MOTT MACDONALD

PennEast PIPELINE

Church Road Interconnects

PennEast Pipeline Project

Date February, 2020

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REGISTERED PROFESSIONAL
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Church Road Interconnects Post Construction Stormwater Management Report

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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 south-eastern 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, 115-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 north-eastern 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 Church Road Interconnects site, which is a part of the PennEast Pipeline Project. The methods of analysis included use of the stormwater modelling software Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2019 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 basin
- Infiltration trench
- Vegetated swales

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 Church Road Interconnects 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 Church Road Interconnects site is located in Bethlehem Township in Northampton County, PA. (See Figure 1 for a Location Map and Appendix I for Proposed Site Plan). The Church Road Interconnects site is being developed to create an interconnect station to support the proposed PennEast 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 Church Road Interconnects site falls to 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 PADEP 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 is subject to the requirements of the Northampton County Act 167 Watershed Management Plan, which imposes stricter requirements than item (g)(2) of PADEP Code Section 102.8. Volume must be provided as the larger of the difference between the post-development and pre-development 2-year runoff volume, or 1.25 inches of precipitation over the site area based on the Rational Method. 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, and the calculations provided in Section 4. To be consistent with other sites, infiltration of 2" runoff from impervious areas will be considered as well.

(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 are no stream channels within 150 feet of the site. Under existing conditions, site stormwater runoff flows overland southwest across the site to a roadside ditch running along Church Road. Under proposed conditions, the northeastern section of the site will be conveyed by an infiltration trench and by vegetated swales that discharge overland towards Church Road. The southwestern section of the site will be conveyed by vegetated swales to an infiltration basin that will discharge via an emergency spillway offsite toward Church Road. These proposed stormwater conveyance systems were designed to preserve existing drainage patterns and the integrity of the receiving watercourse.

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 an infiltration basin and an infiltration trench. The stormwater will be routed through structural and non-structural BMPs and discharged overland towards the stream which is greater than 150' away from the site. Therefore, the project falls into the definition of a non-discharge alternative. See Section 4 for compliance calculations and descriptions.

(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 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 by a subsurface infiltration basin and an infiltration trench 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. The extents of the pad have been restricted to be minimum necessary for safe, 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, through minimizing the extents of the project area to the minimum 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 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 stormwater infiltration trench and an infiltration basin (BMP) are 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 Church Road Interconnects site is located in Bethlehem Township in Northampton County, Pennsylvania. The area of the project site is 3.484 acres. With existing slopes ranging from 0% to 8%, the site generally drains from northeast to southwest and discharges to Nancy Run. 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 Church Road Interconnects site lies within the Cambrian Allentown Formation, according to the Pennsylvania Department of Conservation and Natural Resources (PADCNR). The Cambrian Allentown Formation consists of "Medium- to medium-dark-gray, thick-bedded dolomite and impure limestone; dark-gray chert stringers and nodules; laminated; oolitic and stromatolitic; some orange-brown-weathering calcareous siltstone at base." Based on the United States Geological Survey (USGS) mapping, there are no known faults within the vicinity of the proposed meter station site.

Although the proposed interconnection site falls within the approximate outlines of the Allentown Formation, it is possible that other formations or rock types could occur in the vicinity of the proposed interconnects station site, 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 the Washington silt loam. The excerpt in Appendix C from Table E.1 in the PADEP Erosion and Sediment Pollution Control Program Manual lists the limitations of Washington soil.

The Washington silt loam is mapped as generally 22.4 percent sand, 55.1 percent silt, and 22.5 percent clay. The Washington silt loam has 0 to 8 percent slopes and is part of the group B Hydrologic Soil Group.

These limitations will be addressed through site specific testing for infiltration rates which will 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 2019 depict the Church Road Interconnects site primarily as an open field possibly for agricultural activities with an existing home on the southwestern corner of the site. There are no known wetlands located near the property. The proposed site location has remained a field, surrounded by Church Road to the west and Route 33 to the East. The runoff rate under the existing conditions was calculated based on this site land use.

The project proposes to construct a metering station on approximately 1.01 acres of gravel including a gravel access road on the southwest side of the site, and a launcher station on approximately 0.231 acres of gravel including a gravel access road on the northeast side of the site. The site will drain from northeast to southwest. A subsurface infiltration trench, an infiltration basin, and vegetated swales 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 the Tables 1 and 2. Infiltration volume is provided up to the 2-year storm, and peak runoff rate does not exceed preconstruction rates under the 2, 10, 50, and 100 year/24-hour storm events.

Table 1: Peak Flow Summary

Recurrence Interval (yrs)	Existing Conditions Q (cfs)	Maximum Allowable Proposed Peak Flow (cfs)	Proposed Q (cfs)	Proposed Less than Allowable? (Y/N)
1	0.341	0.341	0.247	Yes
2	0.808	0.808	0.632	Yes
5	2.084	2.084	1.629	Yes
10	3.512	3.512	2.703	Yes
25	6.045	6.045	4.582	Yes
50	8.514	8.514	6.386	Yes
100	11.51	11.51	10.05	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 & Trench Infiltration Capacity (cf)	Adequate Infiltration Volume? (Y/N)
1	2,381	11,439	9,058	9,853 + 2,027 = 11,880	Yes
2	3,975	14,517	10,543	12,413 + 2,497 = 14,910	Yes
Act 167 2" Capture	-	-	8,930	10,637 + 1,525 = 12,162	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 Nancy Run, which in turn drains to the Lehigh River, as shown in Figure 2-1 below. The site is part of the Nancy Run watershed. Chapter 93.9d from the PADEP Code indicates that the length of Nancy Run between the source and SR 3007 Bridge is classified as "CWF, MF" and there are no exceptions to specific criteria. CWF (cold-water fishes) indicates the maintenance or propagation, or both, of fish species 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.

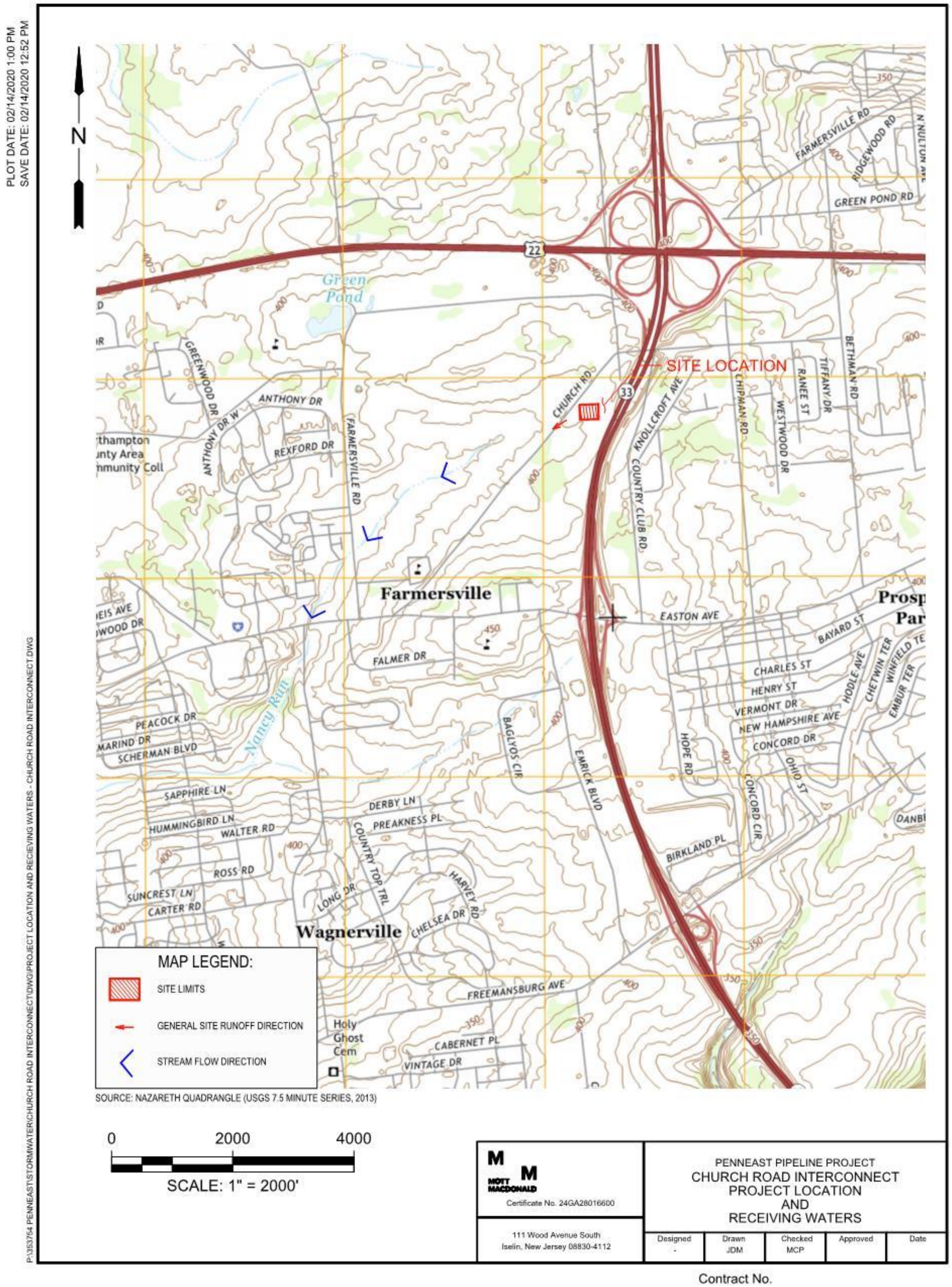

Figure 1: USGS Map showing project site and flow path to receiving waters

(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 Swales: Stormwater runoff from the southwestern side of the site will be conveyed to the infiltration basin via two vegetated swales running along the perimeter of the gravel pad. These swales drain to the infiltration basin. Two additional swales on the northeastern side of the site run along the perimeter of the infiltration trench and will collect stormwater runoff and discharge it offsite. The vegetated swales will be planted with native grasses, and the swales will attenuate runoff volume from gravel surfaces on the site, with some associated settling of pollutants.

Infiltration Basin: An infiltration basin will be constructed at the southwestern side of the site, in order to temporarily store and infiltrate stormwater runoff. Runoff from the gravel pad will drain to the vegetated swales which divert flow to the basin from the east and northeast directions. The basin temporarily stores and infiltrates the runoff and discharges it toward Church Road. The basin bottom will be level and will have a base area of 8,432 square feet and will have side slopes of 3:1. It will have a depth of 2 feet with an emergency spillway one quarter of a foot below the top contour. The basin has been designed to retain and infiltrate the volume difference between pre-construction and post-construction conditions for the 2-year storm. At least one foot of freeboard above the 100-year storm water elevation will be maintained. The outlet discharge to the roadside ditch will have a concrete stilling basin to dissipate energy.

Infiltration Trench: An infiltration trench will be constructed within the 38’ x 170’ gravel pad on the north-eastern side of the site, in order to temporarily store and infiltrate stormwater runoff generated from the gravel pad. The trench temporarily stores the runoff to attenuate peak flows. The trench bottom will have an approximate base area of 6,536 square feet. The trench will entirely of stone. The infiltration trench 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 may be factored out of the loading ratios. In this case, a portion of the influent to the infiltration basin area will pass through vegetated swales which will provide pre-treatment. 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 on 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 vegetated swale. Properly implemented inspection and maintenance practices will verify the basin and trench’s performance.

Table 3: Loading Ratios

Basin Name	Floor Area (Acres)	Total Drainage Area (Acres)	Influent Impervious Area (Acres)	Effective Loading Ratio Based on Influent Total Area	Effective Loading Ratio Based on Influent Impervious Area
BASIN	0.194	0.282	0.000	1.46	0.00
TRENCH	0.150	0.210	0.149	1.40	1.40

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

– *The site has been designed to minimize the required area for MLV Site. The pad area and driveway have been minimized while still allowing for the safe and effective use of the site. The use of the permanent easement has been minimized allowing for BMP 6.7.2 Landscape Restoration and BMP 6.7.3 Soils Amendment/Restoration in areas outside of the gravel pad area.*

See the Post-Construction Stormwater Management Plan drawing in Appendix I for location of infiltration basin and infiltration trench on site and construction details of infiltration basin, infiltration trench, and vegetated swale.

(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.

BMP construction and inspections will be performed based on recommendations from the Pennsylvania Stormwater BMP Manual. The overall sequence of BMP construction is as follows:

1. At least seven (7) days before starting any earth disturbance activities, the owner and/or operator shall notify the PADEP and Northampton 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 these activities shall notify the Pennsylvania One Call system at 1-800-242-1776 to determine the location of existing underground utilities.
3. Install rock construction entrances.
4. Install compost filter sock downslope of any proposed disturbed/excavated area and stockpiles as shown on the ESC Plan.
5. Perform clearing and grubbing to those areas described in each stage of work. Dispose of excess topsoil off-site. The Contractor is responsible for ensuring that off-site waste areas have an E&S plan approved by the local conservation district or PADEP prior to being activated.
6. Construct diversion channels on the easterly side of the site (Swale 3 and Swale 4). Immediately provide temporary seeding and mulch to newly graded slopes. Install weighted sediment filter tubes in swales at locations shown on the E&SC plans. Construct proposed infiltration trench. Engineer shall inspect the infiltration trench upon installation.
7. Perform grading activities detailed by proposed grading, notes, and details shown on the

plan drawings. As per project specifications, additional temporary placement of compost filter sock may be necessary at the contractor's discretion should accelerated erosion be observed during grading activities.

8. Construct pad and facilities according to specifications within these plan sheets including all stabilization measures.

9. Construct proposed infiltration basin and both swales (Swale 1 and Swale 2) leading to the basin. Install weighted sediment filter tubes in swales at locations shown on the E&SC plans. Engineer shall inspect the basin and swale installation.

10. Areas with minor soil compaction shall be ripped to a depth of 8”, and areas of major compaction shall be ripped to a depth of 20”. No ripping shall take place in the vicinity of the mainline piping or other underground utilities.

11. Place topsoil in all areas to be vegetated. If work is completed outside of the germinating season, then immediately provide temporary seeding and mulch to newly graded slopes.

12. Apply permanent seed mix and mulch to disturbed areas as specified and in accordance with this plan.

13. Any temporary measures (such as compost filter sock and weighted sediment filter tubes) installed by contractor during grading shall remain in place until final stabilization has 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. The Engineer shall inspect final stabilization prior to removal of temporary measures.

14. Clean work area of any debris created during the construction sequence.

Vegetated Swales: Vegetated swales will be installed will be installed as described in the overall sequence above. The contractor will be required to prevent the compaction of soils in areas that are occupied or to be occupied by PCSM BMPs. The swales will be rough graded, then fine graded, seeded and vegetated added, and protective lining will be installed. The swales will be inspected after each rainfall between rough grading and fine grading for sediment accumulation, erosion or obstructions. Vegetation will be established as soon as possible to prevent erosion and scour. Once the tributary areas are sufficiently stabilized, temporary erosion and sediment controls will be removed. Immediately following site construction, the swales will be inspected to confirm that runoff conveyance capacity meets the design capacity. If not, they will be regraded and reseeded and any damaged areas will be fully restored to provide functionality.

Infiltration Basin: The infiltration basin will be installed as described in the overall sequence above. Prior to construction, the area of the basin will be protected from compaction by installing orange safety fencing that will be used to protect the area throughout the project. The basin will be used as a sedimentation trap during construction. Clogging of the sub-surface soils will be prevented by grading the basin to a depth of one foot above the proposed invert. Topsoil will be seeded and stabilized, and the basin will be vegetated with native plantings as required. Temporary Erosion and Sediment Control measures will reduce the construction sediment load on the basin. Upon final stabilization of the upstream areas, accumulated sediment will be removed, and the basin will be excavated to its final grade. If necessary, the basin bottom will be excavated to an uncompacted subgrade free from rocks and debris and will be backfilled with a layer of sand or gravel on the bottom of the basin. The contract documents require the contractor to test and amend the soil as necessary to achieve the required infiltration rate. The post-construction performance requirements have been listed on SWM Details. The basin will be inspected after any major rainfall events to confirm that it is functioning properly.

The infiltration basin will not be put into services until stabilization of disturbed area is complete to prevent sedimentation and/or damage from construction activity. Erosion and Sediment Control Measures will be installed as required during construction (refer to ESC Plan).

After completion of construction on site, the basin will be inspected after rainfall events to verify that runoff drains within 72 hours. The basin will also be inspected for accumulation of construction sediment, damage to outlet control structures, erosion control measures, signs of water contamination/spills, and slope stability in the berms. At this time, accumulated sediment will be removed from the basin if required, to restore the original cross section and infiltration capacity of the basin, and sediment will be properly disposed of.

Infiltration Trench: The infiltration trench will be installed per the overall construction sequence above. Prior to construction, the area of the infiltration trench will be protected from compaction by installing orange safety fencing that will be used to protect the area throughout the project. The infiltration trench will be installed early in the project as the trench invert is approximately at existing grade. As the equipment pad is brought to final grade, the infiltration facility will be buried providing protection from compaction. In the event that compaction of the subgrade is unavoidable, see sequence 8. As the equipment pad is brought to final grade, additional stone will be added on top of the infiltration basin to provide protection from compaction.

The infiltration trench will not be put into service until stabilization of disturbed areas is complete to prevent sedimentation and/or damage from construction activity. Erosion and Sediment Control Measures will be installed as required during construction (refer to ESC Plan).

After completion of construction on site, the trench will be inspected after rainfall events (> 1-inch rainfall depth) to verify that runoff drains within 72 hours. The trench will also be inspected for accumulation of construction sediment, erosion control measures and signs of water contamination/spills. At this time, accumulated sediment will be removed from the trench if required.

(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 ensure proper function and operation. The program must provide for completion of a written report documenting each inspection and all 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.

Swales:

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: Standard Upland ROW, Residential, Clover/Food Plot with ROW as listed in the E&S site restoration plans 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 pre-treated salt.*
- *Use salt-tolerant vegetation in swales.*

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, and signs of water contamination/spills.*
- *Inspect for litter.*

Infiltration trench:

- *The trench will be inspected after runoff events event (> 1-inch rainfall depth) to make sure that runoff drains down within 72 hours. The trench will also be inspected for accumulation of sediment, damage to outlet control structures, erosion control measures, and signs of water contamination/spills. Accumulated sediment will be removed from the trench as required, and sediment will be properly disposed of. Sediment to be removed by flooding infiltration to allow for particles to float to the top of the system.*

  The trench will be inspected and cleaned at least two times per year and after runoff events (> 1-inch rainfall depth).

(11)Procedures which ensure 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 confirm 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. Wherever possible, recycling of excess materials is preferred, rather than disposal.

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 soil reaction of acidity or alkalinity (pH levels) for the site soil is approximately 6.5. Upon review of PADCNR's "Geologic Units Containing Potentially Significant Acid-Producing Sulfide Minerals" map, this project site does not lie in a known region containing acid-producing soils.

(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 basin and trench will mitigate thermal impacts from post-construction stormwater. Since the infiltration trench is subsurface it will further mitigate thermal impacts. It is not expected that runoff collected in the basin and discharged overland to the receiving water will be retained in the basin for more than 24 hours, thus providing additional mitigation of potential thermal impacts of discharge from the basin. Existing shade trees are being preserved to the greatest extent possible, and excessive riprapping and concrete channels are being avoided, to minimize the transfer of heat 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 river, stream, or creak, or lake, pond, or reservoir. The project is not located within a watershed of an Exceptional Value or High Quality. 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 an infiltration basin and an infiltration trench. The stormwater will be routed through structural and non-structural BMPs and discharged overland towards the stream which is greater than 150' away from the site. The project falls into the definition of a non-discharge alternative. See Section 4 for compliance calculations and descriptions. 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.

A subsurface investigation consisting of two excavated test pits, TP-1 and TP-2, were conducted on January 31, 2020. Infiltration testing using double-ring infiltrometers was performed within each test pit.

The test pit elevations are summarized in Table 4:

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)
TP-1	403.10	NA	399.10	399.10	No evidence of high groundwater observed
TP-2	401.70	NA	397.70	397.70	No evidence of high groundwater observed

Test Pit TP-1 was excavated 4 feet below existing grade on January 31, 2020. Infiltration testing was performed at this location. No restrictive zones or bedrock were encountered within 2.0 feet of testing depth. Two tests were performed at this location.

Test Pit TP-2 was excavated 4 feet below existing grade on January 31, 2020. Infiltration testing was performed at this location. No restrictive zones or bedrock were encountered within 2.0 feet of testing depth. Two tests were performed at this location.

The boring location plan and proposed test pit location plan can be found on the site plan in Appendix I, drawing number 024B-03-06-001.

The results of the infiltration tests are summarized as follows:

Table 5: Infiltration Testing Summary

Test Pit	Test #1	Test #2	Final Rate Used
TP-1	0.24	0.24	0.24
TP-2	6	2.5	4.25
Observed Overall Rate Trench (TP-1)			0.24 inch/hr^2
Design Rate (Factor of Safety of 2)			0.12 inch/hr^2
Observed Overall Rate Basin (TP-2)			4.25 inch/hr2
Design Rate (Factor of Safety of 2)			2.13 inch/hr^2

(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 Northampton County, in the Nancy Run watershed. The Lehigh Valley Planning Commission produced an Act 167 Stormwater Management Plan which includes the Nancy Run watershed, which states that:

"The Water Quality Volume (WQv) to be captured and treated will be the larger of the

following:

$$WQv = c \times P \times A / 12$$

Where WQv = water quality volume in acre-feet

c = Rational Method post-development runoff coefficient for the 2-year storm

P = 1.25 inches

A = Area in acres of proposed Regulated Activity

OR

WQv = Post-development 2-yr. runoff volume minus Pre-development 2-yr. runoff volume

EXCEPT that in no case shall the WQv exceed

WQv = 1.25 inches x site area in acres / 12"

See Section 4 of this report for details on the pre-development and post-development runoff volume calculations, detailed calculations are provided in Appendix B.

i. **Existing predevelopment nonforested 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 grass. For the purposes of hydraulic calculations, grass was assumed to be meadow.

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 existing pre-development site is grass.

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 Northampton County, in the Nancy Run watershed. The Lehigh Valley Planning Commission produced an Act 167 Stormwater Management Plan which includes the Nancy Run watershed, which states that:

> *"The basic goal is no increase in the peak rate of runoff at any point in the watershed...If, through the use of infiltration or other means, an applicant can demonstrate that neither the peak rate nor the volume of runoff are increasing with development, additional controls to meet the release rates are not required."*

Based on this, the post-development peak runoff rate and volume must not exceed pre-development peak runoff rate and volume under for any design storm event.

The majority of Church Road Interconnects site falls to Area 1 on Release Rate Map 3 that has a release rate of 30% for the 2-Year and 100% rate for 10-,25-,100-Year events. There will be no peak discharge or volume increase for 2-Year event and no peak discharge increase for 10-,25-,100-Year *events. In accordance with Chapter 3 Act 167 Lehigh Valley Stormwater Management plan, the water quantity controls are met, and the release rates are not required.*

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® 2019. 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 antidegradation implementation requirements in § 93.4c(b) (relating to implementation of antidegradation 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 nondischarge alternatives in the PCSM Plan unless a person demonstrates that nondischarge alternatives do not exist for the project.

(2) If the person makes the demonstration in paragraph (1) that nondischarge 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, nondischarge 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. Attenuated peak flows from the basin and trench are routed towards Church Road. The flow will be discharged via riprap apron for downstream drainage feature protection as shown in the Off-site Stormwater Discharge Plan (see Appendix J). The point of discharge from the site has been designed to be stable so as not to impact offsite areas. Therefore, the project falls into the definition of a nondischarge alternative. 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 Church Road Interconnects 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 3.484 acres of grassed land and impervious areas adjacent to Church Road, of which 2.469 acres are the project site itself. In general, the ground slopes to the southwest. A large area north of the site drains through the site. The onsite soils were identified using the USDA's Web Soil Survey. The project site consists of primarily Washington silt loam, which is Hydrologic Soil Group B (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 the Appendix E. For area with times of concentration less than 5 minutes, a minimum time of concentration of 5 minutes was used.

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 D.

Table 6: Existing Conditions Land Use

DA	Cover	Soils	HSG	Area (sq ft)	Area (acres)	CN	CN*Area	Weighted CN
SITE								
EX-SITE-SWALE-1	MEAD	WaA	B	40,765	0.936	58	54.28	58
EX-SITE-SWALE-1	80% IMPERVIOUS	WaA	B	4,256	0.098	98	9.58	98
EX-SITE-SWALE-1	20% MEADOW	WaA	B	1,064	0.024	58	1.42	58
EX-SITE-SWALE-2	MEAD	WaA	B	5,000	0.115	58	6.66	58
EX-SITE-SWALE-2	80% IMPERVIOUS	WaA	B	360	0.008	98	0.81	98
EX-SITE-SWALE-2	20% MEADOW	WaA	B	90	0.002	58	0.12	99
EX-SITE-BASIN	MEAD	WaA	B	12,275	0.282	58	16.34	58
EX-SITE-SWALE-3	MEAD	WaA	B	3,135	0.072	58	4.17	58
EX-SITE-SWALE-3	MEAD	WaB	B	1,585	0.036	58	2.11	58
EX-SITE-SWALE-4	MEAD	WaA	B	3,820	0.088	58	5.09	58
EX-SITE-SWALE-4	MEAD	WaB	B	5,445	0.125	58	7.25	58
EX-SITE-TRENCH	MEAD	WaA	B	9,150	0.210	58	12.18	58
EX-SITE-BYPASS	MEAD	WaA	B	20,385	0.468	58	27.14	58
EX-SITE-BYPASS	80% IMPERVIOUS	WaA	B	188	0.004	98	0.42	98
EX-SITE-BYPASS	20% MEADOW	WaA	B	47	0.001	58	0.06	58
Total				**107,565**	**2.469**		**147.63**	**59.8**
OFFSITE								
EX-OFFSITE-BYPASS-SWALE-1	MEAD	WaB	B	26,790	0.615	58	35.67	58
EX-OFFSITE-BYPASS-SWALE-2	MEAD	WaA	B	1,820	0.042	58	2.42	58

DA	Cover	Soils	HSG	Area (sq ft)	Area (acres)	CN	CN*Area	Weighted CN
EX-OFFSITE-BYPASS-SWALE-2	MEAD	WaB	B	15,585	0.358	58	20.75	58
Total				**44,195**	**1.015**		**58.85**	**58.0**
Grand Total				**151,760**	**3.484**		**206.48**	**59.3**

As per the requirements of Northampton County Act 167 Plan, grass was assumed to have the hydrologic characteristics of meadow, thus the CN number for meadow was used for grassed area that would be disturbed.

Precipitation data was obtained from NOAA Atlas 14 the rainfall data is summarized in Table 9; 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	3.16
5	3.96
10	4.62
25	5.59
50	6.42
100	7.33

4.2 Proposed Conditions

To be conservative, gravel (compacted crushed stone) is considered to be impervious thus it has been modelled as such in the hydraulic calculations. For design purposes, it was assumed that the entire equipment pad was compacted. An infiltration basin and an infiltration trench were designed to meet the regulatory stormwater requirements. Flow from the site will be directed to the infiltration basin via vegetated swales and the infiltration trench will collect runoff from the gravel pad above it. The outflow from the basin and trench will be discharged toward Church Road.

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 (sq ft)	Area (acres)	CN	CN*Area	Weighted CN
SITE								
PR-SITE-SWALE-1	GRAVEL	WaA	B	41,890	0.962	98	94.24	98
PR-SITE-SWALE-1	MEAD	WaA	B	4,195	0.096	58	5.59	58
PR-SITE-SWALE-2	GRAVEL	WaA	B	805	0.018	98	1.81	98
PR-SITE-SWALE-2	MEAD	WaA	B	4,645	0.107	58	6.18	58
PR-SITE-SWALE-3	MEAD	WaA	B	3,135	0.072	58	4.17	58
PR-SITE-SWALE-3	MEAD	WaB	B	1,585	0.036	58	2.11	58
PR-SITE-SWALE-4	MEAD	WaA	B	3,820	0.088	58	5.09	58

DA	Cover	Soils	HSG	Area (sq ft)	Area (acres)	CN	CN*Area	Weighted CN
PR-SITE-SWALE-4	MEAD	WaB	B	5,445	0.125	58	7.25	58
PR-SITE-BASIN	MEAD	WaA	B	12,275	0.282	58	16.34	58
PR-SITE-TRENCH	GRAVEL PAD	WaA	B	6,560	0.151	98	14.76	98
PR-SITE-TRENCH	GRAVEL ROAD	WaA	B	2,590	0.059	98	5.83	98
PR-SITE-BYPASS	GRAVEL	WaA	B	1,610	0.037	98	3.62	98
PR-SITE-BYPASS	MEAD	WaA	B	19,010	0.436	58	25.31	58
Total				**107,565**	**2.469**		**192.31**	**77.9**
OFFSITE								
PR-OFFSITE-BYPASS SWALE-1	MEAD	WaA	B	26,790	0.615	58	35.67	58
PR-OFFSITE-BYPASS SWALE-2	MEAD	WaA	B	1,910	0.044	58	2.54	58
PR-OFFSITE-BYPASS SWALE-2	MEAD	WaB	B	15,495	0.356	58	20.63	58
Total				**44,195**	**1.015**		**58.85**	**58.0**
Grand Total				**151,760**	**3.484**		**251.15**	**72.1**

4.3 Model Development

A model was developed in the Hydraflow Hydrographs extension for AutoCAD Civil 3D 2019 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 emergency spillway will be constructed an elevation of 399.75 and is designed to drain completely in 72 hours at a design infiltration rate of 2.13 inches/hour, based on the observed rate of 4.25 in/hr with a factor of safety of 2 applied. The infiltration trench is designed to drain completely in 72 hours at a design infiltration rate of 0.12 inches/hour, based on the observed rate of 0.24 in/hr with a factor of safety of 2 applied. The proposed flows were routed through the basin and the trench and the attenuated flow rates calculated. Model inputs and model summary and output reports can be found in Appendix H.

4.4 Stormwater Management Rules Compliance

The project meets the requirements under the PADEP code for Post-Construction Stormwater Management (PCSM) Section 102.8 as well as requirements for runoff volume and peak rate listed in the Act 167 Stormwater Management Plan which includes the Nancy Run watershed which was produced by the Lehigh Valley Planning Commission.

4.4.1 Volume Control

An infiltration basin and an infiltration trench are 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 two volume controls, the first is the 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. The second is to remove 1.25" of runoff from new impervious areas, including compacted crushed stone. The larger of the two was used. Because there is no other mechanism such as irrigation or rainwater harvesting, for releasing the required retention volume, infiltration will be employed to remove the required runoff volume.

This was accomplished by providing more than the required volume below the basin's emergency spillway, as shown in Table 9.

The emergency spillway in the infiltration basin was placed 0.25 feet below the top of basin, providing the required infiltration volume (See Appendix B). As such, regulatory volume control requirements are met. The required volume was achieved as follows:

Table 9: Volume Summary with Basin and Trench

Recurrence Interval (yrs)	Existing Volume (cf)	Proposed Unmitigated Volume from Model (cf)	Difference between Proposed and Existing (cf)	Proposed Basin + Trench Infiltration Capacity (cf)	Adequate Infiltration Volume? (Y/N)
1	2,381	11,439	9,058	9,853 + 2,027 = 11,880	Yes
2	3,975	14,517	10,543	12,413 + 2,497 = 14,910	Yes
Act 167 2" Capture	-	-	8,930	10,637 + 1,525 = 12,162	Yes

Table 10: Basin Drain Time

SMP	Infiltration Depth (ft)	Design Infiltration Rate (in/hr)	Drain Time (hrs)	Allowable Drain Time (hrs)	Drain Time less than allowable
BASIN	2.75	2.13	31.47	72	Yes
TRENCH	1.50	0.12	66.40	72	Yes

4.4.2 Peak Flow Control

A stormwater basin and infiltration trench are 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.

Table 11: Peak Flows Summary

Recurrence Interval (yrs)	Existing Conditions Q (cfs)	Maximum Allowable Proposed Peak Flow (cfs)	Proposed Q (cfs)	Proposed Less than Allowable? (Y/N)
1	0.341	0.341	0.247	Yes
2	0.808	0.808	0.632	Yes
5	2.084	2.084	1.629	Yes
10	3.512	3.512	2.703	Yes
25	6.045	6.045	4.582	Yes
50	8.514	8.514	6.386	Yes
100	11.51	11.51	10.05	Yes

4.4.3 Water Quality

The 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 net impervious area, equivalent to 1,778 cf (42,695 sq ft x 0.5" = 1,778 cf). This was accomplished by providing is more than the minimum required volume below the low outlet of the basin's outlet control structure. Compliance with water quality requirements is demonstrated using BMP worksheets 10 in Appendix C.

BMPs utilized to comply with water quality requirements include the following:

- 6.4.8 Vegetated Swale. Vegetated swale will be constructed along the southern portion of gravel pad to convey the flow to the subsurface infiltration basins
- 6.7.2 Landscape Restoration. The disturbed area outside the proposed gravel pad and access drive will be replanted with native vegetation
- 6.7.3 Soils Amendment / Restoration. The characteristic soil affected by compaction will be restored by ripping and addition of amendments such as compost or other material.

4.4.4 Swale Design

The swales were designed based on the requirements set out in the PADEP Erosion and Sediment Pollution Control Manual. Riprap for the emergency overflow was selected based on maximum velocities under the 100-year storm. Sizing calculations are provided in Appendix B.

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.

5 Offsite Discharge Analysis

Attenuated peak flows from the basin and trench are routed offsite toward Church Road. The flow will be discharged via riprap apron for downstream drainage feature protection as shown in the Off-site Stormwater Discharge Plan (see Appendix J). The point of discharge from the site has been designed to be stable so as not to impact offsite areas, see calculations in Appendix B. Therefore, the project falls into definition of nondischarge alternative. The nondischarge alternative is defined in §102.1 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.

The Church Road Interconnects site discharges indirectly to Nancy Run and does not have any additional offsite discharge points. As such, no downstream properties are affected by the proposed work and there is no downstream erosion. Proper construction and maintenance requirements are in place to support continued performance of BMPs. The overall peak flow and runoff volume has been reduced while maintaining the overall existing drainage patterns, thus fulfilling PADEP off-site discharge requirements.

6 Conclusion

As demonstrated in the sections above, the design of the proposed stormwater BMPs for the Church Road Interconnects site for the PennEast pipeline allow the proposed project to comply with the applicable regulatory requirements under PADEP Code Section 102.8 and the applicable Act 167 requirements.

Appendices

A. Rainfall Data

NOAA Atlas 14, Volume 2, Version 3
Location name: Easton, Pennsylvania, USA*
Latitude: 40.6757°, Longitude: -75.2945°
Elevation: 401.51 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	**0.319** (0.286-0.355)	**0.380** (0.341-0.424)	**0.449** (0.402-0.499)	**0.501** (0.448-0.557)	**0.568** (0.504-0.629)	**0.618** (0.545-0.685)	**0.671** (0.588-0.744)	**0.724** (0.629-0.805)	**0.796** (0.683-0.889)	**0.855** (0.725-0.960)
10-min	**0.509** (0.456-0.567)	**0.607** (0.545-0.677)	**0.718** (0.643-0.798)	**0.800** (0.716-0.889)	**0.903** (0.802-1.00)	**0.983** (0.867-1.09)	**1.06** (0.933-1.18)	**1.15** (0.995-1.27)	**1.26** (1.08-1.40)	**1.35** (1.14-1.51)
15-min	**0.636** (0.570-0.708)	**0.762** (0.685-0.850)	**0.908** (0.813-1.01)	**1.01** (0.905-1.12)	**1.14** (1.02-1.27)	**1.24** (1.10-1.38)	**1.34** (1.18-1.49)	**1.44** (1.25-1.61)	**1.58** (1.36-1.77)	**1.69** (1.43-1.89)
30-min	**0.870** (0.780-0.969)	**1.05** (0.944-1.17)	**1.29** (1.15-1.43)	**1.46** (1.31-1.63)	**1.69** (1.50-1.88)	**1.87** (1.65-2.07)	**2.06** (1.80-2.28)	**2.24** (1.95-2.50)	**2.51** (2.15-2.80)	**2.73** (2.31-3.06)
60-min	**1.09** (0.972-1.21)	**1.32** (1.19-1.47)	**1.65** (1.48-1.84)	**1.91** (1.71-2.12)	**2.25** (2.00-2.50)	**2.53** (2.23-2.81)	**2.83** (2.48-3.14)	**3.15** (2.73-3.50)	**3.60** (3.09-4.02)	**3.98** (3.37-4.46)
2-hr	**1.31** (1.17-1.46)	**1.58** (1.42-1.76)	**1.99** (1.78-2.21)	**2.30** (2.06-2.56)	**2.76** (2.46-3.07)	**3.15** (2.79-3.49)	**3.57** (3.13-3.96)	**4.03** (3.50-4.48)	**4.72** (4.04-5.27)	**5.30** (4.48-5.95)
3-hr	**1.44** (1.30-1.61)	**1.74** (1.57-1.94)	**2.17** (1.95-2.42)	**2.52** (2.26-2.80)	**3.01** (2.68-3.34)	**3.42** (3.03-3.79)	**3.87** (3.40-4.29)	**4.37** (3.79-4.85)	**5.09** (4.36-5.68)	**5.72** (4.83-6.41)
6-hr	**1.83** (1.66-2.04)	**2.20** (1.99-2.45)	**2.72** (2.46-3.02)	**3.16** (2.85-3.50)	**3.80** (3.39-4.20)	**4.34** (3.85-4.80)	**4.95** (4.34-5.47)	**5.63** (4.88-6.22)	**6.65** (5.66-7.37)	**7.54** (6.33-8.37)
12-hr	**2.25** (2.04-2.51)	**2.71** (2.46-3.02)	**3.37** (3.05-3.75)	**3.94** (3.54-4.37)	**4.78** (4.26-5.29)	**5.52** (4.87-6.09)	**6.35** (5.54-7.01)	**7.29** (6.29-8.05)	**8.72** (7.37-9.65)	**9.98** (8.29-11.1)
24-hr	**2.63** (2.44-2.85)	**3.16** (2.94-3.43)	**3.96** (3.67-4.27)	**4.62** (4.27-4.98)	**5.59** (5.14-6.02)	**6.42** (5.87-6.90)	**7.33** (6.65-7.86)	**8.32** (7.49-8.91)	**9.78** (8.70-10.5)	**11.0** (9.70-11.8)
2-day	**3.08** (2.86-3.35)	**3.72** (3.44-4.04)	**4.65** (4.30-5.05)	**5.42** (5.00-5.87)	**6.52** (5.98-7.05)	**7.44** (6.80-8.03)	**8.44** (7.67-9.10)	**9.52** (8.59-10.3)	**11.1** (9.90-12.0)	**12.4** (11.0-13.4)
3-day	**3.25** (3.01-3.52)	**3.91** (3.63-4.24)	**4.88** (4.52-5.28)	**5.67** (5.24-6.14)	**6.82** (6.27-7.36)	**7.78** (7.11-8.38)	**8.81** (8.02-9.48)	**9.93** (8.97-10.7)	**11.6** (10.3-12.4)	**12.9** (11.5-13.9)
4-day	**3.41** (3.17-3.69)	**4.11** (3.81-4.44)	**5.11** (4.74-5.52)	**5.93** (5.49-6.41)	**7.12** (6.56-7.67)	**8.12** (7.43-8.74)	**9.18** (8.37-9.87)	**10.3** (9.36-11.1)	**12.0** (10.8-12.9)	**13.4** (11.9-14.4)
7-day	**4.02** (3.74-4.36)	**4.82** (4.47-5.22)	**5.93** (5.51-6.43)	**6.86** (6.35-7.42)	**8.19** (7.56-8.86)	**9.32** (8.56-10.1)	**10.5** (9.61-11.4)	**11.8** (10.7-12.8)	**13.7** (12.3-14.8)	**15.3** (13.7-16.5)
10-day	**4.63** (4.32-4.99)	**5.53** (5.16-5.95)	**6.72** (6.27-7.23)	**7.69** (7.16-8.26)	**9.06** (8.40-9.72)	**10.2** (9.41-10.9)	**11.4** (10.5-12.2)	**12.6** (11.5-13.5)	**14.4** (13.0-15.4)	**15.8** (14.3-17.0)
20-day	**6.23** (5.85-6.63)	**7.38** (6.94-7.85)	**8.78** (8.24-9.33)	**9.89** (9.27-10.5)	**11.4** (10.7-12.1)	**12.6** (11.8-13.4)	**13.9** (12.9-14.7)	**15.1** (14.0-16.1)	**16.9** (15.5-18.0)	**18.3** (16.7-19.5)
30-day	**7.79** (7.36-8.23)	**9.18** (8.67-9.69)	**10.7** (10.1-11.3)	**11.8** (11.2-12.5)	**13.4** (12.6-14.2)	**14.6** (13.7-15.4)	**15.8** (14.8-16.7)	**17.1** (15.9-18.0)	**18.7** (17.4-19.8)	**19.9** (18.4-21.1)
45-day	**9.88** (9.38-10.4)	**11.6** (11.0-12.2)	**13.3** (12.6-14.0)	**14.6** (13.8-15.4)	**16.2** (15.4-17.1)	**17.5** (16.6-18.5)	**18.7** (17.7-19.7)	**19.9** (18.8-21.0)	**21.4** (20.1-22.6)	**22.6** (21.1-23.9)
60-day	**11.8** (11.3-12.5)	**13.9** (13.2-14.6)	**15.8** (15.0-16.6)	**17.2** (16.4-18.2)	**19.1** (18.1-20.1)	**20.5** (19.4-21.5)	**21.8** (20.6-22.9)	**23.0** (21.8-24.3)	**24.6** (23.2-26.0)	**25.8** (24.3-27.3)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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PF graphical

B. Calculation Sheet

PENNEAST-CHURCH ROAD INTERCONNECT
EXISTING CONDITIONS CURVE NUMBER CALCULATIONS

ID	DA	Cover	Soils	HSG	Area	Area (Acres)	CN	CN*A	Weighted CN
	EX-SITE-SWALE-1								
	EX-SITE-SWALE-1	MEAD	WaA	B	40,765	0.936	58	54.28	58.0
	EX-SITE-SWALE-1	80% IMPERVIOUS	WaA	B	4,256	0.098	98	9.58	98.0
	EX-SITE-SWALE-1	20% MEADOW	WaA	B	1,064	0.024	58	1.42	58.0
		EX-SITE-SWALE-1 TOTAL			**46,085**	**1.058**		**65.27**	**61.7**
	EX-SITE-SWALE-2								
	EX-SITE-SWALE-2	MEAD	WaA	B	5,000	0.115	58	6.66	58.0
	EX-SITE-SWALE-2	80% IMPERVIOUS	WaA	B	360	0.008	98	0.81	98.0
	EX-SITE-SWALE-2	20% MEADOW	WaA	B	90	0.002	58	0.12	99.0
		EX-SITE-SWALE-2 TOTAL			**5,450**	**0.125**		**7.59**	**60.6**
	EX-SITE-SWALE-3								
	EX-SITE-SWALE-3	MEAD	WaA	B	3,135	0.072	58	4.17	58.0
	EX-SITE-SWALE-3	MEAD	WaB	B	1,585	0.036	58	2.11	58.0
		EX-SITE-SWALE-3 TOTAL			**4,720**	**0.108**		**6.28**	**58.0**
	EX-SITE-SWALE-4								
	EX-SITE-SWALE-4	MEAD	WaA	B	3,820	0.088	58	5.09	58.0
	EX-SITE-SWALE-4	MEAD	WaB	B	5,445	0.125	58	7.25	58.0
		EX-SITE-SWALE-4 TOTAL			**9,265**	**0.213**		**12.34**	**58.0**
	EX-SITE-BASIN								
	EX-SITE-BASIN	MEAD	WaA	B	12,275	0.282	58	16.34	58.0
		EX-SITE-BASIN TOTAL			**12,275**	**0.282**		**16.34**	**58.0**
	EX-SITE-TRENCH								
	EX-SITE-TRENCH	MEAD	WaA	B	9,150	0.210	58	12.18	58.0
		EX-SITE-TRENCH TOTAL			**9,150**	**0.210**		**12.18**	**58.0**
	EX-SITE-BYPASS								
	EX-SITE-BYPASS	MEAD	WaA	B	20,385	0.468	58	27.14	58.0
	EX-SITE-BYPASS	80% IMPERVIOUS	WaA	B	188	0.004	98	0.42	98.0
	EX-SITE-BYPASS	20% MEADOW	WaA	B	47	0.001	58	0.06	58.0
		EX-SITE-BYPASS-2 TOTAL			**20,620**	**0.473**		**27.57**	**58.2**
	EX-OFFSITE-BYPASS SWALE-1								
	EX-OFFSITE-BYPASS-SWALE-1	MEAD	WaB	B	26,790	0.615	58	35.67	58.0
		EX-OFFSITE-BYPASS SWALE-1 TOTAL			**26,790**	**0.615**		**35.67**	**58.0**
	EX-OFFSITE-BYPASS SWALE-2								
	EX-OFFSITE-BYPASS-SWALE-2	MEAD	WaA	B	1,820	0.042	58	2.42	58.0
	EX-OFFSITE-BYPASS-SWALE-2	MEAD	WaB	B	15,585	0.358	58	20.75	58.0
		EX-OFFSITE-BYPASS SWALE-2 TOTAL			**17,405**	**0.400**		**23.17**	**58.0**
	Grand Total				**151,760**	**3.484**		**206.417**	**59.2**

PENNEAST-CHURCH ROAD INTERCONNECT
PROPOSED CONDITIONS CURVE NUMBER CALCULATIONS

ID	DA	Cover	Soils	HSG	Area	Area (Acres)	CN	CN*A	Weighted CN
	PR-SITE-SWALE-1								
	PR-SITE-SWALE-1	GRAVEL	WaA	B	41,890	0.962	98	94.24	98.0
	PR-SITE-SWALE-1	MEAD	WaA	B	4,195	0.096	58	5.59	58.0
		PR-SITE-SWALE-1 TOTAL			**46,085**	**1.058**		**99.83**	**94.4**
	PR-SITE-SWALE-2								
	PR-SITE-SWALE-2	GRAVEL	WaA	B	805	0.018	98	1.81	98.0
	PR-SITE-SWALE-2	MEAD	WaA	B	4,645	0.107	58	6.18	58.0
		PR-SITE-SWALE-2 TOTAL			**5,450**	**0.125**		**8.00**	**63.9**
	PR-SITE-SWALE-3								
	PR-SITE-SWALE-3	MEAD	WaA	B	3,135	0.072	58	4.17	58.0
	PR-SITE-SWALE-3	MEAD	WaB	B	1,585	0.036	58	2.11	58.0
		PR-SITE-SWALE-3 TOTAL			**4,720**	**0.108**		**6.28**	**58.0**
	PR-SITE-SWALE-4								
	PR-SITE-SWALE-4	MEAD	WaA	B	3,820	0.088	58	5.09	58.0
	PR-SITE-SWALE-4	MEAD	WaB	B	5,445	0.125	58	7.25	58.0
		PR-SITE-SWALE-4 TOTAL			**9,265**	**0.213**		**12.34**	**58.0**
	PR-SITE-BASIN								
	PR-SITE-BASIN	MEAD	WaA	B	12,275	0.282	58	16.34	58.0
		PR-SITE-BASIN TOTAL			**12,275**	**0.282**		**16.34**	**58.0**
	PR-SITE-TRENCH								
	PR-SITE-TRENCH	GRAVEL PAD	WaA	B	6,560	0.151	98	14.76	98.0
	PR-SITE-TRENCH	GRAVEL ROAD	WaA	B	2,590	0.059	98	5.83	98.0
		PR-SITE-TRENCH TOTAL			**9,150**	**0.210**		**14.76**	**70.3**
	PR-SITE-BYPASS								
	PR-SITE-BYPASS	GRAVEL	WaA	B	1,610	0.037	98	3.62	98.0
	PR-SITE-BYPASS	MEAD	WaA	B	19,010	0.436	58	25.31	58.0
		PR-SITE-BYPASS-2 TOTAL			**20,620**	**0.473**		**28.93**	**61.1**
	PR-OFFSITE-BYPASS SWALE-1								
	PR-OFFSITE-BYPASS SWALE-1	MEAD	WaB	B	26,790	0.615	58	35.67	58.0
		PR-OFFSITE-BYPASS SWALE-1 TOTAL			**26,790**	**0.615**		**35.67**	**58.0**
	PR-OFFSITE-BYPASS SWALE-2								
	PR-OFFSITE-BYPASS SWALE-2	MEAD	WaA	B	1,820	0.042	58	2.42	58.0
	PR-OFFSITE-BYPASS SWALE-2	MEAD	WaB	B	15,585	0.358	58	20.75	58.0
		PR-OFFSITE-BYPASS SWALE-2 TOTAL			**17,405**	**0.400**		**23.17**	**58.0**
	Grand Total				**151,760**	**3.484**		**245.327**	**70.4**

EXISTING CONDITIONS
SITE EXISTING BASIN -Tc CALCULATIONS

SHEET FLOW		
Manning's n		0.24
Flow length, ft		69
2-Yr 24-Hr rainfall, in		3.16
Land slope, %		0.14
Sheet flow time, min		**30.5**
Manning's n		0.011
Flow length, ft		18
2-Yr 24-Hr rainfall, in		3.16
Land slope, %		0.56
Sheet flow time, min		**0.5**
Manning's n		0.24
Flow length, ft		63
2-Yr 24-Hr rainfall, in		3.16
Land slope, %		0.32
Sheet flow time, min		**20.7**
SHALLOW CONC. FLOW		
Flow length, ft	0	176
Watercourse slope, %	0	1.14
Surface Description	0	unpaved
Velocity, ft/s	0	1.72
Sh. Conc. Flow time, min	**0**	**1.7**
TIME OF CONC., mins	0	**53.4**

EXISTING CONDITIONS
SITE EXISTING TRENCH -Tc CALCULATIONS

SHEET FLOW	
Manning's n	0.24
Flow length, ft	93
2-Yr 24-Hr rainfall, in	3.16
Land slope, %	1.34
Sheet flow time, min	**15.9**
TIME OF CONC., mins	**15.9**

EXISTING CONDITIONS
SITE EXISTING BYPASS -Tc CALCULATIONS

SHEET FLOW	
Manning's n	0.24
Flow length, ft	94
2-Yr 24-Hr rainfall, in	3.16
Land slope, %	2.93
Sheet flow time, min	**11.7**
TIME OF CONC., mins	**11.7**

EXISTING CONDITIONS
OFFSITE EXISTING BYPASS -Tc

SHEET FLOW	
Manning's n	0.24
Flow length, ft	150
2-Yr 24-Hr rainfall, in	3.16
Land slope, %	2.00
Sheet flow time, min	**19.9**
	0
SHALLOW CONC. FLOW	
Flow length, ft	147
Watercourse slope, %	2.21
Surface Description	unpaved
Velocity, ft/s	2.40
Sh. Conc. Flow time, min	**1.0**
TIME OF CONC., mins	**20.9**

PROPOSED CONDITIONS
SITE PROPOSED BASIN -Tc

SHEET FLOW	
Manning's n	0.011
Flow length, ft	150
2-Yr 24-Hr rainfall, in	3.16
Land slope, %	1.17
Sheet flow time, min	**2.1**
	0
SHALLOW CONC. FLOW - GRAVEL	
Flow length, ft	80
Watercourse slope, %	1.88
Surface Description	paved
Velocity, ft/s	2.78
Sh. Conc. Flow time, min	**0.5**
0	
TIME OF CONC., mins	**2.6**

PROPOSED CONDITIONS
SITE PROPOSED TRENCH -Tc

SHEET FLOW			
Manning's n			0.011
Flow length, ft			150
2-Yr 24-Hr rainfall, in			3.16
Land slope, %			0.17
Sheet flow time, min			**4.6**
	0	0	0
SHALLOW CONC. FLOW - GRAVEL			
Flow length, ft			30
Watercourse slope, %			0.83
Surface Description			paved
Velocity, ft/s			1.86
Sh. Conc. Flow time, min			**0.3**
TIME OF CONC., mins			**4.8**

PROPOSED CONDITIONS
SITE PROPOSED BYPASS -Tc

SHEET FLOW		
Manning's n		0.24
Flow length, ft		118
2-Yr 24-Hr rainfall, in		3.16
Land slope, %		2.75
Sheet flow time, min		**14.4**
SHALLOW CONC. FLOW		
Flow lengtl	0	123
Watercour:	0	0.61
Surface De	0	unpaved
Velocity, ft.	0	1.26
Sh. Conc.	**0**	**1.6**
TIME OF CONC., mins		**16.1**

PROPOSED CONDITIONS
OFFSITE PROPOSED BYPASS -Tc

SHEET FLOW	
Manning's n	0.24
Flow length, ft	150
2-Yr 24-Hr rainfall, in	3.16
Land slope, %	2.00
Sheet flow time, min	**19.9**
	0
SHALLOW CONC. FLOW	
Flow length, ft	147
Watercourse slope, %	2.21
Surface Description	unpaved
Velocity, ft/s	2.40
Sh. Conc. Flow time, min	**1.0**
TIME OF CONC., mins	**20.9**

PENNEAST-CHURCH ROAD INTERCONNECTS

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
SWALE 1	GRAVEL	WaA	B	41,890	0.962	0.22	0.212	0.22
SWALE 1	MEAD	WaA	B	4,195	0.096	0.22	0.021	0.22
SWALE 1 TOTAL					**1.058**		**0.233**	**0.22**
SWALE 2	GRAVEL	WaA	B	805	0.018	0.22	0.004	0.22
SWALE 2	MEAD	WaA	B	4,645	0.107	0.22	0.023	0.22
SWALE 2 TOTAL					**0.125**		**0.028**	**0.22**
SWALE 3	MEAD	WaA	B	3,135	0.072	0.22	0.016	0.22
SWALE 3	MEAD	WaB	B	1,585	0.036	0.22	0.008	0.22
SWALE 3	MEAD	WaB	B	1,820	0.042	0.22	0.009	0.22
SWALE 3	MEAD	WaB	B	15,585	0.358	0.22	0.079	0.22
SWALE 3 TOTAL					**0.508**		**0.112**	**0.22**
SWALE 4	MEAD	WaA	B	3,820	0.088	0.22	0.019	0.22
SWALE 4	MEAD	WaB	B	8,558	0.196	0.22	0.043	0.22
SWALE 4	MEAD	WaA	B	26,790	0.615	0.22	0.135	0.22
SWALE 3 TOTAL					**0.899**		**0.198**	**0.22**
Grand Total					**2.590**		**0.570**	**0.22**

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

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

PENNEAST-TCO&UGI-LEH INTERCONNECTS
RATIONAL METHOD PEAK FLOW CALCULATIONS FOR PROPOSED SWALES

Return Period (Yrs) 10
Min. Time of Concentration (mins) 5 **(Unless otherwise noted below)**

DA	Area (Acres)	RC	Tc (mins)	Rainfall Intensity (in/hr)	Q (cfs)
SWALE 1	1.058	0.22	5.0	6.5	1.5
SWALE 2	0.125	0.22	5.0	6.5	0.2
SWALE 3	0.508	0.22	16.1	5.1	0.6
SWALE 4	0.899	0.22	16.1	5.1	1.0

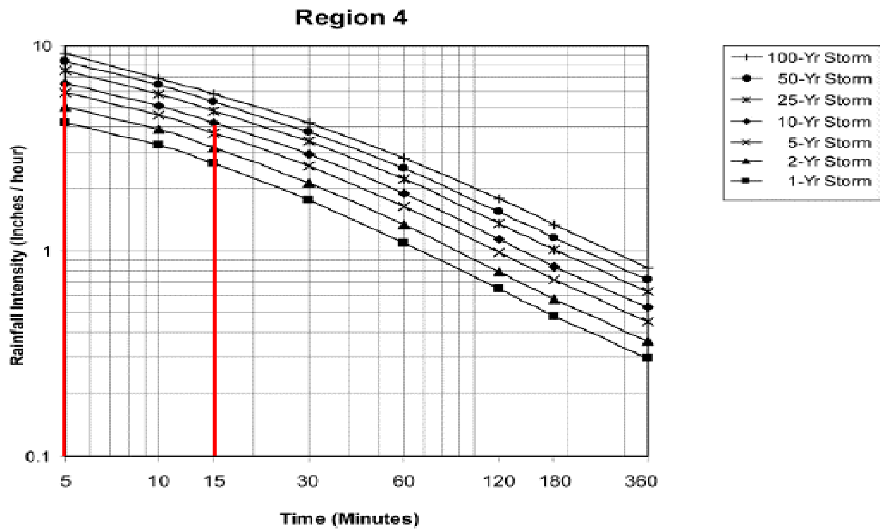


Figure - Rainfall Amount for 1- through 100-year Storms for Region 4 (U.S. Customary).
Source: PennDOT Drainage Manual, March 2015 Edition

PENNEAST-TCO&UGI-LEH INTERCONNECTS
RATIONAL METHOD PEAK FLOW CALCULATIONS FOR PROPOSED SWALES

Return Period (Yrs) 10
Min. Time of Concentration (mins) 5 **(Unless otherwise noted below)**

DA	Area (Acres)	RC	Tc (mins)	Rainfall Intensity (in/hr)	Q (cfs)
SWALE 1	1.058	0.22	5.0	9.1	2.1
SWALE 2	0.125	0.22	5.0	9.1	0.3
SWALE 3	0.508	0.22	16.1	6.0	0.7
SWALE 4	0.899	0.22	16.1	6.0	1.2

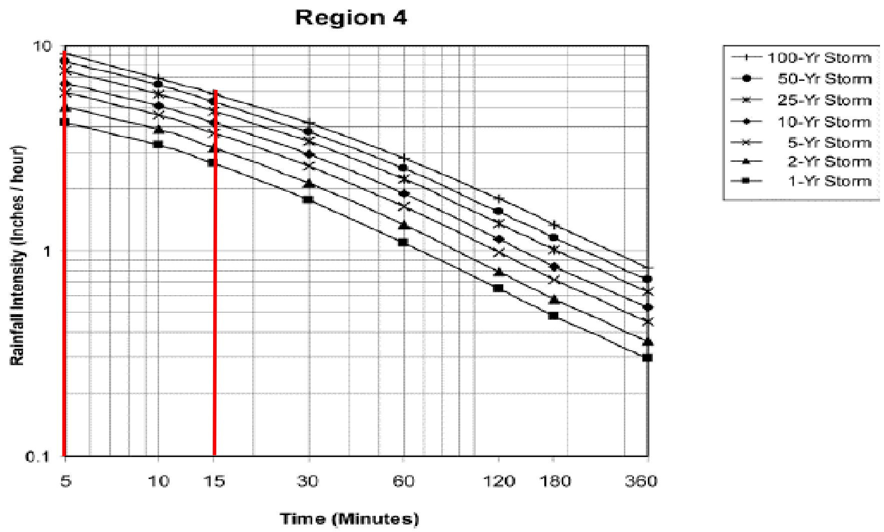


Figure - Rainfall Amount for 1- through 100-year Storms for Region 4 (U.S. Customary).
Source: PennDOT Drainage Manual, March 2015 Edition

PENNEAST SPRINGVILLE INTERCONNECT					
PROPOSED VEGETATED SWALE SCHEDULE					
SWALE No.	BOTTOM WIDTH (FT)	LEFT SIDE SLOPE (H:V)	RIGHT SIDE SLOPE (H:V)	DEPTH (FT)	LINING MATERIAL
SWALE1	3.0	3.0	3.0	1.0	Landlok TRM-435 or equal.
SWALE2	5.0	3.0	3.0	1.0	Landlok TRM-435 or equal.
SWALE3	5.0	3.0	3.0	1.0	Landlok TRM-435 or equal.
SWALE4	5.0	3.0	3.0	1.0	Landlok TRM-435 or equal.

***Note: Refer to Site Plans for location of proposed swales**

PROJECT NAME:	**SWALE-1**	
LOCATION:	**CHURCH ROAD INTERCONNECTION**	
PREPARED BY:	**DATE:**	**2/19/2020**
CHECKED BY:	**DATE:**	**2/19/2020**

CHANNEL OR CHANNEL SECTION		
Temporary or Permanent (T or P)	P	
Required Capacity, Qr (cfs)	1.50	**See attached Rational Peak Flow Calculations**
Left side slope, %	33.33	
Right side slope, %	33.33	
Bottom width, ft	3	
Channel Depth provided, ft	1	
Channel bed slope, %	1	
Mannings N	0.08	
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	0.41	
top width at flow depth, ft	5.48	
Bottom Width:Flow Depth Ratio	7.26	
wetted area, sq. ft	1.75	
wetted peri, ft	5.61	
hyd. Radius, ft	0.31	
velocity, ft/s	0.86	
Discharge, cfs	1.50	
Theta, rad	0.010	
Froudes Number	0.23	
Flow type	subcritical	
Shear Stress, Lb/Sq.Ft	0.26	
Protective Lining	**Vegetated**	
Lining required	**TRM-435**	
D_{50}, inches		
Placement Thickness, inches		
Adjusted Mannings N	0.09	
Calculated Critical Slope,Sc ft/ft	0.18	
0.7 Sc, ft/ft	0.13	
1.3 Sc, ft/ft	0.23	
Stable Flow?	Stable	
Calculated Freeboard, ft	0.50	
Freeboard Provided, ft	0.59	**Freeboard Ok, Calculated<Provided**

PROJECT NAME:	**SWALE-2**	
LOCATION:	**CHURCH ROAD INTERCONNECTION**	
PREPARED BY:	**DATE:**	**2/19/2020**
CHECKED BY:	**DATE:**	**2/19/2020**

CHANNEL OR CHANNEL SECTION		
Temporary or Permanent (T or P)	P	
Required Capacity, Qr (cfs)	0.20	**See attached Rational Peak Flow Calculations**
Left side slope, %	33.33	
Right side slope, %	33.33	
Bottom width, ft	5	
Channel Depth provided, ft	1	
Channel bed slope, %	0.25	
Mannings N	0.08	
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	0.0025	
Calculated channel flow depth, ft	0.15	
top width at flow depth, ft	5.89	
Bottom Width:Flow Depth Ratio	33.56	
wetted area, sq. ft	0.81	
wetted peri, ft	5.94	
hyd. Radius, ft	0.14	
velocity, ft/s	0.25	
Discharge, cfs	0.20	
Theta, rad	0.002	
Froudes Number	0.11	
Flow type	subcritical	
Shear Stress, Lb/Sq.Ft	0.02	
Protective Lining	**Vegetated**	
Lining required	**TRM-435**	
D_{50}, inches		
Placement Thickness, inches		
Adjusted Mannings N	0.22	
Calculated Critical Slope,Sc ft/ft	1.37	
0.7 Sc, ft/ft	0.96	
1.3 Sc, ft/ft	1.78	
Stable Flow?	Stable	
Calculated Freeboard, ft	0.50	
Freeboard Provided, ft	0.85	**Freeboard Ok, Calculated<Provided**

PROJECT NAME:	**SWALE-3**		
LOCATION:	**CHURCH ROAD INTERCONNECTION**		
PREPARED BY:	**DATE:**	**2/19/2020**	
CHECKED BY:	**DATE:**	**2/19/2020**	

CHANNEL OR CHANNEL SECTION		
Temporary or Permanent (T or P)	P	
Required Capacity, Qr (cfs)	0.60	**See attached Rational Peak Flow Calculations**
Left side slope, %	33.33	
Right side slope, %	33.33	
Bottom width, ft	5	
Channel Depth provided, ft	1	
Channel bed slope, %	1.33	
Mannings N	0.08	
Accn. Due to gravity, ft/sec2	32.2	

DESIGN METHOD FOR LINING - SHEAR STRESS

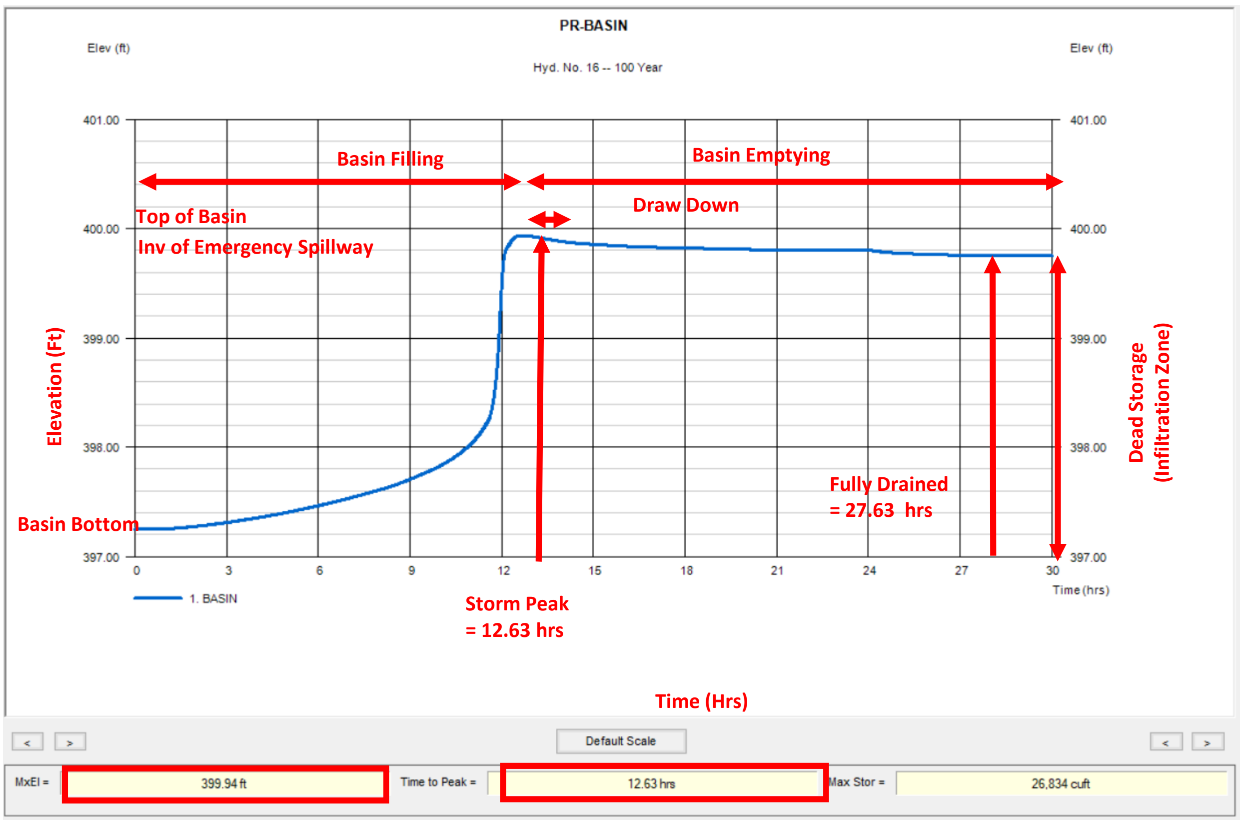
CHECK FOR SHEAR STRESS		
H:V, left	3.00	
H:V, right	3.00	
bed slope, ft/ft	0.0133	
Calculated channel flow depth, ft	0.17	
top width at flow depth, ft	6.04	
Bottom Width:Flow Depth Ratio	28.79	
wetted area, sq. ft	0.96	
wetted peri, ft	6.10	
hyd. Radius, ft	0.16	
velocity, ft/s	0.63	
Discharge, cfs	0.60	
Theta, rad	0.013	
Froudes Number	0.26	
Flow type	subcritical	
Shear Stress, Lb/Sq.Ft	0.14	
Protective Lining	**Vegetated**	
Lining required	**TRM-435**	
D_{50}, inches		
Placement Thickness, inches		
Adjusted Mannings N	0.11	
Calculated Critical Slope,Sc ft/ft	0.31	
0.7 Sc, ft/ft	0.21	
1.3 Sc, ft/ft	0.40	
Stable Flow?	Stable	
Calculated Freeboard, ft	0.50	
Freeboard Provided, ft	0.83	**Freeboard Ok, Calculated<Provided**

PROJECT NAME:	**SWALE-4**		
LOCATION:	**CHURCH ROAD INTERCONNECTION**		
PREPARED BY:	**DATE:**	**2/19/2020**	
CHECKED BY:	**DATE:**	**2/19/2020**	

CHANNEL OR CHANNEL SECTION		
Temporary or Permanent (T or P)	P	
Required Capacity, Qr (cfs)	1.00	**See attached Rational Peak Flow Calculations**
Left side slope, %	33.33	
Right side slope, %	33.33	
Bottom width, ft	5	
Channel Depth provided, ft	1	
Channel bed slope, %	1	
Mannings N	0.08	
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	0.25	
top width at flow depth, ft	6.53	
Bottom Width:Flow Depth Ratio	19.66	**Check Design**
wetted area, sq. ft	1.47	
wetted peri, ft	6.61	
hyd. Radius, ft	0.22	
velocity, ft/s	0.68	
Discharge, cfs	1.00	
Theta, rad	0.010	
Froudes Number	0.24	
Flow type	subcritical	
Shear Stress, Lb/Sq.Ft	0.16	
Protective Lining	**Vegetated**	
Lining required	**TRM-435**	
D_{50}, inches		
Placement Thickness, inches		
Adjusted Mannings N	0.10	
Calculated Critical Slope,Sc ft/ft	0.26	
0.7 Sc, ft/ft	0.18	
1.3 Sc, ft/ft	0.34	
Stable Flow?	Stable	
Calculated Freeboard, ft	0.50	
Freeboard Provided, ft	0.75	**Freeboard Ok, Calculated<Provided**

BASIN DEWATERING TIME CALCULATIONS

BASIN NAME	BASIN
Design Rate, TP-1, IN/HR	6
Design Rate, TP-2, IN/HR	2.5
AVERAGE, IN/HR	4.25
FOS	**2.00**
DESIGN RATE, IN/HR	**2.13**
INFILTRATION OF STORAGE VOLUME BELOW EMERGENCY SPILLWAY	
Bed Bottom Area	8432.00
Storage Volume	24596.00
DRAIN TIME (1)	**16.47** *DRAIN TIME FOR DEAD STORAGE BELOW EMERGENCY SPILLWAY*
INFILTRATION OF STORAGE VOLUME ABOVE EMERGENCY SPILLWAY	

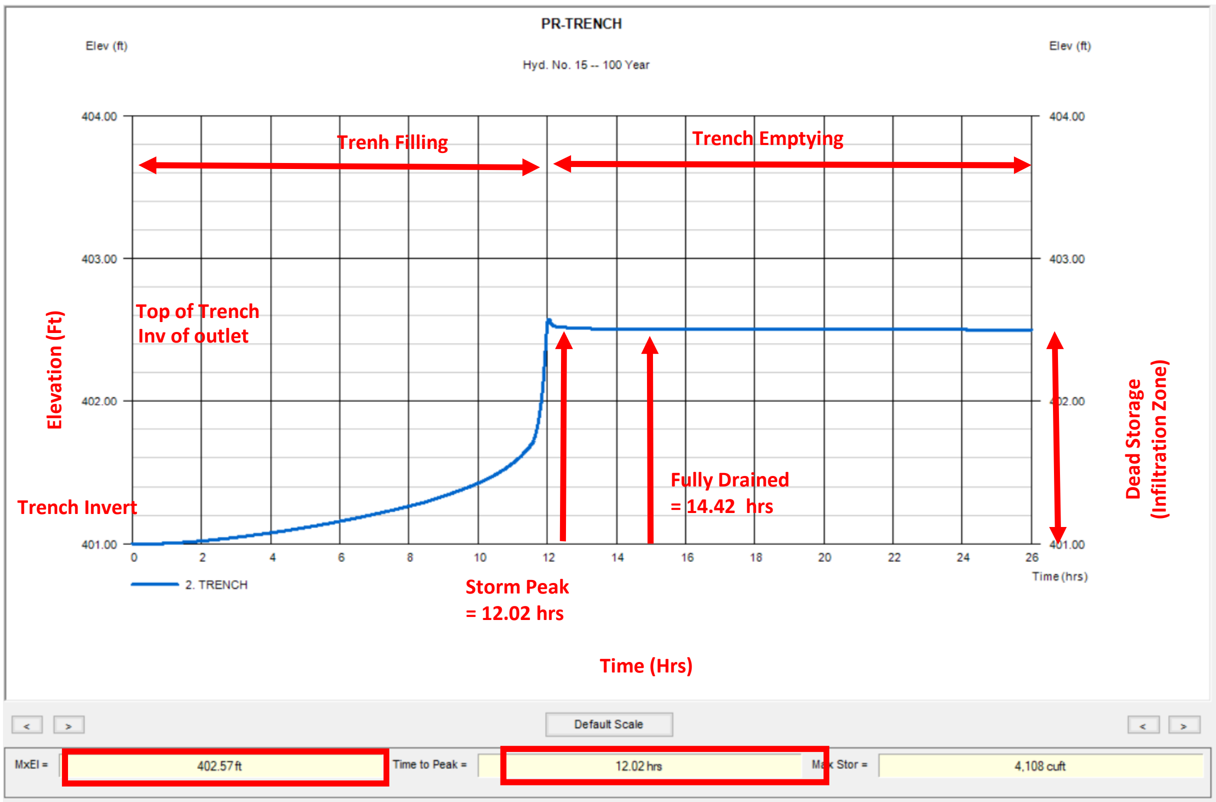


Time (hrs)	Elev (ft)
27.45	399.76
27.47	399.76
27.48	399.76
27.50	399.76
27.52	399.76
27.53	399.76
27.55	399.76
27.57	399.76
27.58	399.76
27.60	399.76
27.62	399.76
27.63	399.75
27.65	399.75
27.67	399.75
27.68	399.75
27.70	399.75
27.72	399.75
27.73	399.75
27.75	399.75
27.77	399.75
27.78	399.75
27.80	399.75
27.82	399.75
27.83	399.75
27.85	399.75
27.87	399.75
27.88	399.75
27.90	399.75

DRAIN TIME (2)	**15.00** *DRAIN TIME FROM 100-YEAR STORM PEAK TO DEAD STORAGE ELEVATION*
TOTAL DRAIN TIME (1+2)	**31.47** OK

TRENCH DEWATERING TIME CALCULATIONS

BASIN NAME	BASIN
Design Rate, TP-1, IN/HR	0.24
Design Rate, TP-2, IN/HR	0.24
AVERAGE, IN/HR	0.24
FOS	**2.00**
DESIGN RATE, IN/HR	**0.12**
INFILTRATION OF STORAGE VOLUME BELOW EMERGENCY SPILLWAY	
Bed Bottom Area	6536.00
Storage Volume	4183.00
DRAIN TIME (1)	**64.00** *DRAIN TIME FOR DEAD STORAGE BELOW EMERGENCY SPILLWAY*
INFILTRATION OF STORAGE VOLUME ABOVE EMERGENCY SPILLWAY	



Time (hrs)	Elev (ft)
14.02	402.51
14.03	402.51
14.05	402.51
14.07	402.51
14.08	402.51
14.10	402.51
14.12	402.51
14.13	402.51
14.15	402.51
14.17	402.51
14.18	402.51
14.20	402.51
14.22	402.51
14.23	402.51
14.25	402.51
14.27	402.51
14.28	402.51
14.30	402.51
14.32	402.51
14.33	402.51
14.35	402.51
14.37	402.51
14.38	402.51
14.40	402.51
14.42	402.50
14.43	402.50
14.45	402.50
14.47	402.50

DRAIN TIME (2)	**2.40** *DRAIN TIME FROM 100-YEAR STORM PEAK TO DEAD STORAGE ELEVATION*
TOTAL DRAIN TIME (1+2)	**66.40** OK

PENNEAST CHURCH ROAD INTERCONNECT
BASIN DISCHARGE

OUTLET ID	BASIN	
Discharge Type	Surface	
10-YR Peak Discharge, cfs	0.00	10-Year Trench Discharge from Model Hydrograph 16
DS Ground Cover	Grass	
Crest Elev.	399.75	
Design Criteria cfs/lf	13.0	
Calculated Crest Length, ft	0.0	
Design Crest Length, ft	**5**	
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	

PENNEAST CHURCH ROAD INTERCONNECT
TRENCH DISCHARGE

OUTLET ID	TRENCH	
Discharge Type	Surface	
10-YR Peak Discharge, cfs	0.014	10-Year Trench Discharge from Model Hydrograph 16
DS Ground Cover	Grass	
Crest Elev.	404	
Design Criteria cfs/lf	13.0	
Calculated Crest Length, ft	0.2	
Design Crest Length, ft	**38**	
Weir Coefficient	3.33	Use sharp crested value to calculate higher velocity
Weir Head (H)	0.00	to be conservative.
Flow Area	0.09	
Velocity	0.00	
Velocity Non-Erosive	YES	

Pond Report

CALCULATION FOR VOLUME STORAGE
FOR INFILTRATION BASIN

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Pond No. 1 - BASIN

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 397.25 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	397.25	8,432	0	0
1.00	398.25	9,370	8,896	8,896
2.00	399.25	10,769	10,060	18,956
2.50	399.75	11,800	5,640	24,596
2.75	400.00	12,275	3,009	27,605

EMERGENCY SPILLWAY ELEVATION

Culvert / Orifice Structures

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

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 5.00	0.00	0.00	0.00
Crest El. (ft)	= 399.75	0.00	0.00	0.00
Weir Coeff.	= 2.60	3.33	3.33	3.33
Weir Type	= Broad	---	---	---
Multi-Stage	= No	No	No	No

Exfil.(in/hr) = 0.000 (by 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	397.25	---	---	---	---	0.00	---	---	---	---	---	0.000
1.00	8,896	398.25	---	---	---	---	0.00	---	---	---	---	---	0.000
2.00	18,956	399.25	---	---	---	---	0.00	---	---	---	---	---	0.000
2.50	24,596	399.75	---	---	---	---	0.00	---	---	---	---	---	0.000
2.75	27,605	400.00	---	---	---	---	1.63	---	---	---	---	---	1.625

Pond Report

CALCULATION FOR VOLUME STORAGE
FOR INFILTRATION TRENCH

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 — Thursday, 02 / 20 / 2020

Pond No. 2 - TRENCH

Pond Data

Trapezoid -Bottom L x W = 38.0 x 172.0 ft, Side slope = 0.00:1, Bottom elev. = 401.00 ft, Depth = 2.00 ft, Voids = 40.00%

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	401.00	6,536	0	0
0.20	401.20	6,536	523	523
0.40	401.40	6,536	523	1,046
0.60	401.60	6,536	523	1,569
0.80	401.80	6,536	523	2,092
1.00	402.00	6,536	523	2,614
1.20	402.20	6,536	523	3,137
1.40	402.40	6,536	523	3,660
1.60	402.60	6,536	523	4,183
1.80	402.80	6,536	523	4,706
2.00	403.00	6,536	523	5,229

TRENCH
OVERFLOW
ELEVATION

Culvert / Orifice Structures

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

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 38.00	0.00	0.00	0.00
Crest El. (ft)	= 402.50	0.00	0.00	0.00
Weir Coeff.	= 2.60	3.33	3.33	3.33
Weir Type	= Broad	---	---	---
Multi-Stage	= No	No	No	No

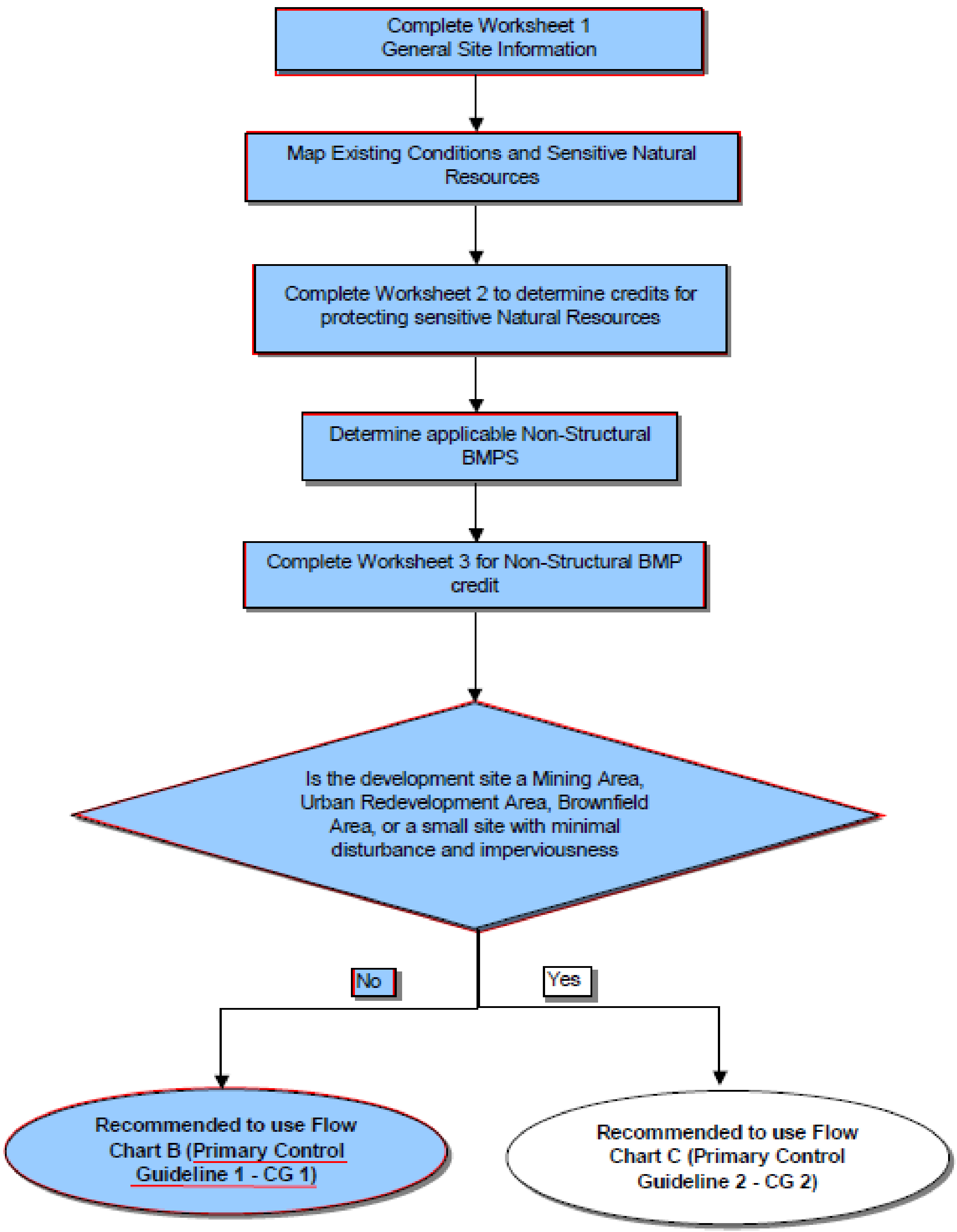
Exfil.(in/hr) = 0.000 (by Wet area)
TW Elev. (ft) = 0.00

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	401.00	---	---	---	---	0.00	---	---	---	---	---	0.000
0.20	523	401.20	---	---	---	---	0.00	---	---	---	---	---	0.000
0.40	1,046	401.40	---	---	---	---	0.00	---	---	---	---	---	0.000
0.60	1,569	401.60	---	---	---	---	0.00	---	---	---	---	---	0.000
0.80	2,092	401.80	---	---	---	---	0.00	---	---	---	---	---	0.000
1.00	2,614	402.00	---	---	---	---	0.00	---	---	---	---	---	0.000
1.20	3,137	402.20	---	---	---	---	0.00	---	---	---	---	---	0.000
1.40	3,660	402.40	---	---	---	---	0.00	---	---	---	---	---	0.000
1.60	4,183	402.60	---	---	---	---	3.12	---	---	---	---	---	3.125
1.80	4,706	402.80	---	---	---	---	16.23	---	---	---	---	---	16.23
2.00	5,229	403.00	---	---	---	---	34.93	---	---	---	---	---	34.93

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: Feb-20

Project Name: PennEast Pipeline -Chruch Road Interconnect

Municipality: Township of Bethlehem

County: Northampton

Total Area (acres): 3.484

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

Watershed: Nancy Run

Sub-Basin: Lehigh

Nearest Surface Water(s) to Receive Runoff: Nancy Run

Chapter 93 - Designated Water Use: CWF, MF
http://www.pacode.com/secure/data/025/chapter93/chap93toc.html

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

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	0.00	Ac.
1.3 Area of Minimum Disturbance/Reduced Grading	0.00	Ac.
TOTAL	0.00	Ac.

