# Gates

# TETRA TECH, INC.

By: RH Date: 1/30/2017 Subject: Gates Road
Checked By: JB Date: 2/1/2017 PCSM Design and Evaluation

**PURPOSE:**

The purpose of these calculations is to design a Post-Construction Stormwater Management (PCSM) Plan for the Gates Road block valve as part of the Sunoco Pipeline L.P. Pennsylvania Pipeline Project. The site is located within Conewago Township, Dauphin County, Pennsylvania. Permanent stormwater controls will be developed to satisfy PADEP and Dauphin County's approved Act 167 Plan.

**PCSM DESIGN REQUIREMENTS:**

The PCSM design for this project follows the PA Department of Environmental Protection's (PADEP) Pennsylvania Stormwater Best Management Practices Manual (BMP Manual), December 2006; and the standard design criteria from PA Title 25, Chapter 102.8.(g)(2) and (3). The design criteria evaluated for the site are summarized below.

**Act 167 Consistency**

Dauphin County has a County-wide Act 167 plan with specific requirements for Spring Creek (East), where the block valve is located. The PCSM design at the Gates Road block valve site has been designed for consistency with Dauphin County's approved Act 167 Plan.

**Recommended Volume Control Guideline**

Use of Control Guideline 1 is recommended where site conditions offer the opportunity to reduce the increase in runoff volume as follows:

- Do not increase the post-development total runoff volume for all storms equal to or less than the two-year/24-hour event;
- Existing (pre-development) non-forested pervious areas must be considered meadow (good condition) or its equivalent; and
- 20 percent of existing impervious area, when present, shall be considered meadow (good condition) or its equivalent.

This site will utilize an infiltration berm to manage the two-year/24-hour volume increase.

**Recommended Peak Rate Control Guideline**

The recommended control guideline for peak rate control is:

- Do not increase the peak rate of discharge for the 2-year through 100-year events (at minimum); as necessary, provide additional peak rate control as required by applicable and approved Act 167 plan.
- The Gates Road block valve site is located in Spring Creek (East) watershed, subwatershed SP5. This particular subwatershed has the release rate requirements listed below.

| Subwatershed | 1-Year | 2-Year | 10-Year | 25-Year | 50-Year | 100-Year |
|---|---|---|---|---|---|---|
| SP5 | 100% | 90% | 90% | 90% | 100% | 100% |

This site will utilize an infiltration berm to manage the two-year through 100-year peak rate increases. The requirements from both PADEP and Dauphin County's Act 167 Plan are met with this proposed design. This BMP will also help to increase the time of concentration for the drainage area encompassing the block valve.

**Recommended Water Quality Control Guideline**

Control Guideline 1 will provide water quality control and stream channel protection as well as flood control protection.

**Infiltration**

Infiltration rates for the PCSM BMPs have been determined from site infiltration testing conducted in accordance of the PA BMP Manual. Documentation for infiltration testing and design infiltration rates can be found in Attachment 5 of the Site Restoration/Post Construction Stormwater Management Plan. Infiltration test locations and recommended design rates are also labeled on the PCSM Plan Drawings in Attachment 6.

During the onsite infiltration tests, the depth to seasonal high groundwater and shallow bedrock or another confining layer were evaluated. The post-construction stormwater management facility for the site has been designed to maintain 2 feet of separation between the ponding elevation of the facility and the seasonal high water table and bedrock.

The post-construction stormwater management design will utilize onsite infiltration to meet Volume Control Guideline 1.

**Loading Ratio**

Loading ratios have been considered for the design of infiltration BMPs. In general, the following Loading Ratio guidelines are recommended:

- Maximum Impervious Loading Ratio of 5:1 relating impervious drainage area to infiltration area.
- Maximum Drainage Area Loading Ratio of 8:1 relating total drainage area to infiltration area.

The maximum impervious loading ratio of 5:1 has been met. The impervious loading ratio for the site is 0.7:1.

The maximum drainage area loading ratio of 8:1 has been met. The drainage area loading ratio for the site is 3.2:1.

**Disturbed Area**

To meet Standard Worksheet 10 guidelines, 90% of the disturbed area is contained by the proposed PCSM BMPs.

**Karst Topography**

The Gates Road block valve is not located in an area of karst terrain.

**Special Protection Watershed**

Gates Road block valve is located within a siltation impaired watershed. The project site was designed to minimize the total amount of impervious area. The impervious area for the Gates Road valve was limited to the amount that is required to safely construct and operate the block valve. In addition, the previously proposed gravel turn-around was eliminated, and replaced with a grass area. Finally, an existing access road was utilized for the site, thus eliminating the need to create a larger impervious area.

Non-discharge alternatives were analyzed for this block valve site. The location of the Gates Road block valve site was evaluated by ASME B31.4 Valve Spacing 434.15.2(e) which states that mainline valves should not be more than 7.5 miles apart. The valve sites were located in such a way that they avoided environmentally sensitive areas (such as wetlands and floodplains), were close to an existing road, and close to power. Land owner preference was also accounted for while locating the block valve sites. Once all of these factors were taken into account, several block valve sites, including Gates Road, were located in special protection or siltation impaired watersheds.

Non-discharge alternatives were also considered when determining the type of BMP proposed. Gates Road block valve site utilizes an infiltration berm to manage stormwater. Stormwater runoff is infiltrated to the maximum extent possible. Stormwater runoff is spread out to flow through areas that have been restored to meadow conditions, to an infiltration berm, or to undisturbed area. There will not be an increase in stormwater runoff rate or volume to prevent the physical degradation of the receiving water, such as scour, and stream bank destabilization. Stormwater runoff volume is not increasing throughout post-construction, and any post-construction stormwater discharge is managed so that it will not degrade the physical, chemical or biological characteristics of the receiving stream.

Runoff from the site will be managed by a downslope infiltration berm. Ponded runoff will be temporarily stored upslope of the berm until it infiltrates and filters through the soil media. Due to the design of the berm, which maintains a constant elevation through the entire berm length, the stormwater runoff will be released in sheet flow down a stabilized slope, without causing erosion, rather than concentrating the flow. Filtration through the existing vegetation and soil is an efficient way to remove suspended stormwater pollutants such as sediment, as the suspended particles are physically filtered from the stormwater as it flows through the vegetation and percolates into the soil.

The extent of the disturbed area will be minimized, and the duration of disturbance will be minimized by stabilizing disturbed areas as soon as practicable. Cut and fill for the project site has been minimized. Where possible based on the criteria listed above, sites were located in areas with shallow slopes to minimize the amount of cut and fill required. There is minimal cut and fill required at the Gates Road block valve site. All of the block valve sites were graded towards the natural slope. No direct discharge to surface water occurs at the site. The site will be restored promptly with proper vegetative cover techniques.

Antidegradation requirements for the special protection watershed are met because the post-construction stormwater infiltration volume equals or exceeds the pre-construction stormwater infiltration volume, and post-construction stormwater discharge is pretreated via infiltration berms. The runoff is managed so that it will not degrade the physical, chemical, or biological characteristics of the receiving stream.

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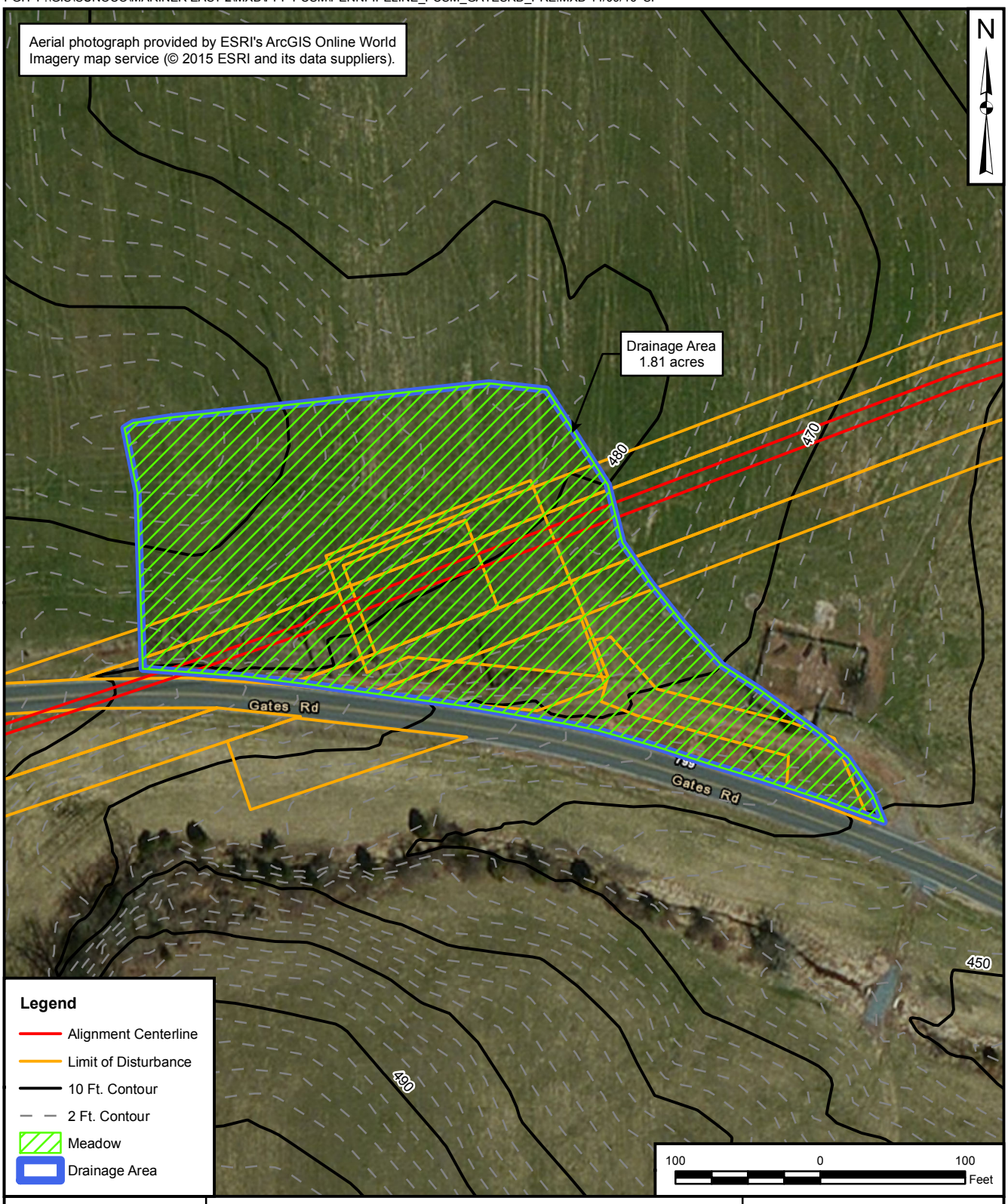


TETRA TECH

PRE-DEVELOPMENT DRAINAGE AREA MAP
GATES ROAD
PENNSYLVANIA PIPELINE PROJECT
SUNOCO LOGISTICS, L.P.
DAUPHIN COUNTY, PENNSYLVANIA

DRAWN BY: J. HERNING 05/04/15
CHECKED BY: J. BRODY 11/09/16

APPROVED BY:

CONTRACT NUMBER: 112IC05958

| FIGURE NUMBER | REV |
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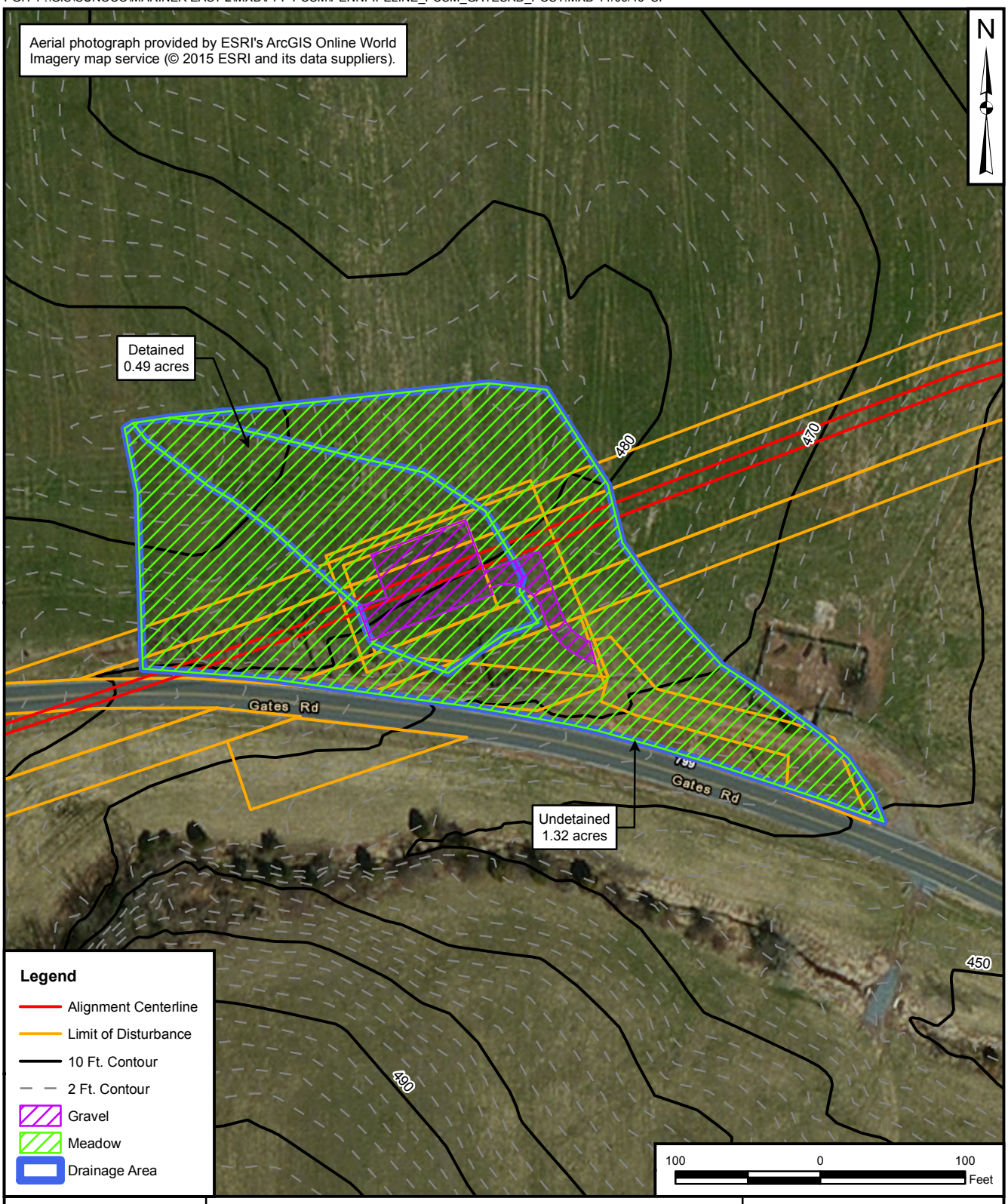


TETRA TECH

POST-DEVELOPMENT DRAINAGE AREA MAP
GATES ROAD
PENNSYLVANIA PIPELINE PROJECT
SUNOCO LOGISTICS, L.P.
DAUPHIN COUNTY, PENNSYLVANIA

DRAWN BY: J. HERNING 05/04/15
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APPROVED BY:

CONTRACT NUMBER: 112IC05958

| FIGURE NUMBER | REV |
|---|---|
| 2 | 0 |

**NOAA Atlas 14, Volume 2, Version 3**
**Location name: Conewago Twp, Pennsylvania, USA***
**Latitude: 40.247°, Longitude: -76.6182°**
**Elevation: 474.34 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 | 0.325 (0.293-0.359) | 0.386 (0.349-0.428) | 0.454 (0.409-0.503) | 0.504 (0.453-0.558) | 0.563 (0.504-0.623) | 0.605 (0.541-0.669) | 0.647 (0.576-0.714) | 0.685 (0.606-0.757) | 0.732 (0.644-0.809) | 0.768 (0.671-0.850) |
| 10-min | 0.518 (0.468-0.574) | 0.617 (0.557-0.685) | 0.726 (0.655-0.806) | 0.803 (0.722-0.889) | 0.893 (0.800-0.988) | 0.960 (0.857-1.06) | 1.02 (0.911-1.13) | 1.08 (0.956-1.19) | 1.15 (1.01-1.27) | 1.20 (1.05-1.33) |
| 15-min | 0.646 (0.583-0.715) | 0.773 (0.698-0.858) | 0.916 (0.825-1.02) | 1.01 (0.912-1.12) | 1.13 (1.01-1.25) | 1.21 (1.08-1.34) | 1.29 (1.15-1.43) | 1.36 (1.21-1.50) | 1.45 (1.28-1.60) | 1.51 (1.32-1.67) |
| 30-min | 0.883 (0.797-0.978) | 1.06 (0.962-1.18) | 1.30 (1.17-1.44) | 1.46 (1.32-1.62) | 1.67 (1.49-1.84) | 1.82 (1.63-2.01) | 1.97 (1.75-2.18) | 2.11 (1.87-2.33) | 2.29 (2.02-2.54) | 2.43 (2.12-2.69) |
| 60-min | 1.10 (0.993-1.22) | 1.33 (1.21-1.48) | 1.66 (1.50-1.84) | 1.90 (1.71-2.11) | 2.22 (1.99-2.45) | 2.46 (2.20-2.72) | 2.71 (2.41-2.99) | 2.95 (2.61-3.26) | 3.28 (2.89-3.63) | 3.54 (3.09-3.92) |
| 2-hr | 1.29 (1.17-1.44) | 1.57 (1.42-1.74) | 1.98 (1.78-2.19) | 2.30 (2.07-2.54) | 2.75 (2.47-3.04) | 3.13 (2.79-3.45) | 3.53 (3.12-3.89) | 3.95 (3.47-4.36) | 4.56 (3.96-5.04) | 5.06 (4.36-5.60) |
| 3-hr | 1.41 (1.27-1.57) | 1.71 (1.55-1.91) | 2.16 (1.95-2.40) | 2.51 (2.26-2.80) | 3.02 (2.70-3.34) | 3.43 (3.05-3.80) | 3.87 (3.42-4.29) | 4.34 (3.81-4.81) | 5.02 (4.35-5.57) | 5.58 (4.79-6.20) |
| 6-hr | 1.74 (1.57-1.95) | 2.11 (1.90-2.37) | 2.65 (2.38-2.97) | 3.10 (2.77-3.46) | 3.76 (3.34-4.18) | 4.32 (3.81-4.79) | 4.92 (4.31-5.46) | 5.59 (4.85-6.19) | 6.57 (5.62-7.27) | 7.39 (6.25-8.20) |
| 12-hr | 2.13 (1.91-2.41) | 2.57 (2.30-2.91) | 3.25 (2.90-3.67) | 3.83 (3.40-4.32) | 4.70 (4.14-5.28) | 5.45 (4.77-6.10) | 6.30 (5.45-7.04) | 7.24 (6.20-8.07) | 8.66 (7.29-9.65) | 9.90 (8.21-11.0) |
| 24-hr | 2.46 (2.25-2.72) | 2.97 (2.72-3.28) | 3.77 (3.45-4.17) | 4.47 (4.08-4.93) | 5.55 (5.01-6.09) | 6.50 (5.83-7.11) | 7.58 (6.72-8.25) | 8.79 (7.71-9.56) | 10.7 (9.21-11.6) | 12.3 (10.5-13.3) |
| 2-day | 2.85 (2.61-3.16) | 3.44 (3.15-3.82) | 4.38 (4.00-4.85) | 5.17 (4.71-5.72) | 6.37 (5.75-7.02) | 7.40 (6.64-8.15) | 8.56 (7.62-9.41) | 9.86 (8.68-10.8) | 11.8 (10.2-13.0) | 13.5 (11.6-14.8) |
| 3-day | 3.02 (2.78-3.33) | 3.65 (3.35-4.02) | 4.63 (4.24-5.10) | 5.46 (4.99-6.01) | 6.71 (6.09-7.37) | 7.81 (7.03-8.55) | 9.02 (8.06-9.86) | 10.4 (9.19-11.3) | 12.5 (10.8-13.6) | 14.2 (12.2-15.6) |
| 4-day | 3.19 (2.94-3.51) | 3.85 (3.55-4.23) | 4.88 (4.48-5.35) | 5.75 (5.27-6.30) | 7.07 (6.43-7.71) | 8.21 (7.42-8.95) | 9.49 (8.51-10.3) | 10.9 (9.70-11.9) | 13.1 (11.5-14.2) | 15.0 (12.9-16.3) |
| 7-day | 3.76 (3.48-4.10) | 4.51 (4.18-4.93) | 5.65 (5.22-6.17) | 6.63 (6.11-7.22) | 8.09 (7.40-8.79) | 9.35 (8.51-10.2) | 10.7 (9.71-11.7) | 12.3 (11.0-13.3) | 14.6 (12.9-15.9) | 16.6 (14.5-18.1) |
| 10-day | 4.31 (4.02-4.66) | 5.17 (4.82-5.59) | 6.40 (5.95-6.91) | 7.43 (6.89-8.01) | 8.92 (8.23-9.61) | 10.2 (9.35-11.0) | 11.6 (10.5-12.4) | 13.0 (11.8-14.0) | 15.2 (13.6-16.4) | 17.1 (15.1-18.4) |
| 20-day | 5.88 (5.53-6.27) | 6.98 (6.56-7.44) | 8.38 (7.87-8.94) | 9.51 (8.91-10.1) | 11.1 (10.4-11.8) | 12.4 (11.6-13.2) | 13.8 (12.8-14.7) | 15.2 (14.0-16.2) | 17.2 (15.7-18.3) | 18.8 (17.1-20.1) |
| 30-day | 7.28 (6.87-7.73) | 8.60 (8.12-9.13) | 10.1 (9.57-10.8) | 11.4 (10.7-12.1) | 13.1 (12.3-13.9) | 14.5 (13.6-15.4) | 15.9 (14.8-16.9) | 17.4 (16.1-18.5) | 19.4 (17.9-20.7) | 21.0 (19.3-22.4) |
| 45-day | 9.16 (8.70-9.65) | 10.8 (10.2-11.4) | 12.5 (11.9-13.2) | 13.8 (13.1-14.6) | 15.6 (14.8-16.4) | 17.0 (16.1-17.9) | 18.3 (17.3-19.3) | 19.7 (18.5-20.7) | 21.5 (20.1-22.7) | 22.9 (21.3-24.1) |
| 60-day | 11.0 (10.4-11.5) | 12.8 (12.2-13.5) | 14.8 (14.1-15.5) | 16.2 (15.4-17.0) | 18.1 (17.2-19.0) | 19.6 (18.6-20.5) | 21.0 (19.8-22.0) | 22.4 (21.1-23.5) | 24.1 (22.7-25.4) | 25.5 (23.9-26.8) |

[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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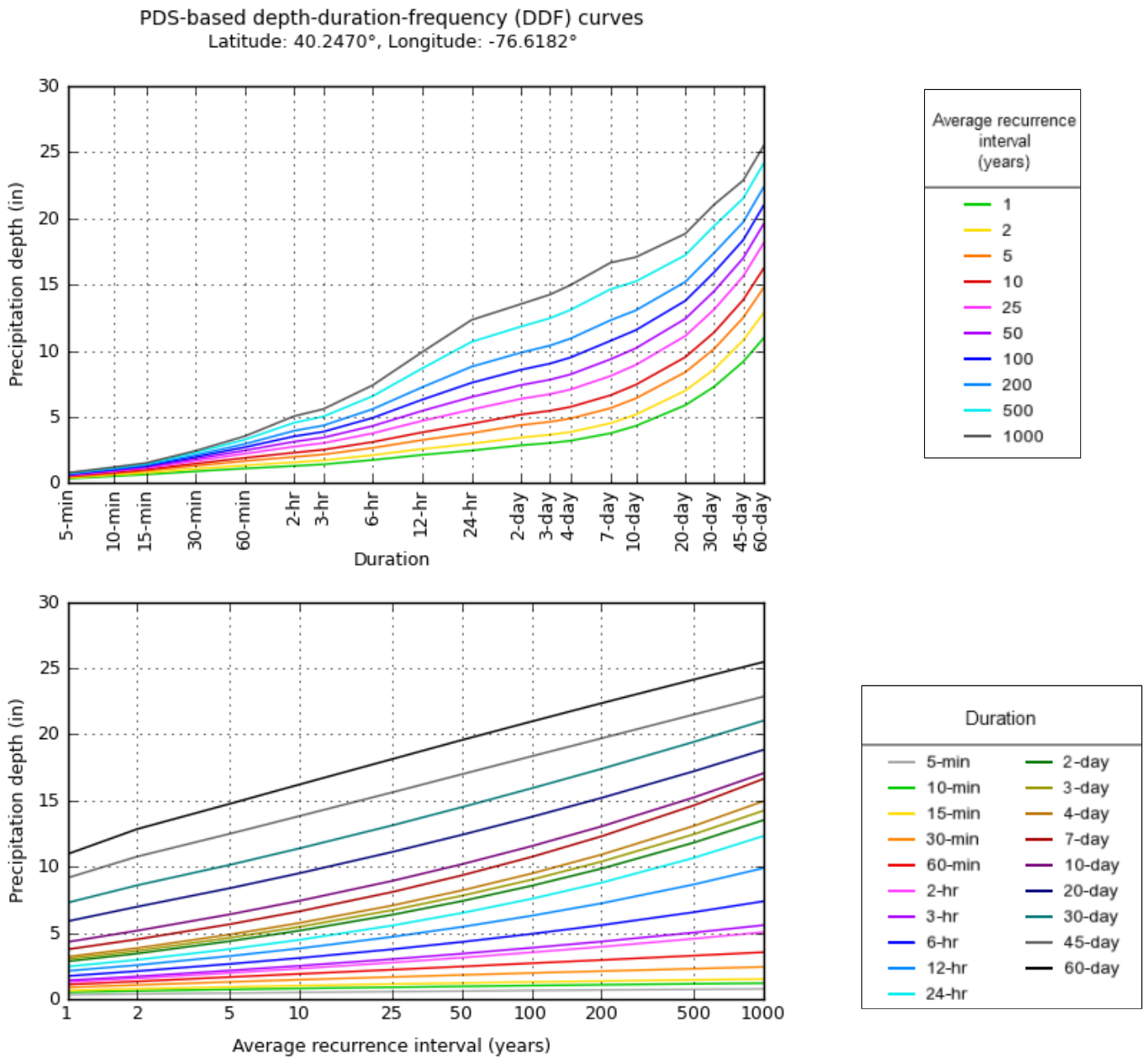
## PF graphical

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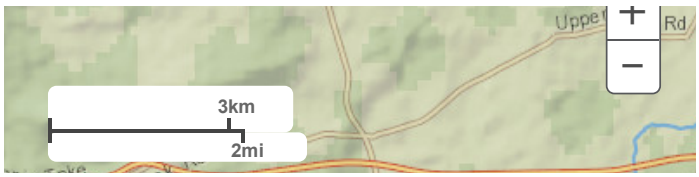
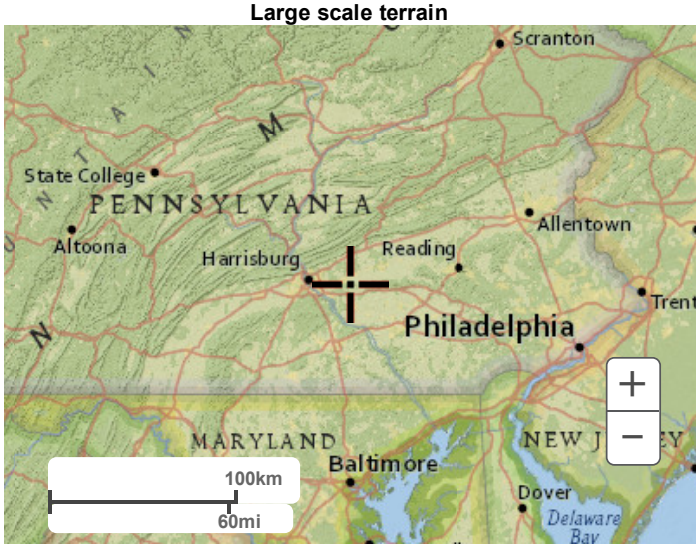
## Maps & aerials

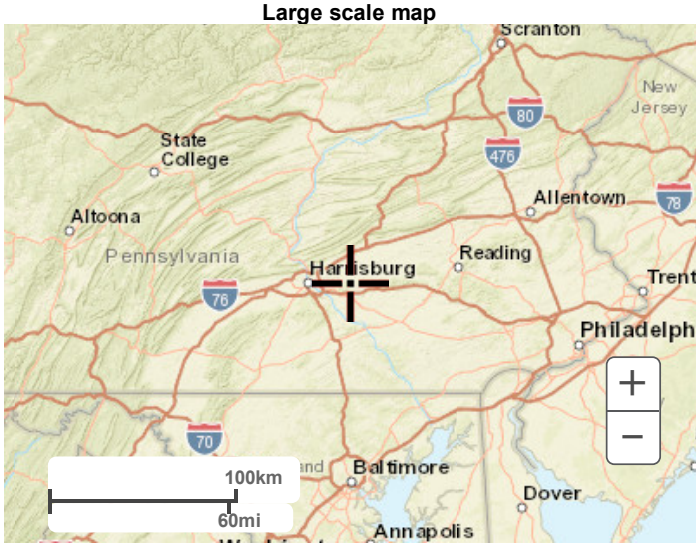
**Small scale terrain**



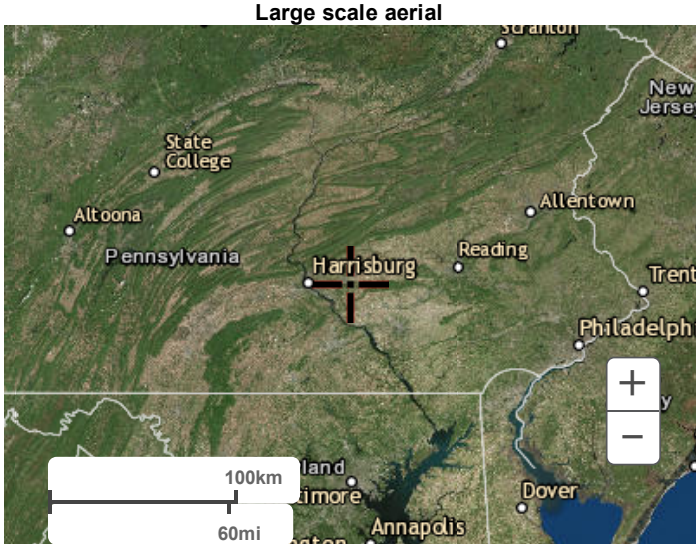

**Large scale terrain**




**Large scale map**




**Large scale aerial**

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## WORKSHEET 1. GENERAL SITE INFORMATION

**Date:** November 11, 2016

**Project Name:** Gates Road

**Municipality:** Conewago

**County:** Dauphin

**Total Area (acres):** 1.81

**Major River Basin:** Susquehanna River

**Watershed:** Little Swatara and Quittapahilla Creeks

**Sub Basin:** Spring Creek (East)

**Nearest Surface Water to Receive Runoff:** Trib 09509 To Spring Creek

**Chapter 93 - Designated Water Use:** WWF

**Impaired according to Chapter 303(d) list?** YES [X] NO [ ]

**List Causes of Impairment:**
Source Unknown - Pathogens, Agriculture - Organic Enrichment/Low D.O. ; Agriculture - Siltation

***Is Project Subject to, or Part of:***

**Municipal Separate Storm Sewer System (MS4) Requirements** YES [ ] NO [X]

**Existing or Planned drinking water supply?** YES [ ] NO [X]

**If yes, distance from proposed discharge (miles):** _____

**Approved Act 167 Plan?** YES [X] NO [ ]

**Existing River Conservation Plan?** YES [X] NO [ ]

## Worksheet 2. Sensitive Natural Resources

**INSTRUCTIONS**

1. Provide Sensitive Resources Map according to non-structural BMP 5.4.1 in Chapter 5. This map should identify wetlands, woodlands, natural drainage ways, steep slopes, and other sensitive natural areas.

