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208 Flynn Avenue, Suite 2A, Burlington, VT 05401 · Tel: 802-863-6225 · Fax: 802-863-6306
85 Mechanic Street, Suite B2-2, Lebanon, NH 03766 · Tel: 603-442-9333 · Fax: 603-442-9331
414 Union Street, Schenectady, NY · Tel: 518-630-9614

Stormwater & Erosion Control Narrative
Proposed Subdivision - Laster Property - Final Plat Submittal

The attached plans and narrative below are in support of the final plat subdivision application to the Town of Hinesburg Development Review Board for the above referenced project. Relevant excerpts from Section 6.6 of the Hinesburg Subdivision Regulations are shown in italics followed by responses:

6.6.1 Erosion Control

(1) Erosion control requirements shall apply to land development that requires a zoning permit or DRB approval, within the disturbance guidelines listed below. For such projects all areas exposed during construction shall be protected from erosion in accordance with the Low Risk Site Handbook for Erosion Prevention and Sediment Control published by the Vermont Department of Environmental Conservation (most current version, original edition is circa 2006), as qualified below.

(a) If the total disturbance area is 3,000-10,000 square feet – follow requirements 1,2,4,6,8-12. Requirement #8 requires stabilization of disturbed areas within 7, 14, or 21 days of initial disturbance, followed by stabilization at the end of each work day with certain exceptions. For the purposes of these regulations, the initial time period shall be 14 days.

(b) If the total disturbance area is greater than 10,000 square feet – follow all twelve requirements (see below for information on requirement #7 – i.e., permanent stormwater controls). Requirement #8 requires stabilization of disturbed areas within 7, 14, or 21 days of initial disturbance, followed by stabilization at the end of each work day with certain exceptions. For the purposes of these regulations, the initial time period shall be 14 days.

> Total earth disturbance for the project is estimated as ±2.1-ac or ±91,400-sf.
> The practices outlined in the Vermont DEC Low Risk Site Handbook for Erosion Prevention and Sediment Control are depicted and described on the Erosion Prevention and Sediment Control Plan and Erosion Prevention and Sediment Control Detail Sheets.

(2) Proper erosion control measures shall also be applied to off-site locations that receive soil or fill from the project in question.

> No offsite areas are anticipated to receive fill from the project site.

(3) An erosion control plan (diagram and supporting narrative) shall be submitted with the zoning permit application or DRB application if any of the following apply.

(a) If there is to be any disturbance with slopes of 15% or steeper.

> The project will disturb an estimated 5,640-sf or 0.13-ac of land on slopes 15% or greater.

(b) If there is to be any disturbance within Town designated stream setback and/or buffer areas.

The project largely avoids impact to Town designated stream setbacks. The project proposes disturbance to 1,375-sf of the stream setback along the Mechanicsville Road right of way. This temporary disturbance enables installation of the stormwater swale and removal of 524-sf of gravel to restore the existing gravel drive to meadow.

(c) If there is to be any disturbance to a channel, ditch or other concentrated stormwater conveyance.

The proposed access drive extending off Mechanicsville Road is positioned roughly at the high point. Only minor earth disturbances are proposed within the portion of the existing roadside ditch which are limited to construction of the new intersection, regrading to direct runoff both north and south as well as the improvements noted above.

(d) If the total area of disturbance is 10,000 square feet or greater.

Total earth disturbance for the project is estimated as ±2.1-ac or ±91,400-sf.

(4) It is the applicant's responsibility to demonstrate that the plan will adequately control erosion, and has, at a minimum, been prepared in accordance with the Low Risk Site Handbook for Erosion Prevention and Sediment Control. Additional measures from the Vermont Standards & Specifications for Erosion Prevention and Sediment Control (most current version, current edition is circa 2006) may be necessary for sites that are not low risk per the categories outlined in the State of Vermont's construction general permit.

An ANR construction general permit will be required for this project with earth disturbance estimated as ±2.1-ac, over the 1-ac threshold for requiring a permit. The project qualifies as Moderate Risk.

6.6.2 Stormwater Control

A stormwater control plan (diagram and supporting narrative) shall be submitted for any land development that requires a zoning permit or DRB approval, and which creates new impervious surface area of 10,000 square feet or more. The calculation of new impervious surface area may be offset through the removal of existing impervious surface in other areas of the site. Such an offset shall be calculated on a 1:1 area basis – new impervious vs. existing impervious removed. Such an offset shall be contingent on substantially better stormwater infiltration for the area where existing impervious surfaces were removed. This may require the replacement of sub-base material in addition to surface materials. The stormwater control plan shall be prepared by a qualified, licensed engineer, and shall include a certification by the engineer that the plan conforms to the following five provisions:

(1) The latest version of the Vermont Stormwater Management Manual:

- *Water Quality Treatment Standard*
- *Channel Protection Treatment Standard*
- *Groundwater Recharge Treatment Standard*
- *Overbank Flood Protection Treatment Standard*
- *Extreme Flood Protection Treatment Standard*

Credits and waivers indicated in the Vermont Stormwater Management Manual may be used to partly or wholly meet these standards. Evidence of an approved State stormwater permit using the standards

contained in the latest version of the manual will constitute compliance with the VT Stormwater Management standards listed above (e.g., water quality, channel protection, groundwater recharge, overbank flood protection, extreme flood protection). A State stormwater permit approved under an earlier version of the manual shall not constitute compliance with the five standards listed above - i.e., compliance with the latest version of the Vermont Stormwater Management Manual must be demonstrated.

Existing on site impervious is limited to the existing gravel access drive at the southwest corner of the property. This 524-sf or 0.01-ac are is proposed to be eliminated by means of restoring the area to meadow. The development proposes 1.43-ac of new impervious surface which includes the new paved roadway, multi-use path, gravel turnaround and individual lot coverage.

- Water Quality Treatment Standard will be met through installation of (2) gravel wetland treatment areas. Adequate storage of the calculated water quality volume is demonstrated in the modeling attachment included at the end of this report.
- Channel Protection Treatment Standard will be met through extended detention within the (2) gravel wetland treatment areas. Required detention times have been met using a permanent pool control orifice, as demonstrated in the modeling attachment.
- Groundwater Recharge Treatment Standard will be waived as on-site soils within the project area are mapped as Hydrologic Soil Group D.
- Overbank Flood Protection Treatment Standard will be met through extended detention within the (2) gravel wetland treatment areas. Post development peak flow rates are reduced from the pre development condition, as demonstrated in the modeling attachment.
- Extreme Flood Protection Treatment Standard will be waived as impervious surface totals are less than 10-acres.

(2) The plan shall locate soils well suited for infiltration, and address the extent to which such soils will be utilized to infiltrate stormwater.

Project site soils are mapped as Hydrologic Soil Group D, not well suited for infiltration. Furthermore, the presence of Class II Wetland and buffer areas indicates shallow depth to seasonal high water table further restricting the ability for runoff to infiltrate.

(3) Post-development drainage patterns shall mimic (except as noted below) pre-development drainage patterns to the greatest extent possible, especially with regard to where stormwater leaves the site. The post-development drainage pattern shall improve upon (rather than mimic) the pre-development drainage conditions if those conditions already contribute to deleterious stormwater runoff impacts. The stormwater plan shall be designed so that off-site drainage areas will not be overwhelmed during larger storm events (i.e., up to and including a 100-year storm) to a greater extent than in pre-development conditions. The evaluation shall demonstrate that off-site areas will not be subject to increased erosion during a 10-year storm event, and will not otherwise be adversely impacted during a 10-year and a 100-year storm event. The off-site areas to be evaluated shall include:
(a) The area between identifiable stormwater discharge points from the site and the receiving water body (e.g., stream, river, lake) at a point along the water body where the site's drainage area constitutes less than 10% of the water body's drainage area at that location.

(b) Should the receiving water body be distant from the site discharge points, the evaluation shall extend as far off site as necessary to reach a point where the site's drainage area constitutes less than 10% of the surrounding drainage area.
(4) Once completed, all such stormwater systems shall be certified as installed per the plan by a qualified, licensed engineer. The plan shall include clear provisions for inspection and long term maintenance by a qualified professional.
(5) Low Impact Development (LID). The use of LID design approaches shall be implemented, taking into consideration the site's soil characteristics, slope, and other relevant factors. To the extent that LID design approaches are not proposed in the stormwater management plan, the applicant shall provide a full justification and demonstrate why the use of LID approaches is not possible. See the Definitions section for an explanation of Low Impact Development.

Project Overview & Basis of Design- The project proposes creation of (8) new residential housing lots. The new roadway, multi-use path and impervious lot coverage will add more than 5,000-sf of new impervious surface, triggering the need for an ANR Operational Stormwater Permit. The project will result in over 1-ac of earth disturbance which will requires coverage under the ANR Construction General Permit.

Site Areas Summary

Drainage Analysis 7.83-acres
Project Earth Disturbance 2.10-acres
New Impervious 1.43-acres

The drainage analysis is based on the estimated 7.83-acres of development area (those altered between the pre development and post development conditions) as well as and upslope areas draining through the project area (which will remain undeveloped). Impervious coverage for proposed Lots 1 and 2 has been estimated as 0.09-ac and 0.08-ac respectively, or 11% and 20% impervious. Based on this, Lots 3-8 are assumed to be a maximum of 0.12-ac or 35% impervious (whichever is greater) for the purpose of the stormwater design. The proposed lot coverage calculations are summarized on the Post Development Drainage Area Map.

The erosion prevention and sediment control plan is based on the project earth disturbance, estimated as ±1.80-ac. This area generally includes work within the proposed road right of way and associated grading disturbance. This does not include the development of individual lots.

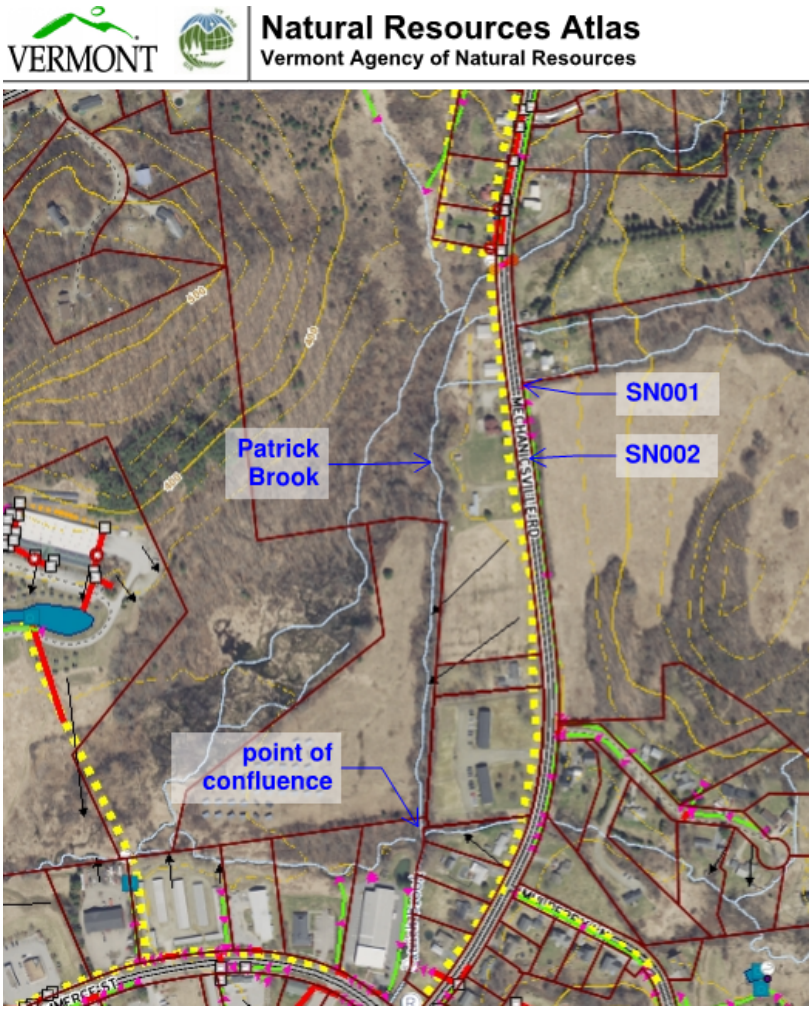
Pre Development (Existing) Condition - The existing site is an undeveloped parcel roughly 102-acres in size. The project area consists mainly of meadow and delineated Class II and Class III wetland and buffer areas constrained to the north by a stream and stream buffer.

The project site is within the Lake Champlain Watershed and ultimately discharges to the Shelburne Bay Segment. Immediate receiving waters for each discharge point are as noted below, which diverge in Patrick Brook roughly a quarter mile south west of the project site. The site discharge points are identified and described as follows and depicted on the following page:

- SN001 – Unnamed tributary of Patrick Brook
  Roughly 60% of the development area drains to an unnamed tributary of Patrick Brook which runs along the norther edge of the project parcel. The unnamed tributary flows beneath Mechanicsville Road via an existing culvert located at the northwest corner of the property, continues east approximately 210-ft to discharge to Patrick Brook.

- SN002 – Unnamed wetland tributary to Patrick Brook
  The remaining 40% of the development area drains to a delineated class II wetland area (identified as wetland i) with associated 50-ft buffer. Existing topography indicates the wetland discharges to the roadside swale flowing south along the east edge of Mechanicsville Road for approximately 1,300-ft before crossing beneath the road. Flow continues east about 350-ft to discharge to Patrick Brook.

Soils underlying the development area are mapped primarily as Munson and Raynham silt loams classified as hydrological soil group (HSG) D with surrounding areas mapped as Peru fine sandy loam (HSG C/D) and Scantic silt loam (HSG C/D). Predevelopment slopes average between 12% and 16%.



Post Development Condition – As noted the project will result in 1.43-acres of new impervious surface which will be permitted with the Vermont DEC Agency of Natural Resources. Two gravel wetland treatment areas have been designed in conformance with the Vermont Stormwater Management Manual. Gravel wetland treatment areas are recognized by the State of Vermont Agency of Natural Resources as a standard treatment practice with pollutant removal rates ranging from 60-80% total phosphorus and 80-97% total suspended solids, as designed for the 1" water quality event. The gravel wetlands include a ponding area above with outlet structures

designed to control the rate at which water is released to adjacent waters. Control orifices and bypass drop inlets are designed to reduce peak flows from the existing condition for the 1-year, 10-year and 100-year storm events.

Existing site constraints present challenges for maintaining existing drainage patterns. With the proposed development sloping up from Mechanicsville Road along with the presence of natural wetlands and stream buffers, there is little opportunity for siting stormwater treatment areas at the low point of the development area. What area is available has been used for siting gravel wetland treatment area #1 which will treat runoff from Lots 1-5 and impervious surfaces within the right of way. The capacity of the treatment area has been maximized to prevent disturbance to the nearby Class II Wetland. The treatment area does impact portions of the associated 50-ft buffer area which area lateral or downslope of the natural wetland.

Remaining impervious flow to gravel wetland treatment area #2 which is situated nearly half way up the access drive. The treatment area has been sized to provide treatment and detention for the remaining developed area and upslope contributing areas.

Because of the limitations at the west end of the site, the two drainage areas do see some modification between the pre and post development condition. Despite this, treatment and peak flow reductions are met with the two treatment areas. The table below summarizes the changes to the drainage areas and peak flow reduction for the 1-year, 10-year and 100-year storm events.

	SN001 (north discharge)					
	Predevelopment		**Post Development**		**Delta**	
Drainage Area	4.83	ac	4.49	ac	-0.34	ac
1-YR Peak	3.20	cfs	1.68	cfs	-1.52	cfs
10-YR Peak	10.63	cfs	8.37	cfs	-2.26	cfs
100-YR Peak	20.93	cfs	20.81	cfs	-0.12	cfs
	SN002 (south discharge)					
	Predevelopment		**Post Development**		**Delta**	
Drainage Area	3.00	ac	3.34	ac	0.34	ac
1-YR Peak	2.03	cfs	0.39	cfs	-1.64	cfs
10-YR Peak	6.75	cfs	3.74	cfs	-3.01	cfs
100-YR Peak	13.31	cfs	12.98	cfs	-0.33	cfs

Refer to the hydrologic modeling attachments and drainage area maps for additional information.

Low impact design (LID) Standards - To the extent practical given existing site constraints, low impact design standards have been implemented. The summary below identifies a number of LID practices and how they have been implemented in the project design, in addition to the installation of the gravel wetland treatment areas discussed above.

- Cluster Development. The development project encompasses an area of ± 6.1-acres and proposes (8) modestly sized residential lots ranging from 0.84 to 0.31-acres in size,

concentrated at the northwest corner of the existing parcel. Building envelopes reduce the developable portions of each lot to 0.16 to 0.29-acres. Beyond the residential development, the new roadway and stormwater treatment practices, remaining lands are to be preserved as undeveloped natural areas; stream buffers, wetlands and wetland buffers. The remaining vegetated or undisturbed open space within the development encompasses an estimated 3-acres or 50% of the project area.

- Minimized Impervious Areas. The roadway serving the development is proposed as 22-ft wide paved surface, reduced from the standard 24-ft wide while still accommodating two way traffic and access for emergency vehicles. A single 6-ft wide multi use path is proposed off the south edge of the roadway, for common use between the lots both north and south of the roadway. Individual lot impervious is prescribed as a maximum of 0.12-acres or 35% of the lot area, whichever is greater.
- Open Space Preservation. Several natural features exist within the development area which are proposed to be preserved to the extent practical. The 75-ft stream setback to the north is largely preserved, with temporary impacts proposed for a new drainage swale along Mechanicsville Road. A drainage swale is proposed along much of the setback limit, providing a physical demarcation of the preserved natural area. Several class II wetlands with 50-ft buffer areas are also present. Minimal impact is proposed to the class II wetland buffer extending along the east edge of Mechanicsville Road, due to grading impacts associated with the development. Split rail fencing and landscape boulders are proposed along the limits of the natural wetland buffer areas, identifying the preserved natural area.
- Site Fingerprinting. The erosion prevention and sediment control plan identify the areas proposed for disturbance along with temporary and permanent practices to be implemented during construction. The limits of earth disturbance for the shared infrastructure are estimated as ±2.1-acres and have been minimized to the extent practical.
- Filtration Practices. The two proposed gravel wetland treatment areas provide treatment for the 1” rainfall event via lateral flow through a subsurface gravel bed, capturing and removing sediment. The surface layer is comprised of an organic wetland soil which remains saturated as controlled by a low flow orifice. This saturated media supports the growth of natural wetland plants, emulating the natural treatment of stormwater within wetland areas with plant roots absorbing phosphorus from contributing runoff. While installation of infiltrating practices such as rain gardens or infiltration trenches is encouraged, existing site conditions including high ground water table and heavy soils do not support proper function of these systems.
- Landscaping Practices. The landscape plan identifies locations for proposed native shrub and tree plantings. Also shown on the plan are areas of existing vegetation to be preserved; the shrubs along Mechanicsville Road and the meadow area within the stream setback, wetlands and wetland buffers. Disturbed areas outside the limits of the residential lots, roadway and multi use path will be planted with meadow seed, consistent with the existing condition.
- Soil Conservation & Amendments. The soils management plan identifies area of disturbed soils subject to restoration along with a strategy for implementation and testing upon completion. The purpose is to amend soils impacted during construction in order to restore soils to pre-development condition and promote infiltration of surface runoff within vegetated areas.

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EX. HEADWALL
36" ADS INV 364.87
EX. STORM MH
RIM 370.95
EX. 36" CMP
INV OUT 367.31
EX. SEWER MH
RIM 367.46
EX. CATCH BASIN
RIM 370.19
EX. 18" CMP
INV 367.23
CMP35
EX. 18" CMP
INV 366.42
18" CMP
18" CMP
POI#1
EX. CLASS II WETLAND
WETLAND H
0.25-AC
35-FT CLASS II WETLAND BUFFER
WETLAND A
50-FT CLASS II WETLAND BUFFER
PRE DEVELOPMENT DRAINAGE AREA 1
DISCHARGING NORTH TO SN001
4.84-AC
0.01-AC IMPERVIOUS
AVERAGE SLOPE 12%
HYDRAULIC LENGTH 926-FT
GrC
GROTON GRAVELLY FINE
SANDY LOAM
12-20% SLOPES
HSG B
EX. CLASS II WETLAND
WETLAND A
1.46-AC
MyB
MUNSON & RAYNHAM SILT LOAMS
2-6% SLOPES
HSG C/D
EX. CLASS III WETLAND
WETLAND D
0.04-AC
EX. CLASS III WETLAND
WETLAND C
0.28-AC
MBX6.1
MECHANICSVILLE ROAD
30MPH AHEAD SIGN
50-FT CLASS II WETLAND BUFFER
PRE DEVELOPMENT DRAINAGE AREA 2
DISCHARGING SOUTH TO SN002
3.00-AC
AVERAGE SLOPE 14.1%
HYDRAULIC LENGTH 921-FT
POI#2
CMP33
EX. SEWER MH
RIM 369.08
EX. CATCH BASIN
RIM 369.08
MBX6.0
UPSLOPE CONTRIBUTING AREA
OUTSIDE LIMITS OF DEVELOPMENT
1.00-AC
EX. CLASS II WETLAND
WETLAND I
0.88-AC
CMP32-(2)
CMP32
ELCO PED
HID
HARTLAND VERY FINE
SANDY LOAM
12-25% SLOPES
HSG B
EX. CLASS III WETLAND
WETLAND E
0.04-AC
EX. CLASS III WETLAND
WETLAND E
0.05-AC
UPSLOPE CONTRIBUTING AREA
OUTSIDE LIMITS OF DEVELOPMENT
1.16-AC
TBM NAIL IN POWER POLE
CMP31
MyC
MUNSON & RAYNHAM SILT LOAMS
6-12% SLOPES
VERY ROCKY
HSG C/D
RADAR SIGN
EX. SEWER MH
RIM 363.42
EX. STORM MH
RIM 364.90
EX. CATCH BASIN
RIM 364.28
PeC
PERU FINE SANDY LOAM
12-20% SLOPES
HSG C/D
CMP30
CTC-VT2 20
CMP31
POST
30MPH SIGN
EX. CATCH BASIN
RIM 362.42
EX. STORM MH
RIM 363.02
ScA
SCANTIC SILT LOAM
0-2% SLOPES
HSG C/D
CTC 2 19
35MPH
SIGN
POSTED
SIGN
EX. CLASS II WETLAND
WETLAND G

N

PRE-DEVELOPMENT DRAINAGE

- PRE DEVELOPMENT DRAINAGE AREA BOUNDARY
- HYDRAULIC LENGTH
- NRCS SOILS BOUNDARY
- EXISTING IMPERVIOUS SURFACE

GRAPHIC SCALE

50 0 25 50 100 200

1 inch = 50 ft.
for sheet size 24" x 36"

Stamp

ENGINEERING VENTURES PC
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85 Mechanic Street, Suite E2-3, Lebanon, NH 03766 s 603-442-9333
414 Union Street, Schenectady, NY 12305 s 518-630-9614
www.engineeringventures.com

JOE LASTER

1139 Lanier Boulevard
Atlanta, GA 30306
404.822.6990

Sheet Title: PRE DEVELOPMENT DRAINAGE AREA MAP

Project Title: PROPOSED SUBDIVISION
LASTER PROPERTY
TOWN OF HINESBURG, CHITTENDEN COUNTY, VERMONT

EV Project #	20542
Drawn By:	HKW
Checked By:	KW
Scale:	1" = 50'
Date:	03/01/2023

No.	Description	Date
1	TOWN & ANR STORMWATER COMMENT RESPONSE	04/12/2023

DR-2

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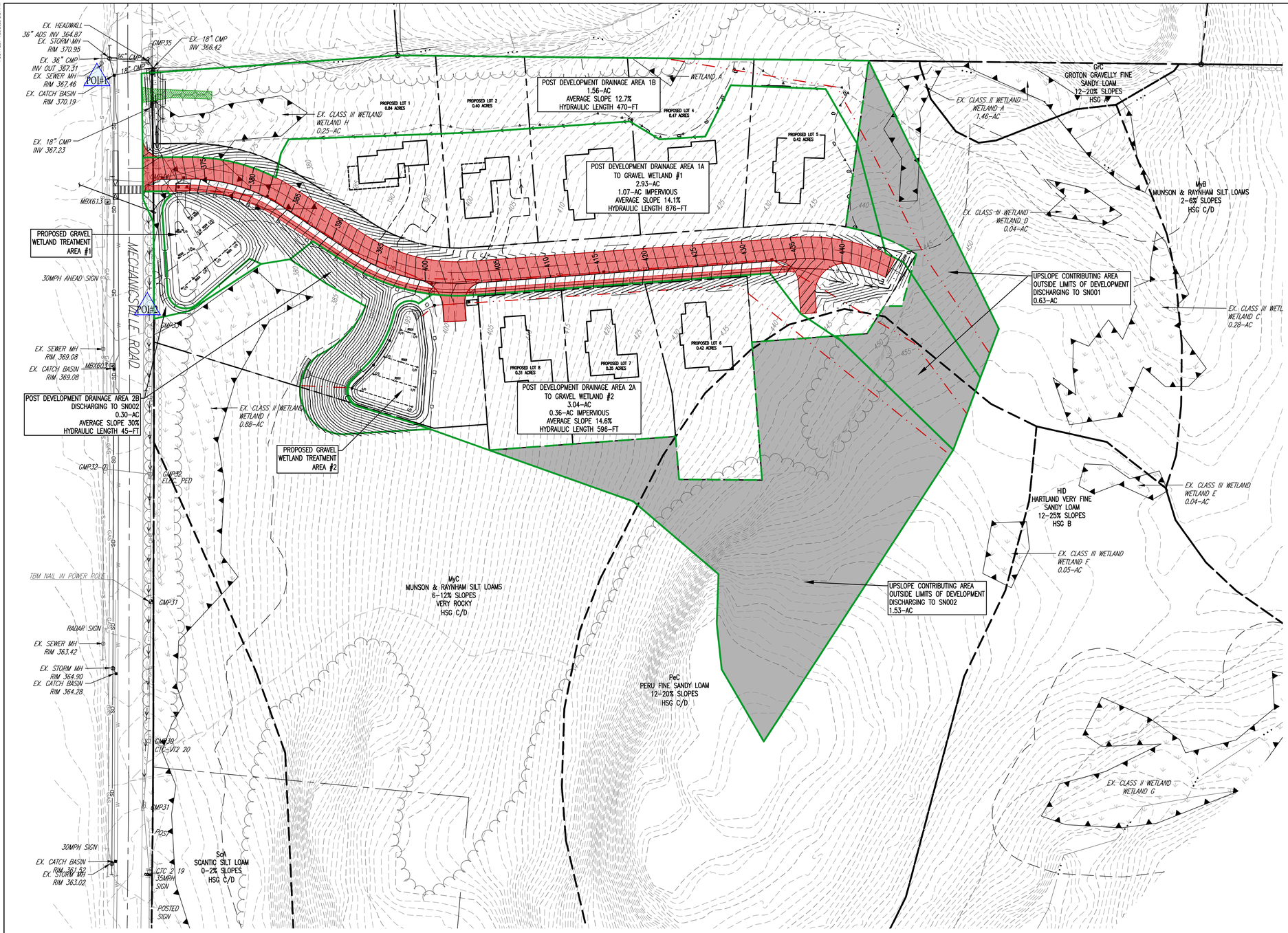

POST-DEVELOPMENT DRAINAGE

- POST DEVELOPMENT DRAINAGE AREA BOUNDARY
- HYDRAULIC LENGTH
- NRCS SOILS BOUNDARY
- ELIMINATED IMPERVIOUS SURFACE
- NEW IMPERVIOUS SURFACE

IMPERVIOUS LOT COVERAGE

	area	impervious	% impervious
Lot 1	0.84 ac	0.09 ac	11%
Lot 2	0.4 ac	0.08 ac	20%
Lot 3	0.44 ac	0.12 ac	28%
Lot 4	0.47 ac	0.12 ac	26%
Lot 5	0.42 ac	0.12 ac	28%
Lot 6	0.42 ac	0.12 ac	28%
Lot 7	0.35 ac	0.12 ac	35%
Lot 8	0.31 ac	0.11 ac	35%

GRAPHIC SCALE

50 0 25 50 100 200

1 inch = 50 ft.
for sheet size 24" x 36"

Stamp

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www.engineeringventures.com

JOE LASTER

1139 Lanier Boulevard
Atlanta, GA 30306
404.822.6990

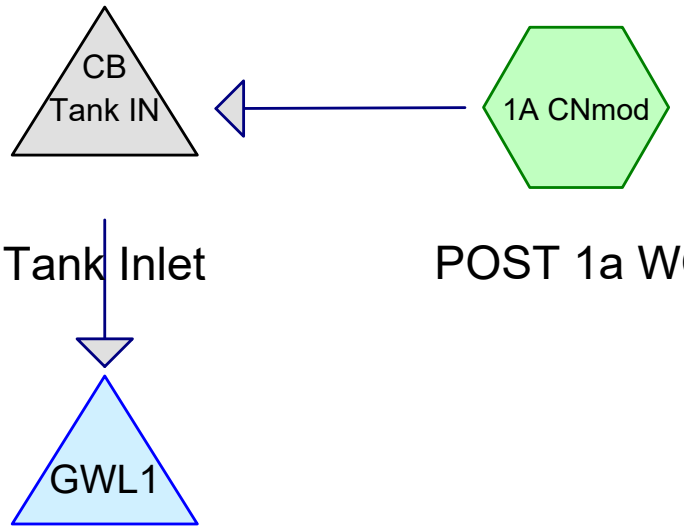
Sheet Title: POST DEVELOPMENT DRAINAGE AREA MAP

Project Title: PROPOSED SUBDIVISION
LASTER PROPERTY
TOWN OF HINESBURG, CHITTENDEN COUNTY, VERMONT

EV Project #	20542
Drawn By:	HKW
Checked By:	KW
Scale:	1" = 50'
Date:	03/01/2023

No.	Description	Date
1	TOWN & ANR STORMWATER COMMENT RESPONSE	04/12/2023

DR-3



Gravel Wetland #1

Version: 11/30/2020

Project Name:	**Laster Subdivision**		
Discharge Point:	**SN001**		
Treatment Wetland #	**Gravel Wetland #1**		

Treatment Wetlands (4.3.5)

	Practice Drainage Area	For Permit Coverage	Not for Permit Coverage	Total to Practice
1	Total Area (acres)	2.930	0.000	2.930
2	New Impervious (acres)	1.070	0.000	1.070
3	Redeveloped Impervious	0.000	0.000	0.000
		WQ_V for credit	WQ_V not for credit	Total WQ_V
4	WQ_V to practice	0.0925	0.0000	0.0925

Modified CN for WQ (1.0") storm: 91

↑Enter this value on the Standards Compliance Workbook

WQ volume required = 4,030-cf
Min. 10% pretreatment volume = 403-cf
Pretreatment volume provided = 450-cf
Provide min. 3,580-cf of WQ storage in gravel wetland.

