STORMWATER CONTROL NARRATIVE

For

My Angelo's Pizza LD

Salvatore Cusumano

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Designed By:

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I. SITE DESCRIPTION AND PROJECT SUMMARY

A. Existing Site Description

The subject tract is located in the Central Business Zoning District of Berlin Township, Camden County. The site is approximately 0.64 acres in size. The site is located along the eastern side of Haddon Avenue and along the southern side of Grant Avenue. In the past 50 years the site has generally been used as meadow land. During the past five years, the site has typically been comprised of meadow land. Stormwater runoff from the site discharges to unnamed tributary of Great Egg Harbor. Based on New Jersey Administrative Code, 7:9B, UNT Great Egg Harbor has been classified as FW2-NT, which is Fresh Waters Nontrout.

B. Proposed Site Description

The proposed development of this site includes the construction of a 3,065 SF with first floor restaurant/tenant space and second floor residential with 24 space parking area. The proposed commercial/residential development will take access from the southern side of Grant Avenue. The proposed development of this site will be serviced by public sanitary sewer and water services. The increased runoff from the subject tract will be handled by a combination of an underground basins and a stormwater management basin/trench.

The stormwater management design for this project was prepared under the direct supervision Joshua D. Hoagland, a licensed Professional Engineer in the State of New Jersey, who has twelve (12) years of experience in stormwater and erosion control design and permitting.

II. HYDROLOGIC CALCULATIONS- GENERAL OVERVIEW

A. Watershed Description

The existing features of the site, and adjoining properties were analyzed and the site has been divided into 5 (five) separate drainage sheds. These sheds relate to specific points on-site, where stormwater run-off leaves the site. These points of interest were used to perform a pre-development versus post-development analysis of stormwater run-off. The following descriptions identify each drainage shed and associated point of interest:

Drainage Shed 1:
Pre-Development: The drainage shed is in the northwest region of the property. The existing cover consists of meadow. The point of interest is located on the western property line.

Post-Development: This shed loses area to post shed 3. The point of interest remains the same.

Drainage Shed 2:
Pre-Development: The drainage shed is in the northeast region of the property. The existing cover consists of meadow area. The point of interest is located on the northeast corner of the property line.

Post-Development: This shed loses area to post sheds 3 and 4 and goes into Trench A. Cover now includes impervious area along with meadow. The point of interest remains the same.

Drainage Shed 3:
Pre-Development: The drainage shed is located eastern of the property. The existing cover consists of meadow. The point of interest is located on the eastern property line.

Post-Development: This shed gains area from sheds 4 & 5. It is broken up into two sheds, one bypass area and one BMP UG Basin A. Cover now includes impervious area along with lawn. The point of interest remains the same.

Drainage Shed 4:
Pre-Development: The drainage shed is in the southwest region of the property. The existing cover consists of meadow, impervious areas. The point of interest is located on the southwest property line.

Post-Development: Entire drainage area taken up by shed 3.

Drainage Shed 5:
Pre-Development: The drainage shed is in the southeast region of the property. The existing cover consists of meadow. The point of interest is located on the southeast corner of the property line.

Post-Development: This shed loses area from Post Shed 3. The point of interest and cover remains the same.

B. Stormwater Management Objectives

Several stormwater management objectives were established prior to calculating the pre and post development run-off flows for this project. These objectives were based on New Jersey State Residential Site Improvement Standards (NJ RSIS). The important stormwater management objectives include the following:

1. Each shed area was individually analyzed to determine the effects of the proposed development in terms of peak flow rate and volume of run-off.

2. The pre-development CN values for the subject property were considered to be those associated with existing covers.

3. Average antecedent moisture conditions and a Type II storm distribution were used. The following 24-hour design storms were evaluated, with associated 24-hour rainfall:

- 2-year (3.31 inches)
- 5-year (4.25 inches)
- 10-year (5.05 inches)
- 25-year (6.26 inches)
- 50-year (7.31 inches)
- 100-year (8.47 inches)

4. Each drainage shed was analyzed to compare the 2- through 100-year pre- and post-development flows. The NJ RSIS requires that the peak discharges from the site after development meet the following criteria:

Post development flows must be reduced to be equal or less than that of predevelopment flows.

5. Storm sewer calculations were performed utilizing the Rational Formula. The pipes were sized to convey the 25-year, with low points designed to convey the 100-year storm event with no surcharging in the proposed structures.

Sections III and IV of this report contain the pre- and post-development run-off calculations for this project.

C. Nonstructural Strategies

Stormwater quality standards, erosion control, groundwater recharge, and runoff quality were analyzed with nonstructural strategies to maximize extent practicable before relying on structural BMPs. The following nine (9) nonstructural strategies as identified in N.J.A.C. subchapter 7:45-8.4 were addressed:

1. Protect areas that provide water quality benefits or areas particularly susceptible to erosion and sediment loss.

Erosion and sediment controls have been put in place to protect such areas if they exist. All earth disturbance activities shall proceed in accordance with the sequence provided on the plan drawings.

2. Minimize impervious surface and break up or disconnect the flow of runoff over impervious surface.

Minimum sidewalk and parking lot dimensions have been proposed to reduce impervious areas. Runoff from the impervious areas on site have been broken up as feasible from draining directly into waterways and into proposed stormwater BMPs.

3. Maximize the protection of natural drainage features and vegetation.

Tree removal and clearing is required for the construction of the site, protection of these features is to be maximized wherever possible. Post construction landscaping and natural ground cover are proposed.

4. Minimize the decrease in the "time of concentration" from pre-construction to post-construction. "Time of concentration" is defined as the time it takes for runoff to travel from the hydraulically most distant point of the drainage area to the point of interest within a watershed.

Due to the increase of impervious areas compared to the existing conditions on site, concentration times for all sheds has decreased. The decreases were minimized by proposing minimal slopes and vegetated conveyances such as the swale.

5. Minimize land disturbance including clearing and grading.

As mentioned, minimum sidewalk and parking lot dimension have been proposed, however due to the size of the project much of the site will still need to be cleared and graded to meet stormwater requirements.

6. Minimize soil compaction.

Soil compaction to be utilized only where required (i.e. parking lot, foundation).

7. Provide low-maintenance landscaping that encourages retention and planting of native vegetation and minimizes the use of lawns, fertilizers and pesticides.

Landscaping has been proposed to provide such retention and planting, see sheet 2.00 of plans for more details.

8. Provide vegetated open-channel conveyance systems discharging into and through stable vegetated areas.

One (1) vegetated open-channel conveyance system that leads into a stormwater BMP is proposed for this project.

9. Provide other source controls to prevent or minimize the use or exposure of pollutants at the site in order to prevent or minimize the release of those pollutants into stormwater runoff. These source controls include, but are not limited to:

i. Site design features that help to prevent accumulation of trash and debris in drainage systems.

Bike safe grates have been proposed on all catch basins to prevent the accumulation of such. Dimensions of the grate holes are 4 3 3/8” x1 ½” which will prevent larger items from entering the BMPs.

ii. Site design features that help to prevent discharge of trash and debris from drainage systems.

A green infrastructure manufactured treatment device (MTD) as required by N.J.A.C. 7:8 is proposed to remove pollutants and filtrate stormwater routed to Underground Basin B. All catch basins with outlet pipes to receive a

iii. Site design features that help to prevent and/or contain spills or other harmful accumulations of pollutants at industrial or commercial developments.

An outdoor solid waste and trash storage area is proposed.

iv. When establishing vegetation after land disturbance, applying fertilizer in accordance with the requirements established under the Soil Erosion and Sediment Control Act, 4:24-39 et seq., and implementing rules.

Fertilizer to conform to referenced requirements.

D. Downstream Impact Analysis

The NJ RSIS requires the development's stormwater management facilities to reduce the proposed run-off from the site to match the pre-development rates. The stormwater management facilities were designed so that the flows leaving the site, and entering the existing watercourse, were less than or equal to the rate currently entering the watercourse. Additionally three (3) stormwater BMP's were designed on-site to mitigate the increased stormwater volume generated by a 2-year run-off event over the 100-year pre development conditions, as required by NJ RSIS. As a result of these design factors the downstream watercourses should not see an increase in erosion once the development has been constructed.

E. Calculation Methodology

The following list summarizes the computer programs, tools and methodologies which were utilized for the calculations contained in this report:

1. The runoff curve numbers (CN values) are taken from the Soil Conservation Service (SCS) Urban Hydrology for Small Watersheds TR-55 Manual (1986).

2. The time of concentration calculations are based on the Soil Conservation Service (SCS) Segmental Approach from the TR-55 Manual (1986).

3. The hydrographs included in the report were generated and analyzed using the Hydraflow Hydrographs, version 12 program developed and distributed by Autodesk, Inc.

4. The storm sewer piping design was prepared using the Hydraflow Storm Sewers Extension, version 12 program developed and distributed by Autodesk, Inc. This program accepts the input data from each structure, as well as physical characteristics of the storm sewer system to be designed, and calculates the flow rates, pipe sizes, and hydraulic grade line throughout the system. Hydraflow Storm Sewers Extension 2015 uses the energy based Standard Step Method to

compute the hydraulic profile. This methodology is an iterative procedure that applies Bernoulli's Energy Equation between the downstream and upstream ends of each line in the system. It uses Manning's Equation to determine head losses due to pipe friction.

5. Drainage swale calculations were prepared using Standard Worksheet #21 from the Erosion and Sediment Pollution Control Program Manual (2012) prepared by the New Jersey Department of Environmental Protection.

III. HYDROLOGIC CALCULATIONS- PRE-DEVELOPMENT

A. Watershed Area and Time of Concentration Calculations

The watershed areas and time of concentration calculations were calculated for each pre-development drainage shed utilizing the design criteria noted in Section II of this report. Refer to the Pre-Development Drainage Shed Plan(s), which are included with the construction plans for Angelo's Pizza LD, for the graphical representation of each drainage shed and associated Tc path. The drainage shed area(s) and weighted CN calculations are located in Appendix E of this report.

B. Run-off Routing Calculations

Run-off hydrographs were calculated for each drainage shed to determine the total volume and peak flows for each of the 2-year through 100-year storm event. The individual graphical hydrographs are located in Appendix E of this report. A summary of the pre-development run-off rates has been included in Appendix D of this report.

IV. HYDROLOGIC CALCULATIONS- POST-DEVELOPMENT

A. Watershed Area and Time of Concentrations Calculations

The watershed areas and time of concentration calculations were calculated for each post-development drainage shed utilizing the design criteria noted in Section II of this report. Refer to the Post-Development Drainage Shed Plan(s), which are included with the construction plans for Angelo Pizza LD, for the graphical representation of each drainage shed. Tc times were assumed to be 6-min for all post development sheds. The drainage shed area(s) and weighted CN calculations are located in Appendix F of this report.

B. Detention Basin Storage and Release Rate Calculations

As noted above, three (3) stormwater detention basins were required to attenuate the post development run-off flows to meet the requirements of the NJ RSIS. Stage-storage- discharge calculations for the detention basins are provided in Appendix F of this report.

C. Run-off Routing Calculations

Run-off hydrographs were calculated for each drainage shed to determine the total volume and peak flows for each of the 2 yr–100 yr. Each basin inflow hydrograph was routed through its respective detention facility to calculate the peak outflow from

the facility. The individual graphical hydrographs, including basin inflow and outflow, are located in Appendix F of this report. A summary of the post-development run-off rates has been included in Appendix D of this report.

D. Groundwater Mounding Analysis

Mounding Analysis was completed for each infiltration BMP to determine the hydraulic impact on the seasonal highwater groundwater table and design of the site. Modeling of this analysis was completed using the Hantush Spreadsheet, a factor of safety of three (3) was use for permeability rates. Since both Infiltration BMPs are rectangular the x and y inputs were swapped resulting in two calculations for each BMP. Seasonal high-water table is assumed to be the lowest depth dug of the soil profiles. The average of infiltration tests 2 & 4 were used for the permeability rate for UG Basin A.

V. STORM SEWER PIPING CALCULATIONS

A. Storm Piping Design Overview

The storm sewer piping system has been designed to meet the requirements of NJ RSIS. All piping has been sized to carry the 25-year peak flow rate, as calculated by the Rational Method. Additionally, the storm sewer system was checked to ensure that inlets in sump would drain the run-off from a 100-year storm event with no surcharging of the proposed structures. The storm sewer piping system calculations are contained in Appendix F of this report.

VI. THERMAL IMPACT ANALYSIS

Thermal impacts for this project have been avoided by minimizing or eliminating paved surfaces, conveying runoff in vegetated swales to the maximum extent possible, and discharging water overland before arriving at NJAC 7:9B receiving watercourse.

VII. POST CONSTRUCTION BEST MANAGEMENT PRACTICES

A. General Overview

The New Jersey Department of Environmental Protection (DEP) requires that all proposed developments within the State of New Jersey must submit a Post Construction Stormwater Management Plan (PCSMP). The purpose of the PCSMP is to improve water quality and protect water resources through improved stormwater management. The PCSMP should strive to:

1. Prevent or reduce stormwater problems through planning and development techniques, and

2. Mitigate any impacts through both structural and non-structural techniques.

DEP requires that each developer and engineer must make an effort to manage all aspects of stormwater: rate, volume, quality, and groundwater recharge.

Controlling the peak rate of flow during extreme rainfall events is important, but it is not sufficient to protect the quality and integrity of New Jersey streams. Reducing the overall volume of runoff during large and small rainfall events, improving water quality, and maintaining groundwater recharge for wells and stream flow are all important to a program of protecting and improving the quality of New Jersey's streams and waterways.

B. Description of Proposed BMP's

The proposed development of this site was analyzed to determine which Best Management Practices (BMP's) would be the most effective at treating the peak rate and volume of stormwater run-off leaving the site once construction is completed. The BMP's that were considered for this site were taken from the New Jersey's Department of Environmental Protection's "New Jersey Stormwater Best Management Practices Manual" dated March 2021. The following BMP's were determined to be the most efficient means to meet the requirements of DEP's Application:

Infiltration Trench:

An infiltration Trench is a shallow impoundment that stores and infiltrates run-off over a level, uncompacted, (preferably undisturbed area) with relatively permeable soils. This BMP will be used to help reduce the quantity of stormwater run-off while promoting recharging of the groundwater table.

Subsurface Infiltration Bed:

A subsurface infiltration bed provides temporary storage and infiltration of stormwater run-off by placing storage media of varying types beneath the proposed surface grade. The proposed underground storage basin has been designed with perforated pipe to allow a portion of the collected stormwater run-off to infiltrate. This BMP will be used to help reduce the quantity of stormwater run-off while promoting recharging of the groundwater table.

Vegetated Filter Swale:

A vegetated swale is a broad, shallow, trapezoidal or parabolic channel, densely planted with a variety of trees, shrubs, and/ or grasses. It is designed to attenuate and in some cases infiltrate run-off volume from adjacent impervious surfaces, allowing some pollutants to settle out in the process. In steeper slope situations, check dams may be used to further enhance attenuation and infiltration opportunities. This BMP will help filter run-off prior to discharging the collected run-off into a basin, or off-site. The swale(s) also have the potential to allow some infiltration to occur.

VIII. POST CONSTRUCTION STORMWATER MNGMNT SEQUENCING

Prior to any work, the contractor/developer shall notify the Camden County Conservation District of the date of the pre-construction meeting.

At least 7 days before starting any earth disturbance activities, the operator shall invite all contractors involved in those activities, the landowner, all appropriate municipal officials, the erosion and sedimentation control plan preparer, and a representative of the Camden County Conservation District to schedule an on-site pre-construction meeting. Also, at least 3 days before starting any earth disturbance activities, all contractors involved in those activities shall notify the New Jersey one call system inc. at 1-732-394-3000 for buried utilities location.

Before implementing any revisions to the approved erosion and sedimentation control plan or revisions to other plans which may affect the effectiveness of the approved E&S control plan, the operator must receive approval of the revisions from the Camden County Conservation District.

Before disposing of soil or receiving borrow for the site, the operator must assure that each spoil or borrow area has an erosion and sediment control plan approved by the Camden County Conservation District, and which is being implemented and maintained according to chapter 102 regulations. The operator shall also notify the Camden County Conservation District in writing of all receiving spoil or borrow areas when they have been identified.

1. Clear areas designated for the proposed infiltration basin/trench. Only clear to the extent necessary for infiltration basin/trench construction. Proposed infiltration basin must remain undisturbed by heavy machinery. Any associated excavation must be outside the delineated area as shown on the post construction stormwater management plan.

2. Infiltration basin shall be constructed as follows:
   A. Install silt fence downslope of the topsoil stockpiles and temporarily seed and mulch the stockpiles after stripping operations are completed.

   B. Excavate infiltration basin area and place compacted embankment fill, and line inside/outside of infiltration basin with erosion control lining. (Critical stage for engineering supervision of an NPDES required BMP installation).

   C. Spread excess topsoil and permanently seed and mulch the inside/outside slopes.

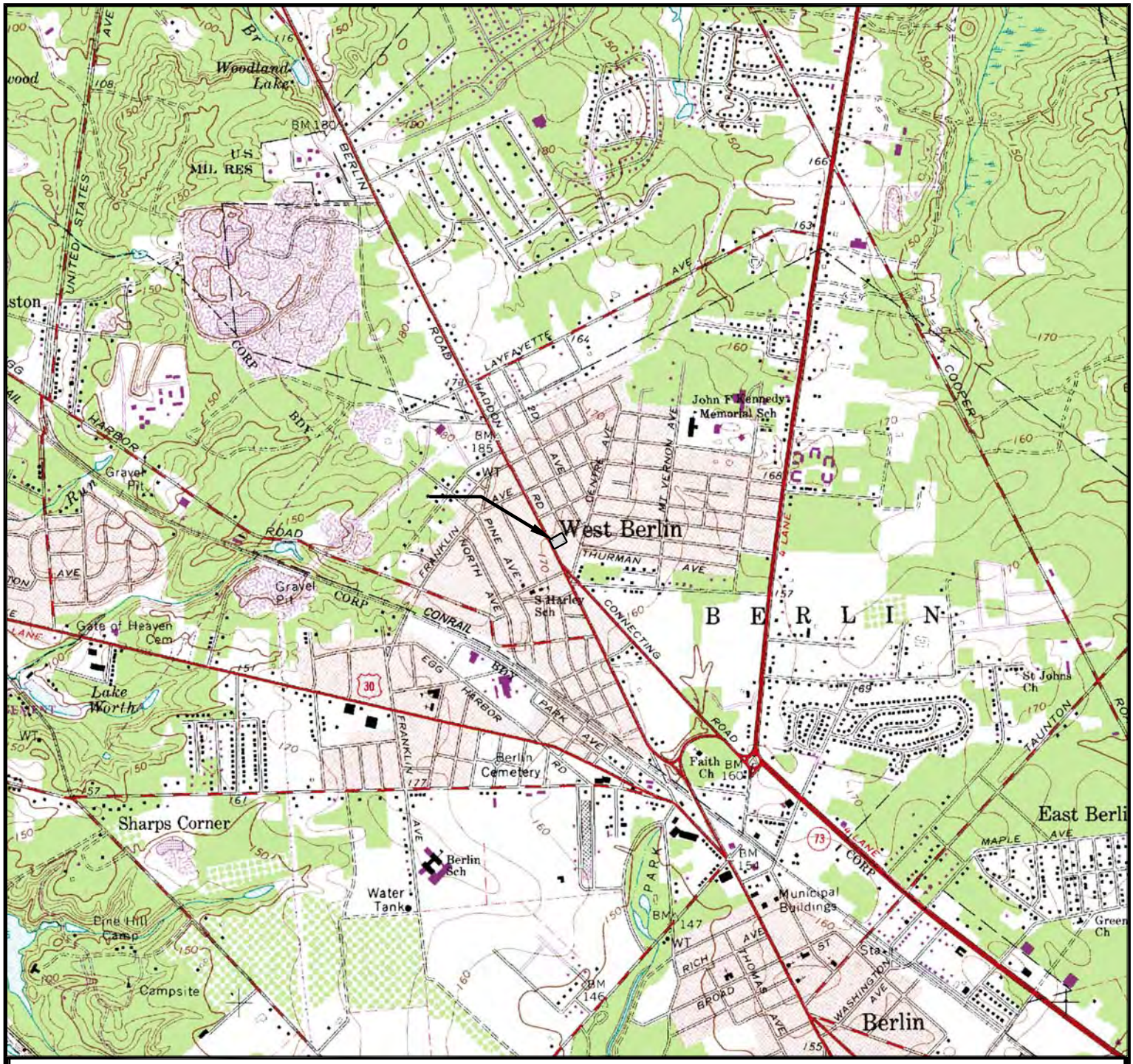
IX. MAINTENANCE PROCEDURES FOR PROPOSED BMP'S

A maintenance procedure for each of the proposed BMP's is located in Appendix K of this report.

x. APPENDIX

Appendix A

SITE LOCATION MAP



SITE LOCATION MAP 1" = 2000'

PREPARED FOR

ANGELO'S PIZZA LD

LOCATED IN
BERLIN TOWNSHIP, CAMDEN
COUNTY, NEW JERSEY

U.S.G.S. - CLEMENTON, NJ
QUADRANGLE 7.5' SERIES

PROJECT NO. 3824

2000 0 1000 2000 4000 6000

GRAPHIC SCALE

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CIVIL ENGINEERING ╬ LAND DEVELOPMENT ╬ SITE SURVEY ╬ A/E TELECOM

Appendix B

SOILS SURVEY DATA

Custom Soil Resource Report
Soil Map

Map Scale: 1:742 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 10 20 40 60

Feet
0 35 70 140 210

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N 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: Camden County, New Jersey
Survey Area Data: Version 14, Jun 1, 2020

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

Date(s) aerial images were photographed: Data not available.

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
AvdB	Aura-Downer loamy sands, 0 to 5 percent slopes	1.1	100.0%
Totals for Area of Interest		**1.1**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Table—Corrosion of Concrete

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
AvdB	Aura-Downer loamy sands, 0 to 5 percent slopes	High	1.1	100.0%
Totals for Area of Interest			**1.1**	**100.0%**

Rating Options—Corrosion of Concrete

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Corrosion of Steel

"Risk of corrosion" pertains to potential soil-induced electrochemical or chemical action that corrodes or weakens uncoated steel. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. Special site examination and design may be needed if the combination of factors results in a severe hazard of corrosion. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than the steel in installations that are entirely within one kind of soil or within one soil layer.

The risk of corrosion is expressed as "low," "moderate," or "high."

Table—Corrosion of Steel

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
AvdB	Aura-Downer loamy sands, 0 to 5 percent slopes	Low	1.1	100.0%
Totals for Area of Interest			**1.1**	**100.0%**

Rating Options—Corrosion of Steel

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Dwellings With Basements

Dwellings are single-family houses of three stories or less. For dwellings with basements, the foundation is assumed to consist of spread footings of reinforced concrete built on undisturbed soil at a depth of about 7 feet.

The ratings for dwellings are based on the soil properties that affect the capacity of the soil to support a load without movement and on the properties that affect excavation and construction costs. The properties that affect the load-supporting capacity include depth to a water table, ponding, flooding, subsidence, linear extensibility (shrink-swell potential), and compressibility. Compressibility is inferred from the Unified classification of the soil. The properties that affect the ease and amount of excavation include depth to a water table, ponding, flooding, slope, depth to bedrock or a cemented pan, hardness of bedrock or a cemented pan, and the amount and size of rock fragments.

The ratings are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect the specified use. "Not limited" indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance can be expected. "Somewhat limited" indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. "Very limited" indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

Numerical ratings indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use (1.00) and the point at which the soil feature is not a limitation (0.00).

Tables—Dwellings With Basements

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
AvdB	Aura-Downer loamy sands, 0 to 5 percent slopes	Not limited	Aura (60%)		1.1	100.0%
			Downer (40%)			
Totals for Area of Interest					**1.1**	**100.0%**

Rating	Acres in AOI	Percent of AOI
Not limited	1.1	100.0%
Totals for Area of Interest	**1.1**	**100.0%**

Rating Options—Dwellings With Basements

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Shallow Excavations

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for graves, utility lines, open ditches, or other purposes. The ratings are based on the soil properties that influence the ease of digging and the resistance to sloughing. Depth to bedrock or a cemented pan, hardness of bedrock or a cemented pan, the amount of large stones, and dense layers influence the ease of digging, filling, and compacting. Depth to the seasonal high water table, flooding, and ponding may restrict the period when excavations can be made. Slope influences the ease of using machinery. Soil texture, depth to the water table, and linear extensibility (shrink-swell potential) influence the resistance to sloughing.

The ratings are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect the specified use. "Not limited" indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance can be expected. "Somewhat limited" indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. "Very limited" indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

Tables—Shallow Excavations

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
AvdB	Aura-Downer loamy sands, 0 to 5 percent slopes	Somewhat limited	Aura (60%)	Unstable excavation walls (0.01)	1.1	100.0%
			Downer (40%)	Unstable excavation walls (0.02)		
Totals for Area of Interest					**1.1**	**100.0%**

Rating	Acres in AOI	Percent of AOI
Somewhat limited	1.1	100.0%
Totals for Area of Interest	**1.1**	**100.0%**

Rating Options—Shallow Excavations

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Small Commercial Buildings

Small commercial buildings are structures that are less than three stories high and do not have basements. The foundation is assumed to consist of spread footings of reinforced concrete built on undisturbed soil at a depth of 2 feet or at the depth of maximum frost penetration, whichever is deeper. The ratings are based on the soil properties that affect the capacity of the soil to support a load without movement and on the properties that affect excavation and construction costs. The properties that affect the load-supporting capacity include depth to a water table, ponding, flooding, subsidence, linear extensibility (shrink-swell potential), and compressibility (which is inferred from the Unified classification of the soil). The properties that affect the ease and amount of excavation include flooding, depth to a water table, ponding, slope, depth to bedrock or a cemented pan, hardness of bedrock or a cemented pan, and the amount and size of rock fragments.

The ratings are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect the specified use. "Not limited" indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance can be expected. "Somewhat limited" indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. "Very limited" indicates that the soil has one or more

Tables—Small Commercial Buildings

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
AvdB	Aura-Downer loamy sands, 0 to 5 percent slopes	Somewhat limited	Aura (60%)	Depth to thin cemented pan (1.00)	1.1	100.0%
				Depth to thick cemented pan (0.10)		
Totals for Area of Interest					**1.1**	**100.0%**

Rating	Acres in AOI	Percent of AOI
Somewhat limited	1.1	100.0%
Totals for Area of Interest	**1.1**	**100.0%**

Rating Options—Small Commercial Buildings

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Water Management

Water Management interpretations are tools for evaluating the potential of the soil in the application of various water management practices. Example interpretations include pond reservoir area, embankments, dikes, levees, and excavated ponds.

Embankments, Dikes, and Levees

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. Embankments that have zoned construction (core and shell) are not considered. The soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the suitability of the undisturbed soil for supporting the embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Tables—Embankments, Dikes, and Levees

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
AvdB	Aura-Downer loamy sands, 0 to 5 percent slopes	Not limited	Aura (60%)		1.1	100.0%
Totals for Area of Interest					**1.1**	**100.0%**

Rating	Acres in AOI	Percent of AOI
Not limited	1.1	100.0%
Totals for Area of Interest	**1.1**	**100.0%**

Rating Options—Embankments, Dikes, and Levees

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Table—Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
AvdB	Aura-Downer loamy sands, 0 to 5 percent slopes	B	1.1	100.0%
Totals for Area of Interest			**1.1**	**100.0%**

Rating Options—Hydrologic Soil Group

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Appendix C

GEOTECHNICAL REPORT

The Crossroads Group, LLC
1174 SR 487
Paxinos, PA 17860

April 10, 2021

RE: Stormwater Infiltration Report
Haddon Avenue Tract
West Berlin Twp., Camden Co., NJ
PTE #4825

Dear Mr. Hoagland;

Penn's Trail Environmental, LLC has performed a subsurface soil and permeability investigation on the referenced parcel. The intent of this investigation was to evaluate the subsurface soil profile and determine the permeability characteristics of the areas indicated for proposed stormwater disposal via infiltration. Test excavations were developed with a backhoe and described in accordance with United States Department of Agriculture-Natural Resource Conservation Service (USDA-NRCS) methodology. In-situ permeability testing was conducted using the Double Ring Infiltrometer (DRI) method as described by ASTM-D3385-09 standards.

Current regulation requires that stormwater control be designed for this proposed new land development project. Permeability testing is required to determine if infiltrative capacity of the subsoil is present. Test locations were positioned throughout this site at the direction of the project engineer. Depth of testing was determined by final constructed grade of the stormwater facilities or adjusted for depth to bedrock or groundwater encountered in test excavations. A backhoe was required for excavation of the test probes and establishment of the double rings.

Soil profile descriptions were developed at each test point and include information such as texture, structure, soil depth, and indication (or lack thereof) of a seasonal high-water table or restricted drainage as would be indicated by redoximorphic features. Redox features can occur when infiltrating water encounters a slowly permeable layer as it moves downward through the soil profile. These features do not necessarily indicate a true water table or zone that is saturated for prolonged periods by regional groundwater.

Neither regional groundwater nor redox features indicative of restrictive drainage were encountered at this site.

Pre-development USDA-NRCS soil mapping at this site, or more specifically the test locations, was the Aura-Downer soil series. The Aura series consists of moderately deep, well drained soils. They form from coarse-loamy eolian deposits over loamy gravelly fluviomarine deposits. Saturated hydraulic conductivity is high in the fragipan and very high in all other horizons. Slopes range from 0 to 15 percent. Diagnostic horizons and other soil characteristics recognized in this pedon are an ochric epipedon from the soil surface to a depth of 1.5 inches (A and E horizons), an argillic horizon from 8 to 60 inches (Bt and 2Btx horizons), a fragipan horizon from 22 to 60 inches (2Btx horizons) and a lithologic discontinuity from 22 to 80 inches (2Btx and 2C horizons).

The Downer series consists of very deep, well drained soils. Permeability is moderate or moderate rapid. These soils form from loamy fluviomarine deposits on the Atlantic Coastal Plain. Saturated hydraulic conductivity is moderately high to high. Diagnostic horizons and other diagnostic soil characteristics recognized in this pedon are an ochric epipedon from the soil surface to a depth of 10 inches (Ap horizon) and an argillic horizon from 18 to 30 inches (Bt horizon).

The soils at the testing locations were found to be deep well drained primarily fluviomarine deposits as mapped. This investigation was not conducted for the purpose of disputing current mapping or as a re-mapping effort.

Soil profiles of backhoe excavated test pits were developed to depths eight-feet below final constructed grade of proposed stormwater control facilities. The most restrictive barriers from the point of infiltration to contacting the base flow groundwater table were determined. The most common of these barriers in our region include restrictive soil horizons, varying lithology, fracturing of the bedrock or insufficient fracturing of the bedrock, and encountering groundwater among other factors. Our field observations, as reported on the attached soil profile data sheets, did not indicate that slowly diggable conditions exist in the test pits.

Testing sought to identify zones that would potentially allow the infiltration of stormwater. The testing protocol used considers regional construction practices, the likelihood of "silting in" during and following construction and the subsurface characteristics of the soil and geology. The determination at this site was that no restrictive conditions to the established installation depth for infiltration of stormwater were encountered. The double rings were established at a level with sufficient residual subsoil above groundwater and bedrock to seat and seal the rings permitting unsaturated flow through the soil to the water table.

The recommended acceptable range for subsurface disposal of stormwater is 0.10 inches per hour to 10.0 inches per hour according to current BMP guidance. Surface basins where additional storage is economical can have much slower rates and still provide some infiltration. Our office recommends that the design engineer assume zero infiltration for any stormwater area which achieves less than 0.10 inches per hour.

There are various means to arrive at an infiltrative rate for the substratum following testing. Our method is to average the last four stabilized readings as established in the PA BMP Manual. Another is to use the "last" reading as is common for percolation testing for wastewater disposal. Averaging more accurately reflects what would likely occur during a rain (soil saturation) event.

Testing was conducted at discreet locations selected by the project engineer using double ring infiltrometers. Data sheets containing the information recorded for the soil profile descriptions and double ring infiltrometers have been included as attachments to this report. A table summarizing the field data can be found below:

Stormwater Testing Summary					
Test Location	**Depth of Test Pit** Inches	**Depth to Water** Inches	**Depth to Rock** Inches	**Depth of Testing** Inches	**Infiltration Rate** Inches per hour
1	108	---	---	6	7.90
2	114	---	---	24	18.45
3	112	---	---	12	11.43
4	116	---	---	36	11.43

The soil encountered demonstrated varied infiltration rates. Subsurface conditions may change following construction and resultant redirection of surface water following development. Results suggest that the average infiltration rates at all tested locations and test depths are within the recommended guidelines even after a safety factor of two is applied.

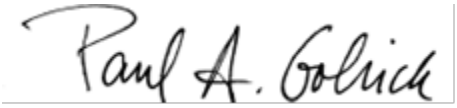
Stormwater control devices can include surface and subsurface facilities that allow the design engineer flexibility in reducing velocity containing and disposing of stormwater on this site in select areas due to the sandy composition of the soil at this site. Surface features such as vegetated swales and berms can be employed to reduce overland flow and retain water in-situ thus extending contact time and providing for additional infiltration.

Our findings are a result of testing conducted in specific locations and conditions. Should evidence contrary to the findings in this report be discovered prior to, during, or after construction of the stormwater control devices, our office must be notified immediately so our recommendations can be reviewed and revised if necessary.

Penn's Trail Environmental, LLC expresses no guarantee that the soil conditions following excavation will be identical to those encountered during this investigation. We recommend that caution is exercised during construction to minimize compaction, or other disturbance in those areas intended for use as infiltration areas.

Please review the enclosed information and if any questions arise do not hesitate to contact our office.

Sincerely,
Penn's Trail Environmental, LLC



Paul A. Golrick
Soil Scientist

Penn's Trail Environmental, LLC

21 East Lincoln Ave - Suite 160
Hatfield, PA 19440
ph. (215) 362-4610
fax (215) 362-4620

Date: 3/31/21 Pit # 1 PTE # 4825
Project: The Crossroads Group
Location: Haddon Avenue
West Berlin Twp., Camden Co., PA
Soil Series Downer

Horizon	Depth (in.)	Color	Redox Features	Texture	Structure	Consistence	Boundary
A	0-8	10YR 3/2		sandy loam	structureless sg	very friable	abrupt smooth
AC	8-15	10YR 6/3		sandy loam	structureless sg	very friable	abrupt smooth
C1	15-64	10YR 7/8		gravelly loamy sand	structureless sg	very friable/loose	clear wavy
C2	64-108	7.5YR 5/8		loamy sand	structureless sg	very friable/loose	

Soil Scientist: Terry Harris

Notes: Roots to 58 inches below grade.

EPIPEDON
Ochric

SUBSURFACE HORIZON(S)

SOIL ORDER

DRAINAGE CLASS
Well Drained

LANDFORM
Outwash Plain

POSITION
Summit

PARENT MATERIAL
Outwash

BEDROCK LITHOLOGY
Coastal Plain (unconsolidated)

REDOX FEATURES

Abundance
Few ..... <2%
Common .. 2-20%
Many .....>20%

Contrast
faint
hue & chroma of matrix and redox are closely related.
distinct
matrix & redox features vary 1-2 units of hue and several units of chroma & value.
prominent
Matrix & redox features vary several units in hue, value & chroma.

STRUCTURE

Grade
Structureless - No observable aggregation or arrangement of lines of weakness.
Weak - Poorly formed, indistinct peds barely observable in place.
Moderate - Well-formed, distinct peds moderately durable & evident in place.
Strong - Durable peds evident in undisturbed soil & become separated when disturbed.

COURSE FRAGMENTS (% of profile)

15-35%	35-65%	>65%
gravelly	very gravelly	extremely gravelly
channery	very channery	extremely channery
cobbly	very cobbly	extremely cobbly
flaggy	very flaggy	extremely flaggy
stony	very stony	extremely stony

BOUNDARY

Distinctness
abrupt. ..<1" (thick)
clear. ....1-2.5"
gradual ...2.5-5"
diffuse... ....>5"

Topography
smooth - boundary is nearly level
wavy - pockets with width greater than depth
irregular - pockets with depth greater than width
broken - boundary is discontinuous and interrupted

Type
pl - platy
pr - prismatic
cpr - columnar
gr - granular
abk - angular blocky
sbk - subangular blocky

Penn's Trail Environmental, LLC

21 East Lincoln Ave - Suite 160
Hatfield, PA 19440
ph. (215) 362-4610
fax (215) 362-4620

Date: 3/31/21 Pit # 2 PTE # 4825
Project: The Crossroads Group
Location: Haddon Avenue
West Berlin Twp., Camden Co., PA
Soil Series Downer

Horizon	Depth (in.)	Color	Redox Features	Texture	Structure	Consistence	Boundary
A	0-9	10YR 3/2		sandy loam	structureless sg	very friable	abrupt smooth
C1	9-27	10YR 7/8		lomay sand	structureless sg	very friable	clear wavy
C2	27-55	10YR 7/8		loamy sand	structureless sg	very friable	clear wavy
C3	55-114	7.5YR 5/8		loamy sand	structureless sg	very friable	

Soil Scientist: Terry Harris

Notes: Roots to 68 inches below grade.

EPIPEDON
Ochric

SUBSURFACE HORIZON(S)

SOIL ORDER
Entisol

DRAINAGE CLASS
Well Drained

LANDFORM
Upland

POSITION
Other

PARENT MATERIAL
Outwash

BEDROCK LITHOLOGY
Coastal Plain (unconsolidated)

REDOX FEATURES

Abundance
Few ..... <2%
Common .. 2-20%
Many .....>20%

Contrast
faint
hue & chroma of matrix and redox are closely related.
distinct
matrix & redox features vary 1-2 units of hue and several units of chroma & value.
prominent
Matrix & redox features vary several units in hue, value & chroma.

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Penn's Trail Environmental, LLC

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Hatfield, PA 19440
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fax (215) 362-4620

Date: 3/31/21 Pit # 3 PTE # 4825
Project: The Crossroads Group
Location: Haddon Avenue
West Berlin Twp., Camden Co., PA
Soil Series Downer

Horizon	Depth (in.)	Color	Redox Features	Texture	Structure	Consistence	Boundary
AC	0-10	10YR 3/2		sandy loam	structureless sg	very friable	abrupt smooth
C1	10-59	10YR 7/8		lomay sand	structureless sg	very friable	clear wavy
C2	59-112	7.5YR 5/8		loamy sand	structureless sg	very friable	

Soil Scientist: Terry Harris

Notes: Roots to 65 inches below grade.

EPIPEDON
Ochric

SUBSURFACE HORIZON(S)

SOIL ORDER

DRAINAGE CLASS
Well Drained

LANDFORM
Outwash Plain

POSITION
Summit

PARENT MATERIAL
Outwash

BEDROCK LITHOLOGY
Coastal Plain (unconsolidated)

REDOX FEATURES

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Few ..... <2%
Common .. 2-20%
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cpr - columnar
gr - granular
abk - angular blocky
sbk - subangular blocky

Penn's Trail Environmental, LLC

21 East Lincoln Ave - Suite 160
Hatfield, PA 19440
ph. (215) 362-4610
fax (215) 362-4620

Date: 3/31/21 Pit # 4 PTE # 4825
Project: The Crossroads Group
Location: Haddon Avenue
West Berlin Twp., Camden Co., PA
Soil Series Downer

Horizon	Depth (in.)	Color	Redox Features	Texture	Structure	Consistence	Boundary
A	0-6	10YR 3/2		sandy loam	structureless sg	very friable	abrupt smooth
AC	6-13	10YR 6/3		sandy loam	structureless sg	very friable	clear wavy
C1	13-41	10YR 7/8		loamy sand	structureless sg	very friable	clear wavy
C2	41-116	7.5YR 5/8		gravelly sandy loam	structureless sg	very friable	

Soil Scientist: Terry Harris

Notes: Roots to 65 inches below grade.

EPIPEDON
Ochric

SUBSURFACE HORIZON(S)

SOIL ORDER

DRAINAGE CLASS
Well Drained

LANDFORM
Outwash Plain

POSITION
Summit

PARENT MATERIAL
Outwash

BEDROCK LITHOLOGY
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irregular - pockets with depth greater than width
broken - boundary is discontinuous and interrupted

Type
pl - platy
pr - prismatic
cpr - columnar
gr - granular
abk - angular blocky
sbk - subangular blocky

Double Ring Infiltrometer Data Reporting Sheet

Job Name:	***The Crossroads Group***	Job #	**4825**
Location:	Haddon Avenue	Date:	3/31/2021
Township:	*West Berlin Township*	Ring #:	1
County:	*Camden Co, NJ*	Technician:	Terry Harris
Witness:	---	Tax Parcel:	Block 625, Lot 1
Water Temp:	40's °F	Weather:	cloudy 40's °F
Test Depth:	6 inches	pH:	6.9

Time (hr:min)	**Interval** (min.)	**Inner Ring Drop** (in.)	**Inner Ring Volume change** (ml)	**Outer Ring Drop** (in.)	**Outer Ring Volume Change** (ml)	**Rate** (ml/min)	**Infiltration rate** (in/hr)
8:30 AM			fill		fill		
9:00 AM	30	6 4/8	3,000	6 3/8	5,280	100.00	12.95
9:30 AM	30	6 4/8	3,000	6 3/8	5,280	100.00	12.95
9:40 AM	10	1 3/8	640	1 4/8	1,250	64.00	8.29
9:50 AM	10	1 2/8	600	1 3/8	1,100	60.00	7.77
10:00 AM	10	1 2/8	590	1 3/8	1,140	59.00	7.64
10:10 AM	10	1 3/8	610	1 3/8	1,150	61.00	7.90
Average			610.00		1,160.00	61.00	7.90

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Double Ring Infiltrometer Data Reporting Sheet

Job Name:	***The Crossroads Group***	Job #	**4825**
Location:	Haddon Avenue	Date:	3/31/2021
Township:	*West Berlin Township*	Ring #:	2
County:	*Camden Co, NJ*	Technician:	Terry Harris
Witness:	---	Tax Parcel:	Block 625, Lot 1
Water Temp:	40's °F	Weather:	cloudy 40's °F
Test Depth:	24 inches	pH:	6.9

Time (hr:min)	**Interval** (min.)	**Inner Ring Drop** (in.)	**Inner Ring Volume change** (ml)	**Outer Ring Drop** (in.)	**Outer Ring Volume Change** (ml)	**Rate** (ml/min)	**Infiltration rate** (in/hr)
9:00 AM			fill		fill		
9:30 AM	30	6 4/8	3,000	6 3/8	5,280	100.00	12.95
10:00 AM	30	6 4/8	3,000	6 3/8	5,280	100.00	12.95
10:10 AM	10	3	1,400	1 4/8	1,200	140.00	18.13
10:20 AM	10	3 1/8	1,470	1 5/8	1,310	147.00	19.03
10:30 AM	10	3 1/8	1,450	1 5/8	1,300	145.00	18.77
10:40 AM	10	3	1,380	1 4/8	1,280	138.00	17.87
Average			1,425.00		1,272.50	142.50	18.45

Penn's Trail Environmental, LLC
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Hatfield, PA 19440

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Fax (215) 362-4620

Double Ring Infiltrometer Data Reporting Sheet

Job Name:	***The Crossroads Group***	Job #	**4825**
Location:	Haddon Avenue	Date:	3/31/2021
Township:	*West Berlin Township*	Ring #:	3
County:	*Camden Co, NJ*	Technician:	Terry Harris
Witness:	---	Tax Parcel:	Block 625, Lot 1
Water Temp:	40's °F	Weather:	cloudy 40's °F
Test Depth:	12 inches	pH:	6.9

Time (hr:min)	**Interval** (min.)	**Inner Ring Drop** (in.)	**Inner Ring Volume change** (ml)	**Outer Ring Drop** (in.)	**Outer Ring Volume Change** (ml)	**Rate** (ml/min)	**Infiltration rate** (in/hr)
9:45 AM			fill		fill		
10:15 AM	30	6 4/8	3,000	6 3/8	5,280	100.00	12.95
10:45 AM	30	6 4/8	3,000	6 3/8	5,280	100.00	12.95
10:55 AM	10	1 7/8	850	1 7/8	1,500	85.00	11.01
11:05 AM	10	2	910	1 6/8	1,420	91.00	11.78
11:15 AM	10	1 7/8	890	1 6/8	1,460	89.00	11.52
11:25 AM	10	1 7/8	880	1 6/8	1,490	88.00	11.39
Average			882.50		1,467.50	88.25	11.43

Penn's Trail Environmental, LLC
21 E. Lincoln Ave.-Suite 160
Hatfield, PA 19440
Ph. (215) 362-4610
Fax (215) 362-4620

Double Ring Infiltrometer Data Reporting Sheet

Job Name:	***The Crossroads Group***	Job #	**4825**
Location:	Haddon Avenue	Date:	3/31/2021
Township:	*West Berlin Township*	Ring #:	4
County:	*Camden Co, NJ*	Technician:	Terry Harris
Witness:	---	Tax Parcel:	Block 625, Lot 1
Water Temp:	40's °F	Weather:	cloudy 40's °F
Test Depth:	36 inches	pH:	6.9

Time (hr:min)	**Interval** (min.)	**Inner Ring Drop** (in.)	**Inner Ring Volume change** (ml)	**Outer Ring Drop** (in.)	**Outer Ring Volume Change** (ml)	**Rate** (ml/min)	**Infiltration rate** (in/hr)
8:45 AM			fill		fill		
9:15 AM	30	6 4/8	3,000	6 3/8	5,280	100.00	12.95
9:45 AM	30	6 4/8	3,000	6 3/8	5,280	100.00	12.95
9:55 AM	10	1 7/8	890	1 7/8	1,510	89.00	11.52
10:05 AM	10	2	910	1 6/8	1,460	91.00	11.78
10:15 AM	10	1 7/8	870	1 6/8	1,490	87.00	11.26
10:25 AM	10	1 7/8	860	1 6/8	1,460	86.00	11.14
Average			882.50		1,480.00	88.25	11.43

Penn's Trail Environmental, LLC
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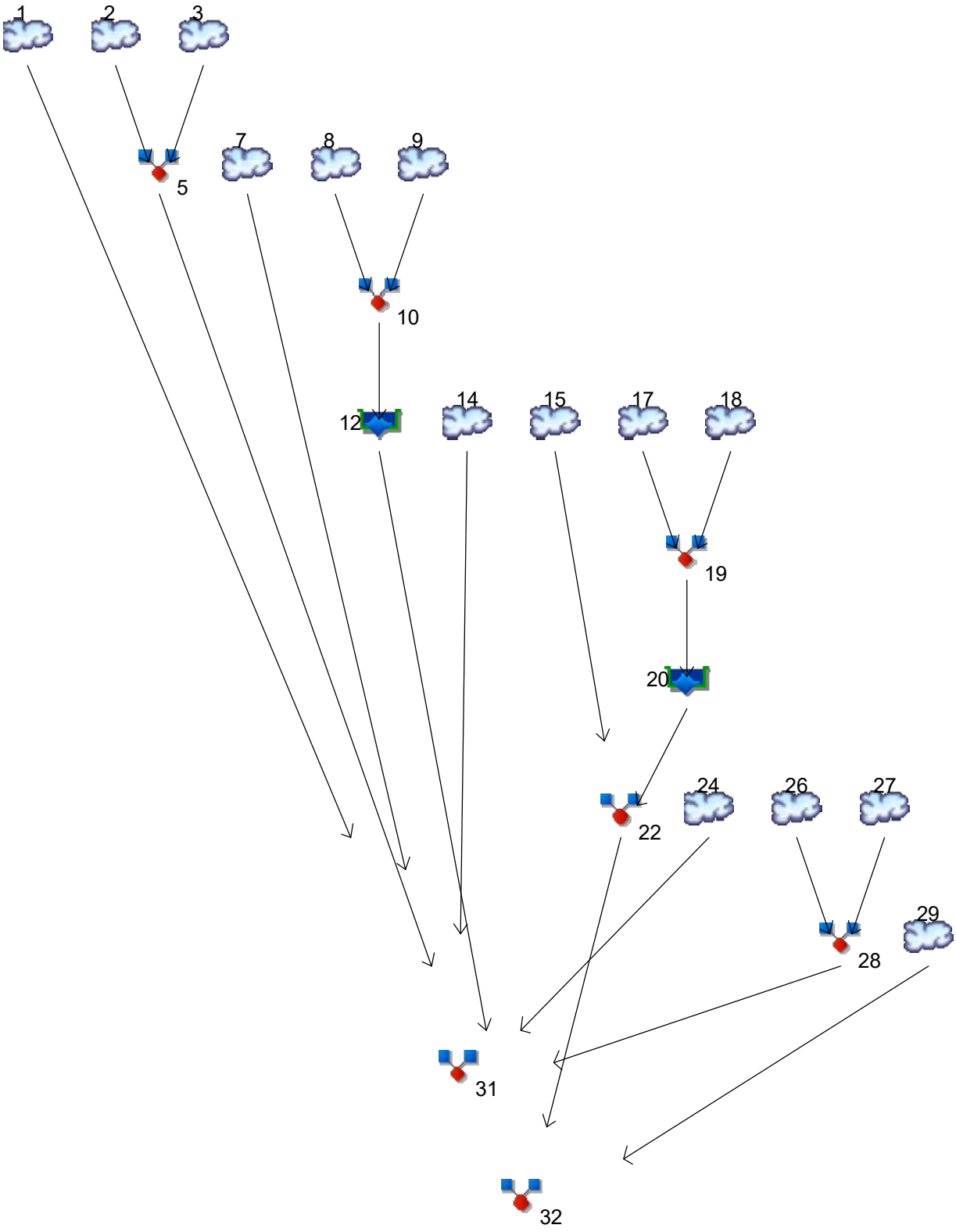
Appendix D

HYDROGRAPH SUMMARIES

Watershed Model Schematic

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



NOAA Atlas 14, Volume 2, Version 3
Location name: West Berlin, New Jersey, USA*
Latitude: 39.8097°, Longitude: -74.9421°
Elevation: 172.42 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

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

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

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

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.350** (0.318-0.384)	**0.416** (0.379-0.457)	**0.491** (0.446-0.539)	**0.548** (0.497-0.602)	**0.617** (0.557-0.678)	**0.668** (0.600-0.735)	**0.718** (0.642-0.792)	**0.763** (0.678-0.846)	**0.819** (0.719-0.914)	**0.864** (0.752-0.971)
10-min	**0.559** (0.509-0.613)	**0.666** (0.606-0.731)	**0.786** (0.714-0.863)	**0.877** (0.795-0.962)	**0.983** (0.888-1.08)	**1.06** (0.956-1.17)	**1.14** (1.02-1.26)	**1.21** (1.07-1.34)	**1.30** (1.14-1.45)	**1.36** (1.18-1.53)
15-min	**0.698** (0.636-0.766)	**0.837** (0.762-0.919)	**0.994** (0.903-1.09)	**1.11** (1.00-1.22)	**1.25** (1.13-1.37)	**1.35** (1.21-1.48)	**1.44** (1.29-1.59)	**1.53** (1.36-1.69)	**1.63** (1.43-1.82)	**1.71** (1.49-1.92)
30-min	**0.958** (0.872-1.05)	**1.16** (1.05-1.27)	**1.41** (1.28-1.55)	**1.61** (1.46-1.76)	**1.85** (1.67-2.03)	**2.03** (1.82-2.23)	**2.21** (1.98-2.44)	**2.38** (2.11-2.63)	**2.60** (2.28-2.90)	**2.77** (2.41-3.11)
60-min	**1.19** (1.09-1.31)	**1.45** (1.32-1.59)	**1.81** (1.65-1.99)	**2.09** (1.90-2.30)	**2.46** (2.22-2.70)	**2.75** (2.47-3.02)	**3.04** (2.72-3.35)	**3.33** (2.96-3.69)	**3.72** (3.27-4.16)	**4.04** (3.51-4.54)
2-hr	**1.44** (1.30-1.59)	**1.75** (1.58-1.94)	**2.20** (1.98-2.43)	**2.55** (2.30-2.83)	**3.03** (2.71-3.36)	**3.41** (3.03-3.79)	**3.80** (3.36-4.23)	**4.19** (3.68-4.69)	**4.73** (4.10-5.33)	**5.17** (4.43-5.86)
3-hr	**1.57** (1.42-1.75)	**1.91** (1.73-2.12)	**2.40** (2.17-2.67)	**2.81** (2.52-3.12)	**3.35** (2.99-3.72)	**3.80** (3.36-4.22)	**4.26** (3.74-4.74)	**4.73** (4.12-5.29)	**5.39** (4.62-6.07)	**5.93** (5.01-6.71)
6-hr	**1.96** (1.77-2.19)	**2.37** (2.14-2.65)	**2.97** (2.68-3.32)	**3.48** (3.13-3.88)	**4.20** (3.73-4.68)	**4.80** (4.24-5.36)	**5.44** (4.76-6.08)	**6.13** (5.29-6.87)	**7.10** (6.02-8.02)	**7.93** (6.61-9.02)
12-hr	**2.38** (2.15-2.66)	**2.87** (2.60-3.22)	**3.62** (3.27-4.05)	**4.29** (3.85-4.79)	**5.25** (4.67-5.86)	**6.10** (5.36-6.81)	**7.02** (6.09-7.86)	**8.03** (6.86-9.04)	**9.52** (7.94-10.8)	**10.8** (8.86-12.4)
24-hr	**2.73** (2.52-2.96)	**3.31** (3.06-3.59)	**4.25** (3.92-4.62)	**5.05** (4.64-5.48)	**6.26** (5.72-6.76)	**7.31** (6.63-7.88)	**8.47** (7.62-9.12)	**9.77** (8.71-10.5)	**11.7** (10.3-12.6)	**13.4** (11.7-14.4)
2-day	**3.14** (2.89-3.42)	**3.81** (3.52-4.15)	**4.89** (4.51-5.33)	**5.81** (5.34-6.32)	**7.18** (6.55-7.79)	**8.35** (7.57-9.05)	**9.64** (8.68-10.4)	**11.1** (9.88-12.0)	**13.2** (11.6-14.3)	**15.1** (13.1-16.4)
3-day	**3.31** (3.06-3.59)	**4.01** (3.71-4.36)	**5.13** (4.74-5.57)	**6.07** (5.59-6.58)	**7.47** (6.84-8.07)	**8.66** (7.88-9.35)	**9.97** (9.01-10.7)	**11.4** (10.2-12.3)	**13.6** (12.0-14.6)	**15.4** (13.5-16.6)
4-day	**3.48** (3.22-3.77)	**4.21** (3.90-4.56)	**5.36** (4.97-5.81)	**6.33** (5.85-6.84)	**7.75** (7.12-8.35)	**8.97** (8.19-9.64)	**10.3** (9.34-11.1)	**11.7** (10.6-12.6)	**13.9** (12.4-14.9)	**15.7** (13.8-16.9)
7-day	**4.06** (3.79-4.38)	**4.89** (4.56-5.27)	**6.14** (5.72-6.62)	**7.19** (6.67-7.74)	**8.72** (8.06-9.39)	**10.0** (9.21-10.8)	**11.4** (10.4-12.3)	**13.0** (11.8-13.9)	**15.2** (13.6-16.4)	**17.1** (15.2-18.4)
10-day	**4.60** (4.31-4.93)	**5.52** (5.16-5.92)	**6.82** (6.37-7.31)	**7.89** (7.36-8.45)	**9.42** (8.76-10.1)	**10.7** (9.89-11.4)	**12.0** (11.1-12.9)	**13.5** (12.3-14.4)	**15.6** (14.1-16.7)	**17.4** (15.6-18.6)
20-day	**6.22** (5.89-6.60)	**7.40** (7.00-7.86)	**8.91** (8.42-9.45)	**10.1** (9.55-10.7)	**11.8** (11.1-12.5)	**13.1** (12.3-13.9)	**14.5** (13.5-15.3)	**15.9** (14.8-16.9)	**17.9** (16.5-18.9)	**19.4** (17.8-20.6)

Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	36.9395	8.6000	0.8332	--------
2	385850.8125	61.3996	2.6803	--------
3	0.0000	0.0000	0.0000	--------
5	42.5069	8.1000	0.7697	--------
10	44.6965	7.9000	0.7487	--------
25	48.8267	7.8000	0.7319	--------
50	46.6640	6.8000	0.6956	--------
100	43.7690	5.7000	0.6569	--------

File name: Reg4.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	4.20	3.23	2.65	2.26	1.98	1.76	1.59	1.45	1.34	1.24	1.16	1.09
2	5.04	4.15	3.46	2.92	2.49	2.14	1.86	1.62	1.42	1.26	1.12	1.00
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	5.87	4.58	3.79	3.26	2.88	2.58	2.35	2.16	2.00	1.86	1.75	1.65
10	6.59	5.16	4.29	3.70	3.27	2.94	2.68	2.47	2.29	2.14	2.01	1.90
25	7.56	5.94	4.95	4.28	3.79	3.42	3.12	2.88	2.68	2.51	2.36	2.23
50	8.38	6.56	5.47	4.74	4.21	3.80	3.48	3.21	3.00	2.81	2.65	2.51
100	9.22	7.17	5.98	5.19	4.62	4.18	3.84	3.55	3.32	3.12	2.95	2.80

Tc = time in minutes. Values may exceed 60.