   See pre-development drainage area map

2. Summarize the existing extent of each sensitive resource in the Existing Sensitive Resources Table (below, using Acres). If none present, insert 0.

   0.00 acres

3. Summarize Total Protected Area as defined under BMPs in Chapter 5.

   0.00 acres

4. Do not count any area twice. For example, an area that is both a floodplain and a wetland may only be considered once.

| EXISTING NATURAL SENSITIVE RESOURCE | MAPPED? Yes/no/n/a | TOTAL AREA (Ac.) | PROTECTED AREA (Ac.) |
|---|---|---|---|
| Waterbodies | N/A | | |
| Floodplains | N/A | | |
| Riparian Areas | N/A | | |
| Wetlands | N/A | | |
| Woodlands | N/A | | |
| Natural Drainage Ways | N/A | | |
| Steep Slopes, 15% - 25% | N/A | | |
| Steep Slopes, over 25% | N/A | | |
| Other: | | | |
| Other: | | | |
| **TOTAL EXISTING:** | | **0.00** | **0.00** |

## Worksheet 3. Nonstructural BMP Credits

### PROTECTED AREA

**1.1 Area of Protected Sensitive/Special Value Features (see WS 2)** 0.00 **Ac.**

**1.2 Area of Riparian Forest Buffer Protection** 0.00 **Ac.**

**3.1 Area of Minimum Disturbance/Reduced Grading** 0.00 **Ac**

**TOTAL** 0.00 **Ac**

| Site Area | Minus | Protected Area | = | Stormwater Management Area |
|---|---|---|---|---|
| 0.89 | - | 0 | = | 0.89 |

This is the area that requires stormwater management

### VOLUME CREDITS

**3.1 Minimum Soil Compaction** (See Chapter 8, page 22 – SW BMP Manual)

Lawn _____ $ft^2$ x 1/4" x 1/12 = _____ $ft^3$

Meadow _____ $ft^2$ x 1/3" x 1/12 = _____ $ft^3$

**3.3 Protect Existing Trees** (See Chapter 8, page 23 – SW BMP Manual)

*For Trees within 100 feet of impervious area:*

Tree Canopy _____ $ft^2$ x 1/2" x 1/12 = _____ $ft^3$

**5.1 Disconnect Roof Leaders to Vegetated Areas** (See Chapter 8 page 25 – SW BMP Manual)

*For runoff directed to areas protected under 5.8.1 and 5.8.2*

Roof Area _____ $ft^2$ x 1/3" x 1/12 = _____ $ft^3$

*For all other disconnected roof areas*

Roof Area _____ $ft^2$ x 1/4" x 1/12 = _____ $ft^3$

**5.2 Disconnect Non-Roof impervious to Vegetated Areas** (See Chapter 8, page 26 – SW BMP Manual)

*For Runoff directed to areas protected under 5.8.1 and 5.8.2*

Impervious Area _____ $ft^2$ x 1/3" x 1/12 = _____ $ft^3$

*For all other disconnected roof areas*

Impervious Area _____ $ft^2$ x 1/4" x 1/12 = _____ $ft^3$

**TOTAL NON-STRUCTURAL VOLUME CREDIT*** _____ $ft^3$

**For use on Worksheet 5*

## WORKSHEET 4. CHANGE IN RUNOFF VOLUME FOR 2-YR STORM EVENT

PROJECT: Gates Road
Drainage Area: 1.81 acres
2-Year Rainfall: 2.97 in

Total Site Area: 0.89 acres
Protected Site Area: N/A acres
Managed Site Area: 0.89 acres

Existing Conditions

| Cover Type/Condition | Soil Type | Area (sf) | Area (ac) | CN | S | Ia (0.2*S) | Q Runoff[1] (in) | Runoff Volume[3] ($ft^3$) |
|---|---|---|---|---|---|---|---|---|
| Woods | B | 0.00 | 0.00 | 55 | 8.18 | 1.64 | 0.19 | 0 |
| Meadow | B | 38768 | 0.89 | 58 | 7.24 | 1.45 | 0.26 | 854 |
| TOTAL: | | **38768** | **0.89** | | | | | **854** |

Developed Conditions

| Cover Type/Condition | Soil Type | Area (sf) | Area (ac) | CN | S | Ia (0.2*S) | Q Runoff[1] (in) | Runoff Volume[3] ($ft^3$) |
|---|---|---|---|---|---|---|---|---|
| Impervious - Gravel | B | 5663 | 0.13 | 85 | 1.76 | 0.35 | 1.56 | 738 |
| Meadow | B | 33106 | 0.76 | 58 | 7.24 | 1.45 | 0.26 | 729 |
| TOTAL: | | **38768** | **0.89** | | | | | **1,467** |

| 2-Year Volume Increase (ft3): | **613** |
|---|---|

**2-Year Volume Increase = Developed Conditions Runoff Volume - Existing Conditions Runoff Volume**

1. Runoff (in) = Q = (P - 0.2S)2 / (P+ 0.8S) where
   P = 2-Year Rainfall (in)
   S = (1000/CN)-10

2. Runoff Volume (CF) = Q x Area x 1/12
   Q = Runoff (in)
   Area = Land use area (sq. ft.)

**Note: Runoff Volume must be calculated for EACH land use type/condition and HSGI.**
**The use of a weighted CN value for volume calculations is not acceptable.**

Worksheet 5. Structural BMP Volume Credits

**PROJECT:** Gates Road
**SUB-BASIN:**

**Required Control Volume ($ft^3$) - *from Worksheet 4:*** 613

**Non-structural Volume Credit ($ft^3$) - *from Worksheet 3:*** N/A
(maximum is 25% of required volume)

**Structural Volume Reqmt ($ft^3$)** 613
***(Required Control Volume minus Non-structural Credit)***

| Proposed BMPs from PA Stormwater Best Management Practices Manual Chapter 6 | | Area ($ft^2$) | Volume Reduction Permanently Removed ($ft^3$) |
|---|---|---|---|
| 6.4.1 | Porous Pavement | | |
| 6.4.2 | Infiltration Basin | | |
| 6.4.3 | Infiltration Bed | | |
| 6.4.4 | Infiltration Trench | | |
| 6.4.5 | Rain Garden/Bioretention | | |
| 6.4.6 | Dry Well/Seepage Pit | | |
| 6.4.7 | Constructed Filter | | |
| 6.4.8 | Vegetated Swale | | |
| 6.4.9 | Vegetated Filter Strip | | |
| 6.4.10 | Berm | 1,607 | 811 |
| 6.5.1 | Vegetated Roof | | |
| 6.5.2 | Capture and Re-Use | | |
| 6.6.1 | Constructed Wetlands | | |
| 6.6.2 | Wet Pond/Retention Basin | | |
| 6.7.1 | Riparian Buffer/Riparian Forest Buffer Restoration | | |
| 6.7.2 | Landscape Restoration/Reforestation | | |
| 6.7.3 | Soil Amendment | | |
| 6.8.1 | Level Spreader | | |
| 6.8.2 | Special Storage Areas | | |
| *Other:* | | | |
| | **Total Structural Volume ($ft^3$):** | | **811** |
| | **Structural Volume Requirement ($ft^3$):** | | **613** |
| | **DIFFERENCE:** | | **-198** |

**VOLUME CREDIT DETERMINATION**

| | | | | |
|---|---|---|---|---|
| 1 | Detained area runoff volume from Hydraflow | = | 811 | cf |
| 2a | Storage volume of the BMPs | = | 2,343 | cf |
| 2b | Infiltrated volume within 2 hours after the 2-yr/24-hr event (Infiltration Rate/12) x Infiltration Area x 2 hrs | = | 3,362 | cf |
| 2 (total) | 2a + 2b | = | 5,705 | cf |

## WORKSHEET 10. WATER QUALITY COMPLIANCE FOR NITRATE

***Does the site design incorporate the following BMPs to address nitrate pollution? A summary "yes" rating is achieved if at least 2 Primary BMPs for nitrate are provided across the site or 4 secondary BMPs for nitrate are provided across the site (or the***

***PRIMARY BMPs FOR NITRATE:***

| | YES | NO |
|---|---|---|
| NS BMP 5.4.2 - Protect / Conserve / Enhance Riparian Buffers | | |
| NS BMP 5.5.4 - Cluster Uses at Each Site | | |
| NS BMP 5.6.1 - Minimize Total Disturbed Area | X | |
| NS BMP 5.6.3 - Re-Vegetate / Re-Forest Disturbed Areas (Native Species) | X | |
| NS BMP 5.9.1 - Street Sweeping / Vacuuming | | |
| Structural BMP 6.7.1 - Riparian Buffer Restoration | | |
| Structural BMP 6.7.2 - Landscape Restoration | | |

***SECONDARY BMPs FOR NITRATE:***

| | | |
|---|---|---|
| NS BMP 5.4.1 - Protect Sensitive / Special Value Features | | |
| NS BMP 5.4.3 - Protect / Utilize Natural Drainage Features | | |
| NS BMP 5.6.2 - Minimize Soil Compaction | X | |
| Structural BMP 6.4.5 - Rain Garden / Bioretention | | |
| Structural BMP 6.4.8 - Vegetated Swale | | |
| Structural BMP 6.4.9 - Vegetated Filter Strip | | |
| Structural BMP 6.6.1 - Constructed Wetland | | |
| Structural BMP 6.7.1 - Riparian Buffer Restoration | | |
| Structural BMP 6.7.2 - Landscape Restoration | | |
| Structural BMP 6.7.3 - Soils Amendment/Restoration | X | |

**TIME OF CONCENTRATION ADJUSTMENT**

POST CONSTRUCTION TC TO BMP (DETAINED TC) BEFORE ADJUSTMENT 7.0 MIN

STRUCTURAL VOLUME PROVIDED BY BMP

811 CF FOR 2-YR/24-HR STORM EVENT
2,219 CF FOR 10-YR/24-HR STORM EVENT
2,343 CF FOR ALL REMANING STORM EVENTS

RATES OF RUNOFF TO THE BMP (FROM HYDRAFLOW REPORT)

| Storm Event | Q (CFS) |
|---|---|
| 2 YR/24 HR | 0.285 |
| 10 YR/24 HR | 0.943 |
| 50 YR/24 HR | 2.041 |
| 100 YR/24 HR | 2.678 |

ADDITIONAL RESIDENCE TIME (MIN) = (STRUCTURAL VOLUME PROVIDED BY BMP / RATE OF RUNOFF TO BMP) / 60

| Storm Event | Q (CFS) | Additional Residence Time (min.) |
|---|---|---|
| 2 YR/24 HR | 0.285 | 47.427 |
| 10 YR/24 HR | 0.943 | 39.219 |
| 50 YR/24 HR | 2.041 | 19.133 |
| 100 YR/24 HR | 2.678 | 14.582 |

ADJUSTED TC = POST CONSTRUCTION TC TO BMP BEFORE ADJUSTMENT + ADDITIONAL RESIDENCE TIME

| Storm Event | Q (CFS) | Additional Residence Time (min.) | Adjusted Time of Concentration (min.) |
|---|---|---|---|
| 2 YR/24 HR | 0.285 | 47.43 | 54.43 |
| 10 YR/24 HR | 0.943 | 39.22 | 46.22 |
| 50 YR/24 HR | 2.041 | 19.13 | 26.13 |
| 100 YR/24 HR | 2.678 | 14.58 | 21.58 |

INFILTRATION BERM DEWATERING CALCULATION SITE NAME: GATES ROAD

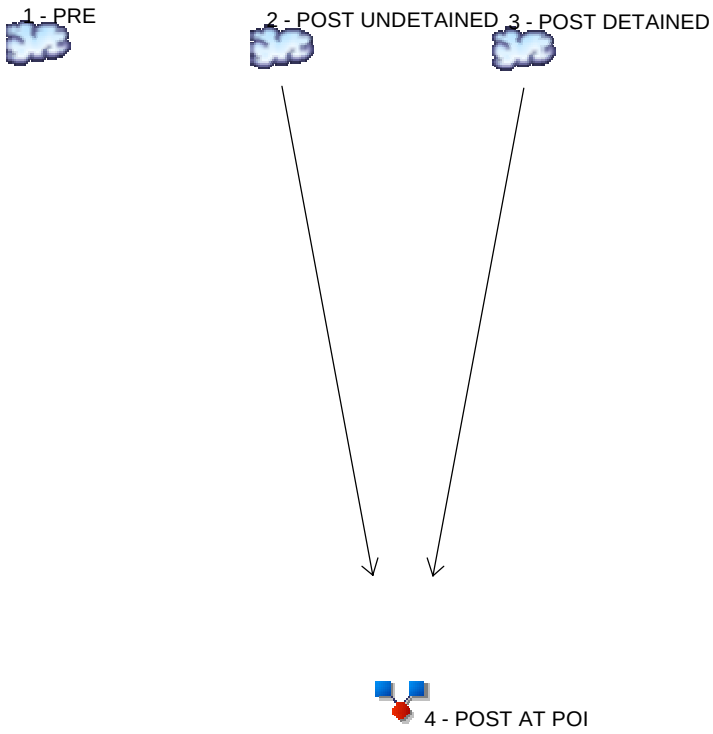
| | | | |
|---|---|---|---|
| STORAGE VOLUME | 811 | CF | AFTER 2-YEAR/24-HOUR STORM |
| DESIGN INFILTRATION RATE | 0.10 | IN/HR | IT-A RECOMMENDED RATE |
| INFILTRATION AREA | 2,343 | SF | |

DEWATERING TIME = STORAGE VOLUME / ((DESIGN INFILTRATION RATE /12) * INFILTRATION AREA)

**DEWATERING TIME = 41.5 HOURS**

# Watershed Model Schematic

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4




## Legend

| Hyd. | Origin | Description |
|---|---|---|
| 1 | SCS Runoff | PRE |
| 2 | SCS Runoff | POST UNDETAINED |
| 3 | SCS Runoff | POST DETAINED |
| 4 | Combine | POST AT POI |

# Hydrograph Return Period Recap



| Hyd. No. | Hydrograph type (origin) | Inflow hyd(s) | Peak Outflow (cfs) | | | | | | | | Hydrograph Description |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1-yr | 2-yr | 3-yr | 5-yr | 10-yr | 25-yr | 50-yr | 100-yr | |
| 1 | SCS Runoff | ------ | ------- | 0.471 | ------- | ------- | 2.571 | ------- | 6.376 | 8.660 | PRE |
| 2 | SCS Runoff | ------ | ------- | 0.344 | ------- | ------- | 1.875 | ------- | 4.650 | 6.316 | POST UNDETAINED |
| 3 | SCS Runoff | ------ | ------- | 0.285 | ------- | ------- | 0.943 | ------- | 2.041 | 2.678 | POST DETAINED |
| 4 | Combine | 2, 3 | ------- | 0.629 | ------- | ------- | 2.782 | ------- | 6.673 | 8.992 | POST AT POI |

# Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

| 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 | 0.471 | 2 | 720 | 1,625 | ------ | ------ | ------ | PRE |
| 2 | SCS Runoff | 0.344 | 2 | 720 | 1,185 | ------ | ------ | ------ | POST UNDETAINED |
| 3 | SCS Runoff | 0.285 | 2 | 720 | 811 | ------ | ------ | ------ | POST DETAINED |
| 4 | Combine | 0.629 | 2 | 720 | 1,996 | 2, 3 | ------ | ------ | POST AT POI |

# Hydrograph Report

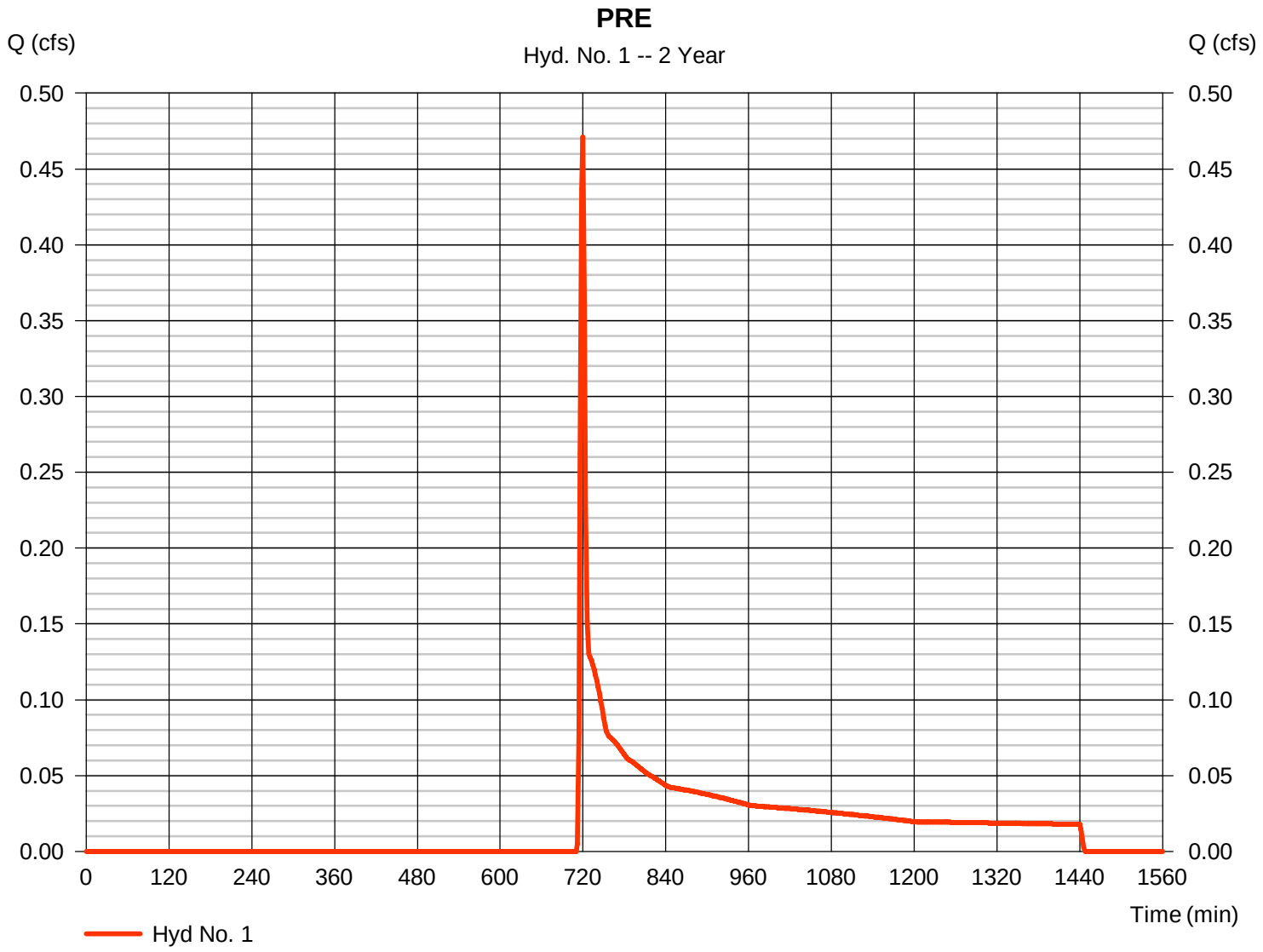


## Hyd. No. 1

PRE

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | SCS Runoff | Peak discharge | = | 0.471 cfs |
| Storm frequency | = | 2 yrs | Time to peak | = | 720 min |
| Time interval | = | 2 min | Hyd. volume | = | 1,625 cuft |
| Drainage area | = | 1.810 ac | Curve number | = | 58* |
| Basin Slope | = | 0.0 % | Hydraulic length | = | 0 ft |
| Tc method | = | TR55 | Time of conc. (Tc) | = | 6.30 min |
| Total precip. | = | 2.97 in | Distribution | = | Type II |
| Storm duration | = | 24 hrs | Shape factor | = | 484 |

* Composite (Area/CN) = [(1.810 x 58)] / 1.810



# TR55 Tc Worksheet



## Hyd. No. 1

PRE

| Description | A | B | C | Totals |
|---|---|---|---|---|
| **Sheet Flow** | | | | |
| Manning's n-value | = 0.240 | 0.011 | 0.011 | |
| Flow length (ft) | = 50.0 | 0.0 | 0.0 | |
| Two-year 24-hr precip. (in) | = 2.97 | 0.00 | 0.00 | |
| Land slope (%) | = 8.00 | 0.00 | 0.00 | |
| **Travel Time (min)** | **= 4.89** | **+ 0.00** | **+ 0.00** | **= 4.89** |
| **Shallow Concentrated Flow** | | | | |
| Flow length (ft) | = 173.00 | 22.00 | 123.00 | |
| Watercourse slope (%) | = 9.10 | 1.60 | 4.50 | |
| Surface description | = Unpaved | Unpaved | Unpaved | |
| Average velocity (ft/s) | =4.87 | 2.04 | 3.42 | |
| **Travel Time (min)** | **= 0.59** | **+ 0.18** | **+ 0.60** | **= 1.37** |
| **Channel Flow** | | | | |
| X sectional flow area (sqft) | = 0.00 | 0.00 | 0.00 | |
| Wetted perimeter (ft) | = 0.00 | 0.00 | 0.00 | |
| Channel slope (%) | = 0.00 | 0.00 | 0.00 | |
| Manning's n-value | = 0.015 | 0.015 | 0.015 | |
| Velocity (ft/s) | =0.00 | | | |
| | | 0.00 | | |
| | | | 0.00 | |
| Flow length (ft) | ({0})0.0 | 0.0 | 0.0 | |
| **Travel Time (min)** | **= 0.00** | **+ 0.00** | **+ 0.00** | **= 0.00** |

**Total Travel Time, Tc ..... 6.30 min**

# Hydrograph Report

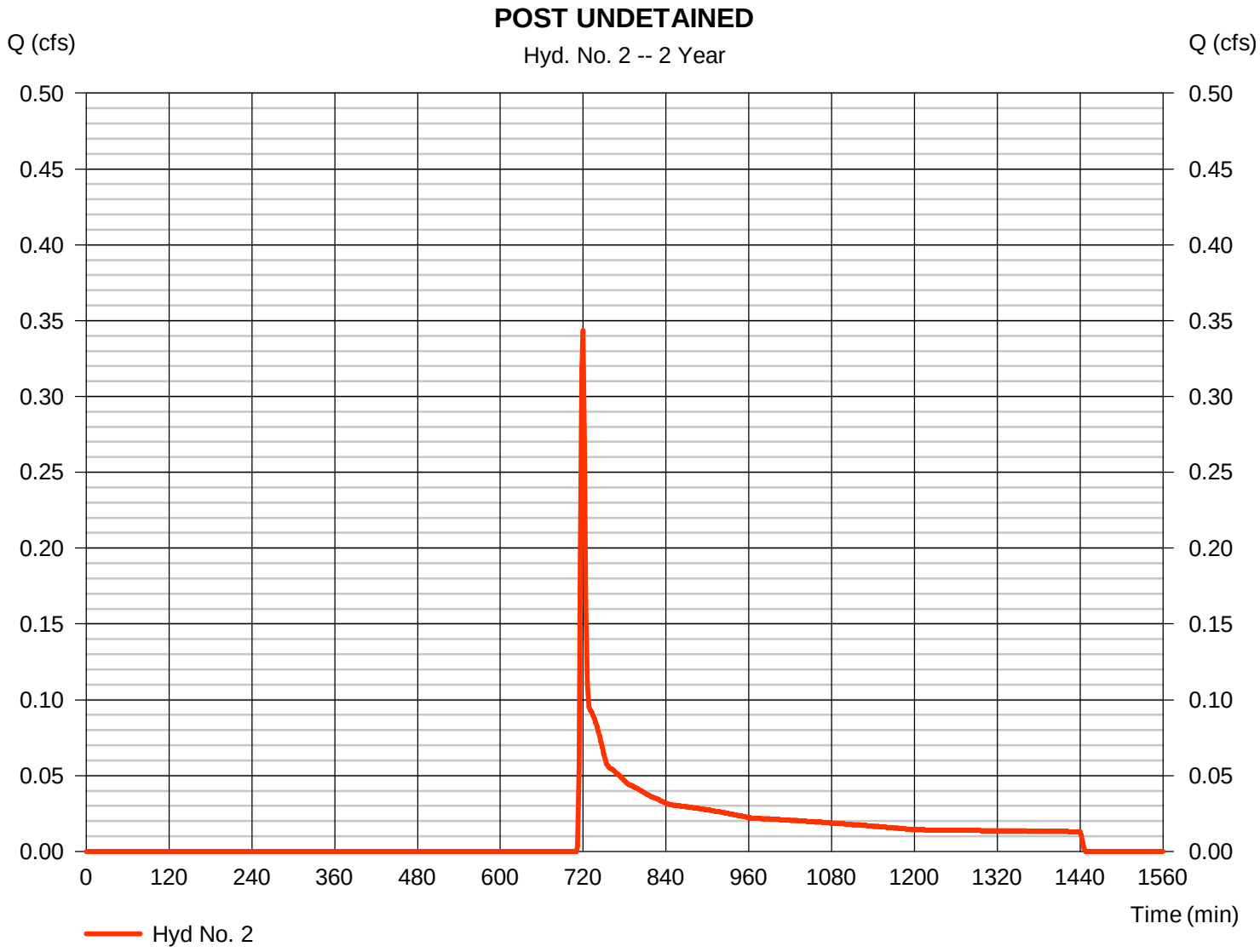


## Hyd. No. 2

POST UNDETAINED

| | | | |
|---|---|---|---|
| Hydrograph type | = SCS Runoff | Peak discharge | = 0.344 cfs |
| Storm frequency | = 2 yrs | Time to peak | = 720 min |
| Time interval | = 2 min | Hyd. volume | = 1,185 cuft |
| Drainage area | = 1.320 ac | Curve number | = 58* |
| Basin Slope | = 0.0 % | Hydraulic length | = 0 ft |
| Tc method | = TR55 | Time of conc. (Tc) | = 6.30 min |
| Total precip. | = 2.97 in | Distribution | = Type II |
| Storm duration | = 24 hrs | Shape factor | = 484 |

