PRELIMINARY STORMWATER EVALUATION

For

Demarest Pointe

New Hanover County, North Carolina

Prepared for

Middlesound LLC.

Date: June 29, 2020

Prepared by:

CAPE FEAR ENGINEERING

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Cape Fear Engineering (CFE) was requested to analyze independently the conceptual stormwater management plan for the proposed Demarest Pointe neighborhood prepared by Middlesound LLC, Scott D Stewart RLA ASLA and was requested to further provide CFE's professional opinion regarding the 5-13-20 CSD Engineering conceptual stormwater evaluation **(attached as Exhibit A**).

CFE further prepared preliminary hydrologic analysis (**Water Quantity),** evaluated potential flooding impacts **(Flood Zone Information)**, Watershed Impacts **(Watershed Characteristics)** and water quality impacts **(Water Quality)** on neighboring and downstream properties.

WATER QUANTITY

The Demarest Pointe project would be required to comply with New Hanover County stormwater ordinance which requires attenuation post-development runoff rates from the 2-year (4.5"), 10-year (7.0"), and 25-year (8.05") 24-hour storm events to pre-development values.

CFE performed a preliminary routing analysis of the concept stormwater plan **(attached as Exhibit B)** utilizing Hydraflow Hydrographs modeling software. Model results show that the Demarest Pointe neighborhood is expected to reduce runoff for not only the NHC required design storms but also the 500-year (18.10") and 1,000-year (21.1") storms.

A summary of results from CFE's routing analysis is shown in the table below.

Design Storm	Pre-Dev. Runoff (CFS)	Post-Dev. Discharge (CFS)	Difference (CFS)
2-year	0.15	0.10	-0.05 (33% reduction)
10-year	2.40	1.46	-0.94 (39% reduction)
25-year	4.12	2.35	-1.77 (43% reduction)
50-year	5.92	2.92	-3.0 (51% reduction)
100-year	8.02	4.07	-3.95 (49% reduction)
500-year	29.00	22.69	-6.31 (22% reduction)
1000-year	37.92	35.26	-2.66 (7% reduction)

A similar analysis was performed by CSD Engineering **(attached as Exhibit A**) which also showed attenuation of post-development runoff rates for up to the 1,000-year storm. The analysis performed by CSD Engineering was performed using the same methodology and modeling software as CFE; however, there were very minor differences in model inputs for drainage area due to the conceptual nature of the

study, SCS curve numbers, times of concentrations, pond contour surface areas, and pond outlet configuration/elevations.

In conclusion, CFE agrees with the overall findings of the 5-13-20 CSD Engineering report. CFE recognizes the Demarest Pointe neighborhood stormwater program will confidently manage a minimum of a 500-year storm event and through the required permitting process, it is feasible to approach or meet attenuation of the 1,000 year storm event.

FLOOD ZONE INFORMATION

According to FEMA flood maps, **(attached as Exhibit C)** the Demarest Pointe neighborhood is located outside of the 100-year flood zone. Elevations onsite range from approximately +27' to +29'. The nearest 100-year flood zone is located approximately 2,400' to the southeast with a reported food elevation of +13'.

We understand that there have been concerns raised about the Demarest Pointe neighborhood proposal because there has been a history of downstream flooding. Review of FEMA maps and available elevation information shows that the downstream properties are at significantly lower elevations than the proposed Demarest Pointe project site whereas many downstream properties have been built within the 100 year flood zone and experience frequent flooding due to the existing elevations of the homes that were built within the 100 year flood zone of Pages Creek.

One specific location of historical flooding is at the intersection of Parliament Drive and E. Bedford Drive. According to survey information provided by Atlantic Coast Surveying **(attached as Exhibit D)** the elevation of this intersection is approximately 6.0' msl as compared to flood zone elevation of 13' msl.

WATER QUALITY

Because the proposed Demarest Pointe neighborhood will disturb more than one acre and construct more than 10,000 sf it will require a State Stormwater permit from NCDEQ. The required water quality design storm standards are based on the location of the Demarest Pointe neighborhood, classification of receiving waterbody, and proximity of the site to the receiving water body.

Typically, projects are required to store and treat runoff volume from the 1.5" design storm; however, Projects draining to and withing ½ mile of SA waters are required to store and treat runoff volume equal to the difference in post-development and pre-development runoff from the 1-year 24-hour storm.

Pages Creek is classified as SA waters but since the Demarest Pointe neighborhood is greater than ½ mile from Pages Creek, approximately 0.65 miles, **(attached as Exhibit E)** the Demarest Pointe neighborhood is only required to be designed for the 1.5" water quality design storm.

Preliminary calculations for the project indicate a water quality design volume of approximately 8,300 CF for the 1.5" event compared to 16,200 CF for the 1-year 24-hour storm event.

Due to low infiltration rates and relatively shallow seasonal highwater table (SHWT), (**attached as Exhibit F),** a wet detention basis is expected to be the primary water quality treatment BMP. Based on the contributing drainage area, proposed impervious coverage, and anticipated pond depth it is estimated that a pond surface area of 4,800 sf will be required. The conceptual stormwater plan includes a pond with estimated surface area of 12,500 sf (approximately 260% of requirement).

Additionally, the conceptual stormwater plan incorporates additional storage and treatment in four rain gardens and one water quality swale **(attached as Exhibit G).**

It is the opinion of CFE that the proposed Demarest Pointe neighborhood will provide significantly more stormwater treatment than required by NCDEQ. It is anticipated that the Demarest Pointe neighborhood will provide total treatment volume equal to the more stringent SA waters requirements, though not required. Demarest Pointe will have no adverse or negative impacts on downstream water quality.

WATERSHED CHRACTERISTICS

Utilizing USGS Quad maps and NCDEQ Online Stream Mapping application it was determined that the Demarest Pointe neighborhood is part of the Pages Creek watershed. According to the USGS StreamStats online application the contributing drainage area at the upper end of Pages creek is 2.21 square miles (~1400 acres) with an estimated impervious coverage of 14.4% (~202 acres) **(attached as Exhibit H)**.

The entire Demarest Pointe site area (including drainage easement) is approximately 4.7 acres, which makes up less than 0.035% of the contributing watershed at the point of analysis on Pages Creek.

Additionally, the Demarest Pointe neighborhood is expected to have impervious coverage of 65,000 sf. Construction of this impervious will result in a new watershed impervious coverage of 14.54% (~0.14%% increase).

EXHIBIT A

CSD Engineering Conceptual Stormwater Evaluation

CSD ENGINEERING

May 13, 2020

Scott D. Stewart
Middlesound, LLC
6933 Runningbrook Terrace
Wilmington, North Carolina 28411

Re: Demarest Pointe
Additional Stormwater Calculations
New Hanover County

Dear Scott:

We have reviewed the conceptual stormwater management program for the proposed Demarest Pointe project to determine if the conceptual onsite stormwater management control measures have the capacity to attenuate a storm event larger than the 100 yr storm. In reviewing the New Hanover County Stormwater Design Manual, the 100 yr storm is the largest event referenced and lists the rainfall as 10 inches over a 24 hr period. For larger storm events, we utilize online rainfall data published on NOAA's website for the Wilmington Station, in this case to analyze the 500 year and 1,000 year events. Relevant rainfall data was input into our hydraulic modeling software along with site specific data and design contour information associated with the proposed stormwater control measures (SCM's). SCS hydrographs with Type III distributions were then generated for the pre-development, post-development, and routed conditions, producing volumes, peak flow rates, and maximum stage elevations within the SCM for each condition. Please reference the table below for the results of the 100 year, 500 year, and 1,000 year pre/post/routed analyses:

Storm Event	Rainfall (inches)	Pre-Dev Volume (CF)	Pre-Dev Peak Flow (CFS)	Post-Dev Volume (CF)	Post-Dev Peak Flow (CFS)	Routed Flow (CFS)	Max. Water elev. (FT)	Top of pond (FT)
100	10.0	48,774	16.12	82,322	26.95	8.44	26.00	27.0
500	18.1	126,880	42.31	174,484	54.26	32.05	26.75	27.0
1,000	21.1	158,089	52.43	206,452	64.26	46.02	26.87	27.0

To further summarize, results of the 500 year storm event (18.1 inches over a 24 hour period) model show the proposed stormwater management system will decrease the flow from the developed site to a lower rate than if the site was left undeveloped, reducing the flow by over 10 CFS. For the 1,000 yr storm event (21.1 inches over a 24 hour period), the

modeling also yields similar results with a reduction in overall routed post development flow from the site, decreasing the post development flow by over 6 CFS when compared to the pre-development condition. For all three events, the models indicate that the SCM's peak stage elevation will not overtop the pond embankment.

For your reference, we have attached the hydrograph modeling reports. We thank you for the opportunity to be involved in this project and look forward to assisting in any manner possible. Please call or email me if you require any additional information or have any questions.

Sincerely,

Howard Resnik, PE

Attachments

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	16.12	2	724	48,774	----	----	----	Pre_Dev
2	SCS Runoff	26.95	2	724	82,322	----	----	----	Post_Dev
4	Reservoir	8.435	2	742	79,730	2	26.00	36,160	Routed

Hydrograph Report

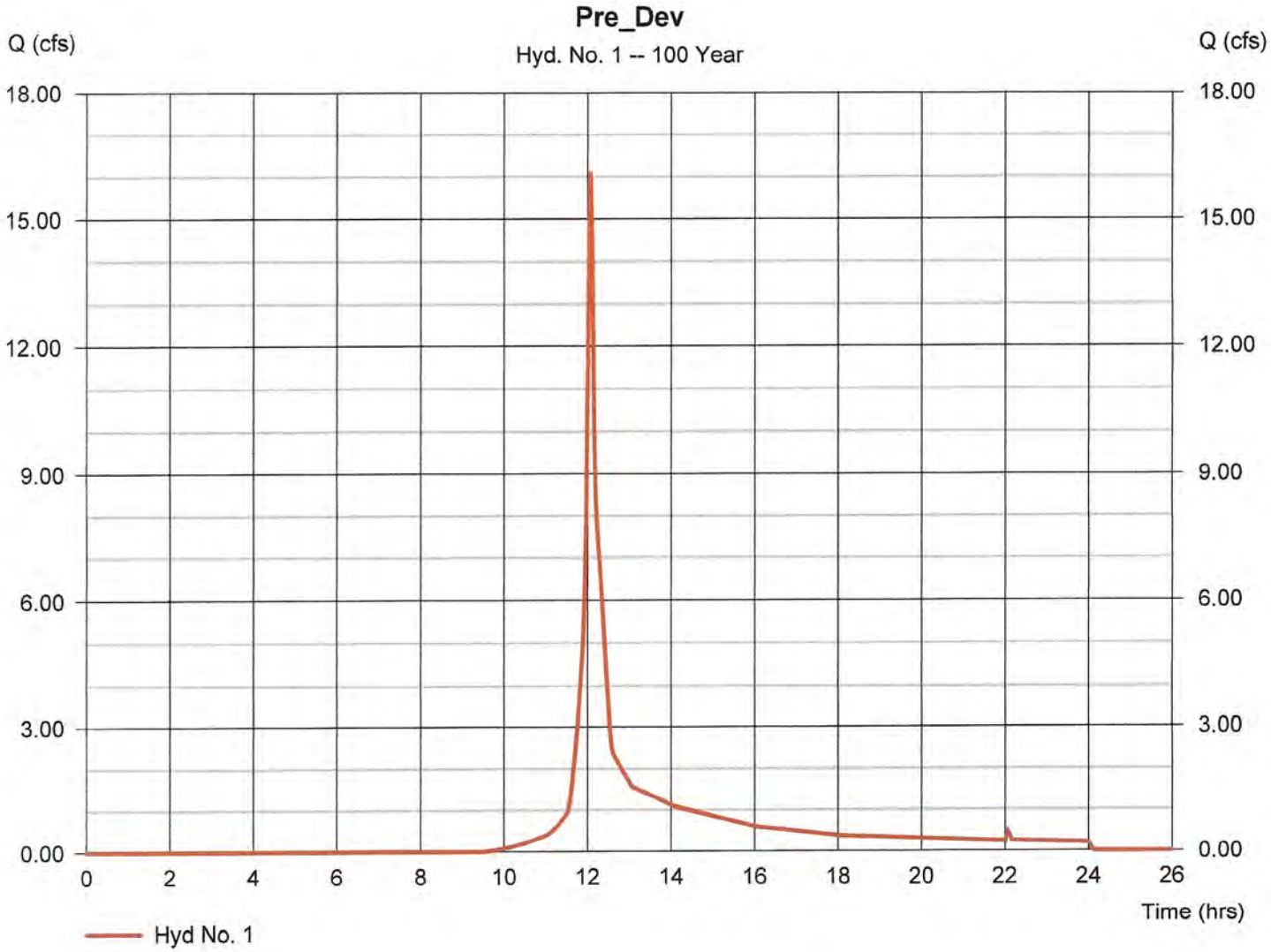
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Wednesday, 05 / 13 / 2020

Hyd. No. 1

Pre_Dev

Hydrograph type	= SCS Runoff	Peak discharge	= 16.12 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.07 hrs
Time interval	= 2 min	Hyd. volume	= 48,774 cuft
Drainage area	= 3.390 ac	Curve number	= 55*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 10.00 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.610 x 98) + (2.670 x 39)] / 3.390



Hydrograph Report

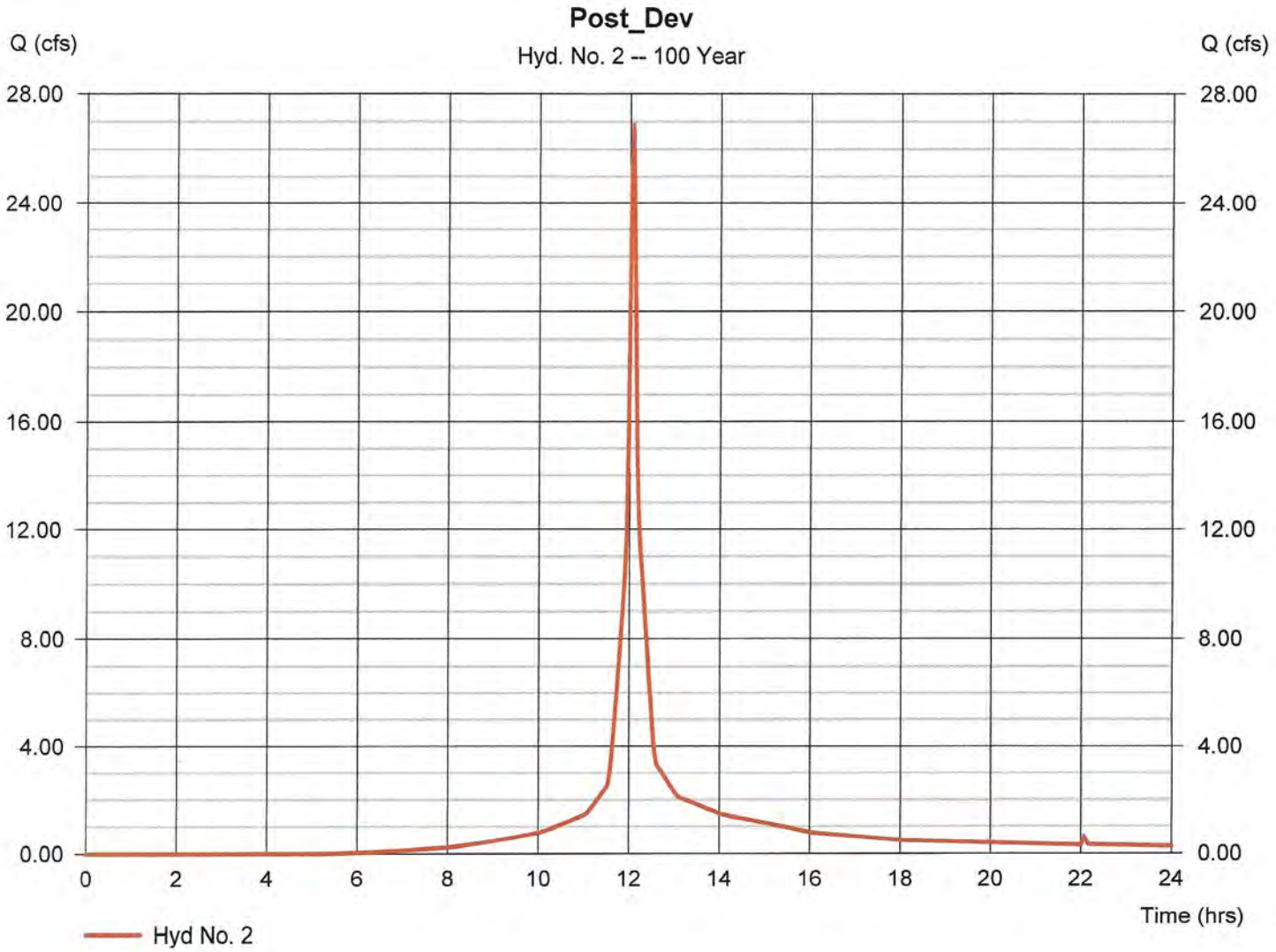
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 — Wednesday, 05 / 13 / 2020

Hyd. No. 2

Post_Dev

Hydrograph type	= SCS Runoff	Peak discharge	= 26.95 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.07 hrs
Time interval	= 2 min	Hyd. volume	= 82,322 cuft
Drainage area	= 3.390 ac	Curve number	= 77*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 10.00 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.490 x 98) + (1.900 x 61)] / 3.390



Hydrograph Report

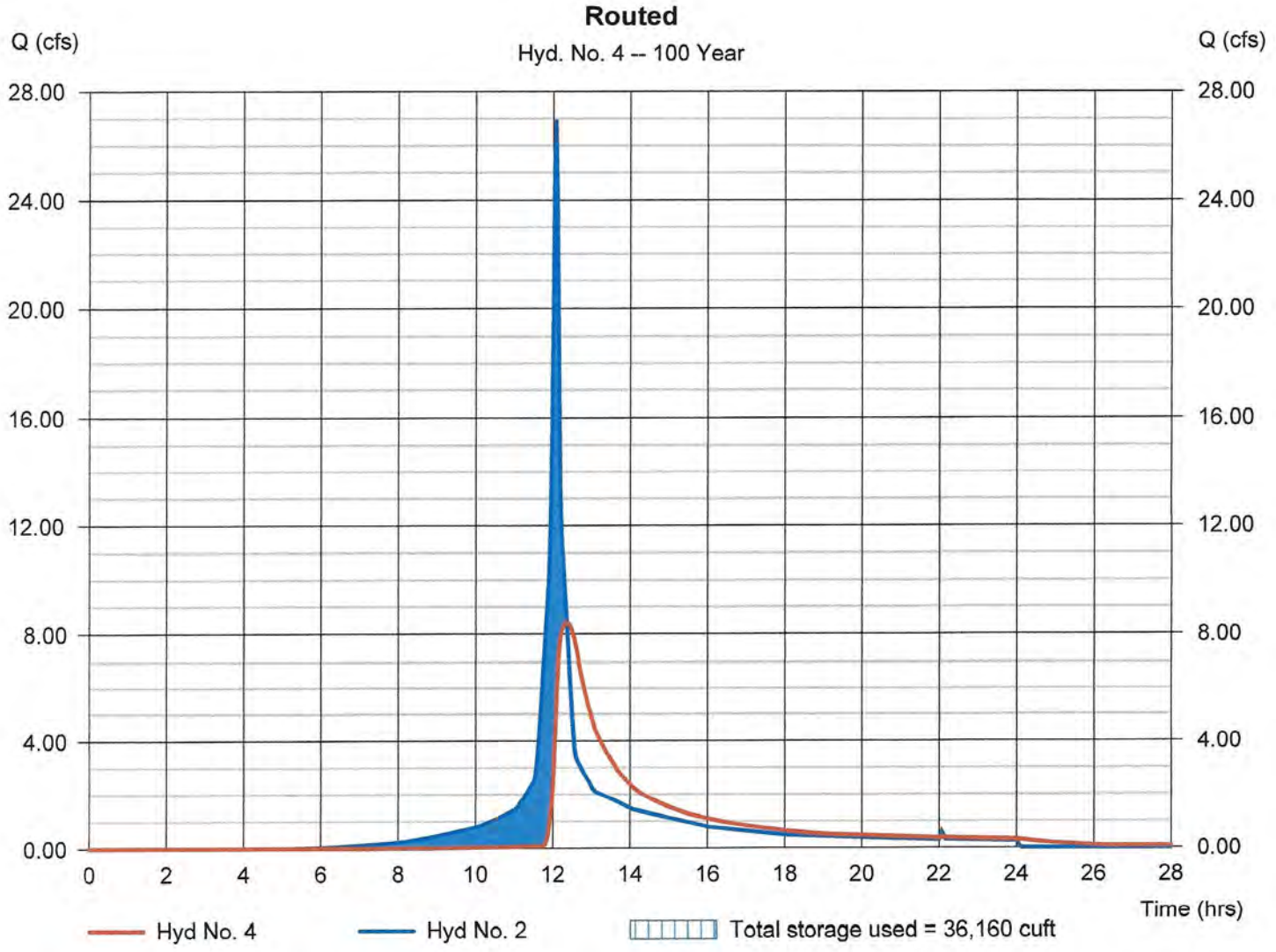
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Wednesday, 05 / 13 / 2020

Hyd. No. 4

Routed

Hydrograph type	= Reservoir	Peak discharge	= 8.435 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.37 hrs
Time interval	= 2 min	Hyd. volume	= 79,730 cuft
Inflow hyd. No.	= 2 - Post_Dev	Max. Elevation	= 26.00 ft
Reservoir name	= Retaining Wall	Max. Storage	= 36,160 cuft

Storage Indication method used.



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	42.31	2	724	126,880	----	----	----	Pre_Dev
2	SCS Runoff	54.26	2	724	172,484	----	----	----	Post_Dev
4	Reservoir	32.05	2	730	169,829	2	26.75	58,358	Routed

Hydrograph Report

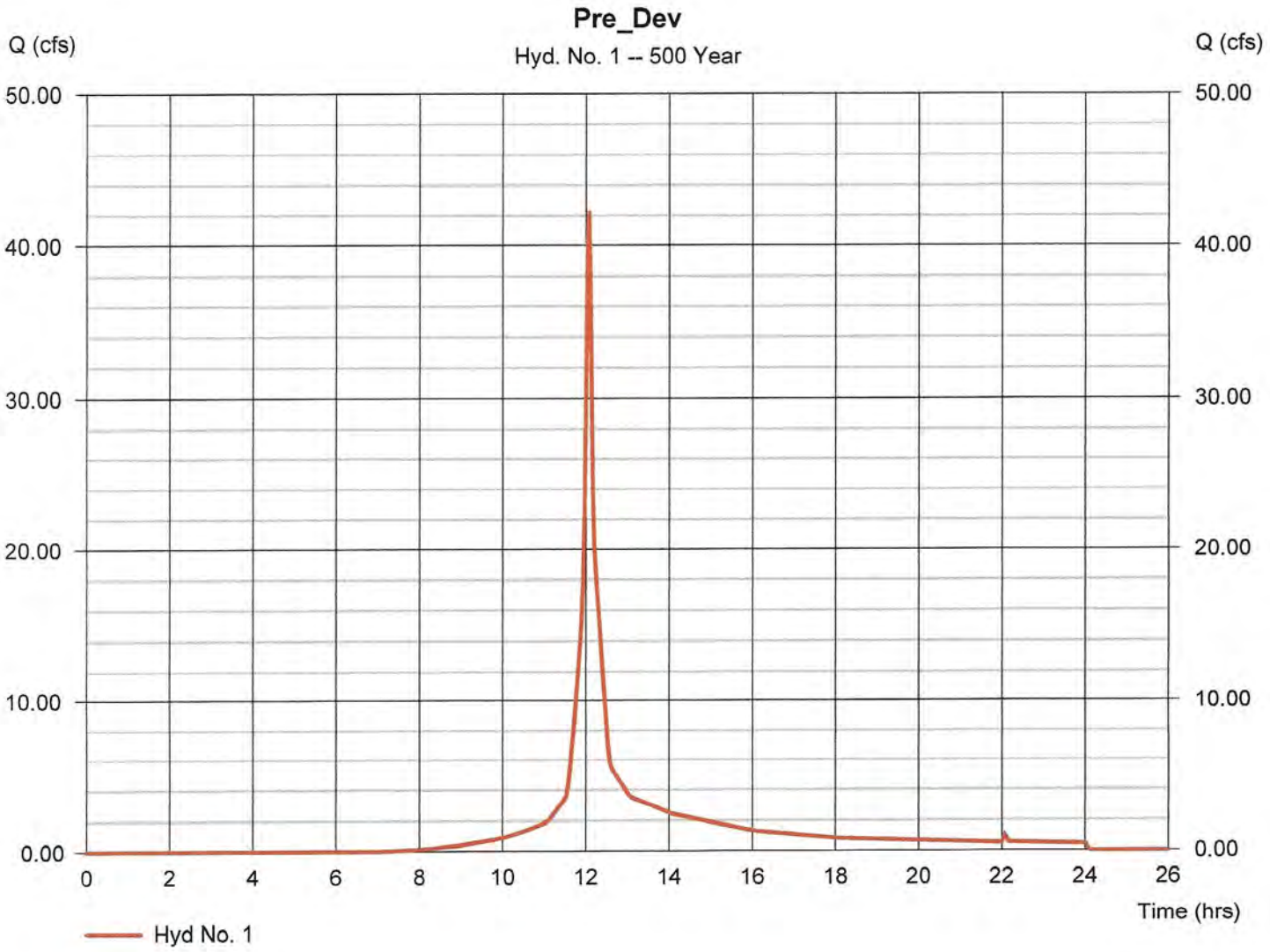
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 — Wednesday, 05 / 13 / 2020

Hyd. No. 1

Pre_Dev

Hydrograph type	= SCS Runoff	Peak discharge	= 42.31 cfs
Storm frequency	= 500 yrs	Time to peak	= 12.07 hrs
Time interval	= 2 min	Hyd. volume	= 126,880 cuft
Drainage area	= 3.390 ac	Curve number	= 55*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 18.10 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.610 x 98) + (2.670 x 39)] / 3.390