Subcat Reach Pond Link

Summary for Subcatchment 1A CNmod: POST 1a WQ

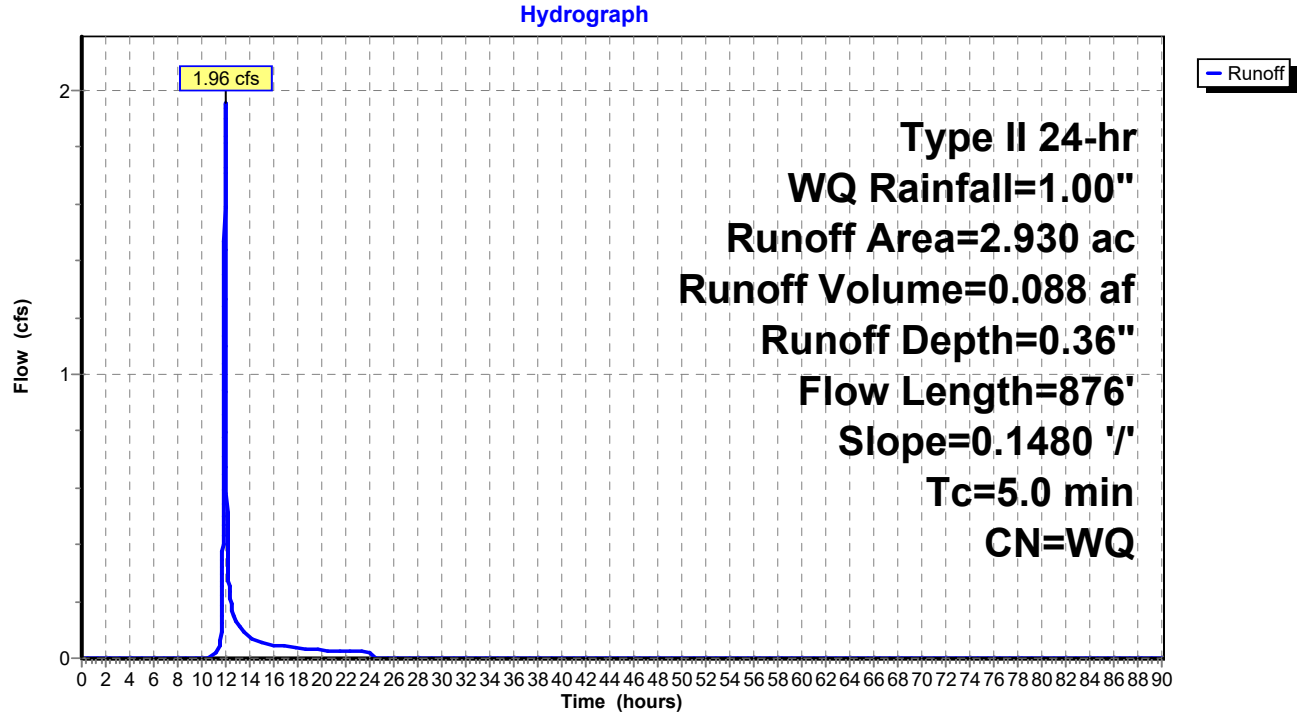
Runoff = 1.96 cfs @ 11.97 hrs, Volume= 0.088 af, Depth= 0.36"
Routed to Pond Tank IN : Tank Inlet

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
Type II 24-hr WQ Rainfall=1.00"

	Area (ac)	CN	Description
*	1.070	91	Modified CN
*	1.860	91	Modified CN
	2.930		Weighted Average
	2.930		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0	876	0.1480	2.92		**Lag/CN Method, Watershed Lag**

Subcatchment 1A CNmod: POST 1a WQ



Summary for Pond GWL1: Gravel Wetland #1

Inflow Area = 2.930 ac, 0.00% Impervious, Inflow Depth = 0.36" for WQ event
Inflow = 1.96 cfs @ 11.97 hrs, Volume= 0.088 af
Outflow = 0.06 cfs @ 14.94 hrs, Volume= 0.088 af, Atten= 97%, Lag= 178.6 min
Primary = 0.06 cfs @ 14.94 hrs, Volume= 0.088 af
Routed to Link N : SN001
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Link S : SN002

Routing by Stor-Ind method, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs / 2
Starting Elev= 368.50' Surf.Area= 6,106 sf Storage= 3,053 cf
Peak Elev= 369.53' @ 14.94 hrs Surf.Area= 9,755 sf Storage= 5,143 cf (2,090 cf above start)
Flood Elev= 372.00' Surf.Area= 12,451 sf Storage= 17,859 cf (14,806 cf above start)

Plug-Flow detention time= 1,106.3 min calculated for 0.018 af (20% of inflow)
Center-of-Mass det. time= 436.3 min (1,287.8 - 851.4)

Volume	Invert	Avail.Storage	Storage Description
#1	365.00'	2,748 cf	**Gravel Storage (Prismatic)** Listed below (Recalc)
#2	368.00'	611 cf	**Media Storage (Prismatic)** Listed below (Recalc)
#3	369.00'	17,792 cf	**Ponding Storage (Prismatic)** Listed below (Recalc)
		21,150 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
365.00	3,053	0.0	0	0
368.00	3,053	30.0	2,748	2,748

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
368.00	3,053	0.0	0	0
368.50	3,053	20.0	305	305
369.00	3,053	20.0	305	611

permanent pool storage 3,053-cf (elev. 368.5)

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
369.00	3,053	0.0	0	0
370.00	4,173	100.0	3,613	3,613
370.10	4,676	100.0	442	4,055
371.00	5,441	100.0	4,553	8,608
372.00	6,345	100.0	5,893	14,501
372.50	6,818	100.0	3,291	17,792

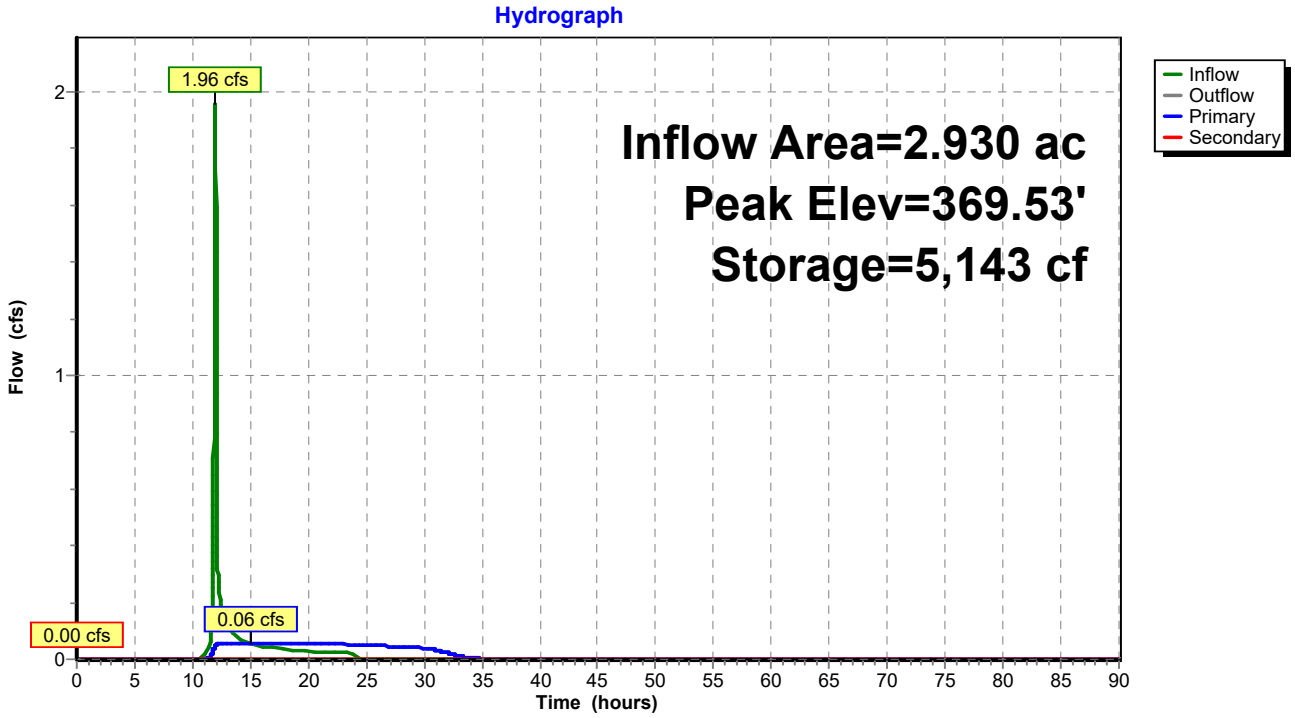
Device	Routing	Invert	Outlet Devices
#1	Primary	368.20'	**12.0" Round Culvert** L= 12.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 368.20' / 368.00' S= 0.0167 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf
#2	Device 1	368.50'	**1.5" Vert. Permanent Pool Orifice/Grate** C= 0.600

			Limited to weir flow at low heads
#3	Device 1	370.83'	**10.3" Horiz. 12" Orifice/Grate** C= 0.600
			Limited to weir flow at low heads
#4	Secondary	371.50'	**20.0' long + 3.0 '/' SideZ x 3.0' breadth Spillway**
			Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50
			Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=0.06 cfs @ 14.94 hrs HW=369.53' (Free Discharge)
└─**1=Culvert** (Passes 0.06 cfs of 2.72 cfs potential flow)
  ├─**2=Permanent Pool Orifice/Grate** (Orifice Controls 0.06 cfs @ 4.74 fps)
  └─**3=12" Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=368.50' (Free Discharge)
└─**4=Spillway** (Controls 0.00 cfs)

Pond GWL1: Gravel Wetland #1



Stage-Area-Storage for Pond GWL1: Gravel Wetland #1

Elevation (feet)	Storage (cubic-feet)	Elevation (feet)	Storage (cubic-feet)	Elevation (feet)	Storage (cubic-feet)
365.00	0	367.55	2,336	370.10	7,414
365.05	46	367.60	2,381	370.15	7,649
365.10	92	367.65	2,427	370.20	7,886
365.15	137	367.70	2,473	370.25	8,125
365.20	183	367.75	2,519	370.30	8,366
365.25	229	367.80	2,565	370.35	8,609
365.30	275	367.85	2,610	370.40	8,855
365.35	321	367.90	2,656	370.45	9,102
365.40	366	367.95	2,702	370.50	9,352
365.45	412	368.00	2,748	370.55	9,604
365.50	458	368.05	2,778	370.60	9,858
365.55	504	368.10	2,809	370.65	10,114
365.60	550	368.15	2,839	370.70	10,372
365.65	595	368.20	2,870	370.75	10,633
365.70	641	368.25	2,900	370.80	10,895
365.75	687	368.30	2,931	370.85	11,160
365.80	733	368.35	2,961	370.90	11,427
365.85	779	368.40	2,992	370.95	11,695
365.90	824	368.45	3,022	371.00	11,966
365.95	870	368.50	3,053	371.05	12,240
366.00	916	368.55	3,084	371.10	12,515
366.05	962	368.60	3,114	371.15	12,793
366.10	1,007	368.65	3,145	371.20	13,073
366.15	1,053	368.70	3,175	371.25	13,355
366.20	1,099	368.75	3,206	371.30	13,639
366.25	1,145	368.80	3,236	371.35	13,926
366.30	1,191	368.85	3,267	371.40	14,215
366.35	1,236	368.90	3,297	371.45	14,506
366.40	1,282	368.95	3,328	371.50	14,800
366.45	1,328	369.00	3,358	371.55	15,096
366.50	1,374	369.05	3,512	371.60	15,394
366.55	1,420	369.10	3,669	371.65	15,694
366.60	1,465	369.15	3,829	371.70	15,997
366.65	1,511	369.20	3,991	371.75	16,301
366.70	1,557	369.25	4,157	371.80	16,608
366.75	1,603	369.30	4,325	371.85	16,918
366.80	1,649	369.35	4,495	371.90	17,229
366.85	1,694	369.40	4,669	371.95	17,543
366.90	1,740	369.45	4,846	372.00	17,859
366.95	1,786	369.50	5,025	372.05	18,178
367.00	1,832	369.55	5,207	372.10	18,499
367.05	1,878	369.60	5,392	372.15	18,822
367.10	1,923	369.65	5,579	372.20	19,147
367.15	1,969	369.70	5,770	372.25	19,475
367.20	2,015	369.75	5,963	372.30	19,805
367.25	2,061	369.80	6,159	372.35	20,138
367.30	2,107	369.85	6,358	372.40	20,473
367.35	2,152	369.90	6,560	372.45	20,810
367.40	2,198	369.95	6,764	372.50	**21,150**
367.45	2,244	370.00	6,971		
367.50	2,290	370.05	7,186		

Pretreatment storage = 450-cf
Permanent pool storage = 3,053-cf
Extended detention storage = 616-cf
WQv provided = 4,119-cf

Summary for Pond Tank IN: Tank Inlet

Inflow Area = 2.930 ac, 0.00% Impervious, Inflow Depth = 0.36" for WQ event
Inflow = 1.96 cfs @ 11.97 hrs, Volume= 0.088 af
Outflow = 1.96 cfs @ 11.97 hrs, Volume= 0.088 af, Atten= 0%, Lag= 0.0 min
Primary = 1.96 cfs @ 11.97 hrs, Volume= 0.088 af
Routed to Pond GWL1 : Gravel Wetland #1
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Reach Tank Out : Tank Outlet

Routing by Stor-Ind method, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
Peak Elev= 369.90' @ 11.97 hrs

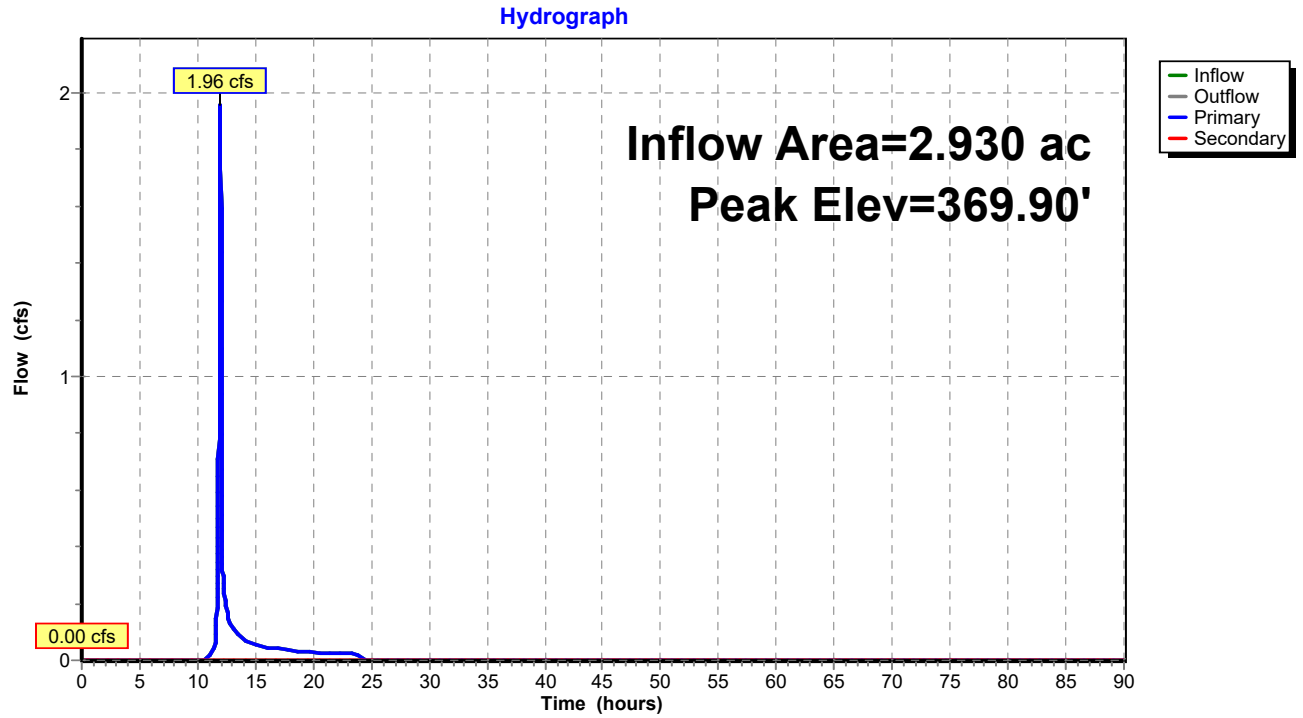
Device	Routing	Invert	Outlet Devices
#1	Primary	369.10'	**18.0" Round 18" Culvert to GWL** L= 20.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 369.10' / 369.00' S= 0.0050 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 1.77 sf
#2	Secondary	370.58'	**7.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

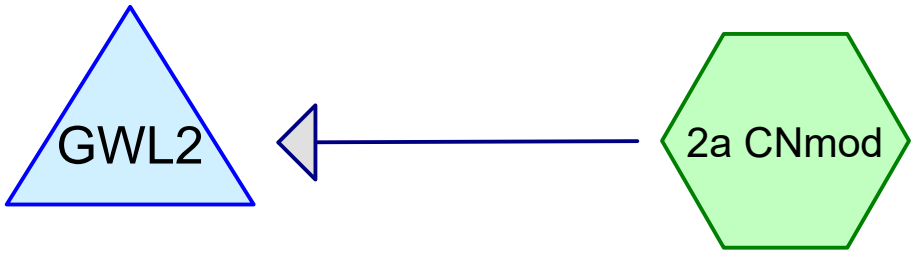
Primary OutFlow Max=1.95 cfs @ 11.97 hrs HW=369.90' (Free Discharge)
└**1=18" Culvert to GWL** (Barrel Controls 1.95 cfs @ 2.98 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=369.10' (Free Discharge)
└**2=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

no flow from tank overflow

Pond Tank IN: Tank Inlet





Gravel Wetland #2

POST 2a WQ

Version: 11/30/2020				Project Name:	Laster Subdivision
Treatment Wetlands (4.3.5)				Discharge Point:	SN002
				Treatment Wetland #	Gravel Wetland #2

	Practice Drainage Area	For Permit Coverage	Not for Permit Coverage	Total to Practice
1	Total Area (acres)	3.040	0.000	3.040
2	New Impervious (acres)	0.360	0.000	0.360
3	Redeveloped Impervious	0.000	0.000	0.000
		WQ_v for credit	WQ_v not for credit	Total WQ_v
4	WQ_v to practice	0.0397	0.0000	0.0397

Modified CN for WQ (1.0") storm: 84

↑Enter this value on the Standards Compliance Workbook

WQ volume required = 1,730-cf
Min. 10% pretreatment volume = 173-cf
Pretreatment volume provided = 175-cf
Provide min. 1,555-cf of WQ storage in gravel wetland.

Subcat Reach Pond Link

Summary for Subcatchment 2a CNmod: POST 2a WQ

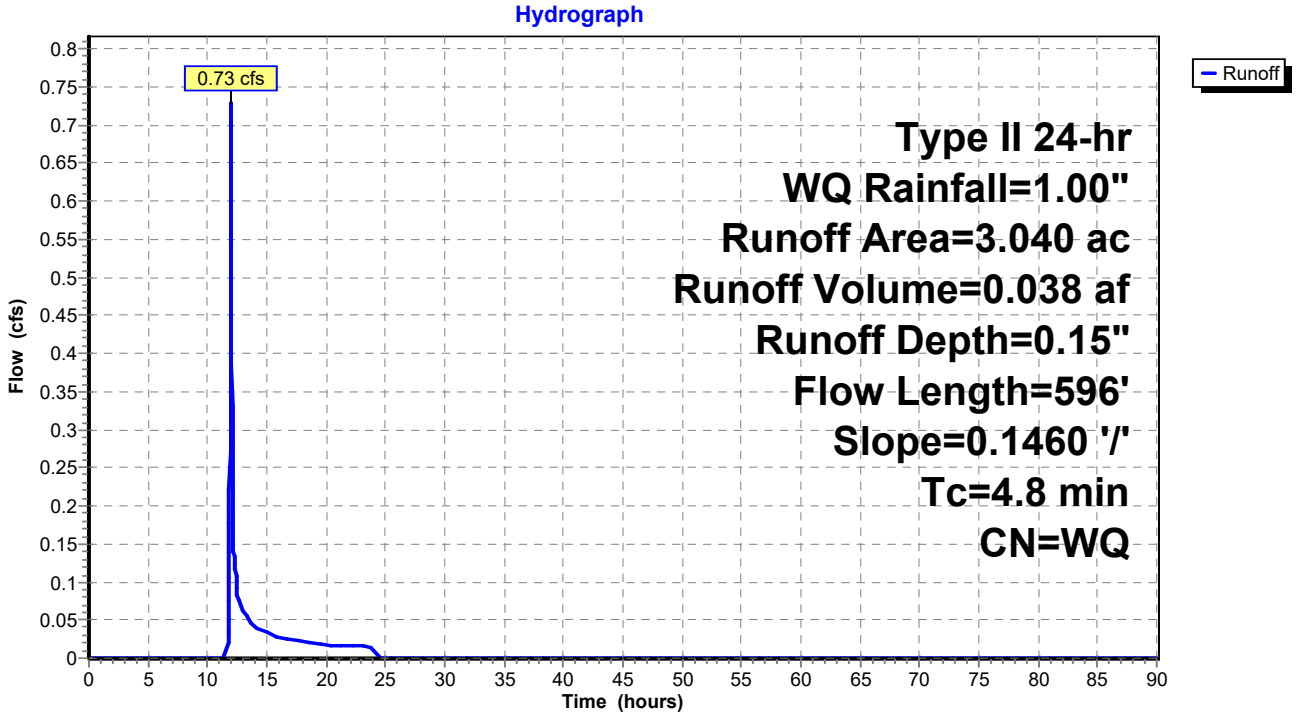
Runoff = 0.73 cfs @ 11.98 hrs, Volume= 0.038 af, Depth= 0.15"
Routed to Pond GWL2 : Gravel Wetland #2

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs
Type II 24-hr WQ Rainfall=1.00"

	Area (ac)	CN	Description
*	0.360	84	Modified CN
*	2.680	84	Modified CN
	3.040		Weighted Average
	3.040		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.8	596	0.1460	2.06		**Lag/CN Method, Watershed Lag**

Subcatchment 2a CNmod: POST 2a WQ



Summary for Pond GWL2: Gravel Wetland #2

Inflow Area = 3.040 ac, 0.00% Impervious, Inflow Depth = 0.15" for WQ event
Inflow = 0.73 cfs @ 11.98 hrs, Volume= 0.038 af
Outflow = 0.02 cfs @ 18.54 hrs, Volume= 0.038 af, Atten= 97%, Lag= 393.7 min
Primary = 0.02 cfs @ 18.54 hrs, Volume= 0.038 af

Routing by Stor-Ind method, Time Span= 0.00-90.00 hrs, dt= 0.01 hrs / 2
Starting Elev= 396.50' Surf.Area= 8,520 sf Storage= 4,896 cf
Peak Elev= 397.15' @ 18.54 hrs Surf.Area= 12,090 sf Storage= 5,773 cf (877 cf above start)
Flood Elev= 400.00' Surf.Area= 14,200 sf Storage= 18,882 cf (13,986 cf above start)

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= 536.5 min (1,442.5 - 906.0)

Volume	Invert	Avail.Storage	Storage Description
#1	393.00'	4,550 cf	**Gravel Storage (Prismatic)** Listed below (Recalc)
#2	396.00'	693 cf	**Media Storage (Prismatic)** Listed below (Recalc)
#3	397.00'	16,581 cf	**Ponding Storage (Prismatic)** Listed below (Recalc)
		21,823 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
393.00	5,055	0.0	0	0
396.00	5,055	30.0	4,550	4,550

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
396.00	3,465	0.0	0	0
396.50	3,465	20.0	347	347
397.00	3,465	20.0	347	693

permanent pool storage 4,897-cf (elev. 396.5)

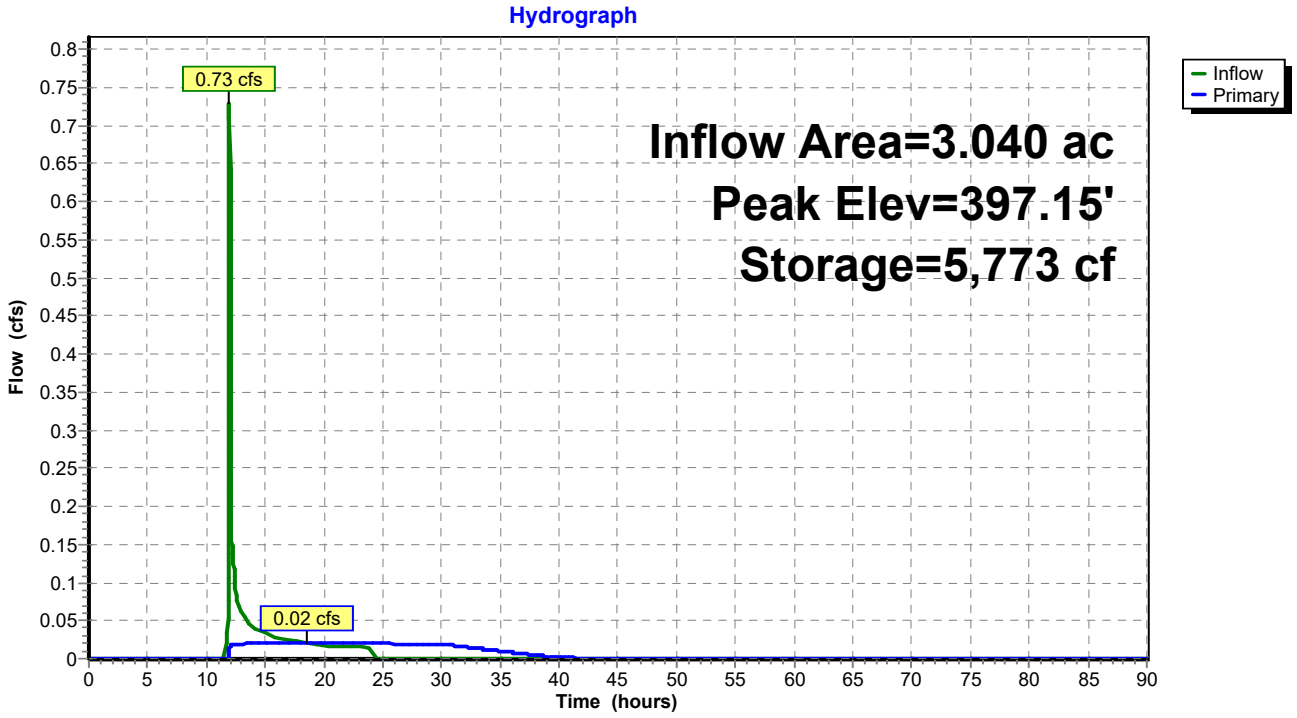
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
397.00	3,465	0	0
398.00	4,164	3,815	3,815
399.00	4,903	4,534	8,348
400.00	5,680	5,292	13,640
400.50	6,084	2,941	16,581

Device	Routing	Invert	Outlet Devices
#1	Primary	394.50'	**24.0" Round Culvert** L= 45.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 394.50' / 384.00' S= 0.2333 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 3.14 sf
#2	Device 1	396.50'	**1.0" Vert. Permanent Pool Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	398.50'	**12.5" Horiz. 15" Orifice/Grate X 2.00** C= 0.600 Limited to weir flow at low heads
#4	Primary	399.50'	**30.0' long + 3.0 '/' SideZ x 3.0' breadth Spillway**

Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50
Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=0.02 cfs @ 18.54 hrs HW=397.15' (Free Discharge)
- **1=Culvert** (Passes 0.02 cfs of 15.34 cfs potential flow)
  - **2=Permanent Pool Orifice/Grate** (Orifice Controls 0.02 cfs @ 3.76 fps)
  - **3=15" Orifice/Grate** (Controls 0.00 cfs)
- **4=Spillway** (Controls 0.00 cfs)

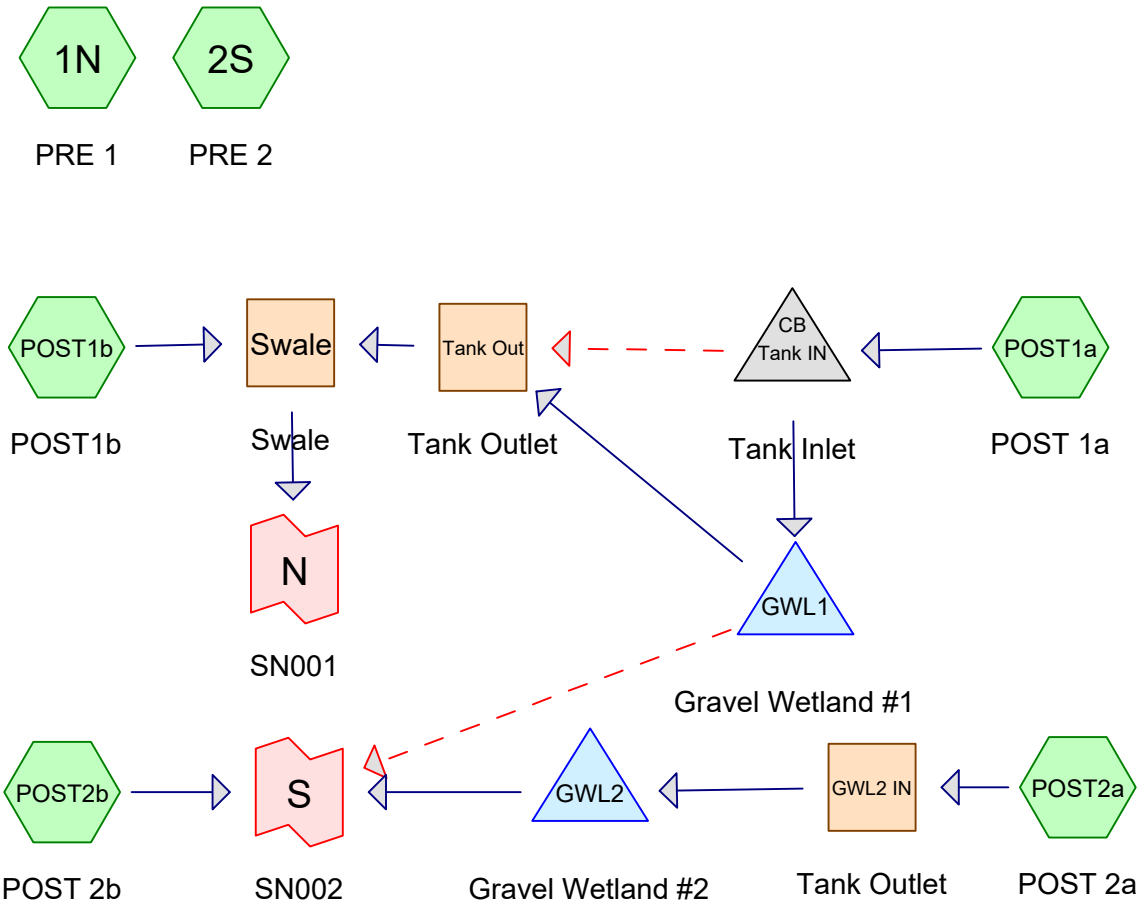
Pond GWL2: Gravel Wetland #2



Stage-Area-Storage for Pond GWL2: Gravel Wetland #2

Elevation (feet)	Storage (cubic-feet)	Elevation (feet)	Storage (cubic-feet)	Elevation (feet)	Storage (cubic-feet)
393.00	0	395.55	3,867	398.10	9,477
393.05	76	395.60	3,943	398.15	9,690
393.10	152	395.65	4,019	398.20	9,905
393.15	227	395.70	4,095	398.25	10,121
393.20	303	395.75	4,170	398.30	10,339
393.25	379	395.80	4,246	398.35	10,560
393.30	455	395.85	4,322	398.40	10,782
393.35	531	395.90	4,398	398.45	11,006
393.40	607	395.95	4,474	398.50	11,231
393.45	682	396.00	4,550	398.55	11,459
393.50	758	396.05	4,584	398.60	11,688
393.55	834	396.10	4,619	398.65	11,920
393.60	910	396.15	4,653	398.70	12,153
393.65	986	396.20	4,688	398.75	12,388
393.70	1,062	396.25	4,723	398.80	12,625
393.75	1,137	396.30	4,757	398.85	12,863
393.80	1,213	396.35	4,792	398.90	13,104
393.85	1,289	396.40	4,827	398.95	13,346
393.90	1,365	396.45	4,861	399.00	13,591
393.95	1,441	396.50	4,896	399.05	13,837
394.00	1,517	396.55	4,931	399.10	14,085
394.05	1,592	396.60	4,965	399.15	14,335
394.10	1,668	396.65	5,000	399.20	14,587
394.15	1,744	396.70	5,035	399.25	14,841
394.20	1,820	396.75	5,069	399.30	15,096
394.25	1,896	396.80	5,104	399.35	15,354
394.30	1,971	396.85	5,139	399.40	15,614
394.35	2,047	396.90	5,173	399.45	15,876
394.40	2,123	396.95	5,208	399.50	16,139
394.45	2,199	397.00	5,243	399.55	16,405
394.50	2,275	397.05	5,417	399.60	16,672
394.55	2,351	397.10	5,592	399.65	16,942
394.60	2,426	397.15	5,770	399.70	17,213
394.65	2,502	397.20	5,949	399.75	17,486
394.70	2,578	397.25	6,131	399.80	17,762
394.75	2,654	397.30	6,313	399.85	18,039
394.80	2,730	397.35	6,498	399.90	18,318
394.85	2,806	397.40	6,684	399.95	18,599
394.90	2,881	397.45	6,873	400.00	18,882
394.95	2,957	397.50	7,062	400.05	19,167
395.00	3,033	397.55	7,254	400.10	19,454
395.05	3,109	397.60	7,447	400.15	19,743
395.10	3,185	397.65	7,642	400.20	20,034
395.15	3,260	397.70	7,839	400.25	20,327
395.20	3,336	397.75	8,038	400.30	20,622
395.25	3,412	397.80	8,238	400.35	20,919
395.30	3,488	397.85	8,440	400.40	21,219
395.35	3,564	397.90	8,644	400.45	21,520
395.40	3,640	397.95	8,850	400.50	**21,823**
395.45	3,715	398.00	9,057		
395.50	3,791	398.05	9,266		