* Composite (Area/CN) = [(0.020 x 85) + (1.300 x 58)] / 1.320



# TR55 Tc Worksheet



## Hyd. No. 2

POST UNDETAINED

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.240 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 50.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 2.97 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 8.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 4.89** | **+** | **0.00** | **+** | **0.00** | **=** | **4.89** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 173.00 | | 22.00 | | 123.00 | | |
| Watercourse slope (%) | = 9.10 | | 1.60 | | 4.50 | | |
| Surface description | = Unpaved | | Unpaved | | Unpaved | | |
| Average velocity (ft/s) | =4.87 | | 2.04 | | 3.42 | | |
| **Travel Time (min)** | **= 0.59** | **+** | **0.18** | **+** | **0.60** | **=** | **1.37** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 6.30 min**

# Hydrograph Report

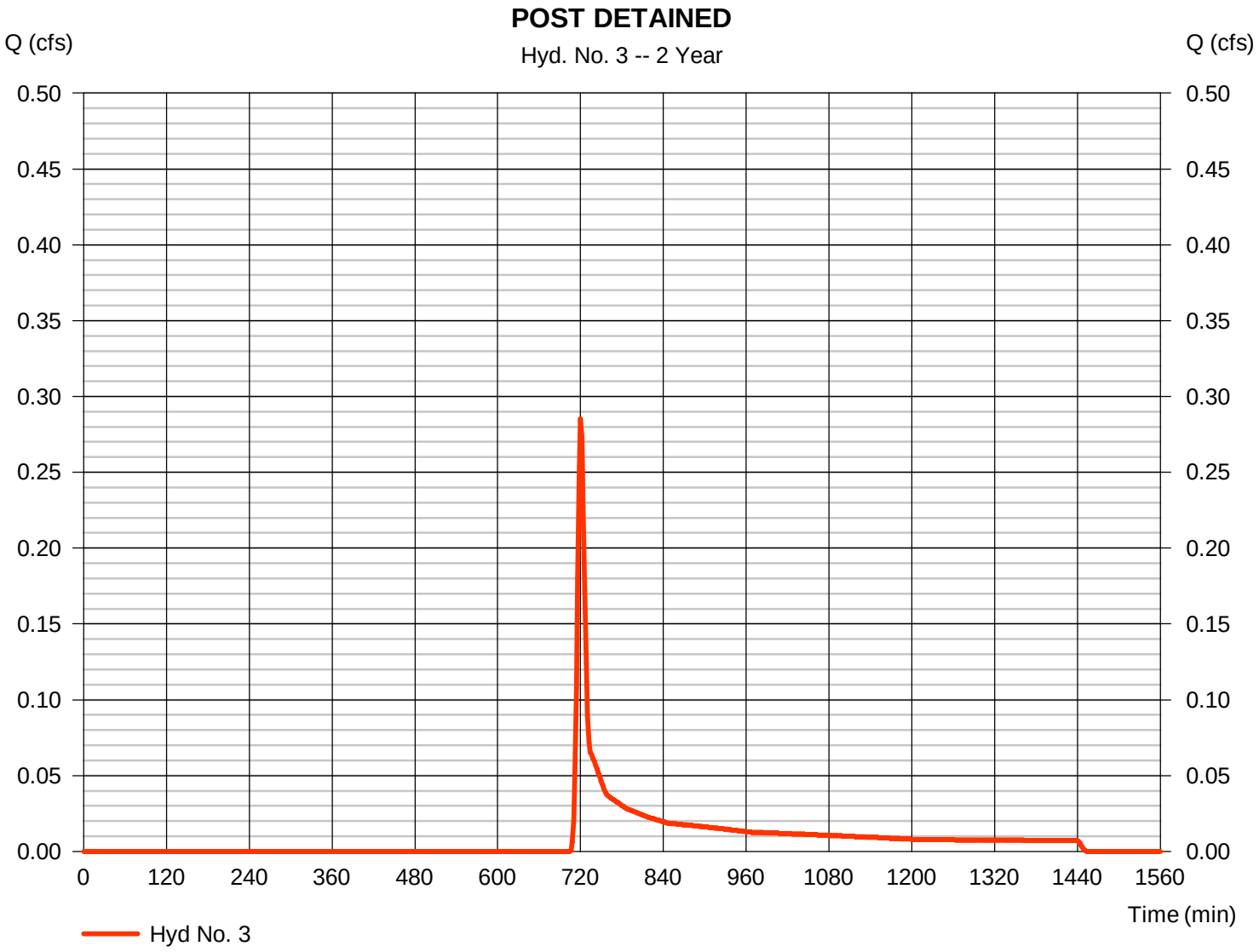


## Hyd. No. 3

POST DETAINED

| | | | |
|---|---|---|---|
| Hydrograph type | = SCS Runoff | Peak discharge | = 0.285 cfs |
| Storm frequency | = 2 yrs | Time to peak | = 720 min |
| Time interval | = 2 min | Hyd. volume | = 811 cuft |
| Drainage area | = 0.490 ac | Curve number | = 64* |
| Basin Slope | = 0.0 % | Hydraulic length | = 0 ft |
| Tc method | = TR55 | Time of conc. (Tc) | = 7.00 min |
| Total precip. | = 2.97 in | Distribution | = Type II |
| Storm duration | = 24 hrs | Shape factor | = 484 |

* Composite (Area/CN) = [(0.110 x 85) + (0.380 x 58)] / 0.490



# TR55 Tc Worksheet



## Hyd. No. 3

POST DETAINED

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.240 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 50.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 2.97 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 5.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 5.90** | **+** | **0.00** | **+** | **0.00** | **=** | **5.90** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 179.00 | | 55.00 | | 32.00 | | |
| Watercourse slope (%) | = 7.30 | | 5.50 | | 3.10 | | |
| Surface description | = Unpaved | | Paved | | Unpaved | | |
| Average velocity (ft/s) | =4.36 | | 4.77 | | 2.84 | | |
| **Travel Time (min)** | **= 0.68** | **+** | **0.19** | **+** | **0.19** | **=** | **1.06** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 7.00 min**

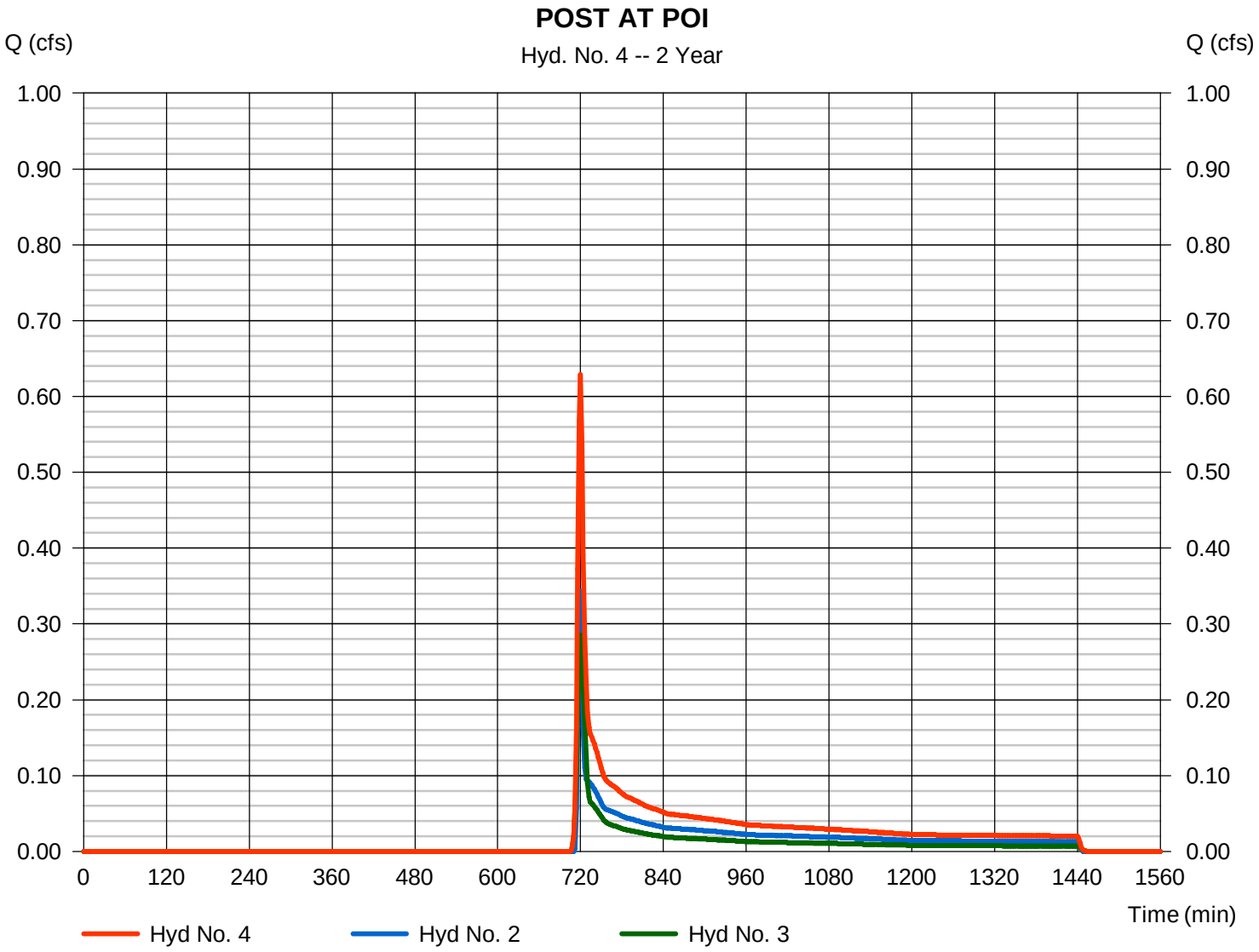
# Hydrograph Report



## Hyd. No. 4

POST AT POI

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | Combine | Peak discharge | = | 0.629 cfs |
| Storm frequency | = | 2 yrs | Time to peak | = | 720 min |
| Time interval | = | 2 min | Hyd. volume | = | 1,996 cuft |
| Inflow hyds. | = | 2, 3 | Contrib. drain. area | = | 1.810 ac |



# Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

| 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 | 2.571 | 2 | 718 | 5,480 | ------ | ------ | ------ | PRE |
| 2 | SCS Runoff | 1.875 | 2 | 718 | 3,996 | ------ | ------ | ------ | POST UNDETAINED |
| 3 | SCS Runoff | 0.943 | 2 | 720 | 2,219 | ------ | ------ | ------ | POST DETAINED |
| 4 | Combine | 2.782 | 2 | 718 | 6,215 | 2, 3 | ------ | ------ | POST AT POI |

# Hydrograph Report

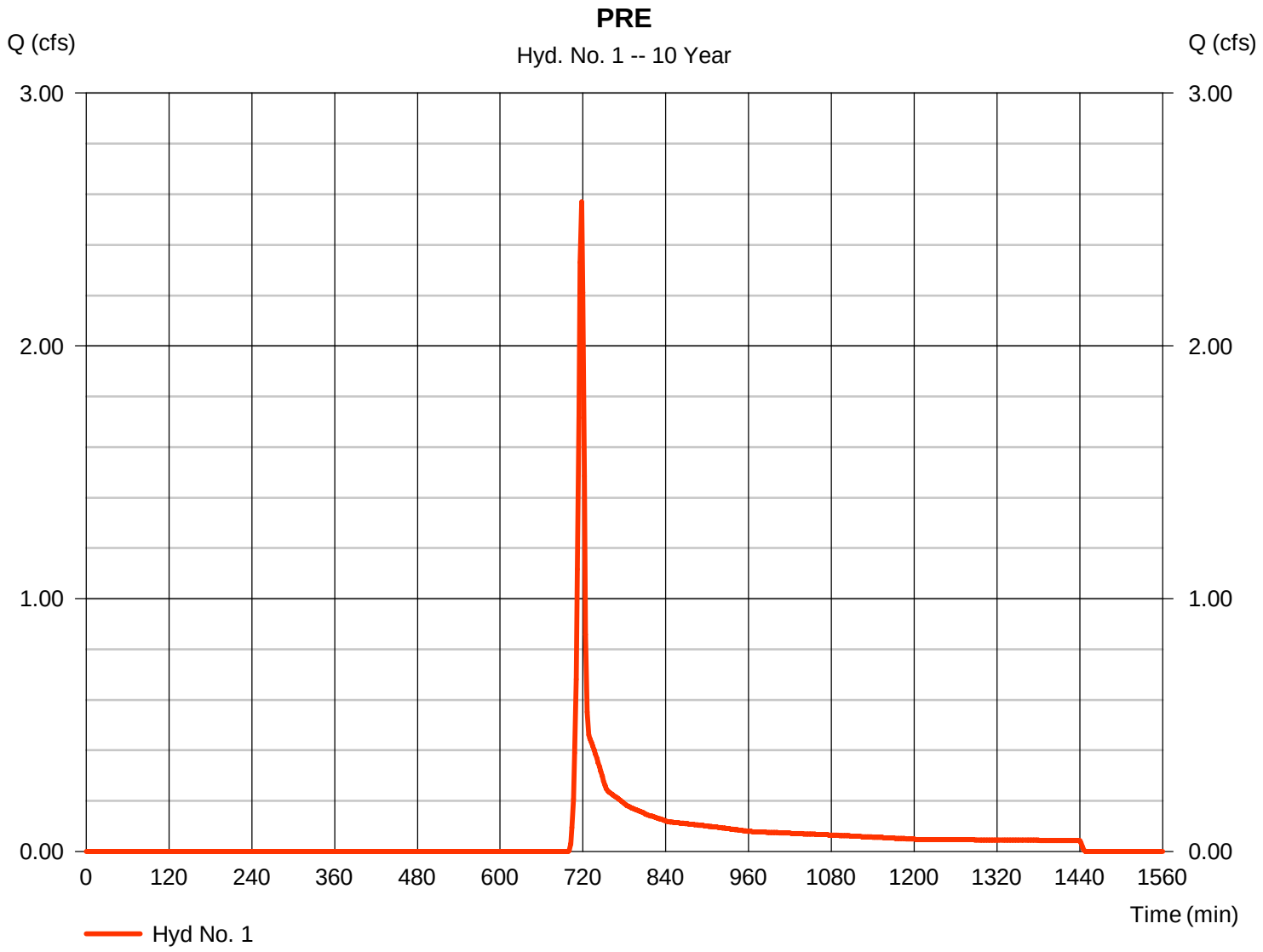


## Hyd. No. 1

PRE

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | SCS Runoff | Peak discharge | = | 2.571 cfs |
| Storm frequency | = | 10 yrs | Time to peak | = | 718 min |
| Time interval | = | 2 min | Hyd. volume | = | 5,480 cuft |
| Drainage area | = | 1.810 ac | Curve number | = | 58* |
| Basin Slope | = | 0.0 % | Hydraulic length | = | 0 ft |
| Tc method | = | TR55 | Time of conc. (Tc) | = | 6.30 min |
| Total precip. | = | 4.47 in | Distribution | = | Type II |
| Storm duration | = | 24 hrs | Shape factor | = | 484 |

* Composite (Area/CN) = [(1.810 x 58)] / 1.810



# Hydrograph Report

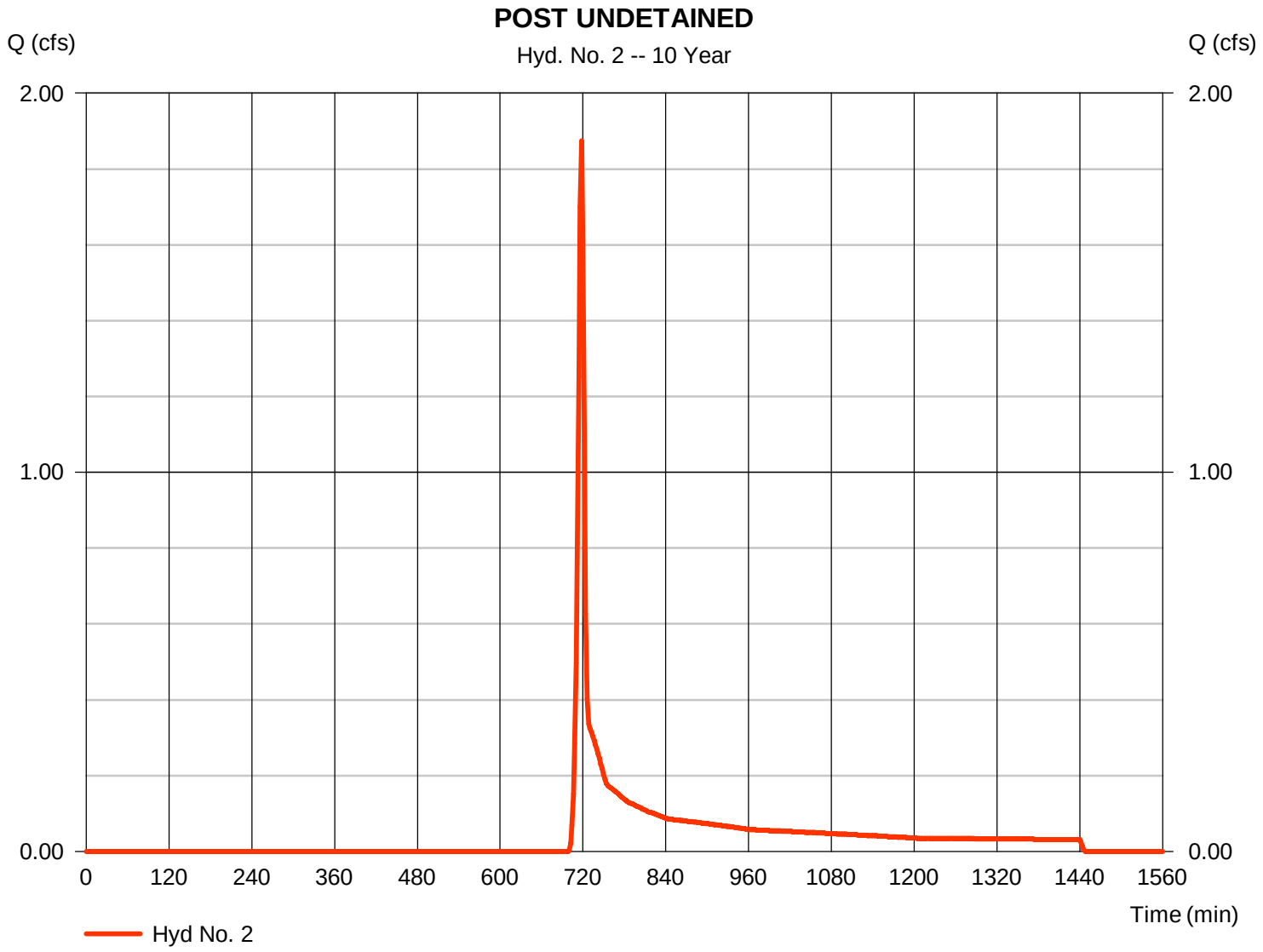


## Hyd. No. 2

POST UNDETAINED

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | SCS Runoff | Peak discharge | = | 1.875 cfs |
| Storm frequency | = | 10 yrs | Time to peak | = | 718 min |
| Time interval | = | 2 min | Hyd. volume | = | 3,996 cuft |
| Drainage area | = | 1.320 ac | Curve number | = | 58* |
| Basin Slope | = | 0.0 % | Hydraulic length | = | 0 ft |
| Tc method | = | TR55 | Time of conc. (Tc) | = | 6.30 min |
| Total precip. | = | 4.47 in | Distribution | = | Type II |
| Storm duration | = | 24 hrs | Shape factor | = | 484 |

* Composite (Area/CN) = [(0.020 x 85) + (1.300 x 58)] / 1.320



# Hydrograph Report

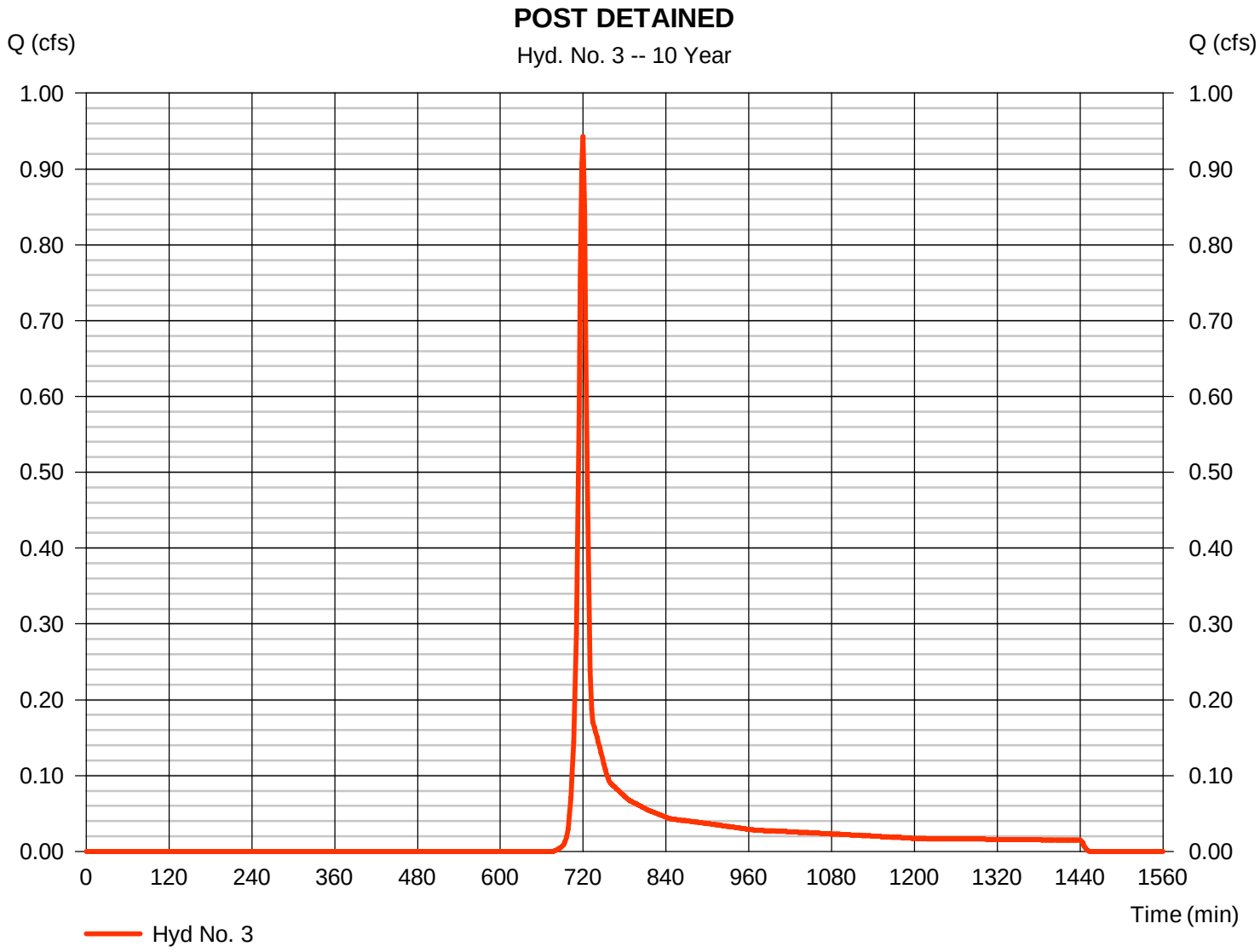


## Hyd. No. 3

POST DETAINED

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | SCS Runoff | Peak discharge | = | 0.943 cfs |
| Storm frequency | = | 10 yrs | Time to peak | = | 720 min |
| Time interval | = | 2 min | Hyd. volume | = | 2,219 cuft |
| Drainage area | = | 0.490 ac | Curve number | = | 64* |
| Basin Slope | = | 0.0 % | Hydraulic length | = | 0 ft |
| Tc method | = | TR55 | Time of conc. (Tc) | = | 7.00 min |
| Total precip. | = | 4.47 in | Distribution | = | Type II |
| Storm duration | = | 24 hrs | Shape factor | = | 484 |

* Composite (Area/CN) = [(0.110 x 85) + (0.380 x 58)] / 0.490



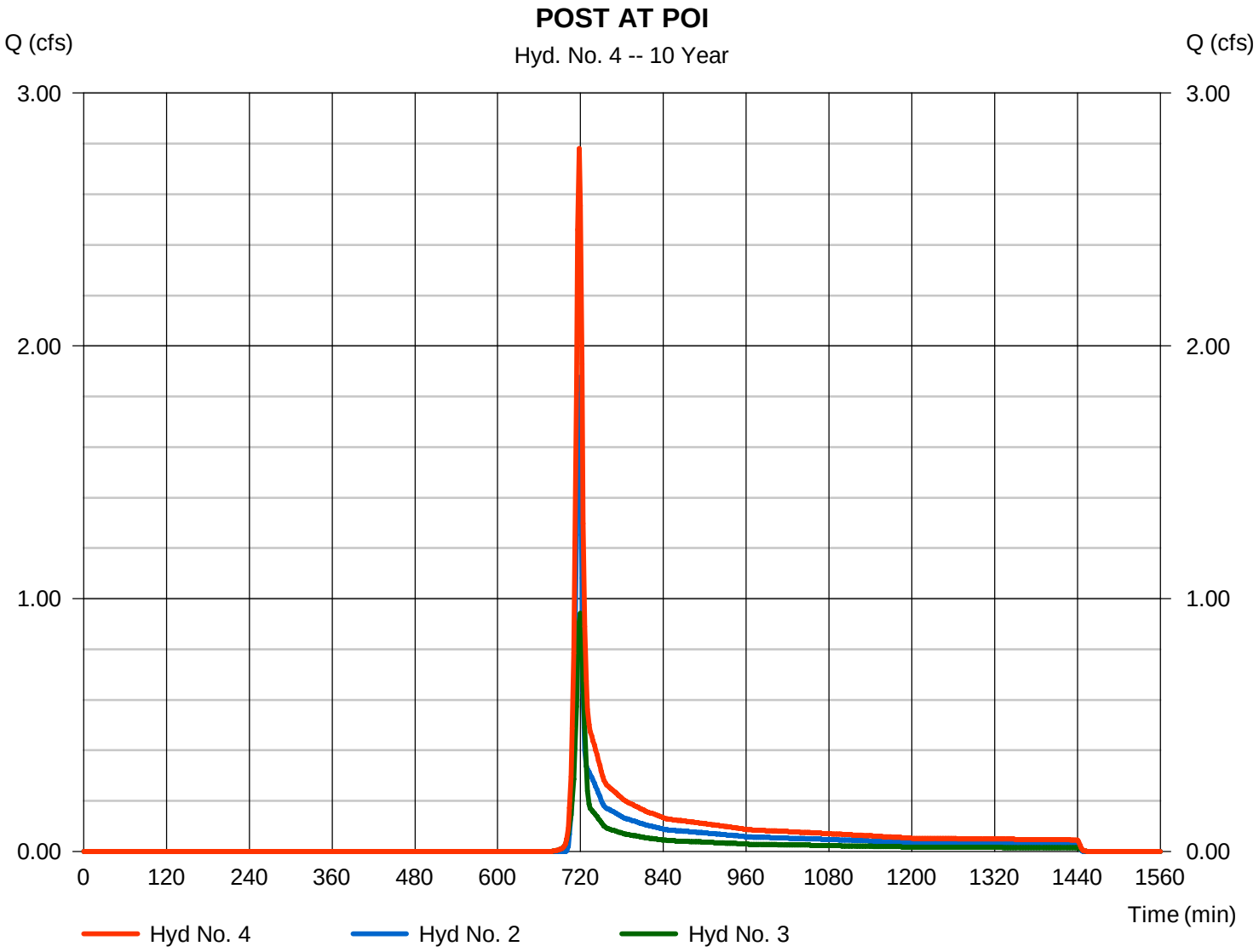
# Hydrograph Report



## Hyd. No. 4

POST AT POI

| | | | |
|---|---|---|---|
| Hydrograph type | = Combine | Peak discharge | = 2.782 cfs |
| Storm frequency | = 10 yrs | Time to peak | = 718 min |
| Time interval | = 2 min | Hyd. volume | = 6,215 cuft |
| Inflow hyds. | = 2, 3 | Contrib. drain. area | = 1.810 ac |



# Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

| Hyd. No. | Hydrograph type (origin) | Peak flow (cfs) | Time interval (min) | Time to Peak (min) | Hyd. volume (cuft) | Inflow hyd(s) | Maximum elevation (ft) | Total strge used (cuft) | Hydrograph Description |
|---|---|---|---|---|---|---|---|---|---|
| 1 | SCS Runoff | 6.376 | 2 | 718 | 12,787 | ------ | ------ | ------ | PRE |
| 2 | SCS Runoff | 4.650 | 2 | 718 | 9,325 | ------ | ------ | ------ | POST UNDETAINED |
| 3 | SCS Runoff | 2.041 | 2 | 720 | 4,672 | ------ | ------ | ------ | POST DETAINED |
| 4 | Combine | 6.673 | 2 | 718 | 13,997 | 2, 3 | ------ | ------ | POST AT POI |

# Hydrograph Report

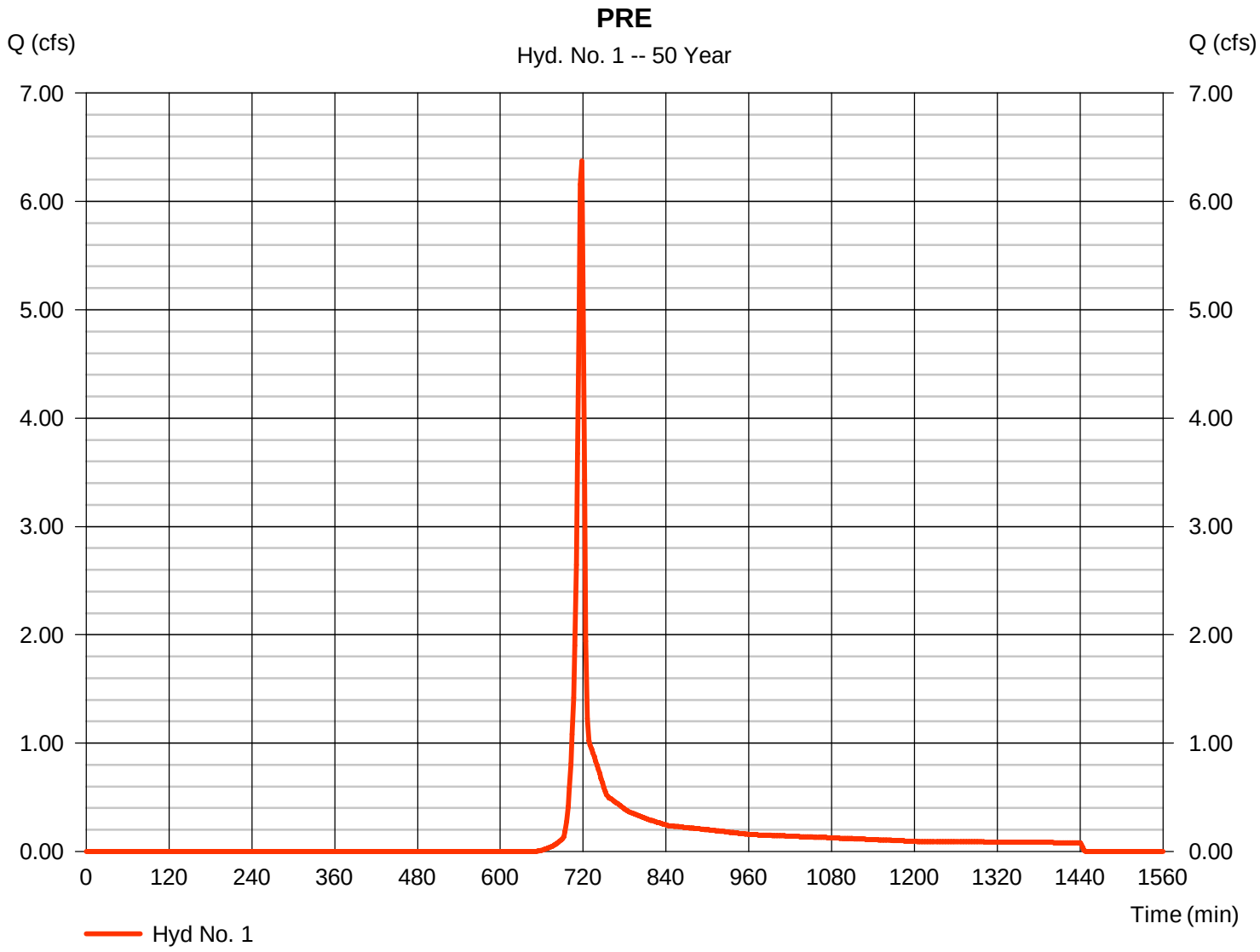


## Hyd. No. 1

PRE

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | SCS Runoff | Peak discharge | = | 6.376 cfs |
| Storm frequency | = | 50 yrs | Time to peak | = | 718 min |
| Time interval | = | 2 min | Hyd. volume | = | 12,787 cuft |
| Drainage area | = | 1.810 ac | Curve number | = | 58* |
| Basin Slope | = | 0.0 % | Hydraulic length | = | 0 ft |
| Tc method | = | TR55 | Time of conc. (Tc) | = | 6.30 min |
| Total precip. | = | 6.50 in | Distribution | = | Type II |
| Storm duration | = | 24 hrs | Shape factor | = | 484 |

* Composite (Area/CN) = [(1.810 x 58)] / 1.810



# Hydrograph Report

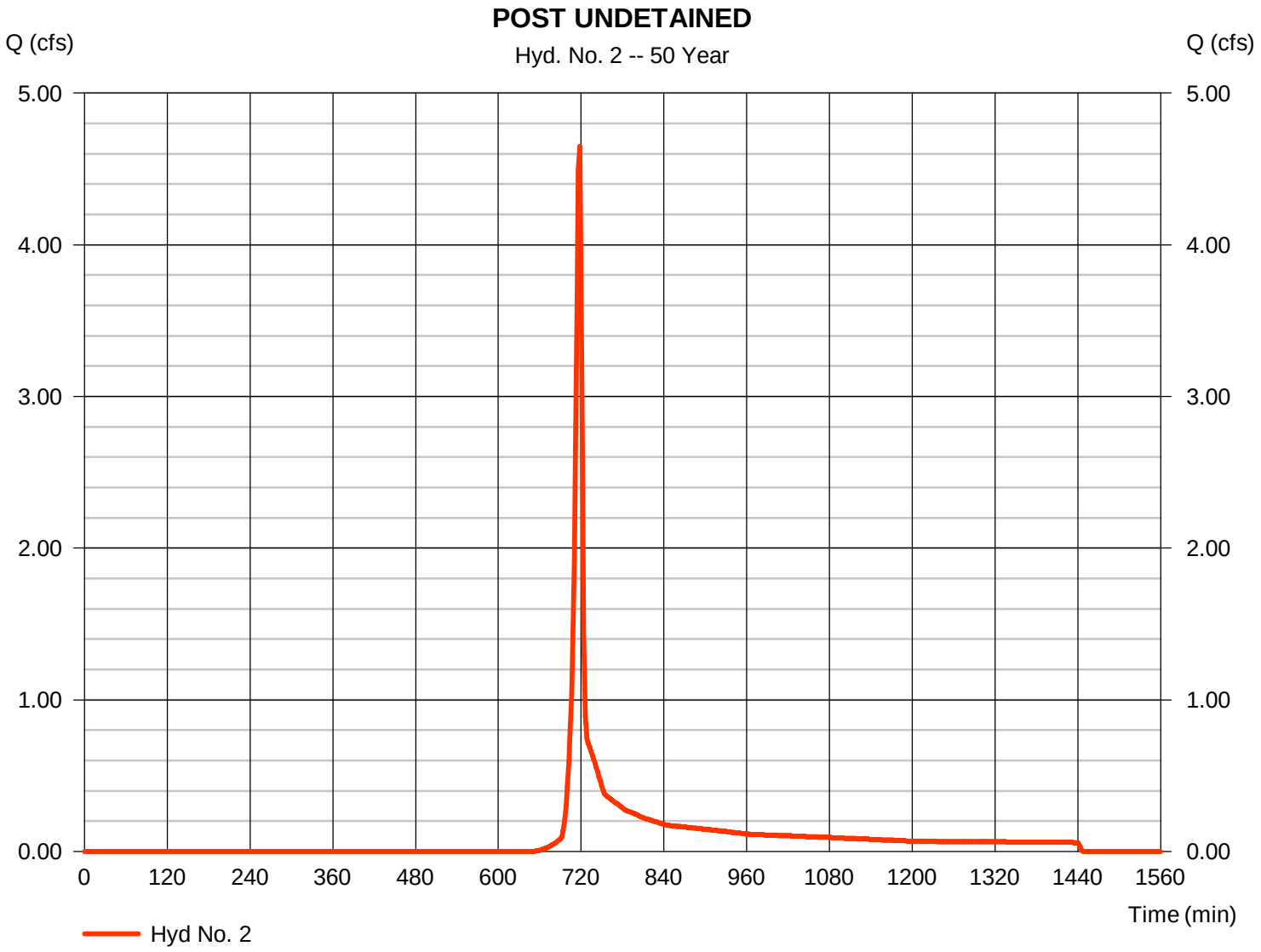


## Hyd. No. 2

POST UNDETAINED

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | SCS Runoff | Peak discharge | = | 4.650 cfs |
| Storm frequency | = | 50 yrs | Time to peak | = | 718 min |
| Time interval | = | 2 min | Hyd. volume | = | 9,325 cuft |
| Drainage area | = | 1.320 ac | Curve number | = | 58* |
| Basin Slope | = | 0.0 % | Hydraulic length | = | 0 ft |
| Tc method | = | TR55 | Time of conc. (Tc) | = | 6.30 min |
| Total precip. | = | 6.50 in | Distribution | = | Type II |
| Storm duration | = | 24 hrs | Shape factor | = | 484 |

* Composite (Area/CN) = [(0.020 x 85) + (1.300 x 58)] / 1.320



# Hydrograph Report

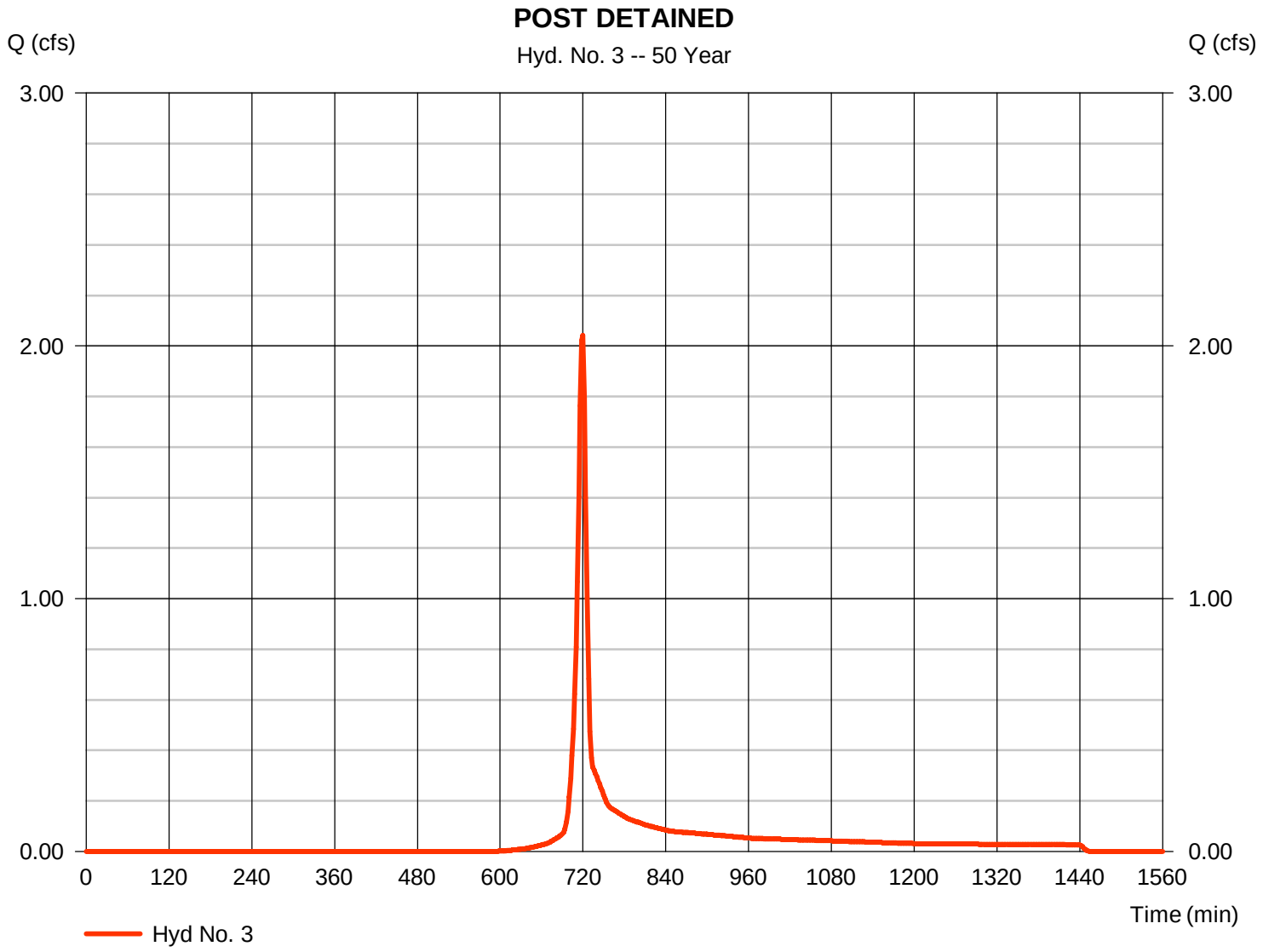


## Hyd. No. 3

POST DETAINED

| | | | |
|---|---|---|---|
| Hydrograph type | = SCS Runoff | Peak discharge | = 2.041 cfs |
| Storm frequency | = 50 yrs | Time to peak | = 720 min |
| Time interval | = 2 min | Hyd. volume | = 4,672 cuft |
| Drainage area | = 0.490 ac | Curve number | = 64* |
| Basin Slope | = 0.0 % | Hydraulic length | = 0 ft |
| Tc method | = TR55 | Time of conc. (Tc) | = 7.00 min |
| Total precip. | = 6.50 in | Distribution | = Type II |
| Storm duration | = 24 hrs | Shape factor | = 484 |

* Composite (Area/CN) = [(0.110 x 85) + (0.380 x 58)] / 0.490



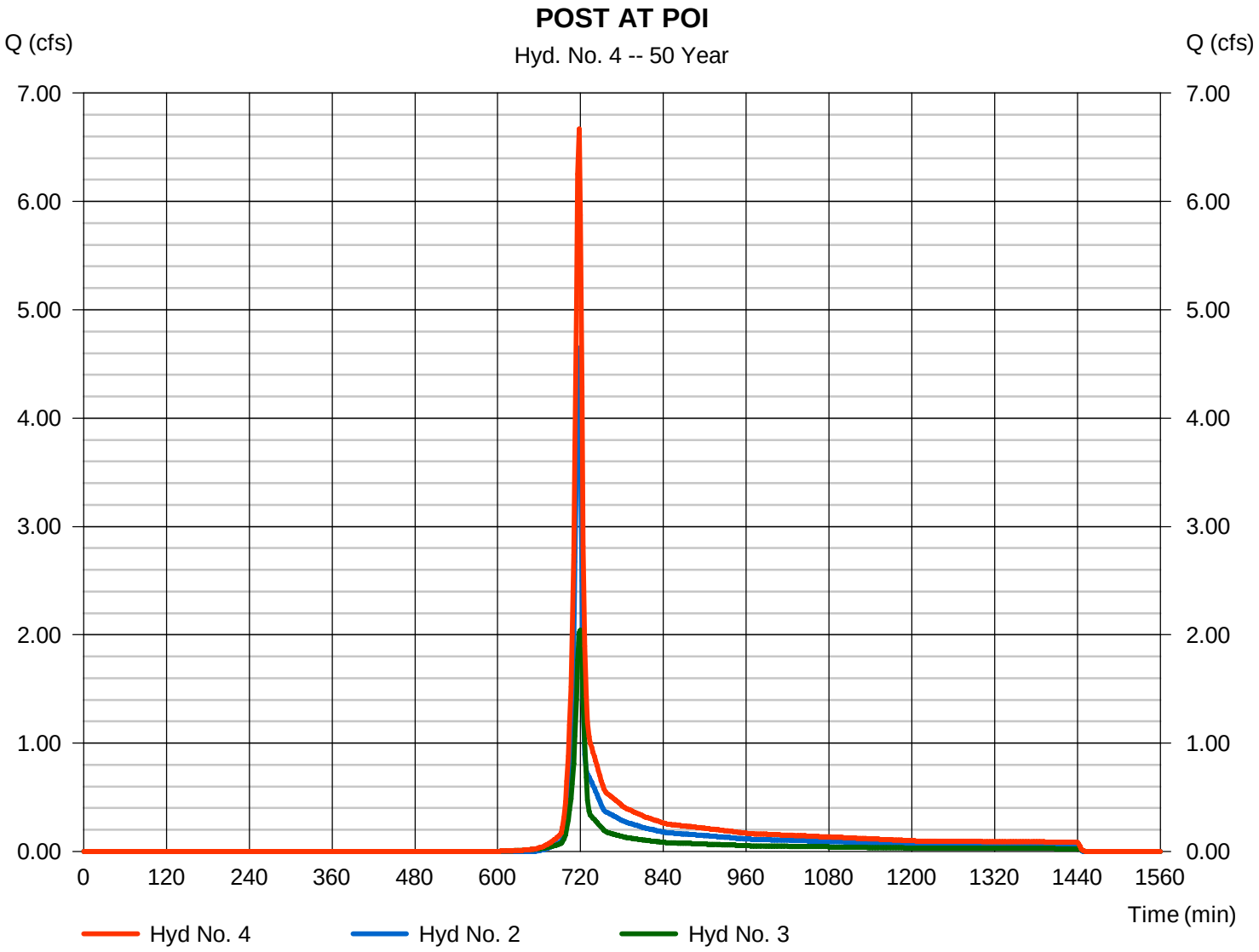
# Hydrograph Report



## Hyd. No. 4

POST AT POI

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | Combine | Peak discharge | = | 6.673 cfs |
| Storm frequency | = | 50 yrs | Time to peak | = | 718 min |
| Time interval | = | 2 min | Hyd. volume | = | 13,997 cuft |
| Inflow hyds. | = | 2, 3 | Contrib. drain. area | = | 1.810 ac |



# Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

| 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 | 8.660 | 2 | 718 | 17,318 | ------ | ------ | ------ | PRE |
| 2 | SCS Runoff | 6.316 | 2 | 718 | 12,629 | ------ | ------ | ------ | POST UNDETAINED |
| 3 | SCS Runoff | 2.678 | 2 | 720 | 6,135 | ------ | ------ | ------ | POST DETAINED |
| 4 | Combine | 8.992 | 2 | 718 | 18,765 | 2, 3 | ------ | ------ | POST AT POI |

# Hydrograph Report

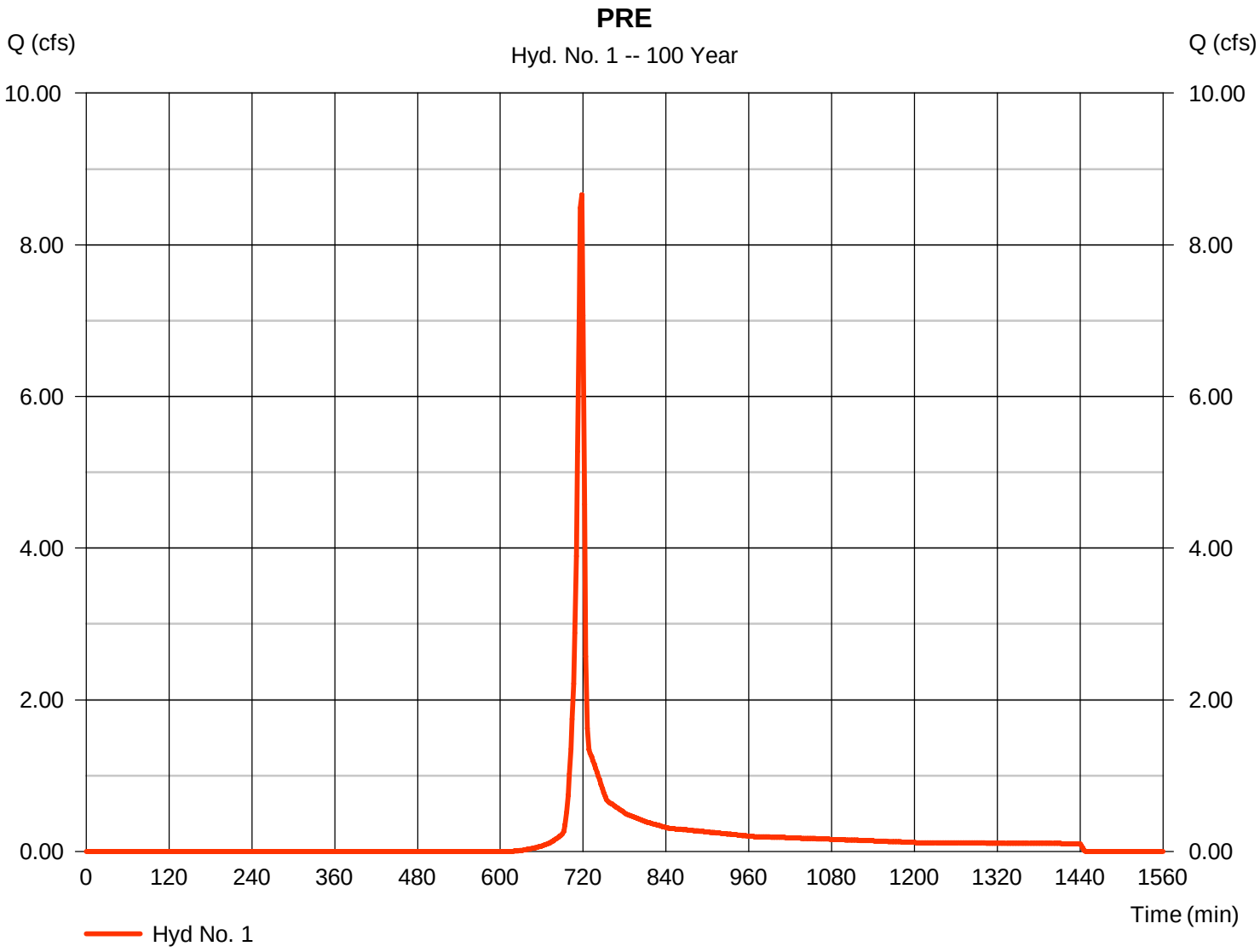


## Hyd. No. 1

PRE

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | SCS Runoff | Peak discharge | = | 8.660 cfs |
| Storm frequency | = | 100 yrs | Time to peak | = | 718 min |
| Time interval | = | 2 min | Hyd. volume | = | 17,318 cuft |
| Drainage area | = | 1.810 ac | Curve number | = | 58* |
| Basin Slope | = | 0.0 % | Hydraulic length | = | 0 ft |
| Tc method | = | TR55 | Time of conc. (Tc) | = | 6.30 min |
| Total precip. | = | 7.58 in | Distribution | = | Type II |
| Storm duration | = | 24 hrs | Shape factor | = | 484 |

* Composite (Area/CN) = [(1.810 x 58)] / 1.810



# Hydrograph Report

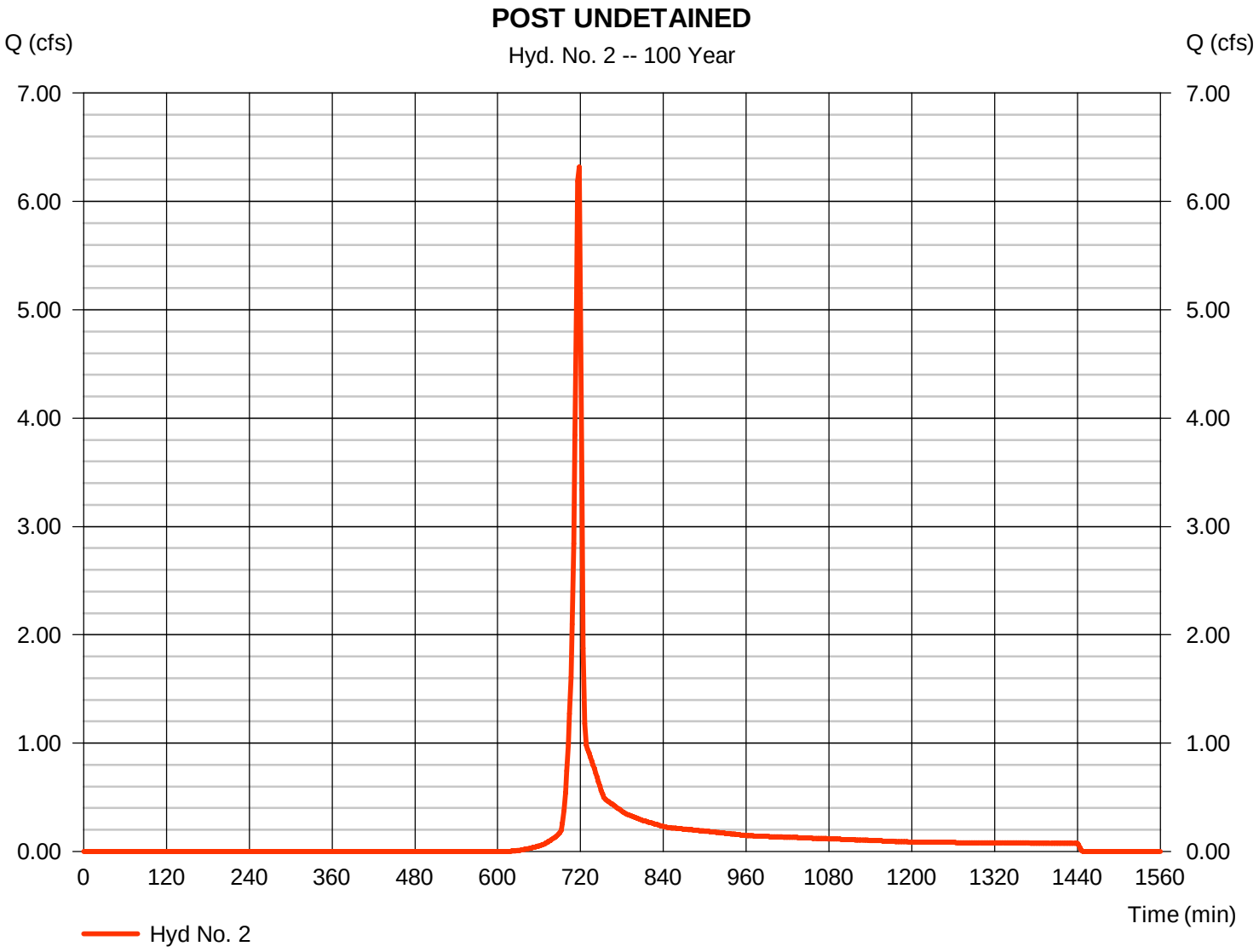


## Hyd. No. 2

POST UNDETAINED

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | SCS Runoff | Peak discharge | = | 6.316 cfs |
| Storm frequency | = | 100 yrs | Time to peak | = | 718 min |
| Time interval | = | 2 min | Hyd. volume | = | 12,629 cuft |
| Drainage area | = | 1.320 ac | Curve number | = | 58* |
| Basin Slope | = | 0.0 % | Hydraulic length | = | 0 ft |
| Tc method | = | TR55 | Time of conc. (Tc) | = | 6.30 min |
| Total precip. | = | 7.58 in | Distribution | = | Type II |
| Storm duration | = | 24 hrs | Shape factor | = | 484 |