Hydrograph Report

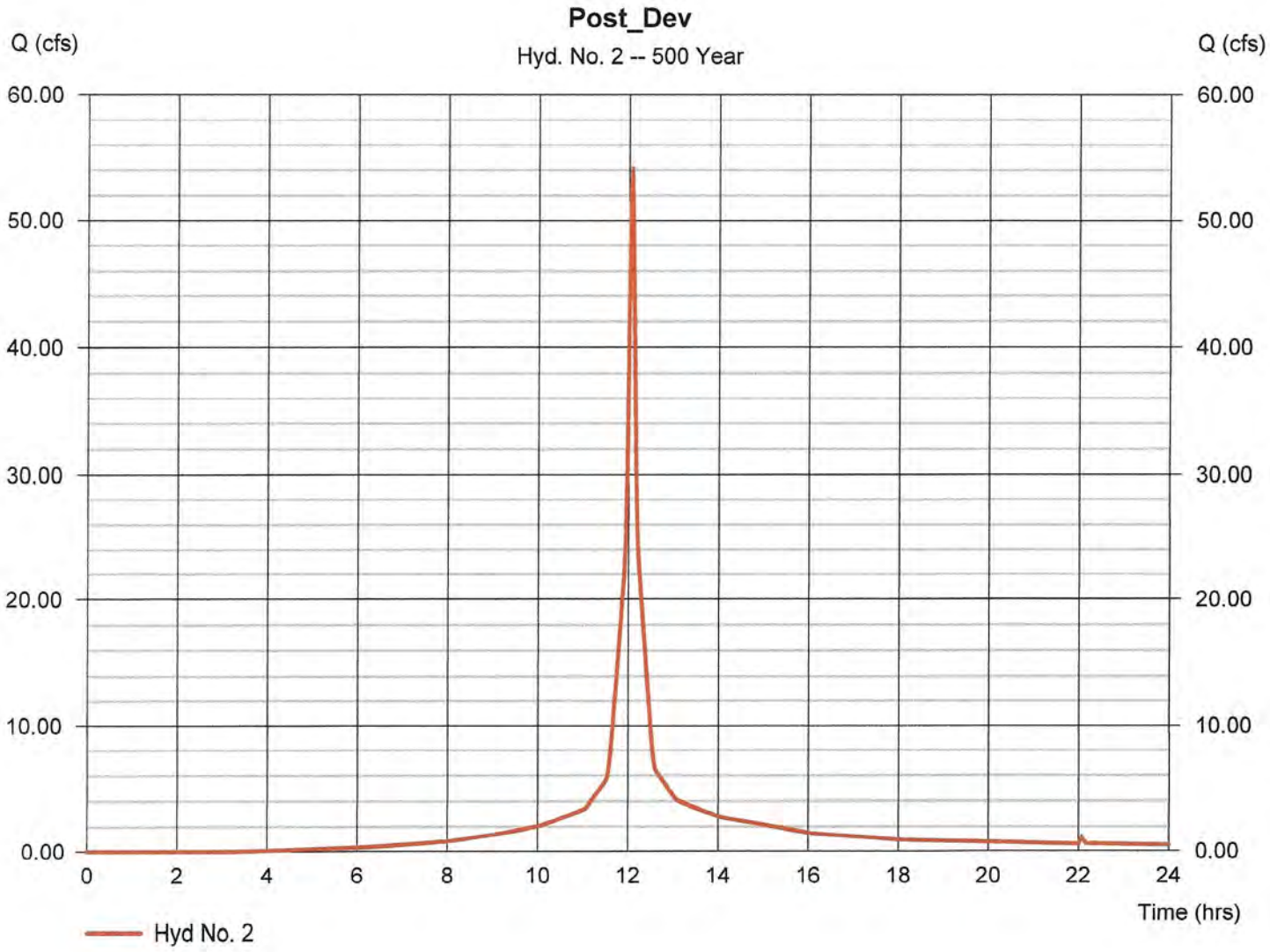
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Wednesday, 05 / 13 / 2020

Hyd. No. 2

Post_Dev

Hydrograph type	= SCS Runoff	Peak discharge	= 54.26 cfs
Storm frequency	= 500 yrs	Time to peak	= 12.07 hrs
Time interval	= 2 min	Hyd. volume	= 172,484 cuft
Drainage area	= 3.390 ac	Curve number	= 77*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 18.10 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.490 x 98) + (1.900 x 61)] / 3.390



Hydrograph Report

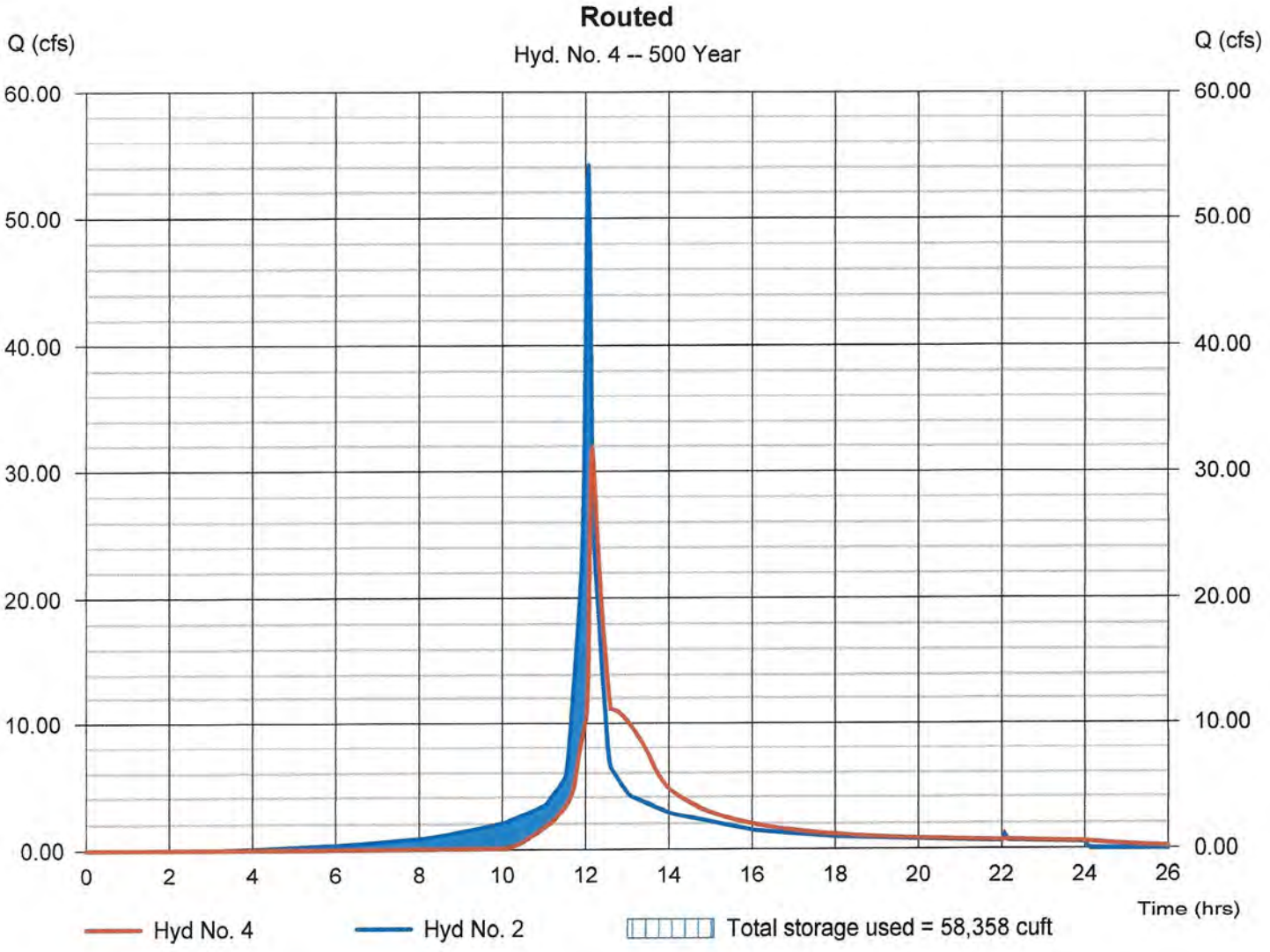
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Wednesday, 05 / 13 / 2020

Hyd. No. 4

Routed

Hydrograph type	= Reservoir	Peak discharge	= 32.05 cfs
Storm frequency	= 500 yrs	Time to peak	= 12.17 hrs
Time interval	= 2 min	Hyd. volume	= 169,829 cuft
Inflow hyd. No.	= 2 - Post_Dev	Max. Elevation	= 26.75 ft
Reservoir name	= Retaining Wall	Max. Storage	= 58,358 cuft

Storage Indication method used.



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	52.43	2	724	158,089	-----	-----	-----	Pre_Dev
2	SCS Runoff	64.26	2	724	206,452	-----	-----	-----	Post_Dev
4	Reservoir	46.02	2	728	203,786	2	26.87	61,987	Routed

Hydrograph Report

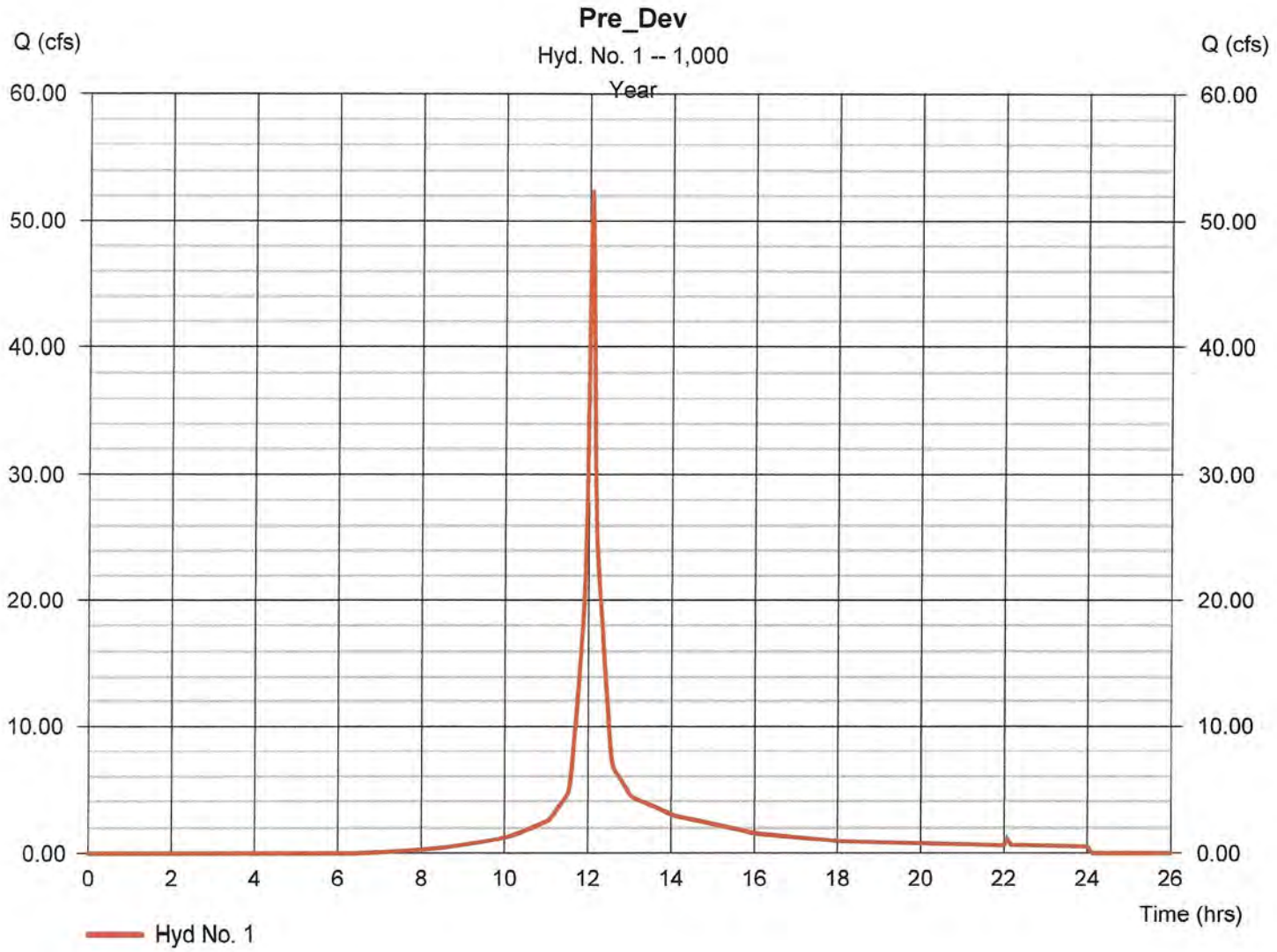
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 — Wednesday, 05 / 13 / 2020

Hyd. No. 1

Pre_Dev

Hydrograph type	= SCS Runoff	Peak discharge	= 52.43 cfs
Storm frequency	= 1,000 yrs	Time to peak	= 12.07 hrs
Time interval	= 2 min	Hyd. volume	= 158,089 cuft
Drainage area	= 3.390 ac	Curve number	= 55*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 21.10 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.610 x 98) + (2.670 x 39)] / 3.390



Hydrograph Report

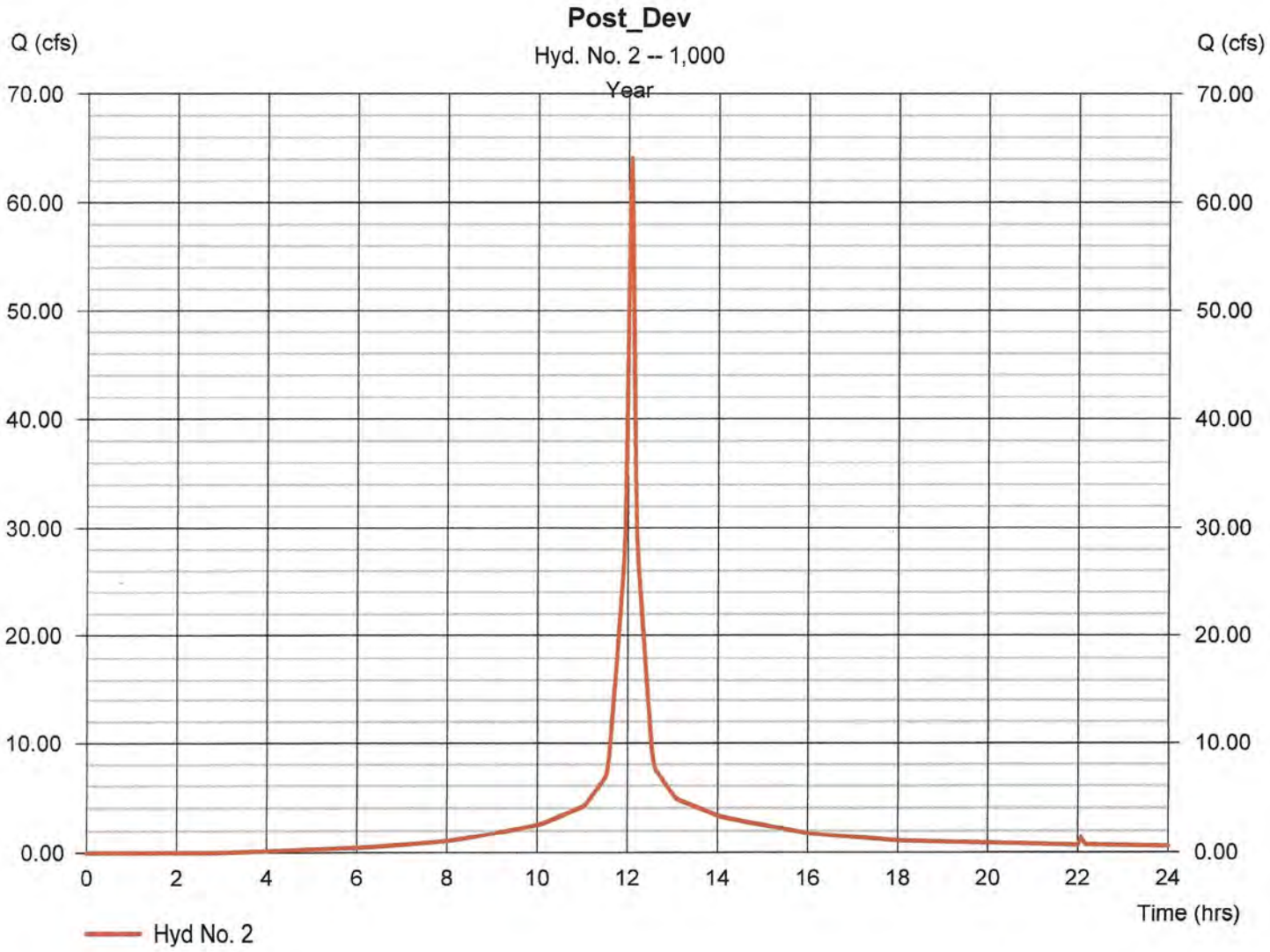
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Wednesday, 05 / 13 / 2020

Hyd. No. 2

Post_Dev

Hydrograph type	= SCS Runoff	Peak discharge	= 64.26 cfs
Storm frequency	= 1,000 yrs	Time to peak	= 12.07 hrs
Time interval	= 2 min	Hyd. volume	= 206,452 cuft
Drainage area	= 3.390 ac	Curve number	= 77*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 21.10 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.490 x 98) + (1.900 x 61)] / 3.390



Hydrograph Report

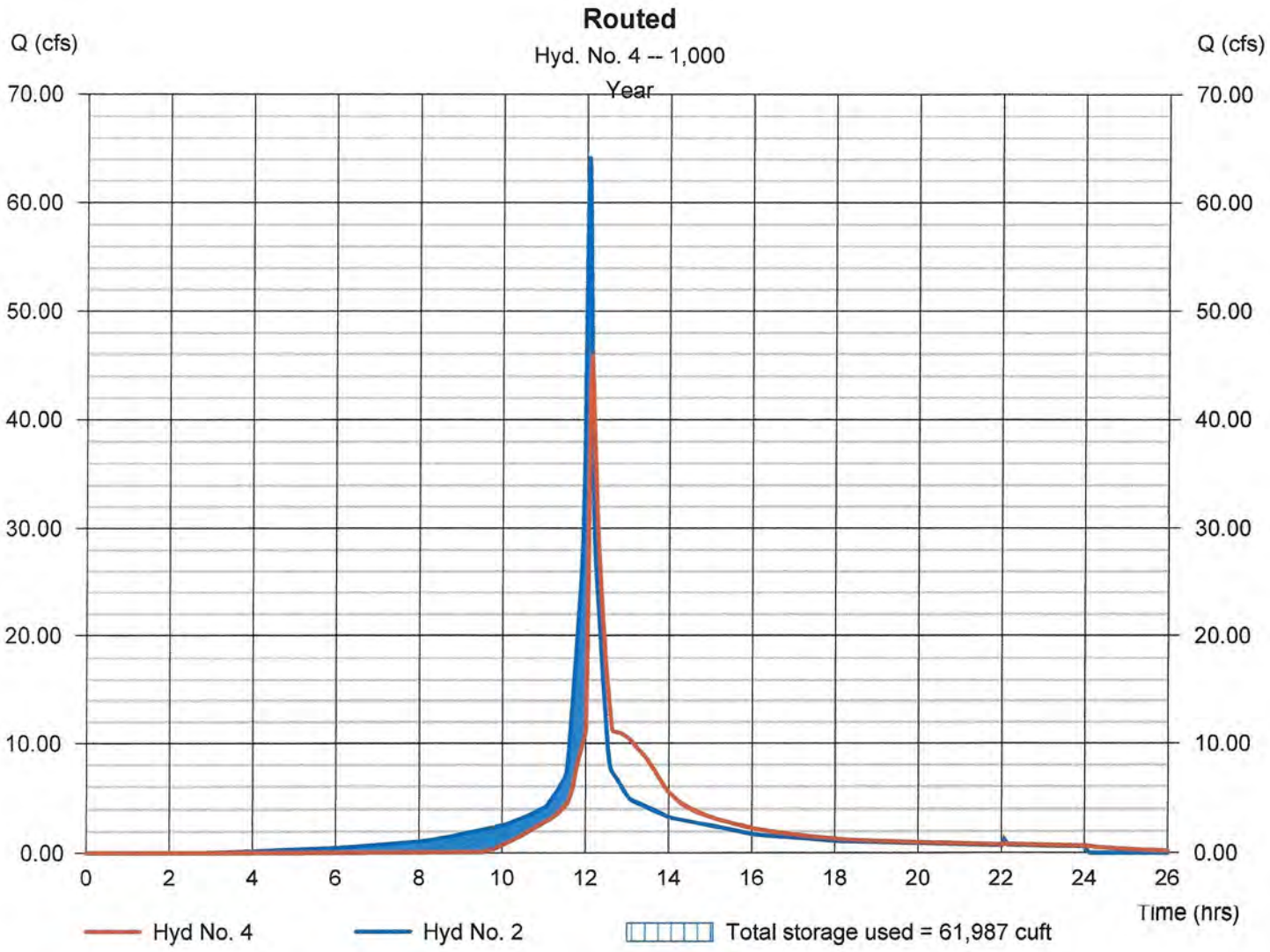
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 | Wednesday, 05 / 13 / 2020

Hyd. No. 4

Routed

Hydrograph type	= Reservoir	Peak discharge	= 46.02 cfs
Storm frequency	= 1,000 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 203,786 cuft
Inflow hyd. No.	= 2 - Post_Dev	Max. Elevation	= 26.87 ft
Reservoir name	= Retaining Wall	Max. Storage	= 61,987 cuft

Storage Indication method used.



Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 — Wednesday, 05 / 13 / 2020

Pond No. 4 - Retaining Wall

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 24.50 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	24.50	19,413	0	0
0.50	25.00	23,283	10,658	10,658
1.50	26.00	27,679	25,447	36,105
2.50	27.00	32,185	29,901	66,006

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	2.00	0.00	0.00
Span (in)	= 24.00	2.00	0.00	0.00
No. Barrels	= 2	1	0	0
Invert El. (ft)	= 24.50	24.50	0.00	0.00
Length (ft)	= 30.00	1.00	0.00	0.00
Slope (%)	= 0.30	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	Yes	No	No

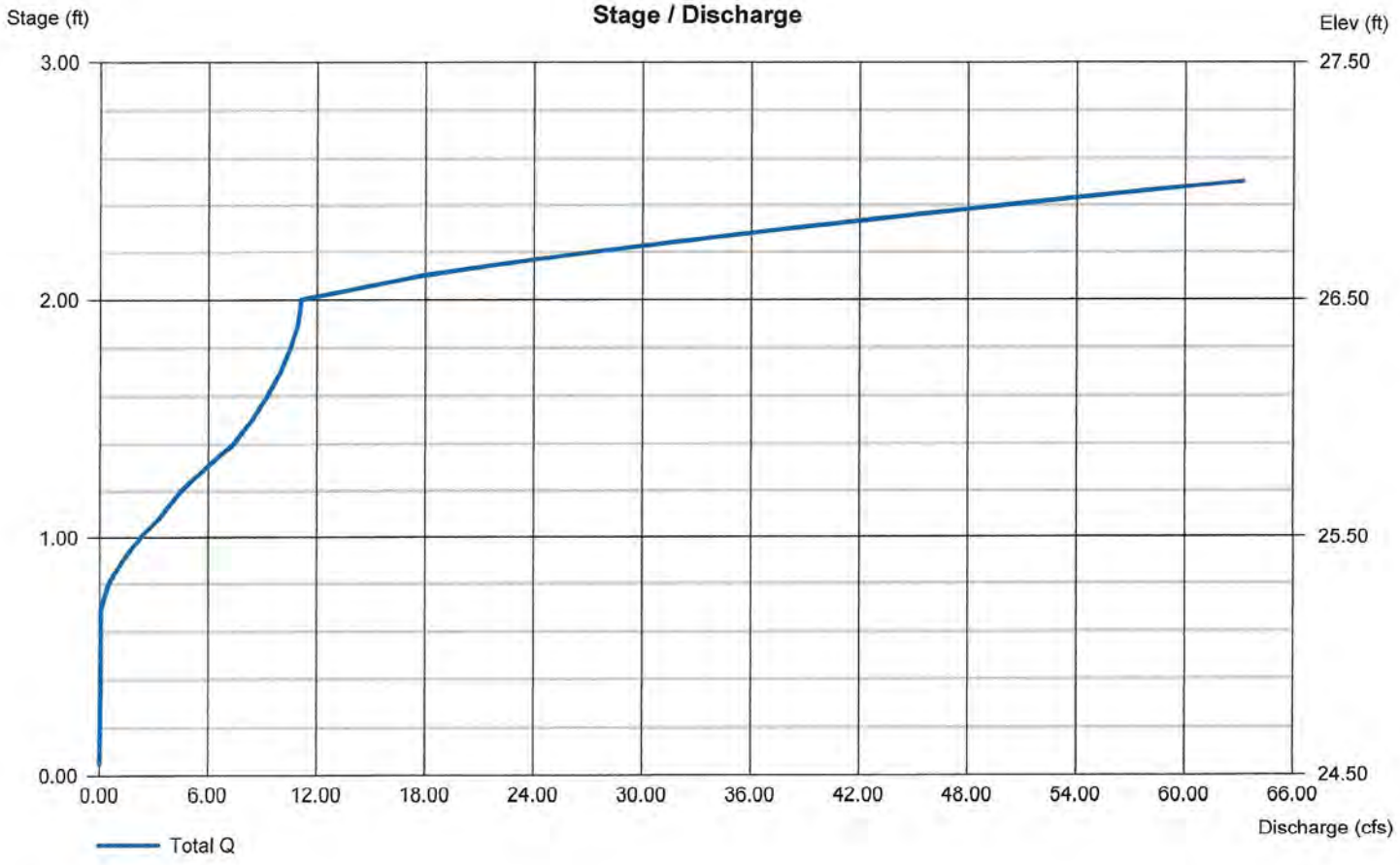
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 8.00	4.00	40.00	0.00
Crest El. (ft)	= 25.70	25.20	26.50	0.00
Weir Coeff.	= 3.33	3.33	2.60	3.33
Weir Type	= 1	Rect	Broad	---
Multi-Stage	= Yes	Yes	No	No

Exfil.(in/hr) = 0.000 (by Wet area)

TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).