Site Area	*minus*	Protected Area	=	Stormwater Management Area
3.48	-	0.00	=	3.48

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

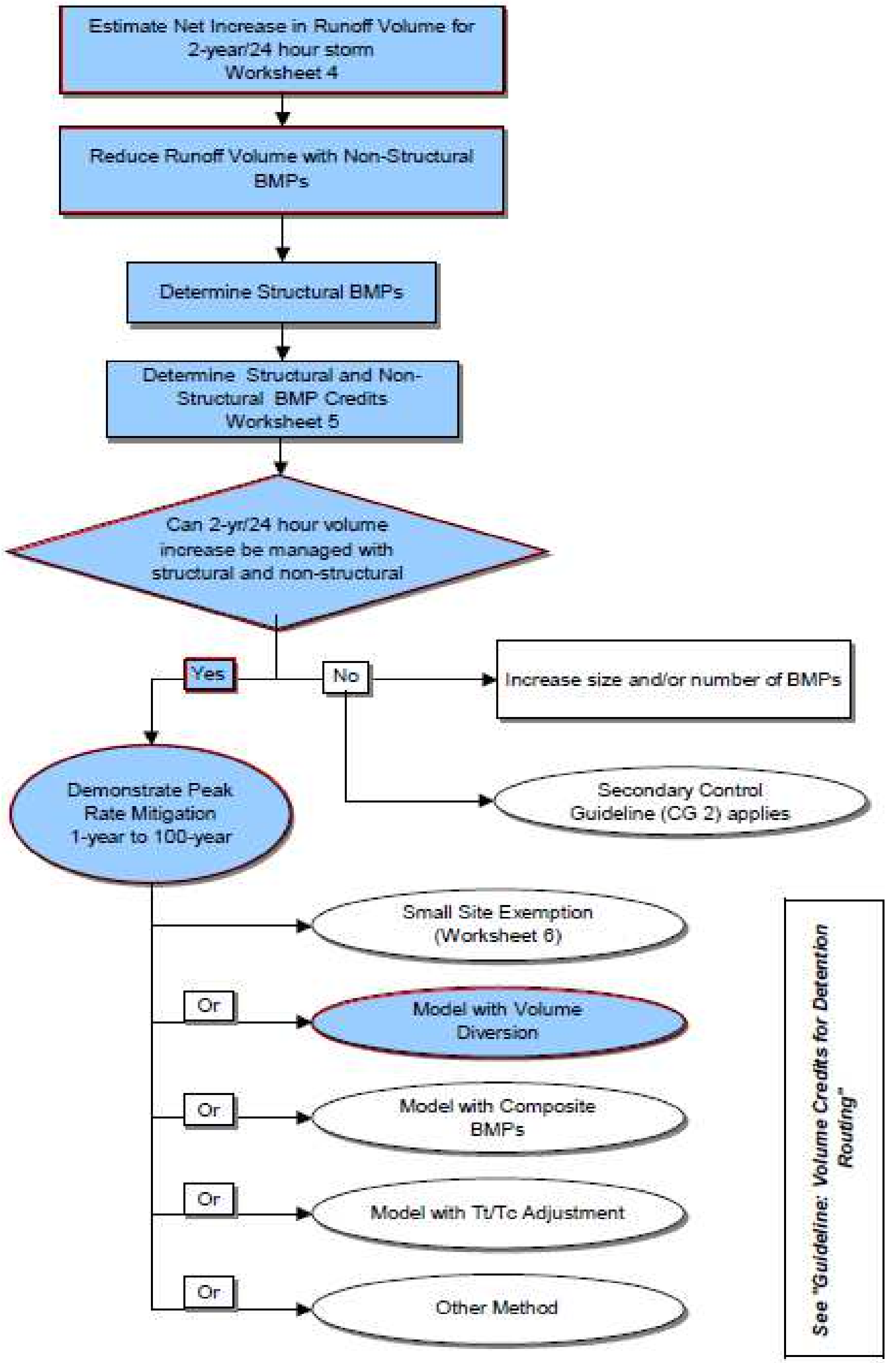
For all other disconnected areas

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 -Chruch Road Interconnect
Drainage Area: 3.484 acres
1-Year Rainfall: 2.63 in

Total Site Area: 2.469 acres -equals to Project Site Area plus Adjacent Site Area
Protected Site Area: 0.00 acres
Managed Area: 2.469 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)
Meadow	WaA	5,000	0.115	58	7.24	1.45	0.17	69
80% Impervious	WaA	360	0.008	98	0.20	0.04	2.40	72
20% Meadow	WaA	90	0.002	58	7.24	1.45	0.17	1
Meadow	WaA	40,765	0.936	58	7.24	1.45	0.17	563
80% Impervious	WaA	4,256	0.098	98	0.20	0.04	2.40	851
20% Meadow	WaA	1,064	0.024	58	7.24	1.45	0.17	15
Meadow	WaA	12,275	0.282	58	7.24	1.45	0.17	170
Meadow	WaA	3,820	0.088	58	7.24	1.45	0.17	53
Meadow	WaB	5,445	0.125	58	7.24	1.45	0.17	75
Meadow	WaA	3,135	0.072	58	7.24	1.45	0.17	43
Meadow	WaB	1,585	0.036	58	7.24	1.45	0.17	22
Meadow	WaA	9,150	0.210	58	7.24	1.45	0.17	126
Meadow	WaA	20,385	0.468	58	7.24	1.45	0.17	282
80% Impervious	WaA	188	0.004	98	0.20	0.04	2.40	38
20% Meadow	WaA	47	0.001	58	7.24	1.45	0.17	1
TOTAL:		**107,565**	**2.469**				**9.19**	**2,381**

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	WaA	805	0.02	98	0.20	0.04	2.40	161
Meadow	WaA	4,645	0.11	58	7.24	1.45	0.17	64
Gravel	WaA	41,890	0.96	98	0.20	0.04	2.40	8,378
Meadow	WaA	4,195	0.10	58	7.24	1.45	0.17	58
Meadow	WaA	12,275	0.28	58	7.24	1.45	0.17	170
Meadow	WaA	3,820	0.09	58	7.24	1.45	0.17	53
Meadow	WaB	5,445	0.13	58	7.24	1.45	0.17	75
Meadow	WaA	3,135	0.07	58	7.24	1.45	0.17	43
Meadow	WaB	1,585	0.04	58	7.24	1.45	0.17	22
Gravel Pad	WaA	6,560	0.15	98	0.20	0.04	2.40	1,312
Gravel Road	WaA	2,590	0.06	98	0.20	0.04	2.40	518
Gravel	WaA	1,610	0.04	98	0.20	0.04	2.40	322
Meadow	WaA	19,010	0.44	58	7.24	1.45	0.17	263
TOTAL:		**107,565**	**2.469**				**13.33**	**11,439**

1-Year Volume Increase (cubic ft):	9,058

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 -Chruch Road Interconnect
Drainage Area: 3.453 acres
2-Year Rainfall: 3.16 in

Total Site Area: 2.469 acres -equals to Project Site Area plus Adjacent Site Area
Protected Site Area: 0.000 acres
Managed Area: 2.469 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)
Meadow	WaA	5,000	0.115	58	7.24	1.45	0.33	136
80% Impervious	WaA	360	0.008	98	0.20	0.04	2.93	88
20% Meadow	WaA	90	0.002	58	7.24	1.45	0.33	2
Meadow	WaA	40,765	0.936	58	7.24	1.45	0.33	1,112
80% Impervious	WaA	4,256	0.098	98	0.20	0.04	2.93	1,038
20% Meadow	WaA	1,064	0.024	58	7.24	1.45	0.33	29
Meadow	WaA	12,275	0.282	58	7.24	1.45	0.33	335
Meadow	WaA	3,820	0.088	58	7.24	1.45	0.33	104
Meadow	WaB	5,445	0.125	58	7.24	1.45	0.33	148
Meadow	WaA	3,135	0.072	58	7.24	1.45	0.33	85
Meadow	WaB	1,585	0.036	58	7.24	1.45	0.33	43
Meadow	WaA	9,150	0.210	58	7.24	1.45	0.33	250
Meadow	WaA	20,385	0.468	58	7.24	1.45	0.33	556
80% Impervious	WaA	188	0.004	98	0.20	0.04	2.93	46
20% Meadow	WaA	47	0.001	58	7.24	1.45	0.33	1
TOTAL:		**107,565**	**2.469**				**12.71**	**3,975**

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	WaA	805	0.02	98	0.20	0.04	2.93	196
Meadow	WaA	4,645	0.11	58	7.24	1.45	0.33	127
Gravel	WaA	41,890	0.96	98	0.20	0.04	2.93	10,220
Meadow	WaA	4,195	0.10	58	7.24	1.45	0.33	114
Meadow	WaA	12,275	0.28	58	7.24	1.45	0.33	335
Meadow	WaA	3,820	0.09	58	7.24	1.45	0.33	104
Meadow	WaB	5,445	0.13	58	7.24	1.45	0.33	148
Meadow	WaA	3,135	0.07	58	7.24	1.45	0.33	85
Meadow	WaB	1,585	0.04	58	7.24	1.45	0.33	43
Gravel Pad	WaA	6,560	0.15	98	0.20	0.04	2.93	1,600
Gravel Road	WaA	2,590	0.06	98	0.20	0.04	2.93	632
Gravel	WaA	1,610	0.04	98	0.20	0.04	2.93	393
Meadow	WaA	19,010	0.44	58	7.24	1.45	0.33	518
TOTAL:		**107,565**	**2.469**				**17.26**	**14,517**

2-Year Volume Increase (cubic ft):	10,543

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

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

P = 2-Year Rainfall (in)

S = (1000/CN) - 10

2. Runoff Volume (CF) = Q x Area x 1/12

Q = Runoff (in)

Area = Land use area (sq. ft)

Note: Runoff Volume must be calculated for EACH land use type/condition and 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 -Chruch Road Interconnect
SUB-BASIN: Lehigh

Required Control Volume (cubic ft) - from Worksheet 4: 10,543
Non-structural Volume Credit (cubic ft) - from Worksheet 3: - 0

Structural Volume Requirement (cubic ft) 10,543
(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	13,354	12,413
6.4.3	Infiltration Bed		
6.4.4	Infiltration Trench	6,536	2,497
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): 14,910

Structural Volume Requirement (cubic ft): 10,543

DIFFERENCE 4,367 cubic ft

Note: The infiltration volume provided is significantly larger than the worksheet voume because it is based on the modeled runoff volumes which account for the existing infiltration facility.

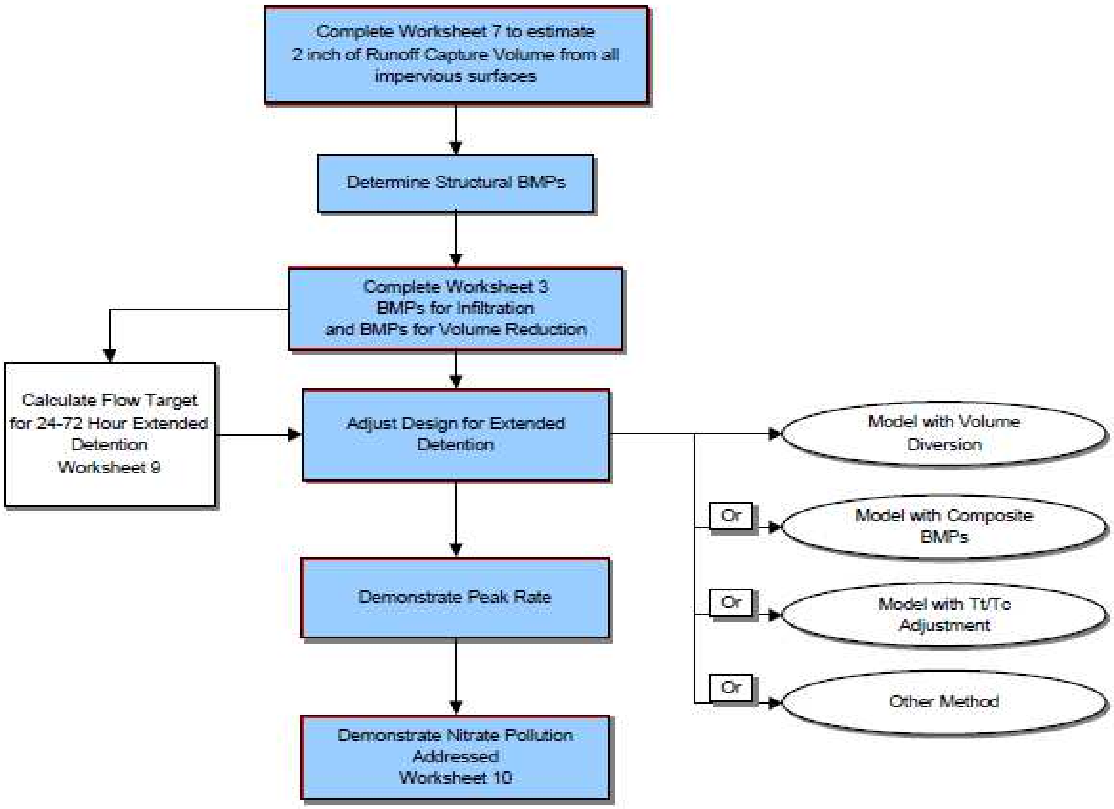
Worksheet 6. Small Site / Small Impervious Area Exception for Peak Rate Mitigation Calculations

The following conditions must be met for exemption from peak rate analysis for small sites under CG-1:

Y	The 2-Year Runoff Volume increase must be met in BMPs designed in accordance with Manual Standards.
N	Total Site Impervious Area may not exceed **1 acre.**
N	Maximum Development Area is **5 acres.**
Y	Maximum site impervious cover is 50%.
N	No more than 25% Volume Control can be in Non-structural BMPs.
Y	Infiltration BMPs must have an infiltration of at least 0.5 in/hr.

Site Area	Percent Impervious	Total Impervious
5 acre	20%	1 acre
2 acre	50%	1 acre
1 acre	50%	0.5 acre
0.5 acre	50%	0.25 acre

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 -Chruch Road Interconnect
DRAINAGE AREA: 3.484

Total Site Area: 2.469 acres
Protected Site Area: 0.000 acres
Managed Area: 2.469 acres
Total Impervious Area: 1.230 acres

2 Inch Runoff - Multiply Total Impervious Area by 2 inch

Cover Type	Area (ac)	Runoff Capture Volume (cubic ft)
Roof	0.000	0
Pavement	1.230	8930
Other Impervious	0.000	0
TOTAL:	1.230	8930

1 Inch Rainfall -

Cover Type	Area (square ft)	Area (ac)	Runoff (in)	Runoff Volumes (cubic ft)
Meadow	21,115	0.48	0.03	52
Meadow	32,995	0.76	0.03	81
Impervious	42,695	0.98	0.79	2,814
Impervious	1,610	0.04	0.79	106
Impervious	9,150	0.21	0.79	603
TOTAL:	107,565	2.469		3,657

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 -Chruch Road Interconnect
SUB-BASIN: Lehigh

Required Control Volume (cubic ft) - *from Worksheet 7:* 8,930
Non-structural Volume Credit (cubic ft) - *from Worksheet 3:* - 0

Structural Volume Reqmt (cubic ft) 8,930
(Required Control Volume minus Non-structural Credit)

Proposed BMP*		Area (square ft)	Storage Volume (cubic ft)
6.4.1	Porous Pavement		
6.4.2	Infiltration Basin	13,354	10,637
6.4.3	Infiltration Bed		
6.4.4	Infiltration Trench	6,536	1,525
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): 12,162

Structural Volume Requirement (cubic ft): 8,930

DIFFERENCE 3,232

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		X
NS BMP 5.4.3 - Protect / Utilize Natural Drainage Features		X
NS BMP 5.6.2 - Minimize Soil Compaction		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

Northampton County, Pennsylvania

December 4, 2019

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.

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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.

Soil Map

75° 17' 43" W

75° 17' 26" W

Map Scale: 1:1,790 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 25 50 100 150

Feet: 0 50 100 200 300

Map projection: Web Mercator   Corner coordinates: WGS84   Edge tics: UTM Zone 18N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Unit Polygons

Soil Map Unit Lines

Soil Map Unit Points

Special Point Features

Blowout

Borrow Pit

Clay Spot

Closed Depression

Gravel Pit

Gravelly Spot

Landfill

Lava Flow

Marsh or swamp

Mine or Quarry

Miscellaneous Water

Perennial Water

Rock Outcrop

Saline Spot

Sandy Spot

Severely Eroded Spot

Sinkhole

Slide or Slip

Sodic Spot

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Other

Special Line Features

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Northampton County, Pennsylvania
Survey Area Data: Version 12, Sep 17, 2019

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
UudB	Urban land-Udorthents, limestone complex, 0 to 8 percent slopes	0.4	4.8%
WaA	Washington silt loam, 0 to 3 percent slopes	5.7	63.6%
WaB	Washington silt loam, 3 to 8 percent slopes	2.8	31.5%
Totals for Area of Interest		**8.9**	**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.

Northampton County, Pennsylvania

UudB—Urban land-Udorthents, limestone complex, 0 to 8 percent slopes

Map Unit Setting

National map unit symbol: 227x6
Elevation: 300 to 1,000 feet
Mean annual precipitation: 36 to 50 inches
Mean annual air temperature: 46 to 57 degrees F
Frost-free period: 140 to 200 days
Farmland classification: Not prime farmland

Map Unit Composition

Urban land: 80 percent
Udorthents, limestone, and similar soils: 15 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Urban Land

Setting

Landform: Hills, valleys
Landform position (two-dimensional): Summit, shoulder, backslope, footslope
Landform position (three-dimensional): Interfluve, side slope, nose slope, head slope
Down-slope shape: Linear, convex
Across-slope shape: Convex, linear
Parent material: Pavement, buildings and other artifically covered areas

Typical profile

H1 - 0 to 6 inches: variable

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: 10 to 99 inches to lithic bedrock
Available water storage in profile: Very low (about 0.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8s
Hydric soil rating: No

Description of Udorthents, Limestone

Setting

Landform: Valleys, hills
Landform position (two-dimensional): Shoulder, footslope, backslope, summit
Landform position (three-dimensional): Interfluve, side slope, nose slope, head slope
Down-slope shape: Linear, convex
Across-slope shape: Convex, linear
Parent material: Graded areas of argillaceous limestone

Typical profile

H1 - 0 to 6 inches: clay loam

H2 - 6 to 60 inches: clay

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: 20 to 99 inches to lithic bedrock
Natural drainage class: Moderately well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 6 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 10.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: C/D
Hydric soil rating: No

Minor Components

Duffield

Percent of map unit: 5 percent
Landform: Hills
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

WaA—Washington silt loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: l7dt
Elevation: 200 to 1,500 feet
Mean annual precipitation: 32 to 50 inches
Mean annual air temperature: 46 to 57 degrees F
Frost-free period: 120 to 200 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Washington and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Washington

Setting

Landform: Valleys

Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium derived from limestone and/or old glacial drift

Typical profile

H1 - 0 to 9 inches: silt loam
H2 - 9 to 42 inches: clay loam
H3 - 42 to 61 inches: gravelly loam
H4 - 61 to 71 inches: bedrock

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: 60 to 99 inches to lithic bedrock
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.06 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 10.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 1
Hydrologic Soil Group: B
Hydric soil rating: No

Minor Components

Clarksburg

Percent of map unit: 5 percent
Landform: Valley flats
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave, linear
Across-slope shape: Linear, concave
Hydric soil rating: No

Ryder

Percent of map unit: 3 percent
Landform: Hills
Landform position (two-dimensional): Backslope, shoulder, summit
Landform position (three-dimensional): Side slope, interfluve
Down-slope shape: Convex, linear
Across-slope shape: Linear, convex
Hydric soil rating: No

Thorndale

Percent of map unit: 1 percent
Landform: Depressions
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Linear, concave

Hydric soil rating: Yes

Penlaw

Percent of map unit: 1 percent
Landform: Swales
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: No

WaB—Washington silt loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: l7dv
Elevation: 200 to 1,500 feet
Mean annual precipitation: 32 to 50 inches
Mean annual air temperature: 46 to 57 degrees F
Frost-free period: 120 to 200 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Washington and similar soils: 90 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Washington

Setting

Landform: Valleys
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium derived from limestone and/or old glacial drift

Typical profile

H1 - 0 to 9 inches: silt loam
H2 - 9 to 42 inches: clay loam
H3 - 42 to 61 inches: silt loam

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 60 to 99 inches to lithic bedrock
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Available water storage in profile: High (about 10.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: B
Hydric soil rating: No

Minor Components

Clarksburg

Percent of map unit: 2 percent
Landform: Valley flats
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave, linear
Across-slope shape: Linear, concave
Hydric soil rating: No

Loudonville

Percent of map unit: 1 percent
Landform: Till plains
Landform position (three-dimensional): Head slope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Ryder

Percent of map unit: 1 percent
Landform: Hills
Landform position (two-dimensional): Backslope, shoulder, summit
Landform position (three-dimensional): Side slope, interfluve
Down-slope shape: Convex, linear
Across-slope shape: Linear, convex
Hydric soil rating: No

Thorndale

Percent of map unit: 1 percent
Landform: Depressions
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Linear, concave
Hydric soil rating: Yes

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

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 NME	CUTBANKS CAVE	CORROSIVE TO CONCRETE\STEEL	DROUGHTY	EASLY ERODIBLE	FLOODING	DEPTH TO SATURATED ZONE/ SEASONAL HIGH WATER TABLE	HYDRIC/ HYDRIC INCLUSIONS	LOW STRENGTH/ LANDSLIDE PRONE	SLOW PERCOLATION	PIPING	POOR SOURCE OF TOPSOIL	FROST ACTION	SHRINK-SWELL	POTENTIAL SINKHOLE	PONDING	WETNESS
Church Road Interconnect	Washington	X	S				X	X	X	X	X		X	X	X		

E. Existing Conditions Stormwater Management Map

Legend

- Tc Path
- Drainage Area
- MEAD
- GRV
- Contours

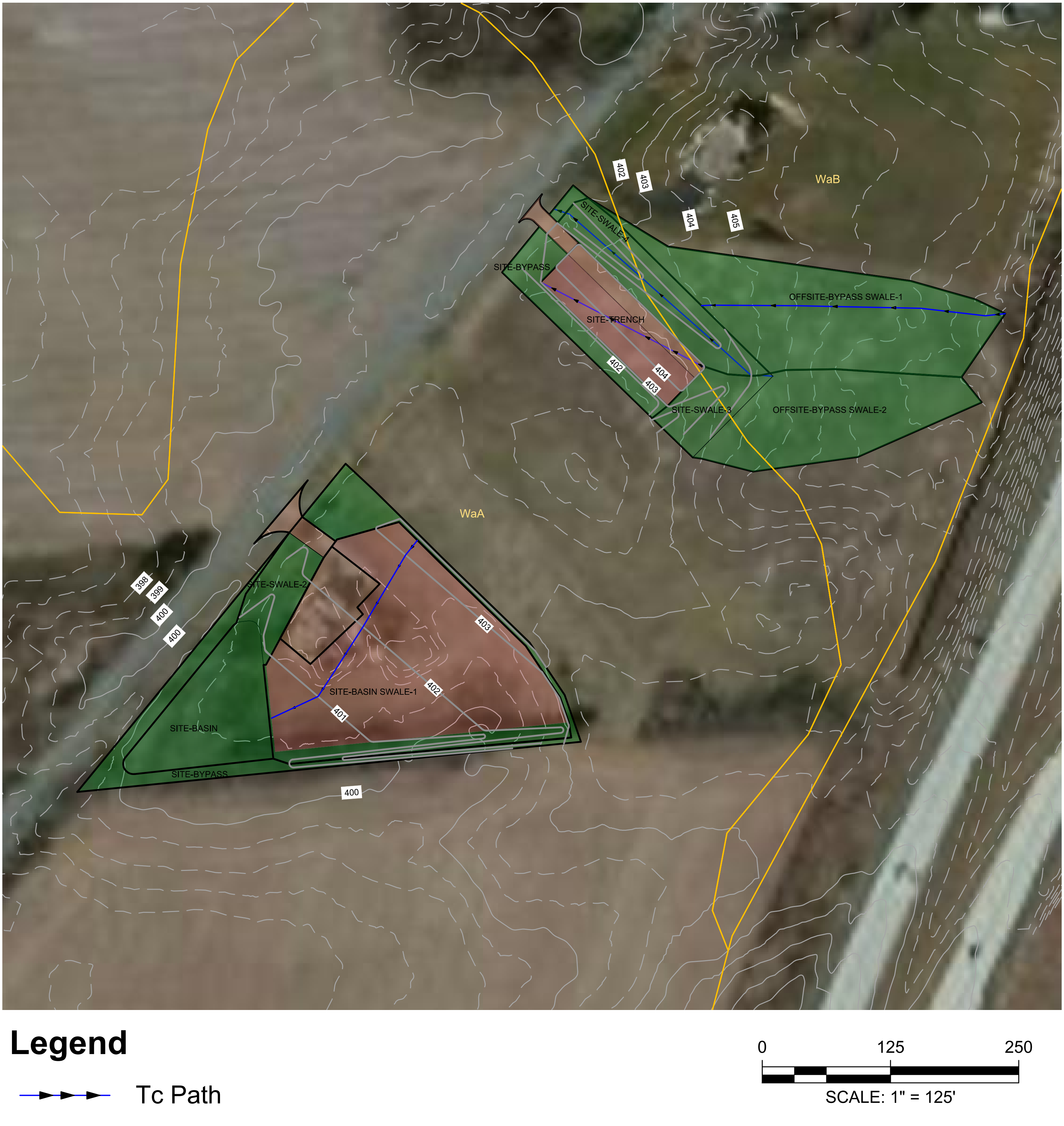
0 125 250

SCALE: 1" = 125'

N
W
E
S

CHURCH ROAD INTERCONNECT - EXISTING CONDITIONS DRAINAGE AREA MAP

F. Proposed Conditions Stormwater Management Map



Legend

Tc Path

Drainage Area

MEAD

GRV

GRV-IMP

Existing Contours

Proposed Contours

CHURCH ROAD INTERCONNECT - EXISTING CONDITIONS DRAINAGE AREA MAP

G. Infiltration Memo

Geotechnical Recommendations Report Church Road Interconnects

PennEast Pipeline Project

February 06, 2020

PennEast Pipeline

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Geotechnical Recommendations Report Church Road Interconnects

PennEast Pipeline Project

February 06, 2020

PennEast Pipeline

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Executive summary

At the request of the PennEast Pipeline Company, LLC. (PennEast), Mott MacDonald has conducted a geotechnical recommendation report for the foundation design of the proposed natural gas interconnects in Bethlehem Township along Route 33 in Northampton County, PA. A site-specific geotechnical investigation was performed for this area in January 2017 by Mott MacDonald. The information from that investigation, including boring B-JBRS33-1 and geophysical test results, were reviewed to prepare geotechnical recommendations for this site. In addition to the foundation design, two test pits with infiltration testing were performed on January 31, 2020 to facilitate the design of stomrwater management features for the proposed interconnects. The results of the infiltration tests are presented in this recommendations report.

Mott MacDonald evaluated two foundation types which may be used at the site including sonotubes or slab-on-grade. Assuming the bottom of the sonotube is at 3 feet BGS, we recommend an allowable bearing capacity of 2,000 psf. This recommendation is made considering a minimum 18-inch diameter sonotube foundation embedded 3 feet BGS. We recommend 12-inch of structural fill be placed below the foundation. We recommend an allowable bearing capacity of 1,500 psf for slab-on-grade foundations. This recommendation is made considering a 3-foot by 5-foot concrete slab with a thickness of at least 8 inches. Our analysis assumed one foot of native soil will be excavated and backfilled with compacted structural fill.

The allowable capacity will likely, in our opinion, experience a total settlement of 1-inch or less. Should foundation dimensions or construction be different than that provided above, Mott MacDonald should be consulted to evaluate the effect of changes in above recommendation, if any. The structural fill shall be built up to the proposed elevation in 8-inch lifts and compacted to 95% of its maximum dry density as determined by the Modified Proctor Test (ASTM D1557). The existing site soils may be used for reused as general backfill only.

Both test pits were excavated to to 6 feet below existing grade. Silty clay was encountered within both test pits. Infiltration testing was performed at 4 feet below existing grade utilizing double-ring infiltrometers in accordance with the Pennsylvania Stormwater Best Management Practices Manual. Based on the field infiltration test results, it is recommended that infiltration rates between 0.12 and 3.0 inches per hour shall be considered for stormwater management design.

1 Introduction

PennEast Pipeline Company, LLC. (PennEast) is proposing natural gas interconnects in Bethlehem Township along Route 33 in Northampton County, PA. The facility will support its 120-mile, 36-inch diameter high pressure natural gas pipeline that spans from Luzerne County, Pennsylvania to Mercer County, New Jersey.

A site-specific geotechnical investigation was performed for this area in January 2017 by Mott MacDonald. The information from that investigation, including boring B-JBRS33-1 and geophysical test results, were reviewed to prepare geotechnical recommendations for this site. In addition, a subsurface investigation for stormwater management design comprised of two test pits with infiltration tests were completed on January 31, 2020, for a proposed stormwater management feature. At the time of this report, a conceptual site plan of the proposed station is not included in Appendix A. A boring location plan and boring log for B-JBSR33-1 are provided in Appendix B and C, respectively. Figure 1, shown below, depicts the approximate site location, while Figure 2 shows an enhanced view of the proposed site with completed subsrufuace investigation.

Figure 1 – Site Vicinity Map

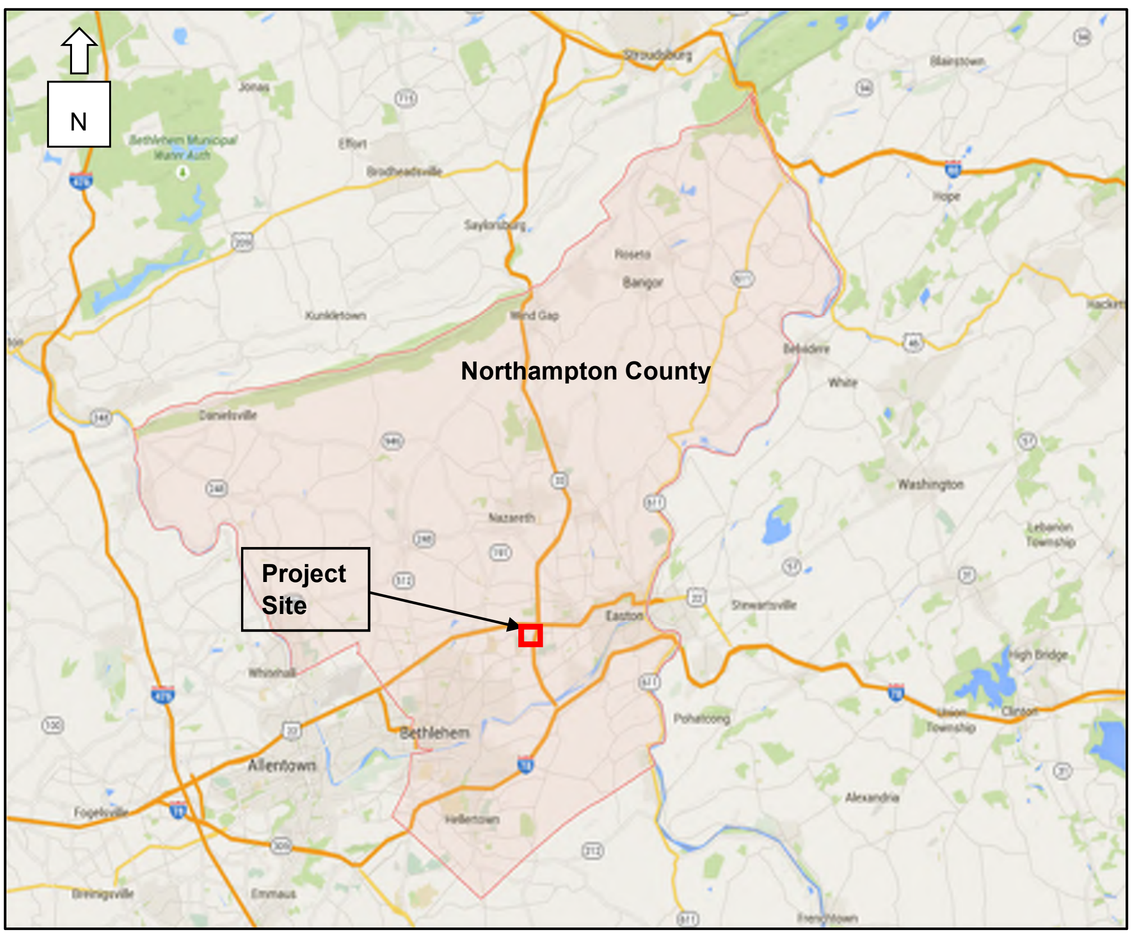

Figure 2 – Site Location Map

2 Local Geology

Mott MacDonald performed a desktop evaluation of publicly-available geologic data prior to evaluating the project site.

2.1 Surficial Geology

Based on the Natural Resources Conservation Service (NRCS) Web Soil Survey, the surficial overburden within the area of interest consists primarily Urban land and Washington series silt loam. The Washington series consists of well drained soils formed from a Pre-Wisconsin Age glacial drift and colluvium (limestone and granitic gneiss).

2.2 Bedrock Geology

Based on geological mapping through the Pennsylvania Department of Conservation and Natural Resources (PA DCNR), the proposed site location lies within the Rickenbach and Allentown Formations of Ordovician age consisting of medium to dark gray coarse-grained dolomite and limestone with occasional chert beds and nodules.

It is possible that other formations or rock types could occur within the vicinity of the interconnects, due to the nature of USGS maps.

Mapped geologic data is provided in Appendix C.

2.3 Karst Formations and Abandoned Mines

Mapped karst features in the vicinity of the proposed interconnects are depicted in Figure 3. Pennsylvania Department of Conservation & Natural Resources (PA DCNR) mapping indicate that there are more than 100 surface depressions and 29 sinkholes within 0.5 miles of the proposed site location. There are two documented surface depressions on site, and one documented sinkhole near the site.

Figure 3 – Karst Formations

Source: PA DCNR Interactive Online Map

2.4 Presence of Faults

PA DCNR and United Stated Geological Survey (USGS) mapping indicate that one fault line exists approximately one mile south of the site vicinity. This can be seen on the bedrock map located in Appendix D. This fault is not considered to be an active fault as earthquake activity has not been mapped within the site vicinity. Mott MacDonald does not believe this presents a risk to the proposed site improvements.

3 Subsurface Description

3.1 Subsurface Conditions

The major strata encountered in boring B-JBSR33-1 are described in the general profile below. The profile is described in approximate order found, from existing ground surface to the boring termination depth. Refer to the typed boring log provided in Appendix D for a more detailed description.

- **TOPSOIL with roots:** encountered at the top of boring and was approximately 0.3 feet thick.
- **SILT:** encountered below the topsoil and was generally described as soft to medium stiff, brownish yellow to reddish brown, and extended to 4 feet BGS.
- **CLAY:** encountered underlying the silt stratum. This stratum was described as medium stiff to very stiff, light brown to brownish yellow clay with varying amounts of gravel and sand.
- **CLAYEY SAND:** interbedded within the clay stratum and described as very loose to medium dense, brownish yellow to reddish brown, clayey sand with varying amounts of gravel.
- **DECOMPOSED ROCK:** encountered below the clay stratum at 50.5 feet BGS to the boring termination depth of 51 feet BGS and was described as decomposed dolomite.

3.2 Test Pit and Infiltration Test Results

Craig Test Boring of Mays Landing, New Jersey was retained by Mott MacDonald to excavate test pits at the project site. Excavation activities were performed using a Bobcat E 55 excavator on January 31, 2020. Two test pits were excavated with two infiltration tests performed within each test pit. Test pit, TP-1, was excavated within the proposed stone trench while test pit, TP-2, was excavated within the proposed detention basin area. The test pits and double-ring infiltration tests were conducted in accordance with Pennsylvania Stormwater Best Management Practice Manual (PSBMP).

Table 1 – Test Pit Schedule

Test Pit No.	Existing Grade El. (feet)	Test Depth (feet)	Depth To Groundwater (feet)
TP-1	403.10	4	Not encountered
TP-2	401.70	4	Not encountered

TP-1

Test Pit TP-1 was excavated 4 feet below existing grade on January 31, 2020.

The general description of the soil profile observed within the excavated test pits are provided below:

- **0 to 12 inches:** Topsoil with dark brown sand with roots, moist
- **12 to 36 inches:** Brownish yellow clay, some silt and occasional cobbles, moist
- **36 to 72 inches:** Reddish brown silty clay, trace sub rounded cobbles, wet

TP-2

Test Pit TP-2 was excavated 4 feet below existing grade on January 31, 2020.

The general description of the soil profile observed within the excavated test pits are provided below:

- **0 to 12 inches:** Topsoil with dark brown sand with roots, moist

- **12 to 36 inches:** Brownish yellow silty clay, frequent subangular cobbles, moist
- **36 to 48 inches:** Reddish brown to brownish yellow silty clay, moist
- **48 to 72 inches:** Reddish brown to brownish yellow silty clay with frequent angular cobbles, wet

Test Pit and Infiltration test Logs are provided in Appendix E, and Test Pit Photo Logs are provided in Appendix F.

3.3 Groundwater

Groundwater was not encountered within the boring at the time of our investigation. It should be noted that groundwater depths are ephemeral and may fluctuate due to weather or seasonal influences.

3.4 Design Infiltration Rates

Based on the Pennsylvania Stormwater Best Management Practices and the soils encountered during our investigation, the following table provides the recommended design infiltration rates at each test pit location:

Table 2 – Infiltration Test Results

Test Pit No.	Test	Existing Grade El. (feet)	Test Pit Total Depth (feet)	Inifltration Test El. (feet)	Infiltration Test Depth (feet)	Infiltration Test Results (in/hr)	Factor of Safety	Recommended Infiltration Rates (in/hr)
TP-1	1	403.10	4	399.10	4	0.24	2.0	0.12
	2	403.10	4	399.10	4	0.24	2.0	0.12
TP-2	1	401.70	4	397.70	4	6	2.0	3.0
	2	401.70	4	397.70	4	2.5	2.0	1.25

3.5 Geophysical Survey

A geophysical survey was performed at the site on September 24 and 27, 2018 by Hager-Richter Geoscience, Inc to identify and map the stratigraphy for possible karst zones. The resistivity data was acquired using an AGI SuperSting R8 with Dipole-Dipole electrode configuration with 56 electrodes and 8-foot electrode spacing. The results of this geophysical survey are provided as Appendix G. The geophysical survey did not record the presence of possible karst formations within the alignment surveyed at the project site.

4 Geotechnical Assessment and Recommendations

4.1 Project Information

A site plan of the proposed interconnects is currently being finalized at the time of this report. A sonotube and slab-on-grade foundations are expected and have been analyzed for the proposed site improvements.

4.2 Bearing Capacity and Settlement

4.2.1 Sonotube Foundation

The station's foundation should be designed using the resistances presented below. The factored resistances were calculated in accordance with the Allowable Capacity Design (ASD). Based on the site location, the frost depth is expected to be at 30 inches BGS. Assuming the bottom of the sonotube is at 3 feet BGS, we recommend an allowable bearing capacity of 2,000 psf. This recommendation is made considering a minimum 18-inch diameter sonotube foundation embedded 3 feet BGS. We recommend 12-inch of structural fill be placed below the foundation.

4.2.2 Slab-on-Grade Foundation

We recommend an allowable bearing capacity of 1,500 psf for slab-on-grade foundations. This recommendation is made considering a 3-foot by 5-foot concrete slab with a thickness of at least 8 inches. Our analysis assumed one foot of native soil will be excavated and backfilled with compacted structural fill.

It is our professional opinion that applied pressures within this limit will cause a settlement of one-inch or less. However increasing the dimensions of the slab may cause larger settlement.

It should be noted that additional borings throughout the site could be performed to confirm subsurface conditions.

Should the foundation dimensions be different than those evaluated above, Mott MacDonald should be consulted to evaluate the effect of the change in the above recommendations, if any. Bearing resistances and settlement calculations supporting these recommendations are provided as Appendix H.

4.3 Seismic Design Considerations

4.3.1 Liquefaction

Liquefaction is the full or partial loss of shear strength of granular or cohesionless soil during an earthquake event. Liquefiable soils can be loose sands, silty sands, and soft silts. The general soils observed at the site consisted mainly of stiff clay with decomposed rock. Based on our assessment liquefaction is unlikely during a seismic event.

4.3.2 Site Classification

Mott MacDonald utilized data obtained from the soil boring, B-JBSR33-1, to determine the seismic site class of the site. In accordance with the SPT average N-value method as prescribed in Chapter 20 of the ASCE Standard 7-10 design manual, site class D for "stiff soil" should be utilized across the project site.

The following Site Class D seismic ground motion values were obtained from the USGS Seismic Hazard Maps, referenced in ASCE 7-10 Standard, for this site:

- 0.2 second spectral response acceleration, S_S= 0.2 g
- 1 second spectral response acceleration, S_1= 0.063 g
- Maximum spectral acceleration for short periods, S_{MS}= 0.32 g
- Maximum spectral acceleration for a 1-second period, S_{M1}= 0.15 g
- 5% damped design spectral acceleration at short periods, S_{DS}= 0. 213 g
- 5% damped design spectral acceleration at 1-second period, S_{D1}= 0.1 g

USGS seismic ground motion data is provided as Appendix I.

5 Construction Recommendations

5.1 General

Selections for recommended designs are based on project-specific conditions obtained from the data collected from the soil boing.

5.2 Temporary Excavation Support

Excavation openings shall follow local building code requirements, or OSHA Standard 1926.651 and all applicable regulations. The contractor should be prepared to provide adequate drainage at the base of any excavation and during sub base preparation to maintain the in-place density of subgrade soils as well as provide a safe and stable working area. All storm water runoff should be directed away from any excavation to avoid ponding of water.

5.3 Dewatering

Based on the historic boring, it is not expected that dewatering of groundwater is likely to be required for activities related to the foundation construction; however, the contractor should be prepared to control runoff from precipitation by using local sumps and pumps. It should be noted that depth to groundwater is ephemeral and is subject to seasonal variation.

5.4 Foundations and Backfilling

A foundation analysis comparing sonotubes and slab-on-grade designs was performed. The designs considered an 18-inch sonotube foundation embedded a depth of 3 feet below grade and a slab-on-grade foundation with 3-foot by 5-foot dimensions.

Any soil material which contains organic and deleterious material shall be removed under any foundation structure. Prior to the installation of the foundation, it is recommended that the foundation subgrade be confirmed by a qualified geotechnical engineer.

Native material on site may be used as general backfill for cut and fill activities on site. However, due to its fine grain content, it will not be suitable for use beneath structural components. The use of native and imported general backfill below non-structural elements may be built up in 6 to 8-inch loose lifts and compacted to 90% Modified Proctor density as determined in accordance with ASTM D1557.

Mott MacDonald recommends over excavation of a minimum one foot below each foundation element and backfilled with compacted structural fill to meet the final subgrade elevations. Any placed structural fill shall be built up to the proposed elevation in 8-inch loose lifts and compacted to 95% of its maximum dry density as determined by the Modified Proctor Test in accordance with the testing procedures found in the most recent version of ASTM D1557. Any material used as structural fill shall be free draining, structurally sound, and free from deleterious material. The recommended gradation for structural fill is shown in the table below.

Table 3 – Recommended Gradation for Structural Fill

Sieve Size	Percent Passing
1 ½ inch	60-100
No. 4	30-60
No. 200	0-10

6 Limitations

The results and recommendations presented in this report are based on subsurface information from a limited amount of explorations and our use of generally accepted analytical procedures. If further investigation reveals significant differences in the subsurface conditions, or if foundation elevations or locations are revised, Mott MacDonald should be given the opportunity to review and modify our recommendations, if appropriate.

Appendices

A. Conceptual Site Plan (not included)

B. Boring Location Plan

MOTT MACDONALD

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Client

PennEast PIPELINE

Rev	Date	Drawn	Description	Ch'k'd	App'd
0	12/18/2019				

0 75 150 300 450 600 Feet

Reference Scale: 1:3,600	Absolute Scale: 1 inch = 300 feet

Project Number	B/O	Total
507353754	1	1

Designed	BK	Eng check	
Drawn	AGW	Coordination	
Dwg Check	TR	Approved	VAS

Scale at 11" x 17"	Status	Rev	Security
AS SHOWN			

Drawing Number
BLP-1

Title

BORING LOCATION

CHURCH ROAD INTERCONNECTS

PENNEAST PIPELINE
BETHLEHEM, PENNSYLVANIA

P:\353754 PennEast\Geotechnical\009-Stations\12 - Church Rd Interconnect\I - Drawings\Location Plans\MXD\Boring Location Plan.mxd

IMAGE SOURCE: OGRIP

C. Geologic Background

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

Northampton County, Pennsylvania

Church Road Interconnects

December 18, 2019

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.

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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.

Soil Map

Map Scale: 1:1,190 if printed on A landscape (11" x 8.5") sheet.

Meters: 0, 15, 30, 60, 90

Feet: 0, 50, 100, 200, 300

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N WGS84

MAP LEGEND

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

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

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

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Northampton County, Pennsylvania
Survey Area Data: Version 12, Sep 17, 2019

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
UudB	Urban land-Udorthents, limestone complex, 0 to 8 percent slopes	0.0	0.0%
WaA	Washington silt loam, 0 to 3 percent slopes	3.1	99.5%
WaB	Washington silt loam, 3 to 8 percent slopes	0.0	0.5%
Totals for Area of Interest		**3.2**	**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.

Northampton County, Pennsylvania

UudB—Urban land-Udorthents, limestone complex, 0 to 8 percent slopes

Map Unit Setting

National map unit symbol: 227x6
Elevation: 300 to 1,000 feet
Mean annual precipitation: 36 to 50 inches
Mean annual air temperature: 46 to 57 degrees F
Frost-free period: 140 to 200 days
Farmland classification: Not prime farmland

Map Unit Composition

Urban land: 80 percent
Udorthents, limestone, and similar soils: 15 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Urban Land

Setting

Landform: Hills, valleys
Landform position (two-dimensional): Summit, shoulder, backslope, footslope
Landform position (three-dimensional): Interfluve, side slope, nose slope, head slope
Down-slope shape: Linear, convex
Across-slope shape: Convex, linear
Parent material: Pavement, buildings and other artifically covered areas

Typical profile

H1 - 0 to 6 inches: variable

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: 10 to 99 inches to lithic bedrock
Available water storage in profile: Very low (about 0.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8s
Hydric soil rating: No

Description of Udorthents, Limestone

Setting

Landform: Valleys, hills
Landform position (two-dimensional): Shoulder, footslope, backslope, summit
Landform position (three-dimensional): Interfluve, side slope, nose slope, head slope
Down-slope shape: Linear, convex
Across-slope shape: Convex, linear
Parent material: Graded areas of argillaceous limestone

Typical profile

H1 - 0 to 6 inches: clay loam

H2 - 6 to 60 inches: clay

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: 20 to 99 inches to lithic bedrock
Natural drainage class: Moderately well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 6 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 10.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: C/D
Hydric soil rating: No

Minor Components

Duffield

Percent of map unit: 5 percent
Landform: Hills
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

WaA—Washington silt loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: l7dt
Elevation: 200 to 1,500 feet
Mean annual precipitation: 32 to 50 inches
Mean annual air temperature: 46 to 57 degrees F
Frost-free period: 120 to 200 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Washington and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Washington

Setting

Landform: Valleys

Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium derived from limestone and/or old glacial drift

Typical profile

H1 - 0 to 9 inches: silt loam
H2 - 9 to 42 inches: clay loam
H3 - 42 to 61 inches: gravelly loam
H4 - 61 to 71 inches: bedrock

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: 60 to 99 inches to lithic bedrock
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.06 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 10.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 1
Hydrologic Soil Group: B
Hydric soil rating: No

Minor Components

Clarksburg

Percent of map unit: 5 percent
Landform: Valley flats
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave, linear
Across-slope shape: Linear, concave
Hydric soil rating: No

Ryder

Percent of map unit: 3 percent
Landform: Hills
Landform position (two-dimensional): Backslope, shoulder, summit
Landform position (three-dimensional): Side slope, interfluve
Down-slope shape: Convex, linear
Across-slope shape: Linear, convex
Hydric soil rating: No

Thorndale

Percent of map unit: 1 percent
Landform: Depressions
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Linear, concave

Hydric soil rating: Yes

Penlaw

Percent of map unit: 1 percent
Landform: Swales
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: No

WaB—Washington silt loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: l7dv
Elevation: 200 to 1,500 feet
Mean annual precipitation: 32 to 50 inches
Mean annual air temperature: 46 to 57 degrees F
Frost-free period: 120 to 200 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Washington and similar soils: 90 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Washington

Setting

Landform: Valleys
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium derived from limestone and/or old glacial drift

Typical profile

H1 - 0 to 9 inches: silt loam
H2 - 9 to 42 inches: clay loam
H3 - 42 to 61 inches: silt loam

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 60 to 99 inches to lithic bedrock
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Available water storage in profile: High (about 10.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: B
Hydric soil rating: No

Minor Components

Clarksburg

Percent of map unit: 2 percent
Landform: Valley flats
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave, linear
Across-slope shape: Linear, concave
Hydric soil rating: No

Loudonville

Percent of map unit: 1 percent
Landform: Till plains
Landform position (three-dimensional): Head slope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Ryder

Percent of map unit: 1 percent
Landform: Hills
Landform position (two-dimensional): Backslope, shoulder, summit
Landform position (three-dimensional): Side slope, interfluve
Down-slope shape: Convex, linear
Across-slope shape: Linear, convex
Hydric soil rating: No

Thorndale

Percent of map unit: 1 percent
Landform: Depressions
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Linear, concave
Hydric soil rating: Yes

Soil Information for All Uses

Soil Reports

The Soil Reports section includes various formatted tabular and narrative reports (tables) containing data for each selected soil map unit and each component of each unit. No aggregation of data has occurred as is done in reports in the Soil Properties and Qualities and Suitabilities and Limitations sections.

The reports contain soil interpretive information as well as basic soil properties and qualities. A description of each report (table) is included.

Soil Chemical Properties

This folder contains a collection of tabular reports that present soil chemical properties. The reports (tables) include all selected map units and components for each map unit. Soil chemical properties are measured or inferred from direct observations in the field or laboratory. Examples of soil chemical properties include pH, cation exchange capacity, calcium carbonate, gypsum, and electrical conductivity.

Chemical Soil Properties

This table shows estimates of some chemical characteristics and features that affect soil behavior. These estimates are given for the layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Depth to the upper and lower boundaries of each layer is indicated.

Cation-exchange capacity is the total amount of extractable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. Soils having a low cation-exchange capacity hold fewer cations and may require more frequent applications of fertilizer than soils having a high cation-exchange capacity. The ability to retain cations reduces the hazard of ground-water pollution.

Effective cation-exchange capacity refers to the sum of extractable cations plus aluminum expressed in terms of milliequivalents per 100 grams of soil. It is determined for soils that have pH of less than 5.5.

Soil reaction is a measure of acidity or alkalinity. It is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Calcium carbonate equivalent is the percent of carbonates, by weight, in the fraction of the soil less than 2 millimeters in size. The availability of plant nutrients is influenced by the amount of carbonates in the soil.

Gypsum is expressed as a percent, by weight, of hydrated calcium sulfates in the fraction of the soil less than 20 millimeters in size. Gypsum is partially soluble in water. Soils that have a high content of gypsum may collapse if the gypsum is removed by percolating water.

Salinity is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of soil if used as construction material, and the potential of the soil to corrode metal and concrete.

Sodium adsorption ratio (SAR) is a measure of the amount of sodium (Na) relative to calcium (Ca) and magnesium (Mg) in the water extract from saturated soil paste. It is the ratio of the Na concentration divided by the square root of one-half of the Ca + Mg concentration. Soils that have SAR values of 13 or more may be characterized by an increased dispersion of organic matter and clay particles, reduced saturated hydraulic conductivity and aeration, and a general degradation of soil structure.

Chemical Soil Properties–Northampton County, Pennsylvania								
Map symbol and soil name	**Depth**	**Cation-exchange capacity**	**Effective cation-exchange capacity**	**Soil reaction**	**Calcium carbonate**	**Gypsum**	**Salinity**	**Sodium adsorption ratio**
	In	*meq/100g*	*meq/100g*	*pH*	*Pct*	*Pct*	*mmhos/cm*	
UudB—Urban land-Udorthents, limestone complex, 0 to 8 percent slopes								
Urban land	0-6	—	—	—	0	0	0	0
Udorthents, limestone	0-6	19-25	—	5.1-6.5	0	0	0	0
	6-60	23-34	—	5.1-6.5	0	0	0	0
WaA—Washington silt loam, 0 to 3 percent slopes								
Washington	0-9	10-20	—	5.6-7.3	0	0	0	0
	9-42	10-16	—	5.6-7.3	0	0	0	0
	42-61	7.0-13	—	5.6-7.3	0	0	0	0
	61-71	—	—	—	0	0	0	0
WaB—Washington silt loam, 3 to 8 percent slopes								
Washington	0-9	10-20	—	5.6-7.3	0	0	0	0
	9-42	10-16	—	5.6-7.3	0	0	0	0
	42-61	7.0-13	—	5.6-7.3	0	0	0	0

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

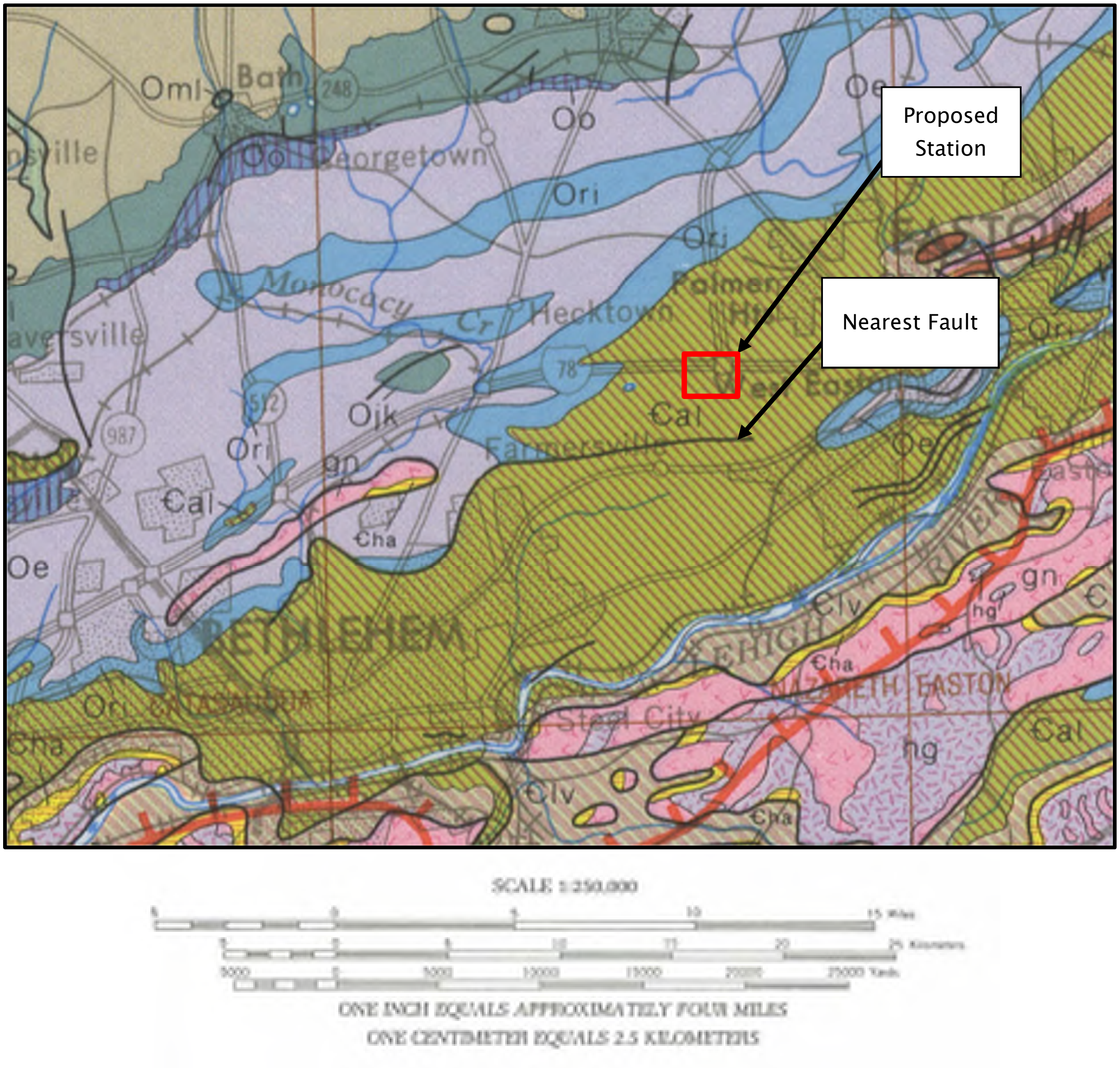
United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084

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

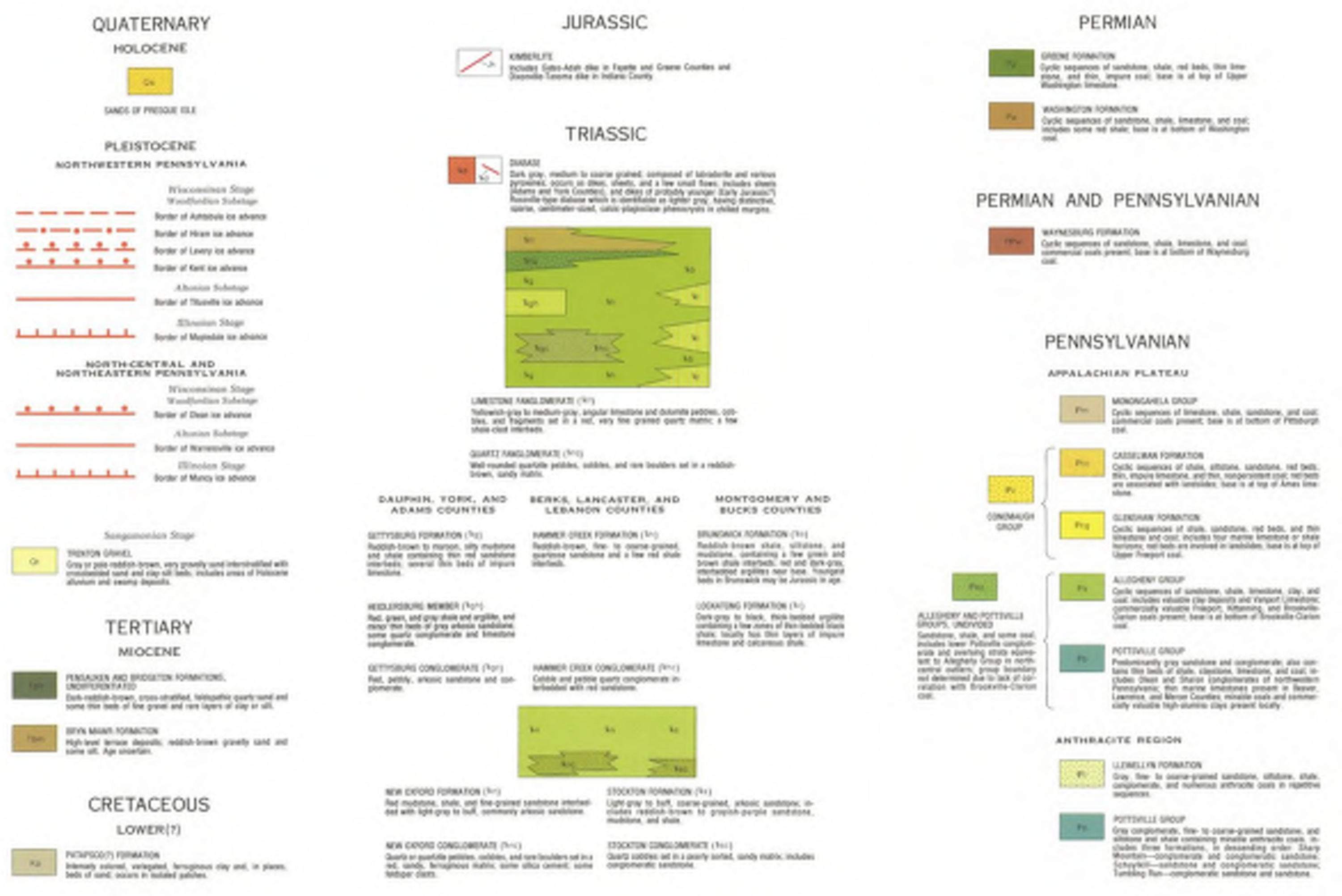
United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf

Bedrock Geology



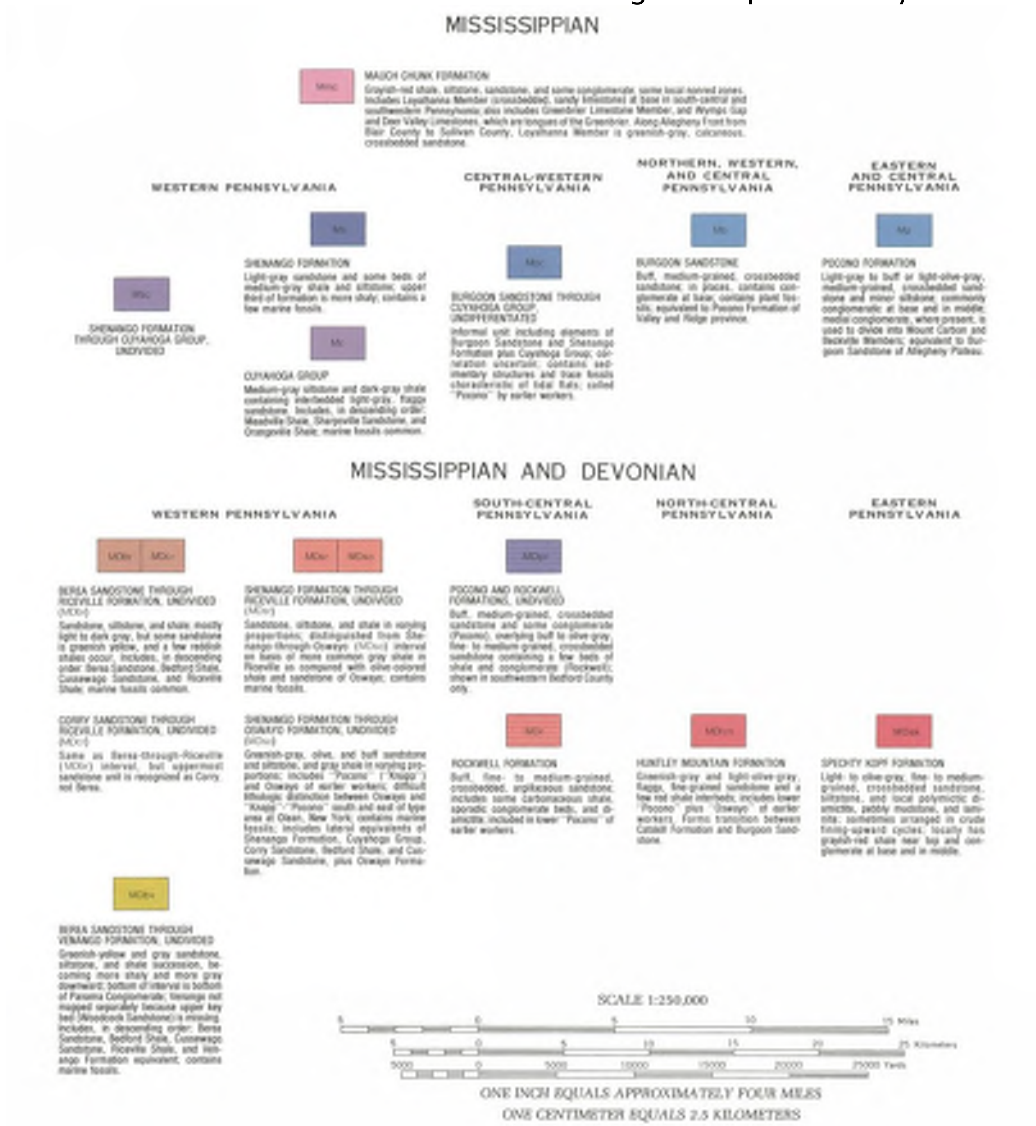
Source:
Berg, T.M., Edmunds, W.E., Geyer, A.R., and others, compilers, 1980, Geologic map of Pennsylvania (2nd ed.): Pennsylvania Geological Survey, 4th ser., Map 1, 3 sheets, scale 1:250,000.

Geological Map of Pennsylvania: Bedrock Formation Legend



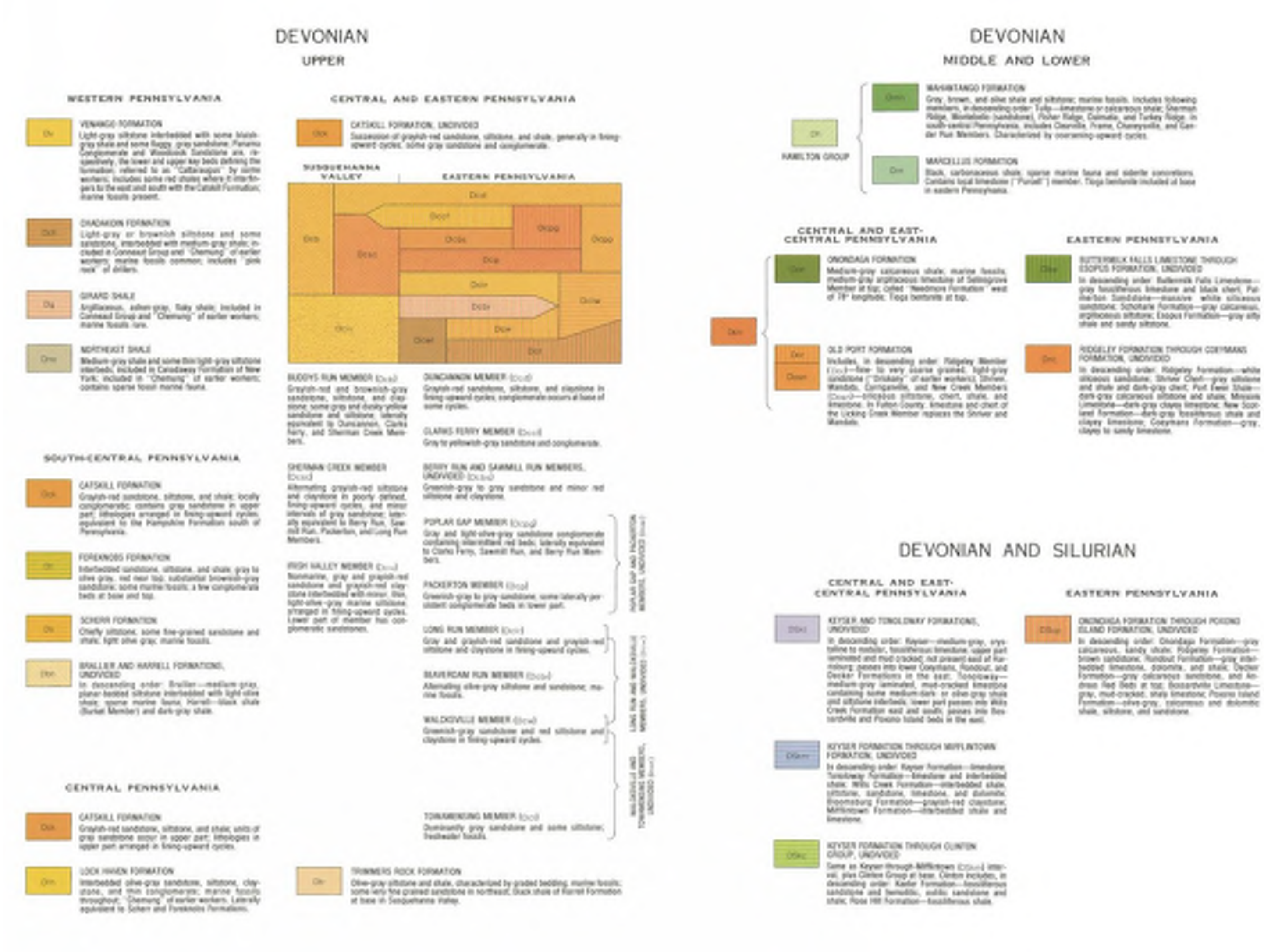
1. Note: Geologic Legend taken from:
    a. Berg, T.M., Edmunds, W.E., Geyer, A.R., and others, compilers, 1980, Geologic map of Pennsylvania (2nd ed.): Pennsylvania Geological Survey, 4th ser., Map 1, 3 sheets, scale 1:250,000.

Geological Map of Pennsylvania: Bedrock Formation Legend



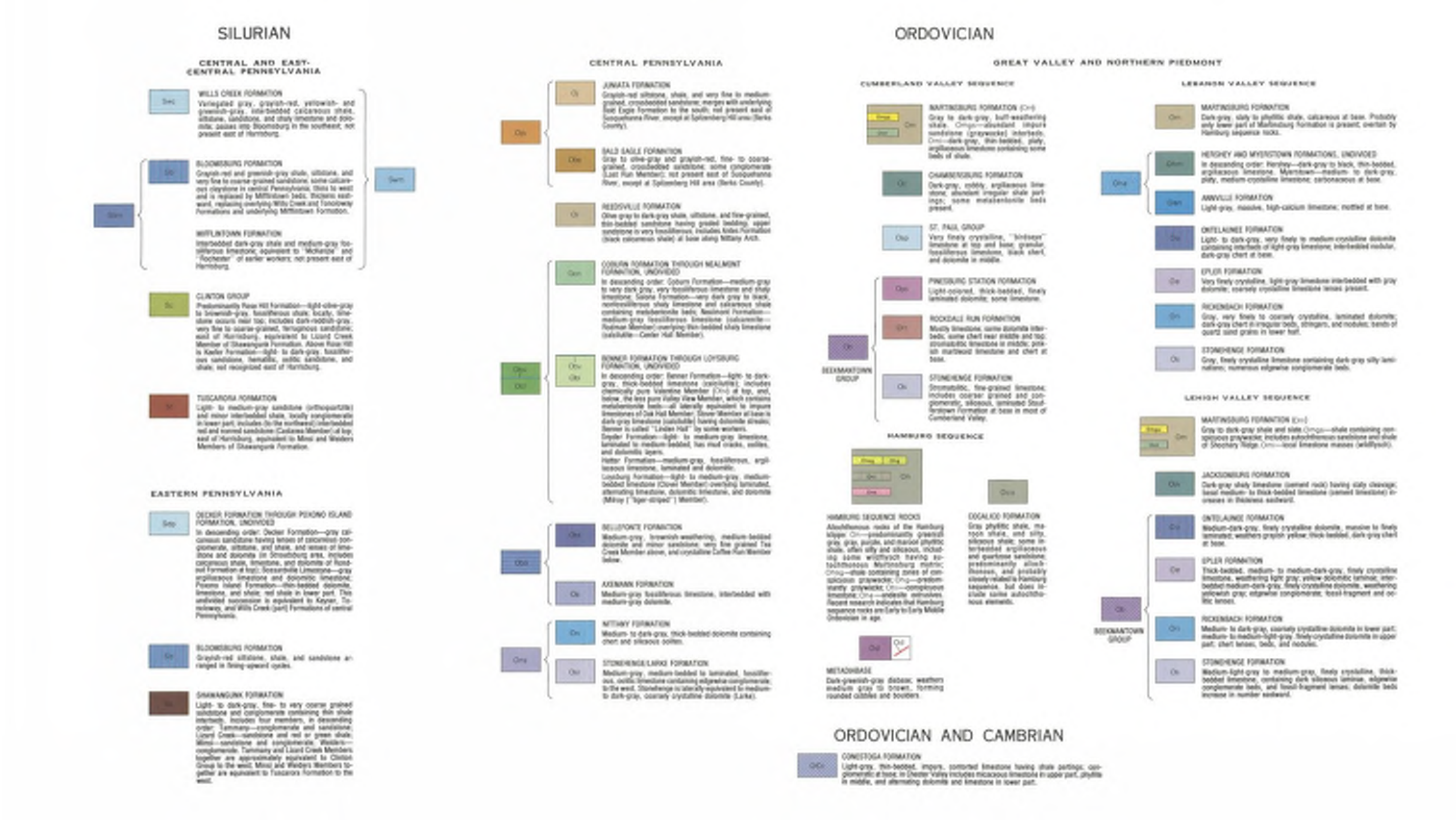
1. Note: Geologic Legend taken from:
    a. Berg, T.M., Edmunds, W.E., Geyer, A.R., and others, compilers, 1980, Geologic map of Pennsylvania (2nd ed.): Pennsylvania Geological Survey, 4th ser., Map 1, 3 sheets, scale 1:250,000.

