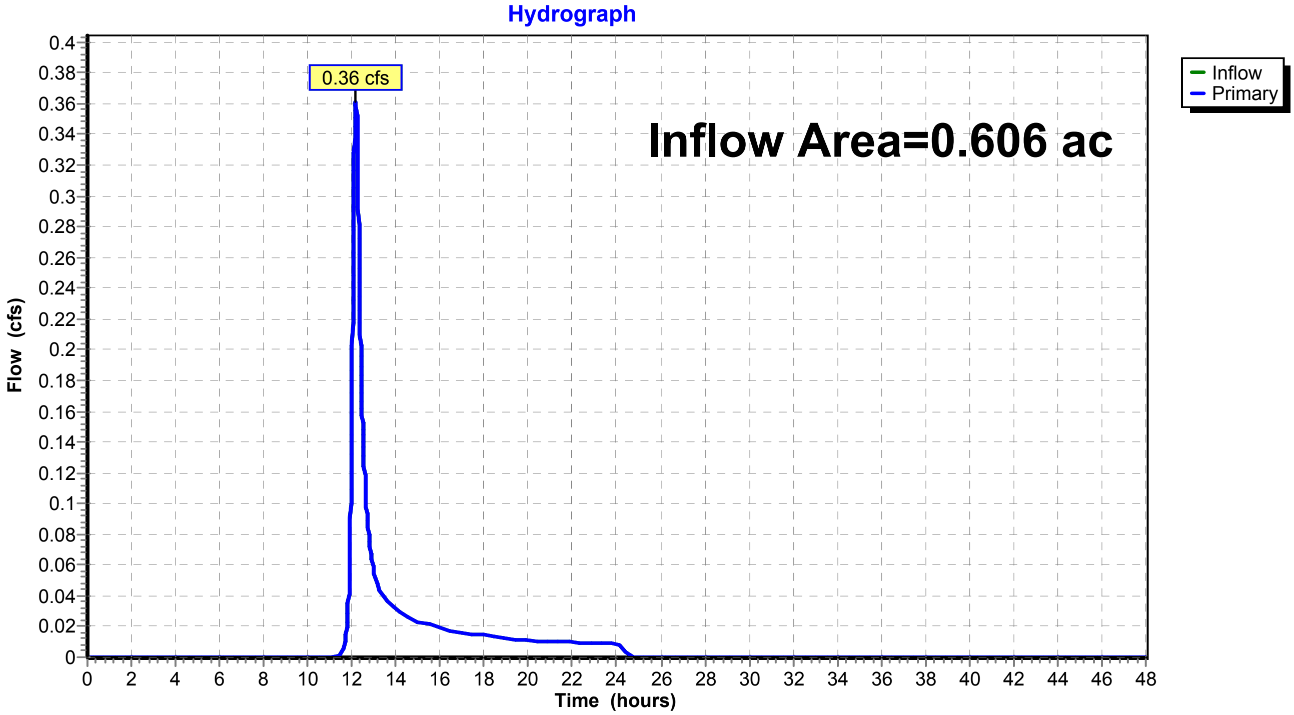


Summary for Link 6L: Proposed Conditions

Inflow Area = 0.606 ac, Inflow Depth = 0.62" for 2-Year event
Inflow = 0.36 cfs @ 12.18 hrs, Volume= 0.031 af
Primary = 0.36 cfs @ 12.18 hrs, Volume= 0.031 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 6L: Proposed Conditions



Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment4S: OFFSITE DA Runoff Area=17,975 sf Runoff Depth=1.44"
Flow Length=379' Tc=22.6 min CN=73 Runoff=0.60 cfs 0.050 af

Subcatchment5S: DA TO MLV PAD Runoff Area=8,415 sf Runoff Depth=2.81"
Flow Length=199' Tc=40.0 min CN=90 Runoff=0.38 cfs 0.045 af

Pond 12P: MLV PAD Peak Elev=495.81' Storage=1,795 cf Inflow=0.38 cfs 0.045 af
Outflow=0.01 cfs 0.004 af

Link 6L: Proposed Conditions Inflow=0.60 cfs 0.054 af
Primary=0.60 cfs 0.054 af

Total Runoff Area = 0.606 ac Runoff Volume = 0.095 af Average Runoff Depth = 1.88"

Summary for Subcatchment 4S: OFFSITE DA

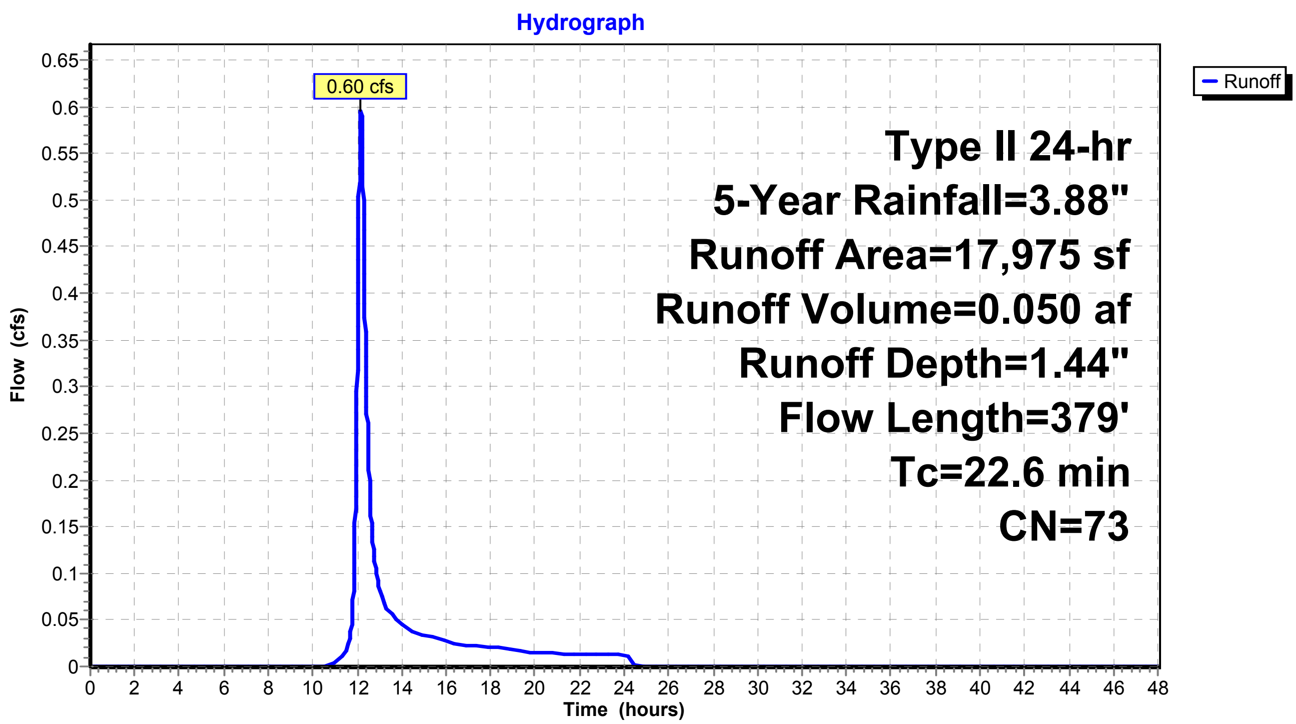
Runoff = 0.60 cfs @ 12.17 hrs, Volume= 0.050 af, Depth= 1.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 5-Year Rainfall=3.88"

	Area (sf)	CN	Description
*	1,308	98	Paved Road, HSG C
	16,667	71	Meadow, non-grazed, HSG C
	0	70	Woods, Good, HSG C
	17,975	73	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	15	0.0500	1.3		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.09"
5.2	39	0.0400	0.1		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.09"
10.3	46	0.0100	0.1		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.09"
5.6	166	0.0050	0.5		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
1.3	113	0.0400	1.4		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
22.6	379	Total			

Subcatchment 4S: OFFSITE DA



Summary for Subcatchment 5S: DA TO MLV PAD

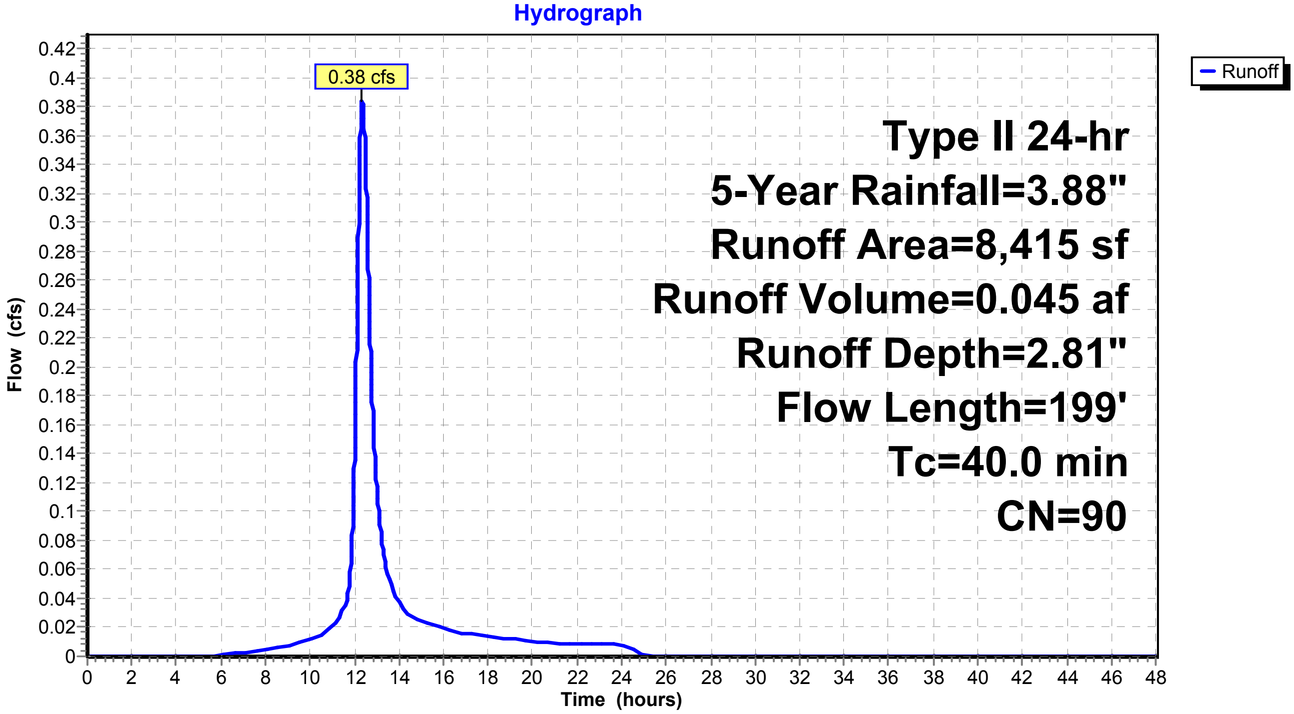
Runoff = 0.38 cfs @ 12.36 hrs, Volume= 0.045 af, Depth= 2.81"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 5-Year Rainfall=3.88"

	Area (sf)	CN	Description
*	4,680	98	Stone Pad, HSG C
	1,295	89	Gravel roads, HSG C
	2,054	71	Meadow, non-grazed, HSG C
	386	98	Paved parking, HSG C
	8,415	90	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	11	0.0200	0.9		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.09"
0.3	15	0.0200	0.9		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.09"
37.8	74	0.0010	0.0		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.09"
0.5	6	0.0010	0.2		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
1.2	93	0.0070	1.3		**Shallow Concentrated Flow, SC2** Unpaved Kv= 16.1 fps
40.0	199	Total			

Subcatchment 5S: DA TO MLV PAD



Summary for Pond 12P: MLV PAD

Inflow Area = 0.193 ac, Inflow Depth = 2.81" for 5-Year event
Inflow = 0.38 cfs @ 12.36 hrs, Volume= 0.045 af
Outflow = 0.01 cfs @ 19.39 hrs, Volume= 0.004 af, Atten= 97%, Lag= 422.0 min
Primary = 0.01 cfs @ 19.39 hrs, Volume= 0.004 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 495.81' @ 19.39 hrs Surf.Area= 4,680 sf Storage= 1,795 cf

Plug-Flow detention time= 715.2 min calculated for 0.004 af (9% of inflow)
Center-of-Mass det. time= 481.6 min (1,309.7 - 828.0)

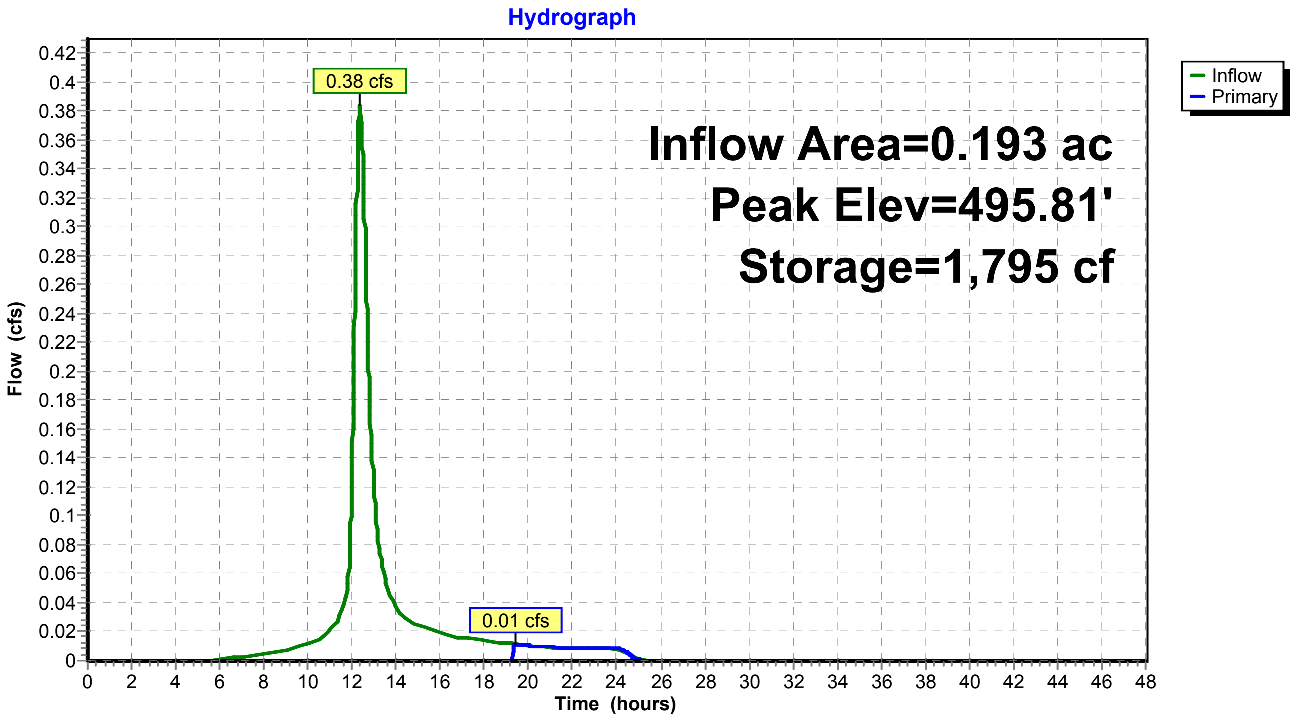
Volume	Invert	Avail.Storage	Storage Description
#1	494.31'	2,730 cf	**Stone Pad Void Storage (Prismatic)** Listed below 6,825 cf Overall x 40.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
494.31	0	0	0
494.81	2,020	505	505
495.31	4,610	1,658	2,163
495.81	4,680	2,323	4,485
496.31	4,680	2,340	6,825

