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PRELIMINARY STORMWATER IMPACT ANALYSIS

Town of Carrboro Due Diligence

Pathway Drive, Carrboro, NC
Crest Street, Carrboro, NC

SUMMIT PROJECT #23-0350.204

PIN: 9779427516, 9779429615, 9779531130, 9778899390

TOWN OF CARRBORO REVIEW: June 11, 2024

ENGINEER:

Summit Design and Engineering

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Introduction

This report includes a preliminary stormwater analysis for four (4) parcels owned by the Town of Carrboro. Three (3) parcels, PIN: 9779427516, 9779427516, and 9779429615, are located off Pathway Drive and have adjacent residential subdivisions. One (1) parcel, PIN: 9778899390, is located off Crest Street and is adjacent to single family and multifamily dwellings. All the abovementioned properties are undeveloped forested lands with a perennial stream flowing eastward through both properties. The purpose of this analysis is to analyze existing stormwater patterns and conduct a preliminary stormwater analysis to develop the abovementioned parcels and manage run-off to minimize downstream effects.

Site Analysis

Site conditions such as ground cover, soil type, topography, and key features such as streams were analyzed for pre and post development impacts. These are further summarized below.

Existing Conditions

The topography for the three (3) parcels located on Pathway Drive generally flows north to the stream and the stream then flows eastward. The site has an approximate elevation range of 512.00' to 430.00' with Pathway Drive separating the parcels. These parcels are ultimately bounded by residential properties to the east, south, and west, and Carolina North Forrest to the north.

The topography for the parcel located on Crest Street generally flows northwest to the stream and the streams flows northeast through the site. The site has an approximate elevation range of 431.00' to 405.00' with Crest Street located at the southeasternmost portion of the property. This parcel is bounded by Crest Street right-of-way and residential properties to the southeast, and residential properties to the east, north, and west.

As previously stated, all subject parcels are undeveloped and predominantly wooded. The sites have varied on-site soils and are summarized in the table below. Soil data was obtained through the USDA NRCS Web Soil Survey for both subject sites.

On-Site Soils		
Map Symbol	Map Name	HSG Rating
EnC	Enon loam, 2 to 6 percent slopes	C
GeC	Georgeville silt loam, 6 to 10 percent slopes	B
GIF	Goldston channery silt loam, 15 to 45 percent slopes	D
TaD	Tarrus silt loam, 8 to 15 percent slopes	B

Pre-Development Drainage Conditions – Pathway Drive

The Pathway Drive parcels generally sheet flow north to the stream while the stream flows eastward, making one analysis point at the eastern end of the stream.

Pre-Development Drainage Area Summary – Pathway Drive			
Drainage Area ID	Total Area (Ac.)	Composite Curve Number	Time of Concentration (min.)
PRE-1	13.1	70	24.9

Pre-Development Drainage Conditions – Crest Street

The Crest Street parcel generally sheet flows northwest to the on-site stream while the stream flows northeast through the parcel, making one analysis point at the northeastern end of the stream.

Pre-Development Drainage Area Summary – Crest Street			
Drainage Area ID	Total Area (Ac.)	Composite Curve Number	Time of Concentration (min.)
PRE-2	6.92	70	15.6

Post-Development Drainage Conditions – Pathway Drive

The proposed development condition for the Pathway Drive parcels includes a developable area of approximately 3.15 acres. Assuming the 3.15 acres is 100% impervious, the resulting curve number for the parcels is 85. For conservative initial analysis, the buildable area for these parcels does not factor in setbacks, however, considerations have been assumed for on-site easements and stream buffers.

Post-Development Drainage Area Summary – Pathway Drive					
Drainage Area ID	Total Area (Ac.)	Buildable Area (Ac.)	Area to Remain Forested (Ac.)	Composite Curve Number	Time of Concentration (min.)
POST-1A	6.06	3.15	2.91	85	5

Post-Development Drainage Conditions – Crest Street

The proposed development condition for the Crest Street parcel includes a total tract area for this parcel is 47,102 SF or 1.081 acres. Considering that this site is more restrictive for development, a conservative estimate of 24% impervious cover was assumed. With a 24% impervious cover limit, the total impervious for these parcels is 11,305 SF or 0.26 acres.

Post-Development Drainage Area Summary – Crest Street					
Drainage Area ID	Total Area (Ac.)	Buildable Area (Ac.)	Area to Remain Forested (Ac.)	Composite Curve Number	Time of Concentration (min.)
POST-2A	1.081	0.26	0.821	77	5

Impervious Cover Conditions Assumptions

The impervious area assumptions made for these sites were selected by considering site access, maximizing housing density, and evaluating site restrictions such as topography and stream buffers. The goal of this analysis is to assume a “worst case scenario” understanding that much of the site layout is dependent on the Owner’s choice and the governing development regulations of the properties’ zoning districts which were not determined as part of this analysis. The ultimate stormwater management plan could be scaled depending on what the ultimate site layout is, but these assumptions provide a reliable baseline for preliminary analysis.

Stormwater Management Requirements and Analysis

The Town of Carrboro’s Land Use Ordinance, Article XVI, the North Carolina Department of Environmental Quality’s Best Management Practices Manual and the newer Minimum Design Criteria were reviewed and used as the primary references for this analysis. These state that all storms up to and including the 25-year storm must be analyzed and pre- vs post-development runoff shall match and/or be reduced for all storms within the 25-year and below. For the purposes of this analysis, two analyses points have been identified, one for the Pathway Drive parcels, and one for the Crest Street parcel.

Stormwater Quantity

The Town of Carrboro’s Land Use Ordinance, Article XVI states that all storms up to and including the 25-year storm must be analyzed and pre- vs post-development runoff shall match and/or be reduced for all storms within the 25-year and below. For the purposes of this analysis, two analyses points have been identified, one for the Pathway Drive parcels, and one for the Crest Street parcel.

On-site stormwater quantity peak flows for the analyzed storm events are summarized below for both subject points of analysis. The peak flows listed below are the pre-development flows that must be matched and/or reduced in the post-development condition utilizing on-site SCMs. Additionally, runoff volume matches are required for pre- vs post-development analysis and the pre-development assumed runoff volumes are summarized below.

Pathway Drive Maximum Peak Flows and Runoff Volumes		
Storm Event	Pre-Development Peak Flow (cfs)	Pre-Development Peak Runoff Volume (cf)
1	7.542	32,401
2	12.43	49,517
5	20.29	77,355
10	26.98	101,261
25	36.54	135,409

Crest Street Maximum Peak Flows and Runoff Volumes		
Storm Event	Pre-Development Peak Flow (cfs)	Pre-Development Peak Runoff Volume (cf)
1	5.398	16,952
2	8.720	25,908
5	14.04	40,473
10	28.66	52,981
25	25.19	70,848

Stormwater Quality

Water Quality volume sizing was determined by using the Simple Method per State guidance and is provided in Appendix B. Carrboro’s Land Use Ordinance, Article XVI requires that runoff be treated to achieve 85% removal of Total Suspended Solids (TSS) and reduce and/or maintain the nutrient load as a result of the development to 2.2 pounds per acre per year for nitrogen, and 0.82 pounds per acre per for phosphorus. Water treatment can achieve the target rates described above using any number of Stormwater Control Measures.

Low Impact Development

Opportunities for Low Impact Development (LID) are largely dependent on the site type and layout chosen by the Owner, as discussed in the Impervious Cover Conditions Assumptions subsection above. Low Impact Development is a site that is designed, constructed and maintained to protect the natural hydrology of the site so that the overall integrity of the watershed is protected. A lot of open space or undisturbed area must be provided to maintain LID. These goals can be achieved through the following means:

- Disconnected Impervious Surface – Dedicated open space where impervious areas can drain directly to defusing the flow as opposed to draining to pipes and ditches.

- Limiting Site Clearing and Disturbing – Maintains natural ground cover reducing runoff.
- Promoting Tree Conservation – Helps to control erosion allowing for direct drainage into open spaces which in turn can reduce runoff volume.
- Bioretention – Discussed below, these cells can be provided in parking lot islands, in front yards as landscape features, and as larger stormwater ponds.
- Providing Shared Driveways – Reduce total impervious area.
- Relaxing Setbacks – Reduces road length, provides shorter driveways and more room for open space.
- Undisturbed Buffers – Buffer that restrict clearing of existing vegetation. These are along streams but could also be provided where not otherwise required, like between lots that are zoned the same.
- Permeable Pavers/Paving – Discussed below, provided in parking stalls, sidewalk, and driveways.
- Rainwater Harvesting – For irrigation and other non-potable uses, drastically increases overall site runoff retention time.
- Defuse Flow – Providing structures like rip-rap pads that will spread flow out which allows for more infiltration across the natural surface and reduces scour.
- Maintain Existing Wetlands – Maintains natural runoff retention time.

Stormwater Control Measures

Summaries of stormwater control measures that would be viable for these sites are below. Considerations for each measure include cost, constructability, safety, maintenance, and land usage required.

Wet Pond

Wet ponds are often the most cost efficient SCM option for development. Wet ponds do not require additional testing i.e. infiltration testing and are oftentimes the best option for stormwater quantity management due to the versatility in achieving excess storage above the minimum requirement. The ease of constructability and maintenance are also among the top considerations for proposed wet ponds. However, wet ponds require a large amount of land within the site to meet the State's Minimum Design Criteria standards. Maintenance/access easements, vegetative shelves, forebays and embankment slopes all increase the overall size of the wet pond. Additionally, safety is a top priority with wet ponds due to their overall depth and constant water elevation. Safety fencing can be placed around the limits of the wet pond and outlet control structure and outfall pipe to increase overall safety. Wet ponds also lack aesthetic appearance however, plantings and fountains can be added to increase the aesthetic appeal.

Bioretention Cell (Low Impact Development Option)

Bioretention cells are among the top options for water quality and water quantity control. Additional infiltration testing may be required to achieve water quality requirements however, underdrains can be used as an alternative to infiltration testing. If the depth required for bioretention cells and underdrains is available, they could use minimal land footprints and have plantings throughout to increase the aesthetic appearance. Maintenance for bioretention cells is similar to that of a wet pond. However, additional monitoring may be required to ensure that media infiltration is being achieved.

Permeable Pavement (Low Impact Development Option)

Permeable pavement achieves a high rate of infiltration with a minimal footprint. Permeable pavement can be used in parking stalls, sidewalks, and amenity areas. Asphalt, concrete, and pavers provide different applications in which permeable pavement can be used. Permeable pavement can be versatile and installed in specific areas of the site and connected via underdrains. Access ports and the pavement itself are all that is visible on the surface. Due to the majority of the SCM being underground, there are minimal safety risks with permeable pavement. However, the cost to install and maintain this as an SCM can be high. If permeable pavement is not properly installed and/or maintained it will not function as designed, infiltration will not be achieved, and complete removal and reinstallation may be required.

Underground Detention

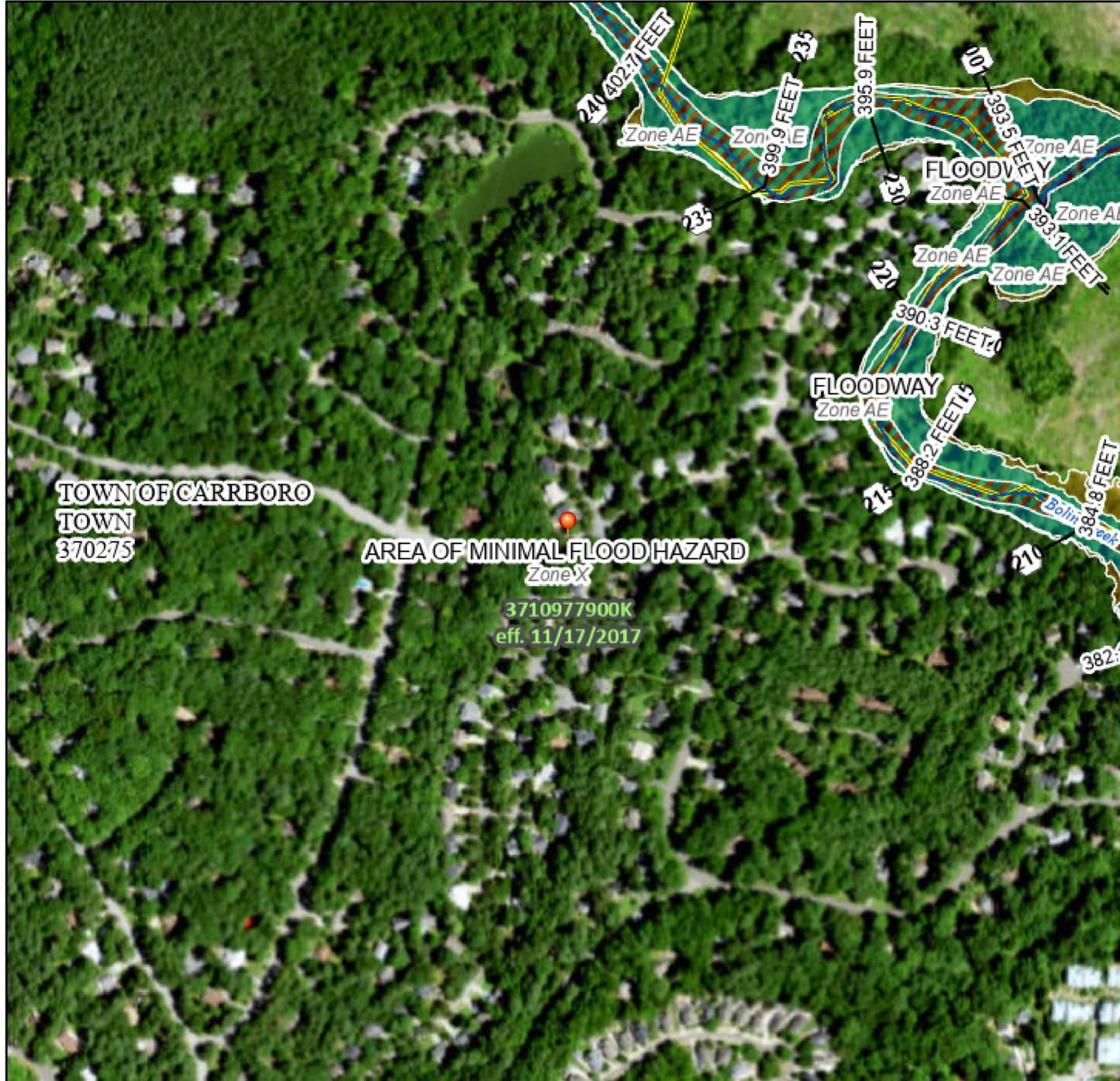
Underground stormwater detention is not as cost efficient as other options listed above; however, it is a great option if land space is limited and there is a large amount of depth available for storage from the surface to the outlet elevation. Underground detention has the ability to be placed around other utility infrastructure making it more versatile and specific to the site. Access ports and an outlet control structure top are the only features of the system that are visible on the surface making it one of the safest options. It can also provide additional infiltration within the footprint of the system due to the stone base. Maintenance for an underground detention facility is relatively low but it may require manufacturer specific items to achieve optimal performance for the system.

Appendix A – Maps

National Flood Hazard Layer FIRMMette



79°5'11"W 35°55'52"N



1:6,000

79°4'34"W 35°55'23"N

Basemap Imagery Source: USGS National Map 2023

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS		Without Base Flood Elevation (BFE) Zone A, V, A99
		With BFE or Depth Zone AE, AO, AH, VE, AR
		Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD		0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
		Future Conditions 1% Annual Chance Flood Hazard Zone X
		Area with Reduced Flood Risk due to Levee. See Notes. Zone X
		Area with Flood Risk due to Levee Zone D
OTHER AREAS		NO SCREEN Area of Minimal Flood Hazard Zone X
		Effective LOMRs
		Area of Undetermined Flood Hazard Zone D
GENERAL STRUCTURES		Channel, Culvert, or Storm Sewer
		Levee, Dike, or Floodwall
OTHER FEATURES		20.2 Cross Sections with 1% Annual Chance Water Surface Elevation
		17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
		Coastal Transect
		Base Flood Elevation Line (BFE)
		Limit of Study
		Jurisdiction Boundary
MAP PANELS		Digital Data Available
		No Digital Data Available
		Unmapped
		The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.



This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

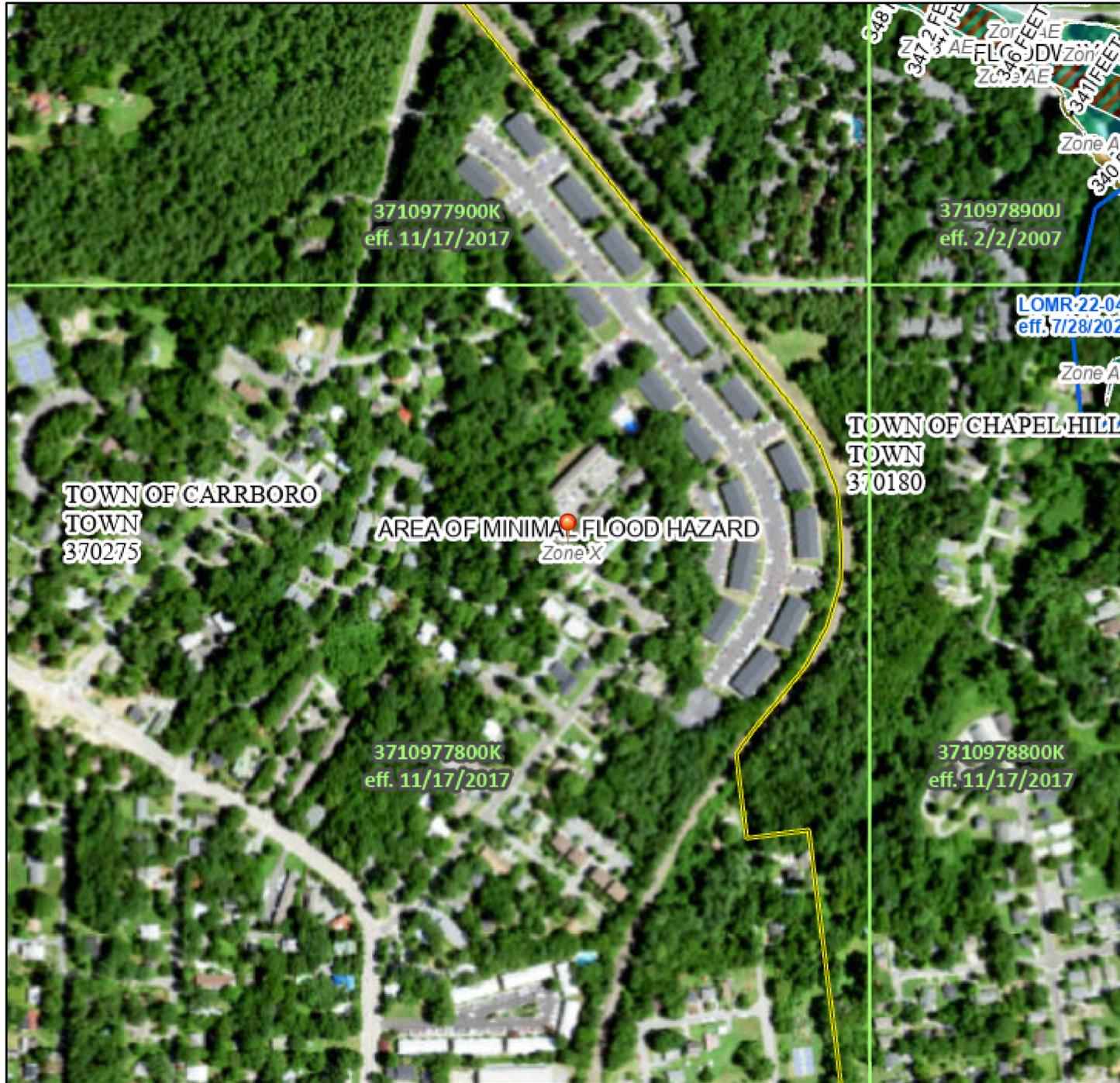
The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on **6/11/2024 at 4:09 PM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

National Flood Hazard Layer FIRMMette



79°4'32"W 35°55'22"N



Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

- | | |
|------------------------------------|--|
| SPECIAL FLOOD HAZARD AREAS | Without Base Flood Elevation (BFE)
<i>Zone A, V, A99</i> |
| | With BFE or Depth <i>Zone AE, AO, AH, VE, AR</i> |
| | Regulatory Floodway |
| OTHER AREAS OF FLOOD HAZARD | 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile <i>Zone X</i> |
| | Future Conditions 1% Annual Chance Flood Hazard <i>Zone X</i> |
| | Area with Reduced Flood Risk due to Levee. See Notes. <i>Zone X</i> |
| | Area with Flood Risk due to Levee <i>Zone D</i> |
| OTHER AREAS | NO SCREEN Area of Minimal Flood Hazard <i>Zone X</i> |
| | Effective LOMRs |
| | Area of Undetermined Flood Hazard <i>Zone D</i> |
| GENERAL STRUCTURES | Channel, Culvert, or Storm Sewer |
| | Levee, Dike, or Floodwall |
| OTHER FEATURES | 20.2 Cross Sections with 1% Annual Chance Water Surface Elevation |
| | 17.5 Coastal Transect |
| | Base Flood Elevation Line (BFE) |
| | Limit of Study |
| | Jurisdiction Boundary |
| | Coastal Transect Baseline |
| | Profile Baseline |
| | Hydrographic Feature |
| MAP PANELS | Digital Data Available |
| | No Digital Data Available |
| | Unmapped |
- The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.



1:6,000

79°3'54"W 35°54'53"N

Basemap Imagery Source: USGS National Map 2023

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on **6/11/2024 at 4:08 PM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

Soil Map—Orange County, North Carolina



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 1:20,000.

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: Orange County, North Carolina

Survey Area Data: Version 24, Sep 13, 2023

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

Date(s) aerial images were photographed: Apr 23, 2022—Apr 27, 2022

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.

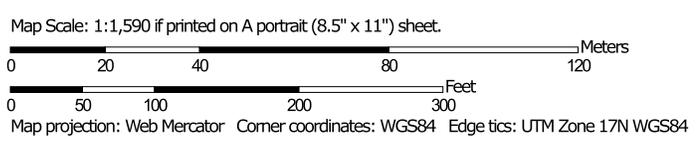
Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
EnB	Enon loam, 2 to 6 percent slopes	0.7	1.8%
EnC	Enon loam, 6 to 12 percent slopes	3.9	10.2%
GeC	Georgeville silt loam, 6 to 10 percent slopes	14.5	37.4%
GIF	Goldston channery silt loam, 15 to 45 percent slopes	9.2	23.7%
HrB	Herndon silt loam, 2 to 6 percent slopes	0.5	1.3%
TaD	Tarrus silt loam, 8 to 15 percent slopes	9.9	25.6%
Totals for Area of Interest		38.8	100.0%

Soil Map—Orange County, North Carolina



Soil Map may not be valid at this scale.