Geological Map of Pennsylvania: Bedrock Formation Legend



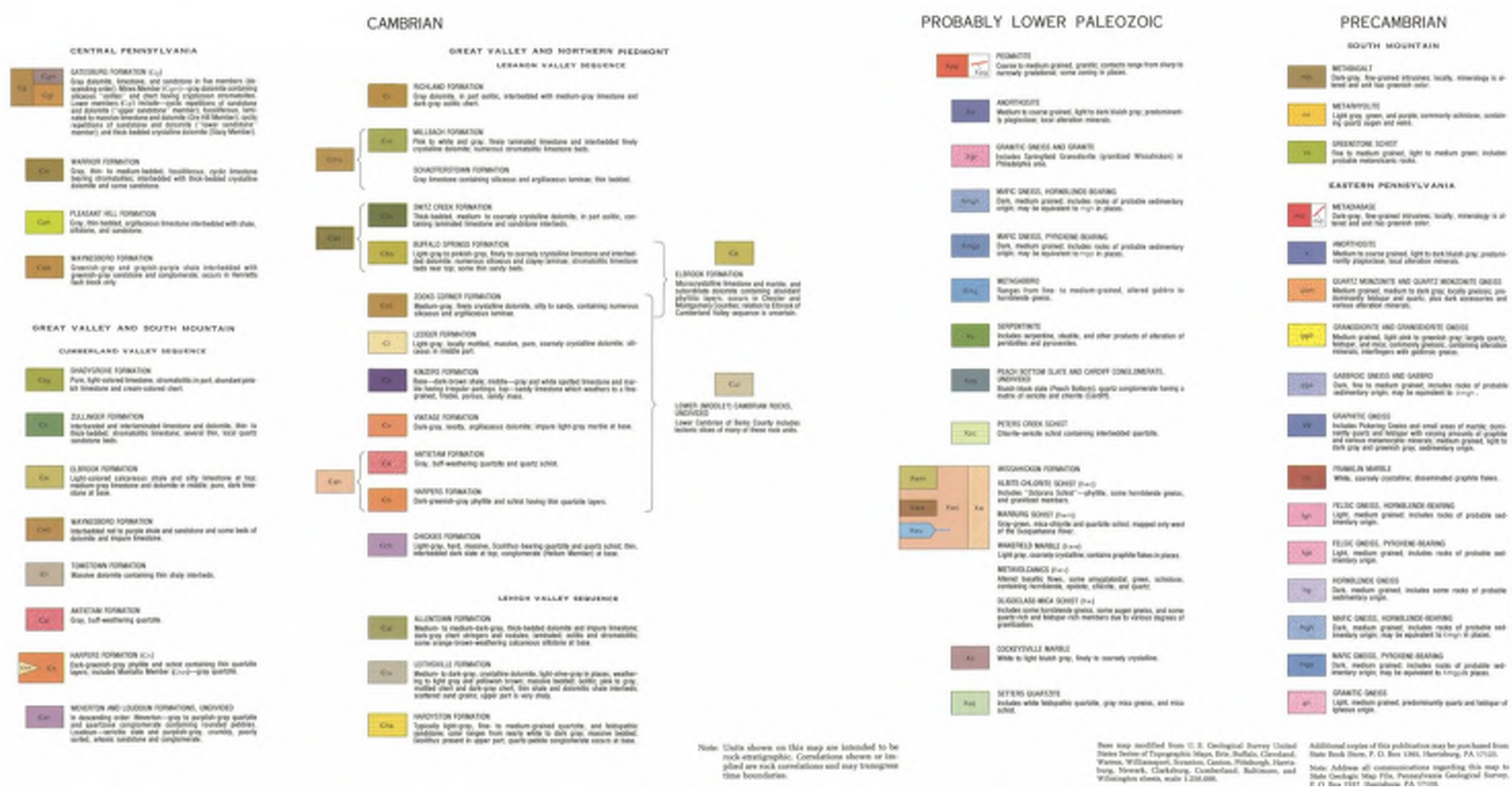
1. Note: Geologic Legend taken from:
   a. Berg, T.M., Edmunds, W.E., Geyer, A.R., and others, compilers, 1980, Geologic map of Pennsylvania (2nd ed.): Pennsylvania Geological Survey, 4th ser., Map 1, 3 sheets, scale 1:250,000.

Geological Map of Pennsylvania: Bedrock Formation Legend



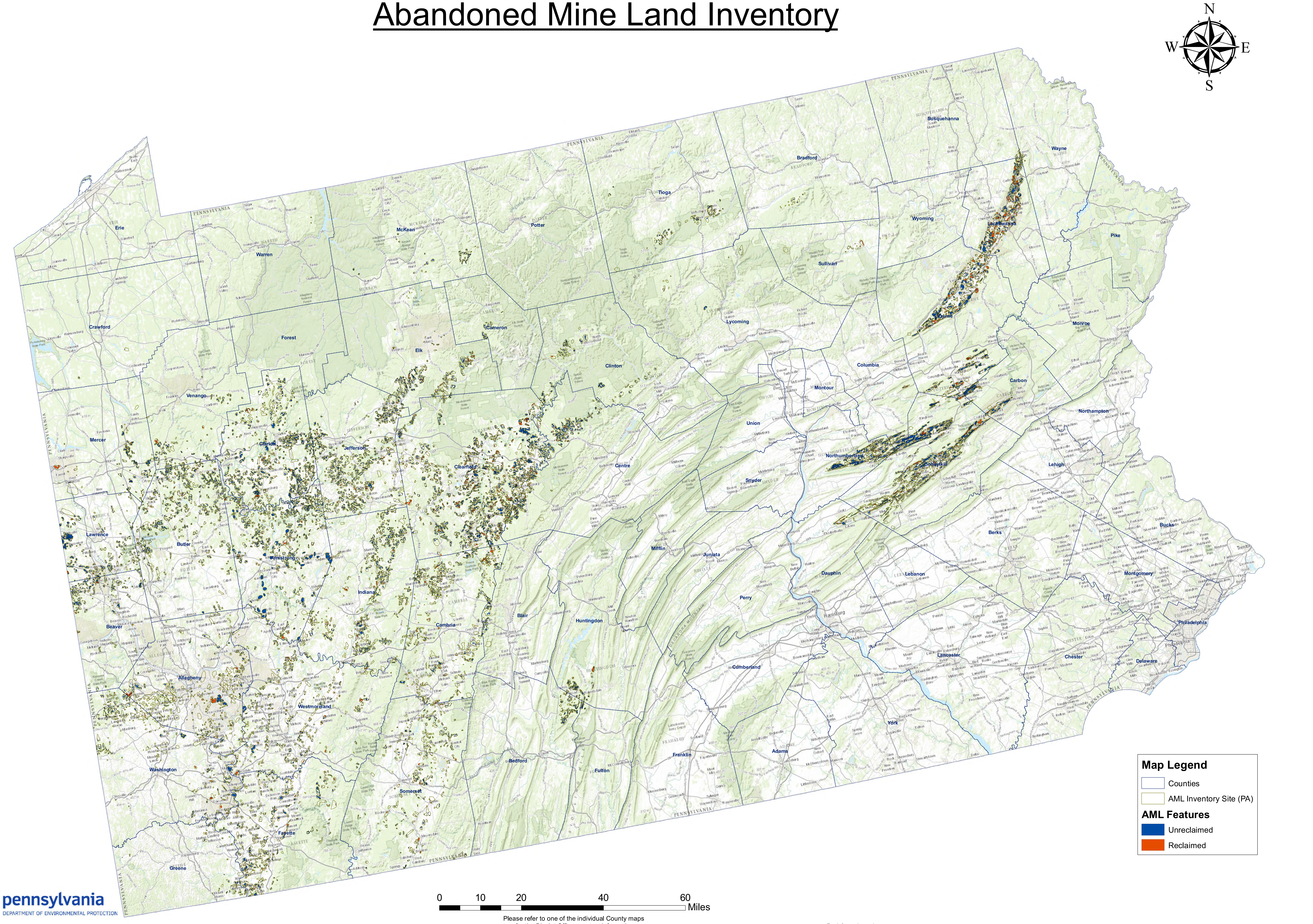
1. Note: Geologic Legend taken from:
   a. Berg, T.M., Edmunds, W.E., Geyer, A.R., and others, compilers, 1980, Geologic map of Pennsylvania (2nd ed.): Pennsylvania Geological Survey, 4th ser., Map 1, 3 sheets, scale 1:250,000.

Geological Map of Pennsylvania: Bedrock Formation Legend



1. Note: Geologic Legend taken from:
   a. Berg, T.M., Edmunds, W.E., Geyer, A.R., and others, compilers, 1980, Geologic map of Pennsylvania (2nd ed.): Pennsylvania Geological Survey, 4th ser., Map 1, 3 sheets, scale 1:250,000.

Pennsylvania
Abandoned Mine Land Inventory



pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

Please refer to one of the individual County maps
for the Disrtict Offices contact information

Map Prepared By: Katelyn I. Smith
Date: 1/09/2014
Data Source: Bureau of Abandoned Mine Reclamation
Projection: North_America_Albers_Equal_Area_Conic

For Information only
Priority 1 (P1): An AML problem concerning the protection of public health, safety, and property from extreme danger of adverse effects of mining practices or adjacent land and water reclamation.
Priority 2 (P2): An AML problem concerning the protection of public health and safety from adverse effects of mining practices or adjacent land and water reclamation.
Priority 3 (P3): An AML problem concerning the restoration of land and water resources and the environment previously degraded by adverse effects of mining practices.

D. Boring Logs

MOTT MACDONALD

SOIL BORING LOG

BORING NO.: **B-JBSR33-1**

Project:	PennEast Pipeline Project	**Project No.:**	353754
Location:	Bethlehem, PA	**Project Mgr:**	Vatsal Shah
Client:	PennEast Pipeline	**Field Eng. Staff:**	Jonathan Nelson
Drilling Co.:	Uni-Tech Drilling Co., Inc.	**Date/Time Started:**	January 10, 2017 at 9:20 am
Driller/Helper:	Jay Blemings /Gene Blemings	**Date/Time Finished:**	January 10, 2017 at 12:00 pm

Elevation: 403.4 ft. **Vertical Datum:** NAVD 1988 **Boring Location:** Church Road, Bethlehem, PA **Coord.:** **N:** 40.67568268 **E:** -75.29259395 **Horizontal Datum:** NAD 1983

Item	Casing	Sampler	Core Barrel
Type	HW	SS	NQ2
Length (ft)	5	2	5
Inside Dia. (in.)	4	1.375	2.0
Hammer Wt. (lb.)	140	140	-
Hammer Fall (in.)	30	30	-

Rig Make & Model: CME-55LC

Rig			Hammer Type	Drilling Fluid
☐ Truck	☐ Tripod	☐ Cat-Head	☐ Safety	☐ Bentonite
☐ ATV	☐ Geoprobe	✓ Winch	☐ Doughnut	☐ Polymer
✓ Track	☐ Air Track	☐ Roller Bit	✓ Automatic	✓ Water
☐ Skid	☐	✓ Cutting Head	☐	☐ None

Drill Rod Size:

Casing Advance: Hollow Stem Auger

Depth/ Elev. (ft)	Sample No. / Interval (ft)	Rec. (in)	Sample Blows per 6"	USCS Group Symbol	Visual - Manual Identification & Description (Density/consistency, color, Group Name, constituents, particle size, structure, moisture, optional descriptions, geologic interpretation, Symbol)	Dilatancy	Toughness	Plasticity	Dry Strength	Remarks
0.3	S-1 0.0'- 2.0'	19	2 2 2 2		4" - TOPSOIL	-	-	-	-	PP= 1.6 tsf TV= 0.0 tsf
				ML	Soft, Brown to brownish yellow SILT, dry (ML)					
	S-2 2.0'- 4.0'	17	2 3 3 4	ML	Medium stiff, Reddish brown SILT, moist (ML)	-	-	-	-	PP= 3.6 tsf TV= 0.35 tsf
400										
4.0	S-3 4.0'- 6.0'	21	3 3 4 3	SC	Loose, Brownish yellow Clayey SAND with Gravel, moist (SC)	-	-	-	-	PP= 1.0 tsf TV= N/A Gravel is Dolomite and Quartz fragments. Sieve and Hydrometer analysis performed WC = 14.6%
5										
6.0	S-4 6.0'- 8.0'	24	2 4 4 2	CL	Stiff, Brownish yellow Sandy CLAY, trace Gravel, moist (CL)	-	L	L	M	
	S-5 8.0'- 10.0'	23	2 3 5 5	CL	Stiff, Brownish yellow to light brown CLAY, moist (CL)	-	L	L	M	LL = 37 PL = 20 PI = 17 WC = 24.9%
10	S-6 10.0'- 12.0'	22	5 7 7 7	CL	Stiff, Light brown to brownish yellow CLAY with Gravel, moist (CL)	-	L	L	L	PP= 3.9 tsf TV= 0.39 tsf Gravel is Chert and Quartz fragments.
390										
15	S-7 15.0'- 17.0'	20	4 5 5 6	CL	Stiff, Light brown to brownish yellow CLAY with Gravel, moist (CL)	-	L	L	M	PP= 4.5 tsf TV= 0.46 tsf Gravel is Dolomite fragments. LL = 38 PL = 22 PI = 16 WC = 25.5%

Water Level Data

Date	Time	Elapsed Time (hr)	Bot. of Casing	Bottom of Hole	Water

Sample Type

- **O** Open End Rod
- **T** Thin-Wall Tube
- **U** Undisturbed Sample
- **S** Split Spoon Sample
- **G** Geoprobe

Notes:

PP = Pocket Penetrometer
TV = Torvane
LL = Liqiud Limit
PL = Plastic Limit
PI = Plasticity Index
WC = Water Content

Boring No.: **B-JBSR33-1**

Field Test Legend: Dilatancy: N - None S - Slow R - Rapid; Plasticity: NP - Non-Plastic L - Low M - Medium H - High; Toughness: L - Low M - Medium H - High; Dry Strength: N - None L - Low M - Medium H - High VH - Very High

NOTES: 1.) "ppd" denotes soil sample average diametral pocket penetrometer reading. 2.) "ppa" denotes soil sample average axial pocket penetrometer reading. 3.) Maximum Particle Size is determined by direct observation within limitations of sampler size. 4.) Soil identifications and field tests based on visual-manual methods per ASTM D2488.

Depth/ Elev. (ft)	Sample No. / Interval (ft)	Rec. (in)	Sample Blows per 6"	Stratum Graphic	USCS Symbol Group	Visual - Manual Identification & Description (Density/consistency, color, Group Name, constituents, particle size, structure, moisture, optional descriptions, geologic interpretation, Symbol)	Dilatancy	Toughness	Plasticity	Dry Strength	Remarks*
	S-8 20.0'-22.0'	20	4 4 4 4		CL	Stiff, Light brown to brownish yellow CLAY with Gravel, moist (CL)	-	L	L	M	PP= 3.5 tsf TV= 0.55 tsf
380											
25	S-9 25.0'-27.0'	23	4 4 3 2		CL	Medium stiff, Brownish yellow to light brown CLAY with Gravel, moist (CL)	-	L	L	M	PP= 2.0 tsf TV= N/A LL = 37 PL = 20 PI = 17 WC = 25.9%
						28.5					
30	S-10 30.0'-32.0'	24	4 5 7 7		SC	Medium dense, Brownish yellow Clayey SAND, moist (SC)	-	L	L	L	PP= 3.9 tsf TV= N/A
370						33.5					
35	S-11 35.0'-37.0'	24	3 5 4 4		CL	Stiff, Brownish yellow CLAY, trace Gravel, moist (CL)	-	L	L	M	PP= 1.5 tsf TV= 0.31 tsf Gravel is Dolomite fragments. LL = 36 PL = 19 PI = 17 WC = 25.2%
						38.5					
40	S-12 40.0'-42.0'	15	5 2 2 3		SC	Very loose, Brownish yellow Clayey SAND, moist (SC)	-	L	L	L	
360						43.5					
45	S-13 45.0'-47.0'	24	18 13 8 8		CL	Very stiff, Brownish yellow to reddish brown Sandy CLAY, moist (CL)	-	L	L	M	PP= 3.6 tsf TV= N/A

NOTES:

NOTES: 1.) "ppd" denotes soil sample average diametral pocket penetrometer reading. 2.) "ppa" denotes soil sample average axial pocket penetrometer reading.
3.) Maximum Particle Size is determined by direct observation within limitations of sampler size. 4.) Soil identifications and field tests based on visual-manual methods per ASTM D2488.

Depth/ Elev. (ft)	Sample No. / Interval (ft)	Rec. (in)	Sample Blows per 6"	Stratum Graphic	USCS Symbol Group	Visual - Manual Identification & Description (Density/consistency, color, Group Name, constituents, particle size, structure, moisture, optional descriptions, geologic interpretation, Symbol)	Dilatancy	Toughness	Plasticity	Dry Strength	Remarks*
50	S-14 50.0'-51.0'	12	23 50/5"		CL	50.5 Top (6") Brownish yellow Sandy CLAY, moist (CL)	-	L	L	M	
						51.0 Bottom (6") Gray DECOMPOSED ROCK fragments					Decomposed Rock is Dolomite fragments.
						End of Boring at 51 feet BGS. Borehole grouted with cement and bentonite hole plug.					
350											
55											
60											
340											
65											
70											
330											
75											

NOTES:

PROJECT NO.: **353754**

BORING NO.: **B-JBSR33-1**

NOTES: 1.) "ppd" denotes soil sample average diametral pocket penetrometer reading. 2.) "ppa" denotes soil sample average axial pocket penetrometer reading.
3.) Maximum Particle Size is determined by direct observation within limitations of sampler size. 4.) Soil identifications and field tests based on visual-manual methods per ASTM D2488.

E. Test Pit and Infiltration Test Logs

MOTT MACDONALD M M

Infiltration Test Form

Geotechnical Investigation:

- Project Name: PennEast Church Rd Interconnects
- Date: 1/31/20
- Job Number: 507353754
- Site Location: CHURCH RD EASTON, PA
- Contractor: CRAIG TEST BORING
- Weather/Temp: 25° cloudy
- Infiltration Test ID: TP-1
- Report by: J. WALSH
- Testing Depth: 4'
- Infiltration Test Method: Double-Ring Infiltrometer

Infiltration Test Pit Soil Description:

Depth Range (inches)		Description of Soil/Rock Layers
0	12"	TOPSOIL
12"	36"	Brownish yellow CLAY, some silt, occasional cobbles, moist
36"	72"	Reddish brown silty CLAY, trace subrounded cobbles, wet

Percolation Test:

RIGHT

Test #1

Time (min.)	30 pre-soak	30 pre-soak	30 min	30 min	30 min	30 min	30 min	30 min	
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)**
4'	0.84"	0.24"	0.12"	0.12"	0.24"	0.24"	0.10"	0.12"	0.24"

LEFT

Test #2

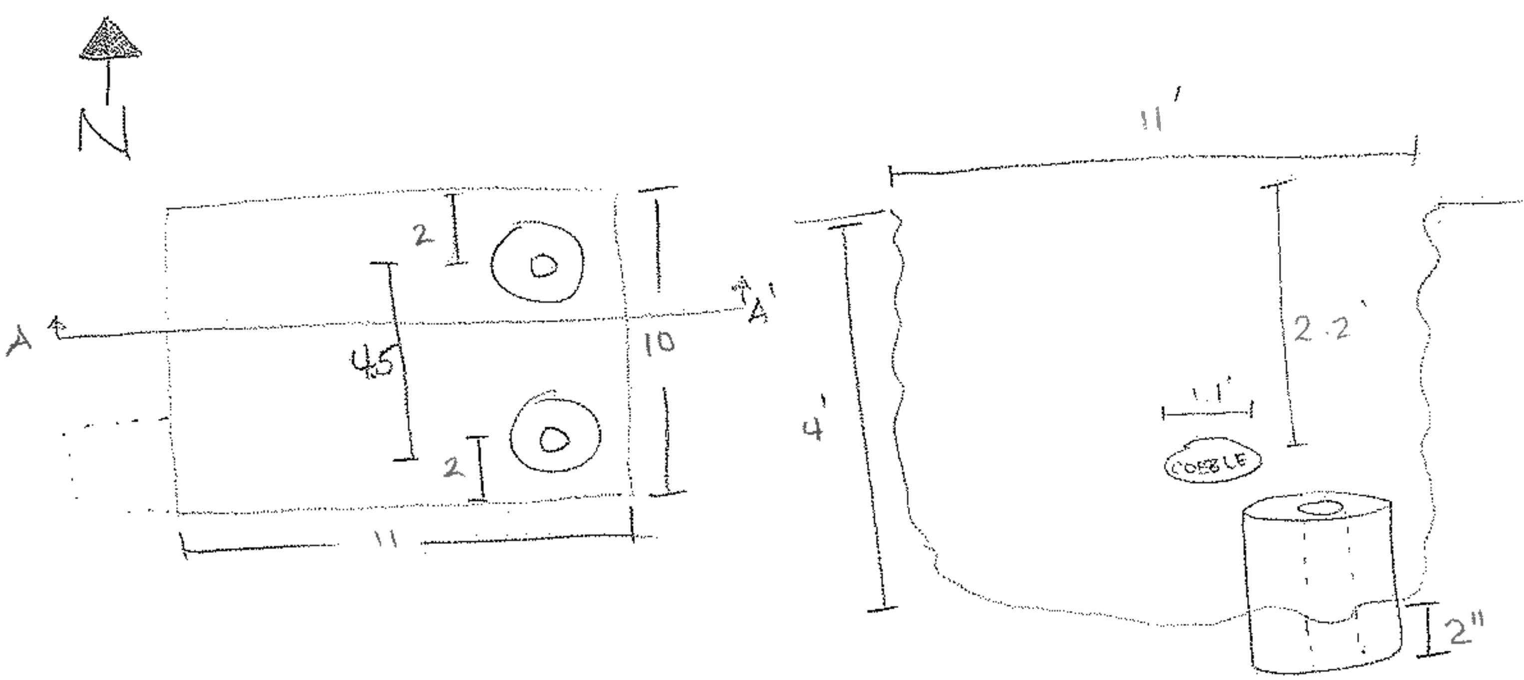
Time (min.)	30 pre-soak	30 pre-soak	30 min	30 min	30 min	30 min	30 min	30 min	
Test Depth (feet)	**Reading No. 1**	**Reading No. 2**	**Reading No. 3**	**Reading No. 4**	**Reading No. 5**	**Reading No. 6**	**Reading No. 7**	**Reading No. 8**	**Infil. Rate (in. / hour)**
4'	0.36"	0.72"	0.24"	0.12"	0"	0.12"	0.20"	0.12"	0.24"

MOTT MACDONALD

Infiltration Test Form Continued from Page 1

Notes:

Infiltration Test Pit Sketch (Plan & Profile):



Field Inspector Signature:

MOTT MACDONALD M M

Infiltration Test Form

Geotechnical Investigation:

- Project Name: PennEast Church Rd. Interconnects
- Date: 1/31/20
- Job Number: 507353754
- Site Location: EASTON, PA
- Contractor: Craig Test
- Weather/Temp: 25° cloudy
- Infiltration Test ID: TP-2
- Report by: B. Kalpouzos
- Testing Depth: 4 FT
- Infiltration Test Method: Double-Ring Infiltrometer

Infiltration Test Pit Soil Description:

Depth Range (inches)		Description of Soil/Rock Layers
0	12	Topsoil w/ roots
12	36	Brownish yellow Silty CLAY, frequent subangular cobbles, moist.
36	48	reddish brown to brownish yellow Silty CLAY, moist.
48	72	reddish brown to brownish yellow Silty CLAY frequent angular cobbles, wet.

Percolation Test:

Test #1

Time (min.)	~~30~~ 20 pre-soak	30 pre-soak	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)**
4	4	4	1	1.25	1.25	1.			6

Test #2

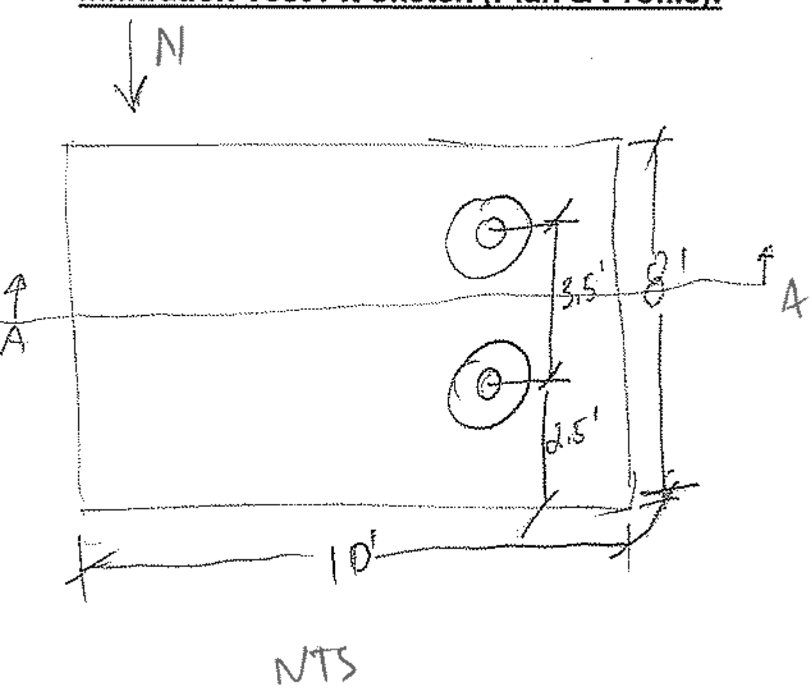
Time (min.)	30 pre-soak	30 pre-soak	30	30	30	30			
Test Depth (feet)	**Reading No. 1**	**Reading No. 2**	**Reading No. 3**	**Reading No. 4**	**Reading No. 5**	**Reading No. 6**	**Reading No. 7**	**Reading No. 8**	**Infil. Rate (in. / hour)**
4	2	1	1.0	1.25	1.0	1.25			2.5

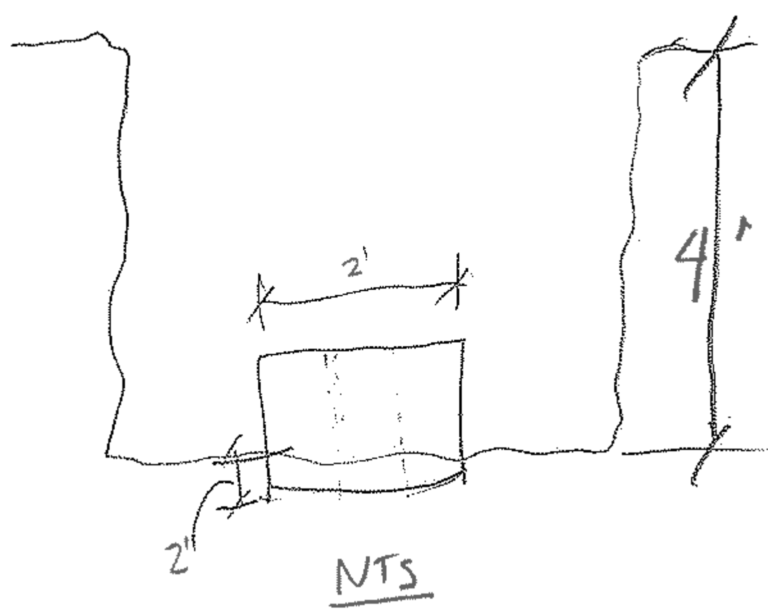
MOTT MACDONALD M M

Infiltration Test Form Continued from Page 1

Notes:

Infiltration Test Pit Sketch (Plan & Profile):





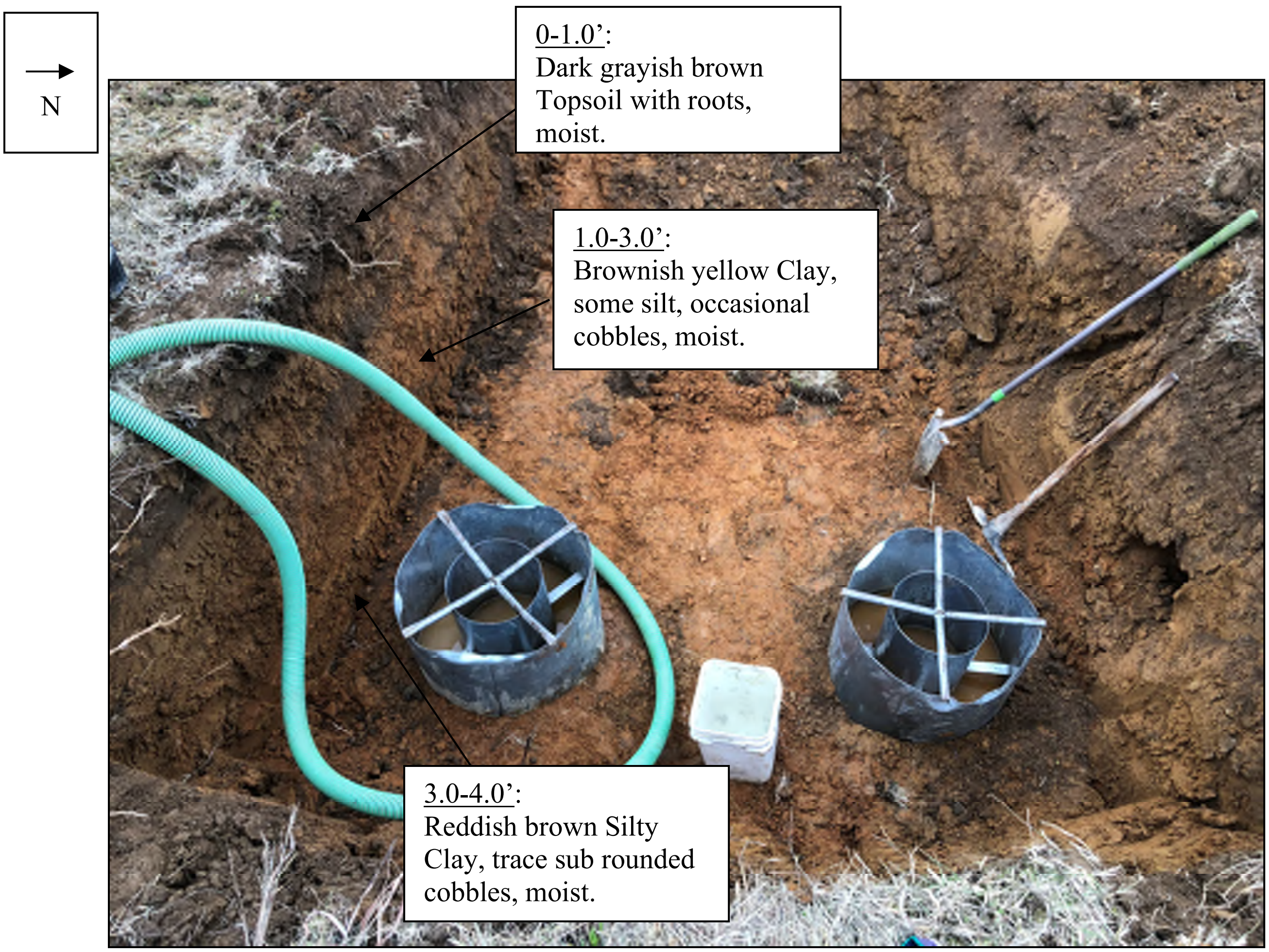
Field Inspector Signature:____________________

F. Test Pit Photo Logs

MOTT MACDONALD M M

TEST PIT LOG

SITE LOCATION	Northampton County, PA	**TEST PIT NUMBER**	**TP- 1**
PROJECT NUMBER	353754	**MM REPRESENTATIVE**	J.Walsh
GENERAL LOCATION	Southwest side of site	**CONTRACTOR**	Craig Test Boring
TIME OPENED	9:00 am	**TIME CLOSED**	3:00 PM
DEPTH TO WATER (ft. BGS)	Not Encountered	**EQUIPMENT**	Bobcat E 55
TOTAL DEPTH (Feet BGS)	4	**TOTAL LENGTH (ft.)**	11
DATE	01/31/2020	**ELEVATION (ft.)**	403.10



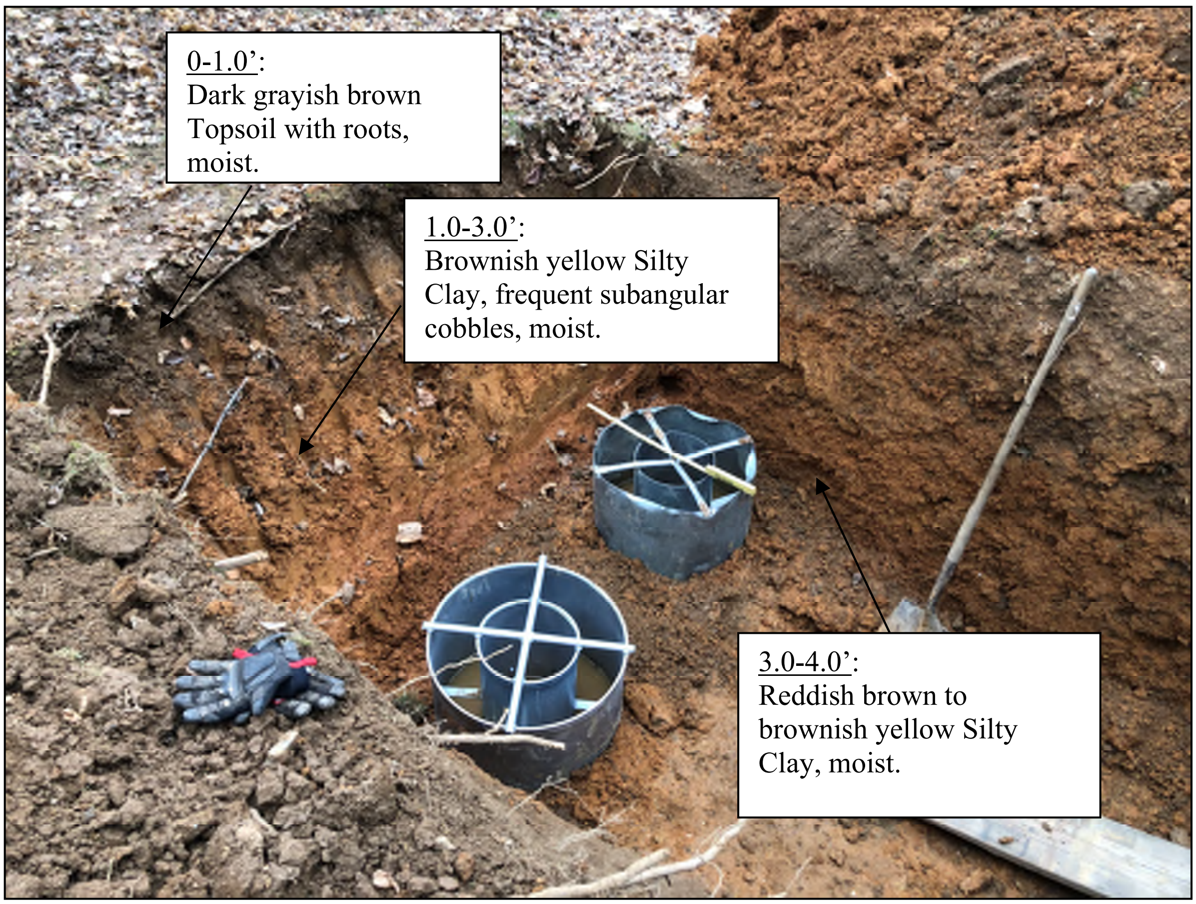
Note: All classifications and descriptions in this log are solely based on visual field observations. They were developed to generally characterize soils for environmental purposes only. They are not to be relied for any other purpose.

MOTT MACDONALD

TEST PIT LOG

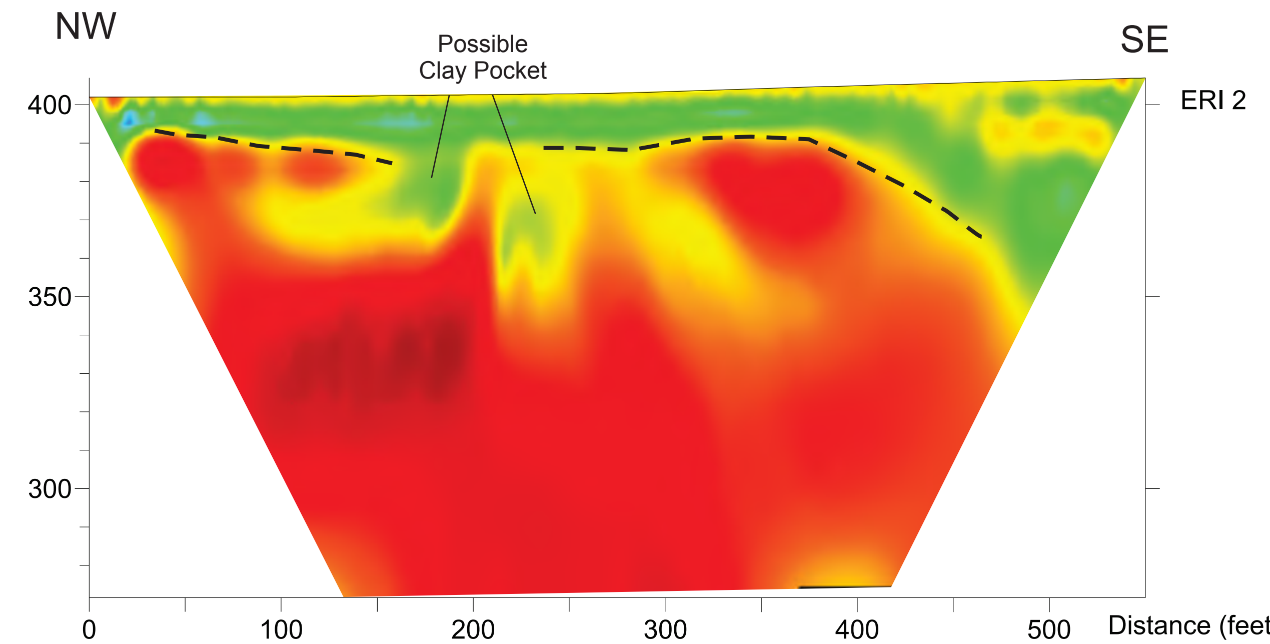
SITE LOCATION	Northampton County, PA	TEST PIT NUMBER	TP- 2
PROJECT NUMBER	353754	MM REPRESENTATIVE	B. Kalpouzos
GENERAL LOCATION	Middle of field	CONTRACTOR	Craig Test Boring
TIME OPENED	10:30 am	TIME CLOSED	2:30 PM
DEPTH TO WATER (ft. BGS)	Not Encountered	EQUIPMENT	Bobcat E 55
TOTAL DEPTH (Feet BGS)	4	TOTAL LENGTH (ft.)	10
DATE	01/31/2020	ELEVATION (ft.)	401.70

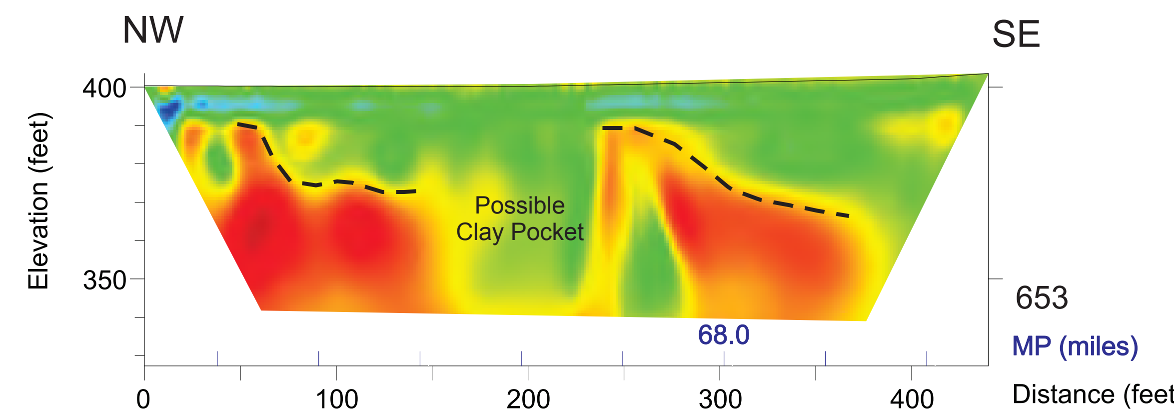
N

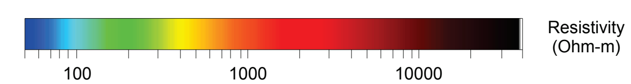


Note: All classifications and descriptions in this log are solely based on visual field observations. They were developed to generally characterize soils for environmental purposes only. They are not to be relied for any other purpose.

G. Geophysical Survey







LEGEND

POSSIBLE COMPETENT BEDROCK SURFACE

POSSIBLE KARST ZONE

LEGEND

COMPLETED AS OF MAY 2016

COMPLETED AS OF MAY 2018

NOT TO SCALE

NOTES:

1. Surface elevations determined from GPS measurements

2. Resistivity data acquired using a AGI SuperSting R8 with the Dipole–Dipole electrode configuration, 56 electrodes, and 8 & 10–foot electrode spacing.

3. Resistivity data processed and inverted using Earthimager2D Software by AGI.

HORIZONTAL SCALE (feet)

0 100 200

Vertical Exaggeration = 2X

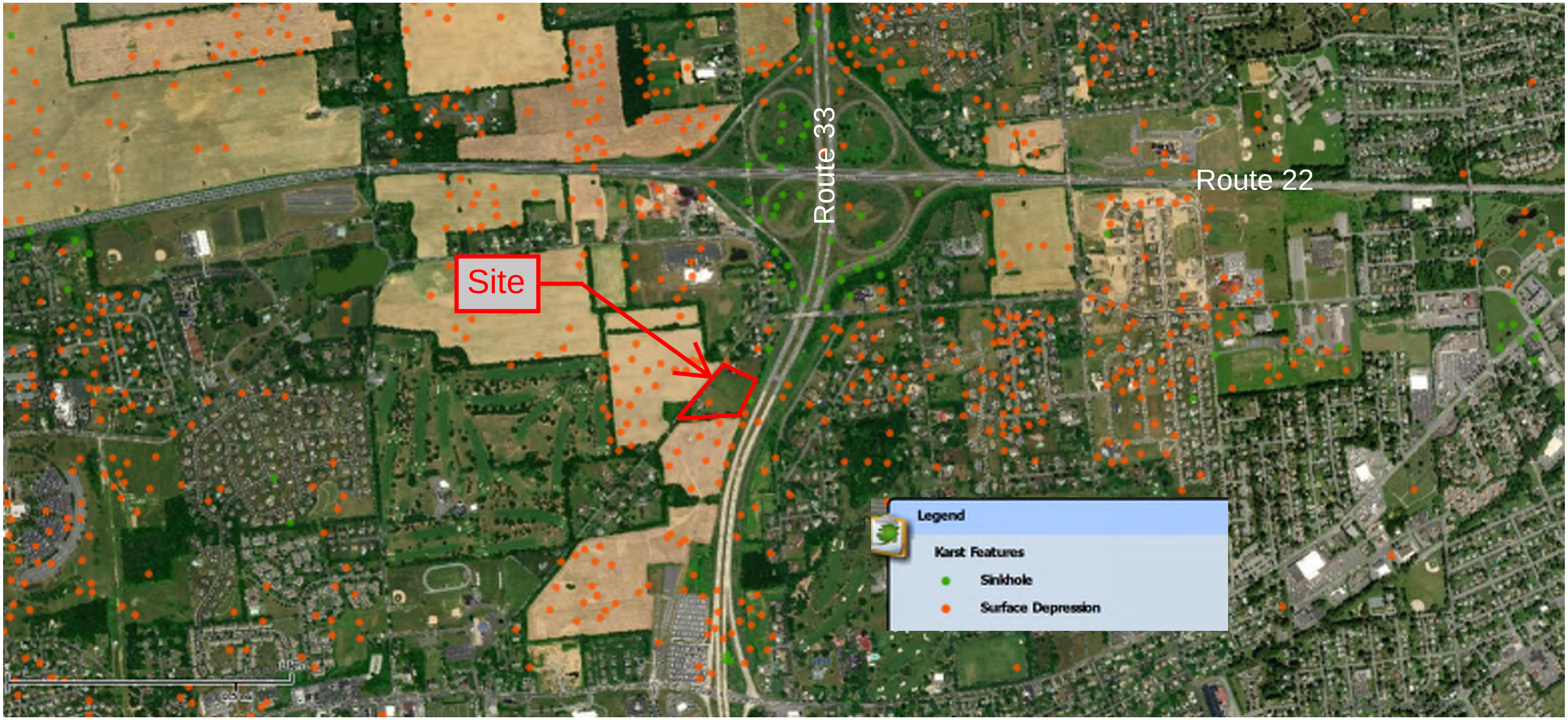
Figure 1
Resistivity Lines ERI 2 and 653
PennEast Pipeline Karst Investigation
Carbon, Northampton,
& Bucks Counties, Pennsylvania

File 15JCC19	June 2018

HAGER–RICHTER GEOSCIENCE, INC.
Fords, New Jersey

Karst Features

PA-Route 33 Station



H. Calculations

MOTT MACDONALD

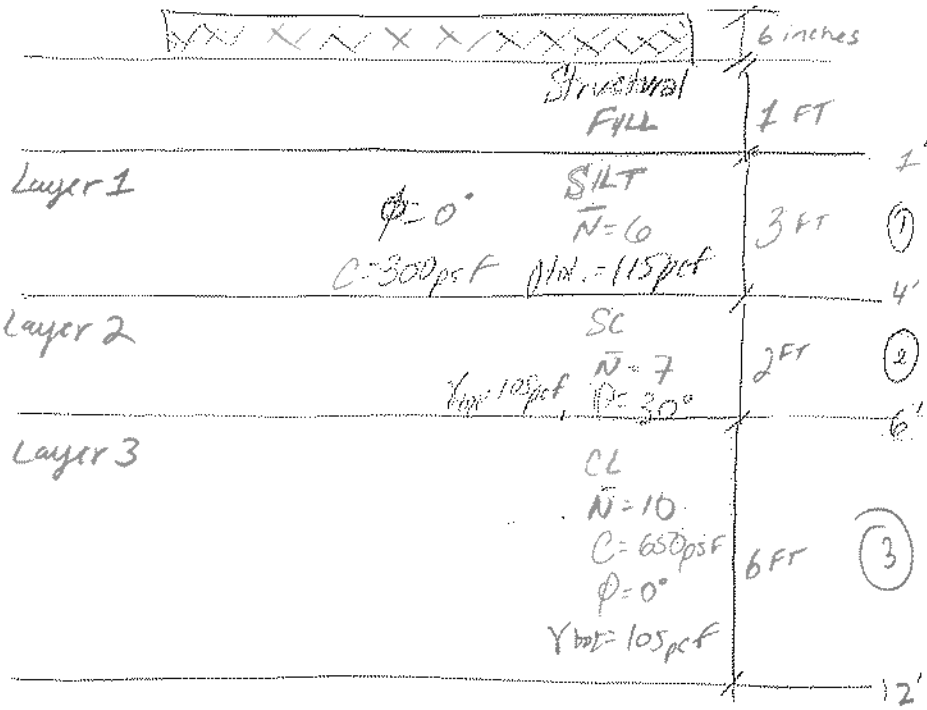
Project Name Penneast
Project # 5125353754
Subject Church Rd. Interconnect
Calculated by B. KAZPOUTOS
Checked by

Page 1 of 4
Sheet #
Date 10/16/2019
Date

SLAB-ON-GRADE

→ Assume 1 ft of structural Fill is placed.

Assumed Slab dimensions : $B = 3$ FT $L = 5$ FT concrete slab.



MOTT MACDONALD

Project Name: Penneast
Project #: 505 353754
Page 2 of 4
Subject: Church Rd. Interconnect
Sheet #:
Calculated by: B. Kaliboutos
Date: 12/16/19
Checked by:
Date:

1.0 BEARING CAPACITY

\# SLAB-ON-GRADE ; Bearing of Silt underlying structural Fill layer

$D_f = 1.0$ foot (structural Fill).

$$q_n = c' N_{cm} + \gamma D_f N_{qm} C_{wq} + 0.5 \cancel{B} N_{\gamma m} C_{w\gamma}$$

$\phi = 0° \therefore N_c = 5.14 \quad N_q = 1.0 \quad N_\gamma = 0$

$N_{qm} = N_q \cdot s_q \cdot d_q \cdot i_q$

$s_q = 1.0$

$d_q = 1.0$

$i_q = 1.0$

$N_{cm} = N_c \cdot s_c \cdot i_c = 5.14(1.2) = 6.17$

$s_c = 1 + \left(\frac{3}{3.5}\right) = 1.2$

$i_c = 1.0$

$C_{wq} = 1.0$

$$q_n = 300 \text{ psf}(6.17) + 115 \text{ pcf}(1.0)(1.0)(1.0) = 1966 \text{ psf} = 1.966 \text{ ksf}$$

$q_{ult} = 2.0 \text{ ksf}$

MOTT MACDONALD

Project Name: Penneast
Project #: 505353754
Subject: Church Rd. Interconnect
Calculated by: B. KALPOUZOS
Checked by:

Sheet #:
Date: 12/16/15
Date:

2.0. SETTLEMENT

SLAB-ON-GRADE

ZONE OF INFLUENCE = 4B = 4(3) = 12 FT

* ASSUME: 2V:1H FOR INCREAS BASE WIDTH FROM FILL.

$B' = 3 + 1 = 4$ FT.

$L' = 5 + 1 = 6$ FT

$$\frac{BL\,(1.5\,ksf)}{B'L'} = \frac{3(5)(1.5)}{4(6)} = 0.94\ ksf$$

* ASSUME SETTLEMENT IN STRUCTURAL FILL TO BE NEGLIGABLE.

Layer 1 = 1.5 FT MIDPOINT.

$\sigma'_o = 115\,pcf\,(1.5\,ft) = 345\,psf = 0.172\,ksf$

$C_N = 0.77 \log\left(\frac{40}{.172}\right) = 1.82(6) \approx 11 \therefore C' = 45$

Influence factor (Appendix 40A, Cern) $I = 0.4$

$$S_e = 3\,ft\left(\frac{1}{45}\right)\log\left[\frac{0.172 + 0.94\,ksf\,(0.4)}{0.172}\right] = 0.033' = 0.4 \text{ inches}$$

Layer 2 4 FT MIDPOINT

$\sigma'_o = 3(115\,pcf) + 1(105\,pcf) = 450\,psf = 0.45\,ksf$

$C_N = 0.77 \log\left(\frac{40}{.45}\right) = 2.53(7) \approx 18 \therefore C' = 55$

Influence factor, $I = 0.18$

$$S_e = 2\,ft\left(\frac{1}{55}\right)\cdot\log\left[\frac{0.45 + 0.94(0.18)}{0.45}\right] = 0.005' = 0.06 \text{ inches}$$

M M
MOTT MACDONALD

Project Name Penneast	
Project # 505353754	Page 4 of 4
Subject Church Rd Interconnect	Sheet #
Calculated by B. KALPOUZOS	Date 12/16/19
Checked by	Date

Layer 3 8 feet Midpoint

$\sigma'_o = 3(115 pcf) + 2(105\ pcf) + 3(105 pcf) = 870\ psf = 0.87\ ksf$

$CN = 0.77 \log\left(\frac{40}{0.87}\right) = 1.66(10) \approx 17 \therefore C' = 50$

Influence factor, $I = 0.05$

$S_e = (6\ ft)\left(\frac{1}{50}\right) \cdot \log\left[\frac{0.87 + 0.94(0.05)}{0.87}\right] = 0.002' = 0.03$ inches

$S_{e_{TOTAL}} = 0.4" + 0.06" + 0.03" = 0.49$ inches

Layer 3, Consolidation Settlement, S_c

$$S_c = \frac{H_c}{1+e_o} C_c \log\left(\frac{\sigma'_o + \Delta\sigma_v}{\sigma'_o}\right)$$

Assumed properties: $e_o = 0.4$ $C_c = 0.20$

$$S_c = \frac{6\ ft}{1.4}(0.2)\log\left(\frac{0.87 + 0.94(.05)}{0.87}\right) = 0.02' = 0.23 \text{ inches}$$

$S_T = S_e + S_c = 0.49" + 0.23" = 0.72$ inches < 1.0 inch ✓ O.K.

$\boxed{\text{USE 1.5 KSF FOR DESIGN}}$

MOTT MACDONALD

Project Name: PENNEAST
Project #: 505353354
Page 1 of 5
Subject: Church Rd Interconnect
Sheet #:
Calculated by: B. KALPOUZOS
Date: 12/12/2019
Checked by:
Date:

$\boxed{\text{SONOTUBE}}$

General Assumptions:

- → Soil freeze Depth for foundations = 30"
- → Depth to water table is assumed based on presence of wet Soil during subsurface exploration.

Sources:

- → AASHTO Bridge Specifications
- → Geotechnicalinfo.com.
- → Historic boring B-JBSR33-1 performed in January of 2017 by MM.

Soil Profile

0'

① ~~AL~~ ST. FILL
$\phi = 32°$
$\gamma_{tot} = 130pcf$

over excavate SILT & install Structural Fill (0'-4').

4'

② SC
N = 7 $\phi = 30°$
$\gamma_{total} = 105pcf$

6'

CL

③ N=10 $\gamma_{tot} = 125pcf$
C = 650 psf
$\phi = 0°$

12'

CL

④ N=10 $\gamma_{tot} = 125pcf$
C = 650 psf
$\phi = 0°$

17'

⑤ CL $\gamma_{tot.} = 120pcf$
N = 8
C = 600 psf
$\phi = 0'$

22'

MOTT MACDONALD

Project Name Penneast
Project # 505353754 Page 2 of 5
Subject Church Rd. Interconnect Sheet #
Calculated by B. KALPOUTOS Date 12/12/19
Checked by Date

1.0 BEARING CAPACITY AASHTO 10.6.3.1.2a-1

- Due to presence of soft fine grained soils to 4 feet below grade, it's recommended to excavate native soil to approximately 4 feet below grade and backfill with engineered fill.

$$q_n = cN_{cm} + \gamma D_f N_{qm} C_{wq} + 0.5\gamma B N_{\gamma m} C_{w\gamma}$$

$N_{cm} = N_c s_c i_c$ (10.6.3.1.2a-2)
$N_{qm} = N_q s_q d_q i_q$ (10.6.3.1.2a-3)
$N_{\gamma m} = N_\gamma s_\gamma i_\gamma$ (10.6.3.1.2a-4)

Sonotubes bearing on compacted engineered fill, Cohesion resistance $c = 0$.

$$q_n = \gamma D_f N_{qm} C_{wq} + 0.5\gamma B N_{\gamma m} C_{w\gamma}$$

$N_q = 23.2$ $N_\gamma = 30.2$ (Table 10.6.3.1.2a-1)

$s_q = 1 + \left(\frac{B}{L}\tan\phi\right)$ $s_\gamma = 1 - 0.4\left(\frac{B}{L}\right)$ (Table 10.6.3.1.2a-3)
$1 + \left(\frac{1.5}{1.5}\tan 32\right) = 1.62$ $1 - 0.4\left(\frac{1.5}{1.5}\right) = 0.6$

$d_q = D_f/B = 3/1.5 = 2$ $d_q = 1.30$ (Table 10.6.3.1.2a-4)

Assume inclination factors = 1.0.
$C_{wq} = 1.0$ $C_{w\gamma} = 1.0$ (Table 10.6.3.1.2a-2)

$$q_n = 130\,pcf\,(3\,ft)(23.2)(1.62)(1.30)(1.0)(1.0) + 0.5(130\,pcf)(1.5\,ft)(30.2)(0.6)(1.0)(1.0)$$

$$q_n = 19{,}055 + 1{,}766 = 20{,}821\ lbs/ft^2 \approx 20\ ksf$$

$q_{ult} = 20\ ksf$
$q_{all} = 6.9\ ksf$

MOTT MACDONALD

Project Name Penneast
Project # 505353751
Subject Church Rd. Interconnect
Calculated by B. KALPOUZOS
Checked by

Page 3 of 5
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Date 12/12/19
Date

2.0 SETTLEMENT

2.1 VERTICAL STRESS IN SOILS UNDER SONOTUBE

Layer 1 • Structural backfill
- assumed 0" settlement.

Layer 2 • Loose SC $\gamma_{tot} = 105 pcf$
midpoint under sonotube = 5 ft.
$\sigma'_V = (4' \times 130 pcf) + (1 ft \times 105 pcf) = 625 psf$

Layer 3 Stiff CL $\gamma_{tot} = 125 pcf$
midpoint = 9 feet.
$\sigma'_V = 520 psf + 210 psf + 3'(125 pcf) = 1{,}105 psf$

LAYER 4 Stiff (CL) $\gamma_{tot} = 125 pcf$
midpoint = 14.5 ft.
$\sigma'_V = 520 psf + 210 psf + 750 + 2.5'(125 pcf) = 1{,}792.5 psf$

Layer 5 STIFF (CL) $\gamma_{tot} = 120 pcf$
midpoint = 19.5 ft.
$\sigma'_V = 520 psf + 210 psf + 750 psf + 625 + 2.5'(120 pcf) = 2{,}405 psf$

2.2 Stress Distribution

Layer	H_c (ft)	Z (ft)	Z/R	Boussinesq Factor (CERM A-113)
1	N/A	N/A	N/A	N/A
2	2	2	2.67	0.24
3	6	6	8	0.024
4	5	11.5	15.3	0.0065
5	5	14.5	19.3	<0.0065

MOTT MACDONALD

Project Name: Penneast
Project #: 505353754
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Calculated by: B. Kalpouzos
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2.3 INITIAL & LONG TERM SETTLEMENT

$$S_t = S_e + S_c + S_s \quad \text{AASHTO 10.6.2.4.1-1}$$

*ASSUME S_s TO BE MINIMAL & CAN BE IGNORED.

Elastic Settlement, S_e

$$S_e = \Sigma \Delta H \quad \text{AASHTO 10.6.2.4.2-2}$$

$$\Delta H = H_c \frac{1}{C'} \log\left(\frac{\sigma'_o + \Delta\sigma_v}{\sigma'_o}\right) \quad \text{AASHTO 10.6.2.4.2-3}$$

Consolidation Settlement, S_c

$$S_c = \left[\frac{H_c}{1+e_o}\right] C_c \log\left(\frac{\sigma'_o + \Delta\sigma_v}{\sigma'_o}\right) \quad \text{AASHTO 10.6.2.4.3-2}$$

Assumed soil properties

Layer	e_o	C'	C_c	
1	N/A	N/A	N/A	
2	—	45	—	$S_c = \emptyset$
3	0.4	37	0.20	
4	0.4	35	0.20	
5	0.4	30	0.20	

MOTT MACDONALD

Project Name	Penneast		
Project #	505353754	Page	5 of 5
Subject	Church Rd. Interconnect	Sheet #	
Calculated by	B. KALPOUZOS	Date	12/13/19
Checked by		Date	

4.3 INITIAL & LONG TERM SETTLEMENT

Layer	S_e $[H_c \cdot \frac{1}{c'} \cdot 12(in/ft)]$	S_c $[H_c/1+e_0 \cdot C_c \cdot 12(in/ft)]$
1	—	—
2.	0.53	—
3.	1.95	10.28
4	1.71	8.57
5.	2	8.57

4.4 SOLVE FOR MAXIMUM STRESS, $S_t < 1.0$ inch

4.4.1 TRY, 2.0 ksf

Layer	σ'_0 (ksf)	Boussinesq factor	$\Delta\sigma_v$ (ksf)	$\frac{\sigma'_0+\Delta\sigma_v}{\sigma'_0}$	Se (in)	Sc (in)
1	/	/	/	/	Ø	Ø
2	.625	0.24	0.48	1.768	0.13	Ø
3	1.105	0.024	0.048	1.043	0.035	0.187
4	1.792	0.0065	0.013	1.007	Ø	0.027
5	2.405	<0.0065	0.013	1.007	Ø	0.027
				totals	0.165"	0.241"

$S_t = 0.4'' < 1.0$ ok ✓

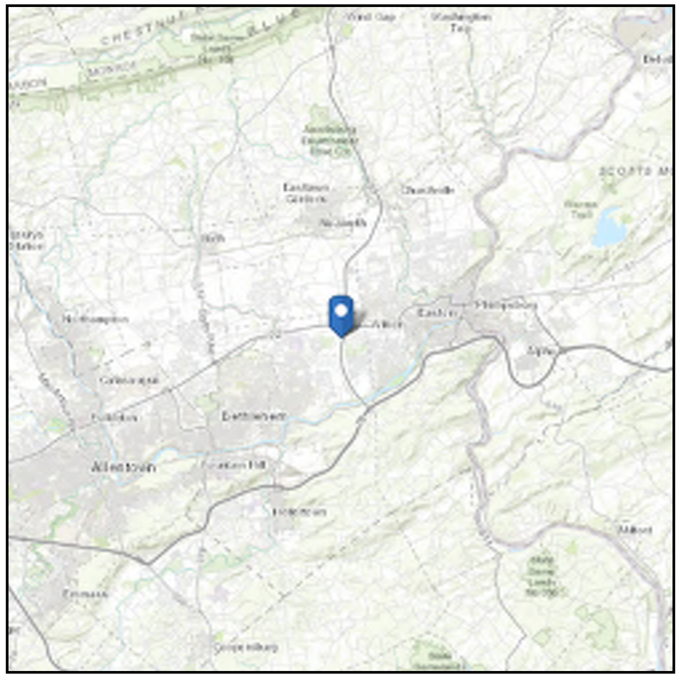
I. Seismic Site Classification

ASCE 7 Hazards Report

Address:
No Address at This Location

Standard: ASCE/SEI 7-10
Risk Category: IV
Soil Class: D - Stiff Soil

Elevation: 401.4 ft (NAVD 88)
Latitude: 40.676319
Longitude: -75.293357



ASCE
AMERICAN SOCIETY OF CIVIL ENGINEERS

Seismic

Site Soil Class: D - Stiff Soil

Results:

S_S :	0.2	S_{DS} :	0.213
S_1 :	0.063	S_{D1} :	0.1
F_a :	1.6	T_L :	6
F_v :	2.4	PGA :	0.108
S_{MS} :	0.32	PGA_M :	0.17
S_{M1} :	0.15	F_{PGA} :	1.585
		I_e :	1.5

Seismic Design Category C

Data Accessed: Fri Dec 13 2019

Date Source: USGS Seismic Design Maps based on ASCE/SEI 7-10, incorporating Supplement 1 and errata of March 31, 2013, and ASCE/SEI 7-10 Table 1.5-2. Additional data for site-specific ground motion procedures in accordance with ASCE/SEI 7-10 Ch. 21 are available from USGS.

The ASCE 7 Hazard Tool is provided for your convenience, for informational purposes only, and is provided "as is" and without warranties of any kind. The location data included herein has been obtained from information developed, produced, and maintained by third party providers; or has been extrapolated from maps incorporated in the ASCE 7 standard. While ASCE has made every effort to use data obtained from reliable sources or methodologies, ASCE does not make any representations or warranties as to the accuracy, completeness, reliability, currency, or quality of any data provided herein. Any third-party links provided by this Tool should not be construed as an endorsement, affiliation, relationship, or sponsorship of such third-party content by or from ASCE.

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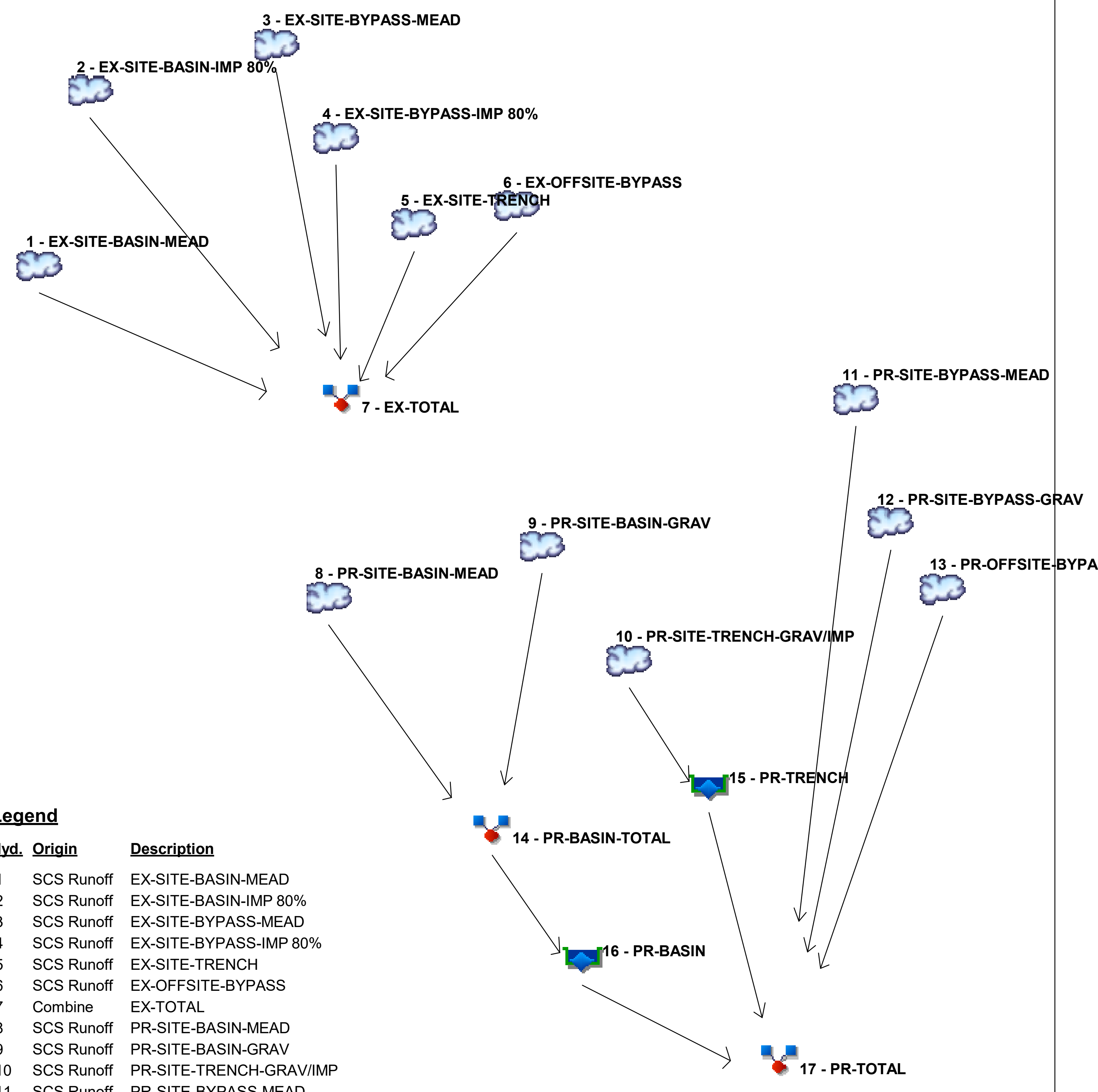
In using this Tool, you expressly assume all risks associated with your use. Under no circumstances shall ASCE or its officers, directors, employees, members, affiliates, or agents be liable to you or any other person for any direct, indirect, special, incidental, or consequential damages arising from or related to your use of, or reliance on, the Tool or any information obtained therein. To the fullest extent permitted by law, you agree to release and hold harmless ASCE from any and all liability of any nature arising out of or resulting from any use of data provided by the ASCE 7 Hazard Tool.

H. Model Input and Model Output Report

Watershed Model Schematic

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020



Legend

Hyd.	Origin	Description
1	SCS Runoff	EX-SITE-BASIN-MEAD
2	SCS Runoff	EX-SITE-BASIN-IMP 80%
3	SCS Runoff	EX-SITE-BYPASS-MEAD
4	SCS Runoff	EX-SITE-BYPASS-IMP 80%
5	SCS Runoff	EX-SITE-TRENCH
6	SCS Runoff	EX-OFFSITE-BYPASS
7	Combine	EX-TOTAL
8	SCS Runoff	PR-SITE-BASIN-MEAD
9	SCS Runoff	PR-SITE-BASIN-GRAV
10	SCS Runoff	PR-SITE-TRENCH-GRAV/IMP
11	SCS Runoff	PR-SITE-BYPASS-MEAD
12	SCS Runoff	PR-SITE-BYPASS-GRAV
13	SCS Runoff	PR-OFFSITE-BYPASS-MEAD
14	Combine	PR-BASIN-TOTAL
15	Reservoir	PR-TRENCH
16	Reservoir	PR-BASIN
17	Combine	PR-TOTAL

Hydrograph Return Period Recap

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

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	------	0.074	0.202	-------	0.554	0.958	1.685	2.392	3.253	EX-SITE-BASIN-MEAD
2	SCS Runoff	------	0.155	0.190	-------	0.248	0.299	0.375	0.442	0.518	EX-SITE-BASIN-IMP 80%
3	SCS Runoff	------	0.103	0.333	-------	0.913	1.530	2.589	3.603	4.822	EX-SITE-BYPASS-MEAD
4	SCS Runoff	------	0.014	0.017	-------	0.022	0.027	0.033	0.039	0.046	EX-SITE-BYPASS-IMP 80%
5	SCS Runoff	------	0.022	0.070	-------	0.196	0.333	0.571	0.799	1.076	EX-SITE-TRENCH
6	SCS Runoff	------	0.088	0.280	-------	0.795	1.364	2.359	3.317	4.479	EX-OFFSITE-BYPASS
7	Combine	1, 2, 3, 4, 5, 6	0.341	0.808	-------	2.084	3.512	6.045	8.514	11.51	EX-TOTAL
8	SCS Runoff	------	0.089	0.277	-------	0.717	1.179	1.968	2.720	3.622	PR-SITE-BASIN-MEAD
9	SCS Runoff	------	4.030	4.913	-------	6.424	7.726	9.699	11.42	13.38	PR-SITE-BASIN-GRAV
10	SCS Runoff	------	0.863	1.053	-------	1.377	1.656	2.078	2.448	2.867	PR-SITE-TRENCH-GRAV/IMP
11	SCS Runoff	------	0.078	0.251	-------	0.707	1.201	2.058	2.880	3.880	PR-SITE-BYPASS-MEAD
12	SCS Runoff	------	0.110	0.134	-------	0.176	0.212	0.266	0.313	0.367	PR-SITE-BYPASS-GRAV
13	SCS Runoff	------	0.088	0.280	-------	0.795	1.364	2.359	3.317	4.479	PR-OFFSITE-BYPASS-MEAD
14	Combine	8, 9,	4.078	5.144	-------	7.100	8.860	11.62	14.10	16.96	PR-BASIN-TOTAL
15	Reservoir	10	0.000	0.000	-------	0.000	0.014	0.074	0.288	1.898	PR-TRENCH
16	Reservoir	14	0.000	0.000	-------	0.000	0.000	0.127	0.365	1.044	PR-BASIN
17	Combine	11, 12, 13, 15, 16	0.247	0.632	-------	1.629	2.703	4.582	6.386	10.05	PR-TOTAL

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

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	0.074	1	766	1,059	------	------	------	EX-SITE-BASIN-MEAD
2	SCS Runoff	0.155	1	745	989	------	------	------	EX-SITE-BASIN-IMP 80%
3	SCS Runoff	0.103	1	724	629	------	------	------	EX-SITE-BYPASS-MEAD
4	SCS Runoff	0.014	1	720	38	------	------	------	EX-SITE-BYPASS-IMP 80%
5	SCS Runoff	0.022	1	728	166	------	------	------	EX-SITE-TRENCH
6	SCS Runoff	0.088	1	732	802	------	------	------	EX-OFFSITE-BYPASS
7	Combine	0.341	1	743	3,683	1, 2, 3, 4, 5, 6	------	------	EX-TOTAL
8	SCS Runoff	0.089	1	721	391	------	------	------	PR-SITE-BASIN-MEAD
9	SCS Runoff	4.030	1	717	9,462	------	------	------	PR-SITE-BASIN-GRAV
10	SCS Runoff	0.863	1	717	2,027	------	------	------	PR-SITE-TRENCH-GRAV/IMP
11	SCS Runoff	0.078	1	728	600	------	------	------	PR-SITE-BYPASS-MEAD
12	SCS Runoff	0.110	1	722	351	------	------	------	PR-SITE-BYPASS-GRAV
13	SCS Runoff	0.088	1	732	802	------	------	------	PR-OFFSITE-BYPASS-MEAD
14	Combine	4.078	1	717	9,853	8, 9,	------	------	PR-BASIN-TOTAL
15	Reservoir	0.000	1	n/a	0	10	401.78	2,027	PR-TRENCH
16	Reservoir	0.000	1	n/a	0	14	398.35	9,853	PR-BASIN
17	Combine	0.247	1	727	1,752	11, 12, 13, 15, 16	------	------	PR-TOTAL

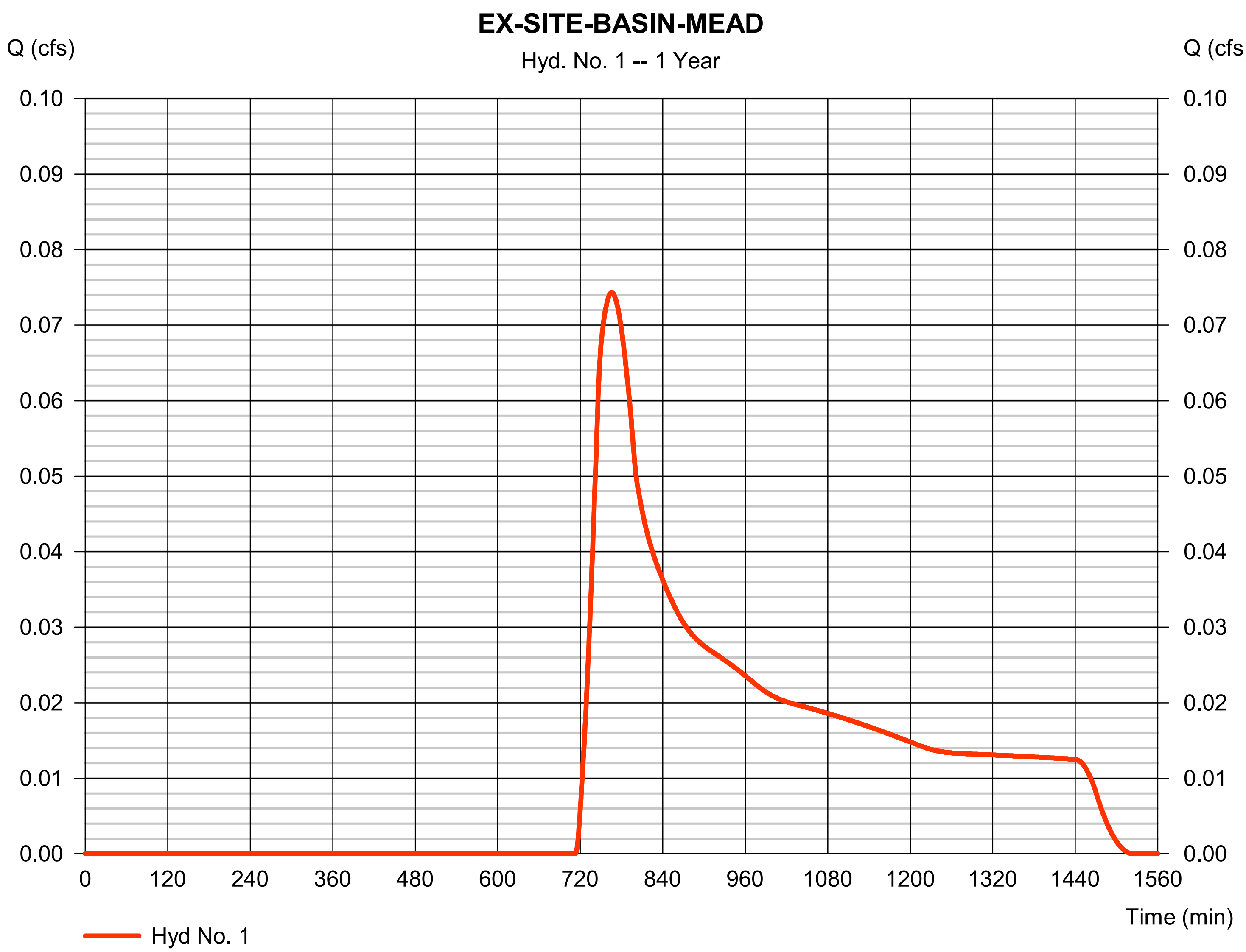
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 1

EX-SITE-BASIN-MEAD

Hydrograph type	= SCS Runoff	Peak discharge	= 0.074 cfs
Storm frequency	= 1 yrs	Time to peak	= 766 min
Time interval	= 1 min	Hyd. volume	= 1,059 cuft
Drainage area	= 1.359 ac	Curve number	= 58
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 53.40 min
Total precip.	= 2.81 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

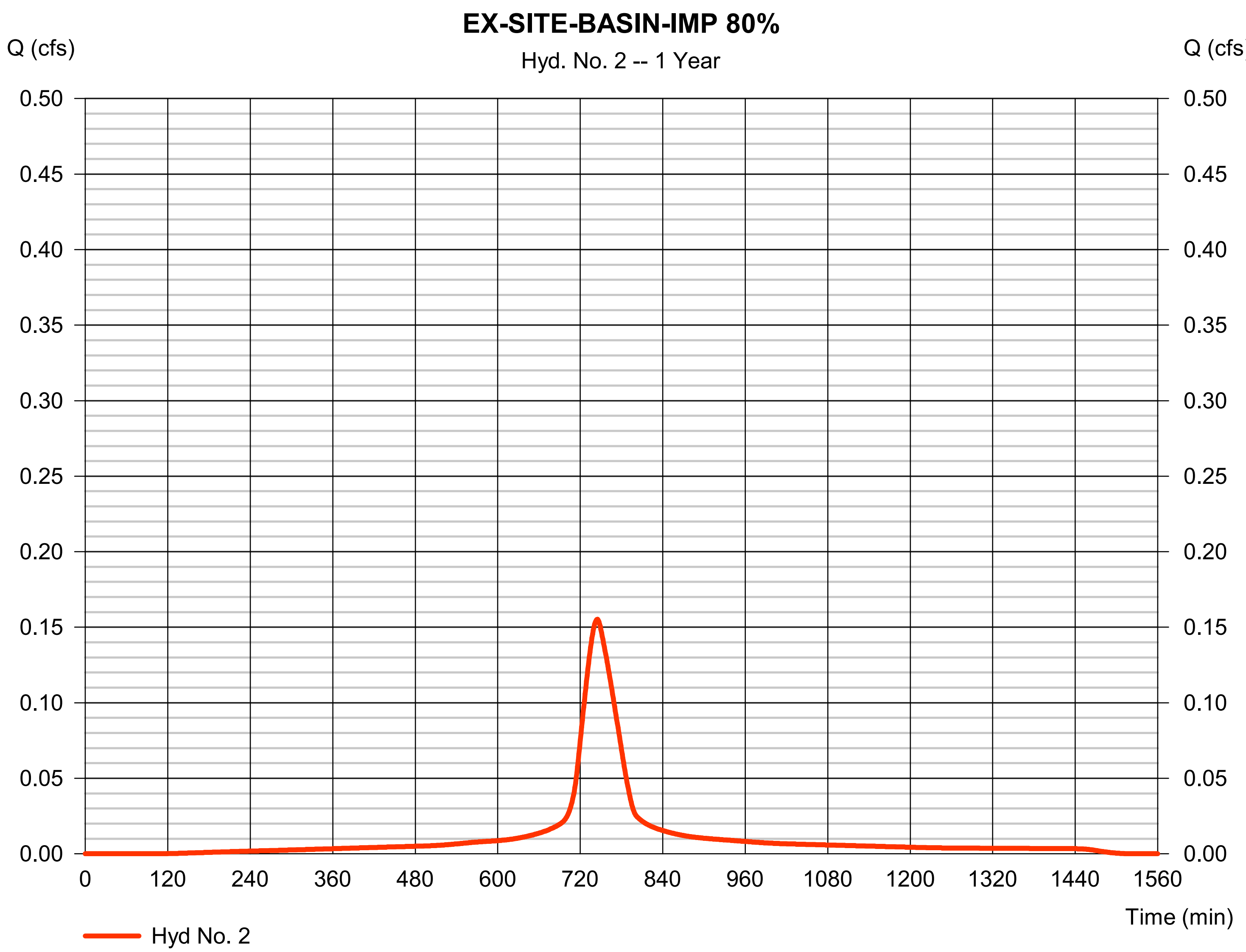


Hydrograph Report

Hyd. No. 2

EX-SITE-BASIN-IMP 80%

Hydrograph type	= SCS Runoff	Peak discharge	= 0.155 cfs
Storm frequency	= 1 yrs	Time to peak	= 745 min
Time interval	= 1 min	Hyd. volume	= 989 cuft
Drainage area	= 0.106 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 53.40 min
Total precip.	= 2.81 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



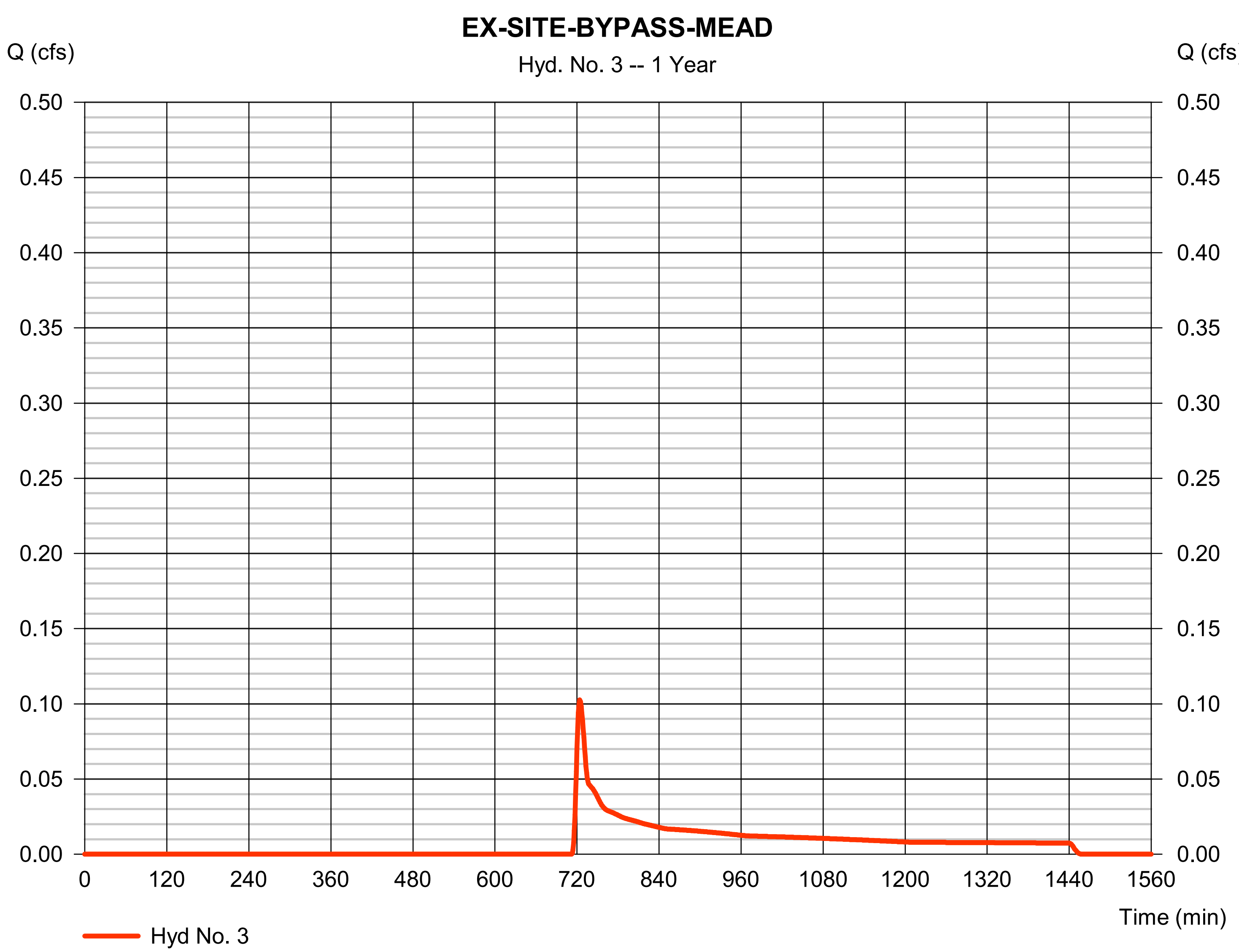
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 3

EX-SITE-BYPASS-MEAD

Hydrograph type	= SCS Runoff	Peak discharge	= 0.103 cfs
Storm frequency	= 1 yrs	Time to peak	= 724 min
Time interval	= 1 min	Hyd. volume	= 629 cuft
Drainage area	= 0.790 ac	Curve number	= 58
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 11.70 min
Total precip.	= 2.81 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

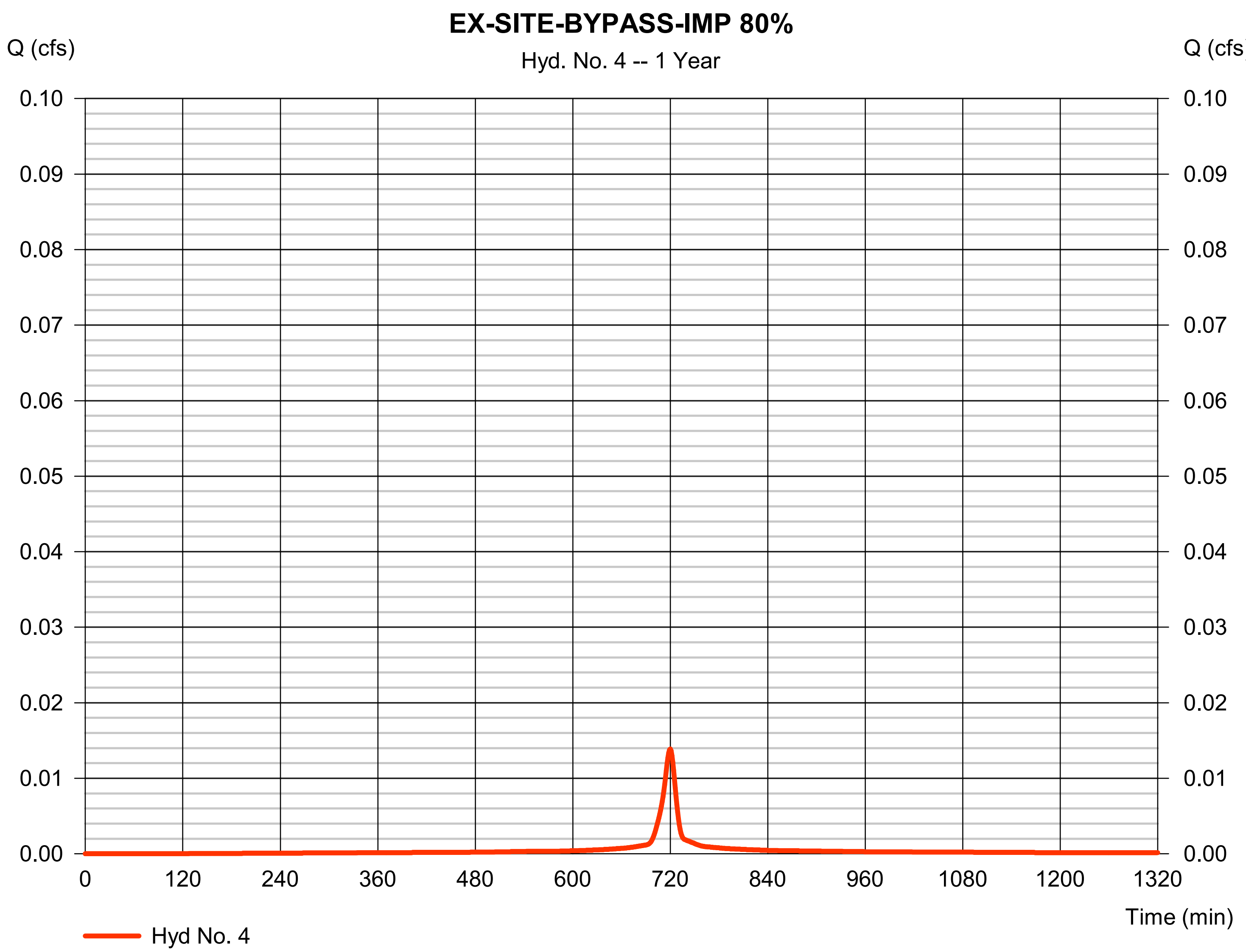


Hydrograph Report

Hyd. No. 4

EX-SITE-BYPASS-IMP 80%

Hydrograph type	= SCS Runoff	Peak discharge	= 0.014 cfs
Storm frequency	= 1 yrs	Time to peak	= 720 min
Time interval	= 1 min	Hyd. volume	= 38 cuft
Drainage area	= 0.004 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 11.70 min
Total precip.	= 2.81 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



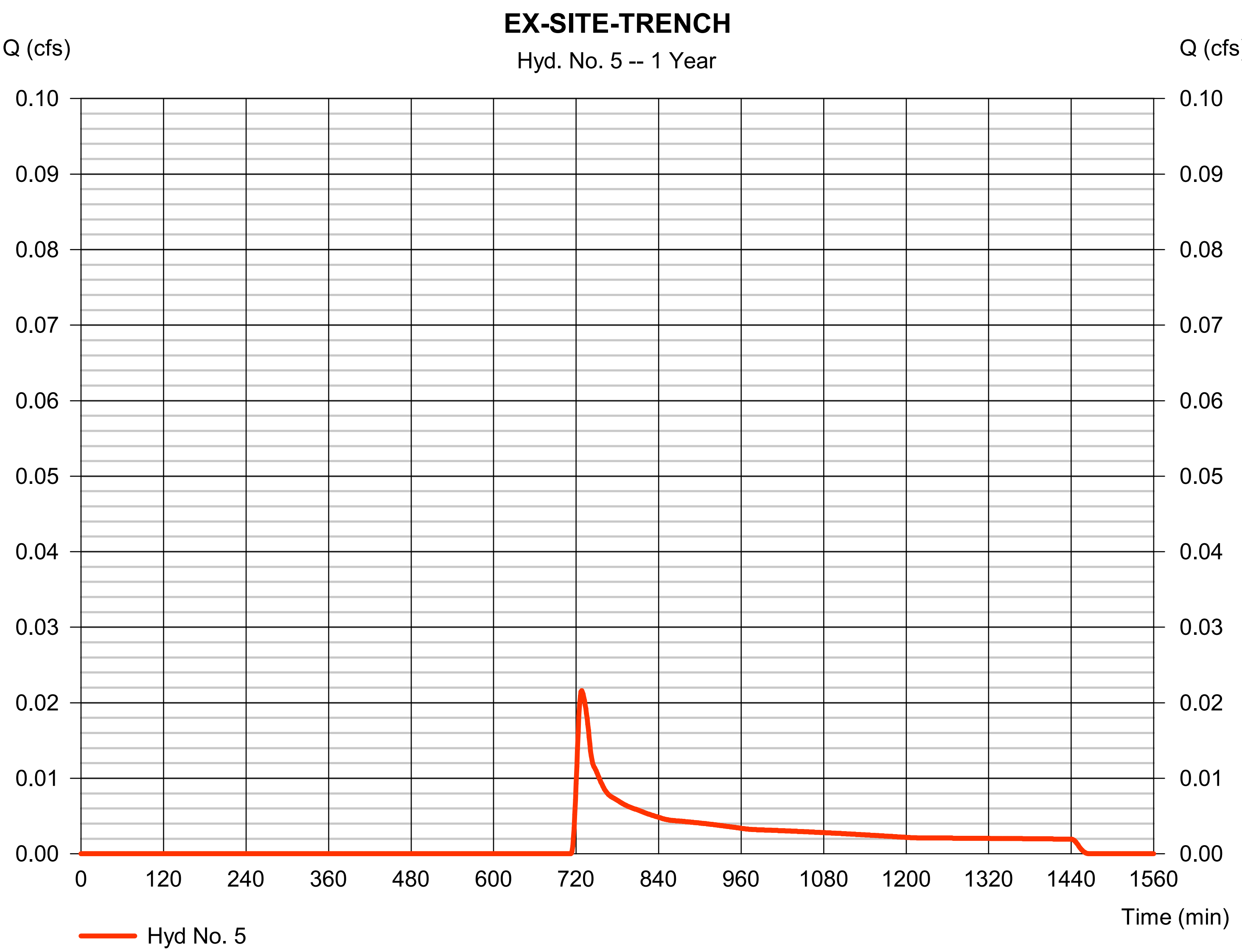
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 — Thursday, 02 / 20 / 2020

Hyd. No. 5

EX-SITE-TRENCH

Hydrograph type	= SCS Runoff	Peak discharge	= 0.022 cfs
Storm frequency	= 1 yrs	Time to peak	= 728 min
Time interval	= 1 min	Hyd. volume	= 166 cuft
Drainage area	= 0.210 ac	Curve number	= 58
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 15.90 min
Total precip.	= 2.81 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



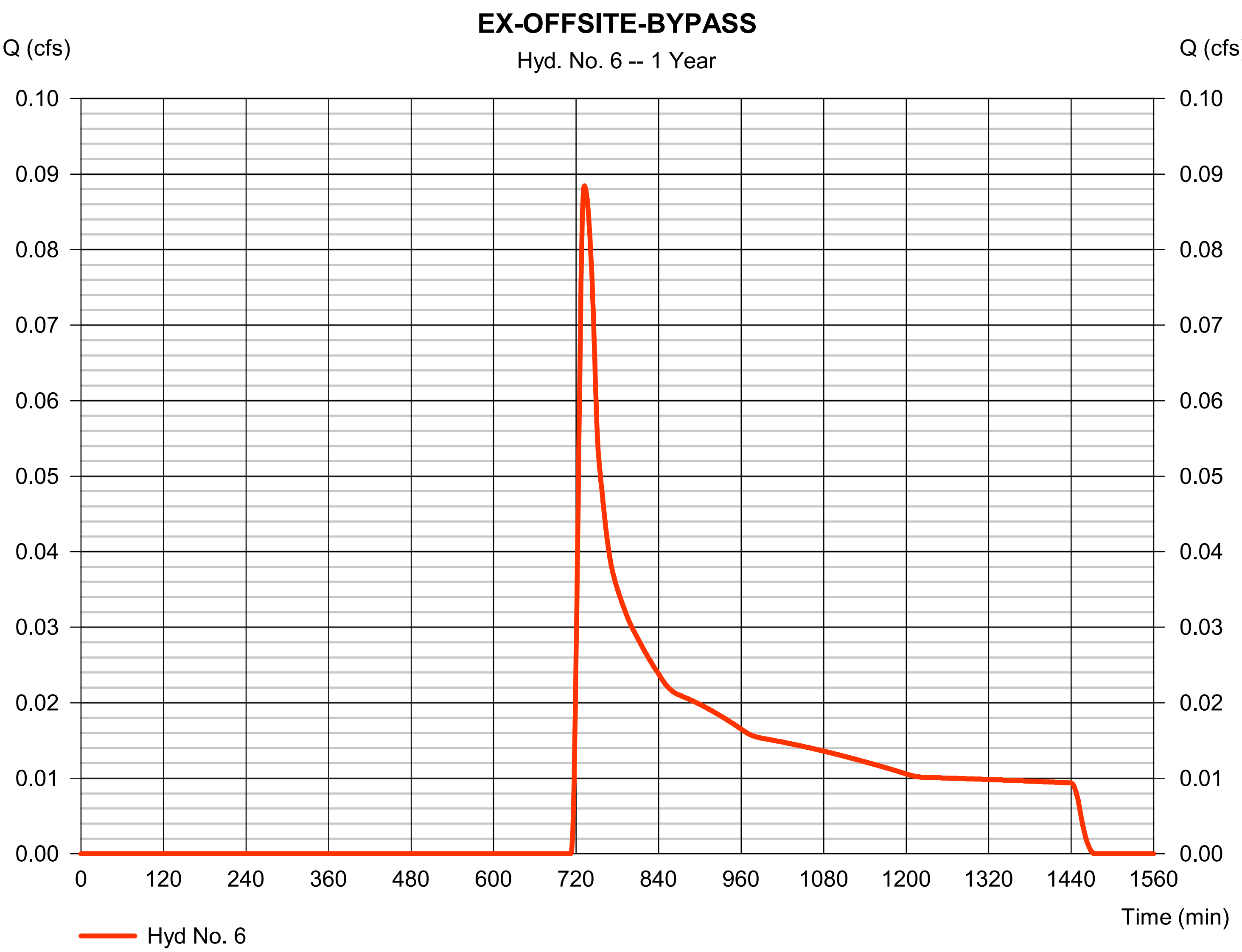
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 6

EX-OFFSITE-BYPASS

Hydrograph type	= SCS Runoff	Peak discharge	= 0.088 cfs
Storm frequency	= 1 yrs	Time to peak	= 732 min
Time interval	= 1 min	Hyd. volume	= 802 cuft
Drainage area	= 1.015 ac	Curve number	= 58
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 20.90 min
Total precip.	= 2.81 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



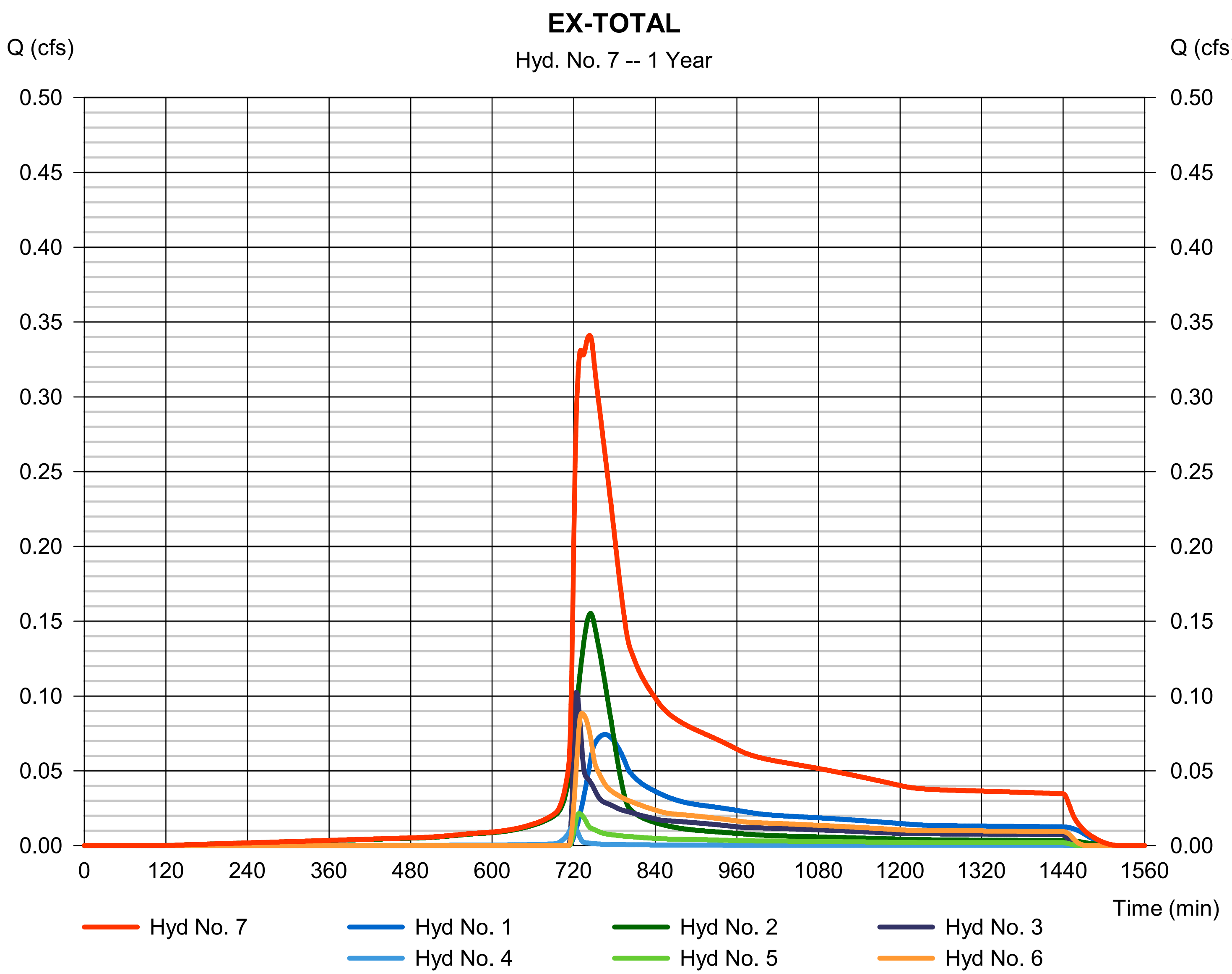
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 7

EX-TOTAL

Hydrograph type	= Combine	Peak discharge	= 0.341 cfs
Storm frequency	= 1 yrs	Time to peak	= 743 min
Time interval	= 1 min	Hyd. volume	= 3,683 cuft
Inflow hyds.	= 1, 2, 3, 4, 5, 6	Contrib. drain. area	= 3.484 ac



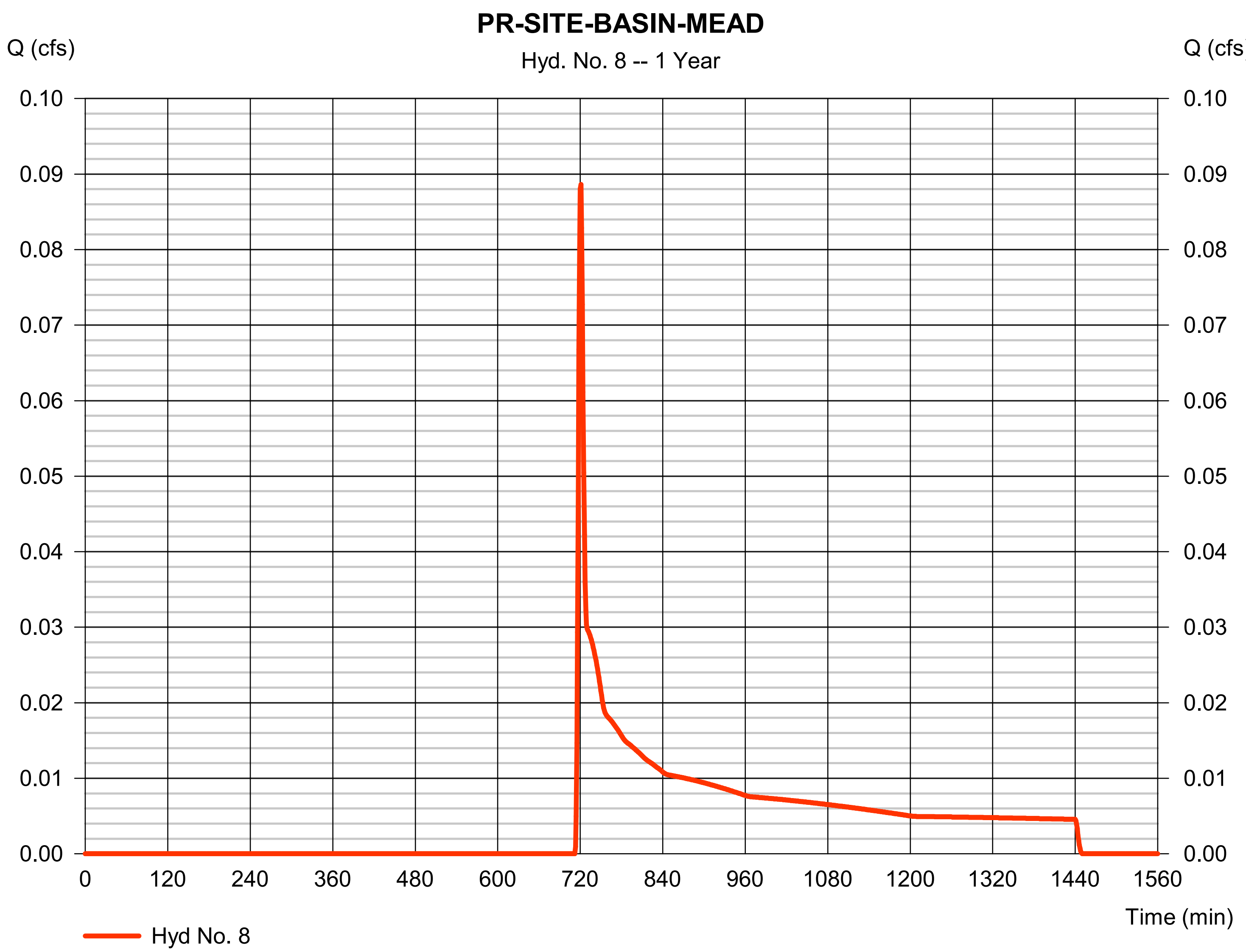
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 8

PR-SITE-BASIN-MEAD

Hydrograph type	= SCS Runoff	Peak discharge	= 0.089 cfs
Storm frequency	= 1 yrs	Time to peak	= 721 min
Time interval	= 1 min	Hyd. volume	= 391 cuft
Drainage area	= 0.485 ac	Curve number	= 58
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 2.81 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



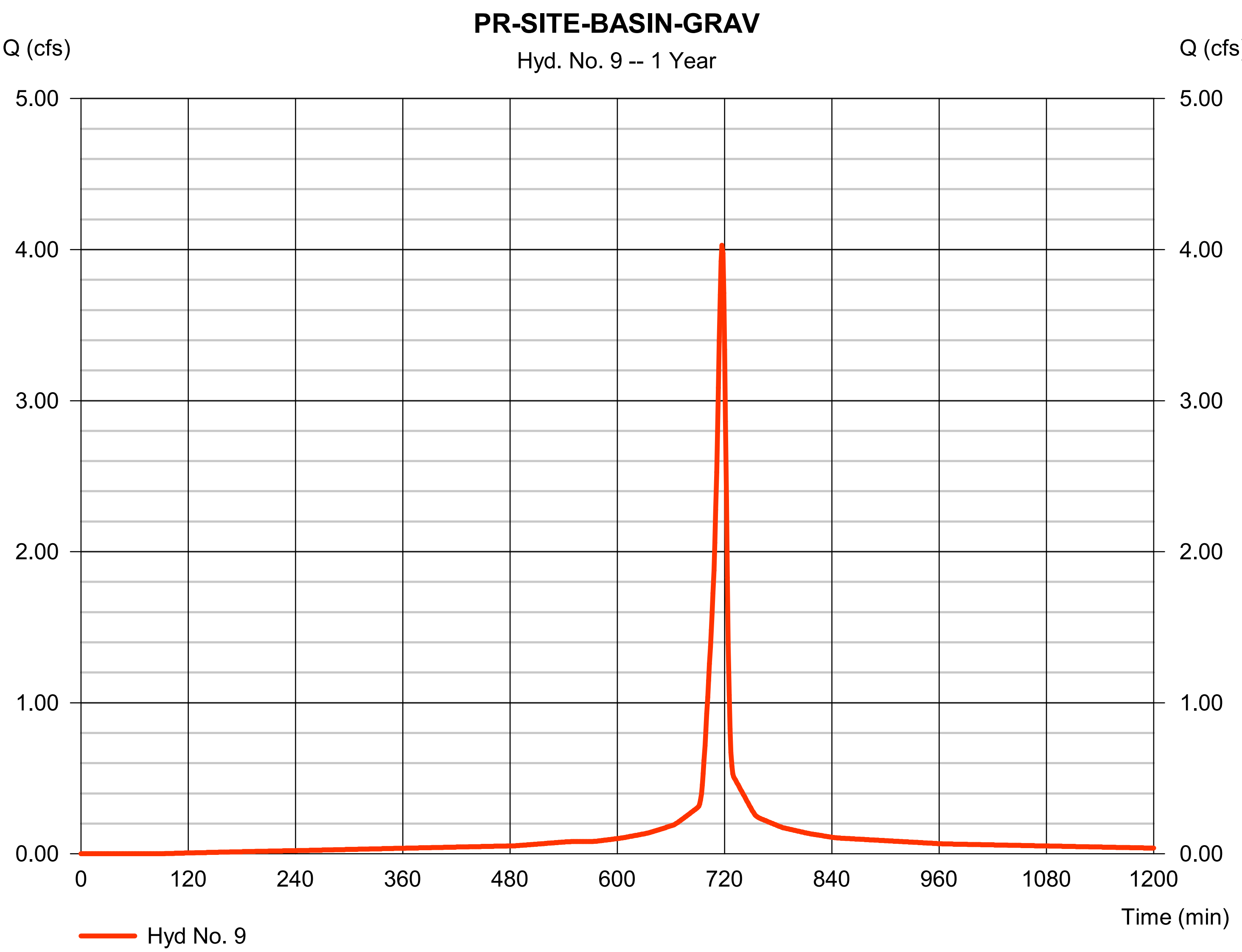
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 9

PR-SITE-BASIN-GRAV

Hydrograph type	= SCS Runoff	Peak discharge	= 4.030 cfs
Storm frequency	= 1 yrs	Time to peak	= 717 min
Time interval	= 1 min	Hyd. volume	= 9,462 cuft
Drainage area	= 0.980 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 2.81 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

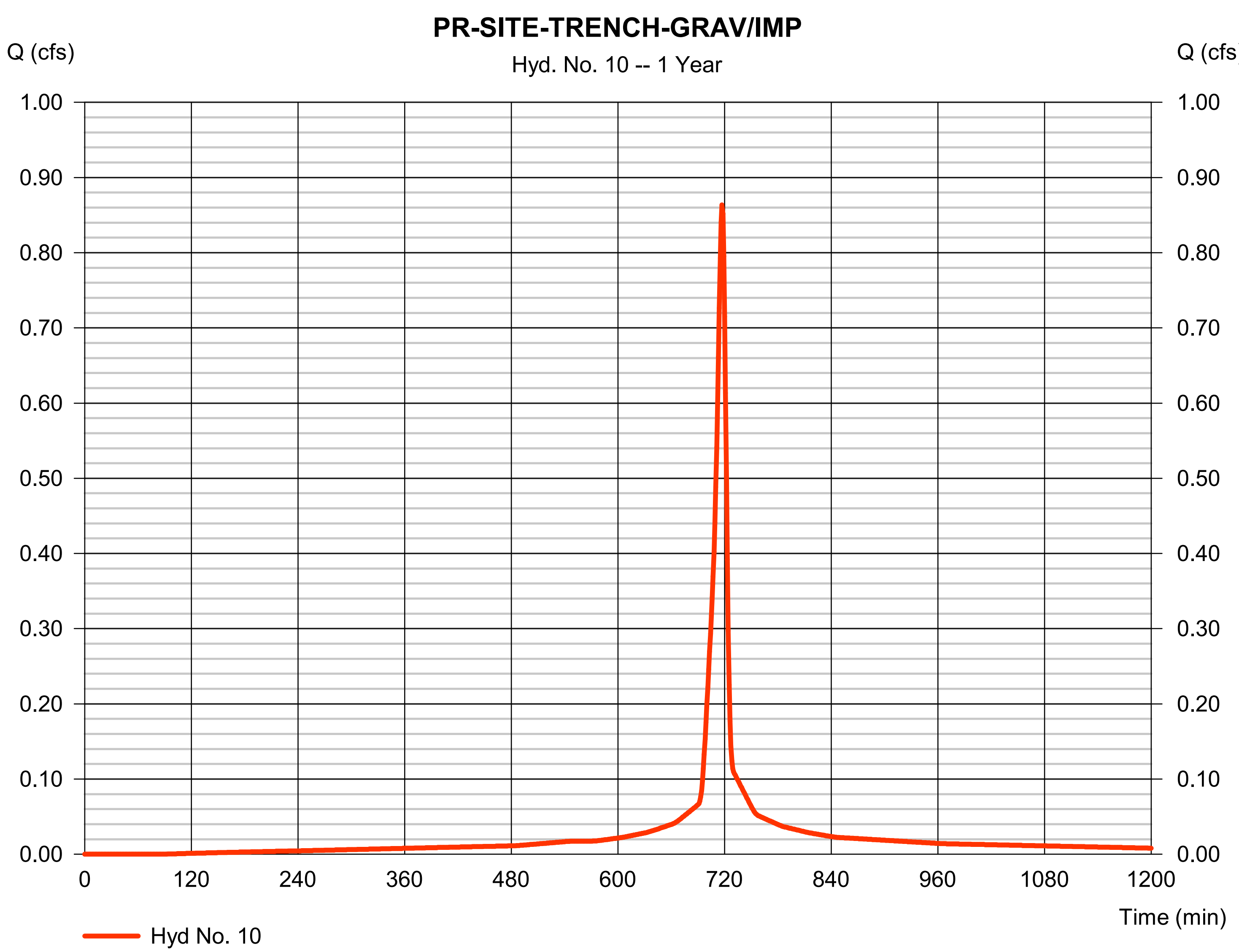


Hydrograph Report

Hyd. No. 10

PR-SITE-TRENCH-GRAV/IMP

Hydrograph type	= SCS Runoff	Peak discharge	= 0.863 cfs
Storm frequency	= 1 yrs	Time to peak	= 717 min
Time interval	= 1 min	Hyd. volume	= 2,027 cuft
Drainage area	= 0.210 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 2.81 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



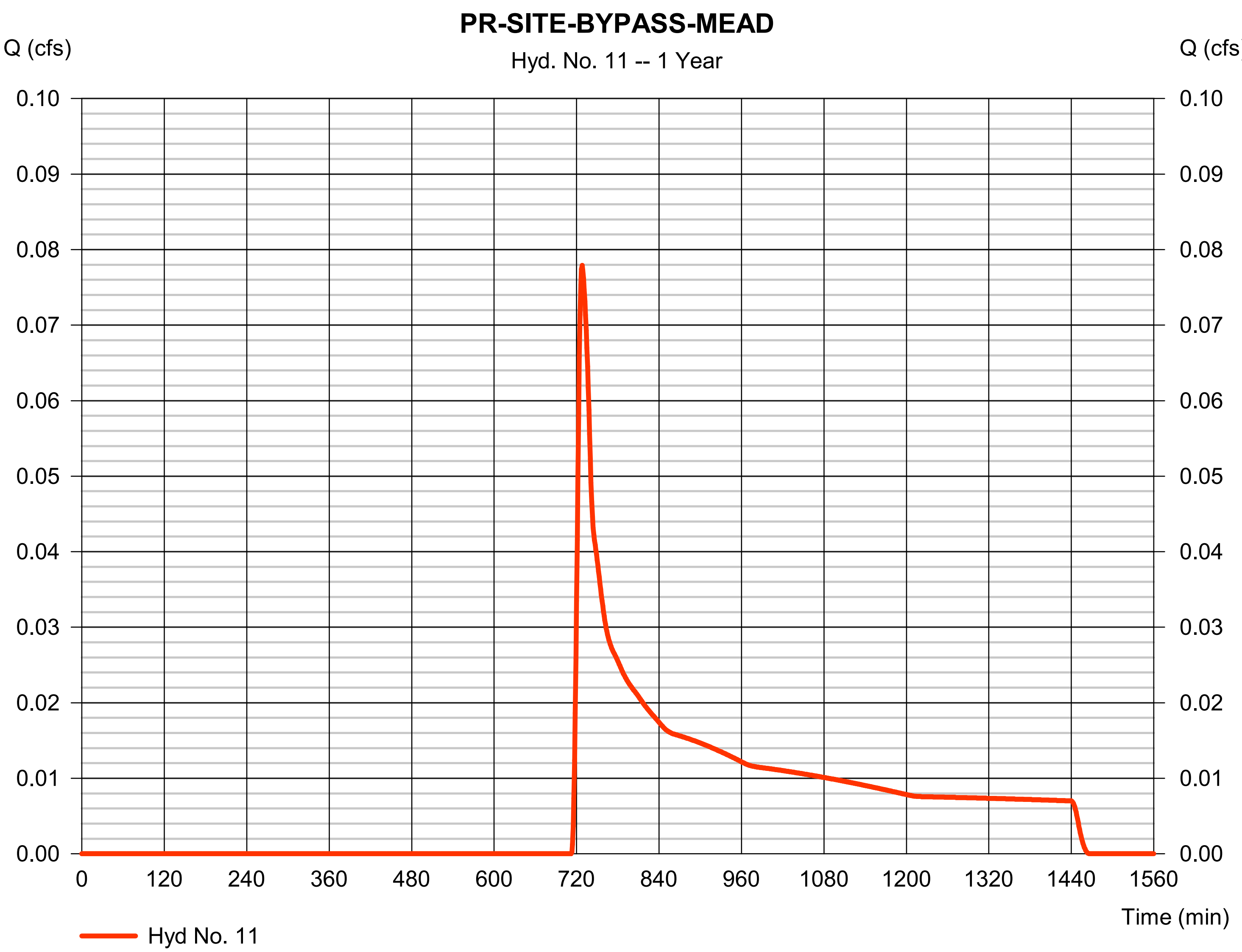
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 — Thursday, 02 / 20 / 2020

Hyd. No. 11

PR-SITE-BYPASS-MEAD

Hydrograph type	= SCS Runoff	Peak discharge	= 0.078 cfs
Storm frequency	= 1 yrs	Time to peak	= 728 min
Time interval	= 1 min	Hyd. volume	= 600 cuft
Drainage area	= 0.757 ac	Curve number	= 58
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 16.10 min
Total precip.	= 2.81 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



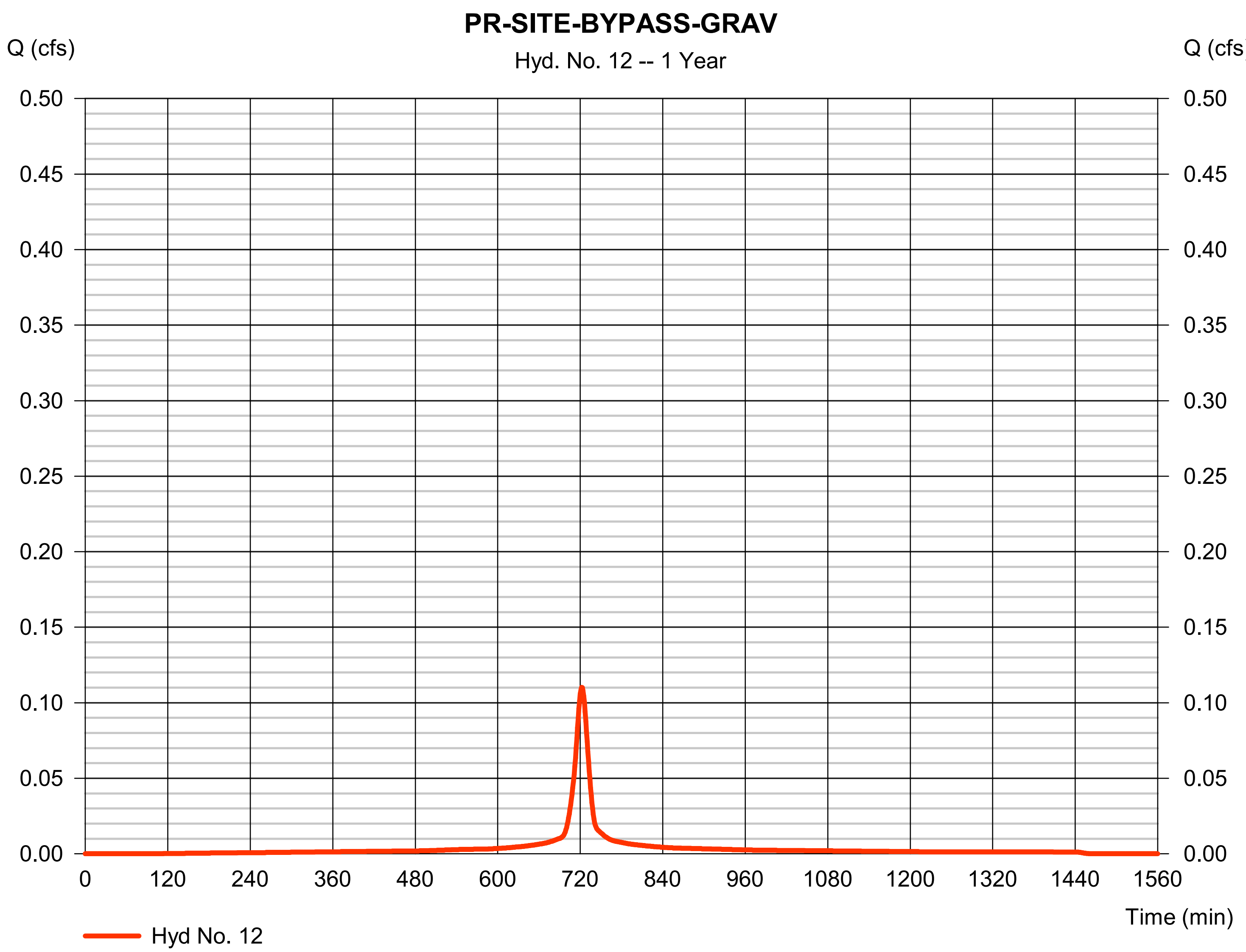
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 12

PR-SITE-BYPASS-GRAV

Hydrograph type	= SCS Runoff	Peak discharge	= 0.110 cfs
Storm frequency	= 1 yrs	Time to peak	= 722 min
Time interval	= 1 min	Hyd. volume	= 351 cuft
Drainage area	= 0.037 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 16.10 min
Total precip.	= 2.81 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 13

PR-OFFSITE-BYPASS-MEAD

Hydrograph type	= SCS Runoff	Peak discharge	= 0.088 cfs
Storm frequency	= 1 yrs	Time to peak	= 732 min
Time interval	= 1 min	Hyd. volume	= 802 cuft
Drainage area	= 1.015 ac	Curve number	= 58
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 20.90 min
Total precip.	= 2.81 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

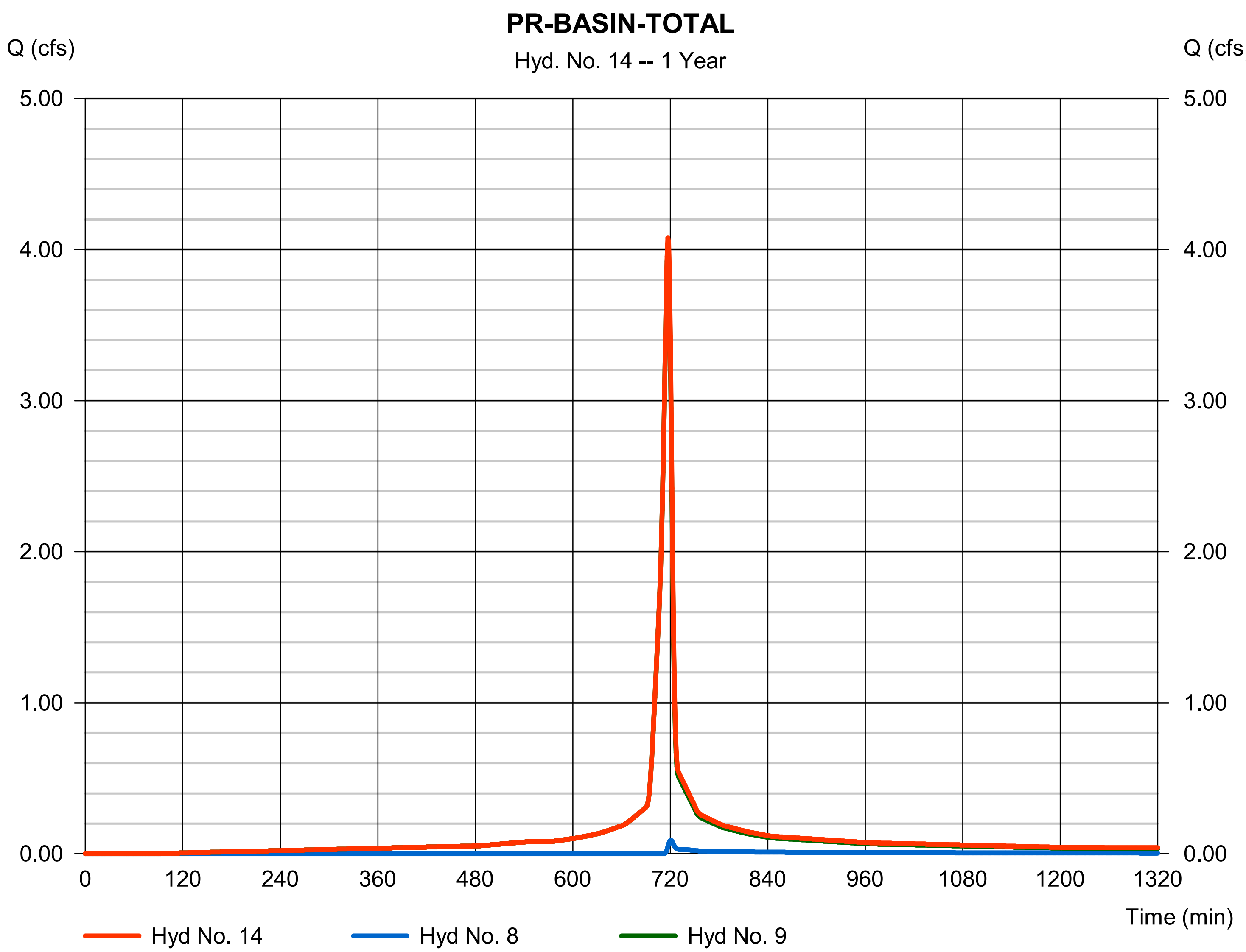
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 14

PR-BASIN-TOTAL

Hydrograph type	= Combine	Peak discharge	= 4.078 cfs
Storm frequency	= 1 yrs	Time to peak	= 717 min
Time interval	= 1 min	Hyd. volume	= 9,853 cuft
Inflow hyds.	= 8, 9	Contrib. drain. area	= 1.465 ac



Hydrograph Report

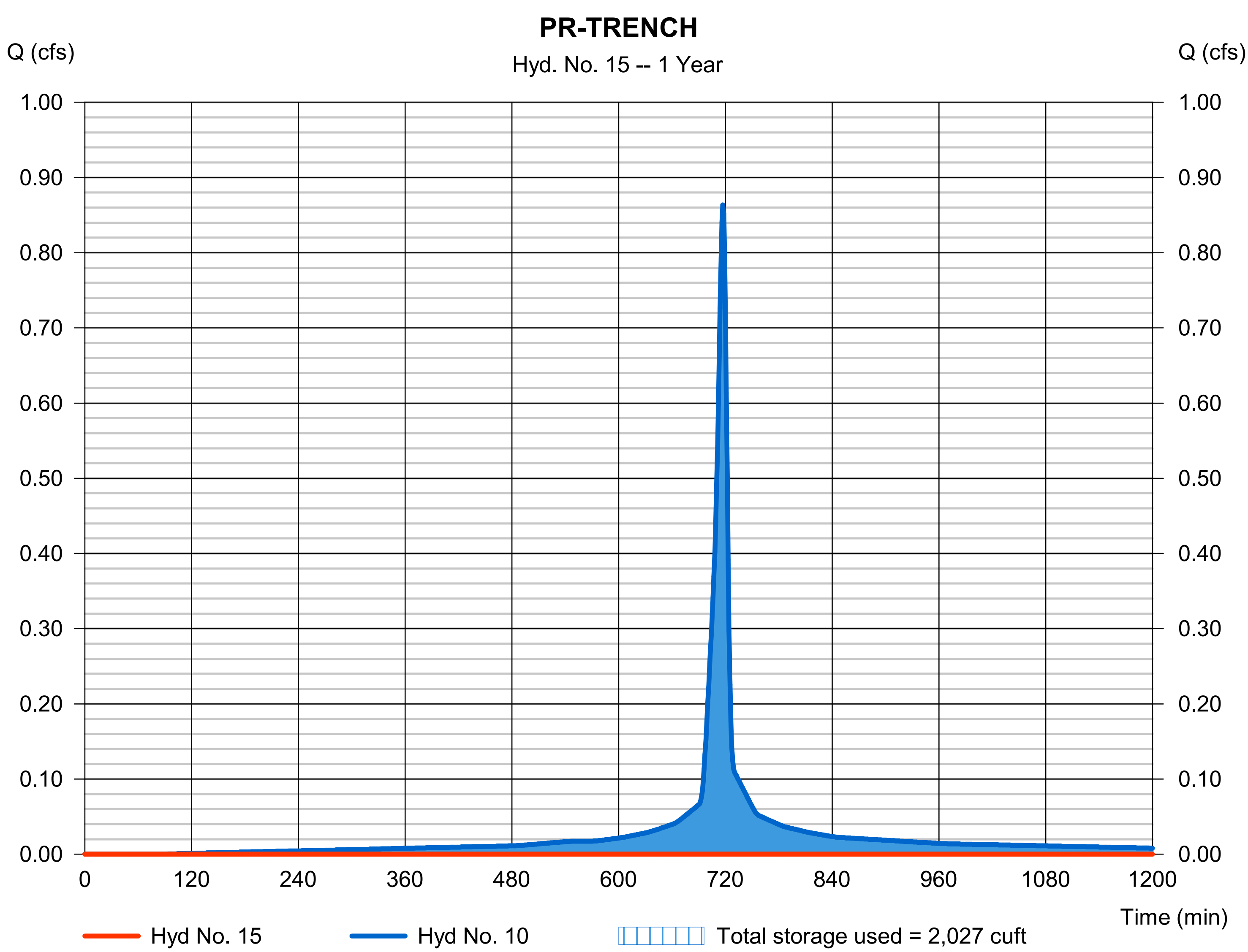
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 15

PR-TRENCH

Hydrograph type	= Reservoir	Peak discharge	= 0.000 cfs
Storm frequency	= 1 yrs	Time to peak	= n/a
Time interval	= 1 min	Hyd. volume	= 0 cuft
Inflow hyd. No.	= 10 - PR-SITE-TRENCH-GRAVMAP	Max. Elevation	= 401.78 ft
Reservoir name	= TRENCH	Max. Storage	= 2,027 cuft

Storage Indication method used.



Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 — Thursday, 02 / 20 / 2020

Pond No. 2 - TRENCH

Pond Data

Trapezoid - Bottom L x W = 38.0 x 172.0 ft, Side slope = 0.00:1, Bottom elev. = 401.00 ft, Depth = 2.00 ft, Voids = 40.00%

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	401.00	6,536	0	0
0.20	401.20	6,536	523	523
0.40	401.40	6,536	523	1,046
0.60	401.60	6,536	523	1,569
0.80	401.80	6,536	523	2,092
1.00	402.00	6,536	523	2,614
1.20	402.20	6,536	523	3,137
1.40	402.40	6,536	523	3,660
1.60	402.60	6,536	523	4,183
1.80	402.80	6,536	523	4,706
2.00	403.00	6,536	523	5,229

Culvert / Orifice Structures

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

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 38.00	0.00	0.00	0.00
Crest El. (ft)	= 402.50	0.00	0.00	0.00
Weir Coeff.	= 2.60	3.33	3.33	3.33
Weir Type	= Broad	---	---	---
Multi-Stage	= No	No	No	No

Exfil.(in/hr) = 0.000 (by 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	401.00	---	---	---	---	0.00	---	---	---	---	---	0.000
0.20	523	401.20	---	---	---	---	0.00	---	---	---	---	---	0.000
0.40	1,046	401.40	---	---	---	---	0.00	---	---	---	---	---	0.000
0.60	1,569	401.60	---	---	---	---	0.00	---	---	---	---	---	0.000
0.80	2,092	401.80	---	---	---	---	0.00	---	---	---	---	---	0.000
1.00	2,614	402.00	---	---	---	---	0.00	---	---	---	---	---	0.000
1.20	3,137	402.20	---	---	---	---	0.00	---	---	---	---	---	0.000
1.40	3,660	402.40	---	---	---	---	0.00	---	---	---	---	---	0.000
1.60	4,183	402.60	---	---	---	---	3.12	---	---	---	---	---	3.125
1.80	4,706	402.80	---	---	---	---	16.23	---	---	---	---	---	16.23
2.00	5,229	403.00	---	---	---	---	34.93	---	---	---	---	---	34.93

Hydrograph Report

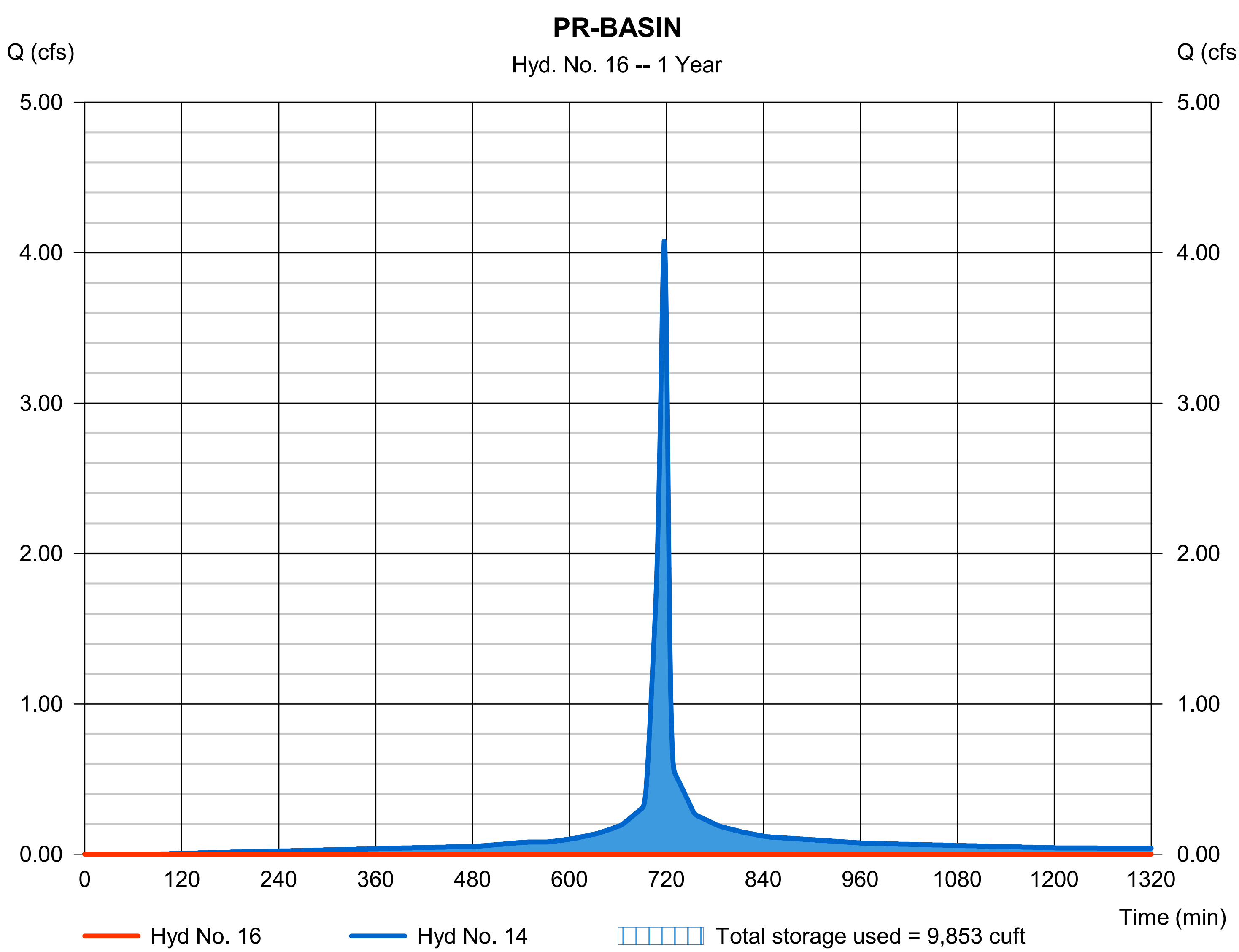
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 16

PR-BASIN

Hydrograph type	= Reservoir	Peak discharge	= 0.000 cfs
Storm frequency	= 1 yrs	Time to peak	= n/a
Time interval	= 1 min	Hyd. volume	= 0 cuft
Inflow hyd. No.	= 14 - PR-BASIN-TOTAL	Max. Elevation	= 398.35 ft
Reservoir name	= BASIN	Max. Storage	= 9,853 cuft

Storage Indication method used.



Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Pond No. 1 - BASIN

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 397.25 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	397.25	8,432	0	0
1.00	398.25	9,370	8,896	8,896
2.00	399.25	10,769	10,060	18,956
2.50	399.75	11,800	5,640	24,596
2.75	400.00	12,275	3,009	27,605

Culvert / Orifice Structures

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

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 5.00	0.00	0.00	0.00
Crest El. (ft)	= 399.75	0.00	0.00	0.00
Weir Coeff.	= 2.60	3.33	3.33	3.33
Weir Type	= Broad	---	---	---
Multi-Stage	= No	No	No	No

Exfil.(in/hr) = 0.000 (by 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	397.25	---	---	---	---	0.00	---	---	---	---	---	0.000
1.00	8,896	398.25	---	---	---	---	0.00	---	---	---	---	---	0.000
2.00	18,956	399.25	---	---	---	---	0.00	---	---	---	---	---	0.000
2.50	24,596	399.75	---	---	---	---	0.00	---	---	---	---	---	0.000
2.75	27,605	400.00	---	---	---	---	1.63	---	---	---	---	---	1.625

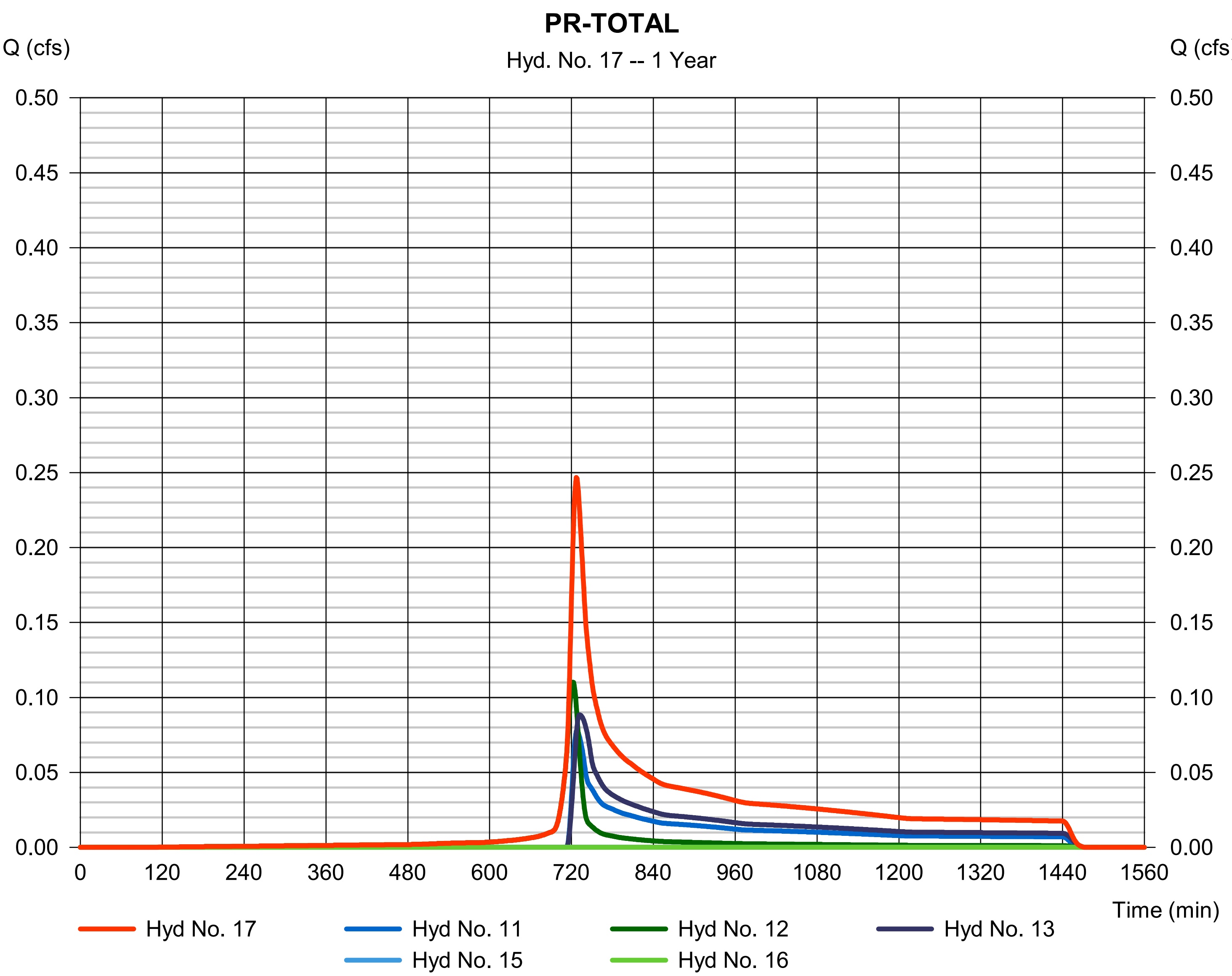
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 17

PR-TOTAL

Hydrograph type	= Combine	Peak discharge	= 0.247 cfs
Storm frequency	= 1 yrs	Time to peak	= 727 min
Time interval	= 1 min	Hyd. volume	= 1,752 cuft
Inflow hyds.	= 11, 12, 13, 15, 16	Contrib. drain. area	= 1.809 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

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	0.202	1	754	2,055	------	------	------	EX-SITE-BASIN-MEAD
2	SCS Runoff	0.190	1	745	1,218	------	------	------	EX-SITE-BASIN-IMP 80%
3	SCS Runoff	0.333	1	723	1,220	------	------	------	EX-SITE-BYPASS-MEAD
4	SCS Runoff	0.017	1	720	47	------	------	------	EX-SITE-BYPASS-IMP 80%
5	SCS Runoff	0.070	1	726	323	------	------	------	EX-SITE-TRENCH
6	SCS Runoff	0.280	1	730	1,555	------	------	------	EX-OFFSITE-BYPASS
7	Combine	0.808	1	726	6,417	1, 2, 3, 4, 5, 6	------	------	EX-TOTAL
8	SCS Runoff	0.277	1	719	759	------	------	------	PR-SITE-BASIN-MEAD
9	SCS Runoff	4.913	1	717	11,654	------	------	------	PR-SITE-BASIN-GRAV
10	SCS Runoff	1.053	1	717	2,497	------	------	------	PR-SITE-TRENCH-GRAV/IMP
11	SCS Runoff	0.251	1	726	1,163	------	------	------	PR-SITE-BYPASS-MEAD
12	SCS Runoff	0.134	1	722	432	------	------	------	PR-SITE-BYPASS-GRAV
13	SCS Runoff	0.280	1	730	1,555	------	------	------	PR-OFFSITE-BYPASS-MEAD
14	Combine	5.144	1	717	12,413	8, 9,	------	------	PR-BASIN-TOTAL
15	Reservoir	0.000	1	n/a	0	10	401.96	2,497	PR-TRENCH
16	Reservoir	0.000	1	n/a	0	14	398.60	12,413	PR-BASIN
17	Combine	0.632	1	727	3,151	11, 12, 13, 15, 16	------	------	PR-TOTAL

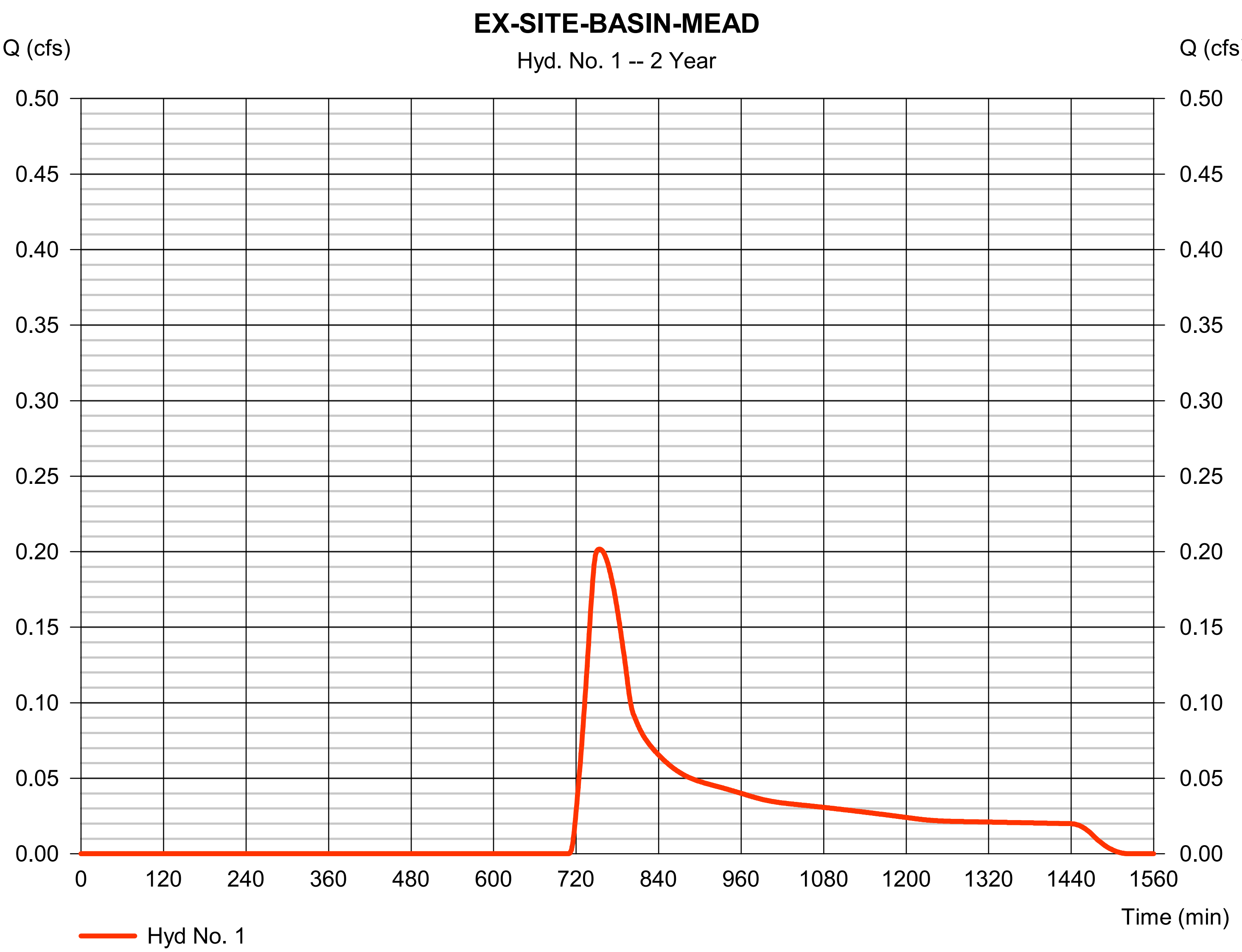
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 — Thursday, 02 / 20 / 2020

Hyd. No. 1

EX-SITE-BASIN-MEAD

Hydrograph type	= SCS Runoff	Peak discharge	= 0.202 cfs
Storm frequency	= 2 yrs	Time to peak	= 754 min
Time interval	= 1 min	Hyd. volume	= 2,055 cuft
Drainage area	= 1.359 ac	Curve number	= 58
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 53.40 min
Total precip.	= 3.41 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



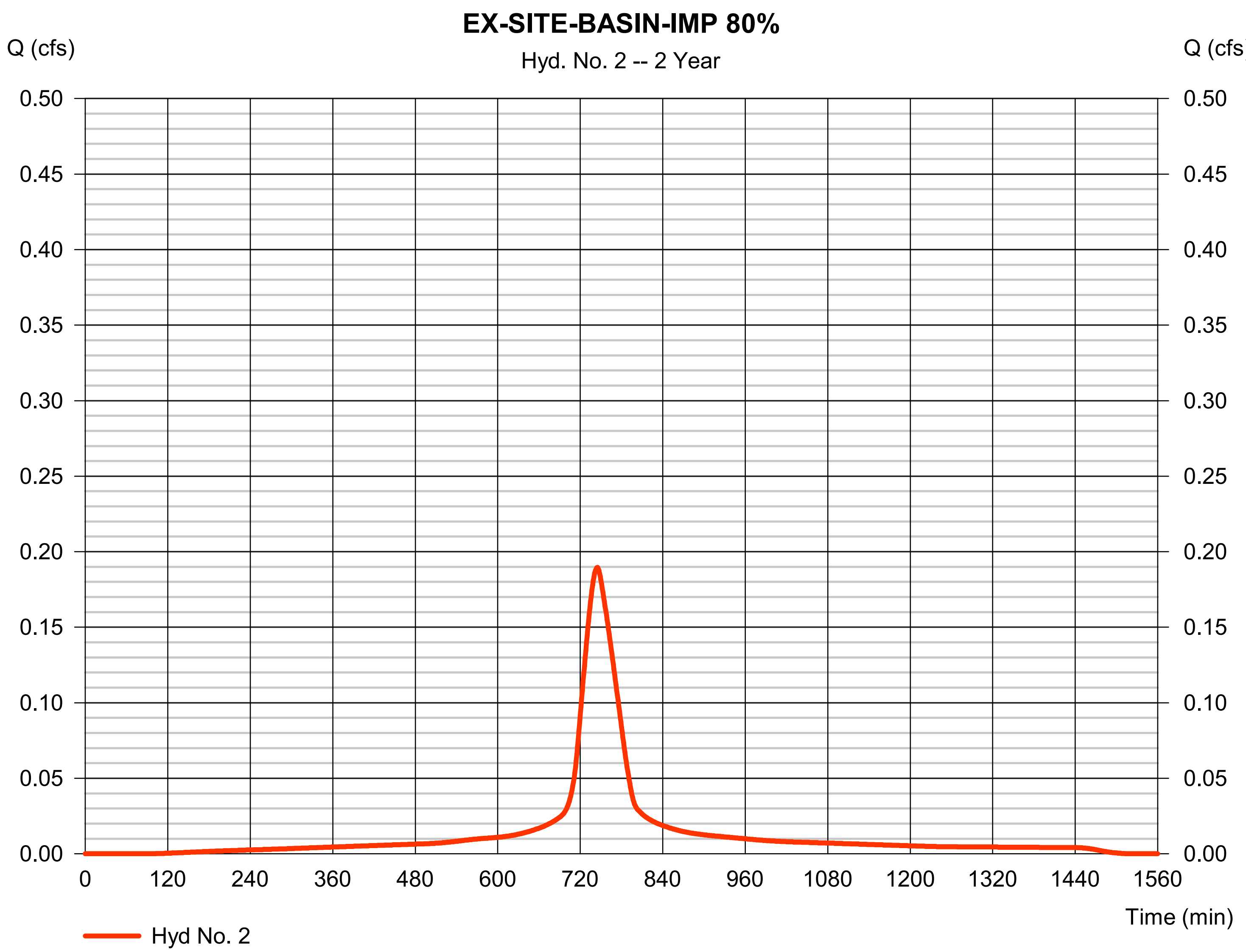
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 2

EX-SITE-BASIN-IMP 80%

Hydrograph type	= SCS Runoff	Peak discharge	= 0.190 cfs
Storm frequency	= 2 yrs	Time to peak	= 745 min
Time interval	= 1 min	Hyd. volume	= 1,218 cuft
Drainage area	= 0.106 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 53.40 min
Total precip.	= 3.41 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



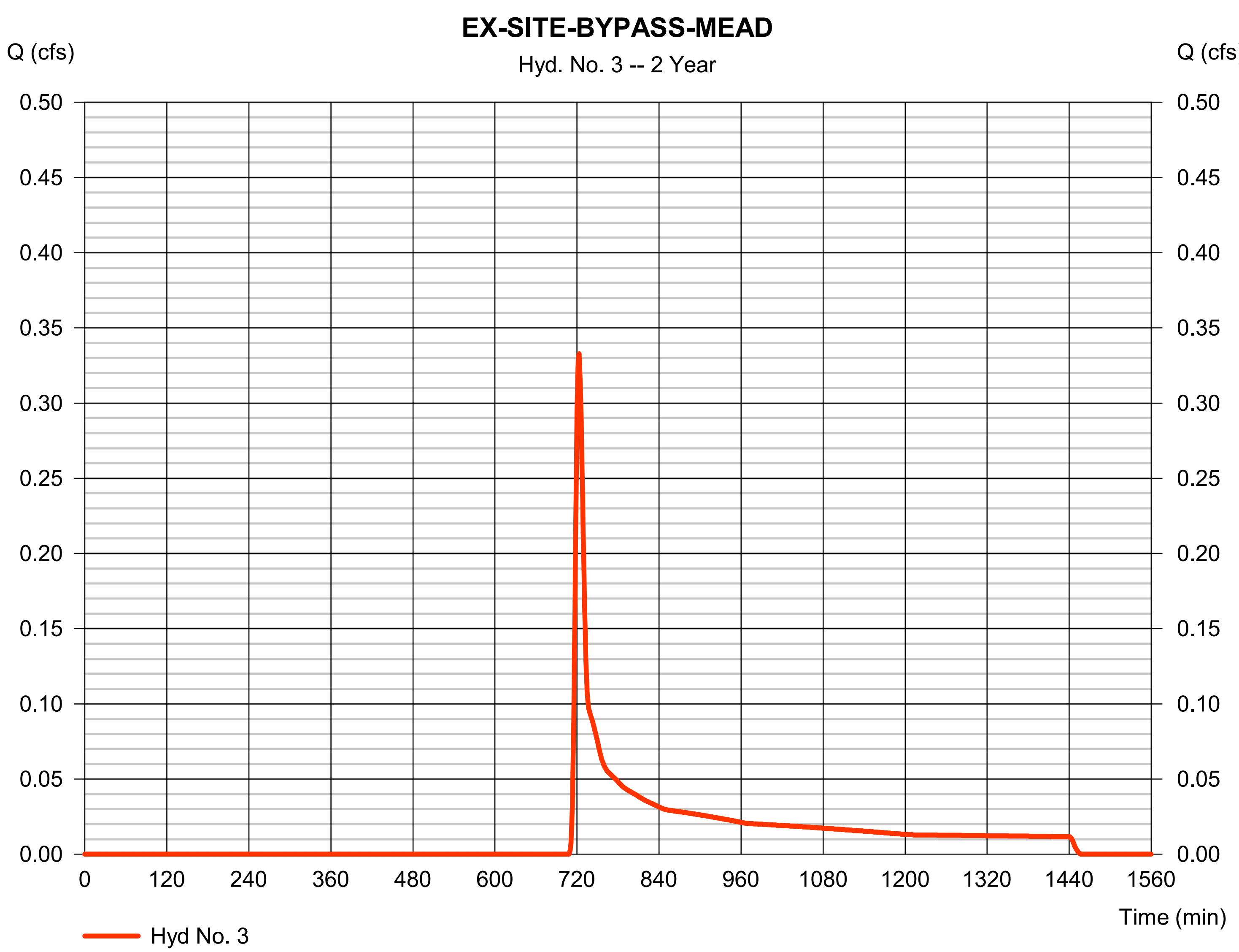
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 3

EX-SITE-BYPASS-MEAD

Hydrograph type	= SCS Runoff	Peak discharge	= 0.333 cfs
Storm frequency	= 2 yrs	Time to peak	= 723 min
Time interval	= 1 min	Hyd. volume	= 1,220 cuft
Drainage area	= 0.790 ac	Curve number	= 58
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 11.70 min
Total precip.	= 3.41 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



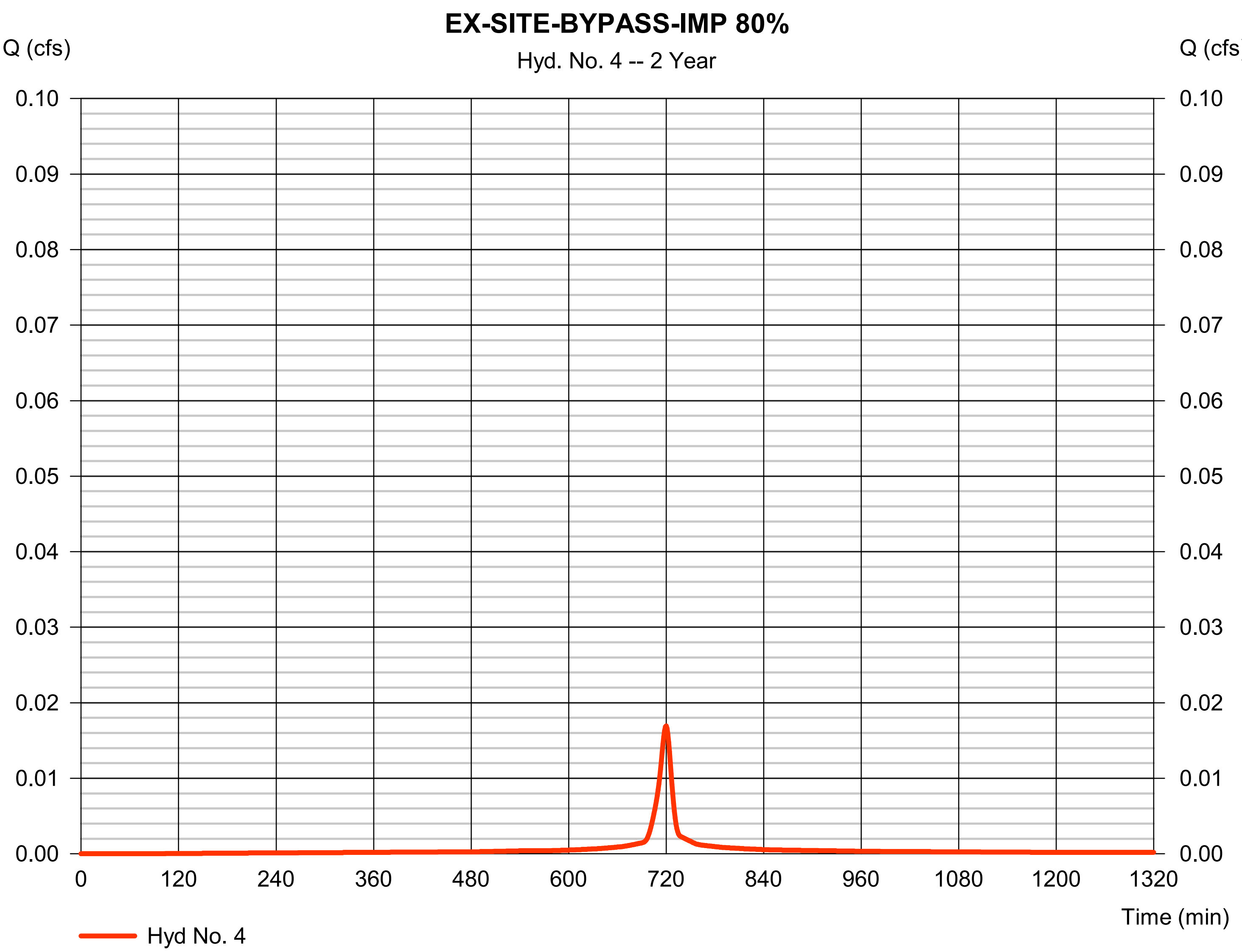
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 4

EX-SITE-BYPASS-IMP 80%

Hydrograph type	= SCS Runoff	Peak discharge	= 0.017 cfs
Storm frequency	= 2 yrs	Time to peak	= 720 min
Time interval	= 1 min	Hyd. volume	= 47 cuft
Drainage area	= 0.004 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 11.70 min
Total precip.	= 3.41 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



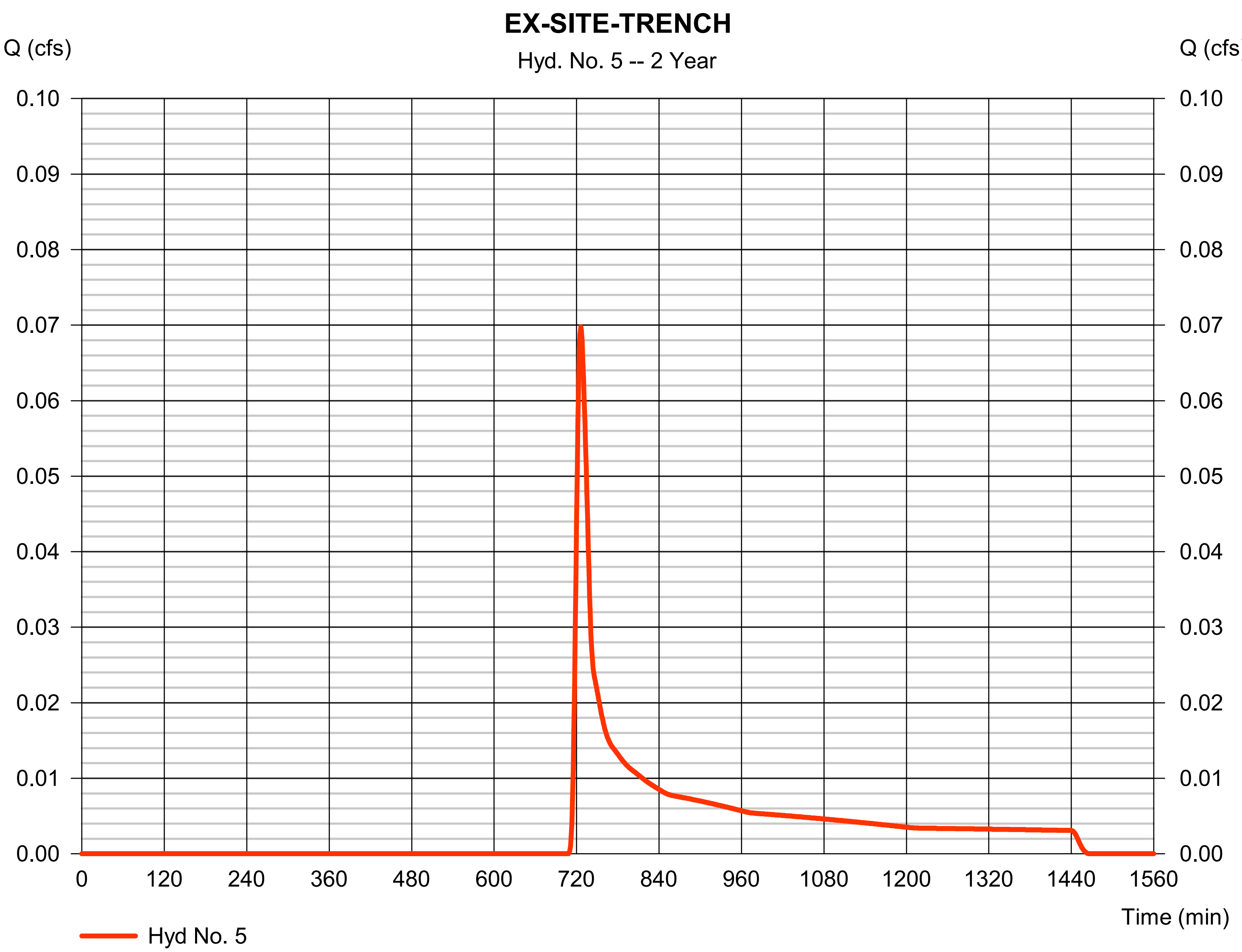
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 5

EX-SITE-TRENCH

Hydrograph type	= SCS Runoff	Peak discharge	= 0.070 cfs
Storm frequency	= 2 yrs	Time to peak	= 726 min
Time interval	= 1 min	Hyd. volume	= 323 cuft
Drainage area	= 0.210 ac	Curve number	= 58
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 15.90 min
Total precip.	= 3.41 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



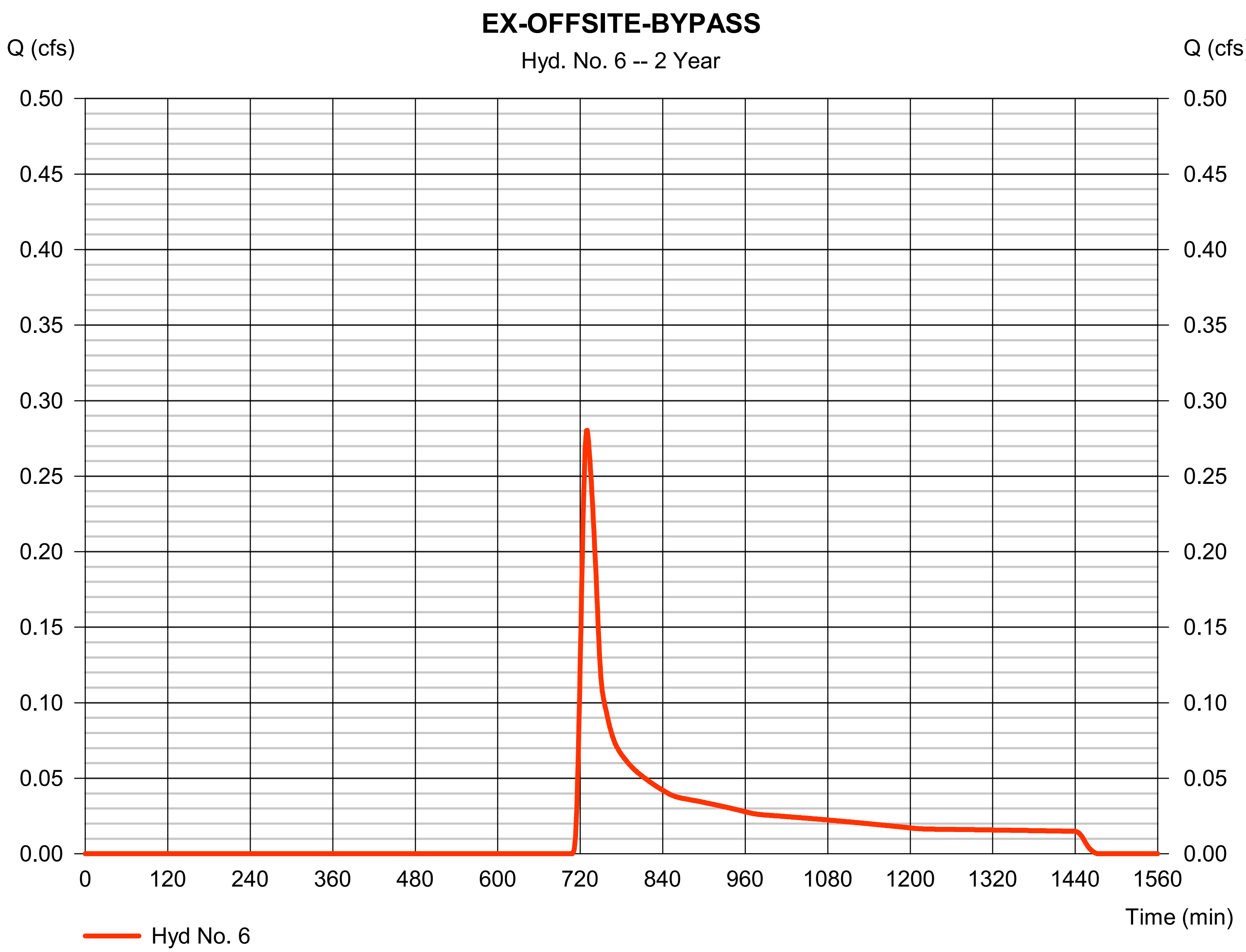
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 6

EX-OFFSITE-BYPASS

Hydrograph type	= SCS Runoff	Peak discharge	= 0.280 cfs
Storm frequency	= 2 yrs	Time to peak	= 730 min
Time interval	= 1 min	Hyd. volume	= 1,555 cuft
Drainage area	= 1.015 ac	Curve number	= 58
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 20.90 min
Total precip.	= 3.41 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



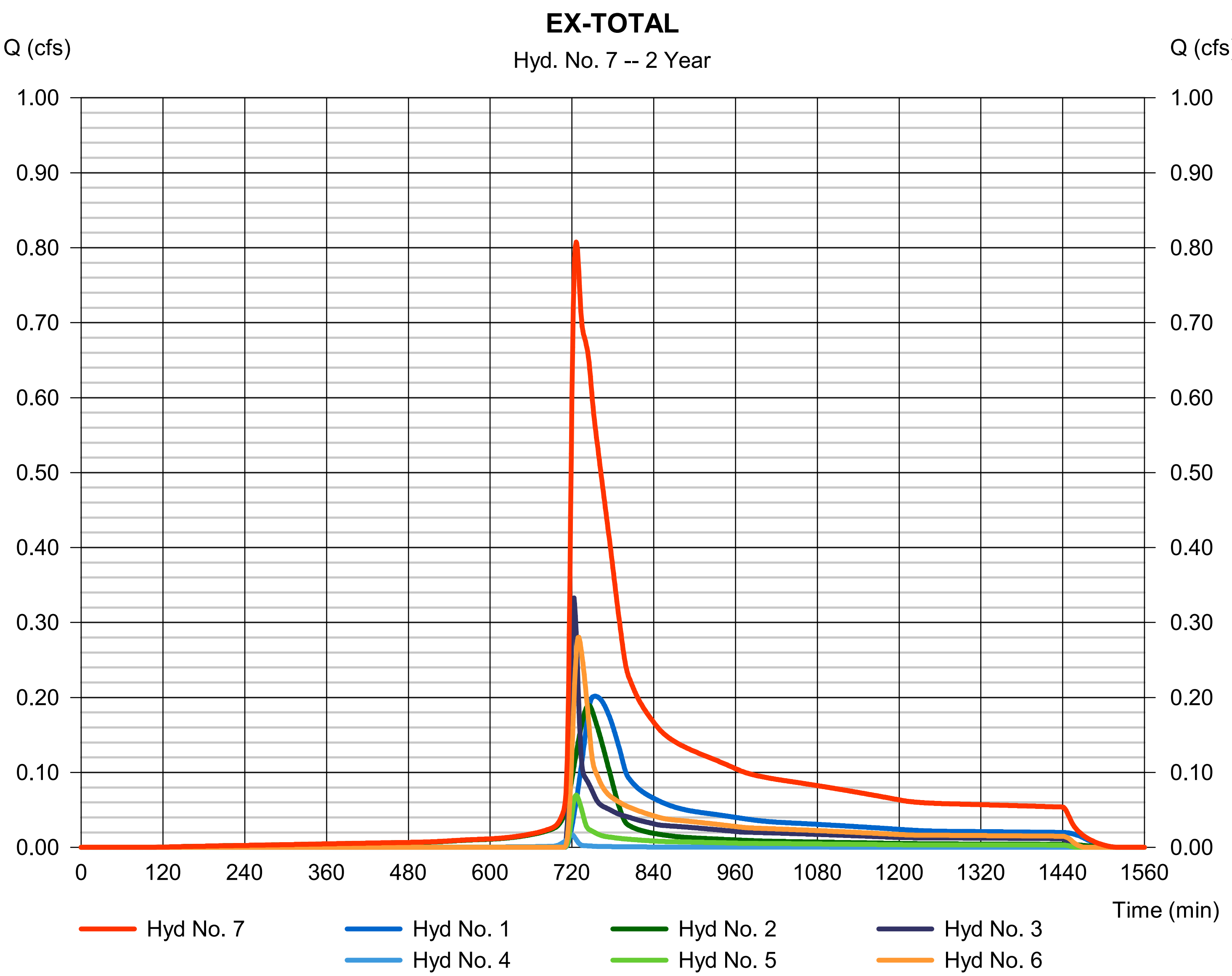
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 7

EX-TOTAL

Hydrograph type	= Combine	Peak discharge	= 0.808 cfs
Storm frequency	= 2 yrs	Time to peak	= 726 min
Time interval	= 1 min	Hyd. volume	= 6,417 cuft
Inflow hyds.	= 1, 2, 3, 4, 5, 6	Contrib. drain. area	= 3.484 ac



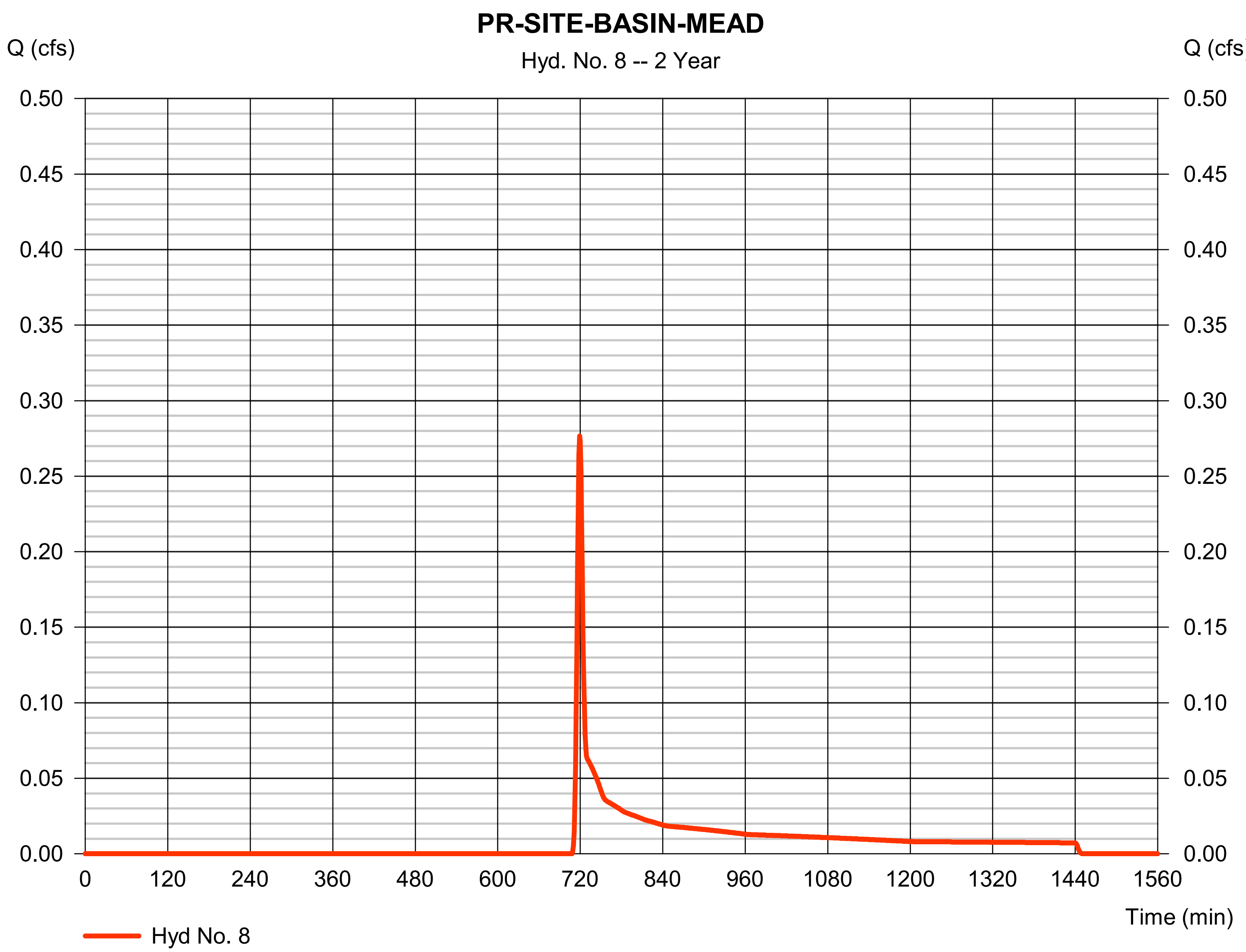
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 8

PR-SITE-BASIN-MEAD

Hydrograph type	= SCS Runoff	Peak discharge	= 0.277 cfs
Storm frequency	= 2 yrs	Time to peak	= 719 min
Time interval	= 1 min	Hyd. volume	= 759 cuft
Drainage area	= 0.485 ac	Curve number	= 58
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 3.41 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



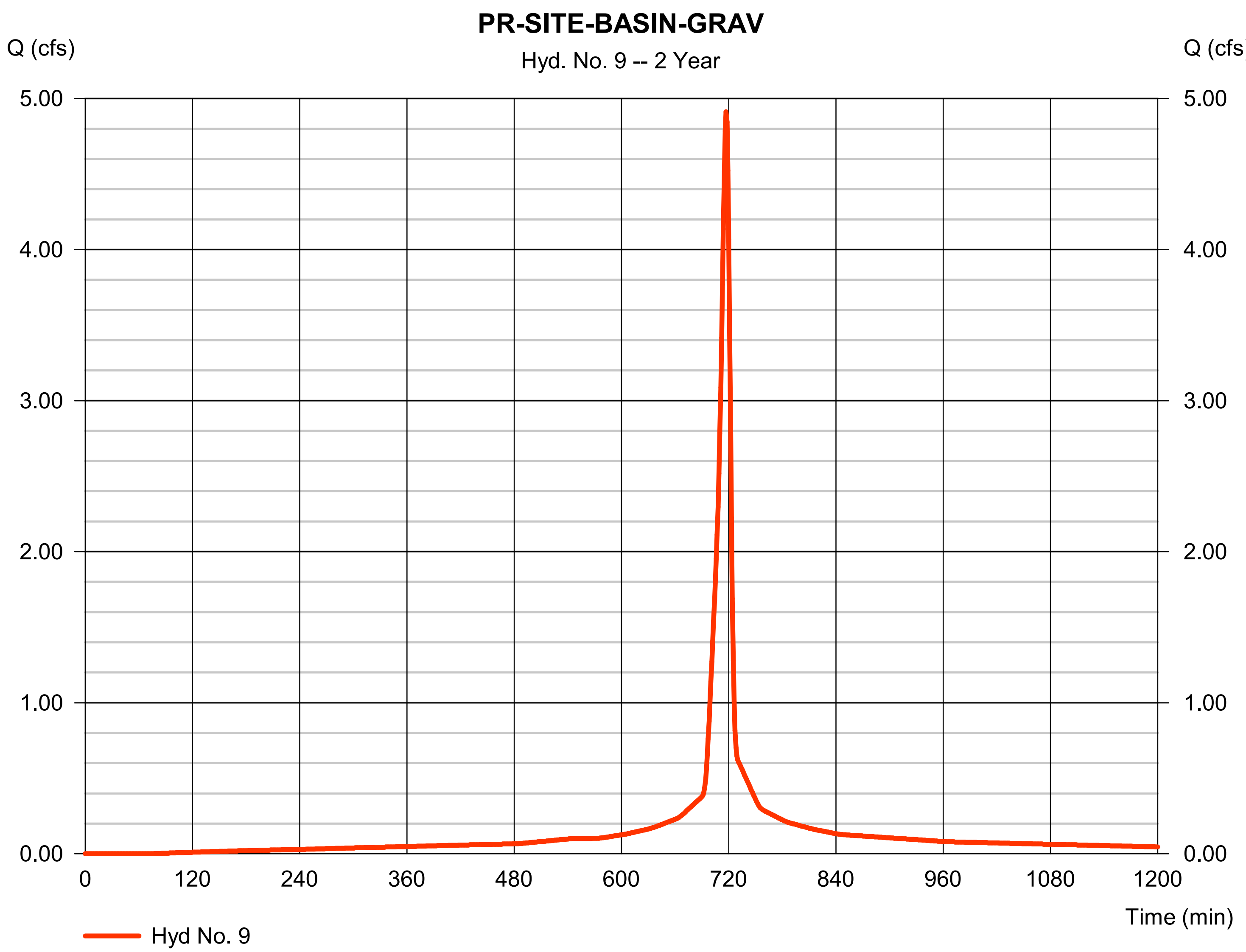
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 | Thursday, 02 / 20 / 2020

Hyd. No. 9

PR-SITE-BASIN-GRAV

Hydrograph type	= SCS Runoff	Peak discharge	= 4.913 cfs
Storm frequency	= 2 yrs	Time to peak	= 717 min
Time interval	= 1 min	Hyd. volume	= 11,654 cuft
Drainage area	= 0.980 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 3.41 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



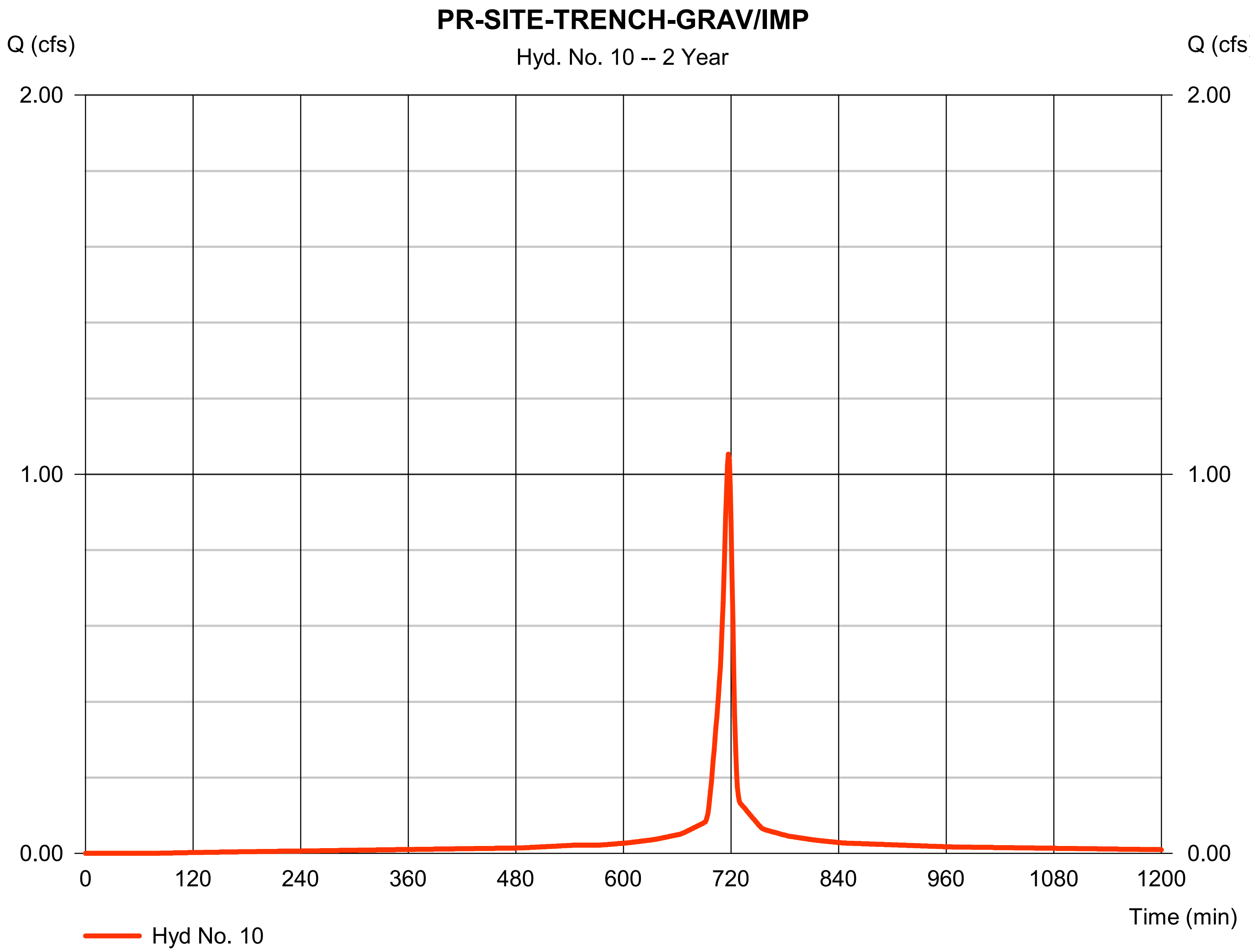
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 — Thursday, 02 / 20 / 2020

Hyd. No. 10

PR-SITE-TRENCH-GRAV/IMP

Hydrograph type	= SCS Runoff	Peak discharge	= 1.053 cfs
Storm frequency	= 2 yrs	Time to peak	= 717 min
Time interval	= 1 min	Hyd. volume	= 2,497 cuft
Drainage area	= 0.210 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 3.41 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



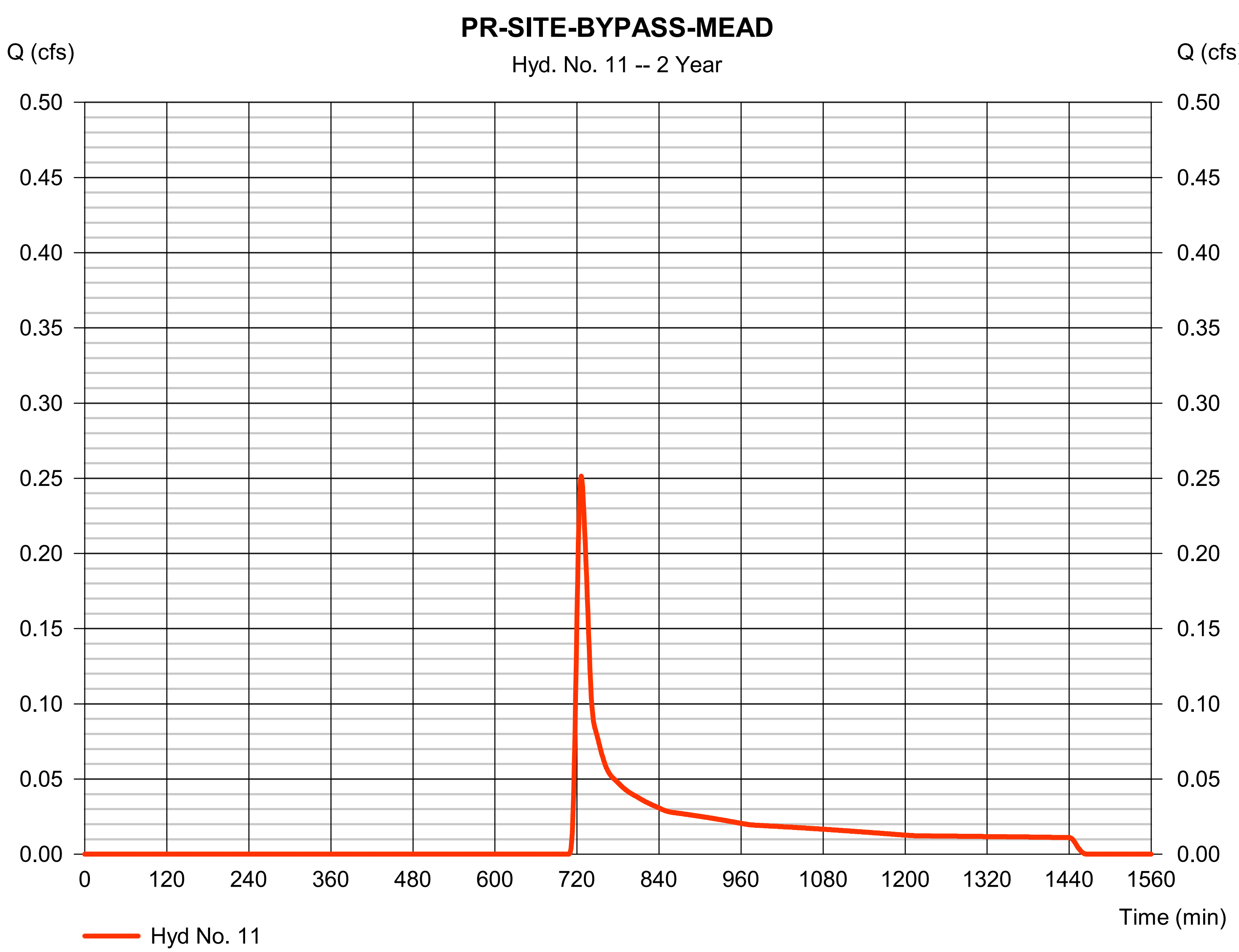
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 11

PR-SITE-BYPASS-MEAD

Hydrograph type	= SCS Runoff	Peak discharge	= 0.251 cfs
Storm frequency	= 2 yrs	Time to peak	= 726 min
Time interval	= 1 min	Hyd. volume	= 1,163 cuft
Drainage area	= 0.757 ac	Curve number	= 58
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 16.10 min
Total precip.	= 3.41 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



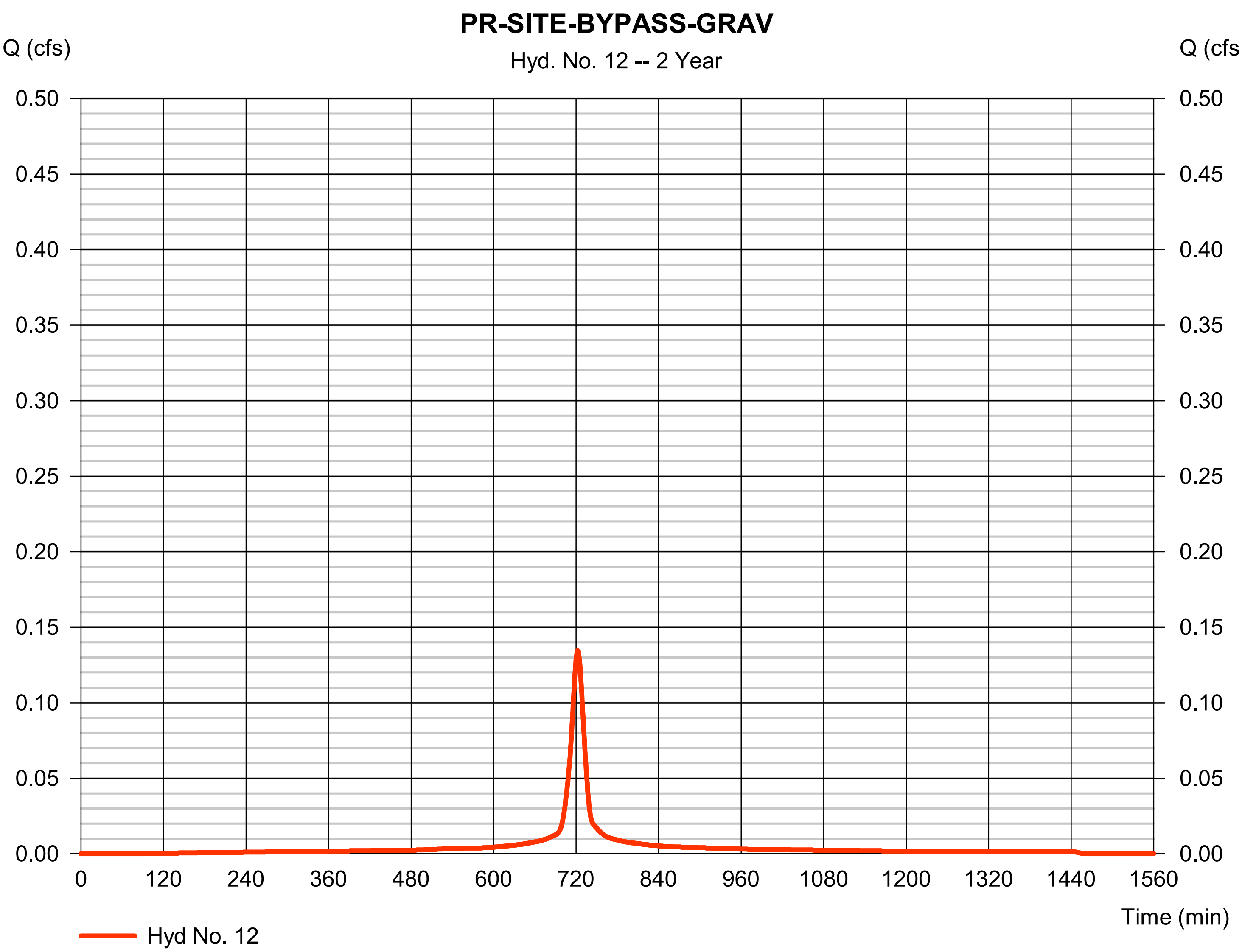
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 12

PR-SITE-BYPASS-GRAV

Hydrograph type	= SCS Runoff	Peak discharge	= 0.134 cfs
Storm frequency	= 2 yrs	Time to peak	= 722 min
Time interval	= 1 min	Hyd. volume	= 432 cuft
Drainage area	= 0.037 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 16.10 min
Total precip.	= 3.41 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

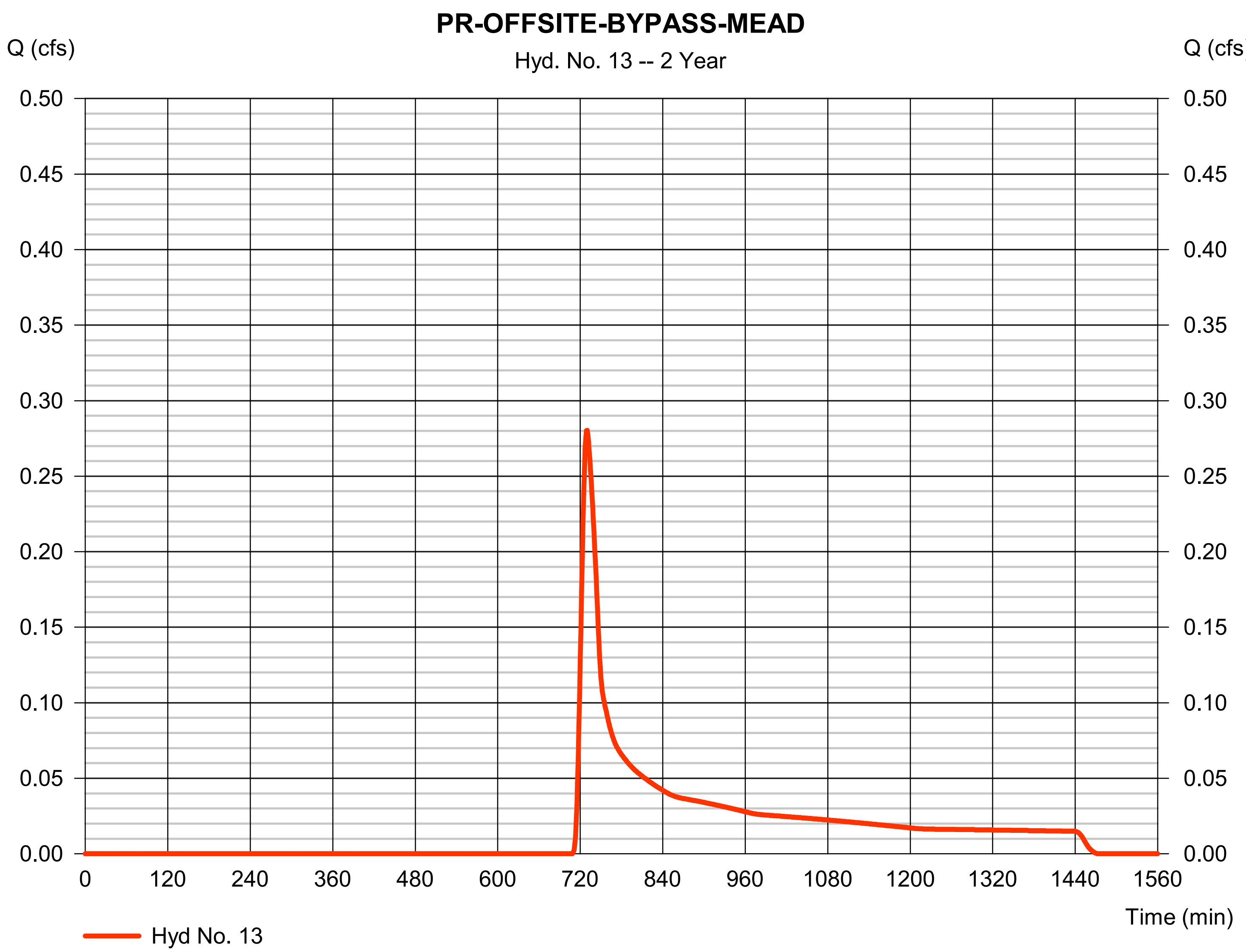


Hydrograph Report

Hyd. No. 13

PR-OFFSITE-BYPASS-MEAD

Hydrograph type	= SCS Runoff	Peak discharge	= 0.280 cfs
Storm frequency	= 2 yrs	Time to peak	= 730 min
Time interval	= 1 min	Hyd. volume	= 1,555 cuft
Drainage area	= 1.015 ac	Curve number	= 58
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 20.90 min
Total precip.	= 3.41 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



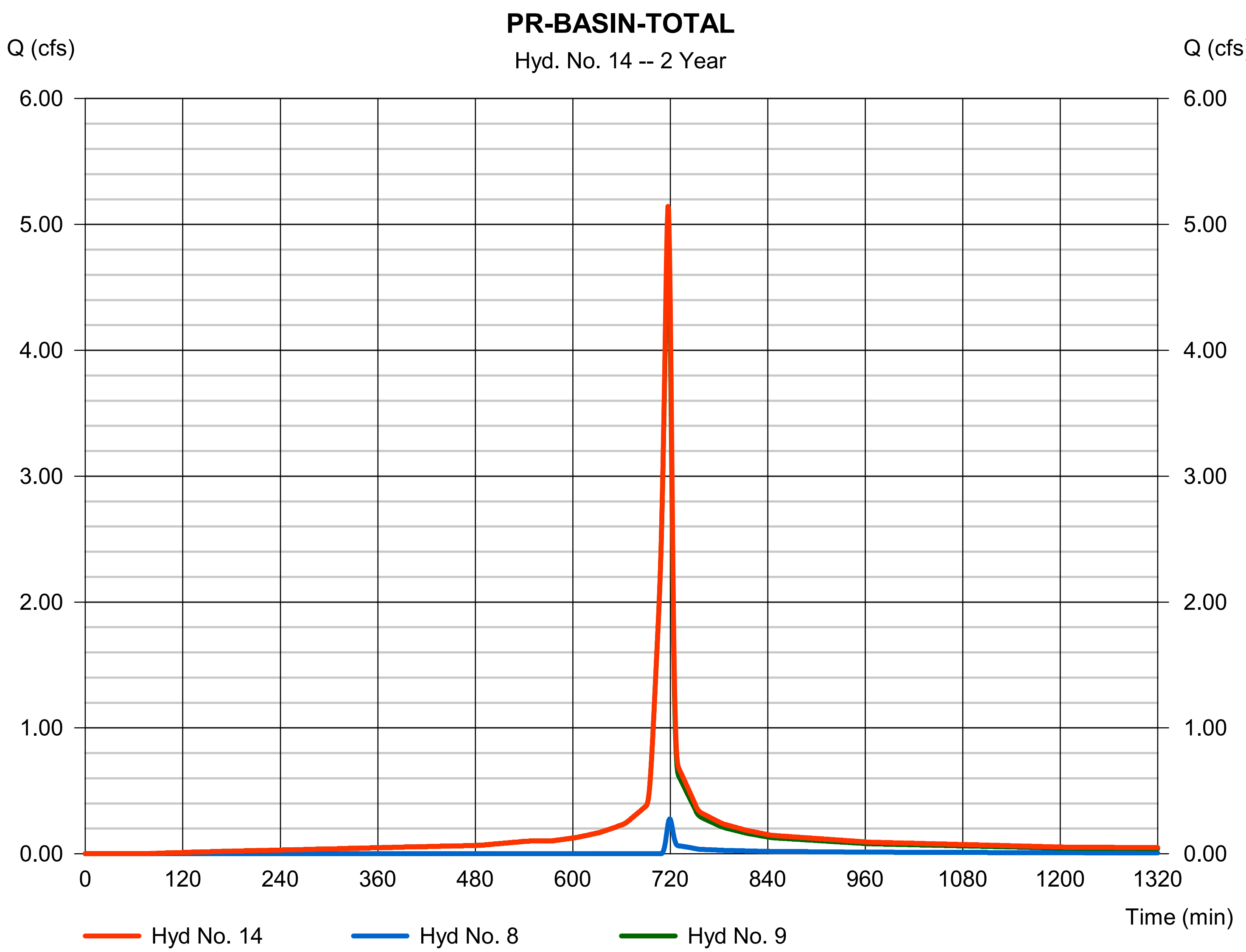
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 14

PR-BASIN-TOTAL

Hydrograph type	= Combine	Peak discharge	= 5.144 cfs
Storm frequency	= 2 yrs	Time to peak	= 717 min
Time interval	= 1 min	Hyd. volume	= 12,413 cuft
Inflow hyds.	= 8, 9	Contrib. drain. area	= 1.465 ac



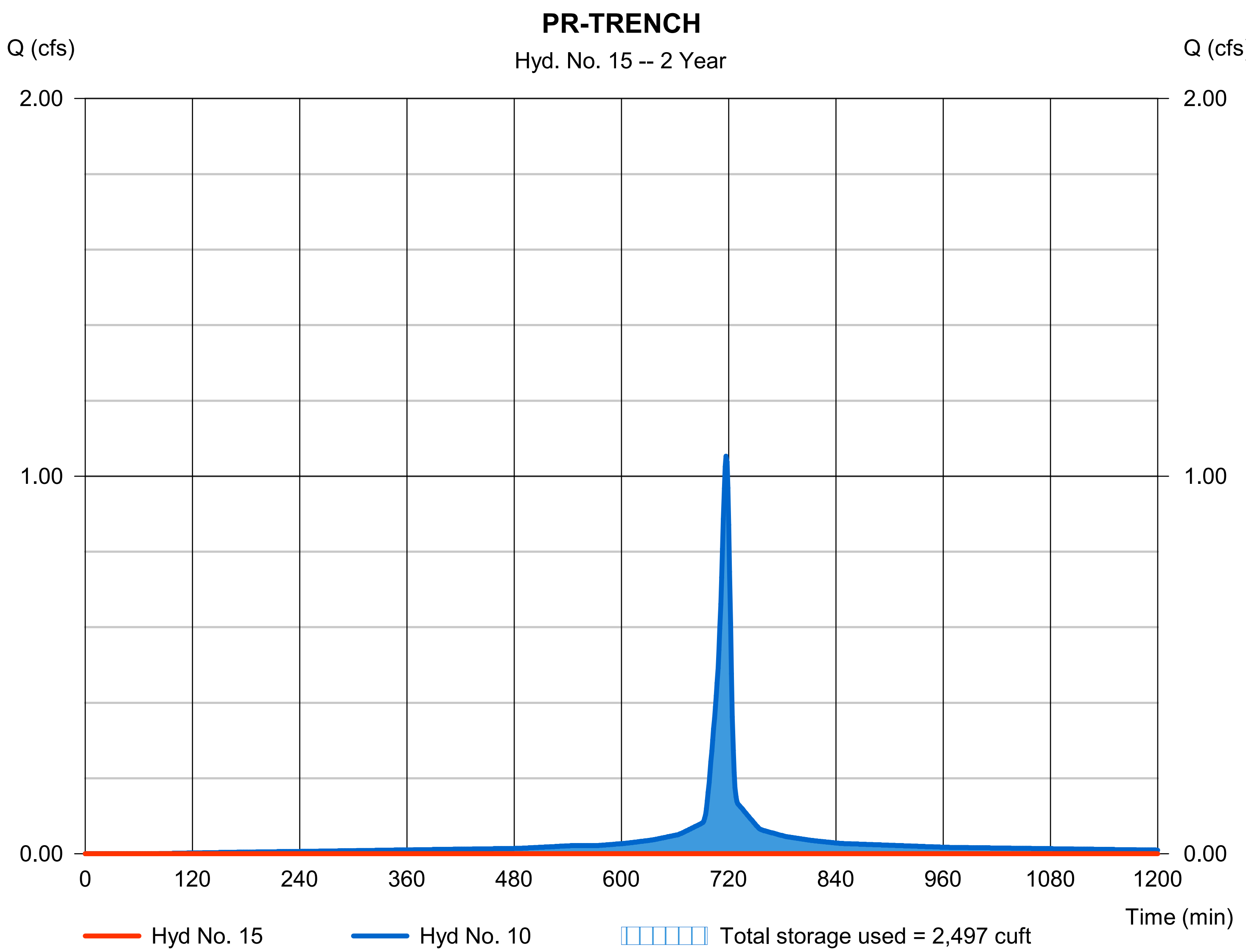
Hydrograph Report

Hyd. No. 15

PR-TRENCH

Hydrograph type	= Reservoir	Peak discharge	= 0.000 cfs
Storm frequency	= 2 yrs	Time to peak	= n/a
Time interval	= 1 min	Hyd. volume	= 0 cuft
Inflow hyd. No.	= 10 - PR-SITE-TRENCH-GRAV	Max. Elevation	= 401.96 ft
Reservoir name	= TRENCH	Max. Storage	= 2,497 cuft

Storage Indication method used.



Hydrograph Report

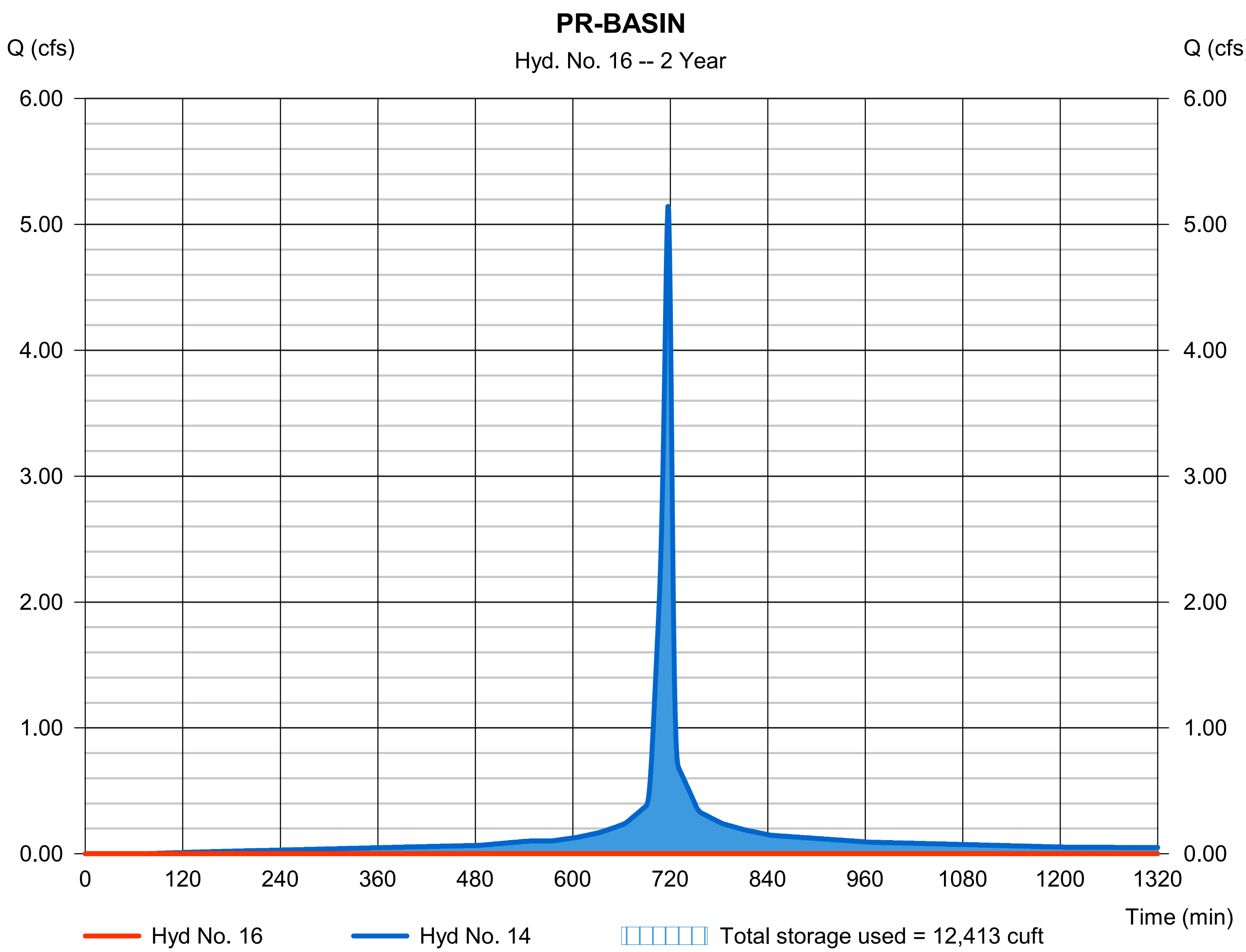
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 16

PR-BASIN

Hydrograph type	= Reservoir	Peak discharge	= 0.000 cfs
Storm frequency	= 2 yrs	Time to peak	= n/a
Time interval	= 1 min	Hyd. volume	= 0 cuft
Inflow hyd. No.	= 14 - PR-BASIN-TOTAL	Max. Elevation	= 398.60 ft
Reservoir name	= BASIN	Max. Storage	= 12,413 cuft

Storage Indication method used.



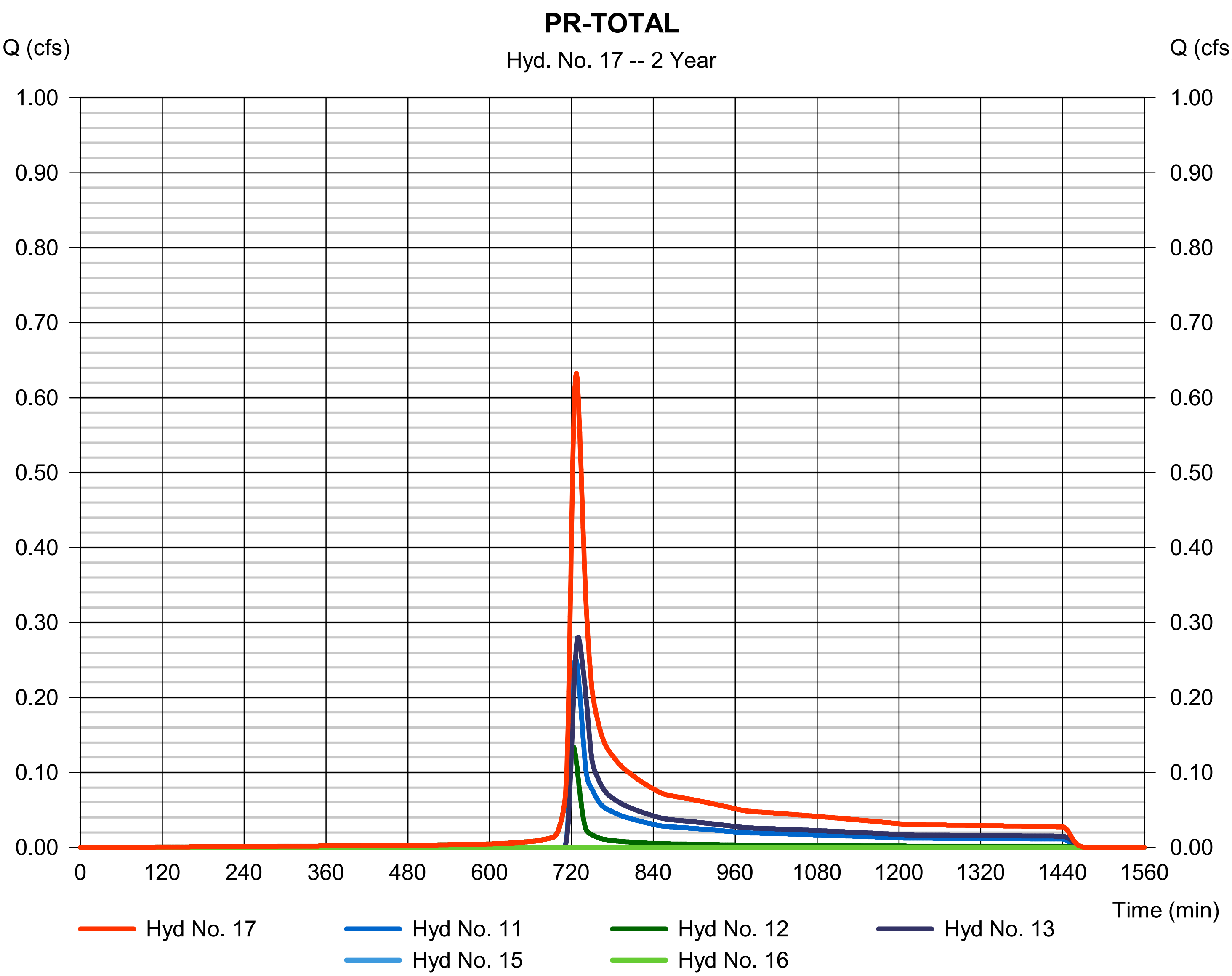
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 17

PR-TOTAL

Hydrograph type	= Combine	Peak discharge	= 0.632 cfs
Storm frequency	= 2 yrs	Time to peak	= 727 min
Time interval	= 1 min	Hyd. volume	= 3,151 cuft
Inflow hyds.	= 11, 12, 13, 15, 16	Contrib. drain. area	= 1.809 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

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	0.554	1	749	4,298	------	------	------	EX-SITE-BASIN-MEAD
2	SCS Runoff	0.248	1	745	1,611	------	------	------	EX-SITE-BASIN-IMP 80%
3	SCS Runoff	0.913	1	721	2,553	------	------	------	EX-SITE-BYPASS-MEAD
4	SCS Runoff	0.022	1	720	62	------	------	------	EX-SITE-BYPASS-IMP 80%
5	SCS Runoff	0.196	1	725	675	------	------	------	EX-SITE-TRENCH
6	SCS Runoff	0.795	1	728	3,254	------	------	------	EX-OFFSITE-BYPASS
7	Combine	2.084	1	724	12,453	1, 2, 3, 4, 5, 6	------	------	EX-TOTAL
8	SCS Runoff	0.717	1	718	1,588	------	------	------	PR-SITE-BASIN-MEAD
9	SCS Runoff	6.424	1	717	15,423	------	------	------	PR-SITE-BASIN-GRAV
10	SCS Runoff	1.377	1	717	3,305	------	------	------	PR-SITE-TRENCH-GRAV/IMP
11	SCS Runoff	0.707	1	725	2,433	------	------	------	PR-SITE-BYPASS-MEAD
12	SCS Runoff	0.176	1	722	572	------	------	------	PR-SITE-BYPASS-GRAV
13	SCS Runoff	0.795	1	728	3,254	------	------	------	PR-OFFSITE-BYPASS-MEAD
14	Combine	7.100	1	717	17,011	8, 9,	------	------	PR-BASIN-TOTAL
15	Reservoir	0.000	1	n/a	0	10	402.26	3,305	PR-TRENCH
16	Reservoir	0.000	1	n/a	0	14	399.06	17,011	PR-BASIN
17	Combine	1.629	1	726	6,259	11, 12, 13, 15, 16	------	------	PR-TOTAL

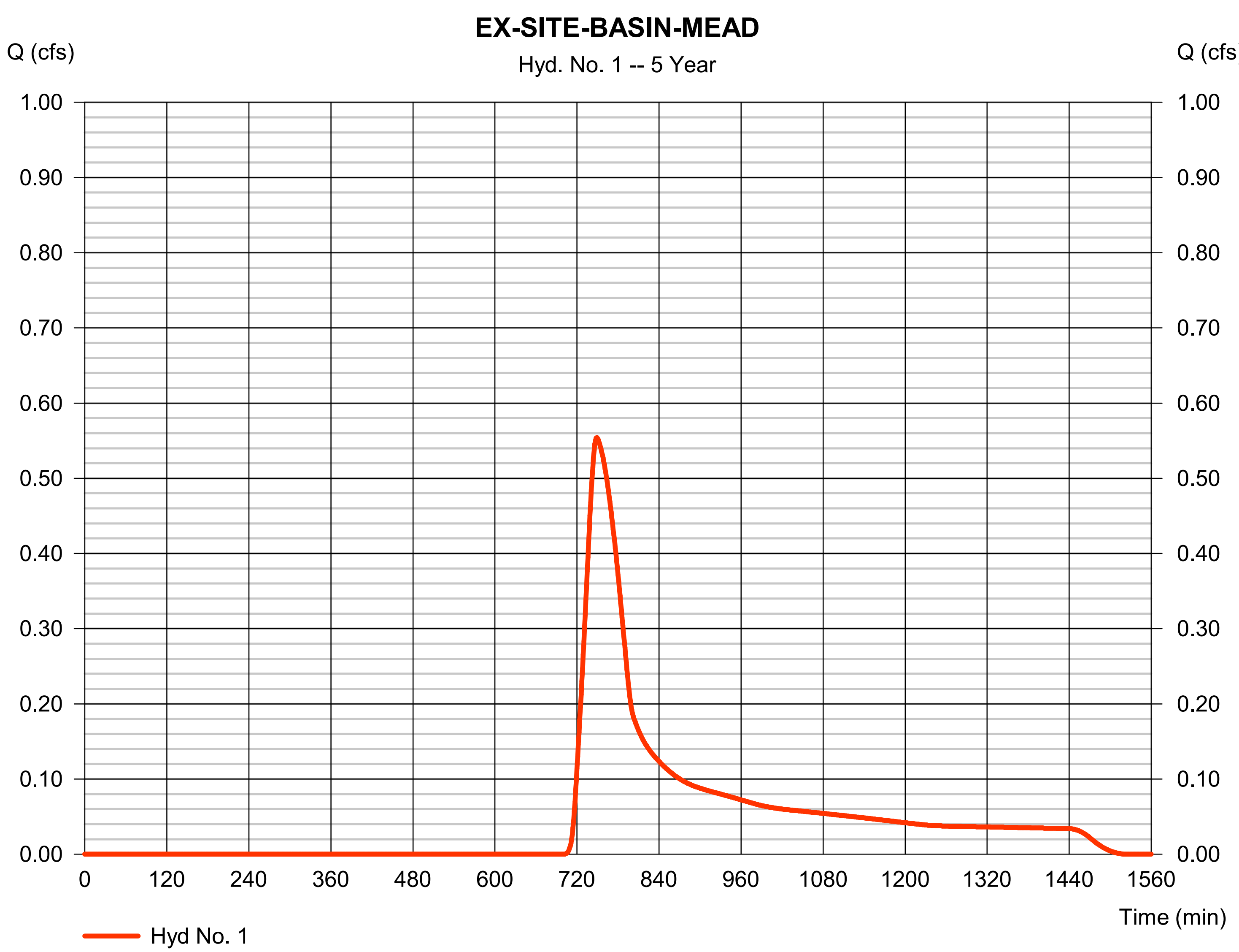
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 1

EX-SITE-BASIN-MEAD

Hydrograph type	= SCS Runoff	Peak discharge	= 0.554 cfs
Storm frequency	= 5 yrs	Time to peak	= 749 min
Time interval	= 1 min	Hyd. volume	= 4,298 cuft
Drainage area	= 1.359 ac	Curve number	= 58
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 53.40 min
Total precip.	= 4.44 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



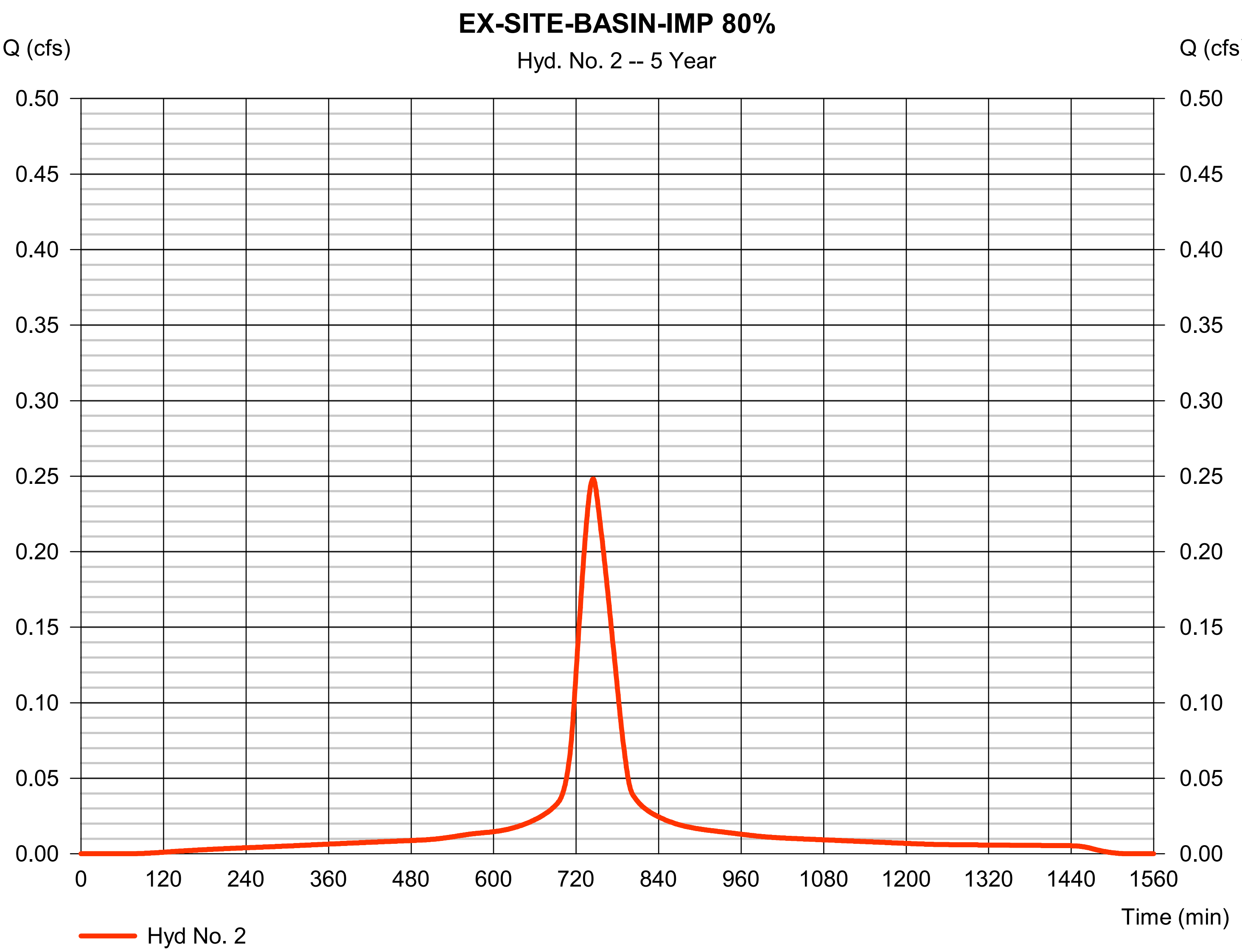
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 2

EX-SITE-BASIN-IMP 80%

Hydrograph type	= SCS Runoff	Peak discharge	= 0.248 cfs
Storm frequency	= 5 yrs	Time to peak	= 745 min
Time interval	= 1 min	Hyd. volume	= 1,611 cuft
Drainage area	= 0.106 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 53.40 min
Total precip.	= 4.44 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



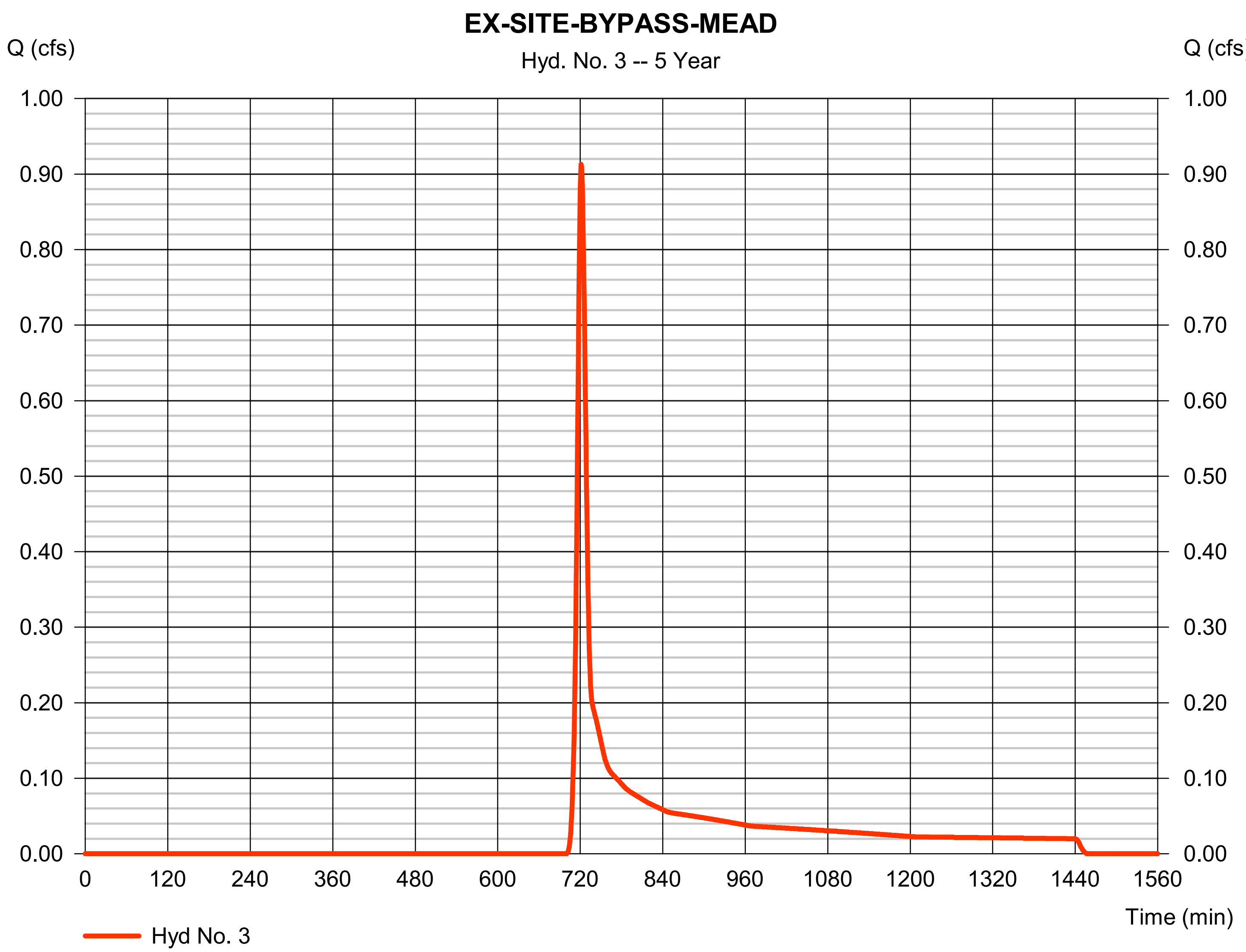
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 3

EX-SITE-BYPASS-MEAD

Hydrograph type	= SCS Runoff	Peak discharge	= 0.913 cfs
Storm frequency	= 5 yrs	Time to peak	= 721 min
Time interval	= 1 min	Hyd. volume	= 2,553 cuft
Drainage area	= 0.790 ac	Curve number	= 58
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 11.70 min
Total precip.	= 4.44 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



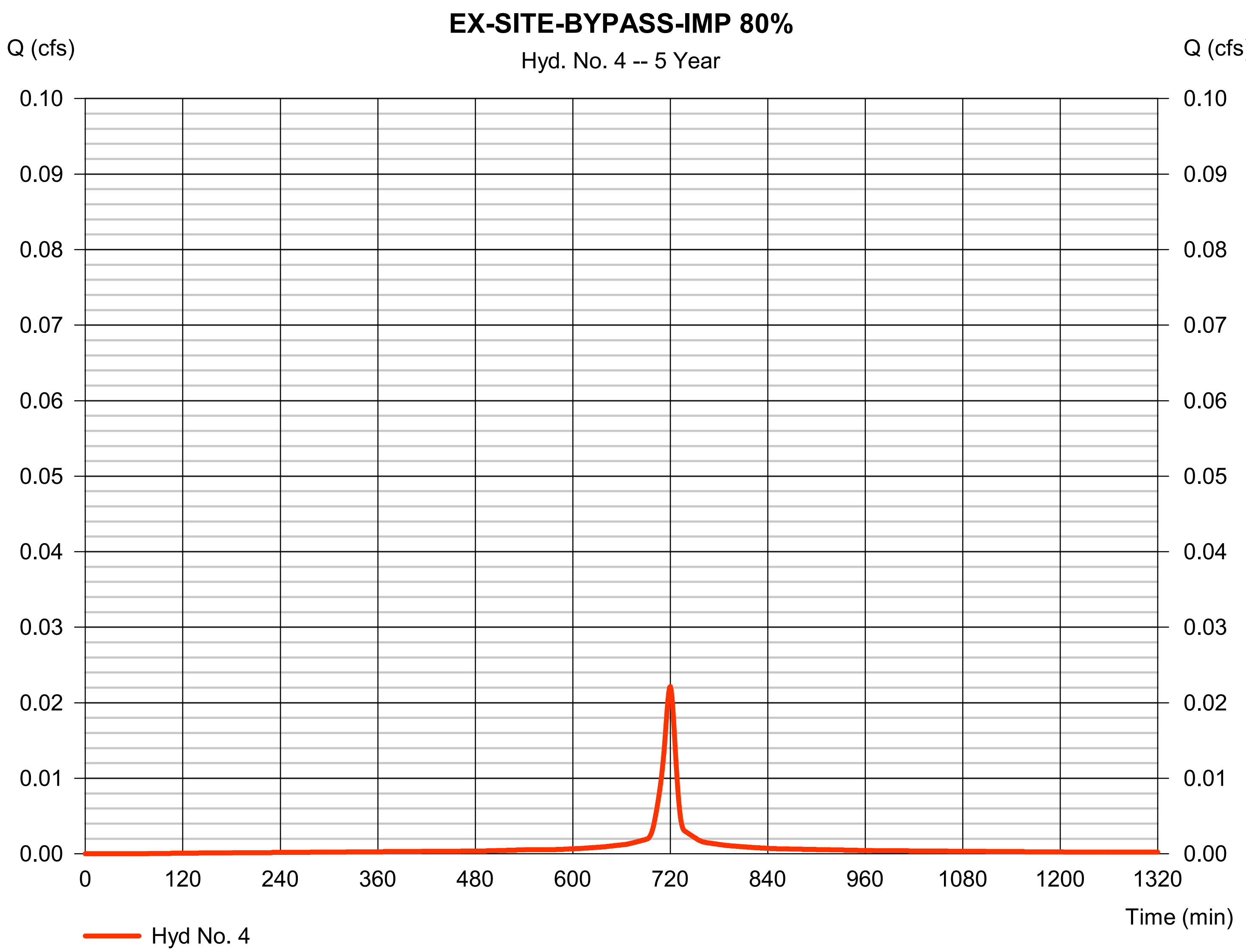
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 4

EX-SITE-BYPASS-IMP 80%

Hydrograph type	= SCS Runoff	Peak discharge	= 0.022 cfs
Storm frequency	= 5 yrs	Time to peak	= 720 min
Time interval	= 1 min	Hyd. volume	= 62 cuft
Drainage area	= 0.004 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 11.70 min
Total precip.	= 4.44 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



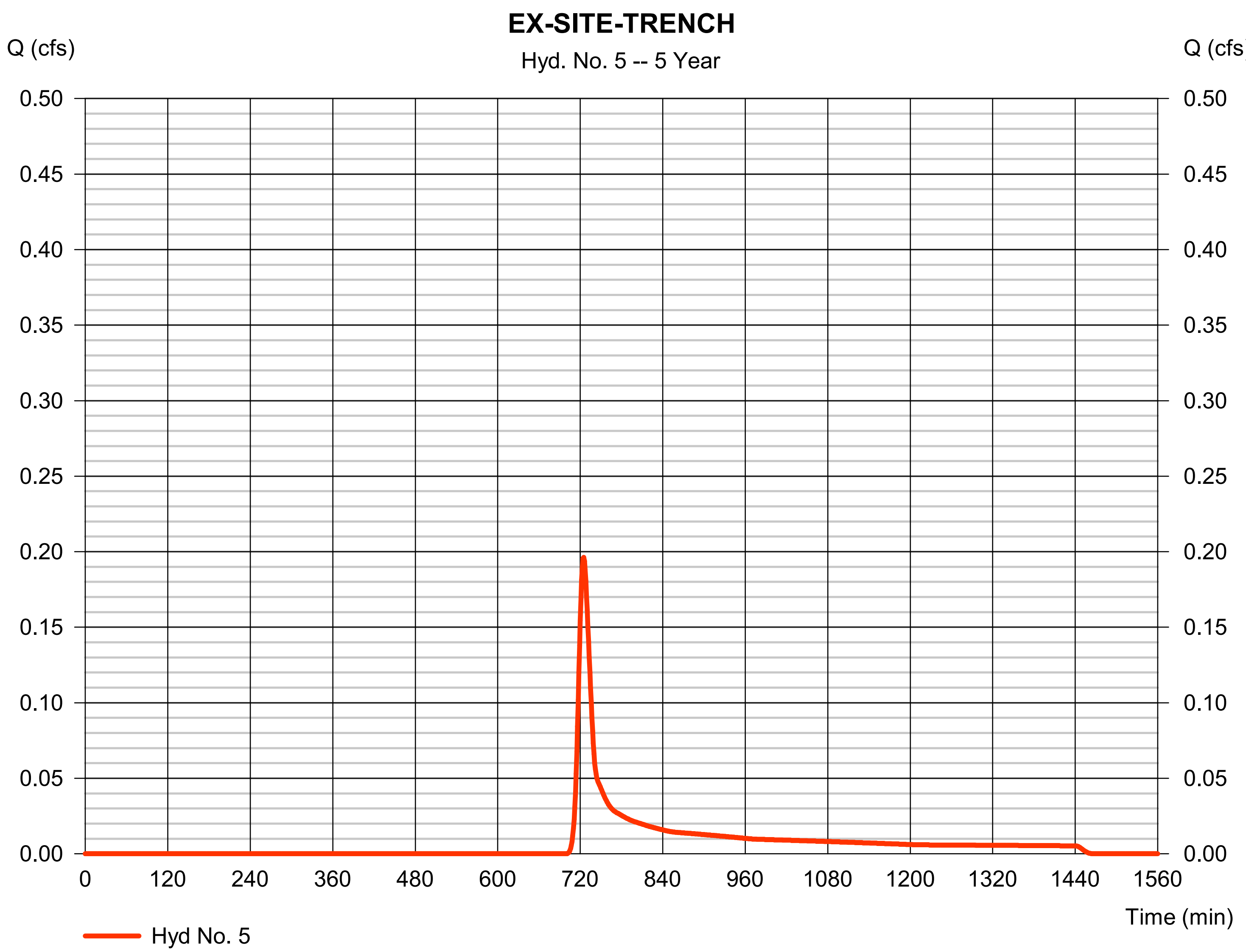
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 5

EX-SITE-TRENCH

Hydrograph type	= SCS Runoff	Peak discharge	= 0.196 cfs
Storm frequency	= 5 yrs	Time to peak	= 725 min
Time interval	= 1 min	Hyd. volume	= 675 cuft
Drainage area	= 0.210 ac	Curve number	= 58
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 15.90 min
Total precip.	= 4.44 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



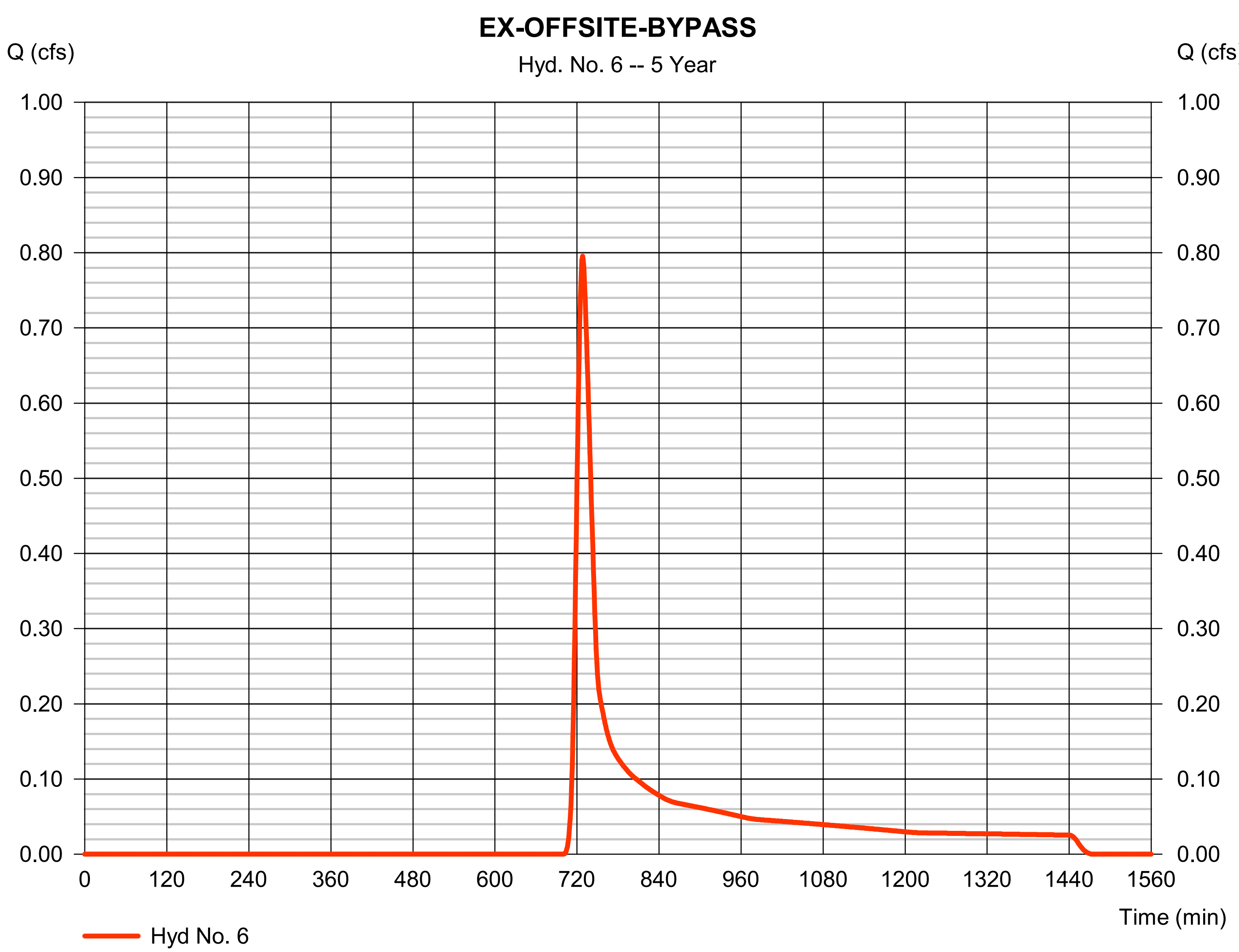
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 6

EX-OFFSITE-BYPASS

Hydrograph type	= SCS Runoff	Peak discharge	= 0.795 cfs
Storm frequency	= 5 yrs	Time to peak	= 728 min
Time interval	= 1 min	Hyd. volume	= 3,254 cuft
Drainage area	= 1.015 ac	Curve number	= 58
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 20.90 min
Total precip.	= 4.44 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



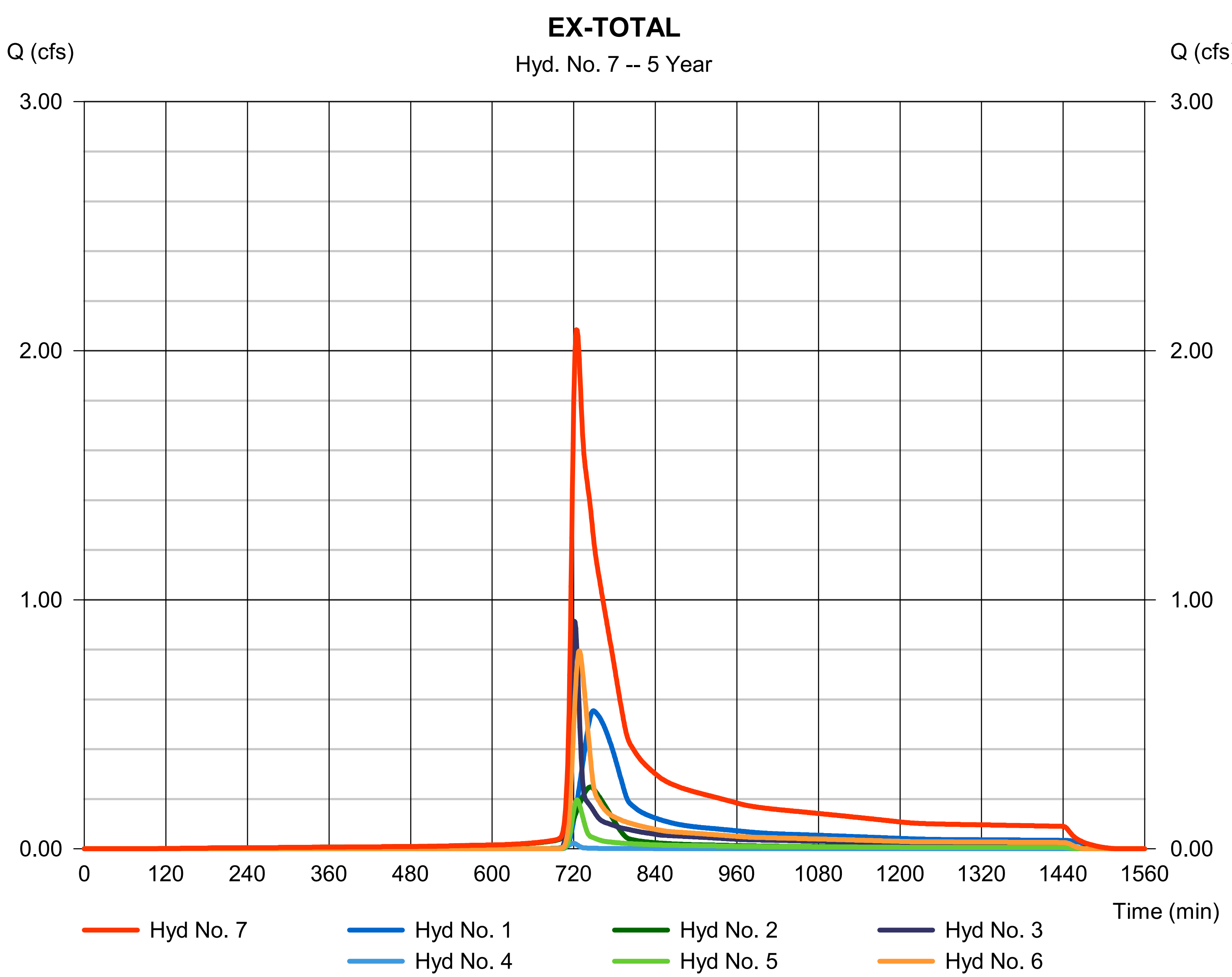
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 7

EX-TOTAL

Hydrograph type	= Combine	Peak discharge	= 2.084 cfs
Storm frequency	= 5 yrs	Time to peak	= 724 min
Time interval	= 1 min	Hyd. volume	= 12,453 cuft
Inflow hyds.	= 1, 2, 3, 4, 5, 6	Contrib. drain. area	= 3.484 ac

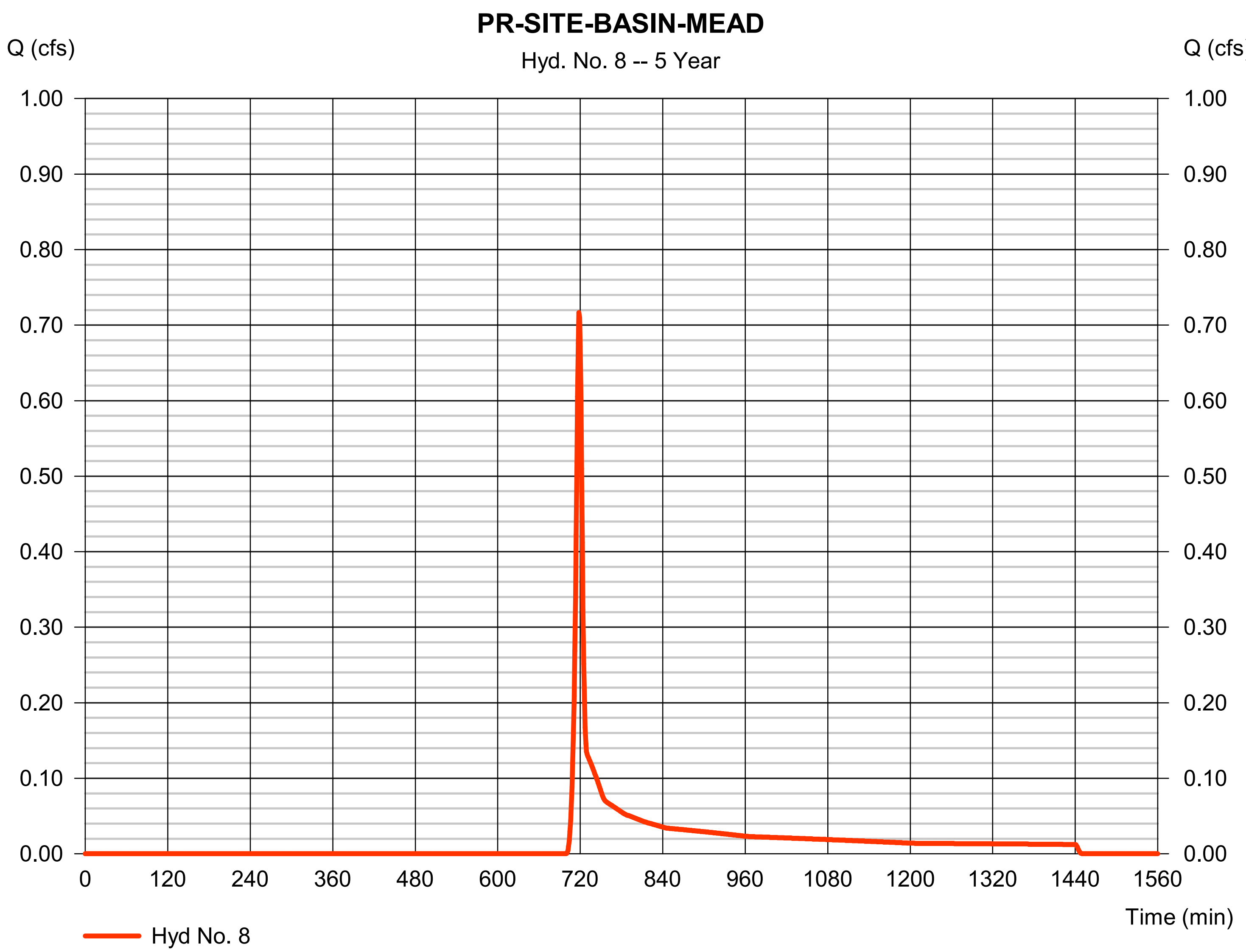


Hydrograph Report

Hyd. No. 8

PR-SITE-BASIN-MEAD

Hydrograph type	= SCS Runoff	Peak discharge	= 0.717 cfs
Storm frequency	= 5 yrs	Time to peak	= 718 min
Time interval	= 1 min	Hyd. volume	= 1,588 cuft
Drainage area	= 0.485 ac	Curve number	= 58
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 4.44 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



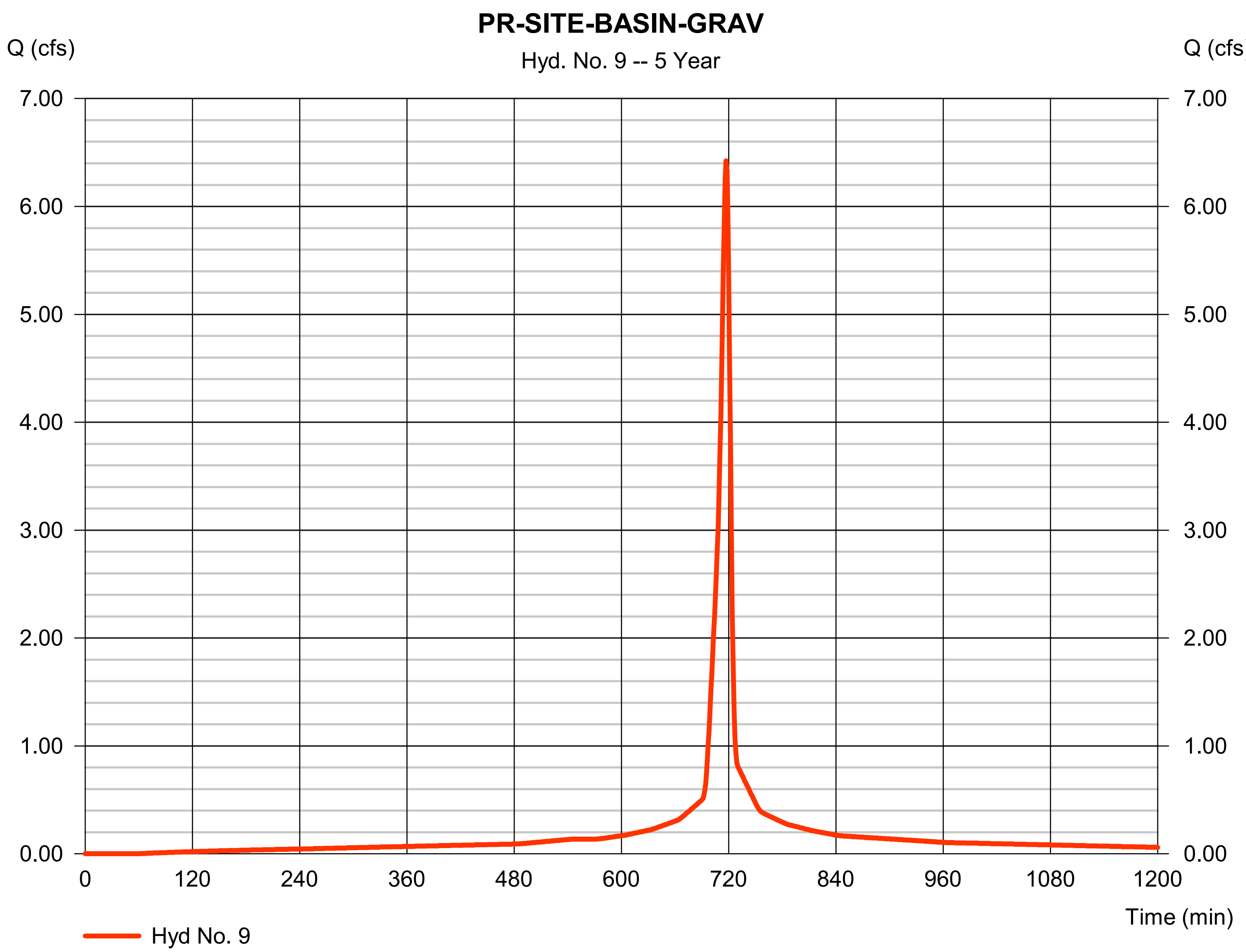
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 9

PR-SITE-BASIN-GRAV

Hydrograph type	= SCS Runoff	Peak discharge	= 6.424 cfs
Storm frequency	= 5 yrs	Time to peak	= 717 min
Time interval	= 1 min	Hyd. volume	= 15,423 cuft
Drainage area	= 0.980 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 4.44 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



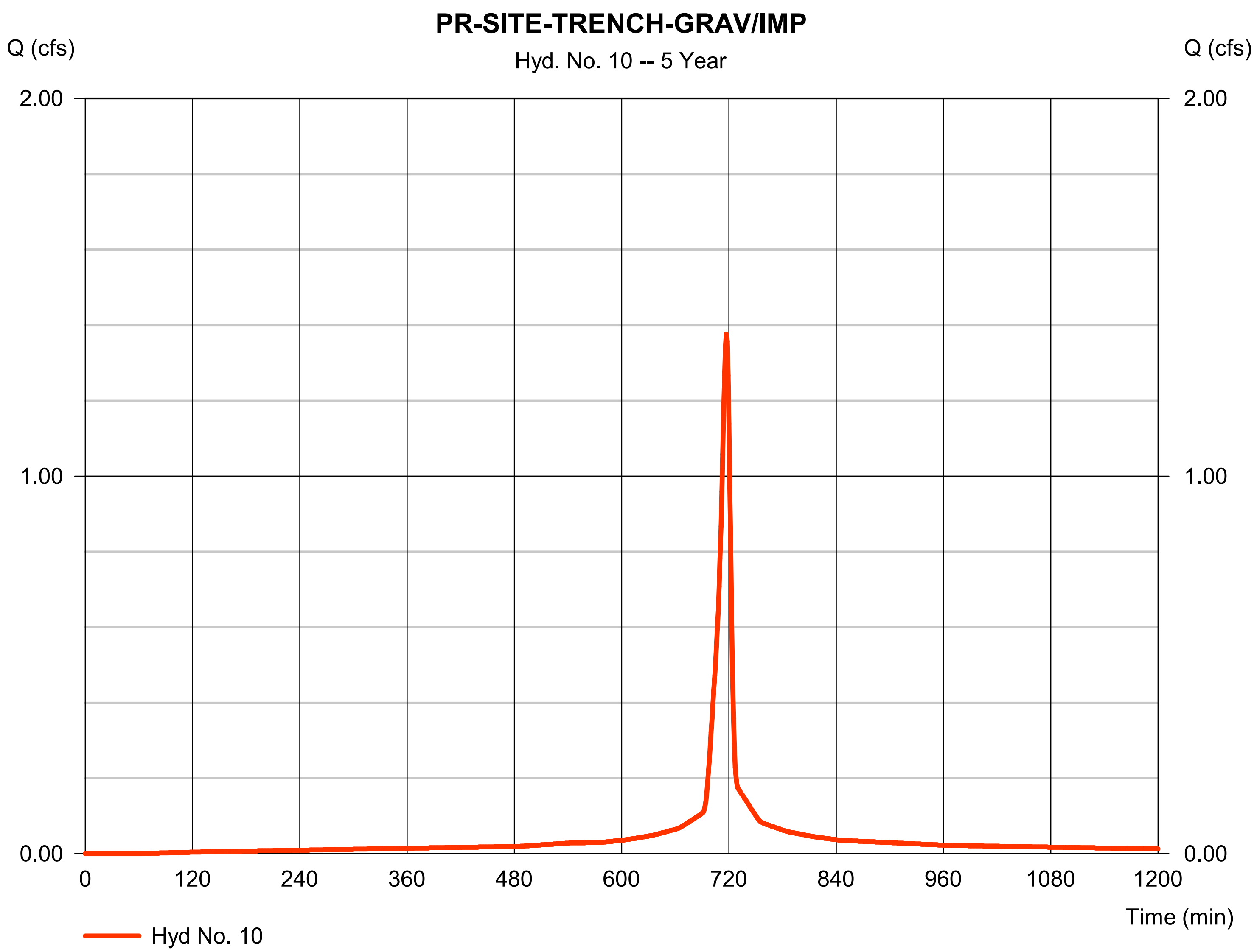
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 10

PR-SITE-TRENCH-GRAV/IMP

Hydrograph type	= SCS Runoff	Peak discharge	= 1.377 cfs
Storm frequency	= 5 yrs	Time to peak	= 717 min
Time interval	= 1 min	Hyd. volume	= 3,305 cuft
Drainage area	= 0.210 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 4.44 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



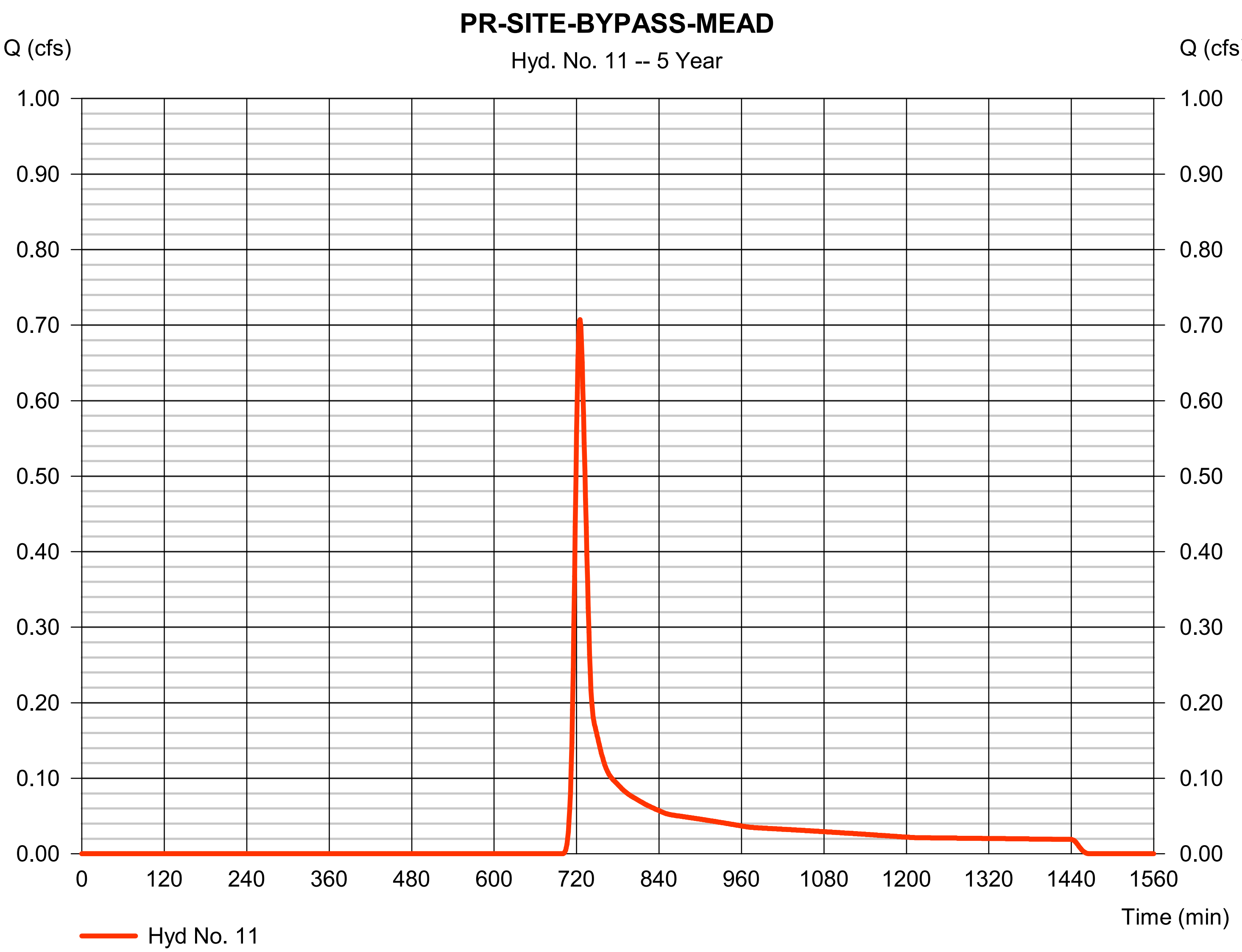
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 11

PR-SITE-BYPASS-MEAD

Hydrograph type	= SCS Runoff	Peak discharge	= 0.707 cfs
Storm frequency	= 5 yrs	Time to peak	= 725 min
Time interval	= 1 min	Hyd. volume	= 2,433 cuft
Drainage area	= 0.757 ac	Curve number	= 58
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 16.10 min
Total precip.	= 4.44 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



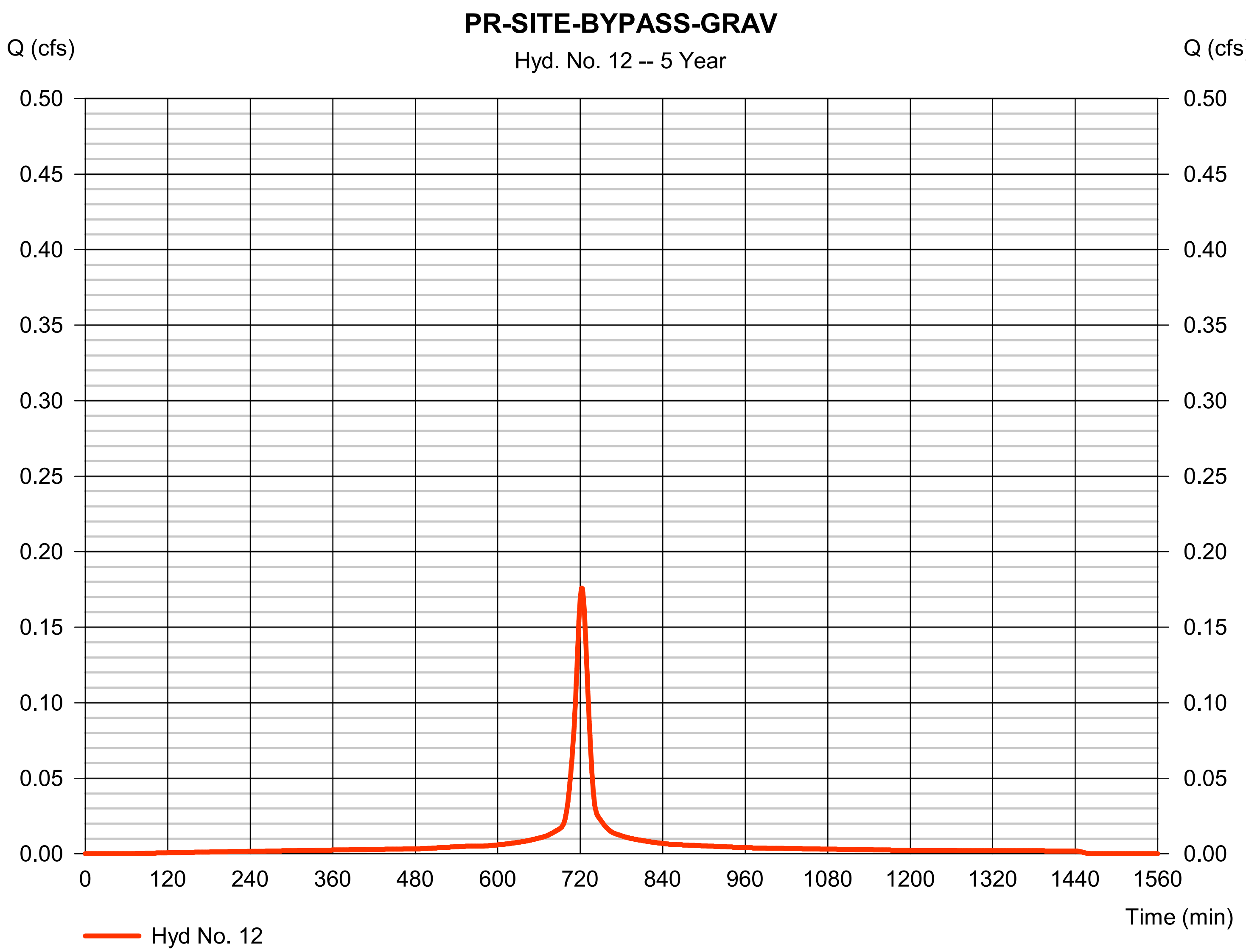
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 12

PR-SITE-BYPASS-GRAV

Hydrograph type	= SCS Runoff	Peak discharge	= 0.176 cfs
Storm frequency	= 5 yrs	Time to peak	= 722 min
Time interval	= 1 min	Hyd. volume	= 572 cuft
Drainage area	= 0.037 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 16.10 min
Total precip.	= 4.44 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

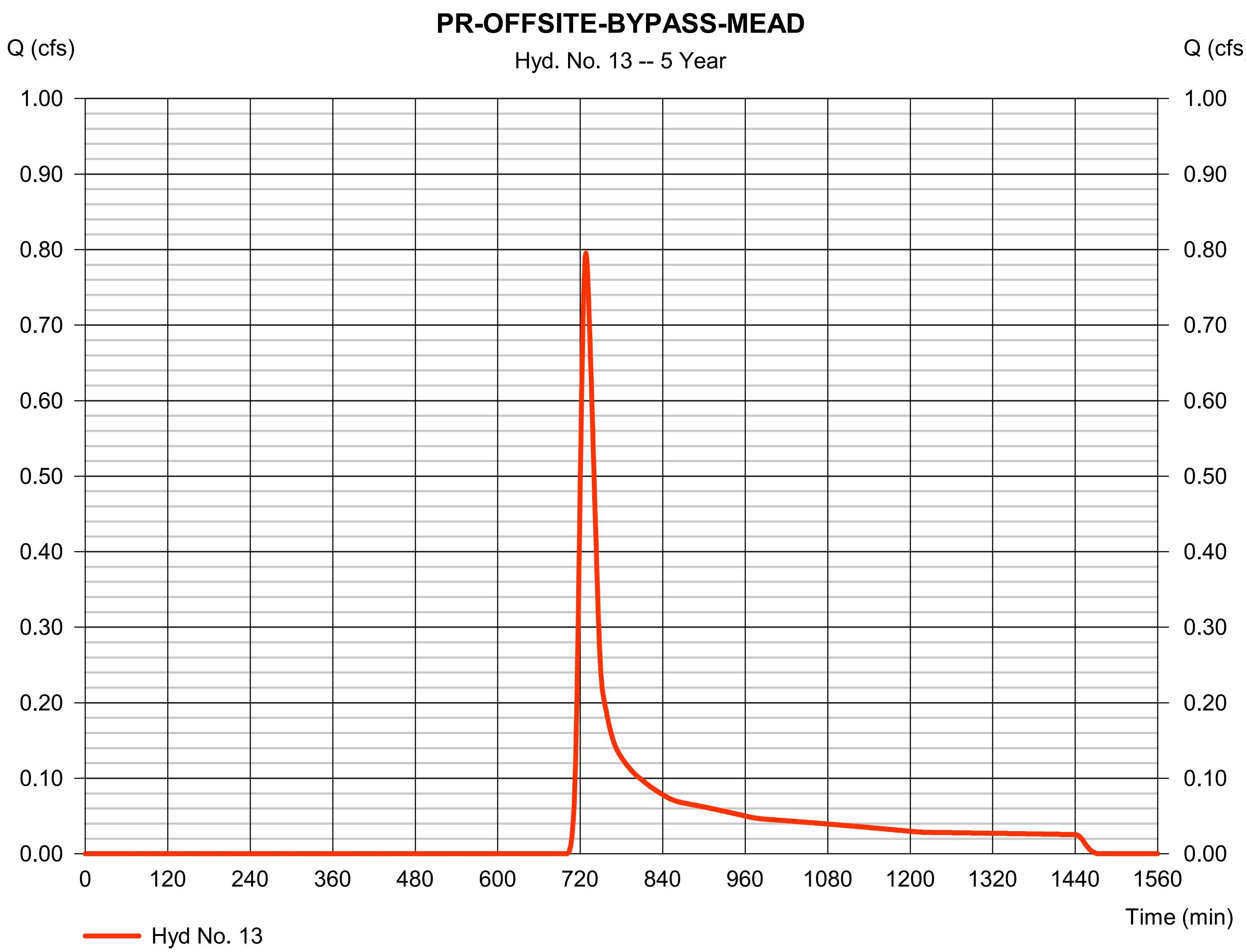


Hydrograph Report

Hyd. No. 13

PR-OFFSITE-BYPASS-MEAD

Hydrograph type	= SCS Runoff	Peak discharge	= 0.795 cfs
Storm frequency	= 5 yrs	Time to peak	= 728 min
Time interval	= 1 min	Hyd. volume	= 3,254 cuft
Drainage area	= 1.015 ac	Curve number	= 58
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 20.90 min
Total precip.	= 4.44 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



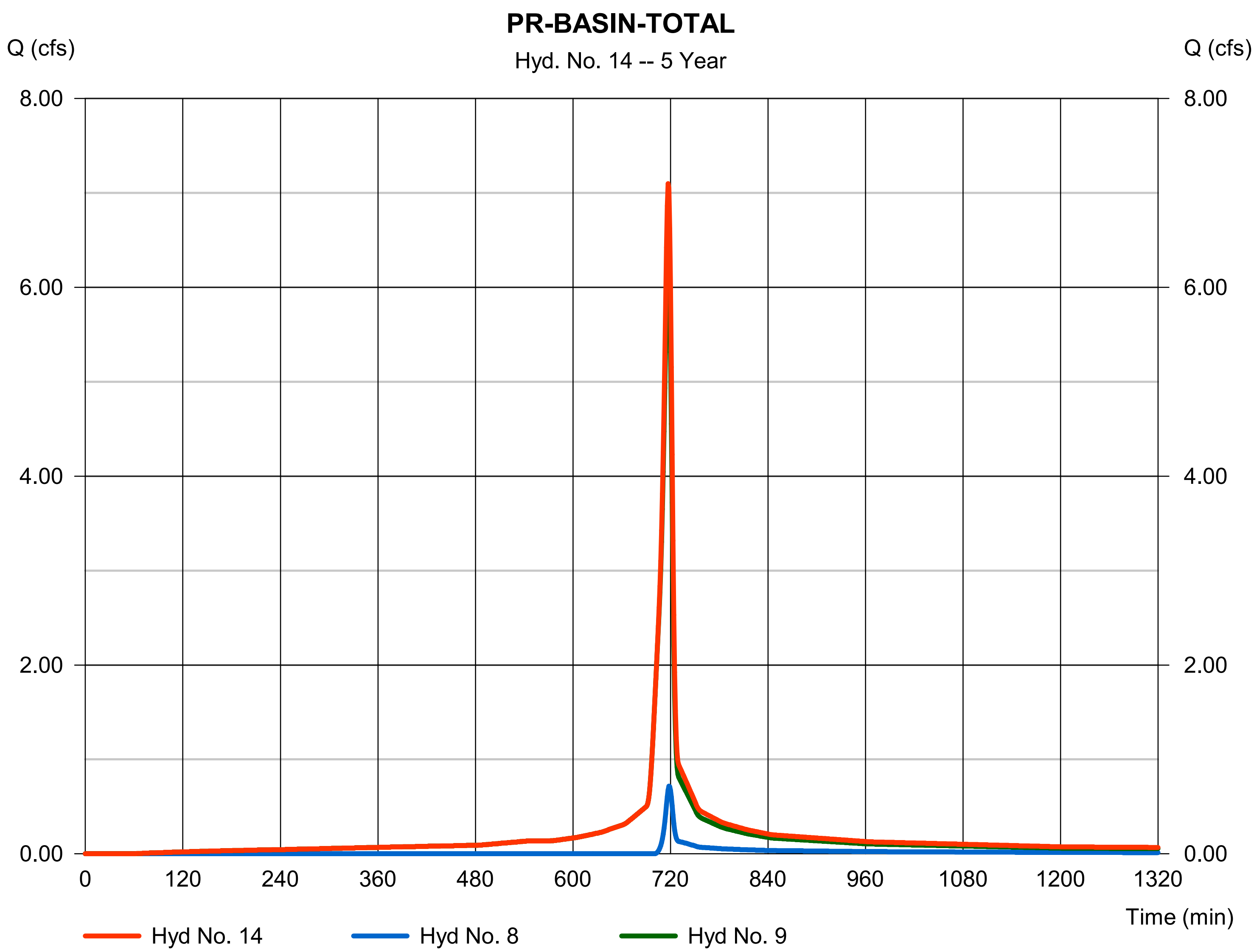
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 14

PR-BASIN-TOTAL

Hydrograph type	= Combine	Peak discharge	= 7.100 cfs
Storm frequency	= 5 yrs	Time to peak	= 717 min
Time interval	= 1 min	Hyd. volume	= 17,011 cuft
Inflow hyds.	= 8, 9	Contrib. drain. area	= 1.465 ac



Hydrograph Report

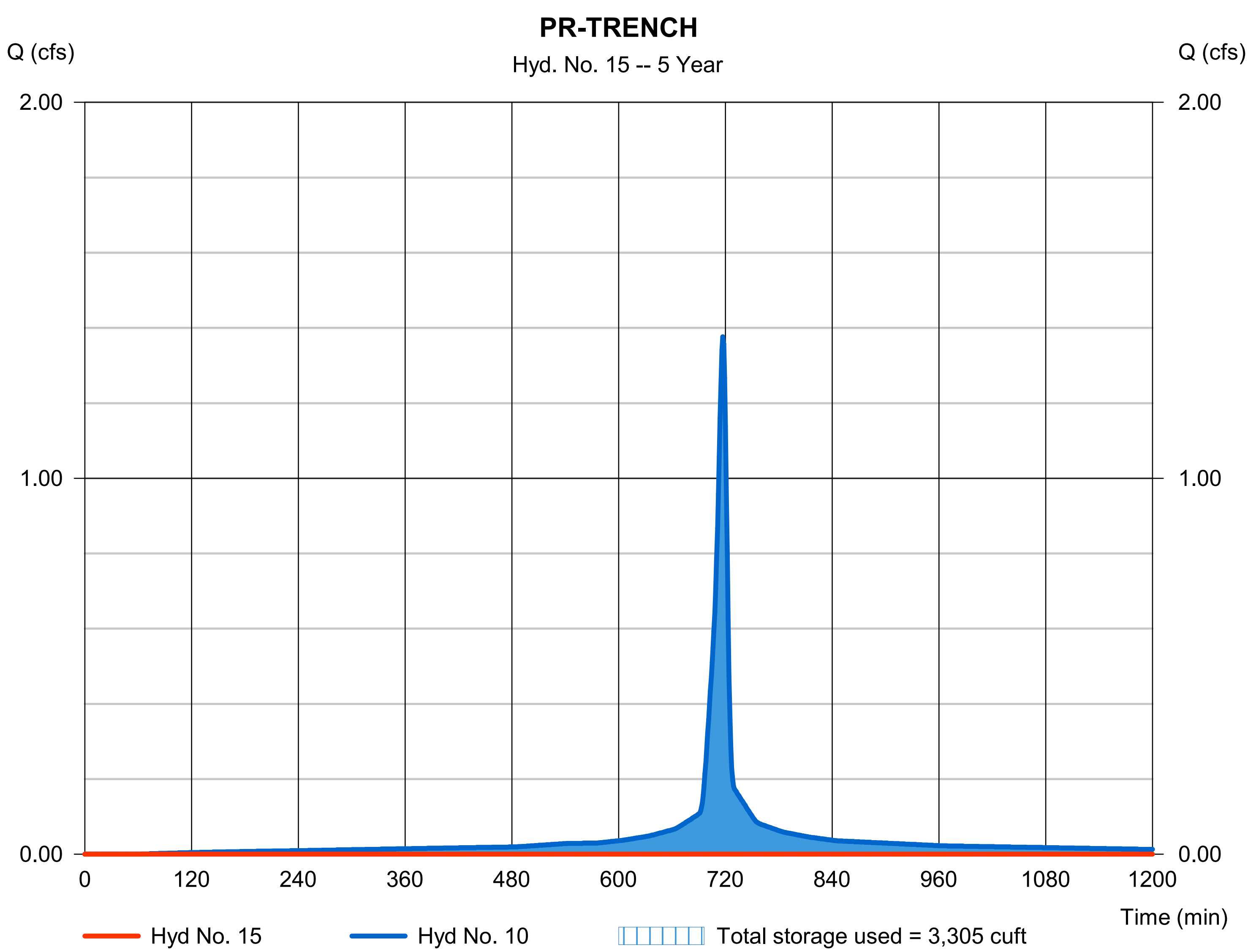
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 15

PR-TRENCH

Hydrograph type	= Reservoir	Peak discharge	= 0.000 cfs
Storm frequency	= 5 yrs	Time to peak	= n/a
Time interval	= 1 min	Hyd. volume	= 0 cuft
Inflow hyd. No.	= 10 - PR-SITE-TRENCH-GRAVMax. Elevation		= 402.26 ft
Reservoir name	= TRENCH	Max. Storage	= 3,305 cuft

Storage Indication method used.



Hydrograph Report

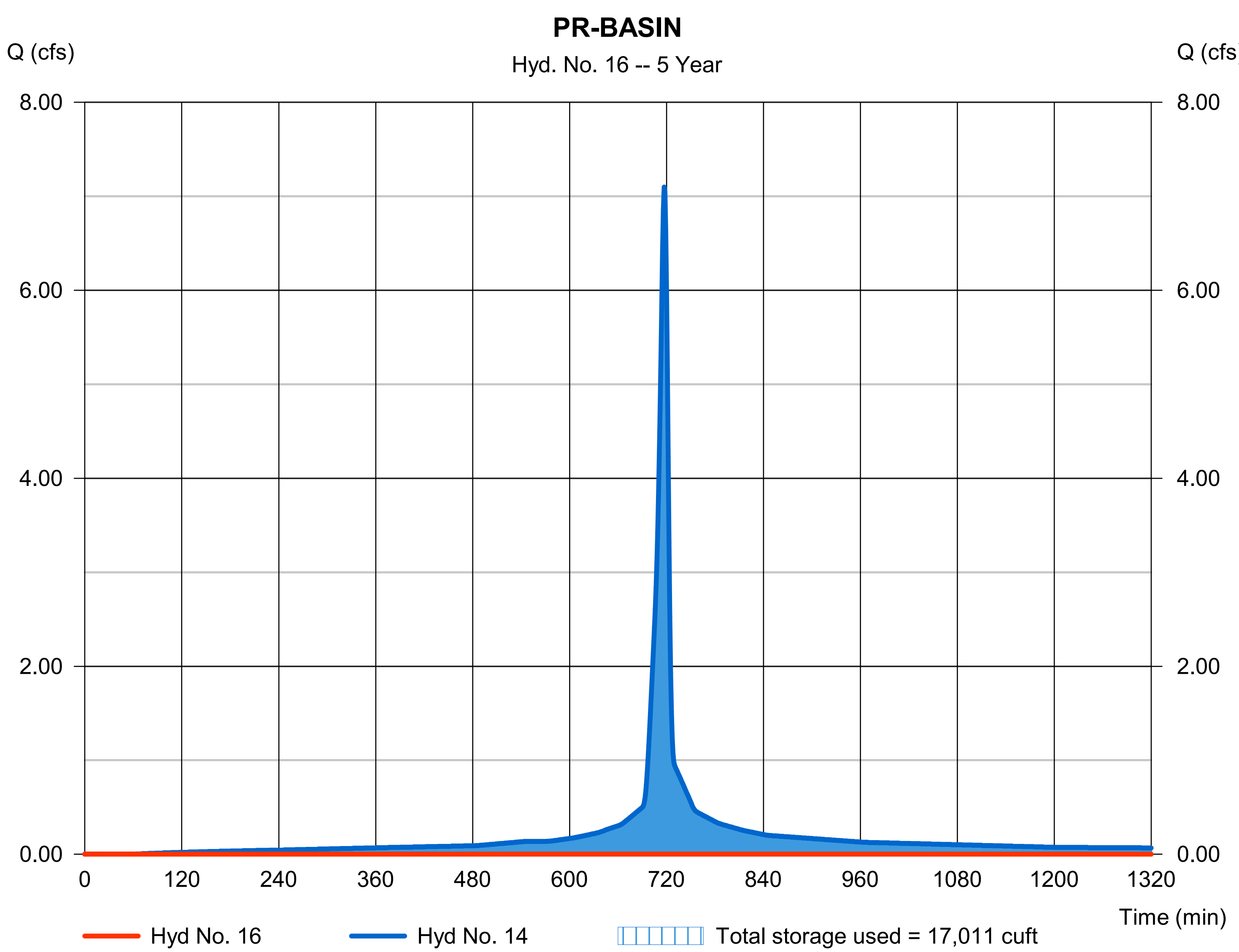
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 16

PR-BASIN

Hydrograph type	= Reservoir	Peak discharge	= 0.000 cfs
Storm frequency	= 5 yrs	Time to peak	= n/a
Time interval	= 1 min	Hyd. volume	= 0 cuft
Inflow hyd. No.	= 14 - PR-BASIN-TOTAL	Max. Elevation	= 399.06 ft
Reservoir name	= BASIN	Max. Storage	= 17,011 cuft

Storage Indication method used.



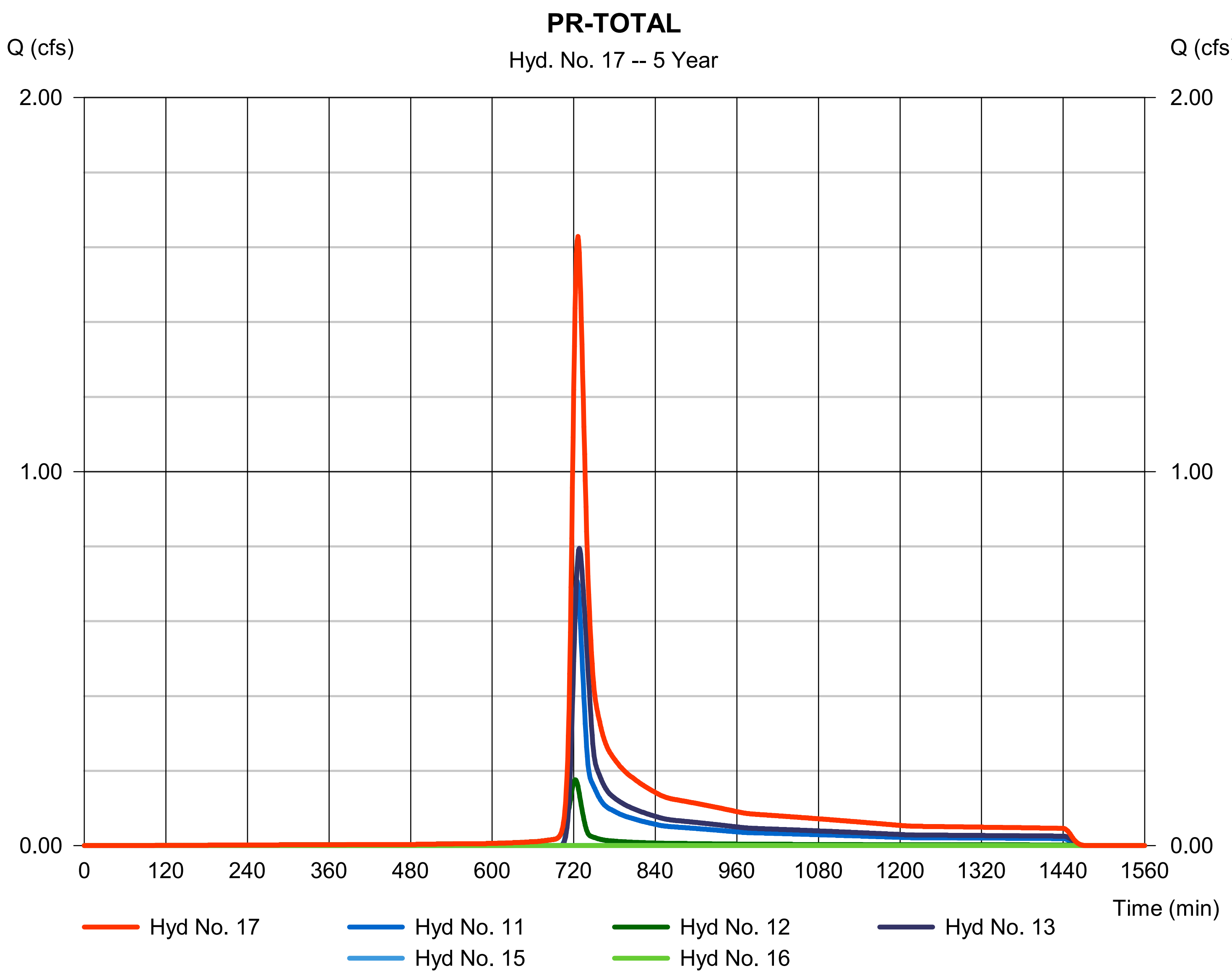
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 17

PR-TOTAL

Hydrograph type	= Combine	Peak discharge	= 1.629 cfs
Storm frequency	= 5 yrs	Time to peak	= 726 min
Time interval	= 1 min	Hyd. volume	= 6,259 cuft
Inflow hyds.	= 11, 12, 13, 15, 16	Contrib. drain. area	= 1.809 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

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	0.958	1	748	6,657	------	------	------	EX-SITE-BASIN-MEAD
2	SCS Runoff	0.299	1	745	1,952	------	------	------	EX-SITE-BASIN-IMP 80%
3	SCS Runoff	1.530	1	721	3,954	------	------	------	EX-SITE-BYPASS-MEAD
4	SCS Runoff	0.027	1	720	75	------	------	------	EX-SITE-BYPASS-IMP 80%
5	SCS Runoff	0.333	1	724	1,046	------	------	------	EX-SITE-TRENCH
6	SCS Runoff	1.364	1	727	5,039	------	------	------	EX-OFFSITE-BYPASS
7	Combine	3.512	1	724	18,722	1, 2, 3, 4, 5, 6	------	------	EX-TOTAL
8	SCS Runoff	1.179	1	718	2,459	------	------	------	PR-SITE-BASIN-MEAD
9	SCS Runoff	7.726	1	717	18,683	------	------	------	PR-SITE-BASIN-GRAV
10	SCS Runoff	1.656	1	717	4,003	------	------	------	PR-SITE-TRENCH-GRAV/IMP
11	SCS Runoff	1.201	1	724	3,769	------	------	------	PR-SITE-BYPASS-MEAD
12	SCS Runoff	0.212	1	722	693	------	------	------	PR-SITE-BYPASS-GRAV
13	SCS Runoff	1.364	1	727	5,039	------	------	------	PR-OFFSITE-BYPASS-MEAD
14	Combine	8.860	1	717	21,142	8, 9,	------	------	PR-BASIN-TOTAL
15	Reservoir	0.014	1	1360	82	10	402.50	3,924	PR-TRENCH
16	Reservoir	0.000	1	n/a	0	14	399.44	21,142	PR-BASIN
17	Combine	2.703	1	726	9,582	11, 12, 13, 15, 16	------	------	PR-TOTAL

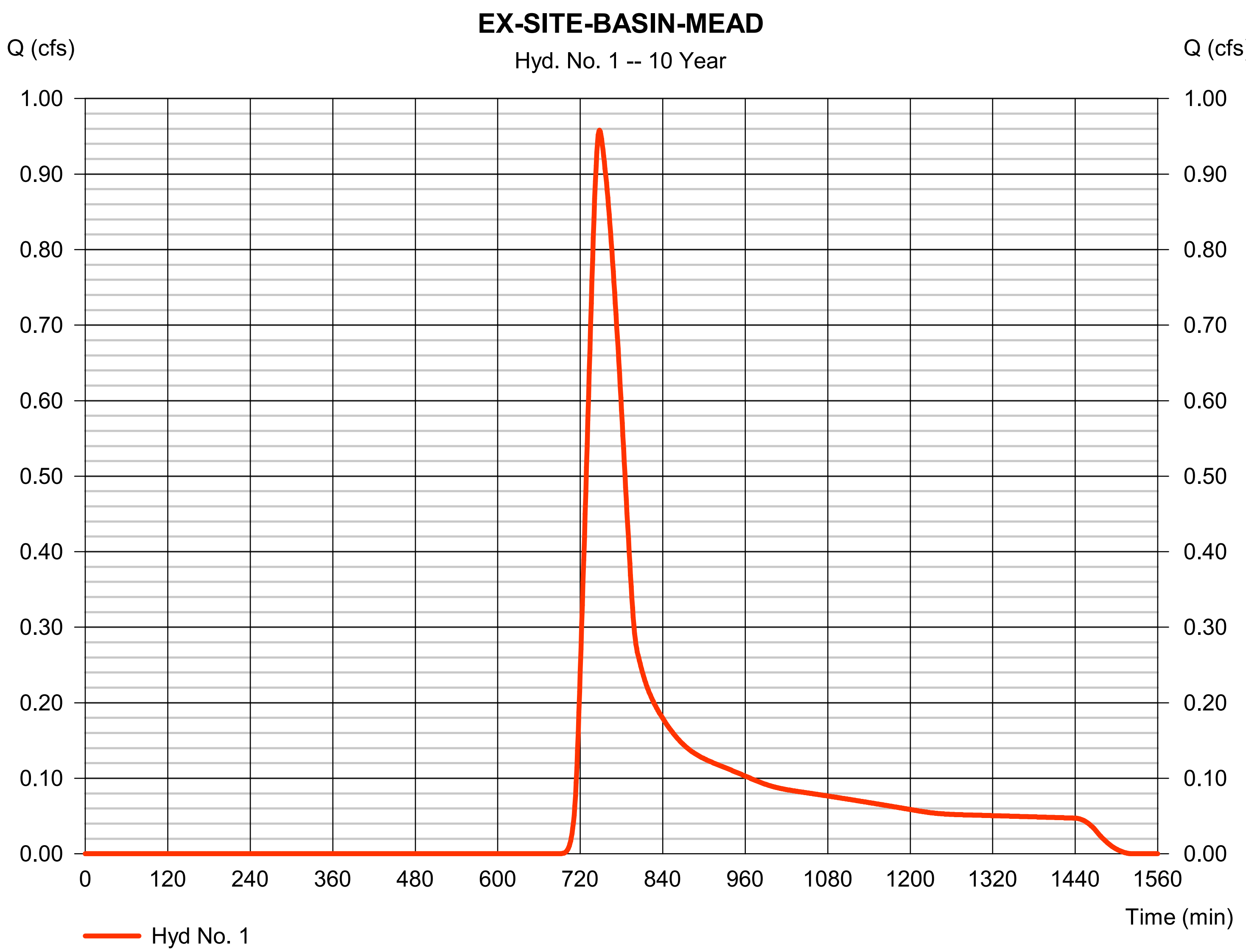
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 1

EX-SITE-BASIN-MEAD

Hydrograph type	= SCS Runoff	Peak discharge	= 0.958 cfs
Storm frequency	= 10 yrs	Time to peak	= 748 min
Time interval	= 1 min	Hyd. volume	= 6,657 cuft
Drainage area	= 1.359 ac	Curve number	= 58
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 53.40 min
Total precip.	= 5.33 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



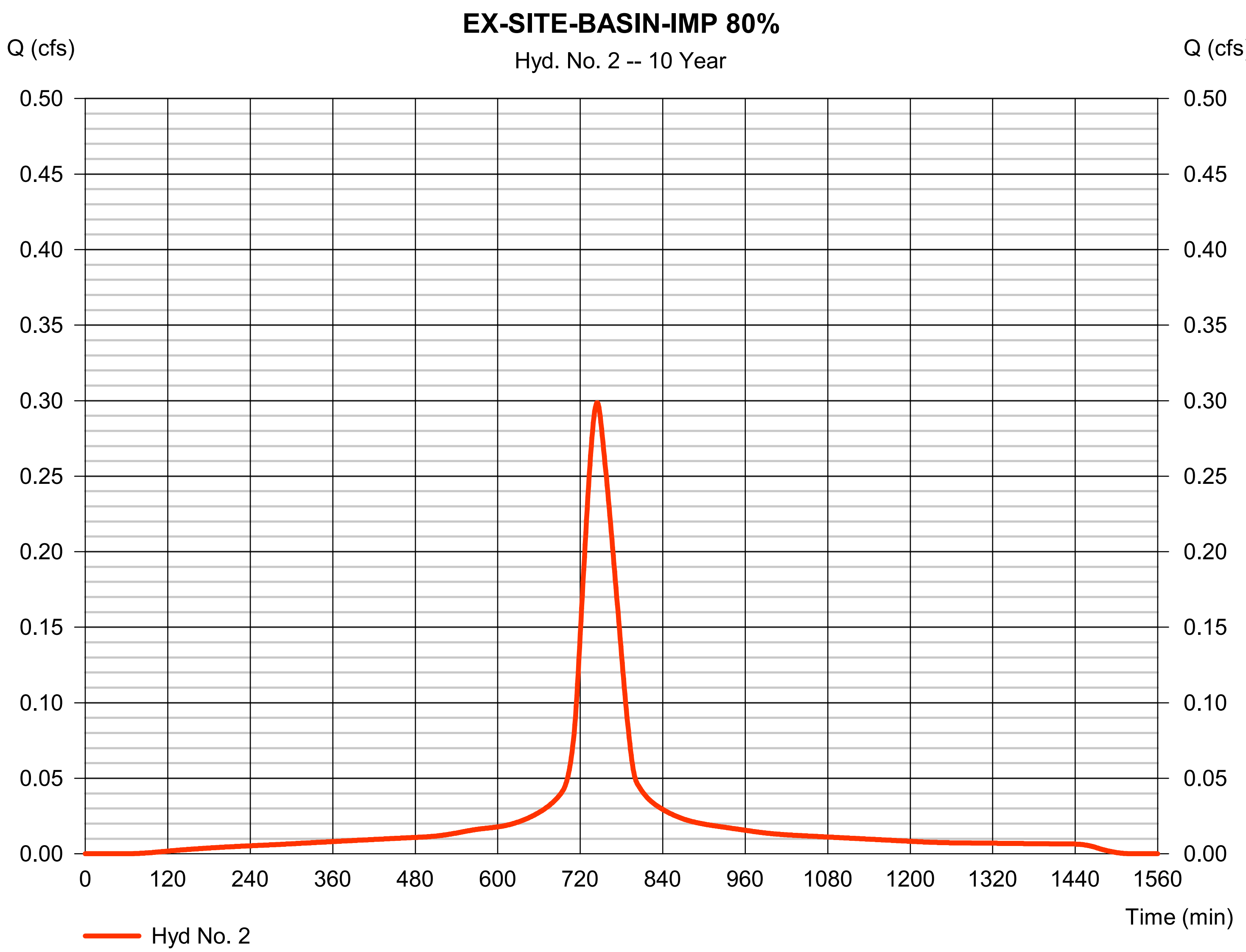
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 2

EX-SITE-BASIN-IMP 80%

Hydrograph type	= SCS Runoff	Peak discharge	= 0.299 cfs
Storm frequency	= 10 yrs	Time to peak	= 745 min
Time interval	= 1 min	Hyd. volume	= 1,952 cuft
Drainage area	= 0.106 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 53.40 min
Total precip.	= 5.33 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



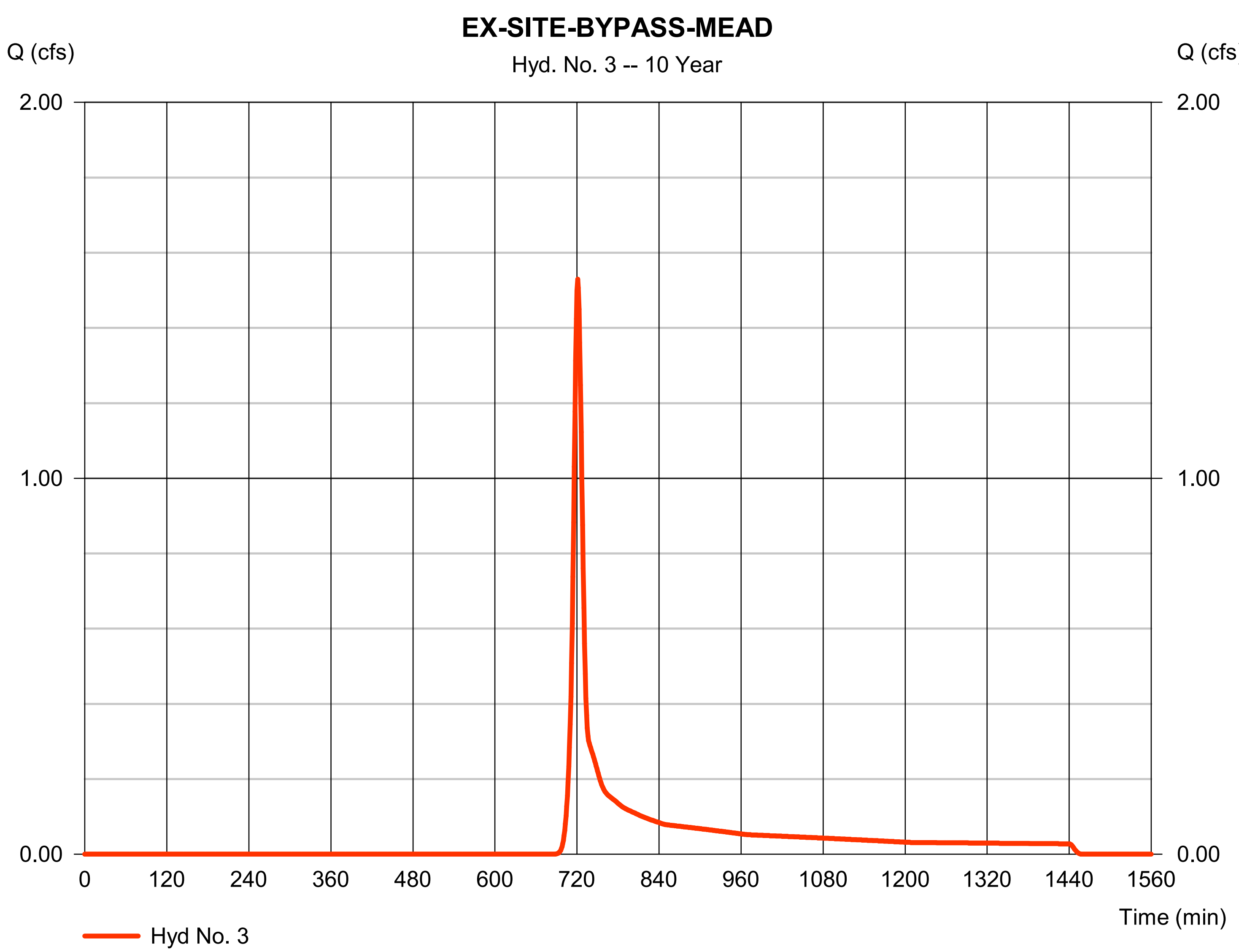
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 3

EX-SITE-BYPASS-MEAD

Hydrograph type	= SCS Runoff	Peak discharge	= 1.530 cfs
Storm frequency	= 10 yrs	Time to peak	= 721 min
Time interval	= 1 min	Hyd. volume	= 3,954 cuft
Drainage area	= 0.790 ac	Curve number	= 58
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 11.70 min
Total precip.	= 5.33 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



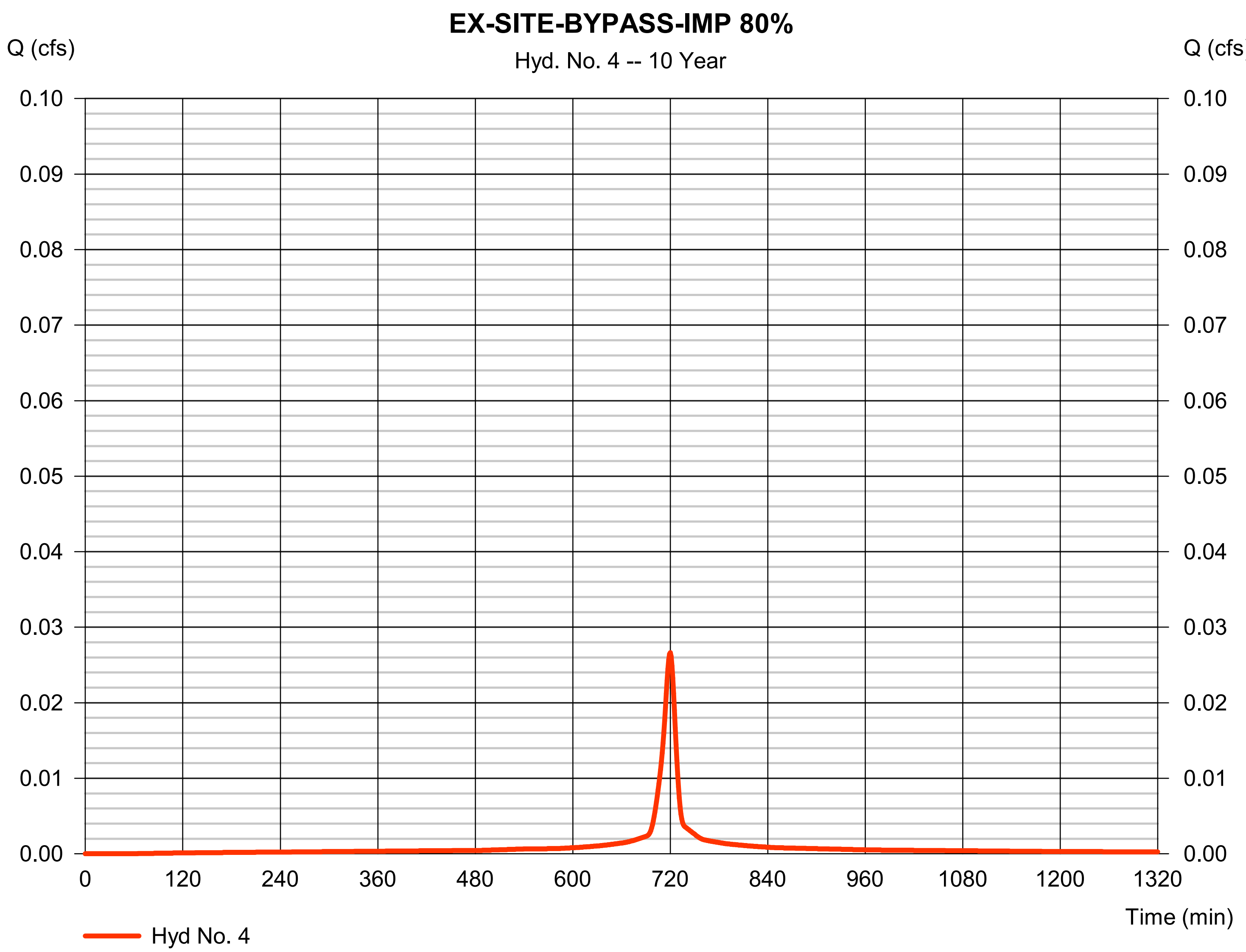
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 — Thursday, 02 / 20 / 2020

Hyd. No. 4

EX-SITE-BYPASS-IMP 80%

Hydrograph type	= SCS Runoff	Peak discharge	= 0.027 cfs
Storm frequency	= 10 yrs	Time to peak	= 720 min
Time interval	= 1 min	Hyd. volume	= 75 cuft
Drainage area	= 0.004 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 11.70 min
Total precip.	= 5.33 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



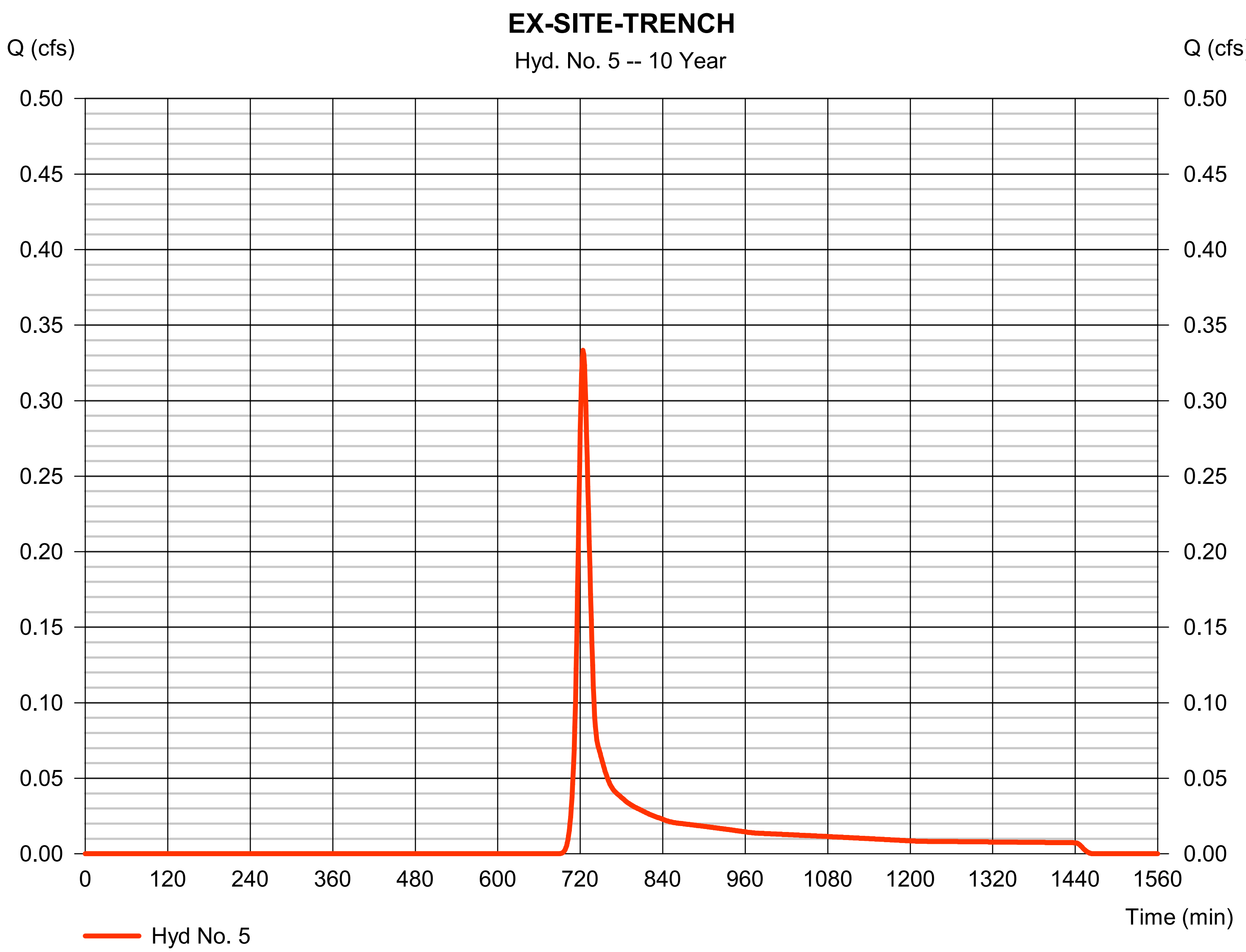
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 — Thursday, 02 / 20 / 2020

Hyd. No. 5

EX-SITE-TRENCH

Hydrograph type	= SCS Runoff	Peak discharge	= 0.333 cfs
Storm frequency	= 10 yrs	Time to peak	= 724 min
Time interval	= 1 min	Hyd. volume	= 1,046 cuft
Drainage area	= 0.210 ac	Curve number	= 58
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 15.90 min
Total precip.	= 5.33 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



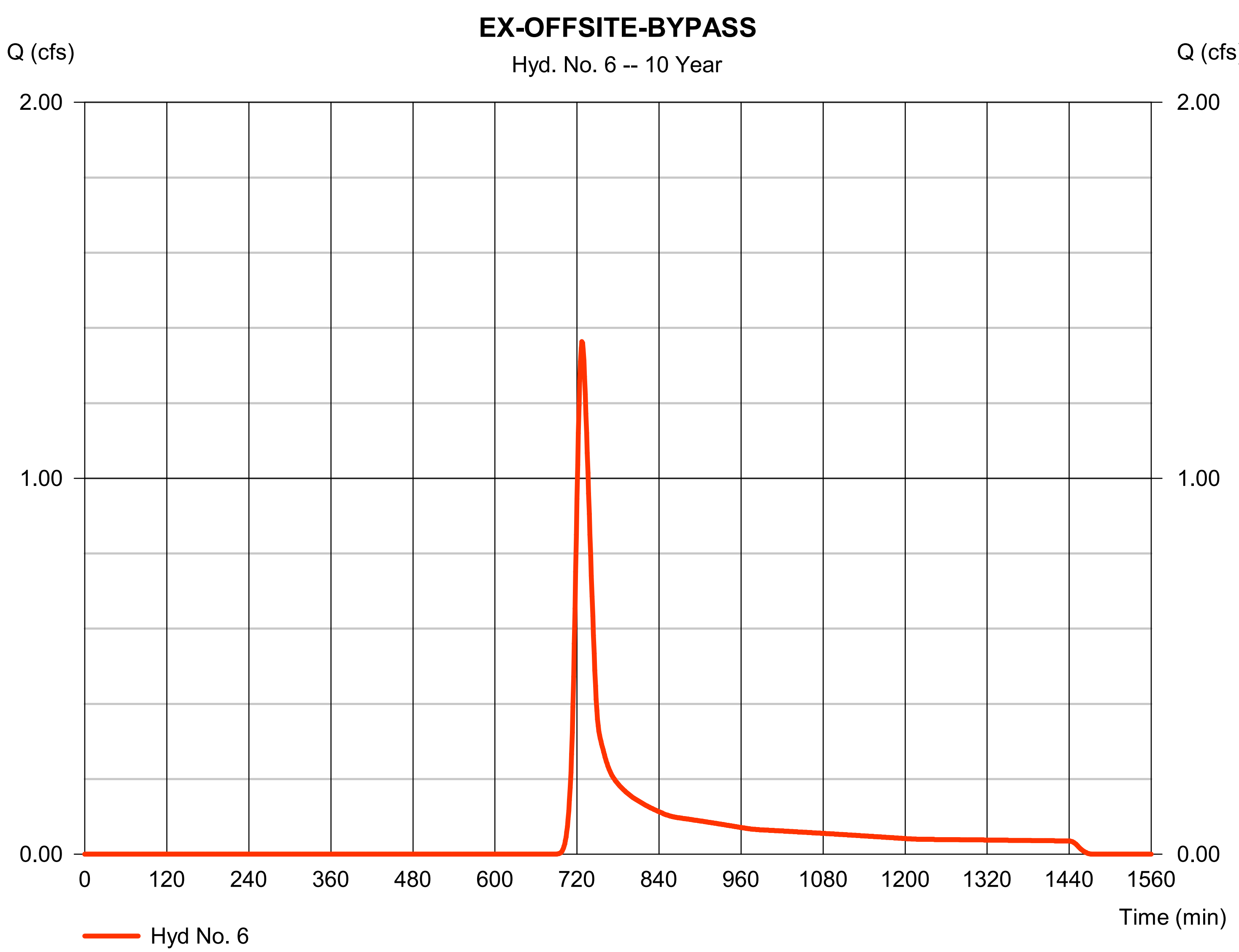
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 6

EX-OFFSITE-BYPASS

Hydrograph type	= SCS Runoff	Peak discharge	= 1.364 cfs
Storm frequency	= 10 yrs	Time to peak	= 727 min
Time interval	= 1 min	Hyd. volume	= 5,039 cuft
Drainage area	= 1.015 ac	Curve number	= 58
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 20.90 min
Total precip.	= 5.33 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



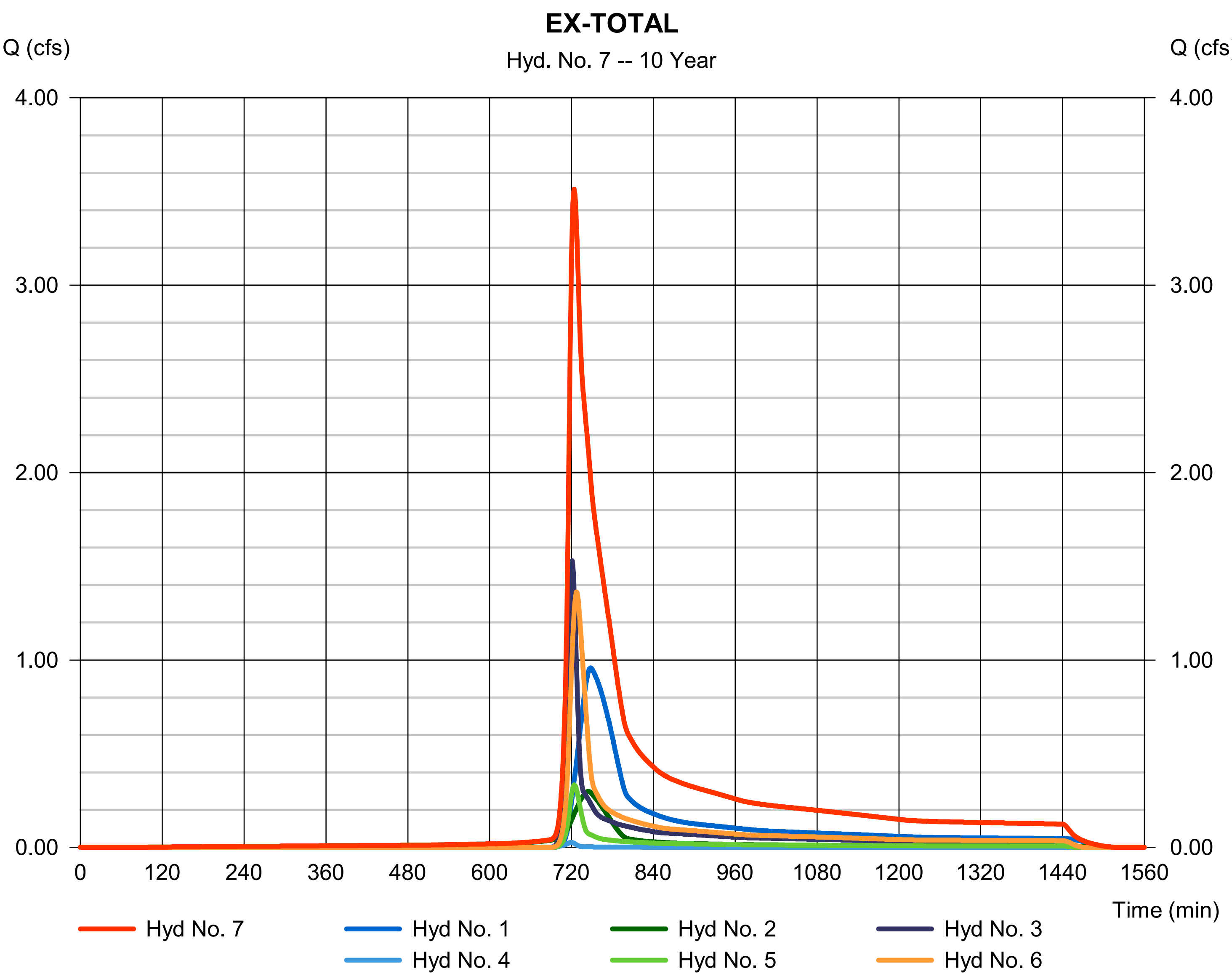
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 — Thursday, 02 / 20 / 2020

Hyd. No. 7

EX-TOTAL

Hydrograph type	= Combine	Peak discharge	= 3.512 cfs
Storm frequency	= 10 yrs	Time to peak	= 724 min
Time interval	= 1 min	Hyd. volume	= 18,722 cuft
Inflow hyds.	= 1, 2, 3, 4, 5, 6	Contrib. drain. area	= 3.484 ac



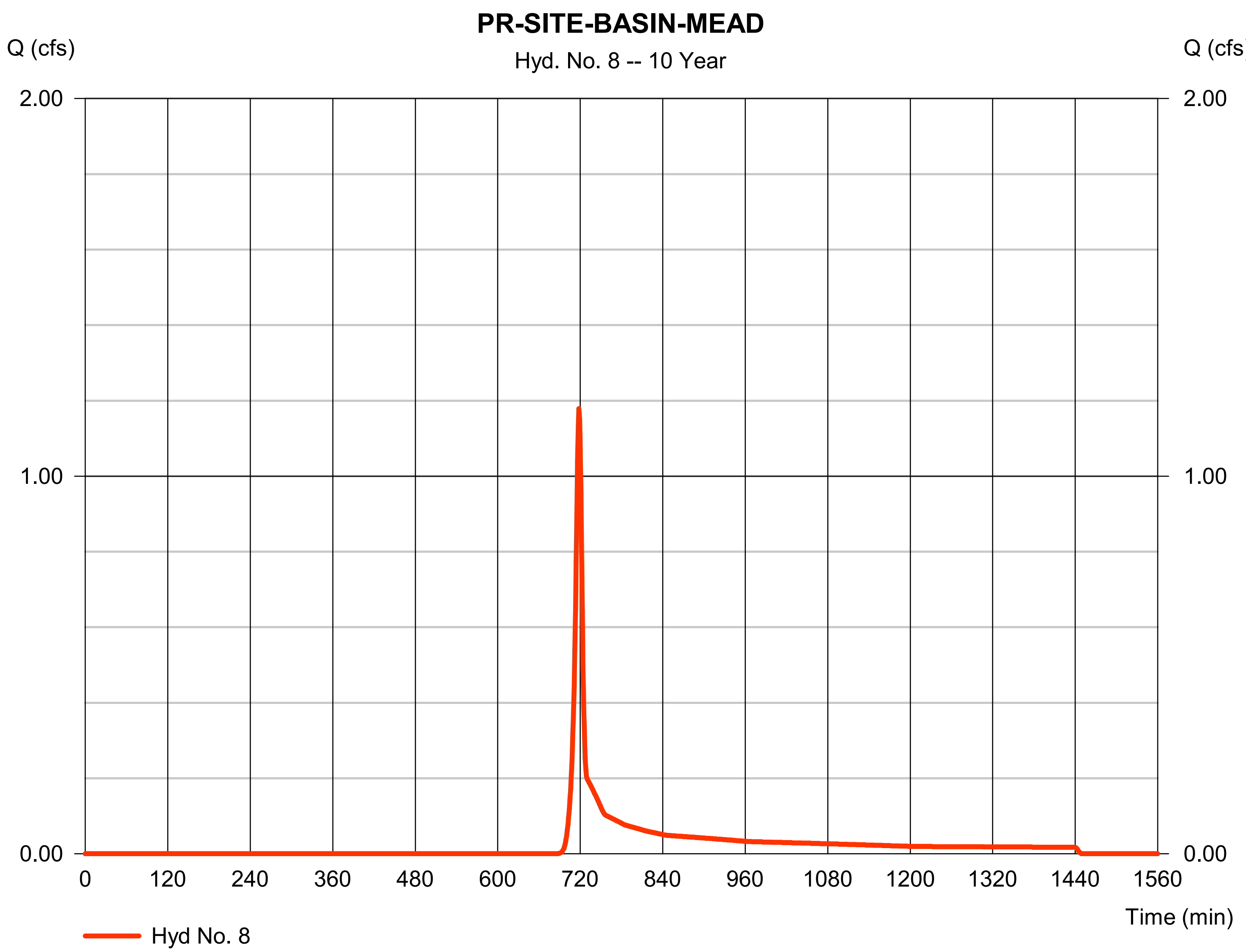
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 8

PR-SITE-BASIN-MEAD

Hydrograph type	= SCS Runoff	Peak discharge	= 1.179 cfs
Storm frequency	= 10 yrs	Time to peak	= 718 min
Time interval	= 1 min	Hyd. volume	= 2,459 cuft
Drainage area	= 0.485 ac	Curve number	= 58
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 5.33 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



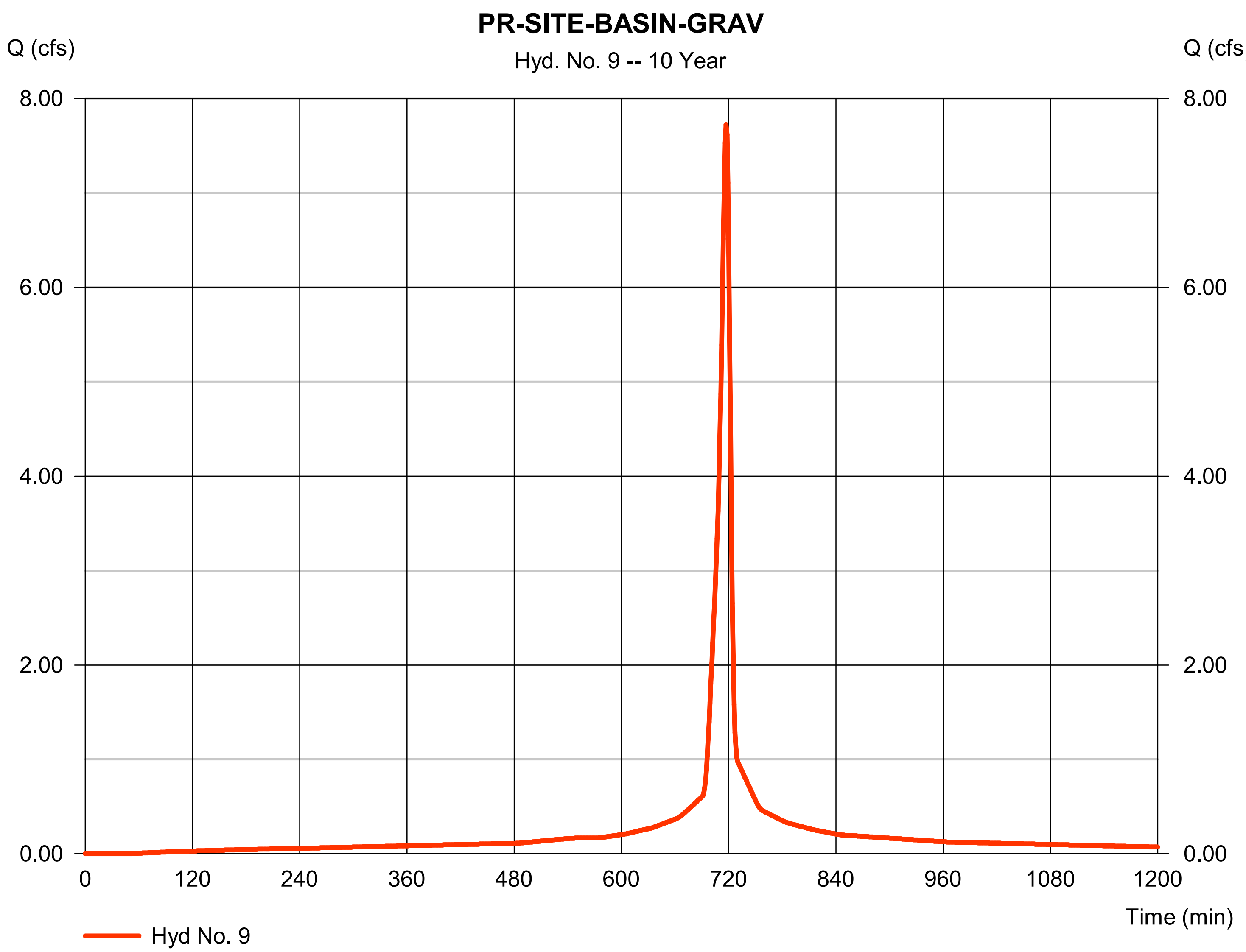
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 9

PR-SITE-BASIN-GRAV

Hydrograph type	= SCS Runoff	Peak discharge	= 7.726 cfs
Storm frequency	= 10 yrs	Time to peak	= 717 min
Time interval	= 1 min	Hyd. volume	= 18,683 cuft
Drainage area	= 0.980 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 5.33 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



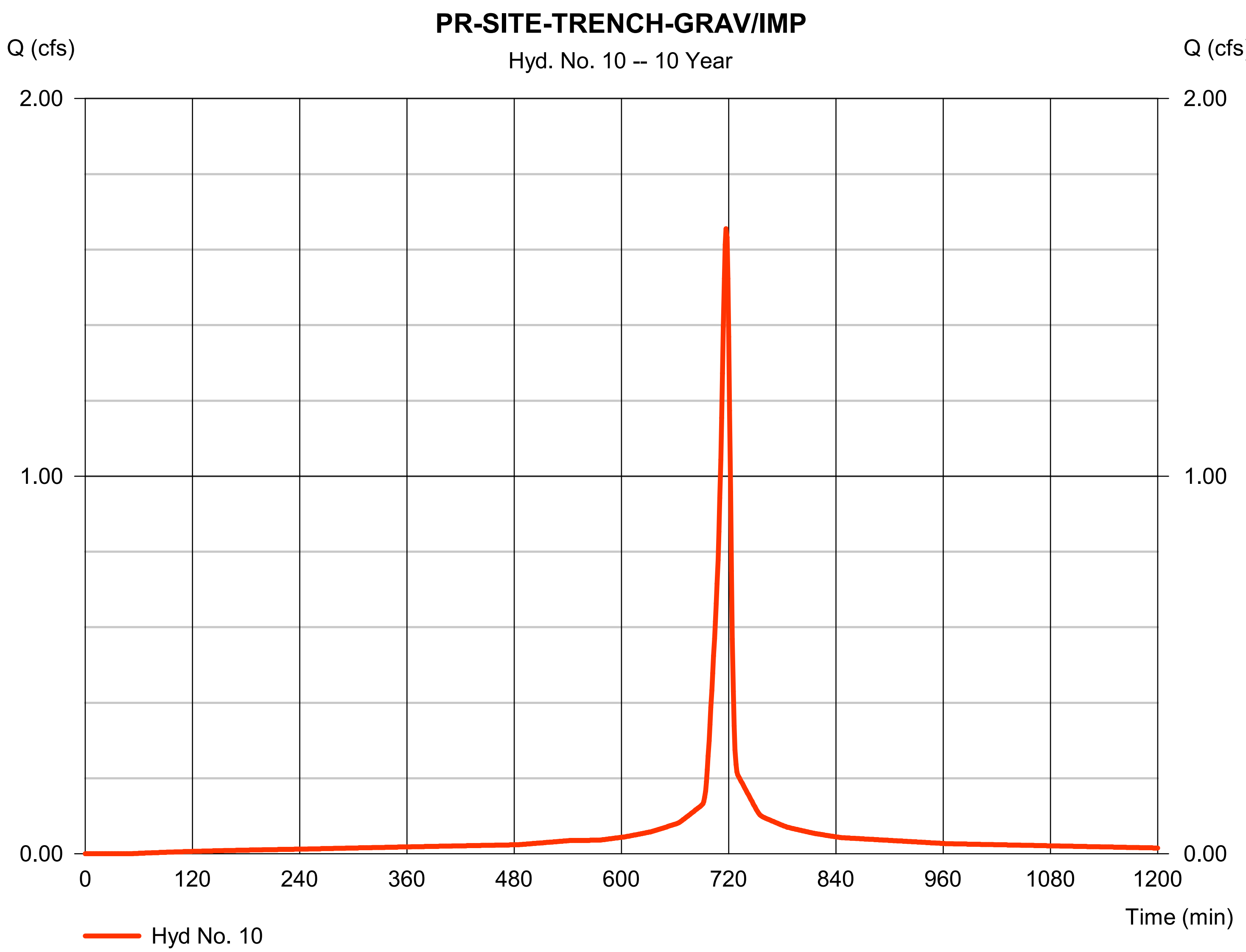
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 — Thursday, 02 / 20 / 2020

Hyd. No. 10

PR-SITE-TRENCH-GRAV/IMP

Hydrograph type	= SCS Runoff	Peak discharge	= 1.656 cfs
Storm frequency	= 10 yrs	Time to peak	= 717 min
Time interval	= 1 min	Hyd. volume	= 4,003 cuft
Drainage area	= 0.210 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 5.33 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

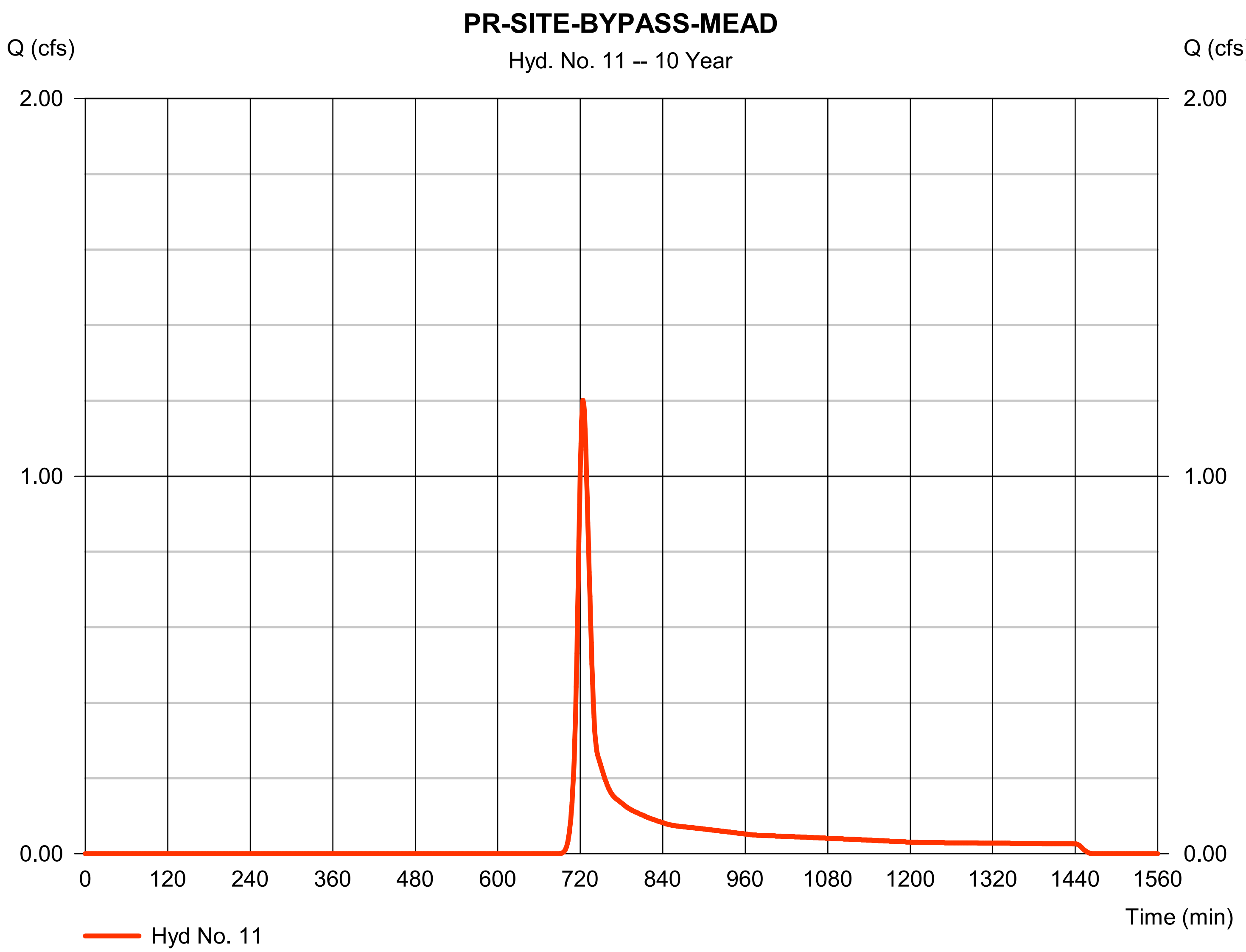


Hydrograph Report

Hyd. No. 11

PR-SITE-BYPASS-MEAD

Hydrograph type	= SCS Runoff	Peak discharge	= 1.201 cfs
Storm frequency	= 10 yrs	Time to peak	= 724 min
Time interval	= 1 min	Hyd. volume	= 3,769 cuft
Drainage area	= 0.757 ac	Curve number	= 58
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 16.10 min
Total precip.	= 5.33 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



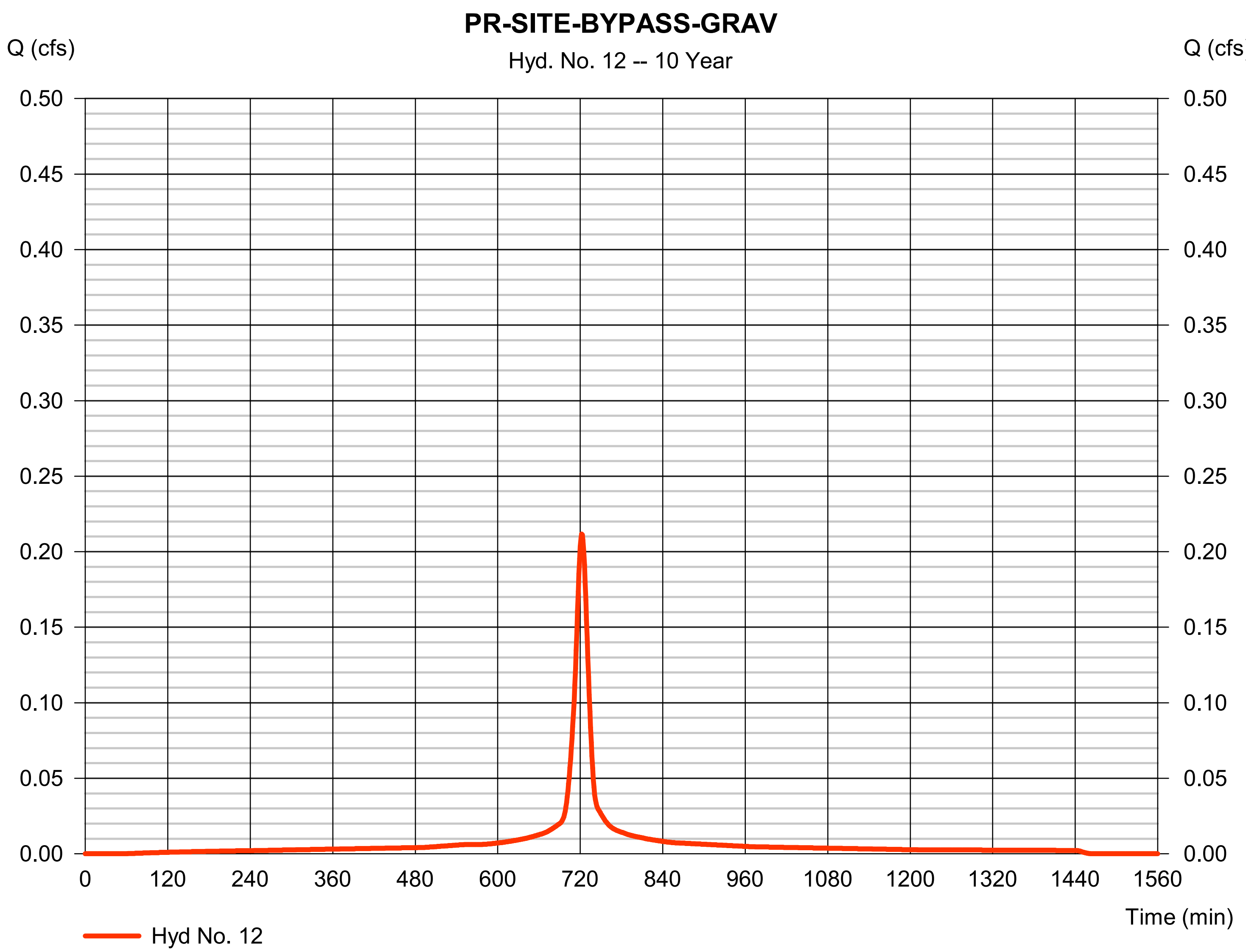
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 | Thursday, 02 / 20 / 2020

Hyd. No. 12

PR-SITE-BYPASS-GRAV

Hydrograph type	= SCS Runoff	Peak discharge	= 0.212 cfs
Storm frequency	= 10 yrs	Time to peak	= 722 min
Time interval	= 1 min	Hyd. volume	= 693 cuft
Drainage area	= 0.037 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 16.10 min
Total precip.	= 5.33 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



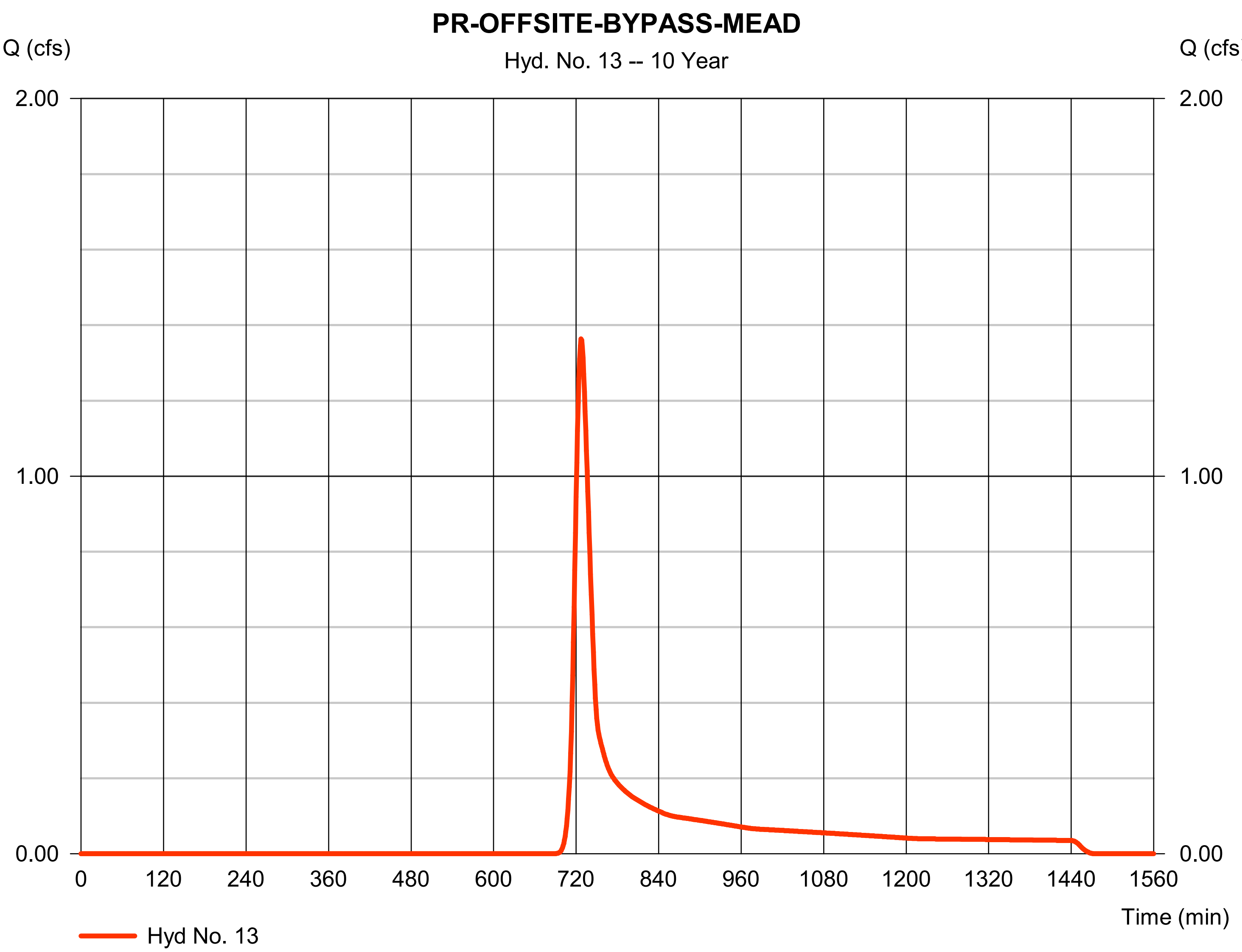
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 13

PR-OFFSITE-BYPASS-MEAD

Hydrograph type	= SCS Runoff	Peak discharge	= 1.364 cfs
Storm frequency	= 10 yrs	Time to peak	= 727 min
Time interval	= 1 min	Hyd. volume	= 5,039 cuft
Drainage area	= 1.015 ac	Curve number	= 58
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 20.90 min
Total precip.	= 5.33 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



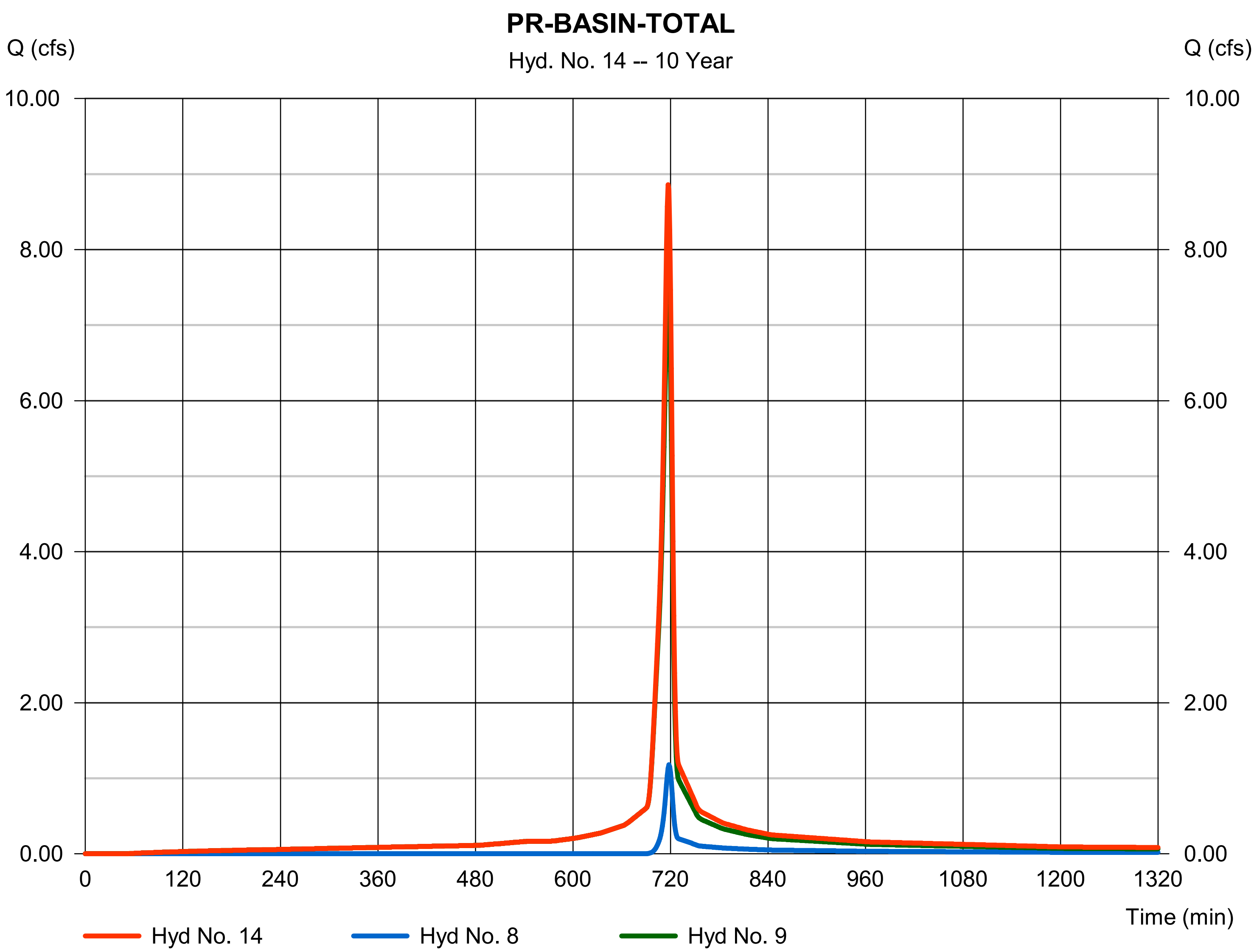
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 14

PR-BASIN-TOTAL

Hydrograph type	= Combine	Peak discharge	= 8.860 cfs
Storm frequency	= 10 yrs	Time to peak	= 717 min
Time interval	= 1 min	Hyd. volume	= 21,142 cuft
Inflow hyds.	= 8, 9	Contrib. drain. area	= 1.465 ac



Hydrograph Report

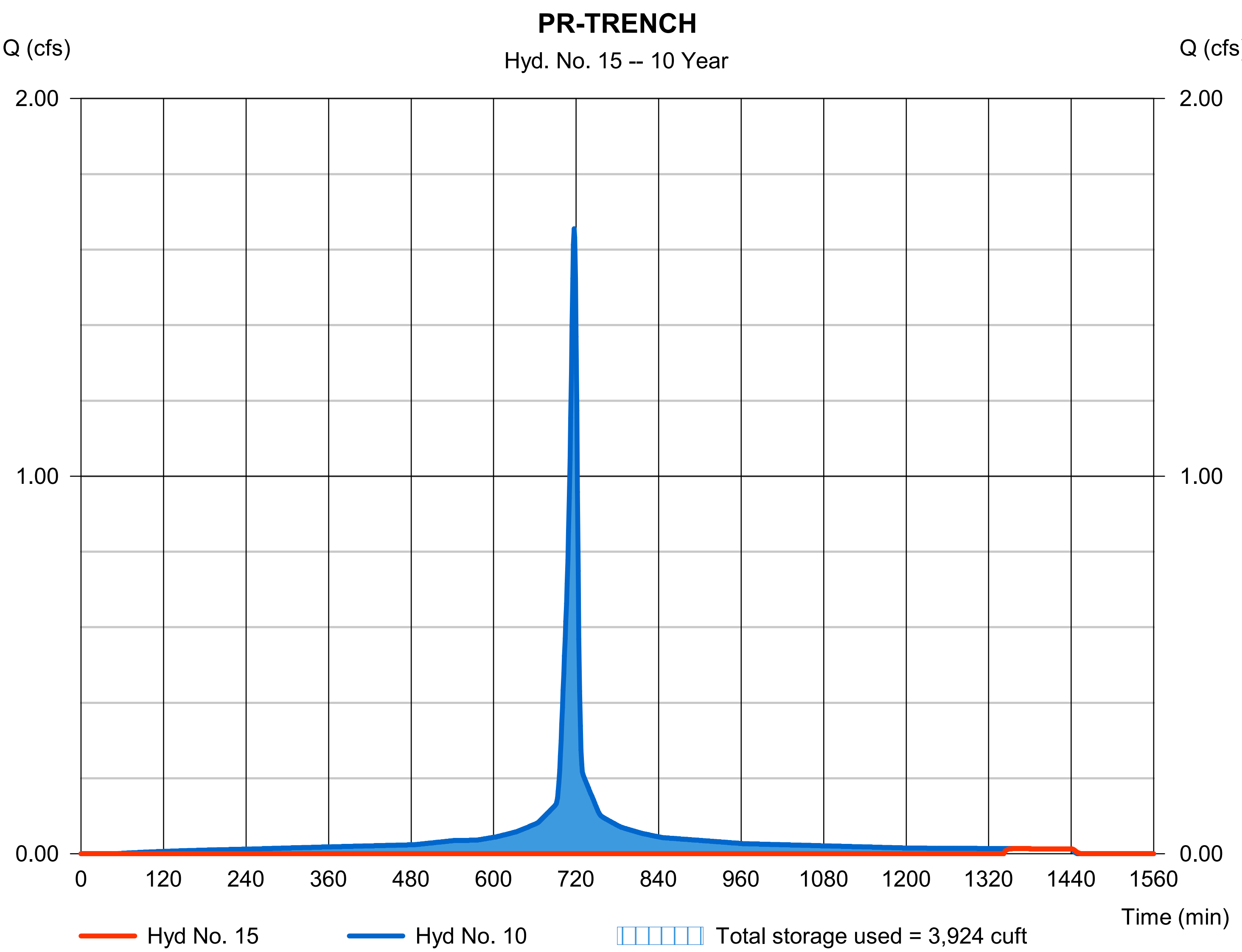
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 15

PR-TRENCH

Hydrograph type	= Reservoir	Peak discharge	= 0.014 cfs
Storm frequency	= 10 yrs	Time to peak	= 1360 min
Time interval	= 1 min	Hyd. volume	= 82 cuft
Inflow hyd. No.	= 10 - PR-SITE-TRENCH-GRAVMMP	Max. Elevation	= 402.50 ft
Reservoir name	= TRENCH	Max. Storage	= 3,924 cuft

Storage Indication method used.



Hydrograph Report

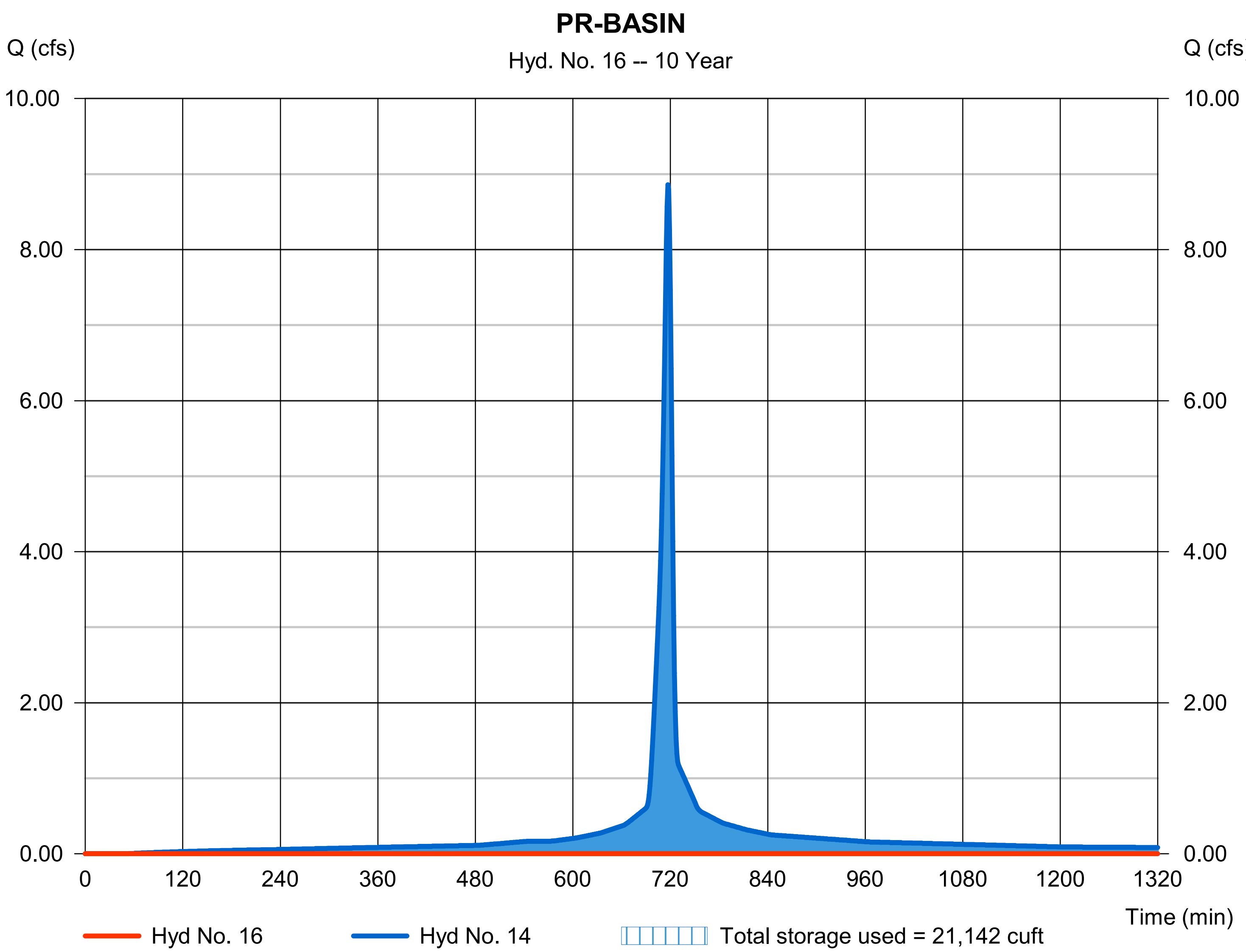
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 16

PR-BASIN

Hydrograph type	= Reservoir	Peak discharge	= 0.000 cfs
Storm frequency	= 10 yrs	Time to peak	= n/a
Time interval	= 1 min	Hyd. volume	= 0 cuft
Inflow hyd. No.	= 14 - PR-BASIN-TOTAL	Max. Elevation	= 399.44 ft
Reservoir name	= BASIN	Max. Storage	= 21,142 cuft

Storage Indication method used.



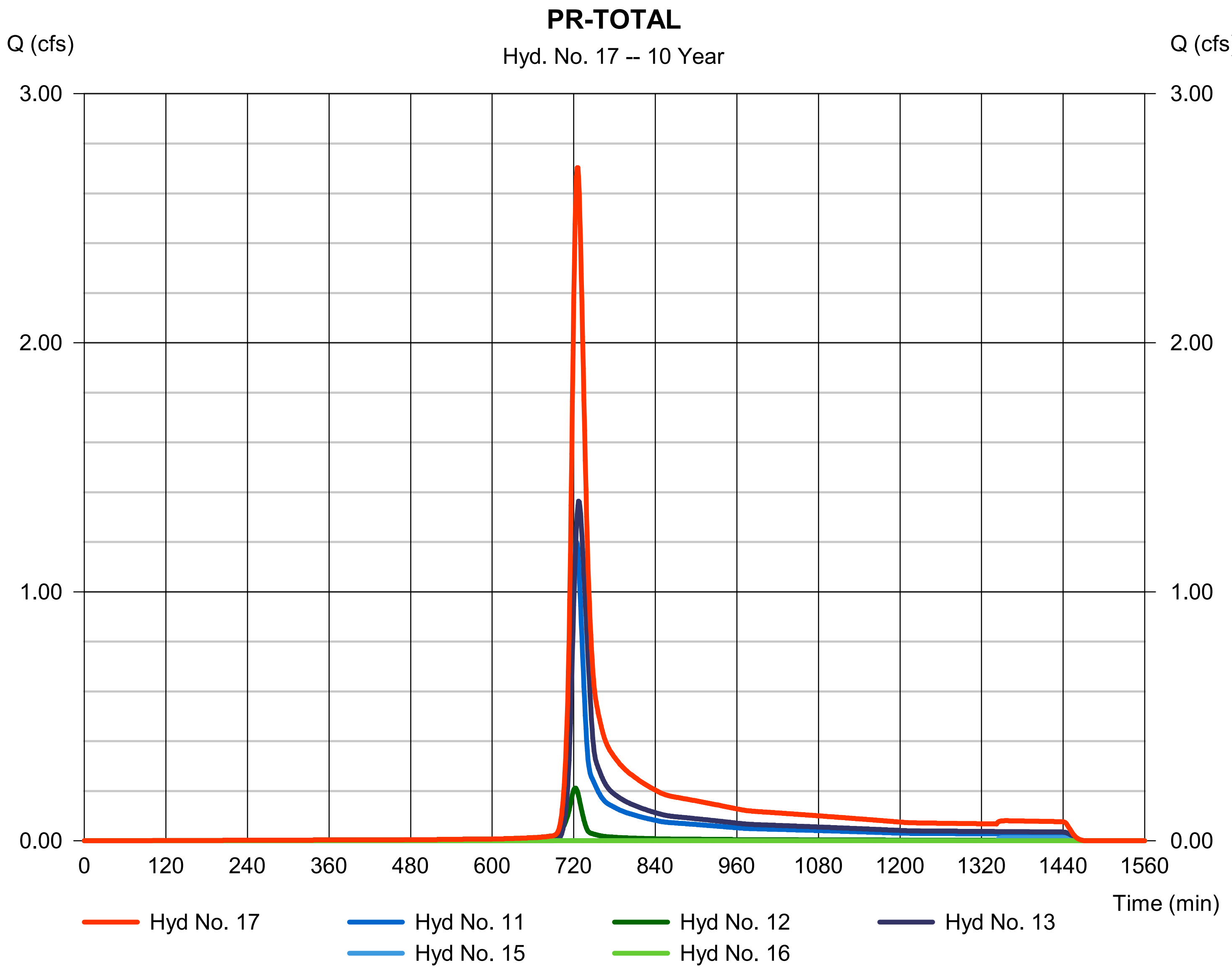
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 17

PR-TOTAL

Hydrograph type	= Combine	Peak discharge	= 2.703 cfs
Storm frequency	= 10 yrs	Time to peak	= 726 min
Time interval	= 1 min	Hyd. volume	= 9,582 cuft
Inflow hyds.	= 11, 12, 13, 15, 16	Contrib. drain. area	= 1.809 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

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	1.685	1	747	10,783	------	------	------	EX-SITE-BASIN-MEAD
2	SCS Runoff	0.375	1	745	2,469	------	------	------	EX-SITE-BASIN-IMP 80%
3	SCS Runoff	2.589	1	721	6,405	------	------	------	EX-SITE-BYPASS-MEAD
4	SCS Runoff	0.033	1	720	95	------	------	------	EX-SITE-BYPASS-IMP 80%
5	SCS Runoff	0.571	1	724	1,694	------	------	------	EX-SITE-TRENCH
6	SCS Runoff	2.359	1	727	8,163	------	------	------	EX-OFFSITE-BYPASS
7	Combine	6.045	1	723	29,609	1, 2, 3, 4, 5, 6	------	------	EX-TOTAL
8	SCS Runoff	1.968	1	718	3,984	------	------	------	PR-SITE-BASIN-MEAD
9	SCS Runoff	9.699	1	717	23,630	------	------	------	PR-SITE-BASIN-GRAV
10	SCS Runoff	2.078	1	717	5,064	------	------	------	PR-SITE-TRENCH-GRAV/IMP
11	SCS Runoff	2.058	1	724	6,105	------	------	------	PR-SITE-BYPASS-MEAD
12	SCS Runoff	0.266	1	722	876	------	------	------	PR-SITE-BYPASS-GRAV
13	SCS Runoff	2.359	1	727	8,163	------	------	------	PR-OFFSITE-BYPASS-MEAD
14	Combine	11.62	1	717	27,614	8, 9,	------	------	PR-BASIN-TOTAL
15	Reservoir	0.074	1	807	1,142	10	402.51	3,935	PR-TRENCH
16	Reservoir	0.127	1	1176	3,012	14	399.80	25,140	PR-BASIN
17	Combine	4.582	1	725	19,298	11, 12, 13, 15, 16	------	------	PR-TOTAL

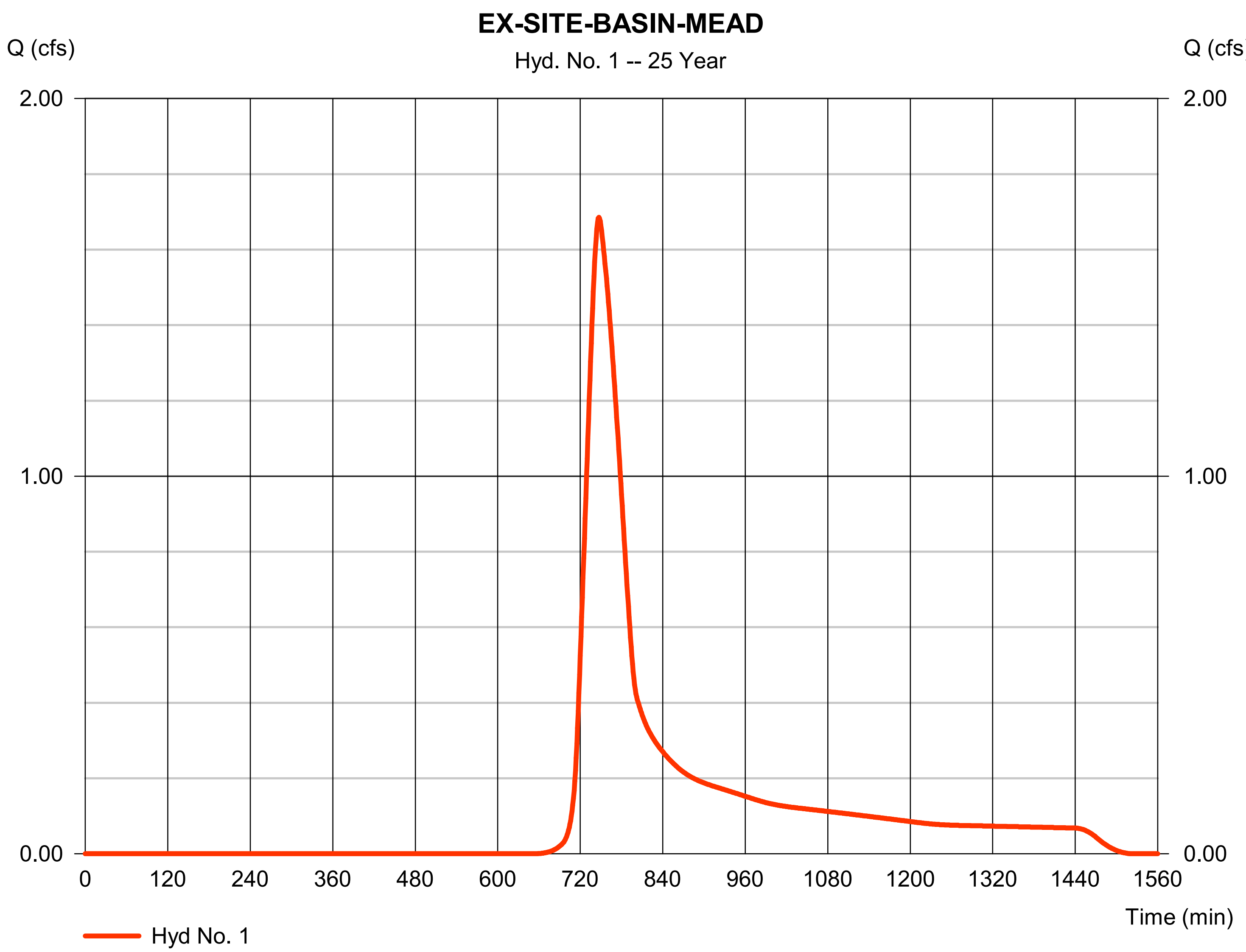
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 1

EX-SITE-BASIN-MEAD

Hydrograph type	= SCS Runoff	Peak discharge	= 1.685 cfs
Storm frequency	= 25 yrs	Time to peak	= 747 min
Time interval	= 1 min	Hyd. volume	= 10,783 cuft
Drainage area	= 1.359 ac	Curve number	= 58
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 53.40 min
Total precip.	= 6.68 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

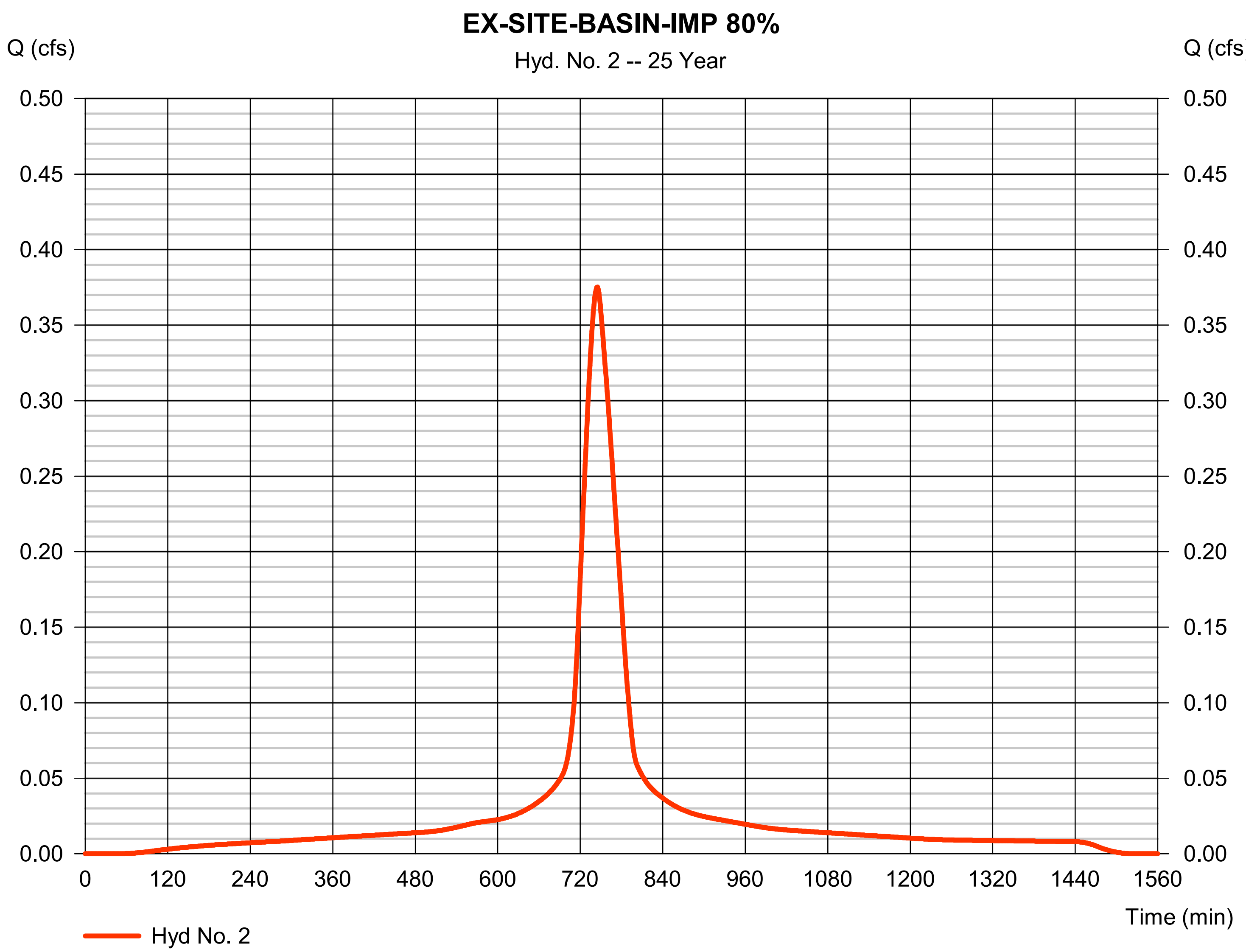


Hydrograph Report

Hyd. No. 2

EX-SITE-BASIN-IMP 80%

Hydrograph type	= SCS Runoff	Peak discharge	= 0.375 cfs
Storm frequency	= 25 yrs	Time to peak	= 745 min
Time interval	= 1 min	Hyd. volume	= 2,469 cuft
Drainage area	= 0.106 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 53.40 min
Total precip.	= 6.68 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



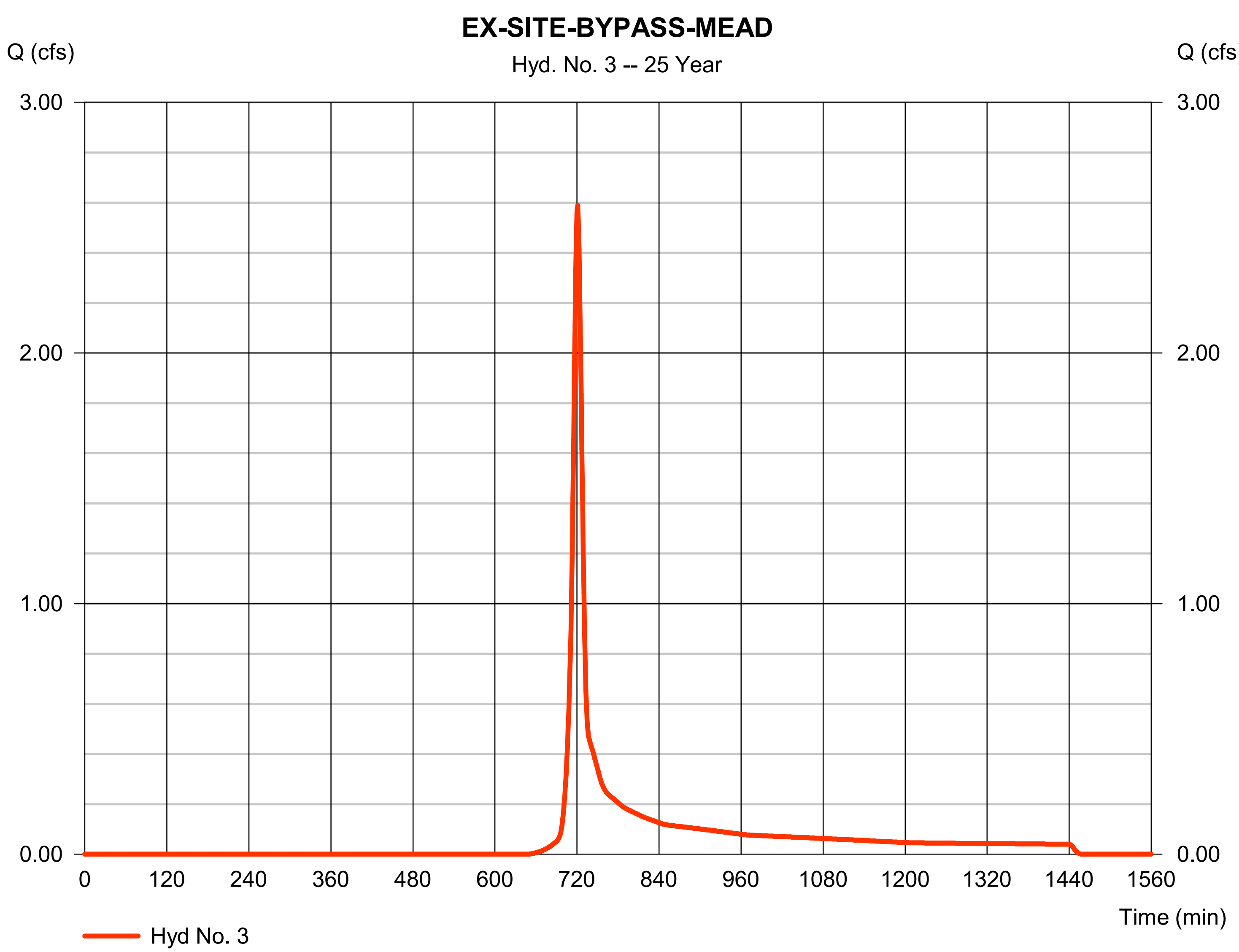
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 — Thursday, 02 / 20 / 2020

Hyd. No. 3

EX-SITE-BYPASS-MEAD

Hydrograph type	= SCS Runoff	Peak discharge	= 2.589 cfs
Storm frequency	= 25 yrs	Time to peak	= 721 min
Time interval	= 1 min	Hyd. volume	= 6,405 cuft
Drainage area	= 0.790 ac	Curve number	= 58
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 11.70 min
Total precip.	= 6.68 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



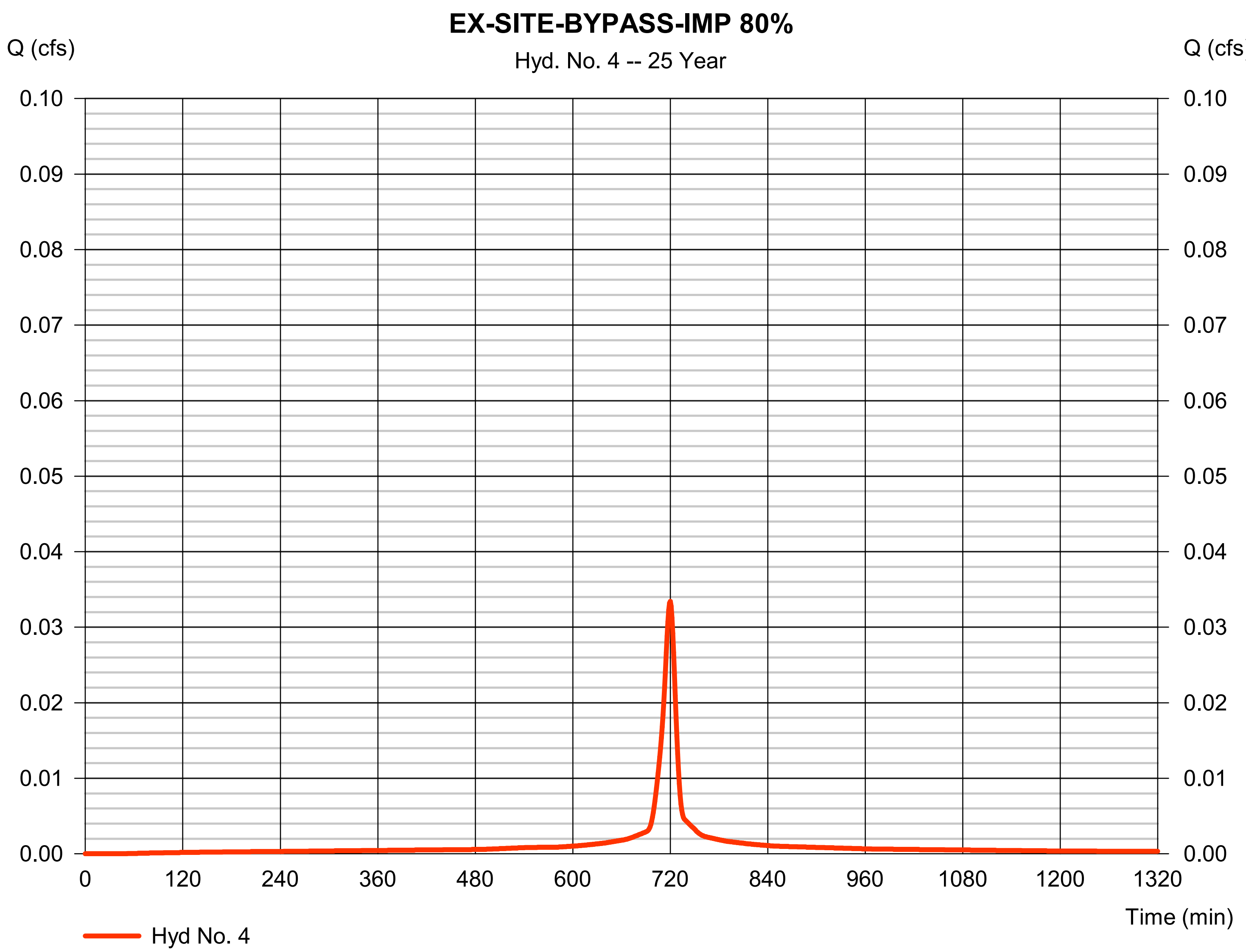
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 4

EX-SITE-BYPASS-IMP 80%

Hydrograph type	= SCS Runoff	Peak discharge	= 0.033 cfs
Storm frequency	= 25 yrs	Time to peak	= 720 min
Time interval	= 1 min	Hyd. volume	= 95 cuft
Drainage area	= 0.004 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 11.70 min
Total precip.	= 6.68 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



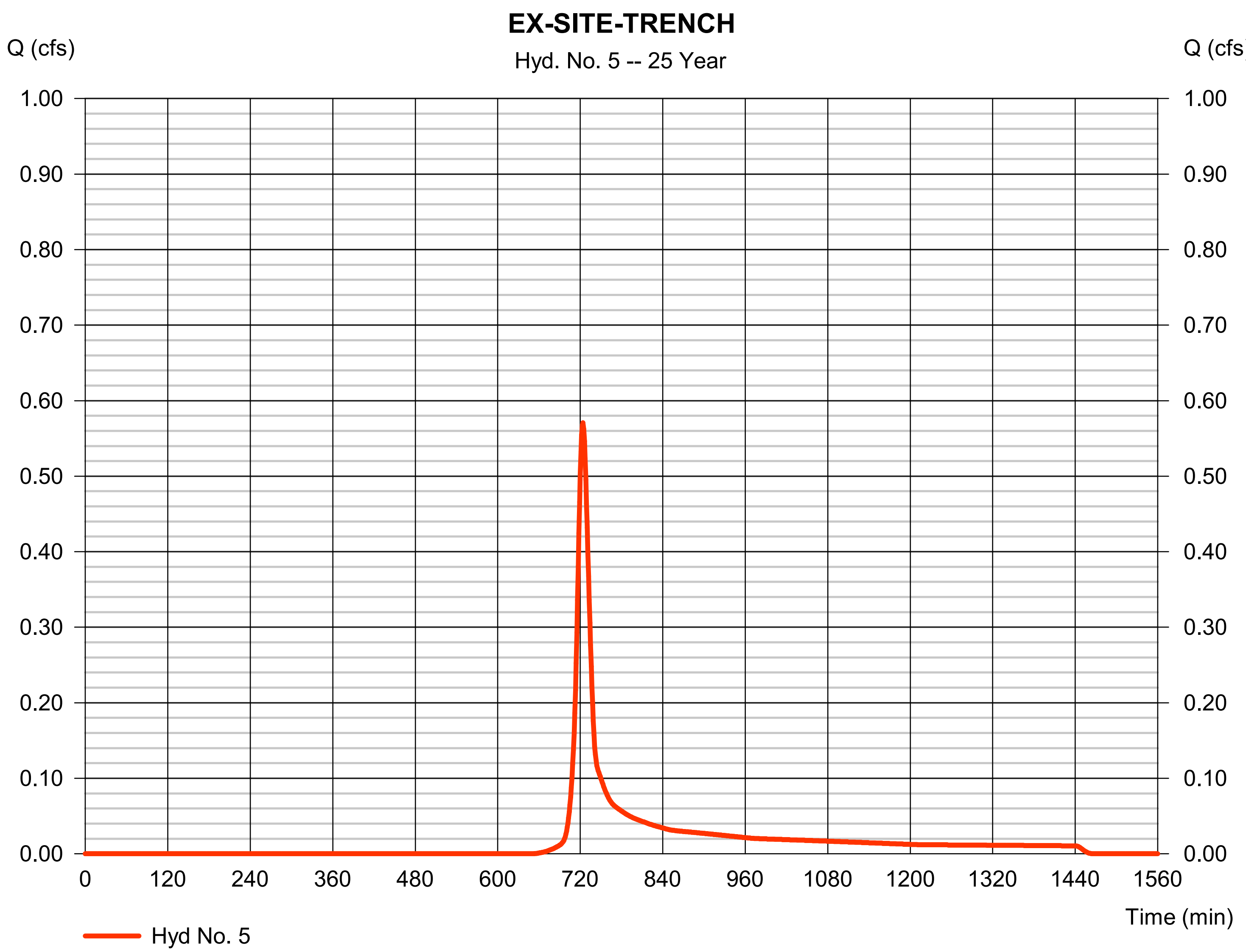
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 — Thursday, 02 / 20 / 2020

Hyd. No. 5

EX-SITE-TRENCH

Hydrograph type	= SCS Runoff	Peak discharge	= 0.571 cfs
Storm frequency	= 25 yrs	Time to peak	= 724 min
Time interval	= 1 min	Hyd. volume	= 1,694 cuft
Drainage area	= 0.210 ac	Curve number	= 58
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 15.90 min
Total precip.	= 6.68 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



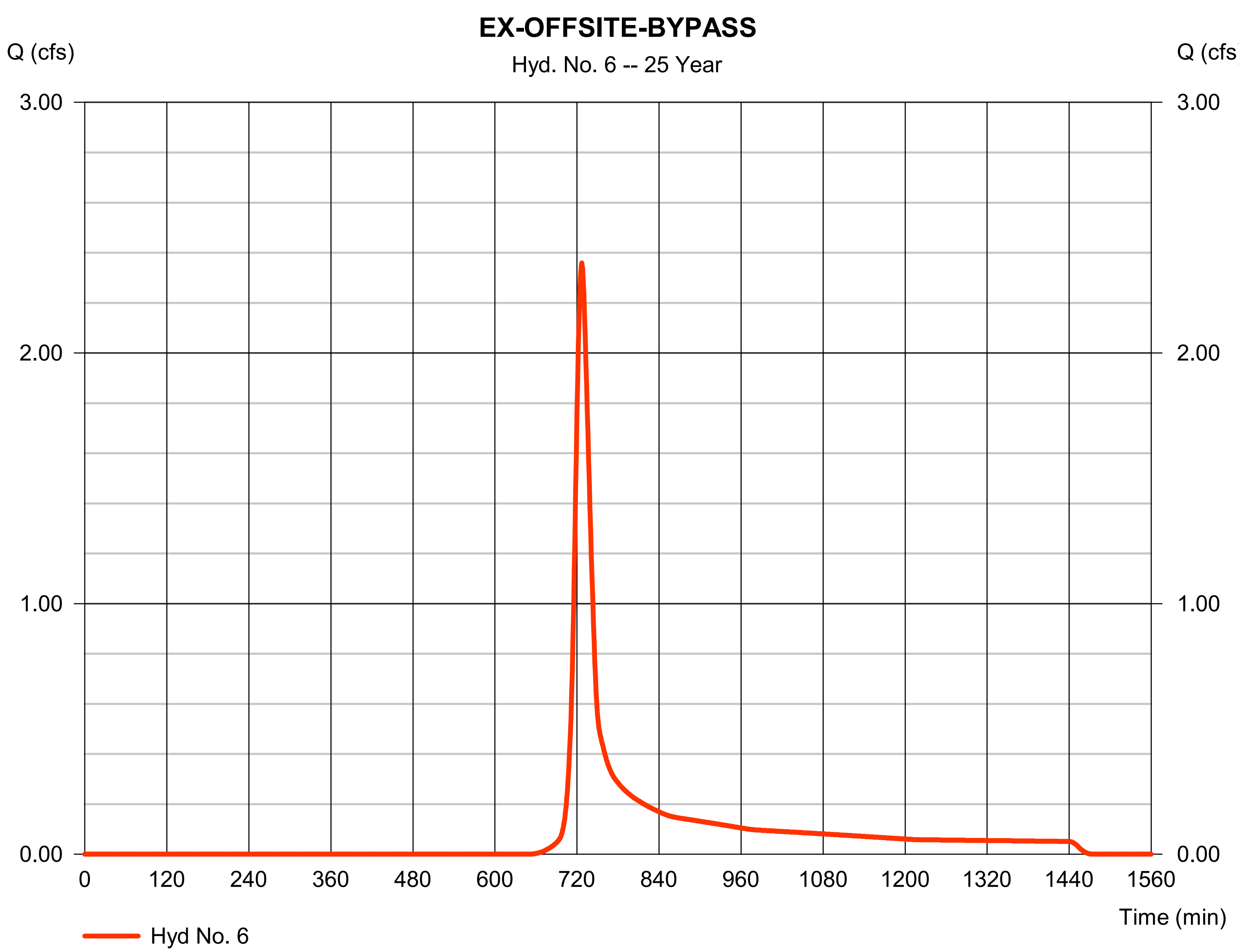
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 — Thursday, 02 / 20 / 2020

Hyd. No. 6

EX-OFFSITE-BYPASS

Hydrograph type	= SCS Runoff	Peak discharge	= 2.359 cfs
Storm frequency	= 25 yrs	Time to peak	= 727 min
Time interval	= 1 min	Hyd. volume	= 8,163 cuft
Drainage area	= 1.015 ac	Curve number	= 58
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 20.90 min
Total precip.	= 6.68 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



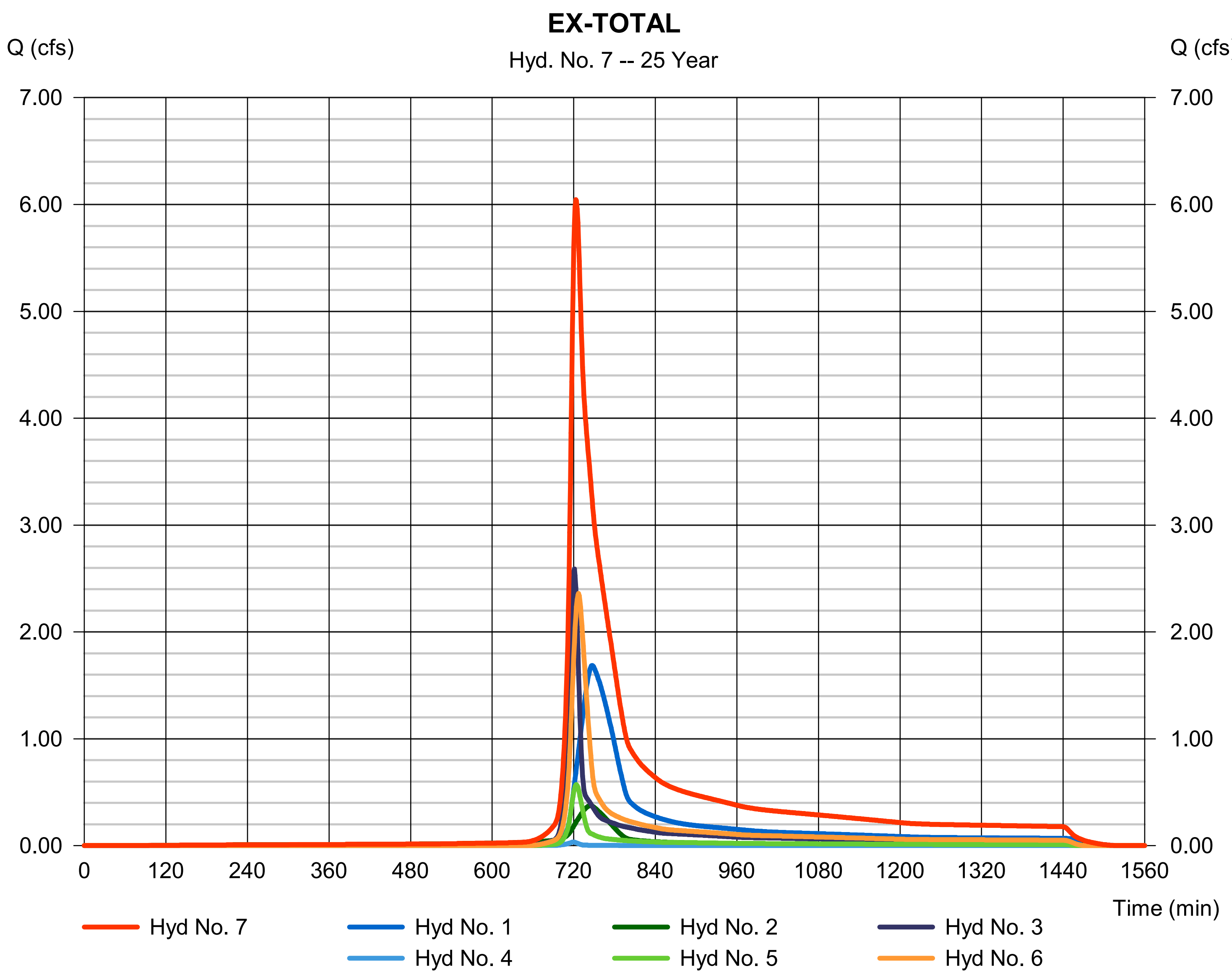
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 7

EX-TOTAL

Hydrograph type	= Combine	Peak discharge	= 6.045 cfs
Storm frequency	= 25 yrs	Time to peak	= 723 min
Time interval	= 1 min	Hyd. volume	= 29,609 cuft
Inflow hyds.	= 1, 2, 3, 4, 5, 6	Contrib. drain. area	= 3.484 ac