NOAA Atlas 14, Volume 2, Version 3
Location name: Wilmington, North Carolina, USA*
Latitude: 34.235°, Longitude: -77.946°
Elevation: 32.65 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.522 (0.488-0.563)	0.620 (0.579-0.668)	0.726 (0.676-0.780)	0.808 (0.750-0.869)	0.913 (0.844-0.978)	0.991 (0.911-1.06)	1.07 (0.981-1.15)	1.15 (1.05-1.24)	1.26 (1.13-1.35)	1.34 (1.20-1.45)
10-min	0.834 (0.779-0.899)	0.992 (0.925-1.07)	1.16 (1.08-1.25)	1.29 (1.20-1.39)	1.46 (1.34-1.56)	1.58 (1.45-1.69)	1.70 (1.56-1.83)	1.83 (1.66-1.96)	1.99 (1.79-2.14)	2.11 (1.89-2.28)
15-min	1.04 (0.974-1.12)	1.25 (1.16-1.34)	1.47 (1.37-1.58)	1.64 (1.52-1.76)	1.84 (1.70-1.98)	2.00 (1.84-2.15)	2.15 (1.97-2.31)	2.31 (2.09-2.48)	2.50 (2.25-2.70)	2.65 (2.37-2.86)
30-min	1.43 (1.34-1.54)	1.72 (1.61-1.86)	2.09 (1.95-2.25)	2.37 (2.20-2.55)	2.73 (2.52-2.93)	3.01 (2.77-3.23)	3.30 (3.02-3.54)	3.59 (3.26-3.86)	3.98 (3.58-4.29)	4.30 (3.83-4.64)
60-min	1.78 (1.67-1.92)	2.16 (2.02-2.33)	2.68 (2.50-2.88)	3.09 (2.86-3.32)	3.64 (3.36-3.90)	4.08 (3.75-4.38)	4.54 (4.16-4.88)	5.03 (4.57-5.41)	5.71 (5.14-6.16)	6.27 (5.59-6.77)
2-hr	2.11 (1.95-2.30)	2.57 (2.37-2.81)	3.28 (3.02-3.57)	3.87 (3.55-4.21)	4.72 (4.31-5.13)	5.45 (4.96-5.93)	6.25 (5.65-6.79)	7.12 (6.40-7.73)	8.42 (7.48-9.16)	9.53 (8.40-10.4)
3-hr	2.26 (2.09-2.47)	2.74 (2.53-3.00)	3.52 (3.24-3.84)	4.18 (3.83-4.56)	5.17 (4.71-5.62)	6.03 (5.47-6.57)	7.00 (6.30-7.60)	8.07 (7.20-8.75)	9.71 (8.56-10.5)	11.1 (9.70-12.1)
6-hr	2.80 (2.59-3.06)	3.40 (3.15-3.73)	4.36 (4.02-4.77)	5.20 (4.77-5.68)	6.45 (5.88-7.02)	7.54 (6.84-8.21)	8.78 (7.91-9.54)	10.2 (9.05-11.0)	12.3 (10.8-13.4)	14.2 (12.3-15.4)
12-hr	3.27 (3.00-3.61)	3.99 (3.65-4.38)	5.14 (4.70-5.66)	6.16 (5.60-6.76)	7.69 (6.94-8.42)	9.06 (8.13-9.98)	10.6 (9.45-11.8)	12.4 (10.9-13.5)	15.1 (13.1-16.5)	17.5 (15.0-19.1)
24-hr	3.84 (3.50-4.28)	4.66 (4.25-5.20)	6.03 (5.48-6.72)	7.23 (6.56-8.05)	9.09 (8.16-10.1)	10.7 (9.56-11.9)	12.6 (11.1-14.0)	14.8 (12.8-16.4)	18.1 (15.4-20.2)	21.1 (17.5-23.7)
2-day	4.53 (4.14-5.01)	5.48 (5.01-6.06)	7.02 (6.41-7.78)	8.37 (7.61-9.27)	10.4 (9.39-11.6)	12.2 (10.9-13.6)	14.3 (12.6-15.9)	16.6 (14.4-18.5)	20.1 (17.1-22.6)	23.2 (19.4-26.3)
3-day	4.82 (4.42-5.33)	5.82 (5.33-6.43)	7.41 (6.77-8.20)	8.79 (8.00-9.72)	10.9 (9.80-12.0)	12.7 (11.3-14.1)	14.7 (13.0-16.3)	17.0 (14.8-18.9)	20.4 (17.5-23.0)	23.5 (19.7-26.5)
4-day	5.11 (4.69-5.64)	6.16 (5.65-6.80)	7.80 (7.13-8.62)	9.21 (8.39-10.2)	11.3 (10.2-12.5)	13.1 (11.7-14.5)	15.1 (13.4-16.8)	17.3 (15.2-19.3)	20.7 (17.9-23.3)	23.7 (20.1-26.8)
7-day	5.87 (5.43-6.41)	7.08 (6.55-7.72)	8.90 (8.22-9.71)	10.4 (9.59-11.4)	12.7 (11.6-13.8)	14.5 (13.2-15.9)	16.6 (14.9-18.1)	18.8 (16.7-20.6)	22.1 (19.3-24.4)	24.8 (21.4-27.7)
10-day	6.63 (6.15-7.20)	7.94 (7.36-8.62)	9.84 (9.09-10.7)	11.4 (10.5-12.4)	13.7 (12.6-14.9)	15.7 (14.3-17.1)	17.8 (16.1-19.4)	20.0 (17.9-21.9)	23.3 (20.6-25.7)	26.1 (22.7-29.0)
20-day	8.88 (8.29-9.56)	10.6 (9.88-11.4)	12.9 (12.0-13.9)	14.8 (13.8-15.9)	17.5 (16.2-18.9)	19.8 (18.2-21.3)	22.1 (20.2-24.0)	24.7 (22.3-26.8)	28.3 (25.2-31.0)	31.2 (27.5-34.4)
30-day	10.9 (10.3-11.7)	13.0 (12.2-13.9)	15.6 (14.6-16.6)	17.7 (16.6-18.9)	20.6 (19.3-22.0)	23.0 (21.3-24.6)	25.4 (23.4-27.2)	27.9 (25.6-30.0)	31.4 (28.4-34.0)	34.1 (30.6-37.2)
45-day	13.6 (12.9-14.5)	16.1 (15.2-17.1)	19.1 (18.0-20.3)	21.5 (20.3-22.9)	24.9 (23.3-26.4)	27.5 (25.7-29.3)	30.2 (28.1-32.3)	33.0 (30.4-35.4)	36.9 (33.6-39.7)	39.8 (36.0-43.2)
60-day	16.4 (15.5-17.4)	19.3 (18.2-20.4)	22.5 (21.3-23.9)	25.1 (23.7-26.6)	28.6 (26.9-30.4)	31.4 (29.4-33.3)	34.1 (31.8-36.3)	36.8 (34.1-39.3)	40.4 (37.1-43.4)	43.1 (39.4-46.6)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

Back to Top

PF graphical

DEMAREST POINTE
A Classic American Neighborhood

DEVELOPER:
Middlesound LLC
6522 Running Brook Terrace
Wilmington, North Carolina 28411

SURVEYOR:
Atlantic Coast Survey
1050 N 23rd Street, Suite 107
Wilmington, North Carolina 28405

CIVIL ENGINEERING:
CDE Engineering
3805 Cherry Avenue
Wilmington, North Carolina 28403

LAND PLANNING LANDSCAPE ARCHITECTURE:

BUILDER
PBC | DESIGN · BUILD
314 Walnut Street Wilmington, North Carolina 28401

PROJECT TITLE:
DEMAREST POINTE
MASTER DEVELOPMENT PLAN
New Hanover County, North Carolina

CIRCULATION

RAIN GARDEN RETENTION

DWG TITLE:
STORMWATER PLAN

GRAPHIC SCALE: APPROXIMATE

PROJECT NO.:
REF. NO.:
DATE: 2/28/25
DRAWN: SDS
CHECKED: SDS
DRAWING SCALE: NTS
CHECKED:

DRAWING NO.
17

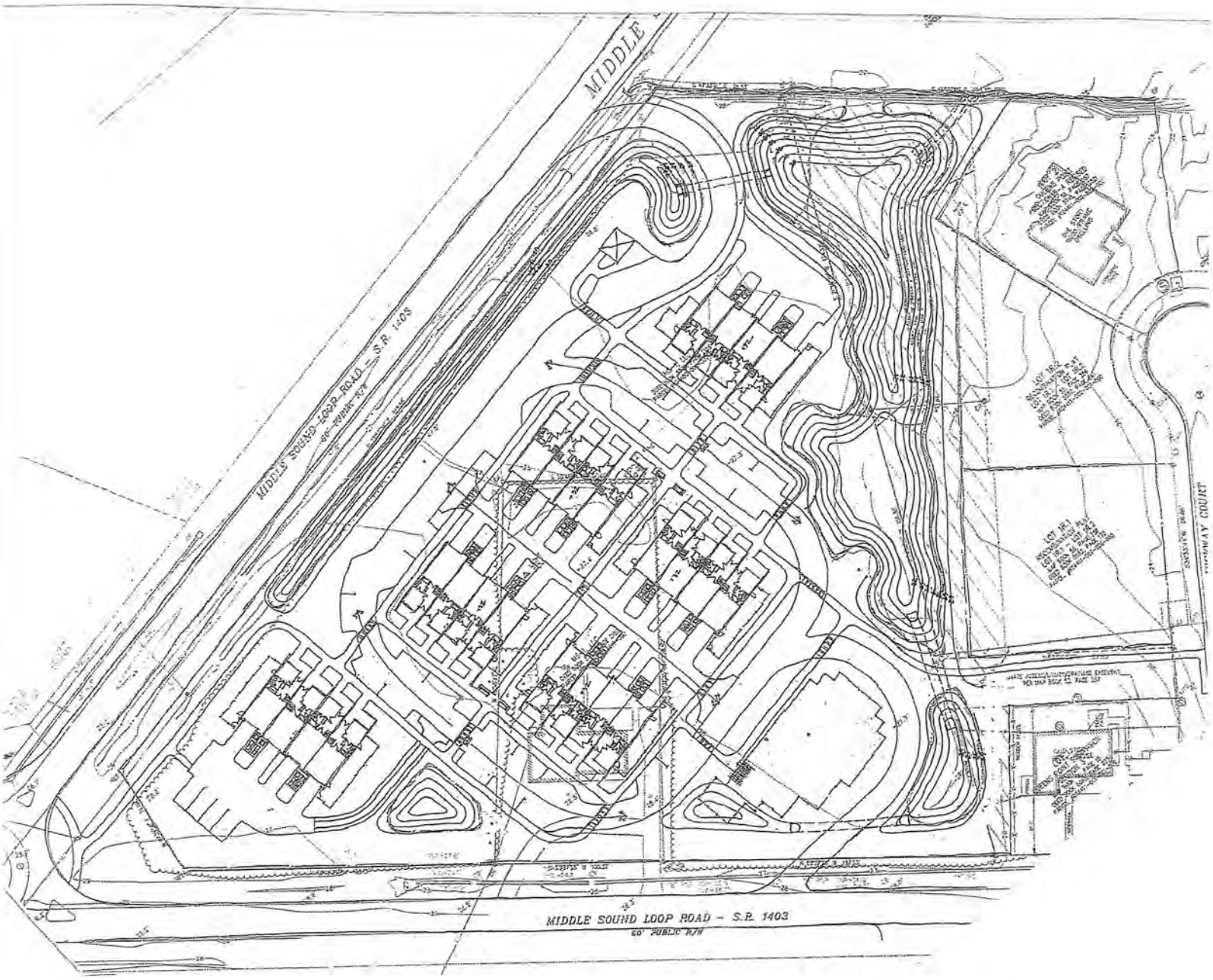
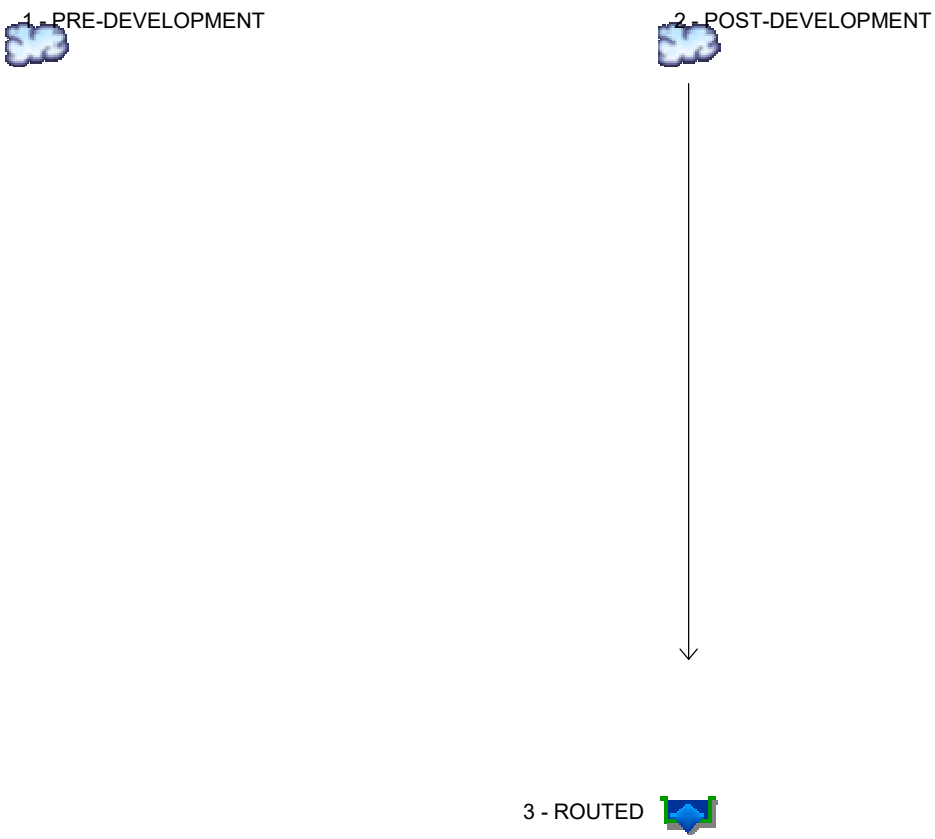

MIDDLE SOUND LOOP ROAD – S.R. 1405
60' PUBLIC R/W
MIDDLE SOUND LOOP ROAD – S.P. 1403
60' PUBLIC R/W

EXHIBIT B

Cape Fear Engineering Preliminary Routing Analysis

Watershed Model Schematic



Legend

Hyd.	Origin	Description
1	SCS Runoff	PRE-DEVELOPMENT
2	SCS Runoff	POST-DEVELOPMENT
3	Reservoir	ROUTED

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2019.2

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	0.149	2	752	2,713	------	------	------	PRE-DEVELOPMENT
2	SCS Runoff	4.611	2	724	15,260	------	------	------	POST-DEVELOPMENT
3	Reservoir	0.096	2	1346	12,058	2	25.23	12,515	ROUTED

Hydrograph Report

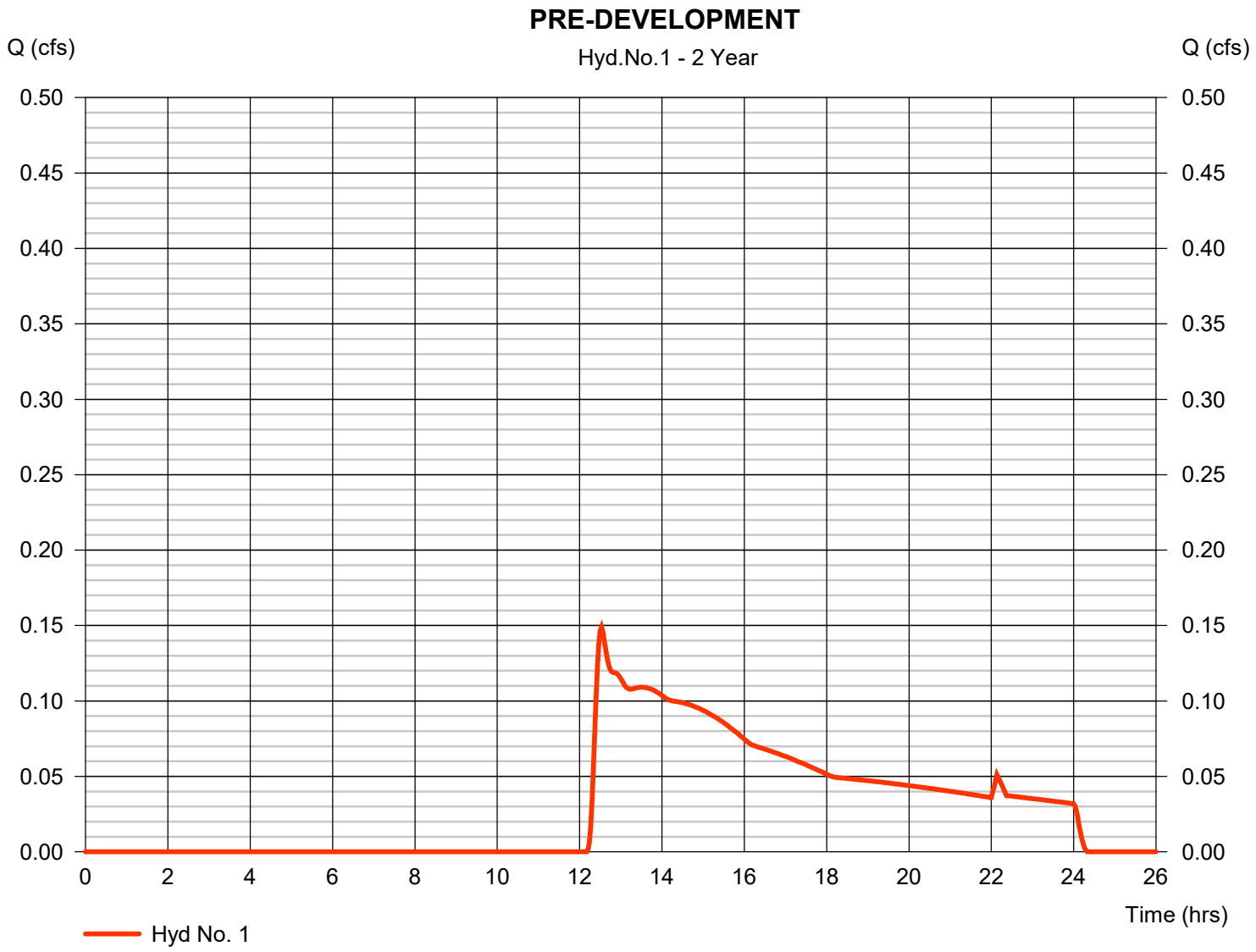
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2019.2 Wednesday, 06 / 24 / 2020

Hyd. No. 1

PRE-DEVELOPMENT

Hydrograph type	=SCS Runoff	Peak discharge	= 0.149 cfs
Storm frequency	=2 yrs	Time to peak	= 12.53 hrs
Time interval	=2min	Hyd. volume	= 2,713 cuft
Drainage area	=3.730 ac	Curve number	= 42*
Basin Slope	=0.0%	Hydraulic length	= 0 ft
Tc method	=User	Time of conc. (Tc)	= 10.00 min
Total precip.	=4.50in	Distribution	= Type III
Storm duration	=24hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.200 x 98) + (3.530 x 39)] / 3.730



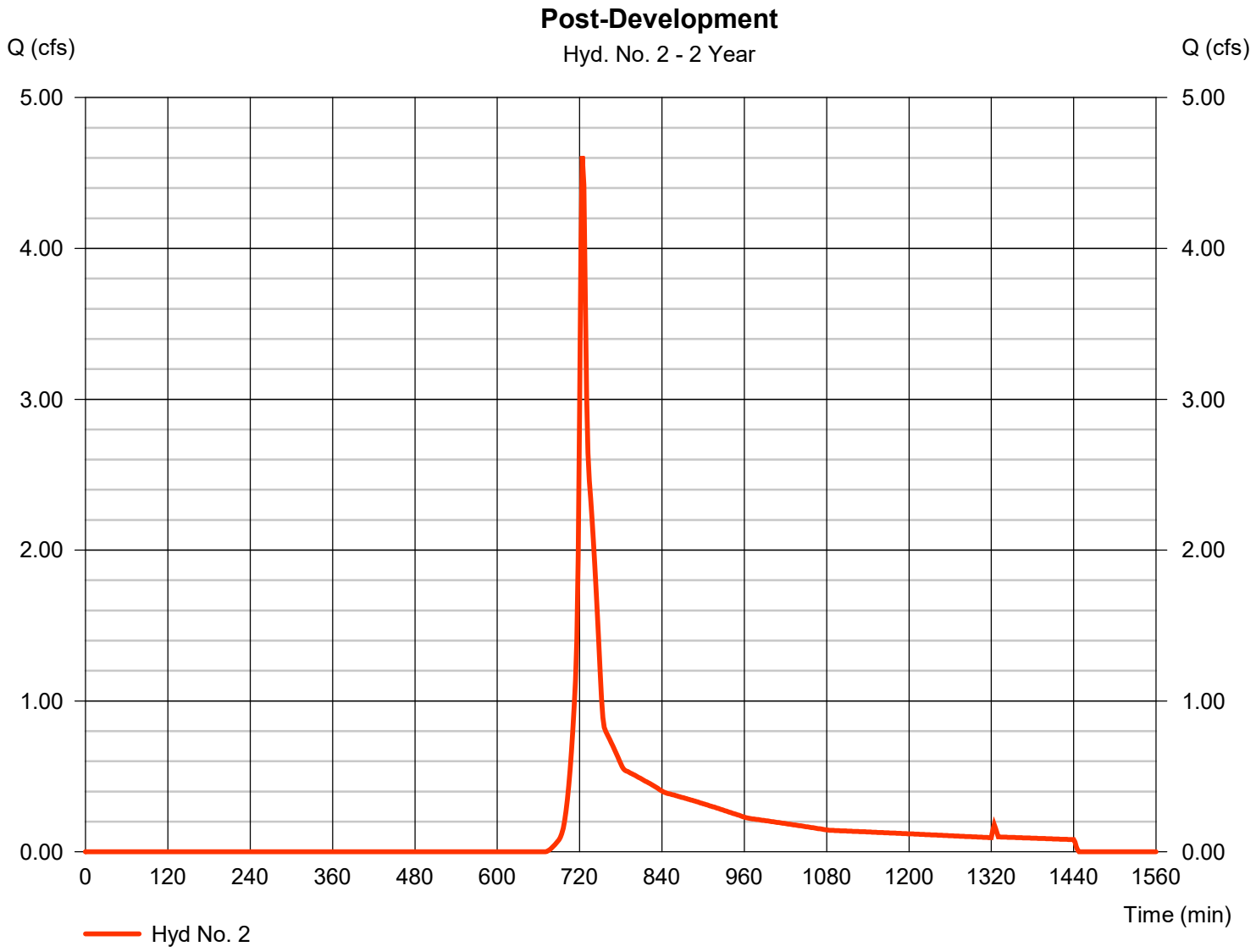
Hydrograph Report

Hyd. No. 2

POST-DEVELOPMENT

Hydrograph type	= SCS Runoff	Peak discharge	= 4.611 cfs
Storm frequency	= 2 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 15,260 cuft
Drainage area	= 3.730 ac	Curve number	= 63*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 4.50 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.490 x 98) + (2.240 x 39)] / 3.730



Hydrograph Report

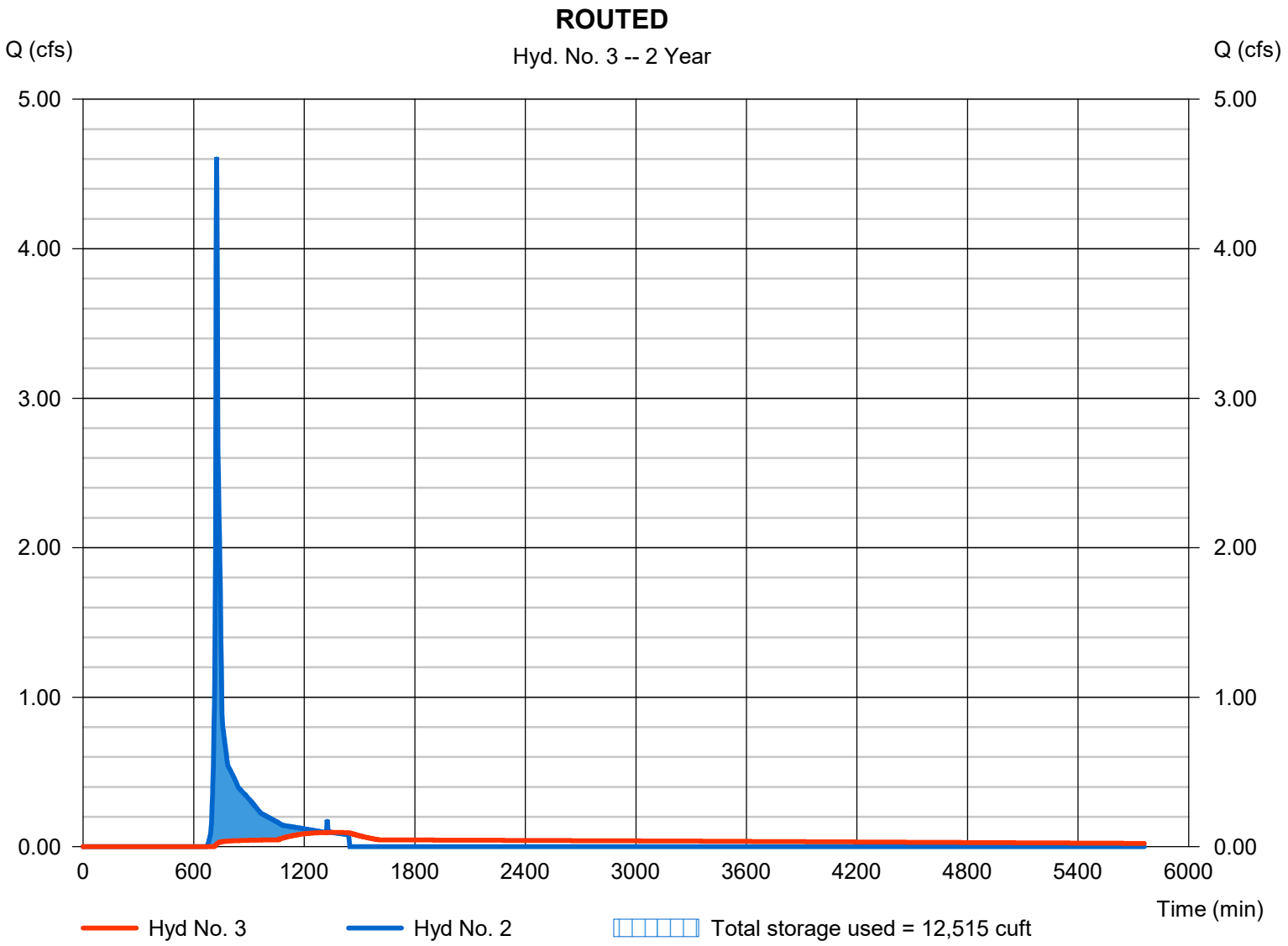
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2019.2 Wednesday, 06 / 24 / 2020

Hyd. No. 3

ROUTED

Hydrograph type	=	Reservoir	Peak discharge	=	0.096 cfs
Storm frequency	=	2 yrs	Time to peak	=	1346 min
Time interval	=	2 min	Hyd. volume	=	12,058 cuft
Inflow hyd. No.	=	2 - POST DEV.	Max. Elevation	=	25.23 ft
Reservoir name	=	POND#1	Max. Storage	=	12,515 cuft

Storage Indication method used.



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2019.2

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	2.402	2	734	13,894	------	------	------	PRE-DEVELOPMENT
2	SCS Runoff	12.14	2	724	36,822	------	------	------	POST-DEVELOPMENT
3	Reservoir	1.464	2	772	33,400	2	25.48	17,538	ROUTED

Hydrograph Report

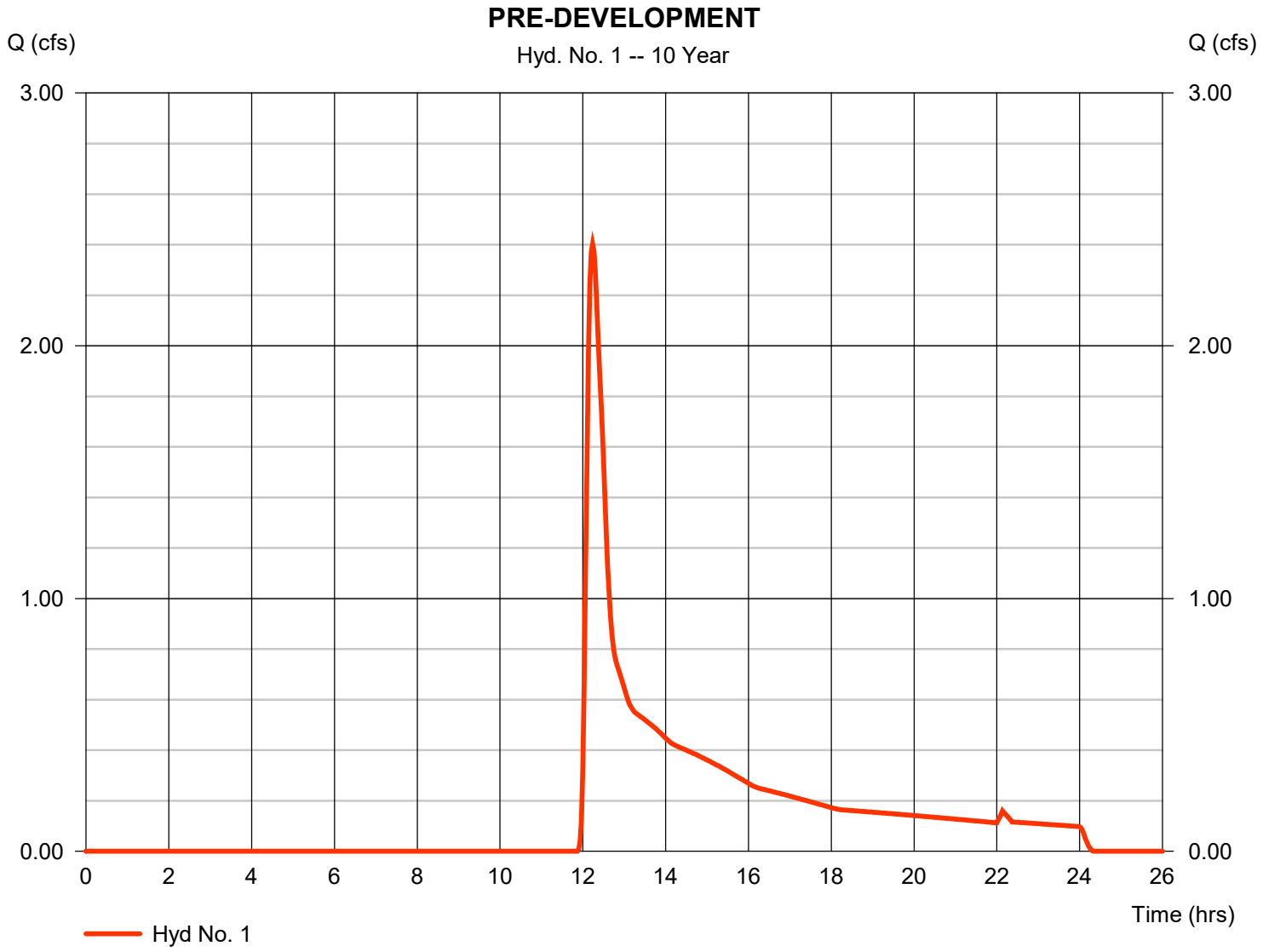
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2019.2 Wednesday, 06 / 24 / 2020

Hyd. No. 1

PRE-DEVELOPMENT

Hydrograph type	= SCS Runoff	Peak discharge	= 2.402 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.23 hrs
Time interval	= 2 min	Hyd. volume	= 13,894 cuft
Drainage area	= 3.730 ac	Curve number	= 42*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.00 min
Total precip.	= 7.00 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.200 x 98) + (3.530 x 39)] / 3.730



Hydrograph Report

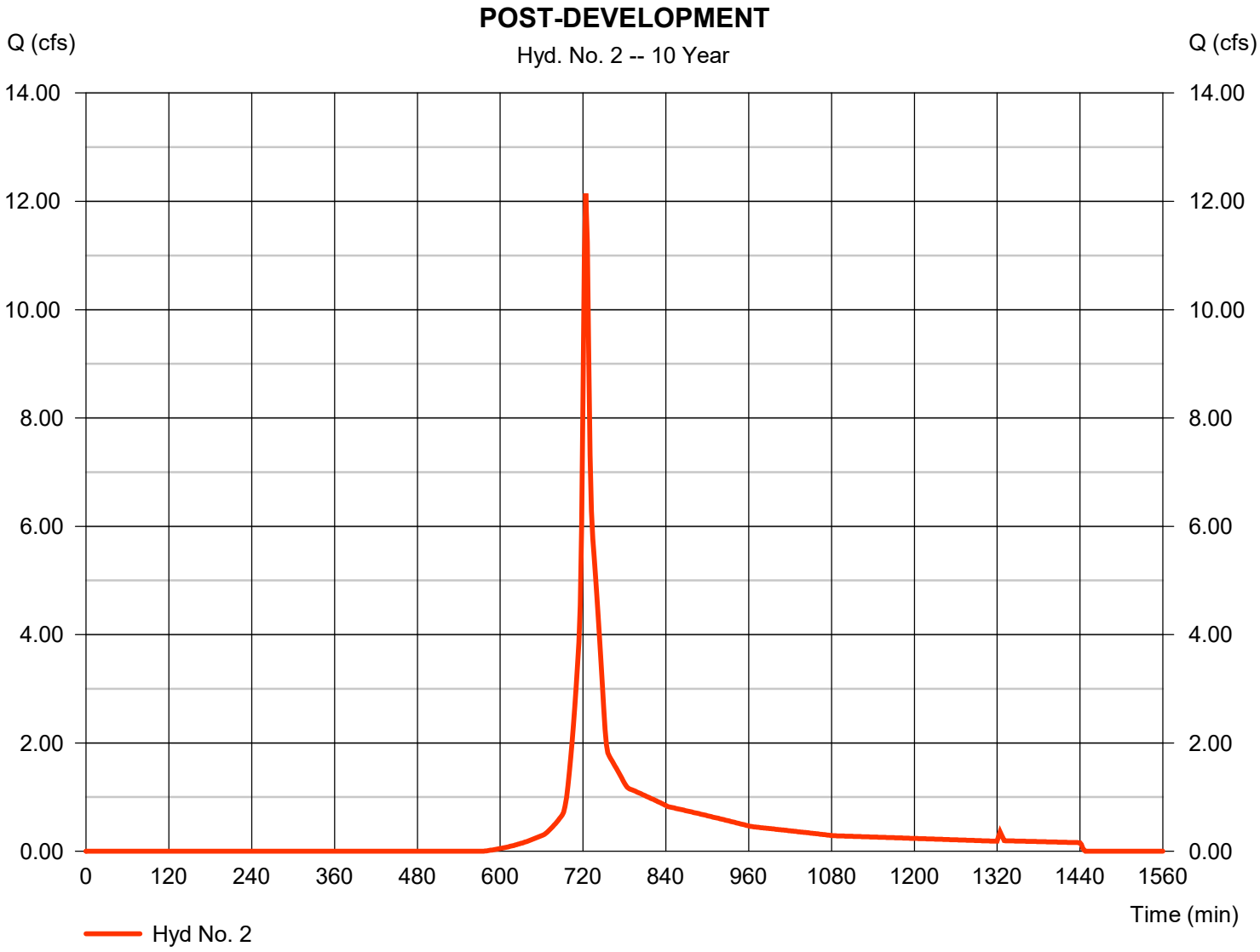
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2019.2 Wednesday, 06 / 24 / 2020

Hyd. No. 2

POST-DEVELOPMENT

Hydrograph type	= SCS Runoff	Peak discharge	= 12.14 cfs
Storm frequency	= 10 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 36,822 cuft
Drainage area	= 3.730 ac	Curve number	= 63*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 7.00 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.490 x 98) + (2.240 x 39)] / 3.730



Hydrograph Report

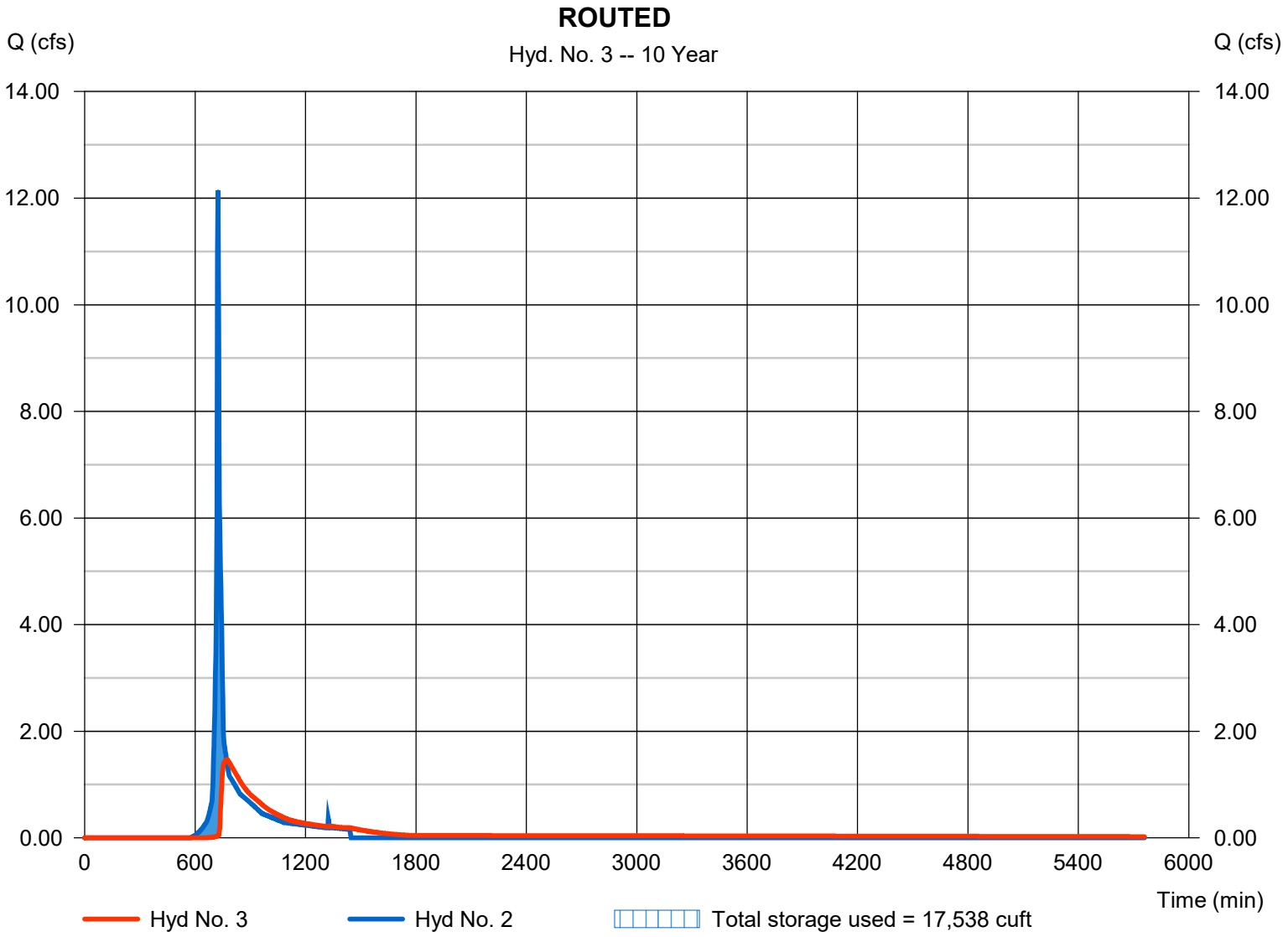
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2019.2 Wednesday, 06 / 24 / 2020

Hyd. No. 3

ROUTED

Hydrograph type	= Reservoir	Peak discharge	= 1.464 cfs
Storm frequency	= 10 yrs	Time to peak	= 772 min
Time interval	= 2 min	Hyd. volume	= 33,400 cuft
Inflow hyd. No.	= 2 - POST-DEVELOPMENT	Max. Elevation	= 25.48 ft
Reservoir name	= POND#1	Max. Storage	= 17,538 cuft

Storage Indication method used.



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2019.2

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	4.124	2	732	20,445	------	------	------	PRE-DEVELOPMENT
2	SCS Runoff	15.66	2	724	47,068	------	------	------	POST-DEVELOPMENT
3	Reservoir	2.351	2	756	43,629	2	25.67	21,421	ROUTED

Hydrograph Report

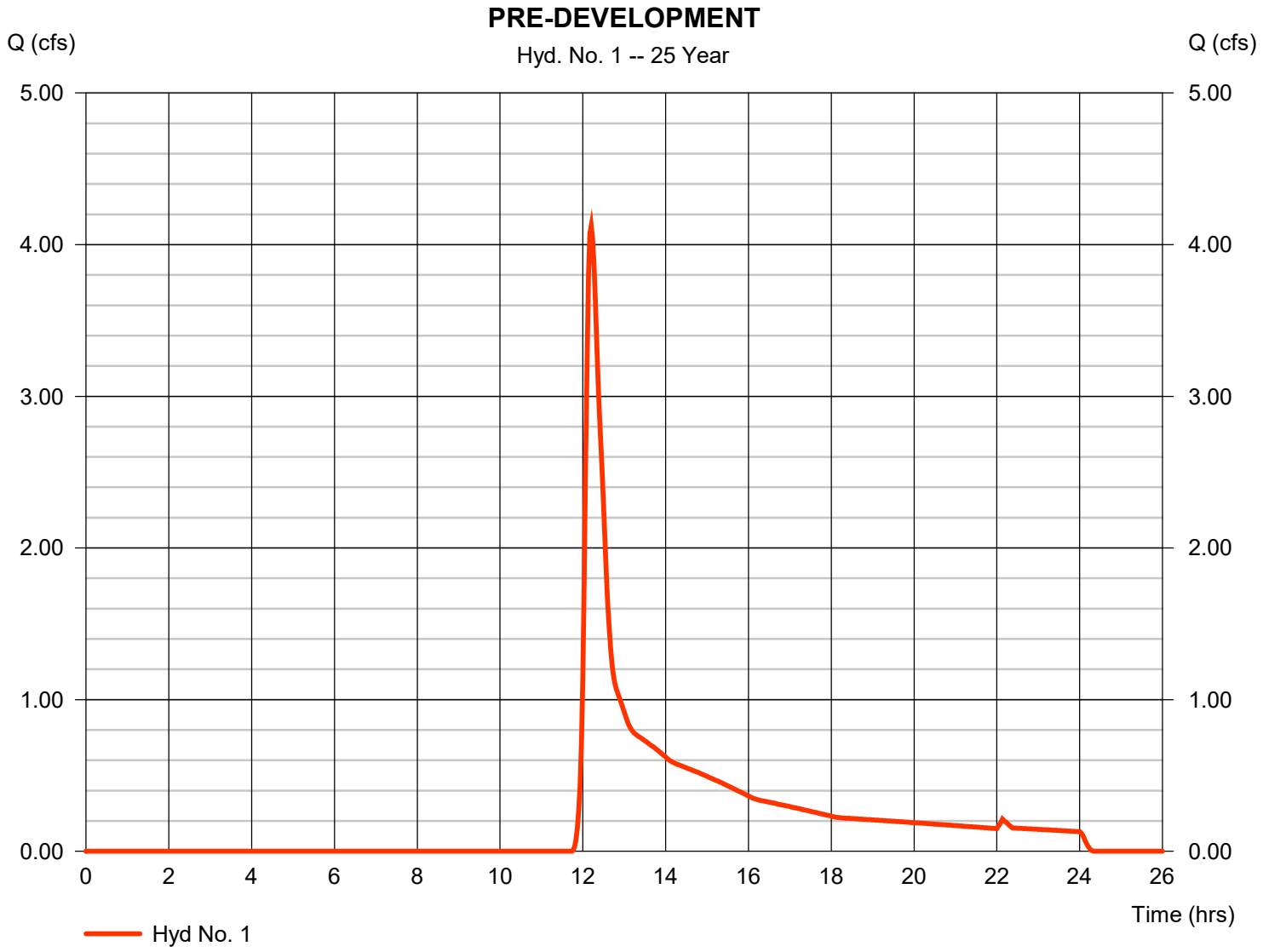
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2019.2 Wednesday, 06 / 24 / 2020

Hyd. No. 1

PRE-DEVELOPMENT

Hydrograph type	= SCS Runoff	Peak discharge	= 4.124 cfs
Storm frequency	= 25 yrs	Time to peak	= 12.20 hrs
Time interval	= 2 min	Hyd. volume	= 20,445 cuft
Drainage area	= 3.730 ac	Curve number	= 42*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.00 min
Total precip.	= 8.05 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.200 x 98) + (3.530 x 39)] / 3.730



Hydrograph Report

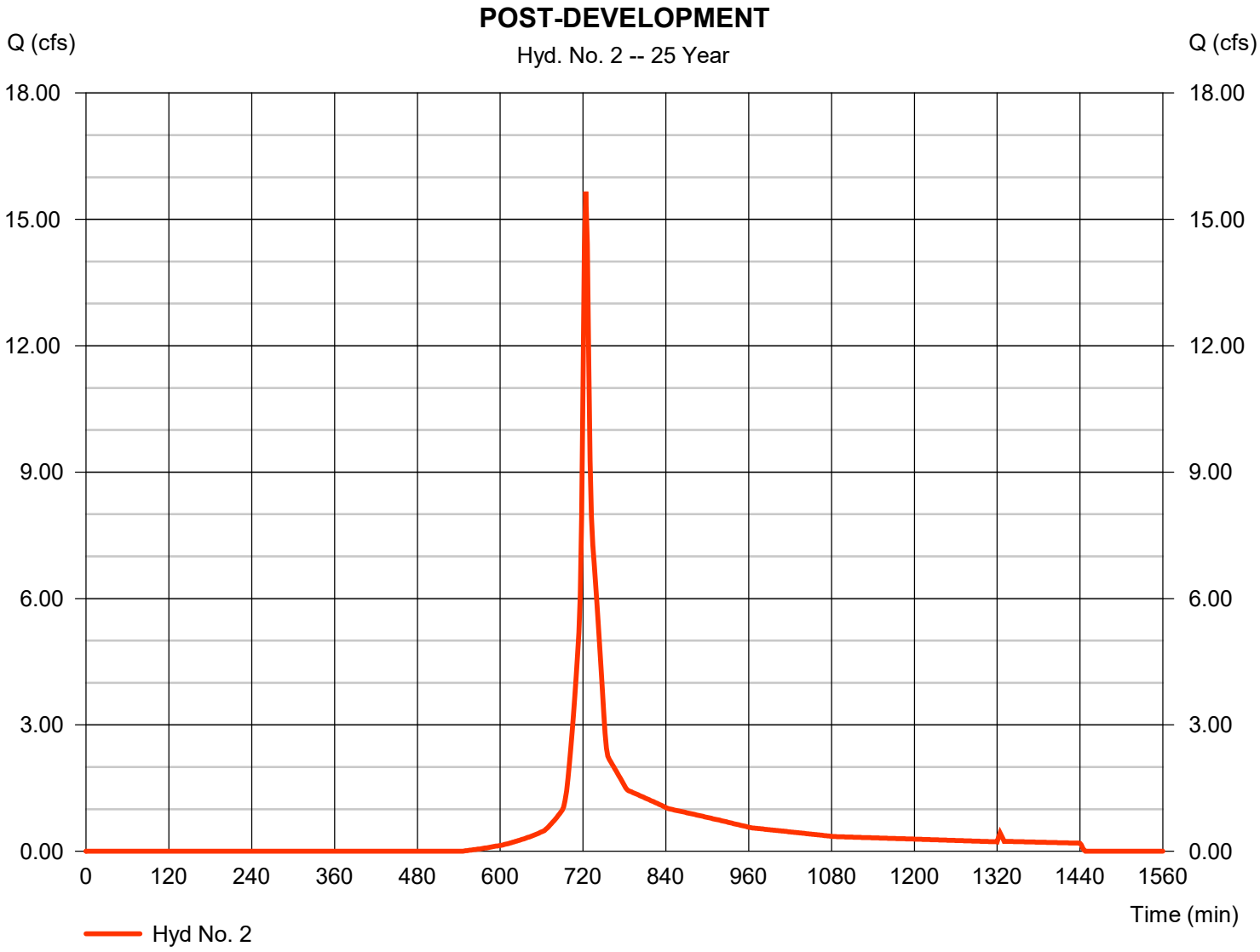
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2019.2 Wednesday, 06 / 24 / 2020

Hyd. No. 2

POST-DEVELOPMENT

Hydrograph type	= SCS Runoff	Peak discharge	= 15.66 cfs
Storm frequency	= 25 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 47,068 cuft
Drainage area	= 3.730 ac	Curve number	= 63*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 8.05 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.490 x 98) + (2.240 x 39)] / 3.730



Hydrograph Report

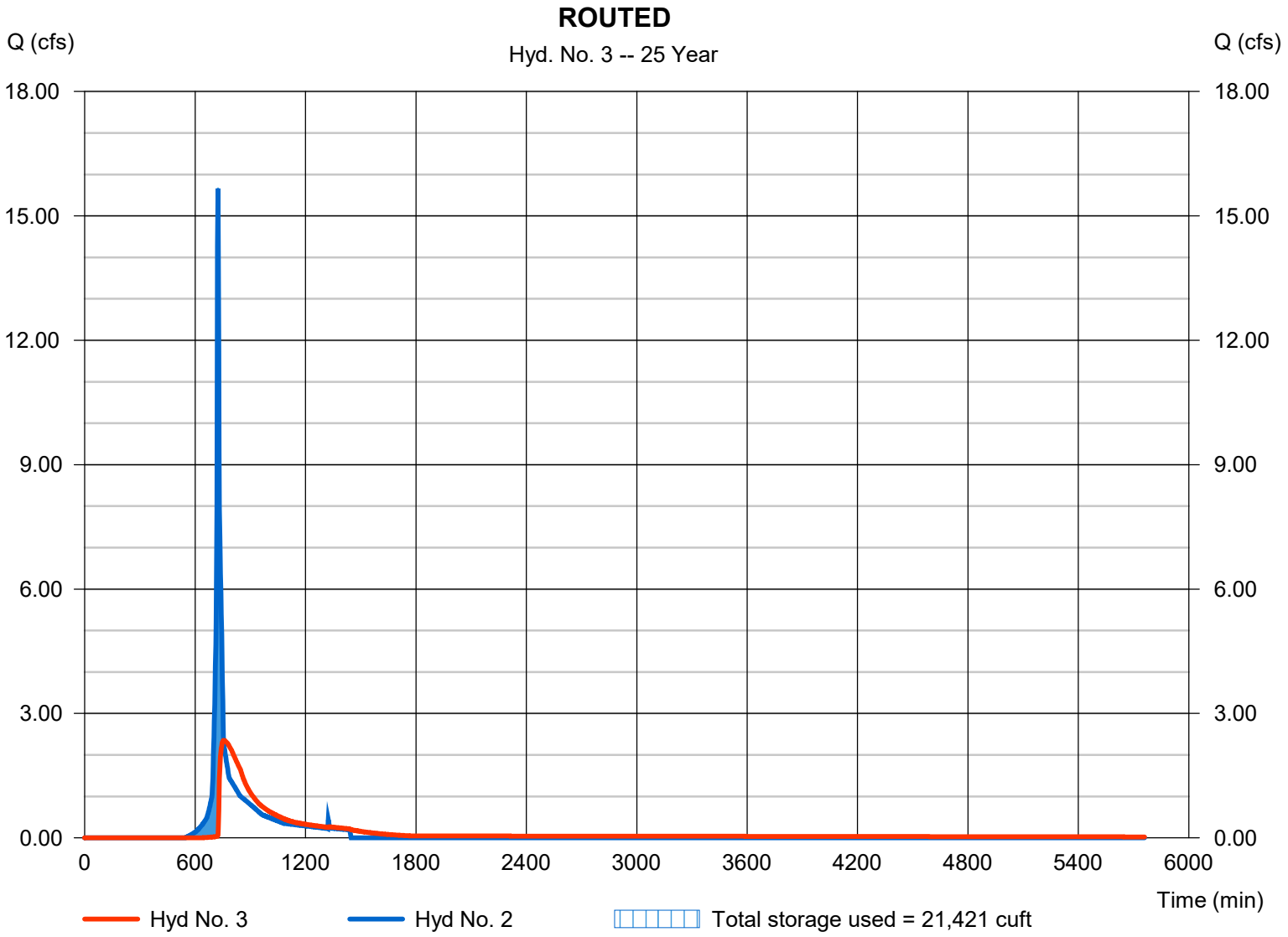
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2019.2 Wednesday, 06 / 24 / 2020

Hyd. No. 3

ROUTED

Hydrograph type	= Reservoir	Peak discharge	= 2.351 cfs
Storm frequency	= 25 yrs	Time to peak	= 756 min
Time interval	= 2 min	Hyd. volume	= 43,629 cuft
Inflow hyd. No.	= 2 - POST-DEVELOPMENT	Max. Elevation	= 25.67 ft
Reservoir name	= POND#1	Max. Storage	= 21,421 cuft

Storage Indication method used.



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2019.2

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	5.916	2	730	27,103	------	------	------	PRE-DEVELOPMENT
2	SCS Runoff	18.96	2	724	56,745	------	------	------	POST-DEVELOPMENT
3	Reservoir	2.920	2	754	53,295	2	25.88	25,825	ROUTED

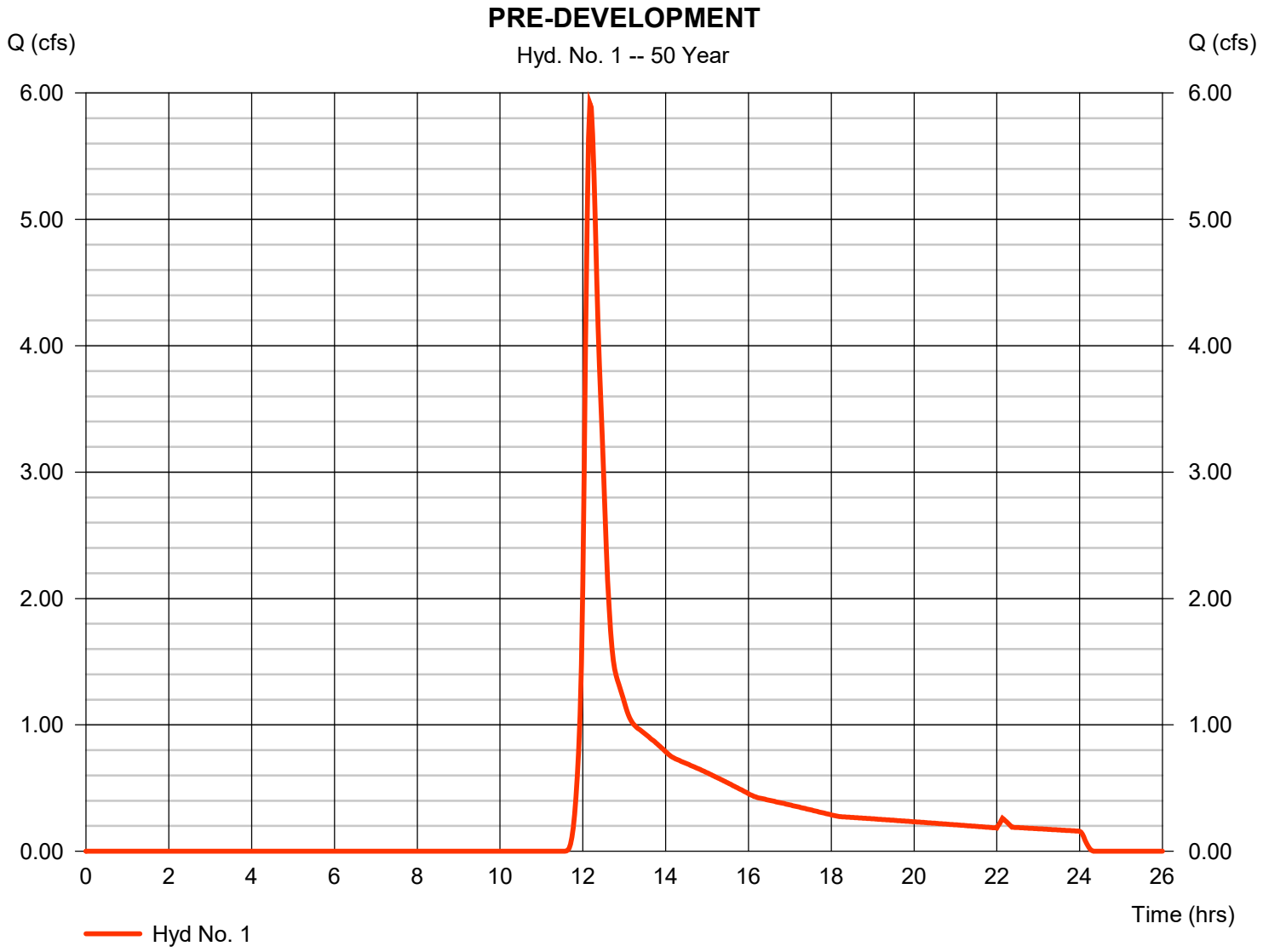
Hydrograph Report

Hyd. No. 1

PRE-DEVELOPMENT

Hydrograph type	= SCS Runoff	Peak discharge	= 5.916 cfs
Storm frequency	= 50 yrs	Time to peak	= 12.17 hrs
Time interval	= 2 min	Hyd. volume	= 27,103 cuft
Drainage area	= 3.730 ac	Curve number	= 42*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.00 min
Total precip.	= 9.00 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.200 x 98) + (3.530 x 39)] / 3.730



Hydrograph Report

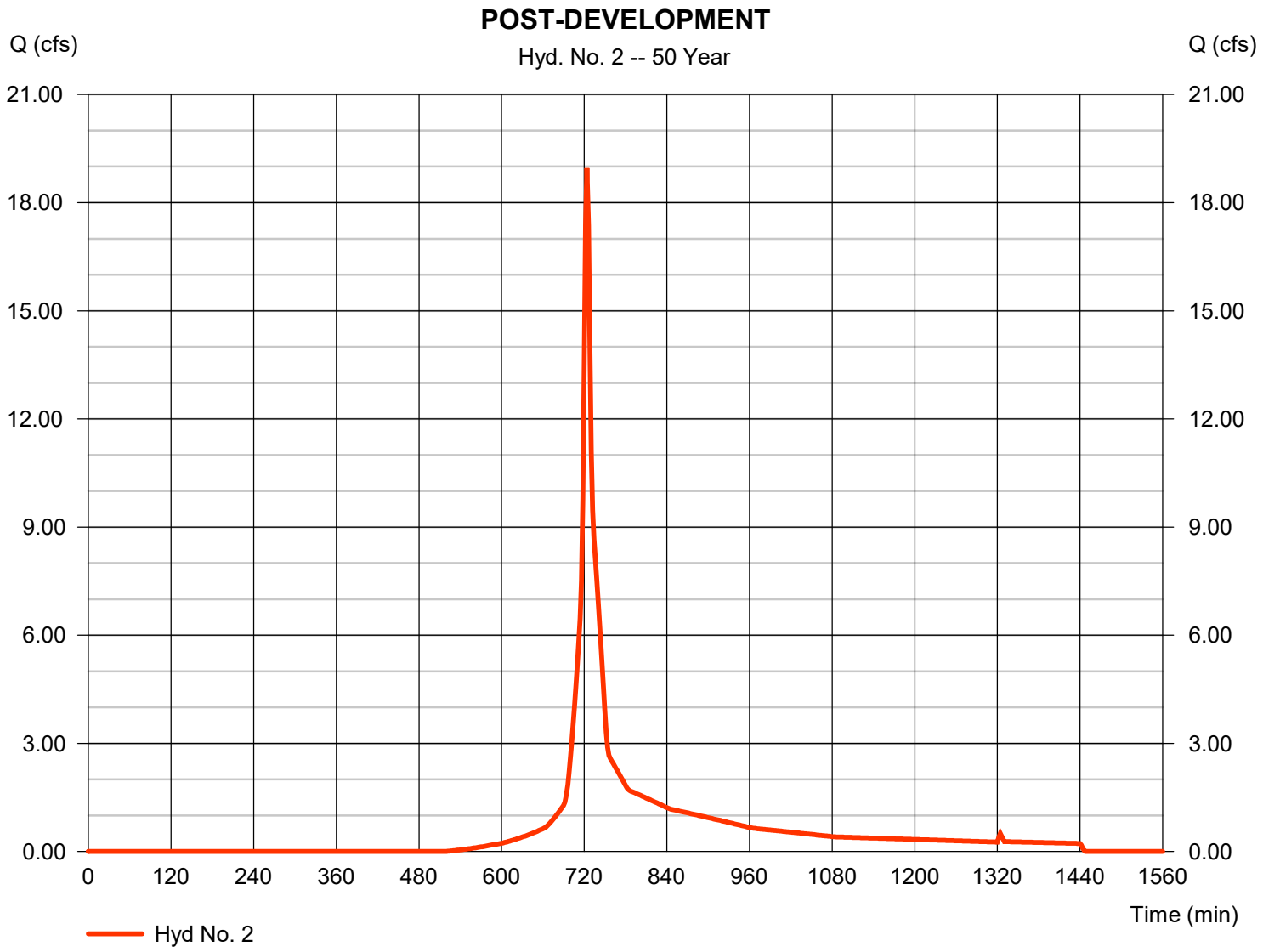
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2019.2 Wednesday, 06 / 24 / 2020

Hyd. No. 2

POST-DEVELOPMENT

Hydrograph type	= SCS Runoff	Peak discharge	= 18.96 cfs
Storm frequency	= 50 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 56,745 cuft
Drainage area	= 3.730 ac	Curve number	= 63*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 9.00 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.490 x 98) + (2.240 x 39)] / 3.730



Hydrograph Report

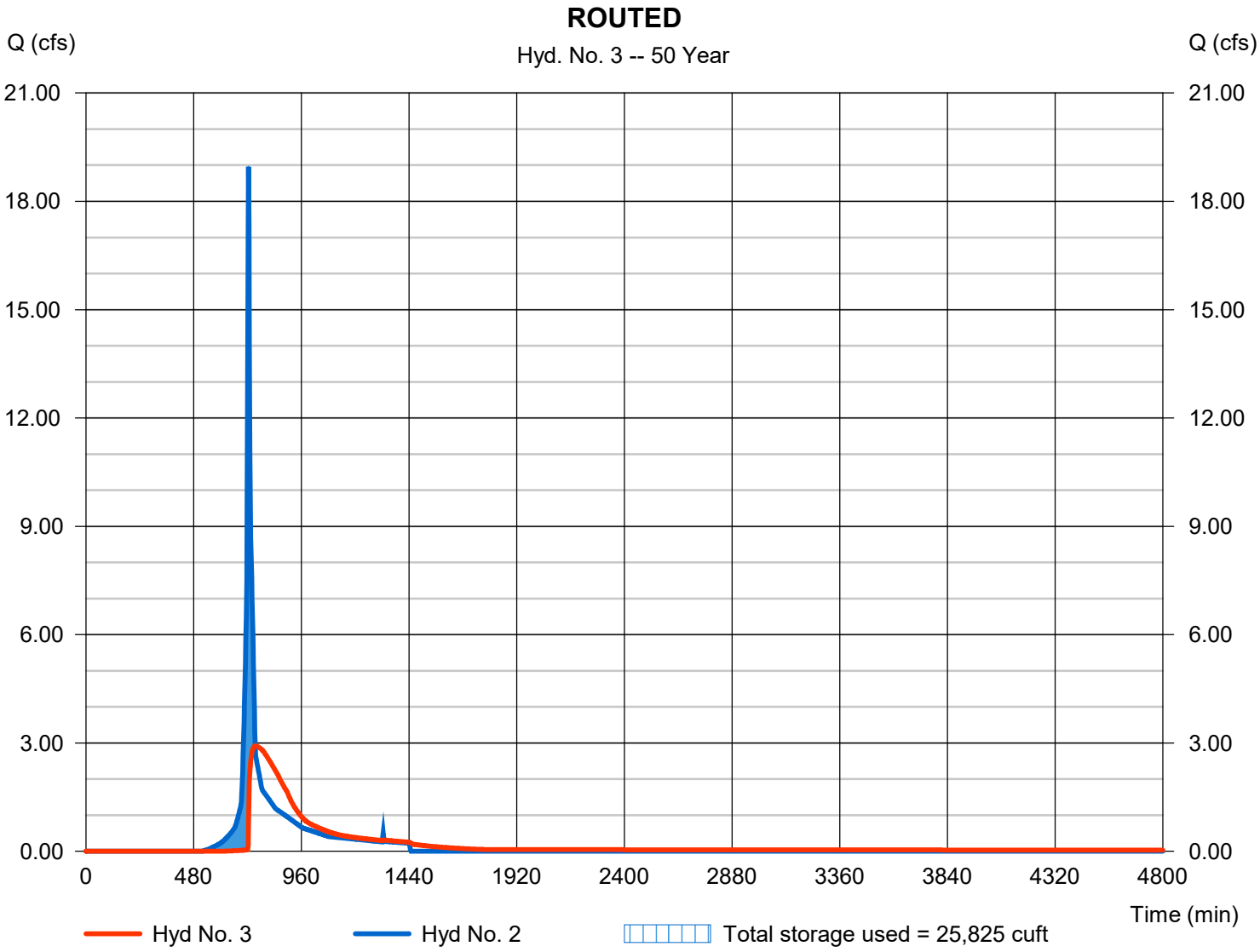
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2019.2 Wednesday, 06 / 24 / 2020

Hyd. No. 3

ROUTED

Hydrograph type	= Reservoir	Peak discharge	= 2.920 cfs
Storm frequency	= 50 yrs	Time to peak	= 754 min
Time interval	= 2 min	Hyd. volume	= 53,295 cuft
Inflow hyd. No.	= 2 - POST-DEVELOPMENT	Max. Elevation	= 25.88 ft
Reservoir name	= POND#1	Max. Storage	= 25,825 cuft

Storage Indication method used.



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2019.2

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	8.022	2	730	34,756	------	------	------	PRE-DEVELOPMENT
2	SCS Runoff	22.51	2	724	67,264	------	------	------	POST-DEVELOPMENT
3	Reservoir	4.071	2	752	63,804	2	26.09	30,664	ROUTED

Hydrograph Report

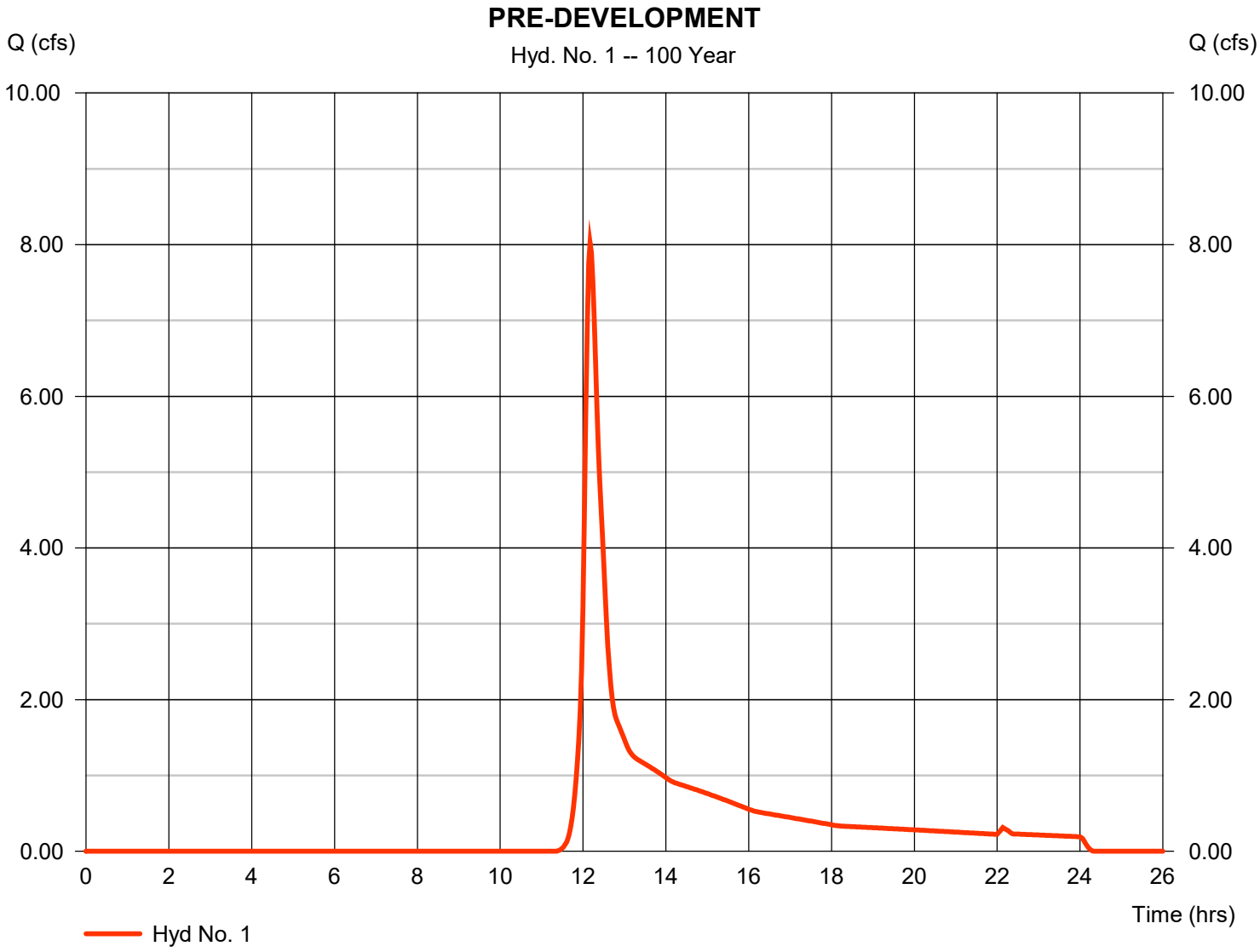
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2019.2 Wednesday, 06 / 24 / 2020

Hyd. No. 1

PRE-DEVELOPMENT

Hydrograph type	= SCS Runoff	Peak discharge	= 8.022 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.17 hrs
Time interval	= 2 min	Hyd. volume	= 34,756 cuft
Drainage area	= 3.730 ac	Curve number	= 42*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.00 min
Total precip.	= 10.00 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.200 x 98) + (3.530 x 39)] / 3.730



Hydrograph Report

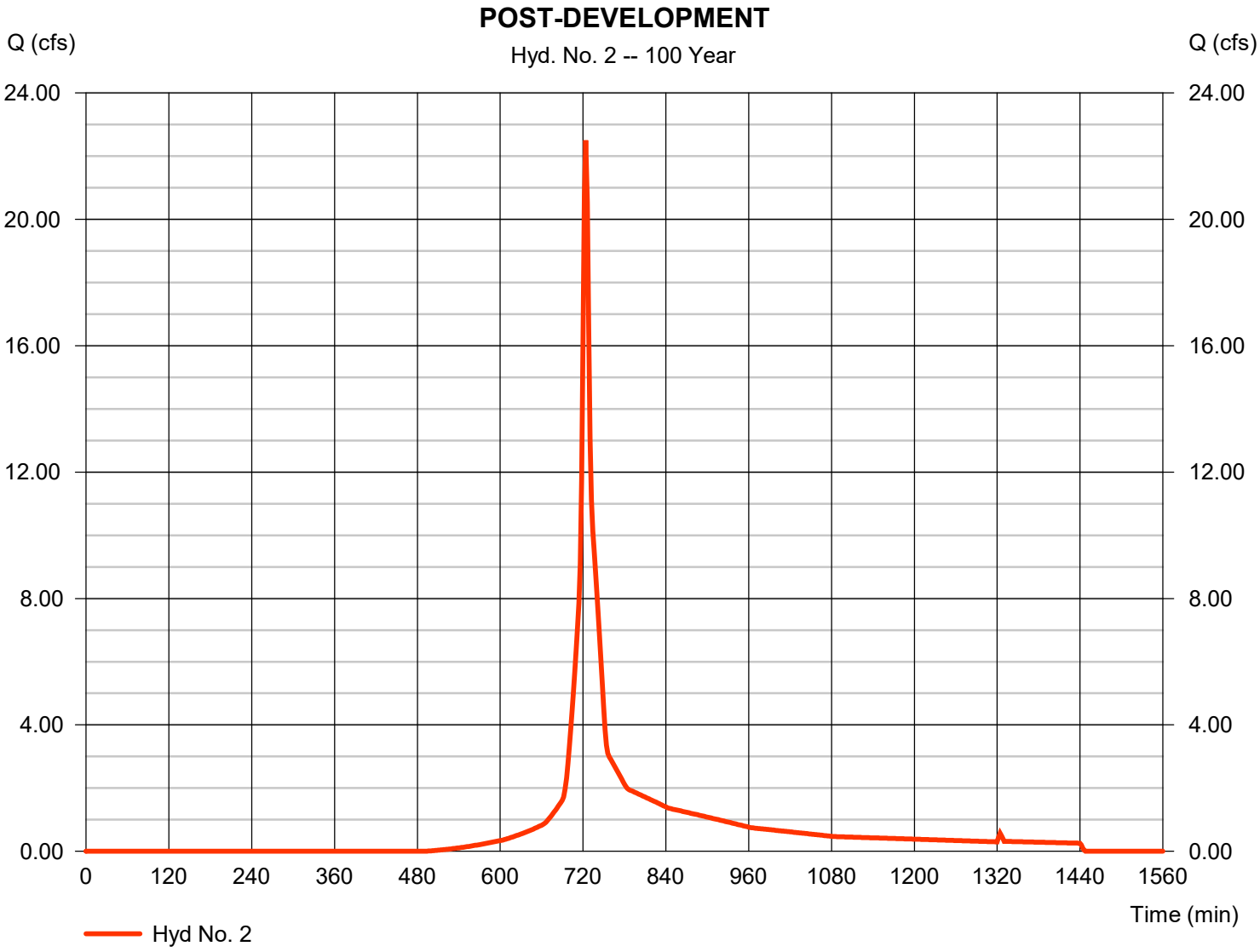
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2019.2 Wednesday, 06 / 24 / 2020

Hyd. No. 2

POST-DEVELOPMENT

Hydrograph type	= SCS Runoff	Peak discharge	= 22.51 cfs
Storm frequency	= 100 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 67,264 cuft
Drainage area	= 3.730 ac	Curve number	= 63*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 10.00 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.490 x 98) + (2.240 x 39)] / 3.730



Hydrograph Report

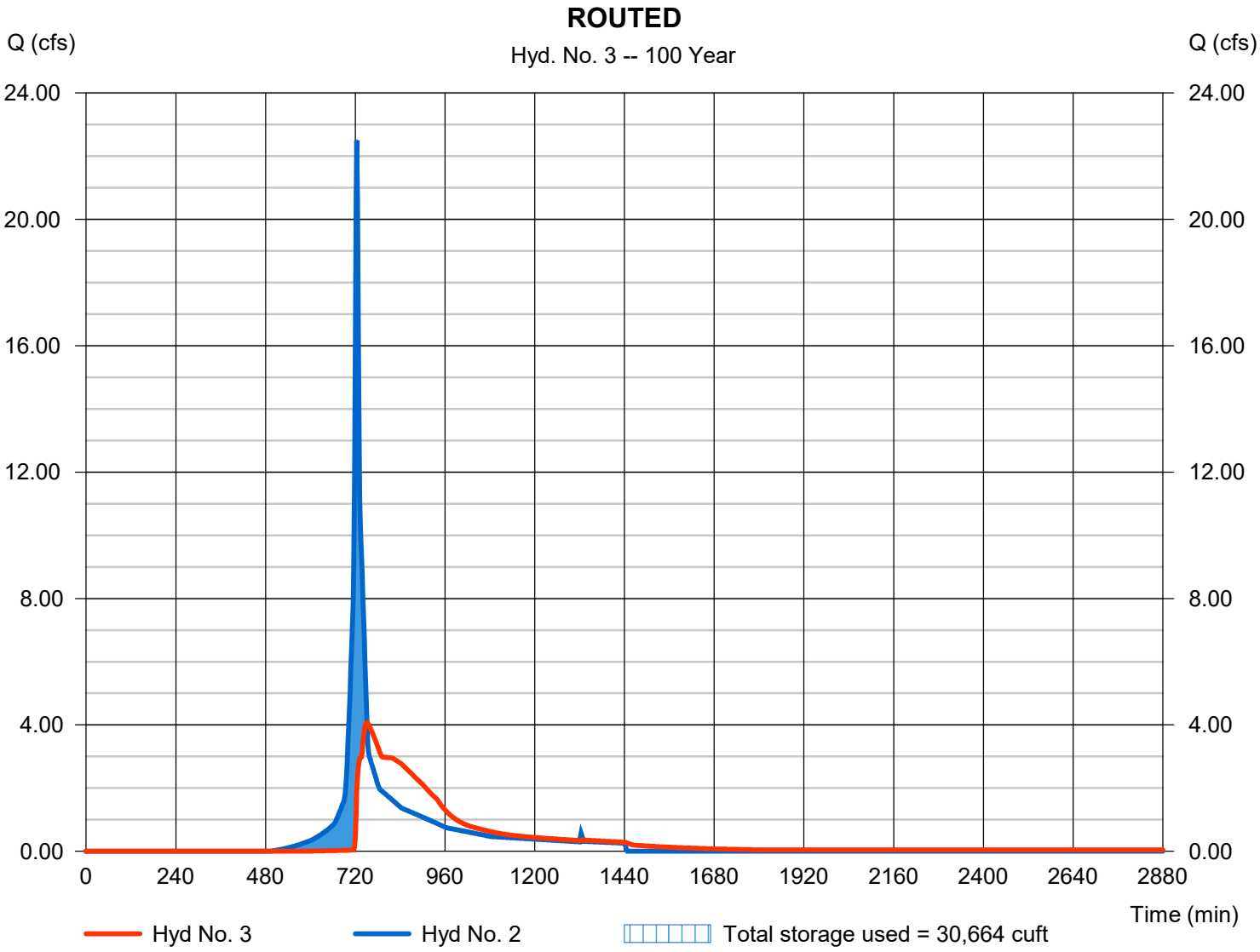
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2019.2 Wednesday, 06 / 24 / 2020

Hyd. No. 3

ROUTED

Hydrograph type	= Reservoir	Peak discharge	= 4.071 cfs
Storm frequency	= 100 yrs	Time to peak	= 752 min
Time interval	= 2 min	Hyd. volume	= 63,804 cuft
Inflow hyd. No.	= 2 - POST-DEVELOPMENT	Max. Elevation	= 26.09 ft
Reservoir name	= POND#1	Max. Storage	= 30,664 cuft

Storage Indication method used.



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2019.2

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	29.00	2	730	112,699	------	------	------	PRE-DEVELOPMENT
2	SCS Runoff	52.45	2	724	159,500	------	------	------	POST-DEVELOPMENT
3	Reservoir	22.69	2	734	155,985	2	27.08	58,509	ROUTED

Hydrograph Report

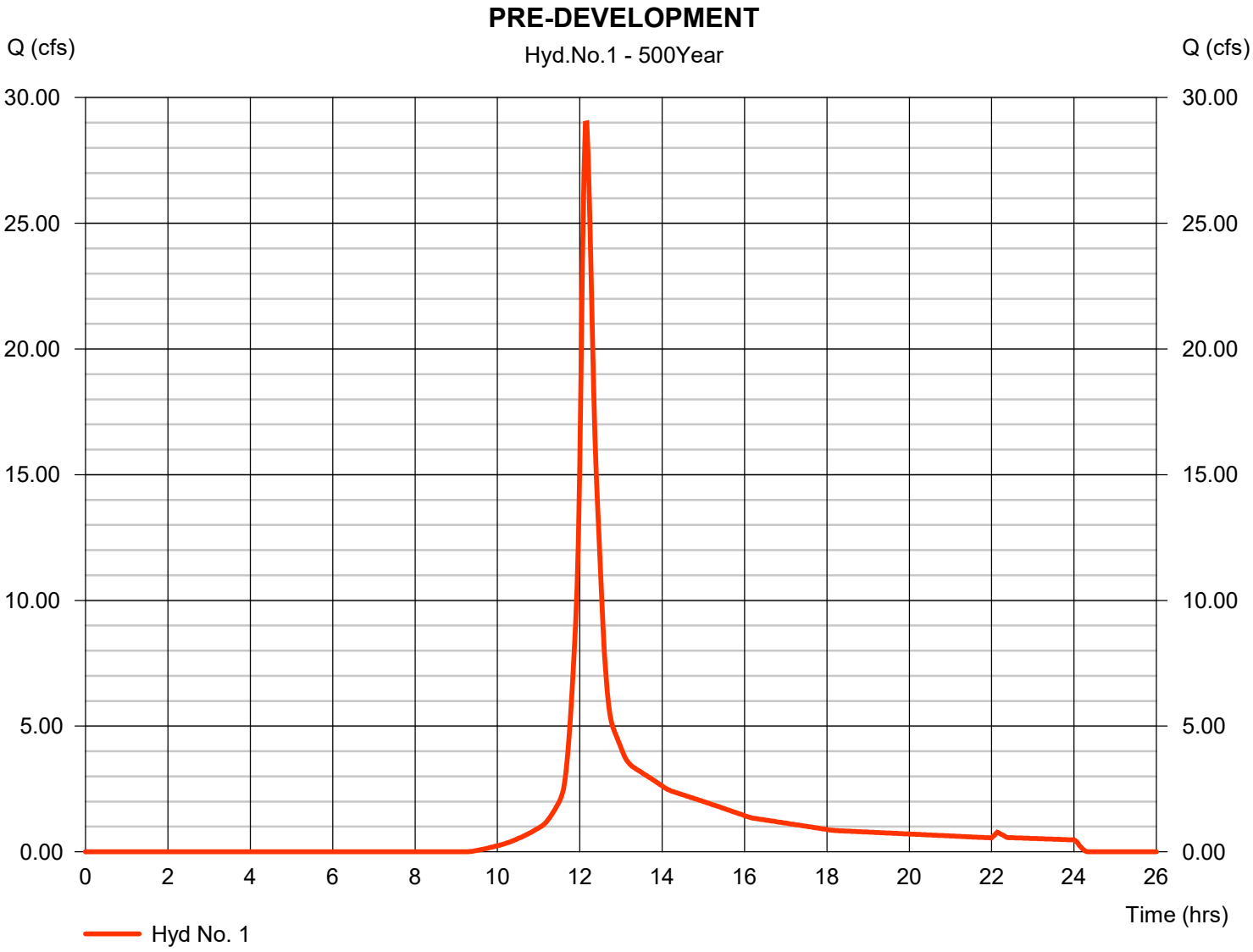
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2019.2 Wednesday, 06 / 24 / 2020

Hyd. No. 1

PRE-DEVELOPMENT

Hydrograph type	=SCSRunoff	Peak discharge	= 29.00 cfs
Storm frequency	=500 yrs	Time to peak	= 12.17 hrs
Time interval	=2min	Hyd. volume	= 112,699 cuft
Drainage area	=3.730 ac	Curve number	= 42*
Basin Slope	=0.0%	Hydraulic length	= 0 ft
Tc method	=User	Time of conc. (Tc)	= 10.00 min
Total precip.	=18.10 in	Distribution	= Type III
Storm duration	=24hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.200 x 98) + (3.530 x 39)] / 3.730



Hydrograph Report

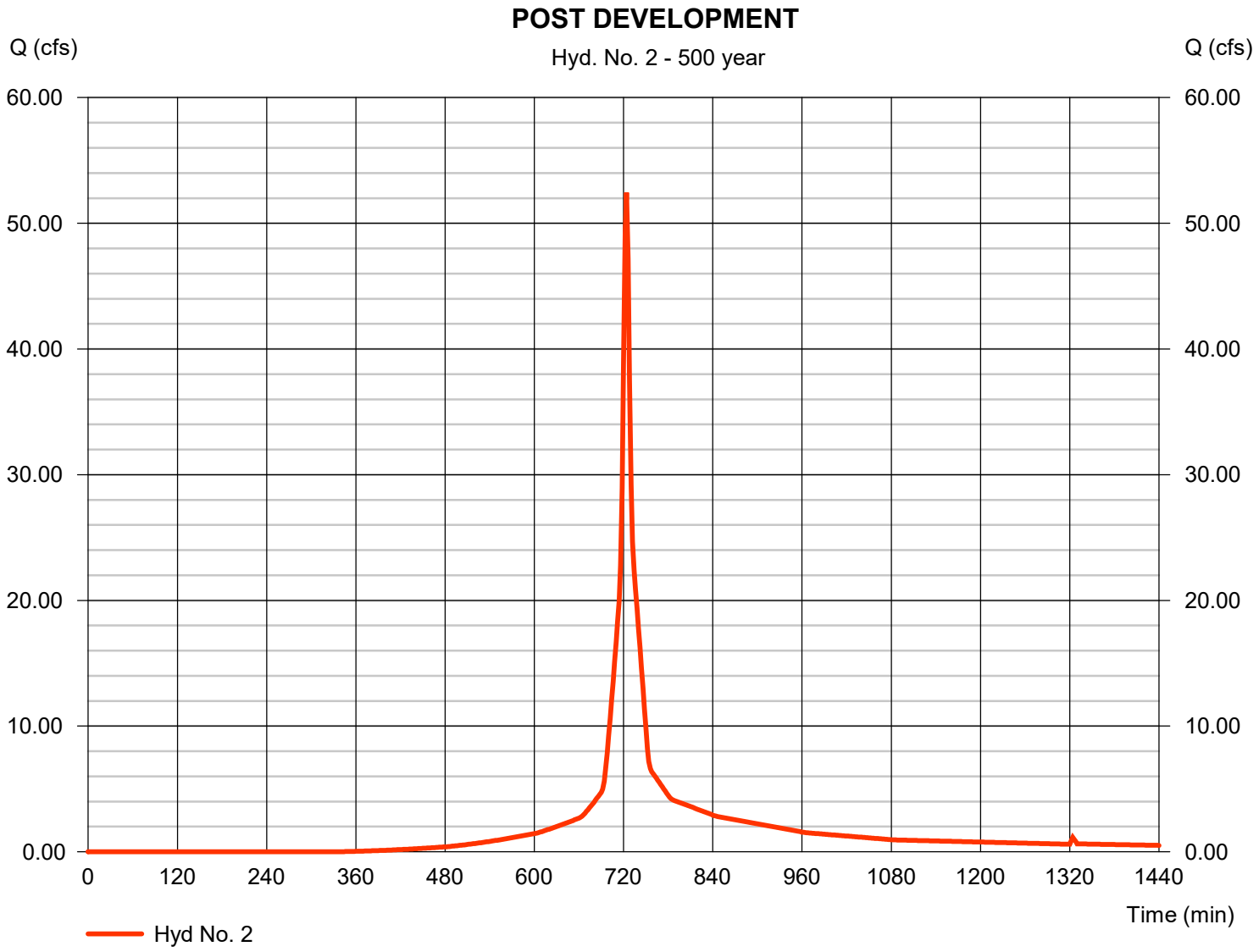
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2019.2 Wednesday, 06 / 24 / 2020

Hyd. No. 2

POST-DEVELOPMENT

Hydrograph type	= SCS Runoff	Peak discharge	= 52.45 cfs
Storm frequency	= 500 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 159,500 cuft
Drainage area	= 3.730 ac	Curve number	= 63*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 18.10 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.490 x 98) + (2.240 x 39)] / 3.730



Hydrograph Report

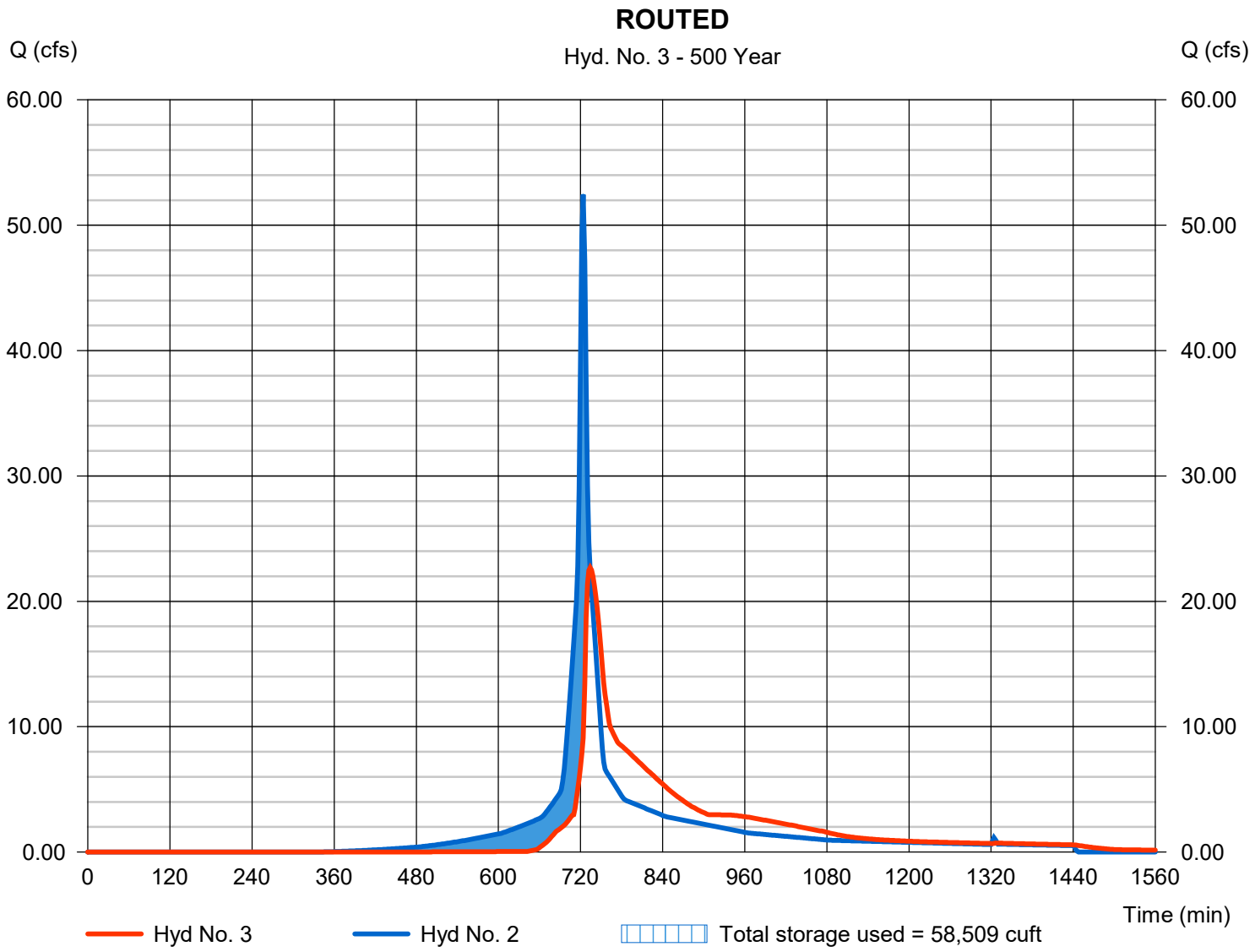
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2019.2 Wednesday, 06 / 24 / 2020

Hyd. No. 3

ROUTED

Hydrograph type	= Reservoir	Peak discharge	= 22.69 cfs
Storm frequency	= 500 yrs	Time to peak	= 734 min
Time interval	= 2 min	Hyd. volume	= 155,985 cuft
Inflow hyd. No.	= 2 - POST DEV.	Max. Elevation	= 27.08 ft
Reservoir name	= POND#1	Max. Storage	= 58,509 cuft

Storage Indication method used.



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2019.2

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	37.92	2	728	146,063	------	------	------	PRE-DEVELOPMENT
2	SCS Runoff	63.67	2	724	195,347	------	------	------	POST-DEVELOPMENT
3	Reservoir	35.23	2	730	191,820	2	27.26	64,723	ROUTED

Hydrograph Report

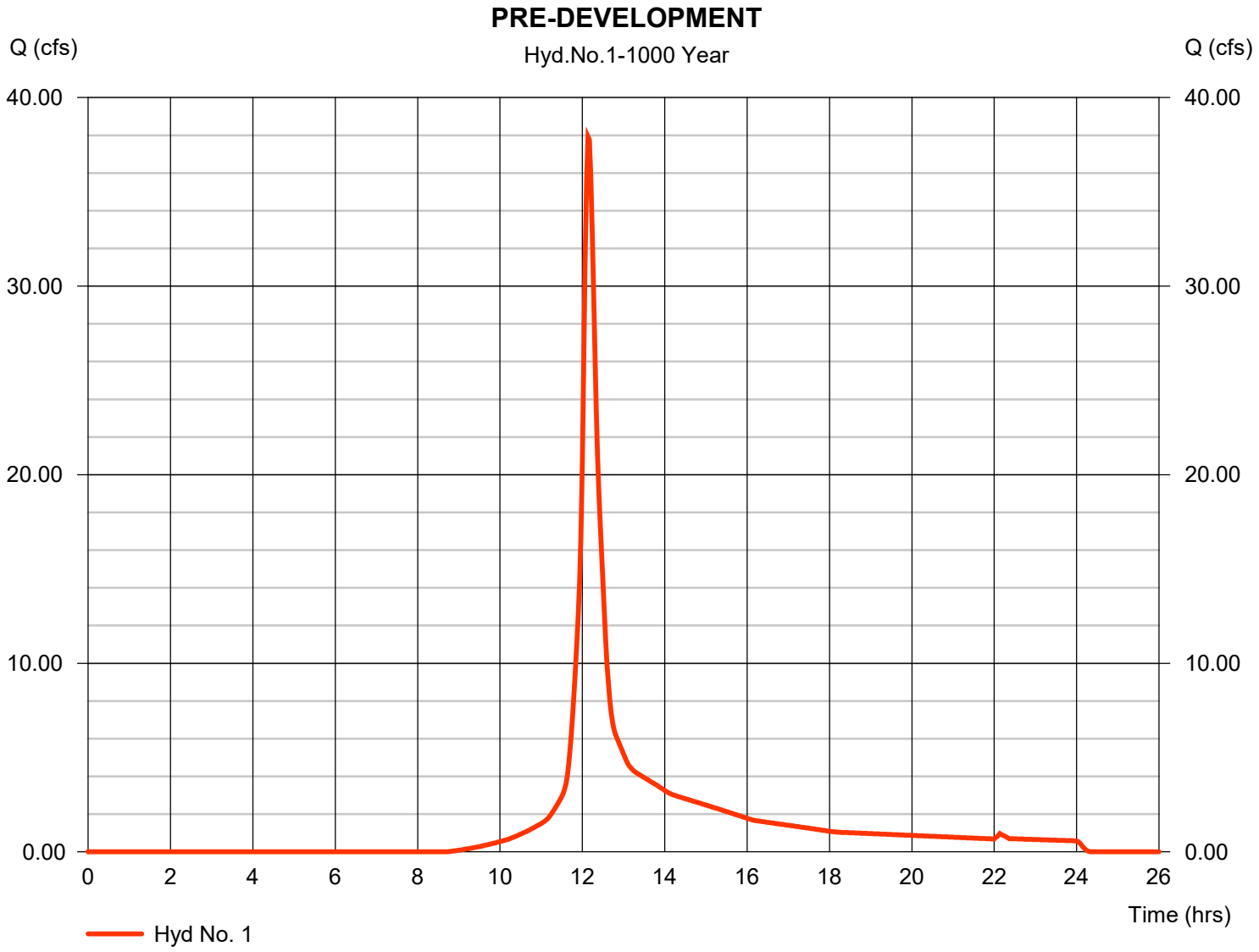
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2019.2 Wednesday, 06 / 24 / 2020

Hyd. No. 1

PRE-DEVELOPMENT

Hydrograph type	=SCS Runoff	Peak discharge	= 37.92 cfs
Storm frequency	=1000 yrs	Time to peak	= 12.13 hrs
Time interval	=2 min	Hyd. volume	= 146,063 cuft
Drainage area	=3.730ac	Curve number	= 42*
Basin Slope	=0.0%	Hydraulic length	= 0 ft
Tc method	=User	Time of conc. (Tc)	= 10.00 min
Total precip.	=21.10 in	Distribution	= Type III
Storm duration	=24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.200 x 98) + (3.530 x 39)] / 3.730



Hydrograph Report

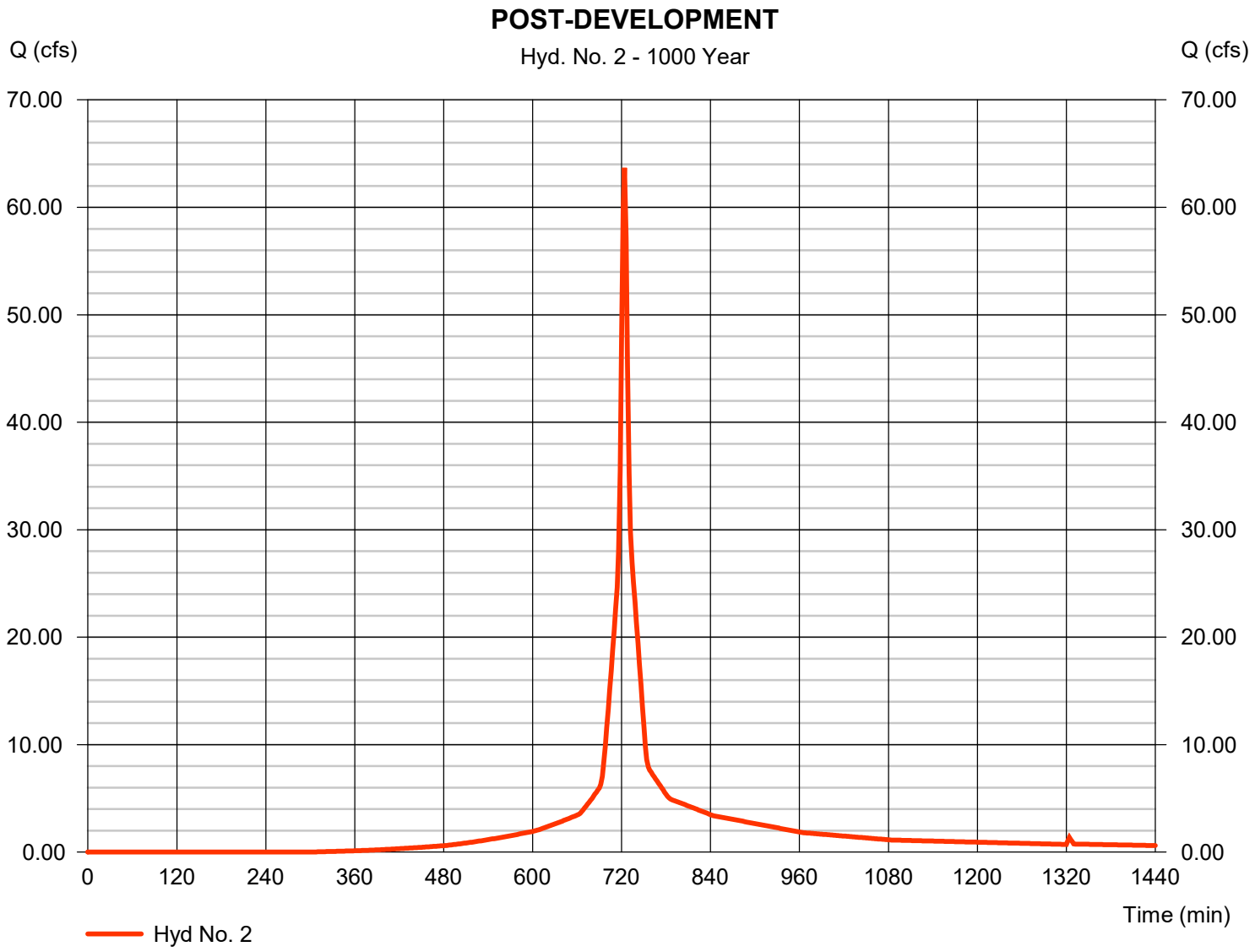
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2019.2 Wednesday, 06 / 24 / 2020

Hyd. No. 2

POST-DEVELOPMENT

Hydrograph type	= SCS Runoff	Peak discharge	= 63.67 cfs
Storm frequency	= 1000 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 195,347 cuft
Drainage area	= 3.730 ac	Curve number	= 63*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 21.10 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.490 x 98) + (2.240 x 39)] / 3.730



Hydrograph Report

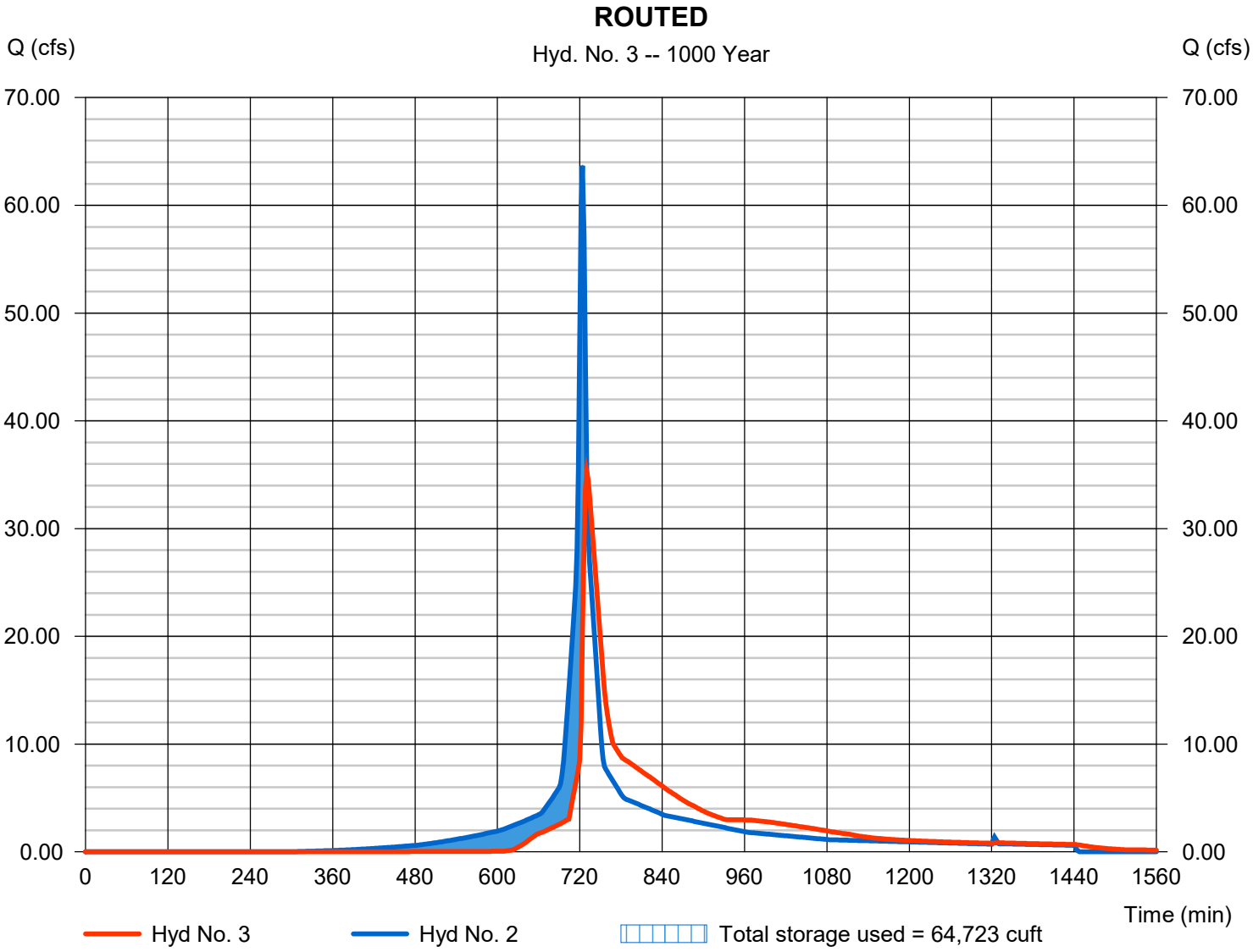
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2019.2 Wednesday, 06 / 24 / 2020

Hyd. No. 3

ROUTED

Hydrograph type	= Reservoir	Peak discharge	= 35.23 cfs
Storm frequency	= 1000 yrs	Time to peak	= 730 min
Time interval	= 2 min	Hyd. volume	= 191,820 cuft
Inflow hyd. No.	= 2 - POST-DEV	Max. Elevation	= 27.26 ft
Reservoir name	= POND#1	Max. Storage	= 64,723 cuft

Storage Indication method used.



Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2019.2 Wednesday, 06 / 24 / 2020

Pond No. 1 - POND#1

Pond Data

Contours -User-defined contour areas. Average end area method used for volume calculation. Begining Elevation = 24.50 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	24.50	13,988	0	0
0.50	25.00	16,908	7,724	7,724
1.50	26.00	24,075	20,492	28,216
2.50	27.00	31,512	27,794	56,009
3.00	27.50	35,345	16,714	72,723

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 18.00	1.50	0.00	0.00
Span (in)	= 18.00	1.50	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 24.50	24.50	0.00	0.00
Length (ft)	= 30.00	1.00	0.00	0.00
Slope (%)	= 0.30	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	Yes	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 4.00	12.00	25.00	0.00
Crest El. (ft)	= 25.25	25.75	26.75	0.00
Weir Coeff.	= 3.33	3.33	2.60	3.33
Weir Type	= 1	Rect	Broad	---
Multi-Stage	= Yes	Yes	No	No

Exfil.(in/hr) = 0.000 (by Contour)

TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	24.50	0.00	0.00	---	---	0.00	0.00	0.00	---	---	---	0.000
0.05	772	24.55	0.00 oc	0.00 ic	---	---	0.00	0.00	0.00	---	---	---	0.003
0.10	1,545	24.60	0.01 oc	0.01 ic	---	---	0.00	0.00	0.00	---	---	---	0.011
0.15	2,317	24.65	0.02 oc	0.02 ic	---	---	0.00	0.00	0.00	---	---	---	0.017
0.20	3,090	24.70	0.02 oc	0.02 ic	---	---	0.00	0.00	0.00	---	---	---	0.022
0.25	3,862	24.75	0.03 oc	0.02 ic	---	---	0.00	0.00	0.00	---	---	---	0.025
0.30	4,634	24.80	0.03 oc	0.03 ic	---	---	0.00	0.00	0.00	---	---	---	0.028
0.35	5,407	24.85	0.03 oc	0.03 ic	---	---	0.00	0.00	0.00	---	---	---	0.031
0.40	6,179	24.90	0.03 oc	0.03 ic	---	---	0.00	0.00	0.00	---	---	---	0.033
0.45	6,952	24.95	0.04 oc	0.04 ic	---	---	0.00	0.00	0.00	---	---	---	0.036
0.50	7,724	25.00	0.04 oc	0.04 ic	---	---	0.00	0.00	0.00	---	---	---	0.038
0.60	9,773	25.10	0.04 oc	0.04 ic	---	---	0.00	0.00	0.00	---	---	---	0.042
0.70	11,822	25.20	0.05 oc	0.05 ic	---	---	0.00	0.00	0.00	---	---	---	0.046
0.80	13,871	25.30	0.20 oc	0.05 ic	---	---	0.15	0.00	0.00	---	---	---	0.194
0.90	15,921	25.40	0.84 oc	0.04 ic	---	---	0.77	0.00	0.00	---	---	---	0.811
1.00	17,970	25.50	1.65 oc	0.03 ic	---	---	1.61 s	0.00	0.00	---	---	---	1.638
1.10	20,019	25.60	2.11 oc	0.02 ic	---	---	2.09 s	0.00	0.00	---	---	---	2.115
1.20	22,068	25.70	2.46 oc	0.02 ic	---	---	2.44 s	0.00	0.00	---	---	---	2.460
1.30	24,117	25.80	2.76 oc	0.01 ic	---	---	2.32 s	0.43 s	0.00	---	---	---	2.761
1.40	26,166	25.90	2.95 oc	0.01 ic	---	---	1.86 s	1.08 s	0.00	---	---	---	2.952
1.50	28,216	26.00	3.00 oc	0.00 ic	---	---	1.58 s	1.39 s	0.00	---	---	---	2.984
1.60	30,995	26.10	4.24 oc	0.01 ic	---	---	1.99 s	2.22 s	0.00	---	---	---	4.218
1.70	33,774	26.20	5.27 oc	0.01 ic	---	---	2.28 s	2.97 s	0.00	---	---	---	5.252
1.80	36,554	26.30	6.14 oc	0.01 ic	---	---	2.48 s	3.62 s	0.00	---	---	---	6.111
1.90	39,333	26.40	6.90 oc	0.00 ic	---	---	2.66 s	4.22 s	0.00	---	---	---	6.891
2.00	42,112	26.50	7.58 oc	0.00 ic	---	---	2.80 s	4.75 s	0.00	---	---	---	7.560
2.10	44,892	26.60	8.21 oc	0.00 ic	---	---	2.93 s	5.25 s	0.00	---	---	---	8.191
2.20	47,671	26.70	8.79 oc	0.00 ic	---	---	3.04 s	5.69 s	0.00	---	---	---	8.732
2.30	50,450	26.80	9.34 oc	0.00 ic	---	---	3.17 s	6.15 s	0.73	---	---	---	10.05
2.40	53,230	26.90	9.85 oc	0.00 ic	---	---	3.28 s	6.57 s	3.78	---	---	---	13.63
2.50	56,009	27.00	10.34 oc	0.00 ic	---	---	3.36 s	6.93 s	8.13	---	---	---	18.42
2.55	57,680	27.05	10.58 oc	0.00 ic	---	---	3.40 s	7.09 s	10.68	---	---	---	21.17
2.60	59,352	27.10	10.81 oc	0.00 ic	---	---	3.46 s	7.31 s	13.46	---	---	---	24.24
2.65	61,023	27.15	11.04 oc	0.00 ic	---	---	3.49 s	7.44 s	16.44	---	---	---	27.37
2.70	62,695	27.20	11.26 oc	0.00 ic	---	---	3.55 s	7.65 s	19.62	---	---	---	30.82
2.75	64,366	27.25	11.47 oc	0.00 ic	---	---	3.60 s	7.84 s	22.98	---	---	---	34.43
2.80	66,038	27.30	11.69 oc	0.00 ic	---	---	3.66 s	8.03 s	26.51	---	---	---	38.20
2.85	67,709	27.35	11.90 oc	0.00 ic	---	---	3.65 s	8.08 s	30.21	---	---	---	41.94

Continues on next page...

POND#1

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
2.90	69,380	27.40	12.10 oc	0.00 ic	---	---	3.69 s	8.24 s	34.06	---	---	---	46.00
2.95	71,052	27.45	12.30 oc	0.00 ic	---	---	3.73 s	8.40 s	38.07	---	---	---	50.20
3.00	72,723	27.50	12.50 oc	0.00 ic	---	---	3.77 s	8.55 s	42.22	---	---	---	54.54

...End

Hydraflow Rainfall Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2019.2 Wednesday, 06 / 24 / 2020

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	0.0000	0.0000	0.0000	--------
2	171.3185	25.1001	0.9905	--------
3	0.0000	0.0000	0.0000	--------
5	164.8976	26.4001	0.9324	--------
10	161.1999	26.6001	0.8991	--------
25	185.0618	28.2001	0.8916	--------
50	201.4255	29.2001	0.8841	--------
100	215.5537	29.8001	0.8767	--------

File name: NEW HANOVER COUNTY.IDF

Intensity = B / (Tc + D)^E

Return Period (Yrs)	Intensity Values (in/hr)											
	5 min	10	15	20	25	30	35	40	45	50	55	60
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	5.88	5.05	4.42	3.94	3.55	3.23	2.96	2.74	2.54	2.38	2.23	2.10
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	6.63	5.78	5.12	4.61	4.19	3.84	3.55	3.30	3.08	2.89	2.73	2.58
10	7.23	6.33	5.65	5.10	4.65	4.28	3.97	3.70	3.46	3.26	3.08	2.92
25	8.15	7.19	6.44	5.84	5.35	4.94	4.59	4.29	4.03	3.80	3.59	3.41
50	8.87	7.86	7.07	6.43	5.90	5.46	5.08	4.76	4.47	4.22	4.00	3.80
100	9.60	8.53	7.69	7.01	6.44	5.97	5.56	5.21	4.91	4.64	4.40	4.18

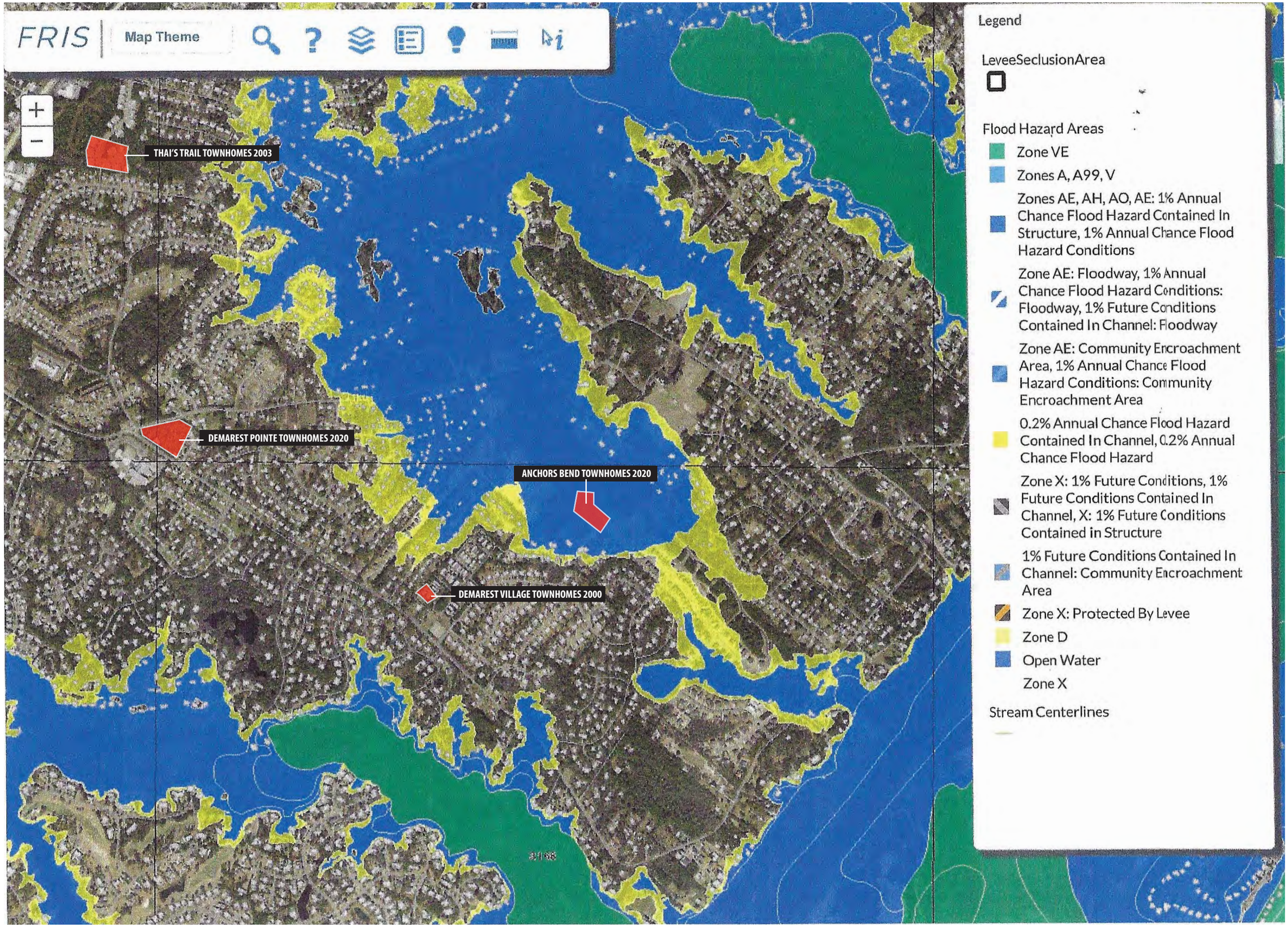
Tc = time in minutes. Values may exceed 60.

Precip. file name: L:\Civil\CALCS\STORMWATER\IDF CURVES FOR HYDRAFLOW\NEW HANOVER COUNTY.pcp

Storm Distribution	Rainfall Precipitation Table (in)							
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
SCS 24-hour	18.10	21.10	4.50	0.00	7.00	8.05	9.00	10.00
SCS 6-Hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-1st	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-4th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-Indy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Custom	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

EXHIBIT C

FEMA Floodmaps



DEMAREST POINTE
A Classic American Neighborhood
Sustainability-Diversity-Ecology-Connectivity

DEVELOPER:
Middlesound LLC
6933 Running Brook Terrace
Wilmington, North Carolina 28411

SURVEYOR:
Atlantic Coast Survey
1200 N 23rd Street, Suite 107
Wilmington, North Carolina 28405

CIVIL ENGINEERING:
CDS Engineering
3805 Cherry Avenue
Wilmington, North Carolina 28403

LAND PLANNING LANDSCAPE ARCHITECTURE:
DEMAREST COMPANY Landscape Architects Land Planners ASLA
6933 Running Brook Terrace Wilmington, NC 28411 910-231-2428

BUILDER
PBC DESIGN + BUILD
314 Walnut Street Wilmington, North Carolina 28401

PROJECT TITLE:
DEMAREST POINTE
MASTER DEVELOPMENT PLAN
New Hanover County, North Carolina

Rev	Description	Date	DWN	CKD

DWG TITLE
MIDDLE SOUND COMMUNITY TOWNHOMES FLOOD MAP

GRAPHIC SCALE: APPROXIMATE

PROJECT NO.:	
REF. NO.	
DATE: 3/28/20	
DRAWN: SDS	
CHECKED: SDS	
DRAWING SCALE: NTS	
CHECKED:	

NORTH CAROLINA REGISTERED LANDSCAPE ARCHITECT SCOTT D. STEWART 1728

DRAWING NO. **31**

EXHIBIT D

Atlantic Coast Survey – Downstream Survey Information

Atlantic Coast Survey, PLLC
Professional Land Surveyors
(910) 443-0080
PO Box 12588
Wilmington, NC 28405

Report of Survey

Date: June 3, 2020

Property Location/Address: Bedford Road

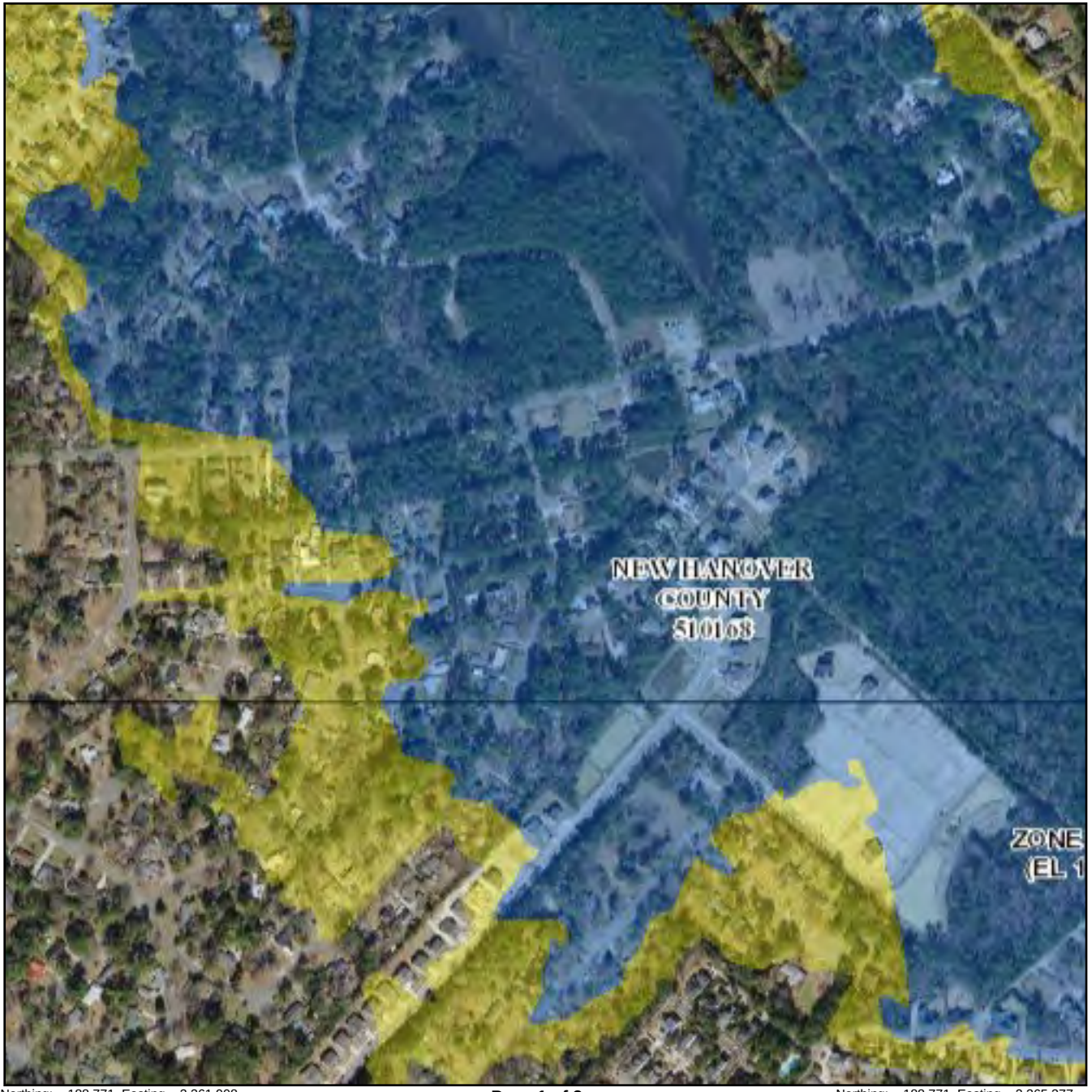
Survey Task Requested: Measure top of pavement elevation at the intersection of Bedford Road and Parliament Drive, Wilmington, NC 28411 and identify the base flood elevation at the same location.

Field measurements were made on June 1, 2020 and the pavement elevation at this intersection was found to be 6.0 feet referenced to N.A.V.D 1988 datum. According to F.I.R.M. map #3720316900 K, Effective Date 8/28/2018, the base flood elevation at that location is 13.0 feet. It was also noted that the horizontal distance from this location is approximately 0.65 mile from the intersection of Middle Sound Loop Road and Pickway Court.

Signed & Sealed this 3rd day of June, 2020

Northing: = 192,239, Easting = 2,361,908

Northing: = 192,239, Easting = 2,365,377



Without Base Flood Elevation (BFE)
Zone A, V, A99
With BFE or Depth
Zone AE, AO, AH, VE, AR
Regulatory Floodway
0.2% Annual Chance Flood Hazard
Future Conditions 1% Annual Chance Flood Hazard Zone X
Areas Determined to be Outside the 0.2% Annual Chance Flood Hazard
Zone X
Jurisdiction Boundary
FIRM Panel Boundary

North Carolina State Plane Projection Feet (Zone 3200)
Datum: NAD 1983 (Horizontal), NAVD 1988 (Vertical)

1 inch = 500 feet 1:6000

0 125 250 500 Feet

0 25 50 100 Meters

FEMA National Flood Insurance Program

NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP

Panel(s):3169,3168

CONTAINS:

COMMUNITY	CID
NEW HANOVER COUNTY	370168

Notice to User: The Map Number(s) shown below should be used when placing map orders; the Community Number(s) shown above should be used on insurance applications for the subject community.

SELECTED PANELS:

MAP NUMBER	EFFECTIVE DATE
3720316900K	8/28/2018
3720316800K	8/28/2018

Northing: = 188,771, Easting = 2,361,908

Northing: = 188,771, Easting = 2,365,377

FEMA: National Flood Insurance Program

Panel(s):3169,3168

CONTAINS:

COMMUNITY	CID
NEW HANOVER COUNTY	370168

Notice to User: The Map Number(s) shown below should be used when placing map orders; the Community Number(s) shown above should be used on insurance applications for the subject community.

SELECTED PANELS:

MAP NUMBER	EFFECTIVE DATE
3720316900K	8/28/2018
3720316800K	8/28/2018

NOTES TO USERS

This is an official FIRMette of a portion of the effective panels listed in the Title Block shown on Page 1. The information represented on this FIRMette was extracted from the effective digital flood hazard data available at http://fris.nc.gov/fris.

Base flood elevation data, floodway, nonencroachment widths, information on certain areas no in the Special Flood Hazard Areas protected by flood control structures, and other pertinent data are available in the Flood Insurance Study (FIS) available at http://fris.nc.gov/fris. Users should be aware that flood elevations shown on this FIRMette represent elevations rounded to one tenth of a foot (0.1') and should be utilized in conjunction with data available in the FIS.

NOTES TO USERS

Base map information and geospatial data used to develop this FIRMette were obtained from various organizations, including the participating local community(ies), state and federal agencies, and/or other sources. The primary base for this FIRM is aerial imagery acquired by the State in 2010. Information and geospatial data supplied by the local community(ies) that met FEMA base map specifications were considered the preferred source for development of the base map.

See geospatial metadata for the associated digital FIRMette for additional information about base map preparation. Base map features shown on this FIRMette, such as corporate limits, are based on the most up-to-date data available at the time of publication. Changes in the corporate limits may have occurred since this map was published. Map users should consult the appropriate community official or website to verify current conditions of jurisdictional boundaries and base map features. This map may contain roads that were not considered in the hydraulic analysis of streams where no new hydraulic model was created during the production of this statewide format FIRM.

Flood elevations on this map are referenced to either or both the North American Vertical Datum of 1988 (NAVD 88) or National Geodetic Datum of 1929 (NGVD 29), and are labeled accordingly. These flood elevations must be compared to structure and ground elevations referenced to the same vertical datum. To obtain current elevation, description, and/or location information for bench marks shown on this map, or for information regarding conversion between NGVD 29 and NAVD 88, please contact the Information Services Branch of the National Geodetic Survey at (301) 713-3242, or visit its website at http://www.ngs.noaa.gov/.

MORE INFORMATION

Letters of Map Amendment (LOMA)	1-877-336-2627 http://msc.fema.gov/
Letters of Map Revision (LOMR)	919-715-5711 www.ncfloodmaps.com
Flood Insurance Availability	
North Carolina Division of Emergency Management (NCDEM)	919-715-5711 http://www.nccrimecontrol.org/nfip
National Flood Insurance Program (NFIP)	1-877-638-6620 http://www.fema.gov/business/nfip
Questions about this FIRMette	1-877-336-2627 http://fema.gov

LEGEND

LEGEND

MAP REVISIONS

There are no map revisions for the selected area.

EXHIBIT E

Receiving Watershed Information

Half Mile

From: rodney@csd-engineering.com

To: scottstewart6933@yahoo.com

Cc: howard@CSD-ENGINEERING.COM

Date: Monday, May 18, 2020, 10:52 AM EDT

Scott,

I pulled the dimension from Pages Creek and Howe Creek and they're both over 0.5 mile using the DEQ website.