Precip. file name: storm.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	0.00	3.31	0.00	4.03	5.05	6.26	7.31	8.47
SCS 6-Hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-1st	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-4th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-Indy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Custom	1.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Hydrograph Return Period Recap

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

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	------	-------	0.025	-------	-------	0.112	0.192	0.270	0.362	Pre Shed 1
2	SCS Runoff	------	-------	0.004	-------	-------	0.020	0.036	0.050	0.068	Post Shed 1 med
3	SCS Runoff	------	-------	0.008	-------	-------	0.013	0.016	0.018	0.021	Post Shed 1 (Imp)
5	Combine	2, 3,	-------	0.011	-------	-------	0.033	0.051	0.069	0.089	Total Post Shed 1
7	SCS Runoff	------	-------	0.009	-------	-------	0.041	0.071	0.100	0.135	Pre Shed 2
8	SCS Runoff	------	-------	0.011	-------	-------	0.017	0.021	0.024	0.028	POST SHED 2 (TRENCH A Imp)
9	SCS Runoff	------	-------	0.015	-------	-------	0.039	0.058	0.075	0.095	POST SHED 2 (TRENCH A Lawn)
10	Combine	8, 9	-------	0.026	-------	-------	0.056	0.079	0.099	0.123	Post Shed 2 (Trench A)
12	Reservoir	10	-------	0.000	-------	-------	0.000	0.000	0.000	0.000	PostShed 2 (TRENCH A)
14	SCS Runoff	------	-------	0.021	-------	-------	0.094	0.161	0.227	0.306	Pre Shed 3
15	SCS Runoff	------	-------	0.003	-------	-------	0.015	0.026	0.037	0.050	Post Shed 3 Bypass
17	SCS Runoff	------	-------	0.956	-------	-------	1.469	1.825	2.133	2.473	Post Shed 3 Imp
18	SCS Runoff	------	-------	0.081	-------	-------	0.213	0.318	0.413	0.521	Post Shed 3 Lawn
19	Combine	17, 18	-------	1.037	-------	-------	1.683	2.143	2.546	2.995	Total Post Shed 3 UG Basin A
20	Reservoir	19	-------	0.000	-------	-------	0.000	0.000	0.000	0.000	UG Basin A
22	Combine	15, 20,	-------	0.003	-------	-------	0.015	0.026	0.037	0.050	Total Post Shed 3
24	SCS Runoff	------	-------	0.011	-------	-------	0.051	0.087	0.122	0.164	Pre Shed 4
26	SCS Runoff	------	-------	0.018	-------	-------	0.027	0.034	0.039	0.046	Pre Shed 5 Imp
27	SCS Runoff	------	-------	0.022	-------	-------	0.099	0.169	0.238	0.319	Pre Shed 5 med
28	Combine	26, 27	-------	0.037	-------	-------	0.124	0.202	0.276	0.364	Pre Shed 5
29	SCS Runoff	------	-------	0.012	-------	-------	0.058	0.101	0.142	0.191	Post Shed 5
31	Combine	1, 7, 14, 24, 28,	-------	0.103	-------	-------	0.416	0.703	0.982	1.311	Total Pre Shed
32	Combine	5, 12, 22, 29,	-------	0.025	-------	-------	0.106	0.178	0.248	0.330	Total Post Shed

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	0.025	2	752	233	------	------	------	Pre Shed 1
2	SCS Runoff	0.004	2	734	27	------	------	------	Post Shed 1 med
3	SCS Runoff	0.008	2	726	33	------	------	------	Post Shed 1 (Imp)
5	Combine	0.011	2	726	61	2, 3,	------	------	Total Post Shed 1
7	SCS Runoff	0.009	2	746	73	------	------	------	Pre Shed 2
8	SCS Runoff	0.011	2	726	44	------	------	------	POST SHED 2 (TRENCH A Imp)
9	SCS Runoff	0.015	2	726	61	------	------	------	POST SHED 2 (TRENCH A Lawn)
10	Combine	0.026	2	726	105	8, 9	------	------	Post Shed 2 (Trench A)
12	Reservoir	0.000	2	n/a	0	10	170.96	105	PostShed 2 (TRENCH A)
14	SCS Runoff	0.021	2	746	164	------	------	------	Pre Shed 3
15	SCS Runoff	0.003	2	734	20	------	------	------	Post Shed 3 Bypass
17	SCS Runoff	0.956	2	726	3,871	------	------	------	Post Shed 3 Imp
18	SCS Runoff	0.081	2	726	333	------	------	------	Post Shed 3 Lawn
19	Combine	1.037	2	726	4,204	17, 18	------	------	Total Post Shed 3 UG Basin A
20	Reservoir	0.000	2	n/a	0	19	168.76	4,204	UG Basin A
22	Combine	0.003	2	734	20	15, 20,	------	------	Total Post Shed 3
24	SCS Runoff	0.011	2	750	98	------	------	------	Pre Shed 4
26	SCS Runoff	0.018	2	736	111	------	------	------	Pre Shed 5 Imp
27	SCS Runoff	0.022	2	752	205	------	------	------	Pre Shed 5 med
28	Combine	0.037	2	748	316	26, 27	------	------	Pre Shed 5
29	SCS Runoff	0.012	2	734	77	------	------	------	Post Shed 5
31	Combine	0.103	2	748	883	1, 7, 14, 24, 28,	------	------	Total Pre Shed
32	Combine	0.025	2	730	158	5, 12, 22, 29,	------	------	Total Post Shed

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	0.112	2	746	731	------	------	------	Pre Shed 1
2	SCS Runoff	0.020	2	726	86	------	------	------	Post Shed 1 med
3	SCS Runoff	0.013	2	726	52	------	------	------	Post Shed 1 (Imp)
5	Combine	0.033	2	726	138	2, 3,	------	------	Total Post Shed 1
7	SCS Runoff	0.041	2	736	228	------	------	------	Pre Shed 2
8	SCS Runoff	0.017	2	726	69	------	------	------	POST SHED 2 (TRENCH A Imp)
9	SCS Runoff	0.039	2	726	143	------	------	------	POST SHED 2 (TRENCH A Lawn)
10	Combine	0.056	2	726	213	8, 9	------	------	Post Shed 2 (Trench A)
12	Reservoir	0.000	2	n/a	0	10	171.20	213	PostShed 2 (TRENCH A)
14	SCS Runoff	0.094	2	736	516	------	------	------	Pre Shed 3
15	SCS Runoff	0.015	2	726	64	------	------	------	Post Shed 3 Bypass
17	SCS Runoff	1.469	2	726	6,055	------	------	------	Post Shed 3 Imp
18	SCS Runoff	0.213	2	726	788	------	------	------	Post Shed 3 Lawn
19	Combine	1.683	2	726	6,843	17, 18	------	------	Total Post Shed 3 UG Basin A
20	Reservoir	0.000	2	n/a	0	19	169.49	6,843	UG Basin A
22	Combine	0.015	2	726	64	15, 20,	------	------	Total Post Shed 3
24	SCS Runoff	0.051	2	742	308	------	------	------	Pre Shed 4
26	SCS Runoff	0.027	2	736	173	------	------	------	Pre Shed 5 Imp
27	SCS Runoff	0.099	2	746	645	------	------	------	Pre Shed 5 med
28	Combine	0.124	2	744	818	26, 27	------	------	Pre Shed 5
29	SCS Runoff	0.058	2	726	243	------	------	------	Post Shed 5
31	Combine	0.416	2	742	2,601	1, 7, 14, 24, 28,	------	------	Total Pre Shed
32	Combine	0.106	2	726	445	5, 12, 22, 29,	------	------	Total Post Shed

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	0.192	2	742	1,174	------	------	------	Pre Shed 1
2	SCS Runoff	0.036	2	726	138	------	------	------	Post Shed 1 med
3	SCS Runoff	0.016	2	726	65	------	------	------	Post Shed 1 (Imp)
5	Combine	0.051	2	726	203	2, 3,	------	------	Total Post Shed 1
7	SCS Runoff	0.071	2	734	366	------	------	------	Pre Shed 2
8	SCS Runoff	0.021	2	726	87	------	------	------	POST SHED 2 (TRENCH A Imp)
9	SCS Runoff	0.058	2	726	210	------	------	------	POST SHED 2 (TRENCH A Lawn)
10	Combine	0.079	2	726	296	8, 9	------	------	Post Shed 2 (Trench A)
12	Reservoir	0.000	2	n/a	0	10	171.37	296	PostShed 2 (TRENCH A)
14	SCS Runoff	0.161	2	734	829	------	------	------	Pre Shed 3
15	SCS Runoff	0.026	2	726	102	------	------	------	Post Shed 3 Bypass
17	SCS Runoff	1.825	2	726	7,575	------	------	------	Post Shed 3 Imp
18	SCS Runoff	0.318	2	726	1,153	------	------	------	Post Shed 3 Lawn
19	Combine	2.143	2	726	8,729	17, 18	------	------	Total Post Shed 3 UG Basin A
20	Reservoir	0.000	2	n/a	0	19	170.02	8,729	UG Basin A
22	Combine	0.026	2	726	102	15, 20,	------	------	Total Post Shed 3
24	SCS Runoff	0.087	2	740	494	------	------	------	Pre Shed 4
26	SCS Runoff	0.034	2	736	216	------	------	------	Pre Shed 5 Imp
27	SCS Runoff	0.169	2	742	1,036	------	------	------	Pre Shed 5 med
28	Combine	0.202	2	742	1,252	26, 27	------	------	Pre Shed 5
29	SCS Runoff	0.101	2	726	390	------	------	------	Post Shed 5
31	Combine	0.703	2	738	4,114	1, 7, 14, 24, 28,	------	------	Total Pre Shed
32	Combine	0.178	2	726	695	5, 12, 22, 29,	------	------	Total Post Shed

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	0.270	2	742	1,602	------	------	------	Pre Shed 1
2	SCS Runoff	0.050	2	726	189	------	------	------	Post Shed 1 med
3	SCS Runoff	0.018	2	726	76	------	------	------	Post Shed 1 (Imp)
5	Combine	0.069	2	726	265	2, 3,	------	------	Total Post Shed 1
7	SCS Runoff	0.100	2	734	500	------	------	------	Pre Shed 2
8	SCS Runoff	0.024	2	726	102	------	------	------	POST SHED 2 (TRENCH A Imp)
9	SCS Runoff	0.075	2	726	271	------	------	------	POST SHED 2 (TRENCH A Lawn)
10	Combine	0.099	2	726	373	8, 9	------	------	Post Shed 2 (Trench A)
12	Reservoir	0.000	2	n/a	0	10	171.52	373	PostShed 2 (TRENCH A)
14	SCS Runoff	0.227	2	734	1,131	------	------	------	Pre Shed 3
15	SCS Runoff	0.037	2	726	139	------	------	------	Post Shed 3 Bypass
17	SCS Runoff	2.133	2	726	8,895	------	------	------	Post Shed 3 Imp
18	SCS Runoff	0.413	2	726	1,491	------	------	------	Post Shed 3 Lawn
19	Combine	2.546	2	726	10,386	17, 18	------	------	Total Post Shed 3 UG Basin A
20	Reservoir	0.000	2	n/a	0	19	170.48	10,386	UG Basin A
22	Combine	0.037	2	726	139	15, 20,	------	------	Total Post Shed 3
24	SCS Runoff	0.122	2	738	674	------	------	------	Pre Shed 4
26	SCS Runoff	0.039	2	736	254	------	------	------	Pre Shed 5 Imp
27	SCS Runoff	0.238	2	742	1,414	------	------	------	Pre Shed 5 med
28	Combine	0.276	2	740	1,668	26, 27	------	------	Pre Shed 5
29	SCS Runoff	0.142	2	726	533	------	------	------	Post Shed 5
31	Combine	0.982	2	738	5,575	1, 7, 14, 24, 28,	------	------	Total Pre Shed
32	Combine	0.248	2	726	937	5, 12, 22, 29,	------	------	Total Post Shed

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	0.362	2	740	2,112	------	------	------	Pre Shed 1
2	SCS Runoff	0.068	2	726	249	------	------	------	Post Shed 1 med
3	SCS Runoff	0.021	2	726	89	------	------	------	Post Shed 1 (Imp)
5	Combine	0.089	2	726	337	2, 3,	------	------	Total Post Shed 1
7	SCS Runoff	0.135	2	732	659	------	------	------	Pre Shed 2
8	SCS Runoff	0.028	2	726	118	------	------	------	POST SHED 2 (TRENCH A Imp)
9	SCS Runoff	0.095	2	726	342	------	------	------	POST SHED 2 (TRENCH A Lawn)
10	Combine	0.123	2	726	460	8, 9	------	------	Post Shed 2 (Trench A)
12	Reservoir	0.000	2	n/a	0	10	171.70	460	PostShed 2 (TRENCH A)
14	SCS Runoff	0.306	2	732	1,491	------	------	------	Pre Shed 3
15	SCS Runoff	0.050	2	726	184	------	------	------	Post Shed 3 Bypass
17	SCS Runoff	2.473	2	726	10,353	------	------	------	Post Shed 3 Imp
18	SCS Runoff	0.521	2	726	1,879	------	------	------	Post Shed 3 Lawn
19	Combine	2.995	2	726	12,232	17, 18	------	------	Total Post Shed 3 UG Basin A
20	Reservoir	0.000	2	n/a	0	19	170.99	12,232	UG Basin A
22	Combine	0.050	2	726	184	15, 20,	------	------	Total Post Shed 3
24	SCS Runoff	0.164	2	738	889	------	------	------	Pre Shed 4
26	SCS Runoff	0.046	2	736	296	------	------	------	Pre Shed 5 Imp
27	SCS Runoff	0.319	2	740	1,864	------	------	------	Pre Shed 5 med
28	Combine	0.364	2	740	2,160	26, 27	------	------	Pre Shed 5
29	SCS Runoff	0.191	2	726	702	------	------	------	Post Shed 5
31	Combine	1.311	2	736	7,310	1, 7, 14, 24, 28,	------	------	Total Pre Shed
32	Combine	0.330	2	726	1,223	5, 12, 22, 29,	------	------	Total Post Shed

Appendix E

WATERSHED CALCULATIONS: PRE-DEVELOPMENT

PRE-DEVELOPMENT WATERSHED #1

PRE-DEVELOPMENT WATERSHED #1

- DRAINAGE AREAS/ WEIGHTED CN VALUES
- TIME OF CONCENTRATION CALCULATIONS
- HYDROGRAPHS (2, 10, 25, 50, & 100 yr)

PRE-DEVELOPMENT SHED COVERAGE CALCULATIONS

Project Name:	Angelo Pizza LD
Location:	Berlin Twp, Camden County
Project Number:	3824
Prepared By:	Colin Camp
Date:	April 14, 2021

Cover	CN Values			
	Soil A	Soil B	Soil C	Soil D
Impervious	98	98	98	98
Meadow	30	58	71	78
Woodland	36	60	73	79
Cultivated	75	85	90	92
Lawn	49	69	79	84

Shed ID	Pre-Shed 1			
Soil Type	Cover	Area (Ac.)	CN Value	CN*Area
A	Meadow	0.00	30	0.00
	Woodland	0.00	36	0.00
	Cultivated	0.00	75	0.00
	Lawn	0.00	49	0.00
B	Meadow	0.17	58	9.86
	Woodland	0.00	60	0.00
	Cultivated	0.00	85	0.00
	Lawn	0.00	69	0.00
C	Meadow	0.00	71	0.00
	Woodland	0.00	73	0.00
	Cultivated	0.00	90	0.00
	Lawn	0.00	79	0.00
D	Meadow	0.00	78	0.00
	Woodland	0.00	79	0.00
	Cultivated	0.00	92	0.00
	Lawn	0.00	84	0.00
IMPERVIOUS			98	0.00
			Total Area:	0.17
			Wtd CN:	58.00

TIME OF CONCENTRATION CALCULATIONS FOR PRE SHED #1

Project Name: Angelo Pizza LD
Municipality: Berlin Twp
County Camden
Project Number: 3824
Prepared By: Colin Camp
Date: December 14, 2020

SHEET FLOW

Ground Cover: Dense Grass
Mannings n Value: 0.24
2-Yr/ 24 Hr Rainfall: 2.84 in

FLOW TYPE	FLOW LENGTH (FT)	SLOPE (FT/FT)	PAVED/ UNPAVED	CROSS SECTION FLOW AREA (SQ FT)	WETTED PERIMETER (FT)	MANNING'S N	TRAVEL TIME (HR)	VELOCITY (FT/S)
Sheet Flow	100	0.0100	N/A	N/A	N/A	N/A	0.3331	N/A
Shallow Concentrated Flow	14.64	0.0340	Unpaved				0.0014	2.98
PIPED FLOW	**FLOW LENGTH (FT)**	**SLOPE (FT/FT)**	**PIPE DIAMETER (IN)**	**CROSS SECTION FLOW AREA (SQ FT)**	**WETTED PERIMETER (FT)**	**MANNING'S N**	**TRAVEL TIME (HR)**	**VELOCITY (FT/S)**
				0.00	0.00			
				0.00	0.00			
				0.00	0.00			

Time of Concentration: 0.3345 Hr.

20.07 Min.

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Wednesday, 04 / 14 / 2021

Hyd. No. 1

Pre Shed 1

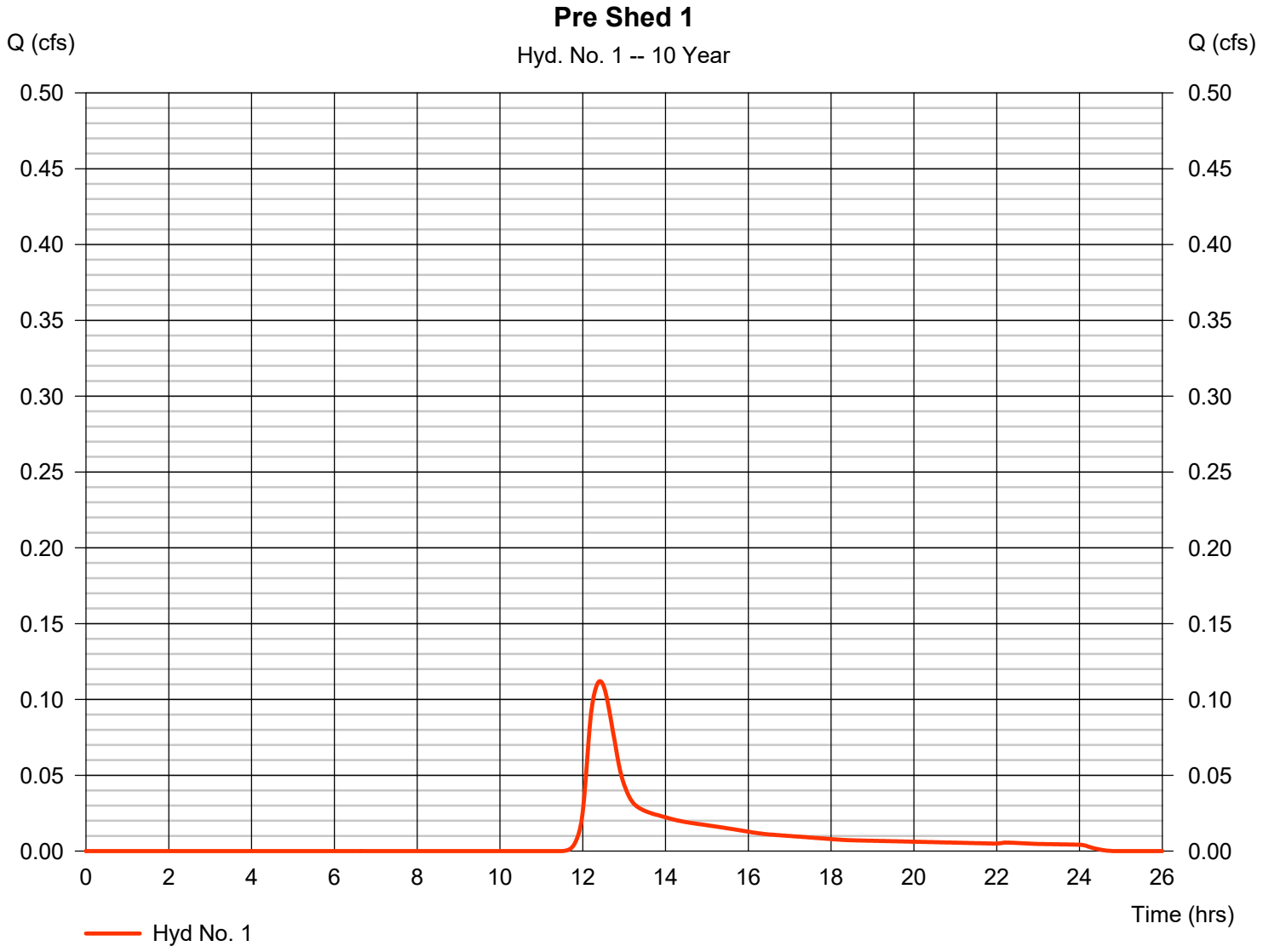
Hydrograph type	=	SCS Runoff	Peak discharge	=	0.025 cfs
Storm frequency	=	2 yrs	Time to peak	=	12.53 hrs
Time interval	=	2 min	Hyd. volume	=	233 cuft
Drainage area	=	0.170 ac	Curve number	=	58
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	20.10 min
Total precip.	=	3.31 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	284

Hydrograph Report

Hyd. No. 1

Pre Shed 1

Hydrograph type	= SCS Runoff	Peak discharge	= 0.112 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.43 hrs
Time interval	= 2 min	Hyd. volume	= 731 cuft
Drainage area	= 0.170 ac	Curve number	= 58
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 20.10 min
Total precip.	= 5.05 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 284



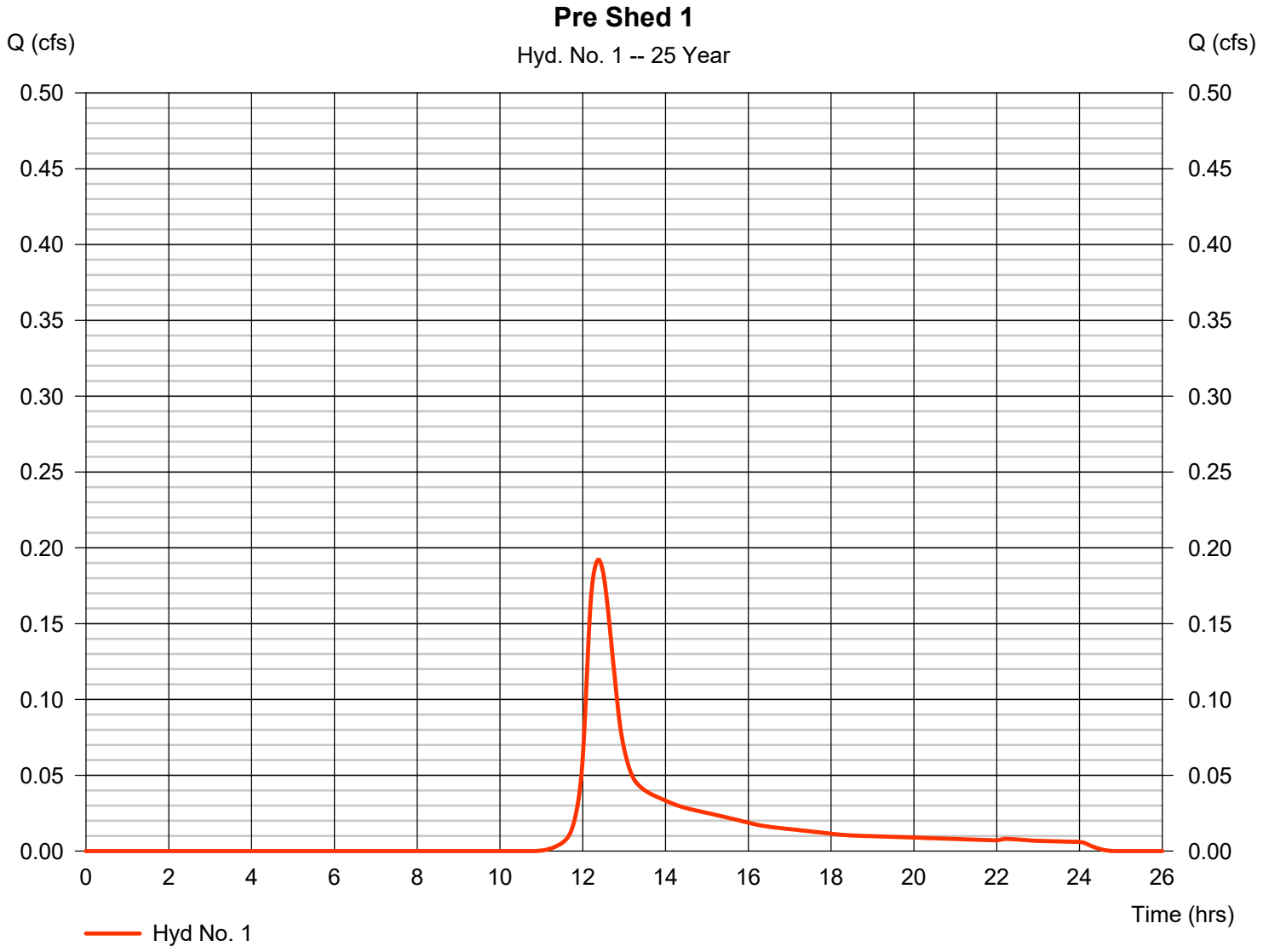
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Wednesday, 04 / 14 / 2021

Hyd. No. 1

Pre Shed 1

Hydrograph type	= SCS Runoff	Peak discharge	= 0.192 cfs
Storm frequency	= 25 yrs	Time to peak	= 12.37 hrs
Time interval	= 2 min	Hyd. volume	= 1,174 cuft
Drainage area	= 0.170 ac	Curve number	= 58
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 20.10 min
Total precip.	= 6.26 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 284



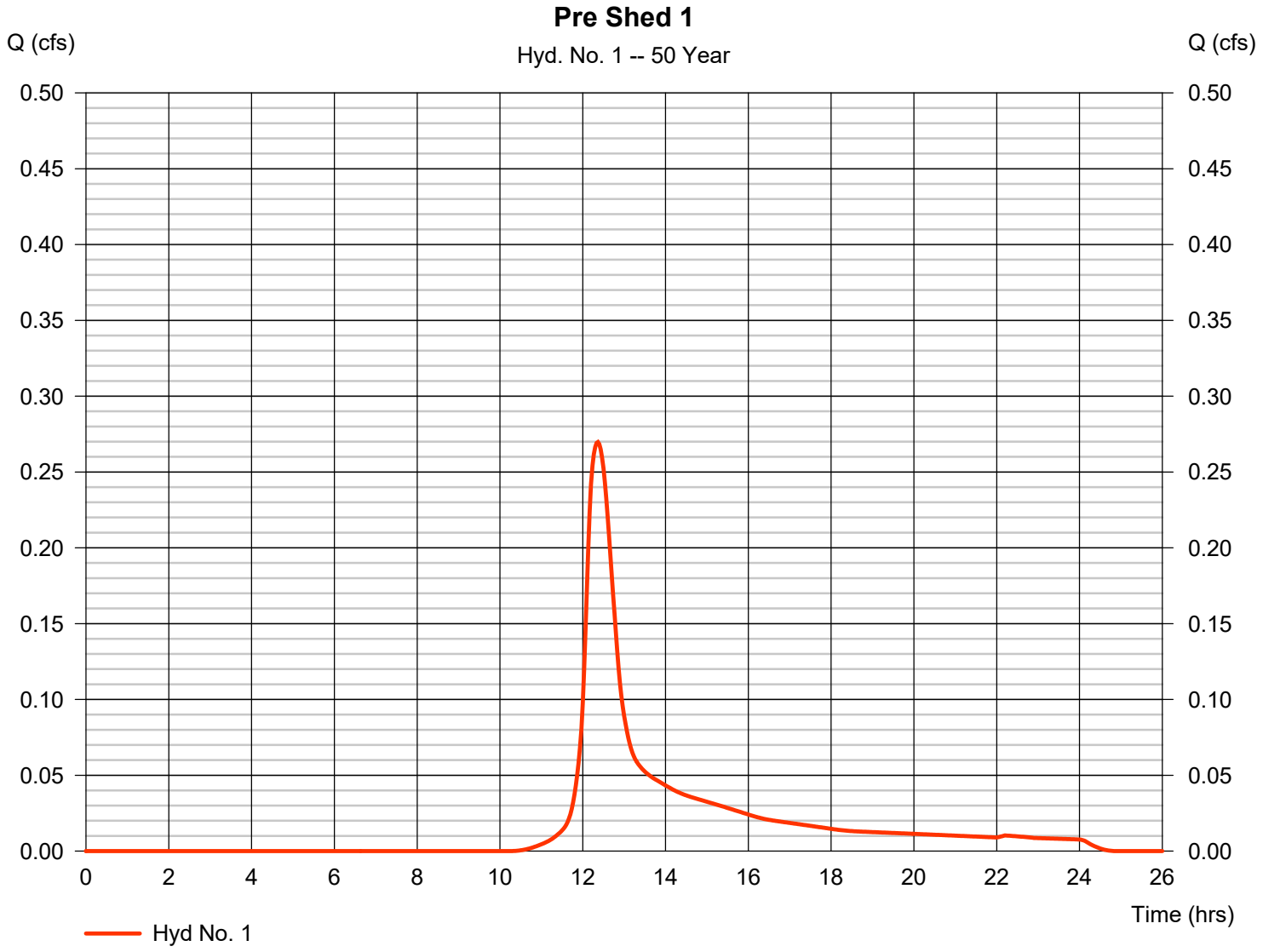
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Wednesday, 04 / 14 / 2021

Hyd. No. 1

Pre Shed 1

Hydrograph type	= SCS Runoff	Peak discharge	= 0.270 cfs
Storm frequency	= 50 yrs	Time to peak	= 12.37 hrs
Time interval	= 2 min	Hyd. volume	= 1,602 cuft
Drainage area	= 0.170 ac	Curve number	= 58
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 20.10 min
Total precip.	= 7.31 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 284



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Wednesday, 04 / 14 / 2021

Hyd. No. 1

Pre Shed 1

Hydrograph type	= SCS Runoff	Peak discharge	= 0.362 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.33 hrs
Time interval	= 2 min	Hyd. volume	= 2,112 cuft
Drainage area	= 0.170 ac	Curve number	= 58
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 20.10 min
Total precip.	= 8.47 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 284

PRE-DEVELOPMENT WATERSHED #2

PRE-DEVELOPMENT WATERSHED #2

- DRAINAGE AREAS/ WEIGHTED CN VALUES
- TIME OF CONCENTRATION CALCULATIONS
- HYDROGRAPHS (2, 10, 25, 50, & 100 yr)

PRE-DEVELOPMENT SHED COVERAGE CALCULATIONS

Project Name:	Angelo Pizza LD
Location:	Berlin Twp, Camden County
Project Number:	3824
Prepared By:	Colin Camp
Date:	April 14, 2021

Cover	CN Values			
	Soil A	Soil B	Soil C	Soil D
Impervious	98	98	98	98
Meadow	30	58	71	78
Woodland	36	60	73	79
Cultivated	75	85	90	92
Lawn	49	69	79	84

Shed ID	Pre-Shed 2			
Soil Type	Cover	Area (Ac.)	CN Value	CN*Area
A	Meadow	0.00	30	0.00
	Woodland	0.00	36	0.00
	Cultivated	0.00	75	0.00
	Lawn	0.00	49	0.00
B	Meadow	0.05	58	2.90
	Woodland	0.00	60	0.00
	Cultivated	0.00	85	0.00
	Lawn	0.00	69	0.00
C	Meadow	0.00	71	0.00
	Woodland	0.00	73	0.00
	Cultivated	0.00	90	0.00
	Lawn	0.00	79	0.00
D	Meadow	0.00	78	0.00
	Woodland	0.00	79	0.00
	Cultivated	0.00	92	0.00
	Lawn	0.00	84	0.00
IMPERVIOUS			98	0.00
			Total Area:	0.05
			Wtd CN:	58.00

TIME OF CONCENTRATION CALCULATIONS FOR PRE SHED #2

Project Name:	Angelo Pizza LD
Municipality:	Berlin Twp
County	Camden
Project Number:	3824
Prepared By:	Colin Camp
Date:	December 14, 2020

SHEET FLOW

Ground Cover:	Dense Grass	
Mannings n Value:	0.24	
2-Yr/ 24 Hr Rainfall:	2.84	in

FLOW TYPE	FLOW LENGTH (FT)	SLOPE (FT/FT)	PAVED/ UNPAVED	CROSS SECTION FLOW AREA (SQ FT)	WETTED PERIMETER (FT)	MANNING'S N	TRAVEL TIME (HR)	VELOCITY (FT/S)
Sheet Flow	65	0.0154	N/A	N/A	N/A	N/A	0.1986	N/A
PIPED FLOW	FLOW LENGTH (FT)	SLOPE (FT/FT)	PIPE DIAMETER (IN)	CROSS SECTION FLOW AREA (SQ FT)	WETTED PERIMETER (FT)	MANNING'S N	TRAVEL TIME (HR)	VELOCITY (FT/S)
				0.00	0.00			
				0.00	0.00			
				0.00	0.00			

Time of Concentration: 0.1986 Hr.

11.91 Min.

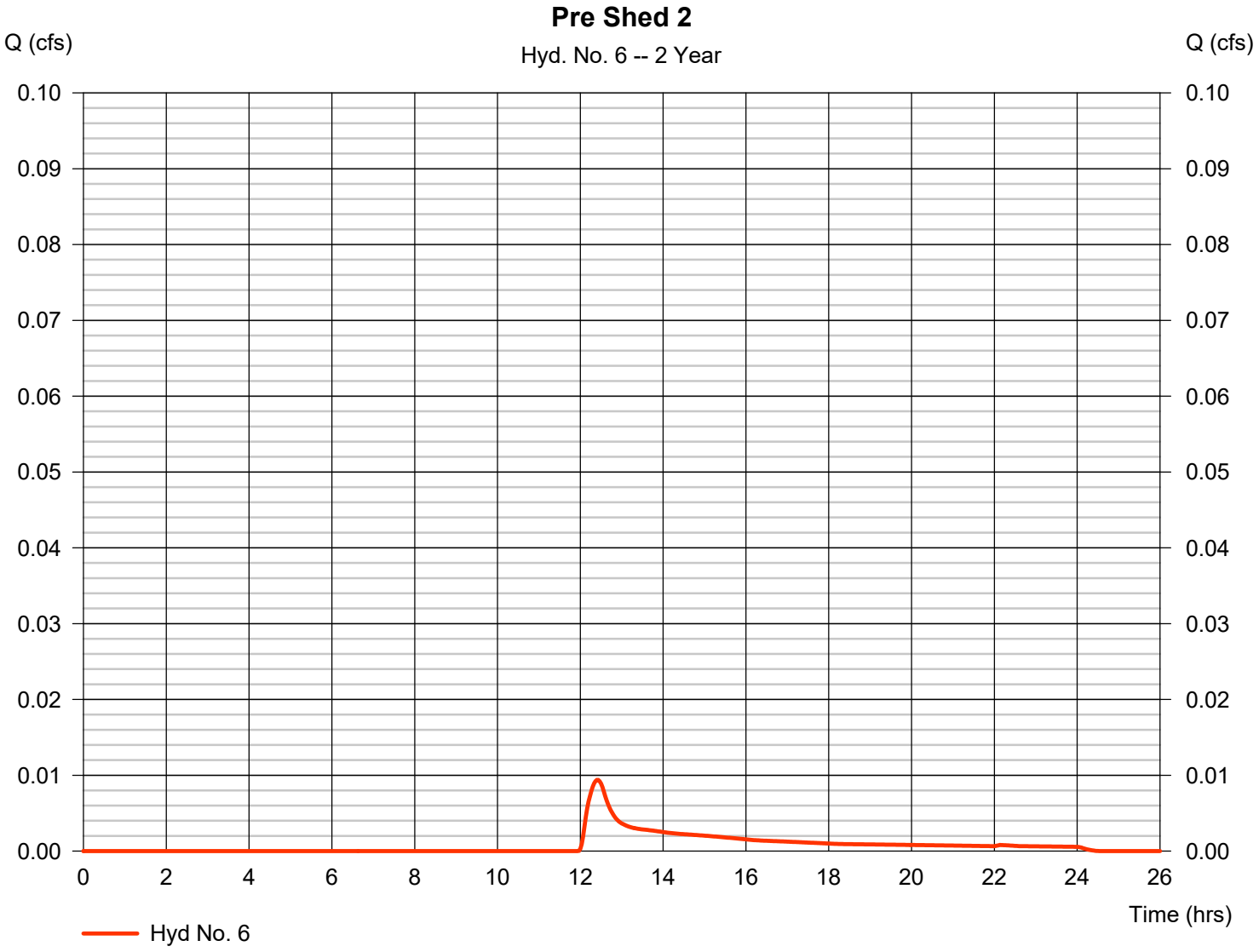
THE CROSSROADS GROUP, LLC
16590 Pottsville Pike
Hamburg, PA 19526

Hydrograph Report

Hyd. No. 6

Pre Shed 2

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.009 cfs
Storm frequency	=	2 yrs	Time to peak	=	12.43 hrs
Time interval	=	2 min	Hyd. volume	=	73 cuft
Drainage area	=	0.053 ac	Curve number	=	58
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	11.90 min
Total precip.	=	3.31 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	284

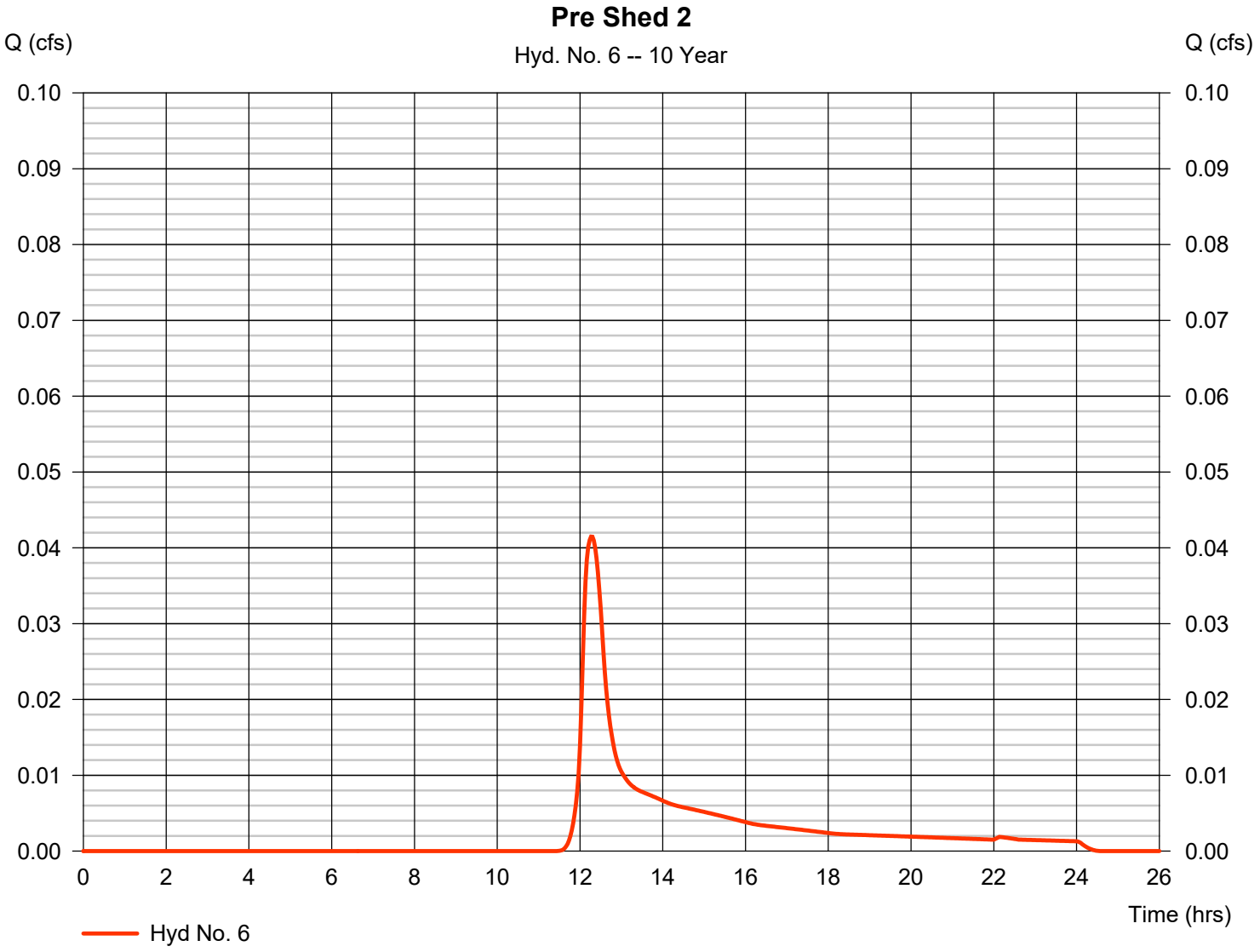


Hydrograph Report

Hyd. No. 6

Pre Shed 2

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.041 cfs
Storm frequency	=	10 yrs	Time to peak	=	12.27 hrs
Time interval	=	2 min	Hyd. volume	=	228 cuft
Drainage area	=	0.053 ac	Curve number	=	58
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	11.90 min
Total precip.	=	5.05 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	284



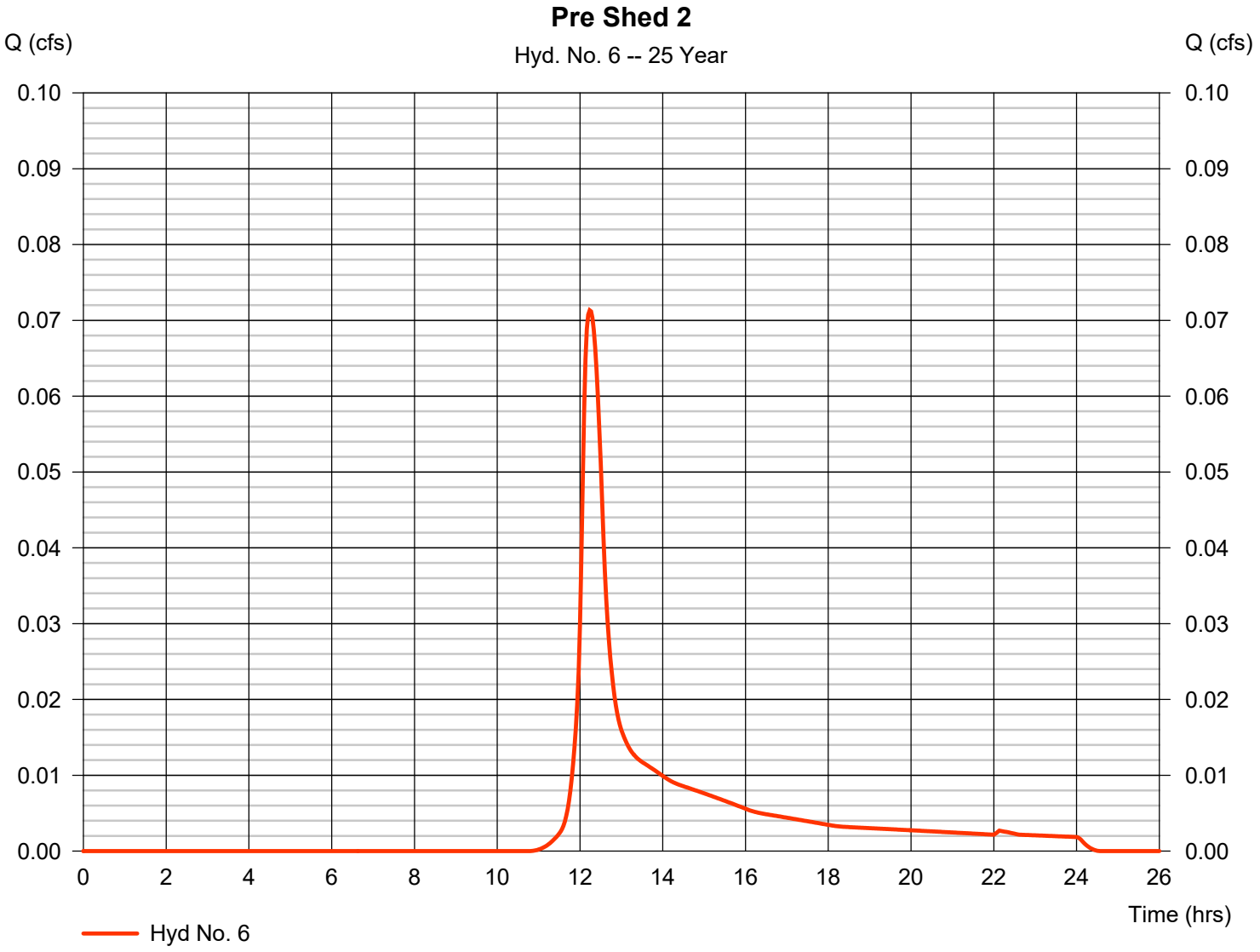
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Wednesday, 04 / 14 / 2021

Hyd. No. 6

Pre Shed 2

Hydrograph type	= SCS Runoff	Peak discharge	= 0.071 cfs
Storm frequency	= 25 yrs	Time to peak	= 12.23 hrs
Time interval	= 2 min	Hyd. volume	= 366 cuft
Drainage area	= 0.053 ac	Curve number	= 58
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 11.90 min
Total precip.	= 6.26 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 284

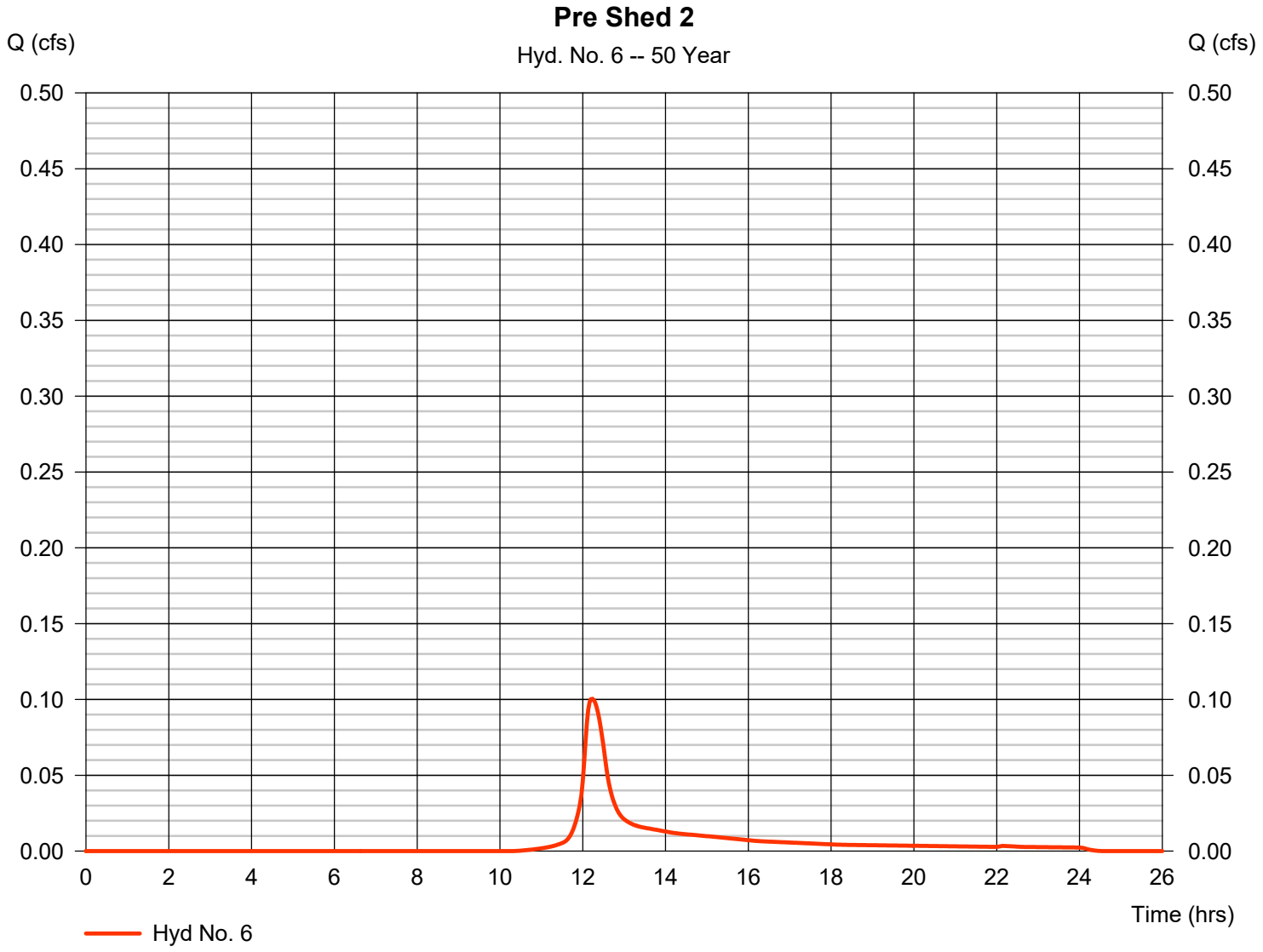


Hydrograph Report

Hyd. No. 6

Pre Shed 2

Hydrograph type	= SCS Runoff	Peak discharge	= 0.100 cfs
Storm frequency	= 50 yrs	Time to peak	= 12.23 hrs
Time interval	= 2 min	Hyd. volume	= 500 cuft
Drainage area	= 0.053 ac	Curve number	= 58
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 11.90 min
Total precip.	= 7.31 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 284

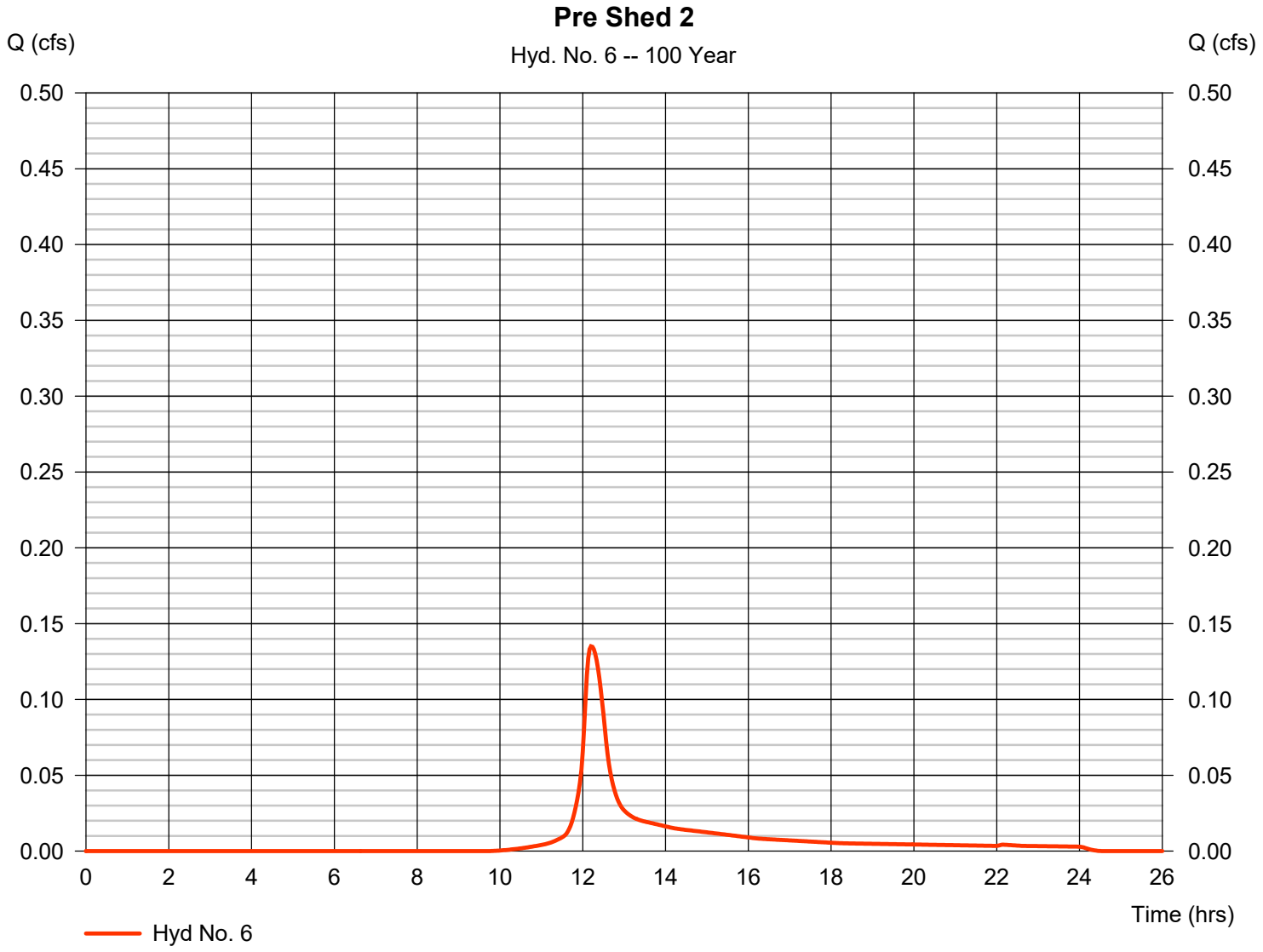


Hydrograph Report

Hyd. No. 6

Pre Shed 2

Hydrograph type	= SCS Runoff	Peak discharge	= 0.135 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.20 hrs
Time interval	= 2 min	Hyd. volume	= 659 cuft
Drainage area	= 0.053 ac	Curve number	= 58
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 11.90 min
Total precip.	= 8.47 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 284



PRE-DEVELOPMENT WATERSHED #3

PRE-DEVELOPMENT WATERSHED #3

- DRAINAGE AREAS/ WEIGHTED CN VALUES
- TIME OF CONCENTRATION CALCULATIONS
- HYDROGRAPHS (2, 10, 25, 50, & 100 yr)

PRE-DEVELOPMENT SHED COVERAGE CALCULATIONS

Project Name:	Angelo Pizza LD
Location:	Berlin Twp, Camden County
Project Number:	3824
Prepared By:	Colin Camp
Date:	April 14, 2021

Cover	CN Values			
	Soil A	Soil B	Soil C	Soil D
Impervious	98	98	98	98
Meadow	30	58	71	78
Woodland	36	60	73	79
Cultivated	75	85	90	92
Lawn	49	69	79	84

Shed ID	Pre-Shed 3			
Soil Type	Cover	Area (Ac.)	CN Value	CN*Area
A	Meadow	0.00	30	0.00
	Woodland	0.00	36	0.00
	Cultivated	0.00	75	0.00
	Lawn	0.00	49	0.00
B	Meadow	0.12	58	6.96
	Woodland	0.00	60	0.00
	Cultivated	0.00	85	0.00
	Lawn	0.00	69	0.00
C	Meadow	0.00	71	0.00
	Woodland	0.00	73	0.00
	Cultivated	0.00	90	0.00
	Lawn	0.00	79	0.00
D	Meadow	0.00	78	0.00
	Woodland	0.00	79	0.00
	Cultivated	0.00	92	0.00
	Lawn	0.00	84	0.00
IMPERVIOUS		0.00	98	0.00
			Total Area:	0.12
			Wtd CN:	58.00

TIME OF CONCENTRATION CALCULATIONS FOR PRE SHED #3

Project Name:	Angelo Pizza LD
Municipality:	Berlin Twp
County	Camden
Project Number:	3824
Prepared By:	Colin Camp
Date:	December 14, 2020

SHEET FLOW

Ground Cover:	Dense Grass	
Mannings n Value:	0.24	
2-Yr/ 24 Hr Rainfall:	2.84	in

FLOW TYPE	FLOW LENGTH (FT)	SLOPE (FT/FT)	PAVED/ UNPAVED	CROSS SECTION FLOW AREA (SQ FT)	WETTED PERIMETER (FT)	MANNING'S N	TRAVEL TIME (HR)	VELOCITY (FT/S)
Sheet Flow	63	0.0159	N/A	N/A	N/A	N/A	0.1912	N/A
PIPED FLOW	FLOW LENGTH (FT)	SLOPE (FT/FT)	PIPE DIAMETER (IN)	CROSS SECTION FLOW AREA (SQ FT)	WETTED PERIMETER (FT)	MANNING'S N	TRAVEL TIME (HR)	VELOCITY (FT/S)
				0.00	0.00			
				0.00	0.00			
				0.00	0.00			

Time of Concentration: 0.1912 Hr.