* Composite (Area/CN) = [(0.020 x 85) + (1.300 x 58)] / 1.320



# Hydrograph Report

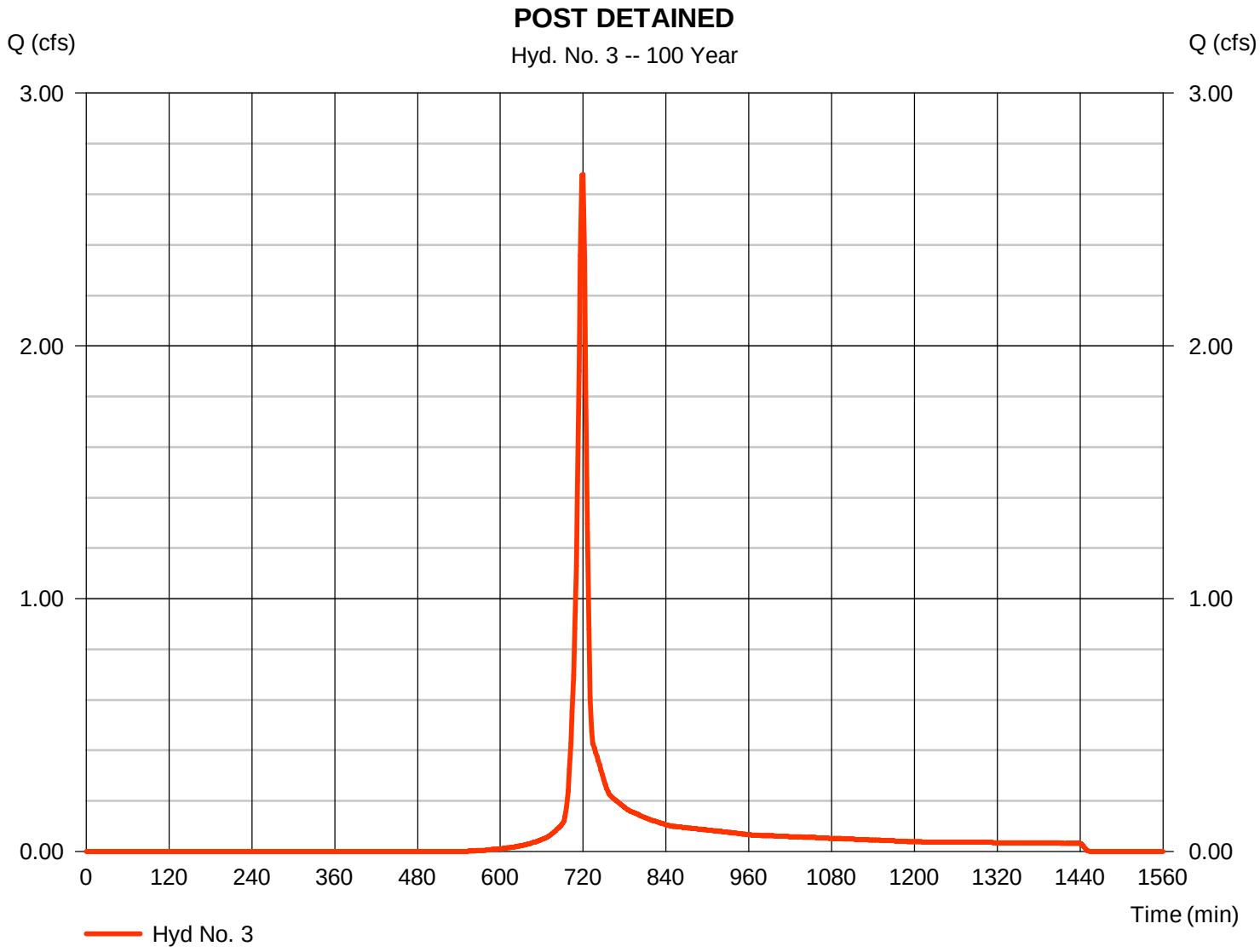


## Hyd. No. 3

POST DETAINED

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | SCS Runoff | Peak discharge | = | 2.678 cfs |
| Storm frequency | = | 100 yrs | Time to peak | = | 720 min |
| Time interval | = | 2 min | Hyd. volume | = | 6,135 cuft |
| Drainage area | = | 0.490 ac | Curve number | = | 64* |
| Basin Slope | = | 0.0 % | Hydraulic length | = | 0 ft |
| Tc method | = | TR55 | Time of conc. (Tc) | = | 7.00 min |
| Total precip. | = | 7.58 in | Distribution | = | Type II |
| Storm duration | = | 24 hrs | Shape factor | = | 484 |

* Composite (Area/CN) = [(0.110 x 85) + (0.380 x 58)] / 0.490



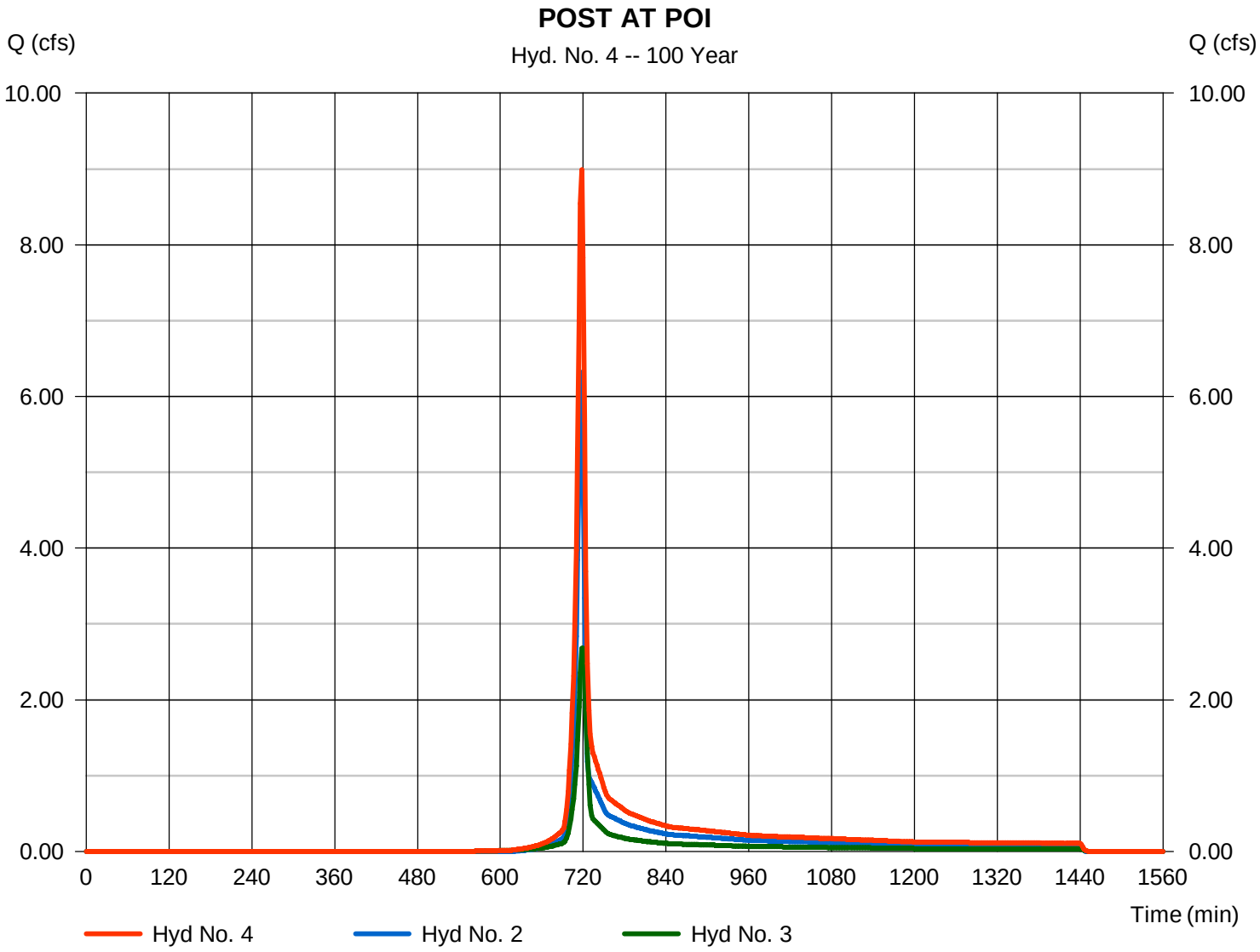
# Hydrograph Report



## Hyd. No. 4

POST AT POI

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | Combine | Peak discharge | = | 8.992 cfs |
| Storm frequency | = | 100 yrs | Time to peak | = | 718 min |
| Time interval | = | 2 min | Hyd. volume | = | 18,765 cuft |
| Inflow hyds. | = | 2, 3 | Contrib. drain. area | = | 1.810 ac |



# Hydraflow Rainfall Report



| Return Period (Yrs) | Intensity-Duration-Frequency Equation Coefficients (FHA) | | | |
|---|---|---|---|---|
| | B | D | E | (N/A) |
| 1 | 47.8383 | 12.2000 | 0.8815 | -------- |
| 2 | 54.1927 | 12.1000 | 0.8666 | -------- |
| 3 | 0.0000 | 0.0000 | 0.0000 | -------- |
| 5 | 62.5798 | 12.9000 | 0.8462 | -------- |
| 10 | 55.8141 | 11.6000 | 0.7914 | -------- |
| 25 | 52.1635 | 10.8000 | 0.7411 | -------- |
| 50 | 47.5325 | 9.8000 | 0.6975 | -------- |
| 100 | 42.7369 | 8.7000 | 0.6521 | -------- |

File name: Gates Road IDF.IDF

**Intensity = B / (Tc + D)^E**

| Return Period (Yrs) | Intensity Values (in/hr) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 5 min | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 | 60 |
| 1 | 3.90 | 3.11 | 2.60 | 2.24 | 1.97 | 1.77 | 1.60 | 1.46 | 1.35 | 1.25 | 1.17 | 1.10 |
| 2 | 4.63 | 3.71 | 3.11 | 2.68 | 2.37 | 2.12 | 1.92 | 1.76 | 1.63 | 1.51 | 1.42 | 1.33 |
| 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 | 5.45 | 4.42 | 3.74 | 3.25 | 2.89 | 2.60 | 2.37 | 2.18 | 2.02 | 1.88 | 1.76 | 1.66 |
| 10 | 6.04 | 4.91 | 4.16 | 3.63 | 3.23 | 2.92 | 2.67 | 2.46 | 2.29 | 2.14 | 2.01 | 1.90 |
| 25 | 6.75 | 5.50 | 4.69 | 4.11 | 3.68 | 3.34 | 3.07 | 2.84 | 2.65 | 2.49 | 2.34 | 2.22 |
| 50 | 7.26 | 5.92 | 5.06 | 4.45 | 4.00 | 3.64 | 3.35 | 3.11 | 2.91 | 2.74 | 2.59 | 2.46 |
| 100 | 7.75 | 6.33 | 5.42 | 4.79 | 4.31 | 3.94 | 3.64 | 3.39 | 3.18 | 3.00 | 2.85 | 2.71 |

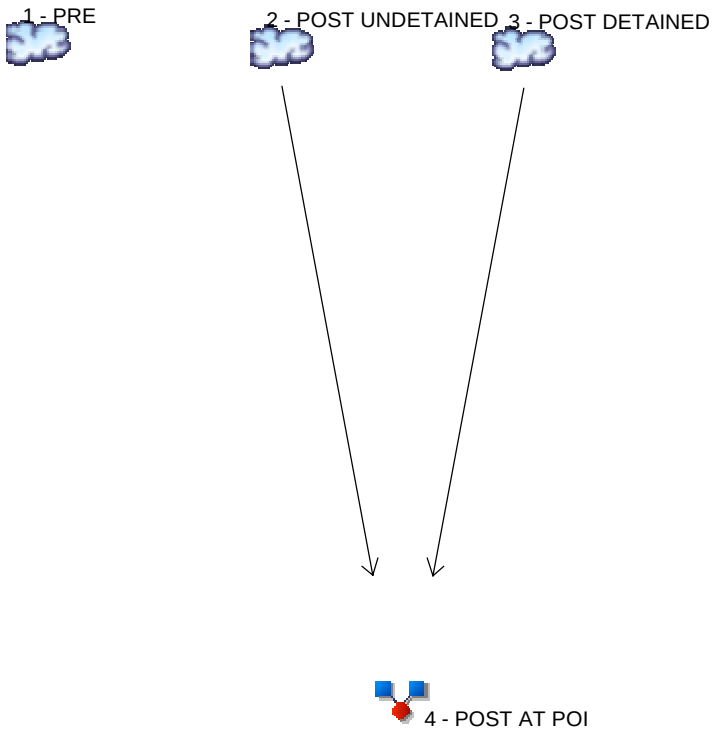
Tc = time in minutes. Values may exceed 60.

\ESCGP-2\PPP\02 SCRO\07 PCSM\Attach 4 Stormwater Calcs\Gates Road\Hydraflow Rev 1\Gates Road Precip.pc

| Storm Distribution | Rainfall Precipitation Table (in) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1-yr | 2-yr | 3-yr | 5-yr | 10-yr | 25-yr | 50-yr | 100-yr |
| SCS 24-hour | 2.46 | 2.97 | 0.00 | 3.77 | 4.47 | 5.55 | 6.50 | 7.58 |
| SCS 6-Hr | 1.74 | 2.11 | 0.00 | 2.65 | 3.10 | 3.76 | 4.32 | 4.92 |
| Huff-1st | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Huff-2nd | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Huff-3rd | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Huff-4th | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Huff-Indy | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Custom | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

# Watershed Model Schematic

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4




## Legend

| Hyd. | Origin | Description |
|---|---|---|
| 1 | SCS Runoff | PRE |
| 2 | SCS Runoff | POST UNDETAINED |
| 3 | SCS Runoff | POST DETAINED |
| 4 | Combine | POST AT POI |

# Hydrograph Return Period Recap



| Hyd. No. | Hydrograph type (origin) | Inflow hyd(s) | Peak Outflow (cfs) | | | | | | | | Hydrograph Description |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1-yr | 2-yr | 3-yr | 5-yr | 10-yr | 25-yr | 50-yr | 100-yr | |
| 1 | SCS Runoff | ------ | ------- | 0.471 | ------- | ------- | ------- | ------- | ------- | ------- | PRE |
| 2 | SCS Runoff | ------ | ------- | 0.344 | ------- | ------- | ------- | ------- | ------- | ------- | POST UNDETAINED |
| 3 | SCS Runoff | ------ | ------- | 0.087 | ------- | ------- | ------- | ------- | ------- | ------- | POST DETAINED |
| 4 | Combine | 2, 3 | ------- | 0.358 | ------- | ------- | ------- | ------- | ------- | ------- | POST AT POI |

# Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

| 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 | 0.471 | 2 | 720 | 1,625 | ------ | ------ | ------ | PRE |
| 2 | SCS Runoff | 0.344 | 2 | 720 | 1,185 | ------ | ------ | ------ | POST UNDETAINED |
| 3 | SCS Runoff | 0.087 | 2 | 752 | 805 | ------ | ------ | ------ | POST DETAINED |
| 4 | Combine | 0.358 | 2 | 720 | 1,990 | 2, 3 | ------ | ------ | POST AT POI |

# Hydrograph Report

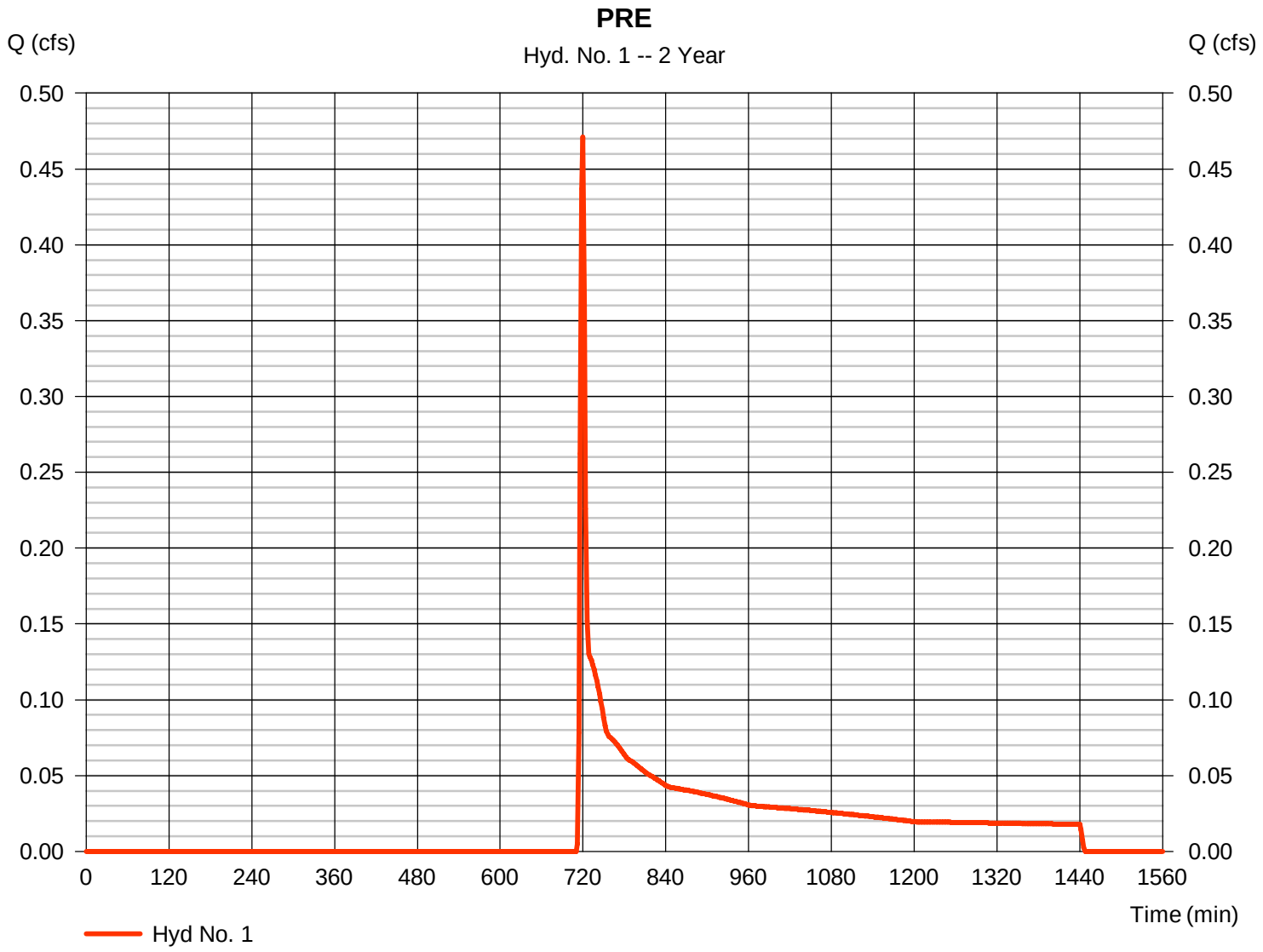


## Hyd. No. 1

PRE

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | SCS Runoff | Peak discharge | = | 0.471 cfs |
| Storm frequency | = | 2 yrs | Time to peak | = | 720 min |
| Time interval | = | 2 min | Hyd. volume | = | 1,625 cuft |
| Drainage area | = | 1.810 ac | Curve number | = | 58* |
| Basin Slope | = | 0.0 % | Hydraulic length | = | 0 ft |
| Tc method | = | TR55 | Time of conc. (Tc) | = | 6.30 min |
| Total precip. | = | 2.97 in | Distribution | = | Type II |
| Storm duration | = | 24 hrs | Shape factor | = | 484 |

* Composite (Area/CN) = [(1.810 x 58)] / 1.810



# TR55 Tc Worksheet



## Hyd. No. 1

PRE

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.240 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 50.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 2.97 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 8.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 4.89** | **+** | **0.00** | **+** | **0.00** | **=** | **4.89** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 173.00 | | 22.00 | | 123.00 | | |
| Watercourse slope (%) | = 9.10 | | 1.60 | | 4.50 | | |
| Surface description | = Unpaved | | Unpaved | | Unpaved | | |
| Average velocity (ft/s) | =4.87 | | 2.04 | | 3.42 | | |
| **Travel Time (min)** | **= 0.59** | **+** | **0.18** | **+** | **0.60** | **=** | **1.37** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 6.30 min**

# Hydrograph Report

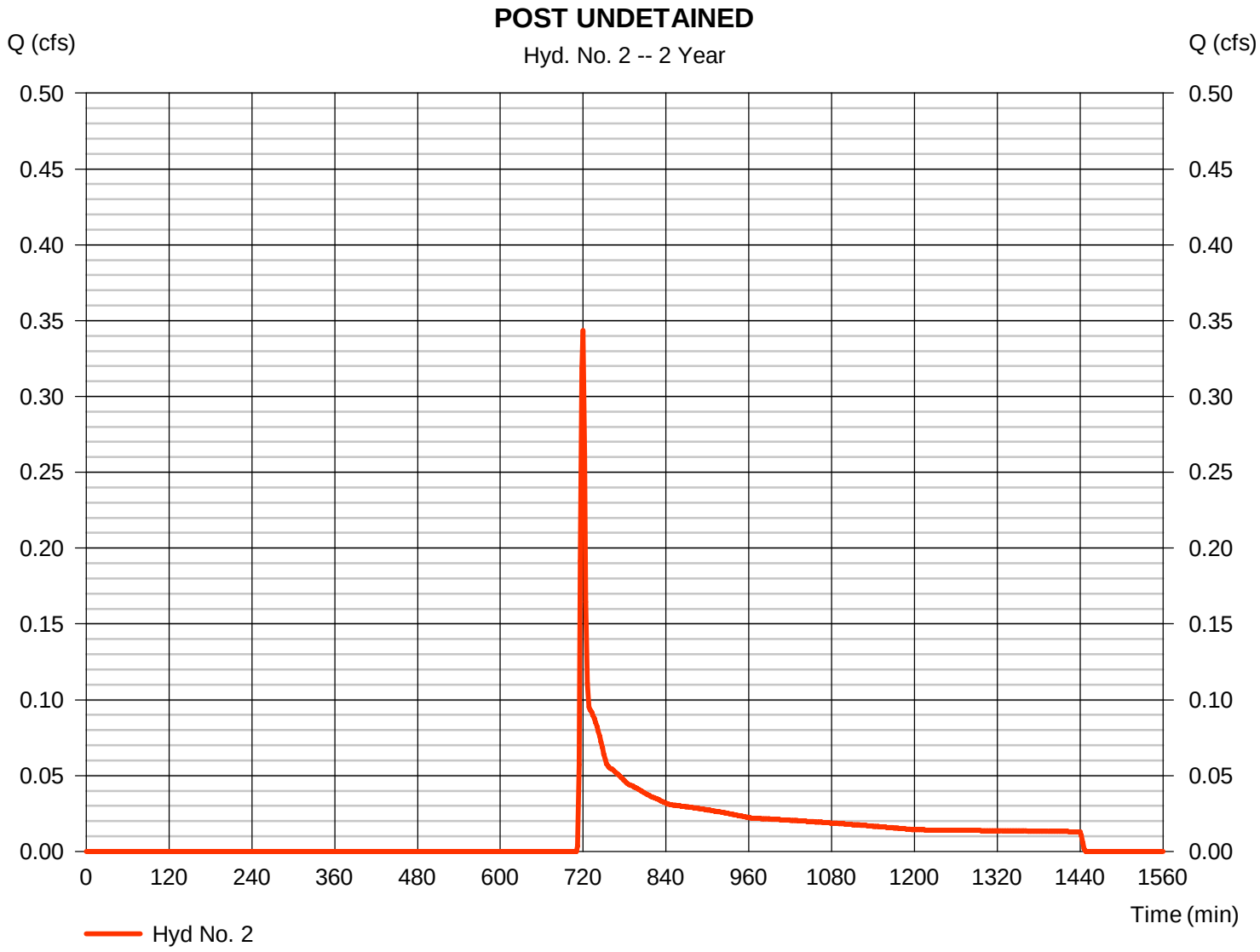


## Hyd. No. 2

POST UNDETAINED

| | | | |
|---|---|---|---|
| Hydrograph type | = SCS Runoff | Peak discharge | = 0.344 cfs |
| Storm frequency | = 2 yrs | Time to peak | = 720 min |
| Time interval | = 2 min | Hyd. volume | = 1,185 cuft |
| Drainage area | = 1.320 ac | Curve number | = 58* |
| Basin Slope | = 0.0 % | Hydraulic length | = 0 ft |
| Tc method | = TR55 | Time of conc. (Tc) | = 6.30 min |
| Total precip. | = 2.97 in | Distribution | = Type II |
| Storm duration | = 24 hrs | Shape factor | = 484 |

* Composite (Area/CN) = [(0.020 x 85) + (1.300 x 58)] / 1.320



# TR55 Tc Worksheet



## Hyd. No. 2

POST UNDETAINED

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.240 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 50.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 2.97 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 8.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 4.89** | **+** | **0.00** | **+** | **0.00** | **=** | **4.89** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 173.00 | | 22.00 | | 123.00 | | |
| Watercourse slope (%) | = 9.10 | | 1.60 | | 4.50 | | |
| Surface description | = Unpaved | | Unpaved | | Unpaved | | |
| Average velocity (ft/s) | =4.87 | | 2.04 | | 3.42 | | |
| **Travel Time (min)** | **= 0.59** | **+** | **0.18** | **+** | **0.60** | **=** | **1.37** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 6.30 min**

# Hydrograph Report

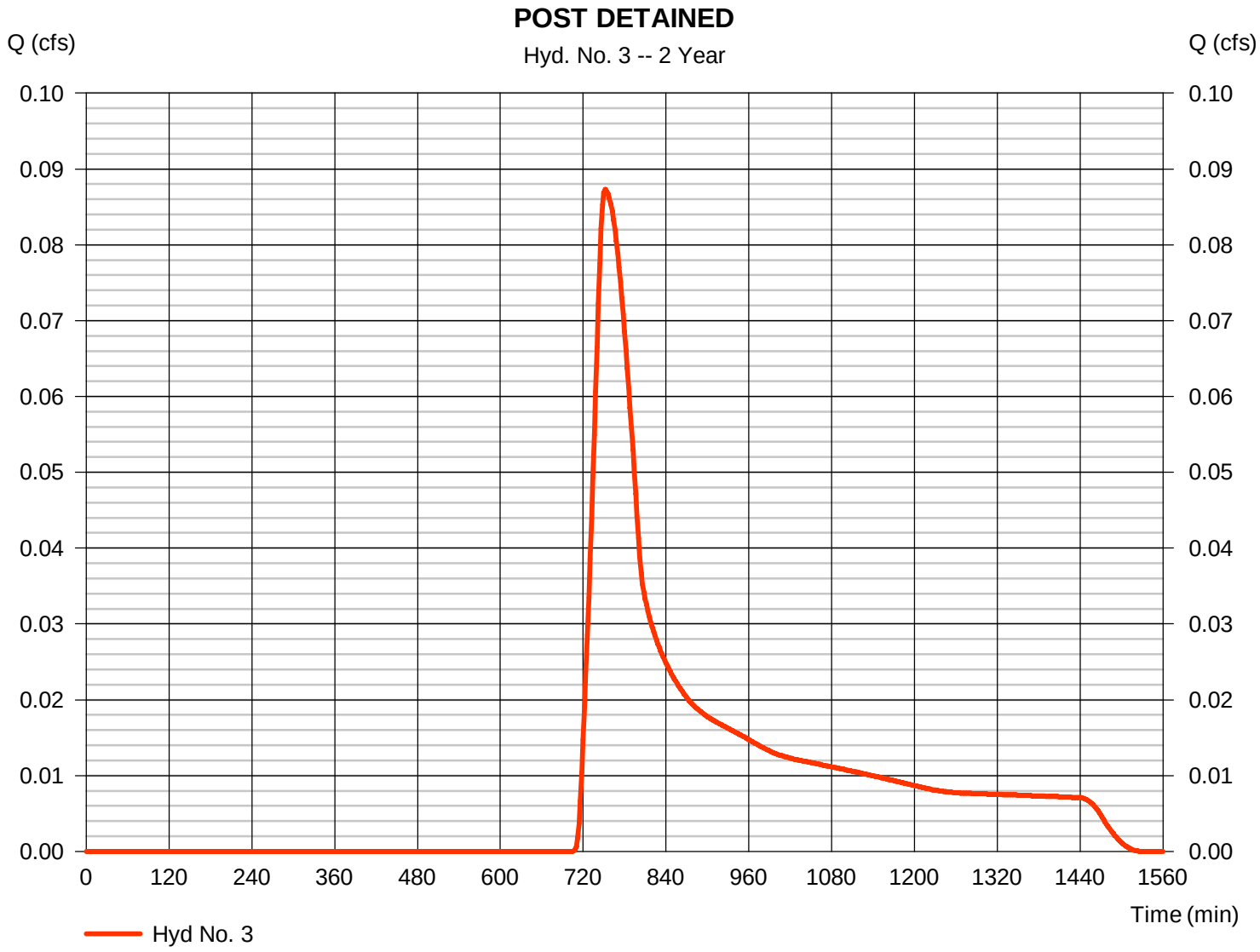


## Hyd. No. 3

POST DETAINED

| | | | |
|---|---|---|---|
| Hydrograph type | = SCS Runoff | Peak discharge | = 0.087 cfs |
| Storm frequency | = 2 yrs | Time to peak | = 752 min |
| Time interval | = 2 min | Hyd. volume | = 805 cuft |
| Drainage area | = 0.490 ac | Curve number | = 64* |
| Basin Slope | = 0.0 % | Hydraulic length | = 0 ft |
| Tc method | = User | Time of conc. (Tc) | = 54.43 min |
| Total precip. | = 2.97 in | Distribution | = Type II |
| Storm duration | = 24 hrs | Shape factor | = 484 |

