

STORMWATER MANAGEMENT REPORT

**Athletic Field Improvements at
Leonia High School
100 Christie Heights Street
Block 210 - Lots 1, 11, 12, 13 & 18
Borough of Leonia
Bergen County, New Jersey 07605**

Prepared By:

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Introduction:

Purpose:

The applicant proposes to replace an existing multi-use athletic field with synthetic turf at Leonia High School. The proposed turf maintains the same general layout as the existing baseball, softball, and soccer fields.

Location:

The Leonia High School is located at 100 Christie Heights Street in the Borough of Leonia, Bergen County, New Jersey also known as Lots 1, 11, 12, 13, & 18 in Block 210. The proposed athletic field upgrades are located on the northern portion of the subject property.

Design Requirements:

This report has been prepared in accordance with the requirements provided by the local code, Soil Conservation District (SCD), and New Jersey Department of Environmental Protection (NJDEP). The project is considered a major development due to the land disturbance exceeding 1 acre, therefore the runoff quantity standards apply. The project is also located within a Tidal Flood Hazard Area so the stormwater runoff quantity reductions only apply if the increased volume of stormwater runoff could increase flood damages below the point of discharge, therefore the stormwater management system is conservatively designed to incorporate the peak runoff rate reductions. The proposed stormwater management system is designed to comply with these requirements by reducing peak flow runoff rates for the 2, 10, and 100-year storm events to 50%, 75% and 80%, respectively, of the pre-construction rates as per N.J.A.C. 7:8-5.4(a)3iii.

This project is not subject to water quality and groundwater recharge standards due to an increase in impervious area of less than ¼ acre that is not used as a vehicular surface and is located in an urban redevelopment zone known as Metropolitan Planning Area (PA 1).

Land Surface Analysis:

The land surface within the limit of disturbance of the study area is analyzed for the existing and proposed conditions.

Existing Conditions:

The existing grade of the study area is relatively level with elevations ranging between 4 to 7 feet (NAVD 88). The natural grading in this general area slopes from higher elevations near the driveway along the building to the southeast of the field down to the northwest towards the Overpeck Creek tributary.

Hydrologic Soil Type:

The NRCS Web Soil Survey (Appendix A) provides hydrologic soil group data and mapping for the site and surrounding areas. The site consists of soil types "UR" and portions of "UdwuB" that have a hydrologic soil group "D" rating.

UR – Urban Land

UdwuB – Udorthents, Wet Substratum-Urban Land Complex

Coverage & Disturbance:

The project design intends to minimize disturbance. The limit of disturbance of this project is entirely within previously developed areas and avoids disturbance within vegetated areas. The proposed activities primarily consist of converting the grass athletic field to synthetic turf with detention basin storage located below the new turf areas. The project proposes a minor increase to impervious area attributed to new concrete pads for the new bleachers. The following table summarizes the coverages and disturbances resulting from the overall project:

COVERAGE AND DISTURBANCE SUMMARY			
STUDY AREA =	214,000 SF	= 4.91 AC	
EXISTING IMPERVIOUS =	1,064 SF	= 0.02 AC	= 0.50%
PROPOSED IMPERVIOUS =	3,228 SF	= 0.07 AC	= 1.51%
NET IMPERVIOUS AREA =	2,164 SF	= 0.05 AC	< 0.25 AC (WQ NOT REQUIRED) (1.01% INCREASE)
LIMIT OF DISTURBANCE =	214,000 SF	= 4.91 AC	> 1 AC (MAJOR)

Stormwater Management Design Analysis:

Proposed Design:

The project proposes to raise the grade by approximately 1 foot to facilitate the functionality of an underground detention basin below the synthetic turf. The surface of the proposed turf is porous, so runoff permeates to the gravel drainage layer below that incorporates perforated flat drains and perforated collector drains to manage stormwater. The detention basin consists of gravel and pipes encased in filter fabric that is at least 1' above the estimated seasonal high water table. The new grading will not have a significant impact to runoff flow patterns. The bottom of the subsurface storage area is graded to drain towards the westerly side of the field to the outlet control structure. The outlet control structure discharges to existing stormwater connections located on the southern side of the field.

Time of Concentration:

The study area consists of a natural turf field that includes a network of several inlets to handle runoff, so the estimated time of concentration is minimal.

Runoff Analysis:

The SCS (Soil Conservation Service) Unit Hydrograph Method is used in accordance with the NRCS standards to determine the 2, 10, 25, & 100-year peak discharges for the existing and proposed drainage areas, calculated with Hydraflow 2019 drainage software. The calculations use aggregate CN (runoff curve number) values and a Type D distribution with 24-hour rainfall data from the New Jersey 24 Hour Rainfall Frequency Data for Bergen County (Figure 3). The NOAA Precipitation Frequency Data (Appendix B) for the project location is also provided for reference. The aggregate curve numbers utilized in the calculations are referenced from Table 2-2a in the TR55-Urban Hydrology for Small Watersheds (Figure 4) and are based on the groundcover surface coverage for the existing and proposed conditions. The curve number used for the lawn area in the pre-developed condition is based on open space, good condition, for hydrologic soil group B. The curve number used for the new synthetic turf area in the post-developed condition is based on impervious surfaces with a curve number of 98. The new synthetic turf area consists of a pervious surface with a subsurface consisting of underdrains surrounded by gravel. The curve number used for lawn areas that were grass and will remain grass is based on open space, good condition, for hydrologic soil group B. Impervious surfaces for both existing and proposed conditions utilize a curve number of 98.

The groundcover analysis table below summarizes the areas and associated curve numbers (CN) within the limit of disturbance of the project for the existing and proposed conditions.

Groundcover Analysis			
Existing Conditions	Area		CN
Open Space Lawn Area	212,936 SF	4.89 AC	61
Impervious Area to be Disturbed	260 SF	0.01 AC	98
Impervious Area to Remain Undisturbed	804 SF	0.02 AC	98
Total Area	214,000 SF	4.91 AC	-
Proposed Conditions	Area		CN
Synthetic Turf Area	155,845 SF	3.58 AC	98
Open Space Lawn Area Remaining	54,927 SF	1.26 AC	61
New Impervious Area	2,164 SF	0.05 AC	98
Disturbed Impervious Area	260 SF	0.01 AC	98
Impervious Area Remaining Undisturbed	804 SF	0.02 AC	98
Total Area	214,000 SF	4.91 AC	-

The groundcover analysis existing conditions consist of open space lawn areas and impervious areas that remain as impervious areas within the limit of disturbance. The open space lawn areas consist of the existing grass field area where the proposed development is to be constructed and adjacent grass areas. The impervious areas to be disturbed consist of the portions of existing asphalt disturbed for the new drainage line connections. The impervious areas to remain undisturbed consist of the existing dugouts that are to remain and do not include any changes with the associated project, therefore these areas are excluded from the runoff analysis.

The groundcover analysis proposed conditions consist of the new synthetic turf area that directs runoff to the subsurface detention system and the other areas that remain uncaptured and/or utilize existing stormwater connections, which are not directed to the proposed subsurface detention system within the limit of disturbance. The open space lawn areas remaining consist of the grass areas adjacent to the new synthetic turf field that are to remain as grass areas in the existing and proposed conditions. The new impervious areas consist of the new concrete pads for the proposed bleachers and ancillary concrete surfaces. The disturbed impervious areas consist of the portions of existing asphalt disturbed for the new drainage line connections. The impervious areas remaining undisturbed consist of the existing dugouts that are to remain and do not include any changes with the associated project.

The required peak flow reductions are summarized below:

Required Peak Flow Reduction Summary			
Design Storm	Existing Q_{PEAK}	Peak Flow Reduction Factor	Allowable Q_{PEAK}
2-Year	1.848 cfs	50%	0.924 cfs
10-Year	6.617 cfs	75%	4.963 cfs
25-Year	10.620 cfs	100%	10.620 cfs
100-Year	18.660 cfs	80%	14.928 cfs

Conclusion:

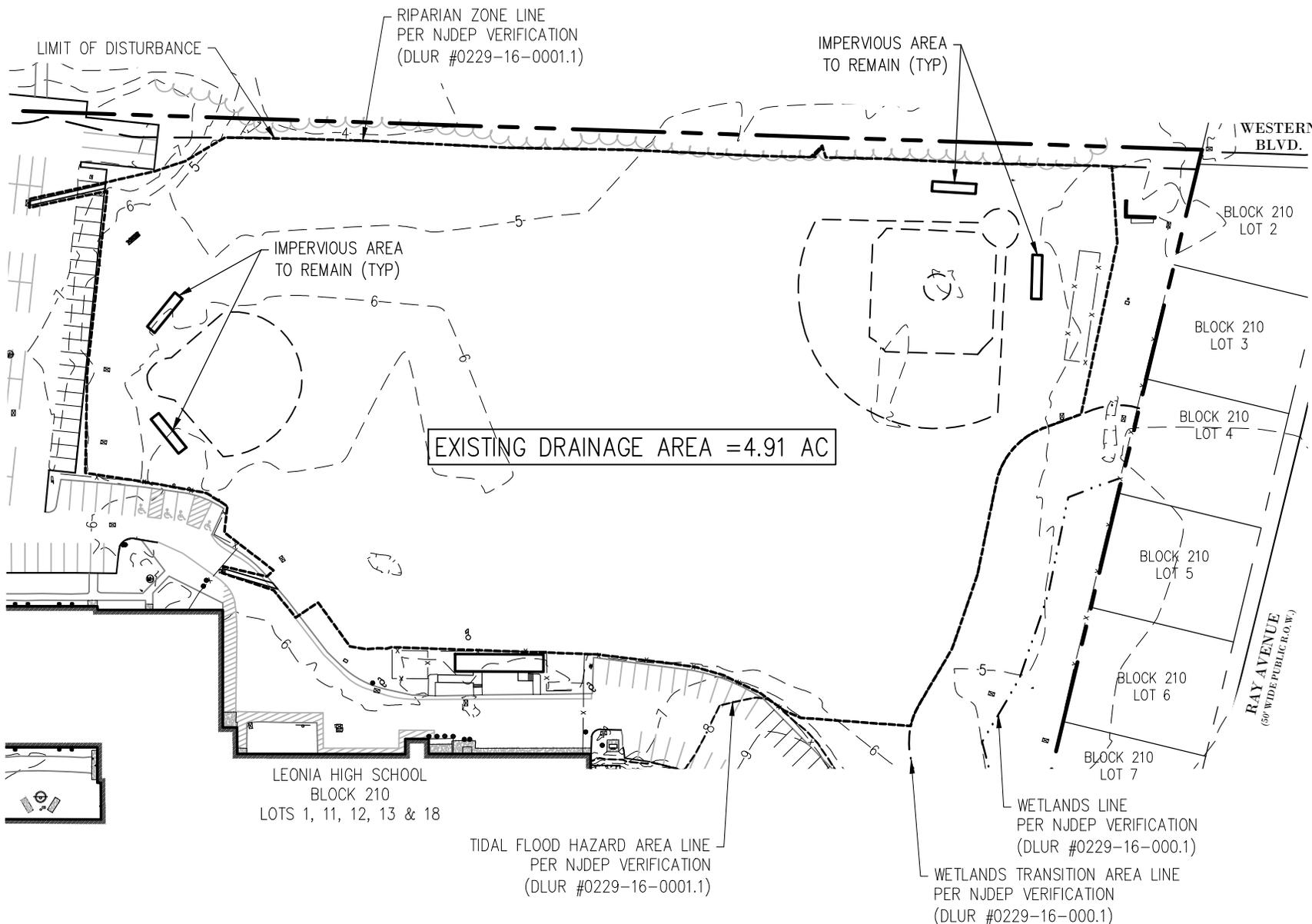
The proposed stormwater management system is designed to provide adequate storage capacity to reduce peak flows from the project in accordance with the required peak flow reductions. The outlet control structure consists of a 3" height by 3.38" length low-flow orifice and a 48" weir to reduce peak flows from the stormwater volume stored in the subsurface detention system for the design storms analyzed. Remaining stormwater runoff that is not captured by the proposed detention system is handled by existing drainage structures and referred to as uncaptured flow in the table below. The combination of the peak flows associated with the OCS discharge and the uncaptured areas meet the required peak flow reductions and are summarized in the following table. The bottom of the OCS structure and subsurface detention system are greater than one foot above the observed groundwater table to maintain a minimum depth of at least one foot above the seasonal high groundwater table. The OCS discharges into an existing inlet that shall be equipped with backflow preventers to prevent tailwater from entering the system during flood conditions.

The table below summarizes the allowable peak flow and the combined total peak flow in the proposed condition as calculated with Hydraflow software:

Proposed Peak Flow Summary				
Design Storm	Uncaptured Q_{PEAK}	Detention Basin Q_{PEAK}	Total Q_{PEAK}	Allowable Q_{PEAK}
2-Year	0.628 cfs	0.327 cfs	0.916 cfs	0.924 cfs
10-Year	1.978 cfs	1.291 cfs	2.311 cfs	4.963 cfs
25-Year	3.091 cfs	2.393 cfs	4.039 cfs	10.620 cfs
100-Year	5.297 cfs	2.998 cfs	8.005 cfs	14.928 cfs

FIGURE 1

Drainage Area Map – Existing



EXISTING DRAINAGE AREA = 4.91 AC

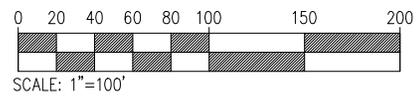
LEONIA HIGH SCHOOL
BLOCK 210
LOTS 1, 11, 12, 13 & 18

TIDAL FLOOD HAZARD AREA LINE
PER NJDEP VERIFICATION
(DLUR #0229-16-0001.1)

WETLANDS LINE
PER NJDEP VERIFICATION
(DLUR #0229-16-000.1)

WETLANDS TRANSITION AREA LINE
PER NJDEP VERIFICATION
(DLUR #0229-16-000.1)

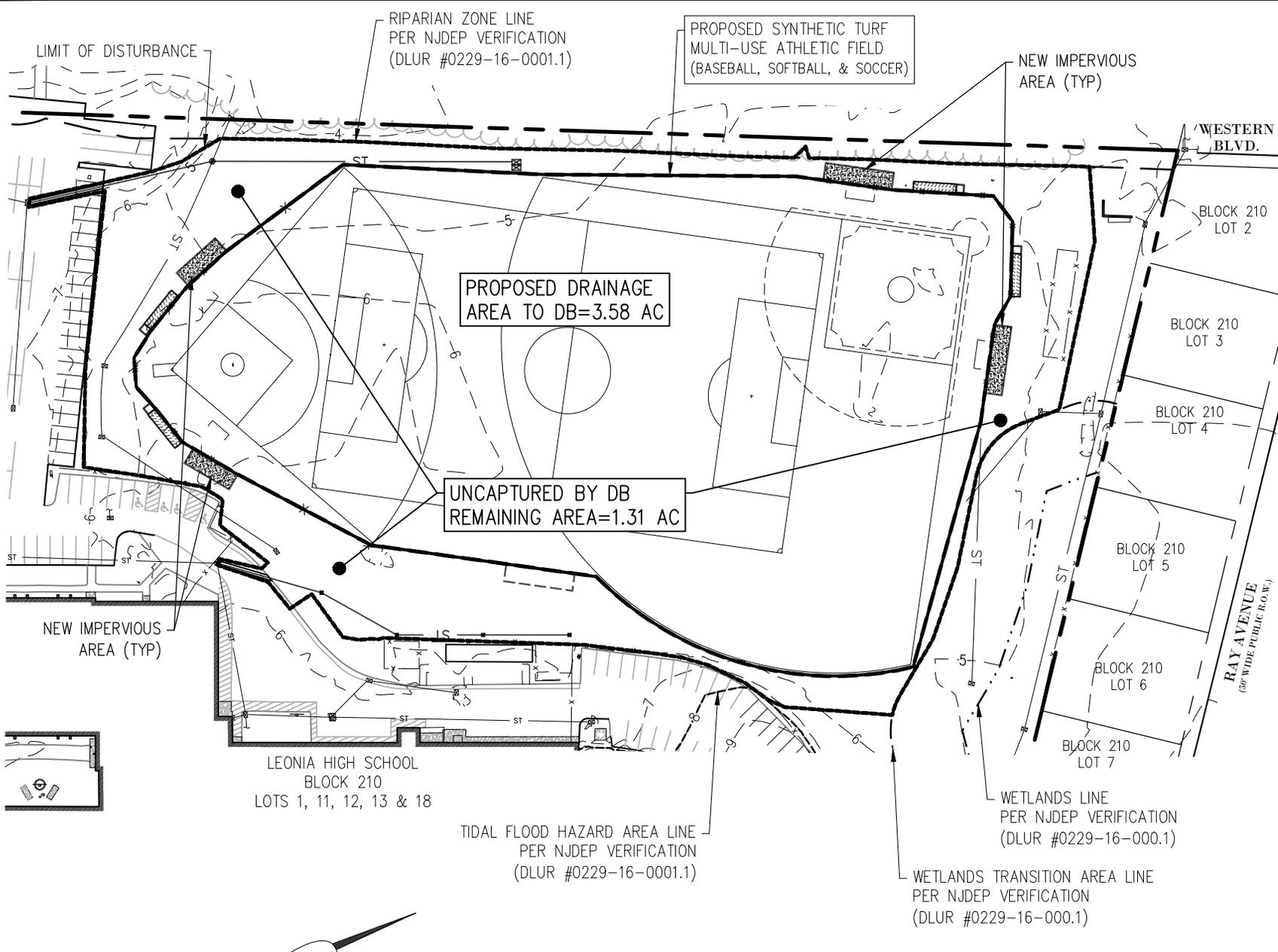
DRAINAGE AREA MAP - EXISTING



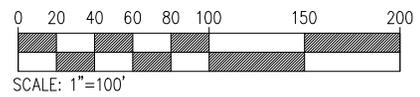
PROJECT	LEONIA HIGH SCHOOL ATHLETIC FIELD UPGRADES	DRAWN	PRE/HLT
DRAWING TITLE	DRAINAGE AREA MAP - EXISTING	SCALE	1" = 100'
LAN ASSOCIATES engineering planning architecture surveying 445 GODWIN AVENUE, MIDLAND PARK, N.J. 07432 (201) 447-8400		DRAWING NO.	DAM.E

FIGURE 2

Drainage Area Map – Proposed



DRAINAGE AREA MAP - PROPOSED



PROJECT LEONIA HIGH SCHOOL ATHLETIC FIELD UPGRADES	DRAWN PRE/HLT
	SCALE 1" = 100'
DRAWING TITLE DRAINAGE AREA MAP - PROPOSED	DRAWING NO. DAM.P
LAN ASSOCIATES engineering planning architecture surveying 445 GODWIN AVENUE, MIDLAND PARK, N.J. 07432 (201) 447-8400	

FIGURE 3

NRCS New Jersey 24 Hour Rainfall Frequency Data

NEW JERSEY 24 HOUR RAINFALL FREQUENCY DATA

Rainfall amounts in Inches

County	1 year	2 year	5 year	10 year	25 year	50 year	100 year
Atlantic	2.72	3.31	4.30	5.16	6.46	7.61	8.90
Bergen	2.75	3.34	4.27	5.07	6.28	7.32	8.47
Burlington	2.77	3.36	4.34	5.18	6.45	7.56	8.81
Camden	2.73	3.31	4.25	5.06	6.28	7.34	8.52
Cape May	2.67	3.25	4.22	5.07	6.34	7.47	8.73
Cumberland	2.69	3.27	4.25	5.09	6.37	7.49	8.76
Essex	2.85	3.44	4.40	5.22	6.44	7.49	8.66
Gloucester	2.71	3.29	4.24	5.05	6.29	7.36	8.55
Hudson	2.73	3.31	4.23	5.02	6.19	7.20	8.31
Hunterdon	2.80	3.38	4.26	5.00	6.09	7.02	8.03
Mercer	2.74	3.31	4.23	5.01	6.19	7.20	8.33
Middlesex	2.76	3.35	4.30	5.12	6.36	7.43	8.63
Monmouth	2.79	3.38	4.38	5.23	6.53	7.66	8.94
Morris	2.94	3.54	4.47	5.24	6.37	7.32	8.35
Ocean	2.81	3.42	4.45	5.33	6.68	7.87	9.20
Passaic	2.87	3.47	4.42	5.23	6.43	7.47	8.62
Salem	2.69	3.26	4.20	5.00	6.22	7.28	8.45
Somerset	2.76	3.34	4.25	5.01	6.15	7.13	8.21
Sussex	2.68	3.22	4.02	4.70	5.72	6.60	7.58
Union	2.80	3.39	4.35	5.17	6.42	7.49	8.69
Warren	2.78	3.34	4.18	4.89	5.93	6.83	7.82

Notes: The average point rainfall amounts listed above were developed from data contained in NOAA Atlas 14 Volume 2.

Point rainfall estimates for specific locations may be obtained from the Precipitation Frequency Data Server located at <http://www.nws.noaa.gov/ohd/hdsc/>

For most hydrologic design procedures, the rainfall amounts listed above may be rounded to the nearest tenth of an inch.

