



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
demarest.gpw					Return Period: 100 Year			Wednesday, 05 / 13 / 2020	

Hydrograph Report

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

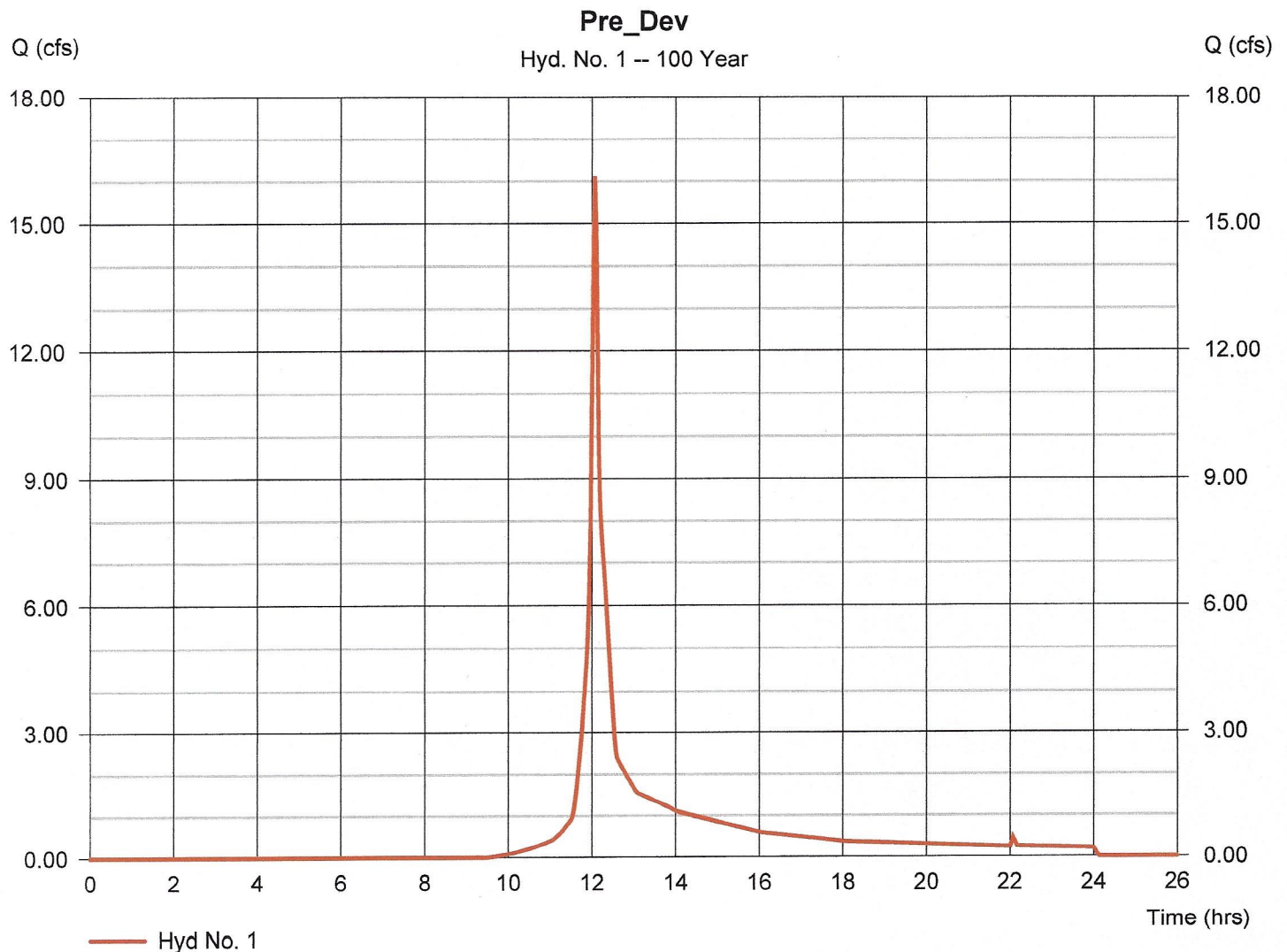
Wednesday, 05 / 13 / 2020

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

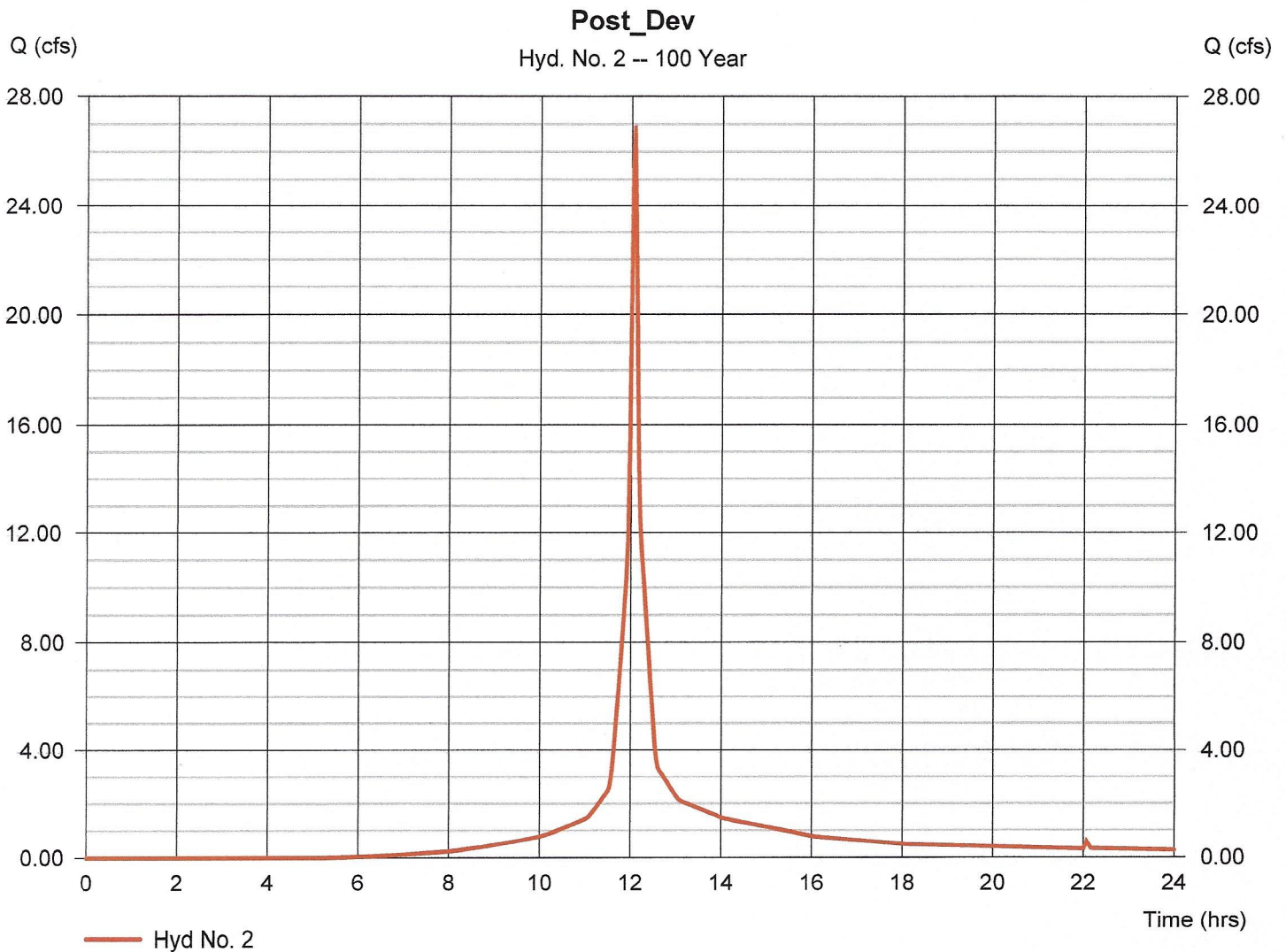
Wednesday, 05 / 13 / 2020

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) = $[(1.490 \times 98) + (1.900 \times 61)] / 3.390$



Hydrograph Report

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

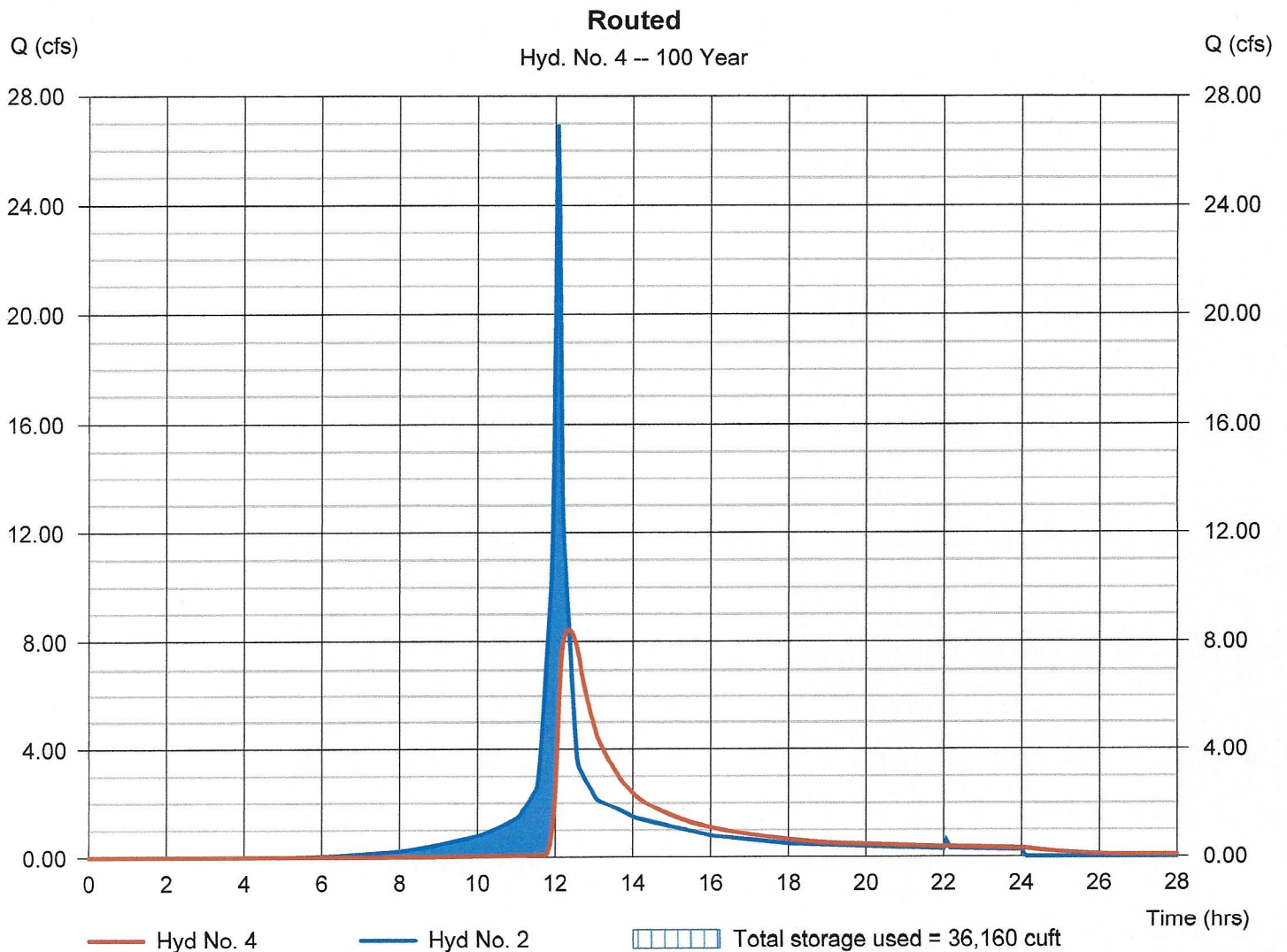
Wednesday, 05 / 13 / 2020

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
demarest.gpw					Return Period: 500 Year			Wednesday, 05 / 13 / 2020	

Hydrograph Report

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

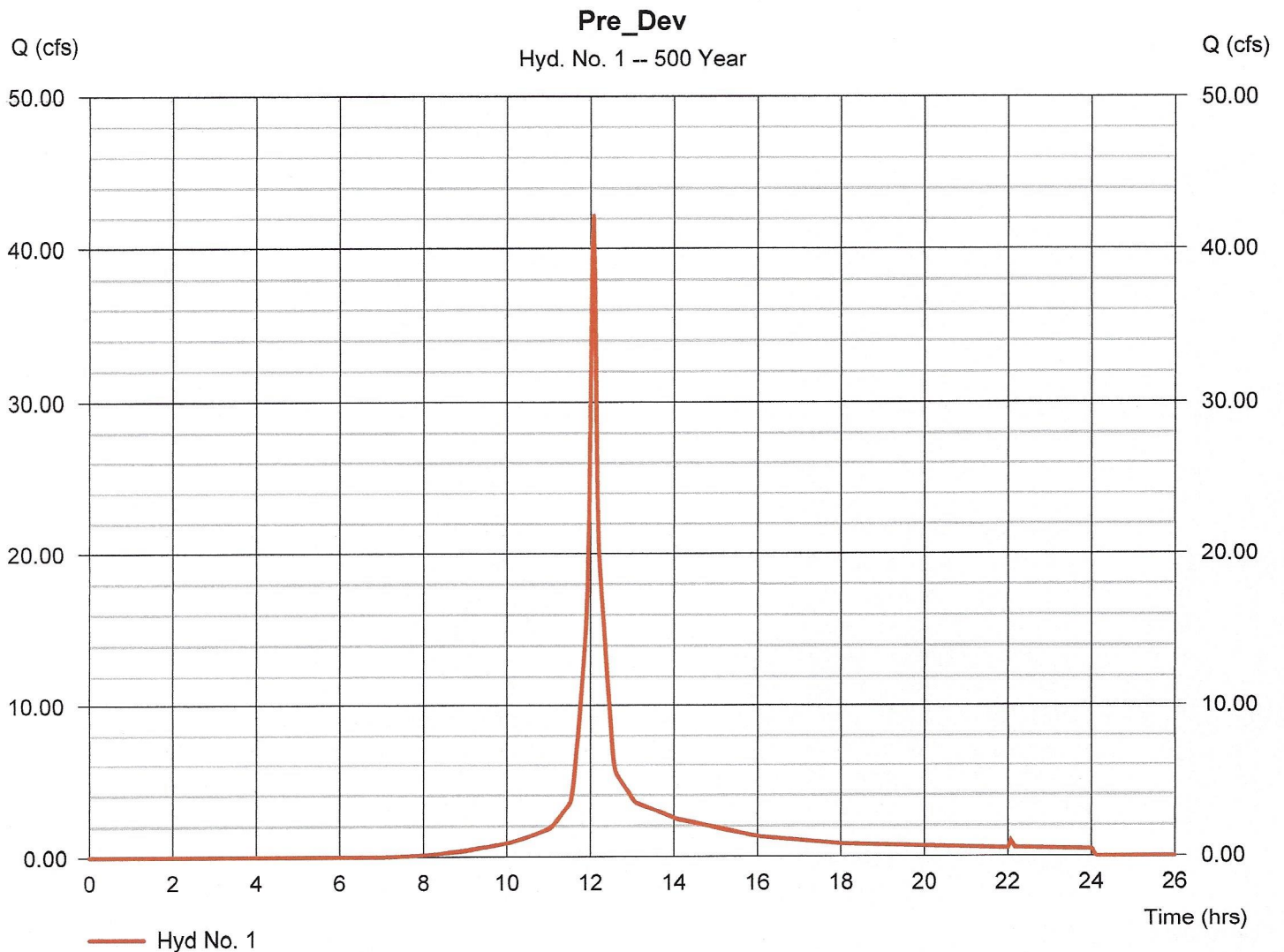
Wednesday, 05 / 13 / 2020

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) = $[(0.610 \times 98) + (2.670 \times 39)] / 3.390$



Hydrograph Report

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

Wednesday, 05 / 13 / 2020

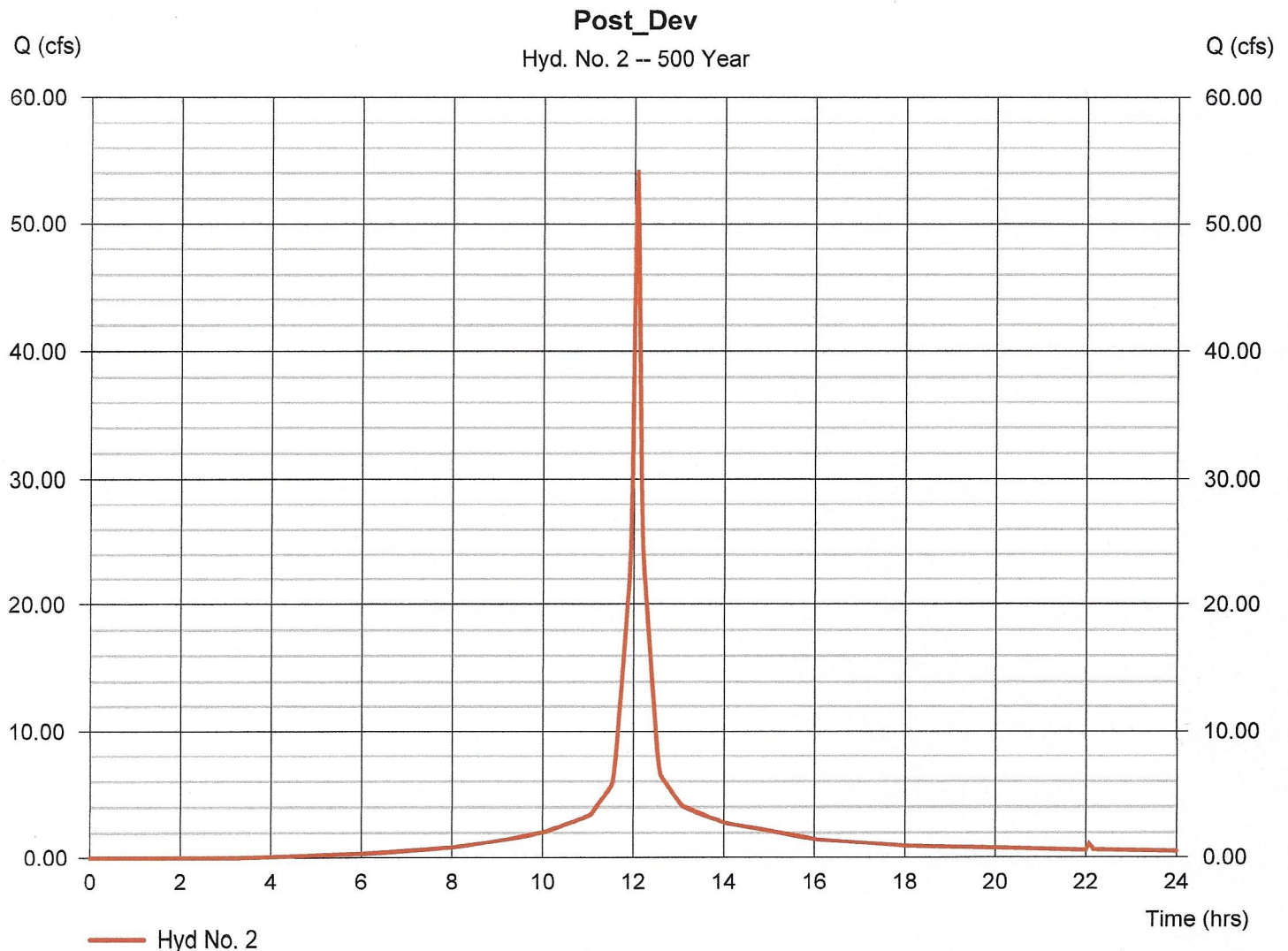
Hyd. No. 2

Post_Dev

Hydrograph type = SCS Runoff
Storm frequency = 500 yrs
Time interval = 2 min
Drainage area = 3.390 ac
Basin Slope = 0.0 %
Tc method = User
Total precip. = 18.10 in
Storm duration = 24 hrs

Peak discharge = 54.26 cfs
Time to peak = 12.07 hrs
Hyd. volume = 172,484 cuft
Curve number = 77*
Hydraulic length = 0 ft
Time of conc. (Tc) = 5.00 min
Distribution = Type III
Shape factor = 484

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



Hydrograph Report

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

Wednesday, 05 / 13 / 2020

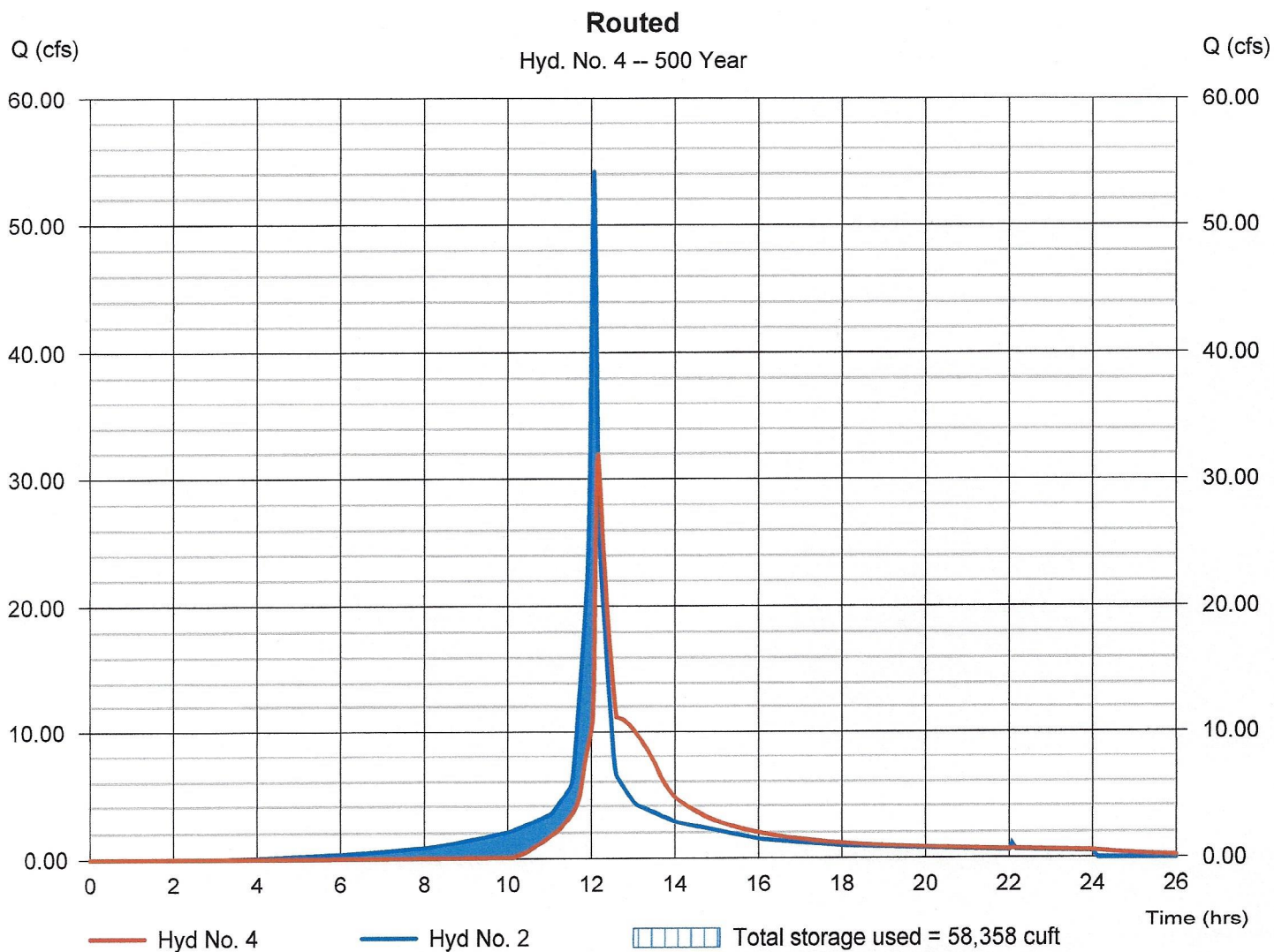
Hyd. No. 4

Routed

Hydrograph type = Reservoir
Storm frequency = 500 yrs
Time interval = 2 min
Inflow hyd. No. = 2 - Post_Dev
Reservoir name = Retaining Wall

Peak discharge = 32.05 cfs
Time to peak = 12.17 hrs
Hyd. volume = 169,829 cuft
Max. Elevation = 26.75 ft
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
demarest.gpw					Return Period: 1,000 Year			Wednesday, 05 / 13 / 2020	