11.47 Min.

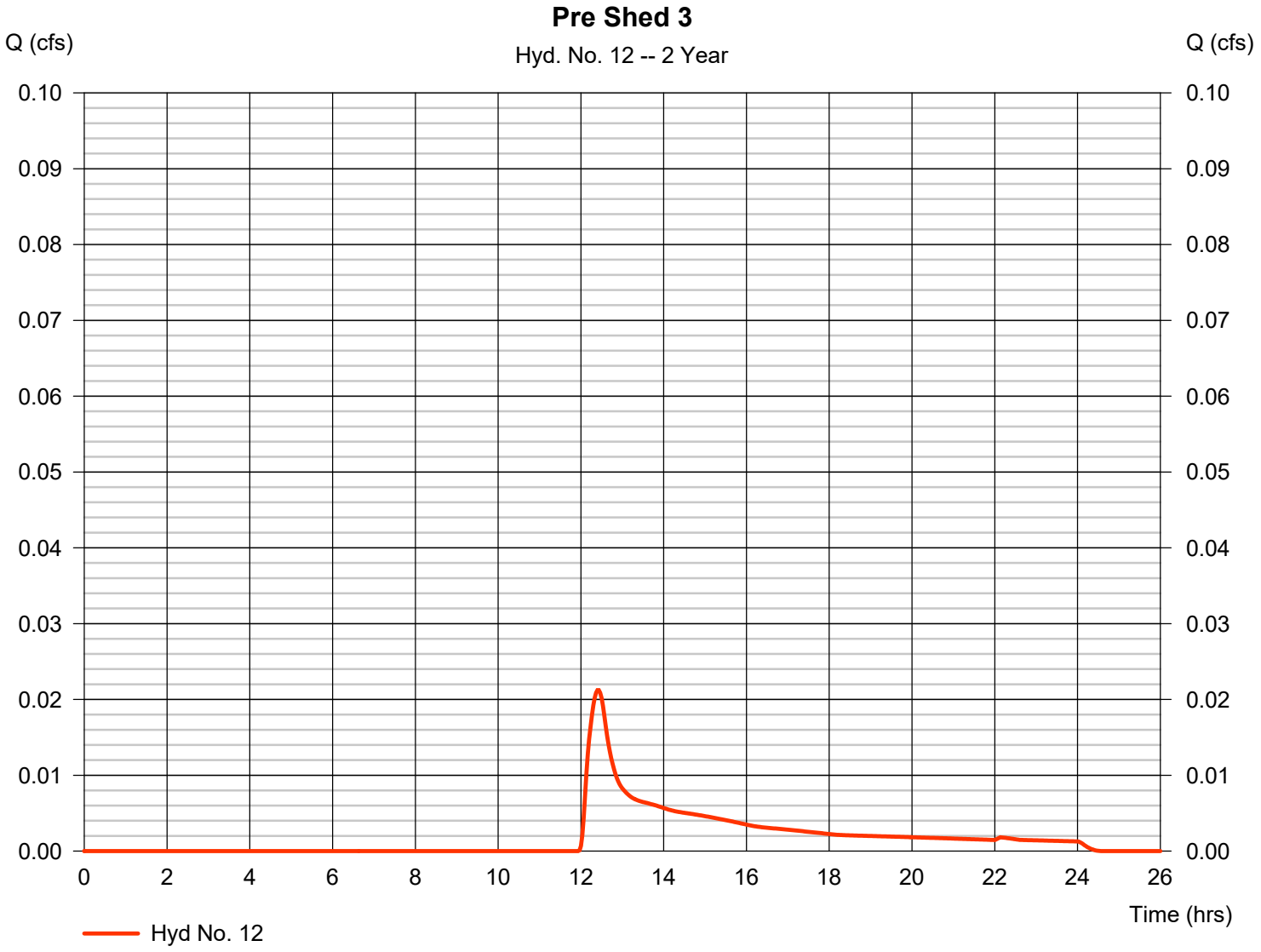
THE CROSSROADS GROUP, LLC
16590 Pottsville Pike
Hamburg, PA 19526

Hydrograph Report

Hyd. No. 12

Pre Shed 3

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.021 cfs
Storm frequency	=	2 yrs	Time to peak	=	12.43 hrs
Time interval	=	2 min	Hyd. volume	=	164 cuft
Drainage area	=	0.120 ac	Curve number	=	58
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	11.50 min
Total precip.	=	3.31 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	284



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Wednesday, 04 / 14 / 2021

Hyd. No. 12

Pre Shed 3

Hydrograph type	= SCS Runoff	Peak discharge	= 0.094 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.27 hrs
Time interval	= 2 min	Hyd. volume	= 516 cuft
Drainage area	= 0.120 ac	Curve number	= 58
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 11.50 min
Total precip.	= 5.05 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 284

Hydrograph Report

Hyd. No. 12

Pre Shed 3

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.161 cfs
Storm frequency	=	25 yrs	Time to peak	=	12.23 hrs
Time interval	=	2 min	Hyd. volume	=	829 cuft
Drainage area	=	0.120 ac	Curve number	=	58
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	11.50 min
Total precip.	=	6.26 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	284

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Wednesday, 04 / 14 / 2021

Hyd. No. 12

Pre Shed 3

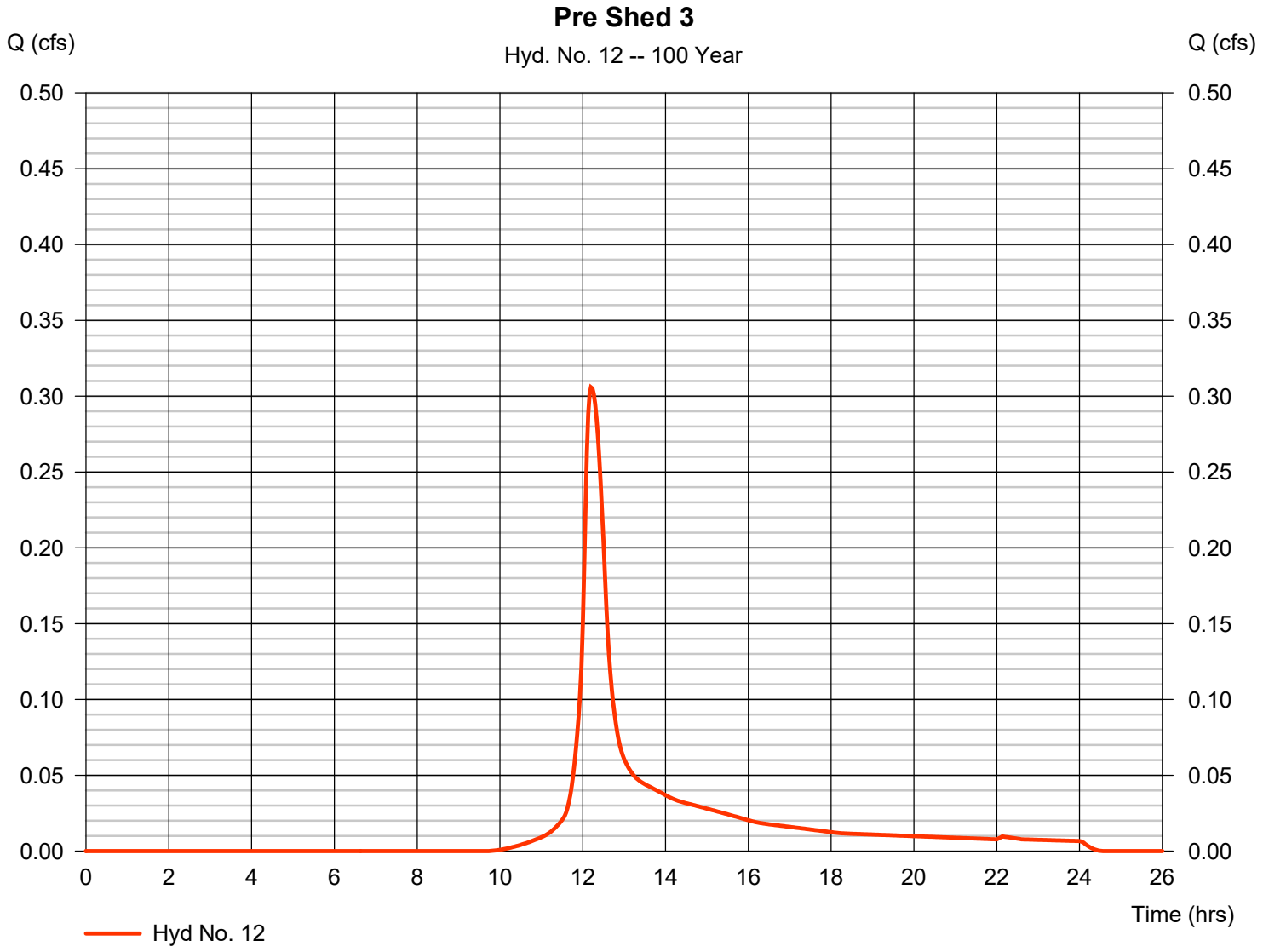
Hydrograph type	=	SCS Runoff	Peak discharge	=	0.227 cfs
Storm frequency	=	50 yrs	Time to peak	=	12.23 hrs
Time interval	=	2 min	Hyd. volume	=	1,131 cuft
Drainage area	=	0.120 ac	Curve number	=	58
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	11.50 min
Total precip.	=	7.31 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	284

Hydrograph Report

Hyd. No. 12

Pre Shed 3

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.306 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.20 hrs
Time interval	=	2 min	Hyd. volume	=	1,491 cuft
Drainage area	=	0.120 ac	Curve number	=	58
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	11.50 min
Total precip.	=	8.47 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	284



PRE-DEVELOPMENT WATERSHED #4

PRE-DEVELOPMENT WATERSHED #4

- DRAINAGE AREAS/ WEIGHTED CN VALUES
- TIME OF CONCENTRATION CALCULATIONS
- HYDROGRAPHS (2, 10, 25, 50, & 100 yr)

PRE-DEVELOPMENT SHED COVERAGE CALCULATIONS

Project Name:	Angelo Pizza LD
Location:	Berlin Twp, Camden County
Project Number:	3824
Prepared By:	Colin Camp
Date:	April 14, 2021

Cover	CN Values			
	Soil A	Soil B	Soil C	Soil D
Impervious	98	98	98	98
Meadow	30	58	71	78
Woodland	36	60	73	79
Cultivated	75	85	90	92
Lawn	49	69	79	84

Shed ID	Pre-Shed 4 (Meadow)			
Soil Type	Cover	Area (Ac.)	CN Value	CN*Area
A	Meadow	0.00	30	0.00
	Woodland	0.00	36	0.00
	Cultivated	0.00	75	0.00
	Lawn	0.00	49	0.00
B	Meadow	0.15	58	8.70
	Woodland	0.00	60	0.00
	Cultivated	0.00	85	0.00
	Lawn	0.00	69	0.00
C	Meadow	0.00	71	0.00
	Woodland	0.00	73	0.00
	Cultivated	0.00	90	0.00
	Lawn	0.00	79	0.00
D	Meadow	0.00	78	0.00
	Woodland	0.00	79	0.00
	Cultivated	0.00	92	0.00
	Lawn	0.00	84	0.00
IMPERVIOUS			98	0.00
			Total Area:	0.15
			Wtd CN:	58.00

PRE-DEVELOPMENT SHED COVERAGE CALCULATIONS

Project Name:	Angelo Pizza LD
Location:	Berlin Twp, Camden County
Project Number:	3824
Prepared By:	Colin Camp
Date:	April 14, 2021

Cover	CN Values			
	Soil A	Soil B	Soil C	Soil D
Impervious	98	98	98	98
Meadow	30	58	71	78
Woodland	36	60	73	79
Cultivated	75	85	90	92
Lawn	49	69	79	84

Shed ID	Pre-Shed 4 (Imp.)			
Soil Type	Cover	Area (Ac.)	CN Value	CN*Area
A	Meadow	0.00	30	0.00
	Woodland	0.00	36	0.00
	Cultivated	0.00	75	0.00
	Lawn	0.00	49	0.00
B	Meadow	0.00	58	0.00
	Woodland	0.00	60	0.00
	Cultivated	0.00	85	0.00
	Lawn	0.00	69	0.00
C	Meadow	0.00	71	0.00
	Woodland	0.00	73	0.00
	Cultivated	0.00	90	0.00
	Lawn	0.00	79	0.00
D	Meadow	0.00	78	0.00
	Woodland	0.00	79	0.00
	Cultivated	0.00	92	0.00
	Lawn	0.00	84	0.00
IMPERVIOUS		0.01	98	0.98
			Total Area:	0.01
			Wtd CN:	98.00

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TIME OF CONCENTRATION CALCULATIONS FOR PRE SHED #4

Project Name:	Angelo Pizza LD
Municipality:	Berlin Twp
County	Camden
Project Number:	3824
Prepared By:	Colin Camp
Date:	December 14, 2020

SHEET FLOW

Ground Cover:	Dense Grass	
Mannings n Value:	0.24	
2-Yr/ 24 Hr Rainfall:	2.84	in

FLOW TYPE	FLOW LENGTH (FT)	SLOPE (FT/FT)	PAVED/ UNPAVED	CROSS SECTION FLOW AREA (SQ FT)	WETTED PERIMETER (FT)	MANNING'S N	TRAVEL TIME (HR)	VELOCITY (FT/S)
Sheet Flow	100	0.0100	N/A	N/A	N/A	N/A	0.3331	N/A
PIPED FLOW	FLOW LENGTH (FT)	SLOPE (FT/FT)	PIPE DIAMETER (IN)	CROSS SECTION FLOW AREA (SQ FT)	WETTED PERIMETER (FT)	MANNING'S N	TRAVEL TIME (HR)	VELOCITY (FT/S)
				0.00	0.00			
				0.00	0.00			
				0.00	0.00			

Time of Concentration: 0.3331 Hr.

19.99 Min.

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Hamburg, PA 19526

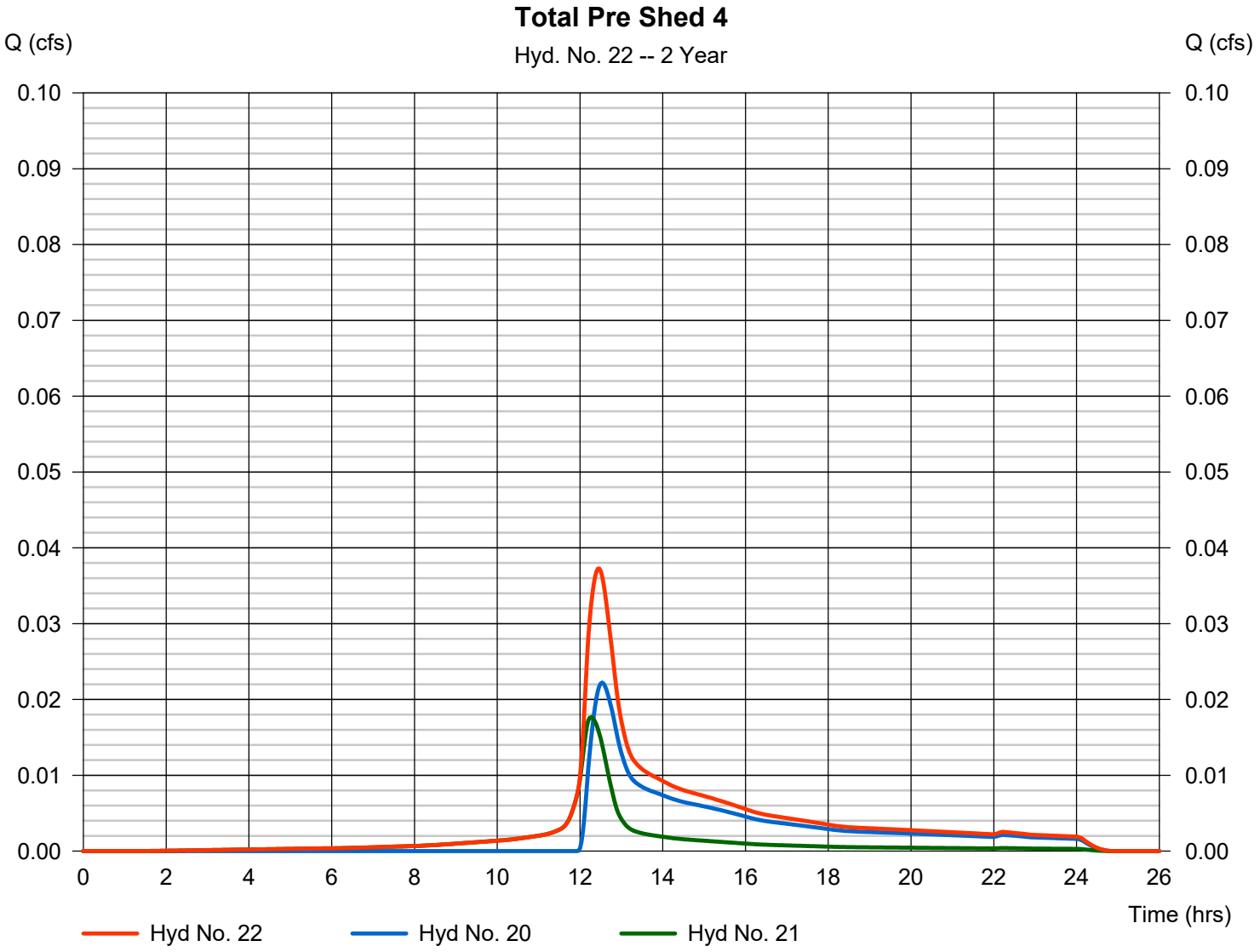
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Wednesday, 04 / 14 / 2021

Hyd. No. 22

Total Pre Shed 4

Hydrograph type	= Combine	Peak discharge	= 0.037 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.47 hrs
Time interval	= 2 min	Hyd. volume	= 316 cuft
Inflow hyds.	= 20, 21	Contrib. drain. area	= 0.160 ac

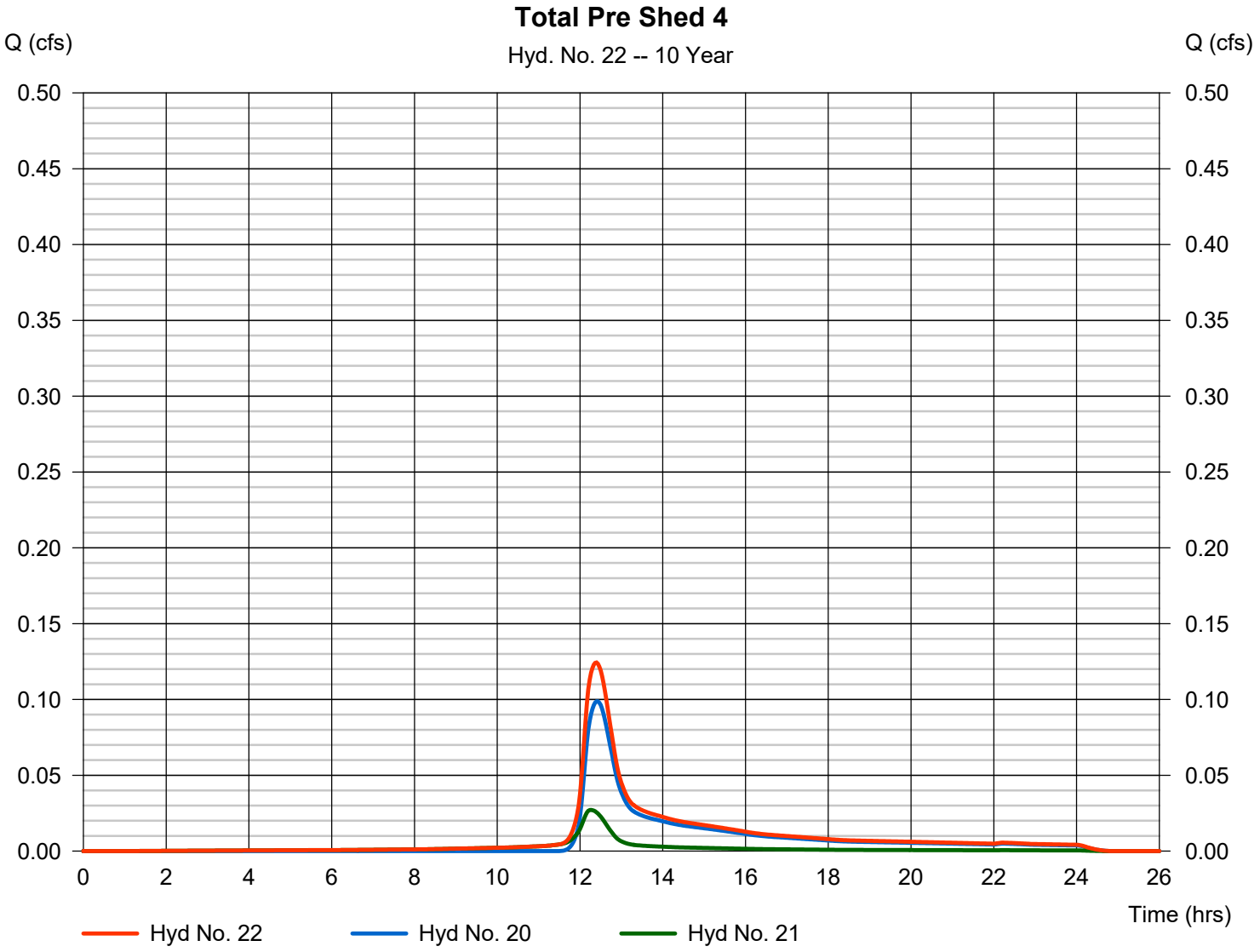


Hydrograph Report

Hyd. No. 22

Total Pre Shed 4

Hydrograph type	= Combine	Peak discharge	= 0.124 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.40 hrs
Time interval	= 2 min	Hyd. volume	= 818 cuft
Inflow hyds.	= 20, 21	Contrib. drain. area	= 0.160 ac

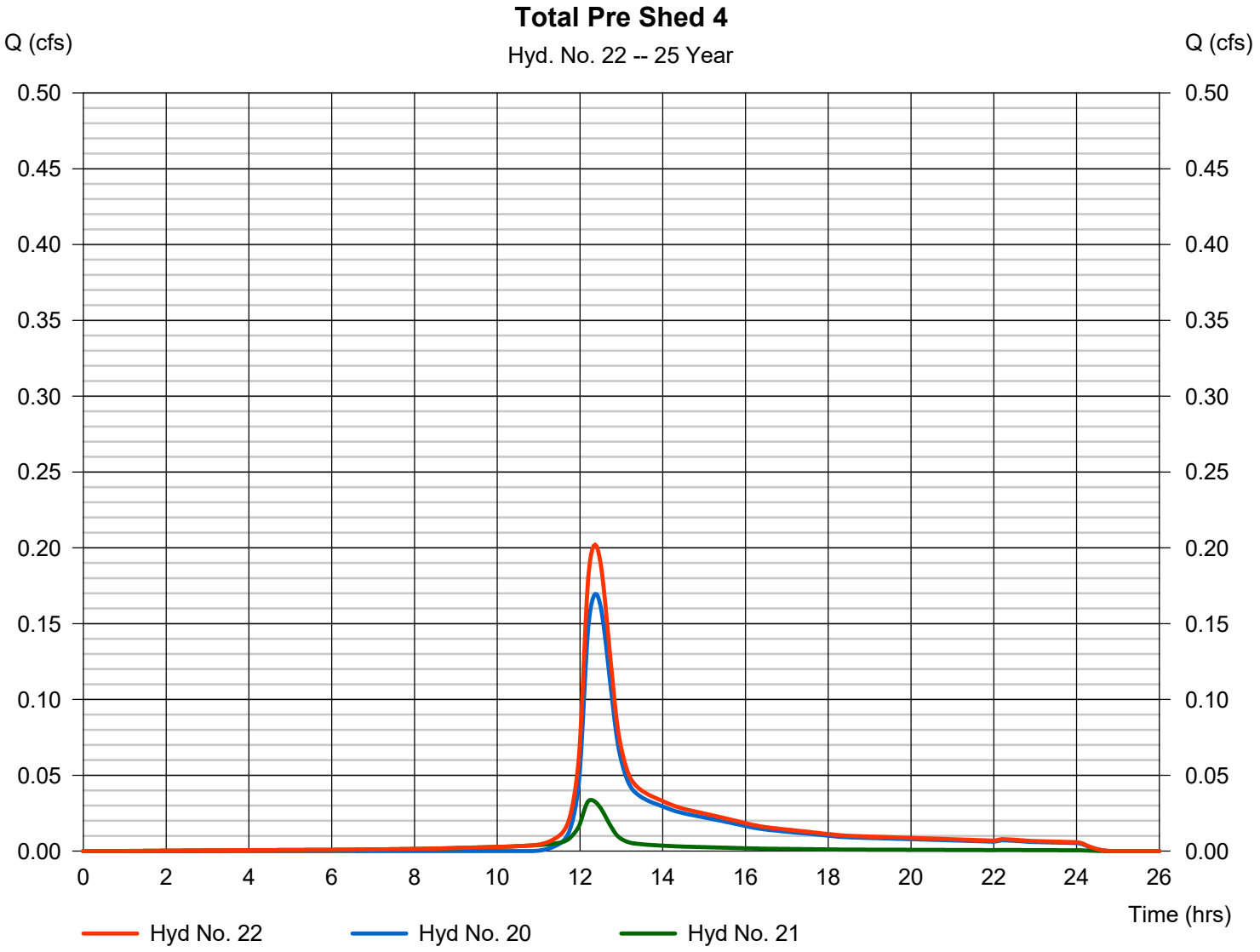


Hydrograph Report

Hyd. No. 22

Total Pre Shed 4

Hydrograph type	= Combine	Peak discharge	= 0.202 cfs
Storm frequency	= 25 yrs	Time to peak	= 12.37 hrs
Time interval	= 2 min	Hyd. volume	= 1,252 cuft
Inflow hyds.	= 20, 21	Contrib. drain. area	= 0.160 ac



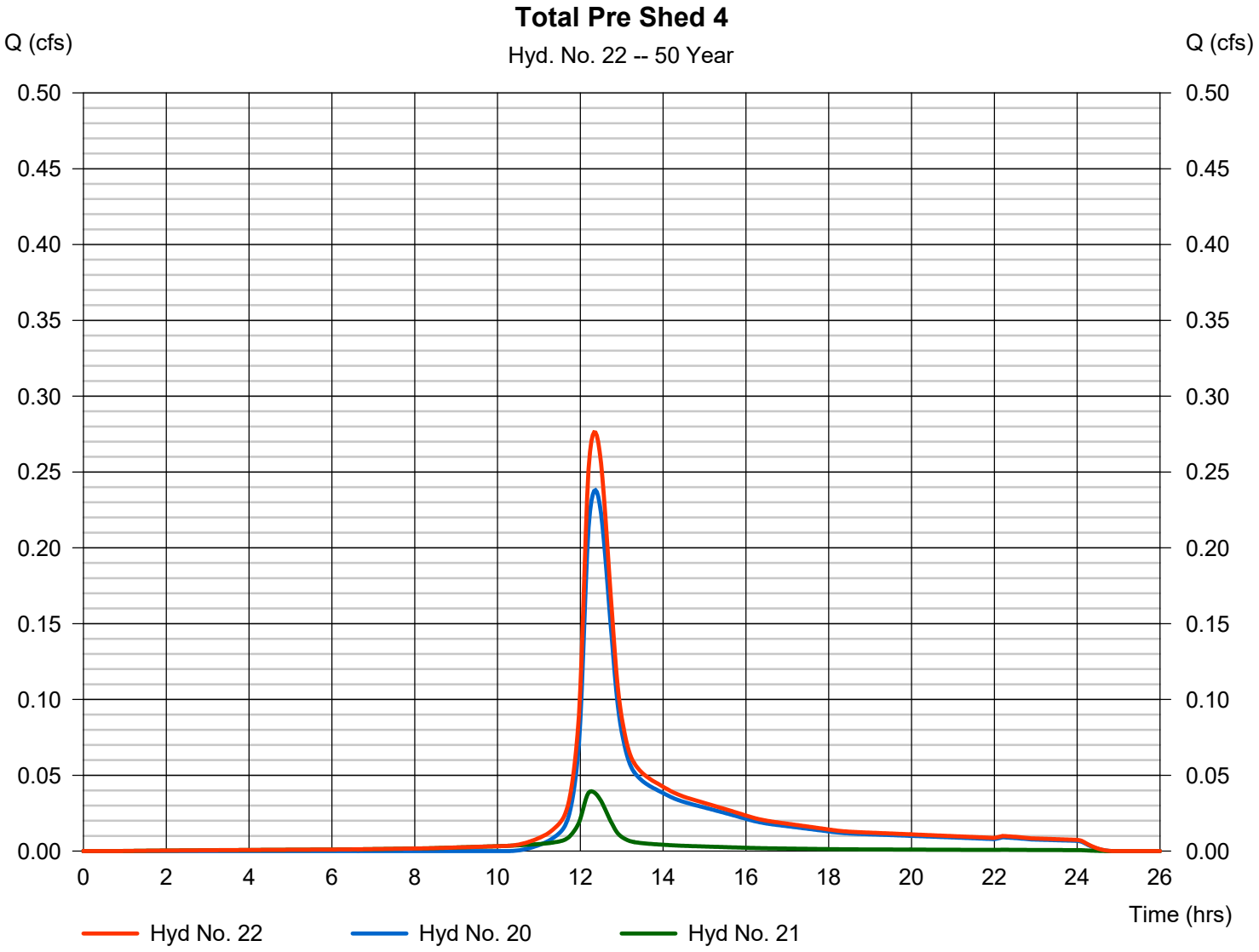
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Wednesday, 04 / 14 / 2021

Hyd. No. 22

Total Pre Shed 4

Hydrograph type	= Combine	Peak discharge	= 0.276 cfs
Storm frequency	= 50 yrs	Time to peak	= 12.33 hrs
Time interval	= 2 min	Hyd. volume	= 1,668 cuft
Inflow hyds.	= 20, 21	Contrib. drain. area	= 0.160 ac



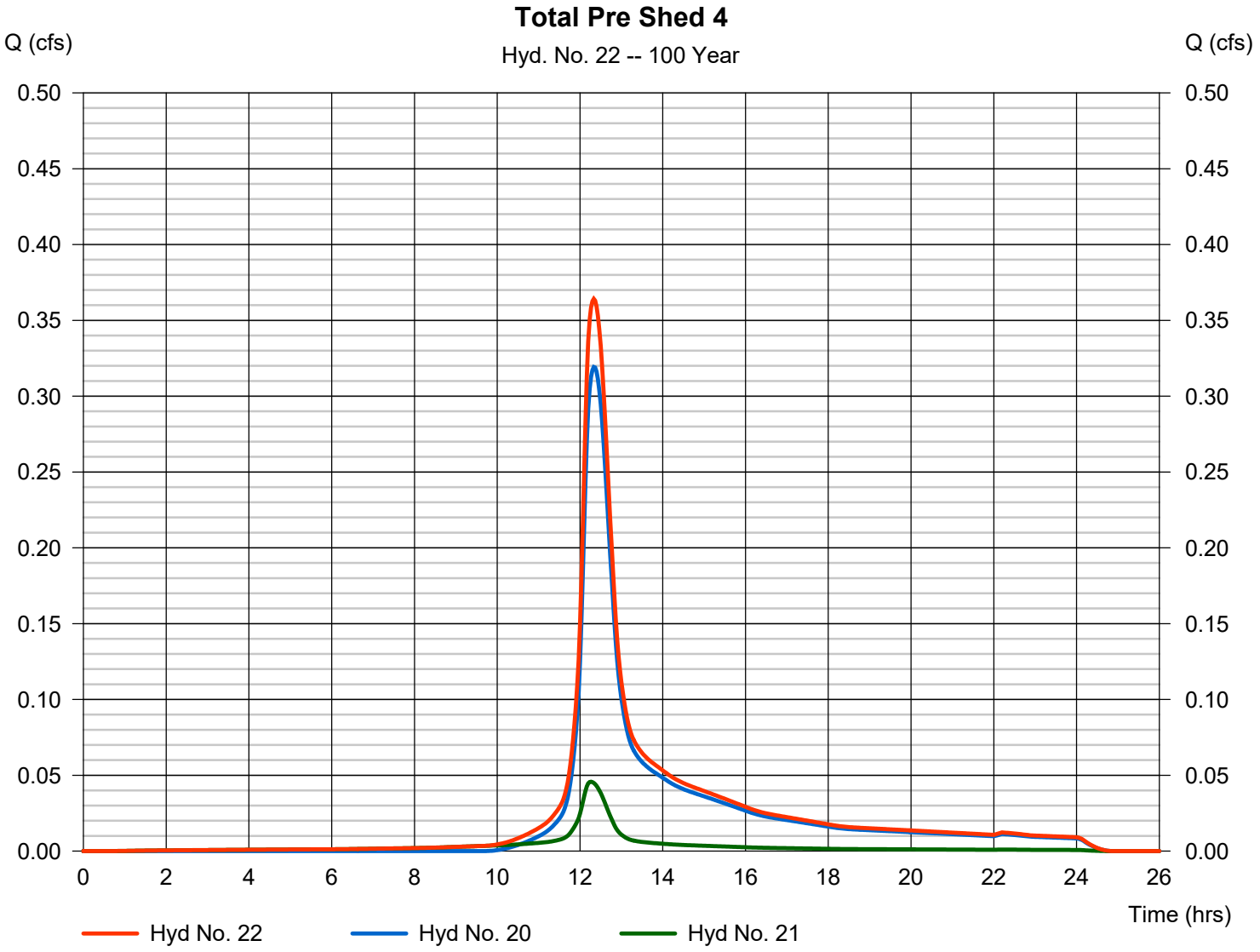
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Wednesday, 04 / 14 / 2021

Hyd. No. 22

Total Pre Shed 4

Hydrograph type	= Combine	Peak discharge	= 0.364 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.33 hrs
Time interval	= 2 min	Hyd. volume	= 2,160 cuft
Inflow hyds.	= 20, 21	Contrib. drain. area	= 0.160 ac



PRE-DEVELOPMENT WATERSHED #5

PRE-DEVELOPMENT WATERSHED #5

- DRAINAGE AREAS/ WEIGHTED CN VALUES
- TIME OF CONCENTRATION CALCULATIONS
- HYDROGRAPHS (2, 10, 25, 50, & 100 yr)

PRE-DEVELOPMENT SHED COVERAGE CALCULATIONS

Project Name:	Angelo Pizza LD
Location:	Berlin Twp, Camden County
Project Number:	3824
Prepared By:	Colin Camp
Date:	April 14, 2021

Cover	CN Values			
	Soil A	Soil B	Soil C	Soil D
Impervious	98	98	98	98
Meadow	30	58	71	78
Woodland	36	60	73	79
Cultivated	75	85	90	92
Lawn	49	69	79	84

Shed ID	Pre-Shed 5			
Soil Type	Cover	Area (Ac.)	CN Value	CN*Area
A	Meadow	0.00	30	0.00
	Woodland	0.00	36	0.00
	Cultivated	0.00	75	0.00
	Lawn	0.00	49	0.00
B	Meadow	0.07	58	4.06
	Woodland	0.00	60	0.00
	Cultivated	0.00	85	0.00
	Lawn	0.00	69	0.00
C	Meadow	0.00	71	0.00
	Woodland	0.00	73	0.00
	Cultivated	0.00	90	0.00
	Lawn	0.00	79	0.00
D	Meadow	0.00	78	0.00
	Woodland	0.00	79	0.00
	Cultivated	0.00	92	0.00
	Lawn	0.00	84	0.00
IMPERVIOUS		0.00	98	0.00
			Total Area:	0.07
			Wtd CN:	58.00

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16590 Pottsville Pike
Hamburg, PA 19526

TIME OF CONCENTRATION CALCULATIONS FOR PRE SHED #5

Project Name: Angelo Pizza LD
Municipality: Berlin Twp
County: Camden
Project Number: 3824
Prepared By: Colin Camp
Date: December 14, 2020

SHEET FLOW

Ground Cover: Dense Grass
Mannings n Value: 0.24
2-Yr/ 24 Hr Rainfall: 2.84 in

FLOW TYPE	FLOW LENGTH (FT)	SLOPE (FT/FT)	PAVED/ UNPAVED	CROSS SECTION FLOW AREA (SQ FT)	WETTED PERIMETER (FT)	MANNING'S N	TRAVEL TIME (HR)	VELOCITY (FT/S)
Sheet Flow	100	0.0200	N/A	N/A	N/A	N/A	0.2525	N/A
PIPED FLOW	FLOW LENGTH (FT)	SLOPE (FT/FT)	PIPE DIAMETER (IN)	CROSS SECTION FLOW AREA (SQ FT)	WETTED PERIMETER (FT)	MANNING'S N	TRAVEL TIME (HR)	VELOCITY (FT/S)
				0.00	0.00			
				0.00	0.00			
				0.00	0.00			

Time of Concentration: 0.2525 Hr.

15.15 Min.

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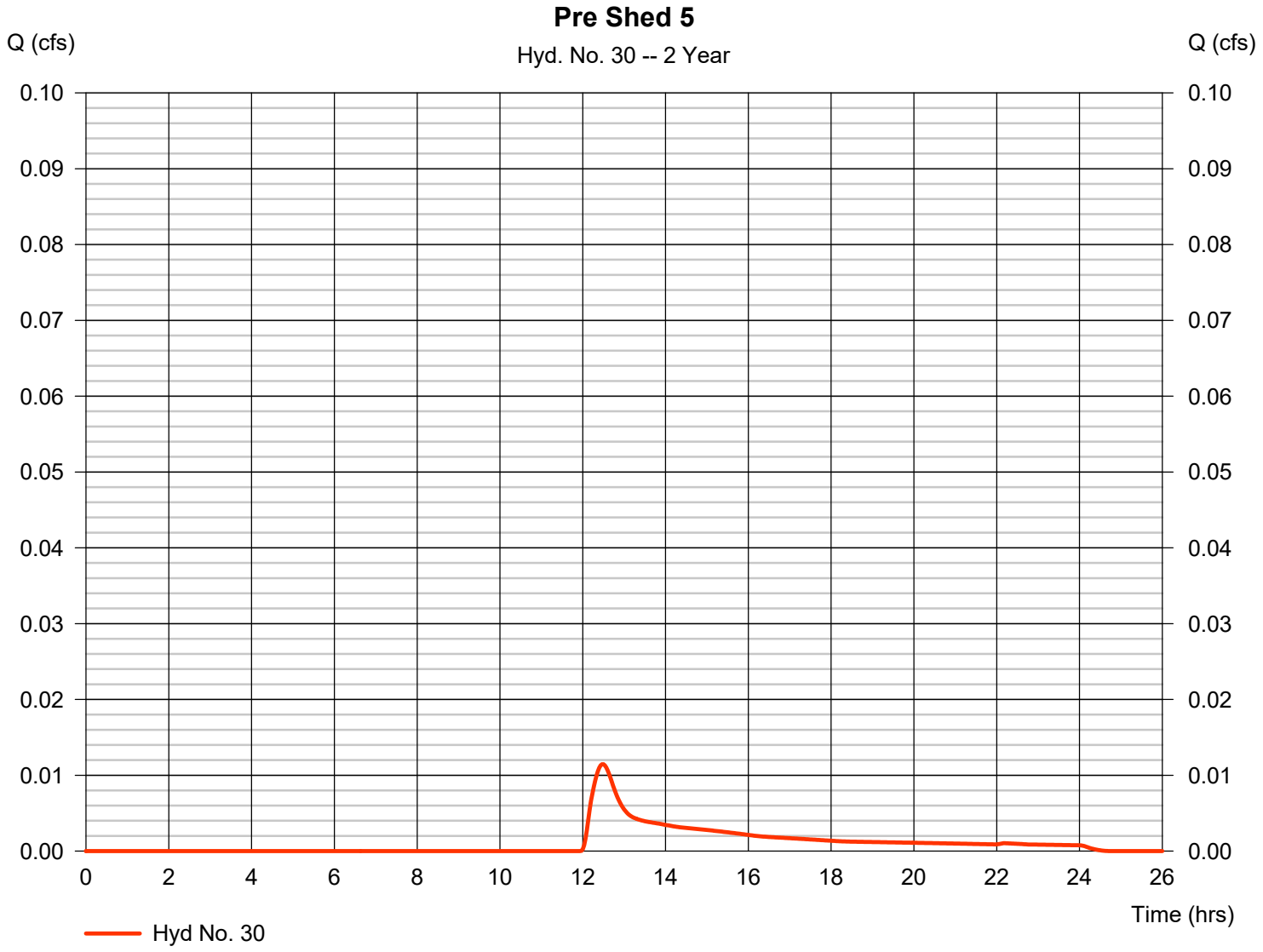
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Wednesday, 04 / 14 / 2021

Hyd. No. 30

Pre Shed 5

Hydrograph type	= SCS Runoff	Peak discharge	= 0.011 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.50 hrs
Time interval	= 2 min	Hyd. volume	= 98 cuft
Drainage area	= 0.070 ac	Curve number	= 58
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 15.10 min
Total precip.	= 3.31 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 284



Hydrograph Report

Hyd. No. 30

Pre Shed 5

Hydrograph type	= SCS Runoff	Peak discharge	= 0.051 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.37 hrs
Time interval	= 2 min	Hyd. volume	= 308 cuft
Drainage area	= 0.070 ac	Curve number	= 58
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 15.10 min
Total precip.	= 5.05 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 284

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Wednesday, 04 / 14 / 2021

Hyd. No. 30

Pre Shed 5

Hydrograph type	= SCS Runoff	Peak discharge	= 0.087 cfs
Storm frequency	= 25 yrs	Time to peak	= 12.33 hrs
Time interval	= 2 min	Hyd. volume	= 494 cuft
Drainage area	= 0.070 ac	Curve number	= 58
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 15.10 min
Total precip.	= 6.26 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 284

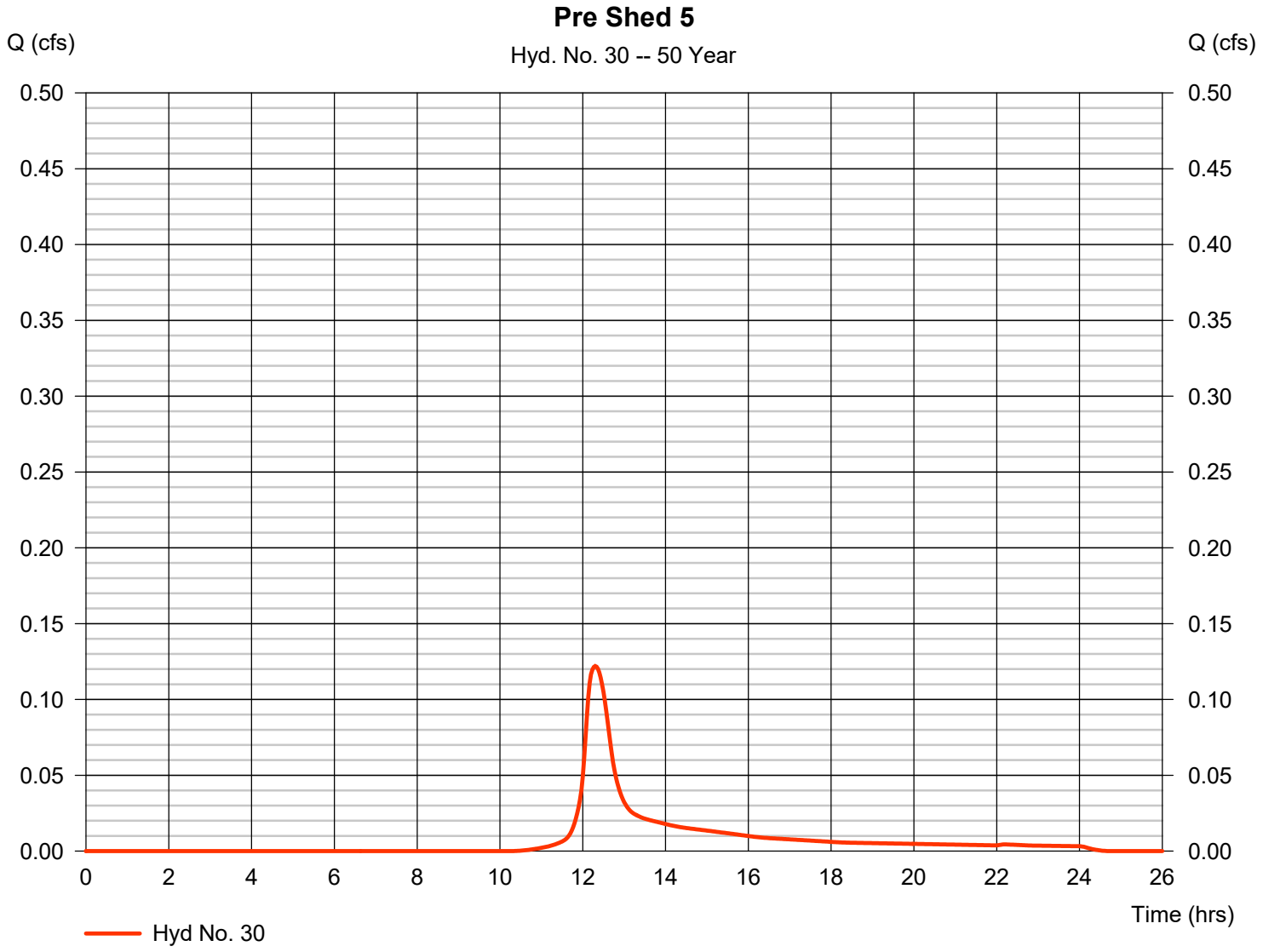
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Wednesday, 04 / 14 / 2021

Hyd. No. 30

Pre Shed 5

Hydrograph type	= SCS Runoff	Peak discharge	= 0.122 cfs
Storm frequency	= 50 yrs	Time to peak	= 12.30 hrs
Time interval	= 2 min	Hyd. volume	= 674 cuft
Drainage area	= 0.070 ac	Curve number	= 58
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 15.10 min
Total precip.	= 7.31 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 284



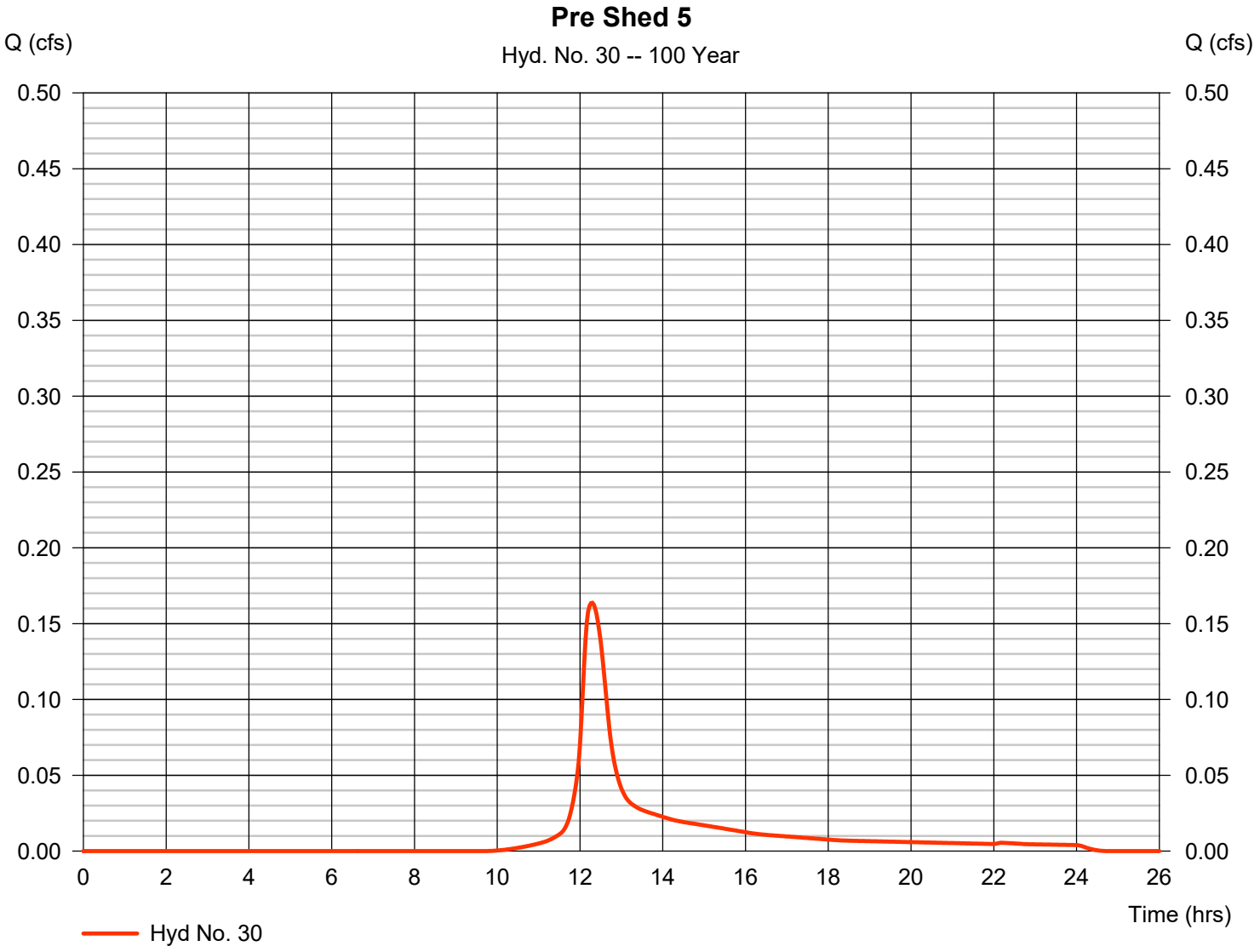
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Wednesday, 04 / 14 / 2021

Hyd. No. 30

Pre Shed 5

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.164 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.30 hrs
Time interval	=	2 min	Hyd. volume	=	889 cuft
Drainage area	=	0.070 ac	Curve number	=	58
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	15.10 min
Total precip.	=	8.47 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	284



Appendix F

WATERSHED CALCULATIONS: POST-DEVELOPMENT

POST-DEVELOPMENT WATERSHED #1

WATERSHED #1 BYPASS AREA

- DRAINAGE AREAS/ WEIGHTED CN VALUES
- HYDROGRAPHS (2, 10, 25, 50, & 100 yr)

POST-DEVELOPMENT SHED COVERAGE CALCULATIONS

Project Name:	Angelo Pizza LD
Location:	Berlin Twp, Camden County
Project Number:	3824
Prepared By:	Colin Camp
Date:	July 14, 2021

Cover	CN Values			
	Soil A	Soil B	Soil C	Soil D
Impervious	98	98	98	98
Meadow	30	58	71	78
Woodland	36	60	73	79
Cultivated	75	85	90	92
Lawn	49	69	79	84

Shed ID	Post-Shed 1 (Meadow)			
Soil Type	Cover	Area (Ac.)	CN Value	CN*Area
A	Meadow	0.00	30	0.00
	Woodland	0.00	36	0.00
	Cultivated	0.00	75	0.00
	Lawn	0.00	49	0.00
B	Meadow	0.02	58	1.27
	Woodland	0.00	60	0.00
	Cultivated	0.00	85	0.00
	Lawn	0.00	69	0.00
C	Meadow	0.00	71	0.00
	Woodland	0.00	73	0.00
	Cultivated	0.00	90	0.00
	Lawn	0.00	79	0.00
D	Meadow	0.00	78	0.00
	Woodland	0.00	79	0.00
	Cultivated	0.00	92	0.00
	Lawn	0.00	84	0.00
IMPERVIOUS		0.00	98	0.00
			Total Area:	0.02
			Wtd CN:	58.00

POST-DEVELOPMENT SHED COVERAGE CALCULATIONS

Project Name:	Angelo Pizza LD
Location:	Berlin Twp, Camden County
Project Number:	3824
Prepared By:	Colin Camp
Date:	July 14, 2021

Cover	CN Values			
	Soil A	Soil B	Soil C	Soil D
Impervious	98	98	98	98
Meadow	30	58	71	78
Woodland	36	60	73	79
Cultivated	75	85	90	92
Lawn	49	69	79	84

Shed ID	Post-Shed 1 (Imp.)			
Soil Type	Cover	Area (Ac.)	CN Value	CN*Area
A	Meadow	0.00	30	0.00
	Woodland	0.00	36	0.00
	Cultivated	0.00	75	0.00
	Lawn	0.00	49	0.00
B	Meadow	0.00	58	0.00
	Woodland	0.00	60	0.00
	Cultivated	0.00	85	0.00
	Lawn	0.00	69	0.00
C	Meadow	0.00	71	0.00
	Woodland	0.00	73	0.00
	Cultivated	0.00	90	0.00
	Lawn	0.00	79	0.00
D	Meadow	0.00	78	0.00
	Woodland	0.00	79	0.00
	Cultivated	0.00	92	0.00
	Lawn	0.00	84	0.00
IMPERVIOUS		0.0030	98	0.29
			Total Area:	0.00
			Wtd CN:	98.00

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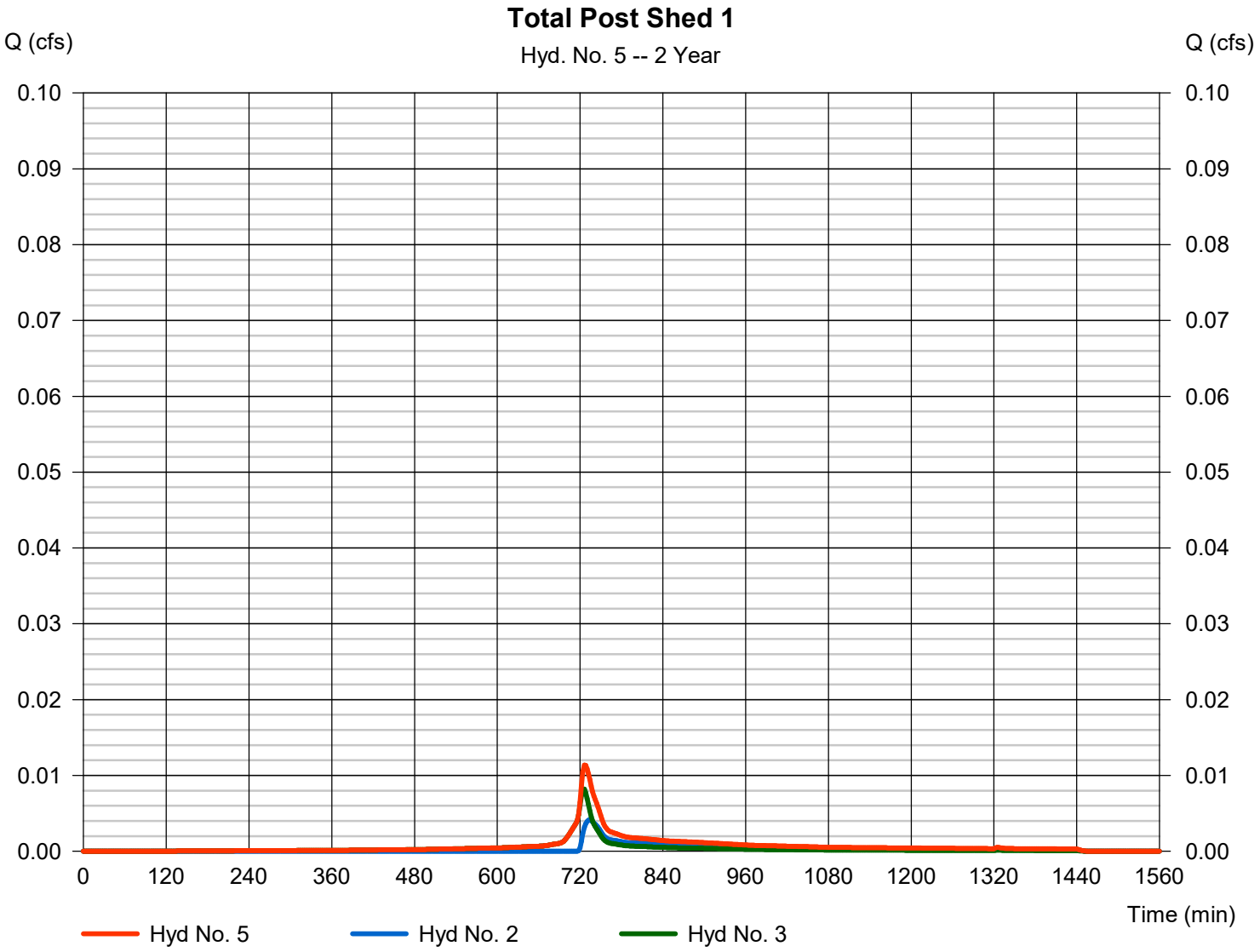
Hamburg, PA 19526

Hydrograph Report

Hyd. No. 5

Total Post Shed 1

Hydrograph type	= Combine	Peak discharge	= 0.011 cfs
Storm frequency	= 2 yrs	Time to peak	= 726 min
Time interval	= 2 min	Hyd. volume	= 61 cuft
Inflow hyds.	= 2, 3	Contrib. drain. area	= 0.023 ac



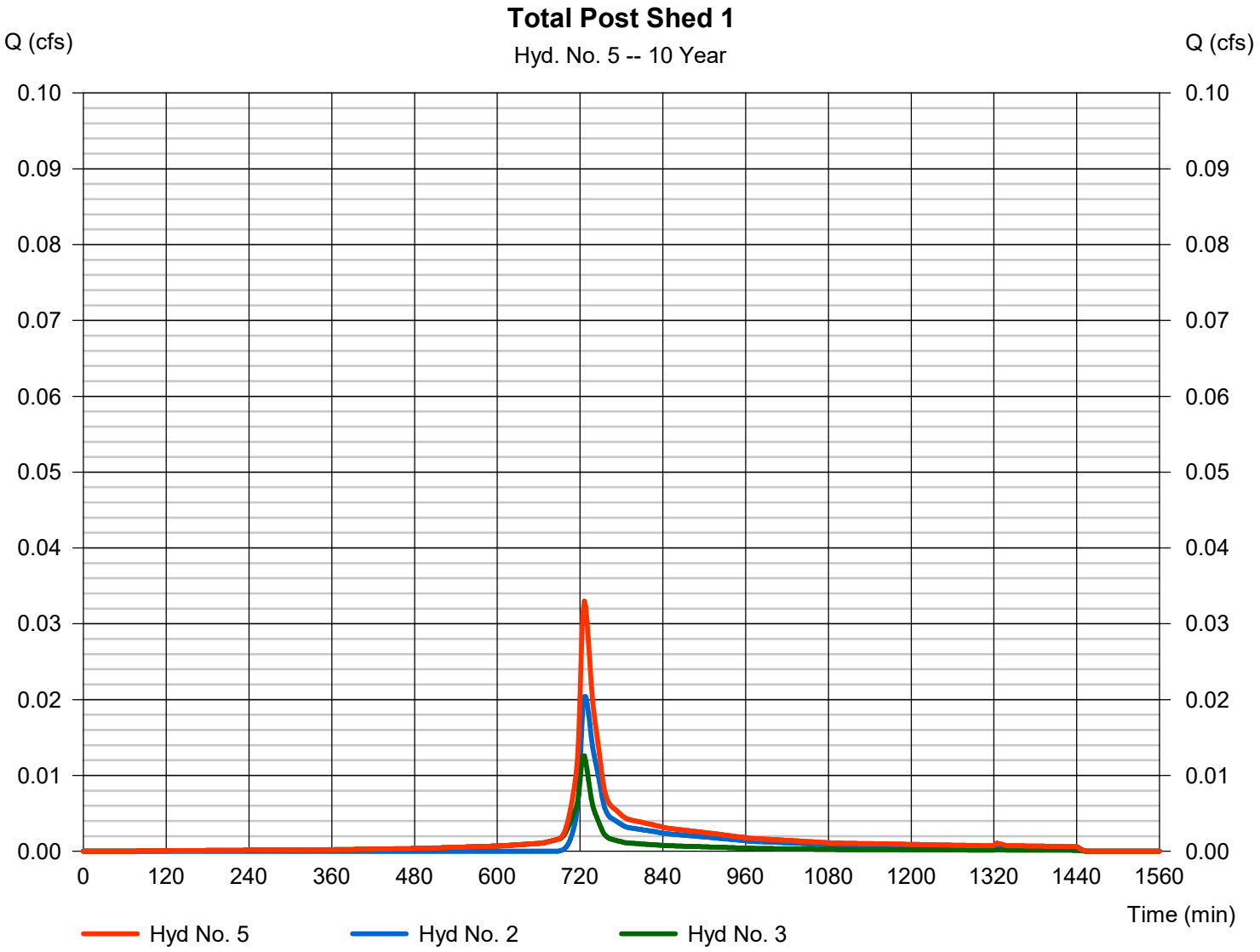
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Thursday, 07 / 15 / 2021

Hyd. No. 5

Total Post Shed 1

Hydrograph type	= Combine	Peak discharge	= 0.033 cfs
Storm frequency	= 10 yrs	Time to peak	= 726 min
Time interval	= 2 min	Hyd. volume	= 138 cuft
Inflow hyds.	= 2, 3	Contrib. drain. area	= 0.023 ac

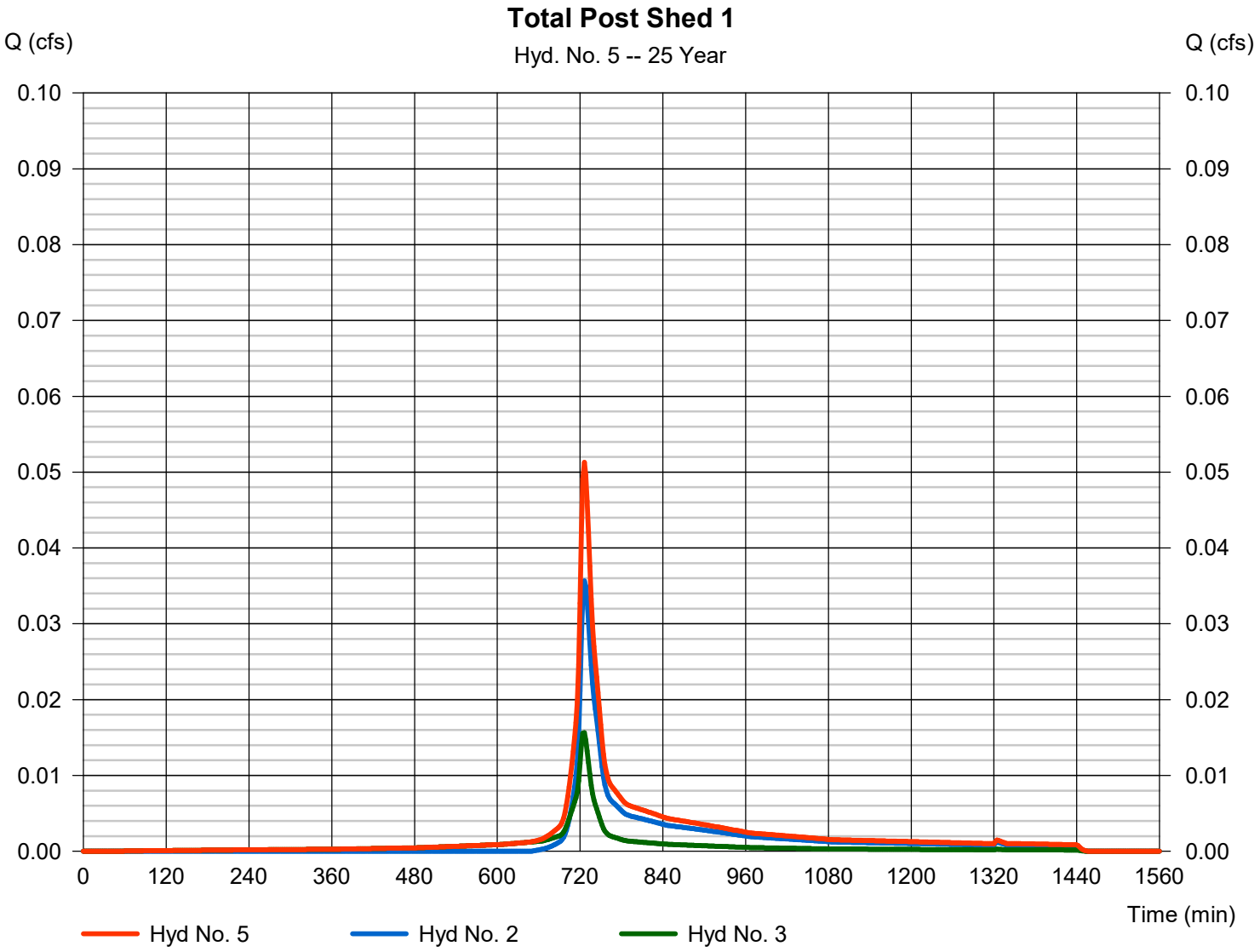


Hydrograph Report

Hyd. No. 5

Total Post Shed 1

Hydrograph type	= Combine	Peak discharge	= 0.051 cfs
Storm frequency	= 25 yrs	Time to peak	= 726 min
Time interval	= 2 min	Hyd. volume	= 203 cuft
Inflow hyds.	= 2, 3	Contrib. drain. area	= 0.023 ac



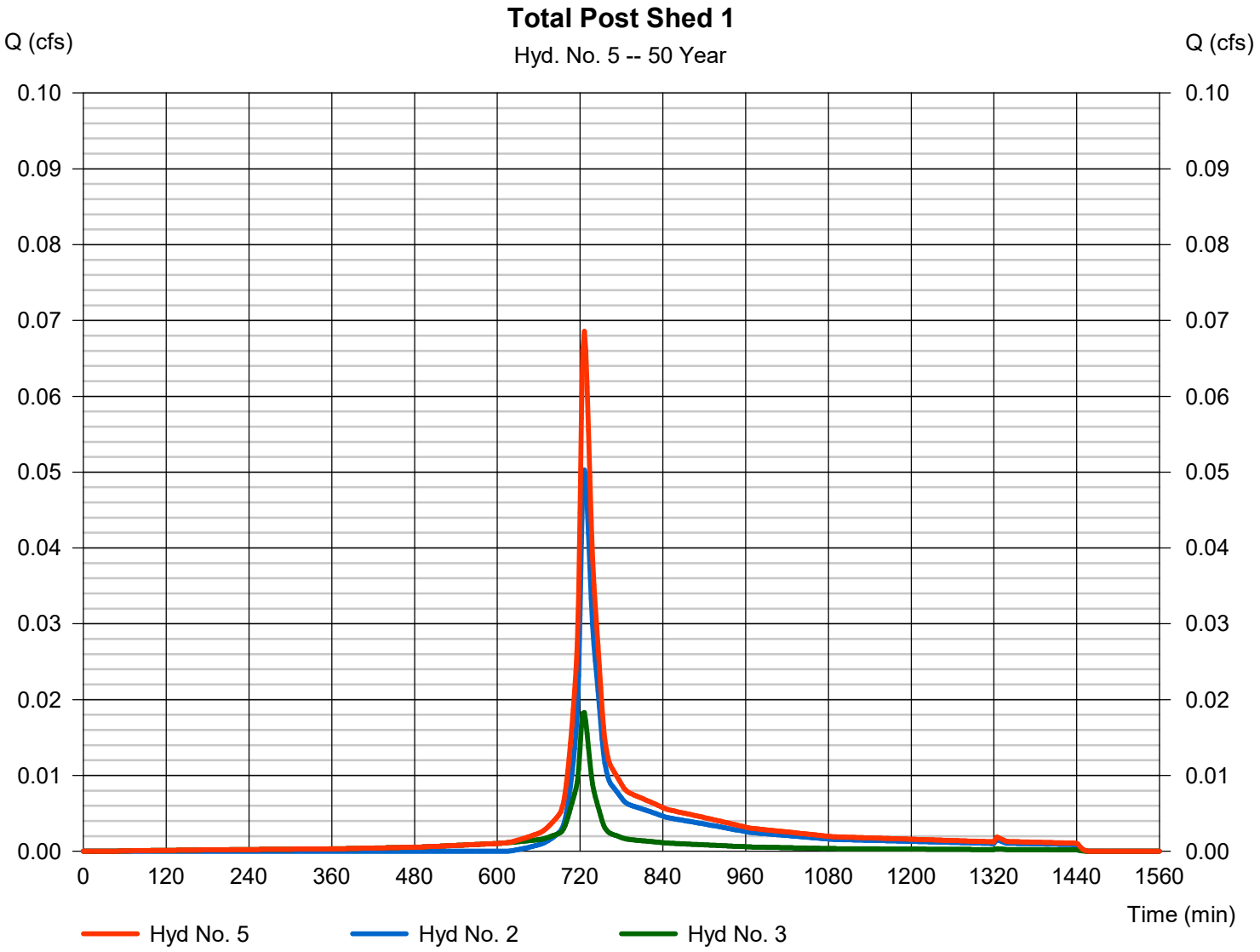
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Thursday, 07 / 15 / 2021

Hyd. No. 5

Total Post Shed 1

Hydrograph type	= Combine	Peak discharge	= 0.069 cfs
Storm frequency	= 50 yrs	Time to peak	= 726 min
Time interval	= 2 min	Hyd. volume	= 265 cuft
Inflow hyds.	= 2, 3	Contrib. drain. area	= 0.023 ac



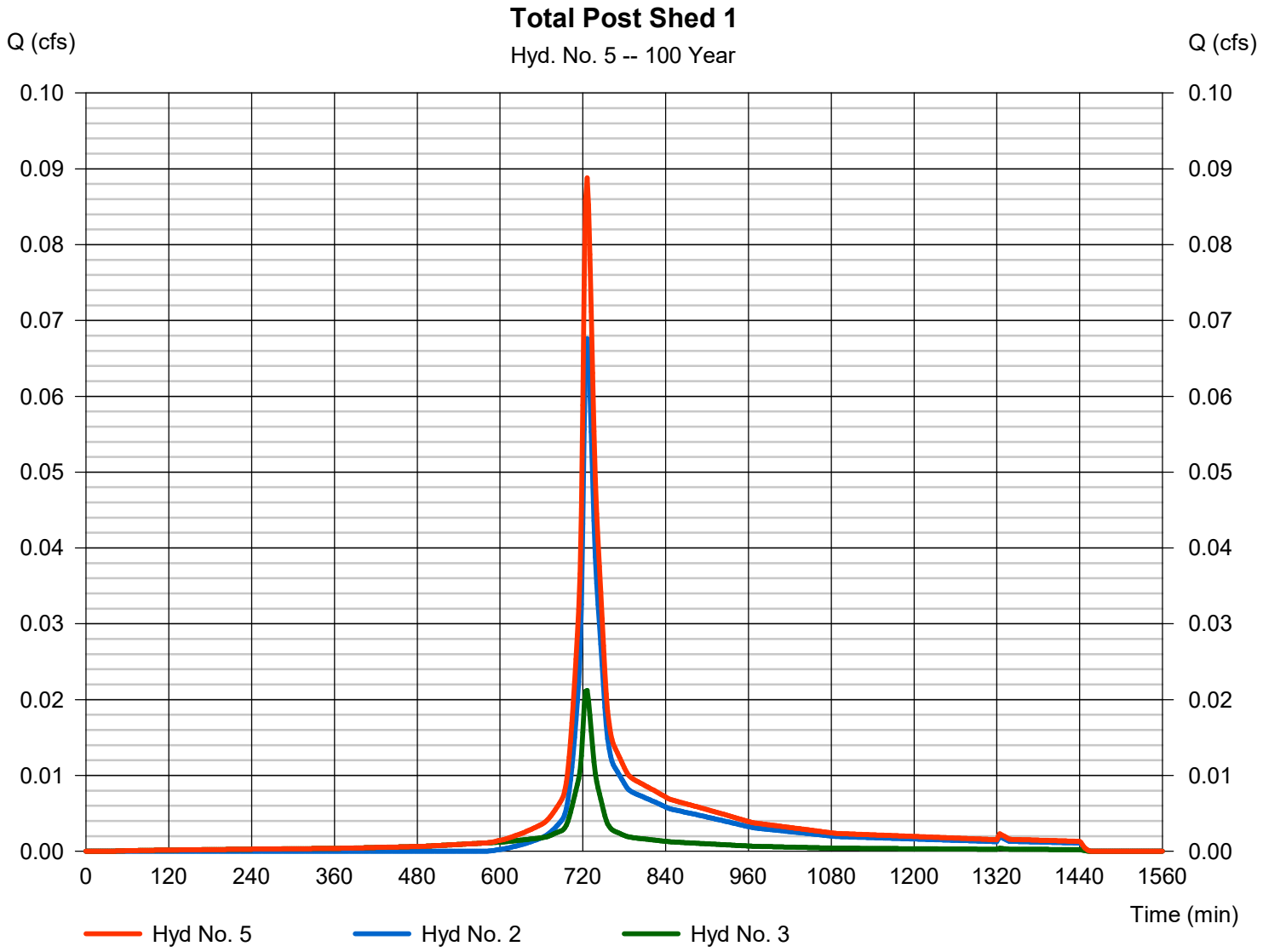
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Thursday, 07 / 15 / 2021

Hyd. No. 5

Total Post Shed 1

Hydrograph type	= Combine	Peak discharge	= 0.089 cfs
Storm frequency	= 100 yrs	Time to peak	= 726 min
Time interval	= 2 min	Hyd. volume	= 337 cuft
Inflow hyds.	= 2, 3	Contrib. drain. area	= 0.023 ac



POST-DEVELOPMENT WATERSHED #2

TRENCH A WATERSHED AREA

- DRAINAGE AREAS/ WEIGHTED CN VALUES
- TRENCH A INFLOW HYDROGRAPHS (2, 10, 25, 50 & 100 yr)
- TRENCH A STAGE/ STORAGE CALCULATIONS
- TRENCH A ROUTING HYDROGRAPHS (2, 10, 25, 50 & 100 yr)
- MOUNDING ANALYSIS

POST-DEVELOPMENT SHED COVERAGE CALCULATIONS

Project Name:	Angelo Pizza LD
Location:	Berlin Twp, Camden County
Project Number:	3824
Prepared By:	Colin Camp
Date:	July 14, 2021

Cover	CN Values			
	Soil A	Soil B	Soil C	Soil D
Impervious	98	98	98	98
Meadow	30	58	71	78
Woodland	36	60	73	79
Cultivated	75	85	90	92
Lawn	49	69	79	84

Shed ID	Post-Shed 2 (Trench A) (Lawn)			
Soil Type	Cover	Area (Ac.)	CN Value	CN*Area
A	Meadow	0.00	30	0.00
	Woodland	0.00	36	0.00
	Cultivated	0.00	75	0.00
	Lawn	0.00	49	0.00
B	Meadow	0.00	58	0.00
	Woodland	0.00	60	0.00
	Cultivated	0.00	85	0.00
	Lawn	0.02	69	1.38
C	Meadow	0.00	71	0.00
	Woodland	0.00	73	0.00
	Cultivated	0.00	90	0.00
	Lawn	0.00	79	0.00
D	Meadow	0.00	78	0.00
	Woodland	0.00	79	0.00
	Cultivated	0.00	92	0.00
	Lawn	0.00	84	0.00
IMPERVIOUS		0.00	98	0.00
			Total Area:	0.02
			Wtd CN:	69.00

POST-DEVELOPMENT SHED COVERAGE CALCULATIONS

Project Name:	Angelo Pizza LD
Location:	Berlin Twp, Camden County
Project Number:	3824
Prepared By:	Colin Camp
Date:	July 14, 2021

Cover	CN Values			
	Soil A	Soil B	Soil C	Soil D
Impervious	98	98	98	98
Meadow	30	58	71	78
Woodland	36	60	73	79
Cultivated	75	85	90	92
Lawn	49	69	79	84

Shed ID	Post-Shed 2 (Trench A) (Imp.)			
Soil Type	Cover	Area (Ac.)	CN Value	CN*Area
A	Meadow	0.00	30	0.00
	Woodland	0.00	36	0.00
	Cultivated	0.00	75	0.00
	Lawn	0.00	49	0.00
B	Meadow	0.00	58	0.00
	Woodland	0.00	60	0.00
	Cultivated	0.00	85	0.00
	Lawn	0.00	69	0.00
C	Meadow	0.00	71	0.00
	Woodland	0.00	73	0.00
	Cultivated	0.00	90	0.00
	Lawn	0.00	79	0.00
D	Meadow	0.00	78	0.00
	Woodland	0.00	79	0.00
	Cultivated	0.00	92	0.00
	Lawn	0.00	84	0.00
IMPERVIOUS		0.0040	98	0.39
			Total Area:	0.00
			Wtd CN:	98.00

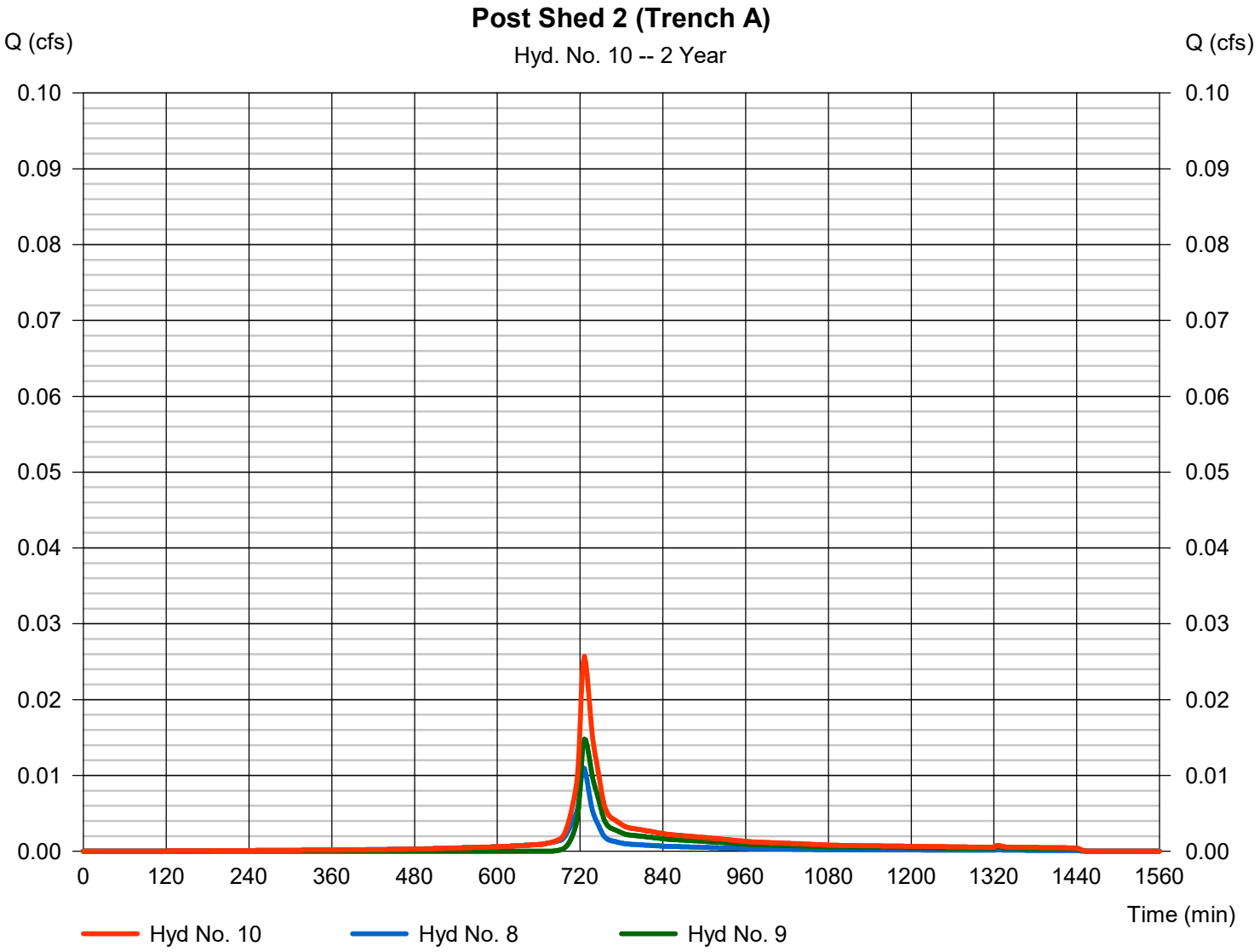
THE CROSSROADS GROUP, LLC
16590 Pottsville Pike
Hamburg, PA 19526

Hydrograph Report

Hyd. No. 10

Post Shed 2 (Trench A)

Hydrograph type	= Combine	Peak discharge	= 0.026 cfs
Storm frequency	= 2 yrs	Time to peak	= 726 min
Time interval	= 2 min	Hyd. volume	= 105 cuft
Inflow hyds.	= 8, 9	Contrib. drain. area	= 0.024 ac

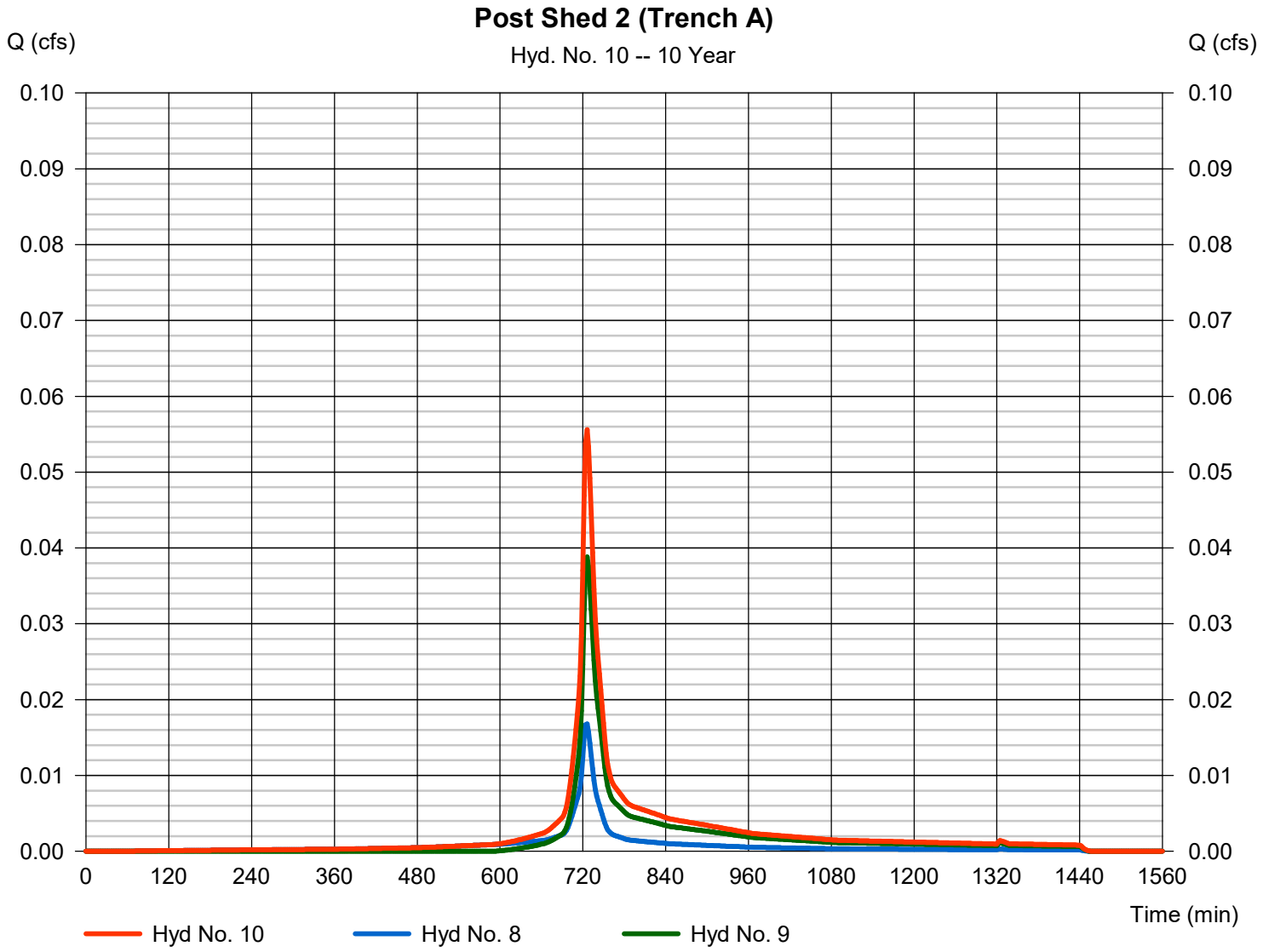


Hydrograph Report

Hyd. No. 10

Post Shed 2 (Trench A)

Hydrograph type	= Combine	Peak discharge	= 0.056 cfs
Storm frequency	= 10 yrs	Time to peak	= 726 min
Time interval	= 2 min	Hyd. volume	= 213 cuft
Inflow hyds.	= 8, 9	Contrib. drain. area	= 0.024 ac

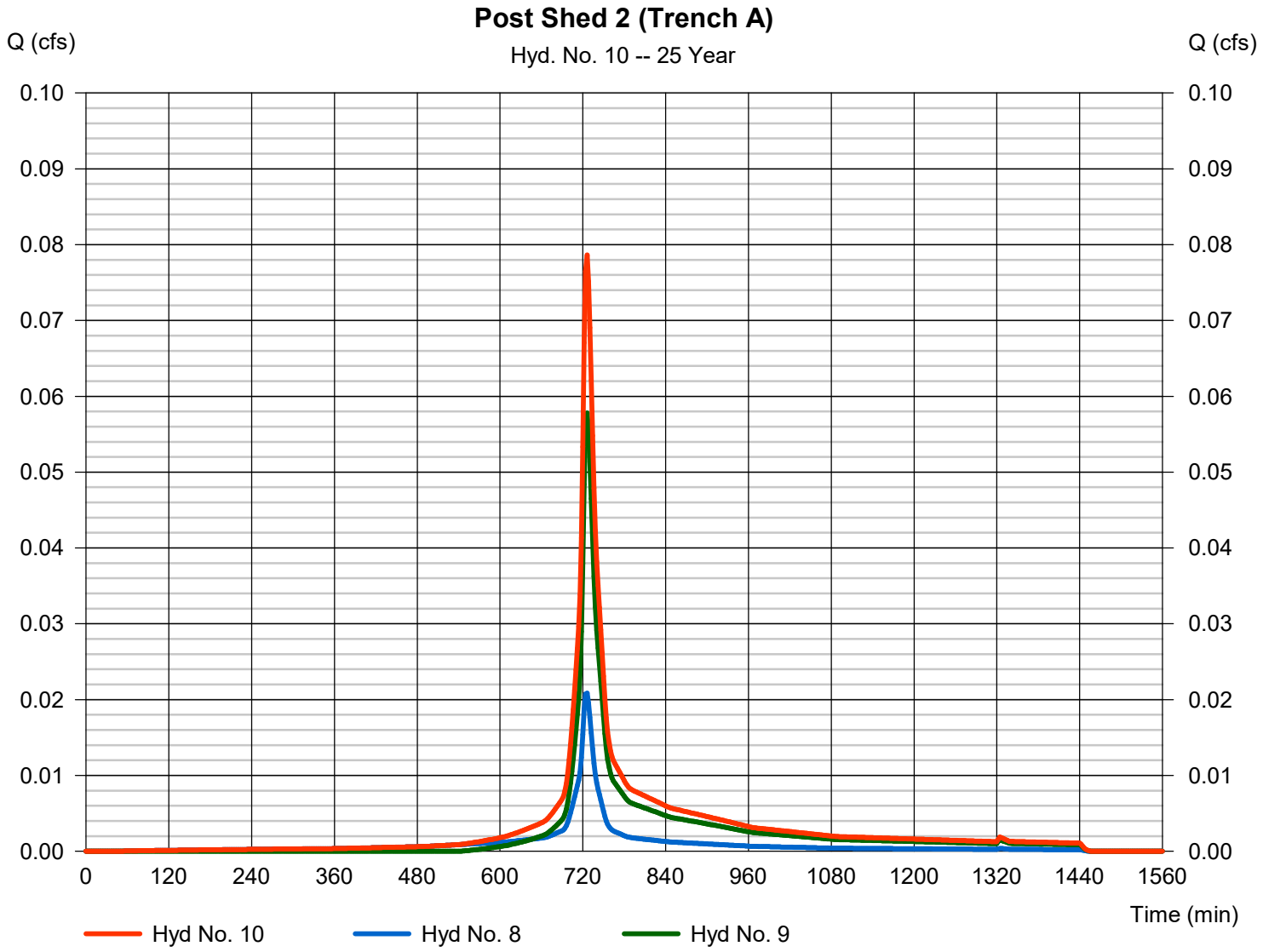


Hydrograph Report

Hyd. No. 10

Post Shed 2 (Trench A)

Hydrograph type	= Combine	Peak discharge	= 0.079 cfs
Storm frequency	= 25 yrs	Time to peak	= 726 min
Time interval	= 2 min	Hyd. volume	= 296 cuft
Inflow hyds.	= 8, 9	Contrib. drain. area	= 0.024 ac

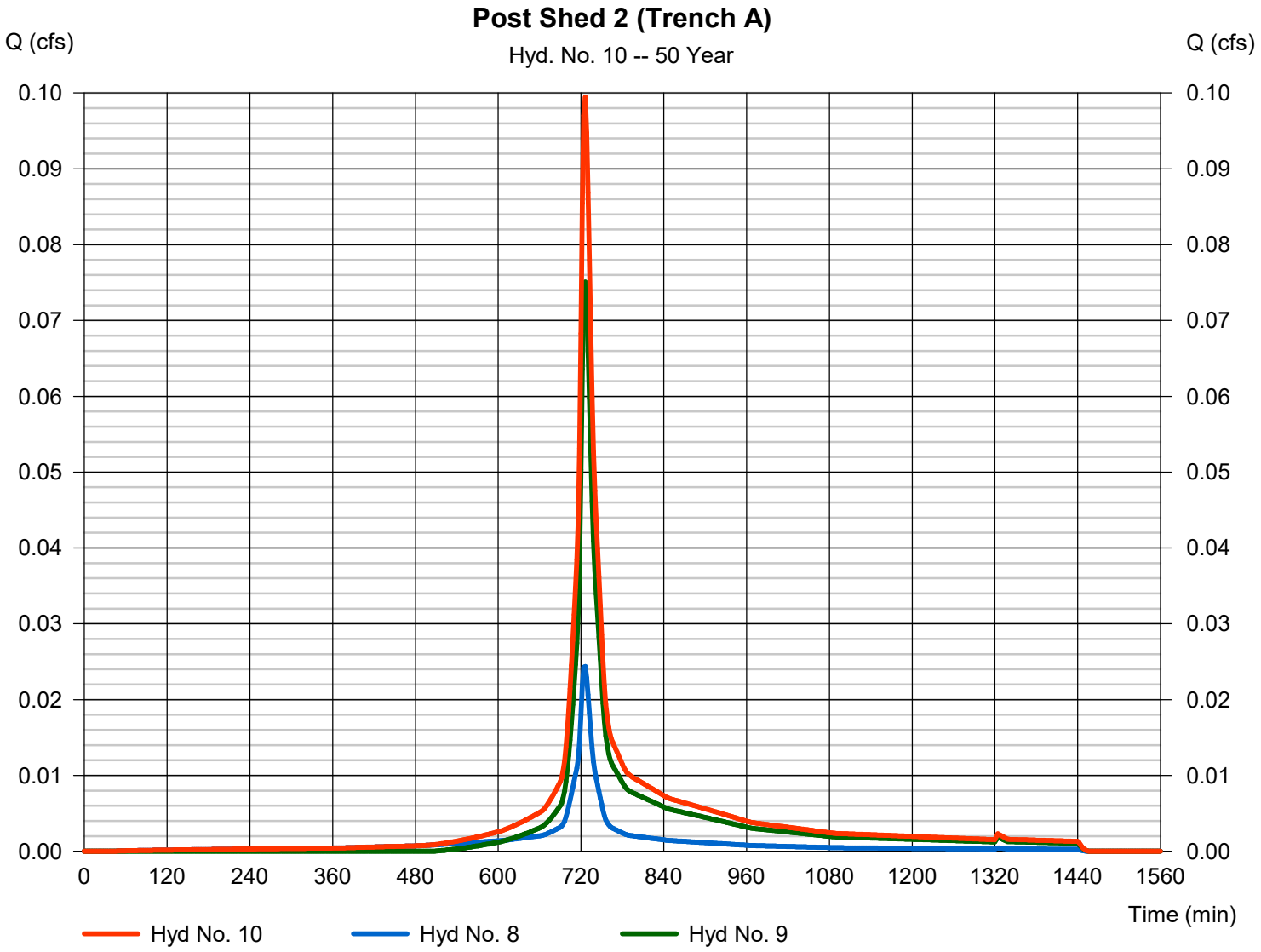


Hydrograph Report

Hyd. No. 10

Post Shed 2 (Trench A)

Hydrograph type	= Combine	Peak discharge	= 0.099 cfs
Storm frequency	= 50 yrs	Time to peak	= 726 min
Time interval	= 2 min	Hyd. volume	= 373 cuft
Inflow hyds.	= 8, 9	Contrib. drain. area	= 0.024 ac



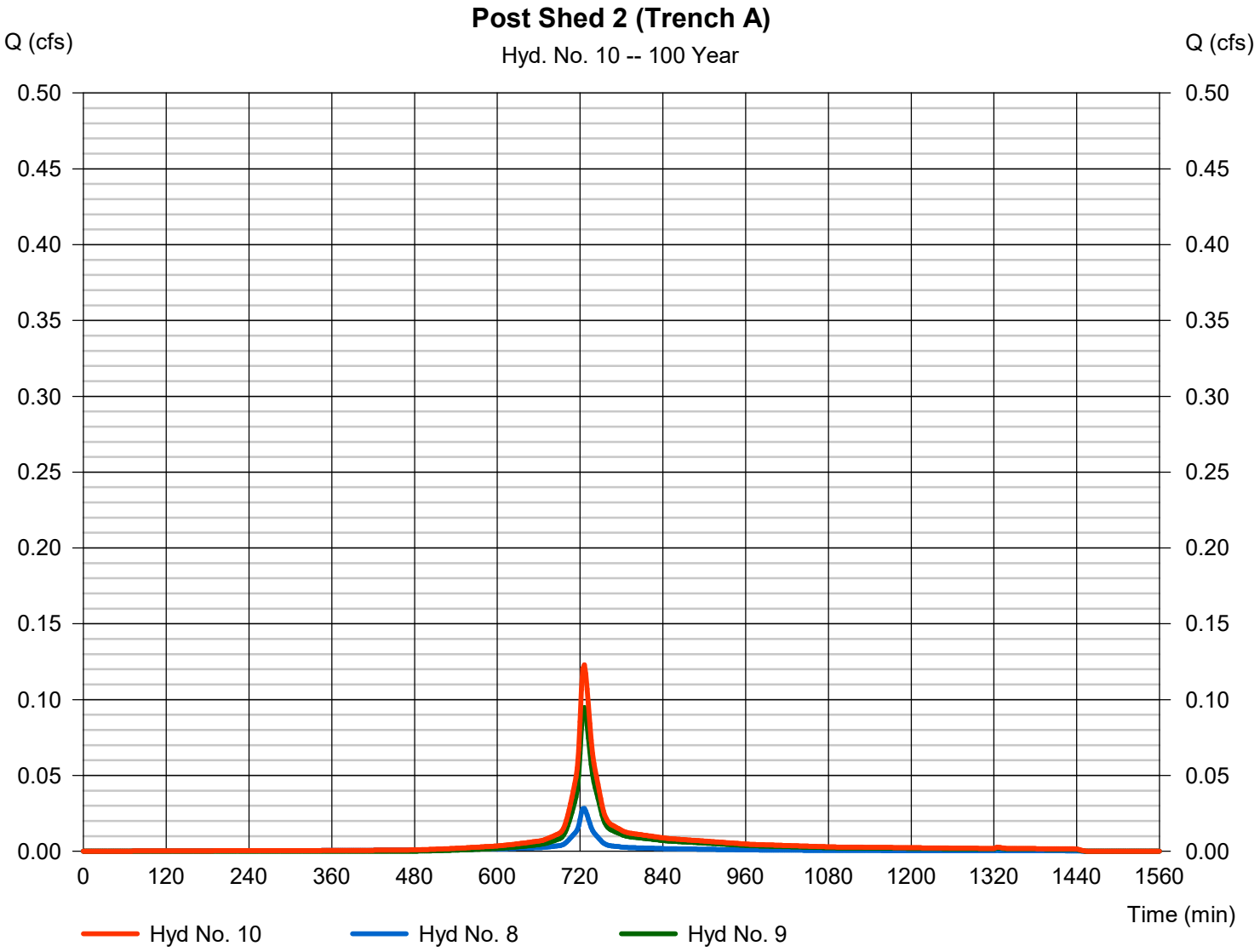
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Thursday, 07 / 15 / 2021

Hyd. No. 10

Post Shed 2 (Trench A)

Hydrograph type	= Combine	Peak discharge	= 0.123 cfs
Storm frequency	= 100 yrs	Time to peak	= 726 min
Time interval	= 2 min	Hyd. volume	= 460 cuft
Inflow hyds.	= 8, 9	Contrib. drain. area	= 0.024 ac



Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Wednesday, 08 / 4 / 2021

Pond No. 2 - TRENCH A

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 170.50 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	170.50	148	0	0
0.50	171.00	313	113	113
1.50	172.00	708	497	610

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 0.00	0.00	0.00	0.00
Span (in)	= 0.00	0.00	0.00	0.00
No. Barrels	= 0	0	0	0
Invert El. (ft)	= 0.00	0.00	0.00	0.00
Length (ft)	= 0.00	0.00	0.00	0.00
Slope (%)	= 0.00	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

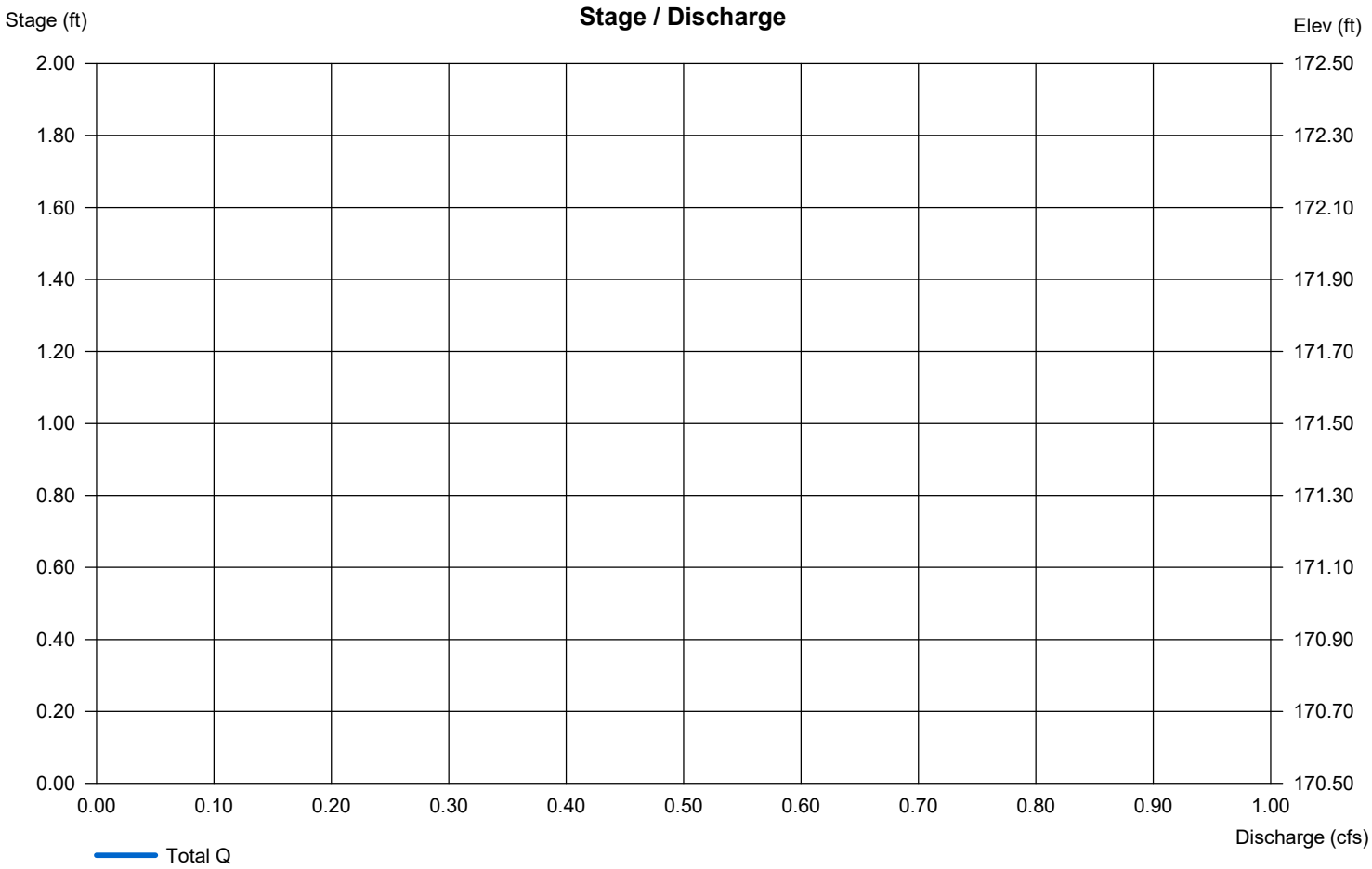
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	Inactive	0.00	0.00	0.00
Crest El. (ft)	= 0.00	0.00	0.00	0.00
Weir Coeff.	= 2.60	3.33	3.33	3.33
Weir Type	= Broad	---	---	---
Multi-Stage	= No	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).



