MOTT MACDONALD

PennEast PIPELINE

Blue Mountain Side Valve Post Construction Stormwater Management Report

PennEast Pipeline Project

Date October 15, 2018

10/25/2019

PennEast Pipeline Project
353754-MM-E-E-114

Mott MacDonald
111 Wood Avenue South
Iselin, NJ 08830-4112
973-379-3400

UGI Energy Services Inc.
One Meridian Blvd.
Suite 2C01
Wyomissing, PA 19610
610-373-7999

Blue Mountain Side Valve Post Construction Stormwater Management Report

PennEast Pipeline Project

Date October 15, 2018

Issue and revision record

Revision	Date	Originator	Checkout	Approver	Descriptor
0	10/15/2018	P. Zhinhel	J. Dening	M. Wilcox	Issued for PADEP

Information class: **Standard**

Contents

Tables

Figures

1 Executive Summary

PennEast proposes to construct, install and operate the Project facilities to provide approximately 1.1 million dekatherms per day (MMDth/d) of year-round transportation service from northern Pennsylvania to markets in New Jersey, eastern and southeastern Pennsylvania and surrounding states. The Project is designed to provide a long-term solution to bring the lowest cost natural gas available in the country, produced in the Marcellus Shale region in northern Pennsylvania, to homes and businesses in New Jersey, Pennsylvania and surrounding states.

The Project facilities include a 36-inch diameter, 120-mile mainline pipeline, extending from Luzerne County, Pennsylvania, to Mercer County, New Jersey. The Project will extend from various receipt point interconnections in the eastern Marcellus region, including interconnections with Transcontinental Gas Pipe Line Company, LLC (Transco) and gathering systems operated by Williams Partners L.P., Energy Transfer Partners, L.P. (formerly Regency Energy Partners, LP), and UGI Energy Services, LLC in Luzerne County, Pennsylvania, to various delivery point interconnections in the heart of major northeastern natural gas-consuming markets, including interconnections with UGI Central Penn Gas, Inc., (Blue Mountain) in Carbon County, Pennsylvania, UGI Utilities, Inc. and Columbia Gas Transmission, LLC in Northampton County, Pennsylvania, and Elizabethtown Gas, NRG REMA, LLC, Texas Eastern Transmission, LP (Texas Eastern) and Algonquin Gas Transmission, LLC (Algonquin), in Hunterdon County, New Jersey. The terminus of the proposed PennEast system will be located at a delivery point with Transco in Mercer County, New Jersey.

This report provides an engineering analysis of the stormwater management practices for the Blue Mountain Side Valve site, which is a part of the PennEast Pipeline Project. The methods of analysis included use of the stormwater modeling software Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc., Rational Method Calculations, and the associated PADEP BMP worksheets. The methods of analysis were used to demonstrate the meeting of the proposed requirements for the following facilities:

- Infiltration berms
- Infiltration basin
- Level spreaders
- Swale

The resulting data for the stormwater facilities can be found in Section 4 and in the appendices. The completed model and worksheets show that the post-construction stormwater runoff does not exceed the pre-construction stormwater flows and that the volume requirements are met. The report shows that the proposed stormwater BMPs for the Blue Mountain Side Valve site for the PennEast pipeline will allow the proposed project to comply with the applicable regulatory requirements under Pennsylvania Code Section 102.8, and the applicable Act 167 requirements.

2 Introduction/Overview

The PennEast Pipeline Project was developed in response to market demands in New Jersey and Pennsylvania, and interest from shippers that require transportation capacity to accommodate increased demand and greater reliability of natural gas in the region. The Project will include a new pipeline and above ground facilities that will provide a new source of natural gas supply from the Marcellus Shale producing region to New Jersey and Pennsylvania.

The Blue Mountain Side Valve site is located in Lower Towamensing Township in Carbon County, PA (See Figure 1 for a Location Map and Appendix I for PCSM Plan). The Blue Mountain Side Valve site is being developed to create a lateral support to the proposed pipeline. The proposed site will include the pipeline meter and supporting equipment on a gravel pad. Stormwater management facilities are proposed to meet the regulatory requirements for this type of development.

3 Regulatory Compliance

Regulatory jurisdiction over stormwater runoff from the Blue Mountain Side Valve is the responsibility of the Pennsylvania Department of Environmental Protection (PADEP) code under Title 25 – Environmental Protection, Chapter 102 Erosion and Sediment Control, Section 102.8 – Post-Construction Stormwater Requirements. This Post-Construction Stormwater Management Plan fulfills part of the requirements of the Erosion and Sediment Control General Permit (ESCGP-3).

The following text presents each of the requirements of Pennsylvania Code Section 102.8, incorporating the requirements of Act 167 where applicable, and indicates how they will be addressed. Regulatory requirements are shown in **bold**, and compliance is shown in *italics*.

3.1 Post-Construction Stormwater Management Plan General Requirements

(b) General PCSM planning and design. The management of post construction stormwater shall be planned and conducted to the extent practicable in accordance with the following:

This site does not have an Act 167 Watershed Management Plan; thus it is subject to the requirements of item (g)(2) of Pennsylvania Code Section 102.8. Volume reduction must be provided as the difference between the post-development and pre-development 2-year runoff volume and the post-development peak runoff rate must not exceed pre-development peak runoff rate under any storm condition. Volume and peak flow requirements of the Act 167 Plan have been met, with the objective to preserve the integrity of stream channels and the receiving stream.

(1) Preserve the integrity of stream channels and maintain and protect the physical, biological and chemical qualities of the receiving stream.

One of the objectives in minimizing changes in runoff volume and rate of runoff flow is to preserve the integrity of stream channels and any receiving streams. There is no stream located within 150 feet of the site. Under existing conditions, offsite stormwater runoff flows overland across the site. Under proposed conditions, runoff will be conveyed overland via vegetated swales to the subsurface infiltration basin at the north end of the site where it will be attenuated. It will be discharged overland with a level spreader to preserve existing drainage patterns and the integrity of the receiving watercourse.

(2) Prevent an increase in the rate of stormwater runoff.

Increases in the rate of stormwater runoff are not anticipated. Stormwater management will be provided by two swales and an infiltration basin to attenuate peaks in post-development runoff. See Table 1.

(3) Minimize any increase in stormwater runoff volume.

Increases in stormwater runoff volume up to and including the 2-year storm are not anticipated. Stormwater management will be provided with infiltration basin to provide storage and infiltration of post-development runoff. See Table 2.

(4) Minimize impervious areas.

The site has been designed to minimize the area of disturbance, which minimizes impervious areas. Gravel is proposed in lieu of asphalt, and areas that are not graveled will be vegetated. Given the limited site traffic (several vehicles a week), and the fact that equipment will block vehicular access to parts of the site, it is anticipated that the gravel will have some infiltrative capacity, however, it has been considered impervious in this analysis for regulatory purposes. Certain areas of the pad have been restricted from vehicular traffic through the use of bollards as per discussion with PADEP, these

areas will be considered pervious. The extents of the pad have been restricted to be minimum necessary for safe and effective operation of the station.

(5) Maximize the protection of existing drainage features and existing vegetation.

Existing drainage features and vegetation have been preserved and protected to the greatest extent practicable, by limiting disturbances and limiting the extents of the project area to the minimum necessary to accomplish the project objectives.

(6) Minimize land clearing and grading.

The site layout has been designed to minimize the area of disturbance, which minimizes land clearing and grading.

(7) Minimize soil compaction.

The site has been designed to minimize the area of disturbance, which minimizes areas of soil compaction. Heavy construction equipment will be restricted to access roads, designated laydown areas and localized work areas. Areas to be used for PCSM BMPs will be clearly identified during construction, and the contractor will be required to prevent compaction of soils in areas that are occupied or to be occupied by PCSM BMPs.

(8) Utilize other structural or nonstructural BMPs that prevent or minimize changes in stormwater runoff.

Gravel is proposed instead of asphalt in order to minimize any increase in the rate or volume of stormwater runoff from the site, and a subsurface infiltration basin (BMP) is utilized to minimize any remaining changes in stormwater runoff from pre-development to post-development.

3.1.1 Fifteen Factors of the Post-Construction Stormwater Management Plan

(f) PCSM Plan contents. The PCSM Plan must contain drawings and a narrative consistent with the requirements of this chapter. The PCSM Plan shall be designed to minimize the threat to human health, safety and the environment to the greatest extent practicable. PCSM Plans must contain at a minimum the following:

(1) The existing topographic features of the project site and the immediate surrounding area.

The proposed Blue Mountain Side Valve site is located Lower Towamensing Township, in Carbon County, Pennsylvania.

The drainage area of the project site is 0.61 acres, with existing slopes ranging from 9% to 20%. The site generally drains from south to north and eventually discharges to Aquashicola Creek. See Existing Conditions figure in Appendix E for site topographic information.

(2) The types, depth, slope, locations and limitations of the soils and geologic formations.

The Blue Mountain Side Valve site lies within the Bloomsburg Formation, according to the Pennsylvania Department of Conservation and Natural Resources (PADCNR). The Bloomsburg Formation is Silurian age, predominantly red shale and siltstone. United States Geological Survey (USGS) mapping indicates there are fault lines within the vicinity of the proposed meter station site.

Although the proposed meter station site falls within the approximate outlines of the Bloomsburg Formation, it is possible that other formations or rock types could occur in the vicinity of the meter station, due to the approximate nature of USGS maps.

Based on the Natural Resources Conservation Service (NRCS) Web Soil Survey, the surficial geology within the area of interest consists heavily of Meckesville very stony loam.

The Meckesville very stony loam has 8 to 25 percent slopes, well drained, has a medium runoff class, and moderately high rate of water transmission.

These limitations have been addressed through site specific testing for infiltration rates which serve as the basis of design for stormwater BMPs.

(3) The characteristics of the project site, including the past, present and proposed land uses and the proposed alteration to the project site.

Aerial images from 1951 depict the Blue Mountain Side Valve site and its surroundings as forested land. There are no known wetlands located near the property. The proposed site location existed over the past five years as predominantly forested land accessible by Blue Mountain Resort internal drive to the south of the property. In order to estimate runoff analysis conservatively, the existing predevelopment site was assumed to be 100% good condition woods. Under the proposed construction, the existing wooded areas will be turned into meadow. The runoff rate under the existing conditions was calculated based on this site land use.

The project proposes to construct a valve site on approximately 0.07 acres of gravel. The site will continue to drain from south to the north. The subsurface infiltration system will be installed to comply with regulatory stormwater requirements.

(4) An identification of the net change in volume and rate of stormwater from preconstruction hydrology to post construction hydrology for the entire project site and each drainage area.

See Section 4 of this report for details on net change in volume and rate of stormwater runoff from pre-construction to post construction.

The summary of these net changes is provided in Tables 1 and 2. Infiltration volume is provided up to the 2-year storm, and peak runoff rate does not exceed preconstruction rates (see column 'Maximum Allowable Proposed Peak Flow) under the 2, 10, 50, and 100 year/24-hour storm events.

Table 1: Peak Flow Summary

Recurrence Interval (yrs)	Existing Peak Flow (cfs)	Maximum Allowable Proposed Peak Flow (cfs)	Proposed Q (cfs)	Proposed Less than Allowable? (Y/N)
1	0.45	0.45	0.22	Yes
2	0.74	0.74	0.34	Yes
5	1.23	1.23	0.56	Yes
10	1.67	1.67	0.75	Yes
25	2.44	2.44	1.11	Yes
50	3.17	3.17	2.18	Yes
100	4.04	4.04	3.50	Yes

Table 2: Volume Summary

Recurrence Interval (yrs)	Existing Volume (cf)	Proposed Unmitigated Volume from Model (cf)	Difference between Proposed and Existing (cf)	Proposed Basin Infiltration Capacity (cf)	Adequate Infiltration Volume? (Y/N)
1	1,147	1,651	504	1,259	Yes
2	1,767	2,350	583	1,259	Yes

(5) An identification of the location of surface waters of this Commonwealth, which may receive runoff within or from the project site and their classification under Chapter 93 (relating to water quality standards).

The site drains to Aquashicola Creek, which in turn drains to the Lehigh River, see Figure 1. The site is part of the Aquashicola Creek watershed. Chapter 93.9d from the Pennsylvania Code indicates that Aquashicola Creek from source to Buckwha Creek is classified as "HQ-CWF", MF". HQ-CWF indicates the stream is high quality waters with cold water fishes maintenance or propagation, or both, of fish species including the family Salmonidae and additional flora and fauna which are indigenous to a cold water habitat. MF (migratory fishes) indicates the passage, maintenance and propagation of anadromous and catadromous fishes and other fishes which move to or from flowing waters to complete their life cycle in other waters.

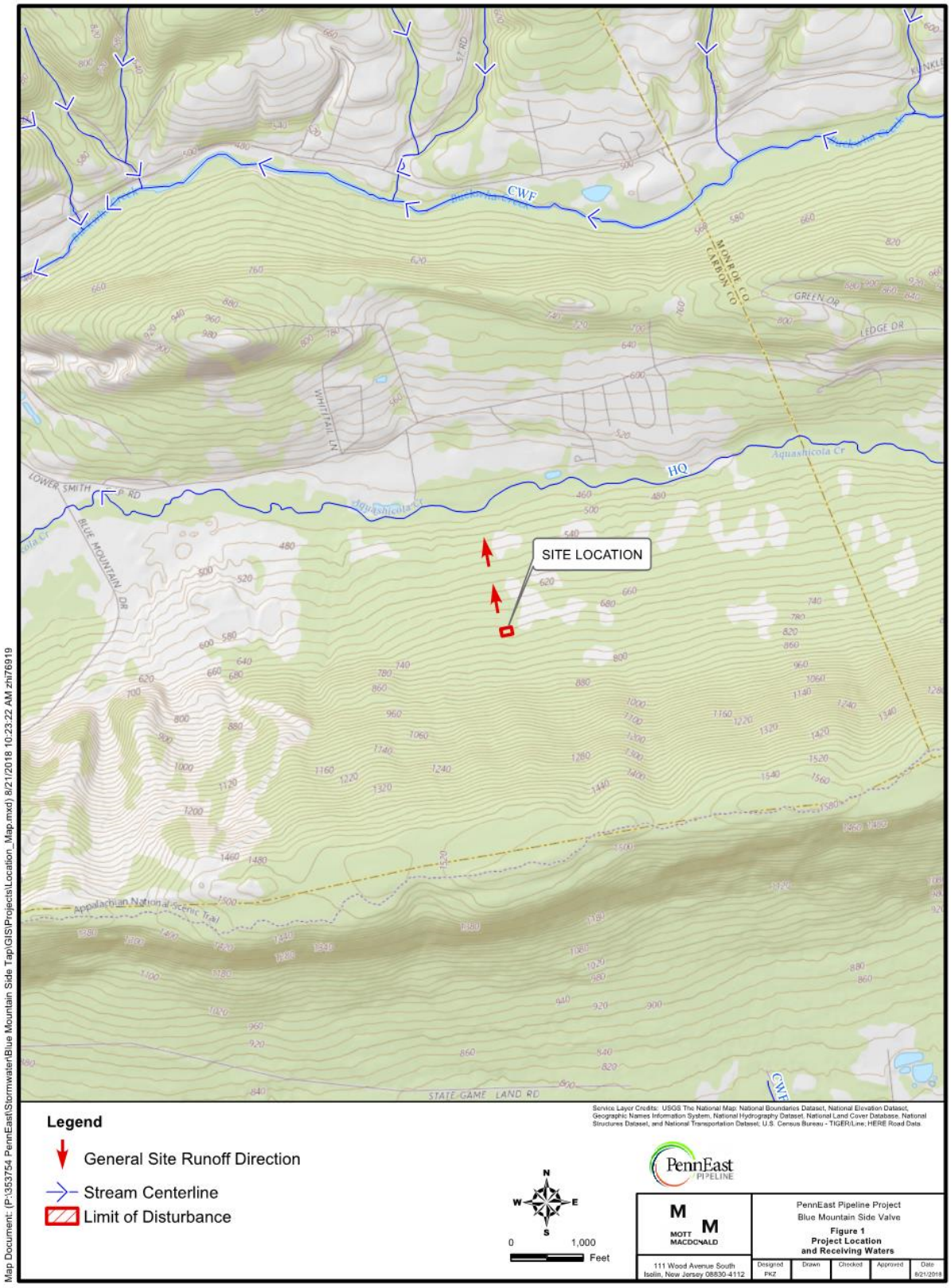


Figure 1: USGS Map showing project site and flow path to receiving waters

(6) A written description of the location and type of PCSM BMPs including construction details for permanent stormwater BMPs including permanent stabilization specifications and locations.

BMPs have been designed according to the recommendations set out in the Pennsylvania Stormwater BMP Manual, as follows:

Vegetated Swale: Swale 1 and Swale 2 are designed to collect the runoff from access road embankment and site areas adjacent to existing road. Both swales are designed in accordance with Pennsylvania BMP to provide for 50% TSS removal rate. The swale will provide pretreatment from gravel surfaces on the site and reduce basin loading ratio. The swales will convey the 100-year storm event with a minimum of 6 inches of freeboard.

Subsurface infiltration basin: A subsurface infiltration basin will be constructed in the northern portion of the site. Runoff from the offsite area west of the site and the gravel pad drains to the basin. The basin temporarily stores the runoff to attenuate peak flows. The basin bottom will be sloped at 0.25% and will have an approximate base area of 969 square feet. The basin will consist 3 rows of 36 inch diameter 50 linear feet each HDPE pipes with headers in a gravel bed. The infiltration basin will be constructed on uncompacted subgrade.

As per discussions with PA DEP areas receiving pre-treatment by passing through other BMPs such as vegetated swales and hydrodynamic separators may be factored out of the loading ratios. The recommended guideline in the PA BMP Manual is Impervious Loading Ratio of 5:1 and Total Loading Ratio of 8:1, which are achieved, see Table 3. It is also noted that the hydrologic calculations in Section 4 demonstrate that the basin performance requirements are met. Very little sediment load is anticipated as the site sees minimal vehicular traffic and some of the flow reaching the basin receives pre-treatment from a manufactured treatment device. Properly implemented inspection and maintenance practices will determine the basin's performance.

Table 3: Basin Loading Ratios

Basin ID	Basin Floor Area (Acres)	Total Drainage Area (Acres)	Influent Impervious Area (Acres)	Effective Loading Ratio Based on Total Area	Effective Loading Ratio Based on Influent Impervious Area
Basin	0.02	0.36	0.05	3.5	3.5

In addition to structural BMPs, the follow non-structural PCSM BMPs are employed on the site:

- The site has been designed to minimize the area of disturbance, which minimizes impervious areas, and the extents of the gravel pad have been restricted to be minimum necessary for safe, effective operation of the station. Gravel was selected in lieu of asphalt for the pad area, the extents of the gravel were limited where possible to align with BMPs 5.7 – Reduce Impervious Cover.
- Existing drainage features and vegetated areas (forests and open space) have been preserved where possible and protected to the greatest extent practicable. By maintaining natural cover, runoff volume and peak flow increases are mitigated. Grading has been minimized, as previously discussed in accordance with BMP 5.6.1 Minimized Total Disturbed Area – Grading.
- In accordance with BMP 5.6.2 – Minimized Soil Compaction in Disturbed Areas, the site has been designed to minimize the area of disturbance, which minimizes soil compaction. Care will be taken to prevent the use of heavy machinery on stormwater BMPs and on areas of the site not being developed; the contractor will be required to prevent compaction of soils in areas that are occupied or to be occupied by PCSM BMPs.

See the Post-Construction Stormwater Management Plan drawing in Appendix I for location of infiltration site on site and construction details of infiltration basin, outlet control structure, inlets and level spreader.

(7) A sequence of PCSM BMP implementation or installation in relation to earth disturbance activities of the project site and a schedule of inspections for critical stages of PCSM BMP installation.

1. At least seven (7) days before starting any earth disturbance activities, the owner and/or operator shall notify the PADEP and Carbon County Conservation District by either telephone or certified mail of the intent to commence earth disturbance activities. Attendance at a pre-construction conference is required upon request of the PADEP.
2. At least three (3) days before starting any earth disturbance activities, all contractors involved in those activities shall notify the Pennsylvania One Call system at 1-800-242-1776 to determine the location of existing subsurface utilities.
3. Install the rock construction entrance as shown on the ESC Plan.
4. Verify compost filter sock placement downslope of proposed disturbed/excavated area and stockpiles as shown on the ESC plan. Inspect permanent and temporary waterbars as shown on the ESC plan and make repairs as needed.
5. Perform clearing and grubbing to those areas described in each stage of work. Remove excess topsoil from the Limits of Disturbance and stockpile off-site. The Contractor is responsible for ensuring that any off-site waste areas have an E&S plan approved by the local conservation district or PADEP prior to being activated. Orange safety fencing shall be installed to prevent compaction of infiltration areas.
6. Perform grading activities detailed by proposed grading, notes, and details shown on the plan drawings. Remove temporary waterbar concurrently with development of access road. Install weighted filter tube in Swales 1 and 2 and maintain per BMP Maintenance Schedule in Section 7 of this report until the site has been stabilized. Per project specifications, additional temporary placement of compost filter sock may be necessary at the contractor's discretion, should accelerated erosion be encountered during grading activities.
7. Installation of subsurface stormwater infiltration system shall be coordinated with bulk filling operations. Install geotextile at the bottom of the stone base as shown on the plans. Install crushed stone base and perforated HDPE piping in accordance with the project specifications. The bottom elevations of stone base, pipe inverts, and pipe spacing shall be in accordance with the PCSM Plan. Grade the stone base to a smooth, uniform grade to allow for proper placement of the pipe. Fill the areas between the pipe runs and the edges with crushed stone. Crushed stone shall be worked into the pipe haunches by means of shovel-slicing, rodding, air tamper, vibratory rod, or other effective methods. Contractor shall perform level runs during the installation of subsurface infiltration system to confirm critical elevations (including but not limited to pipe inverts, bottom of stone, top of stone) and submit records of the same to Engineer for review before backfilling. Heavy construction equipment shall be placed outside of the footprint of the subsurface infiltration system to the maximum extent practicable, to avoid compaction of underlying soils. Once the top of stone elevation is achieved, wrap the geotextile over the top to prevent silting of pipes or the stone. Coordinate with the Engineer for final inspection of the installed subsurface infiltration system before backfilling. Backfill material shall be placed in loose lifts and compacted in accordance with the project specifications. Install orange safety fence around the perimeter of the infiltration basin to keep heavy construction equipment outside footprint of the subsurface infiltration system.
8. Grades will be left 1 foot below top of grate elevations at IN-1 and IN-2 to prevent silt-laden stormwater runoff from entering the subsurface piping. Inlet filter bags shall be installed on inlet grates and checked per BMP Maintenance Schedule. Install PCSM BMPs detailed by proposed

contours, notes, and details shown on the E&SCP & PCSM Plan Drawings. Once the site has been stabilized and inspected by the Engineer, grading shall be brought to final elevations.

9. Gravel shall be installed and graded on the pad area and access road.
10. Place topsoil in areas to be vegetated. Fine grade topsoil, apply fertilizer and seed. Immediately install erosion control blankets over seeded areas in accordance with this plan.
11. Any temporary BMPs installed by contractor during grading shall remain in place until final stabilization has occurred with a minimum uniform 70% perennial vegetative cover or other permanent non-vegetative cover, with a density sufficient to resist accelerated surface erosion and subsurface characteristics sufficient to resist sliding and other movements.
12. Upon achieving site stabilization, excavate accumulated sediment in traps. Repair, regrade, reseed, and mulch any bare soil areas as needed to stabilize the surface.
13. Clean work area of any debris created during construction activities.

(8) Supporting calculations.

See Appendix B for supporting calculations for hydraulic analysis and BMP design.

(9) Plan drawings.

See Post-Construction Stormwater Management Plan drawing in Appendix I.

(10) A long-term operation and maintenance schedule, which provides for inspection of PCSM BMPs, including the repair, replacement, or other routine maintenance of the PCSM BMPs to support its proper function and operation. The program must provide for completion of a written report documenting each inspection and BMP repair and maintenance activities and how access to the PCSM BMPs will be provided.

A maintenance program that provides for routine inspection, as well as repair and replacement as necessary, is essential to effective and efficient operation of the proposed stormwater BMPs. Implementation of the following maintenance plan is a key component in achieving the intent of this PCSM Plan and minimizing negative impacts of stormwater runoff from the proposed facilities. The permittee and any co-permittees shall be responsible for long-term operation and maintenance of the stormwater BMPs unless a different person is identified in the Notice of Termination and has agreed to long-term operation and maintenance of the stormwater BMPs. A formal long-term operation and maintenance plan will be provided in subsequent stages of the undertaking, outlining additional details of maintenance schedules, procedures and reporting requirements.

PennEast will be responsible for the proper construction, stabilization, and maintenance of erosion and sediment controls and post-construction stormwater management facilities which include the vegetated areas. Vegetated areas will be inspected for erosion, distressed vegetation and bare ground. General maintenance will include the regular removal of debris and litter to help prevent possible damage to vegetated areas. Growth of woody vegetation will be controlled by mowing (approximately two times per year) and clearing as appropriate.

Infiltration basin:

- *Inlets will be inspected and cleaned at least two times per year and after runoff events (>1 inch rainfall depth.)*
- *Vehicles will not be parked or driven on the basin, and excessive compaction by mowers will be avoided.*
- *The basin will be inspected after runoff events to make sure that runoff drains down within 72 hours. The basin will also be inspected for accumulation of sediment, damage to outlet control structures, erosion control measures, signs of water contamination/spills, and slope stability in the*

berms. Accumulated sediment will be removed from the basin as required, the original cross section of the basin will be restored, and sediment will be properly disposed of.

Vegetated swale:

Maintenance activities to be performed annually and within 48 hours after every major storm event (> 1 inch rainfall depth).

- *Inspect and correct erosion problems, damage to vegetation, and sediment and debris accumulation (address when > 3 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 an approved location and restore to design grade.*
- *Mow and trim vegetation to provide 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 of erosion or blockage, correct as needed.*

Maintenance activities to be performed as needed:

- *Plant alternative grass species in the event of unsuccessful establishment.*
- *Reseed bare areas; install appropriate erosion control measures when native soil is exposed, or erosion channels are forming.*
- *Rototill and replant 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.*

Maintenance under winter conditions:

- *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 runoff 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 de-icing agents.*
- *Use nontoxic, organic de-icing agents, applied either as blended, magnesium chloride-based liquid products or as pretreated salt.*
- *Use salt-tolerant vegetation in swales.*

(11) Procedures which verify that the proper measures for recycling or disposal of materials associated with or from the PCSM BMPs are in accordance with Department laws, regulations and requirements.

The responsible party (construction contractor) for earth disturbance activities must verify that proper mechanisms are in place to control waste materials. Construction wastes include, but are not limited to, excess soil materials, damaged netting or matting, sanitary wastes, and general trash that could adversely affect or impact water quality. Measures for housekeeping of the site, materials management, and litter control should be planned and implemented throughout the life of the project.

The contractor/operator will remove, recycle or dispose from the site excess construction materials and wastes in accordance with PADEP's Solid Waste Management Regulations at 25 PA. Code 260.1 et seq., 271.1 et seq. The contractor/operator will not illegally bury, dump, or discharge any building material or wastes at the site.

Sediment removed from erosion control measures or facilities and other soils deemed unsuitable for use as fill shall be stabilized and disposed of offsite at a licensed disposal facility. Offsite disposal must comply with local, county, state and federal rules, regulations, and laws.

(12)An identification of naturally occurring geologic formations or soil conditions that may have the potential to cause pollution after earth disturbance activities are completed and PCSM BMPs are operational and development of a management plan to avoid or minimize potential pollution and its impacts.

Based on NRCS Web Soil Survey, the existing soils have a reaction of acidity or alkalinity (pH levels). Upon review of PADCNR's "Geologic Units Containing Potentially Significant Acid-Producing Sulfide Minerals" map, this valve site lies in a known region containing acid-producing soils. Further soil testing will be required to determine potential limitations and countermeasures.

(13)An identification of potential thermal impacts from post construction stormwater to surface waters of this Commonwealth including BMPs to avoid, minimize or mitigate potential pollution from thermal impacts.

Infiltration of runoff collected in the subsurface infiltration basin is anticipated to mitigate thermal impacts from post-construction stormwater. Because the infiltration basin is subsurface it will further mitigate thermal impacts. It is not expected that runoff collected in the infiltration basin and discharged overland to the receiving water will be retained for more than 24 hours, thus thermal impacts of discharge from infiltration basin are not expected. Existing shade trees are being preserved to the greatest extent possible, and no riprap and concrete channels have been proposed, to minimize the heat transfer to the runoff.

(14)A riparian forest buffer management plan when required under §102.14 (relating to riparian buffer requirements).

The project is not located within 150 feet of a perennial or intermittent stream. Therefore, a riparian forest buffer management plan is not required.

(15)Additional information requested by the Department.

Additional information requested by the Department will be provided.

3.1.2 Post Construction Stormwater Management Plan Stormwater Analysis

This section addresses the portion of the regulations pertaining to the site-specific stormwater analysis.

(g) PCSM Plan Stormwater analysis. Except for regulated activities that require site restoration or reclamation, and small earth disturbance activities identified in subsection (n), PCSM Plans for proposed activities requiring a permit under this chapter require the following additional information:

(1) Predevelopment site characterization and assessment of soil and geology including appropriate infiltration and geotechnical studies that identify location and depths of test sites and methods used.

Subsurface Infiltration tests using a double ring infiltrometer in the two test pits were conducted at the location of the proposed infiltration basin. At least one Infiltration test was conducted at an elevation equal to the proposed basin invert. The infiltration tests were conducted at 3.5 feet below existing

grade. Upon completion of the infiltration testing, the test location was excavated an additional 2 feet to further identify subsurface material and look for evidence of groundwater. Initial proposed basin invert elevation was set at 701.0 feet. The test pit elevations are summarized in a table below:

Table 4: Test Pit Summary

Test Pit No.	Existing Grade Elevation (feet)	Proposed BMP Invert (feet)	Infiltration Test Elevation (feet)	Excavation Depth Elevation (feet)	Depth to High Groundwater (feet)
BM-ST-TP-1	705.2	701.0	701.7	5.5	No evidence of high groundwater observed
BM-ST-TP-2	704.5	701.0	701.0	5.5	No evidence of high groundwater observed

Test pit BMST-TP-1 was excavated to 5.5 feet below existing grade on May 25, 2018. Infiltration testing was performed at 3.5 feet below existing grade. Two tests were performed at this location.

Test pit BMST-TP-2 was excavated to 5.5 feet below existing grade on May 25, 2018. Infiltration testing was performed at 3.5 feet below existing grade. Two tests were performed at this location.

The results of the infiltration tests are summarized as follows:

Table 5: Infiltration Test Summary

Test Pit	Test #1	Test #2	Final Rate Used
BMST-TP-1	6.00 inch/hr	6.00 inch/hr	6.00 inch/hr
BMST-TP-2	6.00 inch/hr	3.75 inch/hr	4.88 inch/hr
Recommended Overall Rate			5.44 inch/hr
Design Rate (Factor of Safety of 2)			2.72 inch/hr

(2) Analysis demonstrating that the PCSM BMPs will meet the volume reduction and water quality requirements specified in an applicable Department approved and current Act 167 stormwater management watershed plan; or manage the net change for storms up to and including the 2-year/24-hour storm event when compared to preconstruction runoff volume and water quality. The analysis for the 2-year/24-hour storm event shall be conducted using the following minimum criteria:

The project site is located in Carbon County, in the Aquashicola Creek watershed, which does not have an Act 167 Stormwater Management Plan. As such, the applicable runoff volume requirements are to manage the net change in volume between pre-construction and post-construction, for storms up to and including the 2-year/24-hour storm event.

Please see Section 4 of this report for details on the pre-development and post-development runoff volume calculations with detailed calculations provided in Appendix B.

i. **Existing predevelopment non-forested pervious areas must be considered meadow in good condition or its equivalent except for repair, reconstruction or restoration of roadways or rail lines, or construction, repair, reconstruction or restoration of utility infrastructure when the site will be returned to existing condition.**

The existing pre-development site is mainly good condition woods.

ii. When the existing project site contains impervious area, 20% of the existing impervious area to be disturbed must be considered meadow in good condition or better, except for repair, reconstruction or restoration of roadways or rail lines, or construction, repair, reconstruction, or restoration of utility infrastructure when the site will be returned to existing condition.

Not applicable. The project site does not contain any impervious area under existing conditions.

iii. When the existing site contains impervious area and the existing site conditions have public health, safety or environmental limitations, the applicant may demonstrate to the Department that it is not practicable to satisfy the requirement in subparagraph (ii), but the stormwater volume reduction and water quality treatment will be maximized to the extent practicable to maintain and protect existing water quality and existing and designated uses.

Not applicable. The stormwater volume reduction and water quality treatment requirements are achieved.

iv. Approaches other than that required under paragraph (2) may be proposed by the applicant when the applicant demonstrates to the Department that the alternative will either be more protective than required under paragraph (2) or will maintain and protect existing water quality and existing and designated uses by maintaining the site hydrology, water quality, and erosive impacts of the conditions prior to initiation of any earth disturbance activities.

Not applicable.

(3) Analysis demonstrating that the PCSM BMPs will meet the rate requirements specified in an applicable Department approved and current Act 167 stormwater management watershed plan; or manage the net change in peak rate for the 2, 10, 50, and 100 year/24-hour storm events in a manner not to exceed preconstruction rates.

The project site is located in Carbon County, in the Aquashicola Creek watershed. According to PADEP's eMapPA,, Carbon County does not have an Act 167 Stormwater Management Plan. As such, the applicable requirement is that the post-development peak runoff rate must not exceed pre-development peak runoff rate under the 2, 10, 50, and 100 year/24-hour storm events.

The peak runoff rate requirements are achieved; summarized in the table below. See Section 4 of this report for details on the pre-development and post-development peak runoff rate calculations.

i. Hydrologic computations or a routing analysis are required to demonstrate that this requirement has been met.

See Section 4 of this report for details on hydrologic computations that demonstrate that runoff rate requirements have been met.

ii. Exempt from this requirement are Department- approved direct discharges to tidal areas or Department-approved no detention areas.

Not applicable. Project site does not discharge to tidal areas or no-detention areas.

iii. Approaches other than that required under paragraph (3) may be proposed by the applicant when the applicant demonstrates to the Department that the alternative will either be more protective than required under paragraph (3) or will maintain and protect existing water quality and existing and designated uses by maintaining the preconstruction site hydrologic impact.

Not applicable. The requirements of paragraph (3) have been met.

(4) Identification of the methodologies for calculating the total runoff volume and peak rate of runoff and provide supporting documentation and calculations.

See Section 4 of this report for details on the pre-development and post-development peak runoff rate and total runoff volume calculation methodology, which was completed using TR-55 methodology implemented by Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016. See Appendix B for calculation documentation.

(5) Identification of construction techniques or special considerations to address soil and geologic limitations.

Methods to address potential soil limitations have been provided on the PCSM plans.

(h) PCSM implementation for special protection waters. To satisfy the anti-degradation implementation requirements in §93.4c(b) (relating to implementation of anti-degradation requirements), an earth disturbance activity that requires a permit under this chapter and for which any receiving water that is classified as High Quality or Exceptional Value under Chapter 93, the person proposing the activity shall, in the permit application, do the following:

(1) Evaluate and include non-discharge alternatives in the PCSM Plan unless a person demonstrates that non-discharge alternatives do not exist for the project.

(2) If the person makes the demonstration in paragraph (1) that non-discharge alternatives do not exist for the project, the PCSM Plan must include ABACT, except as provided in §93.4c(b)(1)(iii).

(3) For purposes of this chapter, non-discharge alternatives and ABACT and their design standards are listed in the Pennsylvania Stormwater Best Management Practices Manual Commonwealth of Pennsylvania, Department of Environmental Protection, No. 363-0300-002 (December 2006), as amended and updated.

The project will eliminate the net change in stormwater volume, rate and quality for stormwater events up to and including the 2-year/24-hour storm. The project will use various structural and non-structural BMPs to meet the water quantity and quality requirements. The peak runoffs will be attenuated with subsurface infiltration basin. There will be no stormwater discharge from the basin for up to 10-year rainfall events. Therefore, the project falls into definition of nondischarge alternative as environmentally sound and cost-effective BMPs that individually or collectively eliminate the net change in stormwater volume, rate and quality for storm events up to and including the 2-year/24-hour storm when compared to the stormwater rate, volume and quality prior to the earth disturbance activities to maintain and protect the existing quality of the receiving surface waters of this Commonwealth.

See Section 4 for compliance calculations and description.

4 Hydrologic and Hydraulic Analysis

This Section outlines the hydrologic calculations that were performed in order to design the stormwater BMPs for the Blue Mountain Side Valve site, and to confirm that requirements for stormwater runoff volume and peak rate would be met.

4.1 Existing Conditions

The total drainage area to the point of analysis including site and offsite areas is 0.61 acres of forested, paved, and grassed land, of which the project site is 0.41 acres. In general, the gravel pad and a small offsite area drain southeast to northwest, which the northwestern portion of the site drains towards the southeast. The onsite soils were identified using the USDA's Web Soil Survey. The project site consists of primarily Meckesville very stony loam, which is Hydrologic Soil Group C (see Appendix C for a breakdown of existing condition soils type and curve numbers). Existing condition curve numbers were assigned as per Table 2-2a from USDA's TR-55 "Urban Hydrology for Small Watersheds" (see Appendix B). The time of concentration was calculated using TR-55 methodology, and the routing is shown in the Existing Conditions figure in Appendix E. For times of concentration less than 5 minutes, a minimum time of concentration of 5 minutes was assumed.

Under existing conditions, the land use breakdown is given in Table 6 below. The drainage area boundaries are shown in the Existing Conditions figure in Appendix E.

Table 6: Existing Conditions Land Use

DA	Cover	Soils	HSG	Area (sf)	Area (Ac)	CN	CN*Area	Weighted CN
SITE-BASIN	WO	McD	C	8,557	0.196	70	13.75	70.0
SITE-BYP	WO	McD	C	9,106	0.209	70	14.63	70.0
SITE Total					**0.405**		**28.38**	**70.0**
OFFSITE-BASIN	WO	McD	C/D	7,136	0.164	70	11.47	70.0
OFFSITE-BYP	WO	McD	C/D	1,735	0.040	70	2.79	70.0
OFFSITE Total					**0.204**		**14.26**	**70.0**
Grand Total					**0.609**		**42.64**	**70.0**

Precipitation data was obtained from NOAA Atlas 14 the rainfall data is presented in the Appendix and summarized in Table 7, these rainfall depths were applied to the model as a NRCS Type II rainfall.

Table 7: 24-Hour Design Rainfall Depths

Recurrence Interval (years)	Rainfall (inches)
1	2.63
2	3.15
5	3.92
10	4.58
25	5.61
50	6.55
100	7.62

4.2 Proposed Conditions

For the purposes of determining peak flow and volume reduction gravel (compacted crushed stone) is considered to be impervious, thus it has been modeled as such in the hydraulic calculations. For design purposes, it was assumed that the entire equipment pad was compacted. Infiltration basin and swales were designed to meet the regulatory stormwater requirements. Areas that will be restricted from vehicular traffic will be considered to be pervious. These areas were designed to provide additional infiltration volume that accounts for 40% void space within the surface gravel layer. Flow from the site will be directed to the swales via overland flow and infiltrated. The outflow from the basin will be discharged overland via a level spreader.

Under proposed conditions, the land use breakdown is given in Table 8 below. The drainage area boundaries are shown in the Proposed Conditions figure in Appendix F.

Table 8: Proposed Condition Land Use

DA	Cover	Soils	HSG	Area (sf)	Area (Ac)	CN	CN*Area	Weighted CN
SITE-BASIN	IMP/GRAVEL	McD	C	2,251	0.052	98	5.06	98.0
SITE-BASIN	GRAVEL	McD	C	869	0.020	89	1.78	89.0
SITE-BASIN	MEAD	McD	C	5,437	0.125	71	8.86	71.0
SITE-BYP	MEAD	McD	C	9,106	0.209	71	14.84	71.0
SITE Total					**0.405**		**30.54**	**75.3**
OFFSITE-BASIN	MEAD	McD	C/D	7,136	0.164	71	11.63	71.0
OFFSITE-BYP	MEAD	McD	C/D	1,735	0.040	71	2.83	71.0
OFFSITE Total					**0.204**		**14.46**	**71.0**
Grand Total					**0.609**		**45.18**	**74.2**

4.3 Model Development

A model was developed in the Hydraflow Hydrographs extension for AutoCAD Civil 3D 2016 to simulate existing and proposed flow. This model was used to determine the existing and proposed runoff volumes and peak runoff rates. The basin's outlet control structure will be constructed with the lowest opening 0.5' above the basin invert, to drain completely in 72 hours at the design infiltration rate of 2.72 in/hr, based on the observed rat of 5.44 in/hr with a factor of safety of 2 applied. The proposed flows were routed through the storage BMPs and the attenuated flow rates were calculated. Model inputs and summary output reports can be found in Appendix H.

4.4 Stormwater Management Rules Compliance

The project meets the requirements listed under the Pennsylvania code for Post-Construction Stormwater Management (PCSM) Section 102.8 for peak runoff volume and peak rate.

4.4.1 Volume Control

A stormwater basin is utilized to provide storage and infiltration to prevent any increases in stormwater runoff volume, up to and including the 2-year/24-hour storm event using the prescribed land use characteristics, thus it meets the PADEP requirements.

The project is subject to volume control Design Storm Method that requires for storms up to the 2-year storm there be no increase in runoff volume as a result of this project. Because there is no other mechanism such as irrigation or rainwater harvesting, for releasing the required retention volume, infiltration capacity of subsurface infiltration basin will be employed to remove the required runoff volume.

This was accomplished by providing the required volume below the low outlet of the basin's outlet control structure and using infiltration berms, as show in Table 9. Basin drain time is shown in Table 10.

The low orifice in the infiltration basin was placed above the invert, providing the required infiltration volume. Additional volume is infiltrated by infiltration berms which are located in the area northeast of the site. As such, regulatory volume control requirements are met. The required volume was achieved as follows:

Table 9: Total Volume Summary

Recurrence Interval (yrs)	Existing Volume (cf)	Proposed Unmitigated Volume from Model (cf)	Difference between Proposed and Existing (cf)	Proposed Basin Infiltration Capacity (cf)	Adequate Infiltration Volume? (Y/N)
1-Year	1,147	1,651	504	1,259	Yes
2-year	1,767	2,350	583	1,259	Yes

Table 10: Basin Drain Time

Basin Infiltration Depth (ft)	Design Infiltration Rate (in/hr)	Drain Time (hrs)	Allowable Drain Time (hrs)	Drain Time less than allowable
0.5	2.72	8.61	72	Yes

4.4.2 Peak Flow Control

A stormwater infiltration basin is utilized to provide storage attenuation to prevent any increases in the rate of stormwater runoff, thus it meets the PADEP requirements. The model indicates that the basin will result in a peak runoff rate under the 2, 10, 50, and 100 year/24-hour storm events that does not exceed preconstruction rates.

The attenuated flows are summarized in Table 11 below.

Table 11: Peak Flows Summary

Recurrence Interval (yrs)	Existing Peak Flow (cfs)	Maximum Allowable Proposed Peak Flow (cfs)	Proposed Q (cfs)	Proposed Less than Allowable? (Y/N)
1	0.45	0.45	0.22	Yes
2	0.74	0.74	0.34	Yes
5	1.23	1.23	0.56	Yes
10	1.67	1.67	0.75	Yes
25	2.44	2.44	1.11	Yes
50	3.17	3.17	2.18	Yes
100	4.04	4.04	3.50	Yes

4.4.3 Water Quality

Soil classifications were obtained from the USDA Web Soil Survey to estimate if there would be adequate infiltration. The required water quality requirements were met through basin infiltration of a minimum of 0.5" of runoff from the impervious area, equivalent to 87 cf (2,251 x 0.5"). This was accomplished by providing the required volume below the low outlet of the basin's outlet control structure. Compliance with water quality requirements is demonstrated using BMP Worksheet 10 in Appendix C

BMPs utilized to comply with water quality requirements:

- 5.4.3 Protect / Utilize Natural Flow Pathways in Overall Stormwater Planning and Design
- 5.6.1 Minimize Total Disturbed Area. The site layout has been designed to minimize the area of disturbance and provide safe operations.
- 5.6.2 Minimize Soil Compaction. Soil compaction will be minimized within the area of subsurface infiltration basin as shown on plans.
- 5.6.3 - Re-Vegetate / Re-Forest Disturbed Area. The disturbed non-graveled land will be re-vegetated with native species to transition into meadow.
- 6.7.2 Landscape Restoration. Disturbed areas outside the proposed gravel pad and access drive will be replanted with native vegetation.
- 6.7.3 Soil Amendment and Restoration. Disturbed areas outside the proposed gravel pad and access drive will be tilled or ripped before replanting.

4.4.4 Swale Design

The vegetated swales were designed based on the requirements set out in the PADEP Erosion and Sediment Pollution Control Manual and conveyance capacity for the 100-year storm. Sizing calculations are provided in Appendix B.

Pipe and swale capacities were sized based on output flows from the model as well as Rational Method Calculations, and the Manning's equation was used to select the appropriate size for each location. Sizing calculations are provided in Appendix B.

Swale capacities were designed based on the requirements set out in the PADEP Erosions and Sediment Control Manual. Sizing calculations are provided in Appendix B.

Level spreader sizing was based upon requirements defined in the PADEP Erosion and Sediment Pollution Control Manual. The proposed level spreader has been placed on a grassy area.

5 Conclusion

As demonstrated in the sections above, the design of the proposed stormwater BMPs for the Blue Mountain Side Valve site for the PennEast pipeline allow the proposed project to comply with the applicable regulatory requirements under Pennsylvania Code Section 102.8.

Appendices

A. Rainfall Data

NOAA Atlas 14, Volume 2, Version 3
Location name: Lower Towamensing Twp, Pennsylvania, USA*
Latitude: 40.8182°, Longitude: -75.505°
Elevation: 659.54 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	0.318 (0.286–0.354)	0.380 (0.341–0.423)	0.453 (0.405–0.503)	0.512 (0.457–0.568)	0.590 (0.522–0.654)	0.655 (0.575–0.727)	0.724 (0.631–0.804)	0.803 (0.690–0.894)	0.911 (0.772–1.02)	1.01 (0.843–1.14)
10-min	0.504 (0.453–0.561)	0.604 (0.542–0.673)	0.720 (0.645–0.801)	0.810 (0.723–0.899)	0.930 (0.822–1.03)	1.03 (0.902–1.14)	1.13 (0.988–1.26)	1.25 (1.08–1.39)	1.42 (1.20–1.59)	1.56 (1.30–1.75)
15-min	0.627 (0.563–0.697)	0.753 (0.676–0.839)	0.903 (0.809–1.00)	1.02 (0.909–1.13)	1.17 (1.04–1.30)	1.30 (1.14–1.44)	1.43 (1.25–1.59)	1.57 (1.35–1.75)	1.78 (1.50–1.99)	1.95 (1.63–2.20)
30-min	0.852 (0.765–0.948)	1.03 (0.926–1.15)	1.27 (1.14–1.41)	1.46 (1.30–1.62)	1.72 (1.52–1.90)	1.92 (1.69–2.13)	2.15 (1.88–2.39)	2.40 (2.07–2.68)	2.77 (2.35–3.11)	3.09 (2.58–3.49)
60-min	1.06 (0.949–1.18)	1.29 (1.16–1.43)	1.62 (1.45–1.80)	1.89 (1.69–2.10)	2.27 (2.01–2.51)	2.59 (2.27–2.87)	2.95 (2.57–3.27)	3.34 (2.88–3.72)	3.94 (3.34–4.42)	4.47 (3.73–5.04)
2-hr	1.28 (1.16–1.43)	1.56 (1.40–1.73)	1.96 (1.76–2.18)	2.30 (2.06–2.55)	2.81 (2.49–3.11)	3.26 (2.88–3.61)	3.78 (3.30–4.19)	4.38 (3.78–4.87)	5.31 (4.51–5.95)	6.17 (5.16–6.96)
3-hr	1.42 (1.29–1.58)	1.72 (1.55–1.91)	2.14 (1.94–2.38)	2.50 (2.25–2.76)	3.04 (2.71–3.36)	3.52 (3.12–3.89)	4.07 (3.57–4.50)	4.71 (4.08–5.22)	5.72 (4.87–6.38)	6.63 (5.56–7.45)
6-hr	1.82 (1.65–2.02)	2.18 (1.98–2.41)	2.68 (2.43–2.97)	3.12 (2.81–3.45)	3.80 (3.39–4.19)	4.41 (3.91–4.87)	5.12 (4.48–5.66)	5.95 (5.14–6.59)	7.26 (6.17–8.10)	8.47 (7.07–9.49)
12-hr	2.25 (2.05–2.50)	2.71 (2.46–3.00)	3.36 (3.04–3.72)	3.92 (3.53–4.34)	4.81 (4.29–5.31)	5.62 (4.96–6.21)	6.56 (5.73–7.25)	7.67 (6.61–8.50)	9.44 (7.97–10.5)	11.1 (9.18–12.4)
24-hr	2.63 (2.43–2.85)	3.15 (2.92–3.42)	3.92 (3.63–4.25)	4.58 (4.23–4.96)	5.61 (5.14–6.05)	6.55 (5.96–7.03)	7.62 (6.88–8.16)	8.88 (7.94–9.47)	10.9 (9.57–11.6)	12.7 (11.0–13.5)
2-day	3.08 (2.85–3.35)	3.70 (3.43–4.02)	4.59 (4.25–4.98)	5.36 (4.94–5.80)	6.54 (5.99–7.06)	7.60 (6.91–8.19)	8.83 (7.97–9.49)	10.3 (9.16–11.0)	12.5 (11.0–13.4)	14.6 (12.7–15.6)
3-day	3.25 (3.01–3.53)	3.89 (3.61–4.24)	4.82 (4.46–5.23)	5.61 (5.18–6.07)	6.83 (6.26–7.37)	7.92 (7.22–8.53)	9.18 (8.30–9.85)	10.6 (9.53–11.4)	12.9 (11.4–13.8)	15.0 (13.1–16.0)
4-day	3.42 (3.17–3.71)	4.09 (3.80–4.45)	5.05 (4.67–5.48)	5.86 (5.42–6.35)	7.12 (6.54–7.68)	8.24 (7.52–8.87)	9.53 (8.63–10.2)	11.0 (9.89–11.8)	13.3 (11.8–14.3)	15.5 (13.5–16.5)
7-day	4.05 (3.75–4.41)	4.84 (4.47–5.28)	5.91 (5.46–6.44)	6.83 (6.30–7.43)	8.24 (7.55–8.95)	9.50 (8.65–10.3)	10.9 (9.88–11.8)	12.6 (11.3–13.5)	15.1 (13.4–16.2)	17.4 (15.2–18.7)
10-day	4.68 (4.35–5.07)	5.57 (5.18–6.04)	6.73 (6.25–7.28)	7.71 (7.13–8.33)	9.17 (8.45–9.89)	10.5 (9.59–11.3)	11.9 (10.8–12.8)	13.5 (12.2–14.5)	16.0 (14.3–17.1)	18.1 (16.1–19.4)
20-day	6.32 (5.94–6.74)	7.46 (7.01–7.96)	8.78 (8.24–9.37)	9.88 (9.25–10.5)	11.5 (10.7–12.2)	12.8 (11.9–13.7)	14.3 (13.3–15.2)	16.0 (14.7–17.0)	18.4 (16.8–19.5)	20.5 (18.6–21.7)
30-day	7.88 (7.44–8.37)	9.26 (8.74–9.83)	10.7 (10.1–11.3)	11.9 (11.2–12.6)	13.6 (12.8–14.4)	15.0 (14.0–15.9)	16.5 (15.4–17.5)	18.2 (16.9–19.2)	20.5 (18.9–21.8)	22.5 (20.7–23.9)
45-day	9.99 (9.50–10.5)	11.7 (11.1–12.3)	13.3 (12.6–14.0)	14.6 (13.8–15.4)	16.4 (15.5–17.3)	17.9 (16.9–18.9)	19.5 (18.3–20.5)	21.1 (19.8–22.3)	23.4 (21.9–24.7)	25.3 (23.6–26.8)
60-day	12.0 (11.4–12.6)	14.0 (13.3–14.7)	15.8 (15.0–16.6)	17.3 (16.4–18.2)	19.3 (18.3–20.3)	21.0 (19.8–22.0)	22.7 (21.4–23.8)	24.5 (23.0–25.7)	27.0 (25.3–28.4)	29.1 (27.1–30.6)

[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.

Back to Top

B. Calculation Sheet

EXISTING CONDITIONS
SITE -Tc CALCULATIONS

SHEET FLOW	
Manning's n	0.4
Flow length, ft	100
2-Yr 24-Hr rainfall, in	3.15
Land slope, %	16.18
Sheet flow time, min	**9.4**
SHALLOW CONC. FLOW	
Flow length, ft	52
Watercourse slope, %	17.31
Surface Description	unpaved
Velocity, ft/s	6.71
Sh. Conc. Flow time, min	**0.1**
TIME OF CONC., mins	**9.5**

EXISTING CONDITIONS
OFFSITE -Tc CALCULATIONS

SHEET FLOW	
Manning's n	0.4
Flow length, ft	100
2-Yr 24-Hr rainfall, in	3.15
Land slope, %	14.10
Sheet flow time, min	**9.9**
SHALLOW CONC. FLOW	
Flow length, ft	40
Watercourse slope, %	17.75
Surface Description	unpaved
Velocity, ft/s	6.80
Sh. Conc. Flow time, min	**0.1**
TIME OF CONC., mins	**10.0**

PROPOSED CONDITIONS
SITE-TO-BASIN Tc CALCULATIONS

SHEET FLOW	
Manning's n	0.24
Flow length, ft	86
2-Yr 24-Hr rainfall, in	3.15
Land slope, %	14.45
Sheet flow time, min	**5.8**
TIME OF CONC., mins	**5.8**

PROPOSED CONDITIONS
SITE-BYP Tc CALCULATIONS

SHEET FLOW	
Manning's n	0.24
Flow length, ft	100
2-Yr 24-Hr rainfall, in	3.15
Land slope, %	13.65
Sheet flow time, min	**6.7**
SHALLOW CONC. FLOW	
Flow length, ft	52
Watercourse slope, %	15.96
Surface Description	unpaved
Velocity, ft/s	6.45
Sh. Conc. Flow time, min	**0.1**
TIME OF CONC., mins	**6.8**

PROPOSED CONDITIONS
OFFSITE-BASIN -Tc CALCULATIONS

SHEET FLOW	
Manning's n	0.24
Flow length, ft	100
2-Yr 24-Hr rainfall, in	3.15
Land slope, %	15.10
Sheet flow time, min	**6.4**
SHALLOW CONC. FLOW	
Flow length, ft	3
Watercourse slope, %	16.67
Surface Description	unpaved
Velocity, ft/s	6.59
Sh. Conc. Flow time, min	**0.0**
TIME OF CONC., mins	**6.4**

PROPOSED CONDITIONS
OFFSITE-BYP -Tc CALCULATIONS

SHEET FLOW	
Manning's n	0.24
Flow length, ft	100
2-Yr 24-Hr rainfall, in	3.15
Land slope, %	14.10
Sheet flow time, min	**6.6**
SHALLOW CONC. FLOW	
Flow length, ft	40
Watercourse slope, %	17.75
Surface Description	unpaved
Velocity, ft/s	6.80
Sh. Conc. Flow time, min	**0.1**
TIME OF CONC., mins	**6.7**

SWALE1 Tc CALCULATIONS

SHEET FLOW	
Manning's n	0.24
Flow length, ft	100
2-Yr 24-Hr rainfall, in	3.15
Land slope, %	15.10
Sheet flow time, min	**6.4**
SHALLOW CONC. FLOW	
Flow length, ft	3
Watercourse slope, %	16.67
Surface Description	unpaved
Velocity, ft/s	6.59
Sh. Conc. Flow time, min	**0.0**
TIME OF CONC., mins	**6.4**

SWALE 2 Tc CALCULATIONS

SHEET FLOW	
Manning's n	0.24
Flow length, ft	87
2-Yr 24-Hr rainfall, in	3.15
Land slope, %	11.78
Sheet flow time, min	**6.3**
TIME OF CONC., mins	**6.3**

PENNEAST-BLUE MOUNTAIN SIDE VALVE
PROPOSED CONDITIONS RUNOFF COEFFICIENT CALCULATIONS FOR PROPOSED SWALES

***Note: Rational C Coefficients adopted from PA Erosion and Sediment Pollution Control Program Manual, Mar 2012, Table 5.2**

DA	Land Use	Soils	HSG	Area	Area (Acres)	C	C*A	RC
SWALE1	MEAD	McD	C	1615	0.037	0.36	0.013	0.36
SWALE1	WOODS	McD	C	1818	0.042	0.16	0.007	0.16
SWALE1 Total					**0.079**		**0.020**	**0.25**
SWALE2	MEAD	McD	C	1185	0.027	0.36	0.010	0.36
SWALE2 Total					**0.027**		**0.010**	**0.36**
Grand Total					**0.106**		**0.030**	**0.28**

The "RC" value is an area averaged runoff coefficient value (arithmetic mean) calculated as:

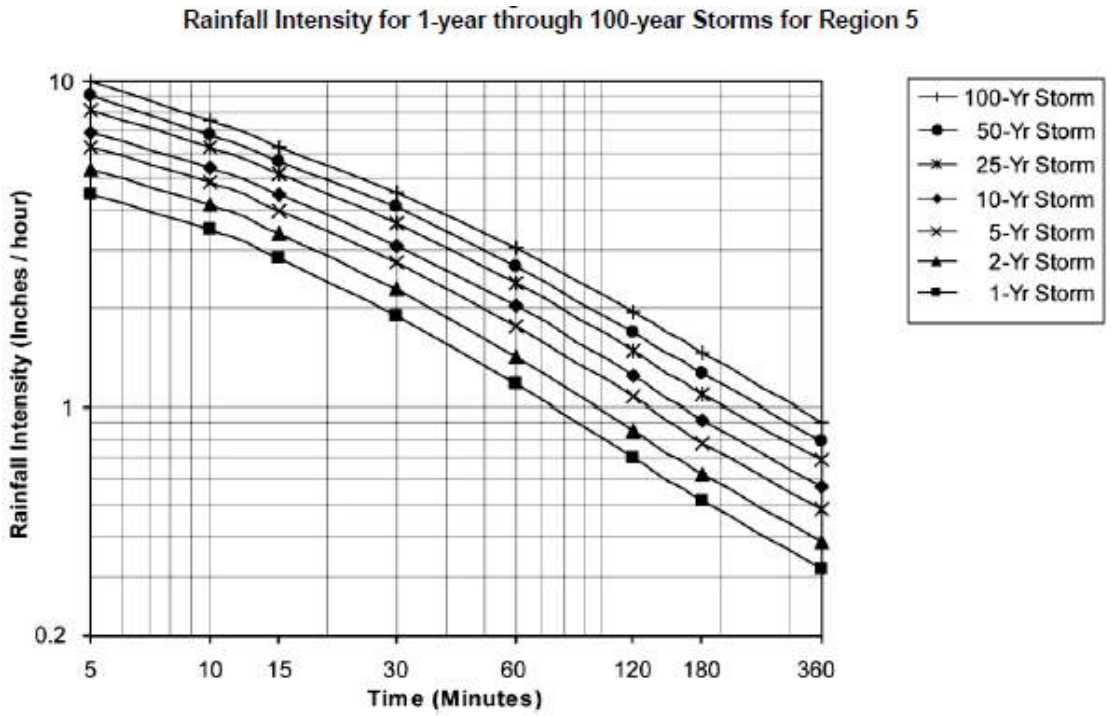
$$RC = \frac{\sum_{i=1}^{n} C_i \, x \, Area_i}{\sum_{i=1}^{n} Area_i}$$

PENNEAST-BLUE MOUNTAIN SIDE VALVE
RATIONAL METHOD PEAK FLOW CALCULATIONS FOR PROPOSED SWALES

Return Period (Yrs) 10

Time of Concentration (Min) 5 **(Unless otherwise noted below)**

DA	Area (Acres)	RC	Tc (mins)	Rainfall Intensity (in/hr)	Q (cfs)
SWALE1	0.079	0.25	6.4	6.4	0.1
SWALE2	0.027	0.36	6.3	6.5	0.1



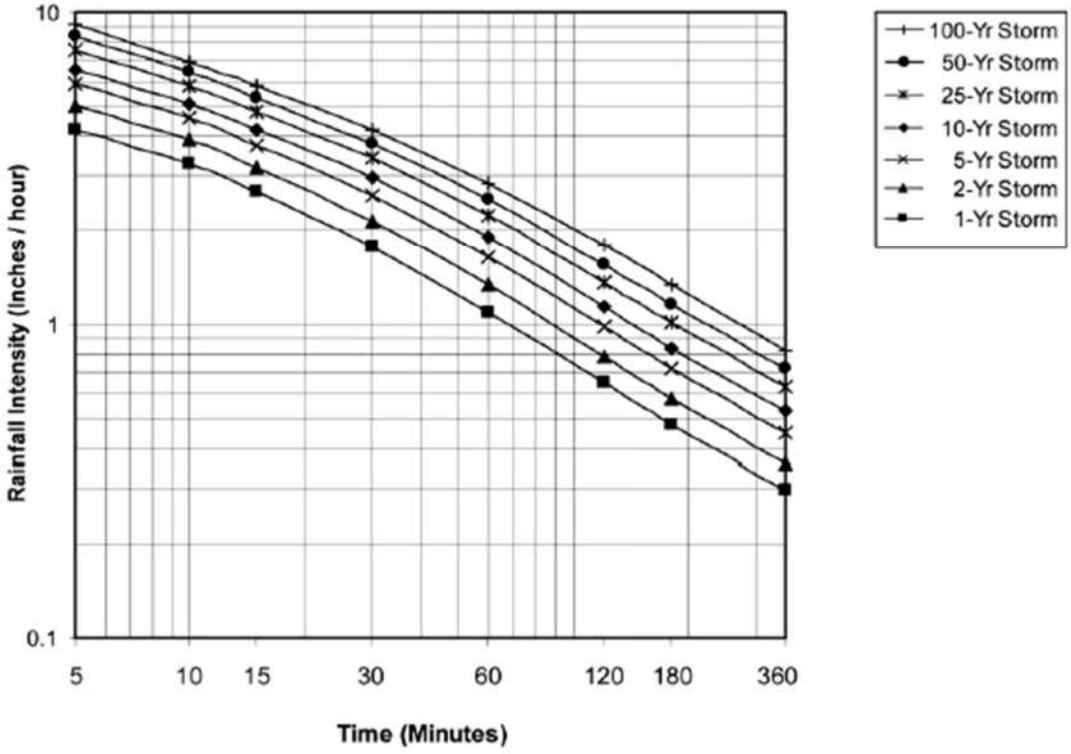
Adapted from Appendix A of PennDOT Publication 584 (2008 Edition)

PENNEAST-BLUE MOUNTAIN SIDE VALVE
RATIONAL METHOD PEAK FLOW CALCULATIONS FOR PROPOSED SWALES

Return Period (Yrs) 100
Time of Concentration (Min) 5 **(Unless otherwise noted below)**

DA	Area (Acres)	RC	Tc (mins)	Rainfall Intensity (in/hr)	Q (cfs)
SWALE1	0.079	0.25	6.4	8.3	0.2
SWALE2	0.027	0.36	6.3	8.4	0.1

Rainfall Intensity for 1-year through 100-year Storms for Region 4



Adapted from Appendix A of PennDOT Publication 584 (2008 Edition)

PROJECT NAME:	**SWALE 1**	
LOCATION:	**TOWAMENSING TOWNSHIP, CARBON COUNTY PA**	
PREPARED BY:	**DATE:**	**10/12/2018**
CHECKED BY:	**DATE:**	**10/12/2018**

CHANNEL OR CHANNEL SECTION	SOLVE FOR FLOW DEPTH	
Temporary or Permanent (T or P)	P	
Required Capacity, Qr (cfs)	0.2	**See attached Rational Peak Flow Calculations**
Left side slope, %	33.33	
Right side slope, %	33.33	
Bottom width, ft	2	
Channel Depth provided, ft	0.75	
Channel bed slope, %	5	
Mannings N	0.09	
Accn. Due to gravity, ft/sec2	32.2	

DESIGN METHOD FOR LINING - SHEAR STRESS

CHECK FOR SHEAR STRESS		
H:V, left	3.00	
H:V, right	3.00	
bed slope, ft/ft	0.05	
Calculated channel flow depth, ft	0.11	
top width at flow depth, ft	2.66	
Bottom Width:Flow Depth Ratio	18.07	
wetted area, sq. ft	0.26	
wetted peri, ft	2.70	
hyd. Radius, ft	0.10	
velocity, ft/s	0.77	
Discharge, cfs	0.20	
Theta, rad	0.050	
Froudes Number	0.41	
Flow type	subcritical	
Shear Stress, Lb/Sq.Ft	0.35	
Protective Lining	**Vegetated**	
Lining required	**TRM-435**	
D_{50}, inches		
Placement Thickness, inches		
Adjusted Mannings N	0.08	
Calculated Critical Slope,Sc ft/ft	0.19	
0.7 Sc, ft/ft	0.13	
1.3 Sc, ft/ft	0.24	
Stable Flow?	Stable	
Calculated Freeboard, ft	0.50	
Freeboard Provided, ft	0.64	**Freeboard Ok, Calculated<Provided**

PROJECT NAME:	**SWALE 2**	
LOCATION:	**TOWAMENSING TOWNSHIP, CARBON COUNTY PA**	
PREPARED BY:	**DATE:**	**10/12/2018**
CHECKED BY:	**DATE:**	**10/12/2018**

CHANNEL OR CHANNEL SECTION	SOLVE FOR FLOW DEPTH	
Temporary or Permanent (T or P)	P	
Required Capacity, Qr (cfs)	0.1	**See attached Rational Peak Flow Calculations**
Left side slope, %	33.33	
Right side slope, %	33.33	
Bottom width, ft	2	
Channel Depth provided, ft	0.7	
Channel bed slope, %	1	
Mannings N	0.12	
Accn. Due to gravity, ft/sec2	32.2	

DESIGN METHOD FOR LINING - SHEAR STRESS

CHECK FOR SHEAR STRESS		
H:V, left	3.00	
H:V, right	3.00	
bed slope, ft/ft	0.01	
Calculated channel flow depth, ft	0.14	
top width at flow depth, ft	2.84	
Bottom Width:Flow Depth Ratio	14.37	
wetted area, sq. ft	0.34	
wetted peri, ft	2.88	
hyd. Radius, ft	0.12	
velocity, ft/s	0.30	
Discharge, cfs	0.10	
Theta, rad	0.010	
Froudes Number	0.14	
Flow type	subcritical	
Shear Stress, Lb/Sq.Ft	0.09	
Protective Lining	**Vegetated**	
Lining required	**TRM-435**	
D_{50}, inches		
Placement Thickness, inches		
Adjusted Mannings N	0.13	
Calculated Critical Slope,Sc ft/ft	0.54	
0.7 Sc, ft/ft	0.38	
1.3 Sc, ft/ft	0.71	
Stable Flow?	Stable	
Calculated Freeboard, ft	0.50	
Freeboard Provided, ft	0.56	**Freeboard Ok, Calculated<Provided**

PENNEAST-BLUE MOUNTAIN SIDE VALVE
PROPOSED DRAINAGE PIPES CAPACITY ANALYSIS

Pipe ID	P#1	
Upstream Str	CS-1	
Downstream Str	HW-1	Basin
peak Discharge, cfs	1.97	100-Year Event Flow from Model
Pipe Diamater, in	15.00	
Manning's N	0.011	
% Slope	1.00	
diameter of pipe, d, ft	1.25	
wetted area, sf =	1.23	
wetted perimeter, P, ft =	3.93	
R =	0.31	
Slope, ft/ft =	0.01	
Full Flow Velocity, ft/s =	**6.24**	
Full Flow Q, cfs =	**7.65**	**Capacity Ok**

PENNEAST-BLUE MOUNTAIN SIDE VALVE
LEVEL SPREADER

From Pennsylvania Stormwater Best Management Manual Chapter 6.8.1 Design Consideration 7

Conventional level spreaders designed to diffuse all flow rates should be sized based on the following:

For grass or thick ground cover vegetation:

a) 13 linear feet of level spreader for every 1 cfs flow
b) Slopes of 8% or less from level spreader to toe of slope

For forested areas with little or no ground cover vegetation:

a) 100 linear feet of level spreader for every 1 cfs flow
b) Slopes of 6% or less from level spreader to toe of slope

10-YEAR DESIGN CALCULATIONS

Level Spreader ID	LS-1	
Level Spreader Discharge Type	Surface	
10-YR Peak Discharge, cfs	0.00	10-Year Basin Discharge from Model Hydrograph 11
DS Ground Cover	Forest	
Crest Elev.	701.25	
Design Criteria cfs/lf	100.0	
Calculated Crest Length, ft	0.0	
Design Crest Length, ft	**32**	
Weir Coefficient	3.33	Use sharp crested value to calculate higher velocity
Weir Head (H)	0.00	to be conservative.
Flow Area	0.00	
Velocity	0.00	
Velocity Non-Erosive	YES	

In accordance with Pennsylvania Stormwater Best Management Practices Manual - Chapter 6.8.1

100-YEAR DISCHARGE CHECK

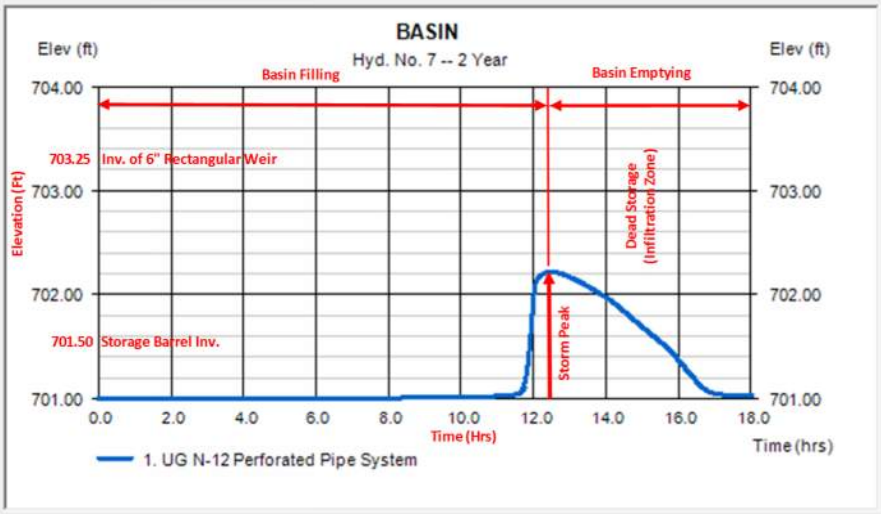
Level Spreader ID	LS-1	
Level Spreader Discharge Type	Surface	
100-YR Peak Discharge, cfs	1.97	Discharge Check
Crest Elev.	701.25	
Design Crest Length, ft	**32**	
Weir Coefficient	3.33	
Weir Head (H)	0.07	
Flow Area	2.24	
Velocity	0.88	Use sharp crested value to calculate higher velocity
Velocity Non-Erosive	YES	to be conservative.