Hydrograph Report

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

Wednesday, 05 / 13 / 2020

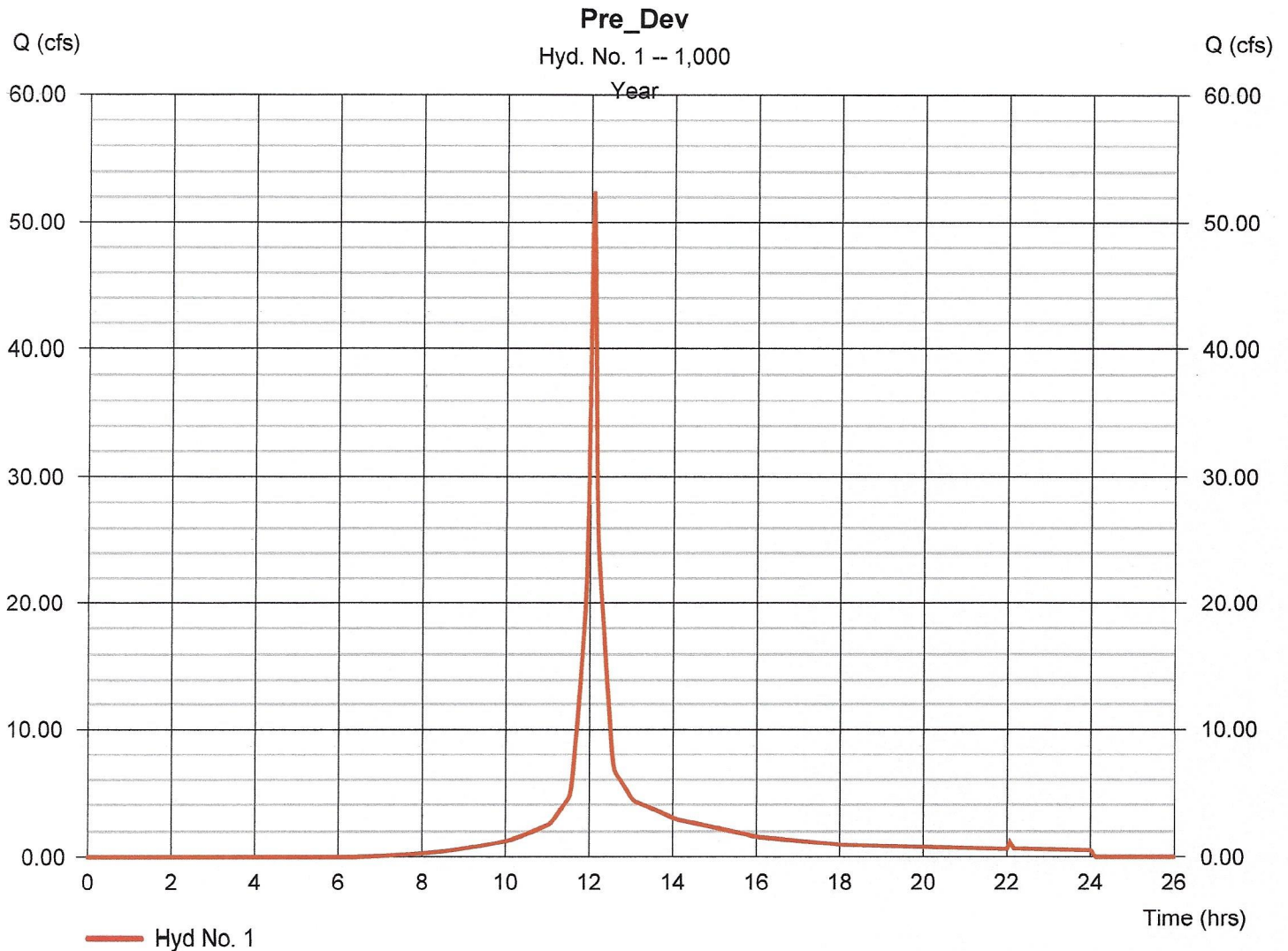
Hyd. No. 1

Pre_Dev

Hydrograph type = SCS Runoff
Storm frequency = 1,000 yrs
Time interval = 2 min
Drainage area = 3.390 ac
Basin Slope = 0.0 %
Tc method = User
Total precip. = 21.10 in
Storm duration = 24 hrs

Peak discharge = 52.43 cfs
Time to peak = 12.07 hrs
Hyd. volume = 158,089 cuft
Curve number = 55*
Hydraulic length = 0 ft
Time of conc. (Tc) = 5.00 min
Distribution = Type III
Shape factor = 484

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



Hydrograph Report

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

Wednesday, 05 / 13 / 2020

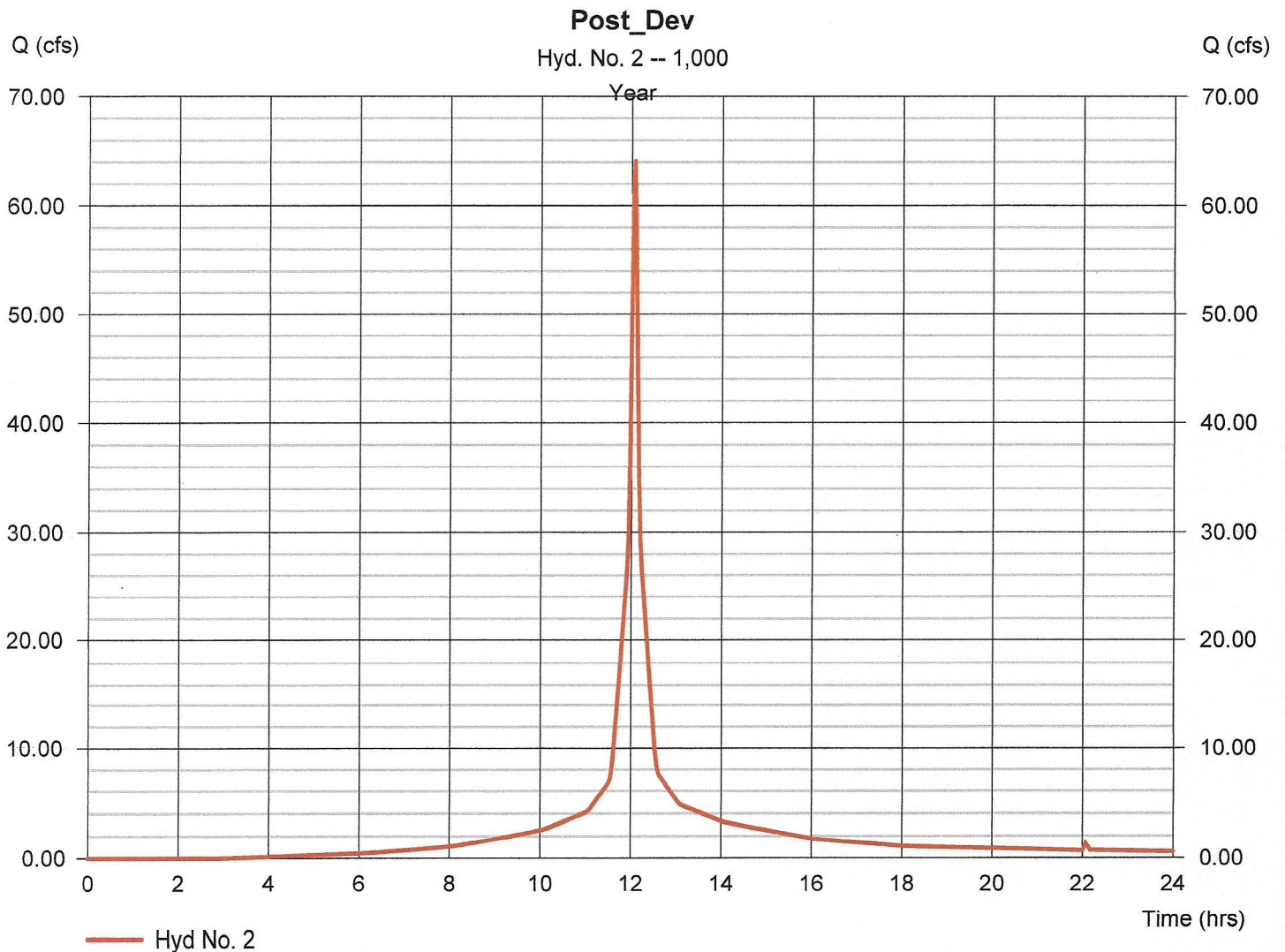
Hyd. No. 2

Post_Dev

Hydrograph type = SCS Runoff
Storm frequency = 1,000 yrs
Time interval = 2 min
Drainage area = 3.390 ac
Basin Slope = 0.0 %
Tc method = User
Total precip. = 21.10 in
Storm duration = 24 hrs

Peak discharge = 64.26 cfs
Time to peak = 12.07 hrs
Hyd. volume = 206,452 cuft
Curve number = 77*
Hydraulic length = 0 ft
Time of conc. (Tc) = 5.00 min
Distribution = Type III
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

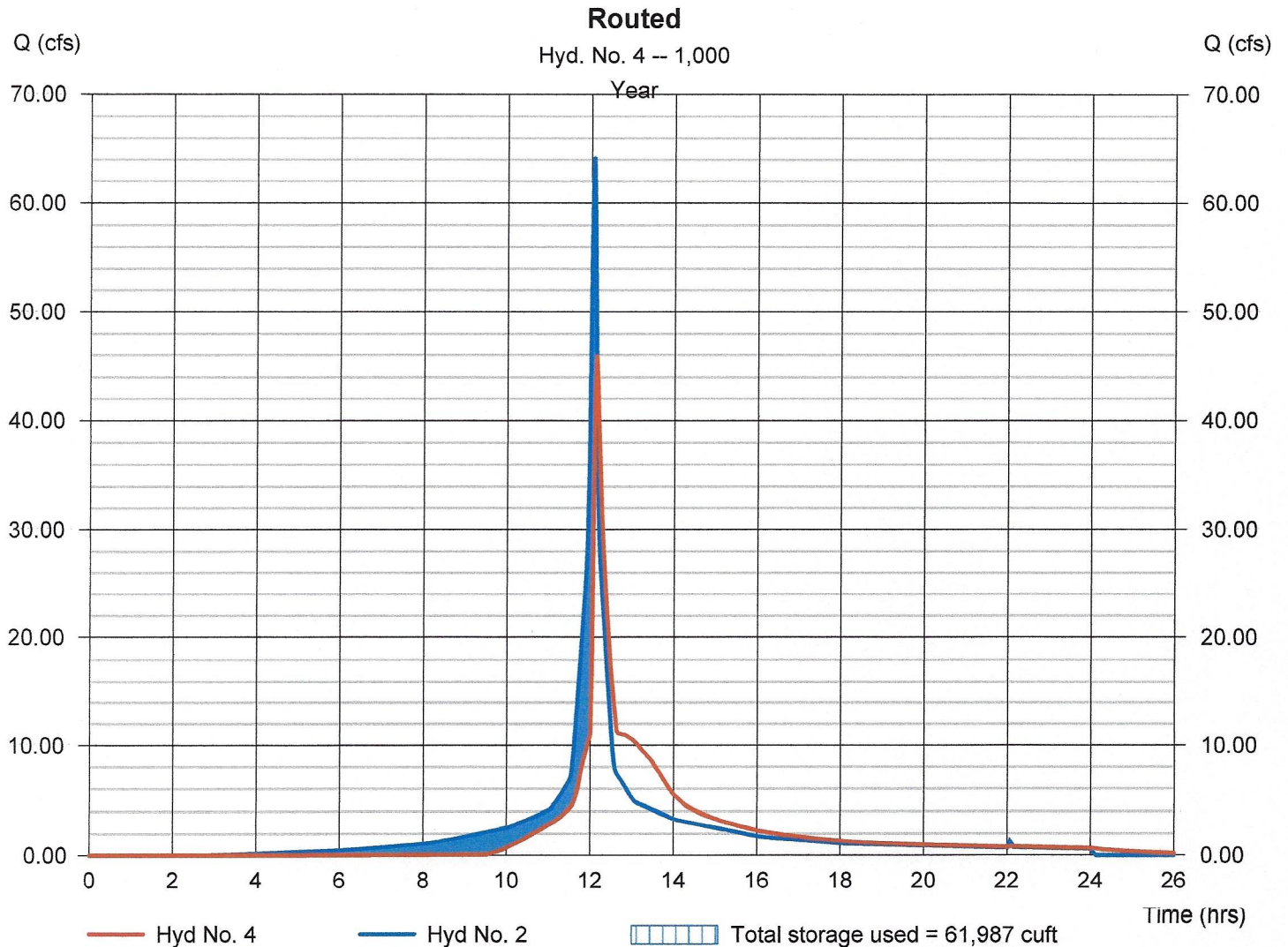
Hyd. No. 4

Routed

Hydrograph type = Reservoir
Storm frequency = 1,000 yrs
Time interval = 2 min
Inflow hyd. No. = 2 - Post_Dev
Reservoir name = Retaining Wall

Peak discharge = 46.02 cfs
Time to peak = 12.13 hrs
Hyd. volume = 203,786 cuft
Max. Elevation = 26.87 ft
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. Beginning 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

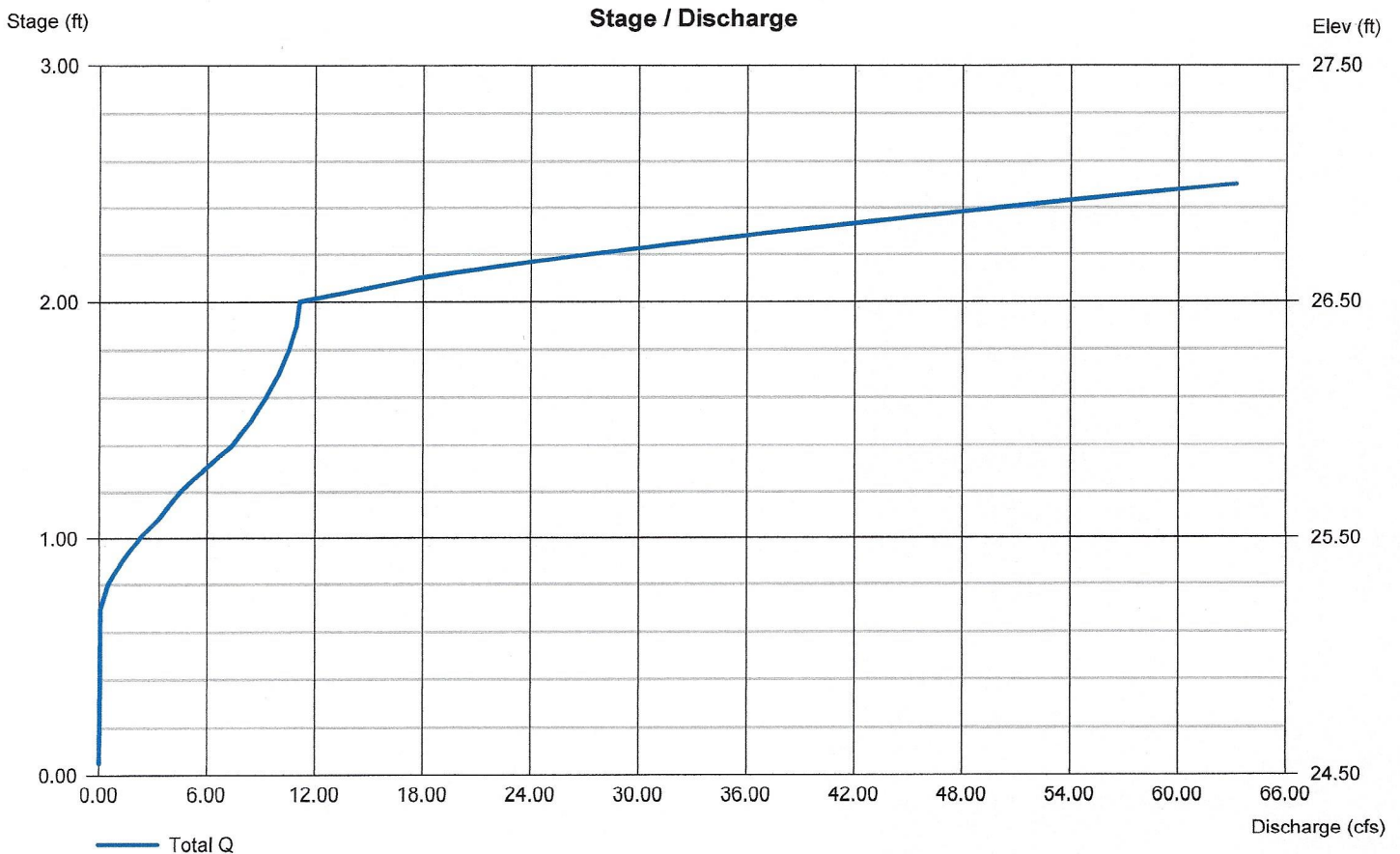
Culvert / Orifice Structures

	[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 (1.61-1.88)	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 (8.10-9.90)	10.6 (9.45-11.6)	12.4 (10.9-13.5)	15.1 (13.1-16.5)	17.5 (15.6-19.1)
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)

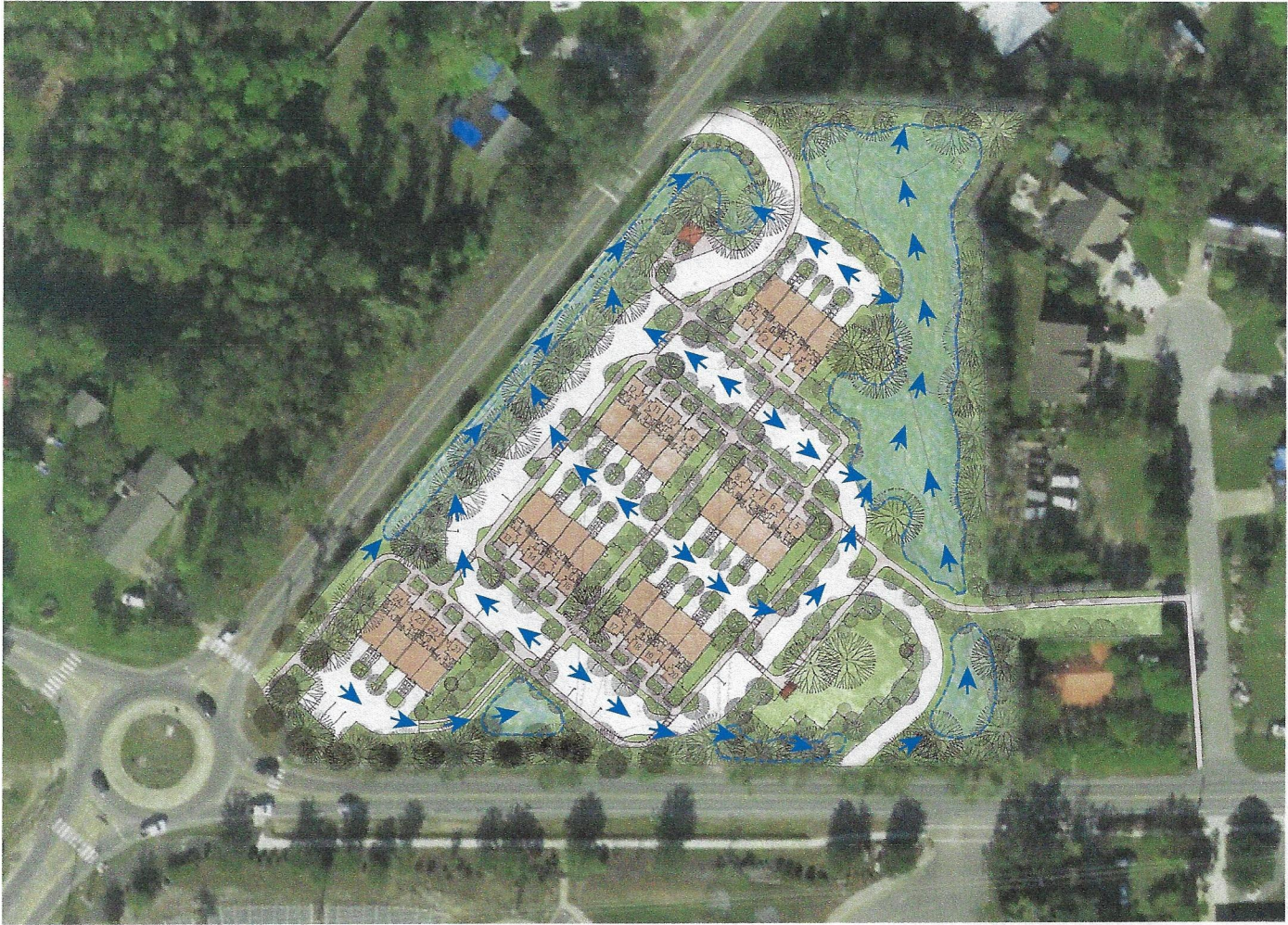
¹ Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

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.

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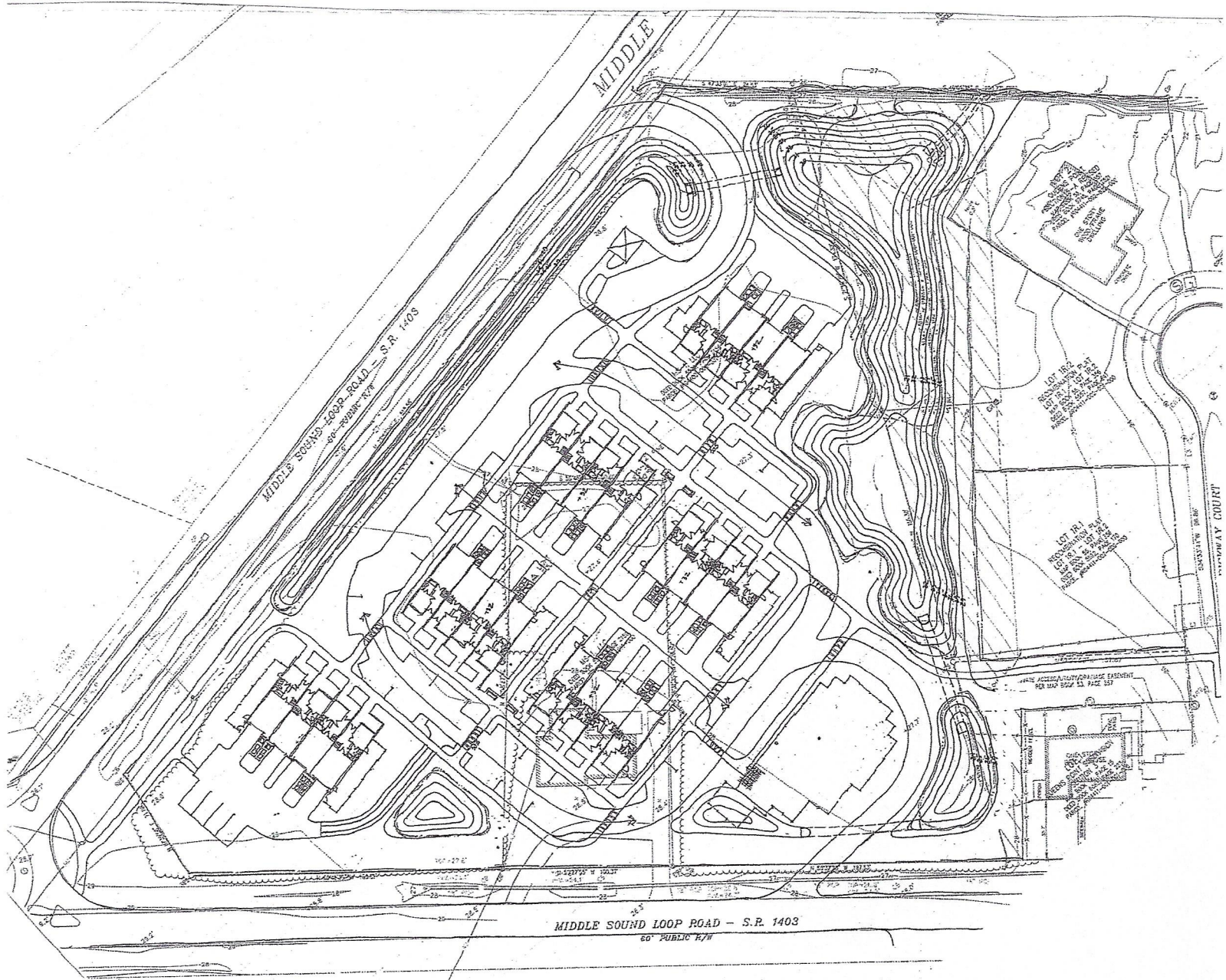
PF graphical





DEMAREST POINTE
A Classic American Neighborhood
Sustainability • Integrity • Quality of Life

DEVELOPER: McMinn & Co. 8000 Rainsford Drive, Suite 100 Wilmington, North Carolina 28403
DESIGNER: PBC Design Build 1100 W. 2nd Street, Suite 100 Wilmington, North Carolina 28403
CIVIL ENGINEERING: QDS Engineering 2000 Cherry Lane Wilmington, North Carolina 28403
LAND PLANNING / LANDSCAPE ARCHITECTURE: JENNIFER DUNN 8000 Rainsford Drive, Suite 100 Wilmington, North Carolina 28403
BUILDER: PBC DESIGN BUILD 1100 W. 2nd Street, Suite 100 Wilmington, North Carolina 28403
PROJECT TITLE: DEMAREST POINTE LANDSCAPE ARCHITECTURE PLAN AND PRELIMINARY SITE DEVELOPMENT
DATE: 01/11/2011
PROJECT TITLE: STORMWATER PLAN
GRAPHIC SCALE: APPROXIMATE
PROJECT NO.: 17 DATE: 01/11/2011 DRAWN BY: JDD CHECKED BY: JDD DATE: 01/11/2011 DRAWING NO.: 17



MIDDLE SOUND LOOP ROAD - S.R. 1403
60' PUBLIC R/W