Hydrograph Report

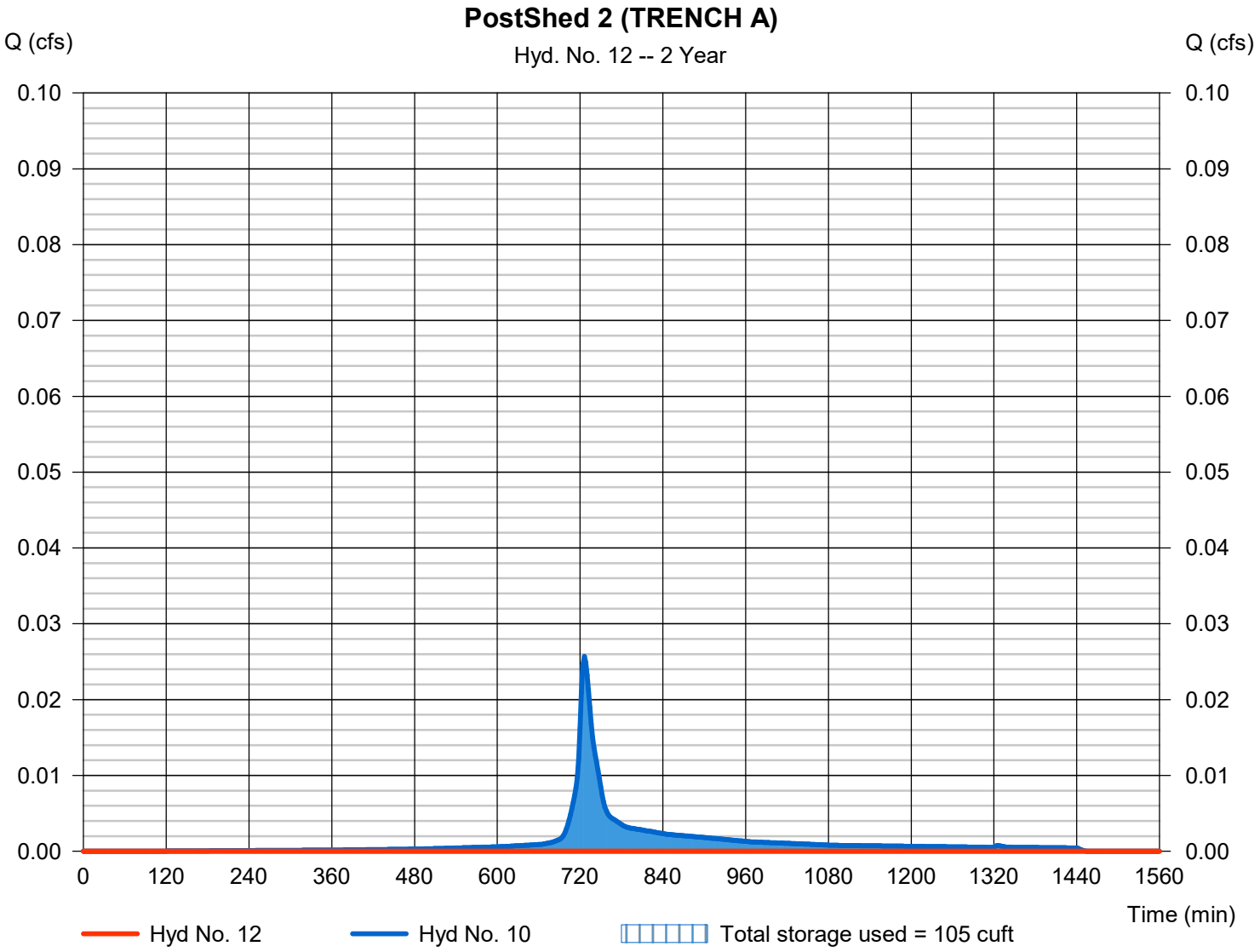
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Wednesday, 08 / 4 / 2021

Hyd. No. 12

PostShed 2 (TRENCH A)

Hydrograph type	=	Reservoir	Peak discharge	=	0.000 cfs
Storm frequency	=	2 yrs	Time to peak	=	n/a
Time interval	=	2 min	Hyd. volume	=	0 cuft
Inflow hyd. No.	=	10 - Post Shed 2 (Trench A)	Max. Elevation	=	170.96 ft
Reservoir name	=	TRENCH A	Max. Storage	=	105 cuft

Storage Indication method used.



Hydrograph Report

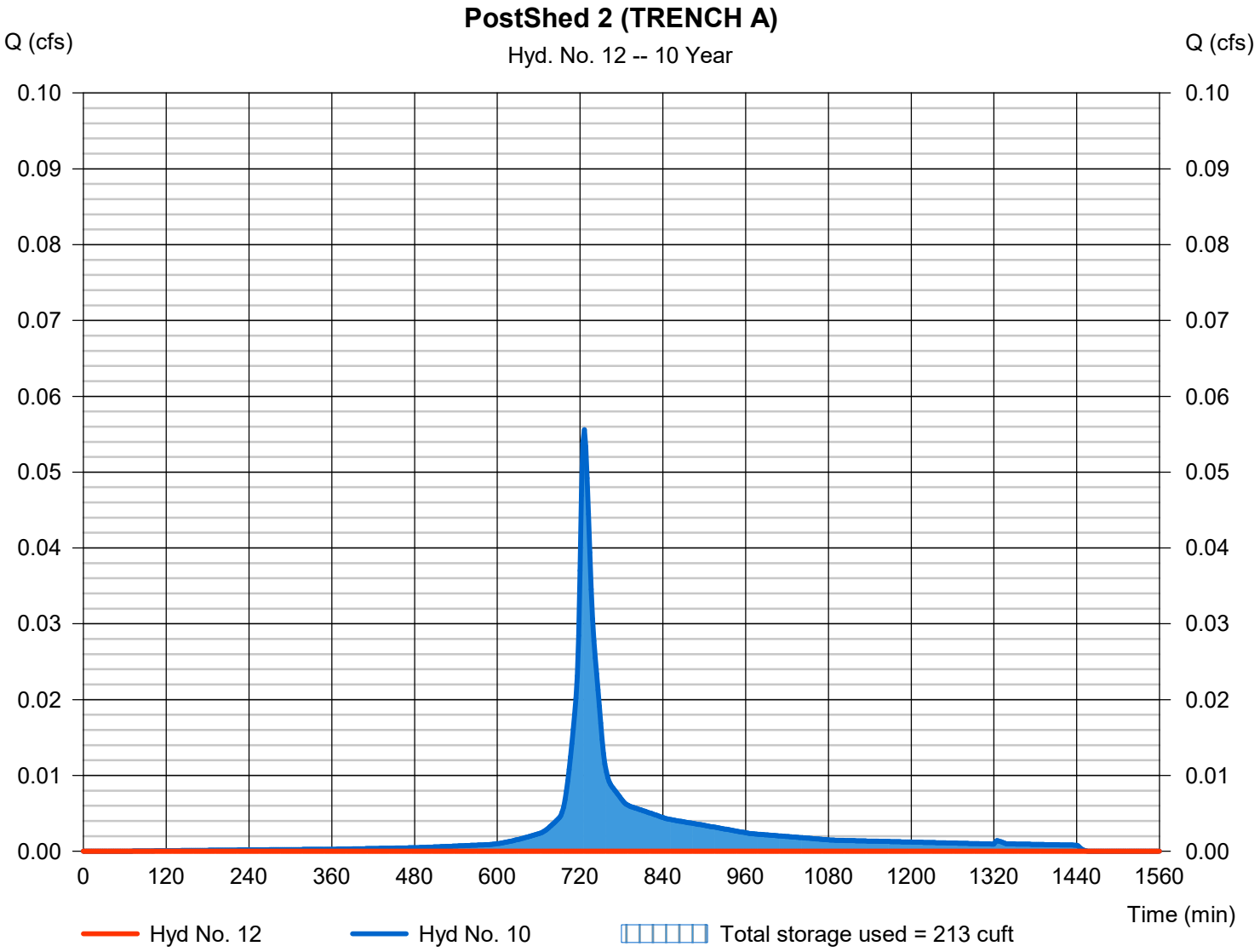
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Wednesday, 08 / 4 / 2021

Hyd. No. 12

PostShed 2 (TRENCH A)

Hydrograph type	=	Reservoir	Peak discharge	=	0.000 cfs
Storm frequency	=	10 yrs	Time to peak	=	n/a
Time interval	=	2 min	Hyd. volume	=	0 cuft
Inflow hyd. No.	=	10 - Post Shed 2 (Trench A)	Max. Elevation	=	171.20 ft
Reservoir name	=	TRENCH A	Max. Storage	=	213 cuft

Storage Indication method used.



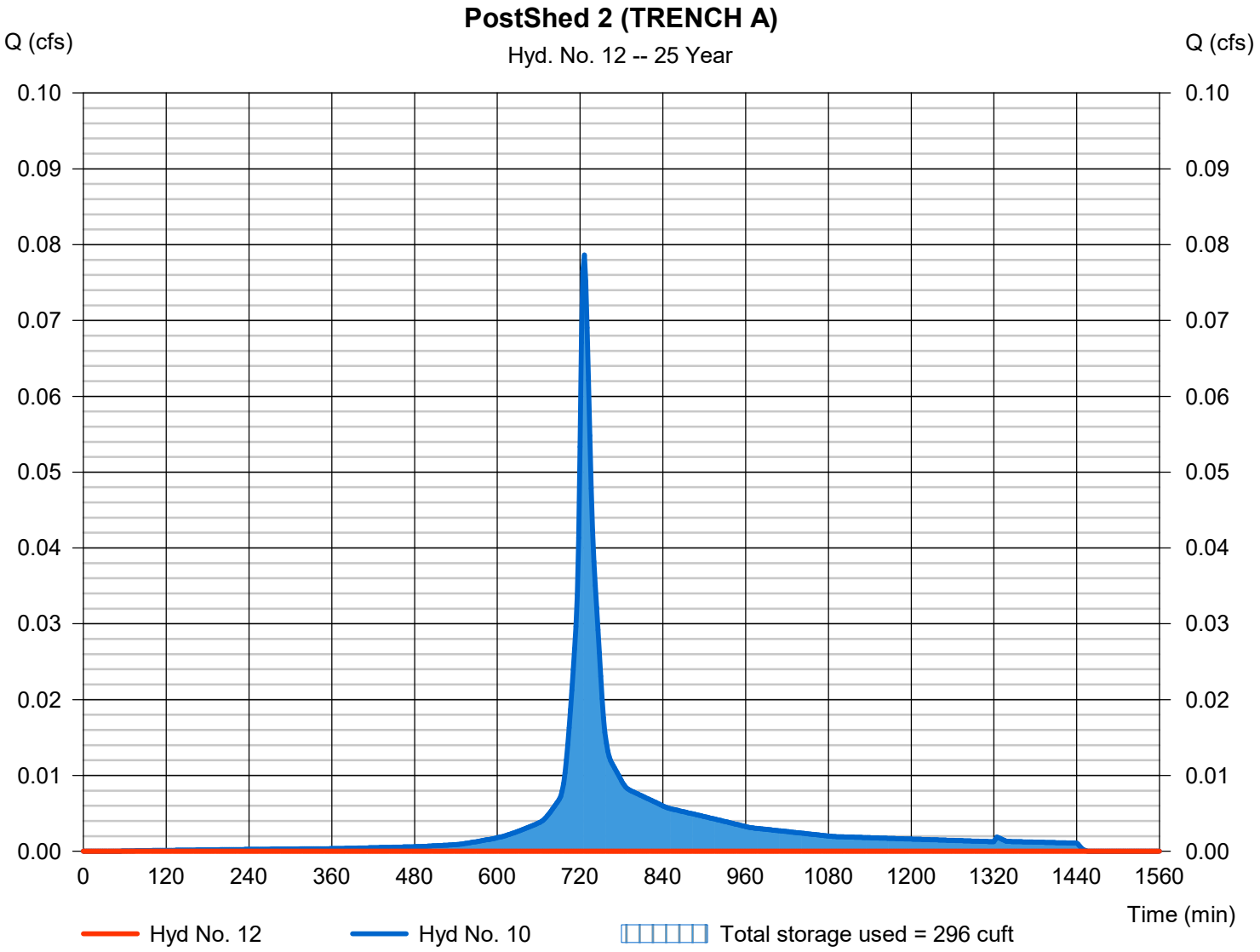
Hydrograph Report

Hyd. No. 12

PostShed 2 (TRENCH A)

Hydrograph type	=	Reservoir	Peak discharge	=	0.000 cfs
Storm frequency	=	25 yrs	Time to peak	=	n/a
Time interval	=	2 min	Hyd. volume	=	0 cuft
Inflow hyd. No.	=	10 - Post Shed 2 (Trench A)	Max. Elevation	=	171.37 ft
Reservoir name	=	TRENCH A	Max. Storage	=	296 cuft

Storage Indication method used.



Hydrograph Report

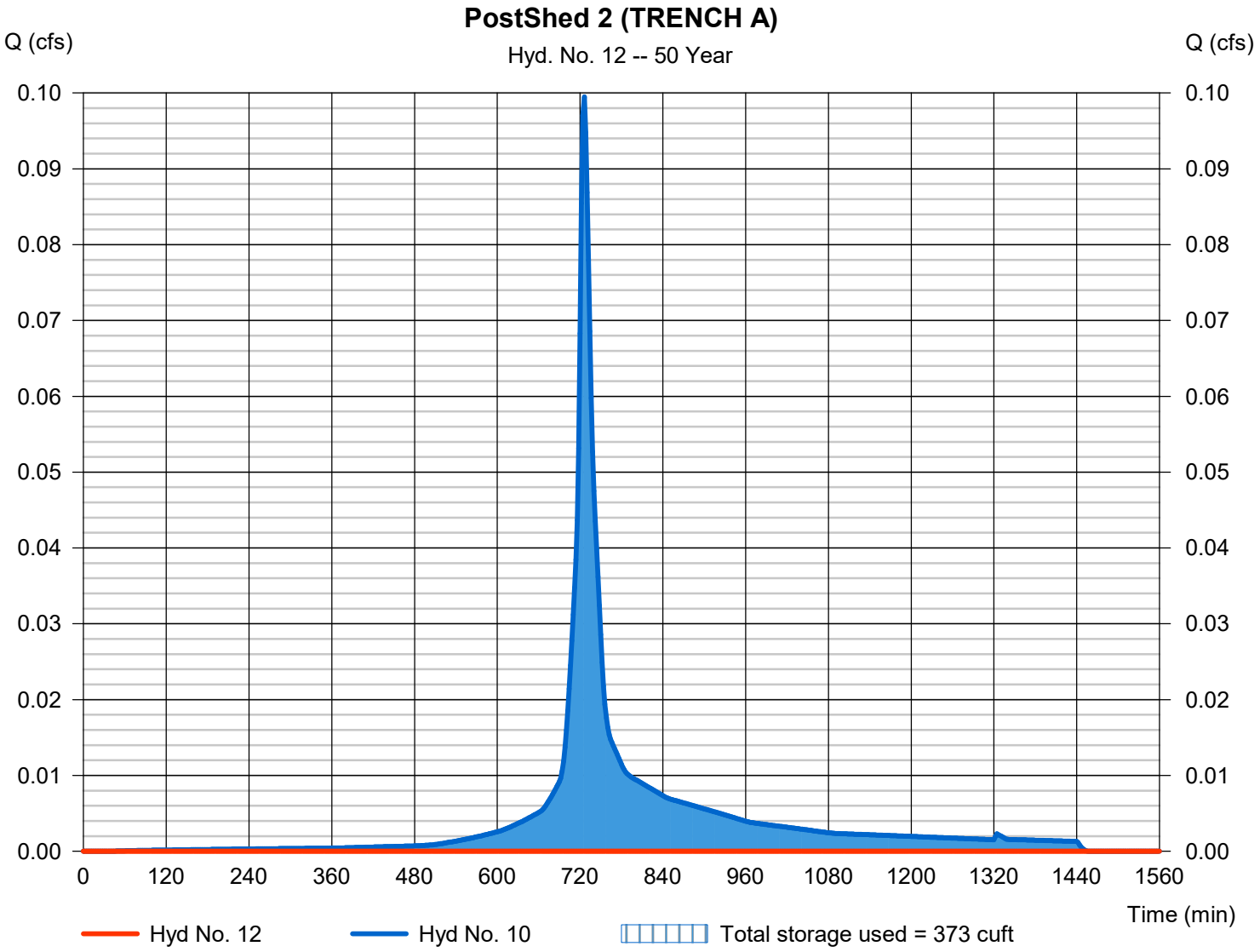
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Wednesday, 08 / 4 / 2021

Hyd. No. 12

PostShed 2 (TRENCH A)

Hydrograph type	=	Reservoir	Peak discharge	=	0.000 cfs
Storm frequency	=	50 yrs	Time to peak	=	n/a
Time interval	=	2 min	Hyd. volume	=	0 cuft
Inflow hyd. No.	=	10 - Post Shed 2 (Trench A)	Max. Elevation	=	171.52 ft
Reservoir name	=	TRENCH A	Max. Storage	=	373 cuft

Storage Indication method used.



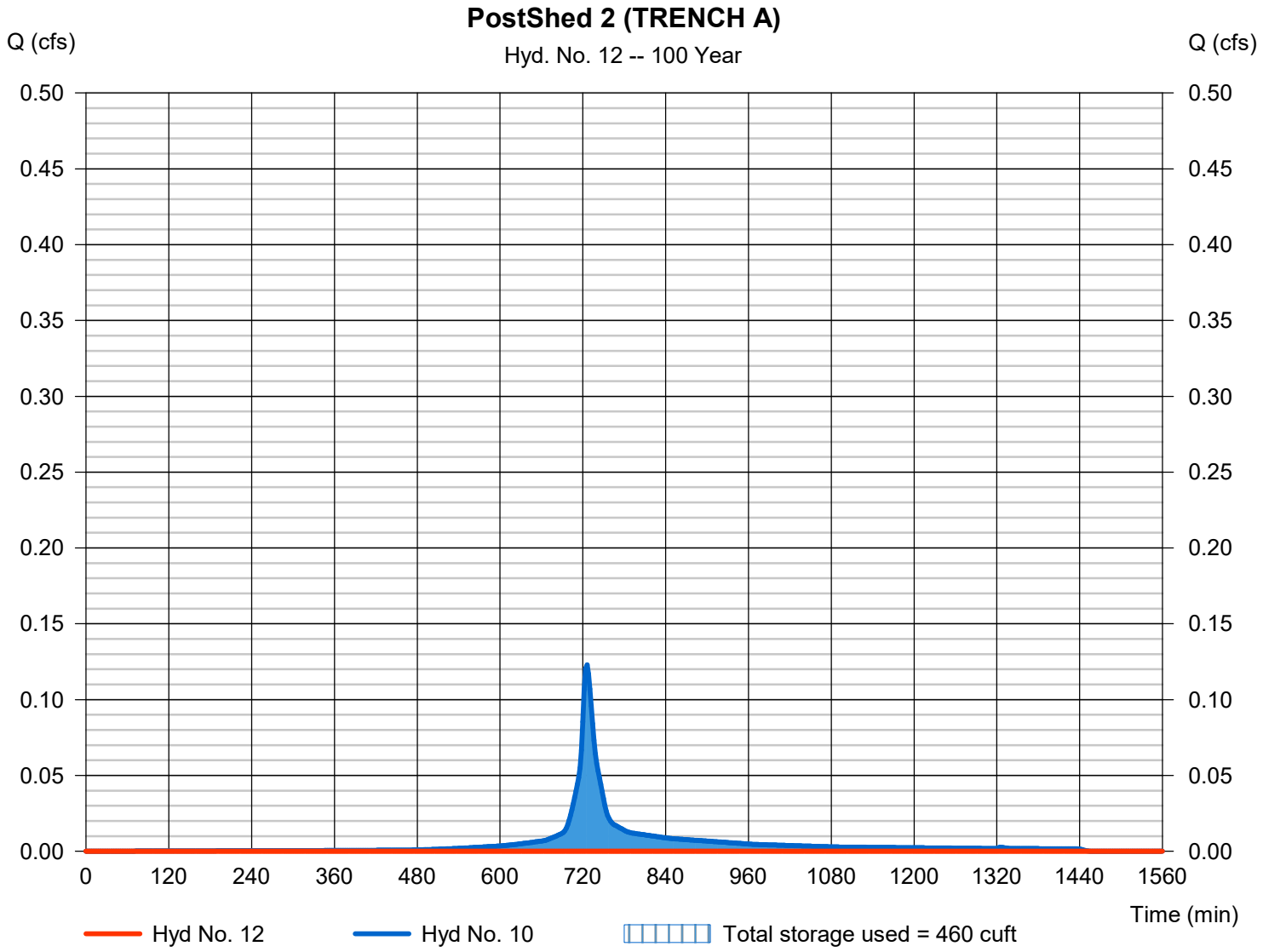
Hydrograph Report

Hyd. No. 12

PostShed 2 (TRENCH A)

Hydrograph type	=	Reservoir	Peak discharge	=	0.000 cfs
Storm frequency	=	100 yrs	Time to peak	=	n/a
Time interval	=	2 min	Hyd. volume	=	0 cuft
Inflow hyd. No.	=	10 - Post Shed 2 (Trench A)	Max. Elevation	=	171.70 ft
Reservoir name	=	TRENCH A	Max. Storage	=	460 cuft

Storage Indication method used.



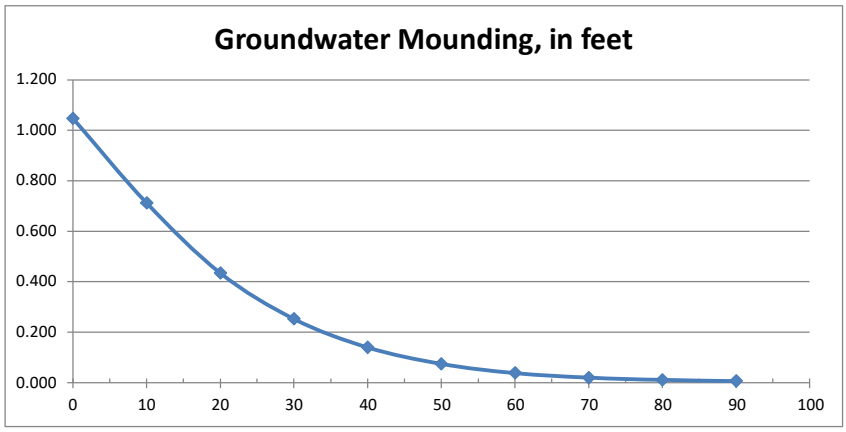
Input Values

2.63	R	Recharge rate (permeability rate) (in/hr)
		Specific yield, Sy (dimensionless)
0.150	Sy	default value is 0.15; max value is 0.2 provided that a lab test data is submitted
		Horizontal hydraulic conductivity (in/hr)
13.17	Kh	Kh = 5xRecharge Rate (R) in the costal plan; Kh=R outside the coastal plan
2.500	x	1/2 length of basin (x direction, in feet)
26.500	y	1/2 width of basin (y direction, in feet)
7.920	t	Duration of infiltration period (hours)
10.000	hi(0)	Initial thickness of saturated zone (feet)

11.047	h(max)	Maximum thickness of saturated zone (beneath center of basin at end of infiltration period)
1.047	Δh(max)	Maximum groundwater mounding (beneath center of basin at end of infiltration period)

Ground-water Mounding, in feet	Distance from center of basin in x direction, in feet
1.047	0
0.712	10
0.434	20
0.252	30
0.140	40
0.074	50
0.038	60
0.019	70
0.011	80
0.007	90

Re-Calculate Now



Disclaimer

This spreadsheet solving the Hantush (1967) equation for ground-water mounding beneath an infiltration basin is made available to the general public as a convenience for those wishing to replicate values documented in the USGS Scientific Investigations Report 2010-5102 "Groundwater mounding beneath hypothetical stormwater infiltration basins" or to calculate values based on user-specified site conditions. Any changes made to the spreadsheet (other than values identified as user-specified) after transmission from the USGS could have unintended, undesirable consequences. These consequences could include, but may not be limited to: erroneous output, numerical instabilities, and violations of underlying assumptions that are inherent in results presented in the accompanying USGS published report. The USGS assumes no responsibility for the consequences of any changes made to the spreadsheet. If changes are made to the spreadsheet, the user is responsible for documenting the changes and justifying the results and conclusions.

Input Values

2.63	R	Recharge rate (permeability rate) (in/hr)
		Specific yield, Sy (dimensionless)
0.150	Sy	default value is 0.15; max value is 0.2 provided that a lab test data is submitted
		Horizontal hydraulic conductivity (in/hr)
13.17	Kh	Kh = 5xRecharge Rate (R) in the costal plan; Kh=R outside the coastal plan
26.500	x	1/2 length of basin (x direction, in feet)
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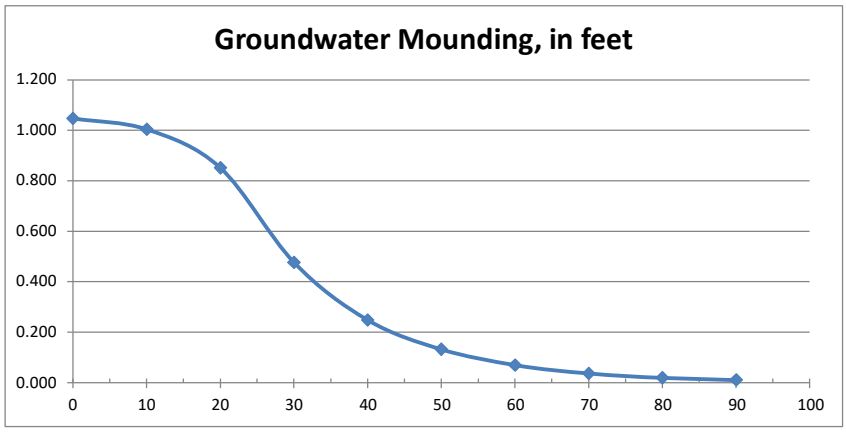
7.920	t	Duration of infiltration period (hours)
10.000	hi(0)	Initial thickness of saturated zone (feet)

11.047	h(max)	Maximum thickness of saturated zone (beneath center of basin at end of infiltration period)
1.047	Δh(max)	Maximum groundwater mounding (beneath center of basin at end of infiltration period)

Ground-water Mounding, in feet	Distance from center of basin in x direction, in feet
1.047	0
1.004	10
0.851	20
0.476	30
0.248	40
0.132	50
0.069	60
0.036	70
0.019	80
0.010	90

Re-Calculate Now



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POST-DEVELOPMENT WATERSHED #3

WATERSHED #3 BYPASS AREA

- DRAINAGE AREAS/ WEIGHTED CN VALUES
- HYDROGRAPHS (2, 10, 25, 50, & 100 yr)

POST-DEVELOPMENT SHED COVERAGE CALCULATIONS

Project Name:	Angelo Pizza LD
Location:	Berlin Twp, Camden County
Project Number:	3824
Prepared By:	Colin Camp
Date:	July 14, 2021

Cover	CN Values			
	Soil A	Soil B	Soil C	Soil D
Impervious	98	98	98	98
Meadow	30	58	71	78
Woodland	36	60	73	79
Cultivated	75	85	90	92
Lawn	49	69	79	84

Shed ID	Post-Shed 3 (Bypass)			
Soil Type	Cover	Area (Ac.)	CN Value	CN*Area
A	Meadow	0.00	30	0.00
	Woodland	0.00	36	0.00
	Cultivated	0.00	75	0.00
	Lawn	0.00	49	0.00
B	Meadow	0.01	58	0.86
	Woodland	0.00	60	0.00
	Cultivated	0.00	85	0.00
	Lawn	0.00	69	0.00
C	Meadow	0.00	71	0.00
	Woodland	0.00	73	0.00
	Cultivated	0.00	90	0.00
	Lawn	0.00	79	0.00
D	Meadow	0.00	78	0.00
	Woodland	0.00	79	0.00
	Cultivated	0.00	92	0.00
	Lawn	0.00	84	0.00
IMPERVIOUS			98	0.00
			Total Area:	0.01
			Wtd CN:	58.00

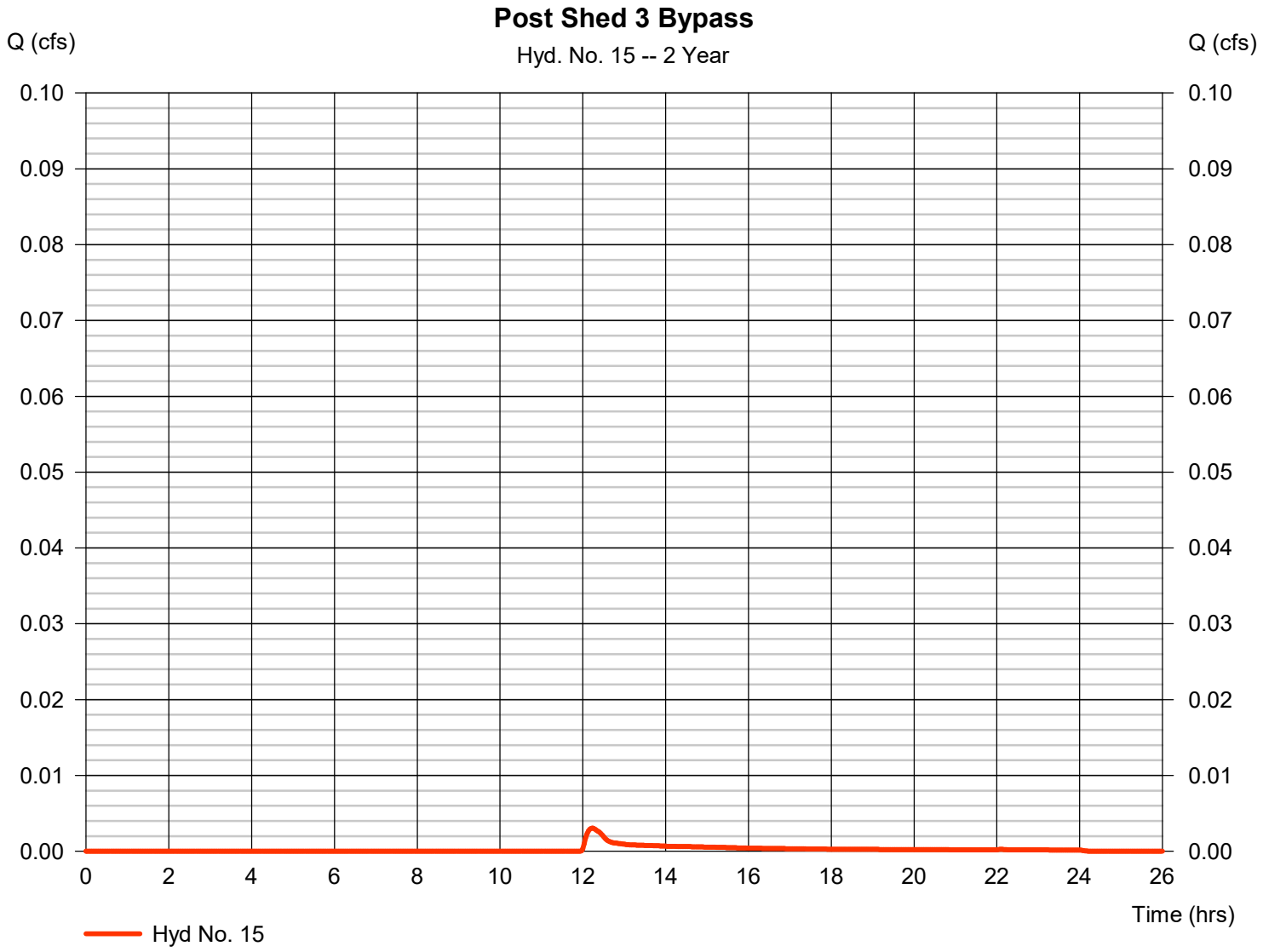
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Thursday, 07 / 15 / 2021

Hyd. No. 15

Post Shed 3 Bypass

Hydrograph type	= SCS Runoff	Peak discharge	= 0.003 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.23 hrs
Time interval	= 2 min	Hyd. volume	= 20 cuft
Drainage area	= 0.015 ac	Curve number	= 58
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 3.31 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 284



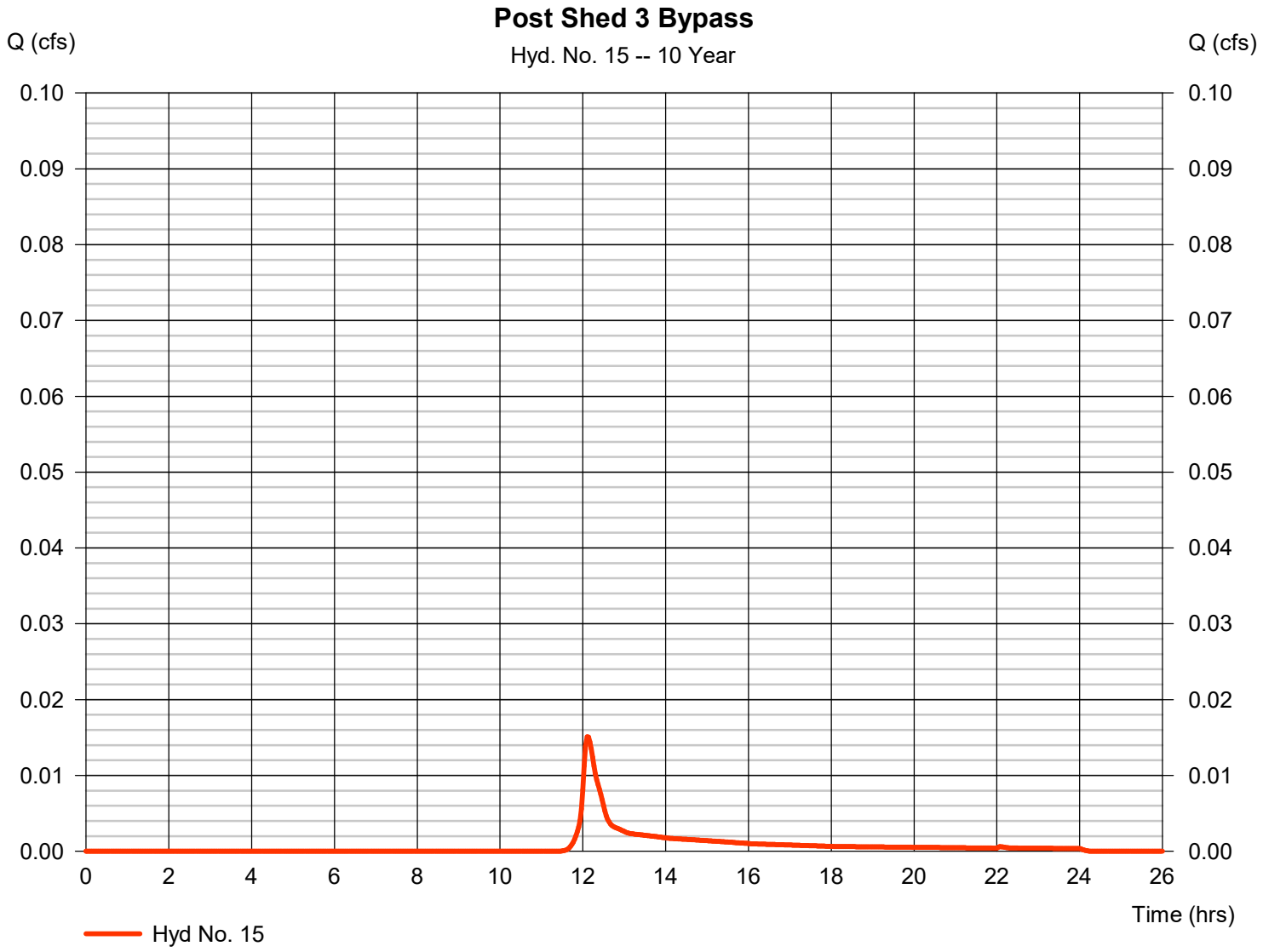
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Thursday, 07 / 15 / 2021

Hyd. No. 15

Post Shed 3 Bypass

Hydrograph type	= SCS Runoff	Peak discharge	= 0.015 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.10 hrs
Time interval	= 2 min	Hyd. volume	= 64 cuft
Drainage area	= 0.015 ac	Curve number	= 58
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 5.05 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 284



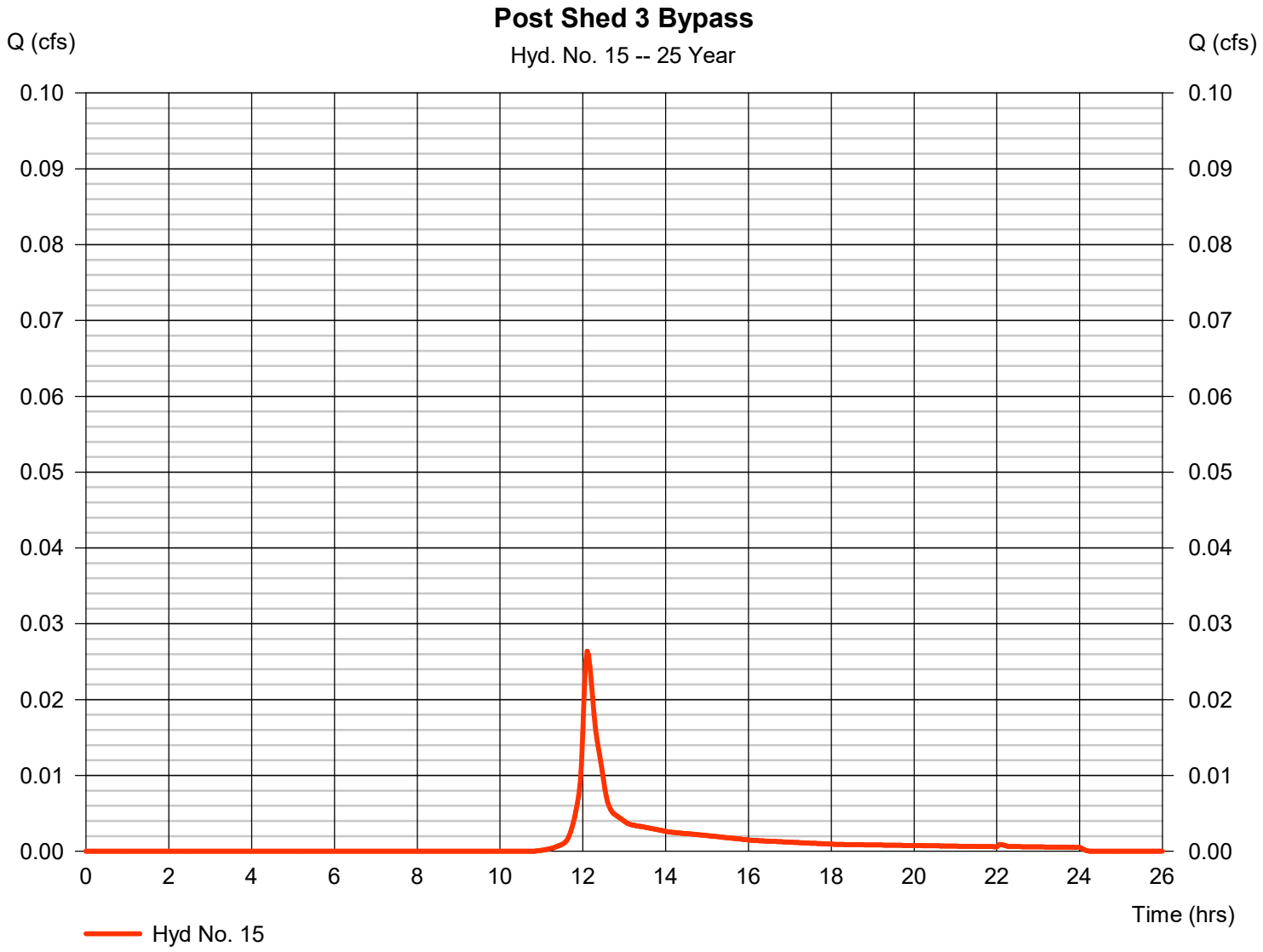
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Thursday, 07 / 15 / 2021

Hyd. No. 15

Post Shed 3 Bypass

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.026 cfs
Storm frequency	=	25 yrs	Time to peak	=	12.10 hrs
Time interval	=	2 min	Hyd. volume	=	102 cuft
Drainage area	=	0.015 ac	Curve number	=	58
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	6.00 min
Total precip.	=	6.26 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	284



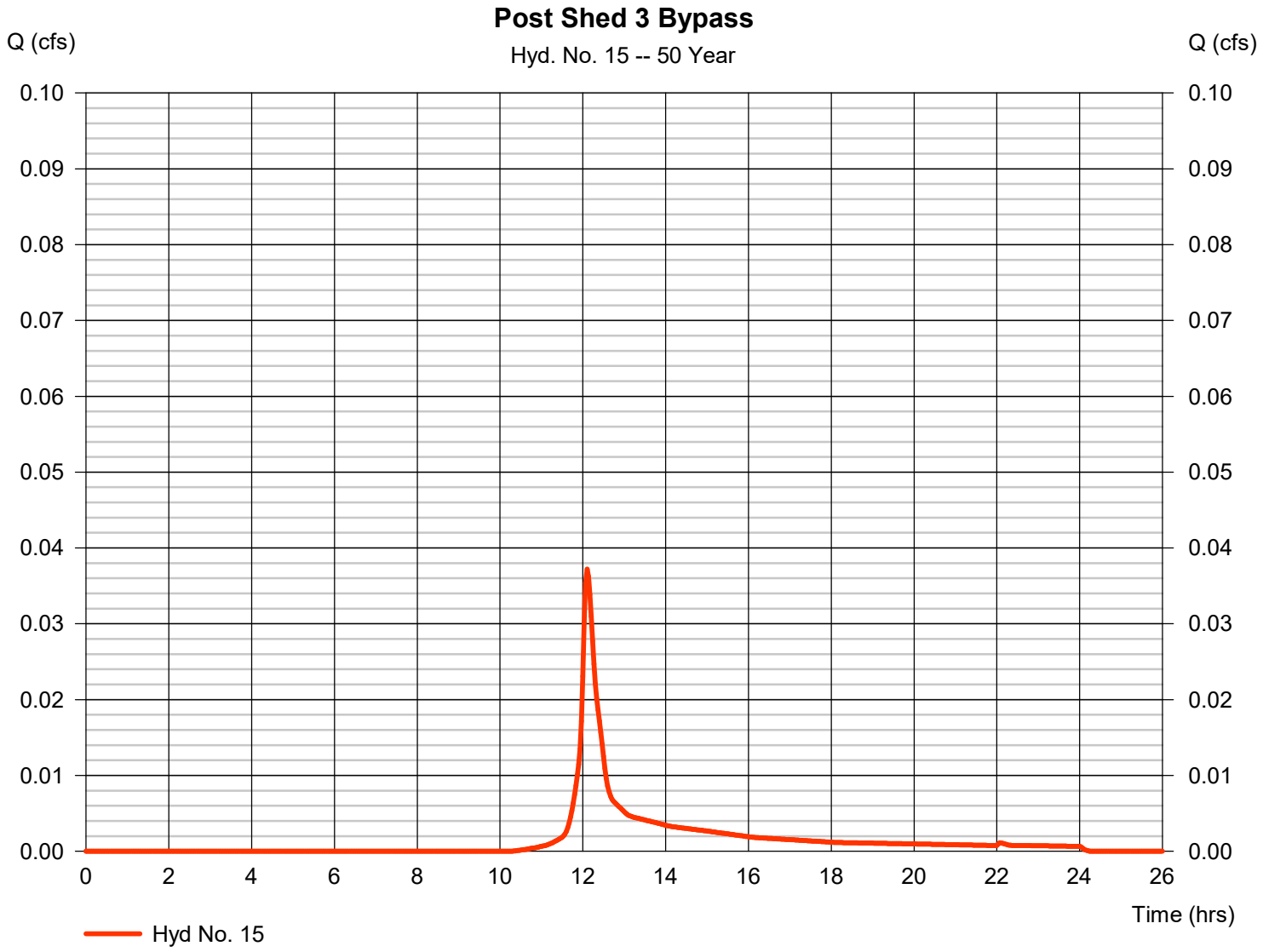
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Thursday, 07 / 15 / 2021

Hyd. No. 15

Post Shed 3 Bypass

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.037 cfs
Storm frequency	=	50 yrs	Time to peak	=	12.10 hrs
Time interval	=	2 min	Hyd. volume	=	139 cuft
Drainage area	=	0.015 ac	Curve number	=	58
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	6.00 min
Total precip.	=	7.31 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	284



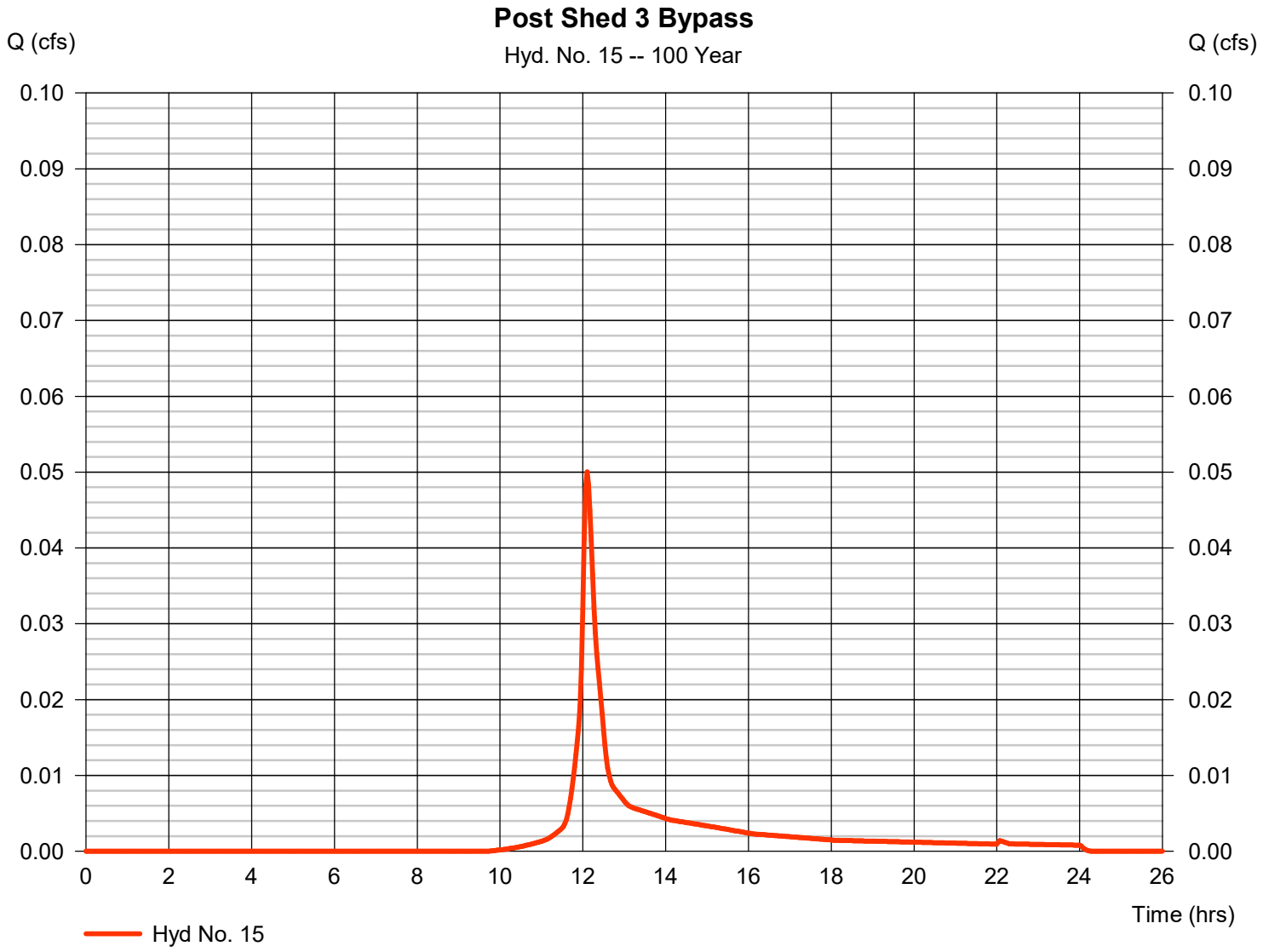
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Thursday, 07 / 15 / 2021

Hyd. No. 15

Post Shed 3 Bypass

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.050 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.10 hrs
Time interval	=	2 min	Hyd. volume	=	184 cuft
Drainage area	=	0.015 ac	Curve number	=	58
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	6.00 min
Total precip.	=	8.47 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	284



UG BASIN A WATERSHED AREA

- DRAINAGE AREAS/ WEIGHTED CN VALUES
- UG BASIN A INFLOW HYDROGRAPHS (2, 10, 25, 50 & 100 yr)
- UG BASIN A STAGE/ STORAGE CALCULATIONS
- UG BASIN A ROUTING HYDROGRAPHS (2, 10, 25, 50 & 100 yr)
- MOUNDING ANALYSIS

POST-DEVELOPMENT SHED COVERAGE CALCULATIONS

Project Name:	Angelo Pizza LD
Location:	Berlin Twp, Camden County
Project Number:	3824
Prepared By:	Colin Camp
Date:	July 14, 2021

Cover	CN Values			
	Soil A	Soil B	Soil C	Soil D
Impervious	98	98	98	98
Meadow	30	58	71	78
Woodland	36	60	73	79
Cultivated	75	85	90	92
Lawn	49	69	79	84

Shed ID	Post-Shed 3 (UG Basin B) (Lawn)			
Soil Type	Cover	Area (Ac.)	CN Value	CN*Area
A	Meadow	0.00	30	0.00
	Woodland	0.00	36	0.00
	Cultivated	0.00	75	0.00
	Lawn	0.00	49	0.00
B	Meadow	0.00	58	0.00
	Woodland	0.00	60	0.00
	Cultivated	0.00	85	0.00
	Lawn	0.11	69	7.74
C	Meadow	0.00	71	0.00
	Woodland	0.00	73	0.00
	Cultivated	0.00	90	0.00
	Lawn	0.00	79	0.00
D	Meadow	0.00	78	0.00
	Woodland	0.00	79	0.00
	Cultivated	0.00	92	0.00
	Lawn	0.00	84	0.00
IMPERVIOUS		0.00	98	0.00
			Total Area:	0.11
			Wtd CN:	69.00

POST-DEVELOPMENT SHED COVERAGE CALCULATIONS

Project Name:	Angelo Pizza LD
Location:	Berlin Twp, Camden County
Project Number:	3824
Prepared By:	Colin Camp
Date:	July 14, 2021

Cover	CN Values			
	Soil A	Soil B	Soil C	Soil D
Impervious	98	98	98	98
Meadow	30	58	71	78
Woodland	36	60	73	79
Cultivated	75	85	90	92
Lawn	49	69	79	84

