TOWN OF HARWICH
NOTICE OF PUBLIC HEARING
July 11, 2022

Pursuant to M.G.L. c. 83, §10 and Chapter 295 of the Code of the Town of Harwich, the Board of Selectmen, acting as the Town of Harwich Stormwater Authority, will hold a Public Hearing on Monday, July 11, 2022 no earlier than 6:00 P.M. in the Griffin Room at the Harwich Town Hall, 732 Main Street, Harwich MA 02645 .

O'Loughlin Family Realty Trust, Judith A. Lonergan, Tr., as owner seeks a Local Stormwater Permit Application filed pursuant to the Town of Harwich Comprehensive Stormwater and Illicit Discharge Regulations for a proposed six (6) lot definitive subdivision plan. The property is located at 16 Squantum Path (98 N Westgate Road); Assessors Map 78 Parcel G10.

All abutters and others interested persons are invited to attend. For further information, Please call the Administration Office at 508-430-7513.

Board of Selectmen

Cape Cod Chronicle
June 30, 2022

Town of Harwich
Comprehensive Stormwater and Illicit Discharge Regulations
Local Stormwater Permit Application

A. General Information

1. Project Location:

16 Squantum Path(98 N Westgate Rd) | Map 78 Parcel G-10 | Book 31417 Page 277

Street Address | Assessors Map and Parcel(s) | Deed Reference

2. Applicant:

Jay — a. First Name
Thrasher — b. Last Name
Robial Water LTD — c. Organization
85 Courtland Street Providence, RI 02904 — d. Legal Mailing Address
508-954-0677 — h. Phone Number
i. Fax Number
jay@robialwater.com — j. Email Address

3. Property owner (required if different from applicant): ☐ Check if more than one owner

Judith — a. First Name
Lonergan — b. Last Name
O'loughlin Family Realty Trust — c. Organization
P.O Box 2020 East Dennis, MA 02641 — d. Legal Mailing Address
h. Phone Number
i. Fax Number
j. Email address

4. Representative (if any):

a. First Name
b. Last Name
c. Company
d. Legal Mailing Address
h. Phone Number
i. Fax Number
j. Email address

5. Total Fee Paid:

a. Total Fee Paid (per the Local Stormwater Permit fee schedule)

6. General Project Description (include the land disturbance, existing and proposed impervious areas):

Town of Harwich
Comprehensive Stormwater and Illicit Discharge Regulations
Local Stormwater Permit Application

B. Signatures and Notifications

I hereby certify under the penalties of perjury that the foregoing Stormwater Management Permit Application and accompanying plans, documents, and supporting data are true and complete to the best of my knowledge. I understand that the Stormwater Authority will place notification of this application in a local newspaper and notify abutters in accordance with the Town of Harwich Comprehensive Stormwater and Illicit Discharge Regulations.

Signature of Applicant

Signature of Property Owner (if different)

Signature of Representative (if any)

Date_____

Town of Harwich
Comprehensive Stormwater and Illicit Discharge Regulations
Local Stormwater Permit

Application Fee Schedule

Area of Land Disturbance	Permit Application Fee
≥ 1 acre and < 2 acres	$300.00
≥ 2 acres and < 3 acres	$600.00
≥ 3 acres and < 4 acres	$900.00
≥ 4 acres	TBD*

* Fee amount to be determined based on Engineering Peer Review Fee.

TOWN OF HARWICH PLANNING BOARD
ENGINEERING REVIEW OF DEFINITIVE SUBDIVISION PLAN
FOR CONFORMANCE WITH THE
TOWN OF HARWICH SUBDIVISION RULES AND REGULATION

Plan Title:	Plan and Profile, 16 Squantum Path, Map 78, Parcel G10		
Location:	16 Squantum Path, Harwich MA		
Applicant:	O'Loughlin Family Realty Trust, P.O. Box 2020, East Dennis, MA 02641		
Applicant's Engineer:	Stephen A. Haas, PE., 293 Cranview Road, Brewster, MA, 02631		
Plan Date:	February 7, 2022	**Review Date:**	March 10, 2022
VHB No.:	15657.01		

The plans were reviewed for conformance to the Town of Harwich Rules and Regulations Governing the Subdivision of Land (adopted 11/12/2008). The Applicant has submitted the following information for review:

- List of requested waivers from Subdivision Rules and Regulations dated 2/9/2022;
- Stamped plan entitled "Miskell Woods Definitive Subdivision Plan of Land in Harwich, MA., #15 Bells Neck Road, Prepared for J. O'Loughlin, Inc., Scale 1"=40', Revised Date 1/10/2022, by Terry A. Warner, P.L.S., 22 Long Road, Harwich, MA 02645 ("Definitive Plan");
- Plan sheet entitled "Drainage Areas, 16 Squantum Path, Map 78, Parcel G10, Harwich, MA," prepared for O'Loughlin Family RE TR, Scale 1"=40', Date December 1, 2021, by Stephen A. Haas, P.E., Brewster, MA;
- Plan sheet entitled "Plan and Profile, 16 Squantum Path, Map 78, Parcel G10, Harwich, MA," prepared for O'Loughlin Family RE TR, Scale: As Noted, Date February 7, 2022, by Stephen A. Haas, P.E., Brewster, MA;
- Drainage calculations dated 3/24/2021, prepared and stamped by Stephen A. Haas, P.E.

The following comments note non-conformance with specific sections of the Rules and Regulations and questions/comments on the proposed design and VHB's recommendations/ suggestions.

Rules and Regulations Governing the Subdivision of Land

1. Section 400-10.B.3-Appendix 4B, line 48: The drainage easement located on lot 6 does not provide a distance measured along the frontage of Miskell Drive between the boundary line of the easement and the adjacent bound to be set for Lot 6. The Applicant should add this information as required.
2. Section 400-12.A.4: The typical cross section shall be updated to show the water main on the opposite side of the road to correspond with the plan location. Please remove or adjust references to gas and cable utilities.

General Comments/Standard Engineering Practice

3. We suggest the geometry points in of the roadway (appears to be one angle point near Sta. 1+90) and the cul-de-sac are added to the plan for contractor use. Tie all PC/PRC/PCC/PT points to the construction baseline.

Reviewed by:	Stefen Nguyen Civil Engineer – Highway and Municipal	**Date:**	3/10/22
Checked by:	Stephen Rhoads, P. E. Project Manager – Highway and Municipal	**Date:**	3/15/22

STORMWATER & EROSION CONTROL REPORT

June 6th, 2022

Project Site:

Miskell Woods

16 Squantum Path

(98 North Westgate Road)

Harwich, MA 02493

Prepared for:

O'Loughlin Family Realty Trust
16 Squantum Path
Harwich, MA 02493

Prepared by:

Robial Water Ltd.
85 Courtland Street
Providence, RI 02909

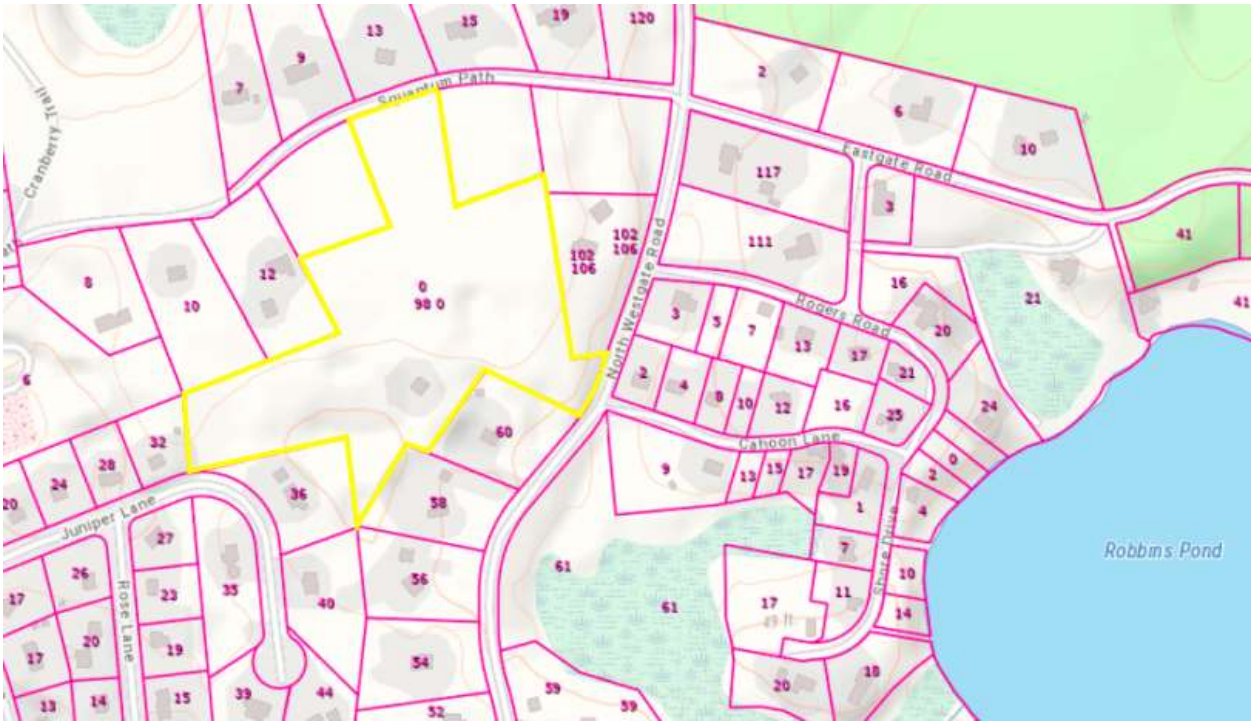
ROBIAL WATER LTD
ENGINEERING SERVICES

Contents

Project Summary

This Stormwater and Erosion Control Report discusses the stormwater management system for the residential subdivision at 16 Squantum Path in Harwich, Massachusetts. The lot (Map # 78, Parcel # G10) currently is owned by O'Loughlin Family Realty Trust.

Figure 1.1 – Locus map of the Miskell Woods residential development project site.



Existing Conditions

The existing site is approximately 325,515 SF (7.47 acres) and is accessed via a private gravel path off of Squantum path. An additional 1,343 SF slope easement was analyzed as part of the storm water runoff analysis for a total of 326,858 SF. A small structure and concrete foundation exists near the center of the site (proposed Lot #1) that will be razed as part of the development plan. A small shed exists on the western section of the property surrounded by a wire fence (proposed Lot #4). There is an existing 811 sf dwelling on the project site (proposed Lot #2).

In general, the existing topography on the site runs downhill from the northwest property line adjacent to Squantum Path to the southeast property line adjacent to Westgate Road. The average slope of the property is roughly 15%, with sections of slope as high as 40%. The entire site to be analyzed with the exception of the gravel road and existing dwelling is moderately wooded. A single design point at Westgate Road was analyzed for the run-off from the project site.

Proposed Conditions

The proposed development project establishes a 28,750 SF right of way proposed adjacent to and perpendicular to North Westgate Road with a road (way) and cul-de-sac in the center of the property providing access to all of the proposed subdivision lots (6 total) with the exception of Lot #3, which will have frontage along Squantum Path.

Stormwater Design/ Analysis

The stormwater management design for the development of the Miskell Woods project site includes Best Management Practices that address the existing versus the proposed site conditions including runoff volumes and peak flows, TSS removal and recharge to groundwater. A HydroCAD analysis was performed on the existing and proposed conditions for the entire site using the standard SCS TR-20 method.

The following Type III 24-hour design storms were analyzed in accordance with the MA DEP stormwater guidance and NOAA Storm frequency data:

- 1” storm
- 2-year storm: 3.2”
- 5-year storm: 4.63”
- 25-year storm: 5.52”
- 100-year storm: 6.90”

All infiltration systems were designed to completely store and infiltrate the 25-year frequency storm.

Soil data was acquired from the NRCS web soil survey and is consistent with soil logs performed in 2001 on the project site by Mike O’Loughlin. The NRCS soil data is included in Appendix B of this report. The soil horizons where infiltration systems will be present all showed HSG Class A loamy sands at a minimum and all calculations were based on this criterion.

A total of 16,511 SF of impervious road surface is proposed for the Miskell Woods development. Stormwater runoff from the upper road cul-de-sac area will be directed to a catch basin that first conveys stormwater through a 1,500 gallon oil & grit separator in order to achieve the required 44% TSS removal pre-treatment prior to infiltration. The stormwater is then conveyed to two bioretention areas in series. The first bioretention area will be capable of storing and infiltrating the majority of storm events including the 25 year storm. The first bioretention area will be equipped with a flood-level atrium grate overflow that will lead to a second bioretention area for a larger storm event. The bioretention areas will include a 6” deep gravel bed at its base to enhance infiltration covered by a 2.5’ section of bioretention soil media and a small top layer of mulch. Both will be planted with a mixture of plants capable of handling both wet and dry conditions.

Stormwater runoff from the remaining section of the proposed road sloping down toward North Westgate Road will be captured by 4 different catch basins, two of which are located roughly

halfway down the road and two of which are located at the bottom of the road just before connection to North Westgate Road. The upper catch basins first convey stormwater through a 1,500 gallon oil & grit separator in order to achieve the required 44% TSS removal pre-treatment prior to infiltration. The stormwater then flows to a set of two 8-ft diameter concrete leaching basins each with a 2-foot radius of stone all around. The lower catch basins first convey stormwater through a 1,500 gallon oil & grit separator before feeding a set of two 8-ft diameter leaching basins each with a 4-foot radius of stone all around. The leaching basins are designed to completely capture and infiltrate runoff from the 25-year frequency storm. In the event of the 100-year storm, stormwater will overflow from the catch basins to North Westgate Road.

A hydrologic sub- basin map is given in Appendix A for the existing and proposed conditions.

Compliance Standards

The proposed stormwater management system complies with the ten standards of the MassDEP Stormwater Management Policy and Stormwater Handbook.

This report was prepared under the direction of Jay Thrasher, a registered Professional Engineer (PE # 54434) licensed to do business in the Commonwealth of Massachusetts pursuant to MGL Chapter 112 Section 81R.

This section of the Stormwater Report includes the calculations required to document compliance with the following standards.

Standard 1

"No new stormwater conveyances may discharge untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth."

A vegetative wetland adjacent to Robbins Pond lies roughly 300 feet from the proposed Miskell Woods project site. Based on the proposed stormwater infiltration system's capacity for a 25-year storm was well as the distance between the project site and the wetland it is assumed that the proposed project will not have an impact (erosion or runoff) on the wetland.

Standard 2

"Stormwater management systems shall be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates. This Standard may be waived for discharges to land subject to coastal storm flowage as defined in 310 CMR 10.04."

The HydroCAD analysis performed on the development site pre and post-construction show that post-development peak discharges rates do not exceed pre-development discharge rates and runoff volumes for all design storm analyzed in this report. Table 5.1 below shows the estimated pre- and post-development peak discharge rates and runoff volumes for the five design storms.

Table 5.1 – Pre and post-development peak discharge rates for Design Point #1: North Westgate Road.

	Existing peak discharge rate (cfs)	Proposed peak discharge rate (cfs)	Existing runoff volume (CF)	Proposed runoff volume (CF)
1-in. storm	0.00	0.00	0.00	0.00
2-yr storm: 3.2 in.	0.04	0.03	1,198	828
10-yr storm: 4.63 in.	0.81	0.61	8,030	7,587
25-yr storm: 5.52 in.	2.12	1.73	16,842	14,573
100-yr storm: 6.9 in.	5.36	5.00	32,422	29,212

Standard 3

"Loss of annual recharge to groundwater shall be eliminated or minimized through the use of infiltration measures including environmentally sensitive site design, low impact development techniques, stormwater best management practices, and good operation and maintenance. At a minimum, the annual recharge from the post-development site shall approximate the annual recharge from pre-development conditions based on soil type. This Standard is met when the stormwater management system is designed to infiltrate the required recharge volume as determined in accordance with the Massachusetts Stormwater Handbook."

The calculation for required recharge volume provided by the Massachusetts Stormwater Handbook is given below:

Rv = F x impervious area

- Rv is the required recharge volume.
- F is the target depth factor based on local regulation (F = 1-inch).
- Impervious area is the total cumulative impervious area on the site.

Rv = (1-inch) * (1 ft/12 inches) * (16,511 SF)

Rv = 1376 CF

The proposed drainage and infiltration system design provides 2,192 CF of recharge volume storage capacity in the leaching basins. The bioretention areas that are fed by the cul-de-sac catch basin provide an additional 3,500 CF of recharge volume.

The HydroCAD analysis performed utilizes the "simple dynamic" method to ensure adequate sizing of the infiltration BMPs. The analysis showed that the storage capacity proposed is sized to completely store the 25-year storm runoff volume.

The calculation for ensuring the design meets the minimum 72-hour drawdown period associated with the "simple dynamic' method provided by the Massachusetts Stormwater handbook is given below:

$$\boldsymbol{Time_{drawdown} = \frac{Rv}{(K)(Bottom\ Area)}}$$

Bottom Area is the bottom area of all infiltration BMPs combined, Rv is the calculated recharge volume, and K is the Rawl's Rate which is dependent on the soil classification according to Table 5.4 below.

Table 5.4 – 1982 Rawls Rates

Texture Class	NRCS Hydrologic Soil Group (HSG)	Infiltration Rate Inches/Hour
Sand	A	8.27
Loamy Sand	A	2.41
Sandy Loam	B	1.02
Loam	B	0.52
Silt Loam	C	0.27
Sandy Clay Loam	C	0.17
Clay Loam	D	0.09

The soil at the project site was determined to be HSG Class A Loamy sand and therefore a Rawl's Rate of 2.41 inches/hour was used for the calculation given below:

$$\boldsymbol{Time_{drawdown} = \frac{1{,}376\ CF}{(2.41\ in./hour)(1ft/12\ in.)(515\ SF)}}$$

$$\boldsymbol{Time_{drawdown} = 13.3\ hours}$$

The calculated drawdown-time only includes the bottom area of the infiltration basins and does not include the bottom area of the bioretention areas. When the bioretention area is included the drawdown time is under 4 hours. The calculation ensures the entire infiltration volume will draw down well within the maximum allowable 72 hours.

Standard 4

"Stormwater management systems shall be designed to remove 80% of the average annual post-construction load of Total Suspended Solids (TSS). This Standard is met when:

a. Suitable practices for source control and pollution prevention are identified in a long-term pollution prevention plan, and thereafter are implemented and maintained;

b. Structural stormwater best management practices are sized to capture the required water quality volume determined in accordance with the Massachusetts Stormwater Handbook; and

c. Pretreatment is provided in accordance with the Massachusetts Stormwater Handbook."

All stormwater drainage systems were designed to remove the required 80% of suspended solids from the stormwater as well as 44% removed prior to the infiltration systems. Completed TSS removal worksheets (provided by MassDEP) can be found in Appendix C of this report.

Standard 5

"For land uses with higher potential pollutant loads, source control and pollution prevention shall be implemented in accordance with the Massachusetts Stormwater Handbook to eliminate or reduce the discharge of stormwater runoff from such land uses to the maximum extent practicable. If through source control and/or pollution prevention all land uses with higher potential pollutant loads cannot be completely protected from exposure to rain, snow, snow melt, and stormwater runoff, the proponent shall use the specific structural stormwater BMPs determined by the Department to be suitable for such uses as provided in the Massachusetts Stormwater Handbook. Stormwater discharges from land uses with higher potential pollutant loads shall also comply with the requirements of the Massachusetts Clean Waters Act, M.G.L. c. 21, §§ 26-53 and the regulations promulgated thereunder at 314 CMR 3.00, 314 CMR 4.00 and 314 CMR 5.00."

The development project site does not qualify as land use with higher potential pollutant loads (LUHPPL) according to the Massachusetts Stormwater Handbook, 310 CMR 10.04 and 314 CMR 9.02.

Standard 6

"Stormwater discharges within the Zone II or Interim Wellhead Protection Area of a public water supply, and stormwater discharges near or to any other critical area, require the use of the specific source control and pollution prevention measures and the specific structural stormwater best management practices determined by the Department to be suitable for managing discharges to such areas, as provided in the Massachusetts Stormwater Handbook. A discharge is near a critical area if there is a strong likelihood of a significant impact occurring to said area, taking into account site-specific factors. Stormwater discharges to Outstanding Resource Waters and Special Resource Waters shall be removed and set back from the receiving water or wetland and receive the highest and best practical method of treatment. A "storm water discharge" as defined in 314 CMR 3.04(2)(a)1 or (b) to an Outstanding Resource Water or Special Resource Water shall comply with 314 CMR 3.00and 314 CMR 4.00. Stormwater

discharges to a Zone I or Zone A are prohibited unless essential to the operation of a public water supply."

The entire Miskell Woods development project does lies within a Zone II and therefore 44% TSS removal is proposed prior to the infiltration systems (90% total). The project does not lie within an Interim Wellhead Protection Area or any other critical area defined in the Massachusetts Stormwater Handbook.

Standard 7

"A redevelopment project is required to meet the following Stormwater Management Standards only to the maximum extent practicable: Standard 2, Standard 3, and the pretreatment and structural best management practice requirements of Standards 4, 5, and 6. Existing stormwater discharges shall comply with Standard 1 only to the maximum extent practicable. A redevelopment project shall also comply with all other requirements of the Stormwater Management Standards and improve existing conditions."

The Miskell Woods development project is not a redevelopment project and therefore shall comply with all standards set forth by the Massachusetts Stormwater Handbook.

Standard 8

"A plan to control construction-related impacts including erosion, sedimentation and other pollutant sources during construction and land disturbance activities (construction period erosion, sedimentation, and pollution prevention plan) shall be developed and implemented."

The sediment and erosion control plan is given in the next section of this report.

Standard 9

"A long-term operation and maintenance plan shall be developed and implemented to ensure that stormwater management systems function as designed."

A long-tern Stormwater O & M Manual has been prepared and can be found in Appendix E of this report.

Standard 10

"All illicit discharges to the stormwater management system are prohibited."

No known illicit discharges exist at the project site and no illicit discharges will be added for this development project.

Sediment and Erosion Control

Site Disturbance

The total area of site disturbance both permanent and temporary is approximately 72,460 SF.

Estimated Construction Phasing

The estimated construction phasing for the Miskell Woods development project is as follows:

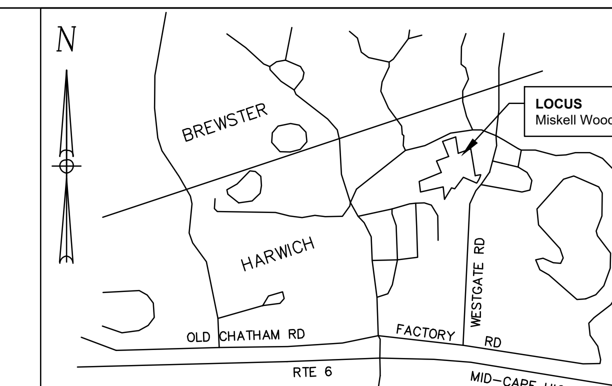
- Installation of a temporary site access
- Installation of erosion controls and slope stabilization
- Installation of all temporary structures including portable toilets and trash receptacles
- Initial site clearing
- Demolition, razing, and removal of existing structures
- Drainage and recharge basin installation
- Utilities installation
- Site grading
- Road paving
- Final site landscaping and stabilization

Sediment and Erosion Control Plan

Multiple sediment and erosion control BMPs will be implemented for the Miskell Woods development project. The construction phase sediment and erosion control plans are detailed in the submitted drawings set. The following sediment and erosion control BMPs will be implemented:

- A temporary construction driveway tracking pad will be installed at the entrance to the site.
- All areas with slopes greater than 2:1 will be stabilized with jute matting slope stabilization blankets.
- A silt fence will be installed around the entire limit of work to prevent stormwater from entering the limit of work during the construction phase.
- A straw wattle barrier will be placed around the limit of work on all slopes downhill of the limit of work area.
- All disturbed areas will be loamed and seeded at the completion of construction.

SURVEY WITH PROPERTY BOUNDARIES, UTILITY
LOCATION AND EXISTING TOPOGRAPHY PROVIDED BY
TERRY A. WARNER, P.L.S.



LOCUS MAP
NOT TO SCALE

MISKELL WOODS RESIDENTIAL DEVELOPMENT
SITE PLANS
PREPARED FOR
O'LOUGHLIN FAMILY REALTY TRUST
HARWICH, MA

16 SQUANTUM PATH
ASSESSORS MAP 78 PARCEL G10

SITE PLAN
SCALE: 1" = 80'
0 80 160

ROBIAL WATER LTD
ENGINEERING SERVICES
85 Courtland Street
Providence, RI 02909
P: +1 (508) 954 0677
E: jay@robialwater.com

CONSULTANTS:

STEPHEN A. HAAS, P.E.
293 Cranview Road
Brewster, MA 02631
(508) 367-1691

No.	REVISION/SUBMISSION	DATE

PROJECT No. SW2022.010

SHEET TITLE:

EXISTING CONDITIONS PLAN

SHEET SIZE: 18 IN. X 24 IN. (ARCH C)
DATE: 6 June 2022
SHEET NUMBER:

SHEET 1 of 5

PROJECT:

RESIDENTIAL DEVELOPMENT

CONSTRUCTION DRAWINGS
PENDING TOWN APPROVAL

16 Squantum Path
Harwich, MA 02493

LEGEND

- SOIL TEST PIT
- EXISTING CONTOUR
- PROPOSED CONTOUR
- SPOT ELEVATION
- OVERHEAD ELECTRICAL
- MUNICIPAL WATER
- NATURAL GAS LINE
- CONCRETE BOUND FOUND
- CONCRETE BOUND TO BE SET
- WATER HYDRANT

16 SQUANTUM PATH
ASSESSORS MAP 78 PARCEL G10

SITE PLAN
SCALE: 1" = 80'
0 80 160

NOTES

1. EXISTING CONDITIONS PLAN AND ALL SURVEY INFORMATION PROVIDED BY TERRY A. WARNER PLS.
2. ROAD AND SUBDIVISION PLAN APPROVED BY TOWN OF HARWICH PLANNING BOARD, REVIEWED 10 MARCH 2022: VHB# 15657.01
3. THE ENTIRE PROJECT SITE LIES WITHIN MASSACHUSETTS ZONE II.
4. THE LOCATION OF EXISTING UTILITIES IS APPROXIMATE, THE CONTRACTOR SHALL VERIFY THE LOCATION OF ALL UTILITIES IN THE FIELD PRIOR TO THE START OF CONSTRUCTION. NOTIFY "DIG-SAFE" AT 1-888-344-7233 AT LEAST 72 HOURS PRIOR TO ANY SITE DEMOLITION OR EXCAVATION.
5. ALL IMPROVEMENTS SPECIFIED ON THE DEFINITIVE SUBDIVISION PLAN, ROAD PROFILE PLANS AND ROAD CROSS SECTIONS SHALL BE CONSTRUCTED OR INSTALLED IN ACCORDANCE WITH THE PROVISIONS OF THE HARWICH BYLAWS AND SECTION 400-14 (REQUIRED IMPROVEMENTS AND SPECIFICATIONS FOR CONSTRUCTION) OF THE SUBDIVISION RULES AND REGULATIONS.
6. INITIAL SOIL STABILIZATION WITHIN THE LIMIT OF CLEARING SHALL BE ACCOMPLIUSHED BY APPLICATION OF MULCH AND/OR LOAM AND SEED, WEATHER PERMITTING. REFER TO SECTION 400-14 D. EROSION CONTROL MEASURES FOR GUIDANCE DURING AND AFTER CONSTRUCTION.

	Miskell Woods Zoning Data Table (Harwich Zone R-R)						
	Required (Minimum)	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5	Lot 6
Area (SF)	40,000	41,500	45,288	40,340	40,167	74,483	57,051
Area (acres)	0.92	0.95	1.04	0.93	0.92	1.71	1.31
Frontage (feet)	50	337.6	57.55	199.67	191.93	88.0	499.87
Perimeter (feet)	200	838.94	876.76	816.41	859.55	1179.17	1516.26

ROBIAL WATER LTD
ENGINEERING SERVICES

85 Courtland Street
Providence, RI 02909

P: +1 (508) 954 0677
E: jay@robialwater.com

CONSULTANTS:

STEPHEN A. HAAS, P.E.
293 Cranview Road
Brewster, MA 02631
(508) 367-1691

No. REVISION/SUBMISSION DATE

PROJECT No. SW2022.010

SHEET TITLE:

SUBDIVISION
LAYOUT PLAN

SHEET SIZE: 18 IN. X 24 IN. (ARCH C)

DATE: 6 June 2022

SHEET NUMBER:

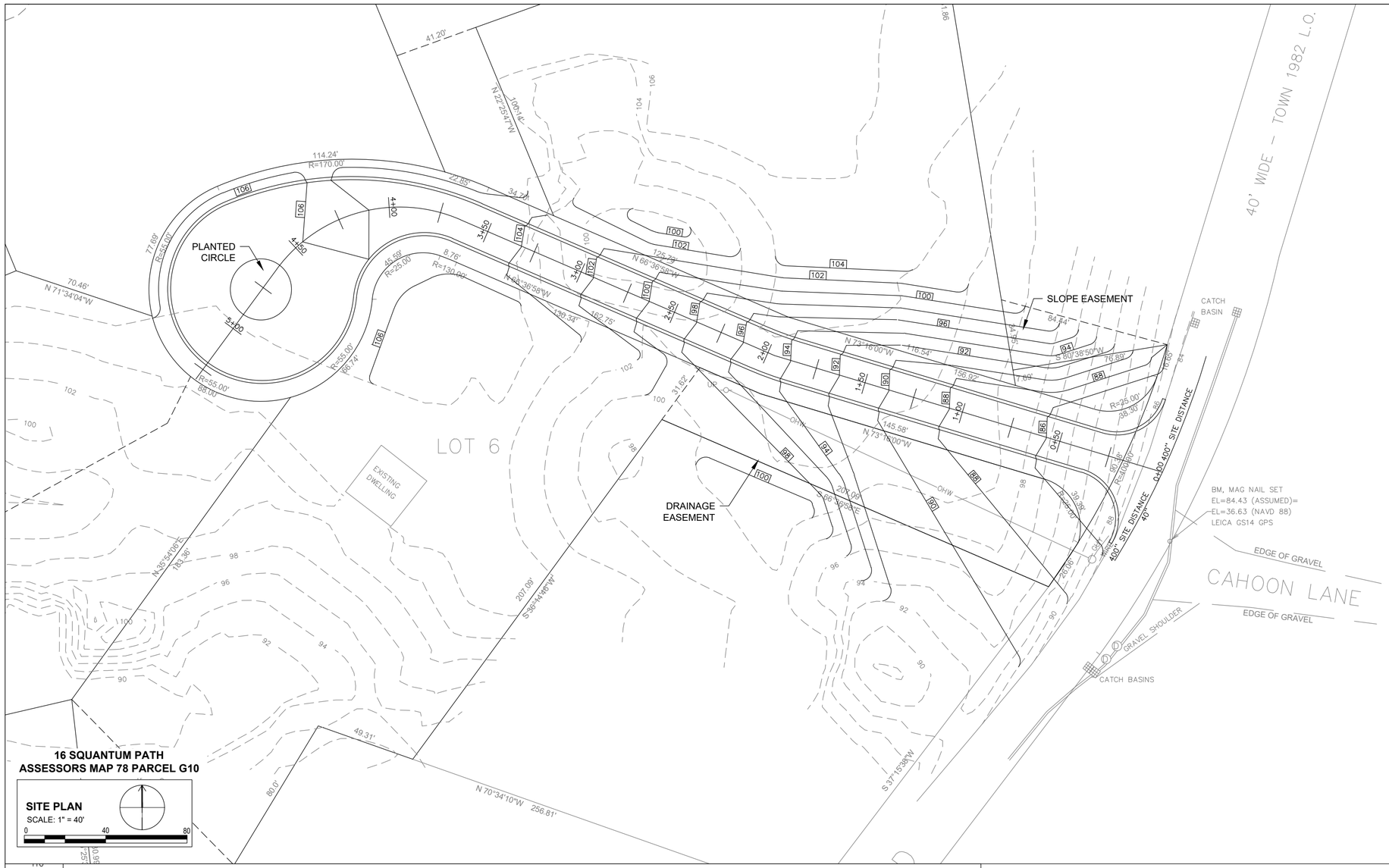
SHEET 2 of 5

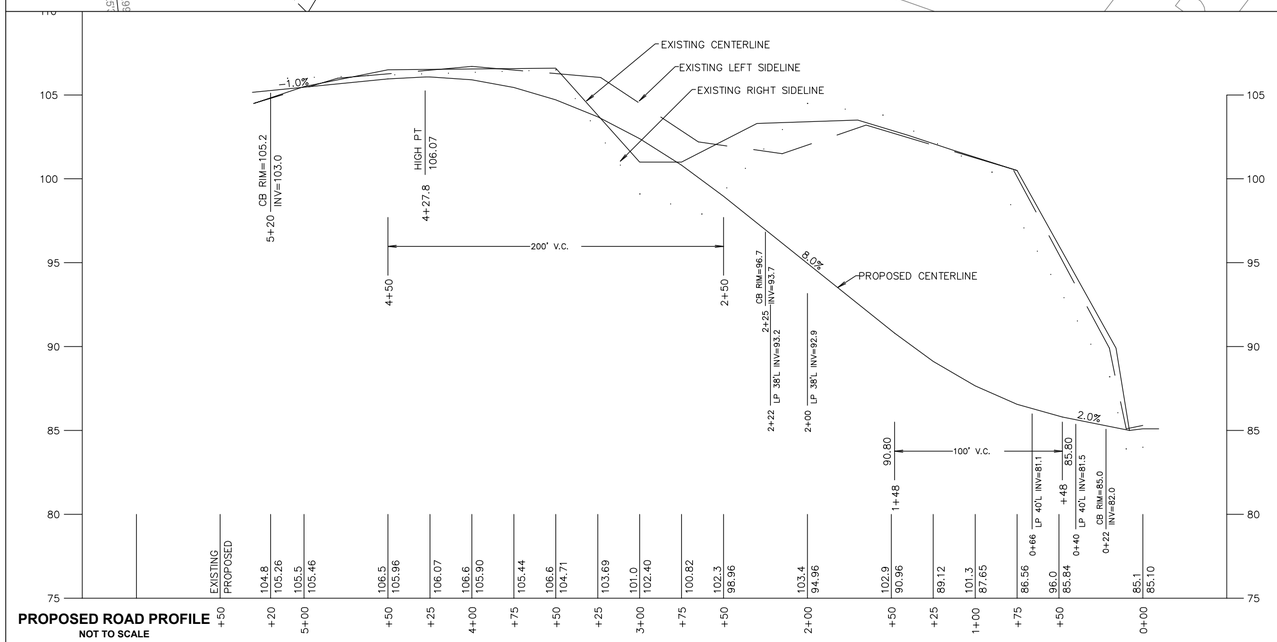
PROJECT:

RESIDENTIAL DEVELOPMENT

CONSTRUCTION DRAWINGS
PENDING TOWN APPROVAL

16 Squantum Path
Harwich, MA 02493





PROPOSED ROAD PROFILE
NOT TO SCALE

NOTES

1. EXISTING CONDITIONS PLAN AND ALL SURVEY INFORMATION PREPARED BY TERRY A. WARNER PLS.
2. ROAD AND SUBDIVISION PLAN APPROVED BY TOWN OF HARWICH PLANNING BOARD, REVIEWED 10 MARCH 2022: VHB# 15657.01
3. THE ENTIRE PROJECT SITE LIES WITHIN MASSACHUSETTS ZONE II.
4. THE LOCATION OF EXISTING UTILITIES IS APPROXIMATE, THE CONTRACTOR SHALL VERIFY THE LOCATION OF ALL UTILITIES IN THE FIELD PRIOR TO THE START OF CONSTRUCTION. NOTIFY "DIG-SAFE" AT 1-888-344-7233 AT LEAST 72 HOURS PRIOR TO ANY SITE DEMOLITION OR EXCAVATION.
5. ALL IMPROVEMENTS SPECIFIED ON THE DEFINITIVE SUBDIVISION PLAN, ROAD PROFILE PLANS AND ROAD CROSS SECTIONS SHALL BE CONSTRUCTED OR INSTALLED IN ACCORDANCE WITH THE PROVISIONS OF THE HARWICH BYLAWS AND SECTION 400-14 (REQUIRED IMPROVEMENTS AND SPECIFICATIONS FOR CONSTRUCTION) OF THE SUBDIVISION RULES AND REGULATIONS.
6. INITIAL SOIL STABILIZATION WITHIN THE LIMIT OF CLEARING SHALL BE ACCOMPLISHED BY APPLICATION OF MULCH AND/OR LOAM AND SEED, WEATHER PERMITTING. REFER TO SECTION 400-14 D. EROSION CONTROL MEASURES FOR GUIDANCE DURING AND AFTER CONSTRUCTION.

ROBIAL WATER LTD
ENGINEERING SERVICES

85 Courtland Street
Providence, RI 02909

P: +1 (508) 954 0677
E: jay@robialwater.com

CONSULTANTS:

STEPHEN A. HAAS, P.E.

293 Cranview Road
Brewster, MA 02631
(508) 367-1691

No.	REVISION/SUBMISSION	DATE

PROJECT No. SW2022.010

SHEET TITLE:

ROAD LAYOUT
&
GRADING PLAN

SHEET SIZE: 18 IN. X 24 IN. (ARCH C)

DATE: 6 June 2022

SHEET NUMBER:

SHEET 3 of 5

PROJECT:

RESIDENTIAL DEVELOPMENT

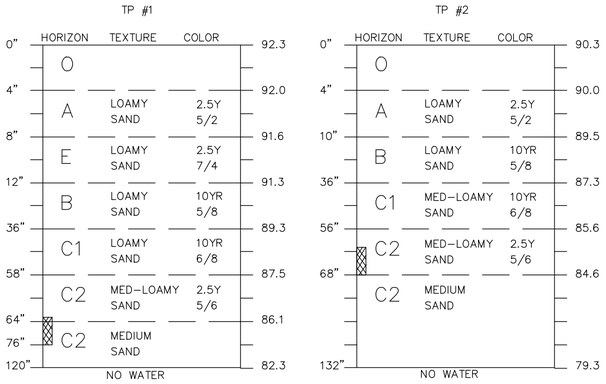
CONSTRUCTION DRAWINGS
PENDING TOWN APPROVAL

16 Squantum Path
Harwich, MA 02493

SOIL TEST PIT DATA

INDICATES PERCOLATION TEST

INDICATES OBSERVED GROUNDWATER



DATE: JANUARY 30, 2001
TEST BY: MIKE O'LOUGHLIN
WITNESSED BY: HERBERT SCHNITZER
PERC RATE: < 2 MIN/INCH

GENERAL NOTES

1. SIZE OF STROMWATER INFASTRUCTURE COMPONENTS BASED ON STORM ANALYSIS IN HYDROCAD MODEL AND DETAILED IN ENGINEER'S STORMWATER & EROSION CONTROL REPORT DATED 06 JUNE 2022..
2. INSTALLATION OF THE PROPOSED DRAINAGE SYSTEM AND ALL UTILITIES SHALL BE IN ACCORDANCE WITH THE COMMONWEALTH OF MASSACHUSETTS AND THE TOWN OF HARWICH REGULATIONS.
3. THE CONTRACTOR IS RESPONSIBLE FOR CONTACTING DIGSAFE AT 1-888-344-7233 PRIOR TO CONSTRUCTION.
4. THE CONTRACTOR SHALL NOTIFY THE ENGINEER AND THE LOCAL PLANNING BOARD OF ANY CHANGES TO THESE PLANS.
5. EXISTING FINISHED GRADE ELEVATIONS SHALL BE CONFIRMED PRIOR TO CONSTRUCTION. THE ENGINEER SHALL BE NOTIFIED IMMEDIATELY OF ANY DISCREPANCIES +/- 6 INCHES.
6. THE RESPONSIBILITY, OWNERSHIP AND MAINTENANCE OF THE PROPOSED DRAINAGE SYSTEM ON PRIVATE PROPERTY SHALL REMAIN THAT OF THE OWNER.
7. CONTRACTOR SHALL CALL FOR INSPECTIONS AND APPROVALS FROM THE DESIGNATED TOWN STORMWATER INSPECTOR AND THE DESIGN ENGINEER :
   (a.) PRIOR TO CONSTRUCTION
   (b.) AFTER EXCAVATION PRIOR TO INSTALLATION
   (c.) AFTER COMPLETE INSTALLATION OF ALL SYSTEM COMPONENTS

CONSTRUCTION NOTES:

1. ALL PIPE ROUTING SHOWN ON SITE LAYOUT IS APPROXIMATE. CONTRACTOR SHALL DETERMINE MOST EFFICIENT ROUTING IN THE FIELD MAINTAINING A MINIMUM SLOPE OF 1 PERCENT BETWEEN CATCH BASIN OUTLET INVERTS AND INFILTRATION BASIN INLET INVERTS. CLEANOUTS SHALL BE INSTALLED FLUSH TO FINISHED GRADE AT EVERY POINT WHERE THE DRAIN PIPE CHANGES DIRECTION.
2. TRENCHES MUST BE ADEQUATELY BRACED TO PROTECT AGAINST CAVE-IN DURING EXCAVATION AND CONSTRUCTION OF PIPES AND STRUCTURES.
3. THE CONTRACTOR MUST RECORD ALL INVERT ELEVATIONS AND PIPE LOCATIONS FOR DEVELOPMENT OF AN AS-BUILT PLAN. RECORDED INVERT ELEVATIONS SHALL INCLUDE BOTTOM OF BASIN, BASIN RIM, BASIN INLET PIPE AND BASIN OUTLET PIPE.
4. WHERE DEEMED NECESSARY, THE CONTRACTOR SHALL DIG A DEEP HOLE TEST PIT IN THE AREA OF EACH RECHARGE BASIN PRIOR TO ITS INSTALLATION FOR EVALUATION OF SHGW. THE ENGINEER WILL VERIFY THE SOIL CONDITIONS AND GROUNDWATER ELEVATION AND CERTIFY THAT THERE IS AT LEAST A 2-FOOT SEPARATION BETWEEN THE BOTTOM OF THE RECHARGE BASIN AND THE SHGW.
5. THE BACKFILL MATERIAL SHALL BE CRUSHED STONE OR OTHER GRANULAR MATERIAL MEETING THE REQUIREMENTS OF CLASS I, CLASS II, OR CLASS III MATERIAL AS DEFINED IN ASTM D2321. BEDDING & BACKFILL FOR SURFACE DRAINAGE INLETS SHALL BE PLACED & COMPACTED UNIFORMLY IN ACCORDANCE WITH ASTM D2321.
6. ALL UNSUITABLE MATERIAL SHALL BE REMOVED AND REPLACED WITH CLEAN GRANULAR FILL FOR A DISTANCE OF 2 FEET IN ALL DIRECTIONS.

EROSION AND SEDIMENT CONTROL NOTES:

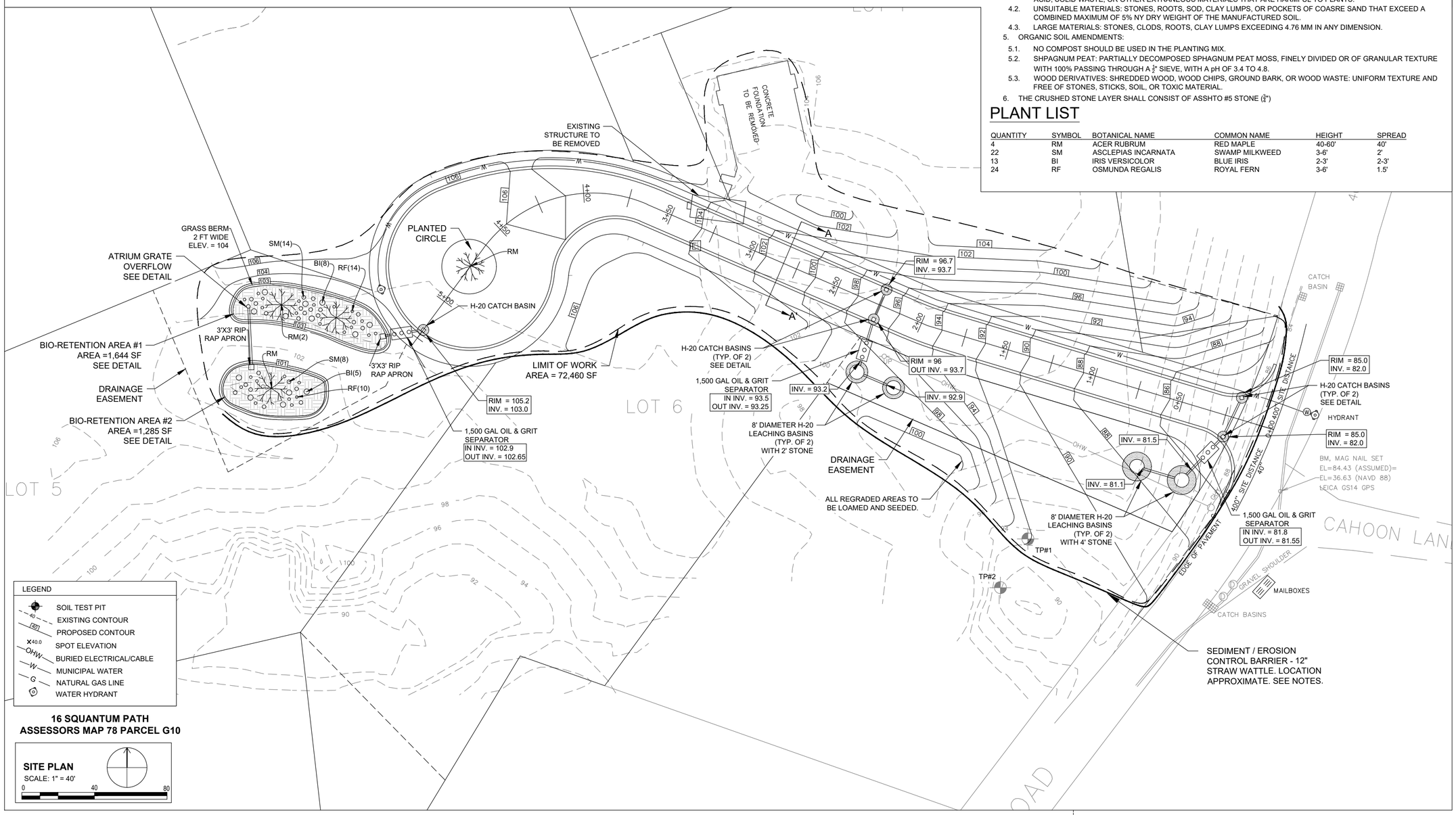
1. THIS PLAN DEPICTS THE MINIMUM SEDIMENTATION AND EROSION CONTROLS. THE CONTRACTOR SHALL EMPLOY ADDITIONAL CONTROL MEASURES AS NECESSITATED BY THE SITE CONDITIONS.
2. THE CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING ALL TEMPORARY AND PERMANENT SEDIMENTATION AND EROSION CONTROLS UNTIL THE WORK IS COMPLETE AND ALL AREAS HAVE BEEN PERMANENTLY STABILIZED. AT SUCH TIME THE CONTRACTOR IS RESPONSIBLE FOR REMOVING ALL SEDIMENTATION AND EROSION CONTROL MEASURES.
3. A 12 INCH STRAW WATTLE OR APPROVED SEDIMENT CONTROL EQUIVALENT SHALL BE PLACED ON THE DOWN-SLOPE SIDE OF THE PROPOSED LIMIT OF WORK. SEE SITE PLAN FOR APPROXIMATE LOCATION AND STRAW WATTLE DETAIL FOR INSTALLATION INSTRUCTION.
4. ALL DISTURBED AREAS SHALL BE STABILIZED WITH LOAM AND SEED AFTER CONSTRUCTION IS COMPLETED.
5. ALL CATCH BASINS ON WESTGATE ROAD THAT MAY RECEIVE STORMWATER FLOW FROM DISTURBED AREAS, SHALL BE PROVIDED WITH INLET PROTECTION SUCH AS A SILT SACK.SILT SACKS SHALL BE INSPECTED WEEKLY DURING CONSTRUCTION AND IMMEDIATELY AFTER STORM EVENTS. IF SILT SACKS ARE MORE THAN 1/3RD FULL, THEY SHALL BE EMPTIED IMMEDIATELY. CAPTURED SILT SHALL BE RETAINED ON SITE AND REUSED. SILT SACKS SHALL REMAIN IN PLACE UNTIL ALL VEGETATION IN IMMEDIATE VICINITY IS FULLY ESTABLISH.
6. STREET TO BE SWEPT CLEAN AFTER EVERY WORK DAY AS NECESSARY.
7. CONTRACTOR SHALL FILE A "STREET OPENING PERMIT" WITH THE HARWICH DEPARTMENT OF PUBLIC WORKS.
8. CONTRACTOR TO REPAIR OR REPLACE ANY ROAD DAMAGED AS A RESULT OF THE PROPOSED CONSTRUCTION AND DISTURBANCE BEFORE PROJECT COMPLETION.