In accordance with Pennsylvania Stormwater Best Management Practices Manual - Chapter 6.8.1

BLUE MOUNTAIN SIDE VALVE
BASIN DEWATERING TIME CALCULATIONS

BASIN NAME	UG-BASIN	
BMST-TP-1, IN/HR	6	
BMST-TP-2, IN/HR	4.875	
AVERAGE, IN/HR	5.44	
FOS	**2.00**	
DESIGN RATE, IN/HR	**2.72**	
INFILTRATION OF STORAGE VOLUME BELOW WEIR EL.		
BASIN INV. EL., FT	701.00	
PIPE INV. EL., FT	701.50	
TOP OF DEAD STORAGE EL., FT	703.25	
DEAD STORAGE DEPTH, IN	23.40	*VALUE ADJUSTED FOR 40% ROCK POROSITY*
DRAIN TIME (1)	**8.61**	*DRAIN TIME FOR DEAD STORAGE BELOW WEIR EL.*

1-Yr 2-Yr 3-Yr 5-Yr 10-Yr 25-Yr 50-Yr 100-Yr Show All



< > Default Scale < >

MxEl = 702.22 ft Time to Peak = 13.30 hrs Max Stor = 570 cuft

Time (hrs)	Elev (ft)
12.25	702.20
12.27	702.20
12.28	702.21
12.30	702.21
12.32	702.21
12.33	702.21
12.35	702.21
12.37	702.22
12.38	702.22
12.40	702.22
12.42	702.22
12.43	702.22
12.45	702.22
12.47	702.22
12.48	702.22
12.50	702.22
12.52	702.22
12.53	702.22
12.55	702.22
12.57	702.21
12.58	702.21
12.60	702.21
12.62	702.21
12.63	702.21

DRAIN TIME (2)	**0.00**	*DRAIN TIME FROM 2-YEAR STORM PEAK TO DEAD STORAGE ELEVATION*
TOTAL DRAIN TIME (1+2)	**8.61**	OK

Pond No. 1 - UG N-12 Perforated Pipe System

Pond Data

UG Chambers -Invert elev. = 701.50 ft, Rise x Span = 3.00 x 3.00 ft, Barrel Len = 50.00 ft, No. Barrels = 3, Slope = 0.25%, Headers = Yes
Encasement -Invert elev. = 701.00 ft, Width = 5.25 ft, Height = 4.50 ft, Voids = 40.00%

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	701.00	n/a	0	0
0.46	701.46	n/a	152	152
0.93	701.92	n/a	229	382
1.39	702.39	n/a	295	677
1.85	702.85	n/a	320	997
2.31	703.31	n/a	327	1,324
2.78	703.78	n/a	319	1,643
3.24	704.24	n/a	292	1,935
3.70	704.70	n/a	222	2,157
4.16	705.16	n/a	176	2,333
4.63	705.63	n/a	176	2,509

Lowest weir elevation

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 15.00	Inactive	0.00	0.00
Span (in)	= 15.00	4.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 701.00	704.39	0.00	0.00
Length (ft)	= 8.00	0.00	0.00	0.00
Slope (%)	= 1.00	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	Yes	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 4.00	0.50	0.00	0.00
Crest El. (ft)	= 704.50	703.25	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= Rect	Rect	---	---
Multi-Stage	= No	Yes	No	No

Exfil.(in/hr) = 2.500 (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).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	701.00	0.00	0.00	---	---	0.00	0.00	---	---	0.000	---	0.000
0.05	15	701.05	0.00	0.00	---	---	0.00	0.00	---	---	0.022	---	0.022
0.09	30	701.09	0.00	0.00	---	---	0.00	0.00	---	---	0.039	---	0.039
0.14	46	701.14	0.00	0.00	---	---	0.00	0.00	---	---	0.052	---	0.052
0.19	61	701.19	0.00	0.00	---	---	0.00	0.00	---	---	0.053	---	0.053
0.23	76	701.23	0.00	0.00	---	---	0.00	0.00	---	---	0.054	---	0.054
0.28	91	701.28	0.00	0.00	---	---	0.00	0.00	---	---	0.054	---	0.054
0.32	107	701.32	0.00	0.00	---	---	0.00	0.00	---	---	0.055	---	0.055
0.37	122	701.37	0.00	0.00	---	---	0.00	0.00	---	---	0.056	---	0.056
0.42	137	701.42	0.00	0.00	---	---	0.00	0.00	---	---	0.057	---	0.057
0.46	152	701.46	0.00	0.00	---	---	0.00	0.00	---	---	0.058	---	0.058
0.51	175	701.51	0.00	0.00	---	---	0.00	0.00	---	---	0.059	---	0.059
0.56	198	701.56	0.00	0.00	---	---	0.00	0.00	---	---	0.060	---	0.060
0.60	221	701.60	0.00	0.00	---	---	0.00	0.00	---	---	0.061	---	0.061
0.65	244	701.65	0.00	0.00	---	---	0.00	0.00	---	---	0.062	---	0.062
0.69	267	701.69	0.00	0.00	---	---	0.00	0.00	---	---	0.062	---	0.062
0.74	290	701.74	0.00	0.00	---	---	0.00	0.00	---	---	0.063	---	0.063
0.79	313	701.79	0.00	0.00	---	---	0.00	0.00	---	---	0.064	---	0.064
0.83	336	701.83	0.00	0.00	---	---	0.00	0.00	---	---	0.065	---	0.065
0.88	359	701.88	0.00	0.00	---	---	0.00	0.00	---	---	0.066	---	0.066
0.93	382	701.92	0.00	0.00	---	---	0.00	0.00	---	---	0.067	---	0.067
0.97	411	701.97	0.00	0.00	---	---	0.00	0.00	---	---	0.068	---	0.068
1.02	441	702.02	0.00	0.00	---	---	0.00	0.00	---	---	0.069	---	0.069
1.06	471	702.06	0.00	0.00	---	---	0.00	0.00	---	---	0.070	---	0.070
1.11	500	702.11	0.00	0.00	---	---	0.00	0.00	---	---	0.070	---	0.070
1.16	530	702.16	0.00	0.00	---	---	0.00	0.00	---	---	0.071	---	0.071
1.20	559	702.20	0.00	0.00	---	---	0.00	0.00	---	---	0.072	---	0.072
1.25	589	702.25	0.00	0.00	---	---	0.00	0.00	---	---	0.073	---	0.073
1.29	618	702.30	0.00	0.00	---	---	0.00	0.00	---	---	0.074	---	0.074
1.34	648	702.34	0.00	0.00	---	---	0.00	0.00	---	---	0.075	---	0.075
1.39	677	702.39	0.00	0.00	---	---	0.00	0.00	---	---	0.076	---	0.076
1.43	709	702.43	0.00	0.00	---	---	0.00	0.00	---	---	0.077	---	0.077

Continues on next page...

UG N-12 Perforated Pipe System

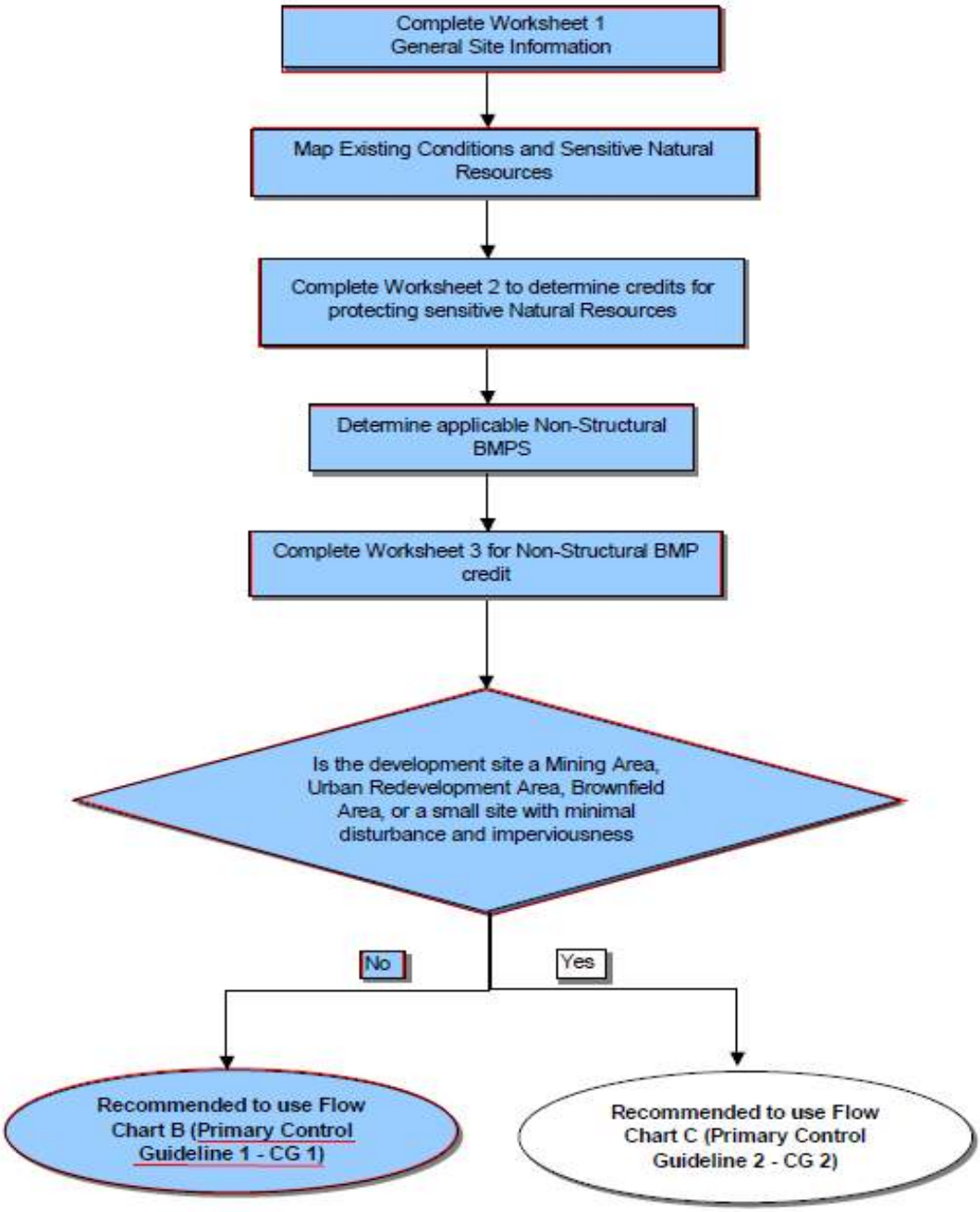
Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
1.48	741	702.48	0.00	0.00	---	---	0.00	0.00	---	---	0.078	---	0.078
1.53	773	702.53	0.00	0.00	---	---	0.00	0.00	---	---	0.078	---	0.078
1.57	805	702.57	0.00	0.00	---	---	0.00	0.00	---	---	0.079	---	0.079
1.62	837	702.62	0.00	0.00	---	---	0.00	0.00	---	---	0.080	---	0.080
1.66	869	702.67	0.00	0.00	---	---	0.00	0.00	---	---	0.081	---	0.081
1.71	901	702.71	0.00	0.00	---	---	0.00	0.00	---	---	0.082	---	0.082
1.76	933	702.76	0.00	0.00	---	---	0.00	0.00	---	---	0.083	---	0.083
1.80	965	702.80	0.00	0.00	---	---	0.00	0.00	---	---	0.084	---	0.084
1.85	997	702.85	0.00	0.00	---	---	0.00	0.00	---	---	0.085	---	0.085
1.90	1,030	702.90	0.00	0.00	---	---	0.00	0.00	---	---	0.086	---	0.086
1.94	1,063	702.94	0.00	0.00	---	---	0.00	0.00	---	---	0.086	---	0.086
1.99	1,095	702.99	0.00	0.00	---	---	0.00	0.00	---	---	0.087	---	0.087
2.04	1,128	703.03	0.00	0.00	---	---	0.00	0.00	---	---	0.088	---	0.088
2.08	1,161	703.08	0.00	0.00	---	---	0.00	0.00	---	---	0.089	---	0.089
2.13	1,193	703.13	0.00	0.00	---	---	0.00	0.00	---	---	0.090	---	0.090
2.17	1,226	703.17	0.00	0.00	---	---	0.00	0.00	---	---	0.091	---	0.091
2.22	1,259	703.22	0.00	0.00	---	---	0.00	0.00	---	---	0.092	---	0.092
2.27	1,291	703.27	0.00 ic	0.00	---	---	0.00	0.00	---	---	0.093	---	0.096
2.31	1,324	703.31	0.03 ic	0.00	---	---	0.00	0.03	---	---	0.094	---	0.120
2.36	1,356	703.36	0.06 ic	0.00	---	---	0.00	0.06	---	---	0.094	---	0.154
2.40	1,388	703.41	0.11 ic	0.00	---	---	0.00	0.10	---	---	0.095	---	0.197
2.45	1,420	703.45	0.15 ic	0.00	---	---	0.00	0.15	---	---	0.096	---	0.247
2.50	1,452	703.50	0.21 ic	0.00	---	---	0.00	0.21	---	---	0.097	---	0.302
2.54	1,483	703.54	0.27 oc	0.00	---	---	0.00	0.27	---	---	0.098	---	0.363
2.59	1,515	703.59	0.34 oc	0.00	---	---	0.00	0.33	---	---	0.099	---	0.429
2.64	1,547	703.64	0.40 oc	0.00	---	---	0.00	0.40	---	---	0.100	---	0.500
2.68	1,579	703.68	0.49 oc	0.00	---	---	0.00	0.47	---	---	0.101	---	0.574
2.73	1,611	703.73	0.56 oc	0.00	---	---	0.00	0.55	---	---	0.102	---	0.653
2.78	1,643	703.78	0.64 oc	0.00	---	---	0.00	0.63	---	---	0.102	---	0.736
2.82	1,672	703.82	0.72 oc	0.00	---	---	0.00	0.72	---	---	0.103	---	0.822
2.87	1,701	703.87	0.81 oc	0.00	---	---	0.00	0.81	---	---	0.104	---	0.912
2.91	1,730	703.91	0.92 oc	0.00	---	---	0.00	0.90	---	---	0.105	---	1.006
2.96	1,760	703.96	1.01 oc	0.00	---	---	0.00	1.00	---	---	0.106	---	1.102
3.01	1,789	704.01	1.10 oc	0.00	---	---	0.00	1.10	---	---	0.107	---	1.202
3.05	1,818	704.05	1.21 oc	0.00	---	---	0.00	1.20	---	---	0.108	---	1.305
3.10	1,847	704.10	1.32 oc	0.00	---	---	0.00	1.30	---	---	0.109	---	1.411
3.15	1,877	704.15	1.42 oc	0.00	---	---	0.00	1.41	---	---	0.109	---	1.520
3.19	1,906	704.19	1.52 oc	0.00	---	---	0.00	1.52	---	---	0.110	---	1.631
3.24	1,935	704.24	1.64 oc	0.00	---	---	0.00	1.63	---	---	0.111	---	1.745
3.28	1,957	704.28	1.76 oc	0.00	---	---	0.00	1.75	---	---	0.112	---	1.862
3.33	1,979	704.33	1.88 oc	0.00	---	---	0.00	1.87	---	---	0.113	---	1.982
3.38	2,001	704.38	2.00 oc	0.00	---	---	0.00	1.99	---	---	0.114	---	2.104
3.42	2,024	704.42	2.12 oc	0.00	---	---	0.00	2.11	---	---	0.115	---	2.229
3.47	2,046	704.47	2.24 oc	0.00	---	---	0.00	2.24	---	---	0.116	---	2.356
3.52	2,068	704.52	2.37 oc	0.00	---	---	0.02	2.37	---	---	0.117	---	2.510
3.56	2,090	704.56	2.50 oc	0.00	---	---	0.20	2.50	---	---	0.117	---	2.820
3.61	2,112	704.61	2.63 oc	0.00	---	---	0.47	2.63	---	---	0.118	---	3.222
3.65	2,134	704.65	2.77 oc	0.00	---	---	0.80	2.77	---	---	0.119	---	3.693
3.70	2,157	704.70	2.91 oc	0.00	---	---	1.19	2.91	---	---	0.120	---	4.219
3.75	2,174	704.75	3.05 oc	0.00	---	---	1.63	3.05	---	---	0.121	---	4.796
3.79	2,192	704.79	3.19 oc	0.00	---	---	2.11	3.19	---	---	0.122	---	5.419
3.84	2,209	704.84	3.34 oc	0.00	---	---	2.63	3.33	---	---	0.123	---	6.084
3.89	2,227	704.89	3.48 oc	0.00	---	---	3.18	3.48	---	---	0.124	---	6.788
3.93	2,245	704.93	3.63 oc	0.00	---	---	3.77	3.63	---	---	0.125	---	7.528
3.98	2,262	704.98	3.78 oc	0.00	---	---	4.40	3.78	---	---	0.125	---	8.303
4.02	2,280	705.02	3.93 oc	0.00	---	---	5.05	3.93	---	---	0.126	---	9.110
4.07	2,298	705.07	4.09 oc	0.00	---	---	5.73	4.09	---	---	0.127	---	9.950
4.12	2,315	705.12	4.25 oc	0.00	---	---	6.45	4.25	---	---	0.128	---	10.82
4.16	2,333	705.16	4.40 oc	0.00	---	---	7.18	4.40	---	---	0.129	---	11.71
4.21	2,351	705.21	4.56 oc	0.00	---	---	7.95	4.56	---	---	0.130	---	12.64
4.26	2,368	705.26	4.73 oc	0.00	---	---	8.74	4.73	---	---	0.131	---	13.60
4.30	2,386	705.30	4.89 oc	0.00	---	---	9.55	4.89	---	---	0.132	---	14.58
4.35	2,403	705.35	5.06 oc	0.00	---	---	10.39	5.06	---	---	0.133	---	15.58
4.39	2,421	705.39	5.23 oc	0.00	---	---	11.26	5.23	---	---	0.133	---	16.62
4.44	2,439	705.44	5.40 oc	0.00	---	---	12.14	5.40	---	---	0.134	---	17.67
4.49	2,456	705.49	5.57 oc	0.00	---	---	13.05	5.57	---	---	0.135	---	18.75
4.53	2,474	705.53	5.74 oc	0.00	---	---	13.98	5.74	---	---	0.136	---	19.85
4.58	2,492	705.58	5.92 oc	0.00	---	---	14.93	5.92	---	---	0.137	---	20.98
4.63	2,509	705.63	6.09 oc	0.00	---	---	15.89	6.09	---	---	0.138	---	22.13

Storage under lowest weir elevation

...End

C. BMP Worksheets


Complete Worksheet 1
General Site Information
Map Existing Conditions and Sensitive Natural Resources
Complete Worksheet 2 to determine credits for protecting sensitive Natural Resources
Determine applicable Non-Structural BMPS
Complete Worksheet 3 for Non-Structural BMP credit
Is the development site a Mining Area, Urban Redevelopment Area, Brownfield Area, or a small site with minimal disturbance and imperviousness
No
Yes
Recommended to use Flow Chart B (Primary Control Guideline 1 - CG 1)
Recommended to use Flow Chart C (Primary Control Guideline 2 - CG 2)

Worksheet 1. General Site Information

Date: 5/30/2018

Project Name: PennEast Pipeline - Blue Mountain Side Valve

Municipality: Lower Towamesing

County: Carbon

Total Area (acres): 0.61

Major River Basin: Delaware

http://www.dep.state.pa.us/dep/deputate/watermgt/wc/default.htm - newtopics

Watershed: Lehigh River

Sub-Basin: Lehigh

Nearest Surface Water(s) to Receive Runoff: Aquashicola Creek

Chapter 93 - Designated Water Use: HQ-CWF, MF

http://www.pacode.com/secure/data/025/chapter93/chap93toc.html

Impaired according to Chapter 303(d) List ? Yes ☐
http://www.dep.state.pa.us/dep/deputate/watermgt/wqp/wqstandards/303d-Repc No ☑

List Causes of Impairment:

Is project subject to, or part of:

Municipal Separate Storm Sewer System (MS4) Requirements? Yes ☐ No ☑

http://www.dep.state.pa.us/dep/deputate/watermgt/wc/Subjects/StormwaterManagement/GeneralPermits/default.htm

Existing or planned drinking water supply? Yes ☐ No ☑

If yes, distance from proposed discharge (miles):

Approved Act 167 Plan? Yes ☐ No ☑

http://www.dep.state.pa.us/dep/deputate/watermgt/wc/Subjects/StormwaterManagement/Approved_1.html

Existing River Conservation Plan? Yes ☐ No ☑

http://www.dcnr.state.pa.us/cs/groups/public/documents/document/d_001448.pdf

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.

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

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

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	no	0.00	
Floodplains	no	0.00	
Riparian Areas	no	0.00	
Wetlands	no	0.00	
Woodlands	no	0.00	
Natural Drainage Ways	no	0.00	
Steep Slopes, 15%-25%	no	0.00	
Steep Slopes, over 25%	no	0.00	
Other:	no	0.00	
Other:	no	0.00	
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 Ac.

1.3 Area of Minimum Disturbance/Reduced Grading Ac.

TOTAL 0.00 Ac.

Site Area	*minus*	Protected Area	=	Stormwater Management Area
0.61	-	0.00	=	0.61

VOLUME CREDITS

3.1 Minimum Soil Compaction

Lawn sq. ft x 1/4" x 1/12 = 0 cubic ft

Meadow sq. ft x 1/3" x 1/12 = 0 cubic ft

3.3 Protect Existing Trees

For Trees within 100 feet of impervious area:

Tree Canopy sq. ft x 1/2" x 1/12 = 0 cubic ft

For Trees within 20 feet of impervious area:

Tree Canopy sq. ft x 1" x 1/12 = 0 cubic ft

5.1 Disconnect Roof Leaders to Vegetated Areas

For runoff directed to areas protected under 5.8.1 and 5.8.2

Roof Area sq. ft x 1/3" x 1/12 = 0 cubic ft

For all other disconnected roof areas

Roof Area sq. ft x 1/4" x 1/12 = 0 cubic ft

5.2 Disconnect Non-Roof Impervious to Vegetated Areas

For runoff directed to areas protected under 5.8.1 and 5.8.2

Impervious Area sq. ft x 1/3" x 1/12 = 0 cubic ft

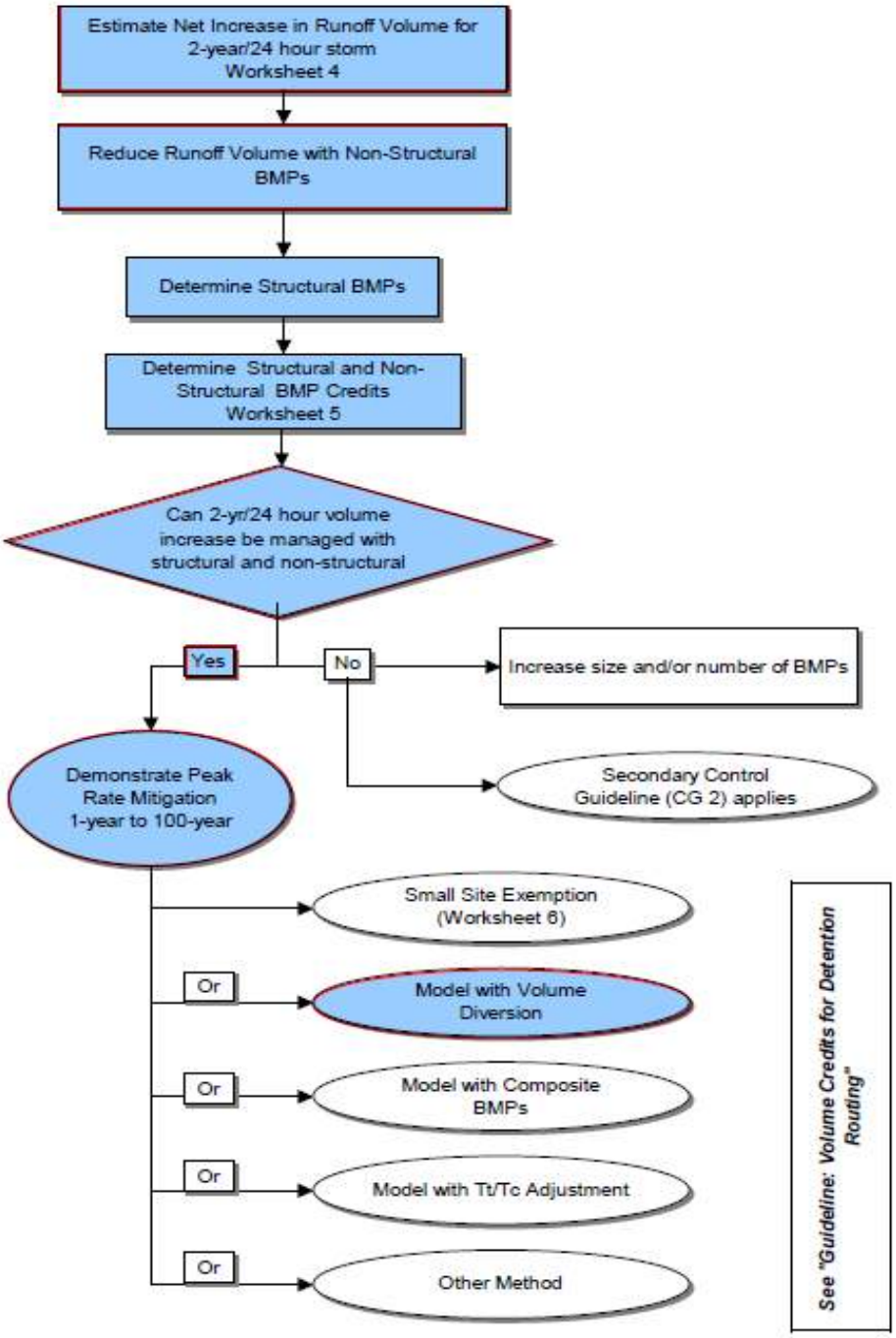
For all other disconnected areas

Impervious Area sq. ft x 1/4" x 1/12 = 0 cubic ft

TOTAL NON-STRUCTURAL VOLUME CREDIT* 0 cubic ft

* For use on Worksheet 5

FLOW CHART B
Control Guideline 1 Process



Worksheet 4. Change in Runoff Volume for 1-Yr Storm Event

PROJECT: PennEast Pipeline - Blue Mountain Side Valve
Drainage Area: 0.61 acres
1-Year Rainfall: 2.63 in

Total Site Area: 0.41 acres
Protected Site Area: 0.00 acres
Managed Area: 0.36 acres

Existing Conditions:

Cover Type/ Condition	Soil Type	Area (sf)	Area (ac)	CN	S	Ia (0.2*S)	Q Runoff (in)	Runoff Volume (cubic ft)
Woods	McD	26,535	0.61	70	4.29	0.86	0.52	1,147
TOTAL:		**26,535**	**0.61**				**0.52**	**1,147**

Developed Conditions:

Cover Type/ Condition	Soil Type	Area (sf)	Area (ac)	CN	S	Ia (0.2*S)	Q Runoff (in)	Runoff Volume (cubic ft)
Gravel	McD	869	0.02	89	1.24	0.25	1.57	114
Impervious/Gravel	McD	2,251	0.05	98	0.20	0.04	2.40	450
Meadow	McD	23,415	0.54	71	4.08	0.82	0.56	1,088
TOTAL:		**26,535**	**0.61**				**4.53**	**1,651**

1-Year Volume Increase (cubic ft): 504

1-Year Volume Increase = Developed Conditions Runoff Volume - Existing Conditions Runoff Volume

1. Runoff (in) = Q = (P - 0.2S)^2 / (P + 0.8S) where

P = 1-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 HSG.
The use of a weighted CN value for volume calculations is not acceptable.

Note: The existing runoff volume caclulation differs from the modeled volume because the existing infiltration facility is taken into account.

Worksheet 4. Change in Runoff Volume for 2-Yr Storm Event

PROJECT: PennEast Pipeline - Blue Mountain Side Valve
Drainage Area: 0.61 acres
2-Year Rainfall: 3.15 in

Total Site Area: 0.41 acres
Protected Site Area: 0.00 acres
Managed Area: 0.36 acres

Existing Conditions:

Cover Type/ Condition	Soil Type	Area (sf)	Area (ac)	CN	S	Ia (0.2*S)	Q Runoff (in)	Runoff Volume (cubic ft)
Woods	McD	26,535	0.61	70	4.29	0.86	0.80	1,767
TOTAL:		**26,535**	**0.61**				**0.80**	**1,767**

Developed Conditions:

Cover Type/ Condition	Soil Type	Area (sf)	Area (ac)	CN	S	Ia (0.2*S)	Q Runoff (in)	Runoff Volume (cubic ft)
Gravel	McD	869	0.02	89	1.24	0.25	2.04	147
Impervious/Gravel	McD	2,251	0.05	98	0.20	0.04	2.92	547
Meadow	McD	23,415	0.54	71	4.08	0.82	0.85	1,655
TOTAL:		**26,535**	**0.61**				**5.80**	**2,350**

2-Year Volume Increase (cubic ft): 583

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 = 1-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 HSG.
The use of a weighted CN value for volume calculations is not acceptable.

Note: The existing runoff volume caclulation differs from the modeled volume because the existing infiltration facility is taken into account.

Worksheet 5. Structural BMP Volume Credits

PROJECT: PennEast Pipeline - Blue Mountain Side Valve
SUB-BASIN: Lehigh

Required Control Volume (cubic ft) - from Worksheet 4: 583
Non-structural Volume Credit (cubic ft) - from Worksheet 3: - 0

Structural Volume Requirement (cubic ft) 583
(Required Control Volume minus Non-structural Credit)

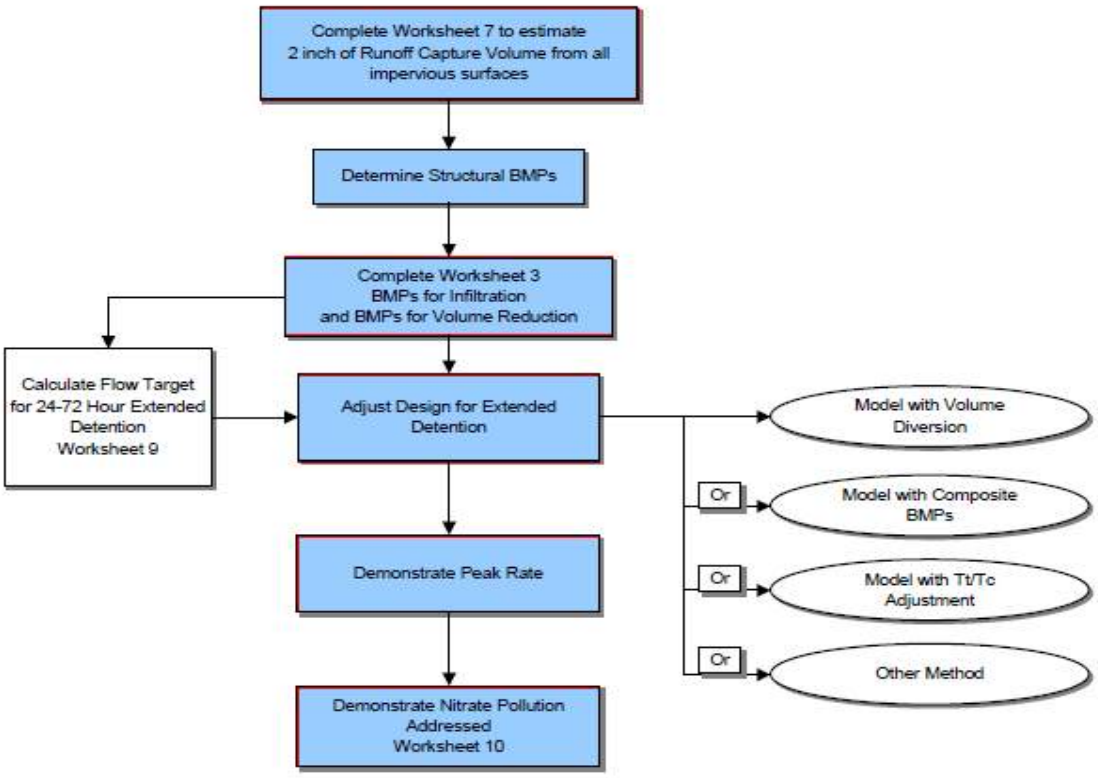
Proposed BMP		Area (sq. ft)	Storage Volume (cubic ft)
6.4.1	Porous Pavement		
6.4.2	Infiltration Basin	969	1,324
6.4.3	Infiltration Bed		
6.4.4	Infiltration Trench		
6.4.5	Rain Garden / Bioretention		
6.4.6	Dry Well / Seepage Pit		
6.4.7	Constructed Filter		
6.4.8	Vegetated Swale		
6.4.9	Vegetated Filter Strip		
6.4.10	Berm		
6.5.1	Vegetated Roof		
6.5.2	Capture and Re-use		
6.6.1	Constructed Wetlands		
6.6.2	Wet Pond / Retention Basin		
6.6.3	Dry Extended Detention Basin		
6.6.4	Water Quality Filters		
6.7.1	Riparian 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 (cubic ft): 1,324

Structural Volume Requirement (cubic ft): 583

DIFFERENCE 741 cubic ft

FLOW CHART C
Control Guideline 2 Process



Since the Act 167 Plan requires complinace with CG1 and CG2 Flow Chart C and Worksheets 7 and 8 have been included.

Worksheet 7. Calculation of Runoff Volume (PRV and EDV) for CG-2 Only

PROJECT: PennEast Pipeline - Blue Mountain Side Valve
DRAINAGE AREA: 0.61

Total Site Area: 0.41 acres
Protected Site Area: 0.00 acres
Managed Area: 0.36 acres
Total Impervious Area: 0.05 acres

2 Inch Runoff - Multiply Total Impervious Area by 2 inch

Cover Type	Area (ac)	Runoff Capture Volume (cubic ft)
Roof	0.00	0
Pavement	0.05	378
Other Impervious	0.00	0
TOTAL:	0.05	378

1 Inch Rainfall -

Cover Type	Area (square ft)	Area (ac)	Runoff (in)	Runoff Volumes (cubic ft)
Impervious/Gravel	2,251	0.05	0.79	148
Gravel	869	0.02	0.28	21
Meadow	14,543	0.33	0.01	10
TOTAL:	17,663	0.41		179

1. Total Runoff Capture Volume (cu ft) = Total Impervious Area (sq ft x 2 inch x 1/12

2. PRV (cu ft) = Total Impervious Area (sq ft) x 1 inch x 1/12

3. EDV (cu ft) = Total Area (sq ft) x 1 inch x 1/12

Water quality volume requirements for land areas with existing cover consisting of meadow, brush, wood-grass combination, or woods proposed for conversion to any other non-equivalent type of pervious cover shall be sized for one-half (1/2) the volume required for impervious surfaces as mentioned in this worksheet and calculated in items 1 through 3 above

Worksheet 8. Structural BMP Volume Credits

PROJECT: PennEast Pipeline - Blue Mountain Side Valve
SUB-BASIN: Lehigh

Required Control Volume (cubic ft) - *from Worksheet 7:*		378
Non-structural Volume Credit (cubic ft) - *from Worksheet 3:*	-	0
Structural Volume Reqmt (cubic ft) *(Required Control Volume minus Non-structural Credit)*		378

	Proposed BMP*	Area (square ft)	Storage Volume (cubic ft)
6.4.1	Porous Pavement		
6.4.2	Infiltration Basin	969	1259
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		
6.5.1	Vegetated Roof		
6.5.2	Capture and Re-use		
6.6.1	Constructed Wetlands		
6.6.2	Wet Pond / Retention Basin		
6.6.3	Dry Extended Detention Basin		
6.6.4	Water Quality Filters		
6.7.1	Riparian 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			

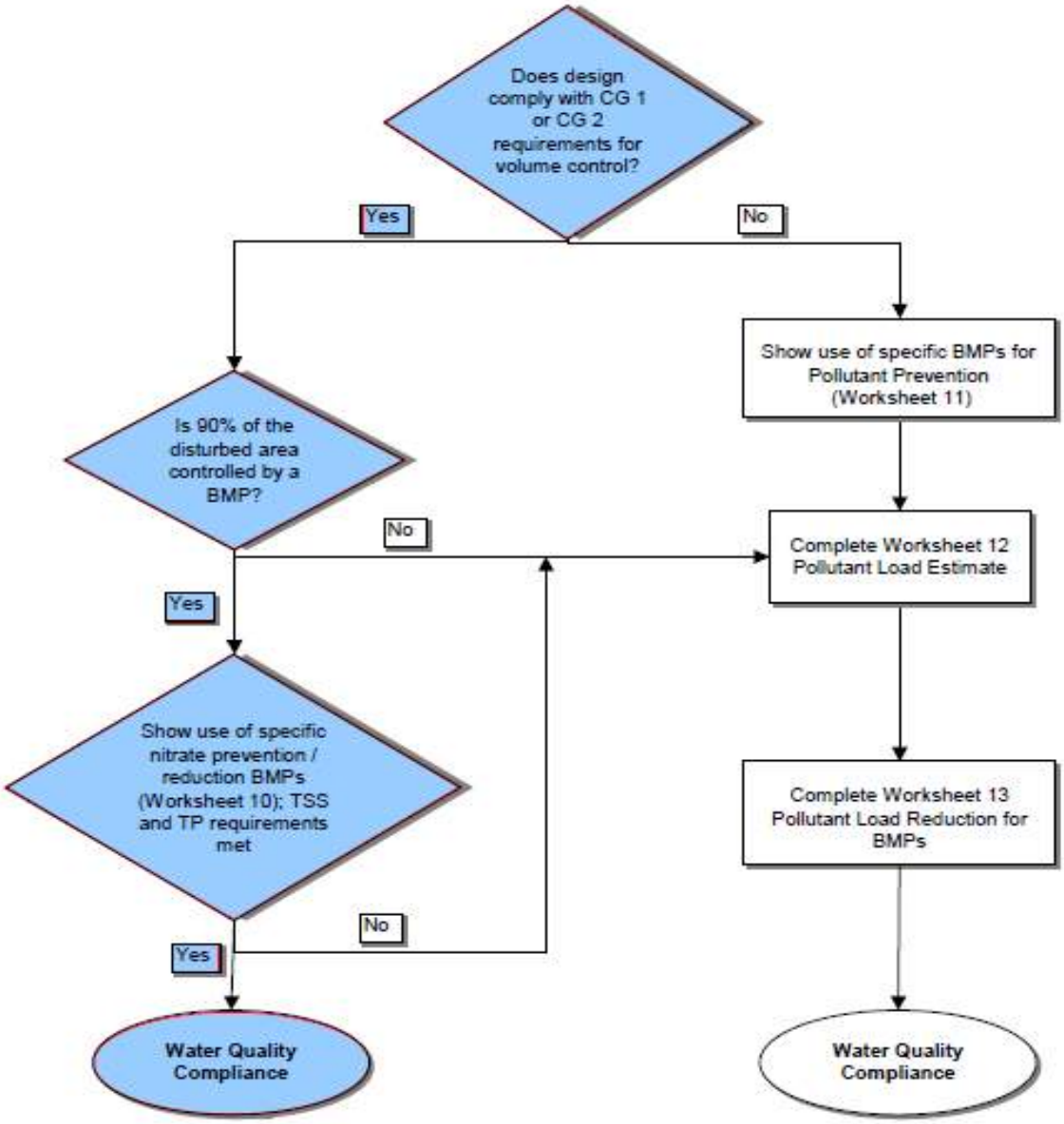
Total Structural Volume (cubic ft): 1259

Structural Volume Requirement (cubic ft): 378

DIFFERENCE 881

Flow Chart D

Water Quality Process



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 1 primary and 2 secondary).

PRIMARY BMPs FOR NITRATE:

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

SECONDARY BMPs FOR NITRATE:

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

D. Soil Report

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Carbon County, Pennsylvania

Blue Mountain Side Tap

May 31, 2018

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require

alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map

Map Scale: 1:270 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 4 8 16 24

Feet: 0 10 20 40 60

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 1:20,000.

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

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

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

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

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

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

Soil Survey Area: Carbon County, Pennsylvania
Survey Area Data: Version 15, Oct 3, 2017

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

Date(s) aerial images were photographed: Sep 20, 2010—Aug 28, 2016

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
McD	Meckesville very stony loam, 8 to 25 percent slopes	0.2	100.0%
Totals for Area of Interest		**0.2**	**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.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Carbon County, Pennsylvania

McD—Meckesville very stony loam, 8 to 25 percent slopes

Map Unit Setting

National map unit symbol: l387
Elevation: 600 to 2,800 feet
Mean annual precipitation: 34 to 48 inches
Mean annual air temperature: 46 to 55 degrees F
Frost-free period: 130 to 190 days
Farmland classification: Not prime farmland

Map Unit Composition

Meckesville and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Meckesville

Setting

Landform: Mountain valleys
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Lower third of mountainflank
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Sandstone, siltstone and shale colluvium derived from sedimentary rock

Typical profile

H1 - 0 to 9 inches: very stony loam
H2 - 9 to 36 inches: gravelly loam
H3 - 36 to 60 inches: very cobbly loam

Properties and qualities

Slope: 8 to 25 percent
Percent of area covered with surface fragments: 1.6 percent
Depth to restrictive feature: 25 to 48 inches to fragipan
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: C
Hydric soil rating: No

References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

National Research Council. 1995. Wetlands: Characteristics and boundaries.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577

Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580

Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.

United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374

United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf

E. Existing Conditions Drainage Area Map

Legend

- WO - Woods
- Soils
- Limit of Disturbance
- 2ft Contours
- 10ft Contours
- Tc Path

0 12.5 25 50 Feet

N W E S

BLUE MOUNTAIN SIDE VALVE
EXISTING CONDITIONS
DRAINAGE AREA MAP

F. Proposed Conditions Drainage Area Map

SITE-BYPASS

OFFSITE-BYPASS

SITE-BASIN

McD

OFFSITE-BASIN

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Legend

DA

- WO - Woods
- MEAD - Meadow
- IMP/GRAVEL - Impervious Gravel
- GRAVEL - Pervious Gravel

- Soils
- Limit of Disturbance
- 2ft Contours
- 10ft Contours
- Tc Path

0 12.5 25 50 Feet

N W E S

BLUE MOUNTAIN SIDE VALVE PROPOSED CONDITIONS DRAINAGE AREA MAP

Map Document: (P:\353754 PennEast\Stormwater\Blue Mountain Side Tap\GIS\Projects\PR_DA_Map.mxd) 6/13/2018 11:47:26 AM zhi76919

Legend

- Tc Path
- Swale Drainage Area

DA

- WO - Woods
- MEAD - Meadow
- IMP/GRAVEL - Impervious Gravel
- GRAVEL - Pervious Gravel
- Soils
- Limit of Disturbance
- 2ft Contours
- 10ft Contours

0 12.5 25 50 Feet

N W E S

BLUE MOUNTAIN SIDE VALVE SWALE DRAINAGE AREA MAP

Map Document: (\\mil-data.hmmg.cc\Projects-ine\353754 PennEast\Stormwater\Blue Mountain Side Tap\GIS\Projects\Swale_DA_Map.mxd) 6/11/2018 2:31:10 PM zhi76919

G. Infiltration Memo

MOTT MACDONALD

Technical Note

Project:	PennEast Pipeline Project		
Our reference:	353754-GT-SW-08	**Your reference:**	353754-GT-SW-08
Prepared by:	E. Vigliorolo, EIT	**Date:**	May 31, 2018
Approved by:	V. Shah, PE, PhD	**Checked by:**	E. Pauli, EIT
Subject:	Test Pit and Infiltration Testing – Blue Mountain Side Tap		

1 Introduction

This technical note addresses the geotechnical considerations regarding the suitability of native soils for stormwater management design of the Blue Mountain Side Tap located in Lower Towamensing Township, Carbon County, Pennsylvania (site). The subsurface investigation consisting of two test pits, BMST-TP1 and BMST-TP2, was conducted by Craig Test Boring Co., Inc. of Mays Landing, New Jersey on May 25, 2018. Infiltration testing using double-ring infiltrometers was subsequently performed within each test pit. A Locus Map depicting the area of our investigation is provided in Attachment A.

2 Subsurface Investigation and Infiltration Testing Results

Given the presence of suitable soils and absence of competent bedrock within testing zones, all infiltration tests were performed using a double-ring infiltrometer. The double-ring infiltrometer was placed on level ground within the excavated test pits, and driven a minimum of two inches below the excavated surface. Two 30-minute presoak periods were conducted prior to the start of infiltration testing. Both the outer and inner ring were filled with four inches of water, beginning with the outer ring. The drop in the water level during the second 30-minute presoaking period was utilized to determine the timed intervals to be used during testing. The timed interval between readings was determined based on the following criteria:

- If water level drop is two inches or more, 10-minute intervals were used for recording measurements.
- If water level drop is less than two inches, 30-minute intervals were used for recording measurements.

After each reading, both rings were refilled with water to the four-inch level in an iterative manner. Water level depths at the determined timed interval were recorded until a minimum of eight readings were completed, or a stabilized rate of drop was obtained, whichever occurred first. A stabilized rate of drop is defined a maximum difference of 0.25 inches between the highest and lowest readings of four consecutive measurements. The drop that occurs in the center ring during the final period or the average stabilized rate is expressed in inches per hour and represents the infiltration rate for that test location. At the completion of

the infiltration test, each test pit was excavated an additional two feet to observe the subsurface conditions below the test depth. The test pit and infiltration test results are summarized below.

BMST-TP1

Test pit BMST-TP1 was excavated to 5.5 feet below existing grade on May 25, 2018. Two infiltration tests were performed at 3.5 feet below existing grade within this test pit. Both the first and second tests yielded an infiltration rate of 6.0 inches per hour (in/hr). In accordance with the Pennsylvania Stormwater Best Management Practices Manual (PA BMP), a factor of safety of 2.0 is recommended in relation to soils at this location. Therefore, the recommended design infiltration rate is 3.0 in/hr.

The general description of the soil profile observed within the excavated test pits are as follows:

- **0 – 12 inches**: Topsoil with tree roots, dry
- **12 – 30 inches**: Light brown Clay, some fine sand, dry
- **30 – 66 inches**: Dark brown Silt, few boulders, some coarse gravel, dry

No evidence of groundwater or mottling were observed within this test pit.

BMST-TP2

Test pit BMST-TP2 was also excavated to 5.5 feet below existing grade on May 25, 2018. Two infiltration tests were performed at 3.5 feet below existing grade within this test pit. The first test yielded an infiltration rate of 6.0 in/hr, and the second test yielded an infiltration rate of 3.75 in/hr. It is recommended that an average infiltration rate of 4.9 in/hr be considered at this location. In accordance with the PA BMP, a factor of safety of 2.0 is recommended in relation to soils at this location. Therefore, the recommended design infiltration rate is 2.45 in/hr.

The general description of the soil profile observed within the excavated test pits are as follows:

- **0 – 12 inches**: Topsoil with tree roots, dry
- **12 – 40 inches**: Light brown Clay, few boulders, trace fine sand, dry
- **40 – 66 inches**: Dark brown Silt, few boulders, some coarse gravel, trace clay, dry

No evidence of groundwater or mottling were observed within this test pit.

Table 1- Infiltration Test Result

Test Pit No.	Existing Grade El. (feet)	Infiltration Test El. (feet)	Infiltration Test Results (Average) (in/hr)	Recommended Safety Factor	Recommended Design Infiltration Rate (in/hr)
BMST-TP1	705.2	701.7	6.0	2.0	3.0
BMST-TP2	704.5	701	4.9	2.0	2.45

Based on the existing subsurface conditions encountered in the test pits, it is recommended that the lower of the design infiltration rates (2.45 in/hr) should be considered for design purposes.

Mott MacDonald notes that infiltration rates observed during our investigation are dependent on the subsurface conditions encountered within each test pit. Test locations which resulted in low infiltration rates consisted of predominately low permeable soils such as silt and clay, whereas those with higher infiltration rates consisted of more permeable soils such as sand, gravel, and cobbles. The test pit logs and infiltration test forms are provided in Attachment B.

Pennsylvania Stormwater Best Management Practices Manual. Department of Environmental Protection. Bureau of Watershed Management. December 30, 2006 was utilized as a reference for this scope of work.

Attachments:

- Attachment A – Locus Map
- Attachment B – Test Pit Logs and Infiltration Test Forms

Appendices

A. Locus Map

NAME	NORTHING	EASTING	ELEVATION (ft)
BMST-TP1	14825560.66	1503277.2	705.2
BMST-TP2	14825566.91	1503319.89	704.5

NOTES:
1. SCALE IS APPROXIMATE
2. GOOGLE EARTH AERIAL IMAGERY DATED 04/17/2017

1500 0 1500 3000
SCALE IN FEET

MOTT MACDONALD
Certificate No. 24GA28016600
111 Wood Avenue South
Iselin, New Jersey 08830-4112

PENNEAST PIPELINE PROJECT
BLUE MOUNTAIN SIDE TAP
CARBON COUNTY, PA

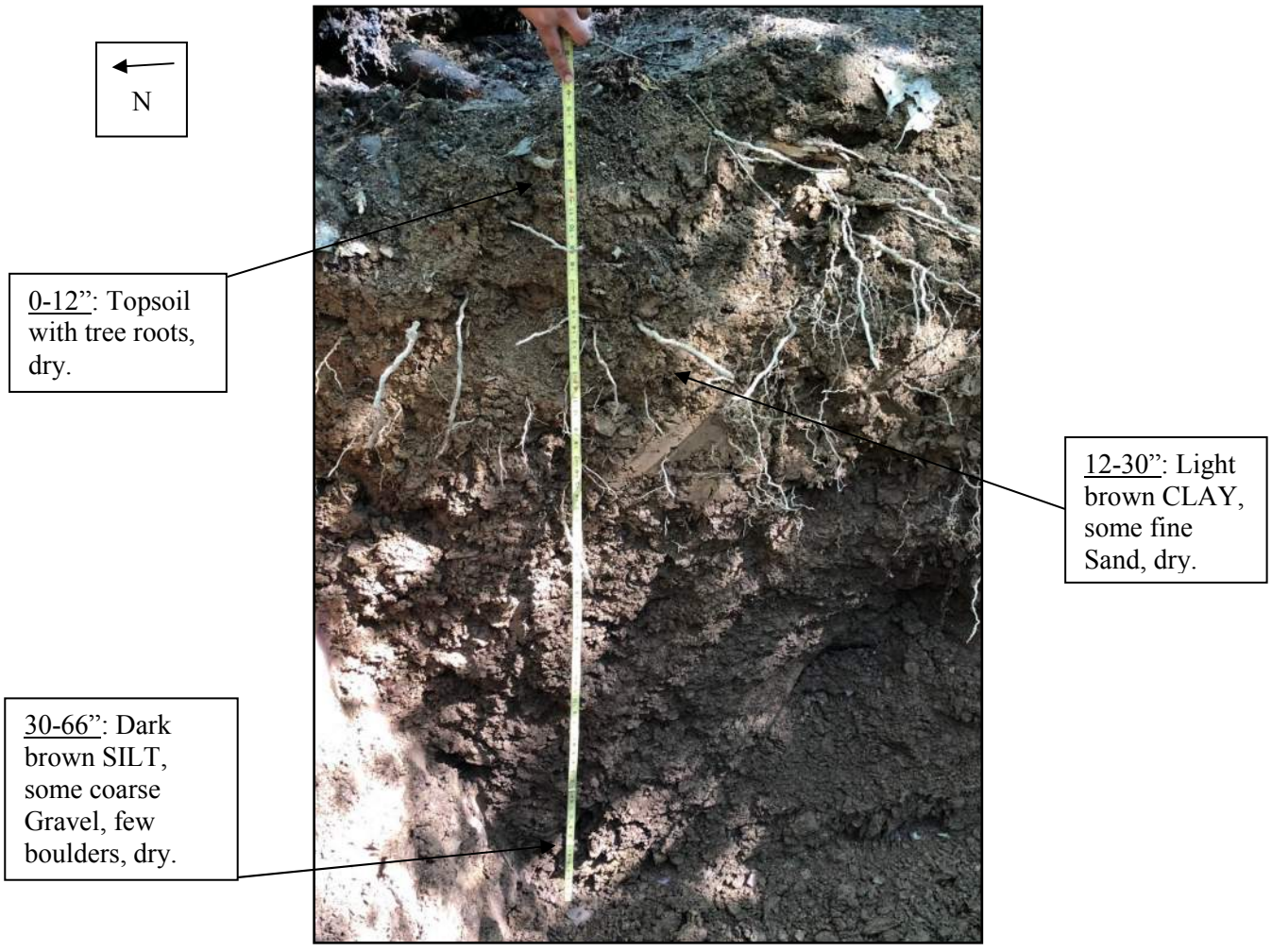
Designed	Drawn	Checked	Approved	Date
EAV	EAV	EWP	TR	05-30-2018

B. Test Pit Logs and Infiltration Test Forms

MOTT MACDONALD

TEST PIT LOG

SITE LOCATION	Blue Mountain Side Tap (BMST)	**TEST PIT NUMBER**	**BMST-TP1**
PROJECT NUMBER	353754	**MOTT MACDONALD REPRESENTATIVE**	V. Vijayashanthar
GENERAL LOCATION	Lower Towamensing Township, PA	**CONTRACTOR**	Craig Test Boring Co. Inc.
TIME OPENED	12:15 PM	**TIME CLOSED**	3:50 PM
DEPTH TO WATER (Feet BGS)	Not encountered	**EQUIPMENT**	Kubota KX057-4
TESTING DEPTH (Feet BGS)	3.5	**FINAL EXCAVATION DEPTH (Feet BGS)**	5.5
DATE	5/25/2018		

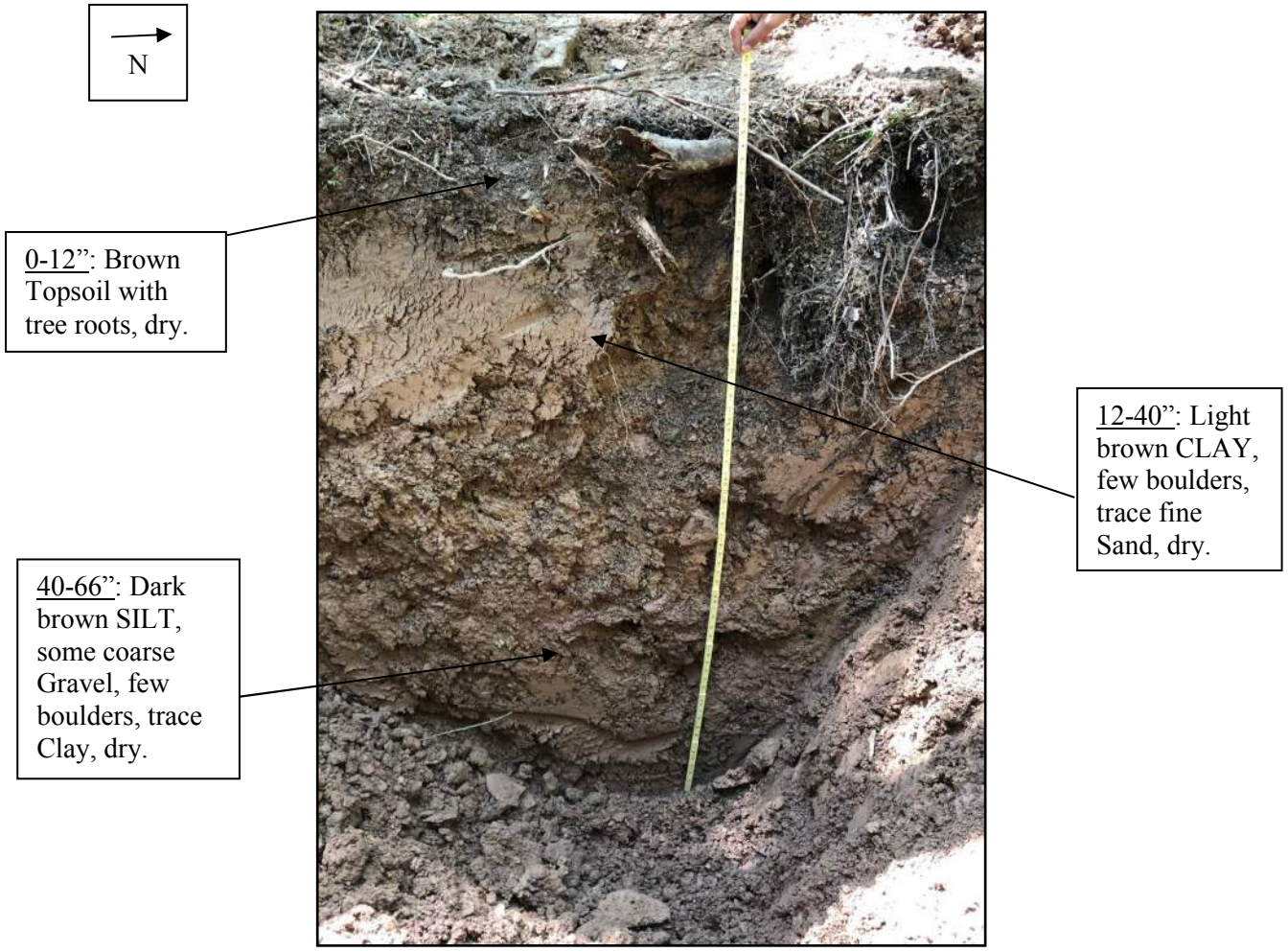


Note: All classifications and descriptions in this log are solely based on visual field observations. They were developed to generally characterize soils for environmental purposes only. They are not to be relied for any other purpose.

MOTT MACDONALD

TEST PIT LOG

SITE LOCATION	Blue Mountain Side Tap (BMST)	**TEST PIT NUMBER**	**BMST-TP2**
PROJECT NUMBER	353754	**MOTT MACDONALD REPRESENTATIVE**	V. Vijayashanthar
GENERAL LOCATION	Lower Towamensing Township, PA	**CONTRACTOR**	Craig Test Boring Co. Inc.
TIME OPENED	11:00 AM	**TIME CLOSED**	2:15 PM
DEPTH TO WATER (Feet BGS)	Not encountered	**EQUIPMENT**	Kubota KX057-4
TESTING DEPTH (Feet BGS)	3.5	**FINAL EXCAVATION DEPTH (Feet BGS)**	5.5
DATE	5/25/2018		



Note: All classifications and descriptions in this log are solely based on visual field observations. They were developed to generally characterize soils for environmental purposes only. They are not to be relied for any other purpose.

MOTT MACDONALD **M M**

Infiltration Test Form

Geotechnical Investigation:

- Project Name: Penn East Pipeline
- Date: 5/25/18
- Job Number: 363754
- Site Location: Blue Mountain
- Contractor: Craig (Hammel)
- Weather/Temp: 80° / Sunny
- Infiltration Test ID: BMST-TP2
- Report by: V Vijayashanther
- Testing Depth: 3.5ft
- Infiltration Test Method: Double-Ring Infiltrometer

Infiltration Test Pit Soil Description:

Depth Range (inches)		Description of Soil/Rock Layers
0	12	Brown Topsoil with tree roots, dry
12	40	Light brown CLAY, trace fine Sand, dry. Few Boulders Encountered
40	66	Dark brown SILT, some coarse Gravel, trace Clay, dry. Few Boulders Encountered.

Percolation Test:

Test #1

Time (min.)	30 pre-soak	30 pre-soak	10	10	10	10	10	10	
Test Depth (feet)	Reading No. 1	Reading No. 2	Reading No. 3	Reading No. 4	Reading No. 5	Reading No. 6	Reading No. 7	Reading No. 8	Infil. Rate (in. / hour)
3.5	2 3/4	2 1/8	1	3/4	1	1	1	1	6

Test #2

Time (min.)	30 pre-soak	30 pre-soak	10	10	10	10	10	10	
Test Depth (feet)	Reading No. 1	Reading No. 2	Reading No. 3	Reading No. 4	Reading No. 5	Reading No. 6	Reading No. 7	Reading No. 8	Infil. Rate (in. / hour)
3.5	2 1/2	2 1/8	1	3/4	1/2	1/2	5/8	5/8	3 3/4

MOTT MACDONALD M M

Sheet 1 of 2

Infiltration Test Form

Geotechnical Investigation:

- Project Name: Penn East Pipeline
- Date: 5/25/18
- Job Number: 353954
- Site Location: Blue Mountain
- Contractor: Craig (Hammel)
- Weather/Temp: 80 / Sunny
- Infiltration Test ID: BMST-TP1
- Report by: V. Vijayashanthar
- Testing Depth: 3.5 ft
- Infiltration Test Method: Double-Ring Infiltrometer

Infiltration Test Pit Soil Description:

Depth Range (inches)		Description of Soil/Rock Layers
0	12	Topsoil w/ tree roots, dry
12	30	Light brown CLAY, some fine Sand, dry
30	66	Dark brown SILT, some coarse Gravel, dry. Few Boulders Encountered

Percolation Test:

Test #1

Time (min.)	30 pre-soak	30 pre-soak	10	10	10	10	10	10	
Test Depth (feet)	Reading No. 1	Reading No. 2	Reading No. 3	Reading No. 4	Reading No. 5	Reading No. 6	Reading No. 7	Reading No. 8	Infil. Rate (in. / hour)
3.5	2 3/4	2 1/4	3/4	3/4	3/4	1	3/4	1	6

Test #2

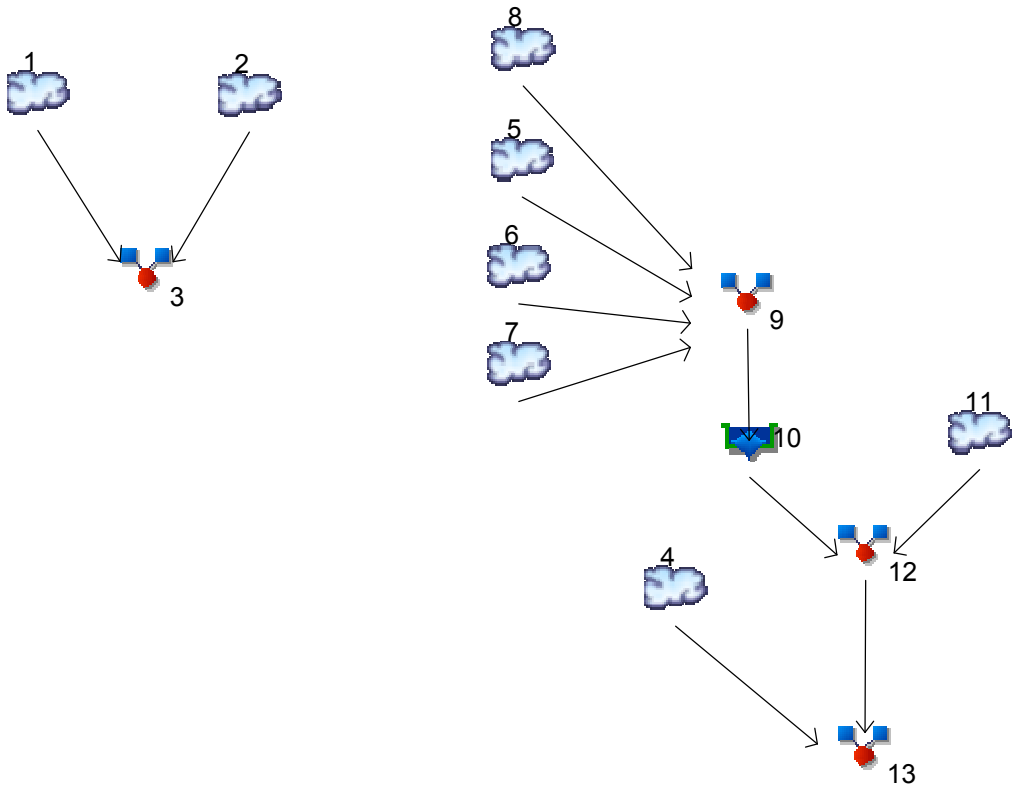
Time (min.)	30 pre-soak	30 pre-soak	10	10	10	10	10	10	
Test Depth (feet)	Reading No. 1	Reading No. 2	Reading No. 3	Reading No. 4	Reading No. 5	Reading No. 6	Reading No. 7	Reading No. 8	Infil. Rate (in. / hour)
3.5	3 1/4	2 3/4	1	1 1/4	1 1/4	1	1	1	6

TABLE E.1 LIMITATIONS OF PENNSYLVANIA SOILS PERTAINING TO EARTHMOVING PROJECTS (Absence of an X does not mean "No Potential Limitation")
NOTE: THIS IS NOT NECESSARILY AN ALL-INCLUSIVE LIST.