Device	Routing	Invert	Outlet Devices
#1	Primary	495.81'	**90.0' long x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=0.00 cfs @ 19.39 hrs HW=495.81' (Free Discharge)
1=Broad-Crested Rectangular Weir (Weir Controls 0.00 cfs)

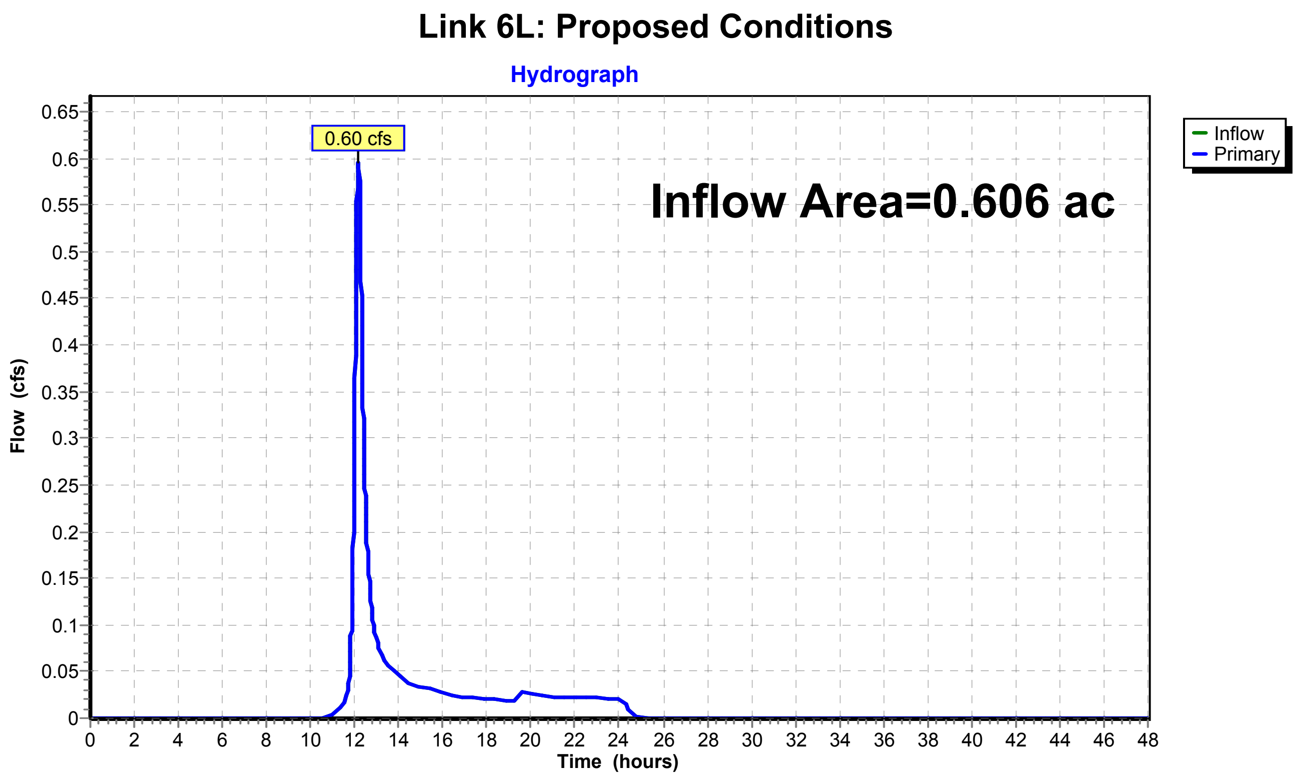
Pond 12P: MLV PAD



Summary for Link 6L: Proposed Conditions

Inflow Area = 0.606 ac, Inflow Depth = 1.06" for 5-Year event
Inflow = 0.60 cfs @ 12.17 hrs, Volume= 0.054 af
Primary = 0.60 cfs @ 12.17 hrs, Volume= 0.054 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs



Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment4S: OFFSITE DA Runoff Area=17,975 sf Runoff Depth=1.95"
Flow Length=379' Tc=22.6 min CN=73 Runoff=0.82 cfs 0.067 af

Subcatchment5S: DA TO MLV PAD Runoff Area=8,415 sf Runoff Depth=3.46"
Flow Length=199' Tc=40.0 min CN=90 Runoff=0.47 cfs 0.056 af

Pond 12P: MLV PAD Peak Elev=495.81' Storage=1,797 cf Inflow=0.47 cfs 0.056 af
Outflow=0.04 cfs 0.015 af

Link 6L: Proposed Conditions Inflow=0.82 cfs 0.082 af
Primary=0.82 cfs 0.082 af

Total Runoff Area = 0.606 ac Runoff Volume = 0.123 af Average Runoff Depth = 2.43"

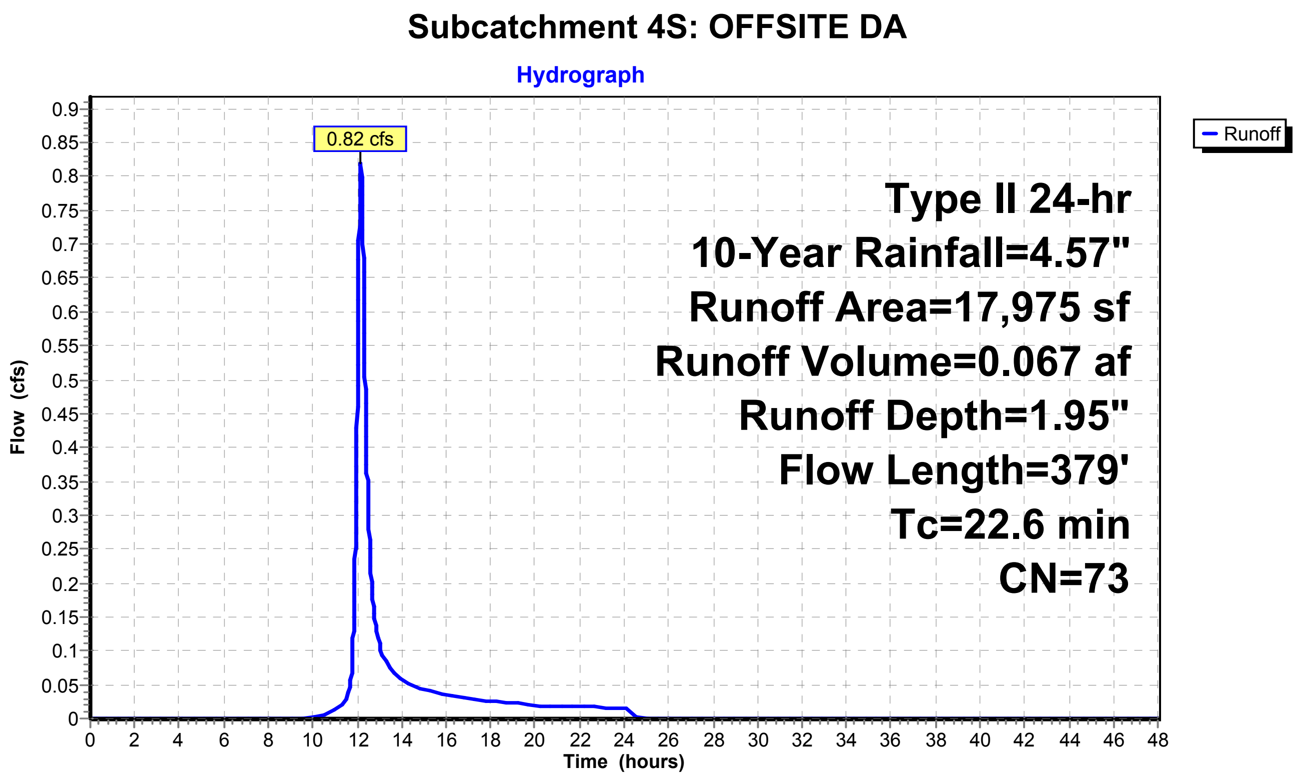
Summary for Subcatchment 4S: OFFSITE DA

Runoff = 0.82 cfs @ 12.16 hrs, Volume= 0.067 af, Depth= 1.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 10-Year Rainfall=4.57"

	Area (sf)	CN	Description
*	1,308	98	Paved Road, HSG C
	16,667	71	Meadow, non-grazed, HSG C
	0	70	Woods, Good, HSG C
	17,975	73	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	15	0.0500	1.3		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.09"
5.2	39	0.0400	0.1		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.09"
10.3	46	0.0100	0.1		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.09"
5.6	166	0.0050	0.5		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
1.3	113	0.0400	1.4		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
22.6	379	Total			



Summary for Subcatchment 5S: DA TO MLV PAD

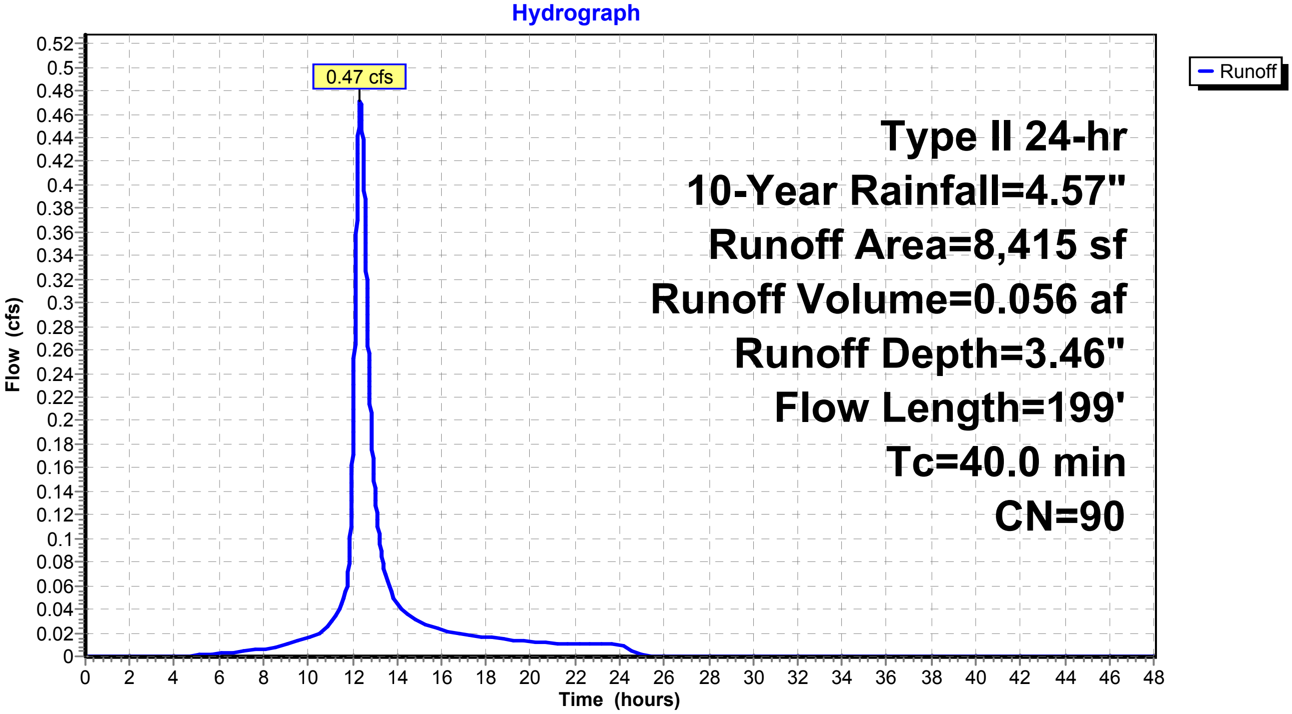
Runoff = 0.47 cfs @ 12.35 hrs, Volume= 0.056 af, Depth= 3.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 10-Year Rainfall=4.57"

	Area (sf)	CN	Description
*	4,680	98	Stone Pad, HSG C
	1,295	89	Gravel roads, HSG C
	2,054	71	Meadow, non-grazed, HSG C
	386	98	Paved parking, HSG C
	8,415	90	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	11	0.0200	0.9		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.09"
0.3	15	0.0200	0.9		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.09"
37.8	74	0.0010	0.0		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.09"
0.5	6	0.0010	0.2		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
1.2	93	0.0070	1.3		**Shallow Concentrated Flow, SC2** Unpaved Kv= 16.1 fps
40.0	199	Total			

Subcatchment 5S: DA TO MLV PAD



Summary for Pond 12P: MLV PAD

Inflow Area = 0.193 ac, Inflow Depth = 3.46" for 10-Year event
Inflow = 0.47 cfs @ 12.35 hrs, Volume= 0.056 af
Outflow = 0.04 cfs @ 14.07 hrs, Volume= 0.015 af, Atten= 91%, Lag= 103.2 min
Primary = 0.04 cfs @ 14.07 hrs, Volume= 0.015 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 495.81' @ 14.07 hrs Surf.Area= 4,680 sf Storage= 1,797 cf

Plug-Flow detention time= 412.9 min calculated for 0.015 af (26% of inflow)
Center-of-Mass det. time= 259.7 min (1,081.8 - 822.1)