BIORETENTION AREA NOTES:

1. PLANT THE SYSTEM AS SPECIFIED; AT A MINIMUM, SEED THE SYSTEM FLOOR AND SIDE SLOPES WITH RYE GRASS MIXTURE CONTAINING PERENNIAL AND WINTER RYES, AT A RATE SPECIFIED BY THE MANUFACTURER. STABILIZE THE SLOPES WITH STRAW TO A DEPTH OF 1".
2. LIGHTLY COMPACT FINISHED FLOOR ELEVATION AND FINISHED SLOPES USING THE BUCKET OF AN EXCAVATOR, NON-MOTARIZED ROLLER, HAND TAMP, OR OTHER MEANS. THEN ROUGHEN SURFACE WITH A RAKE TO LOOSEN SOILS BEFORE SEEDING. DO NOT COMPACT THE SUBGRADE AT THE BOTTOM OF EXCAVATION UNLESS PERMEABILITY EXCEEDS 1 X 10 ^ -5 CM/S.
3. BIORETENTION SOIL MEDIA (BSM) MIXTURE SPECIFICATIONS:
   - 3.1. BIORETENTION SOIL SHOULD BE A MIXTURE OF THE FOLLOWING: 50-70 % SAND, 20-30% LOAM, 10-20% COMPOST
   - 3.2. STICKS AND ROOTS SHOULD BE MINIMIZED IN THE BSM MIXTURE, AND PREFERABLY NOTHING LARGER THAN 4.76 MM.
   - 3.3. NO DEBRIS OR OTHER FOREIGN MATERIALS.
   - 3.4. ORGANIC MATTER SHOULD MAKE UP A MINIMUM 3% BY VOLUME AND A MAXIMUM 8% BY VOLUME OF THE BSM.
   - 3.5. BSM MIXTURE SHALL HAVE A SOIL REACTION pH OF 6 TO 7.
   - 3.6. CATION EXCHANGE CAPACITY (CEC) OF BSM SHOULD BE A MINIMUM OF 10 meq PER 100 mL AT A pH OF 7.
4. IF BSM IS PURCHASED FROM A MANUFACTURER, BSM MIXTURE SHALL NOT CONTAIN THE FOLLOWING:
   - 4.1. UNSUITABLE MATERIALS: CONCRETE SLURRY, CONCRETE LAYERS OR CHUNKS, CEMENT, PLASTER, BUILDING DEBRIS, ASPHALT, BRICKS, OILS, GASOLINE, DIESEL FUEL, PAINT THINNER, TERPENTINE, TAR, ROOFING COMPOUND, ACID, SOLID WASTE, OR OTHER EXTRANEOUS MATERIALS THAT ARE HARMFUL TO PLANTS.
   - 4.2. UNSUITABLE MATERIALS: STONES, ROOTS, SOD, CLAY LUMPS, OR POCKETS OF COASRE SAND THAT EXCEED A COMBINED MAXIMUM OF 5% NY DRY WEIGHT OF THE MANUFACTURED SOIL.
   - 4.3. LARGE MATERIALS: STONES, CLODS, ROOTS, CLAY LUMPS EXCEEDING 4.76 MM IN ANY DIMENSION.
5. ORGANIC SOIL AMENDMENTS:
   - 5.1. NO COMPOST SHOULD BE USED IN THE PLANTING MIX.
   - 5.2. SHPAGNUM PEAT: PARTIALLY DECOMPOSED SPHAGNUM PEAT MOSS, FINELY DIVIDED OR OF GRANULAR TEXTURE WITH 100% PASSING THROUGH A $\frac{1}{2}$" SIEVE, WITH A pH OF 3.4 TO 4.8.
   - 5.3. WOOD DERIVATIVES: SHREDDED WOOD, WOOD CHIPS, GROUND BARK, OR WOOD WASTE: UNIFORM TEXTURE AND FREE OF STONES, STICKS, SOIL, OR TOXIC MATERIAL.
6. THE CRUSHED STONE LAYER SHALL CONSIST OF ASSHTO #5 STONE ($\frac{3}{4}$")

PLANT LIST

QUANTITY	SYMBOL	BOTANICAL NAME	COMMON NAME	HEIGHT	SPREAD
4	RM	ACER RUBRUM	RED MAPLE	40-60'	40'
22	SM	ASCLEPIAS INCARNATA	SWAMP MILKWEED	3-6'	2'
13	BI	IRIS VERSICOLOR	BLUE IRIS	2-3'	2-3'
24	RF	OSMUNDA REGALIS	ROYAL FERN	3-6'	1.5'



LEGEND

- SOIL TEST PIT
- EXISTING CONTOUR
- PROPOSED CONTOUR
- SPOT ELEVATION
- BURIED ELECTRICAL/CABLE
- MUNICIPAL WATER
- NATURAL GAS LINE
- WATER HYDRANT

16 SQUANTUM PATH
ASSESSORS MAP 78 PARCEL G10

SITE PLAN
SCALE: 1" = 40'
0 40 80

ROBIAL WATER LTD
ENGINEERING SERVICES

85 Courtland Street
Providence, RI 02909

P: +1 (508) 954 0677
E: jay@robialwater.com

CONSULTANTS:

STEPHEN A. HAAS, P.E.
293 Cranview Road
Brewster, MA 02631
(508) 367-1691

No.	REVISION/SUBMISSION	DATE

PROJECT No. SW2022.010

SHEET TITLE:

STORMWATER COLLECTION & INFILTRATION PLAN

SHEET SIZE: 18 IN. X 24 IN. (ARCH C)

DATE: 6 June 2022

SHEET NUMBER:

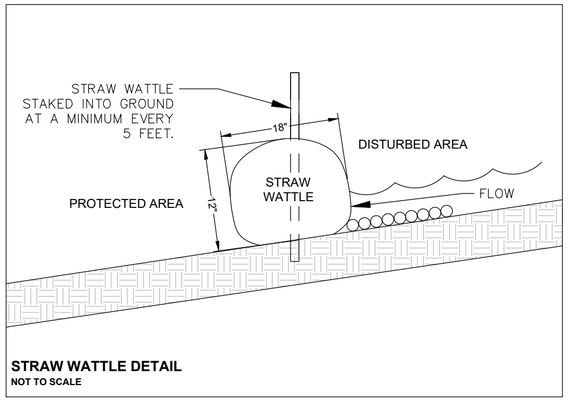
SHEET 4 of 5

PROJECT:

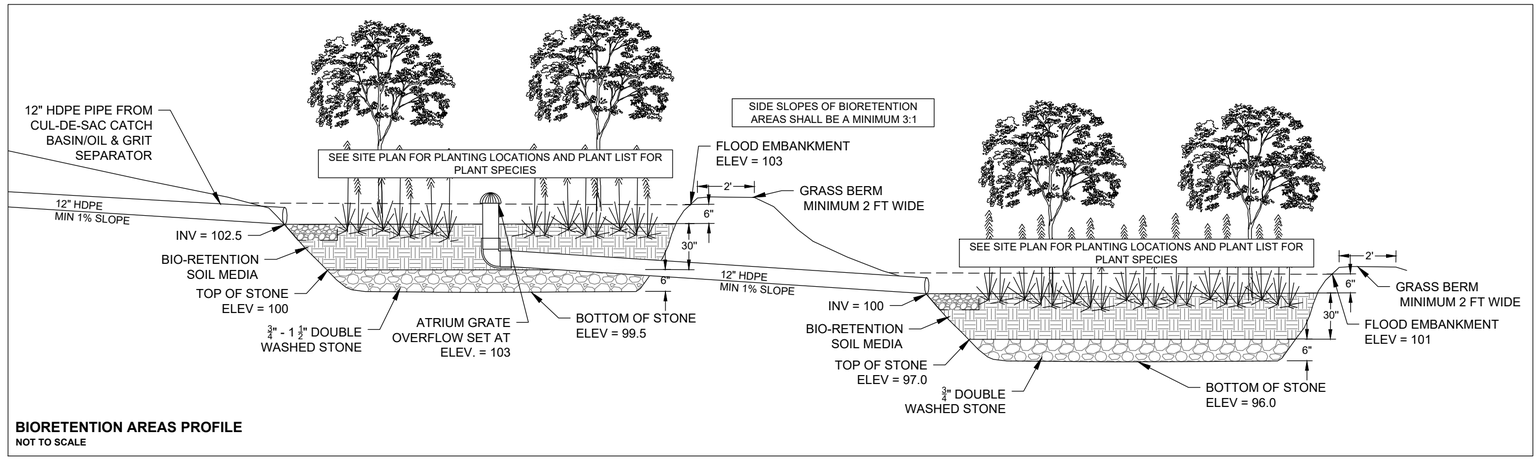
RESIDENTIAL DEVELOPMENT

CONSTRUCTION DRAWINGS
PENDING TOWN APPROVAL

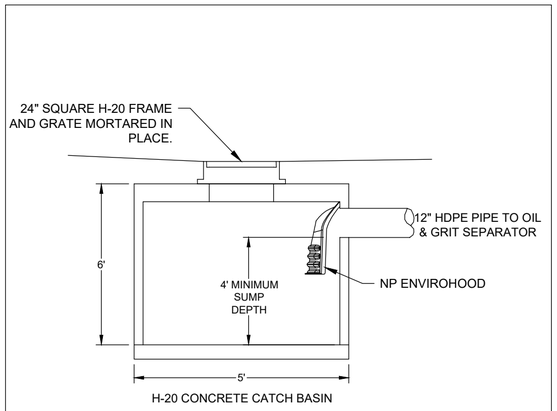
16 Squantum Path
Harwich, MA 02493



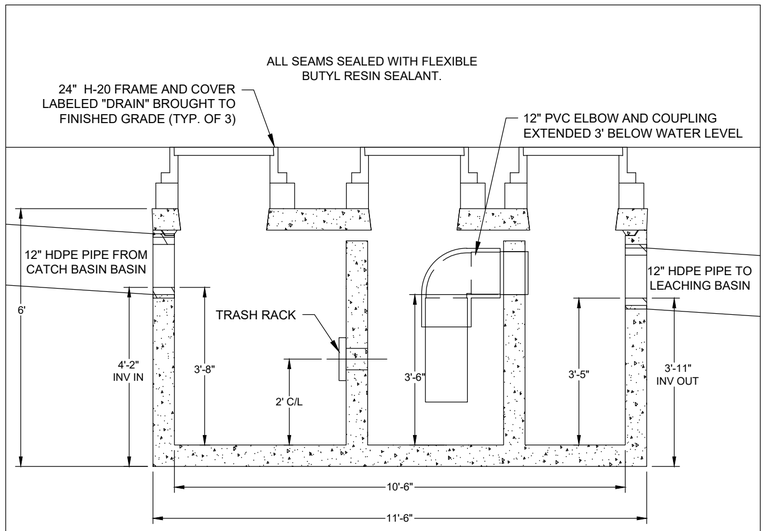
STRAW WATTLE DETAIL
NOT TO SCALE



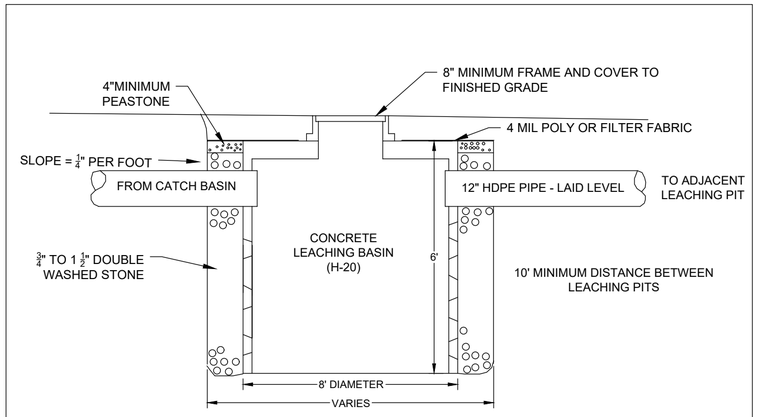
BIORETENTION AREAS PROFILE
NOT TO SCALE



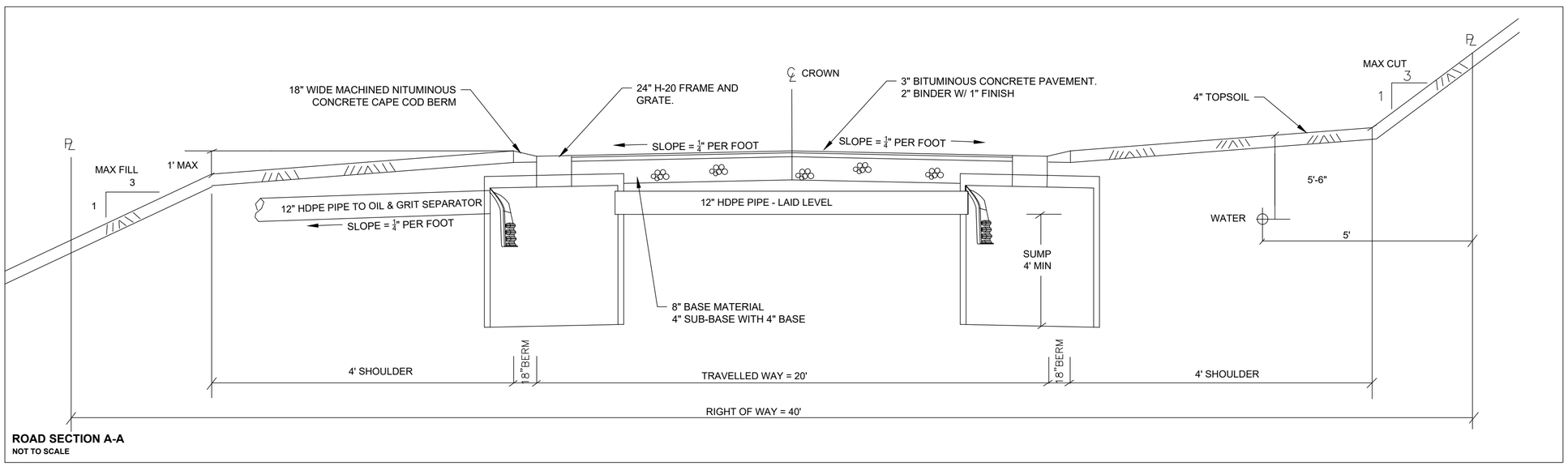
CATCH BASIN DETAIL
NOT TO SCALE



OIL & GRIT SEPARATOR DETAIL
NOT TO SCALE



INFILTRATION BASIN DETAIL
NOT TO SCALE



ROAD SECTION A-A
NOT TO SCALE

ROBIAL WATER LTD
ENGINEERING SERVICES

85 Courtland Street
Providence, RI 02909

P: +1 (508) 954 0677
E: jay@robialwater.com

CONSULTANTS:

STEPHEN A. HAAS, P.E.
293 Cranview Road
Brewster, MA 02631
(508) 367-1691

No.	REVISION/SUBMISSION	DATE

PROJECT No. SW2022.010

SHEET TITLE:

SEDIMENT & EROSION CONTROL PLAN

SHEET SIZE: 18 IN. X 24 IN. (ARCH C)

DATE: 6 June 2022

SHEET NUMBER:

SHEET 5 of 5

PROJECT:

RESIDENTIAL DEVELOPMENT

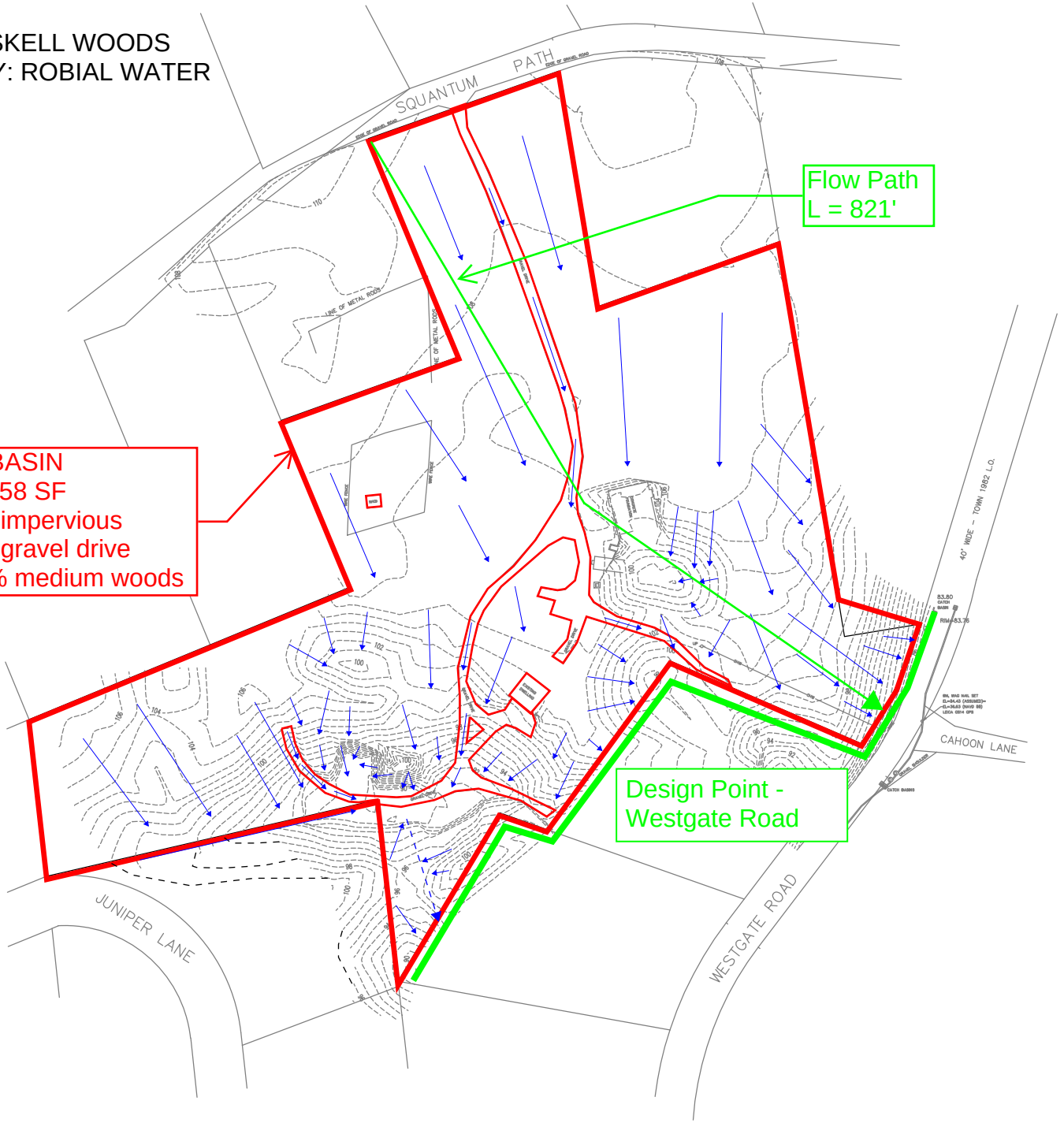
CONSTRUCTION DRAWINGS
PENDING TOWN APPROVAL

16 Squantum Path
Harwich, MA 02493

Appendix A: Hydrologic Sub-basin Maps

EXISTING HYDROLOGIC SUBBASIN MAP

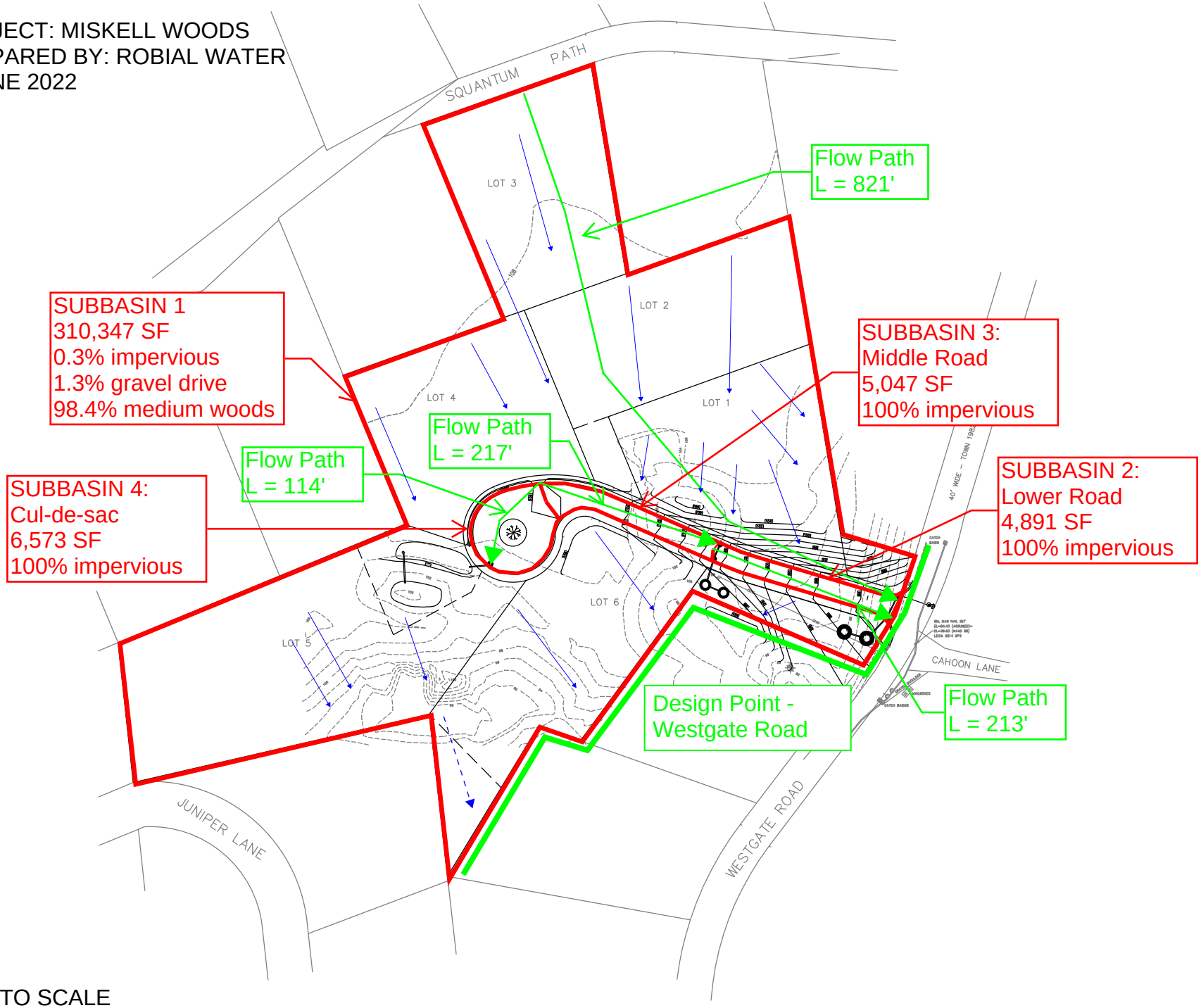
PROJECT: MISKELL WOODS
PREPARED BY: ROBIAL WATER
2 JUNE 2022



NOT TO SCALE

PROPOSED HYDROLOGIC SUBBASIN MAP

PROJECT: MISKELL WOODS
PREPARED BY: ROBIAL WATER
2 JUNE 2022



NOT TO SCALE

Appendix B: Soil Data

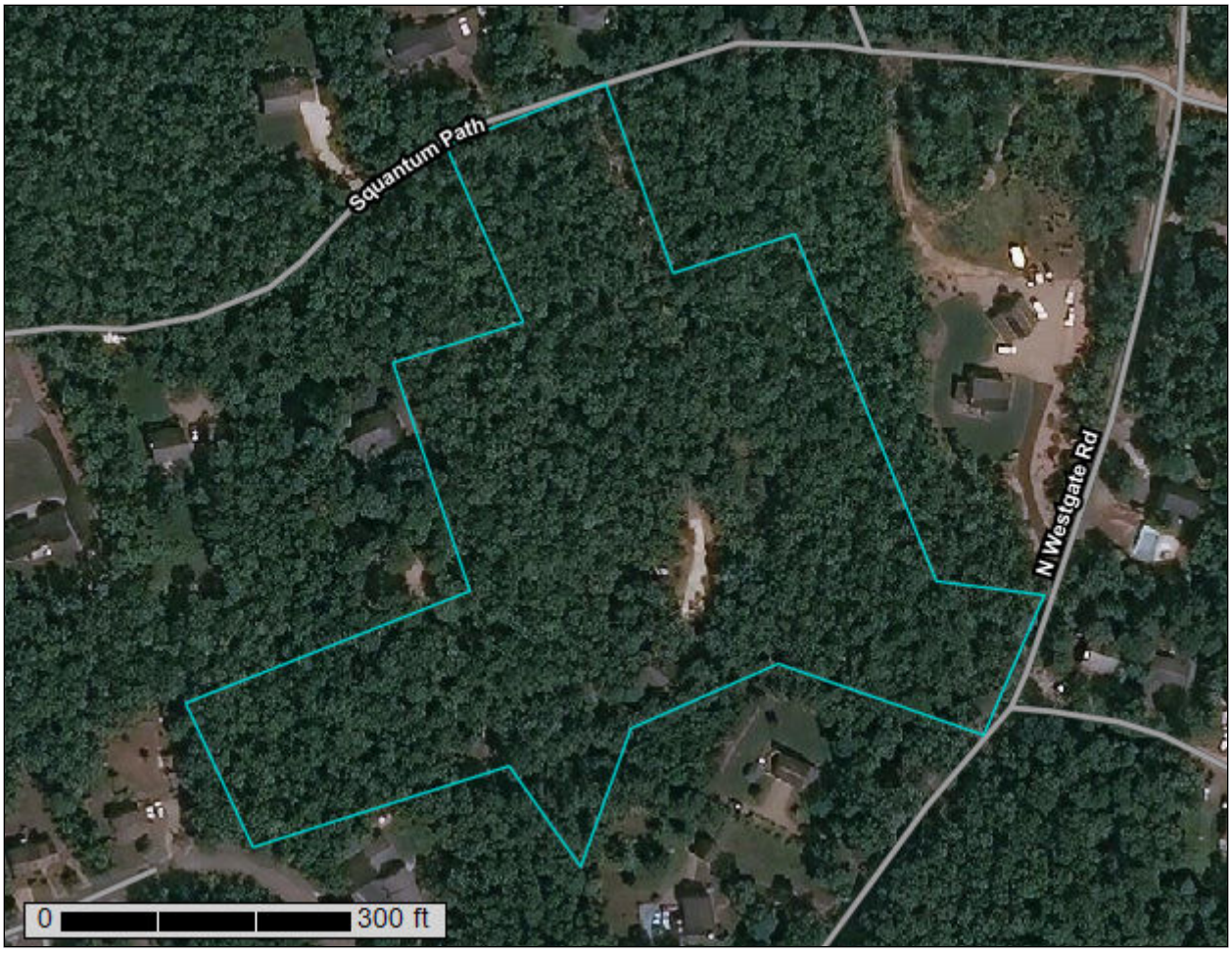
United States Department of Agriculture

NRCS

Natural Resources Conservation Service

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

Custom Soil Resource Report for Barnstable County, Massachusetts



April 3, 2022

Preface

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

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

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

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

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

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

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require

alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

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

Custom Soil Resource Report
Soil Map

Map Scale: 1:2,080 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 30 60 120 180

Feet
0 100 200 400 600

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 19N 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 1:25,000.

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: Barnstable County, Massachusetts
Survey Area Data: Version 18, Sep 1, 2021

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

Date(s) aerial images were photographed: Jul 10, 2018—Nov 17, 2018

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
252A	Carver coarse sand, 0 to 3 percent slopes	4.1	57.6%
252B	Carver coarse sand, 3 to 8 percent slopes	1.1	15.9%
252C	Carver coarse sand, 8 to 15 percent slopes	1.5	21.2%
252D	Carver coarse sand, 15 to 35 percent slopes	0.4	5.3%
Totals for Area of Interest		**7.1**	**100.0%**

Map Unit Descriptions

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

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

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

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

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

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

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

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

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

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

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

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

Barnstable County, Massachusetts

252A—Carver coarse sand, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2y07w
Elevation: 0 to 990 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Carver, coarse sand, and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Carver, Coarse Sand

Setting

Landform: Moraines, outwash plains
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Side slope, crest, tread
Down-slope shape: Convex, linear
Across-slope shape: Linear
Parent material: Sandy glaciofluvial deposits

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
Oe - 2 to 3 inches: moderately decomposed plant material
A - 3 to 7 inches: coarse sand
E - 7 to 10 inches: coarse sand
Bw1 - 10 to 15 inches: coarse sand
Bw2 - 15 to 28 inches: coarse sand
BC - 28 to 32 inches: coarse sand
C - 32 to 67 inches: coarse sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 14.17 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 4.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3s
Hydrologic Soil Group: A
Ecological site: F149BY005MA - Dry Outwash

Hydric soil rating: No

Minor Components

Deerfield

Percent of map unit: 10 percent
Landform: Outwash deltas, outwash terraces, outwash plains, kame terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Concave
Hydric soil rating: No

Hinckley

Percent of map unit: 5 percent
Landform: Moraines, eskers, kames, outwash deltas, outwash terraces, outwash plains, kame terraces
Landform position (two-dimensional): Summit, toeslope, shoulder, backslope, footslope
Landform position (three-dimensional): Nose slope, head slope, crest, side slope, riser, tread
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Merrimac

Percent of map unit: 3 percent
Landform: Kame terraces, outwash deltas, outwash terraces
Landform position (three-dimensional): Riser, tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Mashpee

Percent of map unit: 2 percent
Landform: Depressions, drainageways, terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

252B—Carver coarse sand, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2y07x
Elevation: 0 to 240 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Carver, coarse sand, and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Carver, Coarse Sand

Setting

Landform: Moraines, outwash plains
Landform position (two-dimensional): Summit, shoulder, backslope, footslope, toeslope
Landform position (three-dimensional): Side slope, nose slope, head slope, crest, tread
Down-slope shape: Convex, linear
Across-slope shape: Linear
Parent material: Sandy glaciofluvial deposits

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
Oe - 2 to 3 inches: moderately decomposed plant material
A - 3 to 7 inches: coarse sand
E - 7 to 10 inches: coarse sand
Bw1 - 10 to 15 inches: coarse sand
Bw2 - 15 to 28 inches: coarse sand
BC - 28 to 32 inches: coarse sand
C - 32 to 67 inches: coarse sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 14.17 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 4.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3s
Hydrologic Soil Group: A
Ecological site: F149BY005MA - Dry Outwash
Hydric soil rating: No

Minor Components

Deerfield

Percent of map unit: 10 percent
Landform: Outwash terraces, outwash plains, kame terraces, outwash deltas
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Concave
Hydric soil rating: No

Hinckley

Percent of map unit: 5 percent
Landform: Moraines, eskers, kames, outwash deltas, outwash terraces, outwash plains, kame terraces
Landform position (two-dimensional): Summit, toeslope, shoulder, backslope, footslope
Landform position (three-dimensional): Side slope, crest, head slope, nose slope, riser, tread
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Merrimac

Percent of map unit: 3 percent
Landform: Kame terraces, outwash deltas, outwash terraces
Landform position (three-dimensional): Riser, tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Mashpee

Percent of map unit: 2 percent
Landform: Depressions, drainageways, terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

252C—Carver coarse sand, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2y07z
Elevation: 0 to 250 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Carver, coarse sand, and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Carver, Coarse Sand

Setting

Landform: Moraines, outwash plains
Landform position (two-dimensional): Shoulder, footslope, backslope
Landform position (three-dimensional): Crest, head slope, nose slope, side slope, riser

Down-slope shape: Convex, linear
Across-slope shape: Linear
Parent material: Sandy glaciofluvial deposits

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
Oe - 2 to 3 inches: moderately decomposed plant material
A - 3 to 7 inches: coarse sand
E - 7 to 10 inches: coarse sand
Bw1 - 10 to 15 inches: coarse sand
Bw2 - 15 to 28 inches: coarse sand
BC - 28 to 32 inches: coarse sand
C - 32 to 67 inches: coarse sand

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 14.17 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 4.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: A
Ecological site: F149BY005MA - Dry Outwash
Hydric soil rating: No

Minor Components

Deerfield

Percent of map unit: 10 percent
Landform: Kame terraces, outwash deltas, outwash terraces, outwash plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Concave
Hydric soil rating: No

Hinckley

Percent of map unit: 5 percent
Landform: Eskers, kames, outwash deltas, outwash terraces, moraines, outwash plains, kame terraces
Landform position (two-dimensional): Footslope, shoulder, backslope, summit, toeslope
Landform position (three-dimensional): Nose slope, side slope, crest, head slope, riser, tread
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Merrimac

Percent of map unit: 5 percent
Landform: Kame terraces, outwash deltas, outwash terraces
Landform position (three-dimensional): Riser, tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

252D—Carver coarse sand, 15 to 35 percent slopes

Map Unit Setting

National map unit symbol: 2y07y
Elevation: 0 to 220 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 250 days
Farmland classification: Not prime farmland

Map Unit Composition

Carver, coarse sand, and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Carver, Coarse Sand

Setting

Landform: Moraines, outwash plains
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Head slope, nose slope, side slope, riser
Down-slope shape: Convex, linear
Across-slope shape: Linear
Parent material: Sandy glaciofluvial deposits

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
Oe - 2 to 3 inches: moderately decomposed plant material
A - 3 to 7 inches: coarse sand
E - 7 to 10 inches: coarse sand
Bw1 - 10 to 15 inches: coarse sand
Bw2 - 15 to 28 inches: coarse sand
BC - 28 to 32 inches: coarse sand
C - 32 to 67 inches: coarse sand

Properties and qualities

Slope: 15 to 35 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 14.17 in/hr)

Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 4.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Ecological site: F149BY005MA - Dry Outwash
Hydric soil rating: No

Minor Components

Deerfield

Percent of map unit: 10 percent
Landform: Outwash terraces, outwash plains, kame terraces, outwash deltas
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Concave
Hydric soil rating: No

Hinckley

Percent of map unit: 5 percent
Landform: Moraines, eskers, kames, outwash deltas, outwash terraces, outwash plains, kame terraces
Landform position (two-dimensional): Summit, toeslope, shoulder, backslope, footslope
Landform position (three-dimensional): Crest, head slope, nose slope, side slope, tread, riser
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Merrimac

Percent of map unit: 3 percent
Landform: Kame terraces, outwash deltas, outwash terraces
Landform position (three-dimensional): Tread, riser
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Freetown, coastal lowland

Percent of map unit: 2 percent
Landform: Bogs, marshes, swamps
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

References

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Appendix C: TSS Removal Worksheets

INSTRUCTIONS:
1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Version 1, Automated: Mar. 4, 2008

Location: Cul-de-sac Bioretention Areas

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Deep Sump and Hooded Catch Basin	0.25	1.00	0.25	0.75
Oil Grit Separator	0.25	0.75	0.19	0.56
Bioretention Area	0.90	0.56	0.51	0.06
	0.00	0.06	0.00	0.06
	0.00	0.06	0.00	0.06

Total TSS Removal = 94%

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: Miskell Woods
Prepared By: Robial Water, LTD
Date: 6/1/2022

*Equals remaining load from previous BMP (E) which enters the BMP

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed
1. From MassDEP Stormwater Handbook Vol. 1

INSTRUCTIONS:
1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Version 1, Automated: Mar. 4, 2008

Location: Cul-de-sac (Pretreatment)

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Deep Sump and Hooded Catch Basin	0.25	1.00	0.25	0.75
Oil Grit Separator	0.25	0.75	0.19	0.56
	0.00	0.56	0.00	0.56
	0.00	0.56	0.00	0.56
	0.00	0.56	0.00	0.56

Total TSS Removal = 44%

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: Miskell Woods
Prepared By: Robial Water, LTD
Date: 6/1/2022

*Equals remaining load from previous BMP (E) which enters the BMP

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed
1. From MassDEP Stormwater Handbook Vol. 1

INSTRUCTIONS:
1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Version 1, Automated: Mar. 4, 2008

Location: Infiltration Basins (Middle of Road)

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Deep Sump and Hooded Catch Basin	0.25	1.00	0.25	0.75
Oil Grit Separator	0.25	0.75	0.19	0.56
Infiltration Basin	0.80	0.56	0.45	0.11
	0.00	0.11	0.00	0.11
	0.00	0.11	0.00	0.11

Total TSS Removal = 89%

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: Miskell Woods
Prepared By: Robial Water, LTD
Date: 6/1/2022

*Equals remaining load from previous BMP (E) which enters the BMP

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed
1. From MassDEP Stormwater Handbook Vol. 1

INSTRUCTIONS:
1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Version 1, Automated: Mar. 4, 2008

Location: Middle of Road (Pretreatment)

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Deep Sump and Hooded Catch Basin	0.25	1.00	0.25	0.75
Oil Grit Separator	0.25	0.75	0.19	0.56
	0.00	0.56	0.00	0.56
	0.00	0.56	0.00	0.56
	0.00	0.56	0.00	0.56

Total TSS Removal = 44%

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: Miskell Woods
Prepared By: Robial Water, LTD
Date: 6/1/2022

*Equals remaining load from previous BMP (E) which enters the BMP

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed
1. From MassDEP Stormwater Handbook Vol. 1

INSTRUCTIONS:
1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Version 1, Automated: Mar. 4, 2008

Location: Infiltration Basins (Lower Road)

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Deep Sump and Hooded Catch Basin	0.25	1.00	0.25	0.75
Oil Grit Separator	0.25	0.75	0.19	0.56
Infiltration Basin	0.80	0.56	0.45	0.11
	0.00	0.11	0.00	0.11
	0.00	0.11	0.00	0.11

Total TSS Removal = 89%

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: Miskell Woods
Prepared By: Robial Water, LTD
Date: 6/1/2022

*Equals remaining load from previous BMP (E) which enters the BMP

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed

1. From MassDEP Stormwater Handbook Vol. 1

INSTRUCTIONS:
1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Version 1, Automated: Mar. 4, 2008

Location: Lower Road (Pretreatment)

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Deep Sump and Hooded Catch Basin	0.25	1.00	0.25	0.75
Oil Grit Separator	0.25	0.75	0.19	0.56
	0.00	0.56	0.00	0.56
	0.00	0.56	0.00	0.56
	0.00	0.56	0.00	0.56

Total TSS Removal = 44%

Separate Form Needs to be Completed for Each Outlet or BMP Train

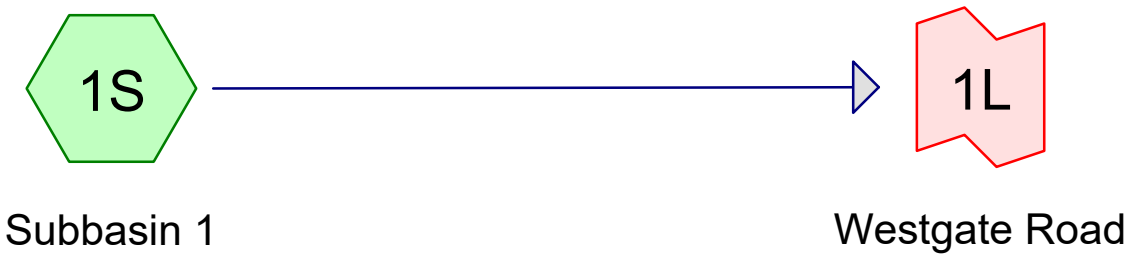
Project: Miskell Woods
Prepared By: Robial Water, LTD
Date: 6/1/2022

*Equals remaining load from previous BMP (E) which enters the BMP

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed

1. From MassDEP Stormwater Handbook Vol. 1

Appendix D: HydroCAD Printouts



Subcat Reach Pond Link

Routing Diagram for Miskell Woods Existing_2022.04.22
Prepared by Robial Water LTD, Printed 4/22/2022

Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	1" Storm	Type III 24-hr		Default	24.00	1	1.00	2
2	2 yr Storm	Type III 24-hr		Default	24.00	1	3.20	2
3	10 yr Storm	Type III 24-hr		Default	24.00	1	4.63	2
4	25 yr Storm	Type III 24-hr		Default	24.00	1	5.52	2
5	100 yr Storm	Type III 24-hr		Default	24.00	1	6.90	2

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
16,796	76	Gravel roads, HSG A (1S)
1,348	98	Unconnected roofs, HSG A (1S)
308,714	43	Woods/grass comb., Fair, HSG A (1S)
326,858	**45**	**TOTAL AREA**

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
326,858	HSG A	1S
0	HSG B	
0	HSG C	
0	HSG D	
0	Other	
326,858		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Su Nu
16,796	0	0	0	0	16,796	Gravel roads	
1,348	0	0	0	0	1,348	Unconnected roofs	
308,714	0	0	0	0	308,714	Woods/grass comb., Fair	
326,858	**0**	**0**	**0**	**0**	**326,858**	**TOTAL AREA**	

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

Subcatchment 1S: Subbasin 1 Runoff Area=326,858 sf 0.41% Impervious Runoff Depth=0.00"
Flow Length=821' Slope=0.0207 '/' Tc=19.0 min CN=45 Runoff=0.00 cfs 0 cf

Link 1L: Westgate Road Inflow=0.00 cfs 0 cf
Primary=0.00 cfs 0 cf

Total Runoff Area = 326,858 sf Runoff Volume = 0 cf Average Runoff Depth = 0.00"
99.59% Pervious = 325,510 sf 0.41% Impervious = 1,348 sf

Summary for Subcatchment 1S: Subbasin 1

[45] Hint: Runoff=Zero

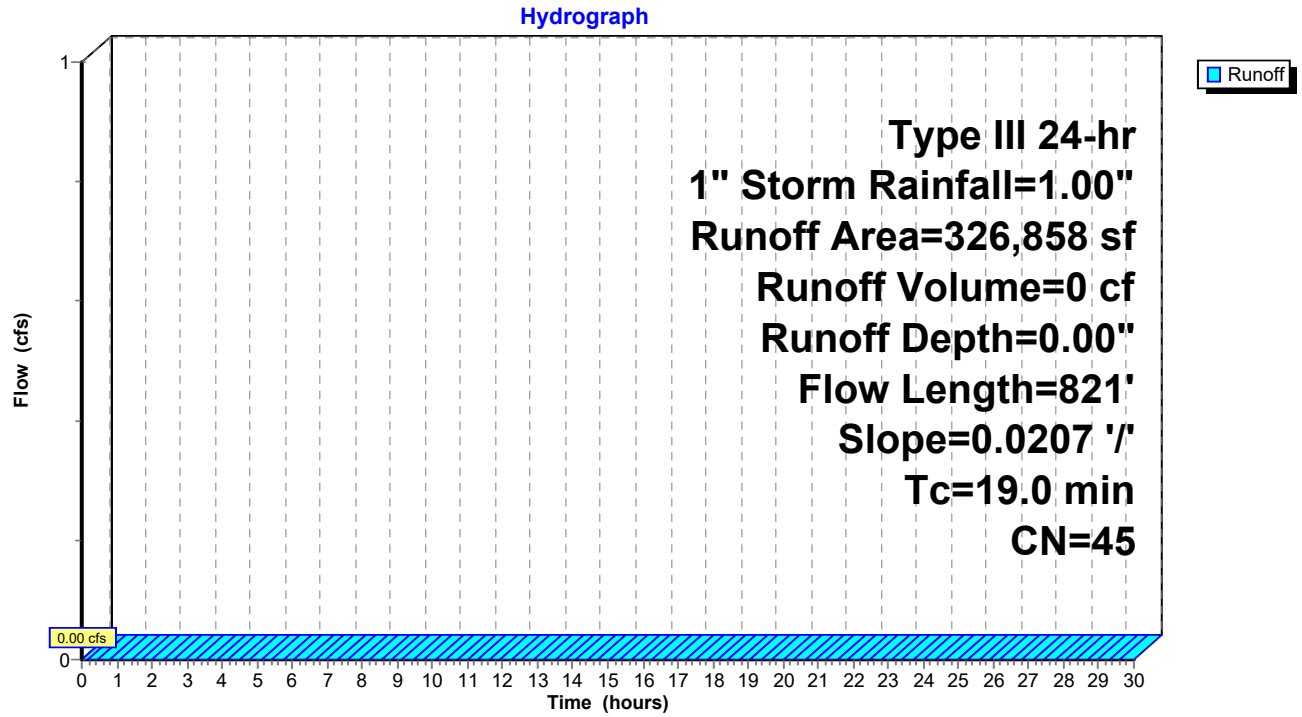
Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Depth= 0.00"
Routed to Link 1L : Westgate Road

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 1" Storm Rainfall=1.00"

Area (sf)	CN	Description
1,348	98	Unconnected roofs, HSG A
16,796	76	Gravel roads, HSG A
308,714	43	Woods/grass comb., Fair, HSG A
326,858	45	Weighted Average
325,510		99.59% Pervious Area
1,348		0.41% Impervious Area
1,348		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.0	821	0.0207	0.72		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps

Subcatchment 1S: Subbasin 1

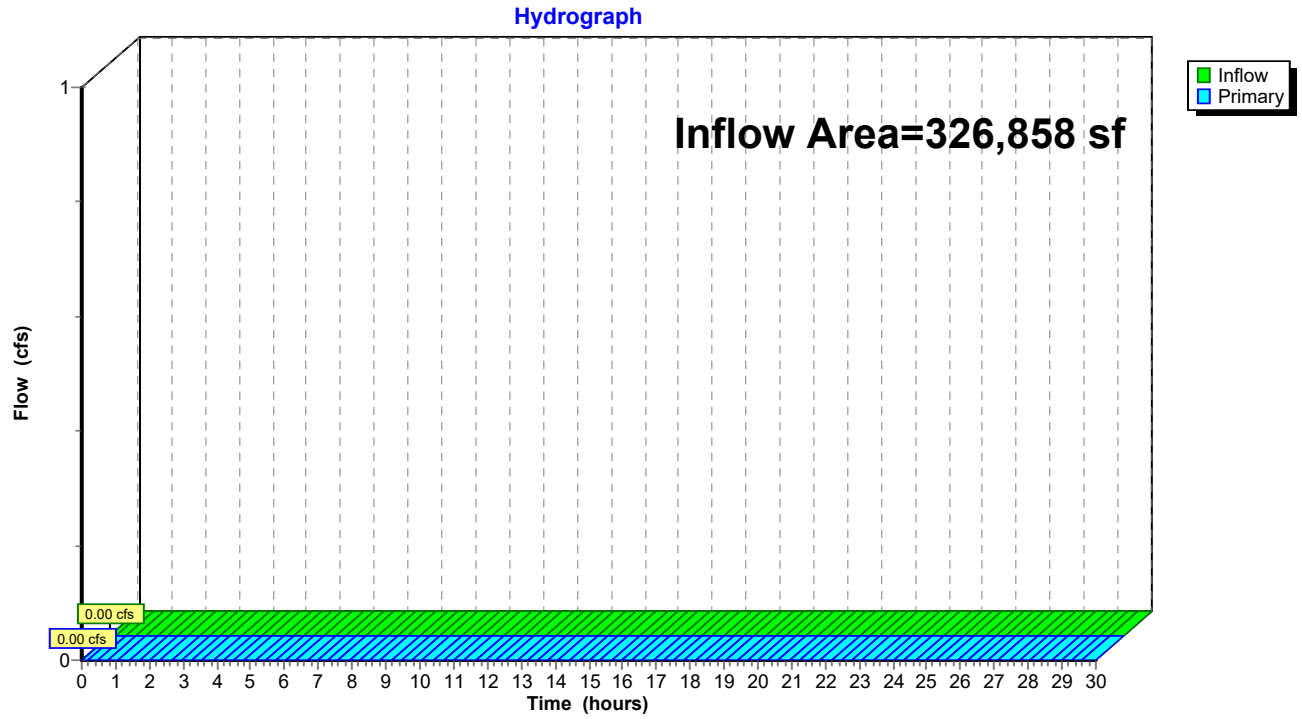


Summary for Link 1L: Westgate Road

Inflow Area = 326,858 sf, 0.41% Impervious, Inflow Depth = 0.00" for 1" Storm event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

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

Link 1L: Westgate Road



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

Subcatchment 1S: Subbasin 1 Runoff Area=326,858 sf 0.41% Impervious Runoff Depth=0.04"
Flow Length=821' Slope=0.0207 '/' Tc=19.0 min CN=45 Runoff=0.04 cfs 1,198 cf

Link 1L: Westgate Road Inflow=0.04 cfs 1,198 cf
Primary=0.04 cfs 1,198 cf

Total Runoff Area = 326,858 sf Runoff Volume = 1,198 cf Average Runoff Depth = 0.04"
99.59% Pervious = 325,510 sf 0.41% Impervious = 1,348 sf

Summary for Subcatchment 1S: Subbasin 1

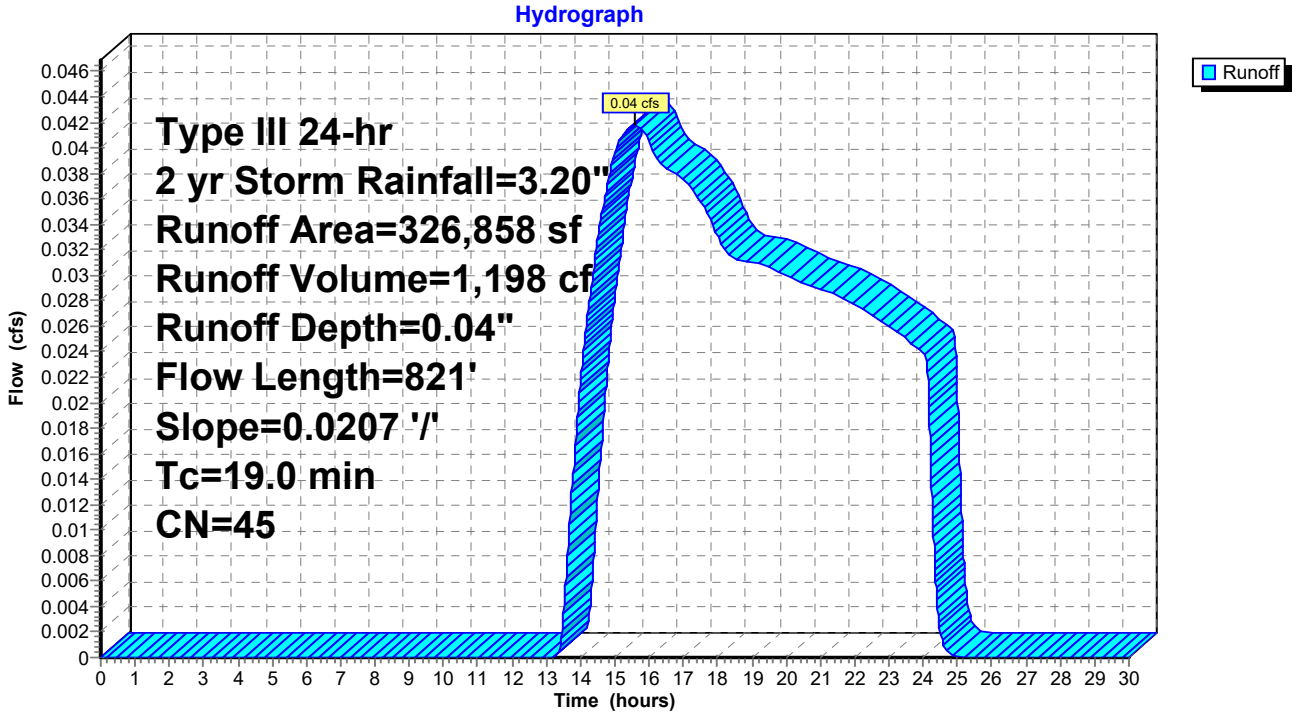
Runoff = 0.04 cfs @ 15.56 hrs, Volume= 1,198 cf, Depth= 0.04"
Routed to Link 1L : Westgate Road

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 yr Storm Rainfall=3.20"

Area (sf)	CN	Description
1,348	98	Unconnected roofs, HSG A
16,796	76	Gravel roads, HSG A
308,714	43	Woods/grass comb., Fair, HSG A
326,858	45	Weighted Average
325,510		99.59% Pervious Area
1,348		0.41% Impervious Area
1,348		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.0	821	0.0207	0.72		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps

Subcatchment 1S: Subbasin 1

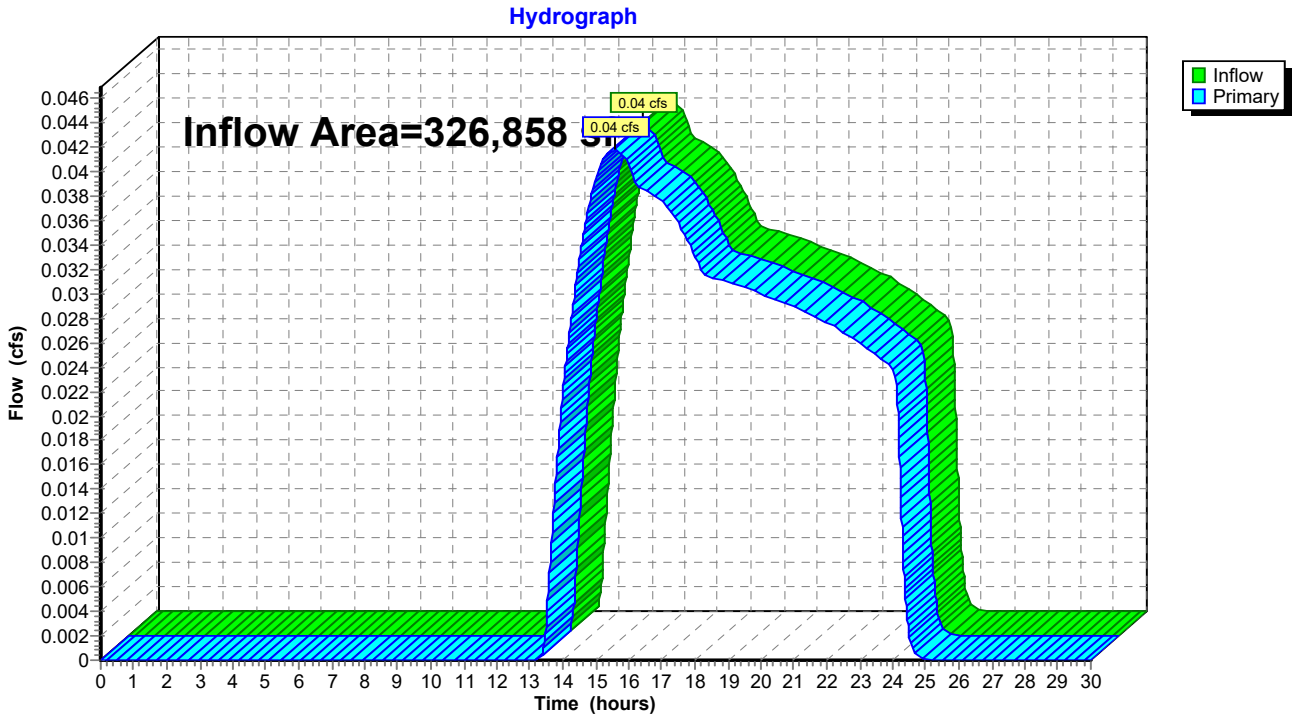


Summary for Link 1L: Westgate Road

Inflow Area = 326,858 sf, 0.41% Impervious, Inflow Depth = 0.04" for 2 yr Storm event
Inflow = 0.04 cfs @ 15.56 hrs, Volume= 1,198 cf
Primary = 0.04 cfs @ 15.56 hrs, Volume= 1,198 cf, Atten= 0%, Lag= 0.0 min

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

Link 1L: Westgate Road



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

Subcatchment 1S: Subbasin 1 Runoff Area=326,858 sf 0.41% Impervious Runoff Depth=0.33"
Flow Length=821' Slope=0.0207 '/' Tc=19.0 min CN=45 Runoff=0.81 cfs 9,030 cf

Link 1L: Westgate Road Inflow=0.81 cfs 9,030 cf
Primary=0.81 cfs 9,030 cf

Total Runoff Area = 326,858 sf Runoff Volume = 9,030 cf Average Runoff Depth = 0.33"
99.59% Pervious = 325,510 sf 0.41% Impervious = 1,348 sf