Shed ID	Post-Shed 3 (UG Basin B) (Imp.)			
Soil Type	Cover	Area (Ac.)	CN Value	CN*Area
A	Meadow	0.00	30	0.00
	Woodland	0.00	36	0.00
	Cultivated	0.00	75	0.00
	Lawn	0.00	49	0.00
B	Meadow	0.00	58	0.00
	Woodland	0.00	60	0.00
	Cultivated	0.00	85	0.00
	Lawn	0.00	69	0.00
C	Meadow	0.00	71	0.00
	Woodland	0.00	73	0.00
	Cultivated	0.00	90	0.00
	Lawn	0.00	79	0.00
D	Meadow	0.00	78	0.00
	Woodland	0.00	79	0.00
	Cultivated	0.00	92	0.00
	Lawn	0.00	84	0.00
IMPERVIOUS		0.35	98	33.84
			Total Area:	0.35
			Wtd CN:	98.00

THE CROSSROADS GROUP, LLC
16590 Pottsville Pike
Hamburg, PA 19526

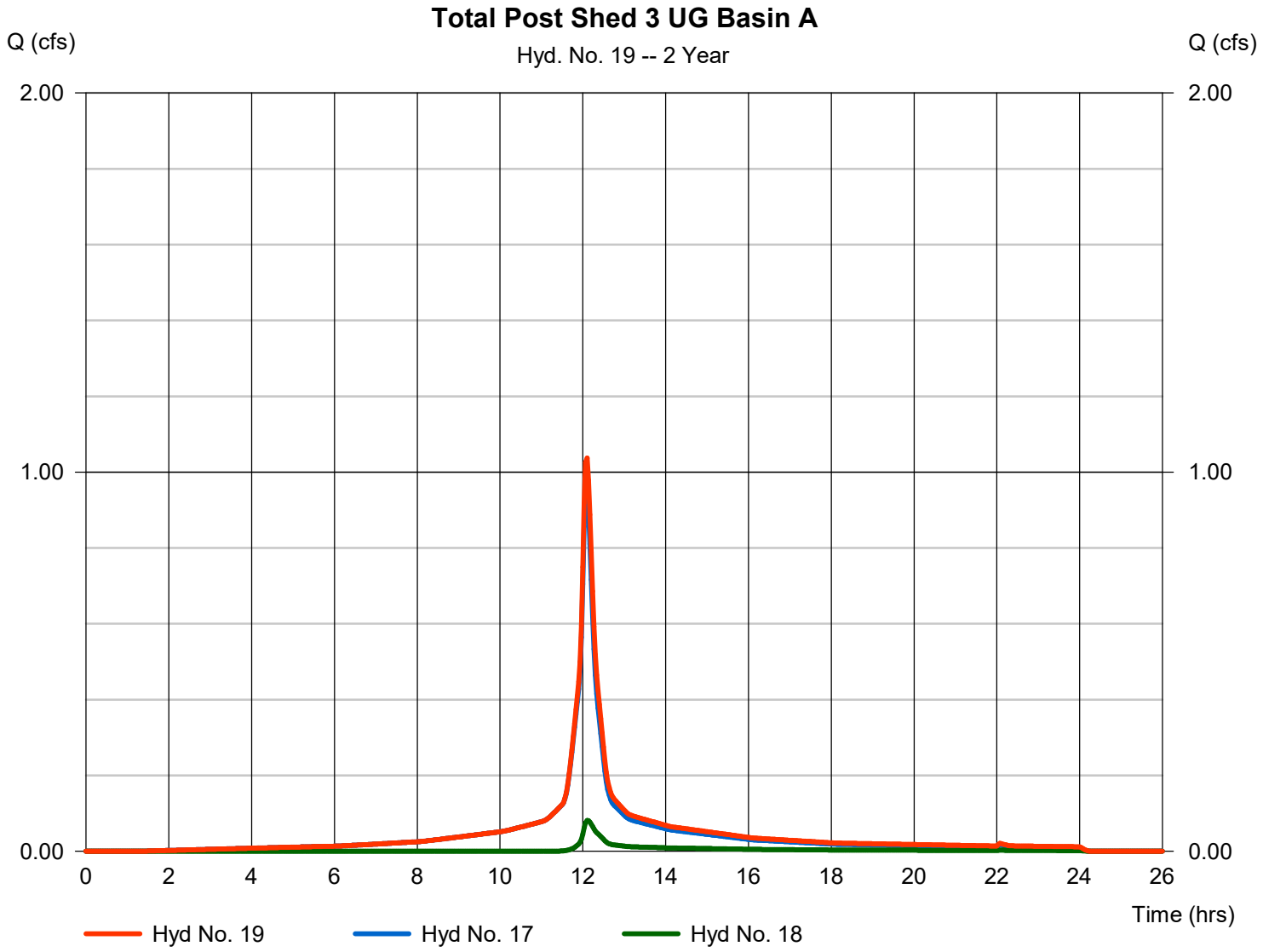
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Thursday, 07 / 15 / 2021

Hyd. No. 19

Total Post Shed 3 UG Basin A

Hydrograph type	= Combine	Peak discharge	= 1.037 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.10 hrs
Time interval	= 2 min	Hyd. volume	= 4,204 cuft
Inflow hyds.	= 17, 18	Contrib. drain. area	= 0.460 ac



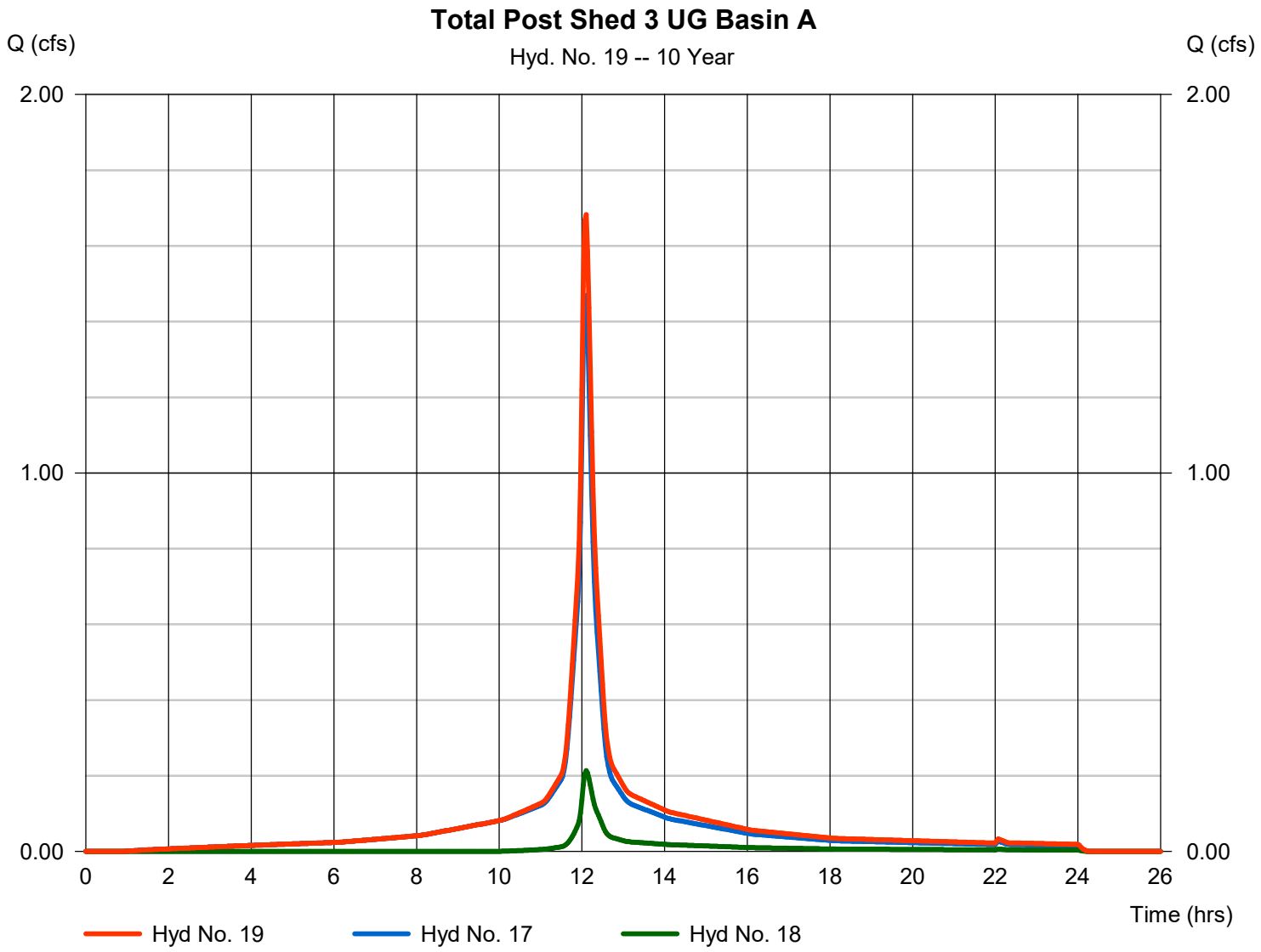
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Thursday, 07 / 15 / 2021

Hyd. No. 19

Total Post Shed 3 UG Basin A

Hydrograph type	= Combine	Peak discharge	= 1.683 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.10 hrs
Time interval	= 2 min	Hyd. volume	= 6,843 cuft
Inflow hyds.	= 17, 18	Contrib. drain. area	= 0.460 ac



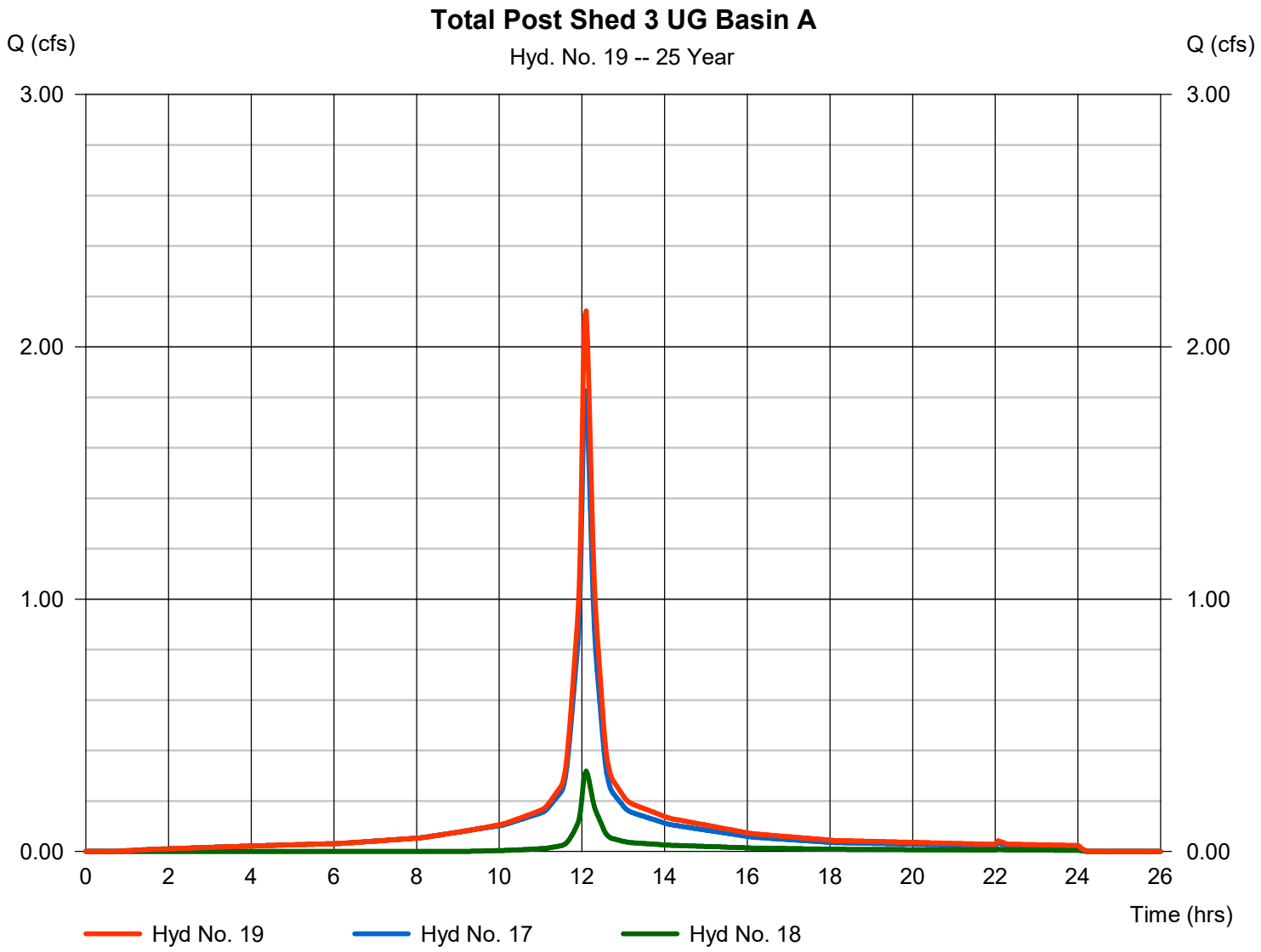
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Thursday, 07 / 15 / 2021

Hyd. No. 19

Total Post Shed 3 UG Basin A

Hydrograph type	= Combine	Peak discharge	= 2.143 cfs
Storm frequency	= 25 yrs	Time to peak	= 12.10 hrs
Time interval	= 2 min	Hyd. volume	= 8,729 cuft
Inflow hyds.	= 17, 18	Contrib. drain. area	= 0.460 ac



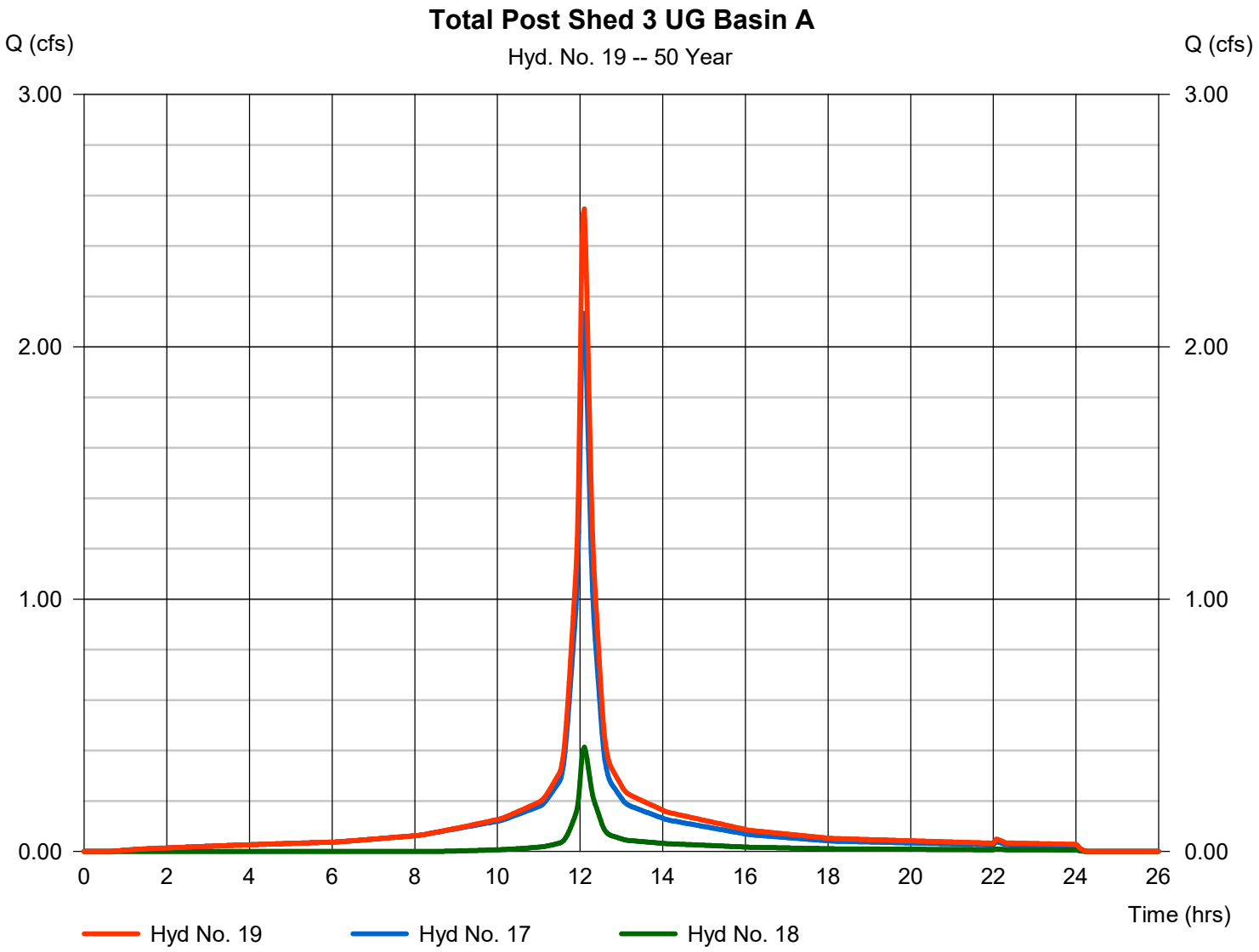
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Thursday, 07 / 15 / 2021

Hyd. No. 19

Total Post Shed 3 UG Basin A

Hydrograph type	= Combine	Peak discharge	= 2.546 cfs
Storm frequency	= 50 yrs	Time to peak	= 12.10 hrs
Time interval	= 2 min	Hyd. volume	= 10,386 cuft
Inflow hyds.	= 17, 18	Contrib. drain. area	= 0.460 ac



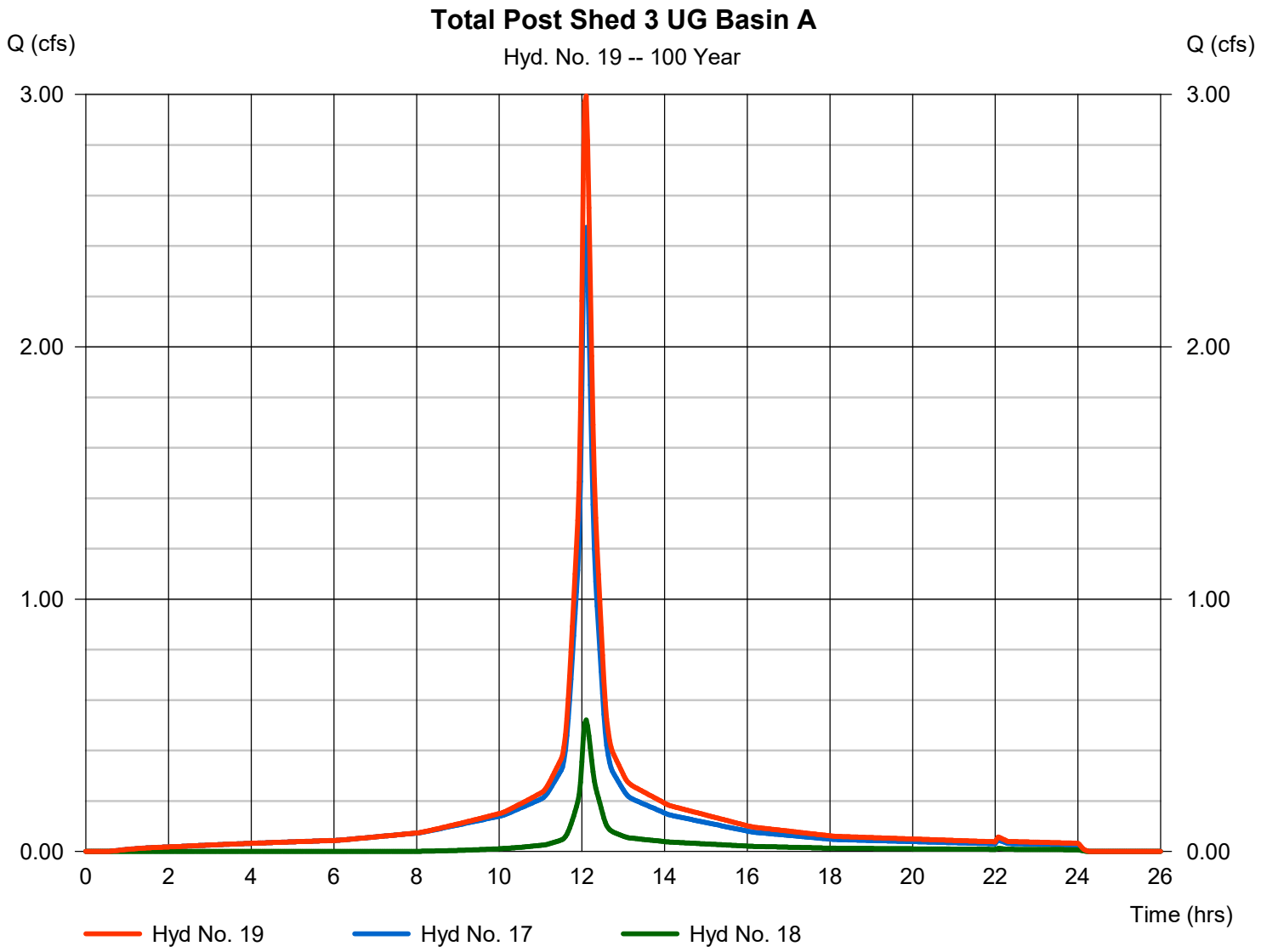
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Thursday, 07 / 15 / 2021

Hyd. No. 19

Total Post Shed 3 UG Basin A

Hydrograph type	= Combine	Peak discharge	= 2.995 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.10 hrs
Time interval	= 2 min	Hyd. volume	= 12,232 cuft
Inflow hyds.	= 17, 18	Contrib. drain. area	= 0.460 ac



Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Wednesday, 08 / 4 / 2021

Pond No. 4 - UG BASIN A

Pond Data

UG Chambers -Invert elev. = 168.00 ft, Rise x Span = 3.00 x 40.00 ft, Barrel Len = 88.00 ft, No. Barrels = 1, Slope = 0.00%, Headers = No
Encasement -Invert elev. = 167.00 ft, Width = 42.00 ft, Height = 4.00 ft, Voids = 40.00%

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	167.00	n/a	0	0
0.40	167.40	n/a	591	591
0.80	167.80	n/a	591	1,183
1.20	168.20	n/a	1,014	2,197
1.60	168.60	n/a	1,436	3,633
2.00	169.00	n/a	1,436	5,070
2.40	169.40	n/a	1,436	6,506
2.80	169.80	n/a	1,436	7,943
3.20	170.20	n/a	1,436	9,379
3.60	170.60	n/a	1,436	10,816
4.00	171.00	n/a	1,436	12,252

Culvert / Orifice Structures

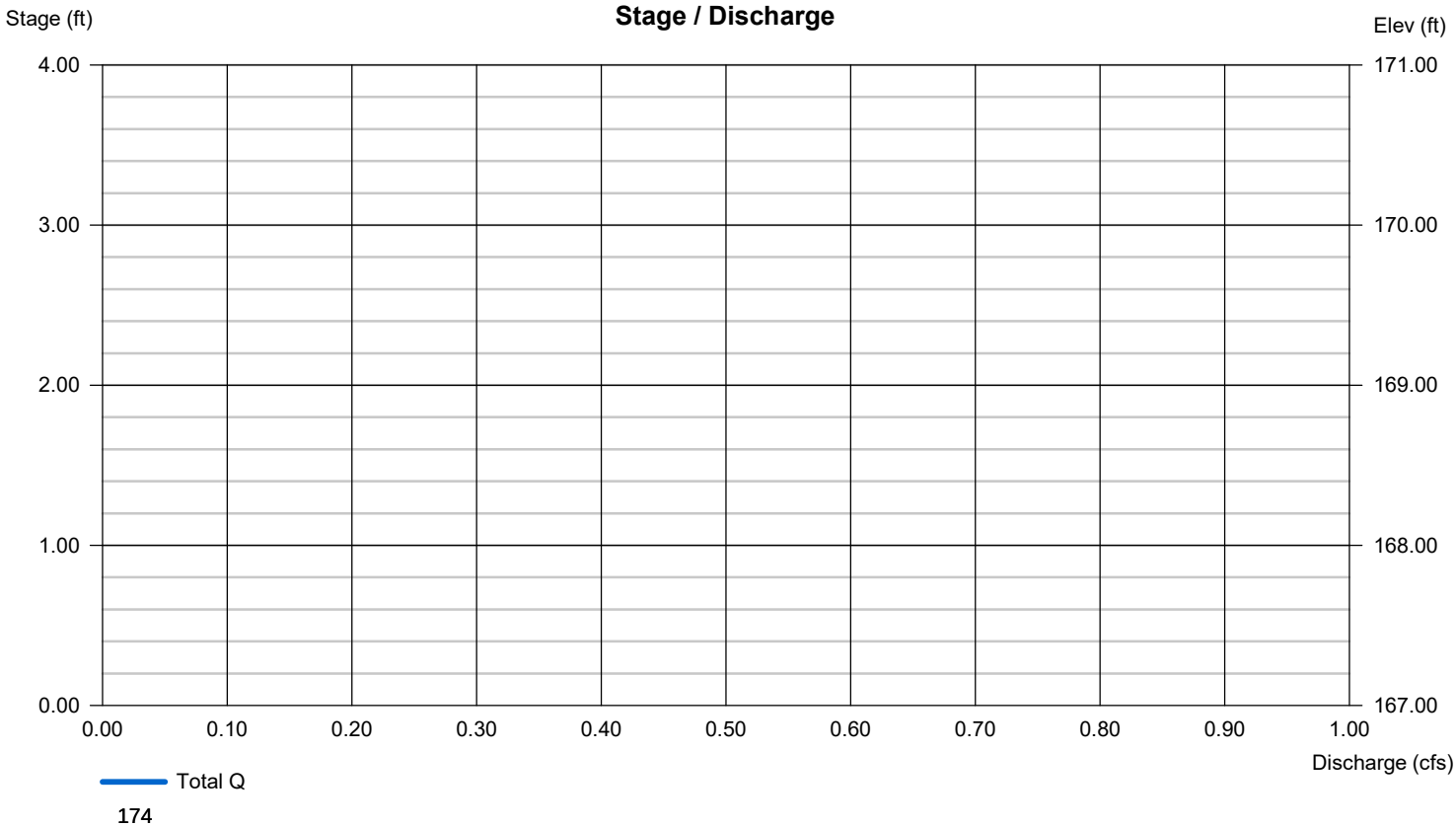
	[A]	[B]	[C]	[PrfRsr]
Rise (in)	Inactive	0.00	0.00	0.00
Span (in)	= 30.00	0.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 168.50	0.00	0.00	0.00
Length (ft)	= 0.00	0.00	0.00	0.00
Slope (%)	= 0.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 8.00	0.00	0.00	0.00
Crest El. (ft)	= 171.67	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= Rect	---	---	---
Multi-Stage	= No	No	No	No

Exfil.(in/hr) = 0.000 (by Wet area)
TW Elev. (ft) = 0.00

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



Hydrograph Report

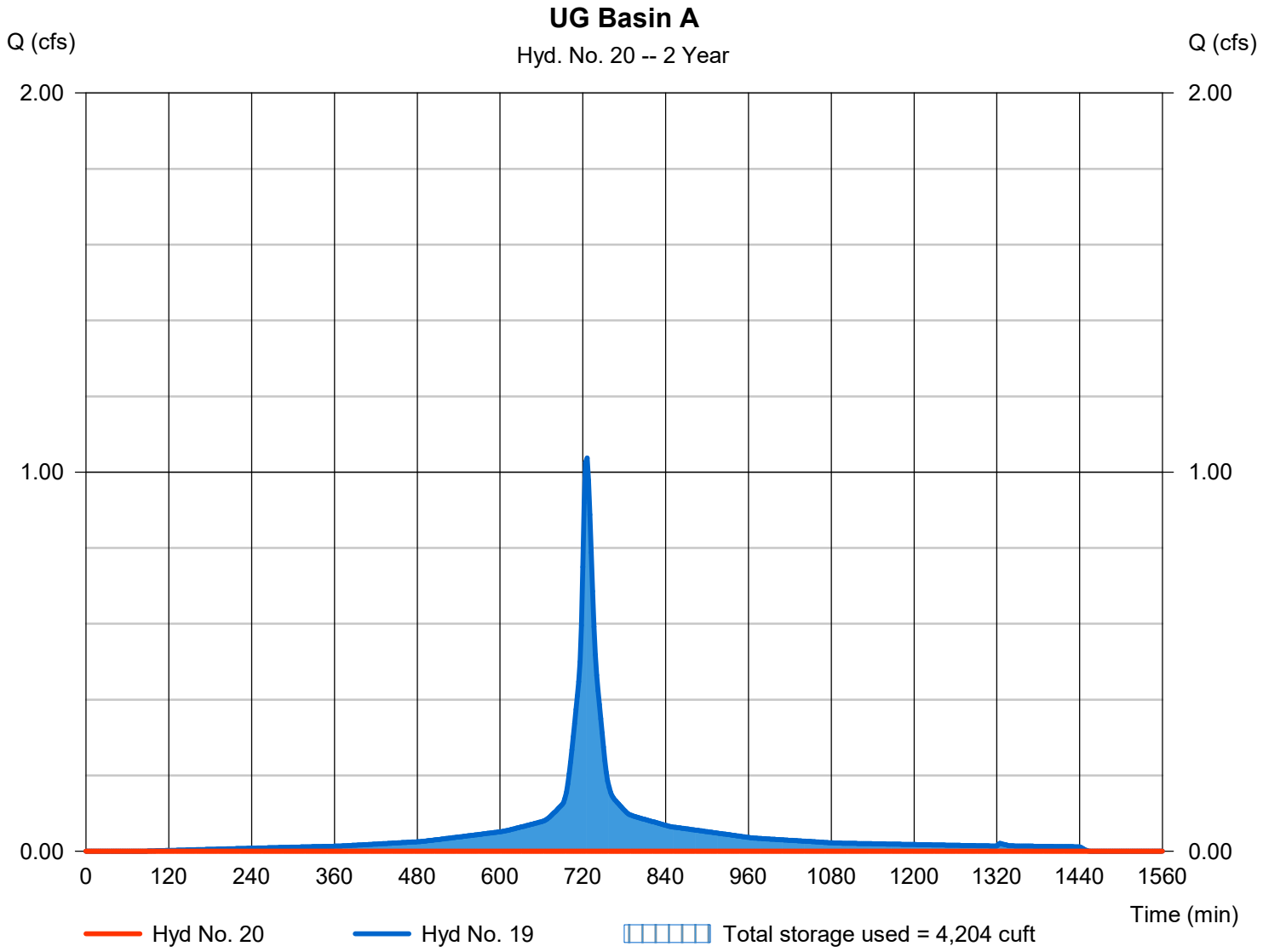
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Wednesday, 08 / 4 / 2021

Hyd. No. 20

UG Basin A

Hydrograph type	=	Reservoir	Peak discharge	=	0.000 cfs
Storm frequency	=	2 yrs	Time to peak	=	n/a
Time interval	=	2 min	Hyd. volume	=	0 cuft
Inflow hyd. No.	=	19 - Total Post Shed 3 UG Basin A	Max. Elevation	=	168.76 ft
Reservoir name	=	UG BASIN A	Max. Storage	=	4,204 cuft

Storage Indication method used.



Hydrograph Report

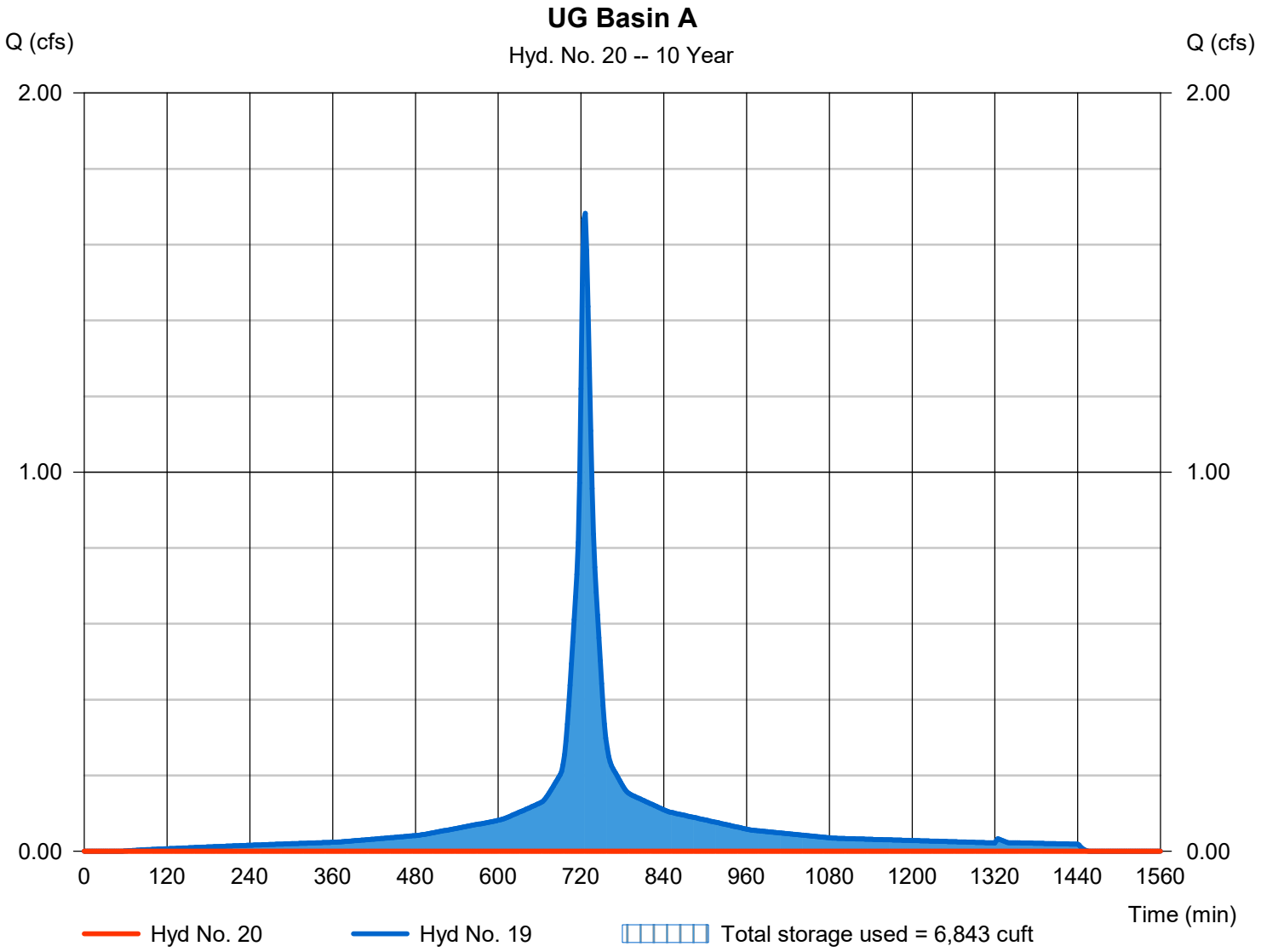
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Wednesday, 08 / 4 / 2021

Hyd. No. 20

UG Basin A

Hydrograph type	=	Reservoir	Peak discharge	=	0.000 cfs
Storm frequency	=	10 yrs	Time to peak	=	n/a
Time interval	=	2 min	Hyd. volume	=	0 cuft
Inflow hyd. No.	=	19 - Total Post Shed 3 UG Basin A	Max. Elevation	=	169.49 ft
Reservoir name	=	UG BASIN A	Max. Storage	=	6,843 cuft

Storage Indication method used.



Hydrograph Report

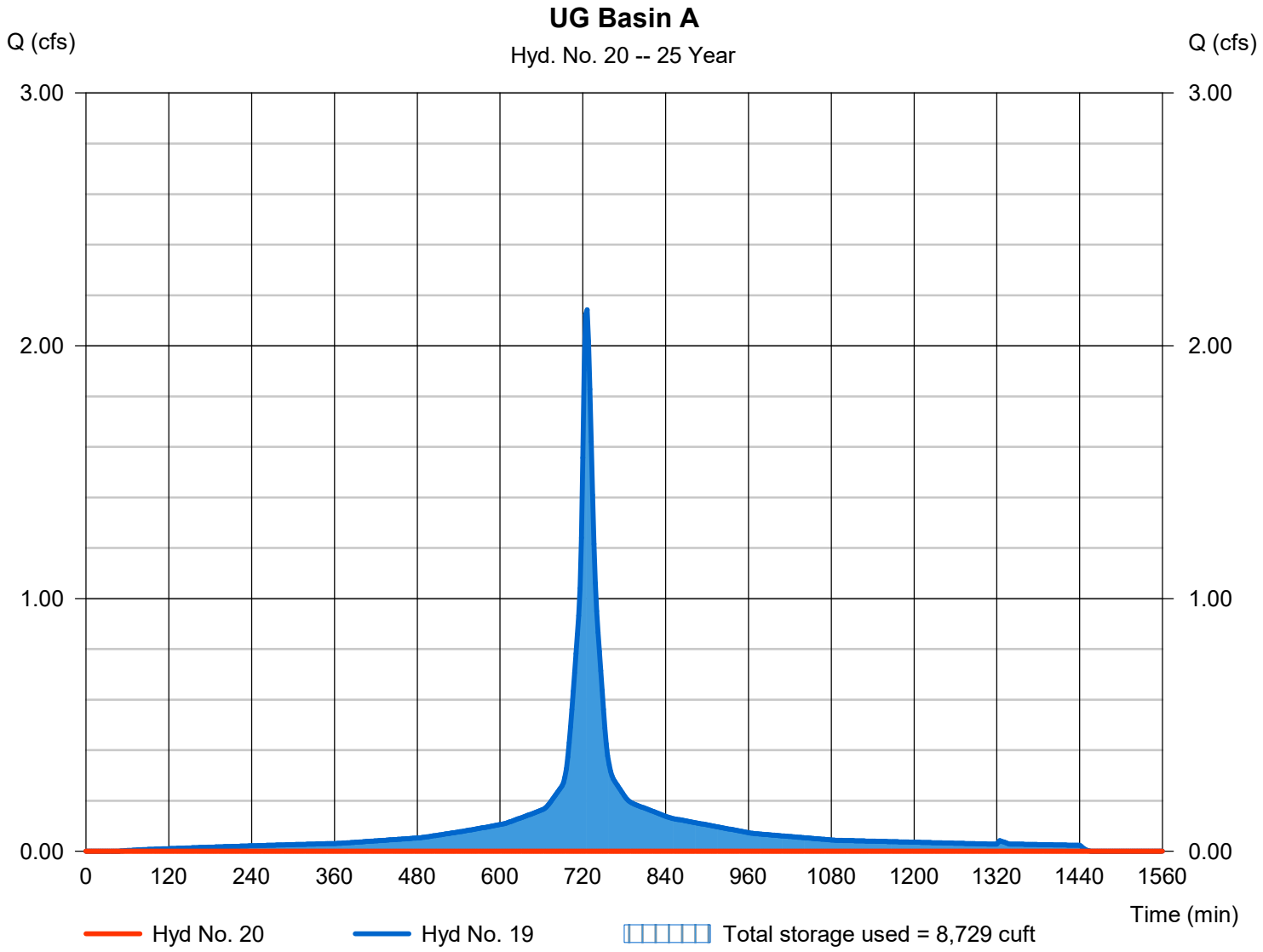
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Wednesday, 08 / 4 / 2021

Hyd. No. 20

UG Basin A

Hydrograph type	=	Reservoir	Peak discharge	=	0.000 cfs
Storm frequency	=	25 yrs	Time to peak	=	n/a
Time interval	=	2 min	Hyd. volume	=	0 cuft
Inflow hyd. No.	=	19 - Total Post Shed 3 UG Basin A	Max. Elevation	=	170.02 ft
Reservoir name	=	UG BASIN A	Max. Storage	=	8,729 cuft

Storage Indication method used.



Hydrograph Report

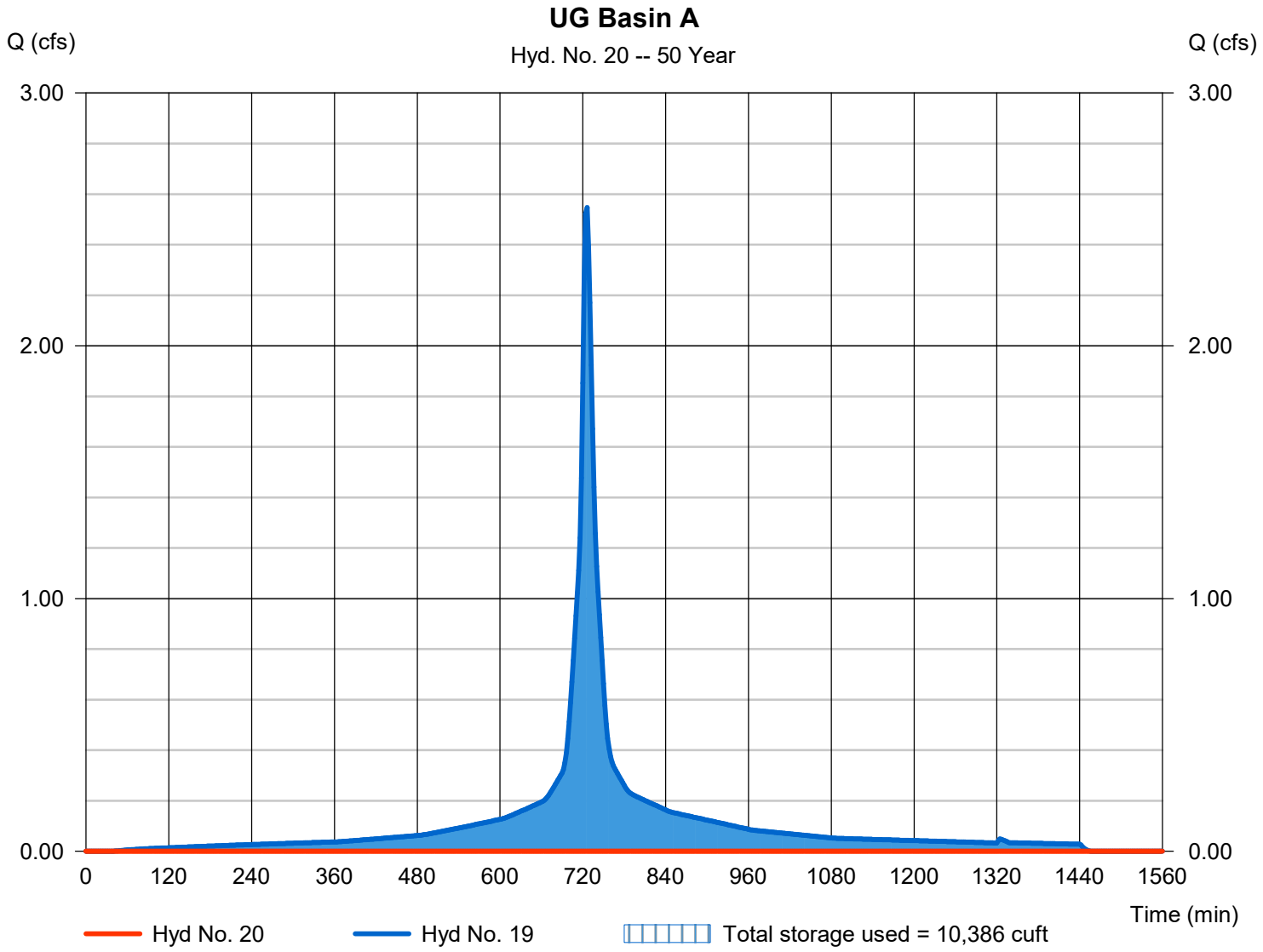
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Wednesday, 08 / 4 / 2021

Hyd. No. 20

UG Basin A

Hydrograph type	=	Reservoir	Peak discharge	=	0.000 cfs
Storm frequency	=	50 yrs	Time to peak	=	n/a
Time interval	=	2 min	Hyd. volume	=	0 cuft
Inflow hyd. No.	=	19 - Total Post Shed 3 UG Basin A	Max. Elevation	=	170.48 ft
Reservoir name	=	UG BASIN A	Max. Storage	=	10,386 cuft

Storage Indication method used.



Hydrograph Report

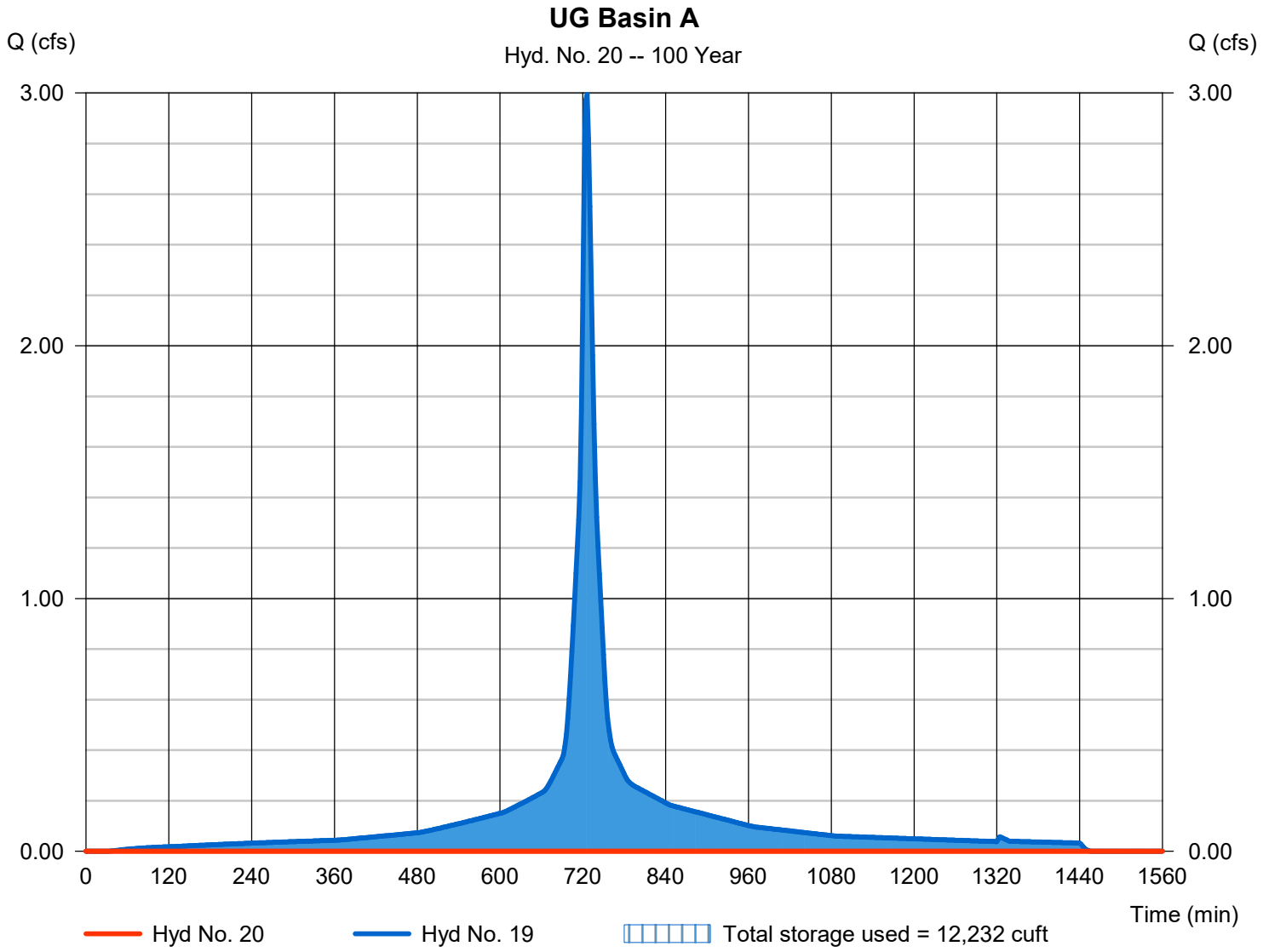
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Wednesday, 08 / 4 / 2021

Hyd. No. 20

UG Basin A

Hydrograph type	=	Reservoir	Peak discharge	=	0.000 cfs
Storm frequency	=	100 yrs	Time to peak	=	n/a
Time interval	=	2 min	Hyd. volume	=	0 cuft
Inflow hyd. No.	=	19 - Total Post Shed 3 UG Basin A	Max. Elevation	=	170.99 ft
Reservoir name	=	UG BASIN A	Max. Storage	=	12,232 cuft

Storage Indication method used.