SITE	SOIL NAME	CUTBANKS CAVE	CORROSIVE TO CONCRETE\STEEL	DROUGHTY	EASLY ERODIBLE	FLOODING	DEPTH TO SATURATED ZONE/ SEASONAL HIGH	HYDRIC/ HYDRIC INCLUSIONS	LOW STRENGTH/ LANDSLIDE PRONE	SLOW PERCOLATION	PIPING	POOR SOURCE OF TOPSOIL	FROST ACTION	SHRINK-SWELL	POTENTIAL SINKHOLE	PONDING	WETNESS
	McD	X	S	X	X		X	X	X	X	X		X				X

H. Model Input and Output Report

Watershed Model Schematic



Legend

Hyd.	Origin	Description
1	SCS Runoff	EX-OFFSITE-WOODS
2	SCS Runoff	EX-SITE-WOODS
3	Combine	EX-SITE-TOTAL
4	SCS Runoff	PR-OFFSITE-BYP-MEAD
5	SCS Runoff	PR-SITE-MEAD
6	SCS Runoff	PR-SITE-GRAVEL
7	SCS Runoff	PR-SITE-IMP/GRAVEL
8	SCS Runoff	PR-OFFSITE-MEAD
9	Combine	TO BASIN
10	Reservoir	BASIN
11	SCS Runoff	EX-SITE-BYP-MEAD
12	Combine	PR-SITE-TOTAL
13	Combine	PR-TOTAL

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	------	0.149	0.247	-------	0.409	0.561	0.814	1.058	1.345	EX-OFFSITE-WOODS
2	SCS Runoff	------	0.299	0.494	-------	0.819	1.123	1.628	2.116	2.690	EX-SITE-WOODS
3	Combine	1, 2	0.448	0.740	-------	1.228	1.684	2.442	3.174	4.036	EX-SITE-TOTAL
4	SCS Runoff	------	0.034	0.055	-------	0.089	0.121	0.173	0.224	0.283	PR-OFFSITE-BYP-MEAD
5	SCS Runoff	------	0.120	0.192	-------	0.310	0.420	0.602	0.774	0.975	PR-SITE-MEAD
6	SCS Runoff	------	0.057	0.073	-------	0.098	0.118	0.150	0.180	0.213	PR-SITE-GRAVEL
7	SCS Runoff	------	0.192	0.231	-------	0.289	0.338	0.415	0.485	0.565	PR-SITE-IMP/GRAVEL
8	SCS Runoff	------	0.158	0.252	-------	0.407	0.552	0.790	1.016	1.280	PR-OFFSITE-MEAD
9	Combine	5, 6, 7, 8	0.524	0.745	-------	1.100	1.423	1.950	2.446	3.027	TO BASIN
10	Reservoir	9	0.000	0.000	-------	0.000	0.002	0.420	1.109	1.972	BASIN
11	SCS Runoff	------	0.180	0.288	-------	0.467	0.633	0.907	1.169	1.478	EX-SITE-BYP-MEAD
12	Combine	10, 11	0.180	0.288	-------	0.467	0.633	0.971	1.989	3.244	PR-SITE-TOTAL
13	Combine	4, 12	0.215	0.343	-------	0.556	0.754	1.105	2.183	3.501	PR-TOTAL

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v11

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	0.149	1	720	382	------	------	------	EX-OFFSITE-WOODS
2	SCS Runoff	0.299	1	720	765	------	------	------	EX-SITE-WOODS
3	Combine	0.448	1	720	1,147	1, 2	------	------	EX-SITE-TOTAL
4	SCS Runoff	0.034	1	719	79	------	------	------	PR-OFFSITE-BYP-MEAD
5	SCS Runoff	0.120	1	718	261	------	------	------	PR-SITE-MEAD
6	SCS Runoff	0.057	1	718	117	------	------	------	PR-SITE-GRAVEL
7	SCS Runoff	0.192	1	717	449	------	------	------	PR-SITE-IMP/GRAVEL
8	SCS Runoff	0.158	1	718	342	------	------	------	PR-OFFSITE-MEAD
9	Combine	0.524	1	718	1,170	5, 6, 7, 8	------	------	TO BASIN
10	Reservoir	0.000	1	810	0	9	701.88	359	BASIN
11	SCS Runoff	0.180	1	719	412	------	------	------	EX-SITE-BYP-MEAD
12	Combine	0.180	1	719	412	10, 11	------	------	PR-SITE-TOTAL
13	Combine	0.215	1	719	491	4, 12	------	------	PR-TOTAL

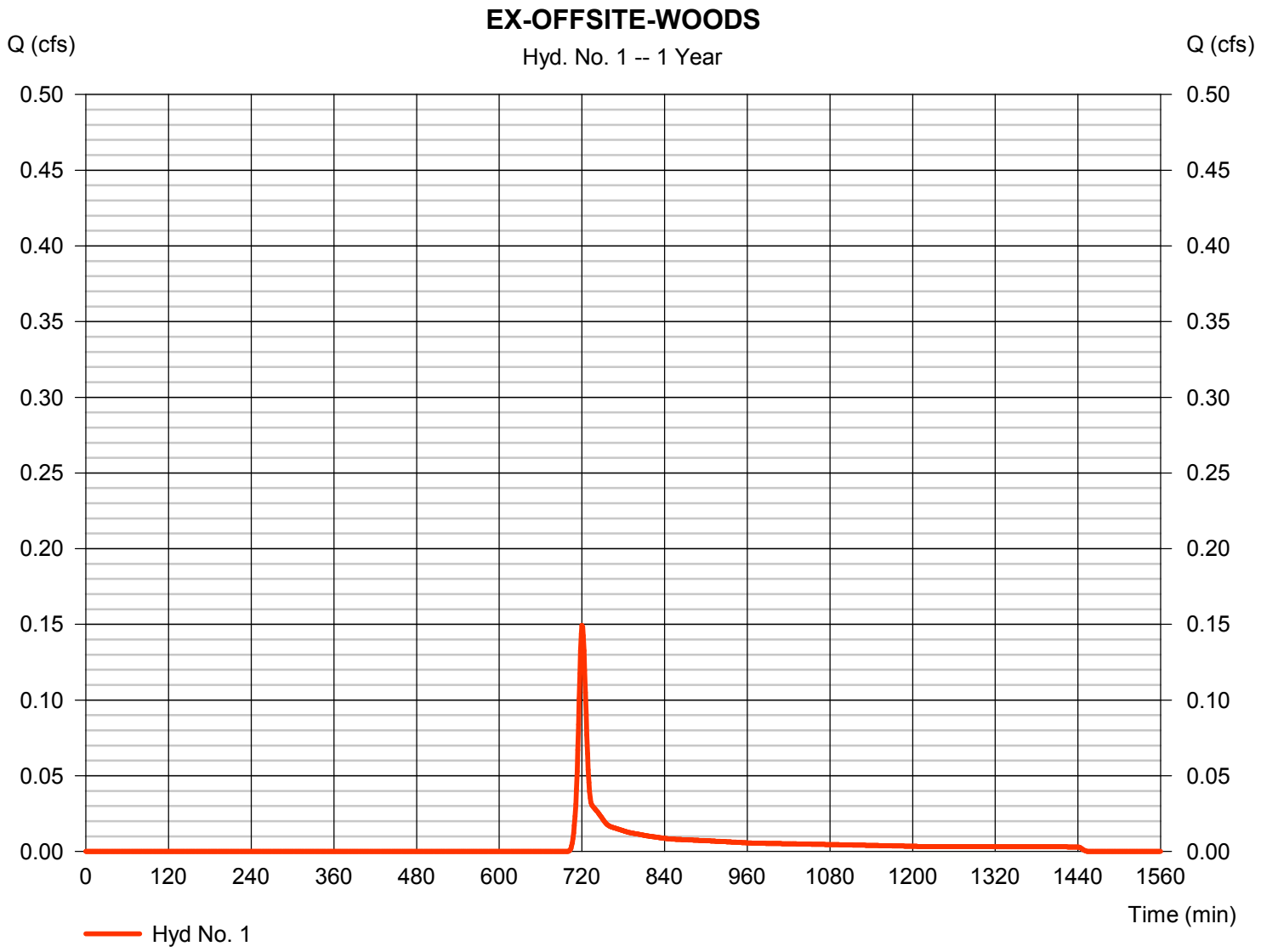
Hydrograph Report

Hyd. No. 1

EX-OFFSITE-WOODS

Hydrograph type	= SCS Runoff	Peak discharge	= 0.149 cfs
Storm frequency	= 1 yrs	Time to peak	= 720 min
Time interval	= 1 min	Hyd. volume	= 382 cuft
Drainage area	= 0.203 ac	Curve number	= 70*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.00 min
Total precip.	= 2.63 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.254 x 30) + (0.103 x 30)] / 0.203



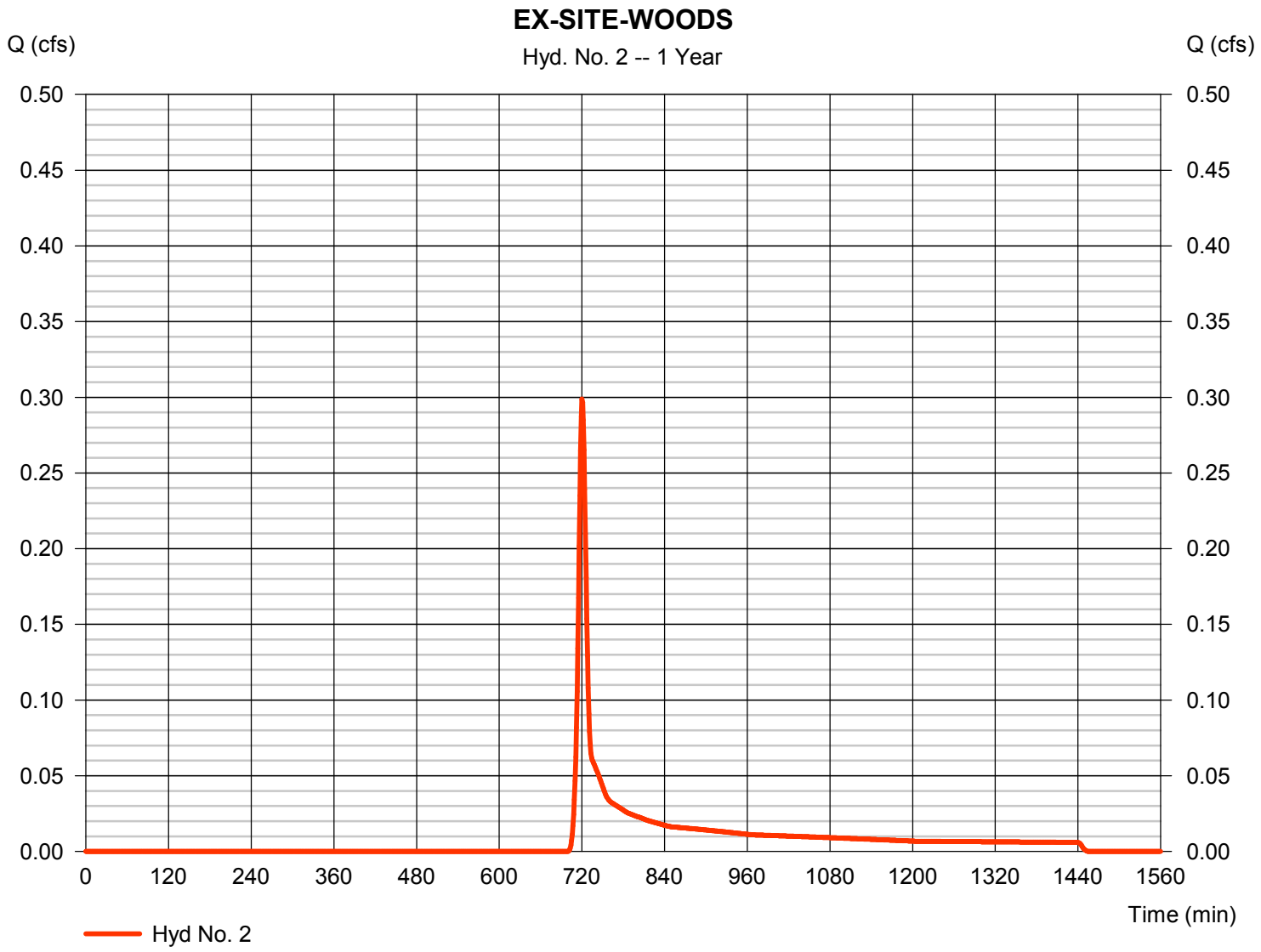
Hydrograph Report

Hyd. No. 2

EX-SITE-WOODS

Hydrograph type	= SCS Runoff	Peak discharge	= 0.299 cfs
Storm frequency	= 1 yrs	Time to peak	= 720 min
Time interval	= 1 min	Hyd. volume	= 765 cuft
Drainage area	= 0.406 ac	Curve number	= 70*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 9.50 min
Total precip.	= 2.63 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.254 x 30) + (0.103 x 30)] / 0.406

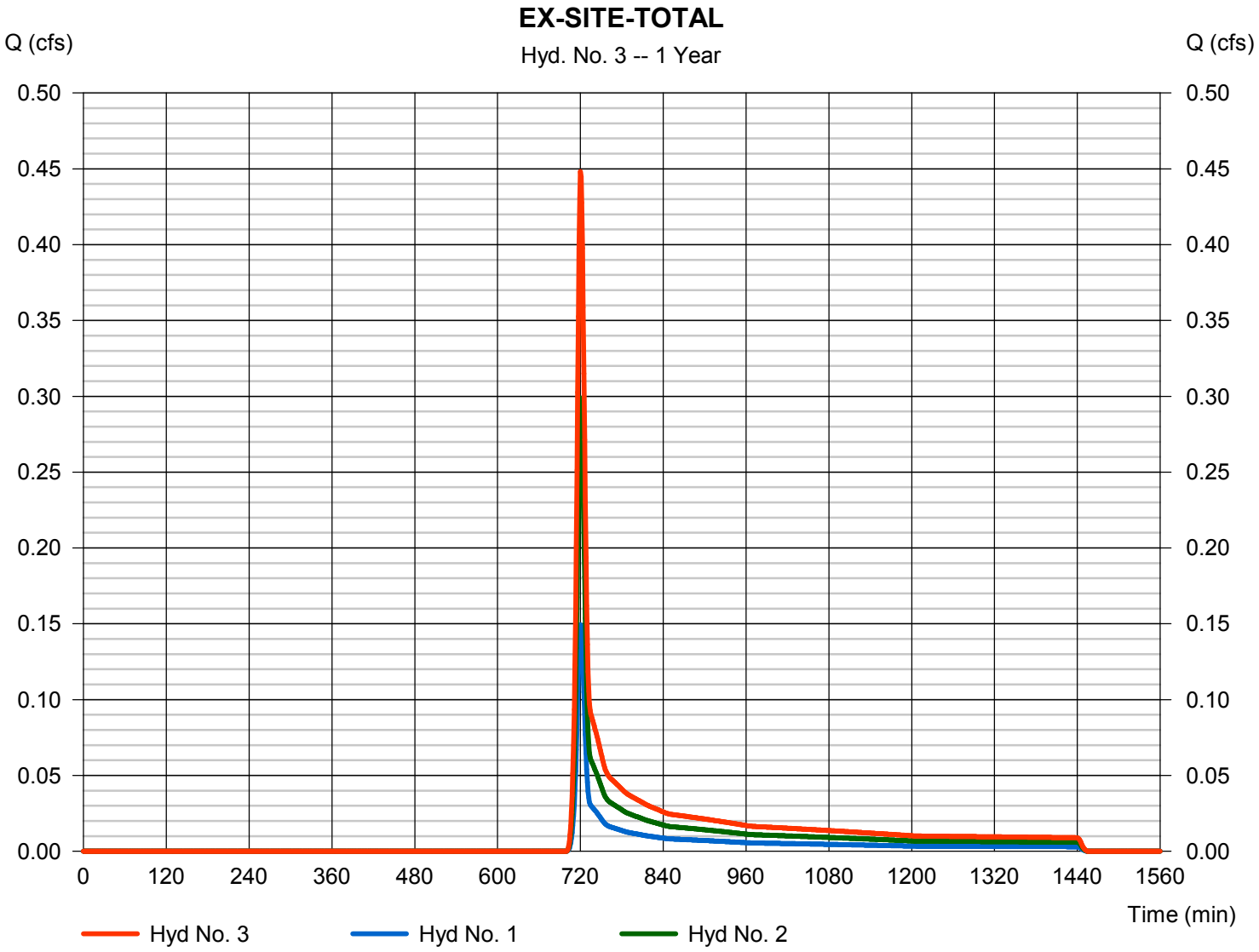


Hydrograph Report

Hyd. No. 3

EX-SITE-TOTAL

Hydrograph type	= Combine	Peak discharge	= 0.448 cfs
Storm frequency	= 1 yrs	Time to peak	= 720 min
Time interval	= 1 min	Hyd. volume	= 1,147 cuft
Inflow hyds.	= 1, 2	Contrib. drain. area	= 0.609 ac



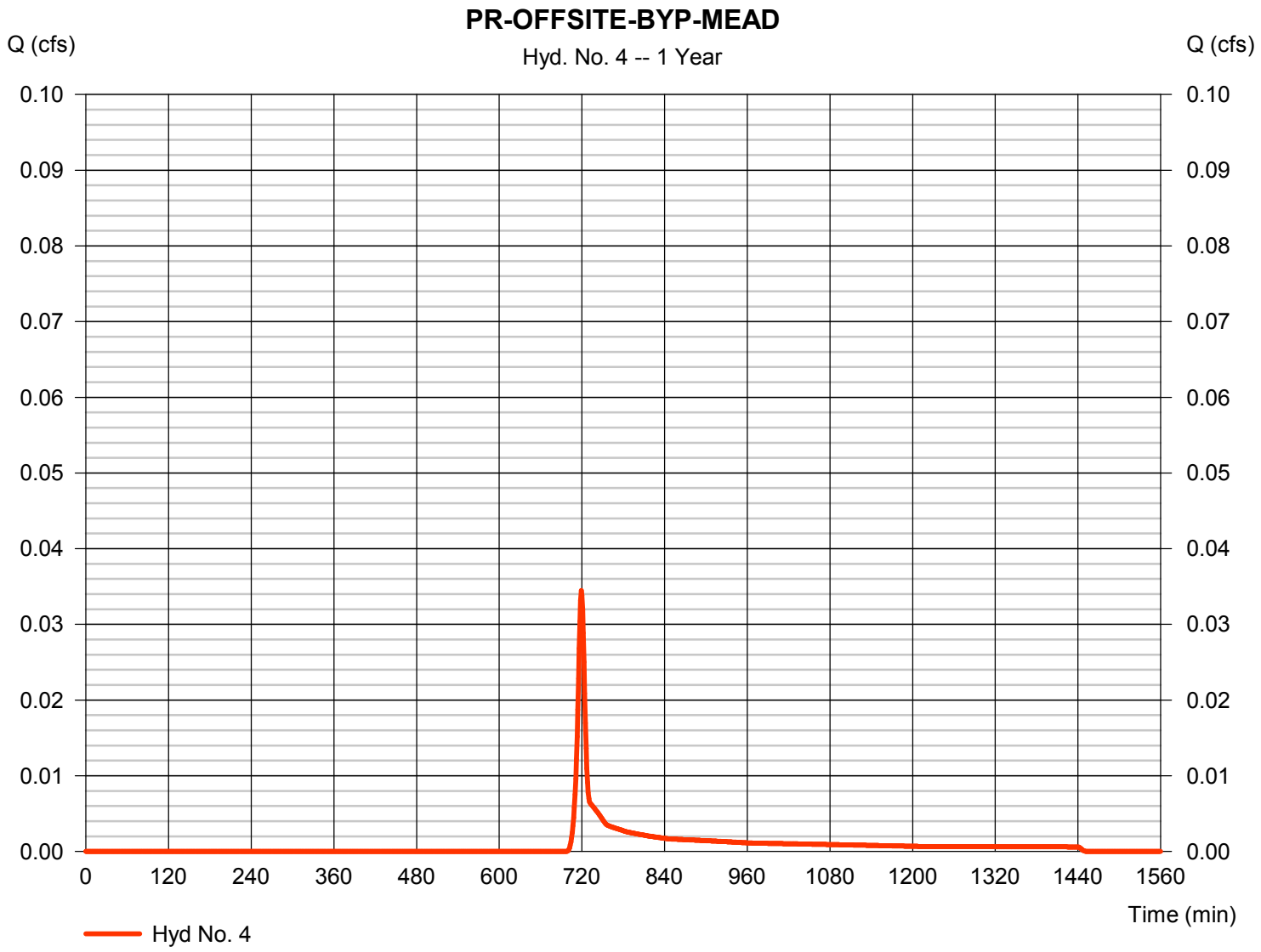
Hydrograph Report

Hyd. No. 4

PR-OFFSITE-BYP-MEAD

Hydrograph type	= SCS Runoff	Peak discharge	= 0.034 cfs
Storm frequency	= 1 yrs	Time to peak	= 719 min
Time interval	= 1 min	Hyd. volume	= 79 cuft
Drainage area	= 0.040 ac	Curve number	= 71*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.70 min
Total precip.	= 2.63 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.254 x 30) + (0.103 x 30)] / 0.040



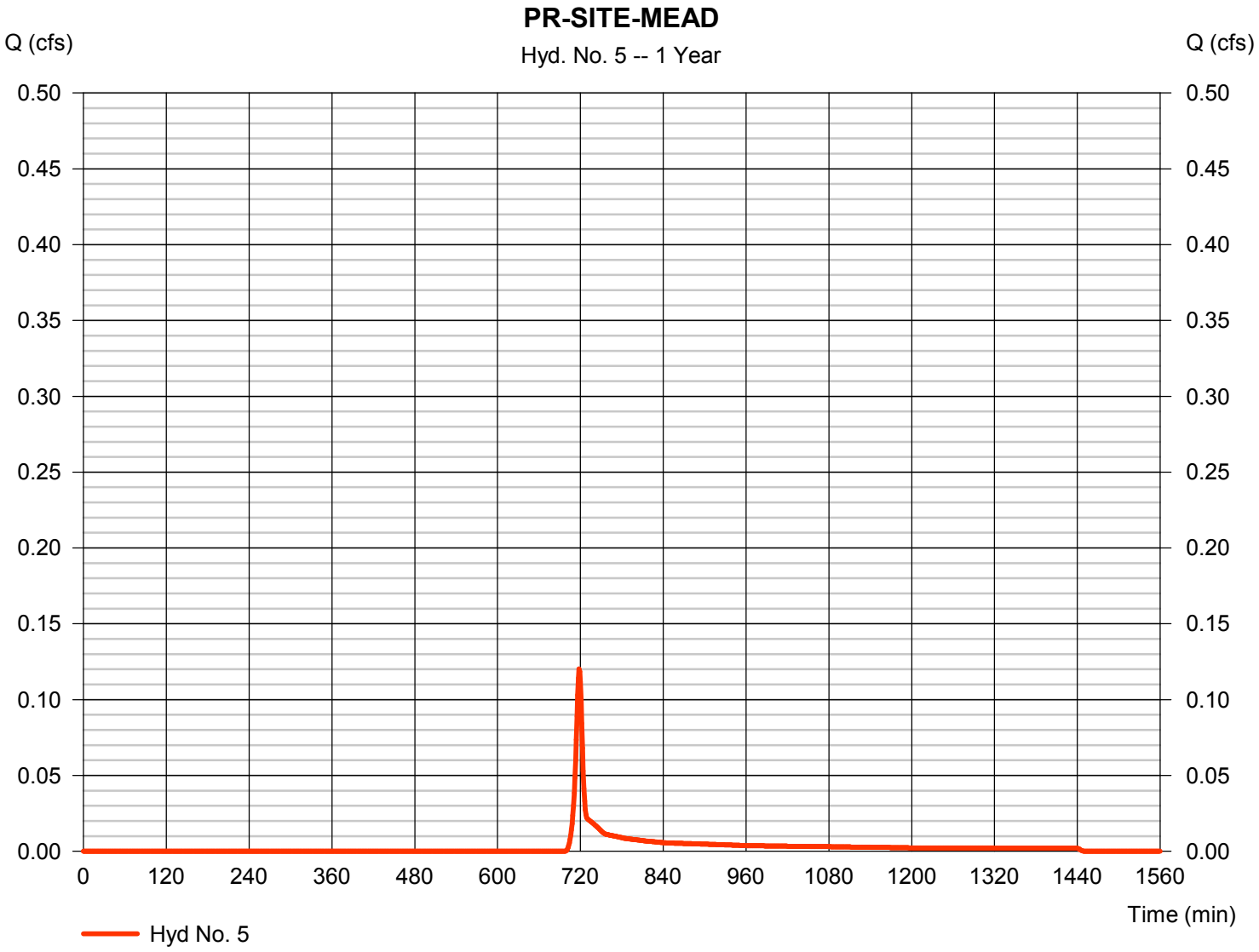
Hydrograph Report

Hyd. No. 5

PR-SITE-MEAD

Hydrograph type	= SCS Runoff	Peak discharge	= 0.120 cfs
Storm frequency	= 1 yrs	Time to peak	= 718 min
Time interval	= 1 min	Hyd. volume	= 261 cuft
Drainage area	= 0.125 ac	Curve number	= 71*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.80 min
Total precip.	= 2.63 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.352 x 71) + (0.054 x 71) + (0.305 x 71)] / 0.125

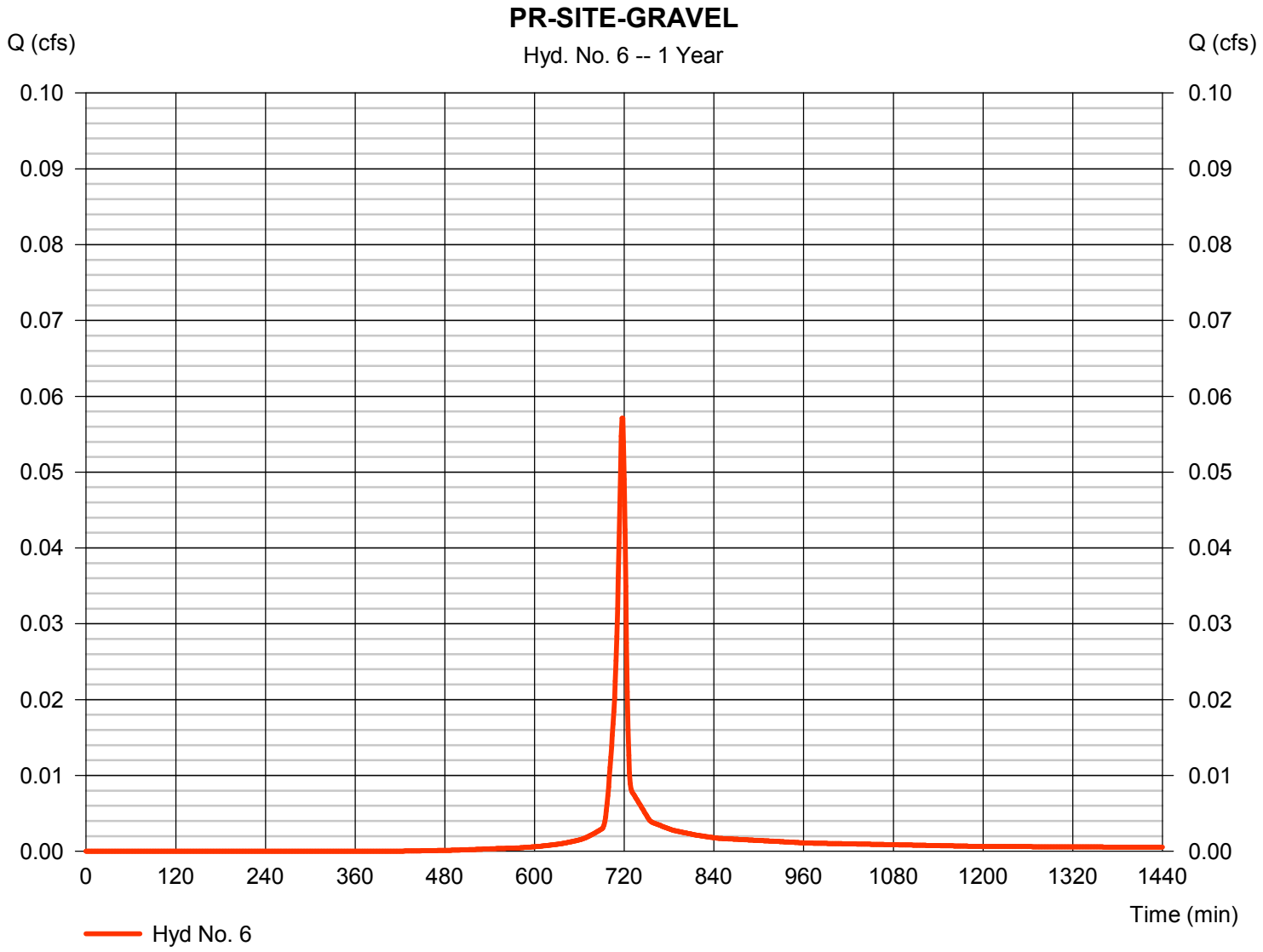


Hydrograph Report

Hyd. No. 6

PR-SITE-GRAVEL

Hydrograph type	= SCS Runoff	Peak discharge	= 0.057 cfs
Storm frequency	= 1 yrs	Time to peak	= 718 min
Time interval	= 1 min	Hyd. volume	= 117 cuft
Drainage area	= 0.020 ac	Curve number	= 89
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.80 min
Total precip.	= 2.63 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

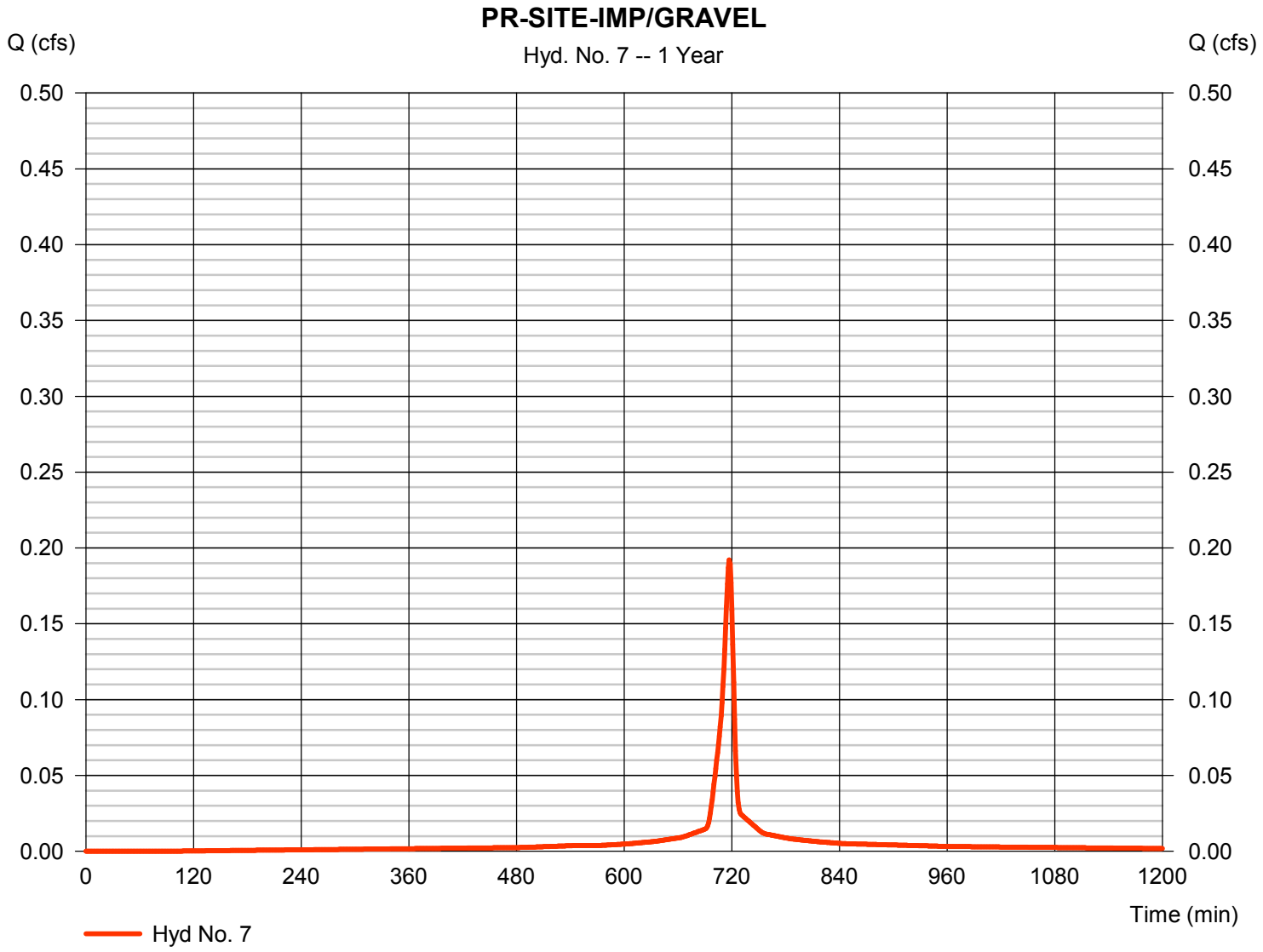


Hydrograph Report

Hyd. No. 7

PR-SITE-IMP/GRAVEL

Hydrograph type	= SCS Runoff	Peak discharge	= 0.192 cfs
Storm frequency	= 1 yrs	Time to peak	= 717 min
Time interval	= 1 min	Hyd. volume	= 449 cuft
Drainage area	= 0.050 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.80 min
Total precip.	= 2.63 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



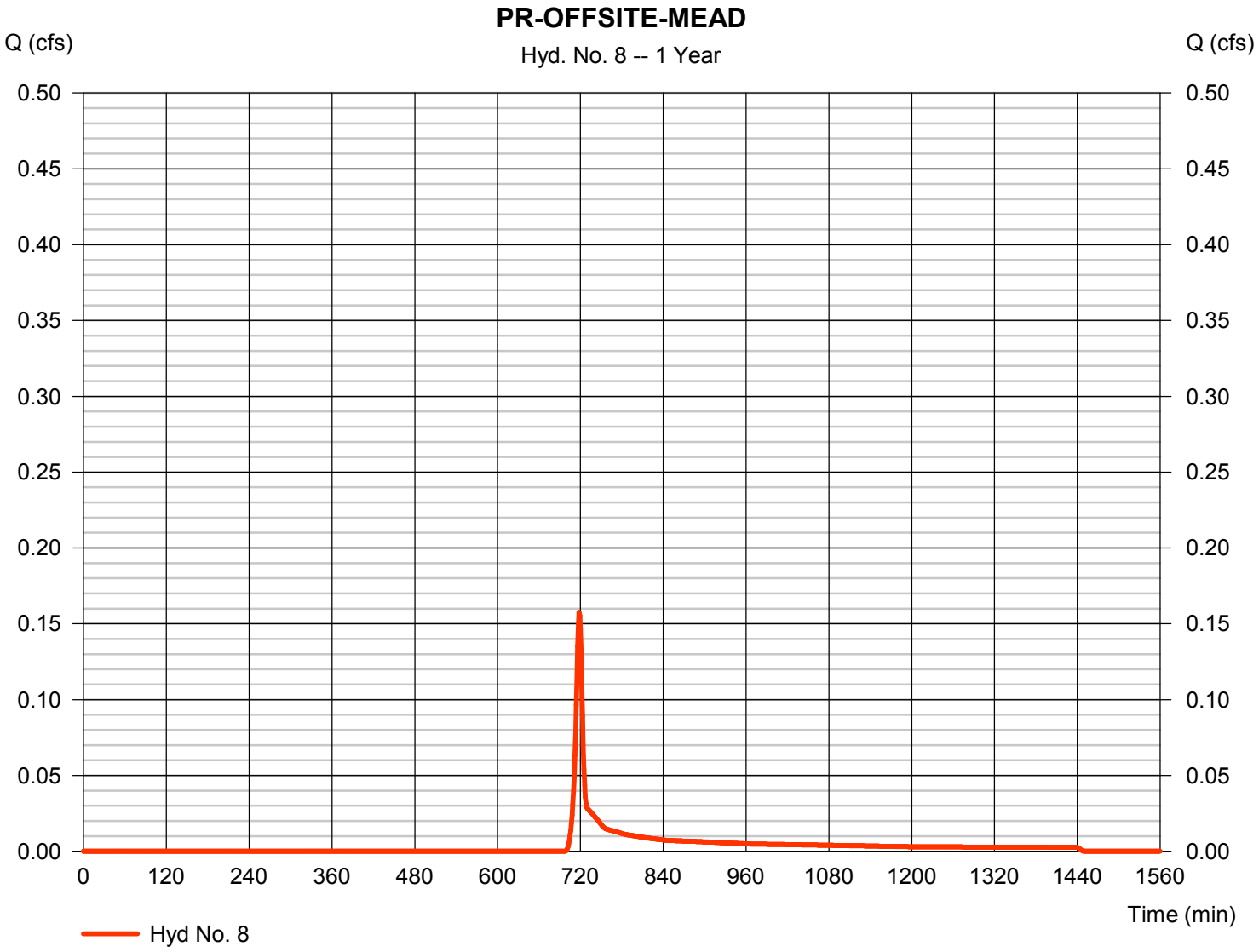
Hydrograph Report

Hyd. No. 8

PR-OFFSITE-MEAD

Hydrograph type	= SCS Runoff	Peak discharge	= 0.158 cfs
Storm frequency	= 1 yrs	Time to peak	= 718 min
Time interval	= 1 min	Hyd. volume	= 342 cuft
Drainage area	= 0.164 ac	Curve number	= 71*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.40 min
Total precip.	= 2.63 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.254 x 30) + (0.103 x 30)] / 0.164

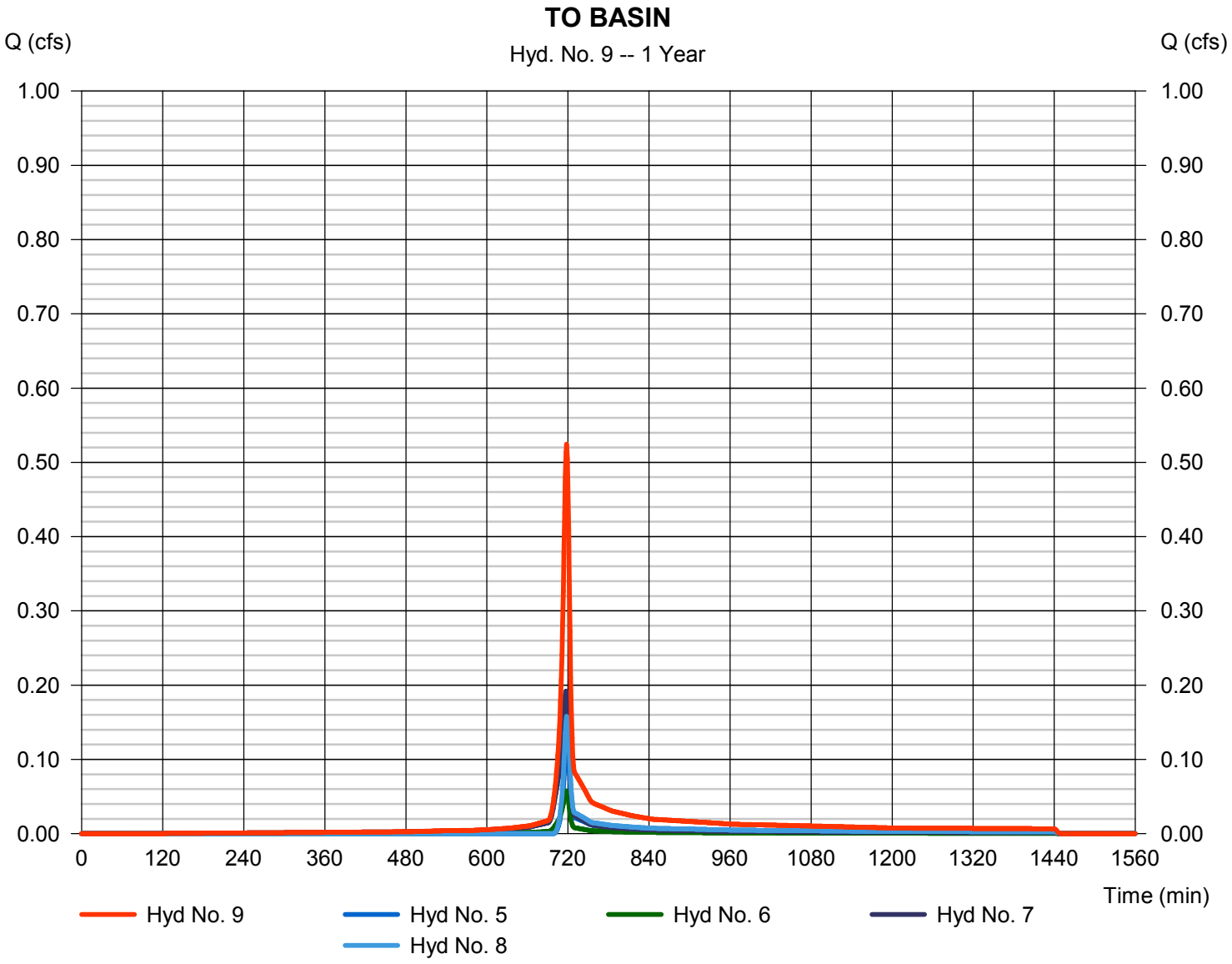


Hydrograph Report

Hyd. No. 9

TO BASIN

Hydrograph type	= Combine	Peak discharge	= 0.524 cfs
Storm frequency	= 1 yrs	Time to peak	= 718 min
Time interval	= 1 min	Hyd. volume	= 1,170 cuft
Inflow hyds.	= 5, 6, 7, 8	Contrib. drain. area	= 0.359 ac



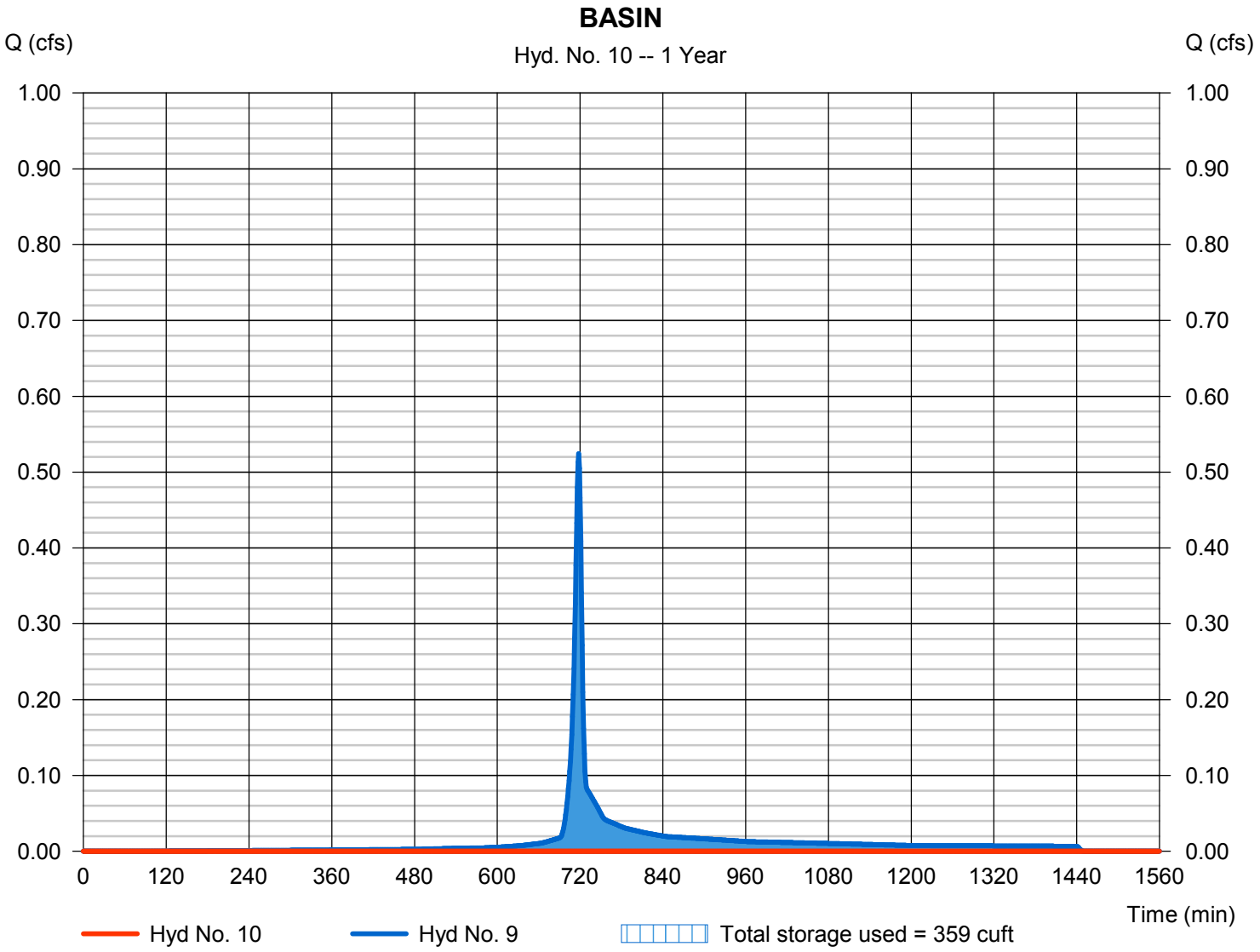
Hydrograph Report

Hyd. No. 10

BASIN

Hydrograph type	=	Reservoir	Peak discharge	=	0.000 cfs
Storm frequency	=	1 yrs	Time to peak	=	810 min
Time interval	=	1 min	Hyd. volume	=	0 cuft
Inflow hyd. No.	=	9 - TO BASIN	Max. Elevation	=	701.88 ft
Reservoir name	=	UG N-12 Perforated Pipe System	Max. Storage	=	359 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Pond No. 1 - UG N-12 Perforated Pipe System

Pond Data

UG Chambers -Invert elev. = 701.50 ft, Rise x Span = 3.00 x 3.00 ft, Barrel Len = 50.00 ft, No. Barrels = 3, Slope = 0.25%, Headers = Yes
Encasement -Invert elev. = 701.00 ft, Width = 5.25 ft, Height = 4.50 ft, Voids = 40.00%

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	701.00	n/a	0	0
0.46	701.46	n/a	152	152
0.93	701.92	n/a	229	382
1.39	702.39	n/a	295	677
1.85	702.85	n/a	320	997
2.31	703.31	n/a	327	1,324
2.78	703.78	n/a	319	1,643
3.24	704.24	n/a	292	1,935
3.70	704.70	n/a	222	2,157
4.16	705.16	n/a	176	2,333
4.63	705.63	n/a	176	2,509

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 15.00	Inactive	0.00	0.00
Span (in)	= 15.00	4.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 701.00	704.39	0.00	0.00
Length (ft)	= 8.00	0.00	0.00	0.00
Slope (%)	= 1.00	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	Yes	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 4.00	0.50	0.00	0.00
Crest El. (ft)	= 704.50	703.25	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= Rect	Rect	---	---
Multi-Stage	= No	Yes	No	No

Exfil.(in/hr) = 2.500 (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).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	701.00	0.00	0.00	---	---	0.00	0.00	---	---	0.000	---	0.000
0.05	15	701.05	0.00	0.00	---	---	0.00	0.00	---	---	0.022	---	0.022
0.09	30	701.09	0.00	0.00	---	---	0.00	0.00	---	---	0.039	---	0.039
0.14	46	701.14	0.00	0.00	---	---	0.00	0.00	---	---	0.052	---	0.052
0.19	61	701.19	0.00	0.00	---	---	0.00	0.00	---	---	0.053	---	0.053
0.23	76	701.23	0.00	0.00	---	---	0.00	0.00	---	---	0.054	---	0.054
0.28	91	701.28	0.00	0.00	---	---	0.00	0.00	---	---	0.054	---	0.054
0.32	107	701.32	0.00	0.00	---	---	0.00	0.00	---	---	0.055	---	0.055
0.37	122	701.37	0.00	0.00	---	---	0.00	0.00	---	---	0.056	---	0.056
0.42	137	701.42	0.00	0.00	---	---	0.00	0.00	---	---	0.057	---	0.057
0.46	152	701.46	0.00	0.00	---	---	0.00	0.00	---	---	0.058	---	0.058
0.51	175	701.51	0.00	0.00	---	---	0.00	0.00	---	---	0.059	---	0.059
0.56	198	701.56	0.00	0.00	---	---	0.00	0.00	---	---	0.060	---	0.060
0.60	221	701.60	0.00	0.00	---	---	0.00	0.00	---	---	0.061	---	0.061
0.65	244	701.65	0.00	0.00	---	---	0.00	0.00	---	---	0.062	---	0.062
0.69	267	701.69	0.00	0.00	---	---	0.00	0.00	---	---	0.062	---	0.062
0.74	290	701.74	0.00	0.00	---	---	0.00	0.00	---	---	0.063	---	0.063
0.79	313	701.79	0.00	0.00	---	---	0.00	0.00	---	---	0.064	---	0.064
0.83	336	701.83	0.00	0.00	---	---	0.00	0.00	---	---	0.065	---	0.065
0.88	359	701.88	0.00	0.00	---	---	0.00	0.00	---	---	0.066	---	0.066
0.93	382	701.92	0.00	0.00	---	---	0.00	0.00	---	---	0.067	---	0.067
0.97	411	701.97	0.00	0.00	---	---	0.00	0.00	---	---	0.068	---	0.068
1.02	441	702.02	0.00	0.00	---	---	0.00	0.00	---	---	0.069	---	0.069
1.06	471	702.06	0.00	0.00	---	---	0.00	0.00	---	---	0.070	---	0.070
1.11	500	702.11	0.00	0.00	---	---	0.00	0.00	---	---	0.070	---	0.070
1.16	530	702.16	0.00	0.00	---	---	0.00	0.00	---	---	0.071	---	0.071
1.20	559	702.20	0.00	0.00	---	---	0.00	0.00	---	---	0.072	---	0.072
1.25	589	702.25	0.00	0.00	---	---	0.00	0.00	---	---	0.073	---	0.073
1.29	618	702.30	0.00	0.00	---	---	0.00	0.00	---	---	0.074	---	0.074
1.34	648	702.34	0.00	0.00	---	---	0.00	0.00	---	---	0.075	---	0.075
1.39	677	702.39	0.00	0.00	---	---	0.00	0.00	---	---	0.076	---	0.076
1.43	709	702.43	0.00	0.00	---	---	0.00	0.00	---	---	0.077	---	0.077

Continues on next page...

UG N-12 Perforated Pipe System

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
1.48	741	702.48	0.00	0.00	---	---	0.00	0.00	---	---	0.078	---	0.078
1.53	773	702.53	0.00	0.00	---	---	0.00	0.00	---	---	0.078	---	0.078
1.57	805	702.57	0.00	0.00	---	---	0.00	0.00	---	---	0.079	---	0.079
1.62	837	702.62	0.00	0.00	---	---	0.00	0.00	---	---	0.080	---	0.080
1.66	869	702.67	0.00	0.00	---	---	0.00	0.00	---	---	0.081	---	0.081
1.71	901	702.71	0.00	0.00	---	---	0.00	0.00	---	---	0.082	---	0.082
1.76	933	702.76	0.00	0.00	---	---	0.00	0.00	---	---	0.083	---	0.083
1.80	965	702.80	0.00	0.00	---	---	0.00	0.00	---	---	0.084	---	0.084
1.85	997	702.85	0.00	0.00	---	---	0.00	0.00	---	---	0.085	---	0.085
1.90	1,030	702.90	0.00	0.00	---	---	0.00	0.00	---	---	0.086	---	0.086
1.94	1,063	702.94	0.00	0.00	---	---	0.00	0.00	---	---	0.086	---	0.086
1.99	1,095	702.99	0.00	0.00	---	---	0.00	0.00	---	---	0.087	---	0.087
2.04	1,128	703.03	0.00	0.00	---	---	0.00	0.00	---	---	0.088	---	0.088
2.08	1,161	703.08	0.00	0.00	---	---	0.00	0.00	---	---	0.089	---	0.089
2.13	1,193	703.13	0.00	0.00	---	---	0.00	0.00	---	---	0.090	---	0.090
2.17	1,226	703.17	0.00	0.00	---	---	0.00	0.00	---	---	0.091	---	0.091
2.22	1,259	703.22	0.00	0.00	---	---	0.00	0.00	---	---	0.092	---	0.092
2.27	1,291	703.27	0.00 ic	0.00	---	---	0.00	0.00	---	---	0.093	---	0.096
2.31	1,324	703.31	0.03 ic	0.00	---	---	0.00	0.03	---	---	0.094	---	0.120
2.36	1,356	703.36	0.06 ic	0.00	---	---	0.00	0.06	---	---	0.094	---	0.154
2.40	1,388	703.41	0.11 ic	0.00	---	---	0.00	0.10	---	---	0.095	---	0.197
2.45	1,420	703.45	0.15 ic	0.00	---	---	0.00	0.15	---	---	0.096	---	0.247
2.50	1,452	703.50	0.21 ic	0.00	---	---	0.00	0.21	---	---	0.097	---	0.302
2.54	1,483	703.54	0.27 oc	0.00	---	---	0.00	0.27	---	---	0.098	---	0.363
2.59	1,515	703.59	0.34 oc	0.00	---	---	0.00	0.33	---	---	0.099	---	0.429
2.64	1,547	703.64	0.40 oc	0.00	---	---	0.00	0.40	---	---	0.100	---	0.500
2.68	1,579	703.68	0.49 oc	0.00	---	---	0.00	0.47	---	---	0.101	---	0.574
2.73	1,611	703.73	0.56 oc	0.00	---	---	0.00	0.55	---	---	0.102	---	0.653
2.78	1,643	703.78	0.64 oc	0.00	---	---	0.00	0.63	---	---	0.102	---	0.736
2.82	1,672	703.82	0.72 oc	0.00	---	---	0.00	0.72	---	---	0.103	---	0.822
2.87	1,701	703.87	0.81 oc	0.00	---	---	0.00	0.81	---	---	0.104	---	0.912
2.91	1,730	703.91	0.92 oc	0.00	---	---	0.00	0.90	---	---	0.105	---	1.006
2.96	1,760	703.96	1.01 oc	0.00	---	---	0.00	1.00	---	---	0.106	---	1.102
3.01	1,789	704.01	1.10 oc	0.00	---	---	0.00	1.10	---	---	0.107	---	1.202
3.05	1,818	704.05	1.21 oc	0.00	---	---	0.00	1.20	---	---	0.108	---	1.305
3.10	1,847	704.10	1.32 oc	0.00	---	---	0.00	1.30	---	---	0.109	---	1.411
3.15	1,877	704.15	1.42 oc	0.00	---	---	0.00	1.41	---	---	0.109	---	1.520
3.19	1,906	704.19	1.52 oc	0.00	---	---	0.00	1.52	---	---	0.110	---	1.631
3.24	1,935	704.24	1.64 oc	0.00	---	---	0.00	1.63	---	---	0.111	---	1.745
3.28	1,957	704.28	1.76 oc	0.00	---	---	0.00	1.75	---	---	0.112	---	1.862
3.33	1,979	704.33	1.88 oc	0.00	---	---	0.00	1.87	---	---	0.113	---	1.982
3.38	2,001	704.38	2.00 oc	0.00	---	---	0.00	1.99	---	---	0.114	---	2.104
3.42	2,024	704.42	2.12 oc	0.00	---	---	0.00	2.11	---	---	0.115	---	2.229
3.47	2,046	704.47	2.24 oc	0.00	---	---	0.00	2.24	---	---	0.116	---	2.356
3.52	2,068	704.52	2.37 oc	0.00	---	---	0.02	2.37	---	---	0.117	---	2.510
3.56	2,090	704.56	2.50 oc	0.00	---	---	0.20	2.50	---	---	0.117	---	2.820
3.61	2,112	704.61	2.63 oc	0.00	---	---	0.47	2.63	---	---	0.118	---	3.222
3.65	2,134	704.65	2.77 oc	0.00	---	---	0.80	2.77	---	---	0.119	---	3.693
3.70	2,157	704.70	2.91 oc	0.00	---	---	1.19	2.91	---	---	0.120	---	4.219
3.75	2,174	704.75	3.05 oc	0.00	---	---	1.63	3.05	---	---	0.121	---	4.796
3.79	2,192	704.79	3.19 oc	0.00	---	---	2.11	3.19	---	---	0.122	---	5.419
3.84	2,209	704.84	3.34 oc	0.00	---	---	2.63	3.33	---	---	0.123	---	6.084
3.89	2,227	704.89	3.48 oc	0.00	---	---	3.18	3.48	---	---	0.124	---	6.788
3.93	2,245	704.93	3.63 oc	0.00	---	---	3.77	3.63	---	---	0.125	---	7.528
3.98	2,262	704.98	3.78 oc	0.00	---	---	4.40	3.78	---	---	0.125	---	8.303
4.02	2,280	705.02	3.93 oc	0.00	---	---	5.05	3.93	---	---	0.126	---	9.110
4.07	2,298	705.07	4.09 oc	0.00	---	---	5.73	4.09	---	---	0.127	---	9.950
4.12	2,315	705.12	4.25 oc	0.00	---	---	6.45	4.25	---	---	0.128	---	10.82
4.16	2,333	705.16	4.40 oc	0.00	---	---	7.18	4.40	---	---	0.129	---	11.71
4.21	2,351	705.21	4.56 oc	0.00	---	---	7.95	4.56	---	---	0.130	---	12.64
4.26	2,368	705.26	4.73 oc	0.00	---	---	8.74	4.73	---	---	0.131	---	13.60
4.30	2,386	705.30	4.89 oc	0.00	---	---	9.55	4.89	---	---	0.132	---	14.58
4.35	2,403	705.35	5.06 oc	0.00	---	---	10.39	5.06	---	---	0.133	---	15.58
4.39	2,421	705.39	5.23 oc	0.00	---	---	11.26	5.23	---	---	0.133	---	16.62
4.44	2,439	705.44	5.40 oc	0.00	---	---	12.14	5.40	---	---	0.134	---	17.67
4.49	2,456	705.49	5.57 oc	0.00	---	---	13.05	5.57	---	---	0.135	---	18.75
4.53	2,474	705.53	5.74 oc	0.00	---	---	13.98	5.74	---	---	0.136	---	19.85
4.58	2,492	705.58	5.92 oc	0.00	---	---	14.93	5.92	---	---	0.137	---	20.98
4.63	2,509	705.63	6.09 oc	0.00	---	---	15.89	6.09	---	---	0.138	---	22.13

...End

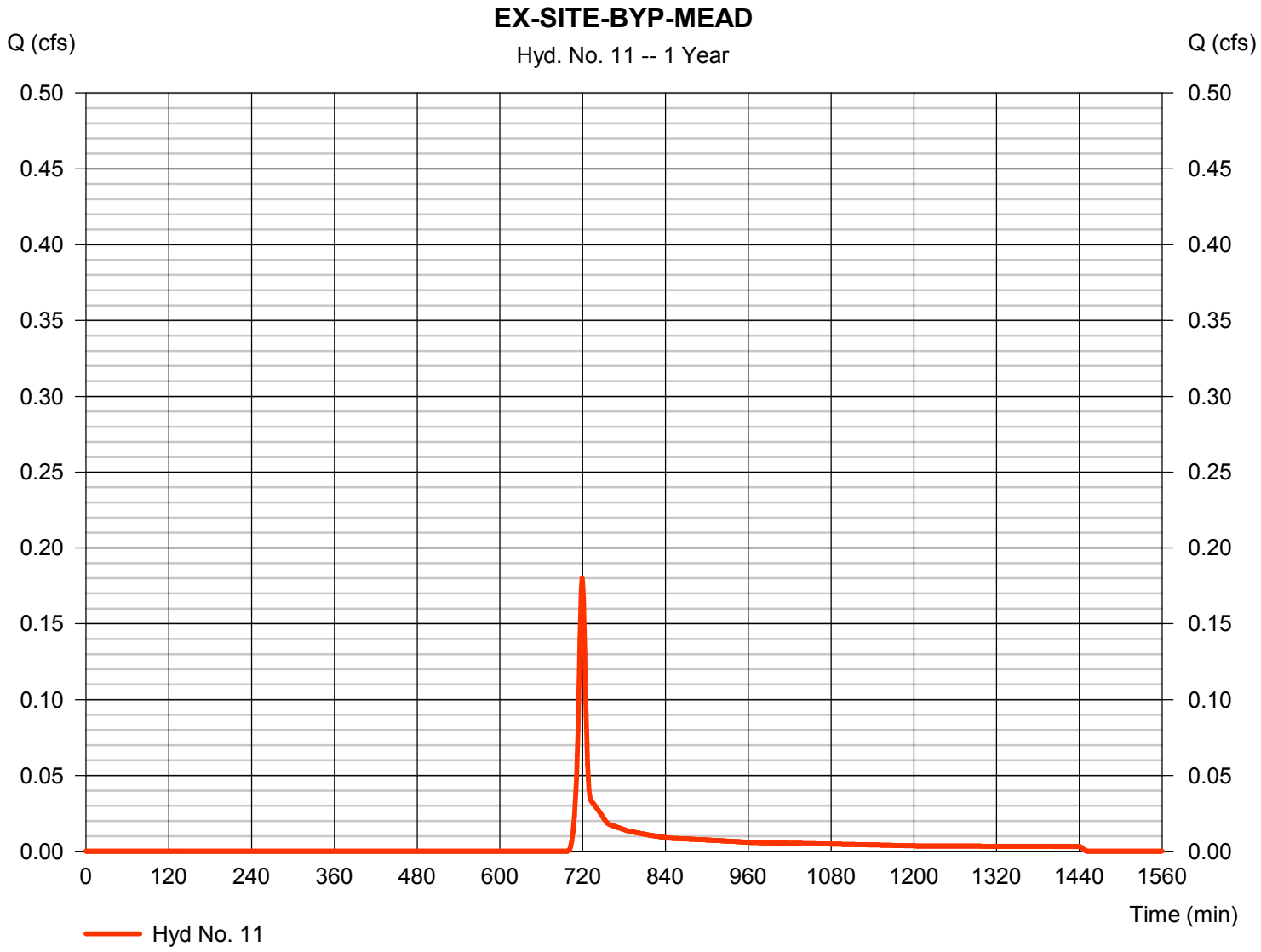
Hydrograph Report

Hyd. No. 11

EX-SITE-BYP-MEAD

Hydrograph type	= SCS Runoff	Peak discharge	= 0.180 cfs
Storm frequency	= 1 yrs	Time to peak	= 719 min
Time interval	= 1 min	Hyd. volume	= 412 cuft
Drainage area	= 0.209 ac	Curve number	= 71*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.80 min
Total precip.	= 2.63 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.364 x 71) + (0.314 x 71) + (0.123 x 71)] / 0.209

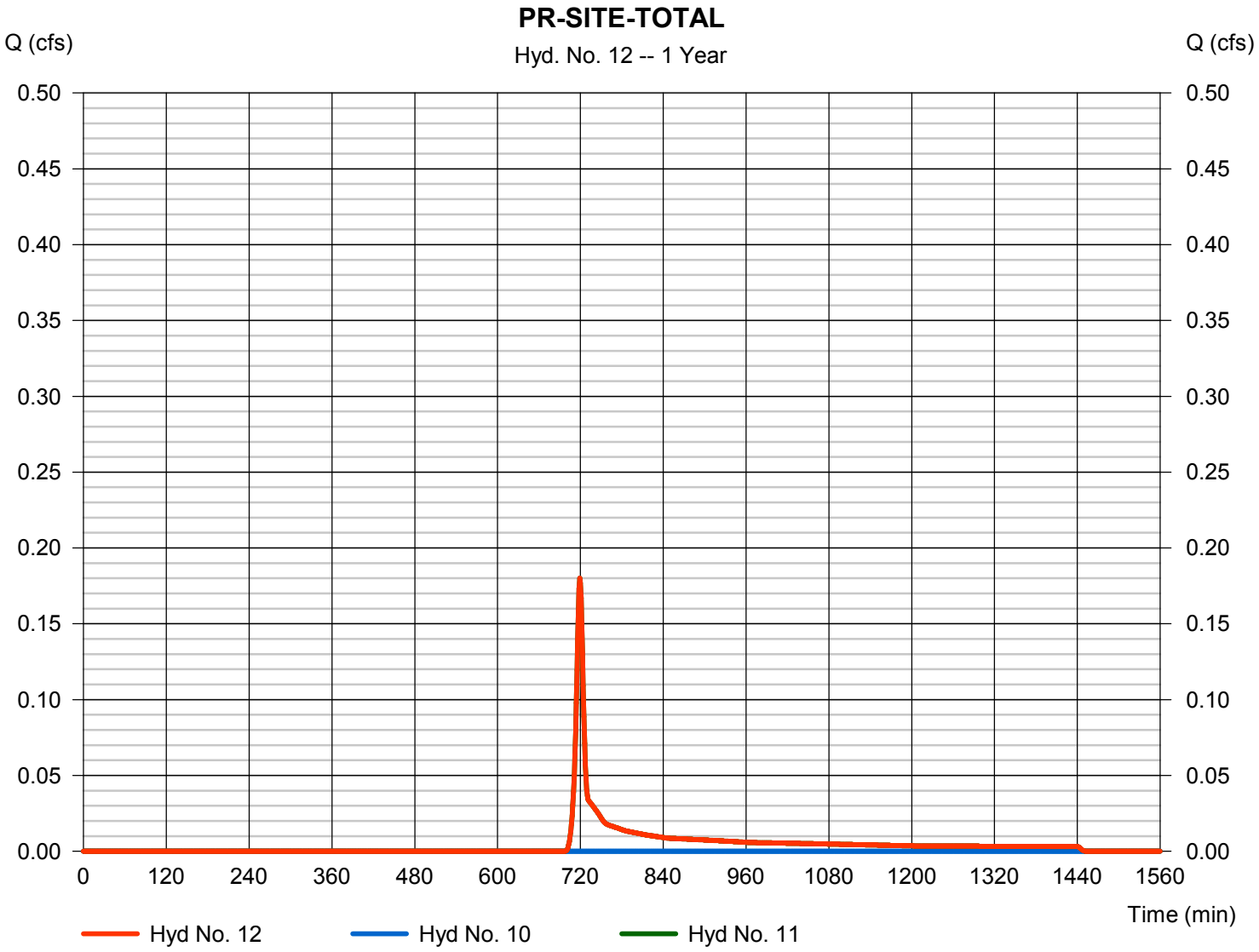


Hydrograph Report

Hyd. No. 12

PR-SITE-TOTAL

Hydrograph type	= Combine	Peak discharge	= 0.180 cfs
Storm frequency	= 1 yrs	Time to peak	= 719 min
Time interval	= 1 min	Hyd. volume	= 412 cuft
Inflow hyds.	= 10, 11	Contrib. drain. area	= 0.209 ac