Rodney Wright

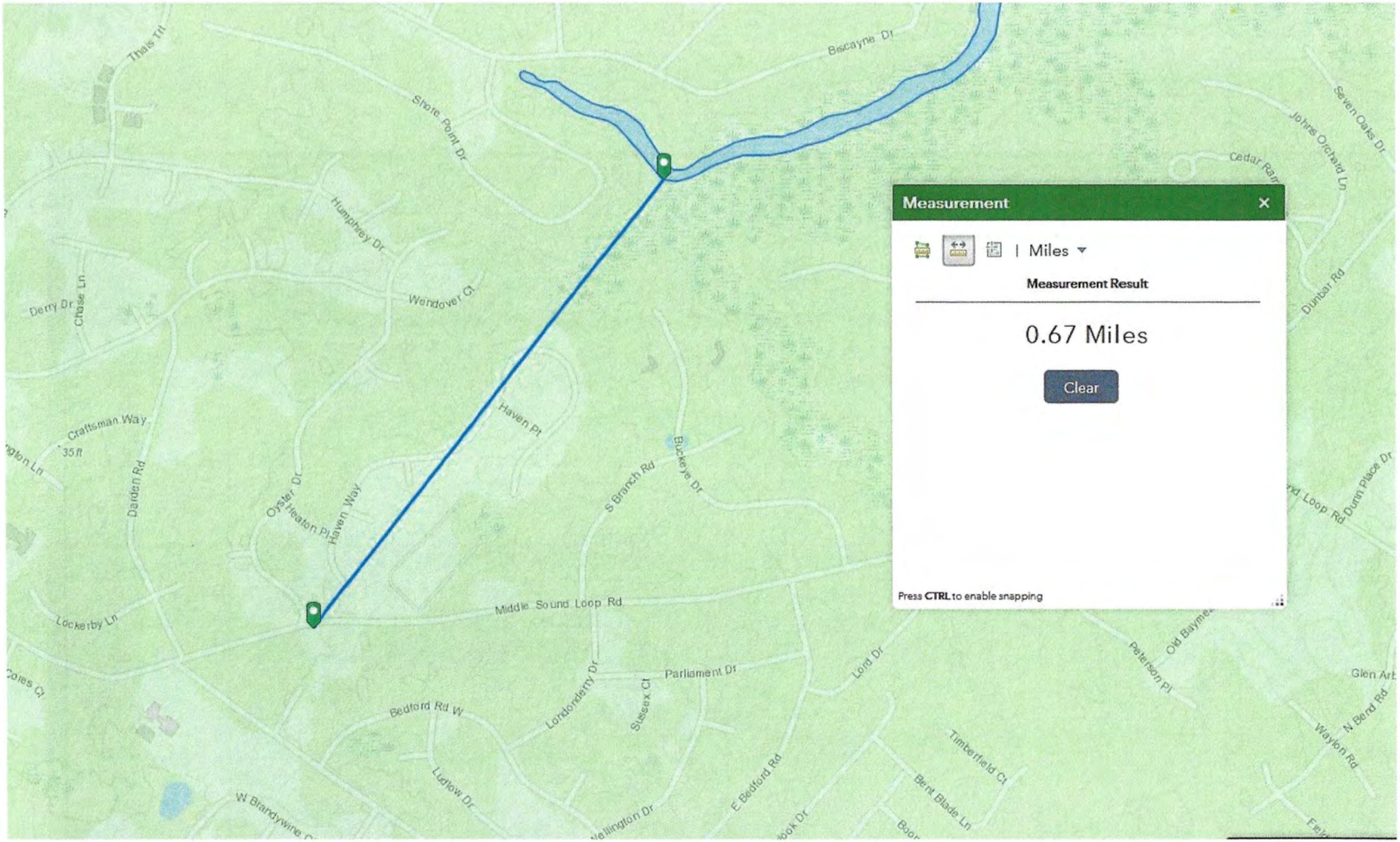
3805 Cherry Avenue
Wilmington, NC 28403
910 791 4441 office

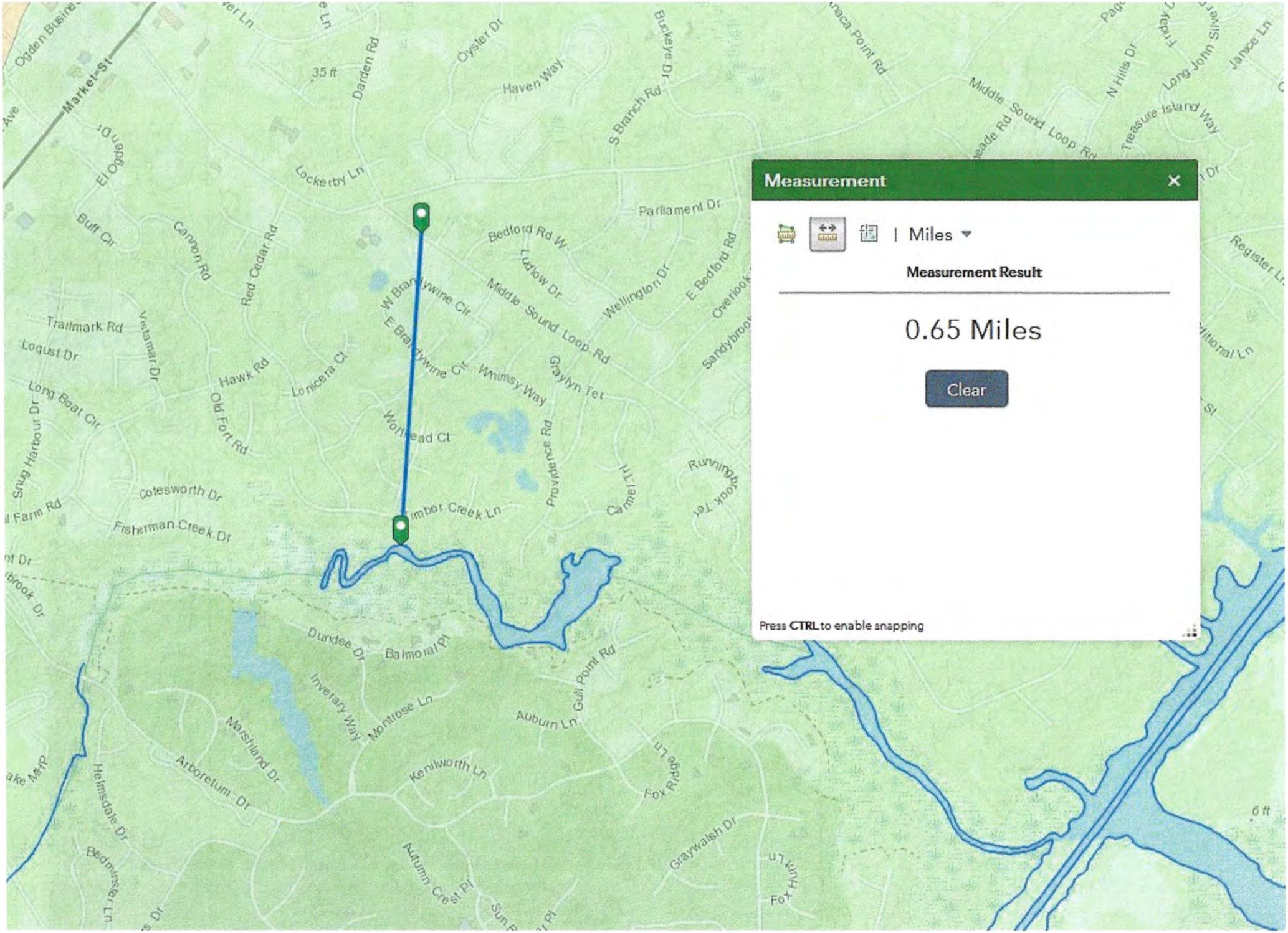
910 791 1501 fax
www.csd-engineering.com

half_mile_Pages_Creek.pdf
121.8kB

half_mile_Howe_Creek.pdf
134.3kB

image001.png
5.7kB


Measurement
Miles
Measurement Result
0.67 Miles
Clear
Press CTRL to enable snapping
Biscayne Dr
Shore Point Dr
Humphrey Dr
Wendover Ct
Haven Pt
Haven Way
Oyster Dr
Heaton Pl
S Branch Rd
Buckeye Dr
Middle Sound Loop Rd
Craftsman Way
35 ft
Darden Rd
Derry Dr
Chase Ln
Lockerby Ln
Bedford Rd W
Londonderry Dr
Sussex Ct
Parliament Dr
Lord Dr
Ludlow Dr
E Bedford Rd
Timberfield Ct
Bent Blade Ln
Waylon Rd
N Bend Rd
Peterson Pl
Old Bayne
Dunbar Rd
Dunn Place Dr
Loop Rd
Cedar Rap
Johns Orchard Ln
Seven Oaks Dr
Thais Trl
Glen Arb


Measurement
Miles
Measurement Result
0.65 Miles
Clear
Press CTRL to enable snapping
Market St
Darden Rd
Oyster Dr
Haven Way
S Branch Rd
Buckeye Dr
Middle Sound Loop Rd
Treasure Island Way
Lockerby Ln
Parliament Dr
Bedford Rd W
Larlow Dr
Wellington Dr
E Bedford Rd
Buff Cir
Cannon Rd
Red Cedar Rd
W Brandywine Cir
E Brandywine Cir
Whimsy Way
Graylyn Ter
Providence Rd
Trailmark Rd
Locust Dr
Vestamar Dr
Hawk Rd
Lonicera Ct
Old Fort Rd
Long Boat Cir
Snug Harbour Dr
Wolfhead Ct
Cotesworth Dr
Fisherman Creek Dr
Timber Creek Ln
Carmel Trl
Running Brook Trl
Dundee Dr
Balmoral Pl
Gull Point Rd
Inverary Way
Montrose Ln
Auburn Ln
Marshland Dr
Arboretum Dr
Kenilworth Ln
Helmsdale Dr
Bedminster Ln
Autumn Crest Pl
Graywalsh Dr
Fox Run Ln
Fox Rdge Ln
35 ft
6 ft

Re: Demarest Pointe

From: Moul, Robert (rmoul@lmgroup.net)

To: scottstewart6933@yahoo.com

Cc: pfarley@lmgroup.net

Date: Tuesday, May 19, 2020, 10:31 AM EDT

Hi Scott: it was nice to speak yesterday and get caught up with family items. Time sure does fly!
I measured the three closest estuarine water points from the Demarest Pointe project. All are greater than .5 mile away.
Pages Creek- the closest point is at the end of a Haven Way lot along the edge of a channelized tributary. I measured 2710 or (.51 mile) away. Where Pages Creek crosses Middle Sound Loop Road I measured 3840 (.72 mile) away.
Howe Creek- the closest point was 3335 lf or (.63 mile) away at the end of Timber Creek Lane.

These measurements are off of google earth maps and as the crow flies so they are the most restrictive interpretations. Therefore the project appears to lie outside of the .5 mile radius.
Best regards,

Rob Moul
Senior Consultant
Land Management Group
910-471-0501

On Mon, May 18, 2020 at 11:41 AM Scott Stewart <scottstewart6933@yahoo.com> wrote:

> Rob,
>
> Attached please find Middlesound LLC " Demarest Pointe" Exhibits 1-25 currently scheduled for Conditional Rezoning 6-4-20 Planning Board and 7-13-20 Commissioners.
>
> Howard Resnick (CSD Engineering) just provided me the stormwater assessment on the storm water program I designed for the site which will accommodate a 100, 500 and 1,000 year storm. Yes, 1,000 year storm! I can retain 21.1 inches on the property which will realize 6 CFS less leaving the site than pre development. I'm actually improving the water quality downstream of the existing ditch that ends up traversing through Queens Pointe and ends up in Pages Creek. This should set a new precedent for NHC.
>
> What I'm "triple checking" is the location of Demarest Pointe in relationship to Pages Creek and the 1/2 mile rule.So far, two opinions agree what I arrived at, I'm "at least" half a mile, actually 3/4 of a mile. Anyway you can confirm this "in house" for me?
>
> If you need to address your time:
>
> Middlesound LLC
> 6933 Running Brook Terrace
> Wilmington, NC 28411
> Attn: Scott D Stewart RLA ASLA
> Member-Manager
> scottstewart6933@yahoo.com
> 910-231-2428

EXHIBIT F

ECS Soils Report

June 3, 2020

Mr. Scott D. Stewart
Middle Sound, LLC
6933 Running Brook Terrace
Wilmington, North Carolina 28411

Reference: Report of Seasonal High Water Table Estimation and Infiltration Testing
Demarest Pointe
Wilmington, New Hanover County, North Carolina
ECS Project No. 49.11777

Dear Mr. Stewart:

ECS Southeast, LLP (ECS) recently conducted a seasonal high water table (SHWT) estimation and infiltration testing within the stormwater control measure (SCM) area(s) off of Middle Sound Loop Road in Wilmington, New Hanover County, North Carolina. This letter, with attachments, is the report of our testing.

Field Testing

On June 1, 2020, ECS conducted an exploration of the subsurface soil and groundwater conditions, in accordance with the NCDEQ Stormwater Design Manual section A-2, at two requested locations shown on the attached Boring Location Plan (Figure 1). ECS used GPS equipment in order to determine the boring locations. The purpose of this exploration was to obtain subsurface information of the in situ soils for the SCM area(s). ECS explored the subsurface soil and groundwater conditions by advancing one hand auger boring into the existing ground surface at each of the requested boring locations. ECS visually classified the subsurface soils and obtained representative samples of each soil type encountered. ECS also recorded the SHWT and groundwater elevation observed at the time of the hand auger borings. The attached Infiltration Testing Form provides a summary of the subsurface conditions encountered at the hand auger boring locations.

The SHWT and groundwater elevation was estimated at the boring locations below the existing grade elevation. A summary of the findings are as follows:

Location	SHWT	Groundwater
I-1	24 inches	38 inches
I-2	26 inches	55 inches

ECS has conducted two infiltration tests utilizing a compact constant head permeameter near the hand auger borings in order to estimate the infiltration rate for the subsurface soils. Infiltration tests are typically conducted at two feet above the SHWT or in the most restrictive soil horizon. Tests in clayey conditions are conducted for durations of up to 30 minutes. If a more precise hydraulic conductivity value is desired for these locations, then ECS recommends collecting samples and performing laboratory permeability testing.

Field Test Results

Below is a summary of the infiltration test results:

Location	Description	Depth	Inches/ hour
I-1	Gray clayey SAND	26 inches	0.008
I-2	Tan/orange/gray CLAY	24 inches	<0.001

Infiltration rates and SHWT may vary within the proposed site due to changes in elevation, soil classification and subsurface conditions. ECS recommends that a licensed surveyor provide the elevations of the boring locations.

Closure

ECS's analysis of the site has been based on our understanding of the site, the project information provided to us, and the data obtained during our exploration. If the project information provided to us is changed, please contact us so that our recommendations can be reviewed and appropriate revisions provided, if necessary. The discovery of any site or subsurface conditions during construction which deviate from the data outlined in this exploration should be reported to us for our review, analysis and revision of our recommendations, if necessary. The assessment of site environmental conditions for the presence of pollutants in the soil and groundwater of the site is beyond the scope of this geotechnical exploration.

ECS appreciates the opportunity to provide our services to you on this project. If you have any questions concerning this report or this project, please contact us.

Respectfully,

ECS SOUTHEAST, LLP

K. Brooks Wall
Project Manager
bwall@ecslimited.com
910-686-9114

W. Brandon Fulton, PSC, PWS, LSS
Environmental Department Manager
bfulton@ecslimited.com
704-525-5152

Winslow E. Goins, PE
Geotech Department Manager
wgoins@ecslimited.com
910-686-9114

Attachments: Figure 1 - Boring Location Plan
Infiltration Testing Form
GBA Document

⊗ **APPROXIMATE BORING LOCATIONS**

N
W E
S

SCALE SHOWN ABOVE

Demarest Pointe
Wilmington, New Hanover County, North Carolina

ECS Project # 49.11777
June 2, 2020
KBW

Figure 1– Boring Location Plan

Provided by: Google Earth

Infiltration Testing Form
Demarest Pointe
Wilmington, New Hanover County, North Carolina
ECS Project No. 49.11777
June 1, 2020

Location	Depth	USCS	Soil Description
I-1	0-24”	SM	Black/gray silty SAND
	24”-38”	SC	Gray clayey SAND
	38”-48”	CL	Gray/orange sandy CLAY

Seasonal High Water Table was estimated to be at 24 inches below the existing grade elevation.
Groundwater was encountered at 38 inches below the existing grade elevation.
Test was conducted at 26 inches below existing grade elevation
Infiltration Rate: 0.008 inches per hour

Location	Depth	USCS	Soil Description
I-2	0-15”	SM	Black silty SAND
	15”-24”	SM	Black silty SAND (hardpan)
	24”-48”	CL	Tan/orange/gray sandy CLAY
	48”-55”	SC	Gray clayey SAND

Seasonal High Water Table was estimated to be at 26 inches below the existing grade elevation.
Groundwater was encountered at 55 inches below the existing grade elevation.
Test was conducted at 24 inches below existing grade elevation
Infiltration Rate: <0.001 inches per hour

Important Information about This

Geotechnical-Engineering Report

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

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

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

Geotechnical-Engineering Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. *Those who rely on a geotechnical-engineering report prepared for a different client can be seriously misled*. No one except authorized client representatives should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one – not even you – should apply this report for any purpose or project except the one originally contemplated.*

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read it *in its entirety*. Do not rely on an executive summary. Do not read selected elements only. *Read this report in full.*

You Need to Inform Your Geotechnical Engineer about Change

Your geotechnical engineer considered unique, project-specific factors when designing the study behind this report and developing the confirmation-dependent recommendations the report conveys. A few typical factors include:

- the client's goals, objectives, budget, schedule, and risk-management preferences;
- the general nature of the structure involved, its size, configuration, and performance criteria;
- the structure's location and orientation on the site; and
- other planned or existing site improvements, such as retaining walls, access roads, parking lots, and underground utilities.

Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.*

This Report May Not Be Reliable

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

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

Note, too, that it could be unwise to rely on a geotechnical-engineering report whose reliability may have been affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If your geotechnical engineer has not indicated an "apply-by" date on the report, ask what it should be*, and, in general, *if you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying it. A minor amount of additional testing or analysis – if any is required at all – could prevent major problems.

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

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

This Report's Recommendations Are Confirmation-Dependent

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

This Report Could Be Misinterpreted

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

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

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

Give Constructors a Complete Report and Guidance

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

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely*. Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures*. If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. As a general rule, *do not rely on an environmental report prepared for a different client, site, or project, or that is more than six months old.*

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, none of the engineer's services were designed, conducted, or intended to prevent uncontrolled migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration.*** Confront the risk of moisture infiltration by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are not building-envelope or mold specialists.***

GEOPROFESSIONAL BUSINESS ASSOCIATION

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

EXHIBIT G

Conceptual Water Quality Plan

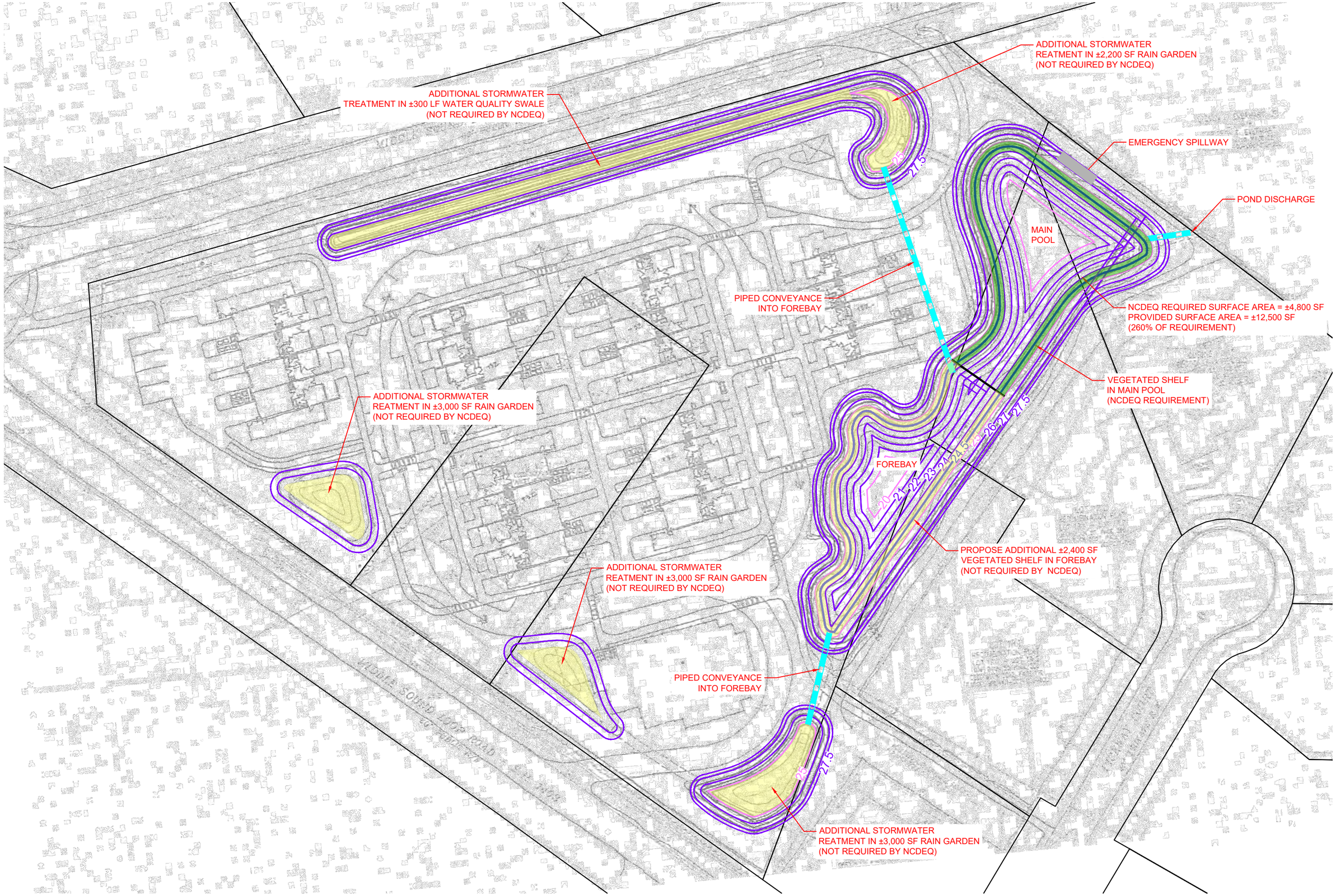
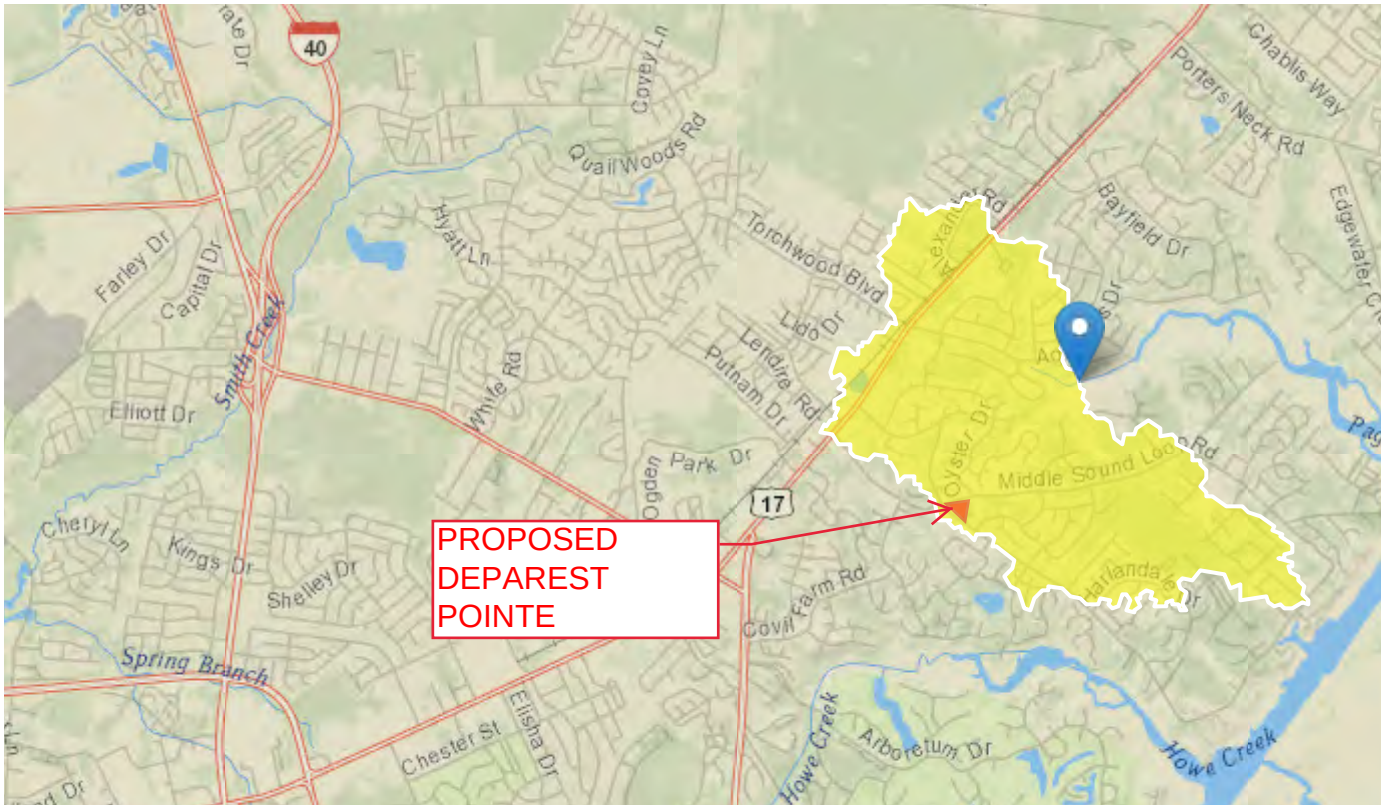

ADDITIONAL STORMWATER
TREATMENT IN ±300 LF WATER QUALITY SWALE
(NOT REQUIRED BY NCDEQ)
ADDITIONAL STORMWATER
REATMENT IN ±2,200 SF RAIN GARDEN
(NOT REQUIRED BY NCDEQ)
EMERGENCY SPILLWAY
POND DISCHARGE
MAIN
POOL
PIPED CONVEYANCE
INTO FOREBAY
NCDEQ REQUIRED SURFACE AREA = ±4,800 SF
PROVIDED SURFACE AREA = ±12,500 SF
(260% OF REQUIREMENT)
VEGETATED SHELF
IN MAIN POOL
(NCDEQ REQUIREMENT)
ADDITIONAL STORMWATER
REATMENT IN ±3,000 SF RAIN GARDEN
(NOT REQUIRED BY NCDEQ)
FOREBAY
PROPOSE ADDITIONAL ±2,400 SF
VEGETATED SHELF IN FOREBAY
(NOT REQUIRED BY NCDEQ)
ADDITIONAL STORMWATER
REATMENT IN ±3,000 SF RAIN GARDEN
(NOT REQUIRED BY NCDEQ)
PIPED CONVEYANCE
INTO FOREBAY
ADDITIONAL STORMWATER
REATMENT IN ±3,000 SF RAIN GARDEN
(NOT REQUIRED BY NCDEQ)

EXHIBIT H

USGS StreamStats Report

Demarast Pointe - Downstream Drainage Analysis

Region ID: NC
Workspace ID: NC20200609181643573000
Clicked Point (Latitude, Longitude): 34.27594, -77.79775
Time: 2020-06-09 14:16:30 -0400



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	2.21	square miles
PCTREG1	Percentage of drainage area located in Region 1	0	percent
PCTREG2	Percentage of drainage area located in Region 2	0	percent
PCTREG3	Percentage of drainage area located in Region 3	0	percent
PCTREG4	Percentage of drainage area located in Region 4	100	percent
PCTREG5	Percentage of drainage area located in Region 5	0	percent

Parameter Code	Parameter Description	Value	Unit
LC06IMP	Percentage of impervious area determined from NLCD 2006 impervious dataset	14.41	percent
I24H50Y	Maximum 24-hour precipitation that occurs on average once in 50 years	10.8	inches

Peak-Flow Statistics Parameters[Peak Southeast US over 1 sqmi 2009 5158]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	2.21	square miles	1	9000
PCTREG1	Percent Area in Region 1	0	percent	0	100
PCTREG2	Percent Area in Region 2	0	percent	0	100
PCTREG3	Percent Area in Region 3	0	percent	0	100
PCTREG4	Percent Area in Region 4	100	percent	0	100
PCTREG5	Percent Area in Region 5	0	percent	0	100

Peak-Flow Statistics Flow Report[Peak Southeast US over 1 sqmi 2009 5158]

PIl: Prediction Interval-Lower, PIu: Prediction Interval-Upper, SEp: Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	PIl	PIu	SEp
2 Year Peak Flood	101	ft^3/s	57.9	176	34.5
5 Year Peak Flood	202	ft^3/s	117	350	34
10 Year Peak Flood	283	ft^3/s	161	498	35.1
25 Year Peak Flood	397	ft^3/s	218	723	37.5
50 Year Peak Flood	497	ft^3/s	264	935	39.6
100 Year Peak Flood	609	ft^3/s	313	1180	41.9
200 Year Peak Flood	713	ft^3/s	353	1440	44.3
500 Year Peak Flood	873	ft^3/s	412	1850	47.7

Peak-Flow Statistics Citations

Weaver, J.C., Feaster, T.D., and Gotvald, A.J.,2009, Magnitude and frequency of rural floods in the Southeastern United States, through 2006—Volume 2, North Carolina: U.S. Geological

Survey Scientific Investigations Report 2009–5158, 111 p. (http://pubs.usgs.gov/sir/2009/5158/)

Application Version: 4.3.11