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

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Source of Map: Natural Resources Conservation Service

Web Soil Survey URL:

Coordinate System: Web Mercator (EPSG:3857)

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Survey Area Data: Version 24, Sep 13, 2023

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

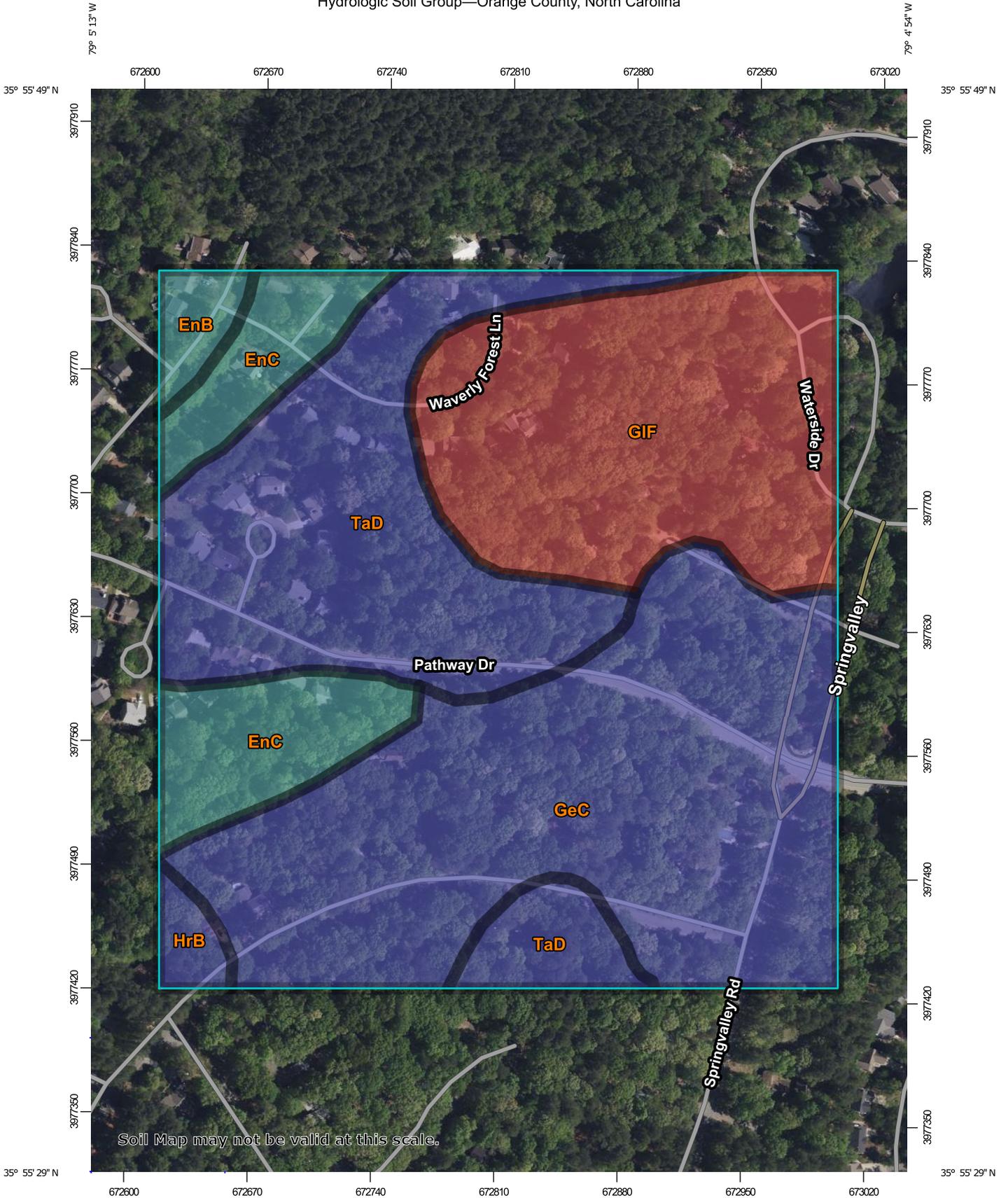
Date(s) aerial images were photographed: Apr 23, 2022—Apr 27, 2022

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Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
EnB	Enon loam, 2 to 6 percent slopes	1.0	9.0%
EnC	Enon loam, 6 to 12 percent slopes	8.8	76.1%
IuB	Iredell-Urban land complex, 1 to 8 percent slopes	1.7	14.9%
Totals for Area of Interest		11.5	100.0%

Hydrologic Soil Group—Orange County, North Carolina



Map Scale: 1:2,990 if printed on A portrait (8.5" x 11") sheet.



Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 17N WGS84



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 1:20,000.

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

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 Survey Area Data: Version 24, Sep 13, 2023

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Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
EnB	Enon loam, 2 to 6 percent slopes	C	0.7	1.8%
EnC	Enon loam, 6 to 12 percent slopes	C	3.9	10.2%
GeC	Georgeville silt loam, 6 to 10 percent slopes	B	14.5	37.4%
GIF	Goldston channery silt loam, 15 to 45 percent slopes	D	9.2	23.7%
HrB	Herndon silt loam, 2 to 6 percent slopes	B	0.5	1.3%
TaD	Tarrus silt loam, 8 to 15 percent slopes	B	9.9	25.6%
Totals for Area of Interest			38.8	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.

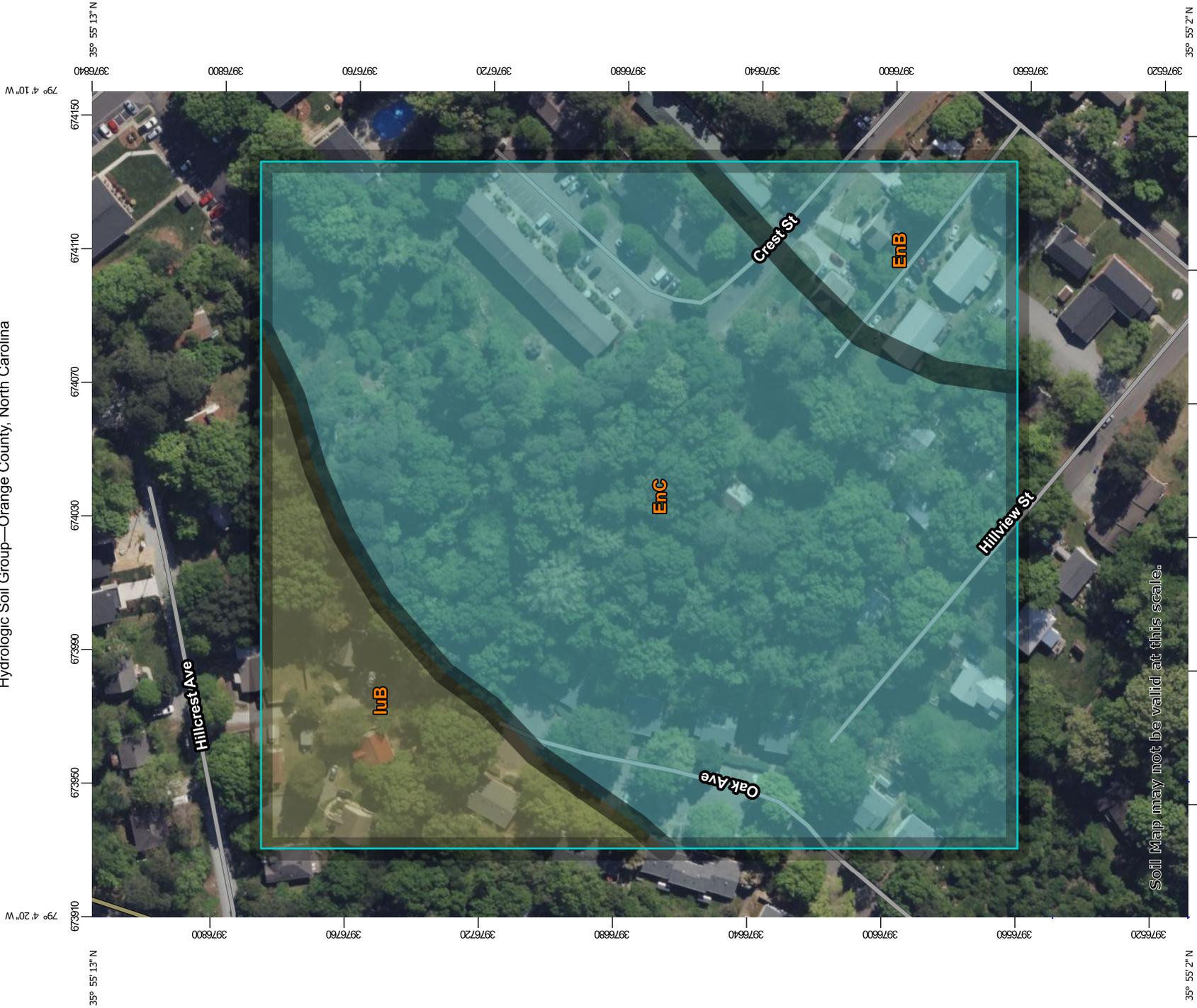
If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

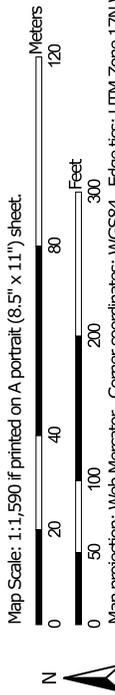
Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher



Soil Map may not be valid at this scale.



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 1:20,000.

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: Orange County, North Carolina
 Survey Area Data: Version 24, Sep 13, 2023

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

Date(s) aerial images were photographed: Apr 23, 2022—Apr 27, 2022

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
EnB	Enon loam, 2 to 6 percent slopes	C	1.0	9.0%
EnC	Enon loam, 6 to 12 percent slopes	C	8.8	76.1%
IuB	Iredell-Urban land complex, 1 to 8 percent slopes	C/D	1.7	14.9%
Totals for Area of Interest			11.5	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

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Watershed Model Schematic

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023



Legend

<u>Hyd. Origin</u>	<u>Description</u>
1	SCS Runoff PRE-1 - PATHWAY
2	SCS Runoff PRE-2 - CREST
3	SCS Runoff POST-1A - PATHWAY UNDISTURBED
4	SCS Runoff POST-1B - PATHWAY DEVELOPED
5	SCS Runoff POST-2A - CREST UNDISTURBED
6	SCS Runoff POST-2B - CREST DEVELOPED

Hydrograph Return Period Recap

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

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	-----	7.542	12.43	-----	20.29	26.98	36.54	-----	52.75	PRE-1 - PATHWAY
2	SCS Runoff	-----	5.398	8.720	-----	14.04	18.66	25.19	-----	36.17	PRE-2 - CREST
3	SCS Runoff	-----	4.053	6.678	-----	10.91	14.50	19.64	-----	28.35	POST-1A - PATHWAY UNDISTURB
4	SCS Runoff	-----	15.85	21.14	-----	28.86	34.99	43.21	-----	56.39	POST-1B - PATHWAY DEVELOPED
5	SCS Runoff	-----	4.556	7.359	-----	11.85	15.75	21.26	-----	30.53	POST-2A - CREST UNDISTURBED
6	SCS Runoff	-----	4.058	5.006	-----	6.357	7.414	8.826	-----	11.08	POST-2B - CREST DEVELOPED

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

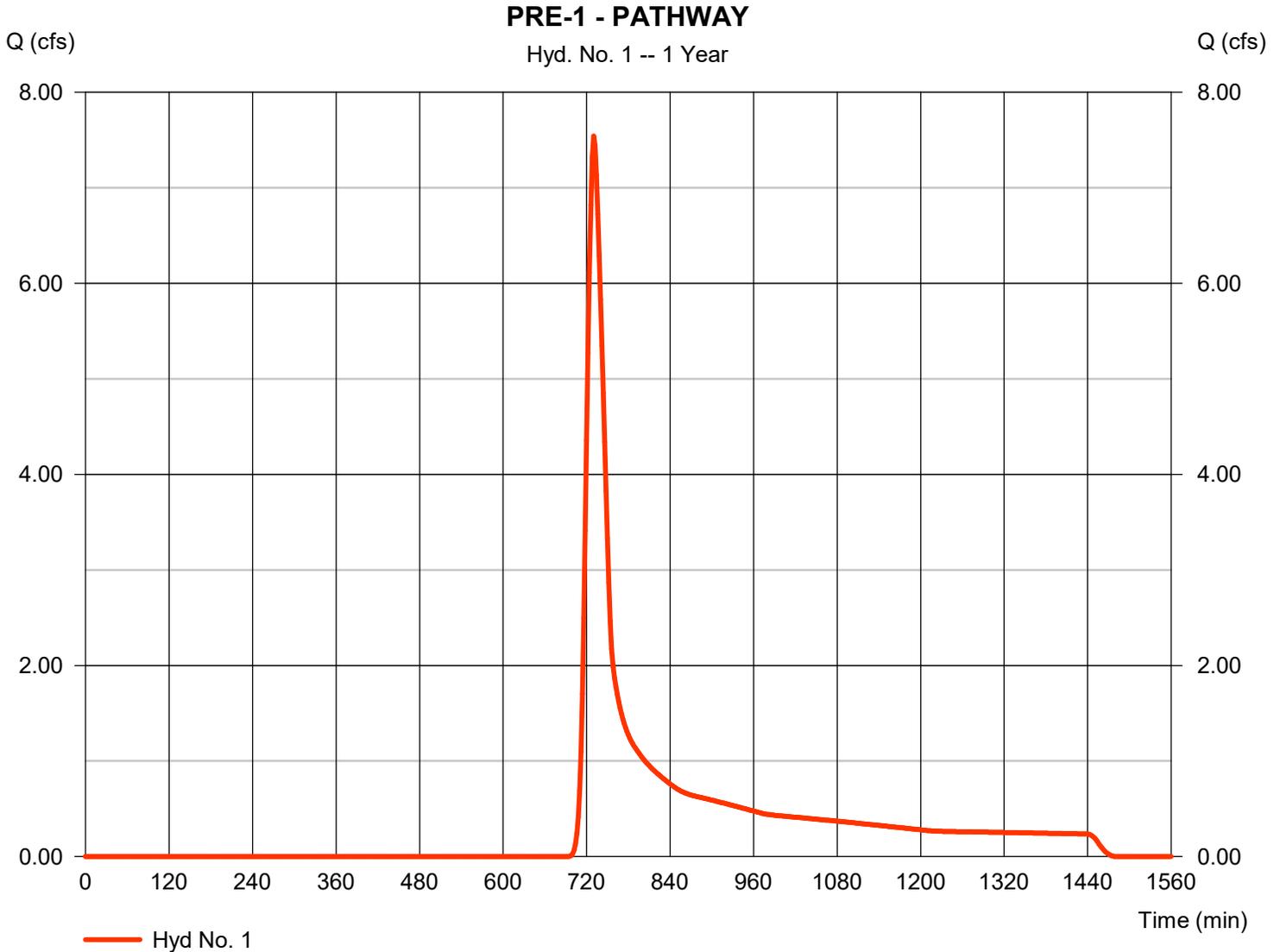
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	7.542	2	730	32,401	-----	-----	-----	PRE-1 - PATHWAY
2	SCS Runoff	5.398	2	724	16,952	-----	-----	-----	PRE-2 - CREST
3	SCS Runoff	4.053	2	730	17,412	-----	-----	-----	POST-1A - PATHWAY UNDISTURB
4	SCS Runoff	15.85	2	716	32,062	-----	-----	-----	POST-1B - PATHWAY DEVELOPED
5	SCS Runoff	4.556	2	724	14,307	-----	-----	-----	POST-2A - CREST UNDISTURBED
6	SCS Runoff	4.058	2	716	8,859	-----	-----	-----	POST-2B - CREST DEVELOPED
23-0350.204 - Prelim Routing.gpw					Return Period: 1 Year			Tuesday, 06 / 11 / 2024	

Hydrograph Report

Hyd. No. 1

PRE-1 - PATHWAY

Hydrograph type	= SCS Runoff	Peak discharge	= 7.542 cfs
Storm frequency	= 1 yrs	Time to peak	= 730 min
Time interval	= 2 min	Hyd. volume	= 32,401 cuft
Drainage area	= 13.100 ac	Curve number	= 70
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 24.90 min
Total precip.	= 2.96 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



TR55 Tc Worksheet

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

Hyd. No. 1

PRE-1 - PATHWAY

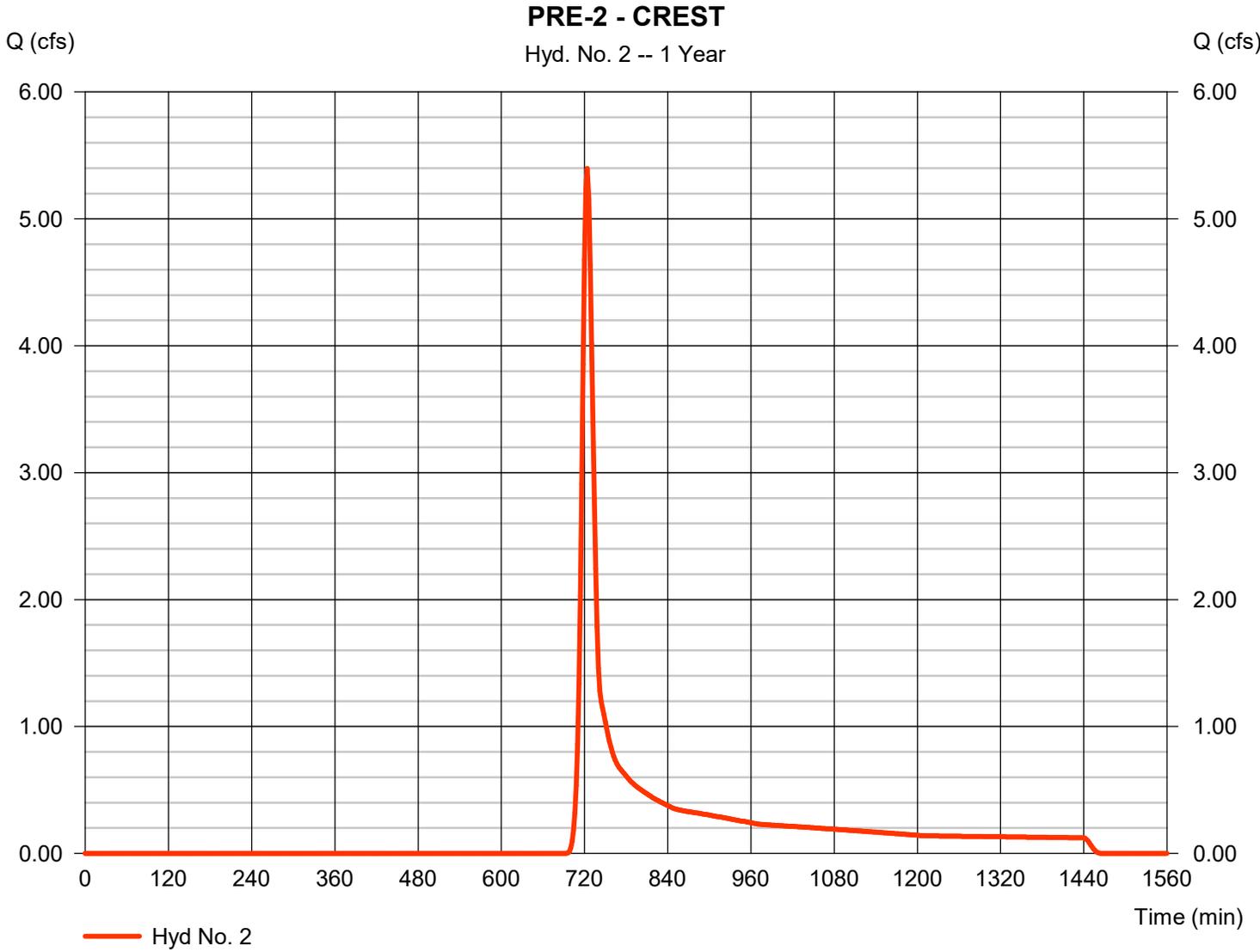
<u>Description</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>Totals</u>
Sheet Flow				
Manning's n-value	= 0.400	0.011	0.011	
Flow length (ft)	= 58.0	0.0	0.0	
Two-year 24-hr precip. (in)	= 3.58	0.00	0.00	
Land slope (%)	= 0.50	0.00	0.00	
Travel Time (min)	= 22.86	+ 0.00	+ 0.00	= 22.86
Shallow Concentrated Flow				
Flow length (ft)	= 328.00	65.00	361.00	
Watercourse slope (%)	= 15.00	10.00	15.00	
Surface description	= Unpaved	Paved	Unpaved	
Average velocity (ft/s)	=6.25	6.43	6.25	
Travel Time (min)	= 0.87	+ 0.17	+ 0.96	= 2.01
Channel Flow				
X sectional flow area (sqft)	= 0.00	0.00	0.00	
Wetted perimeter (ft)	= 0.00	0.00	0.00	
Channel slope (%)	= 0.00	0.00	0.00	
Manning's n-value	= 0.015	0.015	0.015	
Velocity (ft/s)	=0.00	0.00	0.00	
Flow length (ft)	{{0}}0.0	0.0	0.0	
Travel Time (min)	= 0.00	+ 0.00	+ 0.00	= 0.00
Total Travel Time, Tc				24.90 min

Hydrograph Report

Hyd. No. 2

PRE-2 - CREST

Hydrograph type	= SCS Runoff	Peak discharge	= 5.398 cfs
Storm frequency	= 1 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 16,952 cuft
Drainage area	= 6.920 ac	Curve number	= 70
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 15.60 min
Total precip.	= 2.96 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



TR55 Tc Worksheet

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

Hyd. No. 2

PRE-2 - CREST

<u>Description</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>Totals</u>
Sheet Flow				
Manning's n-value	= 0.150	0.011	0.011	
Flow length (ft)	= 100.0	0.0	0.0	
Two-year 24-hr precip. (in)	= 3.58	0.00	0.00	
Land slope (%)	= 1.00	0.00	0.00	
Travel Time (min)	= 12.22	+ 0.00	+ 0.00	= 12.22
Shallow Concentrated Flow				
Flow length (ft)	= 503.00	340.00	0.00	
Watercourse slope (%)	= 5.00	10.00	0.00	
Surface description	= Paved	Paved	Paved	
Average velocity (ft/s)	=4.55	6.43	0.00	
Travel Time (min)	= 1.84	+ 0.88	+ 0.00	= 2.73
Channel Flow				
X sectional flow area (sqft)	= 53.00	0.00	0.00	
Wetted perimeter (ft)	= 21.00	0.00	0.00	
Channel slope (%)	= 3.00	0.00	0.00	
Manning's n-value	= 0.050	0.015	0.015	
Velocity (ft/s)	=9.60	0.00	0.00	
Flow length (ft)	{{0}}380.0	0.0	0.0	
Travel Time (min)	= 0.66	+ 0.00	+ 0.00	= 0.66
Total Travel Time, Tc				15.60 min

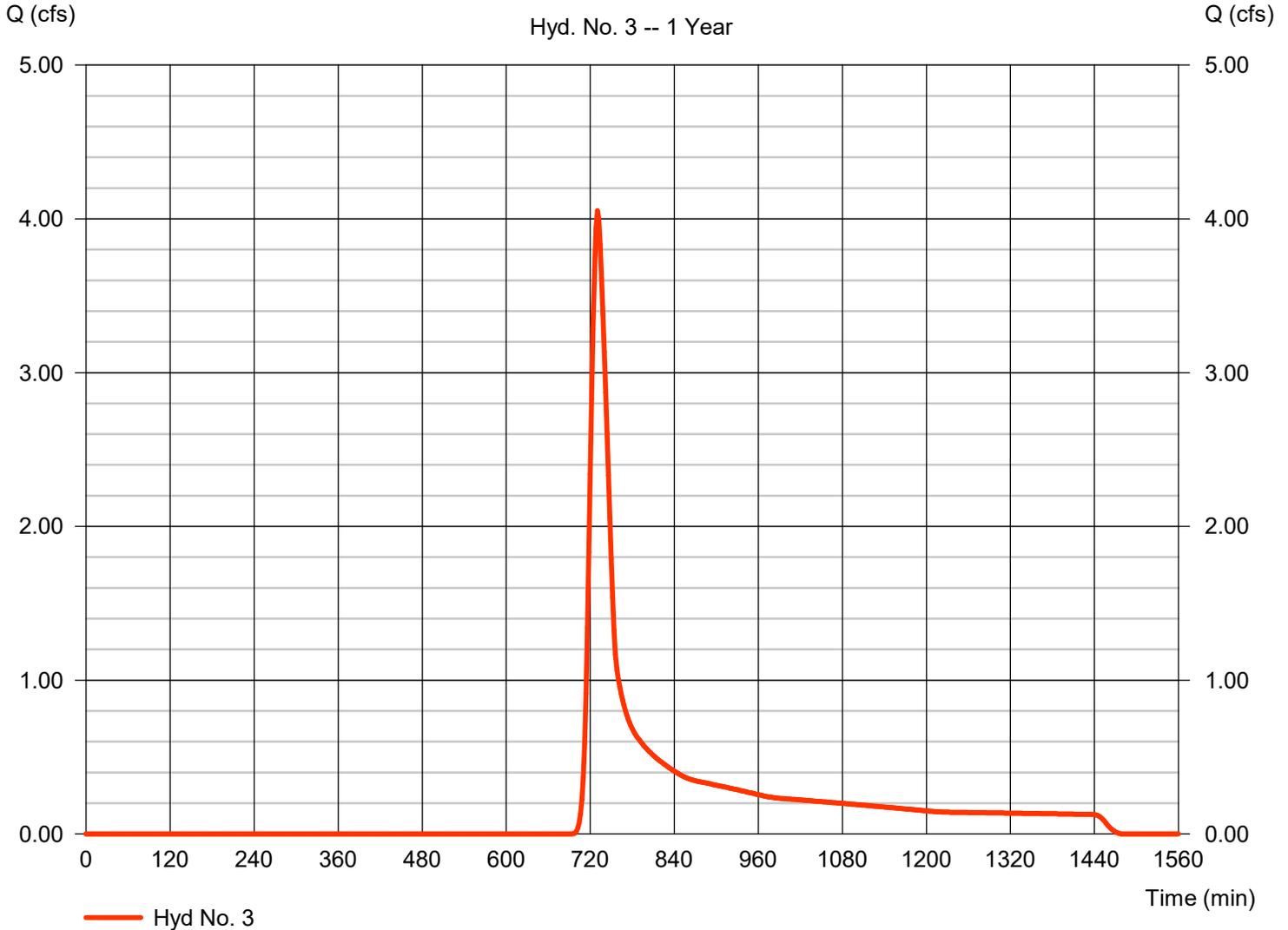
Hydrograph Report

Hyd. No. 3

POST-1A - PATHWAY UNDISTURBED

Hydrograph type	= SCS Runoff	Peak discharge	= 4.053 cfs
Storm frequency	= 1 yrs	Time to peak	= 730 min
Time interval	= 2 min	Hyd. volume	= 17,412 cuft
Drainage area	= 7.040 ac	Curve number	= 70
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 24.90 min
Total precip.	= 2.96 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