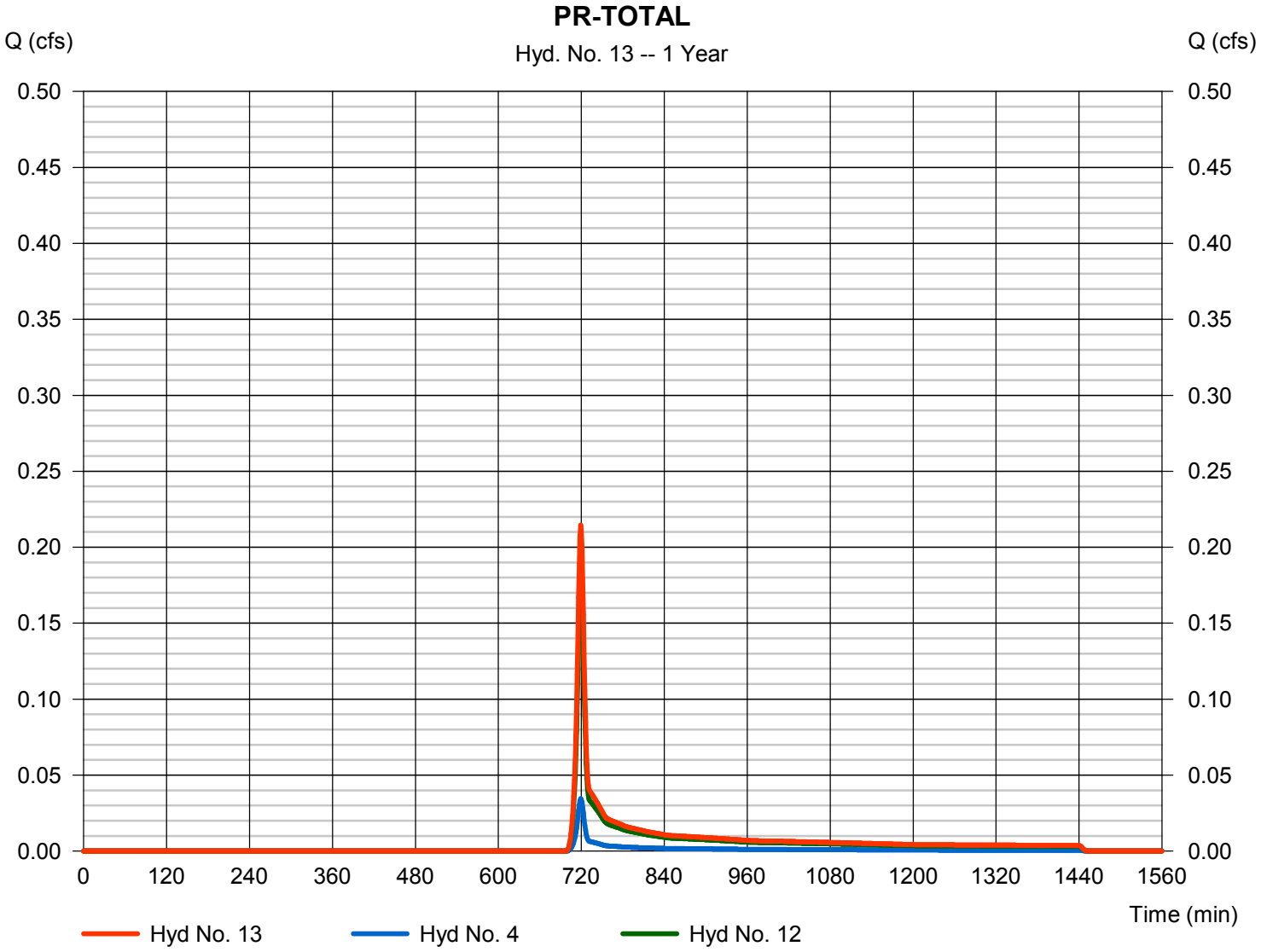


Hydrograph Report

Hyd. No. 13

PR-TOTAL

Hydrograph type	= Combine	Peak discharge	= 0.215 cfs
Storm frequency	= 1 yrs	Time to peak	= 719 min
Time interval	= 1 min	Hyd. volume	= 491 cuft
Inflow hyds.	= 4, 12	Contrib. drain. area	= 0.040 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v11

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	0.247	1	720	589	------	------	------	EX-OFFSITE-WOODS
2	SCS Runoff	0.494	1	720	1,178	------	------	------	EX-SITE-WOODS
3	Combine	0.740	1	720	1,767	1, 2	------	------	EX-SITE-TOTAL
4	SCS Runoff	0.055	1	719	120	------	------	------	PR-OFFSITE-BYP-MEAD
5	SCS Runoff	0.192	1	718	397	------	------	------	PR-SITE-MEAD
6	SCS Runoff	0.073	1	717	152	------	------	------	PR-SITE-GRAVEL
7	SCS Runoff	0.231	1	717	546	------	------	------	PR-SITE-IMP/GRAVEL
8	SCS Runoff	0.252	1	718	521	------	------	------	PR-OFFSITE-MEAD
9	Combine	0.745	1	718	1,616	5, 6, 7, 8	------	------	TO BASIN
10	Reservoir	0.000	1	798	0	9	702.22	570	BASIN
11	SCS Runoff	0.288	1	719	627	------	------	------	EX-SITE-BYP-MEAD
12	Combine	0.288	1	719	627	10, 11	------	------	PR-SITE-TOTAL
13	Combine	0.343	1	719	747	4, 12	------	------	PR-TOTAL

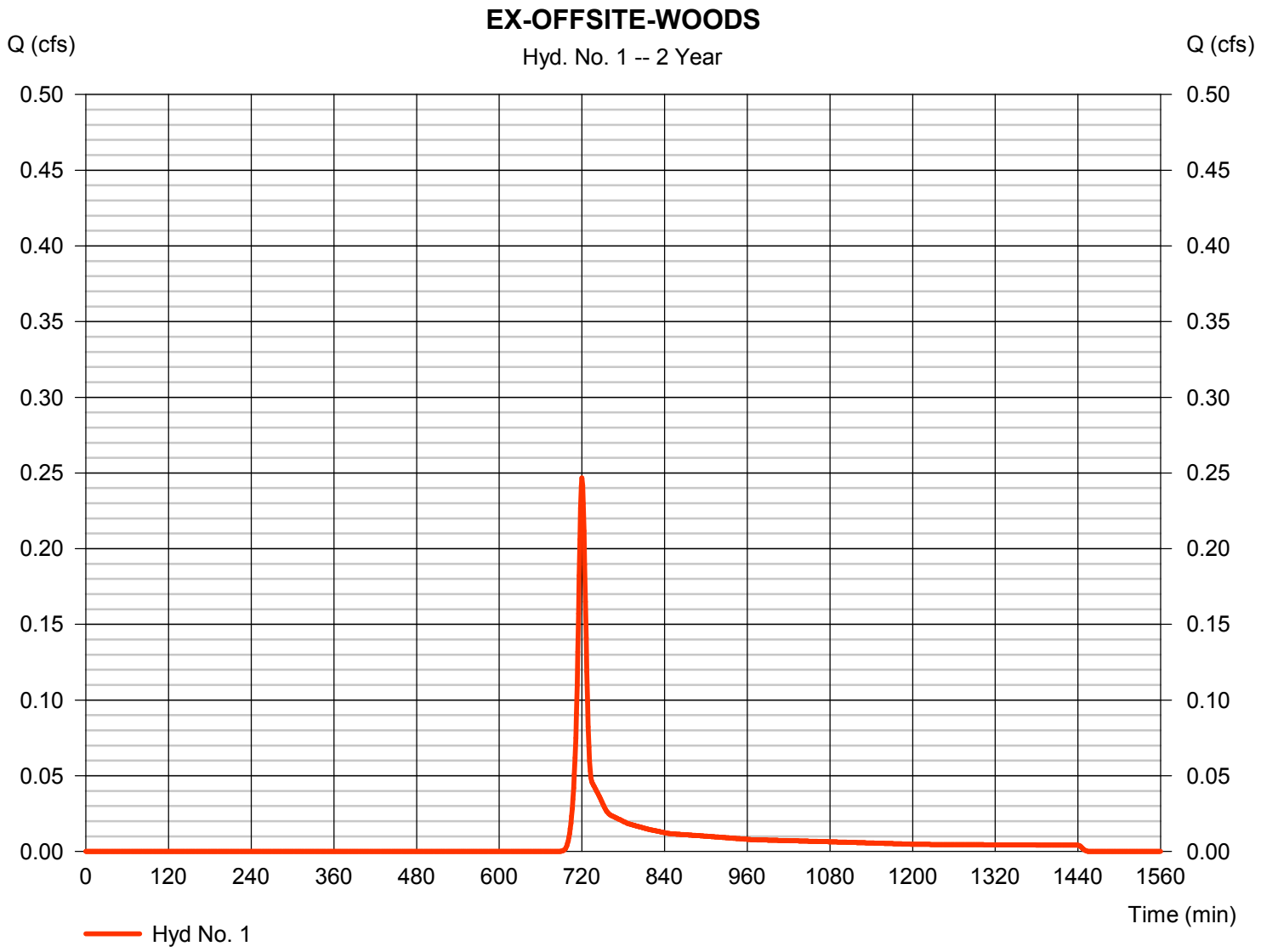
Hydrograph Report

Hyd. No. 1

EX-OFFSITE-WOODS

Hydrograph type	= SCS Runoff	Peak discharge	= 0.247 cfs
Storm frequency	= 2 yrs	Time to peak	= 720 min
Time interval	= 1 min	Hyd. volume	= 589 cuft
Drainage area	= 0.203 ac	Curve number	= 70*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.00 min
Total precip.	= 3.15 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.254 x 30) + (0.103 x 30)] / 0.203



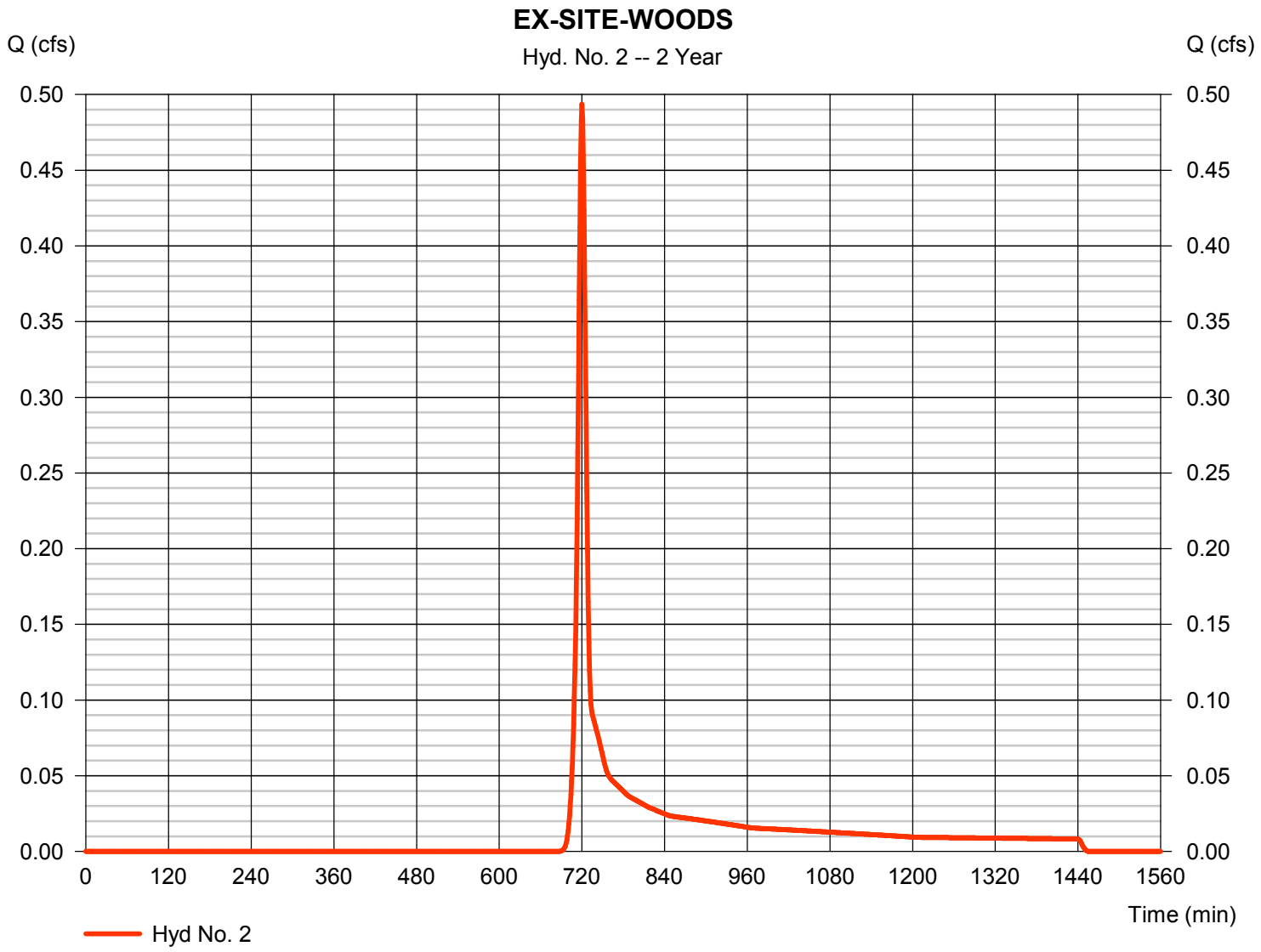
Hydrograph Report

Hyd. No. 2

EX-SITE-WOODS

Hydrograph type	= SCS Runoff	Peak discharge	= 0.494 cfs
Storm frequency	= 2 yrs	Time to peak	= 720 min
Time interval	= 1 min	Hyd. volume	= 1,178 cuft
Drainage area	= 0.406 ac	Curve number	= 70*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 9.50 min
Total precip.	= 3.15 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.254 x 30) + (0.103 x 30)] / 0.406

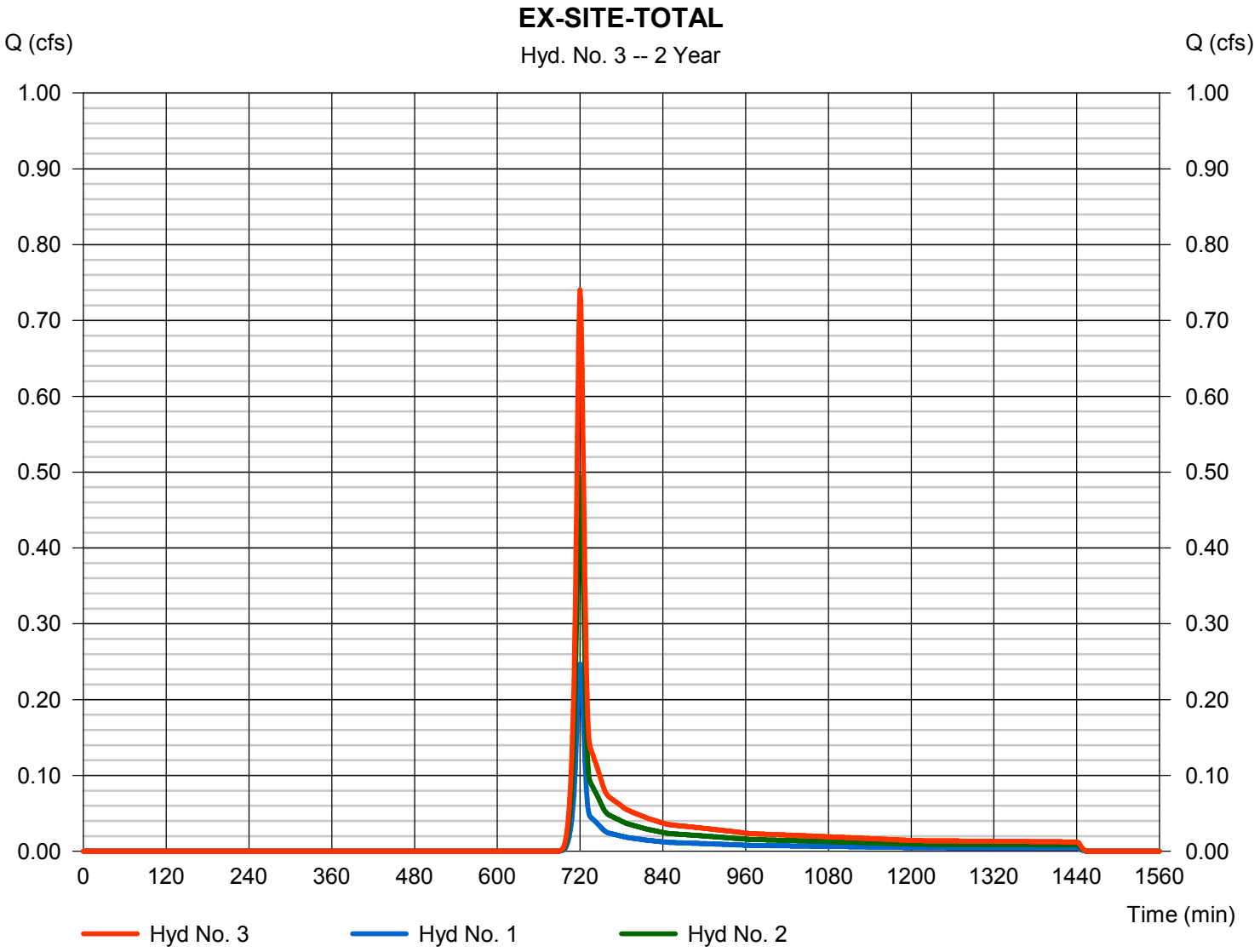


Hydrograph Report

Hyd. No. 3

EX-SITE-TOTAL

Hydrograph type	= Combine	Peak discharge	= 0.740 cfs
Storm frequency	= 2 yrs	Time to peak	= 720 min
Time interval	= 1 min	Hyd. volume	= 1,767 cuft
Inflow hyds.	= 1, 2	Contrib. drain. area	= 0.609 ac



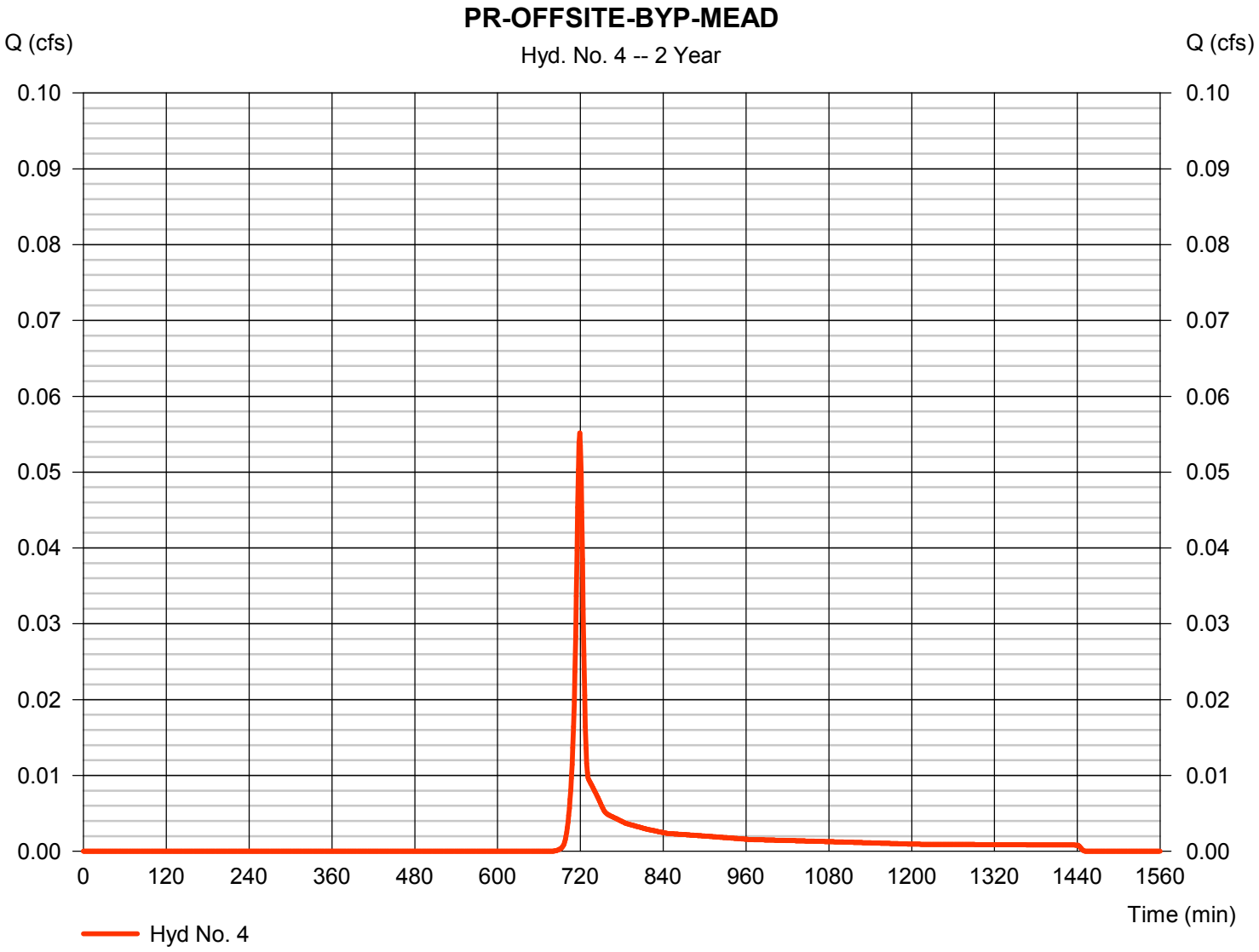
Hydrograph Report

Hyd. No. 4

PR-OFFSITE-BYP-MEAD

Hydrograph type	= SCS Runoff	Peak discharge	= 0.055 cfs
Storm frequency	= 2 yrs	Time to peak	= 719 min
Time interval	= 1 min	Hyd. volume	= 120 cuft
Drainage area	= 0.040 ac	Curve number	= 71*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.70 min
Total precip.	= 3.15 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.254 x 30) + (0.103 x 30)] / 0.040



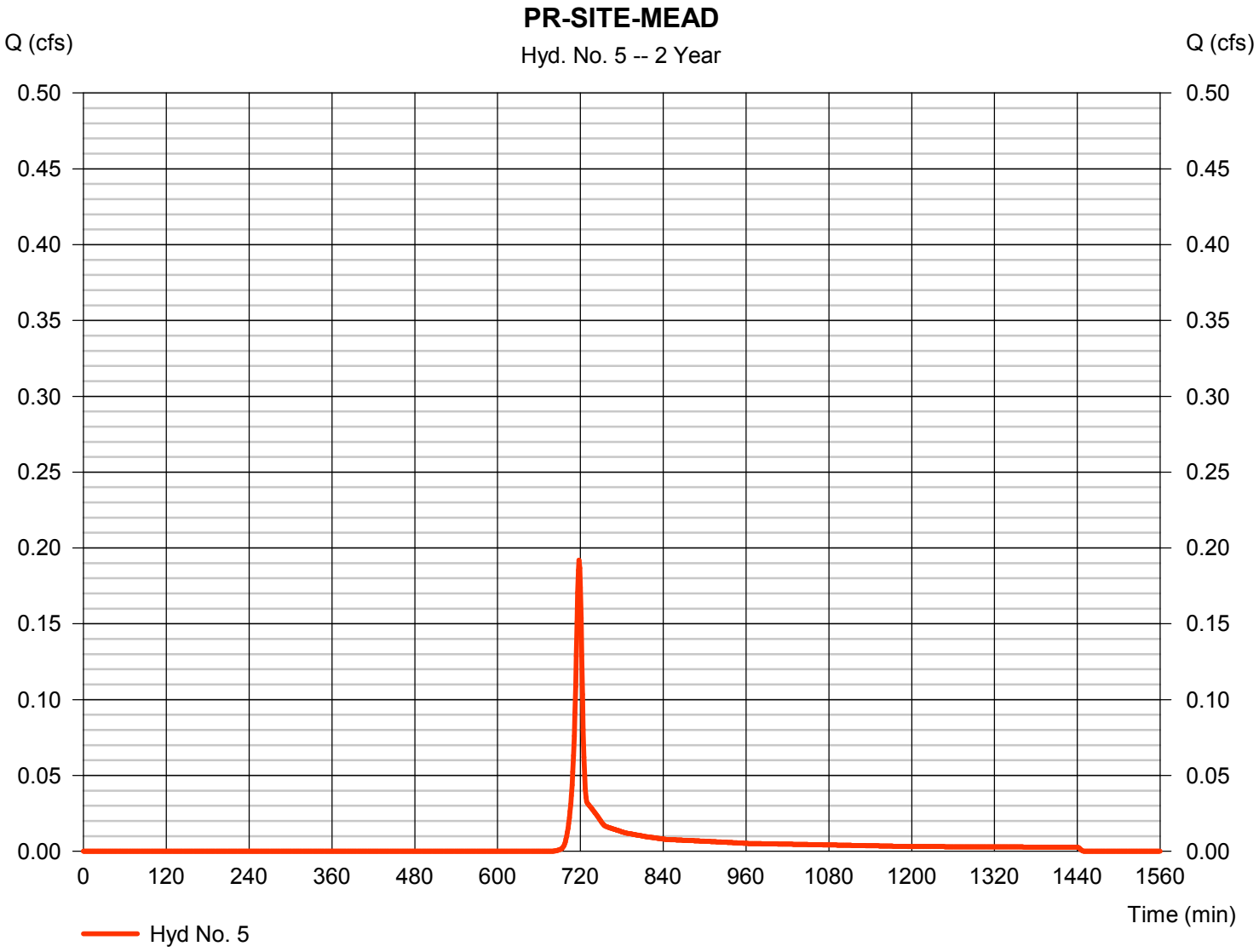
Hydrograph Report

Hyd. No. 5

PR-SITE-MEAD

Hydrograph type	= SCS Runoff	Peak discharge	= 0.192 cfs
Storm frequency	= 2 yrs	Time to peak	= 718 min
Time interval	= 1 min	Hyd. volume	= 397 cuft
Drainage area	= 0.125 ac	Curve number	= 71*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.80 min
Total precip.	= 3.15 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.352 x 71) + (0.054 x 71) + (0.305 x 71)] / 0.125

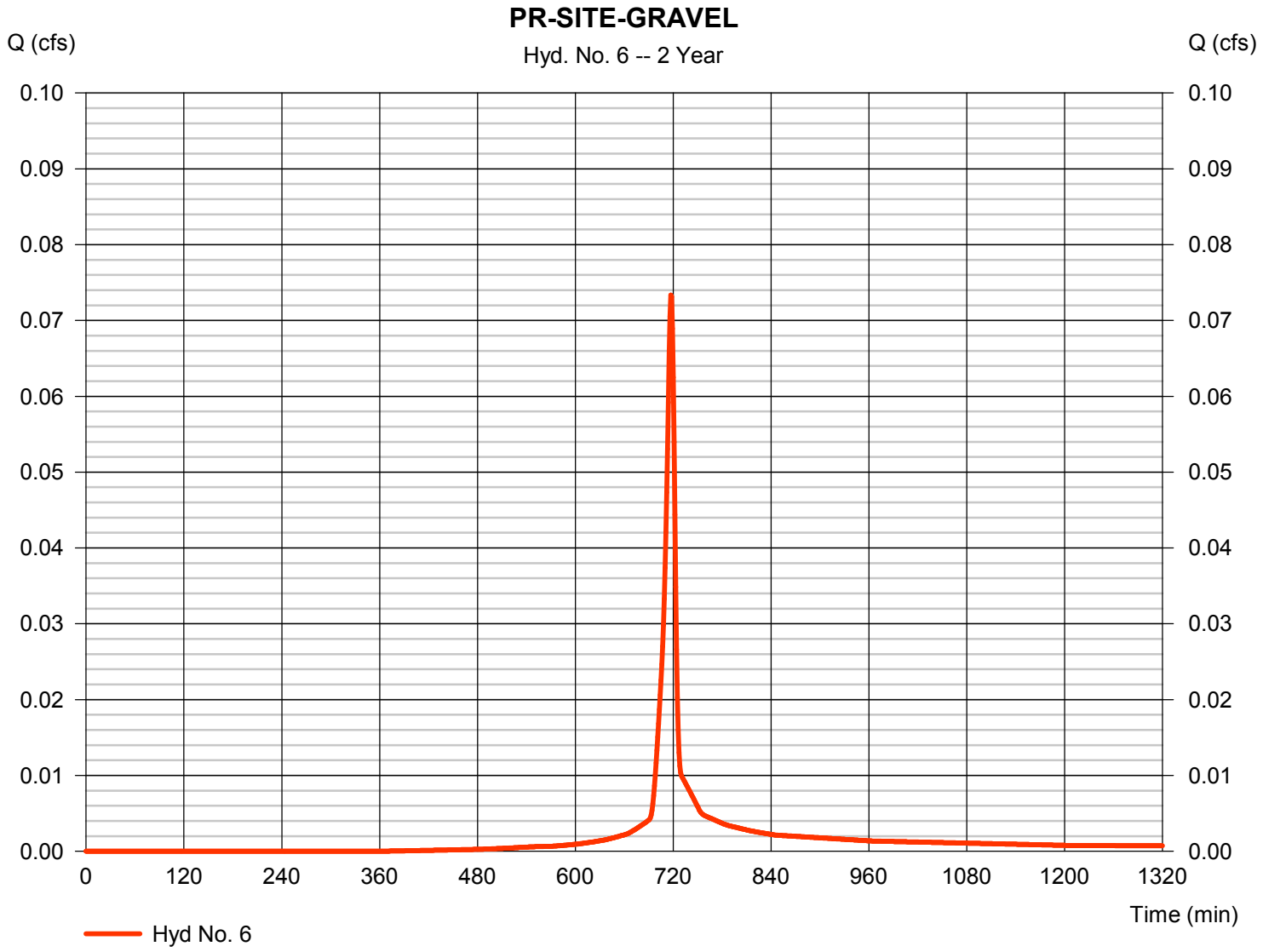


Hydrograph Report

Hyd. No. 6

PR-SITE-GRAVEL

Hydrograph type	= SCS Runoff	Peak discharge	= 0.073 cfs
Storm frequency	= 2 yrs	Time to peak	= 717 min
Time interval	= 1 min	Hyd. volume	= 152 cuft
Drainage area	= 0.020 ac	Curve number	= 89
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.80 min
Total precip.	= 3.15 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

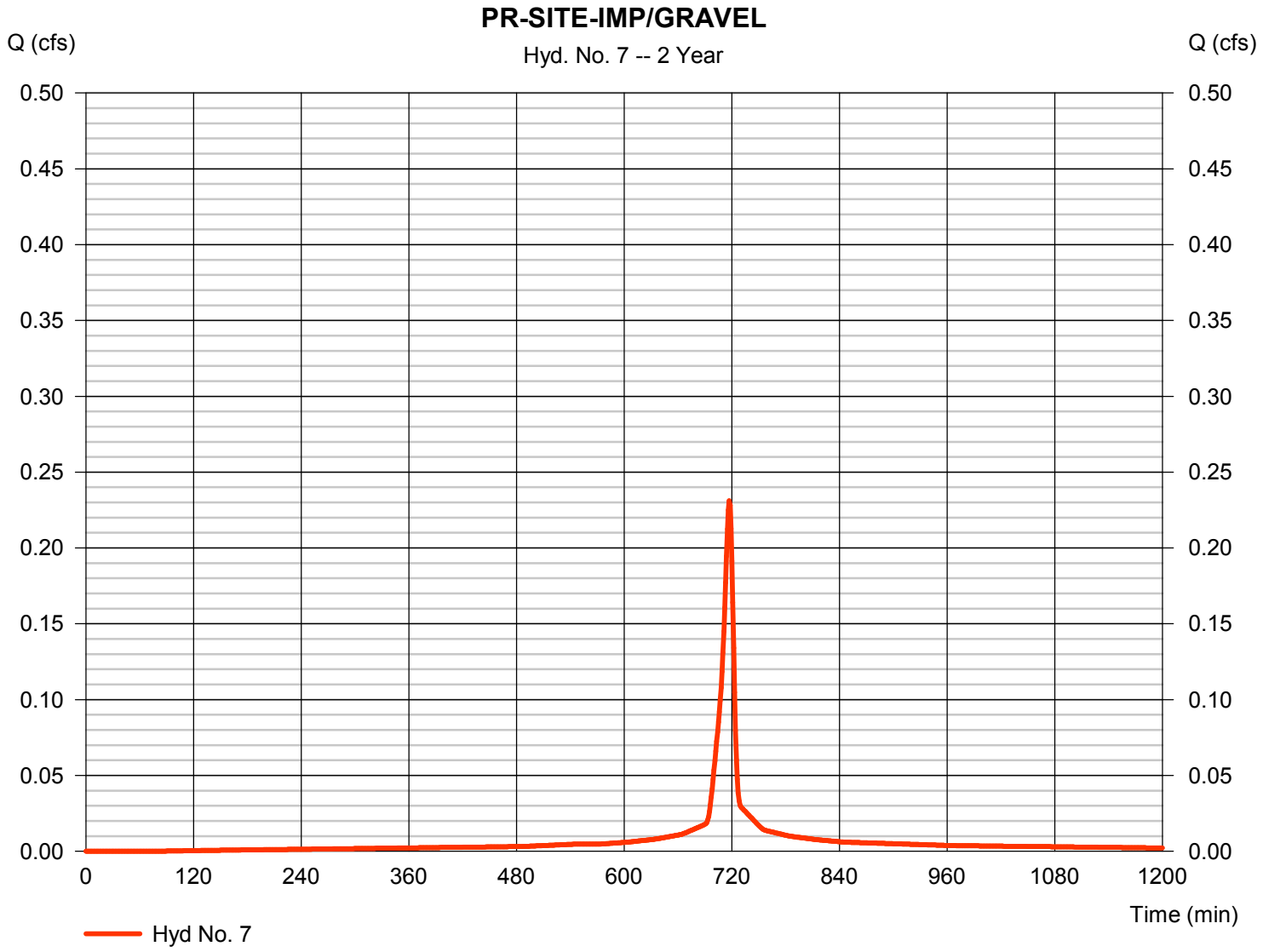


Hydrograph Report

Hyd. No. 7

PR-SITE-IMP/GRAVEL

Hydrograph type	= SCS Runoff	Peak discharge	= 0.231 cfs
Storm frequency	= 2 yrs	Time to peak	= 717 min
Time interval	= 1 min	Hyd. volume	= 546 cuft
Drainage area	= 0.050 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.80 min
Total precip.	= 3.15 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



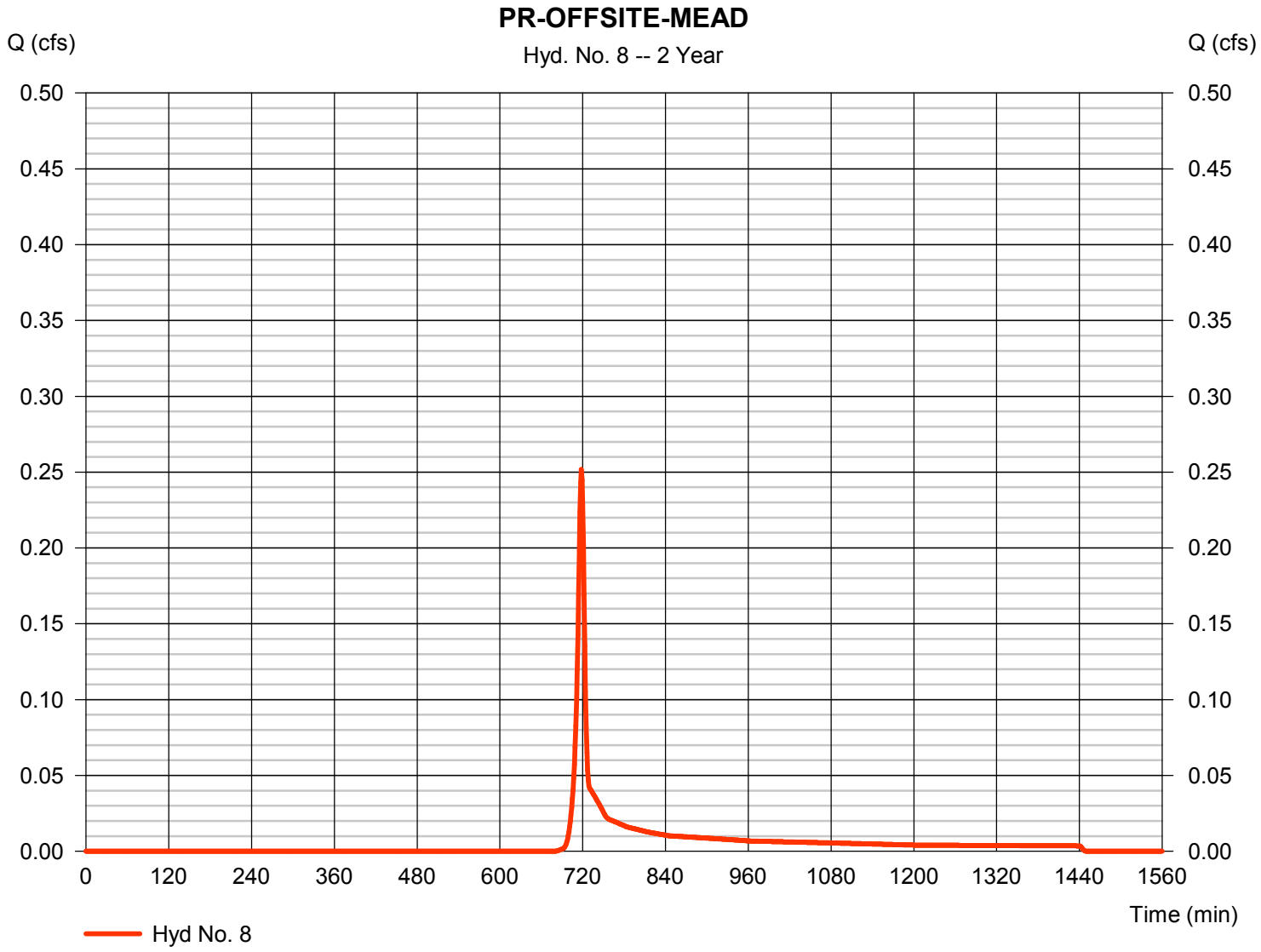
Hydrograph Report

Hyd. No. 8

PR-OFFSITE-MEAD

Hydrograph type	= SCS Runoff	Peak discharge	= 0.252 cfs
Storm frequency	= 2 yrs	Time to peak	= 718 min
Time interval	= 1 min	Hyd. volume	= 521 cuft
Drainage area	= 0.164 ac	Curve number	= 71*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.40 min
Total precip.	= 3.15 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.254 x 30) + (0.103 x 30)] / 0.164

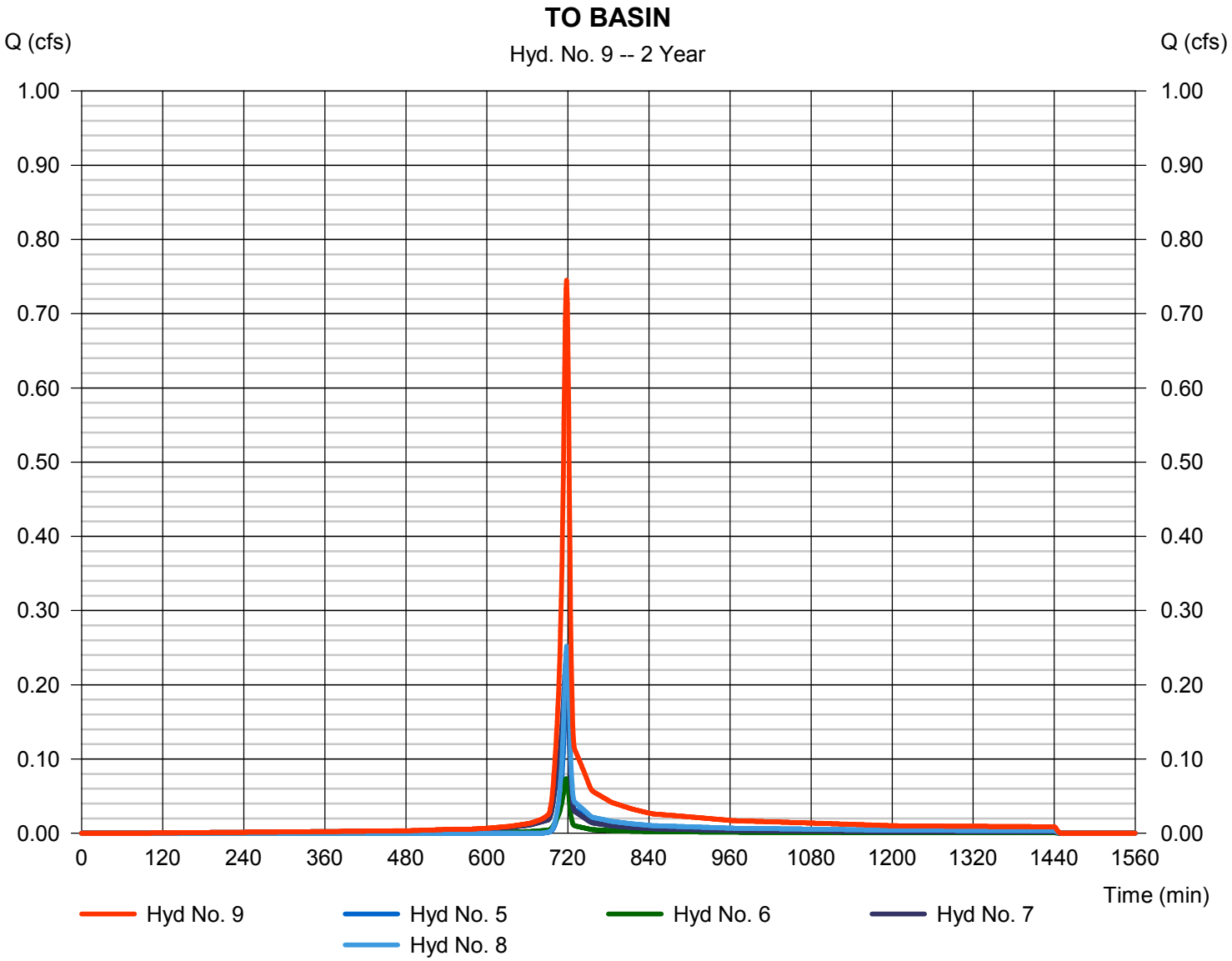


Hydrograph Report

Hyd. No. 9

TO BASIN

Hydrograph type	= Combine	Peak discharge	= 0.745 cfs
Storm frequency	= 2 yrs	Time to peak	= 718 min
Time interval	= 1 min	Hyd. volume	= 1,616 cuft
Inflow hyds.	= 5, 6, 7, 8	Contrib. drain. area	= 0.359 ac



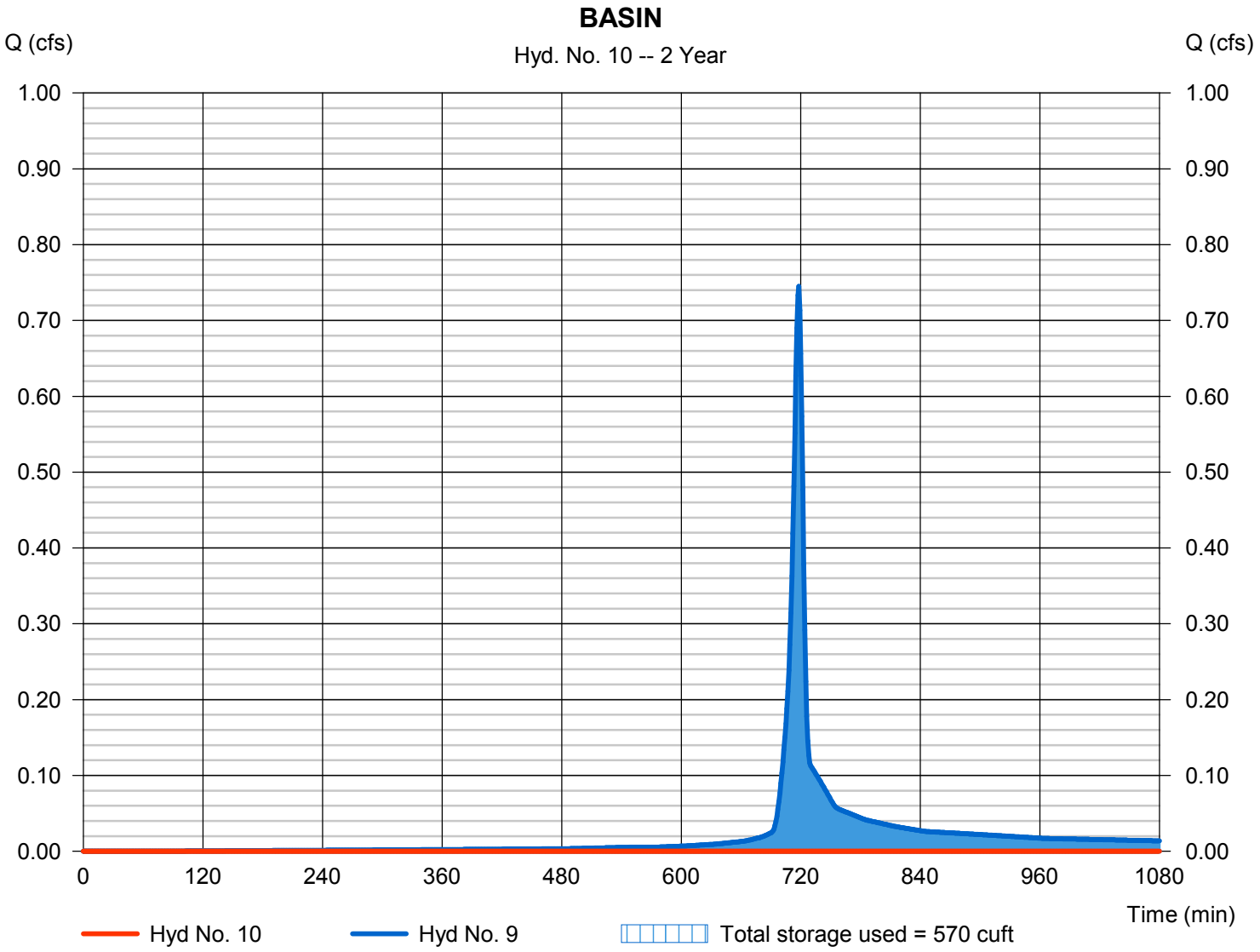
Hydrograph Report

Hyd. No. 10

BASIN

Hydrograph type	= Reservoir	Peak discharge	= 0.000 cfs
Storm frequency	= 2 yrs	Time to peak	= 798 min
Time interval	= 1 min	Hyd. volume	= 0 cuft
Inflow hyd. No.	= 9 - TO BASIN	Max. Elevation	= 702.22 ft
Reservoir name	= UG N-12 Perforated Pipe System	Max. Storage	= 570 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



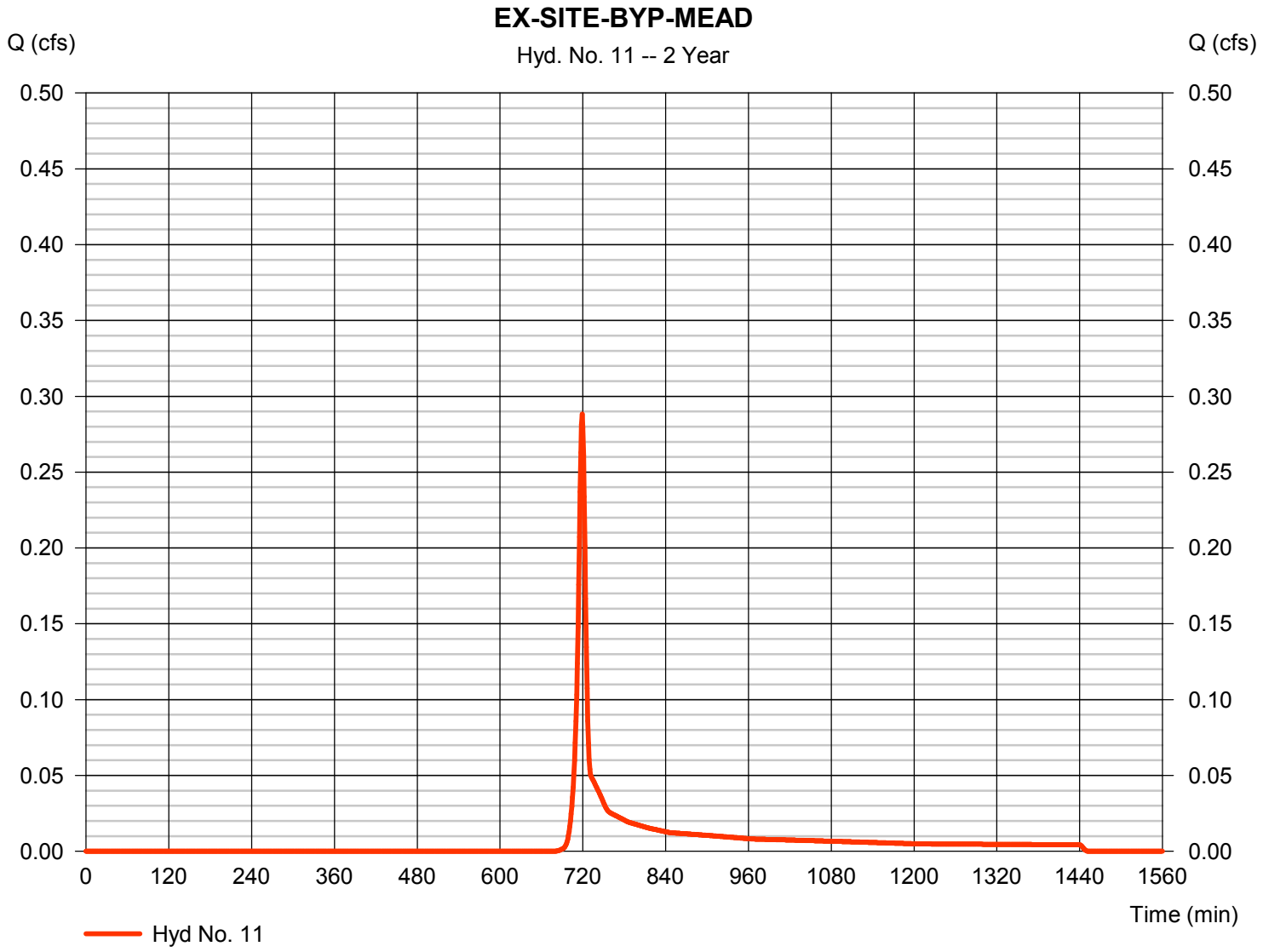
Hydrograph Report

Hyd. No. 11

EX-SITE-BYP-MEAD

Hydrograph type	= SCS Runoff	Peak discharge	= 0.288 cfs
Storm frequency	= 2 yrs	Time to peak	= 719 min
Time interval	= 1 min	Hyd. volume	= 627 cuft
Drainage area	= 0.209 ac	Curve number	= 71*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.80 min
Total precip.	= 3.15 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.364 x 71) + (0.314 x 71) + (0.123 x 71)] / 0.209

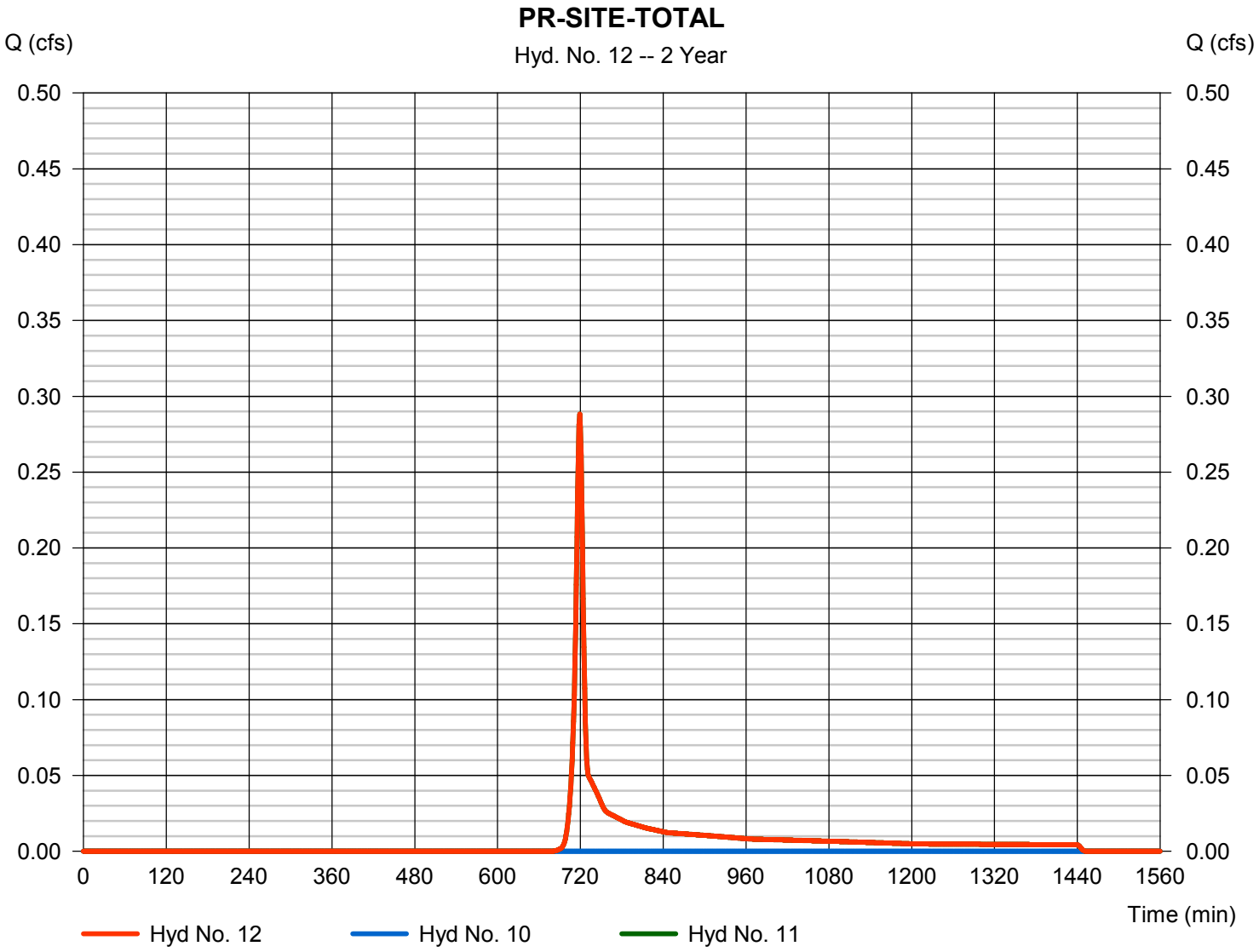


Hydrograph Report

Hyd. No. 12

PR-SITE-TOTAL

Hydrograph type	=	Combine	Peak discharge	=	0.288 cfs
Storm frequency	=	2 yrs	Time to peak	=	719 min
Time interval	=	1 min	Hyd. volume	=	627 cuft
Inflow hyds.	=	10, 11	Contrib. drain. area	=	0.209 ac

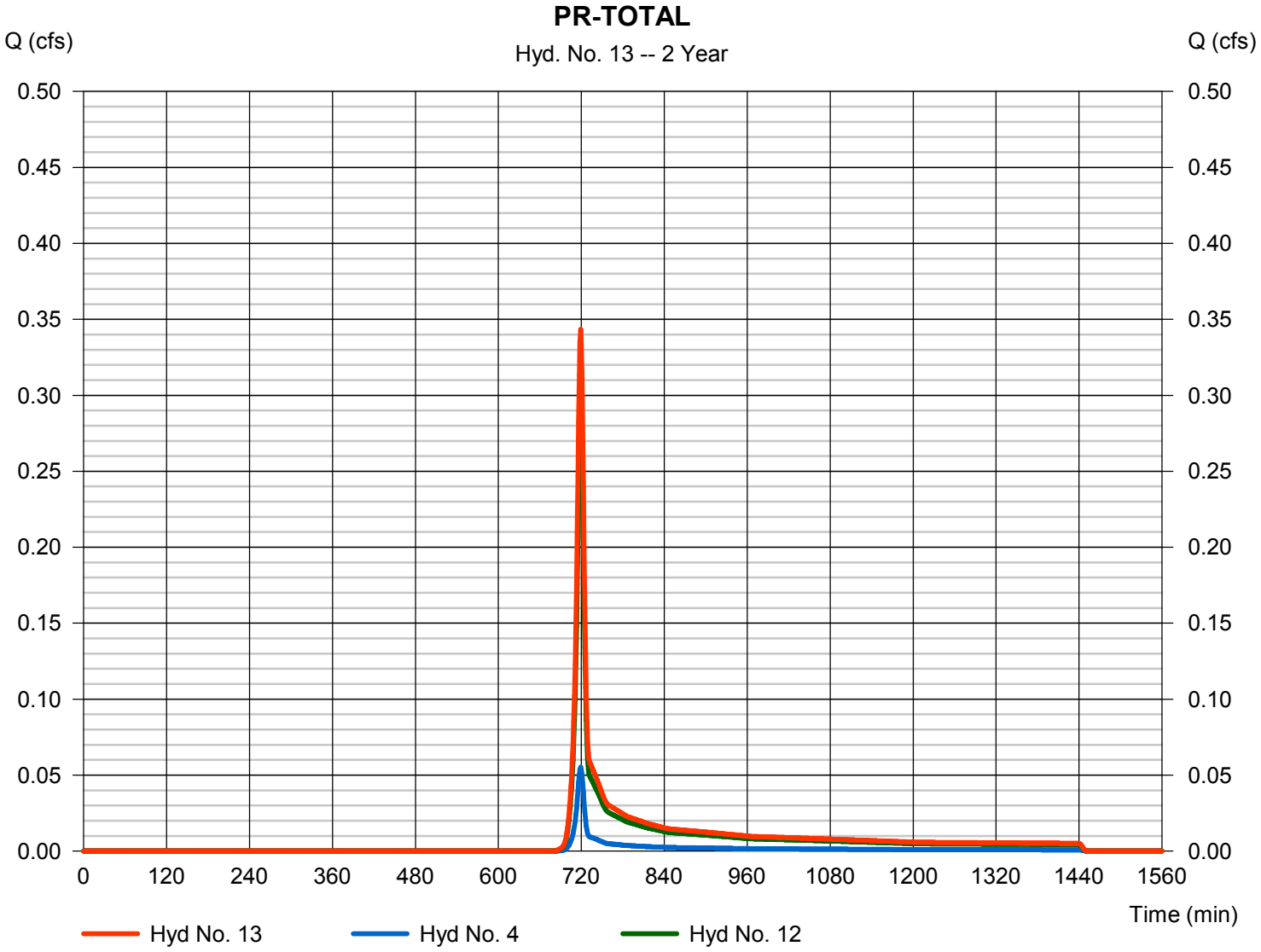


Hydrograph Report

Hyd. No. 13

PR-TOTAL

Hydrograph type	= Combine	Peak discharge	= 0.343 cfs
Storm frequency	= 2 yrs	Time to peak	= 719 min
Time interval	= 1 min	Hyd. volume	= 747 cuft
Inflow hyds.	= 4, 12	Contrib. drain. area	= 0.040 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v11

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	0.409	1	720	941	------	------	------	EX-OFFSITE-WOODS
2	SCS Runoff	0.819	1	720	1,881	------	------	------	EX-SITE-WOODS
3	Combine	1.228	1	720	2,822	1, 2	------	------	EX-SITE-TOTAL
4	SCS Runoff	0.089	1	719	190	------	------	------	PR-OFFSITE-BYP-MEAD
5	SCS Runoff	0.310	1	718	627	------	------	------	PR-SITE-MEAD
6	SCS Runoff	0.098	1	717	206	------	------	------	PR-SITE-GRAVEL
7	SCS Runoff	0.289	1	717	690	------	------	------	PR-SITE-IMP/GRAVEL
8	SCS Runoff	0.407	1	718	822	------	------	------	PR-OFFSITE-MEAD
9	Combine	1.100	1	718	2,345	5, 6, 7, 8	------	------	TO BASIN
10	Reservoir	0.000	1	750	0	9	702.76	935	BASIN
11	SCS Runoff	0.467	1	719	991	------	------	------	EX-SITE-BYP-MEAD
12	Combine	0.467	1	719	991	10, 11	------	------	PR-SITE-TOTAL
13	Combine	0.556	1	719	1,181	4, 12	------	------	PR-TOTAL

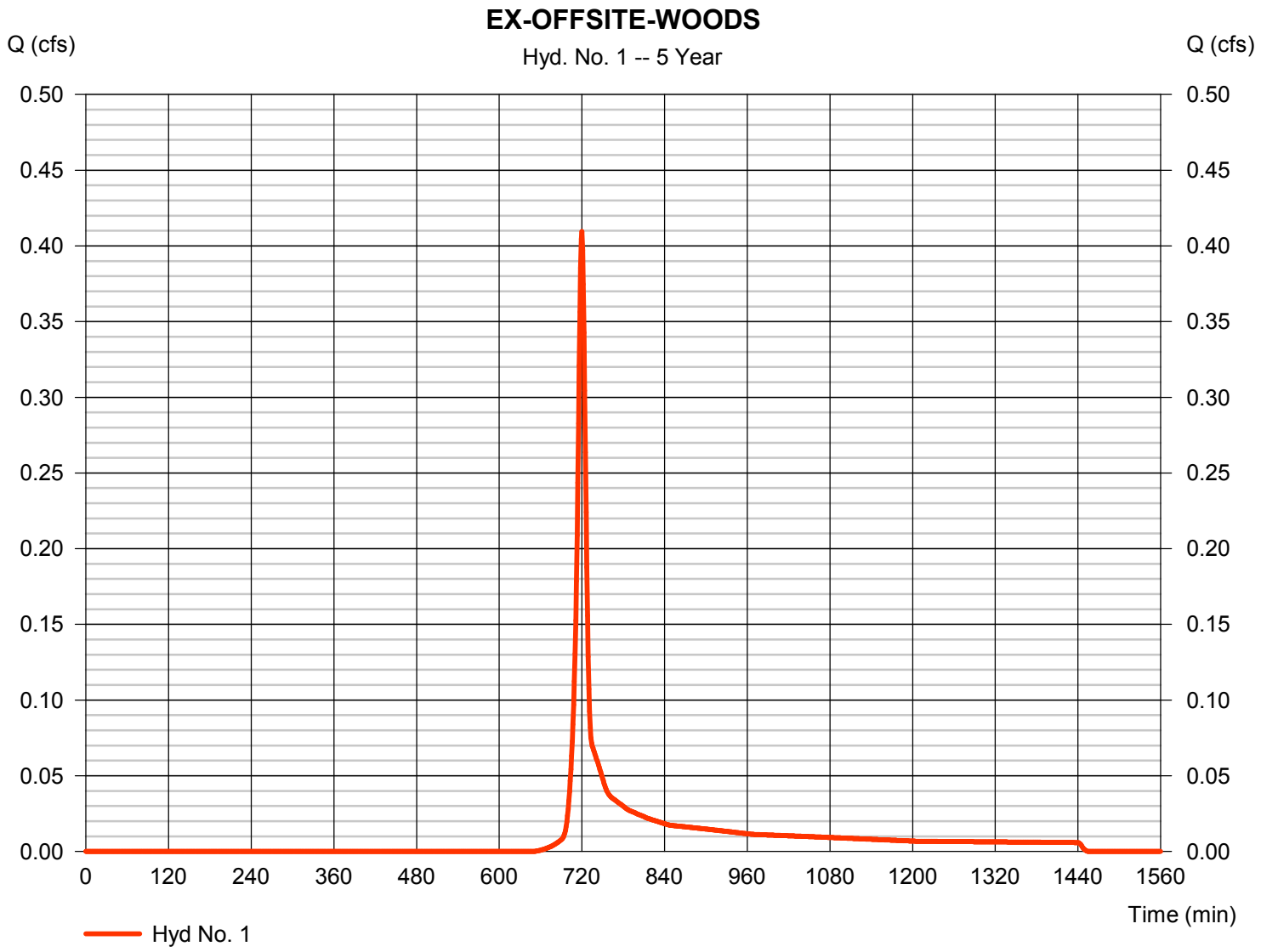
Hydrograph Report

Hyd. No. 1

EX-OFFSITE-WOODS

Hydrograph type	= SCS Runoff	Peak discharge	= 0.409 cfs
Storm frequency	= 5 yrs	Time to peak	= 720 min
Time interval	= 1 min	Hyd. volume	= 941 cuft
Drainage area	= 0.203 ac	Curve number	= 70*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.00 min
Total precip.	= 3.92 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.254 x 30) + (0.103 x 30)] / 0.203



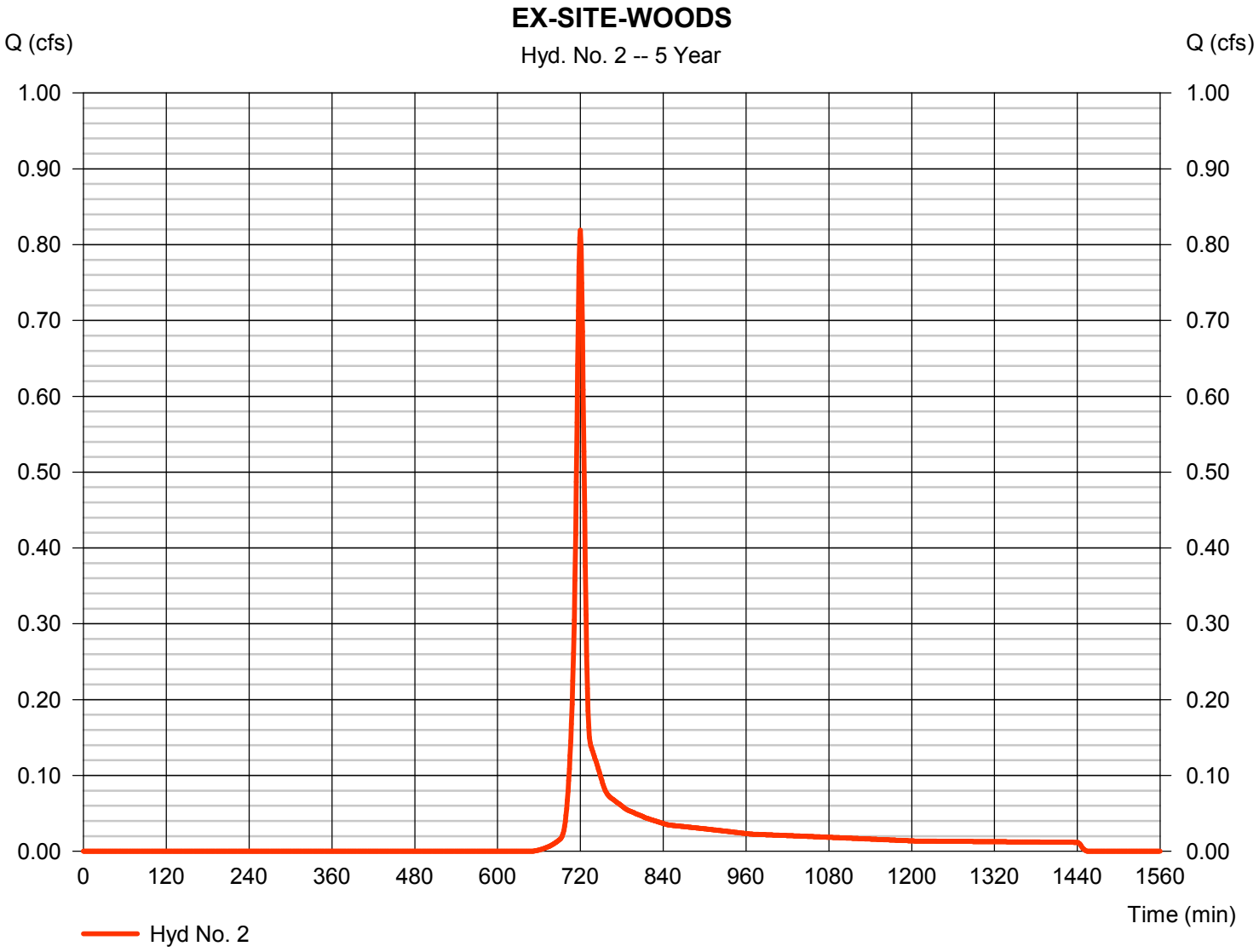
Hydrograph Report

Hyd. No. 2

EX-SITE-WOODS

Hydrograph type	= SCS Runoff	Peak discharge	= 0.819 cfs
Storm frequency	= 5 yrs	Time to peak	= 720 min
Time interval	= 1 min	Hyd. volume	= 1,881 cuft
Drainage area	= 0.406 ac	Curve number	= 70*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 9.50 min
Total precip.	= 3.92 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.254 x 30) + (0.103 x 30)] / 0.406