Summary for Subcatchment 1S: Subbasin 1

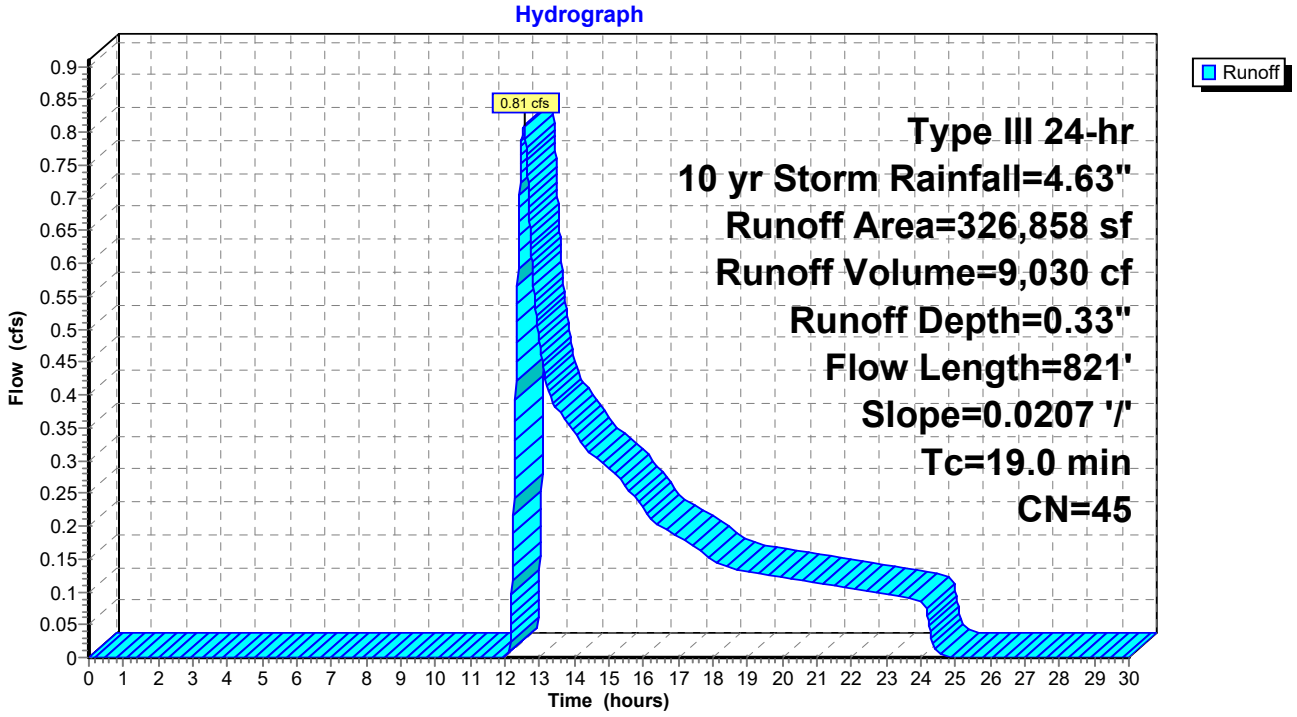
Runoff = 0.81 cfs @ 12.55 hrs, Volume= 9,030 cf, Depth= 0.33"
Routed to Link 1L : Westgate Road

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 yr Storm Rainfall=4.63"

Area (sf)	CN	Description
1,348	98	Unconnected roofs, HSG A
16,796	76	Gravel roads, HSG A
308,714	43	Woods/grass comb., Fair, HSG A
326,858	45	Weighted Average
325,510		99.59% Pervious Area
1,348		0.41% Impervious Area
1,348		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.0	821	0.0207	0.72		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps

Subcatchment 1S: Subbasin 1

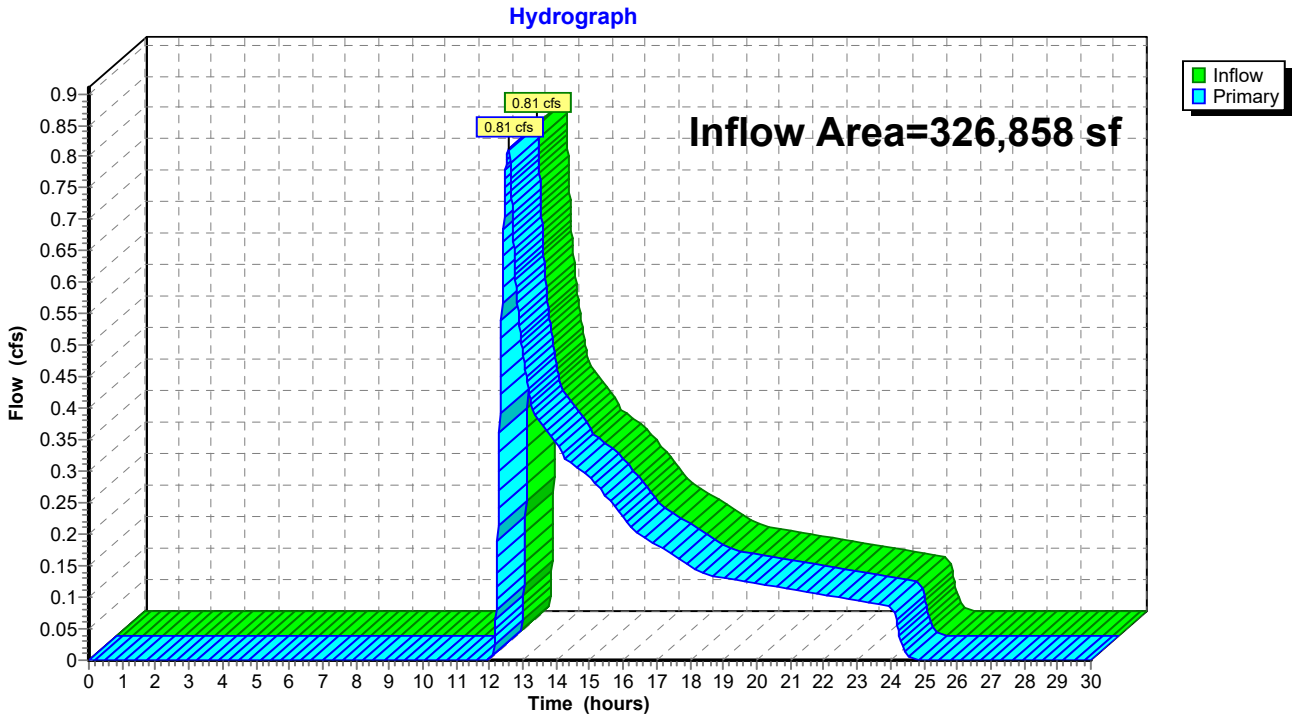


Summary for Link 1L: Westgate Road

Inflow Area = 326,858 sf, 0.41% Impervious, Inflow Depth = 0.33" for 10 yr Storm event
Inflow = 0.81 cfs @ 12.55 hrs, Volume= 9,030 cf
Primary = 0.81 cfs @ 12.55 hrs, Volume= 9,030 cf, Atten= 0%, Lag= 0.0 min

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

Link 1L: Westgate Road



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

Subcatchment 1S: Subbasin 1 Runoff Area=326,858 sf 0.41% Impervious Runoff Depth=0.62"
Flow Length=821' Slope=0.0207 '/' Tc=19.0 min CN=45 Runoff=2.12 cfs 16,842 cf

Link 1L: Westgate Road Inflow=2.12 cfs 16,842 cf
Primary=2.12 cfs 16,842 cf

Total Runoff Area = 326,858 sf Runoff Volume = 16,842 cf Average Runoff Depth = 0.62"
99.59% Pervious = 325,510 sf 0.41% Impervious = 1,348 sf

Summary for Subcatchment 1S: Subbasin 1

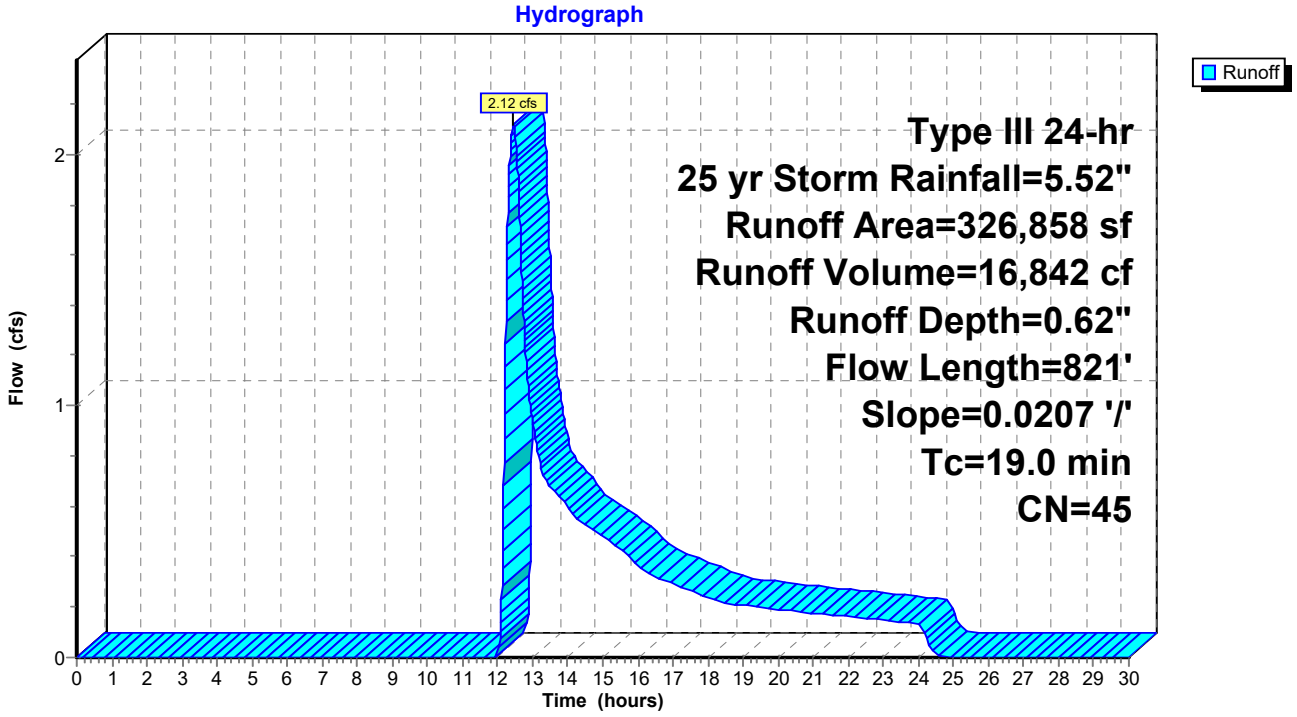
Runoff = 2.12 cfs @ 12.44 hrs, Volume= 16,842 cf, Depth= 0.62"
Routed to Link 1L : Westgate Road

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 yr Storm Rainfall=5.52"

Area (sf)	CN	Description
1,348	98	Unconnected roofs, HSG A
16,796	76	Gravel roads, HSG A
308,714	43	Woods/grass comb., Fair, HSG A
326,858	45	Weighted Average
325,510		99.59% Pervious Area
1,348		0.41% Impervious Area
1,348		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.0	821	0.0207	0.72		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps

Subcatchment 1S: Subbasin 1

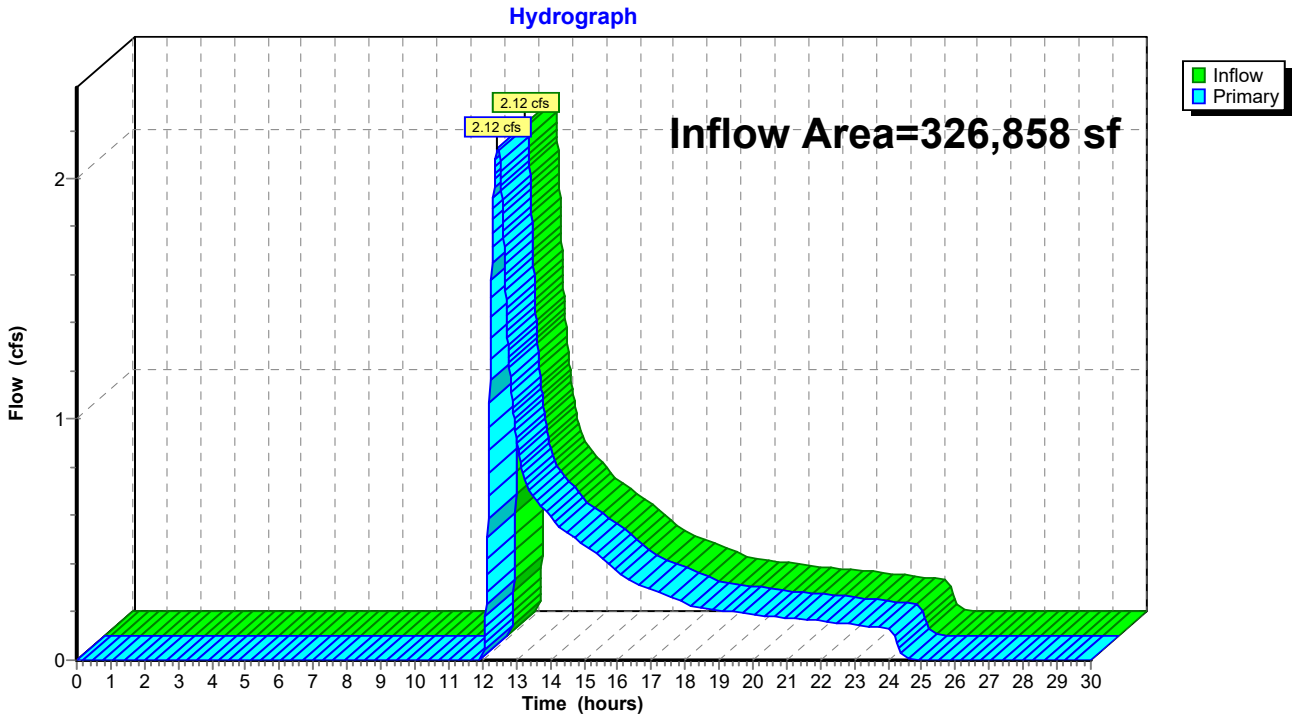


Summary for Link 1L: Westgate Road

Inflow Area = 326,858 sf, 0.41% Impervious, Inflow Depth = 0.62" for 25 yr Storm event
Inflow = 2.12 cfs @ 12.44 hrs, Volume= 16,842 cf
Primary = 2.12 cfs @ 12.44 hrs, Volume= 16,842 cf, Atten= 0%, Lag= 0.0 min

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

Link 1L: Westgate Road



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

Subcatchment 1S: Subbasin 1 Runoff Area=326,858 sf 0.41% Impervious Runoff Depth=1.19"
Flow Length=821' Slope=0.0207 '/' Tc=19.0 min CN=45 Runoff=5.36 cfs 32,422 cf

Link 1L: Westgate Road Inflow=5.36 cfs 32,422 cf
Primary=5.36 cfs 32,422 cf

Total Runoff Area = 326,858 sf Runoff Volume = 32,422 cf Average Runoff Depth = 1.19"
99.59% Pervious = 325,510 sf 0.41% Impervious = 1,348 sf

Summary for Subcatchment 1S: Subbasin 1

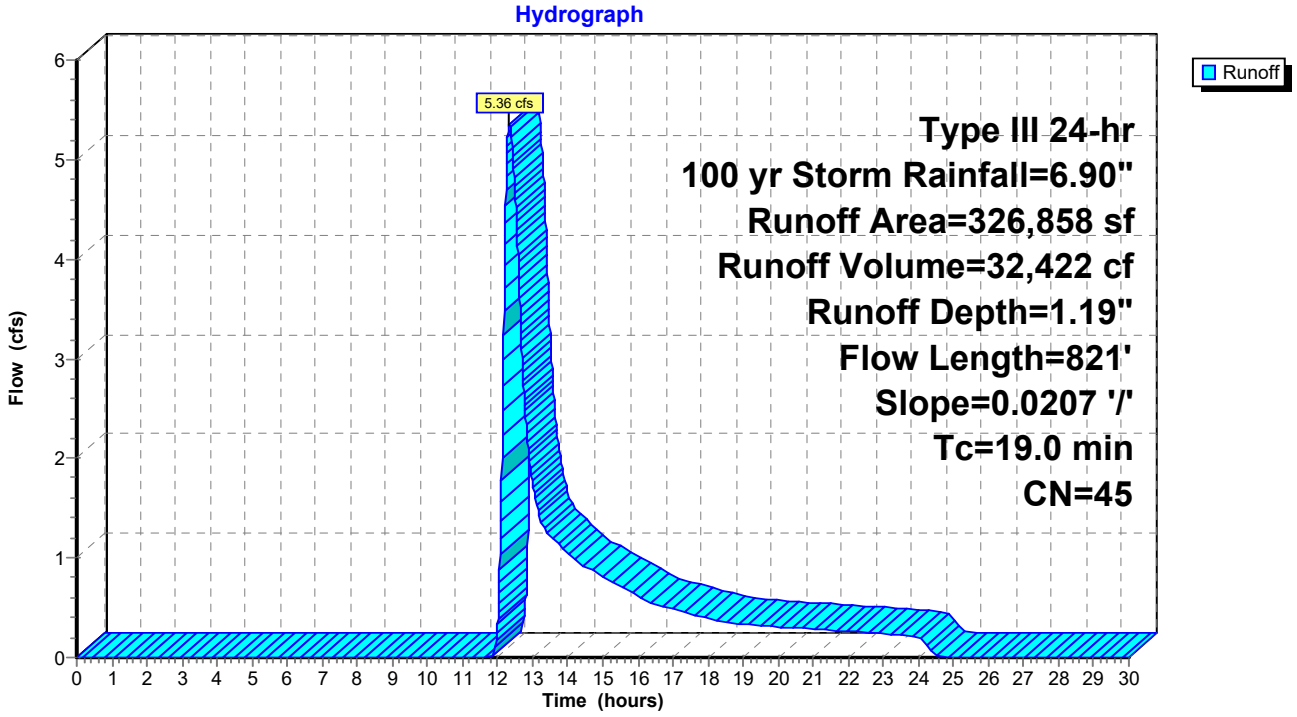
Runoff = 5.36 cfs @ 12.34 hrs, Volume= 32,422 cf, Depth= 1.19"
Routed to Link 1L : Westgate Road

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 yr Storm Rainfall=6.90"

Area (sf)	CN	Description
1,348	98	Unconnected roofs, HSG A
16,796	76	Gravel roads, HSG A
308,714	43	Woods/grass comb., Fair, HSG A
326,858	45	Weighted Average
325,510		99.59% Pervious Area
1,348		0.41% Impervious Area
1,348		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.0	821	0.0207	0.72		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps

Subcatchment 1S: Subbasin 1

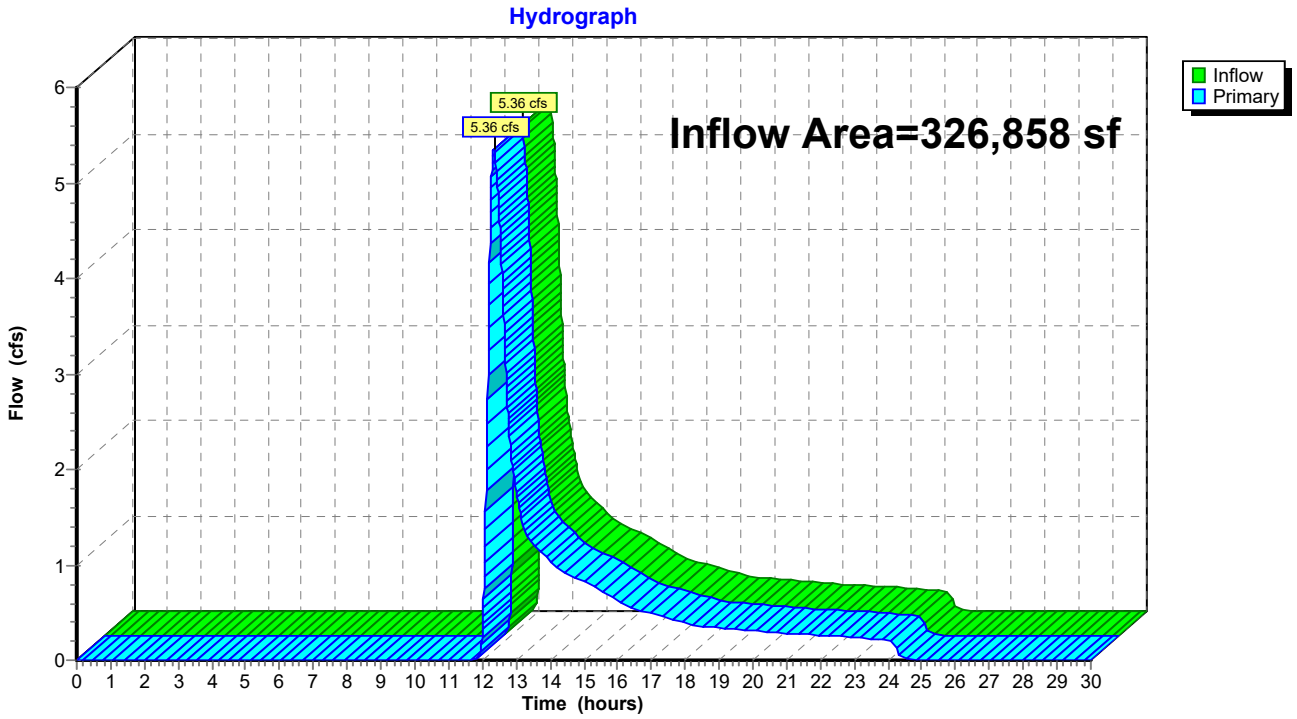


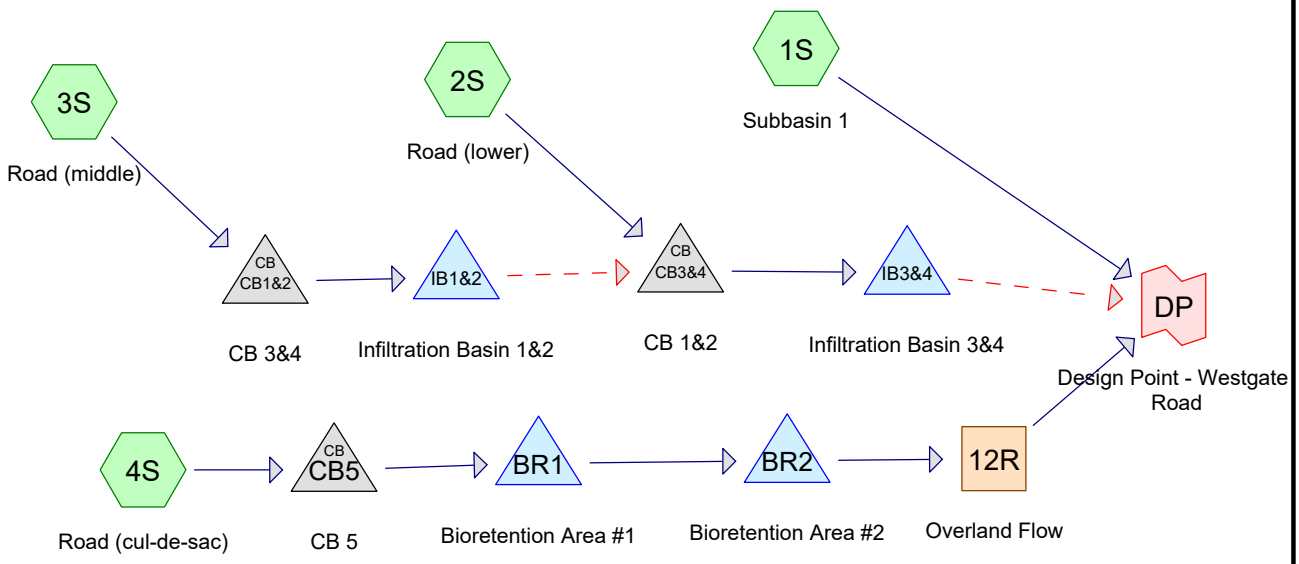
Summary for Link 1L: Westgate Road

Inflow Area = 326,858 sf, 0.41% Impervious, Inflow Depth = 1.19" for 100 yr Storm event
Inflow = 5.36 cfs @ 12.34 hrs, Volume= 32,422 cf
Primary = 5.36 cfs @ 12.34 hrs, Volume= 32,422 cf, Atten= 0%, Lag= 0.0 min

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

Link 1L: Westgate Road





Subcat Reach Pond Link

Routing Diagram for Miskell Woods Proposed_2022.04.22
Prepared by Robial Water LTD, Printed 4/22/2022

Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	1" Storm	Type III 24-hr		Default	24.00	1	1.00	2
2	2 yr Storm	Type III 24-hr		Default	24.00	1	3.20	2
3	10 yr Storm	Type III 24-hr		Default	24.00	1	4.63	2
4	25 yr Storm	Type III 24-hr		Default	24.00	1	5.52	2
5	100 yr Storm	Type III 24-hr		Default	24.00	1	6.90	2

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
4,000	76	Gravel roads, HSG A (1S)
16,511	98	Paved roads w/curbs & sewers, HSG A (2S, 3S, 4S)
980	98	Unconnected roofs, HSG A (1S)
305,367	43	Woods/grass comb., Fair, HSG A (1S)
326,858	**46**	**TOTAL AREA**

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
326,858	HSG A	1S, 2S, 3S, 4S
0	HSG B	
0	HSG C	
0	HSG D	
0	Other	
326,858		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover
4,000	0	0	0	0	4,000	Gravel roads
16,511	0	0	0	0	16,511	Paved roads w/curbs & sewers
980	0	0	0	0	980	Unconnected roofs
305,367	0	0	0	0	305,367	Woods/grass comb., Fair
326,858	**0**	**0**	**0**	**0**	**326,858**	**TOTAL AREA**

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)
1	BR1	103.00	101.05	10.0	0.1950	0.010	0.0	12.0	0.0
2	BR2	100.00	99.00	10.0	0.1000	0.010	0.0	12.0	0.0
3	CB1&2	93.00	92.50	25.0	0.0200	0.010	0.0	12.0	0.0
4	CB3&4	81.00	80.50	25.0	0.0200	0.010	0.0	12.0	0.0
5	CB5	102.00	101.50	20.0	0.0250	0.010	0.0	12.0	0.0

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points x 9
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment1S: Subbasin 1 Runoff Area=310,347 sf 0.32% Impervious Runoff Depth=0.00"
Flow Length=821' Slope=0.0207 '/' Tc=19.0 min CN=44 Runoff=0.00 cfs 0 cf

Subcatchment2S: Road (lower) Runoff Area=4,891 sf 100.00% Impervious Runoff Depth=0.79"
Flow Length=213' Slope=0.0470 '/' Tc=1.6 min CN=98 Runoff=0.12 cfs 322 cf

Subcatchment3S: Road (middle) Runoff Area=5,047 sf 100.00% Impervious Runoff Depth=0.79"
Flow Length=217' Slope=0.0420 '/' Tc=1.7 min CN=98 Runoff=0.12 cfs 333 cf

Subcatchment4S: Road (cul-de-sac) Runoff Area=6,573 sf 100.00% Impervious Runoff Depth=0.79"
Flow Length=114' Slope=0.0100 '/' Tc=1.8 min CN=98 Runoff=0.16 cfs 433 cf

Reach 12R: Overland Flow Avg. Flow Depth=0.00' Max Vel=0.00 fps Inflow=0.00 cfs 0 cf
n=0.400 L=220.0' S=0.0409 '/' Capacity=809,595.25 cfs Outflow=0.00 cfs 0 cf

Pond BR1: Bioretention Area #1 Peak Elev=99.12' Storage=47 cf Inflow=0.16 cfs 433 cf
Discarded=0.06 cfs 433 cf Primary=0.00 cfs 0 cf Outflow=0.06 cfs 433 cf

Pond BR2: Bioretention Area #2 Peak Elev=96.00' Storage=0 cf Inflow=0.00 cfs 0 cf
Discarded=0.00 cfs 0 cf Primary=0.00 cfs 0 cf Outflow=0.00 cfs 0 cf

Pond CB1&2: CB 3&4 Peak Elev=93.15' Inflow=0.12 cfs 333 cf
12.0" Round Culvert n=0.010 L=25.0' S=0.0200 '/' Outflow=0.12 cfs 333 cf

Pond CB3&4: CB 1&2 Peak Elev=81.16' Inflow=0.12 cfs 322 cf
12.0" Round Culvert n=0.010 L=25.0' S=0.0200 '/' Outflow=0.12 cfs 322 cf

Pond CB5: CB 5 Peak Elev=102.20' Inflow=0.16 cfs 433 cf
12.0" Round Culvert n=0.010 L=20.0' S=0.0250 '/' Outflow=0.16 cfs 433 cf

Pond IB1&2: Infiltration Basin 1&2 Peak Elev=88.21' Storage=103 cf Inflow=0.12 cfs 333 cf
Discarded=0.02 cfs 333 cf Secondary=0.00 cfs 0 cf Outflow=0.02 cfs 333 cf

Pond IB3&4: Infiltration Basin 3&4 Peak Elev=75.83' Storage=71 cf Inflow=0.12 cfs 322 cf
Discarded=0.02 cfs 322 cf Secondary=0.00 cfs 0 cf Outflow=0.02 cfs 322 cf

Link DP: Design Point - Westgate Road Inflow=0.00 cfs 0 cf
Primary=0.00 cfs 0 cf

Total Runoff Area = 326,858 sf Runoff Volume = 1,088 cf Average Runoff Depth = 0.04"
94.65% Pervious = 309,367 sf 5.35% Impervious = 17,491 sf

Summary for Subcatchment 1S: Subbasin 1

[45] Hint: Runoff=Zero

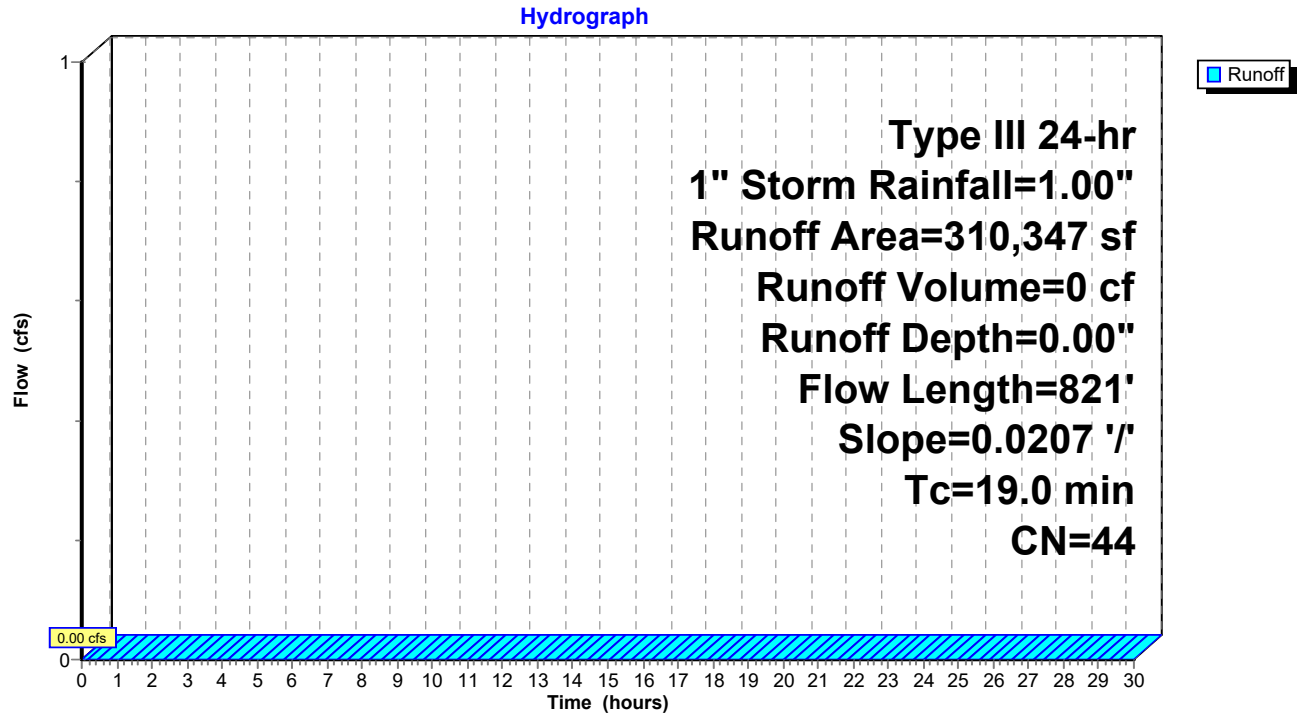
Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Depth= 0.00"
Routed to Link DP : Design Point - Westgate Road

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 1" Storm Rainfall=1.00"

Area (sf)	CN	Description
980	98	Unconnected roofs, HSG A
4,000	76	Gravel roads, HSG A
305,367	43	Woods/grass comb., Fair, HSG A
310,347	44	Weighted Average
309,367		99.68% Pervious Area
980		0.32% Impervious Area
980		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.0	821	0.0207	0.72		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps

Subcatchment 1S: Subbasin 1



Summary for Subcatchment 2S: Road (lower)

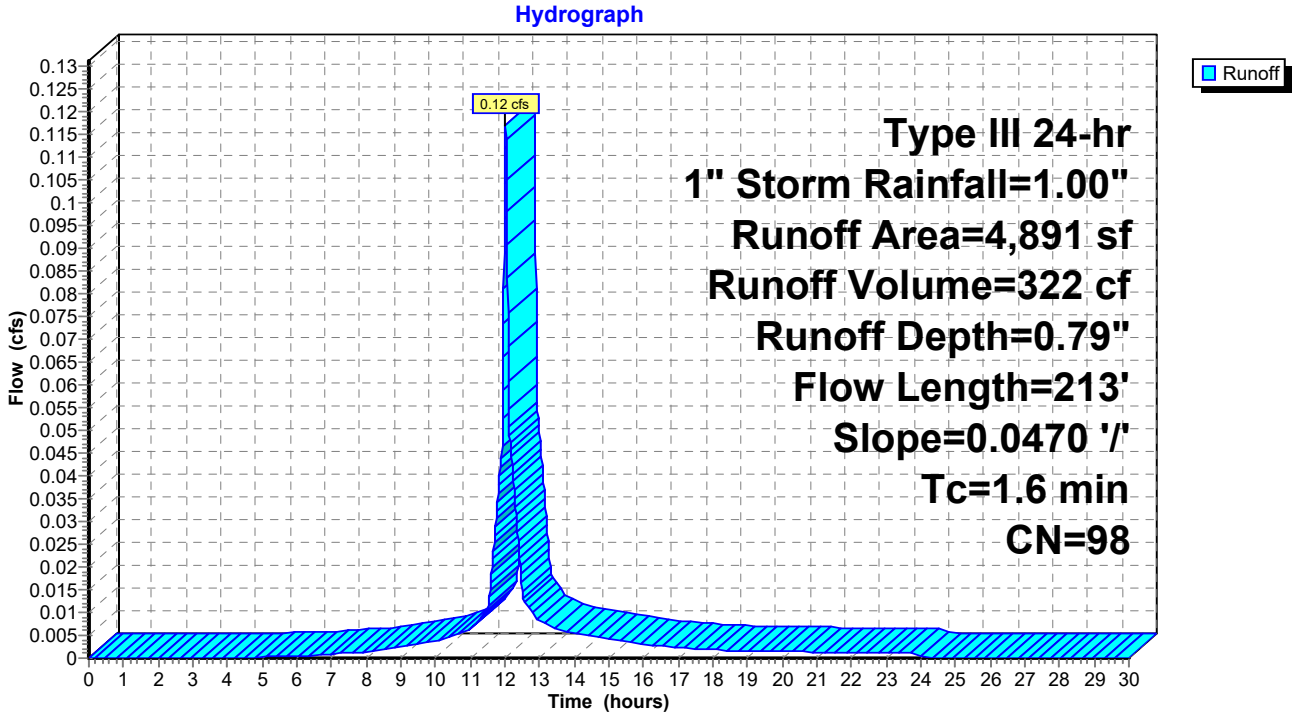
Runoff = 0.12 cfs @ 12.02 hrs, Volume= 322 cf, Depth= 0.79"
Routed to Pond CB3&4 : CB 1&2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 1" Storm Rainfall=1.00"

Area (sf)	CN	Description
4,891	98	Paved roads w/curbs & sewers, HSG A
4,891		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.6	213	0.0470	2.25		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20"

Subcatchment 2S: Road (lower)



Summary for Subcatchment 3S: Road (middle)

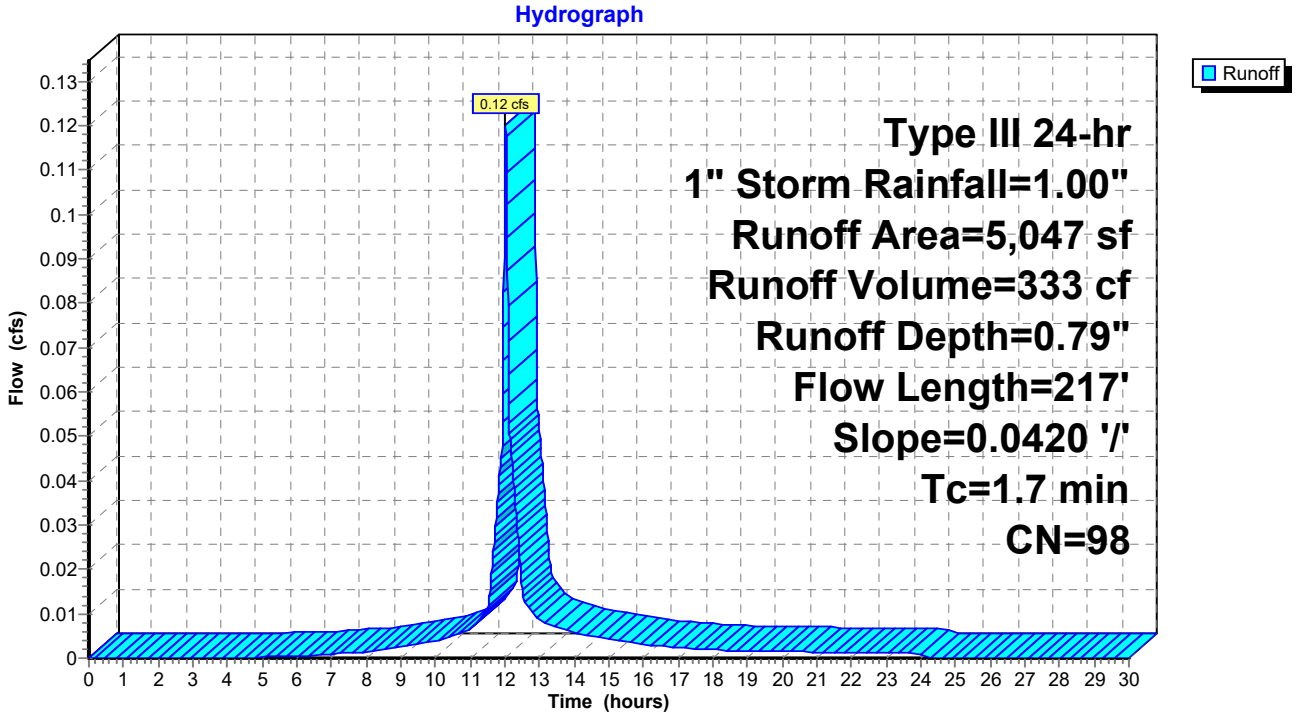
Runoff = 0.12 cfs @ 12.03 hrs, Volume= 333 cf, Depth= 0.79"
Routed to Pond CB1&2 : CB 3&4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 1" Storm Rainfall=1.00"

Area (sf)	CN	Description
5,047	98	Paved roads w/curbs & sewers, HSG A
5,047		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.7	217	0.0420	2.16		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20"

Subcatchment 3S: Road (middle)



Summary for Subcatchment 4S: Road (cul-de-sac)

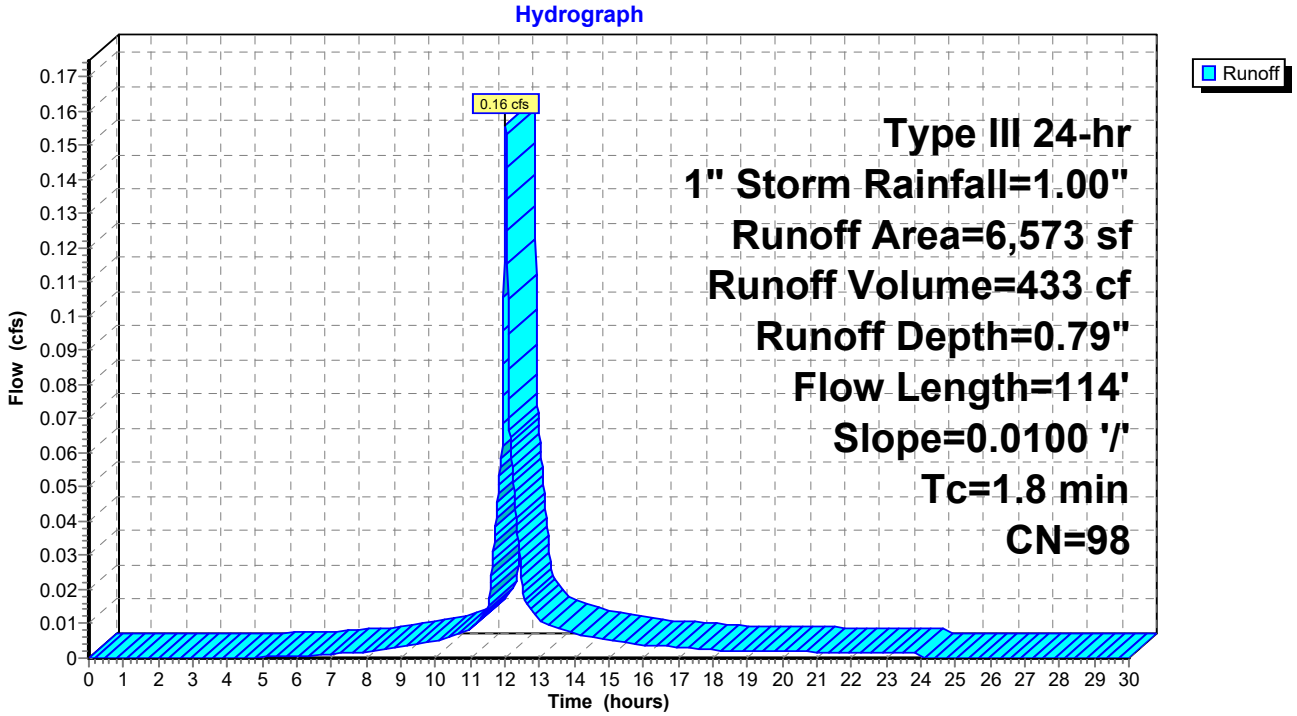
Runoff = 0.16 cfs @ 12.03 hrs, Volume= 433 cf, Depth= 0.79"
Routed to Pond CB5 : CB 5

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 1" Storm Rainfall=1.00"

Area (sf)	CN	Description
6,573	98	Paved roads w/curbs & sewers, HSG A
6,573		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.8	114	0.0100	1.07		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20"

Subcatchment 4S: Road (cul-de-sac)



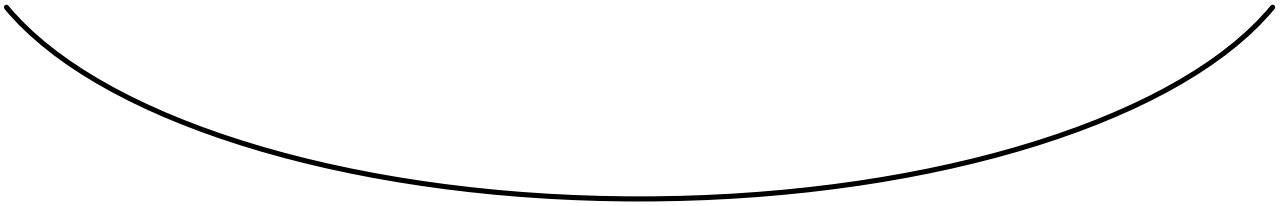
Summary for Reach 12R: Overland Flow

Inflow Area = 6,573 sf,100.00% Impervious, Inflow Depth = 0.00" for 1" Storm event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min
Routed to Link DP : Design Point - Westgate Road

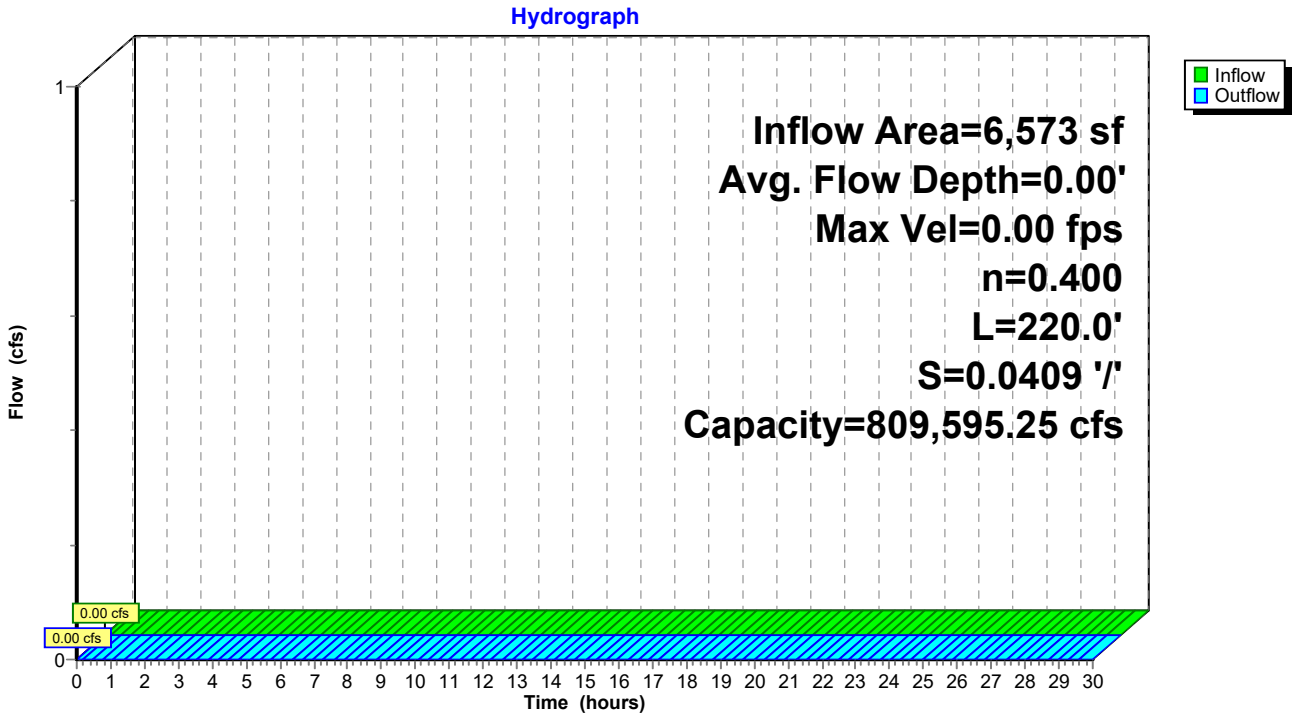
Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 9
Max. Velocity= 0.00 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 0.00 fps, Avg. Travel Time= 0.0 min

Peak Storage= 0 cf @ 0.00 hrs
Average Depth at Peak Storage= 0.00'
Bank-Full Depth= 100.00' Flow Area= 66,666.7 sf, Capacity= 809,595.25 cfs

1,000.00' x 100.00' deep Parabolic Channel, n= 0.400 Sheet flow: Woods+light brush
Length= 220.0' Slope= 0.0409 '/'
Inlet Invert= 99.00', Outlet Invert= 90.00'



‡



Summary for Pond BR1: Bioretention Area #1

Inflow Area = 6,573 sf,100.00% Impervious, Inflow Depth = 0.79" for 1" Storm event
Inflow = 0.16 cfs @ 12.03 hrs, Volume= 433 cf
Outflow = 0.06 cfs @ 12.20 hrs, Volume= 433 cf, Atten= 63%, Lag= 10.1 min
Discarded = 0.06 cfs @ 12.20 hrs, Volume= 433 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Pond BR2 : Bioretention Area #2

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 9
Peak Elev= 99.12' @ 12.20 hrs Surf.Area= 1,043 sf Storage= 47 cf

Plug-Flow detention time= 4.0 min calculated for 433 cf (100% of inflow)
Center-of-Mass det. time= 4.0 min (788.0 - 784.0)

Volume	Invert	Avail.Storage	Storage Description
#1	99.00'	2,984 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

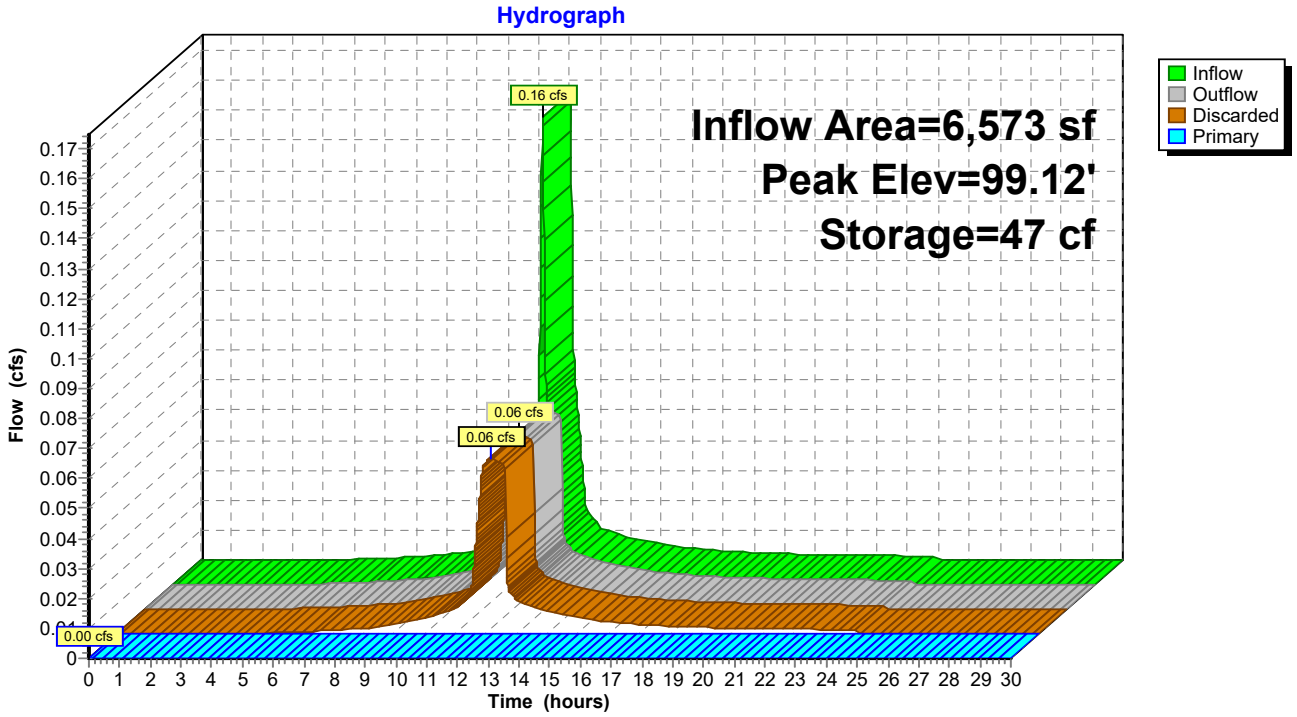
Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
99.00	1,000	0.0	0	0	1,000
100.00	1,400	40.0	478	478	1,418
102.50	1,500	5.0	181	659	1,770
104.00	1,600	100.0	2,325	2,984	2,002

Device	Routing	Invert	Outlet Devices
#0	Primary	104.00'	**Automatic Storage Overflow** (Discharged without head)
#1	Discarded	99.00'	**2.410 in/hr Exfiltration over Wetted area** Phase-In= 0.01'
#2	Primary	103.00'	**12.0" Round CMP_Round 12"** L= 10.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 103.00' / 101.05' S= 0.1950 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf

Discarded OutFlow Max=0.06 cfs @ 12.20 hrs HW=99.12' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.06 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=99.00' TW=96.00' (Dynamic Tailwater)
↑**2=CMP_Round 12"** (Controls 0.00 cfs)

Pond BR1: Bioretention Area #1



Summary for Pond BR2: Bioretention Area #2

Inflow Area = 6,573 sf,100.00% Impervious, Inflow Depth = 0.00" for 1" Storm event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min
Discarded = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Reach 12R : Overland Flow

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 9
Peak Elev= 96.00' @ 0.00 hrs Surf.Area= 700 sf Storage= 0 cf

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

Volume	Invert	Avail.Storage	Storage Description
#1	96.00'	2,060 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

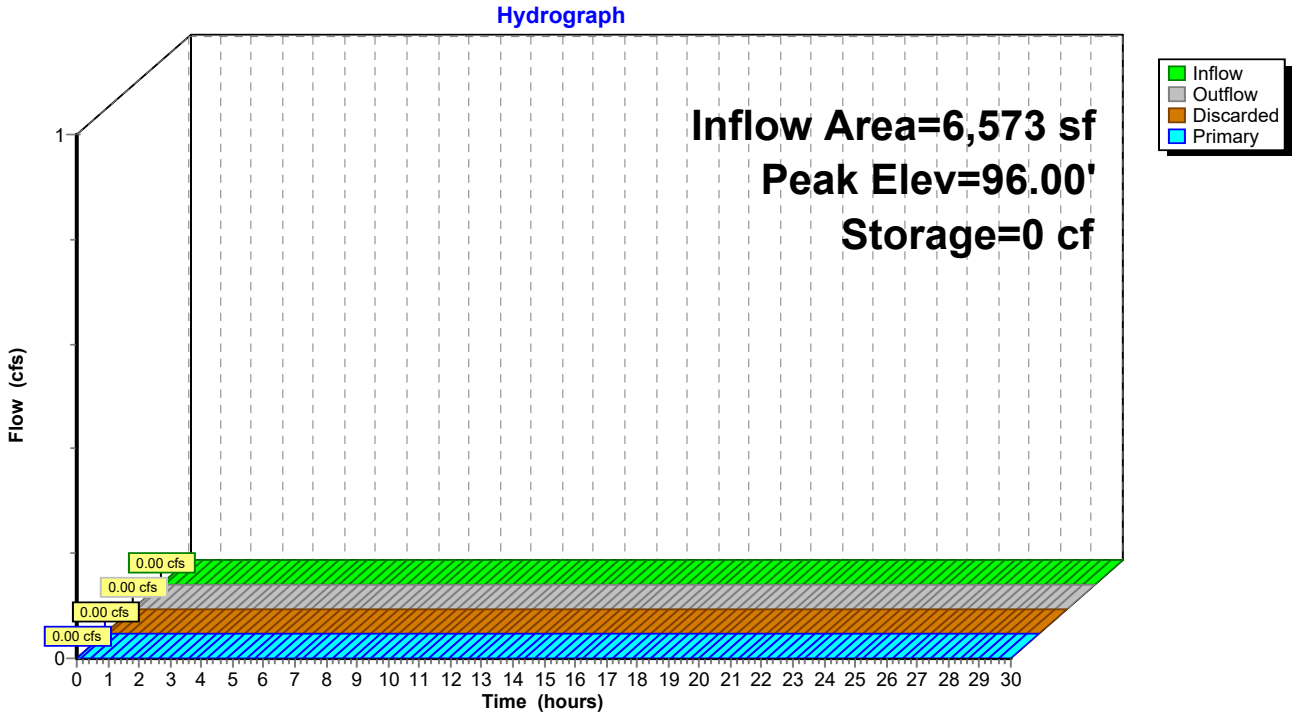
Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
96.00	700	0.0	0	0	700
97.00	800	40.0	300	300	839
99.50	1,000	5.0	112	412	1,172
101.00	1,200	100.0	1,648	2,060	1,438

Device	Routing	Invert	Outlet Devices
#0	Primary	101.00'	**Automatic Storage Overflow** (Discharged without head)
#1	Discarded	96.00'	**2.410 in/hr Exfiltration over Wetted area** Phase-In= 0.01'
#2	Primary	100.00'	**12.0" Round CMP_Round 12"** L= 10.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 100.00' / 99.00' S= 0.1000 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf

Discarded OutFlow Max=0.00 cfs @ 0.00 hrs HW=96.00' (Free Discharge)
1=Exfiltration (Controls 0.00 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=96.00' TW=99.00' (Dynamic Tailwater)
2=CMP_Round 12" (Controls 0.00 cfs)

Pond BR2: Bioretention Area #2



Summary for Pond CB1&2: CB 3&4

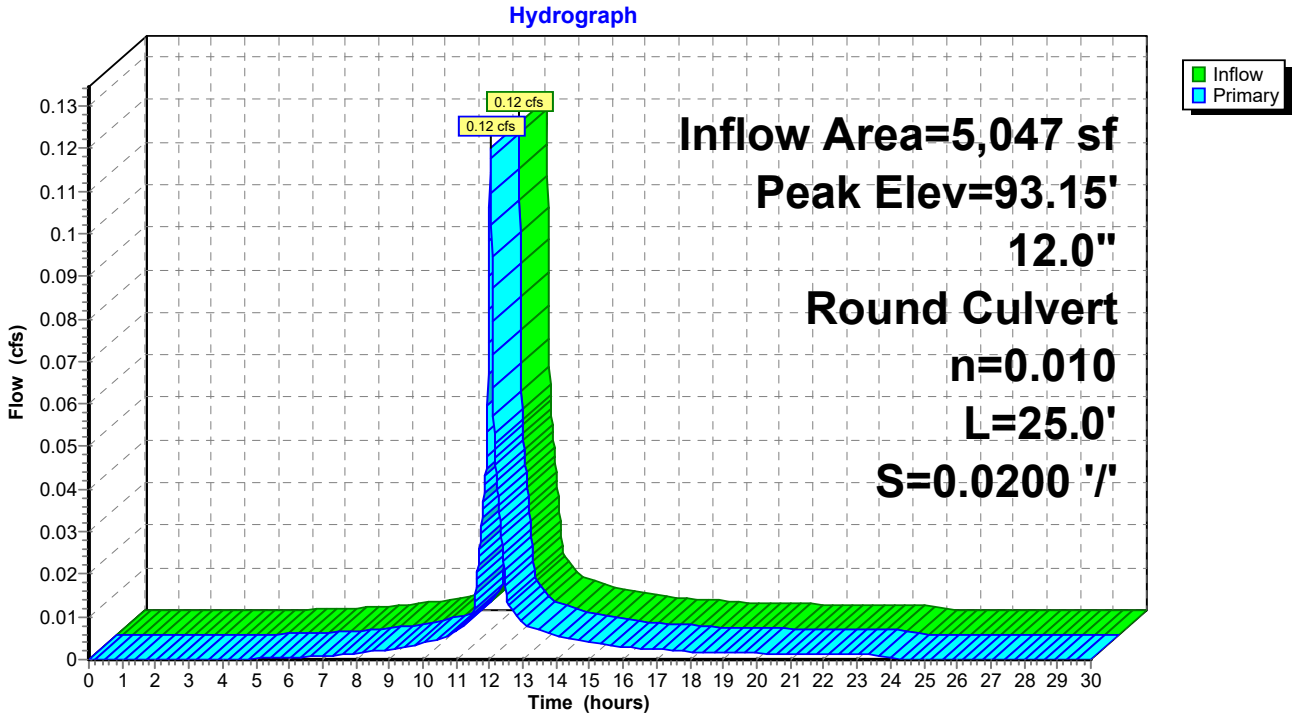
Inflow Area = 5,047 sf,100.00% Impervious, Inflow Depth = 0.79" for 1" Storm event
Inflow = 0.12 cfs @ 12.03 hrs, Volume= 333 cf
Outflow = 0.12 cfs @ 12.03 hrs, Volume= 333 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.12 cfs @ 12.03 hrs, Volume= 333 cf
Routed to Pond IB1&2 : Infiltration Basin 1&2

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 9
Peak Elev= 93.15' @ 12.03 hrs
Flood Elev= 97.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	93.00'	**12.0" Round Culvert** L= 25.0' RCP, groove end w/headwall, Ke= 0.200 Inlet / Outlet Invert= 93.00' / 92.50' S= 0.0200 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.12 cfs @ 12.03 hrs HW=93.15' TW=87.85' (Dynamic Tailwater)
1=Culvert (Inlet Controls 0.12 cfs @ 1.64 fps)

Pond CB1&2: CB 3&4



Summary for Pond CB3&4: CB 1&2

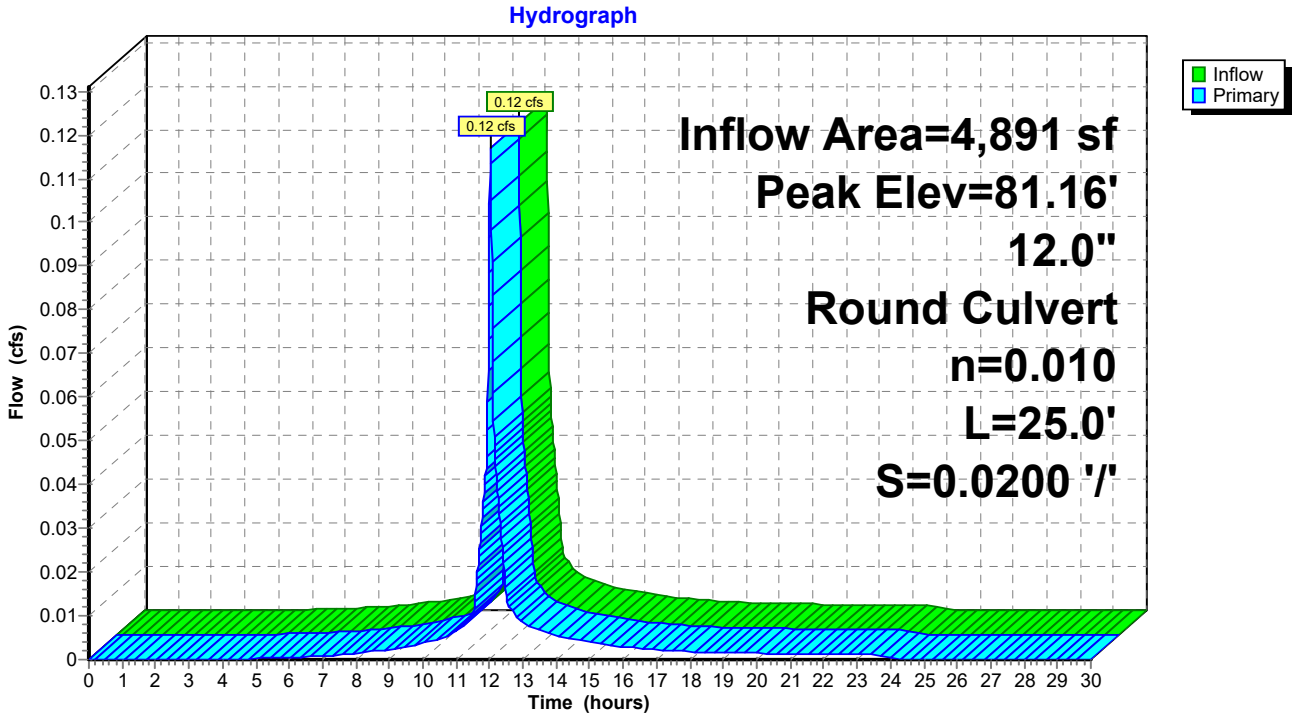
Inflow Area = 4,891 sf,100.00% Impervious, Inflow Depth = 0.79" for 1" Storm event
Inflow = 0.12 cfs @ 12.02 hrs, Volume= 322 cf
Outflow = 0.12 cfs @ 12.02 hrs, Volume= 322 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.12 cfs @ 12.02 hrs, Volume= 322 cf
Routed to Pond IB3&4 : Infiltration Basin 3&4

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 9
Peak Elev= 81.16' @ 12.02 hrs
Flood Elev= 85.15'

Device	Routing	Invert	Outlet Devices
#1	Primary	81.00'	**12.0" Round pipe** L= 25.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 81.00' / 80.50' S= 0.0200 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.12 cfs @ 12.02 hrs HW=81.16' TW=75.66' (Dynamic Tailwater)
1=pipe (Inlet Controls 0.12 cfs @ 1.38 fps)

Pond CB3&4: CB 1&2



Summary for Pond CB5: CB 5

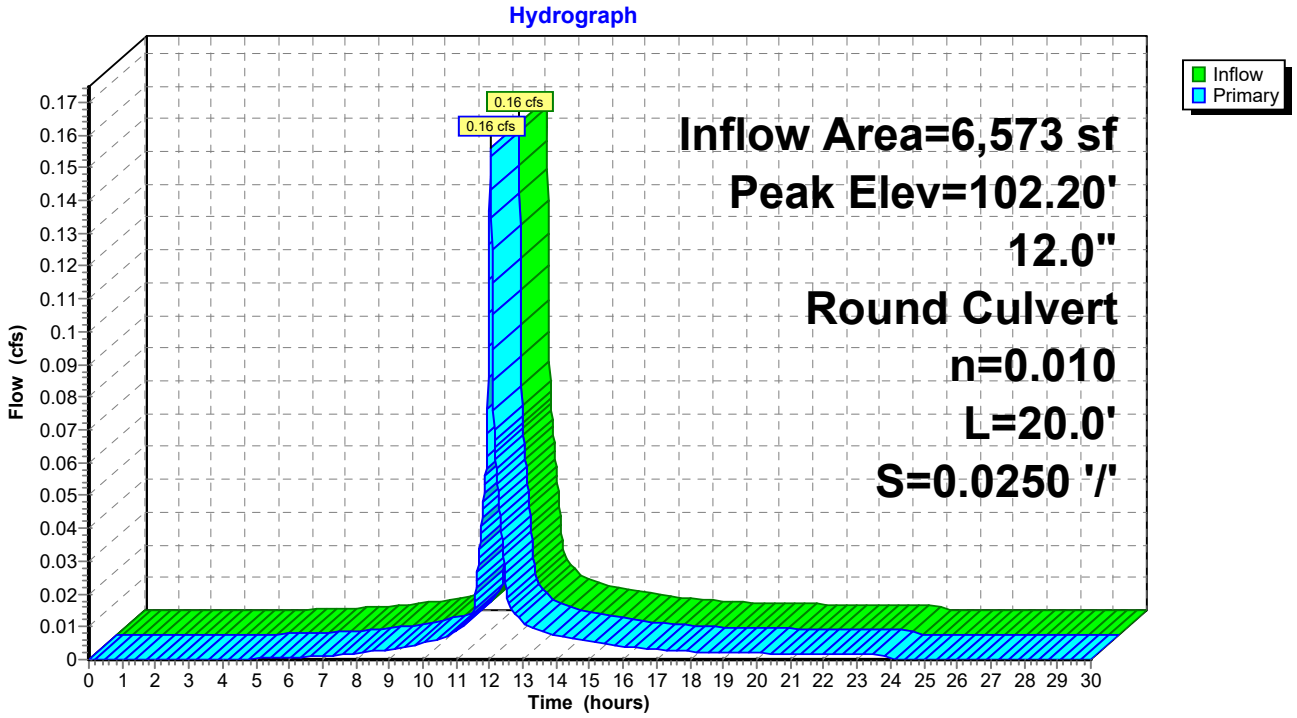
Inflow Area = 6,573 sf,100.00% Impervious, Inflow Depth = 0.79" for 1" Storm event
Inflow = 0.16 cfs @ 12.03 hrs, Volume= 433 cf
Outflow = 0.16 cfs @ 12.03 hrs, Volume= 433 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.16 cfs @ 12.03 hrs, Volume= 433 cf
Routed to Pond BR1 : Bioretention Area #1

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 9
Peak Elev= 102.20' @ 12.03 hrs
Flood Elev= 106.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	102.00'	**12.0" Round CMP_Round 12"** L= 20.0' CMP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 102.00' / 101.50' S= 0.0250 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.16 cfs @ 12.03 hrs HW=102.20' TW=99.06' (Dynamic Tailwater)
1=CMP_Round 12" (Inlet Controls 0.16 cfs @ 1.36 fps)

Pond CB5: CB 5



Summary for Pond IB1&2: Infiltration Basin 1&2

Inflow Area = 5,047 sf,100.00% Impervious, Inflow Depth = 0.79" for 1" Storm event
Inflow = 0.12 cfs @ 12.03 hrs, Volume= 333 cf
Outflow = 0.02 cfs @ 12.50 hrs, Volume= 333 cf, Atten= 87%, Lag= 28.5 min
Discarded = 0.02 cfs @ 12.50 hrs, Volume= 333 cf
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Pond CB3&4 : CB 1&2

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 9
Peak Elev= 88.21' @ 12.50 hrs Surf.Area= 226 sf Storage= 103 cf
Flood Elev= 98.00' Surf.Area= 226 sf Storage= 891 cf

Plug-Flow detention time= 44.6 min calculated for 333 cf (100% of inflow)
Center-of-Mass det. time= 44.6 min (828.4 - 783.9)

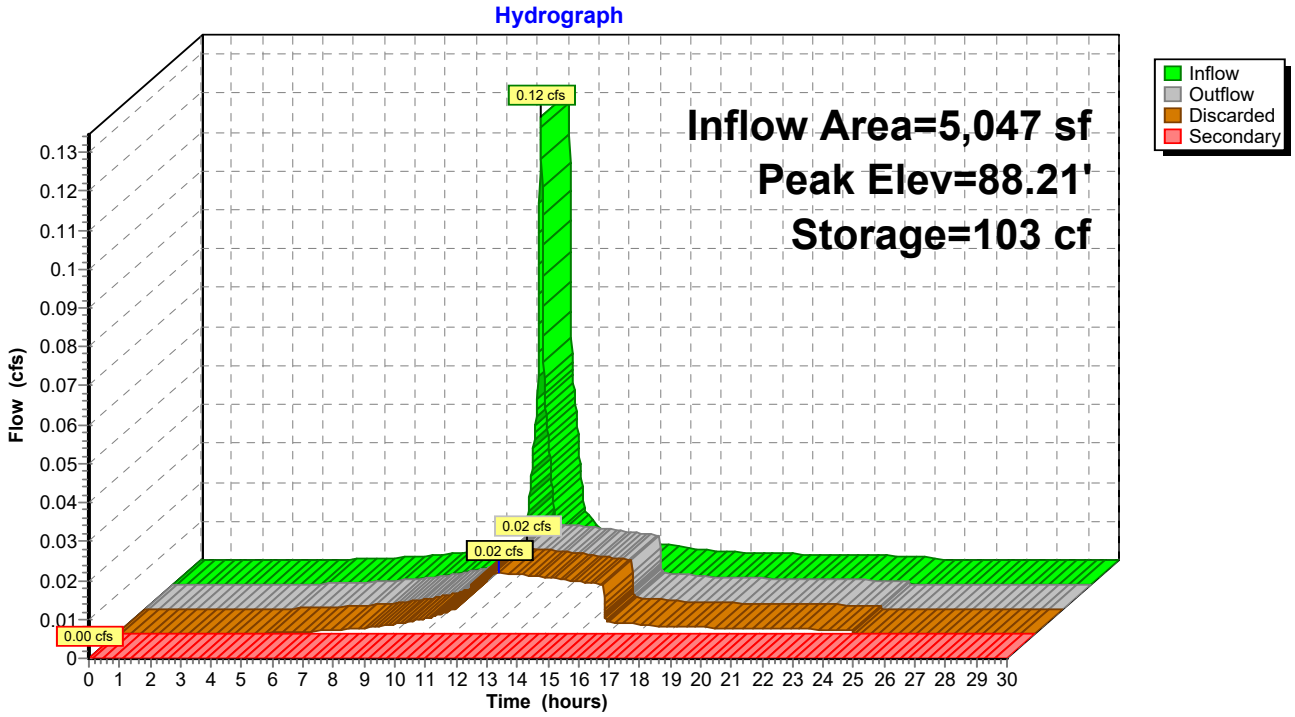
Volume	Invert	Avail.Storage	Storage Description
#1	87.50'	260 cf	**12.00'D x 6.00'H Vertical Cone/Cylinder** x 2 1,357 cf Overall - 708 cf Embedded = 649 cf x 40.0% Voids
#2	87.50'	603 cf	**8.00'D x 6.00'H Vertical Cone/Cylinder** x 2 Inside #1 708 cf Overall - 4.0" Wall Thickness = 603 cf
#3	93.25'	28 cf	**3.00'D x 4.00'H Vertical Cone/Cylinder** Impervious
		891 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	87.50'	**2.410 in/hr Exfiltration over Wetted area** Phase-In= 0.01'
#2	Secondary	96.75'	**2.0" x 2.0" Horiz. Orifice/Grate X 16.00 columns** X 8 rows C= 0.600 in 48.0" x 24.0" Grate (44% open area) Limited to weir flow at low heads

Discarded OutFlow Max=0.02 cfs @ 12.50 hrs HW=88.21' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.02 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=87.50' TW=81.00' (Dynamic Tailwater)
↑—**2=Orifice/Grate** (Controls 0.00 cfs)

Pond IB1&2: Infiltration Basin 1&2



Summary for Pond IB3&4: Infiltration Basin 3&4

Inflow Area = 4,891 sf,100.00% Impervious, Inflow Depth = 0.79" for 1" Storm event
Inflow = 0.12 cfs @ 12.02 hrs, Volume= 322 cf
Outflow = 0.02 cfs @ 12.40 hrs, Volume= 322 cf, Atten= 79%, Lag= 22.6 min
Discarded = 0.02 cfs @ 12.40 hrs, Volume= 322 cf
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Link DP : Design Point - Westgate Road

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 9
Peak Elev= 75.83' @ 12.40 hrs Surf.Area= 402 sf Storage= 71 cf
Flood Elev= 86.00' Surf.Area= 409 sf Storage= 1,302 cf

Plug-Flow detention time= 15.7 min calculated for 322 cf (100% of inflow)
Center-of-Mass det. time= 15.7 min (799.5 - 783.8)

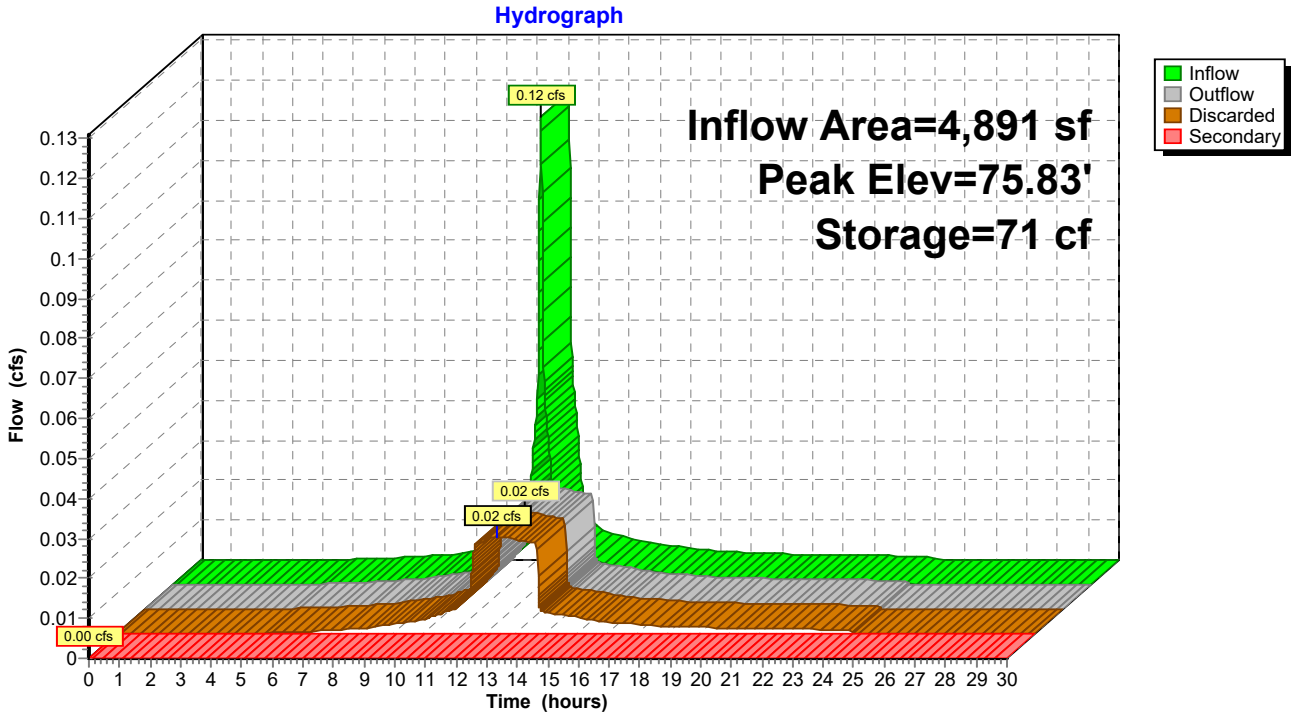
Volume	Invert	Avail.Storage	Storage Description
#1	75.50'	671 cf	**16.00'D x 6.00'H Vertical Cone/Cylinder**x 2 2,413 cf Overall - 735 cf Embedded = 1,677 cf x 40.0% Voids
#2	75.50'	603 cf	**8.00'D x 6.00'H Vertical Cone/Cylinder**x 2 Inside #1 735 cf Overall - 5.0" Wall Thickness = 603 cf
#3	81.25'	28 cf	**3.00'D x 4.00'H Vertical Cone/Cylinder**
		1,302 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	75.50'	**2.410 in/hr Exfiltration over Wetted area** Phase-In= 0.01'
#2	Secondary	85.00'	**2.0" x 2.0" Horiz. Orifice/Grate X 16.00 columns** X 8 rows C= 0.600 in 48.0" x 24.0" Grate (44% open area) Limited to weir flow at low heads

Discarded OutFlow Max=0.02 cfs @ 12.40 hrs HW=75.83' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.02 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=75.50' TW=0.00' (Dynamic Tailwater)
↑—**2=Orifice/Grate** (Controls 0.00 cfs)

Pond IB3&4: Infiltration Basin 3&4

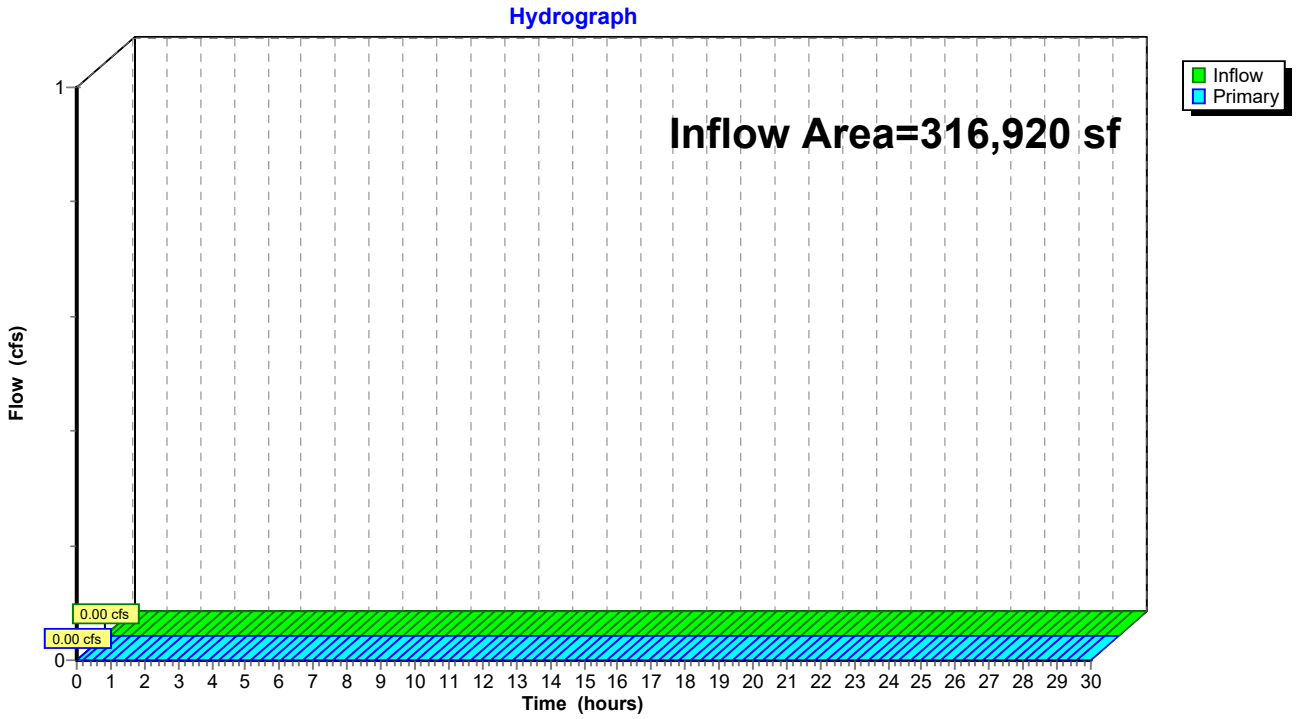


Summary for Link DP: Design Point - Westgate Road

Inflow Area = 316,920 sf, 2.38% Impervious, Inflow Depth = 0.00" for 1" Storm event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

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

Link DP: Design Point - Westgate Road



Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points x 9
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment1S: Subbasin 1 Runoff Area=310,347 sf 0.32% Impervious Runoff Depth=0.03"
Flow Length=821' Slope=0.0207 '/' Tc=19.0 min CN=44 Runoff=0.03 cfs 828 cf

Subcatchment2S: Road (lower) Runoff Area=4,891 sf 100.00% Impervious Runoff Depth=2.97"
Flow Length=213' Slope=0.0470 '/' Tc=1.6 min CN=98 Runoff=0.41 cfs 1,209 cf

Subcatchment3S: Road (middle) Runoff Area=5,047 sf 100.00% Impervious Runoff Depth=2.97"
Flow Length=217' Slope=0.0420 '/' Tc=1.7 min CN=98 Runoff=0.42 cfs 1,248 cf

Subcatchment4S: Road (cul-de-sac) Runoff Area=6,573 sf 100.00% Impervious Runoff Depth=2.97"
Flow Length=114' Slope=0.0100 '/' Tc=1.8 min CN=98 Runoff=0.54 cfs 1,625 cf

Reach 12R: Overland Flow Avg. Flow Depth=0.00' Max Vel=0.00 fps Inflow=0.00 cfs 0 cf
n=0.400 L=220.0' S=0.0409 '/' Capacity=809,595.25 cfs Outflow=0.00 cfs 0 cf

Pond BR1: Bioretention Area #1 Peak Elev=99.97' Storage=459 cf Inflow=0.54 cfs 1,625 cf
Discarded=0.08 cfs 1,625 cf Primary=0.00 cfs 0 cf Outflow=0.08 cfs 1,625 cf

Pond BR2: Bioretention Area #2 Peak Elev=96.00' Storage=0 cf Inflow=0.00 cfs 0 cf
Discarded=0.00 cfs 0 cf Primary=0.00 cfs 0 cf Outflow=0.00 cfs 0 cf

Pond CB1&2: CB 3&4 Peak Elev=93.29' Inflow=0.42 cfs 1,248 cf
12.0" Round Culvert n=0.010 L=25.0' S=0.0200 '/' Outflow=0.42 cfs 1,248 cf

Pond CB3&4: CB 1&2 Peak Elev=81.32' Inflow=0.41 cfs 1,209 cf
12.0" Round Culvert n=0.010 L=25.0' S=0.0200 '/' Outflow=0.41 cfs 1,209 cf

Pond CB5: CB 5 Peak Elev=102.39' Inflow=0.54 cfs 1,625 cf
12.0" Round Culvert n=0.010 L=20.0' S=0.0250 '/' Outflow=0.54 cfs 1,625 cf

Pond IB1&2: Infiltration Basin 1&2 Peak Elev=91.29' Storage=546 cf Inflow=0.42 cfs 1,248 cf
Discarded=0.03 cfs 1,248 cf Secondary=0.00 cfs 0 cf Outflow=0.03 cfs 1,248 cf

Pond IB3&4: Infiltration Basin 3&4 Peak Elev=77.59' Storage=443 cf Inflow=0.41 cfs 1,209 cf
Discarded=0.03 cfs 1,209 cf Secondary=0.00 cfs 0 cf Outflow=0.03 cfs 1,209 cf

Link DP: Design Point - Westgate Road Inflow=0.03 cfs 828 cf
Primary=0.03 cfs 828 cf

Total Runoff Area = 326,858 sf Runoff Volume = 4,911 cf Average Runoff Depth = 0.18"
94.65% Pervious = 309,367 sf 5.35% Impervious = 17,491 sf

Summary for Subcatchment 1S: Subbasin 1

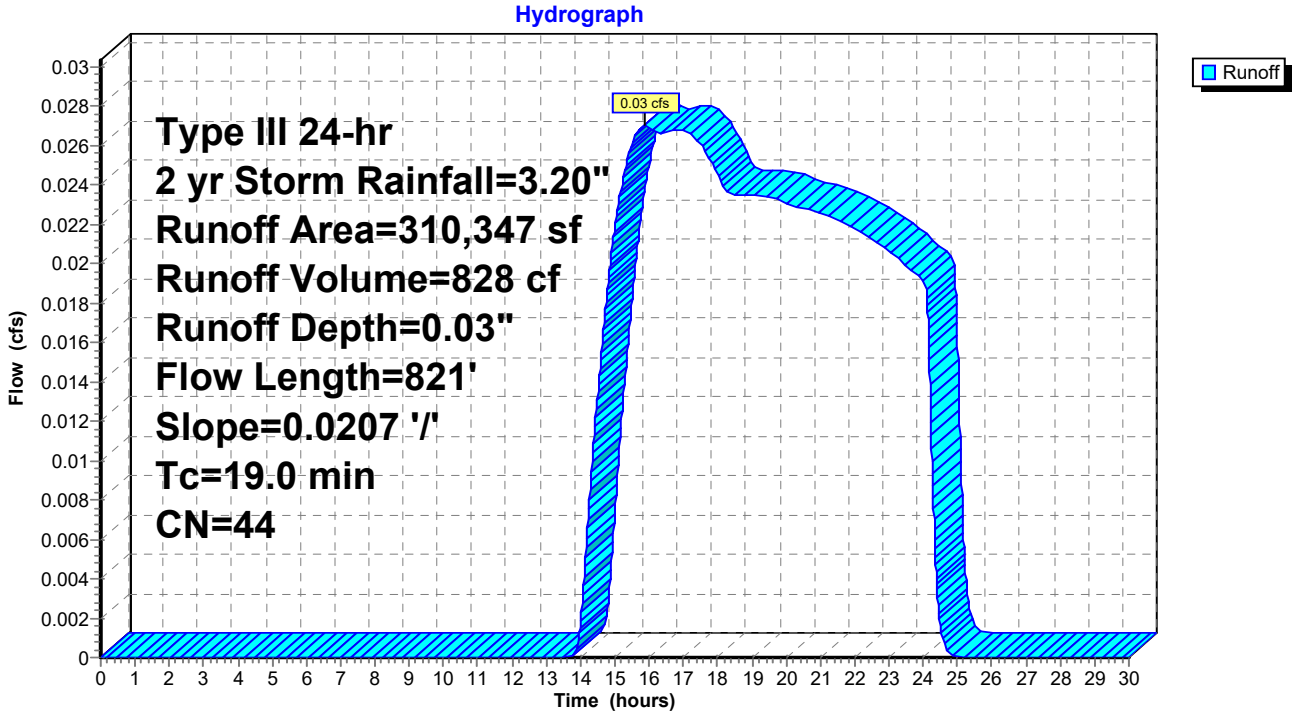
Runoff = 0.03 cfs @ 15.90 hrs, Volume= 828 cf, Depth= 0.03"
Routed to Link DP : Design Point - Westgate Road

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 yr Storm Rainfall=3.20"

Area (sf)	CN	Description
980	98	Unconnected roofs, HSG A
4,000	76	Gravel roads, HSG A
305,367	43	Woods/grass comb., Fair, HSG A
310,347	44	Weighted Average
309,367		99.68% Pervious Area
980		0.32% Impervious Area
980		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.0	821	0.0207	0.72		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps

Subcatchment 1S: Subbasin 1



Summary for Subcatchment 2S: Road (lower)

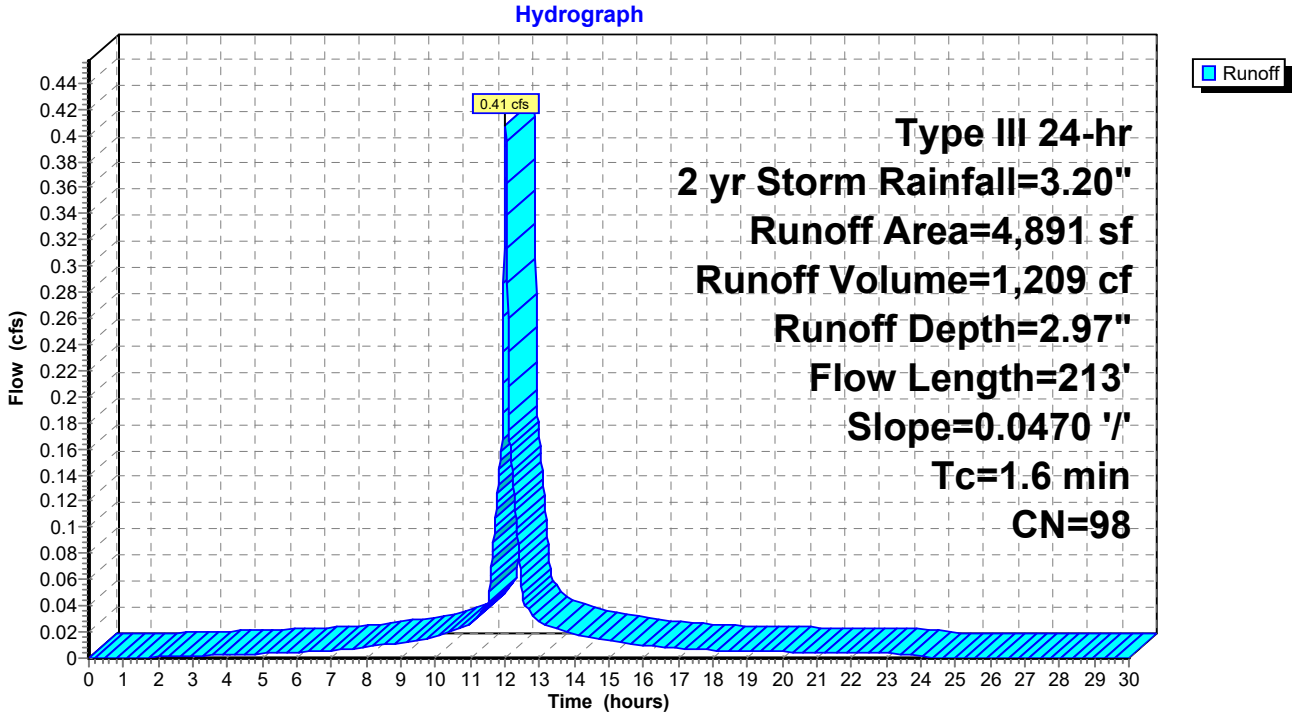
Runoff = 0.41 cfs @ 12.02 hrs, Volume= 1,209 cf, Depth= 2.97"
Routed to Pond CB3&4 : CB 1&2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 yr Storm Rainfall=3.20"

Area (sf)	CN	Description
4,891	98	Paved roads w/curbs & sewers, HSG A
4,891		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.6	213	0.0470	2.25		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20"

Subcatchment 2S: Road (lower)



Summary for Subcatchment 3S: Road (middle)

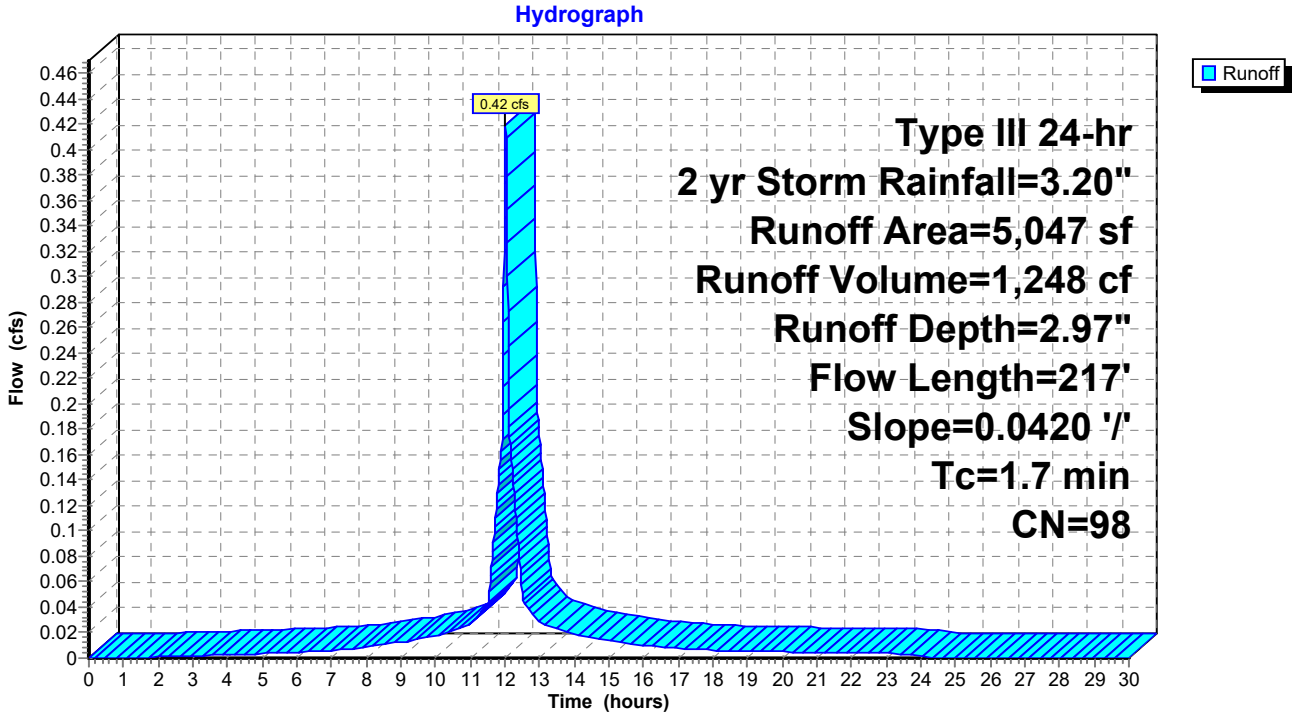
Runoff = 0.42 cfs @ 12.02 hrs, Volume= 1,248 cf, Depth= 2.97"
Routed to Pond CB1&2 : CB 3&4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 yr Storm Rainfall=3.20"

Area (sf)	CN	Description
5,047	98	Paved roads w/curbs & sewers, HSG A
5,047		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.7	217	0.0420	2.16		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20"

Subcatchment 3S: Road (middle)



Summary for Subcatchment 4S: Road (cul-de-sac)

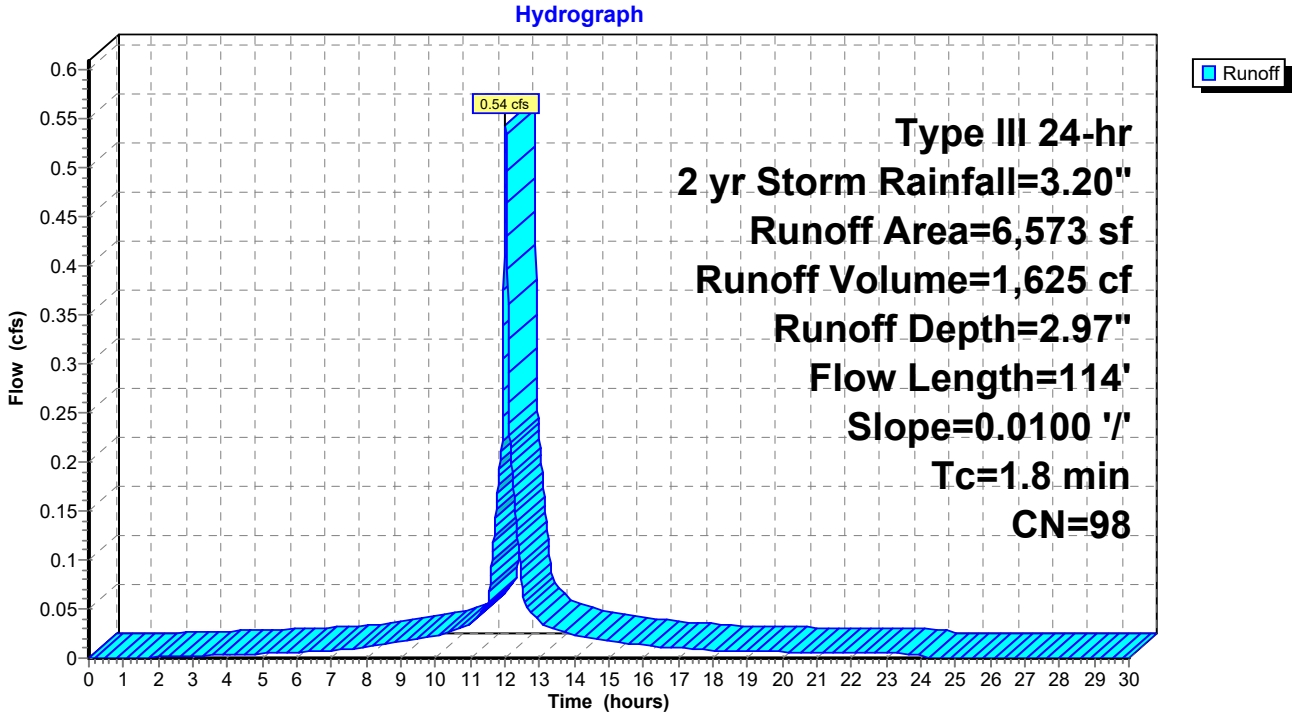
Runoff = 0.54 cfs @ 12.03 hrs, Volume= 1,625 cf, Depth= 2.97"
Routed to Pond CB5 : CB 5

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 yr Storm Rainfall=3.20"

Area (sf)	CN	Description
6,573	98	Paved roads w/curbs & sewers, HSG A
6,573		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.8	114	0.0100	1.07		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20"

Subcatchment 4S: Road (cul-de-sac)



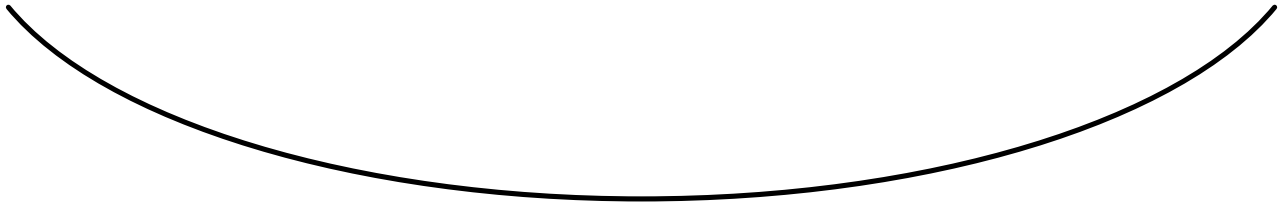
Summary for Reach 12R: Overland Flow

Inflow Area = 6,573 sf,100.00% Impervious, Inflow Depth = 0.00" for 2 yr Storm event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min
Routed to Link DP : Design Point - Westgate Road

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 9
Max. Velocity= 0.00 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 0.00 fps, Avg. Travel Time= 0.0 min

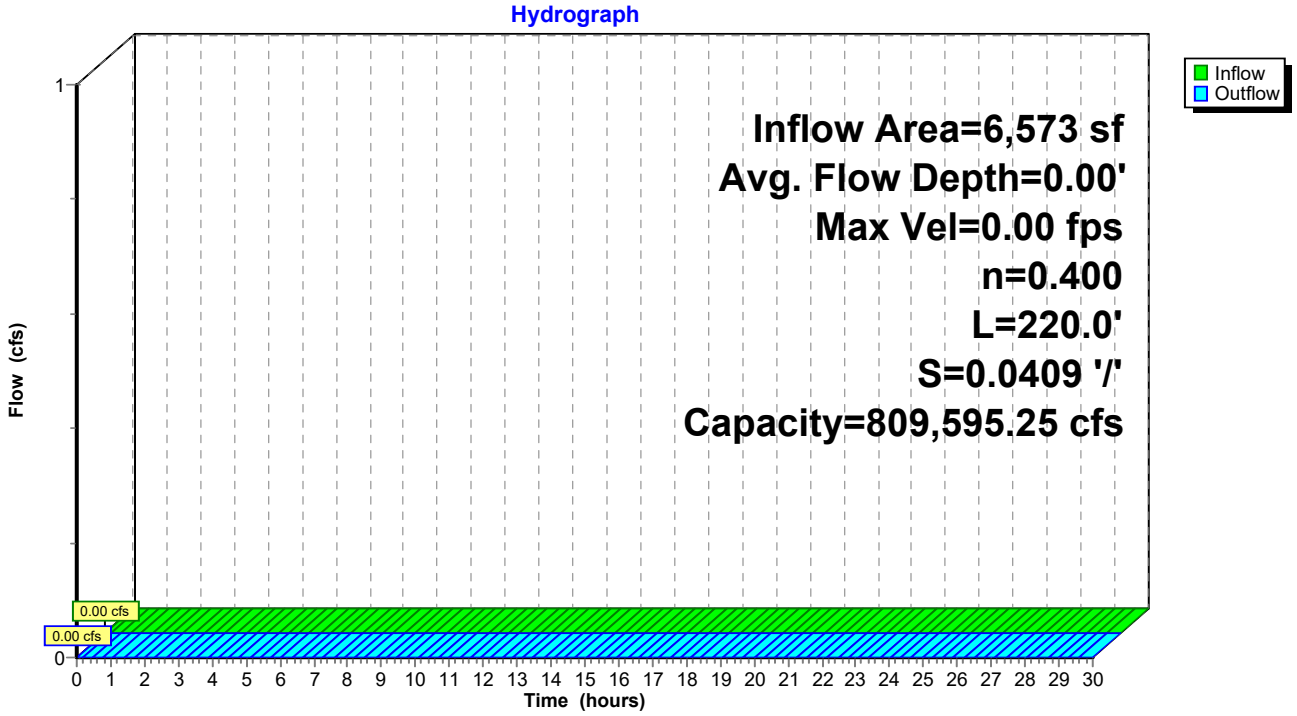
Peak Storage= 0 cf @ 0.00 hrs
Average Depth at Peak Storage= 0.00'
Bank-Full Depth= 100.00' Flow Area= 66,666.7 sf, Capacity= 809,595.25 cfs

1,000.00' x 100.00' deep Parabolic Channel, n= 0.400 Sheet flow: Woods+light brush
Length= 220.0' Slope= 0.0409 '/'
Inlet Invert= 99.00', Outlet Invert= 90.00'



‡

Reach 12R: Overland Flow



Summary for Pond BR1: Bioretention Area #1

Inflow Area = 6,573 sf,100.00% Impervious, Inflow Depth = 2.97" for 2 yr Storm event
Inflow = 0.54 cfs @ 12.03 hrs, Volume= 1,625 cf
Outflow = 0.08 cfs @ 12.48 hrs, Volume= 1,625 cf, Atten= 86%, Lag= 27.2 min
Discarded = 0.08 cfs @ 12.48 hrs, Volume= 1,625 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Pond BR2 : Bioretention Area #2

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 9
Peak Elev= 99.97' @ 12.48 hrs Surf.Area= 1,386 sf Storage= 459 cf

Plug-Flow detention time= 36.6 min calculated for 1,625 cf (100% of inflow)
Center-of-Mass det. time= 36.6 min (789.1 - 752.5)

Volume	Invert	Avail.Storage	Storage Description
#1	99.00'	2,984 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