POST-1A - PATHWAY UNDISTURBED



Hydrograph Report

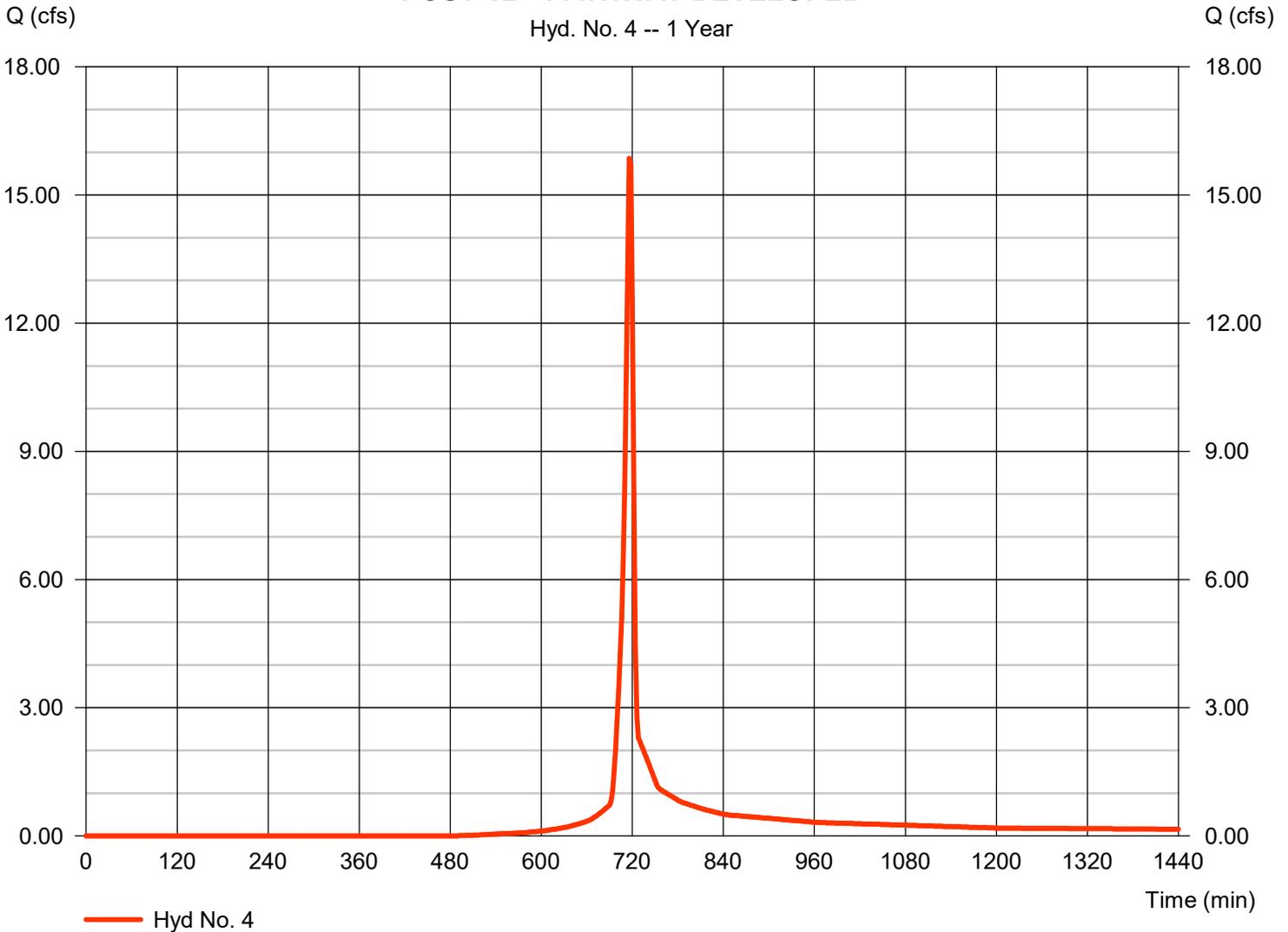
Hyd. No. 4

POST-1B - PATHWAY DEVELOPED

Hydrograph type	= SCS Runoff	Peak discharge	= 15.85 cfs
Storm frequency	= 1 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 32,062 cuft
Drainage area	= 6.060 ac	Curve number	= 85
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 2.96 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

POST-1B - PATHWAY DEVELOPED

Hyd. No. 4 -- 1 Year



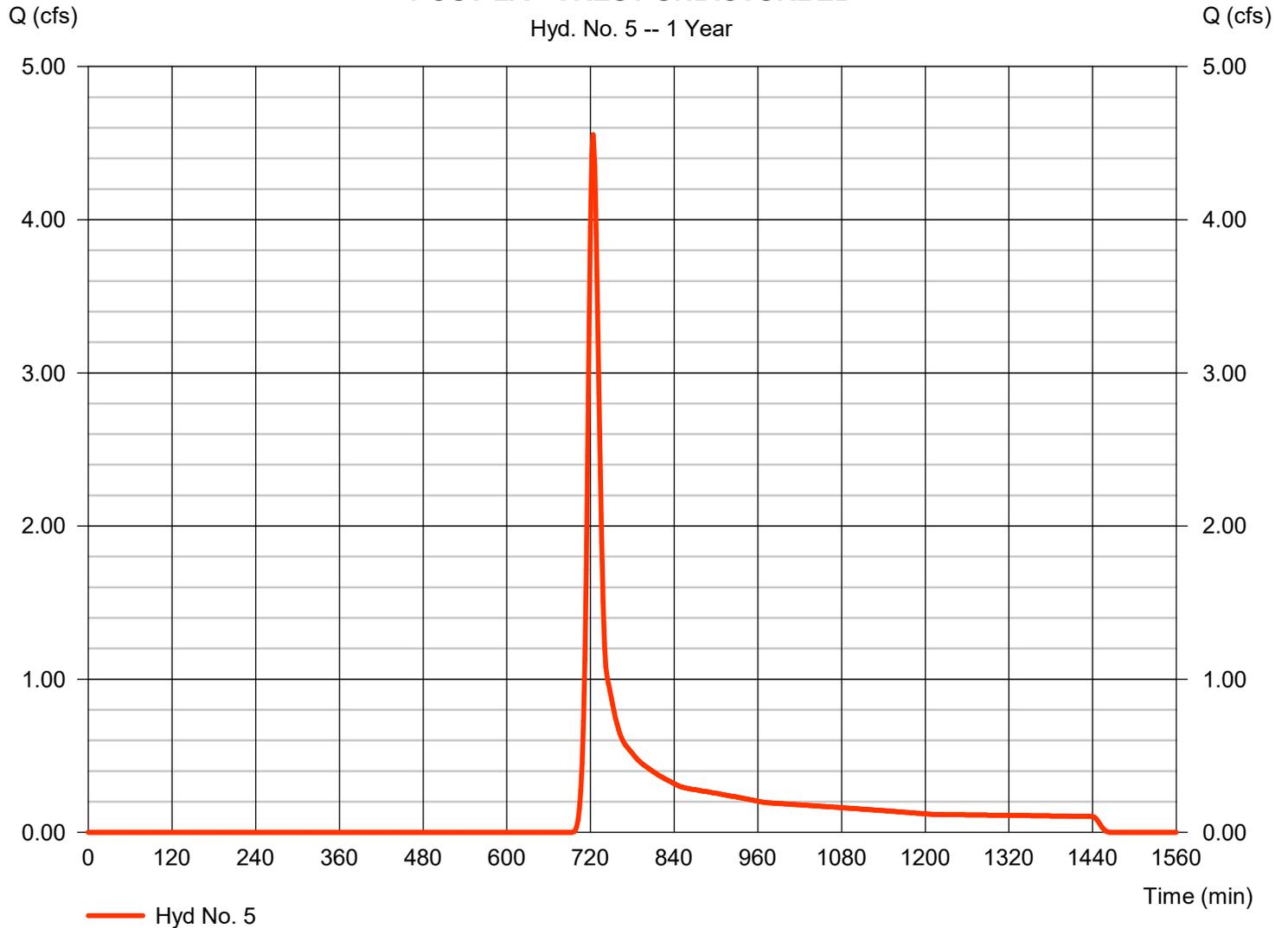
Hydrograph Report

Hyd. No. 5

POST-2A - CREST UNDISTURBED

Hydrograph type	= SCS Runoff	Peak discharge	= 4.556 cfs
Storm frequency	= 1 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 14,307 cuft
Drainage area	= 5.840 ac	Curve number	= 70
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 15.60 min
Total precip.	= 2.96 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

POST-2A - CREST UNDISTURBED

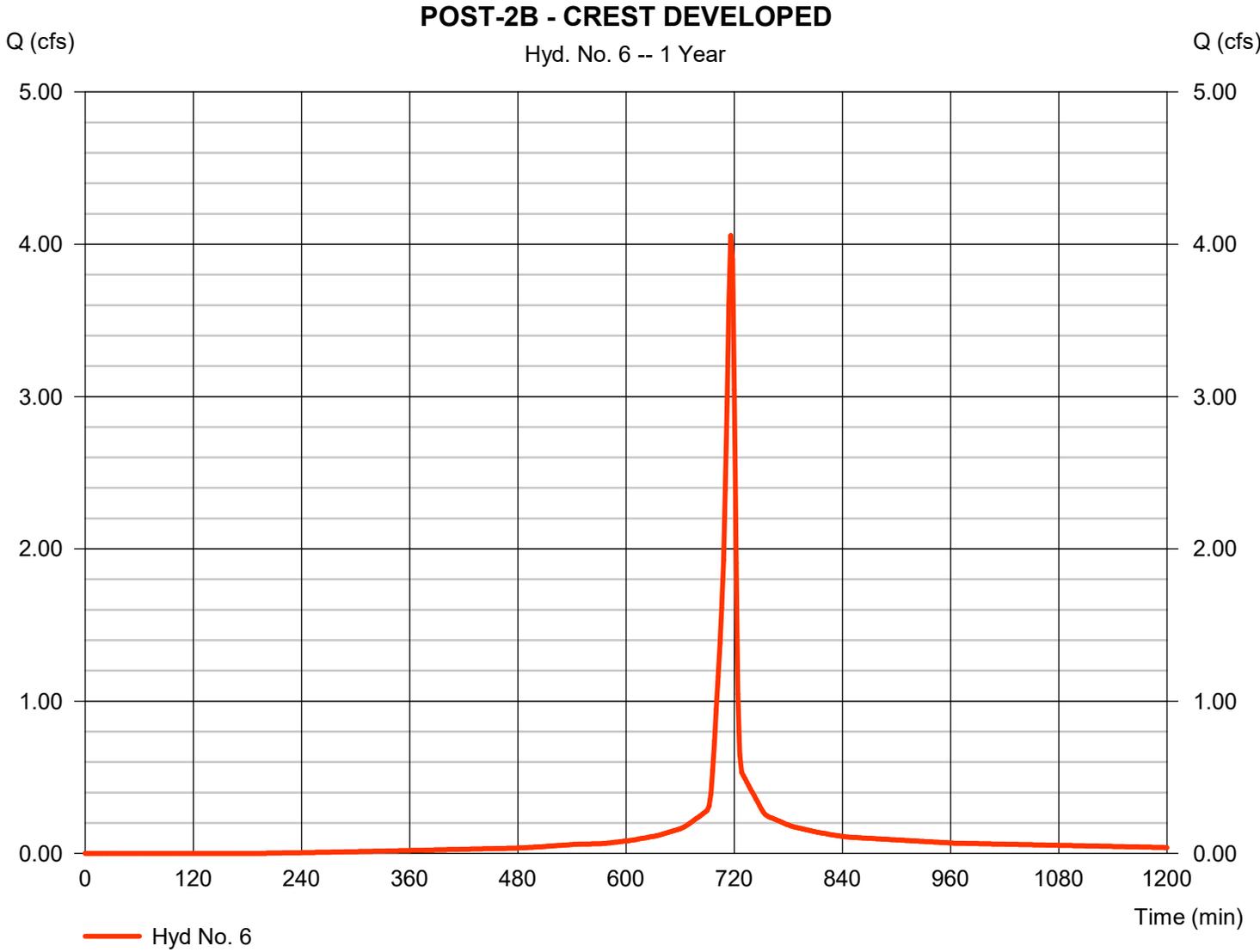


Hydrograph Report

Hyd. No. 6

POST-2B - CREST DEVELOPED

Hydrograph type	= SCS Runoff	Peak discharge	= 4.058 cfs
Storm frequency	= 1 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 8,859 cuft
Drainage area	= 1.080 ac	Curve number	= 95
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 2.96 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

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	12.43	2	730	49,517	-----	-----	-----	PRE-1 - PATHWAY
2	SCS Runoff	8.720	2	724	25,908	-----	-----	-----	PRE-2 - CREST
3	SCS Runoff	6.678	2	730	26,611	-----	-----	-----	POST-1A - PATHWAY UNDISTURB
4	SCS Runoff	21.14	2	716	43,024	-----	-----	-----	POST-1B - PATHWAY DEVELOPED
5	SCS Runoff	7.359	2	724	21,865	-----	-----	-----	POST-2A - CREST UNDISTURBED
6	SCS Runoff	5.006	2	716	11,091	-----	-----	-----	POST-2B - CREST DEVELOPED
23-0350.204 - Prelim Routing.gpw					Return Period: 2 Year			Tuesday, 06 / 11 / 2024	

Hydrograph Report

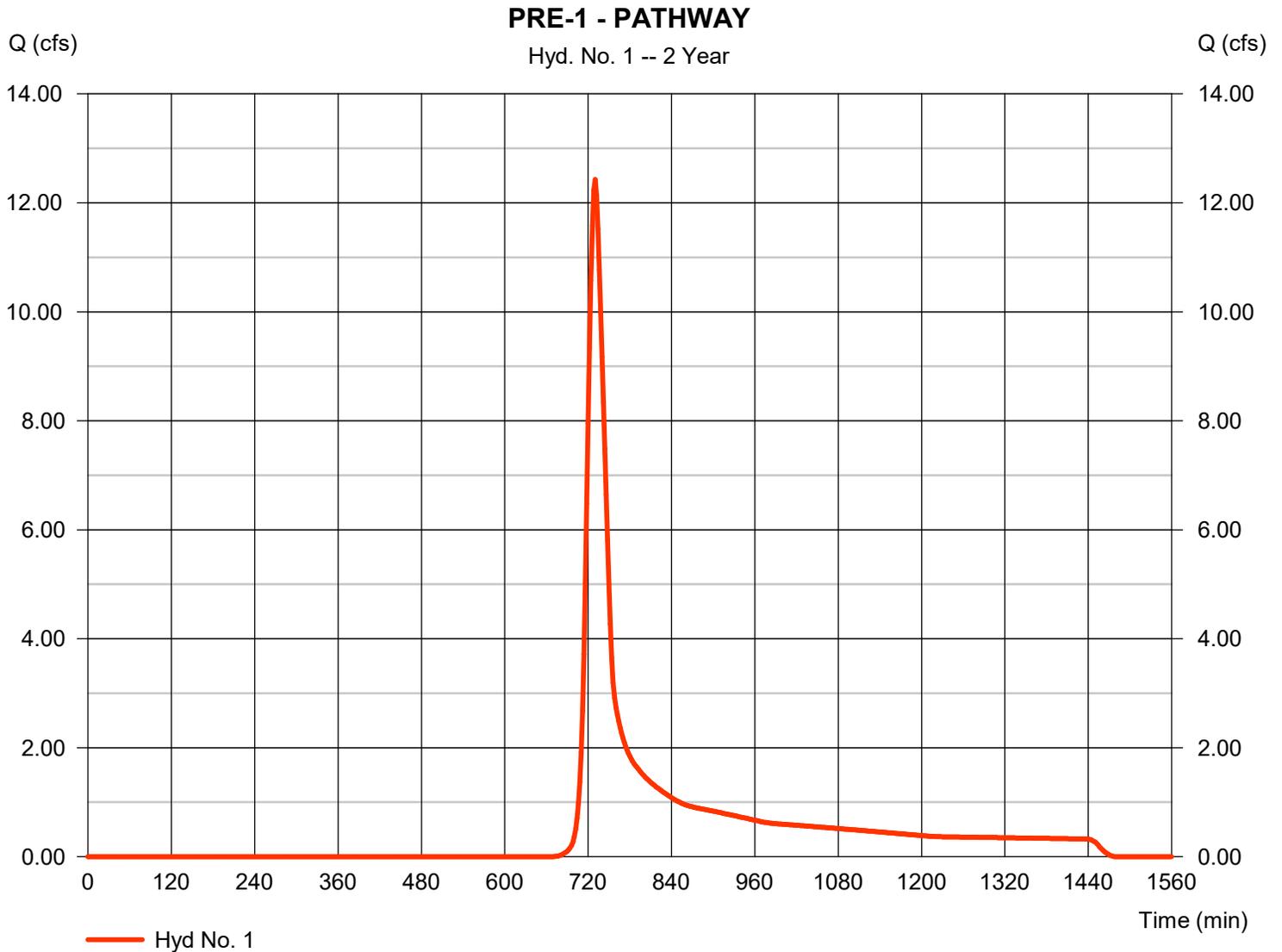
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Tuesday, 06 / 11 / 2024

Hyd. No. 1

PRE-1 - PATHWAY

Hydrograph type	= SCS Runoff	Peak discharge	= 12.43 cfs
Storm frequency	= 2 yrs	Time to peak	= 730 min
Time interval	= 2 min	Hyd. volume	= 49,517 cuft
Drainage area	= 13.100 ac	Curve number	= 70
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 24.90 min
Total precip.	= 3.58 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

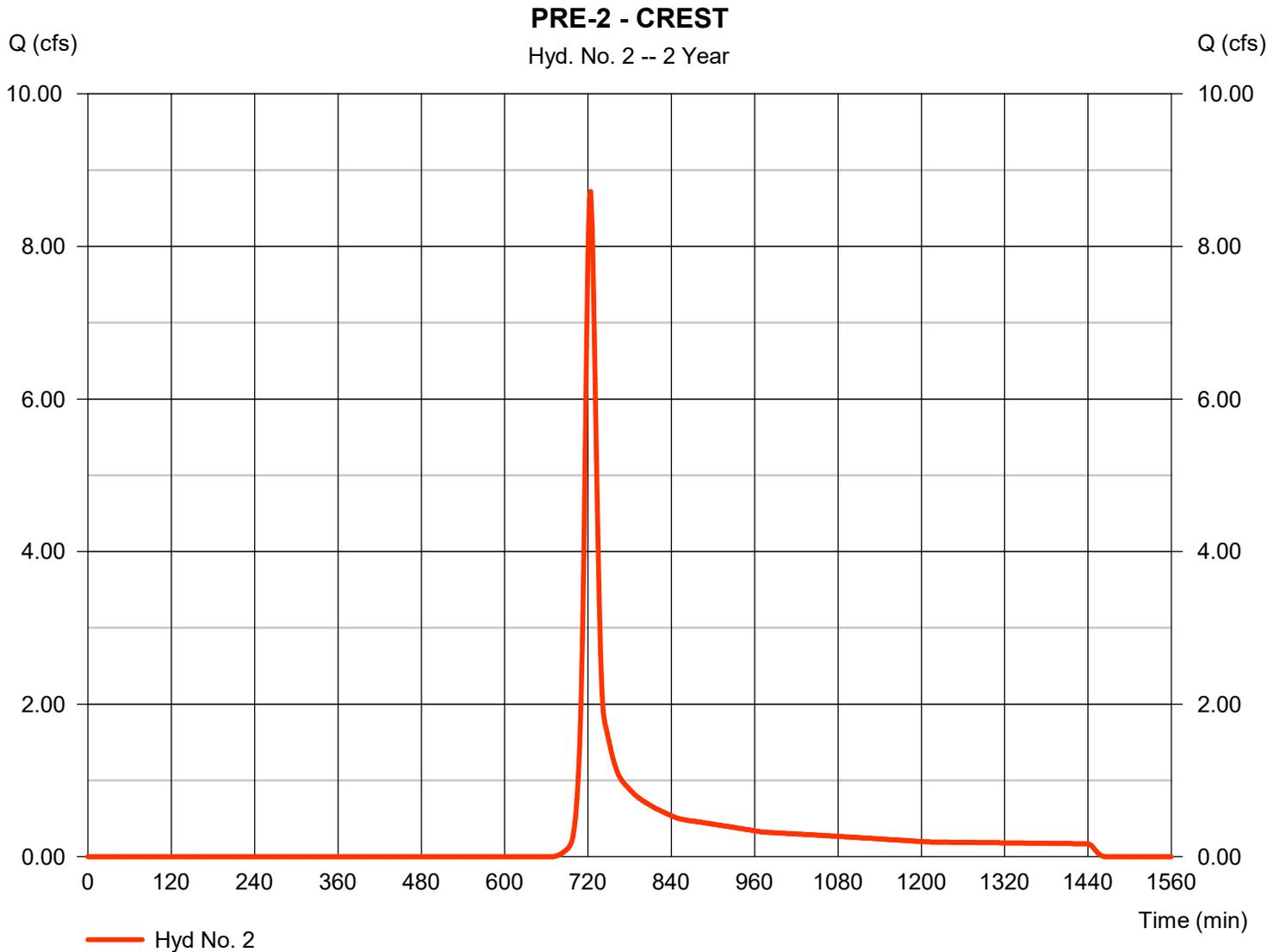


Hydrograph Report

Hyd. No. 2

PRE-2 - CREST

Hydrograph type	= SCS Runoff	Peak discharge	= 8.720 cfs
Storm frequency	= 2 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 25,908 cuft
Drainage area	= 6.920 ac	Curve number	= 70
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 15.60 min
Total precip.	= 3.58 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

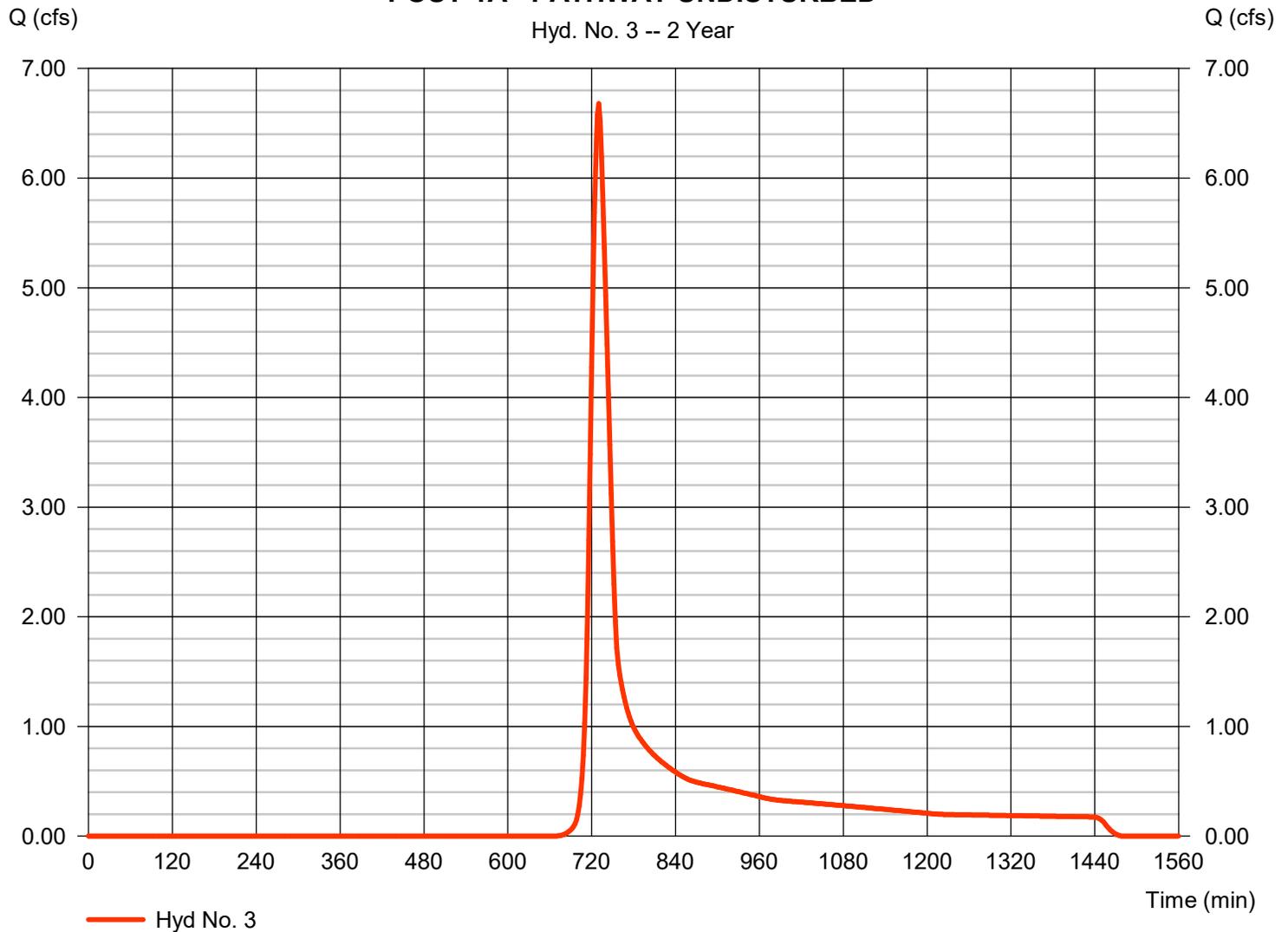
Tuesday, 06 / 11 / 2024

Hyd. No. 3

POST-1A - PATHWAY UNDISTURBED

Hydrograph type	= SCS Runoff	Peak discharge	= 6.678 cfs
Storm frequency	= 2 yrs	Time to peak	= 730 min
Time interval	= 2 min	Hyd. volume	= 26,611 cuft
Drainage area	= 7.040 ac	Curve number	= 70
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 24.90 min
Total precip.	= 3.58 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

POST-1A - PATHWAY UNDISTURBED



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

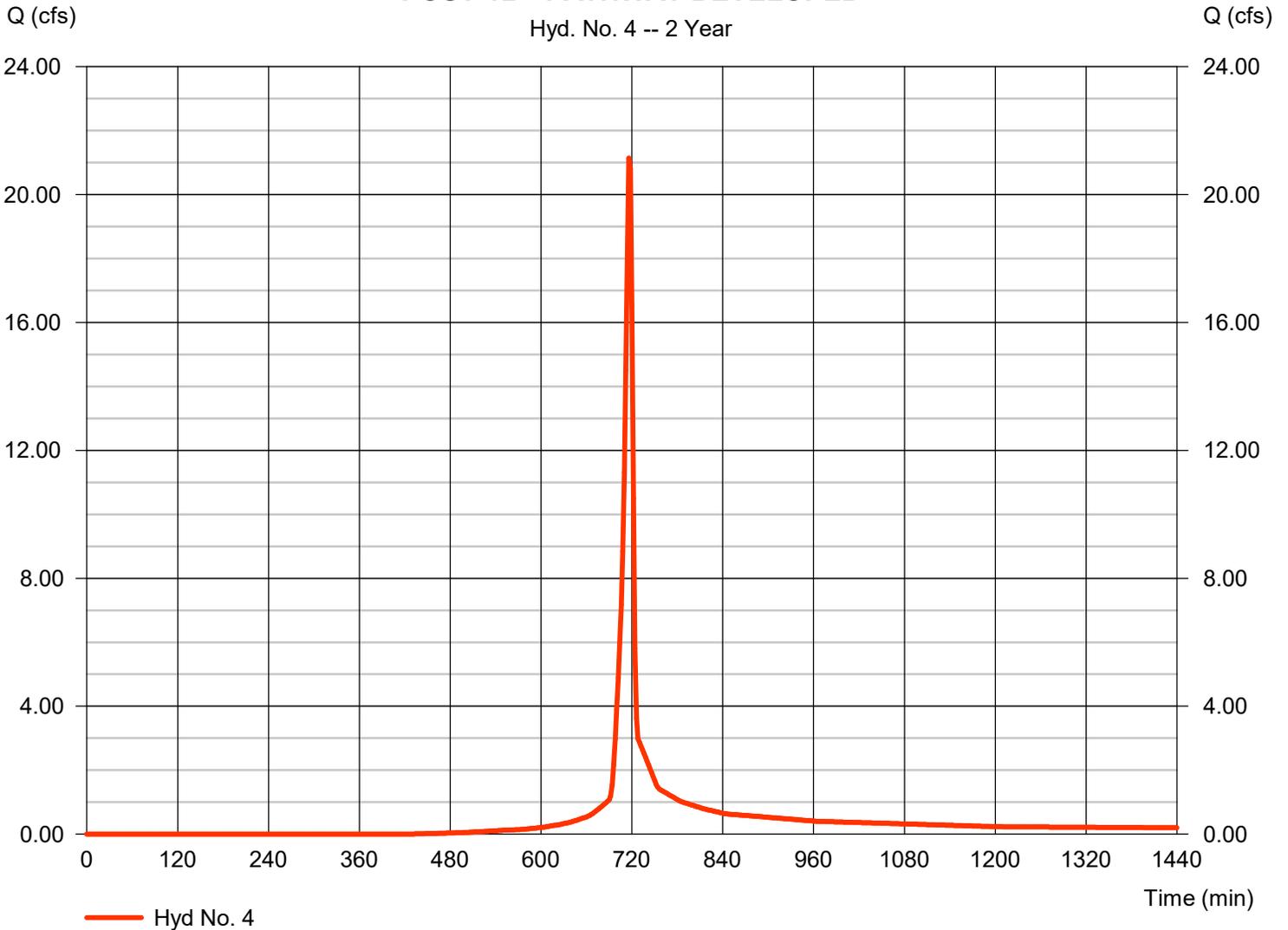
Tuesday, 06 / 11 / 2024

Hyd. No. 4

POST-1B - PATHWAY DEVELOPED

Hydrograph type	= SCS Runoff	Peak discharge	= 21.14 cfs
Storm frequency	= 2 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 43,024 cuft
Drainage area	= 6.060 ac	Curve number	= 85
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 3.58 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

POST-1B - PATHWAY DEVELOPED



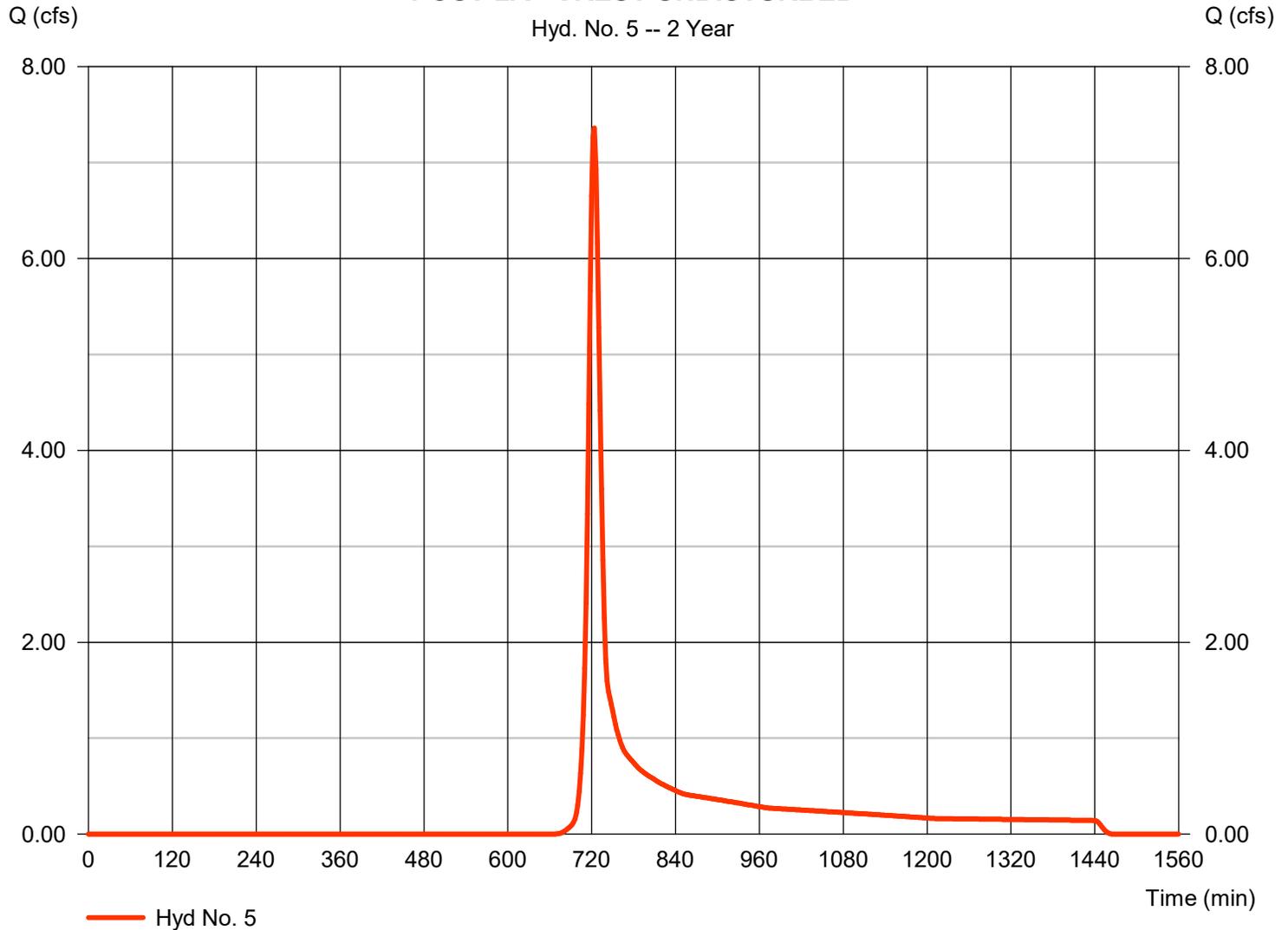
Hydrograph Report

Hyd. No. 5

POST-2A - CREST UNDISTURBED

Hydrograph type	= SCS Runoff	Peak discharge	= 7.359 cfs
Storm frequency	= 2 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 21,865 cuft
Drainage area	= 5.840 ac	Curve number	= 70
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 15.60 min
Total precip.	= 3.58 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

POST-2A - CREST UNDISTURBED



Hydrograph Report

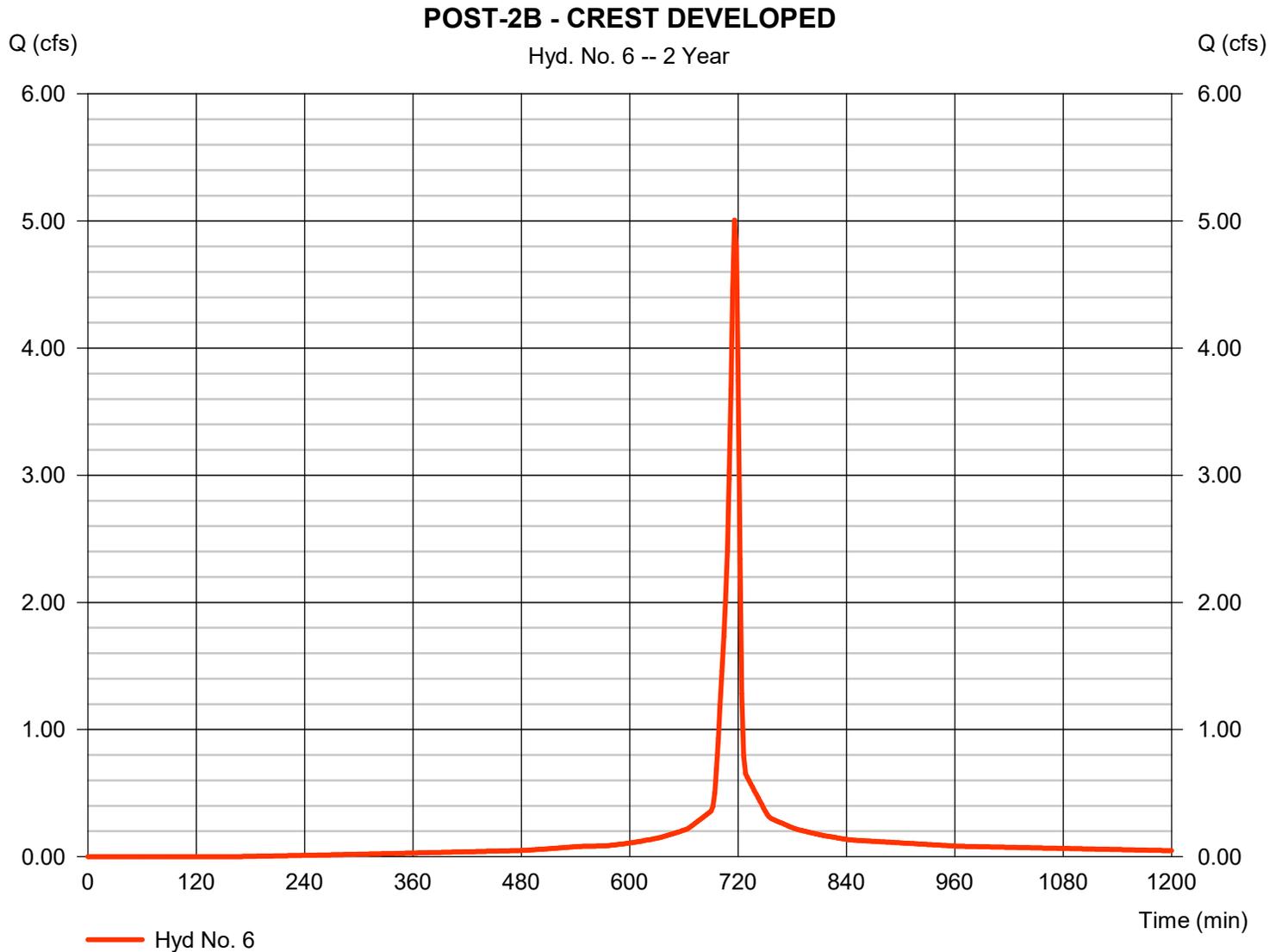
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Tuesday, 06 / 11 / 2024

Hyd. No. 6

POST-2B - CREST DEVELOPED

Hydrograph type	= SCS Runoff	Peak discharge	= 5.006 cfs
Storm frequency	= 2 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 11,091 cuft
Drainage area	= 1.080 ac	Curve number	= 95
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 3.58 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

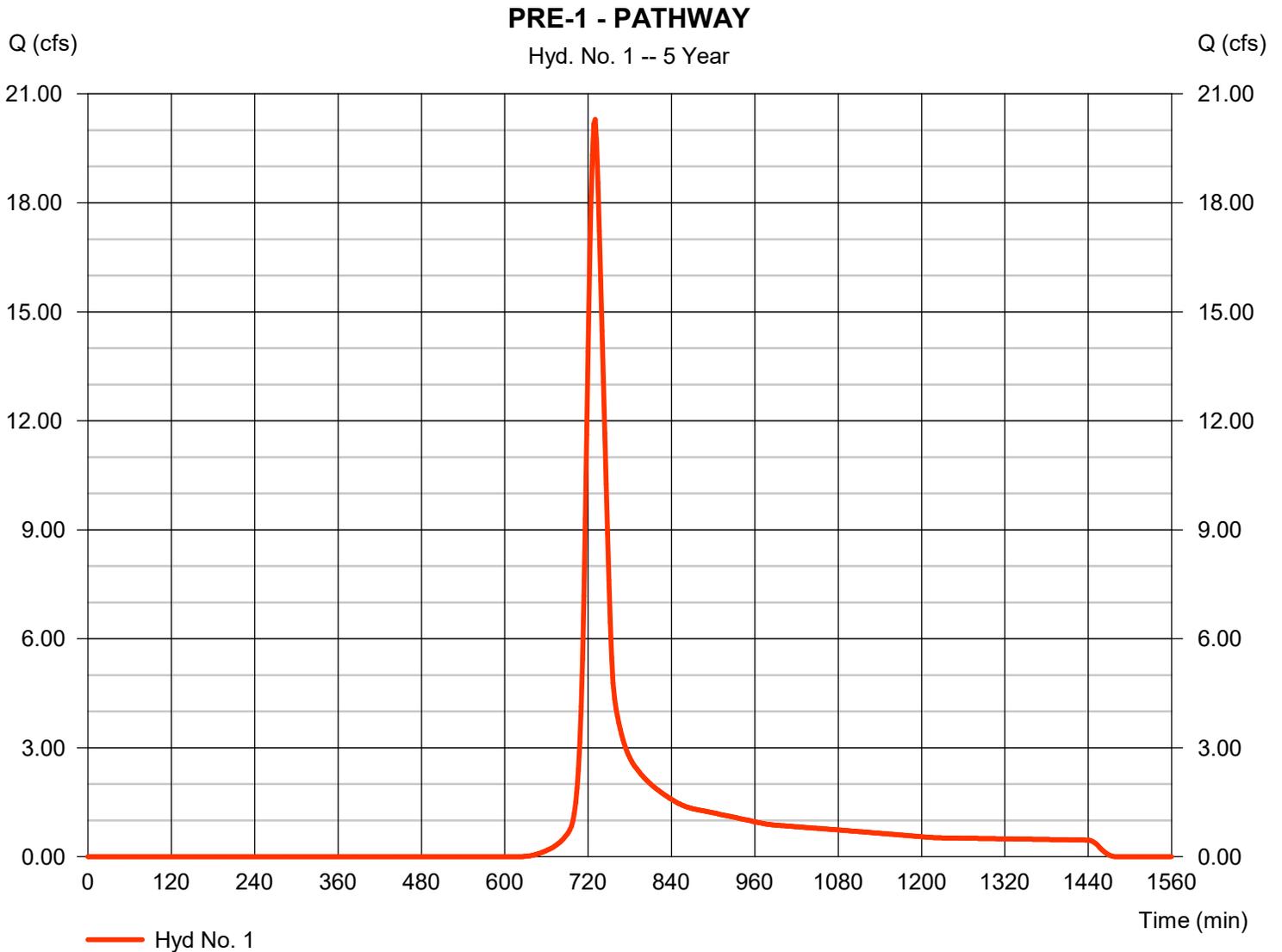
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	20.29	2	730	77,355	-----	-----	-----	PRE-1 - PATHWAY
2	SCS Runoff	14.04	2	722	40,473	-----	-----	-----	PRE-2 - CREST
3	SCS Runoff	10.91	2	730	41,571	-----	-----	-----	POST-1A - PATHWAY UNDISTURB
4	SCS Runoff	28.86	2	716	59,432	-----	-----	-----	POST-1B - PATHWAY DEVELOPED
5	SCS Runoff	11.85	2	722	34,157	-----	-----	-----	POST-2A - CREST UNDISTURBED
6	SCS Runoff	6.357	2	716	14,316	-----	-----	-----	POST-2B - CREST DEVELOPED
23-0350.204 - Prelim Routing.gpw					Return Period: 5 Year			Tuesday, 06 / 11 / 2024	

Hydrograph Report

Hyd. No. 1

PRE-1 - PATHWAY

Hydrograph type	= SCS Runoff	Peak discharge	= 20.29 cfs
Storm frequency	= 5 yrs	Time to peak	= 730 min
Time interval	= 2 min	Hyd. volume	= 77,355 cuft
Drainage area	= 13.100 ac	Curve number	= 70
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 24.90 min
Total precip.	= 4.47 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

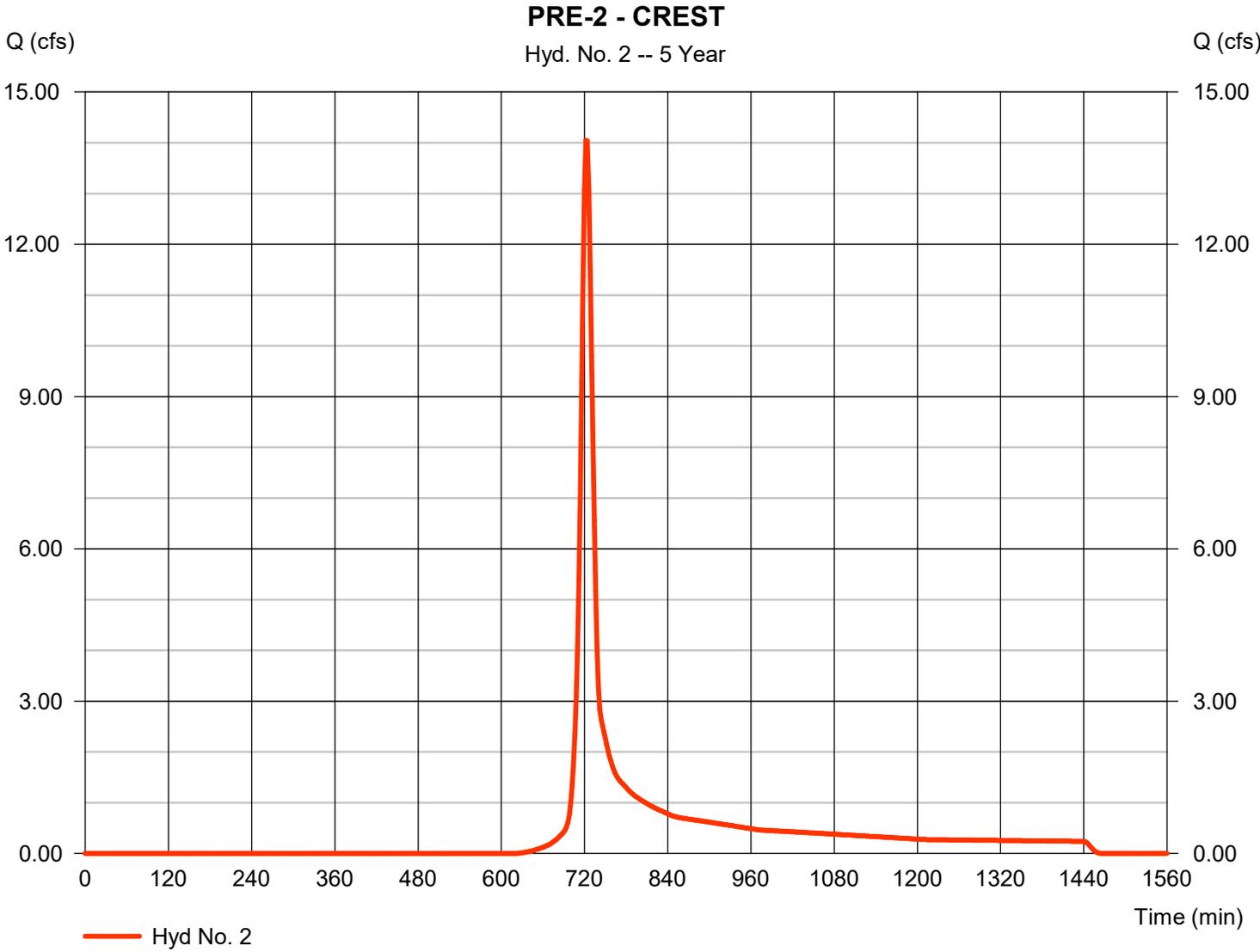


Hydrograph Report

Hyd. No. 2

PRE-2 - CREST

Hydrograph type	= SCS Runoff	Peak discharge	= 14.04 cfs
Storm frequency	= 5 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 40,473 cuft
Drainage area	= 6.920 ac	Curve number	= 70
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 15.60 min
Total precip.	= 4.47 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



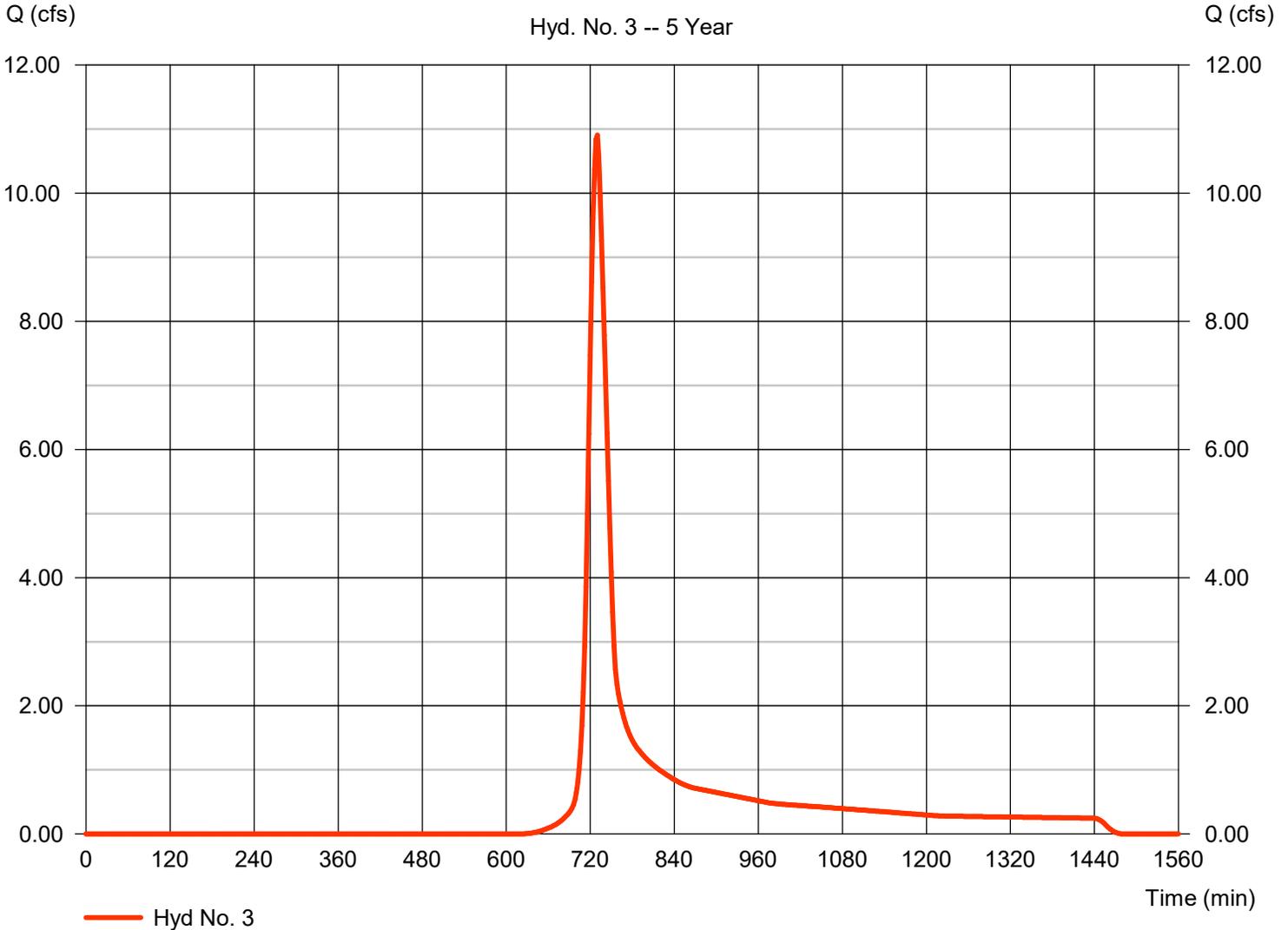
Hydrograph Report

Hyd. No. 3

POST-1A - PATHWAY UNDISTURBED

Hydrograph type	= SCS Runoff	Peak discharge	= 10.91 cfs
Storm frequency	= 5 yrs	Time to peak	= 730 min
Time interval	= 2 min	Hyd. volume	= 41,571 cuft
Drainage area	= 7.040 ac	Curve number	= 70
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 24.90 min
Total precip.	= 4.47 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

POST-1A - PATHWAY UNDISTURBED



Hydrograph Report

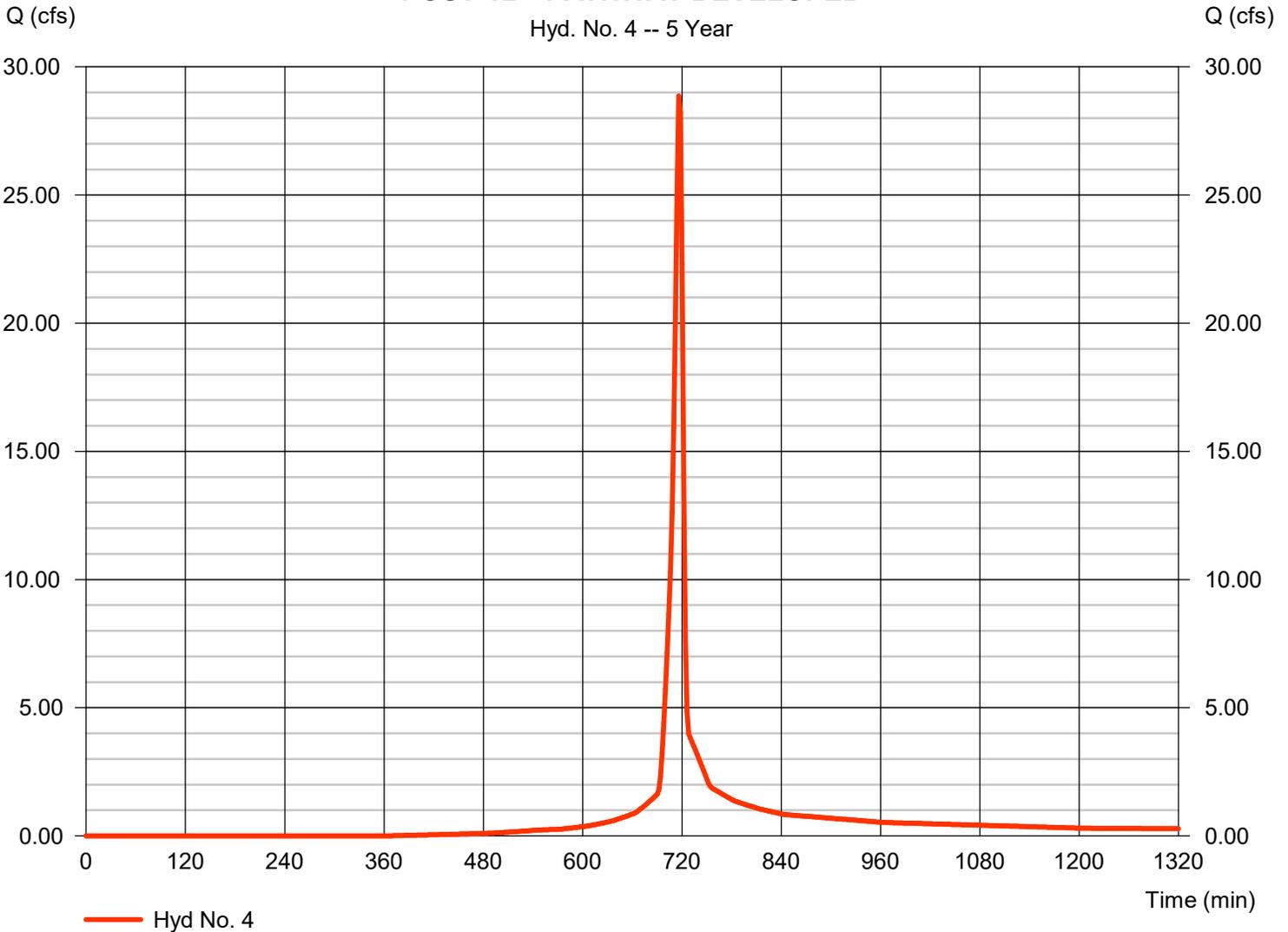
Hyd. No. 4

POST-1B - PATHWAY DEVELOPED

Hydrograph type	= SCS Runoff	Peak discharge	= 28.86 cfs
Storm frequency	= 5 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 59,432 cuft
Drainage area	= 6.060 ac	Curve number	= 85
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 4.47 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

POST-1B - PATHWAY DEVELOPED

Hyd. No. 4 -- 5 Year



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

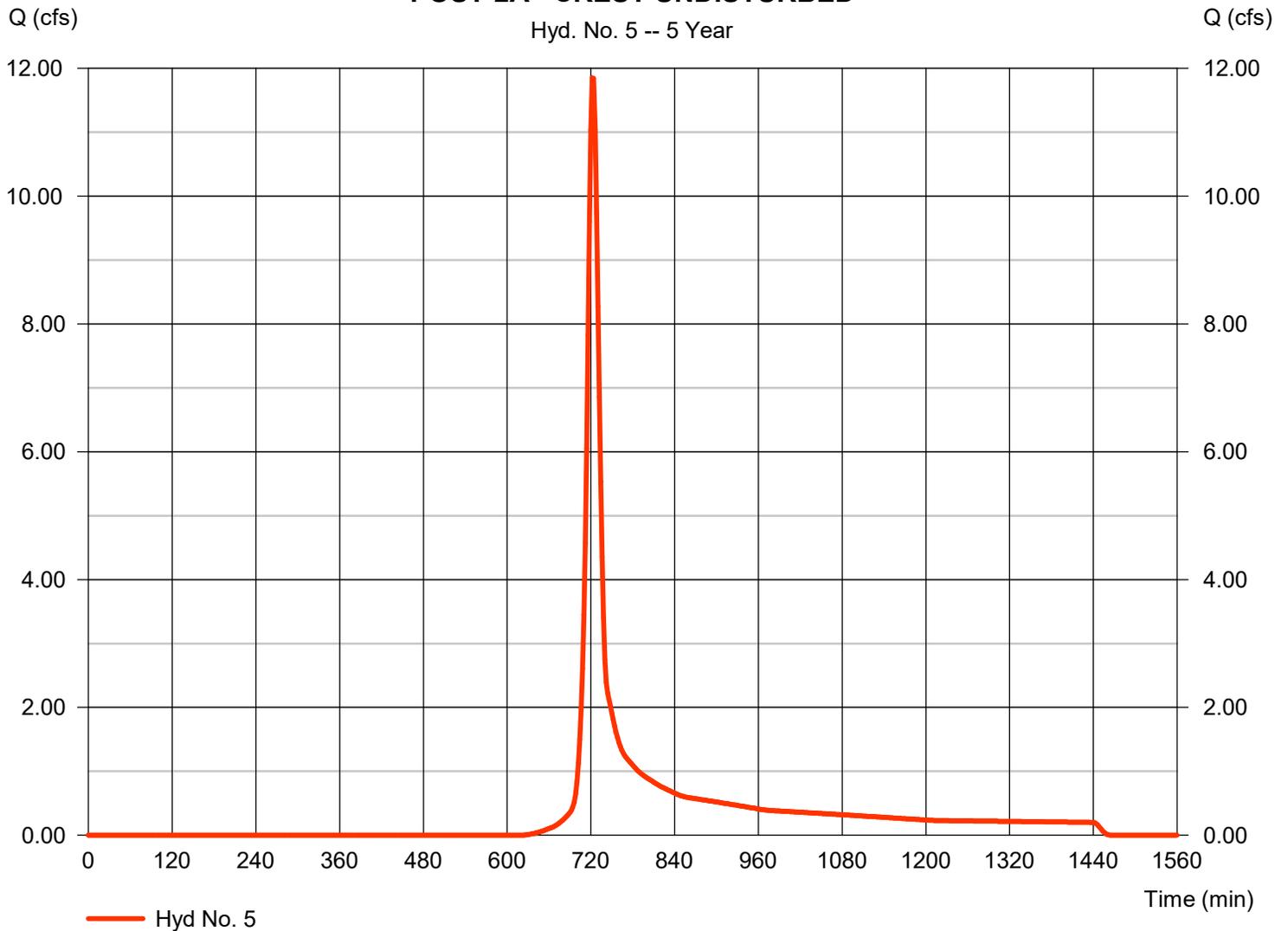
Tuesday, 06 / 11 / 2024

Hyd. No. 5

POST-2A - CREST UNDISTURBED

Hydrograph type	= SCS Runoff	Peak discharge	= 11.85 cfs
Storm frequency	= 5 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 34,157 cuft
Drainage area	= 5.840 ac	Curve number	= 70
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 15.60 min
Total precip.	= 4.47 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

POST-2A - CREST UNDISTURBED



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

Tuesday, 06 / 11 / 2024

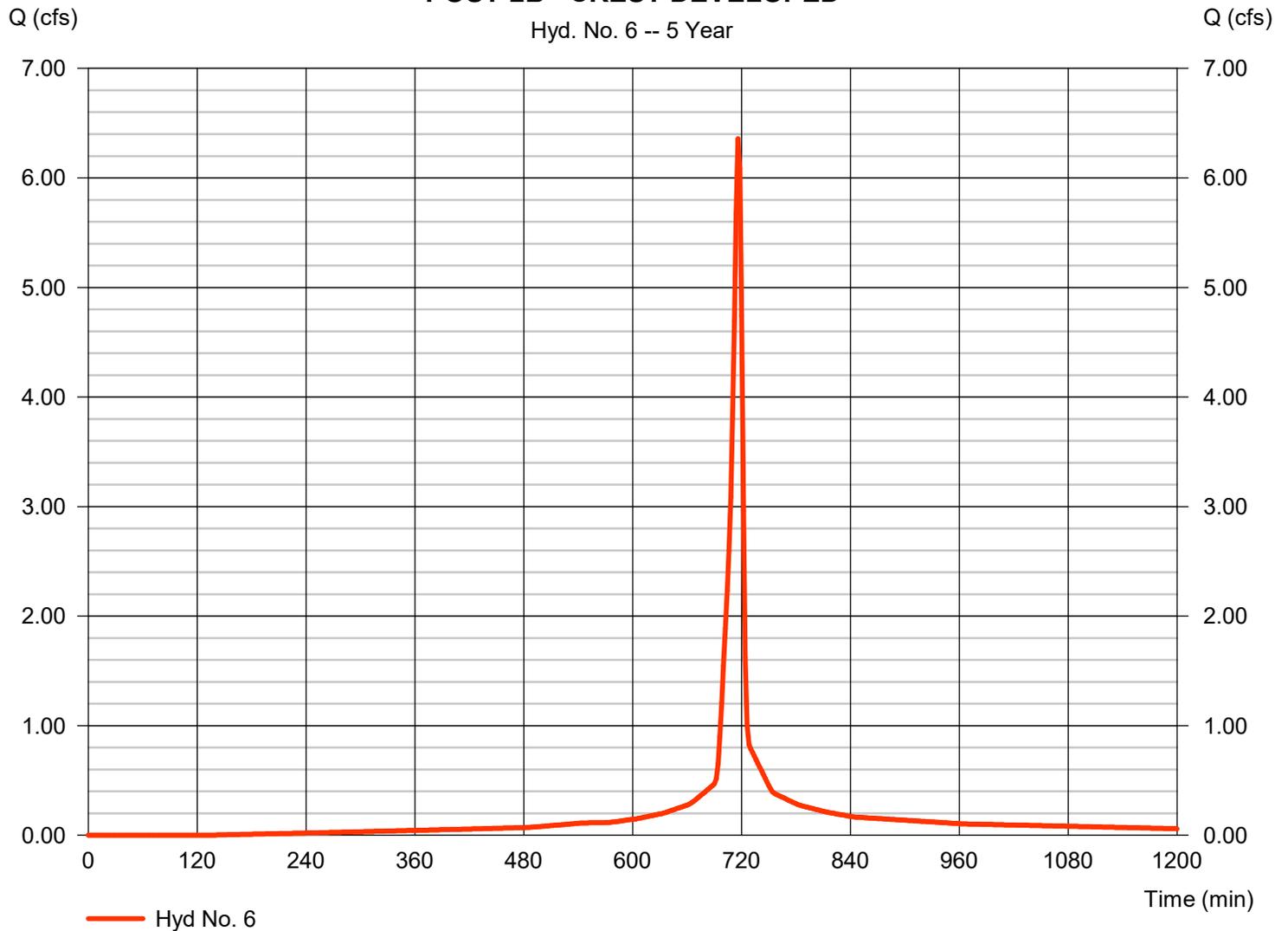
Hyd. No. 6

POST-2B - CREST DEVELOPED

Hydrograph type	= SCS Runoff	Peak discharge	= 6.357 cfs
Storm frequency	= 5 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 14,316 cuft
Drainage area	= 1.080 ac	Curve number	= 95
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 4.47 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

POST-2B - CREST DEVELOPED

Hyd. No. 6 -- 5 Year



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

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	26.98	2	730	101,261	-----	-----	-----	PRE-1 - PATHWAY
2	SCS Runoff	18.66	2	722	52,981	-----	-----	-----	PRE-2 - CREST
3	SCS Runoff	14.50	2	730	54,418	-----	-----	-----	POST-1A - PATHWAY UNDISTURB
4	SCS Runoff	34.99	2	716	72,706	-----	-----	-----	POST-1B - PATHWAY DEVELOPED
5	SCS Runoff	15.75	2	722	44,712	-----	-----	-----	POST-2A - CREST UNDISTURBED
6	SCS Runoff	7.414	2	716	16,862	-----	-----	-----	POST-2B - CREST DEVELOPED
23-0350.204 - Prelim Routing.gpw					Return Period: 10 Year			Tuesday, 06 / 11 / 2024	

Hydrograph Report

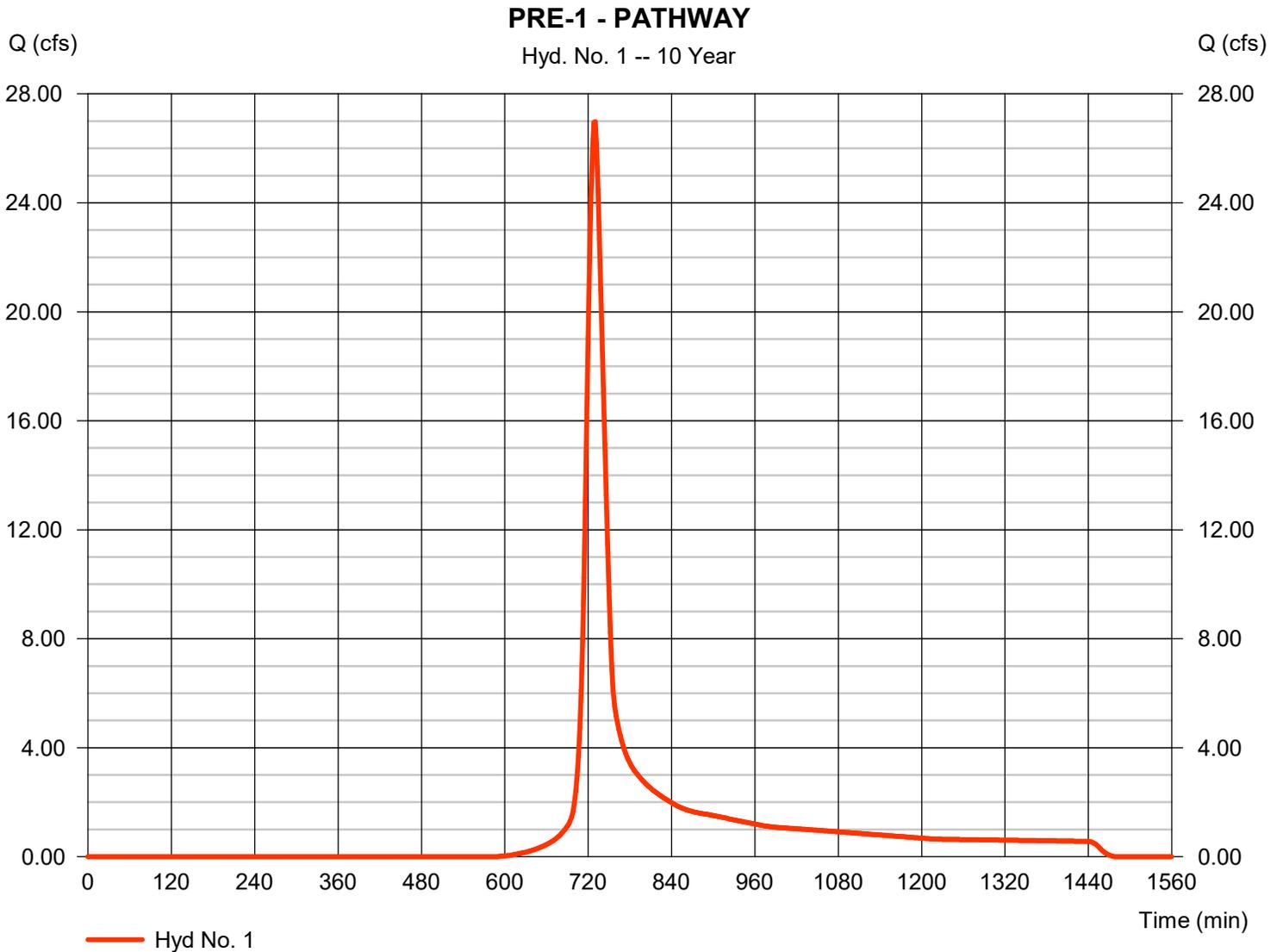
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

Tuesday, 06 / 11 / 2024

Hyd. No. 1

PRE-1 - PATHWAY

Hydrograph type	= SCS Runoff	Peak discharge	= 26.98 cfs
Storm frequency	= 10 yrs	Time to peak	= 730 min
Time interval	= 2 min	Hyd. volume	= 101,261 cuft
Drainage area	= 13.100 ac	Curve number	= 70
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 24.90 min
Total precip.	= 5.17 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

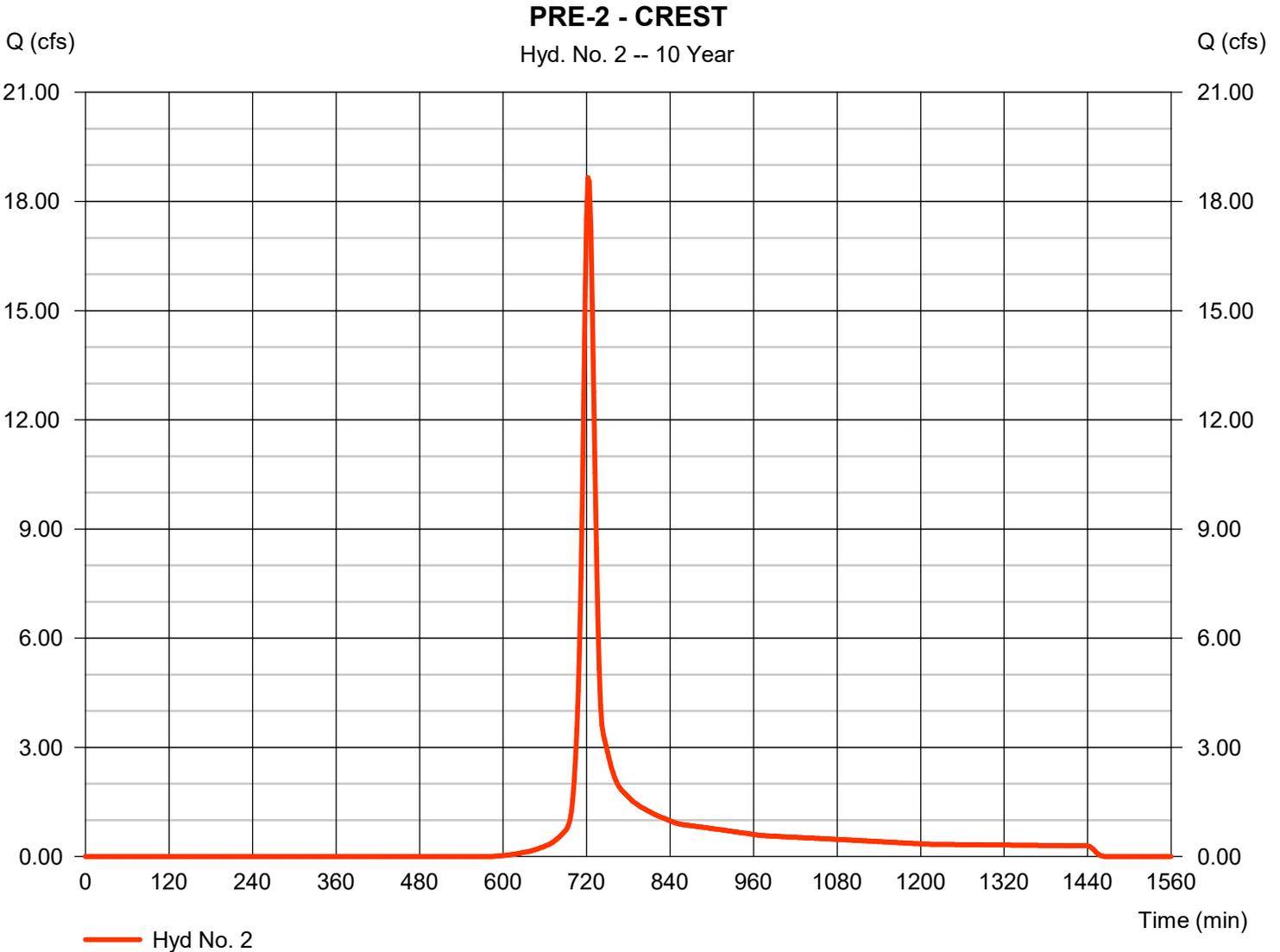


Hydrograph Report

Hyd. No. 2

PRE-2 - CREST

Hydrograph type	= SCS Runoff	Peak discharge	= 18.66 cfs
Storm frequency	= 10 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 52,981 cuft
Drainage area	= 6.920 ac	Curve number	= 70
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 15.60 min
Total precip.	= 5.17 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

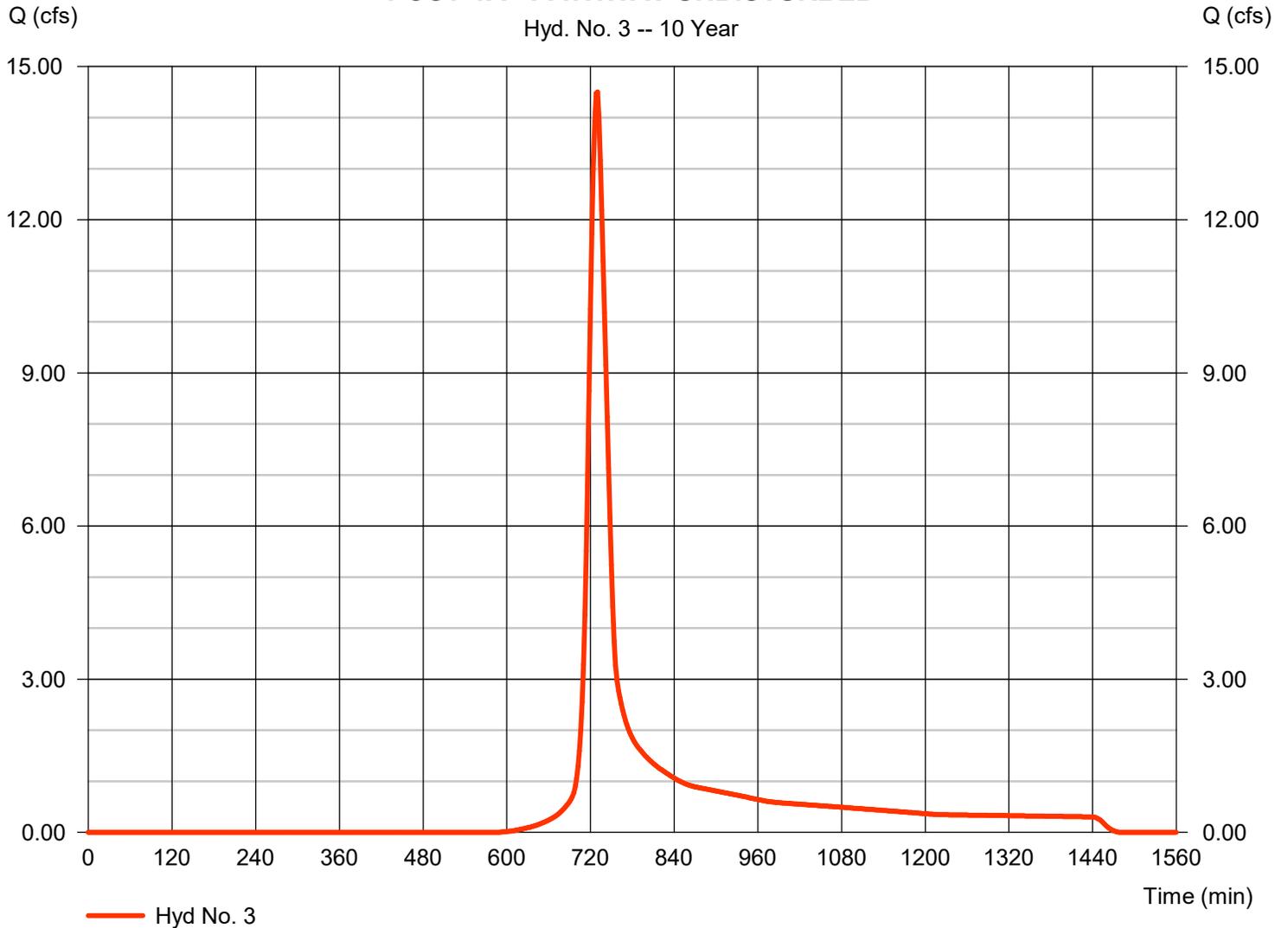
Tuesday, 06 / 11 / 2024

Hyd. No. 3

POST-1A - PATHWAY UNDISTURBED

Hydrograph type	= SCS Runoff	Peak discharge	= 14.50 cfs
Storm frequency	= 10 yrs	Time to peak	= 730 min
Time interval	= 2 min	Hyd. volume	= 54,418 cuft
Drainage area	= 7.040 ac	Curve number	= 70
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 24.90 min
Total precip.	= 5.17 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

POST-1A - PATHWAY UNDISTURBED



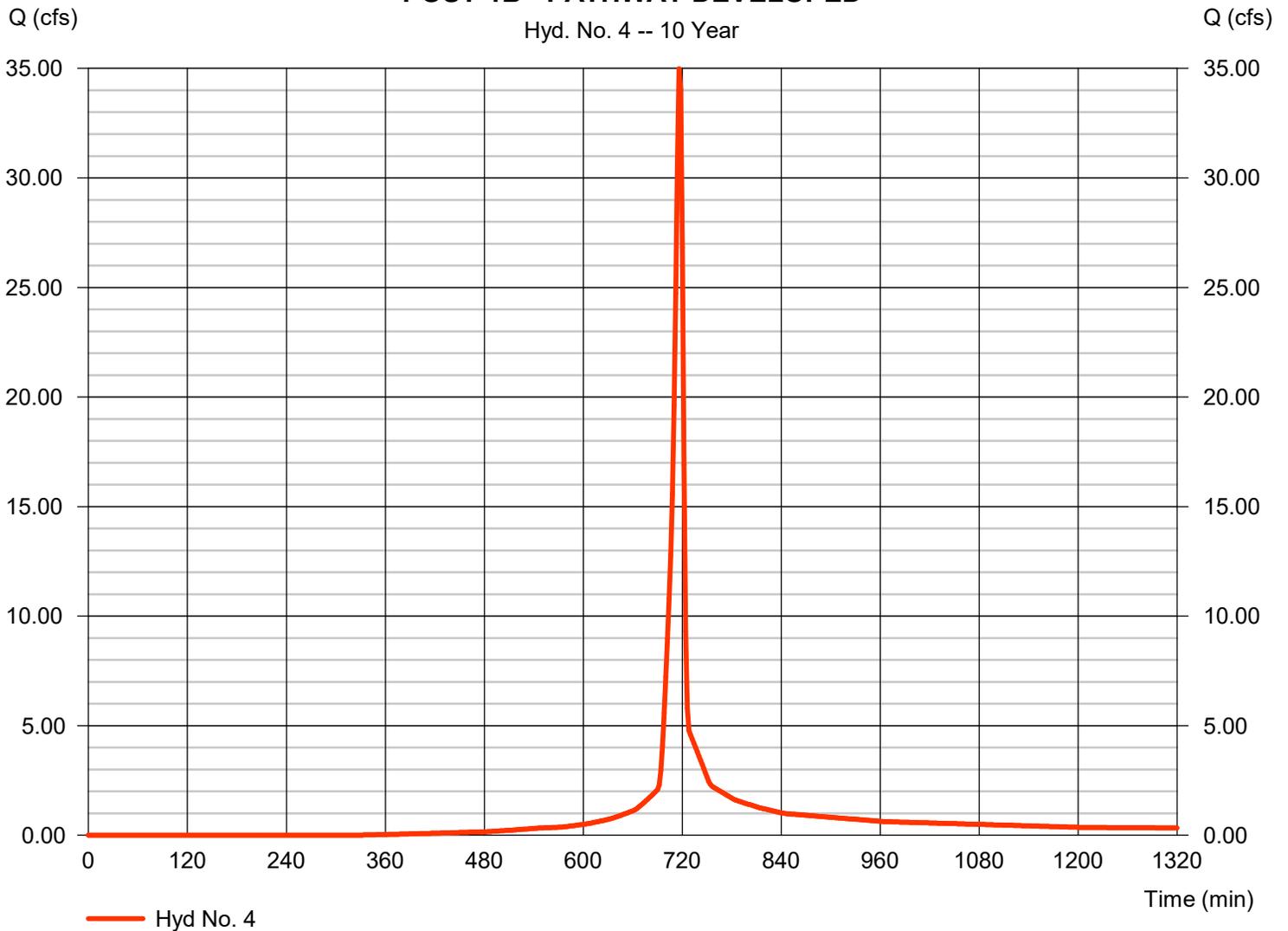
Hydrograph Report

Hyd. No. 4

POST-1B - PATHWAY DEVELOPED

Hydrograph type	= SCS Runoff	Peak discharge	= 34.99 cfs
Storm frequency	= 10 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 72,706 cuft
Drainage area	= 6.060 ac	Curve number	= 85
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 5.17 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

POST-1B - PATHWAY DEVELOPED

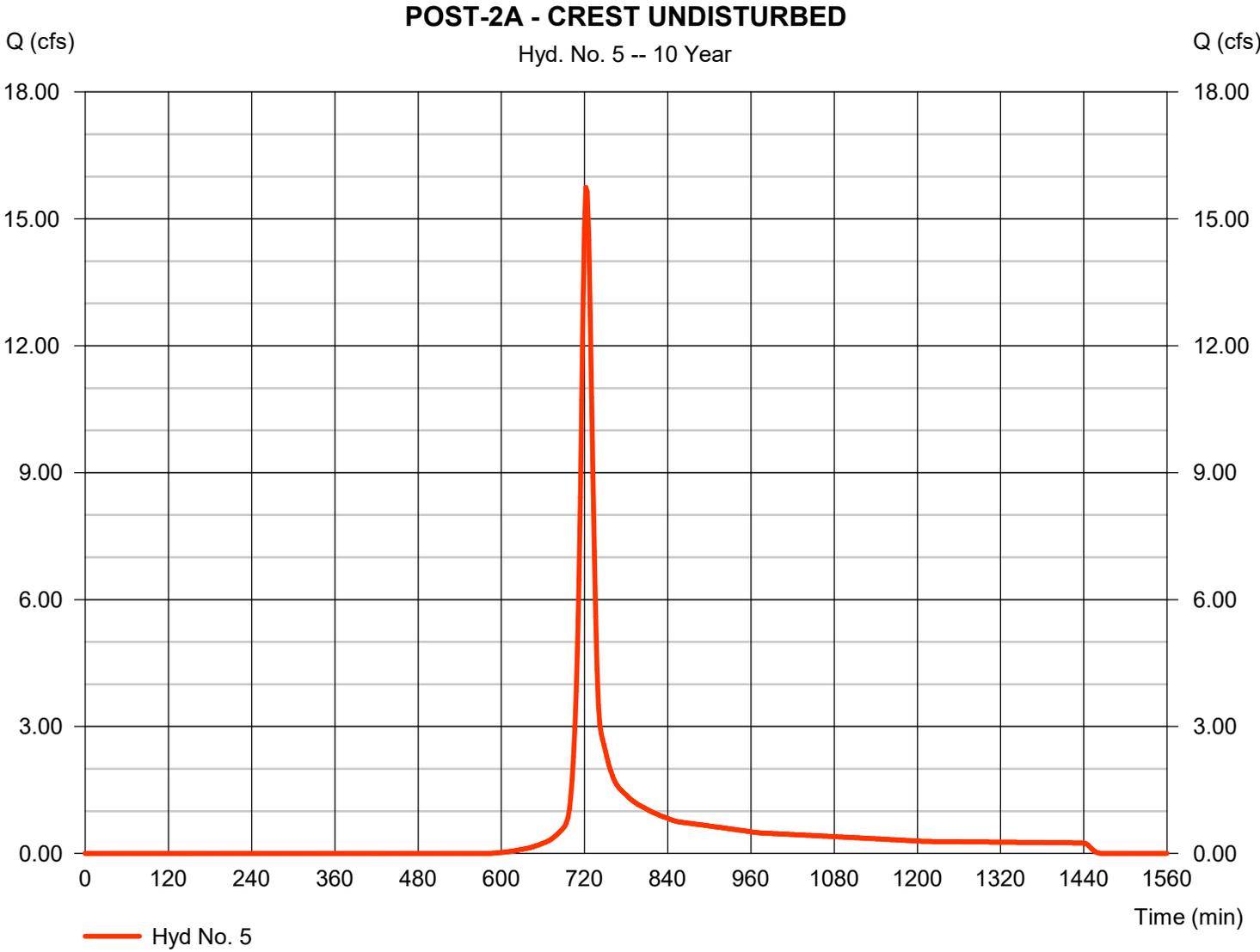


Hydrograph Report

Hyd. No. 5

POST-2A - CREST UNDISTURBED

Hydrograph type	= SCS Runoff	Peak discharge	= 15.75 cfs
Storm frequency	= 10 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 44,712 cuft
Drainage area	= 5.840 ac	Curve number	= 70
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 15.60 min
Total precip.	= 5.17 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

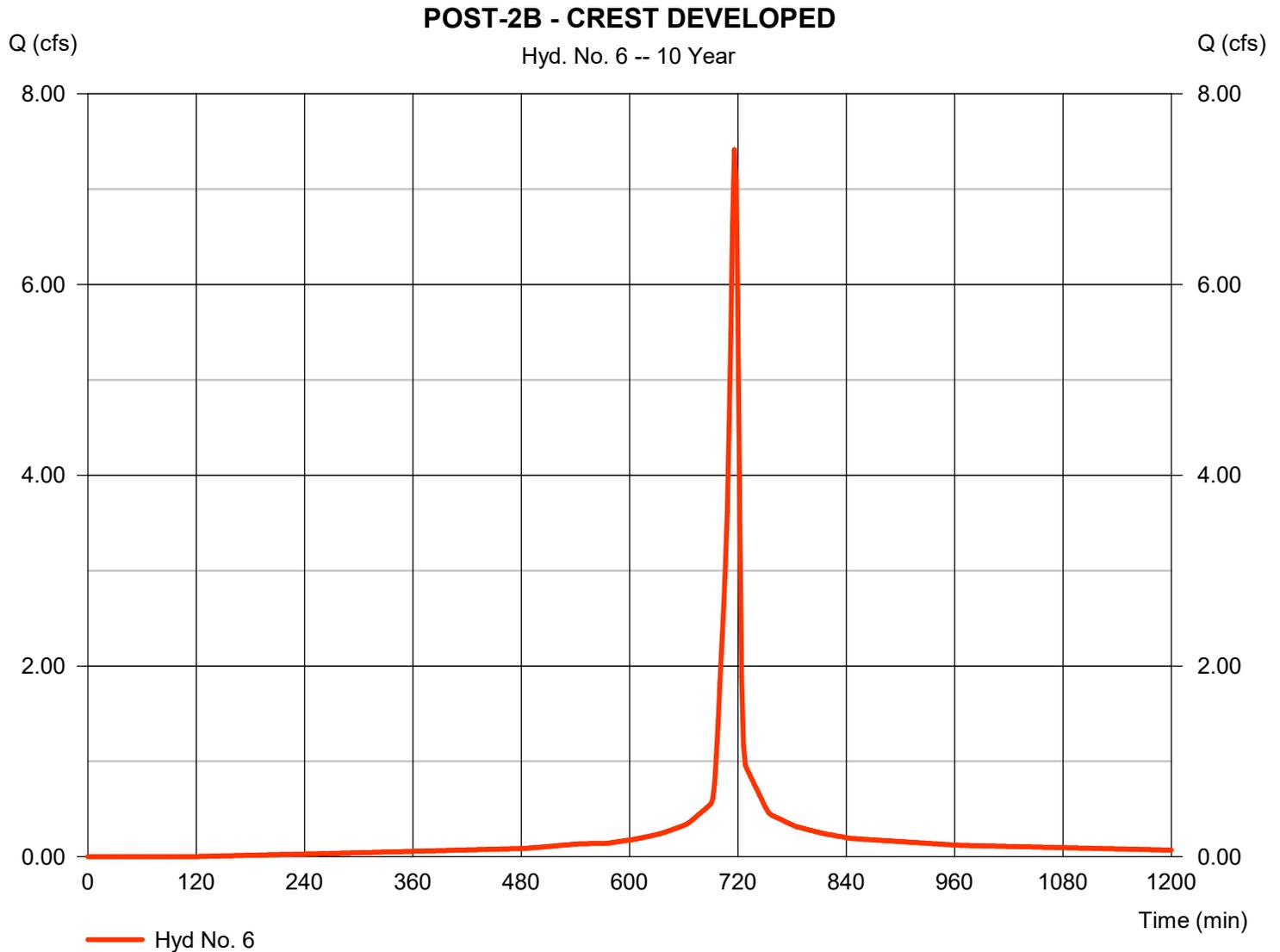
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

Tuesday, 06 / 11 / 2024

Hyd. No. 6

POST-2B - CREST DEVELOPED

Hydrograph type	= SCS Runoff	Peak discharge	= 7.414 cfs
Storm frequency	= 10 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 16,862 cuft
Drainage area	= 1.080 ac	Curve number	= 95
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 5.17 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

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	36.54	2	728	135,409	-----	-----	-----	PRE-1 - PATHWAY
2	SCS Runoff	25.19	2	722	70,848	-----	-----	-----	PRE-2 - CREST
3	SCS Runoff	19.64	2	728	72,769	-----	-----	-----	POST-1A - PATHWAY UNDISTURB
4	SCS Runoff	43.21	2	716	90,872	-----	-----	-----	POST-1B - PATHWAY DEVELOPED
5	SCS Runoff	21.26	2	722	59,790	-----	-----	-----	POST-2A - CREST UNDISTURBED
6	SCS Runoff	8.826	2	716	20,291	-----	-----	-----	POST-2B - CREST DEVELOPED
23-0350.204 - Prelim Routing.gpw					Return Period: 25 Year			Tuesday, 06 / 11 / 2024	

Hydrograph Report

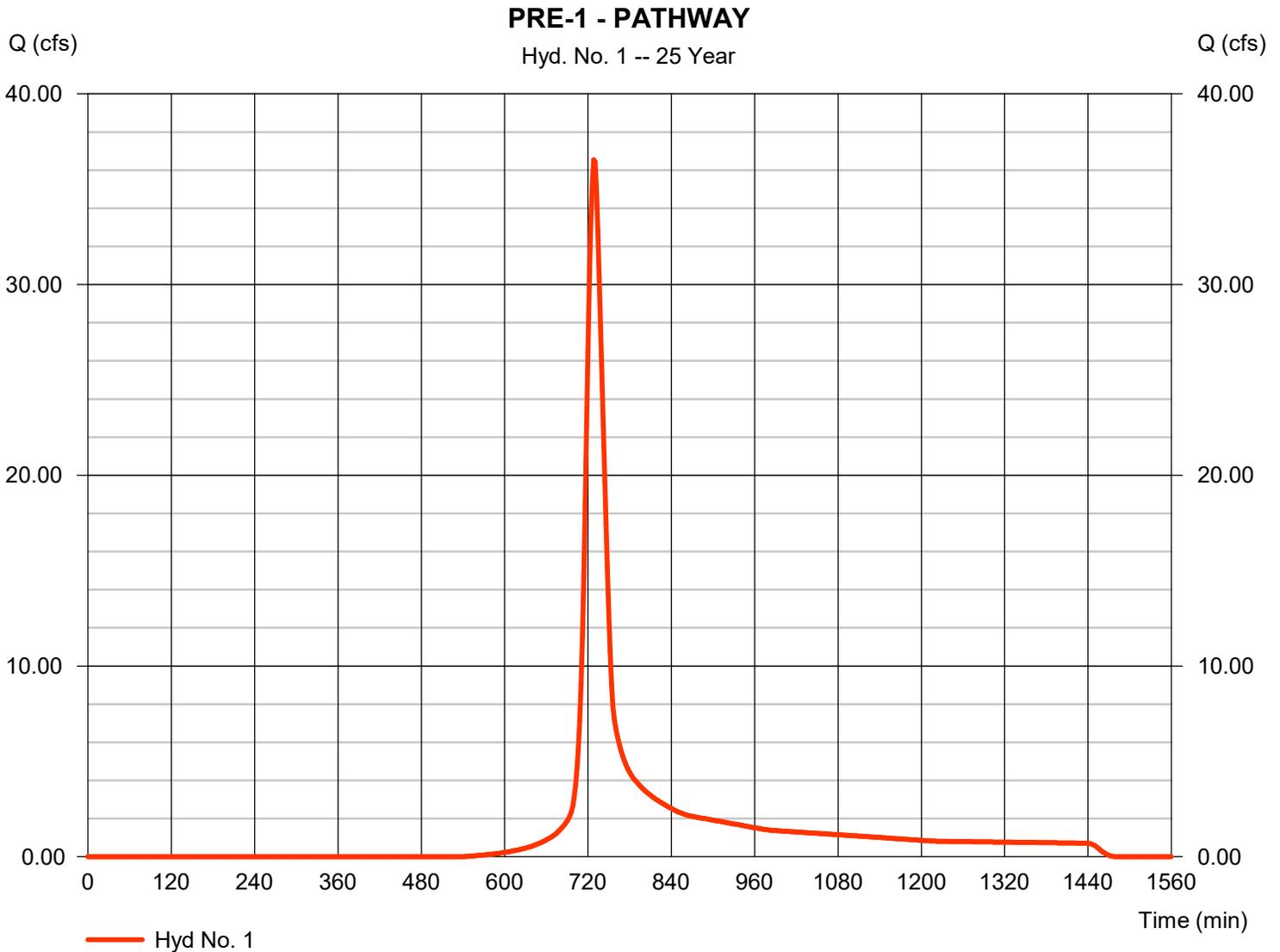
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

Tuesday, 06 / 11 / 2024

Hyd. No. 1

PRE-1 - PATHWAY

Hydrograph type	= SCS Runoff	Peak discharge	= 36.54 cfs
Storm frequency	= 25 yrs	Time to peak	= 728 min
Time interval	= 2 min	Hyd. volume	= 135,409 cuft
Drainage area	= 13.100 ac	Curve number	= 70
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 24.90 min
Total precip.	= 6.11 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

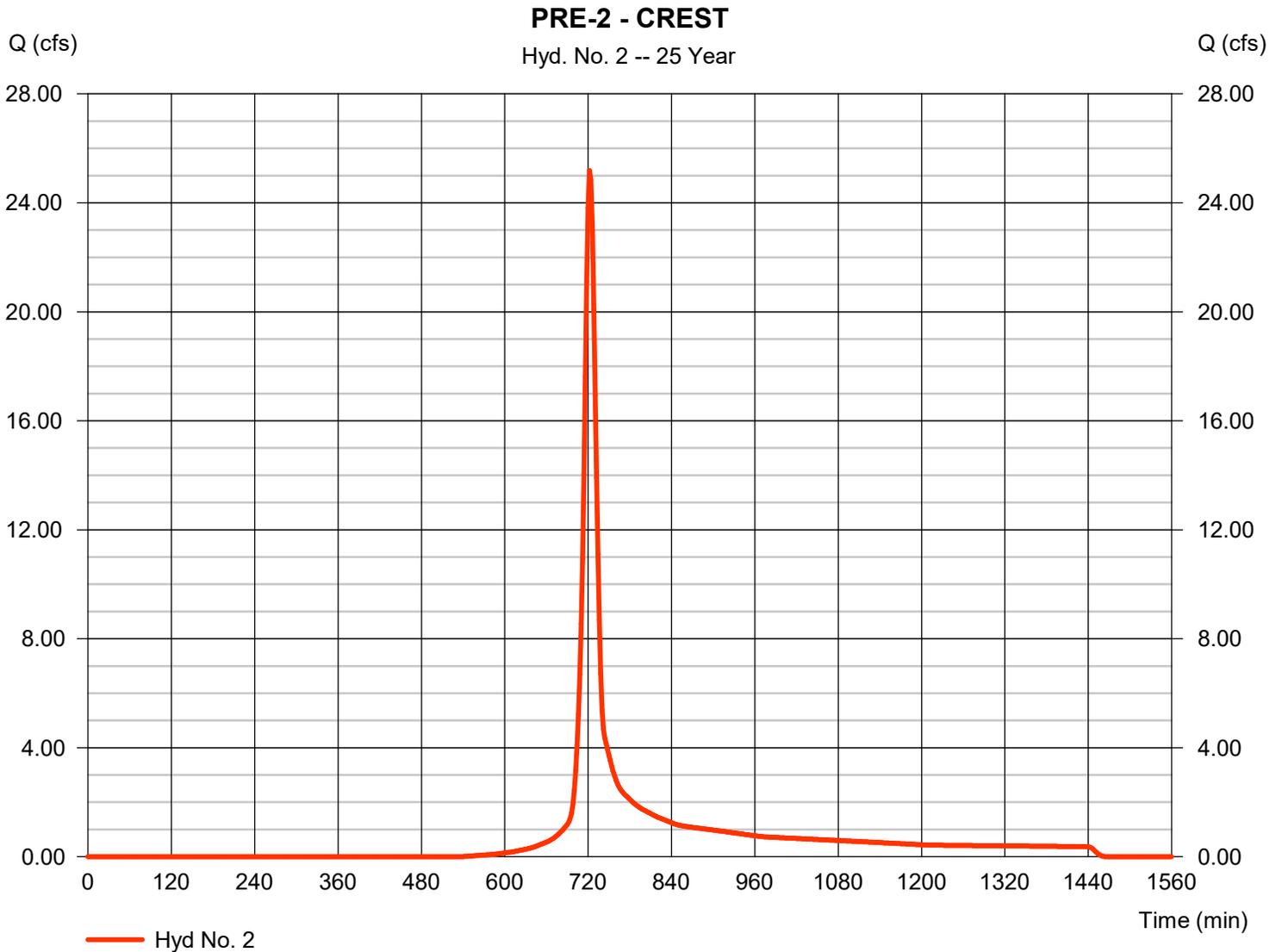
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

Tuesday, 06 / 11 / 2024

Hyd. No. 2

PRE-2 - CREST

Hydrograph type	= SCS Runoff	Peak discharge	= 25.19 cfs
Storm frequency	= 25 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 70,848 cuft
Drainage area	= 6.920 ac	Curve number	= 70
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 15.60 min
Total precip.	= 6.11 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

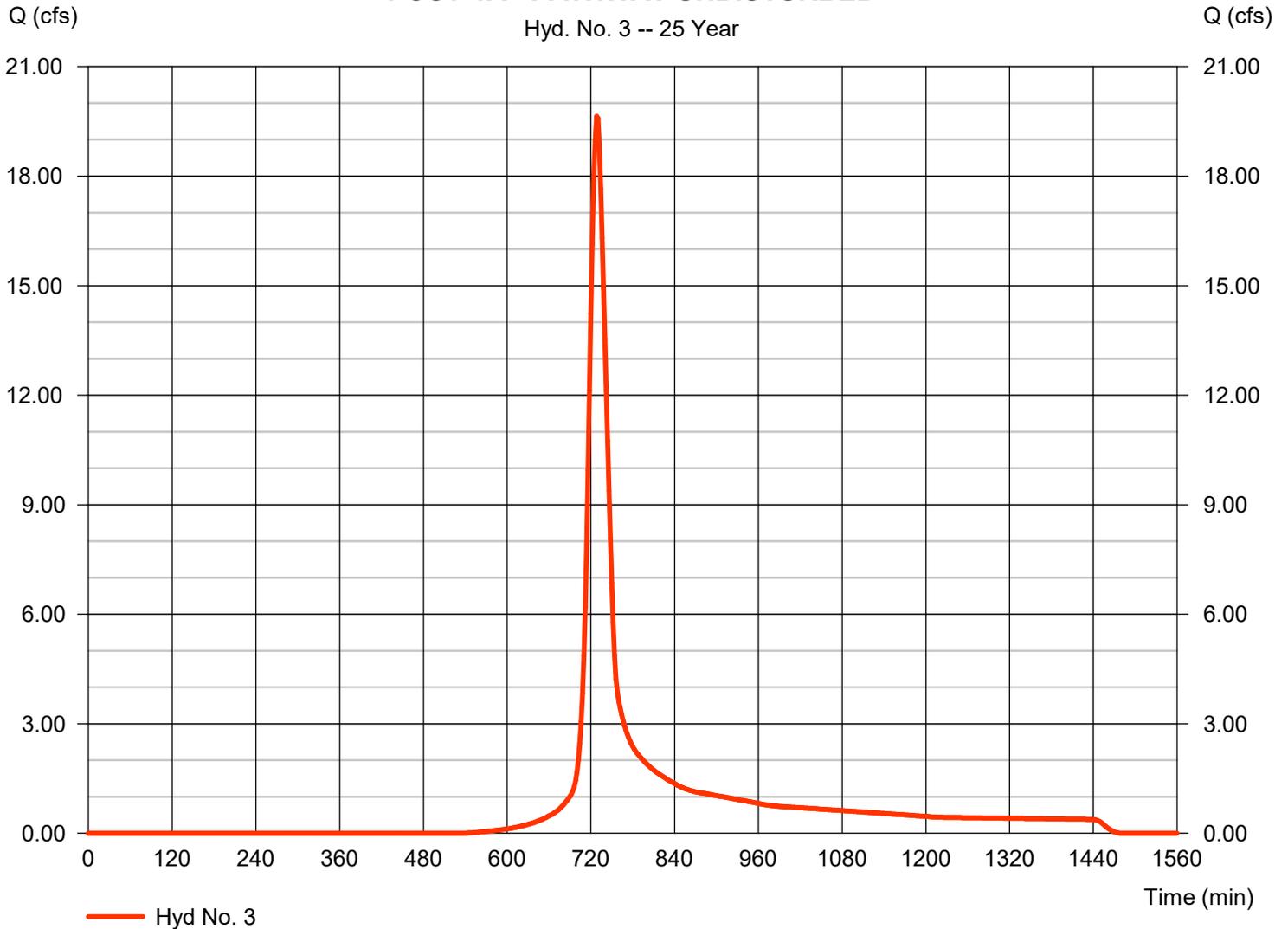
Tuesday, 06 / 11 / 2024

Hyd. No. 3

POST-1A - PATHWAY UNDISTURBED

Hydrograph type	= SCS Runoff	Peak discharge	= 19.64 cfs
Storm frequency	= 25 yrs	Time to peak	= 728 min
Time interval	= 2 min	Hyd. volume	= 72,769 cuft
Drainage area	= 7.040 ac	Curve number	= 70
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 24.90 min
Total precip.	= 6.11 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

POST-1A - PATHWAY UNDISTURBED



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

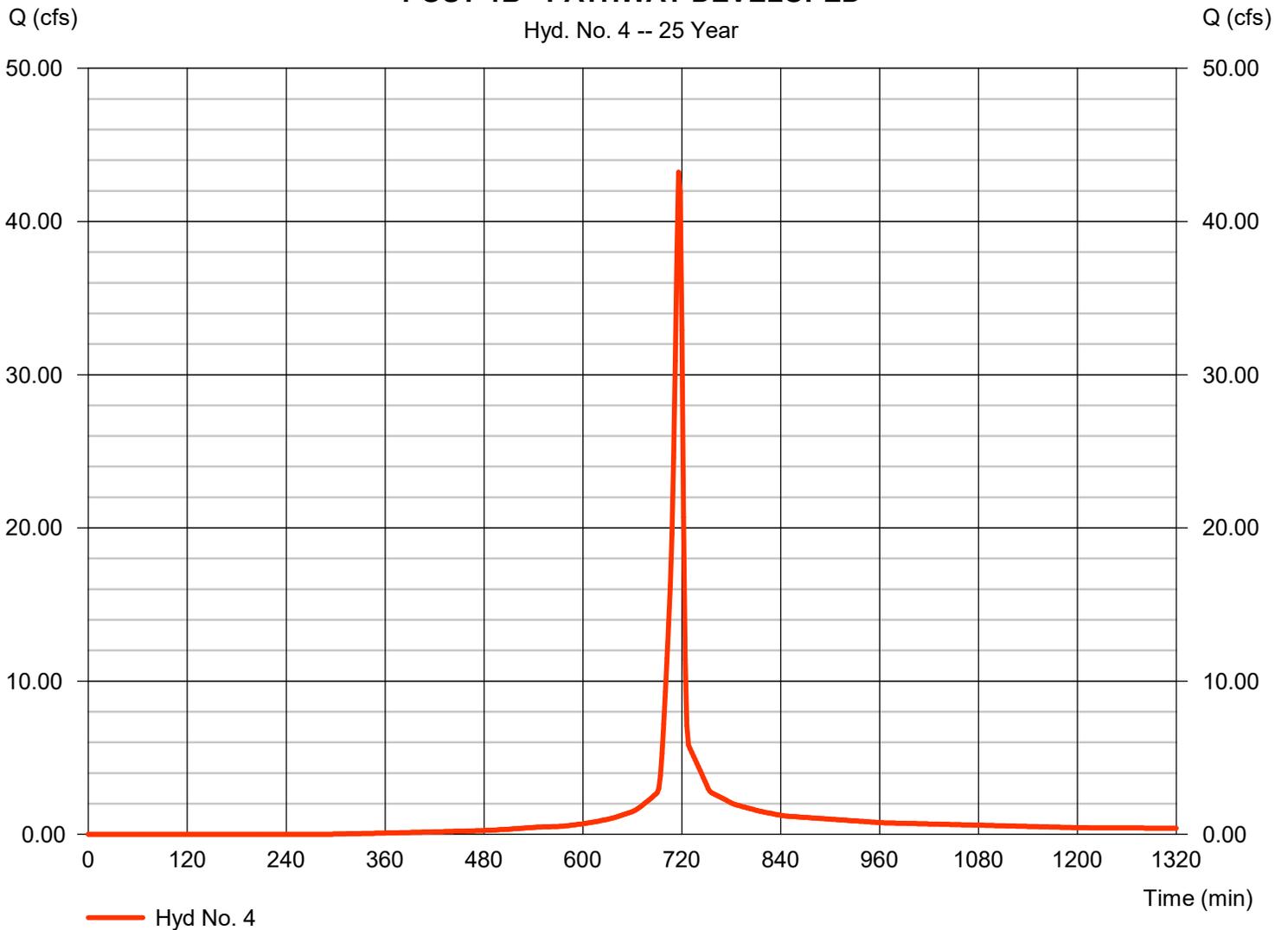
Tuesday, 06 / 11 / 2024

Hyd. No. 4

POST-1B - PATHWAY DEVELOPED

Hydrograph type	= SCS Runoff	Peak discharge	= 43.21 cfs
Storm frequency	= 25 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 90,872 cuft
Drainage area	= 6.060 ac	Curve number	= 85
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 6.11 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

POST-1B - PATHWAY DEVELOPED

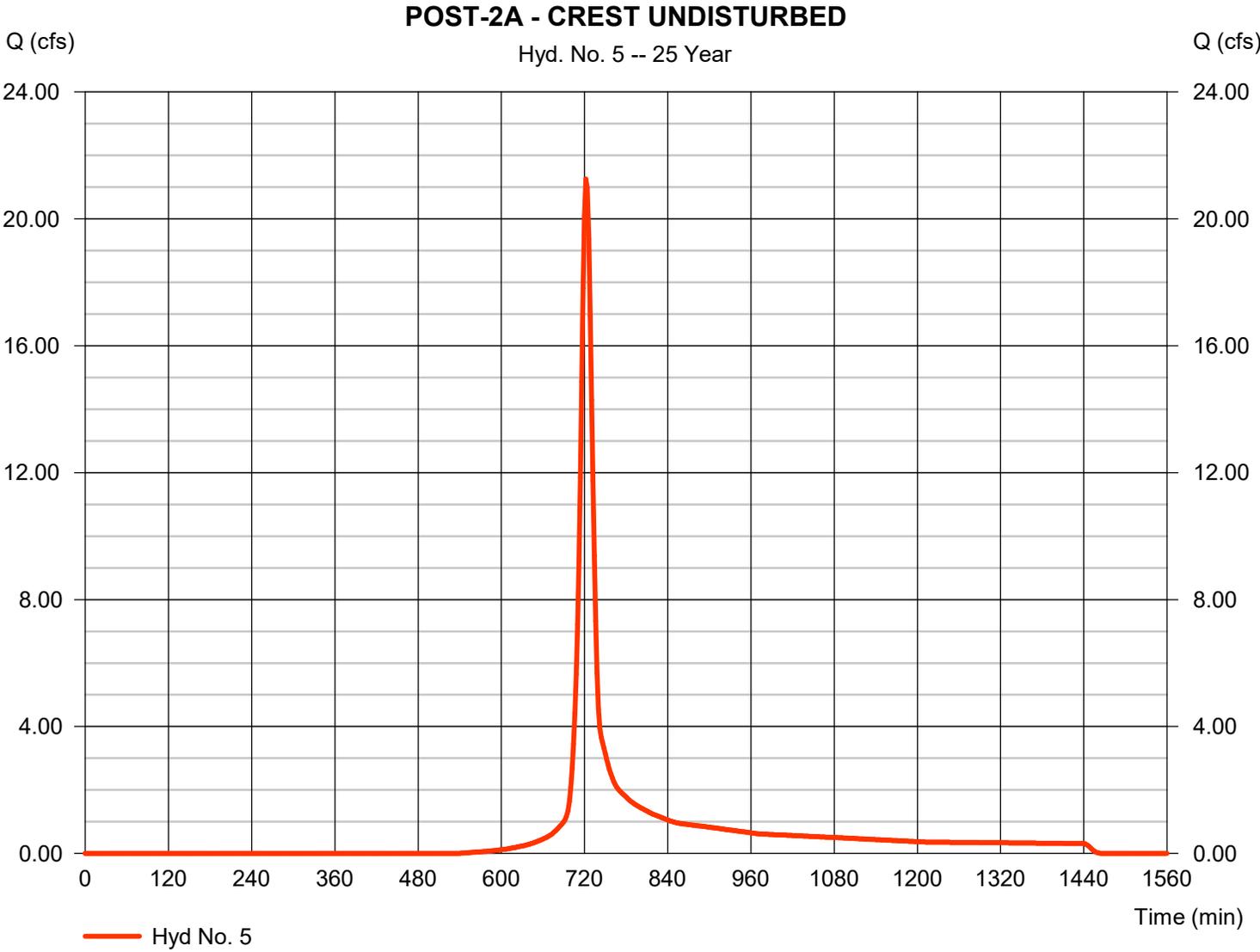


Hydrograph Report

Hyd. No. 5

POST-2A - CREST UNDISTURBED

Hydrograph type	= SCS Runoff	Peak discharge	= 21.26 cfs
Storm frequency	= 25 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 59,790 cuft
Drainage area	= 5.840 ac	Curve number	= 70
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 15.60 min
Total precip.	= 6.11 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

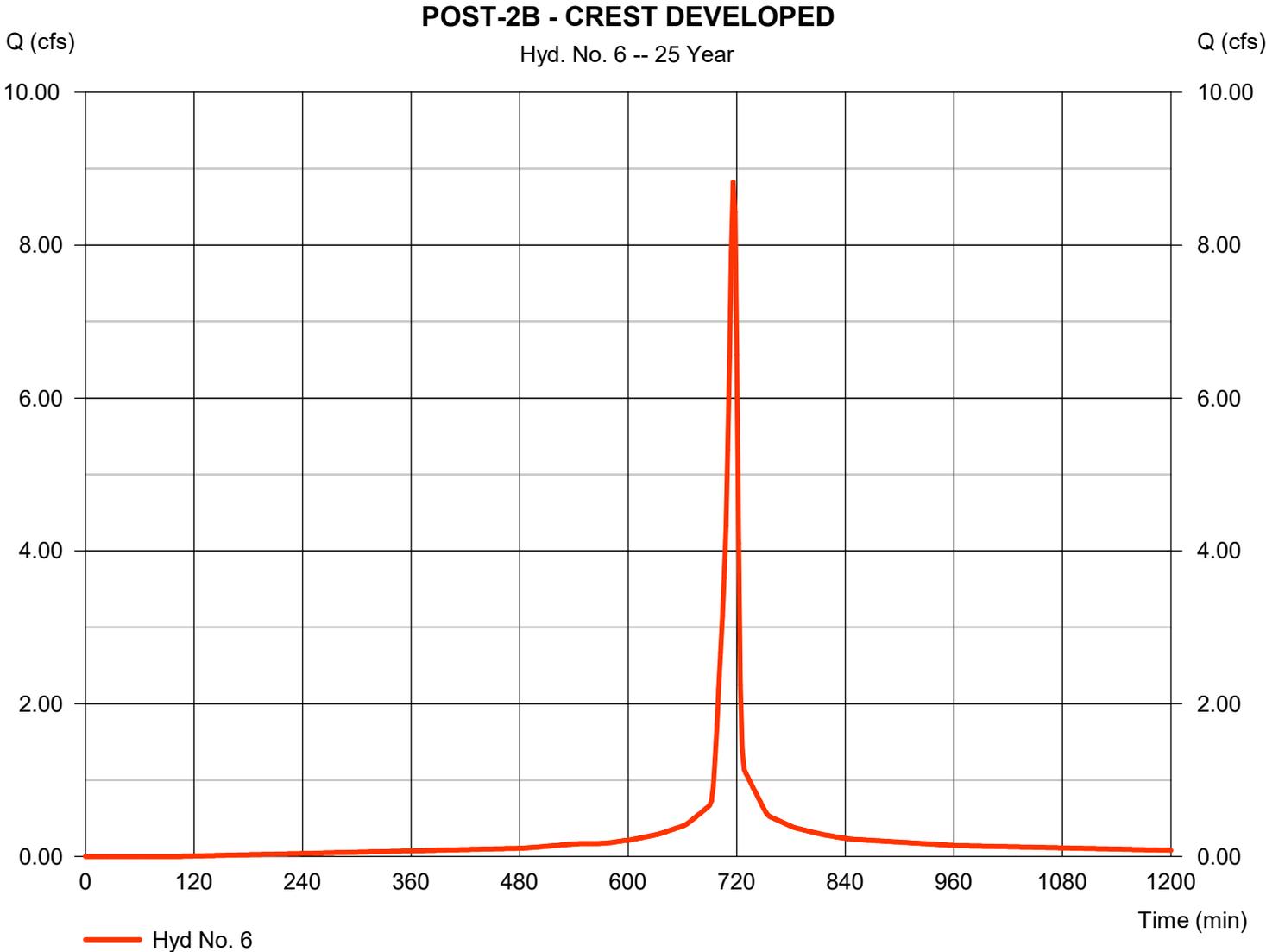


Hydrograph Report

Hyd. No. 6

POST-2B - CREST DEVELOPED

Hydrograph type	= SCS Runoff	Peak discharge	= 8.826 cfs
Storm frequency	= 25 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 20,291 cuft
Drainage area	= 1.080 ac	Curve number	= 95
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 6.11 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	52.75	2	728	193,773	-----	-----	-----	PRE-1 - PATHWAY
2	SCS Runoff	36.17	2	722	101,384	-----	-----	-----	PRE-2 - CREST
3	SCS Runoff	28.35	2	728	104,134	-----	-----	-----	POST-1A - PATHWAY UNDISTURB
4	SCS Runoff	56.39	2	716	120,586	-----	-----	-----	POST-1B - PATHWAY DEVELOPED
5	SCS Runoff	30.53	2	722	85,562	-----	-----	-----	POST-2A - CREST UNDISTURBED
6	SCS Runoff	11.08	2	716	25,812	-----	-----	-----	POST-2B - CREST DEVELOPED
23-0350.204 - Prelim Routing.gpw					Return Period: 100 Year			Tuesday, 06 / 11 / 2024	

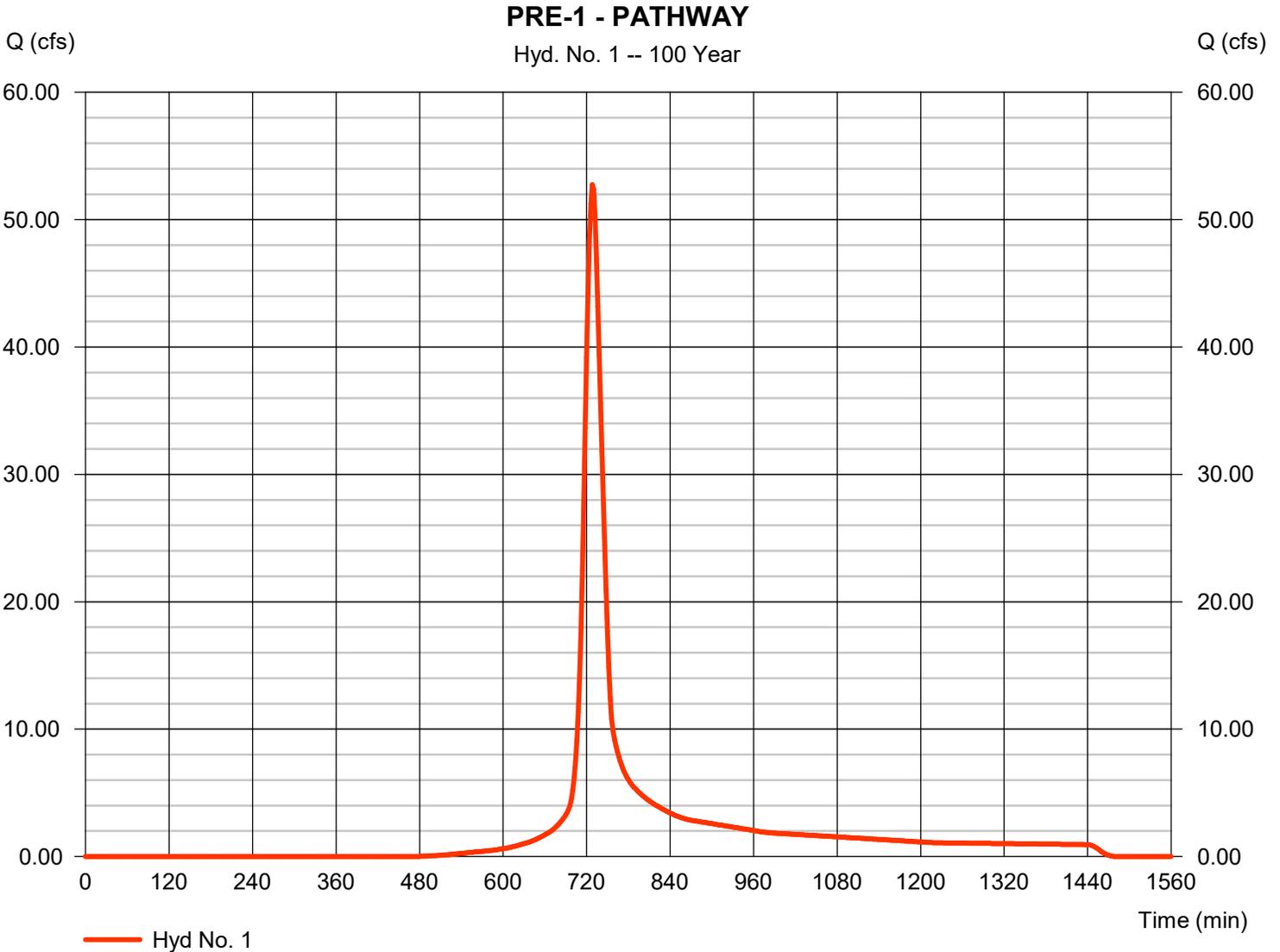
Hydrograph Report

Hyd. No. 1

PRE-1 - PATHWAY

Hydrograph type = SCS Runoff
Storm frequency = 100 yrs
Time interval = 2 min
Drainage area = 13.100 ac
Basin Slope = 0.0 %
Tc method = TR55
Total precip. = 7.62 in
Storm duration = 24 hrs

Peak discharge = 52.75 cfs
Time to peak = 728 min
Hyd. volume = 193,773 cuft
Curve number = 70
Hydraulic length = 0 ft
Time of conc. (Tc) = 24.90 min
Distribution = Type II
Shape factor = 484

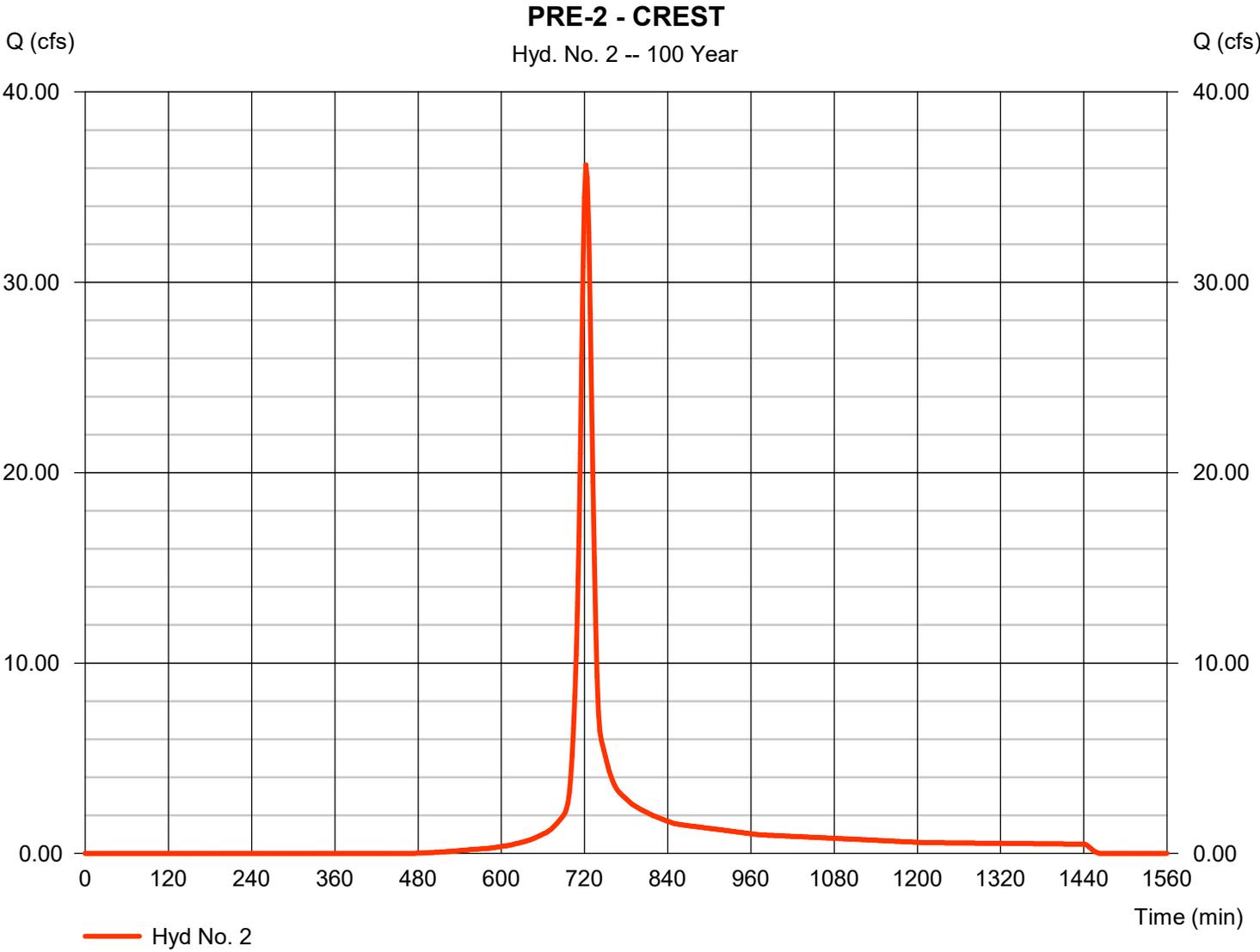


Hydrograph Report

Hyd. No. 2

PRE-2 - CREST

Hydrograph type	= SCS Runoff	Peak discharge	= 36.17 cfs
Storm frequency	= 100 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 101,384 cuft
Drainage area	= 6.920 ac	Curve number	= 70
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 15.60 min
Total precip.	= 7.62 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

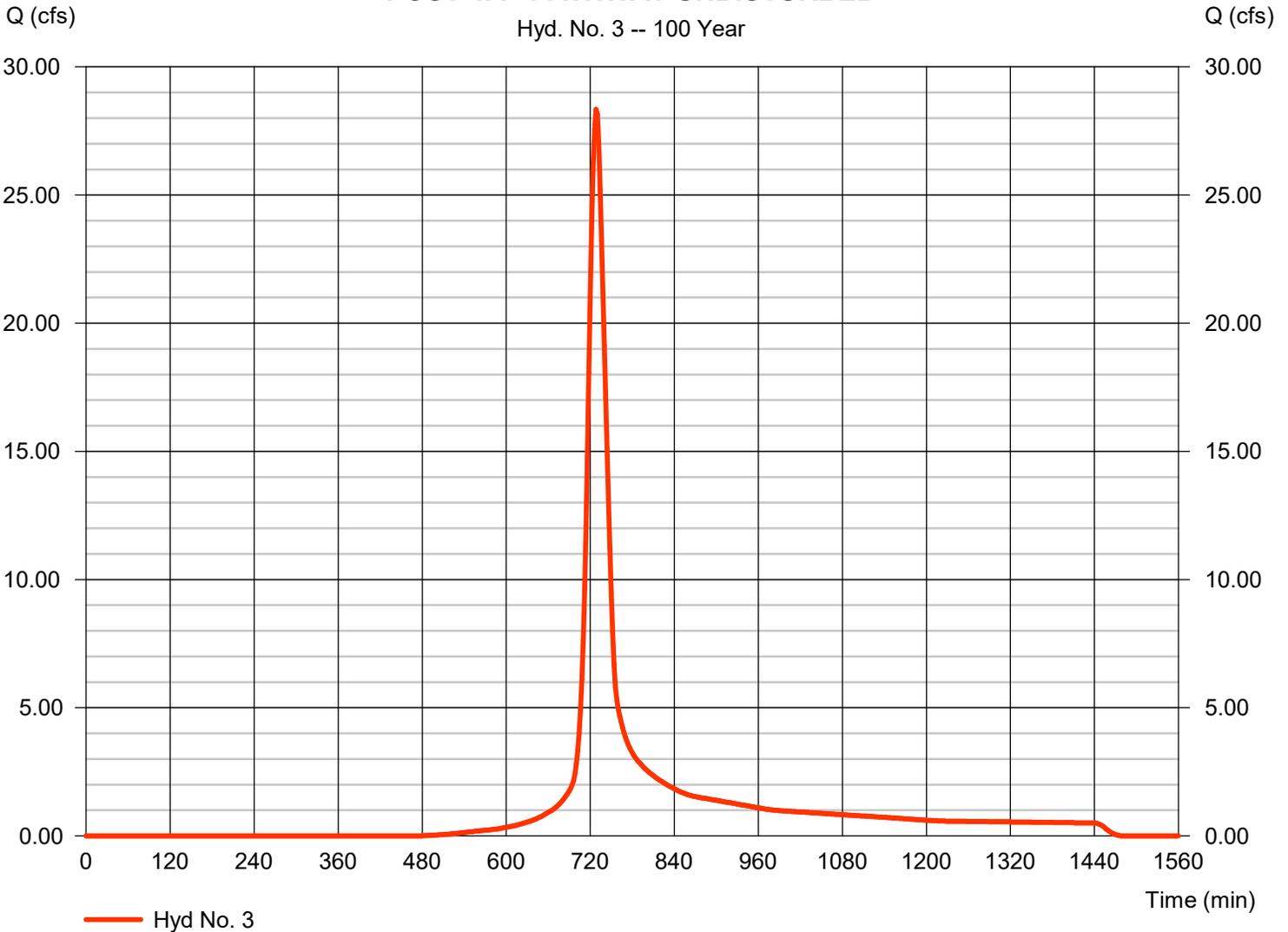
Hyd. No. 3

POST-1A - PATHWAY UNDISTURBED

Hydrograph type = SCS Runoff
Storm frequency = 100 yrs
Time interval = 2 min
Drainage area = 7.040 ac
Basin Slope = 0.0 %
Tc method = User
Total precip. = 7.62 in
Storm duration = 24 hrs

Peak discharge = 28.35 cfs
Time to peak = 728 min
Hyd. volume = 104,134 cuft
Curve number = 70
Hydraulic length = 0 ft
Time of conc. (Tc) = 24.90 min
Distribution = Type II
Shape factor = 484

POST-1A - PATHWAY UNDISTURBED



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

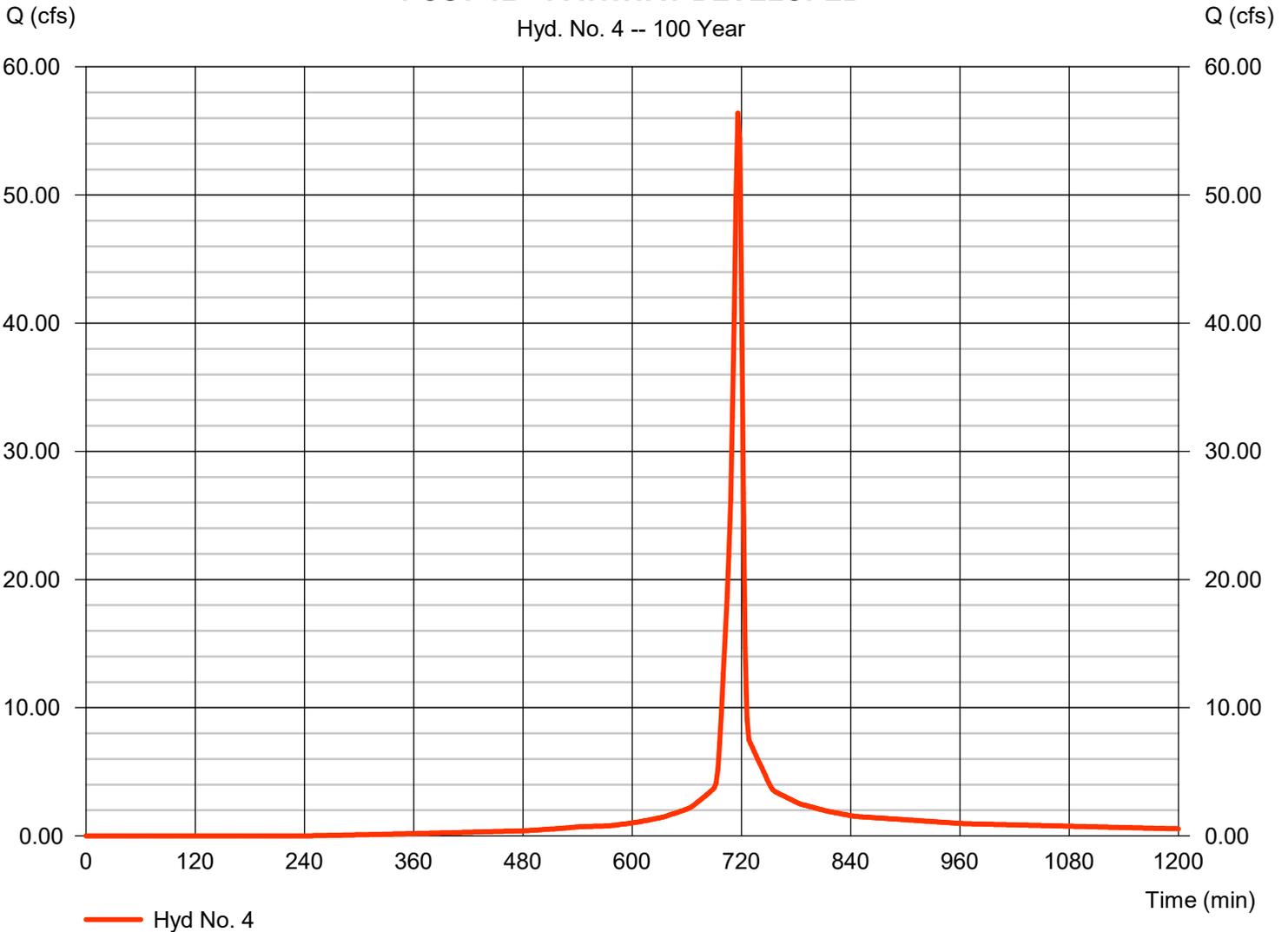
Tuesday, 06 / 11 / 2024

Hyd. No. 4

POST-1B - PATHWAY DEVELOPED

Hydrograph type	= SCS Runoff	Peak discharge	= 56.39 cfs
Storm frequency	= 100 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 120,586 cuft
Drainage area	= 6.060 ac	Curve number	= 85
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 7.62 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

POST-1B - PATHWAY DEVELOPED



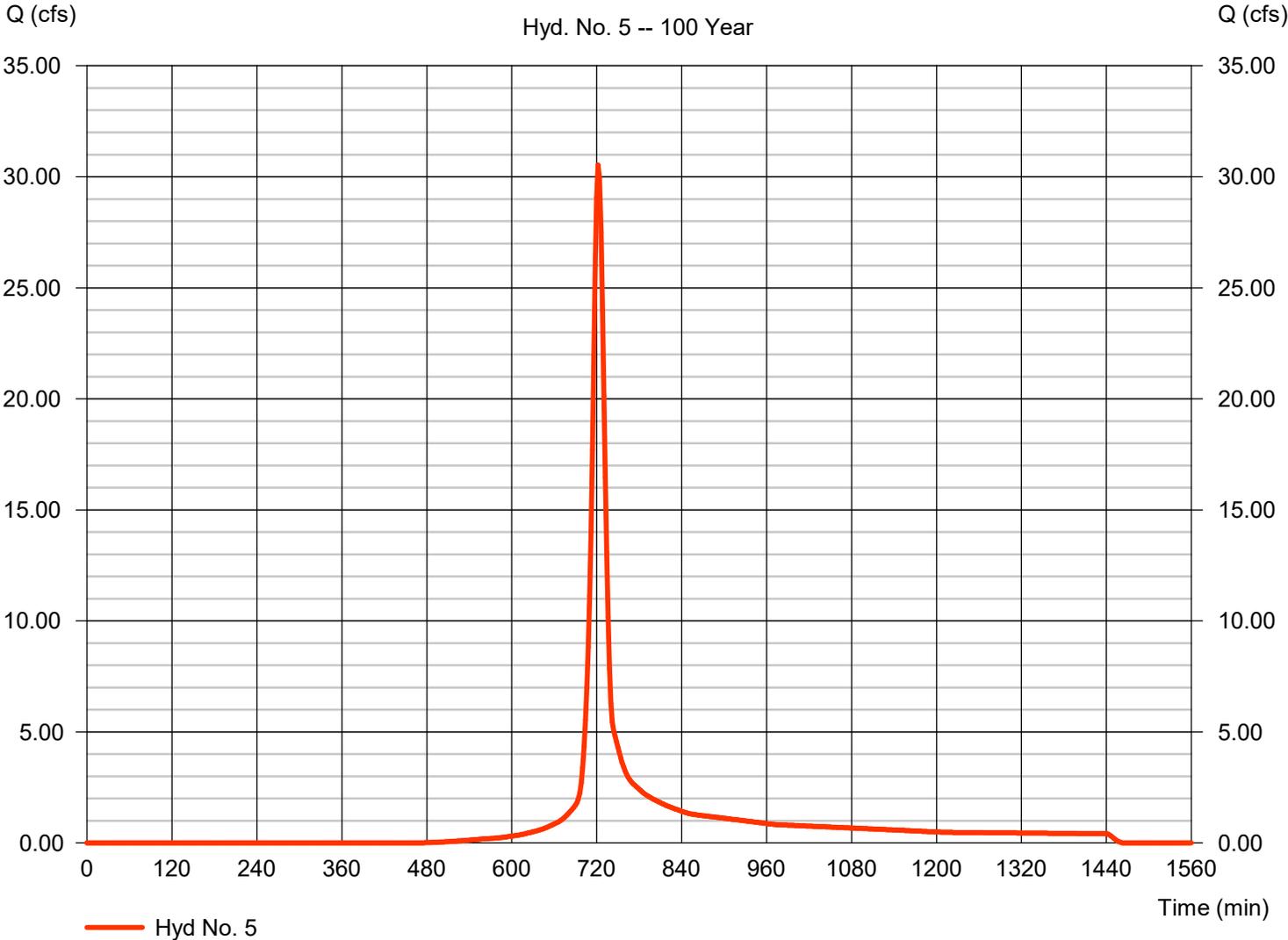
Hydrograph Report

Hyd. No. 5

POST-2A - CREST UNDISTURBED

Hydrograph type	= SCS Runoff	Peak discharge	= 30.53 cfs
Storm frequency	= 100 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 85,562 cuft
Drainage area	= 5.840 ac	Curve number	= 70
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 15.60 min
Total precip.	= 7.62 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

POST-2A - CREST UNDISTURBED

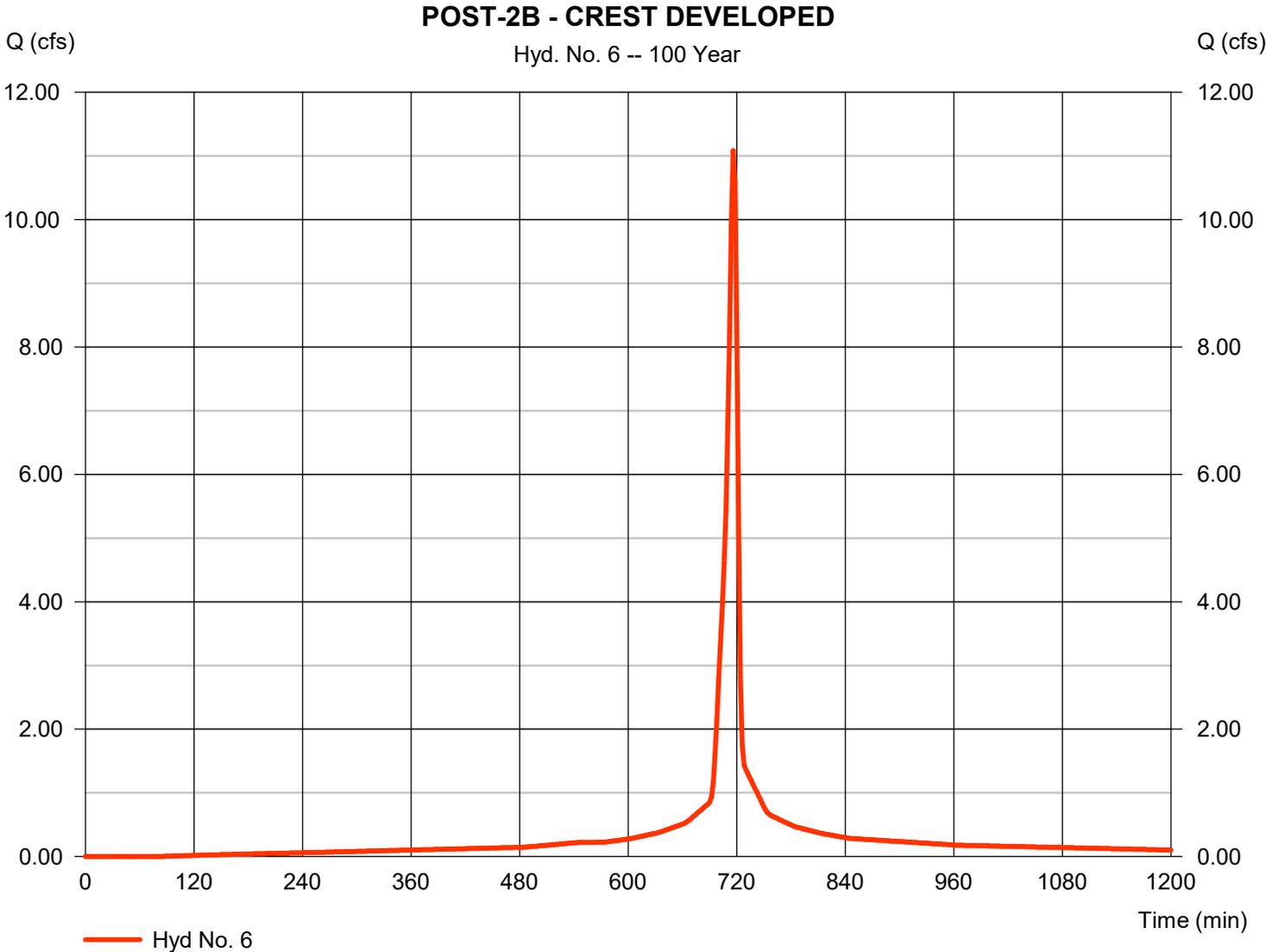


Hydrograph Report

Hyd. No. 6

POST-2B - CREST DEVELOPED

Hydrograph type	= SCS Runoff	Peak discharge	= 11.08 cfs
Storm frequency	= 100 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 25,812 cuft
Drainage area	= 1.080 ac	Curve number	= 95
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 7.62 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



TOWN OF CARRBORO DUE DILIGENCE - CREST STREET

Drainage Area (Ac.)	1.08	Impervious Area (Ac.)	0.26	$V_{WQ} = 3630 * R_D * R_V * A$
Water Quality Vol (cf) :	1.5" V_{WQ}	1" V_{WQ}	Rough Required SA Calc (SF)	3920.4
	1568.16	1045.44		
Approx. Min. Area Required $V_{WQ}=1.0"$ (sf)	D = 9"	D = 12"	Where :	
	1393.92	1045.44	$R_D = 1$ $R_D =$ Rainfall Depth of Design Storm (Usually 1" or 1.5") $R_V = 0.2666667$ $R_V =$ Runoff Coefficient ($0.05+0.9*I_A$) Where $I_A =$ % Impervious in DA	



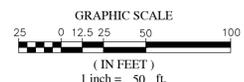
Know what's below.
Call before you dig.



- LEGEND:**
- DRAINAGE DIVIDE
 - TIME OF CONCENTRATION
 - EXISTING TREELINE
 - PERENNIAL ZONE 1 (50 FT BUFFER)
 - PERENNIAL ZONE 2 (50 FT BUFFER)
 - EPHEMERAL ZONE 2 (15 FT BUFFER)
 - WETLAND ZONE 1 (50 FT BUFFER)
 - WETLAND ZONE 2 (50 FT BUFFER)

- NOTES:**
- LIDAR DATA OBTAINED FOR OFF-SITE RUN-ON DRAINAGE.
 - REFER TO ENVIRONMENTAL EVALUATION COMPLETED BY THREE OAKS ENGINEERING, INC. FOR FURTHER INFORMATION REGARDING STREAMS, WETLANDS, AND BUFFERS SHOWN ON THE MAPS.
 - GIVEN THE SITE CONSTRAINTS, BUILDABLE AREA WAS NOT ASSUMED FOR THIS SITE. INSTEAD A 24% IMPERVIOUS AREA WAS ASSIGNED. SEE THE PRELIMINARY STORMWATER IMPACT ANALYSIS FOR MORE INFORMATION.

STREAM DATA		
STREAM NAME	MAP ID	CLASSIFICATION
UNNAMED TRIBUTARY (UT) TO BOLIN CREEK (HOGAN LAKE)	S1	PERENNIAL
UT TO BOLIN CREEK (HOGAN LAKE)	S2	PERENNIAL
UT TO BOLIN CREEK (HOGAN LAKE)	EPH 1	EPHEMERAL
UT TO BOLIN CREEK (HOGAN LAKE)	EPH 2	EPHEMERAL
UT TO BOLIN CREEK (HOGAN LAKE)	EPH 3	EPHEMERAL
UT TO BOLIN CREEK (HOGAN LAKE)	EPH 4	EPHEMERAL
UT TO BOLIN CREEK (HOGAN LAKE)	EPH 5	EPHEMERAL
UT TO BOLIN CREEK (HOGAN LAKE)	EPH 6	EPHEMERAL
UT TO BOLIN CREEK (HOGAN LAKE)	EPH 7	EPHEMERAL
UT TO BOLIN CREEK (HOGAN LAKE)	EPH 8	EPHEMERAL
UT TO BOLIN CREEK (HOGAN LAKE)	EPH 9	EPHEMERAL



NO.	REVISIONS	DATE	BY
7			
6			
5			
4			
3			
2			
1			

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FIRST ISSUE DATE
 JUNE 11, 2024



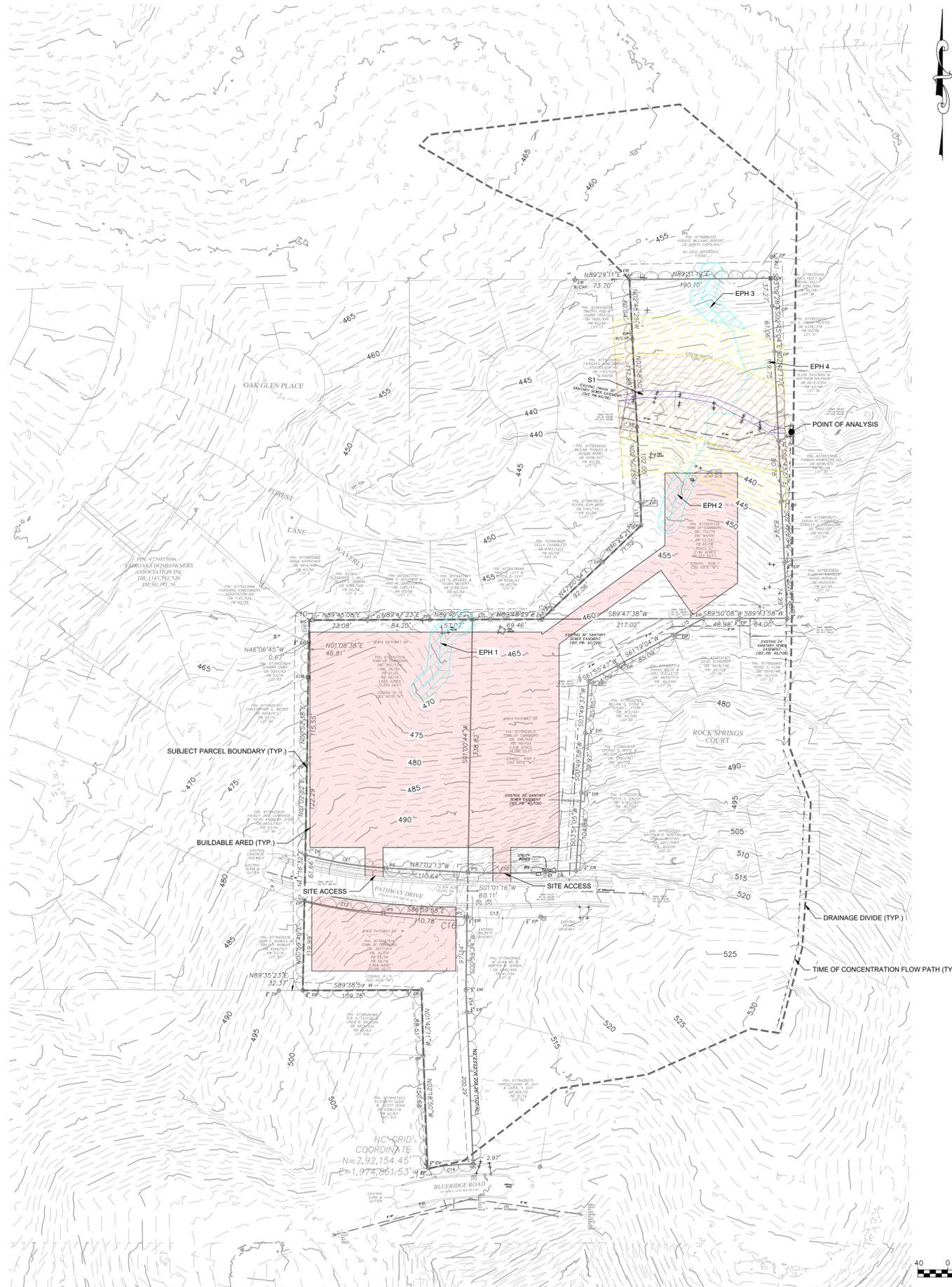
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PRELIMINARY PLANS FOR DUE DILIGENCE
 PATHWAY DRIVE, CARRBORO, NC
 CREST STREET, CARRBORO, NC
DRAINAGE AREA MAP - CREST STREET

PROJECT NO.
 23-0350.204
DRAWING NAME:
 23-0350_base dam.dwg
SHEET NO.
 2



Know what's below.
Call before you dig.



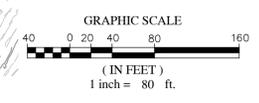
LEGEND:

- DRAINAGE DIVIDE
- TIME OF CONCENTRATION
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- BUILDABLE AREA
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2. REFER TO ENVIRONMENTAL EVALUATION COMPLETED BY THREE OAKS ENGINEERING, INC. FOR FURTHER INFORMATION REGARDING STREAMS, WETLANDS, AND BUFFERS SHOWN ON THE MAPS.

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UT TO BOLIN CREEK (HOGAN LAKE)	EPH 7	EPHEMERAL
UT TO BOLIN CREEK (HOGAN LAKE)	EPH 8	EPHEMERAL
UT TO BOLIN CREEK (HOGAN LAKE)	EPH 9	EPHEMERAL



NO.	REVISIONS	DATE	BY
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PRELIMINARY PLANS FOR DUE DILIGENCE
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 1