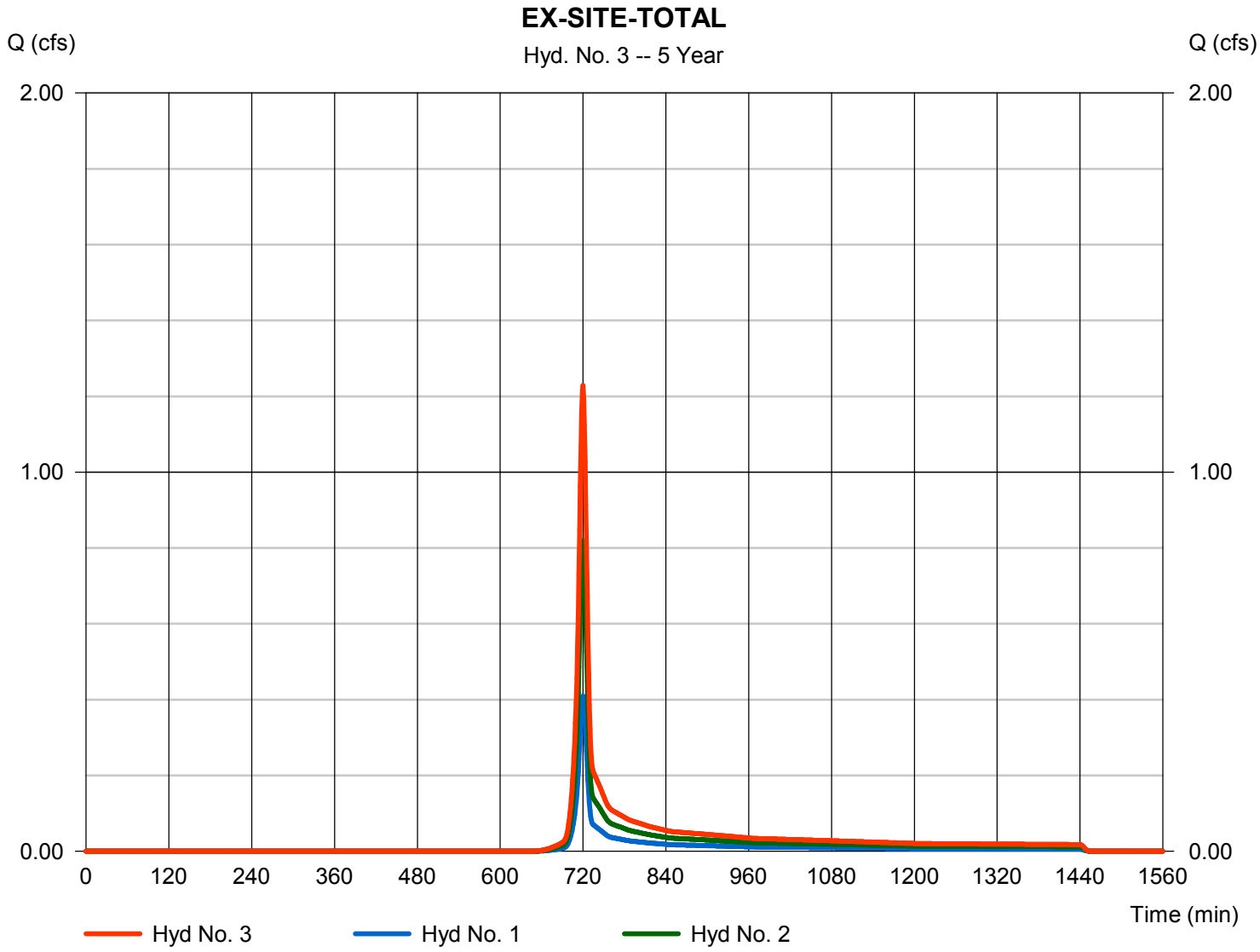


Hydrograph Report

Hyd. No. 3

EX-SITE-TOTAL

Hydrograph type	= Combine	Peak discharge	= 1.228 cfs
Storm frequency	= 5 yrs	Time to peak	= 720 min
Time interval	= 1 min	Hyd. volume	= 2,822 cuft
Inflow hyds.	= 1, 2	Contrib. drain. area	= 0.609 ac



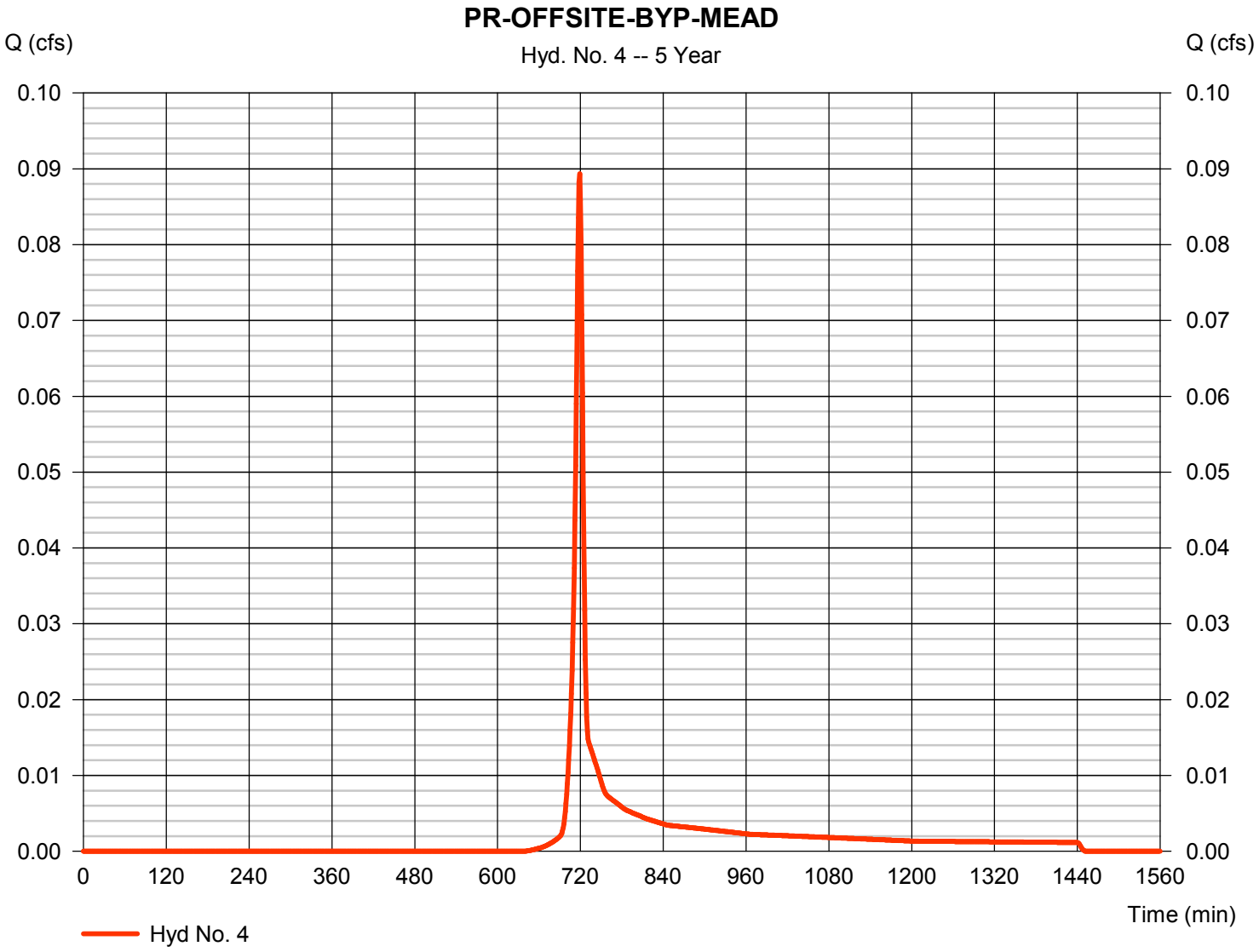
Hydrograph Report

Hyd. No. 4

PR-OFFSITE-BYP-MEAD

Hydrograph type	= SCS Runoff	Peak discharge	= 0.089 cfs
Storm frequency	= 5 yrs	Time to peak	= 719 min
Time interval	= 1 min	Hyd. volume	= 190 cuft
Drainage area	= 0.040 ac	Curve number	= 71*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.70 min
Total precip.	= 3.92 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.254 x 30) + (0.103 x 30)] / 0.040



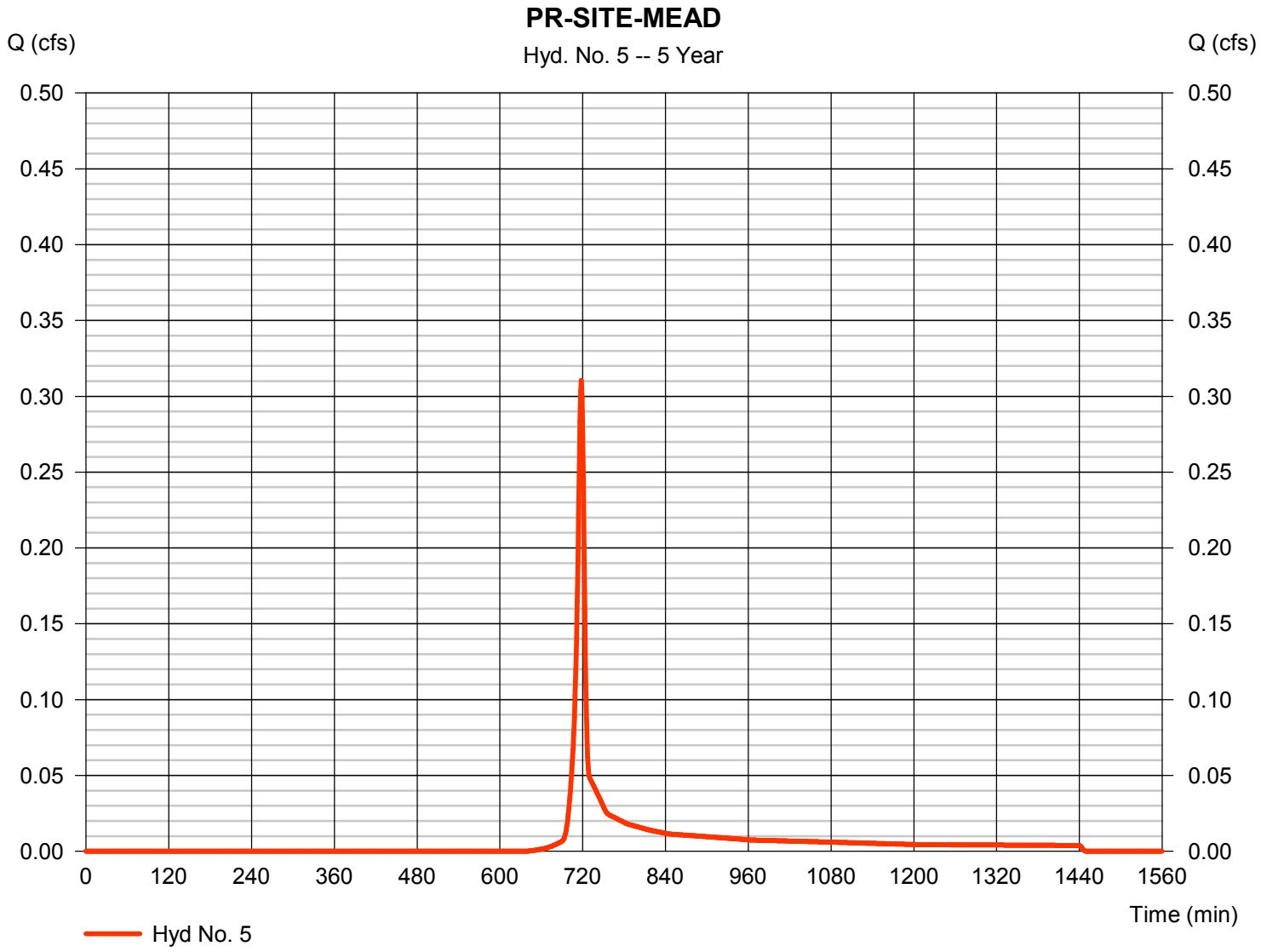
Hydrograph Report

Hyd. No. 5

PR-SITE-MEAD

Hydrograph type	= SCS Runoff	Peak discharge	= 0.310 cfs
Storm frequency	= 5 yrs	Time to peak	= 718 min
Time interval	= 1 min	Hyd. volume	= 627 cuft
Drainage area	= 0.125 ac	Curve number	= 71*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.80 min
Total precip.	= 3.92 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.352 x 71) + (0.054 x 71) + (0.305 x 71)] / 0.125

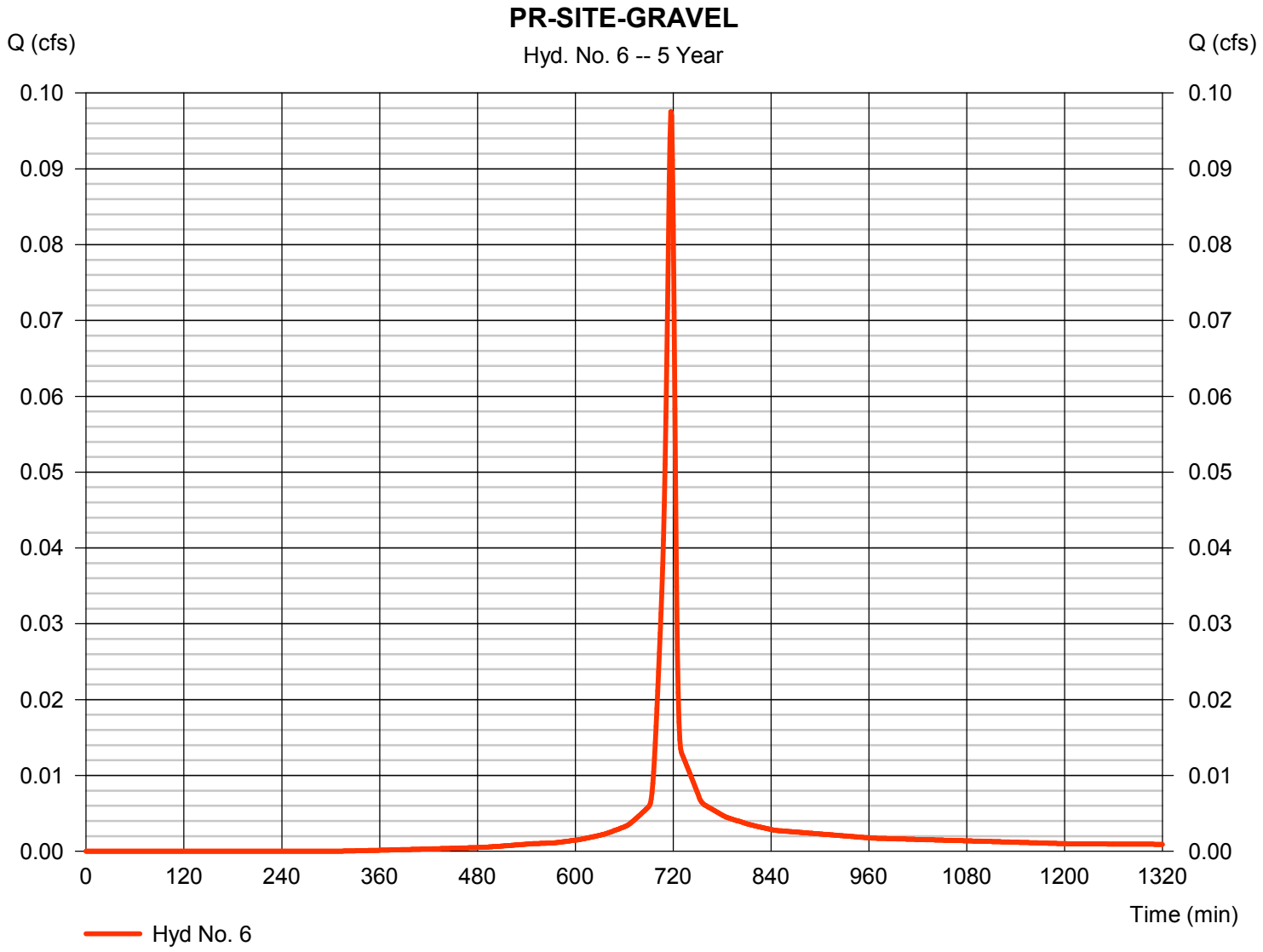


Hydrograph Report

Hyd. No. 6

PR-SITE-GRAVEL

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.098 cfs
Storm frequency	=	5 yrs	Time to peak	=	717 min
Time interval	=	1 min	Hyd. volume	=	206 cuft
Drainage area	=	0.020 ac	Curve number	=	89
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.80 min
Total precip.	=	3.92 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

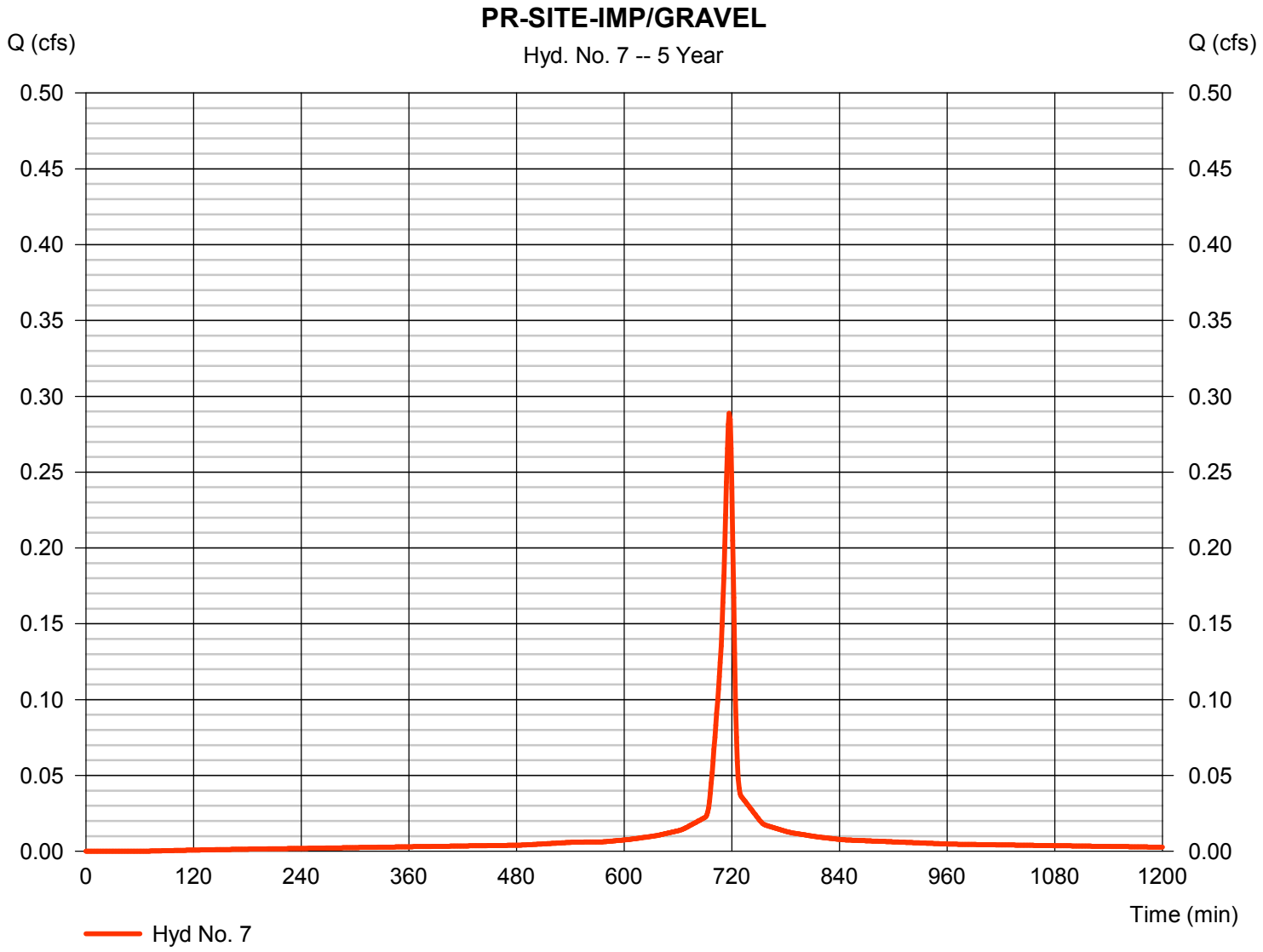


Hydrograph Report

Hyd. No. 7

PR-SITE-IMP/GRAVEL

Hydrograph type	= SCS Runoff	Peak discharge	= 0.289 cfs
Storm frequency	= 5 yrs	Time to peak	= 717 min
Time interval	= 1 min	Hyd. volume	= 690 cuft
Drainage area	= 0.050 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.80 min
Total precip.	= 3.92 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



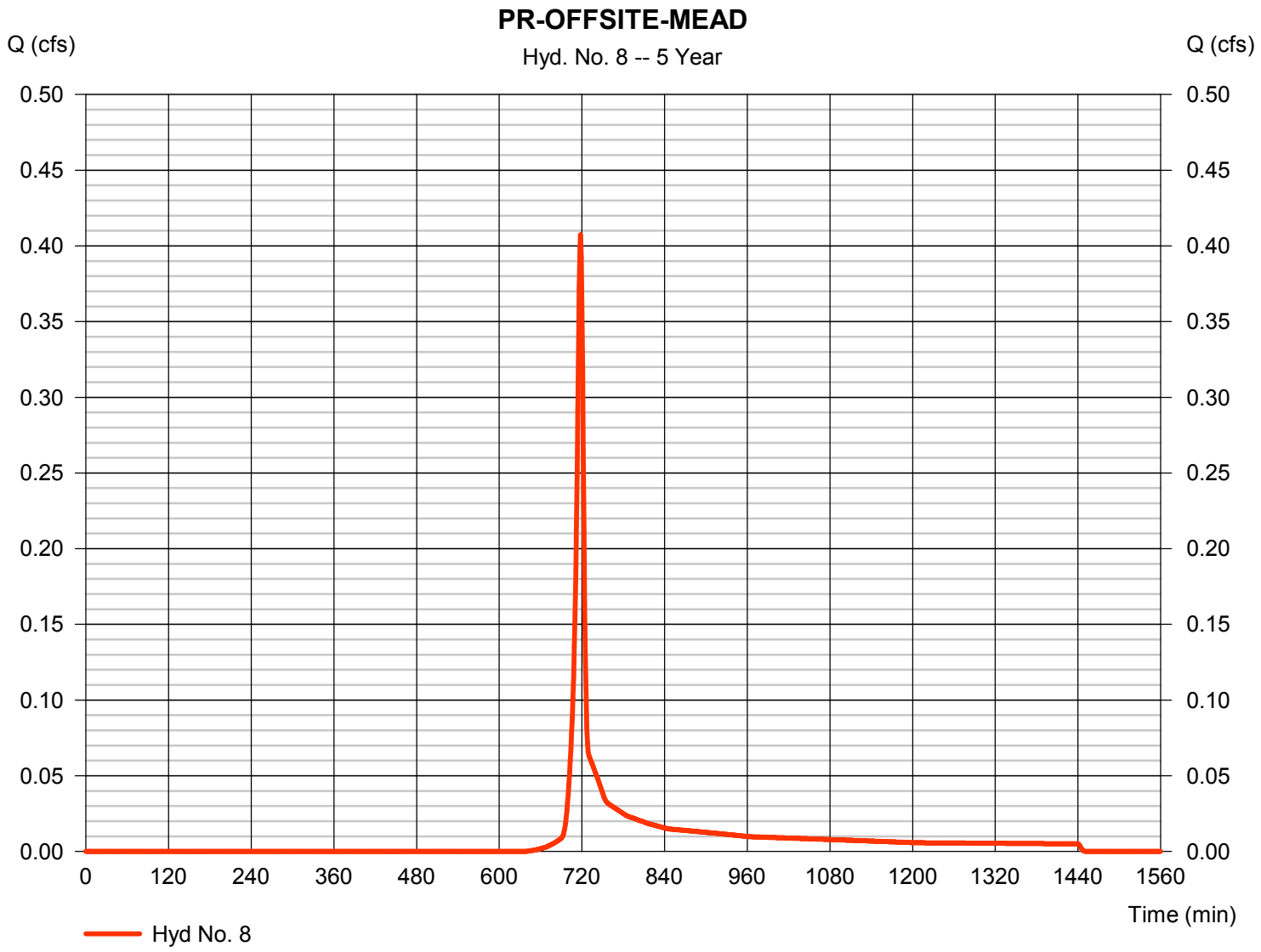
Hydrograph Report

Hyd. No. 8

PR-OFFSITE-MEAD

Hydrograph type	= SCS Runoff	Peak discharge	= 0.407 cfs
Storm frequency	= 5 yrs	Time to peak	= 718 min
Time interval	= 1 min	Hyd. volume	= 822 cuft
Drainage area	= 0.164 ac	Curve number	= 71*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.40 min
Total precip.	= 3.92 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.254 x 30) + (0.103 x 30)] / 0.164

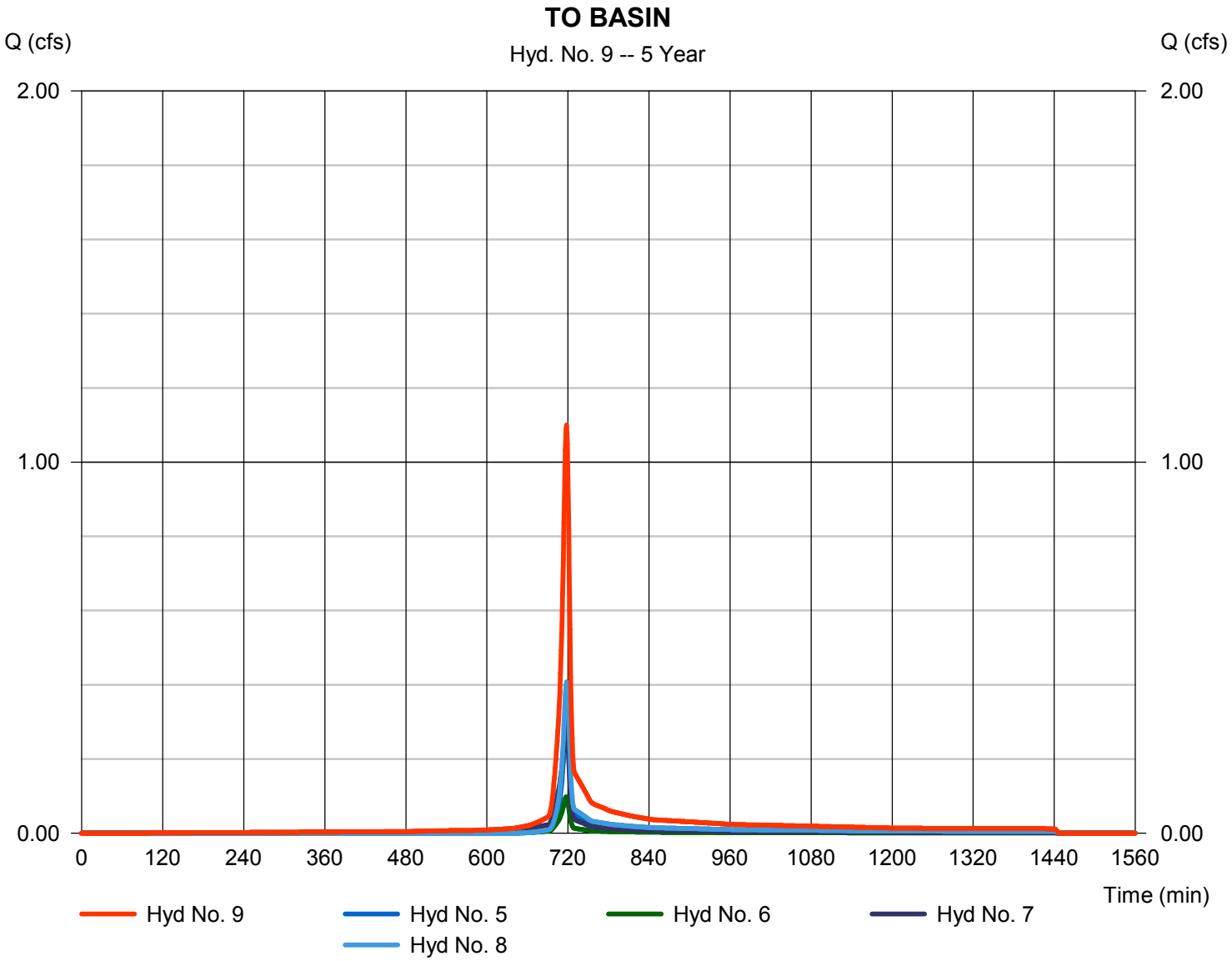


Hydrograph Report

Hyd. No. 9

TO BASIN

Hydrograph type	= Combine	Peak discharge	= 1.100 cfs
Storm frequency	= 5 yrs	Time to peak	= 718 min
Time interval	= 1 min	Hyd. volume	= 2,345 cuft
Inflow hyds.	= 5, 6, 7, 8	Contrib. drain. area	= 0.359 ac



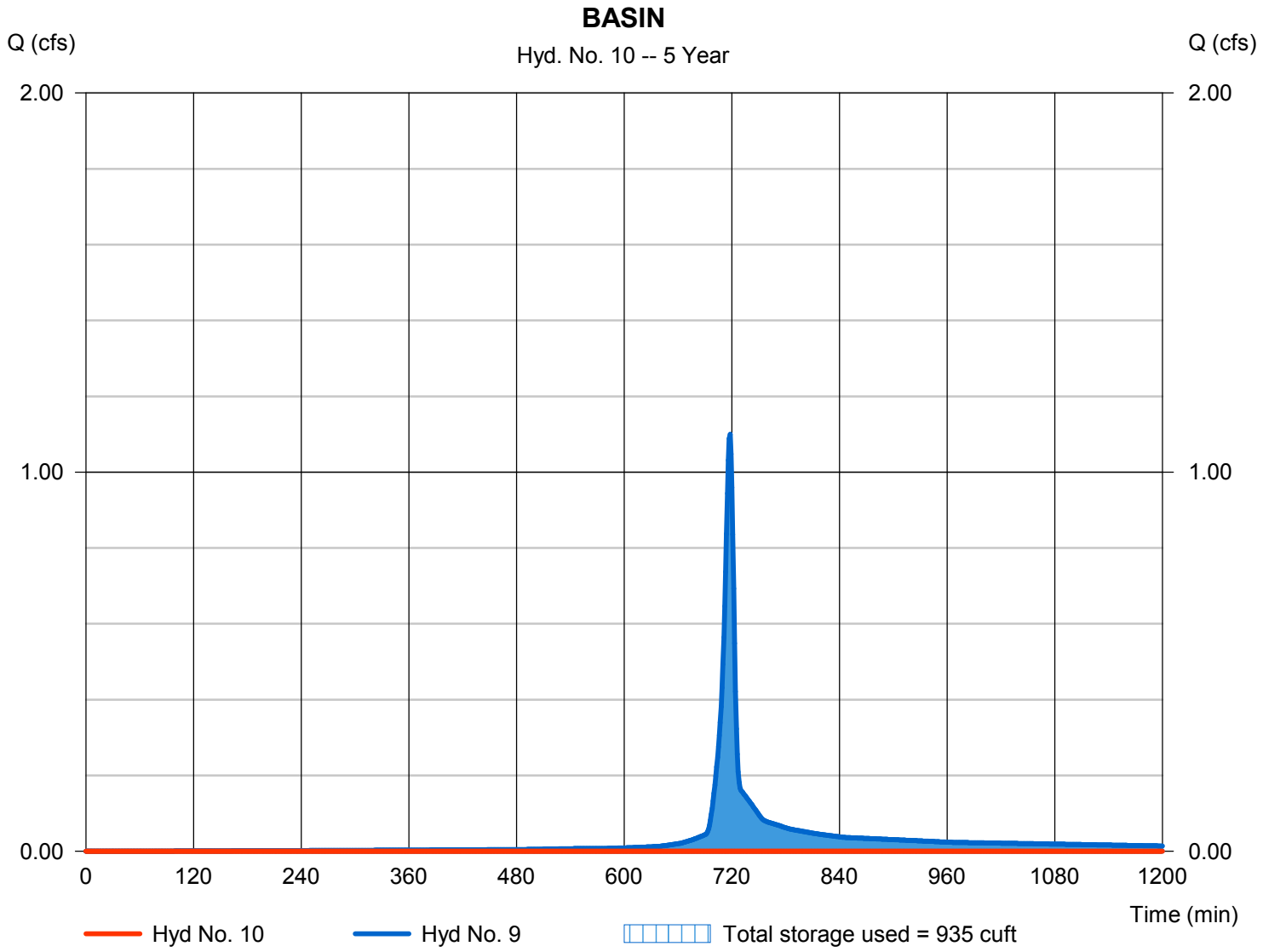
Hydrograph Report

Hyd. No. 10

BASIN

Hydrograph type	=	Reservoir	Peak discharge	=	0.000 cfs
Storm frequency	=	5 yrs	Time to peak	=	750 min
Time interval	=	1 min	Hyd. volume	=	0 cuft
Inflow hyd. No.	=	9 - TO BASIN	Max. Elevation	=	702.76 ft
Reservoir name	=	UG N-12 Perforated Pipe System	Max. Storage	=	935 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



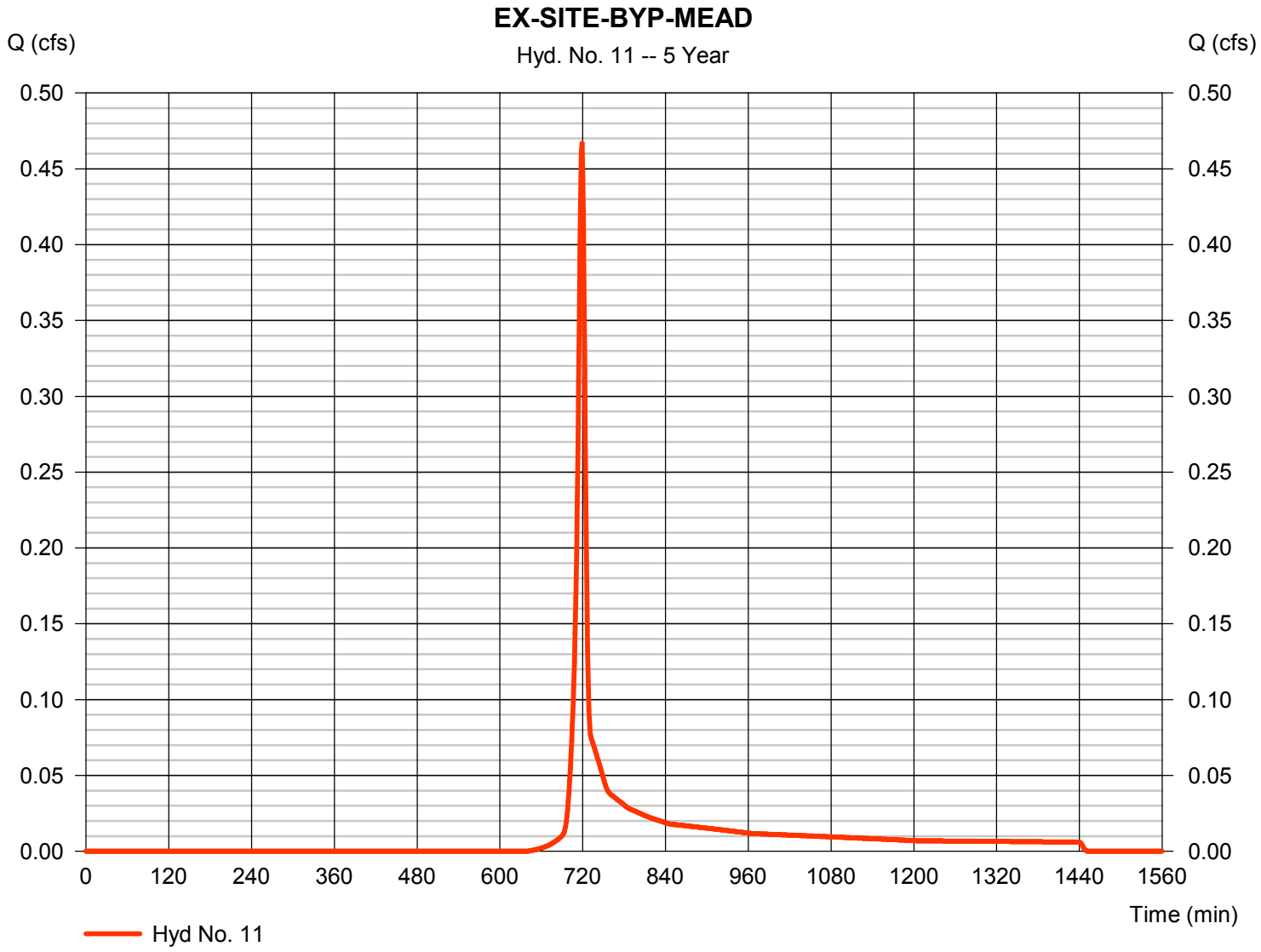
Hydrograph Report

Hyd. No. 11

EX-SITE-BYP-MEAD

Hydrograph type	= SCS Runoff	Peak discharge	= 0.467 cfs
Storm frequency	= 5 yrs	Time to peak	= 719 min
Time interval	= 1 min	Hyd. volume	= 991 cuft
Drainage area	= 0.209 ac	Curve number	= 71*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.80 min
Total precip.	= 3.92 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.364 x 71) + (0.314 x 71) + (0.123 x 71)] / 0.209

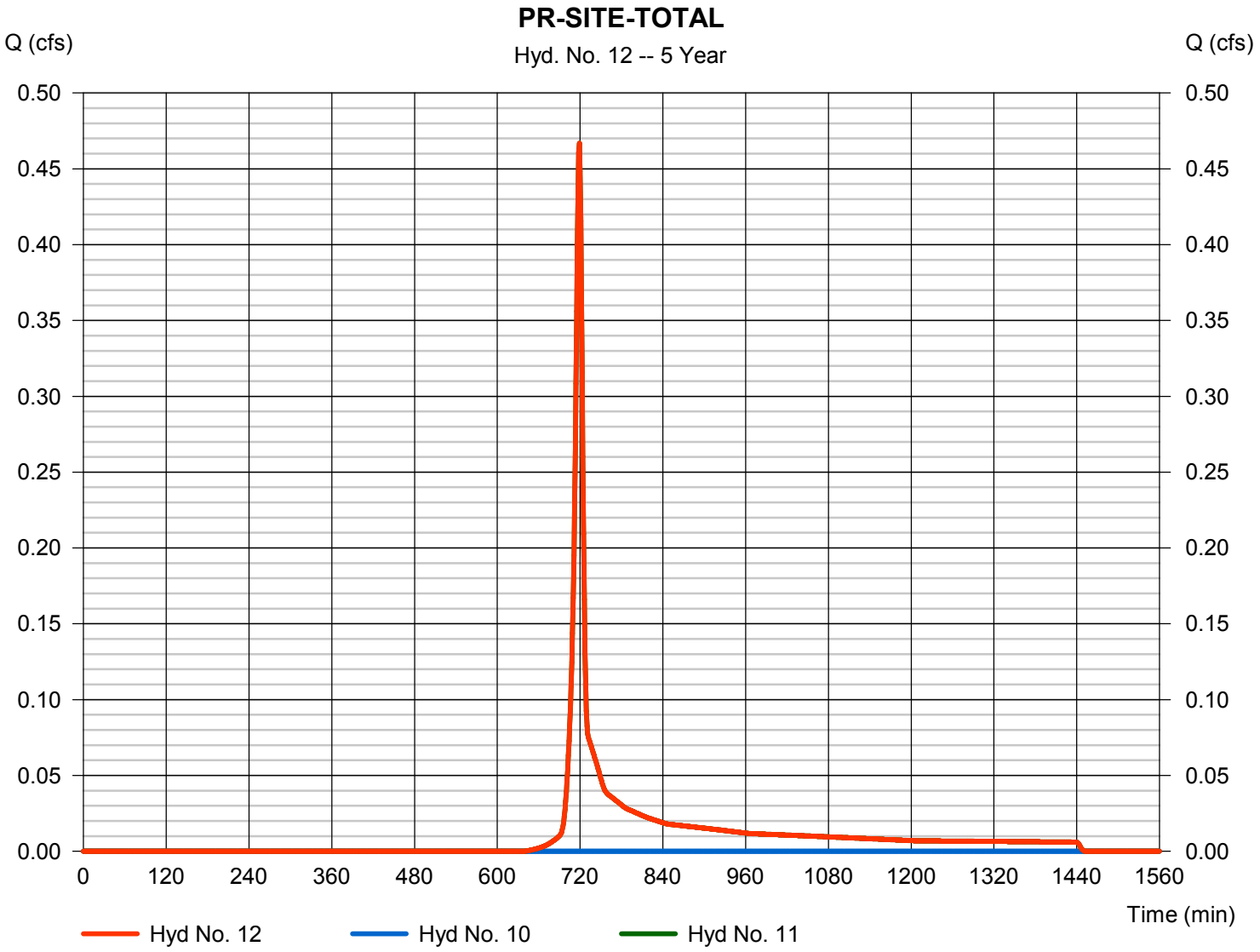


Hydrograph Report

Hyd. No. 12

PR-SITE-TOTAL

Hydrograph type	=	Combine	Peak discharge	=	0.467 cfs
Storm frequency	=	5 yrs	Time to peak	=	719 min
Time interval	=	1 min	Hyd. volume	=	991 cuft
Inflow hyds.	=	10, 11	Contrib. drain. area	=	0.209 ac

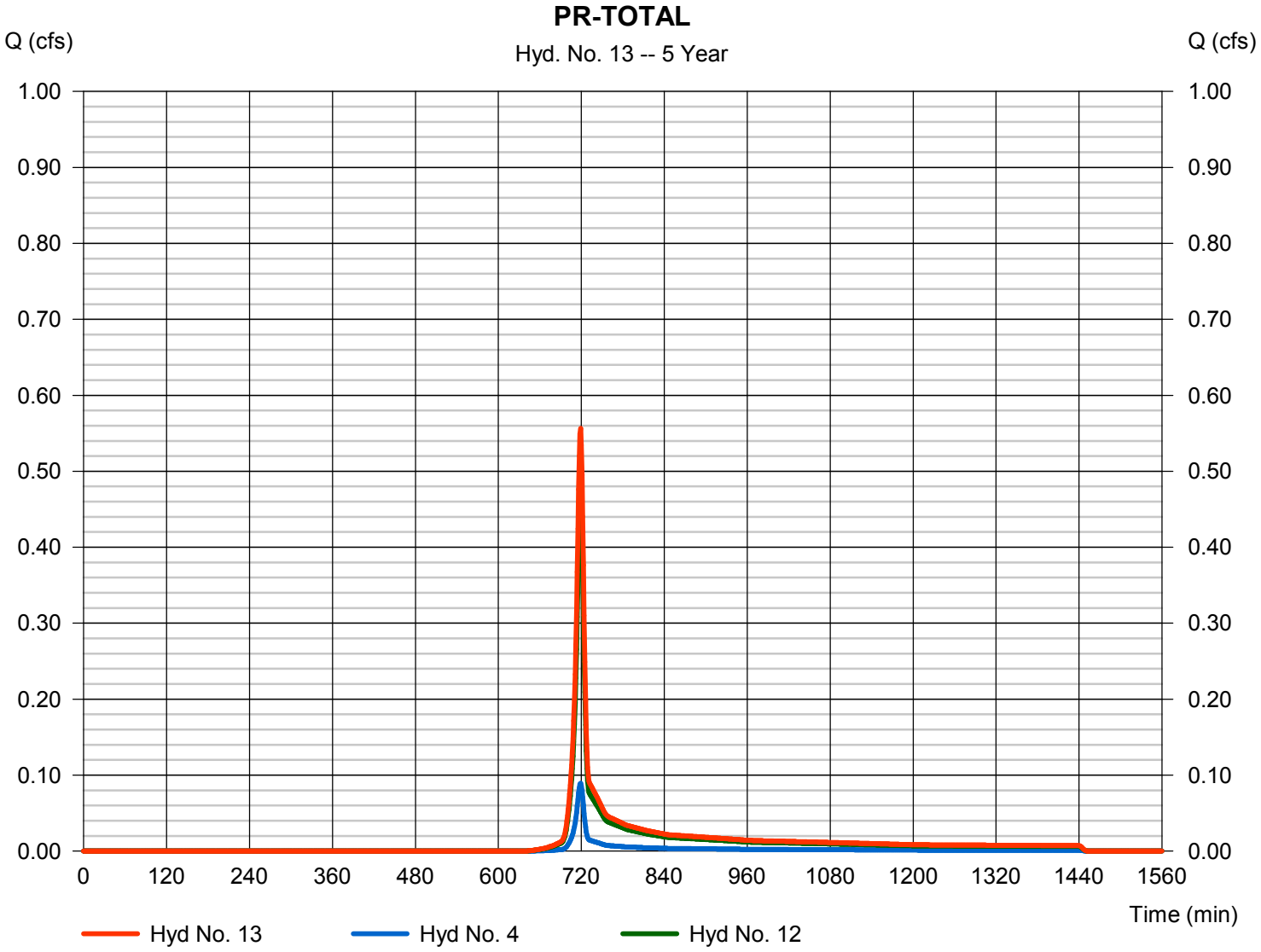


Hydrograph Report

Hyd. No. 13

PR-TOTAL

Hydrograph type	= Combine	Peak discharge	= 0.556 cfs
Storm frequency	= 5 yrs	Time to peak	= 719 min
Time interval	= 1 min	Hyd. volume	= 1,181 cuft
Inflow hyds.	= 4, 12	Contrib. drain. area	= 0.040 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v11

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	0.561	1	720	1,275	------	------	------	EX-OFFSITE-WOODS
2	SCS Runoff	1.123	1	720	2,551	------	------	------	EX-SITE-WOODS
3	Combine	1.684	1	720	3,826	1, 2	------	------	EX-SITE-TOTAL
4	SCS Runoff	0.121	1	719	255	------	------	------	PR-OFFSITE-BYP-MEAD
5	SCS Runoff	0.420	1	718	844	------	------	------	PR-SITE-MEAD
6	SCS Runoff	0.118	1	717	252	------	------	------	PR-SITE-GRAVEL
7	SCS Runoff	0.338	1	717	813	------	------	------	PR-SITE-IMP/GRAVEL
8	SCS Runoff	0.552	1	718	1,108	------	------	------	PR-OFFSITE-MEAD
9	Combine	1.423	1	718	3,018	5, 6, 7, 8	------	------	TO BASIN
10	Reservoir	0.002	1	763	5	9	703.25	1,282	BASIN
11	SCS Runoff	0.633	1	719	1,335	------	------	------	EX-SITE-BYP-MEAD
12	Combine	0.633	1	719	1,340	10, 11	------	------	PR-SITE-TOTAL
13	Combine	0.754	1	719	1,595	4, 12	------	------	PR-TOTAL

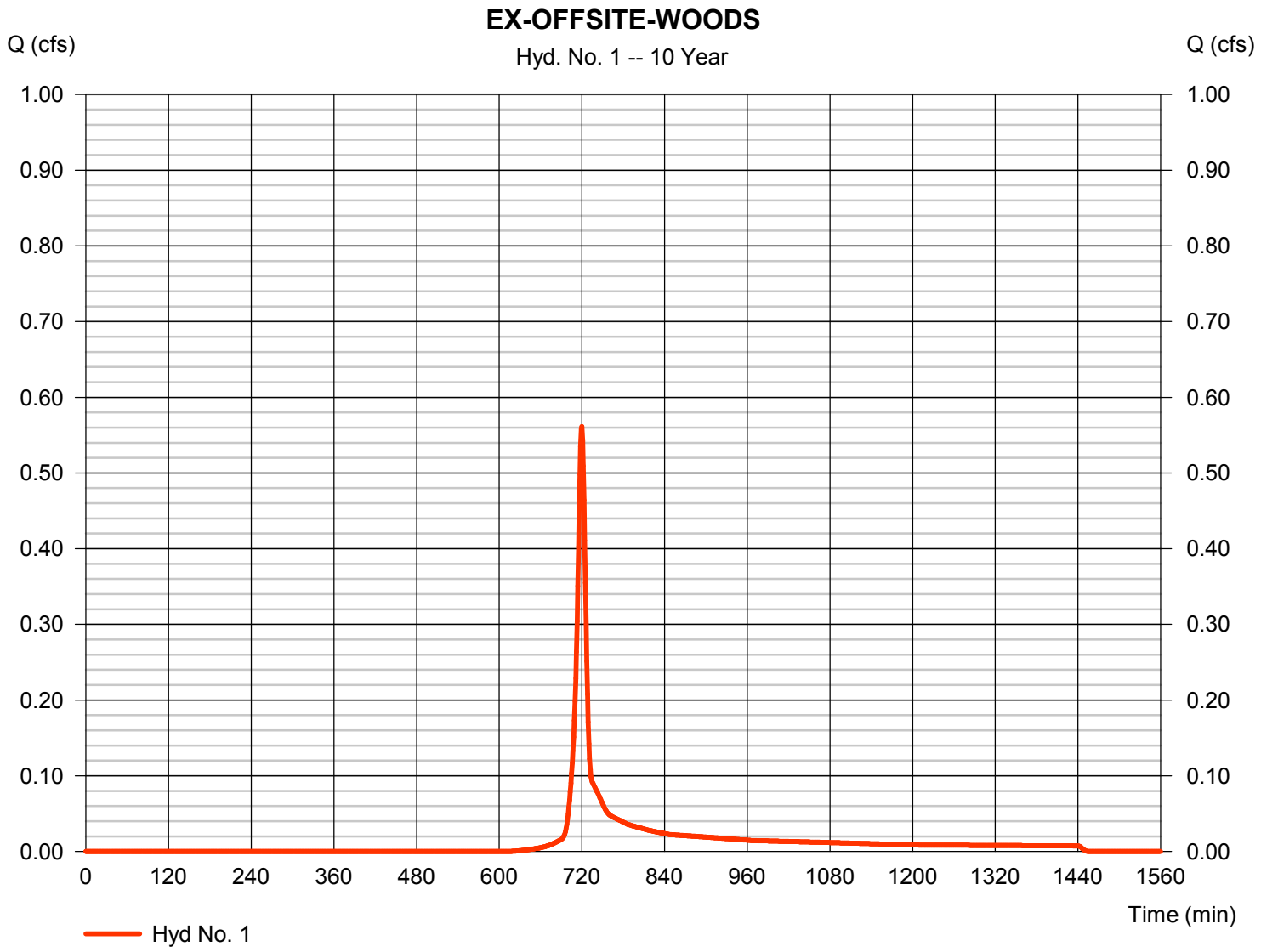
Hydrograph Report

Hyd. No. 1

EX-OFFSITE-WOODS

Hydrograph type	= SCS Runoff	Peak discharge	= 0.561 cfs
Storm frequency	= 10 yrs	Time to peak	= 720 min
Time interval	= 1 min	Hyd. volume	= 1,275 cuft
Drainage area	= 0.203 ac	Curve number	= 70*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.00 min
Total precip.	= 4.58 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.254 x 30) + (0.103 x 30)] / 0.203



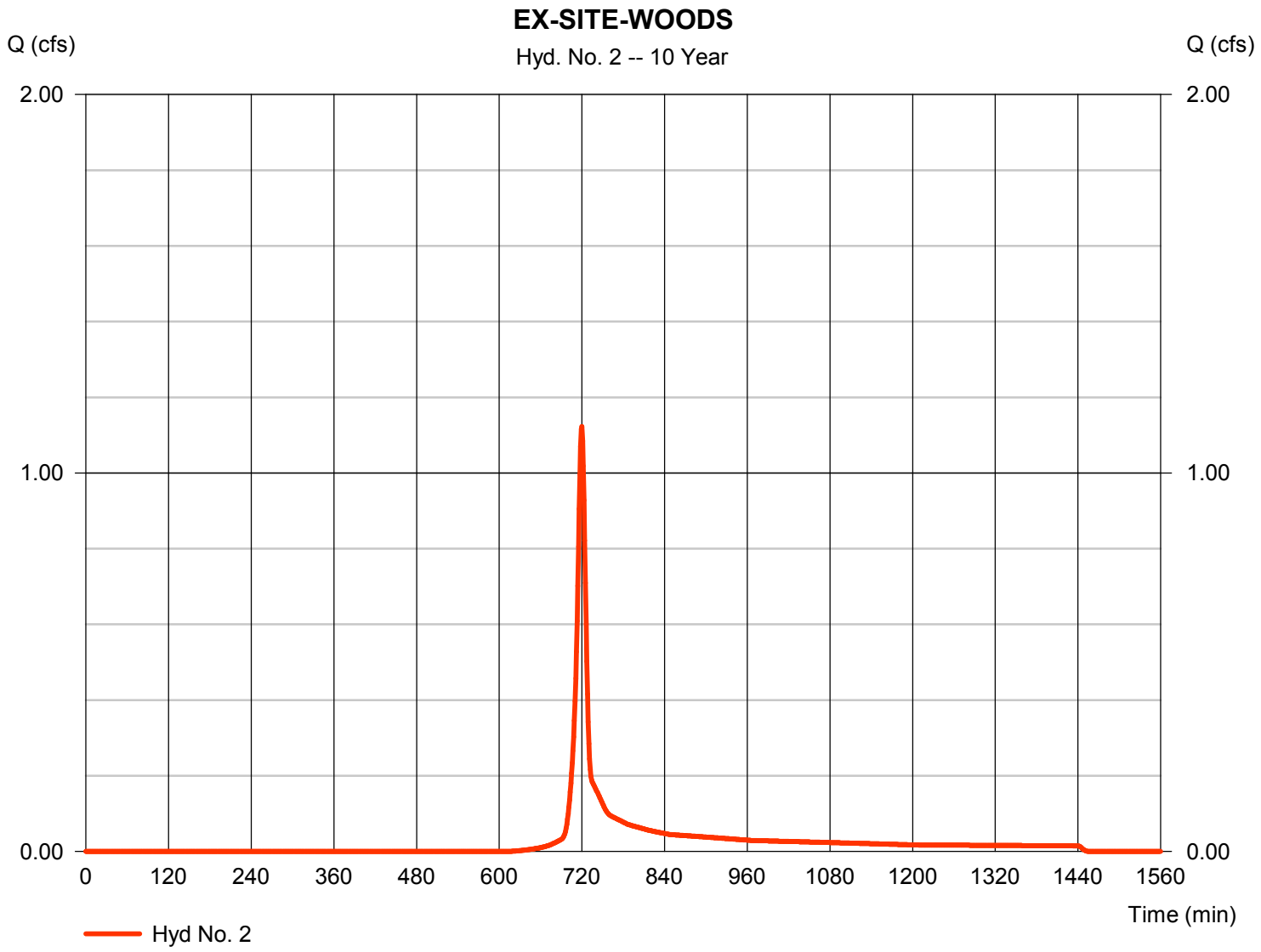
Hydrograph Report

Hyd. No. 2

EX-SITE-WOODS

Hydrograph type	=	SCS Runoff	Peak discharge	=	1.123 cfs
Storm frequency	=	10 yrs	Time to peak	=	720 min
Time interval	=	1 min	Hyd. volume	=	2,551 cuft
Drainage area	=	0.406 ac	Curve number	=	70*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	9.50 min
Total precip.	=	4.58 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.254 x 30) + (0.103 x 30)] / 0.406

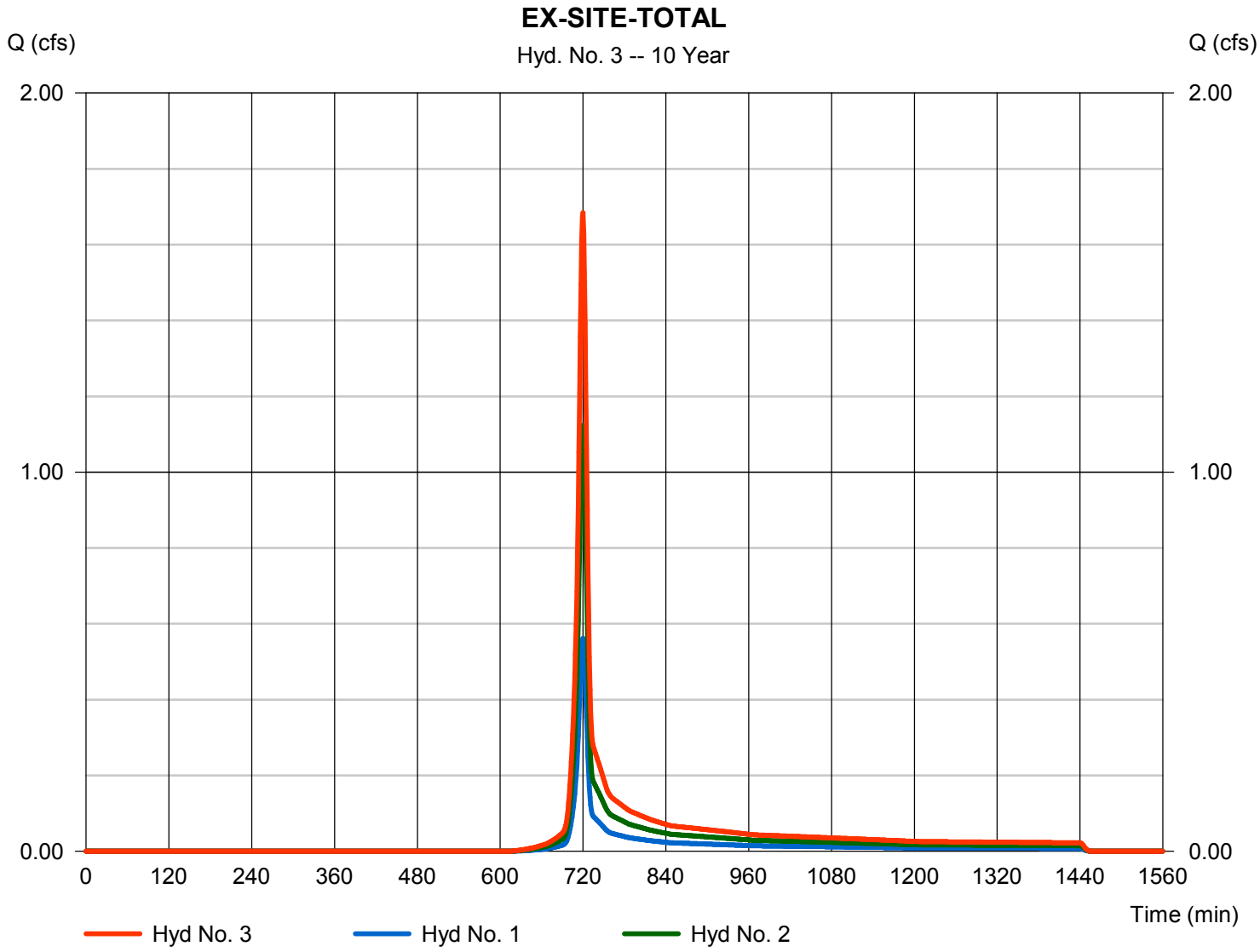


Hydrograph Report

Hyd. No. 3

EX-SITE-TOTAL

Hydrograph type	= Combine	Peak discharge	= 1.684 cfs
Storm frequency	= 10 yrs	Time to peak	= 720 min
Time interval	= 1 min	Hyd. volume	= 3,826 cuft
Inflow hyds.	= 1, 2	Contrib. drain. area	= 0.609 ac



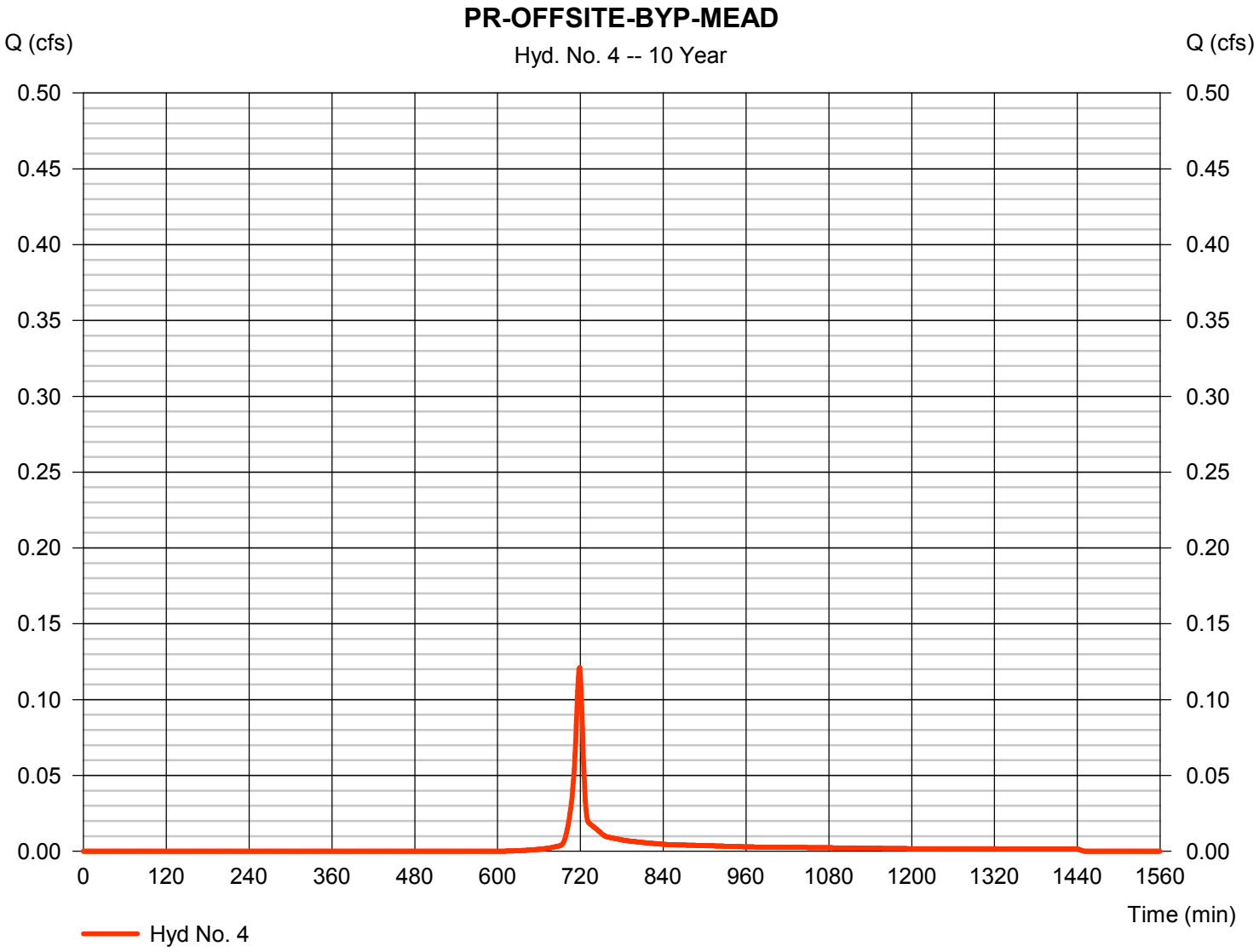
Hydrograph Report

Hyd. No. 4

PR-OFFSITE-BYP-MEAD

Hydrograph type	= SCS Runoff	Peak discharge	= 0.121 cfs
Storm frequency	= 10 yrs	Time to peak	= 719 min
Time interval	= 1 min	Hyd. volume	= 255 cuft
Drainage area	= 0.040 ac	Curve number	= 71*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.70 min
Total precip.	= 4.58 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.254 x 30) + (0.103 x 30)] / 0.040



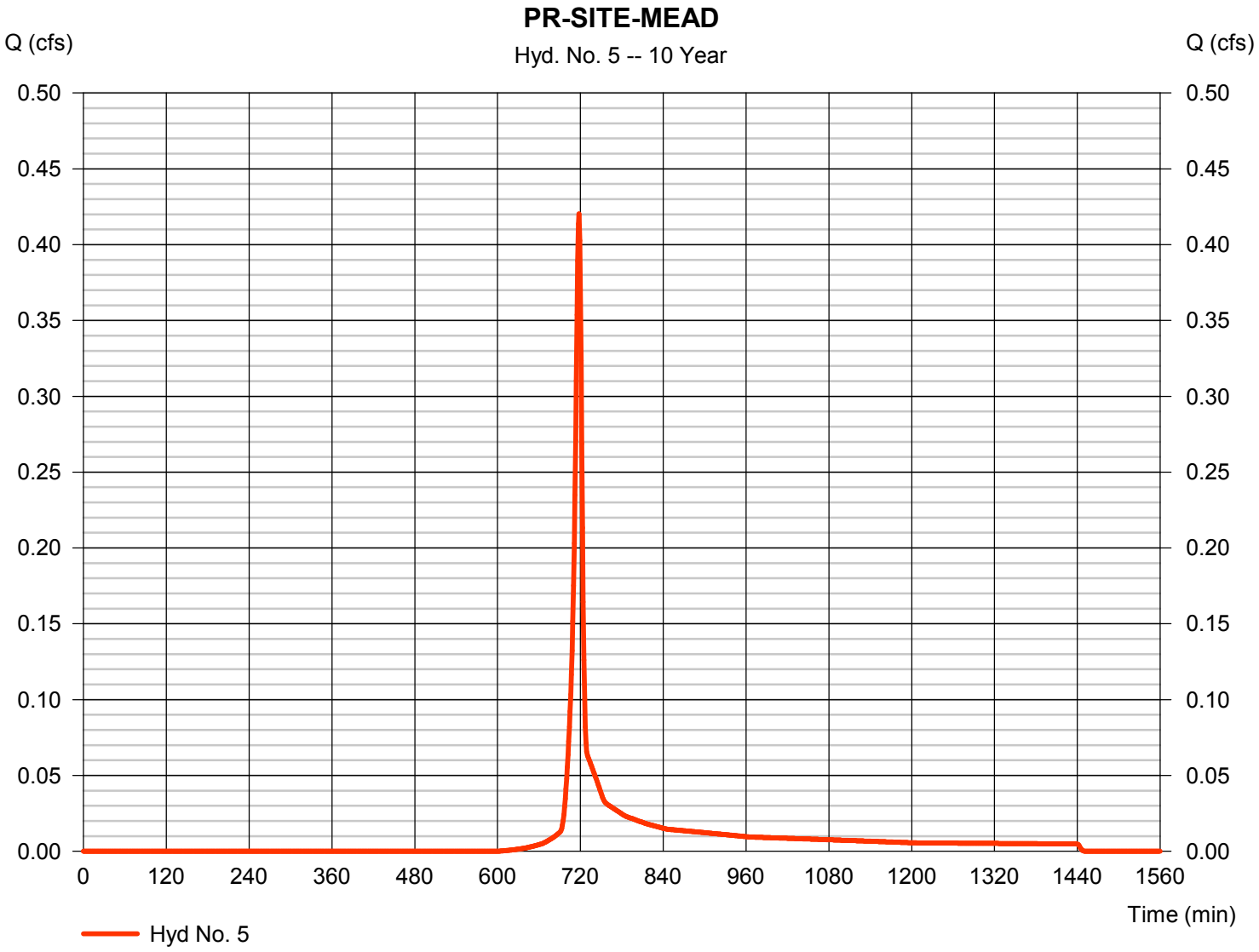
Hydrograph Report

Hyd. No. 5

PR-SITE-MEAD

Hydrograph type	= SCS Runoff	Peak discharge	= 0.420 cfs
Storm frequency	= 10 yrs	Time to peak	= 718 min
Time interval	= 1 min	Hyd. volume	= 844 cuft
Drainage area	= 0.125 ac	Curve number	= 71*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.80 min
Total precip.	= 4.58 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.352 x 71) + (0.054 x 71) + (0.305 x 71)] / 0.125

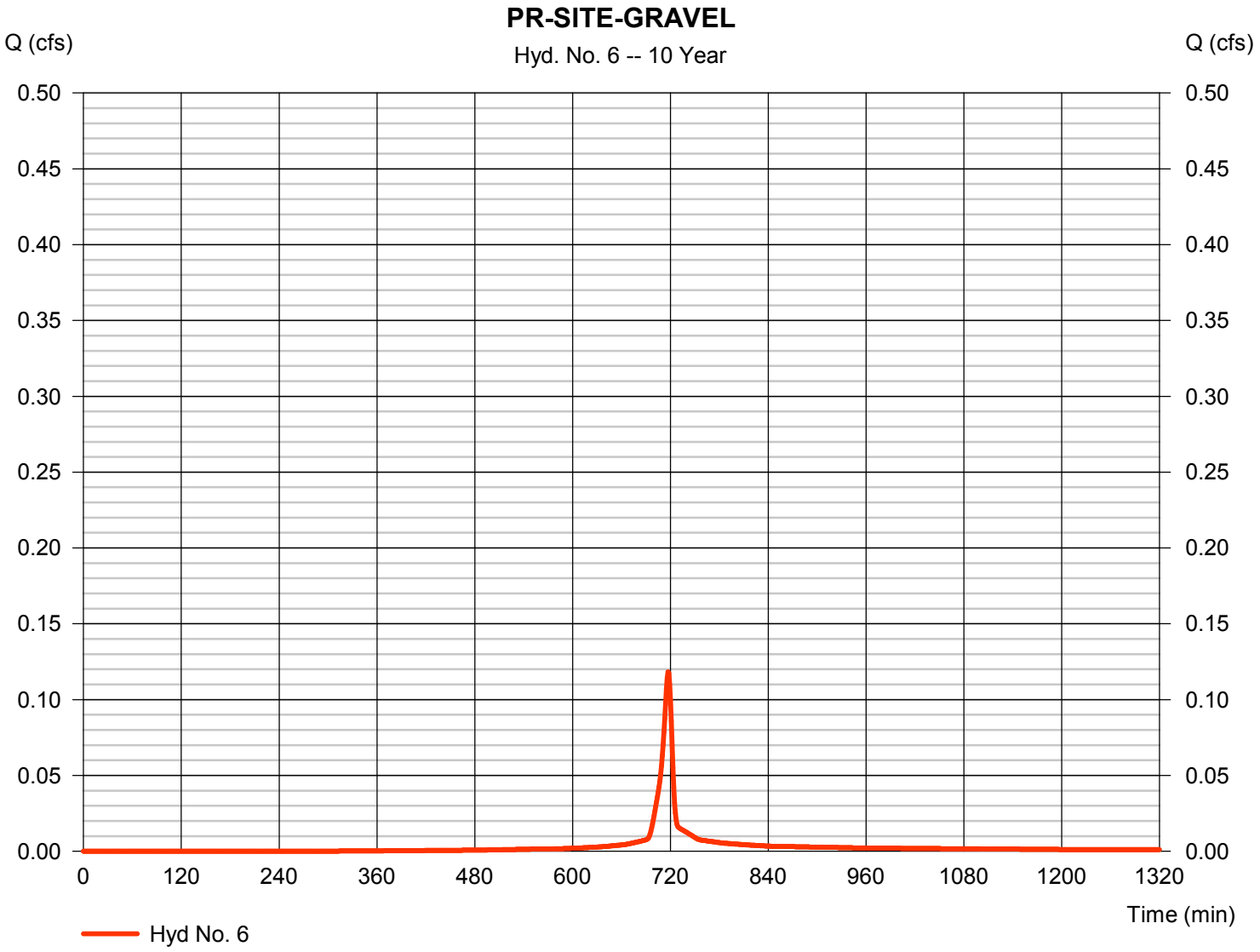


Hydrograph Report

Hyd. No. 6

PR-SITE-GRAVEL

Hydrograph type	= SCS Runoff	Peak discharge	= 0.118 cfs
Storm frequency	= 10 yrs	Time to peak	= 717 min
Time interval	= 1 min	Hyd. volume	= 252 cuft
Drainage area	= 0.020 ac	Curve number	= 89
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.80 min
Total precip.	= 4.58 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

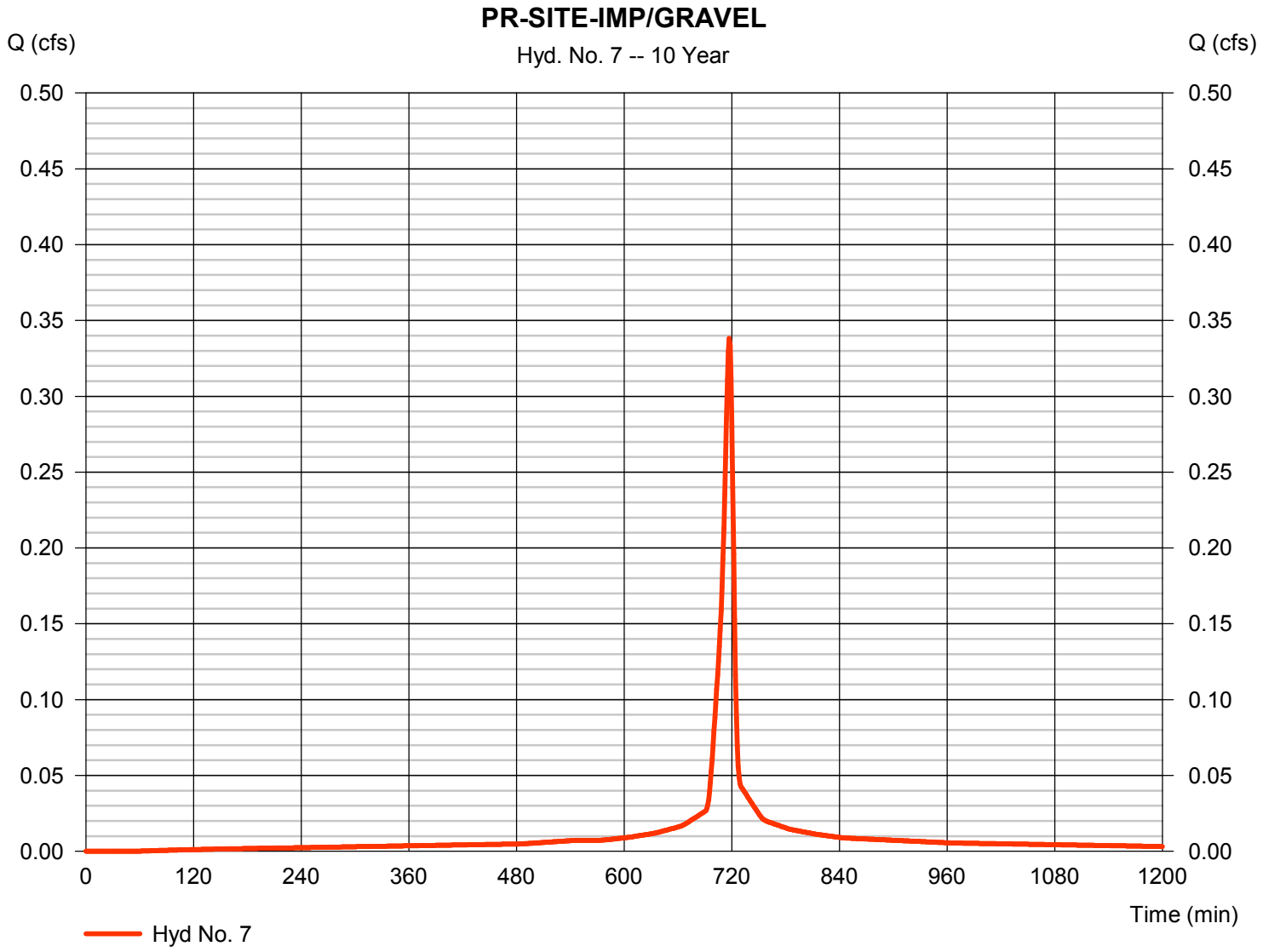


Hydrograph Report

Hyd. No. 7

PR-SITE-IMP/GRAVEL

Hydrograph type	= SCS Runoff	Peak discharge	= 0.338 cfs
Storm frequency	= 10 yrs	Time to peak	= 717 min
Time interval	= 1 min	Hyd. volume	= 813 cuft
Drainage area	= 0.050 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.80 min
Total precip.	= 4.58 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



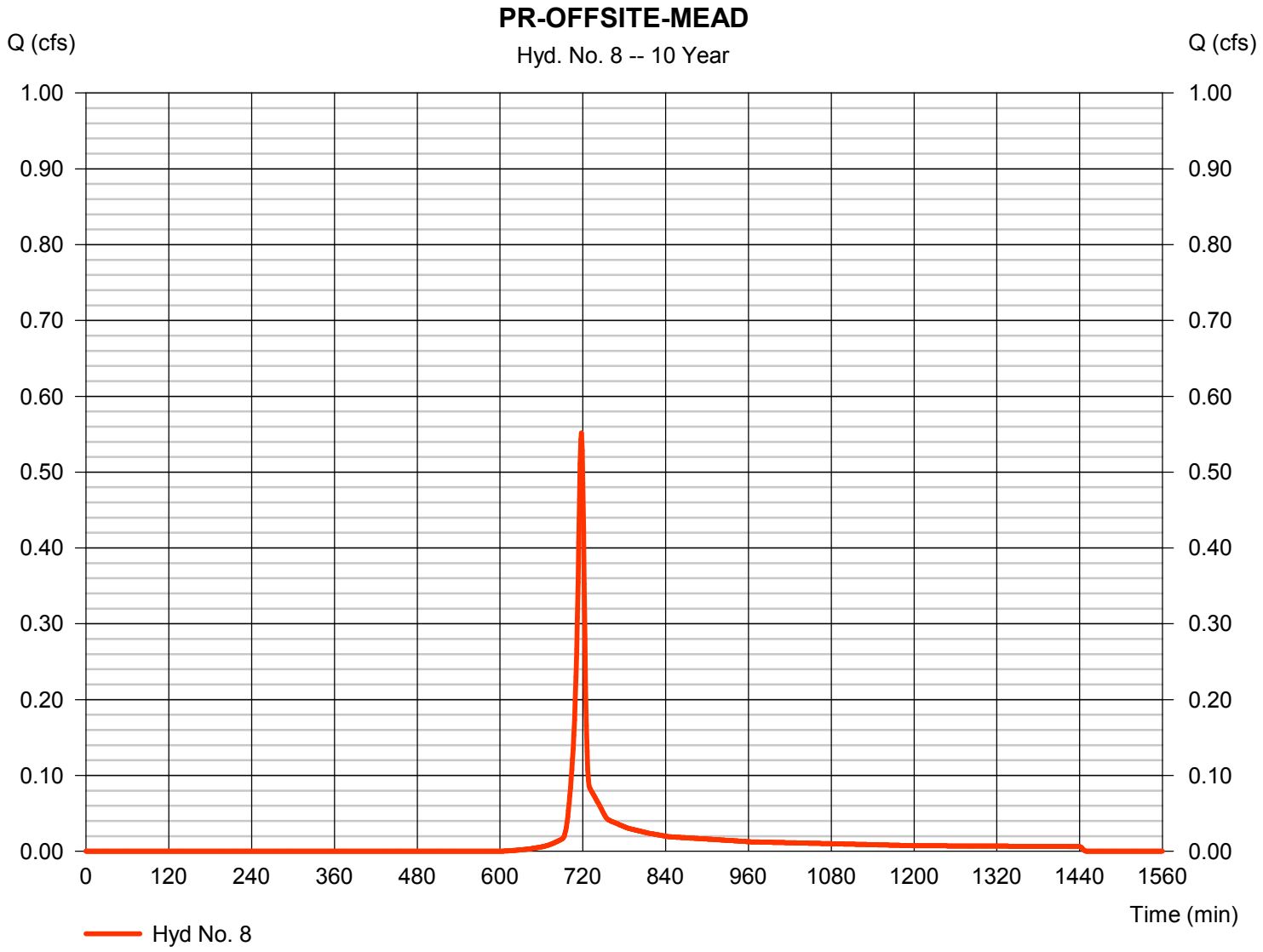
Hydrograph Report

Hyd. No. 8

PR-OFFSITE-MEAD

Hydrograph type	= SCS Runoff	Peak discharge	= 0.552 cfs
Storm frequency	= 10 yrs	Time to peak	= 718 min
Time interval	= 1 min	Hyd. volume	= 1,108 cuft
Drainage area	= 0.164 ac	Curve number	= 71*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.40 min
Total precip.	= 4.58 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.254 x 30) + (0.103 x 30)] / 0.164

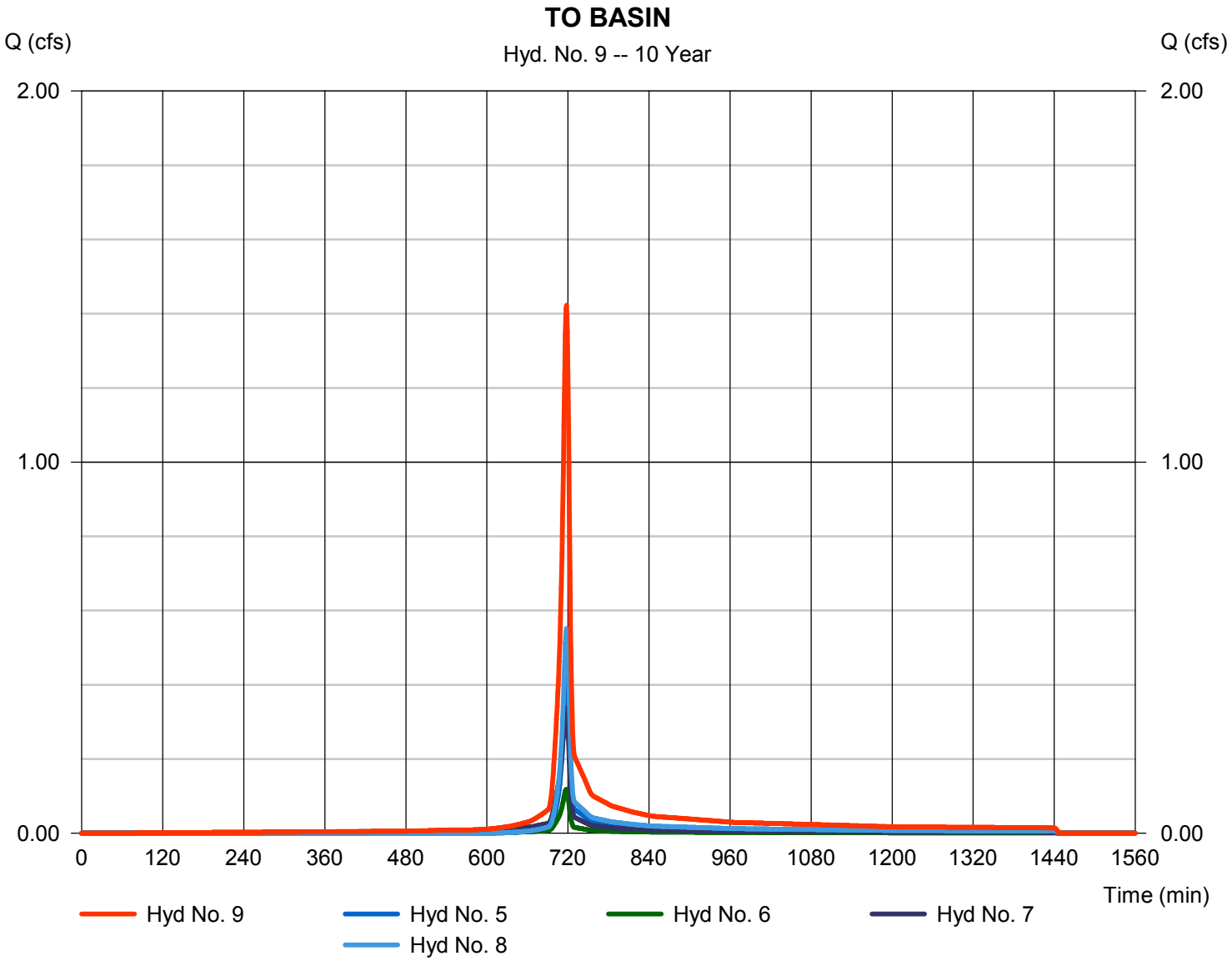


Hydrograph Report

Hyd. No. 9

TO BASIN

Hydrograph type	= Combine	Peak discharge	= 1.423 cfs
Storm frequency	= 10 yrs	Time to peak	= 718 min
Time interval	= 1 min	Hyd. volume	= 3,018 cuft
Inflow hyds.	= 5, 6, 7, 8	Contrib. drain. area	= 0.359 ac



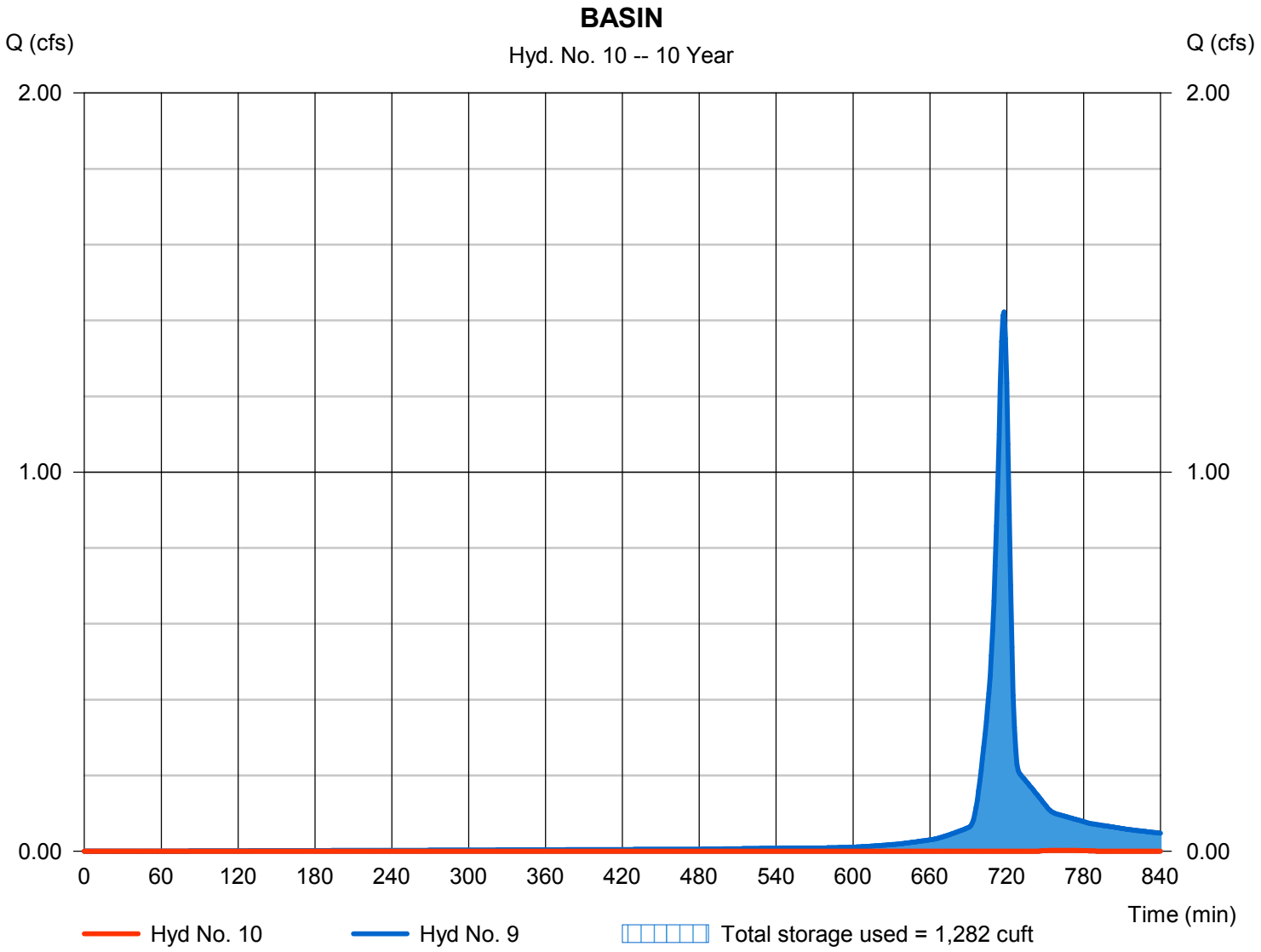
Hydrograph Report

Hyd. No. 10

BASIN

Hydrograph type	=	Reservoir	Peak discharge	=	0.002 cfs
Storm frequency	=	10 yrs	Time to peak	=	763 min
Time interval	=	1 min	Hyd. volume	=	5 cuft
Inflow hyd. No.	=	9 - TO BASIN	Max. Elevation	=	703.25 ft
Reservoir name	=	UG N-12 Perforated Pipe System	Max. Storage	=	1,282 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



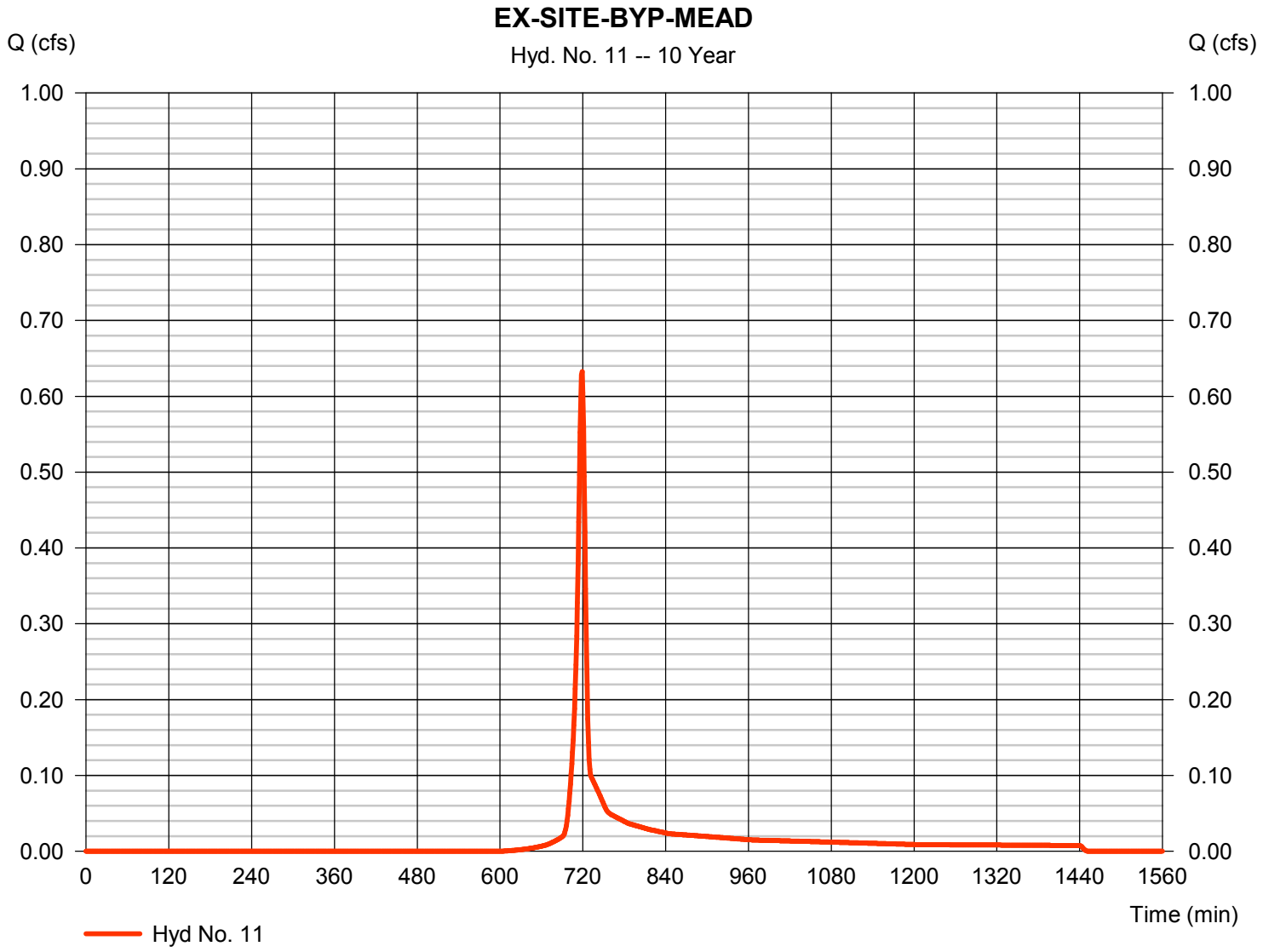
Hydrograph Report

Hyd. No. 11

EX-SITE-BYP-MEAD

Hydrograph type	= SCS Runoff	Peak discharge	= 0.633 cfs
Storm frequency	= 10 yrs	Time to peak	= 719 min
Time interval	= 1 min	Hyd. volume	= 1,335 cuft
Drainage area	= 0.209 ac	Curve number	= 71*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.80 min
Total precip.	= 4.58 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.364 x 71) + (0.314 x 71) + (0.123 x 71)] / 0.209

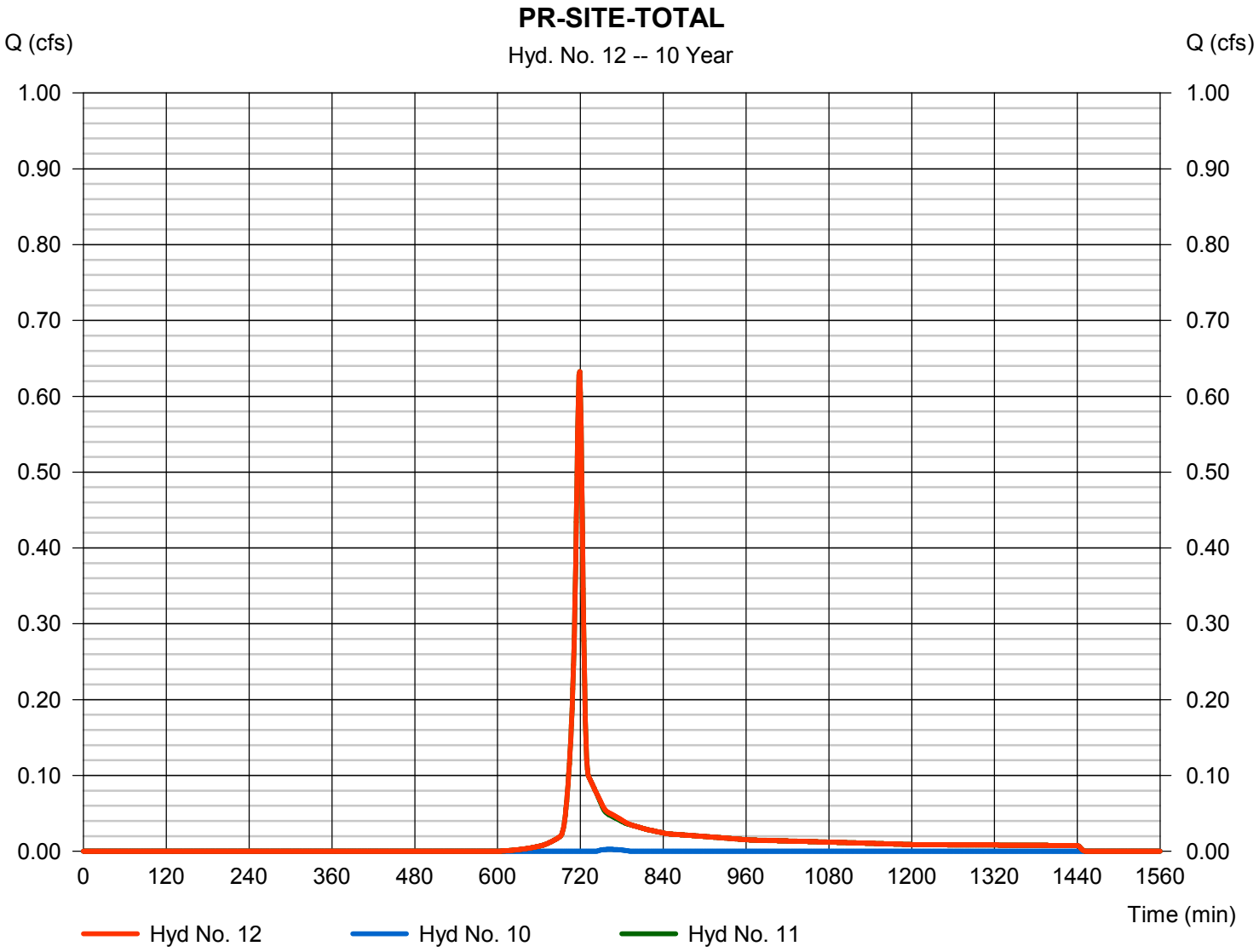


Hydrograph Report

Hyd. No. 12

PR-SITE-TOTAL

Hydrograph type	= Combine	Peak discharge	= 0.633 cfs
Storm frequency	= 10 yrs	Time to peak	= 719 min
Time interval	= 1 min	Hyd. volume	= 1,340 cuft
Inflow hyds.	= 10, 11	Contrib. drain. area	= 0.209 ac

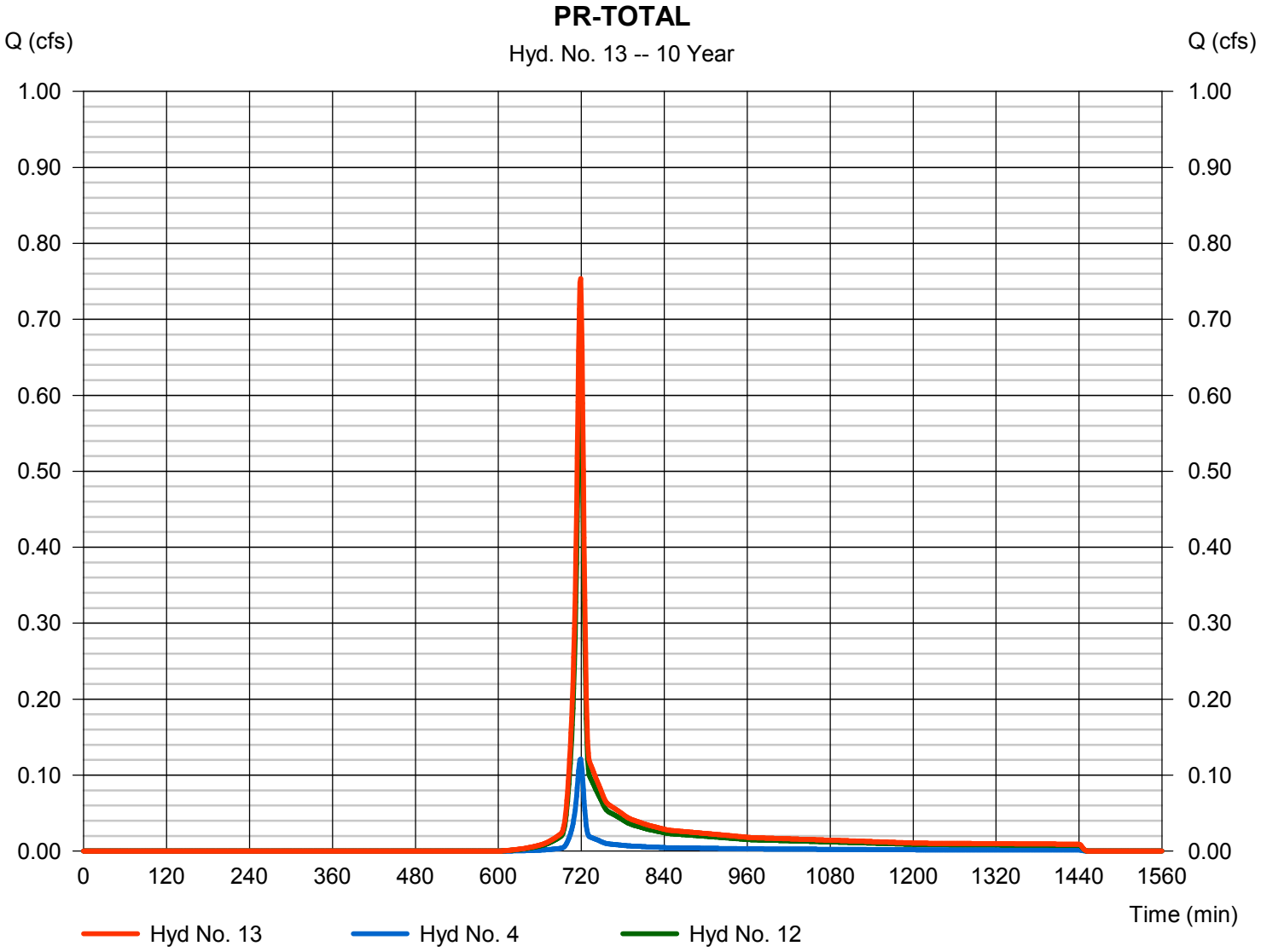


Hydrograph Report

Hyd. No. 13

PR-TOTAL

Hydrograph type	= Combine	Peak discharge	= 0.754 cfs
Storm frequency	= 10 yrs	Time to peak	= 719 min
Time interval	= 1 min	Hyd. volume	= 1,595 cuft
Inflow hyds.	= 4, 12	Contrib. drain. area	= 0.040 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v11

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	0.814	1	720	1,842	------	------	------	EX-OFFSITE-WOODS
2	SCS Runoff	1.628	1	720	3,683	------	------	------	EX-SITE-WOODS
3	Combine	2.442	1	720	5,525	1, 2	------	------	EX-SITE-TOTAL
4	SCS Runoff	0.173	1	719	366	------	------	------	PR-OFFSITE-BYP-MEAD
5	SCS Runoff	0.602	1	718	1,211	------	------	------	PR-SITE-MEAD
6	SCS Runoff	0.150	1	717	326	------	------	------	PR-SITE-GRAVEL
7	SCS Runoff	0.415	1	717	1,006	------	------	------	PR-SITE-IMP/GRAVEL
8	SCS Runoff	0.790	1	718	1,589	------	------	------	PR-OFFSITE-MEAD
9	Combine	1.950	1	718	4,132	5, 6, 7, 8	------	------	TO BASIN
10	Reservoir	0.420	1	725	626	9	703.65	1,556	BASIN
11	SCS Runoff	0.907	1	719	1,914	------	------	------	EX-SITE-BYP-MEAD
12	Combine	0.971	1	722	2,541	10, 11	------	------	PR-SITE-TOTAL
13	Combine	1.105	1	722	2,907	4, 12	------	------	PR-TOTAL

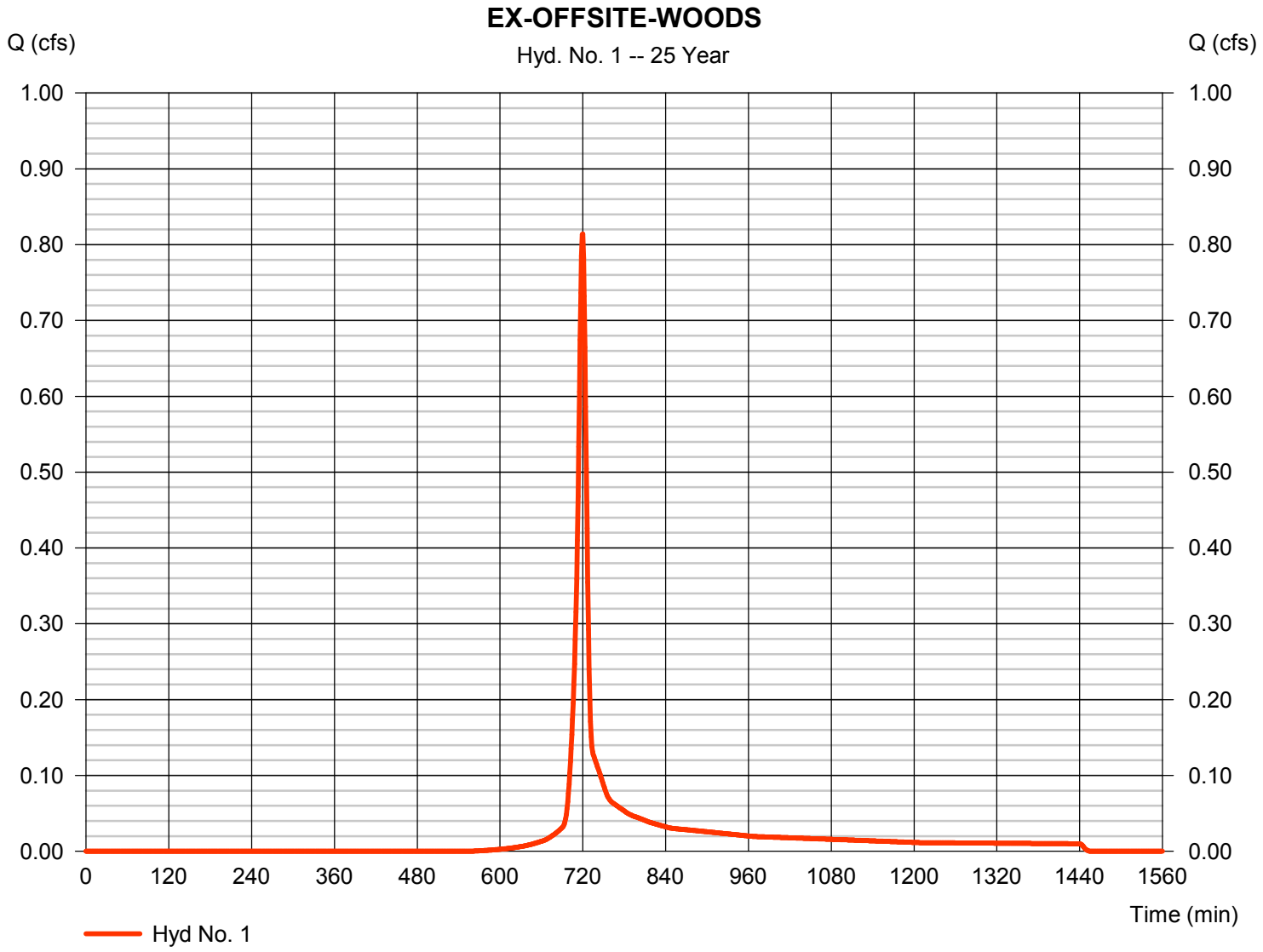
Hydrograph Report

Hyd. No. 1

EX-OFFSITE-WOODS

Hydrograph type	= SCS Runoff	Peak discharge	= 0.814 cfs
Storm frequency	= 25 yrs	Time to peak	= 720 min
Time interval	= 1 min	Hyd. volume	= 1,842 cuft
Drainage area	= 0.203 ac	Curve number	= 70*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.00 min
Total precip.	= 5.61 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.254 x 30) + (0.103 x 30)] / 0.203



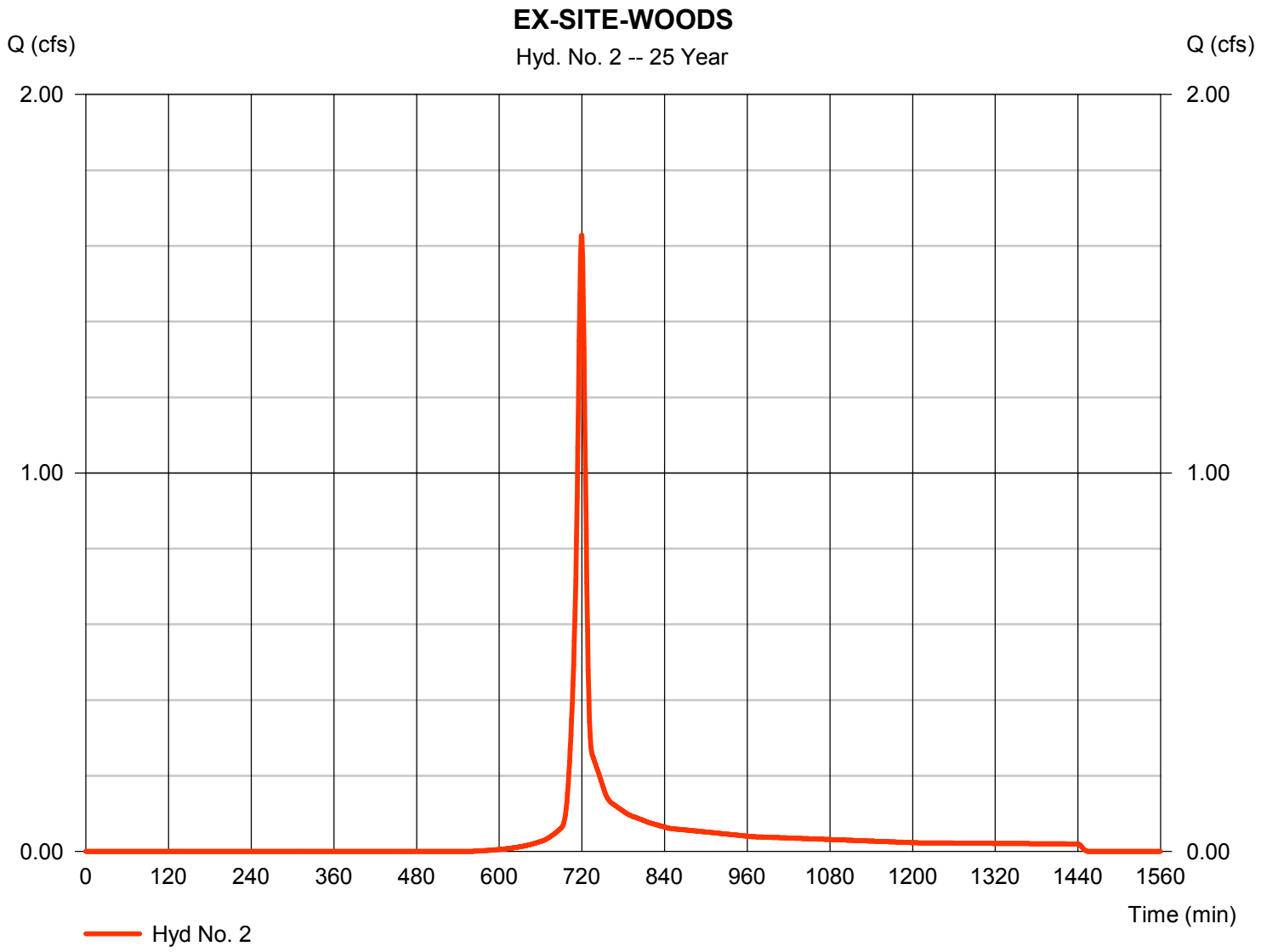
Hydrograph Report

Hyd. No. 2

EX-SITE-WOODS

Hydrograph type	=	SCS Runoff	Peak discharge	=	1.628 cfs
Storm frequency	=	25 yrs	Time to peak	=	720 min
Time interval	=	1 min	Hyd. volume	=	3,683 cuft
Drainage area	=	0.406 ac	Curve number	=	70*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	9.50 min
Total precip.	=	5.61 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.254 x 30) + (0.103 x 30)] / 0.406

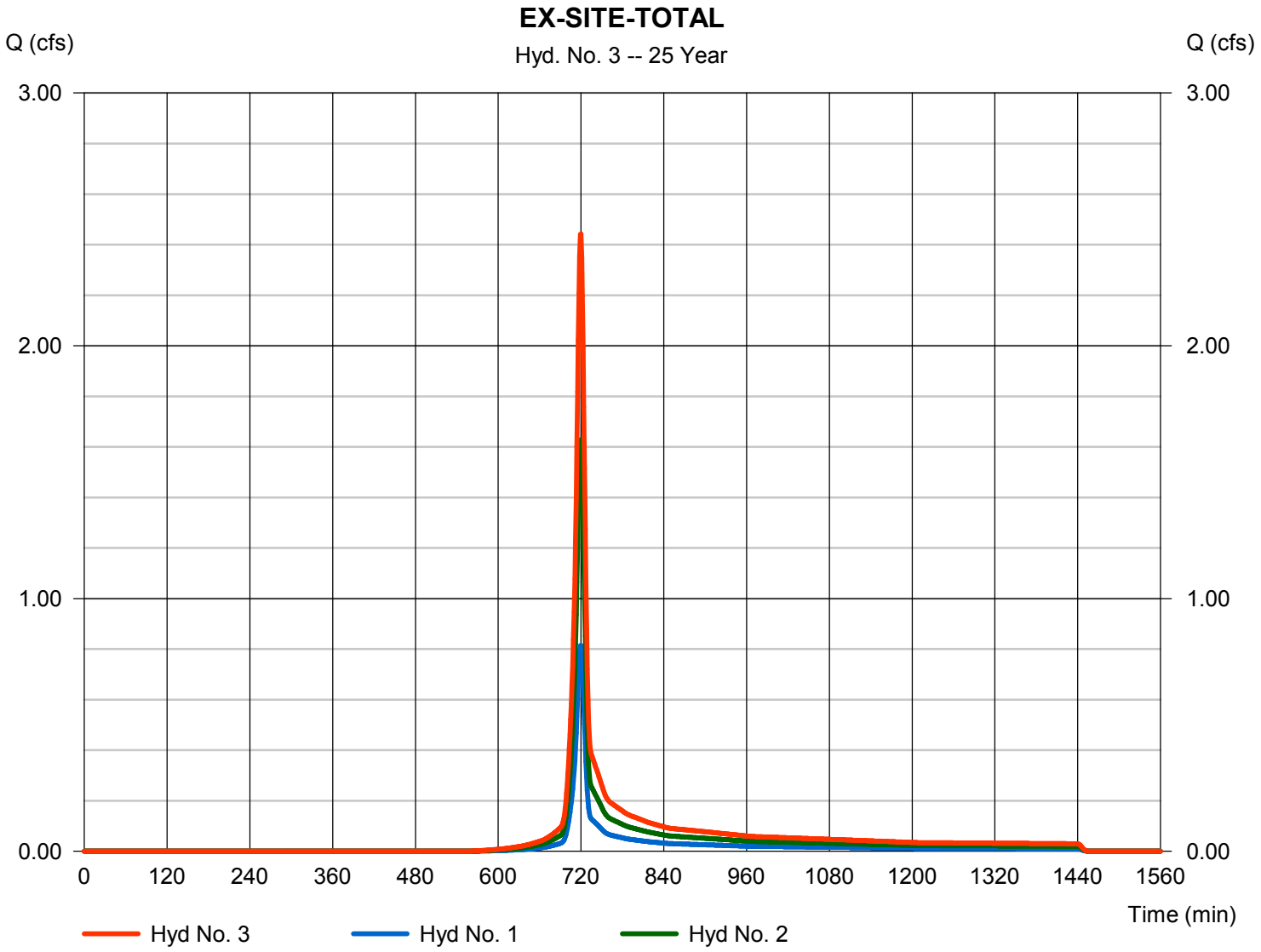


Hydrograph Report

Hyd. No. 3

EX-SITE-TOTAL

Hydrograph type	=	Combine	Peak discharge	=	2.442 cfs
Storm frequency	=	25 yrs	Time to peak	=	720 min
Time interval	=	1 min	Hyd. volume	=	5,525 cuft
Inflow hyds.	=	1, 2	Contrib. drain. area	=	0.609 ac



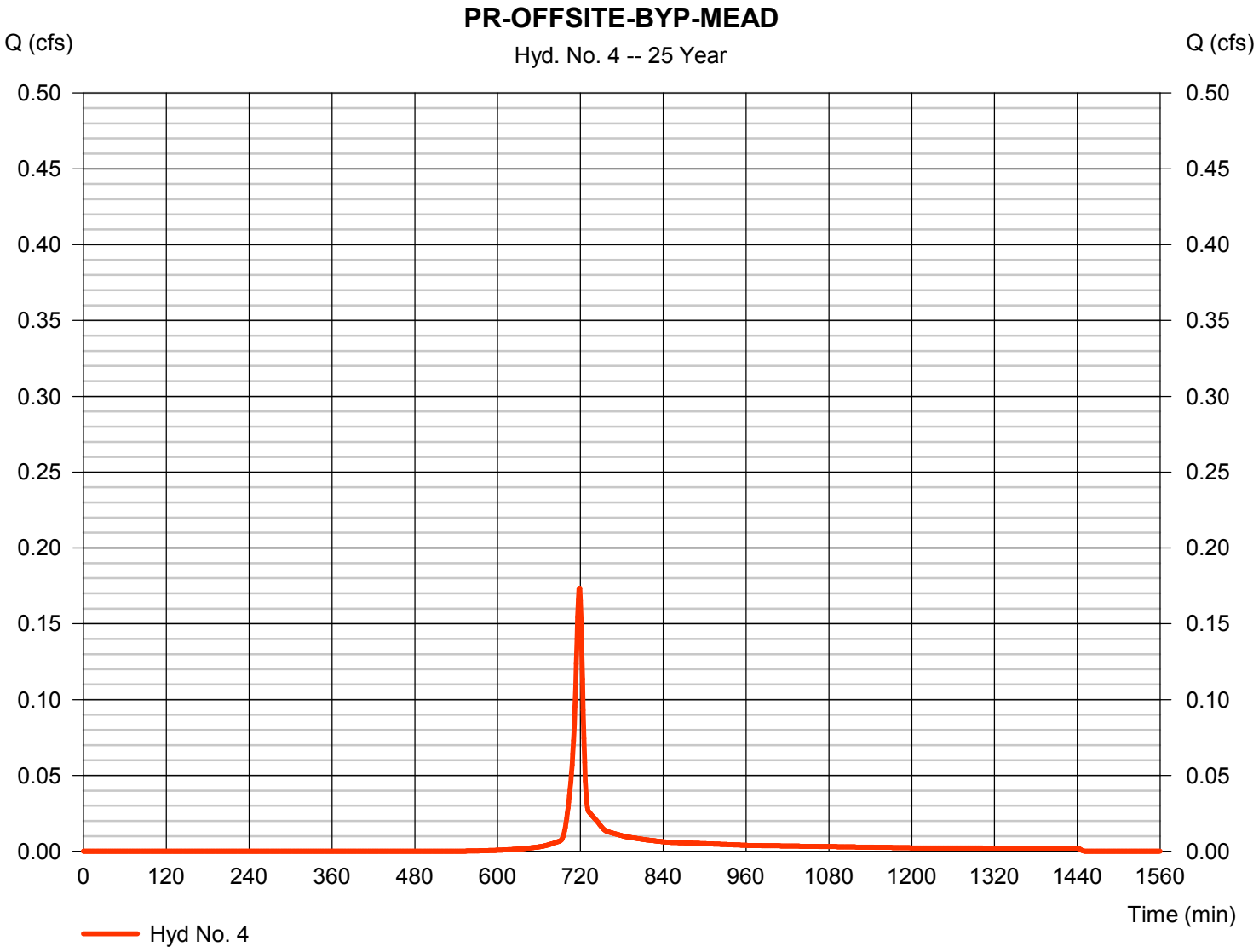
Hydrograph Report

Hyd. No. 4

PR-OFFSITE-BYP-MEAD

Hydrograph type	= SCS Runoff	Peak discharge	= 0.173 cfs
Storm frequency	= 25 yrs	Time to peak	= 719 min
Time interval	= 1 min	Hyd. volume	= 366 cuft
Drainage area	= 0.040 ac	Curve number	= 71*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.70 min
Total precip.	= 5.61 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.254 x 30) + (0.103 x 30)] / 0.040



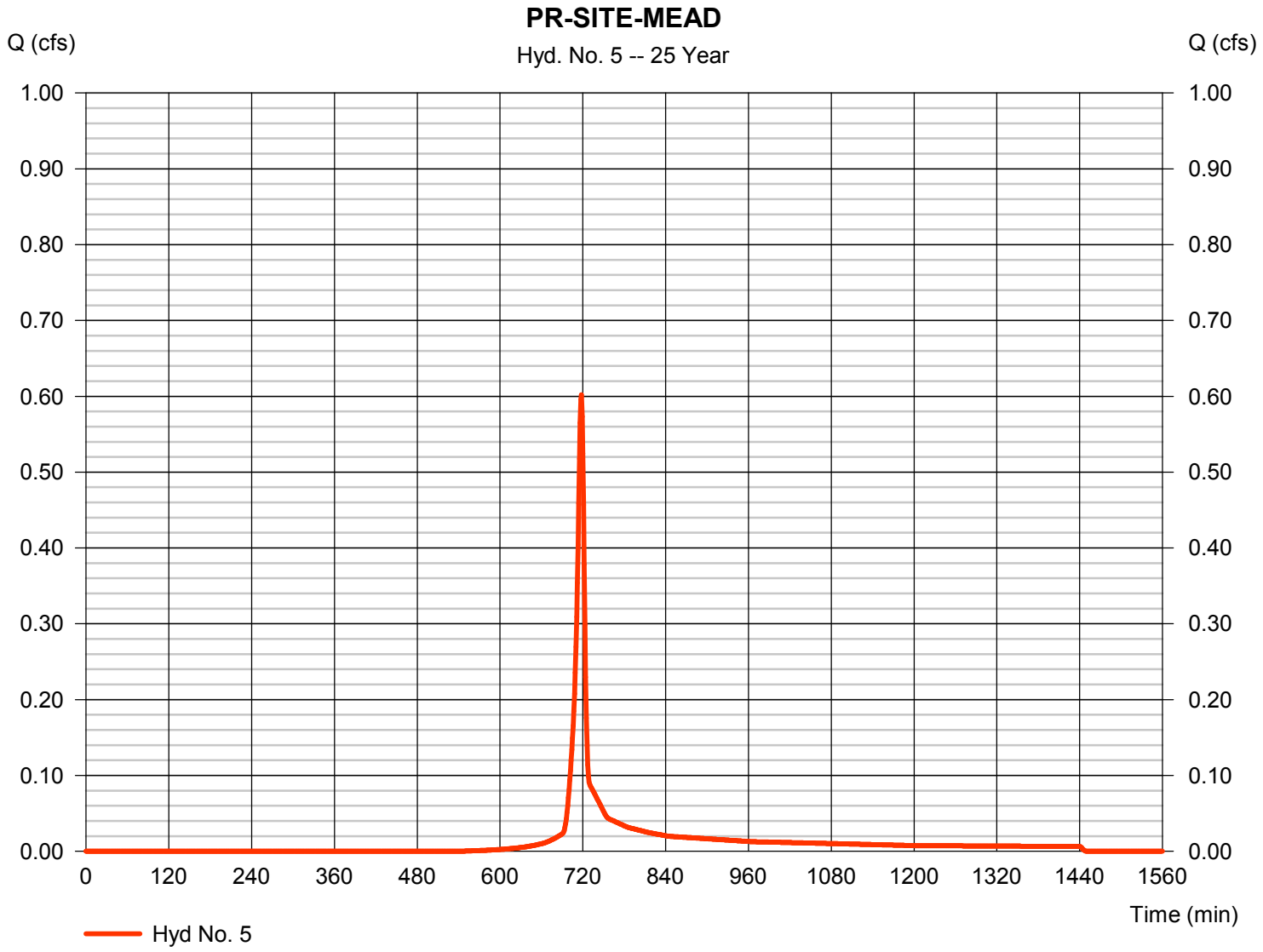
Hydrograph Report

Hyd. No. 5

PR-SITE-MEAD

Hydrograph type	= SCS Runoff	Peak discharge	= 0.602 cfs
Storm frequency	= 25 yrs	Time to peak	= 718 min
Time interval	= 1 min	Hyd. volume	= 1,211 cuft
Drainage area	= 0.125 ac	Curve number	= 71*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.80 min
Total precip.	= 5.61 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.352 x 71) + (0.054 x 71) + (0.305 x 71)] / 0.125

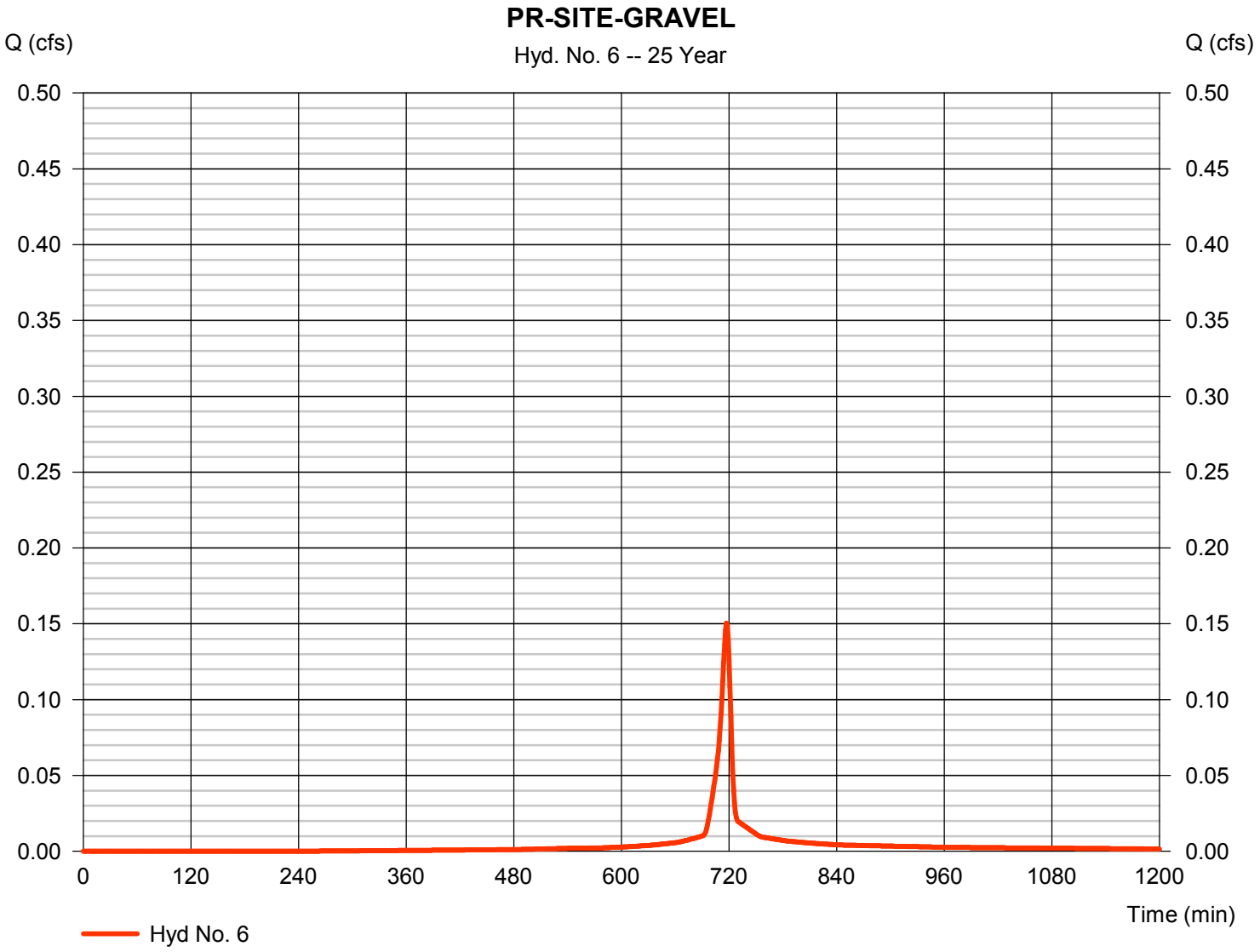


Hydrograph Report

Hyd. No. 6

PR-SITE-GRAVEL

Hydrograph type	= SCS Runoff	Peak discharge	= 0.150 cfs
Storm frequency	= 25 yrs	Time to peak	= 717 min
Time interval	= 1 min	Hyd. volume	= 326 cuft
Drainage area	= 0.020 ac	Curve number	= 89
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.80 min
Total precip.	= 5.61 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

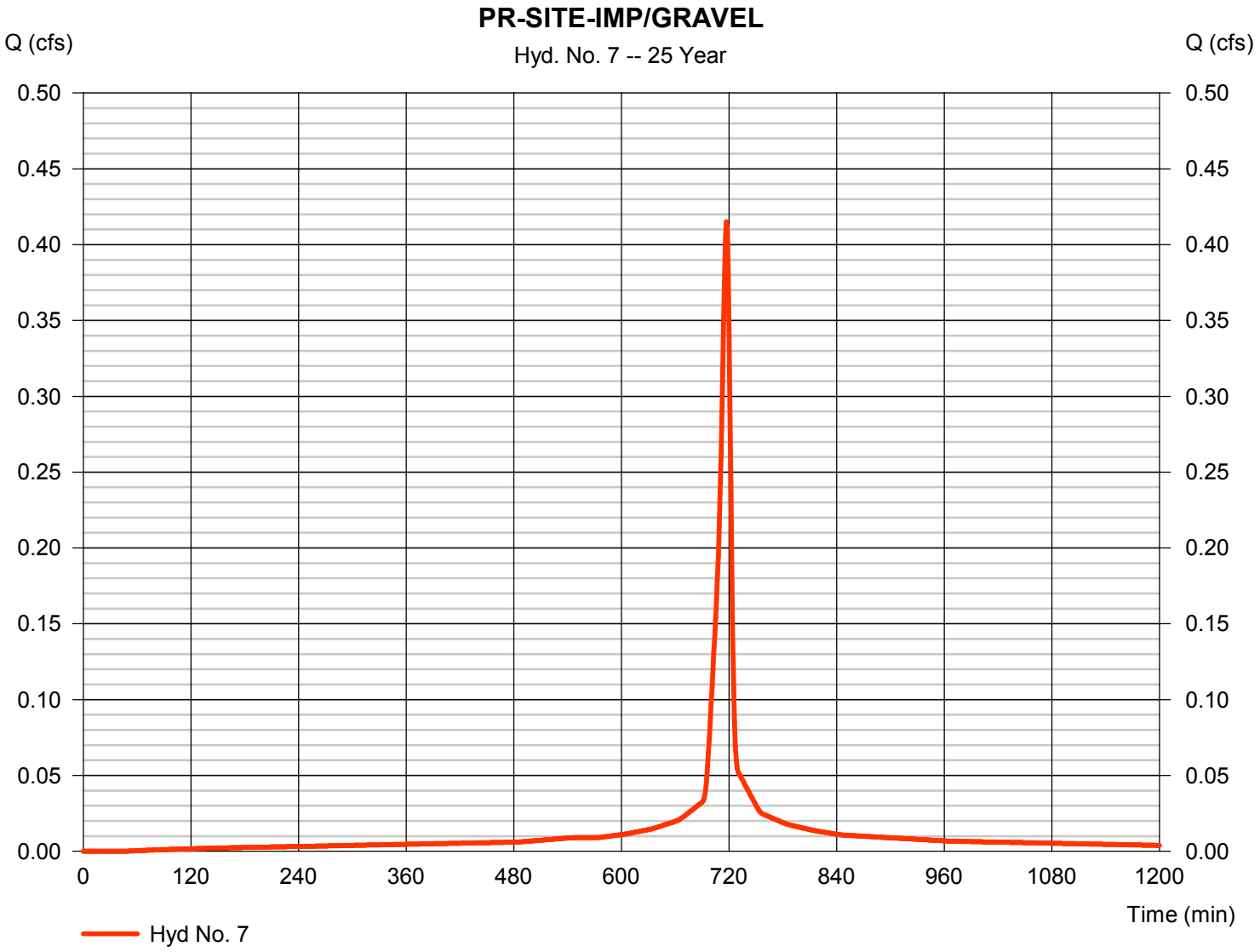


Hydrograph Report

Hyd. No. 7

PR-SITE-IMP/GRAVEL

Hydrograph type	= SCS Runoff	Peak discharge	= 0.415 cfs
Storm frequency	= 25 yrs	Time to peak	= 717 min
Time interval	= 1 min	Hyd. volume	= 1,006 cuft
Drainage area	= 0.050 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.80 min
Total precip.	= 5.61 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



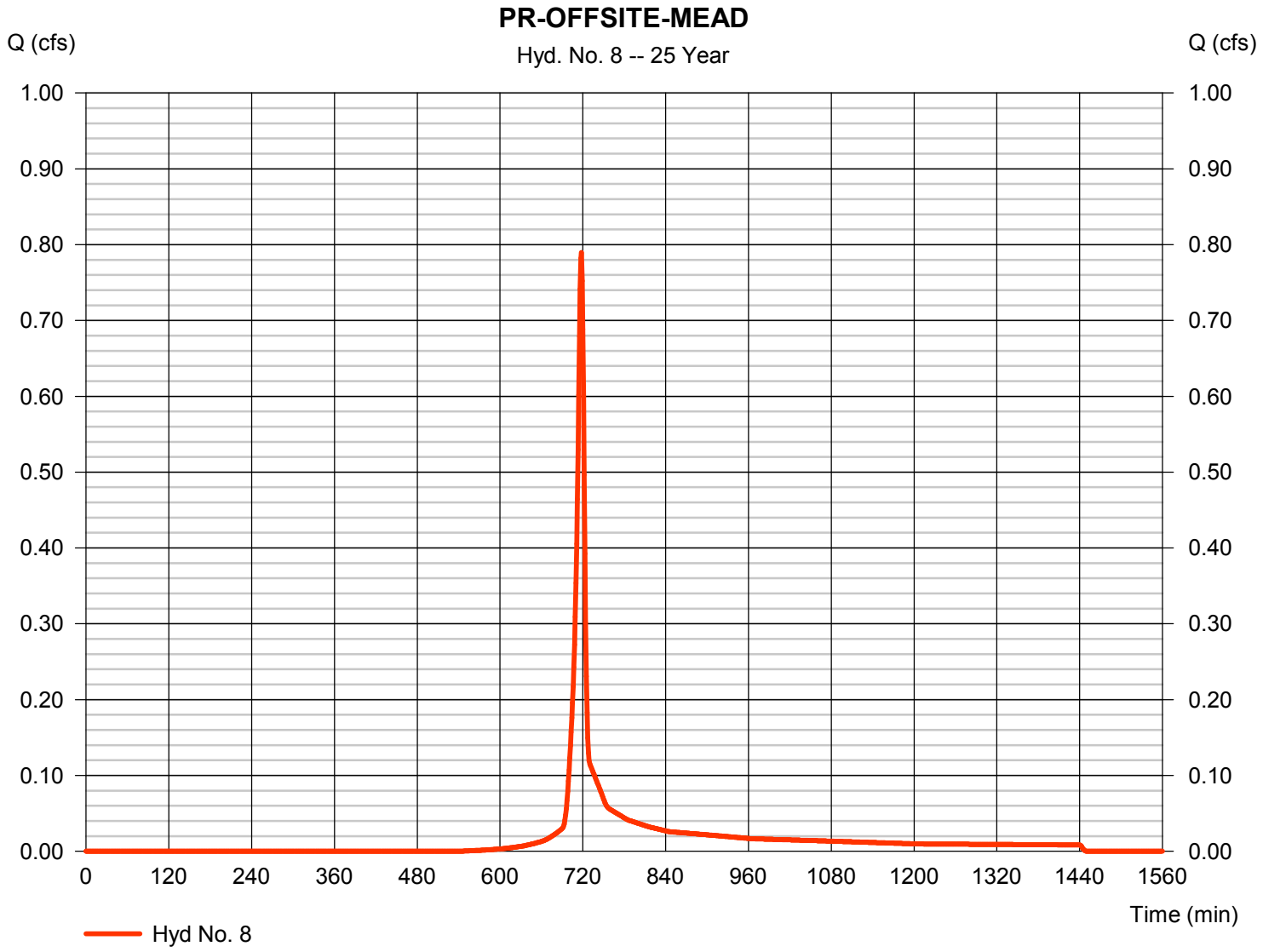
Hydrograph Report

Hyd. No. 8

PR-OFFSITE-MEAD

Hydrograph type	= SCS Runoff	Peak discharge	= 0.790 cfs
Storm frequency	= 25 yrs	Time to peak	= 718 min
Time interval	= 1 min	Hyd. volume	= 1,589 cuft
Drainage area	= 0.164 ac	Curve number	= 71*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.40 min
Total precip.	= 5.61 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.254 x 30) + (0.103 x 30)] / 0.164

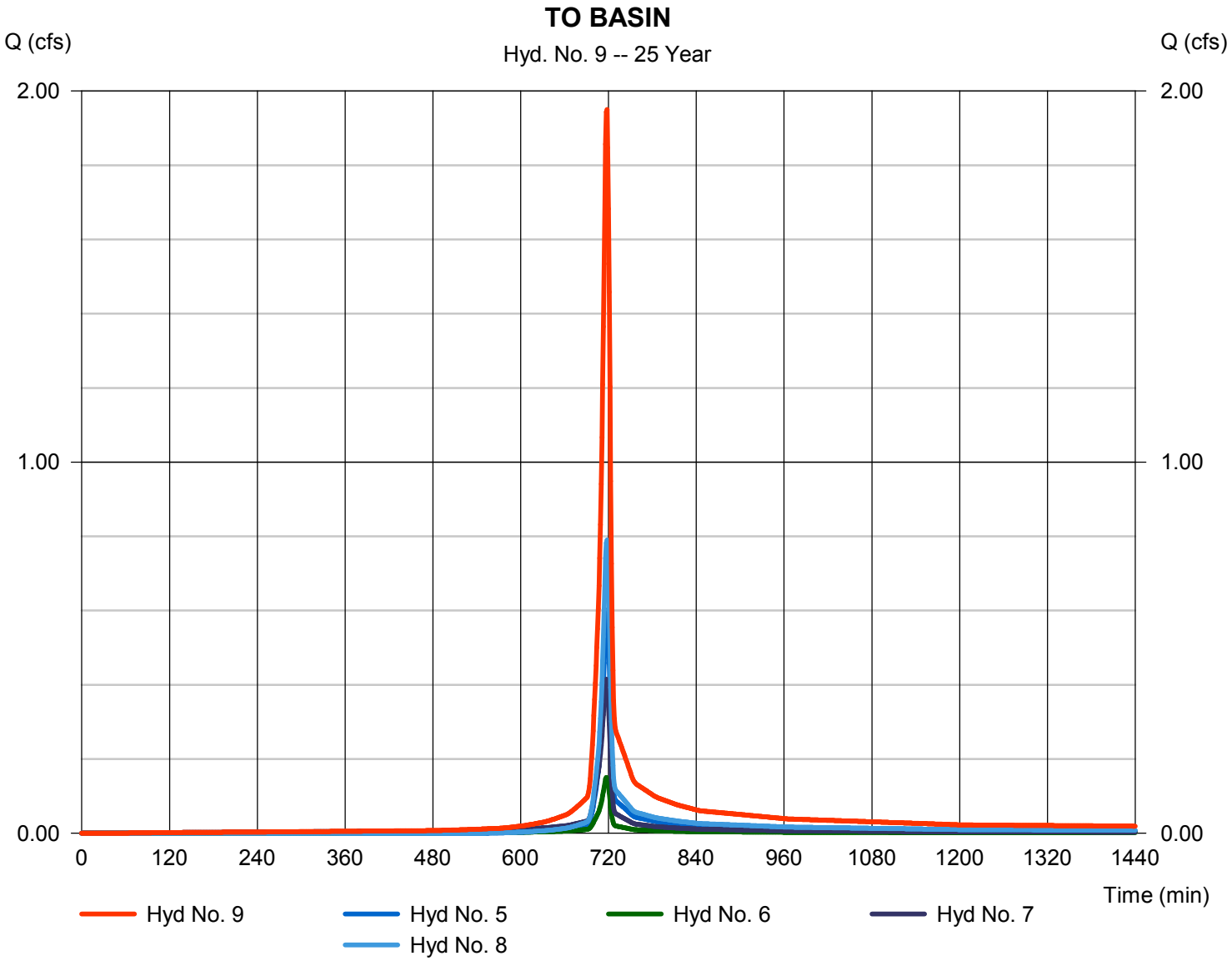


Hydrograph Report

Hyd. No. 9

TO BASIN

Hydrograph type	= Combine	Peak discharge	= 1.950 cfs
Storm frequency	= 25 yrs	Time to peak	= 718 min
Time interval	= 1 min	Hyd. volume	= 4,132 cuft
Inflow hyds.	= 5, 6, 7, 8	Contrib. drain. area	= 0.359 ac



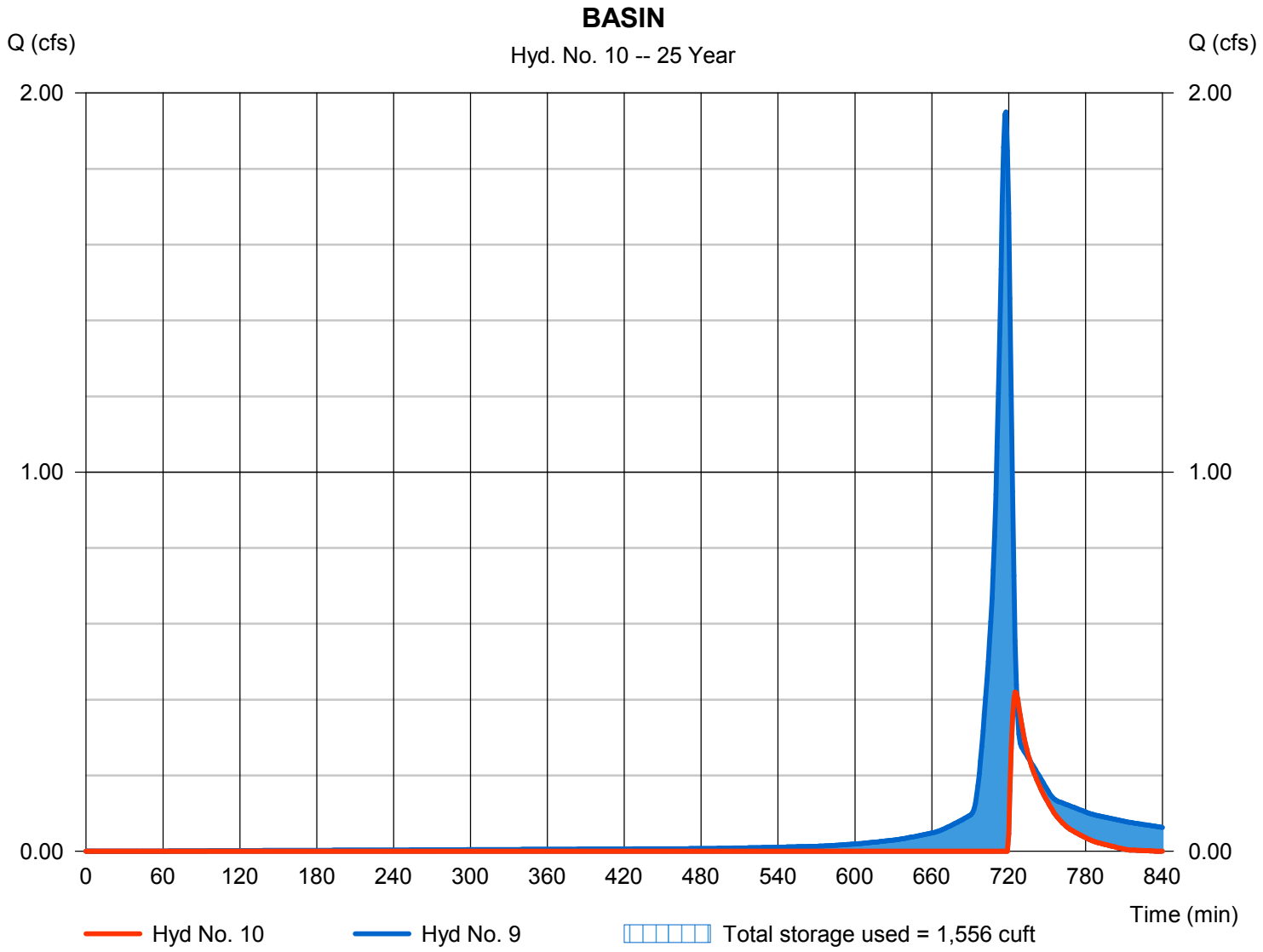
Hydrograph Report

Hyd. No. 10

BASIN

Hydrograph type	=	Reservoir	Peak discharge	=	0.420 cfs
Storm frequency	=	25 yrs	Time to peak	=	725 min
Time interval	=	1 min	Hyd. volume	=	626 cuft
Inflow hyd. No.	=	9 - TO BASIN	Max. Elevation	=	703.65 ft
Reservoir name	=	UG N-12 Perforated Pipe System	Max. Storage	=	1,556 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



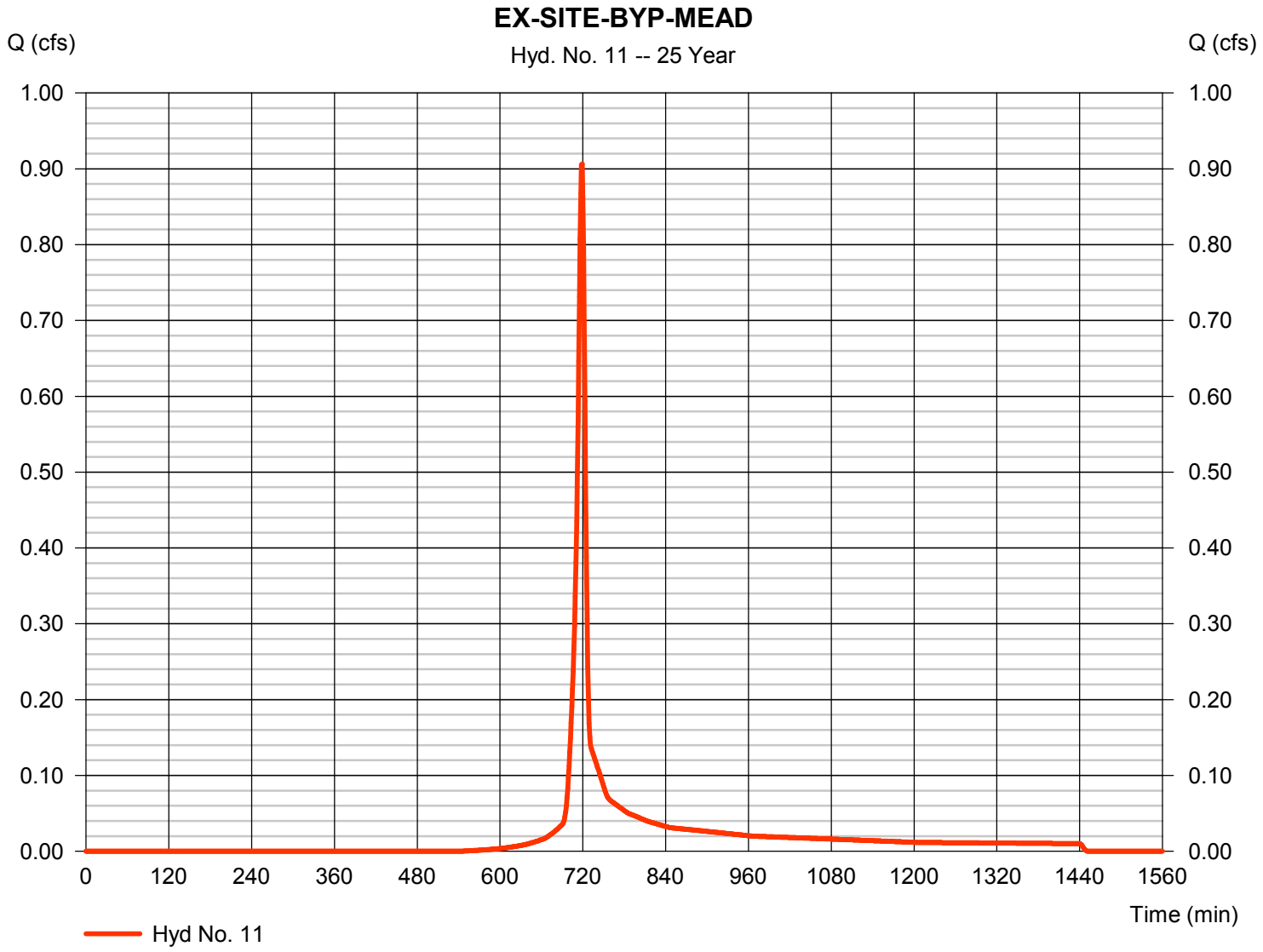
Hydrograph Report

Hyd. No. 11

EX-SITE-BYP-MEAD

Hydrograph type	= SCS Runoff	Peak discharge	= 0.907 cfs
Storm frequency	= 25 yrs	Time to peak	= 719 min
Time interval	= 1 min	Hyd. volume	= 1,914 cuft
Drainage area	= 0.209 ac	Curve number	= 71*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.80 min
Total precip.	= 5.61 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.364 x 71) + (0.314 x 71) + (0.123 x 71)] / 0.209

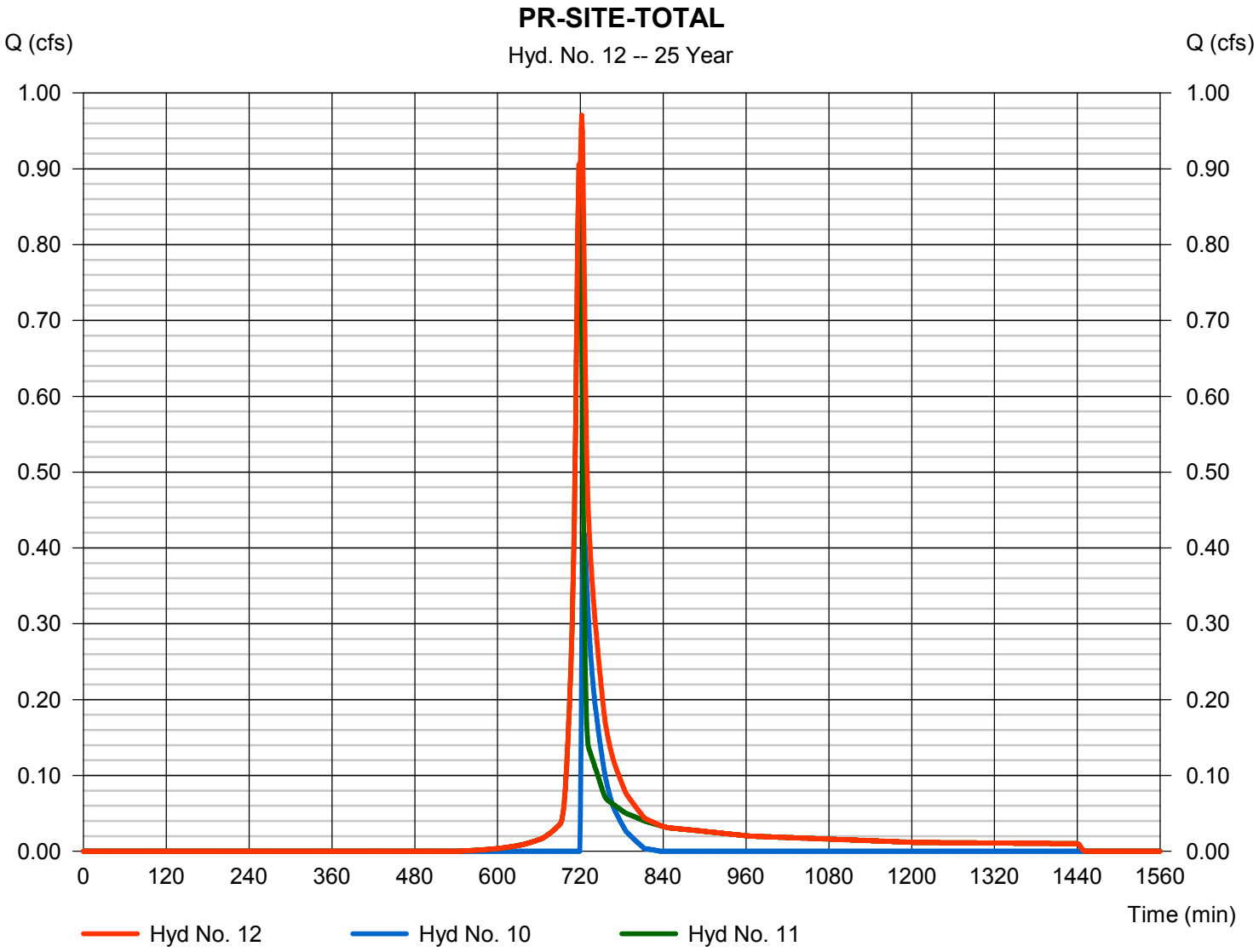


Hydrograph Report

Hyd. No. 12

PR-SITE-TOTAL

Hydrograph type	=	Combine	Peak discharge	=	0.971 cfs
Storm frequency	=	25 yrs	Time to peak	=	722 min
Time interval	=	1 min	Hyd. volume	=	2,541 cuft
Inflow hyds.	=	10, 11	Contrib. drain. area	=	0.209 ac

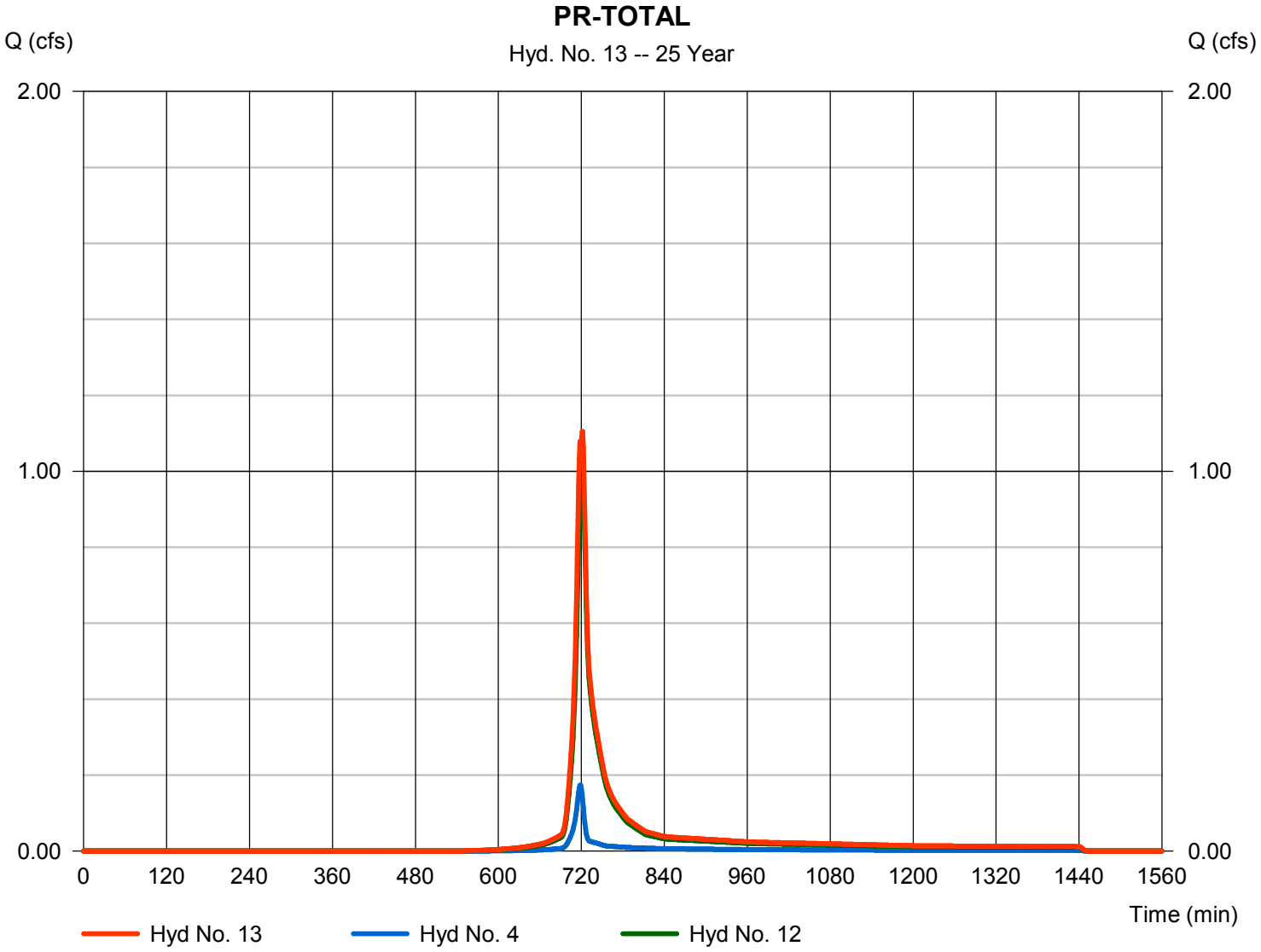


Hydrograph Report

Hyd. No. 13

PR-TOTAL

Hydrograph type	= Combine	Peak discharge	= 1.105 cfs
Storm frequency	= 25 yrs	Time to peak	= 722 min
Time interval	= 1 min	Hyd. volume	= 2,907 cuft
Inflow hyds.	= 4, 12	Contrib. drain. area	= 0.040 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v11

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	1.058	1	719	2,393	------	------	------	EX-OFFSITE-WOODS
2	SCS Runoff	2.116	1	719	4,787	------	------	------	EX-SITE-WOODS
3	Combine	3.174	1	719	7,180	1, 2	------	------	EX-SITE-TOTAL
4	SCS Runoff	0.224	1	718	474	------	------	------	PR-OFFSITE-BYP-MEAD
5	SCS Runoff	0.774	1	718	1,567	------	------	------	PR-SITE-MEAD
6	SCS Runoff	0.180	1	717	395	------	------	------	PR-SITE-GRAVEL
7	SCS Runoff	0.485	1	717	1,181	------	------	------	PR-SITE-IMP/GRAVEL
8	SCS Runoff	1.016	1	718	2,055	------	------	------	PR-OFFSITE-MEAD
9	Combine	2.446	1	718	5,198	5, 6, 7, 8	------	------	TO BASIN
10	Reservoir	1.109	1	723	1,299	9	704.01	1,793	BASIN
11	SCS Runoff	1.169	1	718	2,476	------	------	------	EX-SITE-BYP-MEAD
12	Combine	1.989	1	721	3,776	10, 11	------	------	PR-SITE-TOTAL
13	Combine	2.183	1	721	4,250	4, 12	------	------	PR-TOTAL

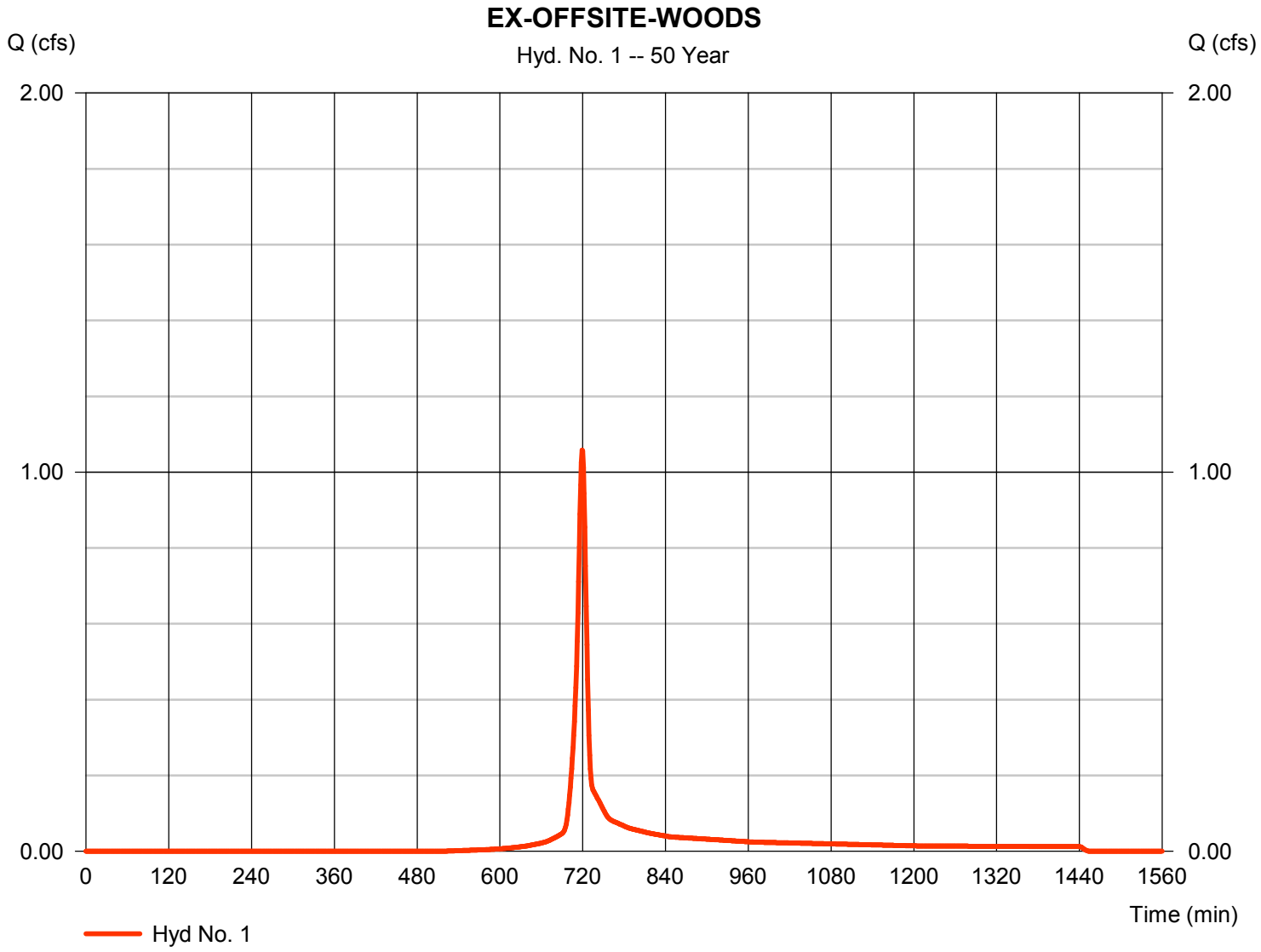
Hydrograph Report

Hyd. No. 1

EX-OFFSITE-WOODS

Hydrograph type	= SCS Runoff	Peak discharge	= 1.058 cfs
Storm frequency	= 50 yrs	Time to peak	= 719 min
Time interval	= 1 min	Hyd. volume	= 2,393 cuft
Drainage area	= 0.203 ac	Curve number	= 70*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.00 min
Total precip.	= 6.55 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.254 x 30) + (0.103 x 30)] / 0.203



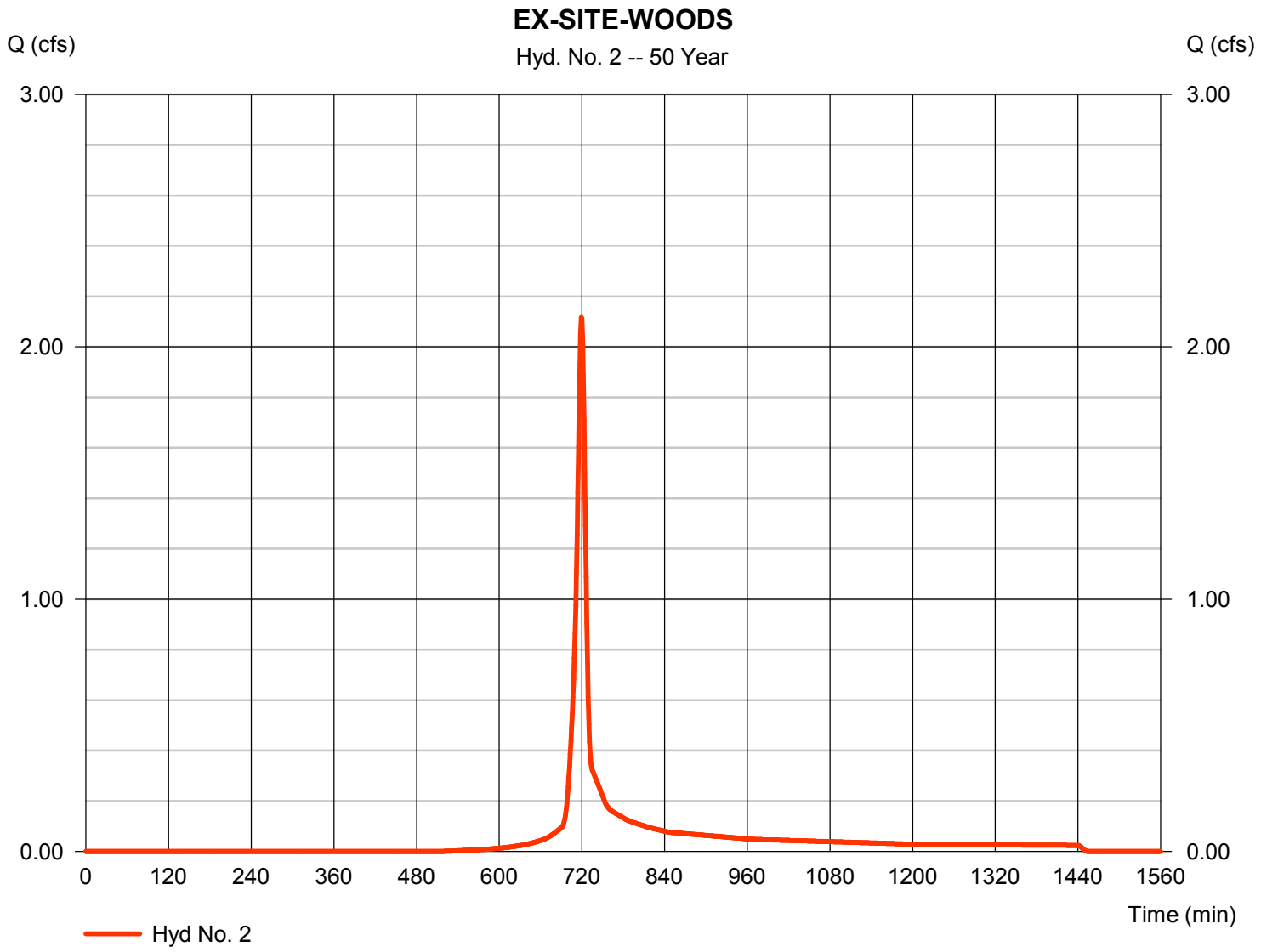
Hydrograph Report

Hyd. No. 2

EX-SITE-WOODS

Hydrograph type	=	SCS Runoff	Peak discharge	=	2.116 cfs
Storm frequency	=	50 yrs	Time to peak	=	719 min
Time interval	=	1 min	Hyd. volume	=	4,787 cuft
Drainage area	=	0.406 ac	Curve number	=	70*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	9.50 min
Total precip.	=	6.55 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.254 x 30) + (0.103 x 30)] / 0.406

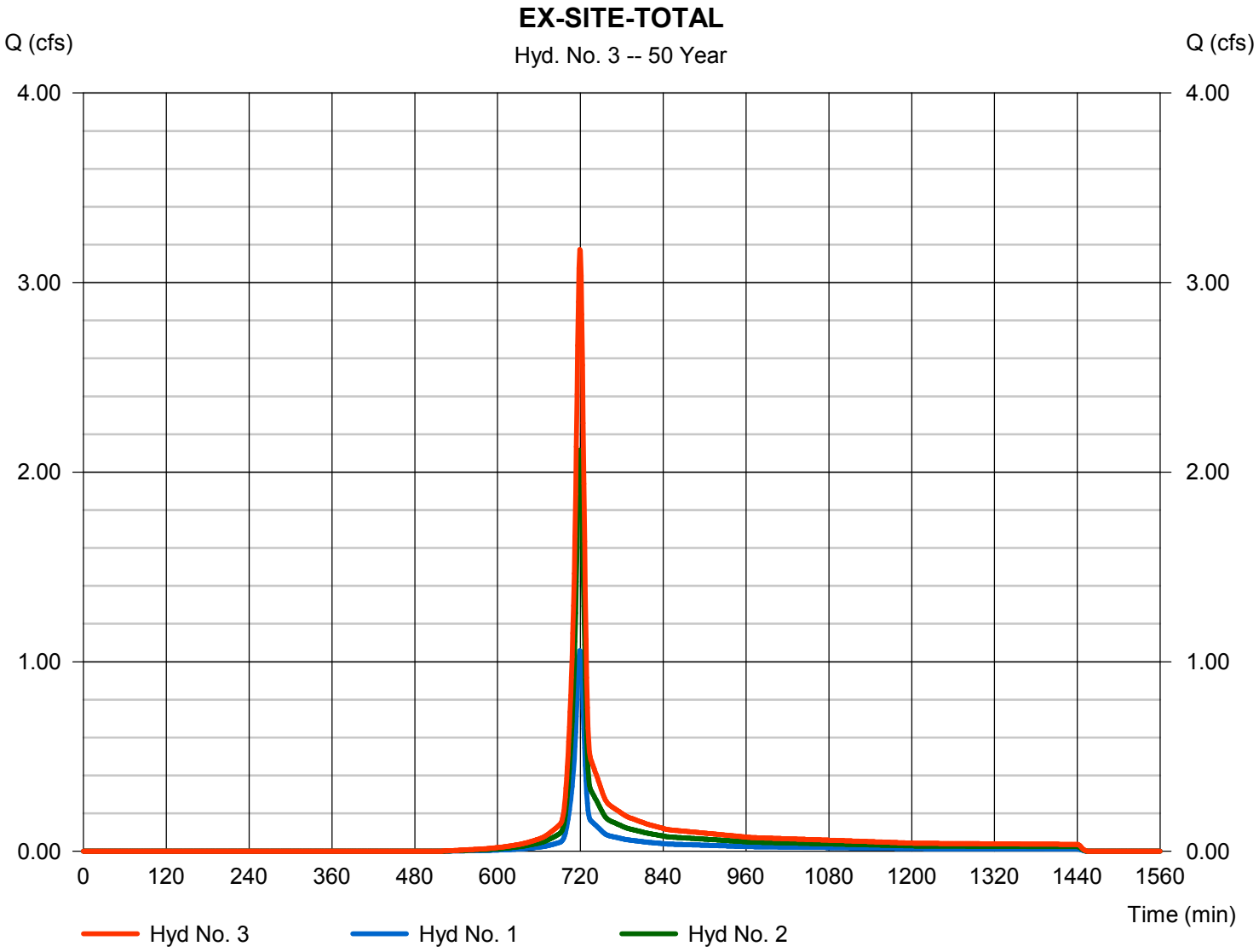


Hydrograph Report

Hyd. No. 3

EX-SITE-TOTAL

Hydrograph type	= Combine	Peak discharge	= 3.174 cfs
Storm frequency	= 50 yrs	Time to peak	= 719 min
Time interval	= 1 min	Hyd. volume	= 7,180 cuft
Inflow hyds.	= 1, 2	Contrib. drain. area	= 0.609 ac



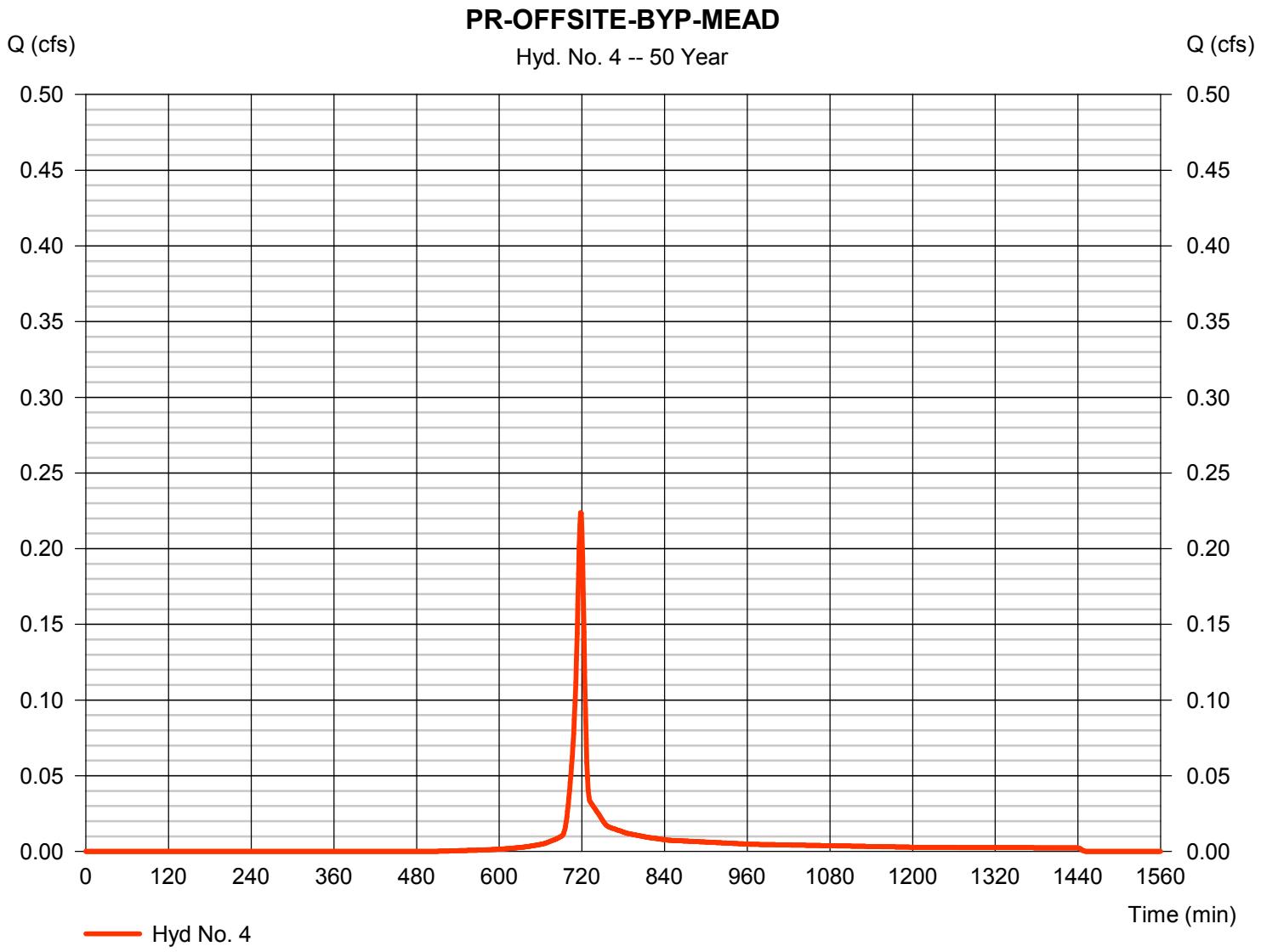
Hydrograph Report

Hyd. No. 4

PR-OFFSITE-BYP-MEAD

Hydrograph type	= SCS Runoff	Peak discharge	= 0.224 cfs
Storm frequency	= 50 yrs	Time to peak	= 718 min
Time interval	= 1 min	Hyd. volume	= 474 cuft
Drainage area	= 0.040 ac	Curve number	= 71*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.70 min
Total precip.	= 6.55 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.254 x 30) + (0.103 x 30)] / 0.040



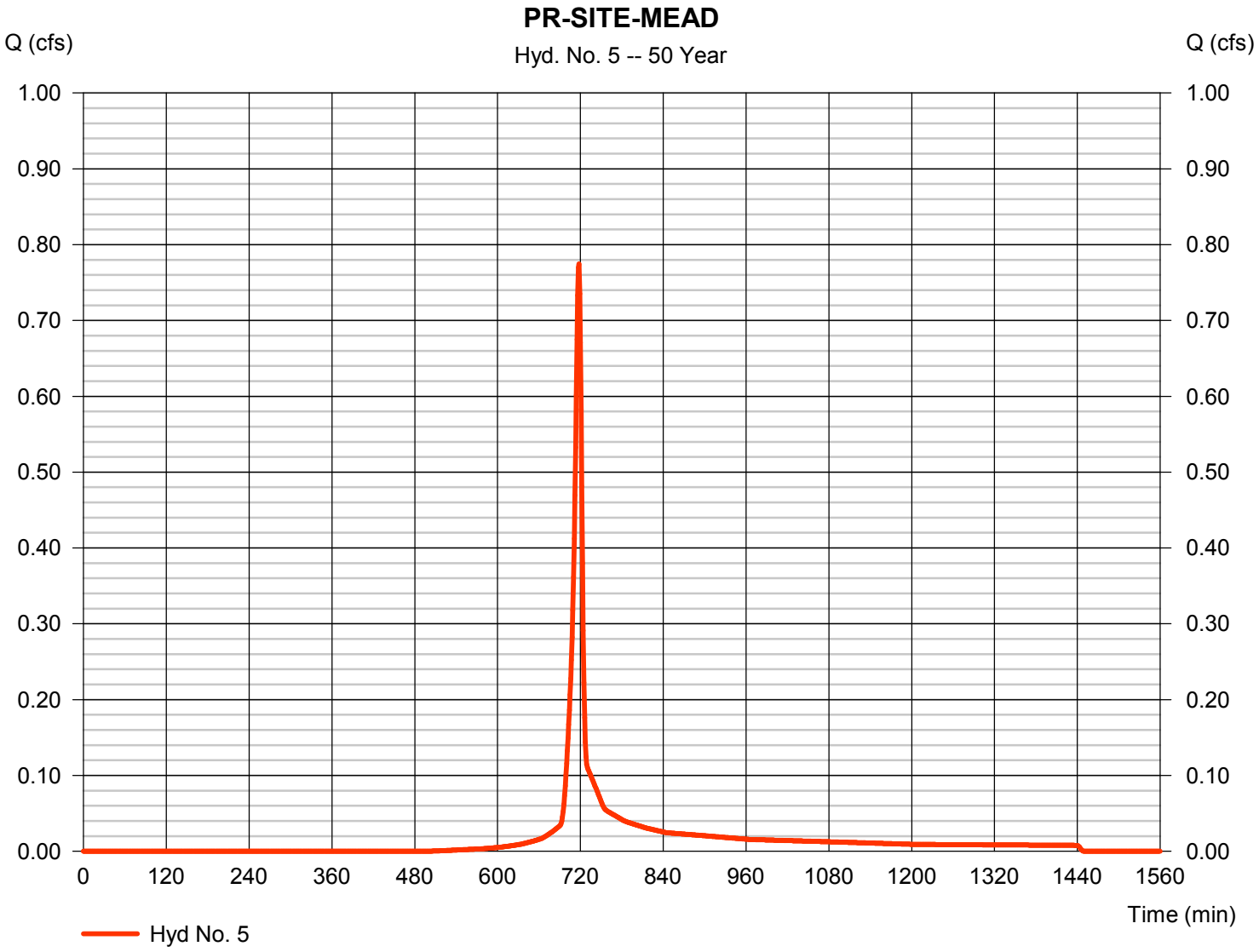
Hydrograph Report

Hyd. No. 5

PR-SITE-MEAD

Hydrograph type	= SCS Runoff	Peak discharge	= 0.774 cfs
Storm frequency	= 50 yrs	Time to peak	= 718 min
Time interval	= 1 min	Hyd. volume	= 1,567 cuft
Drainage area	= 0.125 ac	Curve number	= 71*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.80 min
Total precip.	= 6.55 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.352 x 71) + (0.054 x 71) + (0.305 x 71)] / 0.125

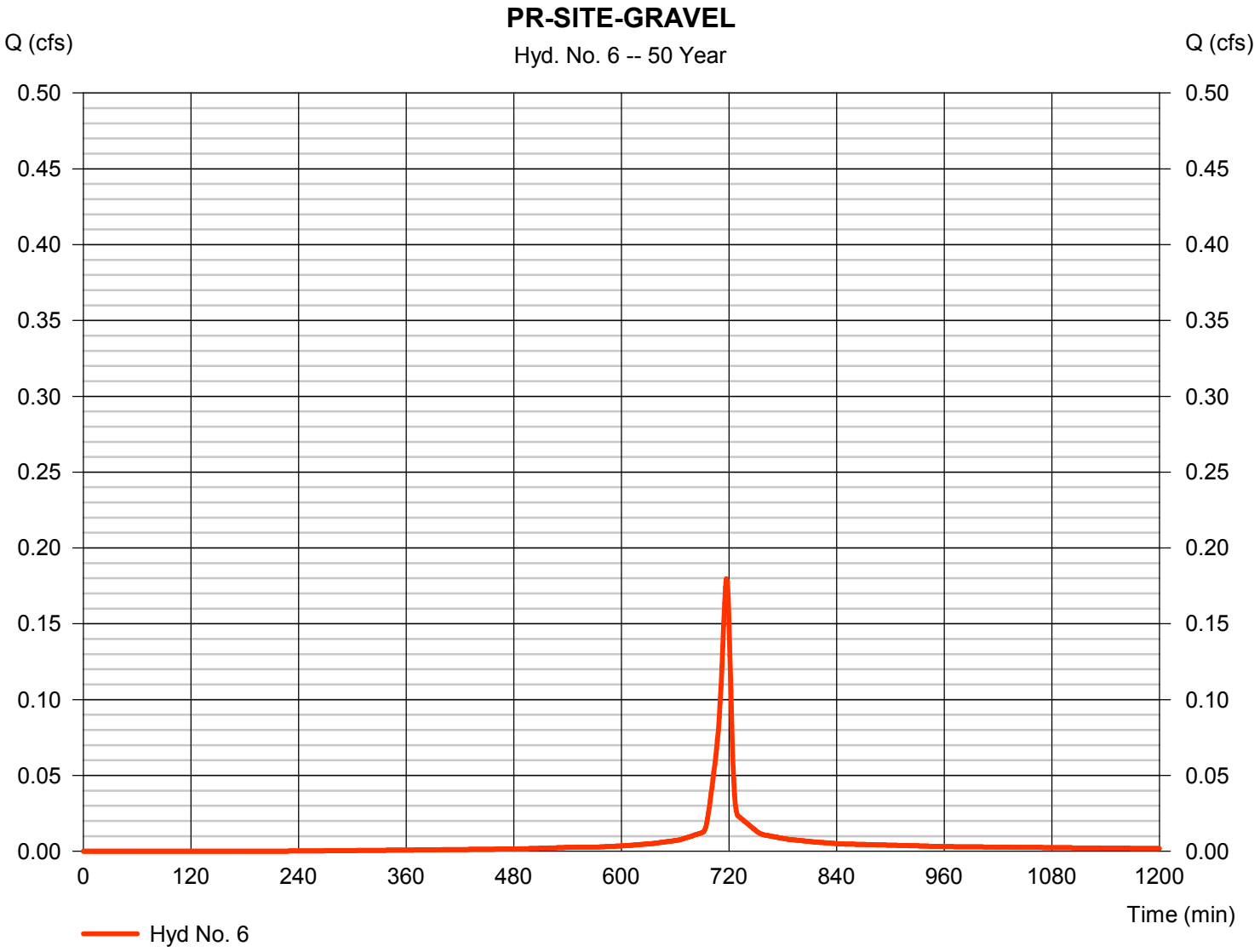


Hydrograph Report

Hyd. No. 6

PR-SITE-GRAVEL

Hydrograph type	= SCS Runoff	Peak discharge	= 0.180 cfs
Storm frequency	= 50 yrs	Time to peak	= 717 min
Time interval	= 1 min	Hyd. volume	= 395 cuft
Drainage area	= 0.020 ac	Curve number	= 89
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.80 min
Total precip.	= 6.55 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

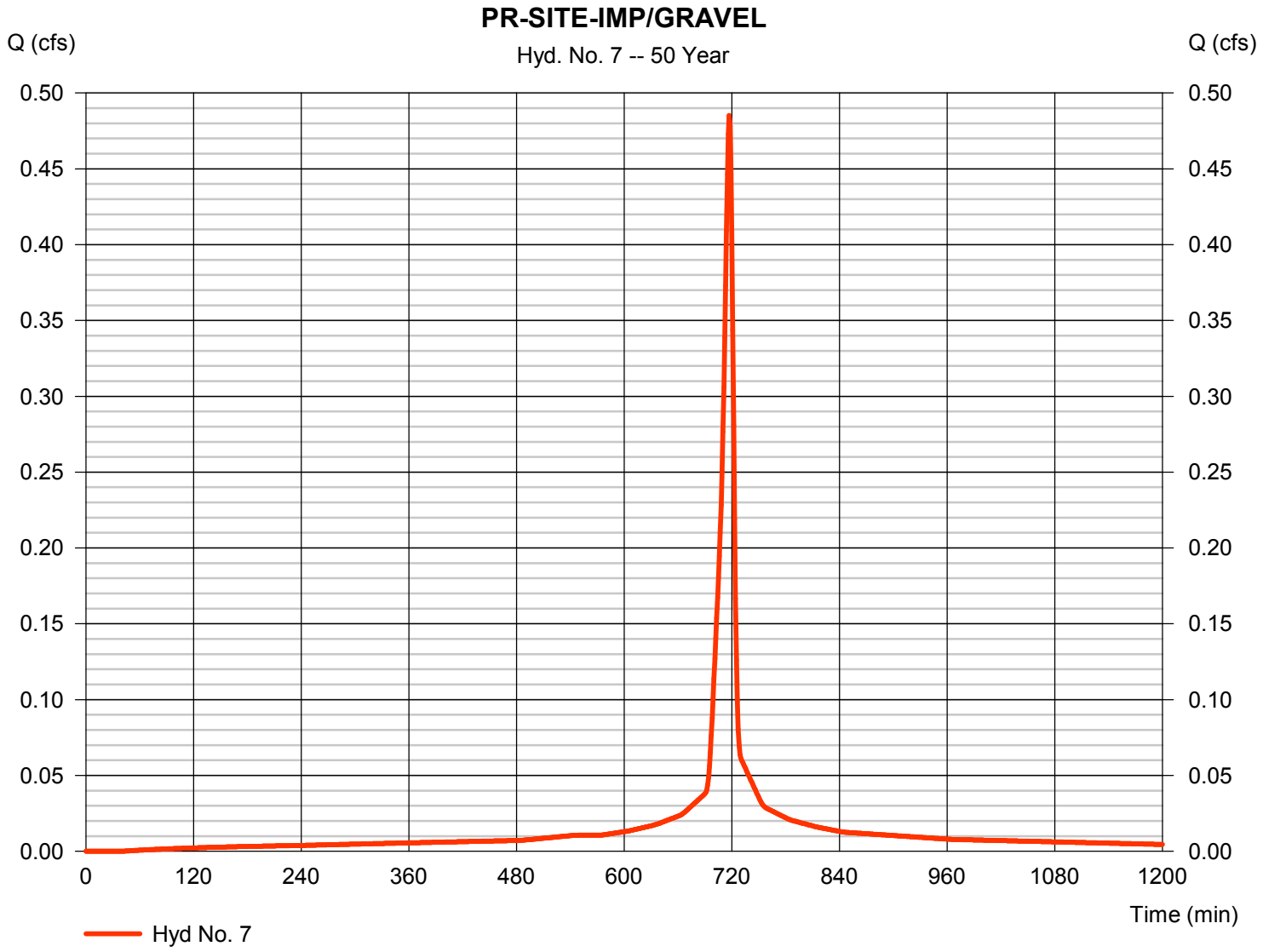


Hydrograph Report

Hyd. No. 7

PR-SITE-IMP/GRAVEL

Hydrograph type	= SCS Runoff	Peak discharge	= 0.485 cfs
Storm frequency	= 50 yrs	Time to peak	= 717 min
Time interval	= 1 min	Hyd. volume	= 1,181 cuft
Drainage area	= 0.050 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.80 min
Total precip.	= 6.55 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



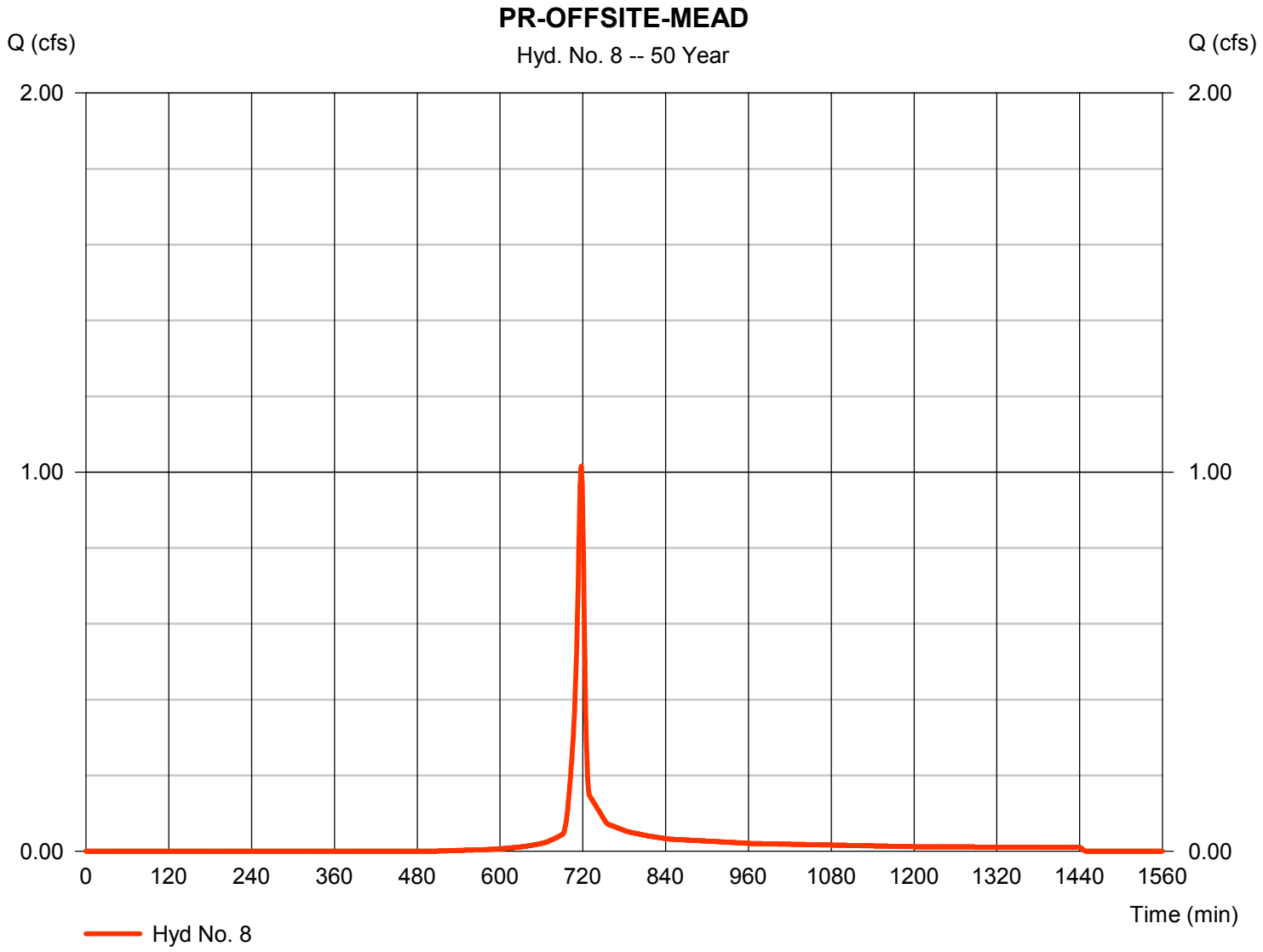
Hydrograph Report

Hyd. No. 8

PR-OFFSITE-MEAD

Hydrograph type	=	SCS Runoff	Peak discharge	=	1.016 cfs
Storm frequency	=	50 yrs	Time to peak	=	718 min
Time interval	=	1 min	Hyd. volume	=	2,055 cuft
Drainage area	=	0.164 ac	Curve number	=	71*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	6.40 min
Total precip.	=	6.55 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.254 x 30) + (0.103 x 30)] / 0.164

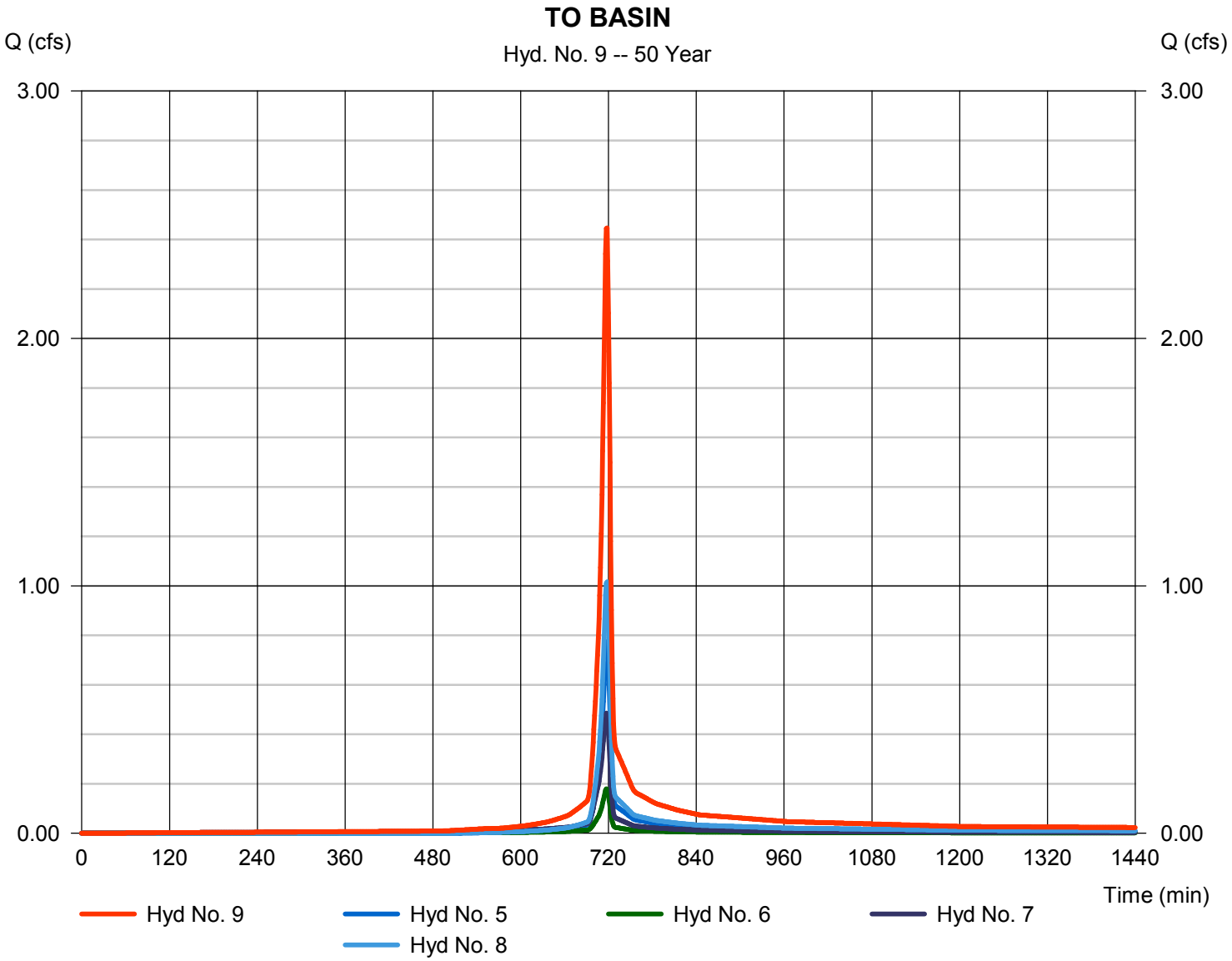


Hydrograph Report

Hyd. No. 9

TO BASIN

Hydrograph type	= Combine	Peak discharge	= 2.446 cfs
Storm frequency	= 50 yrs	Time to peak	= 718 min
Time interval	= 1 min	Hyd. volume	= 5,198 cuft
Inflow hyds.	= 5, 6, 7, 8	Contrib. drain. area	= 0.359 ac



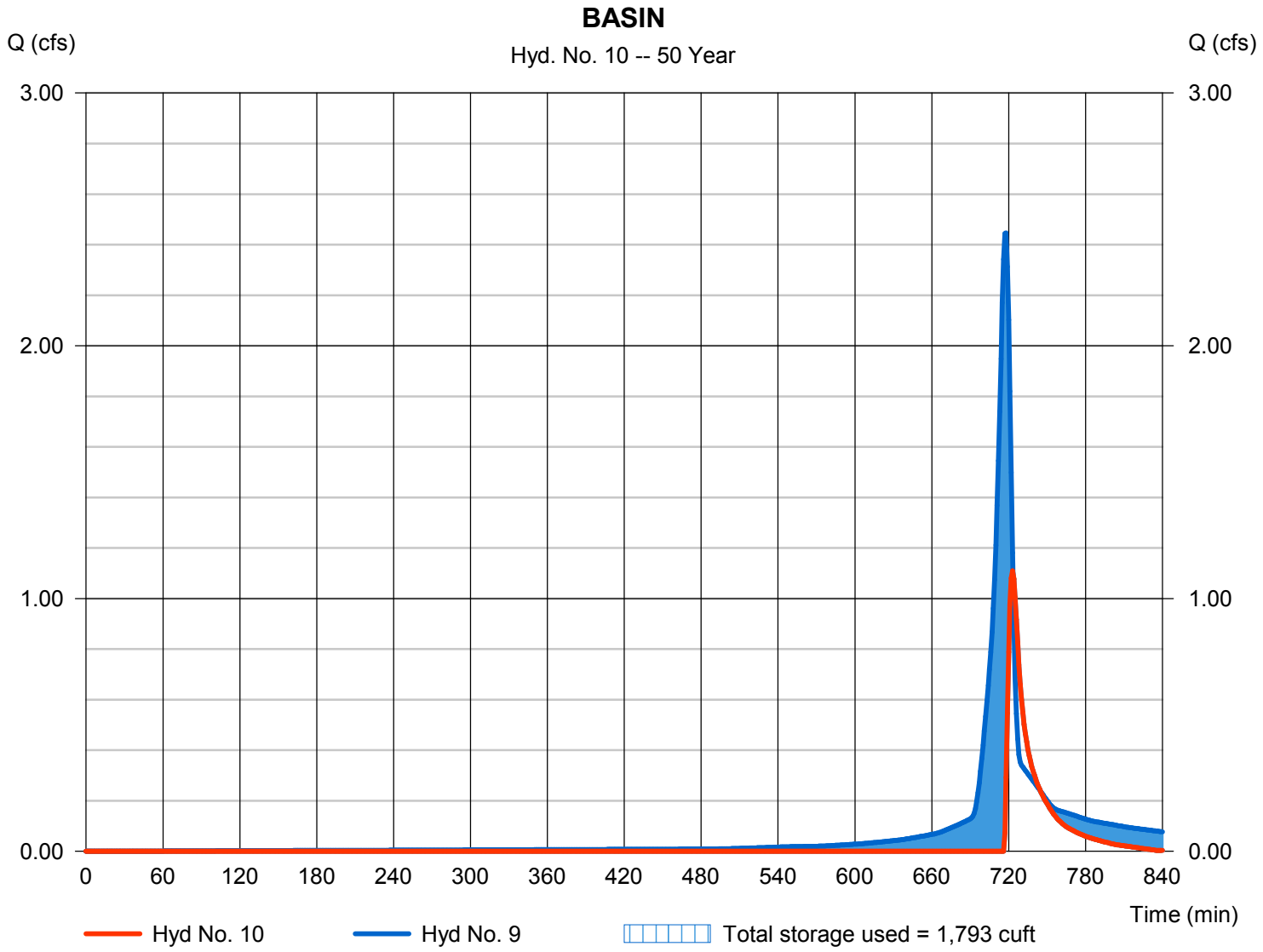
Hydrograph Report

Hyd. No. 10

BASIN

Hydrograph type	=	Reservoir	Peak discharge	=	1.109 cfs
Storm frequency	=	50 yrs	Time to peak	=	723 min
Time interval	=	1 min	Hyd. volume	=	1,299 cuft
Inflow hyd. No.	=	9 - TO BASIN	Max. Elevation	=	704.01 ft
Reservoir name	=	UG N-12 Perforated Pipe System	Max. Storage	=	1,793 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