Required WQv met at elev. 394.05



Subcat Reach Pond Link

Routing Diagram for 20542 Laster 8-Lot Subdivision
Prepared by Engineering Ventures, Inc, Printed 4/13/2023

Summary for Subcatchment 1N: PRE 1

Runoff = 3.20 cfs @ 12.02 hrs, Volume= 0.184 af, Depth= 0.46"
Routed to nonexistent node 2L

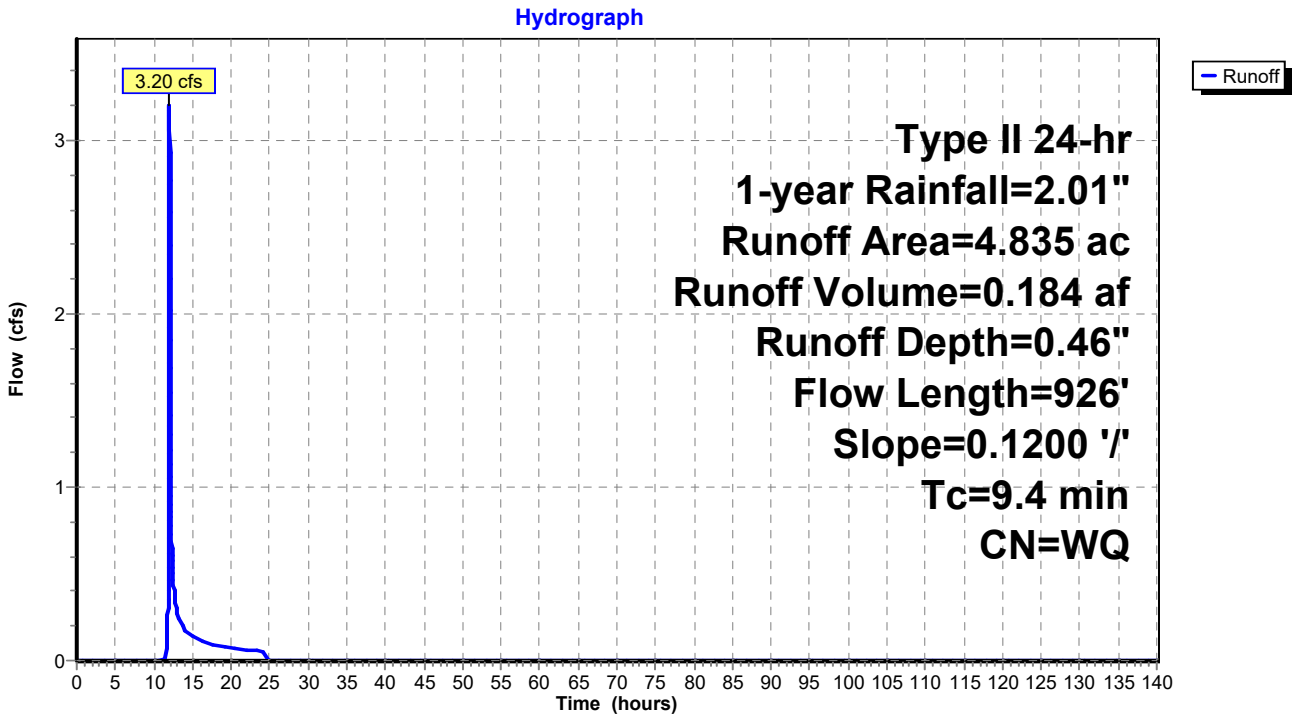
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-140.00 hrs, dt= 0.01 hrs
Type II 24-hr 1-year Rainfall=2.01"

	Area (ac)	CN	Description
	4.820	77	Woods, Good, HSG D
*	0.015	98	Existing Impervious
	4.835		Weighted Average
	4.820		99.69% Pervious Area
	0.015		0.31% Impervious Area

Pre Development
Peak Flow to SN001
3.20-cfs

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.4	926	0.1200	1.63		**Lag/CN Method, Watershed Lag**

Subcatchment 1N: PRE 1



Summary for Subcatchment 2S: PRE 2

Runoff = 2.03 cfs @ 12.02 hrs, Volume= 0.113 af, Depth= 0.45"
Routed to nonexistent node 3L

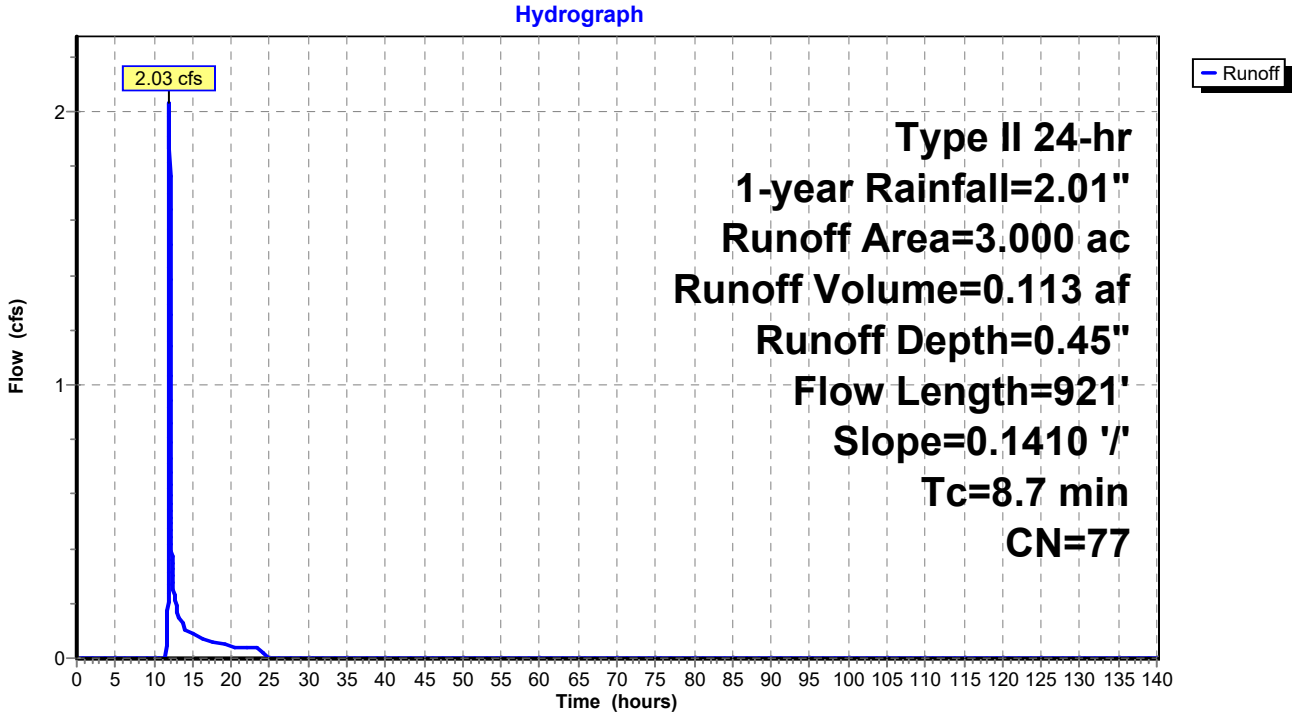
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-140.00 hrs, dt= 0.01 hrs
Type II 24-hr 1-year Rainfall=2.01"

Area (ac)	CN	Description
3.000	77	Woods, Good, HSG D
3.000		100.00% Pervious Area

Pre Development
Peak Flow to SN002
2.03-cfs

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.7	921	0.1410	1.77		**Lag/CN Method, Watershed Lag**

Subcatchment 2S: PRE 2



Summary for Subcatchment POST1a: POST 1a

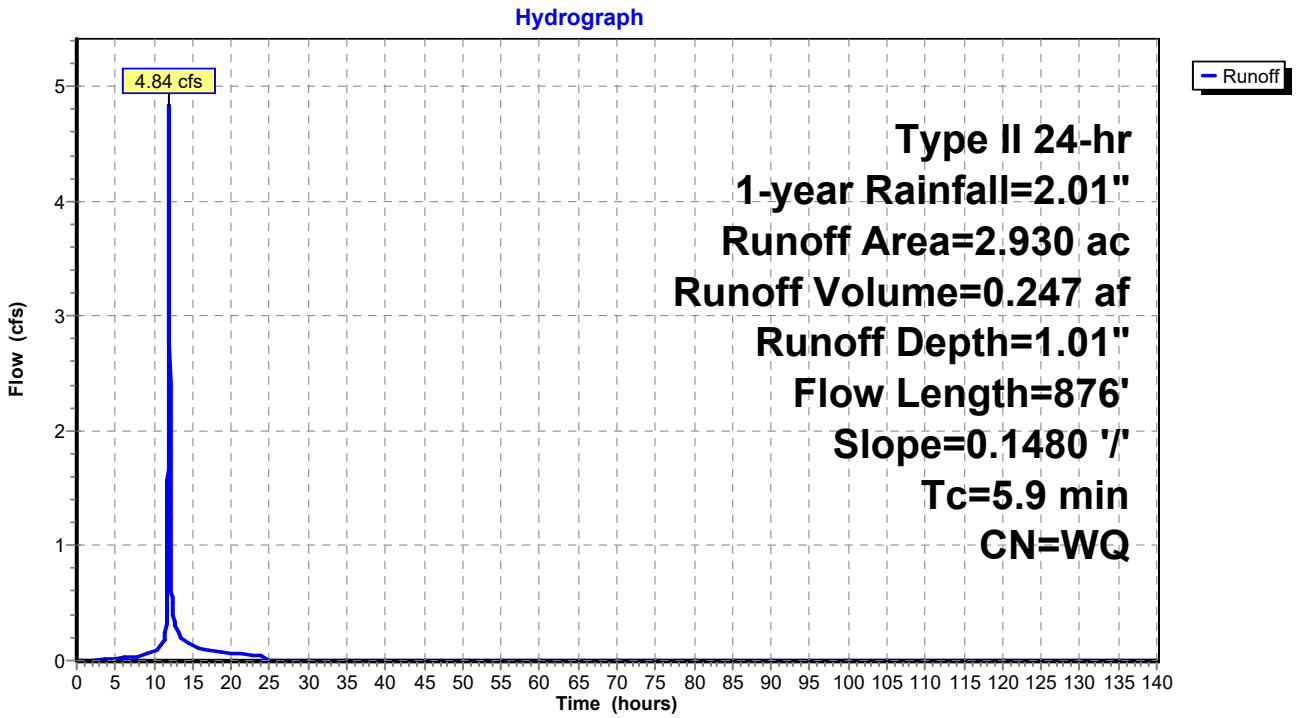
Runoff = 4.84 cfs @ 11.97 hrs, Volume= 0.247 af, Depth= 1.01"
Routed to Pond Tank IN : Tank Inlet

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-140.00 hrs, dt= 0.01 hrs
Type II 24-hr 1-year Rainfall=2.01"

	Area (ac)	CN	Description
*	1.070	98	New Impervious
	1.860	80	>75% Grass cover, Good, HSG D
	2.930		Weighted Average
	1.860		63.48% Pervious Area
	1.070		36.52% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.9	876	0.1480	2.49		**Lag/CN Method, Watershed Lag**

Subcatchment POST1a: POST 1a



Summary for Subcatchment POST1b: POST1b

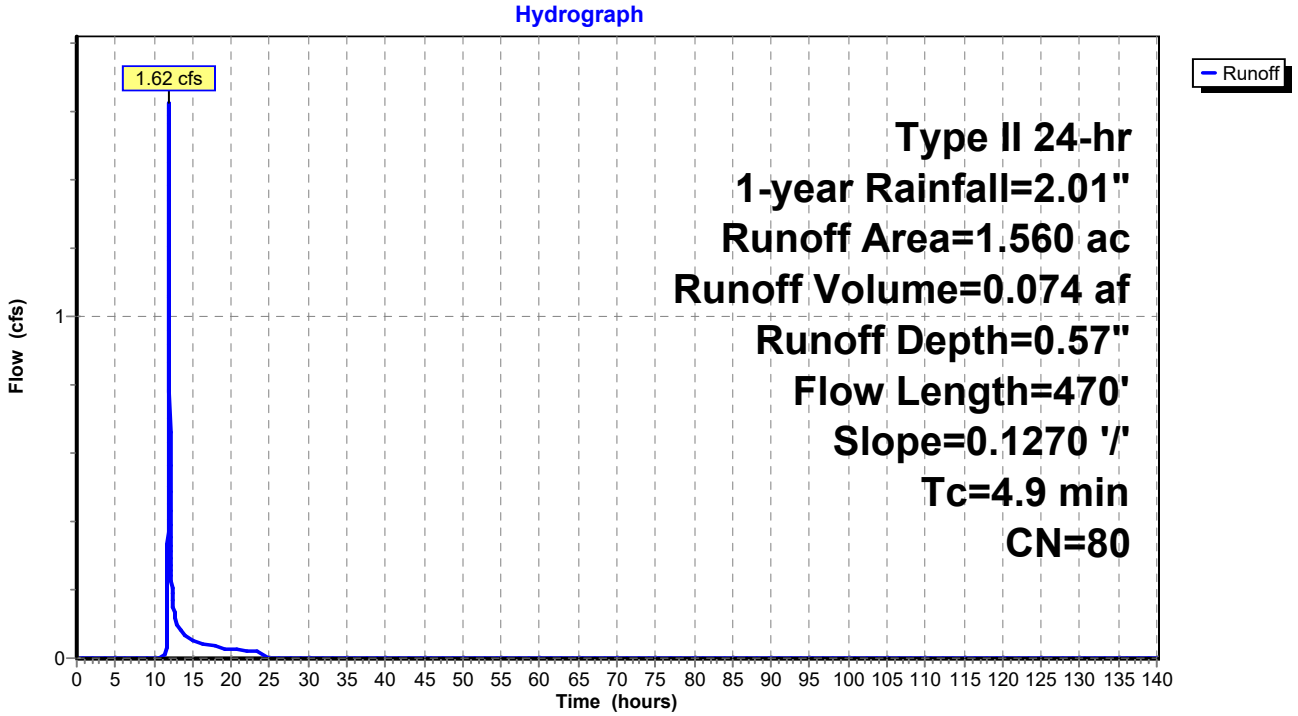
Runoff = 1.62 cfs @ 11.97 hrs, Volume= 0.074 af, Depth= 0.57"
Routed to Reach Swale : Swale

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-140.00 hrs, dt= 0.01 hrs
Type II 24-hr 1-year Rainfall=2.01"

Area (ac)	CN	Description
1.560	80	>75% Grass cover, Good, HSG D
1.560		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	470	0.1270	1.61		**Lag/CN Method, Watershed Lag**

Subcatchment POST1b: POST1b



Summary for Subcatchment POST2a: POST 2a

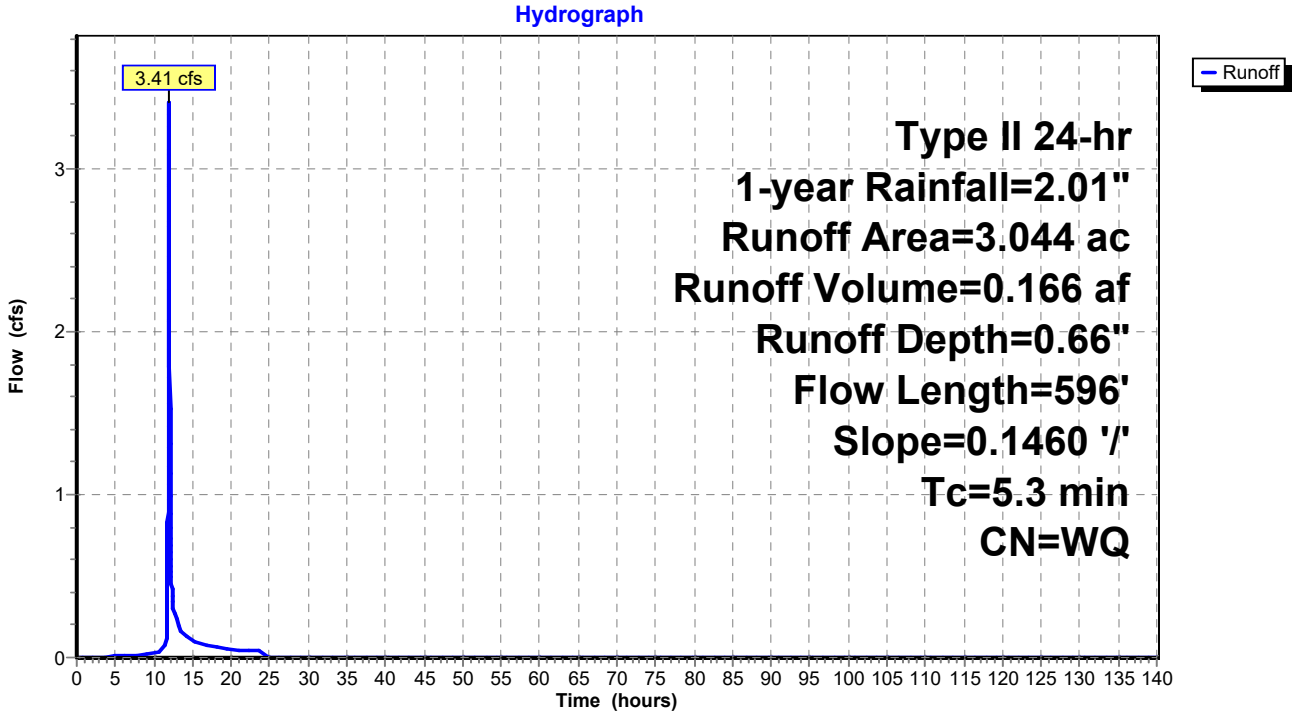
Runoff = 3.41 cfs @ 11.97 hrs, Volume= 0.166 af, Depth= 0.66"
Routed to Reach GWL2 IN : Tank Outlet

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-140.00 hrs, dt= 0.01 hrs
Type II 24-hr 1-year Rainfall=2.01"

	Area (ac)	CN	Description
*	0.014	98	New Impervious Roads & Walks
*	0.350	98	New Impervious Lots
	1.150	80	>75% Grass cover, Good, HSG D
*	1.530	77	Woods, Good, HSG D
	3.044		Weighted Average
	2.680		88.04% Pervious Area
	0.364		11.96% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.3	596	0.1460	1.87		**Lag/CN Method, Watershed Lag**

Subcatchment POST2a: POST 2a



Summary for Subcatchment POST2b: POST 2b

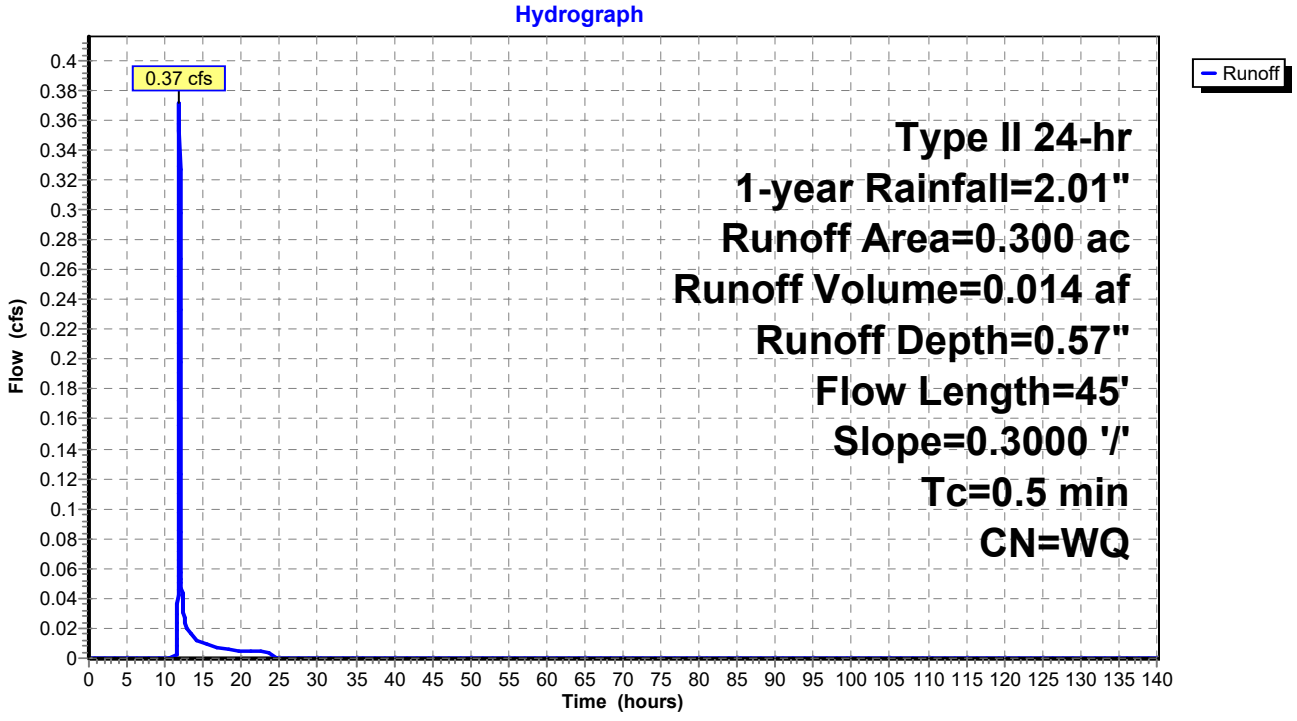
Runoff = 0.37 cfs @ 11.91 hrs, Volume= 0.014 af, Depth= 0.57"
Routed to Link S : SN002

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-140.00 hrs, dt= 0.01 hrs
Type II 24-hr 1-year Rainfall=2.01"

	Area (ac)	CN	Description
	0.300	80	>75% Grass cover, Good, HSG D
*	0.000	98	Impervious
	0.300		Weighted Average
	0.300		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	45	0.3000	1.55		**Lag/CN Method,**

Subcatchment POST2b: POST 2b



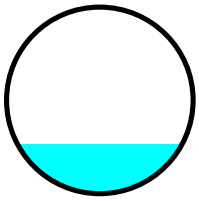
Summary for Reach GWL2 IN: Tank Outlet

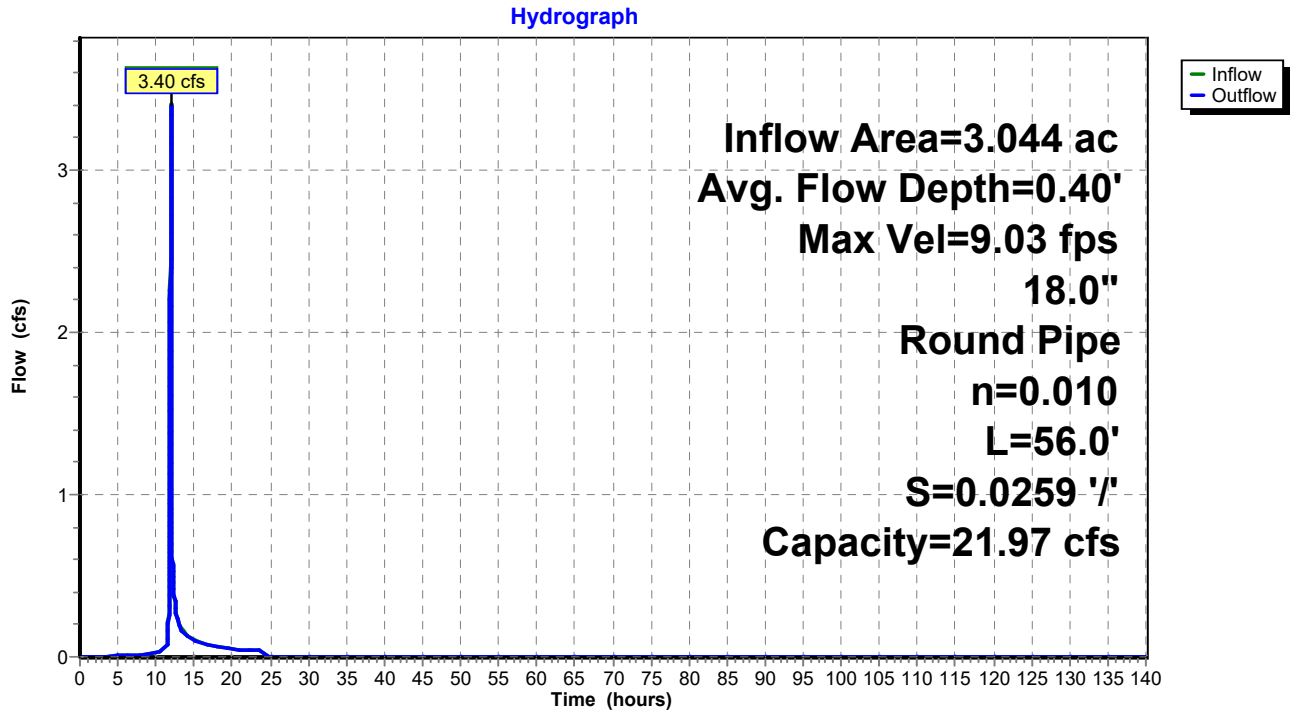
Inflow Area = 3.044 ac, 11.96% Impervious, Inflow Depth = 0.66" for 1-year event
Inflow = 3.41 cfs @ 11.97 hrs, Volume= 0.166 af
Outflow = 3.40 cfs @ 11.97 hrs, Volume= 0.166 af, Atten= 0%, Lag= 0.2 min
Routed to Pond GWL2 : Gravel Wetland #2

Routing by Stor-Ind+Trans method, Time Span= 0.00-140.00 hrs, dt= 0.01 hrs
Max. Velocity= 9.03 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 2.46 fps, Avg. Travel Time= 0.4 min

Peak Storage= 21 cf @ 11.97 hrs
Average Depth at Peak Storage= 0.40' , Surface Width= 1.33'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 21.97 cfs

18.0" Round Pipe
n= 0.010 PVC, smooth interior
Length= 56.0' Slope= 0.0259 '/'
Inlet Invert= 398.45', Outlet Invert= 397.00'





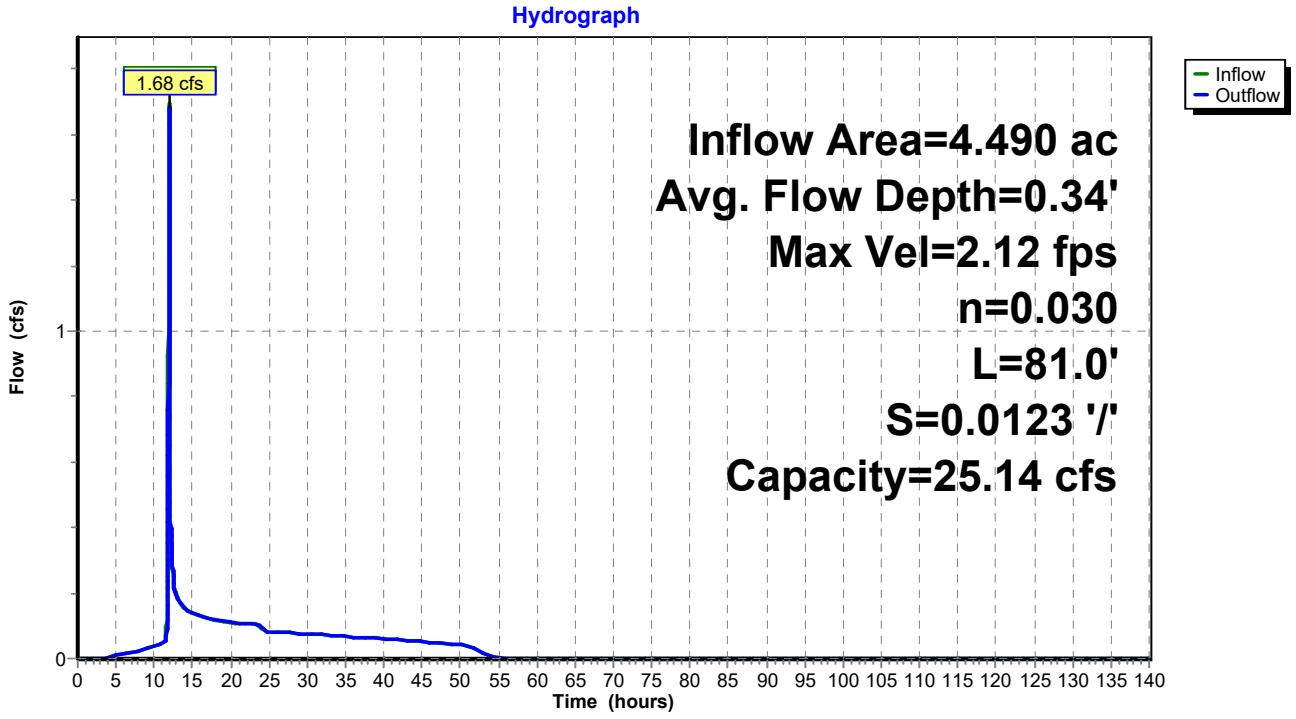
Summary for Reach Swale: Swale

Inflow Area = 4.490 ac, 23.83% Impervious, Inflow Depth = 0.86" for 1-year event
Inflow = 1.69 cfs @ 11.97 hrs, Volume= 0.321 af
Outflow = 1.68 cfs @ 11.99 hrs, Volume= 0.321 af, Atten= 1%, Lag= 1.1 min
Routed to Link N : SN001

Routing by Stor-Ind+Trans method, Time Span= 0.00-140.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.12 fps, Min. Travel Time= 0.6 min
Avg. Velocity = 0.61 fps, Avg. Travel Time= 2.2 min

Peak Storage= 64 cf @ 11.98 hrs
Average Depth at Peak Storage= 0.34' , Surface Width= 3.19'
Bank-Full Depth= 1.25' Flow Area= 5.8 sf, Capacity= 25.14 cfs

1.50' x 1.25' deep channel, n= 0.030
Side Slope Z-value= 2.5 '/' Top Width= 7.75'
Length= 81.0' Slope= 0.0123 '/'
Inlet Invert= 367.00', Outlet Invert= 366.00'