* Composite (Area/CN) = [(0.110 x 85) + (0.380 x 58)] / 0.490



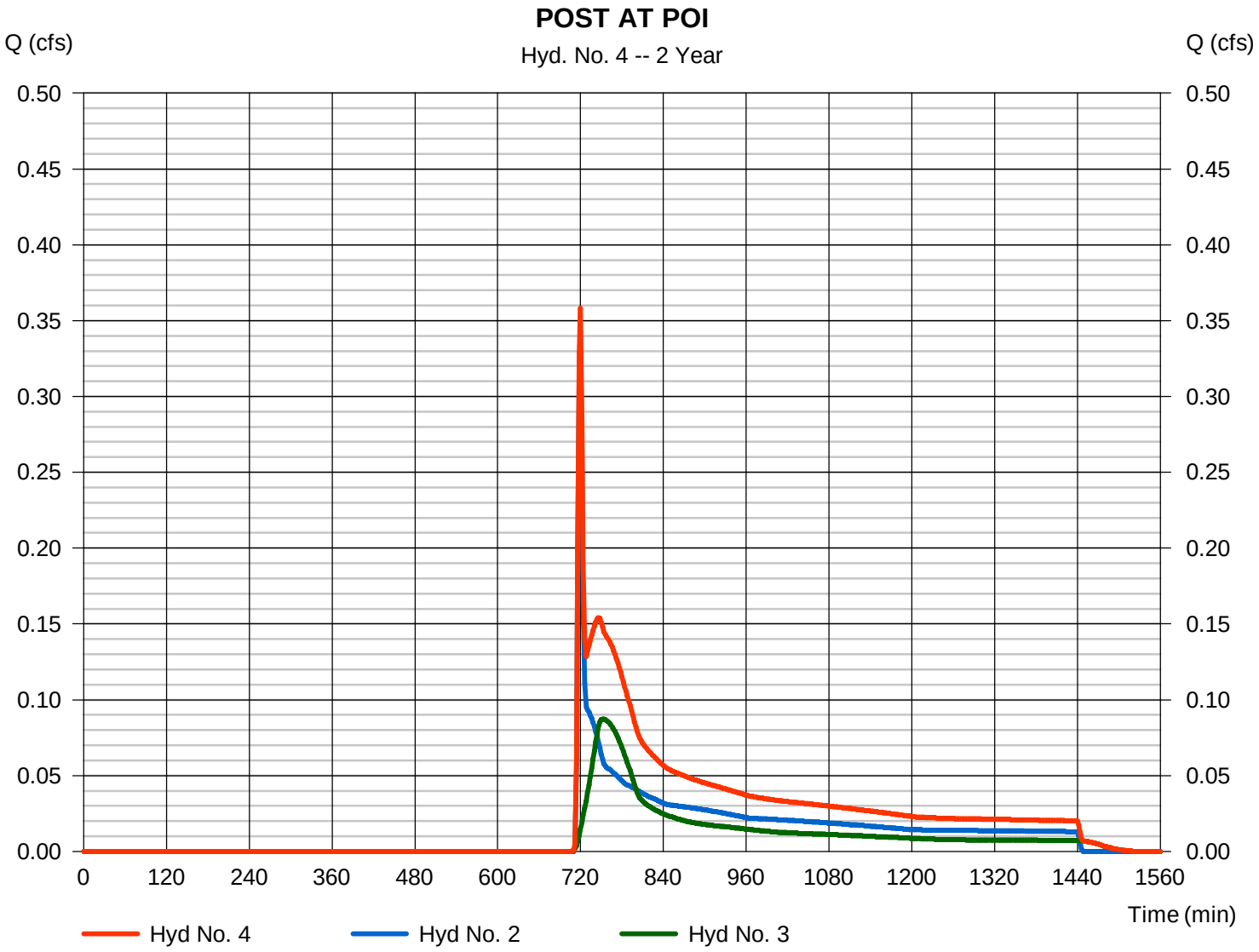
# Hydrograph Report



## Hyd. No. 4

POST AT POI

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | Combine | Peak discharge | = | 0.358 cfs |
| Storm frequency | = | 2 yrs | Time to peak | = | 720 min |
| Time interval | = | 2 min | Hyd. volume | = | 1,990 cuft |
| Inflow hyds. | = | 2, 3 | Contrib. drain. area | = | 1.810 ac |



# Hydraflow Rainfall Report



| Return Period (Yrs) | Intensity-Duration-Frequency Equation Coefficients (FHA) | | | |
|---|---|---|---|---|
| | B | D | E | (N/A) |
| 1 | 47.8383 | 12.2000 | 0.8815 | -------- |
| 2 | 54.1927 | 12.1000 | 0.8666 | -------- |
| 3 | 0.0000 | 0.0000 | 0.0000 | -------- |
| 5 | 62.5798 | 12.9000 | 0.8462 | -------- |
| 10 | 55.8141 | 11.6000 | 0.7914 | -------- |
| 25 | 52.1635 | 10.8000 | 0.7411 | -------- |
| 50 | 47.5325 | 9.8000 | 0.6975 | -------- |
| 100 | 42.7369 | 8.7000 | 0.6521 | -------- |

File name: Gates Road IDF.IDF

**Intensity = B / (Tc + D)^E**

| Return Period (Yrs) | Intensity Values (in/hr) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 5 min | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 | 60 |
| 1 | 3.90 | 3.11 | 2.60 | 2.24 | 1.97 | 1.77 | 1.60 | 1.46 | 1.35 | 1.25 | 1.17 | 1.10 |
| 2 | 4.63 | 3.71 | 3.11 | 2.68 | 2.37 | 2.12 | 1.92 | 1.76 | 1.63 | 1.51 | 1.42 | 1.33 |
| 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 | 5.45 | 4.42 | 3.74 | 3.25 | 2.89 | 2.60 | 2.37 | 2.18 | 2.02 | 1.88 | 1.76 | 1.66 |
| 10 | 6.04 | 4.91 | 4.16 | 3.63 | 3.23 | 2.92 | 2.67 | 2.46 | 2.29 | 2.14 | 2.01 | 1.90 |
| 25 | 6.75 | 5.50 | 4.69 | 4.11 | 3.68 | 3.34 | 3.07 | 2.84 | 2.65 | 2.49 | 2.34 | 2.22 |
| 50 | 7.26 | 5.92 | 5.06 | 4.45 | 4.00 | 3.64 | 3.35 | 3.11 | 2.91 | 2.74 | 2.59 | 2.46 |
| 100 | 7.75 | 6.33 | 5.42 | 4.79 | 4.31 | 3.94 | 3.64 | 3.39 | 3.18 | 3.00 | 2.85 | 2.71 |

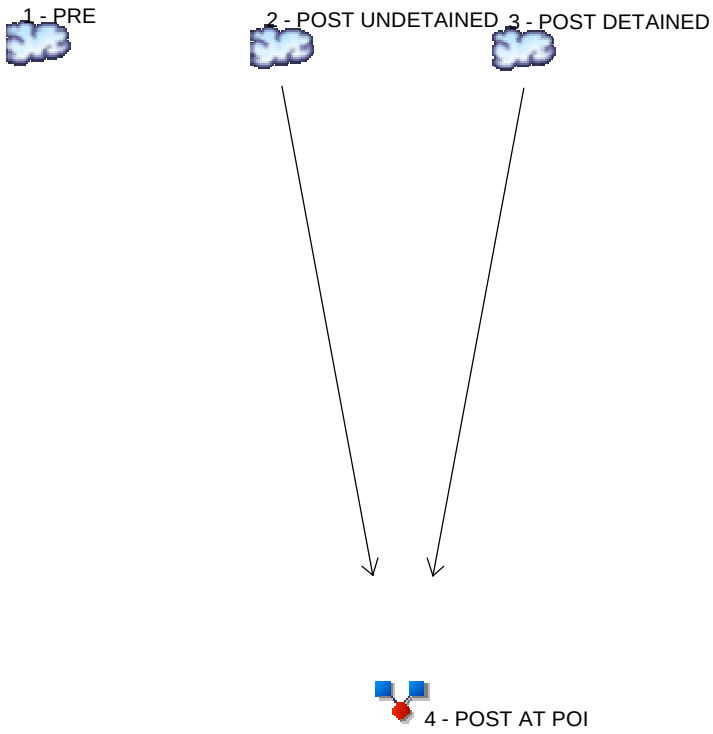
Tc = time in minutes. Values may exceed 60.

\ESCGP-2\PPP\02 SCRO\07 PCSM\Attach 4 Stormwater Calcs\Gates Road\Hydraflow Rev 1\Gates Road Precip.pc

| Storm Distribution | Rainfall Precipitation Table (in) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1-yr | 2-yr | 3-yr | 5-yr | 10-yr | 25-yr | 50-yr | 100-yr |
| SCS 24-hour | 2.46 | 2.97 | 0.00 | 3.77 | 4.47 | 5.55 | 6.50 | 7.58 |
| SCS 6-Hr | 1.74 | 2.11 | 0.00 | 2.65 | 3.10 | 3.76 | 4.32 | 4.92 |
| Huff-1st | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Huff-2nd | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Huff-3rd | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Huff-4th | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Huff-Indy | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Custom | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

# Watershed Model Schematic

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4




## Legend

| Hyd. | Origin | Description |
|---|---|---|
| 1 | SCS Runoff | PRE |
| 2 | SCS Runoff | POST UNDETAINED |
| 3 | SCS Runoff | POST DETAINED |
| 4 | Combine | POST AT POI |

# Hydrograph Return Period Recap



| Hyd. No. | Hydrograph type (origin) | Inflow hyd(s) | Peak Outflow (cfs) | | | | | | | | Hydrograph Description |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1-yr | 2-yr | 3-yr | 5-yr | 10-yr | 25-yr | 50-yr | 100-yr | |
| 1 | SCS Runoff | ------ | ------- | ------- | ------- | ------- | 2.571 | ------- | ------- | ------- | PRE |
| 2 | SCS Runoff | ------ | ------- | ------- | ------- | ------- | 1.875 | ------- | ------- | ------- | POST UNDETAINED |
| 3 | SCS Runoff | ------ | ------- | ------- | ------- | ------- | 0.363 | ------- | ------- | ------- | POST DETAINED |
| 4 | Combine | 2, 3 | ------- | ------- | ------- | ------- | 1.973 | ------- | ------- | ------- | POST AT POI |

# Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

| 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 | 2.571 | 2 | 718 | 5,480 | ------ | ------ | ------ | PRE |
| 2 | SCS Runoff | 1.875 | 2 | 718 | 3,996 | ------ | ------ | ------ | POST UNDETAINED |
| 3 | SCS Runoff | 0.363 | 2 | 742 | 2,199 | ------ | ------ | ------ | POST DETAINED |
| 4 | Combine | 1.973 | 2 | 718 | 6,195 | 2, 3 | ------ | ------ | POST AT POI |

# Hydrograph Report

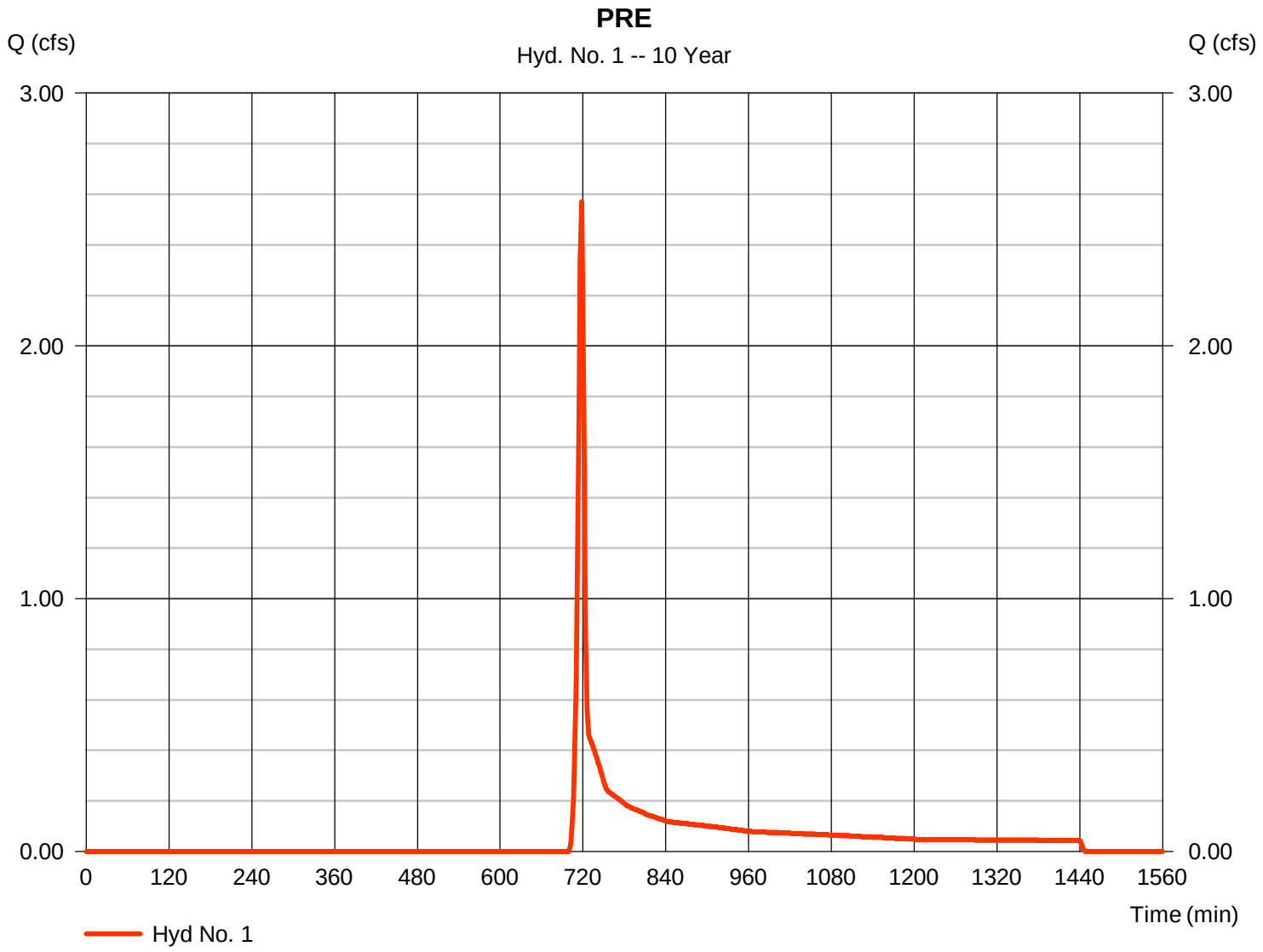


## Hyd. No. 1

PRE

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | SCS Runoff | Peak discharge | = | 2.571 cfs |
| Storm frequency | = | 10 yrs | Time to peak | = | 718 min |
| Time interval | = | 2 min | Hyd. volume | = | 5,480 cuft |
| Drainage area | = | 1.810 ac | Curve number | = | 58* |
| Basin Slope | = | 0.0 % | Hydraulic length | = | 0 ft |
| Tc method | = | TR55 | Time of conc. (Tc) | = | 6.30 min |
| Total precip. | = | 4.47 in | Distribution | = | Type II |
| Storm duration | = | 24 hrs | Shape factor | = | 484 |

* Composite (Area/CN) = [(1.810 x 58)] / 1.810



# TR55 Tc Worksheet



## Hyd. No. 1

PRE

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.240 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 50.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 2.97 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 8.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 4.89** | **+** | **0.00** | **+** | **0.00** | **=** | **4.89** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 173.00 | | 22.00 | | 123.00 | | |
| Watercourse slope (%) | = 9.10 | | 1.60 | | 4.50 | | |
| Surface description | = Unpaved | | Unpaved | | Unpaved | | |
| Average velocity (ft/s) | =4.87 | | 2.04 | | 3.42 | | |
| **Travel Time (min)** | **= 0.59** | **+** | **0.18** | **+** | **0.60** | **=** | **1.37** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 6.30 min**

# Hydrograph Report

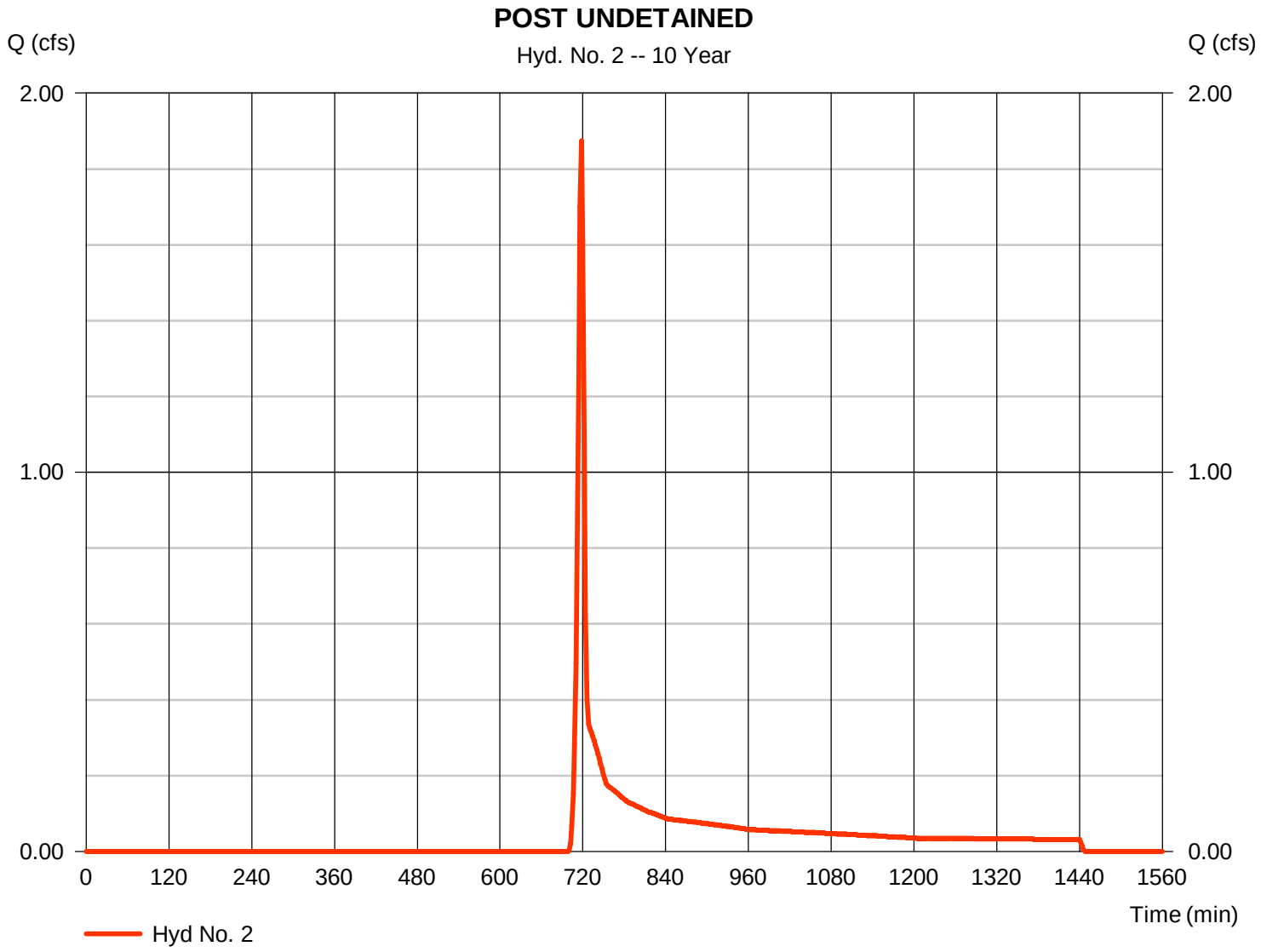


## Hyd. No. 2

POST UNDETAINED

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | SCS Runoff | Peak discharge | = | 1.875 cfs |
| Storm frequency | = | 10 yrs | Time to peak | = | 718 min |
| Time interval | = | 2 min | Hyd. volume | = | 3,996 cuft |
| Drainage area | = | 1.320 ac | Curve number | = | 58* |
| Basin Slope | = | 0.0 % | Hydraulic length | = | 0 ft |
| Tc method | = | TR55 | Time of conc. (Tc) | = | 6.30 min |
| Total precip. | = | 4.47 in | Distribution | = | Type II |
| Storm duration | = | 24 hrs | Shape factor | = | 484 |

* Composite (Area/CN) = [(0.020 x 85) + (1.300 x 58)] / 1.320



# TR55 Tc Worksheet



## Hyd. No. 2

POST UNDETAINED

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.240 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 50.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 2.97 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 8.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 4.89** | **+** | **0.00** | **+** | **0.00** | **=** | **4.89** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 173.00 | | 22.00 | | 123.00 | | |
| Watercourse slope (%) | = 9.10 | | 1.60 | | 4.50 | | |
| Surface description | = Unpaved | | Unpaved | | Unpaved | | |
| Average velocity (ft/s) | =4.87 | | 2.04 | | 3.42 | | |
| **Travel Time (min)** | **= 0.59** | **+** | **0.18** | **+** | **0.60** | **=** | **1.37** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 6.30 min**

# Hydrograph Report

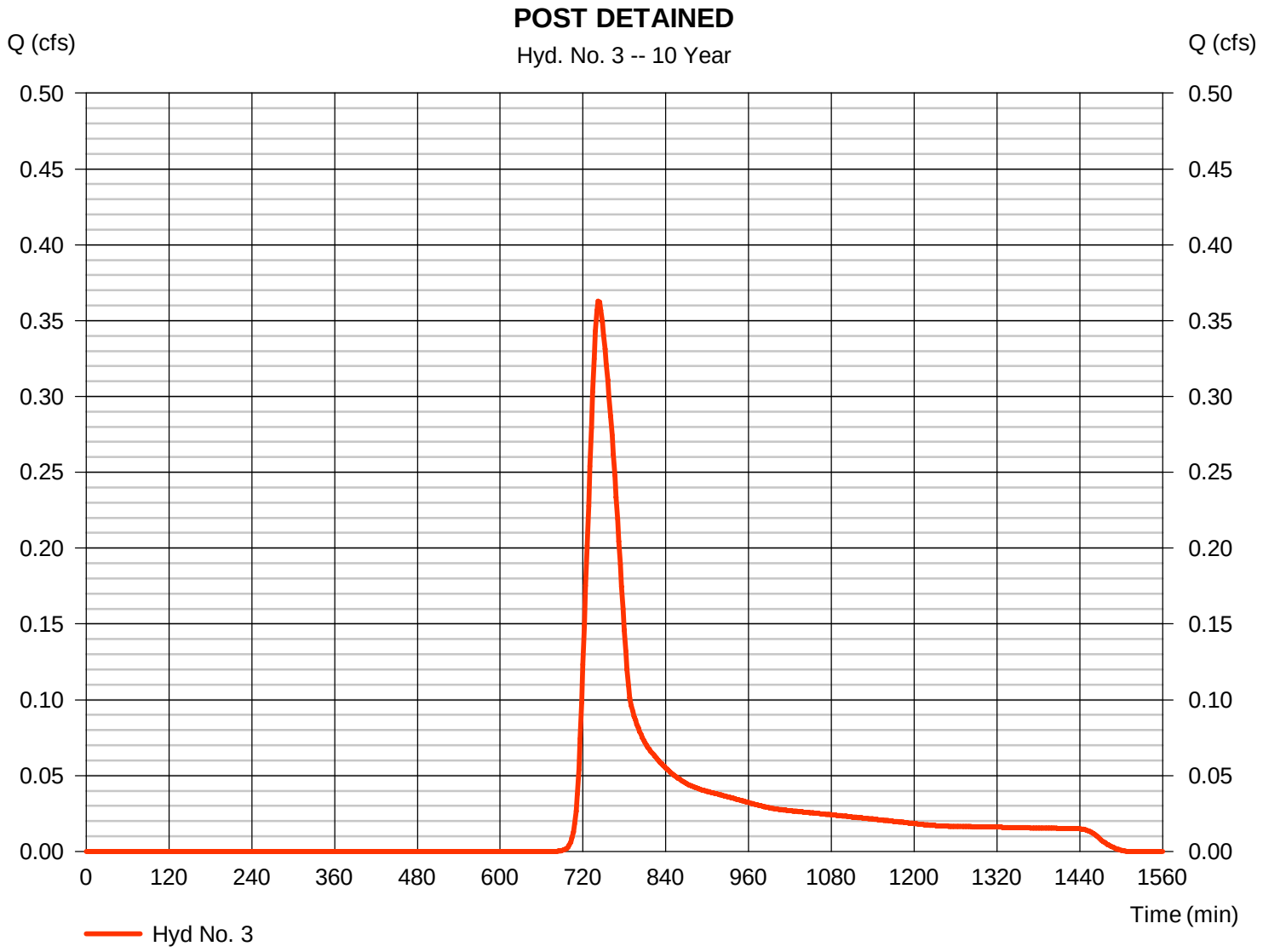


## Hyd. No. 3

POST DETAINED

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | SCS Runoff | Peak discharge | = | 0.363 cfs |
| Storm frequency | = | 10 yrs | Time to peak | = | 742 min |
| Time interval | = | 2 min | Hyd. volume | = | 2,199 cuft |
| Drainage area | = | 0.490 ac | Curve number | = | 64* |
| Basin Slope | = | 0.0 % | Hydraulic length | = | 0 ft |
| Tc method | = | User | Time of conc. (Tc) | = | 46.22 min |
| Total precip. | = | 4.47 in | Distribution | = | Type II |
| Storm duration | = | 24 hrs | Shape factor | = | 484 |

* Composite (Area/CN) = [(0.110 x 85) + (0.380 x 58)] / 0.490



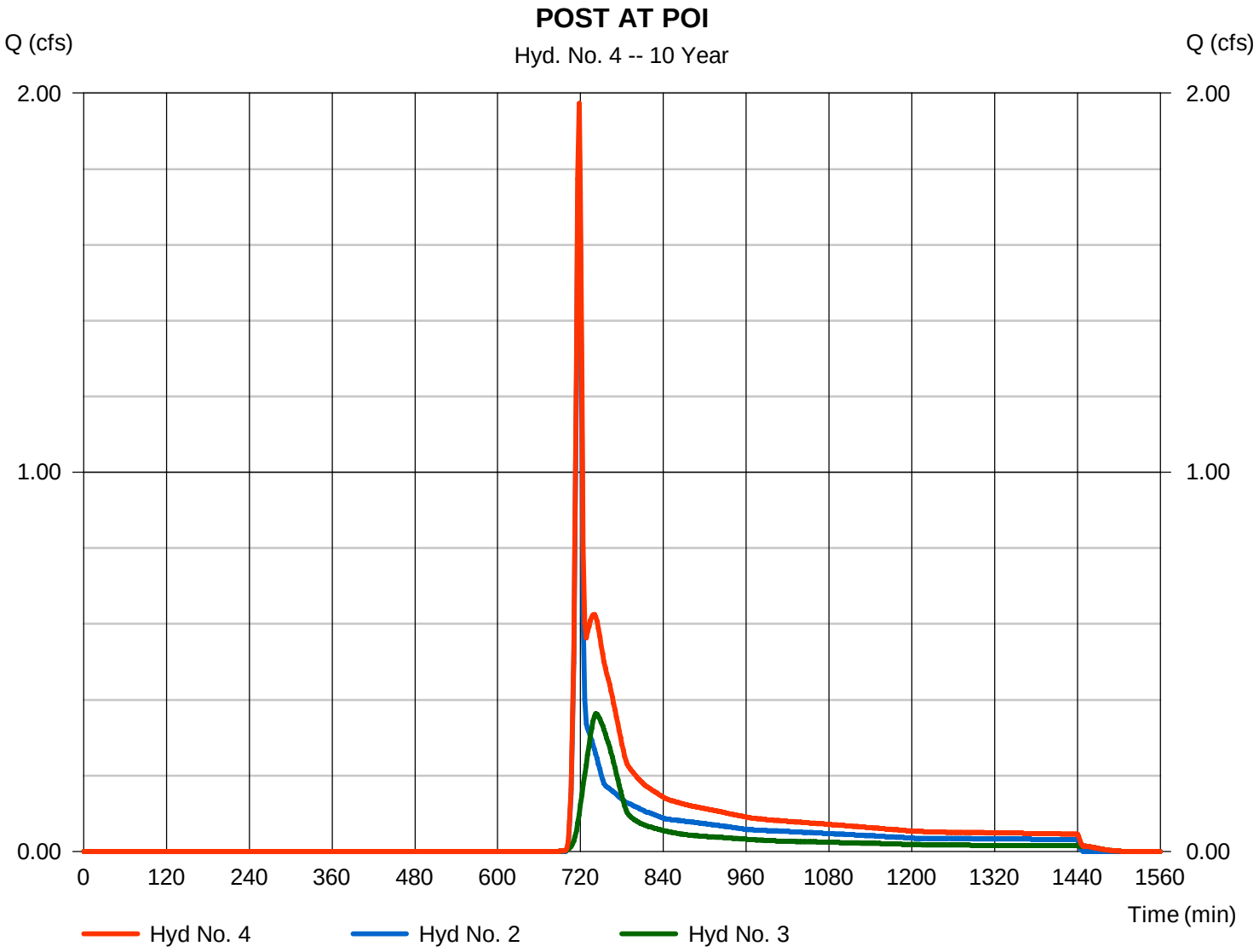
# Hydrograph Report



## Hyd. No. 4

POST AT POI

| | | | |
|---|---|---|---|
| Hydrograph type | = Combine | Peak discharge | = 1.973 cfs |
| Storm frequency | = 10 yrs | Time to peak | = 718 min |
| Time interval | = 2 min | Hyd. volume | = 6,195 cuft |
| Inflow hyds. | = 2, 3 | Contrib. drain. area | = 1.810 ac |