FIGURE 4

Table 2-2a from the TR55-Urban Hydrology for Small Watersheds

Table 2-2a Runoff curve numbers for urban areas ^{1/}

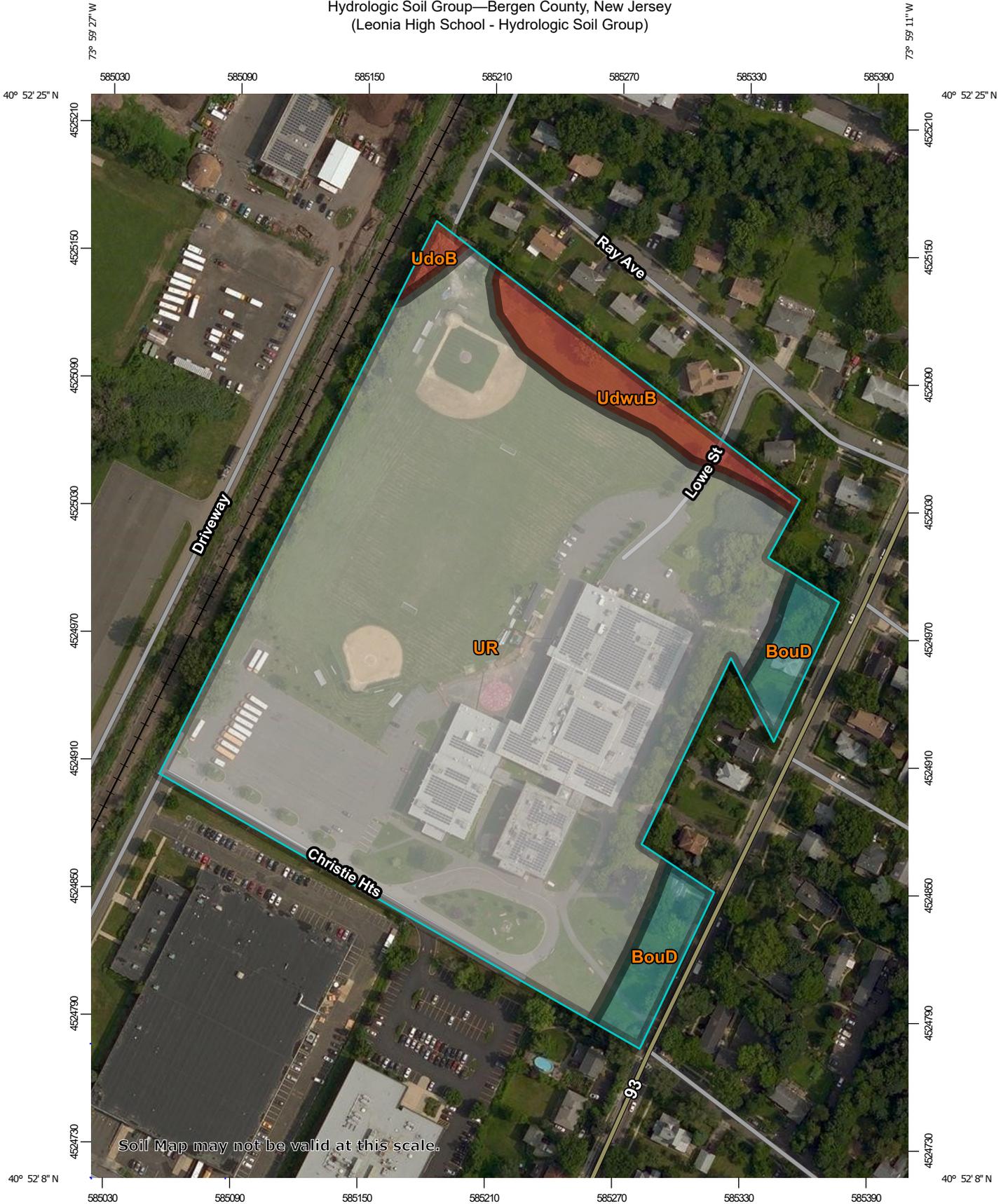
Cover description	Average percent impervious area ^{2/}	Curve numbers for hydrologic soil group			
		A	B	C	D
<i>Fully developed urban areas (vegetation established)</i>					
Open space (lawns, parks, golf courses, cemeteries, etc.) ^{3/} :					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only) ^{4/}		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
<i>Developing urban areas</i>					
Newly graded areas (pervious areas only, no vegetation) ^{5/}		77	86	91	94
Idle lands (CN's are determined using cover types similar to those in table 2-2c).					

^{1/} Average runoff condition, and $I_a = 0.2S$.^{2/} The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 2-3 or 2-4.^{3/} CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.^{4/} Composite CN's for natural desert landscaping should be computed using figures 2-3 or 2-4 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.^{5/} Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 2-3 or 2-4 based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

APPENDIX A

Hydrologic Soil Group – NRCS Web Soil Survey

Hydrologic Soil Group—Bergen County, New Jersey
(Leonia High School - Hydrologic Soil Group)



Soil Map may not be valid at this scale.

Map Scale: 1:2,480 if printed on A portrait (8.5" x 11") sheet.



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



Natural Resources
Conservation Service

Web Soil Survey
National Cooperative Soil Survey

9/18/2019
Page 1 of 4

MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

Soil Rating Polygons

 A
 A/D
 B
 B/D
 C
 C/D
 D
 Not rated or not available

Soil Rating Lines

 A
 A/D
 B
 B/D
 C
 C/D
 D
 Not rated or not available

Soil Rating Points

 A
 A/D
 B
 B/D

 C
 C/D
 D
 Not rated or not available

Water Features

 Streams and Canals

Transportation

 Rails
 Interstate Highways
 US Routes
 Major Roads
 Local Roads

Background

 Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Bergen County, New Jersey
 Survey Area Data: Version 15, Sep 13, 2018

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

Date(s) aerial images were photographed: Jul 23, 2014—Aug 15, 2014

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
BouD	Boonton-Urban land complex, 15 to 25 percent slopes	C	0.9	5.5%
UdoB	Udorthents, organic substratum, 0 to 8 percent slopes	D	0.1	0.7%
Udwb	Udorthents, wet substratum-Urban land complex	D	0.8	4.8%
UR	Urban land		14.4	89.0%
Totals for Area of Interest			16.2	100.0%

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

APPENDIX B

NOAA Atlas 14 – Point Precipitation Frequency Estimates



NOAA Atlas 14, Volume 2, Version 3
Location name: Leonia, New Jersey, USA*
Latitude: 40.8717°, Longitude: -73.9888°
Elevation: 5.42 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	0.339 (0.309-0.373)	0.405 (0.368-0.446)	0.483 (0.438-0.532)	0.542 (0.490-0.595)	0.616 (0.555-0.678)	0.669 (0.599-0.736)	0.725 (0.645-0.799)	0.778 (0.687-0.861)	0.846 (0.737-0.942)	0.899 (0.775-1.01)
10-min	0.535 (0.486-0.588)	0.641 (0.583-0.705)	0.761 (0.691-0.838)	0.851 (0.771-0.935)	0.961 (0.865-1.06)	1.04 (0.934-1.15)	1.12 (0.998-1.24)	1.20 (1.06-1.33)	1.29 (1.13-1.44)	1.36 (1.17-1.53)
15-min	0.663 (0.603-0.728)	0.795 (0.723-0.876)	0.950 (0.863-1.05)	1.06 (0.963-1.17)	1.21 (1.09-1.33)	1.31 (1.17-1.44)	1.41 (1.25-1.55)	1.50 (1.33-1.66)	1.62 (1.41-1.81)	1.71 (1.47-1.91)
30-min	0.894 (0.813-0.982)	1.08 (0.985-1.19)	1.33 (1.21-1.46)	1.51 (1.37-1.66)	1.75 (1.57-1.92)	1.92 (1.72-2.12)	2.10 (1.87-2.32)	2.27 (2.01-2.51)	2.50 (2.17-2.78)	2.67 (2.30-2.99)
60-min	1.11 (1.00-1.21)	1.35 (1.22-1.48)	1.69 (1.53-1.86)	1.95 (1.76-2.14)	2.30 (2.07-2.53)	2.57 (2.31-2.83)	2.85 (2.54-3.15)	3.14 (2.77-3.47)	3.53 (3.07-3.93)	3.82 (3.30-4.28)
2-hr	1.37 (1.24-1.51)	1.66 (1.51-1.84)	2.09 (1.89-2.31)	2.43 (2.19-2.69)	2.90 (2.60-3.20)	3.28 (2.93-3.62)	3.66 (3.25-4.05)	4.07 (3.57-4.52)	4.63 (4.01-5.16)	5.08 (4.34-5.69)
3-hr	1.53 (1.39-1.68)	1.85 (1.69-2.05)	2.33 (2.12-2.58)	2.72 (2.46-3.00)	3.25 (2.93-3.59)	3.69 (3.30-4.07)	4.14 (3.67-4.58)	4.62 (4.05-5.11)	5.28 (4.56-5.87)	5.82 (4.96-6.51)
6-hr	1.98 (1.80-2.17)	2.39 (2.19-2.63)	3.00 (2.74-3.29)	3.48 (3.17-3.82)	4.17 (3.76-4.57)	4.73 (4.25-5.19)	5.31 (4.73-5.84)	5.93 (5.23-6.54)	6.80 (5.90-7.53)	7.50 (6.43-8.35)
12-hr	2.43 (2.20-2.69)	2.94 (2.67-3.26)	3.70 (3.36-4.10)	4.32 (3.91-4.78)	5.21 (4.67-5.75)	5.96 (5.30-6.57)	6.75 (5.95-7.45)	7.60 (6.63-8.41)	8.82 (7.56-9.80)	9.83 (8.31-11.0)
24-hr	2.74 (2.52-3.00)	3.31 (3.05-3.63)	4.22 (3.87-4.62)	4.98 (4.55-5.44)	6.11 (5.55-6.66)	7.07 (6.37-7.70)	8.13 (7.25-8.86)	9.29 (8.20-10.1)	11.0 (9.55-12.1)	12.5 (10.7-13.7)
2-day	3.20 (2.91-3.54)	3.86 (3.53-4.29)	4.93 (4.49-5.46)	5.83 (5.29-6.44)	7.17 (6.45-7.90)	8.32 (7.42-9.17)	9.58 (8.47-10.6)	11.0 (9.59-12.2)	13.0 (11.2-14.5)	14.8 (12.5-16.6)
3-day	3.36 (3.09-3.69)	4.07 (3.74-4.46)	5.18 (4.75-5.67)	6.11 (5.58-6.68)	7.48 (6.79-8.17)	8.65 (7.79-9.45)	9.93 (8.87-10.9)	11.3 (10.0-12.4)	13.4 (11.6-14.8)	15.1 (13.0-16.8)
4-day	3.53 (3.27-3.84)	4.27 (3.96-4.64)	5.42 (5.01-5.89)	6.38 (5.88-6.92)	7.79 (7.13-8.43)	8.98 (8.16-9.72)	10.3 (9.27-11.1)	11.7 (10.5-12.7)	13.8 (12.1-15.0)	15.5 (13.5-17.0)
7-day	4.14 (3.86-4.47)	4.98 (4.64-5.37)	6.23 (5.78-6.71)	7.25 (6.72-7.80)	8.74 (8.04-9.40)	9.98 (9.14-10.7)	11.3 (10.3-12.2)	12.7 (11.5-13.8)	14.8 (13.1-16.1)	16.5 (14.5-18.0)
10-day	4.73 (4.42-5.08)	5.66 (5.29-6.08)	6.96 (6.50-7.47)	8.04 (7.48-8.62)	9.58 (8.86-10.3)	10.9 (9.99-11.6)	12.2 (11.2-13.1)	13.7 (12.4-14.7)	15.7 (14.0-17.0)	17.4 (15.4-18.9)
20-day	6.39 (6.00-6.81)	7.59 (7.13-8.08)	9.08 (8.53-9.66)	10.3 (9.61-10.9)	11.8 (11.1-12.6)	13.1 (12.2-13.9)	14.4 (13.3-15.3)	15.6 (14.4-16.7)	17.3 (15.8-18.6)	18.7 (16.9-20.1)
30-day	7.99 (7.54-8.47)	9.44 (8.90-10.0)	11.1 (10.4-11.7)	12.3 (11.6-13.1)	14.0 (13.1-14.8)	15.2 (14.2-16.1)	16.4 (15.3-17.5)	17.6 (16.4-18.8)	19.2 (17.7-20.5)	20.3 (18.7-21.8)
45-day	10.2 (9.62-10.7)	12.0 (11.3-12.6)	13.8 (13.1-14.6)	15.3 (14.4-16.1)	17.1 (16.1-18.1)	18.5 (17.4-19.5)	19.8 (18.6-21.0)	21.1 (19.7-22.4)	22.8 (21.2-24.2)	24.0 (22.2-25.5)
60-day	12.2 (11.6-12.8)	14.3 (13.6-15.1)	16.4 (15.5-17.2)	17.9 (17.0-18.9)	19.9 (18.8-20.9)	21.3 (20.1-22.4)	22.7 (21.4-23.9)	23.9 (22.5-25.2)	25.5 (23.9-27.0)	26.6 (24.8-28.2)

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

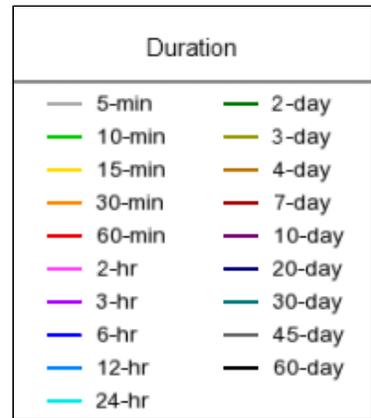
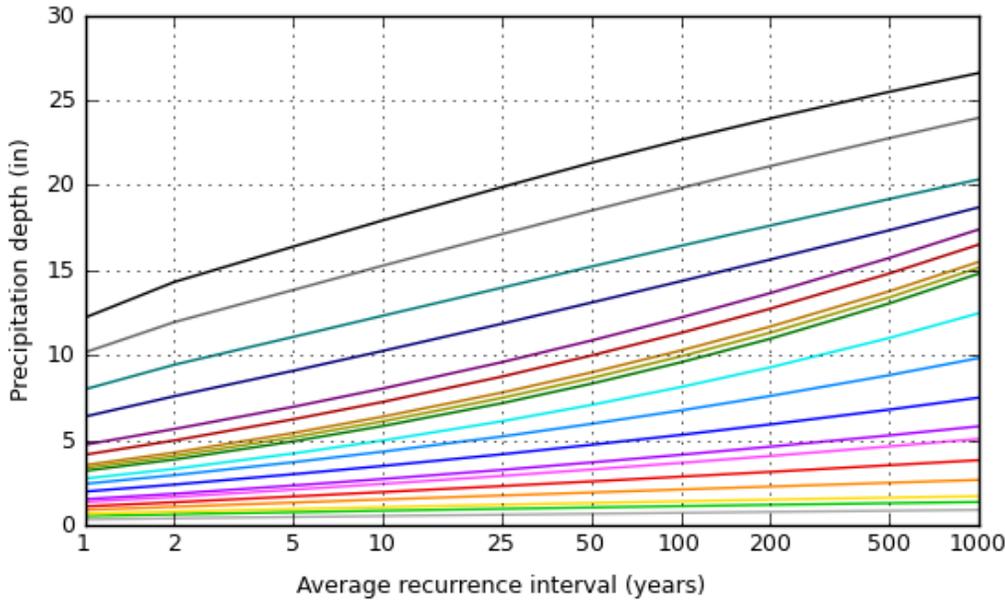
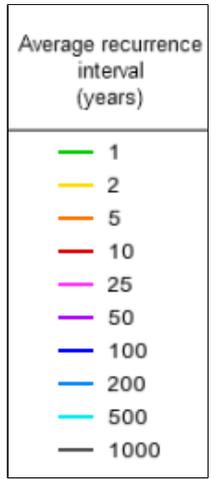
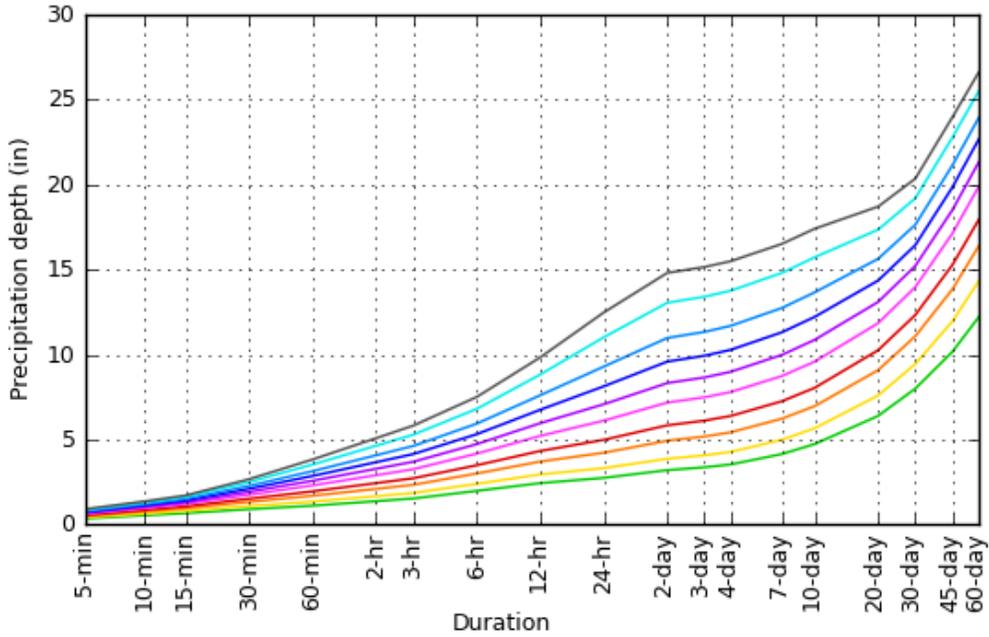
Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper 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

PDS-based depth-duration-frequency (DDF) curves
 Latitude: 40.8717°, Longitude: -73.9888°



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Maps & aerials

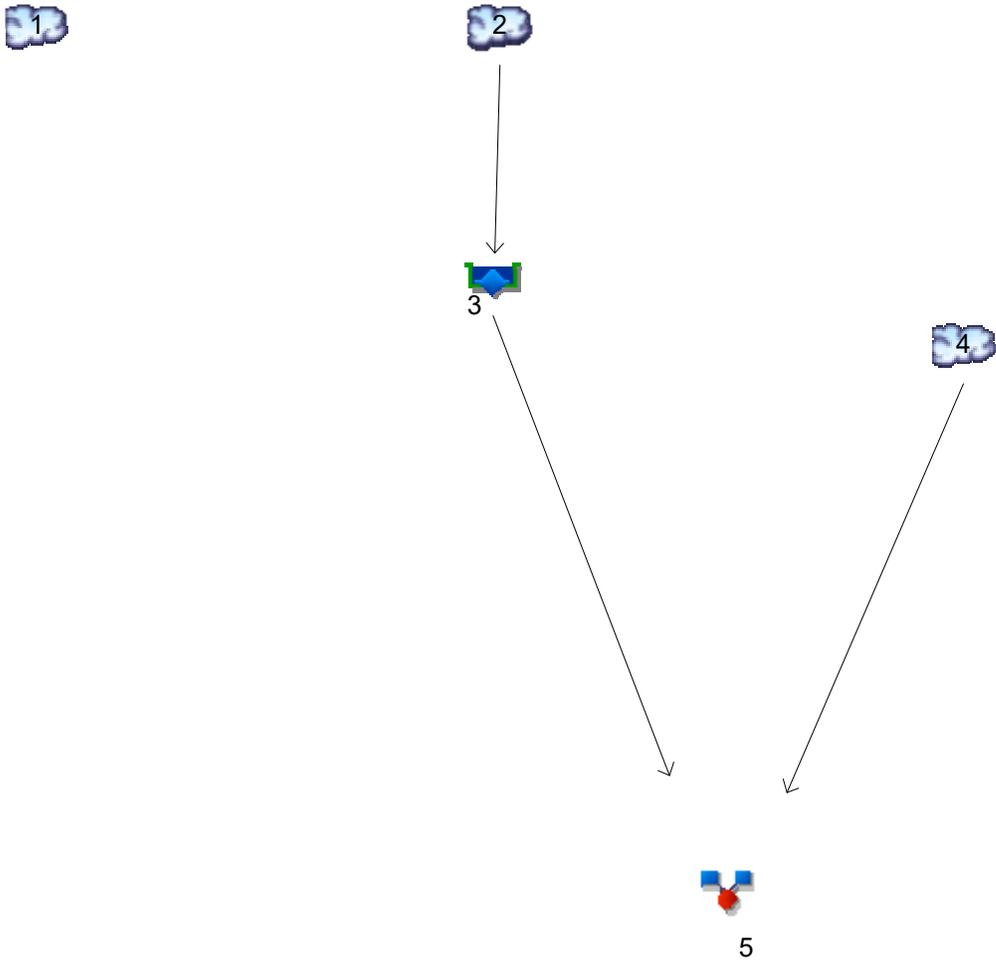
Small scale terrain

APPENDIX C

Hydrograph Report – Hydraflow

Watershed Model Schematic

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



Legend

<u>Hyd. Origin</u>	<u>Description</u>
1 SCS Runoff	Existing Conditions
2 SCS Runoff	P-Detention
3 Reservoir	R-TURF FIELD
4 SCS Runoff	P-Uncaptured
5 Combine	Total Proposed Flow

Hydrograph Return Period Recap

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

Hyd. No.	Hydrograph type (origin)	Inflow hyd(s)	Peak Outflow (cfs)								Hydrograph Description
			1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
1	SCS Runoff	-----	-----	1.848	-----	-----	6.617	10.62	-----	18.66	Existing Conditions
2	SCS Runoff	-----	-----	9.787	-----	-----	14.96	18.56	-----	25.08	P-Detention
3	Reservoir	2	-----	0.327	-----	-----	1.291	2.393	-----	2.998	R-TURF FIELD
4	SCS Runoff	-----	-----	0.628	-----	-----	1.978	3.091	-----	5.297	P-Uncaptured
5	Combine	3, 4	-----	0.916	-----	-----	2.311	4.039	-----	8.005	Total Proposed Flow

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	1.848	3	726	8,380	-----	-----	-----	Existing Conditions	
2	SCS Runoff	9.787	3	723	37,853	-----	-----	-----	P-Detention	
3	Reservoir	0.327	3	933	37,853	2	4.67	23,253	R-TURF FIELD	
4	SCS Runoff	0.628	3	726	2,600	-----	-----	-----	P-Uncaptured	
5	Combine	0.916	3	726	40,453	3, 4	-----	-----	Total Proposed Flow	
2020909_Hydraflow_REV1_4-13-20.gpw					Return Period: 2 Year			Monday, 04 / 13 / 2020		