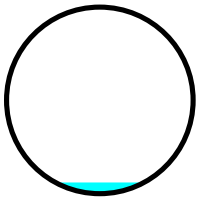
Summary for Reach Tank Out: Tank Outlet

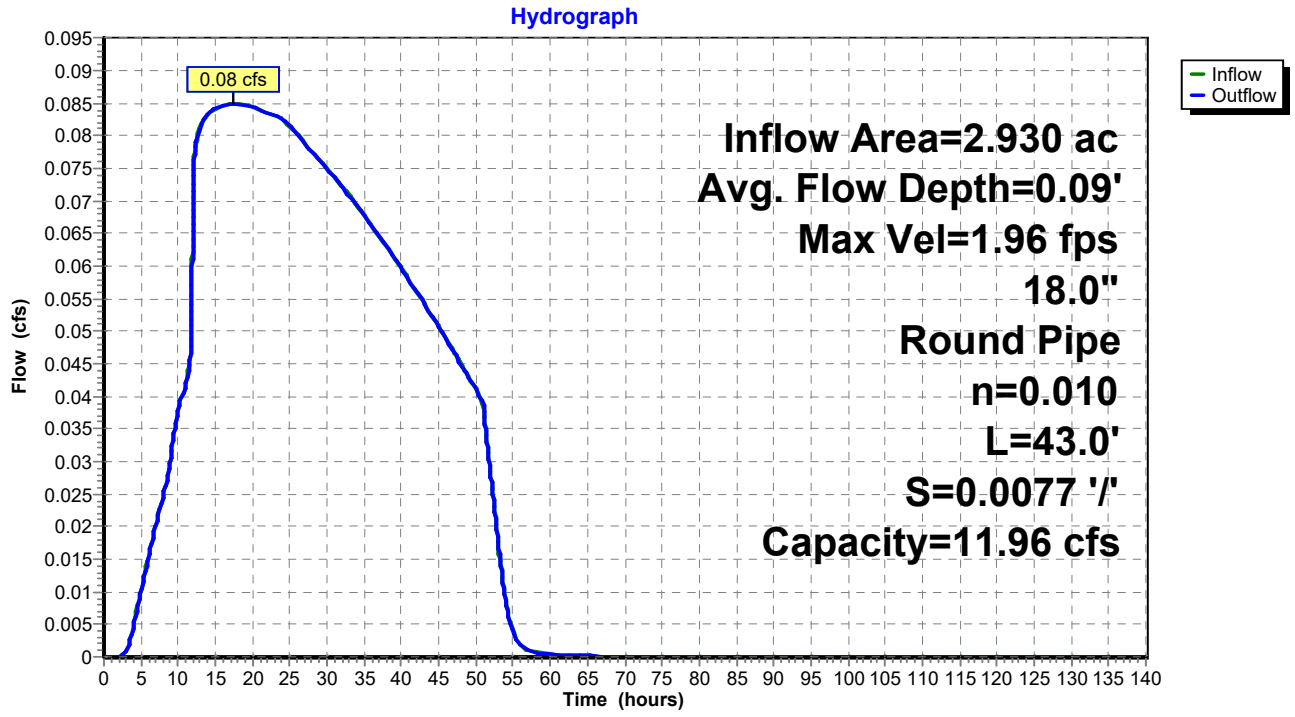
Inflow Area = 2.930 ac, 36.52% Impervious, Inflow Depth = 1.01" for 1-year event
Inflow = 0.08 cfs @ 17.41 hrs, Volume= 0.247 af
Outflow = 0.08 cfs @ 17.42 hrs, Volume= 0.247 af, Atten= 0%, Lag= 0.6 min
Routed to Reach Swale : Swale

Routing by Stor-Ind+Trans method, Time Span= 0.00-140.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.96 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 1.45 fps, Avg. Travel Time= 0.5 min

Peak Storage= 2 cf @ 17.41 hrs
Average Depth at Peak Storage= 0.09' , Surface Width= 0.71'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 11.96 cfs

18.0" Round Pipe
n= 0.010 PVC, smooth interior
Length= 43.0' Slope= 0.0077 '/'
Inlet Invert= 367.33', Outlet Invert= 367.00'





Summary for Pond GWL1: Gravel Wetland #1

Inflow Area = 2.930 ac, 36.52% Impervious, Inflow Depth = 1.01" for 1-year event
Inflow = 4.84 cfs @ 11.97 hrs, Volume= 0.247 af
Outflow = 0.08 cfs @ 17.41 hrs, Volume= 0.247 af, Atten= 98%, Lag= 326.0 min
Primary = 0.08 cfs @ 17.41 hrs, Volume= 0.247 af
Routed to Reach Tank Out : Tank Outlet
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Link S : SN002

Routing by Stor-Ind method, Time Span= 0.00-140.00 hrs, dt= 0.01 hrs / 2
Starting Elev= 368.50' Surf.Area= 6,106 sf Storage= 3,053 cf
Peak Elev= 370.63' @ 17.41 hrs Surf.Area= 11,228 sf Storage= 9,987 cf (6,934 cf above start)
Flood Elev= 372.00' Surf.Area= 12,451 sf Storage= 17,859 cf (14,806 cf above start)

Plug-Flow detention time= 1,353.3 min calculated for 0.177 af (72% of inflow)
Center-of-Mass det. time= 908.3 min (1,708.8 - 800.4)

Volume	Invert	Avail.Storage	Storage Description
#1	365.00'	2,748 cf	**Gravel Storage (Prismatic)** Listed below (Recalc)
#2	368.00'	611 cf	**Media Storage (Prismatic)** Listed below (Recalc)
#3	369.00'	17,792 cf	**Ponding Storage (Prismatic)** Listed below (Recalc)
		21,150 cf	Total Available Storage

detention time > 720-minute minimum

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
365.00	3,053	0.0	0	0
368.00	3,053	30.0	2,748	2,748

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
368.00	3,053	0.0	0	0
368.50	3,053	20.0	305	305
369.00	3,053	20.0	305	611

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
369.00	3,053	0.0	0	0
370.00	4,173	100.0	3,613	3,613
370.10	4,676	100.0	442	4,055
371.00	5,441	100.0	4,553	8,608
372.00	6,345	100.0	5,893	14,501
372.50	6,818	100.0	3,291	17,792

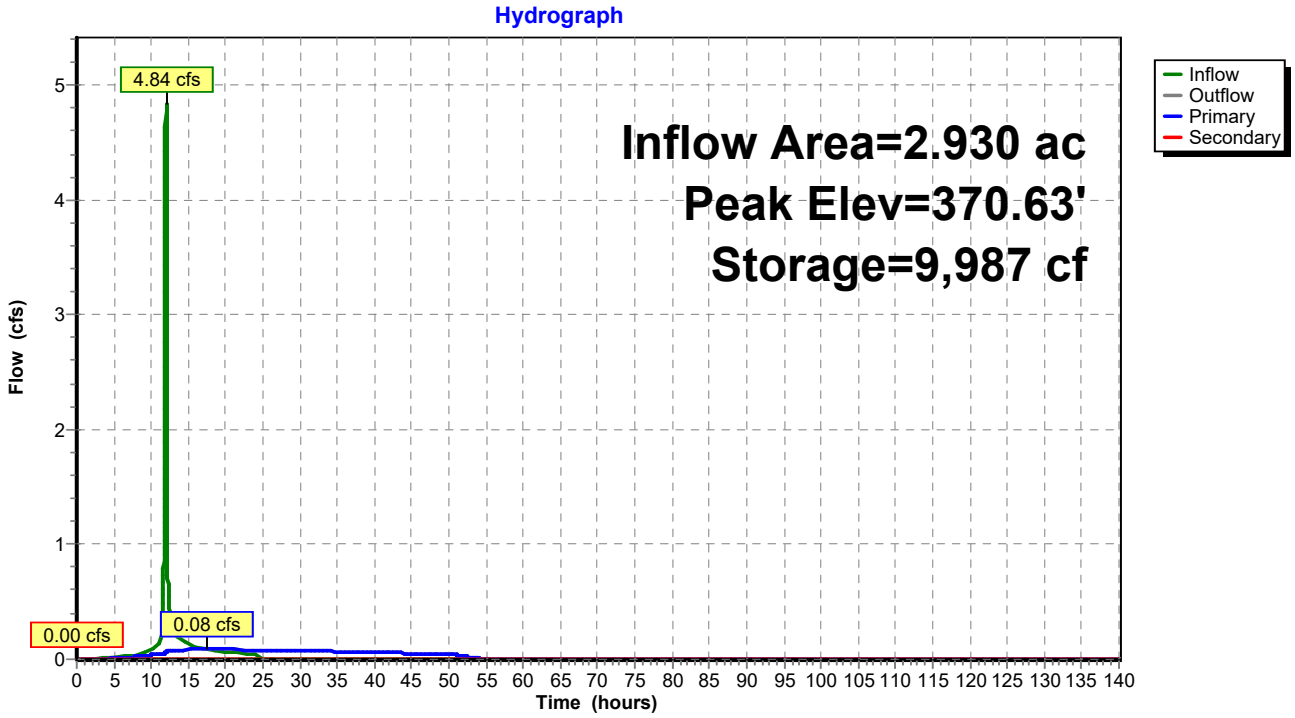
Device	Routing	Invert	Outlet Devices
#1	Primary	368.20'	**12.0" Round Culvert** L= 12.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 368.20' / 368.00' S= 0.0167 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf
#2	Device 1	368.50'	**1.5" Vert. Permanent Pool Orifice/Grate** C= 0.600

			Limited to weir flow at low heads
#3	Device 1	370.83'	**10.3" Horiz. 12" Orifice/Grate** C= 0.600
			Limited to weir flow at low heads
#4	Secondary	371.50'	**20.0' long + 3.0 '/' SideZ x 3.0' breadth Spillway**
			Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50
			Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=0.08 cfs @ 17.41 hrs HW=370.63' (Free Discharge)
└**1=Culvert** (Passes 0.08 cfs of 4.14 cfs potential flow)
  ├**2=Permanent Pool Orifice/Grate** (Orifice Controls 0.08 cfs @ 6.92 fps)
  └**3=12" Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=368.50' (Free Discharge)
└**4=Spillway** (Controls 0.00 cfs)

Pond GWL1: Gravel Wetland #1



Summary for Pond GWL2: Gravel Wetland #2

Inflow Area = 3.044 ac, 11.96% Impervious, Inflow Depth = 0.66" for 1-year event
Inflow = 3.40 cfs @ 11.97 hrs, Volume= 0.166 af
Outflow = 0.04 cfs @ 24.05 hrs, Volume= 0.166 af, Atten= 99%, Lag= 724.7 min
Primary = 0.04 cfs @ 24.05 hrs, Volume= 0.166 af
Routed to Link S : SN002

Routing by Stor-Ind method, Time Span= 0.00-140.00 hrs, dt= 0.01 hrs / 2
Starting Elev= 396.50' Surf.Area= 8,520 sf Storage= 4,896 cf
Peak Elev= 398.33' @ 24.05 hrs Surf.Area= 12,926 sf Storage= 10,459 cf (5,563 cf above start)
Flood Elev= 400.00' Surf.Area= 14,200 sf Storage= 18,882 cf (13,986 cf above start)

Plug-Flow detention time= 3,365.5 min calculated for 0.054 af (32% of inflow)
Center-of-Mass det. time= 1,719.4 min (2,557.4 - 838.0)

Volume	Invert	Avail.Storage	Storage Description
#1	393.00'	4,550 cf	**Gravel Storage (Prismatic)** Listed below (Recalc)
#2	396.00'	693 cf	**Media Storage (Prismatic)** Listed below (Recalc)
#3	397.00'	16,581 cf	**Ponding Storage (Prismatic)** Listed below (Recalc)
		21,823 cf	Total Available Storage

detention time > 1,440-minute minimum

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
393.00	5,055	0.0	0	0
396.00	5,055	30.0	4,550	4,550

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
396.00	3,465	0.0	0	0
396.50	3,465	20.0	347	347
397.00	3,465	20.0	347	693

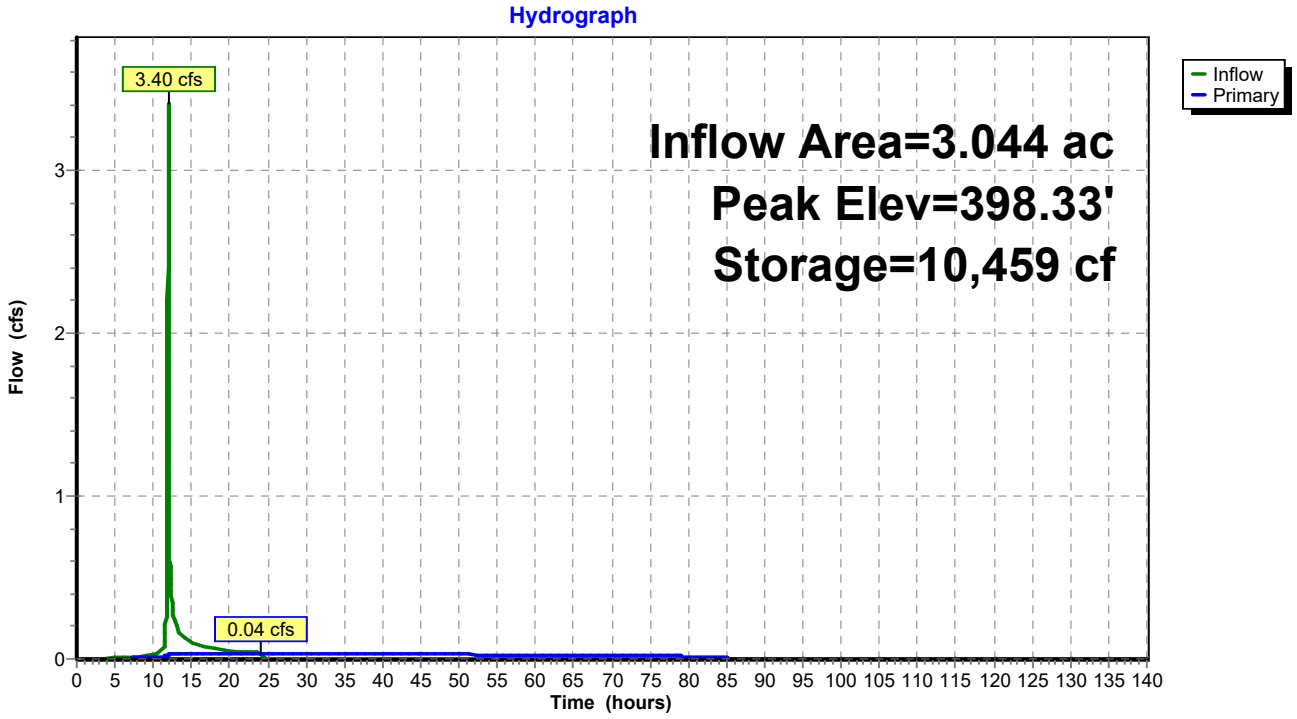
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
397.00	3,465	0	0
398.00	4,164	3,815	3,815
399.00	4,903	4,534	8,348
400.00	5,680	5,292	13,640
400.50	6,084	2,941	16,581

Device	Routing	Invert	Outlet Devices
#1	Primary	394.50'	**24.0" Round Culvert** L= 45.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 394.50' / 384.00' S= 0.2333 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 3.14 sf
#2	Device 1	396.50'	**1.0" Vert. Permanent Pool Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	398.50'	**12.5" Horiz. 15" Orifice/Grate X 2.00** C= 0.600 Limited to weir flow at low heads

#4	Primary	399.50'	**30.0' long + 3.0 '/' SideZ x 3.0' breadth Spillway** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=0.04 cfs @ 24.05 hrs HW=398.33' (Free Discharge)
- **1=Culvert** (Passes 0.04 cfs of 20.08 cfs potential flow)
  - **2=Permanent Pool Orifice/Grate** (Orifice Controls 0.04 cfs @ 6.43 fps)
  - **3=15" Orifice/Grate** (Controls 0.00 cfs)
- **4=Spillway** (Controls 0.00 cfs)

Pond GWL2: Gravel Wetland #2



Summary for Pond Tank IN: Tank Inlet

Inflow Area = 2.930 ac, 36.52% Impervious, Inflow Depth = 1.01" for 1-year event
Inflow = 4.84 cfs @ 11.97 hrs, Volume= 0.247 af
Outflow = 4.84 cfs @ 11.97 hrs, Volume= 0.247 af, Atten= 0%, Lag= 0.0 min
Primary = 4.84 cfs @ 11.97 hrs, Volume= 0.247 af
Routed to Pond GWL1 : Gravel Wetland #1
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Reach Tank Out : Tank Outlet

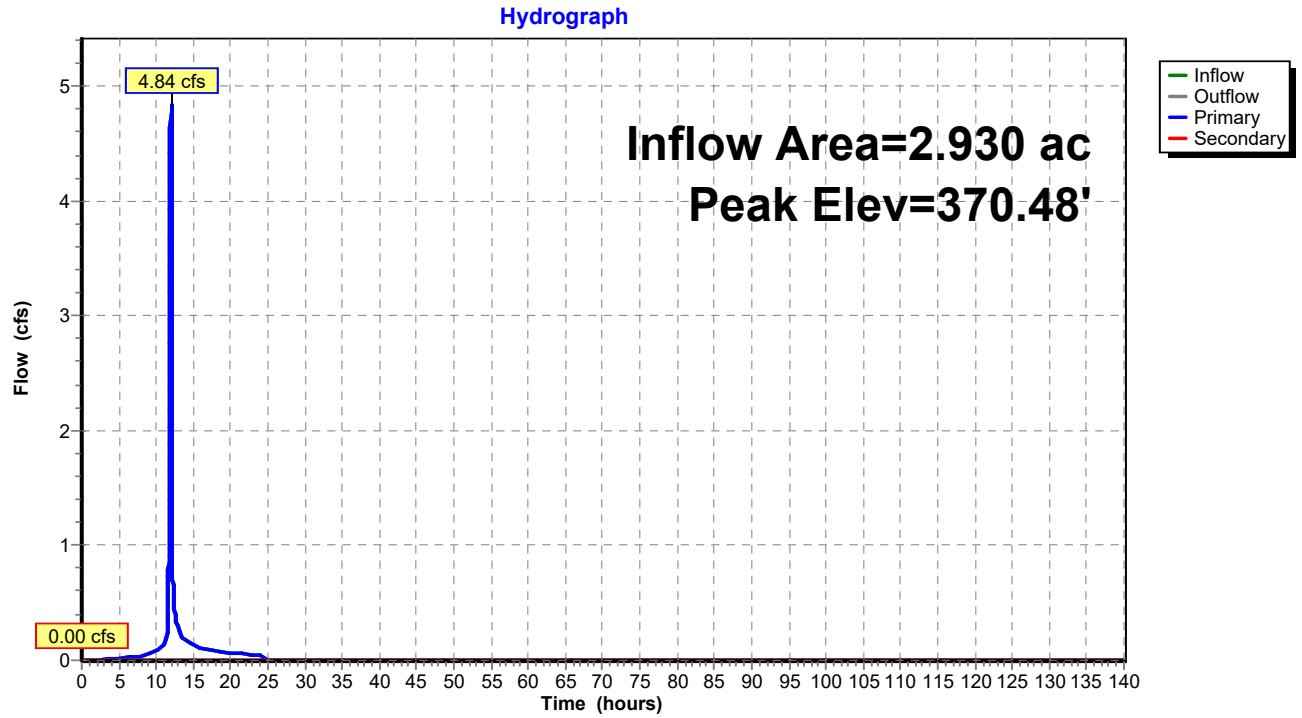
Routing by Stor-Ind method, Time Span= 0.00-140.00 hrs, dt= 0.01 hrs
Peak Elev= 370.48' @ 11.97 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	369.10'	**18.0" Round 18" Culvert to GWL** L= 20.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 369.10' / 369.00' S= 0.0050 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 1.77 sf
#2	Secondary	370.58'	**7.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=4.83 cfs @ 11.97 hrs HW=370.48' (Free Discharge)
└**1=18" Culvert to GWL** (Barrel Controls 4.83 cfs @ 3.72 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=369.10' (Free Discharge)
└**2=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond Tank IN: Tank Inlet



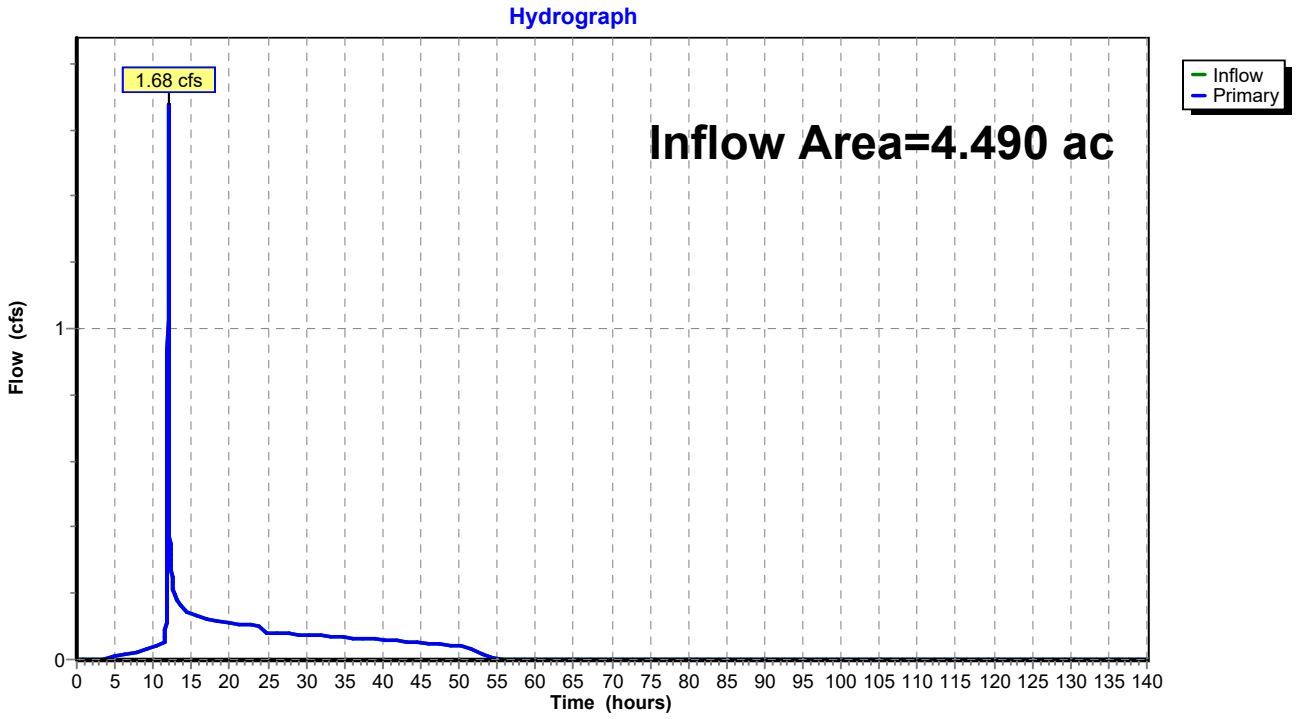
Summary for Link N: SN001

Inflow Area = 4.490 ac, 23.83% Impervious, Inflow Depth = 0.86" for 1-year event
Inflow = 1.68 cfs @ 11.99 hrs, Volume= 0.321 af
Primary = 1.68 cfs @ 11.99 hrs, Volume= 0.321 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-140.00 hrs, dt= 0.01 hrs

Post Development Peak Flow to SN001 1.68-cfs

Link N: SN001



Summary for Link S: SN002

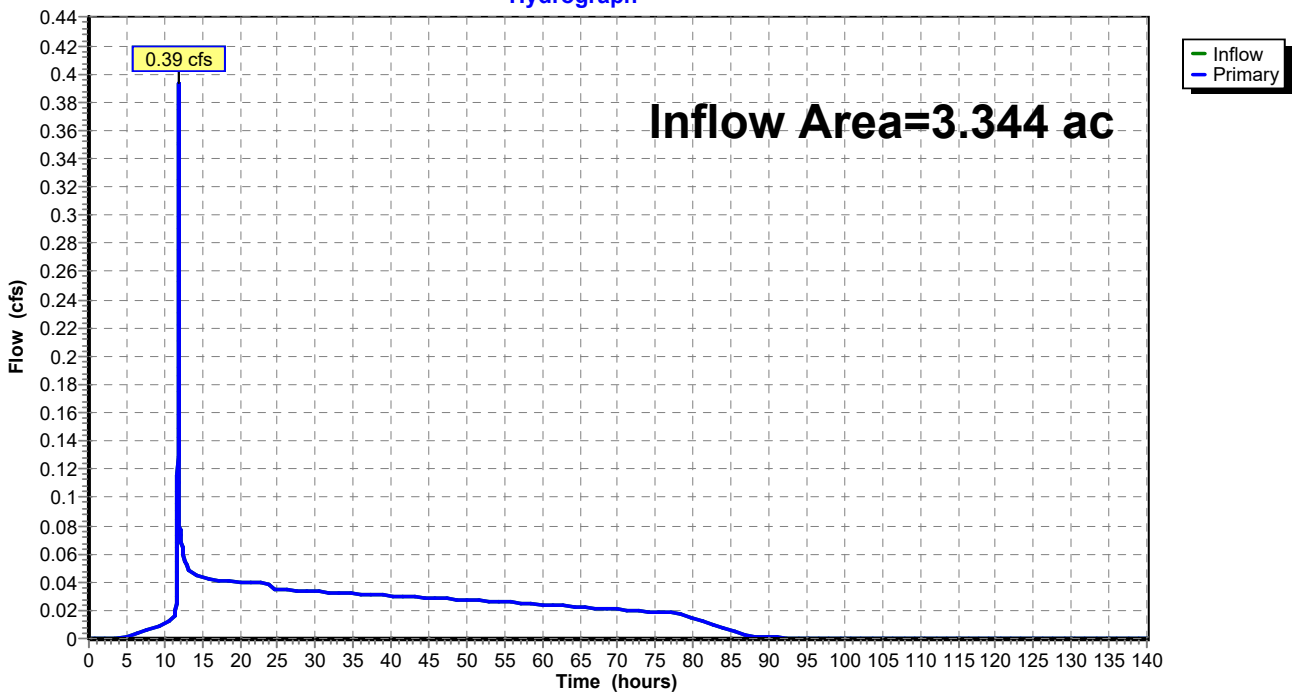
Inflow Area = 3.344 ac, 10.89% Impervious, Inflow Depth = 0.65" for 1-year event
Inflow = 0.39 cfs @ 11.91 hrs, Volume= 0.181 af
Primary = 0.39 cfs @ 11.91 hrs, Volume= 0.181 af, Atten= 0%, Lag= 0.0 min

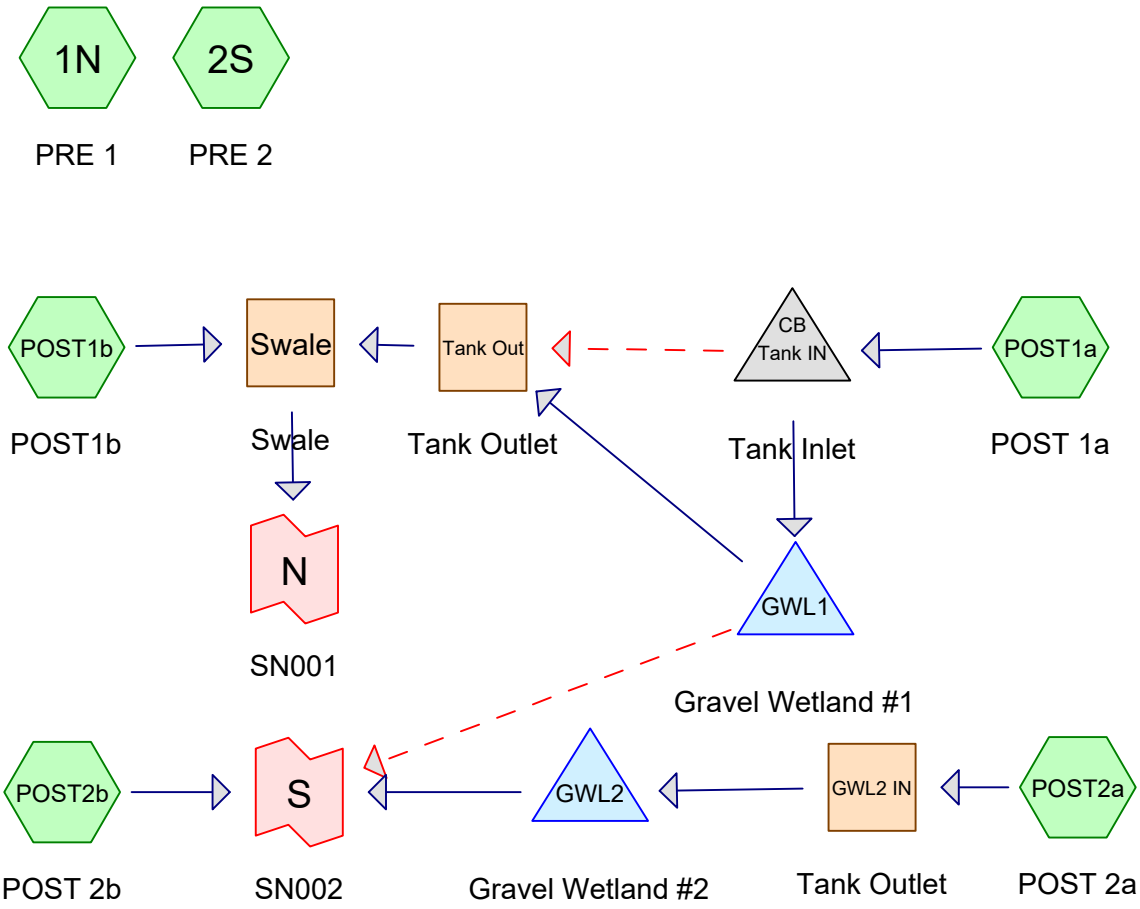
Primary outflow = Inflow, Time Span= 0.00-140.00 hrs, dt= 0.01 hrs

Post Development Peak Flow to SN002 0.39-cfs

Link S: SN002

Hydrograph





Subcat Reach Pond Link

Routing Diagram for 20542 Laster 8-Lot Subdivision
Prepared by Engineering Ventures, Inc, Printed 4/13/2023

Summary for Subcatchment 1N: PRE 1

Runoff = 10.63 cfs @ 12.02 hrs, Volume= 0.564 af, Depth= 1.40"
Routed to nonexistent node 2L

