STORM WATER MANAGEMENT REPORT

New King, Inc.
106 & 110 River Road – Lisbon, CT

Prepared For:

New King, Inc.

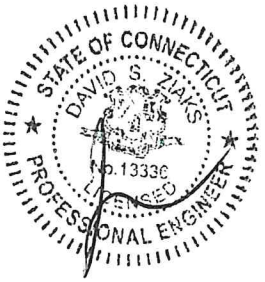
Prepared By:

F. A. Hesketh & Associates, Inc.
3 Creamery Brook
East Granby, CT 06026

F. A. Hesketh
& Associates, Inc.

FAHA # 20110

May 3, 2021



1. Introduction

This storm water management report has been prepared to demonstrate that the storm water management practices for the proposed development meet the requirements of Town of Lisbon Zoning Regulations, attain goal of the CT DEEP 2004 Stormwater Quality Manual (SWQM), follow sound engineering practices, and protect adjacent land owners from adverse storm water impacts.

This report presents hydrologic analysis of both pre- and post-developed conditions to demonstrate that the resulting redevelopment of the parcel will result in a net decrease in peak rate of discharge of runoff from the development.

This report also presents a detailed pipe-to-pipe design analysis to demonstrate that the proposed storm drain systems have adequate capacity to convey runoff for a 25-year return-period storm event.

2. Project Description

The proposed development site is comprised of two lots totaling 5.02-acres, located on the east side of Route 12, River Road, in Lisbon, as depicted on the attached survey map Sheet PTS-1. There is a commercial building and one-car garage located within the property. The proposed development will alter most of the upland portions of the property.

The proposal includes development of a 2,877 S.F. restaurant building and associated site improvements. The proposal includes the construction of 44 paved parking spaces. The proposed development will have access to Route 12, River Road, from dual driveways, one way in and out.

New storm drain collection systems are proposed to handle runoff from the majority of the paved portions of the development. The storm drain systems will consist of catch basins, manholes and flared-end outlets. Stormwater from paved parking area and drive will be discharged into a water quality basin designed to capture and treat the minimum CT DEEP-recommended water quality volume (WQV). Runoff from building rooftops will also be discharged into the storm drain systems and conveyed to the water quality basin. This basin will discharge via catch basin to lower areas on the eastern portion of the development area where discharge will flow to existing grassland.

Sanitary sewer, water service, electric service and telephone/communication services are available along Route 12. Utility services will be extended from Route 12 to serve the proposed use.

3. Hydrologic Analysis

The design of the stormwater management systems for the proposed development is aimed at mitigating total peak rate of runoff and in promoting stormwater cleansing through use of two stormwater quality basins.

Hydrologic analysis was conducted for both the existing condition and the proposed developed condition of the site to determine peak flow of runoff and total volume of runoff, under both conditions. Hydraflow Hydrographs 2007 computer software was utilized in the analysis. Due to the small size of the watershed areas, the Rational Method was used to determine peak flows and total volume of runoff for both the pre- and post-redeveloped conditions. A time of concentration of 10 minutes was assumed in the Hydraflow software for all watersheds being analyzed.

In accordance with CT DOT protocol, rainfall intensity data for the project area is taken from NOAA Atlas 14 data off the NOAA website. A copy of the NOAA rainfall data and the Rainfall Intensity Curve is presented in Attachment 1.

Surficial Soil mapping indicate that existing soil types are Merrimac fine sandy loam and Udorthents-Urban land complex. The Merrimac soils fall under Hydrologic Group A while the Udorthents-Urban soils fall under Hydrologic Group B/D. (See Attachment 2).

Rational Method Runoff Coefficients for the various land-use types are based on the following values (per Tables 6-3 through 6-5 of CT DOT Drainage Manual and Maine DEP Maine Stormwater Management Manual):

- C=0.90 for impervious areas (i.e. rooftops, paved areas, sidewalks, etc.);
- C=0.20 for all landscaped areas; and
- C=0.15 for all wooded areas

Typically, all runoff from the site flows will flow to the easterly end of the property. Runoff along the driveway apron abutting Route 12 will flow back into the roadway.

Existing Conditions Analysis

The entirety of the development presently flows towards the east end of the property, coursing over limited paved areas, landscaped land, undeveloped land and finally to wooded area, some of which is wetland and floodplain soil. Much of the upland site soils have been altered over the years through general excavation, filling or grading. Within the wooded area in the easterly portion of the site, there is an intermittent watercourse that flows to a 24" culvert under the railroad ROW abutting the property. The discharge from that culvert is directed to a swale and wetland system which is tributary to the Quinebaug River.

For purposes of the hydrologic analysis, one watershed was analyzed, Watershed E. Watershed E flows east towards the end of the property and adjoining flood plains. The existing conditions watershed area delineations are depicted on Map DA-1.

Travel times for the existing conditions watershed are calculated using the Rational Method provided in the Hydraflow program. Time of concentration of 10 minutes for Watershed E are calculated by the program for the existing site conditions.

The existing-conditions drainage area map, Map DA-1, shows the existing condition watershed, flow paths, the parameters used for the time of concentration determination and areas of various land-use types. The Hydraflow model calculates the total volume and peak rate of discharge for the existing conditions watershed. Results are summarized on Table 1.

Proposed Conditions Analysis

The post-developed contribution areas that are modeled are substantially the same as those of the existing site conditions. All runoff from the site will continue to flow either east to the flood plain, with a small portion draining west to Route 12. Developed portions of the watershed, however, will be captured and detained by the proposed water quality basin. Un-detained areas will continue to flow east as they do under the existing site conditions. The model combines the flow from both the un-detained watersheds and the outflow from the water quality basins (detained areas) to provide the post-developed condition total flows from the developed area of the site.

For the proposed-condition watersheds, the times of concentration were also calculated using the Rational Method provided in the Hydraflow program. For the proposed-condition, un-detained area that flows to the east, the time of concentration is determined to be 10 minutes. For the proposed-condition, un-detained area that flows to the west, the time of concentration is determined to be 5 minutes. For runoff directed into the water quality basin, the time of concentration is determined to be 10 minutes.

The stage-storage relationships for the water quality basin is calculated by the model using the conical method by inputting the elevation and area of contours within the basin. Contour areas are determined by polyline delineations in the AutoCAD drawings.

The stage-discharge relationship for the basin outlet is modeled by the program, following input of the outlet geometry. For the water quality basin, the outlet structure will consist of CT DOT Type 'C-L', Grate Type 1, catch basin with standard frame and grates modeled as overflow risers.

Stage-Storage and Stage-Discharge relationships for the water quality basin is presented in the model input/output, which is included as Attachment 3.

The basin is designed to act as a dry basin. An underdrain on the bottom of the basin is proposed and designed to lower the water elevation in the basin to provide significant storage volume at the on-set of a storm event. The basin is sized to detain the peak volume of runoff for all storm events for the 2- through 100-year return periods. There are no orifices or weirs in the outlet structure, only the frame and grate at the top of the structure. During extremely intense rainfalls, the basin would be anticipated to fill and stormwater exit through the grate of the outlet structure. The basin is sized to capture and detain 100 percent of the volume of all modeled storm events from the 2- through 10-year event. It is assumed that between storm events, the accumulated stormwater would infiltrate into the underlying underdrain and the basin would be empty at the start of the next storm event.

The Hydraflow model calculates the peak rate of discharge for the proposed development conditions by combining the outflow hydrographs from both the un-detained watersheds and the outflow from the basin. Both un-detained watersheds and the peak rates of inflow and outflow for each basin were modeled for the 2-, 5-, 10-, 25-, 50- and 100-year storm events by the program. To be conservative, infiltration and discharge via the proposed underdrains was not modeled in the exercise. It is assumed that during the storm event, no infiltration takes place in the basin, but that between storm events, water would drain from the basin via the underdrains, to render the basin empty at the start of the subsequent storm.

The data shows that there is no increase in the peak rate of runoff to either the east or to the west as a result of the proposed development. Results of analysis are presented in Attachment 3 and total peak flows of on-site runoff generated are summarized in Table 1.

The analysis indicates that there is no increase in peak rate of flow from the proposed site development for all storm events modeled to either of the design points or the site as a whole.

Town Regulations require the detention facilities to be designed to handle storm frequencies from the 2 to 100-year frequency. The detention facilities proposed handle up to and including the 100-year event with a total of one foot of freeboard in the basin.

In conclusion, there will be no negative impacts downstream from the stormwater discharge from the proposed project. Peak rates of runoff will be attenuated to below the rates generated under existing conditions and water quality treatment will be accomplished by the proposed water quality basin.

TABLE 1

Peak Rates and
Total Volume of Runoff
Existing vs. Proposed Conditions

Return Period (years)	EXISTING CONDITIONS	PROPOSED CONDITIONS		
	Peak Rate of Flow (CFS)	Peak Rate of Flow (CFS)		
	WS-E	WS-P-W-UND	WS-P-E-UND	WS-P-Combined
2-Yr	2.4	0.2	0.5	1.5
5-Yr	3.1	0.3	0.6	1.8
10-Yr	3.7	0.3	0.7	1.9
25-Yr	4.4	0.4	0.9	2.1
50-Yr	5.0	0.4	1.0	2.3
100-Yr	5.6	0.5	1.1	2.4

4. Pipe to Pipe Design Analysis

The proposed development will employ a storm drain system, which is depicted on the Grading & Utility Plan in the submittal set. The storm drains proposed to convey the runoff have been designed to handle the peak flow for a 25-year storm event. To design and analyze the system, a detailed, pipe to pipe analysis was conducted using Hydraflow Storm Sewers Extension (2008) for Windows software. This software uses the Rational Method and Manning's Formula to compute peak flow to each basin, and to calculate the capacity of individual pipes.

Input data includes the geometry and configuration of the storm drain system, catchment area of the inlet, weighted runoff coefficients, and time to inlet. The catchment areas are calculated based on proposed topography utilizing polyline delineations in AutoCAD. The catchment areas are depicted graphically on Map DA-3.

A weighted runoff coefficient is calculated based on percentages of landscaped and impervious areas within the catchment area. The following runoff coefficients are used in the post-development conditions hydrologic model: For impervious areas, C=0.9 is used, for landscaped areas, C=0.20 is used, and for wooded areas, C=0.15 is used.

Times to inlet were all assumed to be five minutes for catchment areas that are

primarily paved. A Manning roughness coefficient of 0.015 was used for the reinforced concrete pipe analyzed. Rainfall intensity data was taken from NOAA Atlas 14 rates off the NOAA website for the project area. A copy of the Rainfall Intensity Curve is presented in Attachment 1.

The model calculates the capacity of the pipe and accounts for loss coefficients at inlet and outlet controls, whichever governs. Input data includes basin geometry, longitudinal slope, cross slope, and basin depression. State of CT DOT 'Type-C' basins or 'Type C-L' drains were modeled for the basin, as appropriate.

As indicated in the stage/discharge graphic attached below, the 100-year storm has a peak flow rate of 7.6 cfs. This peak flow is more than sufficient to accommodate for 1 foot below the berm of the detention basin.

Results of analysis are attached and include summaries of system design based on CT DOT output formats. Program input and output data reports are presented in Attachment 4.

The analysis indicates that the storm drain piping is designed to adequately convey the 25-year storm event and that the outfall piping from the WQ Basin can adequately convey the inflow from a 100-year storm event.

5. Water Quality Volume Computations

In accordance with Chapter 7 of the 2004 Stormwater Quality Manual, the water quality basin has to be designed to capture and treat the minimum water quality volume.

One water quality basin is proposed as part of the stormwater management of the site runoff. The basin is designed to capture and treat more than the minimum required Water Quality Volume (WQV) recommended by the 2004 Connecticut Stormwater Quality Manual. (see Section 7.4.1 of the Manual). WQV calculations for each Water Quality Basin are provided below, using the DEP formula:

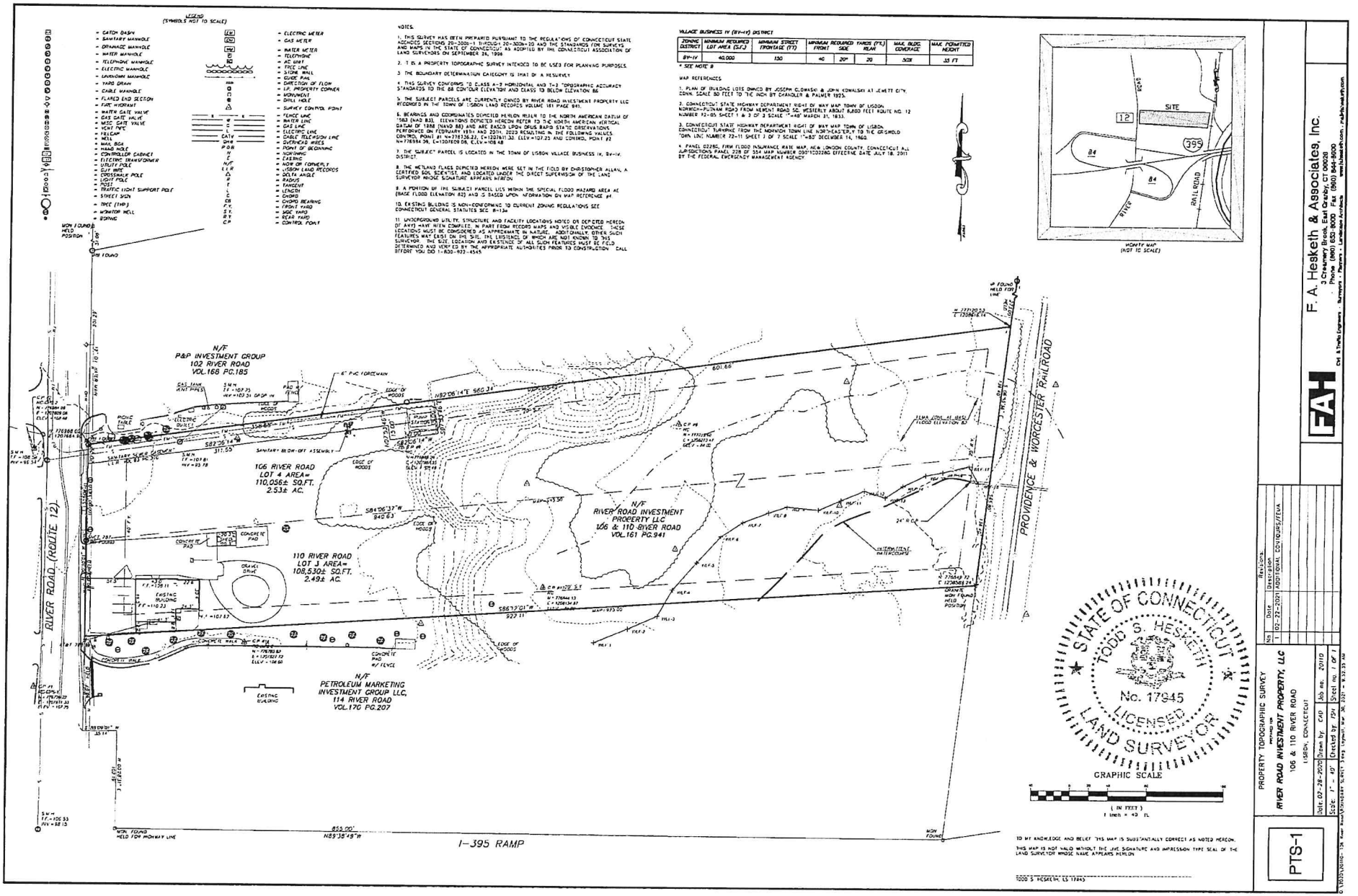
Water Quality Volume:

Water Quality Volume recommended: WQV = [(1")(R)(A)] / 12

WQV	= Water Quality Volume
R	= Vol. runoff coefficient = 0.05+0.009 * (I)
I	= percent impervious cover
A	= site area in acres

Calculations for determining the minimum-recommended WQV and demonstrating that more than the minimum-recommended WQV is provided are included in Attachment 6.

For Watershed WS-P-E-DET, the minimum WQV recommended is 3,217 cubic feet. WQB#1 captures and treats 4,241 cubic feet of volume, or almost 1.3 times the minimum recommended.



TO MY KNOWLEDGE AND BELIEF THIS MAP IS SUBSTANTIALLY CORRECT AS NOTED HEREON.

THIS MAP IS NOT VALID WITHOUT THE LIVE SIGNATURE AND IMPRESSION TYPE SEAL OF THE LAND SURVEYOR WHOSE NAME APPEARS HEREON

TODD S. HESKETH, LS 17945

No.	Date	Revisions
1	02-22-2021	ADDITIONAL CONTOURS/FEMA

PROPERTY TOPOGRAPHIC SURVEY
RIVER ROAD INVESTMENT PROPERTY, LLC
106 & 110 RIVER ROAD
LISBON, CONNECTICUT

Date: 07-28-2020 | Drawn by: CAD | Job no.: 20110
Scale: 1" = 40' | Directed by: TSH | Sheet no.: 1 OF 1

PTS-1

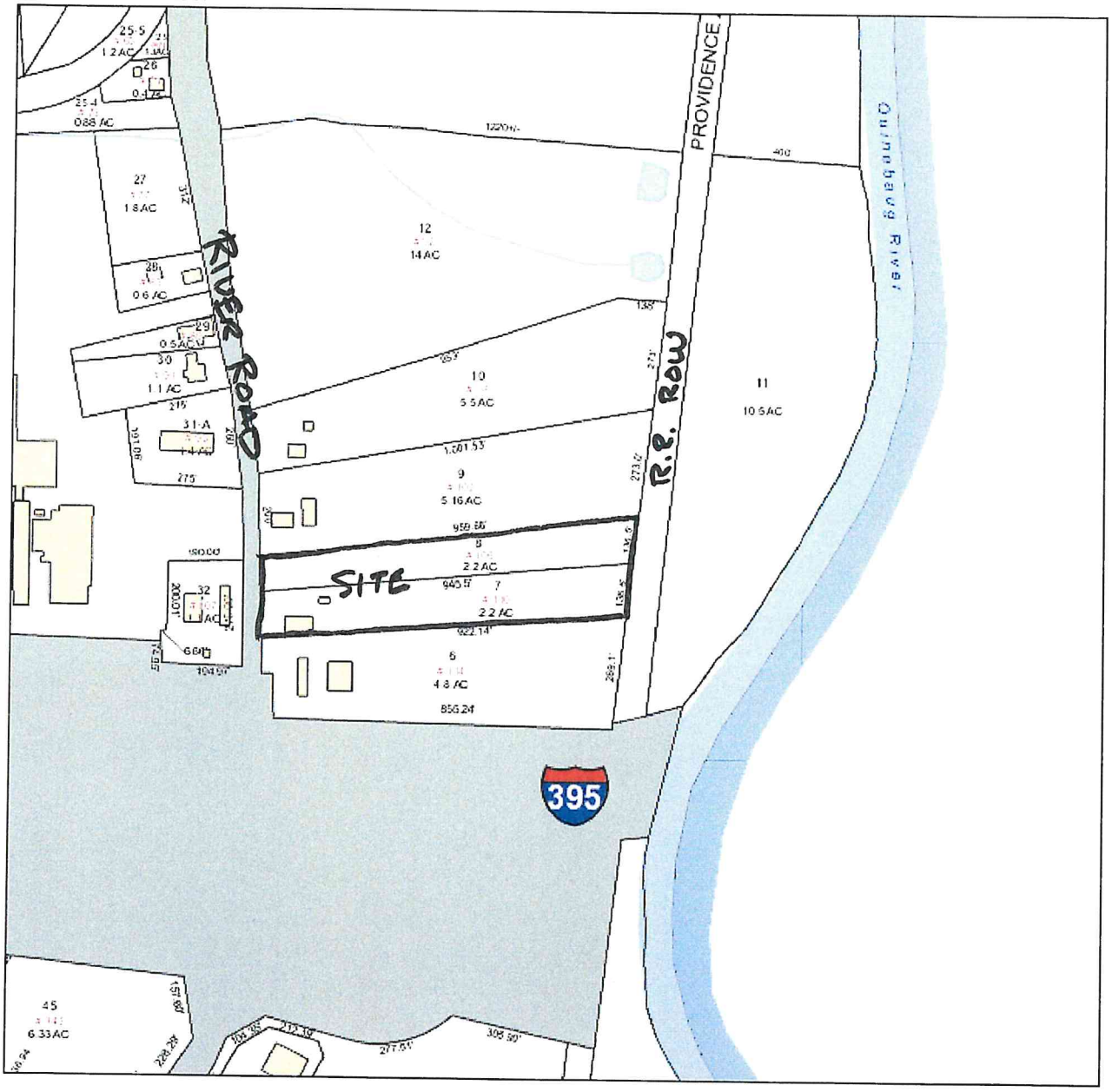
F. A. Hesketh & Associates, Inc.
3 Creamery Brook, East Granby, CT 06026
Phone (860) 653-8000 Fax (860) 844-8000 www.fahesketh.com
Civil & Trestle Engineers - Surveyors - Land Use Consultants

G:\2020\20110 - 106 River Road\SURVEY\20110 Layout.dwg Jul 30, 2021 - 9:33:33 AM

Town of Lisbon

Geographic Information System (GIS)

Date Printed: 5/11/2021



MAP DISCLAIMER - NOTICE OF LIABILITY

This map is for assessment purposes only. It is not for legal description or conveyances. All information is subject to verification by any user. The Town of Lisbon and its mapping contractors assume no legal responsibility for the information contained herein.

Approximate Scale: 1 inch = 400 feet

0 400 Feet

N W E S

WATERSHED AREAS (ACRES)

LANDSCAPE (C=0.20)	IMPERVIOUS (C=.90)	GRAVEL (C=0.60)	WOODS (C=0.15)
56,032 S.F. (1.29 Ac.)	12,906 S.F. (0.30 Ac.)	2,841 S.F. (0.07 Ac.)	36,303 S.F. (0.83 Ac.)

DA-1

EXISTING-CONDITIONS DRAINAGE PLAN

PREPARED FOR

NEW KING INC.

106-110 RIVER ROAD

LISBON, CONNECTICUT

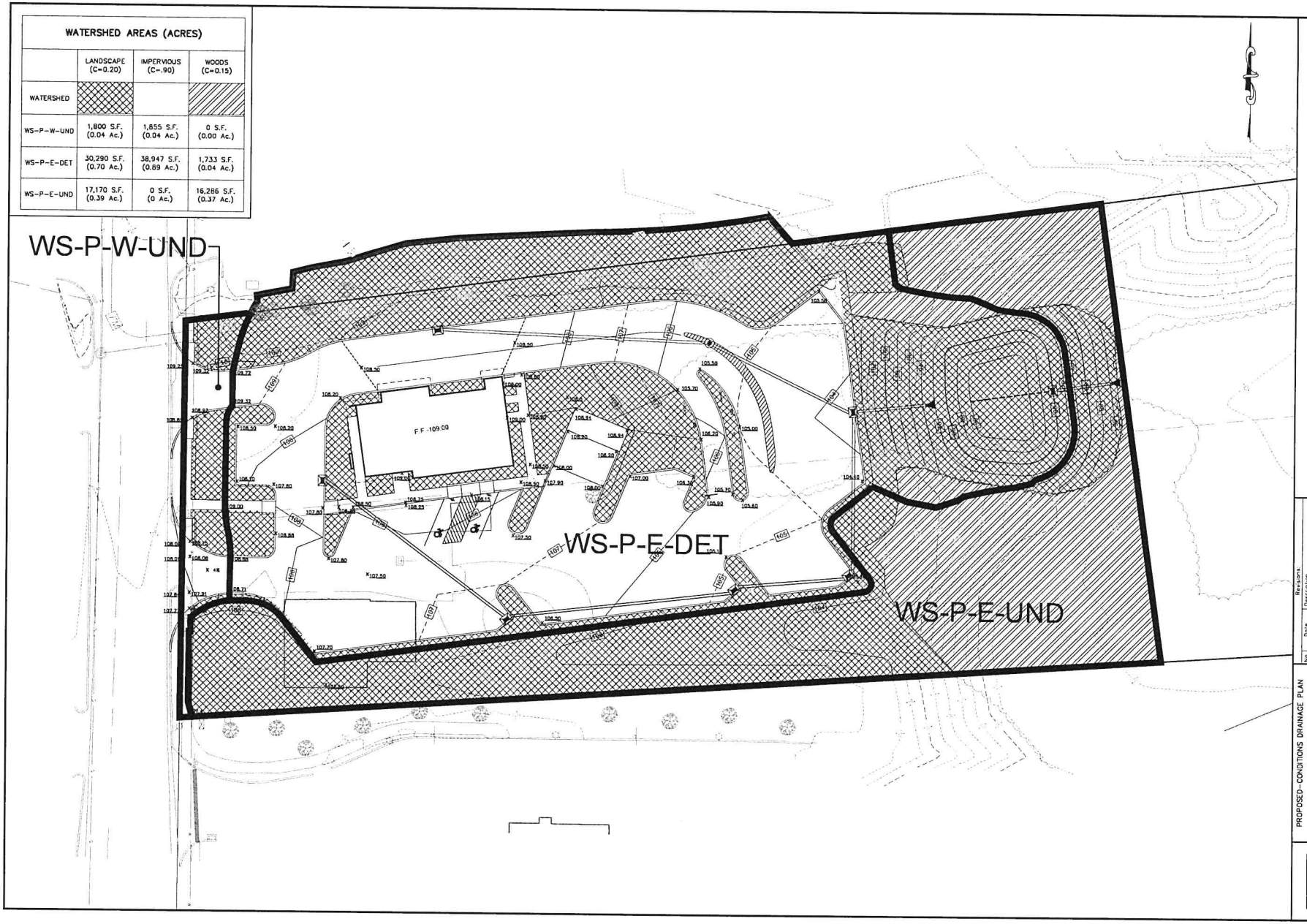
Date: 03-15-2021 | Drawn by: ERN | Job no: 20110

Scale: 1" = 20' | Checked by: DSZ | Sheet no. 1 OF 1

Revisions		
No.	Date	Description

F. A. Hesketh & Associates, Inc.
3 Creamery Brook, East Granby, CT 06026
Phone (860) 653-8000 Fax (860) 844-8600
Civil & Traffic Engineers · Surveyors · Planners · Landscape Architects www.fahesketh.com · mail@fahesketh.com

WATERSHED AREAS (ACRES)			
	LANDSCAPE (C=0.20)	IMPERVIOUS (C=.90)	WOODS (C=0.15)
WATERSHED			
WS-P-W-UND	1,800 S.F. (0.04 Ac.)	1,855 S.F. (0.04 Ac.)	0 S.F. (0.00 Ac.)
WS-P-E-DET	30,290 S.F. (0.70 Ac.)	38,947 S.F. (0.89 Ac.)	1,733 S.F. (0.04 Ac.)
WS-P-E-UND	17,170 S.F. (0.39 Ac.)	0 S.F. (0 Ac.)	16,286 S.F. (0.37 Ac.)



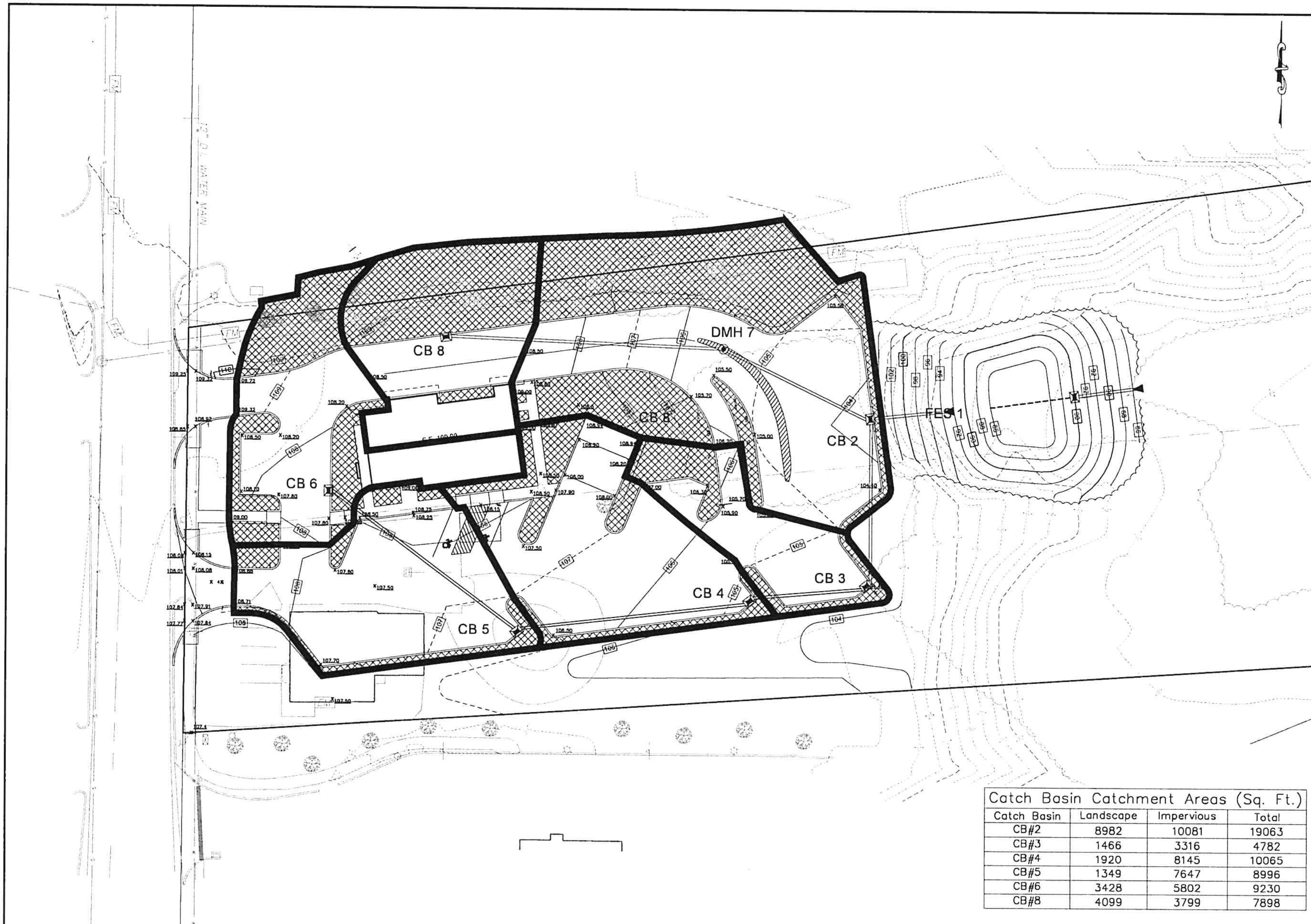
F. A. Hesketh & Associates, Inc.
3 Creamery Brook, East Granby, CT 06026
Phone (860) 653-8000 Fax (860) 844-8600
Civil & Traffic Engineers - Surveyors - Planners - Landscape Architects www.fahesketh.com - mail@fahesketh.com

No	Date	Revisions Description

PROPOSED CONDITIONS DRAINAGE PLAN
prepared for
NEW KING INC.
106-110 RIVER ROAD
LISBON, CONNECTICUT

Date 03-15-2021 | Drawn by ERV | Job no. 20110
Scale 1" = 20' | Checked by DSZ | Sheet no. 1 OF 1

DA-2



Catch Basin Catchment Areas (Sq. Ft.)			
Catch Basin	Landscape	Impervious	Total
CB#2	8982	10081	19063
CB#3	1466	3316	4782
CB#4	1920	8145	10065
CB#5	1349	7647	8996
CB#6	3428	5802	9230
CB#8	4099	3799	7898

DRAINAGE ANALYSIS PLAN

PREPARED FOR

NEW KING INC.