# Hydraflow Rainfall Report



| Return Period (Yrs) | Intensity-Duration-Frequency Equation Coefficients (FHA) | | | |
|---|---|---|---|---|
| | B | D | E | (N/A) |
| 1 | 47.8383 | 12.2000 | 0.8815 | -------- |
| 2 | 54.1927 | 12.1000 | 0.8666 | -------- |
| 3 | 0.0000 | 0.0000 | 0.0000 | -------- |
| 5 | 62.5798 | 12.9000 | 0.8462 | -------- |
| 10 | 55.8141 | 11.6000 | 0.7914 | -------- |
| 25 | 52.1635 | 10.8000 | 0.7411 | -------- |
| 50 | 47.5325 | 9.8000 | 0.6975 | -------- |
| 100 | 42.7369 | 8.7000 | 0.6521 | -------- |

File name: Gates Road IDF.IDF

**Intensity = B / (Tc + D)^E**

| Return Period (Yrs) | Intensity Values (in/hr) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 5 min | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 | 60 |
| 1 | 3.90 | 3.11 | 2.60 | 2.24 | 1.97 | 1.77 | 1.60 | 1.46 | 1.35 | 1.25 | 1.17 | 1.10 |
| 2 | 4.63 | 3.71 | 3.11 | 2.68 | 2.37 | 2.12 | 1.92 | 1.76 | 1.63 | 1.51 | 1.42 | 1.33 |
| 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 | 5.45 | 4.42 | 3.74 | 3.25 | 2.89 | 2.60 | 2.37 | 2.18 | 2.02 | 1.88 | 1.76 | 1.66 |
| 10 | 6.04 | 4.91 | 4.16 | 3.63 | 3.23 | 2.92 | 2.67 | 2.46 | 2.29 | 2.14 | 2.01 | 1.90 |
| 25 | 6.75 | 5.50 | 4.69 | 4.11 | 3.68 | 3.34 | 3.07 | 2.84 | 2.65 | 2.49 | 2.34 | 2.22 |
| 50 | 7.26 | 5.92 | 5.06 | 4.45 | 4.00 | 3.64 | 3.35 | 3.11 | 2.91 | 2.74 | 2.59 | 2.46 |
| 100 | 7.75 | 6.33 | 5.42 | 4.79 | 4.31 | 3.94 | 3.64 | 3.39 | 3.18 | 3.00 | 2.85 | 2.71 |

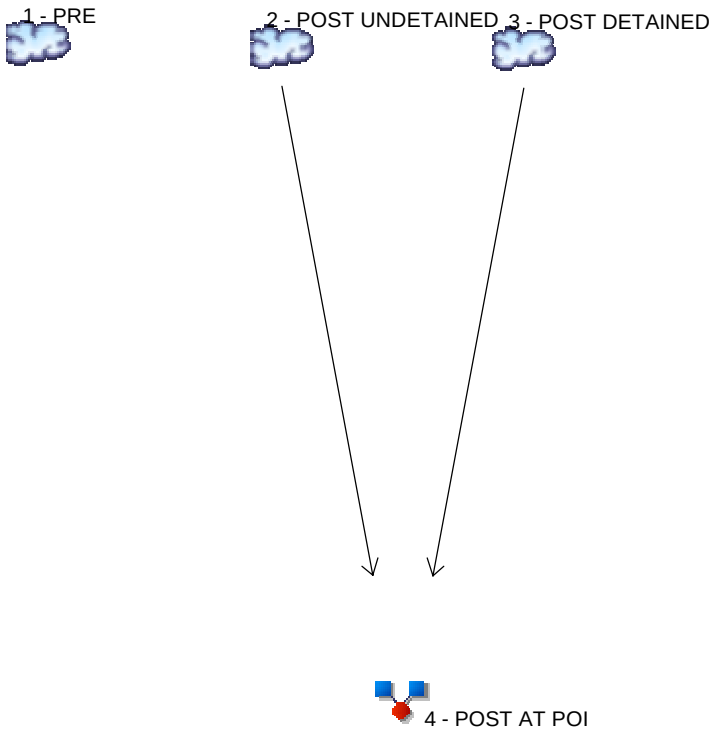
Tc = time in minutes. Values may exceed 60.

\ESCGP-2\PPP\02 SCRO\07 PCSM\Attach 4 Stormwater Calcs\Gates Road\Hydraflow Rev 1\Gates Road Precip.pc

| Storm Distribution | Rainfall Precipitation Table (in) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1-yr | 2-yr | 3-yr | 5-yr | 10-yr | 25-yr | 50-yr | 100-yr |
| SCS 24-hour | 2.46 | 2.97 | 0.00 | 3.77 | 4.47 | 5.55 | 6.50 | 7.58 |
| SCS 6-Hr | 1.74 | 2.11 | 0.00 | 2.65 | 3.10 | 3.76 | 4.32 | 4.92 |
| Huff-1st | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Huff-2nd | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Huff-3rd | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Huff-4th | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Huff-Indy | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Custom | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

# Watershed Model Schematic

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4




## Legend

| Hyd. | Origin | Description |
|---|---|---|
| 1 | SCS Runoff | PRE |
| 2 | SCS Runoff | POST UNDETAINED |
| 3 | SCS Runoff | POST DETAINED |
| 4 | Combine | POST AT POI |

# Hydrograph Return Period Recap



| Hyd. No. | Hydrograph type (origin) | Inflow hyd(s) | Peak Outflow (cfs) | | | | | | | | Hydrograph Description |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1-yr | 2-yr | 3-yr | 5-yr | 10-yr | 25-yr | 50-yr | 100-yr | |
| 1 | SCS Runoff | ------ | ------- | ------- | ------- | ------- | ------- | ------- | 6.376 | ------- | PRE |
| 2 | SCS Runoff | ------ | ------- | ------- | ------- | ------- | ------- | ------- | 4.650 | ------- | POST UNDETAINED |
| 3 | SCS Runoff | ------ | ------- | ------- | ------- | ------- | ------- | ------- | 1.221 | ------- | POST DETAINED |
| 4 | Combine | 2, 3 | ------- | ------- | ------- | ------- | ------- | ------- | 5.370 | ------- | POST AT POI |

# Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

| Hyd. No. | Hydrograph type (origin) | Peak flow (cfs) | Time interval (min) | Time to Peak (min) | Hyd. volume (cuft) | Inflow hyd(s) | Maximum elevation (ft) | Total strge used (cuft) | Hydrograph Description |
|---|---|---|---|---|---|---|---|---|---|
| 1 | SCS Runoff | 6.376 | 2 | 718 | 12,787 | ------ | ------ | ------ | PRE |
| 2 | SCS Runoff | 4.650 | 2 | 718 | 9,325 | ------ | ------ | ------ | POST UNDETAINED |
| 3 | SCS Runoff | 1.221 | 2 | 730 | 4,599 | ------ | ------ | ------ | POST DETAINED |
| 4 | Combine | 5.370 | 2 | 718 | 13,924 | 2, 3 | ------ | ------ | POST AT POI |

# Hydrograph Report

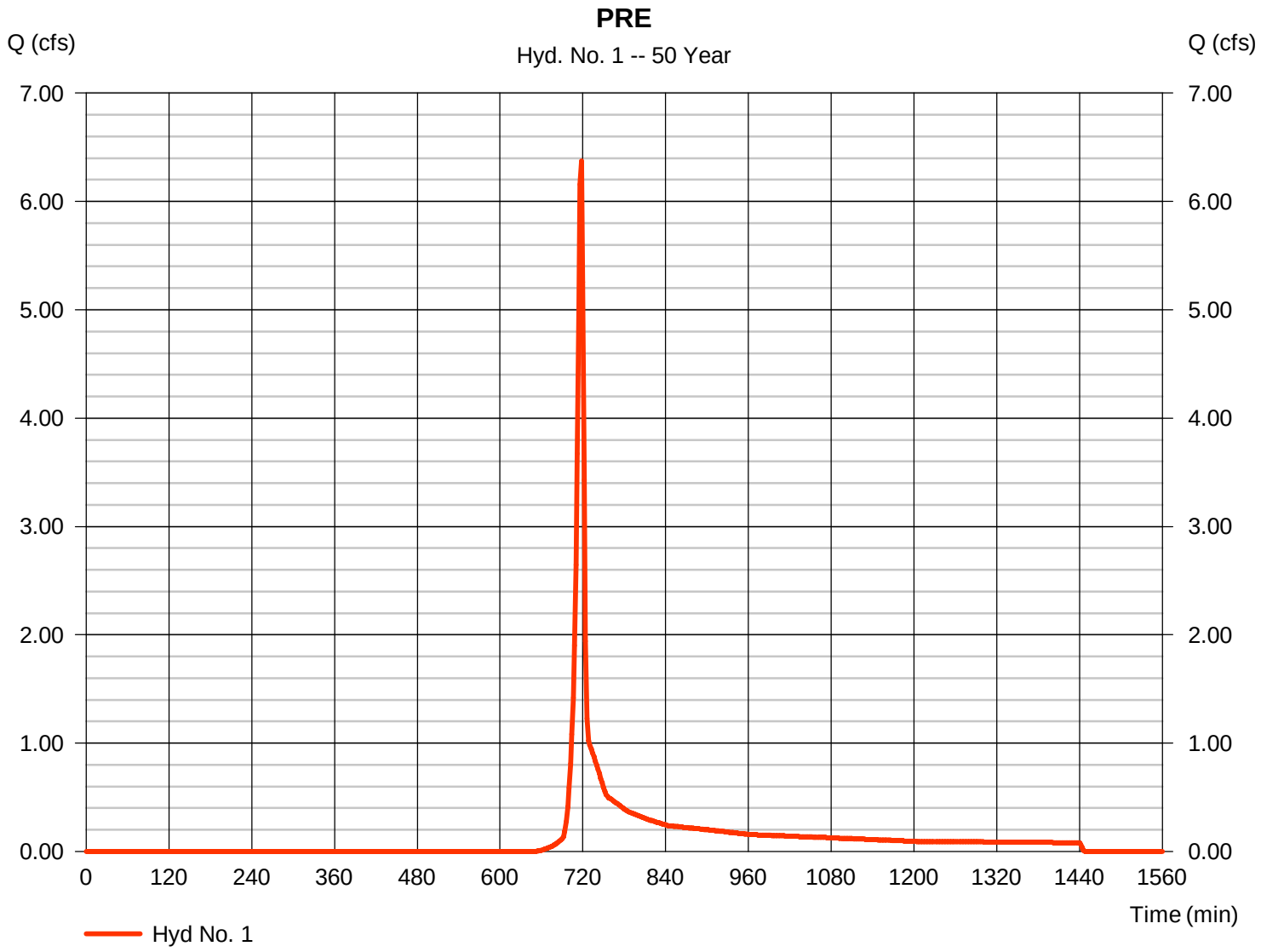


## Hyd. No. 1

PRE

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | SCS Runoff | Peak discharge | = | 6.376 cfs |
| Storm frequency | = | 50 yrs | Time to peak | = | 718 min |
| Time interval | = | 2 min | Hyd. volume | = | 12,787 cuft |
| Drainage area | = | 1.810 ac | Curve number | = | 58* |
| Basin Slope | = | 0.0 % | Hydraulic length | = | 0 ft |
| Tc method | = | TR55 | Time of conc. (Tc) | = | 6.30 min |
| Total precip. | = | 6.50 in | Distribution | = | Type II |
| Storm duration | = | 24 hrs | Shape factor | = | 484 |

* Composite (Area/CN) = [(1.810 x 58)] / 1.810



# TR55 Tc Worksheet



## Hyd. No. 1

PRE

| Description | A | B | C | Totals |
|---|---|---|---|---|
| **Sheet Flow** | | | | |
| Manning's n-value | = 0.240 | 0.011 | 0.011 | |
| Flow length (ft) | = 50.0 | 0.0 | 0.0 | |
| Two-year 24-hr precip. (in) | = 2.97 | 0.00 | 0.00 | |
| Land slope (%) | = 8.00 | 0.00 | 0.00 | |
| **Travel Time (min)** | **= 4.89** | **+ 0.00** | **+ 0.00** | **= 4.89** |
| **Shallow Concentrated Flow** | | | | |
| Flow length (ft) | = 173.00 | 22.00 | 123.00 | |
| Watercourse slope (%) | = 9.10 | 1.60 | 4.50 | |
| Surface description | = Unpaved | Unpaved | Unpaved | |
| Average velocity (ft/s) | =4.87 | 2.04 | 3.42 | |
| **Travel Time (min)** | **= 0.59** | **+ 0.18** | **+ 0.60** | **= 1.37** |
| **Channel Flow** | | | | |
| X sectional flow area (sqft) | = 0.00 | 0.00 | 0.00 | |
| Wetted perimeter (ft) | = 0.00 | 0.00 | 0.00 | |
| Channel slope (%) | = 0.00 | 0.00 | 0.00 | |
| Manning's n-value | = 0.015 | 0.015 | 0.015 | |
| Velocity (ft/s) | =0.00 | | | |
| | | 0.00 | | |
| | | | 0.00 | |
| Flow length (ft) | ({0})0.0 | 0.0 | 0.0 | |
| **Travel Time (min)** | **= 0.00** | **+ 0.00** | **+ 0.00** | **= 0.00** |

**Total Travel Time, Tc ..... 6.30 min**

# Hydrograph Report

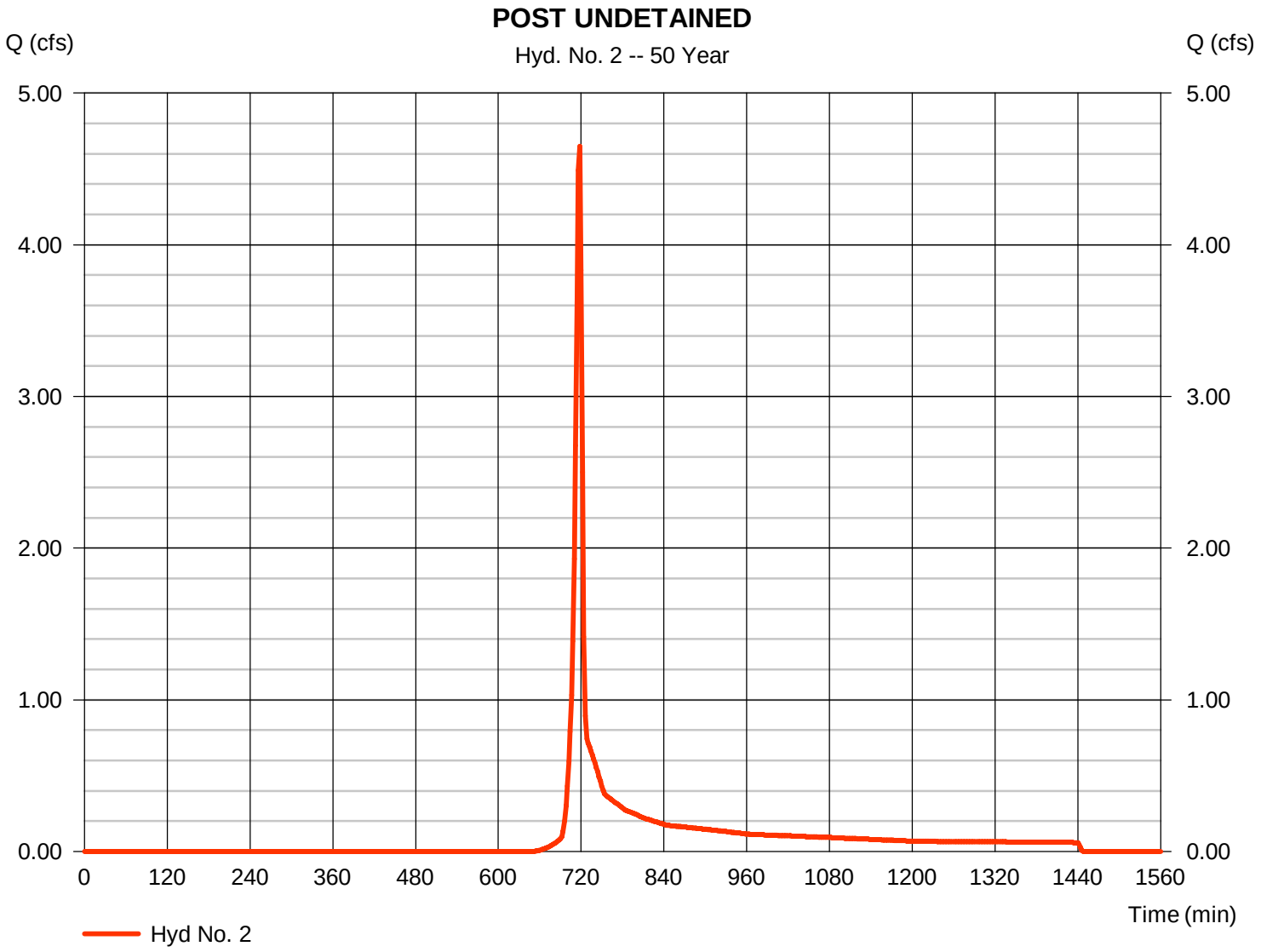


## Hyd. No. 2

POST UNDETAINED

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | SCS Runoff | Peak discharge | = | 4.650 cfs |
| Storm frequency | = | 50 yrs | Time to peak | = | 718 min |
| Time interval | = | 2 min | Hyd. volume | = | 9,325 cuft |
| Drainage area | = | 1.320 ac | Curve number | = | 58* |
| Basin Slope | = | 0.0 % | Hydraulic length | = | 0 ft |
| Tc method | = | TR55 | Time of conc. (Tc) | = | 6.30 min |
| Total precip. | = | 6.50 in | Distribution | = | Type II |
| Storm duration | = | 24 hrs | Shape factor | = | 484 |

* Composite (Area/CN) = [(0.020 x 85) + (1.300 x 58)] / 1.320



# TR55 Tc Worksheet



## Hyd. No. 2

POST UNDETAINED

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.240 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 50.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 2.97 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 8.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 4.89** | **+** | **0.00** | **+** | **0.00** | **=** | **4.89** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 173.00 | | 22.00 | | 123.00 | | |
| Watercourse slope (%) | = 9.10 | | 1.60 | | 4.50 | | |
| Surface description | = Unpaved | | Unpaved | | Unpaved | | |
| Average velocity (ft/s) | =4.87 | | 2.04 | | 3.42 | | |
| **Travel Time (min)** | **= 0.59** | **+** | **0.18** | **+** | **0.60** | **=** | **1.37** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 6.30 min**

# Hydrograph Report

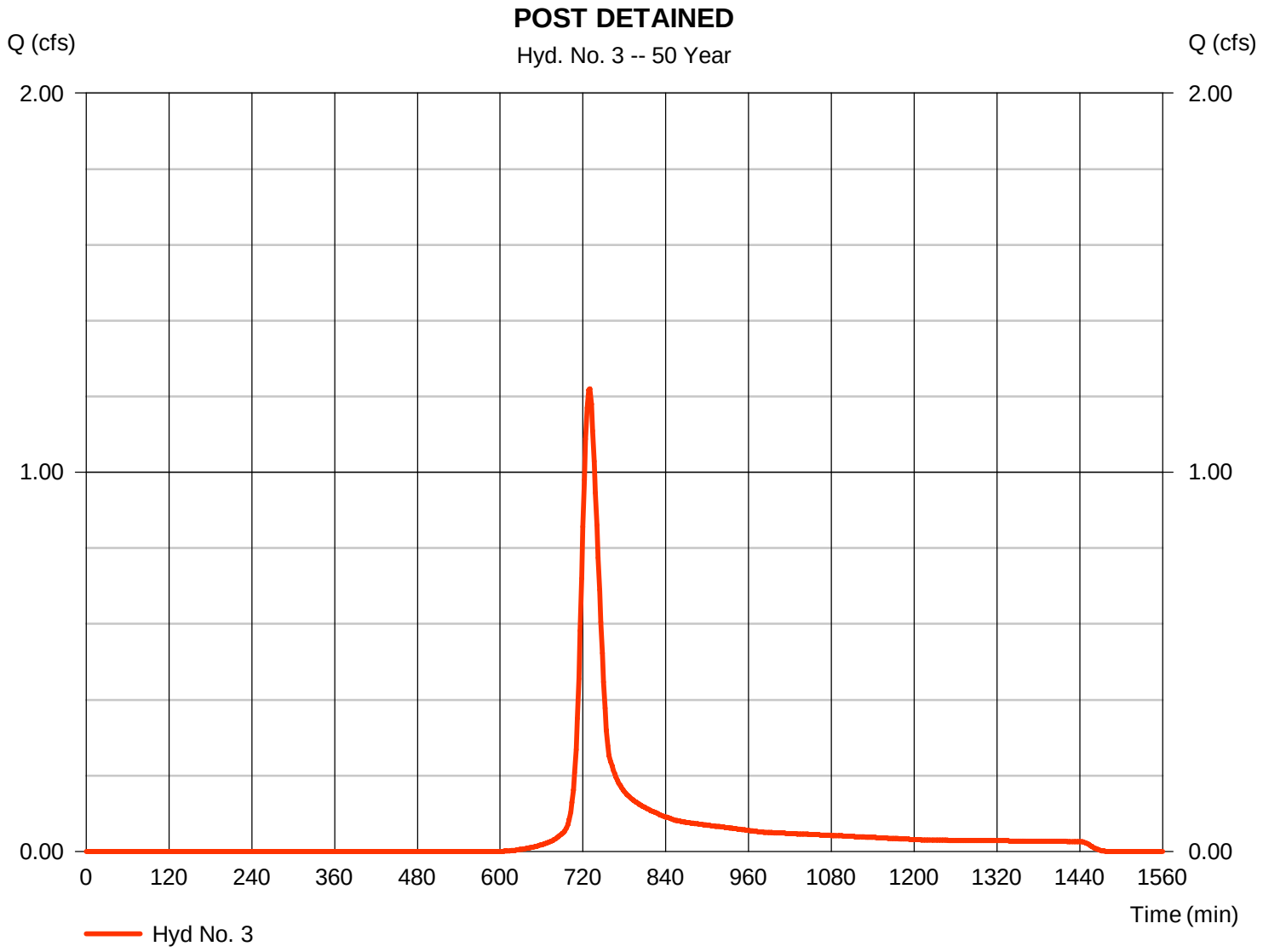


## Hyd. No. 3

POST DETAINED

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | SCS Runoff | Peak discharge | = | 1.221 cfs |
| Storm frequency | = | 50 yrs | Time to peak | = | 730 min |
| Time interval | = | 2 min | Hyd. volume | = | 4,599 cuft |
| Drainage area | = | 0.490 ac | Curve number | = | 64* |
| Basin Slope | = | 0.0 % | Hydraulic length | = | 0 ft |
| Tc method | = | User | Time of conc. (Tc) | = | 26.13 min |
| Total precip. | = | 6.50 in | Distribution | = | Type II |
| Storm duration | = | 24 hrs | Shape factor | = | 484 |

* Composite (Area/CN) = [(0.110 x 85) + (0.380 x 58)] / 0.490



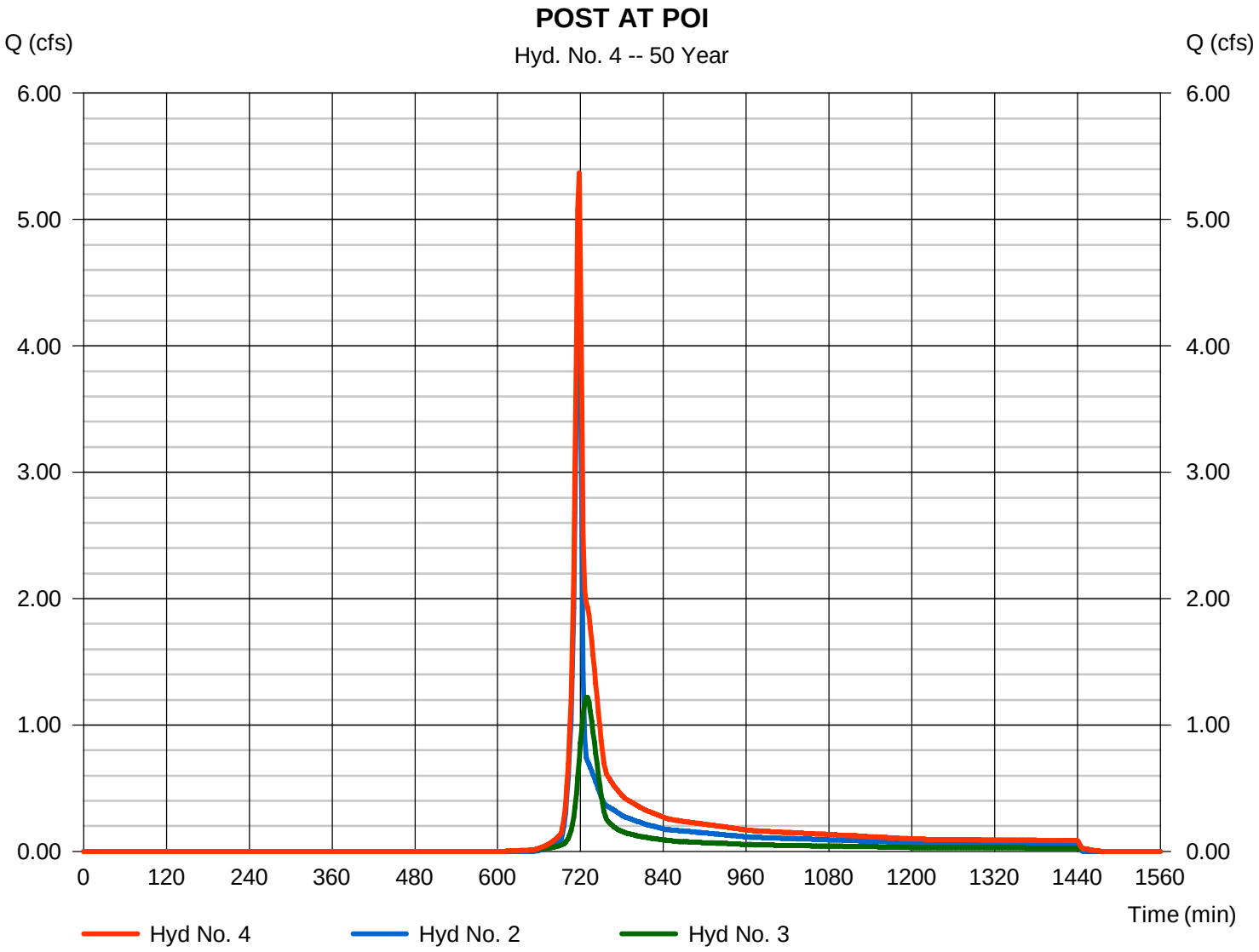
# Hydrograph Report



## Hyd. No. 4

POST AT POI

| | | | |
|---|---|---|---|
| Hydrograph type | = Combine | Peak discharge | = 5.370 cfs |
| Storm frequency | = 50 yrs | Time to peak | = 718 min |
| Time interval | = 2 min | Hyd. volume | = 13,924 cuft |
| Inflow hyds. | = 2, 3 | Contrib. drain. area | = 1.810 ac |



# Hydraflow Rainfall Report



| Return Period (Yrs) | Intensity-Duration-Frequency Equation Coefficients (FHA) | | | |
|---|---|---|---|---|
| | B | D | E | (N/A) |
| 1 | 47.8383 | 12.2000 | 0.8815 | -------- |
| 2 | 54.1927 | 12.1000 | 0.8666 | -------- |
| 3 | 0.0000 | 0.0000 | 0.0000 | -------- |
| 5 | 62.5798 | 12.9000 | 0.8462 | -------- |
| 10 | 55.8141 | 11.6000 | 0.7914 | -------- |
| 25 | 52.1635 | 10.8000 | 0.7411 | -------- |
| 50 | 47.5325 | 9.8000 | 0.6975 | -------- |
| 100 | 42.7369 | 8.7000 | 0.6521 | -------- |

File name: Gates Road IDF.IDF

**Intensity = B / (Tc + D)^E**

| Return Period (Yrs) | Intensity Values (in/hr) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 5 min | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 | 60 |
| 1 | 3.90 | 3.11 | 2.60 | 2.24 | 1.97 | 1.77 | 1.60 | 1.46 | 1.35 | 1.25 | 1.17 | 1.10 |
| 2 | 4.63 | 3.71 | 3.11 | 2.68 | 2.37 | 2.12 | 1.92 | 1.76 | 1.63 | 1.51 | 1.42 | 1.33 |
| 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 | 5.45 | 4.42 | 3.74 | 3.25 | 2.89 | 2.60 | 2.37 | 2.18 | 2.02 | 1.88 | 1.76 | 1.66 |
| 10 | 6.04 | 4.91 | 4.16 | 3.63 | 3.23 | 2.92 | 2.67 | 2.46 | 2.29 | 2.14 | 2.01 | 1.90 |
| 25 | 6.75 | 5.50 | 4.69 | 4.11 | 3.68 | 3.34 | 3.07 | 2.84 | 2.65 | 2.49 | 2.34 | 2.22 |
| 50 | 7.26 | 5.92 | 5.06 | 4.45 | 4.00 | 3.64 | 3.35 | 3.11 | 2.91 | 2.74 | 2.59 | 2.46 |
| 100 | 7.75 | 6.33 | 5.42 | 4.79 | 4.31 | 3.94 | 3.64 | 3.39 | 3.18 | 3.00 | 2.85 | 2.71 |

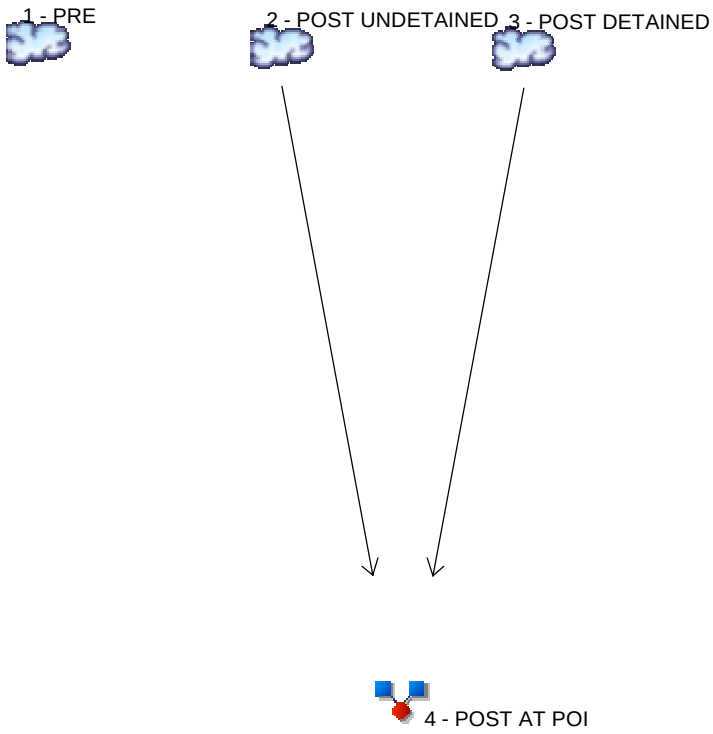
Tc = time in minutes. Values may exceed 60.