Hydrograph Report

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

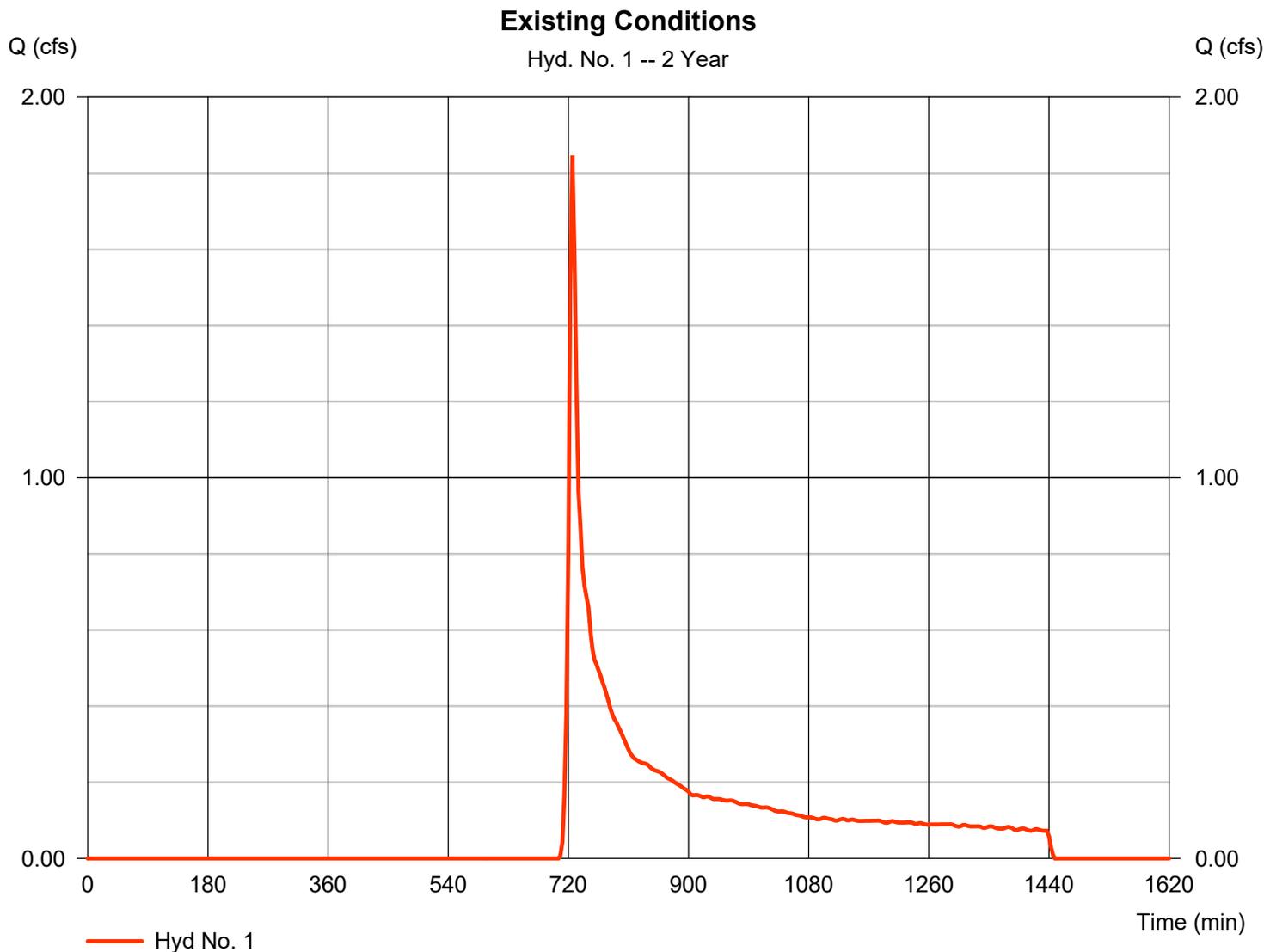
Monday, 04 / 13 / 2020

Hyd. No. 1

Existing Conditions

Hydrograph type	= SCS Runoff	Peak discharge	= 1.848 cfs
Storm frequency	= 2 yrs	Time to peak	= 726 min
Time interval	= 3 min	Hyd. volume	= 8,380 cuft
Drainage area	= 4.900 ac	Curve number	= 61*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 3.34 in	Distribution	= Custom
Storm duration	= P:\200-AE\20200-20299\20209\Shapefile\Report\Stormwater\NOAA_D_Ti		

* Composite (Area/CN) = [(4.890 x 61) + (0.010 x 98)] / 4.900



Precipitation Report

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

Monday, 04 / 13 / 2020

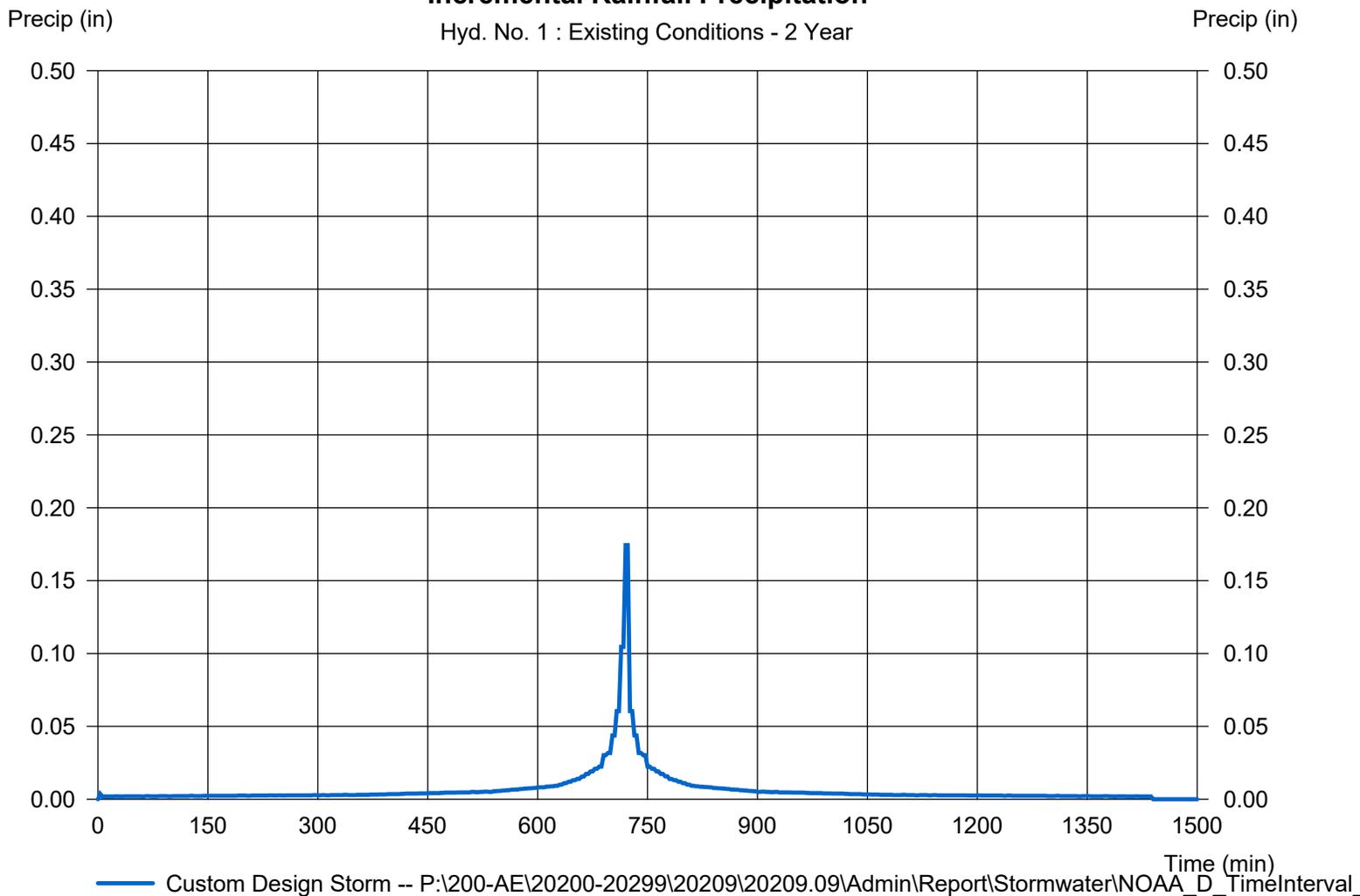
Hyd. No. 1

Existing Conditions

Storm Frequency	= 2 yrs	Time interval	= 3 min
Total precip.	= 3.3400 in	Distribution	= Custom
Storm duration	= P:\200-AE\20200-20299\20209\20209.09\Admin\Report\Stormwater\NOAA_D_T		

Incremental Rainfall Precipitation

Hyd. No. 1 : Existing Conditions - 2 Year



Precipitation Report

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

Monday, 04 / 13 / 2020

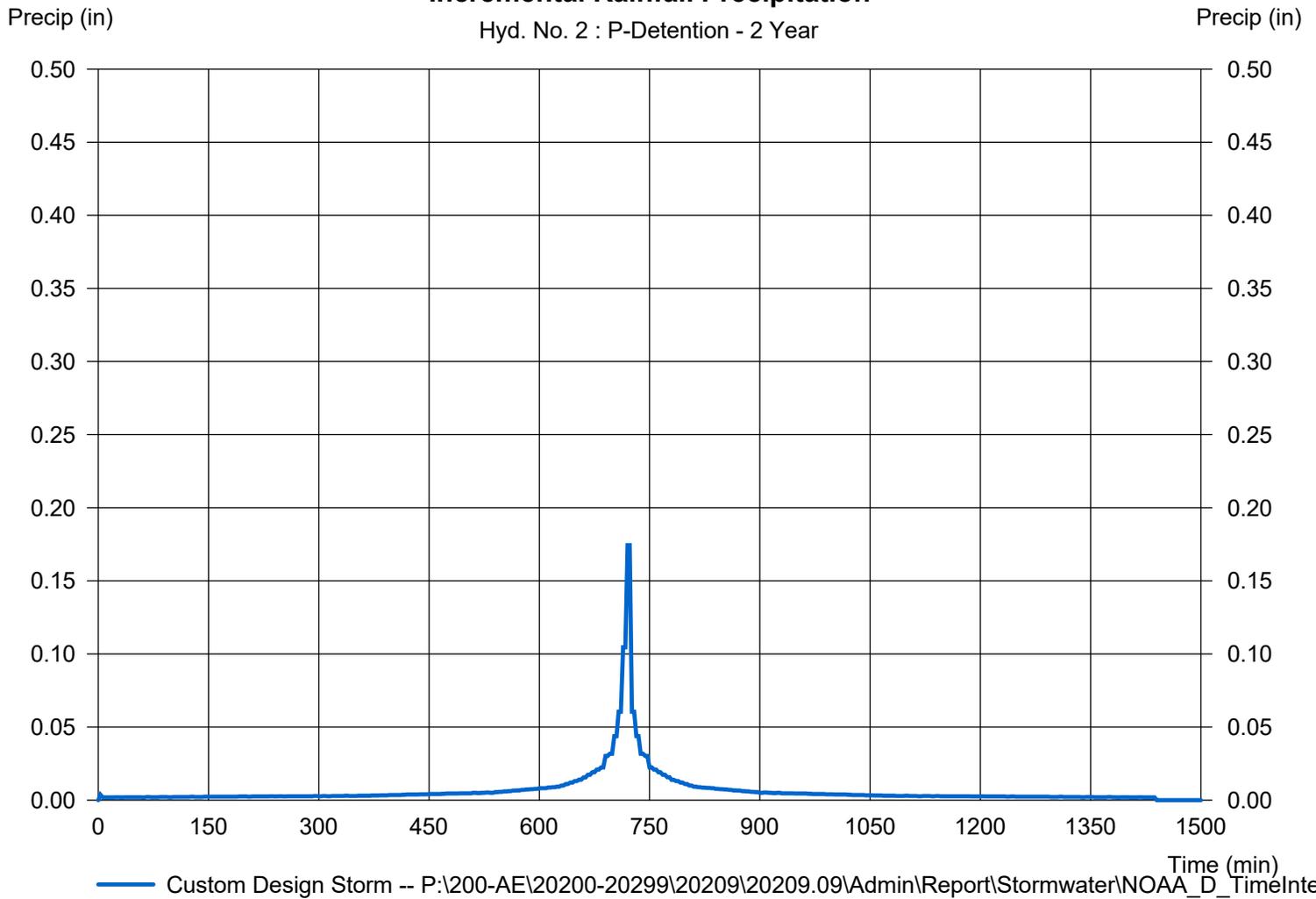
Hyd. No. 2

P-Detention

Storm Frequency	= 2 yrs	Time interval	= 3 min
Total precip.	= 3.3400 in	Distribution	= Custom
Storm duration	= P:\200-AE\20200-20299\20209\20209.09\Admin\Report\Stormwater\NOAA_D_T		

Incremental Rainfall Precipitation

Hyd. No. 2 : P-Detention - 2 Year



Hydrograph Report

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

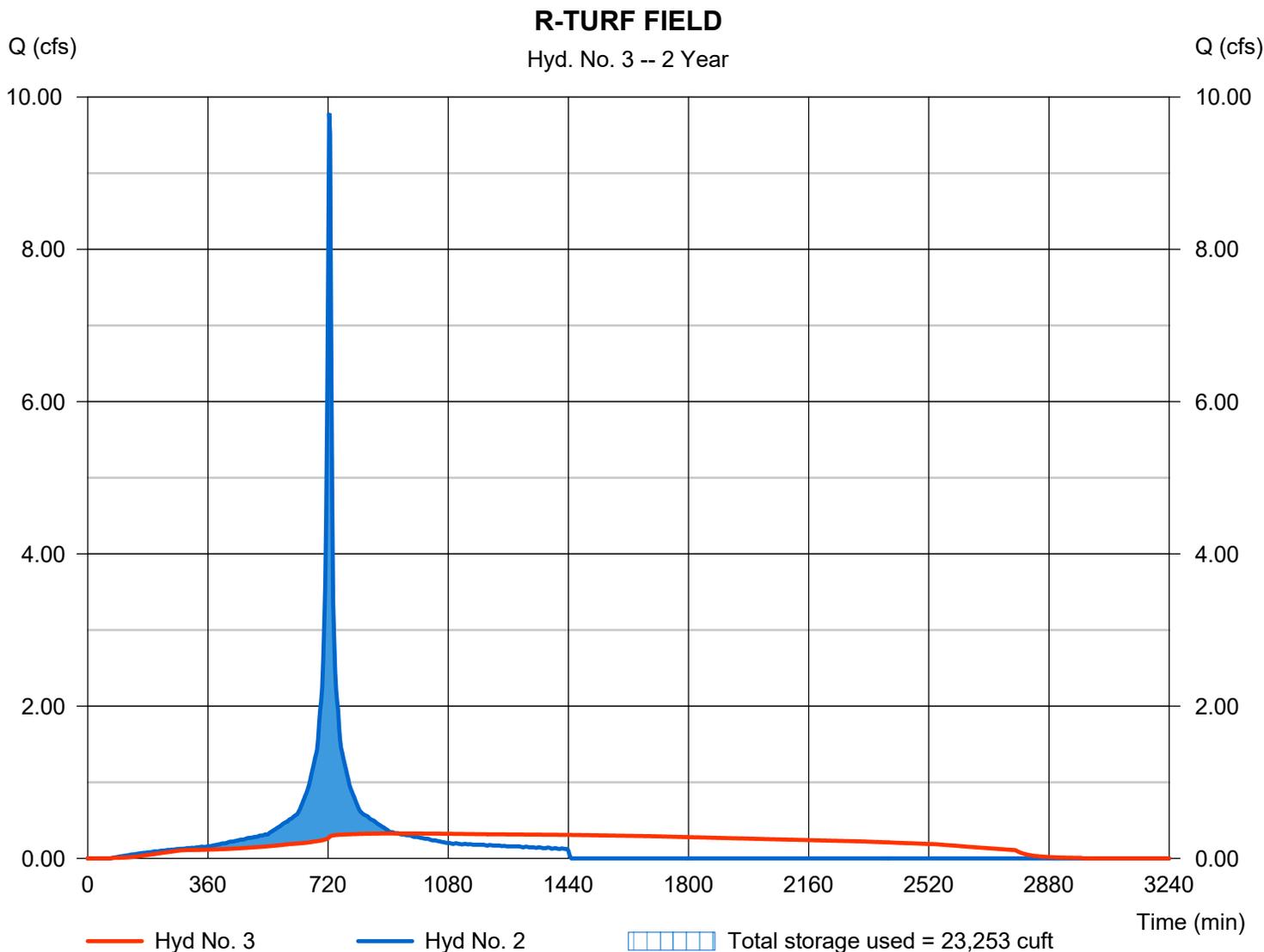
Monday, 04 / 13 / 2020

Hyd. No. 3

R-TURF FIELD

Hydrograph type	= Reservoir	Peak discharge	= 0.327 cfs
Storm frequency	= 2 yrs	Time to peak	= 933 min
Time interval	= 3 min	Hyd. volume	= 37,853 cuft
Inflow hyd. No.	= 2 - P-Detention	Max. Elevation	= 4.67 ft
Reservoir name	= DB - TURF FIELD	Max. Storage	= 23,253 cuft

Storage Indication method used.



Pond No. 1 - DB - TURF FIELD

Pond Data

Contours -User-defined contour areas. Average end area method used for volume calculation. Beginning Elevation = 3.50 ft Voids = 40.00%

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	3.50	25	0	0
0.04	3.54	50	1	1
0.25	3.75	8,000	338	339
0.50	4.00	34,000	2,100	2,439
0.65	4.15	56,000	2,700	5,139
1.00	4.50	86,000	9,940	15,079
1.70	5.20	155,845	33,858	48,937
1.83	5.33	155,845	8,104	57,041

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 12.00	3.00	Inactive	0.00
Span (in)	= 12.00	3.38	6.50	0.00
No. Barrels	= 1	1	1	0
Invert El. (ft)	= 3.49	3.50	3.50	0.00
Length (ft)	= 337.00	0.00	0.00	0.00
Slope (%)	= 0.30	0.00	0.00	n/a
N-Value	= .010	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	Yes	Yes	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 4.00	4.00	0.00	0.00
Crest El. (ft)	= 5.60	4.70	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= 1	Rect	---	---
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	3.50	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
0.04	1	3.54	0.01 ic	0.01 ic	0.00	---	0.00	0.00	---	---	---	---	0.006
0.25	339	3.75	0.11 ic	0.11 ic	0.00	---	0.00	0.00	---	---	---	---	0.108
0.50	2,439	4.00	0.19 ic	0.19 ic	0.00	---	0.00	0.00	---	---	---	---	0.187
0.65	5,139	4.15	0.22 ic	0.22 ic	0.00	---	0.00	0.00	---	---	---	---	0.223
1.00	15,079	4.50	0.29 ic	0.29 ic	0.00	---	0.00	0.00	---	---	---	---	0.293
1.70	48,937	5.20	2.90 oc	0.10 ic	0.00	---	0.00	2.80 s	---	---	---	---	2.903
1.83	57,041	5.33	3.05 oc	0.08 ic	0.00	---	0.00	2.97 s	---	---	---	---	3.049

Hydrograph Report

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

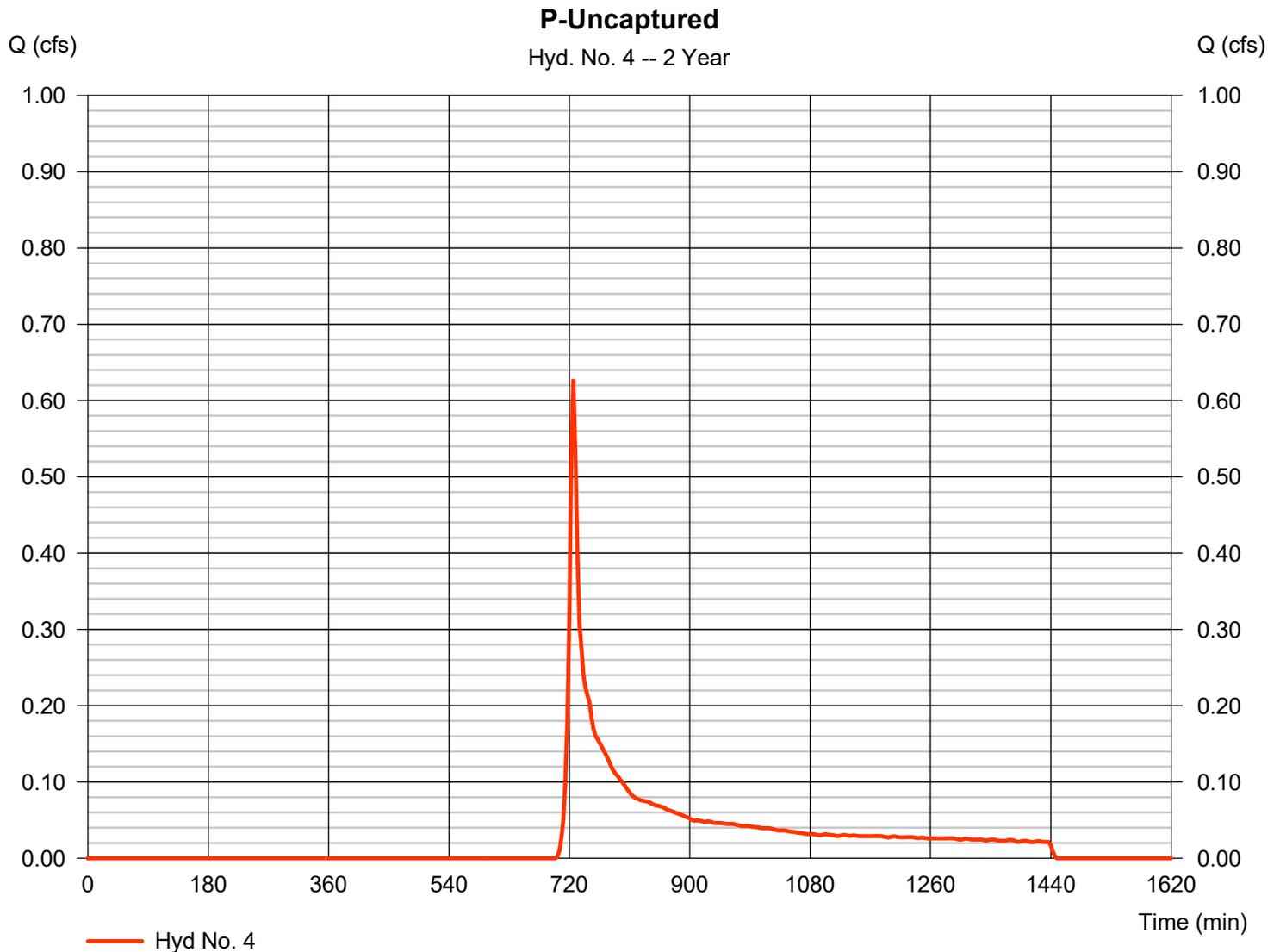
Monday, 04 / 13 / 2020

Hyd. No. 4

P-Uncaptured

Hydrograph type	= SCS Runoff	Peak discharge	= 0.628 cfs
Storm frequency	= 2 yrs	Time to peak	= 726 min
Time interval	= 3 min	Hyd. volume	= 2,600 cuft
Drainage area	= 1.310 ac	Curve number	= 63*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 3.34 in	Distribution	= Custom
Storm duration	= P:\200-AE\20200-20299\20200904\Shapefile\Report\Stormwater\NOAA_D_Ti		