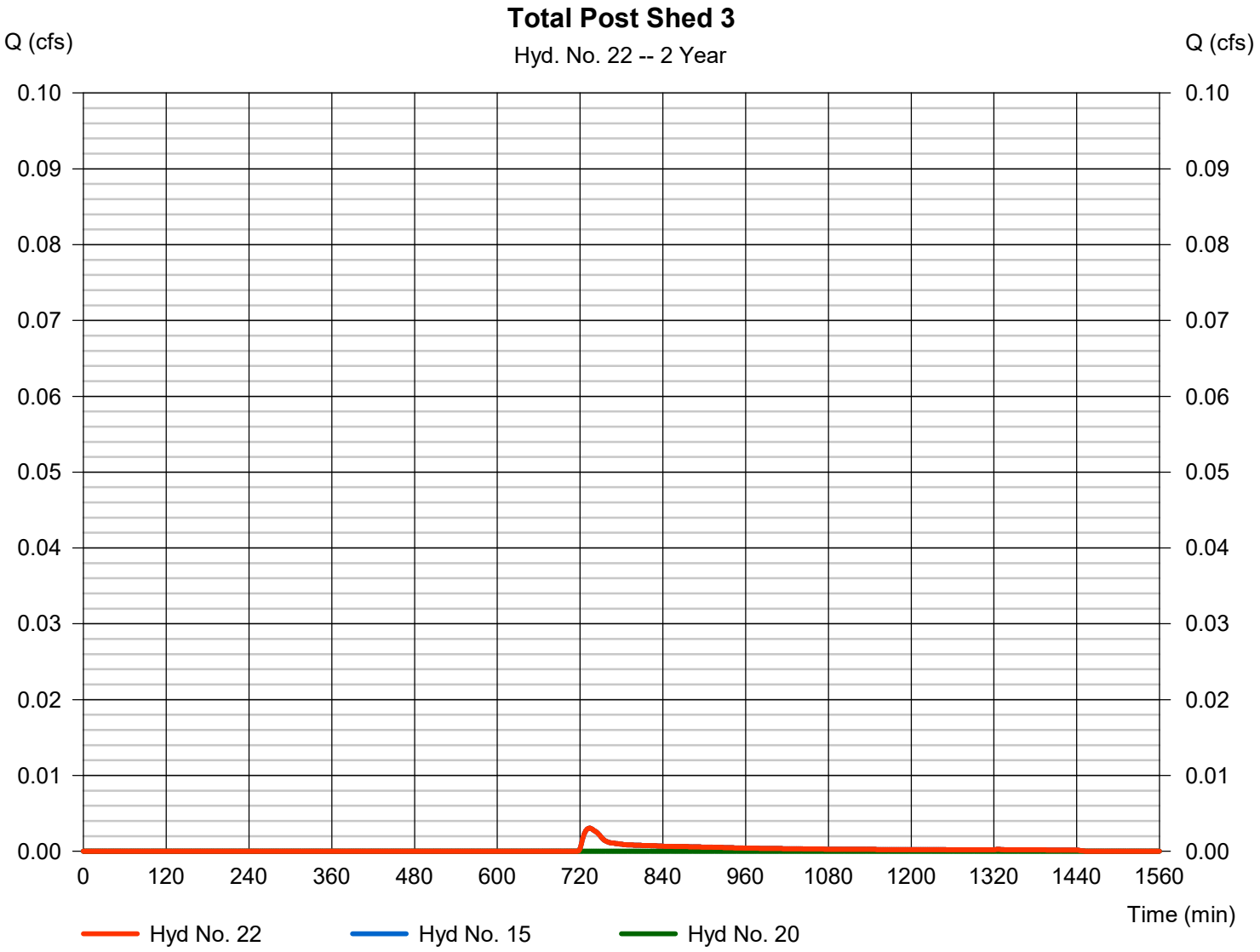


Hydrograph Report

Hyd. No. 22

Total Post Shed 3

Hydrograph type	= Combine	Peak discharge	= 0.003 cfs
Storm frequency	= 2 yrs	Time to peak	= 734 min
Time interval	= 2 min	Hyd. volume	= 20 cuft
Inflow hyds.	= 15, 20	Contrib. drain. area	= 0.015 ac

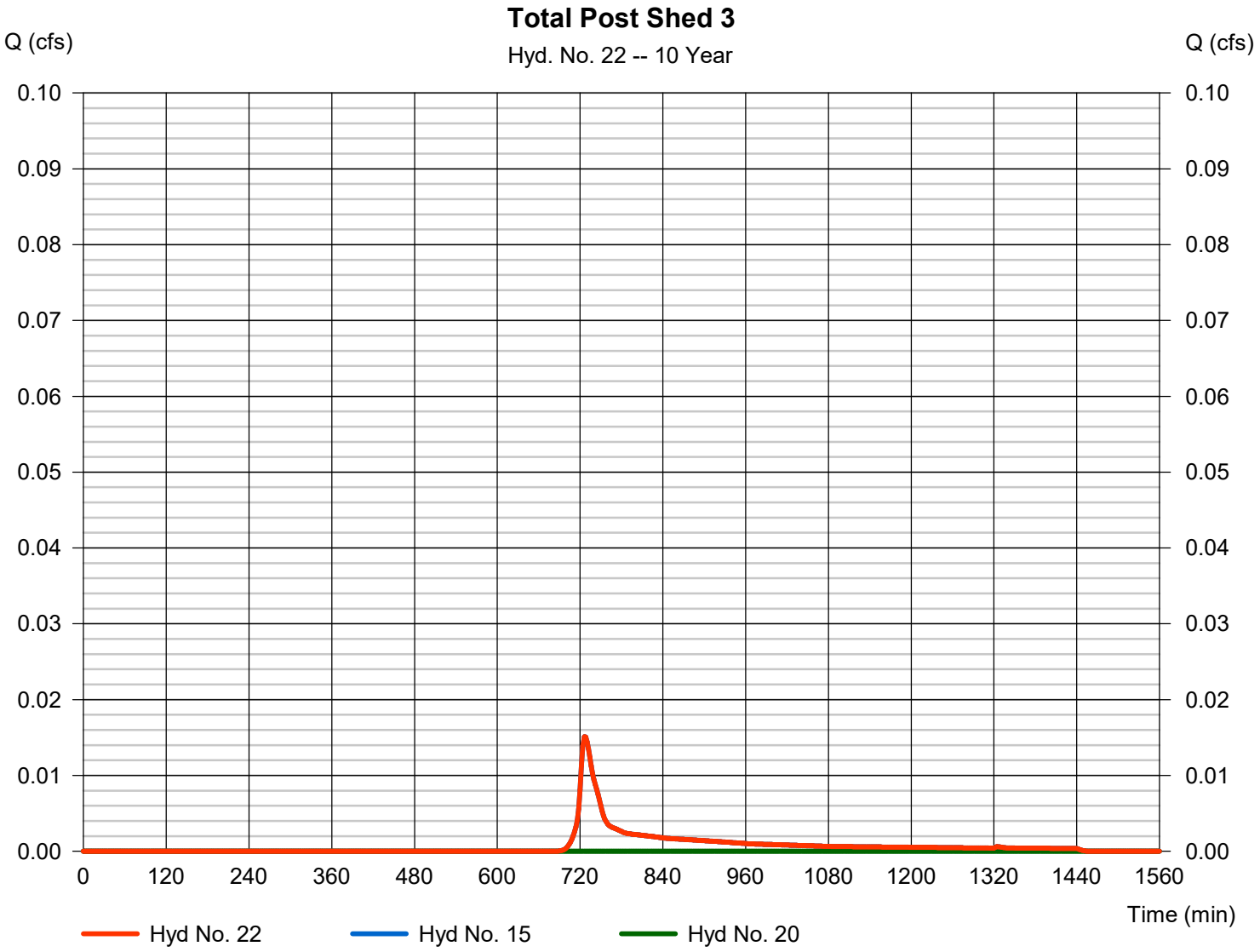


Hydrograph Report

Hyd. No. 22

Total Post Shed 3

Hydrograph type	= Combine	Peak discharge	= 0.015 cfs
Storm frequency	= 10 yrs	Time to peak	= 726 min
Time interval	= 2 min	Hyd. volume	= 64 cuft
Inflow hyds.	= 15, 20	Contrib. drain. area	= 0.015 ac



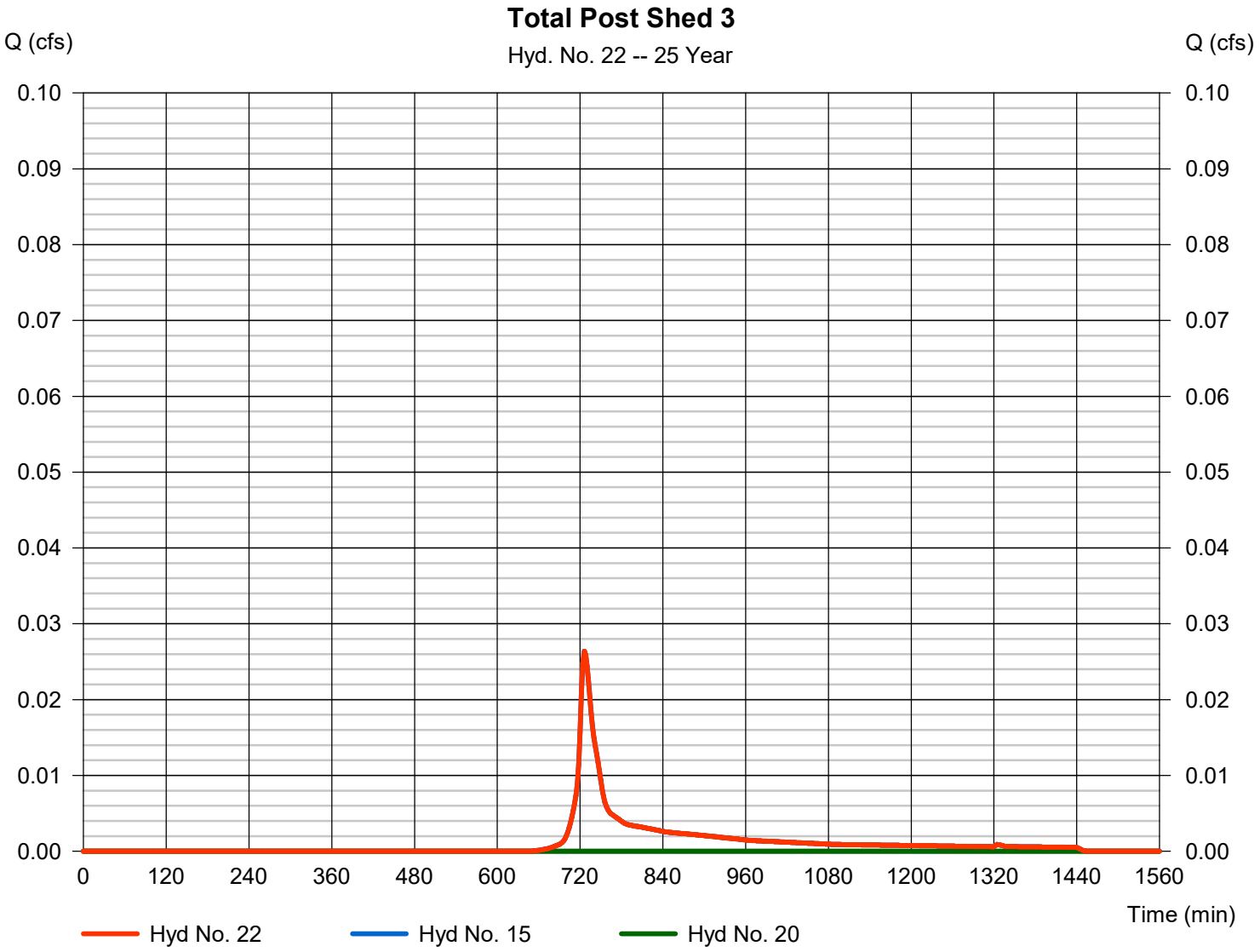
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Wednesday, 08 / 4 / 2021

Hyd. No. 22

Total Post Shed 3

Hydrograph type	= Combine	Peak discharge	= 0.026 cfs
Storm frequency	= 25 yrs	Time to peak	= 726 min
Time interval	= 2 min	Hyd. volume	= 102 cuft
Inflow hyds.	= 15, 20	Contrib. drain. area	= 0.015 ac

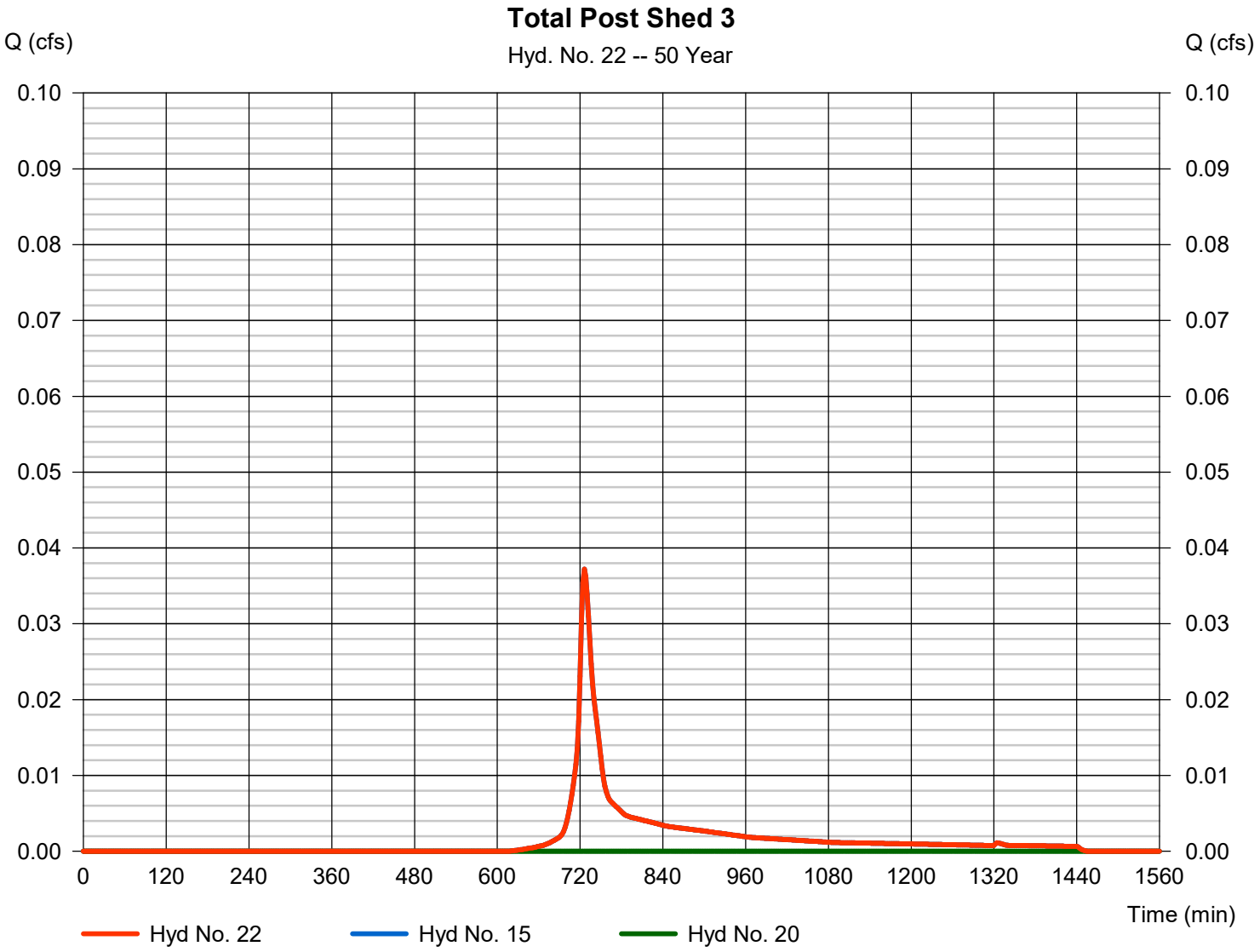


Hydrograph Report

Hyd. No. 22

Total Post Shed 3

Hydrograph type	= Combine	Peak discharge	= 0.037 cfs
Storm frequency	= 50 yrs	Time to peak	= 726 min
Time interval	= 2 min	Hyd. volume	= 139 cuft
Inflow hyds.	= 15, 20	Contrib. drain. area	= 0.015 ac

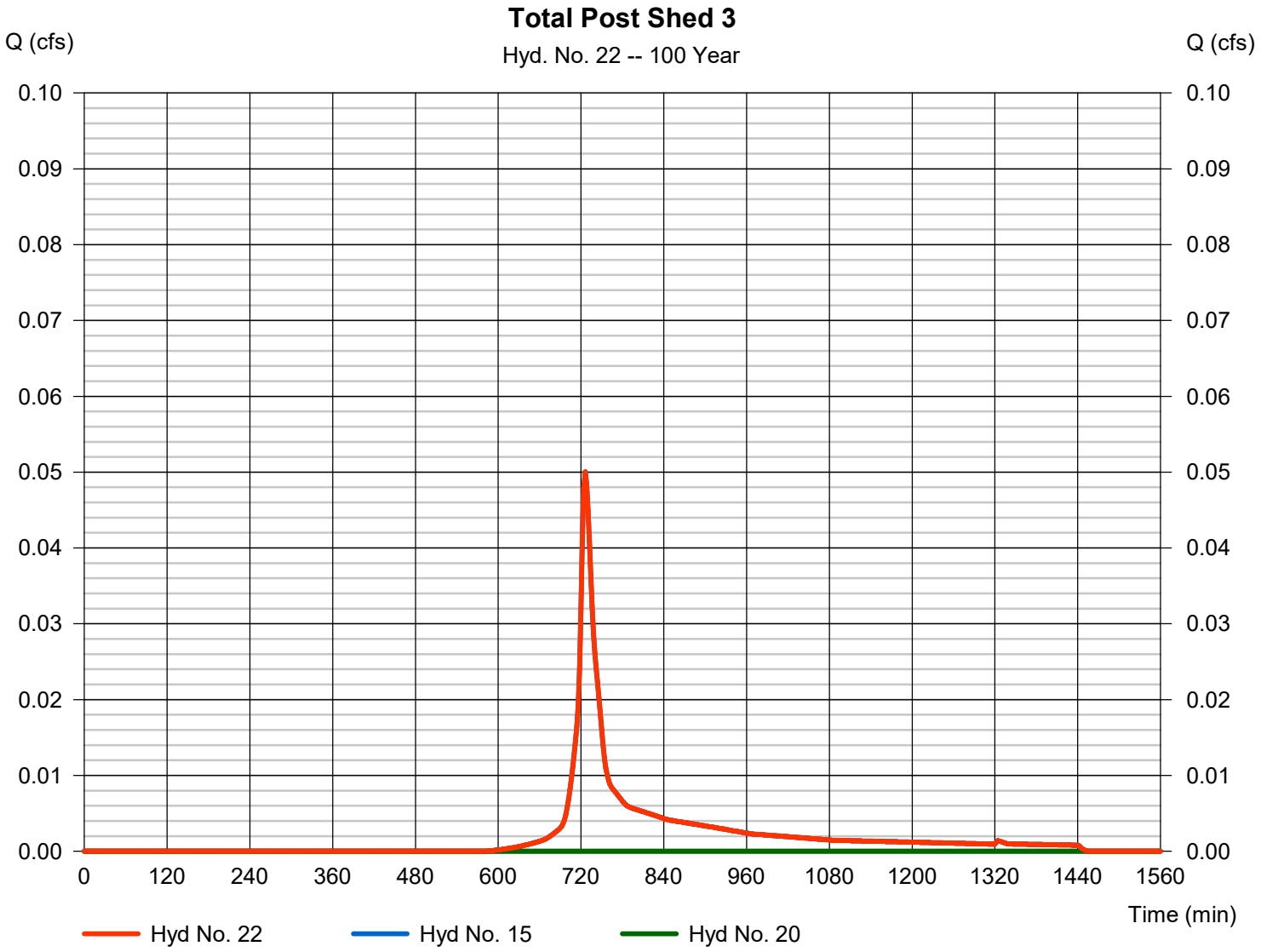


Hydrograph Report

Hyd. No. 22

Total Post Shed 3

Hydrograph type	= Combine	Peak discharge	= 0.050 cfs
Storm frequency	= 100 yrs	Time to peak	= 726 min
Time interval	= 2 min	Hyd. volume	= 184 cuft
Inflow hyds.	= 15, 20	Contrib. drain. area	= 0.015 ac



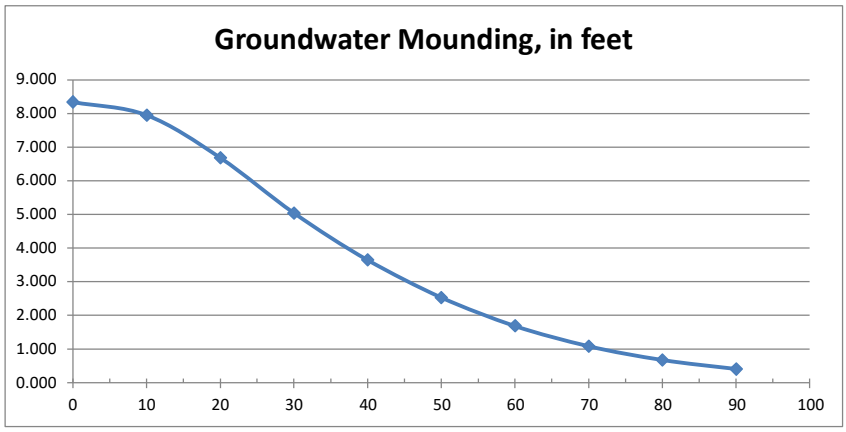
Input Values

4.98	*R*	Recharge rate (permeability rate) (in/hr)
		Specific yield, Sy (dimensionless)
0.150	Sy	default value is 0.15; max value is 0.2 provided that a lab test data is submitted
		Horizontal hydraulic conductivity (in/hr)
24.90	Kh	Kh = 5xRecharge Rate (R) in the costal plan; Kh=R outside the coastal plan
20.000	x	1/2 length of basin (x direction, in feet)
44.000	y	1/2 width of basin (y direction, in feet)
8.370	t	Duration of infiltration period (hours)
10.000	hi(0)	Initial thickness of saturated zone (feet)

18.343	h(max)	Maximum thickness of saturated zone (beneath center of basin at end of infiltration period)
8.343	Δh(max)	Maximum groundwater mounding (beneath center of basin at end of infiltration period)

Ground-water Mounding, in feet	Distance from center of basin in x direction, in feet
8.343	0
7.946	10
6.684	20
5.037	30
3.645	40
2.530	50
1.685	60
1.081	70
0.670	80
0.403	90

Re-Calculate Now



Disclaimer

This spreadsheet solving the Hantush (1967) equation for ground-water mounding beneath an infiltration basin is made available to the general public as a convenience for those wishing to replicate values documented in the USGS Scientific Investigations Report 2010-5102 "Groundwater mounding beneath hypothetical stormwater infiltration basins" or to calculate values based on user-specified site conditions. Any changes made to the spreadsheet (other than values identified as user-specified) after transmission from the USGS could have unintended, undesirable consequences. These consequences could include, but may not be limited to: erroneous output, numerical instabilities, and violations of underlying assumptions that are inherent in results presented in the accompanying USGS published report. The USGS assumes no responsibility for the consequences of any changes made to the spreadsheet. If changes are made to the spreadsheet, the user is responsible for documenting the changes and justifying the results and conclusions.

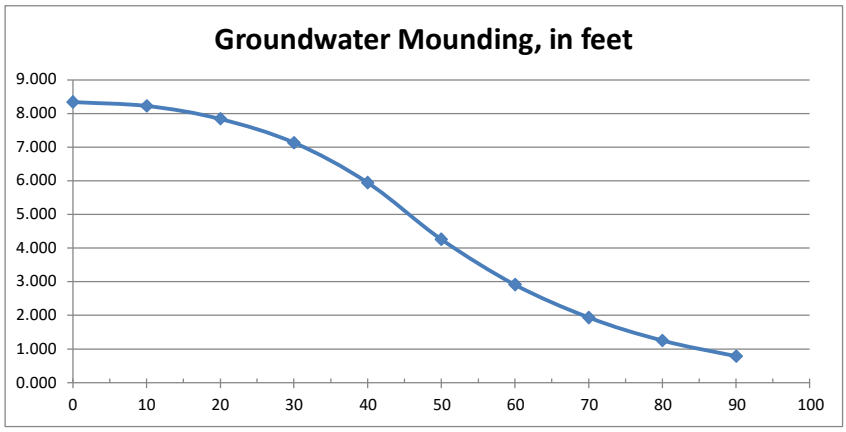
Input Values

4.98	*R*	Recharge rate (permeability rate) (in/hr)
0.150	Sy	Specific yield, Sy (dimensionless) default value is 0.15; max value is 0.2 provided that a lab test data is submitted
24.90	Kh	Horizontal hydraulic conductivity (in/hr) Kh = 5xRecharge Rate (R) in the costal plan; Kh=R outside the coastal plan
44.000	x	1/2 length of basin (x direction, in feet)
20.000	y	1/2 width of basin (y direction, in feet)
8.370	t	Duration of infiltration period (hours)
10.000	hi(0)	Initial thickness of saturated zone (feet)

18.343	h(max)	Maximum thickness of saturated zone (beneath center of basin at end of infiltration period)
8.343	Δh(max)	Maximum groundwater mounding (beneath center of basin at end of infiltration period)

Ground-water Mounding, in feet	Distance from center of basin in x direction, in feet
8.343	0
8.222	10
7.840	20
7.130	30
5.946	40
4.262	50
2.911	60
1.934	70
1.248	80
0.784	90

Re-Calculate Now



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This spreadsheet solving the Hantush (1967) equation for ground-water mounding beneath an infiltration basin is made available to the general public as a convenience for those wishing to replicate values documented in the USGS Scientific Investigations Report 2010-5102 "Groundwater mounding beneath hypothetical stormwater infiltration basins" or to calculate values based on user-specified site conditions. Any changes made to the spreadsheet (other than values identified as user-specified) after transmission from the USGS could have unintended, undesirable consequences. These consequences could include, but may not be limited to: erroneous output, numerical instabilities, and violations of underlying assumptions that are inherent in results presented in the accompanying USGS published report. The USGS assumes no responsibility for the consequences of any changes made to the spreadsheet. If changes are made to the spreadsheet, the user is responsible for documenting the changes and justifying the results and conclusions.

WATERSHED #5 AREA

- DRAINAGE AREAS/ WEIGHTED CN VALUES
- TIME OF CONCENTRATION CALCULATIONS
- HYDROGRAPHS (2, 10, 25, 50, & 100 yr)

POST-DEVELOPMENT SHED COVERAGE CALCULATIONS

Project Name:	Angelo Pizza LD
Location:	Berlin Twp, Camden County
Project Number:	3824
Prepared By:	Colin Camp
Date:	July 14, 2021

Cover	CN Values			
	Soil A	Soil B	Soil C	Soil D
Impervious	98	98	98	98
Meadow	30	58	71	78
Woodland	36	60	73	79
Cultivated	75	85	90	92
Lawn	49	69	79	84

Shed ID	Post-Shed 5			
Soil Type	Cover	Area (Ac.)	CN Value	CN*Area
A	Meadow	0.00	30	0.00
	Woodland	0.00	36	0.00
	Cultivated	0.00	75	0.00
	Lawn	0.00	49	0.00
B	Meadow	0.06	58	3.28
	Woodland	0.00	60	0.00
	Cultivated	0.00	85	0.00
	Lawn	0.00	69	0.00
C	Meadow	0.00	71	0.00
	Woodland	0.00	73	0.00
	Cultivated	0.00	90	0.00
	Lawn	0.00	79	0.00
D	Meadow	0.00	78	0.00
	Woodland	0.00	79	0.00
	Cultivated	0.00	92	0.00
	Lawn	0.00	84	0.00
IMPERVIOUS			98	0.00
			Total Area:	0.06
			Wtd CN:	58.00

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Thursday, 07 / 15 / 2021

Hyd. No. 29

Post Shed 5

Hydrograph type	= SCS Runoff	Peak discharge	= 0.012 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.23 hrs
Time interval	= 2 min	Hyd. volume	= 77 cuft
Drainage area	= 0.056 ac	Curve number	= 58
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 3.31 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 284

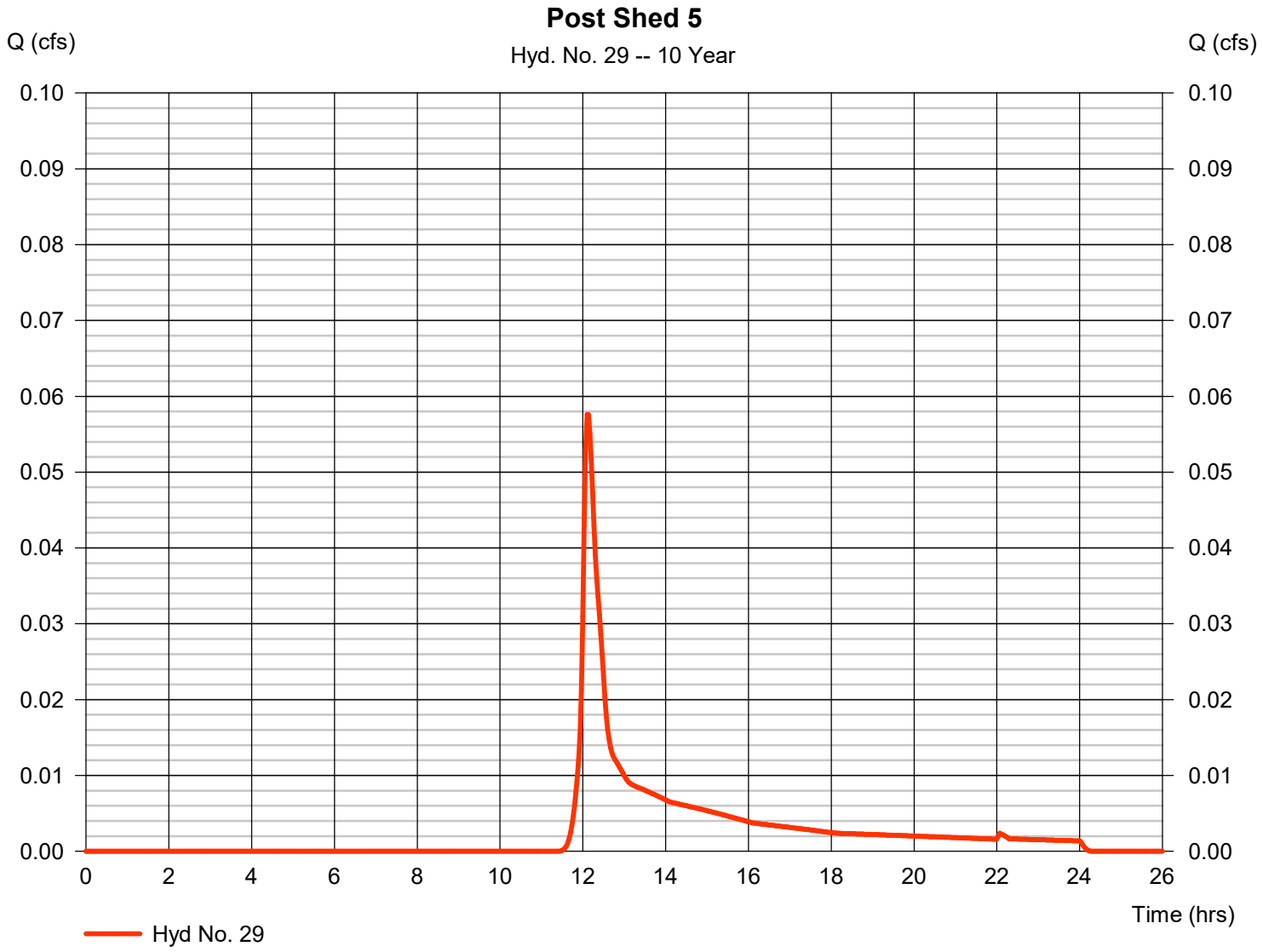
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Thursday, 07 / 15 / 2021

Hyd. No. 29

Post Shed 5

Hydrograph type	= SCS Runoff	Peak discharge	= 0.058 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.10 hrs
Time interval	= 2 min	Hyd. volume	= 243 cuft
Drainage area	= 0.056 ac	Curve number	= 58
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 5.05 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 284



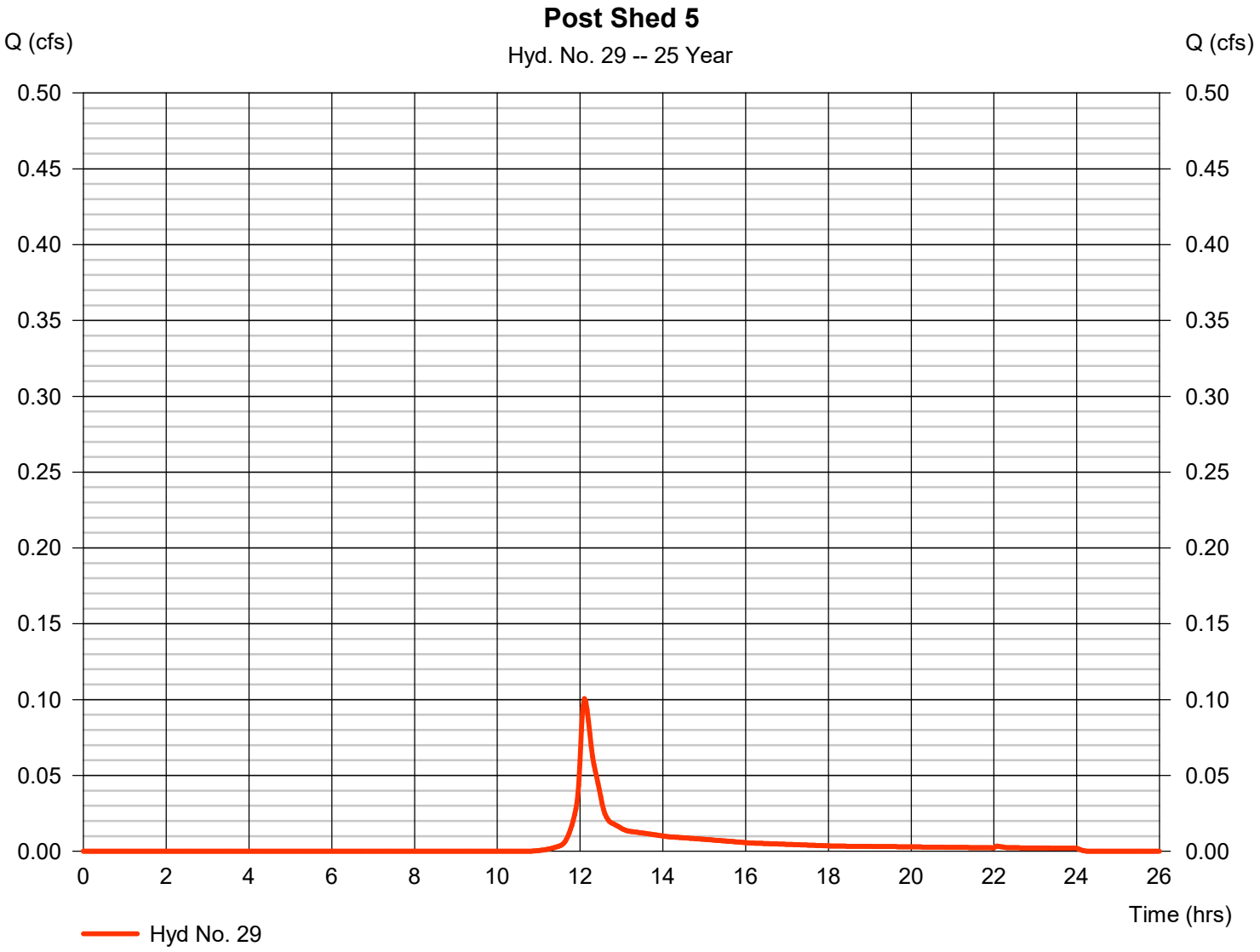
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Thursday, 07 / 15 / 2021

Hyd. No. 29

Post Shed 5

Hydrograph type	= SCS Runoff	Peak discharge	= 0.101 cfs
Storm frequency	= 25 yrs	Time to peak	= 12.10 hrs
Time interval	= 2 min	Hyd. volume	= 390 cuft
Drainage area	= 0.056 ac	Curve number	= 58
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 6.26 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 284



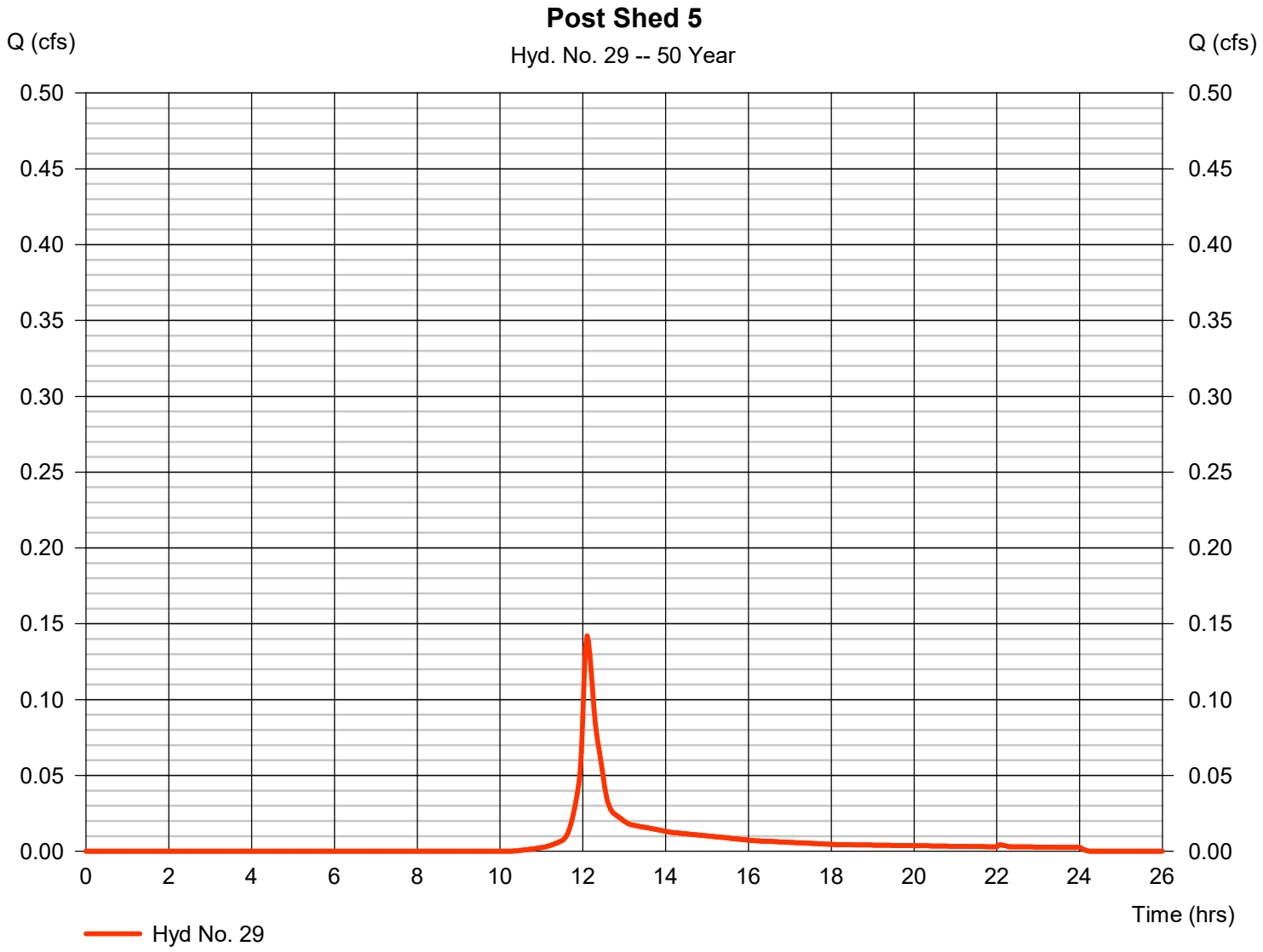
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Thursday, 07 / 15 / 2021

Hyd. No. 29

Post Shed 5

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.142 cfs
Storm frequency	=	50 yrs	Time to peak	=	12.10 hrs
Time interval	=	2 min	Hyd. volume	=	533 cuft
Drainage area	=	0.056 ac	Curve number	=	58
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	6.00 min
Total precip.	=	7.31 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	284



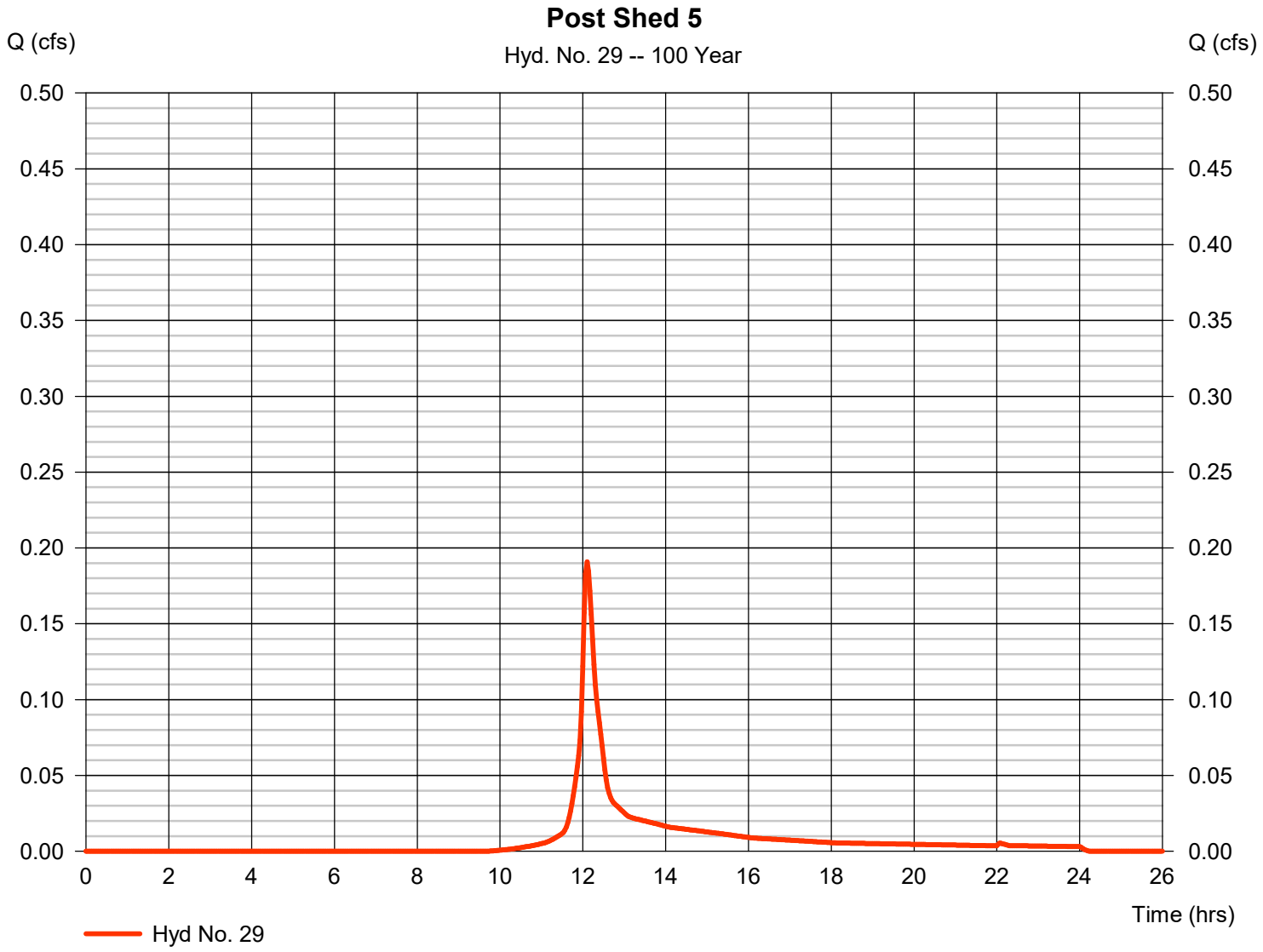
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Thursday, 07 / 15 / 2021

Hyd. No. 29

Post Shed 5

Hydrograph type	= SCS Runoff	Peak discharge	= 0.191 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.10 hrs
Time interval	= 2 min	Hyd. volume	= 702 cuft
Drainage area	= 0.056 ac	Curve number	= 58
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 8.47 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 284



Appendix G

HYDROGRAPH ADDITIONS

PRE-DEVELOPMENT HYDROGRAPH ADDITIONS

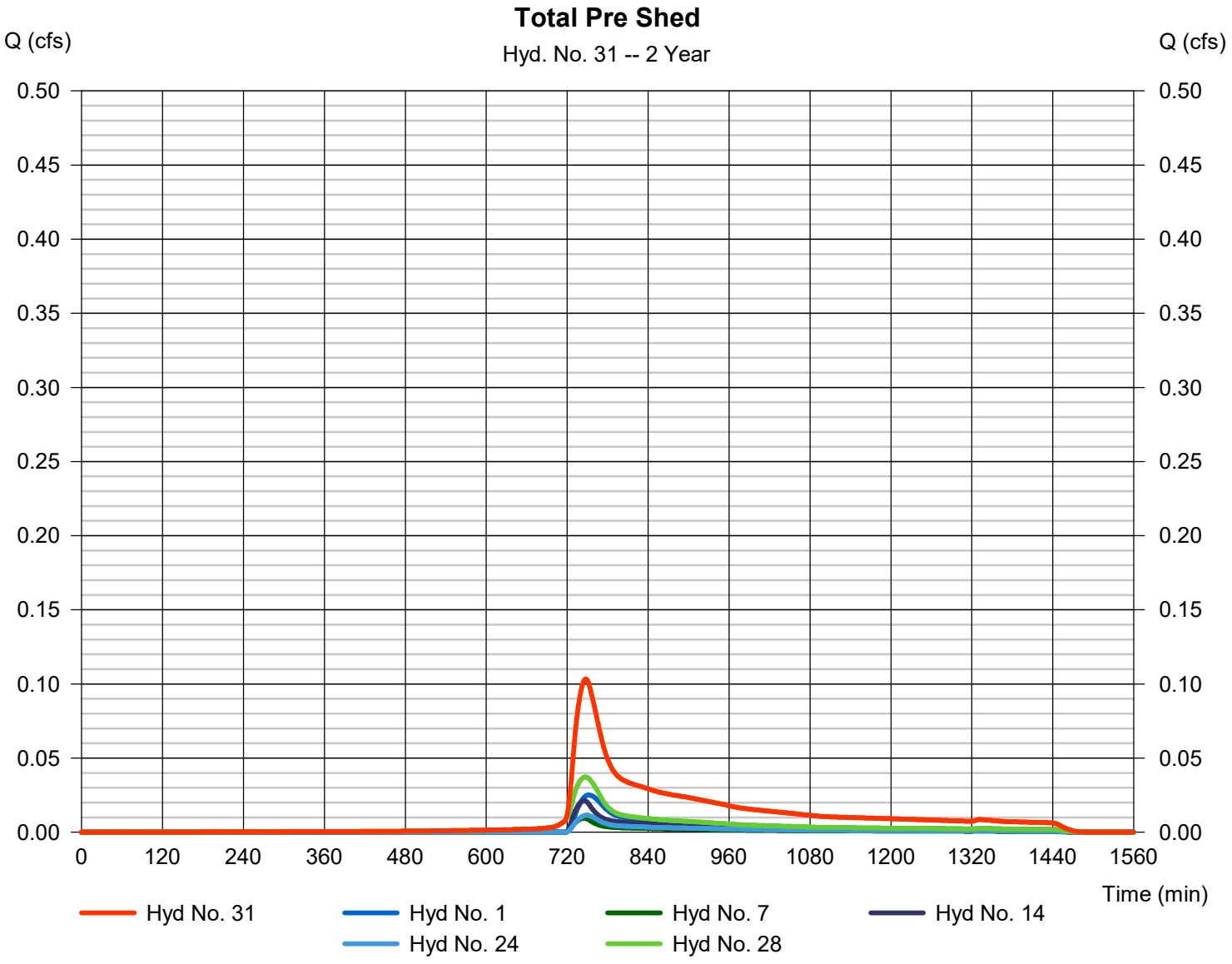
(2. 10, 25, 50, & 100 yr)

Hydrograph Report

Hyd. No. 31

Total Pre Shed

Hydrograph type	= Combine	Peak discharge	= 0.103 cfs
Storm frequency	= 2 yrs	Time to peak	= 748 min
Time interval	= 2 min	Hyd. volume	= 883 cuft
Inflow hyds.	= 1, 7, 14, 24, 28	Contrib. drain. area	= 0.413 ac

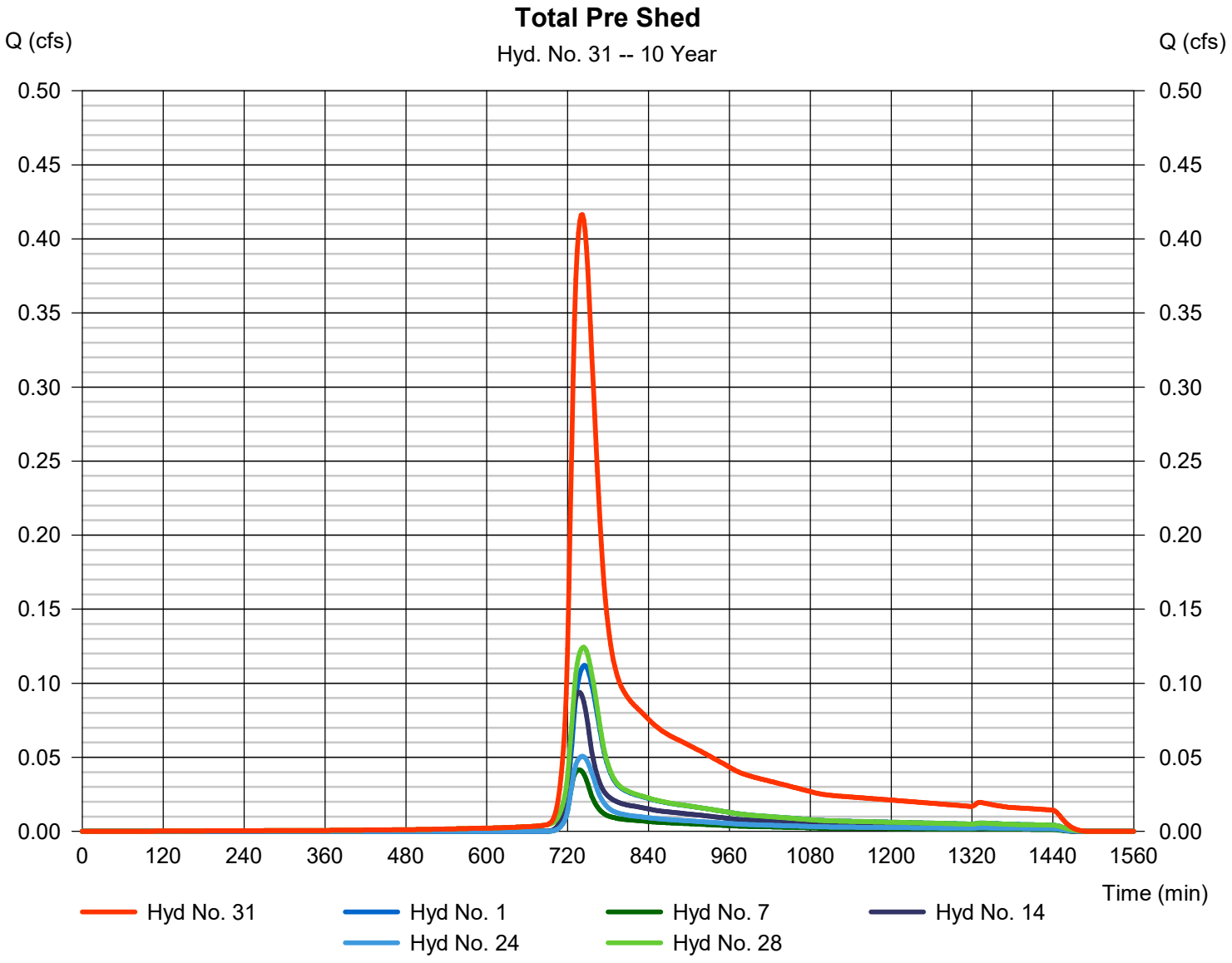


Hydrograph Report

Hyd. No. 31

Total Pre Shed

Hydrograph type	= Combine	Peak discharge	= 0.416 cfs
Storm frequency	= 10 yrs	Time to peak	= 742 min
Time interval	= 2 min	Hyd. volume	= 2,601 cuft
Inflow hyds.	= 1, 7, 14, 24, 28	Contrib. drain. area	= 0.413 ac



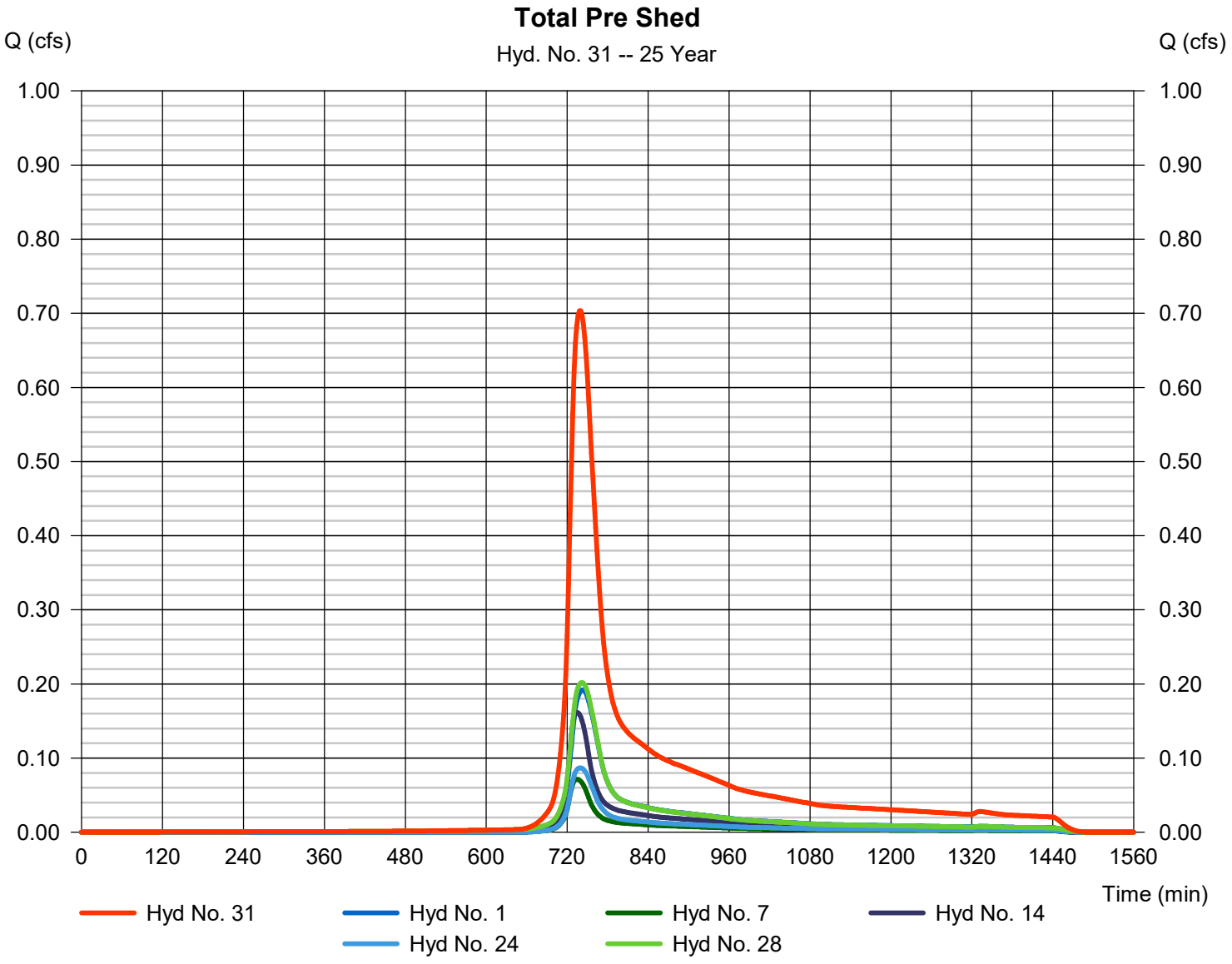
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Wednesday, 08 / 4 / 2021

Hyd. No. 31

Total Pre Shed

Hydrograph type	= Combine	Peak discharge	= 0.703 cfs
Storm frequency	= 25 yrs	Time to peak	= 738 min
Time interval	= 2 min	Hyd. volume	= 4,114 cuft
Inflow hyds.	= 1, 7, 14, 24, 28	Contrib. drain. area	= 0.413 ac



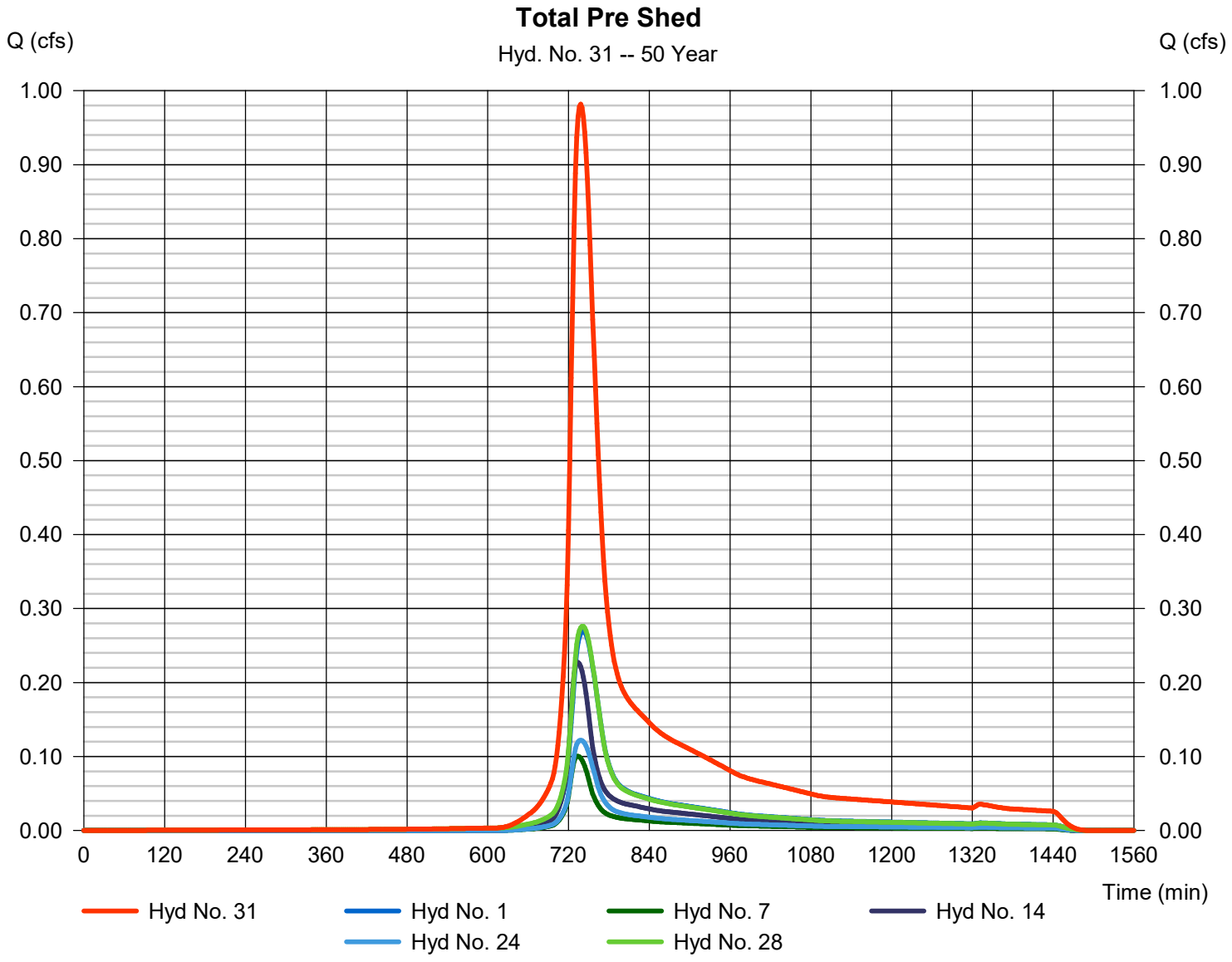
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Wednesday, 08 / 4 / 2021

Hyd. No. 31

Total Pre Shed

Hydrograph type	= Combine	Peak discharge	= 0.982 cfs
Storm frequency	= 50 yrs	Time to peak	= 738 min
Time interval	= 2 min	Hyd. volume	= 5,575 cuft
Inflow hyds.	= 1, 7, 14, 24, 28	Contrib. drain. area	= 0.413 ac



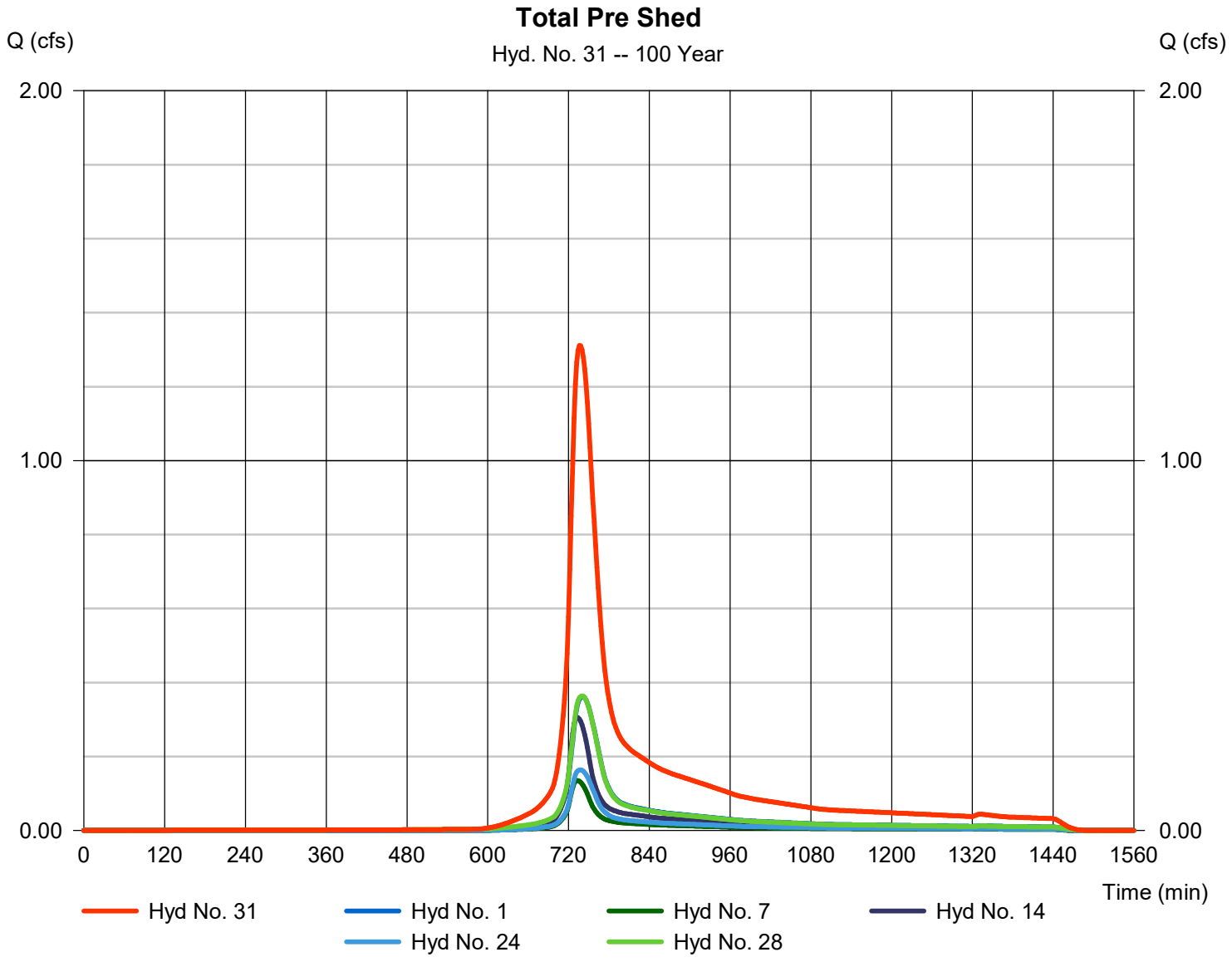
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Wednesday, 08 / 4 / 2021

Hyd. No. 31

Total Pre Shed

Hydrograph type	= Combine	Peak discharge	= 1.311 cfs
Storm frequency	= 100 yrs	Time to peak	= 736 min
Time interval	= 2 min	Hyd. volume	= 7,310 cuft
Inflow hyds.	= 1, 7, 14, 24, 28	Contrib. drain. area	= 0.413 ac



POST-DEVELOPMENT HYDROGRAPH ADDITIONS

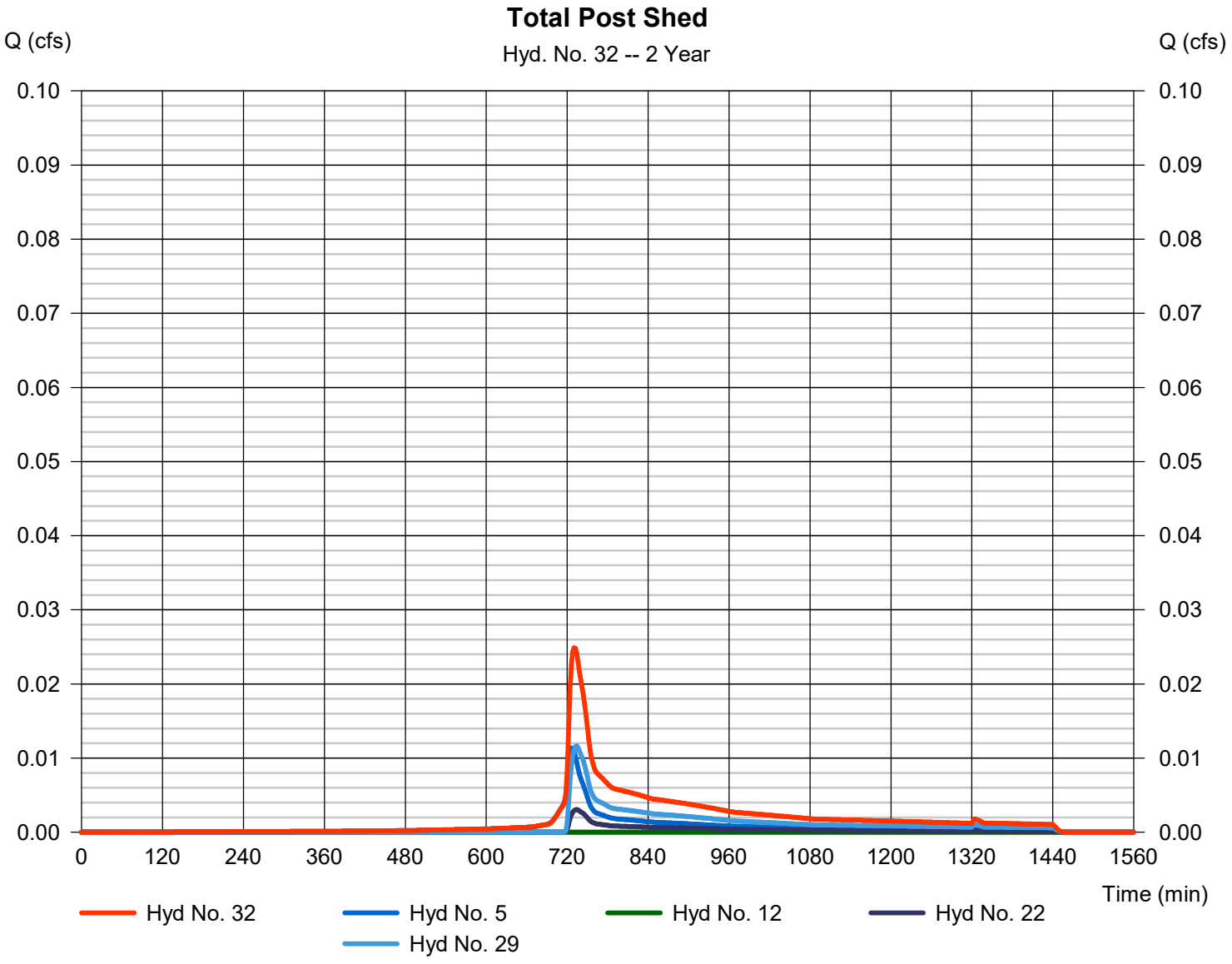
(2, 10, 25, 50, & 100 yr)

Hydrograph Report

Hyd. No. 32

Total Post Shed

Hydrograph type	= Combine	Peak discharge	= 0.025 cfs
Storm frequency	= 2 yrs	Time to peak	= 730 min
Time interval	= 2 min	Hyd. volume	= 158 cuft
Inflow hyds.	= 5, 12, 22, 29	Contrib. drain. area	= 0.056 ac

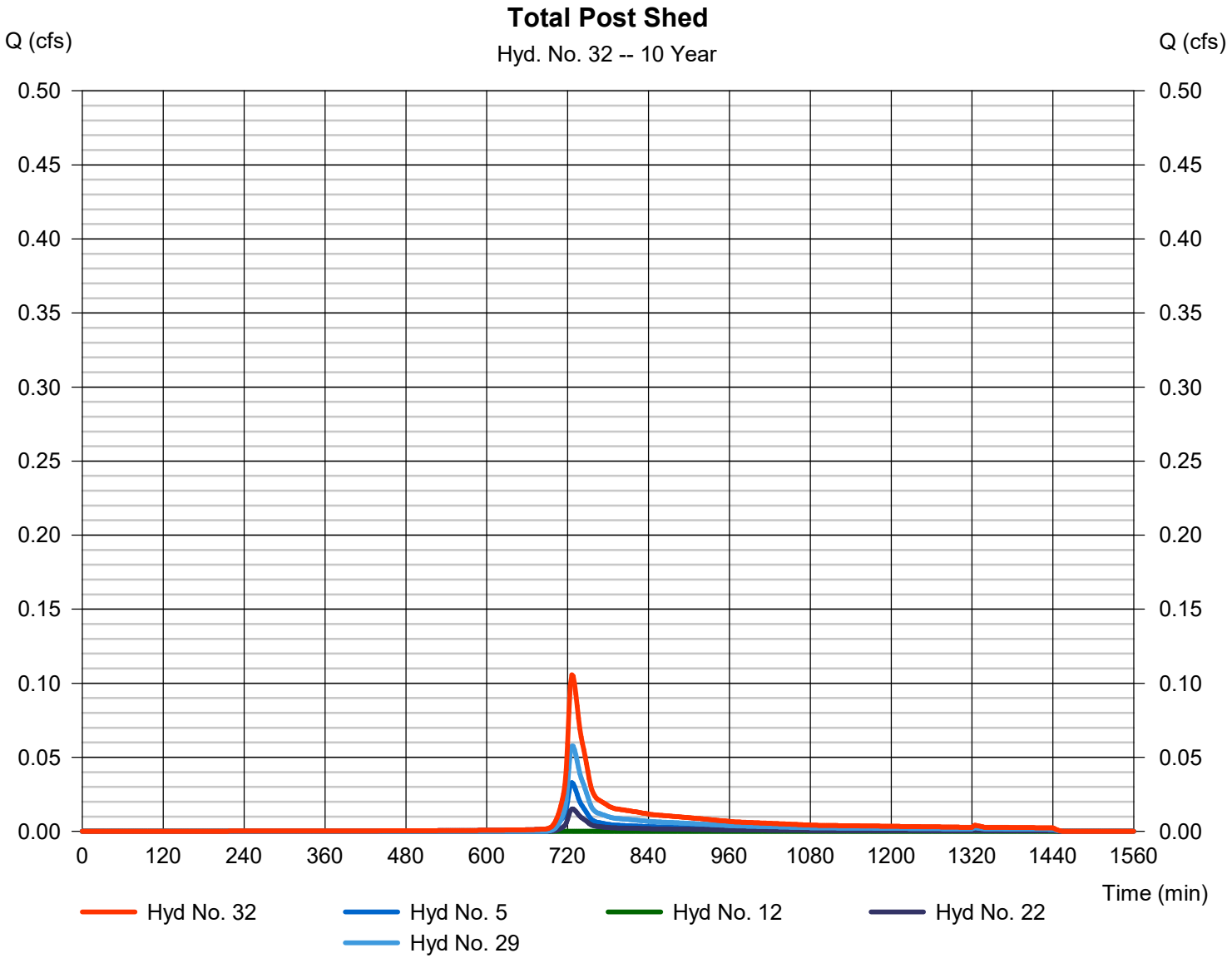


Hydrograph Report

Hyd. No. 32

Total Post Shed

Hydrograph type	= Combine	Peak discharge	= 0.106 cfs
Storm frequency	= 10 yrs	Time to peak	= 726 min
Time interval	= 2 min	Hyd. volume	= 445 cuft
Inflow hyds.	= 5, 12, 22, 29	Contrib. drain. area	= 0.056 ac

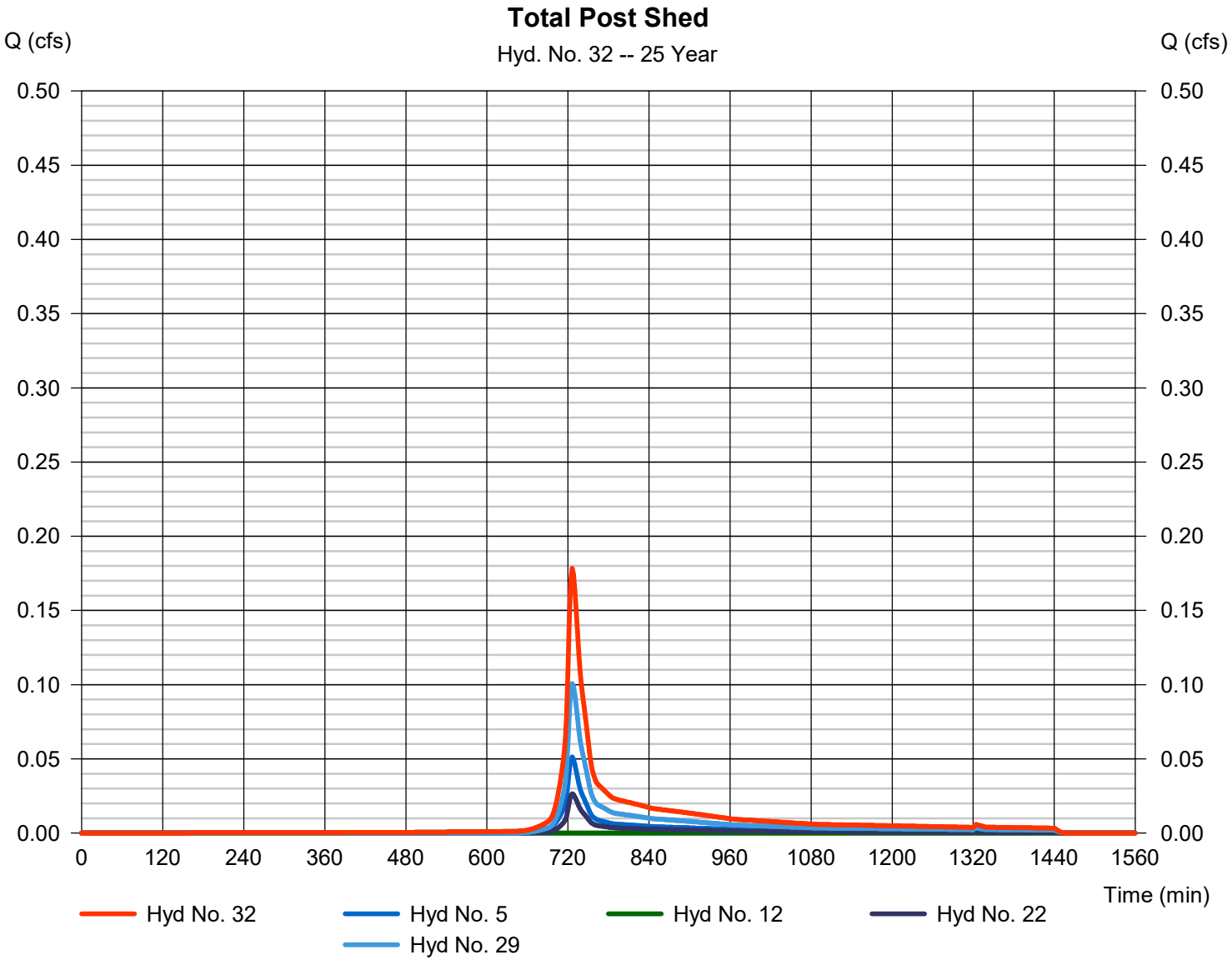


Hydrograph Report

Hyd. No. 32

Total Post Shed

Hydrograph type	= Combine	Peak discharge	= 0.178 cfs
Storm frequency	= 25 yrs	Time to peak	= 726 min
Time interval	= 2 min	Hyd. volume	= 695 cuft
Inflow hyds.	= 5, 12, 22, 29	Contrib. drain. area	= 0.056 ac

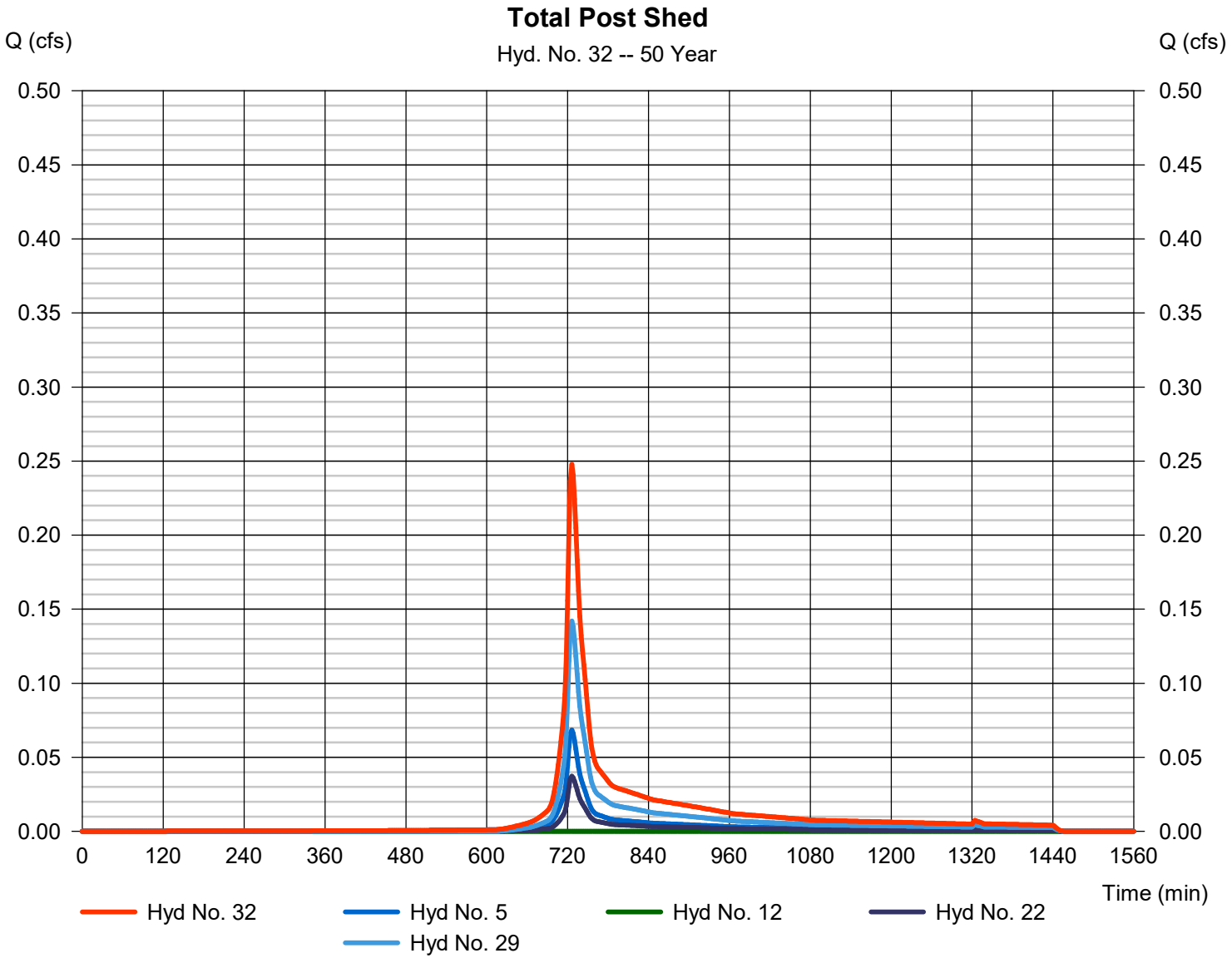


Hydrograph Report

Hyd. No. 32

Total Post Shed

Hydrograph type	= Combine	Peak discharge	= 0.248 cfs
Storm frequency	= 50 yrs	Time to peak	= 726 min
Time interval	= 2 min	Hyd. volume	= 937 cuft
Inflow hyds.	= 5, 12, 22, 29	Contrib. drain. area	= 0.056 ac

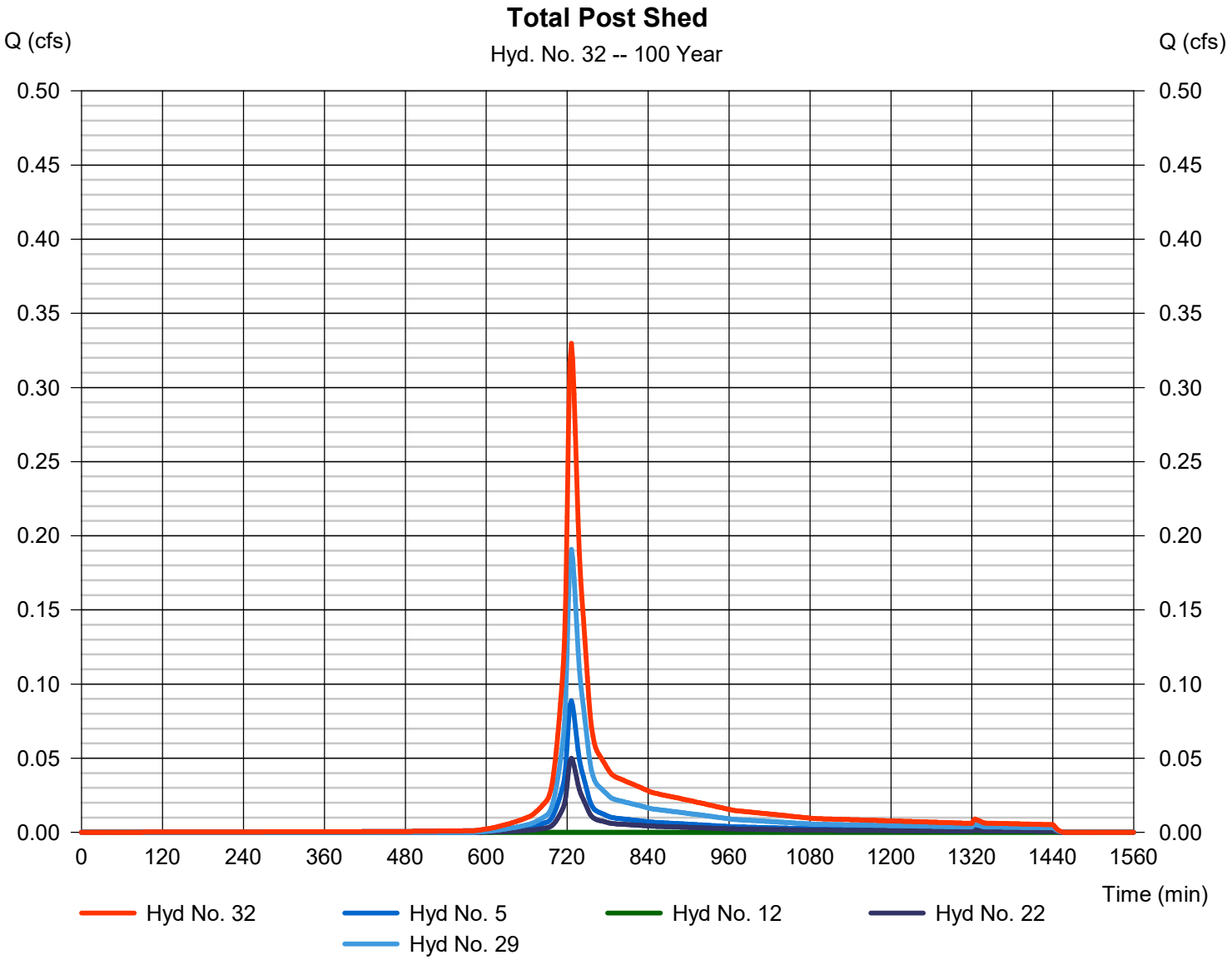


Hydrograph Report

Hyd. No. 32

Total Post Shed

Hydrograph type	= Combine	Peak discharge	= 0.330 cfs
Storm frequency	= 100 yrs	Time to peak	= 726 min
Time interval	= 2 min	Hyd. volume	= 1,223 cuft
Inflow hyds.	= 5, 12, 22, 29	Contrib. drain. area	= 0.056 ac



Appendix H

DRAINAGE SWALE CALCULATIONS

STANDARD WORKSHEET #11
Channel Design Data

PROJECT NAME: My Angelo's Pizza LD
LOCATION: Berlin Twp, Camden County, NJ
PREPARED BY: Colin Camp DATE: July 13, 2021
CHECKED BY: _____ DATE: _____

CHANNEL OR CHANNEL SECTION	SWALE A01				
TEMPORARY OR PERMANENT? (T OR P)	T				
DESIGN STORM (2,5 OR 10 YR)	2-Year				
ACRES (AC)	0.09				
MULTIPLIER (1.6, 2.25, OR 2.75) [1]	1.6				
Q_r (REQUIRED CAPACITY) (CFS)	0.21				
Q (CALCULATED AT FLOW DEPTH d) (CFS)	0.21				
PROTECTIVE LINING [2]	Grass: 2in				
n (MANNING'S COEFFICENT) [2]	0.04				
V_a (ALLOWABLE VELOCITY) (FPS)	3.00				
V (CALCULATED AT FLOW DEPTH, d) (FT/S)	0.85				
t_a (MAX ALLOWABLE SHEAR STRESS) (LB/FT^2)	N/A				
t_d (SHEAR STRESS AT FLOW DEPTH d) (LB/FT^2)	N/A				
CHANNEL BOTTOM WIDTH (FT)	1.00				
CHANNEL SIDE SLOPES (H:V) (FT)	3.00 :1				
D (TOTAL DEPTH) (FT)	1.00				
CHANNEL TOP WIDTH (FT)@ D (FT)	7.00				
d (CALCULATED FLOW DEPTH) (FT)	0.17				
CHANNEL TOP WIDTH @ d (FT)	2.00				
BOTTOM WIDTH: FLOW DEPTH RATIO (12:1 MAX)	6.01 :1				
d_{50} STONE SIZE (IN)	N/A				
A (CROSS-SECTIONAL AREA) (SQ. FT.)	0.25				
R (HYDRAULIC RADIUS)	0.12				
S (BED SLOPE) [3] (FT/FT)	0.01				
S_c (CRITICAL SLOPE) (FT/FT)	0.06				
$.7S_c$	0.04				
$1.3S_c$	0.07				
STABLE FLOW? (Y/N)	Y				
FREEBOARD BASED ON UNSTABLE FLOW (FT)	N/A				
FREEBOARD BASED ON STABLE FLOW (FT)	0.04				
MINIMUM REQUIRED FREEBOARD [4] (FT)	0.50				
DESIGN METHOD FOR PROTECTIVE LINING [5] PERMISSIBLE VELOCITY (V) OR SHEAR STRESS (S)	V				
VEGETATIVE LINING RETARDANCE	C				

[1] Use 1.6 for Temporary Channels; 2.25 for Temporary Channels in Special Protection (HQ or EV) Watersheds; 2.75 for Permanent Channels. For Rartional Method, enter "N/A" and attach E&S Worksheets 9 and 10. For TR-55 enter "N/A" and attach appropriate Worksheets.

[2] Adjust "n" value for changes in channel liner and flow depth. For vegetated channels, provide data for manufactured linings without vegetation and with vegetation in separate columns.

[3] Slopes may not be averaged.

[4] Minimum freeboard (F) is 0.5 ft. or 1/4 Total Channel Depth, whichever is greater.

[5] Permissable velocity lining design method is not acceptable for channels with a bed slope of 10% or greater. Shear stress lining design method is required for channels with a bed slope of 10% or greater. Shear stress lining design method may be used for any channel bed slope.

STANDARD WORKSHEET #11
Channel Design Data

PROJECT NAME: Angelo's Pizza LD
LOCATION: Berlin Twp, Camden County, NJ
PREPARED BY: Colin Camp DATE: July 13, 2021
CHECKED BY: DATE:

CHANNEL OR CHANNEL SECTION	SWALE A01				
TEMPORARY OR PERMANENT? (T OR P)	P				
DESIGN STORM (2,5 OR 10 YR)	10-Year				
ACRES (AC)	0.10				
MULTIPLIER (1.6, 2.25, OR 2.75) [1]	2.75				
Q_r (REQUIRED CAPACITY) (CFS)	0.33				
Q (CALCULATED AT FLOW DEPTH d) (CFS)	0.33				
PROTECTIVE LINING [2]	SC250				
n (MANNING'S COEFFICENT) [2]	0.03				
V_a (ALLOWABLE VELOCITY) (FPS)	9.50				
V (CALCULATED AT FLOW DEPTH, d) (FT/S)	1.19				
t_a (MAX ALLOWABLE SHEAR STRESS) (LB/FT^2)	N/A				
t_d (SHEAR STRESS AT FLOW DEPTH d) (LB/FT^2)	N/A				
CHANNEL BOTTOM WIDTH (FT)	1.00				
CHANNEL SIDE SLOPES (H:V) (FT)	3.00 :1				
D (TOTAL DEPTH) (FT)	2.00				
CHANNEL TOP WIDTH (FT)@ D (FT)	13.00				
d (CALCULATED FLOW DEPTH) (FT)	0.18				
CHANNEL TOP WIDTH @ d (FT)	2.08				
BOTTOM WIDTH: FLOW DEPTH RATIO (12:1 MAX)	5.53 :1				
d_{50} STONE SIZE (IN)	N/A				
A (CROSS-SECTIONAL AREA) (SQ. FT.)	0.28				
R (HYDRAULIC RADIUS)	0.13				
S (BED SLOPE) [3] (FT/FT)	0.01				
S_c (CRITICAL SLOPE) (FT/FT)	0.03				
.7S_c	0.02				
1.3S_c	0.04				
STABLE FLOW? (Y/N)	Y				
FREEBOARD BASED ON UNSTABLE FLOW (FT)	N/A				
FREEBOARD BASED ON STABLE FLOW (FT)	0.05				
MINIMUM REQUIRED FREEBOARD [4] (FT)	0.50				
DESIGN METHOD FOR PROTECTIVE LINING [5] PERMISSIBLE VELOCITY (V) OR SHEAR STRESS (S)	V				
VEGETATIVE LINING RETARDANCE	N/A				

[1] Use 1.6 for Temporary Channels; 2.25 for Temporary Channels in Special Protection (HQ or EV) Watersheds; 2.75 for Permanent Channels. For Rartional Method, enter "N/A" and attach E&S Worksheets 9 and 10. For TR-55 enter "N/A" and attach appropriate Worksheets.

[2] Adjust "n" value for changes in channel liner and flow depth. For vegetated channels, provide data for manufactured linings without vegetation and with vegetation in separate columns.

[3] Slopes may not be averaged.

[4] Minimum freeboard (F) is 0.5 ft. or 1/4 Total Channel Depth, whichever is greater.

[5] Permissable velocity lining design method is not acceptable for channels with a bed slope of 10% or greater. Shear stress lining design method is required for channels with a bed slope of 10% or greater. Shear stress lining design method may be used for any channel bed slope.

Appendix I

INLET SHED CALCULATIONS

INLET SHED COVERAGE CALCULATIONS

Project Name: Angelo's Pizza LD
Location: Berlin Twp, Camden County
Project Number: 3824
Prepared By: Colin Camp
Date: July 12, 2021

Cover	C Value
Impervious	0.9
Roof	0.8
Meadow	0.3
Woodland	0.28
Stone	0.6
Cultivated	0.53
Lawn	0.35

Shed I.D.	Total Area (Ac.)	Impervious Area	Roof Area	Meadow Area	Woodland Area	Stone Area	Cultivated Area	Lawn Area	Weighted C
A001	0.11	0.04	0.03					0.04	0.68
A002	0.02	0.02						0.00	0.91
A003	0.24	0.21						0.03	0.83
SWALE A01/A004	0.09	0.01	0.04					0.04	0.58

THE CROSSROADS GROUP, LLC
19526 Pottsville Pike
Hamburg, PA 19526

NOAA Atlas 14, Volume 2, Version 3
Location name: West Berlin, New Jersey, USA*
Latitude: 39.8097°, Longitude: -74.9418°
Elevation: 172.79 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

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

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

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

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**4.20** (3.82-4.61)	**4.99** (4.55-5.48)	**5.89** (5.35-6.47)	**6.58** (5.96-7.22)	**7.40** (6.68-8.14)	**8.02** (7.20-8.82)	**8.62** (7.70-9.50)	**9.16** (8.14-10.2)	**9.83** (8.63-11.0)	**10.4** (9.02-11.7)
10-min	**3.35** (3.05-3.68)	**4.00** (3.64-4.39)	**4.72** (4.28-5.18)	**5.26** (4.77-5.77)	**5.90** (5.33-6.48)	**6.38** (5.74-7.02)	**6.84** (6.12-7.55)	**7.26** (6.44-8.05)	**7.78** (6.83-8.68)	**8.17** (7.10-9.18)
15-min	**2.79** (2.54-3.06)	**3.35** (3.05-3.68)	**3.98** (3.61-4.36)	**4.44** (4.02-4.87)	**4.98** (4.50-5.48)	**5.38** (4.84-5.93)	**5.76** (5.16-6.36)	**6.11** (5.42-6.76)	**6.52** (5.73-7.28)	**6.83** (5.94-7.68)
30-min	**1.92** (1.74-2.10)	**2.31** (2.10-2.54)	**2.83** (2.57-3.10)	**3.21** (2.91-3.53)	**3.69** (3.33-4.06)	**4.05** (3.64-4.46)	**4.42** (3.95-4.87)	**4.75** (4.22-5.27)	**5.19** (4.56-5.79)	**5.53** (4.81-6.22)
60-min	**1.19** (1.09-1.31)	**1.45** (1.32-1.59)	**1.81** (1.65-1.99)	**2.09** (1.90-2.30)	**2.46** (2.22-2.70)	**2.75** (2.47-3.02)	**3.04** (2.72-3.35)	**3.33** (2.96-3.69)	**3.72** (3.27-4.16)	**4.04** (3.51-4.54)
2-hr	**0.720** (0.650-0.797)	**0.874** (0.790-0.968)	**1.10** (0.990-1.22)	**1.28** (1.15-1.41)	**1.51** (1.35-1.68)	**1.71** (1.52-1.89)	**1.90** (1.68-2.11)	**2.10** (1.84-2.35)	**2.37** (2.05-2.67)	**2.58** (2.21-2.93)
3-hr	**0.524** (0.474-0.582)	**0.636** (0.575-0.706)	**0.801** (0.722-0.888)	**0.935** (0.840-1.04)	**1.12** (0.995-1.24)	**1.26** (1.12-1.40)	**1.42** (1.25-1.58)	**1.58** (1.37-1.76)	**1.79** (1.54-2.02)	**1.97** (1.67-2.24)
6-hr	**0.328** (0.296-0.366)	**0.396** (0.358-0.442)	**0.496** (0.448-0.554)	**0.582** (0.522-0.648)	**0.701** (0.624-0.781)	**0.802** (0.708-0.894)	**0.909** (0.795-1.02)	**1.02** (0.883-1.15)	**1.19** (1.00-1.34)	**1.32** (1.10-1.51)
12-hr	**0.197** (0.179-0.221)	**0.238** (0.216-0.267)	**0.301** (0.271-0.336)	**0.356** (0.319-0.397)	**0.436** (0.387-0.486)	**0.506** (0.445-0.565)	**0.582** (0.505-0.652)	**0.666** (0.569-0.750)	**0.790** (0.659-0.897)	**0.899** (0.735-1.03)
24-hr	**0.114** (0.105-0.123)	**0.138** (0.127-0.150)	**0.177** (0.163-0.192)	**0.210** (0.193-0.228)	**0.261** (0.238-0.282)	**0.304** (0.276-0.328)	**0.353** (0.318-0.380)	**0.407** (0.363-0.438)	**0.489** (0.430-0.526)	**0.560** (0.485-0.602)
2-day	**0.065** (0.060-0.071)	**0.079** (0.073-0.086)	**0.102** (0.094-0.111)	**0.121** (0.111-0.132)	**0.149** (0.136-0.162)	**0.174** (0.158-0.189)	**0.201** (0.181-0.217)	**0.231** (0.206-0.250)	**0.275** (0.242-0.299)	**0.314** (0.273-0.341)
3-day	**0.046** (0.042-0.050)	**0.056** (0.052-0.060)	**0.071** (0.066-0.077)	**0.084** (0.078-0.091)	**0.104** (0.095-0.112)	**0.120** (0.109-0.130)	**0.138** (0.125-0.149)	**0.158** (0.142-0.171)	**0.188** (0.167-0.203)	**0.214** (0.187-0.231)
4-day	**0.036** (0.034-0.039)	**0.044** (0.041-0.048)	**0.056** (0.052-0.060)	**0.066** (0.061-0.071)	**0.081** (0.074-0.087)	**0.093** (0.085-0.100)	**0.107** (0.097-0.115)	**0.122** (0.110-0.131)	**0.145** (0.129-0.155)	**0.164** (0.144-0.176)
7-day	**0.024** (0.023-0.026)	**0.029** (0.027-0.031)	**0.037** (0.034-0.039)	**0.043** (0.040-0.046)	**0.052** (0.048-0.056)	**0.060** (0.055-0.064)	**0.068** (0.062-0.073)	**0.077** (0.070-0.083)	**0.091** (0.081-0.097)	**0.102** (0.090-0.110)
10-day	**0.019** (0.018-0.021)	**0.023** (0.022-0.025)	**0.028** (0.027-0.030)	**0.033** (0.031-0.035)	**0.039** (0.036-0.042)	**0.045** (0.041-0.048)	**0.050** (0.046-0.054)	**0.056** (0.051-0.060)	**0.065** (0.059-0.069)	**0.072** (0.065-0.078)
20-day	**0.013** (0.012-0.014)	**0.015** (0.015-0.016)	**0.019** (0.018-0.020)	**0.021** (0.020-0.022)	**0.025** (0.023-0.026)	**0.027** (0.026-0.029)	**0.030** (0.028-0.032)	**0.033** (0.031-0.035)	**0.037** (0.034-0.039)	**0.040** (0.037-0.043)
30-day	**0.011** (0.010-0.011)	**0.013** (0.012-0.013)	**0.015** (0.014-0.016)	**0.017** (0.016-0.018)	**0.019** (0.018-0.020)	**0.021** (0.020-0.022)	**0.023** (0.022-0.024)	**0.025** (0.023-0.026)	**0.028** (0.026-0.029)	**0.030** (0.027-0.031)
45-day	**0.009** (0.009-0.010)	**0.011** (0.010-0.011)	**0.012** (0.012-0.013)	**0.014** (0.013-0.015)	**0.016** (0.015-0.016)	**0.017** (0.016-0.018)	**0.018** (0.017-0.019)	**0.019** (0.018-0.020)	**0.021** (0.020-0.022)	**0.022** (0.021-0.023)
60-day	**0.008** (0.008-0.009)	**0.010** (0.009-0.010)	**0.011** (0.011-0.012)	**0.012** (0.012-0.013)	**0.014** (0.013-0.014)	**0.015** (0.014-0.015)	**0.015** (0.015-0.016)	**0.016** (0.015-0.017)	**0.017** (0.016-0.018)	**0.018** (0.017-0.019)

[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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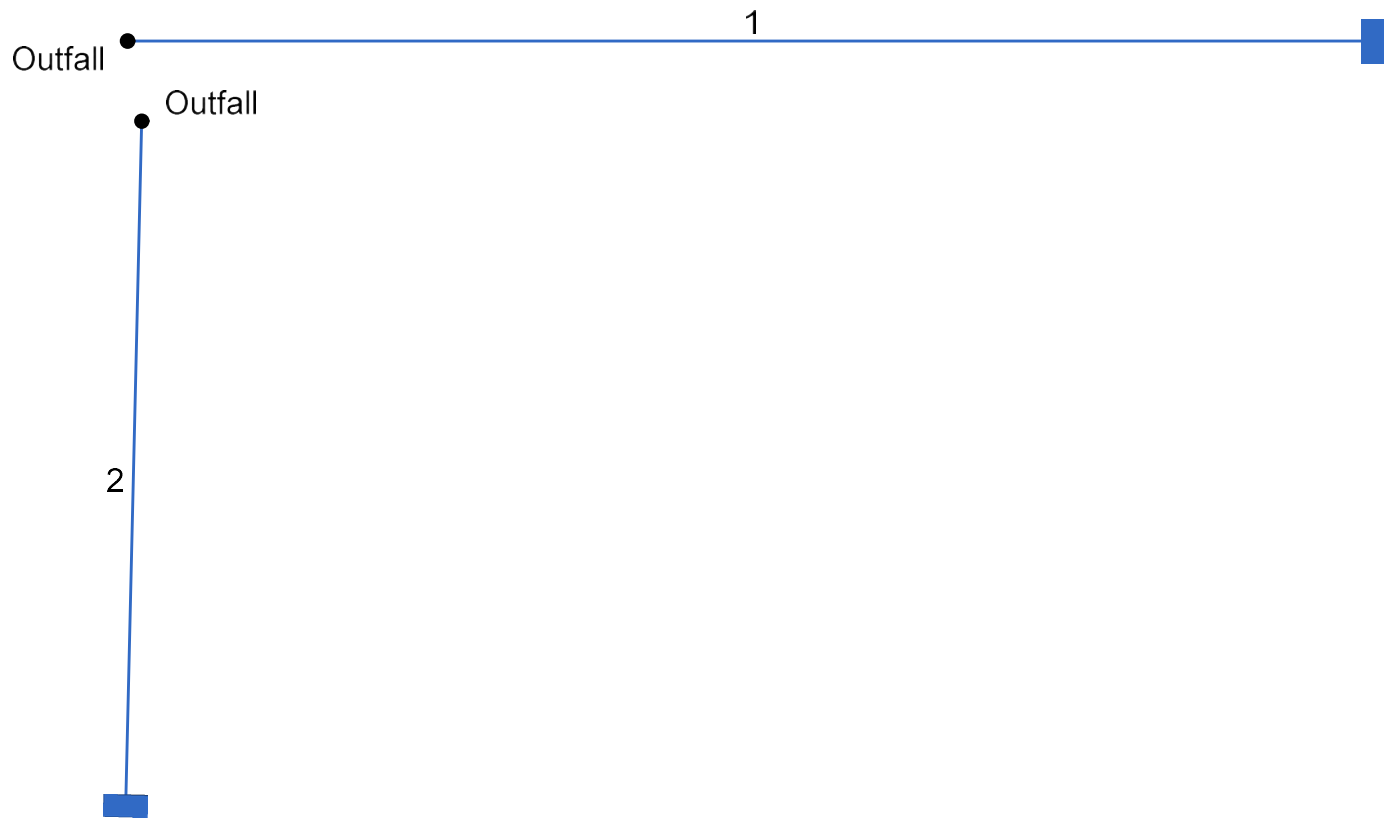
PF graphical

Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: 3824 Pipes.stm	Number of lines: 2	Date: 8/4/2021

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	A001-A002	0.62	12	Cir	112.870	167.50	169.30	1.595	167.74	169.63	0.12	169.63	End	Grate
2	B003-UG BASIN A	0.43	12	Cir	62.400	167.50	169.90	3.846	167.66	170.17	n/a	170.17	End	Grate

Project File: 3824 Pipes.stm | Number of lines: 2 | Run Date: 8/4/2021

NOTES: Return period = 100 Yrs.

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		0.62	0.00	0.61	0.00	Grate	0.0	0.00	0.00	4.00	2.00	0.055	2.00	0.050	0.020	0.013	0.11	2.69	0.02	0.36	0.0	Off
2		0.43	0.00	0.43	0.00	Grate	0.0	0.00	0.00	4.00	2.00	0.055	2.00	0.050	0.020	0.013	0.10	1.99	0.00	0.00	0.0	Off

Project File: 3824 Pipes.stm | Number of lines: 2 | Run Date: 8/4/2021

NOTES: Inlet N-Values = 0.016; Intensity = 49.83 / (Inlet time + 9.30) ^ 0.66; Return period = 100 Yrs. ; * Indicates Known Q added. All curb inlets are Horiz throat.

Appendix J

POST CONSTRUCTION BMP'S

BMP PLANTING SCHEDULE

SEEDING SPECIFICATIONS
FOR PROPOSED BMP'S

The following seeding specifications are recommended for BMP's in Pennsylvania. If a different seed mixture is to be used it must be approved by the appropriate Conservation District prior to application. The seeding mixtures provided below are available from Ernst Conservation Seeds, Meadville PA, 1-800-373-3321, www.ernstseed.com.

General Site Preparation:

Eliminate any weed growth prior to seed installation using an appropriate herbicide to control undesirable vegetation. Supplement topsoil with leaf compost mixed thoroughly into the top 8 inches of soil. For optimal seed establishment, soil pH shall be between 5.5 and 6.5.

Seeding Application:

Carefully proportioning seed for the entire area, broadcast seed into two separate applications by applying seed at half the suggested rate for each application to ensure even and adequate coverage. After the full rate of seeding has been achieved, follow by rolling or tracki8ng seed into the top ¼ inch of soil to achieve good seed to soil contact. Do not roll or track the seed if soil is wet. Cover with a light layer of salt hay.

Individual BMP Seeding Specifications:

INFILTRATION TRENCH:

Basin Side Slope Mix:

Ernst Detention Mix: ERNMX-183

Botanical Name	Percent (%) of Mix by Weight
Panicum virgatum	25.0
Panicum clandestinum	24.0
Carex vulpinoidea	22.0
Elymus virginicus	21.0
Agrostis perennans	6.0
Juncus effusus	1.0
Panicum rigidulum	1.0

Seed at 20 lbs. per acre, or 1/3 lb. to ½ lb. per 1,000 sq. ft.

VEGETATED FILTER SWALES:

Ernst Detention Mix: ERNMX-183

Botanical Name	Percent (%) of Mix by Weight
Panicum virgatum	25.0
Panicum clandestinum	24.0
Carex vulpinoidea	22.0
Elymus virginicus	21.0
Agrostis perennans	6.0
Juncus effusus	1.0
Panicum rigidulum	1.0

Seed at 20 lbs. per acre, or 1/3 lb. to ½ lb. per 1,000 sq. ft.

BMP MAINTENANCE PROCEDURES

MAINTENANCE REQUIREMENTS FOR PROPOSED BMP'S

The following maintenance procedures have been taken from the Pennsylvania Department of Environmental Protection's "Pennsylvania Stormwater Best Management Practices Manual" dated April 2006.

Infiltration Trench:

- Catch basins and inlets (upstream of the proposed infiltration basin) should be inspected and cleaned at least two (2) times per year and after run-off events.
- Vegetation along the slope and bottom of the infiltration basin should be maintained in good condition, and any bare spots re-vegetated as soon as possible.
- Vehicles shall be prohibited from parking or driving on the infiltration basin. Care should also be taken to avoid excess compaction by lawn mowing equipment.
- Basins should be inspected after each run-off event to ensure that collected run-off drains within 72 hours.
- Basins should be inspected after each run-off event for accumulation of sediment, damage to outlet control structures, erosion control measures, signs of water contamination/ spills, and slope stability in the berms.
- Mow only as appropriate for vegetative cover species.
- Remove accumulated sediment from basin(s) as required.

Subsurface Infiltration Basins:

- All upstream catch basins and inlets should be inspected and cleaned at least two (2) times a year.
- For subsurface infiltration basins in lawn areas, the overlying vegetation should be maintained in good condition and any bare spots re-vegetated as soon as possible.
- For subsurface infiltration basins in lawn areas, vehicles should be prohibited from driving over or parking on the basin area.
- For subsurface infiltration basins in paved areas, the overlying paving should be kept in good condition.

- If the paved surface is intended to be used as parking or a driveway the basin should be installed deep enough to prevent damage to the individual pipes (typically 18 inches of cover between the top of pipe and the bottom of the subbase).

- The underground storage pipes should be inspected twice (2) yearly and cleaned as needed to keep the perforations open.

Vegetated Filter Swales:

Maintenance to be performed annually and within 48 hours of a major run-off event:

- Inspect and correct erosion control problems, damage to vegetation, and sediment and debris accumulation (address when greater than three inches at any spot or covering vegetation).

- Inspect vegetation on side slopes for erosion and formation of rills or gullies, correct as needed.

- Inspect for pools of standing water: dewater and discharge to a storm sewer at an approved location and restore design grade.

- Mow and trim vegetation to ensure safety, aesthetics, proper swale operation, or to suppress weeds and invasive vegetation; dispose of cuttings in a local composting facility; mow only when swale is dry to avoid rutting.

- Inspect for litter; remove prior to mowing.

- Inspect for uniformity in cross-section and longitudinal slope, correct as needed.

- Inspect swale inlet (curb cuts, pipes, etc.) and outlet for signs or erosion or blockage, correct as needed.

Maintenance activities to be done as needed:

- Plant alternative grass species in the event of unsuccessful establishment.

- Re-seed bare areas; install appropriate erosion control measures when native soil is exposed or erosion channels are forming.

- Roto-till and re-plant swale if draw down time is more than 48 hours.

- Inspect and correct check dams when signs of altered water flow (channelization, obstructions, erosion, etc.) are identified.

- Water during dry periods, fertilize and apply pesticide only when absolutely necessary.

- Inspect swale immediately after the spring melt, remove residuals (e.g. sand) and replace damaged vegetation without disturbing remaining vegetation.

- If roadside or parking lot run-off is directed to the swale, mulching and/ or soil aeration/ manipulation may be required in the spring to restore soil structure and moisture capacity and to reduce the impacts of deicing agents.

- Use non-toxic, organic deicing agents, applied either as blended, magnesium chloride-based liquid products or as pretreated salt.

- Use salt tolerant vegetation in swales.