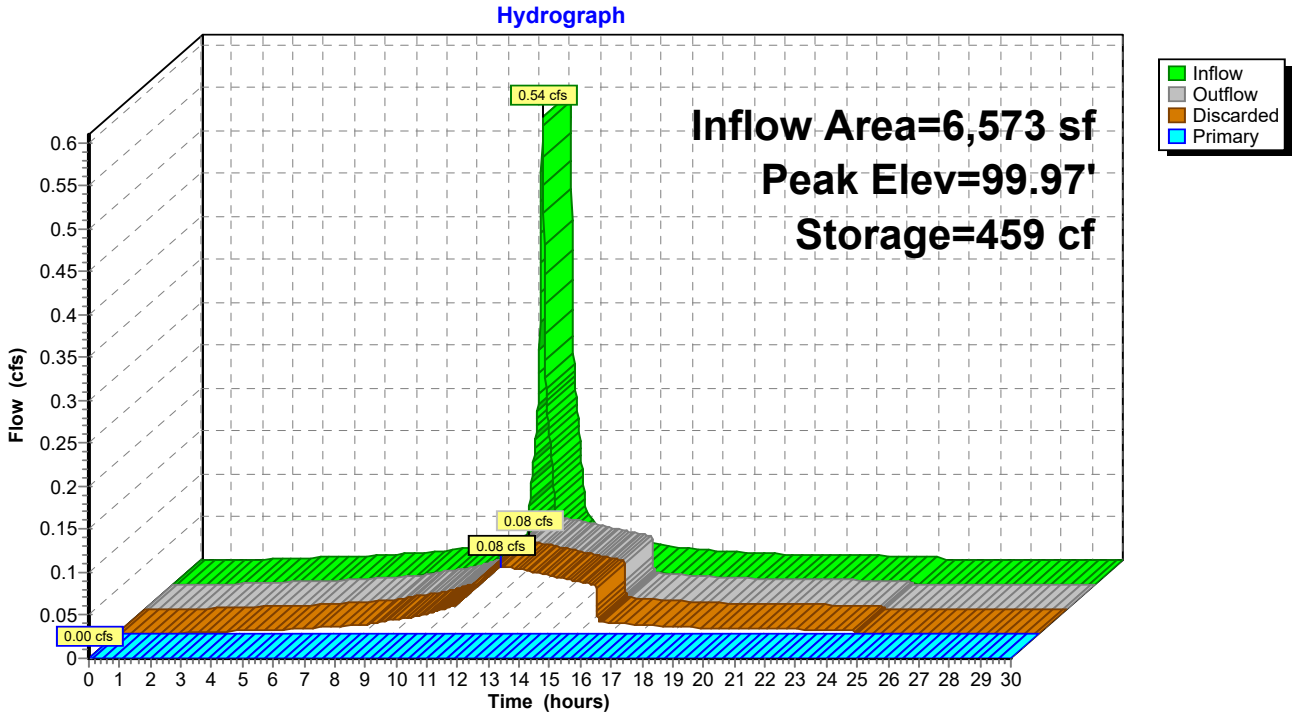
Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
99.00	1,000	0.0	0	0	1,000
100.00	1,400	40.0	478	478	1,418
102.50	1,500	5.0	181	659	1,770
104.00	1,600	100.0	2,325	2,984	2,002

Device	Routing	Invert	Outlet Devices
#0	Primary	104.00'	**Automatic Storage Overflow** (Discharged without head)
#1	Discarded	99.00'	**2.410 in/hr Exfiltration over Wetted area** Phase-In= 0.01'
#2	Primary	103.00'	**12.0" Round CMP_Round 12"** L= 10.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 103.00' / 101.05' S= 0.1950 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf

Discarded OutFlow Max=0.08 cfs @ 12.48 hrs HW=99.97' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.08 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=99.00' TW=96.00' (Dynamic Tailwater)
↑**2=CMP_Round 12"** (Controls 0.00 cfs)

Pond BR1: Bioretention Area #1



Summary for Pond BR2: Bioretention Area #2

Inflow Area = 6,573 sf,100.00% Impervious, Inflow Depth = 0.00" for 2 yr Storm event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min
Discarded = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Reach 12R : Overland Flow

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 9
Peak Elev= 96.00' @ 0.00 hrs Surf.Area= 700 sf Storage= 0 cf

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

Volume	Invert	Avail.Storage	Storage Description
#1	96.00'	2,060 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

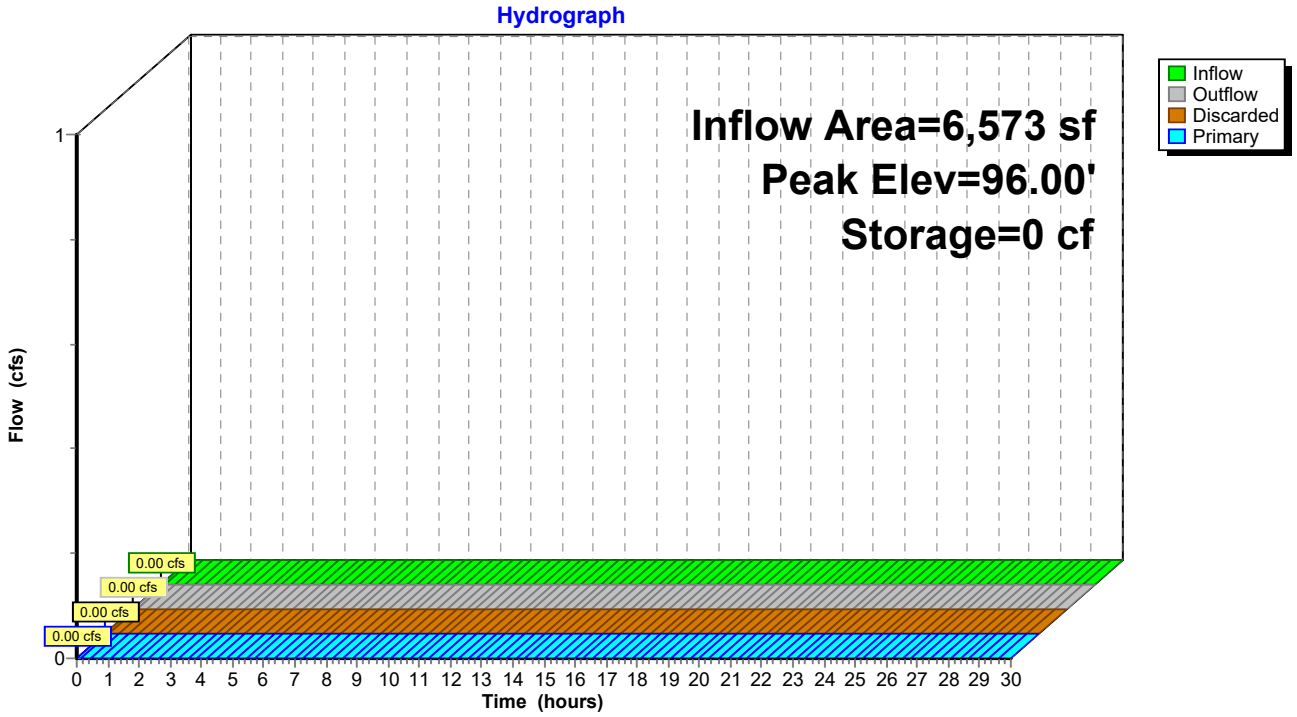
Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
96.00	700	0.0	0	0	700
97.00	800	40.0	300	300	839
99.50	1,000	5.0	112	412	1,172
101.00	1,200	100.0	1,648	2,060	1,438

Device	Routing	Invert	Outlet Devices
#0	Primary	101.00'	**Automatic Storage Overflow** (Discharged without head)
#1	Discarded	96.00'	**2.410 in/hr Exfiltration over Wetted area** Phase-In= 0.01'
#2	Primary	100.00'	**12.0" Round CMP_Round 12"** L= 10.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 100.00' / 99.00' S= 0.1000 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf

Discarded OutFlow Max=0.00 cfs @ 0.00 hrs HW=96.00' (Free Discharge)
↑**1=Exfiltration** (Controls 0.00 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=96.00' TW=99.00' (Dynamic Tailwater)
↑**2=CMP_Round 12"** (Controls 0.00 cfs)

Pond BR2: Bioretention Area #2



Summary for Pond CB1&2: CB 3&4

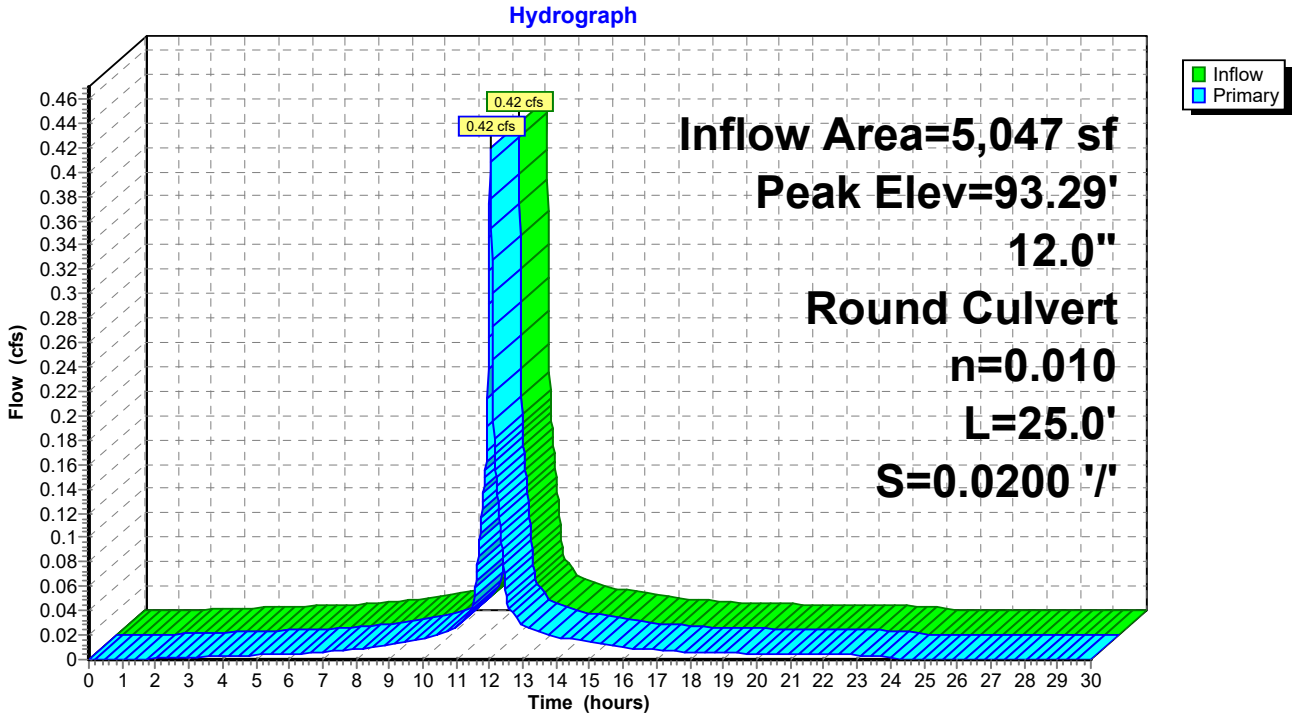
Inflow Area = 5,047 sf,100.00% Impervious, Inflow Depth = 2.97" for 2 yr Storm event
Inflow = 0.42 cfs @ 12.02 hrs, Volume= 1,248 cf
Outflow = 0.42 cfs @ 12.02 hrs, Volume= 1,248 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.42 cfs @ 12.02 hrs, Volume= 1,248 cf
Routed to Pond IB1&2 : Infiltration Basin 1&2

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 9
Peak Elev= 93.29' @ 12.02 hrs
Flood Elev= 97.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	93.00'	**12.0" Round Culvert** L= 25.0' RCP, groove end w/headwall, Ke= 0.200 Inlet / Outlet Invert= 93.00' / 92.50' S= 0.0200 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.42 cfs @ 12.02 hrs HW=93.28' TW=89.64' (Dynamic Tailwater)
1=Culvert (Inlet Controls 0.42 cfs @ 2.27 fps)

Pond CB1&2: CB 3&4



Summary for Pond CB3&4: CB 1&2

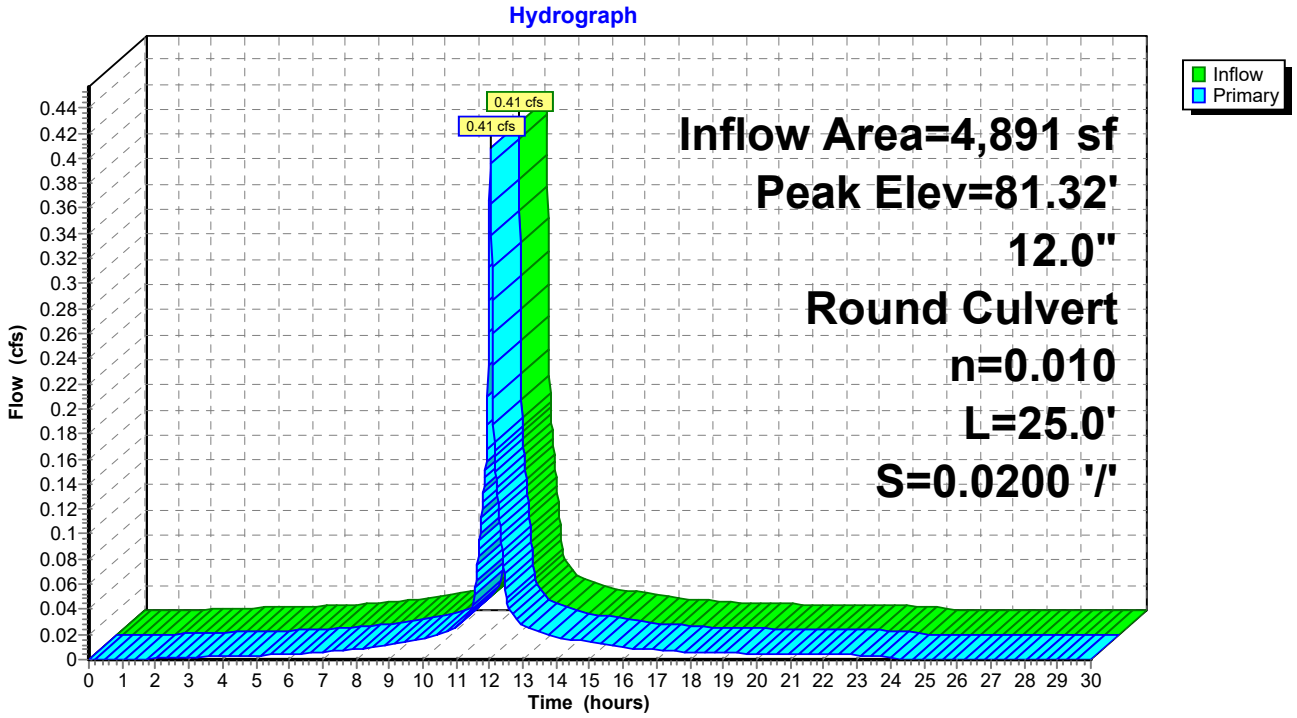
Inflow Area = 4,891 sf,100.00% Impervious, Inflow Depth = 2.97" for 2 yr Storm event
Inflow = 0.41 cfs @ 12.02 hrs, Volume= 1,209 cf
Outflow = 0.41 cfs @ 12.02 hrs, Volume= 1,209 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.41 cfs @ 12.02 hrs, Volume= 1,209 cf
Routed to Pond IB3&4 : Infiltration Basin 3&4

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 9
Peak Elev= 81.32' @ 12.02 hrs
Flood Elev= 85.15'

Device	Routing	Invert	Outlet Devices
#1	Primary	81.00'	**12.0" Round pipe** L= 25.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 81.00' / 80.50' S= 0.0200 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.41 cfs @ 12.02 hrs HW=81.32' TW=76.60' (Dynamic Tailwater)
↑**1=pipe** (Inlet Controls 0.41 cfs @ 1.91 fps)

Pond CB3&4: CB 1&2



Summary for Pond CB5: CB 5

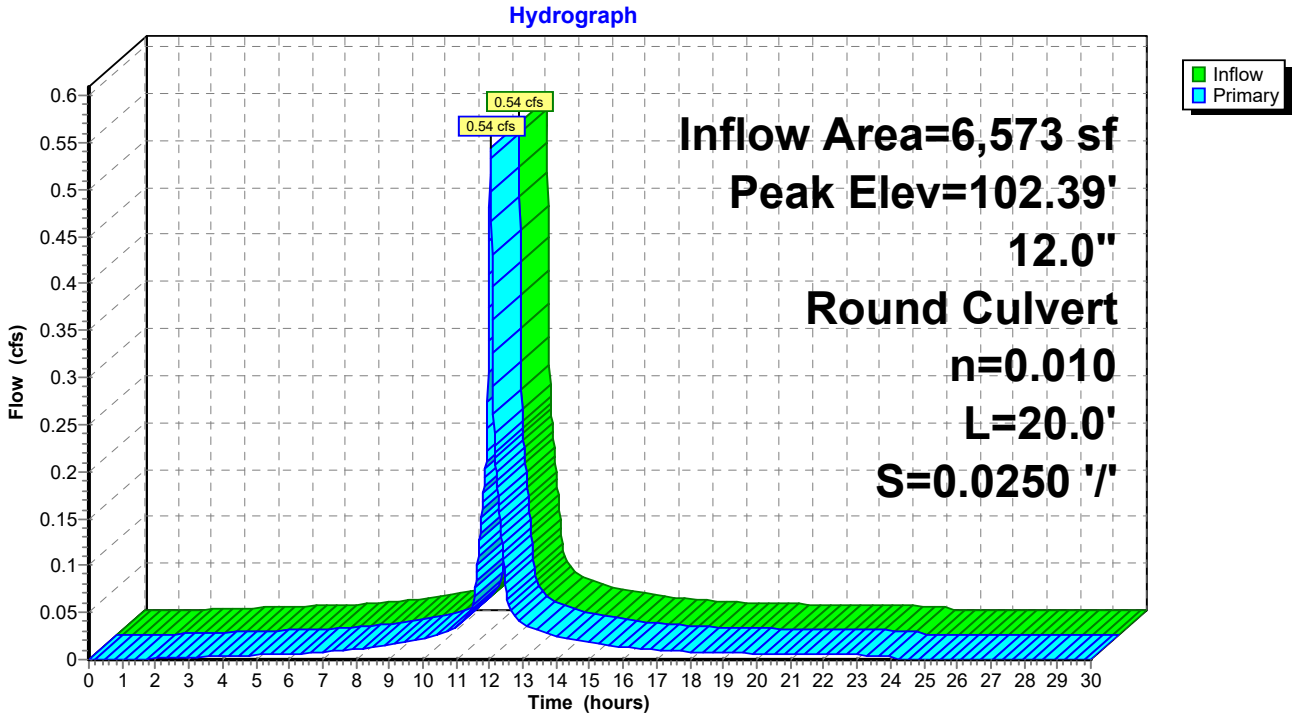
Inflow Area = 6,573 sf,100.00% Impervious, Inflow Depth = 2.97" for 2 yr Storm event
Inflow = 0.54 cfs @ 12.03 hrs, Volume= 1,625 cf
Outflow = 0.54 cfs @ 12.03 hrs, Volume= 1,625 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.54 cfs @ 12.03 hrs, Volume= 1,625 cf
Routed to Pond BR1 : Bioretention Area #1

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 9
Peak Elev= 102.39' @ 12.03 hrs
Flood Elev= 106.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	102.00'	**12.0" Round CMP_Round 12"** L= 20.0' CMP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 102.00' / 101.50' S= 0.0250 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.54 cfs @ 12.03 hrs HW=102.39' TW=99.55' (Dynamic Tailwater)
↑**1=CMP_Round 12"** (Inlet Controls 0.54 cfs @ 1.89 fps)

Pond CB5: CB 5



Summary for Pond IB1&2: Infiltration Basin 1&2

Inflow Area = 5,047 sf,100.00% Impervious, Inflow Depth = 2.97" for 2 yr Storm event
Inflow = 0.42 cfs @ 12.02 hrs, Volume= 1,248 cf
Outflow = 0.03 cfs @ 12.98 hrs, Volume= 1,248 cf, Atten= 93%, Lag= 57.6 min
Discarded = 0.03 cfs @ 12.98 hrs, Volume= 1,248 cf
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Pond CB3&4 : CB 1&2

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 9
Peak Elev= 91.29' @ 12.98 hrs Surf.Area= 226 sf Storage= 546 cf
Flood Elev= 98.00' Surf.Area= 226 sf Storage= 891 cf

Plug-Flow detention time= 188.2 min calculated for 1,248 cf (100% of inflow)
Center-of-Mass det. time= 188.2 min (940.6 - 752.4)

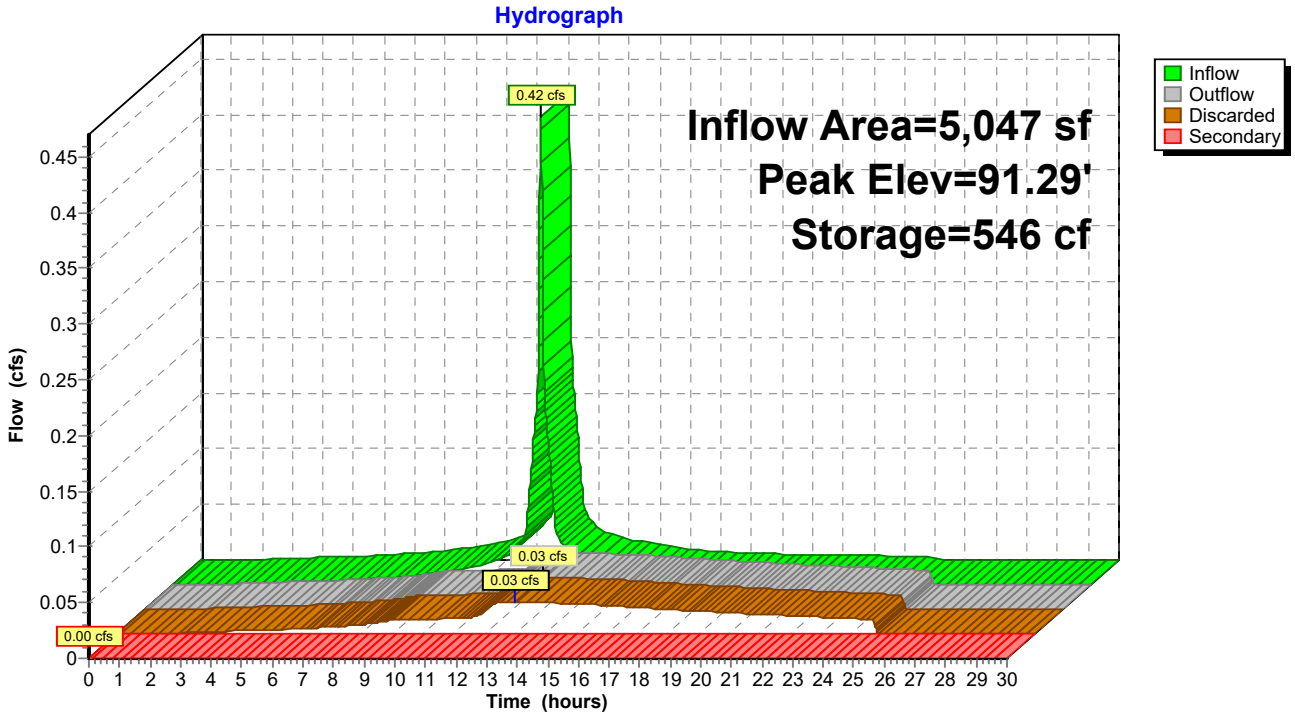
Volume	Invert	Avail.Storage	Storage Description
#1	87.50'	260 cf	**12.00'D x 6.00'H Vertical Cone/Cylinder** x 2 1,357 cf Overall - 708 cf Embedded = 649 cf x 40.0% Voids
#2	87.50'	603 cf	**8.00'D x 6.00'H Vertical Cone/Cylinder** x 2 Inside #1 708 cf Overall - 4.0" Wall Thickness = 603 cf
#3	93.25'	28 cf	**3.00'D x 4.00'H Vertical Cone/Cylinder** Impervious
		891 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	87.50'	**2.410 in/hr Exfiltration over Wetted area** Phase-In= 0.01'
#2	Secondary	96.75'	**2.0" x 2.0" Horiz. Orifice/Grate X 16.00 columns** X 8 rows C= 0.600 in 48.0" x 24.0" Grate (44% open area) Limited to weir flow at low heads

Discarded OutFlow Max=0.03 cfs @ 12.98 hrs HW=91.29' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=87.50' TW=81.00' (Dynamic Tailwater)
↑—**2=Orifice/Grate** (Controls 0.00 cfs)

Pond IB1&2: Infiltration Basin 1&2



Summary for Pond IB3&4: Infiltration Basin 3&4

Inflow Area = 4,891 sf,100.00% Impervious, Inflow Depth = 2.97" for 2 yr Storm event
Inflow = 0.41 cfs @ 12.02 hrs, Volume= 1,209 cf
Outflow = 0.03 cfs @ 12.79 hrs, Volume= 1,209 cf, Atten= 92%, Lag= 45.9 min
Discarded = 0.03 cfs @ 12.79 hrs, Volume= 1,209 cf
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Link DP : Design Point - Westgate Road

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 9
Peak Elev= 77.59' @ 12.79 hrs Surf.Area= 402 sf Storage= 443 cf
Flood Elev= 86.00' Surf.Area= 409 sf Storage= 1,302 cf

Plug-Flow detention time= 102.7 min calculated for 1,209 cf (100% of inflow)
Center-of-Mass det. time= 102.7 min (855.0 - 752.3)

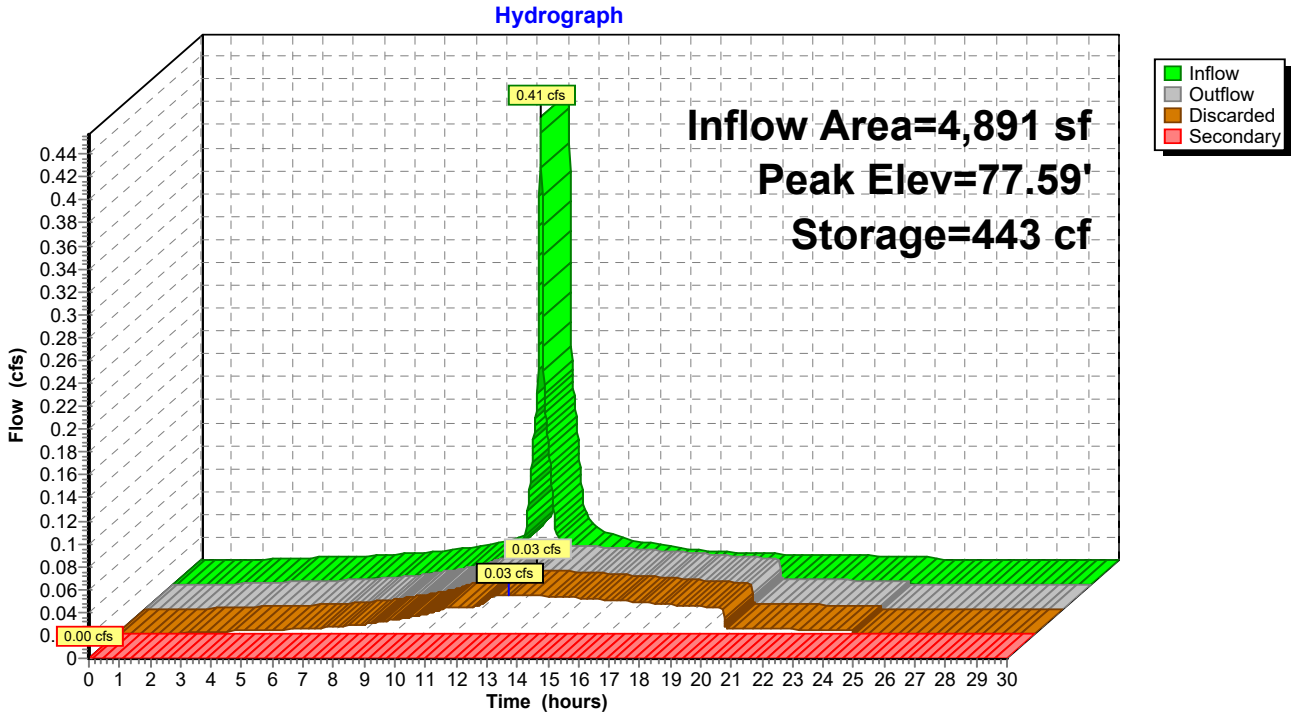
Volume	Invert	Avail.Storage	Storage Description
#1	75.50'	671 cf	**16.00'D x 6.00'H Vertical Cone/Cylinder** x 2 2,413 cf Overall - 735 cf Embedded = 1,677 cf x 40.0% Voids
#2	75.50'	603 cf	**8.00'D x 6.00'H Vertical Cone/Cylinder** x 2 Inside #1 735 cf Overall - 5.0" Wall Thickness = 603 cf
#3	81.25'	28 cf	**3.00'D x 4.00'H Vertical Cone/Cylinder**
		1,302 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	75.50'	**2.410 in/hr Exfiltration over Wetted area** Phase-In= 0.01'
#2	Secondary	85.00'	**2.0" x 2.0" Horiz. Orifice/Grate X 16.00 columns** X 8 rows C= 0.600 in 48.0" x 24.0" Grate (44% open area) Limited to weir flow at low heads

Discarded OutFlow Max=0.03 cfs @ 12.79 hrs HW=77.59' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=75.50' TW=0.00' (Dynamic Tailwater)
↑—**2=Orifice/Grate** (Controls 0.00 cfs)

Pond IB3&4: Infiltration Basin 3&4

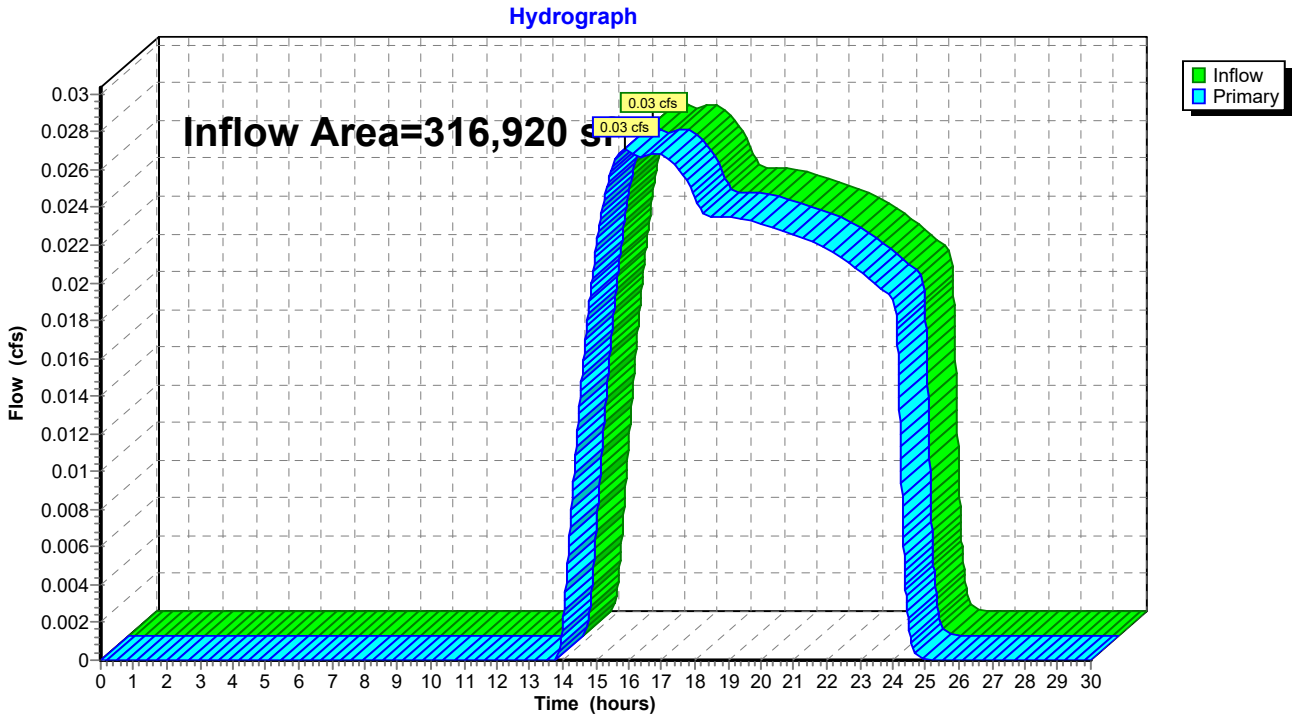


Summary for Link DP: Design Point - Westgate Road

Inflow Area = 316,920 sf, 2.38% Impervious, Inflow Depth = 0.03" for 2 yr Storm event
Inflow = 0.03 cfs @ 15.90 hrs, Volume= 828 cf
Primary = 0.03 cfs @ 15.90 hrs, Volume= 828 cf, Atten= 0%, Lag= 0.0 min

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

Link DP: Design Point - Westgate Road



Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points x 9
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment1S: Subbasin 1 Runoff Area=310,347 sf 0.32% Impervious Runoff Depth=0.29"
Flow Length=821' Slope=0.0207 '/' Tc=19.0 min CN=44 Runoff=0.61 cfs 7,587 cf

Subcatchment2S: Road (lower) Runoff Area=4,891 sf 100.00% Impervious Runoff Depth=4.39"
Flow Length=213' Slope=0.0470 '/' Tc=1.6 min CN=98 Runoff=0.59 cfs 1,791 cf

Subcatchment3S: Road (middle) Runoff Area=5,047 sf 100.00% Impervious Runoff Depth=4.39"
Flow Length=217' Slope=0.0420 '/' Tc=1.7 min CN=98 Runoff=0.61 cfs 1,848 cf

Subcatchment4S: Road (cul-de-sac) Runoff Area=6,573 sf 100.00% Impervious Runoff Depth=4.39"
Flow Length=114' Slope=0.0100 '/' Tc=1.8 min CN=98 Runoff=0.79 cfs 2,407 cf

Reach 12R: Overland Flow Avg. Flow Depth=0.00' Max Vel=0.00 fps Inflow=0.00 cfs 0 cf
n=0.400 L=220.0' S=0.0409 '/' Capacity=809,595.25 cfs Outflow=0.00 cfs 0 cf

Pond BR1: Bioretention Area #1 Peak Elev=102.56' Storage=754 cf Inflow=0.79 cfs 2,407 cf
Discarded=0.10 cfs 2,407 cf Primary=0.00 cfs 0 cf Outflow=0.10 cfs 2,407 cf

Pond BR2: Bioretention Area #2 Peak Elev=96.00' Storage=0 cf Inflow=0.00 cfs 0 cf
Discarded=0.00 cfs 0 cf Primary=0.00 cfs 0 cf Outflow=0.00 cfs 0 cf

Pond CB1&2: CB 3&4 Peak Elev=94.94' Inflow=0.61 cfs 1,848 cf
12.0" Round Culvert n=0.010 L=25.0' S=0.0200 '/' Outflow=0.61 cfs 1,848 cf

Pond CB3&4: CB 1&2 Peak Elev=81.39' Inflow=0.59 cfs 1,791 cf
12.0" Round Culvert n=0.010 L=25.0' S=0.0200 '/' Outflow=0.59 cfs 1,791 cf

Pond CB5: CB 5 Peak Elev=102.57' Inflow=0.79 cfs 2,407 cf
12.0" Round Culvert n=0.010 L=20.0' S=0.0250 '/' Outflow=0.79 cfs 2,407 cf

Pond IB1&2: Infiltration Basin 1&2 Peak Elev=94.94' Storage=875 cf Inflow=0.61 cfs 1,848 cf
Discarded=0.04 cfs 1,848 cf Secondary=0.00 cfs 0 cf Outflow=0.04 cfs 1,848 cf

Pond IB3&4: Infiltration Basin 3&4 Peak Elev=78.95' Storage=732 cf Inflow=0.59 cfs 1,791 cf
Discarded=0.04 cfs 1,791 cf Secondary=0.00 cfs 0 cf Outflow=0.04 cfs 1,791 cf

Link DP: Design Point - Westgate Road Inflow=0.61 cfs 7,587 cf
Primary=0.61 cfs 7,587 cf

Total Runoff Area = 326,858 sf Runoff Volume = 13,633 cf Average Runoff Depth = 0.50"
94.65% Pervious = 309,367 sf 5.35% Impervious = 17,491 sf

Summary for Subcatchment 1S: Subbasin 1

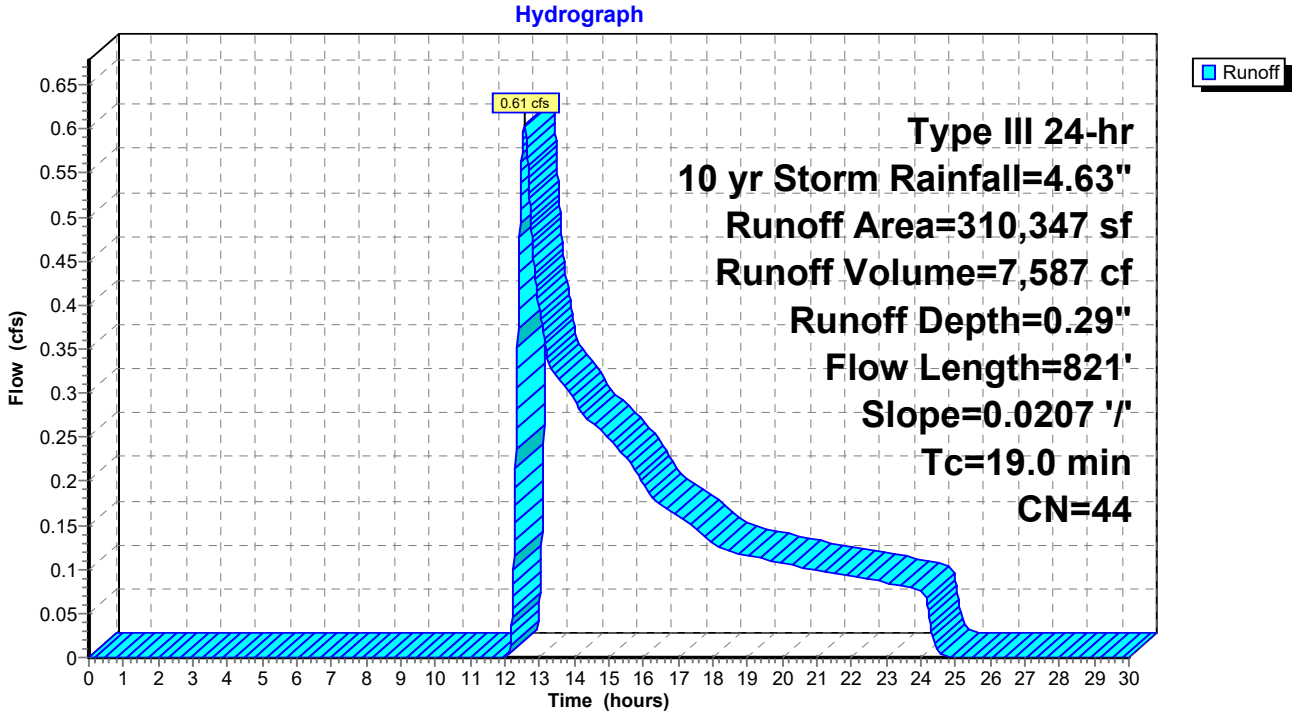
Runoff = 0.61 cfs @ 12.57 hrs, Volume= 7,587 cf, Depth= 0.29"
Routed to Link DP : Design Point - Westgate Road

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 yr Storm Rainfall=4.63"

Area (sf)	CN	Description
980	98	Unconnected roofs, HSG A
4,000	76	Gravel roads, HSG A
305,367	43	Woods/grass comb., Fair, HSG A
310,347	44	Weighted Average
309,367		99.68% Pervious Area
980		0.32% Impervious Area
980		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.0	821	0.0207	0.72		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps

Subcatchment 1S: Subbasin 1



Summary for Subcatchment 2S: Road (lower)

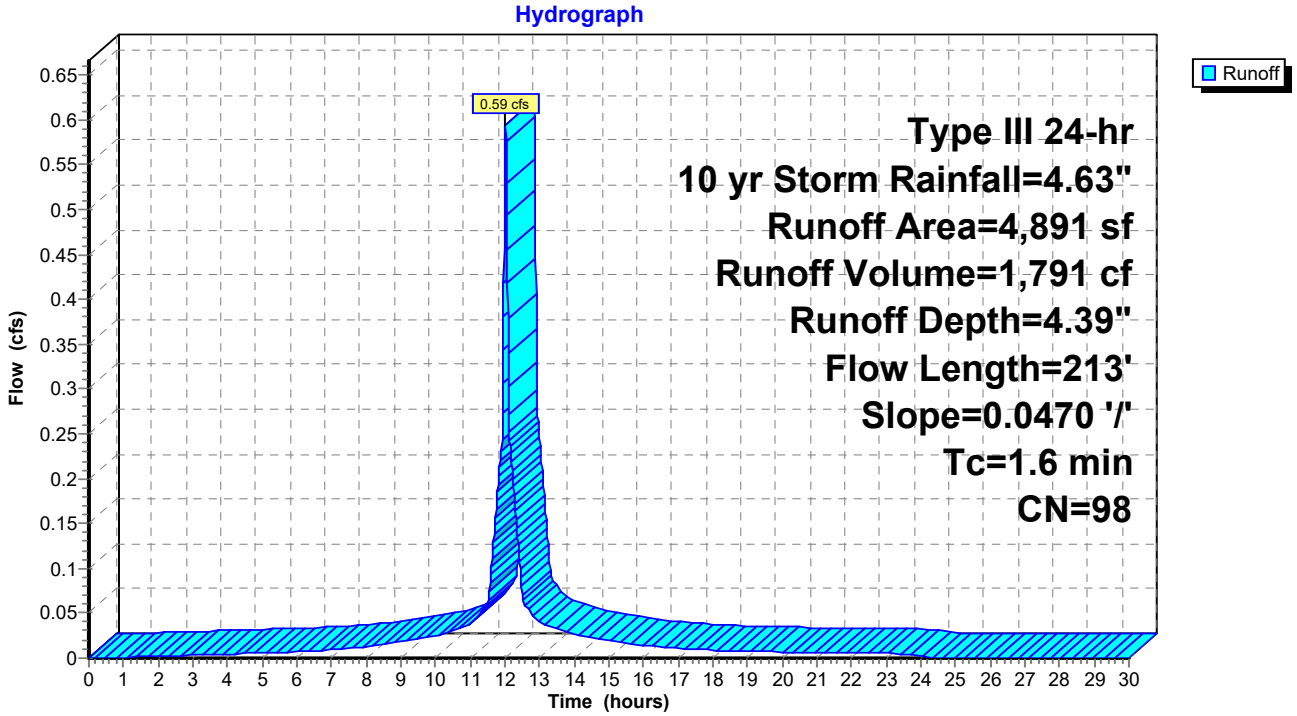
Runoff = 0.59 cfs @ 12.02 hrs, Volume= 1,791 cf, Depth= 4.39"
Routed to Pond CB3&4 : CB 1&2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 yr Storm Rainfall=4.63"

Area (sf)	CN	Description
4,891	98	Paved roads w/curbs & sewers, HSG A
4,891		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.6	213	0.0470	2.25		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20"

Subcatchment 2S: Road (lower)



Summary for Subcatchment 3S: Road (middle)

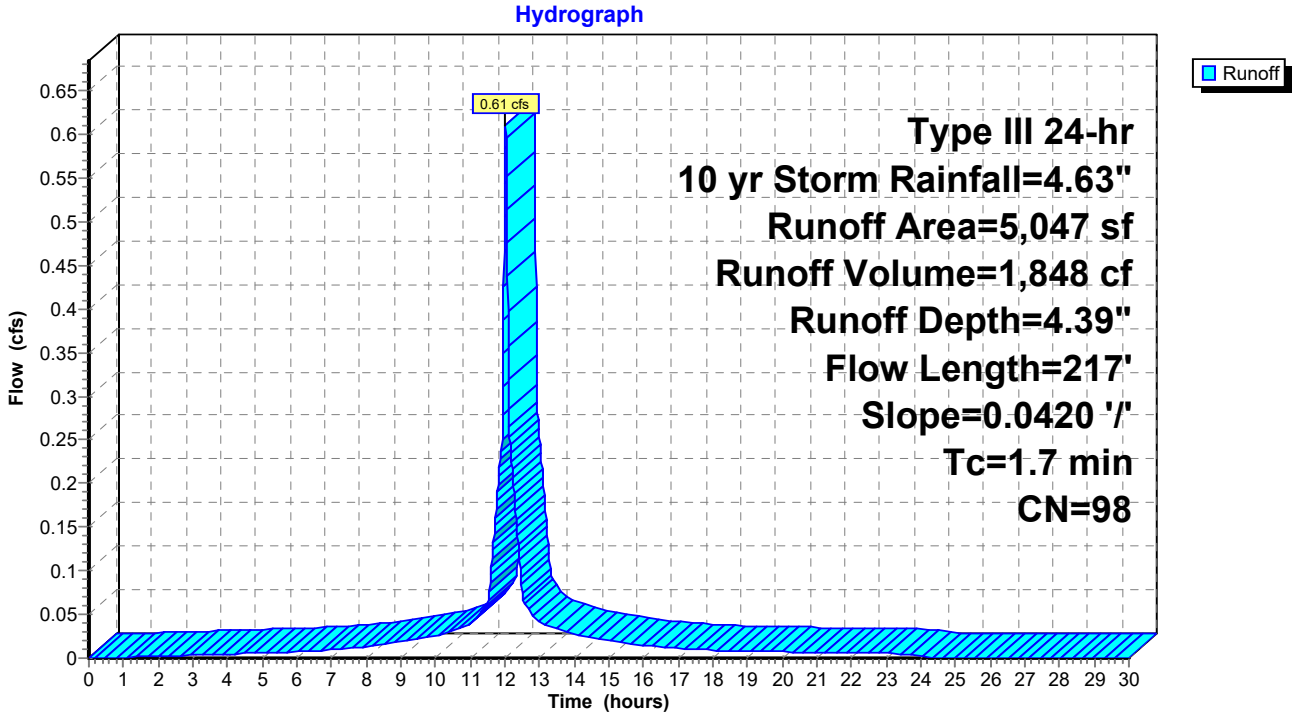
Runoff = 0.61 cfs @ 12.02 hrs, Volume= 1,848 cf, Depth= 4.39"
Routed to Pond CB1&2 : CB 3&4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 yr Storm Rainfall=4.63"

Area (sf)	CN	Description
5,047	98	Paved roads w/curbs & sewers, HSG A
5,047		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.7	217	0.0420	2.16		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20"

Subcatchment 3S: Road (middle)



Summary for Subcatchment 4S: Road (cul-de-sac)

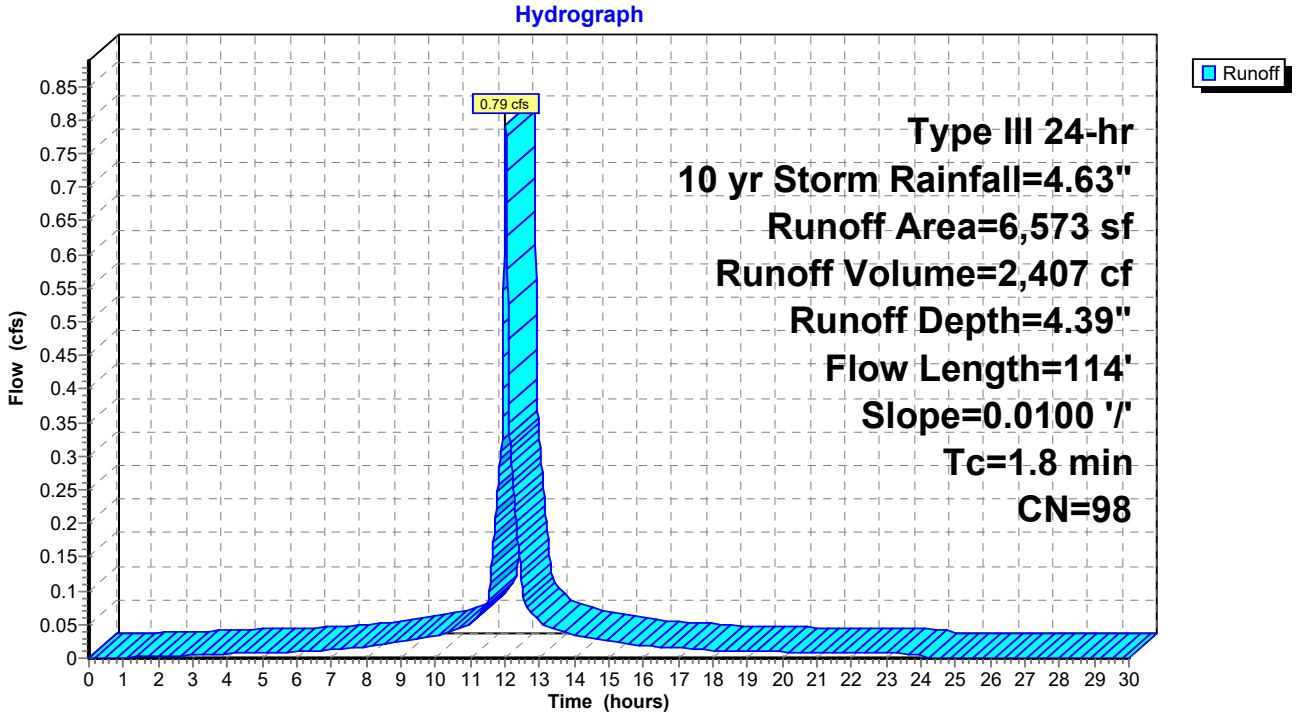
Runoff = 0.79 cfs @ 12.03 hrs, Volume= 2,407 cf, Depth= 4.39"
Routed to Pond CB5 : CB 5

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 yr Storm Rainfall=4.63"

Area (sf)	CN	Description
6,573	98	Paved roads w/curbs & sewers, HSG A
6,573		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.8	114	0.0100	1.07		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20"

Subcatchment 4S: Road (cul-de-sac)



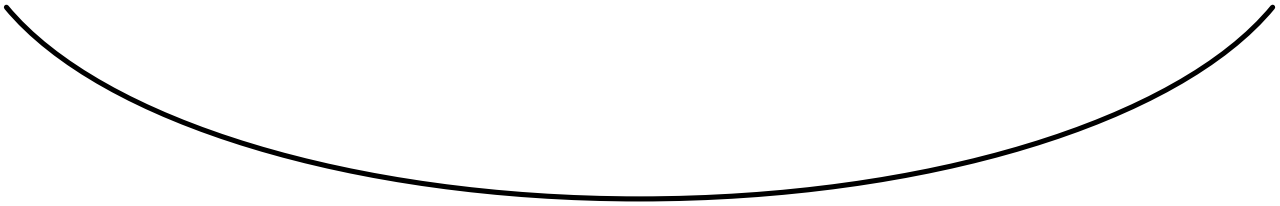
Summary for Reach 12R: Overland Flow

Inflow Area = 6,573 sf,100.00% Impervious, Inflow Depth = 0.00" for 10 yr Storm event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min
Routed to Link DP : Design Point - Westgate Road

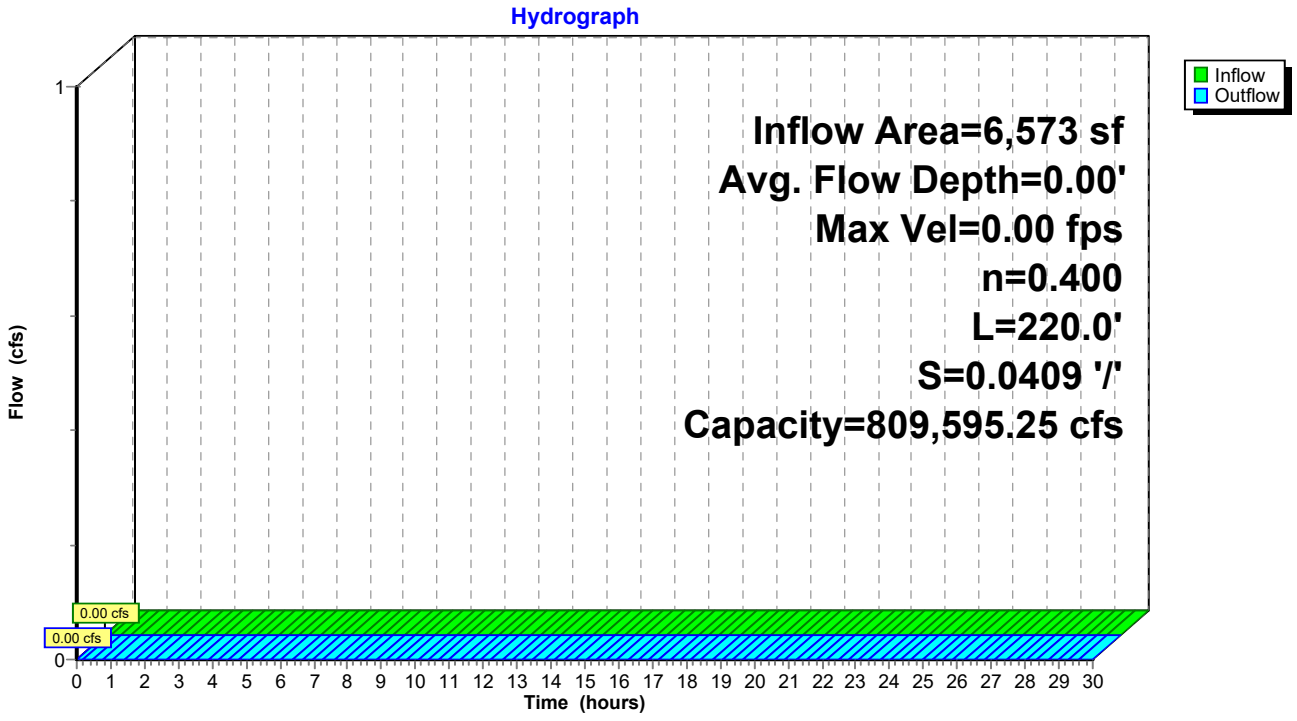
Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 9
Max. Velocity= 0.00 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 0.00 fps, Avg. Travel Time= 0.0 min

Peak Storage= 0 cf @ 0.00 hrs
Average Depth at Peak Storage= 0.00'
Bank-Full Depth= 100.00' Flow Area= 66,666.7 sf, Capacity= 809,595.25 cfs

1,000.00' x 100.00' deep Parabolic Channel, n= 0.400 Sheet flow: Woods+light brush
Length= 220.0' Slope= 0.0409 '/'
Inlet Invert= 99.00', Outlet Invert= 90.00'



‡



Summary for Pond BR1: Bioretention Area #1

Inflow Area = 6,573 sf,100.00% Impervious, Inflow Depth = 4.39" for 10 yr Storm event
Inflow = 0.79 cfs @ 12.03 hrs, Volume= 2,407 cf
Outflow = 0.10 cfs @ 12.50 hrs, Volume= 2,407 cf, Atten= 87%, Lag= 28.6 min
Discarded = 0.10 cfs @ 12.50 hrs, Volume= 2,407 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Pond BR2 : Bioretention Area #2

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 9
Peak Elev= 102.56' @ 12.50 hrs Surf.Area= 1,504 sf Storage= 754 cf

Plug-Flow detention time= 54.7 min calculated for 2,406 cf (100% of inflow)
Center-of-Mass det. time= 54.6 min (800.1 - 745.4)

Volume	Invert	Avail.Storage	Storage Description
#1	99.00'	2,984 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

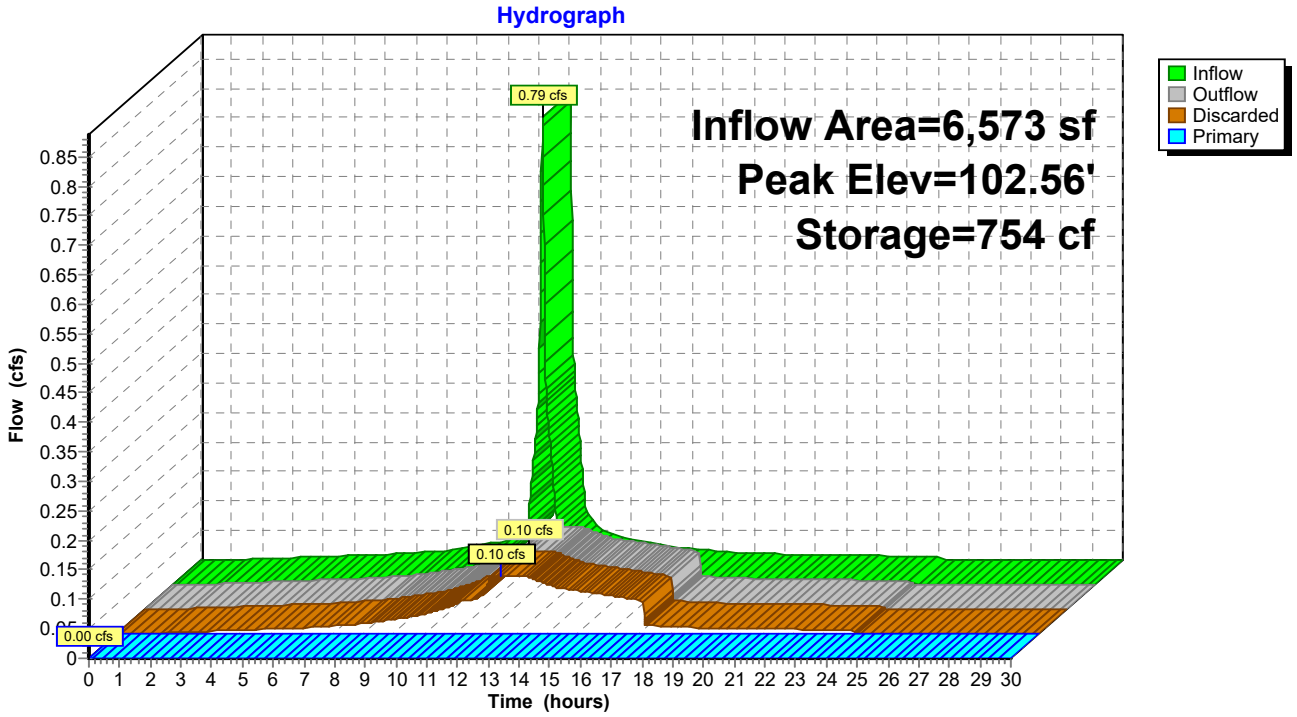
Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
99.00	1,000	0.0	0	0	1,000
100.00	1,400	40.0	478	478	1,418
102.50	1,500	5.0	181	659	1,770
104.00	1,600	100.0	2,325	2,984	2,002

Device	Routing	Invert	Outlet Devices
#0	Primary	104.00'	**Automatic Storage Overflow** (Discharged without head)
#1	Discarded	99.00'	**2.410 in/hr Exfiltration over Wetted area** Phase-In= 0.01'
#2	Primary	103.00'	**12.0" Round CMP_Round 12"** L= 10.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 103.00' / 101.05' S= 0.1950 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf

Discarded OutFlow Max=0.10 cfs @ 12.50 hrs HW=102.56' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.10 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=99.00' TW=96.00' (Dynamic Tailwater)
↑**2=CMP_Round 12"** (Controls 0.00 cfs)

Pond BR1: Bioretention Area #1



Summary for Pond BR2: Bioretention Area #2

Inflow Area = 6,573 sf,100.00% Impervious, Inflow Depth = 0.00" for 10 yr Storm event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min
Discarded = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Reach 12R : Overland Flow

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 9
Peak Elev= 96.00' @ 0.00 hrs Surf.Area= 700 sf Storage= 0 cf

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

Volume	Invert	Avail.Storage	Storage Description
#1	96.00'	2,060 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

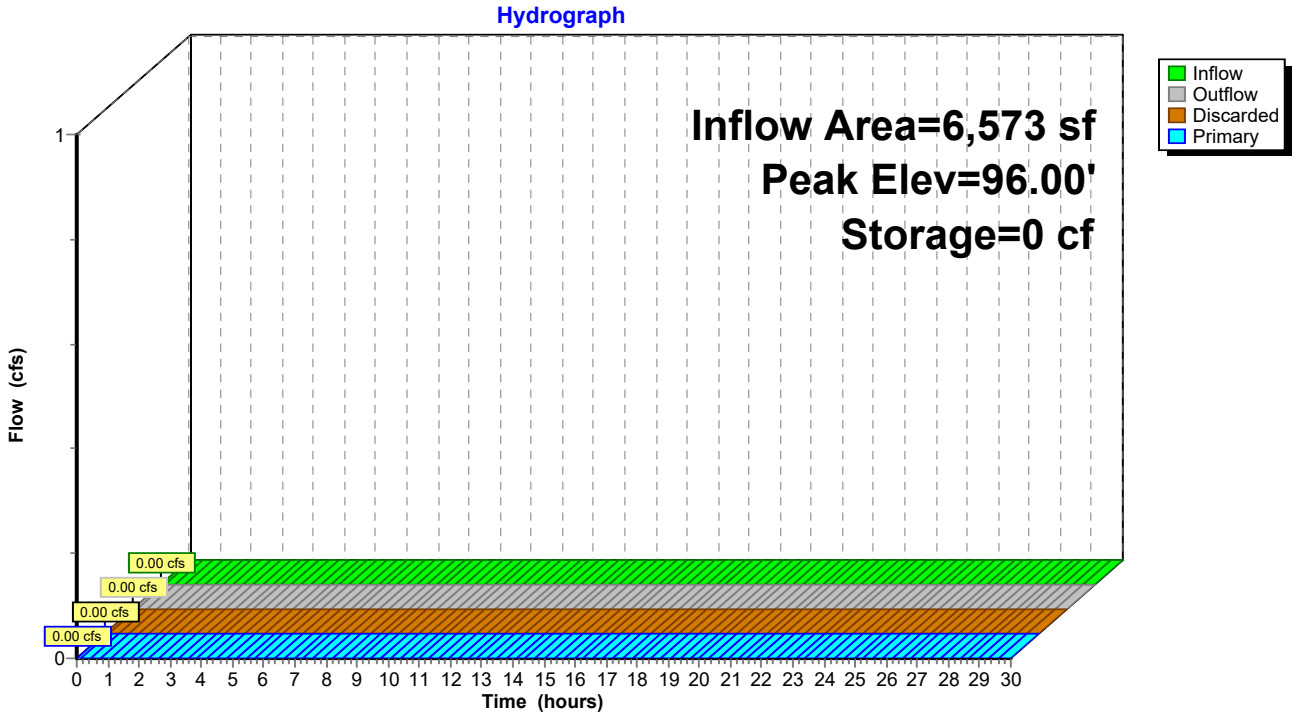
Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
96.00	700	0.0	0	0	700
97.00	800	40.0	300	300	839
99.50	1,000	5.0	112	412	1,172
101.00	1,200	100.0	1,648	2,060	1,438

Device	Routing	Invert	Outlet Devices
#0	Primary	101.00'	**Automatic Storage Overflow** (Discharged without head)
#1	Discarded	96.00'	**2.410 in/hr Exfiltration over Wetted area** Phase-In= 0.01'
#2	Primary	100.00'	**12.0" Round CMP_Round 12"** L= 10.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 100.00' / 99.00' S= 0.1000 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf

Discarded OutFlow Max=0.00 cfs @ 0.00 hrs HW=96.00' (Free Discharge)
1=Exfiltration (Controls 0.00 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=96.00' TW=99.00' (Dynamic Tailwater)
2=CMP_Round 12" (Controls 0.00 cfs)

Pond BR2: Bioretention Area #2



Summary for Pond CB1&2: CB 3&4

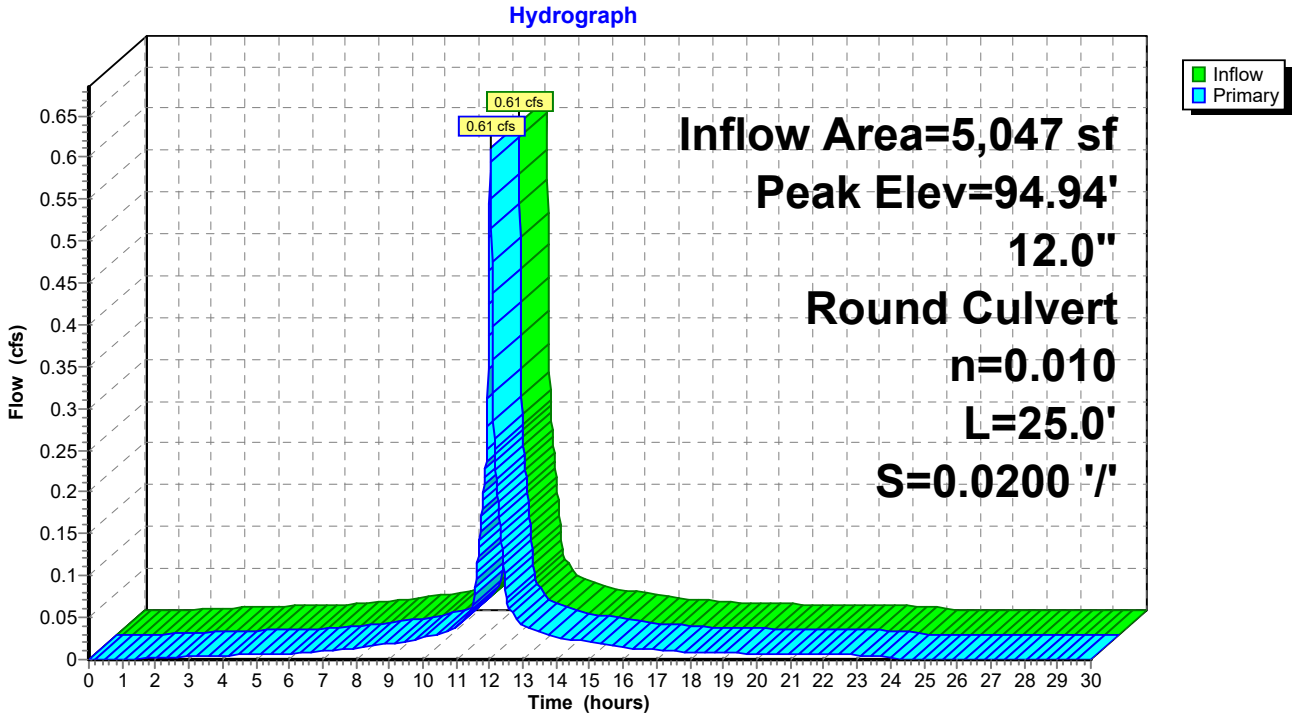
Inflow Area = 5,047 sf,100.00% Impervious, Inflow Depth = 4.39" for 10 yr Storm event
Inflow = 0.61 cfs @ 12.02 hrs, Volume= 1,848 cf
Outflow = 0.61 cfs @ 12.02 hrs, Volume= 1,848 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.61 cfs @ 12.02 hrs, Volume= 1,848 cf
Routed to Pond IB1&2 : Infiltration Basin 1&2

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 9
Peak Elev= 94.94' @ 13.14 hrs
Flood Elev= 97.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	93.00'	**12.0" Round Culvert** L= 25.0' RCP, groove end w/headwall, Ke= 0.200 Inlet / Outlet Invert= 93.00' / 92.50' S= 0.0200 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.61 cfs @ 12.02 hrs HW=93.35' TW=91.09' (Dynamic Tailwater)
1=Culvert (Inlet Controls 0.61 cfs @ 2.51 fps)

Pond CB1&2: CB 3&4



Summary for Pond CB3&4: CB 1&2

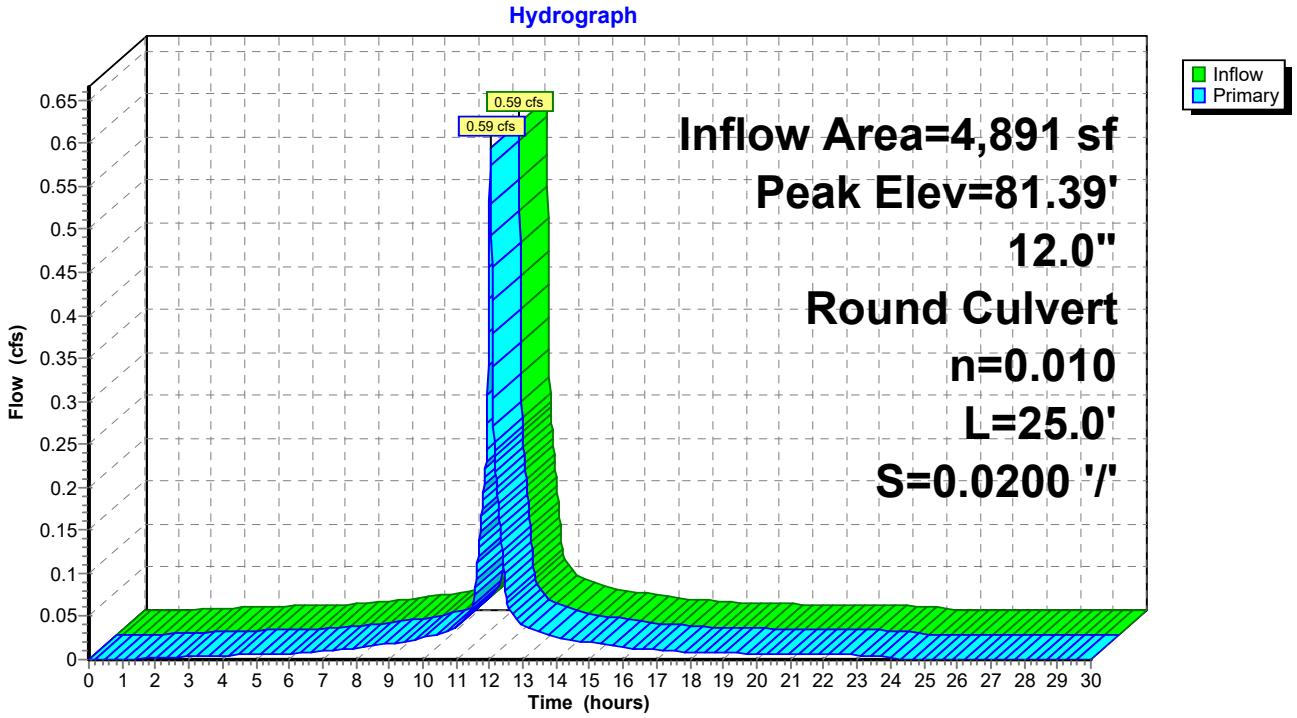
Inflow Area = 4,891 sf,100.00% Impervious, Inflow Depth = 4.39" for 10 yr Storm event
Inflow = 0.59 cfs @ 12.02 hrs, Volume= 1,791 cf
Outflow = 0.59 cfs @ 12.02 hrs, Volume= 1,791 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.59 cfs @ 12.02 hrs, Volume= 1,791 cf
Routed to Pond IB3&4 : Infiltration Basin 3&4

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 9
Peak Elev= 81.39' @ 12.02 hrs
Flood Elev= 85.15'

Device	Routing	Invert	Outlet Devices
#1	Primary	81.00'	**12.0" Round pipe** L= 25.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 81.00' / 80.50' S= 0.0200 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.59 cfs @ 12.02 hrs HW=81.39' TW=77.40' (Dynamic Tailwater)
1=pipe (Inlet Controls 0.59 cfs @ 2.12 fps)

Pond CB3&4: CB 1&2



Summary for Pond CB5: CB 5

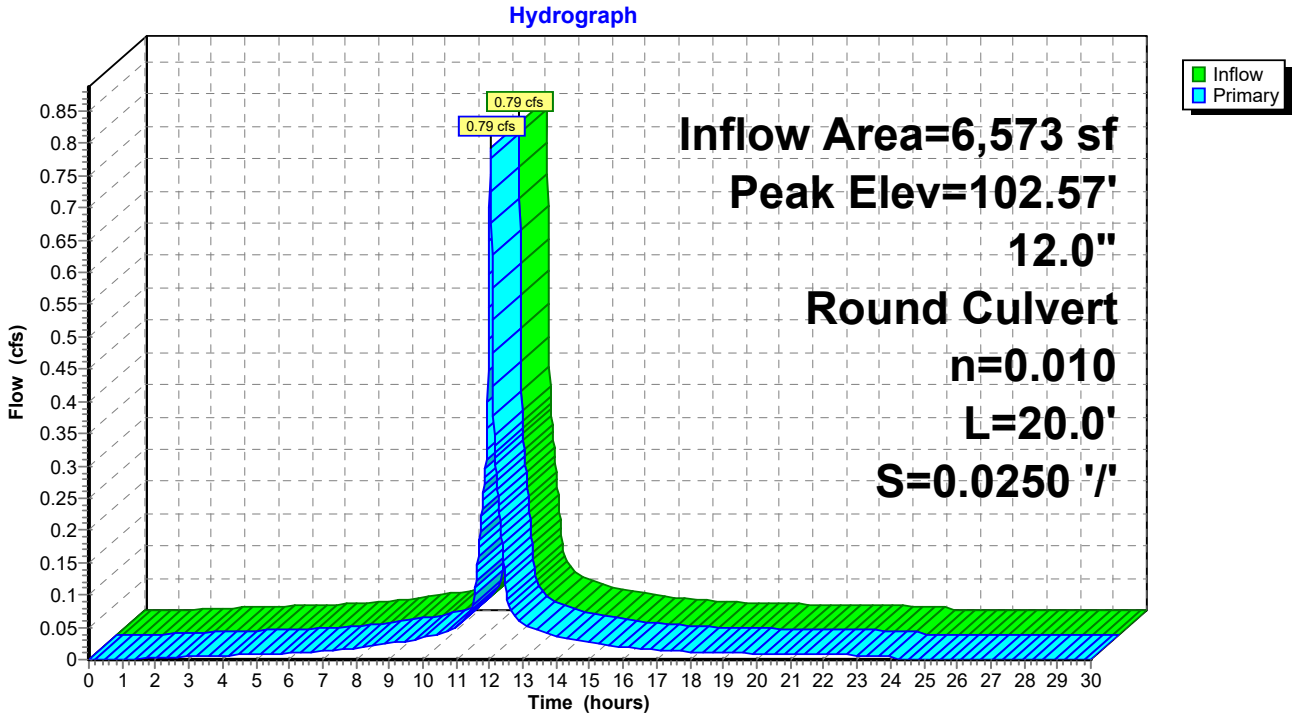
Inflow Area = 6,573 sf,100.00% Impervious, Inflow Depth = 4.39" for 10 yr Storm event
Inflow = 0.79 cfs @ 12.03 hrs, Volume= 2,407 cf
Outflow = 0.79 cfs @ 12.03 hrs, Volume= 2,407 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.79 cfs @ 12.03 hrs, Volume= 2,407 cf
Routed to Pond BR1 : Bioretention Area #1

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 9
Peak Elev= 102.57' @ 12.47 hrs
Flood Elev= 106.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	102.00'	**12.0" Round CMP_Round 12"** L= 20.0' CMP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 102.00' / 101.50' S= 0.0250 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.79 cfs @ 12.03 hrs HW=102.48' TW=99.88' (Dynamic Tailwater)
1=CMP_Round 12" (Inlet Controls 0.79 cfs @ 2.09 fps)

Pond CB5: CB 5



Summary for Pond IB1&2: Infiltration Basin 1&2

Inflow Area = 5,047 sf,100.00% Impervious, Inflow Depth = 4.39" for 10 yr Storm event
Inflow = 0.61 cfs @ 12.02 hrs, Volume= 1,848 cf
Outflow = 0.04 cfs @ 12.73 hrs, Volume= 1,848 cf, Atten= 94%, Lag= 42.3 min
Discarded = 0.04 cfs @ 12.73 hrs, Volume= 1,848 cf
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Pond CB3&4 : CB 1&2

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 9
Peak Elev= 94.94' @ 13.14 hrs Surf.Area= 226 sf Storage= 875 cf
Flood Elev= 98.00' Surf.Area= 226 sf Storage= 891 cf

Plug-Flow detention time= 248.7 min calculated for 1,847 cf (100% of inflow)
Center-of-Mass det. time= 248.7 min (994.0 - 745.3)

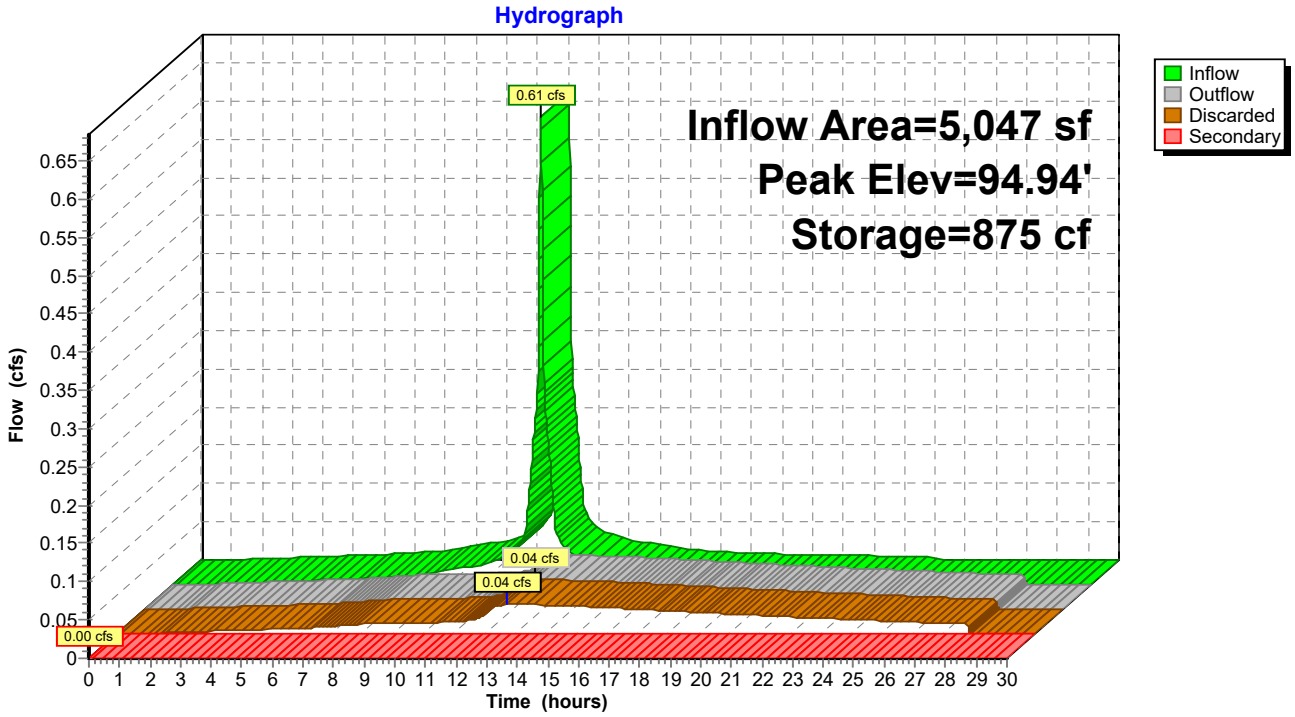
Volume	Invert	Avail.Storage	Storage Description
#1	87.50'	260 cf	**12.00'D x 6.00'H Vertical Cone/Cylinder** x 2 1,357 cf Overall - 708 cf Embedded = 649 cf x 40.0% Voids
#2	87.50'	603 cf	**8.00'D x 6.00'H Vertical Cone/Cylinder** x 2 Inside #1 708 cf Overall - 4.0" Wall Thickness = 603 cf
#3	93.25'	28 cf	**3.00'D x 4.00'H Vertical Cone/Cylinder** Impervious
		891 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	87.50'	**2.410 in/hr Exfiltration over Wetted area** Phase-In= 0.01'
#2	Secondary	96.75'	**2.0" x 2.0" Horiz. Orifice/Grate X 16.00 columns** X 8 rows C= 0.600 in 48.0" x 24.0" Grate (44% open area) Limited to weir flow at low heads

Discarded OutFlow Max=0.04 cfs @ 12.73 hrs HW=93.56' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.04 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=87.50' TW=81.00' (Dynamic Tailwater)
↑—**2=Orifice/Grate** (Controls 0.00 cfs)

Pond IB1&2: Infiltration Basin 1&2



Summary for Pond IB3&4: Infiltration Basin 3&4

Inflow Area = 4,891 sf,100.00% Impervious, Inflow Depth = 4.39" for 10 yr Storm event
Inflow = 0.59 cfs @ 12.02 hrs, Volume= 1,791 cf
Outflow = 0.04 cfs @ 12.95 hrs, Volume= 1,791 cf, Atten= 93%, Lag= 55.6 min
Discarded = 0.04 cfs @ 12.95 hrs, Volume= 1,791 cf
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Link DP : Design Point - Westgate Road

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 9
Peak Elev= 78.95' @ 12.95 hrs Surf.Area= 402 sf Storage= 732 cf
Flood Elev= 86.00' Surf.Area= 409 sf Storage= 1,302 cf

Plug-Flow detention time= 156.8 min calculated for 1,790 cf (100% of inflow)
Center-of-Mass det. time= 156.7 min (902.0 - 745.2)

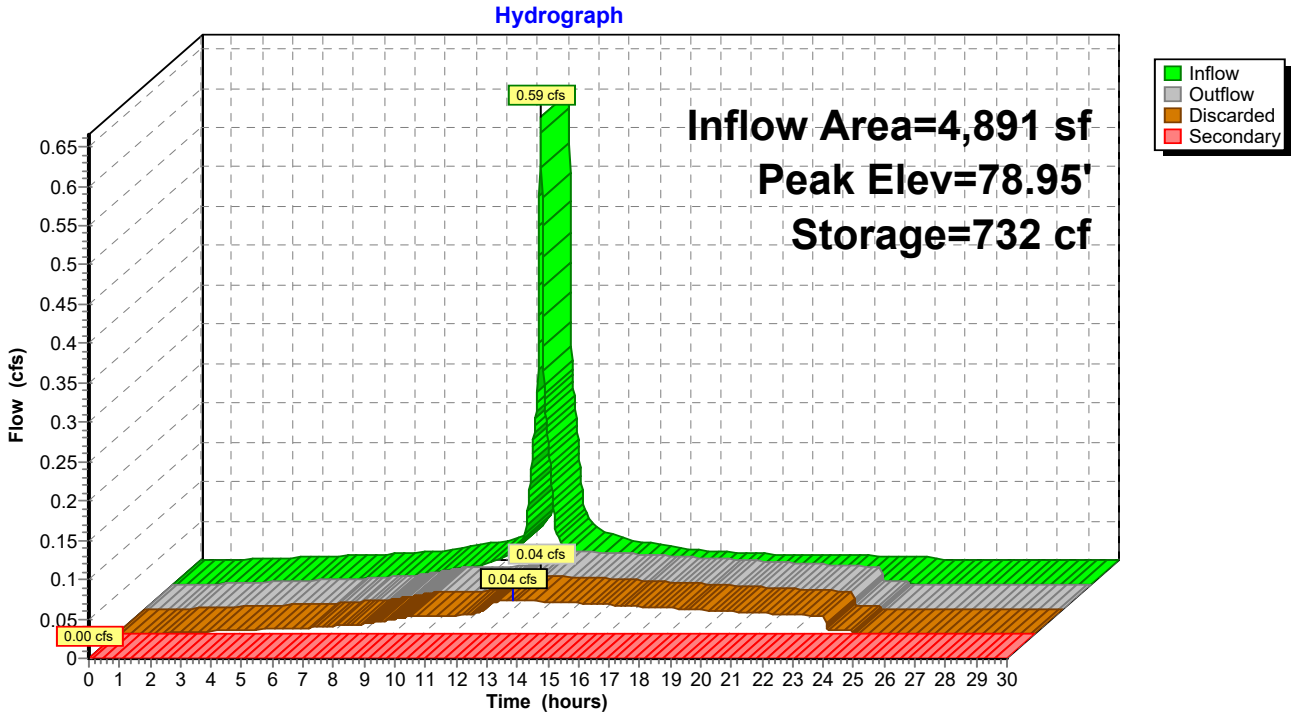
Volume	Invert	Avail.Storage	Storage Description
#1	75.50'	671 cf	**16.00'D x 6.00'H Vertical Cone/Cylinder**x 2 2,413 cf Overall - 735 cf Embedded = 1,677 cf x 40.0% Voids
#2	75.50'	603 cf	**8.00'D x 6.00'H Vertical Cone/Cylinder**x 2 Inside #1 735 cf Overall - 5.0" Wall Thickness = 603 cf
#3	81.25'	28 cf	**3.00'D x 4.00'H Vertical Cone/Cylinder**
		1,302 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	75.50'	**2.410 in/hr Exfiltration over Wetted area** Phase-In= 0.01'
#2	Secondary	85.00'	**2.0" x 2.0" Horiz. Orifice/Grate X 16.00 columns** X 8 rows C= 0.600 in 48.0" x 24.0" Grate (44% open area) Limited to weir flow at low heads

Discarded OutFlow Max=0.04 cfs @ 12.95 hrs HW=78.95' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.04 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=75.50' TW=0.00' (Dynamic Tailwater)
↑—**2=Orifice/Grate** (Controls 0.00 cfs)

Pond IB3&4: Infiltration Basin 3&4

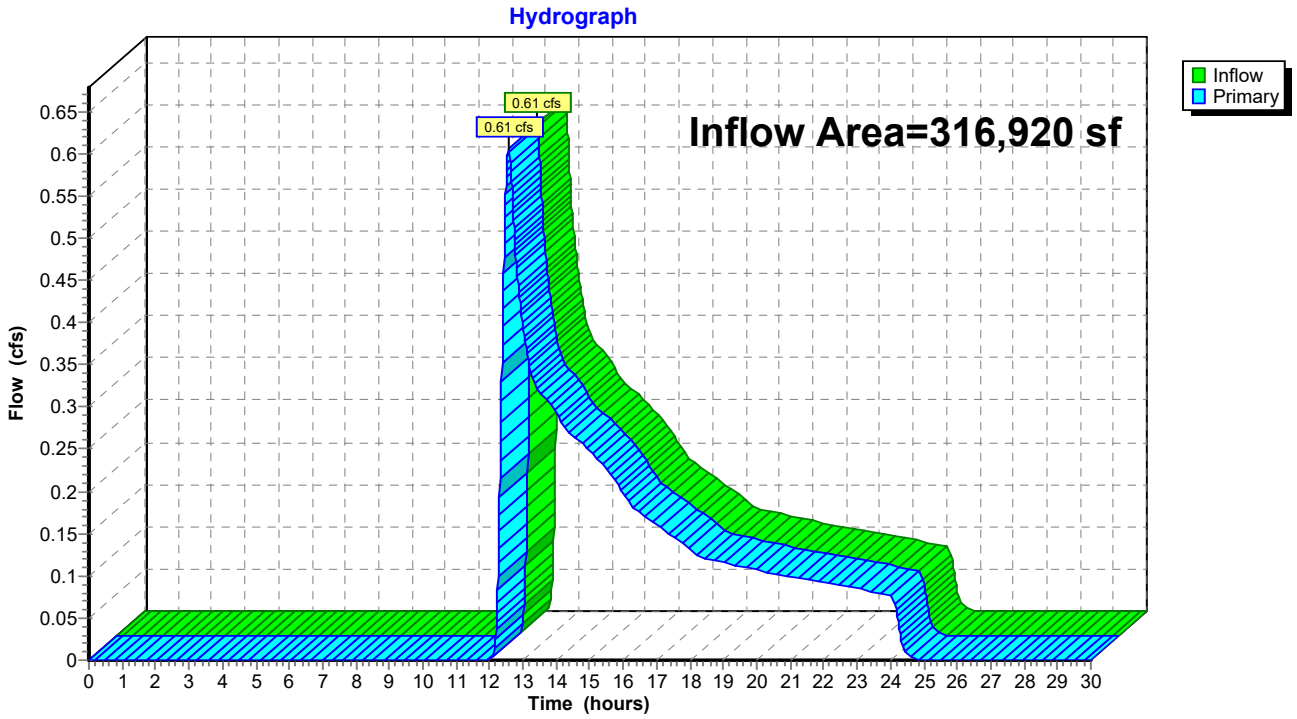


Summary for Link DP: Design Point - Westgate Road

Inflow Area = 316,920 sf, 2.38% Impervious, Inflow Depth = 0.29" for 10 yr Storm event
Inflow = 0.61 cfs @ 12.57 hrs, Volume= 7,587 cf
Primary = 0.61 cfs @ 12.57 hrs, Volume= 7,587 cf, Atten= 0%, Lag= 0.0 min

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

Link DP: Design Point - Westgate Road



Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points x 9
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment1S: Subbasin 1 Runoff Area=310,347 sf 0.32% Impervious Runoff Depth=0.56"
Flow Length=821' Slope=0.0207 '/' Tc=19.0 min CN=44 Runoff=1.73 cfs 14,573 cf

Subcatchment2S: Road (lower) Runoff Area=4,891 sf 100.00% Impervious Runoff Depth=5.28"
Flow Length=213' Slope=0.0470 '/' Tc=1.6 min CN=98 Runoff=0.71 cfs 2,153 cf

Subcatchment3S: Road (middle) Runoff Area=5,047 sf 100.00% Impervious Runoff Depth=5.28"
Flow Length=217' Slope=0.0420 '/' Tc=1.7 min CN=98 Runoff=0.73 cfs 2,222 cf

Subcatchment4S: Road (cul-de-sac) Runoff Area=6,573 sf 100.00% Impervious Runoff Depth=5.28"
Flow Length=114' Slope=0.0100 '/' Tc=1.8 min CN=98 Runoff=0.95 cfs 2,893 cf

Reach 12R: Overland Flow Avg. Flow Depth=0.00' Max Vel=0.00 fps Inflow=0.00 cfs 0 cf
n=0.400 L=220.0' S=0.0409 '/' Capacity=809,595.25 cfs Outflow=0.00 cfs 0 cf

Pond BR1: Bioretention Area #1 Peak Elev=102.70' Storage=964 cf Inflow=0.95 cfs 2,893 cf
Discarded=0.10 cfs 2,893 cf Primary=0.00 cfs 0 cf Outflow=0.10 cfs 2,893 cf

Pond BR2: Bioretention Area #2 Peak Elev=96.00' Storage=0 cf Inflow=0.00 cfs 0 cf
Discarded=0.00 cfs 0 cf Primary=0.00 cfs 0 cf Outflow=0.00 cfs 0 cf

Pond CB1&2: CB 3&4 Peak Elev=96.80' Inflow=0.73 cfs 2,222 cf
12.0" Round Culvert n=0.010 L=25.0' S=0.0200 '/' Outflow=0.73 cfs 2,222 cf

Pond CB3&4: CB 1&2 Peak Elev=81.43' Inflow=0.71 cfs 2,375 cf
12.0" Round Culvert n=0.010 L=25.0' S=0.0200 '/' Outflow=0.71 cfs 2,375 cf

Pond CB5: CB 5 Peak Elev=102.70' Inflow=0.95 cfs 2,893 cf
12.0" Round Culvert n=0.010 L=20.0' S=0.0250 '/' Outflow=0.95 cfs 2,893 cf

Pond IB1&2: Infiltration Basin 1&2 Peak Elev=96.79' Storage=888 cf Inflow=0.73 cfs 2,222 cf
Discarded=0.04 cfs 2,000 cf Secondary=0.35 cfs 222 cf Outflow=0.39 cfs 2,222 cf

Pond IB3&4: Infiltration Basin 3&4 Peak Elev=80.79' Storage=1,124 cf Inflow=0.71 cfs 2,375 cf
Discarded=0.05 cfs 2,375 cf Secondary=0.00 cfs 0 cf Outflow=0.05 cfs 2,375 cf

Link DP: Design Point - Westgate Road Inflow=1.73 cfs 14,573 cf
Primary=1.73 cfs 14,573 cf

Total Runoff Area = 326,858 sf Runoff Volume = 21,841 cf Average Runoff Depth = 0.80"
94.65% Pervious = 309,367 sf 5.35% Impervious = 17,491 sf

Summary for Subcatchment 1S: Subbasin 1

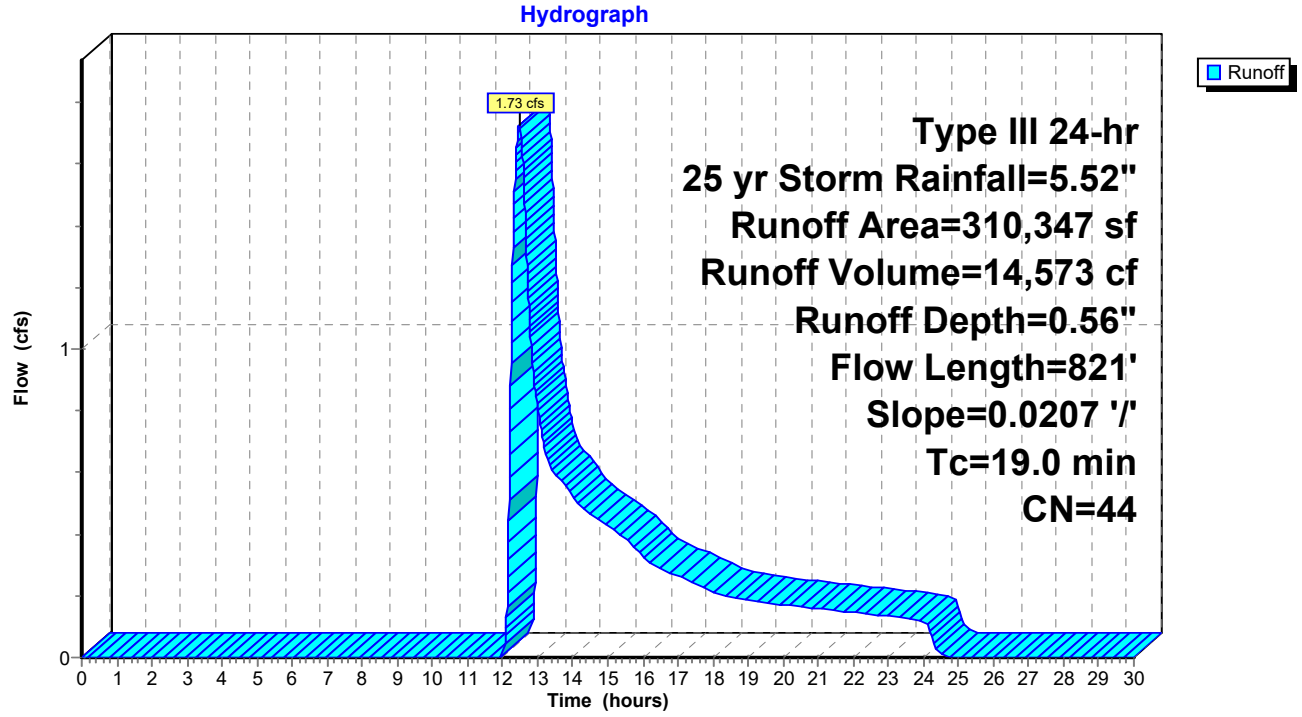
Runoff = 1.73 cfs @ 12.48 hrs, Volume= 14,573 cf, Depth= 0.56"
Routed to Link DP : Design Point - Westgate Road

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 yr Storm Rainfall=5.52"

Area (sf)	CN	Description
980	98	Unconnected roofs, HSG A
4,000	76	Gravel roads, HSG A
305,367	43	Woods/grass comb., Fair, HSG A
310,347	44	Weighted Average
309,367		99.68% Pervious Area
980		0.32% Impervious Area
980		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.0	821	0.0207	0.72		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps

Subcatchment 1S: Subbasin 1



Summary for Subcatchment 2S: Road (lower)

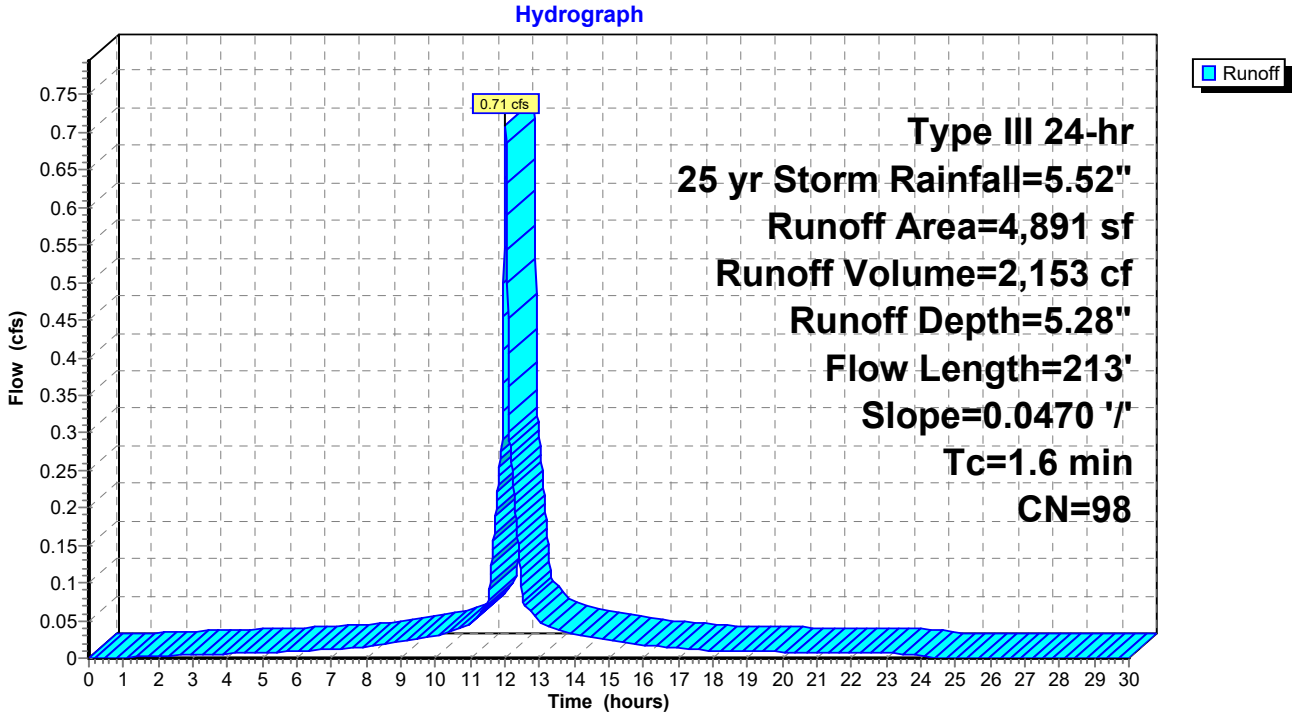
Runoff = 0.71 cfs @ 12.02 hrs, Volume= 2,153 cf, Depth= 5.28"
Routed to Pond CB3&4 : CB 1&2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 yr Storm Rainfall=5.52"

Area (sf)	CN	Description
4,891	98	Paved roads w/curbs & sewers, HSG A
4,891		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.6	213	0.0470	2.25		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20"

Subcatchment 2S: Road (lower)



Summary for Subcatchment 3S: Road (middle)

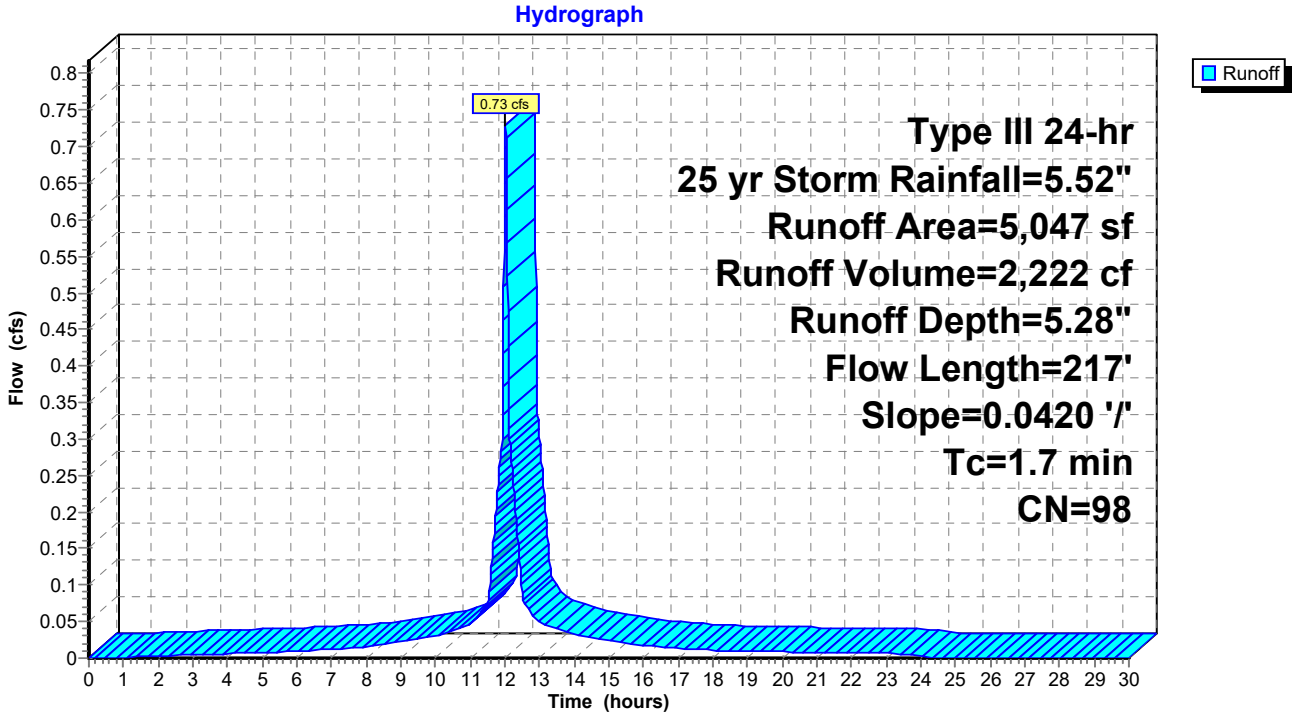
Runoff = 0.73 cfs @ 12.02 hrs, Volume= 2,222 cf, Depth= 5.28"
Routed to Pond CB1&2 : CB 3&4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 yr Storm Rainfall=5.52"

Area (sf)	CN	Description
5,047	98	Paved roads w/curbs & sewers, HSG A
5,047		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.7	217	0.0420	2.16		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20"

Subcatchment 3S: Road (middle)



Summary for Subcatchment 4S: Road (cul-de-sac)

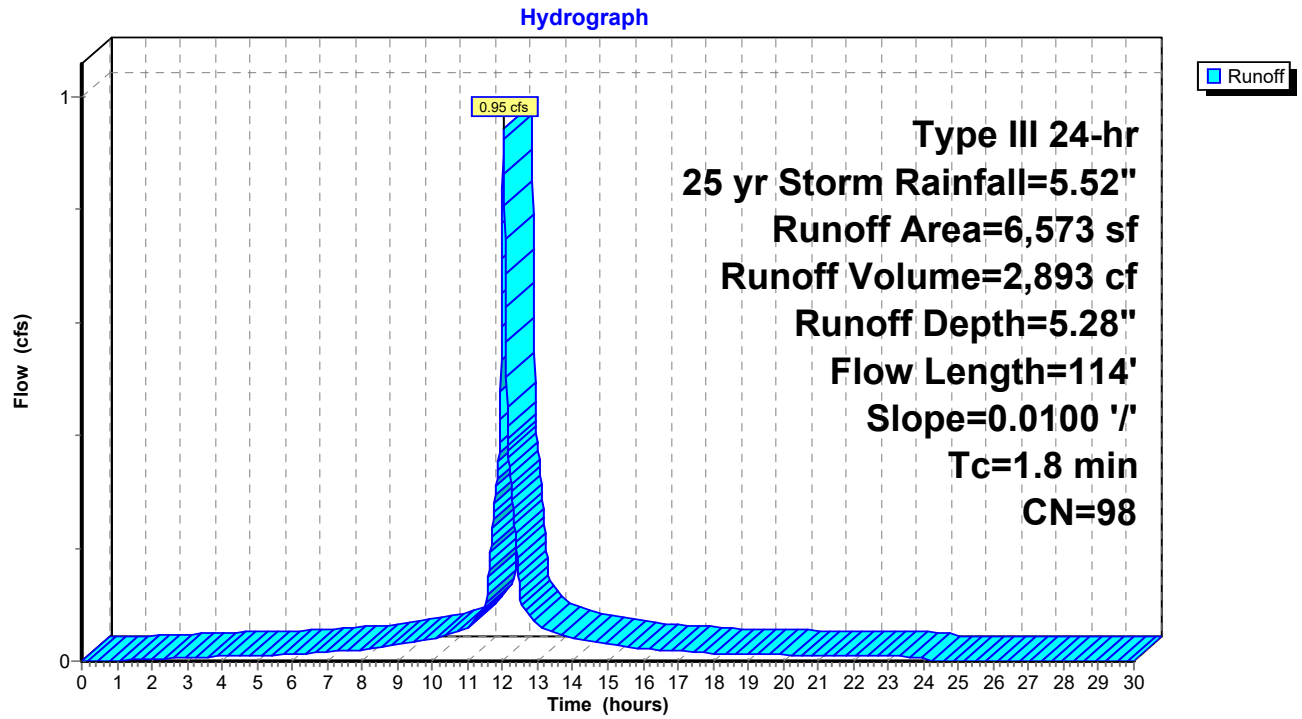
Runoff = 0.95 cfs @ 12.03 hrs, Volume= 2,893 cf, Depth= 5.28"
Routed to Pond CB5 : CB 5

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 yr Storm Rainfall=5.52"

Area (sf)	CN	Description
6,573	98	Paved roads w/curbs & sewers, HSG A
6,573		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.8	114	0.0100	1.07		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20"

Subcatchment 4S: Road (cul-de-sac)



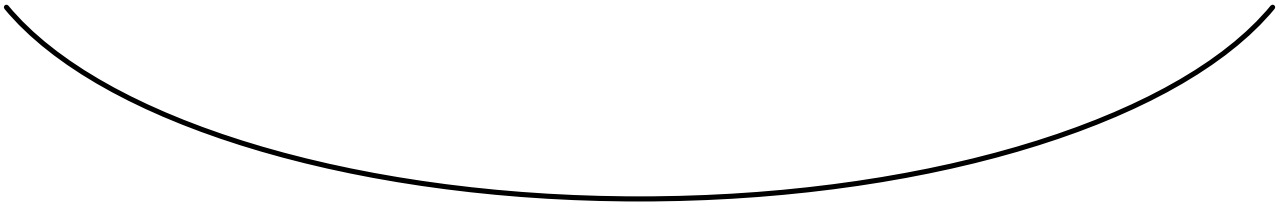
Summary for Reach 12R: Overland Flow

Inflow Area = 6,573 sf,100.00% Impervious, Inflow Depth = 0.00" for 25 yr Storm event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min
Routed to Link DP : Design Point - Westgate Road

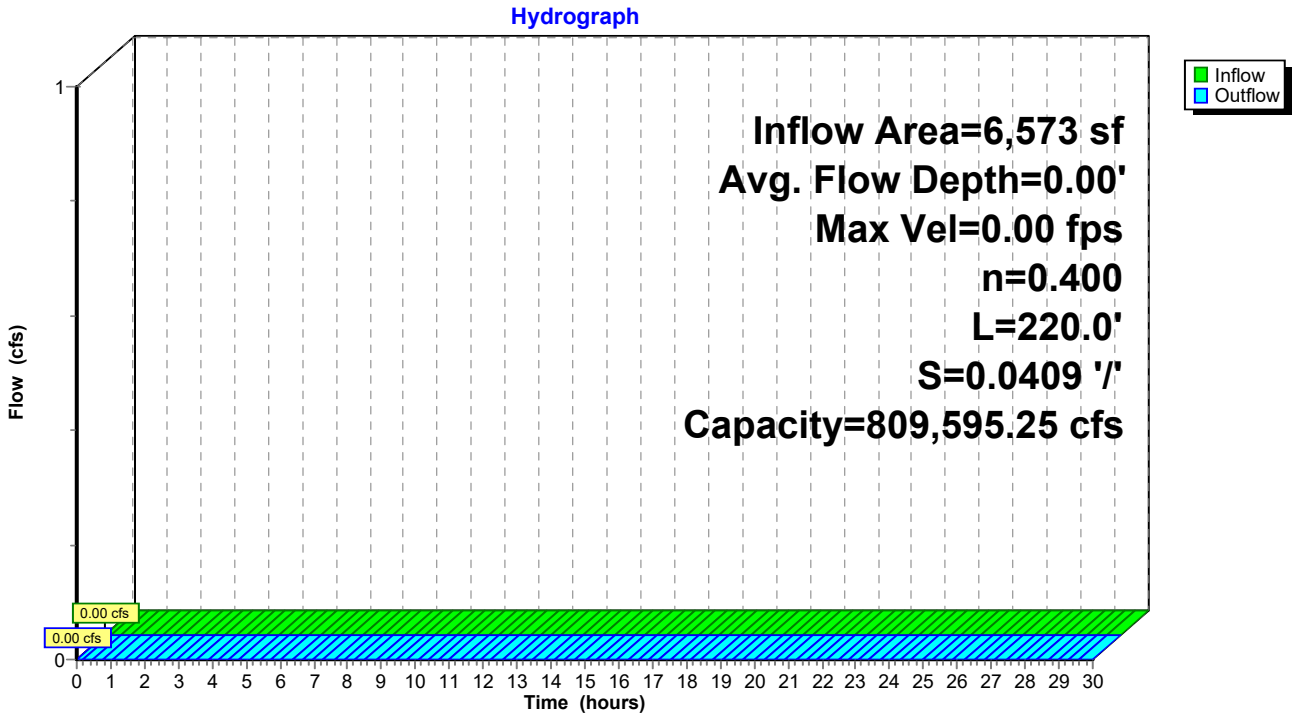
Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 9
Max. Velocity= 0.00 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 0.00 fps, Avg. Travel Time= 0.0 min

Peak Storage= 0 cf @ 0.00 hrs
Average Depth at Peak Storage= 0.00'
Bank-Full Depth= 100.00' Flow Area= 66,666.7 sf, Capacity= 809,595.25 cfs

1,000.00' x 100.00' deep Parabolic Channel, n= 0.400 Sheet flow: Woods+light brush
Length= 220.0' Slope= 0.0409 '/'
Inlet Invert= 99.00', Outlet Invert= 90.00'



‡



Summary for Pond BR1: Bioretention Area #1

Inflow Area = 6,573 sf,100.00% Impervious, Inflow Depth = 5.28" for 25 yr Storm event
Inflow = 0.95 cfs @ 12.03 hrs, Volume= 2,893 cf
Outflow = 0.10 cfs @ 12.54 hrs, Volume= 2,893 cf, Atten= 89%, Lag= 30.8 min
Discarded = 0.10 cfs @ 12.54 hrs, Volume= 2,893 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Pond BR2 : Bioretention Area #2

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 9
Peak Elev= 102.70' @ 12.54 hrs Surf.Area= 1,513 sf Storage= 964 cf

Plug-Flow detention time= 68.9 min calculated for 2,892 cf (100% of inflow)
Center-of-Mass det. time= 68.8 min (811.4 - 742.5)

Volume	Invert	Avail.Storage	Storage Description
#1	99.00'	2,984 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

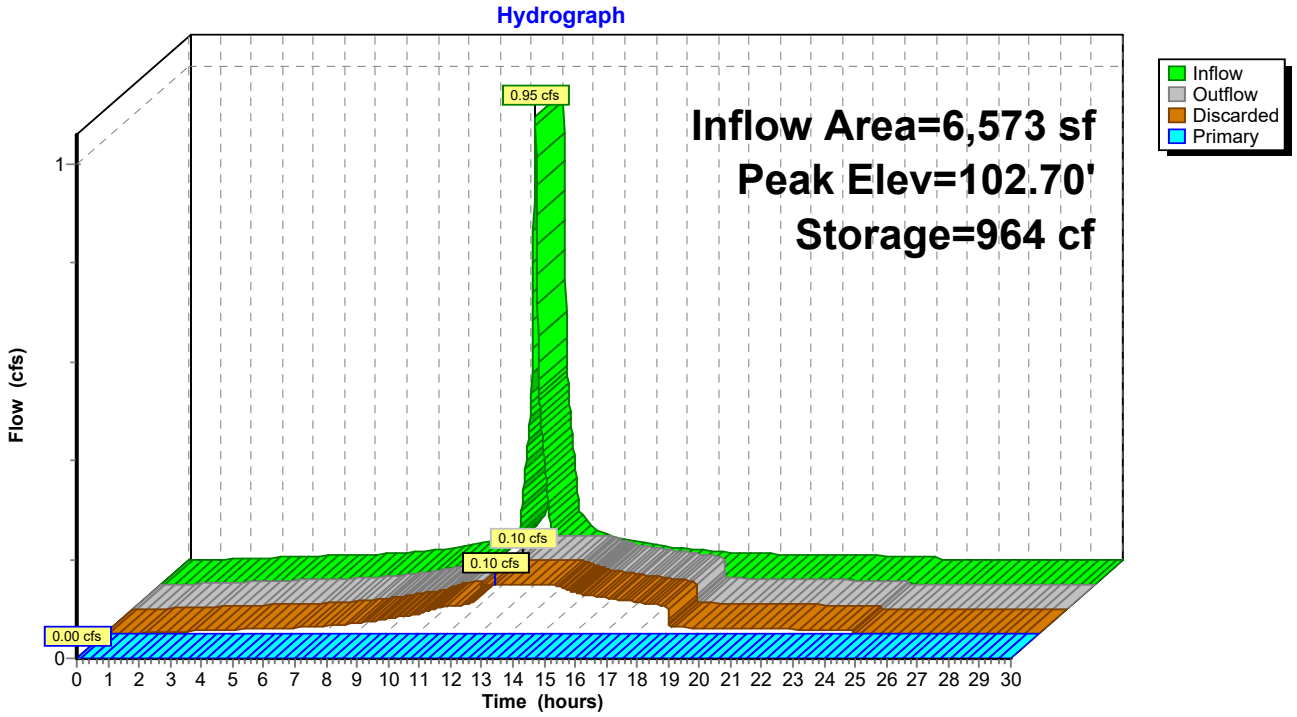
Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
99.00	1,000	0.0	0	0	1,000
100.00	1,400	40.0	478	478	1,418
102.50	1,500	5.0	181	659	1,770
104.00	1,600	100.0	2,325	2,984	2,002

Device	Routing	Invert	Outlet Devices
#0	Primary	104.00'	**Automatic Storage Overflow** (Discharged without head)
#1	Discarded	99.00'	**2.410 in/hr Exfiltration over Wetted area** Phase-In= 0.01'
#2	Primary	103.00'	**12.0" Round CMP_Round 12"** L= 10.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 103.00' / 101.05' S= 0.1950 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf

Discarded OutFlow Max=0.10 cfs @ 12.54 hrs HW=102.70' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.10 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=99.00' TW=96.00' (Dynamic Tailwater)
↑**2=CMP_Round 12"** (Controls 0.00 cfs)

Pond BR1: Bioretention Area #1



Summary for Pond BR2: Bioretention Area #2

Inflow Area = 6,573 sf,100.00% Impervious, Inflow Depth = 0.00" for 25 yr Storm event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min
Discarded = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Reach 12R : Overland Flow

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 9
Peak Elev= 96.00' @ 0.00 hrs Surf.Area= 700 sf Storage= 0 cf

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

Volume	Invert	Avail.Storage	Storage Description
#1	96.00'	2,060 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

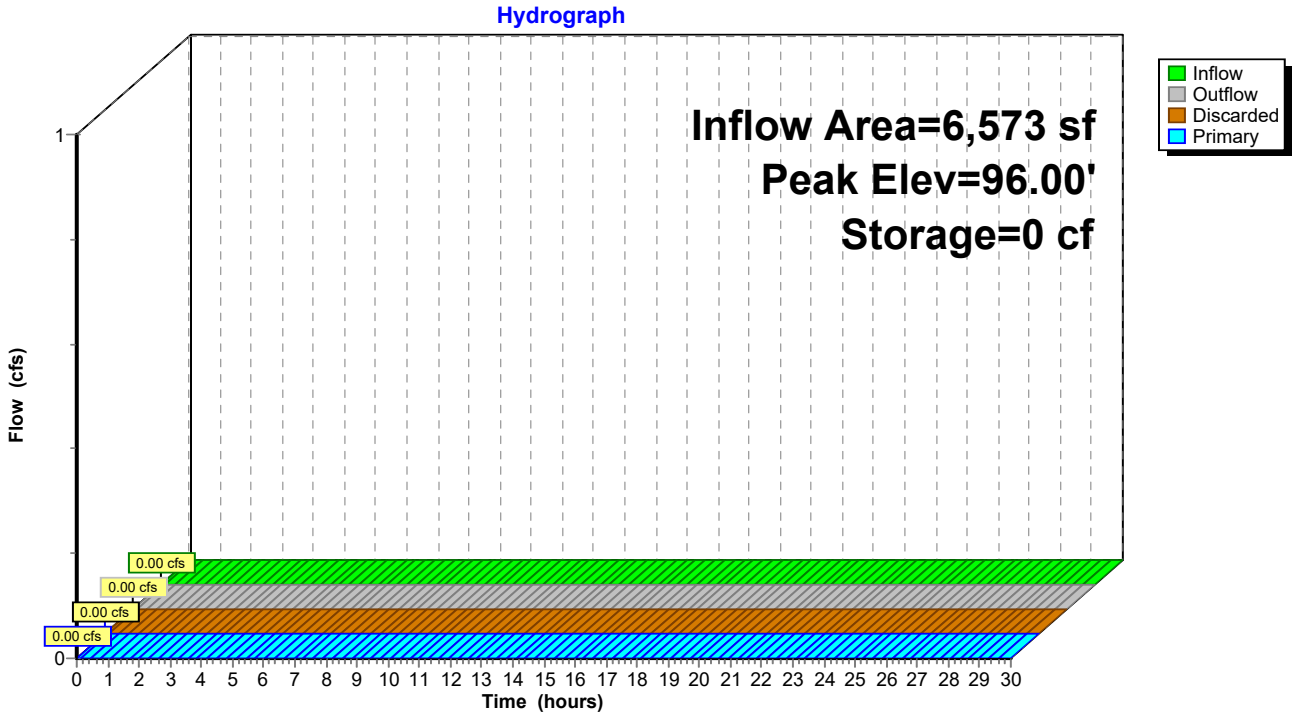
Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
96.00	700	0.0	0	0	700
97.00	800	40.0	300	300	839
99.50	1,000	5.0	112	412	1,172
101.00	1,200	100.0	1,648	2,060	1,438

Device	Routing	Invert	Outlet Devices
#0	Primary	101.00'	**Automatic Storage Overflow** (Discharged without head)
#1	Discarded	96.00'	**2.410 in/hr Exfiltration over Wetted area** Phase-In= 0.01'
#2	Primary	100.00'	**12.0" Round CMP_Round 12"** L= 10.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 100.00' / 99.00' S= 0.1000 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf

Discarded OutFlow Max=0.00 cfs @ 0.00 hrs HW=96.00' (Free Discharge)
1=Exfiltration (Controls 0.00 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=96.00' TW=99.00' (Dynamic Tailwater)
2=CMP_Round 12" (Controls 0.00 cfs)

Pond BR2: Bioretention Area #2



Summary for Pond CB1&2: CB 3&4

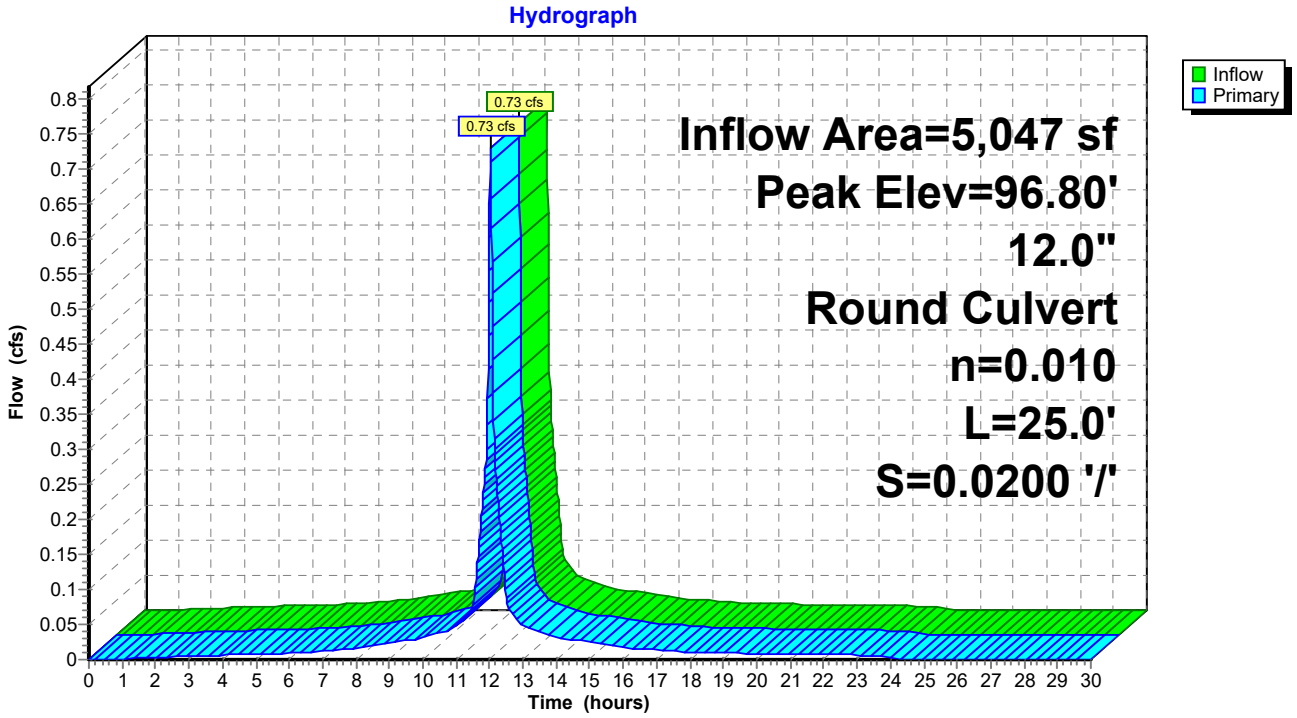
Inflow Area = 5,047 sf,100.00% Impervious, Inflow Depth = 5.28" for 25 yr Storm event
Inflow = 0.73 cfs @ 12.02 hrs, Volume= 2,222 cf
Outflow = 0.73 cfs @ 12.02 hrs, Volume= 2,222 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.73 cfs @ 12.02 hrs, Volume= 2,222 cf
Routed to Pond IB1&2 : Infiltration Basin 1&2

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 9
Peak Elev= 96.80' @ 12.19 hrs
Flood Elev= 97.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	93.00'	**12.0" Round Culvert** L= 25.0' RCP, groove end w/headwall, Ke= 0.200 Inlet / Outlet Invert= 93.00' / 92.50' S= 0.0200 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.73 cfs @ 12.02 hrs HW=93.38' TW=92.03' (Dynamic Tailwater)
1=Culvert (Inlet Controls 0.73 cfs @ 2.63 fps)

Pond CB1&2: CB 3&4



Summary for Pond CB3&4: CB 1&2

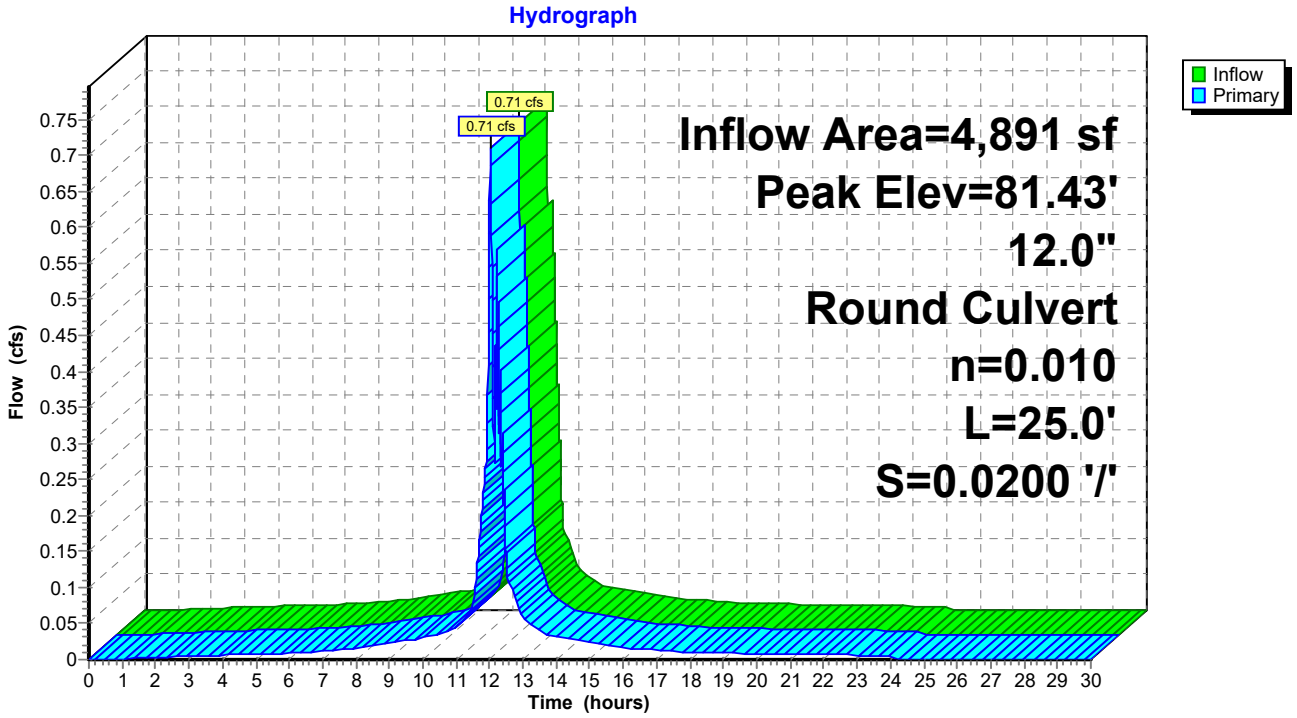
Inflow Area = 4,891 sf,100.00% Impervious, Inflow Depth = 5.83" for 25 yr Storm event
Inflow = 0.71 cfs @ 12.02 hrs, Volume= 2,375 cf
Outflow = 0.71 cfs @ 12.02 hrs, Volume= 2,375 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.71 cfs @ 12.02 hrs, Volume= 2,375 cf
Routed to Pond IB3&4 : Infiltration Basin 3&4

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 9
Peak Elev= 81.43' @ 12.02 hrs
Flood Elev= 85.15'

Device	Routing	Invert	Outlet Devices
#1	Primary	81.00'	**12.0" Round pipe** L= 25.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 81.00' / 80.50' S= 0.0200 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.71 cfs @ 12.02 hrs HW=81.43' TW=77.95' (Dynamic Tailwater)
1=pipe (Inlet Controls 0.71 cfs @ 2.22 fps)

Pond CB3&4: CB 1&2



Summary for Pond CB5: CB 5

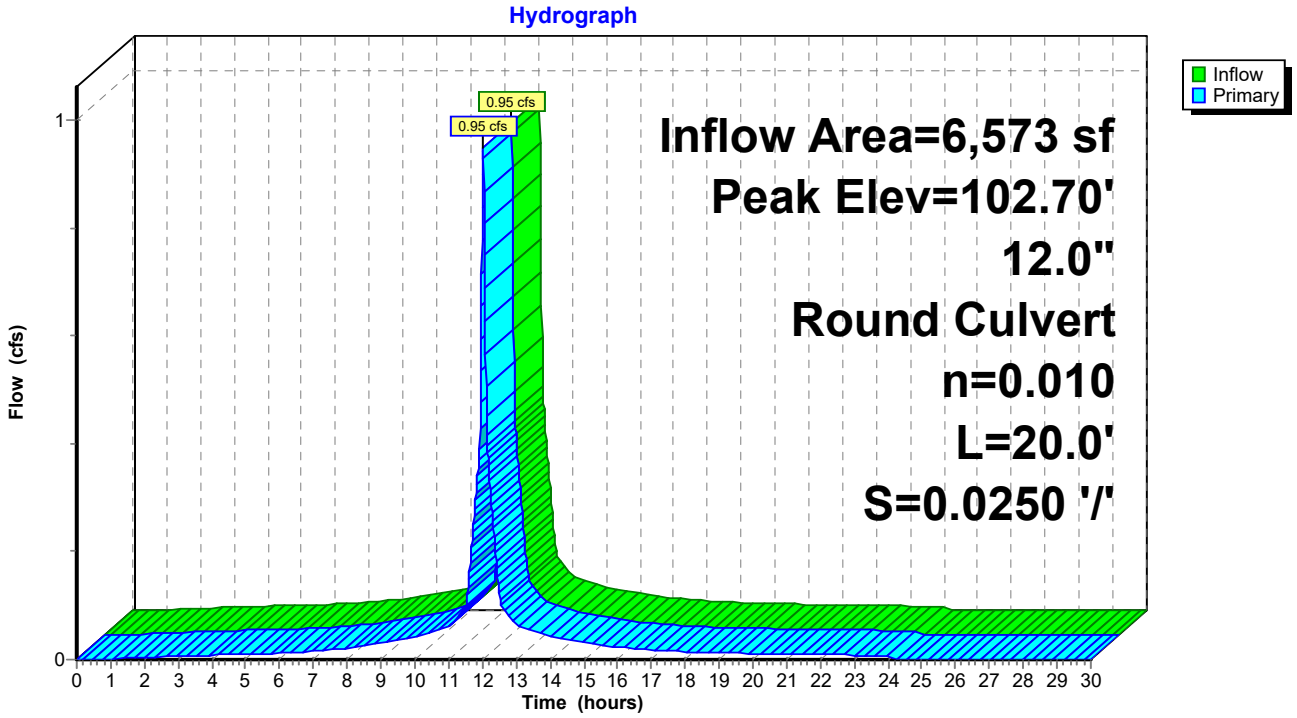
Inflow Area = 6,573 sf,100.00% Impervious, Inflow Depth = 5.28" for 25 yr Storm event
Inflow = 0.95 cfs @ 12.03 hrs, Volume= 2,893 cf
Outflow = 0.95 cfs @ 12.03 hrs, Volume= 2,893 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.95 cfs @ 12.03 hrs, Volume= 2,893 cf
Routed to Pond BR1 : Bioretention Area #1

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 9
Peak Elev= 102.70' @ 12.51 hrs
Flood Elev= 106.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	102.00'	**12.0" Round CMP_Round 12"** L= 20.0' CMP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 102.00' / 101.50' S= 0.0250 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.94 cfs @ 12.03 hrs HW=102.54' TW=100.71' (Dynamic Tailwater)
1=CMP_Round 12" (Inlet Controls 0.94 cfs @ 2.20 fps)

Pond CB5: CB 5



Summary for Pond IB1&2: Infiltration Basin 1&2

[87] Warning: Oscillations may require smaller dt or Finer Routing (severity=20)

Inflow Area = 5,047 sf,100.00% Impervious, Inflow Depth = 5.28" for 25 yr Storm event
Inflow = 0.73 cfs @ 12.02 hrs, Volume= 2,222 cf
Outflow = 0.39 cfs @ 12.19 hrs, Volume= 2,222 cf, Atten= 46%, Lag= 10.0 min
Discarded = 0.04 cfs @ 12.16 hrs, Volume= 2,000 cf
Secondary = 0.35 cfs @ 12.19 hrs, Volume= 222 cf
Routed to Pond CB3&4 : CB 1&2

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 9
Peak Elev= 96.79' @ 12.19 hrs Surf.Area= 226 sf Storage= 888 cf
Flood Elev= 98.00' Surf.Area= 226 sf Storage= 891 cf

Plug-Flow detention time= 230.4 min calculated for 2,221 cf (100% of inflow)
Center-of-Mass det. time= 230.4 min (972.8 - 742.4)

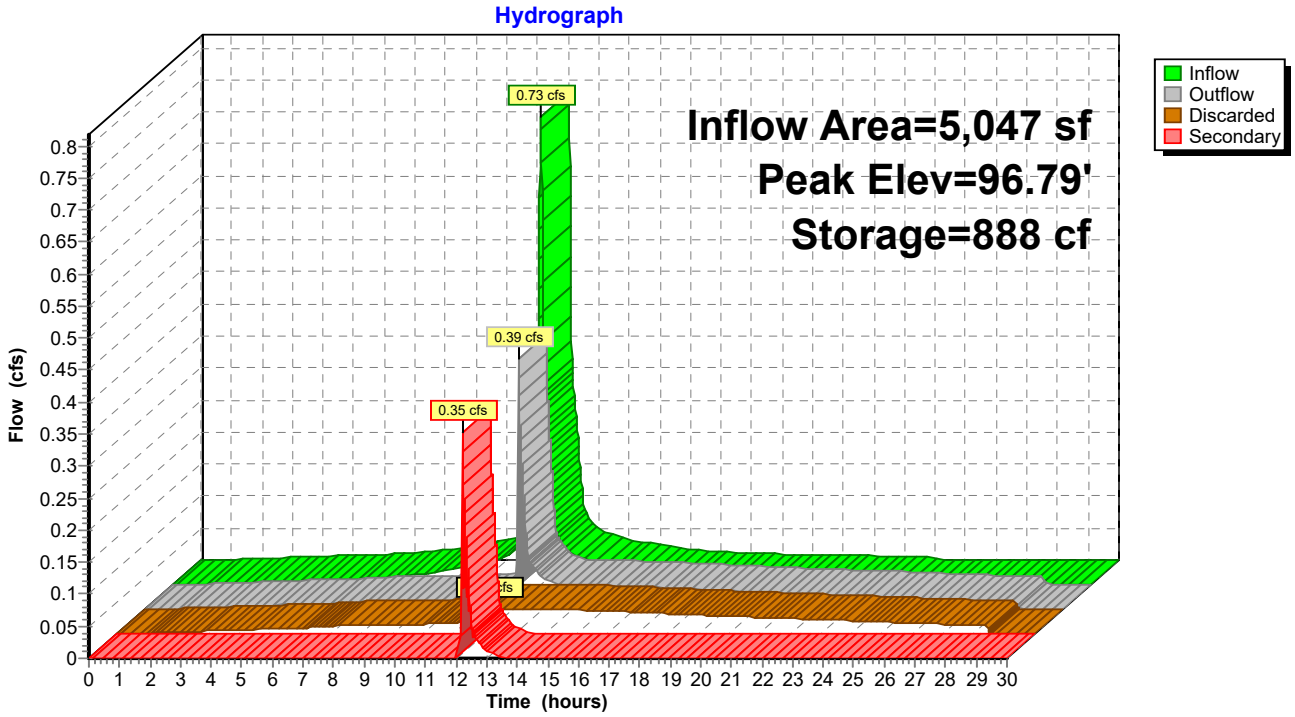
Volume	Invert	Avail.Storage	Storage Description
#1	87.50'	260 cf	**12.00'D x 6.00'H Vertical Cone/Cylinder** x 2 1,357 cf Overall - 708 cf Embedded = 649 cf x 40.0% Voids
#2	87.50'	603 cf	**8.00'D x 6.00'H Vertical Cone/Cylinder** x 2 Inside #1 708 cf Overall - 4.0" Wall Thickness = 603 cf
#3	93.25'	28 cf	**3.00'D x 4.00'H Vertical Cone/Cylinder** Impervious
		891 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	87.50'	**2.410 in/hr Exfiltration over Wetted area** Phase-In= 0.01'
#2	Secondary	96.75'	**2.0" x 2.0" Horiz. Orifice/Grate X 16.00 columns** X 8 rows C= 0.600 in 48.0" x 24.0" Grate (44% open area) Limited to weir flow at low heads

Discarded OutFlow Max=0.04 cfs @ 12.16 hrs HW=94.06' (Free Discharge)
↑└**1=Exfiltration** (Exfiltration Controls 0.04 cfs)

Secondary OutFlow Max=0.33 cfs @ 12.19 hrs HW=96.79' TW=81.38' (Dynamic Tailwater)
↑└**2=Orifice/Grate** (Weir Controls 0.33 cfs @ 0.66 fps)

Pond IB1&2: Infiltration Basin 1&2



Summary for Pond IB3&4: Infiltration Basin 3&4

Inflow Area = 4,891 sf,100.00% Impervious, Inflow Depth = 5.83" for 25 yr Storm event
Inflow = 0.71 cfs @ 12.02 hrs, Volume= 2,375 cf
Outflow = 0.05 cfs @ 13.11 hrs, Volume= 2,375 cf, Atten= 93%, Lag= 65.2 min
Discarded = 0.05 cfs @ 13.11 hrs, Volume= 2,375 cf
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Link DP : Design Point - Westgate Road

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 9
Peak Elev= 80.79' @ 13.11 hrs Surf.Area= 402 sf Storage= 1,124 cf
Flood Elev= 86.00' Surf.Area= 409 sf Storage= 1,302 cf

Plug-Flow detention time= 211.0 min calculated for 2,374 cf (100% of inflow)
Center-of-Mass det. time= 210.9 min (953.6 - 742.7)

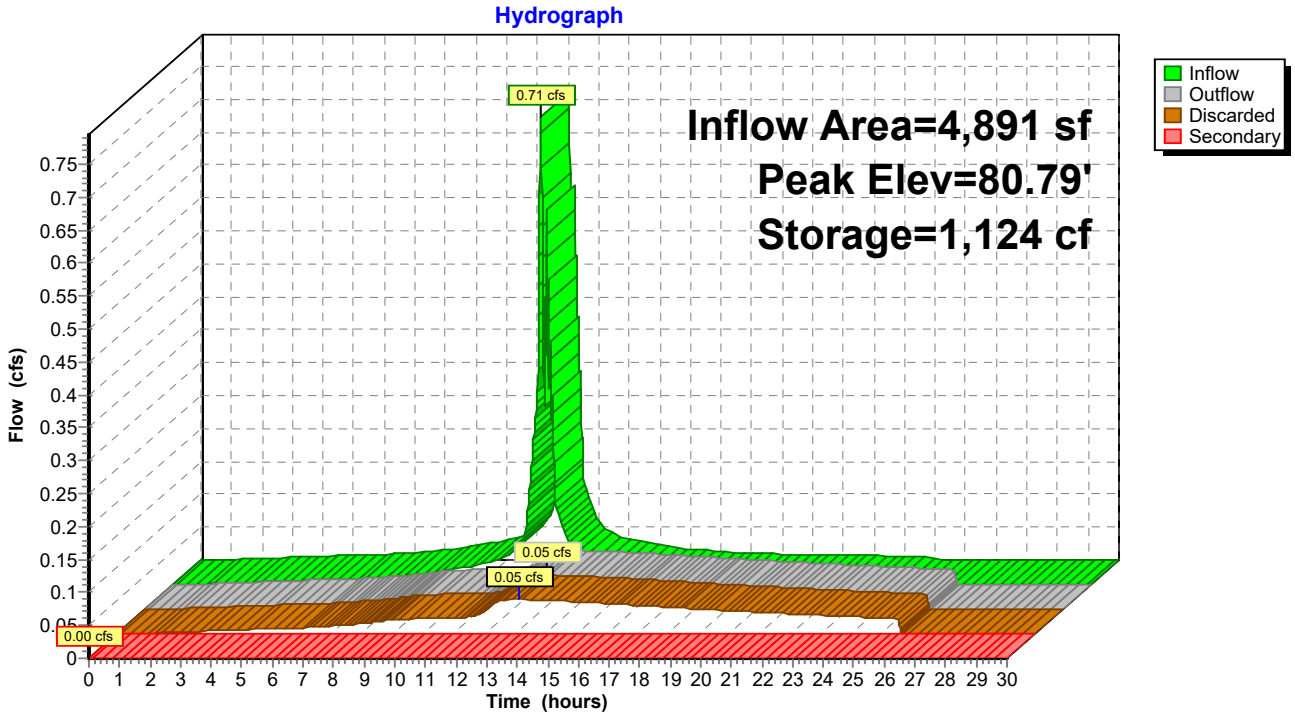
Volume	Invert	Avail.Storage	Storage Description
#1	75.50'	671 cf	**16.00'D x 6.00'H Vertical Cone/Cylinder**x 2 2,413 cf Overall - 735 cf Embedded = 1,677 cf x 40.0% Voids
#2	75.50'	603 cf	**8.00'D x 6.00'H Vertical Cone/Cylinder**x 2 Inside #1 735 cf Overall - 5.0" Wall Thickness = 603 cf
#3	81.25'	28 cf	**3.00'D x 4.00'H Vertical Cone/Cylinder**
		1,302 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	75.50'	**2.410 in/hr Exfiltration over Wetted area** Phase-In= 0.01'
#2	Secondary	85.00'	**2.0" x 2.0" Horiz. Orifice/Grate X 16.00 columns** X 8 rows C= 0.600 in 48.0" x 24.0" Grate (44% open area) Limited to weir flow at low heads

Discarded OutFlow Max=0.05 cfs @ 13.11 hrs HW=80.79' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.05 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=75.50' TW=0.00' (Dynamic Tailwater)
↑—**2=Orifice/Grate** (Controls 0.00 cfs)

Pond IB3&4: Infiltration Basin 3&4

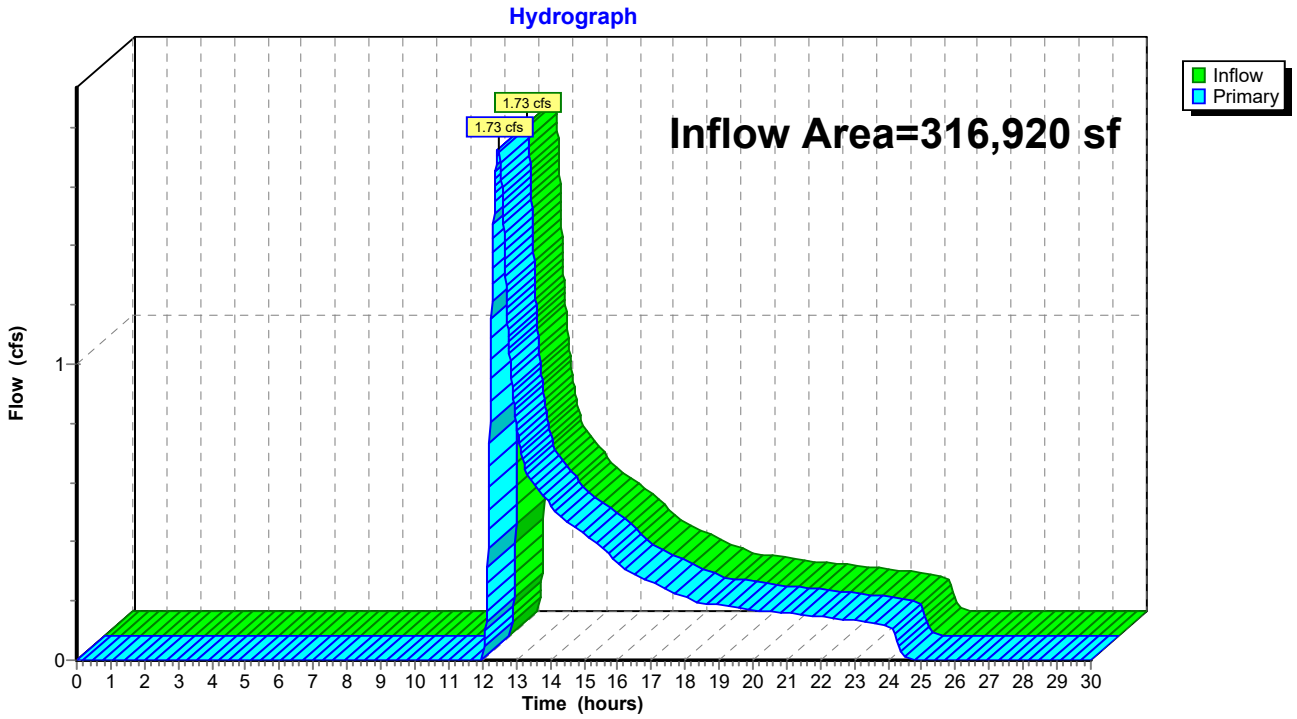


Summary for Link DP: Design Point - Westgate Road

Inflow Area = 316,920 sf, 2.38% Impervious, Inflow Depth = 0.55" for 25 yr Storm event
Inflow = 1.73 cfs @ 12.48 hrs, Volume= 14,573 cf
Primary = 1.73 cfs @ 12.48 hrs, Volume= 14,573 cf, Atten= 0%, Lag= 0.0 min

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

Link DP: Design Point - Westgate Road



Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points x 9
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment1S: Subbasin 1 Runoff Area=310,347 sf 0.32% Impervious Runoff Depth=1.11"
Flow Length=821' Slope=0.0207 '/' Tc=19.0 min CN=44 Runoff=4.57 cfs 28,709 cf

Subcatchment2S: Road (lower) Runoff Area=4,891 sf 100.00% Impervious Runoff Depth=6.66"
Flow Length=213' Slope=0.0470 '/' Tc=1.6 min CN=98 Runoff=0.89 cfs 2,715 cf

Subcatchment3S: Road (middle) Runoff Area=5,047 sf 100.00% Impervious Runoff Depth=6.66"
Flow Length=217' Slope=0.0420 '/' Tc=1.7 min CN=98 Runoff=0.91 cfs 2,802 cf

Subcatchment4S: Road (cul-de-sac) Runoff Area=6,573 sf 100.00% Impervious Runoff Depth=6.66"
Flow Length=114' Slope=0.0100 '/' Tc=1.8 min CN=98 Runoff=1.19 cfs 3,649 cf

Reach 12R: Overland Flow Avg. Flow Depth=0.00' Max Vel=0.00 fps Inflow=0.00 cfs 0 cf
n=0.400 L=220.0' S=0.0409 '/' Capacity=809,595.25 cfs Outflow=0.00 cfs 0 cf

Pond BR1: Bioretention Area #1 Peak Elev=102.94' Storage=1,322 cf Inflow=1.19 cfs 3,649 cf
Discarded=0.10 cfs 3,649 cf Primary=0.00 cfs 0 cf Outflow=0.10 cfs 3,649 cf

Pond BR2: Bioretention Area #2 Peak Elev=96.00' Storage=0 cf Inflow=0.00 cfs 0 cf
Discarded=0.00 cfs 0 cf Primary=0.00 cfs 0 cf Outflow=0.00 cfs 0 cf

Pond CB1&2: CB 3&4 Peak Elev=96.90' Inflow=0.91 cfs 2,802 cf
12.0" Round Culvert n=0.010 L=25.0' S=0.0200 '/' Outflow=0.91 cfs 2,802 cf

Pond CB3&4: CB 1&2 Peak Elev=85.10' Inflow=2.36 cfs 3,329 cf
12.0" Round Culvert n=0.010 L=25.0' S=0.0200 '/' Outflow=2.36 cfs 3,329 cf

Pond CB5: CB 5 Peak Elev=102.94' Inflow=1.19 cfs 3,649 cf
12.0" Round Culvert n=0.010 L=20.0' S=0.0250 '/' Outflow=1.19 cfs 3,649 cf

Pond IB1&2: Infiltration Basin 1&2 Peak Elev=96.86' Storage=888 cf Inflow=0.91 cfs 2,802 cf
Discarded=0.04 cfs 2,188 cf Secondary=1.52 cfs 614 cf Outflow=1.56 cfs 2,802 cf

Pond IB3&4: Infiltration Basin 3&4 Peak Elev=85.06' Storage=1,301 cf Inflow=2.36 cfs 3,329 cf
Discarded=0.06 cfs 2,825 cf Secondary=0.62 cfs 503 cf Outflow=0.68 cfs 3,329 cf

Link DP: Design Point - Westgate Road Inflow=5.00 cfs 29,212 cf
Primary=5.00 cfs 29,212 cf

Total Runoff Area = 326,858 sf Runoff Volume = 37,874 cf Average Runoff Depth = 1.39"
94.65% Pervious = 309,367 sf 5.35% Impervious = 17,491 sf

Summary for Subcatchment 1S: Subbasin 1

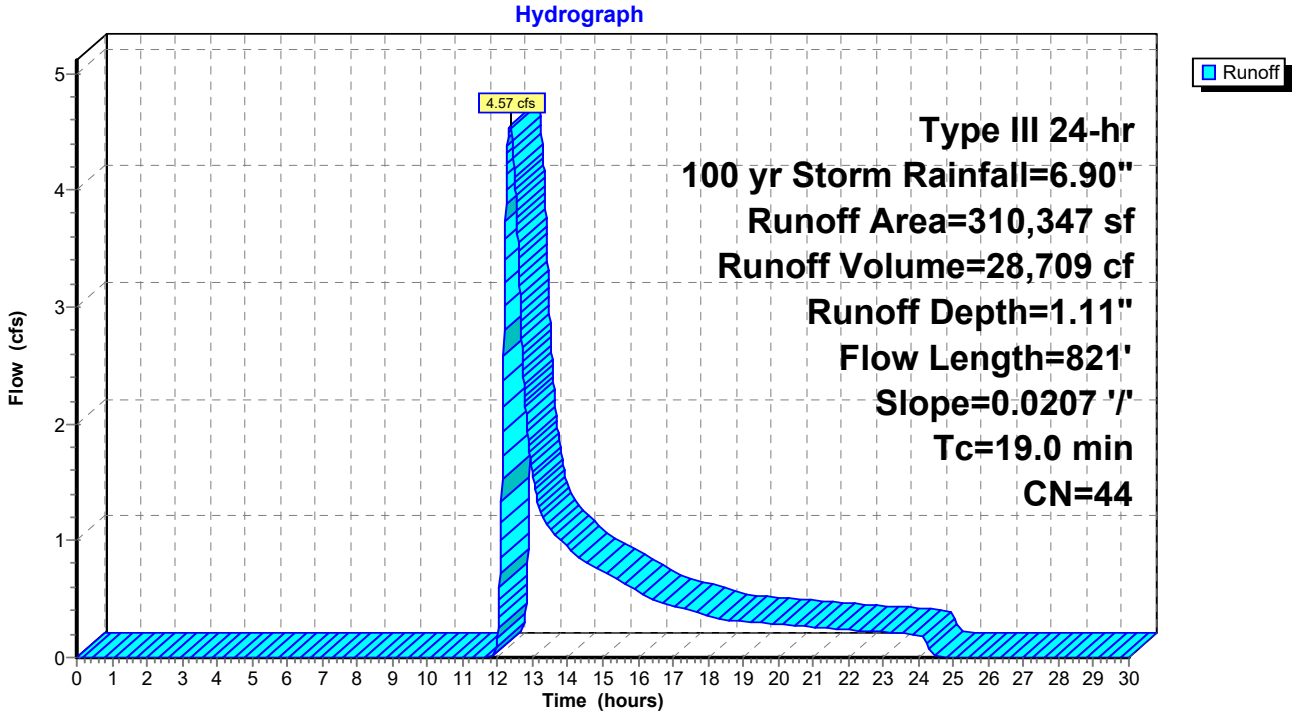
Runoff = 4.57 cfs @ 12.35 hrs, Volume= 28,709 cf, Depth= 1.11"
Routed to Link DP : Design Point - Westgate Road

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 yr Storm Rainfall=6.90"

Area (sf)	CN	Description
980	98	Unconnected roofs, HSG A
4,000	76	Gravel roads, HSG A
305,367	43	Woods/grass comb., Fair, HSG A
310,347	44	Weighted Average
309,367		99.68% Pervious Area
980		0.32% Impervious Area
980		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.0	821	0.0207	0.72		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps

Subcatchment 1S: Subbasin 1



Summary for Subcatchment 2S: Road (lower)

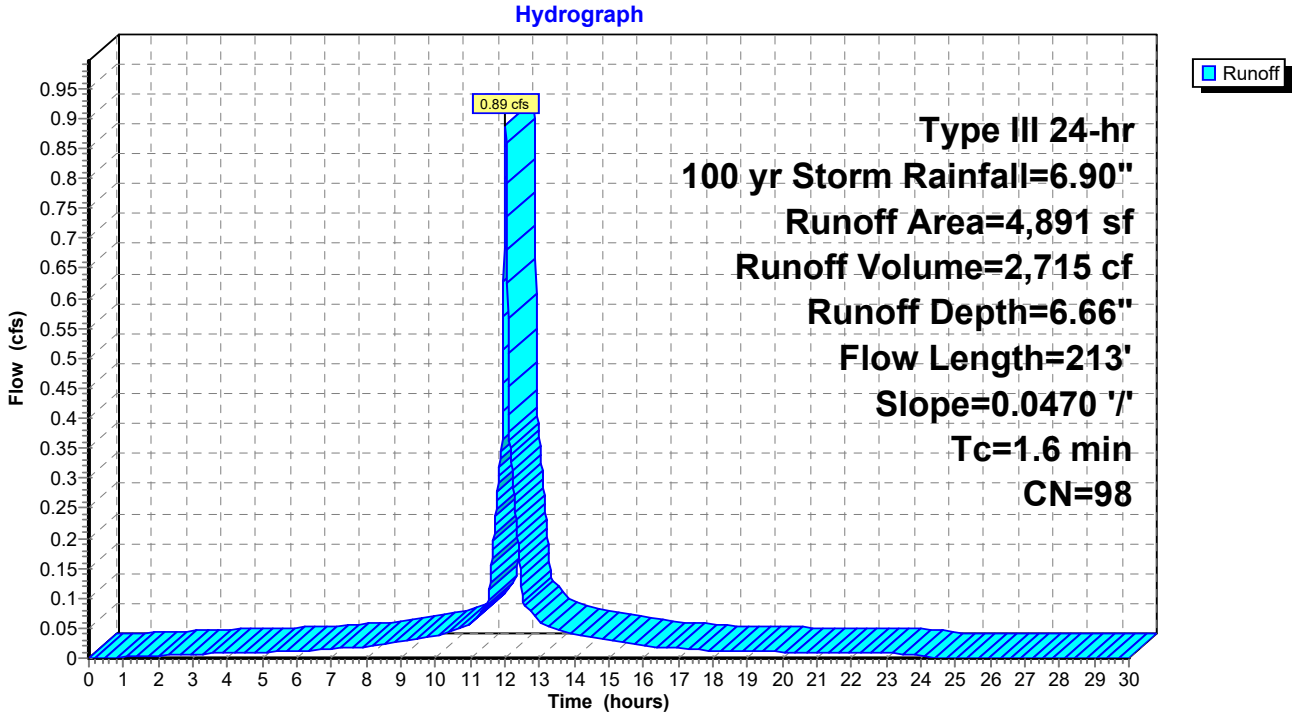
Runoff = 0.89 cfs @ 12.02 hrs, Volume= 2,715 cf, Depth= 6.66"
Routed to Pond CB3&4 : CB 1&2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 yr Storm Rainfall=6.90"

Area (sf)	CN	Description
4,891	98	Paved roads w/curbs & sewers, HSG A
4,891		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.6	213	0.0470	2.25		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20"

Subcatchment 2S: Road (lower)



Summary for Subcatchment 3S: Road (middle)

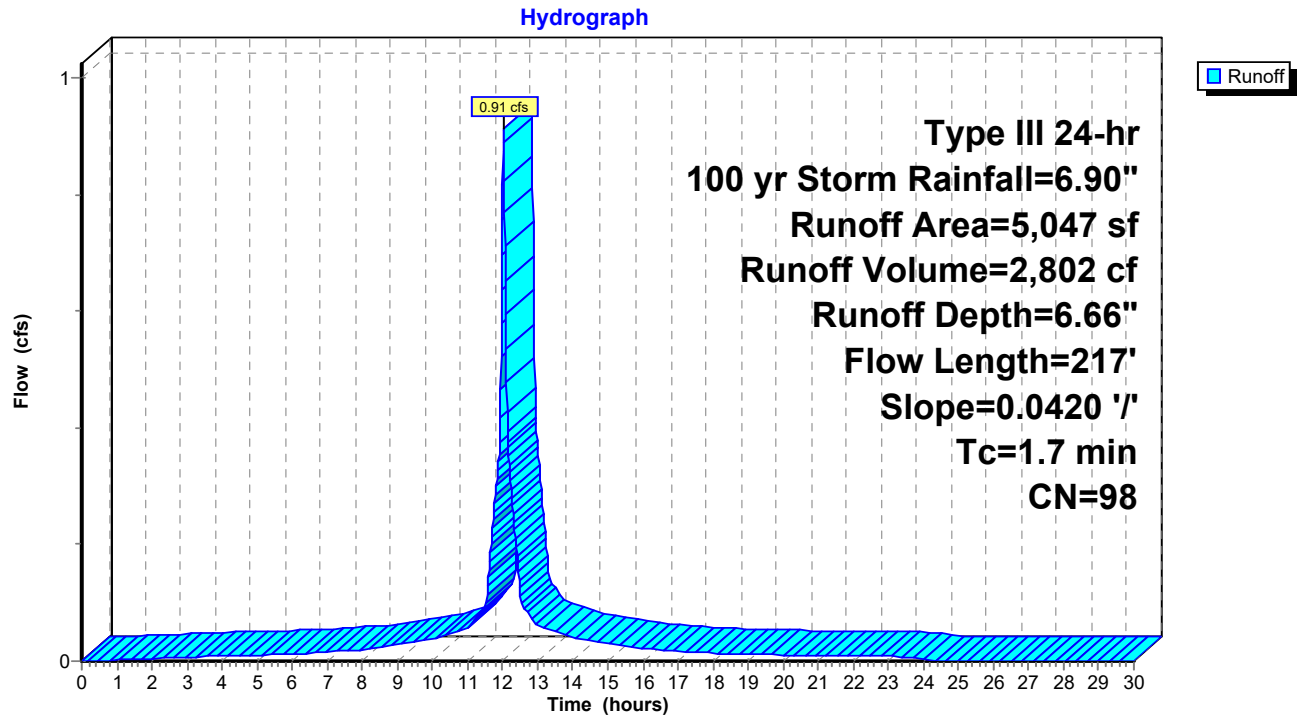
Runoff = 0.91 cfs @ 12.02 hrs, Volume= 2,802 cf, Depth= 6.66"
Routed to Pond CB1&2 : CB 3&4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 yr Storm Rainfall=6.90"