* Composite (Area/CN) = [(1.260 x 61) + (0.055 x 98)] / 1.310



Precipitation Report

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

Monday, 04 / 13 / 2020

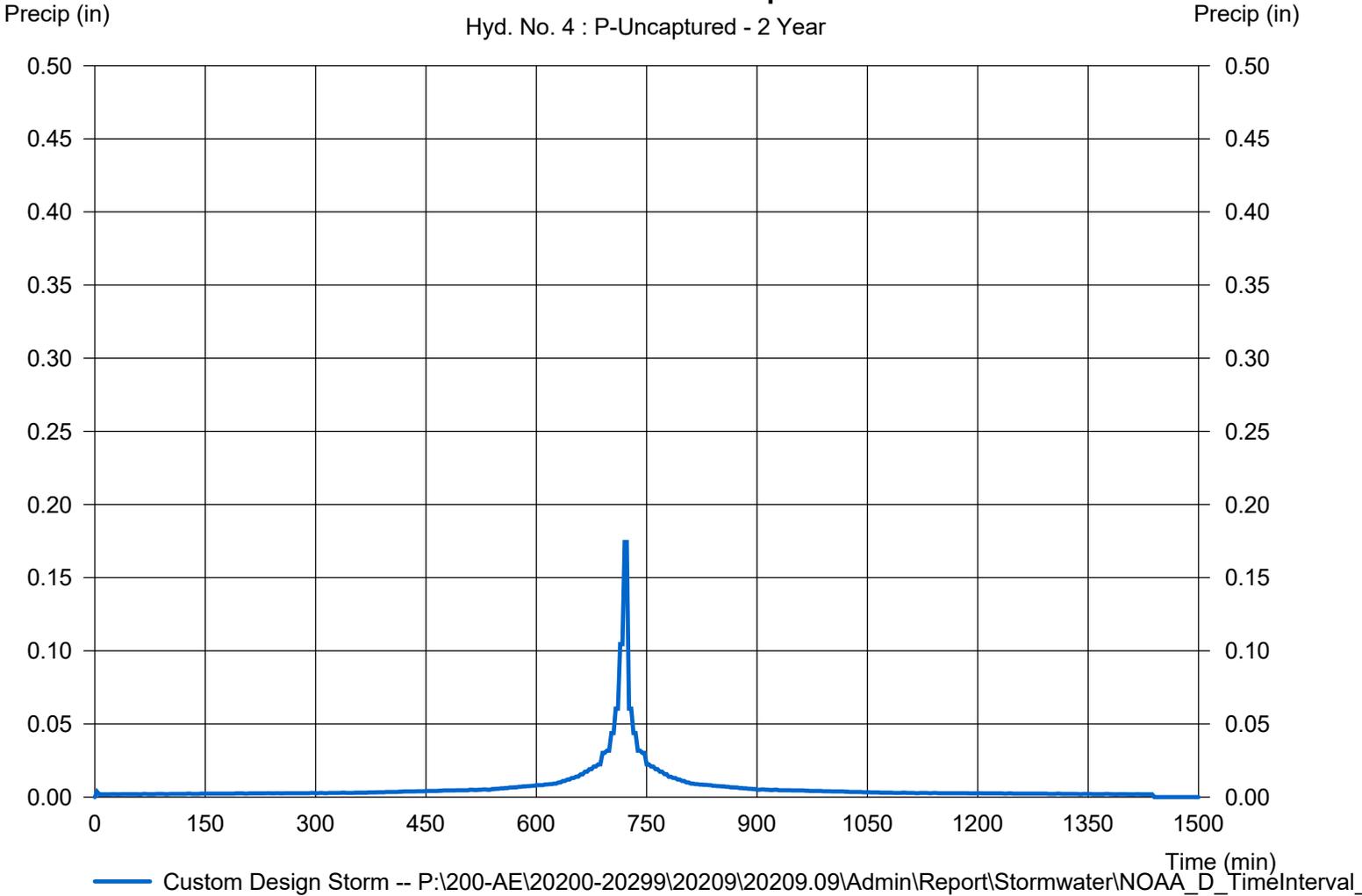
Hyd. No. 4

P-Uncaptured

Storm Frequency	= 2 yrs	Time interval	= 3 min
Total precip.	= 3.3400 in	Distribution	= Custom
Storm duration	= P:\200-AE\20200-20299\20209\20209.09\Admin\Report\Stormwater\NOAA_D_T		

Incremental Rainfall Precipitation

Hyd. No. 4 : P-Uncaptured - 2 Year



Hydrograph Report

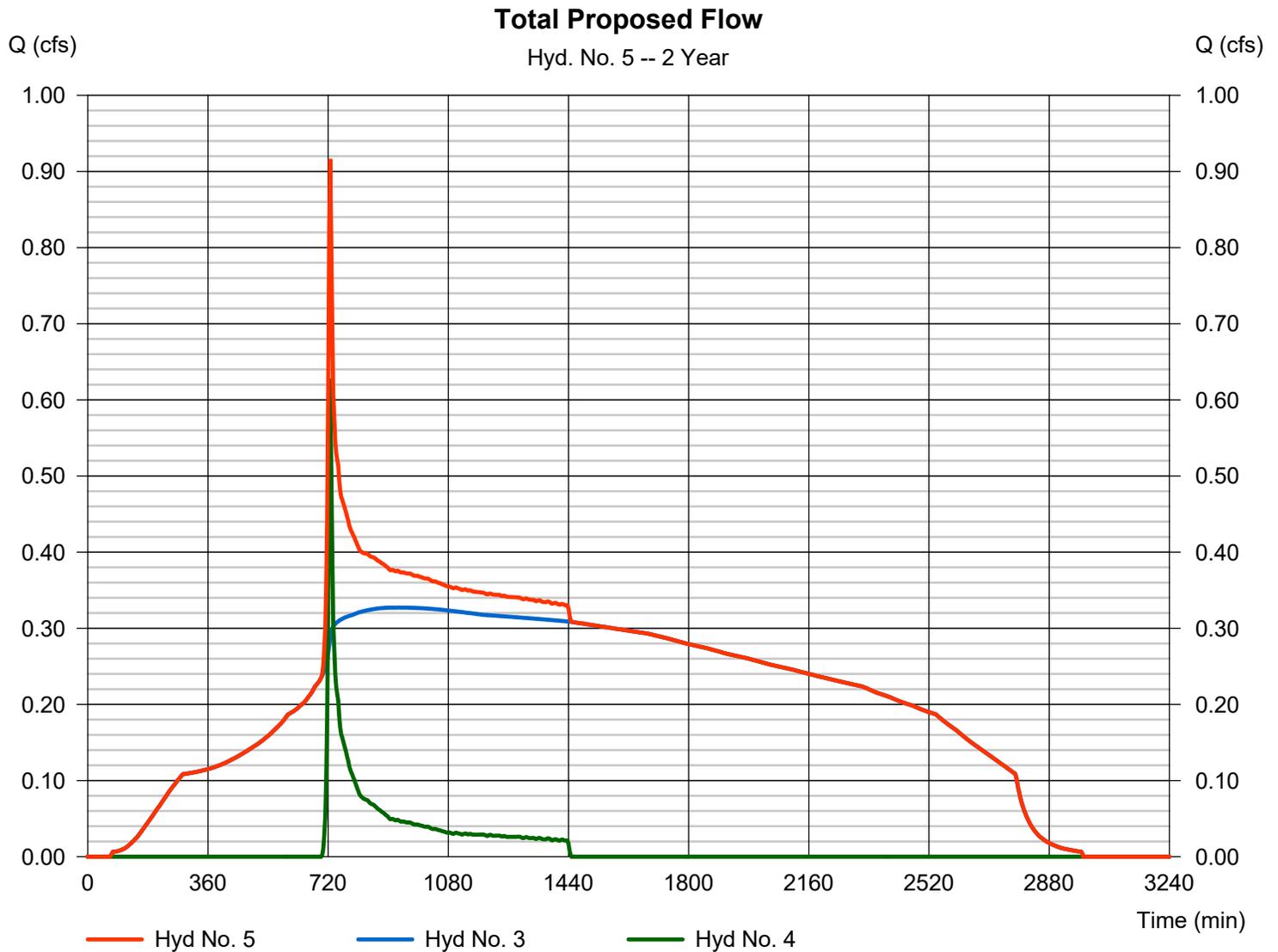
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2019.2

Monday, 04 / 13 / 2020

Hyd. No. 5

Total Proposed Flow

Hydrograph type	= Combine	Peak discharge	= 0.916 cfs
Storm frequency	= 2 yrs	Time to peak	= 726 min
Time interval	= 3 min	Hyd. volume	= 40,453 cuft
Inflow hyds.	= 3, 4	Contrib. drain. area	= 1.310 ac



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	6.617	3	726	23,534	-----	-----	-----	Existing Conditions	
2	SCS Runoff	14.96	3	723	58,882	-----	-----	-----	P-Detention	
3	Reservoir	1.291	3	795	58,882	2	4.88	33,225	R-TURF FIELD	
4	SCS Runoff	1.978	3	726	6,925	-----	-----	-----	P-Uncaptured	
5	Combine	2.311	3	726	65,807	3, 4	-----	-----	Total Proposed Flow	
2020909_Hydraflow_REV1_4-13-20.gpw					Return Period: 10 Year			Monday, 04 / 13 / 2020		

Hydrograph Report

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

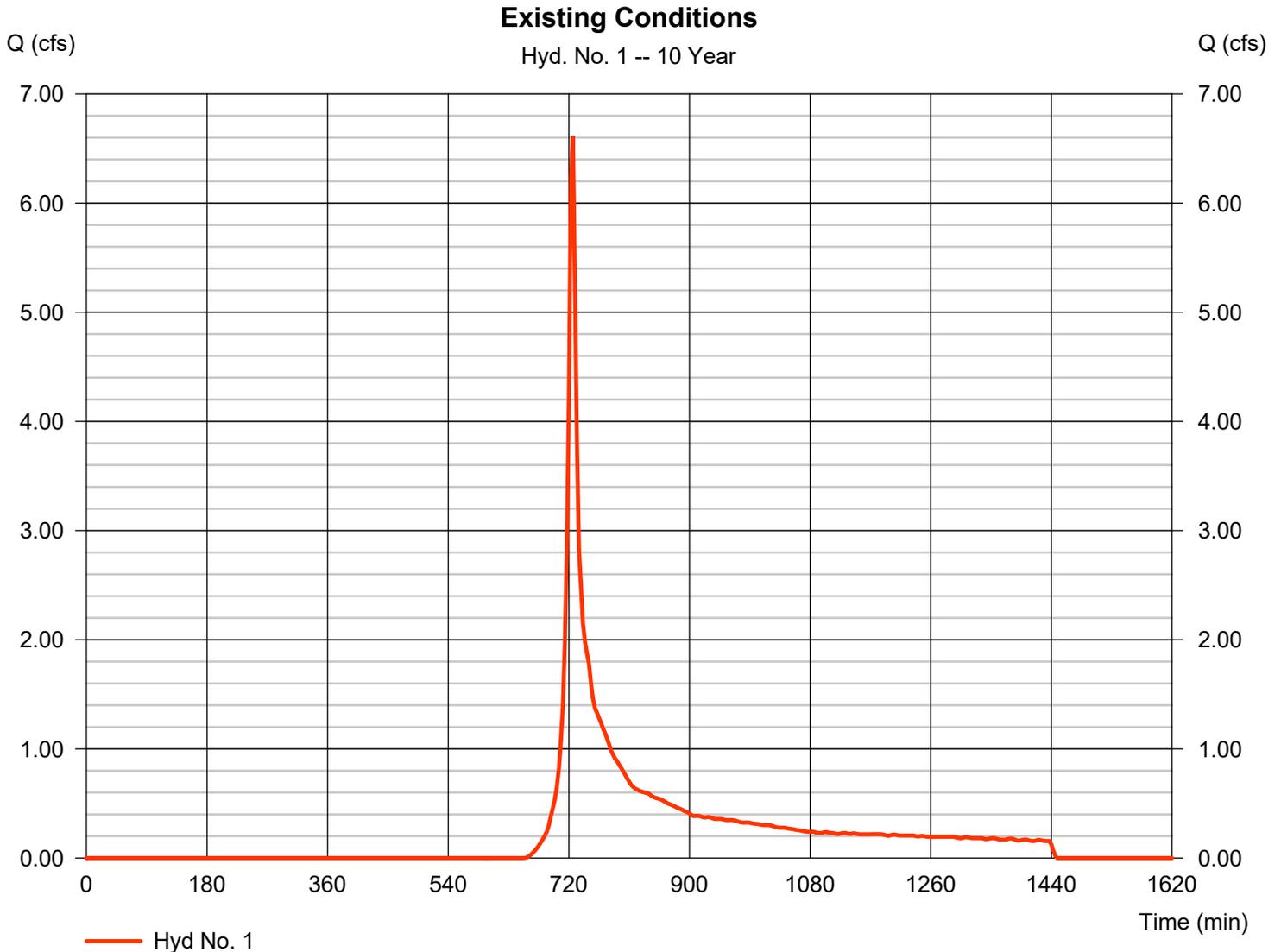
Monday, 04 / 13 / 2020

Hyd. No. 1

Existing Conditions

Hydrograph type	= SCS Runoff	Peak discharge	= 6.617 cfs
Storm frequency	= 10 yrs	Time to peak	= 726 min
Time interval	= 3 min	Hyd. volume	= 23,534 cuft
Drainage area	= 4.900 ac	Curve number	= 61*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 5.07 in	Distribution	= Custom
Storm duration	= P:\200-AE\20200-20299\20209-Shapefile\Report\Stormwater\NOAA_D_Ti		

* Composite (Area/CN) = [(4.890 x 61) + (0.010 x 98)] / 4.900



Precipitation Report

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

Monday, 04 / 13 / 2020

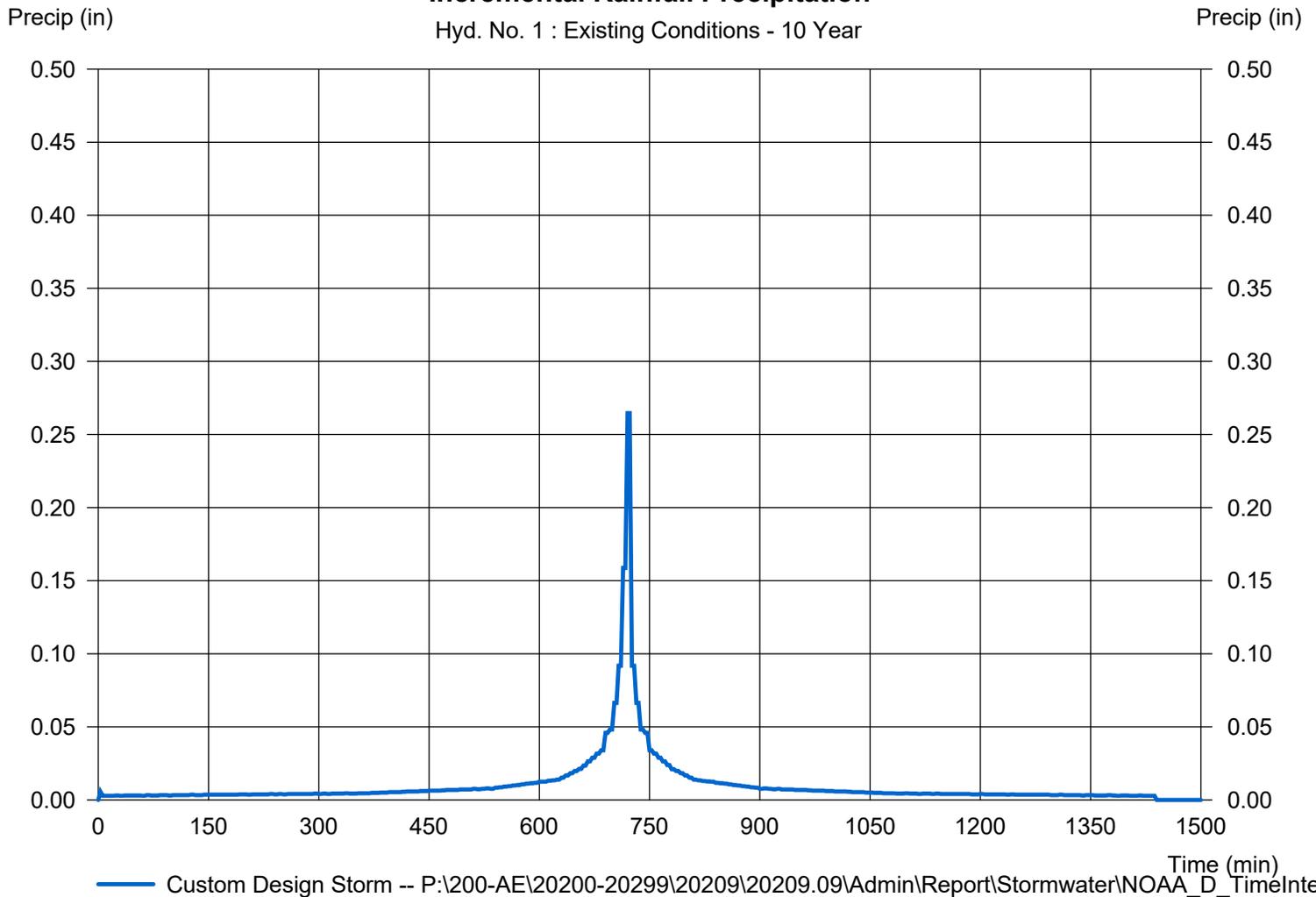
Hyd. No. 1

Existing Conditions

Storm Frequency	= 10 yrs	Time interval	= 3 min
Total precip.	= 5.0700 in	Distribution	= Custom
Storm duration	= P:\200-AE\20200-20299\20209\20209.09\Admin\Report\Stormwater\NOAA_D_T		

Incremental Rainfall Precipitation

Hyd. No. 1 : Existing Conditions - 10 Year



Hydrograph Report

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

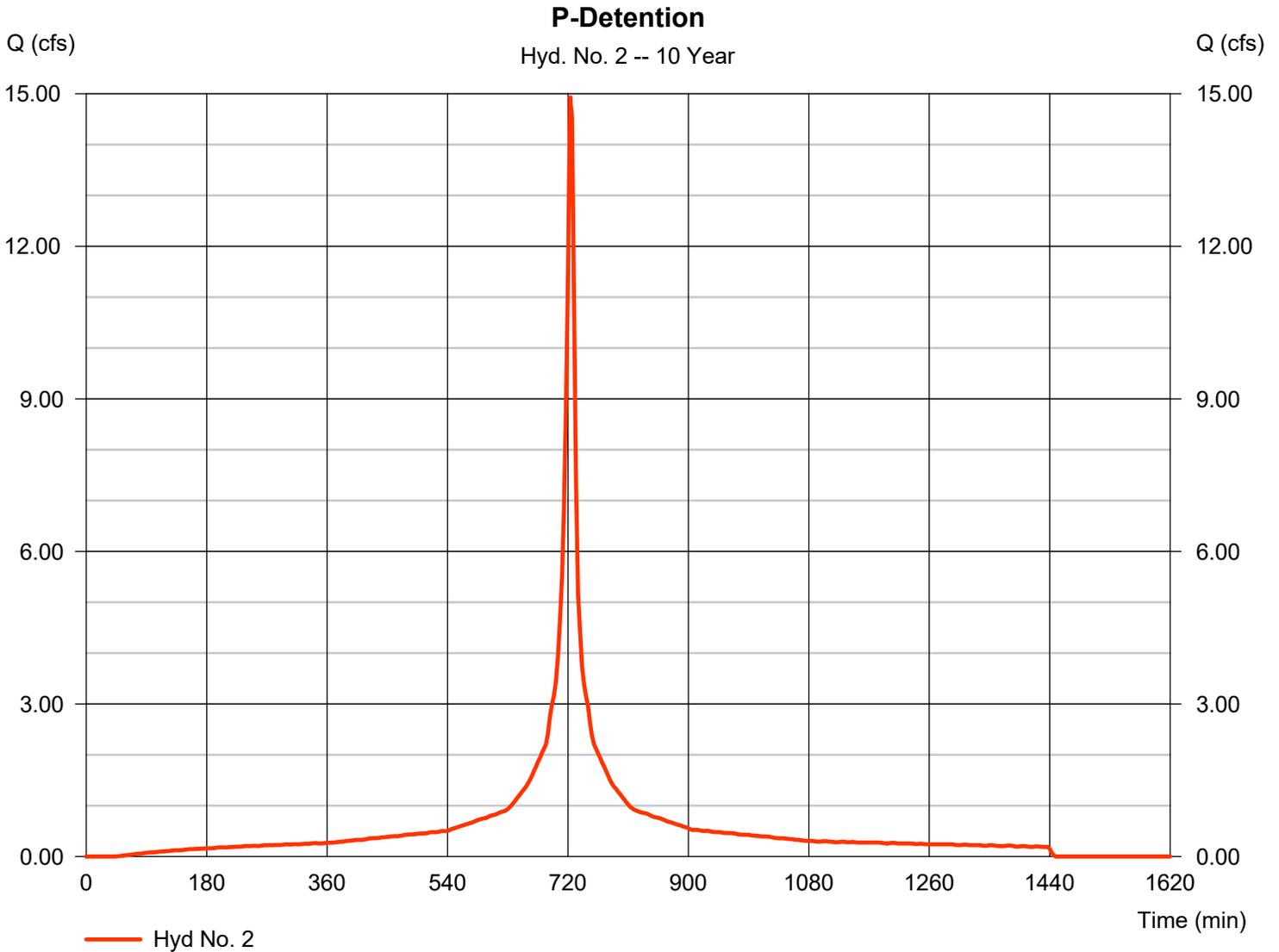
Monday, 04 / 13 / 2020

Hyd. No. 2

P-Detention

Hydrograph type	= SCS Runoff	Peak discharge	= 14.96 cfs
Storm frequency	= 10 yrs	Time to peak	= 723 min
Time interval	= 3 min	Hyd. volume	= 58,882 cuft
Drainage area	= 3.580 ac	Curve number	= 98*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 5.07 in	Distribution	= Custom
Storm duration	= P:\200-AE\20200-20299\20209\Shapefile\A		

* Composite (Area/CN) = [(3.580 x 98)] / 3.580



Precipitation Report

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

Monday, 04 / 13 / 2020

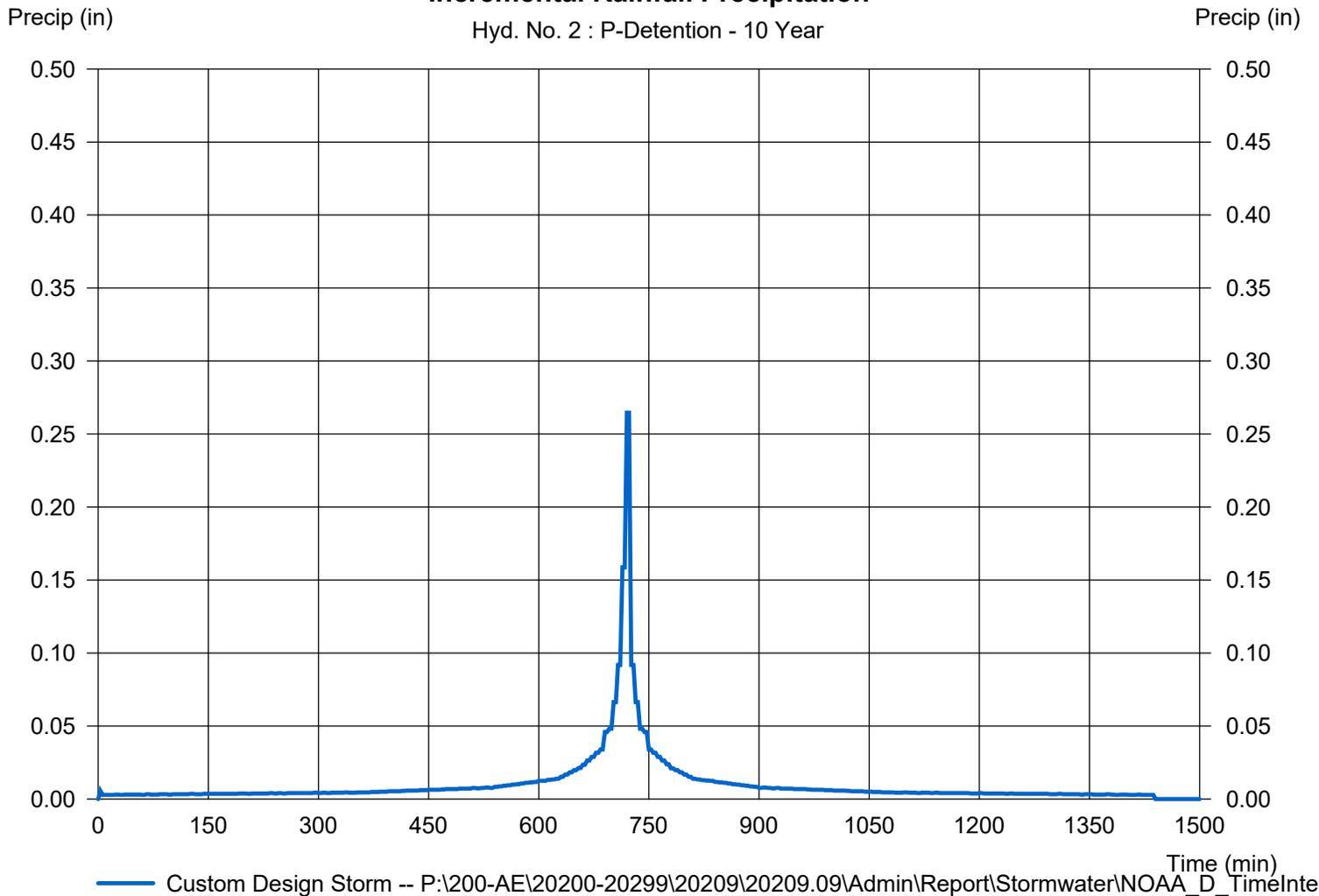
Hyd. No. 2

P-Detention

Storm Frequency	= 10 yrs	Time interval	= 3 min
Total precip.	= 5.0700 in	Distribution	= Custom
Storm duration	= P:\200-AE\20200-20299\20209\20209.09\Admin\Report\Stormwater\NOAA_D_T		

Incremental Rainfall Precipitation

Hyd. No. 2 : P-Detention - 10 Year



Hydrograph Report

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

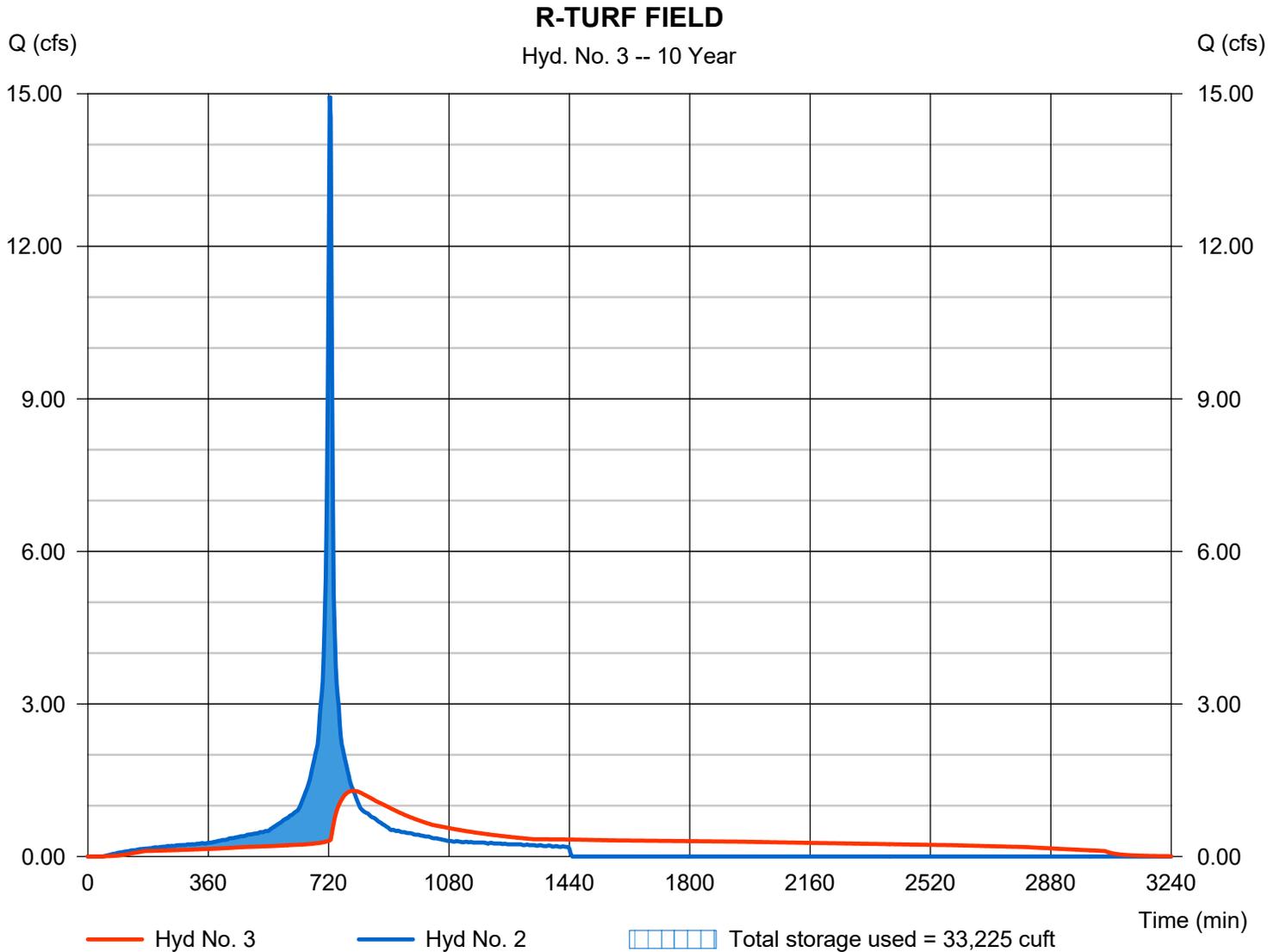
Monday, 04 / 13 / 2020

Hyd. No. 3

R-TURF FIELD

Hydrograph type	= Reservoir	Peak discharge	= 1.291 cfs
Storm frequency	= 10 yrs	Time to peak	= 795 min
Time interval	= 3 min	Hyd. volume	= 58,882 cuft
Inflow hyd. No.	= 2 - P-Detention	Max. Elevation	= 4.88 ft
Reservoir name	= DB - TURF FIELD	Max. Storage	= 33,225 cuft

Storage Indication method used.



Hydrograph Report

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

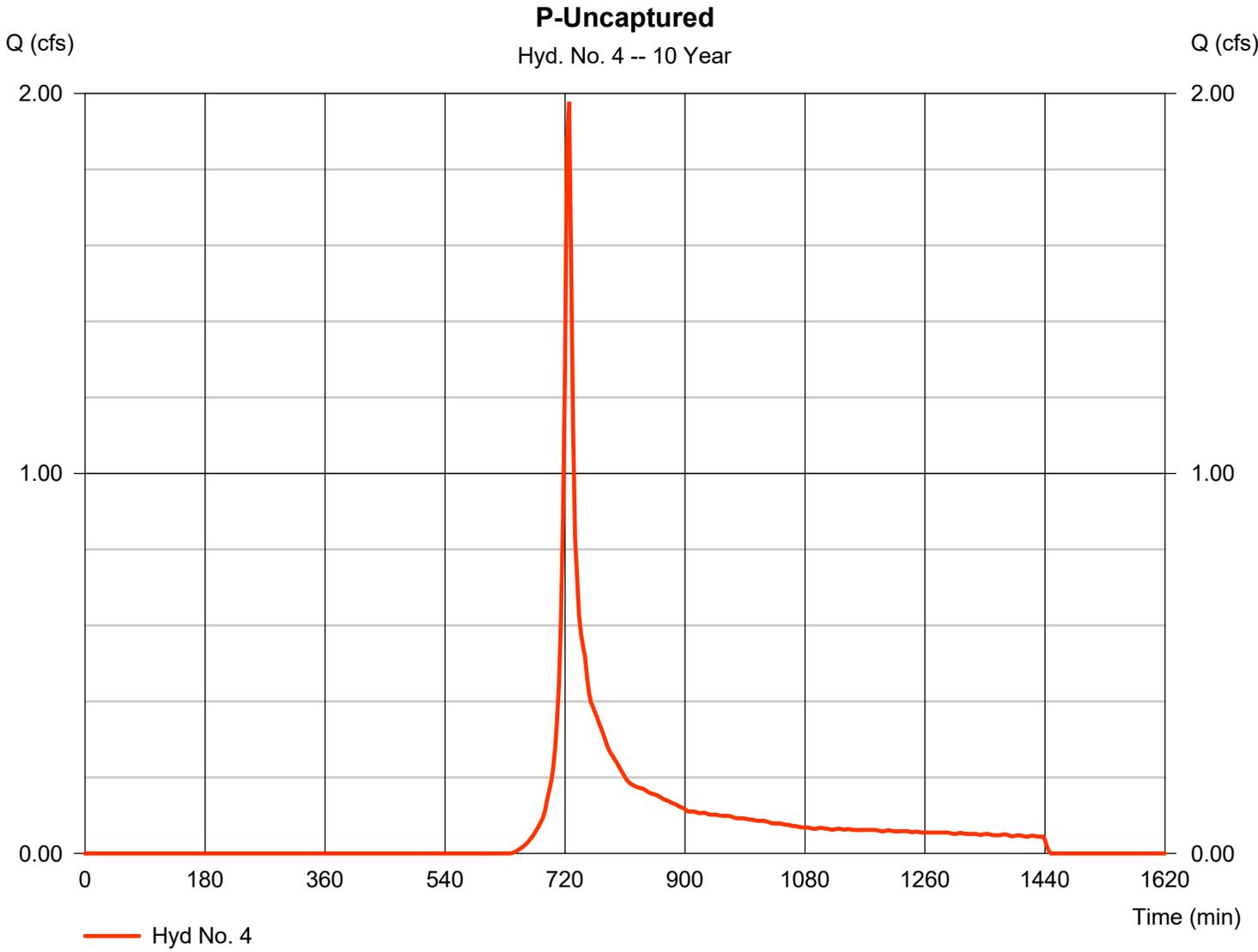
Monday, 04 / 13 / 2020

Hyd. No. 4

P-Uncaptured

Hydrograph type	= SCS Runoff	Peak discharge	= 1.978 cfs
Storm frequency	= 10 yrs	Time to peak	= 726 min
Time interval	= 3 min	Hyd. volume	= 6,925 cuft
Drainage area	= 1.310 ac	Curve number	= 63*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 5.07 in	Distribution	= Custom
Storm duration	= P:\200-AE\20200-20299\20209-Shapefile\Stormwater\NOAA_D_Ti		

* Composite (Area/CN) = [(1.260 x 61) + (0.055 x 98)] / 1.310



Precipitation Report

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

Monday, 04 / 13 / 2020

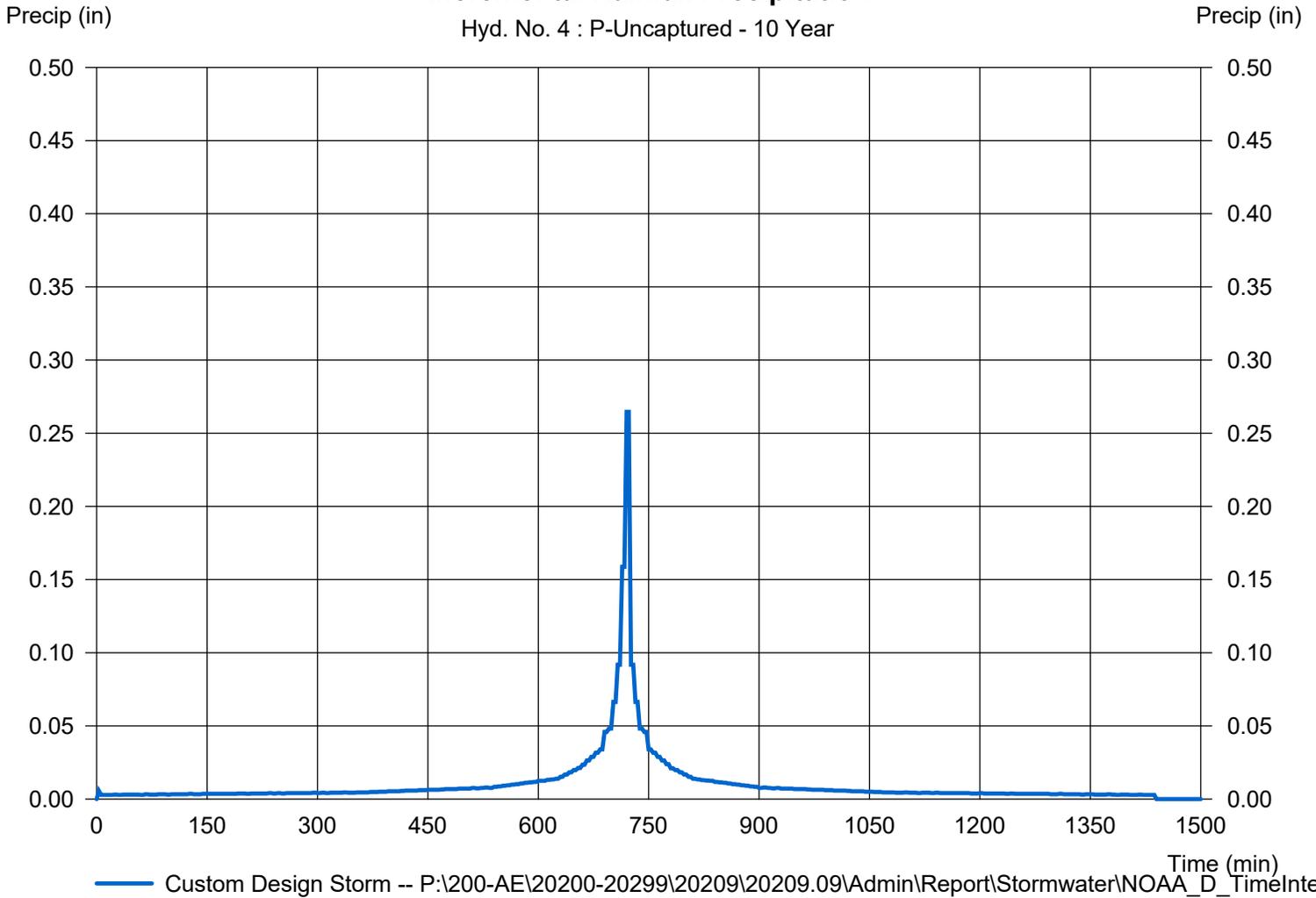
Hyd. No. 4

P-Uncaptured

Storm Frequency	= 10 yrs	Time interval	= 3 min
Total precip.	= 5.0700 in	Distribution	= Custom
Storm duration	= P:\200-AE\20200-20299\20209\20209.09\Admin\Report\Stormwater\NOAA_D_T		

Incremental Rainfall Precipitation

Hyd. No. 4 : P-Uncaptured - 10 Year



Hydrograph Report

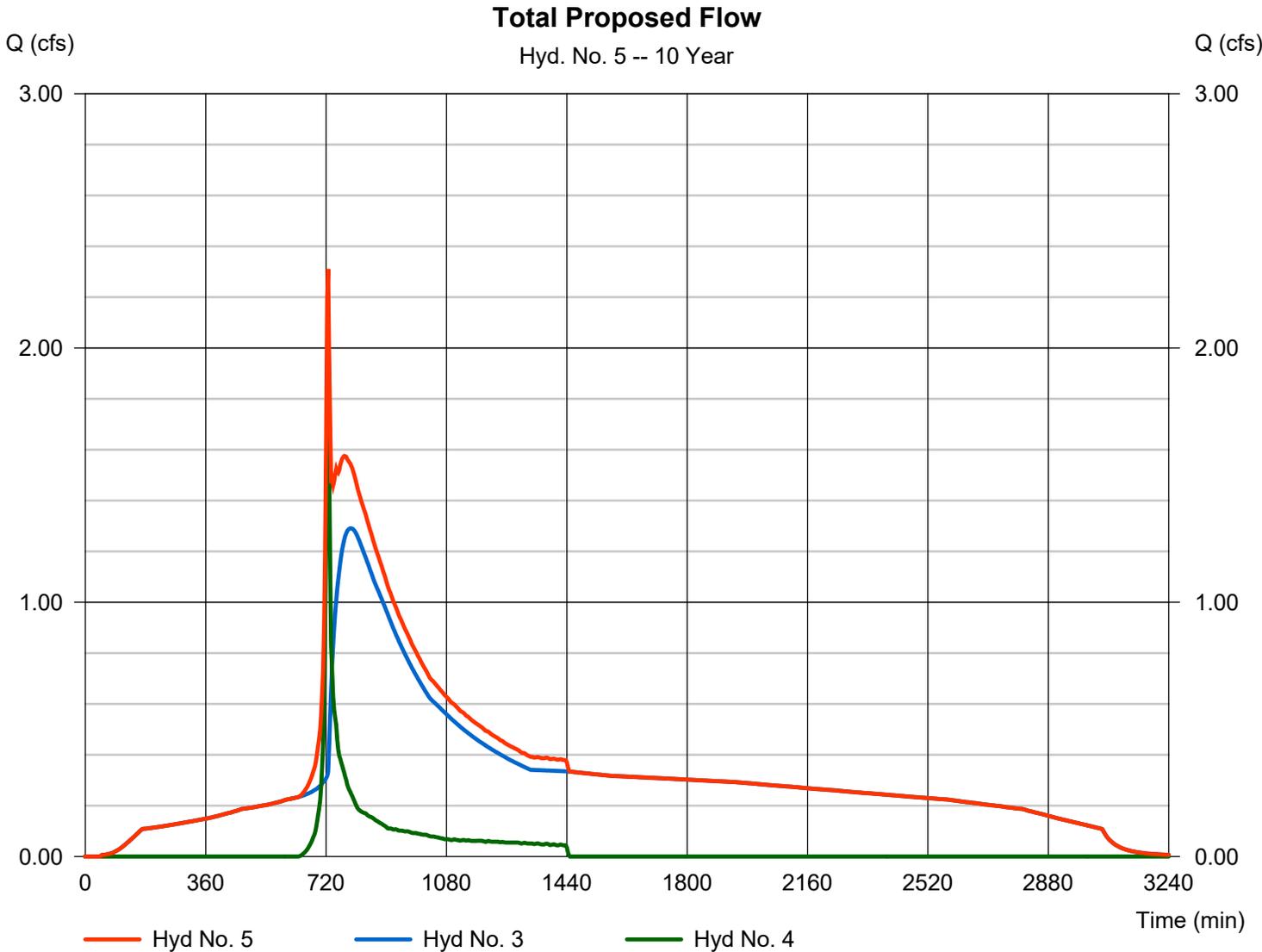
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2019.2

Monday, 04 / 13 / 2020

Hyd. No. 5

Total Proposed Flow

Hydrograph type	= Combine	Peak discharge	= 2.311 cfs
Storm frequency	= 10 yrs	Time to peak	= 726 min
Time interval	= 3 min	Hyd. volume	= 65,807 cuft
Inflow hyds.	= 3, 4	Contrib. drain. area	= 1.310 ac



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	10.62	3	726	36,605	-----	-----	-----	Existing Conditions
2	SCS Runoff	18.56	3	723	73,605	-----	-----	-----	P-Detention
3	Reservoir	2.393	3	768	73,605	2	5.00	39,258	R-TURF FIELD
4	SCS Runoff	3.091	3	726	10,584	-----	-----	-----	P-Uncaptured
5	Combine	4.039	3	726	84,190	3, 4	-----	-----	Total Proposed Flow
2020909_Hydraflow_REV1_4-13-20.gpw					Return Period: 25 Year			Monday, 04 / 13 / 2020	

Hydrograph Report

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

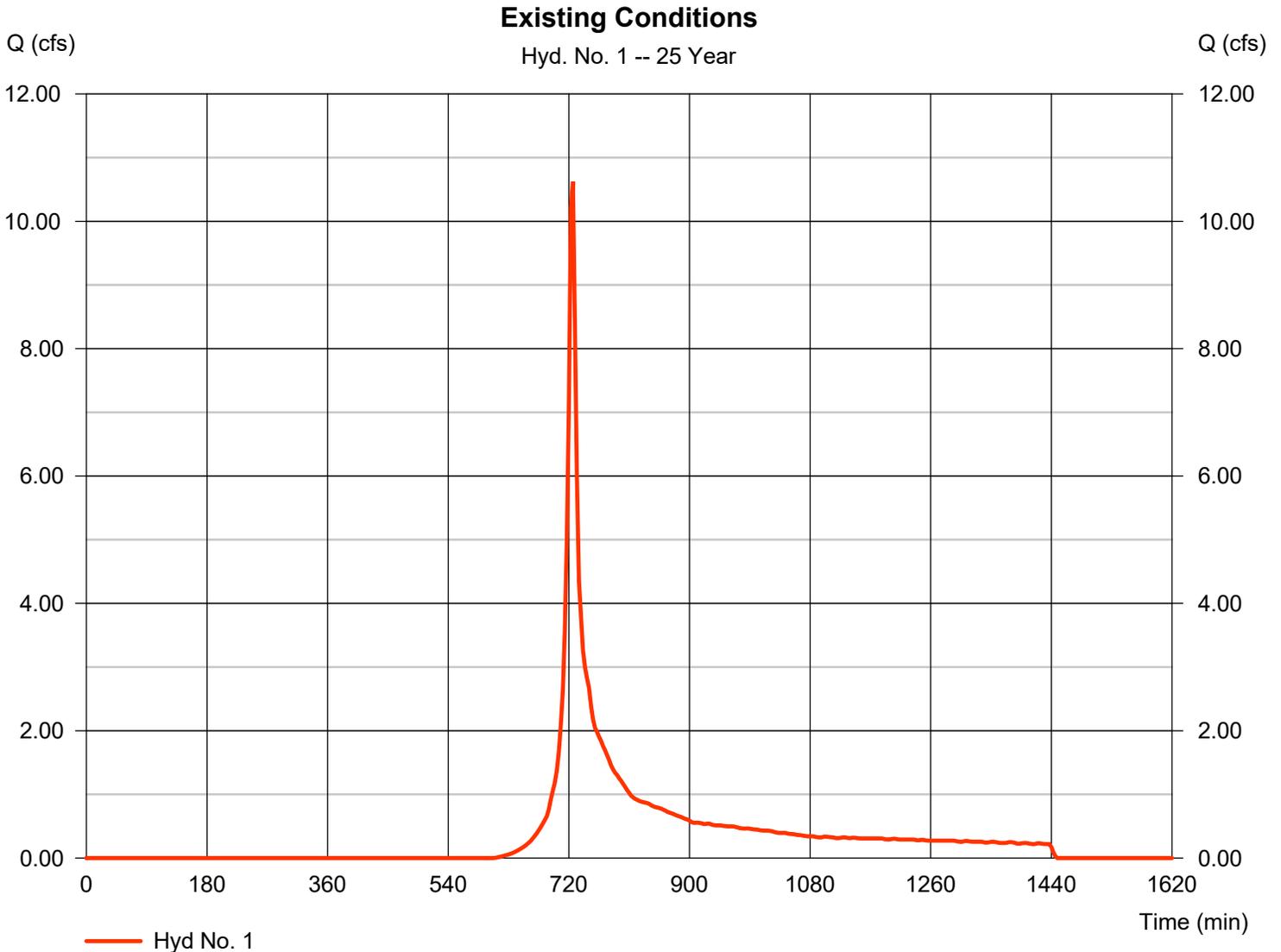
Monday, 04 / 13 / 2020

Hyd. No. 1

Existing Conditions

Hydrograph type	= SCS Runoff	Peak discharge	= 10.62 cfs
Storm frequency	= 25 yrs	Time to peak	= 726 min
Time interval	= 3 min	Hyd. volume	= 36,605 cuft
Drainage area	= 4.900 ac	Curve number	= 61*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 6.28 in	Distribution	= Custom
Storm duration	= P:\200-AE\20200-20299\20209\Shapefile\Report\Stormwater\NOAA_D_Ti		

* Composite (Area/CN) = [(4.890 x 61) + (0.010 x 98)] / 4.900



Precipitation Report

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

Monday, 04 / 13 / 2020

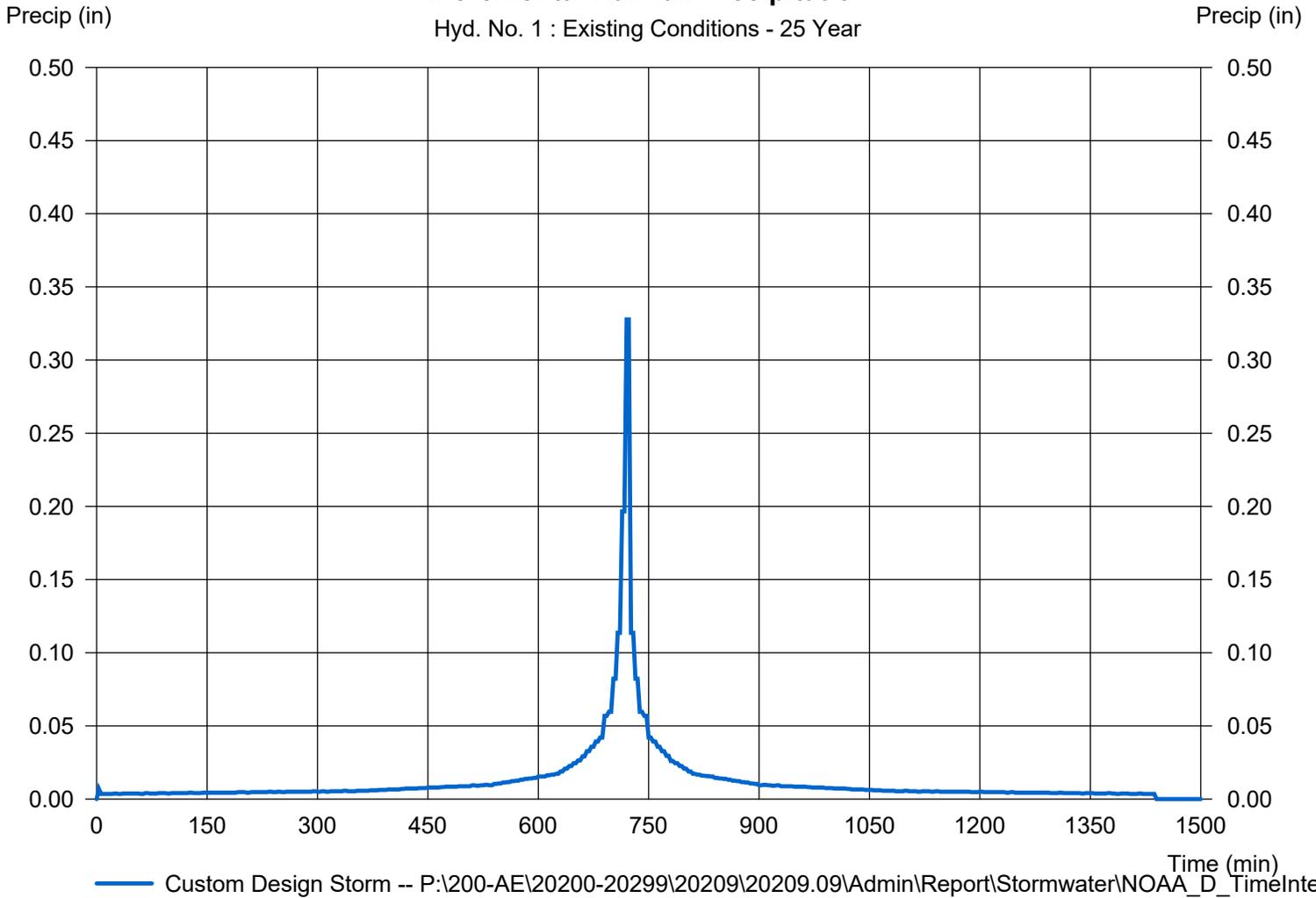
Hyd. No. 1

Existing Conditions

Storm Frequency	= 25 yrs	Time interval	= 3 min
Total precip.	= 6.2800 in	Distribution	= Custom
Storm duration	= P:\200-AE\20200-20299\20209\20209.09\Admin\Report\Stormwater\NOAA_D_T		

Incremental Rainfall Precipitation

Hyd. No. 1 : Existing Conditions - 25 Year



Hydrograph Report

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

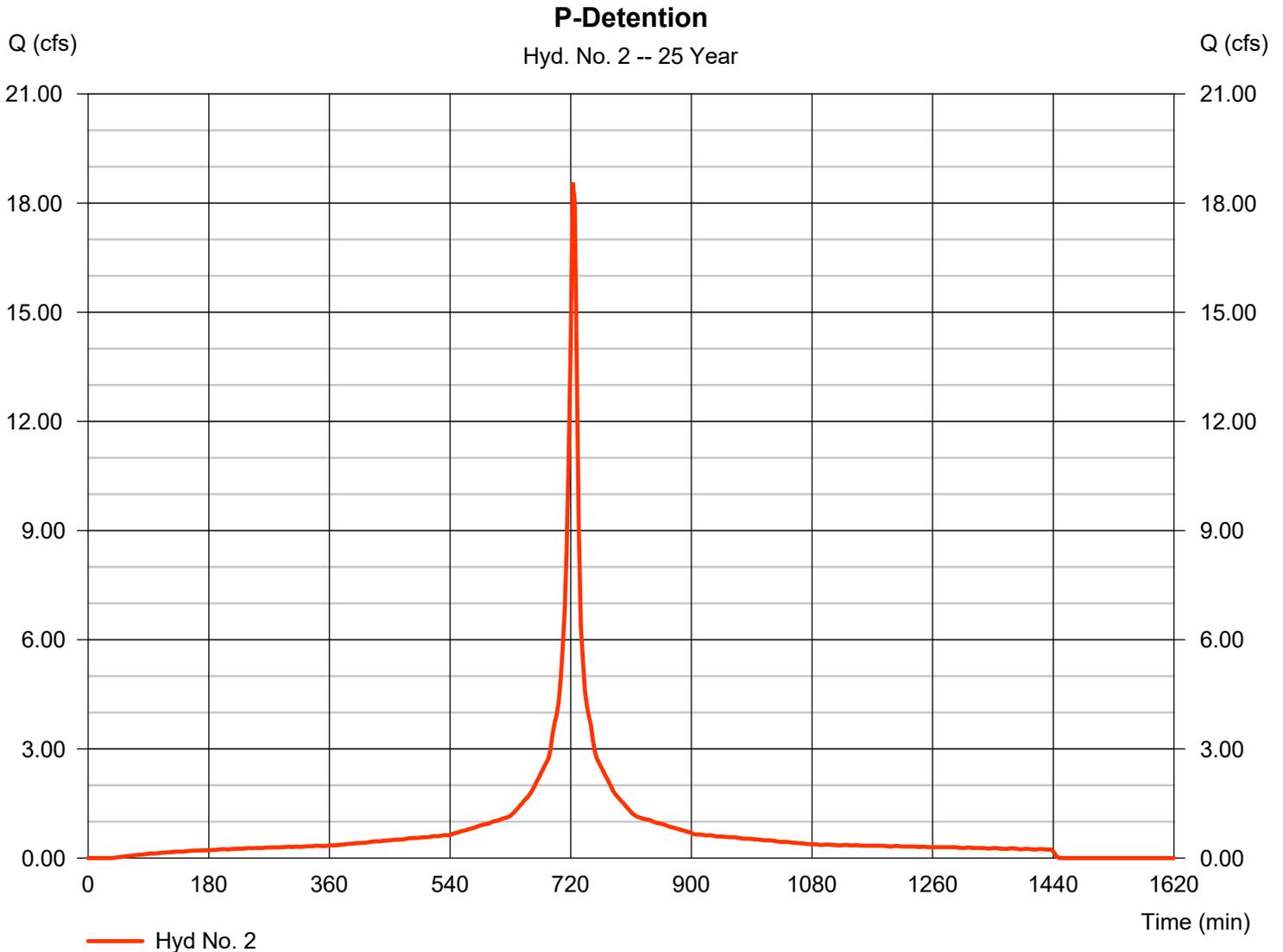
Monday, 04 / 13 / 2020

Hyd. No. 2

P-Detention

Hydrograph type	= SCS Runoff	Peak discharge	= 18.56 cfs
Storm frequency	= 25 yrs	Time to peak	= 723 min
Time interval	= 3 min	Hyd. volume	= 73,605 cuft
Drainage area	= 3.580 ac	Curve number	= 98*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 6.28 in	Distribution	= Custom
Storm duration	= P:\200-AE\20200-20299\20209-Shapefile\20209-01-13-2020-Stormwater\NOAA_D_Ti		

* Composite (Area/CN) = [(3.580 x 98)] / 3.580



Precipitation Report

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

Monday, 04 / 13 / 2020

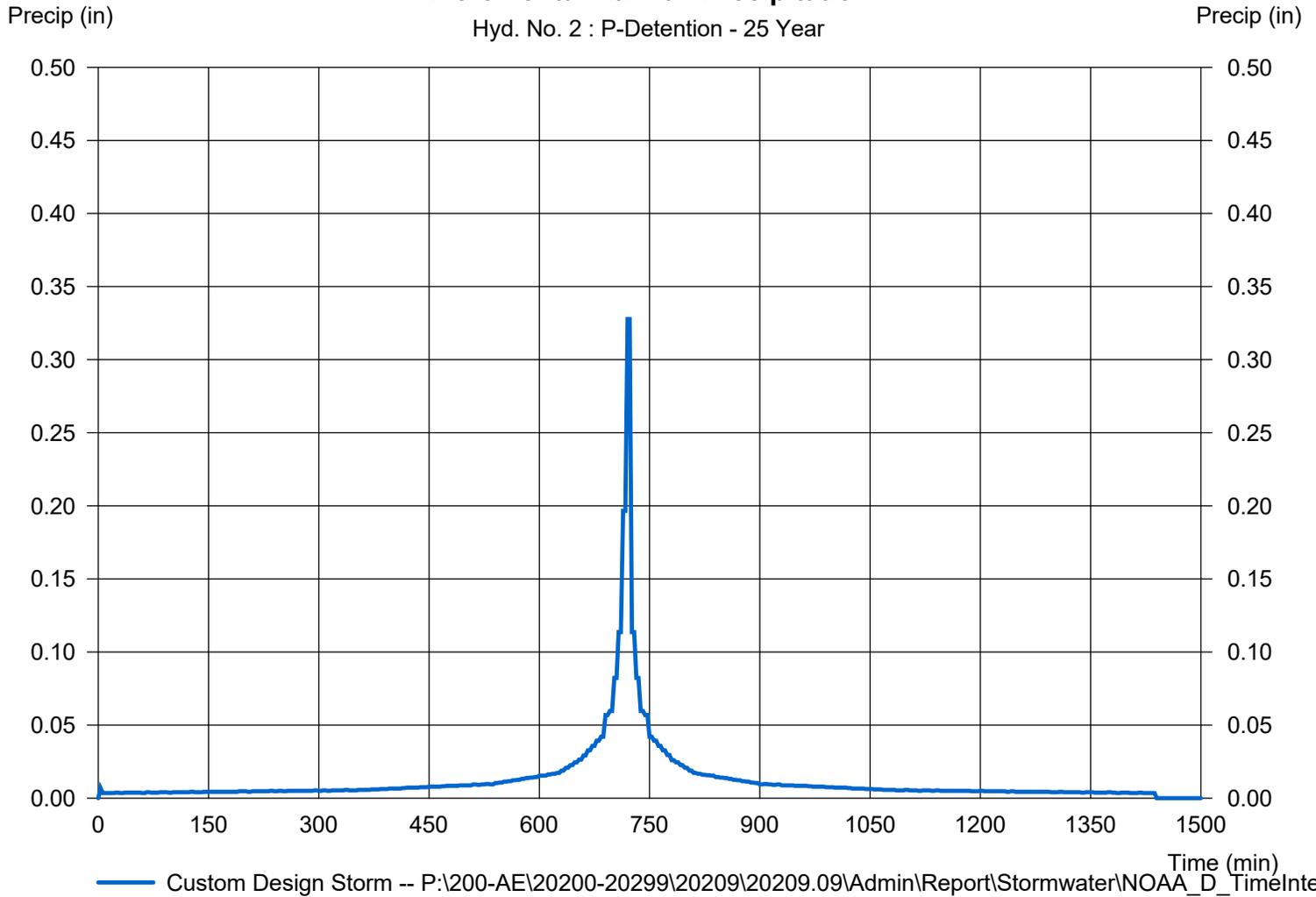
Hyd. No. 2

P-Detention

Storm Frequency	= 25 yrs	Time interval	= 3 min
Total precip.	= 6.2800 in	Distribution	= Custom
Storm duration	= P:\200-AE\20200-20299\20209\20209.09\Admin\Report\Stormwater\NOAA_D_T		

Incremental Rainfall Precipitation

Hyd. No. 2 : P-Detention - 25 Year



Hydrograph Report

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

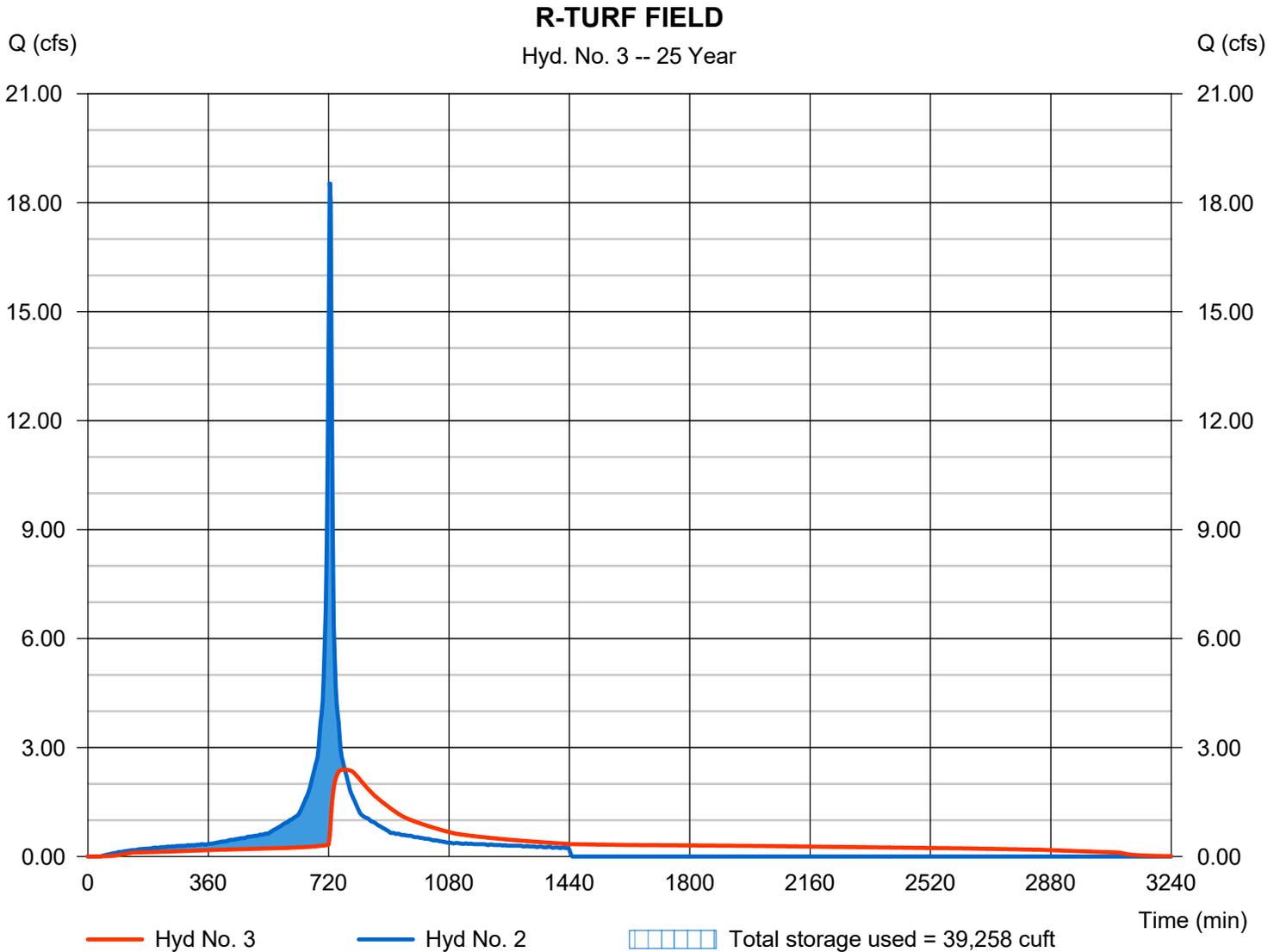
Monday, 04 / 13 / 2020

Hyd. No. 3

R-TURF FIELD

Hydrograph type	= Reservoir	Peak discharge	= 2.393 cfs
Storm frequency	= 25 yrs	Time to peak	= 768 min
Time interval	= 3 min	Hyd. volume	= 73,605 cuft
Inflow hyd. No.	= 2 - P-Detention	Max. Elevation	= 5.00 ft
Reservoir name	= DB - TURF FIELD	Max. Storage	= 39,258 cuft

Storage Indication method used.



Hydrograph Report

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

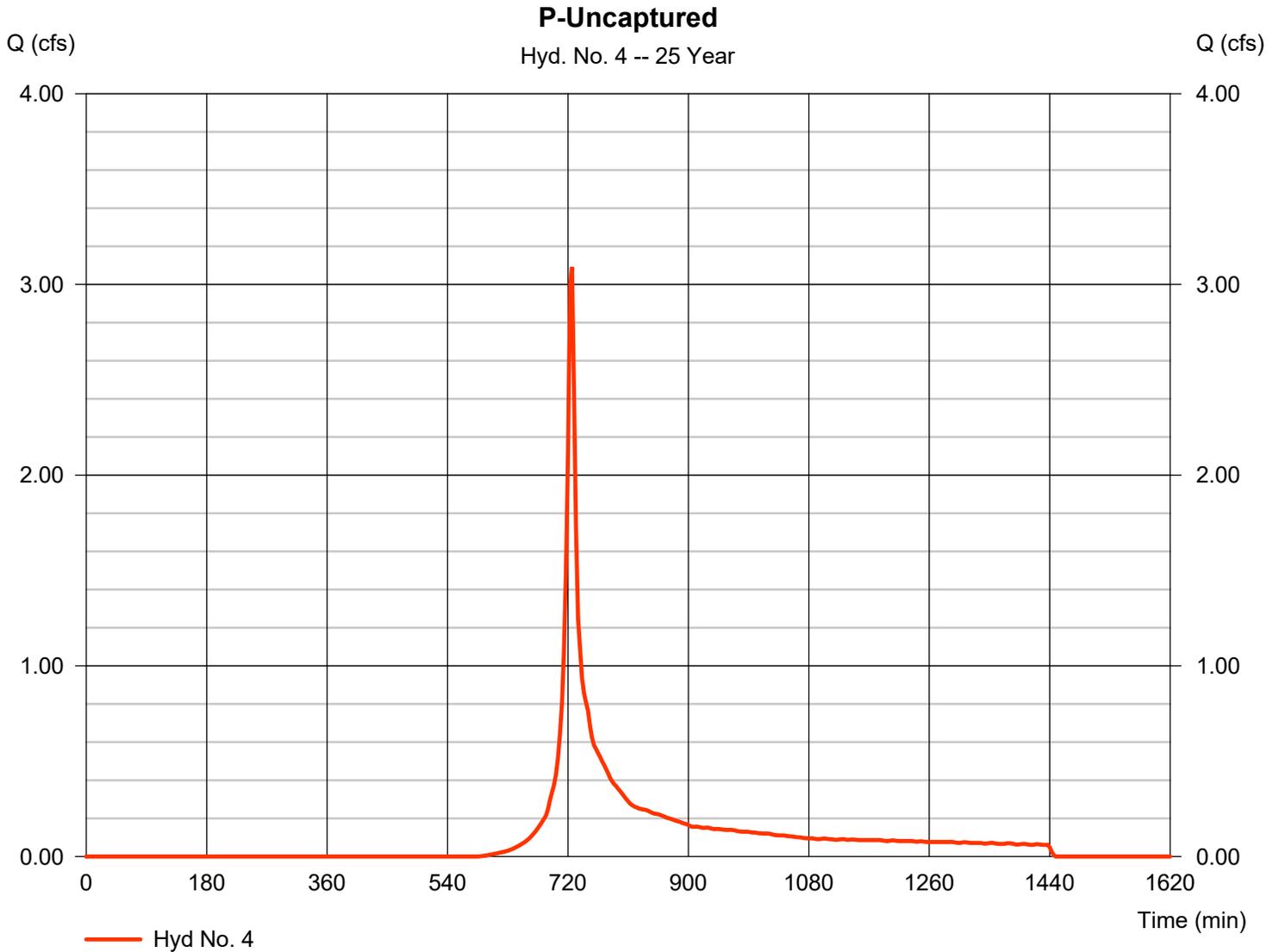
Monday, 04 / 13 / 2020

Hyd. No. 4

P-Uncaptured

Hydrograph type	= SCS Runoff	Peak discharge	= 3.091 cfs
Storm frequency	= 25 yrs	Time to peak	= 726 min
Time interval	= 3 min	Hyd. volume	= 10,584 cuft
Drainage area	= 1.310 ac	Curve number	= 63*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 6.28 in	Distribution	= Custom
Storm duration	= P:\200-AE\20200-20299\20209-Shapefile\Admin\Report\Stormwater\NOAA_D_Ti		

* Composite (Area/CN) = [(1.260 x 61) + (0.055 x 98)] / 1.310



Precipitation Report

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

Monday, 04 / 13 / 2020

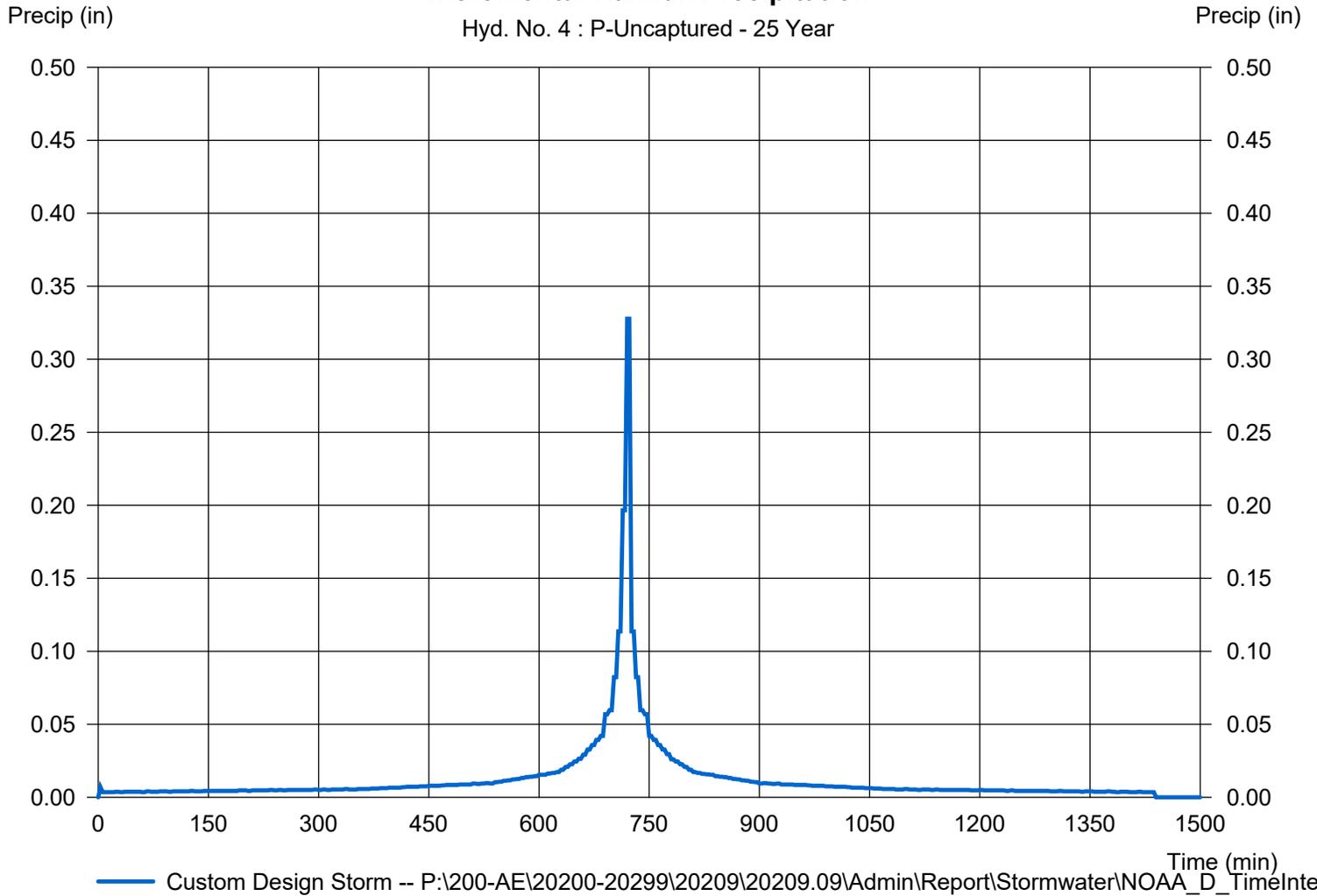
Hyd. No. 4

P-Uncaptured

Storm Frequency	= 25 yrs	Time interval	= 3 min
Total precip.	= 6.2800 in	Distribution	= Custom
Storm duration	= P:\200-AE\20200-20299\20209\20209.09\Admin\Report\Stormwater\NOAA_D_T		

Incremental Rainfall Precipitation

Hyd. No. 4 : P-Uncaptured - 25 Year



Hydrograph Report

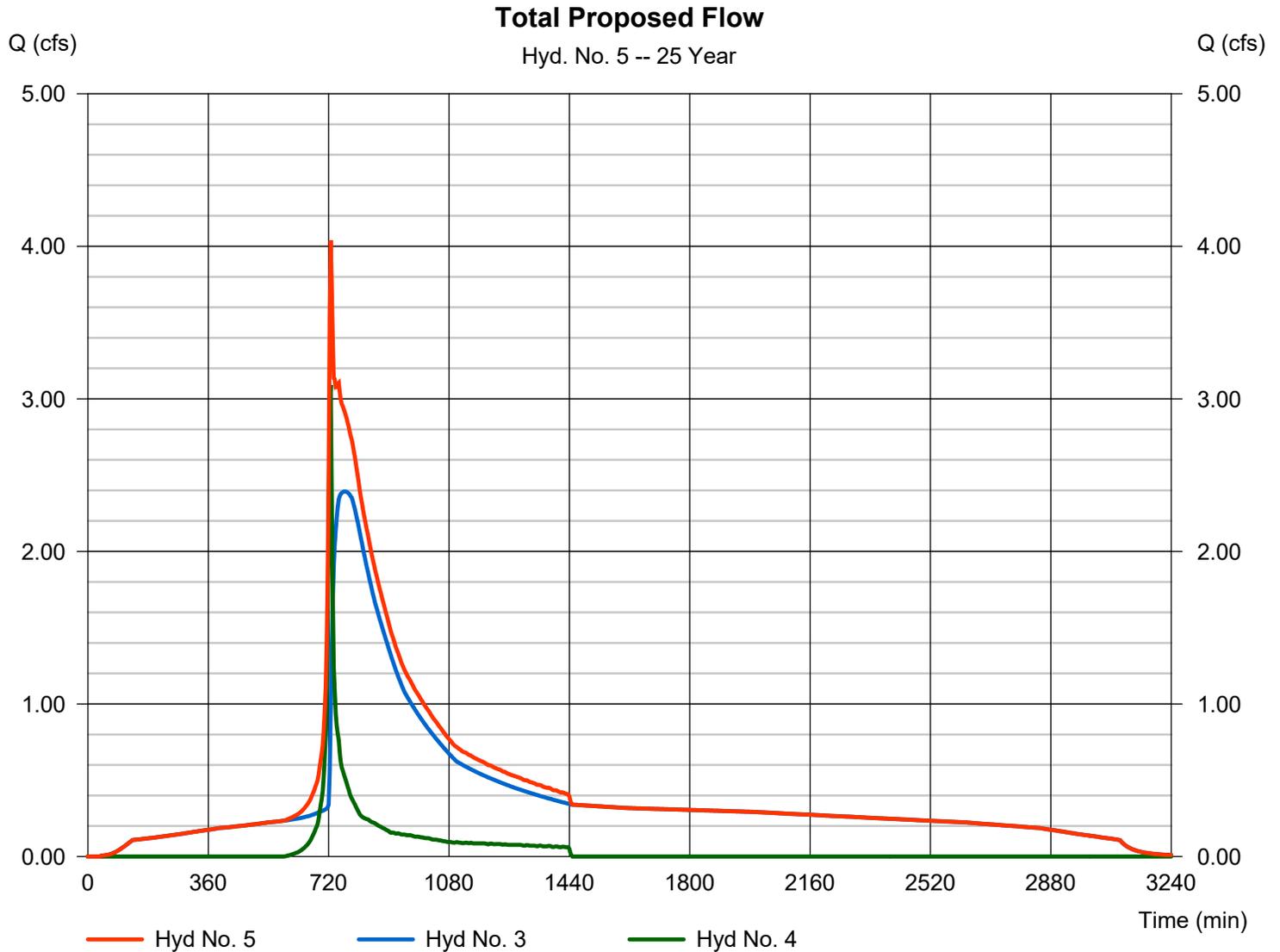
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2019.2

Monday, 04 / 13 / 2020

Hyd. No. 5

Total Proposed Flow

Hydrograph type	= Combine	Peak discharge	= 4.039 cfs
Storm frequency	= 25 yrs	Time to peak	= 726 min
Time interval	= 3 min	Hyd. volume	= 84,190 cuft
Inflow hyds.	= 3, 4	Contrib. drain. area	= 1.310 ac



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	18.66	3	726	63,480	-----	-----	-----	Existing Conditions	
2	SCS Runoff	25.08	3	723	100,267	-----	-----	-----	P-Detention	
3	Reservoir	2.998	3	774	100,267	2	5.28	53,993	R-TURF FIELD	
4	SCS Runoff	5.297	3	726	18,018	-----	-----	-----	P-Uncaptured	
5	Combine	8.005	3	726	118,285	3, 4	-----	-----	Total Proposed Flow	
2020909_Hydraflow_REV1_4-13-20.gpw					Return Period: 100 Year			Monday, 04 / 13 / 2020		

Hydrograph Report

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

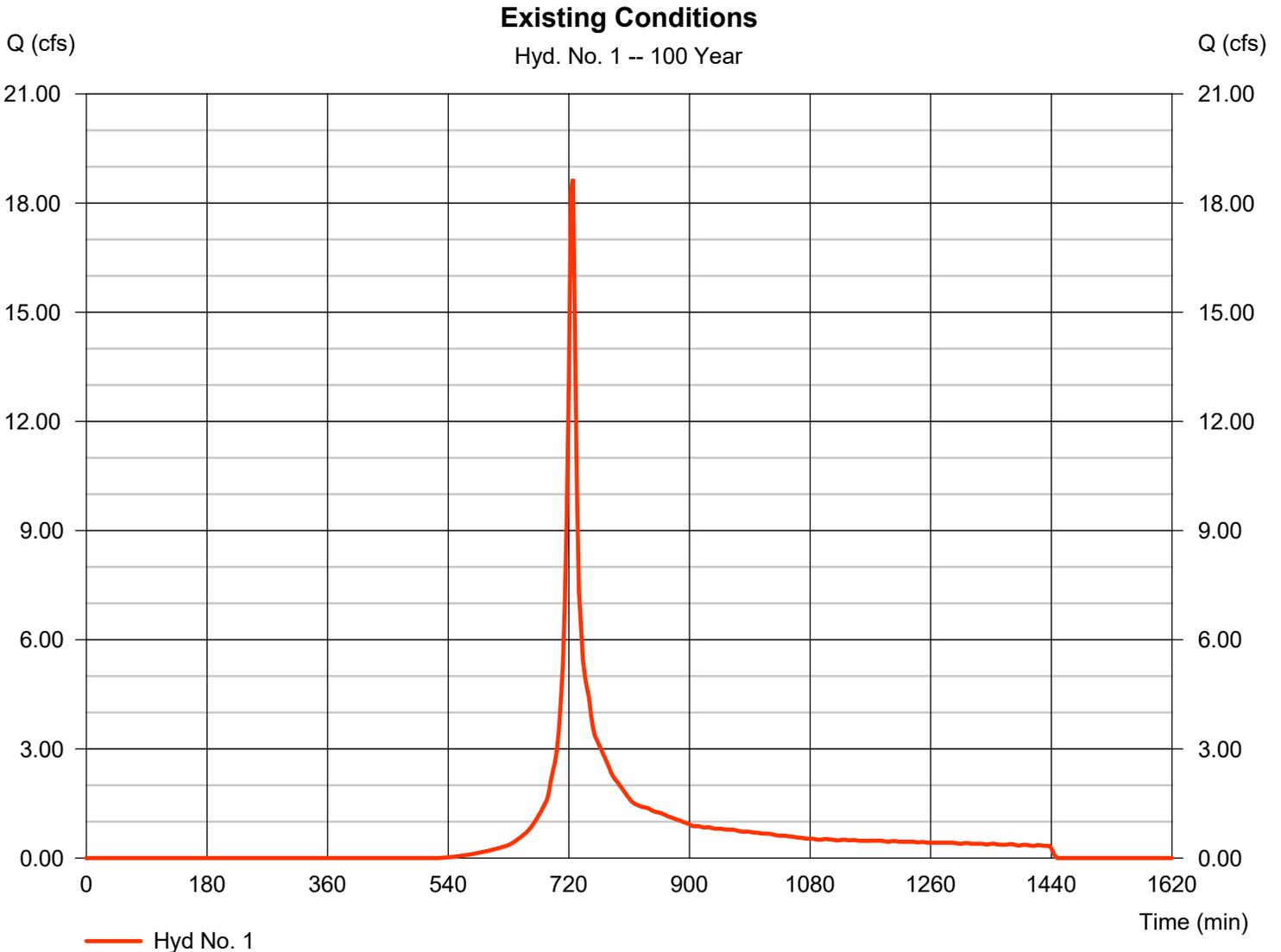
Monday, 04 / 13 / 2020

Hyd. No. 1

Existing Conditions

Hydrograph type	= SCS Runoff	Peak discharge	= 18.66 cfs
Storm frequency	= 100 yrs	Time to peak	= 726 min
Time interval	= 3 min	Hyd. volume	= 63,480 cuft
Drainage area	= 4.900 ac	Curve number	= 61*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 8.47 in	Distribution	= Custom
Storm duration	= P:\200-AE\20200-20299\20209\Shapefile\A		

* Composite (Area/CN) = [(4.890 x 61) + (0.010 x 98)] / 4.900



Precipitation Report

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

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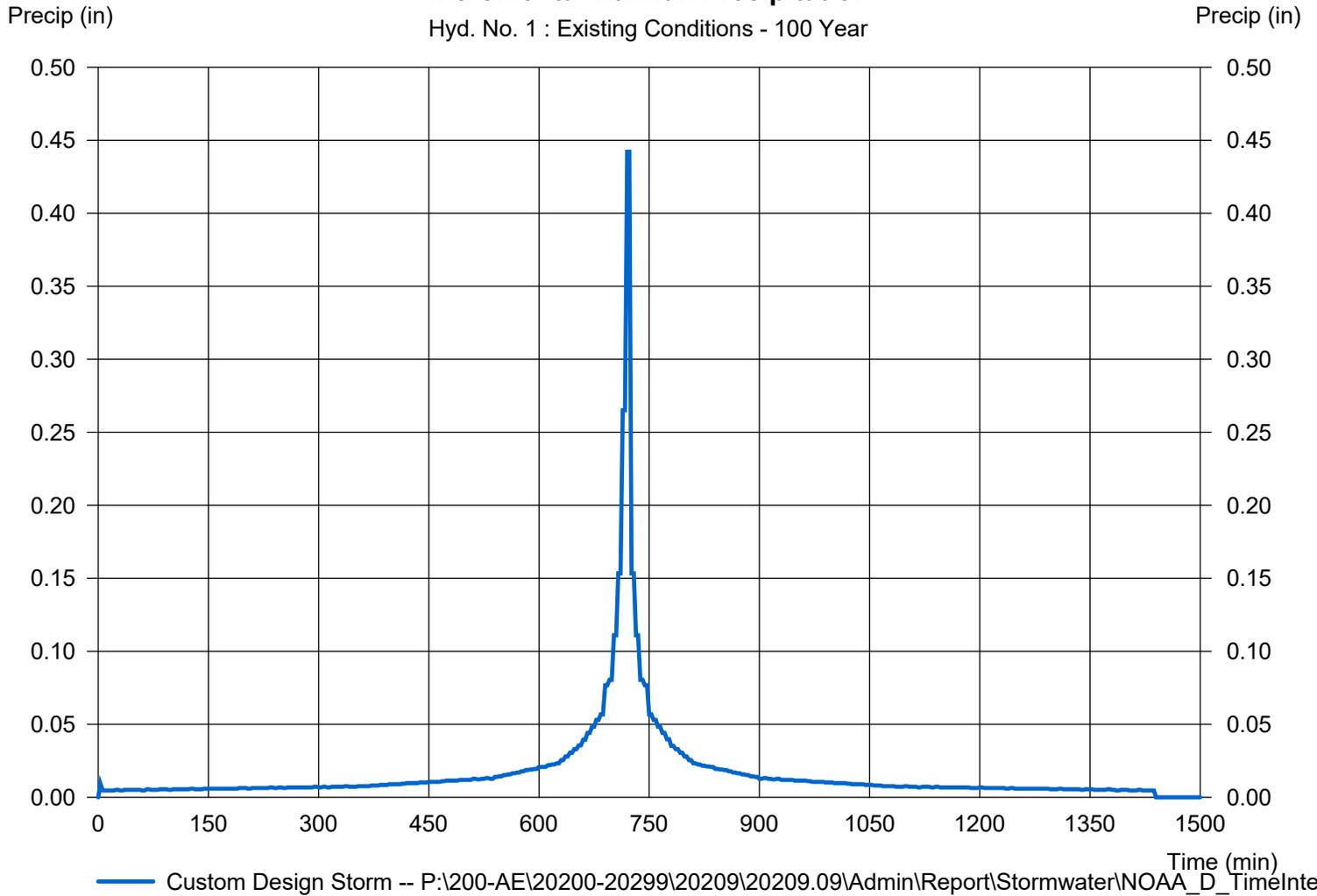
Hyd. No. 1

Existing Conditions

Storm Frequency	= 100 yrs	Time interval	= 3 min
Total precip.	= 8.4700 in	Distribution	= Custom
Storm duration	= P:\200-AE\20200-20299\20209\20209.09\Admin\Report\Stormwater\NOAA_D_T		

Incremental Rainfall Precipitation

Hyd. No. 1 : Existing Conditions - 100 Year



Hydrograph Report

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

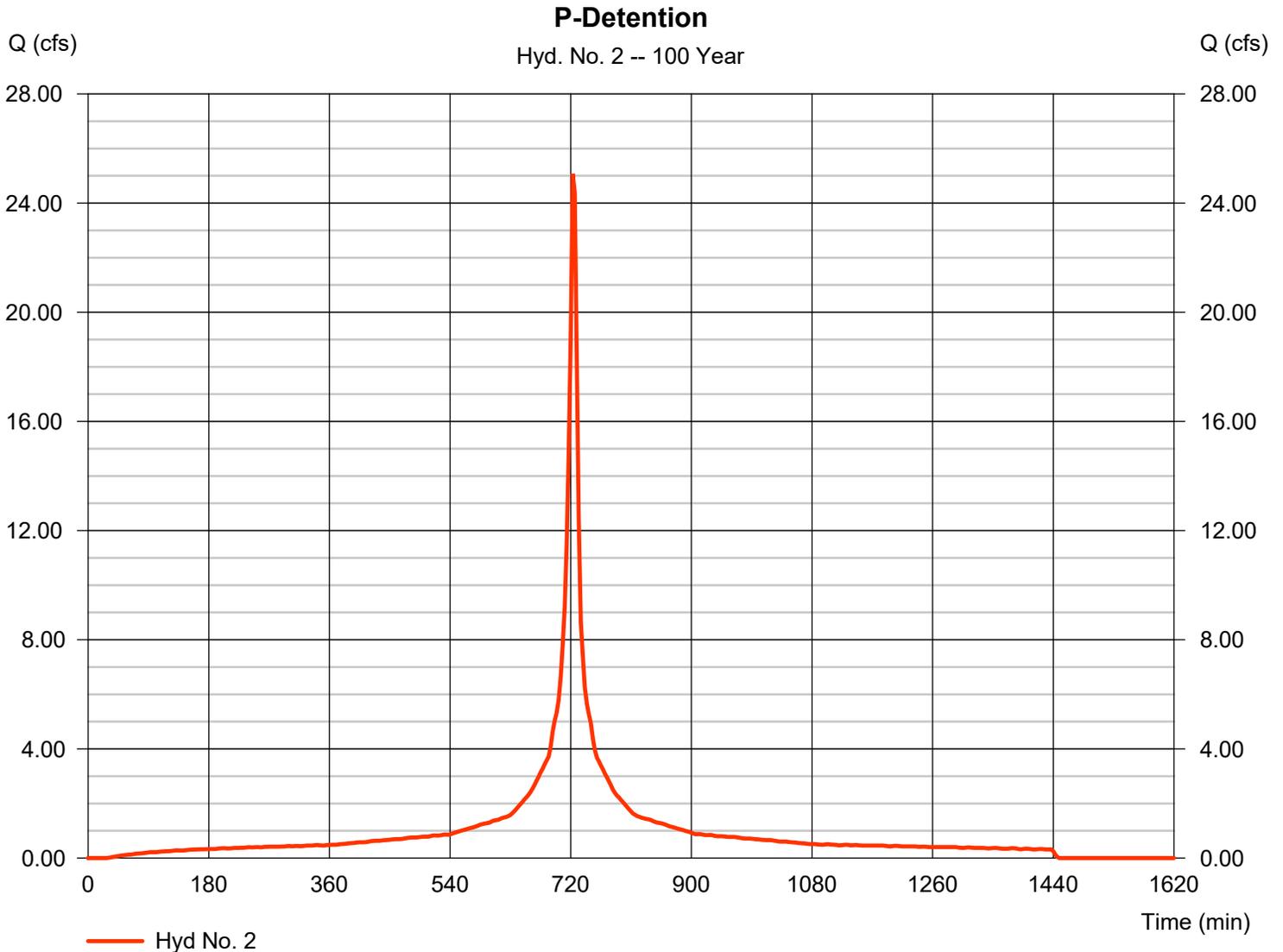
Monday, 04 / 13 / 2020

Hyd. No. 2

P-Detention

Hydrograph type	= SCS Runoff	Peak discharge	= 25.08 cfs
Storm frequency	= 100 yrs	Time to peak	= 723 min
Time interval	= 3 min	Hyd. volume	= 100,267 cuft
Drainage area	= 3.580 ac	Curve number	= 98*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 8.47 in	Distribution	= Custom
Storm duration	= P:\200-AE\20200-20299\20209-Shapefile\Stormwater\NOAA_D_Ti		

* Composite (Area/CN) = [(3.580 x 98)] / 3.580



Precipitation Report

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

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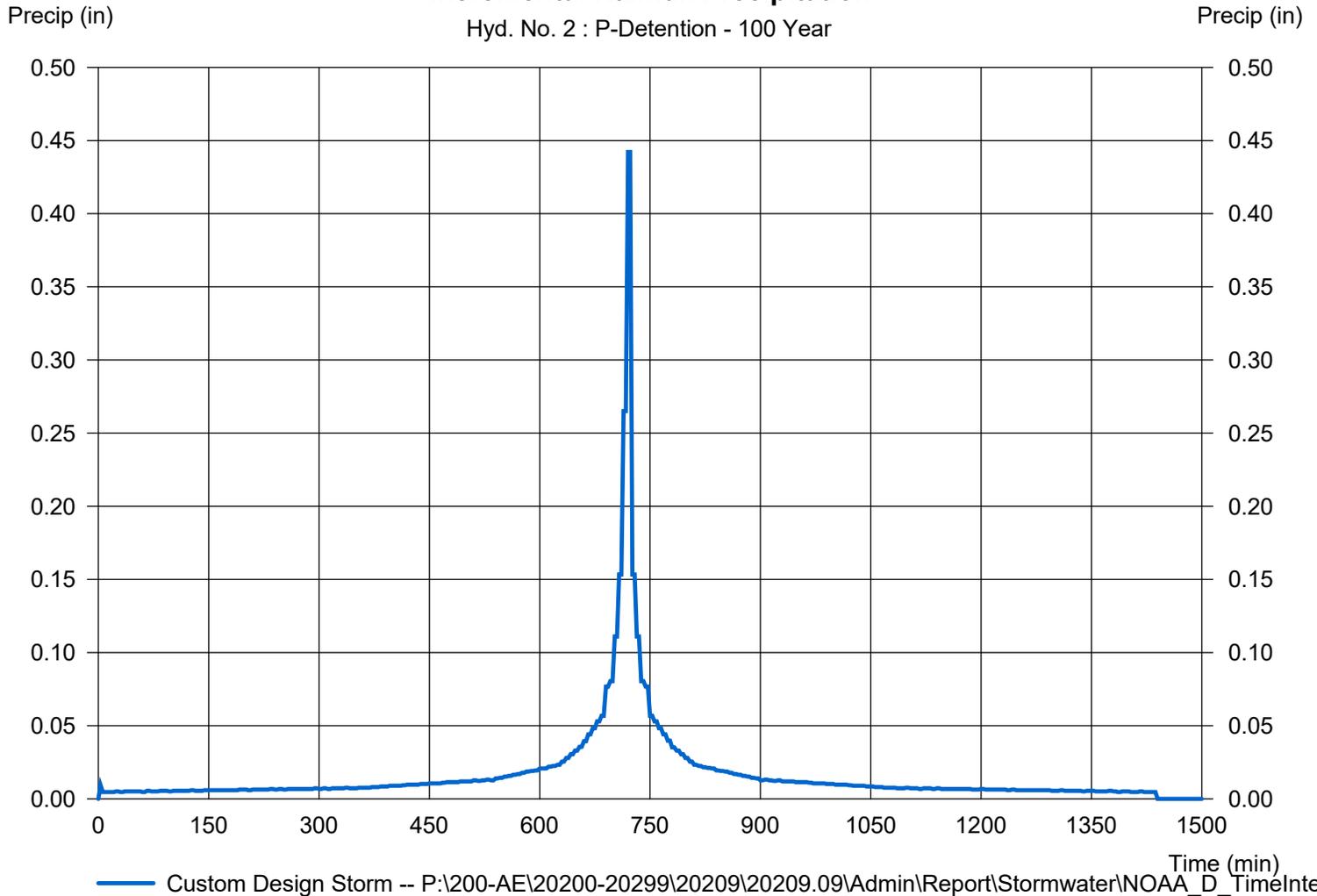
Hyd. No. 2

P-Detention

Storm Frequency	= 100 yrs	Time interval	= 3 min
Total precip.	= 8.4700 in	Distribution	= Custom
Storm duration	= P:\200-AE\20200-20299\20209\20209.09\Admin\Report\Stormwater\NOAA_D_T		

Incremental Rainfall Precipitation

Hyd. No. 2 : P-Detention - 100 Year



Hydrograph Report

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

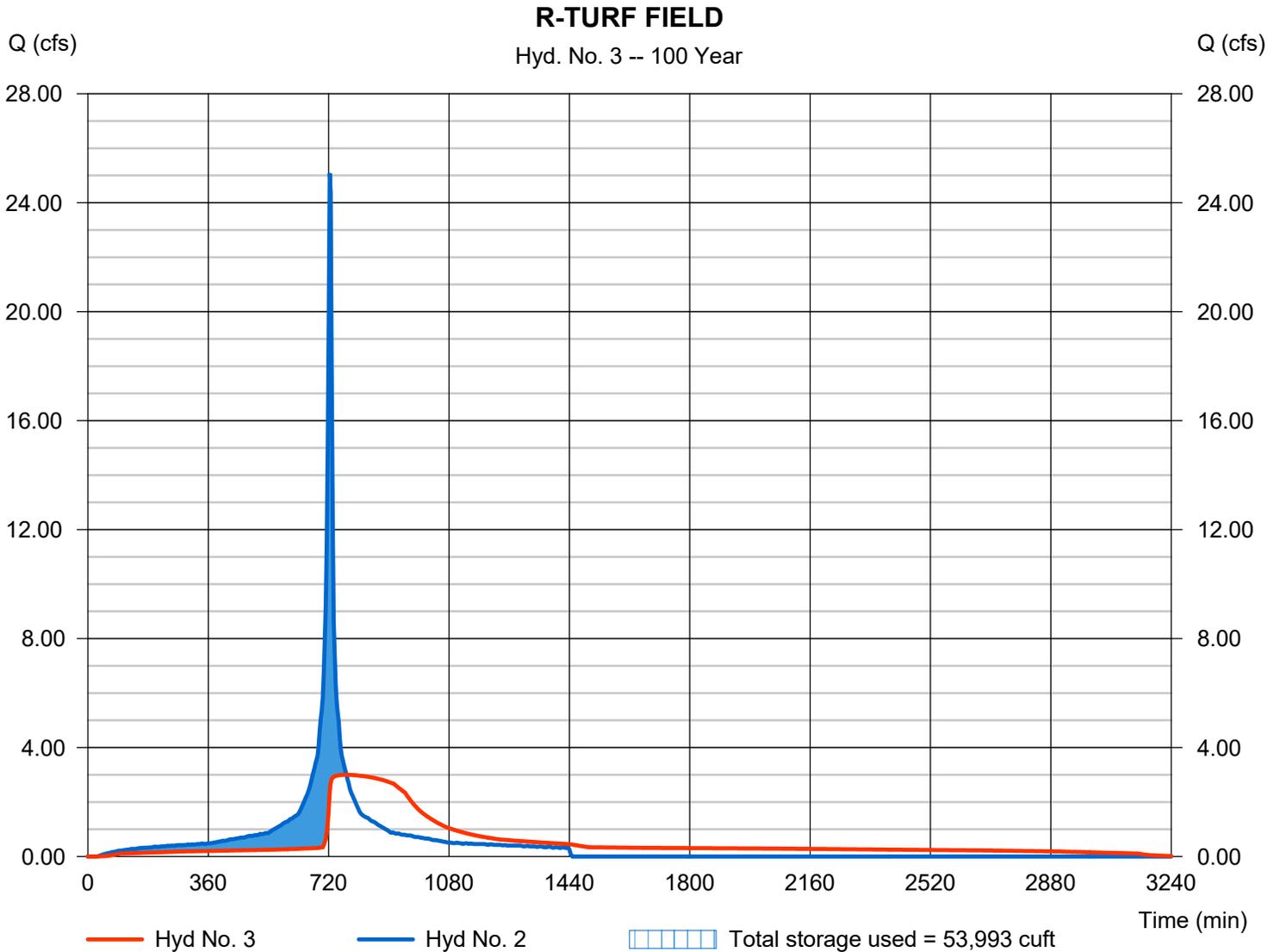
Monday, 04 / 13 / 2020

Hyd. No. 3

R-TURF FIELD

Hydrograph type	= Reservoir	Peak discharge	= 2.998 cfs
Storm frequency	= 100 yrs	Time to peak	= 774 min
Time interval	= 3 min	Hyd. volume	= 100,267 cuft
Inflow hyd. No.	= 2 - P-Detention	Max. Elevation	= 5.28 ft
Reservoir name	= DB - TURF FIELD	Max. Storage	= 53,993 cuft

Storage Indication method used.



Hydrograph Report

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

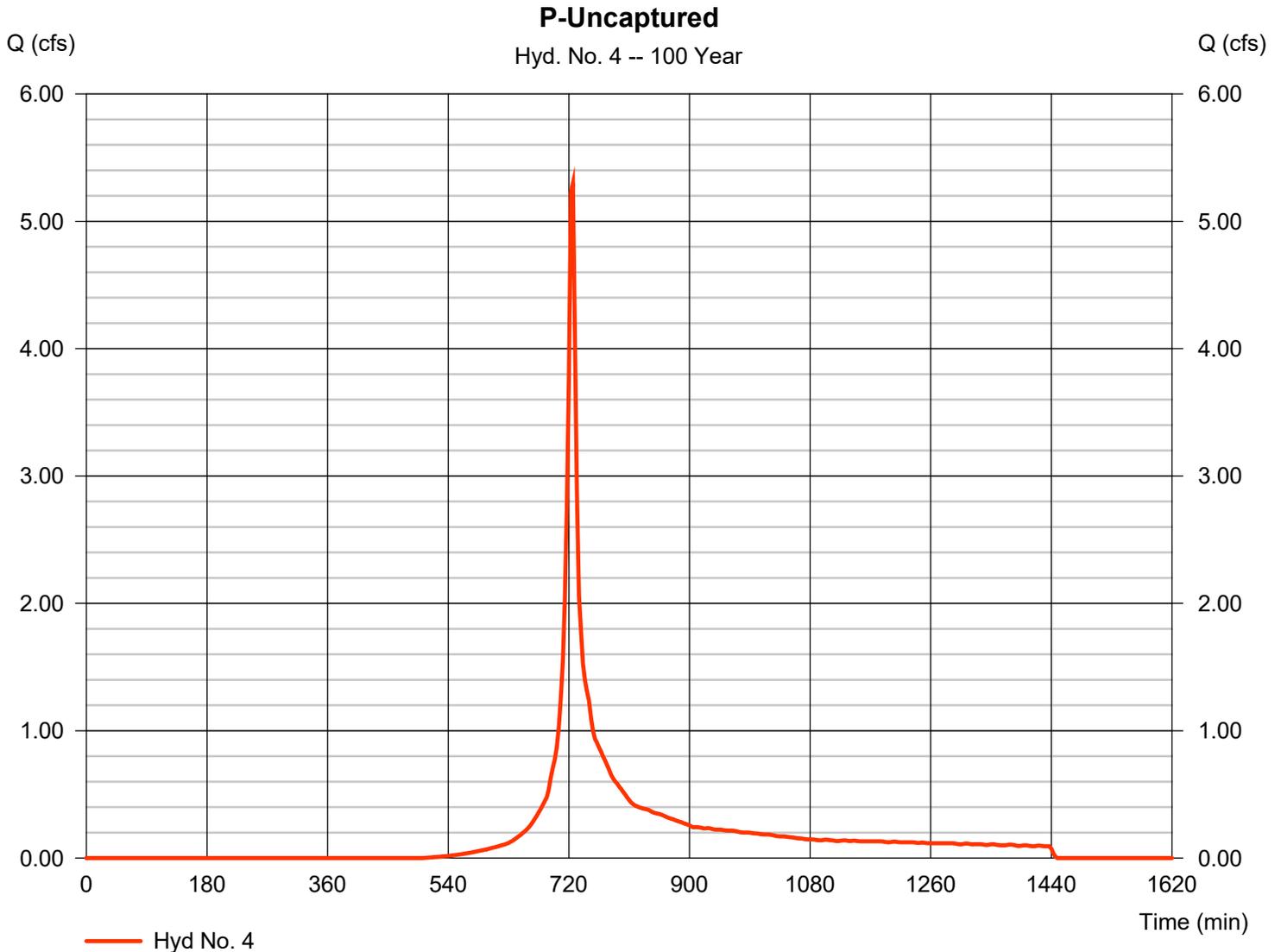
Monday, 04 / 13 / 2020

Hyd. No. 4

P-Uncaptured

Hydrograph type	= SCS Runoff	Peak discharge	= 5.297 cfs
Storm frequency	= 100 yrs	Time to peak	= 726 min
Time interval	= 3 min	Hyd. volume	= 18,018 cuft
Drainage area	= 1.310 ac	Curve number	= 63*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 8.47 in	Distribution	= Custom
Storm duration	= P:\200-AE\20200-20299\20209-Shapefile\Stormwater\NOAA_D_Ti		

* Composite (Area/CN) = [(1.260 x 61) + (0.055 x 98)] / 1.310



Precipitation Report

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

Monday, 04 / 13 / 2020

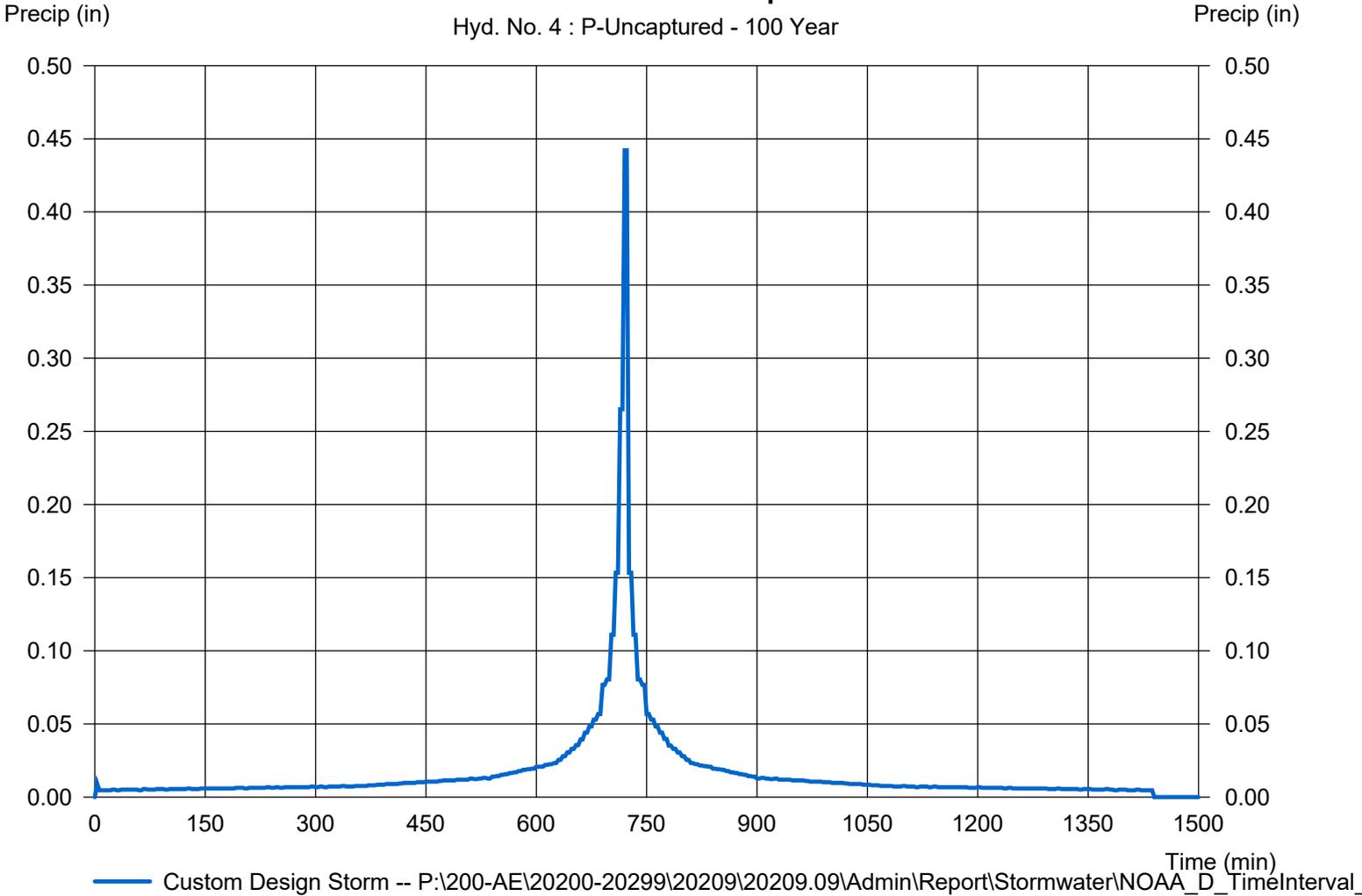
Hyd. No. 4

P-Uncaptured

Storm Frequency	= 100 yrs	Time interval	= 3 min
Total precip.	= 8.4700 in	Distribution	= Custom
Storm duration	= P:\200-AE\20200-20299\20209\20209.09\Admin\Report\Stormwater\NOAA_D_T		

Incremental Rainfall Precipitation

Hyd. No. 4 : P-Uncaptured - 100 Year



Hydrograph Report

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

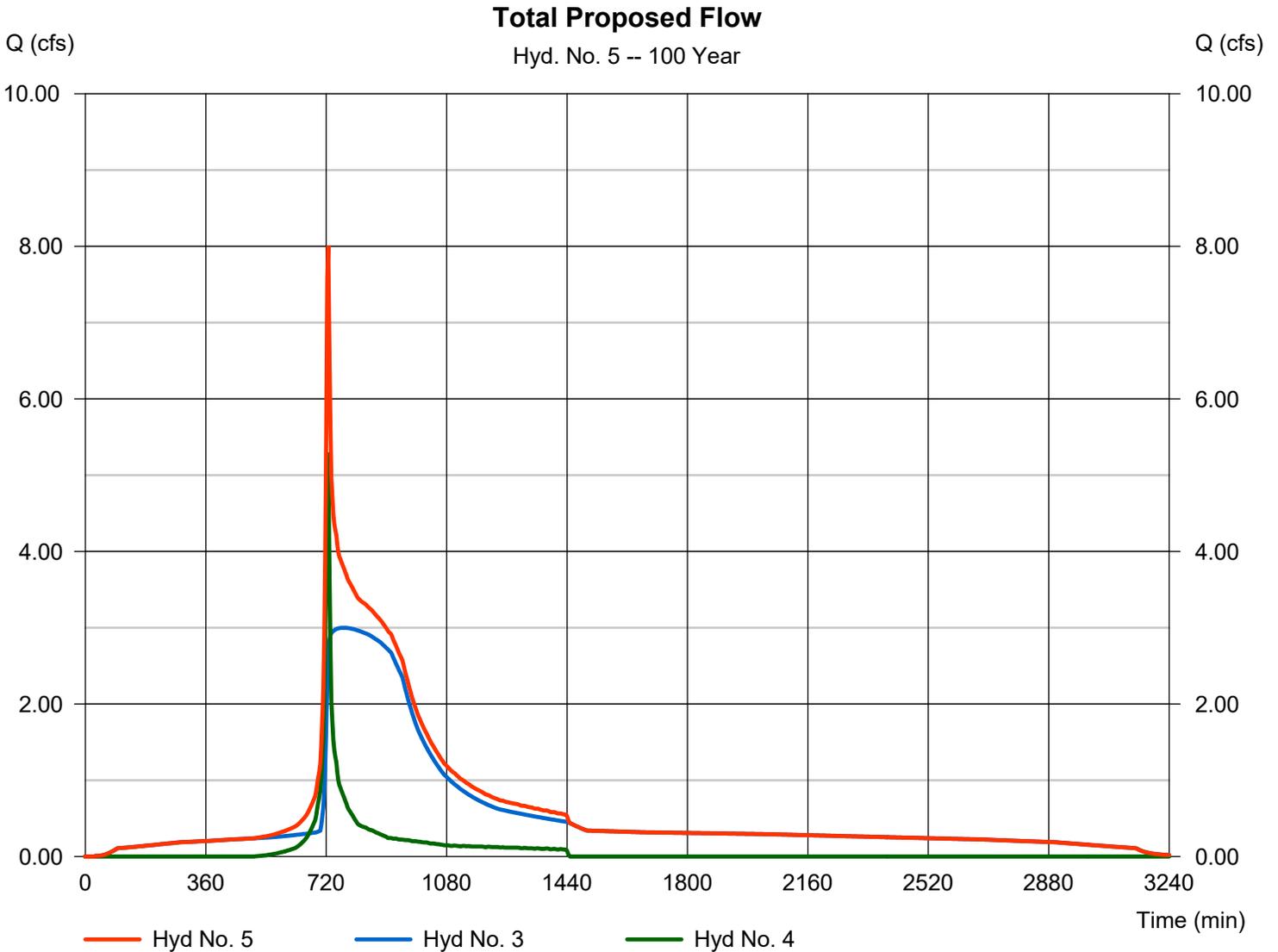
Monday, 04 / 13 / 2020

Hyd. No. 5

Total Proposed Flow

Hydrograph type = Combine
Storm frequency = 100 yrs
Time interval = 3 min
Inflow hyds. = 3, 4

Peak discharge = 8.005 cfs
Time to peak = 726 min
Hyd. volume = 118,285 cuft
Contrib. drain. area = 1.310 ac



Hydraflow Rainfall Report

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

Monday, 04 / 13 / 2020

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	0.0000	0.0000	0.0000	-----
2	69.8703	13.1000	0.8658	-----
3	0.0000	0.0000	0.0000	-----
5	79.2597	14.6000	0.8369	-----
10	88.2351	15.5000	0.8279	-----
25	102.6072	16.5000	0.8217	-----
50	114.8193	17.2000	0.8199	-----
100	127.1596	17.8000	0.8186	-----

File name: SampleFHA.idf

$$\text{Intensity} = B / (T_c + D)^E$$

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	5.69	4.61	3.89	3.38	2.99	2.69	2.44	2.24	2.07	1.93	1.81	1.70
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	6.57	5.43	4.65	4.08	3.65	3.30	3.02	2.79	2.59	2.42	2.27	2.15
10	7.24	6.04	5.21	4.59	4.12	3.74	3.43	3.17	2.95	2.77	2.60	2.46
25	8.25	6.95	6.03	5.34	4.80	4.38	4.02	3.73	3.48	3.26	3.07	2.91
50	9.04	7.65	6.66	5.92	5.34	4.87	4.49	4.16	3.88	3.65	3.44	3.25
100	9.83	8.36	7.30	6.50	5.87	5.36	4.94	4.59	4.29	4.03	3.80	3.60

T_c = time in minutes. Values may exceed 60.

Precip. file name: W:\WORKSHEETS\Worksheets-Civil Eng\HydroFlowStorm Data\Middlesex.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	2.76	3.34	0.00	0.00	5.07	6.28	0.00	8.47
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	2.73	3.34	0.00	0.00	5.07	6.28	0.00	8.47

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