106-110 RIVER ROAD

LISBON, CONNECTICUT

Date: 03-15-2021 | Drawn by: ERN | Job no: 20110

Scale: 1" = 20' | Checked by: DSZ | Sheet no. 1 OF 1

DA-3

Revisions

No	Date	Description

F. A. Hesketh & Associates, Inc.
3 Creamery Brook, East Granby, CT 06026
Phone (860) 653-8000 Fax (860) 844-8600
Civil & Traffic Engineers · Surveyors · Planners · Landscape Architects
www.faHesketh.com · mail@faHesketh.com

Attachment 1

NOAA Rainfall Data
And
Rainfall Intensity Curve

NOAA Atlas 14, Volume 10, Version 3
Location name: Jewett City, Connecticut, USA*
Latitude: 41.5906°, Longitude: -71.9906°
Elevation: 111.26 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sandra Pavlovic, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Orlan Wilhite

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	0.331 (0.256-0.422)	0.397 (0.308-0.508)	0.505 (0.391-0.647)	0.596 (0.458-0.767)	0.720 (0.536-0.957)	0.814 (0.593-1.10)	0.912 (0.646-1.27)	1.02 (0.687-1.44)	1.18 (0.762-1.70)	1.30 (0.825-1.91)
10-min	0.468 (0.363-0.598)	0.563 (0.436-0.719)	0.717 (0.553-0.919)	0.845 (0.649-1.09)	1.02 (0.759-1.36)	1.15 (0.841-1.56)	1.29 (0.916-1.79)	1.45 (0.974-2.04)	1.67 (1.08-2.41)	1.85 (1.17-2.71)
15-min	0.551 (0.427-0.704)	0.662 (0.513-0.846)	0.843 (0.651-1.08)	0.994 (0.763-1.28)	1.20 (0.893-1.60)	1.36 (0.990-1.83)	1.52 (1.08-2.11)	1.70 (1.15-2.39)	1.96 (1.27-2.83)	2.17 (1.38-3.19)
30-min	0.766 (0.594-0.978)	0.921 (0.713-1.18)	1.17 (0.907-1.50)	1.38 (1.06-1.78)	1.67 (1.24-2.22)	1.89 (1.38-2.55)	2.12 (1.50-2.94)	2.37 (1.59-3.33)	2.73 (1.77-3.94)	3.03 (1.92-4.43)
60-min	0.981 (0.761-1.25)	1.18 (0.914-1.51)	1.50 (1.16-1.92)	1.77 (1.36-2.28)	2.14 (1.59-2.85)	2.42 (1.76-3.27)	2.71 (1.92-3.76)	3.04 (2.04-4.27)	3.50 (2.27-5.05)	3.88 (2.46-5.69)
2-hr	1.28 (0.995-1.62)	1.53 (1.19-1.94)	1.95 (1.51-2.48)	2.29 (1.77-2.93)	2.77 (2.07-3.66)	3.12 (2.29-4.20)	3.50 (2.50-4.85)	3.93 (2.66-5.50)	4.57 (2.97-6.55)	5.10 (3.24-7.42)
3-hr	1.48 (1.16-1.87)	1.77 (1.39-2.24)	2.25 (1.75-2.85)	2.65 (2.05-3.37)	3.20 (2.40-4.21)	3.60 (2.65-4.83)	4.04 (2.90-5.58)	4.54 (3.07-6.33)	5.29 (3.44-7.55)	5.91 (3.76-8.57)
6-hr	1.90 (1.49-2.38)	2.27 (1.78-2.85)	2.87 (2.25-3.61)	3.36 (2.62-4.25)	4.05 (3.06-5.30)	4.56 (3.38-6.07)	5.11 (3.68-7.01)	5.74 (3.90-7.94)	6.68 (4.36-9.48)	7.46 (4.76-10.8)
12-hr	2.39 (1.89-2.98)	2.84 (2.25-3.55)	3.59 (2.83-4.49)	4.20 (3.29-5.28)	5.05 (3.83-6.56)	5.68 (4.23-7.51)	6.36 (4.60-8.65)	7.13 (4.87-9.80)	8.27 (5.42-11.7)	9.22 (5.90-13.2)
24-hr	2.84 (2.26-3.52)	3.39 (2.70-4.21)	4.29 (3.40-5.34)	5.04 (3.97-6.30)	6.08 (4.64-7.85)	6.85 (5.12-8.99)	7.67 (5.57-10.4)	8.62 (5.90-11.8)	10.0 (6.59-14.0)	11.2 (7.18-15.9)
2-day	3.19 (2.56-3.93)	3.85 (3.08-4.74)	4.92 (3.92-6.08)	5.81 (4.60-7.21)	7.04 (5.40-9.04)	7.95 (5.98-10.4)	8.92 (6.53-12.0)	10.1 (6.93-13.7)	11.8 (7.80-16.4)	13.3 (8.56-18.7)
3-day	3.46 (2.78-4.25)	4.17 (3.35-5.12)	5.33 (4.27-6.56)	6.30 (5.01-7.78)	7.62 (5.87-9.77)	8.61 (6.50-11.2)	9.67 (7.11-13.0)	10.9 (7.53-14.8)	12.8 (8.50-17.8)	14.5 (9.34-20.3)
4-day	3.71 (2.99-4.54)	4.46 (3.59-5.46)	5.69 (4.56-6.98)	6.70 (5.34-8.26)	8.10 (6.26-10.4)	9.14 (6.92-11.9)	10.3 (7.56-13.8)	11.6 (8.00-15.6)	13.6 (9.03-18.8)	15.3 (9.93-21.5)
7-day	4.40 (3.57-5.36)	5.24 (4.23-6.37)	6.60 (5.31-8.05)	7.72 (6.19-9.46)	9.28 (7.19-11.8)	10.4 (7.92-13.5)	11.7 (8.62-15.6)	13.1 (9.10-17.6)	15.4 (10.2-21.1)	17.2 (11.2-24.0)
10-day	5.10 (4.14-6.18)	5.97 (4.85-7.25)	7.41 (5.99-9.01)	8.60 (6.90-10.5)	10.2 (7.95-12.9)	11.5 (8.71-14.7)	12.8 (9.41-16.9)	14.3 (9.91-19.0)	16.5 (11.0-22.6)	18.4 (12.0-25.6)
20-day	7.26 (5.93-8.74)	8.19 (6.68-9.87)	9.72 (7.90-11.7)	11.0 (8.87-13.3)	12.7 (9.90-15.8)	14.0 (10.7-17.8)	15.4 (11.3-20.0)	16.8 (11.8-22.3)	18.8 (12.6-25.5)	20.4 (13.3-28.1)
30-day	9.08 (7.44-10.9)	10.0 (8.22-12.0)	11.6 (9.46-14.0)	12.9 (10.5-15.6)	14.7 (11.5-18.2)	16.1 (12.2-20.2)	17.5 (12.8-22.3)	18.8 (13.2-24.7)	20.5 (13.8-27.7)	21.8 (14.2-29.9)
45-day	11.3 (9.32-13.5)	12.3 (10.1-14.7)	14.0 (11.4-16.7)	15.3 (12.5-18.4)	17.2 (13.4-21.1)	18.7 (14.2-23.2)	20.1 (14.7-25.4)	21.3 (15.0-27.9)	22.8 (15.4-30.7)	23.8 (15.6-32.6)
60-day	13.2 (10.9-15.7)	14.2 (11.7-17.0)	15.9 (13.1-19.0)	17.4 (14.2-20.8)	19.3 (15.1-23.6)	20.9 (15.9-25.9)	22.3 (16.3-28.1)	23.5 (16.6-30.7)	25.0 (16.9-33.5)	25.8 (16.9-35.2)

[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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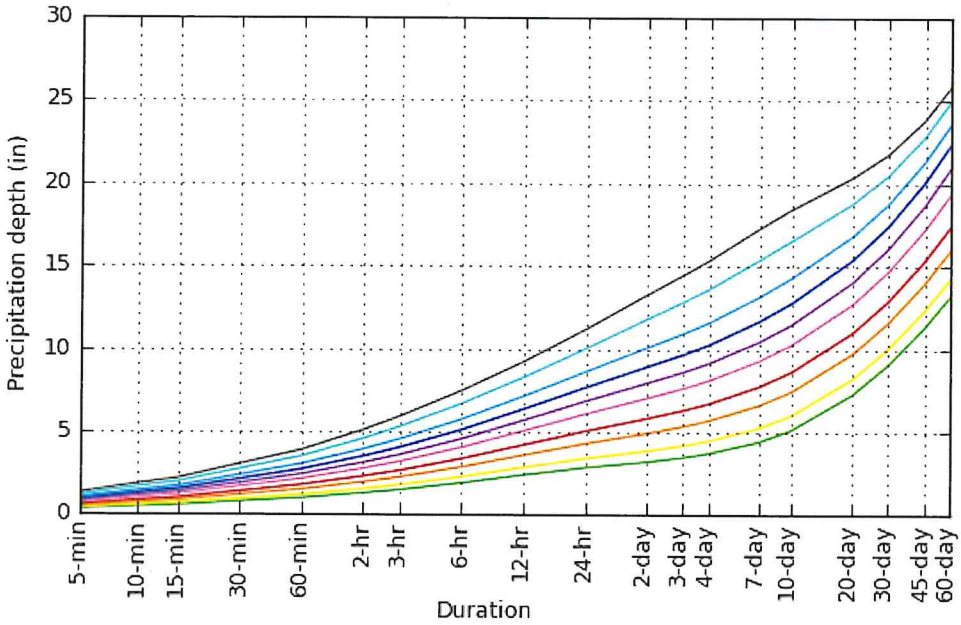
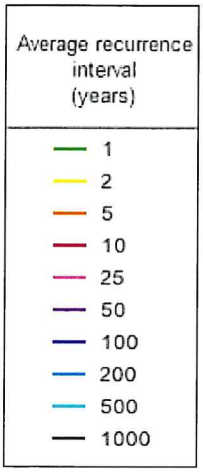
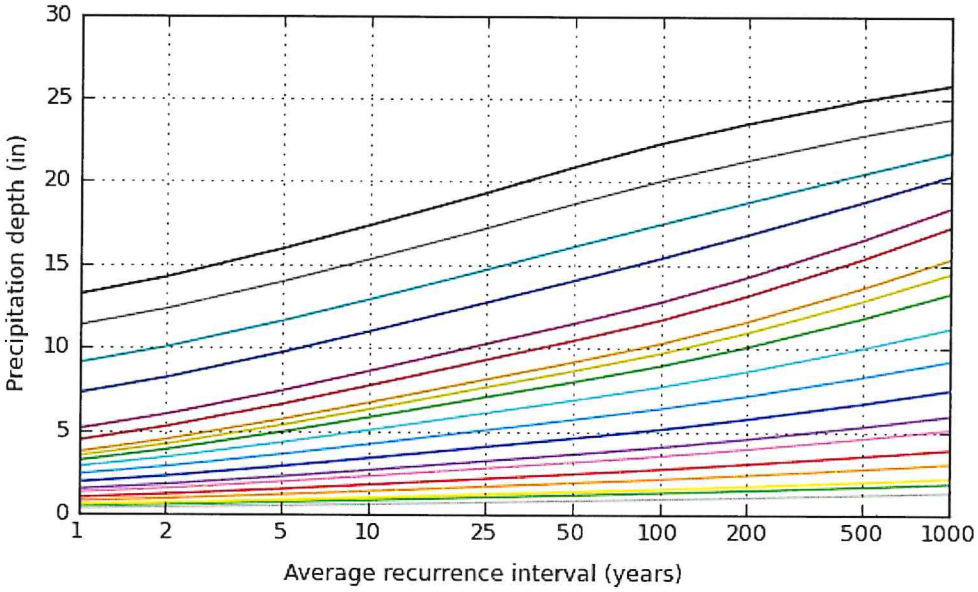
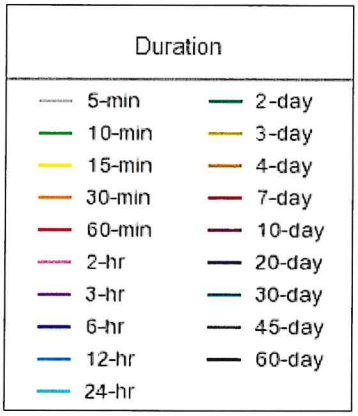
PF graphical

PDS-based depth-duration-frequency (DDF) curves
Latitude: 41.5906°, Longitude: -71.9906°









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Created (GMT): Wed Mar 3 19:40:32 2021

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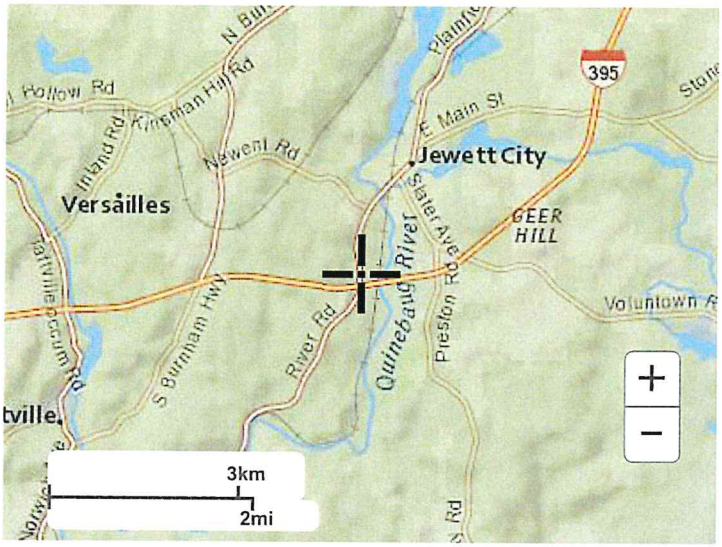
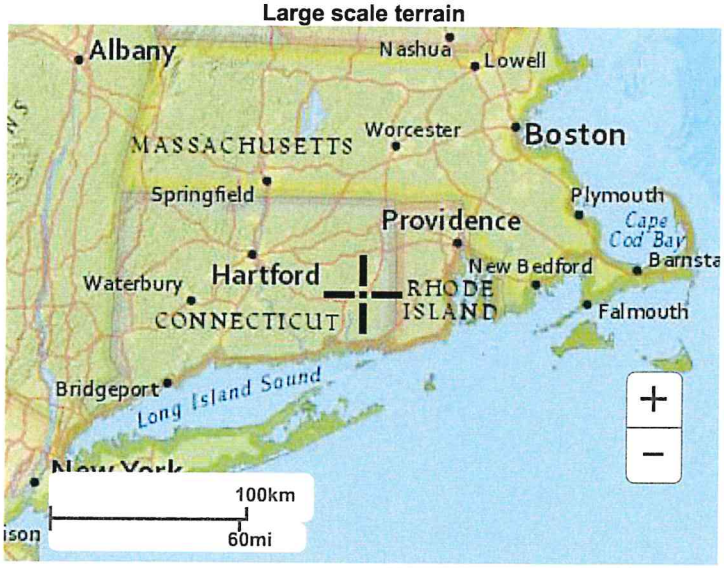
Maps & aerials

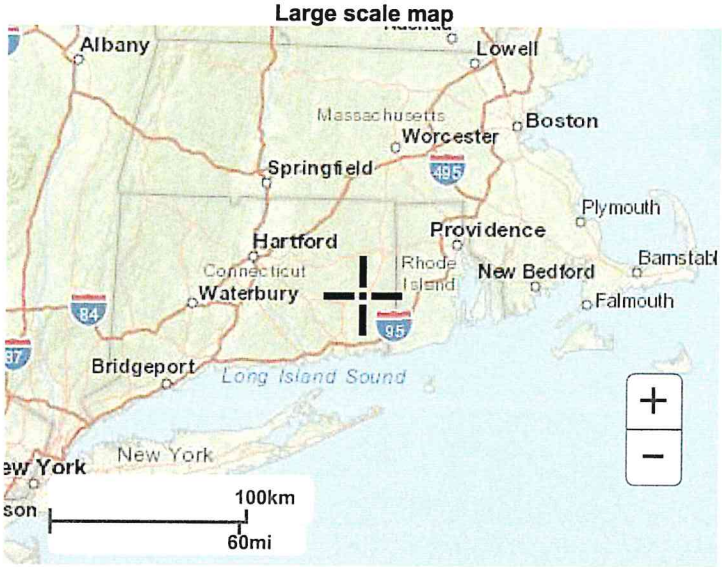
Small scale terrain



Large scale terrain



Large scale map



Large scale aerial

NOAA Atlas 14, Volume 10, Version 3
Location name: Jewett City, Connecticut, USA*
Latitude: 41.5906°, Longitude: -71.9906°
Elevation: 111.26 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sandra Pavlovic, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Orlan Wilhite

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/hour)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	3.97 (3.07-5.06)	4.76 (3.70-6.10)	6.06 (4.69-7.76)	7.15 (5.50-9.20)	8.64 (6.43-11.5)	9.77 (7.12-13.2)	10.9 (7.75-15.2)	12.3 (8.24-17.2)	14.1 (9.14-20.4)	15.6 (9.90-22.9)
10-min	2.81 (2.18-3.59)	3.38 (2.62-4.31)	4.30 (3.32-5.51)	5.07 (3.89-6.52)	6.13 (4.55-8.14)	6.92 (5.05-9.34)	7.75 (5.50-10.8)	8.68 (5.84-12.2)	10.0 (6.48-14.4)	11.1 (7.01-16.2)
15-min	2.20 (1.71-2.82)	2.65 (2.05-3.38)	3.37 (2.60-4.32)	3.98 (3.05-5.11)	4.80 (3.57-6.38)	5.43 (3.96-7.33)	6.08 (4.31-8.44)	6.81 (4.58-9.58)	7.84 (5.08-11.3)	8.69 (5.50-12.7)
30-min	1.53 (1.19-1.96)	1.84 (1.43-2.35)	2.35 (1.81-3.01)	2.77 (2.13-3.56)	3.34 (2.49-4.44)	3.78 (2.75-5.10)	4.23 (3.00-5.87)	4.74 (3.19-6.67)	5.46 (3.54-7.89)	6.05 (3.83-8.87)
60-min	0.981 (0.761-1.25)	1.18 (0.914-1.51)	1.50 (1.16-1.92)	1.77 (1.36-2.28)	2.14 (1.59-2.85)	2.42 (1.76-3.27)	2.71 (1.92-3.76)	3.04 (2.04-4.27)	3.50 (2.27-5.05)	3.88 (2.46-5.69)
2-hr	0.638 (0.498-0.809)	0.765 (0.596-0.972)	0.973 (0.756-1.24)	1.15 (0.884-1.46)	1.38 (1.04-1.83)	1.56 (1.15-2.10)	1.75 (1.25-2.42)	1.97 (1.33-2.75)	2.28 (1.48-3.28)	2.55 (1.62-3.71)
3-hr	0.493 (0.386-0.623)	0.590 (0.462-0.747)	0.750 (0.584-0.950)	0.882 (0.683-1.12)	1.06 (0.800-1.40)	1.20 (0.884-1.61)	1.34 (0.964-1.86)	1.51 (1.02-2.11)	1.76 (1.15-2.52)	1.97 (1.25-2.85)
6-hr	0.317 (0.249-0.398)	0.378 (0.297-0.475)	0.479 (0.375-0.603)	0.562 (0.438-0.710)	0.676 (0.511-0.885)	0.762 (0.564-1.01)	0.853 (0.614-1.17)	0.959 (0.651-1.33)	1.12 (0.729-1.58)	1.25 (0.796-1.80)
12-hr	0.198 (0.157-0.247)	0.236 (0.187-0.295)	0.298 (0.235-0.372)	0.349 (0.273-0.438)	0.419 (0.318-0.545)	0.472 (0.351-0.623)	0.528 (0.381-0.718)	0.592 (0.404-0.814)	0.686 (0.450-0.968)	0.765 (0.490-1.10)
24-hr	0.118 (0.094-0.147)	0.141 (0.112-0.175)	0.179 (0.142-0.222)	0.210 (0.166-0.262)	0.253 (0.193-0.327)	0.285 (0.213-0.375)	0.319 (0.232-0.432)	0.359 (0.246-0.490)	0.417 (0.275-0.584)	0.466 (0.299-0.662)
2-day	0.067 (0.053-0.082)	0.080 (0.064-0.099)	0.103 (0.082-0.127)	0.121 (0.096-0.150)	0.147 (0.113-0.188)	0.166 (0.125-0.216)	0.186 (0.136-0.251)	0.210 (0.144-0.285)	0.246 (0.162-0.342)	0.277 (0.178-0.390)
3-day	0.048 (0.039-0.059)	0.058 (0.047-0.071)	0.074 (0.059-0.091)	0.087 (0.070-0.108)	0.106 (0.082-0.136)	0.120 (0.090-0.156)	0.134 (0.099-0.181)	0.152 (0.105-0.205)	0.178 (0.118-0.247)	0.201 (0.130-0.282)
4-day	0.039 (0.031-0.047)	0.046 (0.037-0.057)	0.059 (0.047-0.073)	0.070 (0.056-0.086)	0.084 (0.065-0.108)	0.095 (0.072-0.124)	0.107 (0.079-0.143)	0.121 (0.083-0.163)	0.142 (0.094-0.196)	0.160 (0.103-0.224)
7-day	0.026 (0.021-0.032)	0.031 (0.025-0.038)	0.039 (0.032-0.048)	0.046 (0.037-0.056)	0.055 (0.043-0.070)	0.062 (0.047-0.080)	0.069 (0.051-0.093)	0.078 (0.054-0.105)	0.091 (0.061-0.126)	0.103 (0.067-0.143)
10-day	0.021 (0.017-0.026)	0.025 (0.020-0.030)	0.031 (0.025-0.038)	0.036 (0.029-0.044)	0.043 (0.033-0.054)	0.048 (0.036-0.061)	0.053 (0.039-0.070)	0.059 (0.041-0.079)	0.069 (0.046-0.094)	0.077 (0.050-0.107)
20-day	0.015 (0.012-0.018)	0.017 (0.014-0.021)	0.020 (0.016-0.024)	0.023 (0.018-0.028)	0.026 (0.021-0.033)	0.029 (0.022-0.037)	0.032 (0.024-0.042)	0.035 (0.024-0.046)	0.039 (0.026-0.053)	0.042 (0.028-0.059)
30-day	0.013 (0.010-0.015)	0.014 (0.011-0.017)	0.016 (0.013-0.019)	0.018 (0.015-0.022)	0.020 (0.016-0.025)	0.022 (0.017-0.028)	0.024 (0.018-0.031)	0.026 (0.018-0.034)	0.028 (0.019-0.038)	0.030 (0.020-0.042)
45-day	0.010 (0.009-0.013)	0.011 (0.009-0.014)	0.013 (0.011-0.015)	0.014 (0.012-0.017)	0.016 (0.012-0.020)	0.017 (0.013-0.021)	0.019 (0.014-0.024)	0.020 (0.014-0.026)	0.021 (0.014-0.028)	0.022 (0.014-0.030)
60-day	0.009 (0.008-0.011)	0.010 (0.008-0.012)	0.011 (0.009-0.013)	0.012 (0.010-0.014)	0.013 (0.011-0.016)	0.014 (0.011-0.018)	0.015 (0.011-0.020)	0.016 (0.012-0.021)	0.017 (0.012-0.023)	0.018 (0.012-0.024)

[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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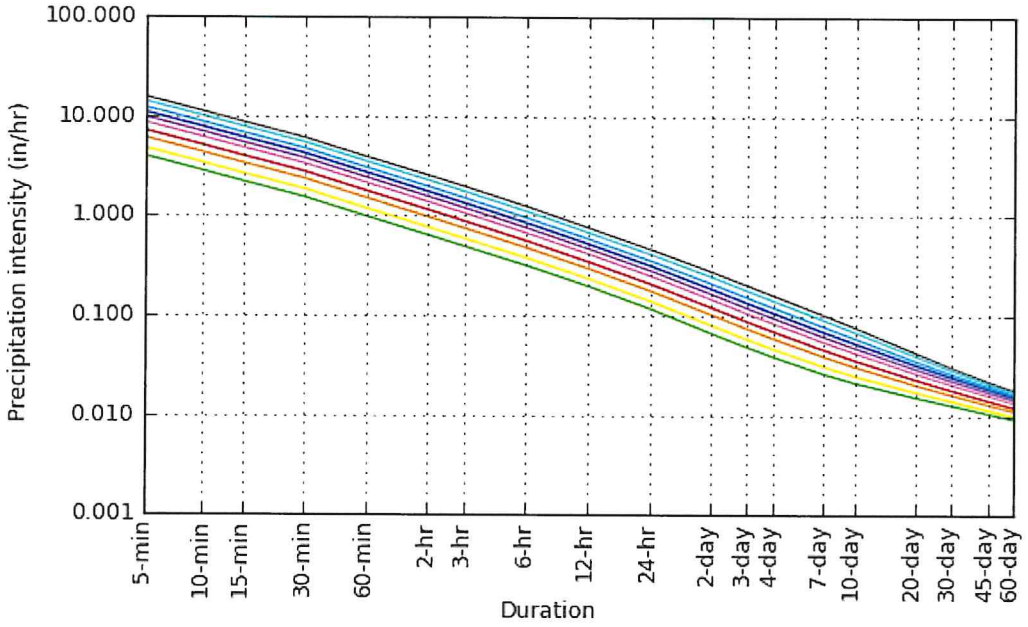
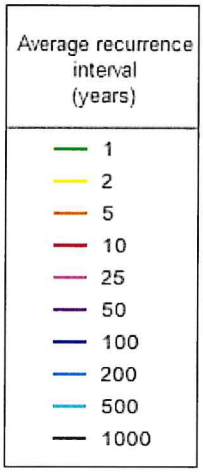
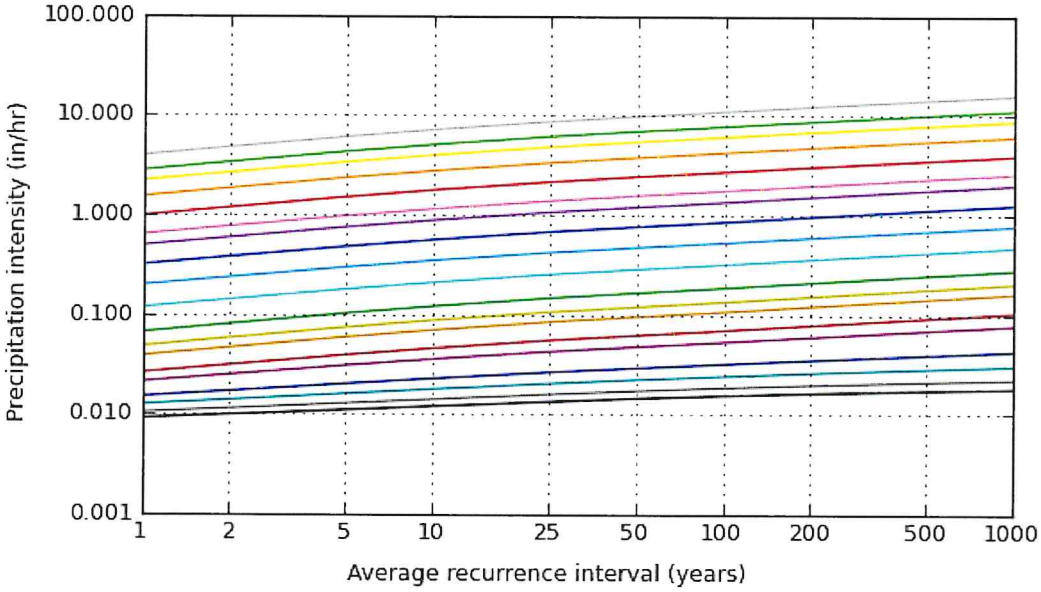
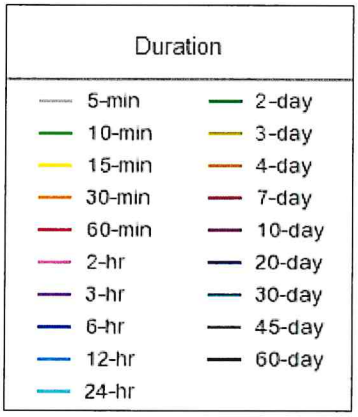
PF graphical

PDS-based intensity-duration-frequency (IDF) curves
Latitude: 41.5906°, Longitude: -71.9906°









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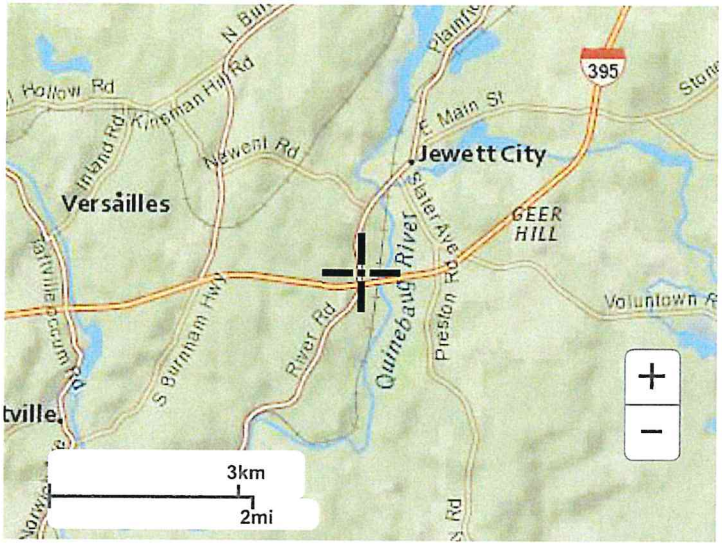
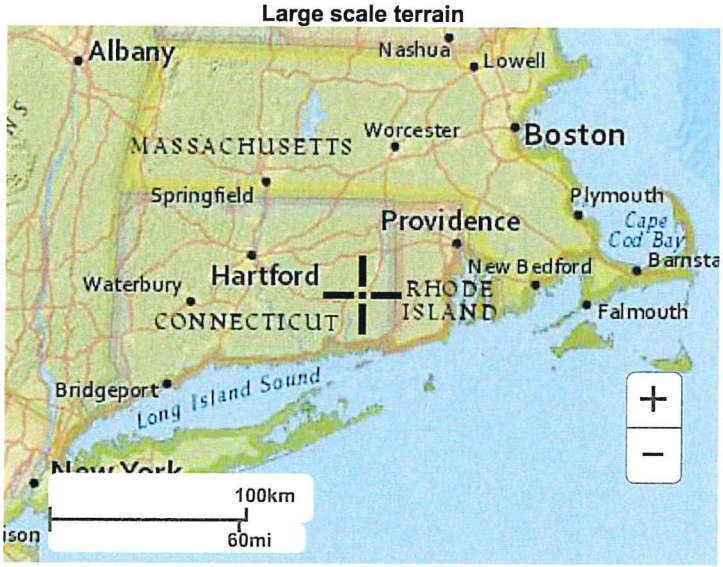
Maps & aerials

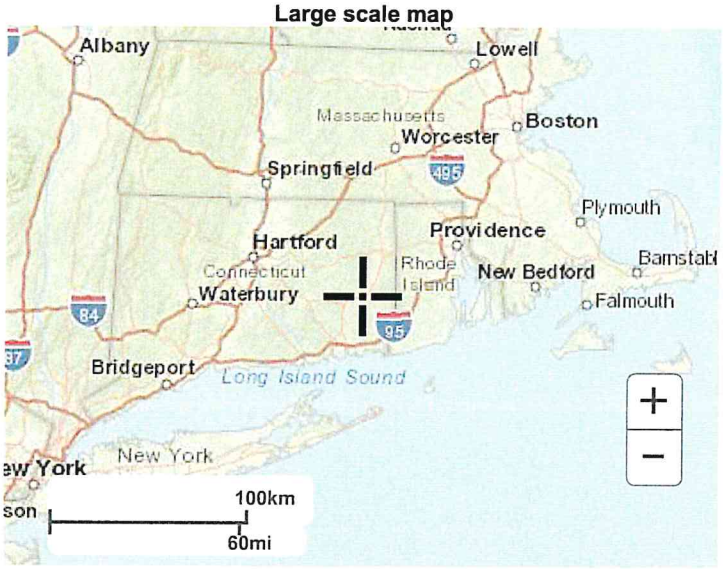
Small scale terrain



Large scale terrain



Large scale map



Large scale aerial

Attachment 2

Surficial Soils Map
And
On-site Soil Types

Soil Map—State of Connecticut
(Lisbon BK)

Map Scale: 1:854 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 10 20 40 60

Feet: 0 40 80 160 240

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 19N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:12,000.

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: State of Connecticut
Survey Area Data: Version 20, Jun 9, 2020

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

Date(s) aerial images were photographed: Mar 20, 2019—Mar 27, 2019

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
34B	Merrimac fine sandy loam, 3 to 8 percent slopes	1.4	49.1%
306	Udorthents-Urban land complex	1.5	50.9%
Totals for Area of Interest		**2.9**	**100.0%**

State of Connecticut

34B—Merrimac fine sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2tyqs
Elevation: 0 to 1,290 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Merrimac and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Merrimac

Setting

Landform: Kames, eskers, moraines, outwash terraces, outwash plains
Landform position (two-dimensional): Backslope, footslope, shoulder, summit
Landform position (three-dimensional): Side slope, crest, riser, tread
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy glaciofluvial deposits derived from granite, schist, and gneiss over sandy and gravelly glaciofluvial deposits derived from granite, schist, and gneiss

Typical profile

Ap - 0 to 10 inches: fine sandy loam
Bw1 - 10 to 22 inches: fine sandy loam
Bw2 - 22 to 26 inches: stratified gravel to gravelly loamy sand
2C - 26 to 65 inches: stratified gravel to very gravelly sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 2 percent
Maximum salinity: Nonsaline (0.0 to 1.4 mmhos/cm)
Sodium adsorption ratio, maximum: 1.0

Available water capacity: Low (about 4.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2s
Hydrologic Soil Group: A
Ecological site: F145XY008MA - Dry Outwash
Hydric soil rating: No

Minor Components

Sudbury

Percent of map unit: 5 percent
Landform: Outwash plains, terraces, deltas
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Hinckley

Percent of map unit: 5 percent
Landform: Deltas, outwash plains, eskers, kames
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Nose slope, side slope, crest, head slope, rise
Down-slope shape: Convex
Across-slope shape: Convex, linear
Hydric soil rating: No

Windsor

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

Agawam

Percent of map unit: 2 percent
Landform: Outwash terraces, outwash plains, kames, eskers, stream terraces, moraines
Landform position (three-dimensional): Rise
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Data Source Information

Soil Survey Area: State of Connecticut
Survey Area Data: Version 20, Jun 9, 2020

State of Connecticut

306—Udorthents-Urban land complex

Map Unit Setting

National map unit symbol: 9lmg
Elevation: 0 to 2,000 feet
Mean annual precipitation: 43 to 56 inches
Mean annual air temperature: 45 to 55 degrees F
Frost-free period: 120 to 185 days
Farmland classification: Not prime farmland

Map Unit Composition

Udorthents and similar soils: 50 percent
Urban land: 35 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Udorthents

Setting

Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Drift

Typical profile

A - 0 to 5 inches: loam
C1 - 5 to 21 inches: gravelly loam
C2 - 21 to 80 inches: very gravelly sandy loam

Properties and qualities

Slope: 0 to 25 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Very low to high (0.00 to 1.98 in/hr)
Depth to water table: About 54 to 72 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Moderate (about 6.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Hydric soil rating: No

Description of Urban Land

Typical profile

H - 0 to 6 inches: material

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydrologic Soil Group: D
Hydric soil rating: Unranked

Minor Components

Unnamed, undisturbed soils

Percent of map unit: 8 percent
Hydric soil rating: No

Udorthents, wet substratum

Percent of map unit: 5 percent
Down-slope shape: Convex
Across-slope shape: Linear
Hydric soil rating: No

Rock outcrop

Percent of map unit: 2 percent
Hydric soil rating: No

Data Source Information

Soil Survey Area: State of Connecticut
Survey Area Data: Version 20, Jun 9, 2020

Attachment 3

Hydrologic Analysis

Rational Method

The final element to be factored into the determination of runoff coefficients is the land slope. As the slope of the drainage basin increases, the selected C value should also increase. This is caused by the fact that as the slope of the drainage area increases, the velocity of overland and channel flow will increase allowing less opportunity for water to infiltrate the ground surface. Thus, more of the rainfall will become runoff from the drainage area.

In summary, it should be reiterated that in assigning a value to the runoff coefficient for use in the rational method, the engineer must rely heavily on experience and judgement.

Table 6-3 Recommended Coefficient Of Runoff For Pervious Surfaces By Selected Hydrologic Soil Groupings And Slope Ranges

Slope	A	B	C	D
Flat (0 - 1%)	0.04-0.09	0.07-0.12	0.11-0.16	0.15-0.20
Average (2 - 6%)	0.09-0.14	0.12-0.17	0.16-0.21	0.20-0.25
Steep (Over 6%)	0.13-0.18	0.18-0.24	0.23-0.31	0.28-0.38

Source: Storm Drainage Design Manual, Erie and Niagara Counties Regional Planning Board.

Table 6-4 Recommended Coefficient Of Runoff Values For Various Selected Land Uses

Description of Area		Runoff Coefficients
Business: Downtown areas		0.70-0.95
Neighborhood areas		0.50-0.70
Residential:	Single-family areas	0.30-0.50
	Multi units, detached	0.40-0.60
	Multi units, attached	0.60-0.75
	Suburban	0.25-0.40
Residential (0.5 ha (1.2 ac) lots or more)		0.30-0.45
Apartment dwelling areas		0.50-0.70
Industrial:	Light areas	0.50-0.80
	Heavy areas	0.60-0.90
Parks, cemeteries		0.10-0.25
Playgrounds		0.20-0.40
Railroad yard areas		0.20-0.40
Unimproved areas		0.10-0.30

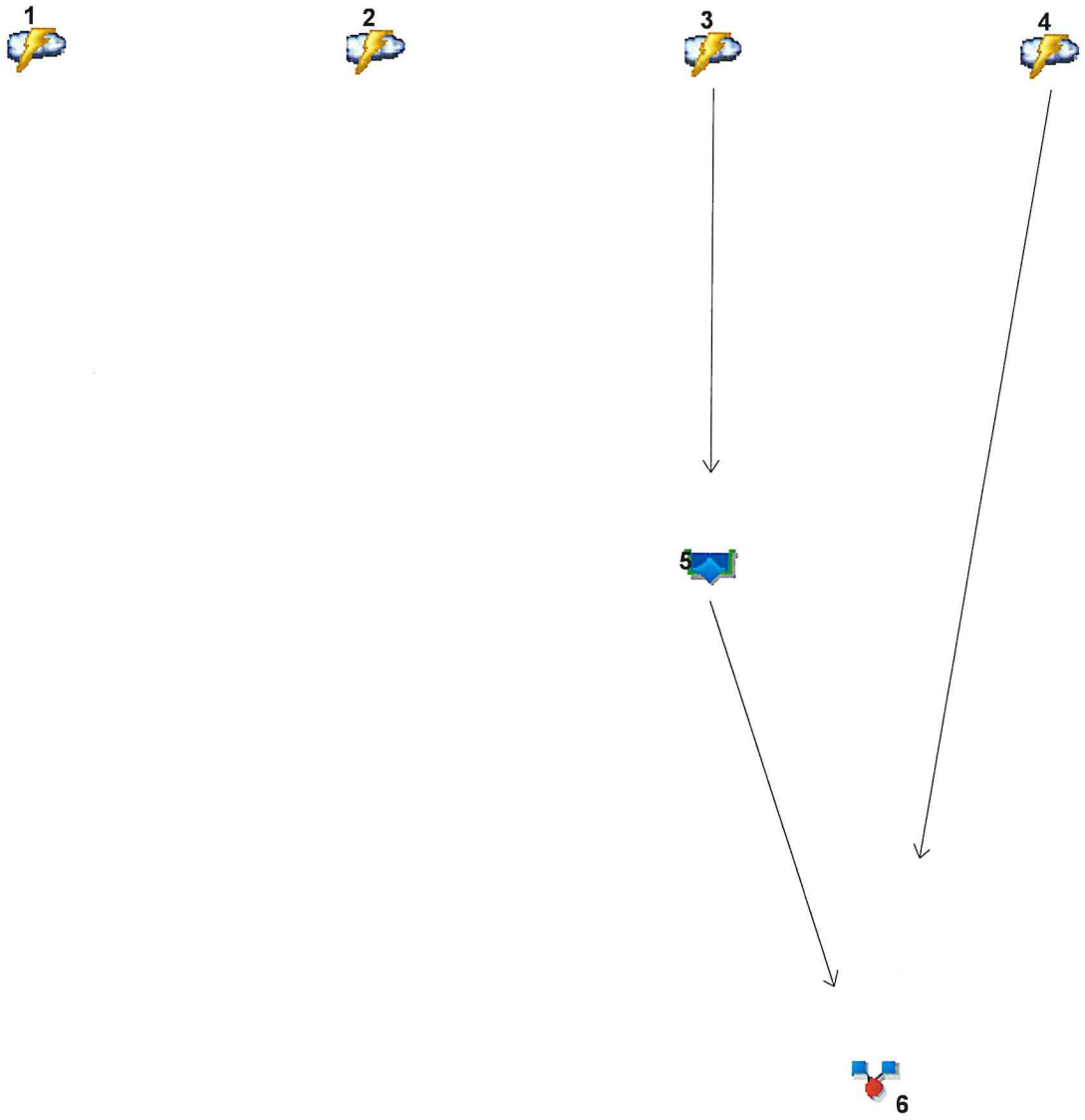
Table 6-5 Coefficients For Composite Runoff Analysis

Surface		Runoff Coefficients
Street:	Asphalt	0.70-0.95
	Concrete	0.80-0.95
Drives and walks		0.75-0.85
Roofs		0.75-0.95

Hydraflow Table of Contents

Watershed Model Schematic

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021



Legend

Hyd.	Origin	Description
1	Rational	Existing WS (WS E)
2	Rational	Proposed West Un-detained (WS-P-W-UND)
3	Rational	Proposed East Detained (WS-P-E-DET)
4	Rational	Proposed East Un-detained (WS-P-E-UND)
5	Reservoir	WQ Basin #1
6	Combine	TOTAL PROPOSED EAST

Hydrograph Return Period Recap

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	Rational	------	2.006	2.408	-------	3.134	3.682	4.430	5.019	5.611	Existing WS (WS E)
2	Rational	------	0.175	0.209	-------	0.278	0.325	0.392	0.444	0.496	Proposed West Un-detained (WS-P-
3	Rational	------	2.720	3.265	-------	4.250	4.992	6.007	6.806	7.609	Proposed East Detained (WS-P-E-DE
4	Rational	------	0.394	0.472	-------	0.615	0.722	0.869	0.985	1.101	Proposed East Un-detained (WS-P-E-
5	Reservoir	3	1.157	1.231	-------	1.360	1.453	1.574	1.665	1.734	WQ Basin #1
6	Combine	4, 5	1.436	1.549	-------	1.756	1.911	2.121	2.284	2.446	TOTAL PROPOSED EAST

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021

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	Rational	2.408	1	10	1,926	------	------	------	Existing WS (WS E)
2	Rational	0.209	1	5	84	------	------	------	Proposed West Un-detained (WS-P-
3	Rational	3.265	1	10	2,612	------	------	------	Proposed East Detained (WS-P-E-DE
4	Rational	0.472	1	10	378	------	------	------	Proposed East Un-detained (WS-P-E-
5	Reservoir	1.231	1	20	2,546	3	86.45	1,339	WQ Basin #1
6	Combine	1.549	1	11	2,914	4, 5	------	------	TOTAL PROPOSED EAST

Hydrograph Report

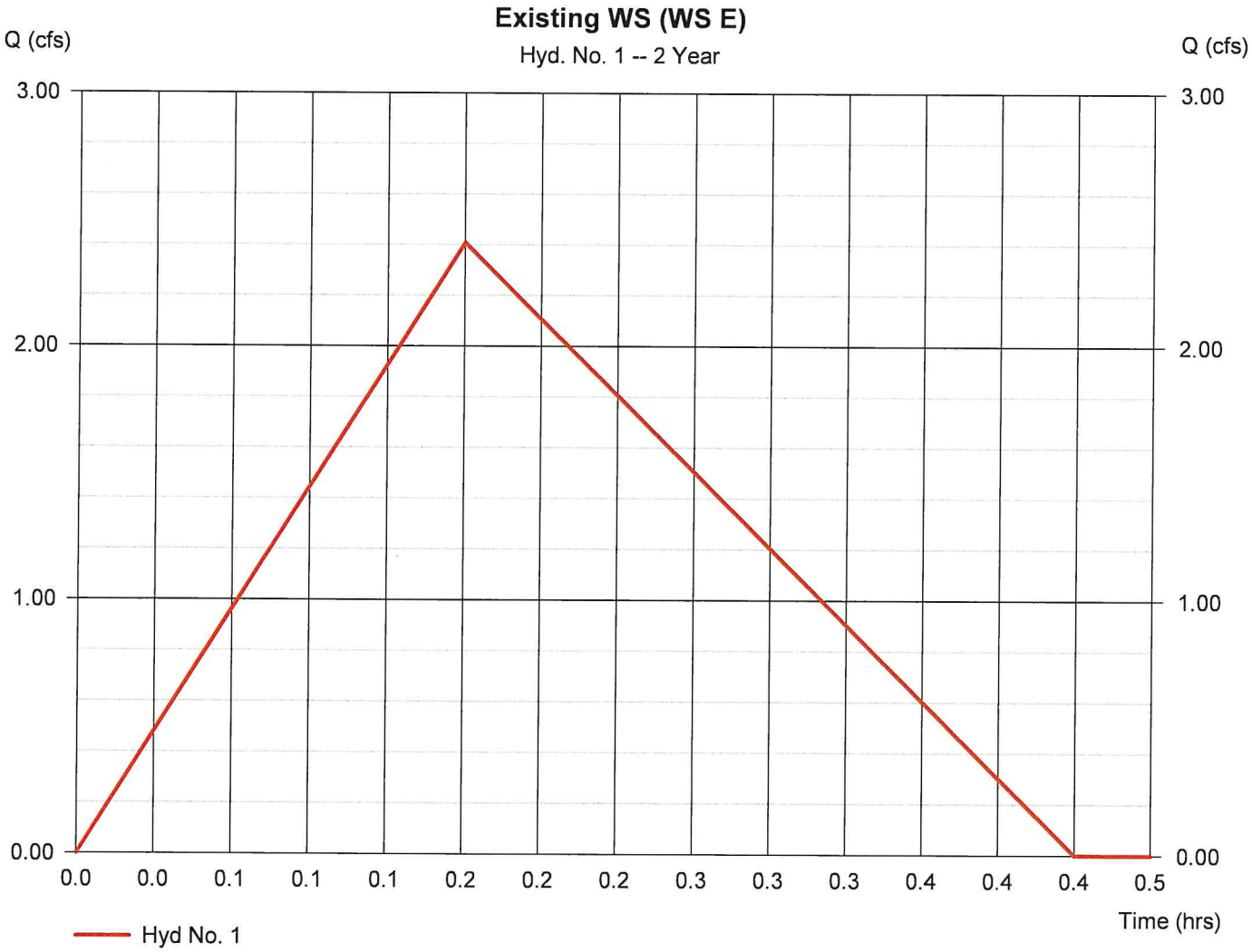
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Monday, 03 / 15 / 2021

Hyd. No. 1

Existing WS (WS E)

Hydrograph type	= Rational	Peak discharge	= 2.408 cfs
Storm frequency	= 2 yrs	Time to peak	= 0.17 hrs
Time interval	= 1 min	Hyd. volume	= 1,926 cuft
Drainage area	= 2.490 ac	Runoff coeff.	= 0.28*
Intensity	= 3.454 in/hr	Tc by User	= 10.00 min
IDF Curve	= Lisbon BK.IDF	Asc/Rec limb fact	= 1/1.66667

* Composite (Area/C) = [(0.830 x 0.15) + (1.290 x 0.20) + (0.070 x 0.80) + (0.300 x 0.90)] / 2.490



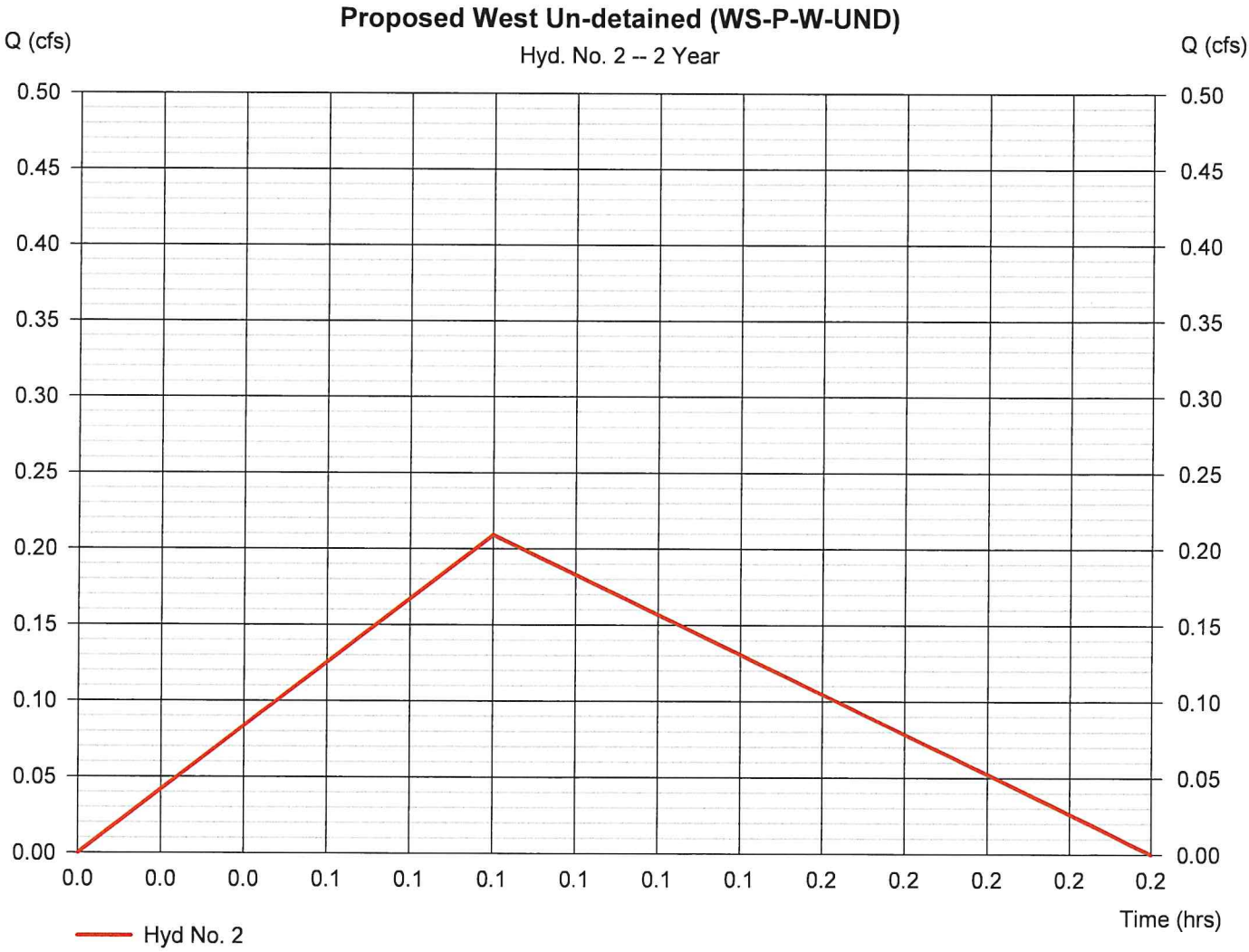
Hydrograph Report

Hyd. No. 2

Proposed West Un-detained (WS-P-W-UND)

Hydrograph type	= Rational	Peak discharge	= 0.209 cfs
Storm frequency	= 2 yrs	Time to peak	= 0.08 hrs
Time interval	= 1 min	Hyd. volume	= 84 cuft
Drainage area	= 0.080 ac	Runoff coeff.	= 0.55*
Intensity	= 4.752 in/hr	Tc by User	= 5.00 min
IDF Curve	= Lisbon BK.IDF	Asc/Rec limb fact	= 1/1.66667

* Composite (Area/C) = + (0.040 x 0.20) + (0.040 x 0.90)] / 0.080



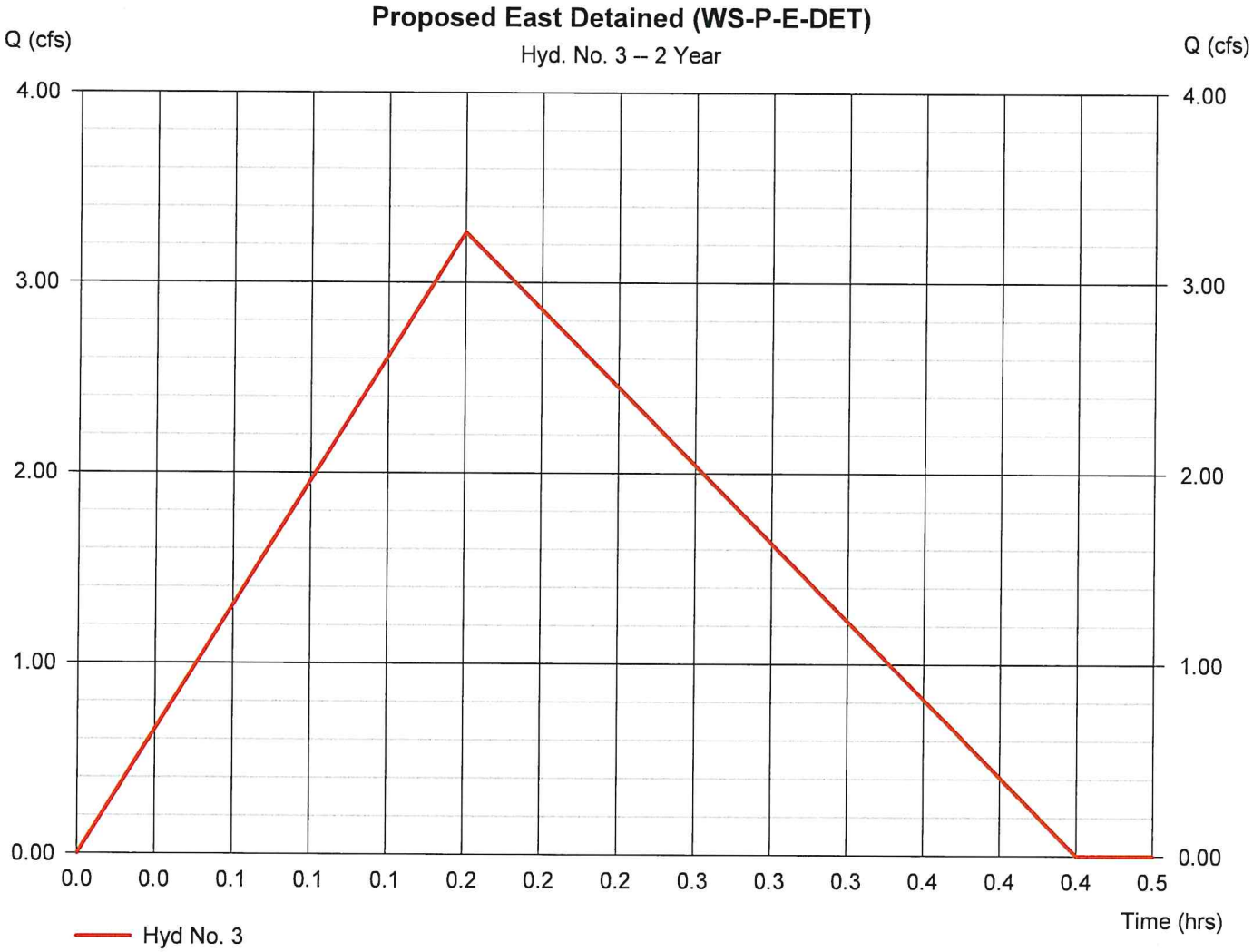
Hydrograph Report

Hyd. No. 3

Proposed East Detained (WS-P-E-DET)

Hydrograph type	= Rational	Peak discharge	= 3.265 cfs
Storm frequency	= 2 yrs	Time to peak	= 0.17 hrs
Time interval	= 1 min	Hyd. volume	= 2,612 cuft
Drainage area	= 1.630 ac	Runoff coeff.	= 0.58*
Intensity	= 3.454 in/hr	Tc by User	= 10.00 min
IDF Curve	= Lisbon BK.IDF	Asc/Rec limb fact	= 1/1.66667

* Composite (Area/C) = [(0.040 x 0.15) + (0.700 x 0.20) + (0.890 x 0.90)] / 1.630



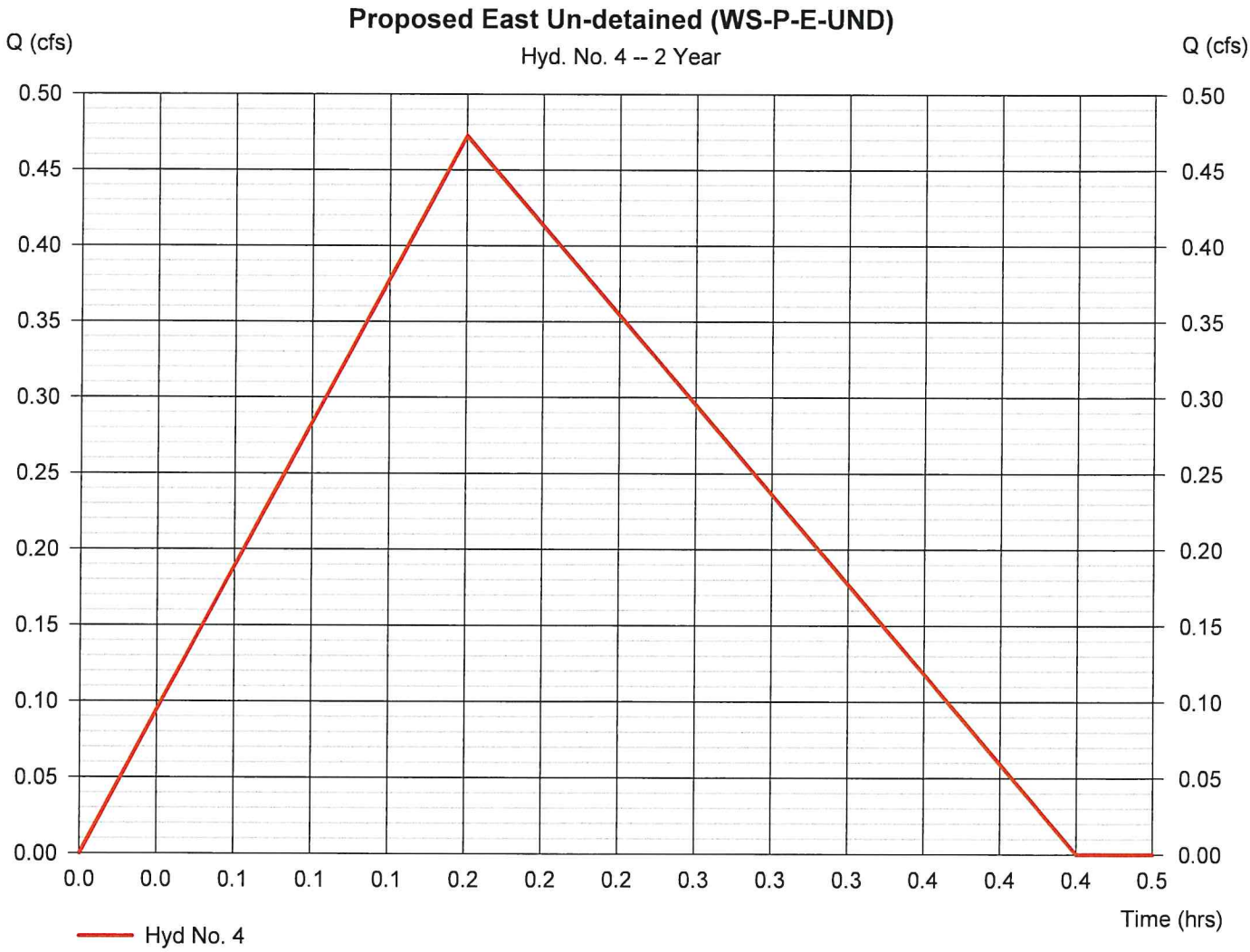
Hydrograph Report

Hyd. No. 4

Proposed East Un-detained (WS-P-E-UND)

Hydrograph type	= Rational	Peak discharge	= 0.472 cfs
Storm frequency	= 2 yrs	Time to peak	= 0.17 hrs
Time interval	= 1 min	Hyd. volume	= 378 cuft
Drainage area	= 0.760 ac	Runoff coeff.	= 0.18*
Intensity	= 3.454 in/hr	Tc by User	= 10.00 min
IDF Curve	= Lisbon BK.IDF	Asc/Rec limb fact	= 1/1.66667

* Composite (Area/C) = [(0.370 x 0.15) + (0.390 x 0.20)] / 0.760



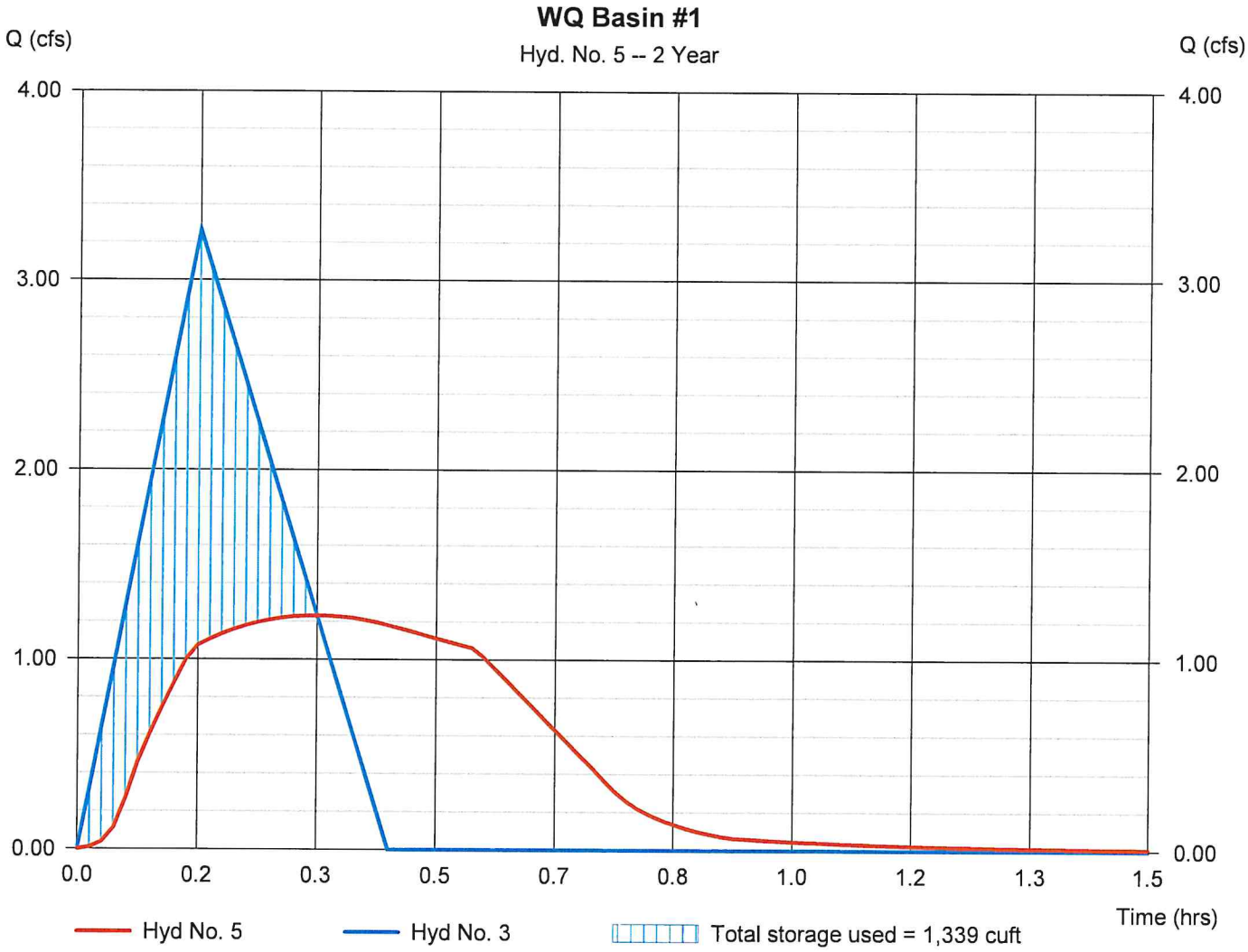
Hydrograph Report

Hyd. No. 5

WQ Basin #1

Hydrograph type	= Reservoir	Peak discharge	= 1.231 cfs
Storm frequency	= 2 yrs	Time to peak	= 0.33 hrs
Time interval	= 1 min	Hyd. volume	= 2,546 cuft
Inflow hyd. No.	= 3 - Proposed East Detained (WSP-EDET)	Max. Elevation	= 86.45 ft
Reservoir name	= WQ BASIN #1	Max. Storage	= 1,339 cuft

Storage Indication method used.



Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Monday, 03 / 15 / 2021

Pond No. 1 - WQ BASIN #1

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 84.50 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	84.50	10	0	0
1.50	86.00	1,149	633	633
3.50	88.00	2,063	3,167	3,800
5.50	90.00	3,206	5,227	9,027
6.50	91.00	3,861	3,528	12,555

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 15.00	6.00	0.00	0.00
Span (in)	= 15.00	6.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 84.50	84.50	0.00	0.00
Length (ft)	= 32.00	0.00	0.00	0.00
Slope (%)	= 0.50	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	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 7.50	0.00	0.00	0.00
Crest El. (ft)	= 89.80	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= 1	---	---	---
Multi-Stage	= Yes	No	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

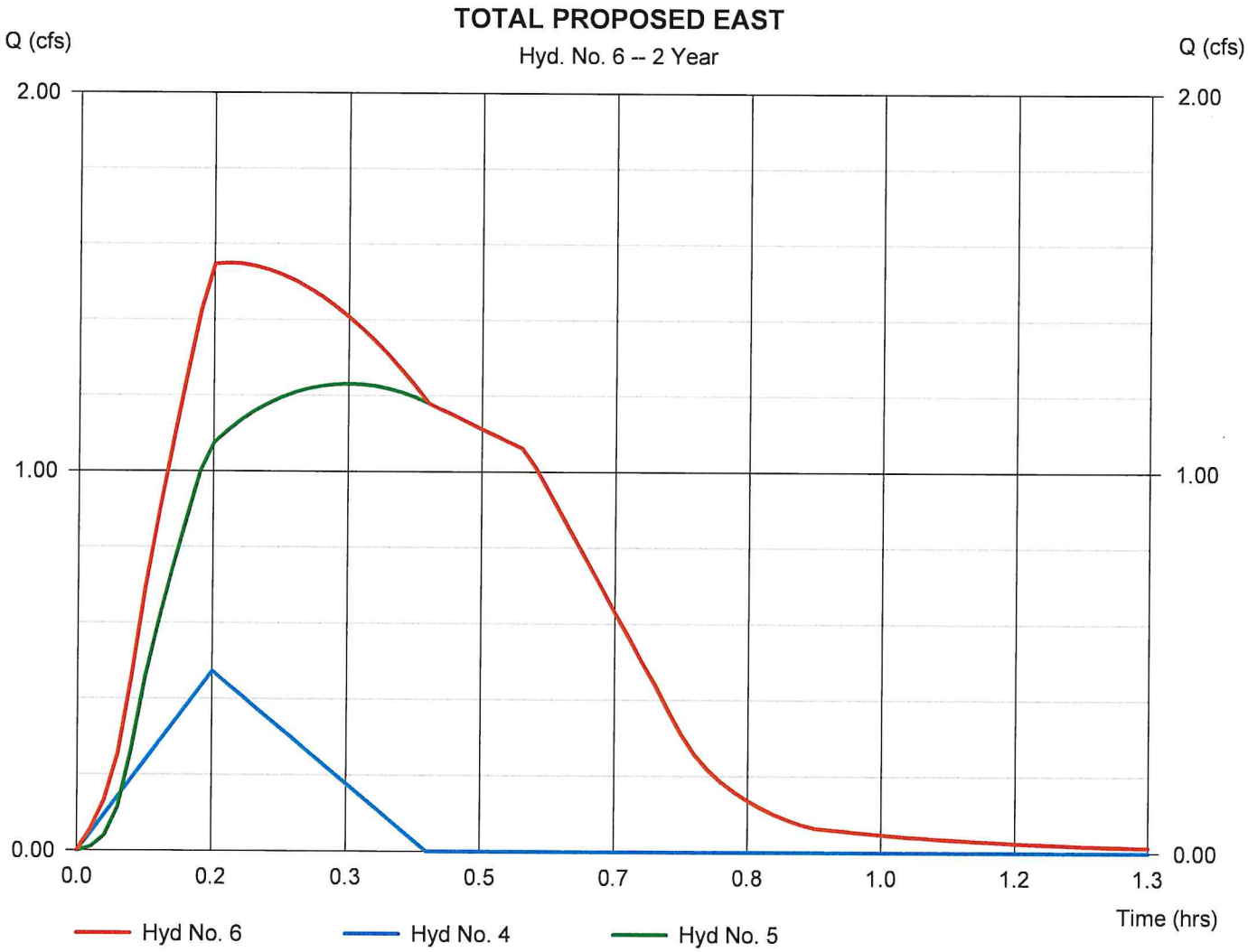
Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	84.50	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
1.50	633	86.00	0.00	1.06 ic	---	---	0.00	---	---	---	---	---	1.057
3.50	3,800	88.00	0.00	1.70 ic	---	---	0.00	---	---	---	---	---	1.704
5.50	9,027	90.00	2.24 oc	2.17 ic	---	---	2.23	---	---	---	---	---	4.400
6.50	12,555	91.00	14.21 ic	2.36 ic	---	---	14.21 s	---	---	---	---	---	16.57

Hydrograph Report

Hyd. No. 6

TOTAL PROPOSED EAST

Hydrograph type	= Combine	Peak discharge	= 1.549 cfs
Storm frequency	= 2 yrs	Time to peak	= 0.18 hrs
Time interval	= 1 min	Hyd. volume	= 2,914 cuft
Inflow hyds.	= 4, 5	Contrib. drain. area	= 0.760 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021

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	Rational	3.134	1	10	2,507	------	------	------	Existing WS (WS E)
2	Rational	0.278	1	5	111	------	------	------	Proposed West Un-detained (WS-P-
3	Rational	4.250	1	10	3,400	------	------	------	Proposed East Detained (WS-P-E-DE
4	Rational	0.615	1	10	492	------	------	------	Proposed East Un-detained (WS-P-E-
5	Reservoir	1.360	1	21	3,314	3	86.82	1,933	WQ Basin #1
6	Combine	1.756	1	11	3,793	4, 5	------	------	TOTAL PROPOSED EAST

Hydrograph Report

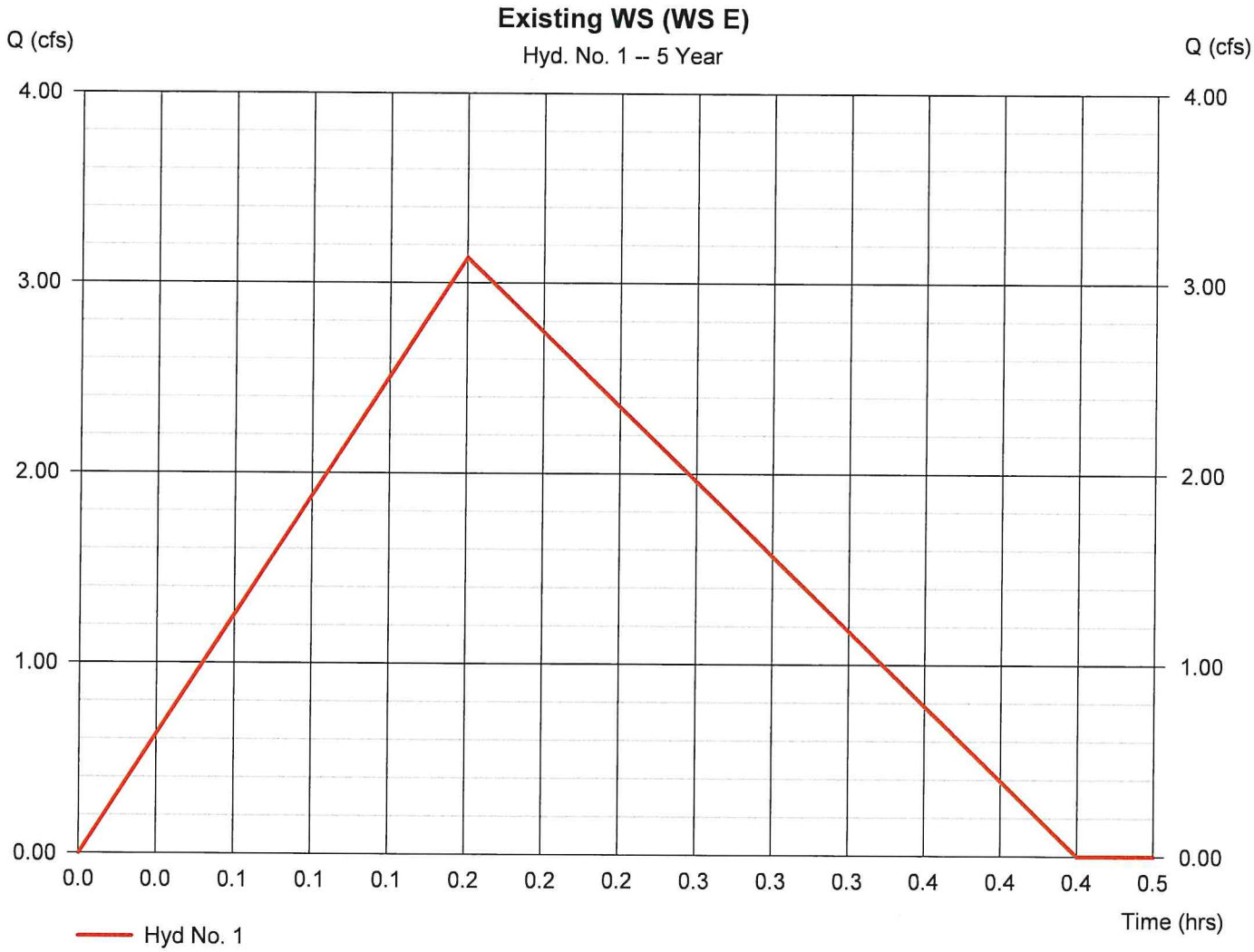
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Monday, 03 / 15 / 2021

Hyd. No. 1

Existing WS (WS E)

Hydrograph type	= Rational	Peak discharge	= 3.134 cfs
Storm frequency	= 5 yrs	Time to peak	= 0.17 hrs
Time interval	= 1 min	Hyd. volume	= 2,507 cuft
Drainage area	= 2.490 ac	Runoff coeff.	= 0.28*
Intensity	= 4.495 in/hr	Tc by User	= 10.00 min
IDF Curve	= Lisbon BK.IDF	Asc/Rec limb fact	= 1/1.66667

* Composite (Area/C) = [(0.830 x 0.15) + (1.290 x 0.20) + (0.070 x 0.80) + (0.300 x 0.90)] / 2.490



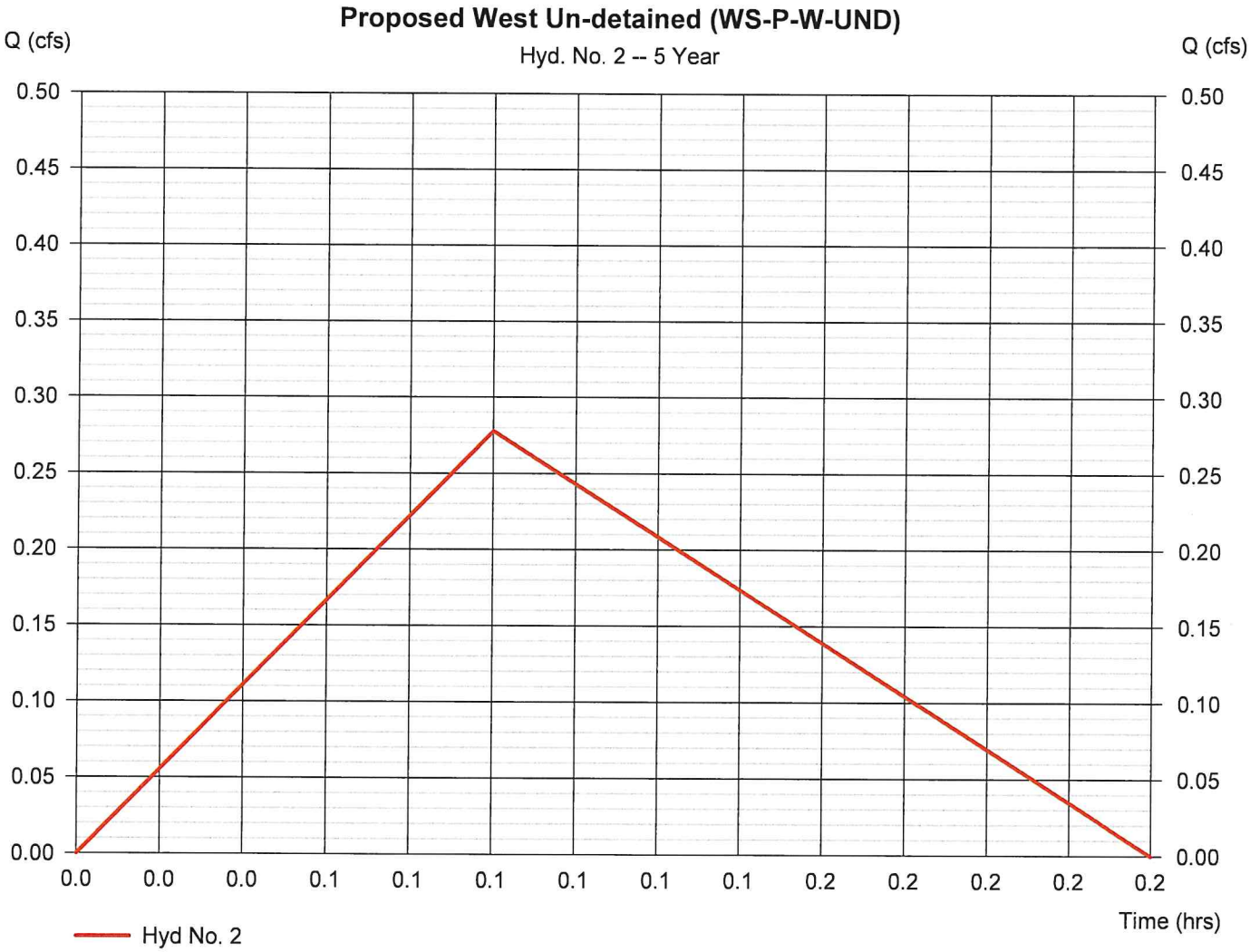
Hydrograph Report

Hyd. No. 2

Proposed West Un-detained (WS-P-W-UND)

Hydrograph type	= Rational	Peak discharge	= 0.278 cfs
Storm frequency	= 5 yrs	Time to peak	= 0.08 hrs
Time interval	= 1 min	Hyd. volume	= 111 cuft
Drainage area	= 0.080 ac	Runoff coeff.	= 0.55*
Intensity	= 6.314 in/hr	Tc by User	= 5.00 min
IDF Curve	= Lisbon BK.IDF	Asc/Rec limb fact	= 1/1.66667

* Composite (Area/C) = + (0.040 x 0.20) + (0.040 x 0.90)] / 0.080



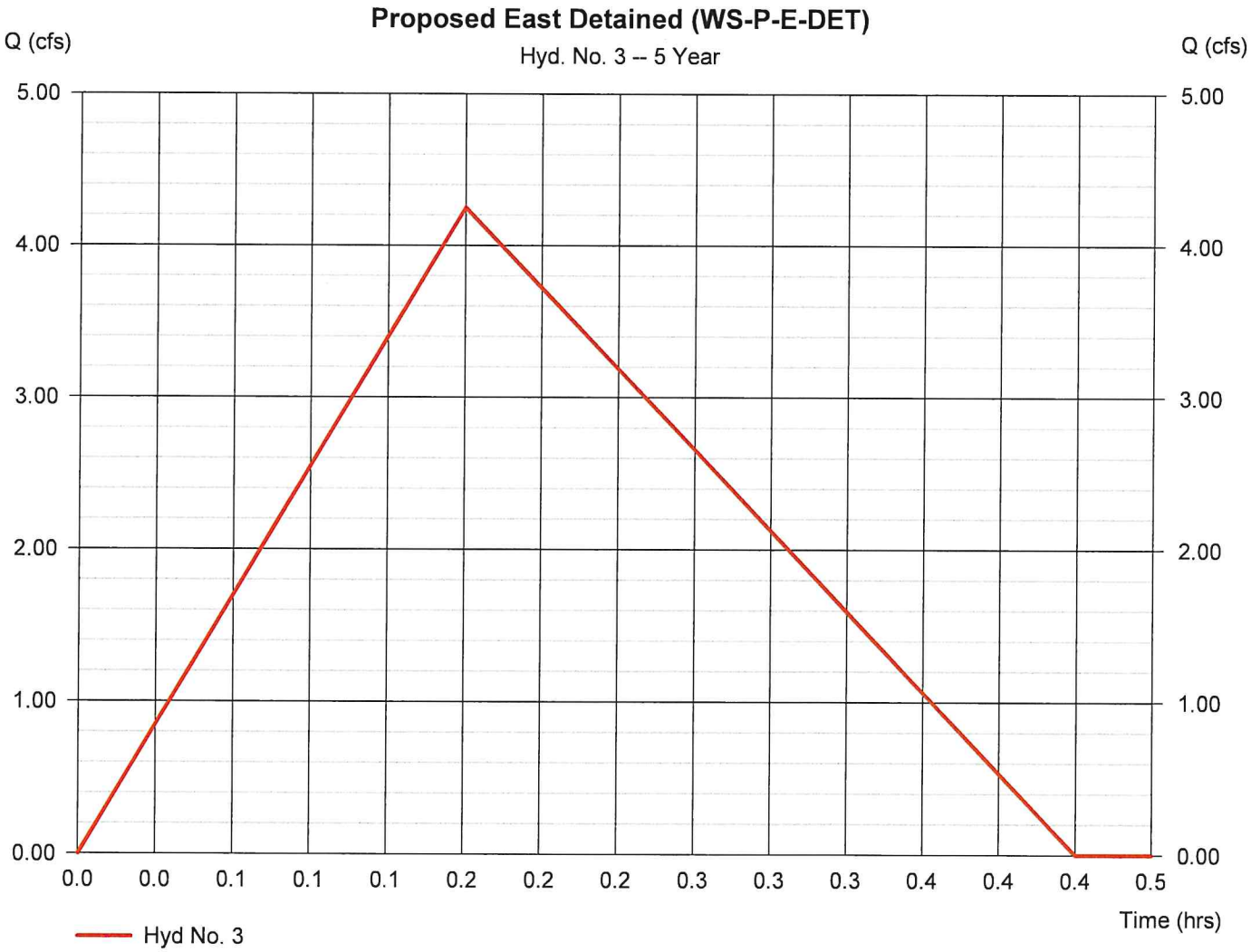
Hydrograph Report

Hyd. No. 3

Proposed East Detained (WS-P-E-DET)

Hydrograph type	= Rational	Peak discharge	= 4.250 cfs
Storm frequency	= 5 yrs	Time to peak	= 0.17 hrs
Time interval	= 1 min	Hyd. volume	= 3,400 cuft
Drainage area	= 1.630 ac	Runoff coeff.	= 0.58*
Intensity	= 4.495 in/hr	Tc by User	= 10.00 min
IDF Curve	= Lisbon BK.IDF	Asc/Rec limb fact	= 1/1.66667

* Composite (Area/C) = [(0.040 x 0.15) + (0.700 x 0.20) + (0.890 x 0.90)] / 1.630



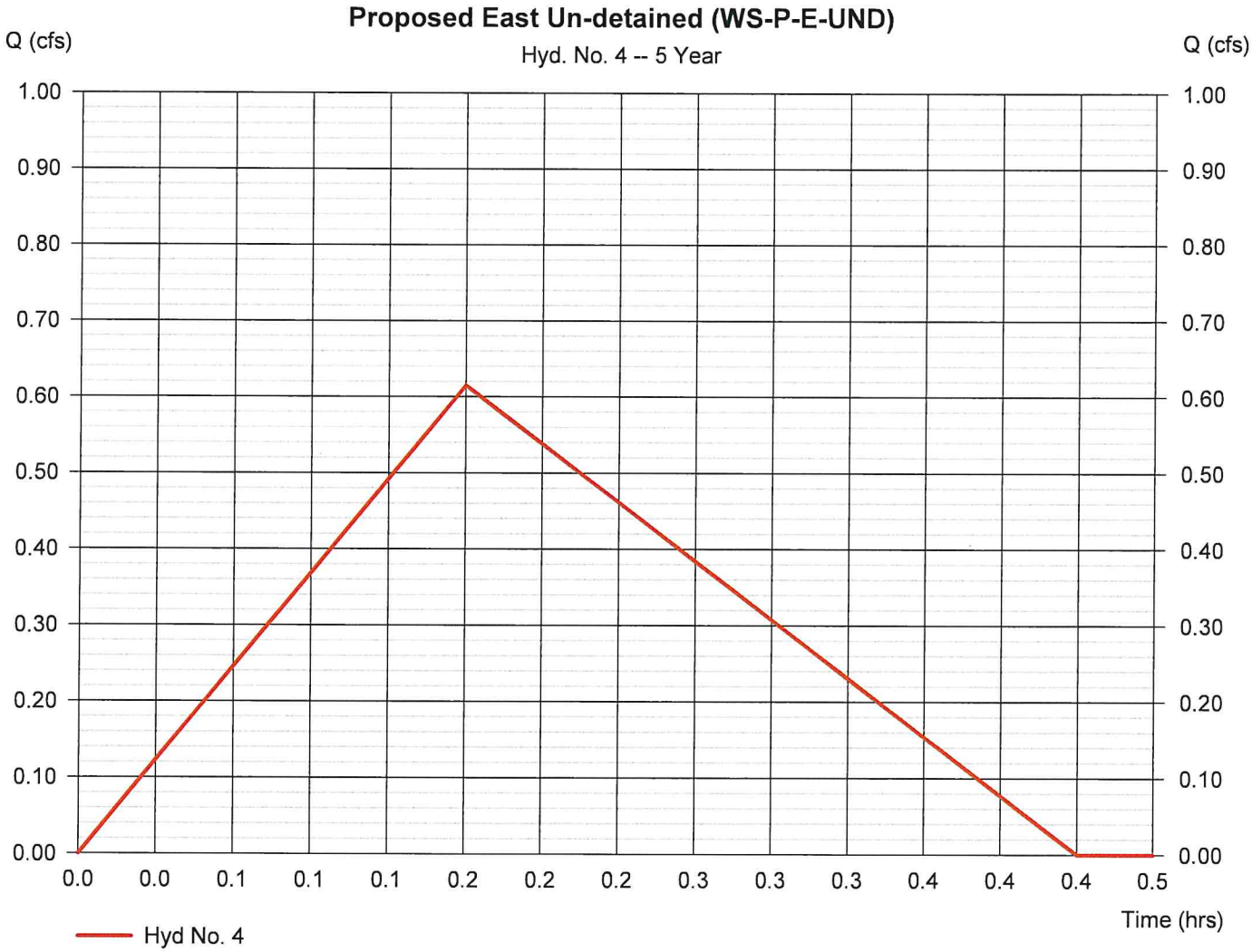
Hydrograph Report

Hyd. No. 4

Proposed East Un-detained (WS-P-E-UND)

Hydrograph type	= Rational	Peak discharge	= 0.615 cfs
Storm frequency	= 5 yrs	Time to peak	= 0.17 hrs
Time interval	= 1 min	Hyd. volume	= 492 cuft
Drainage area	= 0.760 ac	Runoff coeff.	= 0.18*
Intensity	= 4.495 in/hr	Tc by User	= 10.00 min
IDF Curve	= Lisbon BK.IDF	Asc/Rec limb fact	= 1/1.66667

* Composite (Area/C) = [(0.370 x 0.15) + (0.390 x 0.20)] / 0.760



Hydrograph Report

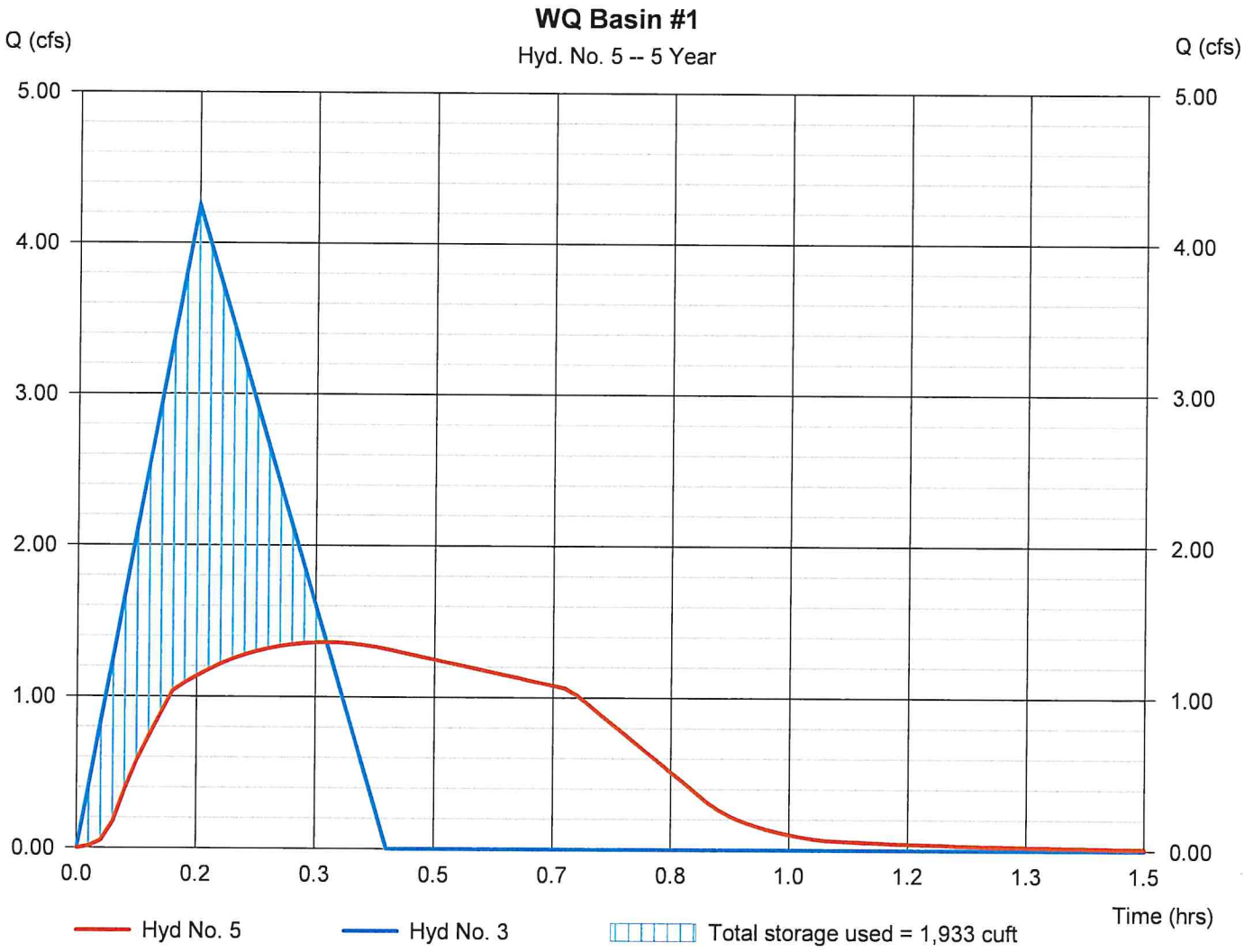
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 — Monday, 03 / 15 / 2021

Hyd. No. 5

WQ Basin #1

Hydrograph type	= Reservoir	Peak discharge	= 1.360 cfs
Storm frequency	= 5 yrs	Time to peak	= 0.35 hrs
Time interval	= 1 min	Hyd. volume	= 3,314 cuft
Inflow hyd. No.	= 3 - Proposed East Detained (WSP-EIDET)	Max. Elevation	= 86.82 ft
Reservoir name	= WQ BASIN #1	Max. Storage	= 1,933 cuft

Storage Indication method used.

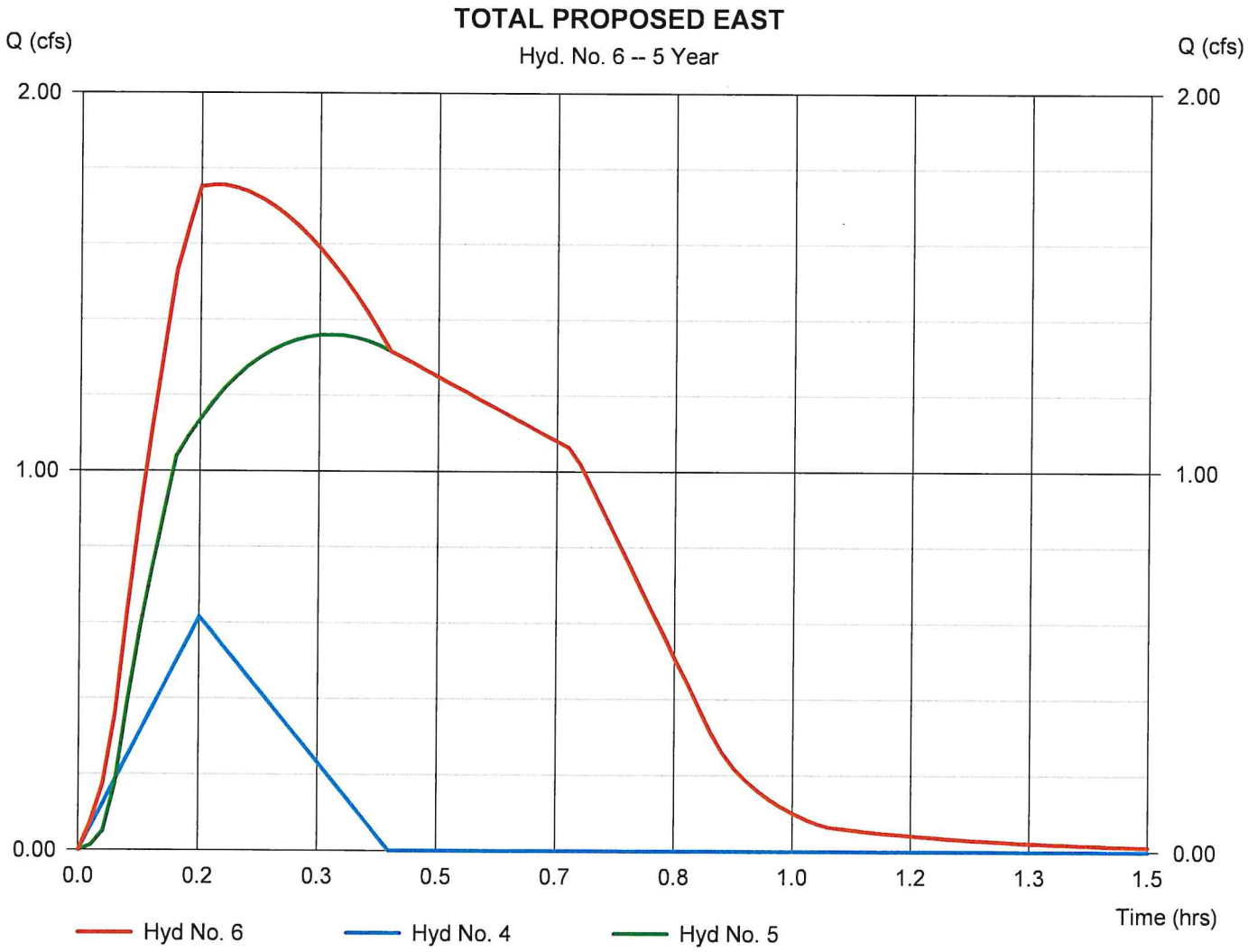


Hydrograph Report

Hyd. No. 6

TOTAL PROPOSED EAST

Hydrograph type	= Combine	Peak discharge	= 1.756 cfs
Storm frequency	= 5 yrs	Time to peak	= 0.18 hrs
Time interval	= 1 min	Hyd. volume	= 3,793 cuft
Inflow hyds.	= 4, 5	Contrib. drain. area	= 0.760 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021

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	Rational	3.682	1	10	2,945	------	------	------	Existing WS (WS E)
2	Rational	0.325	1	5	130	------	------	------	Proposed West Un-detained (WS-P-
3	Rational	4.992	1	10	3,994	------	------	------	Proposed East Detained (WS-P-E-DE
4	Rational	0.722	1	10	578	------	------	------	Proposed East Un-detained (WS-P-E-
5	Reservoir	1.453	1	21	3,893	3	87.11	2,397	WQ Basin #1
6	Combine	1.911	1	11	4,457	4, 5	------	------	TOTAL PROPOSED EAST

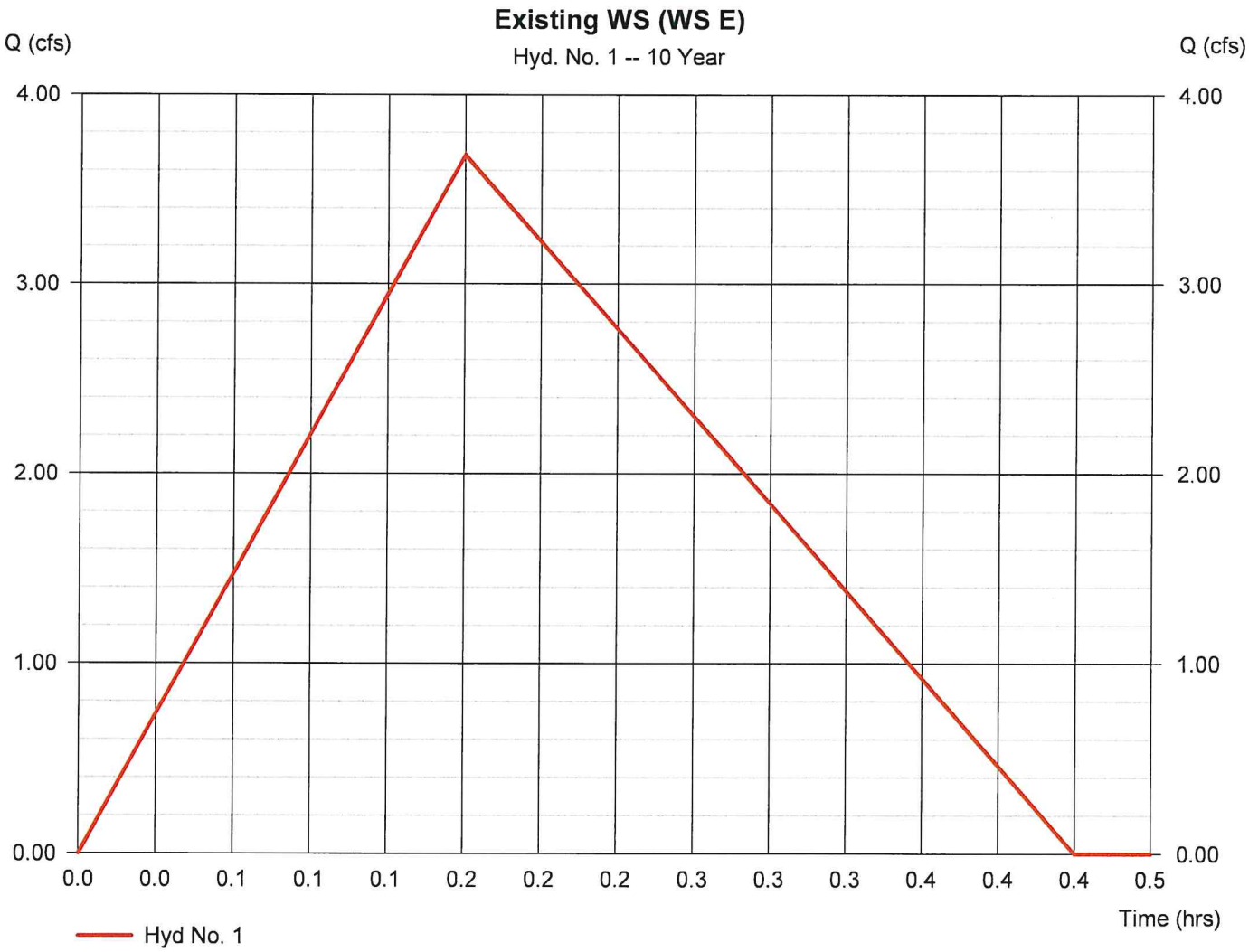
Hydrograph Report

Hyd. No. 1

Existing WS (WS E)

Hydrograph type	= Rational	Peak discharge	= 3.682 cfs
Storm frequency	= 10 yrs	Time to peak	= 0.17 hrs
Time interval	= 1 min	Hyd. volume	= 2,945 cuft
Drainage area	= 2.490 ac	Runoff coeff.	= 0.28*
Intensity	= 5.281 in/hr	Tc by User	= 10.00 min
IDF Curve	= Lisbon BK.IDF	Asc/Rec limb fact	= 1/1.66667

* Composite (Area/C) = [(0.830 x 0.15) + (1.290 x 0.20) + (0.070 x 0.80) + (0.300 x 0.90)] / 2.490



Hydrograph Report

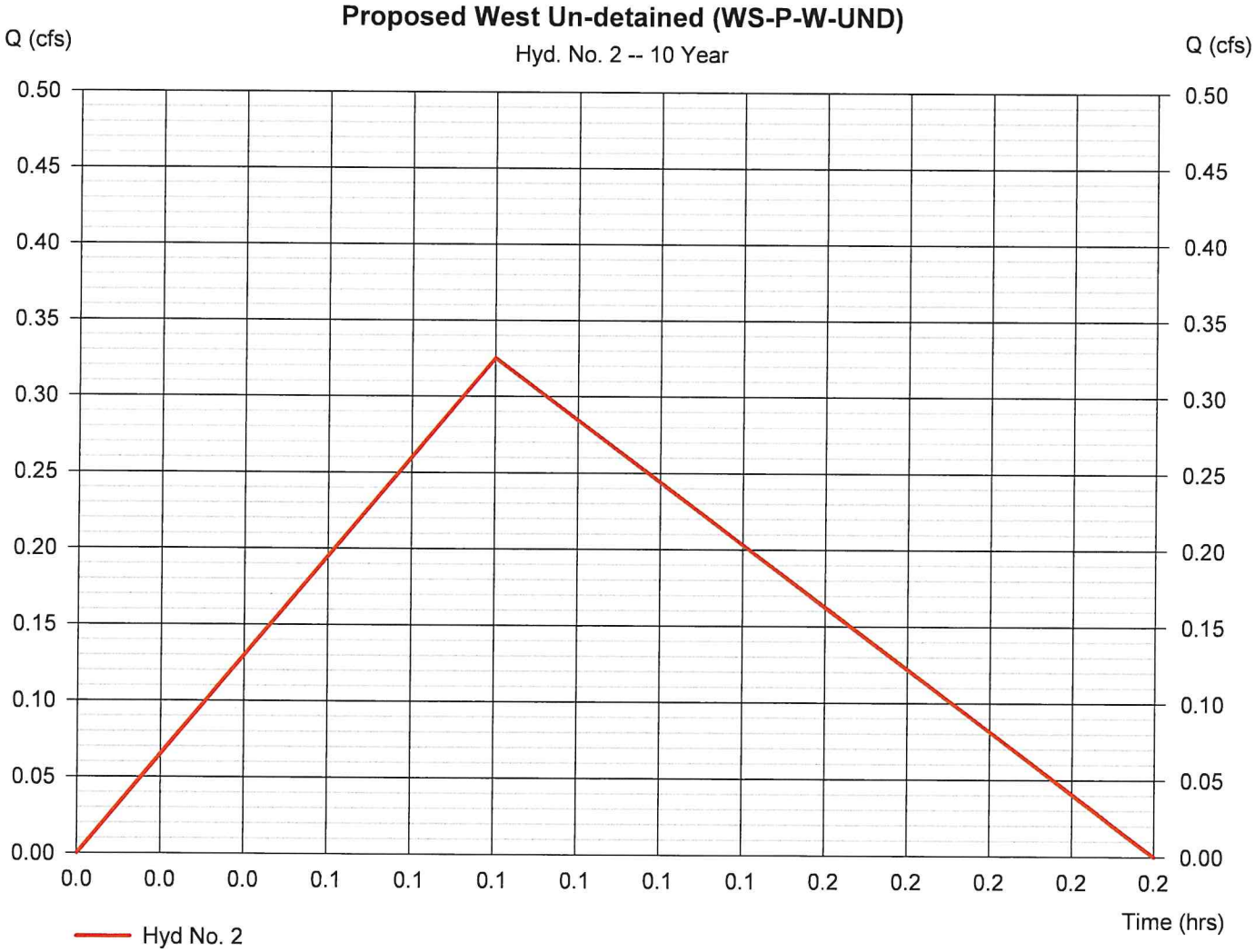
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Monday, 03 / 15 / 2021

Hyd. No. 2

Proposed West Un-detained (WS-P-W-UND)

Hydrograph type	= Rational	Peak discharge	= 0.325 cfs
Storm frequency	= 10 yrs	Time to peak	= 0.08 hrs
Time interval	= 1 min	Hyd. volume	= 130 cuft
Drainage area	= 0.080 ac	Runoff coeff.	= 0.55*
Intensity	= 7.392 in/hr	Tc by User	= 5.00 min
IDF Curve	= Lisbon BK.IDF	Asc/Rec limb fact	= 1/1.66667

* Composite (Area/C) = + (0.040 x 0.20) + (0.040 x 0.90)] / 0.080



Hydrograph Report

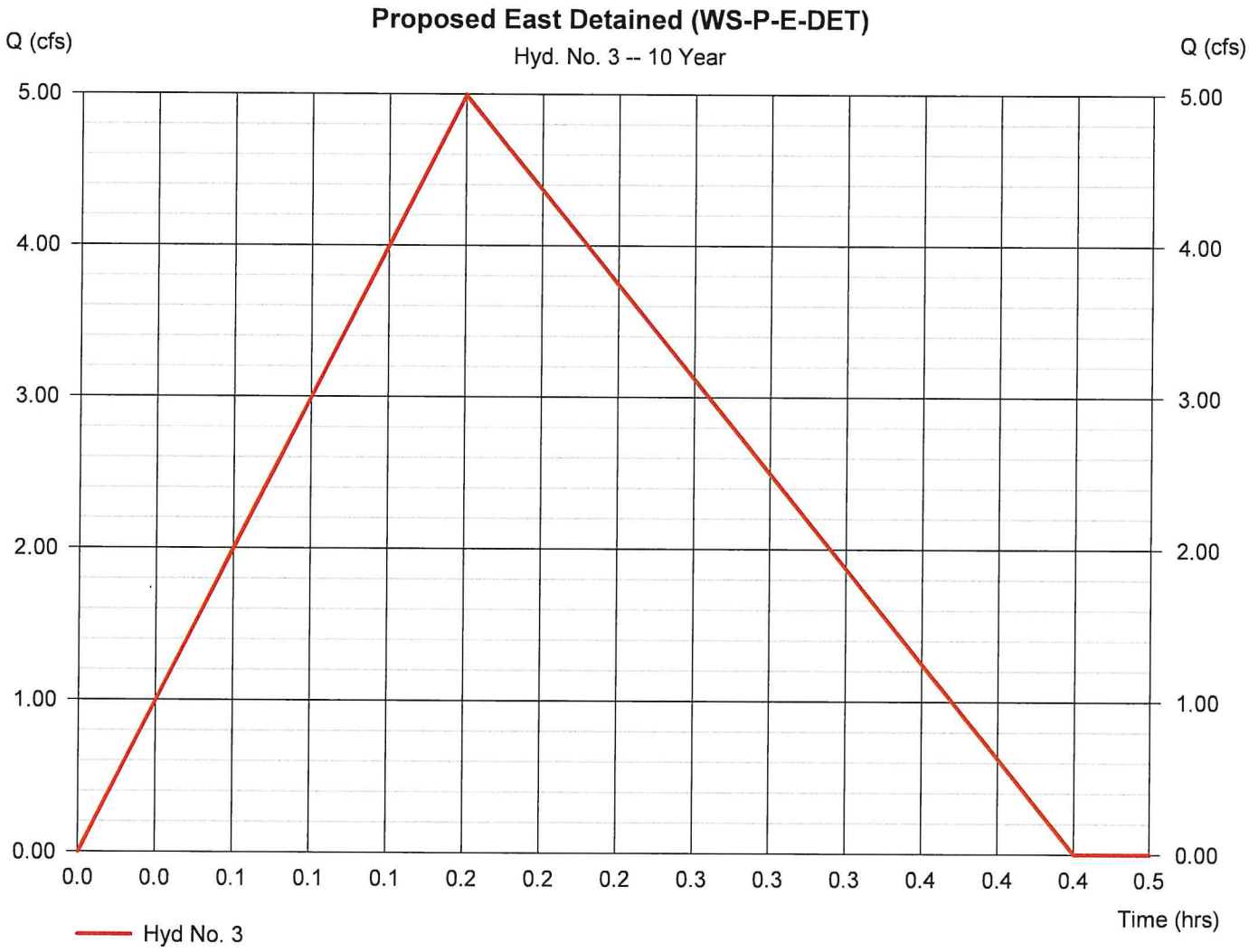
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Monday, 03 / 15 / 2021

Hyd. No. 3

Proposed East Detained (WS-P-E-DET)

Hydrograph type	= Rational	Peak discharge	= 4.992 cfs
Storm frequency	= 10 yrs	Time to peak	= 0.17 hrs
Time interval	= 1 min	Hyd. volume	= 3,994 cuft
Drainage area	= 1.630 ac	Runoff coeff.	= 0.58*
Intensity	= 5.281 in/hr	Tc by User	= 10.00 min
IDF Curve	= Lisbon BK.IDF	Asc/Rec limb fact	= 1/1.66667

* Composite (Area/C) = [(0.040 x 0.15) + (0.700 x 0.20) + (0.890 x 0.90)] / 1.630



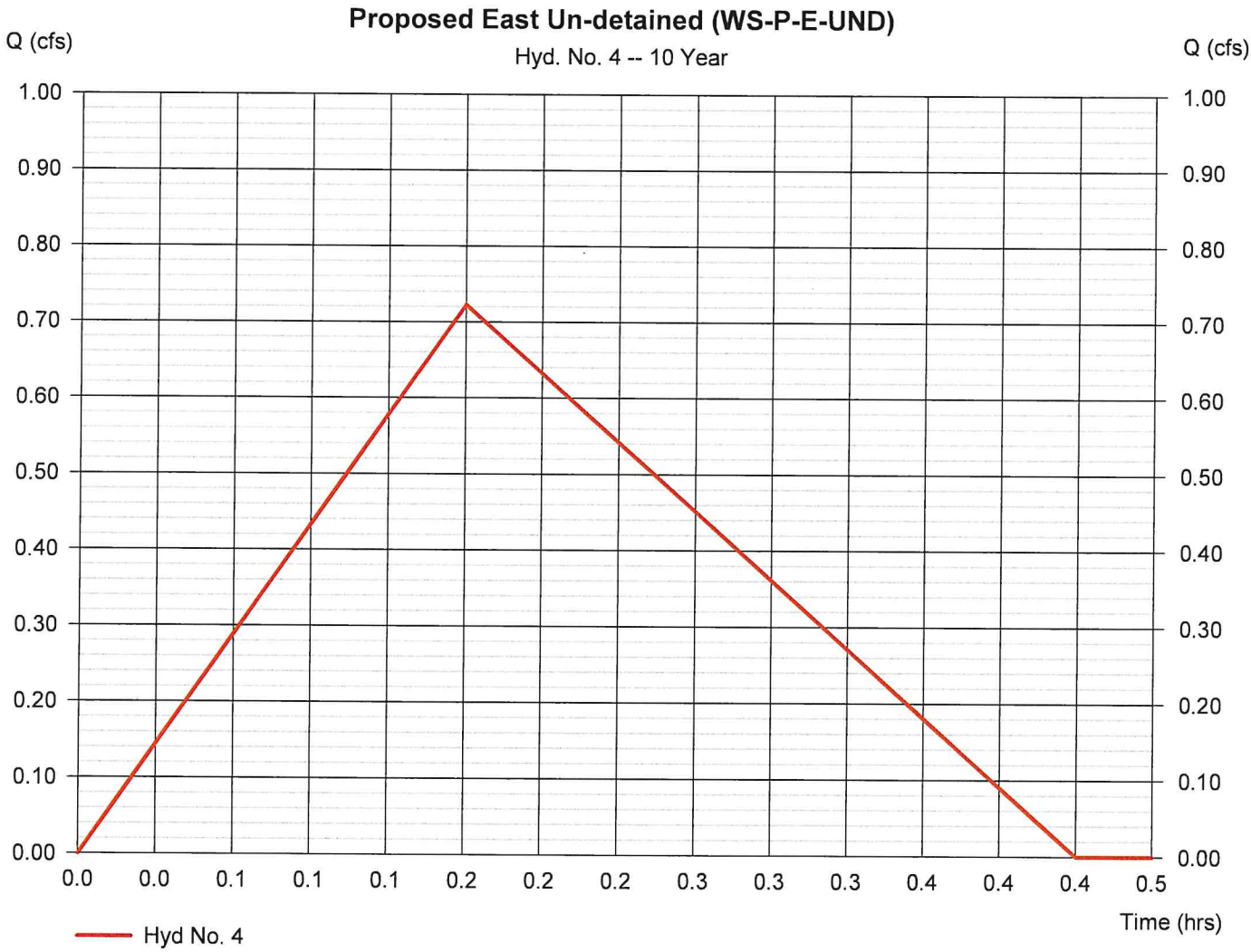
Hydrograph Report

Hyd. No. 4

Proposed East Un-detained (WS-P-E-UND)

Hydrograph type	= Rational	Peak discharge	= 0.722 cfs
Storm frequency	= 10 yrs	Time to peak	= 0.17 hrs
Time interval	= 1 min	Hyd. volume	= 578 cuft
Drainage area	= 0.760 ac	Runoff coeff.	= 0.18*
Intensity	= 5.281 in/hr	Tc by User	= 10.00 min
IDF Curve	= Lisbon BK.IDF	Asc/Rec limb fact	= 1/1.66667

* Composite (Area/C) = [(0.370 x 0.15) + (0.390 x 0.20)] / 0.760



Hydrograph Report

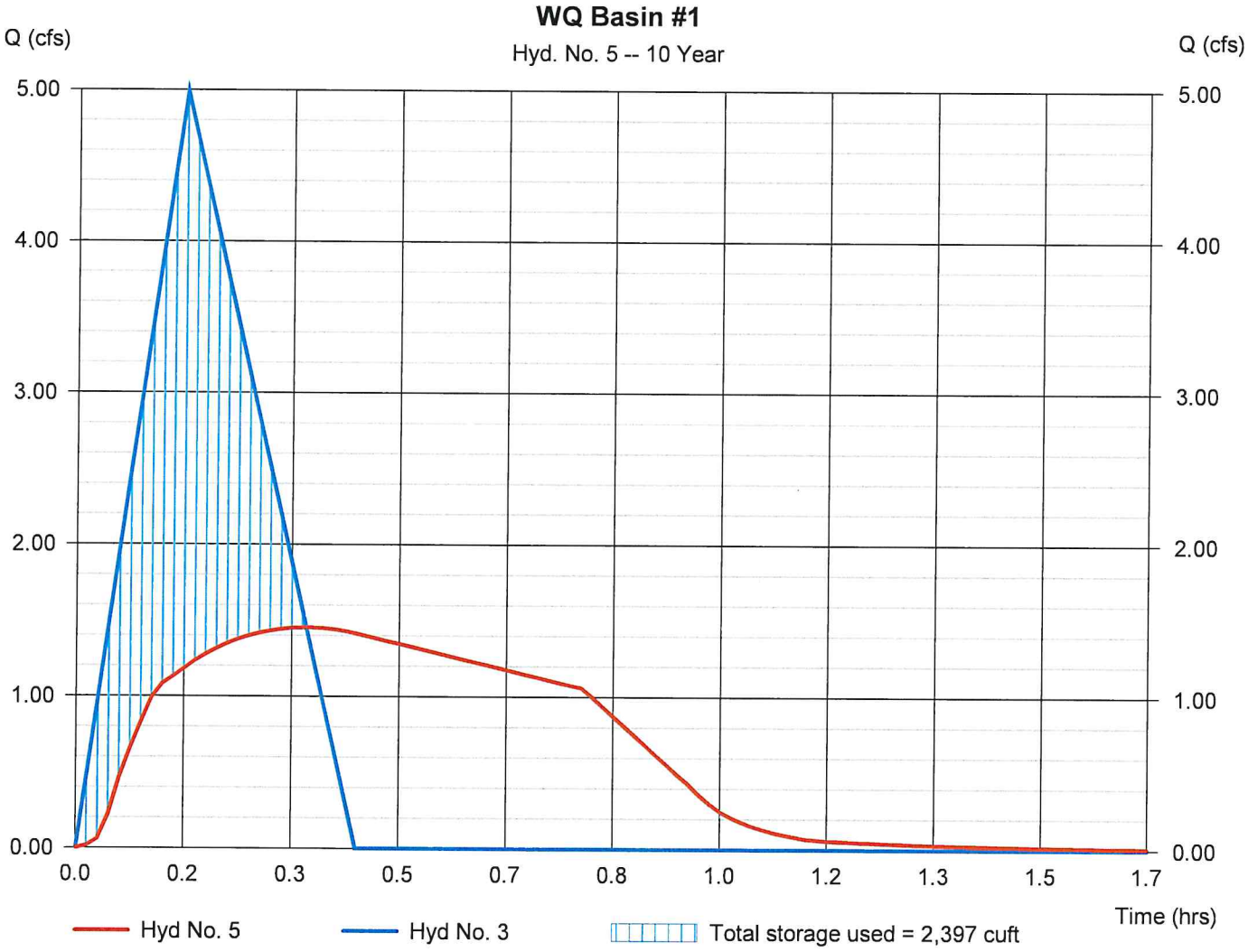
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Monday, 03 / 15 / 2021

Hyd. No. 5

WQ Basin #1

Hydrograph type	= Reservoir	Peak discharge	= 1.453 cfs
Storm frequency	= 10 yrs	Time to peak	= 0.35 hrs
Time interval	= 1 min	Hyd. volume	= 3,893 cuft
Inflow hyd. No.	= 3 - Proposed East Detained (WSAP-EDET)	Max. Elevation	= 87.11 ft
Reservoir name	= WQ BASIN #1	Max. Storage	= 2,397 cuft

Storage Indication method used.



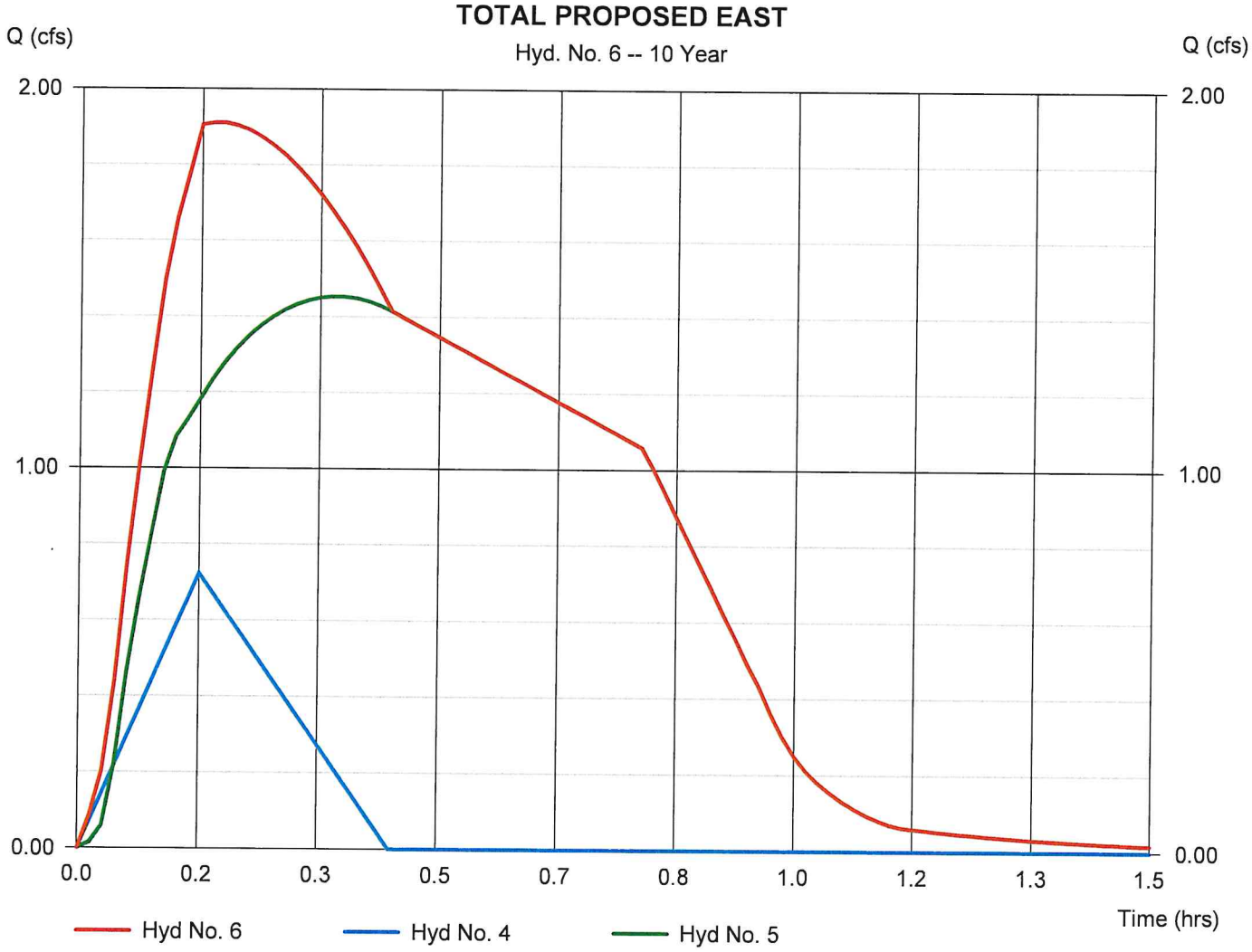
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Monday, 03 / 15 / 2021

Hyd. No. 6

TOTAL PROPOSED EAST

Hydrograph type	= Combine	Peak discharge	= 1.911 cfs
Storm frequency	= 10 yrs	Time to peak	= 0.18 hrs
Time interval	= 1 min	Hyd. volume	= 4,457 cuft
Inflow hyds.	= 4, 5	Contrib. drain. area	= 0.760 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021

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	Rational	4.430	1	10	3,544	------	------	------	Existing WS (WS E)
2	Rational	0.392	1	5	157	------	------	------	Proposed West Un-detained (WS-P-
3	Rational	6.007	1	10	4,806	------	------	------	Proposed East Detained (WS-P-E-DE
4	Rational	0.869	1	10	695	------	------	------	Proposed East Un-detained (WS-P-E-
5	Reservoir	1.574	1	22	4,685	3	87.52	3,047	WQ Basin #1
6	Combine	2.121	1	11	5,363	4, 5	------	------	TOTAL PROPOSED EAST

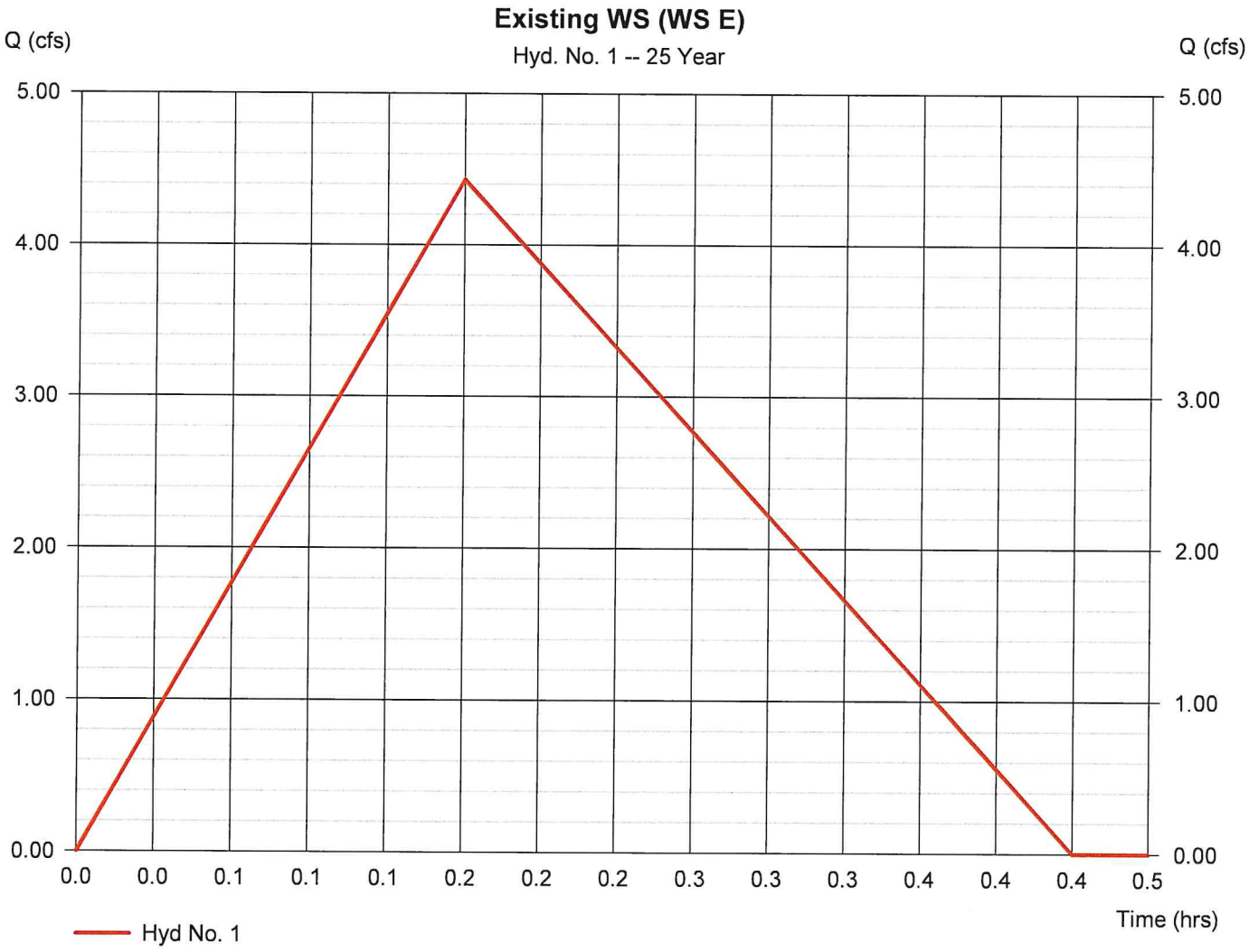
Hydrograph Report

Hyd. No. 1

Existing WS (WS E)

Hydrograph type	= Rational	Peak discharge	= 4.430 cfs
Storm frequency	= 25 yrs	Time to peak	= 0.17 hrs
Time interval	= 1 min	Hyd. volume	= 3,544 cuft
Drainage area	= 2.490 ac	Runoff coeff.	= 0.28*
Intensity	= 6.354 in/hr	Tc by User	= 10.00 min
IDF Curve	= Lisbon BK.IDF	Asc/Rec limb fact	= 1/1.66667

* Composite (Area/C) = [(0.830 x 0.15) + (1.290 x 0.20) + (0.070 x 0.80) + (0.300 x 0.90)] / 2.490



Hydrograph Report

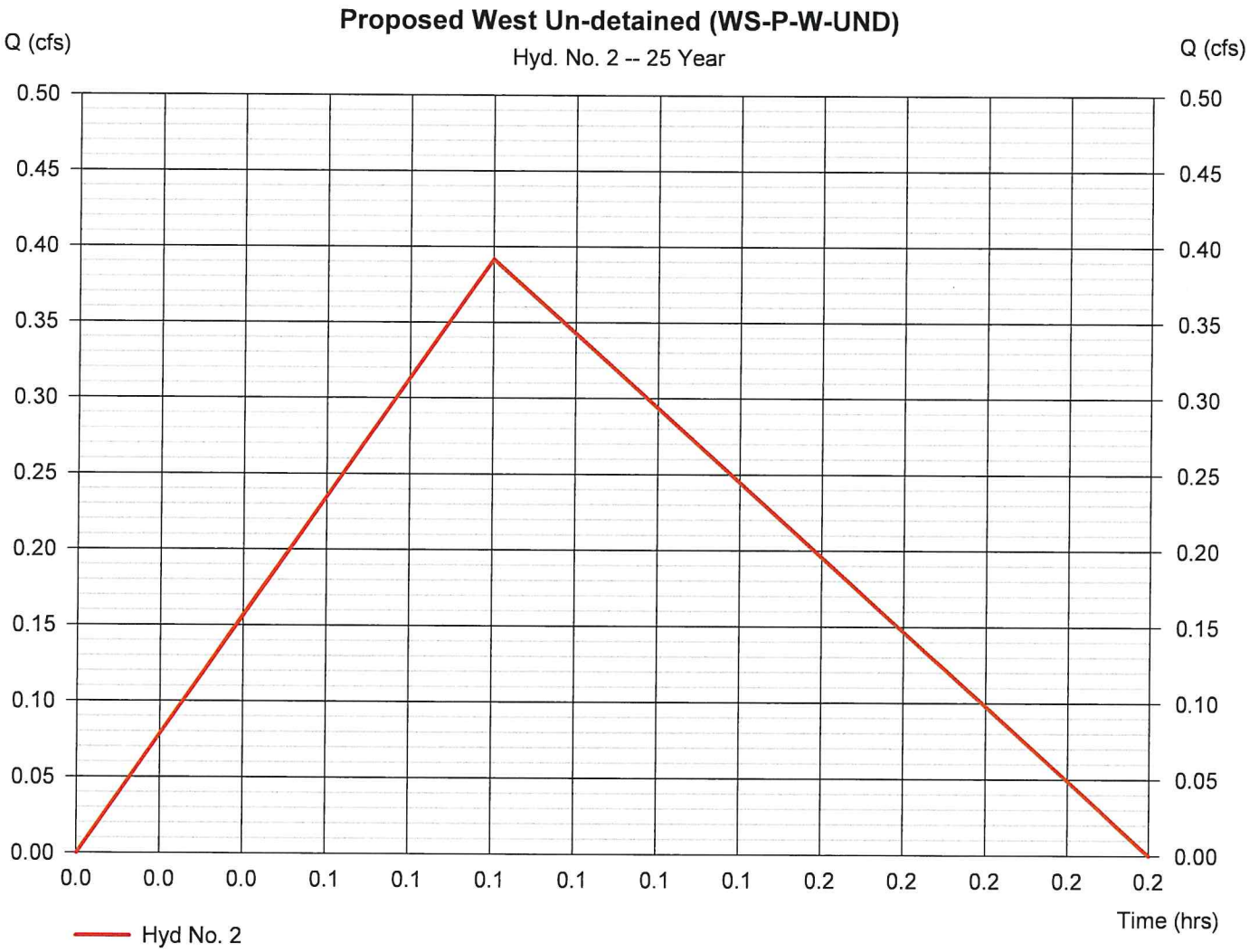
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Monday, 03 / 15 / 2021

Hyd. No. 2

Proposed West Un-detained (WS-P-W-UND)

Hydrograph type	= Rational	Peak discharge	= 0.392 cfs
Storm frequency	= 25 yrs	Time to peak	= 0.08 hrs
Time interval	= 1 min	Hyd. volume	= 157 cuft
Drainage area	= 0.080 ac	Runoff coeff.	= 0.55*
Intensity	= 8.899 in/hr	Tc by User	= 5.00 min
IDF Curve	= Lisbon BK.IDF	Asc/Rec limb fact	= 1/1.66667

* Composite (Area/C) = + (0.040 x 0.20) + (0.040 x 0.90)] / 0.080



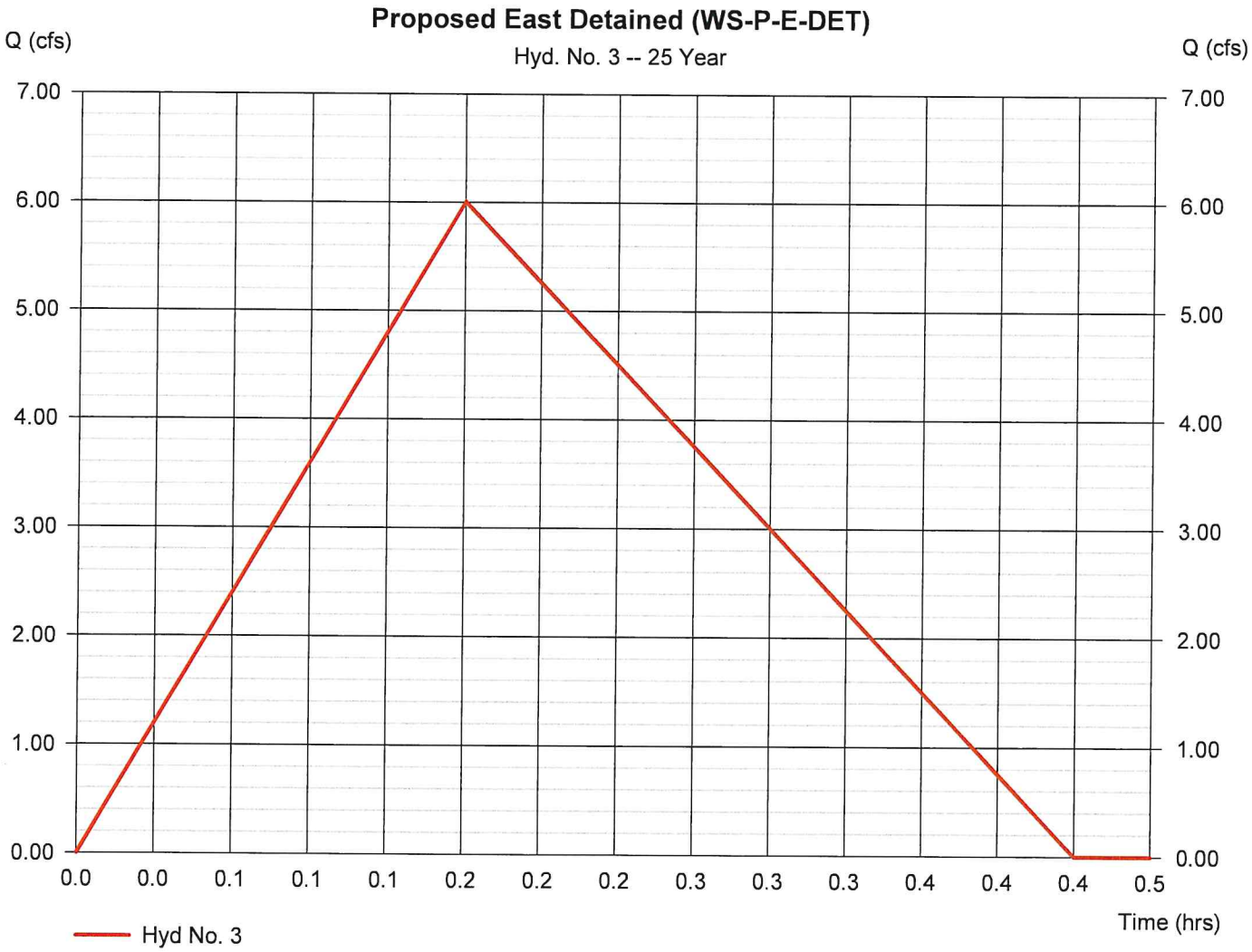
Hydrograph Report

Hyd. No. 3

Proposed East Detained (WS-P-E-DET)

Hydrograph type	= Rational	Peak discharge	= 6.007 cfs
Storm frequency	= 25 yrs	Time to peak	= 0.17 hrs
Time interval	= 1 min	Hyd. volume	= 4,806 cuft
Drainage area	= 1.630 ac	Runoff coeff.	= 0.58*
Intensity	= 6.354 in/hr	Tc by User	= 10.00 min
IDF Curve	= Lisbon BK.IDF	Asc/Rec limb fact	= 1/1.66667

* Composite (Area/C) = [(0.040 x 0.15) + (0.700 x 0.20) + (0.890 x 0.90)] / 1.630



Hydrograph Report

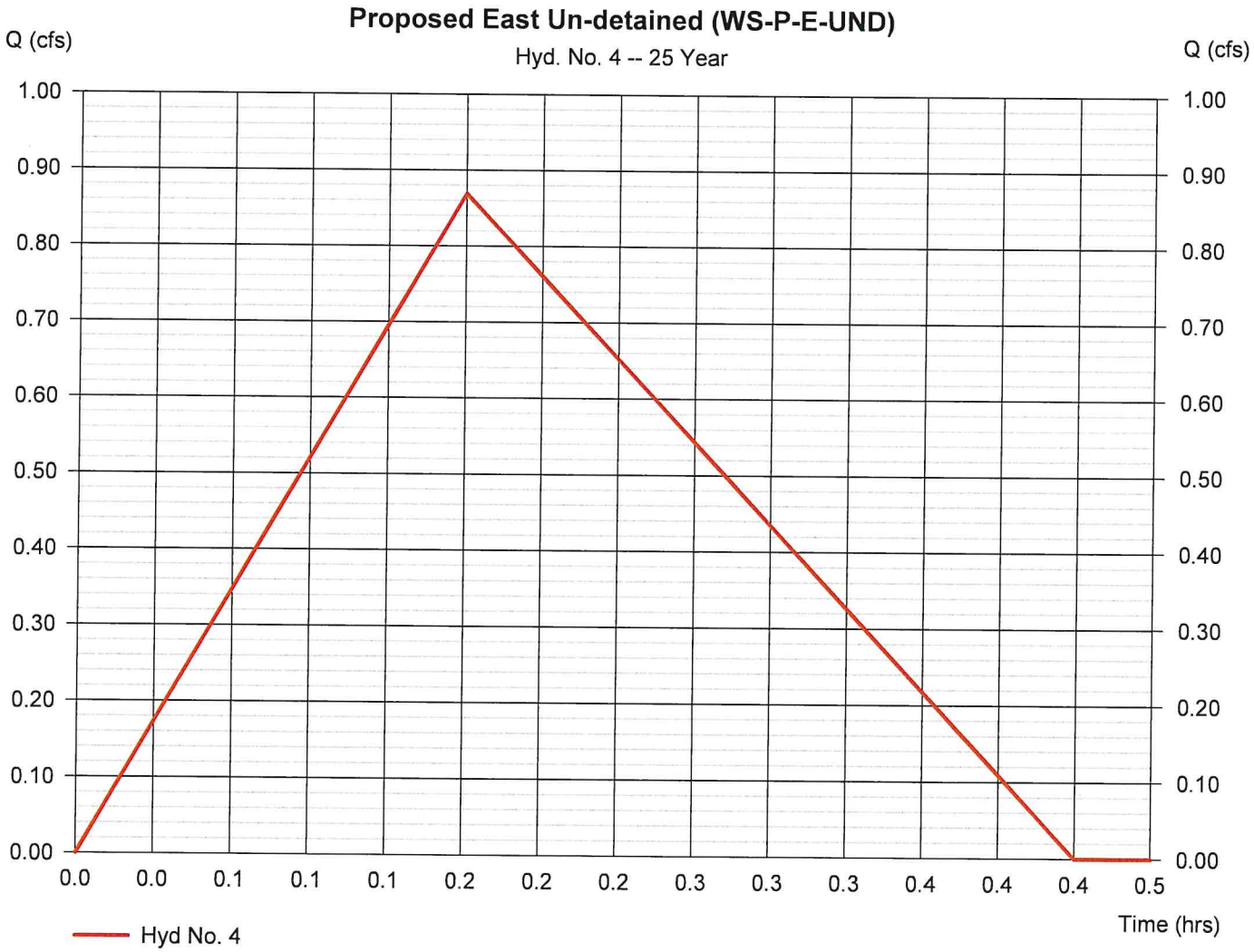
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 — Monday, 03 / 15 / 2021

Hyd. No. 4

Proposed East Un-detained (WS-P-E-UND)

Hydrograph type	= Rational	Peak discharge	= 0.869 cfs
Storm frequency	= 25 yrs	Time to peak	= 0.17 hrs
Time interval	= 1 min	Hyd. volume	= 695 cuft
Drainage area	= 0.760 ac	Runoff coeff.	= 0.18*
Intensity	= 6.354 in/hr	Tc by User	= 10.00 min
IDF Curve	= Lisbon BK.IDF	Asc/Rec limb fact	= 1/1.66667

* Composite (Area/C) = [(0.370 x 0.15) + (0.390 x 0.20)] / 0.760



Hydrograph Report

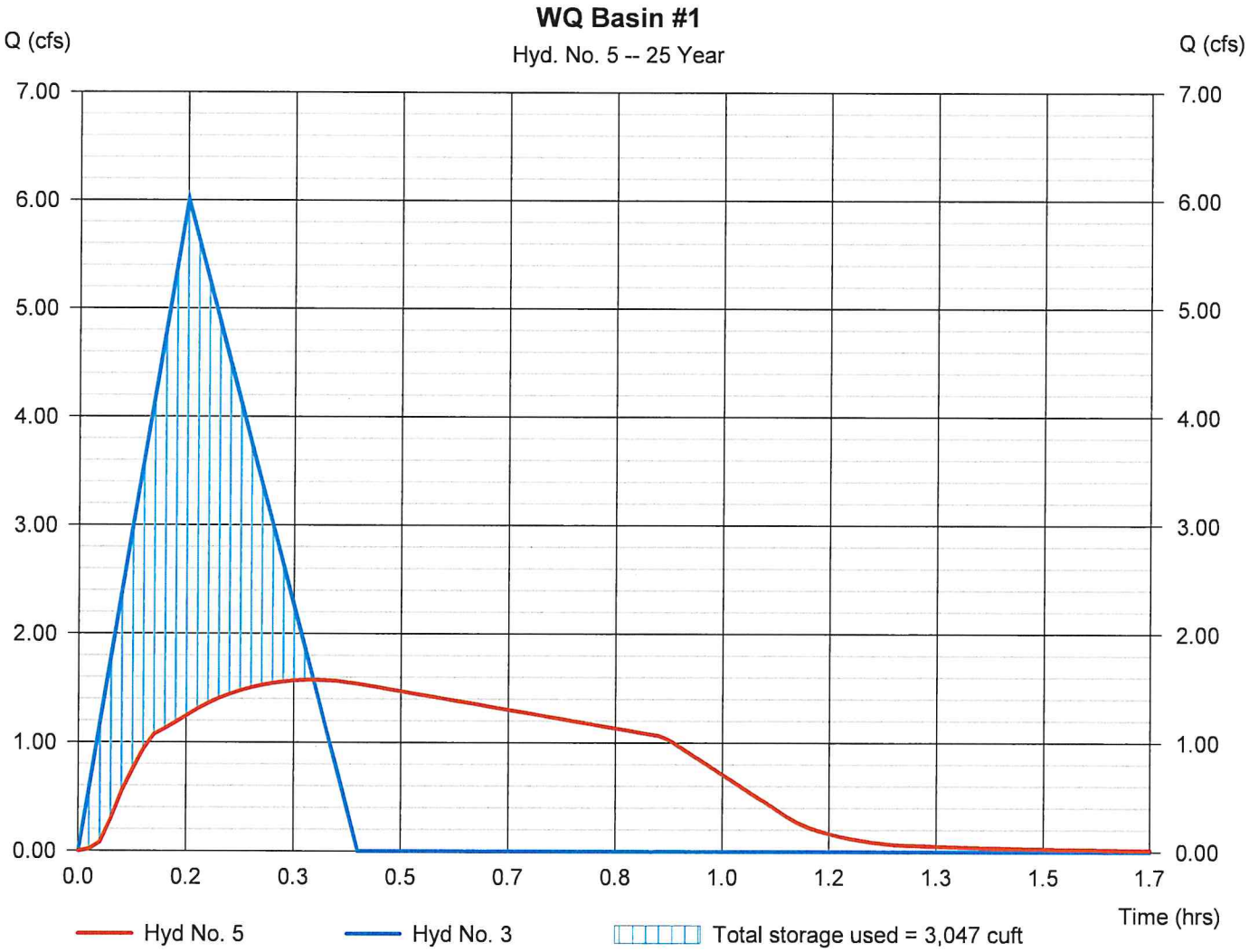
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 — Monday, 03 / 15 / 2021

Hyd. No. 5

WQ Basin #1

Hydrograph type	= Reservoir	Peak discharge	= 1.574 cfs
Storm frequency	= 25 yrs	Time to peak	= 0.37 hrs
Time interval	= 1 min	Hyd. volume	= 4,685 cuft
Inflow hyd. No.	= 3 - Proposed East Detained (WSP EIDET)	Max. Elevation	= 87.52 ft
Reservoir name	= WQ BASIN #1	Max. Storage	= 3,047 cuft

Storage Indication method used.

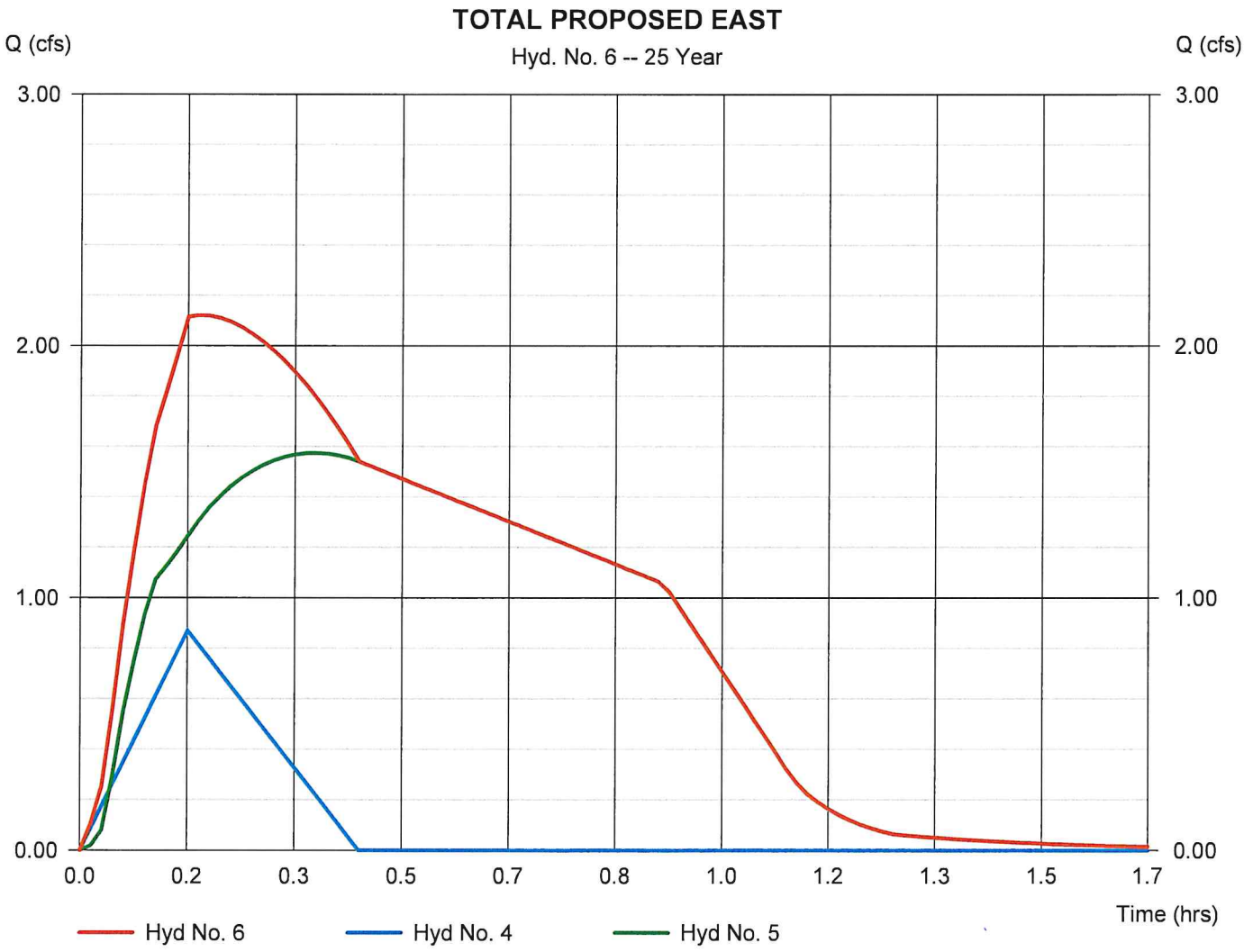


Hydrograph Report

Hyd. No. 6

TOTAL PROPOSED EAST

Hydrograph type	= Combine	Peak discharge	= 2.121 cfs
Storm frequency	= 25 yrs	Time to peak	= 0.18 hrs
Time interval	= 1 min	Hyd. volume	= 5,363 cuft
Inflow hyds.	= 4, 5	Contrib. drain. area	= 0.760 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021

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	Rational	5.019	1	10	4,015	------	------	------	Existing WS (WS E)
2	Rational	0.444	1	5	178	------	------	------	Proposed West Un-detained (WS-P-
3	Rational	6.806	1	10	5,445	------	------	------	Proposed East Detained (WS-P-E-DE
4	Rational	0.985	1	10	788	------	------	------	Proposed East Un-detained (WS-P-E-
5	Reservoir	1.665	1	22	5,308	3	87.85	3,568	WQ Basin #1
6	Combine	2.284	1	11	6,076	4, 5	------	------	TOTAL PROPOSED EAST

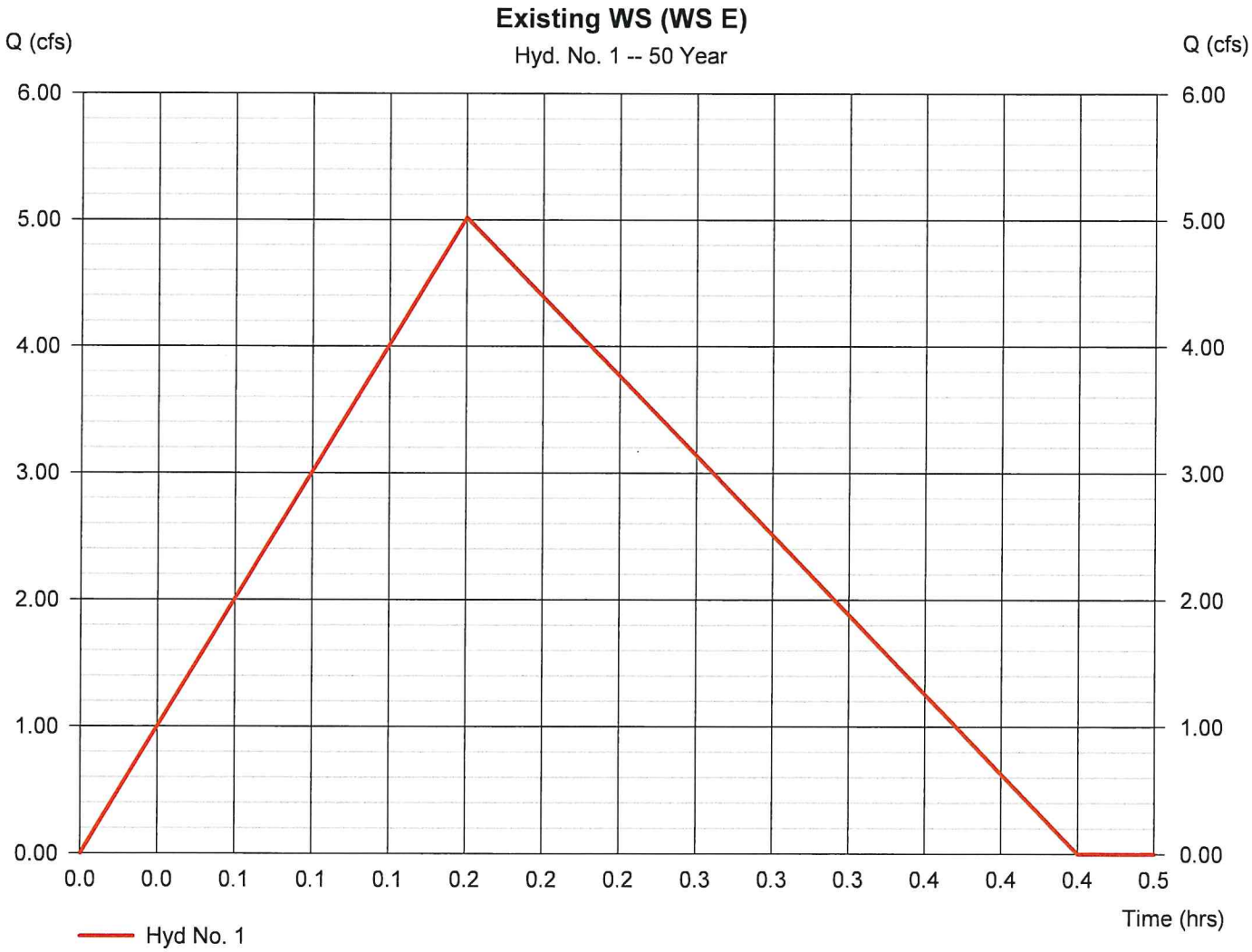
Hydrograph Report

Hyd. No. 1

Existing WS (WS E)

Hydrograph type	= Rational	Peak discharge	= 5.019 cfs
Storm frequency	= 50 yrs	Time to peak	= 0.17 hrs
Time interval	= 1 min	Hyd. volume	= 4,015 cuft
Drainage area	= 2.490 ac	Runoff coeff.	= 0.28*
Intensity	= 7.199 in/hr	Tc by User	= 10.00 min
IDF Curve	= Lisbon BK.IDF	Asc/Rec limb fact	= 1/1.66667

* Composite (Area/C) = [(0.830 x 0.15) + (1.290 x 0.20) + (0.070 x 0.80) + (0.300 x 0.90)] / 2.490



Hydrograph Report

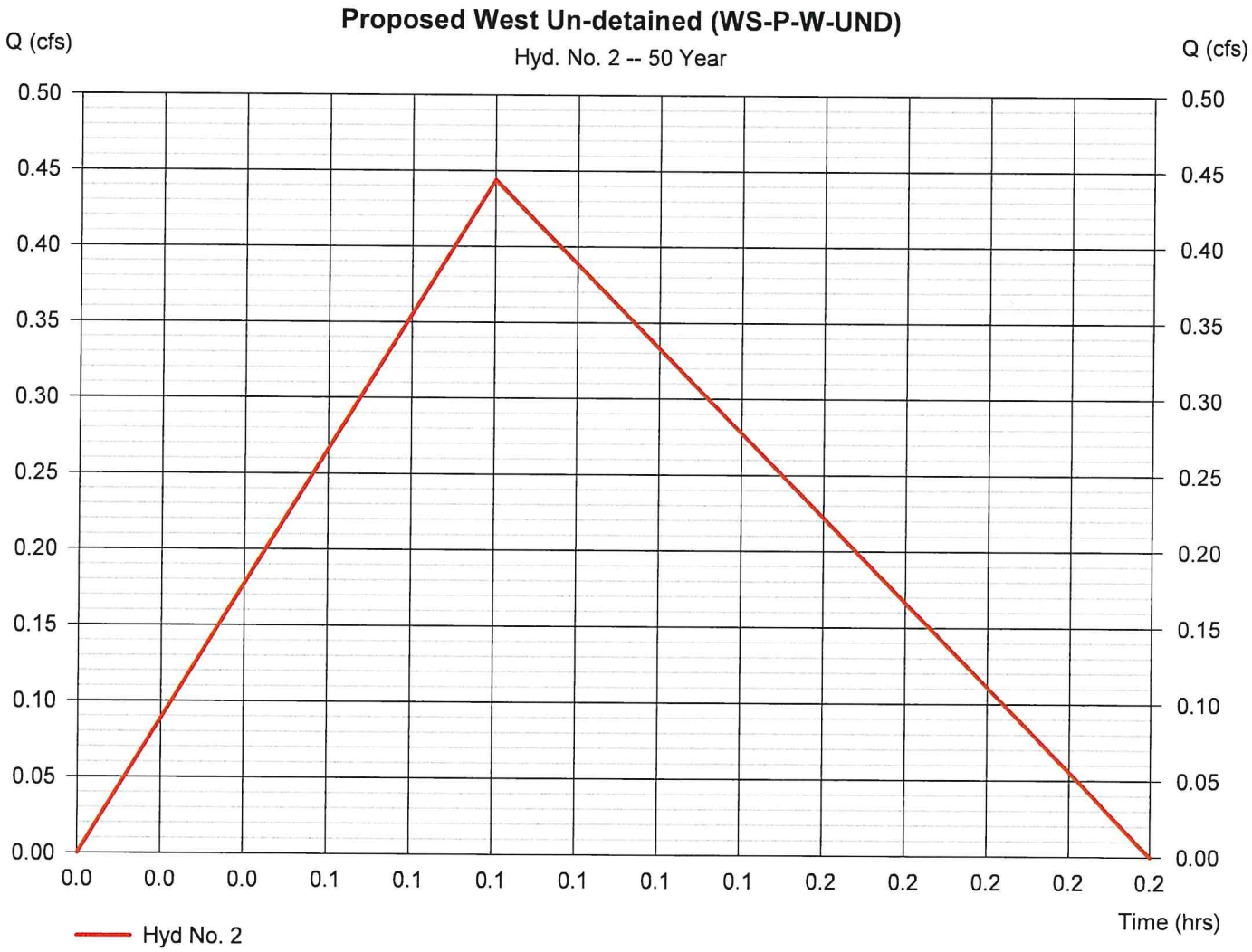
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 — Monday, 03 / 15 / 2021

Hyd. No. 2

Proposed West Un-detained (WS-P-W-UND)

Hydrograph type	= Rational	Peak discharge	= 0.444 cfs
Storm frequency	= 50 yrs	Time to peak	= 0.08 hrs
Time interval	= 1 min	Hyd. volume	= 178 cuft
Drainage area	= 0.080 ac	Runoff coeff.	= 0.55*
Intensity	= 10.089 in/hr	Tc by User	= 5.00 min
IDF Curve	= Lisbon BK.IDF	Asc/Rec limb fact	= 1/1.66667

* Composite (Area/C) = + (0.040 x 0.20) + (0.040 x 0.90)] / 0.080



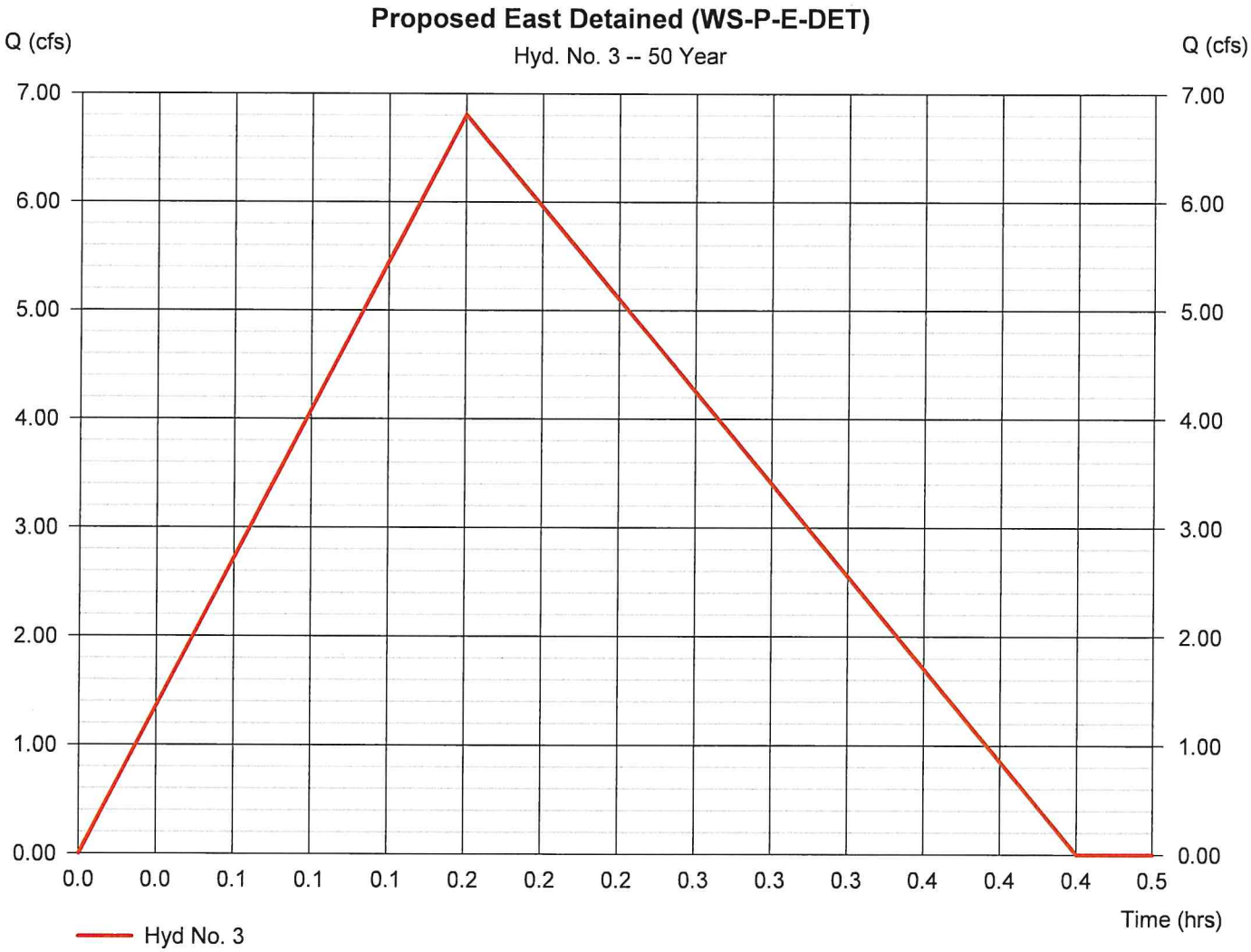
Hydrograph Report

Hyd. No. 3

Proposed East Detained (WS-P-E-DET)

Hydrograph type	= Rational	Peak discharge	= 6.806 cfs
Storm frequency	= 50 yrs	Time to peak	= 0.17 hrs
Time interval	= 1 min	Hyd. volume	= 5,445 cuft
Drainage area	= 1.630 ac	Runoff coeff.	= 0.58*
Intensity	= 7.199 in/hr	Tc by User	= 10.00 min
IDF Curve	= Lisbon BK.IDF	Asc/Rec limb fact	= 1/1.66667

* Composite (Area/C) = [(0.040 x 0.15) + (0.700 x 0.20) + (0.890 x 0.90)] / 1.630



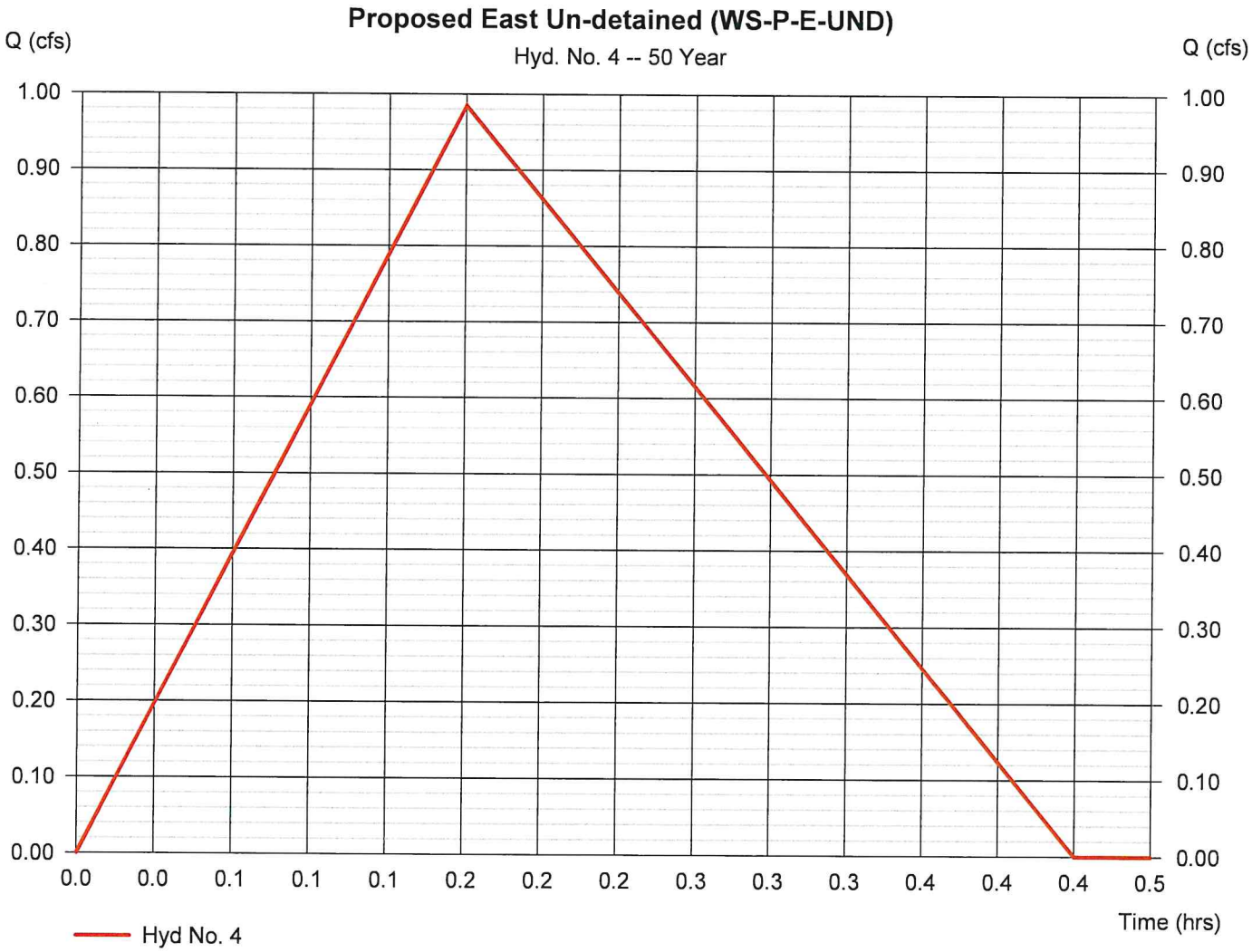
Hydrograph Report

Hyd. No. 4

Proposed East Un-detained (WS-P-E-UND)

Hydrograph type	= Rational	Peak discharge	= 0.985 cfs
Storm frequency	= 50 yrs	Time to peak	= 0.17 hrs
Time interval	= 1 min	Hyd. volume	= 788 cuft
Drainage area	= 0.760 ac	Runoff coeff.	= 0.18*
Intensity	= 7.199 in/hr	Tc by User	= 10.00 min
IDF Curve	= Lisbon BK.IDF	Asc/Rec limb fact	= 1/1.66667

* Composite (Area/C) = [(0.370 x 0.15) + (0.390 x 0.20)] / 0.760



Hydrograph Report

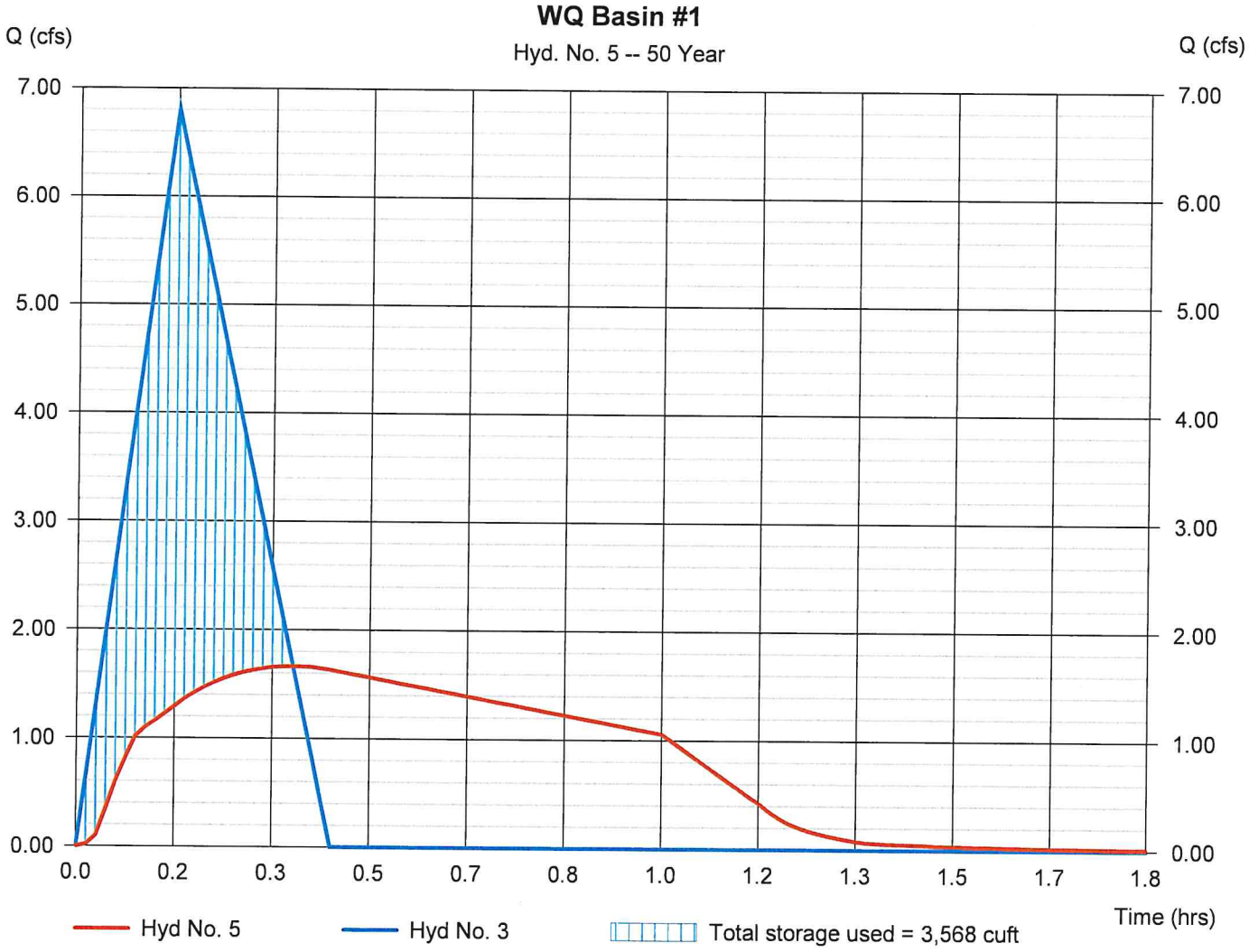
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 — Monday, 03 / 15 / 2021

Hyd. No. 5

WQ Basin #1

Hydrograph type	= Reservoir	Peak discharge	= 1.665 cfs
Storm frequency	= 50 yrs	Time to peak	= 0.37 hrs
Time interval	= 1 min	Hyd. volume	= 5,308 cuft
Inflow hyd. No.	= 3 - Proposed East Detained (WSAP-EDET)	Max. Elevation	= 87.85 ft
Reservoir name	= WQ BASIN #1	Max. Storage	= 3,568 cuft

Storage Indication method used.

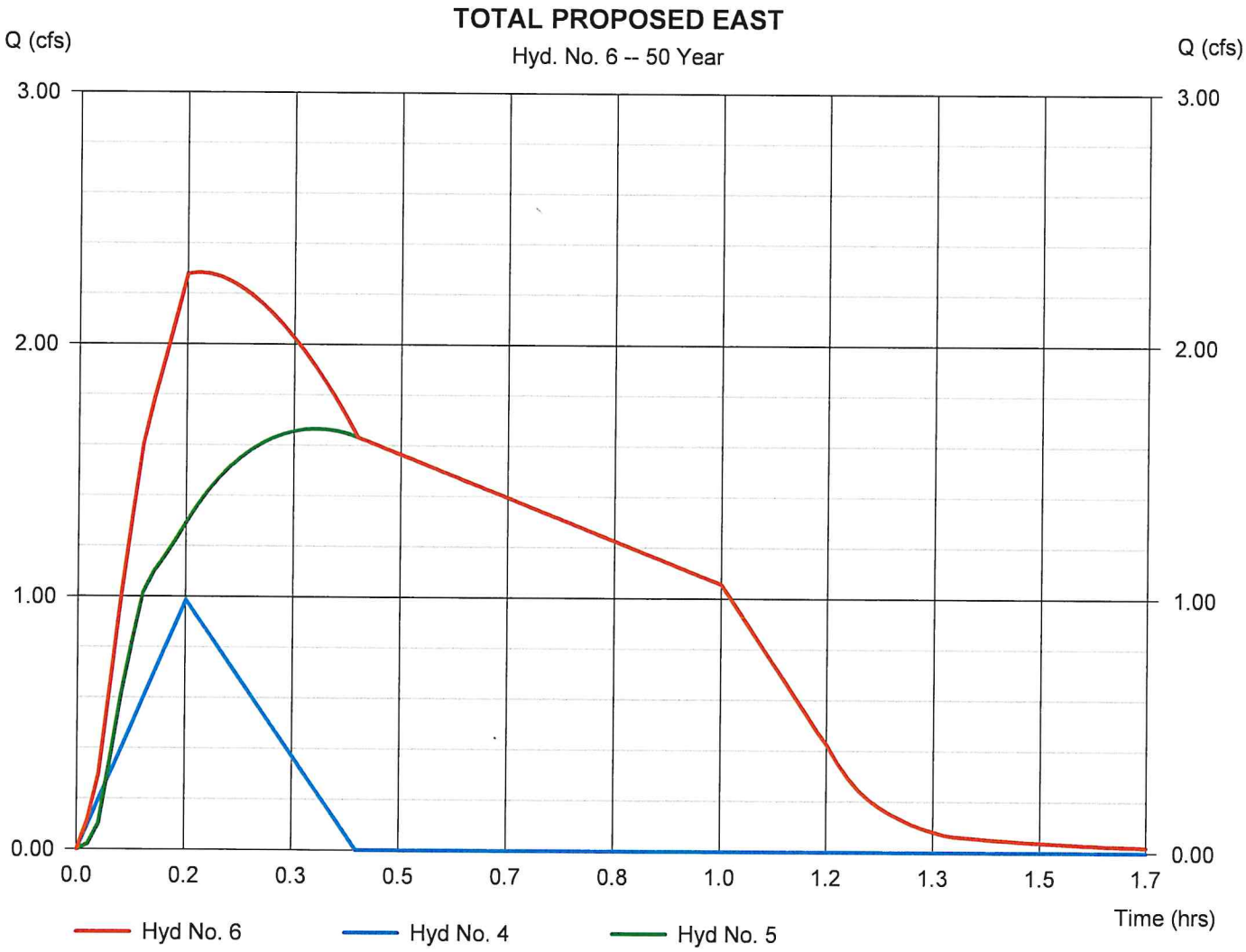


Hydrograph Report

Hyd. No. 6

TOTAL PROPOSED EAST

Hydrograph type	= Combine	Peak discharge	= 2.284 cfs
Storm frequency	= 50 yrs	Time to peak	= 0.18 hrs
Time interval	= 1 min	Hyd. volume	= 6,076 cuft
Inflow hyds.	= 4, 5	Contrib. drain. area	= 0.760 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021

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	Rational	5.611	1	10	4,489	------	------	------	Existing WS (WS E)
2	Rational	0.496	1	5	198	------	------	------	Proposed West Un-detained (WS-P-
3	Rational	7.609	1	10	6,087	------	------	------	Proposed East Detained (WS-P-E-DE
4	Rational	1.101	1	10	881	------	------	------	Proposed East Un-detained (WS-P-E-
5	Reservoir	1.734	1	22	5,934	3	88.11	4,099	WQ Basin #1
6	Combine	2.446	1	11	6,793	4, 5	------	------	TOTAL PROPOSED EAST

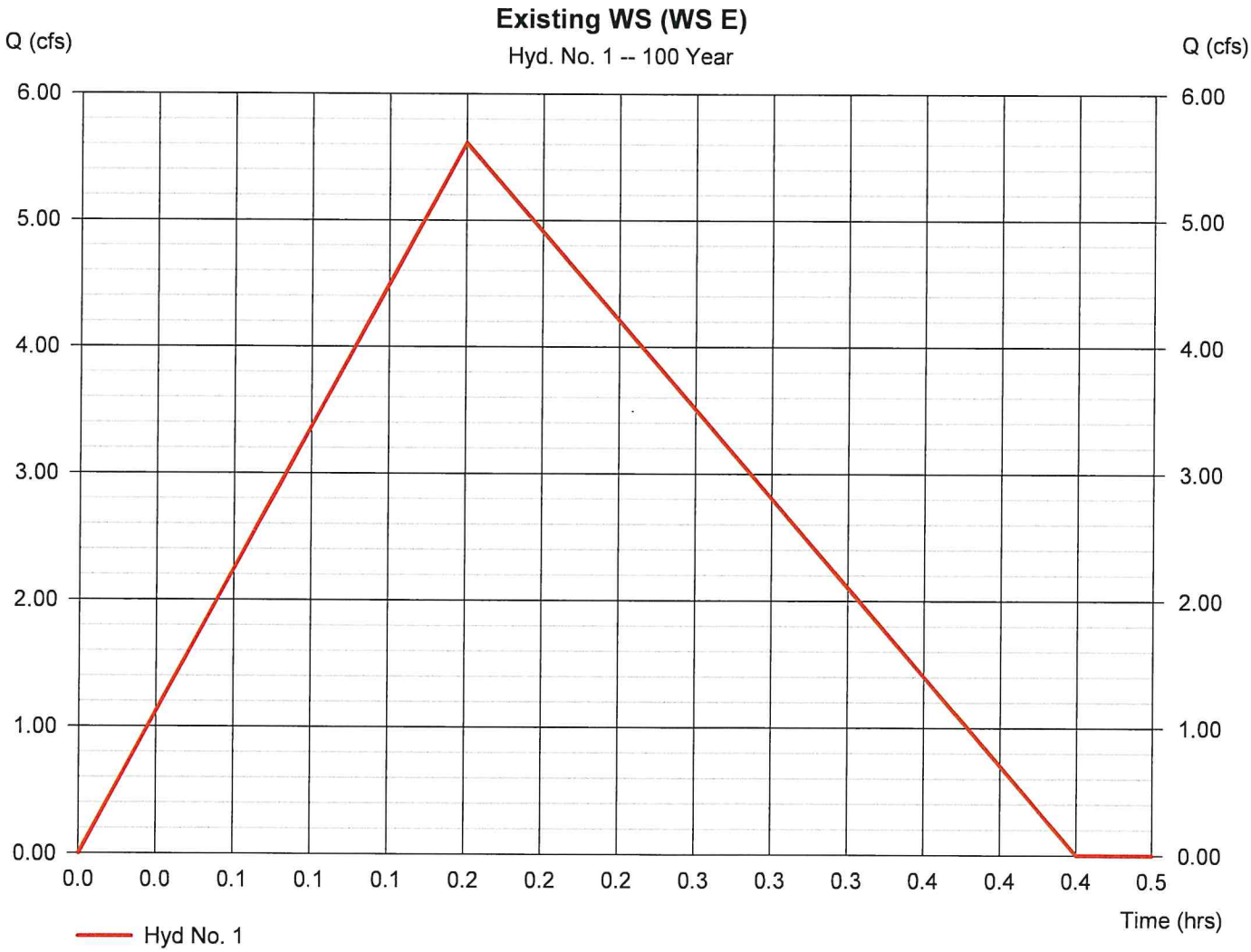
Hydrograph Report

Hyd. No. 1

Existing WS (WS E)

Hydrograph type	= Rational	Peak discharge	= 5.611 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.17 hrs
Time interval	= 1 min	Hyd. volume	= 4,489 cuft
Drainage area	= 2.490 ac	Runoff coeff.	= 0.28*
Intensity	= 8.048 in/hr	Tc by User	= 10.00 min
IDF Curve	= Lisbon BK.IDF	Asc/Rec limb fact	= 1/1.66667

* Composite (Area/C) = [(0.830 x 0.15) + (1.290 x 0.20) + (0.070 x 0.80) + (0.300 x 0.90)] / 2.490



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021

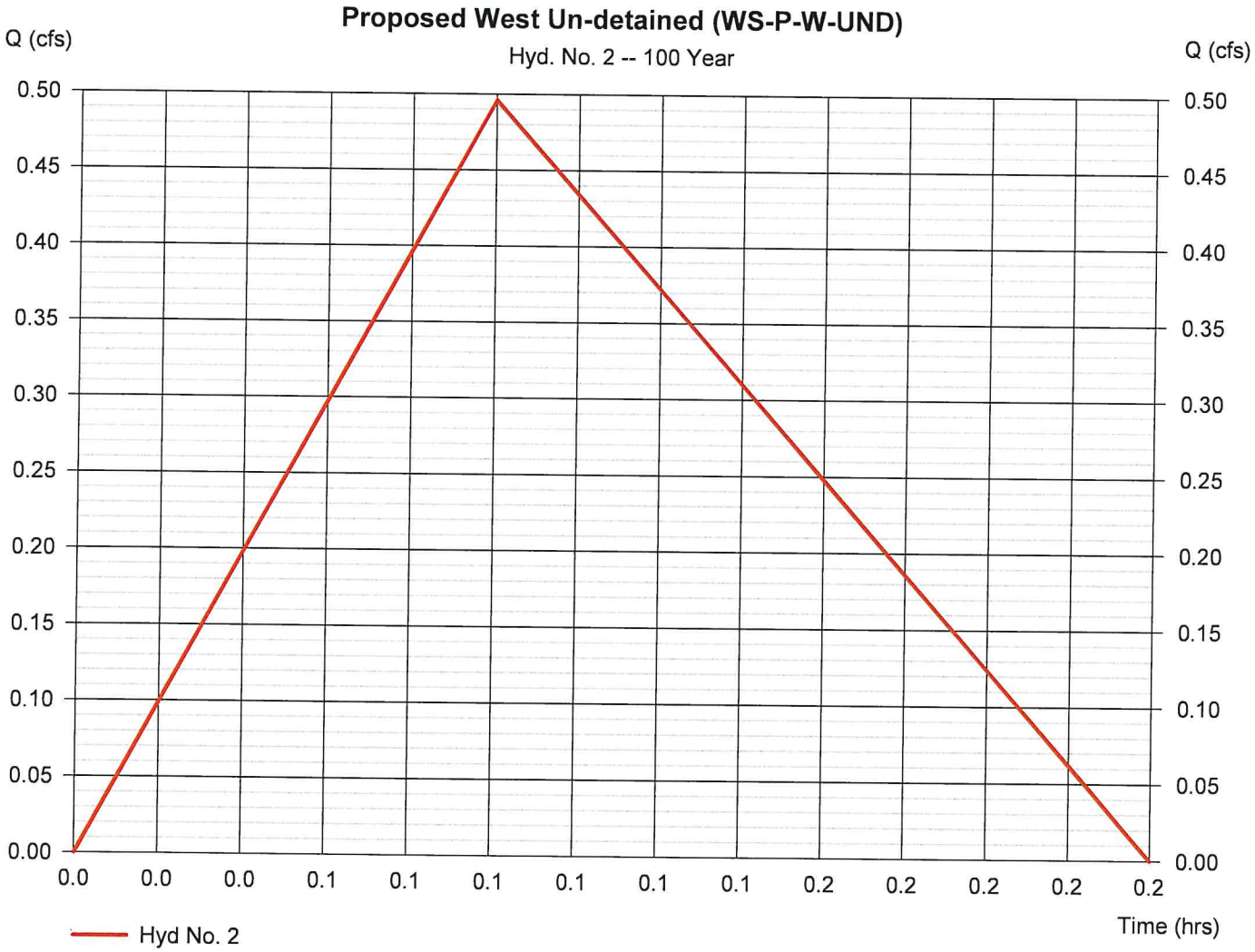
Monday, 03 / 15 / 2021

Hyd. No. 2

Proposed West Un-detained (WS-P-W-UND)

Hydrograph type	= Rational	Peak discharge	= 0.496 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.08 hrs
Time interval	= 1 min	Hyd. volume	= 198 cuft
Drainage area	= 0.080 ac	Runoff coeff.	= 0.55*
Intensity	= 11.272 in/hr	Tc by User	= 5.00 min
IDF Curve	= Lisbon BK.IDF	Asc/Rec limb fact	= 1/1.66667