Area (sf)	CN	Description
5,047	98	Paved roads w/curbs & sewers, HSG A
5,047		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.7	217	0.0420	2.16		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20"

Subcatchment 3S: Road (middle)



Summary for Subcatchment 4S: Road (cul-de-sac)

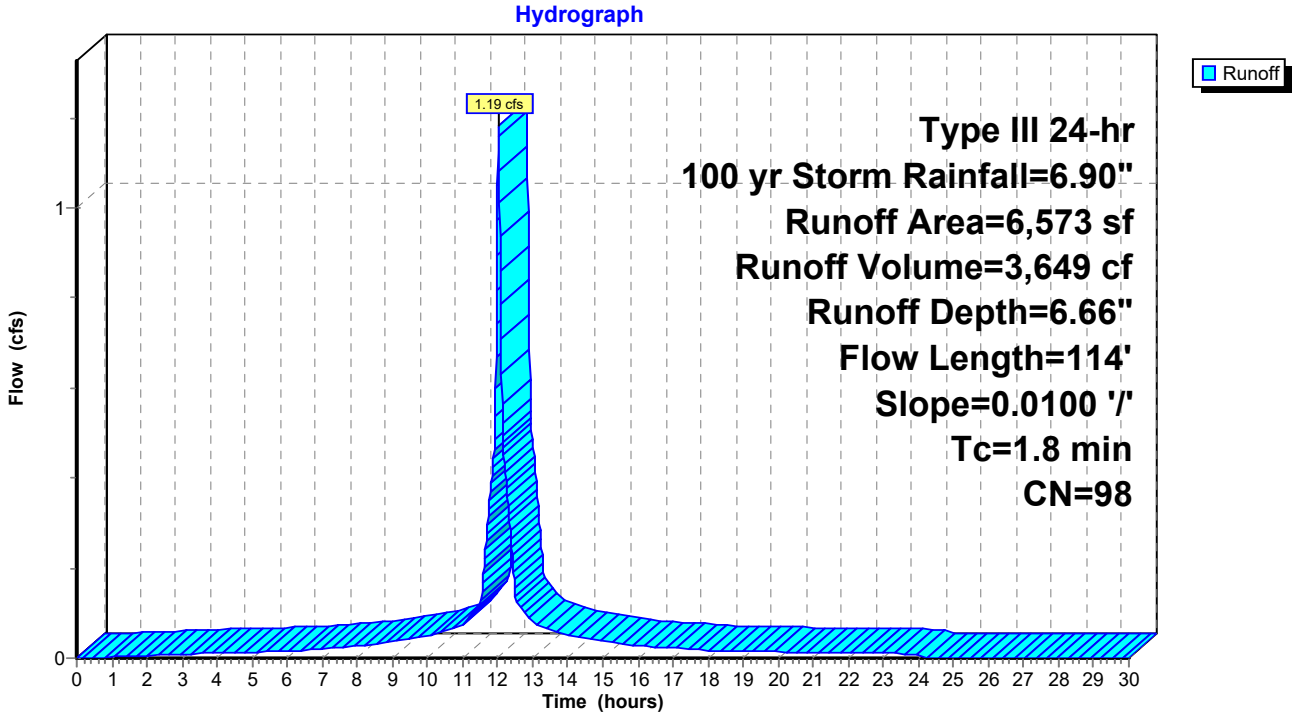
Runoff = 1.19 cfs @ 12.03 hrs, Volume= 3,649 cf, Depth= 6.66"
Routed to Pond CB5 : CB 5

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 yr Storm Rainfall=6.90"

Area (sf)	CN	Description
6,573	98	Paved roads w/curbs & sewers, HSG A
6,573		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.8	114	0.0100	1.07		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20"

Subcatchment 4S: Road (cul-de-sac)



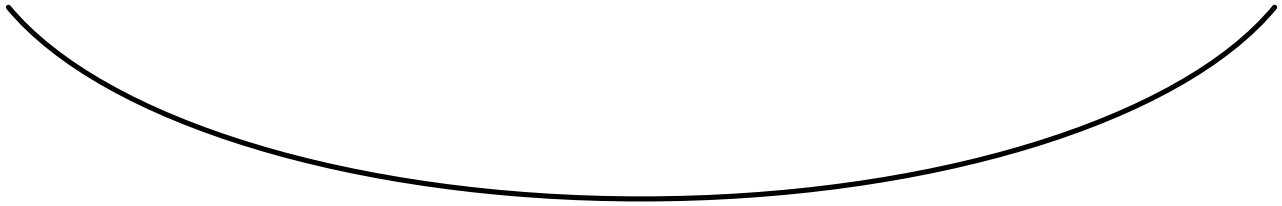
Summary for Reach 12R: Overland Flow

Inflow Area = 6,573 sf,100.00% Impervious, Inflow Depth = 0.00" for 100 yr Storm event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min
Routed to Link DP : Design Point - Westgate Road

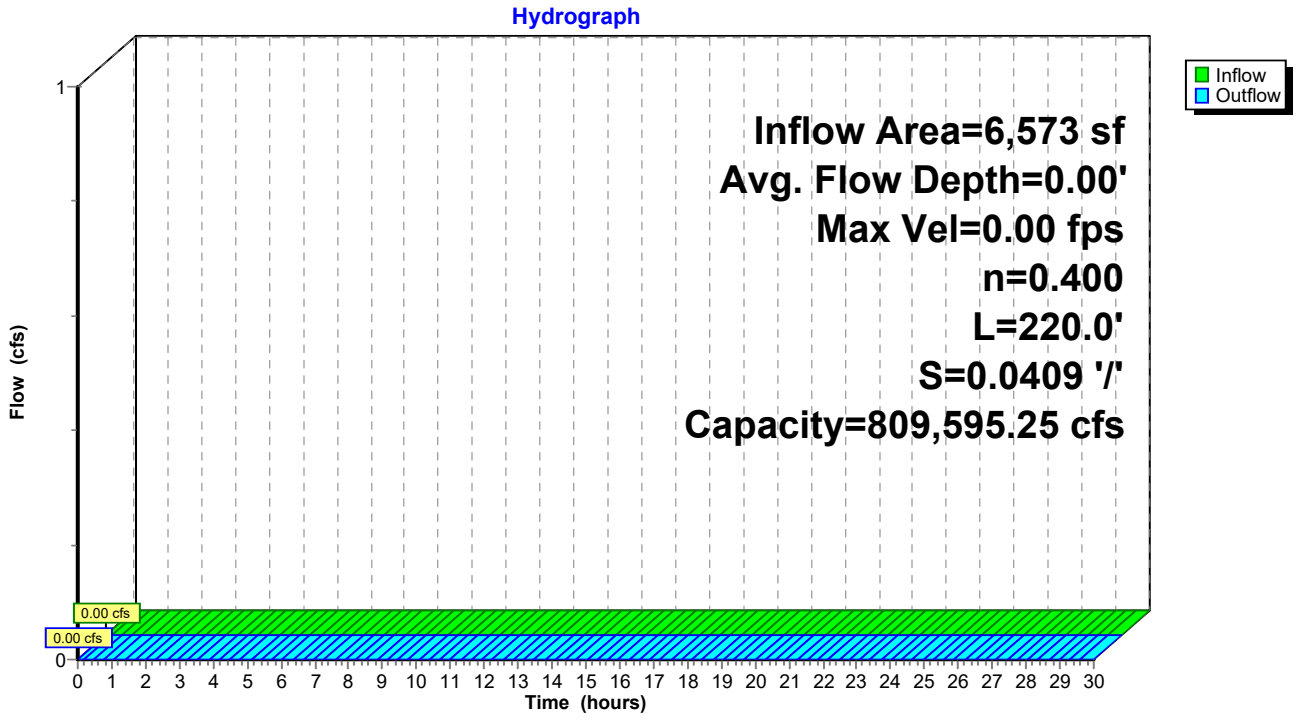
Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 9
Max. Velocity= 0.00 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 0.00 fps, Avg. Travel Time= 0.0 min

Peak Storage= 0 cf @ 0.00 hrs
Average Depth at Peak Storage= 0.00'
Bank-Full Depth= 100.00' Flow Area= 66,666.7 sf, Capacity= 809,595.25 cfs

1,000.00' x 100.00' deep Parabolic Channel, n= 0.400 Sheet flow: Woods+light brush
Length= 220.0' Slope= 0.0409 '/'
Inlet Invert= 99.00', Outlet Invert= 90.00'



‡



Summary for Pond BR1: Bioretention Area #1

Inflow Area = 6,573 sf,100.00% Impervious, Inflow Depth = 6.66" for 100 yr Storm event
Inflow = 1.19 cfs @ 12.03 hrs, Volume= 3,649 cf
Outflow = 0.10 cfs @ 12.76 hrs, Volume= 3,649 cf, Atten= 91%, Lag= 44.0 min
Discarded = 0.10 cfs @ 12.76 hrs, Volume= 3,649 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Pond BR2 : Bioretention Area #2

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 9
Peak Elev= 102.94' @ 12.76 hrs Surf.Area= 1,529 sf Storage= 1,322 cf

Plug-Flow detention time= 96.2 min calculated for 3,647 cf (100% of inflow)
Center-of-Mass det. time= 96.2 min (835.4 - 739.3)

Volume	Invert	Avail.Storage	Storage Description
#1	99.00'	2,984 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

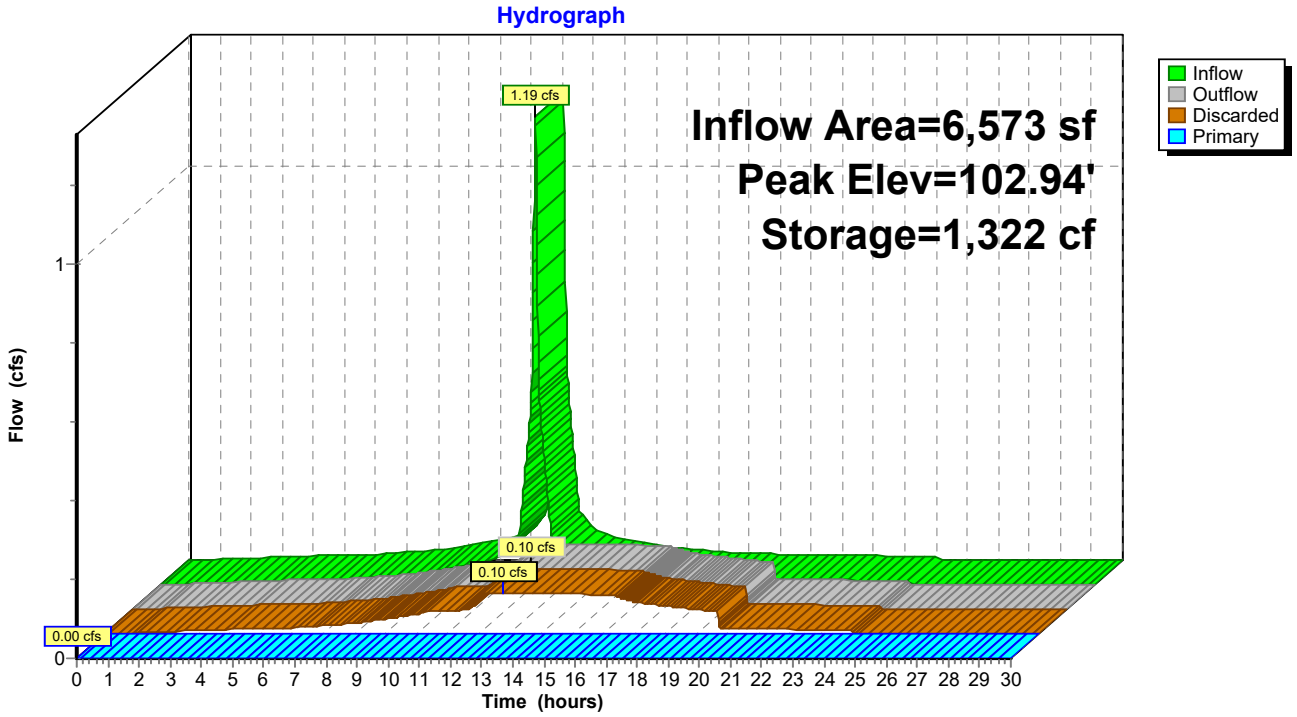
Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
99.00	1,000	0.0	0	0	1,000
100.00	1,400	40.0	478	478	1,418
102.50	1,500	5.0	181	659	1,770
104.00	1,600	100.0	2,325	2,984	2,002

Device	Routing	Invert	Outlet Devices
#0	Primary	104.00'	**Automatic Storage Overflow** (Discharged without head)
#1	Discarded	99.00'	**2.410 in/hr Exfiltration over Wetted area** Phase-In= 0.01'
#2	Primary	103.00'	**12.0" Round CMP_Round 12"** L= 10.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 103.00' / 101.05' S= 0.1950 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf

Discarded OutFlow Max=0.10 cfs @ 12.76 hrs HW=102.94' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.10 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=99.00' TW=96.00' (Dynamic Tailwater)
↑**2=CMP_Round 12"** (Controls 0.00 cfs)

Pond BR1: Bioretention Area #1



Summary for Pond BR2: Bioretention Area #2

Inflow Area = 6,573 sf,100.00% Impervious, Inflow Depth = 0.00" for 100 yr Storm event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min
Discarded = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Reach 12R : Overland Flow

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 9
Peak Elev= 96.00' @ 0.00 hrs Surf.Area= 700 sf Storage= 0 cf

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

Volume	Invert	Avail.Storage	Storage Description
#1	96.00'	2,060 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

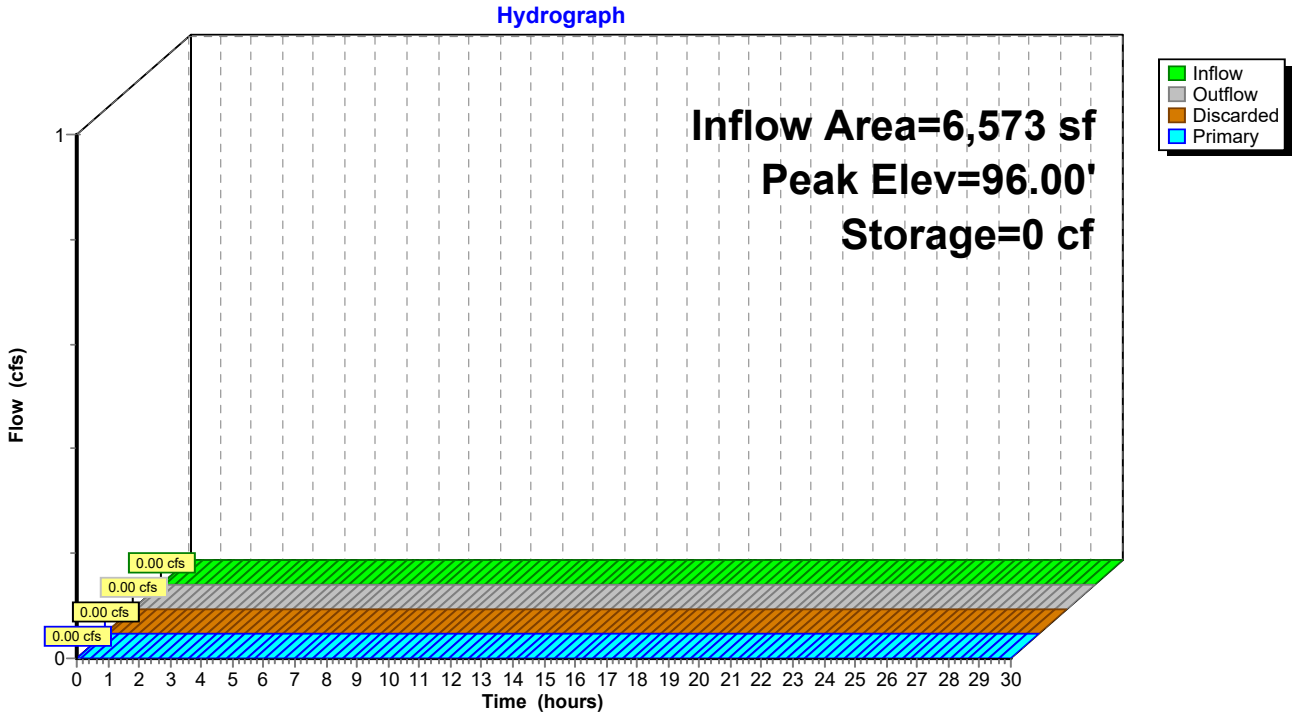
Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
96.00	700	0.0	0	0	700
97.00	800	40.0	300	300	839
99.50	1,000	5.0	112	412	1,172
101.00	1,200	100.0	1,648	2,060	1,438

Device	Routing	Invert	Outlet Devices
#0	Primary	101.00'	**Automatic Storage Overflow** (Discharged without head)
#1	Discarded	96.00'	**2.410 in/hr Exfiltration over Wetted area** Phase-In= 0.01'
#2	Primary	100.00'	**12.0" Round CMP_Round 12"** L= 10.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 100.00' / 99.00' S= 0.1000 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf

Discarded OutFlow Max=0.00 cfs @ 0.00 hrs HW=96.00' (Free Discharge)
1=Exfiltration (Controls 0.00 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=96.00' TW=99.00' (Dynamic Tailwater)
2=CMP_Round 12" (Controls 0.00 cfs)

Pond BR2: Bioretention Area #2



Summary for Pond CB1&2: CB 3&4

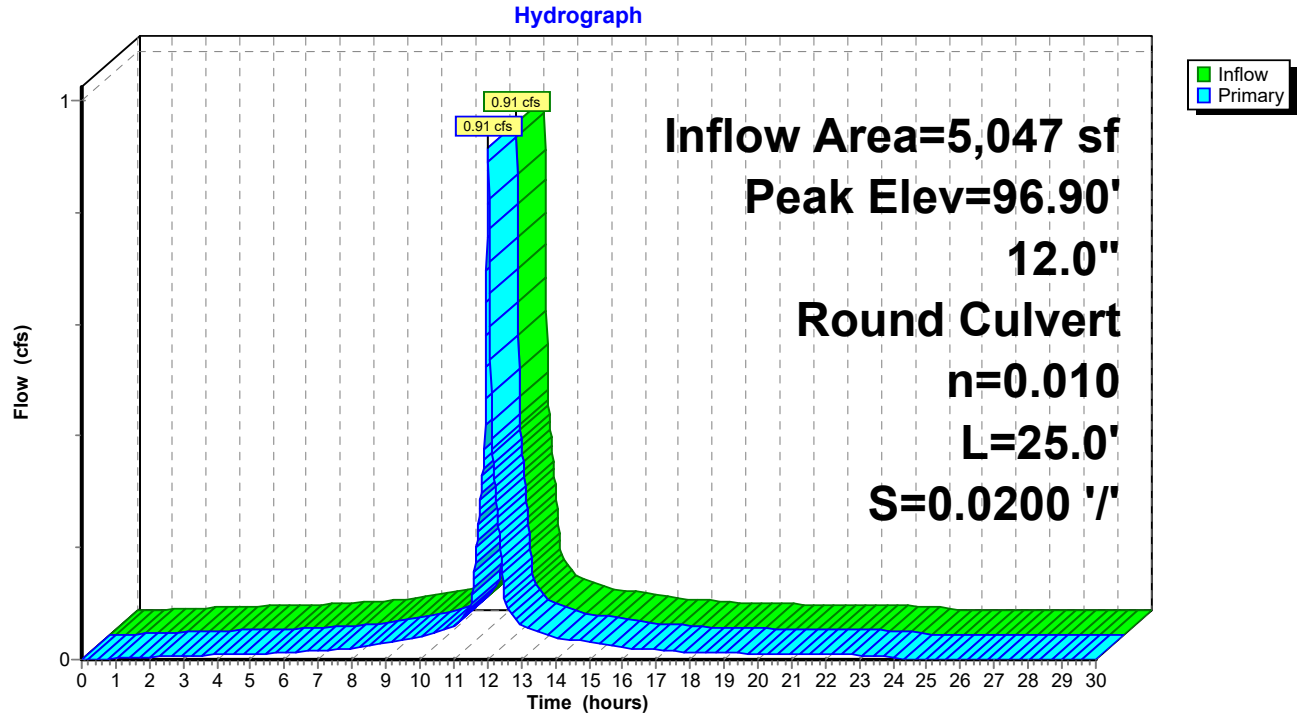
Inflow Area = 5,047 sf,100.00% Impervious, Inflow Depth = 6.66" for 100 yr Storm event
Inflow = 0.91 cfs @ 12.02 hrs, Volume= 2,802 cf
Outflow = 0.91 cfs @ 12.02 hrs, Volume= 2,802 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.91 cfs @ 12.02 hrs, Volume= 2,802 cf
Routed to Pond IB1&2 : Infiltration Basin 1&2

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 9
Peak Elev= 96.90' @ 12.04 hrs
Flood Elev= 97.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	93.00'	**12.0" Round Culvert** L= 25.0' RCP, groove end w/headwall, Ke= 0.200 Inlet / Outlet Invert= 93.00' / 92.50' S= 0.0200 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.63 cfs @ 12.02 hrs HW=94.82' TW=94.70' (Dynamic Tailwater)
1=Culvert (Inlet Controls 1.63 cfs @ 2.07 fps)

Pond CB1&2: CB 3&4



Summary for Pond CB3&4: CB 1&2

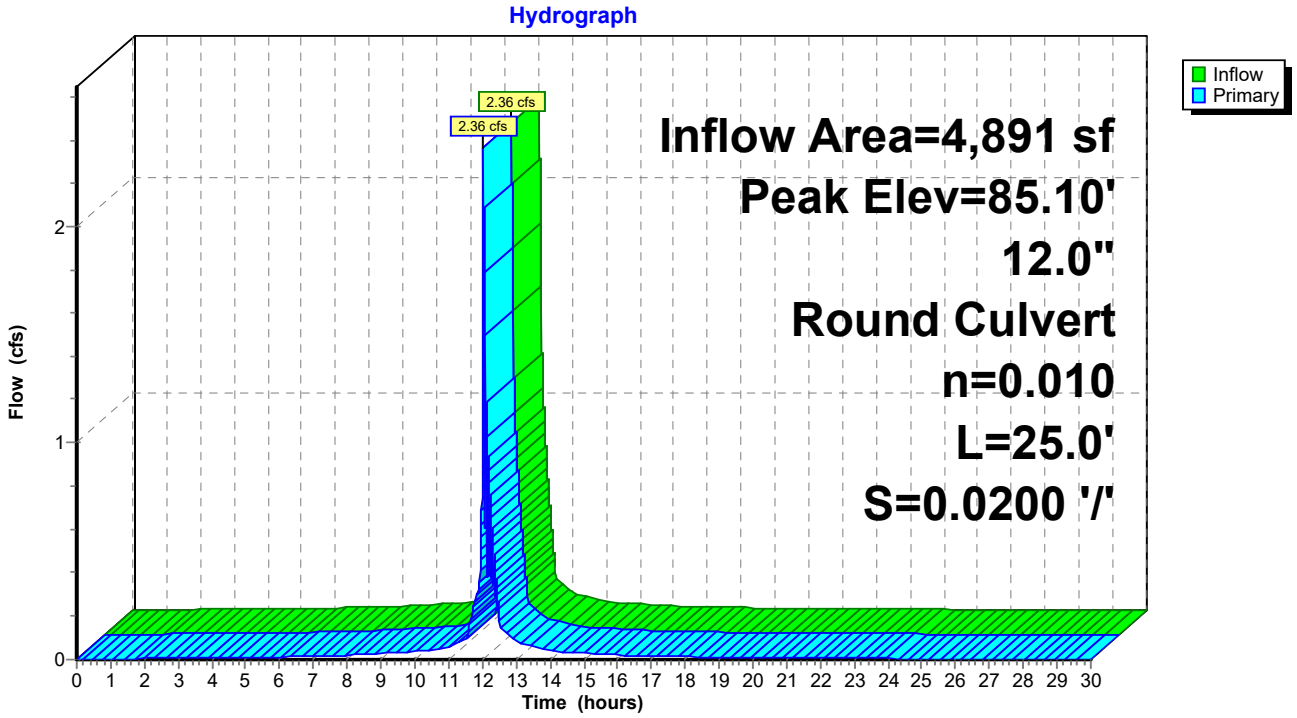
Inflow Area = 4,891 sf,100.00% Impervious, Inflow Depth = 8.17" for 100 yr Storm event
Inflow = 2.36 cfs @ 12.04 hrs, Volume= 3,329 cf
Outflow = 2.36 cfs @ 12.04 hrs, Volume= 3,329 cf, Atten= 0%, Lag= 0.0 min
Primary = 2.36 cfs @ 12.04 hrs, Volume= 3,329 cf
Routed to Pond IB3&4 : Infiltration Basin 3&4

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 9
Peak Elev= 85.10' @ 12.20 hrs
Flood Elev= 85.15'

Device	Routing	Invert	Outlet Devices
#1	Primary	81.00'	**12.0" Round pipe** L= 25.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 81.00' / 80.50' S= 0.0200 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=2.35 cfs @ 12.04 hrs HW=81.88' TW=79.23' (Dynamic Tailwater)
1=pipe (Inlet Controls 2.35 cfs @ 3.20 fps)

Pond CB3&4: CB 1&2



Summary for Pond CB5: CB 5

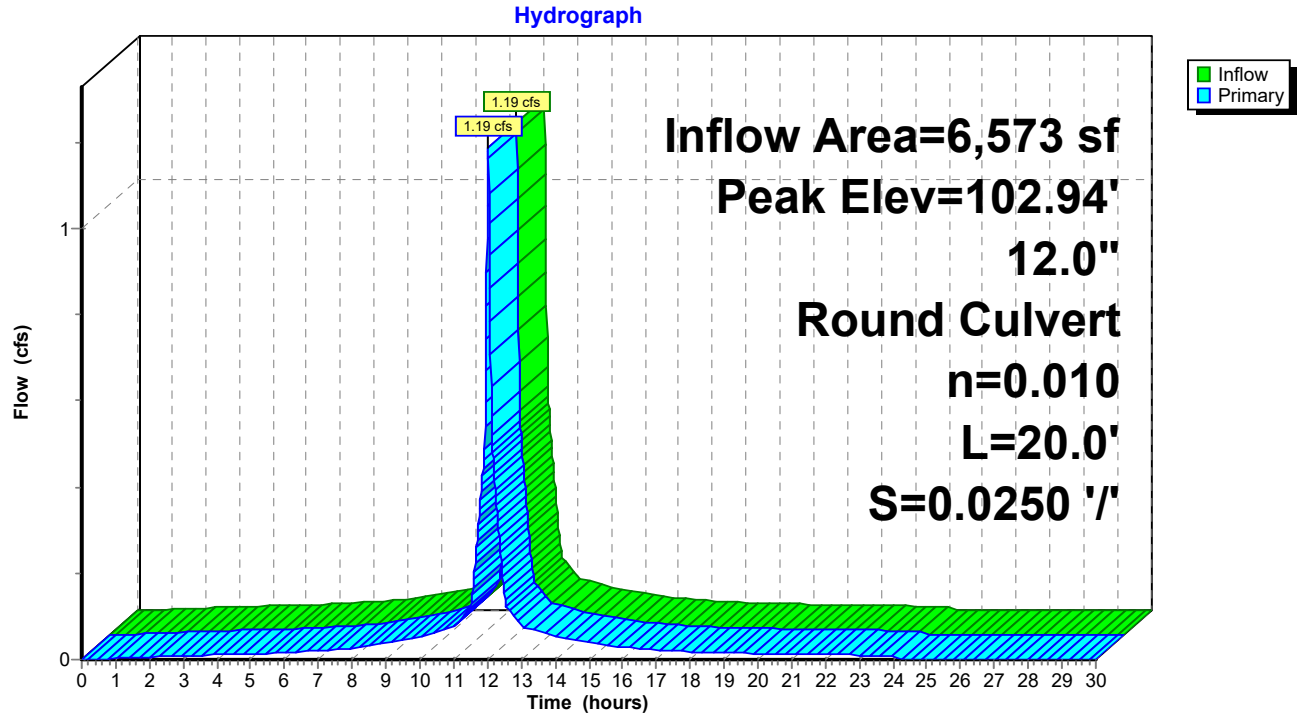
Inflow Area = 6,573 sf,100.00% Impervious, Inflow Depth = 6.66" for 100 yr Storm event
Inflow = 1.19 cfs @ 12.03 hrs, Volume= 3,649 cf
Outflow = 1.19 cfs @ 12.03 hrs, Volume= 3,649 cf, Atten= 0%, Lag= 0.0 min
Primary = 1.19 cfs @ 12.03 hrs, Volume= 3,649 cf
Routed to Pond BR1 : Bioretention Area #1

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 9
Peak Elev= 102.94' @ 12.75 hrs
Flood Elev= 106.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	102.00'	**12.0" Round CMP_Round 12"** L= 20.0' CMP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 102.00' / 101.50' S= 0.0250 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.18 cfs @ 12.03 hrs HW=102.75' TW=102.55' (Dynamic Tailwater)
1=CMP_Round 12" (Outlet Controls 1.18 cfs @ 2.57 fps)

Pond CB5: CB 5



Summary for Pond IB1&2: Infiltration Basin 1&2

[90] Warning: Qout>Qin may require smaller dt or Finer Routing
[87] Warning: Oscillations may require smaller dt or Finer Routing (severity=27)

Inflow Area = 5,047 sf,100.00% Impervious, Inflow Depth = 6.66" for 100 yr Storm event
Inflow = 0.91 cfs @ 12.02 hrs, Volume= 2,802 cf
Outflow = 1.56 cfs @ 12.04 hrs, Volume= 2,802 cf, Atten= 0%, Lag= 1.0 min
Discarded = 0.04 cfs @ 12.03 hrs, Volume= 2,188 cf
Secondary = 1.52 cfs @ 12.04 hrs, Volume= 614 cf
Routed to Pond CB3&4 : CB 1&2

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 9
Peak Elev= 96.86' @ 12.04 hrs Surf.Area= 226 sf Storage= 888 cf
Flood Elev= 98.00' Surf.Area= 226 sf Storage= 891 cf

Plug-Flow detention time= 204.9 min calculated for 2,801 cf (100% of inflow)
Center-of-Mass det. time= 205.0 min (944.1 - 739.2)

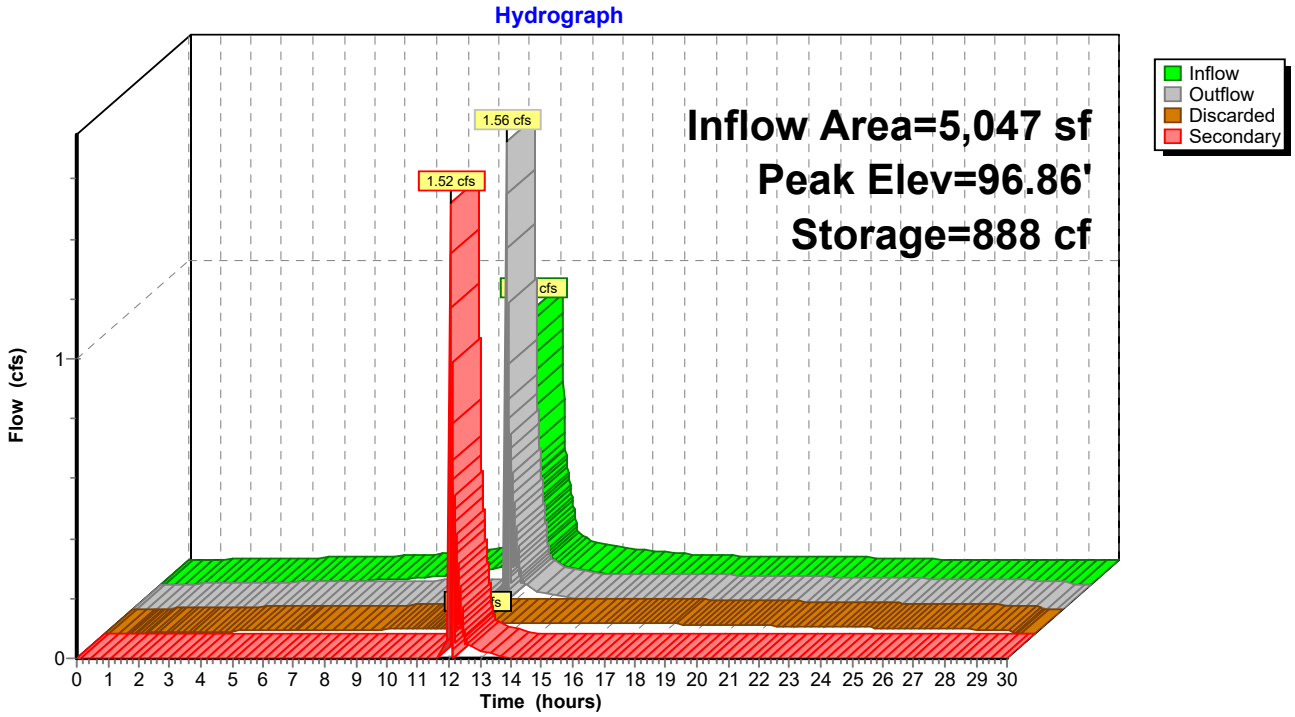
Volume	Invert	Avail.Storage	Storage Description
#1	87.50'	260 cf	**12.00'D x 6.00'H Vertical Cone/Cylinder** x 2 1,357 cf Overall - 708 cf Embedded = 649 cf x 40.0% Voids
#2	87.50'	603 cf	**8.00'D x 6.00'H Vertical Cone/Cylinder** x 2 Inside #1 708 cf Overall - 4.0" Wall Thickness = 603 cf
#3	93.25'	28 cf	**3.00'D x 4.00'H Vertical Cone/Cylinder** Impervious
		891 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	87.50'	**2.410 in/hr Exfiltration over Wetted area** Phase-In= 0.01'
#2	Secondary	96.75'	**2.0" x 2.0" Horiz. Orifice/Grate X 16.00 columns** X 8 rows C= 0.600 in 48.0" x 24.0" Grate (44% open area) Limited to weir flow at low heads

Discarded OutFlow Max=0.04 cfs @ 12.03 hrs HW=96.39' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.04 cfs)

Secondary OutFlow Max=1.48 cfs @ 12.04 hrs HW=96.86' TW=81.88' (Dynamic Tailwater)
2=Orifice/Grate (Weir Controls 1.48 cfs @ 1.10 fps)

Pond IB1&2: Infiltration Basin 1&2



Summary for Pond IB3&4: Infiltration Basin 3&4

[87] Warning: Oscillations may require smaller dt or Finer Routing (severity=2)

Inflow Area = 4,891 sf,100.00% Impervious, Inflow Depth = 8.17" for 100 yr Storm event
Inflow = 2.36 cfs @ 12.04 hrs, Volume= 3,329 cf
Outflow = 0.68 cfs @ 12.20 hrs, Volume= 3,329 cf, Atten= 71%, Lag= 9.9 min
Discarded = 0.06 cfs @ 12.20 hrs, Volume= 2,825 cf
Secondary = 0.62 cfs @ 12.20 hrs, Volume= 503 cf
Routed to Link DP : Design Point - Westgate Road

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 9
Peak Elev= 85.06' @ 12.20 hrs Surf.Area= 409 sf Storage= 1,301 cf
Flood Elev= 86.00' Surf.Area= 409 sf Storage= 1,302 cf

Plug-Flow detention time= 199.0 min calculated for 3,328 cf (100% of inflow)
Center-of-Mass det. time= 199.0 min (938.3 - 739.2)

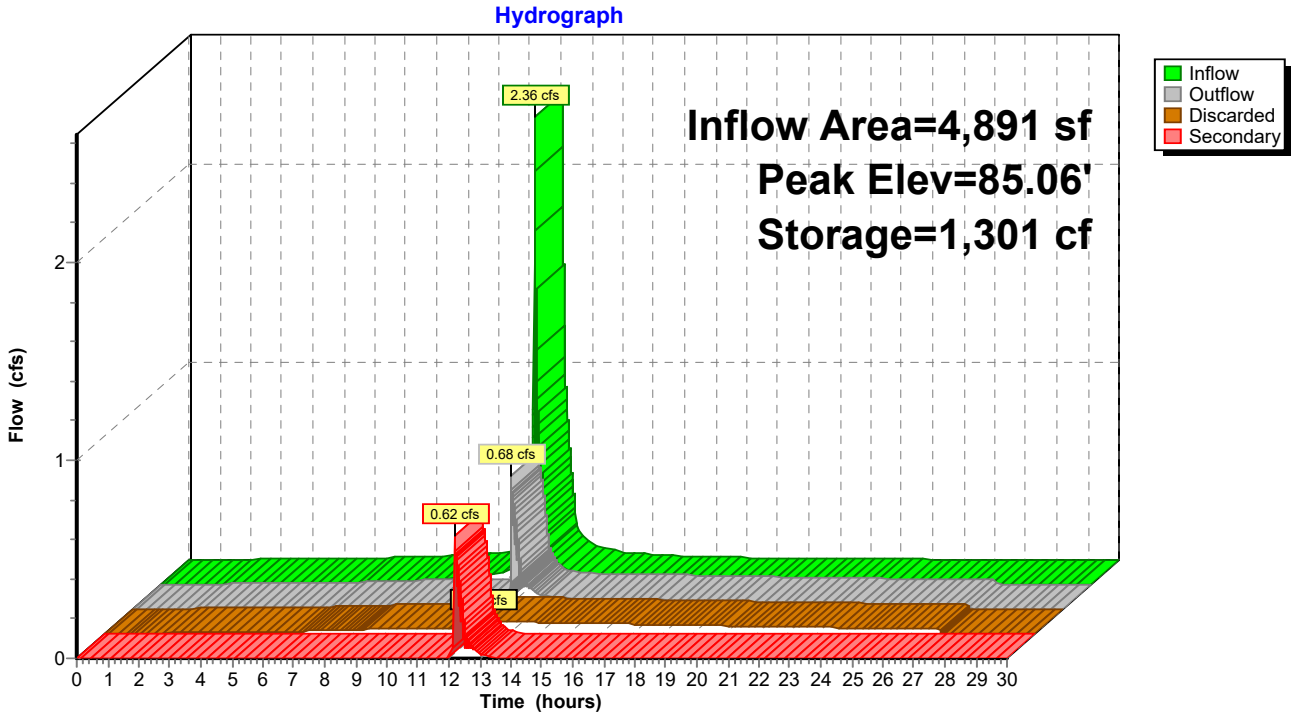
Volume	Invert	Avail.Storage	Storage Description
#1	75.50'	671 cf	**16.00'D x 6.00'H Vertical Cone/Cylinder**x 2 2,413 cf Overall - 735 cf Embedded = 1,677 cf x 40.0% Voids
#2	75.50'	603 cf	**8.00'D x 6.00'H Vertical Cone/Cylinder**x 2 Inside #1 735 cf Overall - 5.0" Wall Thickness = 603 cf
#3	81.25'	28 cf	**3.00'D x 4.00'H Vertical Cone/Cylinder**
		1,302 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	75.50'	**2.410 in/hr Exfiltration over Wetted area** Phase-In= 0.01'
#2	Secondary	85.00'	**2.0" x 2.0" Horiz. Orifice/Grate X 16.00 columns** X 8 rows C= 0.600 in 48.0" x 24.0" Grate (44% open area) Limited to weir flow at low heads

Discarded OutFlow Max=0.06 cfs @ 12.20 hrs HW=85.06' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.06 cfs)

Secondary OutFlow Max=0.55 cfs @ 12.20 hrs HW=85.06' TW=0.00' (Dynamic Tailwater)
↑**2=Orifice/Grate** (Weir Controls 0.55 cfs @ 0.79 fps)

Pond IB3&4: Infiltration Basin 3&4

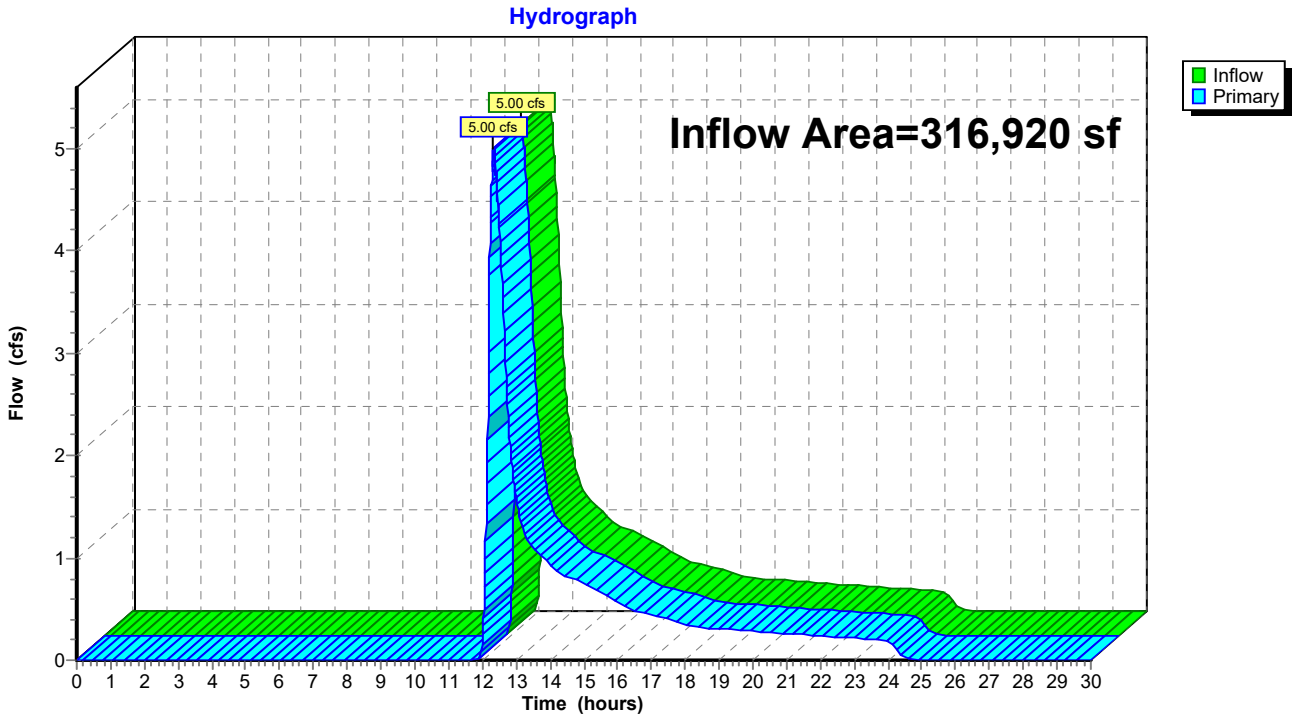


Summary for Link DP: Design Point - Westgate Road

Inflow Area = 316,920 sf, 2.38% Impervious, Inflow Depth = 1.11" for 100 yr Storm event
Inflow = 5.00 cfs @ 12.33 hrs, Volume= 29,212 cf
Primary = 5.00 cfs @ 12.33 hrs, Volume= 29,212 cf, Atten= 0%, Lag= 0.0 min

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

Link DP: Design Point - Westgate Road



Appendix E: Stormwater O&M Manual

STORMWATER OPERATION AND MAINTENANCE PLAN

Miskell Woods Development
16 Squantum Path
Harwich, MA 02645

June 06, 2022

Stormwater Management System Owner: Name: O'loughlin Family Realty Trust
P.O. Box 2020
East Dennis, MA 02641

Engineer of record: Name: Jay Thrasher, P.E.
Robial Water, Ltd.
85 Courtland Street
Providence, RI 02904

Signature: _____

This Operation and Maintenance Plan has been prepared with reference to the MA Department of Environmental Protection stormwater standards and recommendations outlined in the stormwater handbook. This plan outlines the minimum efforts necessary to maintain the stormwater collection and treatment system and sedimentation and erosion control system for this site. This Plan includes O&M practices in accordance with the Massachusetts Department of Environmental Protection (DEP) stormwater management policy. Efforts in addition to the minimum listed herein may be required to ensure adequate stormwater management.

This Plan includes general site restrictions, routine/non-routine operation and maintenance, reporting and record keeping. A plan showing the location of the systems and facilities including easements, roadway drainage system, and stormwater devices is attached.

General Site Conditions

The following conditions are imposed as part of this Plan.

- The Stormwater Permitting Authority or its designee shall be able to enter the property, with notice to the property owner, at reasonable times and in a reasonable manner for the purpose of inspection.
- Illicit discharges into stormwater management system are perpetually prohibited.
- The use of fertilizers should be limited to slow-release fertilizers, except at establishment of vegetation.
- Uncovered and/or uncontained road de-icing materials shall not be stored on-site.

Operation and Maintenance:

Schedule: The entire stormwater management system should be inspected twice per year.

The stormwater system includes 5 grated drain catch basins, 2 oil & grit separators, 4 infiltration basins and 2 bioretention areas. Specific inspection and maintenance practices are listed under each component below. Upon completion of inspection, the inspector should specify any necessary corrective actions to be taken by ownership of the facility. The items to be inspected and maintained are described in the following sections.

Based on the observed conditions, the Responsible Party shall immediately schedule the appropriate maintenance. Some minor maintenance, such as the removal of blockages, debris and saplings in the basins may be conducted at the time of the inspection. More difficult maintenance activities, requiring special equipment, will have to be scheduled, such as the removal of excessive sediment or the repair of eroded areas. All sediment must be removed at least once per year.

Drain Catch Basins:

Location: CB1: Start of Road near Westgate Road Intersection
CB2: Start of Road near Westgate Road Intersection
CB3: Center of Road
CB4: Center of Road
CB5: End of Road and Cul-de-sac.

The catch basins each consist of a 24" square grated inlet and a sump that measures 4 feet deep from the bottom to the outlet pipe. The actual removal of sediments and associated pollutants and trash occurs only when sumps are cleaned out; therefore, regular maintenance is required. The more frequent the cleaning, the less likely sediments will be resuspended and subsequently discharged. Frequent cleaning also results in more volume available for future storms and enhances the overall performance.

At a minimum, the catch basin should be inspected twice annually (spring and fall) and cleaned whenever sediment accumulation comes within 12 inches of the top of the outlet tee, or at a minimum of once per year. Disposal of the accumulated sediment and hydrocarbons must be in accordance with

applicable local, state, and federal guidelines and regulations. At each inspection, inspect outlet structure and repair as necessary.

If upon inspection mosquito breeding is found to be present, larvicide shall be introduced to the catch basins.

Infiltration Basins:

Location: IB1: Lot 6 Drainage Easement (off CB1&2)
IB2: Lot 6 Drainage Easement (off CB1&2)
IB3: Lot 6 Drainage Easement (off CB3&4)
IB4: Lot 6 Drainage Easement (off CB3&4)

The infiltration system consists of 4 infiltration basins surrounded by varied amounts of clean crushed stone. The infiltration basins are inspected through 8 inch manhole covers accessible at finished grade. The infiltration systems shall be inspected at least twice annually (spring and fall) and after every major storm. Any debris found that can potentially clog the system shall be removed.

If upon inspection mosquito breeding is found to be present, larvicide shall be introduced to the infiltration system via the inspection port. The inspection port must be properly sealed between all inspections to ensure no mosquito colonies are introduced to the system.

Oil & Grit Separators:

Location: OGS1: Between CB1&2 and IB1&2 (Lot 6 drainage easement)
OGS2: Between CB3&4 and IB3&4 (Lot 6 drainage easement)
OGs3: Between CB5 and Bioretention Areas (Lot 5 drainage easement)

The oil & grit separators are 1,500 gallon 3-chamber tanks between the catch basins and the infiltration basins. They are inspected through 3-24" manhole covers each. The oil & grit separators shall be inspected at least twice annually (spring and fall) and after every major storm. Any debris found that can potentially clog the system shall be removed. All structural components including inlet/outlet structures and trash racks shall be repaired as needed.

The first chamber of each oil & grit separator shall be cleaned whenever sediment accumulation totals 12 inches, or at a minimum of once per year. Disposal of the accumulated sediment and hydrocarbons must be in accordance with applicable local, state, and federal guidelines and regulations. In the event of a petroleum spill, the oil & grit separators shall be cleaned immediately.

If upon inspection mosquito breeding is found to be present, larvicide shall be introduced to the trench drain.

Bioretention Areas:

Location: Lot 5 Drainage Easement

The bioretention areas are planted areas with 2.5' of sandy bioretention soil media above a 6" bed of gravel. The first bioretention area in series is fed from the cul-de-sac catch basin (CB5) and the proceeding oil & grit separator (OGS3). The second bioretention area is fed through an atrium grate overflow in the first bioretention area set at the flood elevation. The bioretention areas shall be inspected after every storm in the first few months after construction to ensure proper stabilization and function. After this initial period, the systems should be inspected at least twice annually (spring and fall) with one inspection performed after every major storm. If accumulated water is found, a clearance rate should be calculated by dividing the

drop in water levels (inches) by the elapsed time (hours). This clearance rate should be recording along with maintenance and repair records for the stormwater BMPs (see Reporting and record Keeping below).
The following shall be performed during each inspection:

- Check to ensure the surface remains well draining after storm events.
    - If filter bed is clogged, draining poorly, or standing water covers more than 50% of the surface 48 hours after a storm, then remove the top few inches of discolored material and till or rake the remaining material as needed.
- Check inlets, outlets and overflow grate for leaves and debris.
    - Rake in and around the system to clear it of debris. Clear the inlet and overflow structures if obstructed. Repair or replace any damage to structural components.
- Check for animal burrows and short-circuiting in the bioretention areas.
    - Soil erosion form short-circuiting or animal burrows should be repaired when they occur. The holes shall be filled and lightly compacted.
- Check for robust vegetation coverage throughout the system.
    - Remove any dead or dying plants. Trim existing plants as needed. Replace dead or removed plants with new vegetation from MA DEP list of acceptable wet condition species. Vegetation should cover roughly 75% of the bioretention areas.

If upon inspection mosquito breeding is found to be present, larvicide shall be introduced to the mini drywell.

Reporting and Record Keeping

The responsible party will be responsible for maintaining accurate Maintenance Logs for all maintenance, inspections, repairs, replacements, and disposal (for disposal, the log shall indicate the type of material and the disposal location). The logs shall be kept on site to be available for inspection by the Town municipal departments or other auditing authority. This will be a perpetual requirement of the Owners or their Designated Party.

The Site Maintenance Log will be completed as described above, and at a minimum will include:

a. The date of inspection or activity;
b. Name of inspector;
c. The condition of each stormwater management system, including components such as:
    i. Catch basins
    ii. Pretreatment devices (oil & grit separator)
    iii. Inlets and outlets
    iv. Underground drainage
    v. Vegetation condition
    vi. Pavement condition
    ix. Any other item that could affect the proper function of the stormwater management system
d. Description of the need for maintenance; and
e. For disposal include type of material and the disposal location;

Drainage Easements:

Two drainage easements exist at the Miskell Woods development. Lot 5 includes a 11,000 SF drainage easement where the bioretention areas are located. Lot 6 includes a 7,920 SF drainage easement along the lower section of the road where the 4 infiltration basins are located.

Changes to Operation and Maintenance Plans

The owner(s) of the stormwater management system must notify the Stormwater Permitting Authority or its designated Reviewing Agent of changes in ownership or assignment of financial responsibility.

Emergency Response Plan / Spill Control Practices

On-site storage of hazardous materials shall not be allowed.

In the event of an accident in the driveway where a significant amount of gasoline or other petroleum product is released, the following procedure should be followed:

3. Immediately contact the following agencies:

Harwich Fire Department	(508) 430-7546
MassDEP Emergency response	(888) 304-1133

4. Provide support to agencies listed above, which may include contacting an outside contractor to provide clean-up or contacting a Licensed Site Professional (LSP) to lead the clean-up.