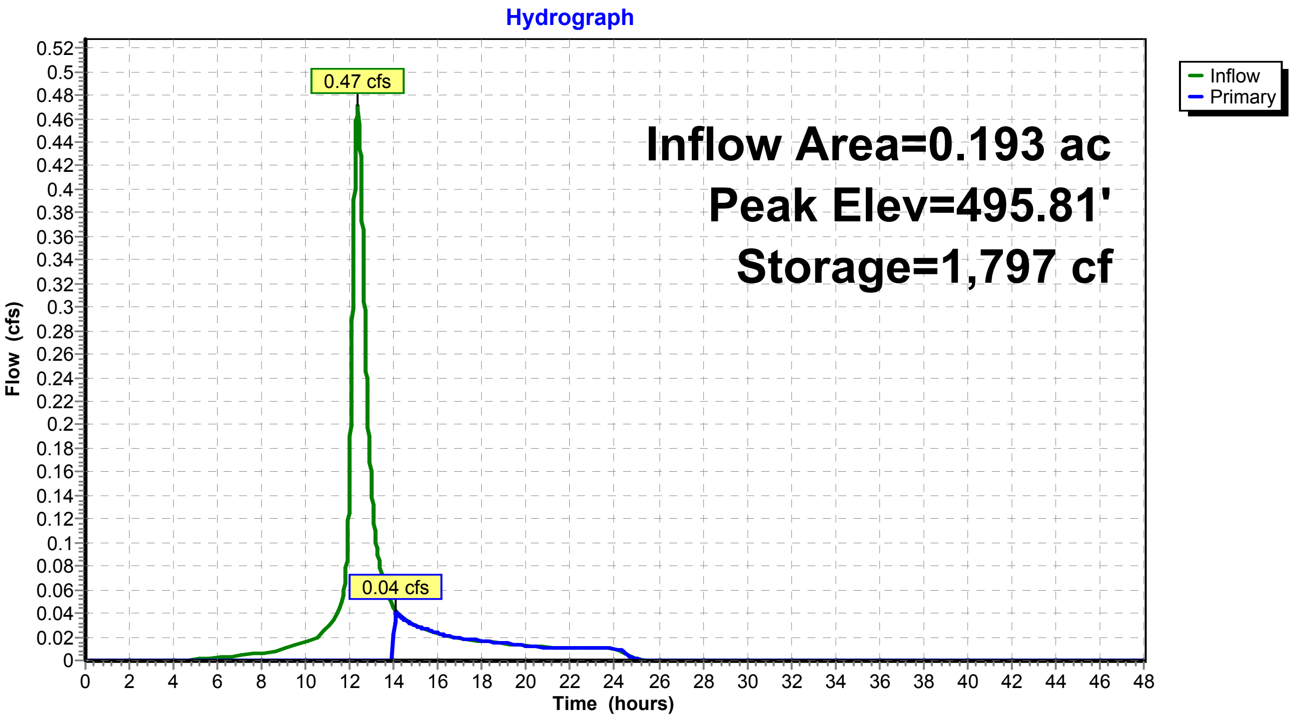
Volume	Invert	Avail.Storage	Storage Description
#1	494.31'	2,730 cf	**Stone Pad Void Storage (Prismatic)** Listed below 6,825 cf Overall x 40.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
494.31	0	0	0
494.81	2,020	505	505
495.31	4,610	1,658	2,163
495.81	4,680	2,323	4,485
496.31	4,680	2,340	6,825

Device	Routing	Invert	Outlet Devices
#1	Primary	495.81'	**90.0' long x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=0.01 cfs @ 14.07 hrs HW=495.81' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Weir Controls 0.01 cfs @ 0.1 fps)

Pond 12P: MLV PAD

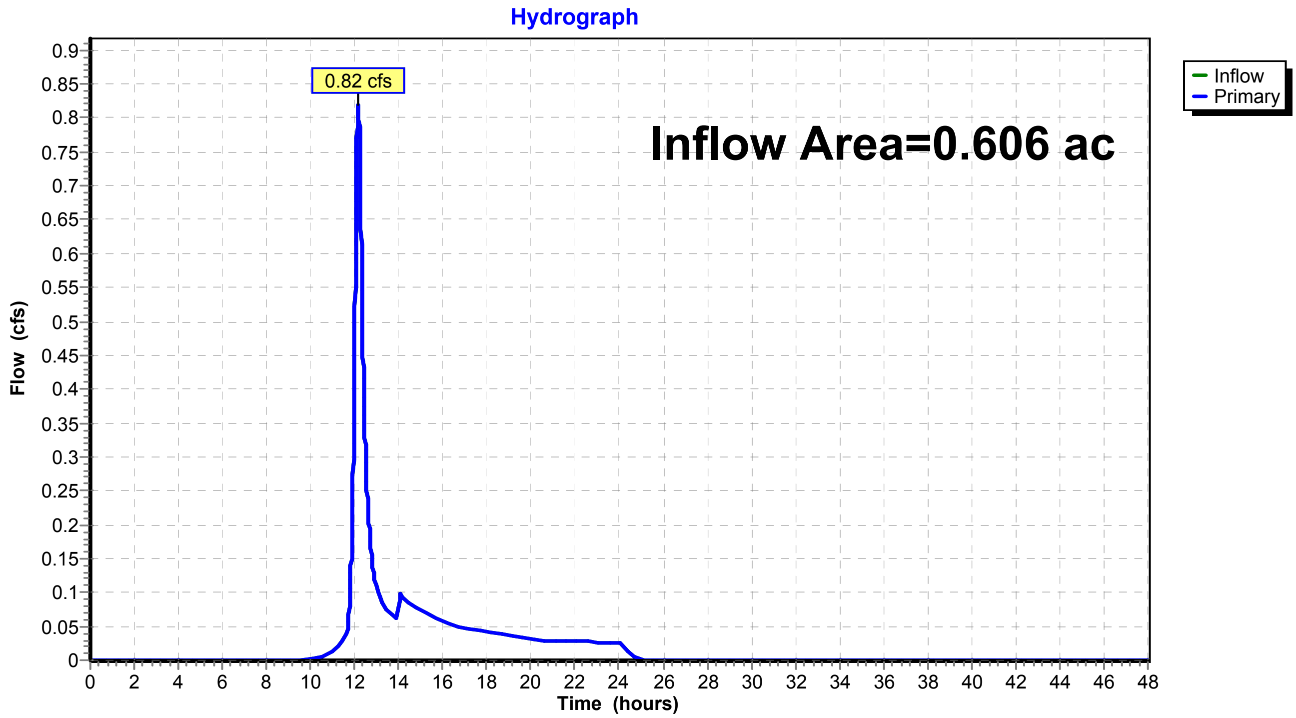


Summary for Link 6L: Proposed Conditions

Inflow Area = 0.606 ac, Inflow Depth = 1.62" for 10-Year event
Inflow = 0.82 cfs @ 12.16 hrs, Volume= 0.082 af
Primary = 0.82 cfs @ 12.16 hrs, Volume= 0.082 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 6L: Proposed Conditions



Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment4S: OFFSITE DA Runoff Area=17,975 sf Runoff Depth=2.78"
Flow Length=379' Tc=22.6 min CN=73 Runoff=1.18 cfs 0.095 af

Subcatchment5S: DA TO MLV PAD Runoff Area=8,415 sf Runoff Depth=4.48"
Flow Length=199' Tc=40.0 min CN=90 Runoff=0.60 cfs 0.072 af

Pond 12P: MLV PAD Peak Elev=495.82' Storage=1,810 cf Inflow=0.60 cfs 0.072 af
Outflow=0.27 cfs 0.031 af

Link 6L: Proposed Conditions Inflow=1.18 cfs 0.126 af
Primary=1.18 cfs 0.126 af

Total Runoff Area = 0.606 ac Runoff Volume = 0.168 af Average Runoff Depth = 3.32"

Summary for Subcatchment 4S: OFFSITE DA

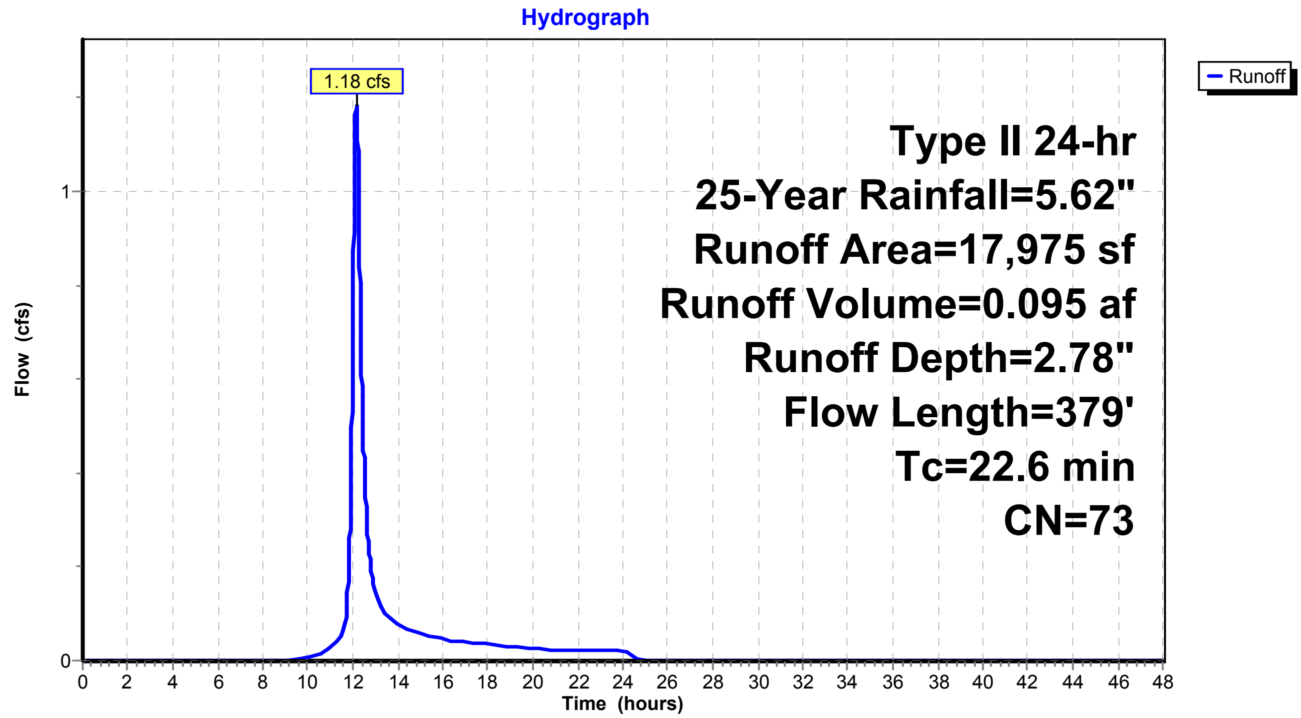
Runoff = 1.18 cfs @ 12.16 hrs, Volume= 0.095 af, Depth= 2.78"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=5.62"

	Area (sf)	CN	Description
*	1,308	98	Paved Road, HSG C
	16,667	71	Meadow, non-grazed, HSG C
	0	70	Woods, Good, HSG C
	17,975	73	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	15	0.0500	1.3		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.09"
5.2	39	0.0400	0.1		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.09"
10.3	46	0.0100	0.1		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.09"
5.6	166	0.0050	0.5		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
1.3	113	0.0400	1.4		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
22.6	379	Total			

Subcatchment 4S: OFFSITE DA



Summary for Subcatchment 5S: DA TO MLV PAD

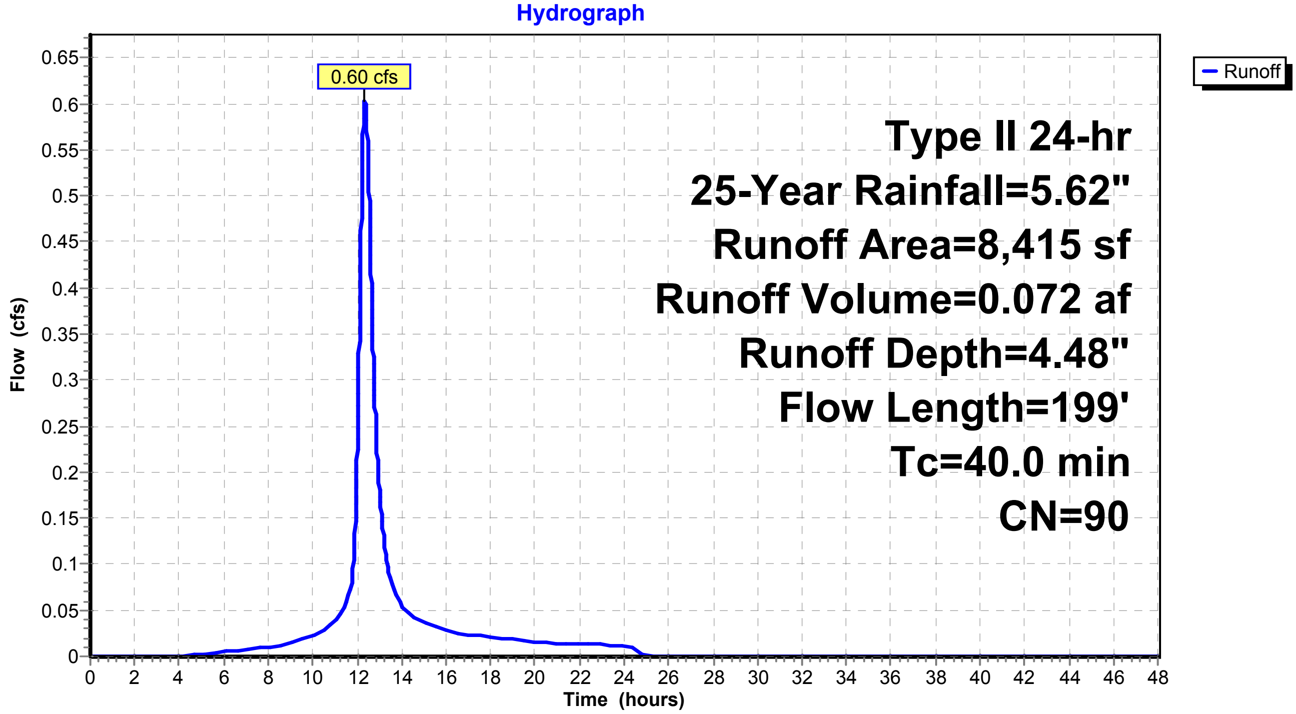
Runoff = 0.60 cfs @ 12.35 hrs, Volume= 0.072 af, Depth= 4.48"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=5.62"

	Area (sf)	CN	Description
*	4,680	98	Stone Pad, HSG C
	1,295	89	Gravel roads, HSG C
	2,054	71	Meadow, non-grazed, HSG C
	386	98	Paved parking, HSG C
	8,415	90	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	11	0.0200	0.9		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.09"
0.3	15	0.0200	0.9		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.09"
37.8	74	0.0010	0.0		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.09"
0.5	6	0.0010	0.2		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
1.2	93	0.0070	1.3		**Shallow Concentrated Flow, SC2** Unpaved Kv= 16.1 fps
40.0	199	Total			

Subcatchment 5S: DA TO MLV PAD



Summary for Pond 12P: MLV PAD

Inflow Area = 0.193 ac, Inflow Depth = 4.48" for 25-Year event
Inflow = 0.60 cfs @ 12.35 hrs, Volume= 0.072 af
Outflow = 0.27 cfs @ 12.81 hrs, Volume= 0.031 af, Atten= 56%, Lag= 27.2 min
Primary = 0.27 cfs @ 12.81 hrs, Volume= 0.031 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 495.82' @ 12.81 hrs Surf.Area= 4,680 sf Storage= 1,810 cf

Plug-Flow detention time= 274.5 min calculated for 0.031 af (43% of inflow)
Center-of-Mass det. time= 147.8 min (962.9 - 815.1)

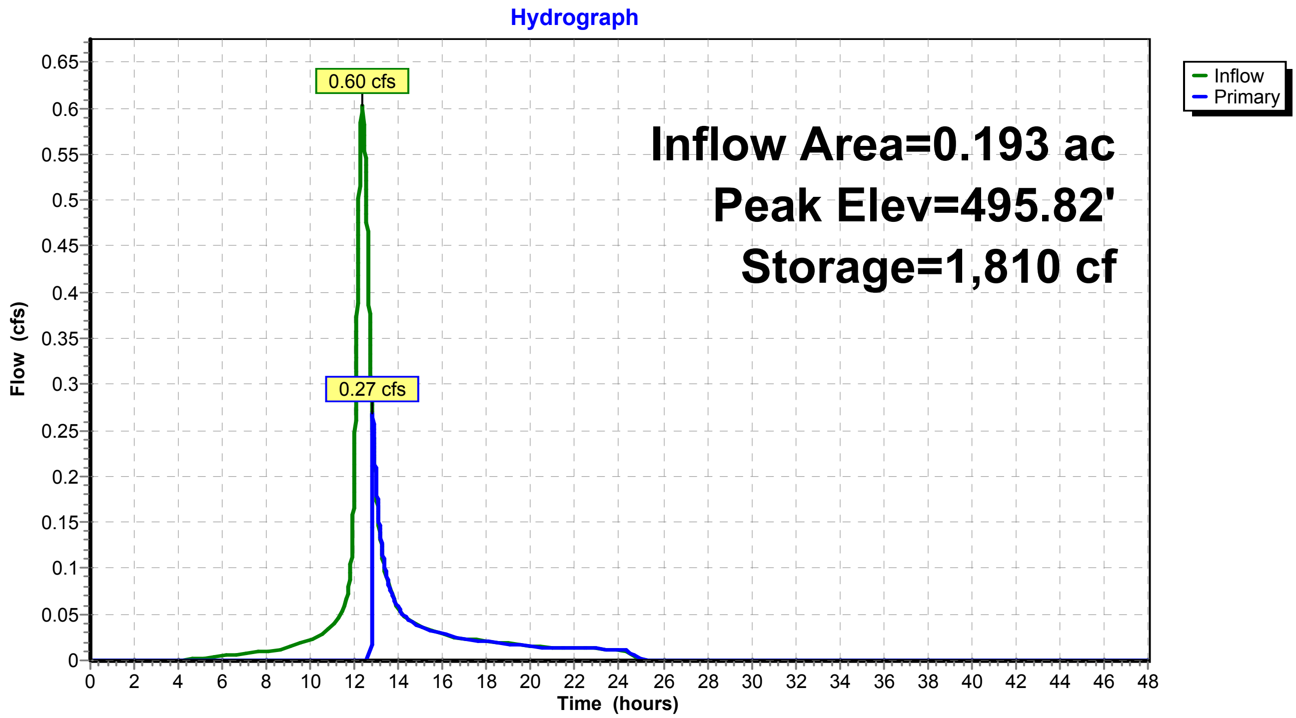
Volume	Invert	Avail.Storage	Storage Description
#1	494.31'	2,730 cf	**Stone Pad Void Storage (Prismatic)** Listed below 6,825 cf Overall x 40.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
494.31	0	0	0
494.81	2,020	505	505
495.31	4,610	1,658	2,163
495.81	4,680	2,323	4,485
496.31	4,680	2,340	6,825

Device	Routing	Invert	Outlet Devices
#1	Primary	495.81'	**90.0' long x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=0.18 cfs @ 12.81 hrs HW=495.82' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Weir Controls 0.18 cfs @ 0.2 fps)

Pond 12P: MLV PAD

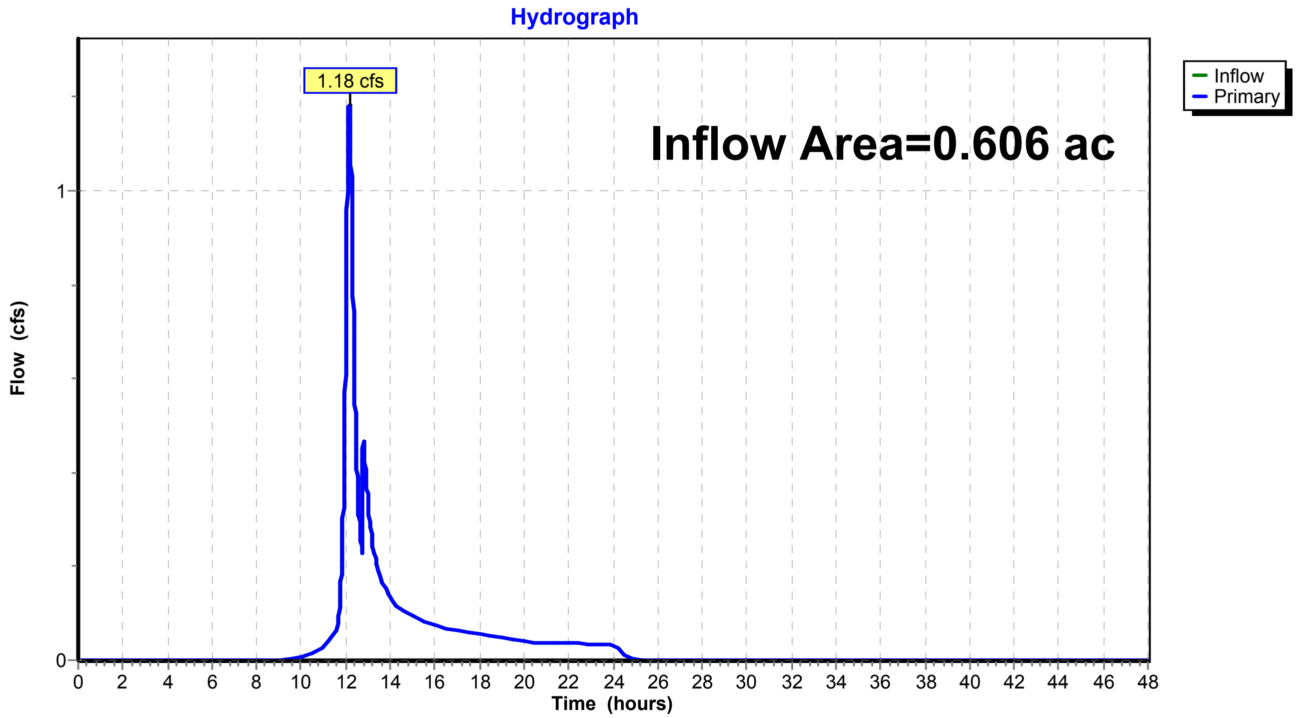


Summary for Link 6L: Proposed Conditions

Inflow Area =	0.606 ac, Inflow Depth = 2.50" for 25-Year event	
Inflow =	1.18 cfs @ 12.16 hrs, Volume=	0.126 af
Primary =	1.18 cfs @ 12.16 hrs, Volume=	0.126 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 6L: Proposed Conditions



Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment4S: OFFSITE DA Runoff Area=17,975 sf Runoff Depth=3.56"
Flow Length=379' Tc=22.6 min CN=73 Runoff=1.52 cfs 0.122 af

Subcatchment5S: DA TO MLV PAD Runoff Area=8,415 sf Runoff Depth=5.39"
Flow Length=199' Tc=40.0 min CN=90 Runoff=0.72 cfs 0.087 af

Pond 12P: MLV PAD Peak Elev=495.83' Storage=1,827 cf Inflow=0.72 cfs 0.087 af
Outflow=0.55 cfs 0.046 af

Link 6L: Proposed Conditions Inflow=1.52 cfs 0.168 af
Primary=1.52 cfs 0.168 af

Total Runoff Area = 0.606 ac Runoff Volume = 0.209 af Average Runoff Depth = 4.14"

Summary for Subcatchment 4S: OFFSITE DA

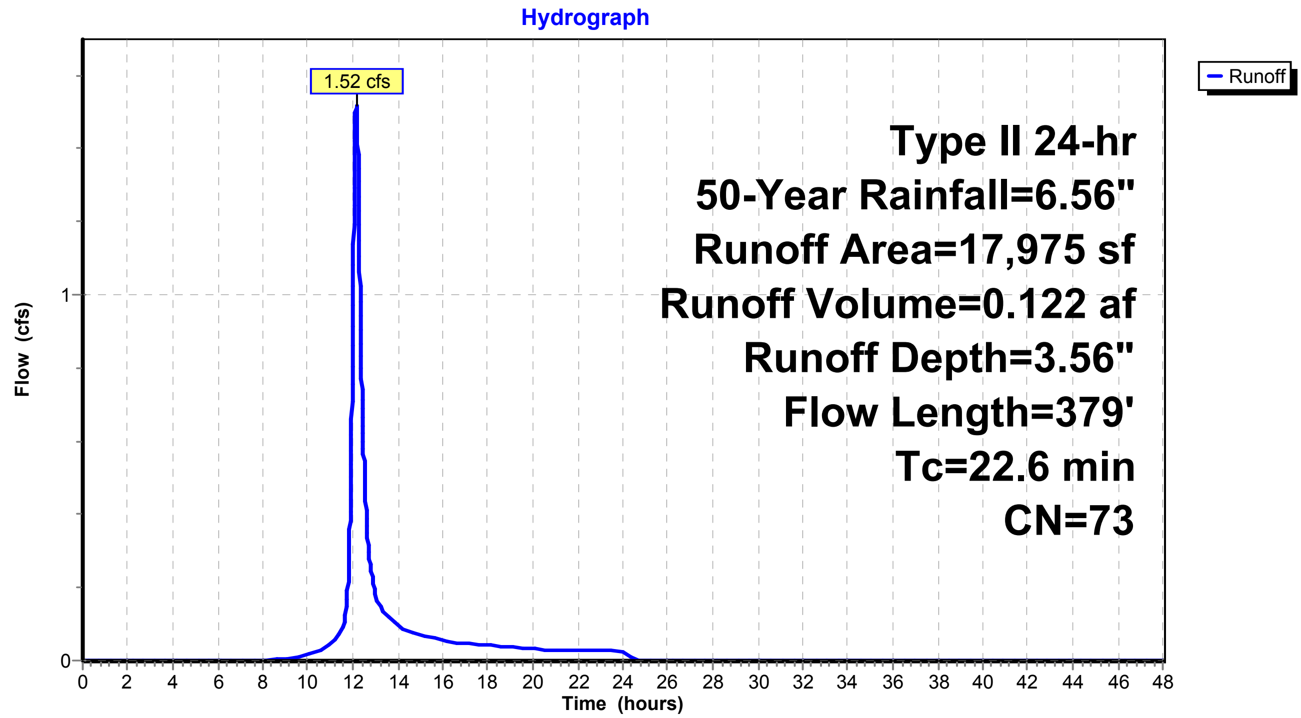
Runoff = 1.52 cfs @ 12.16 hrs, Volume= 0.122 af, Depth= 3.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 50-Year Rainfall=6.56"

	Area (sf)	CN	Description
*	1,308	98	Paved Road, HSG C
	16,667	71	Meadow, non-grazed, HSG C
	0	70	Woods, Good, HSG C
	17,975	73	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	15	0.0500	1.3		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.09"
5.2	39	0.0400	0.1		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.09"
10.3	46	0.0100	0.1		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.09"
5.6	166	0.0050	0.5		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
1.3	113	0.0400	1.4		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
22.6	379	Total			

Subcatchment 4S: OFFSITE DA



Summary for Subcatchment 5S: DA TO MLV PAD

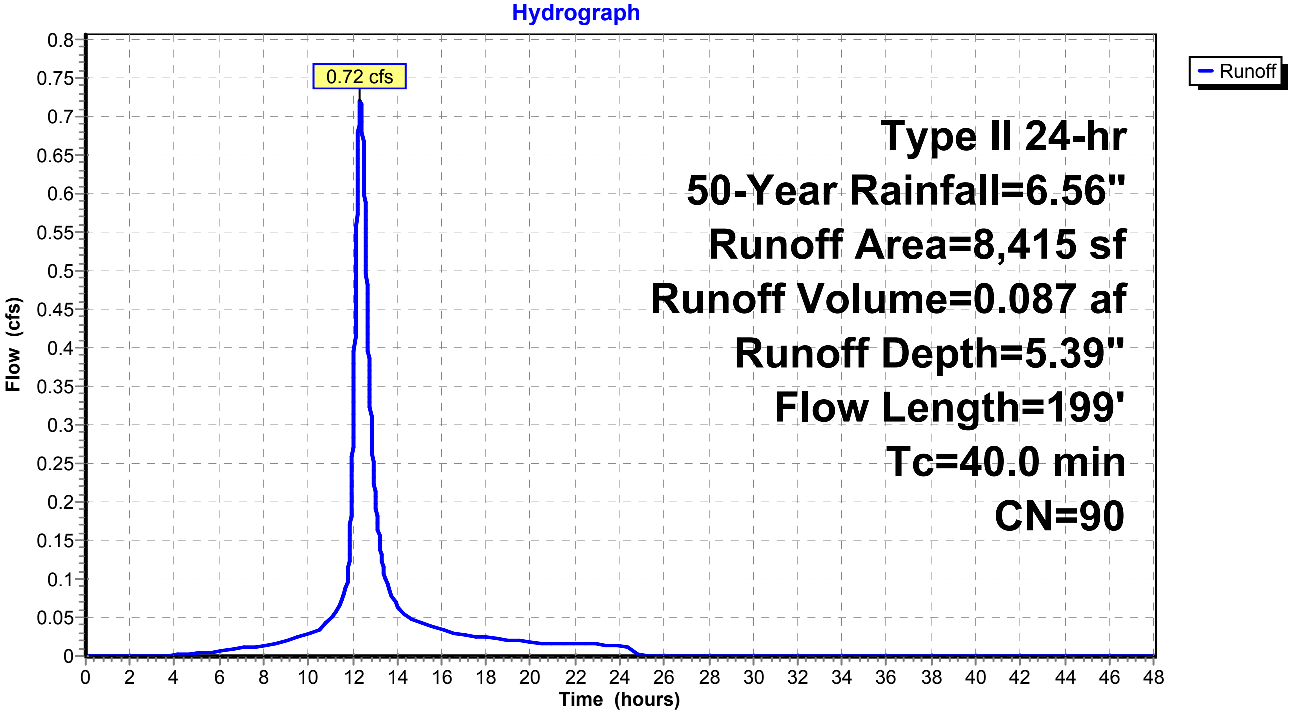
Runoff = 0.72 cfs @ 12.35 hrs, Volume= 0.087 af, Depth= 5.39"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 50-Year Rainfall=6.56"

	Area (sf)	CN	Description
*	4,680	98	Stone Pad, HSG C
	1,295	89	Gravel roads, HSG C
	2,054	71	Meadow, non-grazed, HSG C
	386	98	Paved parking, HSG C
	8,415	90	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	11	0.0200	0.9		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.09"
0.3	15	0.0200	0.9		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.09"
37.8	74	0.0010	0.0		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.09"
0.5	6	0.0010	0.2		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
1.2	93	0.0070	1.3		**Shallow Concentrated Flow, SC2** Unpaved Kv= 16.1 fps
40.0	199	Total			

Subcatchment 5S: DA TO MLV PAD



Summary for Pond 12P: MLV PAD

Inflow Area = 0.193 ac, Inflow Depth = 5.39" for 50-Year event
Inflow = 0.72 cfs @ 12.35 hrs, Volume= 0.087 af
Outflow = 0.55 cfs @ 12.58 hrs, Volume= 0.046 af, Atten= 24%, Lag= 13.6 min
Primary = 0.55 cfs @ 12.58 hrs, Volume= 0.046 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 495.83' @ 12.58 hrs Surf.Area= 4,680 sf Storage= 1,827 cf

Plug-Flow detention time= 227.0 min calculated for 0.046 af (53% of inflow)
Center-of-Mass det. time= 111.2 min (921.3 - 810.0)

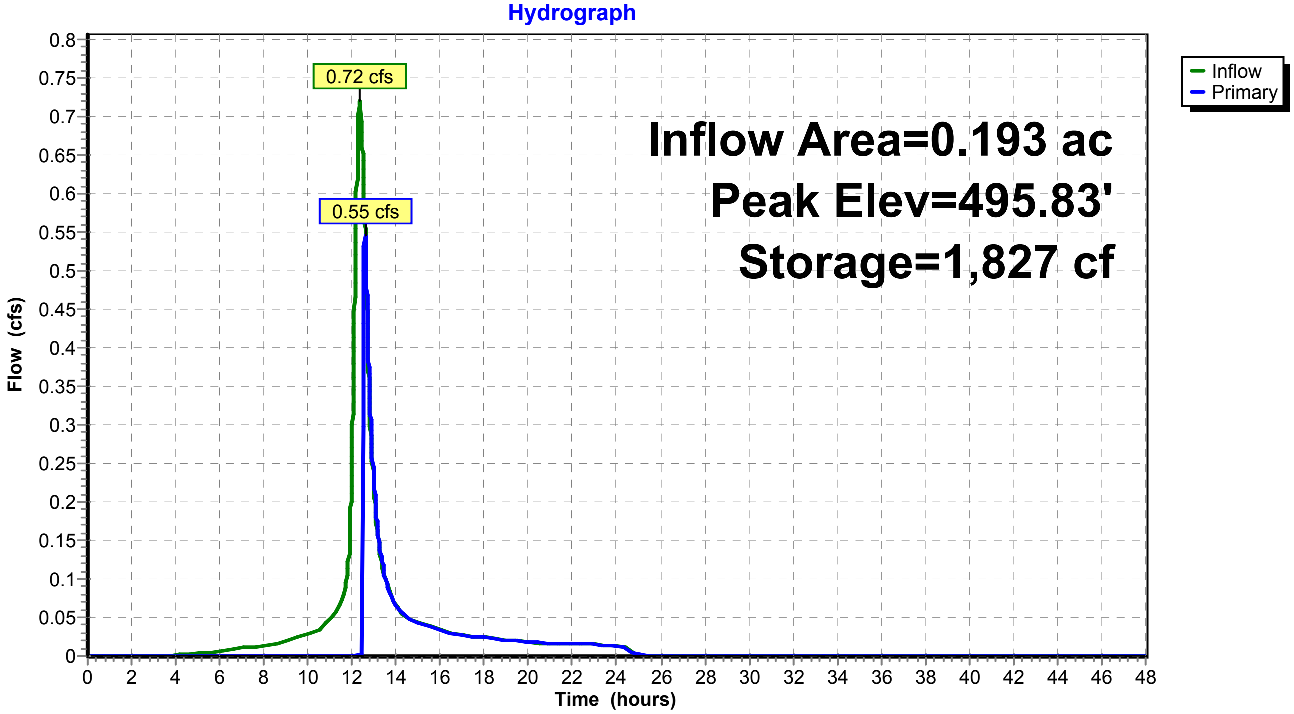
Volume	Invert	Avail.Storage	Storage Description
#1	494.31'	2,730 cf	**Stone Pad Void Storage (Prismatic)** Listed below 6,825 cf Overall x 40.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
494.31	0	0	0
494.81	2,020	505	505
495.31	4,610	1,658	2,163
495.81	4,680	2,323	4,485
496.31	4,680	2,340	6,825

Device	Routing	Invert	Outlet Devices
#1	Primary	495.81'	**90.0' long x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=0.51 cfs @ 12.58 hrs HW=495.83' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Weir Controls 0.51 cfs @ 0.3 fps)

Pond 12P: MLV PAD

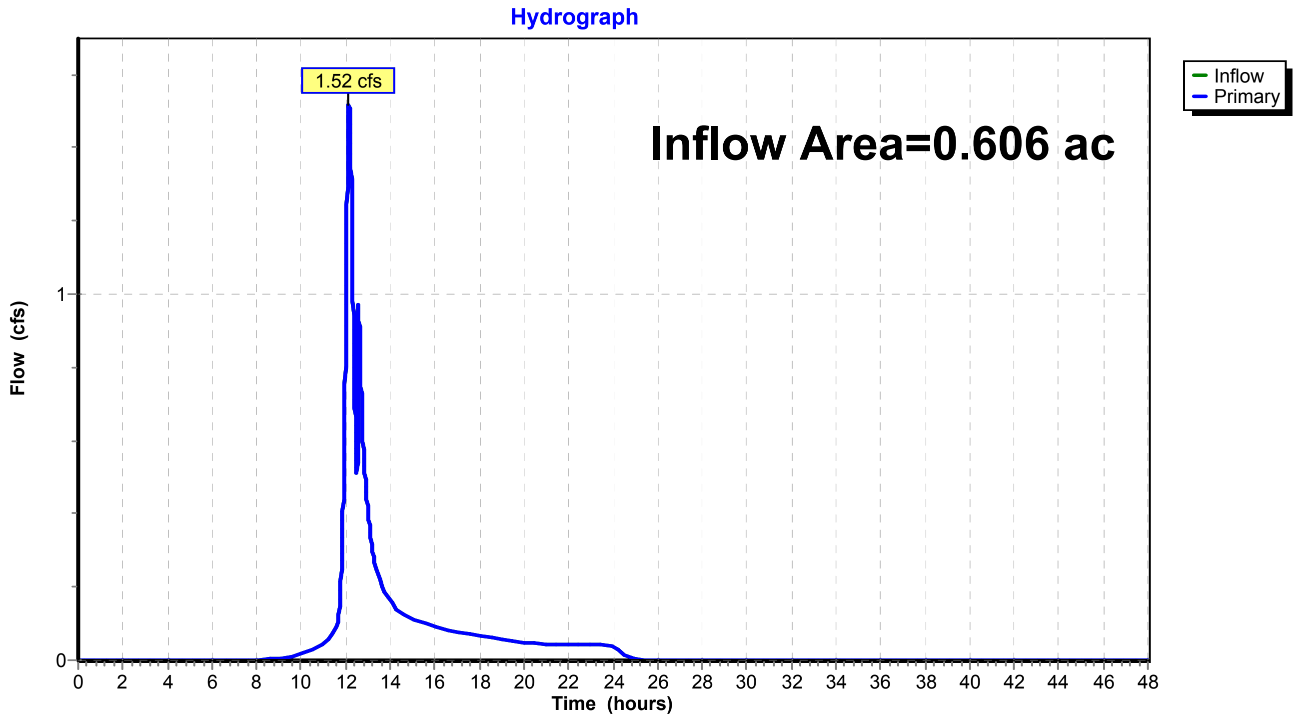


Summary for Link 6L: Proposed Conditions

Inflow Area =	0.606 ac, Inflow Depth = 3.33"	for 50-Year event
Inflow =	1.52 cfs @ 12.16 hrs, Volume=	0.168 af
Primary =	1.52 cfs @ 12.16 hrs, Volume=	0.168 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 6L: Proposed Conditions



Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 4S: OFFSITE DA Runoff Area=17,975 sf Runoff Depth=4.48"
Flow Length=379' Tc=22.6 min CN=73 Runoff=1.92 cfs 0.154 af

Subcatchment 5S: DA TO MLV PAD Runoff Area=8,415 sf Runoff Depth=6.44"
Flow Length=199' Tc=40.0 min CN=90 Runoff=0.85 cfs 0.104 af

Pond 12P: MLV PAD Peak Elev=495.83' Storage=1,838 cf Inflow=0.85 cfs 0.104 af
Outflow=0.81 cfs 0.063 af

Link 6L: Proposed Conditions Inflow=1.92 cfs 0.217 af
Primary=1.92 cfs 0.217 af

Total Runoff Area = 0.606 ac Runoff Volume = 0.258 af Average Runoff Depth = 5.11"

Summary for Subcatchment 4S: OFFSITE DA

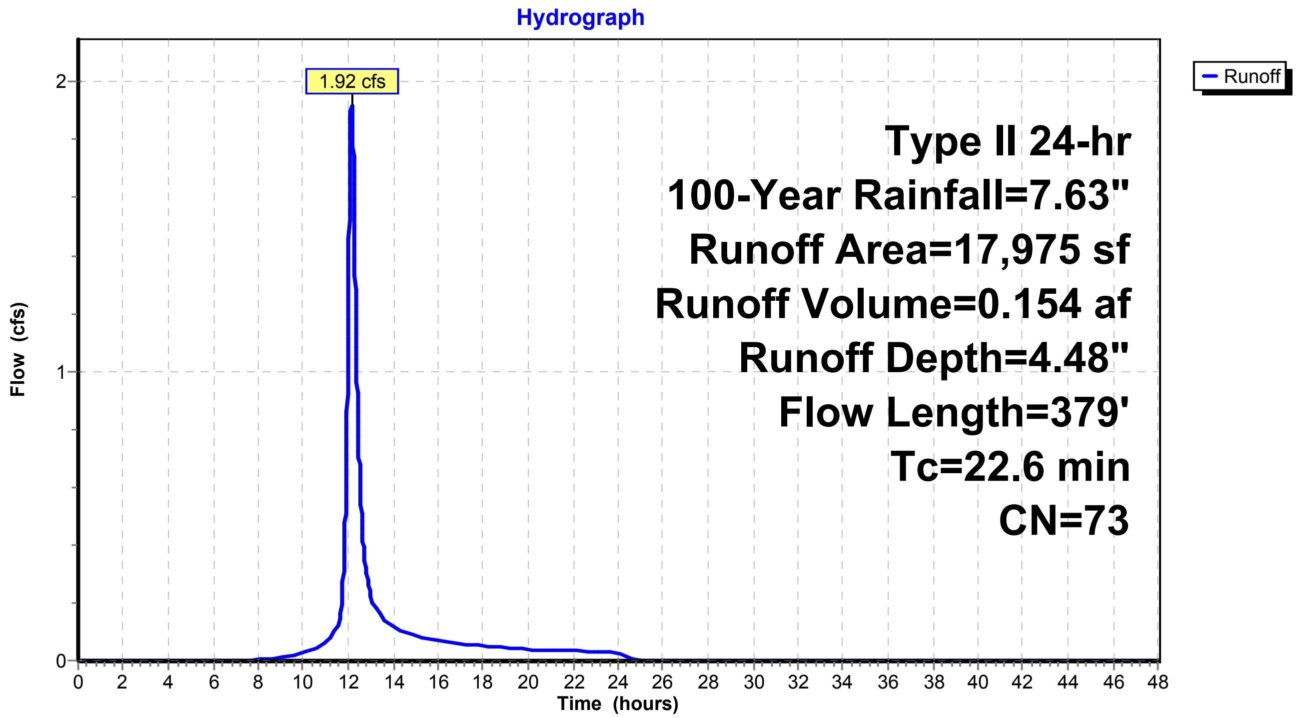
Runoff = 1.92 cfs @ 12.15 hrs, Volume= 0.154 af, Depth= 4.48"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Year Rainfall=7.63"

	Area (sf)	CN	Description
*	1,308	98	Paved Road, HSG C
	16,667	71	Meadow, non-grazed, HSG C
	0	70	Woods, Good, HSG C
	17,975	73	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	15	0.0500	1.3		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.09"
5.2	39	0.0400	0.1		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.09"
10.3	46	0.0100	0.1		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.09"
5.6	166	0.0050	0.5		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
1.3	113	0.0400	1.4		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
22.6	379	Total			

Subcatchment 4S: OFFSITE DA



Summary for Subcatchment 5S: DA TO MLV PAD

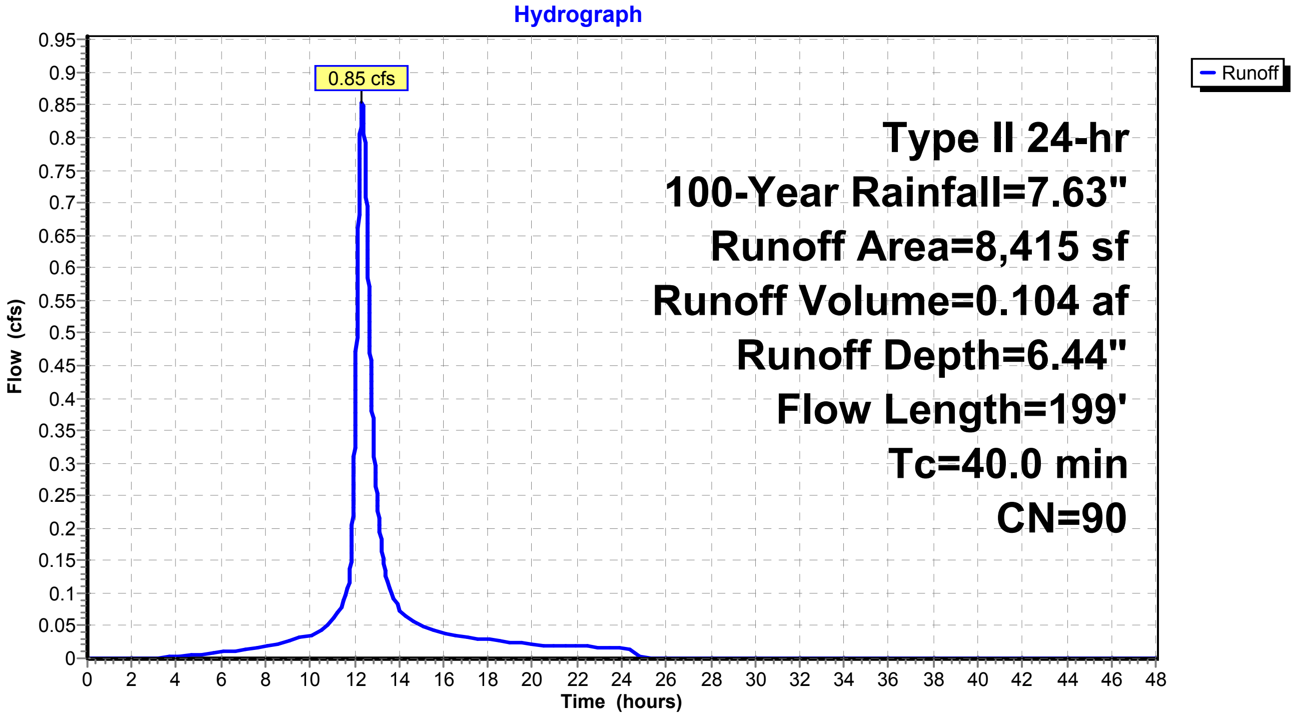
Runoff = 0.85 cfs @ 12.35 hrs, Volume= 0.104 af, Depth= 6.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Year Rainfall=7.63"

	Area (sf)	CN	Description
*	4,680	98	Stone Pad, HSG C
	1,295	89	Gravel roads, HSG C
	2,054	71	Meadow, non-grazed, HSG C
	386	98	Paved parking, HSG C
	8,415	90	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	11	0.0200	0.9		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.09"
0.3	15	0.0200	0.9		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.09"
37.8	74	0.0010	0.0		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.09"
0.5	6	0.0010	0.2		**Shallow Concentrated Flow, SC1** Short Grass Pasture Kv= 7.0 fps
1.2	93	0.0070	1.3		**Shallow Concentrated Flow, SC2** Unpaved Kv= 16.1 fps
40.0	199	Total			

Subcatchment 5S: DA TO MLV PAD



Summary for Pond 12P: MLV PAD

Inflow Area = 0.193 ac, Inflow Depth = 6.44" for 100-Year event
Inflow = 0.85 cfs @ 12.35 hrs, Volume= 0.104 af
Outflow = 0.81 cfs @ 12.44 hrs, Volume= 0.063 af, Atten= 5%, Lag= 5.2 min
Primary = 0.81 cfs @ 12.44 hrs, Volume= 0.063 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 495.83' @ 12.44 hrs Surf.Area= 4,680 sf Storage= 1,838 cf

Plug-Flow detention time= 198.0 min calculated for 0.063 af (60% of inflow)
Center-of-Mass det. time= 90.6 min (896.0 - 805.4)

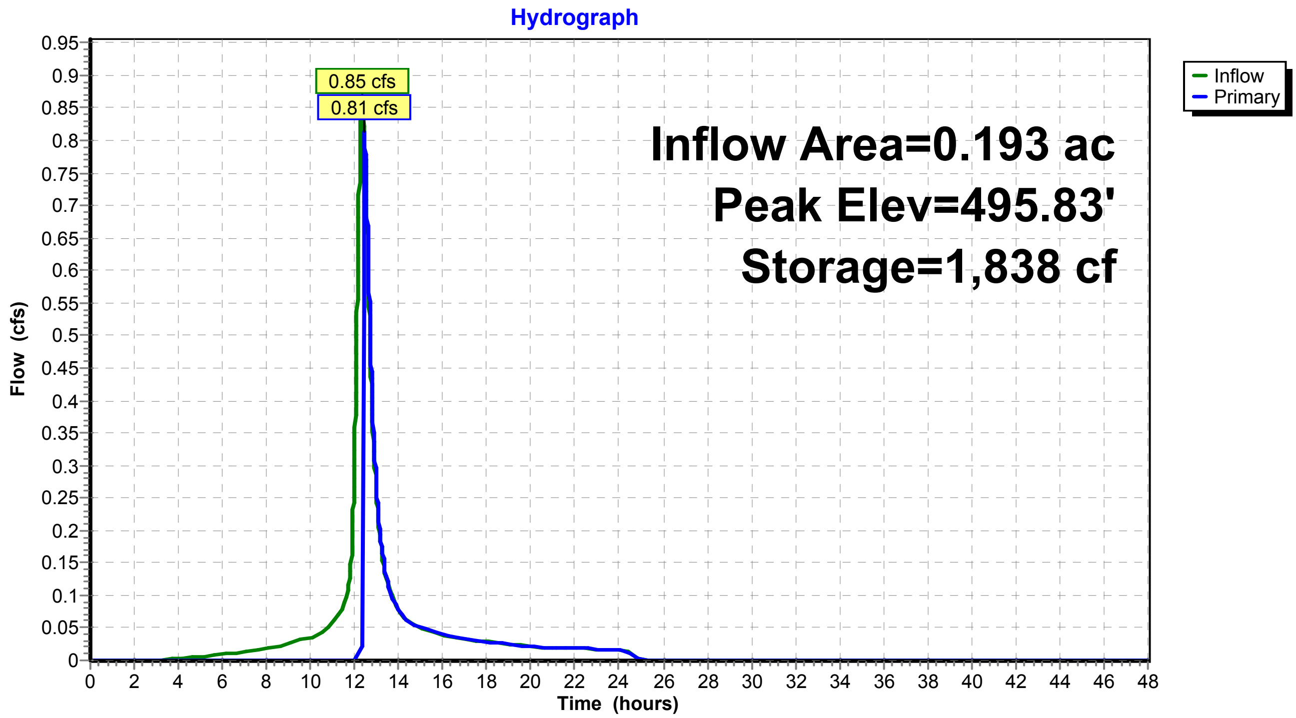
Volume	Invert	Avail.Storage	Storage Description
#1	494.31'	2,730 cf	**Stone Pad Void Storage (Prismatic)** Listed below 6,825 cf Overall x 40.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
494.31	0	0	0
494.81	2,020	505	505
495.31	4,610	1,658	2,163
495.81	4,680	2,323	4,485
496.31	4,680	2,340	6,825

Device	Routing	Invert	Outlet Devices
#1	Primary	495.81'	**90.0' long x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=0.78 cfs @ 12.44 hrs HW=495.83' (Free Discharge)
↑**1=Broad-Crested Rectangular Weir** (Weir Controls 0.78 cfs @ 0.4 fps)

Pond 12P: MLV PAD

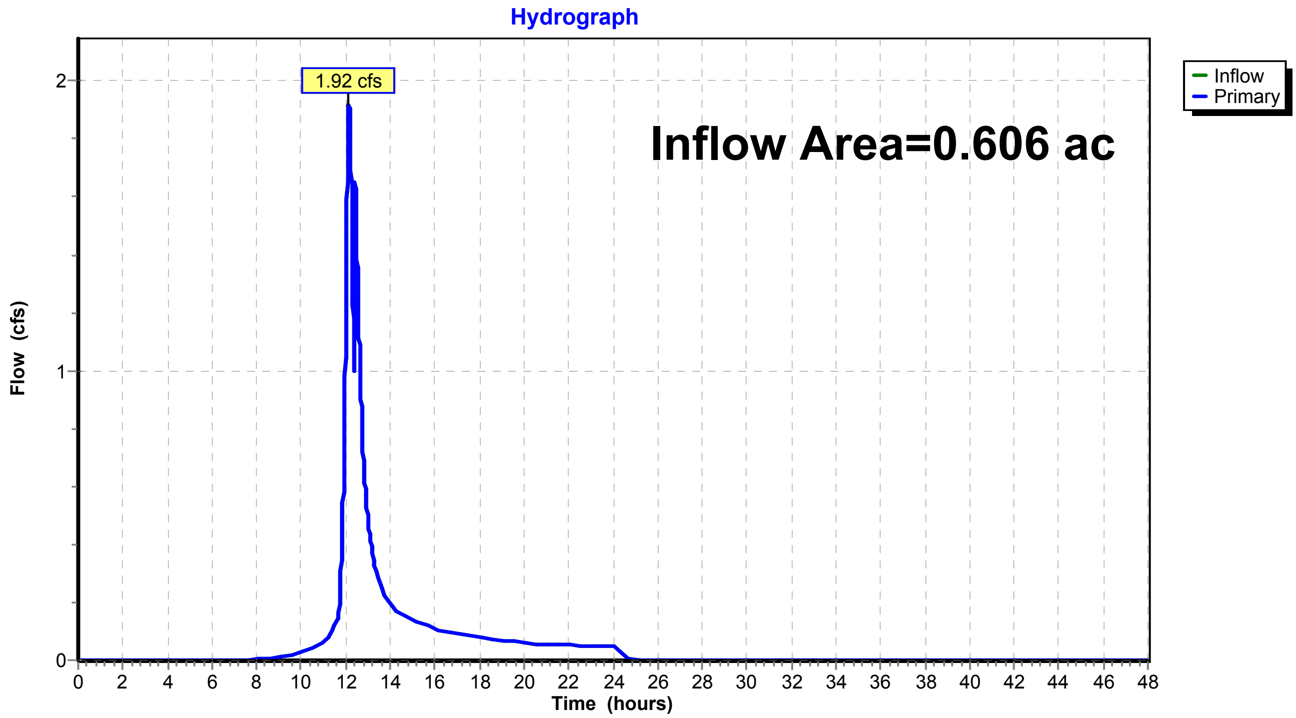


Summary for Link 6L: Proposed Conditions

Inflow Area = 0.606 ac, Inflow Depth = 4.29" for 100-Year event
Inflow = 1.92 cfs @ 12.15 hrs, Volume= 0.217 af
Primary = 1.92 cfs @ 12.15 hrs, Volume= 0.217 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

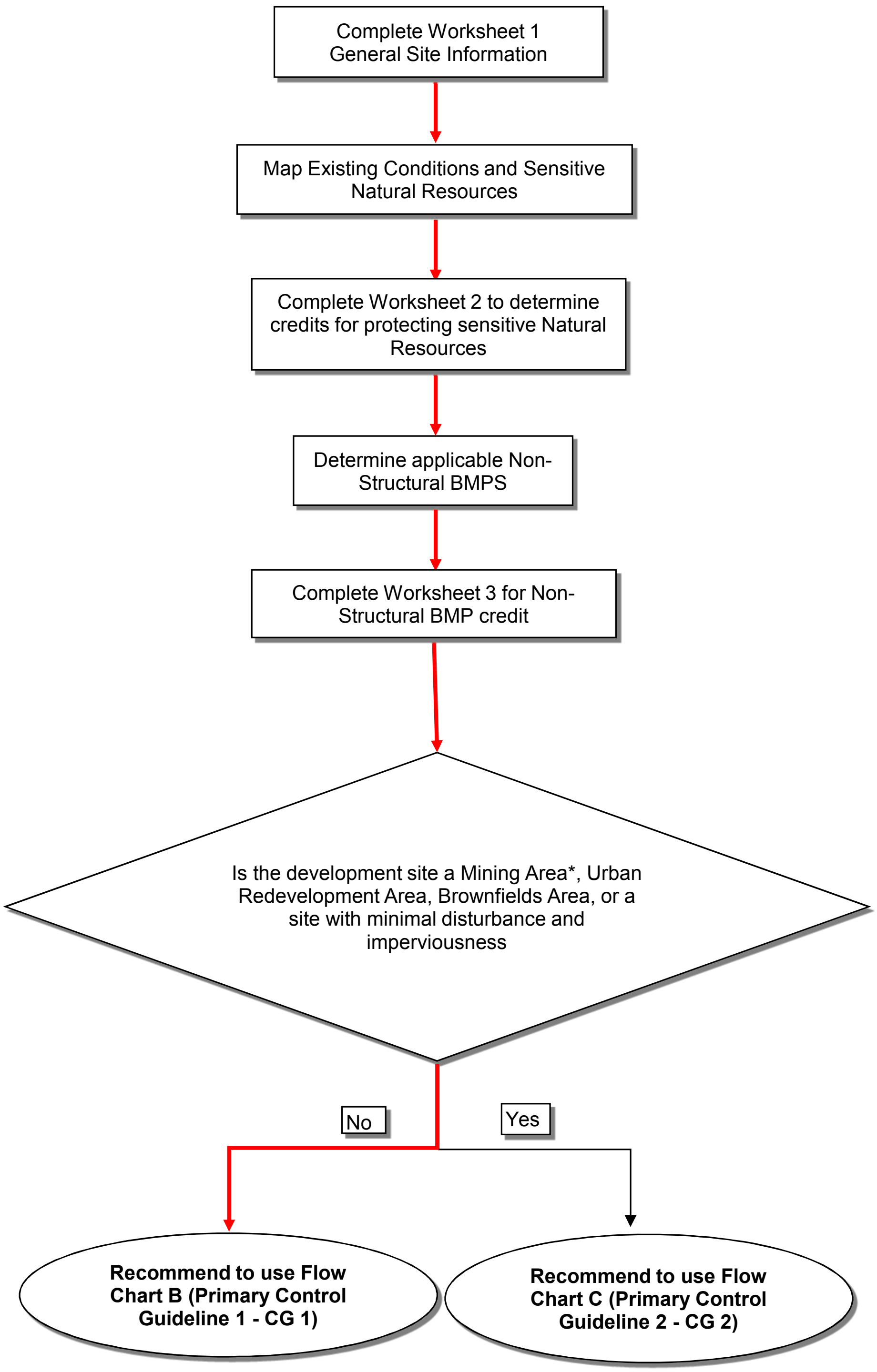
Link 6L: Proposed Conditions



Q.5 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: 20-Sep-16

Project Name: Atlantic Sunrise Pipeline AR-LE-050.1.1

Municipality: Union Township

County: Lebanon

Total Area (acres): 0.79

Major River Basin: Susquehanna

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

Watershed: Swatara Creek

Sub-Basin: Lower Susquehanna

Nearest Surface Water(s) to Receive Runoff: Forge Creek

Chapter 93 - Designated Water Use: WWF, MF

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

Impaired according to Chapter 303(d) List? Yes [X] No [ ]

http://www.dep.state.pa.us/dep/deputate/watermgt/wqp/wqstandards/303d-Report.htm

List Causes of Impairment: Agriculture (Siltation and Flow Alterations)

Is project subject to, or part of:

Municipal Separate Storm Sewer System (MS4) Requirements? Yes [ ] No [X]

http://www.dep.state.pa.us/dep/deputate/watermgt/wc/Subjects/StormwaterManagement/GeneralPermits/default.htm

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

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

Approved Act 167 Plan? Yes [ ] No [X]

http://www.dep.state.pa.us/dep/deputate/watermgt/wc/Subjects/StormwaterManagement/Approved_1.html

Existing River Conservation Plan? Yes [X] No [ ]

http://www.dcnr.state.pa.us/brc/rivers/riversconservation/planningprojects/

Worksheet 2. Sensitive Natural Resources

INSTRUCTIONS:

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

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

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

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

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

EXISTING NATURAL SENSITIVE RESOURCE	MAPPED? yes/no/n/a	TOTAL AREA (Ac.)	PROTECTED AREA (Ac.)
Waterbodies	N/A		
Floodplains	N/A		
Riparian Areas	N/A		
Wetlands	N/A		
Woodlands	Y	0.07	0.00
Natural Drainage Ways	N/A		
Steep Slopes, 15% - 25%	N/A		
Steep Slopes, over 25%	N/A		
Other:			
Other:			
TOTAL EXISTING:		0.07	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
0.79	-	0	=	0.79

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

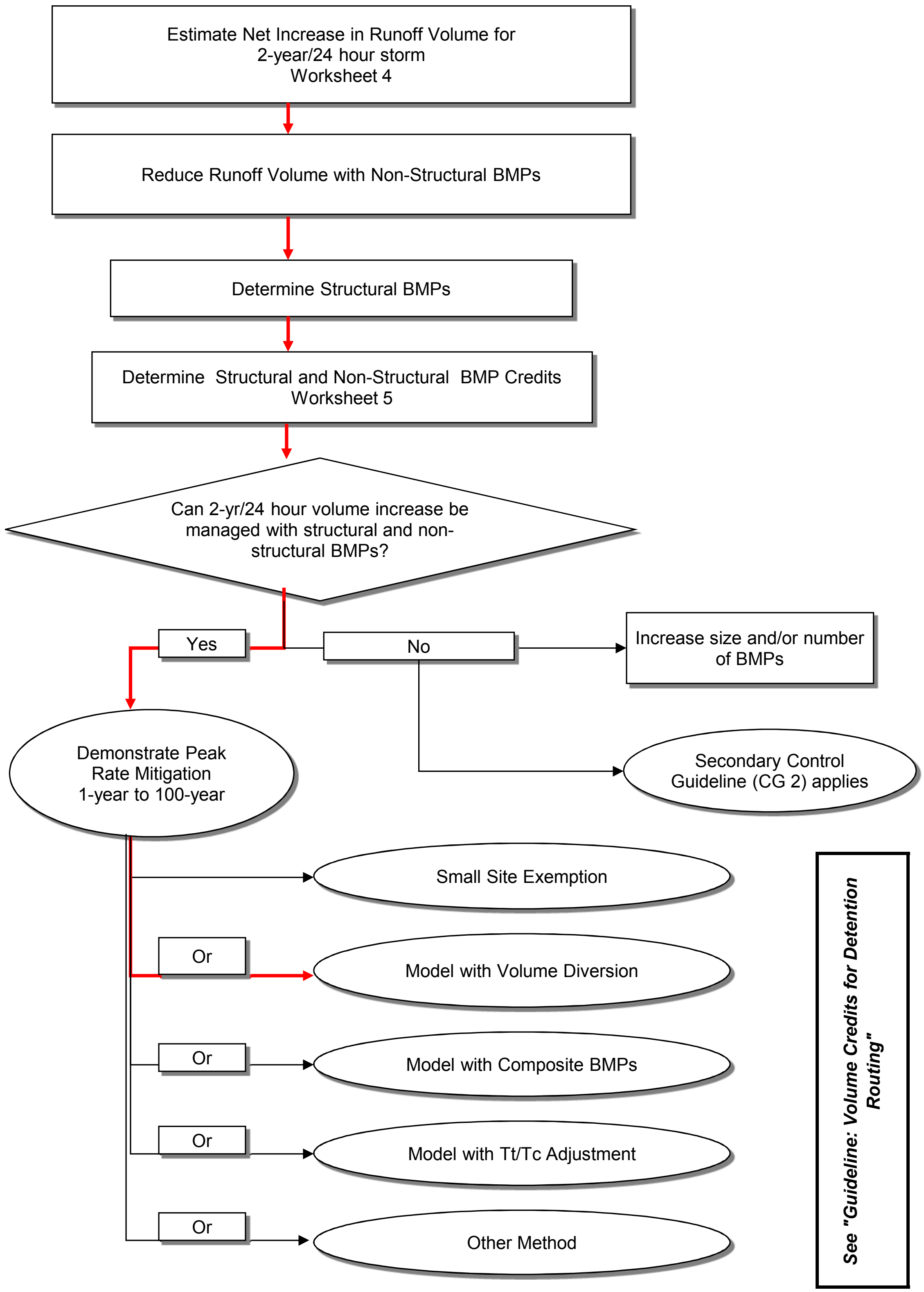
For all other disconnected non-roof areas

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-LE-050.1.1**

2-Year Rainfall: 3.09 **in**

Total Site Area: 0.79 **acres**
Protected Site Area: 0 **acres**
Managed Area 0.79 **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	-	0.000	98	0.20	0.04	2.86	-
"Meadow"[3]	C	-	0.000	71	4.08	0.82	0.81	-
Meadow	C	31,431	0.722	71	4.08	0.82	0.81	2,129
Woods	C	3,129	0.072	70	4.29	0.86	0.76	199
TOTAL:		34,560	0.793					2,129

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	-	0.000	98	0.20	0.04	2.86	-
Meadow	C	28,585	0.656	71	4.08	0.82	0.81	1,936
Gravel Rd	C	1,295	0.030	89	1.24	0.25	1.98	214
Stone Pad	C	4,680	0.107	98	0.20	0.04	2.86	1,115
Woods	C	-	0.000	70	4.29	0.86	0.76	-
TOTAL:		34,560	0.793					3,264

2-Year Volume Increase (ft^3)	**1,135**

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

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

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

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

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

WORKSHEET 5. STRUCTURAL BMP VOLUME CREDITS

PROJECT: Atlantic Sunrise Pipeline AR-LE-050.1.1
SUB-BASIN: Lower Susquehanna

Required Control Volume (ft^3) - *from Worksheet 4*:		1,135
Non-structural Volume Credit (ft^3) - *from Worksheet 3*:	-	0
Structural Volume Reqmt (ft^3)		1,135

(Required Control Volume minus Non-structural Credit)

	Proposed BMP	**Area (ft^2)**	**Volume Reduction Permanently Removed (ft^3)**
6.4.1	Porous Pavement		
6.4.2	Infiltration Basin		
6.4.3	Infiltration Bed		
6.4.4	Infiltration Trench		
6.4.5	Rain Garden/Bioretention		
6.4.6	Dry Well / Seepage Pit		
6.4.7	Constructed Filter		
6.4.8	Vegetated Swale		
6.4.9	Vegetated Filter Strip		
6.4.10	Berm		
6.5.1	Vegetated Roof		
6.5.2	Capture and Re-use		
6.6.1	Constructed Wetlands		
6.6.2	Wet Pond / Retention Basin		
6.6.3	Dry Extended Detention Basin		
6.6.4	Water Quality Filters		
6.7.1	Riparian Buffer Restoration		
6.7.2	Landscape Restoration / Reforestation		
6.7.3	Soil Amendment		
6.8.1	Level Spreader		
6.8.2	Special Storage Areas		
Other	Storage in 24" stone MLV Pad		2,730

Total Structural Volume (ft^3):	2,730
Structural Volume Requirement (ft^3):	1,135
DIFFERENCE	1,595

MLV Pad Infiltration Calculations Summary		
Average Measured Infiltration Rate for MLV Pad	***1.03***	***in/hr***
Factor of Safety	***2.00***	
Design Infiltration Rate	***0.52***	***in/hr***
Dewatering Time for top 6 inches of MLV Pad	***11.65***	***hours***
Depth of AASHTO #57 Section of MLV Pad	***18***	***inches***
Dewatering Time for AASHTO #57 Section of MLV Pad	***34.95***	***hours***
Total Dewatering Time for MLV Pad	***46.60***	***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		

Q.6 Infiltration Information

a. Field Observation Report

Field Observation Report

Project Number:	14C4909 - A
Project Name:	Atlantic Sunrise Project – **AR-LE-050.1.1**
Date of Field Visit:	September 2, 2016
Weather Conditions:	Sunny
Temperature:	Approx. 67-75°F
Prepared By:	Krystal Bealing, CPSS and Jon Libbon

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

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

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

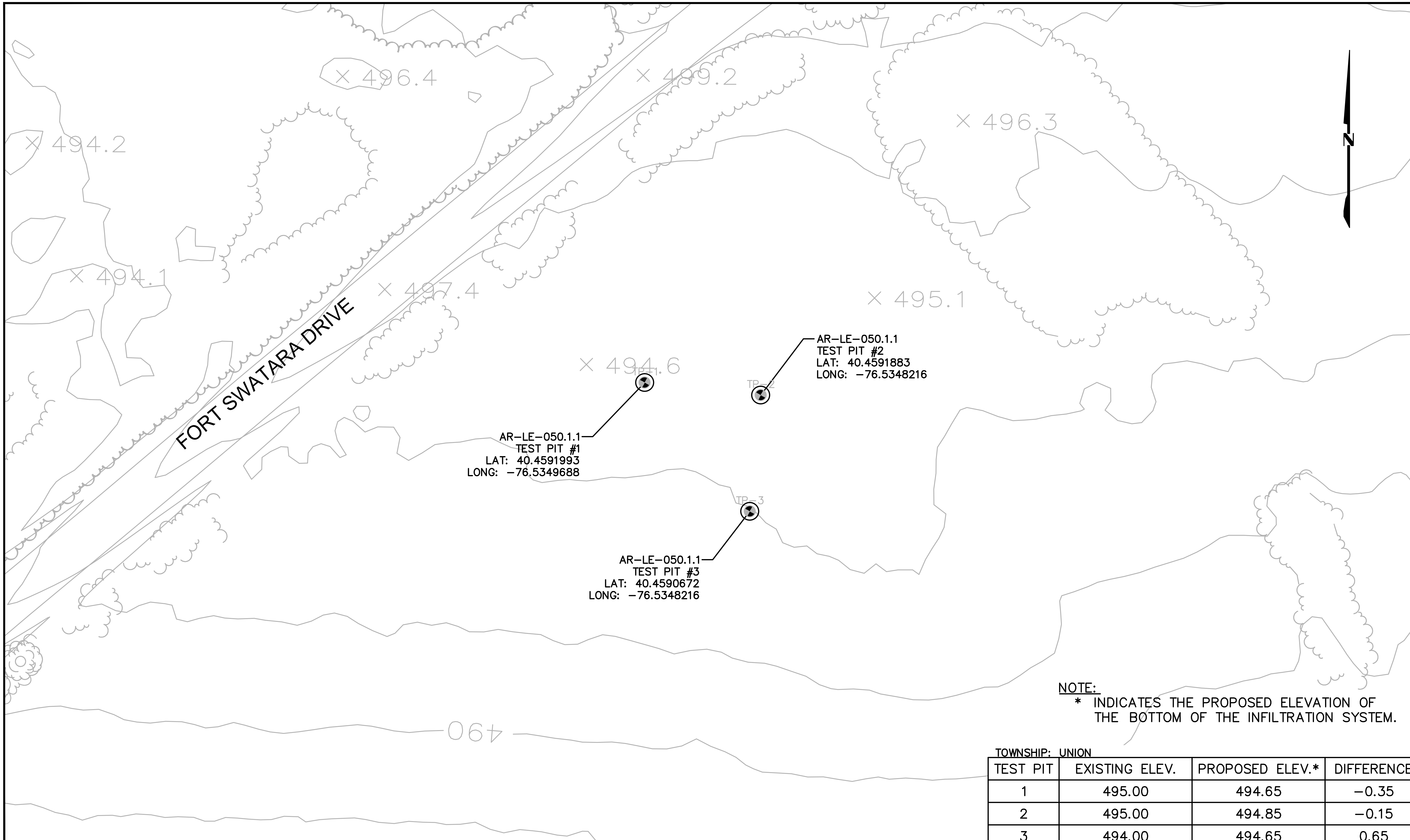
Three soil pits were excavated by backhoe and described by a Certified Professional Soil Scientist (CPSS) to varying depths utilizing the U.S. Department of Agriculture Natural Resources Conservation Service (USDA-NRCS) *Field Book for Describing and Sampling Soils, Version 3.0* and *Keys to Soil Taxonomy,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

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

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

Pit Number	Pit Location (decimal degrees)	Observed Limiting Layer	Infiltration Test Depth (inches below the surface)	Infiltration Rate (inches/hour)
1	40.45920, -76.53497	9 inches, Seasonal High Water Table	0	1.250
2	40.45919, -76.53482	Surface, Seasonal High Water Table	0	0.094
3	40.45908, -76.53482	9 inches, Seasonal High Water Table	0	1.750

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



NOTE:
* INDICATES THE PROPOSED ELEVATION OF THE BOTTOM OF THE INFILTRATION SYSTEM.

TOWNSHIP: UNION

TEST PIT	EXISTING ELEV.	PROPOSED ELEV.*	DIFFERENCE
1	495.00	494.65	-0.35
2	495.00	494.85	-0.15
3	494.00	494.65	0.65

LANDOWNER: PROPST

AR-LE-050.1.1 INFILTRATION TESTING LOCATIONS

GRAPHIC SCALE

40 20 0 40

SCALE IN FEET

Soil Profile Log

Project 14C4909-A Atlantic Sunrise Project - AR-LE-050.1.1
Test Pit # 1
Name Krystal Bealing, CPSS
Date September 2, 2016
Weather Sunny, 67-75°F
Equipment Mini Excavator

Elevation 495.00 AMSL
Soil Type MagB - Markes silt loam, 3-8% slopes
Geology Hamburg sequence rocks (Ordovician)
Landscape Position/Slope Footslope, 0-1% slope
Land Use Hayfield
Additional Notes

Horizon	Depth (inches)	Texture	Coarse Fragments	Matrix Color	Color Patterns	Redoximorphic Features	Structure/Grade	Consistency	Boundary Strike/Dip	Roots/ Pores	Depth to Bedrock	Depth to Water
Ap	0-9	Silt Loam	10% Channery	10YR 4/3	-	-	Granular, 1	Friable	Gradual and Smooth	>20% roots	-	-
Btg	9-17	Silty Clay Loam	20% Channery	2.5YR 4/2	-	5% 2.5Y 6/1 10% 7.5YR 5/8	Subangular Blocky, 2	Firm	Gradual and Irregular	2-20% roots	-	-
Cg	17-22	Silty Clay Loam	70% Channery	2.5Y 6/1	-	15% 7.5YR 5/8	Massive	Firm	Abrupt and Irregular	<2% roots	22	-
R	22-54+	-	-	-	-	-	-	-	-	-	-	54*

Comments: Limiting layer observed at 9 inches as seasonal high water table due to a low chroma matrix and the presence of redoximorphic features.
Observed horizon boundary topography irregularities throughout the profile; please refer to the photographs.
*Observed water at the base of the pit, though no seeps were observed.

Soil Profile Log

Project 14C4909-A Atlantic Sunrise Project - AR-LE-050.1.1
Test Pit # 2
Name Krystal Bealing, CPSS
Date September 2, 2016
Weather Sunny, 67-75°F
Equipment Mini Excavator

Elevation 495.00 AMSL
Soil Type MagB - Markes silt loam, 3-8% slopes
Geology Hamburg sequence rocks (Ordovician)
Landscape Position/Slope Footslope, 0-1% slope
Land Use Hayfield
Additional Notes

Horizon	Depth (inches)	Texture	Coarse Fragments	Matrix Color	Color Patterns	Redoximorphic Features	Structure/Grade	Consistency	Boundary Strike/Dip	Roots/ Pores	Depth to Bedrock	Depth to Water
Ap	0-10	Silt Loam	10% Channery	10YR 4/3	-	5% 7.5YR 5/6	Granular, 1	Friable	Clear and Smooth	>20% roots	-	-
Btg1	10-14	Silt Loam	15% Channery	2.5YR 4/2	-	10% 2.5Y 6/2 25% 7.5YR 5/8	Subangular Blocky, 2	Firm	Clear and Wavy	2-20% roots	-	-
Btg2	14-20	Silty Clay Loam	40% Channery	2.5Y 6/1	-	30% 7.5YR 5/8	Subangular Blocky, 2	Firm	Clear and Wavy	2-20% roots	-	-
Cg	20-26	Silty Clay Loam	70% Channery	2.5Y 5/2	-	10% 5YR 4/6	Massive	Firm	Clear and Irregular	-	26	-
R	26-48+	-	-	-	-	-	-	-	-	-	-	-

Comments: Limiting layer observed at the surface as seasonal high water table due to the presence of redoximorphic features.

Soil Profile Log

Project 14C4909-A Atlantic Sunrise Project - AR-LE-050.1.1
Test Pit # 3
Name Krystal Bealing, CPSS
Date September 2, 2016
Weather Sunny, 67-75°F
Equipment Mini Excavator

Elevation 494.00 AMSL
Soil Type MagB - Markes silt loam, 3-8% slopes
Geology Hamburg sequence rocks (Ordovician)
Landscape Position/Slope Footslope, 0-1% slope
Land Use Hayfield
Additional Notes

Horizon	Depth (inches)	Texture	Coarse Fragments	Matrix Color	Color Patterns	Redoximorphic Features	Structure/ Grade	Consistency	Boundary Strike/Dip	Roots/ Pores	Depth to Bedrock	Depth to Water
Ap	0-9	Silt Loam	10% Channery	10YR 4/3	-	-	Granular, 1	Friable	Gradual and Smooth	>20% roots	-	-
AB	9-14	Silty Clay Loam	15% Channery	10YR 4/3	-	10% 5YR 5/8	Subangular Blocky, 2	Firm	Clear and Smooth	>20% roots	-	-
Btg	14-18	Silty Clay Loam	50% Channery	2.5YR 4/2	-	5% 2.5Y 6/2 5% 7.5YR 5/8	Subangular Blocky, 2	Firm	Clear and Wavy	2-20% roots	-	-
Cg	18-25	Silty Clay Loam	75% Channery	2.5Y 6/2	-	10% 5YR 4/6	Massive	Firm	Clear and Irregular	<2% roots	25	-
R	25-50+	-	-	-	-	-	-	-	-	-	-	-

Comments: Limiting layer observed at 9 inches as seasonal high water table due to the presence of redoximorphic features.

ATLANTIC SUNRISE PROJECT - AR-LE-050.1.1

SOIL INFILTRATION WORKSHEET - DOUBLE RING INFILTROMETER METHOD

Hole Number	Drop >2 inches after 30 minute presoak?[1]	Reading Interval (minutes)	Reading 1 (Inches of Drop)	Reading 2 (Inches of Drop)	Reading 3 (Inches of Drop)	Reading 4 (Inches of Drop)	Reading 5 (Inches of Drop)	Reading 6 (Inches of Drop)	Reading 7 (Inches of Drop)	Reading 8 (Inches of Drop)	Average Stabilized Reading[2] (Inches of Drop)	Infiltration Rate[3] (in/hr)	Comments
1	No	30	0.750	0.750	0.500	0.500					0.625	1.250	67-75°F, sunny. Test done at the surface.
2	No	30	0.063	0.063	0.063	0.000					0.047	0.094	67-75°F, sunny. Test done at the surface.
3	No	30	0.750	0.750	1.000	1.000					0.875	1.750	67-75°F, sunny. Test done at the surface.

[1]Inches of drop greater than 2 inches after the 2nd 30 minute presoak? Yes, use 10 minute interval; No, use 30 minute interval.

[2]Calculated as the average of the last four stabilized (less than 0.25-inch difference overall) readings, or an overall average in the case of eight unstabilized readings.

[3]Calculated as the average stabilized reading x 2 for 30 minute intervals; x 6 for 10 minute intervals.


View of Pit #1.


View of Pit #1.


View of Pit #2.


View of Pit #3.

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

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

Custom Soil Resource Report for
Lebanon County, Pennsylvania

April 17, 2016

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (http://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Soil Map

Map Scale: 1:814 if printed on A landscape (11" x 8.5") sheet.

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

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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

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

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

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

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

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

Soil Survey Area: Lebanon County, Pennsylvania
Survey Area Data: Version 10, Nov 16, 2015

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

Date(s) aerial images were photographed: Mar 26, 2011—Jul 2, 2011

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

Map Unit Legend

Lebanon County, Pennsylvania (PA075)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
MagB	Markes silt loam, 3 to 8 percent slopes	1.3	100.0%
Totals for Area of Interest		**1.3**	**100.0%**

Map Unit Descriptions

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

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

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

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

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

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

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

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

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

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

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

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

Lebanon County, Pennsylvania

MagB—Markes silt loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 1hxp0
Elevation: 300 to 1,400 feet
Mean annual precipitation: 35 to 50 inches
Mean annual air temperature: 44 to 57 degrees F
Frost-free period: 120 to 214 days
Farmland classification: Not prime farmland

Map Unit Composition

Markes and similar soils: 85 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Markes

Setting

Landform: Drainageways, depressions
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Side slope, head slope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Residuum weathered from shale and siltstone

Typical profile

H1 - 0 to 7 inches: silt loam
H2 - 7 to 15 inches: very channery silty clay loam
H3 - 15 to 31 inches: extremely channery silt loam
H4 - 31 to 35 inches: bedrock

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Natural drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: D

Minor Components

Comly

Percent of map unit: 7 percent

Brinkerton

Percent of map unit: 3 percent
Landform: Depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave

References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

National Research Council. 1995. Wetlands: Characteristics and boundaries.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577

Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580

Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.

United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374

United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf

Q.7 Off-Site Discharge Analysis

a. Adequacy of Off-Site Discharge

ACCESS ROAD: AR-LE-050.1.1- Adequacy of Off-Site Discharge

AR-LE-050.1.1 is a proposed permanent access road (PAR) located in Union Township, Lebanon County, Pennsylvania. The intent of this PAR is to provide permanent maintenance and operational access to the proposed Main Line Valve 07 (CS-MLV-07) located on the proposed 42" Central Penn Line South Pipeline. The road begins at Fort Swatara Drive and terminates at the MLV site at approximate mile post 56.8. The PAR is approximately 90 feet long and has an elevation change of approximately 2 feet.
The access road is planned to be located on an existing pasture with pasture land on all sides and wetlands to the east of the pasture land. The proposed improvements have been designed to have no anticipated impacts or changes to downhill properties as a result of construction the MLV site.

The proposed permanent access road and the MLV site has been designed to reduce overall disturbance to the maximum extent practicable. The PAR and MLV site has been constructed with stone rather than pavement to further help with keeping with the existing conditions. The proposed access road will maintain a minimal width of only 14 feet wide. The MLV site has also been design to minimum the footprint to the maximum extent practical for the operation and maintenance requirements.

As for any development, the road and MLV site has been designed to match or reduce peak stormwater runoff from the design areas to an off-site discharge point where stormwater runoff is conveyed. (See the enclosed Pre and Post drainage area maps and calculations in Appendix Q.3 and Q.4 for details). In the case of this design, we were able to achieve a reduced peek runoff for all storm events, as shown in the Pre-vs. Post- Construction Peak Rate of Flow Summary for The Study Point chart below. The reduction was achieved by utilizing the MLV pad as a retention area. This Stormwater BMP measures is used to slow down the stormwater runoff, infiltrate and release at a slower and reduced rate to existing land.

Pre- vs. Post-construction Peak Rate of Flow Summary			
Stormwater discharge rate for the design frequency storm (cfs)	Pre-construction	Post-construction	Net Change
1) 1-Year/24-Hour	0.26	0.22	(0.04)
2) 2-Year/24-Hour	0.43	0.36	(0.07)
3) 5-Year/24-Hour	0.72	0.60	(0.12)
4) 10-Year/24-Hour	1.00	0.82	(0.18)
5) 25-Year/24-Hour	1.46	1.18	(0.28)
6) 50-Year/24-Hour	1.90	1.52	(0.38)
7) 100-Year/24-Hour	2.41	1.92	(0.49)

The MLV pad is used as an infiltration area to slow down peak stormwater runnoff. The pad is a flat area constructed of a top layer of 6” of AASHTO #8 aggregate, on a non-woven geotextile fabric, and a bottom layer of 18” AASHTO #57 stone. This 18-inch-deep area will detain and infiltrate the foot print of the MLV pad, plus areas of the road and agricultural land around the pad to the north.

After being conveyed through the stormwater PCSM BMP’s above, the runoff of the post-construction site matches the pre-construction flow. From the MLV site, the runoff flows approximately 550 feet south until it outlets into Forge Creek (WW-T32-6001).

The flow path from the MLV site crosses the following soil types:
- Ho – Holly silt loam.
- MagB – Markes silt loam, 3 to 8 percent slopes.
- WeB – Weikert channery silt loam, 3 to 8 percent slopes.

The PADEP E&S Manual defines erosion resistant soils as soils having an erodibility “K” factor less than or equal to 0.37. The K factor for the soil types, according to the National Resources Conservation Service (NRCS) website http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx, crossed by the flow path are summarized below:
- Ho – 0.32
- MagB – 0.43
- WeB – 0.17

The post-construction runoff travels approximately 100 feet thru soils with an erodibility factor of greater than 0.37. Since the pre- and post-construction flow paths match, there is no concern that the construction of the MLV site have a negative impact on down slope properties.

In addition to the stormwater flow reduction and soil data above, the MLV pad has reduced the proposed stormwater velocity as it leaves the design points. The velocities at the discharge point is such that they are slower than 2 fps, as see in the Stormwater Velocity Rate Chart. Based on Table G.1 in the Pennsylvania DEP erosion and Sediment Pollution Control Program 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 that we are discharging too.

Stormwater Velocity Rate Chart for the design frequency storm (fps)	MLV Pad Velocities (fps)
1) 1-Year/24-Hour	0.00
2) 2-Year/24-Hour	0.00
3) 5-Year/24-Hour	0.00
4) 10-Year/24-Hour	0.10
5) 25-Year/24-Hour	0.20

6) 50-Year/24-Hour	0.30
7) 100-Year/24-Hour	0.40

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 PDEP E&S PCPM)

In conclusion, based on the designed measures discussed above, and the soil and velocity data provided for this MLV site and access road, there are no anticipated impacts or changes to downhill properties as a result of construction the MLV site.

Down Slope Property Owners:

- Rod Henning (PA-LE-175.300)

Q.8 Storage Volume Analysis

a. Storage Volume Analysis

ACCESS ROAD: LE-050.1.1 – Storage Volume Analysis

Stormwater detention is provided 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.

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-LE-050.1.1 is a low-side pad. Finally, the calculated storage volume was reduced by 60% to determine the available storage volume with 40% voids.

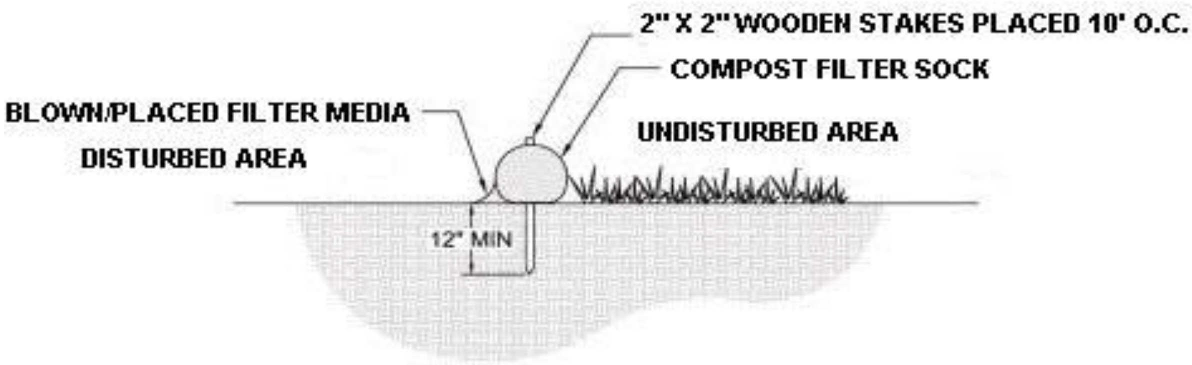
The detained stormwater will infiltrate the ground. The dewatering time for the stormwater detained in the void space of the MLV pad rock is provided at the bottom of Worksheet #5 included in Appendix Q.4.

Q.9 Sediment Barrier Table

a. E&S Worksheet 1

E&S WORKSHEET #1
Compost Filter Sock

PROJECT NAME: Atlantic Sunrise
LOCATION: AR-LE-050.1.1
PREPARED BY: EAW DATE: 10/21/16
CHECKED BY: BJP DATE: 10/21/16



SOCK NO.	Dia. In.	LOCATION	SLOPE PERCENT	SLOPE LENGTH ABOVE BARRIER (FT)	SOCK LENGTH
STOCKPILE					
SP 1	12	STA 1+00 to STA 1+75	N/A	N/A	205

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