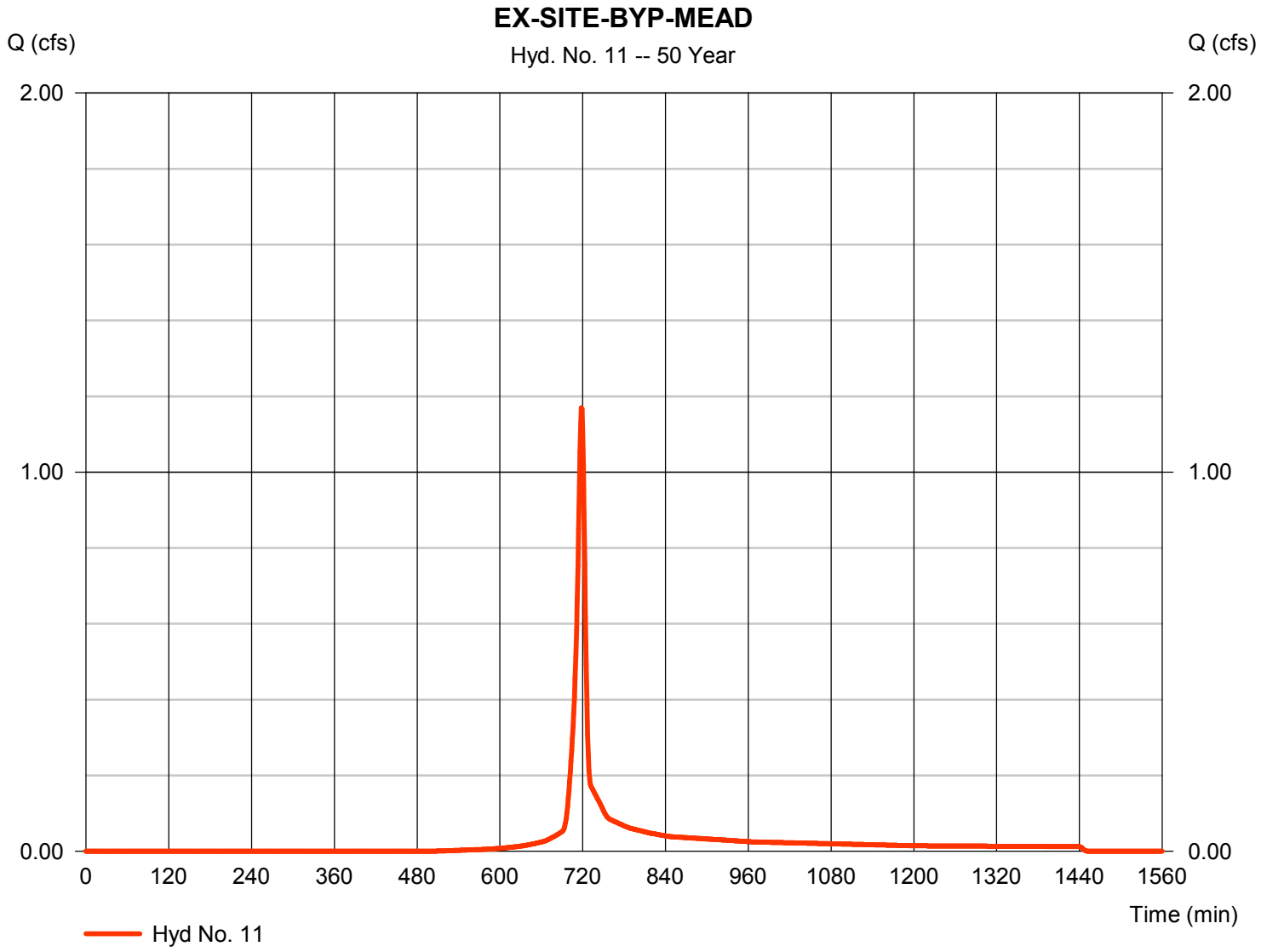
Hydrograph Report

Hyd. No. 11

EX-SITE-BYP-MEAD

Hydrograph type	=	SCS Runoff	Peak discharge	=	1.169 cfs
Storm frequency	=	50 yrs	Time to peak	=	718 min
Time interval	=	1 min	Hyd. volume	=	2,476 cuft
Drainage area	=	0.209 ac	Curve number	=	71*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	6.80 min
Total precip.	=	6.55 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.364 x 71) + (0.314 x 71) + (0.123 x 71)] / 0.209

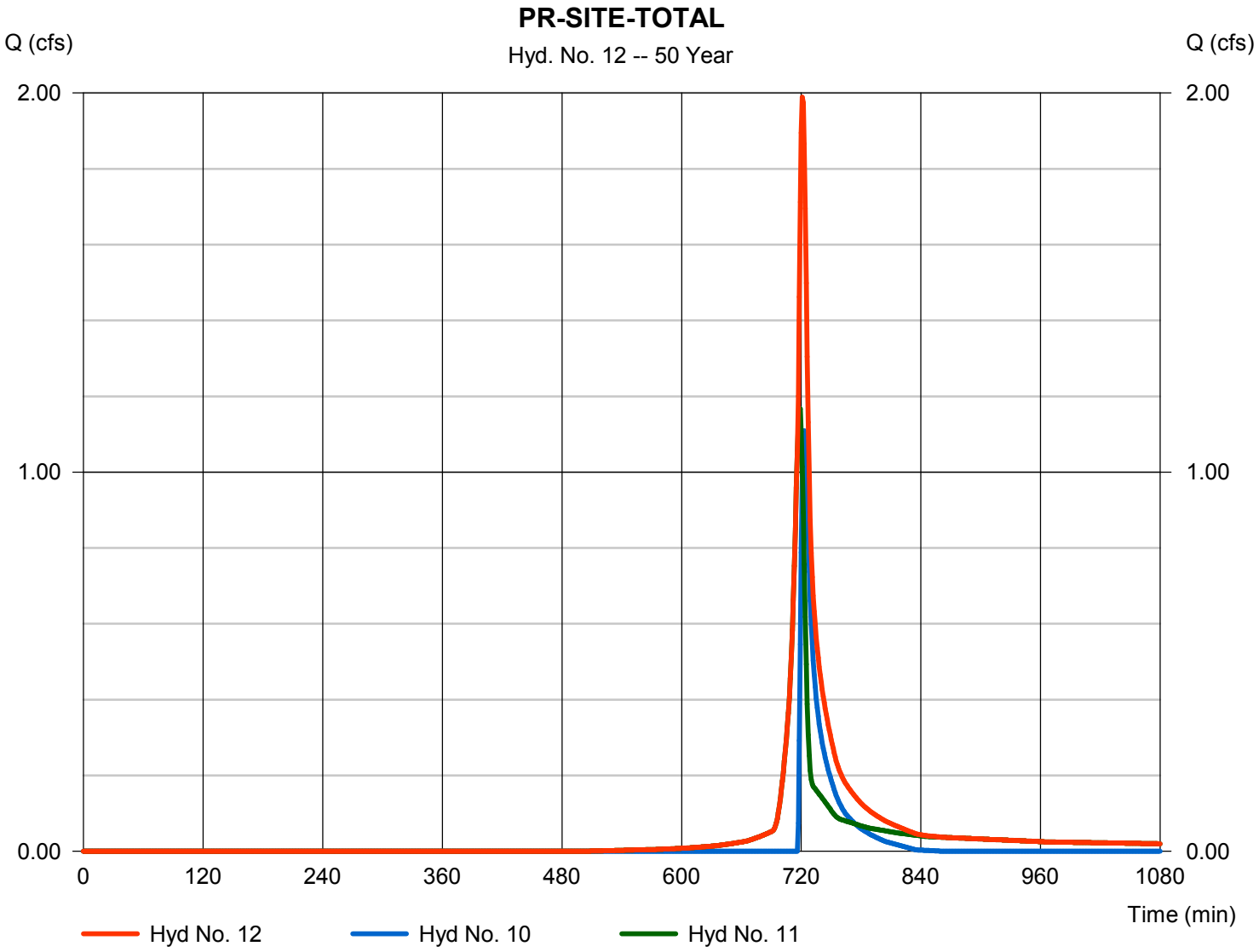


Hydrograph Report

Hyd. No. 12

PR-SITE-TOTAL

Hydrograph type	=	Combine	Peak discharge	=	1.989 cfs
Storm frequency	=	50 yrs	Time to peak	=	721 min
Time interval	=	1 min	Hyd. volume	=	3,776 cuft
Inflow hyds.	=	10, 11	Contrib. drain. area	=	0.209 ac

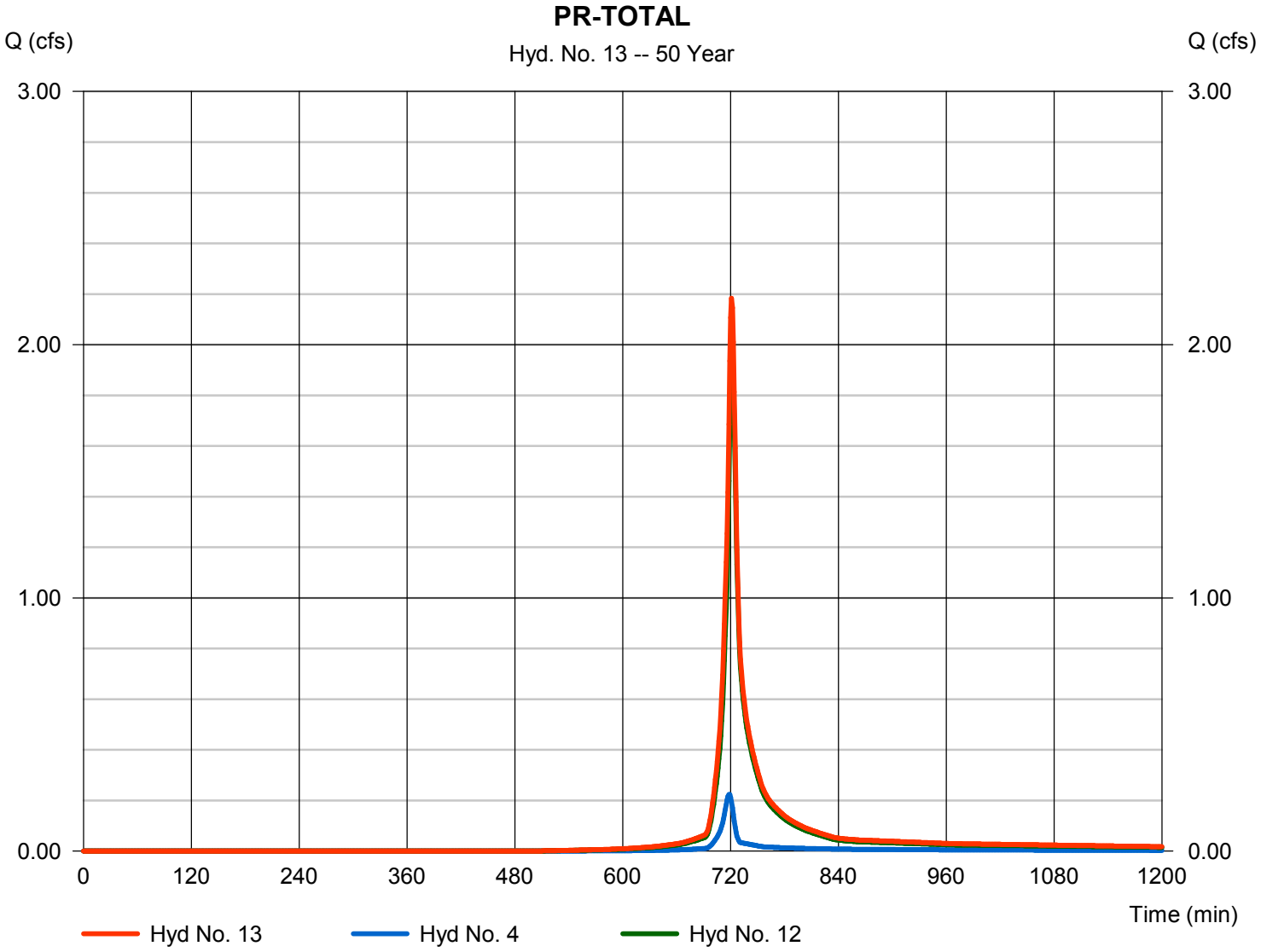


Hydrograph Report

Hyd. No. 13

PR-TOTAL

Hydrograph type	= Combine	Peak discharge	= 2.183 cfs
Storm frequency	= 50 yrs	Time to peak	= 721 min
Time interval	= 1 min	Hyd. volume	= 4,250 cuft
Inflow hyds.	= 4, 12	Contrib. drain. area	= 0.040 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v11

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	1.345	1	719	3,050	------	------	------	EX-OFFSITE-WOODS
2	SCS Runoff	2.690	1	719	6,101	------	------	------	EX-SITE-WOODS
3	Combine	4.036	1	719	9,151	1, 2	------	------	EX-SITE-TOTAL
4	SCS Runoff	0.283	1	718	602	------	------	------	PR-OFFSITE-BYP-MEAD
5	SCS Runoff	0.975	1	718	1,989	------	------	------	PR-SITE-MEAD
6	SCS Runoff	0.213	1	717	473	------	------	------	PR-SITE-GRAVEL
7	SCS Runoff	0.565	1	717	1,381	------	------	------	PR-SITE-IMP/GRAVEL
8	SCS Runoff	1.280	1	718	2,610	------	------	------	PR-OFFSITE-MEAD
9	Combine	3.027	1	717	6,453	5, 6, 7, 8	------	------	TO BASIN
10	Reservoir	1.972	1	721	2,137	9	704.38	1,998	BASIN
11	SCS Runoff	1.478	1	718	3,144	------	------	------	EX-SITE-BYP-MEAD
12	Combine	3.244	1	721	5,281	10, 11	------	------	PR-SITE-TOTAL
13	Combine	3.501	1	720	5,883	4, 12	------	------	PR-TOTAL

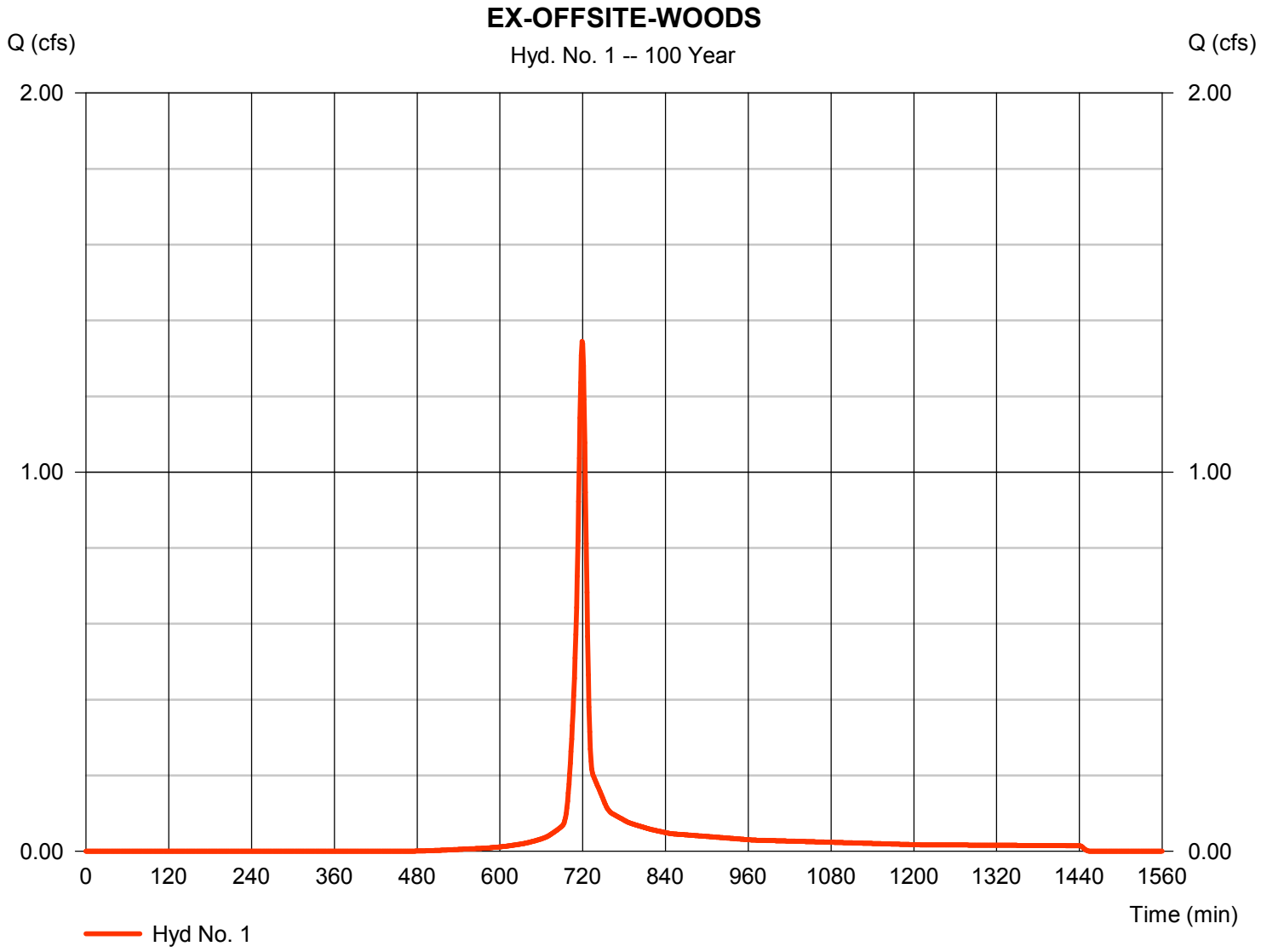
Hydrograph Report

Hyd. No. 1

EX-OFFSITE-WOODS

Hydrograph type	=	SCS Runoff	Peak discharge	=	1.345 cfs
Storm frequency	=	100 yrs	Time to peak	=	719 min
Time interval	=	1 min	Hyd. volume	=	3,050 cuft
Drainage area	=	0.203 ac	Curve number	=	70*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	10.00 min
Total precip.	=	7.62 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.254 x 30) + (0.103 x 30)] / 0.203



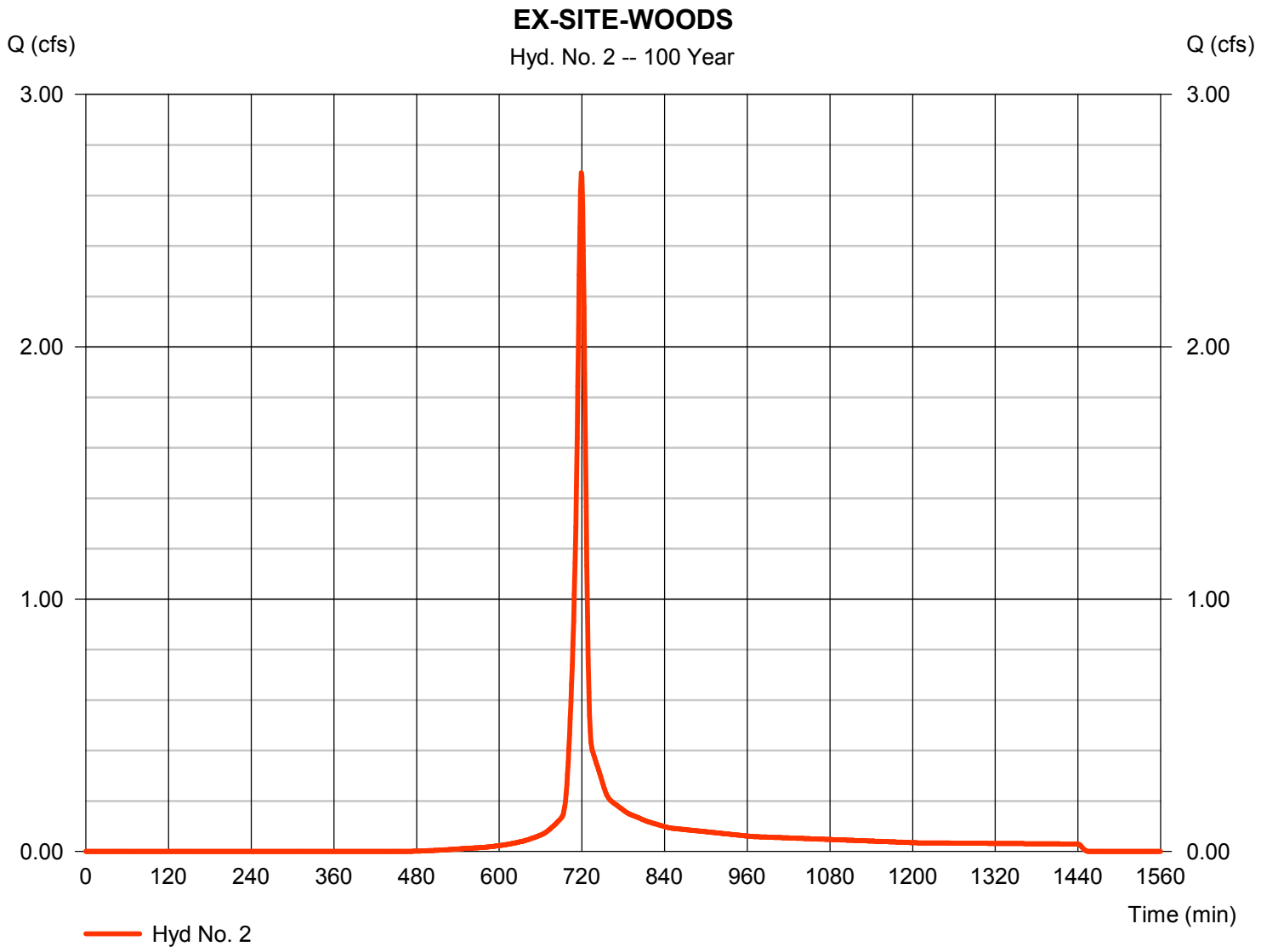
Hydrograph Report

Hyd. No. 2

EX-SITE-WOODS

Hydrograph type	= SCS Runoff	Peak discharge	= 2.690 cfs
Storm frequency	= 100 yrs	Time to peak	= 719 min
Time interval	= 1 min	Hyd. volume	= 6,101 cuft
Drainage area	= 0.406 ac	Curve number	= 70*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 9.50 min
Total precip.	= 7.62 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.254 x 30) + (0.103 x 30)] / 0.406

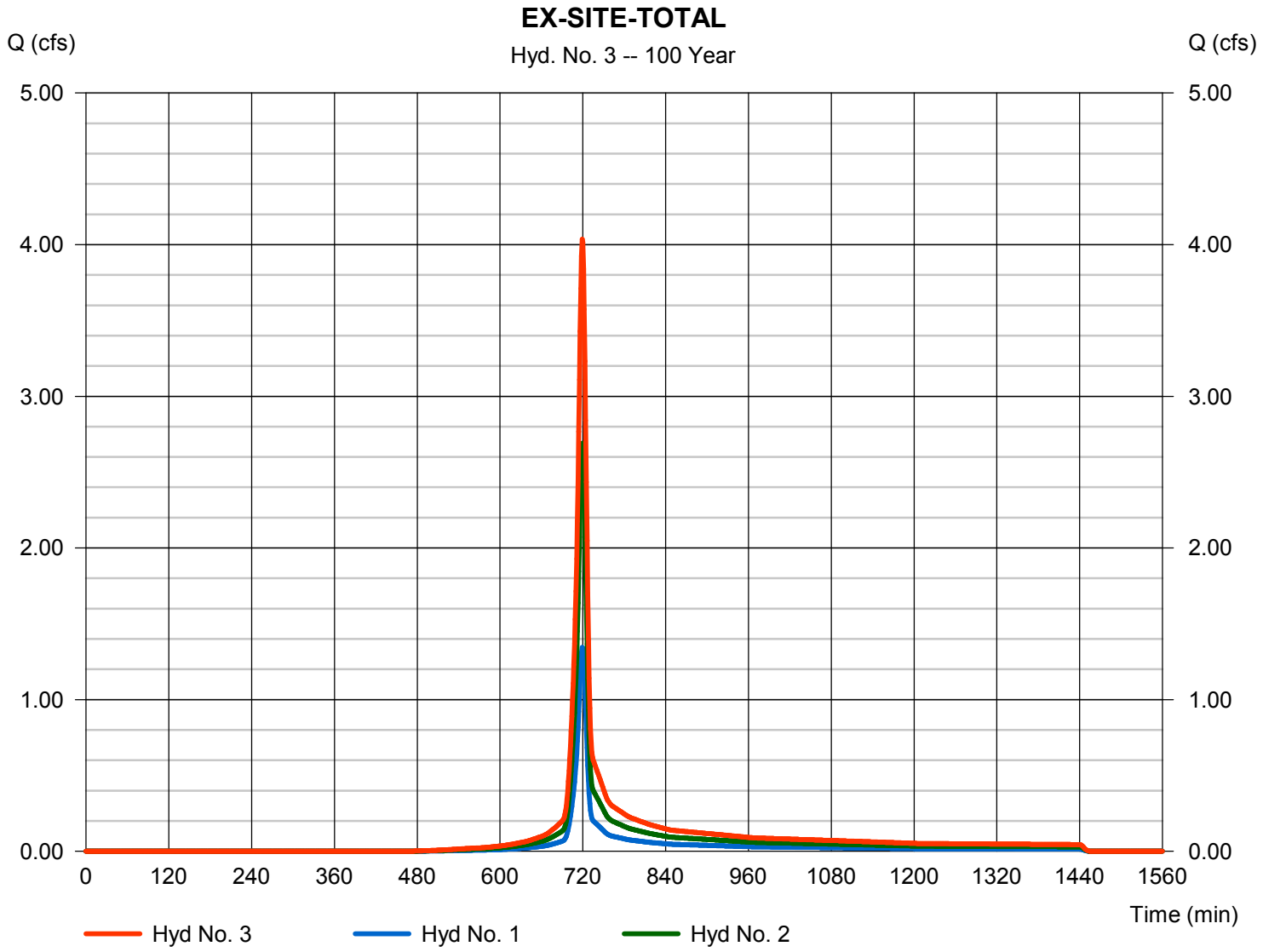


Hydrograph Report

Hyd. No. 3

EX-SITE-TOTAL

Hydrograph type	= Combine	Peak discharge	= 4.036 cfs
Storm frequency	= 100 yrs	Time to peak	= 719 min
Time interval	= 1 min	Hyd. volume	= 9,151 cuft
Inflow hyds.	= 1, 2	Contrib. drain. area	= 0.609 ac



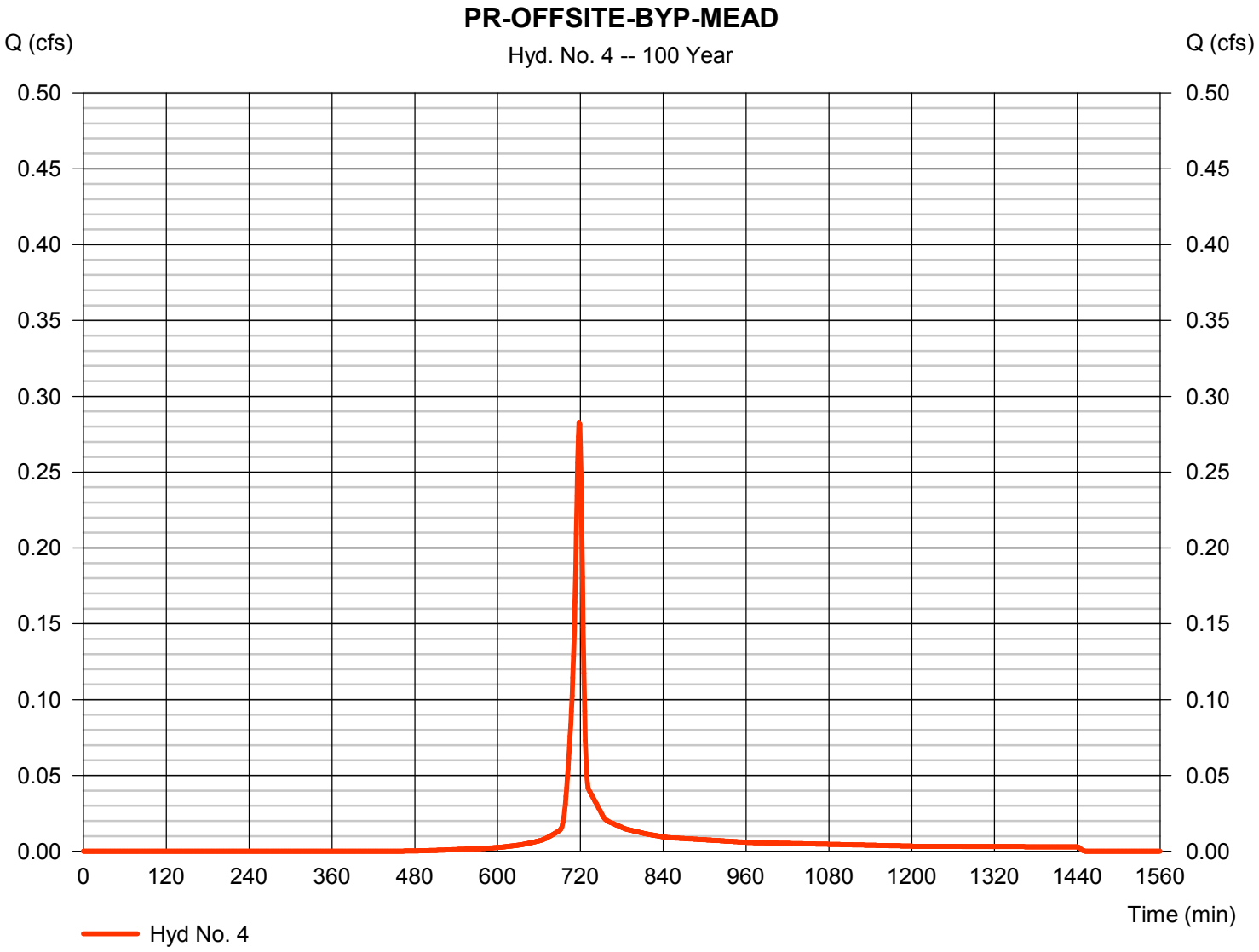
Hydrograph Report

Hyd. No. 4

PR-OFFSITE-BYP-MEAD

Hydrograph type	= SCS Runoff	Peak discharge	= 0.283 cfs
Storm frequency	= 100 yrs	Time to peak	= 718 min
Time interval	= 1 min	Hyd. volume	= 602 cuft
Drainage area	= 0.040 ac	Curve number	= 71*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.70 min
Total precip.	= 7.62 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.254 x 30) + (0.103 x 30)] / 0.040



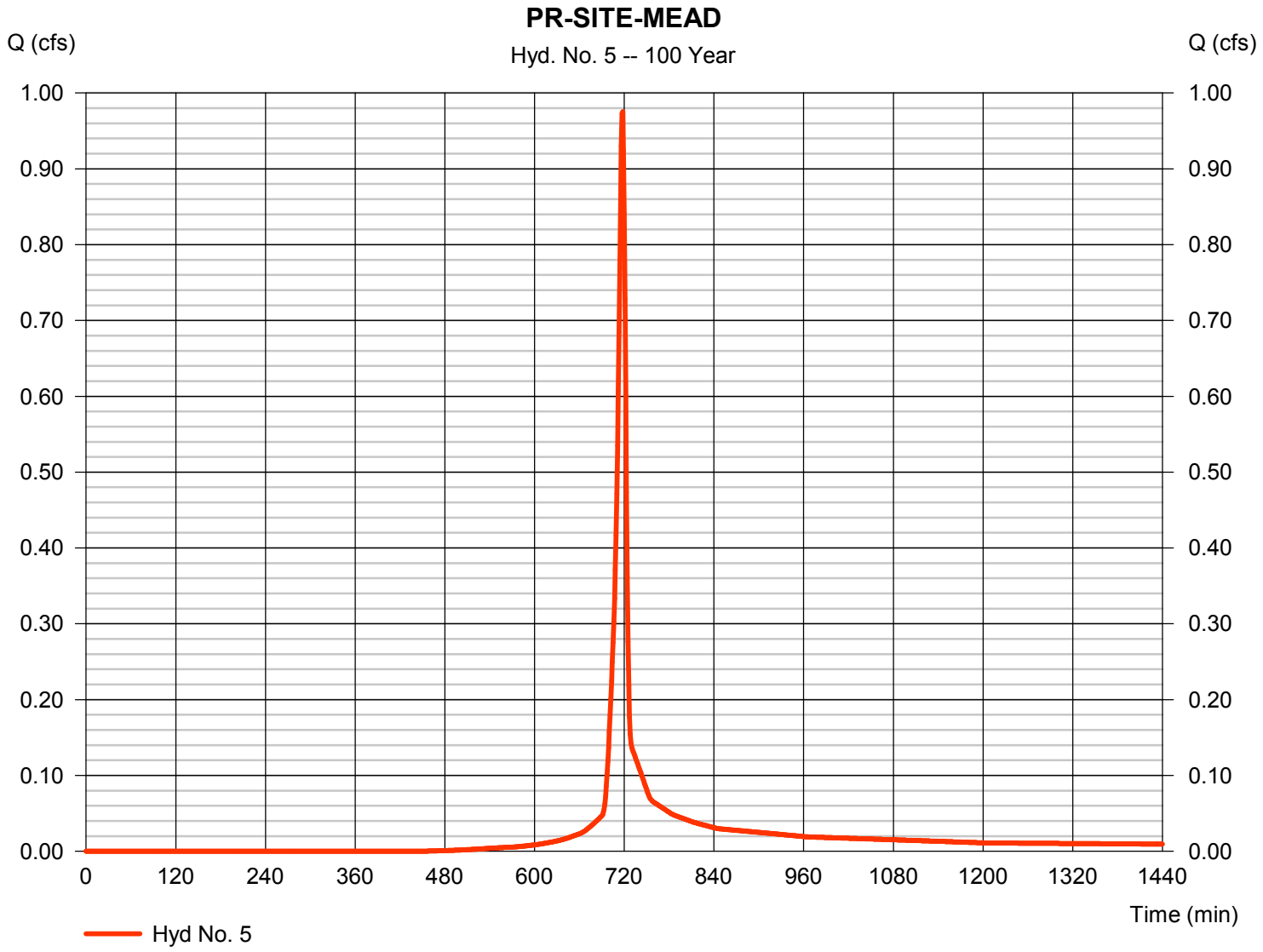
Hydrograph Report

Hyd. No. 5

PR-SITE-MEAD

Hydrograph type	= SCS Runoff	Peak discharge	= 0.975 cfs
Storm frequency	= 100 yrs	Time to peak	= 718 min
Time interval	= 1 min	Hyd. volume	= 1,989 cuft
Drainage area	= 0.125 ac	Curve number	= 71*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.80 min
Total precip.	= 7.62 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.352 x 71) + (0.054 x 71) + (0.305 x 71)] / 0.125

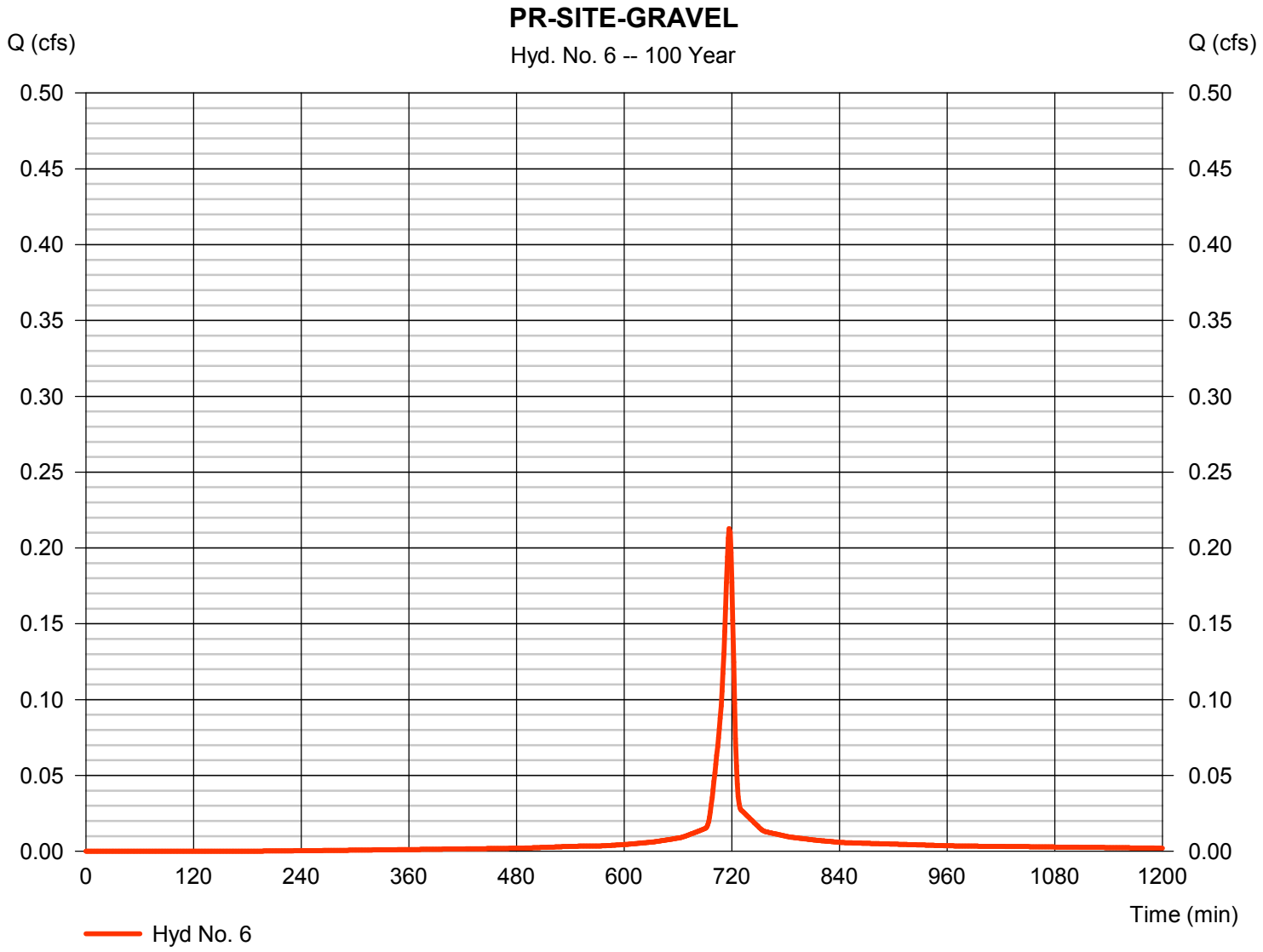


Hydrograph Report

Hyd. No. 6

PR-SITE-GRAVEL

Hydrograph type	= SCS Runoff	Peak discharge	= 0.213 cfs
Storm frequency	= 100 yrs	Time to peak	= 717 min
Time interval	= 1 min	Hyd. volume	= 473 cuft
Drainage area	= 0.020 ac	Curve number	= 89
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.80 min
Total precip.	= 7.62 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

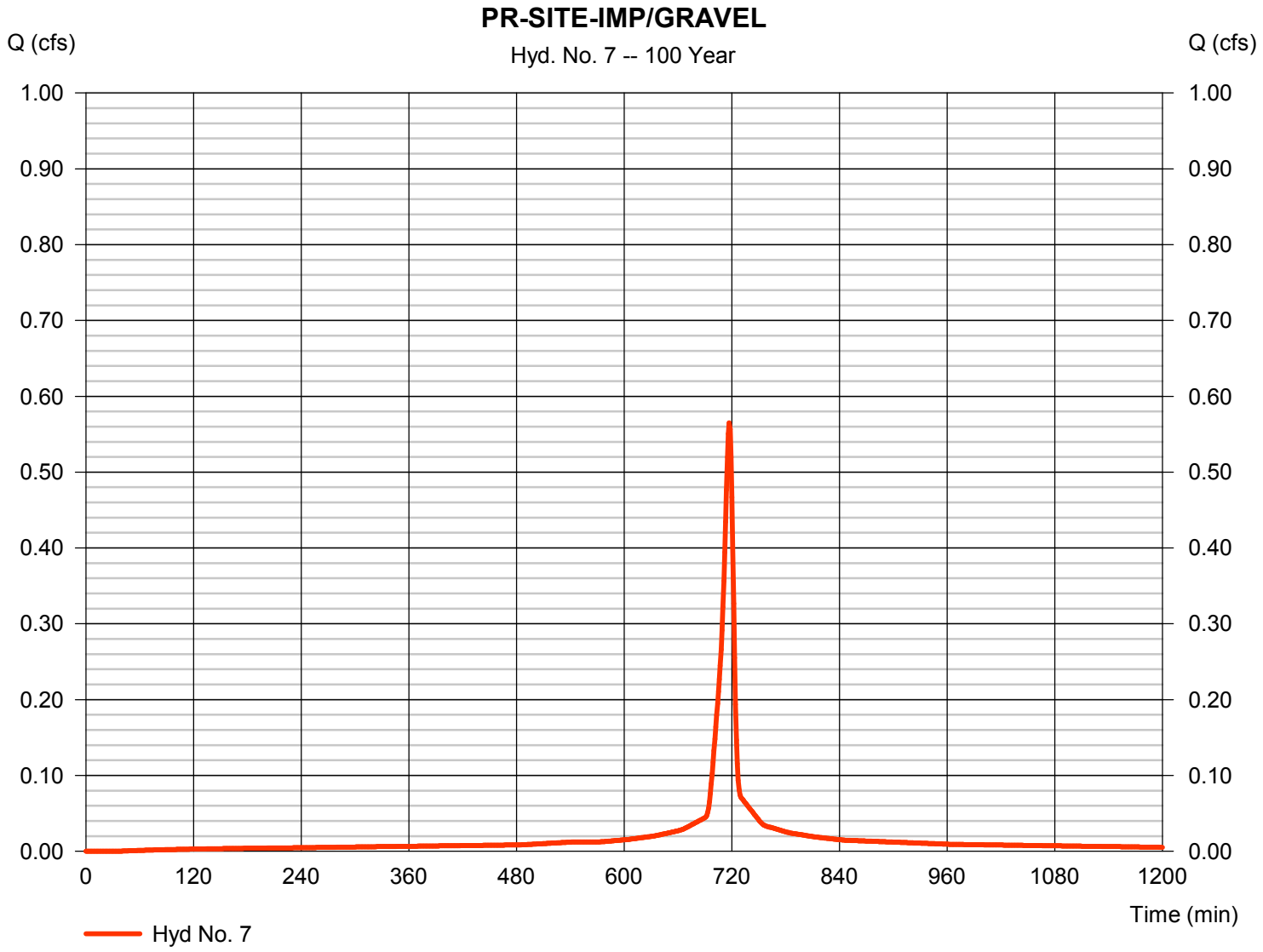


Hydrograph Report

Hyd. No. 7

PR-SITE-IMP/GRAVEL

Hydrograph type	= SCS Runoff	Peak discharge	= 0.565 cfs
Storm frequency	= 100 yrs	Time to peak	= 717 min
Time interval	= 1 min	Hyd. volume	= 1,381 cuft
Drainage area	= 0.050 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.80 min
Total precip.	= 7.62 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



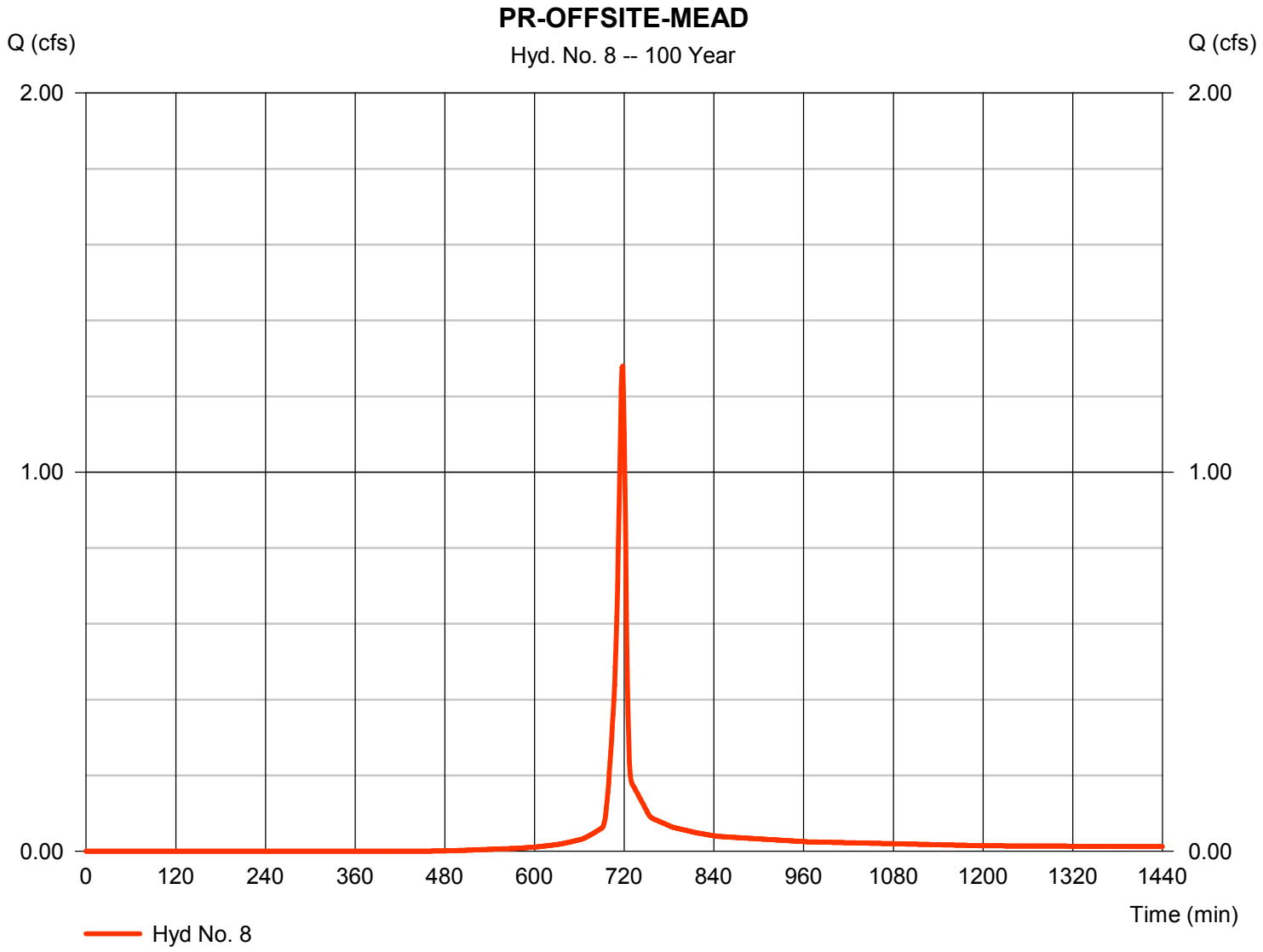
Hydrograph Report

Hyd. No. 8

PR-OFFSITE-MEAD

Hydrograph type	=	SCS Runoff	Peak discharge	=	1.280 cfs
Storm frequency	=	100 yrs	Time to peak	=	718 min
Time interval	=	1 min	Hyd. volume	=	2,610 cuft
Drainage area	=	0.164 ac	Curve number	=	71*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	6.40 min
Total precip.	=	7.62 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.254 x 30) + (0.103 x 30)] / 0.164

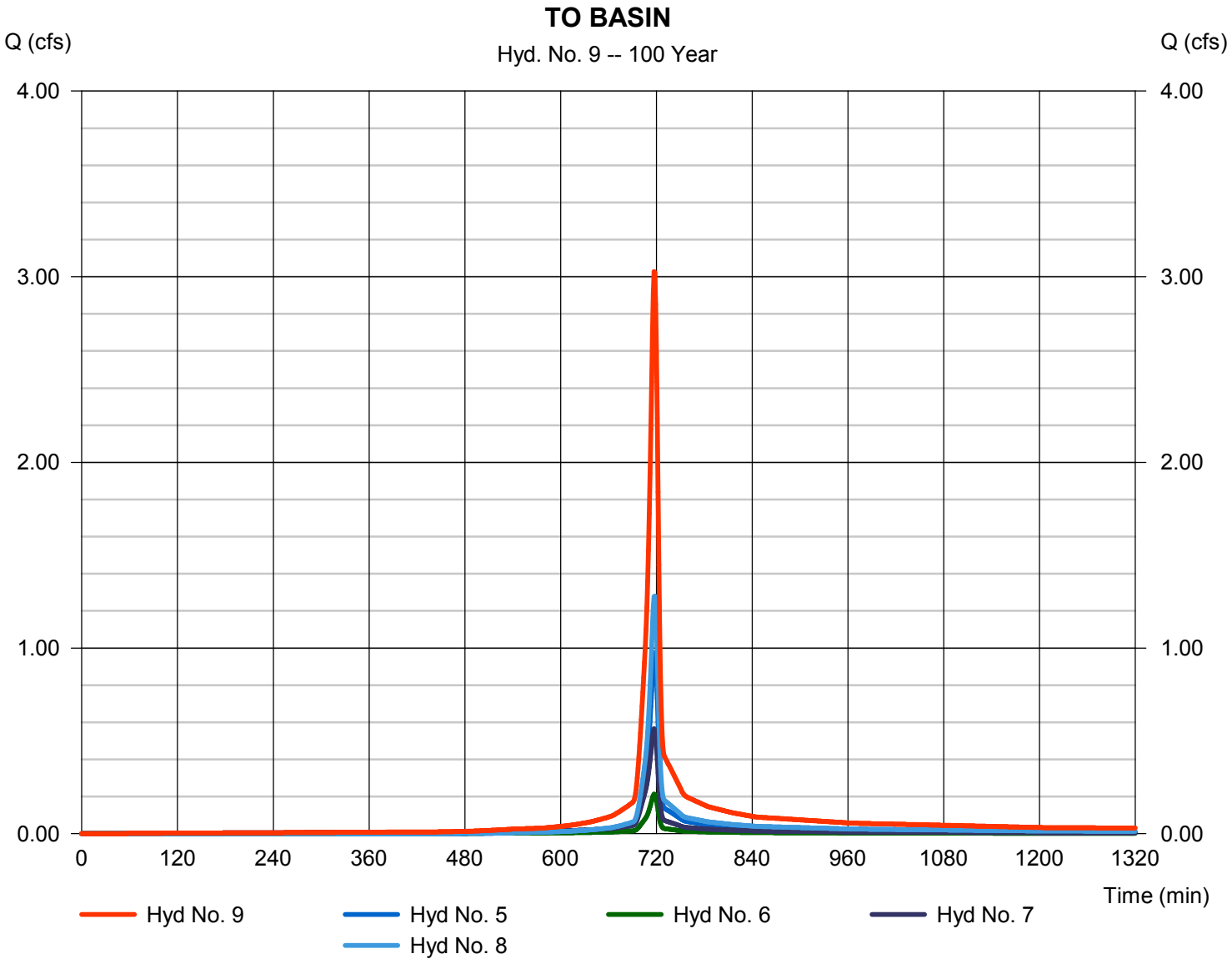


Hydrograph Report

Hyd. No. 9

TO BASIN

Hydrograph type	= Combine	Peak discharge	= 3.027 cfs
Storm frequency	= 100 yrs	Time to peak	= 717 min
Time interval	= 1 min	Hyd. volume	= 6,453 cuft
Inflow hyds.	= 5, 6, 7, 8	Contrib. drain. area	= 0.359 ac



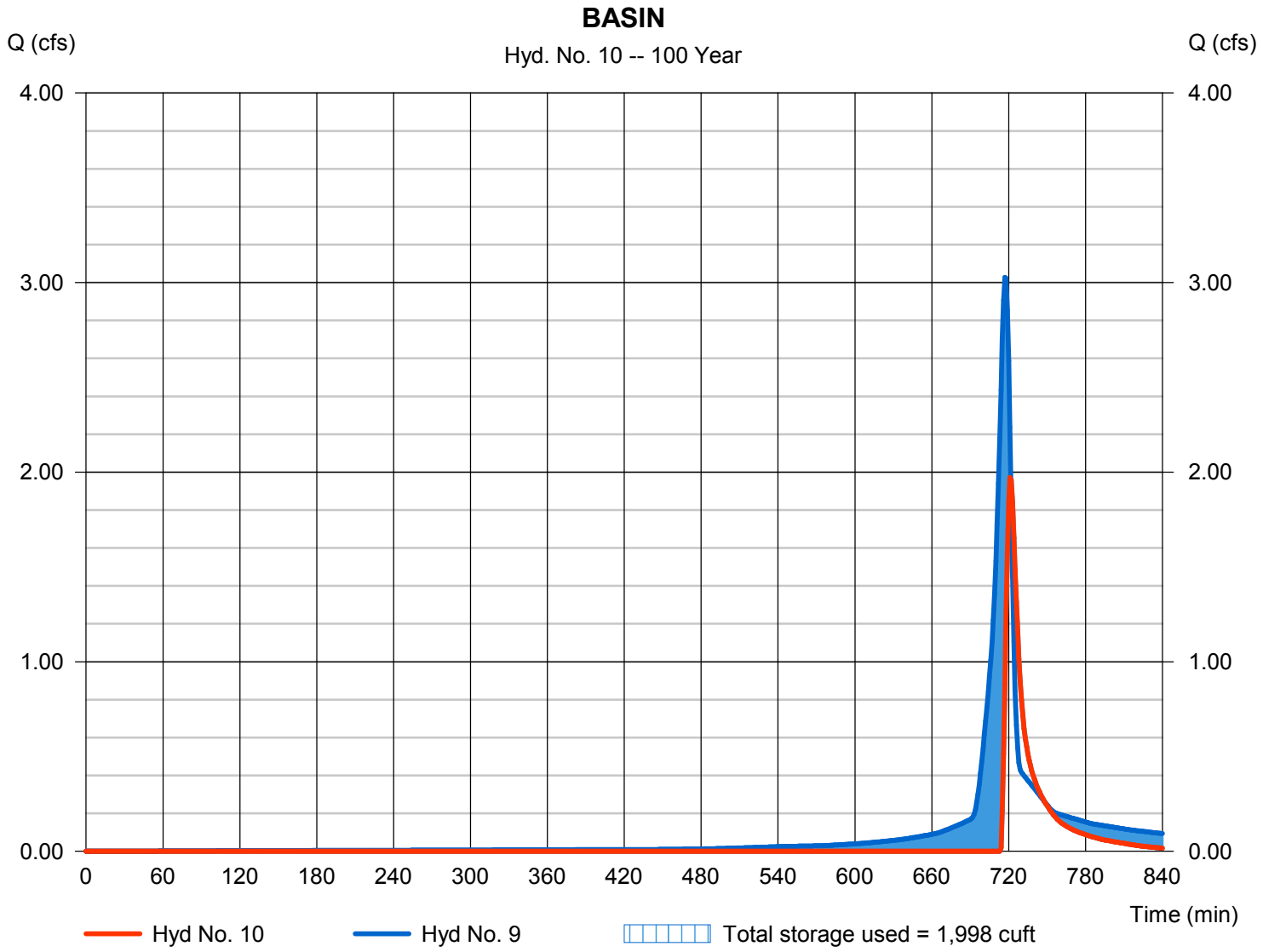
Hydrograph Report

Hyd. No. 10

BASIN

Hydrograph type	=	Reservoir	Peak discharge	=	1.972 cfs
Storm frequency	=	100 yrs	Time to peak	=	721 min
Time interval	=	1 min	Hyd. volume	=	2,137 cuft
Inflow hyd. No.	=	9 - TO BASIN	Max. Elevation	=	704.38 ft
Reservoir name	=	UG N-12 Perforated Pipe System	Max. Storage	=	1,998 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



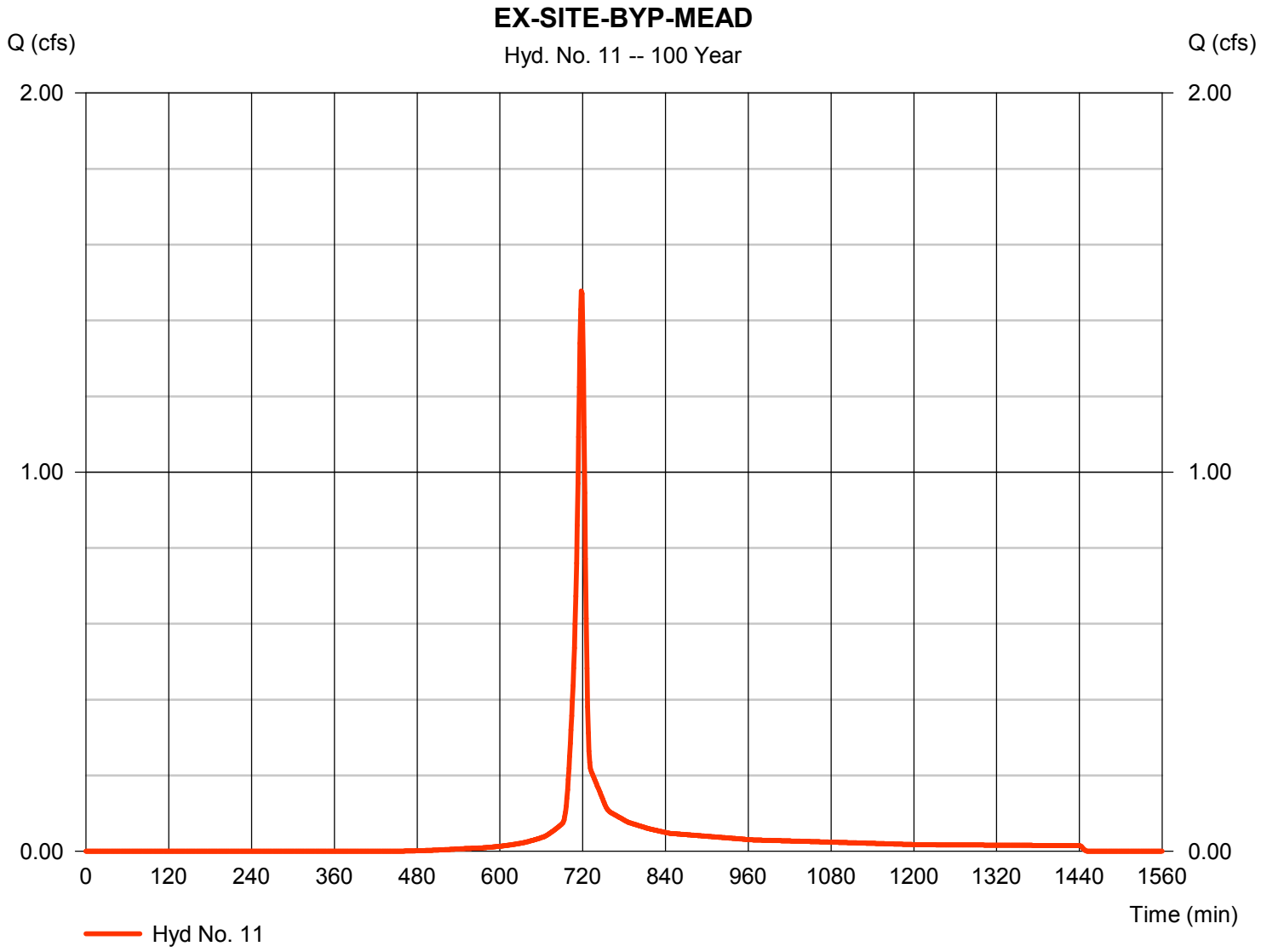
Hydrograph Report

Hyd. No. 11

EX-SITE-BYP-MEAD

Hydrograph type	= SCS Runoff	Peak discharge	= 1.478 cfs
Storm frequency	= 100 yrs	Time to peak	= 718 min
Time interval	= 1 min	Hyd. volume	= 3,144 cuft
Drainage area	= 0.209 ac	Curve number	= 71*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.80 min
Total precip.	= 7.62 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.364 x 71) + (0.314 x 71) + (0.123 x 71)] / 0.209

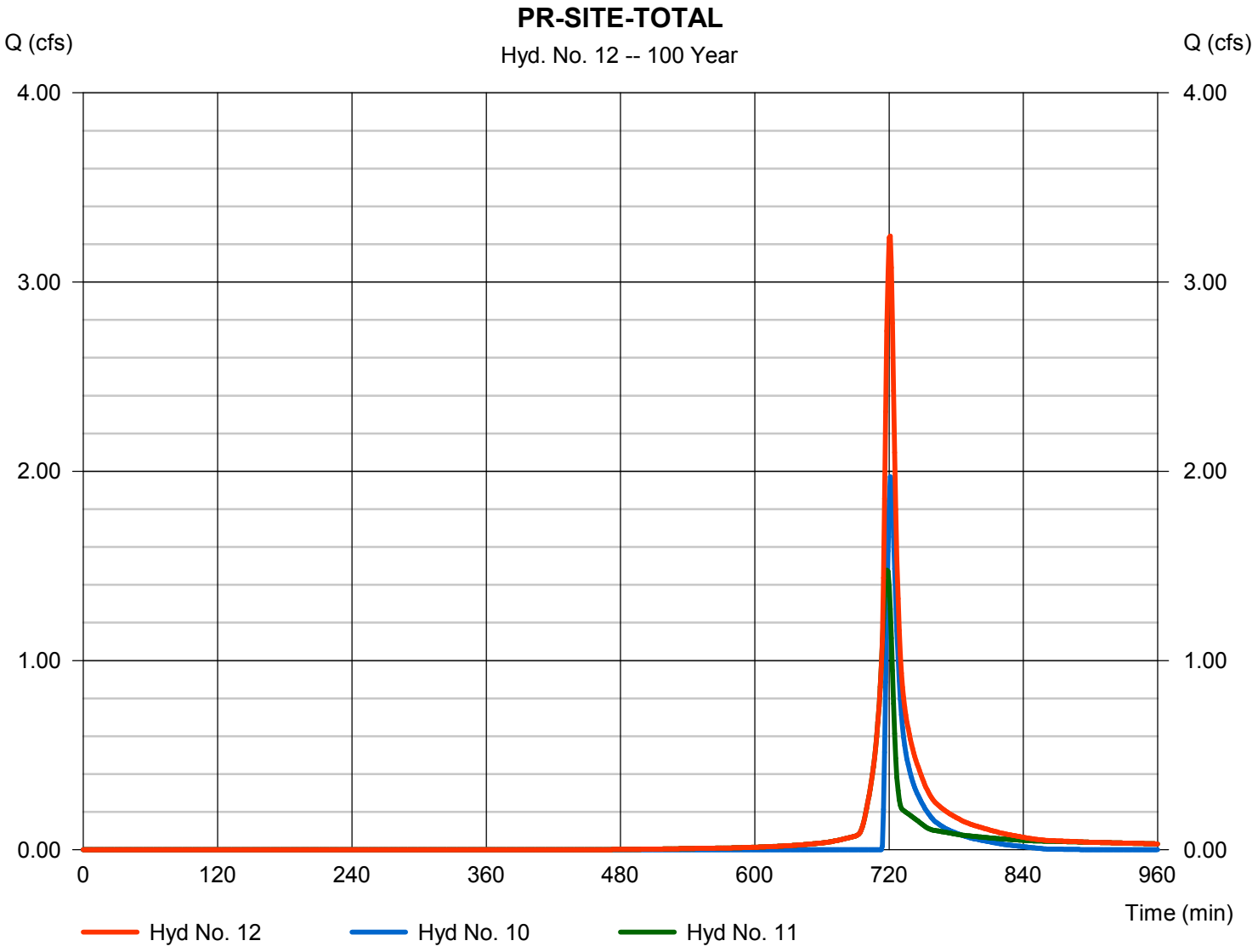


Hydrograph Report

Hyd. No. 12

PR-SITE-TOTAL

Hydrograph type	=	Combine	Peak discharge	=	3.244 cfs
Storm frequency	=	100 yrs	Time to peak	=	721 min
Time interval	=	1 min	Hyd. volume	=	5,281 cuft
Inflow hyds.	=	10, 11	Contrib. drain. area	=	0.209 ac

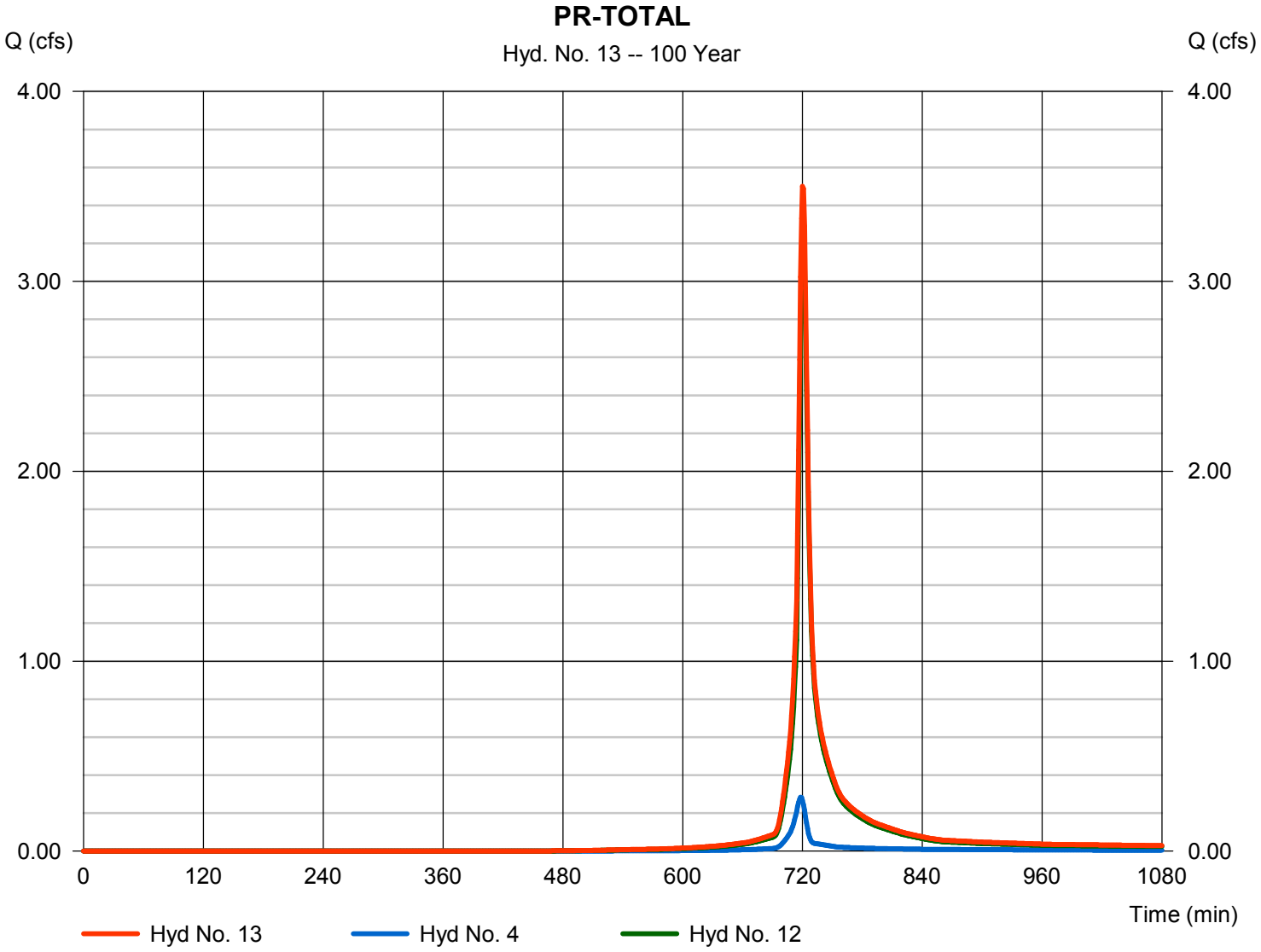


Hydrograph Report

Hyd. No. 13

PR-TOTAL

Hydrograph type	= Combine	Peak discharge	= 3.501 cfs
Storm frequency	= 100 yrs	Time to peak	= 720 min
Time interval	= 1 min	Hyd. volume	= 5,883 cuft
Inflow hyds.	= 4, 12	Contrib. drain. area	= 0.040 ac



Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	36.9738	16.1000	0.7641	--------
2	94.4784	24.8001	0.9391	--------
3	0.0000	0.0000	0.0000	--------
5	176.2795	30.1001	1.0248	--------
10	317.8354	35.8000	1.1154	--------
25	309.7854	36.4000	1.0685	--------
50	1324.7950	53.7998	1.3207	--------
100	68.0213	20.7000	0.7186	--------

File name: Irvington.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	3.60	3.06	2.67	2.39	2.16	1.98	1.83	1.70	1.60	1.50	1.42	1.35
2	3.90	3.37	2.97	2.66	2.41	2.20	2.03	1.88	1.75	1.64	1.55	1.46
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	4.60	4.01	3.56	3.19	2.90	2.65	2.44	2.26	2.11	1.97	1.86	1.75
10	5.08	4.46	3.98	3.58	3.25	2.98	2.75	2.54	2.37	2.22	2.08	1.96
25	5.80	5.13	4.60	4.17	3.81	3.50	3.24	3.01	2.82	2.64	2.49	2.35
50	6.10	5.48	4.96	4.52	4.14	3.82	3.54	3.29	3.07	2.88	2.71	2.55
100	6.60	5.81	5.21	4.74	4.36	4.05	3.79	3.56	3.36	3.19	3.04	2.90

Tc = time in minutes. Values may exceed 60.

Precip. file name: P:\353754 PennEast\Stormwater\Site 10 - Transco\SW Model\Site10.pcp

Storm Distribution	Rainfall Precipitation Table (in)							
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
SCS 24-hour	2.63	3.15	0.00	3.92	4.58	5.61	6.55	7.62
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	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Hydraflow Table of Contents

I. PCSM Drawings (Attached)