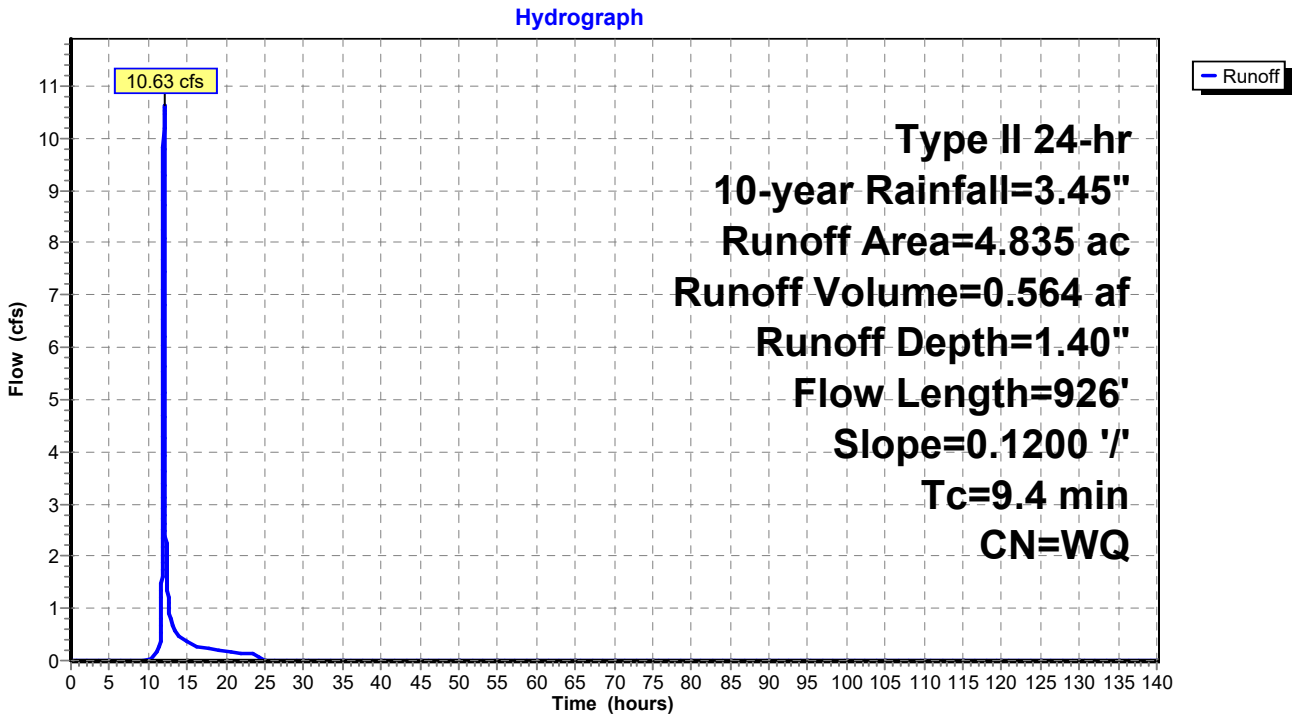
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-140.00 hrs, dt= 0.01 hrs
Type II 24-hr 10-year Rainfall=3.45"

	Area (ac)	CN	Description
	4.820	77	Woods, Good, HSG D
*	0.015	98	Existing Impervious
	4.835		Weighted Average
	4.820		99.69% Pervious Area
	0.015		0.31% Impervious Area

Pre Development
Peak Flow to SN001
10.63-cfs

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.4	926	0.1200	1.63		**Lag/CN Method, Watershed Lag**

Subcatchment 1N: PRE 1



Summary for Subcatchment 2S: PRE 2

Runoff = 6.75 cfs @ 12.01 hrs, Volume= 0.348 af, Depth= 1.39"
Routed to nonexistent node 3L

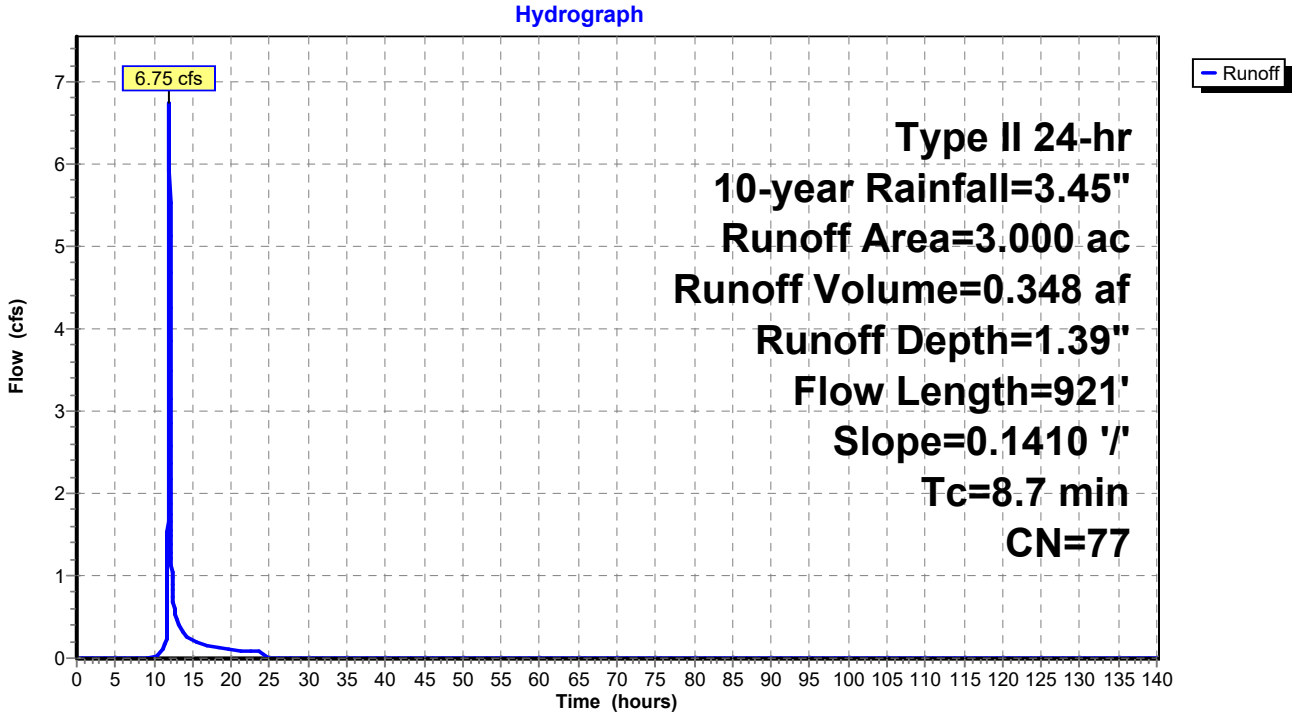
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-140.00 hrs, dt= 0.01 hrs
Type II 24-hr 10-year Rainfall=3.45"

Area (ac)	CN	Description
3.000	77	Woods, Good, HSG D
3.000		100.00% Pervious Area

Pre Development
Peak Flow to SN002
6.75-cfs

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.7	921	0.1410	1.77		**Lag/CN Method, Watershed Lag**

Subcatchment 2S: PRE 2



Summary for Subcatchment POST1a: POST 1a

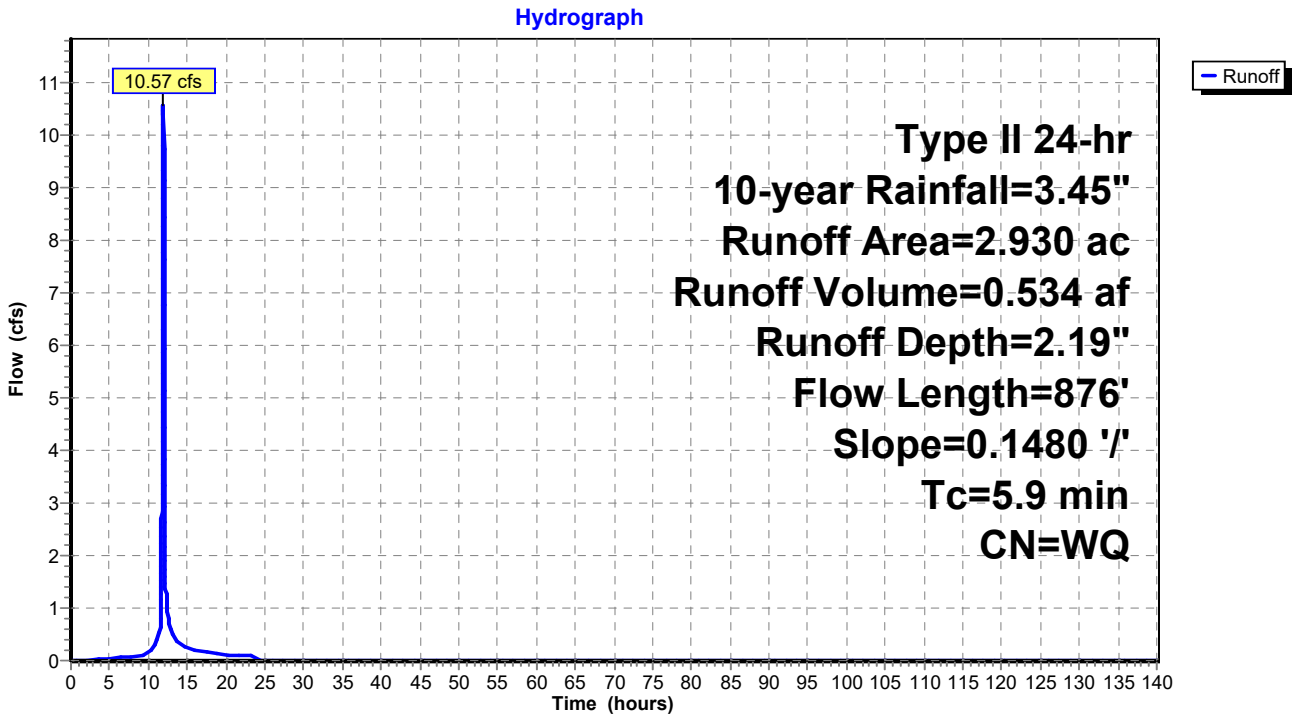
Runoff = 10.57 cfs @ 11.97 hrs, Volume= 0.534 af, Depth= 2.19"
Routed to Pond Tank IN : Tank Inlet

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-140.00 hrs, dt= 0.01 hrs
Type II 24-hr 10-year Rainfall=3.45"

	Area (ac)	CN	Description
*	1.070	98	New Impervious
	1.860	80	>75% Grass cover, Good, HSG D
	2.930		Weighted Average
	1.860		63.48% Pervious Area
	1.070		36.52% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.9	876	0.1480	2.49		**Lag/CN Method, Watershed Lag**

Subcatchment POST1a: POST 1a



Summary for Subcatchment POST1b: POST1b

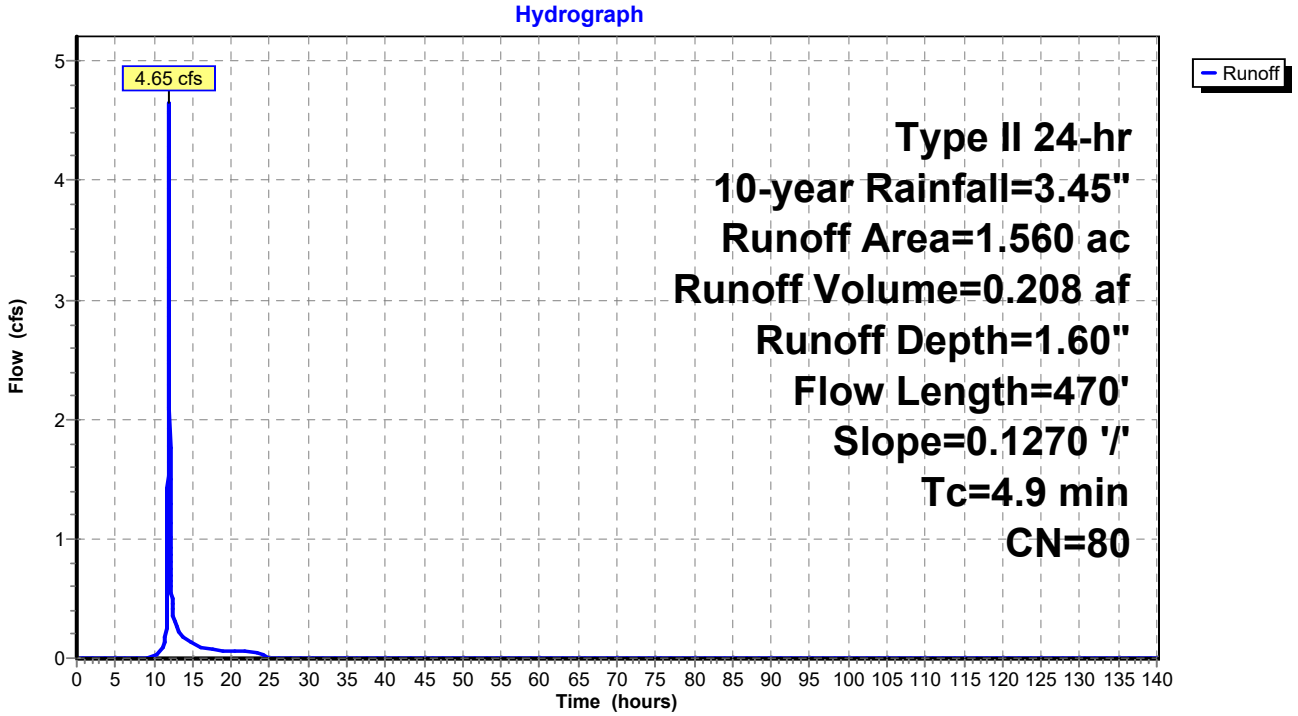
Runoff = 4.65 cfs @ 11.96 hrs, Volume= 0.208 af, Depth= 1.60"
Routed to Reach Swale : Swale

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-140.00 hrs, dt= 0.01 hrs
Type II 24-hr 10-year Rainfall=3.45"

Area (ac)	CN	Description
1.560	80	>75% Grass cover, Good, HSG D
1.560		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	470	0.1270	1.61		**Lag/CN Method, Watershed Lag**

Subcatchment POST1b: POST1b



Summary for Subcatchment POST2a: POST 2a

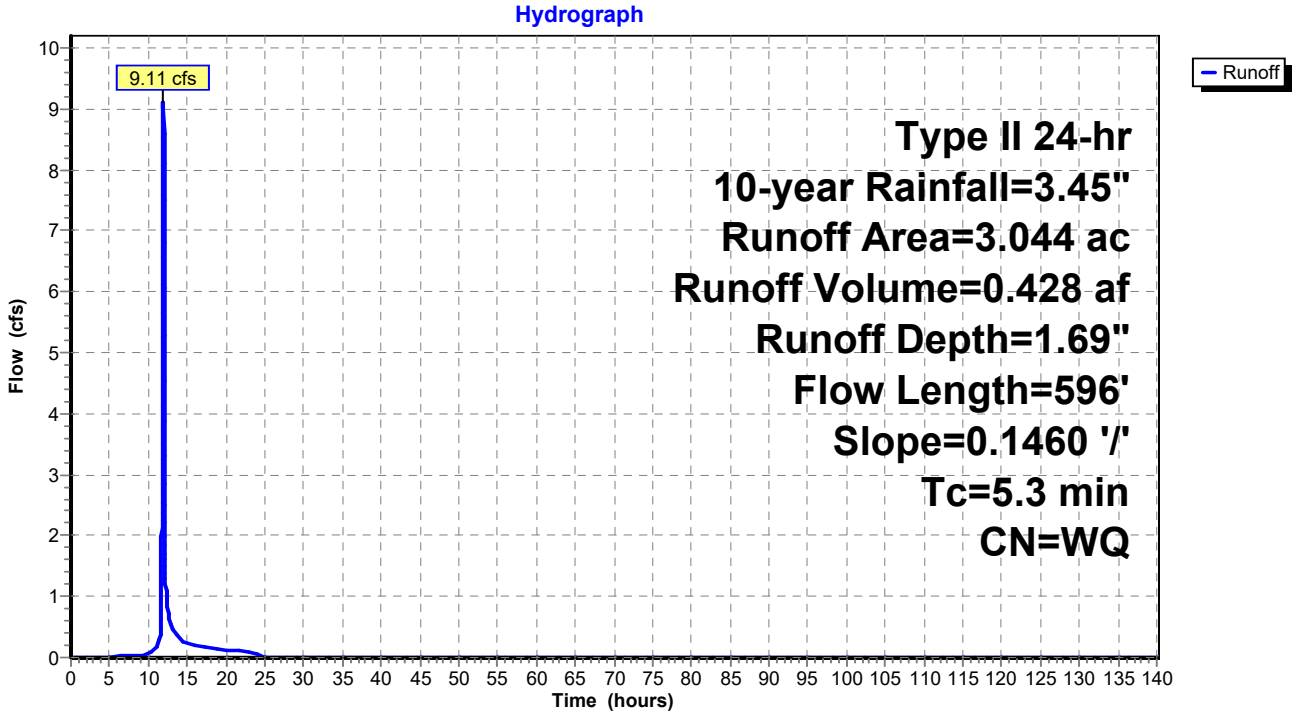
Runoff = 9.11 cfs @ 11.97 hrs, Volume= 0.428 af, Depth= 1.69"
Routed to Reach GWL2 IN : Tank Outlet

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-140.00 hrs, dt= 0.01 hrs
Type II 24-hr 10-year Rainfall=3.45"

	Area (ac)	CN	Description
*	0.014	98	New Impervious Roads & Walks
*	0.350	98	New Impervious Lots
	1.150	80	>75% Grass cover, Good, HSG D
*	1.530	77	Woods, Good, HSG D
	3.044		Weighted Average
	2.680		88.04% Pervious Area
	0.364		11.96% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.3	596	0.1460	1.87		**Lag/CN Method, Watershed Lag**

Subcatchment POST2a: POST 2a



Summary for Subcatchment POST2b: POST 2b

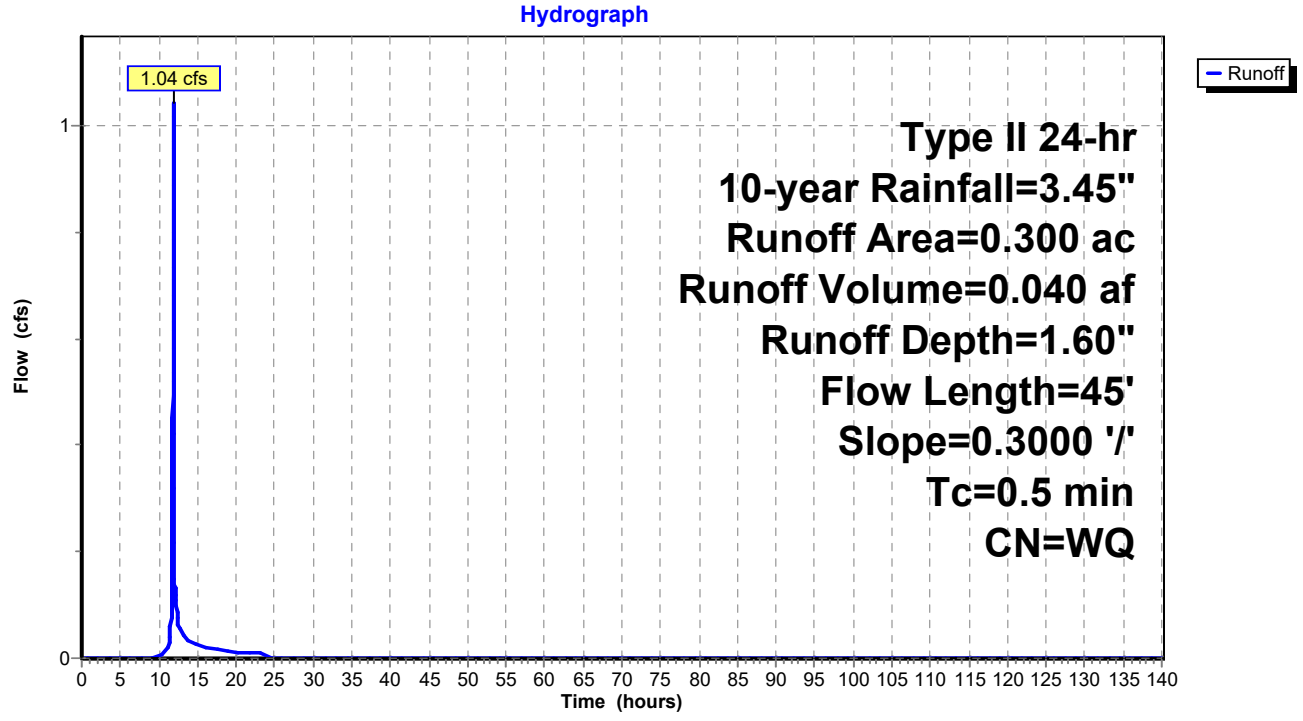
Runoff = 1.04 cfs @ 11.91 hrs, Volume= 0.040 af, Depth= 1.60"
Routed to Link S : SN002

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-140.00 hrs, dt= 0.01 hrs
Type II 24-hr 10-year Rainfall=3.45"

	Area (ac)	CN	Description
	0.300	80	>75% Grass cover, Good, HSG D
*	0.000	98	Impervious
	0.300		Weighted Average
	0.300		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	45	0.3000	1.55		**Lag/CN Method,**

Subcatchment POST2b: POST 2b



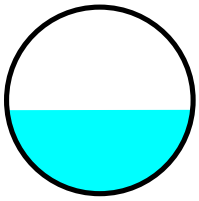
Summary for Reach GWL2 IN: Tank Outlet

Inflow Area = 3.044 ac, 11.96% Impervious, Inflow Depth = 1.69" for 10-year event
Inflow = 9.11 cfs @ 11.97 hrs, Volume= 0.428 af
Outflow = 9.10 cfs @ 11.97 hrs, Volume= 0.428 af, Atten= 0%, Lag= 0.1 min
Routed to Pond GWL2 : Gravel Wetland #2

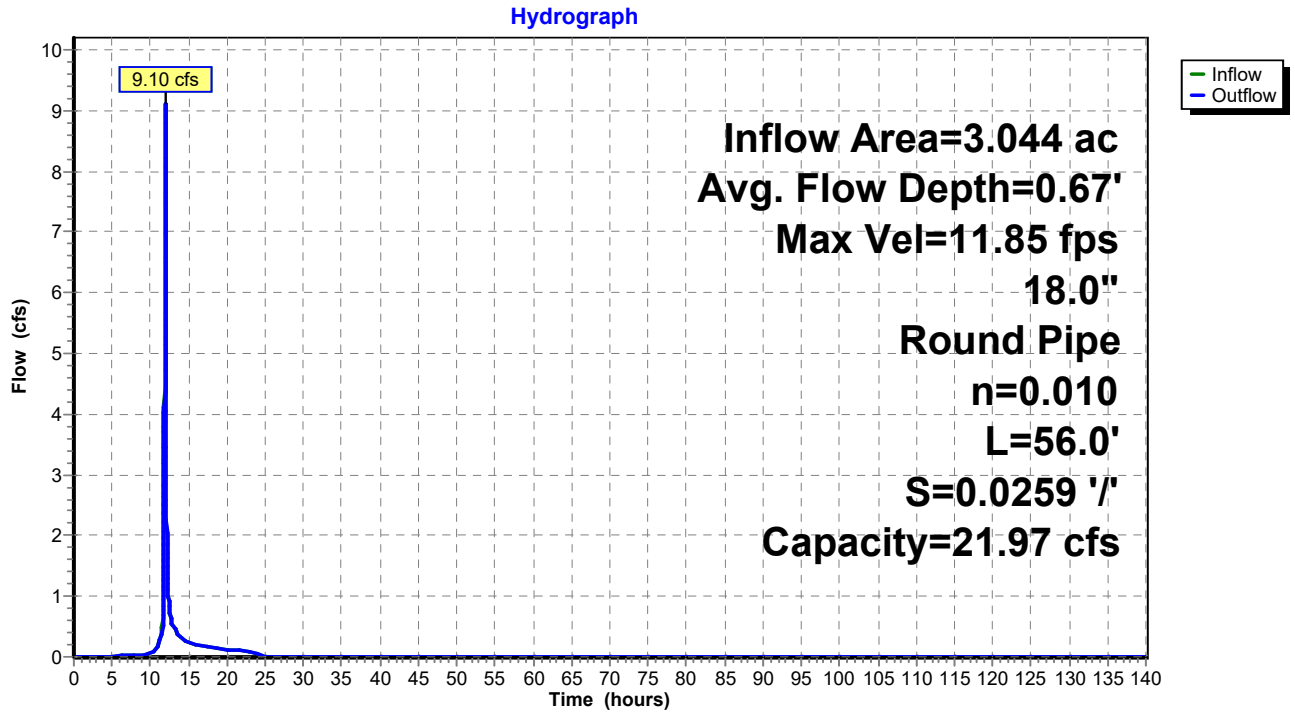
Routing by Stor-Ind+Trans method, Time Span= 0.00-140.00 hrs, dt= 0.01 hrs
Max. Velocity= 11.85 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 3.11 fps, Avg. Travel Time= 0.3 min

Peak Storage= 43 cf @ 11.97 hrs
Average Depth at Peak Storage= 0.67' , Surface Width= 1.49'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 21.97 cfs

18.0" Round Pipe
n= 0.010 PVC, smooth interior
Length= 56.0' Slope= 0.0259 '/'
Inlet Invert= 398.45', Outlet Invert= 397.00'



Reach GWL2 IN: Tank Outlet



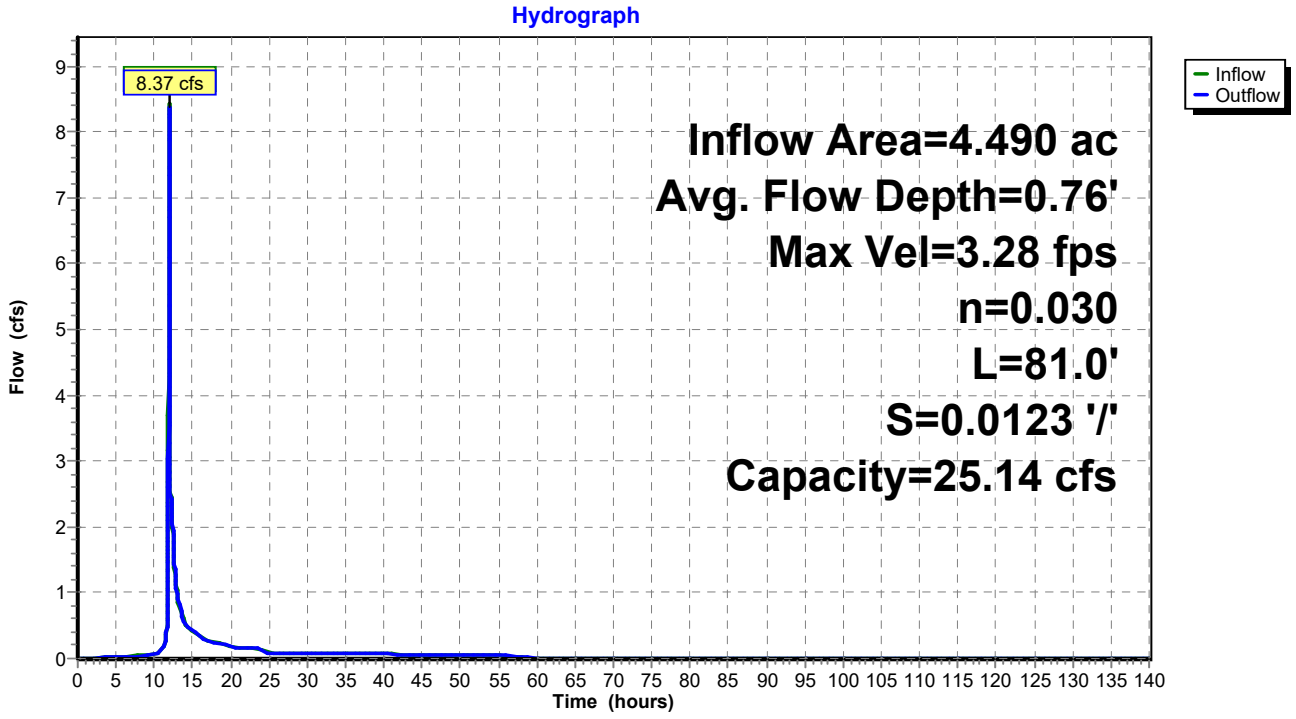
Summary for Reach Swale: Swale

Inflow Area = 4.490 ac, 23.83% Impervious, Inflow Depth = 1.98" for 10-year event
Inflow = 8.43 cfs @ 11.97 hrs, Volume= 0.742 af
Outflow = 8.37 cfs @ 11.98 hrs, Volume= 0.742 af, Atten= 1%, Lag= 0.7 min
Routed to Link N : SN001

Routing by Stor-Ind+Trans method, Time Span= 0.00-140.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.28 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 0.70 fps, Avg. Travel Time= 1.9 min

Peak Storage= 207 cf @ 11.97 hrs
Average Depth at Peak Storage= 0.76' , Surface Width= 5.28'
Bank-Full Depth= 1.25' Flow Area= 5.8 sf, Capacity= 25.14 cfs

1.50' x 1.25' deep channel, n= 0.030
Side Slope Z-value= 2.5 '/' Top Width= 7.75'
Length= 81.0' Slope= 0.0123 '/'
Inlet Invert= 367.00', Outlet Invert= 366.00'



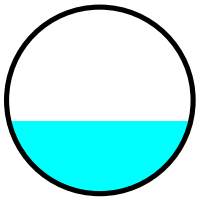
Summary for Reach Tank Out: Tank Outlet

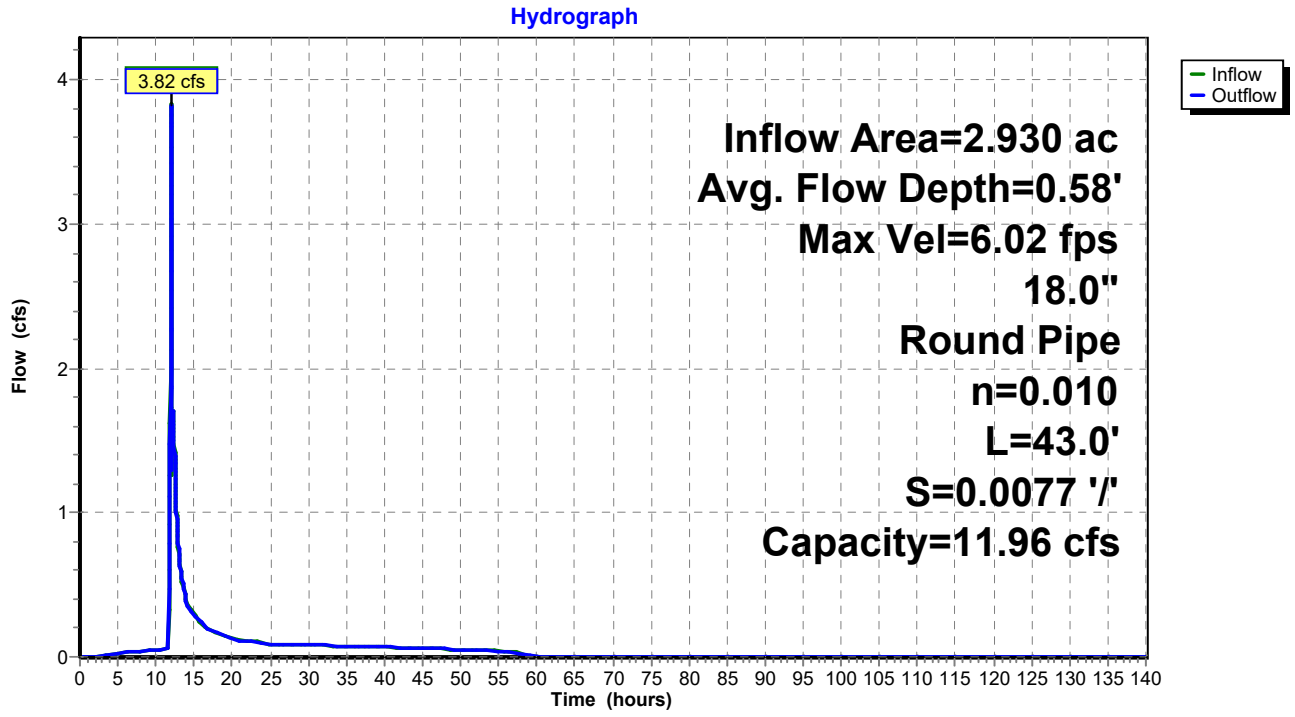
Inflow Area = 2.930 ac, 36.52% Impervious, Inflow Depth = 2.19" for 10-year event
Inflow = 3.83 cfs @ 11.97 hrs, Volume= 0.534 af
Outflow = 3.82 cfs @ 11.97 hrs, Volume= 0.534 af, Atten= 0%, Lag= 0.2 min
Routed to Reach Swale : Swale

Routing by Stor-Ind+Trans method, Time Span= 0.00-140.00 hrs, dt= 0.01 hrs
Max. Velocity= 6.02 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 1.63 fps, Avg. Travel Time= 0.4 min

Peak Storage= 27 cf @ 11.97 hrs
Average Depth at Peak Storage= 0.58' , Surface Width= 1.46'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 11.96 cfs

18.0" Round Pipe
n= 0.010 PVC, smooth interior
Length= 43.0' Slope= 0.0077 '/'
Inlet Invert= 367.33', Outlet Invert= 367.00'





Summary for Pond GWL1: Gravel Wetland #1

Inflow Area = 2.930 ac, 36.52% Impervious, Inflow Depth = 2.04" for 10-year event
Inflow = 6.82 cfs @ 11.97 hrs, Volume= 0.499 af
Outflow = 1.72 cfs @ 12.17 hrs, Volume= 0.499 af, Atten= 75%, Lag= 11.8 min
Primary = 1.72 cfs @ 12.17 hrs, Volume= 0.499 af
Routed to Reach Tank Out : Tank Outlet
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Link S : SN002

Routing by Stor-Ind method, Time Span= 0.00-140.00 hrs, dt= 0.01 hrs / 2
Starting Elev= 368.50' Surf.Area= 6,106 sf Storage= 3,053 cf
Peak Elev= 371.17' @ 12.17 hrs Surf.Area= 11,702 sf Storage= 12,913 cf (9,860 cf above start)
Flood Elev= 372.00' Surf.Area= 12,451 sf Storage= 17,859 cf (14,806 cf above start)

Plug-Flow detention time= 823.1 min calculated for 0.429 af (86% of inflow)
Center-of-Mass det. time= 626.5 min (1,421.7 - 795.2)

Volume	Invert	Avail.Storage	Storage Description
#1	365.00'	2,748 cf	**Gravel Storage (Prismatic)** Listed below (Recalc)
#2	368.00'	611 cf	**Media Storage (Prismatic)** Listed below (Recalc)
#3	369.00'	17,792 cf	**Ponding Storage (Prismatic)** Listed below (Recalc)
		21,150 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
365.00	3,053	0.0	0	0
368.00	3,053	30.0	2,748	2,748

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
368.00	3,053	0.0	0	0
368.50	3,053	20.0	305	305
369.00	3,053	20.0	305	611

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
369.00	3,053	0.0	0	0
370.00	4,173	100.0	3,613	3,613
370.10	4,676	100.0	442	4,055
371.00	5,441	100.0	4,553	8,608
372.00	6,345	100.0	5,893	14,501
372.50	6,818	100.0	3,291	17,792

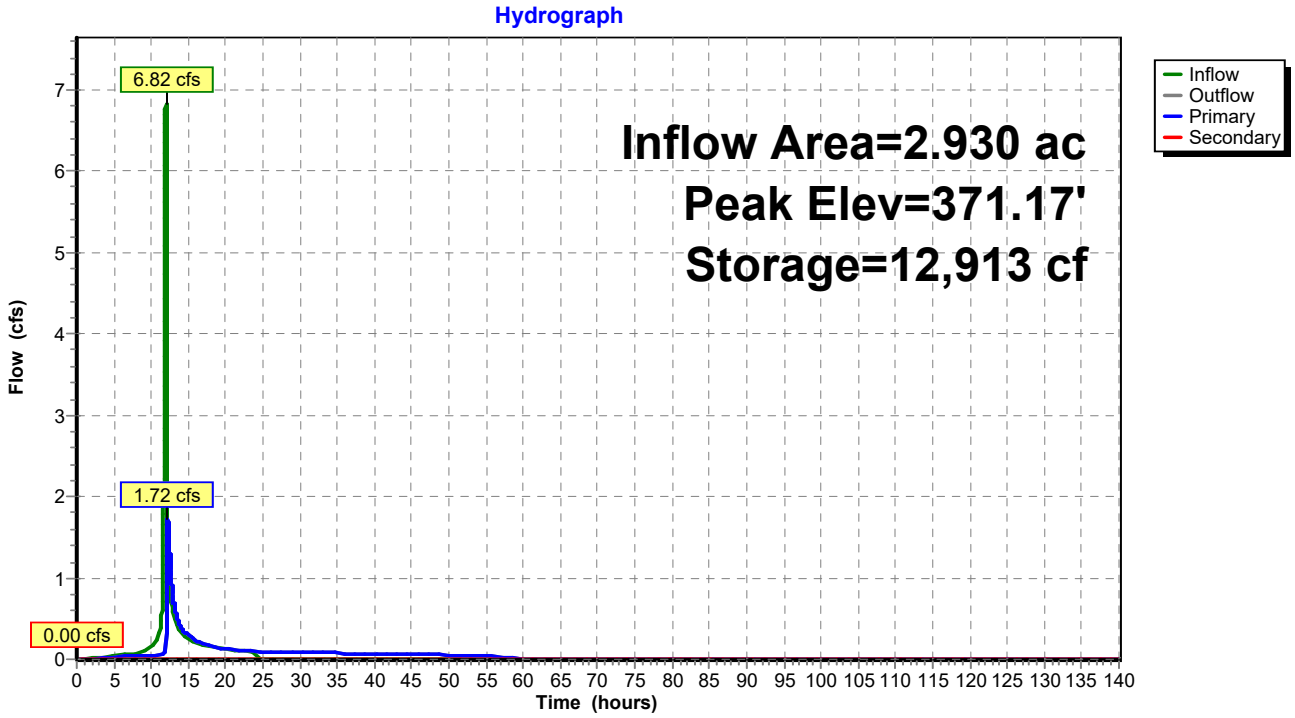
Device	Routing	Invert	Outlet Devices
#1	Primary	368.20'	**12.0" Round Culvert** L= 12.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 368.20' / 368.00' S= 0.0167 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf
#2	Device 1	368.50'	**1.5" Vert. Permanent Pool Orifice/Grate** C= 0.600

			Limited to weir flow at low heads
#3	Device 1	370.83'	**10.3" Horiz. 12" Orifice/Grate** C= 0.600
			Limited to weir flow at low heads
#4	Secondary	371.50'	**20.0' long + 3.0 '/' SideZ x 3.0' breadth Spillway**
			Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50
			Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=1.72 cfs @ 12.17 hrs HW=371.17' (Free Discharge)
└─**1=Culvert** (Passes 1.72 cfs of 4.69 cfs potential flow)
  ├─**2=Permanent Pool Orifice/Grate** (Orifice Controls 0.10 cfs @ 7.78 fps)
  └─**3=12" Orifice/Grate** (Orifice Controls 1.63 cfs @ 2.81 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=368.50' (Free Discharge)
└─**4=Spillway** (Controls 0.00 cfs)

Pond GWL1: Gravel Wetland #1



Summary for Pond GWL2: Gravel Wetland #2

Inflow Area = 3.044 ac, 11.96% Impervious, Inflow Depth = 1.69" for 10-year event
Inflow = 9.10 cfs @ 11.97 hrs, Volume= 0.428 af
Outflow = 3.60 cfs @ 12.07 hrs, Volume= 0.428 af, Atten= 60%, Lag= 6.0 min
Primary = 3.60 cfs @ 12.07 hrs, Volume= 0.428 af
Routed to Link S : SN002

Routing by Stor-Ind method, Time Span= 0.00-140.00 hrs, dt= 0.01 hrs / 2
Starting Elev= 396.50' Surf.Area= 8,520 sf Storage= 4,896 cf
Peak Elev= 398.80' @ 12.07 hrs Surf.Area= 13,276 sf Storage= 12,633 cf (7,737 cf above start)
Flood Elev= 400.00' Surf.Area= 14,200 sf Storage= 18,882 cf (13,986 cf above start)

Plug-Flow detention time= 1,291.1 min calculated for 0.316 af (74% of inflow)
Center-of-Mass det. time= 852.6 min (1,672.4 - 819.8)

Volume	Invert	Avail.Storage	Storage Description
#1	393.00'	4,550 cf	**Gravel Storage (Prismatic)** Listed below (Recalc)
#2	396.00'	693 cf	**Media Storage (Prismatic)** Listed below (Recalc)
#3	397.00'	16,581 cf	**Ponding Storage (Prismatic)** Listed below (Recalc)
		21,823 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
393.00	5,055	0.0	0	0
396.00	5,055	30.0	4,550	4,550

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
396.00	3,465	0.0	0	0
396.50	3,465	20.0	347	347
397.00	3,465	20.0	347	693

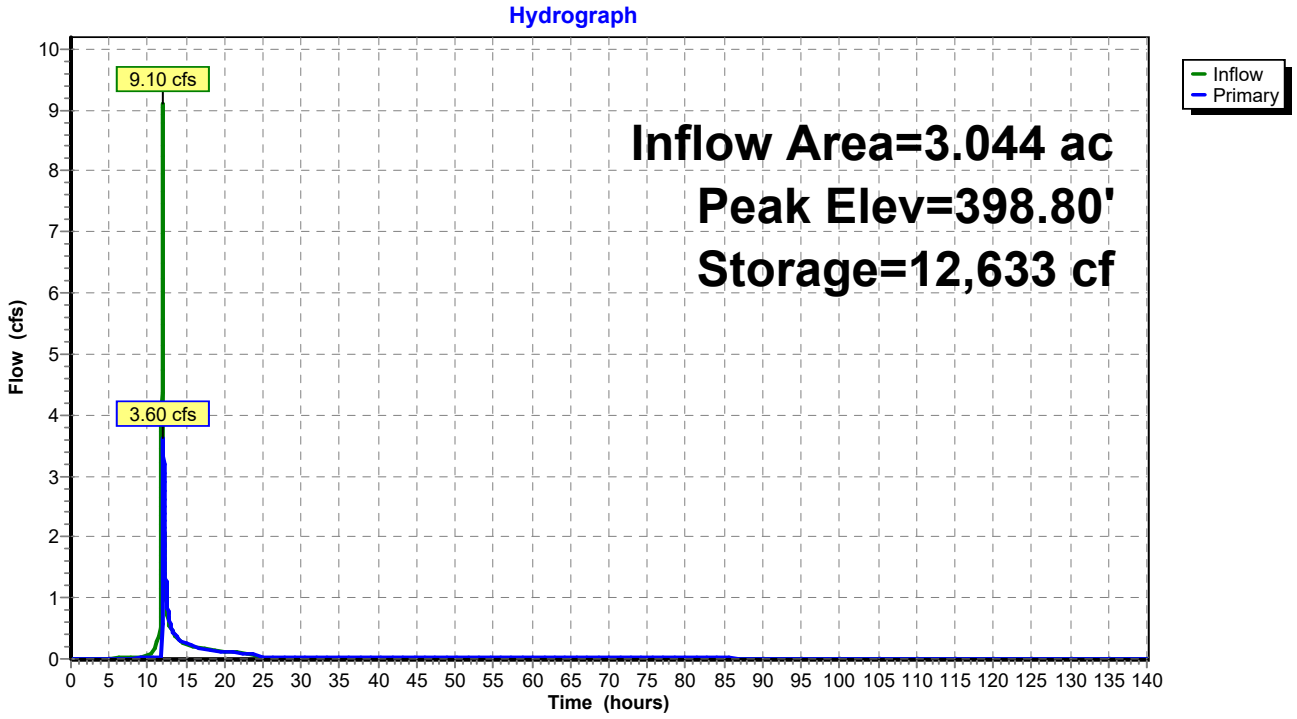
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
397.00	3,465	0	0
398.00	4,164	3,815	3,815
399.00	4,903	4,534	8,348
400.00	5,680	5,292	13,640
400.50	6,084	2,941	16,581

Device	Routing	Invert	Outlet Devices
#1	Primary	394.50'	**24.0" Round Culvert** L= 45.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 394.50' / 384.00' S= 0.2333 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 3.14 sf
#2	Device 1	396.50'	**1.0" Vert. Permanent Pool Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	398.50'	**12.5" Horiz. 15" Orifice/Grate X 2.00** C= 0.600 Limited to weir flow at low heads

#4	Primary	399.50'	**30.0' long + 3.0 '/' SideZ x 3.0' breadth Spillway** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=3.58 cfs @ 12.07 hrs HW=398.80' (Free Discharge)
- **1=Culvert** (Passes 3.58 cfs of 21.70 cfs potential flow)
  - **2=Permanent Pool Orifice/Grate** (Orifice Controls 0.04 cfs @ 7.24 fps)
  - **3=15" Orifice/Grate** (Weir Controls 3.54 cfs @ 1.80 fps)
- **4=Spillway** (Controls 0.00 cfs)

Pond GWL2: Gravel Wetland #2



Summary for Pond Tank IN: Tank Inlet

Inflow Area = 2.930 ac, 36.52% Impervious, Inflow Depth = 2.19" for 10-year event
Inflow = 10.57 cfs @ 11.97 hrs, Volume= 0.534 af
Outflow = 10.57 cfs @ 11.97 hrs, Volume= 0.534 af, Atten= 0%, Lag= 0.0 min
Primary = 6.82 cfs @ 11.97 hrs, Volume= 0.499 af
Routed to Pond GWL1 : Gravel Wetland #1
Secondary = 3.75 cfs @ 11.97 hrs, Volume= 0.035 af
Routed to Reach Tank Out : Tank Outlet

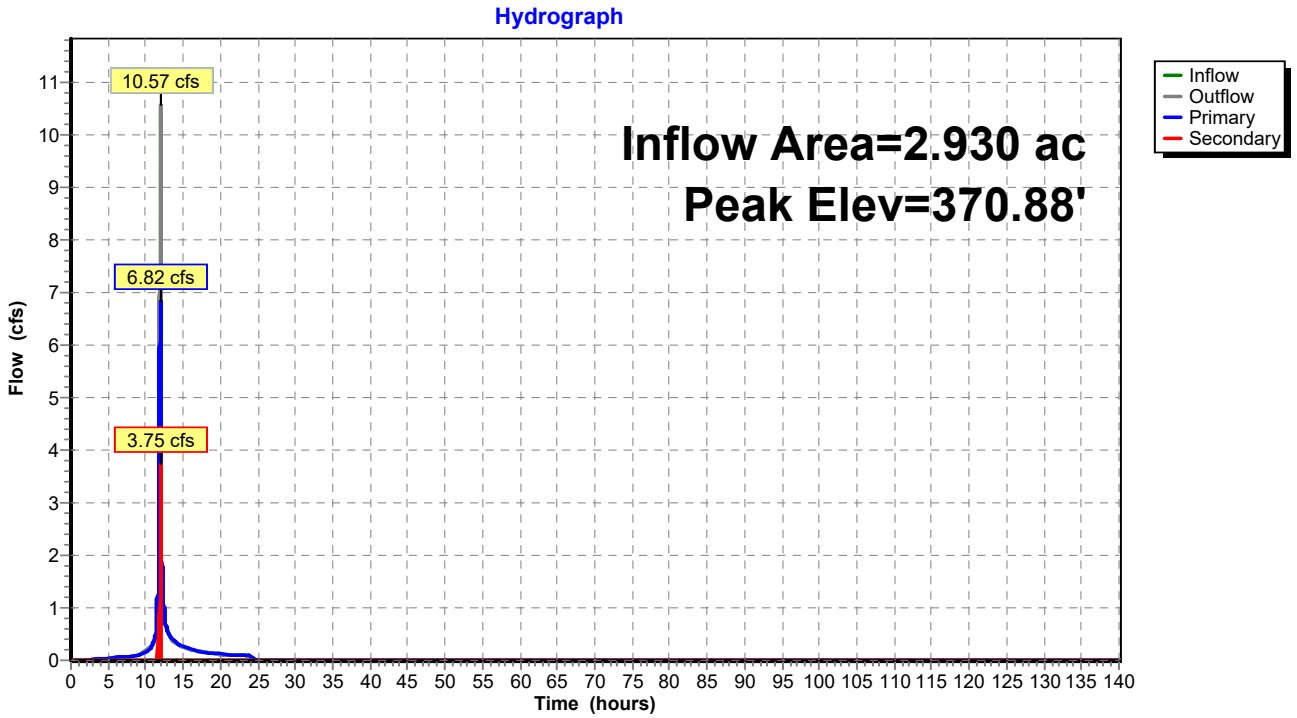
Routing by Stor-Ind method, Time Span= 0.00-140.00 hrs, dt= 0.01 hrs
Peak Elev= 370.88' @ 11.97 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	369.10'	**18.0" Round 18" Culvert to GWL** L= 20.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 369.10' / 369.00' S= 0.0050 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 1.77 sf
#2	Secondary	370.58'	**7.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=6.82 cfs @ 11.97 hrs HW=370.88' (Free Discharge)
└**1=18" Culvert to GWL** (Inlet Controls 6.82 cfs @ 3.86 fps)

Secondary OutFlow Max=3.74 cfs @ 11.97 hrs HW=370.88' (Free Discharge)
└**2=Sharp-Crested Rectangular Weir** (Weir Controls 3.74 cfs @ 1.79 fps)

Pond Tank IN: Tank Inlet



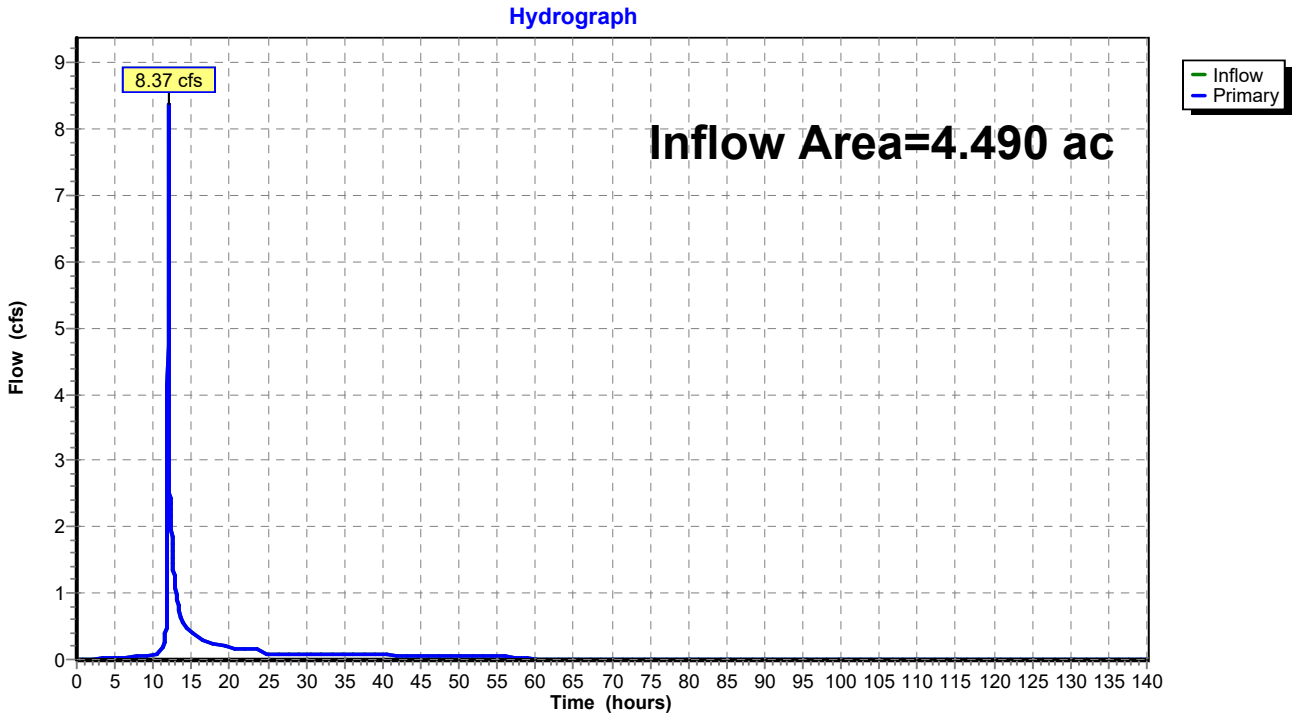
Summary for Link N: SN001

Inflow Area = 4.490 ac, 23.83% Impervious, Inflow Depth = 1.98" for 10-year event
Inflow = 8.37 cfs @ 11.98 hrs, Volume= 0.742 af
Primary = 8.37 cfs @ 11.98 hrs, Volume= 0.742 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-140.00 hrs, dt= 0.01 hrs

Post Development Peak Flow to SN001 8.37-cfs

Link N: SN001



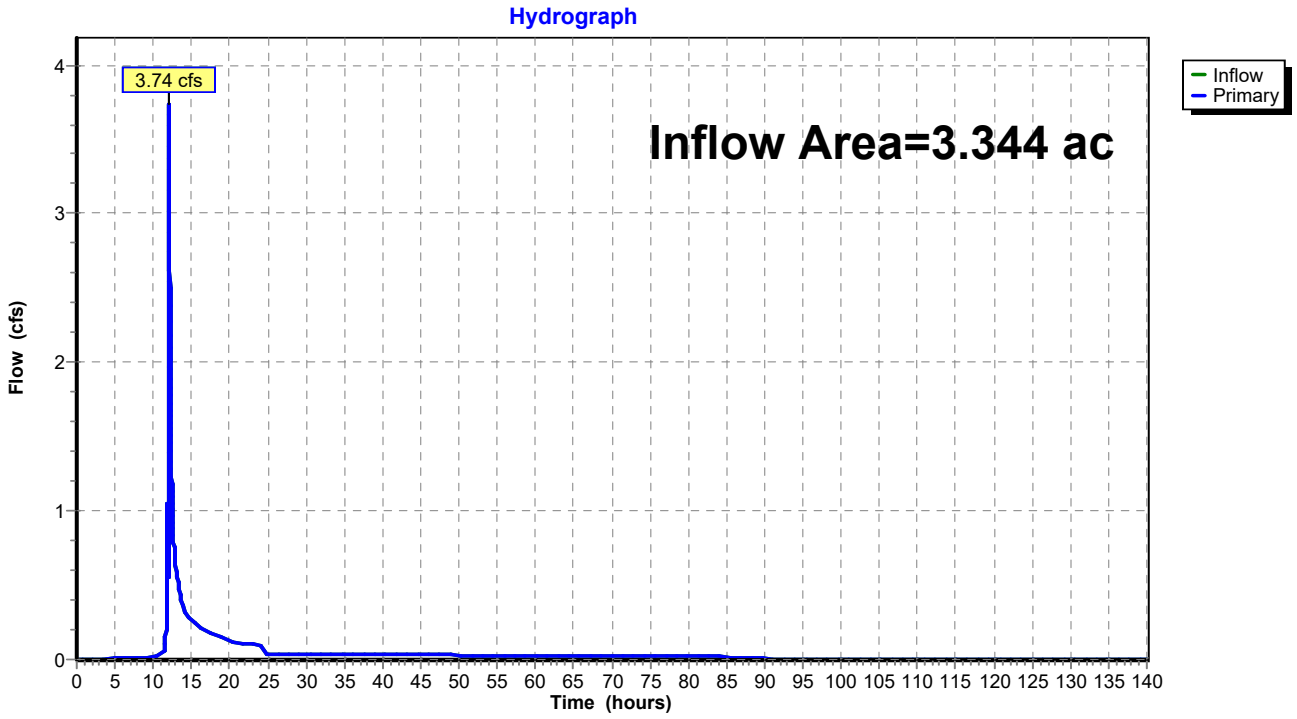
Summary for Link S: SN002

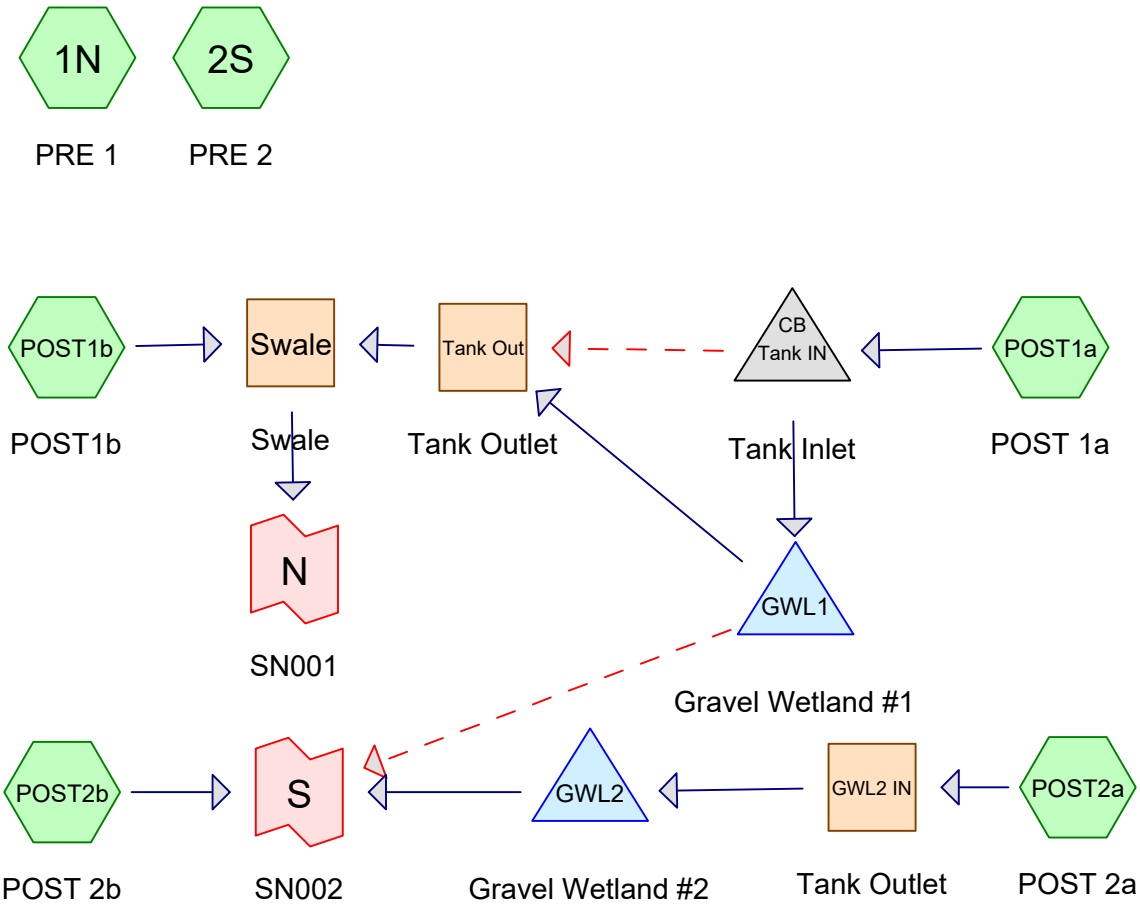
Inflow Area = 3.344 ac, 10.89% Impervious, Inflow Depth = 1.68" for 10-year event
Inflow = 3.74 cfs @ 12.07 hrs, Volume= 0.468 af
Primary = 3.74 cfs @ 12.07 hrs, Volume= 0.468 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-140.00 hrs, dt= 0.01 hrs

Post Development Peak Flow to SN002 3.74-cfs

Link S: SN002





Subcat Reach Pond Link

Routing Diagram for 20542 Laster 8-Lot Subdivision
Prepared by Engineering Ventures, Inc, Printed 4/13/2023

Summary for Subcatchment 1N: PRE 1

Runoff = 20.93 cfs @ 12.01 hrs, Volume= 1.110 af, Depth= 2.76"
Routed to nonexistent node 2L

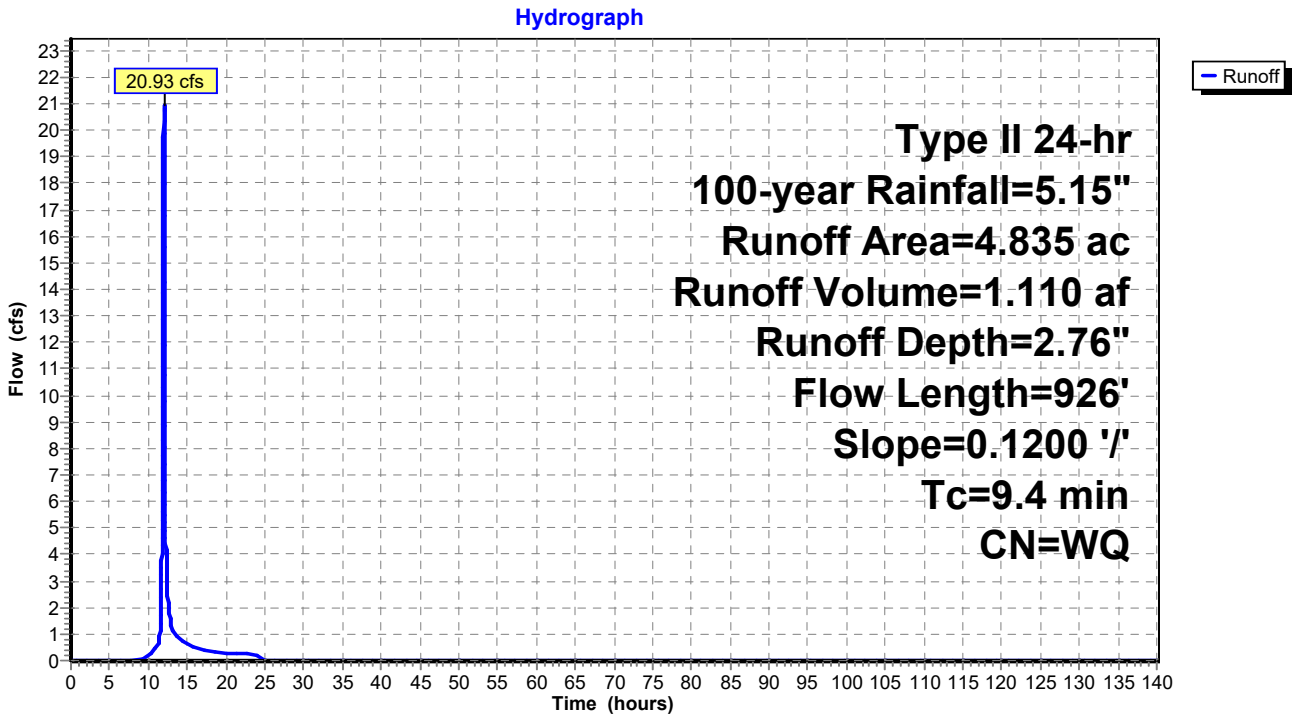
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-140.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-year Rainfall=5.15"

	Area (ac)	CN	Description
	4.820	77	Woods, Good, HSG D
*	0.015	98	Existing Impervious
	4.835		Weighted Average
	4.820		99.69% Pervious Area
	0.015		0.31% Impervious Area

Pre Development Peak Flow to SN001 20.93-cfs

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.4	926	0.1200	1.63		**Lag/CN Method, Watershed Lag**

Subcatchment 1N: PRE 1



Summary for Subcatchment 2S: PRE 2

Runoff = 13.31 cfs @ 12.00 hrs, Volume= 0.687 af, Depth= 2.75"
Routed to nonexistent node 3L