\ESCGP-2\PPP\02 SCRO\07 PCSM\Attach 4 Stormwater Calcs\Gates Road\Hydraflow Rev 1\Gates Road Precip.pc

| Storm Distribution | Rainfall Precipitation Table (in) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1-yr | 2-yr | 3-yr | 5-yr | 10-yr | 25-yr | 50-yr | 100-yr |
| SCS 24-hour | 2.46 | 2.97 | 0.00 | 3.77 | 4.47 | 5.55 | 6.50 | 7.58 |
| SCS 6-Hr | 1.74 | 2.11 | 0.00 | 2.65 | 3.10 | 3.76 | 4.32 | 4.92 |
| Huff-1st | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Huff-2nd | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Huff-3rd | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Huff-4th | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Huff-Indy | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Custom | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

# Watershed Model Schematic

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4




## Legend

| Hyd. | Origin | Description |
|---|---|---|
| 1 | SCS Runoff | PRE |
| 2 | SCS Runoff | POST UNDETAINED |
| 3 | SCS Runoff | POST DETAINED |
| 4 | Combine | POST AT POI |

# Hydrograph Return Period Recap



| Hyd. No. | Hydrograph type (origin) | Inflow hyd(s) | Peak Outflow (cfs) | | | | | | | | Hydrograph Description |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1-yr | 2-yr | 3-yr | 5-yr | 10-yr | 25-yr | 50-yr | 100-yr | |
| 1 | SCS Runoff | ------ | ------- | ------- | ------- | ------- | ------- | ------- | ------- | 8.660 | PRE |
| 2 | SCS Runoff | ------ | ------- | ------- | ------- | ------- | ------- | ------- | ------- | 6.316 | POST UNDETAINED |
| 3 | SCS Runoff | ------ | ------- | ------- | ------- | ------- | ------- | ------- | ------- | 1.785 | POST DETAINED |
| 4 | Combine | 2, 3 | ------- | ------- | ------- | ------- | ------- | ------- | ------- | 7.514 | POST AT POI |

# Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

| 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 | 8.660 | 2 | 718 | 17,318 | ------ | ------ | ------ | PRE |
| 2 | SCS Runoff | 6.316 | 2 | 718 | 12,629 | ------ | ------ | ------ | POST UNDETAINED |
| 3 | SCS Runoff | 1.785 | 2 | 726 | 6,245 | ------ | ------ | ------ | POST DETAINED |
| 4 | Combine | 7.514 | 2 | 718 | 18,874 | 2, 3 | ------ | ------ | POST AT POI |

# Hydrograph Report

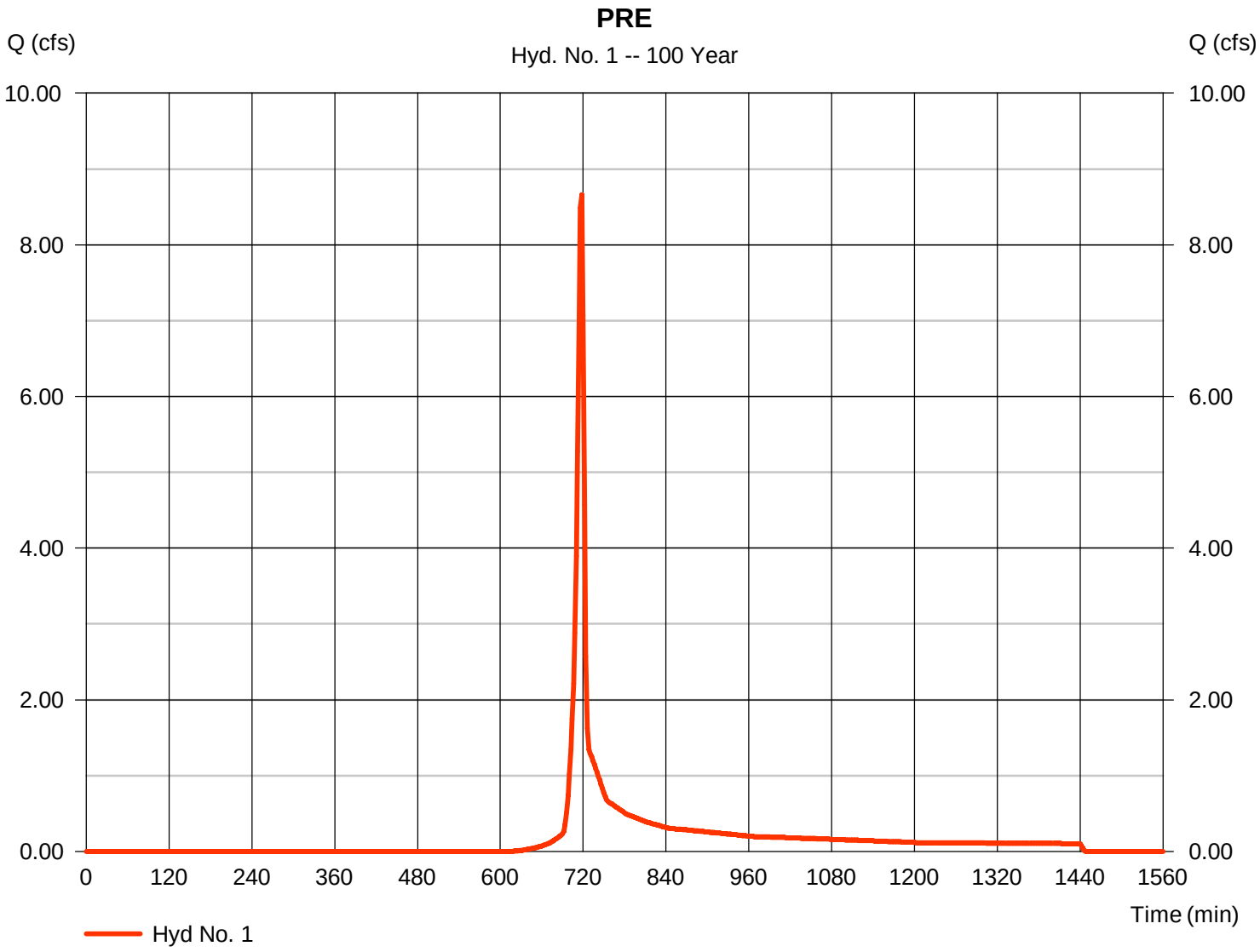


## Hyd. No. 1

PRE

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | SCS Runoff | Peak discharge | = | 8.660 cfs |
| Storm frequency | = | 100 yrs | Time to peak | = | 718 min |
| Time interval | = | 2 min | Hyd. volume | = | 17,318 cuft |
| Drainage area | = | 1.810 ac | Curve number | = | 58* |
| Basin Slope | = | 0.0 % | Hydraulic length | = | 0 ft |
| Tc method | = | TR55 | Time of conc. (Tc) | = | 6.30 min |
| Total precip. | = | 7.58 in | Distribution | = | Type II |
| Storm duration | = | 24 hrs | Shape factor | = | 484 |

* Composite (Area/CN) = [(1.810 x 58)] / 1.810



# TR55 Tc Worksheet



## Hyd. No. 1

PRE

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.240 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 50.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 2.97 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 8.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 4.89** | **+** | **0.00** | **+** | **0.00** | **=** | **4.89** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 173.00 | | 22.00 | | 123.00 | | |
| Watercourse slope (%) | = 9.10 | | 1.60 | | 4.50 | | |
| Surface description | = Unpaved | | Unpaved | | Unpaved | | |
| Average velocity (ft/s) | =4.87 | | 2.04 | | 3.42 | | |
| **Travel Time (min)** | **= 0.59** | **+** | **0.18** | **+** | **0.60** | **=** | **1.37** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 6.30 min**

# Hydrograph Report

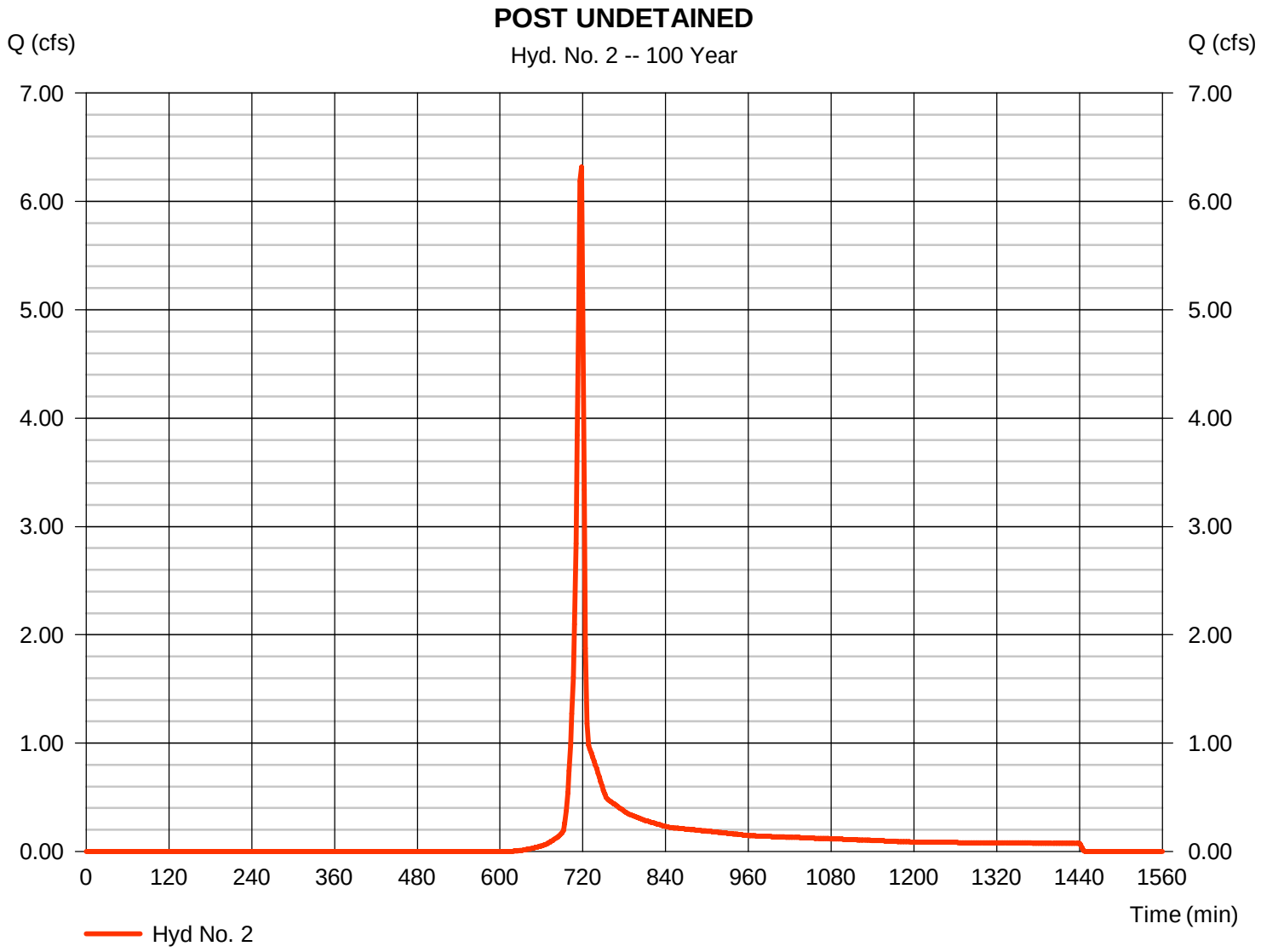


## Hyd. No. 2

POST UNDETAINED

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | SCS Runoff | Peak discharge | = | 6.316 cfs |
| Storm frequency | = | 100 yrs | Time to peak | = | 718 min |
| Time interval | = | 2 min | Hyd. volume | = | 12,629 cuft |
| Drainage area | = | 1.320 ac | Curve number | = | 58* |
| Basin Slope | = | 0.0 % | Hydraulic length | = | 0 ft |
| Tc method | = | TR55 | Time of conc. (Tc) | = | 6.30 min |
| Total precip. | = | 7.58 in | Distribution | = | Type II |
| Storm duration | = | 24 hrs | Shape factor | = | 484 |

* Composite (Area/CN) = [(0.020 x 85) + (1.300 x 58)] / 1.320



# TR55 Tc Worksheet



## Hyd. No. 2

POST UNDETAINED

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.240 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 50.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 2.97 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 8.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 4.89** | **+** | **0.00** | **+** | **0.00** | **=** | **4.89** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 173.00 | | 22.00 | | 123.00 | | |
| Watercourse slope (%) | = 9.10 | | 1.60 | | 4.50 | | |
| Surface description | = Unpaved | | Unpaved | | Unpaved | | |
| Average velocity (ft/s) | =4.87 | | 2.04 | | 3.42 | | |
| **Travel Time (min)** | **= 0.59** | **+** | **0.18** | **+** | **0.60** | **=** | **1.37** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 6.30 min**

# Hydrograph Report

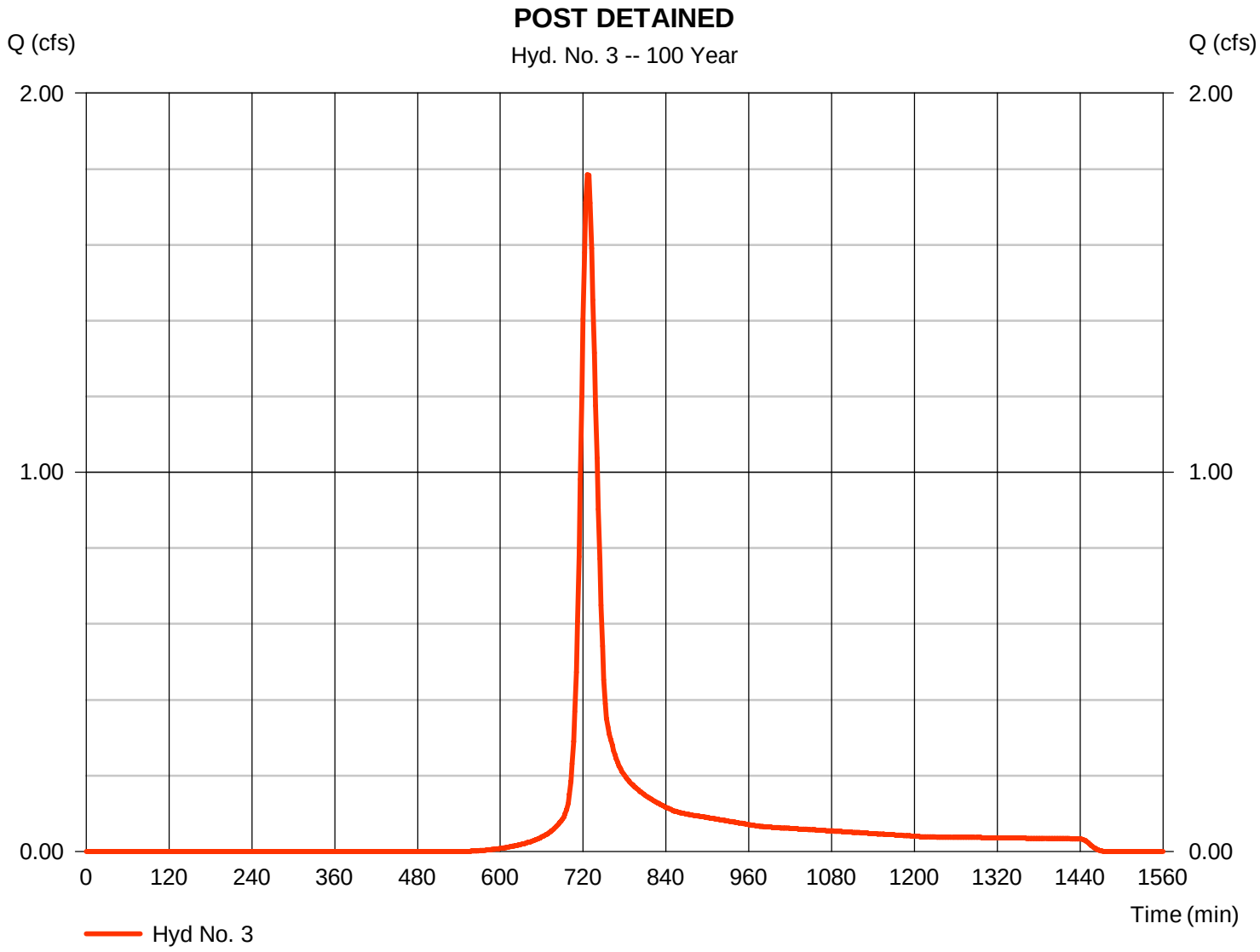


## Hyd. No. 3

POST DETAINED

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | SCS Runoff | Peak discharge | = | 1.785 cfs |
| Storm frequency | = | 100 yrs | Time to peak | = | 726 min |
| Time interval | = | 2 min | Hyd. volume | = | 6,245 cuft |
| Drainage area | = | 0.490 ac | Curve number | = | 64* |
| Basin Slope | = | 0.0 % | Hydraulic length | = | 0 ft |
| Tc method | = | User | Time of conc. (Tc) | = | 21.58 min |
| Total precip. | = | 7.58 in | Distribution | = | Type II |
| Storm duration | = | 24 hrs | Shape factor | = | 484 |

* Composite (Area/CN) = [(0.110 x 85) + (0.380 x 58)] / 0.490



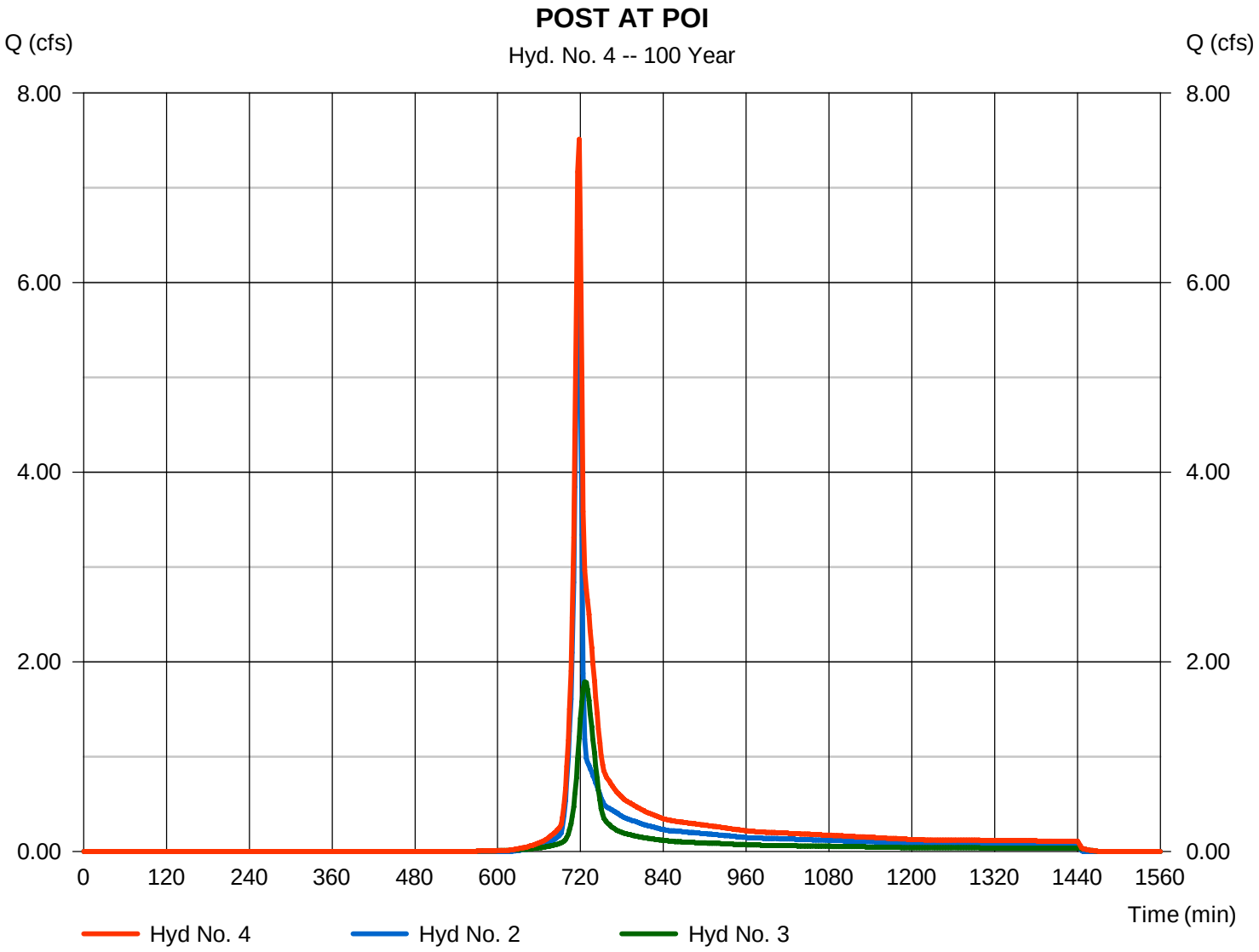
# Hydrograph Report



## Hyd. No. 4

POST AT POI

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | Combine | Peak discharge | = | 7.514 cfs |
| Storm frequency | = | 100 yrs | Time to peak | = | 718 min |
| Time interval | = | 2 min | Hyd. volume | = | 18,874 cuft |
| Inflow hyds. | = | 2, 3 | Contrib. drain. area | = | 1.810 ac |



# Hydraflow Rainfall Report



| Return Period (Yrs) | Intensity-Duration-Frequency Equation Coefficients (FHA) | | | |
|---|---|---|---|---|
| | B | D | E | (N/A) |
| 1 | 47.8383 | 12.2000 | 0.8815 | -------- |
| 2 | 54.1927 | 12.1000 | 0.8666 | -------- |
| 3 | 0.0000 | 0.0000 | 0.0000 | -------- |
| 5 | 62.5798 | 12.9000 | 0.8462 | -------- |
| 10 | 55.8141 | 11.6000 | 0.7914 | -------- |
| 25 | 52.1635 | 10.8000 | 0.7411 | -------- |
| 50 | 47.5325 | 9.8000 | 0.6975 | -------- |
| 100 | 42.7369 | 8.7000 | 0.6521 | -------- |

File name: Gates Road IDF.IDF

**Intensity = B / (Tc + D)^E**

| Return Period (Yrs) | Intensity Values (in/hr) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 5 min | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 | 60 |
| 1 | 3.90 | 3.11 | 2.60 | 2.24 | 1.97 | 1.77 | 1.60 | 1.46 | 1.35 | 1.25 | 1.17 | 1.10 |
| 2 | 4.63 | 3.71 | 3.11 | 2.68 | 2.37 | 2.12 | 1.92 | 1.76 | 1.63 | 1.51 | 1.42 | 1.33 |
| 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 | 5.45 | 4.42 | 3.74 | 3.25 | 2.89 | 2.60 | 2.37 | 2.18 | 2.02 | 1.88 | 1.76 | 1.66 |
| 10 | 6.04 | 4.91 | 4.16 | 3.63 | 3.23 | 2.92 | 2.67 | 2.46 | 2.29 | 2.14 | 2.01 | 1.90 |
| 25 | 6.75 | 5.50 | 4.69 | 4.11 | 3.68 | 3.34 | 3.07 | 2.84 | 2.65 | 2.49 | 2.34 | 2.22 |
| 50 | 7.26 | 5.92 | 5.06 | 4.45 | 4.00 | 3.64 | 3.35 | 3.11 | 2.91 | 2.74 | 2.59 | 2.46 |
| 100 | 7.75 | 6.33 | 5.42 | 4.79 | 4.31 | 3.94 | 3.64 | 3.39 | 3.18 | 3.00 | 2.85 | 2.71 |

Tc = time in minutes. Values may exceed 60.

\ESCGP-2\PPP\02 SCRO\07 PCSM\Attach 4 Stormwater Calcs\Gates Road\Hydraflow Rev 1\Gates Road Precip.pc

| Storm Distribution | Rainfall Precipitation Table (in) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1-yr | 2-yr | 3-yr | 5-yr | 10-yr | 25-yr | 50-yr | 100-yr |
| SCS 24-hour | 2.46 | 2.97 | 0.00 | 3.77 | 4.47 | 5.55 | 6.50 | 7.58 |
| SCS 6-Hr | 1.74 | 2.11 | 0.00 | 2.65 | 3.10 | 3.76 | 4.32 | 4.92 |
| Huff-1st | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Huff-2nd | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Huff-3rd | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Huff-4th | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Huff-Indy | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Custom | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |