PRELIMINARY

STORMWATER MANAGEMENT REPORT

FOR

TOWNSEND ACRES SUBDIVISION

Townsend, Delaware

November 2024

Prepared by:

Becker Morgan Group, Inc.
The Tower at STAR Campus
100 Discovery Boulevard, Suite 102
Newark, DE 19713
(302) 369-3700

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APPENDIX

1.0 INTRODUCTION

This report has been prepared to support the design of the proposed Townsend Acre Subdivision. This residential subdivision is made up of 46 duplex units which will be a new product offered in the Town of Townsend. The project will include construction of the 46-dwelling unit with associated sidewalks, parking areas, parcel ingress and egress improvements, various stormwater management facilities, open space, and other associated appurtenances. The project currently takes singular access off Summit Bridge Road with the potential to connect to the intersection of Gray Street and Ginn Street. The parcel is located within the Appoquinimink Hundred and within the town limits of Townsend. Please refer to Appendix A.1 for the Location Map.

2.0 SITE NARRATIVE

2.1 Existing Conditions

The existing Country Club Estates site consists of approximately 15 ± acres of land and is currently vacant and consists of mainly wooded area. The site is located at 5961 Summit Bridge Road, Townsend, De 19734. The site is bounded by single family dwelling units to the north and east, Summit Bridge Road right-of-way to the east, commercial and solar array to the south, and Townsend Village II East subdivision to the west. See appendix A.1 for location map.

According to New Castle County's online GIS mapping system, the site is located within the Appoquinimink River Watershed. Wetland delineations were performed by Watershed Eco, LLC first in June 2021 and then re-delineated in June 2024 as documented in the report. As found in the report, the wetland area that grew from June 2021 to June 2024, is now illustrated on the plan set. Copies of the wetland delineation have been provided to the Town of Townsend and the stormwater plans within this report coincide with the findings. Per FEMA Maps 10003C0315L and 10003C0318L, the site is not impacted by the 100-yr floodplain. There are riparian buffers associated with wetlands on site. Per NCC GIS data, the entire site is within a Water Resource Protection Area (WRPA) Recharge Area. Disturbance within the WRPA does not exceed any threshold requirement set by the Town of Townsend Greenbelt. We have assumed a 50% impervious coverage on lots which is based on the max impervious area per code in Townsend. The proposed development stays under the 30% impervious coverage of the gross site area.

No disturbance to these natural areas are proposed by the accompanying construction plans.

The site is divided into three (3) major drainage areas where development is proposed. There are no existing stormwater management facilities or sub-surface drainage features on site.

Drainage area 1 (DA-1) is located adjacent to Summit Bridge Road and contains approximately 2.16 acres +/- of mostly wooded areas. The area drains overland via sheet flow and shallow concentrated flow towards a roadside ditch that is drained by a storm drainpipe that crosses Summit Bridge Road. Analysis Point 1 is located prior to the storm drainpipe. There are no stormwater management facilities located within the drainage area.

Drainage area 2 (DA-2) is the largest of the 3 drainage areas and is located in the center of the site with the wetlands. This drainage area contains approximately 11.18 acres +/- of woods and wetlands. The area drains overland via sheet flow and shallow concentrated flow towards a channel ultimately feeding into wetland areas at Analysis Point 2. There are no stormwater management facilities located within the drainage area.

Drainage area 3 (DA-3) is the smallest of the all the drainage areas and is located at the western side of the property and contains approximately 1.89 acres +/- of wooded area. The area drains overland via sheet flow and shallow concentrated flow towards Analysis Point 3, or sump area located at west side of the property. There are no stormwater management facilities located within the drainage area.

Based on the USDA – Natural Resources Conservation Service – Web Soil Survey, the site contains all of the hydrologic soil groups type, "A" though "D." The soil type consists of mostly Reybold silt loam soils. The site ranges from well drained to very poorly drained according to the USDA soil survey website.

Subsurface exploration testing was performed by Geotechnology Associates, Inc. Based on the results, it was determined that ground water table is approximately between 3.8ft to 10.0ft below existing grade. Infiltration testing was not performed as it wasn't deemed feasible at this site location due to soil characteristics and the site's hydrology. Therefore, alternative BMPs have been selected for this site. Please see Appendix A.9 for the full Geotechnical report.

2.2 Post-Developed Conditions

This report is to support the design of the Townsend Acres Subdivision. Townsend Acres is a residential subdivision that contains duplex units, which is a new product for the Town of Townsend. The site proposed 46 duplex units and includes associated stormwater management facilities, open space, vehicular and pedestrian circulation, and other various site improvements. The proposed development will primarily use underground pipe networks that collect and convey the runoff to proposed stormwater management facilities located toward the site perimeters. The overall drainage pattern in the post developed condition will mimic the pre-developed condition. The site will continue to drain to the existing wetlands that are in the center of the property and will be analyzed within the wetlands.

It was assumed that each lot contained the maximum amount of impervious cover on each lot for the hydroCAD modeling calculations. Based on the Townsend code, the maximum amount of impervious cover allowed was 50% and was utilized for the calculations in HydroCAD.

For the purpose of this analysis, the site has been divided into 4 drainage areas for the entire site and have limited our drainage area maps to show areas that are being impacted by the improvements. See Appendix A.2 for Drainage Plans.

Drainage Area 1A (DA-1) is located adjacent to Summit Bridge Road and contains the entrance improvement as well as some lot area. The area contains approximately ± 1.54 acres of runoff. Most of the area will be collected by an underground storm drain network and conveyed to the stormwater facility at the entrance. Ultimately, all the runoff from this drainage area will be direct to analysis point 1 where it has been conveyed to an

underground storm drain network instead of the open channel ditch in the predeveloped condition. The drainage area contains a proposed stormwater management practice, stormwater facility 1.

Drainage Area 2 (DA- 2) is located towards the entrance of the site and roughly half of the overall subdivision improvements. The sub area contains approximately ± 3.59 acres. The runoff from this area will be sheet flow to various catch basins around the site and be collected by the underground storm drain network. This drainage area runoff is ultimately conveyed to the stormwater facility that discharges to the existing wetlands and AP-2. The drainage area contains a proposed stormwater management practice, stormwater facility 2.

Drainage Area 3 (DA-3) is located along the west of the property that borders Townsend Village II East. This drainage area contains the majority of the site improvement within the subdivision. The drainage area contains approximately ± 4.53 acres. The runoff will sheet flows to various catch basins around the site and be collected by underground storm drain network. The runoff generated from this drainage area will eventually be conveyed to the stormwater management facility that ultimately discharges the existing wetlands and AP-2. The drainage area contains a stormwater management practice, stormwater facility 3.

Drainage Area 4 (DA-4) is located towards the center and southeast portion of the site and contains the portion of the site that will remain undistributed. This drainage area contains wetlands, riparian buffer, and existing wooded area. The sub area contains approximately ± 5.57 acres. The runoff from this area will continue to sheet flow overland and be conveyed to the existing wetlands on site. The existing wetlands will eventually discharge the runoff to AP-2. The drainage area does not contain any stormwater management facilities.

See Appendix A.2 for drainage maps.

3.0 STORMWATER MANAGEMENT METHODOLOGY

Compliance with the Delaware Sediment and Stormwater Regulations (DSSR) has been determined by meeting the applicable requirements for the Resource Protection Event (RPv), Conveyance Event (Cv), and Flooding Event (Fv).

3.1 Resource Protection Event (RPv)

RPv (1-year, 24-hour rainfall event) – compliance with this portion of the DSSR is accomplished by modeling the proposed improvements in both HydroCAD v10.00 and DURMM v2.5. First, the various land cover/soil conditions for the project LOD are included in an overall DURMM v2.5 excel spreadsheet. This sheet generates a total shortfall for the proposed development in accordance with the current regulations. The site and upstream contributing areas are then modeled in HydroCAD. The initial abstraction (Ia/S Ratio) is changed from the traditional value of 0.20 to 0.05 to mimic the runoff generated by DURMM. The initial abstraction is adjusted in HydroCAD in place of utilizing the modified CN value from the DURMM spreadsheet. It should be noted that not all drainage areas have an assigned stormwater Best Management Practice (BMP) given grading, elevation, or other site limitations, however, over management of other

areas account for the total required RPV reductions for the project. The RPv volumes treated by each BMP are then added together to prove the total volume treated for the project meets or exceeds the shortfall volume generated by DURMM. This method of analysis has been determined to be functionally equivalent for sizing and verifying compliance of stormwater BMPs under the current DSSR by DNREC.

It should be noted that infiltration was not feasible for this site so other BMPs were provided that were more suitable for the soil types and groundwater. See GTA's geotechnical report, appendix A.9, for more information.

The RPv event shall be managed to the Maximum Extent Practical (MEP) via 3 stormwater facilities. Infiltration testing results yielded poor results for the use of infiltration practices. The RPv treatment for the Submerged Gravel Wetlands (SGW) has been documented using 11.10.6.2.1 for RPv compliance. This facility includes pre-treatment and is designed to collect and treat the required volume of runoff for the proposed project. The SGW includes a layer of gravel that is located below the outlet device and will remain permanently submerged. The gravel area must be large enough to detain 25% of the RPv volume treated by the facility (See HydroCAD Calculations). The stormwater facilities were designed to meet and exceed the required shortfall produced by the developed site. See calculation and table below for RPv credit:

RPv MAX. DISCHARGE RATE (1 INCH OF RUNOFF)

SWM Pond-1 (Submerged Gravel Wetland)
Gravel Area: ± 1,694.3 s.f.
Gravel Depth: 2.33 ft
Gravel Volume: (1,694.3 s.f. * 2.33 ft) =3,947.63 c.f.
Gravel Detention Volume (assume 40% void ratio): 3,947.63 c.f. * 0.40 = 1,579.05 c.f.
SGW RPv Treatment Volume: 1,579.05 c.f. * (1/0.25) = 6316.20 c.f.

SWM Pond-2 (Submerged Gravel Wetland)
Gravel Area: ± 4,405.08 s.f.
Gravel Depth: 2.33 ft
Gravel Volume: (4,405.08 s.f. * 2.33 ft) = 10,263.83 c.f.
Gravel Detention Volume (assume 40% void ratio): 10,263.83 c.f. * 0.40 = 4,105.53 c.f.
SGW RPv Treatment Volume: 4,105.53 c.f. * (1/0.25) = 16,422.12 c.f.
*RPv Credit limited in DURMM Spreadsheet = 16,419.9 c.f.

SWM Pond-3 (Wet Pond ED)

Inflow Volume (1 in x 4.53 acres x 43,560 sf / 1 acre x 1 ft / 12 in)	16,443.9 cf
Average discharge rate (cfs) (16,443.9 cf x 1 / 48 hrs. x 1 / 3600 sec)	0.095 cfs
Max Rate = 5 x Avg. (5 x 0.095)	0.475 cfs

RPv Peak Discharge Rate vs. Max. Peak Discharge Rate
0.23 cfs (from HydroCAD) ≤ 0.475 cfs (Qualifies for Extended Detention)

The attached DURMM and HydroCAD v10.00 calculations show RPv for this development is over managed by 14,501 cu. ft (see Appendix A.3 and A.6 for DURMM and RPv Storage calculations). Below is a table which summarizes the RPv results from the BMPs:

Table 3.1.A: RPv Treatment Summary	
STORMWATER MANAGEMENT FACILITY	**RPv TREATMENT (c.f.)**
Submerged Gravel Wetland #1	6,317
Submerged Gravel Wetland #2	16,420
Wet Pond (ED) #3	16,115
Total Vol. Treated:	**38,852**
DURMM Shortfall:	24,351
RPv Reduction Credit:	**14,501**

As the table above demonstrates, the RPv credit meets and exceeds the shortfall requirement for this project in accordance with the current DSSR. The three (3) stormwater management practices have treated a greater volume than what is required by the DURMM v2.5 spreadsheet and therefore resulted in an RPv credit. Since the RPv requirement has been met using on-site BMPs alone, the use of an offset is not required.

3.2 Conveyance Event (Cv) & Flooding event (Fv)

Cv (10-year, 24-hour rainfall event) & Fv (100-year, 24-hour rainfall event). Compliance with this portion of the DSSR is accomplished by proving this development will cause no adverse impact by limiting the increase in the downstream post-developed water surface elevation by no more than 0.05 ft. in accordance with section 5.3.3.1 and 5.4.3.1 of the DSSR. A Level 1 Hydrologic & Hydraulic (H&H) Analysis are used to prove no adverse impact for each of the two analysis points. For the purpose of analysis, it is assumed that the downstream water surface elevation will not increase if the post-developed peak discharge rate and volume does not exceed the pre-developed conditions.

Analysis Point 1 (Summit Bridge Road): No adverse impact is proven with a Level 1 H&H analysis. The post-developed peak rate of discharge does not exceed the pre-developed peak rate of discharge. The results from the hydrograph are as follows (see Appendix A.4, A.5, A.7, and A.8 for supporting calculations):

Table 3.2.A: Level 1 H & H Results (AP-1)		
	Cv Peak Rate (c.f.s)	Fv Peak Rate (c.f.s.)
Pre-Developed Site	0.89	3.10
Post-Developed Site	**↓ 0.74**	**↓ 3.08**

Analysis Point 2 (Existing Wetland): No adverse impact is proven with a Level 1 H&H analysis. The post-developed peak rate of discharge does not exceed the pre-developed peak rate of discharge. The results from the hydrograph are as follows (see Appendix A.4, A.5, A.7, and A.8 for supporting calculations):

Table 3.2.B: Level 1 H & H Results (AP-2)		
	Cv Peak Rate (c.f.s)	Fv Peak Rate (c.f.s.)
Pre-Developed Site	2.88	10.77
Post-Developed Site	**↓ 3.08**	**↓ 10.10**

Analysis Point 3 (Townsend Village II East open space): As a result of the site improvements, there is no stormwater runoff being directed to analysis point 3. Thus, no adverse impact is proven with a Level 1 H&H analysis. The post-developed volumes and peak rate of discharge do not exceed the pre-developed peak rate of discharge. The results from the hydrograph are as follows (see Appendix A.4, A.5, A.7, and A.8 for supporting calculations):

Table 3.2.C: Level 1 H & H Results (AP-3)				
	Cv Peak Rate (c.f.s)	Cv Volume (ac-ft)	Fv Peak Rate (c.f.s.)	Fv Volume (ac-ft)
Pre-Developed Site	0.00	0.00	0.14	0.066
Post-Developed Site	**↔ 0.00**	**↔ 0.00**	**↓ 0.00**	**↓ 0.00**

The above tables show (3.2.A, 3.2.B & 3.2.C) for AP-1, AP-2, & AP-3 the proposed development meets the requirements for section 5.3 and 5.4 of the DSSR. The comparison of the peak rates and volumes from pre to post confirms that proposed developed site meets or exceeds the requirements set forth by DSSR. The post developed site reduces the peak rates and volumes that will be conveyed to the points of analysis; therefore, no adverse impacts are anticipated for this development.

4.0 CONSTRUCTION SITE CONDITIONS

Erosion and sediment control (ESC) measures are designed to capture any sediment-laden runoff prior to it leaving the site. In accordance with the DSSR and the DNREC Erosion and Sediment Control Handbook the following erosion and sedimentation control practices are utilized for this project: Silt fence, stabilized construction entrance, inlet protection, temporary seeding and mulching, and permanent vegetative cover, culvert inlet protection, concrete washout, concrete mixing operation, stockpile, stabilization matting, sensitive area protection, rock outlet protection, temporary sediment basin, rock outlet sediment trap, etc….

5.0 DESIGN CODE CONSIDERATIONS

The proposed site has been designed to provide positive drainage in a way that is consistent with Townsend's Code of Ordinances, the Drainage Code, as well as Section 5.7 of DelDOT's Development Coordination Manual. Proposed on-lot and open space grading has been designed to direct stormwater runoff away from buildings/structures toward appropriate conveyance features. These conveyance and drainage features have been designed to accommodate the required design storm frequencies, with consideration given to future maintenance responsibility.

6.0 SUPPLEMENTAL CALCULATIONS

6.1 Sediment Trap Calculations

Storage volumes in proposed temporary sediment traps for erosion and sediment control have been sized according to two parameters:

- The minimum required volume of 3,600 cubic feet per acre of drainage area per the Delaware ESC Handbook;
- Per DSSR section 4.4.2.1 as some phases exceed the 20-acre maximum area, where the 2-year bare earth condition runoff volume must be calculated and stored.

See Tables 6.3.A & 6.3.B and Appendix A.11 for supporting calculations.

Table 6.3.A: Sediment Trap Calculations (Minimum Storage)

Sediment Basin #	Total Drainage Area (ac)	Total Storage Required (cf)	Total Storage Provided (cf)
1	1.54	5,544	6,493
2	3.59	12,924	44,050
3	4.53	16,308	26,748

7.0 ADDITIONAL NCC REQUIREMENTS

7.1 Hazard Classification

The SWM approach is to utilize infiltration basins to achieve the stormwater management goals of quality and quantity management. These facilities do not permanently hold water but fill and drain during storm events. In order to evaluate the hazard classification of the facility, TR-60 guidance, and the watershed HydroCAD model were utilized. This analysis shows that, if considered under the umbrella of Pond Code 378 and TR-60, the facility would be considered a Low Hazard Class. If the facility failed during a 100-yr storm event, no buildings are expected to be impacted and there would be no adverse impact to surrounding roads.

7.2 Stormwater Management and Drainage Easements

Drainage easements have been shown on the plan in accordance with NCC UDC 40.20.242 as well as Drainage Code 12.04.005.

- Utility easements are a minimum of 20’ wide. Easements which fall on shared side or rear lot lines have been divided equally.
- When necessary, drainage easements have been placed on lots to convey surface water to storm sewers located on the street or within open spaces.
- The responsible party for each easement is listed on the plan.
- The purpose for each easement (pipe, swale, watercourse, residential lot drainage) is listed on the plan.

In addition, easements for access to and maintenance of stormwater management areas are shown on the plan in accordance with Drainage Code 12.05.006.B.6, UDC 40.03.406, and the Delaware Sediment and Stormwater Regulations.

- Easements not less than 10’ on both sides of outfall pipes.
- Access easements not less than 15’ around the perimeter of SWM areas for access.
- Longitudinal and transverse slopes within the easement areas are not greater than 10%.

- All stormwater management areas for this project are proposed on-site, rather than off-site.

8.0 CONCLUSION

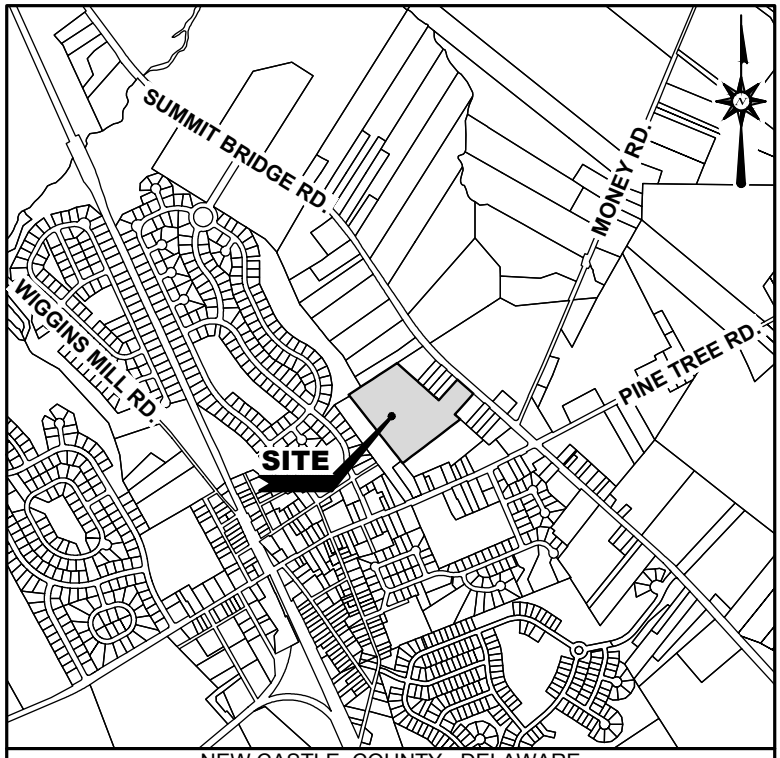
This report has been prepared to address stormwater management and drainage considerations in coordination with the Delaware Sediment and Stormwater Regulations (DSSR) and New Castle County Drainage Code for the subject site known as Townsend Acres Subdivision

This report demonstrates compliance with the Delaware Sediment and Stormwater Regulations (DSSR) as it relates to stormwater management as well as Chapter 12 of New Castle County's Code of Ordinance as it relates to drainage.

A.1
LOCATION MAP

Townsend Acres Subdivision

Townsend, Delaware



NEW CASTLE COUNTY, DELAWARE

LOCATION MAP

SCALE: 1" = 2,000'

0 1000 2000

SCALE: 1" = 2000'

LAYER STATE: C-500

LOCATION MAP

TOWNSEND ACRES SUBDIVISION

TOWN OF TOWNSEND

NEW CASTLE COUNTY / DELAWARE

BECKER MORGAN GROUP

ARCHITECTURE
ENGINEERING
Dover, DE
309 S. Governors Ave.
Dover, DE 19904
Ph. 302.734.7950
Fax 302.734.7965

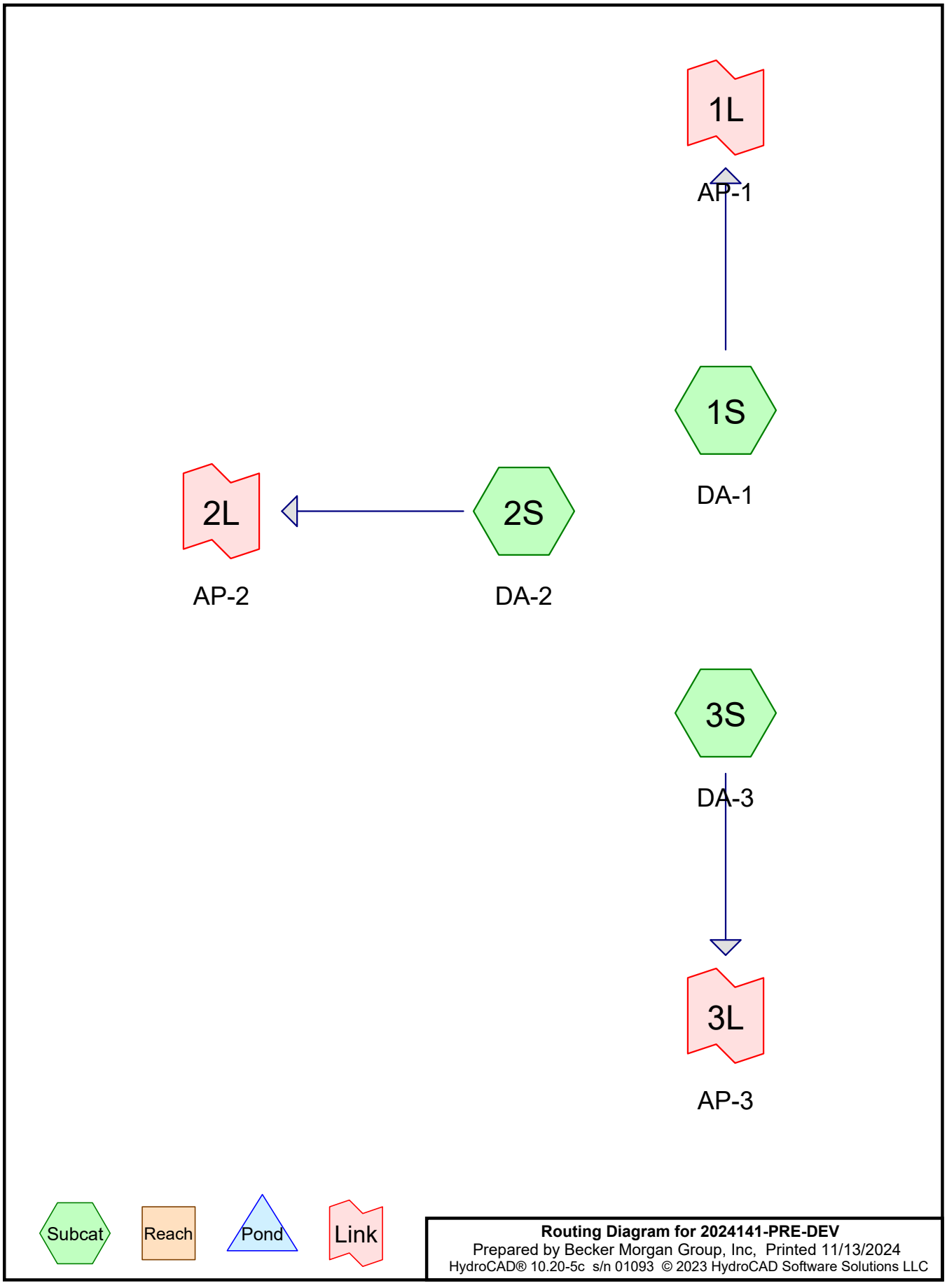
BMG:	**2024141.00**
SCALE:	**1" = 2000'**
DATE:	**11/15/2024**
DRAWN BY:	**R.J.M.**

F:\AutoCAD\Projects\2024\2024141\DWG\2024141-ESC-C3D21-DE.dwg, Nov 13, 2024 - 11:04am

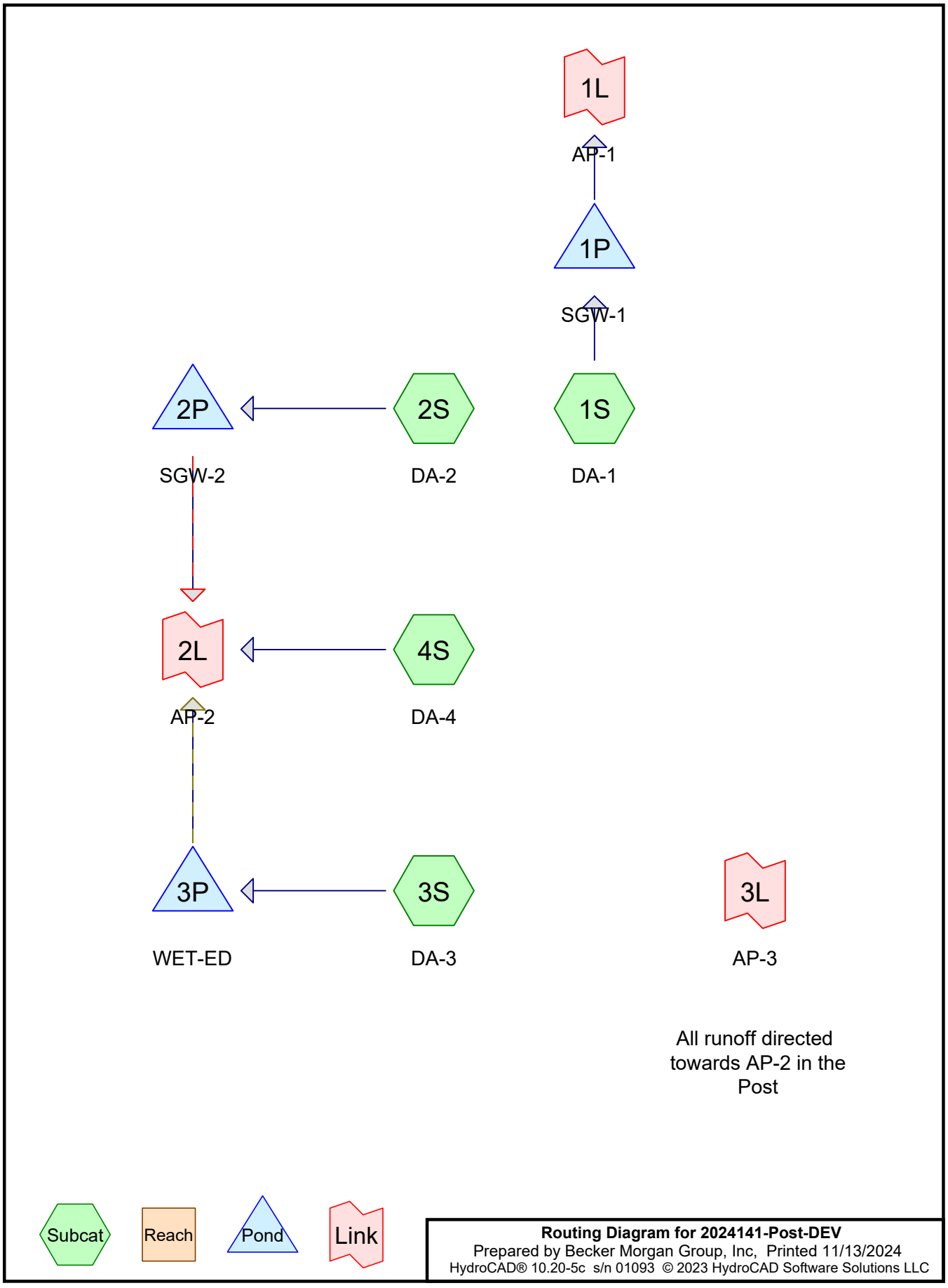
A.2
HYDROCAD SHCEMATIC DIAGRAMS & STORMWATER DRAINAGE PLANS

Townsend Acres Subdivision

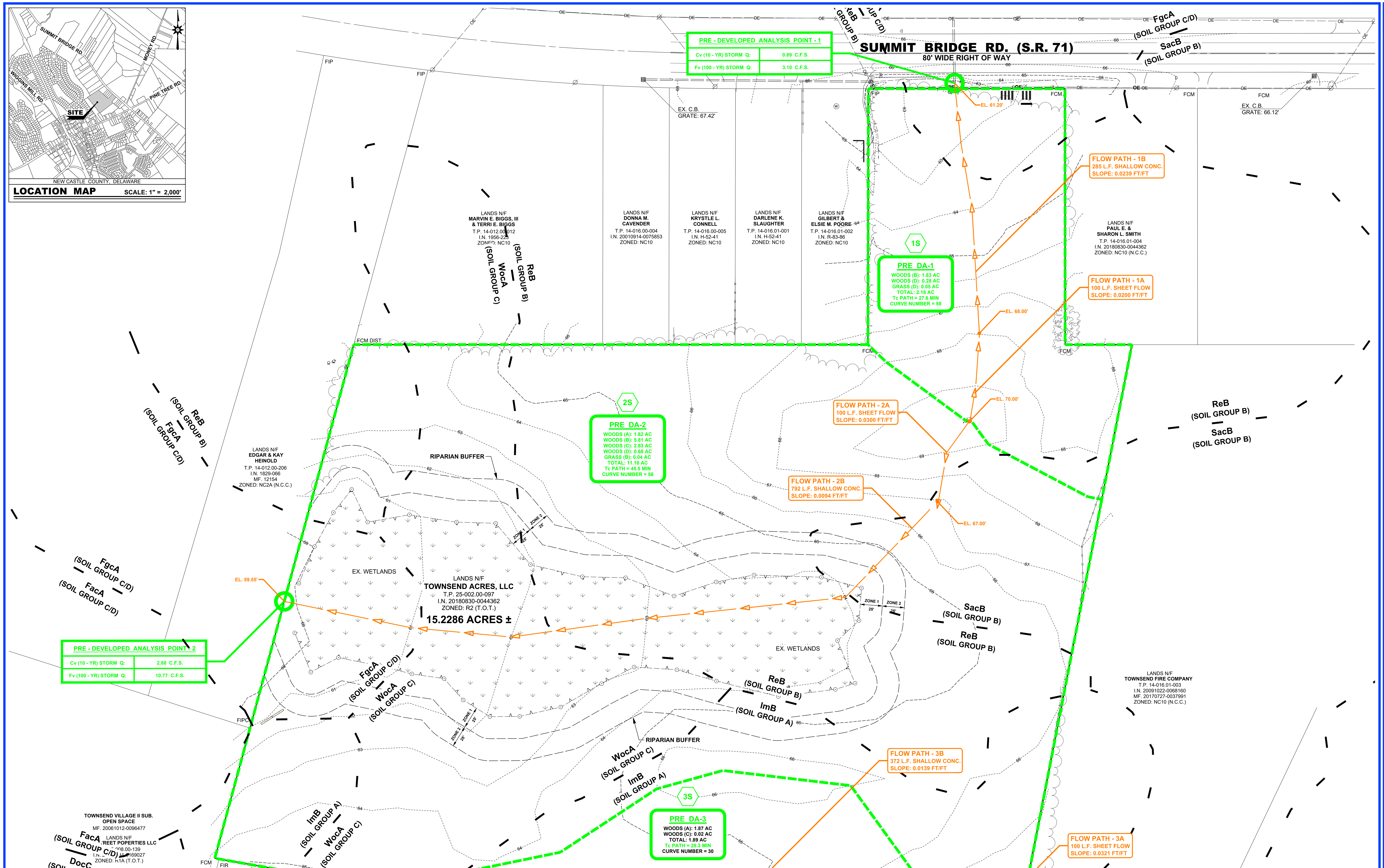
Townsend, Delaware



Routing Diagram for 2024141-PRE-DEV
Prepared by Becker Morgan Group, Inc, Printed 11/13/2024



Routing Diagram for 2024141-Post-DEV
Prepared by Becker Morgan Group, Inc, Printed 11/13/2024


LOCATION MAP
SCALE: 1" = 2,000'
NEW CASTLE COUNTY, DELAWARE
SITE
SUMMIT BRIDGE RD. (S.R. 71)
80' WIDE RIGHT OF WAY
PRE - DEVELOPED ANALYSIS POINT - 1
Cv (10 - YR) STORM Q: 0.89 C.F.S.
Fv (100 - YR) STORM Q: 3.10 C.F.S.
PRE - DEVELOPED ANALYSIS POINT - 2
Cv (10 - YR) STORM Q: 2.88 C.F.S.
Fv (100 - YR) STORM Q: 10.77 C.F.S.
PRE - DEVELOPED ANALYSIS POINT - 3
Cv (10 - YR) STORM Q: 0.00 C.F.S.
Fv (100 - YR) STORM Q: 0.14 C.F.S.
1S
PRE DA-1
WOODS (B): 1.83 AC
WOODS (D): 0.28 AC
GRASS (D): 0.05 AC
TOTAL: 2.16 AC
Tc PATH = 27.6 MIN
CURVE NUMBER = 58
2S
PRE DA-2
WOODS (A): 1.82 AC
WOODS (B): 5.81 AC
WOODS (C): 2.83 AC
WOODS (D): 0.68 AC
GRASS (B): 0.04 AC
TOTAL: 11.18 AC
Tc PATH = 45.5 MIN
CURVE NUMBER = 56
3S
PRE DA-3
WOODS (A): 1.87 AC
WOODS (C): 0.02 AC
TOTAL: 1.89 AC
Tc PATH = 28.3 MIN
CURVE NUMBER = 30
FLOW PATH - 1A
100 L.F. SHEET FLOW
SLOPE: 0.0200 FT/FT
FLOW PATH - 1B
285 L.F. SHALLOW CONC.
SLOPE: 0.0239 FT/FT
FLOW PATH - 2A
100 L.F. SHEET FLOW
SLOPE: 0.0300 FT/FT
FLOW PATH - 2B
792 L.F. SHALLOW CONC.
SLOPE: 0.0094 FT/FT
FLOW PATH - 3A
100 L.F. SHEET FLOW
SLOPE: 0.0321 FT/FT
FLOW PATH - 3B
372 L.F. SHALLOW CONC.
SLOPE: 0.0139 FT/FT
LANDS N/F
TOWNSEND ACRES, LLC
T.P. 25-002.00-097
I.N. 20180830-0044362
ZONED: R2 (T.O.T.)
15.2286 ACRES ±
EX. WETLANDS
RIPARIAN BUFFER
EX. C.B.
GRATE: 67.42'
EX. C.B.
GRATE: 66.12'
LANDS N/F
MARVIN E. BIGGS, III
& TERRI E. BIGGS
LANDS N/F
DONNA M. CAVENDER
T.P. 14-016.00-004
I.N. 20010914-0075853
ZONED: NC10
LANDS N/F
KRYSTLE L. CONNELL
T.P. 14-016.00-005
I.N. H-52-41
ZONED: NC10
LANDS N/F
DARLENE K. SLAUGHTER
T.P. 14-016.01-001
I.N. H-52-41
ZONED: NC10
LANDS N/F
GILBERT & ELSIE M. POORE
T.P. 14-016.01-002
I.N. R-83-86
ZONED: NC10
LANDS N/F
PAUL E. & SHARON L. SMITH
T.P. 14-016.01-004
I.N. 20180830-0044362
ZONED: NC10 (N.C.C.)
LANDS N/F
EDGAR & KAY HEINOLD
T.P. 14-012.00-206
I.N. 1829-066
MF. 12154
ZONED: NC2A (N.C.C.)
LANDS N/F
TOWNSEND FIRE COMPANY
T.P. 14-016.01-003
I.N. 20091022-0068160
MF. 20170727-0037991
ZONED: NC10 (N.C.C.)
TOWNSEND VILLAGE II SUB.
OPEN SPACE
MF. 20061012-0096477
LANDS N/F
SHARON WORKMAN & JAY M. JONES, SR.
T.P. 14-016.01-104
I.N. 2889-303
LANDS N/F
SHARON WORKMAN & JAY M. JONES, SR.
T.P. 14-016.01-104
I.N. 2889-303
MF. 11402
ReB (SOIL GROUP B)
SacB (SOIL GROUP B)
FgcA (SOIL GROUP C/D)
FacA (SOIL GROUP C/D)
WocA (SOIL GROUP C)
ImB (SOIL GROUP A)
DocC (SOIL GROUP B)
EL. 61.20'
EL. 68.00'
EL. 70.00'
EL. 67.00'
EL. 59.55'
EL. 63.32'
EL. 68.50'
EL. 71.71'

LEGEND

- SUBAREA BOUNDARY
- TIME OF CONCENTRATION PATH
- SOIL BOUNDARY (SOIL GROUP B) (SOIL GROUP C)

PRE-DEVELOPED LIMIT OF DISTURBANCE DATA

1. TOTAL L.O.D.: ± 11.31 ACRES
2. PRE-DEVELOPED IMPERVIOUS: ± 0.00 ACRES
3. PRE-DEVELOPED WOODS (HSG A) : ± 3.69 ACRES
4. PRE-DEVELOPED WOODS (HSG B) : ± 5.80 ACRES
5. PRE-DEVELOPED WOODS (HSG D) : ± 1.19 ACRES
6. PRE-DEVELOPED WOODS (HSG D) : ± 0.37 ACRES

BECKER MORGAN GROUP

ARCHITECTURE
ENGINEERING

Delaware
309 South Governors Avenue
Dover, DE 19904
302.734.7950
The Tower at STAR Campus
100 Discovery Boulevard, Suite 102
Newark, DE 19713
302.369.3700

Maryland
312 West Main Street, Suite 300
Salisbury, MD 21801
410.546.9100

North Carolina
3333 Jaeckle Drive, Suite 120
Wilmington, NC 28403
910.341.7600

www.beckermorgan.com

PROJECT TITLE

TOWNSEND ACRES SUBDIVISION

SUMMIT BRIDGE ROAD
TOWN OF TONSEND
NEW CASTLE COUNTY, DE

SHEET TITLE

PRE-DEVELOPED DRAINAGE MAP

0 25 50 100

SCALE: 1" = 50'

ISSUE BLOCK

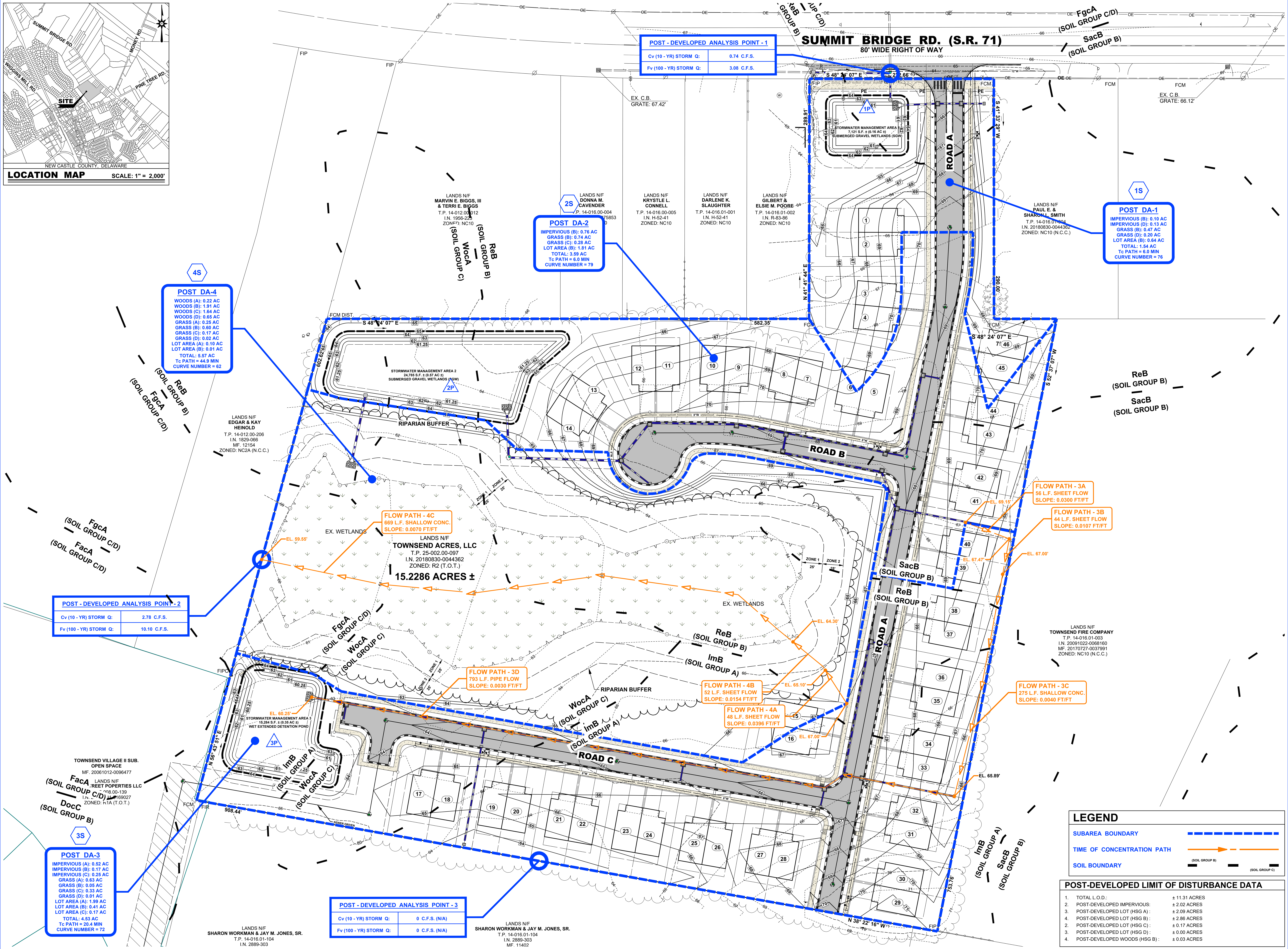
MARK	DATE	DESCRIPTION

LAYER STATE: PRE-DEV

PROJECT NO.: 2024141.00
DATE: 11/15/2024
SCALE: 1" = 50'
DRAWN BY: R.J.M. PROJ. MGR.: R.J.M.

SHEET

PRE-DEV


LOCATION MAP
SCALE: 1" = 2,000'
SITE
SUMMIT BRIDGE RD
WIGGINS MILL RD
MONEY RD
PINE TREE RD
NEW CASTLE COUNTY, DELAWARE
SUMMIT BRIDGE RD. (S.R. 71)
80' WIDE RIGHT OF WAY
POST - DEVELOPED ANALYSIS POINT - 1
Cv (10 - YR) STORM Q: 0.74 C.F.S.
Fv (100 - YR) STORM Q: 3.08 C.F.S.
POST - DEVELOPED ANALYSIS POINT - 2
Cv (10 - YR) STORM Q: 2.78 C.F.S.
Fv (100 - YR) STORM Q: 10.10 C.F.S.
POST - DEVELOPED ANALYSIS POINT - 3
Cv (10 - YR) STORM Q: 0 C.F.S. (N/A)
Fv (100 - YR) STORM Q: 0 C.F.S. (N/A)
1S
POST DA-1
IMPERVIOUS (B): 0.10 AC
IMPERVIOUS (D): 0.13 AC
GRASS (B): 0.47 AC
GRASS (D): 0.20 AC
LOT AREA (B): 0.64 AC
TOTAL: 1.54 AC
Tc PATH = 6.0 MIN
CURVE NUMBER = 76
2S
POST DA-2
IMPERVIOUS (B): 0.76 AC
GRASS (B): 0.74 AC
GRASS (C): 0.28 AC
LOT AREA (B): 1.81 AC
TOTAL: 3.59 AC
Tc PATH = 6.0 MIN
CURVE NUMBER = 79
3S
POST DA-3
IMPERVIOUS (A): 0.52 AC
IMPERVIOUS (B): 0.17 AC
IMPERVIOUS (C): 0.25 AC
GRASS (A): 0.63 AC
GRASS (B): 0.05 AC
GRASS (C): 0.33 AC
GRASS (D): 0.01 AC
LOT AREA (A): 1.99 AC
LOT AREA (B): 0.41 AC
LOT AREA (C): 0.17 AC
TOTAL: 4.53 AC
Tc PATH = 20.4 MIN
CURVE NUMBER = 72
4S
POST DA-4
WOODS (A): 0.22 AC
WOODS (B): 1.91 AC
WOODS (C): 1.64 AC
WOODS (D): 0.65 AC
GRASS (A): 0.25 AC
GRASS (B): 0.60 AC
GRASS (C): 0.17 AC
GRASS (D): 0.02 AC
LOT AREA (A): 0.10 AC
LOT AREA (B): 0.01 AC
TOTAL: 5.57 AC
Tc PATH = 44.9 MIN
CURVE NUMBER = 62
FLOW PATH - 3A
56 L.F. SHEET FLOW
SLOPE: 0.0300 FT/FT
FLOW PATH - 3B
44 L.F. SHEET FLOW
SLOPE: 0.0107 FT/FT
FLOW PATH - 3C
275 L.F. SHALLOW CONC.
SLOPE: 0.0040 FT/FT
FLOW PATH - 3D
793 L.F. PIPE FLOW
SLOPE: 0.0030 FT/FT
FLOW PATH - 4A
48 L.F. SHEET FLOW
SLOPE: 0.0396 FT/FT
FLOW PATH - 4B
52 L.F. SHEET FLOW
SLOPE: 0.0154 FT/FT
FLOW PATH - 4C
669 L.F. SHALLOW CONC.
SLOPE: 0.0070 FT/FT
LANDS N/F
TOWNSEND ACRES, LLC
T.P. 25-002.00-097
I.N. 20180830-0044362
ZONED: R2 (T.O.T.)
15.2286 ACRES ±
EX. WETLANDS
RIPARIAN BUFFER
ROAD A
ROAD B
ROAD C
STORMWATER MANAGEMENT AREA 2
SUBMERGED GRAVEL WETLANDS (SGW)
STORMWATER MANAGEMENT AREA 3
WET EXTENDED DETENTION POND
STORMWATER MANAGEMENT AREA
SUBMERGED GRAVEL WETLANDS (SGW)
LANDS N/F
MARVIN E. BIGGS, III
& TERRI E. BIGGS
LANDS N/F
DONNA M. CAVENDER
T.P. 14-016.00-004
LANDS N/F
KRYSTLE L. CONNELL
T.P. 14-016.00-005
I.N. H-52-41
ZONED: NC10
LANDS N/F
DARLENE K. SLAUGHTER
T.P. 14-016.01-001
I.N. H-52-41
ZONED: NC10
LANDS N/F
GILBERT & ELSIE M. POORE
T.P. 14-016.01-002
I.N. R-83-86
ZONED: NC10
LANDS N/F
EDGAR & KAY HEINOLD
T.P. 14-012.00-206
I.N. 1829-066
MF. 12154
ZONED: NC2A (N.C.C.)
LANDS N/F
TOWNSEND FIRE COMPANY
T.P. 14-016.01-003
I.N. 20091022-0068160
MF. 20170727-0037991
ZONED: NC10 (N.C.C.)
TOWNSEND VILLAGE II SUB.
OPEN SPACE
MF. 20061012-0096477
LANDS N/F
SHARON WORKMAN & JAY M. JONES, SR.
T.P. 14-016.01-104
I.N. 2889-303
MF. 11402
ReB (SOIL GROUP B)
SacB (SOIL GROUP B)
FgcA (SOIL GROUP C/D)
FacA (SOIL GROUP C/D)
WocA (SOIL GROUP C)
ImB (SOIL GROUP A)
DocC (SOIL GROUP B)
SCALE: 1" = 50'
LEGEND
SUBAREA BOUNDARY
TIME OF CONCENTRATION PATH
SOIL BOUNDARY
(SOIL GROUP B)
(SOIL GROUP C)

POST-DEVELOPED LIMIT OF DISTURBANCE DATA

1. TOTAL L.O.D.: ± 11.31 ACRES
2. POST-DEVELOPED IMPERVIOUS: ± 2.02 ACRES
3. POST-DEVELOPED LOT (HSG A) : ± 2.09 ACRES
4. POST-DEVELOPED LOT (HSG B) : ± 2.86 ACRES
2. POST-DEVELOPED LOT (HSG C) : ± 0.17 ACRES
3. POST-DEVELOPED LOT (HSG D) : ± 0.00 ACRES
4. POST-DEVELOPED WOODS (HSG B) : ± 0.03 ACRES

BECKER MORGAN GROUP
ARCHITECTURE
ENGINEERING
Delaware
309 South Governors Avenue
Dover, DE 19904
302.734.7950
The Tower at STAR Campus
100 Discovery Boulevard, Suite 102
Newark, DE 19713
302.369.3700
Maryland
312 West Main Street, Suite 300
Salisbury, MD 21801
410.546.9100
North Carolina
3333 Jaeckle Drive, Suite 120
Wilmington, NC 28403
910.341.7600
www.beckermorgan.com

PROJECT TITLE

TOWNSEND ACRES SUBDIVISION

SUMMIT BRIDGE ROAD
TOWN OF TONSEND
NEW CASTLE COUNTY, DE

SHEET TITLE

POST DEVELOPED DRAINAGE MAP

ISSUE BLOCK

MARK	DATE	DESCRIPTION

LAYER STATE: POST-DEV

PROJECT NO.: 2024141.00
DATE: 11/15/2024
SCALE: 1" = 50'
DRAWN BY: R.J.M. PROJ. MGR.: R.J.M.

SHEET
POST-DEV

F:\AutoCAD\Projects\2024\2024141\DWG\2024141-SWM-C3D21-DE.dwg, Nov 14, 2024 - 9:29am

A.3
DURMM CALCULATIONS

Townsend Acres Subdivision

Townsend, Delaware

Summary Table for Site RPv Compliance[1]

Project:	Townsend Acres				TMDL WS:	Appoquinimink River			Rel. 1
Ref. #	Sub-Area ID[2]	Contributing Area[3] (ac)	Runoff[4] (in)	Runoff (cf)	RPv Runoff Management (cf)		TN Pollutant Load[7] (lb/yr)	TP Pollutant Load[7] (lb/yr)	TSS Pollutant Load[7] (lb/yr)
					Required[5]	Provided[6]			
Section I - Complete this section for total site LOD management requirement									
0	Total Site LOD			0.0	24351				
Section II - Complete this section for BMPs provided for partial LOD management OR sub-area by sub-area management									
1	DA-1 (SGW)	1.54	1.13	6316.9		6317	10.47	1.57	96
2	DA-2 (SGW)	3.59	1.26	16419.9		16420	27.95	4.19	257
3	DA-3 (Wet)	4.53	0.98	16115.0		16115	15.10	1.70	277
4	DA-4	5.57	0.67	13546.8		0	44.77	7.84	1439
5				0.0					
6				0.0					
7				0.0					
8				0.0					
9				0.0					
10				0.0					
11				0.0					
12				0.0					
13				0.0					
14				0.0					
15				0.0					
16				0.0					
17				0.0					
18				0.0					
19				0.0					
20				0.0					
Totals					**24351 cf**	**38852 cf**	**98.29 lb/yr**	**15.30 lb/yr**	**2069 lb/yr**
RPv Runoff Reduction Goal Met?		**YES**							
Total Credit/Shortfall		**14501 cf**	**Credit**						

Notes:

1. All subareas must lie within the same HUC 8 watershed.
2. Only the most downstream sub-area information should be entered for a series of sub-areas that drain to each other or for a treatment train.
3. From DURMM v2.5 Report, Line 7 OR Approved Hydrologic Software Report
4. From DURMM v2.5 Report, Line 35 OR Approved Hydrologic Software Report
5. From DURMM v2.5 Report, Line 39 OR Approved Hydrologic Software Report
6. From DURMM v2.5 Report, Line 40 OR Approved Hydrologic Software Report
7. From DURMM v2.5 Report, Lines 44-46 OR Complete Sheet 2

Ref. #	Subarea ID	Area (ac)	Initial RCN	BMP Pollutant Reduction (%)			Final Pollutant Load (lb/yr)		
				TN	TP	TSS	TN	TP	TSS
0	Total Site LOD						0.00	0.00	0
1	DA-1	1.54	76	30%	40%	80%	10.47	1.57	96
2	DA-2	3.59	79	30%	40%	80%	27.95	4.19	257
3	DA-3	4.53	62	30%	55%	60%	15.10	1.70	277
4	DA-4	5.57	72	0%	0%	0%	44.77	7.84	1439
5							0.00	0.00	0
6							0.00	0.00	0
7							0.00	0.00	0
8							0.00	0.00	0
9							0.00	0.00	0
10							0.00	0.00	0
11							0.00	0.00	0
12							0.00	0.00	0
13							0.00	0.00	0
14							0.00	0.00	0
15							0.00	0.00	0
16							0.00	0.00	0
17							0.00	0.00	0
18							0.00	0.00	0
19							0.00	0.00	0
20							0.00	0.00	0

PROJECT:	Townsend Acres Subdivision
DRAINAGE SUBAREA ID:	LOD
LOCATION (County):	New Castle
UNIT HYDROGRAPH:	DMV

CONTRIBUTING AREA RUNOFF CURVE NUMBER (C.A. RCN) WORKSHEET

Cover Type	Treatment	Hydrologic Condition	Curve Numbers for Hydrologic Soil Type A Acres	A RCN	B Acres	B RCN	C Acres	C RCN	D Acres	D RCN
CULTIVATED AGRICULTURAL LANDS										
Fallow	Bare soil	----		77		86		91		94
	Crop residue (CR)	poor		76		85		90		93
	Crop residue (CR)	good		74		83		88		90
Row Crops	Straight row (SR)	poor		72		81		88		91
	Straight row (SR)	good		67		78		85		89
	SR + Crop residue	poor		71		80		87		90
	SR + Crop residue	good		64		75		82		85
	Contoured (C)	poor		70		79		84		88
	Contoured (C)	good		65		75		82		86
	C + Crop residue	poor		69		78		83		87
	C + Crop residue	good		64		74		81		85
	Cont & terraced(C&T)	poor		66		74		80		82
	Cont & terraced(C&T)	good		62		71		78		81
	C&T + Crop residue	poor		65		73		79		81
	C&T + Crop residue	good		61		70		77		80
Small Grain	Straight row (SR)	poor		65		76		84		88
	Straight row (SR)	good		63		75		83		87
	SR + Crop residue	poor		64		75		83		86
	SR + Crop residue	good		60		72		80		84
	Contoured (C)	poor		63		74		82		85
	Contoured (C)	good		61		73		81		84
	C + Crop residue	poor		62		73		81		84
	C + Crop residue	good		60		72		80		83
	Cont & terraced(C&T)	poor		61		72		79		82
	Cont & terraces(C&T)	good		59		70		78		81
	C&T + Crop residue	poor		60		71		78		81
	C&T + Crop residue	good		58		69		77		80
Close-seeded	Straight row	poor		66		77		85		89
or broadcast	Straight row	good		58		72		81		85
legumes or	Contoured	poor		64		75		83		85
rotation	Contoured	good		55		69		78		83
meadow	Cont & terraced	poor		63		73		80		83
	Cont & terraced	good		51		67		76		80

OTHER AGRICULTURAL LANDS									
Pasture, grassland or range	poor		68		79		86		89
	fair		49		69		79		84
	good		39		61		74		80
Meadow -cont. grass (non grazed)	----		30		58		71		78
Brush - brush, weed, grass mix	poor		48		67		77		83
	fair		35		56		70		77
	good		30		48		65		73
Woods - grass combination	poor		57		73		82		86
	fair		43		65		76		82
	good		32		58		72		79
Woods	poor		45		66		77		83
	fair		36		60		73		79
	good		30	0.03	55		70		77
Farmsteads	----		59		74		82		86
FULLY DEVELOPED URBAN AREAS (Veg Established)									
Open space (Lawns,parks etc.)									
Poor condition; grass cover < 50%			68		79		86		89
Fair condition; grass cover 50% to 75 %			49		69		79		84
Good condition; grass cover > 75%		0.94	39	2.18	61	0.78	74	0.24	80
Impervious Areas									
Paved parking lots, roofs, driveways		0.52	98	1.05	98	0.25	98	0.2	98
Streets and roads									
Paved; curbs and storm sewers			98		98		98		98
Paved; open ditches (w/right-of-way)			83		89		92		93
Gravel (w/ right-of-way)			76		85		89		91
Dirt (w/ right-of-way)			72		82		87		89
Urban Districts	Avg % impervious								
Commercial & business	85		89		92		94		95
Industrial	72		81		88		91		93
Residential districts by average lot size	Avg % impervious								
1/8 acre (town houses)	65		77		85		90		92
1/4 acre	38		61		75		83		87
1/3 acre	30		57		72		81		86
1/2 acre	25		54		70		80		85
1 acre	20		51		68		79		84
2 acre	12		46		65		77		82
DEVELOPING URBAN AREA (No Vegetation)									
Newly graded area (pervious only)			77		86		91		94
USER DEFINED									
Duplex Lot Area (50% Impervious)		2.09	68	2.86	79	0.17	86		89

Subarea Contributing Area per Soil Type (ac)	3.55	6.12	1.2	0.44
Subarea Contributing Area (ac)	11.31			
Subarea Weighted RCN	73			

UPSTREAM CONTRIBUTING AREAS	*Subarea ID*	*Acres*	*RCN*
Upstream Contributing Area 1			
Upstream Contributing Area 2			
Upstream Contributing Area 3			
Upstream Contributing Area 4			

Total Contributing Area w. Upstream Areas (ac)	11.3
Weighted Runoff Curve Number (RCN)	73

PROJECT:	Townsend Acres Subdivision
DRAINAGE SUBAREA ID:	LOD
LOCATION (County):	New Castle
UNIT HYDROGRAPH:	DMV

LIMIT OF DISTURBANCE (LOD) WORKSHEET

Step 1 - Subarea LOD Data	**HSG A**	**HSG B**	**HSG C**	**HSG D**
1.1 HSG Area Within LOD (ac)	3.55	6.12	1.2	0.44
1.2 Pre-Developed Woods/Meadow Within LOD (ac)	3.69	5.8	1.19	0.37
1.3 Pre-Developed Impervious Within LOD (ac)	0	0	0	0
1.4.a Post-Developed Imperviousness Within LOD, Option #1 (ac); ***OR***	1.56	2.48	0.33	0.2
1.4.b Post-Developed Imperviousness Within LOD, Option #2 (%)	44%	41%	28%	45%

Step 2 - Subarea LOD Runoff Calculations				
2.1 RCN per HSG	64.93	75.99	80.60	88.18
2.2 RPv per HSG (in.)	0.75	1.13	1.33	1.74
2.3 Target RCN per HSG	29.65	55.31	70.03	77.48
2.4 Target Runoff per HSG (in.)	0.09	0.51	0.91	1.19

2.5 Subarea LOD (ac)	11.31
2.6 Subarea Weighted RCN	73.48
2.7 Subarea Weighted RPv (in.)	1.04
2.8 Subarea Weighted Target Runoff (in.)	0.45

Step 3 - Upstream LOD Areas ***(from previous DURMM Report as applicable)***	**Area 1**	**Area 2**	**Area 3**	**Area 4**
3.1 Upstream Sub-Area ID				
3.2 Upstream Contributing Area (ac)				
3.3 Target Runoff for Upstream Area (in.)				
3.4 Adjusted CN after all reductions				
3.5 Adjusted RPv (in.)				
3.6 Adjusted Cv (in.)				
3.7 Adjusted Fv (in.)				

Step 4 - RPv Calculations for Combined LOD	
4.1 Combined LOD (ac)	11.31
4.2 Weighted RCN	73.48
4.3 Weighted RPv (in.)	1.04
4.4 Weighted Target Runoff (in.)	0.45
4.5 Estimated Annual Runoff (in.)	13.61
4.6 Req'd Runoff to be Managed within LOD (in.)	0.59
4.7 Req'd Runoff to be Managed within LOD (%)	57%

PROJECT:	Townsend Acres Subdivision
DRAINAGE SUBAREA ID:	LOD
LOCATION (County):	New Castle
UNIT HYDROGRAPH:	DMV

OUTSIDE LIMIT OF DISTURBANCE (OLOD) WORKSHEET

Step 1 - Site Data

1.1 Total Contributing Area (ac)	N/A
1.2 C.A. RCN	N/A
1.3 LOD Area (ac)	N/A
1.4 LOD RCN	N/A
1.5 Outside LOD Area (ac)	N/A
1.6 Outside LOD RCN	N/A

Step 2 - Time of Concentration

FLOW TYPE	2.1 LENGTH (feet)	2.2 SLOPE (ft./ft.)	2.3 SURFACE CODE	2.4 MANNINGS "n"	2.5 VELOCITY (ft./sec.)	2.6 TRAVEL TIME (hrs)
Sheet				----------	N/A	0.00
				----------	N/A	0.00
				----------	N/A	0.00
Shallow Concentrated				N/A	----------	0.00
				N/A	----------	0.00
				N/A	----------	0.00
Open Channel			N/A			0.00
			N/A			0.00
			N/A			0.00
			N/A			0.00
			N/A			0.00

2.7 Time of Concentration (Tc): 0.10

Sheet Flow Surface Codes

a smooth surface
b fallow (no residue)
c cultivated < 20% Res.
d cultivated > 20% Res.
e grass - range, short
f grass, dense
g grass, bermuda
h woods, light
i woods, dense
j range, natural

Shallow Concentrated Surface Codes

u unpaved surface
p paved surface

Step 3 - Peak Discharge

3.1 Unit Hydrograph Type	DMV	
3.2 Frequency (yr)	10	100
3.3 24-HR Rainfall, P (in.)	4.8	8
3.4 Initial Abstraction, Ia (in.)	#N/A	#N/A
3.5 Ia/P ratio	#N/A	#N/A
3.6 Unit Peak Discharge, qu (csm/in)	#N/A	#N/A
3.7 Runoff (in.)	#VALUE!	#VALUE!
3.8 Peak Discharge, qp (cfs)	#VALUE!	#VALUE!
3.9 Equiv. unit peak discharge (cfs/ac)	0.00	0.00

PROJECT:	Townsend Acres Subdivision
DRAINAGE SUBAREA ID:	LOD
LOCATION (County):	New Castle

RESOURCE PROTECTION EVENT (RPv) WORKSHEET

	BMP 1		BMP 2		BMP 3		BMP 4		BMP 5	
	Type	**0-No BMP**	**Type**	**--**	**Type**	**--**	Type	**--**	**Type**	**--**
Step 1 - Calculate Initial RPv	**Data**									
1.1 Total contributing area to BMP (ac)	11.31									
1.2 Initial RCN	73.48									
1.3 RPv for Contributing Area (in.)	1.04									
1.4 Req'd RPv to be Managed for Contributing Area (in.)	0.59									
1.5 Req'd RPv to be Managed for Contributing Area (%)	57%									
Step 2 - Adjust for Retention Reduction										
2.1 Retention volume provided (cu. ft.)										
2.2 Retention reduction allowance (%)	0%		N/A		N/A		N/A		N/A	
2.3 Retention reduction volume (ac-ft)	0.00		N/A		N/A		N/A		N/A	
2.4 Retention reduction volume (in.)	0.00		N/A		N/A		N/A		N/A	
2.5 Runoff volume after retention reduction (in.)	1.04		N/A		N/A		N/A		N/A	
2.6 Adjusted CN*	73.59		N/A		N/A		N/A		N/A	
Step 3 - Adjust for Annual Runoff Reduction										
3.1 Annual CN (ACN)	73.48		N/A		N/A		N/A		N/A	
3.2 Annual runoff (in.)	13.61		N/A		N/A		N/A		N/A	
3.3 Proportion A/B soils in BMP footprint (%)	0%		0%		0%		0%		0%	
3.4 Annual runoff reduction allowance (%)	0%		N/A		N/A		N/A		N/A	
3.5 Annual runoff after reduction (in.)	13.61		N/A		N/A		N/A		N/A	
3.6 Adjusted ACN	73.48		N/A		N/A		N/A		N/A	
3.7 Annual Runoff Reduction Allowance for RPv (in.)	0.00		N/A		N/A		N/A		N/A	
Step 4 - Calculate RPv with BMP Reductions										
4.1 RPv Runoff Manangement Provided (cu. ft.)	0		N/A		N/A		N/A		N/A	
4.2 RPv runoff volume after all reductions (in.)	1.04		N/A		N/A		N/A		N/A	
4.3 RPv runoff volume after all reductions (cu.ft.)	42,698		N/A		N/A		N/A		N/A	
4.4 Total RPv runoff reduction (in.)	0.00		N/A		N/A		N/A		N/A	
4.5 Total RPv runoff reduction (%)	0%		N/A		N/A		N/A		N/A	
4.6 Adjusted CN after all reductions*	73.48		N/A		N/A		N/A		N/A	
4.7 Adjusted equivalent annual runoff (in.)	13.60		N/A		N/A		N/A		N/A	
4.8 RPv Compliance Met Through Runoff Reduction?	NO		N/A		N/A		N/A		N/A	
4.9 Runoff Reduction Credit, if Applicable (cu.ft)	N/A		N/A		N/A		N/A		N/A	
Step 5 - Determine Residual Volume to be Managed or Offset										
5.1 RPv Residual Volume (in.)	0.59		N/A		N/A		N/A		N/A	
5.2 RPv Residual Volume (cu.ft./ac)	2,153		N/A		N/A		N/A		N/A	
5.3 Residual Volume to be Managed or Offset (cu.ft.)	24,351		N/A		N/A		N/A		N/A	
5.4 RPv avg. discharge rate for 48-hr detention (cfs)	0.141		N/A		N/A		N/A		N/A	
5.5 RPv max. discharge rate for 48-hr detention (cfs)	0.705		N/A		N/A		N/A		N/A	

***NOTE: No additional runoff reduction credit can be taken for surface recharge practices once the "Adjusted CN after all reductions" (Step 4.6) reaches the equivalent CN for the native soil-cover condition of the BMP footprint itself (i.e. for Sheet Flow to Turf Filter Strip on B soils Step 4.6 cannot be below 61). If this occurs contact the DNREC – SSP for further guidance**

PROJECT: Townsend Acres Subdivision
DRAINAGE SUBAREA ID: LOD
TMDL WATERSHED: Appoquinimink River

TOTAL MAXIMUM DAILY LOAD (TMDL) WORKSHEET

	BMP 1				BMP 2				BMP 3				BMP 4				BMP 5			
	Type:	0-No BMP			Type:	--			Type:	--			Type:	--			Type:	--		
Step 1 - Calculate Annual Runoff Volume	Data	TN	TP	TSS	Data	TN	TP	TSS	Data	TN	TP	TSS	Data	TN	TP	TSS	Data	TN	TP	TSS
1.1 Total contributing area to BMP (ac)	11.31																			
1.2 Initial RCN	73																			
1.3 Annual runoff volume (in.)	13.61																			
1.4 Annual runoff volume (liters)	1.58E+07																			
Step 2 - Calculate Annual Pollutant Load																				
2.1 EMC (mg/L)		2.80	0.49	90		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A
2.2 Load (mg/yr)		4.43E+07	7.75E+06	1.42E+09		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A
2.3 Stormwater Load (lb/ ac/yr)		8.63	1.51	278		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A
Step 3 - Adjust for Pollutant Reduction																				
3.1 BMP annual runoff reduction (%)	0%				N/A				N/A				N/A				N/A			
3.2 Adjusted annual runoff volume (in)	13.60				N/A				N/A				N/A				N/A			
3.3 Adjusted annual runoff volume (liters)	1.58E+07				N/A				N/A				N/A				N/A			
3.4 Adjusted load from annual reductions (lb/ac/yr)		8.63	1.51	277.49		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A
3.5 BMP removal efficiency (%)		0%	0%	0%		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A
3.6 BMP effluent concentration (mg/L)		2.80	0.49	90.00		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A
3.7 Final Adjusted load (lb/ ac/yr)		8.63	1.51	277		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A
Step 4 - Pollutant Reduction Met? *(For Informational Purposes)*																				
4.1 TMDL (lb/ac/yr)		6.40	0.83	N/A																
4.2 Reduction met?		NO	NO	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A
4.3 Final Adjusted Load (lb/yr)		97.64	17.09	3138		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A

PROJECT:	Townsend Acres Subdivision
DRAINAGE SUBAREA ID:	LOD
LOCATION (County):	New Castle

CONVEYANCE EVENT (Cv) WORKSHEET

	BMP 1		BMP 2		BMP 3		BMP 4		BMP 5	
	Type:	**0-No BMP**	**Type:**	**--**	**Type:**	**--**	**Type:**	**--**	**Type:**	**--**
Step 1 - Calculate Initial Cv	**Data**		**Data**		**Data**		**Data**		**Data**	
1.1 Total contributing area to BMP (ac)	11.31		11.31		11.31		11.31		11.31	
1.2 Initial RCN	73.48									
1.3 10-Year Rainfall (in.)	4.8									
1.4 Cv runoff volume (in.)	2.16									
Step 2 - Adjust for Retention Reduction										
2.1 Storage volume (cu. ft.)	0.00		N/A		N/A		N/A		N/A	
2.2 Storage volume (ac-ft)	0.00		N/A		N/A		N/A		N/A	
2.3 Storage volume (in.)	0.00		N/A		N/A		N/A		N/A	
2.4 Runoff volume after reduction (in.)	2.16		N/A		N/A		N/A		N/A	
2.5 CN*	73.48		N/A		N/A		N/A		N/A	
Step 3 - Adjust for Annual Runoff Reduction										
3.1 Runoff reduction allowance (%)	0%		N/A		N/A		N/A		N/A	
3.2 Annual runoff after reduction (in.)	2.16		N/A		N/A		N/A		N/A	
3.3 Adjusted ACN	73.48		N/A		N/A		N/A		N/A	
3.4 Event-based runoff reduction (in.)	0.00		N/A		N/A		N/A		N/A	
Step 4 - Calculate Cv with BMP Reductions										
4.1 Cv runoff volume after all reductions (in.)	2.16		N/A		N/A		N/A		N/A	
4.2 Total Cv runoff reduction (%)	0%		N/A		N/A		N/A		N/A	
4.3 Adjusted RCN for H&H modeling	73.48		N/A		N/A		N/A		N/A	

PROJECT:	Townsend Acres Subdivision
DRAINAGE SUBAREA ID:	LOD
LOCATION (County):	New Castle

FLOODING EVENT (Fv) WORKSHEET

	BMP 1		BMP 2		BMP 3		BMP 4		BMP 5	
	Type:	**0-No BMP**	**Type:**	**--**	**Type:**	**--**	**Type:**	**--**	**Type:**	**--**
Step 1 - Calculate Initial Fv	**Data**		**Data**		**Data**		**Data**		**Data**	
1.1 Total contributing area to BMP (ac)	11.31		11.31		11.31		11.31		11.31	
1.2 Initial RCN	73.48									
1.3 100-Year Rainfall (in.)	8.0									
1.4 Fv runoff volume (in.)	4.87									
Step 2 - Adjust for Retention Reduction										
2.1 Storage volume (cu. ft.)	0.00		N/A		N/A		N/A		N/A	
2.2 Storage volume (ac-ft)	0.00		N/A		N/A		N/A		N/A	
2.3 Storage volume (in.)	0.00		N/A		N/A		N/A		N/A	
2.4 Runoff volume after reduction (in.)	4.87		N/A		N/A		N/A		N/A	
2.5 CN*	73.48		N/A		N/A		N/A		N/A	
Step 3 - Adjust for Annual Runoff Reduction										
3.1 Runoff reduction allowance (%)	0%		N/A		N/A		N/A		N/A	
3.2 Annual runoff after reduction (in.)	4.87		N/A		N/A		N/A		N/A	
3.3 Adjusted ACN	73.48		N/A		N/A		N/A		N/A	
3.4 Event-based runoff reduction (in.)	0.00		N/A		N/A		N/A		N/A	
Step 4 - Calculate Fv with BMP Reductions										
4.1 Fv runoff volume after all reductions (in.)	4.87		N/A		N/A		N/A		N/A	
4.2 Total Fv runoff reduction (%)	0%		N/A		N/A		N/A		N/A	
4.3 Adjusted RCN for H&H modeling	73.48		N/A		N/A		N/A		N/A	

PROJECT:	Townsend Acres Subdivision		
DRAINAGE SUBAREA ID:	LOD		
COUNTY:	New Castle	**UNIT HYDROGRAPH:**	DMV
TMDL Watershed:	Appoquinimink River	**VERSION:**	DURMM v2.51.220414

DURMM OUTPUT WORKSHEET

Site Data

Contributing Area to BMPs (ac.)	11.31				
C.A. RCN	73.28				
Subarea LOD (ac.)	11.31				
Subarea RCN	73.48				
Upstream Subarea ID	N/A	N/A	N/A	N/A	
Upstream Subarea LOD (ac.)	0.00	0.00	0.00	0.00	
Combined LOD with Upstream Areas (ac.)	11.31				
Combined RCN with Upstream Areas (ac.)	73.48				
Watershed TMDL-TN (lb/ac/yr)	6.40				
Watershed TMDL-TP (lb/ac/yr)	0.83				
Watershed TMDL-TSS (lb/ac/yr)	N/A				

BMP Data

	BMP 1	BMP 2	BMP 3	BMP 4	BMP 5
	0-No BMP	--	--	--	--
RPv runoff volume after all reductions (in.)	1.04	N/A	N/A	N/A	N/A
Total RPv runoff reduction (in.)	0.00	N/A	N/A	N/A	N/A
Total RPv runoff reduction (%)	0%	N/A	N/A	N/A	N/A
RPv Compliance Met Through Runoff Reduction?	NO	N/A	N/A	N/A	N/A
RPv Residual Volume (cu. ft.)	24,351	N/A	N/A	N/A	N/A
Adjusted pollutant load, TN (lb/ac/yr)	8.63	N/A	N/A	N/A	N/A
Adjusted pollutant load, TP (lb/ac/yr)	1.51	N/A	N/A	N/A	N/A
Adjusted pollutant load, TSS (lb/ac/yr)	277.49	N/A	N/A	N/A	N/A
Cv runoff volume after all reductions (in.)	2.16	N/A	N/A	N/A	N/A
Fv runoff volume after all reductions (in.)	4.87	N/A	N/A	N/A	N/A

Resource Protection Event (RPV)

RPv for Contributing Area (in.)	1.04		
Annual Runoff for Contributing Area (in.)	13.61		
Req'd RPv to be Managed for Contributing Area (in.)	0.59		
Req'd RPv to be Managed for Contributing Area (%)	57%		
RPv Runoff Management Required (cu. Ft.)	24351		
RPv Runoff Management Provided (cu. Ft.)	0		
RPv Residual Volume (cu.ft.)	24351	SHORTFALL	(Requires additional management or offset)
C.A. RPv avg. discharge rate (cfs)	0.14		
C.A. RPv max. discharge rate (cfs)	0.70		
TN Pollutant Load (lb/yr)	97.64		
TP Pollutant Load (lb/yr)	17.09		
TSS Pollutant Load (lb/yr)	3138		

Conveyance Event (Cv)

Cv runoff volume (in.)	2.16
Adjusted RCN for H&H Modeling (CN*)	73.48

Flooding Event (Fv)

Fv runoff volume (in.)	4.87
Equivalent RCN for H&H Modeling (CN*)	73.48

PROJECT:	Townsend Acres Subdivision		
DRAINAGE SUBAREA ID:	LOD		
COUNTY:	New Castle	**UNIT HYDROGRAPH:**	DMV
TMDL Watershed:	Appoquinimink River	**VERSION:**	**DURMM v2.51.220414**

DURMM OUTPUT WORKSHEET

Adjusted Subarea Data for Downstream DURMM Modeling

Subarea ID	LOD
Contributing Area (ac.)	11.31
Weighted Target Runoff (in.)	0.45
Adjusted CN after all reductions	73.48
Adjusted RPv (in.)	1.04
Adjusted Cv (in.)	2.16
Adjusted Fv (in.)	4.87

Adjusted Subarea Data for Nutrient Protocol Modeling

Contributing Area (ac.)	11.31
LOD Area (ac.)	11.31
TN Pollutant Load (lb/yr)	97.64
TP Pollutant Load (lb/yr)	17.09
TSS Pollutant Load (lb/yr)	3138
Percent Impervious Cover	40%

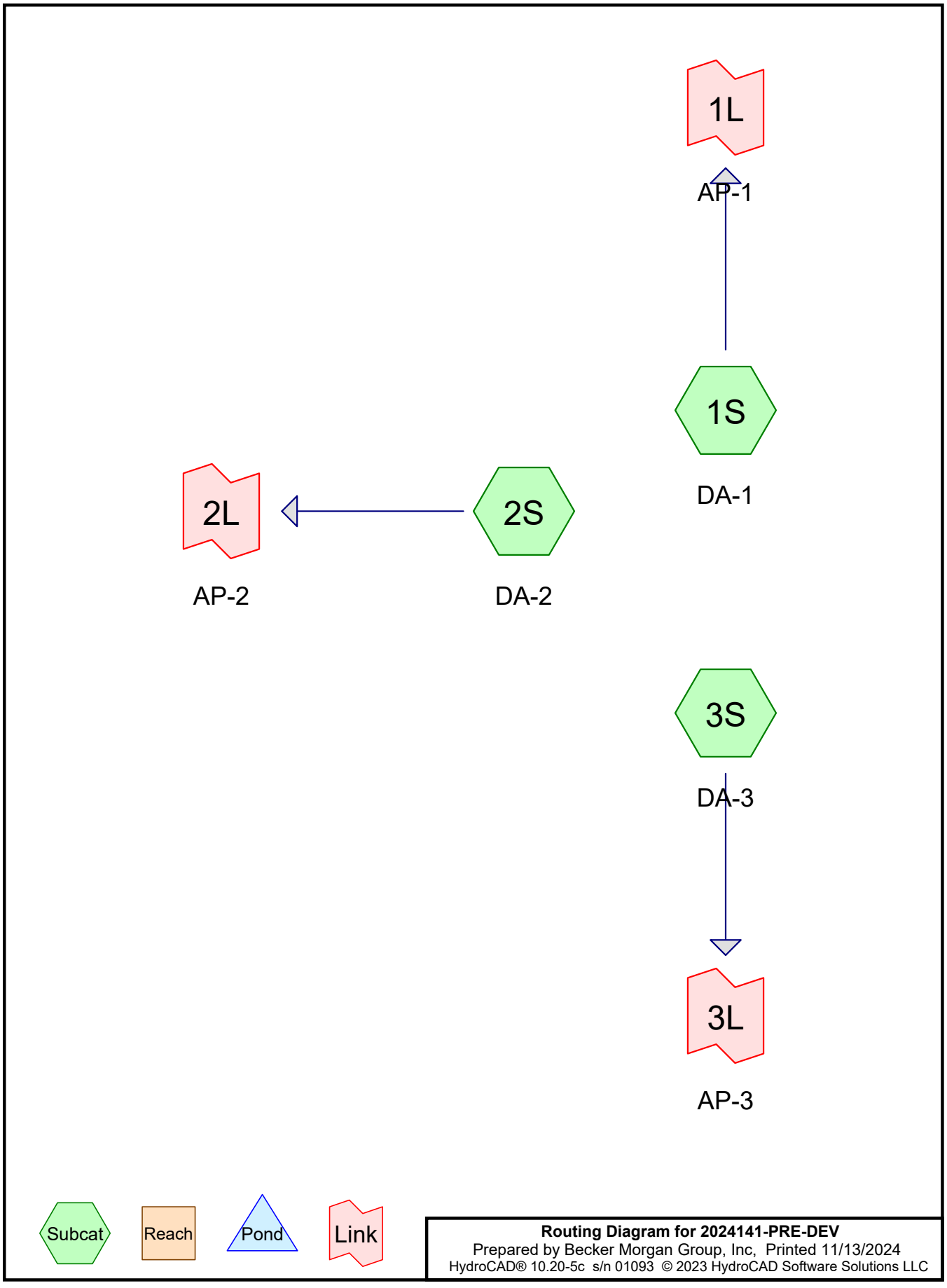
Adjusted Subarea Data for the Summary Table for Sub-Areas Draining to a Common Point of Interest

Subarea ID	LOD	
Contributing Area (ac.)	11.31	
RPv Residual Volume (cu.ft.)	24351	SHORTFALL (Requires additional management or offset)
Adjusted CN after all reductions	73.48	
Cv RCN for H&H Modeling	73.48	
Fv RCN for H&H Modeling	73.48	
TN Pollutant Load (lb/yr)	97.64	
TP Pollutant Load (lb/yr)	17.09	
TSS Pollutant Load (lb/yr)	3138	

A.4
PRE-DEVELOPED Cv (10-YEAR) HYDROCAD CALCULATIONS

Townsend Acres Subdivision

Townsend, Delaware



Routing Diagram for 2024141-PRE-DEV
Prepared by Becker Morgan Group, Inc, Printed 11/13/2024

2024141-PRE-DEV

Prepared by Becker Morgan Group, Inc

Printed 11/13/2024

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.040	61	>75% Grass cover, Good, HSG B (2S)
0.050	80	>75% Grass cover, Good, HSG D (1S)
3.690	30	Woods, Good, HSG A (2S, 3S)
7.640	55	Woods, Good, HSG B (1S, 2S)
2.850	70	Woods, Good, HSG C (2S, 3S)
0.960	77	Woods, Good, HSG D (1S, 2S)
15.230	**53**	**TOTAL AREA**

2024141-PRE-DEV

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
3.690	HSG A	2S, 3S
7.680	HSG B	1S, 2S
2.850	HSG C	2S, 3S
1.010	HSG D	1S, 2S
0.000	Other	
15.230		**TOTAL AREA**

2024141-PRE-DEV

Prepared by Becker Morgan Group, Inc

Printed 11/13/2024

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.040	0.000	0.050	0.000	0.090	>75% Grass cover, Good	1S, 2S
3.690	7.640	2.850	0.960	0.000	15.140	Woods, Good	1S, 2S, 3S
3.690	**7.680**	**2.850**	**1.010**	**0.000**	**15.230**	**TOTAL AREA**	

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

Subcatchment1S: DA-1 Runoff Area=2.160 ac 0.00% Impervious Runoff Depth=1.06"
Flow Length=385' Tc=27.6 min CN=58 Runoff=0.89 cfs 0.191 af

Subcatchment2S: DA-2 Runoff Area=11.180 ac 0.00% Impervious Runoff Depth=0.94"
Flow Length=892' Tc=45.5 min CN=56 Runoff=2.88 cfs 0.876 af

Subcatchment3S: DA-3 Runoff Area=1.890 ac 0.00% Impervious Runoff Depth=0.00"
Flow Length=472' Tc=28.3 min CN=30 Runoff=0.00 cfs 0.000 af

Link 1L: AP-1 Inflow=0.89 cfs 0.191 af
Primary=0.89 cfs 0.191 af

Link 2L: AP-2 Inflow=2.88 cfs 0.876 af
Primary=2.88 cfs 0.876 af

Link 3L: AP-3 Inflow=0.00 cfs 0.000 af
Primary=0.00 cfs 0.000 af

Total Runoff Area = 15.230 ac Runoff Volume = 1.067 af Average Runoff Depth = 0.84"
100.00% Pervious = 15.230 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1S: DA-1

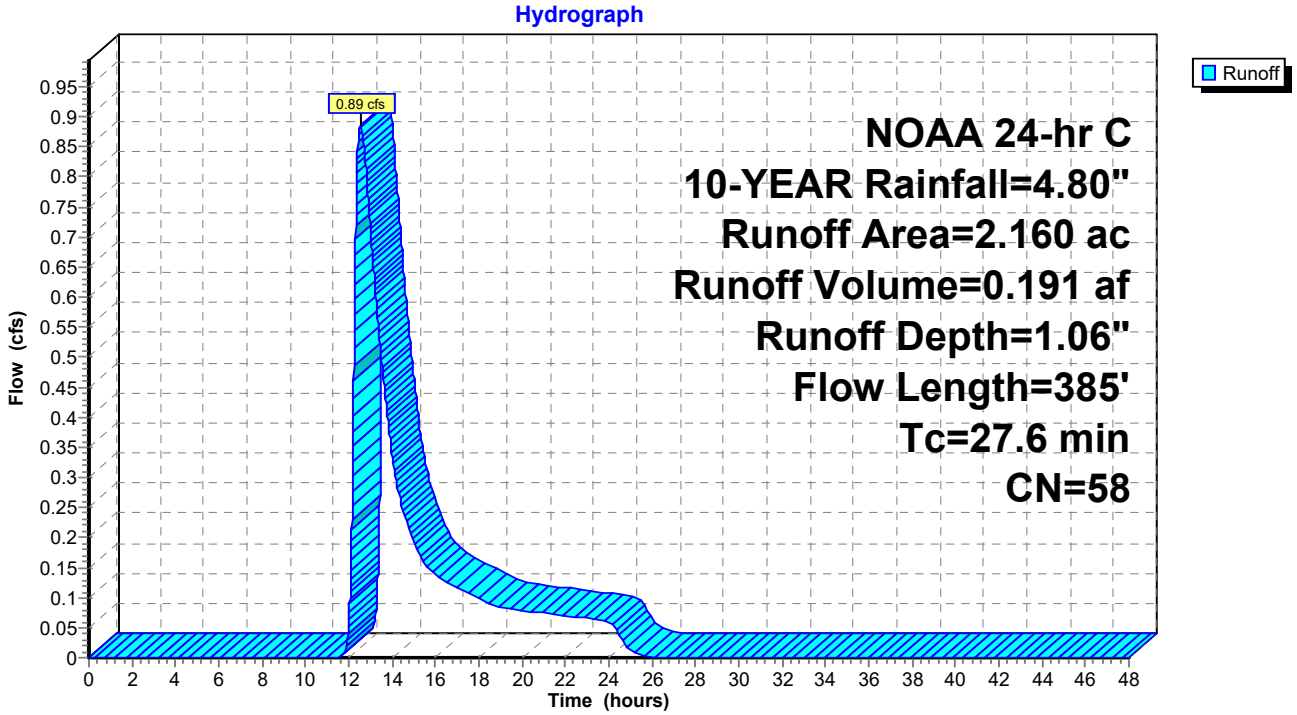
Runoff = 0.89 cfs @ 12.52 hrs, Volume= 0.191 af, Depth= 1.06"
Routed to Link 1L : AP-1

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 10-YEAR Rainfall=4.80"

Area (ac)	CN	Description
1.830	55	Woods, Good, HSG B
0.280	77	Woods, Good, HSG D
0.050	80	>75% Grass cover, Good, HSG D
2.160	58	Weighted Average
2.160		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.5	100	0.0200	0.08		**Sheet Flow, 1A** Woods: Light underbrush n= 0.400 P2= 3.20"
6.1	285	0.0239	0.77		**Shallow Concentrated Flow, 1B** Woodland Kv= 5.0 fps
27.6	385	Total			

Subcatchment 1S: DA-1



Hydrograph for Subcatchment 1S: DA-1

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00
0.50	0.03	0.00	0.00
1.00	0.05	0.00	0.00
1.50	0.08	0.00	0.00
2.00	0.11	0.00	0.00
2.50	0.14	0.00	0.00
3.00	0.17	0.00	0.00
3.50	0.20	0.00	0.00
4.00	0.23	0.00	0.00
4.50	0.27	0.00	0.00
5.00	0.31	0.00	0.00
5.50	0.34	0.00	0.00
6.00	0.38	0.00	0.00
6.50	0.42	0.00	0.00
7.00	0.47	0.00	0.00
7.50	0.52	0.00	0.00
8.00	0.58	0.00	0.00
8.50	0.64	0.00	0.00
9.00	0.70	0.00	0.00
9.50	0.78	0.00	0.00
10.00	0.88	0.00	0.00
10.50	0.99	0.00	0.00
11.00	1.15	0.00	0.00
11.50	1.42	0.00	0.00
12.00	2.29	0.09	0.06
12.50	3.38	0.41	**0.88**
13.00	3.65	0.51	**0.71**
13.50	3.81	0.58	0.50
14.00	3.92	0.63	0.34
14.50	4.02	0.67	0.25
15.00	4.10	0.71	0.19
15.50	4.16	0.74	0.16
16.00	4.22	0.77	0.14
16.50	4.28	0.80	0.13
17.00	4.33	0.82	0.12
17.50	4.38	0.84	0.11
18.00	4.42	0.86	0.10
18.50	4.46	0.88	0.09
19.00	4.49	0.90	0.08
19.50	4.53	0.92	0.08
20.00	4.57	0.94	0.08
20.50	4.60	0.95	0.08
21.00	4.63	0.97	0.07
21.50	4.66	0.99	0.07
22.00	4.69	1.00	0.07
22.50	4.72	1.02	0.07
23.00	4.75	1.03	0.07
23.50	4.77	1.05	0.06
24.00	**4.80**	**1.06**	0.06
24.50	4.80	1.06	0.04
25.00	4.80	1.06	0.01
25.50	4.80	1.06	0.00
26.00	4.80	1.06	0.00
26.50	4.80	1.06	0.00
27.00	4.80	1.06	0.00
27.50	4.80	1.06	0.00
28.00	4.80	1.06	0.00
28.50	4.80	1.06	0.00
29.00	4.80	1.06	0.00
29.50	4.80	1.06	0.00
30.00	4.80	1.06	0.00
30.50	4.80	1.06	0.00
31.00	4.80	1.06	0.00
31.50	4.80	1.06	0.00
32.00	4.80	1.06	0.00
32.50	4.80	1.06	0.00
33.00	4.80	1.06	0.00
33.50	4.80	1.06	0.00
34.00	4.80	1.06	0.00
34.50	4.80	1.06	0.00
35.00	4.80	1.06	0.00
35.50	4.80	1.06	0.00
36.00	4.80	1.06	0.00
36.50	4.80	1.06	0.00
37.00	4.80	1.06	0.00
37.50	4.80	1.06	0.00
38.00	4.80	1.06	0.00
38.50	4.80	1.06	0.00
39.00	4.80	1.06	0.00
39.50	4.80	1.06	0.00
40.00	4.80	1.06	0.00
40.50	4.80	1.06	0.00
41.00	4.80	1.06	0.00
41.50	4.80	1.06	0.00
42.00	4.80	1.06	0.00
42.50	4.80	1.06	0.00
43.00	4.80	1.06	0.00
43.50	4.80	1.06	0.00
44.00	4.80	1.06	0.00
44.50	4.80	1.06	0.00
45.00	4.80	1.06	0.00
45.50	4.80	1.06	0.00
46.00	4.80	1.06	0.00
46.50	4.80	1.06	0.00
47.00	4.80	1.06	0.00
47.50	4.80	1.06	0.00
48.00	4.80	1.06	0.00

Summary for Subcatchment 2S: DA-2

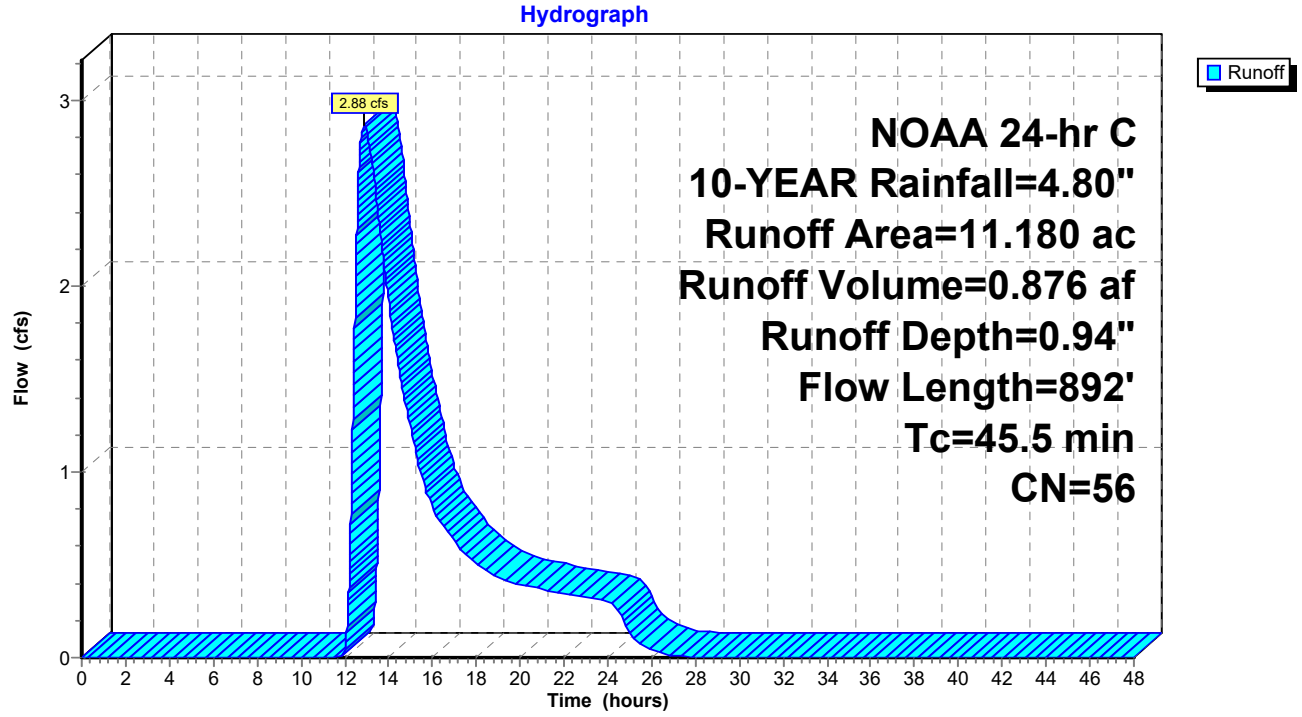
Runoff = 2.88 cfs @ 12.85 hrs, Volume= 0.876 af, Depth= 0.94"
Routed to Link 2L : AP-2

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 10-YEAR Rainfall=4.80"

Area (ac)	CN	Description
1.820	30	Woods, Good, HSG A
5.810	55	Woods, Good, HSG B
2.830	70	Woods, Good, HSG C
0.680	77	Woods, Good, HSG D
0.040	61	>75% Grass cover, Good, HSG B
11.180	56	Weighted Average
11.180		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.3	100	0.0300	0.09		**Sheet Flow, 2A** Woods: Light underbrush n= 0.400 P2= 3.20"
27.2	792	0.0094	0.48		**Shallow Concentrated Flow, 2B** Woodland Kv= 5.0 fps
45.5	892	Total			

Subcatchment 2S: DA-2



Hydrograph for Subcatchment 2S: DA-2

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00
0.50	0.03	0.00	0.00
1.00	0.05	0.00	0.00
1.50	0.08	0.00	0.00
2.00	0.11	0.00	0.00
2.50	0.14	0.00	0.00
3.00	0.17	0.00	0.00
3.50	0.20	0.00	0.00
4.00	0.23	0.00	0.00
4.50	0.27	0.00	0.00
5.00	0.31	0.00	0.00
5.50	0.34	0.00	0.00
6.00	0.38	0.00	0.00
6.50	0.42	0.00	0.00
7.00	0.47	0.00	0.00
7.50	0.52	0.00	0.00
8.00	0.58	0.00	0.00
8.50	0.64	0.00	0.00
9.00	0.70	0.00	0.00
9.50	0.78	0.00	0.00
10.00	0.88	0.00	0.00
10.50	0.99	0.00	0.00
11.00	1.15	0.00	0.00
11.50	1.42	0.00	0.00
12.00	2.29	0.06	0.04
12.50	3.38	0.34	**2.06**
13.00	3.65	0.43	**2.84**
13.50	3.81	0.50	2.42
14.00	3.92	0.54	1.92
14.50	4.02	0.58	1.53
15.00	4.10	0.62	1.24
15.50	4.16	0.64	0.98
16.00	4.22	0.67	0.81
16.50	4.28	0.69	0.71
17.00	4.33	0.72	0.63
17.50	4.38	0.74	0.56
18.00	4.42	0.76	0.51
18.50	4.46	0.78	0.47
19.00	4.49	0.79	0.43
19.50	4.53	0.81	0.41
20.00	4.57	0.83	0.39
20.50	4.60	0.84	0.38
21.00	4.63	0.86	0.37
21.50	4.66	0.87	0.36
22.00	4.69	0.89	0.35
22.50	4.72	0.90	0.34
23.00	4.75	0.91	0.32
23.50	4.77	0.93	0.31
24.00	**4.80**	**0.94**	0.30
24.50	4.80	0.94	0.25
25.00	4.80	0.94	0.14
25.50	4.80	0.94	0.08
26.00	4.80	0.94	0.04
26.50	4.80	0.94	0.02
27.00	4.80	0.94	0.01
27.50	4.80	0.94	0.00
28.00	4.80	0.94	0.00
28.50	4.80	0.94	0.00
29.00	4.80	0.94	0.00
29.50	4.80	0.94	0.00
30.00	4.80	0.94	0.00
30.50	4.80	0.94	0.00
31.00	4.80	0.94	0.00
31.50	4.80	0.94	0.00
32.00	4.80	0.94	0.00
32.50	4.80	0.94	0.00
33.00	4.80	0.94	0.00
33.50	4.80	0.94	0.00
34.00	4.80	0.94	0.00
34.50	4.80	0.94	0.00
35.00	4.80	0.94	0.00
35.50	4.80	0.94	0.00
36.00	4.80	0.94	0.00
36.50	4.80	0.94	0.00
37.00	4.80	0.94	0.00
37.50	4.80	0.94	0.00
38.00	4.80	0.94	0.00
38.50	4.80	0.94	0.00
39.00	4.80	0.94	0.00
39.50	4.80	0.94	0.00
40.00	4.80	0.94	0.00
40.50	4.80	0.94	0.00
41.00	4.80	0.94	0.00
41.50	4.80	0.94	0.00
42.00	4.80	0.94	0.00
42.50	4.80	0.94	0.00
43.00	4.80	0.94	0.00
43.50	4.80	0.94	0.00
44.00	4.80	0.94	0.00
44.50	4.80	0.94	0.00
45.00	4.80	0.94	0.00
45.50	4.80	0.94	0.00
46.00	4.80	0.94	0.00
46.50	4.80	0.94	0.00
47.00	4.80	0.94	0.00
47.50	4.80	0.94	0.00
48.00	4.80	0.94	0.00

Summary for Subcatchment 3S: DA-3

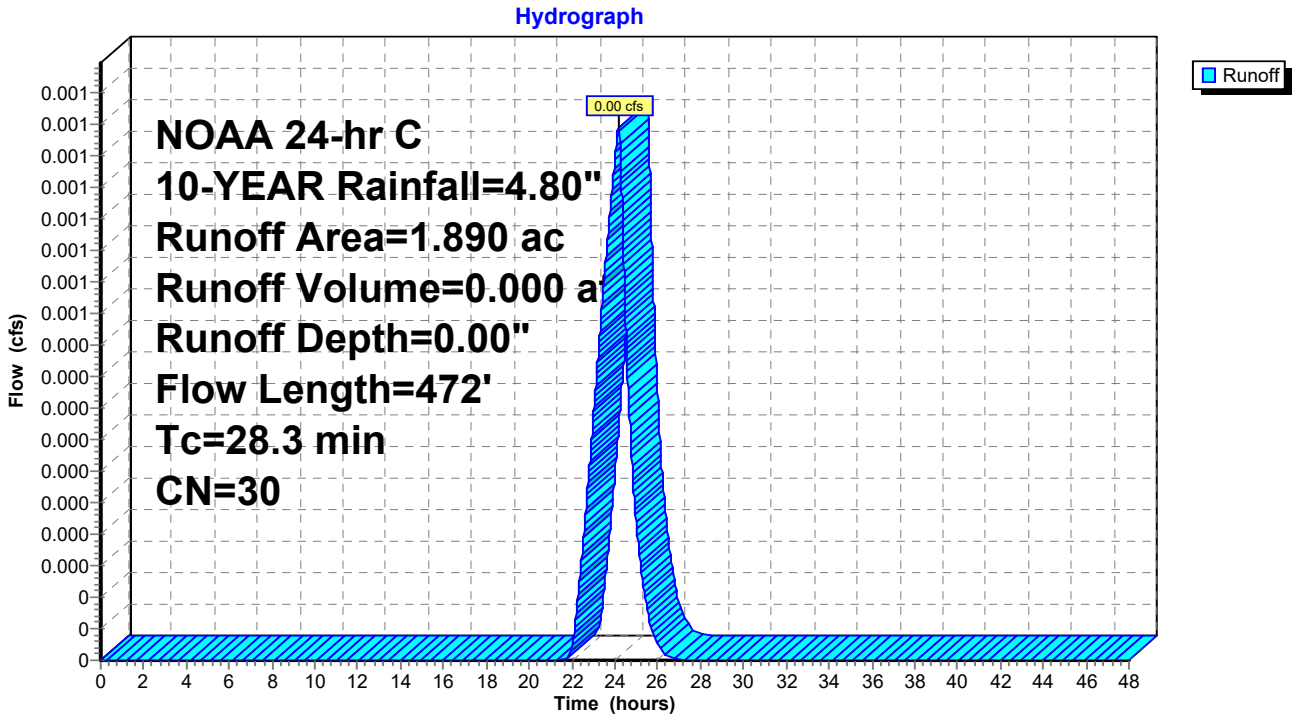
Runoff = 0.00 cfs @ 24.15 hrs, Volume= 0.000 af, Depth= 0.00"
Routed to Link 3L : AP-3

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 10-YEAR Rainfall=4.80"

Area (ac)	CN	Description
1.870	30	Woods, Good, HSG A
0.020	70	Woods, Good, HSG C
1.890	30	Weighted Average
1.890		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.8	100	0.0321	0.09		**Sheet Flow, 3A** Woods: Light underbrush n= 0.400 P2= 3.20"
10.5	372	0.0139	0.59		**Shallow Concentrated Flow, 3B** Woodland Kv= 5.0 fps
28.3	472	Total			

Subcatchment 3S: DA-3



Hydrograph for Subcatchment 3S: DA-3

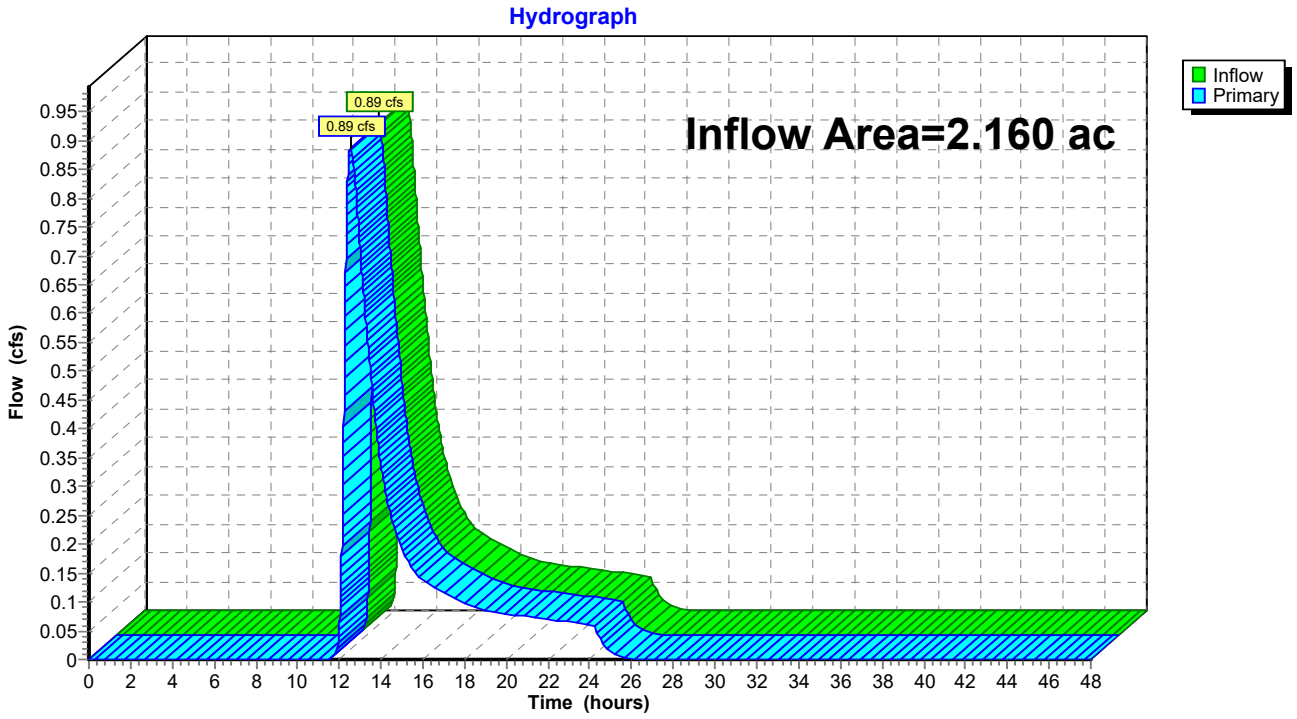
Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00	25.50	4.80	0.00	0.00
0.50	0.03	0.00	0.00	26.00	4.80	0.00	0.00
1.00	0.05	0.00	0.00	26.50	4.80	0.00	0.00
1.50	0.08	0.00	0.00	27.00	4.80	0.00	0.00
2.00	0.11	0.00	0.00	27.50	4.80	0.00	0.00
2.50	0.14	0.00	0.00	28.00	4.80	0.00	0.00
3.00	0.17	0.00	0.00	28.50	4.80	0.00	0.00
3.50	0.20	0.00	0.00	29.00	4.80	0.00	0.00
4.00	0.23	0.00	0.00	29.50	4.80	0.00	0.00
4.50	0.27	0.00	0.00	30.00	4.80	0.00	0.00
5.00	0.31	0.00	0.00	30.50	4.80	0.00	0.00
5.50	0.34	0.00	0.00	31.00	4.80	0.00	0.00
6.00	0.38	0.00	0.00	31.50	4.80	0.00	0.00
6.50	0.42	0.00	0.00	32.00	4.80	0.00	0.00
7.00	0.47	0.00	0.00	32.50	4.80	0.00	0.00
7.50	0.52	0.00	0.00	33.00	4.80	0.00	0.00
8.00	0.58	0.00	0.00	33.50	4.80	0.00	0.00
8.50	0.64	0.00	0.00	34.00	4.80	0.00	0.00
9.00	0.70	0.00	0.00	34.50	4.80	0.00	0.00
9.50	0.78	0.00	0.00	35.00	4.80	0.00	0.00
10.00	0.88	0.00	0.00	35.50	4.80	0.00	0.00
10.50	0.99	0.00	0.00	36.00	4.80	0.00	0.00
11.00	1.15	0.00	0.00	36.50	4.80	0.00	0.00
11.50	1.42	0.00	0.00	37.00	4.80	0.00	0.00
12.00	2.29	0.00	0.00	37.50	4.80	0.00	0.00
12.50	3.38	0.00	0.00	38.00	4.80	0.00	0.00
13.00	3.65	0.00	0.00	38.50	4.80	0.00	0.00
13.50	3.81	0.00	0.00	39.00	4.80	0.00	0.00
14.00	3.92	0.00	0.00	39.50	4.80	0.00	0.00
14.50	4.02	0.00	0.00	40.00	4.80	0.00	0.00
15.00	4.10	0.00	0.00	40.50	4.80	0.00	0.00
15.50	4.16	0.00	0.00	41.00	4.80	0.00	0.00
16.00	4.22	0.00	0.00	41.50	4.80	0.00	0.00
16.50	4.28	0.00	0.00	42.00	4.80	0.00	0.00
17.00	4.33	0.00	0.00	42.50	4.80	0.00	0.00
17.50	4.38	0.00	0.00	43.00	4.80	0.00	0.00
18.00	4.42	0.00	0.00	43.50	4.80	0.00	0.00
18.50	4.46	0.00	0.00	44.00	4.80	0.00	0.00
19.00	4.49	0.00	0.00	44.50	4.80	0.00	0.00
19.50	4.53	0.00	0.00	45.00	4.80	0.00	0.00
20.00	4.57	0.00	0.00	45.50	4.80	0.00	0.00
20.50	4.60	0.00	0.00	46.00	4.80	0.00	0.00
21.00	4.63	0.00	0.00	46.50	4.80	0.00	0.00
21.50	4.66	0.00	0.00	47.00	4.80	0.00	0.00
22.00	4.69	0.00	0.00	47.50	4.80	0.00	0.00
22.50	4.72	0.00	0.00	48.00	4.80	0.00	0.00
23.00	4.75	0.00	0.00				
23.50	4.77	0.00	0.00				
24.00	**4.80**	**0.00**	**0.00**				
24.50	4.80	0.00	**0.00**				
25.00	4.80	0.00	0.00				

Summary for Link 1L: AP-1

Inflow Area = 2.160 ac, 0.00% Impervious, Inflow Depth = 1.06" for 10-YEAR event
Inflow = 0.89 cfs @ 12.52 hrs, Volume= 0.191 af
Primary = 0.89 cfs @ 12.52 hrs, Volume= 0.191 af, Atten= 0%, Lag= 0.0 min

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

Link 1L: AP-1



Hydrograph for Link 1L: AP-1

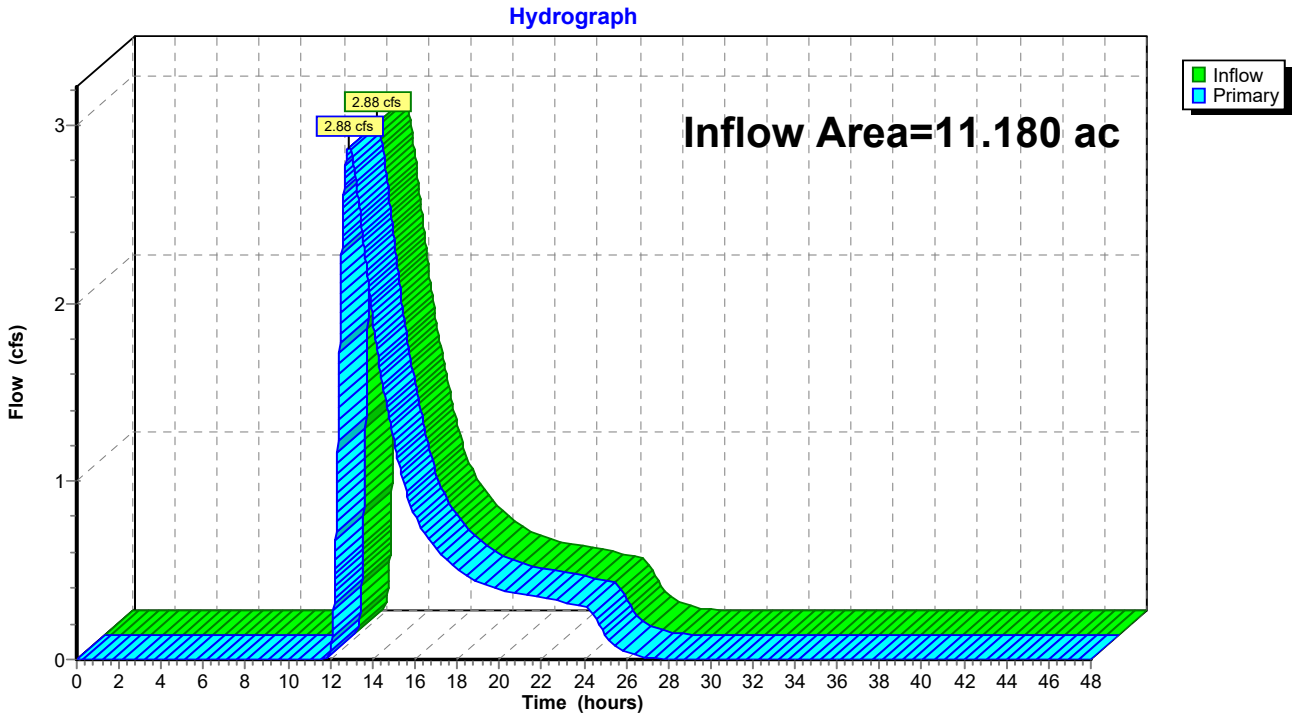
Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)
0.00	0.00	**0.00**	0.00	25.50	0.00	0.00	0.00
0.50	0.00	0.00	0.00	26.00	0.00	0.00	0.00
1.00	0.00	0.00	0.00	26.50	0.00	0.00	0.00
1.50	0.00	0.00	0.00	27.00	0.00	0.00	0.00
2.00	0.00	0.00	0.00	27.50	0.00	0.00	0.00
2.50	0.00	0.00	0.00	28.00	0.00	0.00	0.00
3.00	0.00	0.00	0.00	28.50	0.00	0.00	0.00
3.50	0.00	0.00	0.00	29.00	0.00	0.00	0.00
4.00	0.00	0.00	0.00	29.50	0.00	0.00	0.00
4.50	0.00	0.00	0.00	30.00	0.00	0.00	0.00
5.00	0.00	0.00	0.00	30.50	0.00	0.00	0.00
5.50	0.00	0.00	0.00	31.00	0.00	0.00	0.00
6.00	0.00	0.00	0.00	31.50	0.00	0.00	0.00
6.50	0.00	0.00	0.00	32.00	0.00	0.00	0.00
7.00	0.00	0.00	0.00	32.50	0.00	0.00	0.00
7.50	0.00	0.00	0.00	33.00	0.00	0.00	0.00
8.00	0.00	0.00	0.00	33.50	0.00	0.00	0.00
8.50	0.00	0.00	0.00	34.00	0.00	0.00	0.00
9.00	0.00	0.00	0.00	34.50	0.00	0.00	0.00
9.50	0.00	0.00	0.00	35.00	0.00	0.00	0.00
10.00	0.00	0.00	0.00	35.50	0.00	0.00	0.00
10.50	0.00	0.00	0.00	36.00	0.00	0.00	0.00
11.00	0.00	0.00	0.00	36.50	0.00	0.00	0.00
11.50	0.00	0.00	0.00	37.00	0.00	0.00	0.00
12.00	0.06	0.00	0.06	37.50	0.00	0.00	0.00
12.50	**0.88**	0.00	**0.88**	38.00	0.00	0.00	0.00
13.00	**0.71**	0.00	**0.71**	38.50	0.00	0.00	0.00
13.50	0.50	0.00	0.50	39.00	0.00	0.00	0.00
14.00	0.34	0.00	0.34	39.50	0.00	0.00	0.00
14.50	0.25	0.00	0.25	40.00	0.00	0.00	0.00
15.00	0.19	0.00	0.19	40.50	0.00	0.00	0.00
15.50	0.16	0.00	0.16	41.00	0.00	0.00	0.00
16.00	0.14	0.00	0.14	41.50	0.00	0.00	0.00
16.50	0.13	0.00	0.13	42.00	0.00	0.00	0.00
17.00	0.12	0.00	0.12	42.50	0.00	0.00	0.00
17.50	0.11	0.00	0.11	43.00	0.00	0.00	0.00
18.00	0.10	0.00	0.10	43.50	0.00	0.00	0.00
18.50	0.09	0.00	0.09	44.00	0.00	0.00	0.00
19.00	0.08	0.00	0.08	44.50	0.00	0.00	0.00
19.50	0.08	0.00	0.08	45.00	0.00	0.00	0.00
20.00	0.08	0.00	0.08	45.50	0.00	0.00	0.00
20.50	0.08	0.00	0.08	46.00	0.00	0.00	0.00
21.00	0.07	0.00	0.07	46.50	0.00	0.00	0.00
21.50	0.07	0.00	0.07	47.00	0.00	0.00	0.00
22.00	0.07	0.00	0.07	47.50	0.00	0.00	0.00
22.50	0.07	0.00	0.07	48.00	0.00	0.00	0.00
23.00	0.07	0.00	0.07				
23.50	0.06	0.00	0.06				
24.00	0.06	0.00	0.06				
24.50	0.04	0.00	0.04				
25.00	0.01	0.00	0.01				

Summary for Link 2L: AP-2

Inflow Area = 11.180 ac, 0.00% Impervious, Inflow Depth = 0.94" for 10-YEAR event
Inflow = 2.88 cfs @ 12.85 hrs, Volume= 0.876 af
Primary = 2.88 cfs @ 12.85 hrs, Volume= 0.876 af, Atten= 0%, Lag= 0.0 min

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

Link 2L: AP-2



Hydrograph for Link 2L: AP-2

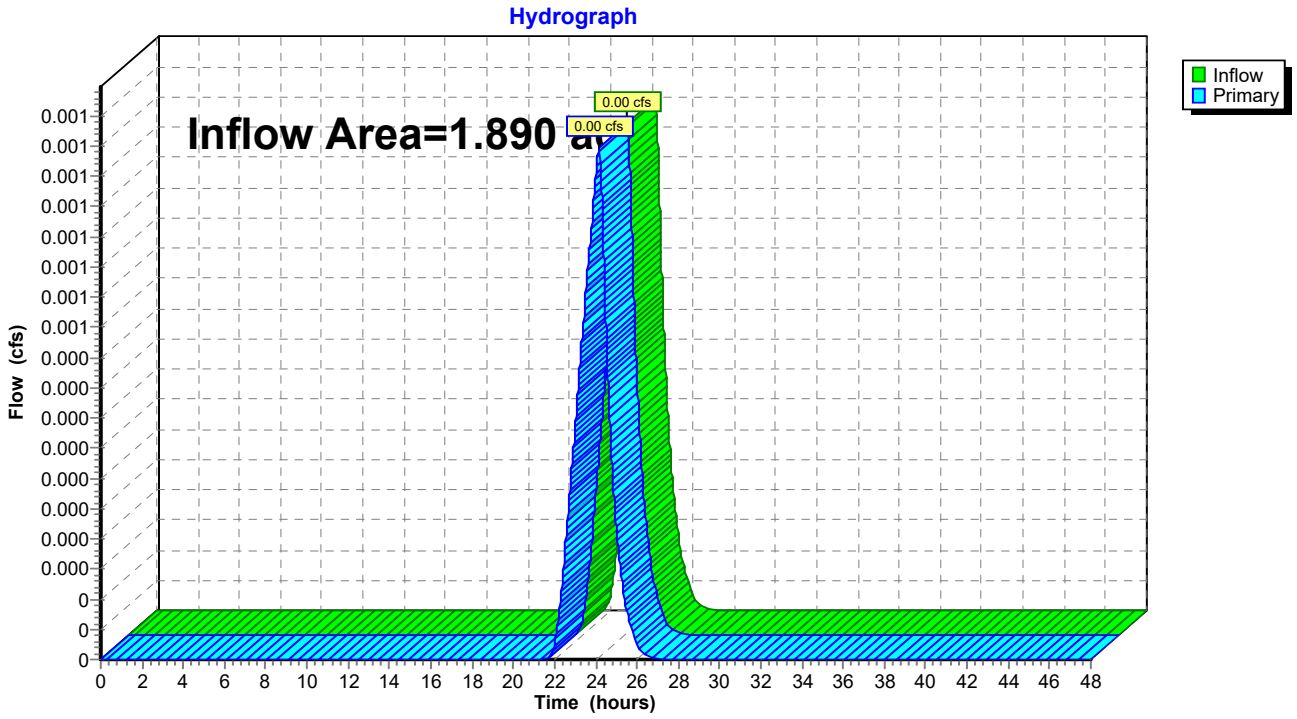
Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)
0.00	0.00	**0.00**	0.00	25.50	0.08	0.00	0.08
0.50	0.00	0.00	0.00	26.00	0.04	0.00	0.04
1.00	0.00	0.00	0.00	26.50	0.02	0.00	0.02
1.50	0.00	0.00	0.00	27.00	0.01	0.00	0.01
2.00	0.00	0.00	0.00	27.50	0.00	0.00	0.00
2.50	0.00	0.00	0.00	28.00	0.00	0.00	0.00
3.00	0.00	0.00	0.00	28.50	0.00	0.00	0.00
3.50	0.00	0.00	0.00	29.00	0.00	0.00	0.00
4.00	0.00	0.00	0.00	29.50	0.00	0.00	0.00
4.50	0.00	0.00	0.00	30.00	0.00	0.00	0.00
5.00	0.00	0.00	0.00	30.50	0.00	0.00	0.00
5.50	0.00	0.00	0.00	31.00	0.00	0.00	0.00
6.00	0.00	0.00	0.00	31.50	0.00	0.00	0.00
6.50	0.00	0.00	0.00	32.00	0.00	0.00	0.00
7.00	0.00	0.00	0.00	32.50	0.00	0.00	0.00
7.50	0.00	0.00	0.00	33.00	0.00	0.00	0.00
8.00	0.00	0.00	0.00	33.50	0.00	0.00	0.00
8.50	0.00	0.00	0.00	34.00	0.00	0.00	0.00
9.00	0.00	0.00	0.00	34.50	0.00	0.00	0.00
9.50	0.00	0.00	0.00	35.00	0.00	0.00	0.00
10.00	0.00	0.00	0.00	35.50	0.00	0.00	0.00
10.50	0.00	0.00	0.00	36.00	0.00	0.00	0.00
11.00	0.00	0.00	0.00	36.50	0.00	0.00	0.00
11.50	0.00	0.00	0.00	37.00	0.00	0.00	0.00
12.00	0.04	0.00	0.04	37.50	0.00	0.00	0.00
12.50	**2.06**	0.00	**2.06**	38.00	0.00	0.00	0.00
13.00	**2.84**	0.00	**2.84**	38.50	0.00	0.00	0.00
13.50	2.42	0.00	2.42	39.00	0.00	0.00	0.00
14.00	1.92	0.00	1.92	39.50	0.00	0.00	0.00
14.50	1.53	0.00	1.53	40.00	0.00	0.00	0.00
15.00	1.24	0.00	1.24	40.50	0.00	0.00	0.00
15.50	0.98	0.00	0.98	41.00	0.00	0.00	0.00
16.00	0.81	0.00	0.81	41.50	0.00	0.00	0.00
16.50	0.71	0.00	0.71	42.00	0.00	0.00	0.00
17.00	0.63	0.00	0.63	42.50	0.00	0.00	0.00
17.50	0.56	0.00	0.56	43.00	0.00	0.00	0.00
18.00	0.51	0.00	0.51	43.50	0.00	0.00	0.00
18.50	0.47	0.00	0.47	44.00	0.00	0.00	0.00
19.00	0.43	0.00	0.43	44.50	0.00	0.00	0.00
19.50	0.41	0.00	0.41	45.00	0.00	0.00	0.00
20.00	0.39	0.00	0.39	45.50	0.00	0.00	0.00
20.50	0.38	0.00	0.38	46.00	0.00	0.00	0.00
21.00	0.37	0.00	0.37	46.50	0.00	0.00	0.00
21.50	0.36	0.00	0.36	47.00	0.00	0.00	0.00
22.00	0.35	0.00	0.35	47.50	0.00	0.00	0.00
22.50	0.34	0.00	0.34	48.00	0.00	0.00	0.00
23.00	0.32	0.00	0.32				
23.50	0.31	0.00	0.31				
24.00	0.30	0.00	0.30				
24.50	0.25	0.00	0.25				
25.00	0.14	0.00	0.14				

Summary for Link 3L: AP-3

Inflow Area = 1.890 ac, 0.00% Impervious, Inflow Depth = 0.00" for 10-YEAR event
Inflow = 0.00 cfs @ 24.15 hrs, Volume= 0.000 af
Primary = 0.00 cfs @ 24.15 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

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

Link 3L: AP-3



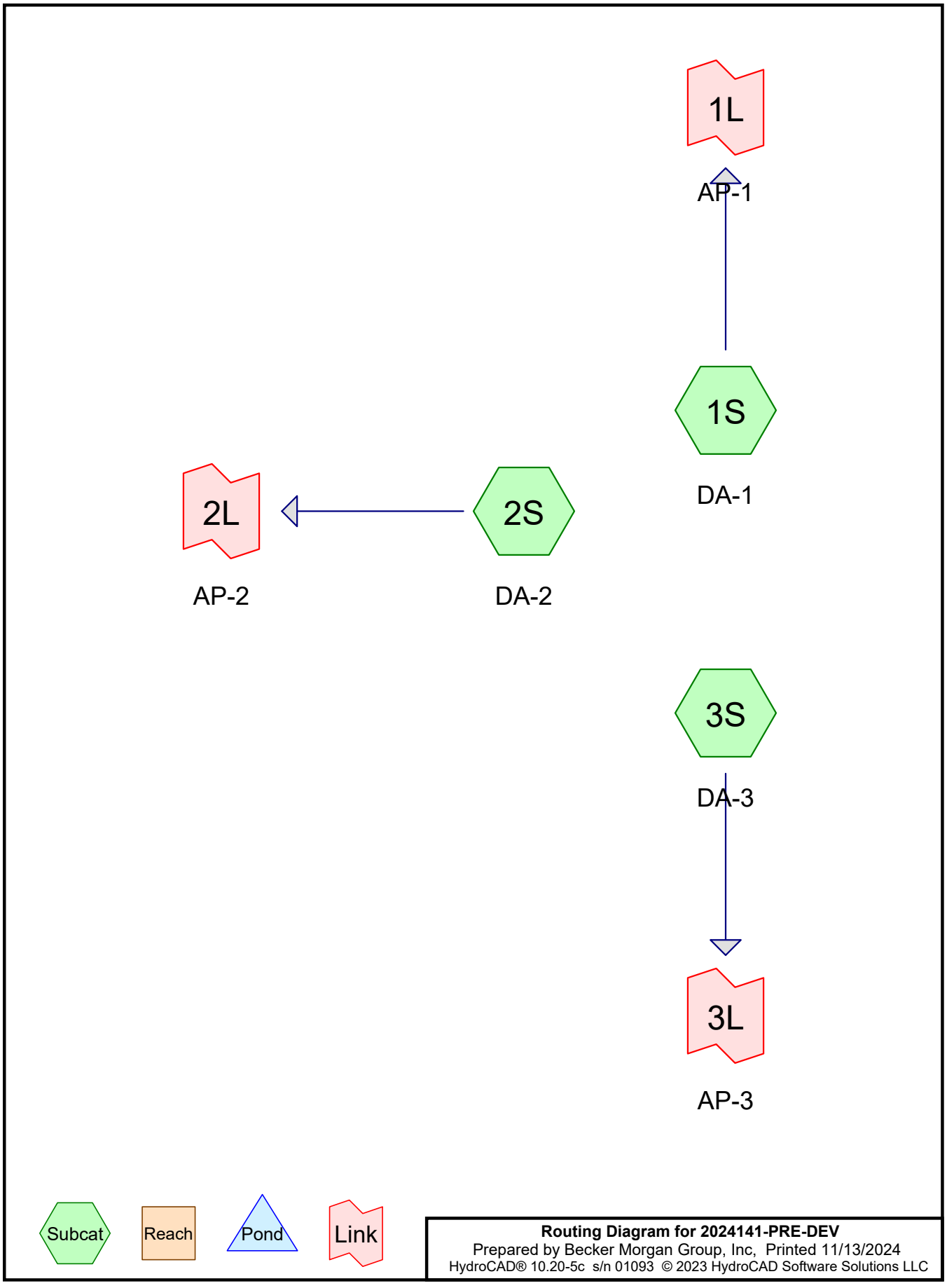
Hydrograph for Link 3L: AP-3

Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)
0.00	0.00	**0.00**	0.00	25.50	0.00	0.00	0.00
0.50	0.00	0.00	0.00	26.00	0.00	0.00	0.00
1.00	0.00	0.00	0.00	26.50	0.00	0.00	0.00
1.50	0.00	0.00	0.00	27.00	0.00	0.00	0.00
2.00	0.00	0.00	0.00	27.50	0.00	0.00	0.00
2.50	0.00	0.00	0.00	28.00	0.00	0.00	0.00
3.00	0.00	0.00	0.00	28.50	0.00	0.00	0.00
3.50	0.00	0.00	0.00	29.00	0.00	0.00	0.00
4.00	0.00	0.00	0.00	29.50	0.00	0.00	0.00
4.50	0.00	0.00	0.00	30.00	0.00	0.00	0.00
5.00	0.00	0.00	0.00	30.50	0.00	0.00	0.00
5.50	0.00	0.00	0.00	31.00	0.00	0.00	0.00
6.00	0.00	0.00	0.00	31.50	0.00	0.00	0.00
6.50	0.00	0.00	0.00	32.00	0.00	0.00	0.00
7.00	0.00	0.00	0.00	32.50	0.00	0.00	0.00
7.50	0.00	0.00	0.00	33.00	0.00	0.00	0.00
8.00	0.00	0.00	0.00	33.50	0.00	0.00	0.00
8.50	0.00	0.00	0.00	34.00	0.00	0.00	0.00
9.00	0.00	0.00	0.00	34.50	0.00	0.00	0.00
9.50	0.00	0.00	0.00	35.00	0.00	0.00	0.00
10.00	0.00	0.00	0.00	35.50	0.00	0.00	0.00
10.50	0.00	0.00	0.00	36.00	0.00	0.00	0.00
11.00	0.00	0.00	0.00	36.50	0.00	0.00	0.00
11.50	0.00	0.00	0.00	37.00	0.00	0.00	0.00
12.00	0.00	0.00	0.00	37.50	0.00	0.00	0.00
12.50	0.00	0.00	0.00	38.00	0.00	0.00	0.00
13.00	0.00	0.00	0.00	38.50	0.00	0.00	0.00
13.50	0.00	0.00	0.00	39.00	0.00	0.00	0.00
14.00	0.00	0.00	0.00	39.50	0.00	0.00	0.00
14.50	0.00	0.00	0.00	40.00	0.00	0.00	0.00
15.00	0.00	0.00	0.00	40.50	0.00	0.00	0.00
15.50	0.00	0.00	0.00	41.00	0.00	0.00	0.00
16.00	0.00	0.00	0.00	41.50	0.00	0.00	0.00
16.50	0.00	0.00	0.00	42.00	0.00	0.00	0.00
17.00	0.00	0.00	0.00	42.50	0.00	0.00	0.00
17.50	0.00	0.00	0.00	43.00	0.00	0.00	0.00
18.00	0.00	0.00	0.00	43.50	0.00	0.00	0.00
18.50	0.00	0.00	0.00	44.00	0.00	0.00	0.00
19.00	0.00	0.00	0.00	44.50	0.00	0.00	0.00
19.50	0.00	0.00	0.00	45.00	0.00	0.00	0.00
20.00	0.00	0.00	0.00	45.50	0.00	0.00	0.00
20.50	0.00	0.00	0.00	46.00	0.00	0.00	0.00
21.00	0.00	0.00	0.00	46.50	0.00	0.00	0.00
21.50	0.00	0.00	0.00	47.00	0.00	0.00	0.00
22.00	0.00	0.00	0.00	47.50	0.00	0.00	0.00
22.50	0.00	0.00	0.00	48.00	0.00	0.00	0.00
23.00	0.00	0.00	0.00				
23.50	0.00	0.00	0.00				
24.00	**0.00**	0.00	**0.00**				
24.50	**0.00**	0.00	**0.00**				
25.00	0.00	0.00	0.00				

A.5
PRE-DEVELOPED Fv (100-YEAR) HYDROCAD CALCULATIONS

Townsend Acres Subdivision

Townsend, Delaware



Routing Diagram for 2024141-PRE-DEV
Prepared by Becker Morgan Group, Inc, Printed 11/13/2024

2024141-PRE-DEV

Prepared by Becker Morgan Group, Inc

Printed 11/13/2024

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.040	61	>75% Grass cover, Good, HSG B (2S)
0.050	80	>75% Grass cover, Good, HSG D (1S)
3.690	30	Woods, Good, HSG A (2S, 3S)
7.640	55	Woods, Good, HSG B (1S, 2S)
2.850	70	Woods, Good, HSG C (2S, 3S)
0.960	77	Woods, Good, HSG D (1S, 2S)
15.230	**53**	**TOTAL AREA**

2024141-PRE-DEV

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
3.690	HSG A	2S, 3S
7.680	HSG B	1S, 2S
2.850	HSG C	2S, 3S
1.010	HSG D	1S, 2S
0.000	Other	
15.230		**TOTAL AREA**

2024141-PRE-DEV

Prepared by Becker Morgan Group, Inc

Printed 11/13/2024

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.040	0.000	0.050	0.000	0.090	>75% Grass cover, Good	1S, 2S
3.690	7.640	2.850	0.960	0.000	15.140	Woods, Good	1S, 2S, 3S
3.690	**7.680**	**2.850**	**1.010**	**0.000**	**15.230**	**TOTAL AREA**	

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

Subcatchment1S: DA-1 Runoff Area=2.160 ac 0.00% Impervious Runoff Depth=3.11"
Flow Length=385' Tc=27.6 min CN=58 Runoff=3.10 cfs 0.560 af

Subcatchment2S: DA-2 Runoff Area=11.180 ac 0.00% Impervious Runoff Depth=2.89"
Flow Length=892' Tc=45.5 min CN=56 Runoff=10.77 cfs 2.695 af

Subcatchment3S: DA-3 Runoff Area=1.890 ac 0.00% Impervious Runoff Depth=0.42"
Flow Length=472' Tc=28.3 min CN=30 Runoff=0.14 cfs 0.066 af

Link 1L: AP-1 Inflow=3.10 cfs 0.560 af
Primary=3.10 cfs 0.560 af

Link 2L: AP-2 Inflow=10.77 cfs 2.695 af
Primary=10.77 cfs 2.695 af

Link 3L: AP-3 Inflow=0.14 cfs 0.066 af
Primary=0.14 cfs 0.066 af

Total Runoff Area = 15.230 ac Runoff Volume = 3.321 af Average Runoff Depth = 2.62"
100.00% Pervious = 15.230 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1S: DA-1

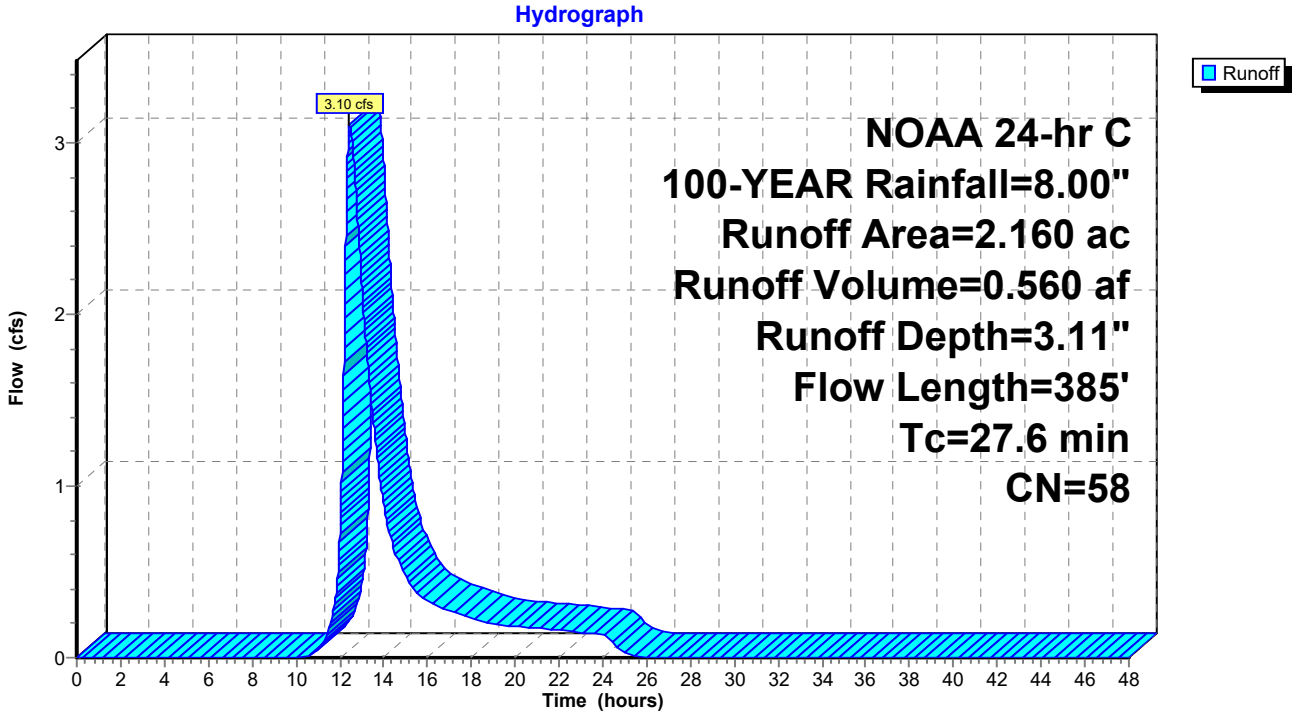
Runoff = 3.10 cfs @ 12.45 hrs, Volume= 0.560 af, Depth= 3.11"
Routed to Link 1L : AP-1

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 100-YEAR Rainfall=8.00"

Area (ac)	CN	Description
1.830	55	Woods, Good, HSG B
0.280	77	Woods, Good, HSG D
0.050	80	>75% Grass cover, Good, HSG D
2.160	58	Weighted Average
2.160		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.5	100	0.0200	0.08		**Sheet Flow, 1A** Woods: Light underbrush n= 0.400 P2= 3.20"
6.1	285	0.0239	0.77		**Shallow Concentrated Flow, 1B** Woodland Kv= 5.0 fps
27.6	385	Total			

Subcatchment 1S: DA-1



Hydrograph for Subcatchment 1S: DA-1

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00
0.50	0.04	0.00	0.00
1.00	0.09	0.00	0.00
1.50	0.13	0.00	0.00
2.00	0.18	0.00	0.00
2.50	0.23	0.00	0.00
3.00	0.28	0.00	0.00
3.50	0.34	0.00	0.00
4.00	0.39	0.00	0.00
4.50	0.45	0.00	0.00
5.00	0.51	0.00	0.00
5.50	0.57	0.00	0.00
6.00	0.63	0.00	0.00
6.50	0.70	0.00	0.00
7.00	0.78	0.00	0.00
7.50	0.87	0.00	0.00
8.00	0.96	0.00	0.00
8.50	1.06	0.00	0.00
9.00	1.17	0.00	0.00
9.50	1.30	0.00	0.00
10.00	1.46	0.00	0.00
10.50	1.65	0.01	0.01
11.00	1.92	0.03	0.05
11.50	2.36	0.10	0.16
12.00	3.81	0.58	**0.68**
12.50	5.64	1.53	**3.08**
13.00	6.08	1.81	2.17
13.50	6.35	1.98	1.40
14.00	6.54	2.10	0.89
14.50	6.70	2.21	0.62
15.00	6.83	2.30	0.48
15.50	6.94	2.37	0.38
16.00	7.04	2.44	0.33
16.50	7.13	2.50	0.30
17.00	7.22	2.56	0.28
17.50	7.30	2.61	0.25
18.00	7.37	2.66	0.23
18.50	7.43	2.71	0.21
19.00	7.49	2.75	0.20
19.50	7.55	2.79	0.19
20.00	7.61	2.83	0.18
20.50	7.66	2.87	0.18
21.00	7.72	2.91	0.17
21.50	7.77	2.95	0.17
22.00	7.82	2.98	0.16
22.50	7.87	3.02	0.15
23.00	7.91	3.05	0.15
23.50	7.96	3.08	0.14
24.00	**8.00**	**3.11**	0.14
24.50	8.00	3.11	0.08
25.00	8.00	3.11	0.03
25.50	8.00	3.11	0.01
26.00	8.00	3.11	0.00
26.50	8.00	3.11	0.00
27.00	8.00	3.11	0.00
27.50	8.00	3.11	0.00
28.00	8.00	3.11	0.00
28.50	8.00	3.11	0.00
29.00	8.00	3.11	0.00
29.50	8.00	3.11	0.00
30.00	8.00	3.11	0.00
30.50	8.00	3.11	0.00
31.00	8.00	3.11	0.00
31.50	8.00	3.11	0.00
32.00	8.00	3.11	0.00
32.50	8.00	3.11	0.00
33.00	8.00	3.11	0.00
33.50	8.00	3.11	0.00
34.00	8.00	3.11	0.00
34.50	8.00	3.11	0.00
35.00	8.00	3.11	0.00
35.50	8.00	3.11	0.00
36.00	8.00	3.11	0.00
36.50	8.00	3.11	0.00
37.00	8.00	3.11	0.00
37.50	8.00	3.11	0.00
38.00	8.00	3.11	0.00
38.50	8.00	3.11	0.00
39.00	8.00	3.11	0.00
39.50	8.00	3.11	0.00
40.00	8.00	3.11	0.00
40.50	8.00	3.11	0.00
41.00	8.00	3.11	0.00
41.50	8.00	3.11	0.00
42.00	8.00	3.11	0.00
42.50	8.00	3.11	0.00
43.00	8.00	3.11	0.00
43.50	8.00	3.11	0.00
44.00	8.00	3.11	0.00
44.50	8.00	3.11	0.00
45.00	8.00	3.11	0.00
45.50	8.00	3.11	0.00
46.00	8.00	3.11	0.00
46.50	8.00	3.11	0.00
47.00	8.00	3.11	0.00
47.50	8.00	3.11	0.00
48.00	8.00	3.11	0.00

Summary for Subcatchment 2S: DA-2

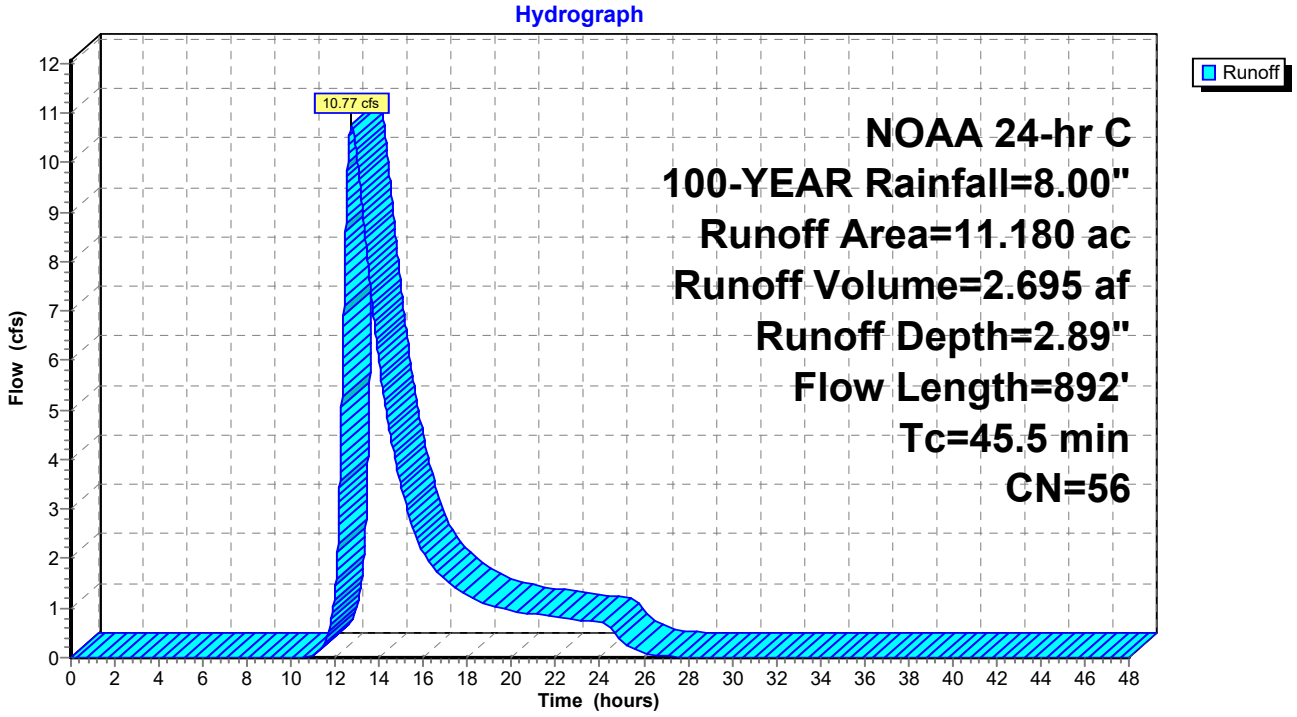
Runoff = 10.77 cfs @ 12.74 hrs, Volume= 2.695 af, Depth= 2.89"
Routed to Link 2L : AP-2

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 100-YEAR Rainfall=8.00"

Area (ac)	CN	Description
1.820	30	Woods, Good, HSG A
5.810	55	Woods, Good, HSG B
2.830	70	Woods, Good, HSG C
0.680	77	Woods, Good, HSG D
0.040	61	>75% Grass cover, Good, HSG B
11.180	56	Weighted Average
11.180		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.3	100	0.0300	0.09		**Sheet Flow, 2A** Woods: Light underbrush n= 0.400 P2= 3.20"
27.2	792	0.0094	0.48		**Shallow Concentrated Flow, 2B** Woodland Kv= 5.0 fps
45.5	892	Total			

Subcatchment 2S: DA-2



Hydrograph for Subcatchment 2S: DA-2

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00
0.50	0.04	0.00	0.00
1.00	0.09	0.00	0.00
1.50	0.13	0.00	0.00
2.00	0.18	0.00	0.00
2.50	0.23	0.00	0.00
3.00	0.28	0.00	0.00
3.50	0.34	0.00	0.00
4.00	0.39	0.00	0.00
4.50	0.45	0.00	0.00
5.00	0.51	0.00	0.00
5.50	0.57	0.00	0.00
6.00	0.63	0.00	0.00
6.50	0.70	0.00	0.00
7.00	0.78	0.00	0.00
7.50	0.87	0.00	0.00
8.00	0.96	0.00	0.00
8.50	1.06	0.00	0.00
9.00	1.17	0.00	0.00
9.50	1.30	0.00	0.00
10.00	1.46	0.00	0.00
10.50	1.65	0.00	0.00
11.00	1.92	0.01	0.04
11.50	2.36	0.07	0.29
12.00	3.81	0.50	1.42
12.50	5.64	1.39	**9.09**
13.00	6.08	1.64	**10.10**
13.50	6.35	1.81	7.92
14.00	6.54	1.93	5.93
14.50	6.70	2.03	4.50
15.00	6.83	2.11	3.46
15.50	6.94	2.18	2.63
16.00	7.04	2.25	2.11
16.50	7.13	2.31	1.80
17.00	7.22	2.36	1.57
17.50	7.30	2.41	1.39
18.00	7.37	2.46	1.26
18.50	7.43	2.50	1.14
19.00	7.49	2.54	1.05
19.50	7.55	2.58	0.99
20.00	7.61	2.62	0.95
20.50	7.66	2.66	0.91
21.00	7.72	2.70	0.88
21.50	7.77	2.73	0.85
22.00	7.82	2.77	0.82
22.50	7.87	2.80	0.79
23.00	7.91	2.83	0.77
23.50	7.96	2.86	0.74
24.00	**8.00**	**2.89**	0.71
24.50	8.00	2.89	0.58
25.00	8.00	2.89	0.33
25.50	8.00	2.89	0.18
26.00	8.00	2.89	0.10
26.50	8.00	2.89	0.05
27.00	8.00	2.89	0.02
27.50	8.00	2.89	0.01
28.00	8.00	2.89	0.00
28.50	8.00	2.89	0.00
29.00	8.00	2.89	0.00
29.50	8.00	2.89	0.00
30.00	8.00	2.89	0.00
30.50	8.00	2.89	0.00
31.00	8.00	2.89	0.00
31.50	8.00	2.89	0.00
32.00	8.00	2.89	0.00
32.50	8.00	2.89	0.00
33.00	8.00	2.89	0.00
33.50	8.00	2.89	0.00
34.00	8.00	2.89	0.00
34.50	8.00	2.89	0.00
35.00	8.00	2.89	0.00
35.50	8.00	2.89	0.00
36.00	8.00	2.89	0.00
36.50	8.00	2.89	0.00
37.00	8.00	2.89	0.00
37.50	8.00	2.89	0.00
38.00	8.00	2.89	0.00
38.50	8.00	2.89	0.00
39.00	8.00	2.89	0.00
39.50	8.00	2.89	0.00
40.00	8.00	2.89	0.00
40.50	8.00	2.89	0.00
41.00	8.00	2.89	0.00
41.50	8.00	2.89	0.00
42.00	8.00	2.89	0.00
42.50	8.00	2.89	0.00
43.00	8.00	2.89	0.00
43.50	8.00	2.89	0.00
44.00	8.00	2.89	0.00
44.50	8.00	2.89	0.00
45.00	8.00	2.89	0.00
45.50	8.00	2.89	0.00
46.00	8.00	2.89	0.00
46.50	8.00	2.89	0.00
47.00	8.00	2.89	0.00
47.50	8.00	2.89	0.00
48.00	8.00	2.89	0.00

Summary for Subcatchment 3S: DA-3

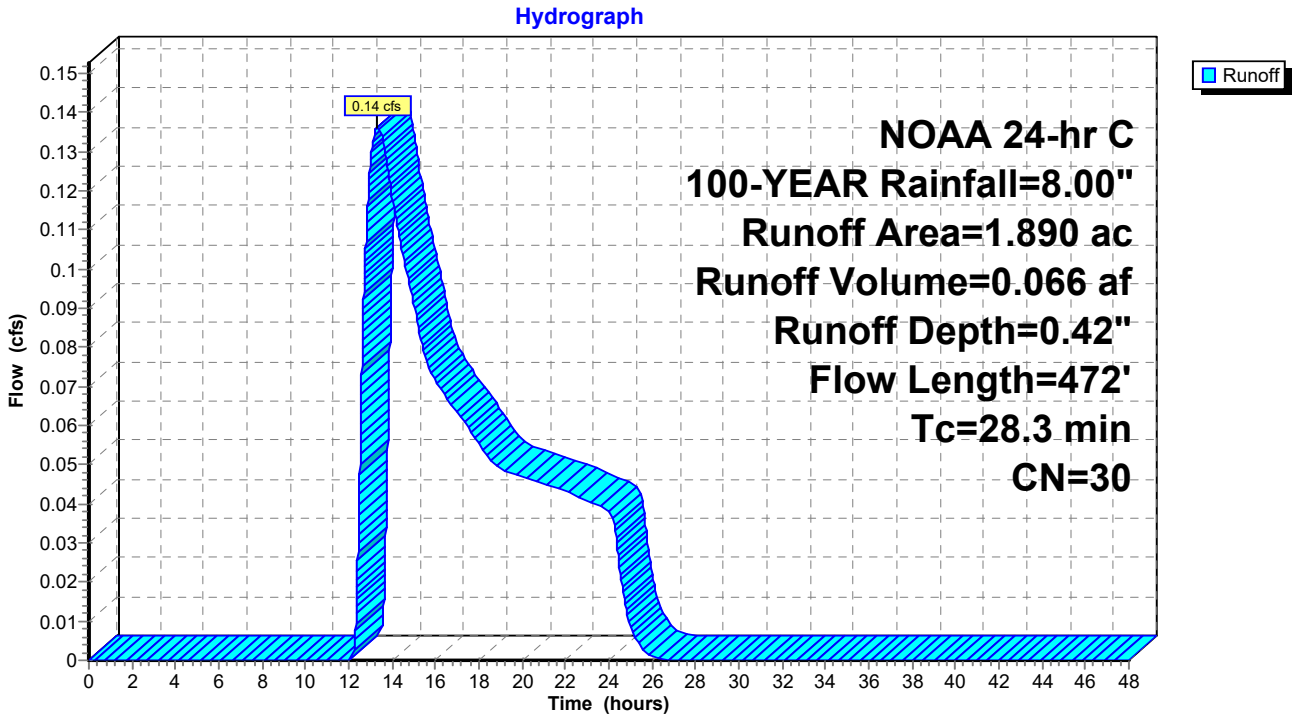
Runoff = 0.14 cfs @ 13.33 hrs, Volume= 0.066 af, Depth= 0.42"
Routed to Link 3L : AP-3

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 100-YEAR Rainfall=8.00"

Area (ac)	CN	Description
1.870	30	Woods, Good, HSG A
0.020	70	Woods, Good, HSG C
1.890	30	Weighted Average
1.890		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.8	100	0.0321	0.09		**Sheet Flow, 3A** Woods: Light underbrush n= 0.400 P2= 3.20"
10.5	372	0.0139	0.59		**Shallow Concentrated Flow, 3B** Woodland Kv= 5.0 fps
28.3	472	Total			

Subcatchment 3S: DA-3



Hydrograph for Subcatchment 3S: DA-3

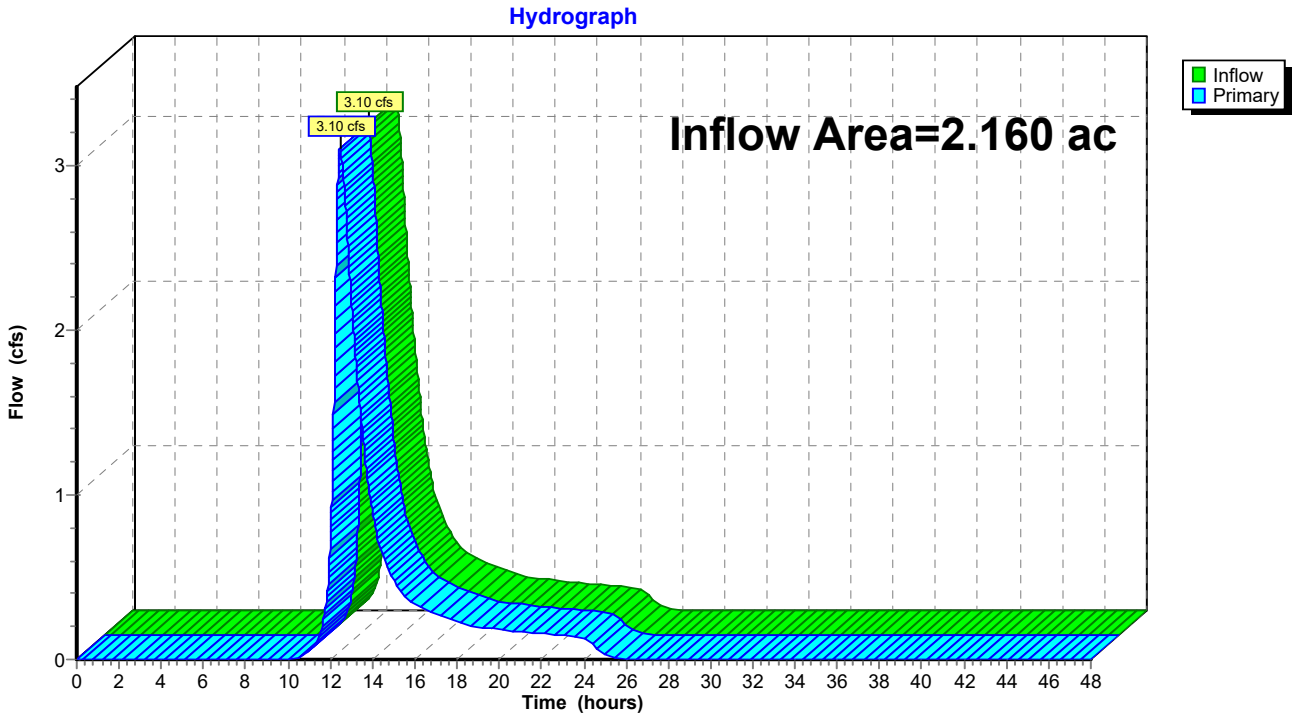
Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00
0.50	0.04	0.00	0.00
1.00	0.09	0.00	0.00
1.50	0.13	0.00	0.00
2.00	0.18	0.00	0.00
2.50	0.23	0.00	0.00
3.00	0.28	0.00	0.00
3.50	0.34	0.00	0.00
4.00	0.39	0.00	0.00
4.50	0.45	0.00	0.00
5.00	0.51	0.00	0.00
5.50	0.57	0.00	0.00
6.00	0.63	0.00	0.00
6.50	0.70	0.00	0.00
7.00	0.78	0.00	0.00
7.50	0.87	0.00	0.00
8.00	0.96	0.00	0.00
8.50	1.06	0.00	0.00
9.00	1.17	0.00	0.00
9.50	1.30	0.00	0.00
10.00	1.46	0.00	0.00
10.50	1.65	0.00	0.00
11.00	1.92	0.00	0.00
11.50	2.36	0.00	0.00
12.00	3.81	0.00	0.00
12.50	5.64	0.04	0.05
13.00	6.08	0.08	**0.13**
13.50	6.35	0.11	**0.13**
14.00	6.54	0.14	0.12
14.50	6.70	0.16	0.10
15.00	6.83	0.18	0.09
15.50	6.94	0.20	0.08
16.00	7.04	0.22	0.07
16.50	7.13	0.24	0.07
17.00	7.22	0.25	0.06
17.50	7.30	0.27	0.06
18.00	7.37	0.28	0.06
18.50	7.43	0.29	0.05
19.00	7.49	0.30	0.05
19.50	7.55	0.32	0.05
20.00	7.61	0.33	0.05
20.50	7.66	0.34	0.05
21.00	7.72	0.35	0.05
21.50	7.77	0.36	0.04
22.00	7.82	0.38	0.04
22.50	7.87	0.39	0.04
23.00	7.91	0.40	0.04
23.50	7.96	0.41	0.04
24.00	**8.00**	**0.42**	0.04
24.50	8.00	0.42	0.02
25.00	8.00	0.42	0.01
25.50	8.00	0.42	0.00
26.00	8.00	0.42	0.00
26.50	8.00	0.42	0.00
27.00	8.00	0.42	0.00
27.50	8.00	0.42	0.00
28.00	8.00	0.42	0.00
28.50	8.00	0.42	0.00
29.00	8.00	0.42	0.00
29.50	8.00	0.42	0.00
30.00	8.00	0.42	0.00
30.50	8.00	0.42	0.00
31.00	8.00	0.42	0.00
31.50	8.00	0.42	0.00
32.00	8.00	0.42	0.00
32.50	8.00	0.42	0.00
33.00	8.00	0.42	0.00
33.50	8.00	0.42	0.00
34.00	8.00	0.42	0.00
34.50	8.00	0.42	0.00
35.00	8.00	0.42	0.00
35.50	8.00	0.42	0.00
36.00	8.00	0.42	0.00
36.50	8.00	0.42	0.00
37.00	8.00	0.42	0.00
37.50	8.00	0.42	0.00
38.00	8.00	0.42	0.00
38.50	8.00	0.42	0.00
39.00	8.00	0.42	0.00
39.50	8.00	0.42	0.00
40.00	8.00	0.42	0.00
40.50	8.00	0.42	0.00
41.00	8.00	0.42	0.00
41.50	8.00	0.42	0.00
42.00	8.00	0.42	0.00
42.50	8.00	0.42	0.00
43.00	8.00	0.42	0.00
43.50	8.00	0.42	0.00
44.00	8.00	0.42	0.00
44.50	8.00	0.42	0.00
45.00	8.00	0.42	0.00
45.50	8.00	0.42	0.00
46.00	8.00	0.42	0.00
46.50	8.00	0.42	0.00
47.00	8.00	0.42	0.00
47.50	8.00	0.42	0.00
48.00	8.00	0.42	0.00

Summary for Link 1L: AP-1

Inflow Area = 2.160 ac, 0.00% Impervious, Inflow Depth = 3.11" for 100-YEAR event
Inflow = 3.10 cfs @ 12.45 hrs, Volume= 0.560 af
Primary = 3.10 cfs @ 12.45 hrs, Volume= 0.560 af, Atten= 0%, Lag= 0.0 min

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

Link 1L: AP-1



Hydrograph for Link 1L: AP-1

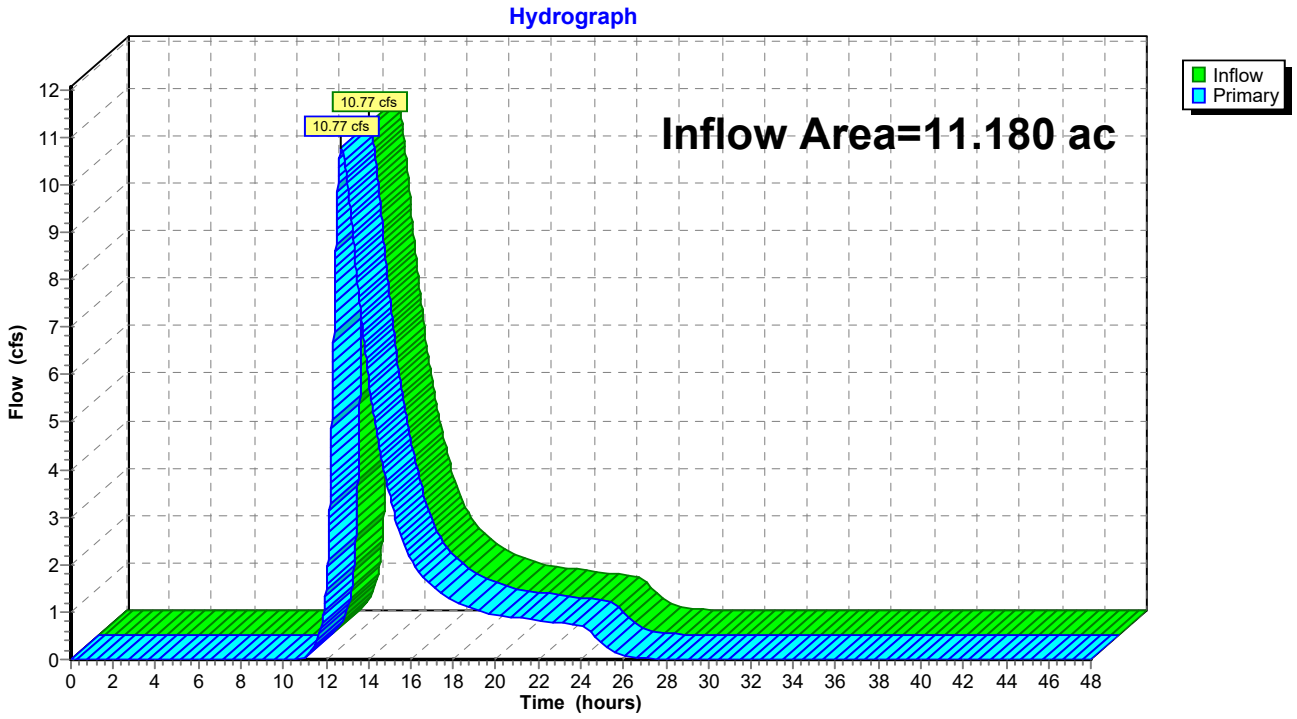
Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)
0.00	0.00	**0.00**	0.00	25.50	0.01	0.00	0.01
0.50	0.00	0.00	0.00	26.00	0.00	0.00	0.00
1.00	0.00	0.00	0.00	26.50	0.00	0.00	0.00
1.50	0.00	0.00	0.00	27.00	0.00	0.00	0.00
2.00	0.00	0.00	0.00	27.50	0.00	0.00	0.00
2.50	0.00	0.00	0.00	28.00	0.00	0.00	0.00
3.00	0.00	0.00	0.00	28.50	0.00	0.00	0.00
3.50	0.00	0.00	0.00	29.00	0.00	0.00	0.00
4.00	0.00	0.00	0.00	29.50	0.00	0.00	0.00
4.50	0.00	0.00	0.00	30.00	0.00	0.00	0.00
5.00	0.00	0.00	0.00	30.50	0.00	0.00	0.00
5.50	0.00	0.00	0.00	31.00	0.00	0.00	0.00
6.00	0.00	0.00	0.00	31.50	0.00	0.00	0.00
6.50	0.00	0.00	0.00	32.00	0.00	0.00	0.00
7.00	0.00	0.00	0.00	32.50	0.00	0.00	0.00
7.50	0.00	0.00	0.00	33.00	0.00	0.00	0.00
8.00	0.00	0.00	0.00	33.50	0.00	0.00	0.00
8.50	0.00	0.00	0.00	34.00	0.00	0.00	0.00
9.00	0.00	0.00	0.00	34.50	0.00	0.00	0.00
9.50	0.00	0.00	0.00	35.00	0.00	0.00	0.00
10.00	0.00	0.00	0.00	35.50	0.00	0.00	0.00
10.50	0.01	0.00	0.01	36.00	0.00	0.00	0.00
11.00	0.05	0.00	0.05	36.50	0.00	0.00	0.00
11.50	0.16	0.00	0.16	37.00	0.00	0.00	0.00
12.00	**0.68**	0.00	**0.68**	37.50	0.00	0.00	0.00
12.50	**3.08**	0.00	**3.08**	38.00	0.00	0.00	0.00
13.00	2.17	0.00	2.17	38.50	0.00	0.00	0.00
13.50	1.40	0.00	1.40	39.00	0.00	0.00	0.00
14.00	0.89	0.00	0.89	39.50	0.00	0.00	0.00
14.50	0.62	0.00	0.62	40.00	0.00	0.00	0.00
15.00	0.48	0.00	0.48	40.50	0.00	0.00	0.00
15.50	0.38	0.00	0.38	41.00	0.00	0.00	0.00
16.00	0.33	0.00	0.33	41.50	0.00	0.00	0.00
16.50	0.30	0.00	0.30	42.00	0.00	0.00	0.00
17.00	0.28	0.00	0.28	42.50	0.00	0.00	0.00
17.50	0.25	0.00	0.25	43.00	0.00	0.00	0.00
18.00	0.23	0.00	0.23	43.50	0.00	0.00	0.00
18.50	0.21	0.00	0.21	44.00	0.00	0.00	0.00
19.00	0.20	0.00	0.20	44.50	0.00	0.00	0.00
19.50	0.19	0.00	0.19	45.00	0.00	0.00	0.00
20.00	0.18	0.00	0.18	45.50	0.00	0.00	0.00
20.50	0.18	0.00	0.18	46.00	0.00	0.00	0.00
21.00	0.17	0.00	0.17	46.50	0.00	0.00	0.00
21.50	0.17	0.00	0.17	47.00	0.00	0.00	0.00
22.00	0.16	0.00	0.16	47.50	0.00	0.00	0.00
22.50	0.15	0.00	0.15	48.00	0.00	0.00	0.00
23.00	0.15	0.00	0.15				
23.50	0.14	0.00	0.14				
24.00	0.14	0.00	0.14				
24.50	0.08	0.00	0.08				
25.00	0.03	0.00	0.03				

Summary for Link 2L: AP-2

Inflow Area = 11.180 ac, 0.00% Impervious, Inflow Depth = 2.89" for 100-YEAR event
Inflow = 10.77 cfs @ 12.74 hrs, Volume= 2.695 af
Primary = 10.77 cfs @ 12.74 hrs, Volume= 2.695 af, Atten= 0%, Lag= 0.0 min

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

Link 2L: AP-2



Hydrograph for Link 2L: AP-2

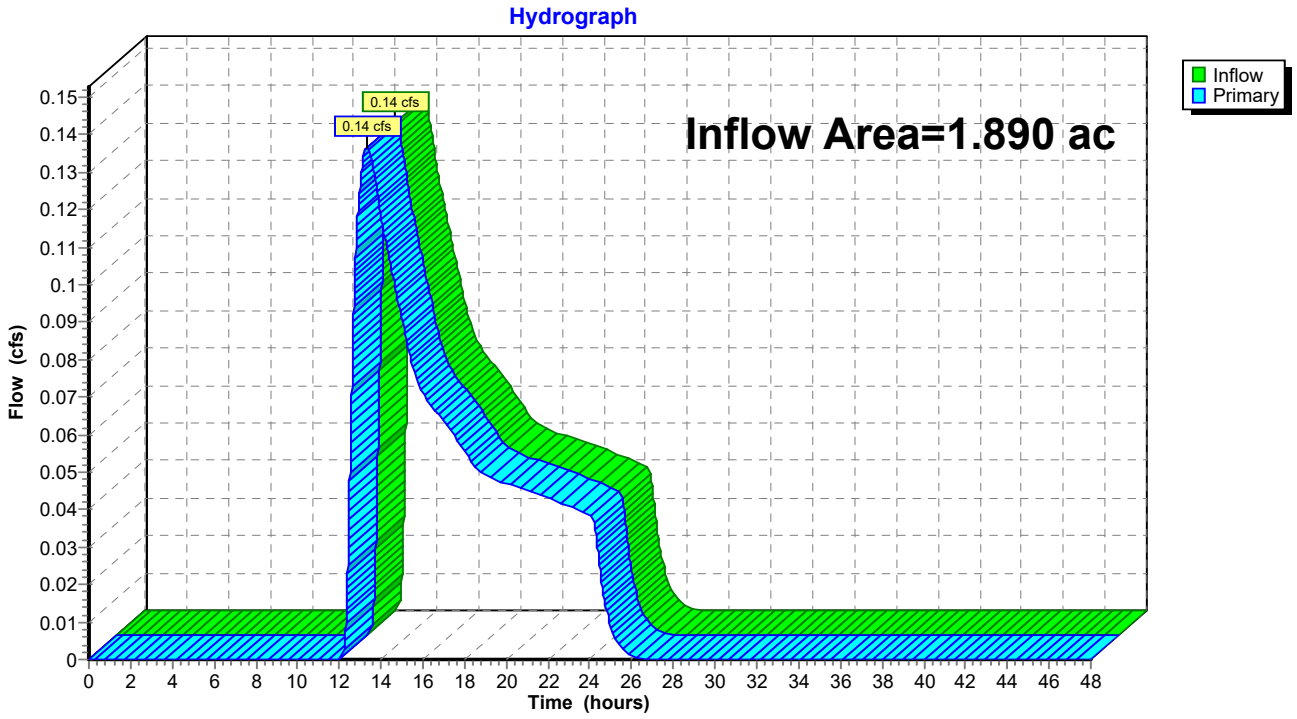
Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)
0.00	0.00	**0.00**	0.00	25.50	0.18	0.00	0.18
0.50	0.00	0.00	0.00	26.00	0.10	0.00	0.10
1.00	0.00	0.00	0.00	26.50	0.05	0.00	0.05
1.50	0.00	0.00	0.00	27.00	0.02	0.00	0.02
2.00	0.00	0.00	0.00	27.50	0.01	0.00	0.01
2.50	0.00	0.00	0.00	28.00	0.00	0.00	0.00
3.00	0.00	0.00	0.00	28.50	0.00	0.00	0.00
3.50	0.00	0.00	0.00	29.00	0.00	0.00	0.00
4.00	0.00	0.00	0.00	29.50	0.00	0.00	0.00
4.50	0.00	0.00	0.00	30.00	0.00	0.00	0.00
5.00	0.00	0.00	0.00	30.50	0.00	0.00	0.00
5.50	0.00	0.00	0.00	31.00	0.00	0.00	0.00
6.00	0.00	0.00	0.00	31.50	0.00	0.00	0.00
6.50	0.00	0.00	0.00	32.00	0.00	0.00	0.00
7.00	0.00	0.00	0.00	32.50	0.00	0.00	0.00
7.50	0.00	0.00	0.00	33.00	0.00	0.00	0.00
8.00	0.00	0.00	0.00	33.50	0.00	0.00	0.00
8.50	0.00	0.00	0.00	34.00	0.00	0.00	0.00
9.00	0.00	0.00	0.00	34.50	0.00	0.00	0.00
9.50	0.00	0.00	0.00	35.00	0.00	0.00	0.00
10.00	0.00	0.00	0.00	35.50	0.00	0.00	0.00
10.50	0.00	0.00	0.00	36.00	0.00	0.00	0.00
11.00	0.04	0.00	0.04	36.50	0.00	0.00	0.00
11.50	0.29	0.00	0.29	37.00	0.00	0.00	0.00
12.00	1.42	0.00	1.42	37.50	0.00	0.00	0.00
12.50	**9.09**	0.00	**9.09**	38.00	0.00	0.00	0.00
13.00	**10.10**	0.00	**10.10**	38.50	0.00	0.00	0.00
13.50	7.92	0.00	7.92	39.00	0.00	0.00	0.00
14.00	5.93	0.00	5.93	39.50	0.00	0.00	0.00
14.50	4.50	0.00	4.50	40.00	0.00	0.00	0.00
15.00	3.46	0.00	3.46	40.50	0.00	0.00	0.00
15.50	2.63	0.00	2.63	41.00	0.00	0.00	0.00
16.00	2.11	0.00	2.11	41.50	0.00	0.00	0.00
16.50	1.80	0.00	1.80	42.00	0.00	0.00	0.00
17.00	1.57	0.00	1.57	42.50	0.00	0.00	0.00
17.50	1.39	0.00	1.39	43.00	0.00	0.00	0.00
18.00	1.26	0.00	1.26	43.50	0.00	0.00	0.00
18.50	1.14	0.00	1.14	44.00	0.00	0.00	0.00
19.00	1.05	0.00	1.05	44.50	0.00	0.00	0.00
19.50	0.99	0.00	0.99	45.00	0.00	0.00	0.00
20.00	0.95	0.00	0.95	45.50	0.00	0.00	0.00
20.50	0.91	0.00	0.91	46.00	0.00	0.00	0.00
21.00	0.88	0.00	0.88	46.50	0.00	0.00	0.00
21.50	0.85	0.00	0.85	47.00	0.00	0.00	0.00
22.00	0.82	0.00	0.82	47.50	0.00	0.00	0.00
22.50	0.79	0.00	0.79	48.00	0.00	0.00	0.00
23.00	0.77	0.00	0.77				
23.50	0.74	0.00	0.74				
24.00	0.71	0.00	0.71				
24.50	0.58	0.00	0.58				
25.00	0.33	0.00	0.33				

Summary for Link 3L: AP-3

Inflow Area = 1.890 ac, 0.00% Impervious, Inflow Depth = 0.42" for 100-YEAR event
Inflow = 0.14 cfs @ 13.33 hrs, Volume= 0.066 af
Primary = 0.14 cfs @ 13.33 hrs, Volume= 0.066 af, Atten= 0%, Lag= 0.0 min

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

Link 3L: AP-3



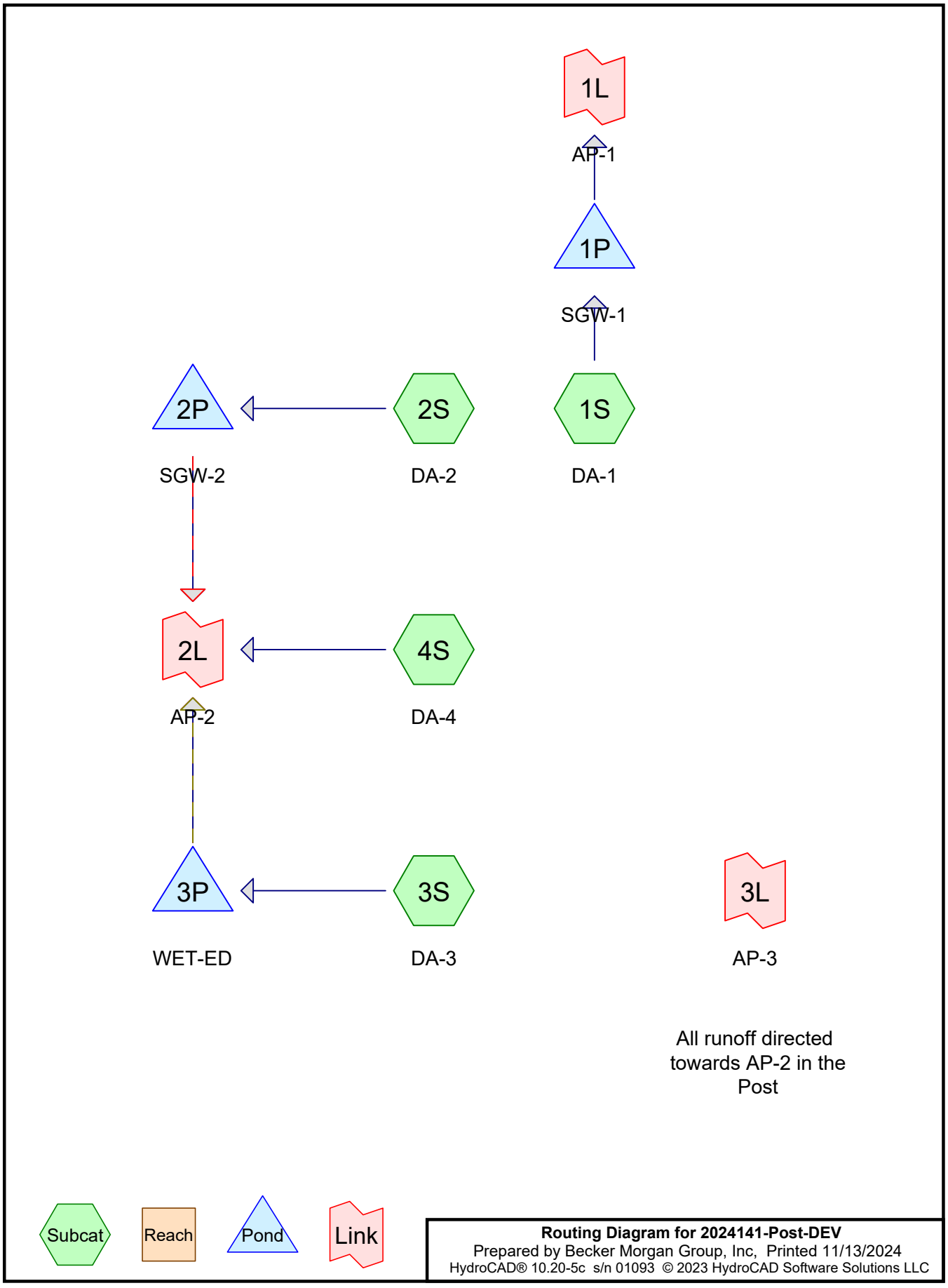
Hydrograph for Link 3L: AP-3

Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)
0.00	0.00	**0.00**	0.00	25.50	0.00	0.00	0.00
0.50	0.00	0.00	0.00	26.00	0.00	0.00	0.00
1.00	0.00	0.00	0.00	26.50	0.00	0.00	0.00
1.50	0.00	0.00	0.00	27.00	0.00	0.00	0.00
2.00	0.00	0.00	0.00	27.50	0.00	0.00	0.00
2.50	0.00	0.00	0.00	28.00	0.00	0.00	0.00
3.00	0.00	0.00	0.00	28.50	0.00	0.00	0.00
3.50	0.00	0.00	0.00	29.00	0.00	0.00	0.00
4.00	0.00	0.00	0.00	29.50	0.00	0.00	0.00
4.50	0.00	0.00	0.00	30.00	0.00	0.00	0.00
5.00	0.00	0.00	0.00	30.50	0.00	0.00	0.00
5.50	0.00	0.00	0.00	31.00	0.00	0.00	0.00
6.00	0.00	0.00	0.00	31.50	0.00	0.00	0.00
6.50	0.00	0.00	0.00	32.00	0.00	0.00	0.00
7.00	0.00	0.00	0.00	32.50	0.00	0.00	0.00
7.50	0.00	0.00	0.00	33.00	0.00	0.00	0.00
8.00	0.00	0.00	0.00	33.50	0.00	0.00	0.00
8.50	0.00	0.00	0.00	34.00	0.00	0.00	0.00
9.00	0.00	0.00	0.00	34.50	0.00	0.00	0.00
9.50	0.00	0.00	0.00	35.00	0.00	0.00	0.00
10.00	0.00	0.00	0.00	35.50	0.00	0.00	0.00
10.50	0.00	0.00	0.00	36.00	0.00	0.00	0.00
11.00	0.00	0.00	0.00	36.50	0.00	0.00	0.00
11.50	0.00	0.00	0.00	37.00	0.00	0.00	0.00
12.00	0.00	0.00	0.00	37.50	0.00	0.00	0.00
12.50	0.05	0.00	0.05	38.00	0.00	0.00	0.00
13.00	**0.13**	0.00	**0.13**	38.50	0.00	0.00	0.00
13.50	**0.13**	0.00	**0.13**	39.00	0.00	0.00	0.00
14.00	0.12	0.00	0.12	39.50	0.00	0.00	0.00
14.50	0.10	0.00	0.10	40.00	0.00	0.00	0.00
15.00	0.09	0.00	0.09	40.50	0.00	0.00	0.00
15.50	0.08	0.00	0.08	41.00	0.00	0.00	0.00
16.00	0.07	0.00	0.07	41.50	0.00	0.00	0.00
16.50	0.07	0.00	0.07	42.00	0.00	0.00	0.00
17.00	0.06	0.00	0.06	42.50	0.00	0.00	0.00
17.50	0.06	0.00	0.06	43.00	0.00	0.00	0.00
18.00	0.06	0.00	0.06	43.50	0.00	0.00	0.00
18.50	0.05	0.00	0.05	44.00	0.00	0.00	0.00
19.00	0.05	0.00	0.05	44.50	0.00	0.00	0.00
19.50	0.05	0.00	0.05	45.00	0.00	0.00	0.00
20.00	0.05	0.00	0.05	45.50	0.00	0.00	0.00
20.50	0.05	0.00	0.05	46.00	0.00	0.00	0.00
21.00	0.05	0.00	0.05	46.50	0.00	0.00	0.00
21.50	0.04	0.00	0.04	47.00	0.00	0.00	0.00
22.00	0.04	0.00	0.04	47.50	0.00	0.00	0.00
22.50	0.04	0.00	0.04	48.00	0.00	0.00	0.00
23.00	0.04	0.00	0.04				
23.50	0.04	0.00	0.04				
24.00	0.04	0.00	0.04				
24.50	0.02	0.00	0.02				
25.00	0.01	0.00	0.01				

A.6
POST-DEVELOPED RPv (1-YEAR) HYDROCAD CALCULATIONS

Townsend Acres Subdivision

Townsend, Delaware



Routing Diagram for 2024141-Post-DEV
Prepared by Becker Morgan Group, Inc, Printed 11/13/2024

2024141-Post-DEV

Prepared by Becker Morgan Group, Inc

Printed 11/13/2024

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.880	39	>75% Grass cover, Good, HSG A (3S, 4S)
1.860	61	>75% Grass cover, Good, HSG B (1S, 2S, 3S, 4S)
0.780	74	>75% Grass cover, Good, HSG C (2S, 3S, 4S)
0.230	80	>75% Grass cover, Good, HSG D (1S, 3S, 4S)
2.090	68	Duplex Lot, 50% Imp., HSG A (3S, 4S)
2.870	79	Duplex Lot, 50% Imp., HSG B (1S, 2S, 3S, 4S)
0.170	86	Duplex Lot, 50% Imp., HSG C (3S)
0.520	98	Paved parking, HSG A (3S)
1.030	98	Paved parking, HSG B (1S, 2S, 3S)
0.250	98	Paved parking, HSG C (3S)
0.130	98	Paved parking, HSG D (1S)
0.220	30	Woods, Good, HSG A (4S)
1.910	55	Woods, Good, HSG B (4S)
1.640	70	Woods, Good, HSG C (4S)
0.650	77	Woods, Good, HSG D (4S)
15.230	**70**	**TOTAL AREA**

2024141-Post-DEV

Prepared by Becker Morgan Group, Inc

Printed 11/13/2024

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
3.710	HSG A	3S, 4S
7.670	HSG B	1S, 2S, 3S, 4S
2.840	HSG C	2S, 3S, 4S
1.010	HSG D	1S, 3S, 4S
0.000	Other	
15.230		**TOTAL AREA**

2024141-Post-DEV

Prepared by Becker Morgan Group, Inc Printed 11/13/2024

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.880	1.860	0.780	0.230	0.000	3.750	>75% Grass cover, Good	1S, 2S, 3S, 4S
2.090	2.870	0.170	0.000	0.000	5.130	Duplex Lot, 50% Imp.	1S, 2S, 3S, 4S
0.520	1.030	0.250	0.130	0.000	1.930	Paved parking	1S, 2S, 3S
0.220	1.910	1.640	0.650	0.000	4.420	Woods, Good	4S
3.710	**7.670**	**2.840**	**1.010**	**0.000**	**15.230**	**TOTAL AREA**	

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: DA-1 Runoff Area=1.540 ac 14.94% Impervious Runoff Depth=1.13"
Tc=6.0 min CN=76 Runoff=1.73 cfs 0.145 af

Subcatchment2S: DA-2 Runoff Area=3.590 ac 21.17% Impervious Runoff Depth=1.26"
Tc=6.0 min CN=79 Runoff=4.51 cfs 0.377 af

Subcatchment3S: DA-3 Runoff Area=4.530 ac 20.75% Impervious Runoff Depth=0.98"
Flow Length=1,168' Tc=20.4 min CN=72 Runoff=2.40 cfs 0.371 af

Subcatchment4S: DA-4 Runoff Area=5.570 ac 0.00% Impervious Runoff Depth=0.67"
Flow Length=769' Tc=44.9 min CN=62 Runoff=1.22 cfs 0.312 af

Pond 1P: SGW-1 Peak Elev=61.81' Storage=3,327 cf Inflow=1.73 cfs 0.145 af
Outflow=0.25 cfs 0.100 af

Pond 2P: SGW-2 Peak Elev=62.29' Storage=16,435 cf Inflow=4.51 cfs 0.377 af
Primary=0.00 cfs 0.000 af Secondary=0.00 cfs 0.000 af Outflow=0.00 cfs 0.000 af

Pond 3P: WET-ED Peak Elev=61.29' Storage=9,572 cf Inflow=2.40 cfs 0.371 af
Primary=0.23 cfs 0.365 af Secondary=0.01 cfs 0.001 af Tertiary=0.00 cfs 0.000 af Outflow=0.23 cfs 0.366 af

Link 1L: AP-1 Inflow=0.25 cfs 0.100 af
Primary=0.25 cfs 0.100 af

Link 2L: AP-2 Inflow=1.40 cfs 0.678 af
Primary=1.40 cfs 0.678 af

Link 3L: AP-3
Primary=0.00 cfs 0.000 af

Total Runoff Area = 15.230 ac Runoff Volume = 1.205 af Average Runoff Depth = 0.95"
87.33% Pervious = 13.300 ac 12.67% Impervious = 1.930 ac

Summary for Subcatchment 1S: DA-1

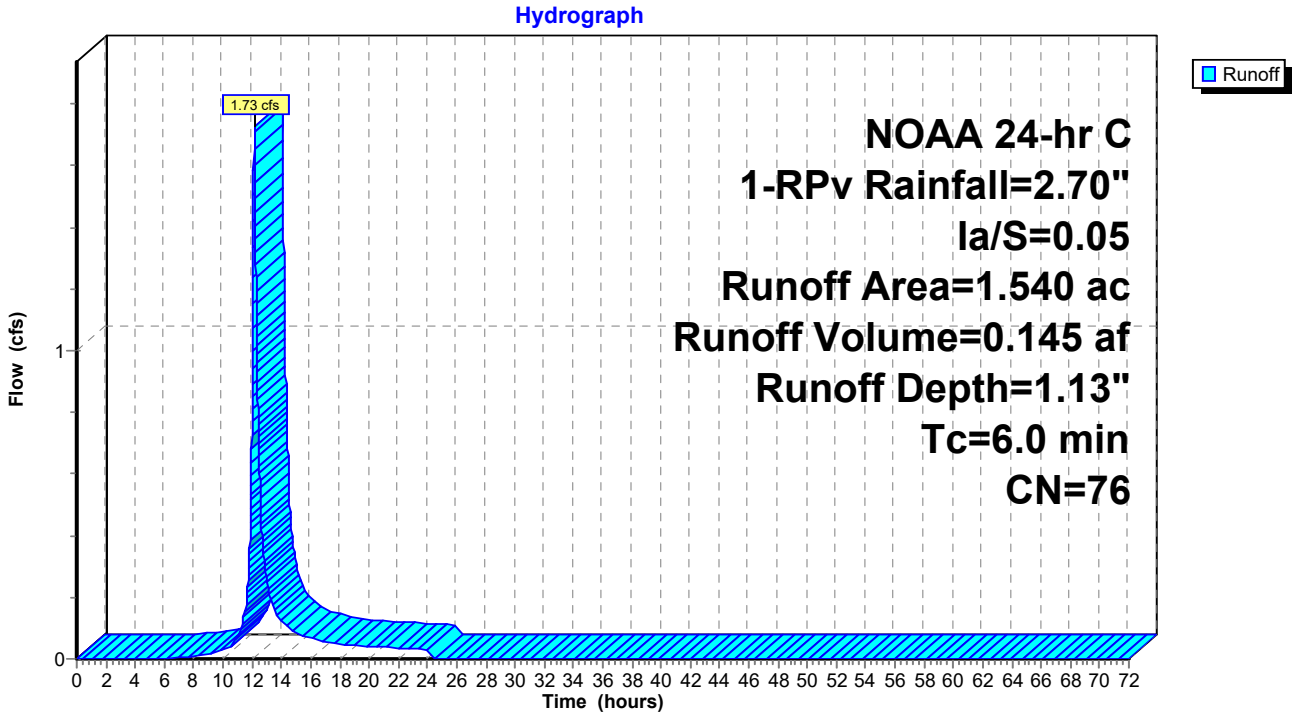
Runoff = 1.73 cfs @ 12.14 hrs, Volume= 0.145 af, Depth= 1.13"
Routed to Pond 1P : SGW-1

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 1-RPv Rainfall=2.70", Ia/S=0.05

	Area (ac)	CN	Description
	0.100	98	Paved parking, HSG B
	0.130	98	Paved parking, HSG D
	0.470	61	>75% Grass cover, Good, HSG B
	0.200	80	>75% Grass cover, Good, HSG D
*	0.640	79	Duplex Lot, 50% Imp., HSG B
	1.540	76	Weighted Average
	1.310		85.06% Pervious Area
	0.230		14.94% Impervious Area

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

Subcatchment 1S: DA-1



Hydrograph for Subcatchment 1S: DA-1

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00
1.00	0.03	0.00	0.00
2.00	0.06	0.00	0.00
3.00	0.10	0.00	0.00
4.00	0.13	0.00	0.00
5.00	0.17	0.00	0.00
6.00	0.21	0.00	0.00
7.00	0.26	0.00	0.00
8.00	0.32	0.01	0.01
9.00	0.39	0.02	0.01
10.00	0.49	0.03	0.03
11.00	0.65	0.07	0.07
12.00	1.29	0.30	**0.81**
13.00	2.05	0.71	**0.26**
14.00	2.21	0.81	0.12
15.00	2.31	0.87	0.08
16.00	2.38	0.92	0.07
17.00	2.44	0.96	0.06
18.00	2.49	0.99	0.05
19.00	2.53	1.02	0.04
20.00	2.57	1.04	0.04
21.00	2.60	1.07	0.04
22.00	2.64	1.09	0.04
23.00	2.67	1.11	0.03
24.00	**2.70**	**1.13**	0.03
25.00	2.70	1.13	0.00
26.00	2.70	1.13	0.00
27.00	2.70	1.13	0.00
28.00	2.70	1.13	0.00
29.00	2.70	1.13	0.00
30.00	2.70	1.13	0.00
31.00	2.70	1.13	0.00
32.00	2.70	1.13	0.00
33.00	2.70	1.13	0.00
34.00	2.70	1.13	0.00
35.00	2.70	1.13	0.00
36.00	2.70	1.13	0.00
37.00	2.70	1.13	0.00
38.00	2.70	1.13	0.00
39.00	2.70	1.13	0.00
40.00	2.70	1.13	0.00
41.00	2.70	1.13	0.00
42.00	2.70	1.13	0.00
43.00	2.70	1.13	0.00
44.00	2.70	1.13	0.00
45.00	2.70	1.13	0.00
46.00	2.70	1.13	0.00
47.00	2.70	1.13	0.00
48.00	2.70	1.13	0.00
49.00	2.70	1.13	0.00
50.00	2.70	1.13	0.00
51.00	2.70	1.13	0.00
52.00	2.70	1.13	0.00
53.00	2.70	1.13	0.00
54.00	2.70	1.13	0.00
55.00	2.70	1.13	0.00
56.00	2.70	1.13	0.00
57.00	2.70	1.13	0.00
58.00	2.70	1.13	0.00
59.00	2.70	1.13	0.00
60.00	2.70	1.13	0.00
61.00	2.70	1.13	0.00
62.00	2.70	1.13	0.00
63.00	2.70	1.13	0.00
64.00	2.70	1.13	0.00
65.00	2.70	1.13	0.00
66.00	2.70	1.13	0.00
67.00	2.70	1.13	0.00
68.00	2.70	1.13	0.00
69.00	2.70	1.13	0.00
70.00	2.70	1.13	0.00
71.00	2.70	1.13	0.00
72.00	2.70	1.13	0.00

Summary for Subcatchment 2S: DA-2

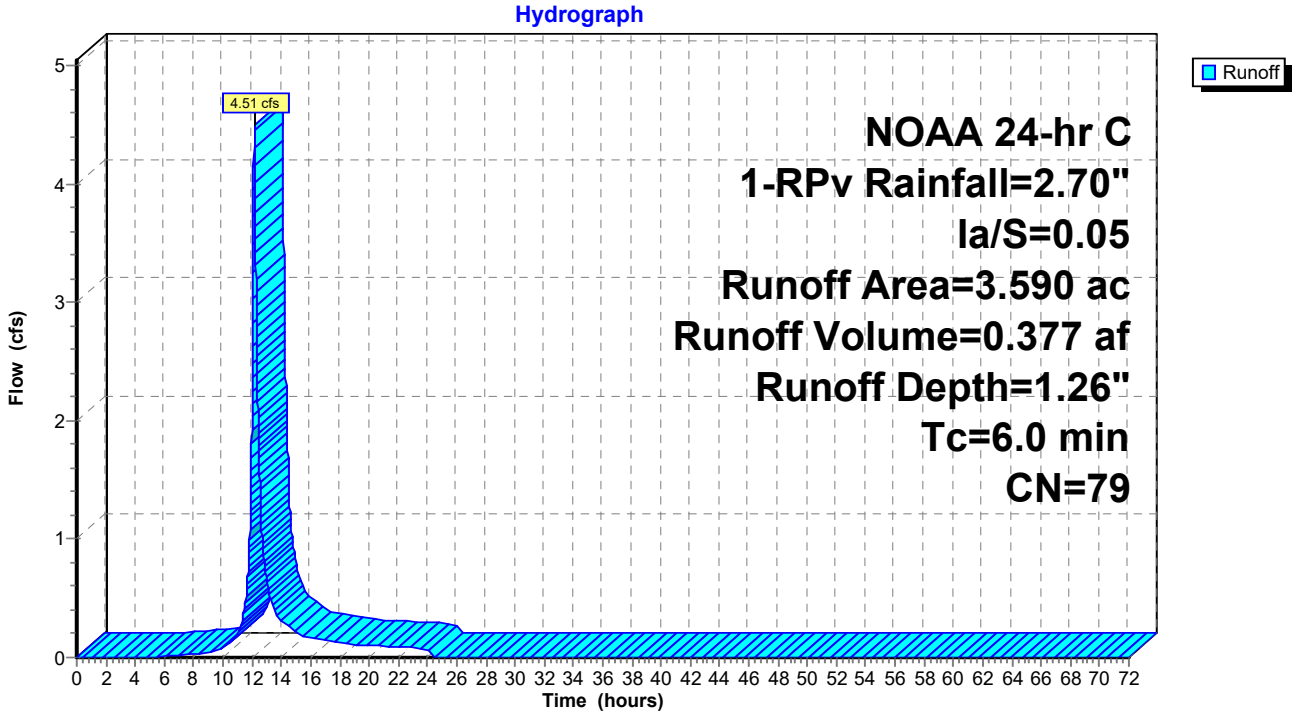
Runoff = 4.51 cfs @ 12.14 hrs, Volume= 0.377 af, Depth= 1.26"
Routed to Pond 2P : SGW-2

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 1-RPv Rainfall=2.70", Ia/S=0.05

	Area (ac)	CN	Description
	0.760	98	Paved parking, HSG B
	0.740	61	>75% Grass cover, Good, HSG B
	0.280	74	>75% Grass cover, Good, HSG C
*	1.810	79	Duplex Lot, 50% Imp., HSG B
	3.590	79	Weighted Average
	2.830		78.83% Pervious Area
	0.760		21.17% Impervious Area

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

Subcatchment 2S: DA-2



Hydrograph for Subcatchment 2S: DA-2

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00
1.00	0.03	0.00	0.00
2.00	0.06	0.00	0.00
3.00	0.10	0.00	0.00
4.00	0.13	0.00	0.00
5.00	0.17	0.00	0.00
6.00	0.21	0.00	0.01
7.00	0.26	0.01	0.02
8.00	0.32	0.01	0.03
9.00	0.39	0.02	0.04
10.00	0.49	0.04	0.09
11.00	0.65	0.08	0.20
12.00	1.29	0.35	**2.15**
13.00	2.05	0.80	**0.65**
14.00	2.21	0.91	0.31
15.00	2.31	0.98	0.21
16.00	2.38	1.03	0.17
17.00	2.44	1.07	0.15
18.00	2.49	1.10	0.12
19.00	2.53	1.14	0.11
20.00	2.57	1.16	0.10
21.00	2.60	1.19	0.10
22.00	2.64	1.22	0.09
23.00	2.67	1.24	0.08
24.00	**2.70**	**1.26**	0.08
25.00	2.70	1.26	0.00
26.00	2.70	1.26	0.00
27.00	2.70	1.26	0.00
28.00	2.70	1.26	0.00
29.00	2.70	1.26	0.00
30.00	2.70	1.26	0.00
31.00	2.70	1.26	0.00
32.00	2.70	1.26	0.00
33.00	2.70	1.26	0.00
34.00	2.70	1.26	0.00
35.00	2.70	1.26	0.00
36.00	2.70	1.26	0.00
37.00	2.70	1.26	0.00
38.00	2.70	1.26	0.00
39.00	2.70	1.26	0.00
40.00	2.70	1.26	0.00
41.00	2.70	1.26	0.00
42.00	2.70	1.26	0.00
43.00	2.70	1.26	0.00
44.00	2.70	1.26	0.00
45.00	2.70	1.26	0.00
46.00	2.70	1.26	0.00
47.00	2.70	1.26	0.00
48.00	2.70	1.26	0.00
49.00	2.70	1.26	0.00
50.00	2.70	1.26	0.00
51.00	2.70	1.26	0.00
52.00	2.70	1.26	0.00
53.00	2.70	1.26	0.00
54.00	2.70	1.26	0.00
55.00	2.70	1.26	0.00
56.00	2.70	1.26	0.00
57.00	2.70	1.26	0.00
58.00	2.70	1.26	0.00
59.00	2.70	1.26	0.00
60.00	2.70	1.26	0.00
61.00	2.70	1.26	0.00
62.00	2.70	1.26	0.00
63.00	2.70	1.26	0.00
64.00	2.70	1.26	0.00
65.00	2.70	1.26	0.00
66.00	2.70	1.26	0.00
67.00	2.70	1.26	0.00
68.00	2.70	1.26	0.00
69.00	2.70	1.26	0.00
70.00	2.70	1.26	0.00
71.00	2.70	1.26	0.00
72.00	2.70	1.26	0.00

Summary for Subcatchment 3S: DA-3

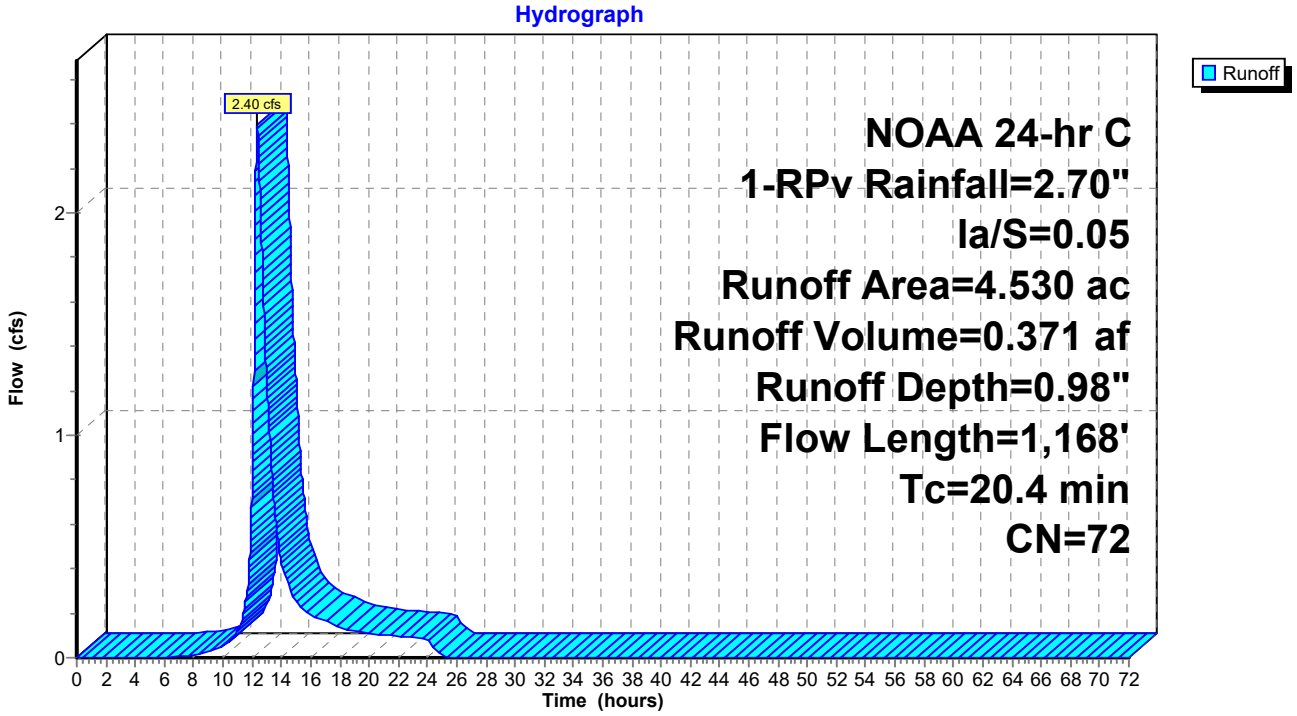
Runoff = 2.40 cfs @ 12.33 hrs, Volume= 0.371 af, Depth= 0.98"
Routed to Pond 3P : WET-ED

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 1-RPv Rainfall=2.70", Ia/S=0.05

	Area (ac)	CN	Description
	0.520	98	Paved parking, HSG A
	0.170	98	Paved parking, HSG B
	0.250	98	Paved parking, HSG C
	0.630	39	>75% Grass cover, Good, HSG A
	0.050	61	>75% Grass cover, Good, HSG B
	0.330	74	>75% Grass cover, Good, HSG C
	0.010	80	>75% Grass cover, Good, HSG D
*	1.990	68	Duplex Lot, 50% Imp., HSG A
*	0.410	79	Duplex Lot, 50% Imp., HSG B
*	0.170	86	Duplex Lot, 50% Imp., HSG C
	4.530	72	Weighted Average
	3.590		79.25% Pervious Area
	0.940		20.75% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.2	56	0.0300	0.18		**Sheet Flow, 3A** Grass: Short n= 0.150 P2= 3.20"
6.5	44	0.0107	0.11		**Sheet Flow, 3B** Grass: Short n= 0.150 P2= 3.20"
4.8	275	0.0040	0.95		**Shallow Concentrated Flow, 3C** Grassed Waterway Kv= 15.0 fps
3.9	793	0.0030	3.42	10.74	**Pipe Channel, RCP_Round 24"** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.015 Concrete sewer w/manholes & inlets
20.4	1,168	Total			

Subcatchment 3S: DA-3



Hydrograph for Subcatchment 3S: DA-3

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00
1.00	0.03	0.00	0.00
2.00	0.06	0.00	0.00
3.00	0.10	0.00	0.00
4.00	0.13	0.00	0.00
5.00	0.17	0.00	0.00
6.00	0.21	0.00	0.00
7.00	0.26	0.00	0.00
8.00	0.32	0.00	0.01
9.00	0.39	0.01	0.03
10.00	0.49	0.02	0.05
11.00	0.65	0.05	0.12
12.00	1.29	0.24	**0.74**
13.00	2.05	0.60	**1.24**
14.00	2.21	0.69	0.43
15.00	2.31	0.74	0.26
16.00	2.38	0.78	0.19
17.00	2.44	0.82	0.16
18.00	2.49	0.85	0.14
19.00	2.53	0.88	0.12
20.00	2.57	0.90	0.11
21.00	2.60	0.92	0.10
22.00	2.64	0.94	0.10
23.00	2.67	0.96	0.09
24.00	**2.70**	**0.98**	0.08
25.00	2.70	0.98	0.01
26.00	2.70	0.98	0.00
27.00	2.70	0.98	0.00
28.00	2.70	0.98	0.00
29.00	2.70	0.98	0.00
30.00	2.70	0.98	0.00
31.00	2.70	0.98	0.00
32.00	2.70	0.98	0.00
33.00	2.70	0.98	0.00
34.00	2.70	0.98	0.00
35.00	2.70	0.98	0.00
36.00	2.70	0.98	0.00
37.00	2.70	0.98	0.00
38.00	2.70	0.98	0.00
39.00	2.70	0.98	0.00
40.00	2.70	0.98	0.00
41.00	2.70	0.98	0.00
42.00	2.70	0.98	0.00
43.00	2.70	0.98	0.00
44.00	2.70	0.98	0.00
45.00	2.70	0.98	0.00
46.00	2.70	0.98	0.00
47.00	2.70	0.98	0.00
48.00	2.70	0.98	0.00
49.00	2.70	0.98	0.00
50.00	2.70	0.98	0.00
51.00	2.70	0.98	0.00
52.00	2.70	0.98	0.00
53.00	2.70	0.98	0.00
54.00	2.70	0.98	0.00
55.00	2.70	0.98	0.00
56.00	2.70	0.98	0.00
57.00	2.70	0.98	0.00
58.00	2.70	0.98	0.00
59.00	2.70	0.98	0.00
60.00	2.70	0.98	0.00
61.00	2.70	0.98	0.00
62.00	2.70	0.98	0.00
63.00	2.70	0.98	0.00
64.00	2.70	0.98	0.00
65.00	2.70	0.98	0.00
66.00	2.70	0.98	0.00
67.00	2.70	0.98	0.00
68.00	2.70	0.98	0.00
69.00	2.70	0.98	0.00
70.00	2.70	0.98	0.00
71.00	2.70	0.98	0.00
72.00	2.70	0.98	0.00

Summary for Subcatchment 4S: DA-4

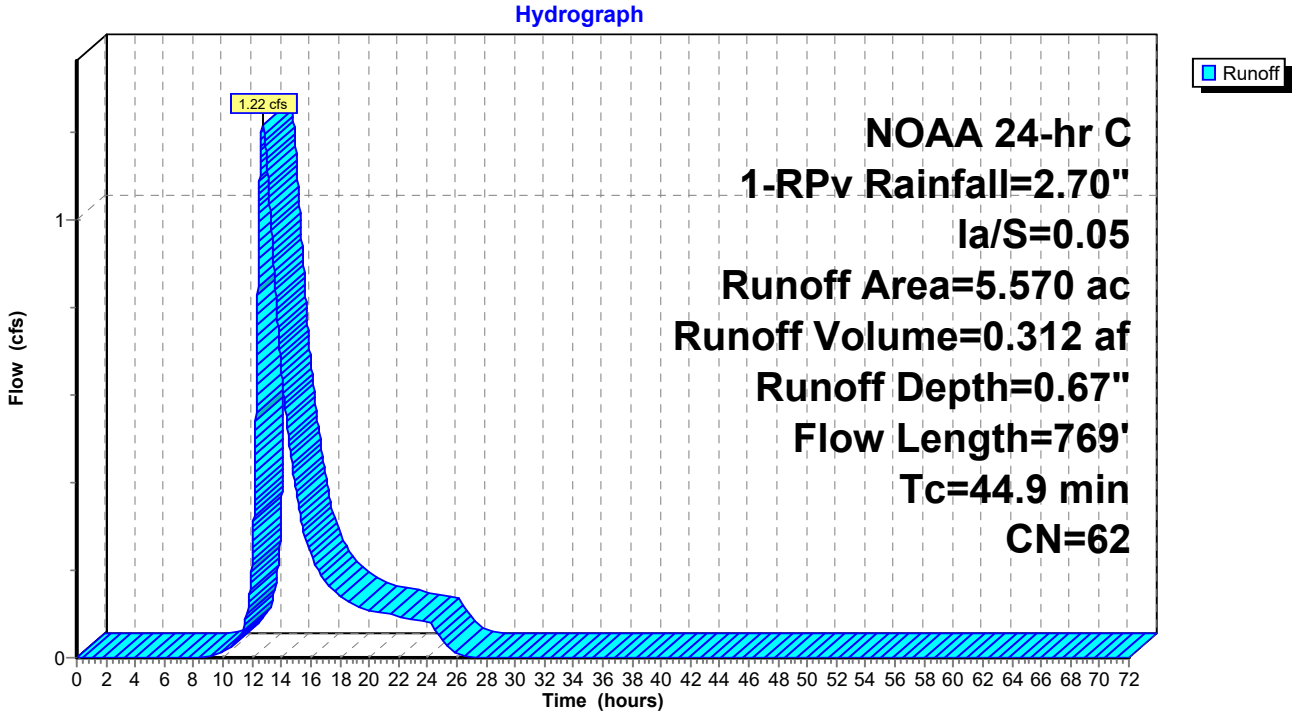
Runoff = 1.22 cfs @ 12.76 hrs, Volume= 0.312 af, Depth= 0.67"
Routed to Link 2L : AP-2

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 1-RPv Rainfall=2.70", Ia/S=0.05

	Area (ac)	CN	Description
	0.220	30	Woods, Good, HSG A
	1.910	55	Woods, Good, HSG B
	1.640	70	Woods, Good, HSG C
	0.650	77	Woods, Good, HSG D
	0.250	39	>75% Grass cover, Good, HSG A
	0.600	61	>75% Grass cover, Good, HSG B
	0.170	74	>75% Grass cover, Good, HSG C
	0.020	80	>75% Grass cover, Good, HSG D
*	0.100	68	Duplex Lot, 50% Imp., HSG A
*	0.010	79	Duplex Lot, 50% Imp., HSG B
	5.570	62	Weighted Average
	5.570		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.1	48	0.0396	0.19		**Sheet Flow, 4A** Grass: Short n= 0.150 P2= 3.20"
14.1	52	0.0154	0.06		**Sheet Flow, 4B** Woods: Light underbrush n= 0.400 P2= 3.20"
26.7	669	0.0070	0.42		**Shallow Concentrated Flow, 4C** Woodland Kv= 5.0 fps
44.9	769	Total			

Subcatchment 4S: DA-4



Hydrograph for Subcatchment 4S: DA-4

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00
1.00	0.03	0.00	0.00
2.00	0.06	0.00	0.00
3.00	0.10	0.00	0.00
4.00	0.13	0.00	0.00
5.00	0.17	0.00	0.00
6.00	0.21	0.00	0.00
7.00	0.26	0.00	0.00
8.00	0.32	0.00	0.00
9.00	0.39	0.00	0.00
10.00	0.49	0.01	0.01
11.00	0.65	0.02	0.04
12.00	1.29	0.14	**0.22**
13.00	2.05	0.39	**1.13**
14.00	2.21	0.45	0.66
15.00	2.31	0.49	0.38
16.00	2.38	0.52	0.24
17.00	2.44	0.55	0.18
18.00	2.49	0.57	0.14
19.00	2.53	0.59	0.12
20.00	2.57	0.61	0.11
21.00	2.60	0.63	0.10
22.00	2.64	0.64	0.09
23.00	2.67	0.66	0.09
24.00	**2.70**	**0.67**	0.08
25.00	2.70	0.67	0.04
26.00	2.70	0.67	0.01
27.00	2.70	0.67	0.00
28.00	2.70	0.67	0.00
29.00	2.70	0.67	0.00
30.00	2.70	0.67	0.00
31.00	2.70	0.67	0.00
32.00	2.70	0.67	0.00
33.00	2.70	0.67	0.00
34.00	2.70	0.67	0.00
35.00	2.70	0.67	0.00
36.00	2.70	0.67	0.00
37.00	2.70	0.67	0.00
38.00	2.70	0.67	0.00
39.00	2.70	0.67	0.00
40.00	2.70	0.67	0.00
41.00	2.70	0.67	0.00
42.00	2.70	0.67	0.00
43.00	2.70	0.67	0.00
44.00	2.70	0.67	0.00
45.00	2.70	0.67	0.00
46.00	2.70	0.67	0.00
47.00	2.70	0.67	0.00
48.00	2.70	0.67	0.00
49.00	2.70	0.67	0.00
50.00	2.70	0.67	0.00
51.00	2.70	0.67	0.00
52.00	2.70	0.67	0.00
53.00	2.70	0.67	0.00
54.00	2.70	0.67	0.00
55.00	2.70	0.67	0.00
56.00	2.70	0.67	0.00
57.00	2.70	0.67	0.00
58.00	2.70	0.67	0.00
59.00	2.70	0.67	0.00
60.00	2.70	0.67	0.00
61.00	2.70	0.67	0.00
62.00	2.70	0.67	0.00
63.00	2.70	0.67	0.00
64.00	2.70	0.67	0.00
65.00	2.70	0.67	0.00
66.00	2.70	0.67	0.00
67.00	2.70	0.67	0.00
68.00	2.70	0.67	0.00
69.00	2.70	0.67	0.00
70.00	2.70	0.67	0.00
71.00	2.70	0.67	0.00
72.00	2.70	0.67	0.00

Summary for Pond 1P: SGW-1

Inflow Area = 1.540 ac, 14.94% Impervious, Inflow Depth = 1.13" for 1-RPv event
Inflow = 1.73 cfs @ 12.14 hrs, Volume= 0.145 af
Outflow = 0.25 cfs @ 13.03 hrs, Volume= 0.100 af, Atten= 86%, Lag= 53.4 min
Primary = 0.25 cfs @ 13.03 hrs, Volume= 0.100 af
Routed to Link 1L : AP-1

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 61.81' @ 13.03 hrs Surf.Area= 4,515 sf Storage= 3,327 cf

Plug-Flow detention time= 326.1 min calculated for 0.100 af (69% of inflow)
Center-of-Mass det. time= 220.1 min (1,055.0 - 834.9)

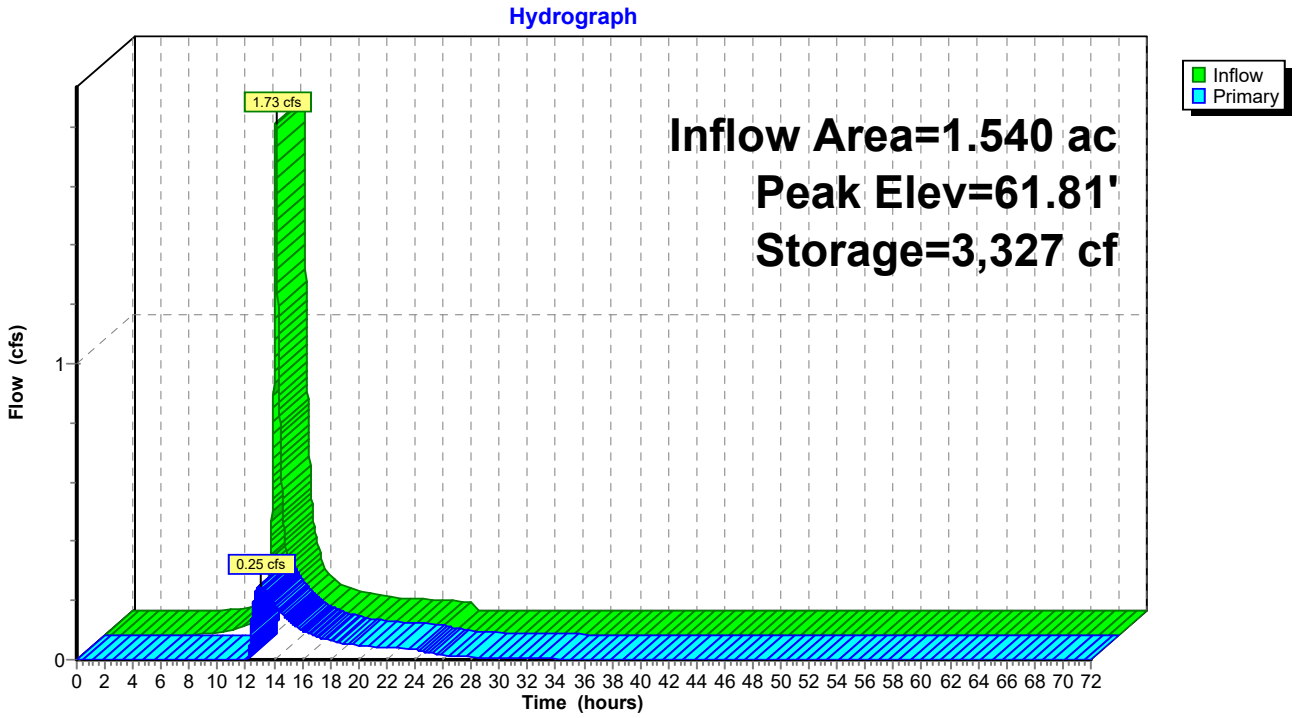
Volume	Invert	Avail.Storage	Storage Description
#1	61.00'	15,965 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
61.00	3,658	0	0
62.00	4,710	4,184	4,184
63.00	5,865	5,288	9,472
64.00	7,121	6,493	15,965

Device	Routing	Invert	Outlet Devices
#1	Primary	60.75'	**18.0" Round RCP_Round 18"** L= 32.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 60.75' / 60.59' S= 0.0050 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 1.77 sf
#2	Device 1	63.25'	**30.0" Horiz. Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	61.50'	**6.0" Vert. Orifice** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.25 cfs @ 13.03 hrs HW=61.81' (Free Discharge)
└─**1=RCP_Round 18"** (Passes 0.25 cfs of 3.56 cfs potential flow)
  ├─**2=Grate** (Controls 0.00 cfs)
  └─**3=Orifice** (Orifice Controls 0.25 cfs @ 1.91 fps)

Pond 1P: SGW-1


Hydrograph
Inflow Area=1.540 ac
Peak Elev=61.81'
Storage=3,327 cf
1.73 cfs
0.25 cfs
Inflow
Primary
Flow (cfs)
0
1
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72
Time (hours)

Hydrograph for Pond 1P: SGW-1

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
0.00	0.00	0	61.00	0.00
2.00	0.00	0	61.00	0.00
4.00	0.00	0	61.00	0.00
6.00	0.00	4	61.00	0.00
8.00	0.01	41	61.01	0.00
10.00	0.03	162	61.04	0.00
12.00	**0.81**	**1,128**	**61.30**	**0.00**
14.00	**0.12**	**3,126**	**61.77**	**0.19**
16.00	0.07	2,765	61.69	0.10
18.00	0.05	2,601	61.65	0.07
20.00	0.04	2,508	61.63	0.05
22.00	0.04	2,458	61.62	0.04
24.00	0.03	2,419	61.61	0.04
26.00	0.00	2,261	61.57	0.02
28.00	0.00	2,176	61.55	0.01
30.00	0.00	2,128	61.54	0.00
32.00	0.00	2,096	61.53	0.00
34.00	0.00	2,072	61.53	0.00
36.00	0.00	2,054	61.52	0.00
38.00	0.00	2,040	61.52	0.00
40.00	0.00	2,029	61.52	0.00
42.00	0.00	2,021	61.51	0.00
44.00	0.00	2,014	61.51	0.00
46.00	0.00	2,010	61.51	0.00
48.00	0.00	2,006	61.51	0.00
50.00	0.00	2,003	61.51	0.00
52.00	0.00	2,001	61.51	0.00
54.00	0.00	1,999	61.51	0.00
56.00	0.00	1,997	61.51	0.00
58.00	0.00	1,995	61.51	0.00
60.00	0.00	1,993	61.51	0.00
62.00	0.00	1,991	61.51	0.00
64.00	0.00	1,989	61.51	0.00
66.00	0.00	1,988	61.51	0.00
68.00	0.00	1,986	61.51	0.00
70.00	0.00	1,985	61.51	0.00
72.00	0.00	1,984	61.51	0.00

Summary for Pond 2P: SGW-2

Inflow Area = 3.590 ac, 21.17% Impervious, Inflow Depth = 1.26" for 1-RPv event
Inflow = 4.51 cfs @ 12.14 hrs, Volume= 0.377 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
Routed to Link 2L : AP-2
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Link 2L : AP-2

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 62.29' @ 24.66 hrs Surf.Area= 17,405 sf Storage= 16,435 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	61.25'	73,539 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

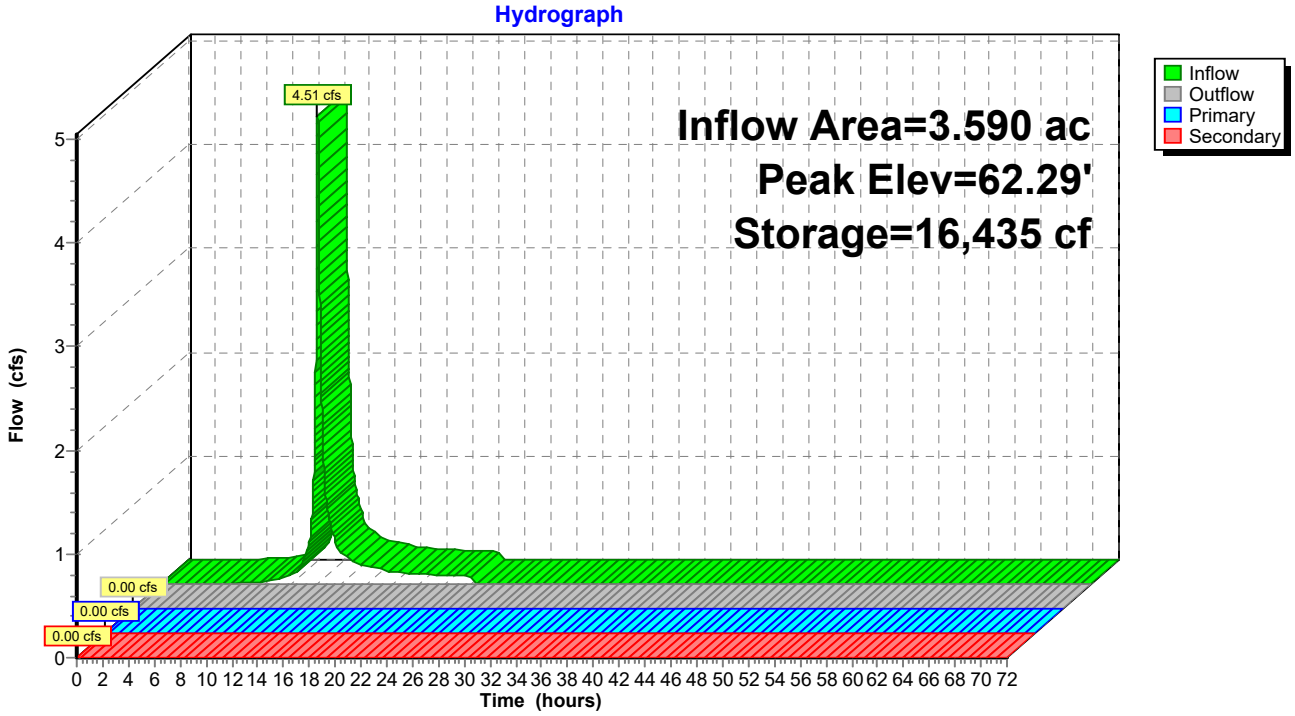
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
61.25	14,204	0	0
62.00	16,662	11,575	11,575
63.00	19,265	17,964	29,538
64.00	21,975	20,620	50,158
65.00	24,786	23,381	73,539

Device	Routing	Invert	Outlet Devices
#1	Primary	61.25'	**24.0" Round RCP_Round 24"** L= 86.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 61.25' / 61.00' S= 0.0029 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 3.14 sf
#2	Device 1	63.75'	**48.0" x 30.0" Horiz. Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	63.00'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 0.75 Width (feet) 0.00 0.50
#4	Secondary	64.00'	**20.0' long x 18.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=61.25' (Free Discharge)
└─**1=RCP_Round 24"** (Controls 0.00 cfs)
└─**2=Grate** (Controls 0.00 cfs)
└─**3=Custom Weir/Orifice** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=61.25' (Free Discharge)
└─**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 2P: SGW-2


Hydrograph
Inflow Area=3.590 ac
Peak Elev=62.29'
Storage=16,435 cf
4.51 cfs
0.00 cfs
0.00 cfs
0.00 cfs
Inflow
Outflow
Primary
Secondary
Flow (cfs)
0 1 2 3 4 5
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72
Time (hours)

Hydrograph for Pond 2P: SGW-2

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Outflow (cfs)	Primary (cfs)	Secondary (cfs)
0.00	0.00	0	61.25	**0.00**	**0.00**	**0.00**
2.00	0.00	0	61.25	0.00	0.00	0.00
4.00	0.00	0	61.25	0.00	0.00	0.00
6.00	0.01	26	61.25	0.00	0.00	0.00
8.00	0.03	150	61.26	0.00	0.00	0.00
10.00	0.09	508	61.29	0.00	0.00	0.00
12.00	**2.15**	3,141	61.47	0.00	0.00	0.00
14.00	**0.31**	11,684	62.01	0.00	0.00	0.00
16.00	0.17	13,288	62.10	0.00	0.00	0.00
18.00	0.12	14,334	62.16	0.00	0.00	0.00
20.00	0.10	15,114	62.21	0.00	0.00	0.00
22.00	0.09	15,799	62.25	0.00	0.00	0.00
24.00	0.08	**16,388**	**62.28**	0.00	0.00	0.00
26.00	0.00	**16,435**	**62.29**	0.00	0.00	0.00
28.00	0.00	16,435	62.29	0.00	0.00	0.00
30.00	0.00	16,435	62.29	0.00	0.00	0.00
32.00	0.00	16,435	62.29	0.00	0.00	0.00
34.00	0.00	16,435	62.29	0.00	0.00	0.00
36.00	0.00	16,435	62.29	0.00	0.00	0.00
38.00	0.00	16,435	62.29	0.00	0.00	0.00
40.00	0.00	16,435	62.29	0.00	0.00	0.00
42.00	0.00	16,435	62.29	0.00	0.00	0.00
44.00	0.00	16,435	62.29	0.00	0.00	0.00
46.00	0.00	16,435	62.29	0.00	0.00	0.00
48.00	0.00	16,435	62.29	0.00	0.00	0.00
50.00	0.00	16,435	62.29	0.00	0.00	0.00
52.00	0.00	16,435	62.29	0.00	0.00	0.00
54.00	0.00	16,435	62.29	0.00	0.00	0.00
56.00	0.00	16,435	62.29	0.00	0.00	0.00
58.00	0.00	16,435	62.29	0.00	0.00	0.00
60.00	0.00	16,435	62.29	0.00	0.00	0.00
62.00	0.00	16,435	62.29	0.00	0.00	0.00
64.00	0.00	16,435	62.29	0.00	0.00	0.00
66.00	0.00	16,435	62.29	0.00	0.00	0.00
68.00	0.00	16,435	62.29	0.00	0.00	0.00
70.00	0.00	16,435	62.29	0.00	0.00	0.00
72.00	0.00	16,435	62.29	0.00	0.00	0.00

Summary for Pond 3P: WET-ED

Inflow Area = 4.530 ac, 20.75% Impervious, Inflow Depth = 0.98" for 1-RPv event
Inflow = 2.40 cfs @ 12.33 hrs, Volume= 0.371 af
Outflow = 0.23 cfs @ 15.26 hrs, Volume= 0.366 af, Atten= 90%, Lag= 175.4 min
Primary = 0.23 cfs @ 15.26 hrs, Volume= 0.365 af
Routed to Link 2L : AP-2
Secondary = 0.01 cfs @ 15.26 hrs, Volume= 0.001 af
Routed to Link 2L : AP-2
Tertiary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Link 2L : AP-2

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 61.29' @ 15.26 hrs Surf.Area= 10,219 sf Storage= 9,572 cf

Plug-Flow detention time= 581.1 min calculated for 0.366 af (99% of inflow)
Center-of-Mass det. time= 574.0 min (1,438.1 - 864.1)

Volume	Invert	Avail.Storage	Storage Description
#1	60.25'	43,946 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
60.25	8,061	0	0
61.00	9,706	6,663	6,663
62.00	11,464	10,585	17,248
63.00	13,324	12,394	29,642
64.00	15,284	14,304	43,946

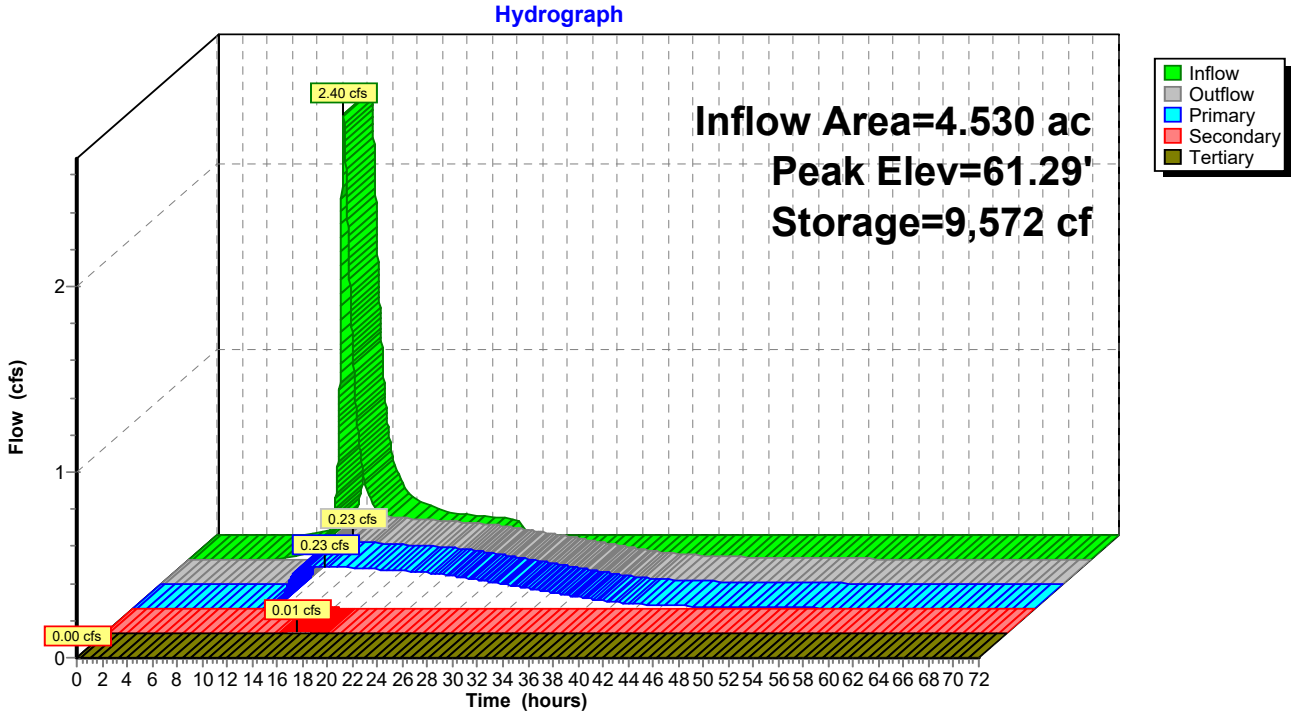
Device	Routing	Invert	Outlet Devices
#1	Primary	60.25'	**3.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Secondary	61.25'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 1.25 Width (feet) 0.25 0.25
#3	Tertiary	63.75'	**25.0' long x 18.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=0.23 cfs @ 15.26 hrs HW=61.29' (Free Discharge)
↑—**1=Orifice/Grate** (Orifice Controls 0.23 cfs @ 4.61 fps)

Secondary OutFlow Max=0.01 cfs @ 15.26 hrs HW=61.29' (Free Discharge)
↑—**2=Custom Weir/Orifice** (Weir Controls 0.01 cfs @ 0.67 fps)

Tertiary OutFlow Max=0.00 cfs @ 0.00 hrs HW=60.25' (Free Discharge)
↑—**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 3P: WET-ED



Hydrograph for Pond 3P: WET-ED

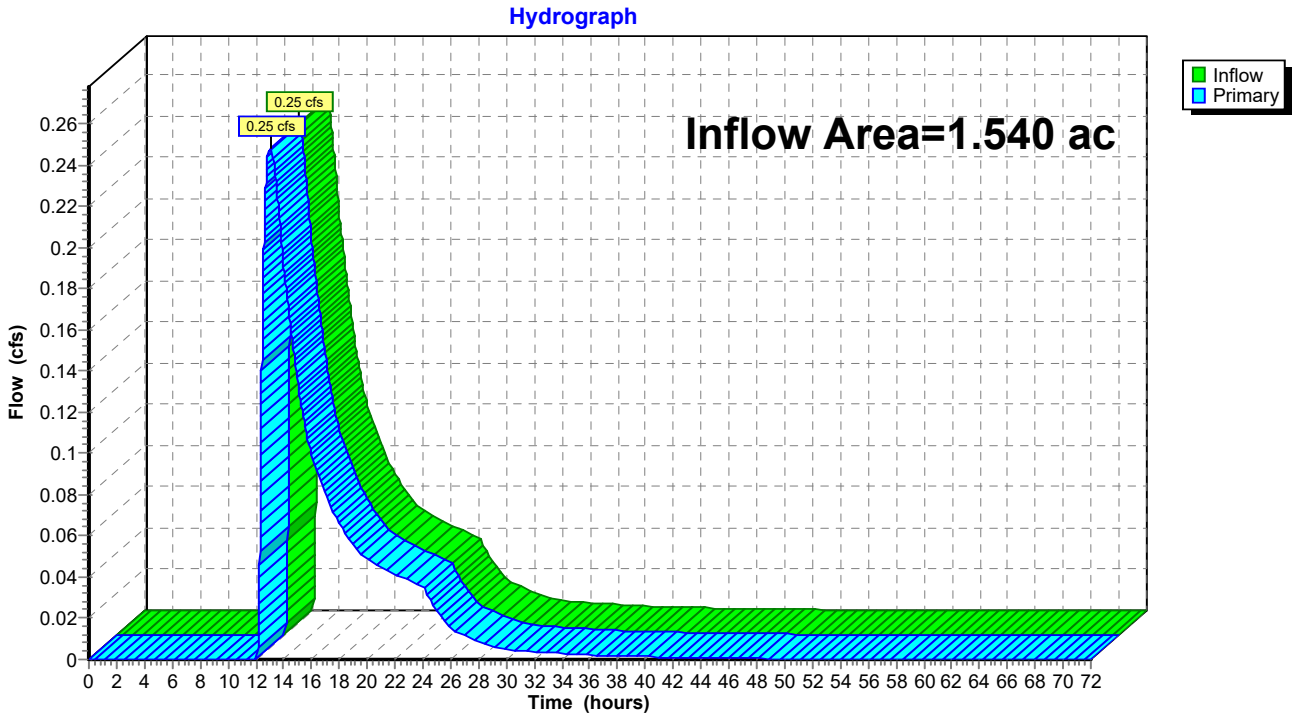
Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Outflow (cfs)	Primary (cfs)	Secondary (cfs)	Tertiary (cfs)
0.00	0.00	0	60.25	0.00	0.00	0.00	**0.00**
2.00	0.00	0	60.25	0.00	0.00	0.00	0.00
4.00	0.00	0	60.25	0.00	0.00	0.00	0.00
6.00	0.00	0	60.25	0.00	0.00	0.00	0.00
8.00	0.01	39	60.25	0.00	0.00	0.00	0.00
10.00	0.05	231	60.28	0.00	0.00	0.00	0.00
12.00	**0.74**	1,434	60.42	0.05	0.05	0.00	0.00
14.00	**0.43**	**9,203**	**61.26**	**0.22**	**0.22**	**0.00**	0.00
16.00	0.19	**9,510**	**61.29**	**0.23**	**0.23**	**0.01**	0.00
18.00	0.14	9,064	61.24	0.22	0.22	0.00	0.00
20.00	0.11	8,372	61.17	0.21	0.21	0.00	0.00
22.00	0.10	7,636	61.10	0.20	0.20	0.00	0.00
24.00	0.08	6,876	61.02	0.19	0.19	0.00	0.00
26.00	0.00	5,729	60.90	0.17	0.17	0.00	0.00
28.00	0.00	4,570	60.78	0.15	0.15	0.00	0.00
30.00	0.00	3,568	60.67	0.13	0.13	0.00	0.00
32.00	0.00	2,727	60.57	0.11	0.11	0.00	0.00
34.00	0.00	2,052	60.50	0.08	0.08	0.00	0.00
36.00	0.00	1,546	60.44	0.06	0.06	0.00	0.00
38.00	0.00	1,202	60.40	0.04	0.04	0.00	0.00
40.00	0.00	968	60.37	0.03	0.03	0.00	0.00
42.00	0.00	803	60.35	0.02	0.02	0.00	0.00
44.00	0.00	682	60.33	0.01	0.01	0.00	0.00
46.00	0.00	591	60.32	0.01	0.01	0.00	0.00
48.00	0.00	519	60.31	0.01	0.01	0.00	0.00
50.00	0.00	460	60.31	0.01	0.01	0.00	0.00
52.00	0.00	412	60.30	0.01	0.01	0.00	0.00
54.00	0.00	373	60.30	0.00	0.00	0.00	0.00
56.00	0.00	340	60.29	0.00	0.00	0.00	0.00
58.00	0.00	314	60.29	0.00	0.00	0.00	0.00
60.00	0.00	292	60.29	0.00	0.00	0.00	0.00
62.00	0.00	272	60.28	0.00	0.00	0.00	0.00
64.00	0.00	253	60.28	0.00	0.00	0.00	0.00
66.00	0.00	235	60.28	0.00	0.00	0.00	0.00
68.00	0.00	219	60.28	0.00	0.00	0.00	0.00
70.00	0.00	203	60.28	0.00	0.00	0.00	0.00
72.00	0.00	189	60.27	0.00	0.00	0.00	0.00

Summary for Link 1L: AP-1

Inflow Area = 1.540 ac, 14.94% Impervious, Inflow Depth > 0.78" for 1-RPv event
Inflow = 0.25 cfs @ 13.03 hrs, Volume= 0.100 af
Primary = 0.25 cfs @ 13.03 hrs, Volume= 0.100 af, Atten= 0%, Lag= 0.0 min

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

Link 1L: AP-1



Hydrograph for Link 1L: AP-1

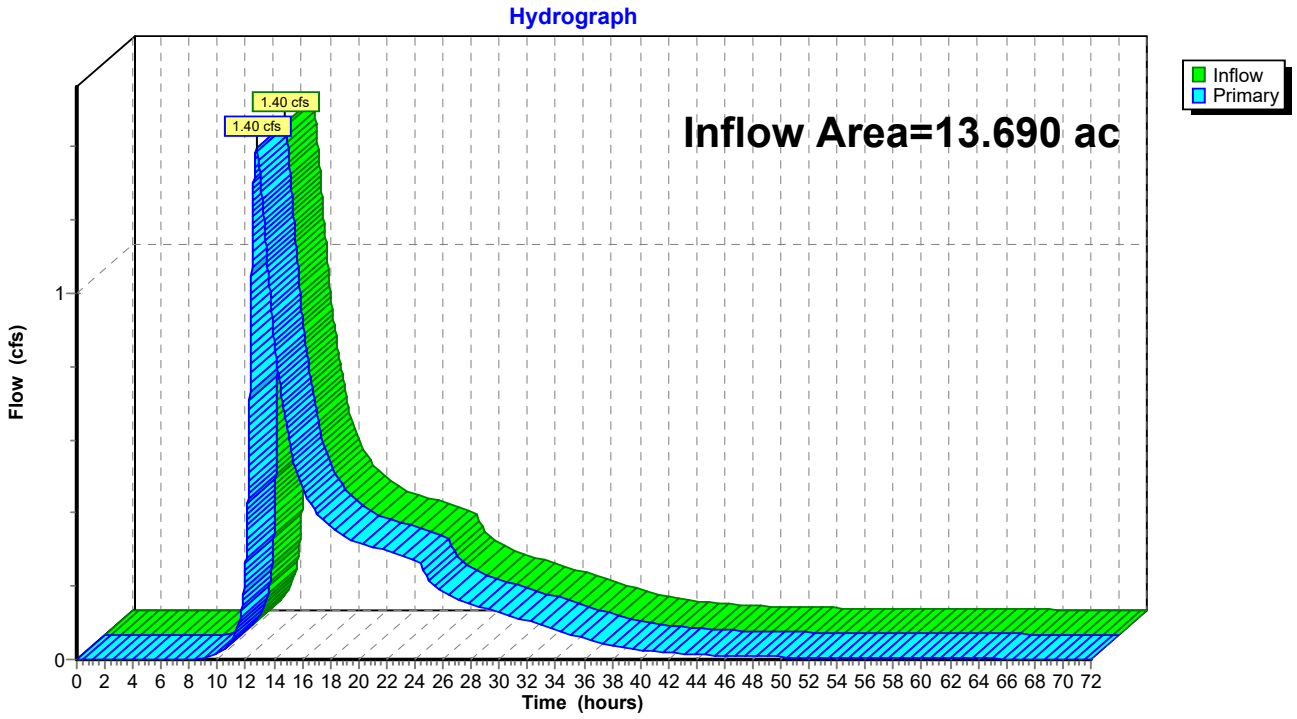
Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)
0.00	0.00	**0.00**	0.00	51.00	0.00	0.00	0.00
1.00	0.00	0.00	0.00	52.00	0.00	0.00	0.00
2.00	0.00	0.00	0.00	53.00	0.00	0.00	0.00
3.00	0.00	0.00	0.00	54.00	0.00	0.00	0.00
4.00	0.00	0.00	0.00	55.00	0.00	0.00	0.00
5.00	0.00	0.00	0.00	56.00	0.00	0.00	0.00
6.00	0.00	0.00	0.00	57.00	0.00	0.00	0.00
7.00	0.00	0.00	0.00	58.00	0.00	0.00	0.00
8.00	0.00	0.00	0.00	59.00	0.00	0.00	0.00
9.00	0.00	0.00	0.00	60.00	0.00	0.00	0.00
10.00	0.00	0.00	0.00	61.00	0.00	0.00	0.00
11.00	0.00	0.00	0.00	62.00	0.00	0.00	0.00
12.00	0.00	0.00	0.00	63.00	0.00	0.00	0.00
13.00	**0.25**	0.00	**0.25**	64.00	0.00	0.00	0.00
14.00	**0.19**	0.00	**0.19**	65.00	0.00	0.00	0.00
15.00	0.14	0.00	0.14	66.00	0.00	0.00	0.00
16.00	0.10	0.00	0.10	67.00	0.00	0.00	0.00
17.00	0.08	0.00	0.08	68.00	0.00	0.00	0.00
18.00	0.07	0.00	0.07	69.00	0.00	0.00	0.00
19.00	0.06	0.00	0.06	70.00	0.00	0.00	0.00
20.00	0.05	0.00	0.05	71.00	0.00	0.00	0.00
21.00	0.04	0.00	0.04	72.00	0.00	0.00	0.00
22.00	0.04	0.00	0.04				
23.00	0.04	0.00	0.04				
24.00	0.04	0.00	0.04				
25.00	0.02	0.00	0.02				
26.00	0.02	0.00	0.02				
27.00	0.01	0.00	0.01				
28.00	0.01	0.00	0.01				
29.00	0.01	0.00	0.01				
30.00	0.00	0.00	0.00				
31.00	0.00	0.00	0.00				
32.00	0.00	0.00	0.00				
33.00	0.00	0.00	0.00				
34.00	0.00	0.00	0.00				
35.00	0.00	0.00	0.00				
36.00	0.00	0.00	0.00				
37.00	0.00	0.00	0.00				
38.00	0.00	0.00	0.00				
39.00	0.00	0.00	0.00				
40.00	0.00	0.00	0.00				
41.00	0.00	0.00	0.00				
42.00	0.00	0.00	0.00				
43.00	0.00	0.00	0.00				
44.00	0.00	0.00	0.00				
45.00	0.00	0.00	0.00				
46.00	0.00	0.00	0.00				
47.00	0.00	0.00	0.00				
48.00	0.00	0.00	0.00				
49.00	0.00	0.00	0.00				
50.00	0.00	0.00	0.00				

Summary for Link 2L: AP-2

Inflow Area = 13.690 ac, 12.42% Impervious, Inflow Depth > 0.59" for 1-RPv event
Inflow = 1.40 cfs @ 12.77 hrs, Volume= 0.678 af
Primary = 1.40 cfs @ 12.77 hrs, Volume= 0.678 af, Atten= 0%, Lag= 0.0 min

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

Link 2L: AP-2



Hydrograph for Link 2L: AP-2

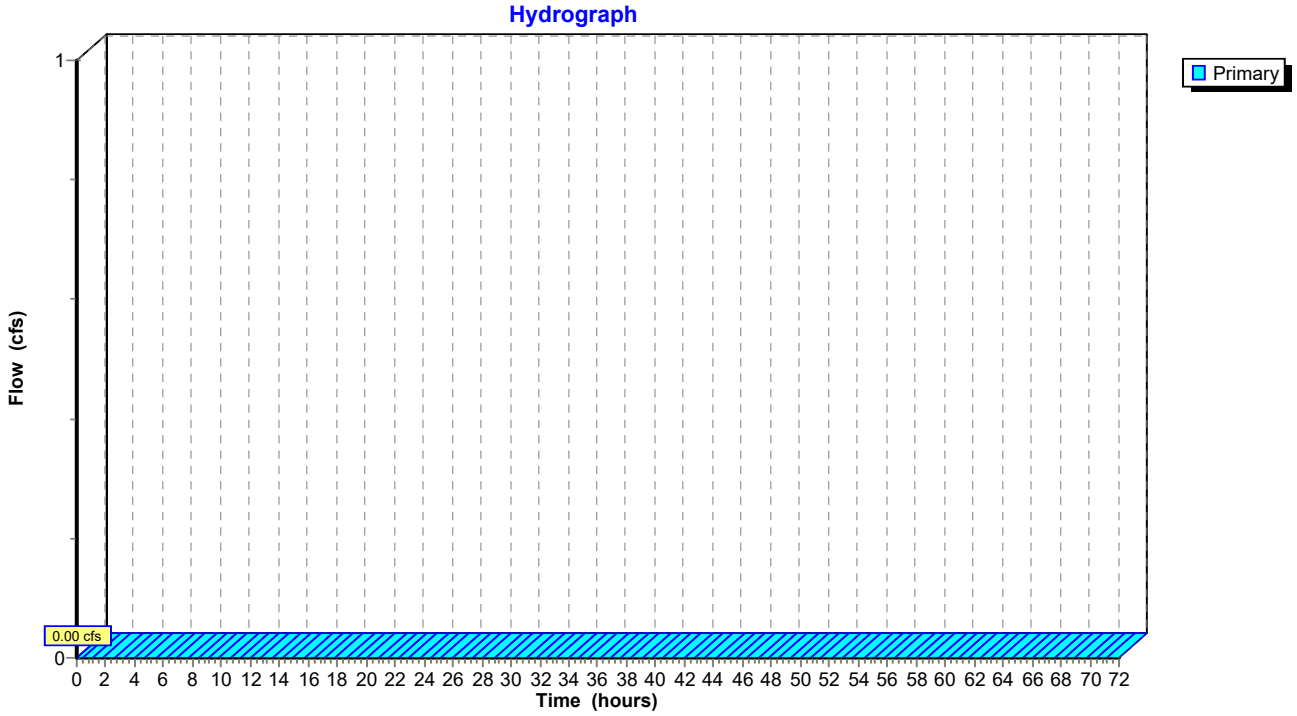
Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)
0.00	0.00	**0.00**	0.00	51.00	0.01	0.00	0.01
1.00	0.00	0.00	0.00	52.00	0.01	0.00	0.01
2.00	0.00	0.00	0.00	53.00	0.01	0.00	0.01
3.00	0.00	0.00	0.00	54.00	0.00	0.00	0.00
4.00	0.00	0.00	0.00	55.00	0.00	0.00	0.00
5.00	0.00	0.00	0.00	56.00	0.00	0.00	0.00
6.00	0.00	0.00	0.00	57.00	0.00	0.00	0.00
7.00	0.00	0.00	0.00	58.00	0.00	0.00	0.00
8.00	0.00	0.00	0.00	59.00	0.00	0.00	0.00
9.00	0.00	0.00	0.00	60.00	0.00	0.00	0.00
10.00	0.02	0.00	0.02	61.00	0.00	0.00	0.00
11.00	0.05	0.00	0.05	62.00	0.00	0.00	0.00
12.00	**0.27**	0.00	**0.27**	63.00	0.00	0.00	0.00
13.00	**1.33**	0.00	**1.33**	64.00	0.00	0.00	0.00
14.00	0.88	0.00	0.88	65.00	0.00	0.00	0.00
15.00	0.62	0.00	0.62	66.00	0.00	0.00	0.00
16.00	0.47	0.00	0.47	67.00	0.00	0.00	0.00
17.00	0.40	0.00	0.40	68.00	0.00	0.00	0.00
18.00	0.36	0.00	0.36	69.00	0.00	0.00	0.00
19.00	0.34	0.00	0.34	70.00	0.00	0.00	0.00
20.00	0.32	0.00	0.32	71.00	0.00	0.00	0.00
21.00	0.31	0.00	0.31	72.00	0.00	0.00	0.00
22.00	0.30	0.00	0.30				
23.00	0.28	0.00	0.28				
24.00	0.27	0.00	0.27				
25.00	0.22	0.00	0.22				
26.00	0.18	0.00	0.18				
27.00	0.16	0.00	0.16				
28.00	0.15	0.00	0.15				
29.00	0.14	0.00	0.14				
30.00	0.13	0.00	0.13				
31.00	0.12	0.00	0.12				
32.00	0.11	0.00	0.11				
33.00	0.09	0.00	0.09				
34.00	0.08	0.00	0.08				
35.00	0.07	0.00	0.07				
36.00	0.06	0.00	0.06				
37.00	0.05	0.00	0.05				
38.00	0.04	0.00	0.04				
39.00	0.03	0.00	0.03				
40.00	0.03	0.00	0.03				
41.00	0.02	0.00	0.02				
42.00	0.02	0.00	0.02				
43.00	0.02	0.00	0.02				
44.00	0.01	0.00	0.01				
45.00	0.01	0.00	0.01				
46.00	0.01	0.00	0.01				
47.00	0.01	0.00	0.01				
48.00	0.01	0.00	0.01				
49.00	0.01	0.00	0.01				
50.00	0.01	0.00	0.01				

Summary for Link 3L: AP-3

Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

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

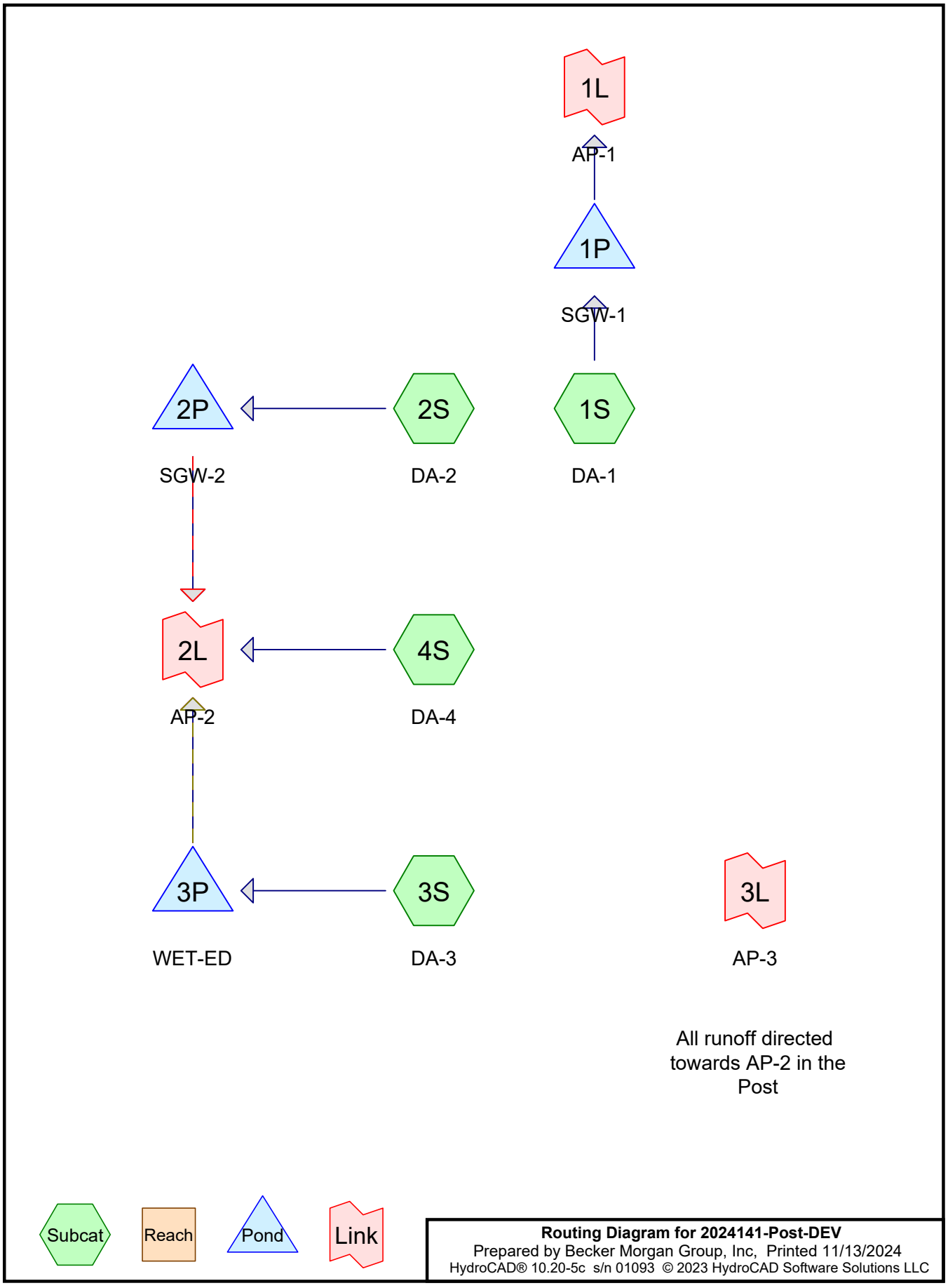
Link 3L: AP-3



A.7
POST-DEVELOPED Cv (10-YEAR) HYDROCAD CALCULATIONS

Townsend Acres Subdivision

Townsend, Delaware



Routing Diagram for 2024141-Post-DEV
Prepared by Becker Morgan Group, Inc, Printed 11/13/2024

2024141-Post-DEV

Prepared by Becker Morgan Group, Inc

Printed 11/13/2024

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.880	39	>75% Grass cover, Good, HSG A (3S, 4S)
1.860	61	>75% Grass cover, Good, HSG B (1S, 2S, 3S, 4S)
0.780	74	>75% Grass cover, Good, HSG C (2S, 3S, 4S)
0.230	80	>75% Grass cover, Good, HSG D (1S, 3S, 4S)
2.090	68	Duplex Lot, 50% Imp., HSG A (3S, 4S)
2.870	79	Duplex Lot, 50% Imp., HSG B (1S, 2S, 3S, 4S)
0.170	86	Duplex Lot, 50% Imp., HSG C (3S)
0.520	98	Paved parking, HSG A (3S)
1.030	98	Paved parking, HSG B (1S, 2S, 3S)
0.250	98	Paved parking, HSG C (3S)
0.130	98	Paved parking, HSG D (1S)
0.220	30	Woods, Good, HSG A (4S)
1.910	55	Woods, Good, HSG B (4S)
1.640	70	Woods, Good, HSG C (4S)
0.650	77	Woods, Good, HSG D (4S)
15.230	**70**	**TOTAL AREA**

2024141-Post-DEV

Prepared by Becker Morgan Group, Inc

Printed 11/13/2024

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
3.710	HSG A	3S, 4S
7.670	HSG B	1S, 2S, 3S, 4S
2.840	HSG C	2S, 3S, 4S
1.010	HSG D	1S, 3S, 4S
0.000	Other	
15.230		**TOTAL AREA**

2024141-Post-DEV

Prepared by Becker Morgan Group, Inc Printed 11/13/2024

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.880	1.860	0.780	0.230	0.000	3.750	>75% Grass cover, Good	1S, 2S, 3S, 4S
2.090	2.870	0.170	0.000	0.000	5.130	Duplex Lot, 50% Imp.	1S, 2S, 3S, 4S
0.520	1.030	0.250	0.130	0.000	1.930	Paved parking	1S, 2S, 3S
0.220	1.910	1.640	0.650	0.000	4.420	Woods, Good	4S
3.710	**7.670**	**2.840**	**1.010**	**0.000**	**15.230**	**TOTAL AREA**	

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: DA-1 Runoff Area=1.540 ac 14.94% Impervious Runoff Depth=2.37"
Tc=6.0 min CN=76 Runoff=3.82 cfs 0.304 af

Subcatchment2S: DA-2 Runoff Area=3.590 ac 21.17% Impervious Runoff Depth=2.63"
Tc=6.0 min CN=79 Runoff=9.88 cfs 0.787 af

Subcatchment3S: DA-3 Runoff Area=4.530 ac 20.75% Impervious Runoff Depth=2.05"
Flow Length=1,168' Tc=20.4 min CN=72 Runoff=5.20 cfs 0.772 af

Subcatchment4S: DA-4 Runoff Area=5.570 ac 0.00% Impervious Runoff Depth=1.32"
Flow Length=769' Tc=44.9 min CN=62 Runoff=2.28 cfs 0.611 af

Pond 1P: SGW-1 Peak Elev=62.35' Storage=5,926 cf Inflow=3.82 cfs 0.304 af
Outflow=0.74 cfs 0.259 af

Pond 2P: SGW-2 Peak Elev=63.23' Storage=34,072 cf Inflow=9.88 cfs 0.787 af
Primary=0.02 cfs 0.049 af Secondary=0.00 cfs 0.000 af Outflow=0.02 cfs 0.049 af

Pond 3P: WET-ED Peak Elev=62.04' Storage=17,703 cf Inflow=5.20 cfs 0.772 af
Primary=0.30 cfs 0.509 af Secondary=0.57 cfs 0.257 af Tertiary=0.00 cfs 0.000 af Outflow=0.88 cfs 0.767 af

Link 1L: AP-1 Inflow=0.74 cfs 0.259 af
Primary=0.74 cfs 0.259 af

Link 2L: AP-2 Inflow=2.78 cfs 1.427 af
Primary=2.78 cfs 1.427 af

Link 3L: AP-3
Primary=0.00 cfs 0.000 af

Total Runoff Area = 15.230 ac Runoff Volume = 2.474 af Average Runoff Depth = 1.95"
87.33% Pervious = 13.300 ac 12.67% Impervious = 1.930 ac

Summary for Subcatchment 1S: DA-1

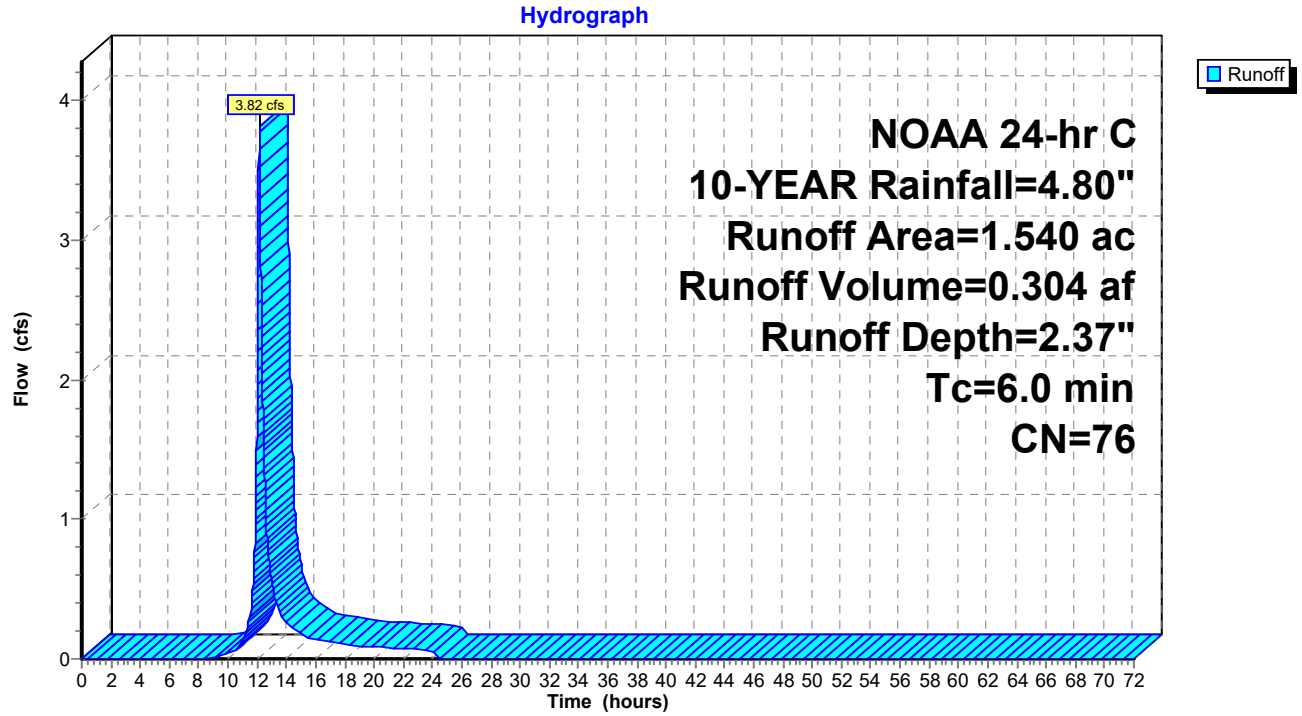
Runoff = 3.82 cfs @ 12.14 hrs, Volume= 0.304 af, Depth= 2.37"
Routed to Pond 1P : SGW-1

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 10-YEAR Rainfall=4.80"

	Area (ac)	CN	Description
	0.100	98	Paved parking, HSG B
	0.130	98	Paved parking, HSG D
	0.470	61	>75% Grass cover, Good, HSG B
	0.200	80	>75% Grass cover, Good, HSG D
*	0.640	79	Duplex Lot, 50% Imp., HSG B
	1.540	76	Weighted Average
	1.310		85.06% Pervious Area
	0.230		14.94% Impervious Area

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

Subcatchment 1S: DA-1



Hydrograph for Subcatchment 1S: DA-1

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00
1.00	0.05	0.00	0.00
2.00	0.11	0.00	0.00
3.00	0.17	0.00	0.00
4.00	0.23	0.00	0.00
5.00	0.31	0.00	0.00
6.00	0.38	0.00	0.00
7.00	0.47	0.00	0.00
8.00	0.58	0.00	0.00
9.00	0.70	0.00	0.01
10.00	0.88	0.02	0.04
11.00	1.15	0.07	0.13
12.00	2.29	0.57	**1.78**
13.00	3.65	1.47	**0.55**
14.00	3.92	1.68	0.26
15.00	4.10	1.81	0.18
16.00	4.22	1.91	0.14
17.00	4.33	2.00	0.12
18.00	4.42	2.07	0.10
19.00	4.49	2.13	0.09
20.00	4.57	2.18	0.09
21.00	4.63	2.23	0.08
22.00	4.69	2.28	0.07
23.00	4.75	2.33	0.07
24.00	**4.80**	**2.37**	0.07
25.00	4.80	2.37	0.00
26.00	4.80	2.37	0.00
27.00	4.80	2.37	0.00
28.00	4.80	2.37	0.00
29.00	4.80	2.37	0.00
30.00	4.80	2.37	0.00
31.00	4.80	2.37	0.00
32.00	4.80	2.37	0.00
33.00	4.80	2.37	0.00
34.00	4.80	2.37	0.00
35.00	4.80	2.37	0.00
36.00	4.80	2.37	0.00
37.00	4.80	2.37	0.00
38.00	4.80	2.37	0.00
39.00	4.80	2.37	0.00
40.00	4.80	2.37	0.00
41.00	4.80	2.37	0.00
42.00	4.80	2.37	0.00
43.00	4.80	2.37	0.00
44.00	4.80	2.37	0.00
45.00	4.80	2.37	0.00
46.00	4.80	2.37	0.00
47.00	4.80	2.37	0.00
48.00	4.80	2.37	0.00
49.00	4.80	2.37	0.00
50.00	4.80	2.37	0.00
51.00	4.80	2.37	0.00
52.00	4.80	2.37	0.00
53.00	4.80	2.37	0.00
54.00	4.80	2.37	0.00
55.00	4.80	2.37	0.00
56.00	4.80	2.37	0.00
57.00	4.80	2.37	0.00
58.00	4.80	2.37	0.00
59.00	4.80	2.37	0.00
60.00	4.80	2.37	0.00
61.00	4.80	2.37	0.00
62.00	4.80	2.37	0.00
63.00	4.80	2.37	0.00
64.00	4.80	2.37	0.00
65.00	4.80	2.37	0.00
66.00	4.80	2.37	0.00
67.00	4.80	2.37	0.00
68.00	4.80	2.37	0.00
69.00	4.80	2.37	0.00
70.00	4.80	2.37	0.00
71.00	4.80	2.37	0.00
72.00	4.80	2.37	0.00

Summary for Subcatchment 2S: DA-2

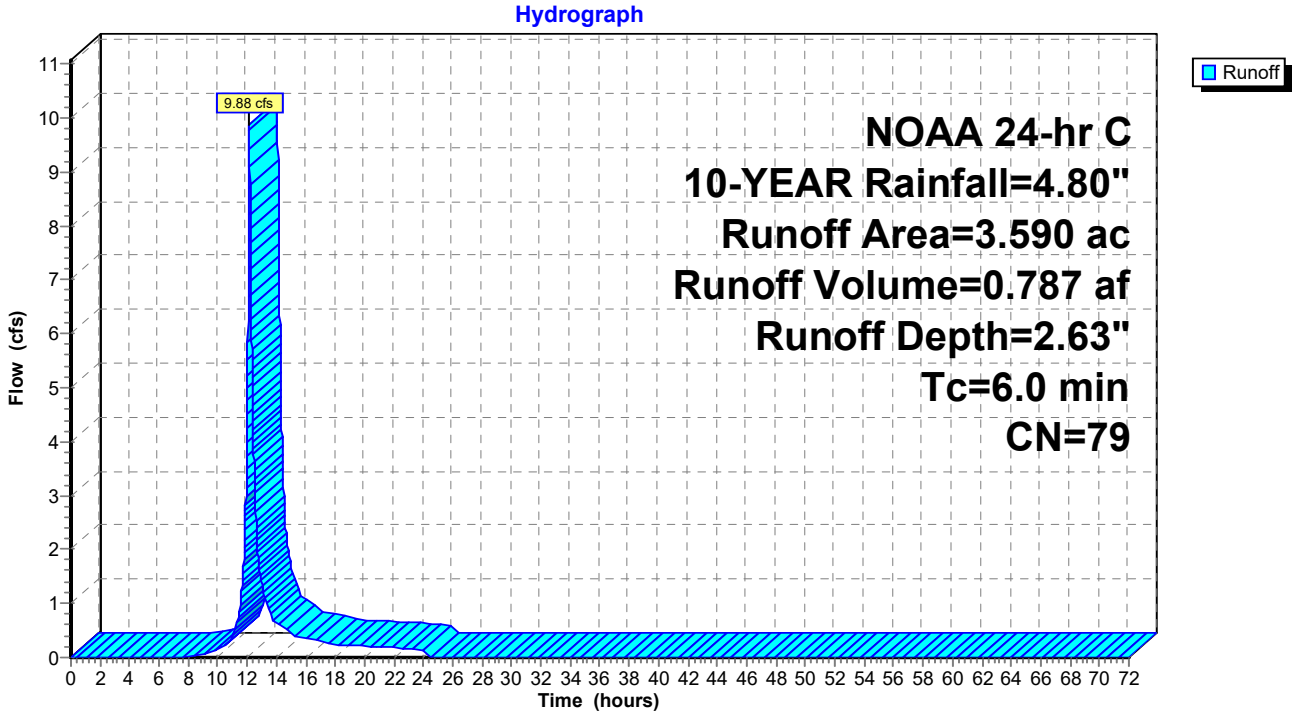
Runoff = 9.88 cfs @ 12.14 hrs, Volume= 0.787 af, Depth= 2.63"
Routed to Pond 2P : SGW-2

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 10-YEAR Rainfall=4.80"

	Area (ac)	CN	Description
	0.760	98	Paved parking, HSG B
	0.740	61	>75% Grass cover, Good, HSG B
	0.280	74	>75% Grass cover, Good, HSG C
*	1.810	79	Duplex Lot, 50% Imp., HSG B
	3.590	79	Weighted Average
	2.830		78.83% Pervious Area
	0.760		21.17% Impervious Area

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

Subcatchment 2S: DA-2



Hydrograph for Subcatchment 2S: DA-2

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00
1.00	0.05	0.00	0.00
2.00	0.11	0.00	0.00
3.00	0.17	0.00	0.00
4.00	0.23	0.00	0.00
5.00	0.31	0.00	0.00
6.00	0.38	0.00	0.00
7.00	0.47	0.00	0.00
8.00	0.58	0.00	0.01
9.00	0.70	0.01	0.05
10.00	0.88	0.04	0.14
11.00	1.15	0.12	0.41
12.00	2.29	0.70	**4.76**
13.00	3.65	1.68	**1.38**
14.00	3.92	1.90	0.64
15.00	4.10	2.04	0.44
16.00	4.22	2.15	0.36
17.00	4.33	2.24	0.30
18.00	4.42	2.31	0.25
19.00	4.49	2.37	0.22
20.00	4.57	2.43	0.21
21.00	4.63	2.49	0.20
22.00	4.69	2.54	0.18
23.00	4.75	2.59	0.17
24.00	**4.80**	**2.63**	0.17
25.00	4.80	2.63	0.00
26.00	4.80	2.63	0.00
27.00	4.80	2.63	0.00
28.00	4.80	2.63	0.00
29.00	4.80	2.63	0.00
30.00	4.80	2.63	0.00
31.00	4.80	2.63	0.00
32.00	4.80	2.63	0.00
33.00	4.80	2.63	0.00
34.00	4.80	2.63	0.00
35.00	4.80	2.63	0.00
36.00	4.80	2.63	0.00
37.00	4.80	2.63	0.00
38.00	4.80	2.63	0.00
39.00	4.80	2.63	0.00
40.00	4.80	2.63	0.00
41.00	4.80	2.63	0.00
42.00	4.80	2.63	0.00
43.00	4.80	2.63	0.00
44.00	4.80	2.63	0.00
45.00	4.80	2.63	0.00
46.00	4.80	2.63	0.00
47.00	4.80	2.63	0.00
48.00	4.80	2.63	0.00
49.00	4.80	2.63	0.00
50.00	4.80	2.63	0.00
51.00	4.80	2.63	0.00
52.00	4.80	2.63	0.00
53.00	4.80	2.63	0.00
54.00	4.80	2.63	0.00
55.00	4.80	2.63	0.00
56.00	4.80	2.63	0.00
57.00	4.80	2.63	0.00
58.00	4.80	2.63	0.00
59.00	4.80	2.63	0.00
60.00	4.80	2.63	0.00
61.00	4.80	2.63	0.00
62.00	4.80	2.63	0.00
63.00	4.80	2.63	0.00
64.00	4.80	2.63	0.00
65.00	4.80	2.63	0.00
66.00	4.80	2.63	0.00
67.00	4.80	2.63	0.00
68.00	4.80	2.63	0.00
69.00	4.80	2.63	0.00
70.00	4.80	2.63	0.00
71.00	4.80	2.63	0.00
72.00	4.80	2.63	0.00

Summary for Subcatchment 3S: DA-3

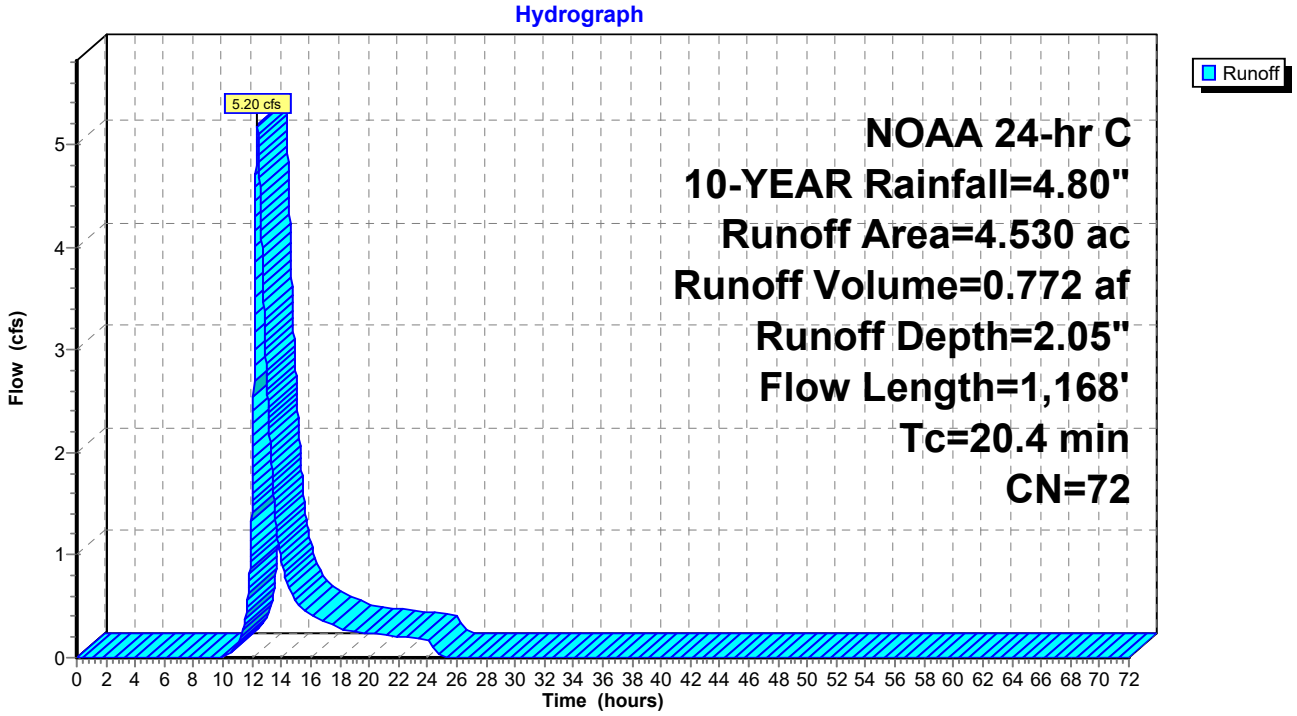
Runoff = 5.20 cfs @ 12.33 hrs, Volume= 0.772 af, Depth= 2.05"
Routed to Pond 3P : WET-ED

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 10-YEAR Rainfall=4.80"

	Area (ac)	CN	Description
	0.520	98	Paved parking, HSG A
	0.170	98	Paved parking, HSG B
	0.250	98	Paved parking, HSG C
	0.630	39	>75% Grass cover, Good, HSG A
	0.050	61	>75% Grass cover, Good, HSG B
	0.330	74	>75% Grass cover, Good, HSG C
	0.010	80	>75% Grass cover, Good, HSG D
*	1.990	68	Duplex Lot, 50% Imp., HSG A
*	0.410	79	Duplex Lot, 50% Imp., HSG B
*	0.170	86	Duplex Lot, 50% Imp., HSG C
	4.530	72	Weighted Average
	3.590		79.25% Pervious Area
	0.940		20.75% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.2	56	0.0300	0.18		**Sheet Flow, 3A** Grass: Short n= 0.150 P2= 3.20"
6.5	44	0.0107	0.11		**Sheet Flow, 3B** Grass: Short n= 0.150 P2= 3.20"
4.8	275	0.0040	0.95		**Shallow Concentrated Flow, 3C** Grassed Waterway Kv= 15.0 fps
3.9	793	0.0030	3.42	10.74	**Pipe Channel, RCP_Round 24"** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.015 Concrete sewer w/manholes & inlets
20.4	1,168	Total			

Subcatchment 3S: DA-3



Hydrograph for Subcatchment 3S: DA-3

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00
1.00	0.05	0.00	0.00
2.00	0.11	0.00	0.00
3.00	0.17	0.00	0.00
4.00	0.23	0.00	0.00
5.00	0.31	0.00	0.00
6.00	0.38	0.00	0.00
7.00	0.47	0.00	0.00
8.00	0.58	0.00	0.00
9.00	0.70	0.00	0.00
10.00	0.88	0.00	0.01
11.00	1.15	0.03	0.14
12.00	2.29	0.42	**1.48**
13.00	3.65	1.22	**2.72**
14.00	3.92	1.41	0.94
15.00	4.10	1.53	0.57
16.00	4.22	1.62	0.42
17.00	4.33	1.70	0.35
18.00	4.42	1.76	0.29
19.00	4.49	1.82	0.25
20.00	4.57	1.87	0.24
21.00	4.63	1.92	0.22
22.00	4.69	1.96	0.21
23.00	4.75	2.01	0.19
24.00	**4.80**	**2.05**	0.18
25.00	4.80	2.05	0.02
26.00	4.80	2.05	0.00
27.00	4.80	2.05	0.00
28.00	4.80	2.05	0.00
29.00	4.80	2.05	0.00
30.00	4.80	2.05	0.00
31.00	4.80	2.05	0.00
32.00	4.80	2.05	0.00
33.00	4.80	2.05	0.00
34.00	4.80	2.05	0.00
35.00	4.80	2.05	0.00
36.00	4.80	2.05	0.00
37.00	4.80	2.05	0.00
38.00	4.80	2.05	0.00
39.00	4.80	2.05	0.00
40.00	4.80	2.05	0.00
41.00	4.80	2.05	0.00
42.00	4.80	2.05	0.00
43.00	4.80	2.05	0.00
44.00	4.80	2.05	0.00
45.00	4.80	2.05	0.00
46.00	4.80	2.05	0.00
47.00	4.80	2.05	0.00
48.00	4.80	2.05	0.00
49.00	4.80	2.05	0.00
50.00	4.80	2.05	0.00
51.00	4.80	2.05	0.00
52.00	4.80	2.05	0.00
53.00	4.80	2.05	0.00
54.00	4.80	2.05	0.00
55.00	4.80	2.05	0.00
56.00	4.80	2.05	0.00
57.00	4.80	2.05	0.00
58.00	4.80	2.05	0.00
59.00	4.80	2.05	0.00
60.00	4.80	2.05	0.00
61.00	4.80	2.05	0.00
62.00	4.80	2.05	0.00
63.00	4.80	2.05	0.00
64.00	4.80	2.05	0.00
65.00	4.80	2.05	0.00
66.00	4.80	2.05	0.00
67.00	4.80	2.05	0.00
68.00	4.80	2.05	0.00
69.00	4.80	2.05	0.00
70.00	4.80	2.05	0.00
71.00	4.80	2.05	0.00
72.00	4.80	2.05	0.00

Summary for Subcatchment 4S: DA-4

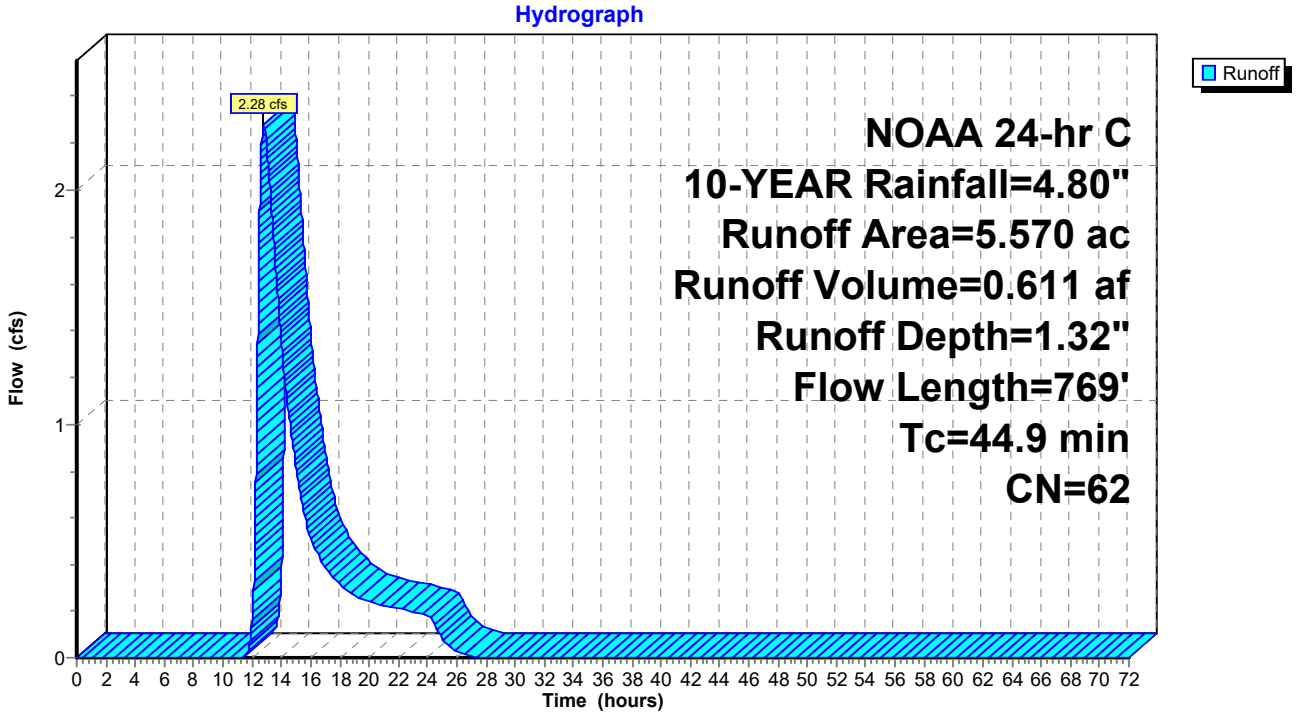
Runoff = 2.28 cfs @ 12.77 hrs, Volume= 0.611 af, Depth= 1.32"
Routed to Link 2L : AP-2

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 10-YEAR Rainfall=4.80"

	Area (ac)	CN	Description
	0.220	30	Woods, Good, HSG A
	1.910	55	Woods, Good, HSG B
	1.640	70	Woods, Good, HSG C
	0.650	77	Woods, Good, HSG D
	0.250	39	>75% Grass cover, Good, HSG A
	0.600	61	>75% Grass cover, Good, HSG B
	0.170	74	>75% Grass cover, Good, HSG C
	0.020	80	>75% Grass cover, Good, HSG D
*	0.100	68	Duplex Lot, 50% Imp., HSG A
*	0.010	79	Duplex Lot, 50% Imp., HSG B
	5.570	62	Weighted Average
	5.570		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.1	48	0.0396	0.19		**Sheet Flow, 4A** Grass: Short n= 0.150 P2= 3.20"
14.1	52	0.0154	0.06		**Sheet Flow, 4B** Woods: Light underbrush n= 0.400 P2= 3.20"
26.7	669	0.0070	0.42		**Shallow Concentrated Flow, 4C** Woodland Kv= 5.0 fps
44.9	769	Total			

Subcatchment 4S: DA-4



Hydrograph for Subcatchment 4S: DA-4

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00
1.00	0.05	0.00	0.00
2.00	0.11	0.00	0.00
3.00	0.17	0.00	0.00
4.00	0.23	0.00	0.00
5.00	0.31	0.00	0.00
6.00	0.38	0.00	0.00
7.00	0.47	0.00	0.00
8.00	0.58	0.00	0.00
9.00	0.70	0.00	0.00
10.00	0.88	0.00	0.00
11.00	1.15	0.00	0.00
12.00	2.29	0.16	**0.15**
13.00	3.65	0.69	**2.19**
14.00	3.92	0.83	1.35
15.00	4.10	0.92	0.82
16.00	4.22	0.99	0.51
17.00	4.33	1.04	0.39
18.00	4.42	1.09	0.32
19.00	4.49	1.14	0.27
20.00	4.57	1.18	0.24
21.00	4.63	1.22	0.22
22.00	4.69	1.25	0.21
23.00	4.75	1.29	0.20
24.00	**4.80**	**1.32**	0.18
25.00	4.80	1.32	0.08
26.00	4.80	1.32	0.02
27.00	4.80	1.32	0.01
28.00	4.80	1.32	0.00
29.00	4.80	1.32	0.00
30.00	4.80	1.32	0.00
31.00	4.80	1.32	0.00
32.00	4.80	1.32	0.00
33.00	4.80	1.32	0.00
34.00	4.80	1.32	0.00
35.00	4.80	1.32	0.00
36.00	4.80	1.32	0.00
37.00	4.80	1.32	0.00
38.00	4.80	1.32	0.00
39.00	4.80	1.32	0.00
40.00	4.80	1.32	0.00
41.00	4.80	1.32	0.00
42.00	4.80	1.32	0.00
43.00	4.80	1.32	0.00
44.00	4.80	1.32	0.00
45.00	4.80	1.32	0.00
46.00	4.80	1.32	0.00
47.00	4.80	1.32	0.00
48.00	4.80	1.32	0.00
49.00	4.80	1.32	0.00
50.00	4.80	1.32	0.00
51.00	4.80	1.32	0.00
52.00	4.80	1.32	0.00
53.00	4.80	1.32	0.00
54.00	4.80	1.32	0.00
55.00	4.80	1.32	0.00
56.00	4.80	1.32	0.00
57.00	4.80	1.32	0.00
58.00	4.80	1.32	0.00
59.00	4.80	1.32	0.00
60.00	4.80	1.32	0.00
61.00	4.80	1.32	0.00
62.00	4.80	1.32	0.00
63.00	4.80	1.32	0.00
64.00	4.80	1.32	0.00
65.00	4.80	1.32	0.00
66.00	4.80	1.32	0.00
67.00	4.80	1.32	0.00
68.00	4.80	1.32	0.00
69.00	4.80	1.32	0.00
70.00	4.80	1.32	0.00
71.00	4.80	1.32	0.00
72.00	4.80	1.32	0.00

Summary for Pond 1P: SGW-1

Inflow Area = 1.540 ac, 14.94% Impervious, Inflow Depth = 2.37" for 10-YEAR event
Inflow = 3.82 cfs @ 12.14 hrs, Volume= 0.304 af
Outflow = 0.74 cfs @ 12.76 hrs, Volume= 0.259 af, Atten= 81%, Lag= 36.7 min
Primary = 0.74 cfs @ 12.76 hrs, Volume= 0.259 af
Routed to Link 1L : AP-1

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 62.35' @ 12.76 hrs Surf.Area= 5,119 sf Storage= 5,926 cf

Plug-Flow detention time= 203.2 min calculated for 0.259 af (85% of inflow)
Center-of-Mass det. time= 135.1 min (976.3 - 841.2)

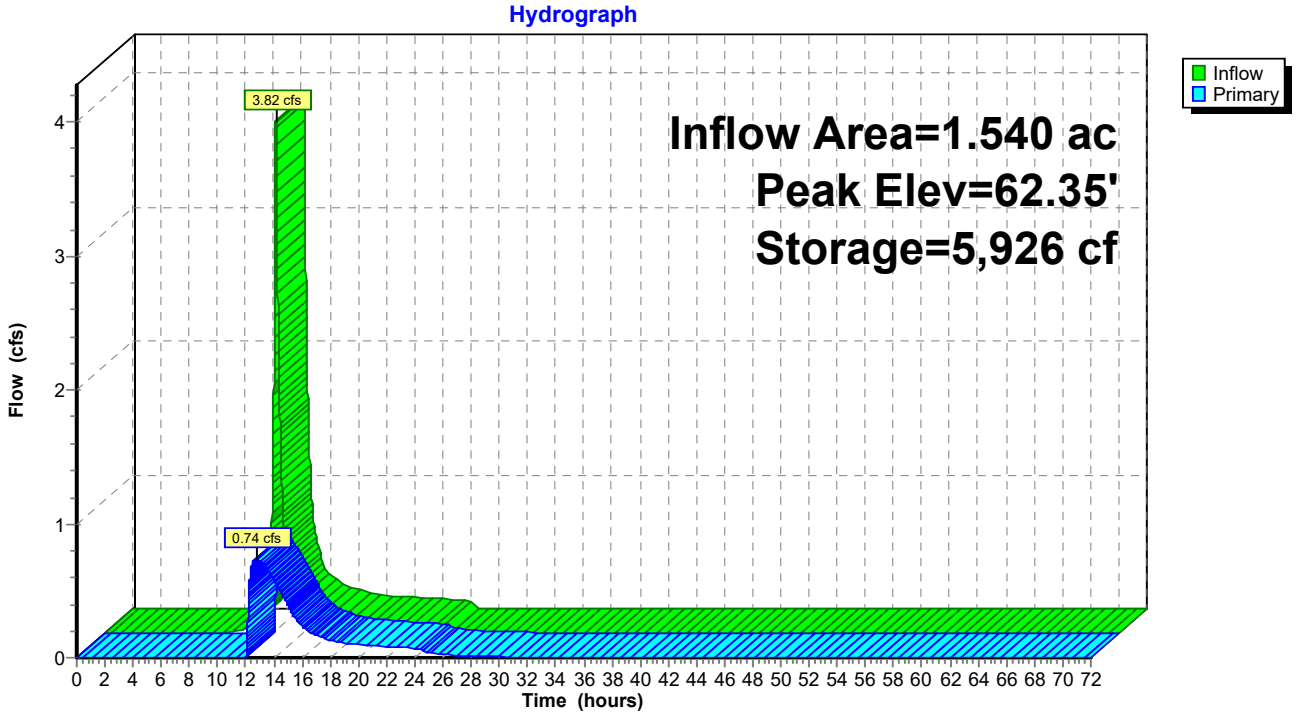
Volume	Invert	Avail.Storage	Storage Description
#1	61.00'	15,965 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
61.00	3,658	0	0
62.00	4,710	4,184	4,184
63.00	5,865	5,288	9,472
64.00	7,121	6,493	15,965

Device	Routing	Invert	Outlet Devices
#1	Primary	60.75'	**18.0" Round RCP_Round 18"** L= 32.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 60.75' / 60.59' S= 0.0050 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 1.77 sf
#2	Device 1	63.25'	**30.0" Horiz. Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	61.50'	**6.0" Vert. Orifice** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.74 cfs @ 12.76 hrs HW=62.35' (Free Discharge)
└**1=RCP_Round 18"** (Passes 0.74 cfs of 6.66 cfs potential flow)
├**2=Grate** (Controls 0.00 cfs)
└**3=Orifice** (Orifice Controls 0.74 cfs @ 3.74 fps)

Pond 1P: SGW-1


Hydrograph
Inflow
Primary
3.82 cfs
0.74 cfs
Inflow Area=1.540 ac
Peak Elev=62.35'
Storage=5,926 cf
Flow (cfs)
0
1
2
3
4
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72
Time (hours)

Hydrograph for Pond 1P: SGW-1

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
0.00	0.00	0	61.00	0.00
2.00	0.00	0	61.00	0.00
4.00	0.00	0	61.00	0.00
6.00	0.00	0	61.00	0.00
8.00	0.00	0	61.00	0.00
10.00	0.04	76	61.02	0.00
12.00	**1.78**	**2,008**	**61.51**	**0.00**
14.00	**0.26**	**4,777**	**62.12**	**0.58**
16.00	0.14	3,290	61.81	0.24
18.00	0.10	2,909	61.72	0.13
20.00	0.09	2,757	61.69	0.10
22.00	0.07	2,685	61.67	0.08
24.00	0.07	2,628	61.66	0.07
26.00	0.00	2,345	61.59	0.03
28.00	0.00	2,219	61.56	0.01
30.00	0.00	2,153	61.55	0.01
32.00	0.00	2,114	61.54	0.00
34.00	0.00	2,086	61.53	0.00
36.00	0.00	2,064	61.52	0.00
38.00	0.00	2,048	61.52	0.00
40.00	0.00	2,035	61.52	0.00
42.00	0.00	2,025	61.52	0.00
44.00	0.00	2,018	61.51	0.00
46.00	0.00	2,012	61.51	0.00
48.00	0.00	2,008	61.51	0.00
50.00	0.00	2,005	61.51	0.00
52.00	0.00	2,002	61.51	0.00
54.00	0.00	2,000	61.51	0.00
56.00	0.00	1,998	61.51	0.00
58.00	0.00	1,996	61.51	0.00
60.00	0.00	1,994	61.51	0.00
62.00	0.00	1,992	61.51	0.00
64.00	0.00	1,990	61.51	0.00
66.00	0.00	1,989	61.51	0.00
68.00	0.00	1,987	61.51	0.00
70.00	0.00	1,986	61.51	0.00
72.00	0.00	1,985	61.51	0.00

Summary for Pond 2P: SGW-2

Inflow Area = 3.590 ac, 21.17% Impervious, Inflow Depth = 2.63" for 10-YEAR event
Inflow = 9.88 cfs @ 12.14 hrs, Volume= 0.787 af
Outflow = 0.02 cfs @ 24.27 hrs, Volume= 0.049 af, Atten= 100%, Lag= 727.9 min
Primary = 0.02 cfs @ 24.27 hrs, Volume= 0.049 af
Routed to Link 2L : AP-2
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Link 2L : AP-2

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 63.23' @ 24.27 hrs Surf.Area= 19,893 sf Storage= 34,072 cf

Plug-Flow detention time= 1,820.7 min calculated for 0.049 af (6% of inflow)
Center-of-Mass det. time= 1,623.2 min (2,456.4 - 833.2)

Volume	Invert	Avail.Storage	Storage Description
#1	61.25'	73,539 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

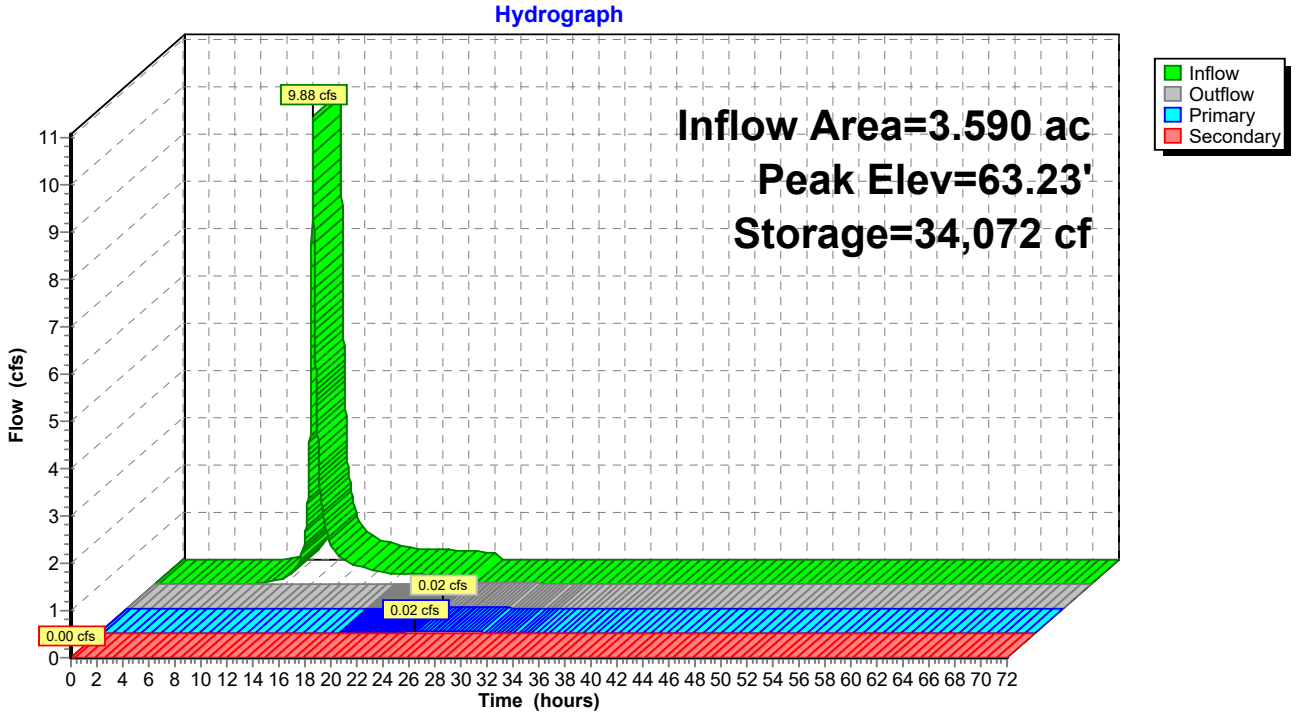
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
61.25	14,204	0	0
62.00	16,662	11,575	11,575
63.00	19,265	17,964	29,538
64.00	21,975	20,620	50,158
65.00	24,786	23,381	73,539

Device	Routing	Invert	Outlet Devices
#1	Primary	61.25'	**24.0" Round RCP_Round 24"** L= 86.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 61.25' / 61.00' S= 0.0029 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 3.14 sf
#2	Device 1	63.75'	**48.0" x 30.0" Horiz. Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	63.00'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 0.75 Width (feet) 0.00 0.50
#4	Secondary	64.00'	**20.0' long x 18.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=0.02 cfs @ 24.27 hrs HW=63.23' (Free Discharge)
└**1=RCP_Round 24"** (Passes 0.02 cfs of 11.66 cfs potential flow)
└**2=Grate** (Controls 0.00 cfs)
└**3=Custom Weir/Orifice** (Weir Controls 0.02 cfs @ 1.26 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=61.25' (Free Discharge)
└**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 2P: SGW-2


Hydrograph
Inflow Area=3.590 ac
Peak Elev=63.23'
Storage=34,072 cf
9.88 cfs
0.02 cfs
0.02 cfs
0.00 cfs
Inflow
Outflow
Primary
Secondary
Flow (cfs)
Time (hours)

Hydrograph for Pond 2P: SGW-2

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Outflow (cfs)	Primary (cfs)	Secondary (cfs)
0.00	0.00	0	61.25	0.00	0.00	**0.00**
2.00	0.00	0	61.25	0.00	0.00	0.00
4.00	0.00	0	61.25	0.00	0.00	0.00
6.00	0.00	0	61.25	0.00	0.00	0.00
8.00	0.01	4	61.25	0.00	0.00	0.00
10.00	0.14	430	61.28	0.00	0.00	0.00
12.00	**4.76**	5,984	61.65	0.00	0.00	0.00
14.00	**0.64**	24,442	62.73	0.00	0.00	0.00
16.00	0.36	27,791	62.91	0.00	0.00	0.00
18.00	0.25	29,958	63.02	0.00	0.00	0.00
20.00	0.21	31,558	63.10	0.00	0.00	0.00
22.00	0.18	32,917	63.17	0.01	0.01	0.00
24.00	0.17	**34,005**	**63.23**	**0.02**	**0.02**	0.00
26.00	0.00	**33,943**	**63.23**	**0.02**	**0.02**	0.00
28.00	0.00	33,796	63.22	0.02	0.02	0.00
30.00	0.00	33,661	63.21	0.02	0.02	0.00
32.00	0.00	33,536	63.20	0.02	0.02	0.00
34.00	0.00	33,421	63.20	0.02	0.02	0.00
36.00	0.00	33,313	63.19	0.01	0.01	0.00
38.00	0.00	33,212	63.19	0.01	0.01	0.00
40.00	0.00	33,117	63.18	0.01	0.01	0.00
42.00	0.00	33,027	63.18	0.01	0.01	0.00
44.00	0.00	32,943	63.17	0.01	0.01	0.00
46.00	0.00	32,864	63.17	0.01	0.01	0.00
48.00	0.00	32,790	63.17	0.01	0.01	0.00
50.00	0.00	32,720	63.16	0.01	0.01	0.00
52.00	0.00	32,653	63.16	0.01	0.01	0.00
54.00	0.00	32,590	63.16	0.01	0.01	0.00
56.00	0.00	32,529	63.15	0.01	0.01	0.00
58.00	0.00	32,471	63.15	0.01	0.01	0.00
60.00	0.00	32,416	63.15	0.01	0.01	0.00
62.00	0.00	32,363	63.15	0.01	0.01	0.00
64.00	0.00	32,312	63.14	0.01	0.01	0.00
66.00	0.00	32,263	63.14	0.01	0.01	0.00
68.00	0.00	32,217	63.14	0.01	0.01	0.00
70.00	0.00	32,172	63.14	0.01	0.01	0.00
72.00	0.00	32,129	63.13	0.01	0.01	0.00

Summary for Pond 3P: WET-ED

Inflow Area = 4.530 ac, 20.75% Impervious, Inflow Depth = 2.05" for 10-YEAR event
Inflow = 5.20 cfs @ 12.33 hrs, Volume= 0.772 af
Outflow = 0.88 cfs @ 14.10 hrs, Volume= 0.767 af, Atten= 83%, Lag= 105.9 min
Primary = 0.30 cfs @ 14.10 hrs, Volume= 0.509 af
Routed to Link 2L : AP-2
Secondary = 0.57 cfs @ 14.10 hrs, Volume= 0.257 af
Routed to Link 2L : AP-2
Tertiary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Link 2L : AP-2

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 62.04' @ 14.10 hrs Surf.Area= 11,538 sf Storage= 17,703 cf

Plug-Flow detention time= 464.3 min calculated for 0.767 af (99% of inflow)
Center-of-Mass det. time= 460.2 min (1,334.1 - 873.8)

Volume	Invert	Avail.Storage	Storage Description
#1	60.25'	43,946 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
60.25	8,061	0	0
61.00	9,706	6,663	6,663
62.00	11,464	10,585	17,248
63.00	13,324	12,394	29,642
64.00	15,284	14,304	43,946

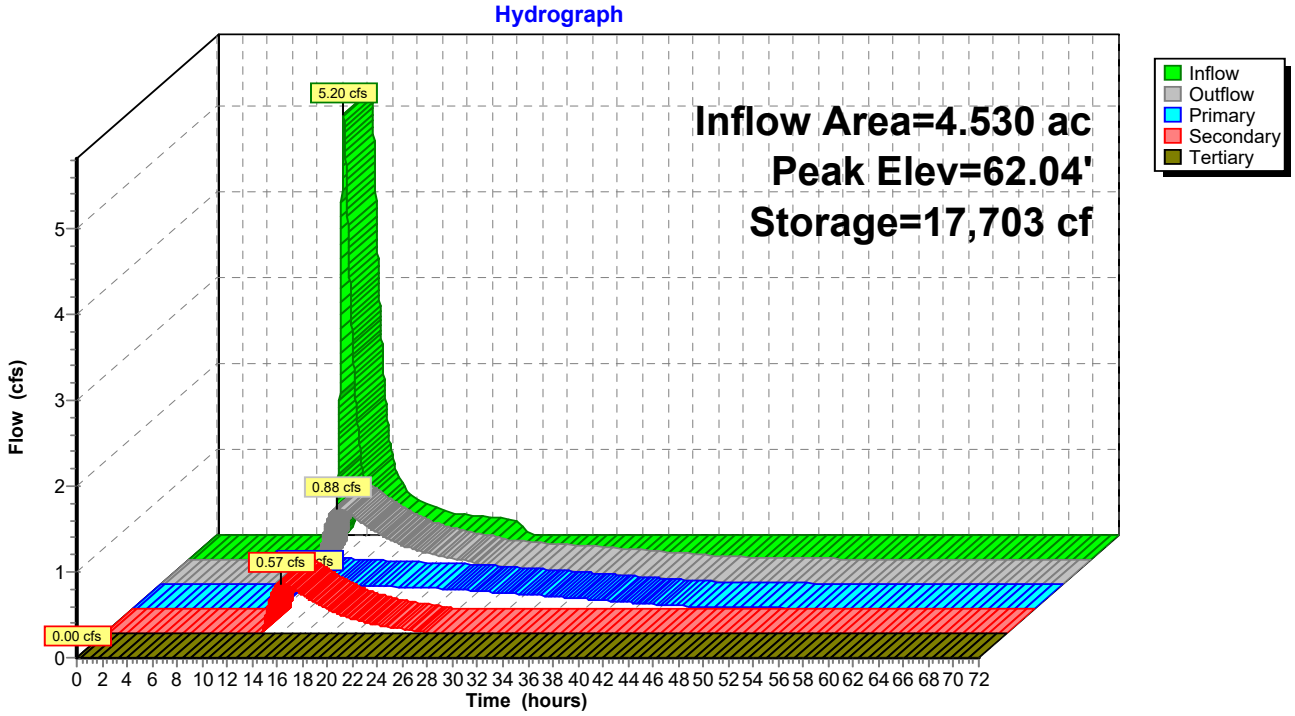
Device	Routing	Invert	Outlet Devices
#1	Primary	60.25'	**3.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Secondary	61.25'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 1.25 Width (feet) 0.25 0.25
#3	Tertiary	63.75'	**25.0' long x 18.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=0.30 cfs @ 14.10 hrs HW=62.04' (Free Discharge)
↑—**1=Orifice/Grate** (Orifice Controls 0.30 cfs @ 6.21 fps)

Secondary OutFlow Max=0.57 cfs @ 14.10 hrs HW=62.04' (Free Discharge)
↑—**2=Custom Weir/Orifice** (Weir Controls 0.57 cfs @ 2.91 fps)

Tertiary OutFlow Max=0.00 cfs @ 0.00 hrs HW=60.25' (Free Discharge)
↑—**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 3P: WET-ED



Hydrograph for Pond 3P: WET-ED

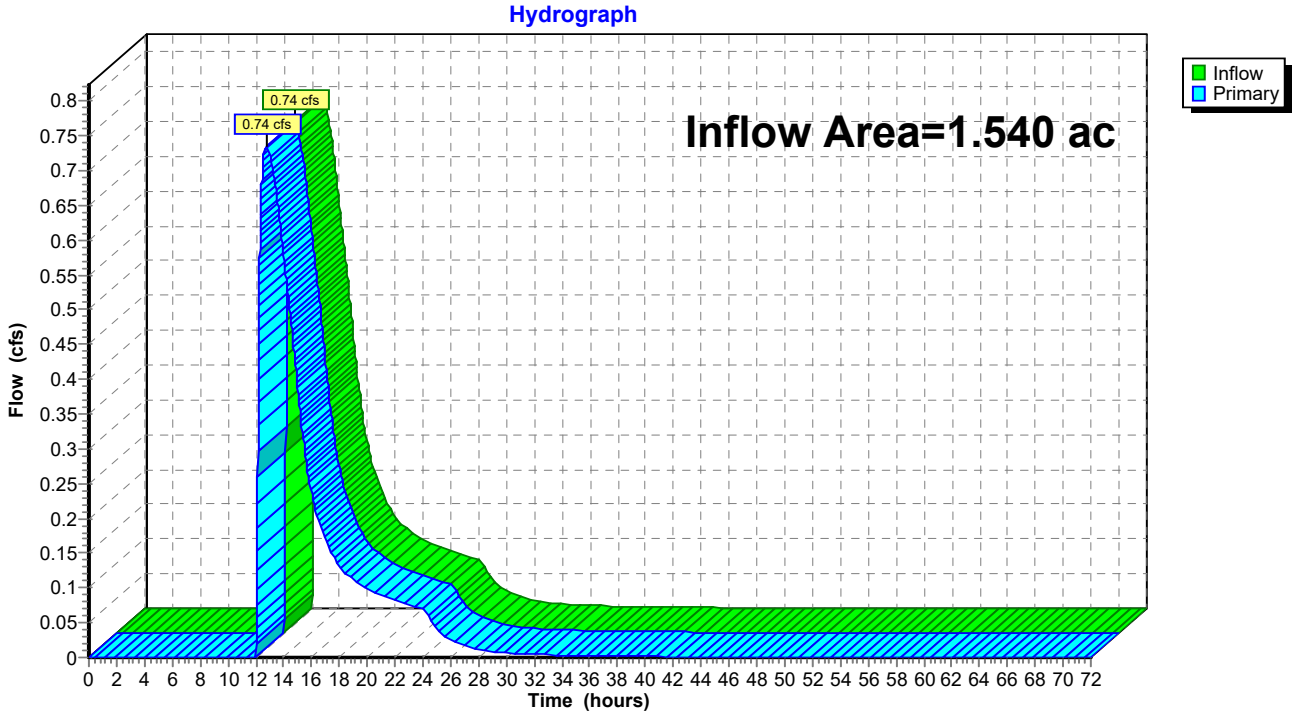
Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Outflow (cfs)	Primary (cfs)	Secondary (cfs)	Tertiary (cfs)
0.00	0.00	0	60.25	0.00	0.00	0.00	**0.00**
2.00	0.00	0	60.25	0.00	0.00	0.00	0.00
4.00	0.00	0	60.25	0.00	0.00	0.00	0.00
6.00	0.00	0	60.25	0.00	0.00	0.00	0.00
8.00	0.00	0	60.25	0.00	0.00	0.00	0.00
10.00	0.01	5	60.25	0.00	0.00	0.00	0.00
12.00	**1.48**	1,861	60.47	0.07	0.07	0.00	0.00
14.00	**0.94**	**17,692**	**62.04**	**0.88**	**0.30**	**0.57**	0.00
16.00	0.42	**16,105**	**61.90**	**0.72**	**0.29**	**0.43**	0.00
18.00	0.29	14,149	61.72	0.54	0.27	0.27	0.00
20.00	0.24	12,598	61.58	0.42	0.26	0.16	0.00
22.00	0.21	11,515	61.48	0.34	0.25	0.09	0.00
24.00	0.18	10,669	61.40	0.29	0.24	0.05	0.00
26.00	0.00	9,190	61.25	0.22	0.22	0.00	0.00
28.00	0.00	7,666	61.10	0.20	0.20	0.00	0.00
30.00	0.00	6,289	60.96	0.18	0.18	0.00	0.00
32.00	0.00	5,062	60.83	0.16	0.16	0.00	0.00
34.00	0.00	3,990	60.72	0.14	0.14	0.00	0.00
36.00	0.00	3,078	60.61	0.12	0.12	0.00	0.00
38.00	0.00	2,329	60.53	0.09	0.09	0.00	0.00
40.00	0.00	1,747	60.46	0.07	0.07	0.00	0.00
42.00	0.00	1,337	60.41	0.05	0.05	0.00	0.00
44.00	0.00	1,061	60.38	0.03	0.03	0.00	0.00
46.00	0.00	870	60.36	0.02	0.02	0.00	0.00
48.00	0.00	731	60.34	0.02	0.02	0.00	0.00
50.00	0.00	628	60.33	0.01	0.01	0.00	0.00
52.00	0.00	549	60.32	0.01	0.01	0.00	0.00
54.00	0.00	485	60.31	0.01	0.01	0.00	0.00
56.00	0.00	432	60.30	0.01	0.01	0.00	0.00
58.00	0.00	389	60.30	0.01	0.01	0.00	0.00
60.00	0.00	354	60.29	0.00	0.00	0.00	0.00
62.00	0.00	325	60.29	0.00	0.00	0.00	0.00
64.00	0.00	301	60.29	0.00	0.00	0.00	0.00
66.00	0.00	280	60.28	0.00	0.00	0.00	0.00
68.00	0.00	261	60.28	0.00	0.00	0.00	0.00
70.00	0.00	243	60.28	0.00	0.00	0.00	0.00
72.00	0.00	226	60.28	0.00	0.00	0.00	0.00

Summary for Link 1L: AP-1

Inflow Area = 1.540 ac, 14.94% Impervious, Inflow Depth > 2.02" for 10-YEAR event
Inflow = 0.74 cfs @ 12.76 hrs, Volume= 0.259 af
Primary = 0.74 cfs @ 12.76 hrs, Volume= 0.259 af, Atten= 0%, Lag= 0.0 min

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

Link 1L: AP-1



Hydrograph for Link 1L: AP-1

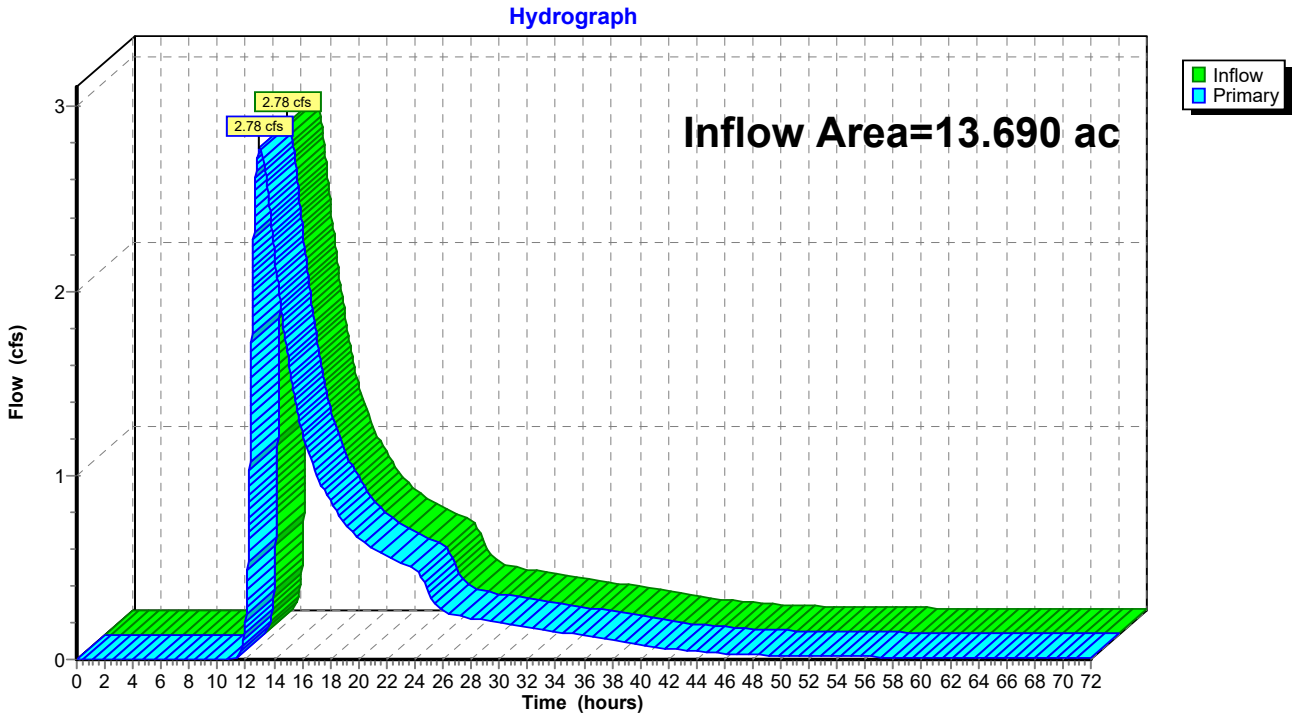
Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)
0.00	0.00	**0.00**	0.00	51.00	0.00	0.00	0.00
1.00	0.00	0.00	0.00	52.00	0.00	0.00	0.00
2.00	0.00	0.00	0.00	53.00	0.00	0.00	0.00
3.00	0.00	0.00	0.00	54.00	0.00	0.00	0.00
4.00	0.00	0.00	0.00	55.00	0.00	0.00	0.00
5.00	0.00	0.00	0.00	56.00	0.00	0.00	0.00
6.00	0.00	0.00	0.00	57.00	0.00	0.00	0.00
7.00	0.00	0.00	0.00	58.00	0.00	0.00	0.00
8.00	0.00	0.00	0.00	59.00	0.00	0.00	0.00
9.00	0.00	0.00	0.00	60.00	0.00	0.00	0.00
10.00	0.00	0.00	0.00	61.00	0.00	0.00	0.00
11.00	0.00	0.00	0.00	62.00	0.00	0.00	0.00
12.00	**0.00**	0.00	**0.00**	63.00	0.00	0.00	0.00
13.00	**0.72**	0.00	**0.72**	64.00	0.00	0.00	0.00
14.00	0.58	0.00	0.58	65.00	0.00	0.00	0.00
15.00	0.39	0.00	0.39	66.00	0.00	0.00	0.00
16.00	0.24	0.00	0.24	67.00	0.00	0.00	0.00
17.00	0.17	0.00	0.17	68.00	0.00	0.00	0.00
18.00	0.13	0.00	0.13	69.00	0.00	0.00	0.00
19.00	0.11	0.00	0.11	70.00	0.00	0.00	0.00
20.00	0.10	0.00	0.10	71.00	0.00	0.00	0.00
21.00	0.09	0.00	0.09	72.00	0.00	0.00	0.00
22.00	0.08	0.00	0.08				
23.00	0.08	0.00	0.08				
24.00	0.07	0.00	0.07				
25.00	0.04	0.00	0.04				
26.00	0.03	0.00	0.03				
27.00	0.02	0.00	0.02				
28.00	0.01	0.00	0.01				
29.00	0.01	0.00	0.01				
30.00	0.01	0.00	0.01				
31.00	0.01	0.00	0.01				
32.00	0.00	0.00	0.00				
33.00	0.00	0.00	0.00				
34.00	0.00	0.00	0.00				
35.00	0.00	0.00	0.00				
36.00	0.00	0.00	0.00				
37.00	0.00	0.00	0.00				
38.00	0.00	0.00	0.00				
39.00	0.00	0.00	0.00				
40.00	0.00	0.00	0.00				
41.00	0.00	0.00	0.00				
42.00	0.00	0.00	0.00				
43.00	0.00	0.00	0.00				
44.00	0.00	0.00	0.00				
45.00	0.00	0.00	0.00				
46.00	0.00	0.00	0.00				
47.00	0.00	0.00	0.00				
48.00	0.00	0.00	0.00				
49.00	0.00	0.00	0.00				
50.00	0.00	0.00	0.00				

Summary for Link 2L: AP-2

Inflow Area = 13.690 ac, 12.42% Impervious, Inflow Depth > 1.25" for 10-YEAR event
Inflow = 2.78 cfs @ 12.98 hrs, Volume= 1.427 af
Primary = 2.78 cfs @ 12.98 hrs, Volume= 1.427 af, Atten= 0%, Lag= 0.0 min

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

Link 2L: AP-2



Hydrograph for Link 2L: AP-2

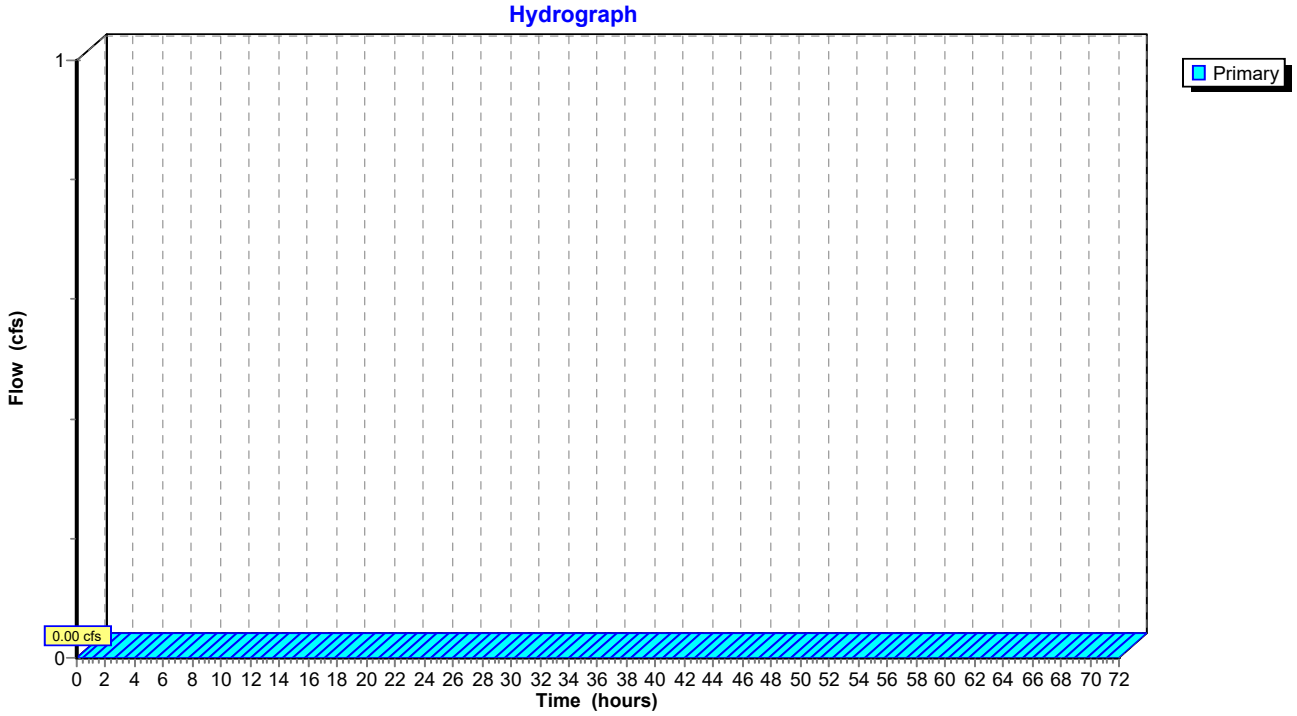
Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)
0.00	0.00	**0.00**	0.00	51.00	0.02	0.00	0.02
1.00	0.00	0.00	0.00	52.00	0.02	0.00	0.02
2.00	0.00	0.00	0.00	53.00	0.02	0.00	0.02
3.00	0.00	0.00	0.00	54.00	0.02	0.00	0.02
4.00	0.00	0.00	0.00	55.00	0.02	0.00	0.02
5.00	0.00	0.00	0.00	56.00	0.01	0.00	0.01
6.00	0.00	0.00	0.00	57.00	0.01	0.00	0.01
7.00	0.00	0.00	0.00	58.00	0.01	0.00	0.01
8.00	0.00	0.00	0.00	59.00	0.01	0.00	0.01
9.00	0.00	0.00	0.00	60.00	0.01	0.00	0.01
10.00	0.00	0.00	0.00	61.00	0.01	0.00	0.01
11.00	0.00	0.00	0.00	62.00	0.01	0.00	0.01
12.00	**0.23**	0.00	**0.23**	63.00	0.01	0.00	0.01
13.00	**2.78**	0.00	**2.78**	64.00	0.01	0.00	0.01
14.00	2.23	0.00	2.23	65.00	0.01	0.00	0.01
15.00	1.64	0.00	1.64	66.00	0.01	0.00	0.01
16.00	1.23	0.00	1.23	67.00	0.01	0.00	0.01
17.00	1.01	0.00	1.01	68.00	0.01	0.00	0.01
18.00	0.86	0.00	0.86	69.00	0.01	0.00	0.01
19.00	0.74	0.00	0.74	70.00	0.01	0.00	0.01
20.00	0.66	0.00	0.66	71.00	0.01	0.00	0.01
21.00	0.60	0.00	0.60	72.00	0.01	0.00	0.01
22.00	0.56	0.00	0.56				
23.00	0.52	0.00	0.52				
24.00	0.49	0.00	0.49				
25.00	0.36	0.00	0.36				
26.00	0.27	0.00	0.27				
27.00	0.24	0.00	0.24				
28.00	0.22	0.00	0.22				
29.00	0.21	0.00	0.21				
30.00	0.20	0.00	0.20				
31.00	0.19	0.00	0.19				
32.00	0.18	0.00	0.18				
33.00	0.16	0.00	0.16				
34.00	0.15	0.00	0.15				
35.00	0.14	0.00	0.14				
36.00	0.13	0.00	0.13				
37.00	0.12	0.00	0.12				
38.00	0.11	0.00	0.11				
39.00	0.09	0.00	0.09				
40.00	0.08	0.00	0.08				
41.00	0.07	0.00	0.07				
42.00	0.06	0.00	0.06				
43.00	0.05	0.00	0.05				
44.00	0.04	0.00	0.04				
45.00	0.04	0.00	0.04				
46.00	0.03	0.00	0.03				
47.00	0.03	0.00	0.03				
48.00	0.03	0.00	0.03				
49.00	0.02	0.00	0.02				
50.00	0.02	0.00	0.02				

Summary for Link 3L: AP-3

Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

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

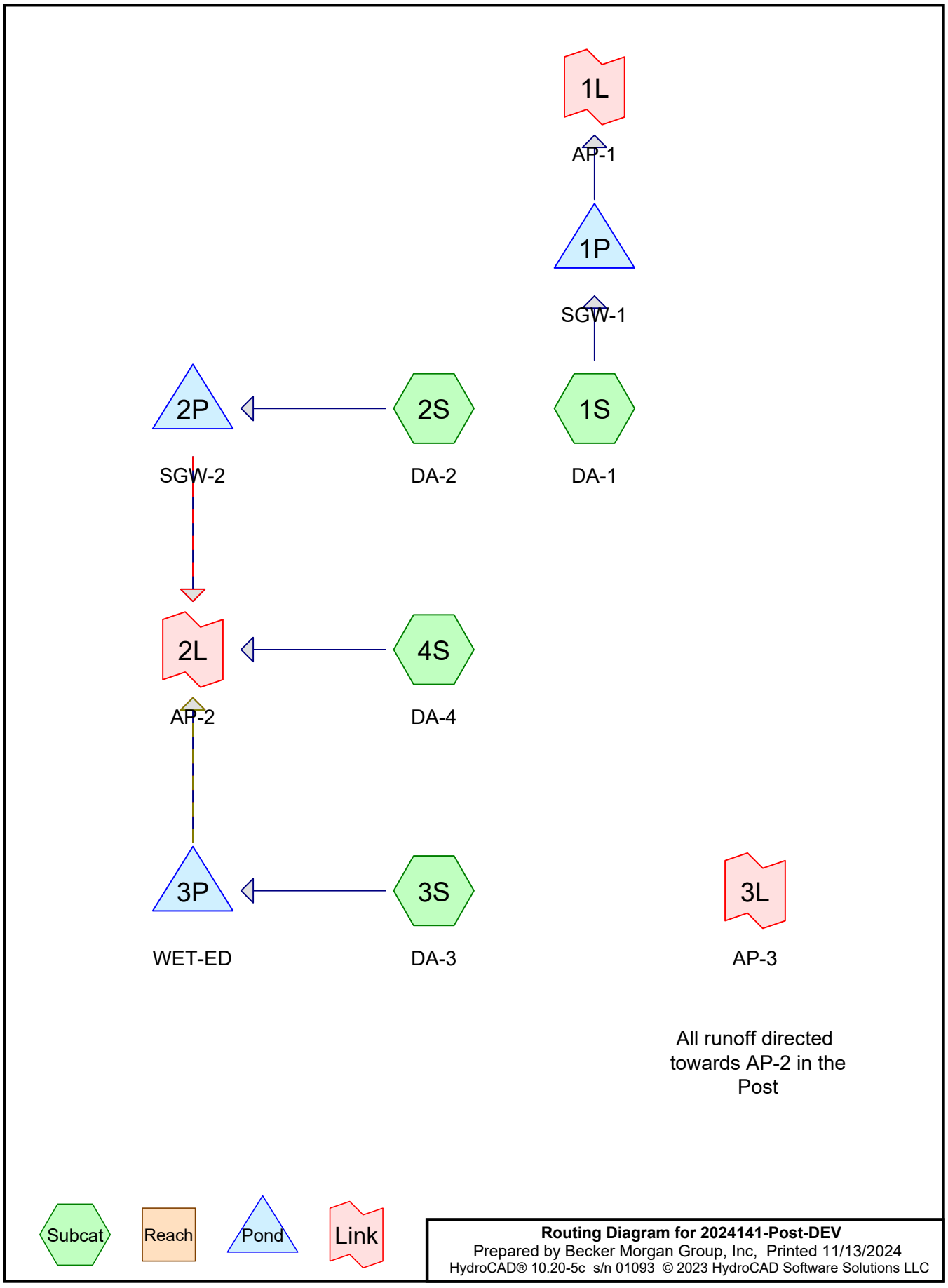
Link 3L: AP-3



A.8
POST-DEVELOPED Fv (100-YEAR) HYDROCAD CALCULATIONS

Townsend Acres Subdivision

Townsend, Delaware



Routing Diagram for 2024141-Post-DEV
Prepared by Becker Morgan Group, Inc, Printed 11/13/2024

2024141-Post-DEV

Prepared by Becker Morgan Group, Inc

Printed 11/13/2024

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.880	39	>75% Grass cover, Good, HSG A (3S, 4S)
1.860	61	>75% Grass cover, Good, HSG B (1S, 2S, 3S, 4S)
0.780	74	>75% Grass cover, Good, HSG C (2S, 3S, 4S)
0.230	80	>75% Grass cover, Good, HSG D (1S, 3S, 4S)
2.090	68	Duplex Lot, 50% Imp., HSG A (3S, 4S)
2.870	79	Duplex Lot, 50% Imp., HSG B (1S, 2S, 3S, 4S)
0.170	86	Duplex Lot, 50% Imp., HSG C (3S)
0.520	98	Paved parking, HSG A (3S)
1.030	98	Paved parking, HSG B (1S, 2S, 3S)
0.250	98	Paved parking, HSG C (3S)
0.130	98	Paved parking, HSG D (1S)
0.220	30	Woods, Good, HSG A (4S)
1.910	55	Woods, Good, HSG B (4S)
1.640	70	Woods, Good, HSG C (4S)
0.650	77	Woods, Good, HSG D (4S)
15.230	**70**	**TOTAL AREA**

2024141-Post-DEV

Prepared by Becker Morgan Group, Inc

Printed 11/13/2024

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
3.710	HSG A	3S, 4S
7.670	HSG B	1S, 2S, 3S, 4S
2.840	HSG C	2S, 3S, 4S
1.010	HSG D	1S, 3S, 4S
0.000	Other	
15.230		**TOTAL AREA**

2024141-Post-DEV

Prepared by Becker Morgan Group, Inc Printed 11/13/2024

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.880	1.860	0.780	0.230	0.000	3.750	>75% Grass cover, Good	1S, 2S, 3S, 4S
2.090	2.870	0.170	0.000	0.000	5.130	Duplex Lot, 50% Imp.	1S, 2S, 3S, 4S
0.520	1.030	0.250	0.130	0.000	1.930	Paved parking	1S, 2S, 3S
0.220	1.910	1.640	0.650	0.000	4.420	Woods, Good	4S
3.710	**7.670**	**2.840**	**1.010**	**0.000**	**15.230**	**TOTAL AREA**	

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: DA-1 Runoff Area=1.540 ac 14.94% Impervious Runoff Depth=5.16"
Tc=6.0 min CN=76 Runoff=8.25 cfs 0.662 af

Subcatchment2S: DA-2 Runoff Area=3.590 ac 21.17% Impervious Runoff Depth=5.51"
Tc=6.0 min CN=79 Runoff=20.36 cfs 1.648 af

Subcatchment3S: DA-3 Runoff Area=4.530 ac 20.75% Impervious Runoff Depth=4.69"
Flow Length=1,168' Tc=20.4 min CN=72 Runoff=12.31 cfs 1.772 af

Subcatchment4S: DA-4 Runoff Area=5.570 ac 0.00% Impervious Runoff Depth=3.56"
Flow Length=769' Tc=44.9 min CN=62 Runoff=6.92 cfs 1.651 af

Pond 1P: SGW-1 Peak Elev=63.42' Storage=12,065 cf Inflow=8.25 cfs 0.662 af
Outflow=3.08 cfs 0.616 af

Pond 2P: SGW-2 Peak Elev=63.85' Storage=46,911 cf Inflow=20.36 cfs 1.648 af
Primary=1.90 cfs 0.889 af Secondary=0.00 cfs 0.000 af Outflow=1.90 cfs 0.889 af

Pond 3P: WET-ED Peak Elev=63.69' Storage=39,231 cf Inflow=12.31 cfs 1.772 af
Primary=0.43 cfs 0.655 af Secondary=2.05 cfs 1.112 af Tertiary=0.00 cfs 0.000 af Outflow=2.48 cfs 1.766 af

Link 1L: AP-1 Inflow=3.08 cfs 0.616 af
Primary=3.08 cfs 0.616 af

Link 2L: AP-2 Inflow=10.10 cfs 4.306 af
Primary=10.10 cfs 4.306 af

Link 3L: AP-3
Primary=0.00 cfs 0.000 af

Total Runoff Area = 15.230 ac Runoff Volume = 5.733 af Average Runoff Depth = 4.52"
87.33% Pervious = 13.300 ac 12.67% Impervious = 1.930 ac

Summary for Subcatchment 1S: DA-1

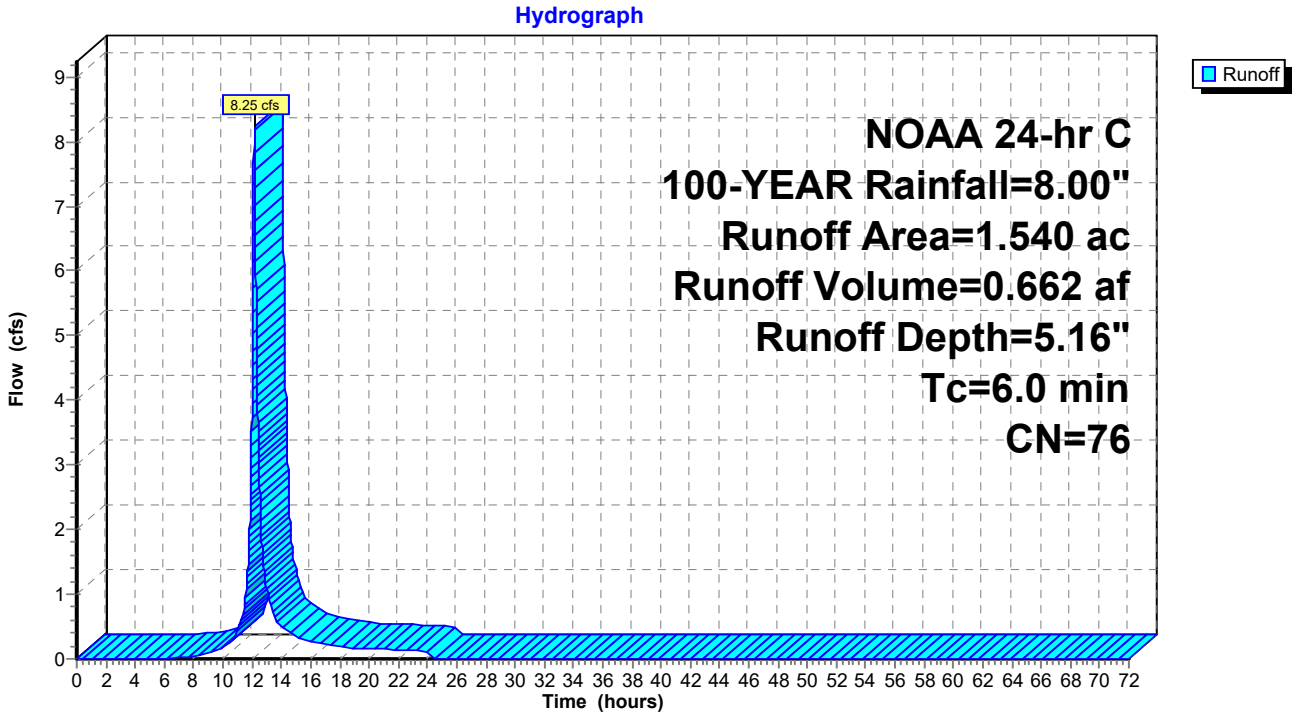
Runoff = 8.25 cfs @ 12.14 hrs, Volume= 0.662 af, Depth= 5.16"
Routed to Pond 1P : SGW-1

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 100-YEAR Rainfall=8.00"

	Area (ac)	CN	Description
	0.100	98	Paved parking, HSG B
	0.130	98	Paved parking, HSG D
	0.470	61	>75% Grass cover, Good, HSG B
	0.200	80	>75% Grass cover, Good, HSG D
*	0.640	79	Duplex Lot, 50% Imp., HSG B
	1.540	76	Weighted Average
	1.310		85.06% Pervious Area
	0.230		14.94% Impervious Area

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

Subcatchment 1S: DA-1



Hydrograph for Subcatchment 1S: DA-1

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00
1.00	0.09	0.00	0.00
2.00	0.18	0.00	0.00
3.00	0.28	0.00	0.00
4.00	0.39	0.00	0.00
5.00	0.51	0.00	0.00
6.00	0.63	0.00	0.00
7.00	0.78	0.01	0.02
8.00	0.96	0.03	0.05
9.00	1.17	0.08	0.09
10.00	1.46	0.17	0.18
11.00	1.92	0.37	0.43
12.00	3.81	1.60	**4.16**
13.00	6.08	3.45	**1.09**
14.00	6.54	3.85	0.50
15.00	6.83	4.11	0.34
16.00	7.04	4.29	0.27
17.00	7.22	4.45	0.23
18.00	7.37	4.58	0.19
19.00	7.49	4.70	0.17
20.00	7.61	4.80	0.16
21.00	7.72	4.90	0.15
22.00	7.82	4.99	0.14
23.00	7.91	5.08	0.13
24.00	**8.00**	**5.16**	0.13
25.00	8.00	5.16	0.00
26.00	8.00	5.16	0.00
27.00	8.00	5.16	0.00
28.00	8.00	5.16	0.00
29.00	8.00	5.16	0.00
30.00	8.00	5.16	0.00
31.00	8.00	5.16	0.00
32.00	8.00	5.16	0.00
33.00	8.00	5.16	0.00
34.00	8.00	5.16	0.00
35.00	8.00	5.16	0.00
36.00	8.00	5.16	0.00
37.00	8.00	5.16	0.00
38.00	8.00	5.16	0.00
39.00	8.00	5.16	0.00
40.00	8.00	5.16	0.00
41.00	8.00	5.16	0.00
42.00	8.00	5.16	0.00
43.00	8.00	5.16	0.00
44.00	8.00	5.16	0.00
45.00	8.00	5.16	0.00
46.00	8.00	5.16	0.00
47.00	8.00	5.16	0.00
48.00	8.00	5.16	0.00
49.00	8.00	5.16	0.00
50.00	8.00	5.16	0.00
51.00	8.00	5.16	0.00
52.00	8.00	5.16	0.00
53.00	8.00	5.16	0.00
54.00	8.00	5.16	0.00
55.00	8.00	5.16	0.00
56.00	8.00	5.16	0.00
57.00	8.00	5.16	0.00
58.00	8.00	5.16	0.00
59.00	8.00	5.16	0.00
60.00	8.00	5.16	0.00
61.00	8.00	5.16	0.00
62.00	8.00	5.16	0.00
63.00	8.00	5.16	0.00
64.00	8.00	5.16	0.00
65.00	8.00	5.16	0.00
66.00	8.00	5.16	0.00
67.00	8.00	5.16	0.00
68.00	8.00	5.16	0.00
69.00	8.00	5.16	0.00
70.00	8.00	5.16	0.00
71.00	8.00	5.16	0.00
72.00	8.00	5.16	0.00

Summary for Subcatchment 2S: DA-2

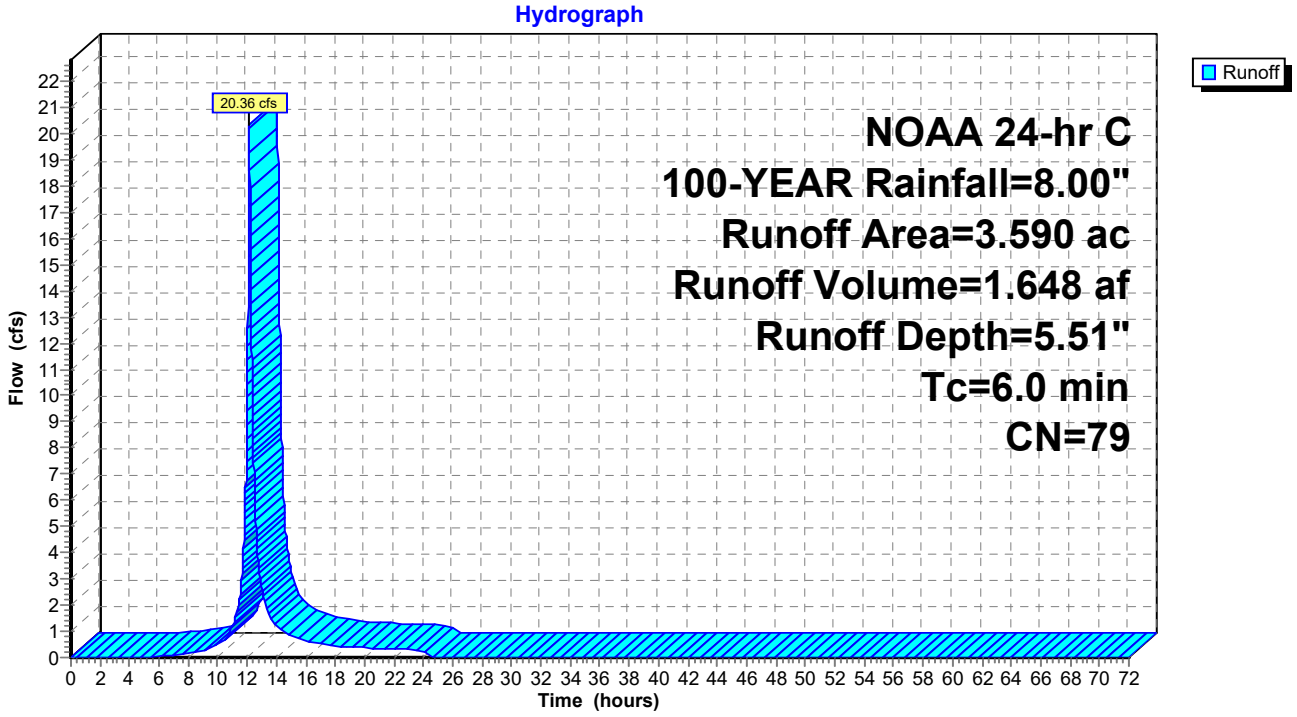
Runoff = 20.36 cfs @ 12.14 hrs, Volume= 1.648 af, Depth= 5.51"
Routed to Pond 2P : SGW-2

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 100-YEAR Rainfall=8.00"

	Area (ac)	CN	Description
	0.760	98	Paved parking, HSG B
	0.740	61	>75% Grass cover, Good, HSG B
	0.280	74	>75% Grass cover, Good, HSG C
*	1.810	79	Duplex Lot, 50% Imp., HSG B
	3.590	79	Weighted Average
	2.830		78.83% Pervious Area
	0.760		21.17% Impervious Area

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

Subcatchment 2S: DA-2



Hydrograph for Subcatchment 2S: DA-2

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00
1.00	0.09	0.00	0.00
2.00	0.18	0.00	0.00
3.00	0.28	0.00	0.00
4.00	0.39	0.00	0.00
5.00	0.51	0.00	0.00
6.00	0.63	0.00	0.03
7.00	0.78	0.02	0.09
8.00	0.96	0.06	0.17
9.00	1.17	0.12	0.27
10.00	1.46	0.24	0.52
11.00	1.92	0.48	1.17
12.00	3.81	1.81	**10.45**
13.00	6.08	3.75	**2.62**
14.00	6.54	4.17	1.21
15.00	6.83	4.43	0.82
16.00	7.04	4.62	0.66
17.00	7.22	4.79	0.56
18.00	7.37	4.92	0.45
19.00	7.49	5.04	0.41
20.00	7.61	5.14	0.38
21.00	7.72	5.25	0.36
22.00	7.82	5.34	0.33
23.00	7.91	5.43	0.31
24.00	**8.00**	**5.51**	0.30
25.00	8.00	5.51	0.00
26.00	8.00	5.51	0.00
27.00	8.00	5.51	0.00
28.00	8.00	5.51	0.00
29.00	8.00	5.51	0.00
30.00	8.00	5.51	0.00
31.00	8.00	5.51	0.00
32.00	8.00	5.51	0.00
33.00	8.00	5.51	0.00
34.00	8.00	5.51	0.00
35.00	8.00	5.51	0.00
36.00	8.00	5.51	0.00
37.00	8.00	5.51	0.00
38.00	8.00	5.51	0.00
39.00	8.00	5.51	0.00
40.00	8.00	5.51	0.00
41.00	8.00	5.51	0.00
42.00	8.00	5.51	0.00
43.00	8.00	5.51	0.00
44.00	8.00	5.51	0.00
45.00	8.00	5.51	0.00
46.00	8.00	5.51	0.00
47.00	8.00	5.51	0.00
48.00	8.00	5.51	0.00
49.00	8.00	5.51	0.00
50.00	8.00	5.51	0.00
51.00	8.00	5.51	0.00
52.00	8.00	5.51	0.00
53.00	8.00	5.51	0.00
54.00	8.00	5.51	0.00
55.00	8.00	5.51	0.00
56.00	8.00	5.51	0.00
57.00	8.00	5.51	0.00
58.00	8.00	5.51	0.00
59.00	8.00	5.51	0.00
60.00	8.00	5.51	0.00
61.00	8.00	5.51	0.00
62.00	8.00	5.51	0.00
63.00	8.00	5.51	0.00
64.00	8.00	5.51	0.00
65.00	8.00	5.51	0.00
66.00	8.00	5.51	0.00
67.00	8.00	5.51	0.00
68.00	8.00	5.51	0.00
69.00	8.00	5.51	0.00
70.00	8.00	5.51	0.00
71.00	8.00	5.51	0.00
72.00	8.00	5.51	0.00

Summary for Subcatchment 3S: DA-3

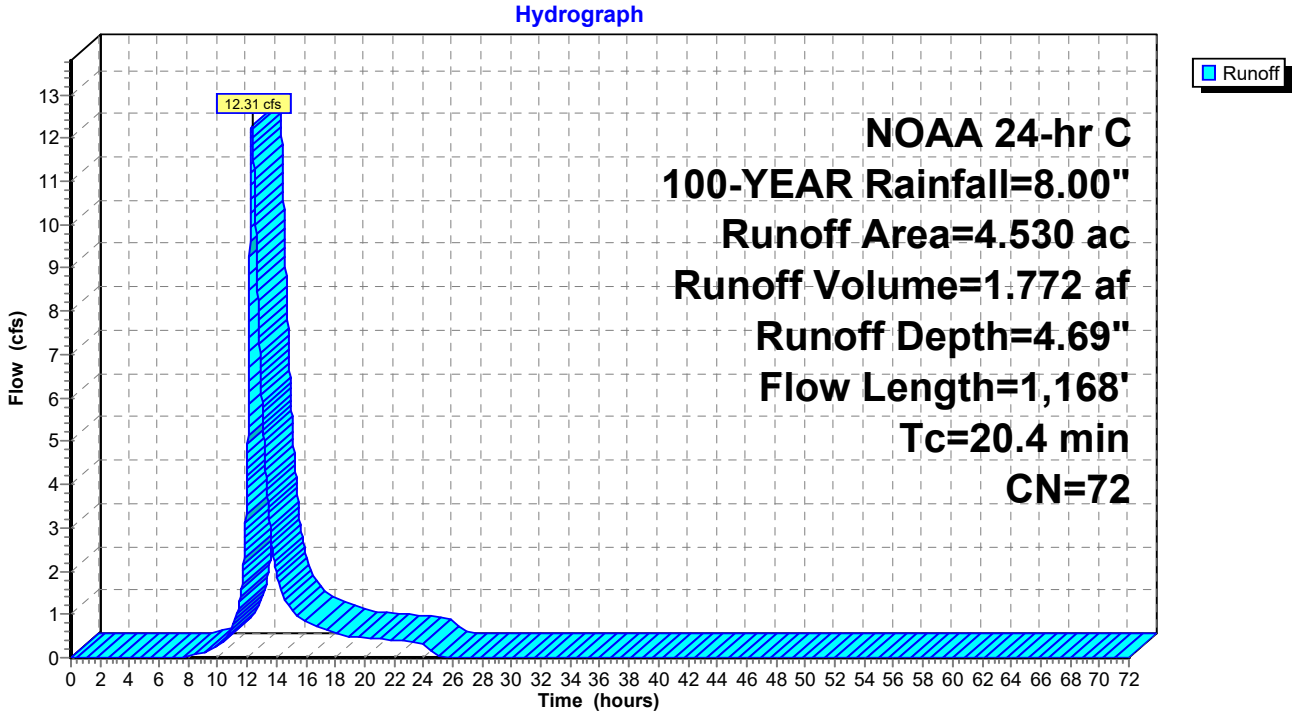
Runoff = 12.31 cfs @ 12.33 hrs, Volume= 1.772 af, Depth= 4.69"
Routed to Pond 3P : WET-ED

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 100-YEAR Rainfall=8.00"

	Area (ac)	CN	Description
	0.520	98	Paved parking, HSG A
	0.170	98	Paved parking, HSG B
	0.250	98	Paved parking, HSG C
	0.630	39	>75% Grass cover, Good, HSG A
	0.050	61	>75% Grass cover, Good, HSG B
	0.330	74	>75% Grass cover, Good, HSG C
	0.010	80	>75% Grass cover, Good, HSG D
*	1.990	68	Duplex Lot, 50% Imp., HSG A
*	0.410	79	Duplex Lot, 50% Imp., HSG B
*	0.170	86	Duplex Lot, 50% Imp., HSG C
	4.530	72	Weighted Average
	3.590		79.25% Pervious Area
	0.940		20.75% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.2	56	0.0300	0.18		**Sheet Flow, 3A** Grass: Short n= 0.150 P2= 3.20"
6.5	44	0.0107	0.11		**Sheet Flow, 3B** Grass: Short n= 0.150 P2= 3.20"
4.8	275	0.0040	0.95		**Shallow Concentrated Flow, 3C** Grassed Waterway Kv= 15.0 fps
3.9	793	0.0030	3.42	10.74	**Pipe Channel, RCP_Round 24"** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.015 Concrete sewer w/manholes & inlets
20.4	1,168	Total			

Subcatchment 3S: DA-3



Hydrograph for Subcatchment 3S: DA-3

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00
1.00	0.09	0.00	0.00
2.00	0.18	0.00	0.00
3.00	0.28	0.00	0.00
4.00	0.39	0.00	0.00
5.00	0.51	0.00	0.00
6.00	0.63	0.00	0.00
7.00	0.78	0.00	0.00
8.00	0.96	0.01	0.04
9.00	1.17	0.04	0.12
10.00	1.46	0.10	0.30
11.00	1.92	0.26	0.71
12.00	3.81	1.33	**4.22**
13.00	6.08	3.06	**5.96**
14.00	6.54	3.44	1.93
15.00	6.83	3.69	1.13
16.00	7.04	3.86	0.83
17.00	7.22	4.02	0.70
18.00	7.37	4.14	0.58
19.00	7.49	4.25	0.50
20.00	7.61	4.35	0.47
21.00	7.72	4.45	0.43
22.00	7.82	4.54	0.40
23.00	7.91	4.62	0.37
24.00	**8.00**	**4.69**	0.34
25.00	8.00	4.69	0.04
26.00	8.00	4.69	0.00
27.00	8.00	4.69	0.00
28.00	8.00	4.69	0.00
29.00	8.00	4.69	0.00
30.00	8.00	4.69	0.00
31.00	8.00	4.69	0.00
32.00	8.00	4.69	0.00
33.00	8.00	4.69	0.00
34.00	8.00	4.69	0.00
35.00	8.00	4.69	0.00
36.00	8.00	4.69	0.00
37.00	8.00	4.69	0.00
38.00	8.00	4.69	0.00
39.00	8.00	4.69	0.00
40.00	8.00	4.69	0.00
41.00	8.00	4.69	0.00
42.00	8.00	4.69	0.00
43.00	8.00	4.69	0.00
44.00	8.00	4.69	0.00
45.00	8.00	4.69	0.00
46.00	8.00	4.69	0.00
47.00	8.00	4.69	0.00
48.00	8.00	4.69	0.00
49.00	8.00	4.69	0.00
50.00	8.00	4.69	0.00
51.00	8.00	4.69	0.00
52.00	8.00	4.69	0.00
53.00	8.00	4.69	0.00
54.00	8.00	4.69	0.00
55.00	8.00	4.69	0.00
56.00	8.00	4.69	0.00
57.00	8.00	4.69	0.00
58.00	8.00	4.69	0.00
59.00	8.00	4.69	0.00
60.00	8.00	4.69	0.00
61.00	8.00	4.69	0.00
62.00	8.00	4.69	0.00
63.00	8.00	4.69	0.00
64.00	8.00	4.69	0.00
65.00	8.00	4.69	0.00
66.00	8.00	4.69	0.00
67.00	8.00	4.69	0.00
68.00	8.00	4.69	0.00
69.00	8.00	4.69	0.00
70.00	8.00	4.69	0.00
71.00	8.00	4.69	0.00
72.00	8.00	4.69	0.00

Summary for Subcatchment 4S: DA-4

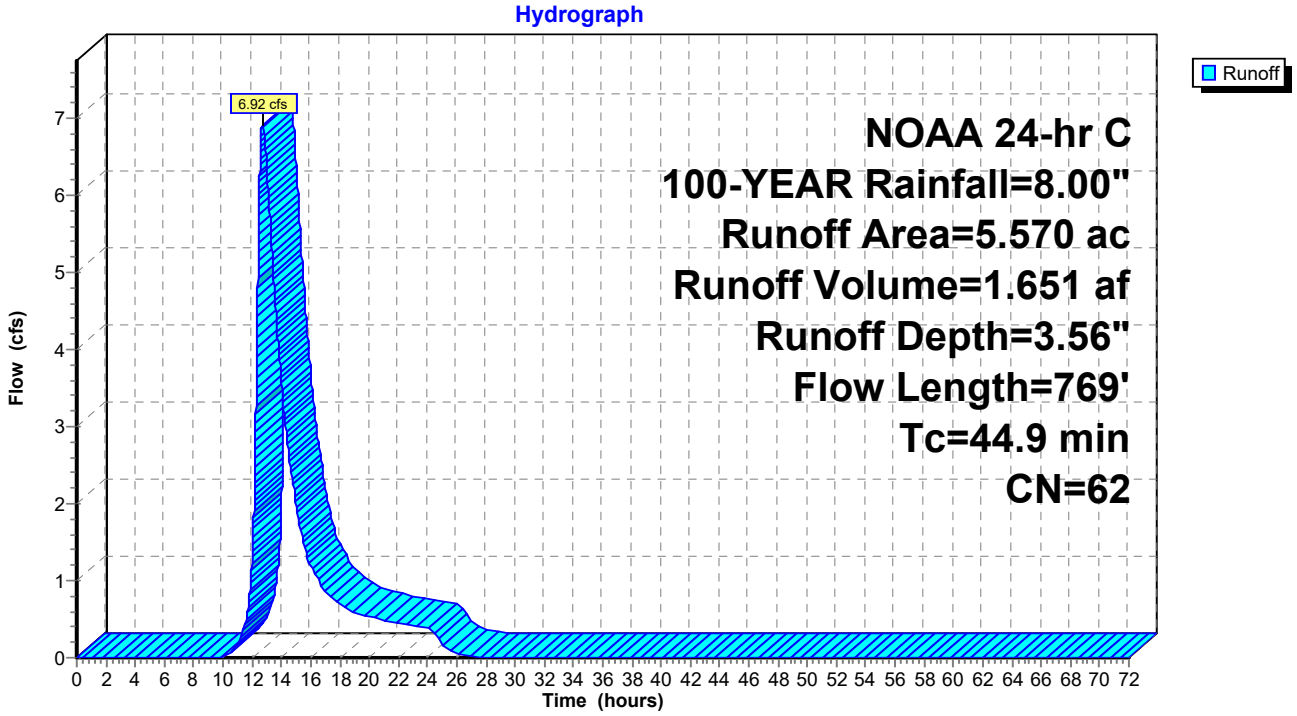
Runoff = 6.92 cfs @ 12.68 hrs, Volume= 1.651 af, Depth= 3.56"
Routed to Link 2L : AP-2

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA 24-hr C 100-YEAR Rainfall=8.00"

	Area (ac)	CN	Description
	0.220	30	Woods, Good, HSG A
	1.910	55	Woods, Good, HSG B
	1.640	70	Woods, Good, HSG C
	0.650	77	Woods, Good, HSG D
	0.250	39	>75% Grass cover, Good, HSG A
	0.600	61	>75% Grass cover, Good, HSG B
	0.170	74	>75% Grass cover, Good, HSG C
	0.020	80	>75% Grass cover, Good, HSG D
*	0.100	68	Duplex Lot, 50% Imp., HSG A
*	0.010	79	Duplex Lot, 50% Imp., HSG B
	5.570	62	Weighted Average
	5.570		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.1	48	0.0396	0.19		**Sheet Flow, 4A** Grass: Short n= 0.150 P2= 3.20"
14.1	52	0.0154	0.06		**Sheet Flow, 4B** Woods: Light underbrush n= 0.400 P2= 3.20"
26.7	669	0.0070	0.42		**Shallow Concentrated Flow, 4C** Woodland Kv= 5.0 fps
44.9	769	Total			

Subcatchment 4S: DA-4



Hydrograph for Subcatchment 4S: DA-4

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00
1.00	0.09	0.00	0.00
2.00	0.18	0.00	0.00
3.00	0.28	0.00	0.00
4.00	0.39	0.00	0.00
5.00	0.51	0.00	0.00
6.00	0.63	0.00	0.00
7.00	0.78	0.00	0.00
8.00	0.96	0.00	0.00
9.00	1.17	0.00	0.00
10.00	1.46	0.01	0.02
11.00	1.92	0.07	0.17
12.00	3.81	0.77	**1.25**
13.00	6.08	2.15	**6.35**
14.00	6.54	2.47	3.56
15.00	6.83	2.68	2.00
16.00	7.04	2.83	1.19
17.00	7.22	2.96	0.87
18.00	7.37	3.07	0.70
19.00	7.49	3.17	0.59
20.00	7.61	3.26	0.53
21.00	7.72	3.34	0.49
22.00	7.82	3.42	0.46
23.00	7.91	3.49	0.42
24.00	**8.00**	**3.56**	0.39
25.00	8.00	3.56	0.18
26.00	8.00	3.56	0.05
27.00	8.00	3.56	0.01
28.00	8.00	3.56	0.00
29.00	8.00	3.56	0.00
30.00	8.00	3.56	0.00
31.00	8.00	3.56	0.00
32.00	8.00	3.56	0.00
33.00	8.00	3.56	0.00
34.00	8.00	3.56	0.00
35.00	8.00	3.56	0.00
36.00	8.00	3.56	0.00
37.00	8.00	3.56	0.00
38.00	8.00	3.56	0.00
39.00	8.00	3.56	0.00
40.00	8.00	3.56	0.00
41.00	8.00	3.56	0.00
42.00	8.00	3.56	0.00
43.00	8.00	3.56	0.00
44.00	8.00	3.56	0.00
45.00	8.00	3.56	0.00
46.00	8.00	3.56	0.00
47.00	8.00	3.56	0.00
48.00	8.00	3.56	0.00
49.00	8.00	3.56	0.00
50.00	8.00	3.56	0.00
51.00	8.00	3.56	0.00
52.00	8.00	3.56	0.00
53.00	8.00	3.56	0.00
54.00	8.00	3.56	0.00
55.00	8.00	3.56	0.00
56.00	8.00	3.56	0.00
57.00	8.00	3.56	0.00
58.00	8.00	3.56	0.00
59.00	8.00	3.56	0.00
60.00	8.00	3.56	0.00
61.00	8.00	3.56	0.00
62.00	8.00	3.56	0.00
63.00	8.00	3.56	0.00
64.00	8.00	3.56	0.00
65.00	8.00	3.56	0.00
66.00	8.00	3.56	0.00
67.00	8.00	3.56	0.00
68.00	8.00	3.56	0.00
69.00	8.00	3.56	0.00
70.00	8.00	3.56	0.00
71.00	8.00	3.56	0.00
72.00	8.00	3.56	0.00

Summary for Pond 1P: SGW-1

Inflow Area = 1.540 ac, 14.94% Impervious, Inflow Depth = 5.16" for 100-YEAR event
Inflow = 8.25 cfs @ 12.14 hrs, Volume= 0.662 af
Outflow = 3.08 cfs @ 12.45 hrs, Volume= 0.616 af, Atten= 63%, Lag= 18.2 min
Primary = 3.08 cfs @ 12.45 hrs, Volume= 0.616 af
Routed to Link 1L : AP-1

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 63.42' @ 12.45 hrs Surf.Area= 6,396 sf Storage= 12,065 cf

Plug-Flow detention time= 155.6 min calculated for 0.616 af (93% of inflow)
Center-of-Mass det. time= 118.2 min (936.9 - 818.6)

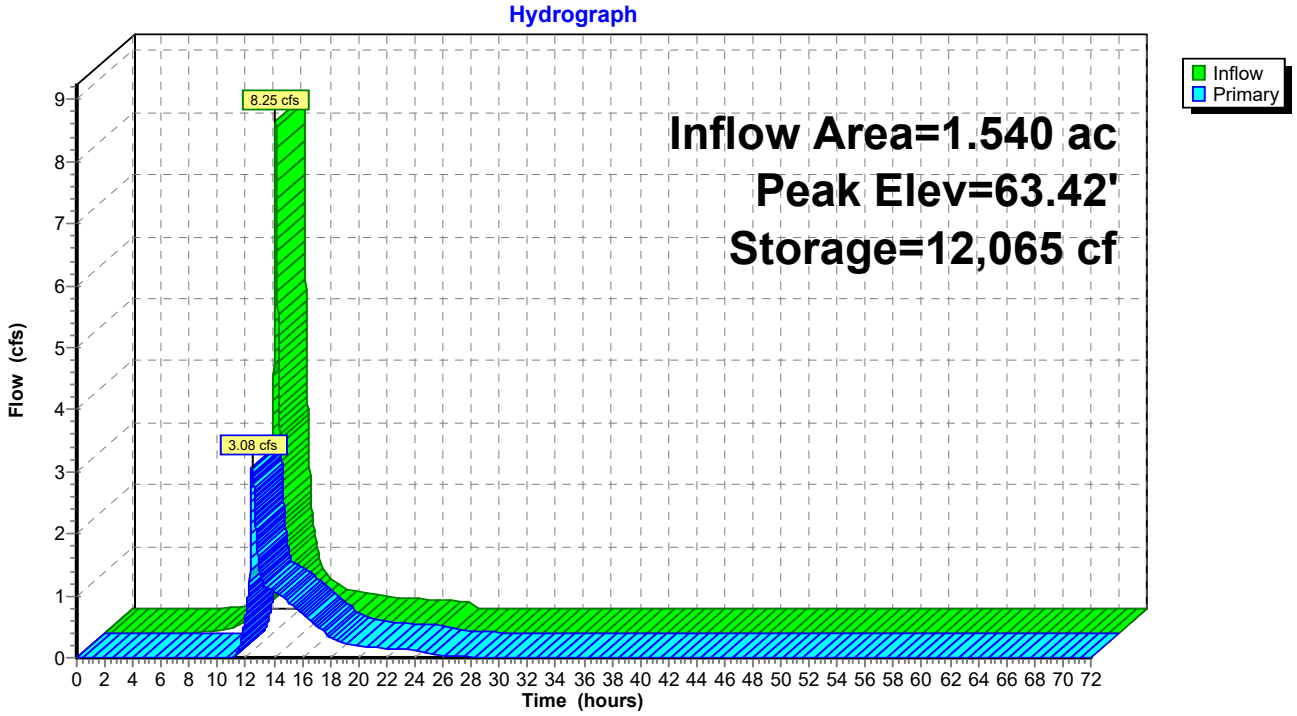
Volume	Invert	Avail.Storage	Storage Description
#1	61.00'	15,965 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
61.00	3,658	0	0
62.00	4,710	4,184	4,184
63.00	5,865	5,288	9,472
64.00	7,121	6,493	15,965

Device	Routing	Invert	Outlet Devices
#1	Primary	60.75'	**18.0" Round RCP_Round 18"** L= 32.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 60.75' / 60.59' S= 0.0050 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 1.77 sf
#2	Device 1	63.25'	**30.0" Horiz. Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	61.50'	**6.0" Vert. Orifice** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=3.07 cfs @ 12.45 hrs HW=63.42' (Free Discharge)
└─**1=RCP_Round 18"** (Passes 3.07 cfs of 11.58 cfs potential flow)
  ├─**2=Grate** (Weir Controls 1.85 cfs @ 1.36 fps)
  └─**3=Orifice** (Orifice Controls 1.22 cfs @ 6.23 fps)

Pond 1P: SGW-1


Hydrograph
Inflow
Primary
8.25 cfs
3.08 cfs
Inflow Area=1.540 ac
Peak Elev=63.42'
Storage=12,065 cf
Flow (cfs)
0 1 2 3 4 5 6 7 8 9
Time (hours)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72

Hydrograph for Pond 1P: SGW-1

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
0.00	0.00	0	61.00	0.00
2.00	0.00	0	61.00	0.00
4.00	0.00	0	61.00	0.00
6.00	0.00	0	61.00	0.00
8.00	0.05	144	61.04	0.00
10.00	0.18	856	61.23	0.00
12.00	**4.16**	**5,493**	**62.27**	**0.68**
14.00	**0.50**	**9,636**	**63.03**	**1.07**
16.00	0.27	5,750	62.32	0.71
18.00	0.19	3,647	61.88	0.34
20.00	0.16	3,123	61.77	0.19
22.00	0.14	2,984	61.74	0.15
24.00	0.13	2,893	61.72	0.13
26.00	0.00	2,429	61.61	0.04
28.00	0.00	2,257	61.57	0.02
30.00	0.00	2,174	61.55	0.01
32.00	0.00	2,127	61.54	0.00
34.00	0.00	2,096	61.53	0.00
36.00	0.00	2,072	61.53	0.00
38.00	0.00	2,053	61.52	0.00
40.00	0.00	2,039	61.52	0.00
42.00	0.00	2,029	61.52	0.00
44.00	0.00	2,021	61.51	0.00
46.00	0.00	2,014	61.51	0.00
48.00	0.00	2,009	61.51	0.00
50.00	0.00	2,006	61.51	0.00
52.00	0.00	2,003	61.51	0.00
54.00	0.00	2,001	61.51	0.00
56.00	0.00	1,999	61.51	0.00
58.00	0.00	1,997	61.51	0.00
60.00	0.00	1,995	61.51	0.00
62.00	0.00	1,993	61.51	0.00
64.00	0.00	1,991	61.51	0.00
66.00	0.00	1,989	61.51	0.00
68.00	0.00	1,988	61.51	0.00
70.00	0.00	1,986	61.51	0.00
72.00	0.00	1,985	61.51	0.00

Summary for Pond 2P: SGW-2

Inflow Area = 3.590 ac, 21.17% Impervious, Inflow Depth = 5.51" for 100-YEAR event
Inflow = 20.36 cfs @ 12.14 hrs, Volume= 1.648 af
Outflow = 1.90 cfs @ 13.32 hrs, Volume= 0.889 af, Atten= 91%, Lag= 70.6 min
Primary = 1.90 cfs @ 13.32 hrs, Volume= 0.889 af
Routed to Link 2L : AP-2
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Link 2L : AP-2

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 63.85' @ 13.32 hrs Surf.Area= 21,571 sf Storage= 46,911 cf

Plug-Flow detention time= 621.5 min calculated for 0.889 af (54% of inflow)
Center-of-Mass det. time= 510.3 min (1,322.0 - 811.7)

Volume	Invert	Avail.Storage	Storage Description
#1	61.25'	73,539 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

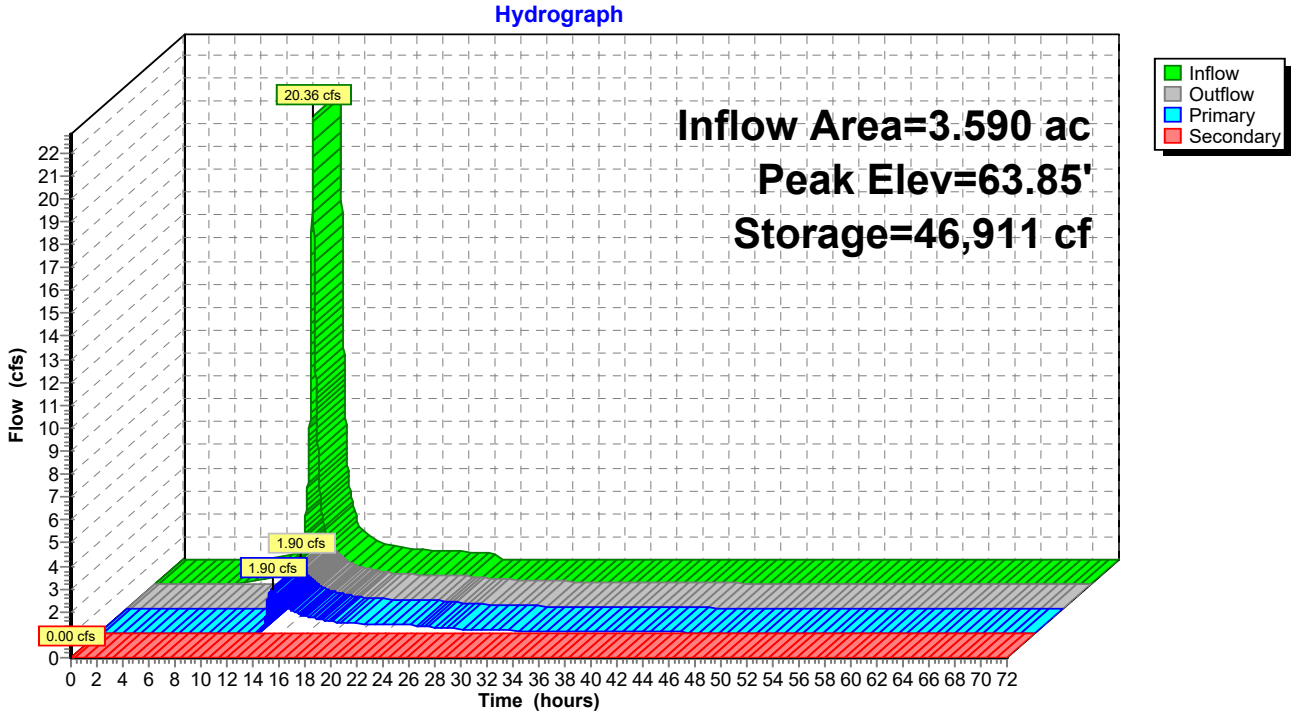
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
61.25	14,204	0	0
62.00	16,662	11,575	11,575
63.00	19,265	17,964	29,538
64.00	21,975	20,620	50,158
65.00	24,786	23,381	73,539

Device	Routing	Invert	Outlet Devices
#1	Primary	61.25'	**24.0" Round RCP_Round 24"** L= 86.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 61.25' / 61.00' S= 0.0029 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 3.14 sf
#2	Device 1	63.75'	**48.0" x 30.0" Horiz. Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	63.00'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 0.75 Width (feet) 0.00 0.50
#4	Secondary	64.00'	**20.0' long x 18.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=1.89 cfs @ 13.32 hrs HW=63.85' (Free Discharge)
└**1=RCP_Round 24"** (Passes 1.89 cfs of 15.67 cfs potential flow)
├**2=Grate** (Weir Controls 1.36 cfs @ 1.04 fps)
└**3=Custom Weir/Orifice** (Orifice Controls 0.53 cfs @ 2.82 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=61.25' (Free Discharge)
└**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 2P: SGW-2


Hydrograph
Inflow Area=3.590 ac
Peak Elev=63.85'
Storage=46,911 cf
20.36 cfs
1.90 cfs
1.90 cfs
0.00 cfs
Inflow
Outflow
Primary
Secondary
Flow (cfs)
Time (hours)

Hydrograph for Pond 2P: SGW-2

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Outflow (cfs)	Primary (cfs)	Secondary (cfs)
0.00	0.00	0	61.25	0.00	0.00	**0.00**
2.00	0.00	0	61.25	0.00	0.00	0.00
4.00	0.00	0	61.25	0.00	0.00	0.00
6.00	0.03	33	61.25	0.00	0.00	0.00
8.00	0.17	675	61.30	0.00	0.00	0.00
10.00	0.52	2,828	61.44	0.00	0.00	0.00
12.00	**10.45**	**16,879**	**62.31**	**0.00**	**0.00**	0.00
14.00	**1.21**	**46,383**	**63.83**	**1.42**	**1.42**	0.00
16.00	0.66	45,420	63.78	0.73	0.73	0.00
18.00	0.45	45,019	63.76	0.50	0.50	0.00
20.00	0.38	44,706	63.75	0.42	0.42	0.00
22.00	0.33	44,320	63.73	0.40	0.40	0.00
24.00	0.30	43,775	63.70	0.36	0.36	0.00
26.00	0.00	41,746	63.61	0.25	0.25	0.00
28.00	0.00	40,206	63.53	0.18	0.18	0.00
30.00	0.00	39,063	63.48	0.14	0.14	0.00
32.00	0.00	38,178	63.44	0.11	0.11	0.00
34.00	0.00	37,468	63.40	0.09	0.09	0.00
36.00	0.00	36,886	63.37	0.07	0.07	0.00
38.00	0.00	36,398	63.35	0.06	0.06	0.00
40.00	0.00	35,981	63.33	0.05	0.05	0.00
42.00	0.00	35,622	63.31	0.05	0.05	0.00
44.00	0.00	35,307	63.29	0.04	0.04	0.00
46.00	0.00	35,029	63.28	0.04	0.04	0.00
48.00	0.00	34,783	63.27	0.03	0.03	0.00
50.00	0.00	34,561	63.26	0.03	0.03	0.00
52.00	0.00	34,361	63.25	0.03	0.03	0.00
54.00	0.00	34,180	63.24	0.02	0.02	0.00
56.00	0.00	34,015	63.23	0.02	0.02	0.00
58.00	0.00	33,862	63.22	0.02	0.02	0.00
60.00	0.00	33,722	63.21	0.02	0.02	0.00
62.00	0.00	33,592	63.21	0.02	0.02	0.00
64.00	0.00	33,473	63.20	0.02	0.02	0.00
66.00	0.00	33,362	63.20	0.01	0.01	0.00
68.00	0.00	33,258	63.19	0.01	0.01	0.00
70.00	0.00	33,160	63.19	0.01	0.01	0.00
72.00	0.00	33,068	63.18	0.01	0.01	0.00

Summary for Pond 3P: WET-ED

Inflow Area = 4.530 ac, 20.75% Impervious, Inflow Depth = 4.69" for 100-YEAR event
Inflow = 12.31 cfs @ 12.33 hrs, Volume= 1.772 af
Outflow = 2.48 cfs @ 13.72 hrs, Volume= 1.766 af, Atten= 80%, Lag= 83.5 min
Primary = 0.43 cfs @ 13.72 hrs, Volume= 0.655 af
Routed to Link 2L : AP-2
Secondary = 2.05 cfs @ 13.72 hrs, Volume= 1.112 af
Routed to Link 2L : AP-2
Tertiary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Link 2L : AP-2

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 63.69' @ 13.72 hrs Surf.Area= 14,667 sf Storage= 39,231 cf

Plug-Flow detention time= 328.1 min calculated for 1.766 af (100% of inflow)
Center-of-Mass det. time= 326.4 min (1,176.0 - 849.5)

Volume	Invert	Avail.Storage	Storage Description
#1	60.25'	43,946 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
60.25	8,061	0	0
61.00	9,706	6,663	6,663
62.00	11,464	10,585	17,248
63.00	13,324	12,394	29,642
64.00	15,284	14,304	43,946

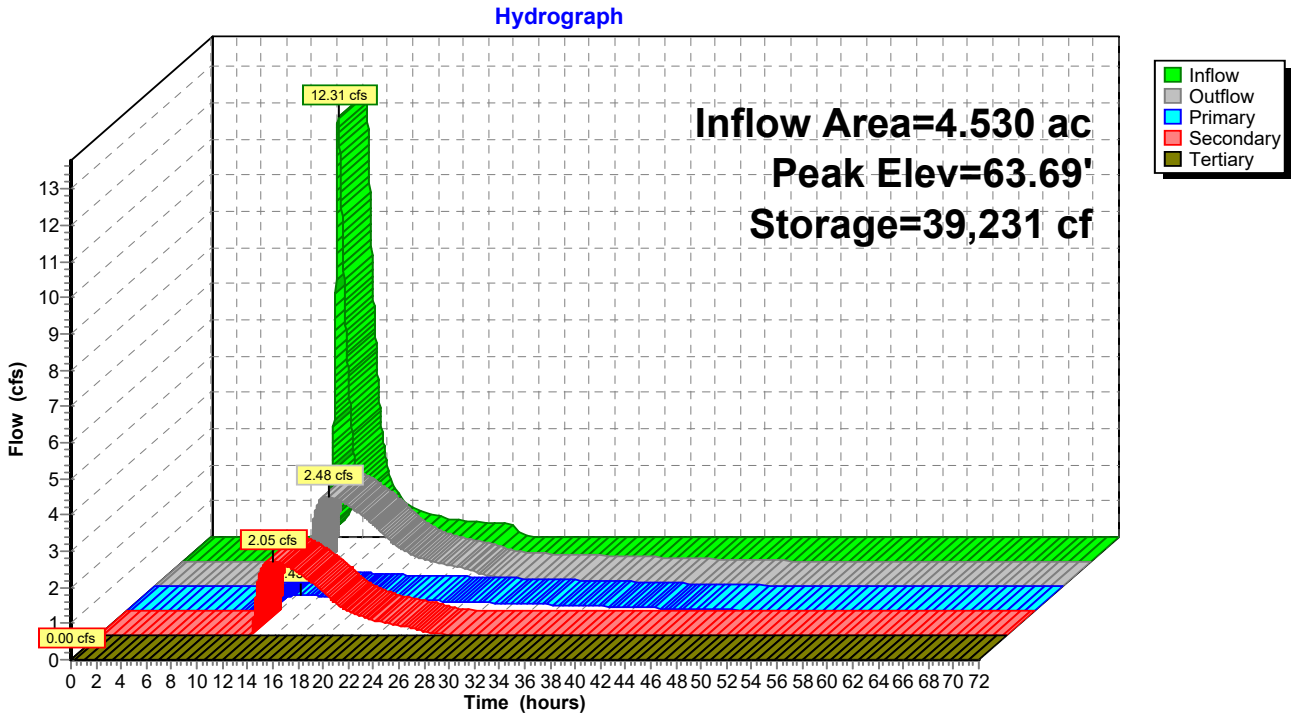
Device	Routing	Invert	Outlet Devices
#1	Primary	60.25'	**3.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Secondary	61.25'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 1.25 Width (feet) 0.25 0.25
#3	Tertiary	63.75'	**25.0' long x 18.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=0.43 cfs @ 13.72 hrs HW=63.69' (Free Discharge)
└**1=Orifice/Grate** (Orifice Controls 0.43 cfs @ 8.76 fps)

Secondary OutFlow Max=2.05 cfs @ 13.72 hrs HW=63.69' (Free Discharge)
└**2=Custom Weir/Orifice** (Orifice Controls 2.05 cfs @ 6.58 fps)

Tertiary OutFlow Max=0.00 cfs @ 0.00 hrs HW=60.25' (Free Discharge)
└**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 3P: WET-ED



Hydrograph for Pond 3P: WET-ED

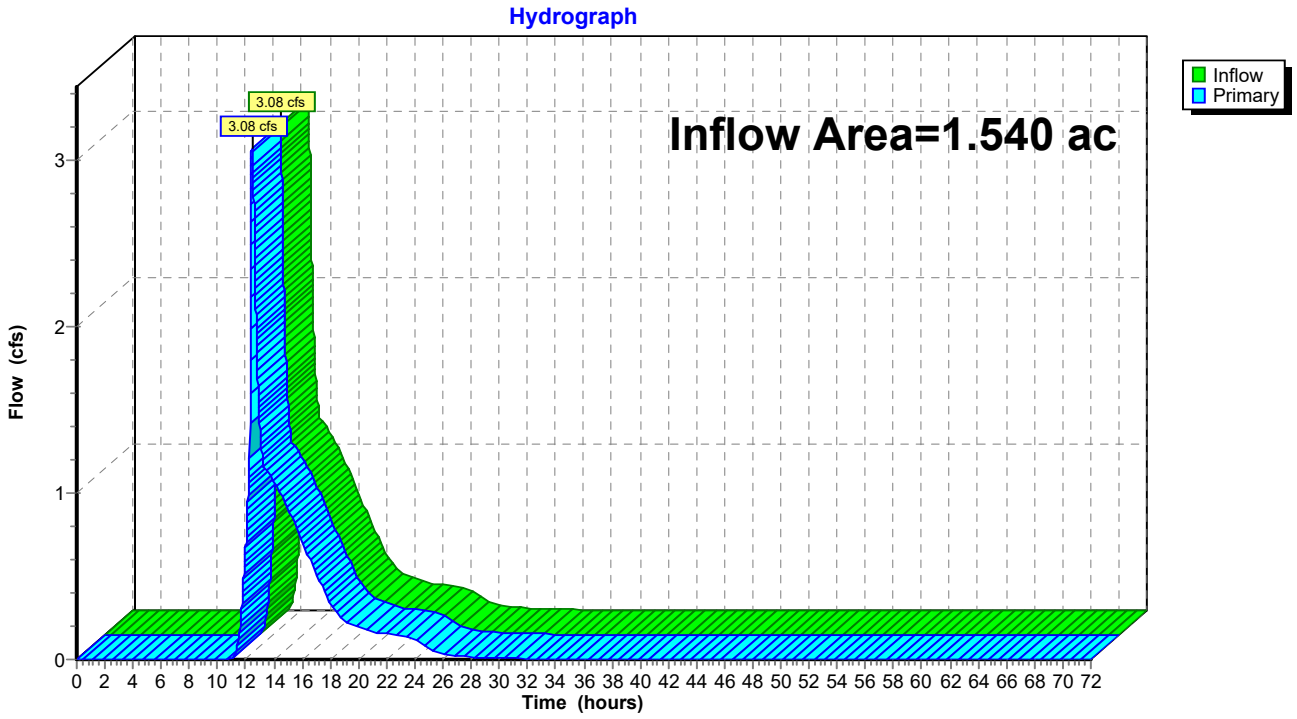
Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Outflow (cfs)	Primary (cfs)	Secondary (cfs)	Tertiary (cfs)
0.00	0.00	0	60.25	0.00	0.00	0.00	**0.00**
2.00	0.00	0	60.25	0.00	0.00	0.00	0.00
4.00	0.00	0	60.25	0.00	0.00	0.00	0.00
6.00	0.00	0	60.25	0.00	0.00	0.00	0.00
8.00	0.04	43	60.26	0.00	0.00	0.00	0.00
10.00	0.30	987	60.37	0.03	0.03	0.00	0.00
12.00	**4.22**	**7,909**	**61.13**	**0.20**	**0.20**	**0.00**	0.00
14.00	**1.93**	**38,929**	**63.66**	**2.47**	**0.43**	**2.04**	0.00
16.00	0.83	31,017	63.10	2.07	0.39	1.68	0.00
18.00	0.58	23,163	62.50	1.48	0.34	1.14	0.00
20.00	0.47	18,313	62.09	0.94	0.31	0.63	0.00
22.00	0.40	15,698	61.86	0.68	0.29	0.39	0.00
24.00	0.34	14,055	61.72	0.53	0.27	0.26	0.00
26.00	0.00	11,553	61.48	0.34	0.25	0.09	0.00
28.00	0.00	9,549	61.29	0.23	0.23	0.01	0.00
30.00	0.00	7,988	61.13	0.21	0.21	0.00	0.00
32.00	0.00	6,578	60.99	0.19	0.19	0.00	0.00
34.00	0.00	5,318	60.86	0.16	0.16	0.00	0.00
36.00	0.00	4,212	60.74	0.14	0.14	0.00	0.00
38.00	0.00	3,264	60.63	0.12	0.12	0.00	0.00
40.00	0.00	2,479	60.55	0.10	0.10	0.00	0.00
42.00	0.00	1,860	60.47	0.07	0.07	0.00	0.00
44.00	0.00	1,414	60.42	0.05	0.05	0.00	0.00
46.00	0.00	1,113	60.39	0.03	0.03	0.00	0.00
48.00	0.00	906	60.36	0.02	0.02	0.00	0.00
50.00	0.00	758	60.34	0.02	0.02	0.00	0.00
52.00	0.00	648	60.33	0.01	0.01	0.00	0.00
54.00	0.00	565	60.32	0.01	0.01	0.00	0.00
56.00	0.00	498	60.31	0.01	0.01	0.00	0.00
58.00	0.00	443	60.30	0.01	0.01	0.00	0.00
60.00	0.00	398	60.30	0.01	0.01	0.00	0.00
62.00	0.00	361	60.29	0.00	0.00	0.00	0.00
64.00	0.00	331	60.29	0.00	0.00	0.00	0.00
66.00	0.00	306	60.29	0.00	0.00	0.00	0.00
68.00	0.00	285	60.29	0.00	0.00	0.00	0.00
70.00	0.00	265	60.28	0.00	0.00	0.00	0.00
72.00	0.00	247	60.28	0.00	0.00	0.00	0.00

Summary for Link 1L: AP-1

Inflow Area = 1.540 ac, 14.94% Impervious, Inflow Depth = 4.80" for 100-YEAR event
Inflow = 3.08 cfs @ 12.45 hrs, Volume= 0.616 af
Primary = 3.08 cfs @ 12.45 hrs, Volume= 0.616 af, Atten= 0%, Lag= 0.0 min

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

Link 1L: AP-1



Hydrograph for Link 1L: AP-1

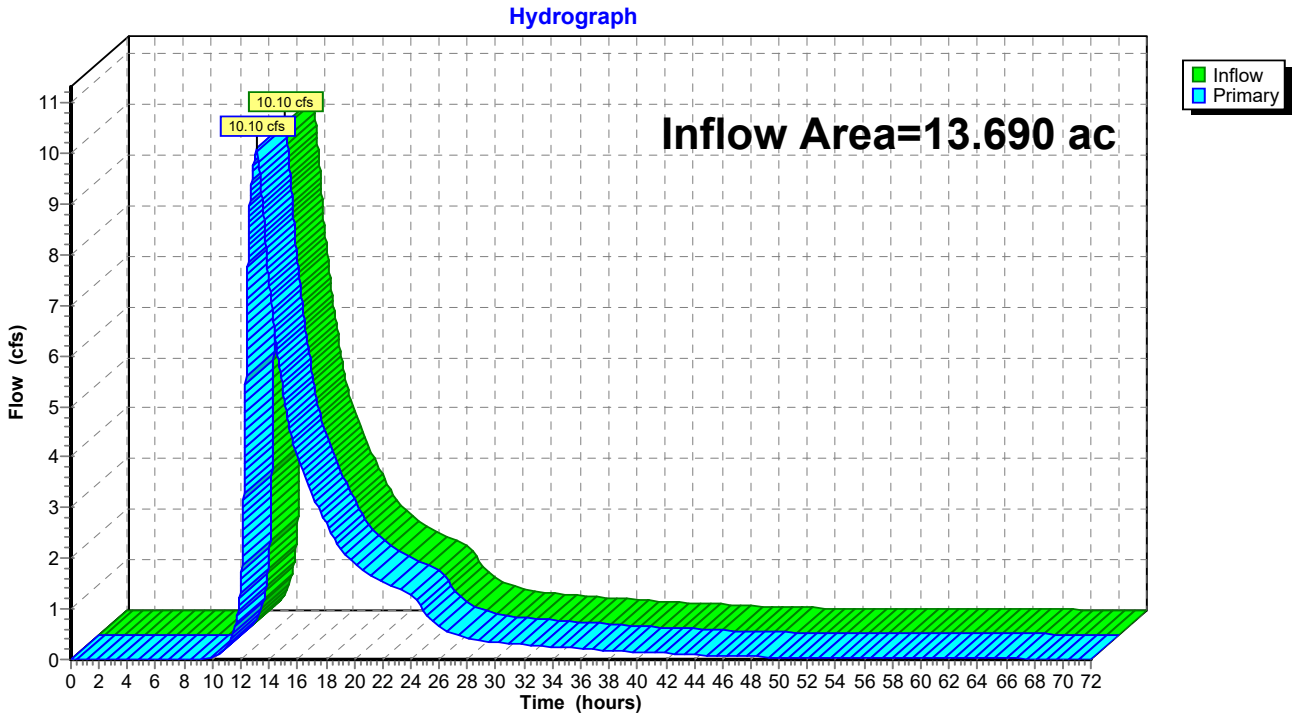
Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)
0.00	0.00	**0.00**	0.00	51.00	0.00	0.00	0.00
1.00	0.00	0.00	0.00	52.00	0.00	0.00	0.00
2.00	0.00	0.00	0.00	53.00	0.00	0.00	0.00
3.00	0.00	0.00	0.00	54.00	0.00	0.00	0.00
4.00	0.00	0.00	0.00	55.00	0.00	0.00	0.00
5.00	0.00	0.00	0.00	56.00	0.00	0.00	0.00
6.00	0.00	0.00	0.00	57.00	0.00	0.00	0.00
7.00	0.00	0.00	0.00	58.00	0.00	0.00	0.00
8.00	0.00	0.00	0.00	59.00	0.00	0.00	0.00
9.00	0.00	0.00	0.00	60.00	0.00	0.00	0.00
10.00	0.00	0.00	0.00	61.00	0.00	0.00	0.00
11.00	0.00	0.00	0.00	62.00	0.00	0.00	0.00
12.00	**0.68**	0.00	**0.68**	63.00	0.00	0.00	0.00
13.00	**1.40**	0.00	**1.40**	64.00	0.00	0.00	0.00
14.00	1.07	0.00	1.07	65.00	0.00	0.00	0.00
15.00	0.91	0.00	0.91	66.00	0.00	0.00	0.00
16.00	0.71	0.00	0.71	67.00	0.00	0.00	0.00
17.00	0.52	0.00	0.52	68.00	0.00	0.00	0.00
18.00	0.34	0.00	0.34	69.00	0.00	0.00	0.00
19.00	0.23	0.00	0.23	70.00	0.00	0.00	0.00
20.00	0.19	0.00	0.19	71.00	0.00	0.00	0.00
21.00	0.17	0.00	0.17	72.00	0.00	0.00	0.00
22.00	0.15	0.00	0.15				
23.00	0.14	0.00	0.14				
24.00	0.13	0.00	0.13				
25.00	0.07	0.00	0.07				
26.00	0.04	0.00	0.04				
27.00	0.02	0.00	0.02				
28.00	0.02	0.00	0.02				
29.00	0.01	0.00	0.01				
30.00	0.01	0.00	0.01				
31.00	0.01	0.00	0.01				
32.00	0.00	0.00	0.00				
33.00	0.00	0.00	0.00				
34.00	0.00	0.00	0.00				
35.00	0.00	0.00	0.00				
36.00	0.00	0.00	0.00				
37.00	0.00	0.00	0.00				
38.00	0.00	0.00	0.00				
39.00	0.00	0.00	0.00				
40.00	0.00	0.00	0.00				
41.00	0.00	0.00	0.00				
42.00	0.00	0.00	0.00				
43.00	0.00	0.00	0.00				
44.00	0.00	0.00	0.00				
45.00	0.00	0.00	0.00				
46.00	0.00	0.00	0.00				
47.00	0.00	0.00	0.00				
48.00	0.00	0.00	0.00				
49.00	0.00	0.00	0.00				
50.00	0.00	0.00	0.00				

Summary for Link 2L: AP-2

Inflow Area = 13.690 ac, 12.42% Impervious, Inflow Depth > 3.77" for 100-YEAR event
Inflow = 10.10 cfs @ 13.09 hrs, Volume= 4.306 af
Primary = 10.10 cfs @ 13.09 hrs, Volume= 4.306 af, Atten= 0%, Lag= 0.0 min

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

Link 2L: AP-2



Hydrograph for Link 2L: AP-2

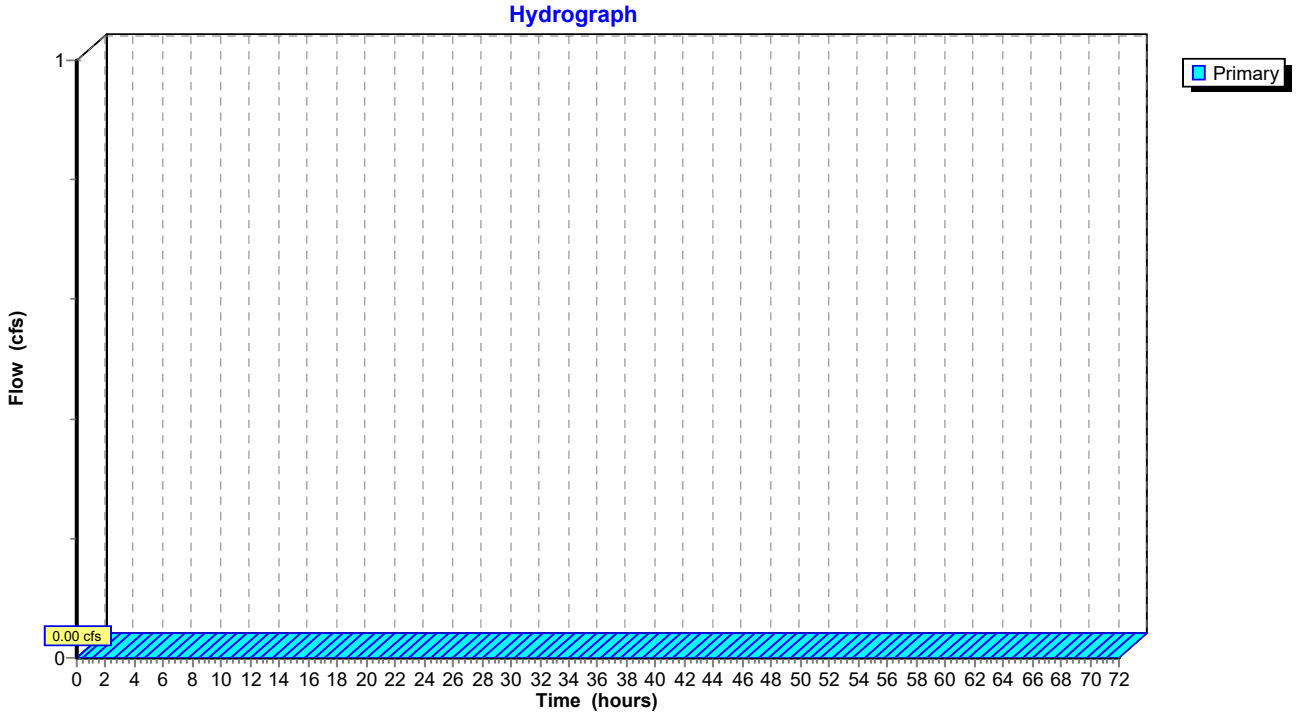
Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)
0.00	0.00	**0.00**	0.00	51.00	0.04	0.00	0.04
1.00	0.00	0.00	0.00	52.00	0.04	0.00	0.04
2.00	0.00	0.00	0.00	53.00	0.04	0.00	0.04
3.00	0.00	0.00	0.00	54.00	0.03	0.00	0.03
4.00	0.00	0.00	0.00	55.00	0.03	0.00	0.03
5.00	0.00	0.00	0.00	56.00	0.03	0.00	0.03
6.00	0.00	0.00	0.00	57.00	0.03	0.00	0.03
7.00	0.00	0.00	0.00	58.00	0.03	0.00	0.03
8.00	0.00	0.00	0.00	59.00	0.03	0.00	0.03
9.00	0.00	0.00	0.00	60.00	0.02	0.00	0.02
10.00	0.04	0.00	0.04	61.00	0.02	0.00	0.02
11.00	0.27	0.00	0.27	62.00	0.02	0.00	0.02
12.00	1.45	0.00	1.45	63.00	0.02	0.00	0.02
13.00	**10.06**	0.00	**10.06**	64.00	0.02	0.00	0.02
14.00	**7.45**	0.00	**7.45**	65.00	0.02	0.00	0.02
15.00	5.27	0.00	5.27	66.00	0.02	0.00	0.02
16.00	4.00	0.00	4.00	67.00	0.02	0.00	0.02
17.00	3.28	0.00	3.28	68.00	0.02	0.00	0.02
18.00	2.69	0.00	2.69	69.00	0.02	0.00	0.02
19.00	2.20	0.00	2.20	70.00	0.02	0.00	0.02
20.00	1.89	0.00	1.89	71.00	0.02	0.00	0.02
21.00	1.69	0.00	1.69	72.00	0.01	0.00	0.01
22.00	1.54	0.00	1.54				
23.00	1.41	0.00	1.41				
24.00	1.29	0.00	1.29				
25.00	0.92	0.00	0.92				
26.00	0.65	0.00	0.65				
27.00	0.50	0.00	0.50				
28.00	0.42	0.00	0.42				
29.00	0.37	0.00	0.37				
30.00	0.34	0.00	0.34				
31.00	0.32	0.00	0.32				
32.00	0.29	0.00	0.29				
33.00	0.27	0.00	0.27				
34.00	0.25	0.00	0.25				
35.00	0.23	0.00	0.23				
36.00	0.22	0.00	0.22				
37.00	0.20	0.00	0.20				
38.00	0.18	0.00	0.18				
39.00	0.17	0.00	0.17				
40.00	0.15	0.00	0.15				
41.00	0.14	0.00	0.14				
42.00	0.12	0.00	0.12				
43.00	0.11	0.00	0.11				
44.00	0.09	0.00	0.09				
45.00	0.08	0.00	0.08				
46.00	0.07	0.00	0.07				
47.00	0.06	0.00	0.06				
48.00	0.06	0.00	0.06				
49.00	0.05	0.00	0.05				
50.00	0.05	0.00	0.05				

Summary for Link 3L: AP-3

Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

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

Link 3L: AP-3



A.9
GEOTECHNICAL REPORT
By
Geo-Technology Associates, Inc.

Townsend Acres Subdivision

Townsend, Delaware

GEO-TECHNOLOGY ASSOCIATES, INC.

GEOTECHNICAL • ENVIRONMENTAL •
CONSTRUCTION OBSERVATION AND TESTING

A Practicing Geoprofessional Business Association Member Firm

November 15, 2024

TAC LLC
1919 Red Lion Road
Bear, Delaware 19701

Attn: Mr. Bob Taylor

Re: Report of Geotechnical Exploration
Townsend Acres
New Castle County, Delaware

Dear Mr. Taylor,

In accordance with our agreement, Geo-Technology Associates, Inc. (GTA) has performed a geotechnical exploration for a proposed residential subdivision, in New Castle County, Delaware. The subsurface exploration consisted of observing the excavation of test pits throughout the site and performing infiltration testing. The results of the field and laboratory testing and geotechnical recommendations regarding design and construction of the proposed residential subdivision are included in this report.

We appreciate the opportunity to be of assistance on this project. Should you have questions or require additional information, please contact our office at (302) 326-2100.

Very truly yours,
GEO-TECHNOLOGY ASSOCIATES, INC.

Thomas Kane
Senior Geotechnical Professional

Meghan McDonough
Principal

MEGHAN MCDONOUGH LICENSE No. 13632 DELAWARE PROFESSIONAL ENGINEER

TK/MM/mt
241837
Attachments

REPORT OF GEOTECHNICAL EXPLORATION

TOWNSEND ACRES

New Castle County, Delaware

NOVEMBER 2024

Prepared For:

TAC LLC
1919 Red Lion Road
Bear, Delaware 19701

Attn: Mr. Bob Taylor

Prepared By:

GEO-TECHNOLOGY ASSOCIATES, INC.
Geotechnical and Environmental Consultants
111 Ruthar Drive
Newark, Delaware 19711
(302) 326-2100
GTA Job No: 241837

TABLE OF CONTENTS

REPORT OF GEOTECHNICAL EXPLORATION

TOWNSEND ACRES
NEW CASTLE COUNTY, DELAWARE
NOVMEBER 2024

INTRODUCTION

We understand that TAC LCC is planning a residential subdivision at a site located west of Summit Bridge Road (State Route 71), in New Castle County, Delaware. Geo-Technology Associates, Inc. (GTA) was provided with an untitled undated plan presenting existing boundary information, and the proposed lot and roadway configuration. Topography and existing features information was not available at the time this report was prepared. We understand that the proposed construction shall consist of a 46 single-family homes including 3 proposed stormwater management facilities, and associated infrastructure and roadways.

In conjunction with the proposed purchase, GTA was retained to perform a preliminary geotechnical exploration at the project site. The scope of this study included a field exploration, site assessment, and engineering analysis. Included in our field exploration were 12 test pits excavated at various locations across the project site to depths ranging from 6 to 10 feet below the existing ground surface and performing singe-. Conclusions and recommendations regarding the site development were derived from engineering analysis of field data, and review of the previously referenced information. GTA was retained to perform a Phase I Environmental Site Assessment which will be transmitted under separate cover.

SITE CONDITIONS

The subject site, is located west of Summit Bridge Road and the location is shown on the *Site Location Map, Figure 1* included in Appendix A. At the time the exploration was performed, the site was wooded and contained moderate to heavy underbrush and small to large sized trees. Trees had been cleared along a pathway in the northeastern portion of the site prior to our site visit; however; large stumps and underbrush had not been grubbed at the time of our site visit. GTA did not observe any structures on the site.

The subject site was generally bound by a residential property and Summit Bridge Road to the northeast, wooded and wetland areas to the northwest, a solar panel field to the southeast, and the Woods at Townsend Village II residential subdivision to the southwest. The site topography generally slopes gently downward from the southern portion of the site to the northern portion of the site. Surface drainage is generally expected to move toward the lower elevations in the northern portion of the site. Tributaries to the Appoquinimink River are located to the north of the subject property. The topographic information presented on Google Earth indicates that ground surface elevations within the subject property range from approximately elevation (EL) 70 feet to about 63 feet above Mean Sea Level (MSL).

PROPOSED CONSTRUCTION

Preliminary information indicates that three stormwater management facilities are proposed. The type and size of facilities have not been finalized; however, preliminary information provided by Becker Morgan Group indicates the following:

FACILITY SUMMARY

FACILITY	TEST PITS	INVERT	EXISTING GSEL
SWM Area I-1	1-1, 1-2, 1-3, 1-4	EL 58	EL 64 to 61
SWM Area I-2	2-1, 2-2, 2-3, 2-4, 2-5	EL 59	EL 66 to 63
SWM Area I-3	3-1, 3-2, 3-3	EL 59	EL 63-62

According to the Water Resource Protection Areas for City of Newark, City of Wilmington, New Castle County Delaware, last revised March 2017, Map 3 of 3, the subject property is mapped as a Water Resource Protection Area (WRPA) Recharge Area. As such, the impervious cover at the site will be limited to 20 percent but can be increased up to 50 percent with a conditional use granted by New Castle County's Resource Protection Advisory Committee.

SITE GEOLOGY

According to the *Geological Map of New Castle County, Delaware (DGS, 2005)*, the site is situated in the Coastal Plain Physiographic Province. The Coastal Plain is characterized by undifferentiated and interlayered sedimentary deposits derived from eroded and transported rock formations to the north and west. Specifically, the site is mapped as underlain by the Columbia Formation. The Columbia Formation is described as yellowish- to reddish-brown, fine to coarse, feldspathic quarts sand with varying amounts of gravel. Typically, cross-bedded with cross-sets ranging from a few inches to over three feet in thickness. Scattered beds of tan to reddish-gray clayey silt are common. In places, the upper 5 to 25 feet of grayish- to reddish- brown silt to very fine sand overlying medium to coarse sand. Near the base, clasts of cobble to small boulder size have been found in a gravel bed ranging from a few inches to three feet thick. Gravel fraction primarily quartz with lesser amounts of chert. Refer to the publication for more detailed descriptions of these geological units.

Based on the U.S. Department of Agriculture (USDA), *Natural Resources Conservation Service (NRCS) Web Soils Survey*, the soils underlying the site are mapped as Woodstown loam in the west-central portion of the site, the Ingleside-Hammonton-Fallingston Complex along the western boundary of the site, Sassafras sandy loam in the southeastern corner of the site, Reybold silt loam in the east-central portion of the site, and Fallsington loam in the northern and eastern portions of the site. The Woodstown loam unit is described as being moderately well drained with a depth to free water of 20 to 40 inches. The Ingleside-Hammonton-Fallsington Complex is described as being well drained to poorly drained with a depth to free water of 0 to 72 inches. The Sassafras sandy loam is described as being well drained with a depth to free water of greater than 80 inches. The Reybold loam unit is described as being well drained with a depth to free water of greater than 80 inches. The Fallsington loam unit is described as being poorly drained with a depth to free water of about 0 to 20 inches.

Additionally, The *Delaware Geologic Information Resource* website describes the depth to the seasonal high groundwater as being 3 to 6 feet below the ground surface in the western portion of the site, 6 to 9 feet below the ground surface in the central portion of the site, and 9 to 16 feet below the ground surface in the eastern portion of the site during the wetter periods of the year.

SUBSURFACE EXPLORATION

The field exploration consisted of observing 12 test pit excavations across the site. The test pits were excavated on November 15, 2024, by Cavan Construction with a rubber-tired backhoe. The test pit locations were field selected by GTA, with the approximate locations indicated on the *Exploration Location Plan, Figure 2*, included in Appendix A.

The soil samples retrieved from the test pits were delivered GTA's laboratory for review by engineering personnel. The soil descriptions indicated on the logs are based on visual observations of the soil samples using the Unified Soil Classification System (USCS) as summarized in the *Notes for Exploration Logs* included in Appendix B.

It should be noted that an instrument survey for elevation was not performed at the test pit locations and the elevations indicated within this report were obtained from the topographic information available on Google Earth aerial imagery. Therefore, it should be understood that all elevations, as well as transitions in soil strata indicated on the test pit logs, are approximate.

SUBSURFACE CONDITIONS

In agreement with the published geology, the test pits typically encountered surficial topsoil underlain by natural soils consistent with the Columbia Formation throughout the maximum depths explored. The topsoil was encountered at the ground surface of the exploration holes and measured about 12 to 24 inches in thickness. Underlying the topsoil, the majority of test pits encountered predominantly fine-grained soils visually classified as sandy lean clay to depths of approximately 7 feet below the ground surface. The fine-grained soils were underlain by granular soils visually classified as clayey sand to the termination depths. Refer to the exploration logs included in Appendix B for detailed information.

Groundwater was observed at the exploration locations at depths ranging from 3.8 to 10.0 feet below the ground surface, corresponding to elevations ranging from approximately EL 59 to 61. Groundwater levels were recorded during the exploration and again at the end of the day. Groundwater levels can fluctuate due to seasonal variations in precipitation several feet in the Columbia Formation.

INFILTRATION TESTING

After observing the soil conditions to evaluate any limiting zones within the soil profile, 36 infiltration tests were conducted in the test pits at the approximate depths indicated below. Single-ring infiltration testing was performed in general accordance with the procedures outlined in ASTM D5126 to estimate hydraulic conductivity in the unsaturated zone. The test consisted of seating an open bottom 12-inch diameter casing 2 to 4 inches into the subgrade soils followed by a pre-soak period. After the pre-soak period, water was added to a level of 4 to 6 inches above the test elevation. Water level measurements were recorded over a minimum one-hour period, after the initial pre-soak period. If the observed rate of less 12-inches was observed in a 15-minute period, an additional 1-hour interval was performed. The steady state values over the last hour are recorded in the table below.

UNFACTORED FIELD INFILTRATION RATES

Location	Depth, ft/EL	Unfactored Field Infiltration Rate	USCS Soil Classification
1-1	3.0/58.0	1-inch per hour	Clayey SAND (SC)
1-2	4.0/58.0	1/8-inch per hour	Sandy Lean CLAY (CL)
1-3	6.0/58.0	½-inch per hour	Clayey SAND (SC)
1-4	4..0/59.0	1-inch per hour	Clayey SAND (SC)
2-1	4.0/59.0	1-inch per hour	Clayey SAND (SC)
2-2	5.0/59.0	½-inch per hour	Clayey SAND (SC)
2-3	5.0/59.0	No measurable rate	Sandy Lean CLAY (CL)
2-4	5.0/59.0	1-inch per hour	Clayey SAND (SC)
3-1	4.0/59.0	1/4-inch per hour	Sandy Lean CLAY (CL)
3-2	4.0/59.0	1-inch per hour	Clayey SAND (SC)
3-3	4.0/59.0	No measurable rate	Sandy Lean CLAY (CL)

It should be noted that infiltration rates can vary widely with variations in soil texture and gradation. The density and plasticity of the soils affected the infiltration potential.

CONCLUSIONS AND RECOMMENDATIONS

Based on our observations made during the subsurface exploration, it is our opinion that managing stormwater through the use of infiltration is feasible with limitations. The DNREC BMP Standards and Specifications dated February 2019 indicate that the minimum infiltration rate for infiltration practices is 1-inch per hour. Also, a vertical separation of two (2) feet from the seasonal high groundwater elevation or bedrock layer is required for infiltration practices unless an underdrain is provided. The unfactored field measured infiltration rates were less than ½-inch to 10+ inches per hour. A factor of safety of 2.0 can be applied to the field measured rates since single ring infiltration tests were performed.

FACTORED FIELD INFILTRATION RATES

Location	Recommended Design Rate	Recommended Invert for Design Rate	Special Design Considerations
1	N/A	EL 58	Significant variability across proposed subgrade elevation and shallow water; consider a bio-retention
2	N/A	EL 59	Significant variability across proposed subgrade elevation and shallow water; consider a bio-retention
3	N/A	EL 59	Significant variability across proposed subgrade elevation and shallow water; consider a bio-retention

Based on a review of the groundwater levels observed during this and previous studies and well records maintained by Delaware Geological Survey, corresponding seasonal high groundwater elevations are estimated to be EL 59 to EL 61 in the eastern and southern portions of the site.

General Construction Recommendations

We do not recommend averaging rates at various locations and applying the averaged rate to the site or per facility. This recommendation is based on the inherent problems associated with these systems as they become less permeable due to the densification during construction partial clogging or siltation occurring over time. We recommend confirmatory testing at the time of excavation and to observe the facility is excavated predominantly in silty sand and poorly-graded sand. GTA

observed a clay lenses and cemented sands that may need to be broken up or punctured to facilitate a higher permeability or removed completed if encountered at the invert elevation.

State Climatologist and Geology Databases and websites report the actual groundwater levels at this site are likely representative of water levels during normal conditions and are 2 to 3 feet below the estimated seasonal high. The proposed inverts will need to be a minimum of 2 feet above the estimated seasonal high-water table.

The infiltration facilities should be excavated using a track-mounted excavator or other equipment which will generally eliminate the need to operate equipment directly on the subgrade. We do not recommend placing topsoil across the bottom after the facilities have been excavated and graded to the design elevations if they will remain open-bottomed. The construction equipment will densify the infiltrating subgrade. Additionally, the topsoil is typically a fine-grained soil which will impede infiltration due to the silt/clay fraction. We recommend that a grass seed mix be sprayed or cast along the bottom during a period which will allow germination, and also can germinate and establish in silty and poorly-graded sands. This eliminates the need for equipment on the subgrade once the facility is constructed. The type of grass can be mowed, if necessary, but the grass clippings will need to be bagged otherwise they could clog the subgrade. A seed mix requiring little to no maintenance is preferred. A landscape architect should be consulted for recommendations on seed mix.

If any facility will be used as a sediment trap during construction, we recommend that a minimum two-foot soil buffer be maintained above the infiltration subgrade to eliminate the need to track on the subgrade so the stresses from the equipment do not affect the infiltration capacity. During conversion of the facility, the geotechnical engineer and Certified Construction Reviewer should be on-site to review means and methods with the earthwork contractor to ensure no equipment operates on the design subgrade. During removal of the collected sediment and excavation process, the contractor will need to work from the sides of the facility (preferred method) or sit on the elevated grade and work backwards to eliminate the need to track on the design subgrade.

Embankments and Liners

Based on a review of the Stormwater Management Sections & Details, the slope geometries along the downstream and upstream slope are designed as 3 horizontal to 1 vertical (3H:1V) and 3H:1V, respectively. If a phreatic line is drawn on a 4H:1V slope starting on the inside slope at the 100-year water surface elevation or F_v storm elevation, the line does not intersect the downstream slope or break out on the downstream face. Given the short duration, the infiltration facilities will impound water (since there are required to infiltrate completely within 48 hours), steady-state seepage will not occur. Also, since the assumed phreatic surface line does not intersect the downstream face, the slope stability will not be affected even if steady state seepage did develop. The primary purpose of the anti-seep collars is to provide resistance against excessive seepage through the embankment soils. However, the movement of water through the embankment soils can be reduced by using proper construction practices during grading operations and densifying materials to reduce permeability and increase shear strength. If the embankments are constructed with on-site materials meeting the USCS Classification ML, CL, MH, CH, SM, SC with at least 30 percent fines; the subgrade is observed to be stable; and the embankments are constructed in accordance with our recommendations below, then it is our opinion that cut-off trenches can be eliminated. The cut-off trench is not necessary for under embankment seepage control considering the encountered granular soils. Also, seepage through the embankment or at the interface between the natural and fill soils may not affect stability of the embankment. The decision to eliminate the cut-off should be made in the field at the time of construction after review by the Geotechnical Engineer.

For the proposed wet pond, a compacted clay liner or geosynthetic should be placed across the bottom and side slopes to at least 1-foot above the proposed permanent pool elevation. A compacted clay liner can be constructed with on-site materials meeting the USCS Classification ML, CL, MH, CH, SC with at least 30 percent fines and a hydraulic conductivity of at least 10^{-7} cm/sec. We recommended a 6-inch-thick topsoil cover over the geosynthetic liner. Embankments and excavated slopes constructed at steeper grades than those recommended will be more susceptible to sloughing and to the formation of erosion gullies. GTA recommends that the completed facility slopes be stabilized and covered with the vegetative cover as quickly as practical to reduce the potential for erosion.

Structural fill areas for facilities with constructed embankments may require additional depth of stripping or drying and reworking to provide a stable subgrade. If excavation for the facility or outlet control structure encounters groundwater, the soils will exhibit instability, such as running sands and side-wall collapse. Temporary dewatering will help reduce these problems but will not eliminate them unless the water levels are drawn down at least 2 feet below the point of excavation.

The more fine-grained materials should be reserved for the upstream zone of the embankment, and the more granular and low plasticity materials should be placed in the central and downstream zones of the embankment, if practical. The embankment materials shall be spread in level, continuous, horizontal layers for the width and length of such portion at that elevation. Additionally, GTA recommends that the embankment faces be filled steeper than proposed then reshaped or shaved to their intended design slope. Also, during construction, any previously placed and compacted materials which have become soft or loose due to exposure to weather, which contain erosion channels or cracks, or which are excessively dry, shall be reworked or removed before successive lifts are placed.

In order to reduce the potential for piping failures, backfill around the outfall pipes should meet the recommended USCS soil types, and be placed in lifts not to exceed 6 to 8 inches, and should be compacted with hand operated equipment to a minimum of 95 percent of ASTM D698 (Standard Proctor) maximum dry density. Consideration should be to placing a concrete cradle or filling with flowable fill to the spring line of the outfall pipe prior to backfill.

ADDITIONAL SERVICES

We recommended that during construction of the subject project, a geotechnical engineer be retained to provide observation and testing services for the following items.

- Review final civil and structural plans to evaluate if they conform with the intent of this report.
- Observe the proof-rolling of fill subgrades prior to placing fill to evaluate stability.
- Perform confirmatory testing in accordance with Delaware Department of Natural Resource Regulations and Town of Townsend.

LIMITATIONS

This report, including all supporting exploration logs, field data, field notes, laboratory test data, calculations, estimates, and other documents prepared by GTA in connection with this project, has been prepared for the exclusive use of TAC LLC pursuant to the agreement between GTA and TAC LLC and in accordance with generally accepted engineering practice. All terms and conditions set forth in the Agreement and the General Provisions attached thereto are incorporated herein by reference. No warranty, express or implied, is given herein. Use and reproduction of this report by any other person without the expressed written permission of GTA and TAC LLC is unauthorized and such use is at the sole risk of the user.

The analysis and recommendations contained in this report are based on the data obtained from limited observation and testing of the encountered materials. Test pits indicate soil conditions only at specific locations and times and only to the depths penetrated. They do not necessarily reflect strata variations that may exist between the test pit locations. Consequently, the analysis and recommendations must be considered preliminary until the subsurface conditions can be verified by direct observation at the time of construction. If variations in subsurface conditions from those described are noted during construction, recommendations in this report may need to be re-evaluated.

In the event that any changes in the nature of the facilities are planned, the conclusions and recommendations contained in this report should not be considered valid unless the changes are reviewed, and conclusions of this report are verified in writing. Geo-Technology Associates, Inc. is not responsible for any claims, damages, or liability associated with interpretation of subsurface data or reuse of the subsurface data or engineering analysis without the expressed, written authorization of Geo-Technology Associates, Inc.

The scope of our services for this geotechnical exploration did not include any environmental assessment or investigation for the presence or absence of wetlands, or hazardous or toxic materials in the soil, surface water, groundwater or air, on or below or around this site. Any statements in this report or on the logs regarding odors or unusual or suspicious items or conditions observed are strictly for the information of our Client.

The subject matter of this report is limited to the facts and matters stated herein. Absence of a reference to any other conditions or subject matter shall not be construed by the reader to imply approval by the writer.

241837 **GEO-TECHNOLOGY ASSOCIATES, INC.**

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, you can benefit from a lowered exposure to problems associated with subsurface conditions at project sites and development of them that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed herein, contact your GBA-member geotechnical engineer. Active engagement in GBA exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Understand the Geotechnical-Engineering Services Provided for this Report

Geotechnical-engineering services typically include the planning, collection, interpretation, and analysis of exploratory data from widely spaced borings and/or test pits. Field data are combined with results from laboratory tests of soil and rock samples obtained from field exploration (if applicable), observations made during site reconnaissance, and historical information to form one or more models of the expected subsurface conditions beneath the site. Local geology and alterations of the site surface and subsurface by previous and proposed construction are also important considerations. Geotechnical engineers apply their engineering training, experience, and judgment to adapt the requirements of the prospective project to the subsurface model(s). Estimates are made of the subsurface conditions that will likely be exposed during construction as well as the expected performance of foundations and other structures being planned and/or affected by construction activities.

The culmination of these geotechnical-engineering services is typically a geotechnical-engineering report providing the data obtained, a discussion of the subsurface model(s), the engineering and geologic engineering assessments and analyses made, and the recommendations developed to satisfy the given requirements of the project. These reports may be titled investigations, explorations, studies, assessments, or evaluations. Regardless of the title used, the geotechnical-engineering report is an engineering interpretation of the subsurface conditions within the context of the project and does not represent a close examination, systematic inquiry, or thorough investigation of all site and subsurface conditions.

Geotechnical-Engineering Services are Performed for Specific Purposes, Persons, and Projects, and At Specific Times

Geotechnical engineers structure their services to meet the specific needs, goals, and risk management preferences of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client.

Likewise, geotechnical-engineering services are performed for a specific project and purpose. For example, it is unlikely that a geotechnical-engineering study for a refrigerated warehouse will be the same as one prepared for a parking garage; and a few borings drilled during a preliminary study to evaluate site feasibility will not be adequate to develop geotechnical design recommendations for the project.

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project or purpose;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, the reliability of a geotechnical-engineering report can be affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying the recommendations in it. A minor amount of additional testing or analysis after the passage of time – if any is required at all – could prevent major problems.

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read the report in its entirety. Do not rely on an executive summary. Do not read selective elements only. *Read and refer to the report in full.*

You Need to Inform Your Geotechnical Engineer About Change

Your geotechnical engineer considered unique, project-specific factors when developing the scope of study behind this report and developing the confirmation-dependent recommendations the report conveys. Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the elevation, configuration, location, orientation, function or weight of the proposed structure and the desired performance criteria;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project or site changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept*

responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface using various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing is performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgement to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team through project completion to obtain informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, they are not final, because the geotechnical engineer who developed them relied heavily on judgement and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* exposed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a continuing member of the design team, to:

- confer with other design-team members;
- help develop specifications;
- review pertinent elements of other design professionals' plans and specifications; and
- be available whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction-phase observations.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for information purposes only.* To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. This happens in part because soil and rock on project sites are typically heterogeneous and not manufactured materials with well-defined engineering properties like steel and concrete. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually provide environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures.* If you have not obtained your own environmental information about the project site, ask your geotechnical consultant for a recommendation on how to find environmental risk-management guidance.

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, the engineer's services were not designed, conducted, or intended to prevent migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration. Confront the risk of moisture infiltration*** by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are not building-envelope or mold specialists.***

GEOPROFESSIONAL BUSINESS ASSOCIATION

Telephone: 301/565-2733
e-mail: info@geoprofessional.org www.geoprofessional.org

APPENDIX A

FIGURE 2: EXPLORATION LOCATION PLAN

INFILTRATION TESTING

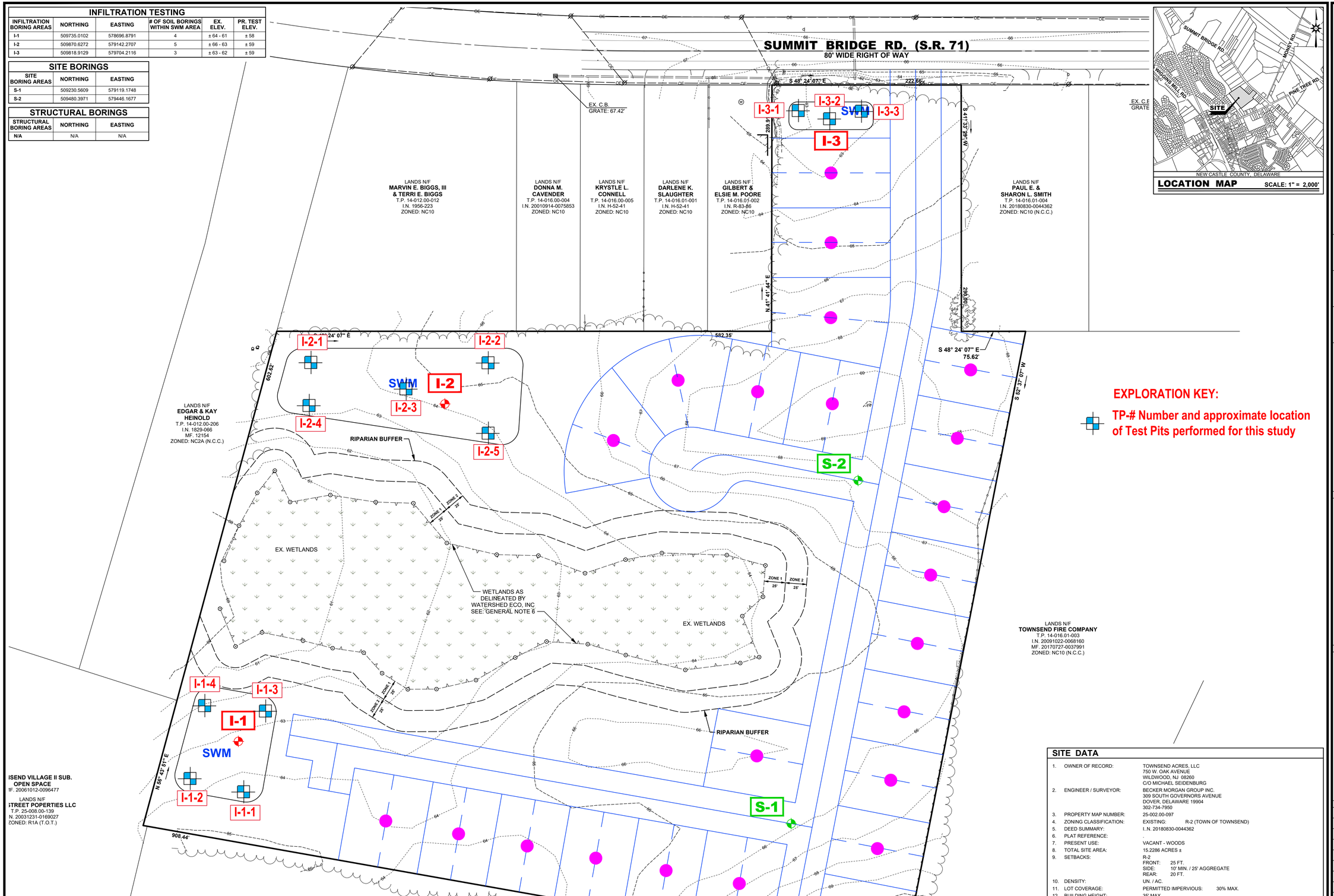
INFILTRATION BORING AREAS	NORTHING	EASTING	# OF SOIL BORINGS WITHIN SWM AREA	EX. ELEV.	PR. TEST ELEV.
I-1	509735.0102	578696.8791	4	± 64 - 61	± 58
I-2	509870.6272	579142.2707	5	± 66 - 63	± 59
I-3	509818.9129	579704.2116	3	± 63 - 62	± 59

SITE BORINGS

SITE BORING AREAS	NORTHING	EASTING
S-1	509230.5609	579119.1748
S-2	509480.3971	579446.1677

STRUCTURAL BORINGS

STRUCTURAL BORING AREAS	NORTHING	EASTING
N/A	N/A	N/A



EXPLORATION KEY:

TP-# Number and approximate location of Test Pits performed for this study

GTA NOTES:

(1) Base plan prepared by Woodin + Associates, and use of this diagram by GTA is limited illustration of the approximate locations of our explorations.
(2) Exploration Location Plan should be read together with GTA Report Townsend Acres, Job No. 241837 for complete evaluation.
(3) The approximate locations of the explorations were measured from site features and GPS stake-out, and should be considered accurate to the degree implied by this method.

S-1 SITE BORING
I-1 INFILTRATION BORING
B-1 STRUCTURAL BORING

SITE DATA

1.	OWNER OF RECORD:	TOWNSEND ACRES, LLC 750 W. OAK AVENUE WILDWOOD, NJ 08260 C/O MICHAEL SEIDENBURG
2.	ENGINEER / SURVEYOR:	BECKER MORGAN GROUP INC. 309 SOUTH GOVERNORS AVENUE DOVER, DELAWARE 19904 302-734-7950
3.	PROPERTY MAP NUMBER:	25-002.00-097
4.	ZONING CLASSIFICATION:	EXISTING: R-2 (TOWN OF TOWNSEND)
5.	DEED SUMMARY:	I..N. 20180830-0044362
6.	PLAT REFERENCE:	.
7.	PRESENT USE:	VACANT - WOODS
8.	TOTAL SITE AREA:	15.2286 ACRES ±
9.	SETBACKS:	R-2 FRONT: 25 FT. SIDE: 10' MIN. / 25' AGGREGATE REAR: 20 FT.
10.	DENSITY:	UN. / AC.
11.	LOT COVERAGE:	PERMITTED IMPERVIOUS: 30% MAX.
12.	BUILDING HEIGHT:	35' MAX.
	)URCE OF WATER:	ARTESIAN WATER CO., INC.
	)URCE OF SEWER:	N.C.C. - DEPT. OF PUBLIC WORKS
	)URCE OF GAS:	CHESAPEAKE UTILITIES
	)URCE OF ELECTRIC:	DELMARVA POWER
	IRVEY BENCHMARK:	NGS MONUMENTATION VERTICAL: NAVD88 HORIZONTAL: NAD83
	)NUMENTATION:	EXISTING: 13 FOUND PROPOSED: 0 TO BE SET

BECKER MORGAN GROUP

ARCHITECTURE
ENGINEERING

Delaware
309 South Governors Avenue
Dover, DE 19904
302.734.7950
The Tower at STAR Campus
100 Discovery Boulevard, Suite 102
Newark, DE 19713
302.369.3700

Maryland
312 West Main Street, Suite 300
Salisbury, MD 21801
410.546.9100

North Carolina
3333 Jaeckle Drive, Suite 120
Wilmington, NC 28403
910.341.7600

www.beckermorgan.com

PROJECT TITLE

TOWNSEND ACRES SUBDIVISION

SUMMIT BRIDGE ROAD
TONW OF TONSEND
NEW CASTLE COUNTY, DE

SHEET TITLE

SOIL BORING EXHIBIT

0 25 50 100
SCALE: 1" = 50'

ISSUE BLOCK

MARK	DATE	DESCRIPTION

LAYER STATE: SOIL BORING

PROJECT NO.:	2024141.00
DATE:	7/10/2024
SCALE:	1" = 50'
DRAWN BY: R.J.M.	PROJ. MGR.: R.J.M.

SHEET

1 OF 1

F:\AutoCAD\Projects\2024\2024141\DWG\2024141-CONCEPT-C3D21-DE.dwg, Jul 10, 2024 - 2:20pm

Notes:

1) Base map obtained from Google Earth Aerial Imagery from April 2017.
2) Site Location Map should be reviewed in conjunction with GTA Report Townsend Acres, Job No. 241837

GEO-TECHNOLOGY ASSOCIATES, INC.
Geotechnical and Environmental Consultants
111 Ruthar Drive
Newark, Delaware 19711
(302) 326-2100

SITE LOCATION MAP

TOWNSEND ACRES

NEW CASTLE COUNTY, DELAWARE

SCALE	DATE	DRAWN BY	REVIEW BY	JOB NO.	FIGURE NO.
NTS	NOV 2024	---	MM	241837	1

APPENDIX B

NOTES FOR EXPLORATION LOGS

KEY TO USCS TERMINOLOGY AND GRAPHIC SYMBOLS

MAJOR DIVISIONS (BASED UPON ASTM D 2488)			SYMBOLS GRAPHIC	SYMBOLS LETTER
COARSE - GRAINED SOILS	GRAVEL AND GRAVELY SOILS	CLEAN GRAVELS (LESS THAN 5% PASSING THE NO. 200 SIEVE)		GW
	MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE			GP
		GRAVELS WITH FINES (MORE THAN 15% PASSING THE NO. 200 SIEVE)		GM
				GC
MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	SAND AND SANDY SOILS	CLEAN SANDS (LESS THAN 5% PASSING THE NO. 200 SIEVE)		SW
	MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE			SP
		SANDS WITH FINES (MORE THAN 15% PASSING THE NO. 200 SIEVE)		SM
				SC
FINE - GRAINED SOILS	SILTS AND CLAYS LIQUID LIMIT LESS THAN 50	SILT OR CLAY (<15% RETAINED THE NO. 200 SIEVE)		ML
		SILT OR CLAY WITH SAND OR GRAVEL (15% TO 30% RETAINED THE NO. 200 SIEVE)		CL
		SANDY OR GRAVELY SILT OR CLAY (>30% RETAINED THE NO. 200 SIEVE)		OL
MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50	SILT OR CLAY (<15% RETAINED THE NO. 200 SIEVE)		MH
		SILT OR CLAY WITH SAND OR GRAVEL (15% TO 30% RETAINED THE NO. 200 SIEVE)		CH
		SANDY OR GRAVELY SILT OR CLAY (>30% RETAINED THE NO. 200 SIEVE)		OH
HIGHLY ORGANIC SOILS				PT

NOTE: DUAL SYMBOLS ARE USED TO INDICATE COARSE-GRAINED SOILS CONTAINING AN ESTIMATED 10% FINES BY VISUAL CLASSIFICATION OR WHEN THE SOIL HAS BETWEEN 5 AND 12 PERCENT FINES FROM LABORATORY TESTS; AND FOR FINE-GRAINED SOILS WHEN THE PLOT OF LIQUID LIMIT & PLASTICITY INDEX VALUES FALLS IN THE PLASTICITY CHART'S CROSSHATCHED AREA. RESULTS OF LABORATORY TESTING ARE USED TO SUPPLEMENT THE CLASSIFICATION OF THE SOILS BASED ON THE VISUAL-MANUAL PROCEDURES OF ASTM D2488.

ADDITIONAL TERMINOLOGY AND GRAPHIC SYMBOLS

	DESCRIPTION		GRAPHIC SYMBOLS
ADDITIONAL DESIGNATION	TOPSOIL		
	MAN-MADE FILL		
	GLACIAL TILL		
	COBBLES AND BOULDERS		
RESIDUAL SOIL DESIGNATION	DESCRIPTION	"N" VALUE	
	HIGHLY WEATHERED ROCK	50 TO 50/1"	
	PARTIALLY WEATHERED ROCK	MORE THAN 50 BLOWS FOR 1" PENETRATION, AUGER PENETRABLE	

COARSE-GRAINED SOILS
(GRAVEL AND SAND)

DESIGNATION	BLOWS PER FOOT (BPF) "N"
VERY LOOSE	0 - 4
LOOSE	5 - 10
MEDIUM DENSE	11 - 30
DENSE	31 - 50
VERY DENSE	>50

NOTE: "N" VALUE DETERMINED AS PER ASTM D1586

FINE-GRAINED SOILS
(SILT AND CLAY)

CONSISTENCY	BPF "N"
VERY SOFT	<2
SOFT	2 - 4
MEDIUM STIFF	5 - 8
STIFF	9 - 15
VERY STIFF	16 - 30
HARD	>30

NOTE: ADDITIONAL DESIGNATIONS TO ADVANCE SAMPLER INDICATED IN BLOW COUNT COLUMN:
WOH = WEIGHT OF HAMMER
WOR = WEIGHT OF ROD(S)

SAMPLE TYPE

DESIGNATION	SYMBOL
SPLIT-SPOON	S-
SHELBY TUBE	U-
ROCK CORE	R-

WATER DESIGNATION

DESCRIPTION	SYMBOL
ENCOUNTERED DURING DRILLING	▽
UPON COMPLETION OF DRILLING	▼
24 HOURS AFTER COMPLETION	⧩

NOTE: WATER OBSERVATIONS WERE MADE AT THE TIME INDICATED. POROSITY OF SOIL STRATA, WEATHER CONDITIONS, SITE TOPOGRAPHY, ETC. MAY CAUSE WATER LEVEL CHANGES.

LOG OF TEST PIT NO. I-1-1

PROJECT: **Townsend Acres**
PROJECT LOCATION: **New Castle County, Delaware**
CLIENT: **TAC LLC**

PROJECT NO.: **241837**

DATE STARTED: **11/15/24**
DATE COMPLETED: **11/15/24**
CONTRACTOR: **Cavan Construction**
EQUIPMENT: **Case 580 Backhoe**

GROUNDWATER ENCOUNTERED: **7.3**
GROUND SURFACE ELEVATION: **64.0**
DATUM: **Google Earth**
LOGGED BY: **M.McDonough**
CHECKED BY: **C. Reith**

ELEVATION (ft.)	DEPTH (ft.)	USCS	GRAPHIC SYMBOL	DESCRIPTION	REMARKS
	0			Topsoil +/- 18 inches	
62.5		SC		Tan, moist, Clayey SAND	
	2				
	4				
	6				
				Same, wet	▼
	8				
54.0	10			Test pit terminated at 10.0 feet. Water observed at 7.5 feet upon completion. Water at 7.3 feet at the end of the day.	
	12				

NOTES: **Elevation and location should be considered approximate.**

GEO-TECHNOLOGY ASSOCIATES, INC.
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New Castle, DE 19720

LOG OF TEST PIT NO. I-1-1

LOG OF TEST PIT NO. I-1-2

PROJECT: **Townsend Acres**
PROJECT LOCATION: **New Castle County, Delaware**
CLIENT: **TAC LLC**

PROJECT NO.: **241837**

DATE STARTED: **11/15/24**
DATE COMPLETED: **11/15/24**
CONTRACTOR: **Cavan Construction**
EQUIPMENT: **Case 580 Backhoe**

GROUNDWATER ENCOUNTERED: **5.5**
GROUND SURFACE ELEVATION: **63.0**
DATUM: **Google Earth**
LOGGED BY: **M.McDonough**
CHECKED BY: **C. Reith**

ELEVATION (ft.)	DEPTH (ft.)	USCS	GRAPHIC SYMBOL	DESCRIPTION	REMARKS
	0			Topsoil +/- 18 inches	
61.5		CL		Tan and gray, moist, Sandy Lean CLAY	
	2				
59.0	4	SC		Tan, moist, Clayey SAND	
	6			Same, wet	
	8				
53.0	10			Test pit terminated at 10.0 feet. Water observed at 6.0 feet upon completion. Water at 5.5 feet at the end of the day.	
	12				

NOTES: **Elevation and location should be considered approximate.**

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LOG OF TEST PIT NO. I-1-2

LOG OF TEST PIT NO. I-1-3

PROJECT: **Townsend Acres**
PROJECT LOCATION: **New Castle County, Delaware**
CLIENT: **TAC LLC**

PROJECT NO.: **241837**

DATE STARTED: **11/15/24**
DATE COMPLETED: **11/15/24**
CONTRACTOR: **Cavan Construction**
EQUIPMENT: **Case 580 Backhoe**

GROUNDWATER ENCOUNTERED: **7.0**
GROUND SURFACE ELEVATION: **64.0**
DATUM: **Google Earth**
LOGGED BY: **M.McDonough**
CHECKED BY: **C. Reith**

ELEVATION (ft.)	DEPTH (ft.)	USCS	GRAPHIC SYMBOL	DESCRIPTION	REMARKS
	0			Topsoil +/- 18 inches	
62.5		CL		Tan and gray, moist, Sandy Lean CLAY	
	2				
	4				
59.5		SC		Tan and gray, moist, Clayey SAND	
	6			Same, wet	▼
	8				
	10				
53.0				Test pit terminated at 11.0 feet. Sidewalls caved at 5.5 feet. Water observed at 7.5 feet upon completion. Water at 7.0 feet at the end of the day.	
	12				

NOTES: **Elevation and location should be considered approximate.**

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LOG OF TEST PIT NO. I-1-3

LOG OF TEST PIT NO. I-1-4

PROJECT: **Townsend Acres**
PROJECT LOCATION: **New Castle County, Delaware**
CLIENT: **TAC LLC**

PROJECT NO.: **241837**

DATE STARTED: **11/15/24**
DATE COMPLETED: **11/15/24**
CONTRACTOR: **Cavan Construction**
EQUIPMENT: **Case 580 Backhoe**

GROUNDWATER ENCOUNTERED: **6.4**
GROUND SURFACE ELEVATION: **62.0**
DATUM: **Google Earth**
LOGGED BY: **M.McDonough**
CHECKED BY: **C. Reith**

ELEVATION (ft.)	DEPTH (ft.)	USCS	GRAPHIC SYMBOL	DESCRIPTION	REMARKS
	0			Topsoil +/- 18 inches	
60.5		CL		Tan and gray, moist, Sandy Lean CLAY	
	2				
58.0	4	SC		Tan, brown and gray, moist, Clayey SAND	
	6			Same, wet	▼
	8				
	10				
51.0				Test pit terminated at 10.0 feet. Water observed at 7.0 feet upon completion. Water at 6.4 feet at the end of the day.	
	12				

NOTES: **Elevation and location should be considered approximate.**

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LOG OF TEST PIT NO. I-1-4

LOG OF TEST PIT NO. I-2-1

PROJECT: **Townsend Acres**
PROJECT LOCATION: **New Castle County, Delaware**
CLIENT: **TAC LLC**

DATE STARTED: **11/15/24**
DATE COMPLETED: **11/15/24**
CONTRACTOR: **Cavan Construction**
EQUIPMENT: **Case 580 Backhoe**

PROJECT NO.: **241837**

GROUNDWATER ENCOUNTERED: **6.2**
GROUND SURFACE ELEVATION: **63.0**
DATUM: **Google Earth**
LOGGED BY: **M.McDonough**
CHECKED BY: **C. Reith**

ELEVATION (ft.)	DEPTH (ft.)	USCS	GRAPHIC SYMBOL	DESCRIPTION	REMARKS
	0			Topsoil +/- 20 inches	
61.3	2	CL		Tan and gray, moist, Sandy Lean CLAY	
60.0	4	SC		Tan and gray, moist, Clayey SAND	
	6				▼
	8			Same, wet	
	10				
52.0	12			Test pit terminated at 11.0 feet. Dry upon completion. Water at 6.2 feet at end of the day.	

NOTES: **Elevation and location should be considered approximate.**

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LOG OF TEST PIT NO. I-2-1

LOG OF TEST PIT NO. I-2-2

PROJECT: **Townsend Acres**
PROJECT LOCATION: **New Castle County, Delaware**
CLIENT: **TAC LLC**

PROJECT NO.: **241837**

DATE STARTED: **11/15/24**
DATE COMPLETED: **11/15/24**
CONTRACTOR: **Cavan Construction**
EQUIPMENT: **Case 580 Backhoe**

GROUNDWATER ENCOUNTERED: **6.0**
GROUND SURFACE ELEVATION: **64.0**
DATUM: **Google Earth**
LOGGED BY: **M.McDonough**
CHECKED BY: **C. Reith**

ELEVATION (ft.)	DEPTH (ft.)	USCS	GRAPHIC SYMBOL	DESCRIPTION	REMARKS
	0			Topsoil +/- 18 inches	
62.5		CL		Tan and gray, moist, Sandy Lean CLAY	
	2				
60.0	4	SC		Tan and gray, moist, Clayey SAND	
	6			Same, wet	▼
	8				
	10				
53.0				Test pit terminated at 10.0 feet. Water observed at 7.5 feet upon completion. Water at 6.0 feet at the end of the day.	
	12				

NOTES: **Elevation and location should be considered approximate.**

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LOG OF TEST PIT NO. I-2-2

LOG OF TEST PIT NO. I-2-3

PROJECT: **Townsend Acres**
PROJECT LOCATION: **New Castle County, Delaware**
CLIENT: **TAC LLC**

DATE STARTED: **11/15/24**
DATE COMPLETED: **11/15/24**
CONTRACTOR: **Cavan Construction**
EQUIPMENT: **Case 580 Backhoe**

PROJECT NO.: **241837**

GROUNDWATER ENCOUNTERED: **6.0**
GROUND SURFACE ELEVATION: **64.0**
DATUM: **Google Earth**
LOGGED BY: **M.McDonough**
CHECKED BY: **C. Reith**

ELEVATION (ft.)	DEPTH (ft.)	USCS	GRAPHIC SYMBOL	DESCRIPTION	REMARKS
	0			Topsoil +/- 20 inches	
62.3		CL		Tan and gray, moist, Sandy Lean CLAY	
	2				
	4				
58.0	6	SC		Tan, moist, Clayey SAND	
	8			Same, wet	
54.0	10			Test pit terminated at 10.0 feet. Dry upon completion. Water at 6.0 feet at the end of the day.	
	12				

NOTES: **Elevation and location should be considered approximate.**

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LOG OF TEST PIT NO. I-2-4

PROJECT: **Townsend Acres**
PROJECT LOCATION: **New Castle County, Delaware**
CLIENT: **TAC LLC**

DATE STARTED: **11/15/24**
DATE COMPLETED: **11/15/24**
CONTRACTOR: **Cavan Construction**
EQUIPMENT: **Case 580 Backhoe**

PROJECT NO.: **241837**

GROUNDWATER ENCOUNTERED: **6.0**
GROUND SURFACE ELEVATION: **64.0**
DATUM: **Google Earth**
LOGGED BY: **M.McDonough**
CHECKED BY: **C. Reith**

ELEVATION (ft.)	DEPTH (ft.)	USCS	GRAPHIC SYMBOL	DESCRIPTION	REMARKS
	0			Topsoil +/- 16 inches	
62.7		CL		Tan and gray, moist, Sandy Lean CLAY	
	2				
60.5		SC		Tan, moist, Clayey SAND	
	4				
	6				▼
				Same, wet	
	8				
54.0	10			Test pit terminated at 11.0 feet. Dry upon completion. Water at 6.0 feet at the end of the day.	
	12				

NOTES: **Elevation and location should be considered approximate.**

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LOG OF TEST PIT NO. I-2-4

LOG OF TEST PIT NO. I-2-5

PROJECT: **Townsend Acres**
PROJECT LOCATION: **New Castle County, Delaware**
CLIENT: **TAC LLC**

DATE STARTED: **11/15/24**
DATE COMPLETED: **11/15/24**
CONTRACTOR: **Cavan Construction**
EQUIPMENT: **Case 580 Backhoe**

PROJECT NO.: **241837**

GROUNDWATER ENCOUNTERED: **5.5**
GROUND SURFACE ELEVATION: **63.0**
DATUM: **Google Earth**
LOGGED BY: **M.McDonough**
CHECKED BY: **C. Reith**

ELEVATION (ft.)	DEPTH (ft.)	USCS	GRAPHIC SYMBOL	DESCRIPTION	REMARKS
	0			Topsoil +/- 16 inches	
61.7		CL		Tan and gray, moist, Sandy Lean CLAY	
	2				
59.5		SC		Tan and gray, moist, Clayey SAND	
	4				
	6			Same, wet	▼
	8				
53.0	10			Test pit terminated at 10.0 feet. Sidewalls caved at 3.0 feet. Water observed at 6.0 feet upon completion. Water at 5.5 feet at the end of the day.	
	12				

NOTES: **Elevation and location should be considered approximate.**

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LOG OF TEST PIT NO. I-2-5

LOG OF TEST PIT NO. I-3-1

PROJECT: **Townsend Acres**
PROJECT LOCATION: **New Castle County, Delaware**
CLIENT: **TAC LLC**

PROJECT NO.: **241837**

DATE STARTED: **11/15/24**
DATE COMPLETED: **11/15/24**
CONTRACTOR: **Cavan Construction**
EQUIPMENT: **Case 580 Backhoe**

GROUNDWATER ENCOUNTERED: **5.1**
GROUND SURFACE ELEVATION: **62.0**
DATUM: **Google Earth**
LOGGED BY: **M.McDonough**
CHECKED BY: **C. Reith**

ELEVATION (ft.)	DEPTH (ft.)	USCS	GRAPHIC SYMBOL	DESCRIPTION	REMARKS
	0			Topsoil +/- 14 inches	
60.8		CL		Tan and gray, moist, Sandy Lean CLAY	
	2				
	4				▼
	6				
55.0		SC		Tan and gray, wet, Clayey SAND	
	8				
52.5				Test pit terminated at 9.5 feet. Water observed at 7.0 feet upon completion. Water at 5.1 feet at the end of the day.	
	10				
	12				

NOTES: **Elevation and location should be considered approximate.**

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LOG OF TEST PIT NO. I-3-1

LOG OF TEST PIT NO. I-3-2

PROJECT: **Townsend Acres**
PROJECT LOCATION: **New Castle County, Delaware**
CLIENT: **TAC LLC**

DATE STARTED: **11/15/24**
DATE COMPLETED: **11/15/24**
CONTRACTOR: **Cavan Construction**
EQUIPMENT: **Case 580 Backhoe**

PROJECT NO.: **241837**

GROUNDWATER ENCOUNTERED: **9.1**
GROUND SURFACE ELEVATION: **62.0**
DATUM: **Google Earth**
LOGGED BY: **M.McDonough**
CHECKED BY: **C. Reith**

ELEVATION (ft.)	DEPTH (ft.)	USCS	GRAPHIC SYMBOL	DESCRIPTION	REMARKS
	0			Topsoil +/- 12 inches	
61.0		SC		Tan, moist, Clayey SAND	
	2				
	4				
	6				
	8			Tan, wet, Clayey SAND	▼
52.0	10			Test pit terminated at 11.0 feet. Sidewalls caved at 8.0 feet. Dry upon completion. Water at 9.1 feet at end of the day.	
	12				

NOTES: **Elevation and location should be considered approximate.**

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New Castle, DE 19720

LOG OF TEST PIT NO. I-3-2

LOG OF TEST PIT NO. I-3-3

PROJECT: **Townsend Acres**
PROJECT LOCATION: **New Castle County, Delaware**
CLIENT: **TAC LLC**

DATE STARTED: **11/15/24**
DATE COMPLETED: **11/15/24**
CONTRACTOR: **Cavan Construction**
EQUIPMENT: **Case 580 Backhoe**

PROJECT NO.: **241837**

GROUNDWATER ENCOUNTERED: **7.2**
GROUND SURFACE ELEVATION: **62.0**
DATUM: **Google Earth**
LOGGED BY: **M.McDonough**
CHECKED BY: **C. Reith**

ELEVATION (ft.)	DEPTH (ft.)	USCS	GRAPHIC SYMBOL	DESCRIPTION	REMARKS
	0			Topsoil +/- 14 inches	
60.8		SC		Tan, moist, Clayey SAND	
	2				
	4				
	6				
	8			Same, wet	
	10				
51.0				Test pit terminated at 11.0 feet. Dry upon completion. Water at 7.2 feet at end of the day.	
	12				

NOTES: **Elevation and location should be considered approximate.**

GEO-TECHNOLOGY ASSOCIATES, INC.
18 Boulden Circle, Suite 36
New Castle, DE 19720

LOG OF TEST PIT NO. I-3-3

APPENDIX C

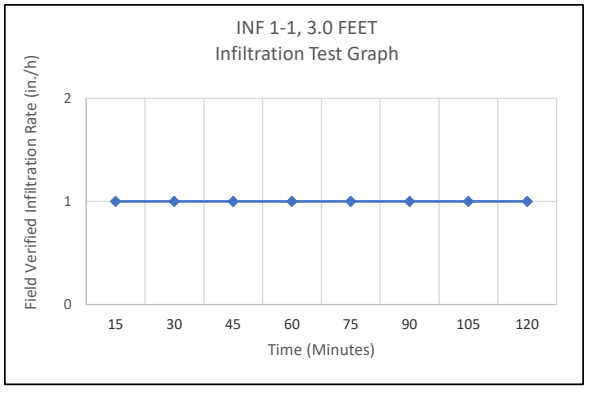
DNREC Delaware Post Construction Stormwater
BMP Standards and Specifications February 2019
Appendix 1: Soil Investigation Procedures for Stormwater Best Management Practices
Single Infiltration Test Results (Design)

Job Name: Townsend Acres | Date: 11/15/2024 | Employee Name: IT & MM
Job No.: 241837 | Weather: Sunny/56 F | Site Location: New Castle County, Delaware

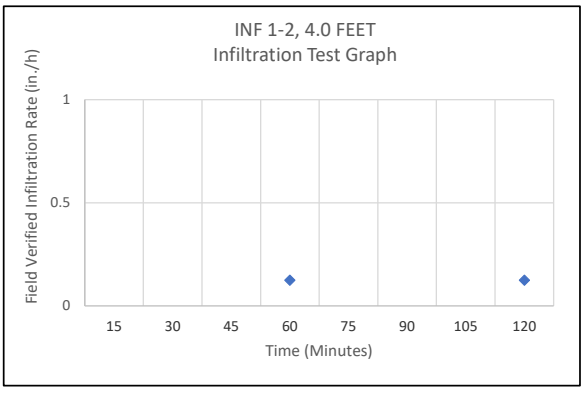
Location		INF 1-1		
Test Depth/Elevation		3.0 FT/EL 58.0		
Time	Start/End	Depth to water (inches)	Drop (inches)	Rate (inches per hour)
9:23	S	0	--	--
9:38	E	1/4	1/4	1.0
9:38	S	1/4	--	--
9:53	E	1/2	1/4	1.0
9:53	S	1/2	--	--
10:08	E	3/4	1/4	1.0
10:08	S	3/4	--	--
10:23	E	1	1/4	1.0
10:23	S	0	--	--
10:38	E	1/4	1/4	1.0
10:38	S	1/4	--	--
10:53	E	1/2	1/4	1.0
10:53	S	1/2	--	--
11:08	E	3/4	1/4	1.0
11:08	S	3/4	--	--
11:23	E	1	1/4	1.0

Location		INF 1-2		
Test Depth/Elevation		4.0 FT/EL 58		
Time	Start/End	Depth to water (inches)	Drop (inches)	Rate (inches per hour)
9:25	S	0	--	--
9:40	E	0	0	0.0
9:40	S	0	--	--
9:55	E	0	0	0.0
9:55	S	0	--	--
10:10	E	0	0	0.0
10:10	S	0	--	--
10:25	E	1/8	1/8	1/8
10:25	S	0	--	--
10:40	E	0	0	0.0
10:40	S	0	--	--
10:55	E	0	0	0.0
10:55	S	0	--	--
11:10	E	0	0	0.0
11:10	S	0	--	--
11:25	E	1/8	1/8	1/8

CLAYEY SAND (SC)



SANDY LEAN CLAY (CL)



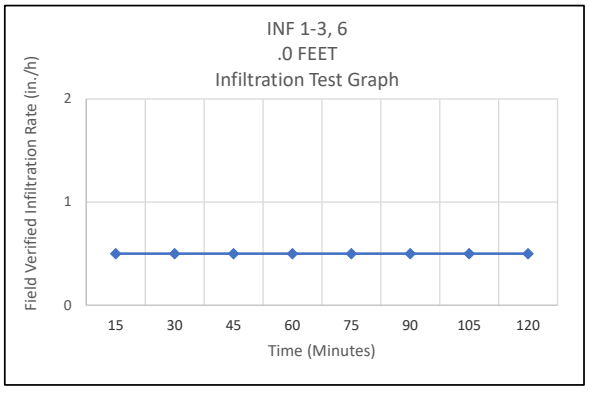
DNREC Delaware Post Construction Stormwater
BMP Standards and Specifications February 2019
Appendix 1: Soil Investigation Procedures for Stormwater Best Management Practices
Single Infiltration Test Results (Design)

Job Name: Townsend Acres | Date: 11/15/2024 | Employee Name: IT & MM
Job No.: 241837 | Weather: Sunny/56 F | Site Location: New Castle County, Delaware

Location		INF 1-3		
Test Depth/Elevation		6.0/EL 58.0		
Time	Start/End	Depth to water (inches)	Drop (inches)	Rate (inches per hour)
9:20	S	0	--	--
9:35	E	1/8	1/8	0.5
9:35	S	1/8	--	--
9:50	E	1/4	1/8	0.5
9:50	S	1/4	--	--
10:05	E	3/8	1/8	0.5
10:05	S	3/8	--	--
10:20	E	1/2	1/8	0.5
10:20	S	0	--	--
10:35	E	1/8	1/8	0.5
10:35	S	1/8	--	--
10:50	E	1/4	1/8	0.5
10:50	S	1/4	--	--
11:05	E	3/8	1/8	0.5
11:05	S	3/8	--	--
11:20	E	1/2	1/8	0.5

Location				
Test Depth/Elevation				
Time	Start/End	Depth to water (inches)	Drop (inches)	Rate (inches per hour)

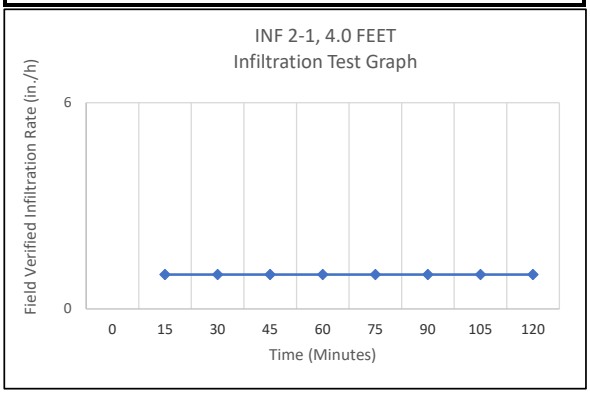
CLAYEY SAND (SC)



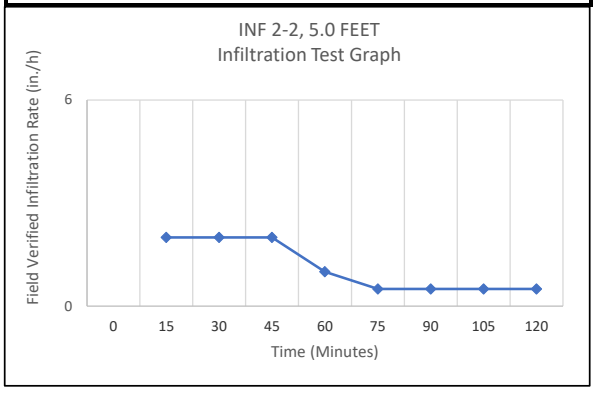
DNREC Delaware Post Construction Stormwater
BMP Standards and Specifications February 2019
Appendix 1: Soil Investigation Procedures for Stormwater Best Management Practices
Single Infiltration Test Results (Design)

Job Name: Townsend Acres | Date: 11/15/2024 | Employee Name: IT & MM
Job No.: 241837 | Weather: Sunny/56 F | Site Location: New Castle County, Delaware

Location		INF 2-1		
Test Depth/Elevation		4.0/EL 59.0		
Time	Start/End	Depth to water (inches)	Drop (inches)	Rate (inches per hour)
8:40	S	0	--	--
8:55	E	1/4	1/4	1.0
8:55	S	1/4	--	--
9:10	E	1/2	1/4	1.0
9:10	S	1/2	--	--
9:25	E	3/4	1/4	1.0
9:25	S	3/4	--	--
9:40	E	1	1/4	1.0
9:40	S	0	--	--
9:55	E	1/4	1/4	1.0
9:55	S	1/4	--	--
10:10	E	1/2	1/4	1.0
10:10	S	1/2	--	--
10:25	E	3/4	1/4	1.0
10:25	S	3/4	--	--
10:40	E	1	1/4	1.0
CLAYEY SAND				



Location		INF 2-2		
Test Depth/Elevation		5.0/EL 59.0		
Time	Start/End	Depth to water (inches)	Drop (inches)	Rate (inches per hour)
8:45	S	0	--	--
9:00	E	1/2	1/2	2.0
9:00	S	1/2	--	--
9:15	E	1	1/2	2.0
9:15	S	1	--	--
9:30	E	1 1/2	1/2	2.0
9:30	S	1 1/2	--	--
9:45	E	1 3/4	1/4	1.0
9:45	S	0	--	--
10:00	E	1/8	1/8	0.5
10:00	S	1/8	--	--
10:15	E	1/4	1/8	0.5
10:15	S	1/4	--	--
10:30	E	3/8	1/8	0.5
10:30	S	3/8	--	--
10:45	E	1/2	1/8	0.5
CLAYEY SAND				



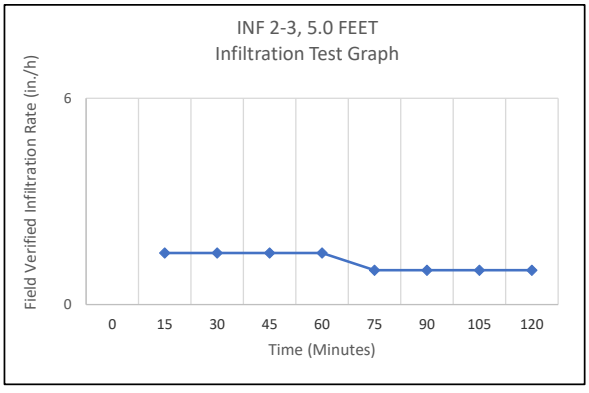
DNREC Delaware Post Construction Stormwater
BMP Standards and Specifications February 2019
Appendix 1: Soil Investigation Procedures for Stormwater Best Management Practices
Single Infiltration Test Results (Design)

Job Name: Townsend Acres | Date: 11/15/2024 | Employee Name: IT & MM
Job No.: 241837 | Weather: Sunny/56 F | Site Location: New Castle County, Delaware

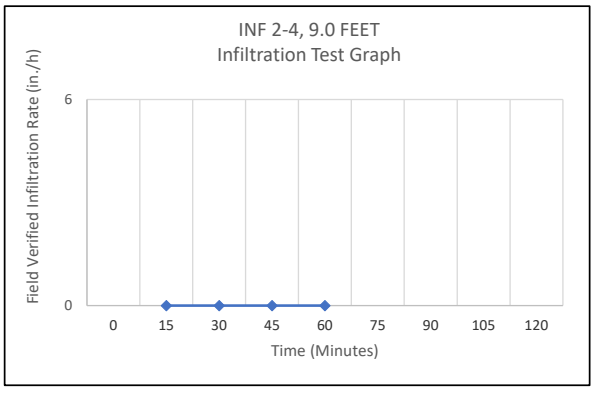
Location		INF 2-3		
Test Depth/Elevation		5.0 FT/EL 59.0		
Time	Start/End	Depth to water (inches)	Drop (inches)	Rate (inches per hour)
8:50	S	0	--	--
9:05	E	3/8	3/8	1.5
9:05	S	3/8	--	--
9:20	E	3/4	3/8	1.5
9:20	S	3/4	--	--
9:35	E	1 1/8	3/8	1.5
9:35	S	1 1/8	--	--
9:50	E	1 1/2	3/8	1.5
9:50	S	0	--	--
10:05	E	1/4	1/4	1.0
10:05	S	1/4	--	--
10:20	E	1/2	1/4	1.0
10:20	S	1/2	--	--
10:35	E	3/4	1/4	1.0
10:35	S	3/4	--	--
10:50	E	1	1/4	1.0

Location		INF 2-4		
Test Depth/Elevation		5.0 FT/EL 59.0		
Time	Start/End	Depth to water (inches)	Drop (inches)	Rate (inches per hour)
8:53	S	0	--	--
9:08	E	0	0	0.0
9:08	S	0	--	--
9:23	E	0	0	0.0
9:23	S	0	--	--
9:38	E	0	0	0.0
9:38	S	0	--	--
9:53	E	0	0	0.0

CLAYEY SAND (SC)



SANDY LEAN CLAY (CL)



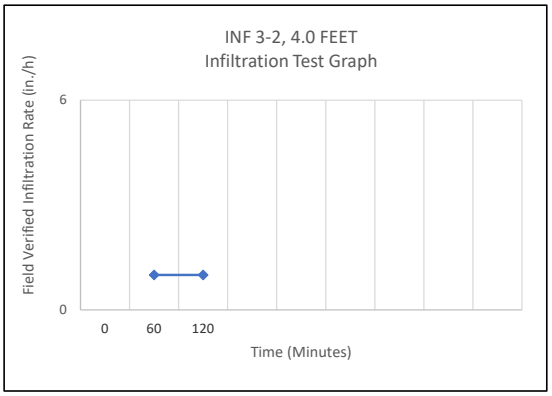
DNREC Delaware Post Construction Stormwater
BMP Standards and Specifications February 2019
Appendix 1: Soil Investigation Procedures for Stormwater Best Management Practices
Single Ring Infiltration Test Results (Design)

Job Name: Townsend Acres Date: 11/15/2024 Employee Name: IT & MM
Job No.: 241837 Weather: Sunny/56 F Site Location: New Castle County, Delaware

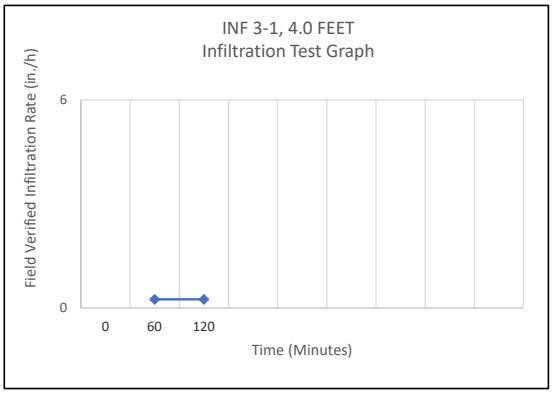
Location		INF 3-2		
Test Depth/Elevation		4.0 FT/ EL 49.0		
Time	Start/End	Depth to water (inches)	Drop (inches)	Rate (inches per hour)
8:00	S	0	--	--
8:15	E	1/4	1/4	1.0
8:15	S	1/4	--	--
8:30	E	1/2	1/4	1.0
8:30	S	1/2	--	--
8:45	E	3/4	1/4	1.0
8:45	S	3/4	--	--
9:00	E	1	1/4	1.0
9:00	S	0	--	--
9:15	E	1/4	1/4	1.0
9:15	S	1/4	--	--
9:30	E	1/2	1/4	1.0
9:30	S	1/2	--	--
9:45	E	3/4	1/4	1.0
9:45	S	3/4	--	--
10:00	E	1	1/4	1.0

Location		INF 3-1		
Test Depth/Elevation		4.0 FT/ EL 49.0		
Time	Start/End	Depth to water (inches)	Drop (inches)	Rate (inches per hour)
8:03	S	0	--	--
8:18	E	0	0	0.0
8:18	S	0	--	--
8:33	E	1/8	1/8	1/4
8:33	S	1/8	--	--
8:48	E	1/8	0	0.0
8:48	S	1/8	--	--
9:03	E	1/4	1/8	1/4
9:03	S	0	--	--
9:18	E	0	0	0.0
9:18	S	0	--	--
9:33	E	1/8	1/8	1/4
9:33	S	1/8	--	--
9:48	E	1/8	0	0.0
9:48	S	1/8	--	--
10:03	E	1/4	1/8	1/4

CLAYEY SAND



SANDY LEAN CLAY (CL)



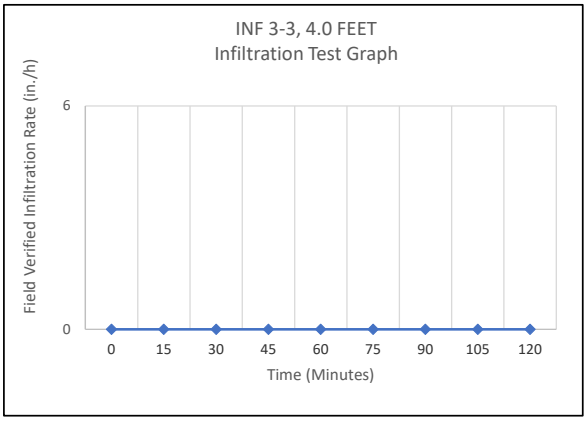
DNREC Delaware Post Construction Stormwater
BMP Standards and Specifications February 2019
Appendix 1: Soil Investigation Procedures for Stormwater Best Management Practices
Single Ring Infiltration Test Results (Design)

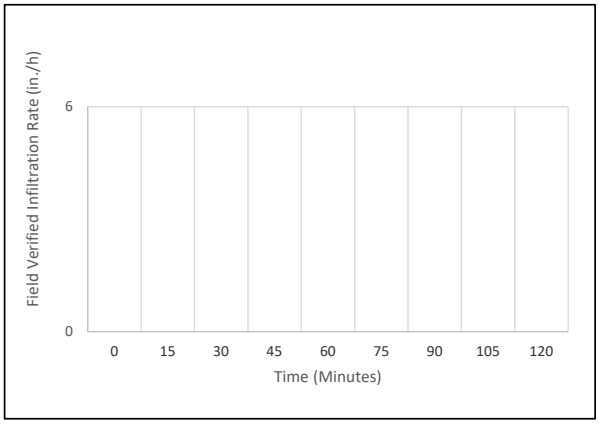
Job Name: Townsend Acres | Date: 11/15/2024 | Employee Name: IT & MM
Job No.: 241837 | Weather: Sunny/56 F | Site Location: New Castle County, Delaware

Location		INF 3-3		
Test Depth/Elevation		4.0 FT/ EL 59.0		
Time	Start/End	Depth to water (inches)	Drop (inches)	Rate (inches per hour)
8:05	S	0	--	--
8:20	E	0	0	0.0
8:20	S	0	--	--
8:35	E	0	0	0.0
8:35	S	0	--	--
8:50	E	0	0	0.0
8:50	S	0	--	--
9:05	E	0	0	0.0

Location				
Test Depth/Elevation				
Time	Start/End	Depth to water (inches)	Drop (inches)	Rate (inches per hour)

SILT





DNREC Division of Watershed Stewardship
285 Beiser Boulevard, Suite 102
Dover, DE 19904
(302) 739-9921

Soil Investigation Report Submittal Checklist

DATE RECEIVED: _____ **PROJECT NUMBER:** _____

PROJECT NAME: Townsend Acres

The items contained on this checklist are necessary to properly evaluate and determine the completeness of any Soil Investigation Report submitted under subsection 12.1 of the Delaware Sediment and Stormwater Regulations. Complete all items. It is understood not all items will be applicable to all projects and as such marking an item "N/A" is acceptable.

I. X **General Soil Investigation Reports.** The following information, as applicable, should be submitted for all projects.

1) X The signature, seal and date of a professional engineer or professional geologist experienced in soils licensed in the State of Delaware.

2) X General description of the project, project elements, and project background.

3) X Project site surface conditions and current use.

4) X Regional and site geology. An initial screening of readily available data to determine feasibility of infiltration practices, if applicable, including:

a) X Site topography

b) X Soil characteristics as defined in the USDA NRCS Web Soil Survey

c) X Depth to groundwater and seasonal high water table

d) X Historical groundwater level data from the nearest Delaware Geological Survey (DGS) monitoring well or wells

5) X Minimum number of borings or test pits conducted in accordance with the following:

a) X Surface area BMPs:

i) X Two (2) borings or pits for the first 8,000 square feet

ii) ___ Three (3) borings or pits for up to 16,000 square feet

iii) X Four (4) borings or pits for up to 25,000 square feet

iv) ☐ One (1) additional boring or pit for each additional 25,000 square feet beyond the first 25,000 square feet

v) X Boring or pit locations distributed within the facility and sufficient to determine soil variability

b) ____ Linear BMPS:

i) ____ Two (2) borings or pits up to 500 linear feet, and

ii) ___ One (1) additional boring or pit per additional 500 linear feet of trench

iii) ____ Boring or pit locations distributed and sufficient to determine soil variability

Soil Investigation Report Submittal Checklist

6) X Borings or test pits advanced to the depth of the limiting layer or a minimum of three (3) feet below bottom of the proposed facility, whichever is encountered first.

7) X Borehole or test pit logs including the following information:

a) X Project name

b) X Name of individual collecting the field data

c) X Date field data was collected

d) X Type of boring or test pit excavation method and equipment used

e) X Air temperature and precipitation, including significant precipitation prior to investigation

f) X Elevation of ground at boring location based on site benchmark

g) X Visual description of soil profile layers, and depths below grade encountered

h) X Sample numbers

i) X Depths to any indications of instability such as cave in, sloughing, flowing sands, or obstructions

j) ____ Blow counts if Standard Penetration Test (SPT) borings are performed

k) X Depth of seasonal high water table indicators such as mottling

l) X Depth of encountered free water during and after excavation

m) ____ Depth to bedrock if encountered

n) X General observations

o) X Testing standards

8) X Depth and type of field testing performed. A summary of the laboratory testing conducted, if applicable.

9) X Project soil and rock conditions including a description of the soil and rock units encountered, and how the units tie into the site geology.

10) X Description of groundwater conditions, including the identification of any of the following:

a) ____ Confined aquifers

b) X Artesian pressures

c) X Perched water tables

d) ____ Potential seasonal variations, if known

e) X Any influences on the ground water levels observed

f) ____ Direction and gradient of groundwater, if known

11) ____ Discussion of rock structure, if applicable, including but not limited to:

a) ____ The results of any field structure mapping using photographs as needed,

b) ____ Joint condition

c) ____ Rock strength

d) ____ Potential for seepage.

12)____ Summary of geological hazards identified and their impact on the project design, if any. Description of the location and extent of the geological hazard.

13)____ For analysis of unstable slopes including existing settlement areas, cuts, and fills, include background regarding the analysis approach, assessment of failure mechanisms, and determination of design parameters. Include a description of any back-analyses conducted, the results of those analyses, comparison of those results to any laboratory test data obtained, and the conclusions made regarding the parameters to be used for final design.

14) X Geotechnical recommendations for structural earthwork including:

a) X Embankment design recommendations, as applicable, including but not limited to the following:

i)____ Slope required for stability

ii) ___ Need and extent of removal of any unsuitable materials beneath the proposed fills

iii)____ Any other measures that need to be taken to provide a stable embankment

iv) ☐ Embankment settlement magnitude and rate

b) X Cut design recommendations, as applicable, including but not limited to the following:

i)____ Slope required for stability

ii) ___ Seepage and piping control

iii)____ Erosion control measures

iv) ☐ Any special measures required to provide a stable slope

c) X Determination of adequacy of excavated material for use as structural fill or spoil

d) ____ Data for structural designs of BMP outlet works

15)____ Long-term or construction monitoring needs, if applicable.

a) ____ Recommendation for types of instrumentation needed to evaluate long-term performance or to control construction

b) ____ Specify the reading schedule required

c) ____ Specify how the data should be used to control construction or to evaluate long-term performance

d) ____ Specify the zone of influence for each instrument.

16)____ Address issues of construction staging, shoring needs and potential installation difficulties, temporary slopes, potential foundation installation problems, earthwork constructability issues, and dewatering, as applicable.

17)____ Appendices to support geotechnical recommendations.

Soil Investigation Report Submittal Checklist

II. X **Infiltration Test Reports.** The following information, as applicable, should be submitted for all stormwater management BMPs that rely upon infiltration.

18) X Description of approved infiltration testing method.

a) X Field Permeability Testing conducted in accordance with ASTM-D5126 "Comparison of Field Methods for Determining Hydraulic Conductivity in the Vadose Zone".

b) X Single Ring or Double Ring Infiltrometer test method

c) ____ Cased Borehole Permeameter test method

i)____ Department or Delegated Agency approval granted prior to conducting the test

ii) ☐ Minimum four (4) inch diameter casing used

d) X Any deviation from infiltration testing procedures approved by the Department or Delegated Agency noted in the report.

19) X Summary table of location of test, depth of test, elevation of test if available and field verified infiltration rate.

20) X The minimum number of field measured infiltration tests are based on the proposed facility's dimensions as follows:

a) ____ For an infiltration trench with less than 10,000 square feet of impervious drainage area:

i)____ One (1) test up to 500 linear feet, and

ii) ___ One (1) additional test per 250 linear feet of trench, and

iii)____ Sufficient to determine variability.

b) ____ For an infiltration trench with greater than 10,000 square feet of impervious drainage area:

i)____ One (1) test up to 250 linear feet, and

ii) ☐ One (1) additional test per 250 linear feet of trench, and

iii)____ Sufficient to determine variability.

c) ____ For an infiltration trench used with roadway perforated pipe layouts:

i)____ One (1) test up to 500 linear feet, and

ii) ☐ One (1) additional test per 500 linear feet of trench, and

iii)____ Sufficient to determine variability.

d) X For an infiltrating bioretention system:

i) X One (1) test for the first 8,000 square feet

ii) ☑ Two (2) tests for up to 16,000 square feet

iii) X Three (3) tests for up to 25,000 square feet

iv) ☑ One (1) additional test for each additional 25,000 square feet beyond the first 25,000 square feet

v) X Test locations distributed within the facility and sufficient to determine variability.

e) X For a surface infiltration basin:

i) X One (1) test for the first 8,000 square feet

ii) ☑ Two (2) tests for up to 16,000 square feet

iii) X Three (3) tests for up to 25,000 square feet

iv) ☑ One (1) additional test for each additional 25,000 square feet beyond the first 25,000 square feet.

v) X Test locations distributed within the facility and sufficient to determine variability.

f) ____ For a subsurface infiltrating practice:

i) ____ One (1) test per infiltration area

ii) ☐ One (1) additional test for every 8,000 square feet of infiltration area

iii) ____ Test locations distributed within the facility and Sufficient to determine variability

21) X Infiltration test log, including:

a) X Name and license number of individual performing test. Individuals in responsible charge of infiltration testing possesses a Class D On-Site License issued by DNREC Division of Water Groundwater Discharges Section or be licensed in the State of Delaware as a Professional Engineer or Professional Geologist.

b) X Date test was performed

c) X Type of test method

d) X Air temperature and precipitation

e) X Depth of test below ground surface and elevation. Separation to a limiting layer such as bedrock or groundwater of at least two (2) feet maintained.

f) X Diameters of boring and casing

g) X Depth of casing penetration

h) X Time and depth from reference point for each time increment.

i) X A saturation period of one hour or a drop of 12 inches or 30.5 centimeters achieved. Saturation period not used in determining field verified infiltration rate.

ii) X After the saturation period, a minimum of two (2) test periods completed or until at least two (2) consecutive test periods are consistent and achieve a stabilized infiltration rate. Each test period has a maximum reading interval of 15 minutes and meets one (1) of the following criteria:

(1) X A minimum of one hour as determined by the sum of the interval times

(2) X A drop of at least 12 inches in 15 minutes or less for a minimum of 30 minutes as determined by the sum of the interval times

iii)X Stabilized infiltration rate met as defined as one of the following:

(1)____ A difference of 0.25 inches or less of drop between the highest and lowest reading of four (4) consecutive readings for infiltration rates greater than two (2.0) inches per hour

(2)X A difference of 0.125 inches or less of drop between the highest and lowest reading of four (4) consecutive readings for infiltration rates equal to or less than two (2.0) inches per hour.

iv)____ When using the constant head test method, water level inside the casing maintained at a constant level or refilled to the starting level after each reading throughout the test period at no more than 15 minute intervals.

v)____ When using the falling head test method each test period starts with the same initial head.

22)X Infiltration rate graph for each test charting the field verified infiltration rate versus elapsed time of test. Append to each graph a table of the testing results. The field verified infiltration rate is the final steady state reading of the test performed.

23)X Geotechnical recommendations for each stormwater management facility, including the following:

a) X Recommended design infiltration rate based on the following:

i)X Apply a minimum factor of safety of 2.0 to field results from Single Ring or Double Ring Infiltrometer testing

ii)____ Apply a minimum factor of safety of 2.5 to field results from Cased Borehole Permeameter testing.

iii)X Provide an elevation range over which the recommended design rates are applicable.

iv)____ The maximum design infiltration rate is less than or equal to 15 inches per hour.

b) ____ Impact of infiltration on adjacent facilities

c) ____ Effect of infiltration on slope stability

d) ____ If the facility is located on a slope, stability of slopes within the facility

e) ____ Foundation bearing resistance

f) ____ If steady state conditions for a given test are not achieved, provide an explanation as to why steady state could not be achieved and the professional's opinion regarding the use of the results for design purposes. If steady state is not achieved for a given test and a reasonable professional opinion is not provided, the Department or Delegated Agency may require additional testing.

Soil Investigation Report Submittal Checklist

III._____ **Geotechnical Reports for Embankments.** The following information, as applicable, should be submitted for all stormwater management BMPs containing an embankment.

24)____ The signature, seal and date of a professional engineer licensed in the State of Delaware.

25)____ Subsurface Exploration

a) ____ Explorations every 200 feet on center along the length of the embankment.

b) ____ Unless bedrock is encountered at a shallower depth, explorations at a depth twice the proposed height from bottom of pond to top of embankment.

c) ____ If bedrock is encountered, a minimum five (5) foot rock core performed. If organic, plastic, or soils with an actual or estimated N-value less than four (4) are encountered, extended exploration to a depth of four (4) times the proposed embankment height.

d) ____ If there is a potential for a significant groundwater gradient beneath an embankment or surface water levels are significantly higher on one side of the embankment than the other, the effect of reduced soil strength caused by water seepage has been evaluated.

e) ____ Seepage effects considered when an embankment is placed on or near the top of a slope that has known or potential seepage through it.

26)____ Summary of design analyses, which provide the project description and basis of the design recommendations.

27)____ Summary of stability analyses, which provide the results of the stability analyses performed for the given embankment dimensions.

28)____ Summary of settlement analyses, including design assumptions and settlement results for above-grade embankments.

29)____ Design recommendations for embankment construction identifying the following actions:

a) ____ Construction procedures for placement of material in embankment widening areas

b) ____ Embankment cut-off and core trench materials for above-grade embankments

c) ____ Special notes for excavation of unsuitable material, with specific backfill requirements

d) ____ Specific measures required prior to placing embankment material

e) ____ Installation of appropriate erosion control and vegetative cover

Map Scale: 1:2,660 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 35 70 140 210

Feet
0 100 200 400 600

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

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

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

Special Point Features

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

Water Features

- Streams and Canals

Transportation

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

Background

- Aerial Photography

MAP INFORMATION

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

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

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

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

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

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

Soil Survey Area: New Castle County, Delaware
Survey Area Data: Version 19, Aug 31, 2024

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

Date(s) aerial images were photographed: Jun 5, 2022—Jul 4, 2022

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
FgcA	Fallsington loams, 0 to 2 percent slopes, Mid-Altlantic Coastal Plain	1.1	7.3%
ImB	Ingleside-Hammonton-Fallsington complex, 0 to 5 percent slopes	3.3	23.3%
ReB	Reybold silt loam, 2 to 5 percent slopes	6.4	44.5%
SacB	Sassafras sandy loam, 2 to 5 percent slopes, Mid-Atlantic Coastal Plain	0.8	5.3%
WocA	Woodstown loam, 0 to 2 percent slopes, Mid-Atlantic Coastal Plain	2.8	19.7%
Totals for Area of Interest		**14.4**	**100.0%**