* Composite (Area/C) = + (0.040 x 0.20) + (0.040 x 0.90)] / 0.080



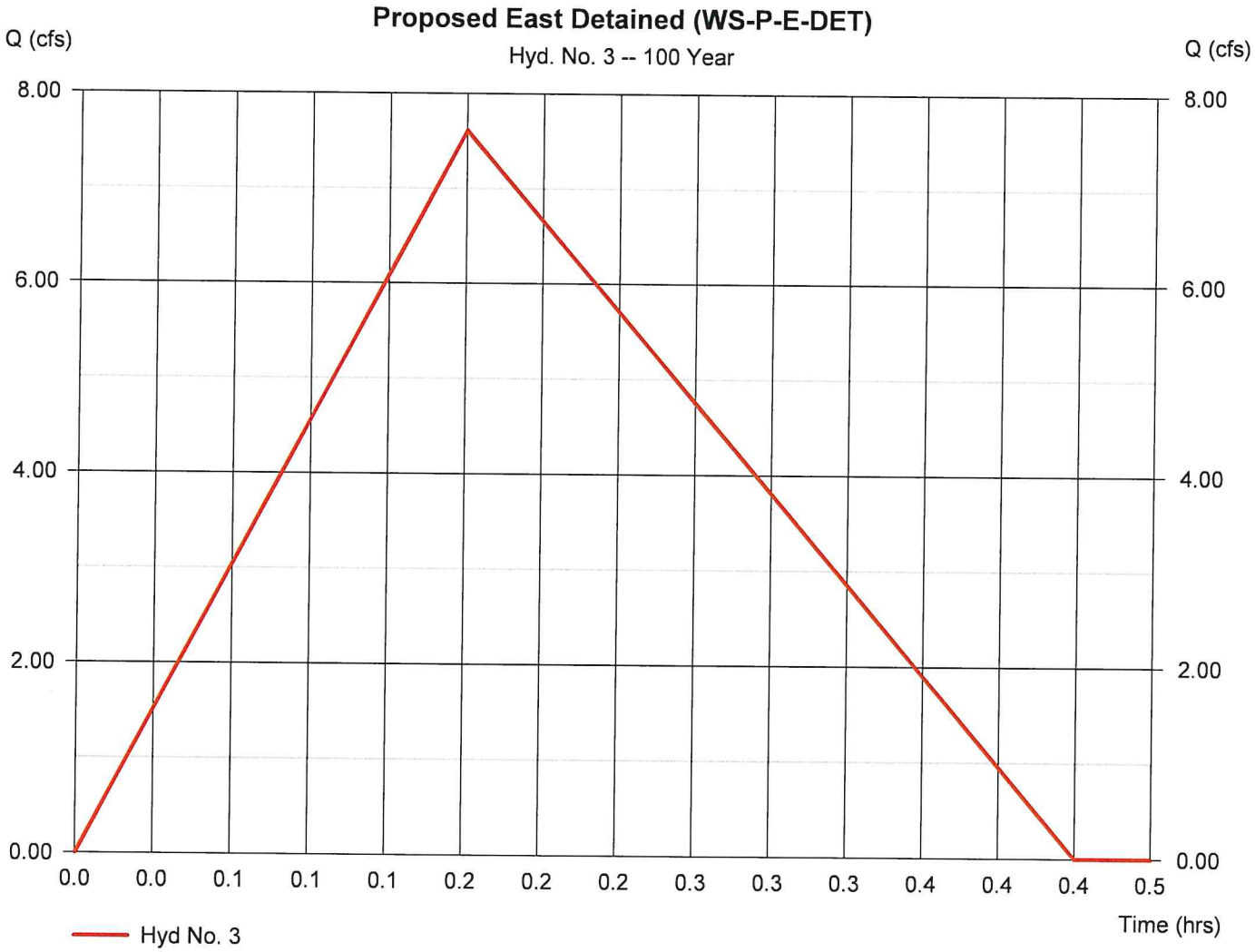
Hydrograph Report

Hyd. No. 3

Proposed East Detained (WS-P-E-DET)

Hydrograph type	= Rational	Peak discharge	= 7.609 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.17 hrs
Time interval	= 1 min	Hyd. volume	= 6,087 cuft
Drainage area	= 1.630 ac	Runoff coeff.	= 0.58*
Intensity	= 8.048 in/hr	Tc by User	= 10.00 min
IDF Curve	= Lisbon BK.IDF	Asc/Rec limb fact	= 1/1.66667

* Composite (Area/C) = [(0.040 x 0.15) + (0.700 x 0.20) + (0.890 x 0.90)] / 1.630



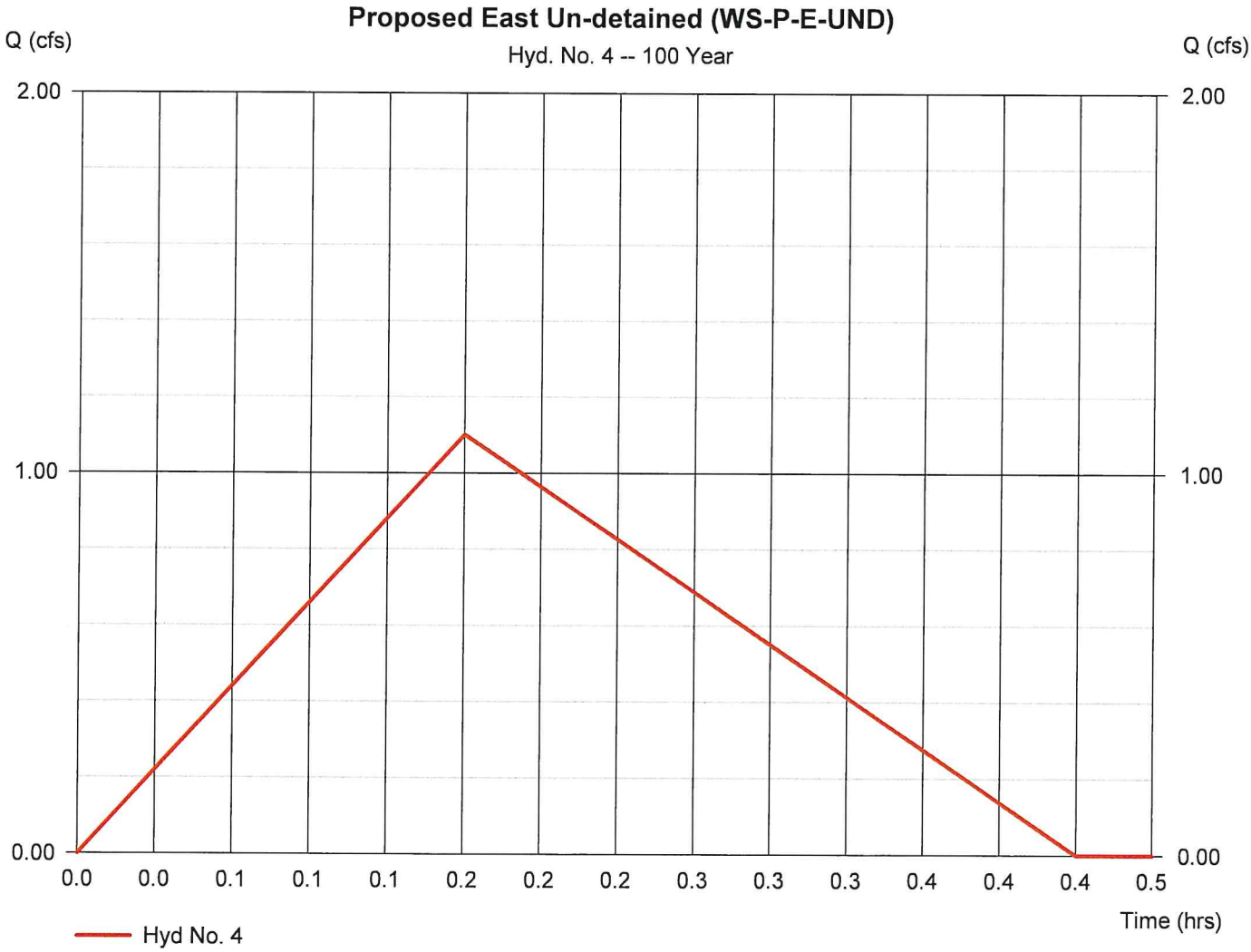
Hydrograph Report

Hyd. No. 4

Proposed East Un-detained (WS-P-E-UND)

Hydrograph type	= Rational	Peak discharge	= 1.101 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.17 hrs
Time interval	= 1 min	Hyd. volume	= 881 cuft
Drainage area	= 0.760 ac	Runoff coeff.	= 0.18*
Intensity	= 8.048 in/hr	Tc by User	= 10.00 min
IDF Curve	= Lisbon BK.IDF	Asc/Rec limb fact	= 1/1.66667

* Composite (Area/C) = [(0.370 x 0.15) + (0.390 x 0.20)] / 0.760



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021

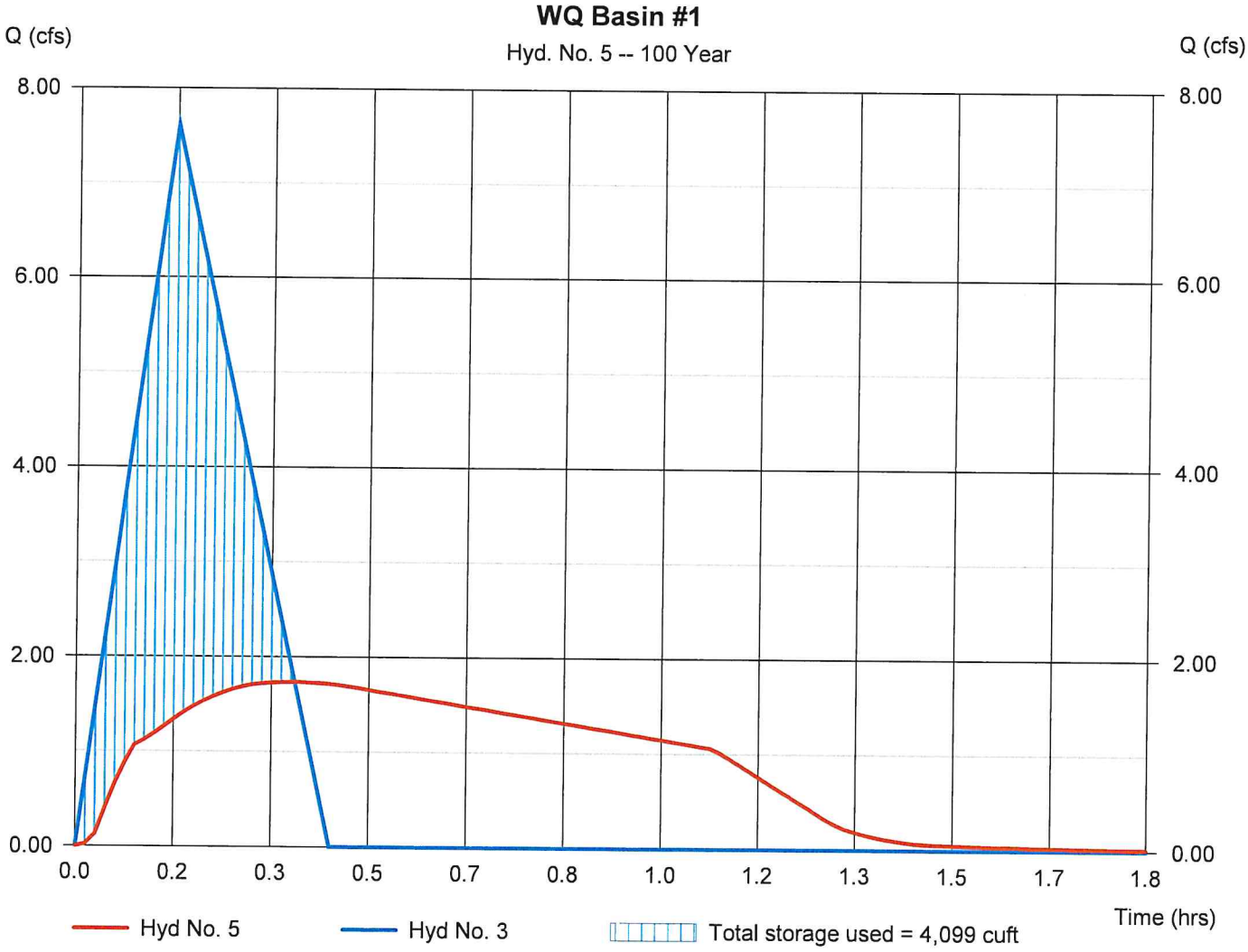
Monday, 03 / 15 / 2021

Hyd. No. 5

WQ Basin #1

Hydrograph type	= Reservoir	Peak discharge	= 1.734 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.37 hrs
Time interval	= 1 min	Hyd. volume	= 5,934 cuft
Inflow hyd. No.	= 3 - Proposed East Detained (WSAP-EDET)	Max. Elevation	= 88.11 ft
Reservoir name	= WQ BASIN #1	Max. Storage	= 4,099 cuft

Storage Indication method used.



Hydrograph Report

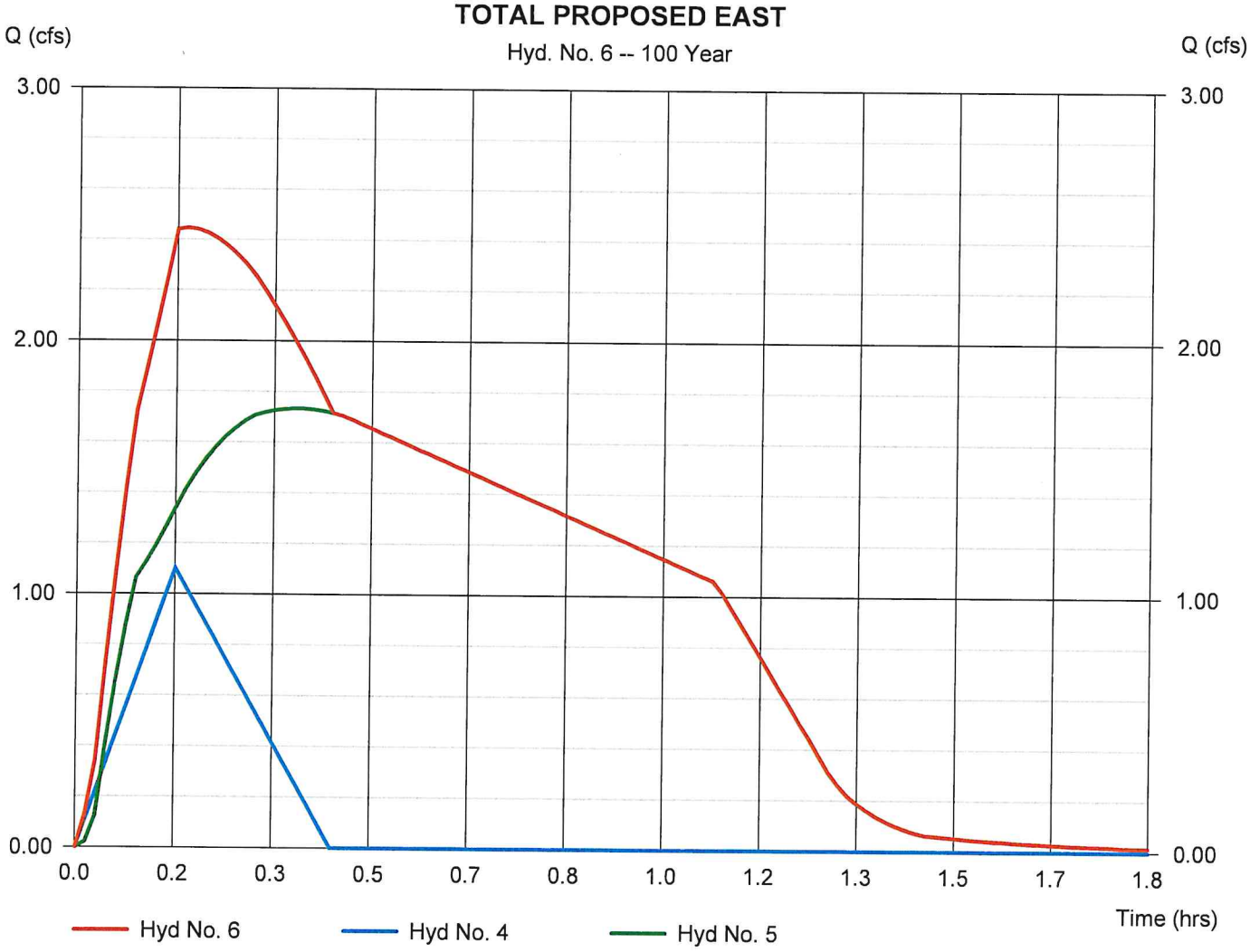
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021

Monday, 03 / 15 / 2021

Hyd. No. 6

TOTAL PROPOSED EAST

Hydrograph type	= Combine	Peak discharge	= 2.446 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.18 hrs
Time interval	= 1 min	Hyd. volume	= 6,793 cuft
Inflow hyds.	= 4, 5	Contrib. drain. area	= 0.760 ac



Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	17.5631	3.5000	0.6950	--------
2	21.2564	3.6000	0.6962	--------
3	0.0000	0.0000	0.0000	--------
5	26.4301	2.9000	0.6927	--------
10	31.2058	3.0000	0.6926	--------
25	36.8057	2.9000	0.6869	--------
50	41.8325	2.9000	0.6881	--------
100	46.6355	2.9000	0.6870	--------

File name: Lisbon BK.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	3.97	2.88	2.31	1.96	1.71	1.53	1.39	1.28	1.18	1.11	1.04	0.98
2	4.75	3.45	2.78	2.35	2.06	1.84	1.67	1.53	1.42	1.33	1.25	1.18
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	6.31	4.50	3.58	3.02	2.63	2.35	2.13	1.96	1.81	1.69	1.59	1.50
10	7.39	5.28	4.22	3.56	3.10	2.77	2.51	2.31	2.14	2.00	1.87	1.77
25	8.90	6.35	5.07	4.28	3.74	3.34	3.03	2.78	2.58	2.41	2.27	2.14
50	10.09	7.20	5.75	4.85	4.23	3.78	3.43	3.15	2.92	2.73	2.56	2.42
100	11.27	8.05	6.43	5.43	4.74	4.23	3.84	3.52	3.27	3.05	2.87	2.71

Tc = time in minutes. Values may exceed 60.

Precip. file name: Lisbon BK.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	2.84	3.39	0.00	4.29	5.04	6.08	6.85	7.67
SCS 6-Hr	1.90	2.27	0.00	2.87	3.36	4.05	4.56	5.11
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

Attachment 4

Hydraulic Analysis

Pipe to Pipe Design Analysis

Using

Rational Method and Manning Equation

BURGER KING - LISBON
PROPOSED DRAINAGE AREAS
Storm Drain Systems

March 8, 2021

Area #	Paved/Roof Area (S.F.)	Landscape Area (S.F.)	Wooded Area (S.F.)	Total Area (S.F.)	Paved/Roof Area (Acre)	Landscape Area (Acre)	Wooded Area (S.F.)	Total Area (Acre)
C.B. #2	10081	8982	0	19063	0.231	0.206	0.000	0.438
C.B. #3	3316	1466	0	4782	0.076	0.034	0.000	0.110
C.B. #4	8145	1920	0	10065	0.187	0.044	0.000	0.231
C.B. #5	7647	1349	0	8996	0.176	0.031	0.000	0.207
C.B. #6	5802	3428	0	9230	0.133	0.079	0.000	0.212
D.M.H. #7	0	0	0	0	0.000	0.000	0.000	0.000
C.B. #8	3799	4099	0	7898	0.087	0.094	0.000	0.181
Total =	**38790**	**21244**	**0**	**60034**	**0.890**	**0.488**	**0.000**	**1.378**

STORM DRAINAGE SYSTEM DESIGN COMPUTATION SHEET

F. A. Hesketh & Associates, Inc.

Civil & Traffic Engineers - Surveyors

Planners - Landscape Architects

JOB: 106-110 River Road, Lisbon, CT - 20110

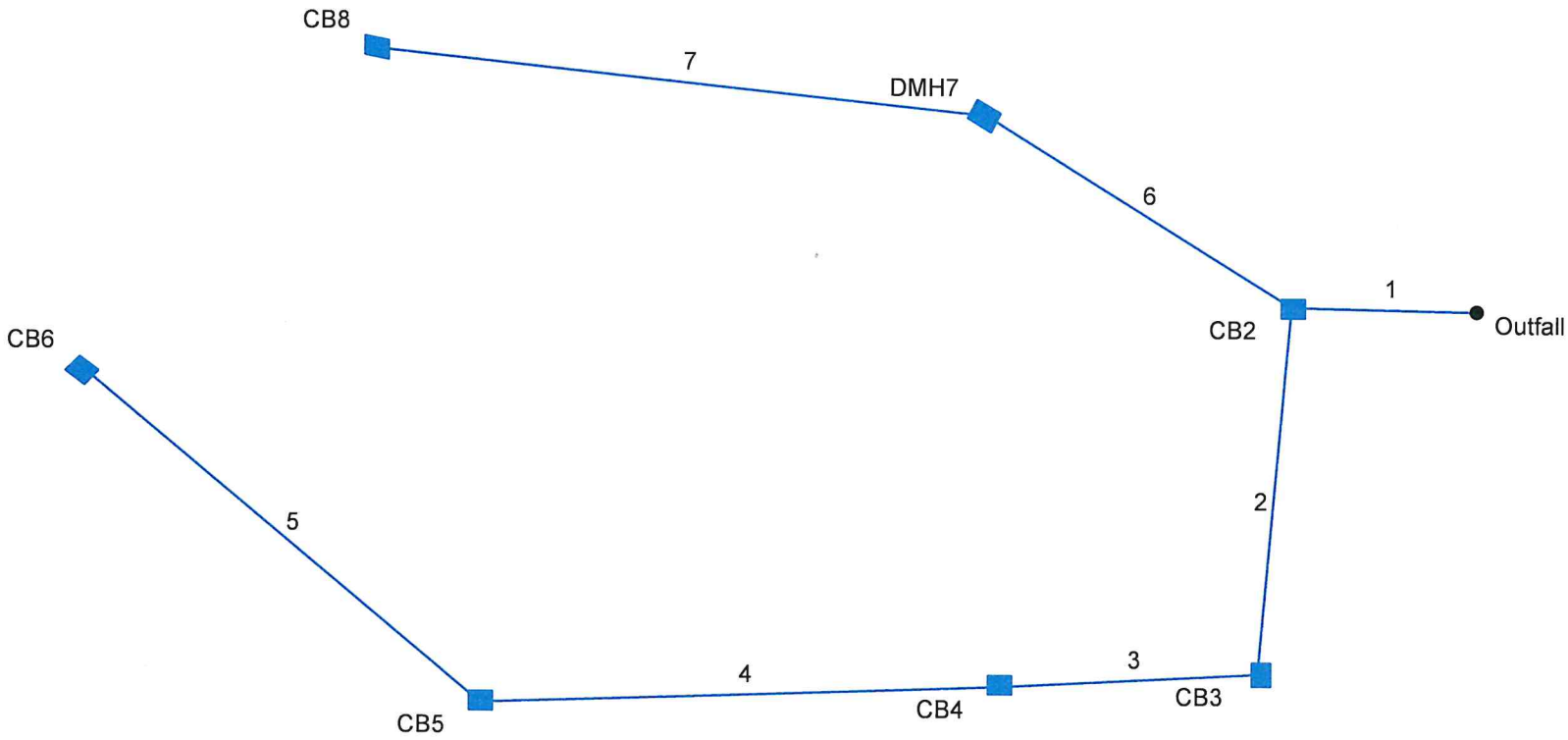
CALCULATED BY: GAH DATE: March 8, 2021

CHECKED BY: ERN DATE: March 15, 2021

PROPOSED CONDITIONS - 106-110 River Road, Lisbon, CT

COVER CONDITION	PAVEMENT/ROOF		LANDSCAPED		WOODED				TOTAL		
RUNOFF 'C'	C_1=0.90		C_2= 0.20		C_3=0.15		C_3=				
DRAINAGE AREA (Ac.)	A_1	$(AxC)_1$	A_2	$(AxC)_2$	A_3	$(AxC)_3$	A_4	$(AxC)_4$	A	AxC	C
C.B. #2	0.231	0.208	0.206	0.041	0.000	0.000		0.000	0.438	0.250	0.570
C.B. #3	0.076	0.069	0.034	0.007	0.000	0.000		0.000	0.110	0.075	0.685
C.B. #4	0.187	0.168	0.044	0.009	0.000	0.000		0.000	0.231	0.177	0.766
C.B. #5	0.176	0.158	0.031	0.006	0.000	0.000		0.000	0.207	0.164	0.795
C.B. #6	0.133	0.120	0.079	0.016	0.000	0.000		0.000	0.212	0.136	0.640
D.M.H. #7	0.000	0.000	0.000	0.000	0.000	0.000		0.000	0.000	0.000	0.000
C.B. #8	0.087	0.078	0.094	0.019	0.000	0.000		0.000	0.181	0.097	0.537
TOTALS	0.890		0.488		0.000		0.000		1.378		

Hydraflow Storm Sewers Plan



Project File: PIPE-TO-PIPE-2021-03-08.stm	Number of lines: 7	Date: 03-09-2021

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	40	0.44	1.38	0.57	0.25	0.90	5.1	10.1	6.3	5.71	12.51	5.29	15	5.00	92.00	94.00	93.12	94.96	93.50	103.30	RCFES1-CB2
2	1	80	0.11	0.76	0.68	0.07	0.55	5.0	8.1	7.1	3.93	5.60	4.85	15	1.00	98.71	99.51	99.48	100.31	103.30	104.00	CB2-CB3
3	2	56	0.23	0.65	0.77	0.18	0.48	5.0	7.8	7.2	3.46	6.85	3.30	15	1.50	99.51	100.35	101.06	101.22	104.00	104.70	CB3-CB4
4	3	112	0.21	0.42	0.80	0.17	0.30	5.0	6.9	7.7	2.32	6.85	2.93	15	1.50	100.35	102.03	101.50	102.64	104.70	106.40	CB4-CB5
5	4	112	0.21	0.21	0.64	0.13	0.13	5.0	5.0	8.9	1.20	5.60	2.25	15	1.00	102.03	103.15	102.86	103.59	106.40	107.40	CB5-CB6
6	1	78	0.00	0.18	0.00	0.00	0.10	5.0	8.1	7.1	0.69	9.03	3.49	15	2.60	98.98	101.01	99.21	101.34	103.30	105.50	CB2-DMH7
7	6	132	0.18	0.18	0.54	0.10	0.10	5.0	5.0	8.9	0.86	7.91	2.56	15	2.00	101.01	103.65	101.44	104.02	105.50	107.90	DMH7-CB8

Project File: PIPE-TO-PIPE-2021-03-08.stm

Number of lines: 7

Run Date: 03-09-2021

NOTES: Intensity = 36.81 / (Inlet time + 2.90) ^ 0.69; Return period = 25 Yrs. ; c = cir e = ellip b = box

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns line No.	Junction Type
1	RCFES1-CB2	5.71	15	Cir	40	92.00	94.00	5.000	93.12	94.96	n/a	94.96 j	End	Combination
2	CB2-CB3	3.93	15	Cir	80	98.71	99.51	1.000	99.48	100.31	0.53	100.83	1	Combination
3	CB3-CB4	3.46	15	Cir	56	99.51	100.35	1.500	101.06	101.22	0.11	101.33	2	Combination
4	CB4-CB5	2.32	15	Cir	112	100.35	102.03	1.500	101.50	102.64	n/a	102.64 j	3	Combination
5	CB5-CB6	1.20	15	Cir	112	102.03	103.15	1.000	102.86	103.59	n/a	103.59 j	4	Combination
6	CB2-DMH7	0.69	15	Cir	78	98.98	101.01	2.603	99.21	101.34	n/a	101.34	1	Manhole
7	DMH7-CB8	0.86	15	Cir	132	101.01	103.65	2.000	101.44	104.02	n/a	104.02 j	6	Combination

Project File: PIPE-TO-PIPE-2021-03-08.stm

Number of lines: 7

Run Date: 03-09-2021

NOTES: Return period = 25 Yrs. ; j - Line contains hyd. jump.

Inlet Report

Line No	Inlet ID	Q = CIA (cfs)	Q carry (cfs)	Q capt (cfs)	Q byp (cfs)	Junc type	Curb Inlet		Grate Inlet			Gutter							Inlet			Byp line No
							Ht (in)	L (ft)	area (sqft)	L (ft)	W (ft)	So (ft/ft)	W (ft)	Sw (ft/ft)	Sx (ft/ft)	n	Depth (ft)	Spread (ft)	Depth (ft)	Spread (ft)	Depr (in)	
1	CB2	2.21	0.00	2.21	0.00	Comb	3.0	2.73	3.14	3.14	1.63	Sag	2.00	0.030	0.030	0.013	0.07	2.44	0.24	2.44	2.0	Off
2	CB3	0.67	0.00	0.67	0.00	Comb	3.0	2.73	3.14	3.14	1.63	Sag	2.00	0.030	0.030	0.013	-0.06	-1.89	0.11	0.97	2.0	Off
3	CB4	1.58	0.00	1.58	0.00	Comb	3.0	2.73	3.14	3.14	1.63	Sag	2.00	0.030	0.030	0.013	0.02	0.78	0.19	1.68	2.0	Off
4	CB5	1.49	0.00	1.49	0.00	Comb	3.0	2.73	3.14	3.14	1.63	Sag	2.00	0.030	0.030	0.013	0.02	0.78	0.19	1.68	2.0	Off
5	CB6	1.20	0.00	1.20	0.00	Comb	3.0	2.73	3.14	3.14	1.63	Sag	2.00	0.030	0.030	0.013	-0.01	-0.22	0.16	1.41	2.0	Off
6	DMH7	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.013	0.00	0.00	0.00	0.00	0.0	Off
7	CB8	0.86	0.00	0.86	0.00	Comb	3.0	2.73	3.14	3.14	1.63	Sag	2.00	0.030	0.030	0.013	-0.04	-1.22	0.13	1.15	2.0	Off

Project File: PIPE-TO-PIPE-2021-03-08.stm | Number of lines: 7 | Run Date: 03-09-2021

NOTES: Inlet N-Values = 0.016 ; Intensity = 36.81 / (Inlet time + 2.90) ^ 0.69; Return period = 25 Yrs. ; * Indicates Known Q added. All curb inlets are Horiz throat.

Attachment 5

Water Quality Volume
And
Groundwater Recharge Volume
Analysis

Burger King - Lisbon , CT
Water Quality Volume Size Calculations

March 15, 2021
Minimum-Recommended Water Quality Volume (WQV)

Watershed	Total Area (Ac)	Impervious Area - I (Ac)	Impervious (%)	Runoff (R)	Min. Rec. WQV (ac-ft)	Min. Rec. WQV (Cu.Ft.)
WS-P-E-DET	1.63	0.89	54.9	0.5437	0.07385	3,217

$$WQV = \frac{(1")(R)(A)}{12}$$

WQV = water quality volume (ac-ft)

R = volumetric runoff coefficient
0.05+0.009(I)

I = percent impervious cover

Provided Water Quality Volume

Water Quality Basin

Watershed	Elevations (Ft.)	Area (Sq. Ft.)	Avg. Area (Sq. Ft.)	Avg. Depth (FT)	Avg. Vol (Cu. Ft.)	Total Provided WQV (Cu. Ft.)
A (WQB#1)	86.0	1149				**4,241**
			1606	1.00	**1606**	
	88.0	2063				
			2635	1.00	**2635**	
	90.0	3206				