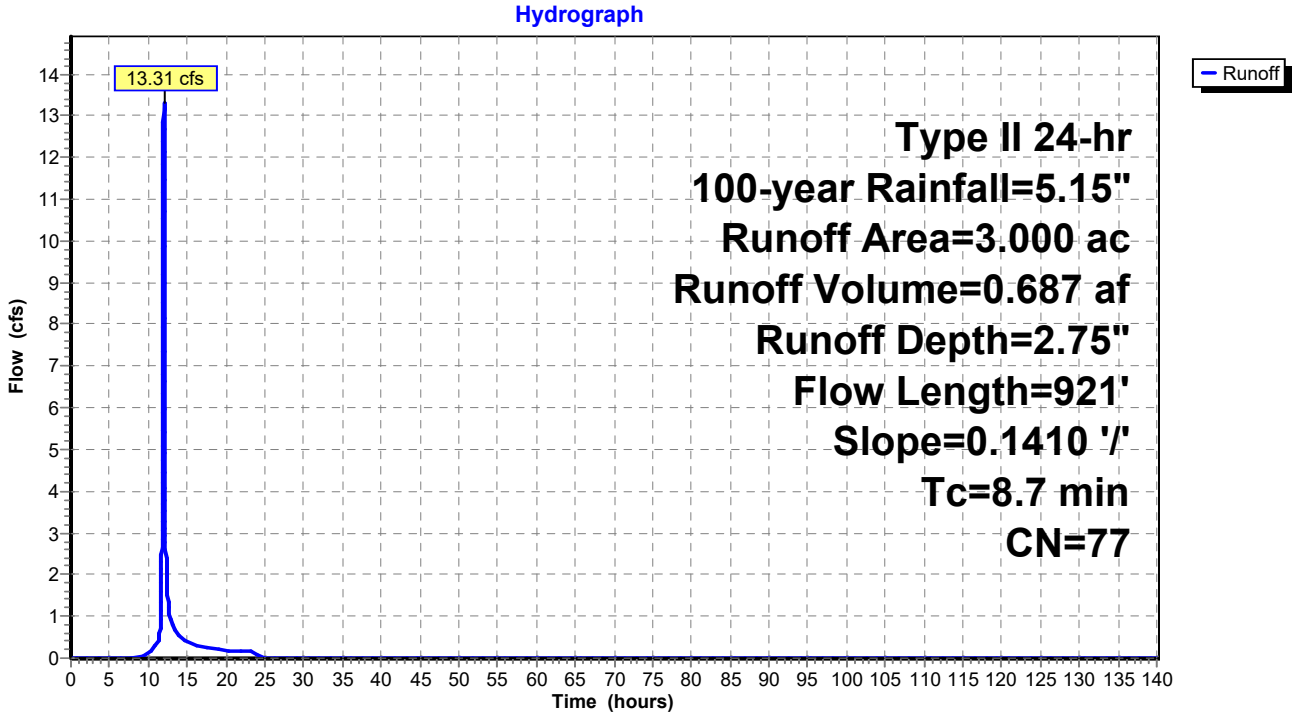
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-140.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-year Rainfall=5.15"

Area (ac)	CN	Description
3.000	77	Woods, Good, HSG D
3.000		100.00% Pervious Area

Pre Development
Peak Flow to SN002
13.31-cfs

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.7	921	0.1410	1.77		**Lag/CN Method, Watershed Lag**

Subcatchment 2S: PRE 2



Summary for Subcatchment POST1a: POST 1a

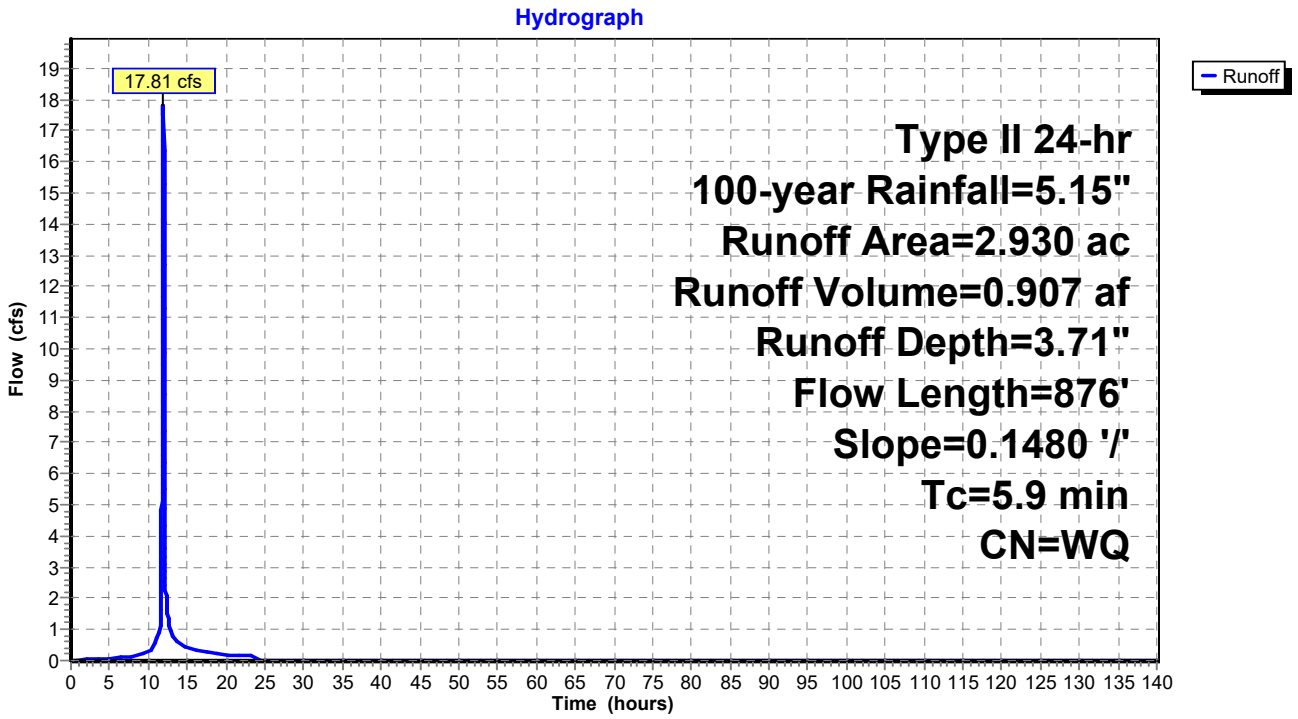
Runoff = 17.81 cfs @ 11.97 hrs, Volume= 0.907 af, Depth= 3.71"
Routed to Pond Tank IN : Tank Inlet

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-140.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-year Rainfall=5.15"

	Area (ac)	CN	Description
*	1.070	98	New Impervious
	1.860	80	>75% Grass cover, Good, HSG D
	2.930		Weighted Average
	1.860		63.48% Pervious Area
	1.070		36.52% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.9	876	0.1480	2.49		**Lag/CN Method, Watershed Lag**

Subcatchment POST1a: POST 1a



Summary for Subcatchment POST1b: POST1b

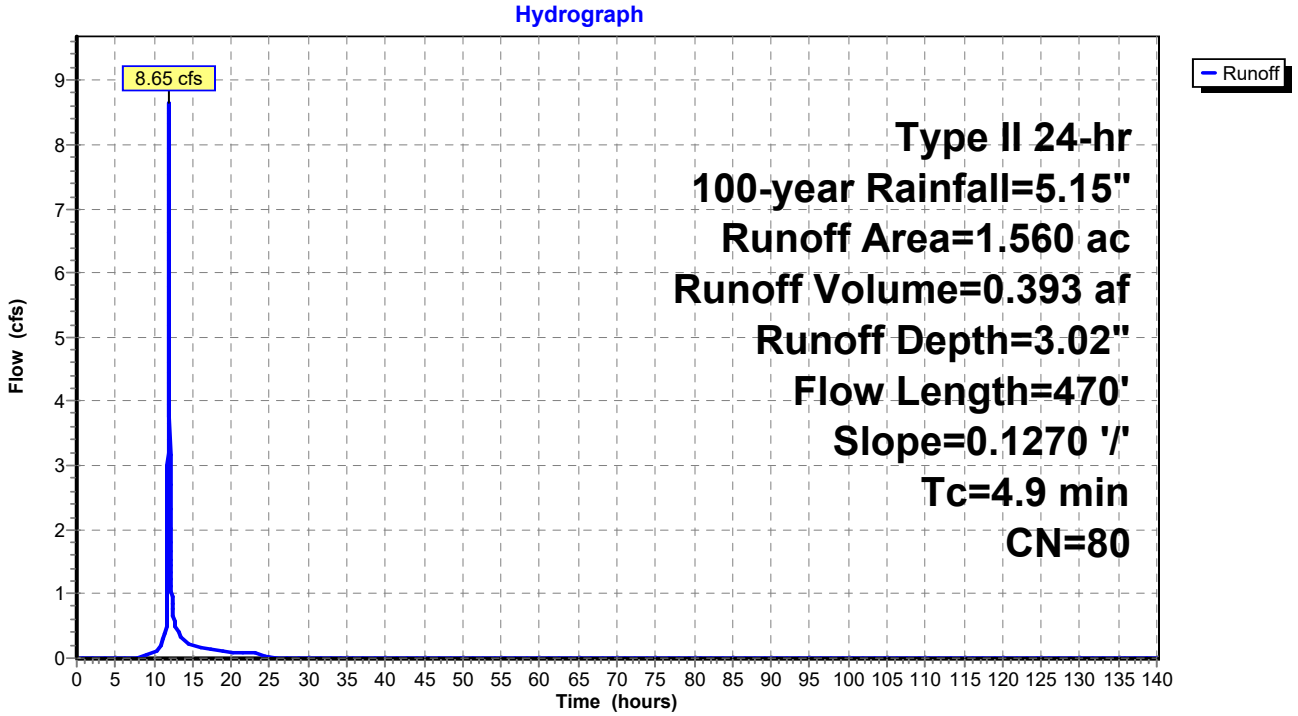
Runoff = 8.65 cfs @ 11.96 hrs, Volume= 0.393 af, Depth= 3.02"
Routed to Reach Swale : Swale

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-140.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-year Rainfall=5.15"

Area (ac)	CN	Description
1.560	80	>75% Grass cover, Good, HSG D
1.560		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	470	0.1270	1.61		**Lag/CN Method, Watershed Lag**

Subcatchment POST1b: POST1b



Summary for Subcatchment POST2a: POST 2a

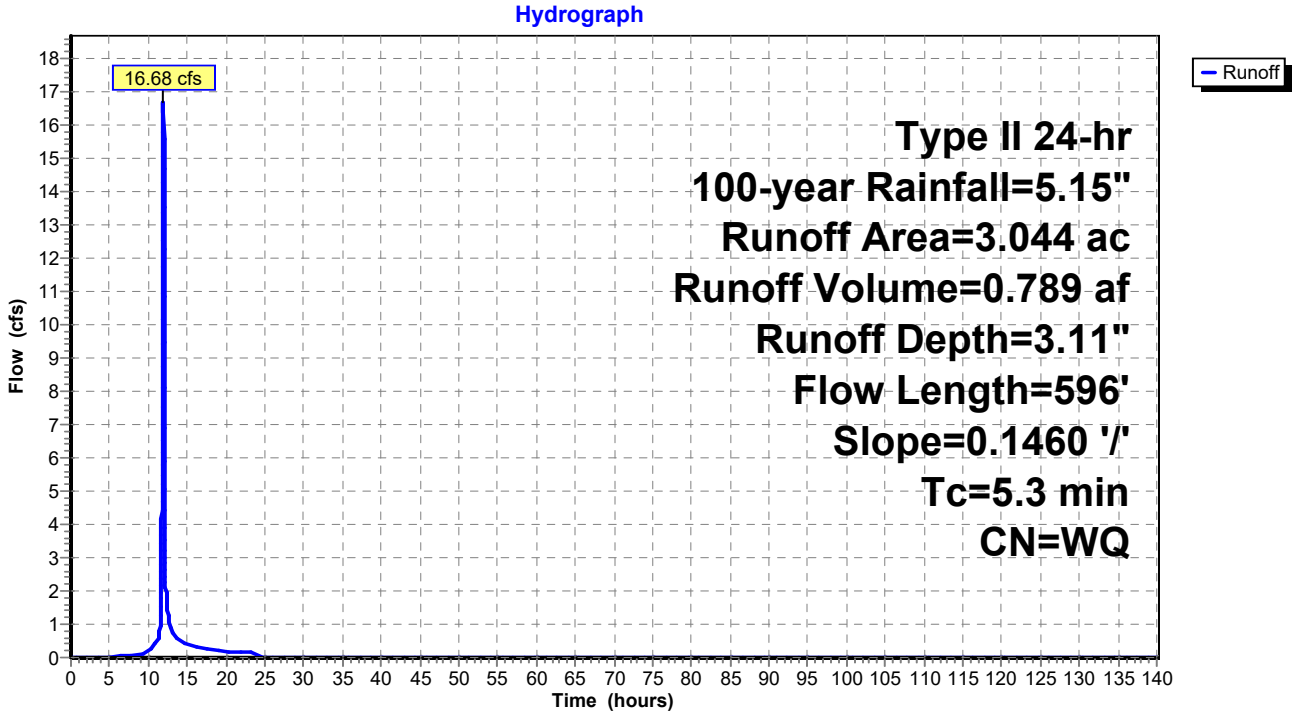
Runoff = 16.68 cfs @ 11.96 hrs, Volume= 0.789 af, Depth= 3.11"
Routed to Reach GWL2 IN : Tank Outlet

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-140.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-year Rainfall=5.15"

	Area (ac)	CN	Description
*	0.014	98	New Impervious Roads & Walks
*	0.350	98	New Impervious Lots
	1.150	80	>75% Grass cover, Good, HSG D
*	1.530	77	Woods, Good, HSG D
	3.044		Weighted Average
	2.680		88.04% Pervious Area
	0.364		11.96% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.3	596	0.1460	1.87		**Lag/CN Method, Watershed Lag**

Subcatchment POST2a: POST 2a



Summary for Subcatchment POST2b: POST 2b

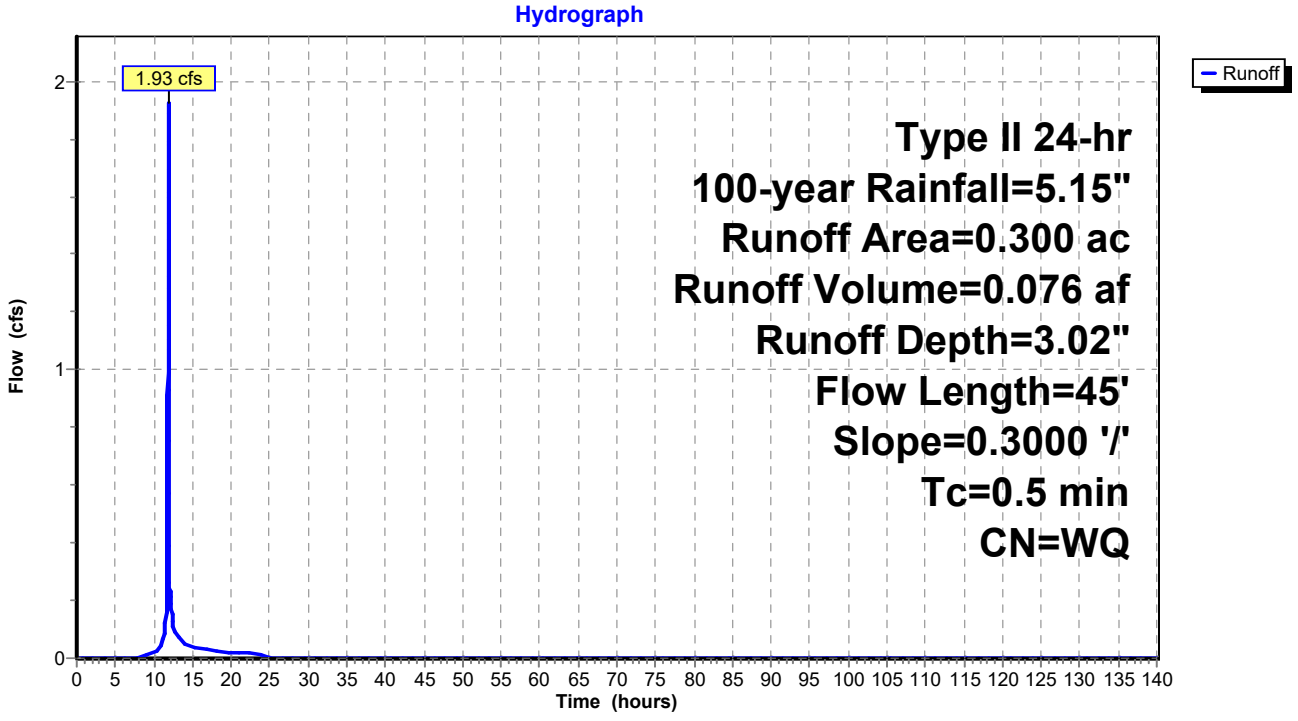
Runoff = 1.93 cfs @ 11.91 hrs, Volume= 0.076 af, Depth= 3.02"
Routed to Link S : SN002

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-140.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-year Rainfall=5.15"

	Area (ac)	CN	Description
	0.300	80	>75% Grass cover, Good, HSG D
*	0.000	98	Impervious
	0.300		Weighted Average
	0.300		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	45	0.3000	1.55		**Lag/CN Method,**

Subcatchment POST2b: POST 2b



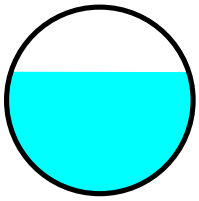
Summary for Reach GWL2 IN: Tank Outlet

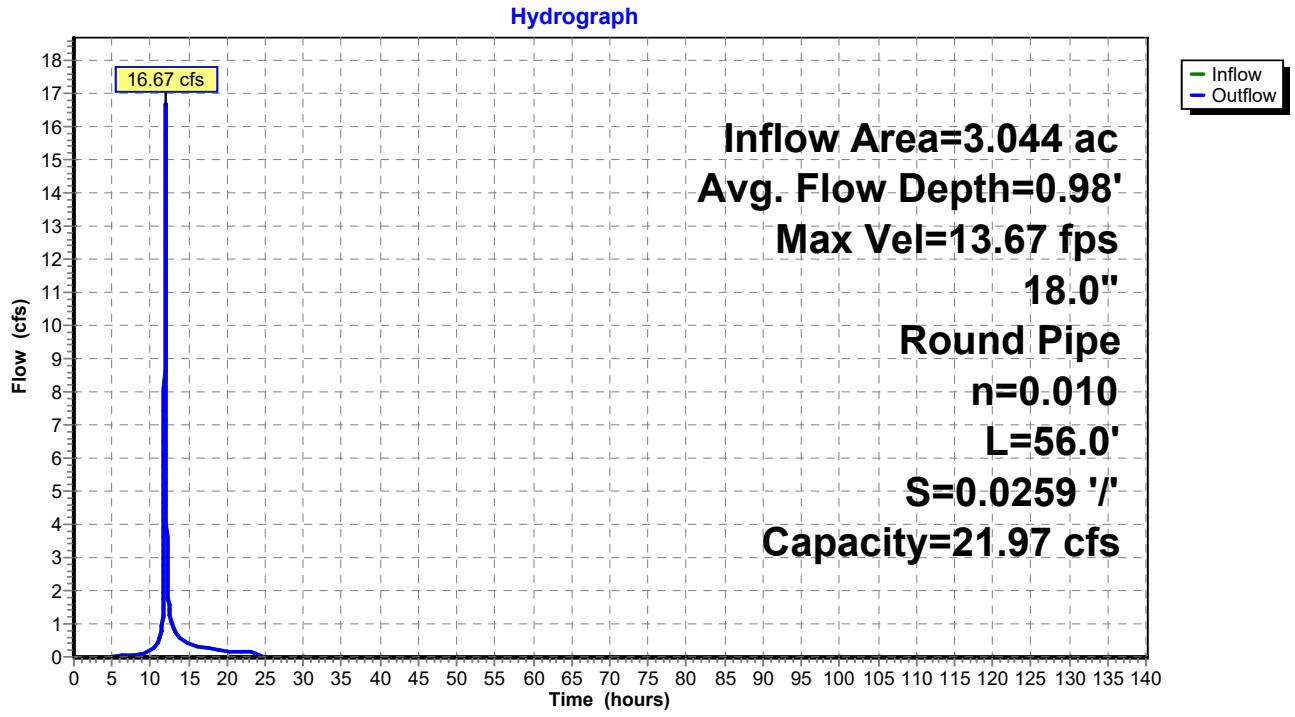
Inflow Area = 3.044 ac, 11.96% Impervious, Inflow Depth = 3.11" for 100-year event
Inflow = 16.68 cfs @ 11.96 hrs, Volume= 0.789 af
Outflow = 16.67 cfs @ 11.97 hrs, Volume= 0.789 af, Atten= 0%, Lag= 0.1 min
Routed to Pond GWL2 : Gravel Wetland #2

Routing by Stor-Ind+Trans method, Time Span= 0.00-140.00 hrs, dt= 0.01 hrs
Max. Velocity= 13.67 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 3.70 fps, Avg. Travel Time= 0.3 min

Peak Storage= 68 cf @ 11.96 hrs
Average Depth at Peak Storage= 0.98' , Surface Width= 1.43'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 21.97 cfs

18.0" Round Pipe
n= 0.010 PVC, smooth interior
Length= 56.0' Slope= 0.0259 '/'
Inlet Invert= 398.45', Outlet Invert= 397.00'





Summary for Reach Swale: Swale

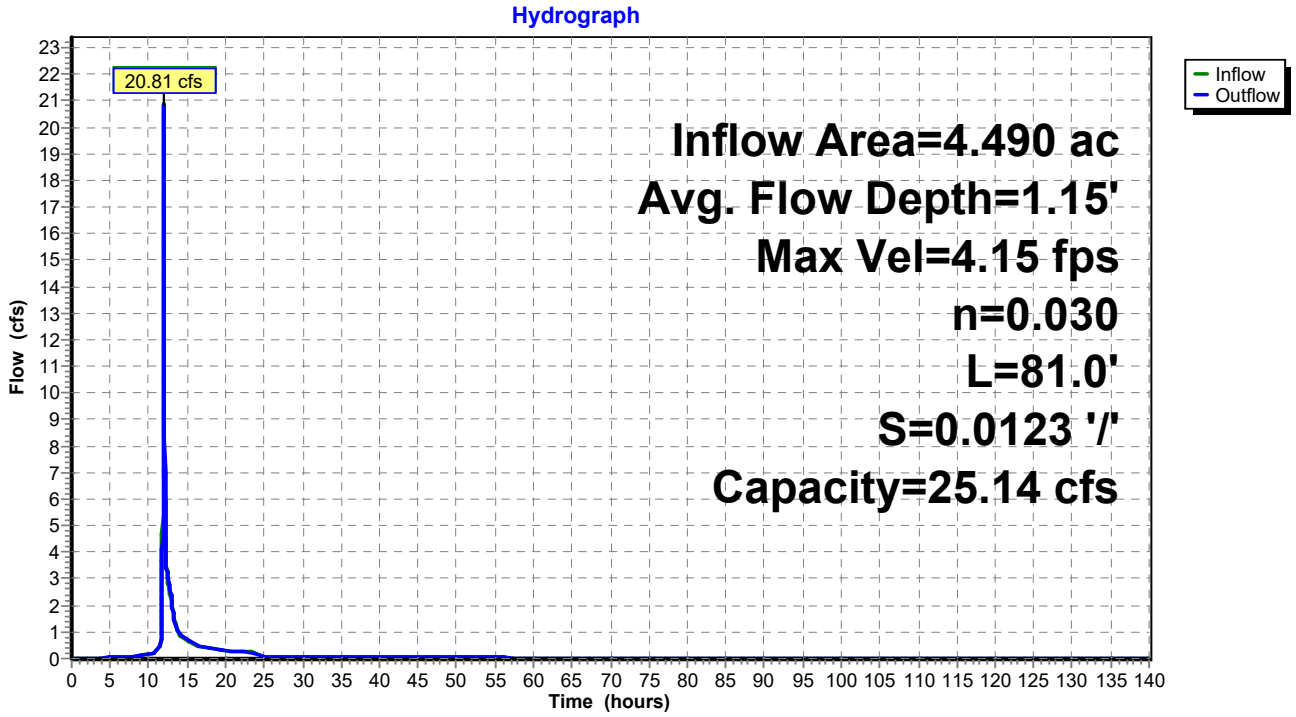
Inflow Area = 4.490 ac, 23.83% Impervious, Inflow Depth = 3.37" for 100-year event
Inflow = 20.90 cfs @ 11.97 hrs, Volume= 1.260 af
Outflow = 20.81 cfs @ 11.98 hrs, Volume= 1.260 af, Atten= 0%, Lag= 0.6 min
Routed to Link N : SN001

Routing by Stor-Ind+Trans method, Time Span= 0.00-140.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.15 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 0.75 fps, Avg. Travel Time= 1.8 min

Peak Storage= 407 cf @ 11.97 hrs
Average Depth at Peak Storage= 1.15' , Surface Width= 7.25'
Bank-Full Depth= 1.25' Flow Area= 5.8 sf, Capacity= 25.14 cfs

1.50' x 1.25' deep channel, n= 0.030
Side Slope Z-value= 2.5 '/' Top Width= 7.75'
Length= 81.0' Slope= 0.0123 '/'
Inlet Invert= 367.00', Outlet Invert= 366.00'

Reach Swale: Swale



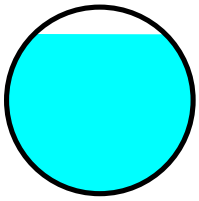
Summary for Reach Tank Out: Tank Outlet

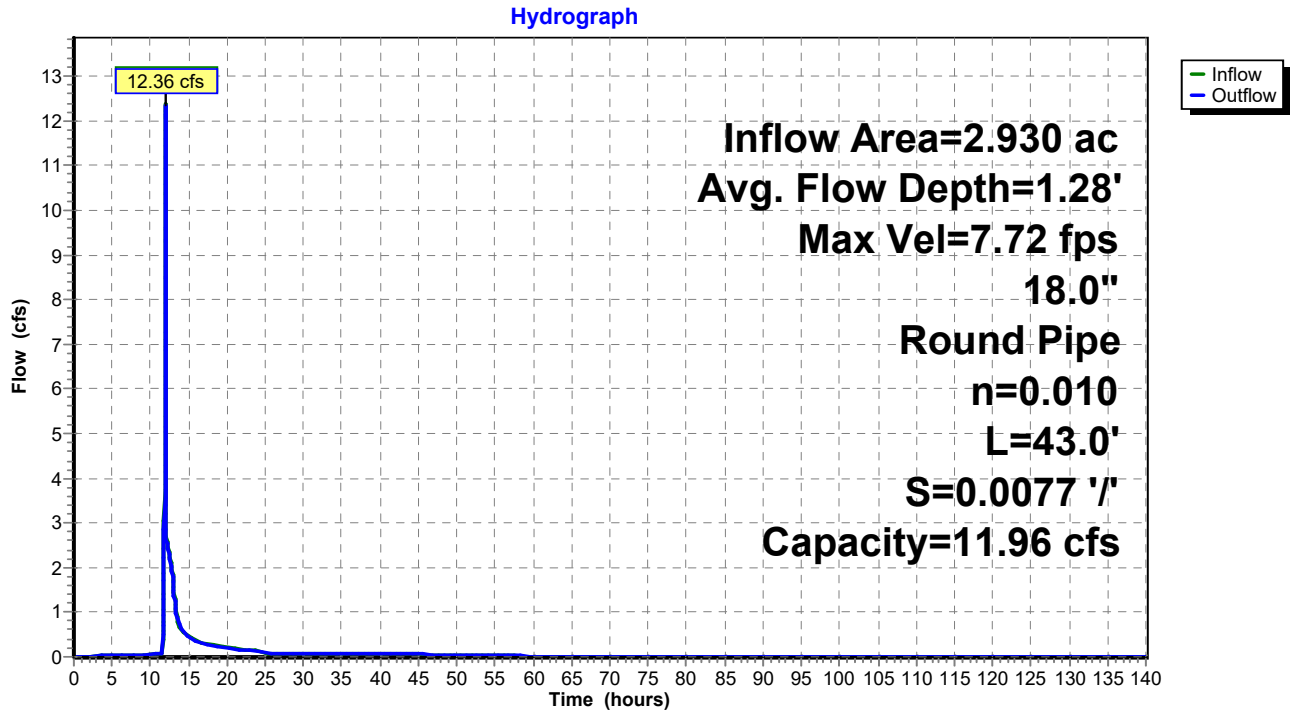
Inflow Area = 2.930 ac, 36.52% Impervious, Inflow Depth = 3.55" for 100-year event
Inflow = 12.39 cfs @ 11.97 hrs, Volume= 0.867 af
Outflow = 12.36 cfs @ 11.97 hrs, Volume= 0.867 af, Atten= 0%, Lag= 0.2 min
Routed to Reach Swale : Swale

Routing by Stor-Ind+Trans method, Time Span= 0.00-140.00 hrs, dt= 0.01 hrs
Max. Velocity= 7.72 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 1.72 fps, Avg. Travel Time= 0.4 min

Peak Storage= 69 cf @ 11.97 hrs
Average Depth at Peak Storage= 1.28' , Surface Width= 1.06'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 11.96 cfs

18.0" Round Pipe
n= 0.010 PVC, smooth interior
Length= 43.0' Slope= 0.0077 '/'
Inlet Invert= 367.33', Outlet Invert= 367.00'





Summary for Pond GWL1: Gravel Wetland #1

Inflow Area = 2.930 ac, 36.52% Impervious, Inflow Depth = 3.18" for 100-year event
Inflow = 7.71 cfs @ 11.97 hrs, Volume= 0.776 af
Outflow = 5.57 cfs @ 12.09 hrs, Volume= 0.776 af, Atten= 28%, Lag= 7.1 min
Primary = 2.63 cfs @ 12.09 hrs, Volume= 0.736 af
Routed to Reach Tank Out : Tank Outlet
Secondary = 2.94 cfs @ 12.09 hrs, Volume= 0.040 af
Routed to Link S : SN002

Routing by Stor-Ind method, Time Span= 0.00-140.00 hrs, dt= 0.01 hrs / 2
Starting Elev= 368.50' Surf.Area= 6,106 sf Storage= 3,053 cf
Peak Elev= 371.65' @ 12.09 hrs Surf.Area= 12,134 sf Storage= 15,692 cf (12,639 cf above start)
Flood Elev= 372.00' Surf.Area= 12,451 sf Storage= 17,859 cf (14,806 cf above start)

Plug-Flow detention time= 538.8 min calculated for 0.706 af (91% of inflow)
Center-of-Mass det. time= 426.7 min (1,219.1 - 792.5)

Volume	Invert	Avail.Storage	Storage Description
#1	365.00'	2,748 cf	**Gravel Storage (Prismatic)** Listed below (Recalc)
#2	368.00'	611 cf	**Media Storage (Prismatic)** Listed below (Recalc)
#3	369.00'	17,792 cf	**Ponding Storage (Prismatic)** Listed below (Recalc)
		21,150 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
365.00	3,053	0.0	0	0
368.00	3,053	30.0	2,748	2,748

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
368.00	3,053	0.0	0	0
368.50	3,053	20.0	305	305
369.00	3,053	20.0	305	611

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
369.00	3,053	0.0	0	0
370.00	4,173	100.0	3,613	3,613
370.10	4,676	100.0	442	4,055
371.00	5,441	100.0	4,553	8,608
372.00	6,345	100.0	5,893	14,501
372.50	6,818	100.0	3,291	17,792

peak elev. 371.65
top berm elev. 372.65
12" freeboard provided

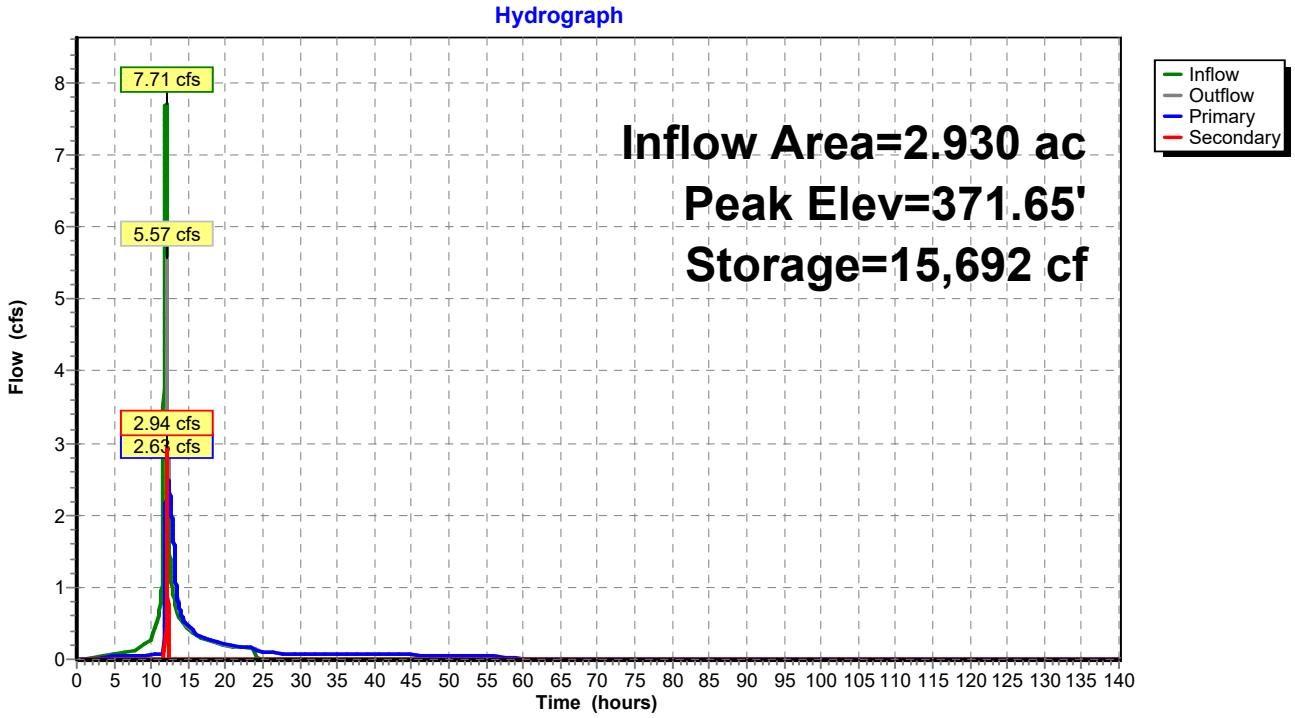
Device	Routing	Invert	Outlet Devices
#1	Primary	368.20'	**12.0" Round Culvert** L= 12.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 368.20' / 368.00' S= 0.0167 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf
#2	Device 1	368.50'	**1.5" Vert. Permanent Pool Orifice/Grate** C= 0.600

			Limited to weir flow at low heads
#3	Device 1	370.83'	**10.3" Horiz. 12" Orifice/Grate** C= 0.600
			Limited to weir flow at low heads
#4	Secondary	371.50'	**20.0' long + 3.0 '/' SideZ x 3.0' breadth Spillway**
			Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50
			Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=2.63 cfs @ 12.09 hrs HW=371.65' (Free Discharge)
└─**1=Culvert** (Passes 2.63 cfs of 5.13 cfs potential flow)
  ├─**2=Permanent Pool Orifice/Grate** (Orifice Controls 0.10 cfs @ 8.46 fps)
  └─**3=12" Orifice/Grate** (Orifice Controls 2.52 cfs @ 4.36 fps)

Secondary OutFlow Max=2.87 cfs @ 12.09 hrs HW=371.65' (Free Discharge)
└─**4=Spillway** (Weir Controls 2.87 cfs @ 0.94 fps)

Pond GWL1: Gravel Wetland #1



Summary for Pond GWL2: Gravel Wetland #2

Inflow Area = 3.044 ac, 11.96% Impervious, Inflow Depth = 3.11" for 100-year event
Inflow = 16.67 cfs @ 11.97 hrs, Volume= 0.789 af
Outflow = 10.57 cfs @ 12.03 hrs, Volume= 0.789 af, Atten= 37%, Lag= 4.1 min
Primary = 10.57 cfs @ 12.03 hrs, Volume= 0.789 af
Routed to Link S : SN002

Routing by Stor-Ind method, Time Span= 0.00-140.00 hrs, dt= 0.01 hrs / 2
Starting Elev= 396.50' Surf.Area= 8,520 sf Storage= 4,896 cf
Peak Elev= 399.59' @ 12.03 hrs Surf.Area= 13,879 sf Storage= 16,600 cf (11,704 cf above start)
Flood Elev= 400.00' Surf.Area= 14,200 sf Storage= 18,882 cf (13,986 cf above start)

Plug-Flow detention time= 639.9 min calculated for 0.677 af (86% of inflow)
Center-of-Mass det. time= 475.4 min (1,281.9 - 806.5)

Volume	Invert	Avail.Storage	Storage Description
#1	393.00'	4,550 cf	**Gravel Storage (Prismatic)** Listed below (Recalc)
#2	396.00'	693 cf	**Media Storage (Prismatic)** Listed below (Recalc)
#3	397.00'	16,581 cf	**Ponding Storage (Prismatic)** Listed below (Recalc)
		21,823 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
393.00	5,055	0.0	0	0
396.00	5,055	30.0	4,550	4,550

peak elev. 399.59
top berm elev. 400.6
12" freeboard provided

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
396.00	3,465	0.0	0	0
396.50	3,465	20.0	347	347
397.00	3,465	20.0	347	693

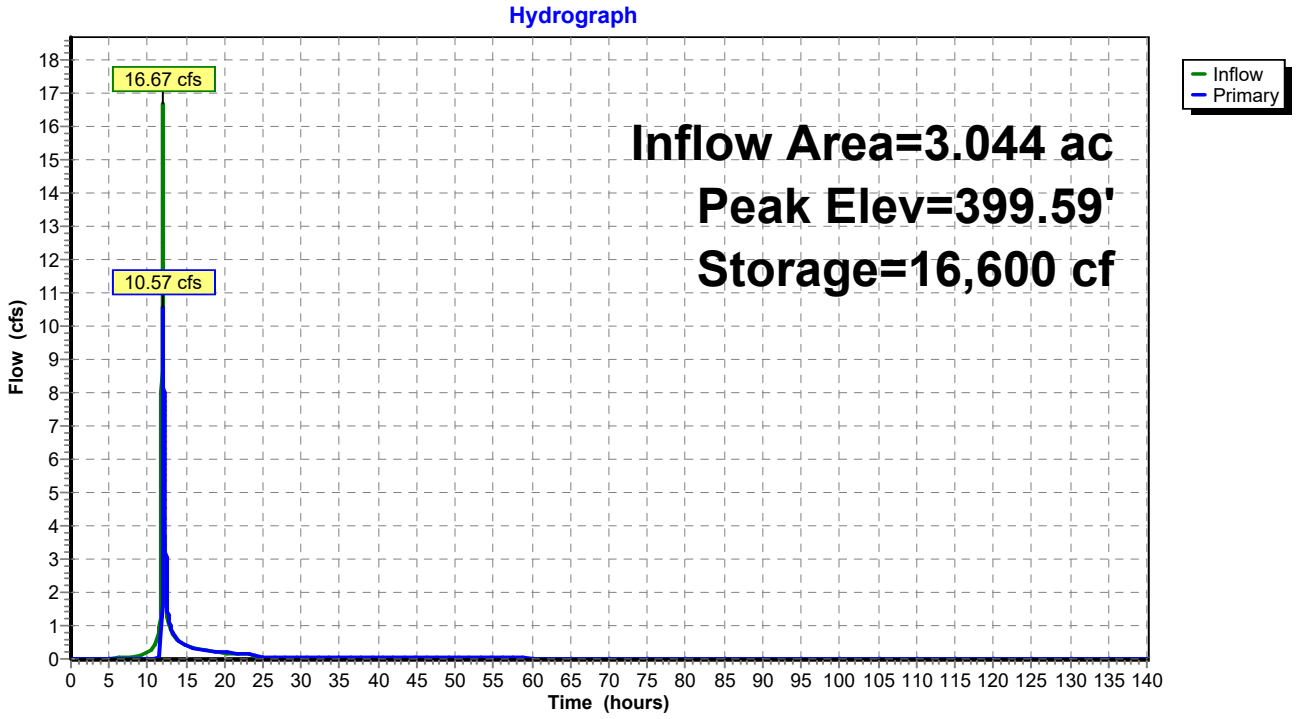
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
397.00	3,465	0	0
398.00	4,164	3,815	3,815
399.00	4,903	4,534	8,348
400.00	5,680	5,292	13,640
400.50	6,084	2,941	16,581

Device	Routing	Invert	Outlet Devices
#1	Primary	394.50'	**24.0" Round Culvert** L= 45.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 394.50' / 384.00' S= 0.2333 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 3.14 sf
#2	Device 1	396.50'	**1.0" Vert. Permanent Pool Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	398.50'	**12.5" Horiz. 15" Orifice/Grate X 2.00** C= 0.600 Limited to weir flow at low heads

#4	Primary	399.50'	**30.0' long + 3.0 '/' SideZ x 3.0' breadth Spillway** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=10.43 cfs @ 12.03 hrs HW=399.59' (Free Discharge)
- **1=Culvert** (Passes 8.60 cfs of 24.14 cfs potential flow)
  - **2=Permanent Pool Orifice/Grate** (Orifice Controls 0.05 cfs @ 8.40 fps)
  - **3=15" Orifice/Grate** (Orifice Controls 8.55 cfs @ 5.02 fps)
- **4=Spillway** (Weir Controls 1.84 cfs @ 0.71 fps)

Pond GWL2: Gravel Wetland #2



Summary for Pond Tank IN: Tank Inlet

Inflow Area = 2.930 ac, 36.52% Impervious, Inflow Depth = 3.71" for 100-year event
Inflow = 17.81 cfs @ 11.97 hrs, Volume= 0.907 af
Outflow = 17.81 cfs @ 11.97 hrs, Volume= 0.907 af, Atten= 0%, Lag= 0.0 min
Primary = 7.71 cfs @ 11.97 hrs, Volume= 0.776 af
Routed to Pond GWL1 : Gravel Wetland #1
Secondary = 10.10 cfs @ 11.97 hrs, Volume= 0.131 af
Routed to Reach Tank Out : Tank Outlet

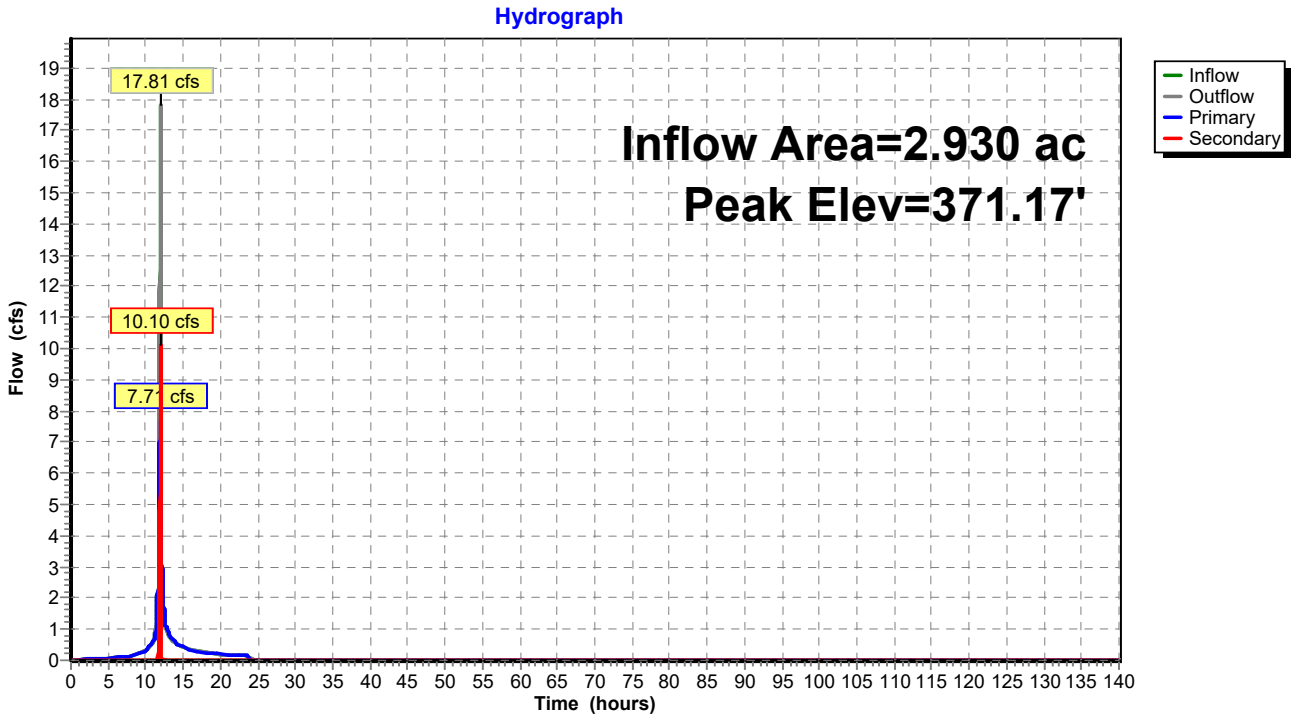
Routing by Stor-Ind method, Time Span= 0.00-140.00 hrs, dt= 0.01 hrs
Peak Elev= 371.17' @ 11.97 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	369.10'	**18.0" Round 18" Culvert to GWL** L= 20.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 369.10' / 369.00' S= 0.0050 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 1.77 sf
#2	Secondary	370.58'	**7.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=7.71 cfs @ 11.97 hrs HW=371.17' (Free Discharge)
└**1=18" Culvert to GWL** (Inlet Controls 7.71 cfs @ 4.36 fps)

Secondary OutFlow Max=10.09 cfs @ 11.97 hrs HW=371.17' (Free Discharge)
└**2=Sharp-Crested Rectangular Weir** (Weir Controls 10.09 cfs @ 2.50 fps) ← **flow over tank overflow weir**

Pond Tank IN: Tank Inlet



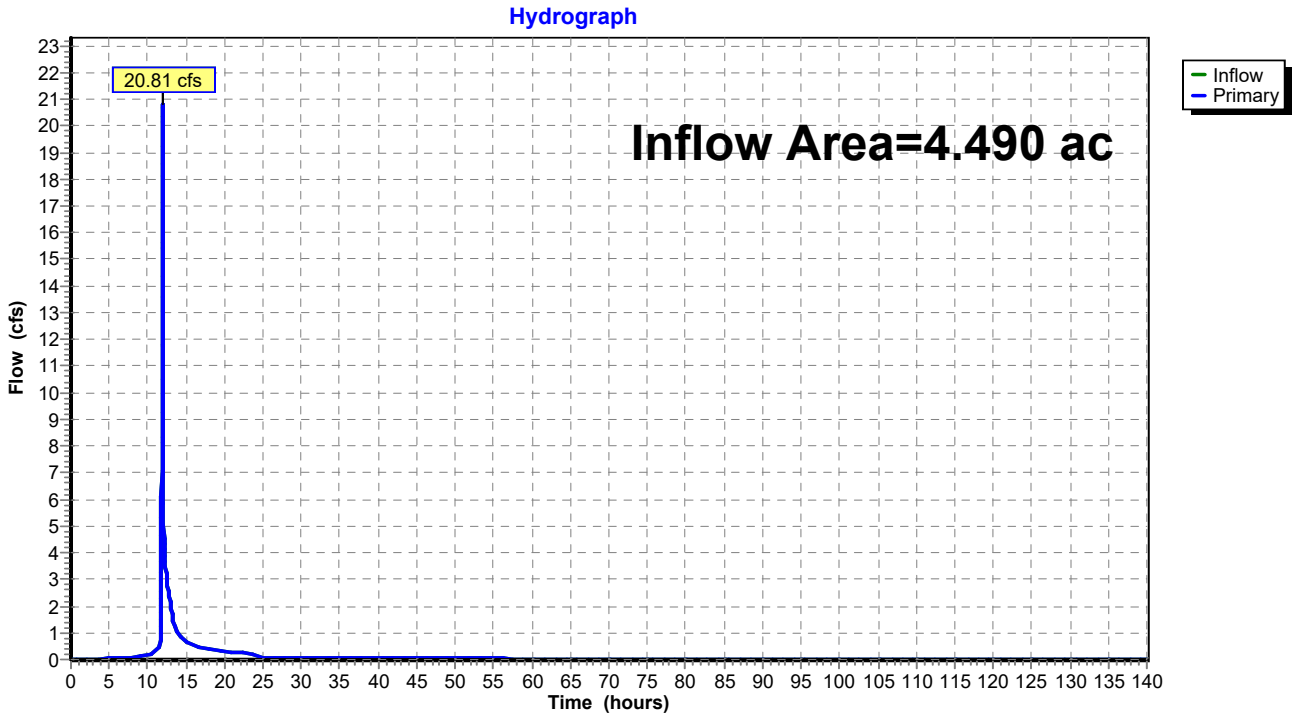
Summary for Link N: SN001

Inflow Area = 4.490 ac, 23.83% Impervious, Inflow Depth = 3.37" for 100-year event
Inflow = 20.81 cfs @ 11.98 hrs, Volume= 1.260 af
Primary = 20.81 cfs @ 11.98 hrs, Volume= 1.260 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-140.00 hrs, dt= 0.01 hrs

Post Development Peak Flow to SN001 20.81-cfs

Link N: SN001



Summary for Link S: SN002

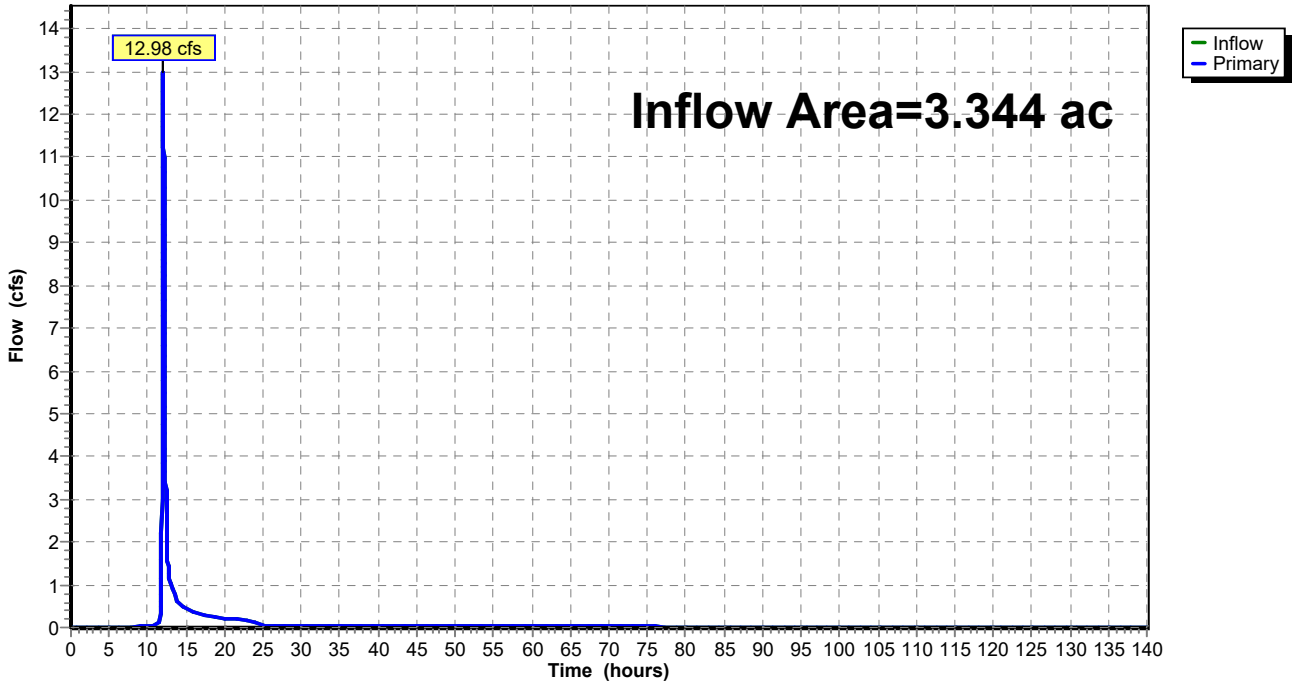
Inflow Area = 3.344 ac, 10.89% Impervious, Inflow Depth = 3.25" for 100-year event
Inflow = 12.98 cfs @ 12.05 hrs, Volume= 0.905 af
Primary = 12.98 cfs @ 12.05 hrs, Volume= 0.905 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-140.00 hrs, dt= 0.01 hrs

Post Development Peak Flow to SN002 12.98-cfs

Link S: SN002

Hydrograph



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Stormwater Operation & Maintenance Manual

This project features stormwater appurtenances which require inspection and maintenance on a regular basis.

These features include:

- (2) underground pretreatment tanks
- (1) deep sump catch basin for pretreatment
- (2) gravel wetland treatment areas
- (2) conveyance swales

The owner shall be responsible for providing ongoing site inspections and maintenance to provide long-term functionality of the stormwater system. It is recommended that, at minimum, the site be inspected on a semi-annual basis, once after snow-melt and once before leaf-drop.

This document identifies the inspection and maintenance requirements of each of the stormwater features.

1. The owner shall be responsible for conducting the required inspection, reporting and maintenance activities outlined by this document:

   Joe Laster
   1139 Lanier Boulevard
   Atlanta, GA 30306
   404-822-6990
   joelaster@mindspring.com

2. An inspection checklist (attached) shall be completed during each inspection.
3. An Operation & Maintenance Log shall be completed to track each inspection as well as maintenance activities. The Log can be found attached to this document.
4. An Operation & Maintenance Plan identifies on-site stormwater appurtenances and is attached to this document.
5. The frequency of the inspections and maintenance requirements shall be as follows:

   Systems shall be inspected at least once annually, and following storm events exceeding 1-inch of rainfall in a 24-hour period, with maintenance and rehabilitation conducted as warranted by such inspection.

UPT – Underground Pretreatment Tanks or Forebays:

- Systems shall be inspected once annually, with inspections recommended semi-annually.
- Structures shall be cleaned annually (by use of vacuum truck or “clam-shell”) and when inspection indicates sediment accumulation depth is approaching half the depth to the lowest outlet.
- All floating debris shall be removed and disposed of in an acceptable manner.
- Remove floating hydrocarbons immediately whenever detected by inspection and review upstream conditions for potential sources.

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CB – Deep Sump Pretreatment Catch Basin:

- Systems shall be inspected once annually, with inspections recommended semi-annually.
- Structures shall be cleaned annually (by use of vacuum truck or "clam-shell") and when inspection indicates sediment accumulation depth is approaching half the depth to the lowest outlet.
- Replace damaged hoods when present on inlet pipes.
- All floating debris shall be removed and disposed of in an acceptable manner.
- Remove floating hydrocarbons immediately whenever detected by inspection.

GWL – Gravel Wetlands:

- During the first year of operation, systems shall be inspected following rainfall events of at least 1-inch over a 24-hour period to verify operation. Vegetation and landscaping condition to be reviewed spring and fall of the first year to ensure growth has been established over 85% of the planting zones. Dead plantings shall be removed and replaced. Invasive species and woody vegetation shall be removed.
- Organic material build-up shall be removed from the gravel treatment area as required, typically every other year at the end of the growing season.
- Inspect and remove trash and debris annually.
- Sediment shall be removed once accumulation approaches a depth of 6-inches.

SWL – Conveyance Swales

- Systems shall be inspected once annually, with inspections recommended semi-annually.
- Inspect for sedimentation, erosion, and condition of vegetative and/or stone surface lining. Repairs, including stone or vegetation replacement, should be made based on each inspection.
- Remove sediment, trash and debris annually, or more frequently as warranted by inspection.
- Sediment shall be removed once accumulation approaches a depth of six inches.
- Mow vegetated channels at least once per year to control establishment of woody vegetation. Vegetation height should be maintained between 4-inches and 6-inches.

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O&M Checklist

Inspector:	Date:
Current Weather:	Time:
Rainfall in the Last 24 Hours (in): Can be checked here: http://www.nrcc.cornell.edu/page_nowdata.html	

Underground Pretreatment Tanks: Inspection Required Annually, Recommended Twice Annually
***Inspections Required after rainfall events of at least 1-inch during six months after installation

Items Inspected (Frequency)	Checked		Maintenance Needed		Maintenance Performed	
DEBRIS CLEANOUT	Y	N	Y	N	Y	N
1. Contributing areas clean of debris.						
2. Litter (trash, debris, etc.) have been removed						
SEDIMENTATION TANK						
3. All Floating debris removed and disposed of.						
4. Sediment removed when height reaches ½ depth to lowest orifice.						
5. Tank cleaned out at least once annually.						
6. Floating hydrocarbons removed immediately.				`		
INLET / OUTLET STRUCTURES						
7. Good condition, no need for repair						
8. No evidence of sediment build-up.						
9. No evidence of any blockages.						

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O&M Checklist

Inspector:	Date:
Current Weather:	Time:
Rainfall in the Last 24 Hours (in): Can be checked here: http://www.nrcc.cornell.edu/page_nowdata.html	

Deep Sump Catch Basin/Manhole: Inspection Required Annually, Recommended Twice Annually

Items Inspected (Frequency)	Checked		Maintenance Needed		Maintenance Performed	
DEBRIS CLEANOUT	Y	N	Y	N	Y	N
1. Contributing areas clean of debris.						
2. Litter (trash, debris, etc.) have been removed						
SEDIMENTATION TANK						
3. All Floating debris removed and disposed of.						
4. Sediment removed when height reaches ½ sump depth.						
5. Structure cleaned out at least once annually.						
6. Floating hydrocarbons removed immediately.				`		
INLET / OUTLET STRUCTURES						
7. No evidence of damaged hood, no need for repair						
8. No evidence of sediment build-up.						
9. No evidence of any blockages.						

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O&M Checklist

Inspector:	Date:
Current Weather:	Time:
Rainfall in the Last 24 Hours (in): Can be checked here: http://www.nrcc.cornell.edu/page_nowdata.html	

Gravel Wetland Treatment Area Components: Inspection Required Annually, Recommended Twice Annually ***Inspections Required after rainfall events of at least 1-inch during first year of operation

Items Inspected (Frequency)	Checked		Maintenance Needed		Maintenance Performed	
DEBRIS CLEANOUT	Y	N	Y	N	Y	N
1. Gravel wetland and contributing areas clean of debris.						
2. No dumping of yard wastes into gravel wetland area.						
3. Litter (trash, debris, etc.) have been removed.						
VEGETATION						
4. No evidence of erosion.						
5. Plant composition is still according to plans.						
6. Vegetation established over 85% of planting zones.						
7. No placement of inappropriate plants.						
8. No evidence of invasive species or woody vegetation.						
9. Dead plantings removed and replaced.						
DEWATERING AND SEDIMENTATION						
10. Surface ponds dewater between storms.						
11. No evidence of standing water.						
12. No evidence of surface clogging.						
13. Sediment removed if approaching six inch depth.						
OUTLETS/OVERFLOW						
14. Good condition, no need for repair						
15. No evidence of erosion.						
16. No evidence of any blockages.						

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Conveyance Swale: Inspection Required Annually, Recommended Twice Annually

Items Inspected	Checked		Maintenance Needed		Maintenance Performed	
DEBRIS CLEANOUT	Y	N	Y	N	Y	N
1. Contributing areas clean of debris.						
2. Litter (trash, debris, etc.) have been removed.						
3. No evidence of sediment accumulation.						
4. Sediment removed if approaching six inch depth.						
VEGETATION						
5. No evidence of erosion.						
6. Grassed channel mowed to no shorter than four inches.						
7. No evidence of invasive species or woody vegetation.						

Comments:_____

Date by which outstanding maintenance must be completed:_____

Inspector's Signature:_____

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O&M Log

Date	Appurtenances Inspected	Maintenance Performed	Inspector's Signature

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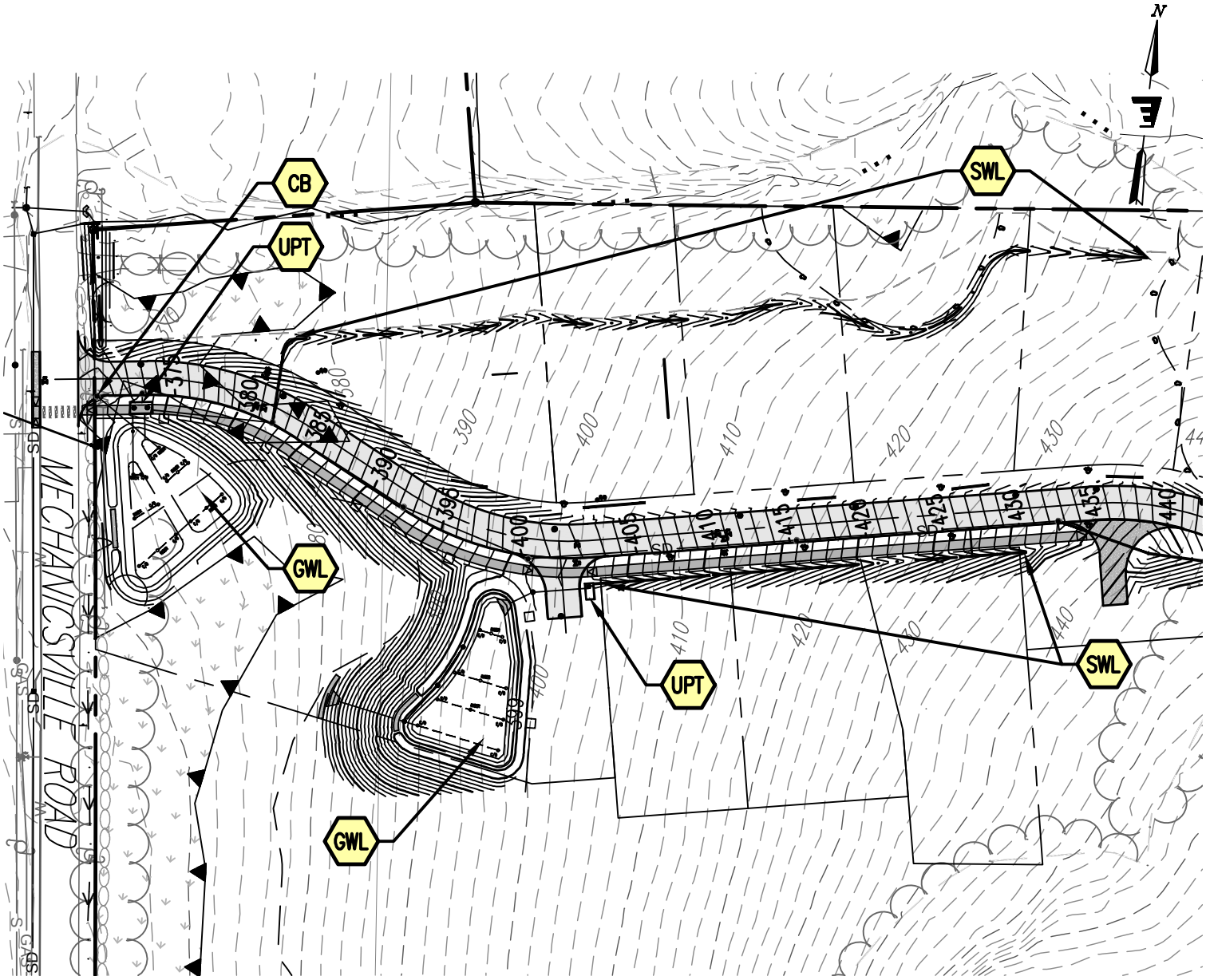

PLAN KEY

scale: 1" = 100'

- UPT — UNDERGROUND PRETREATMENT TANK
- CB — DEEP SUMP CATCH BASIN FOR PRETREATMENT
- GWL — GRAVEL WETLAND TREATMENT AREA
- SWL — STORMWATER CONVEYANCE SWALE