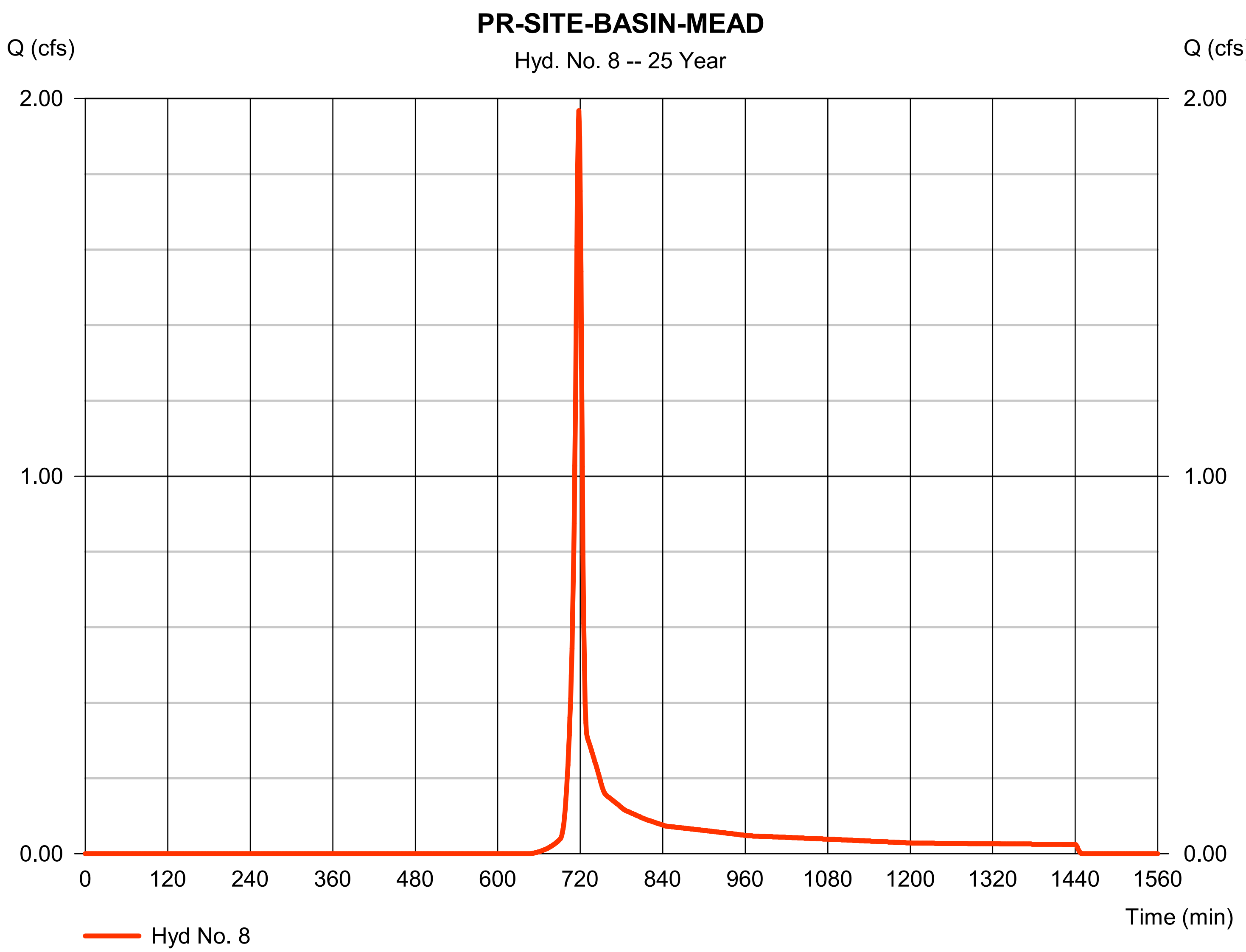
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 — Thursday, 02 / 20 / 2020

Hyd. No. 8

PR-SITE-BASIN-MEAD

Hydrograph type	= SCS Runoff	Peak discharge	= 1.968 cfs
Storm frequency	= 25 yrs	Time to peak	= 718 min
Time interval	= 1 min	Hyd. volume	= 3,984 cuft
Drainage area	= 0.485 ac	Curve number	= 58
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 6.68 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



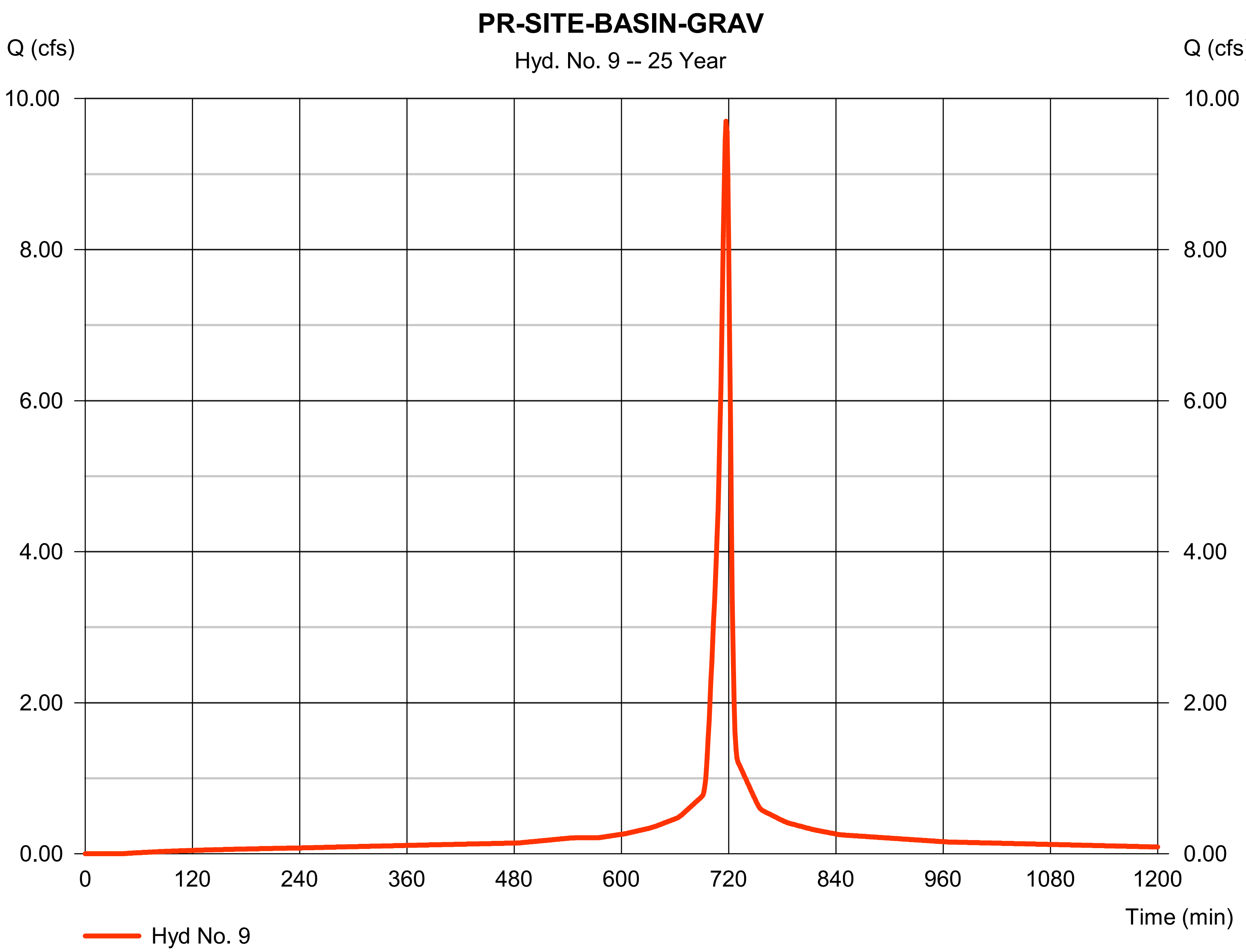
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 9

PR-SITE-BASIN-GRAV

Hydrograph type	= SCS Runoff	Peak discharge	= 9.699 cfs
Storm frequency	= 25 yrs	Time to peak	= 717 min
Time interval	= 1 min	Hyd. volume	= 23,630 cuft
Drainage area	= 0.980 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 6.68 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



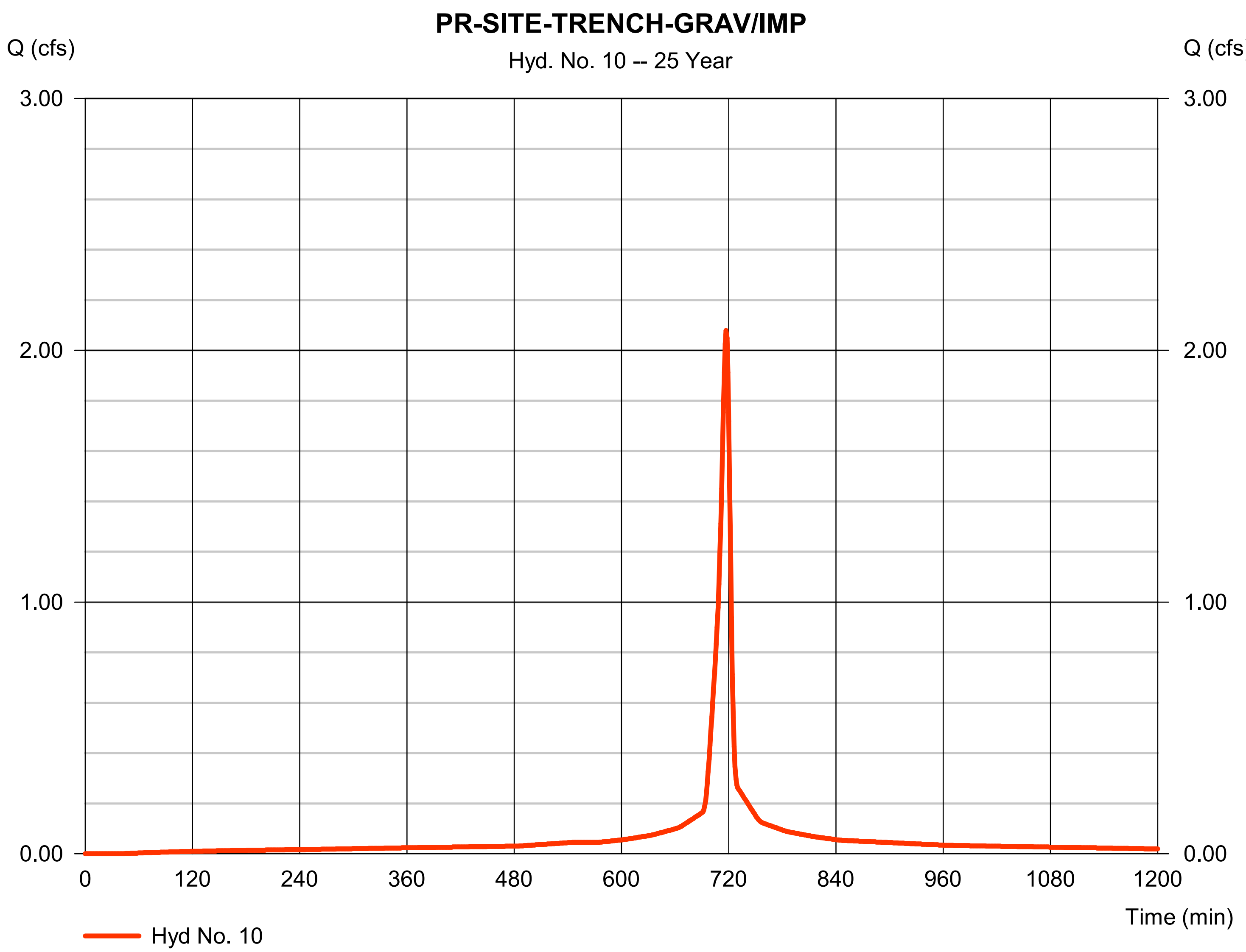
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 10

PR-SITE-TRENCH-GRAV/IMP

Hydrograph type	= SCS Runoff	Peak discharge	= 2.078 cfs
Storm frequency	= 25 yrs	Time to peak	= 717 min
Time interval	= 1 min	Hyd. volume	= 5,064 cuft
Drainage area	= 0.210 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 6.68 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



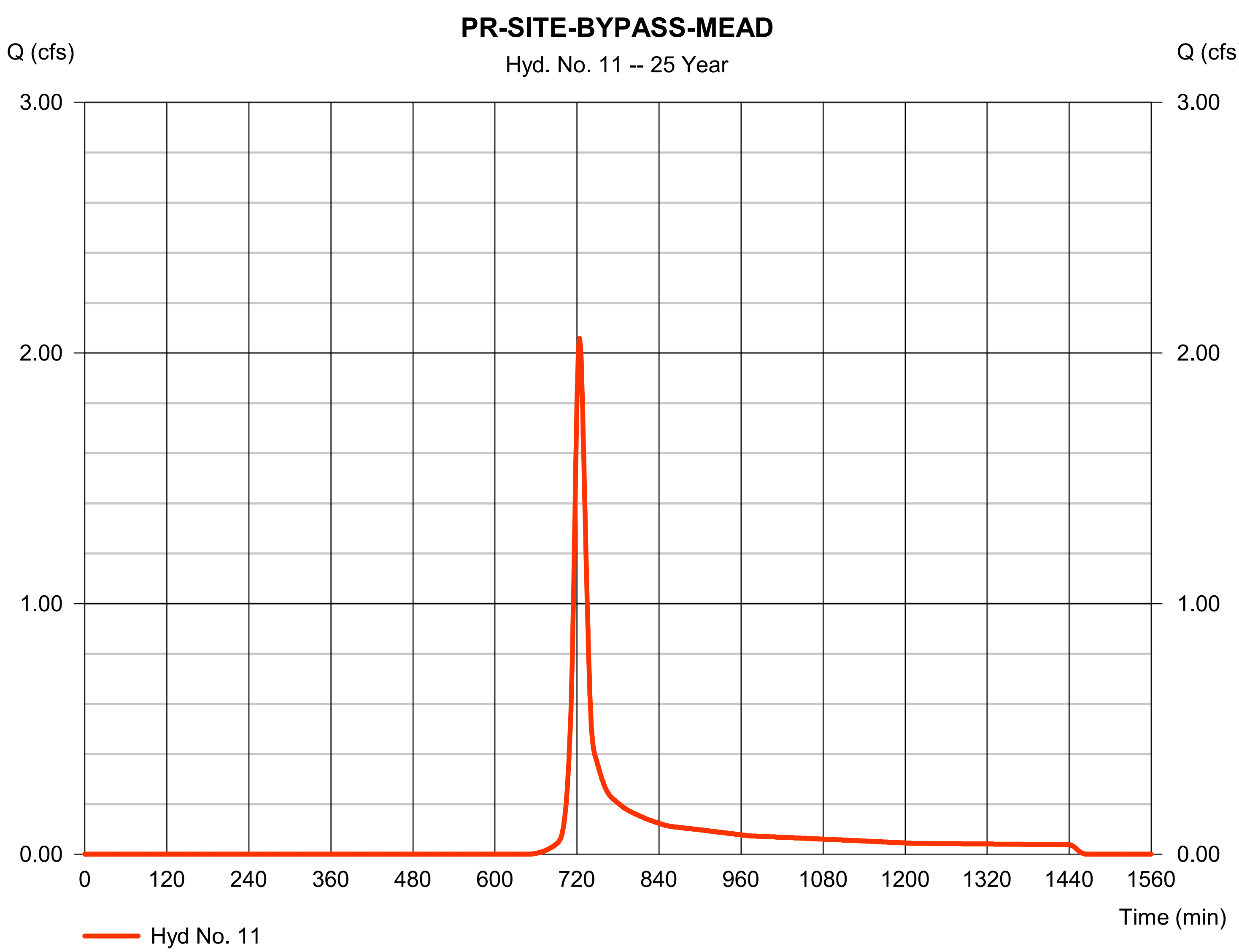
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 — Thursday, 02 / 20 / 2020

Hyd. No. 11

PR-SITE-BYPASS-MEAD

Hydrograph type	= SCS Runoff	Peak discharge	= 2.058 cfs
Storm frequency	= 25 yrs	Time to peak	= 724 min
Time interval	= 1 min	Hyd. volume	= 6,105 cuft
Drainage area	= 0.757 ac	Curve number	= 58
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 16.10 min
Total precip.	= 6.68 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



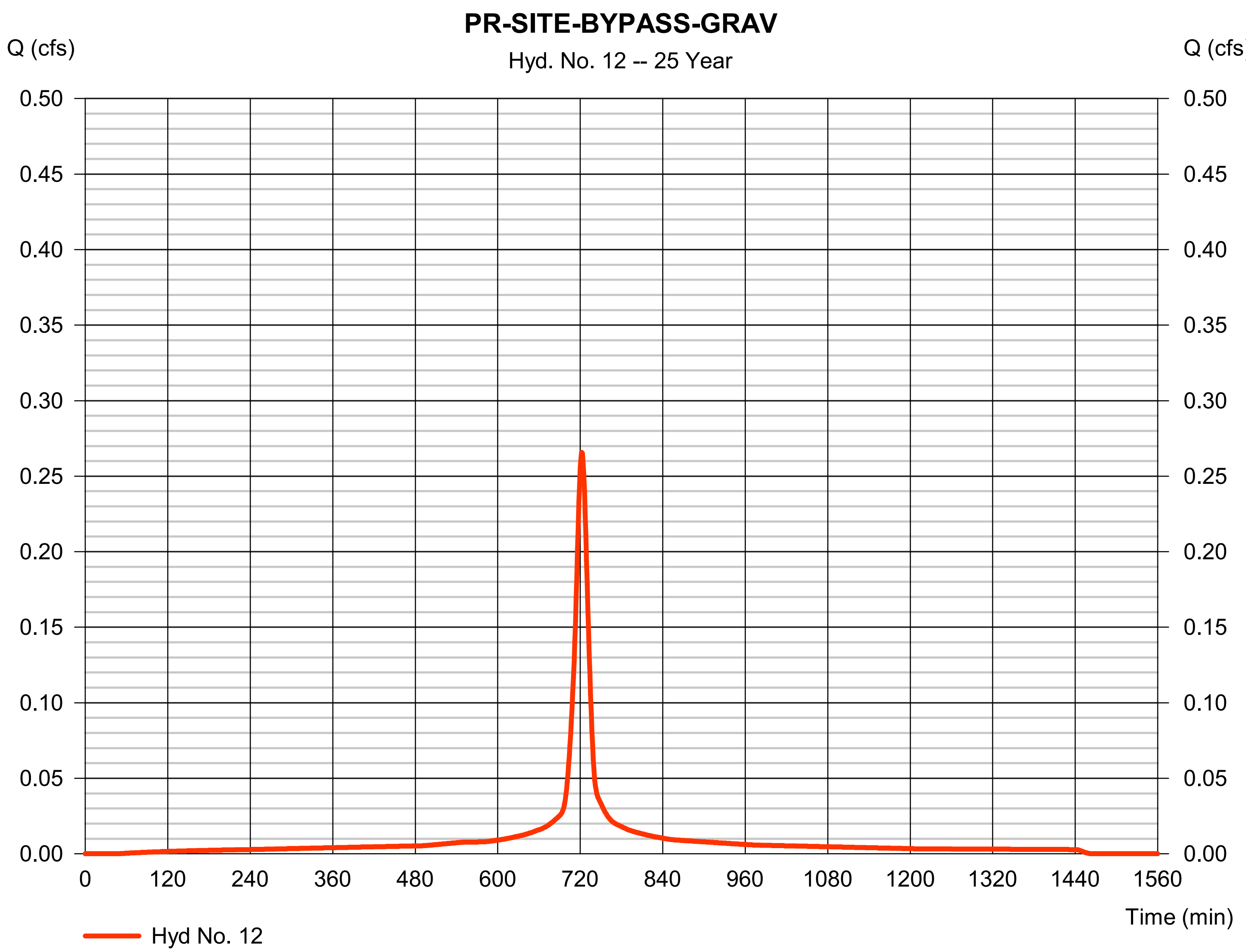
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 12

PR-SITE-BYPASS-GRAV

Hydrograph type	= SCS Runoff	Peak discharge	= 0.266 cfs
Storm frequency	= 25 yrs	Time to peak	= 722 min
Time interval	= 1 min	Hyd. volume	= 876 cuft
Drainage area	= 0.037 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 16.10 min
Total precip.	= 6.68 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



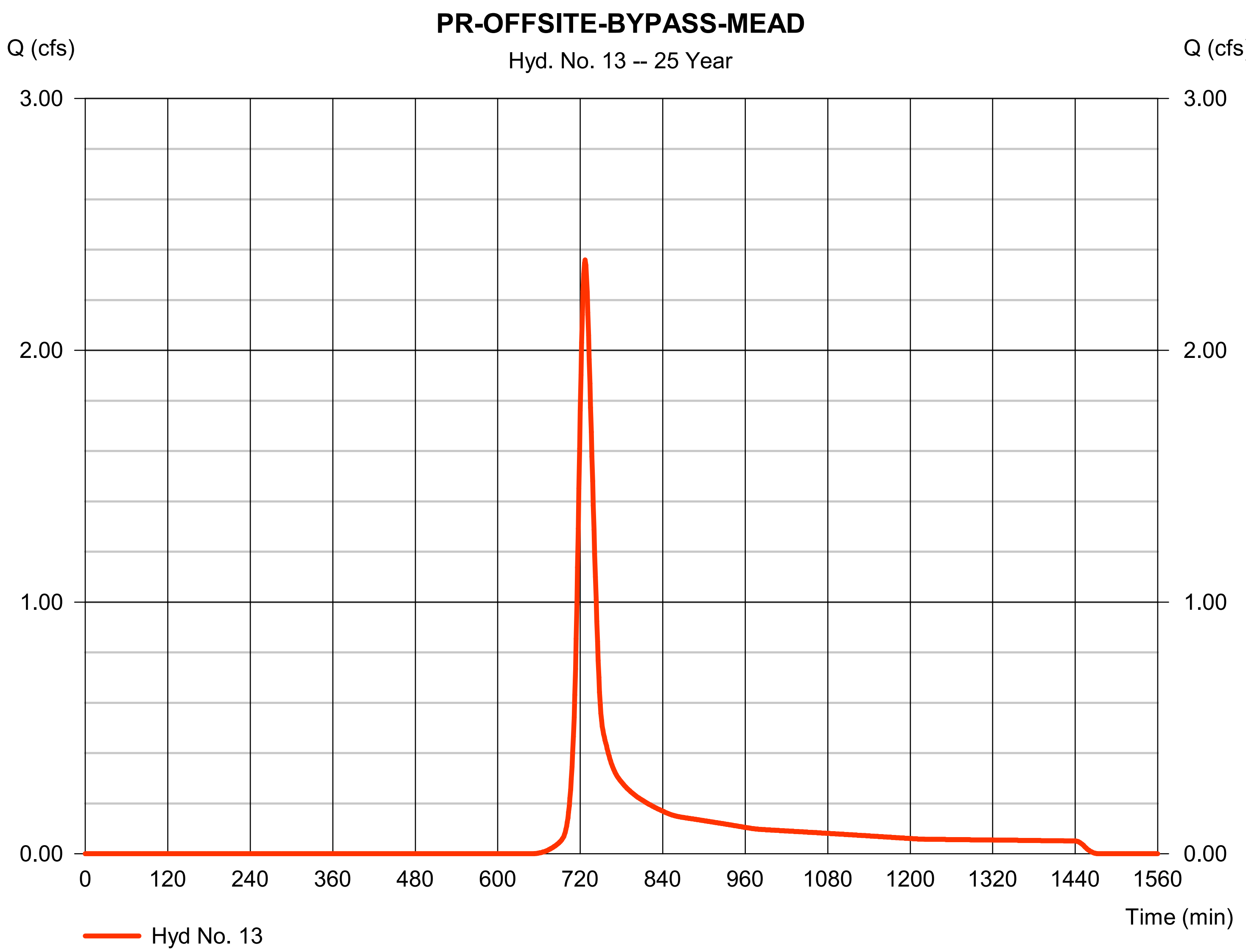
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 | Thursday, 02 / 20 / 2020

Hyd. No. 13

PR-OFFSITE-BYPASS-MEAD

Hydrograph type	= SCS Runoff	Peak discharge	= 2.359 cfs
Storm frequency	= 25 yrs	Time to peak	= 727 min
Time interval	= 1 min	Hyd. volume	= 8,163 cuft
Drainage area	= 1.015 ac	Curve number	= 58
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 20.90 min
Total precip.	= 6.68 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



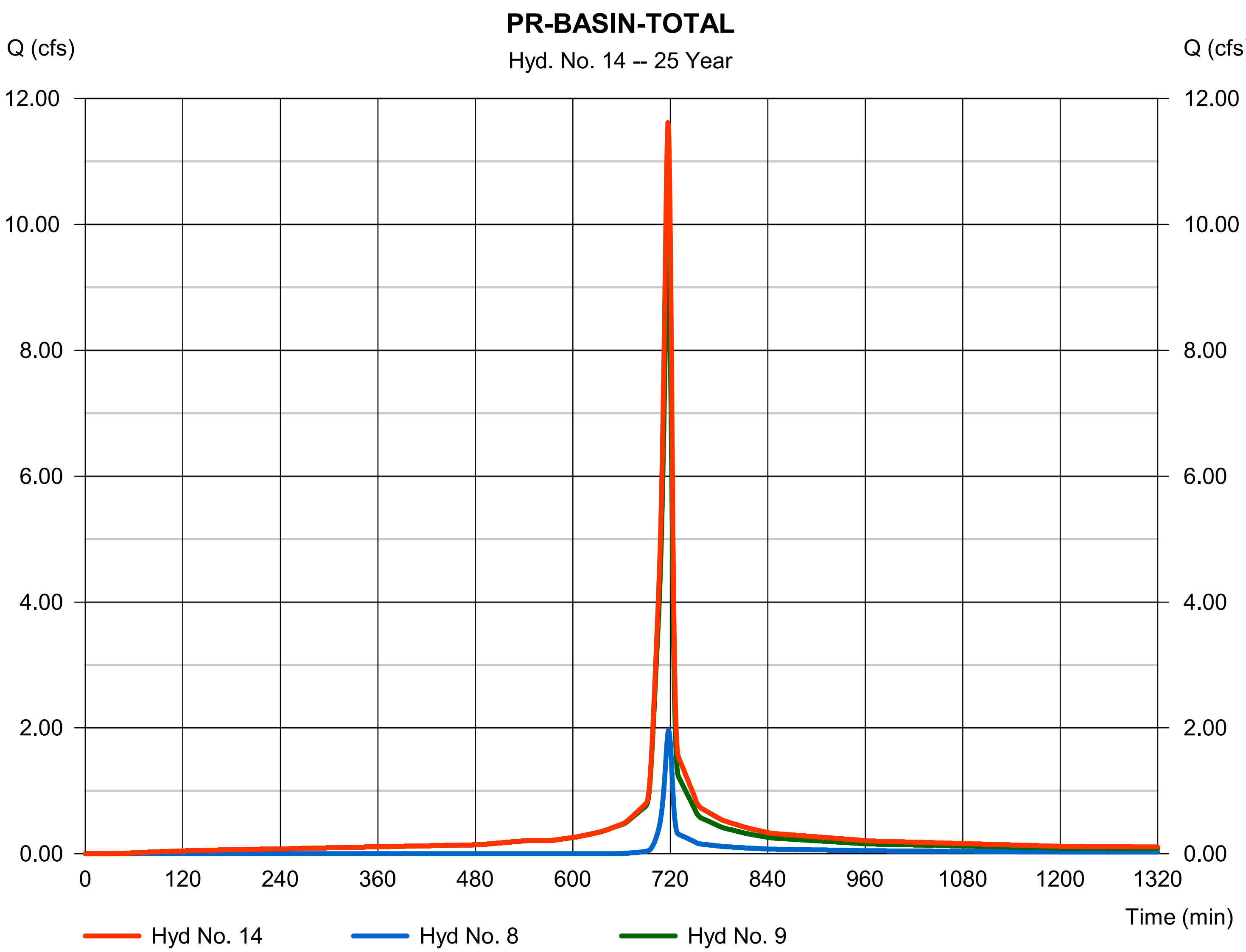
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 | Thursday, 02 / 20 / 2020

Hyd. No. 14

PR-BASIN-TOTAL

Hydrograph type	= Combine	Peak discharge	= 11.62 cfs
Storm frequency	= 25 yrs	Time to peak	= 717 min
Time interval	= 1 min	Hyd. volume	= 27,614 cuft
Inflow hyds.	= 8, 9	Contrib. drain. area	= 1.465 ac



Hydrograph Report

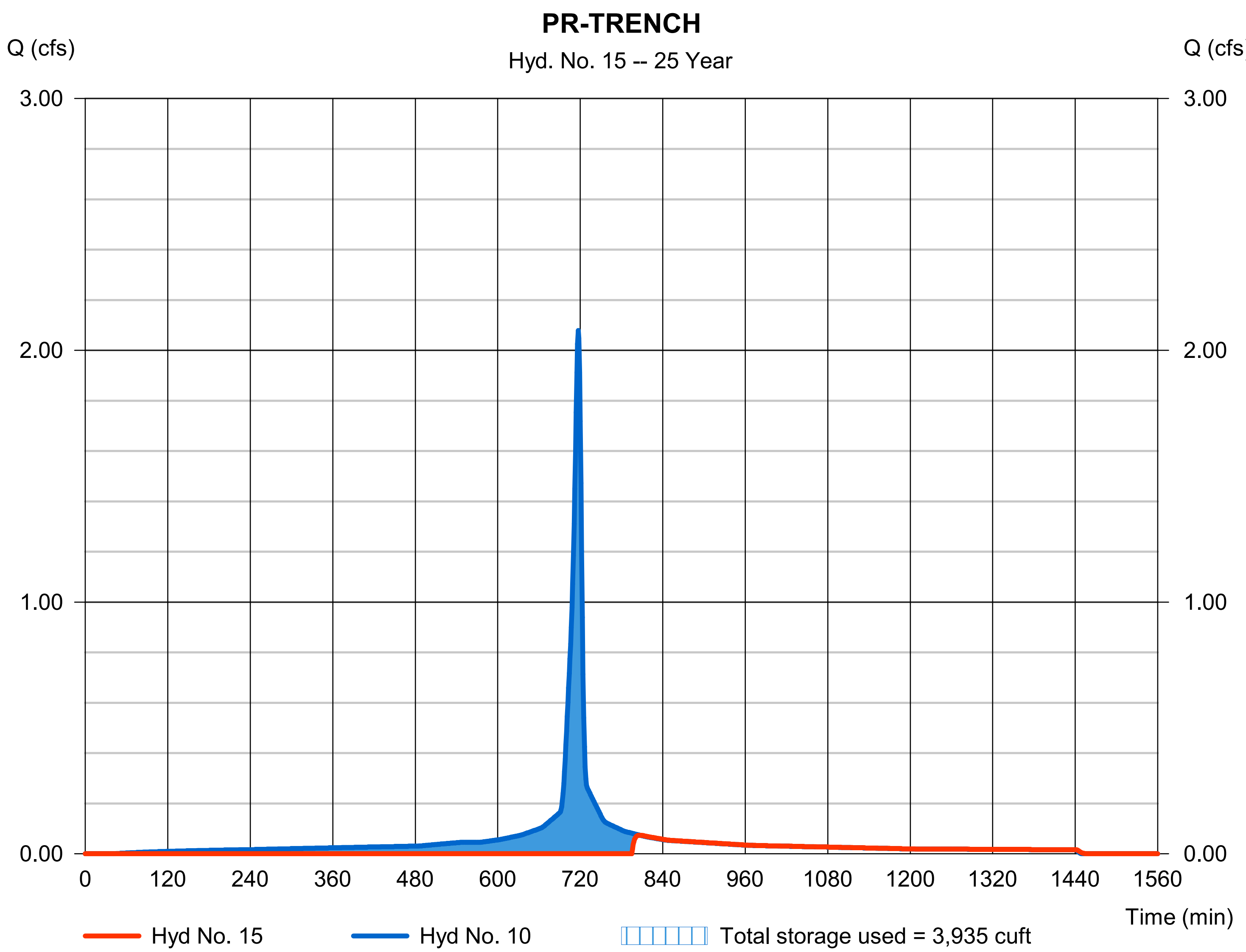
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 15

PR-TRENCH

Hydrograph type	= Reservoir	Peak discharge	= 0.074 cfs
Storm frequency	= 25 yrs	Time to peak	= 807 min
Time interval	= 1 min	Hyd. volume	= 1,142 cuft
Inflow hyd. No.	= 10 - PR-SITE-TRENCH-GRAVMAP	Max. Elevation	= 402.51 ft
Reservoir name	= TRENCH	Max. Storage	= 3,935 cuft

Storage Indication method used.



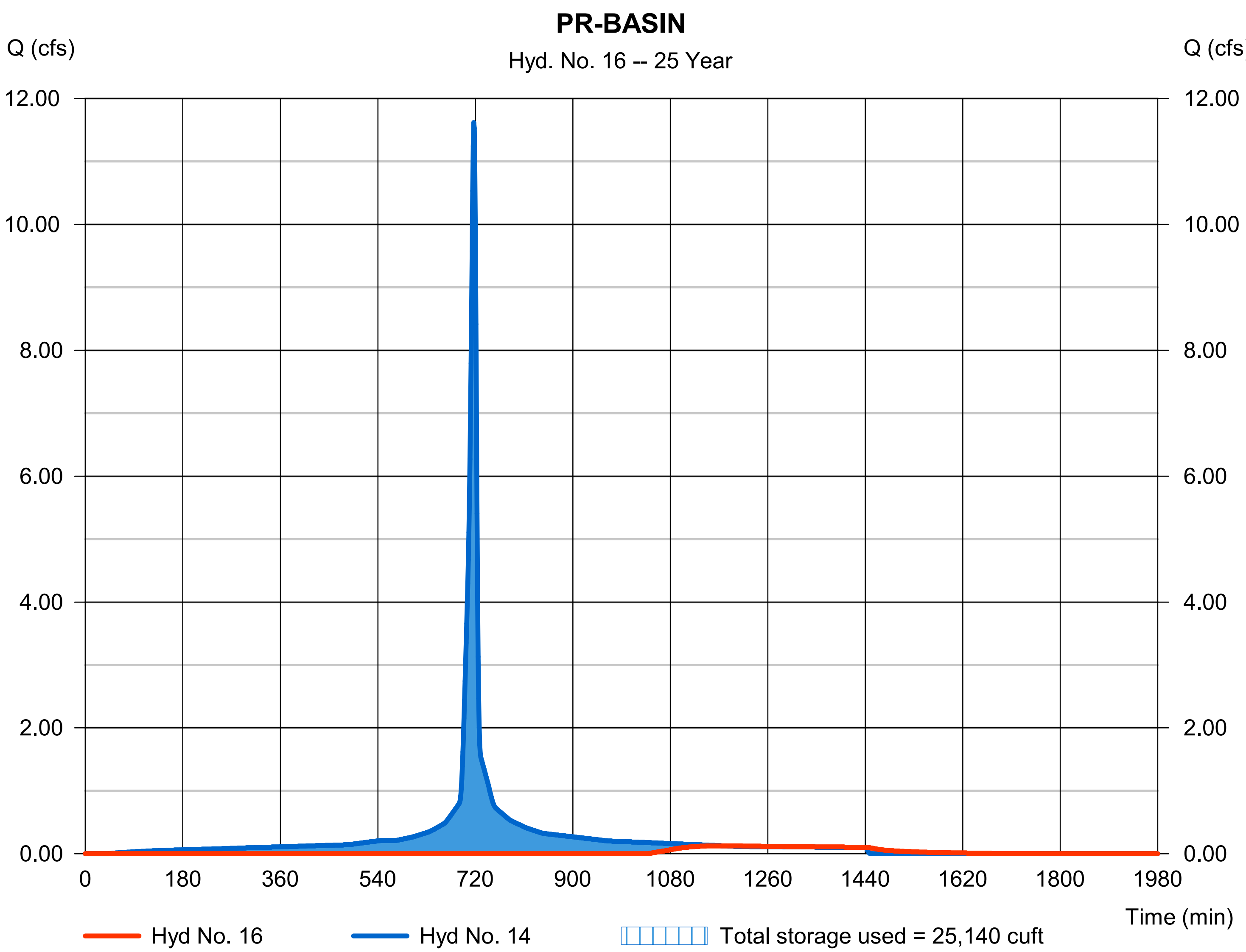
Hydrograph Report

Hyd. No. 16

PR-BASIN

Hydrograph type	= Reservoir	Peak discharge	= 0.127 cfs
Storm frequency	= 25 yrs	Time to peak	= 1176 min
Time interval	= 1 min	Hyd. volume	= 3,012 cuft
Inflow hyd. No.	= 14 - PR-BASIN-TOTAL	Max. Elevation	= 399.80 ft
Reservoir name	= BASIN	Max. Storage	= 25,140 cuft

Storage Indication method used.



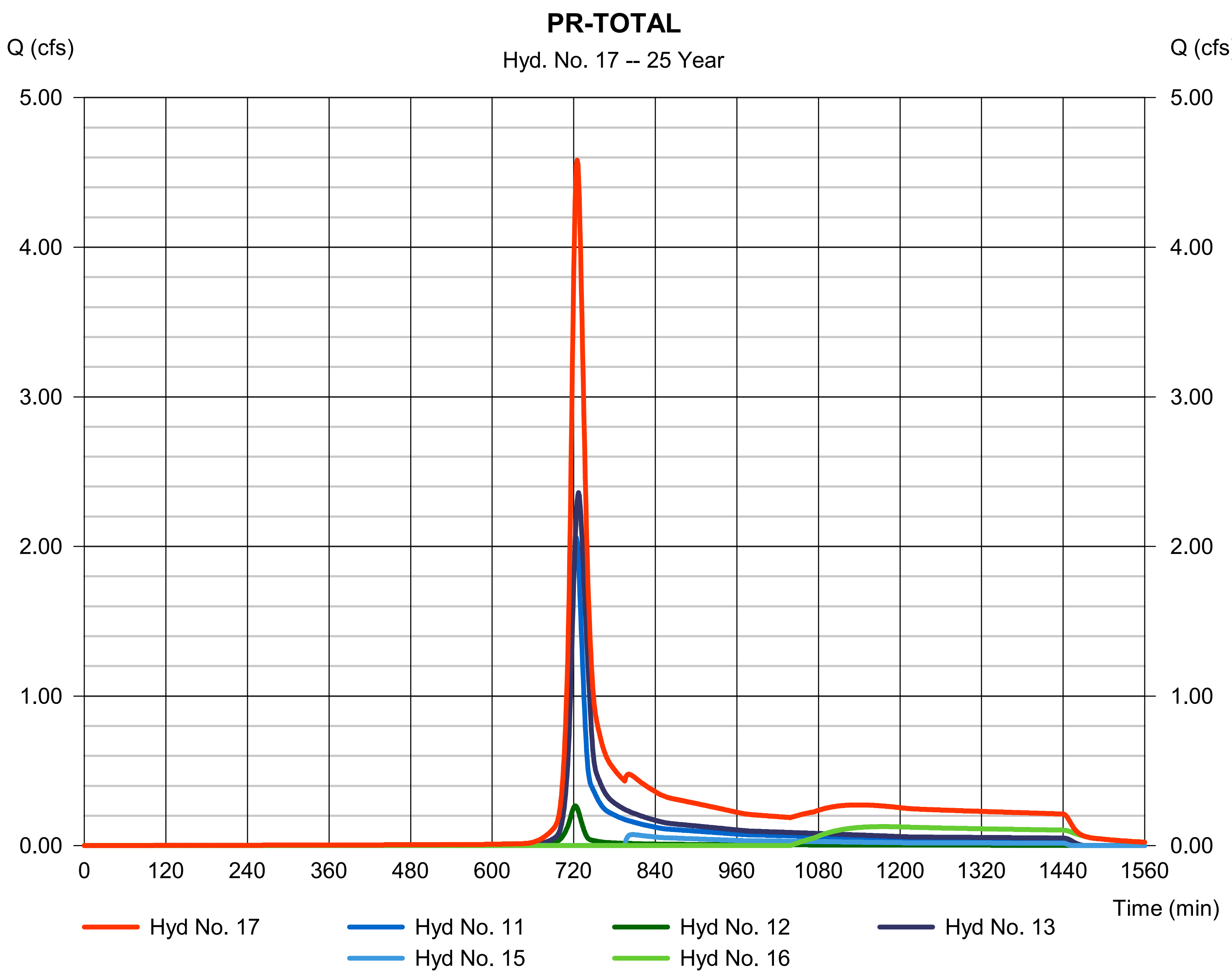
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 — Thursday, 02 / 20 / 2020

Hyd. No. 17

PR-TOTAL

Hydrograph type	= Combine	Peak discharge	= 4.582 cfs
Storm frequency	= 25 yrs	Time to peak	= 725 min
Time interval	= 1 min	Hyd. volume	= 19,298 cuft
Inflow hyds.	= 11, 12, 13, 15, 16	Contrib. drain. area	= 1.809 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	2.392	1	747	14,796	------	------	------	EX-SITE-BASIN-MEAD
2	SCS Runoff	0.442	1	745	2,921	------	------	------	EX-SITE-BASIN-IMP 80%
3	SCS Runoff	3.603	1	721	8,789	------	------	------	EX-SITE-BYPASS-MEAD
4	SCS Runoff	0.039	1	720	113	------	------	------	EX-SITE-BYPASS-IMP 80%
5	SCS Runoff	0.799	1	724	2,324	------	------	------	EX-SITE-TRENCH
6	SCS Runoff	3.317	1	727	11,201	------	------	------	EX-OFFSITE-BYPASS
7	Combine	8.514	1	723	40,143	1, 2, 3, 4, 5, 6	------	------	EX-TOTAL
8	SCS Runoff	2.720	1	718	5,467	------	------	------	PR-SITE-BASIN-MEAD
9	SCS Runoff	11.42	1	717	27,956	------	------	------	PR-SITE-BASIN-GRAV
10	SCS Runoff	2.448	1	717	5,990	------	------	------	PR-SITE-TRENCH-GRAV/IMP
11	SCS Runoff	2.880	1	724	8,378	------	------	------	PR-SITE-BYPASS-MEAD
12	SCS Runoff	0.313	1	722	1,036	------	------	------	PR-SITE-BYPASS-GRAV
13	SCS Runoff	3.317	1	727	11,201	------	------	------	PR-OFFSITE-BYPASS-MEAD
14	Combine	14.10	1	717	33,422	8, 9,	------	------	PR-BASIN-TOTAL
15	Reservoir	0.288	1	733	2,069	10	402.52	3,975	PR-TRENCH
16	Reservoir	0.365	1	867	8,820	14	399.84	25,703	PR-BASIN
17	Combine	6.386	1	725	31,504	11, 12, 13, 15, 16	------	------	PR-TOTAL

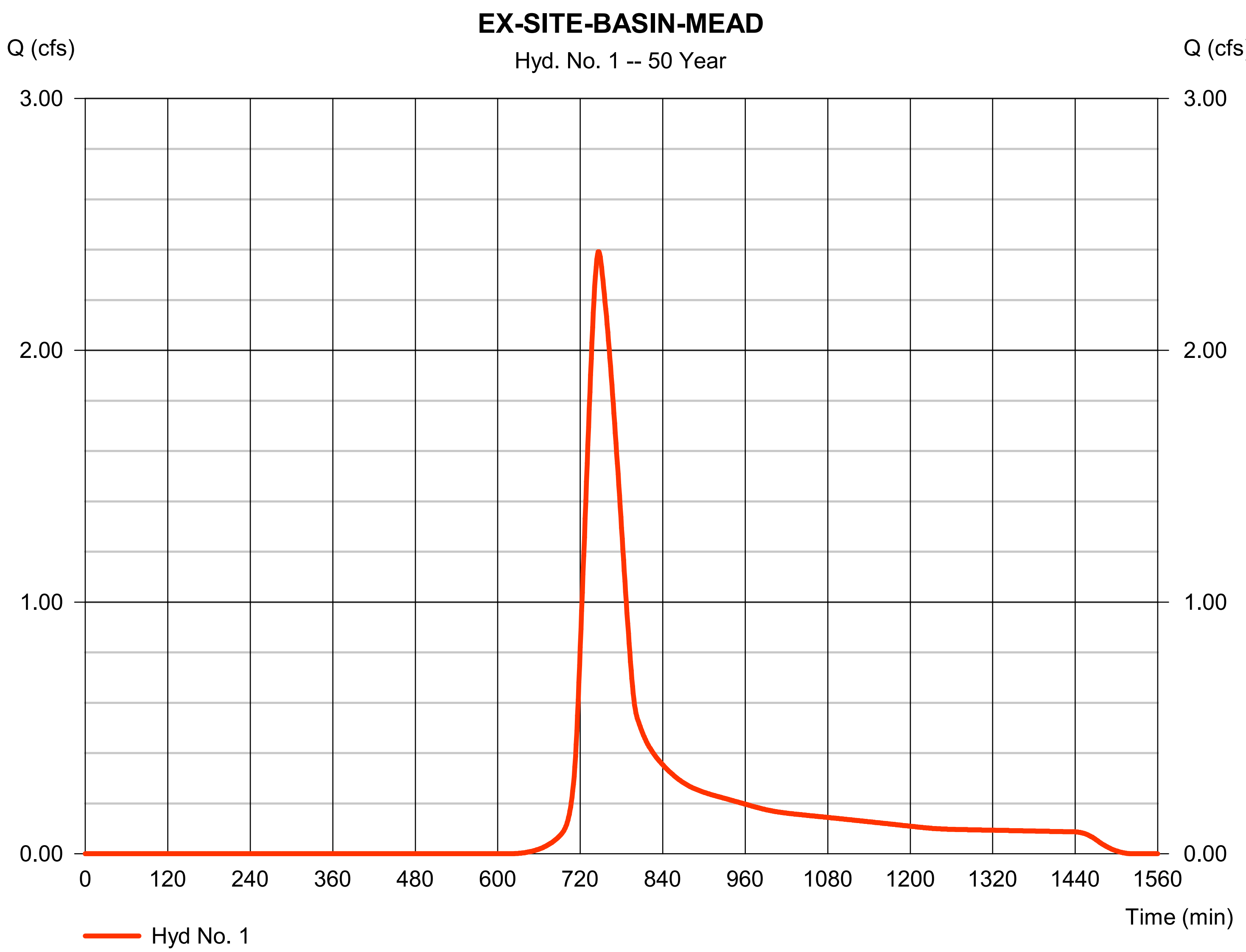
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 1

EX-SITE-BASIN-MEAD

Hydrograph type	= SCS Runoff	Peak discharge	= 2.392 cfs
Storm frequency	= 50 yrs	Time to peak	= 747 min
Time interval	= 1 min	Hyd. volume	= 14,796 cuft
Drainage area	= 1.359 ac	Curve number	= 58
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 53.40 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



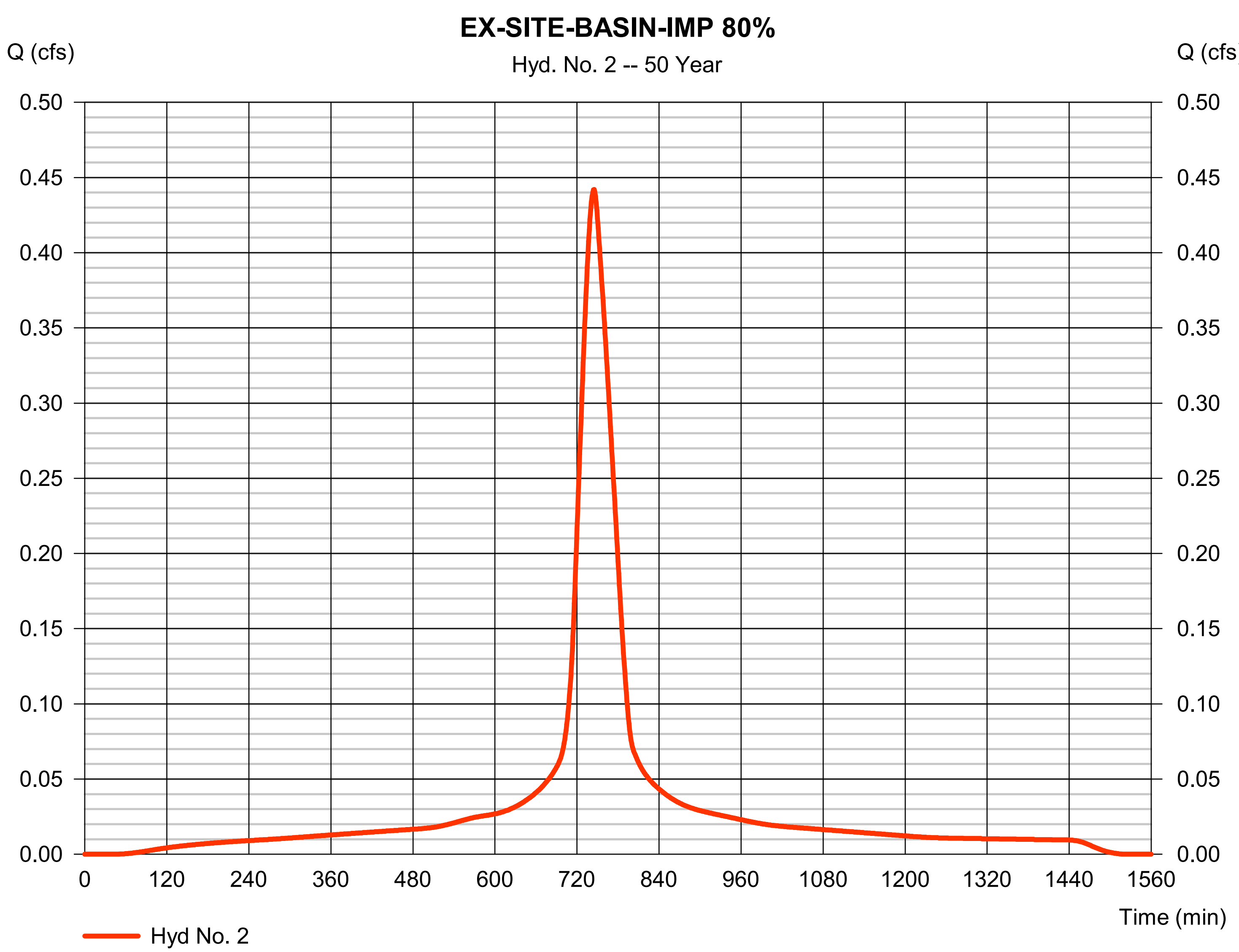
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 — Thursday, 02 / 20 / 2020

Hyd. No. 2

EX-SITE-BASIN-IMP 80%

Hydrograph type	= SCS Runoff	Peak discharge	= 0.442 cfs
Storm frequency	= 50 yrs	Time to peak	= 745 min
Time interval	= 1 min	Hyd. volume	= 2,921 cuft
Drainage area	= 0.106 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 53.40 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



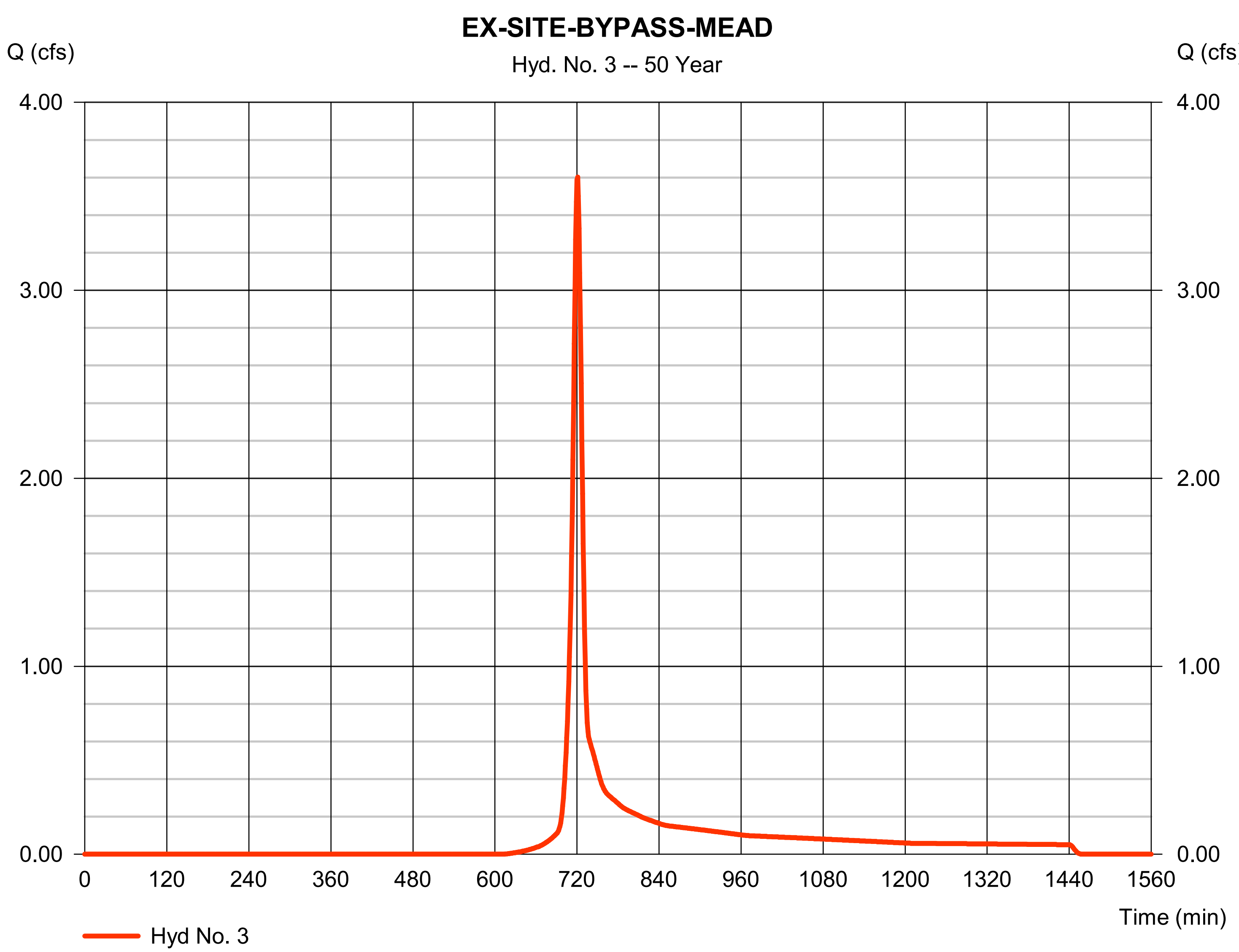
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 3

EX-SITE-BYPASS-MEAD

Hydrograph type	= SCS Runoff	Peak discharge	= 3.603 cfs
Storm frequency	= 50 yrs	Time to peak	= 721 min
Time interval	= 1 min	Hyd. volume	= 8,789 cuft
Drainage area	= 0.790 ac	Curve number	= 58
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 11.70 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



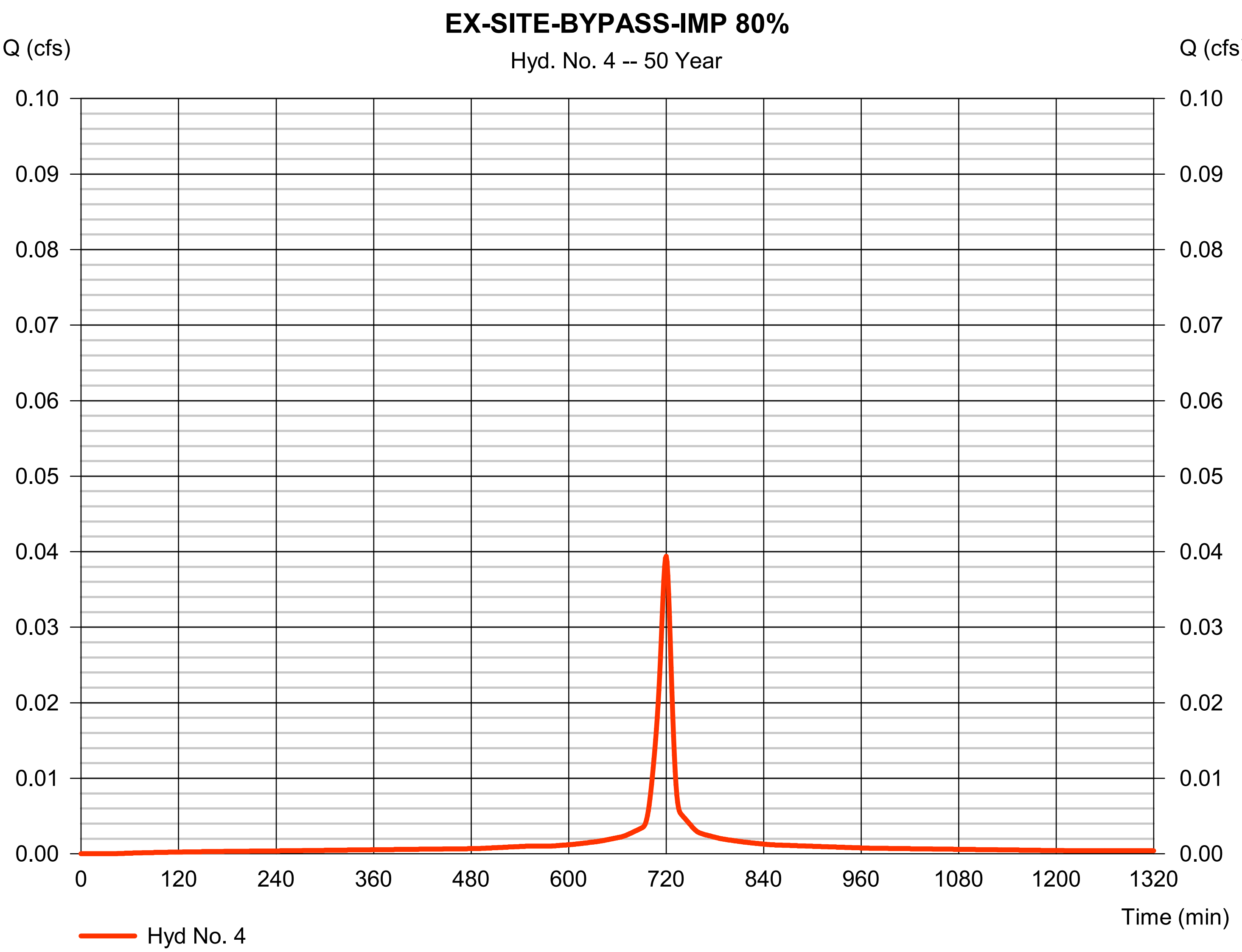
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 4

EX-SITE-BYPASS-IMP 80%

Hydrograph type	= SCS Runoff	Peak discharge	= 0.039 cfs
Storm frequency	= 50 yrs	Time to peak	= 720 min
Time interval	= 1 min	Hyd. volume	= 113 cuft
Drainage area	= 0.004 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 11.70 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



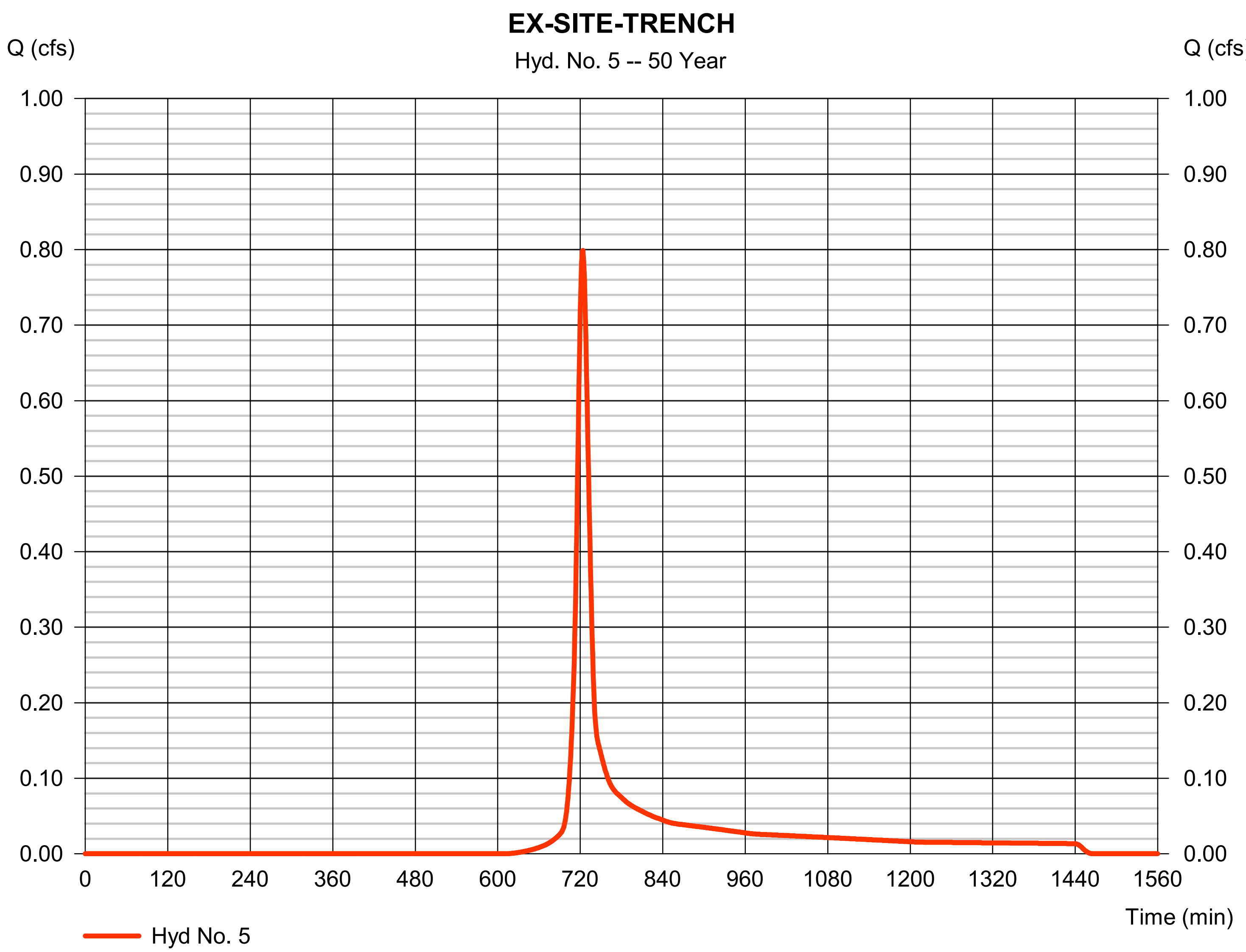
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 5

EX-SITE-TRENCH

Hydrograph type	= SCS Runoff	Peak discharge	= 0.799 cfs
Storm frequency	= 50 yrs	Time to peak	= 724 min
Time interval	= 1 min	Hyd. volume	= 2,324 cuft
Drainage area	= 0.210 ac	Curve number	= 58
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 15.90 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



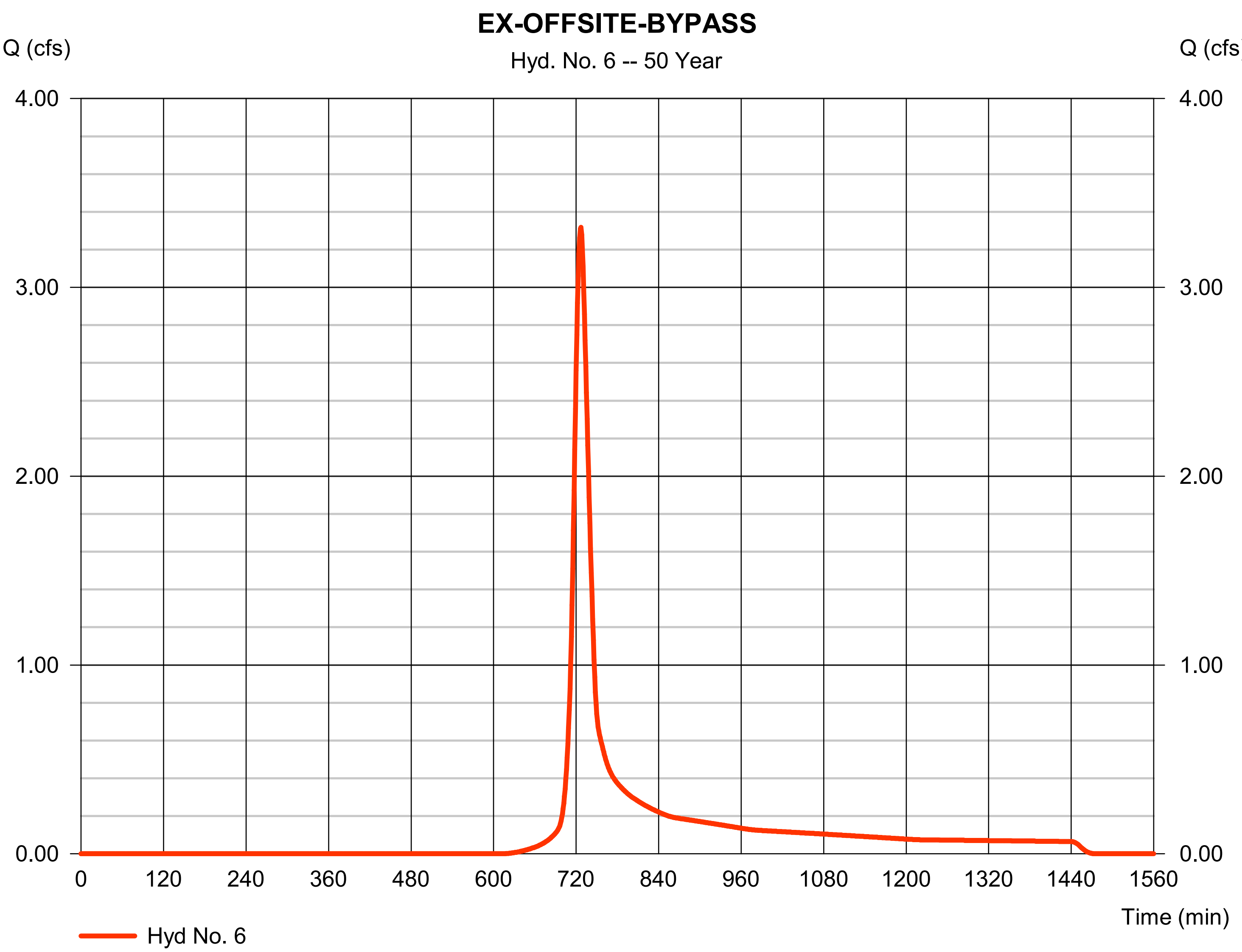
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 6

EX-OFFSITE-BYPASS

Hydrograph type	= SCS Runoff	Peak discharge	= 3.317 cfs
Storm frequency	= 50 yrs	Time to peak	= 727 min
Time interval	= 1 min	Hyd. volume	= 11,201 cuft
Drainage area	= 1.015 ac	Curve number	= 58
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 20.90 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



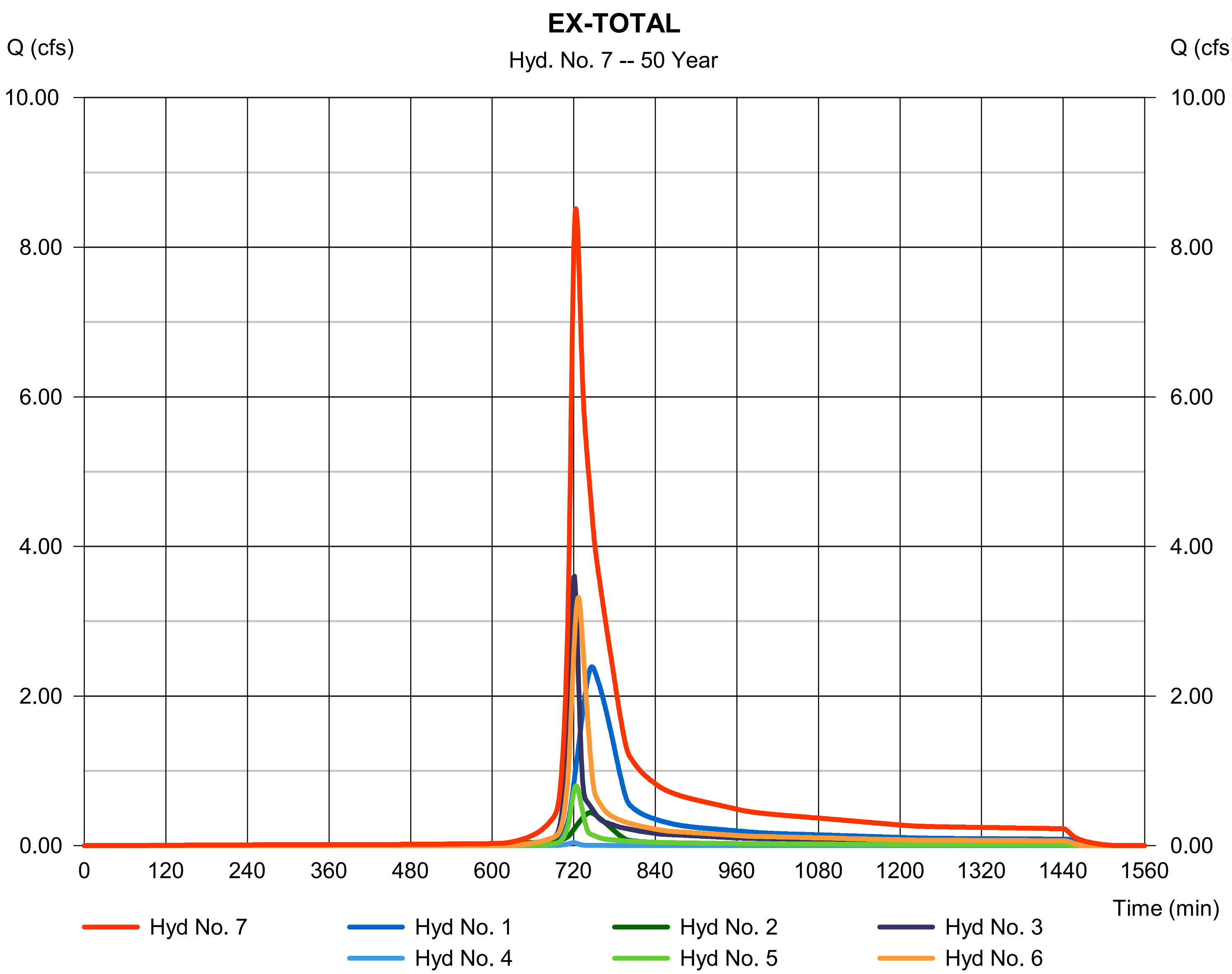
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 7

EX-TOTAL

Hydrograph type	= Combine	Peak discharge	= 8.514 cfs
Storm frequency	= 50 yrs	Time to peak	= 723 min
Time interval	= 1 min	Hyd. volume	= 40,143 cuft
Inflow hyds.	= 1, 2, 3, 4, 5, 6	Contrib. drain. area	= 3.484 ac



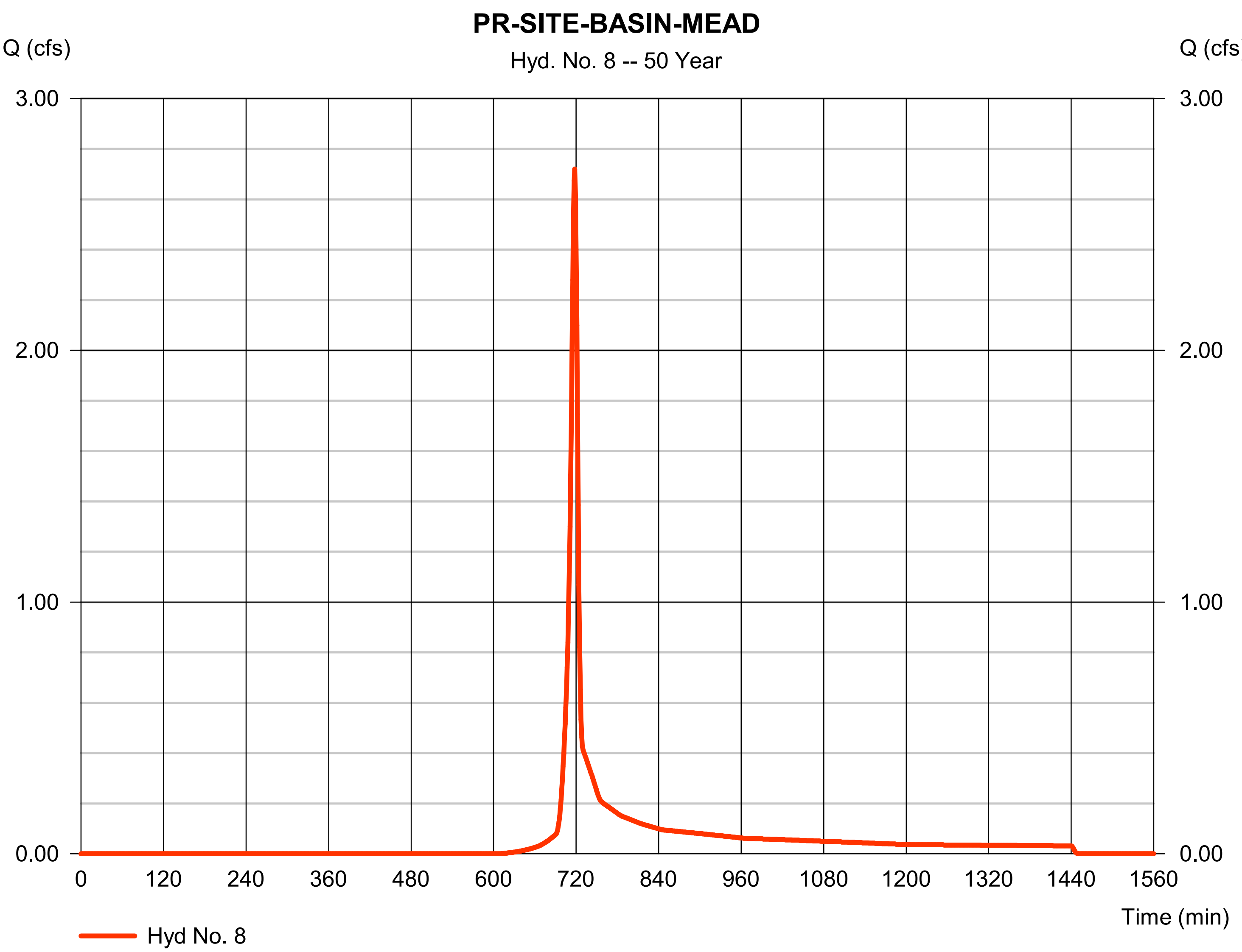
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 8

PR-SITE-BASIN-MEAD

Hydrograph type	= SCS Runoff	Peak discharge	= 2.720 cfs
Storm frequency	= 50 yrs	Time to peak	= 718 min
Time interval	= 1 min	Hyd. volume	= 5,467 cuft
Drainage area	= 0.485 ac	Curve number	= 58
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



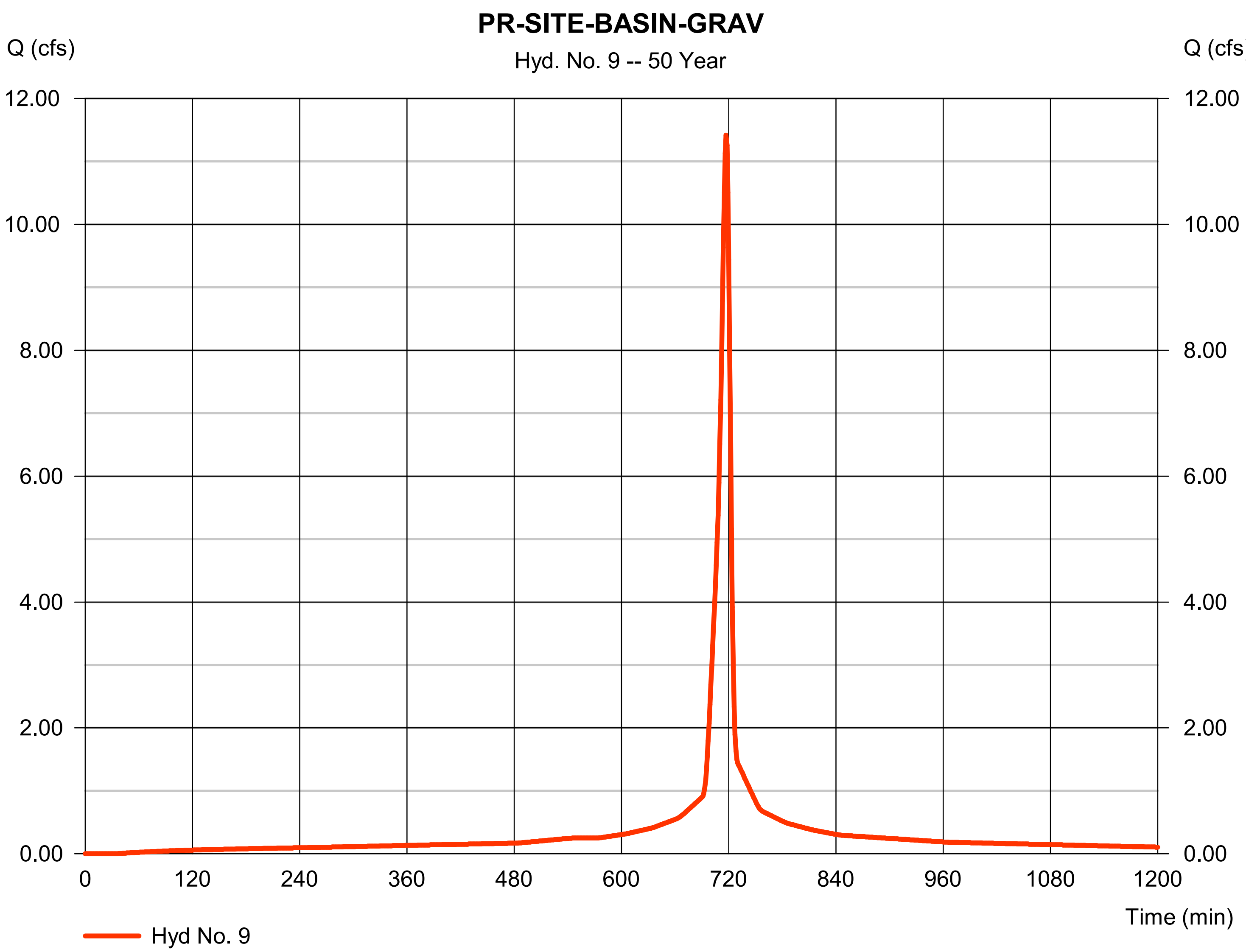
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 9

PR-SITE-BASIN-GRAV

Hydrograph type	= SCS Runoff	Peak discharge	= 11.42 cfs
Storm frequency	= 50 yrs	Time to peak	= 717 min
Time interval	= 1 min	Hyd. volume	= 27,956 cuft
Drainage area	= 0.980 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



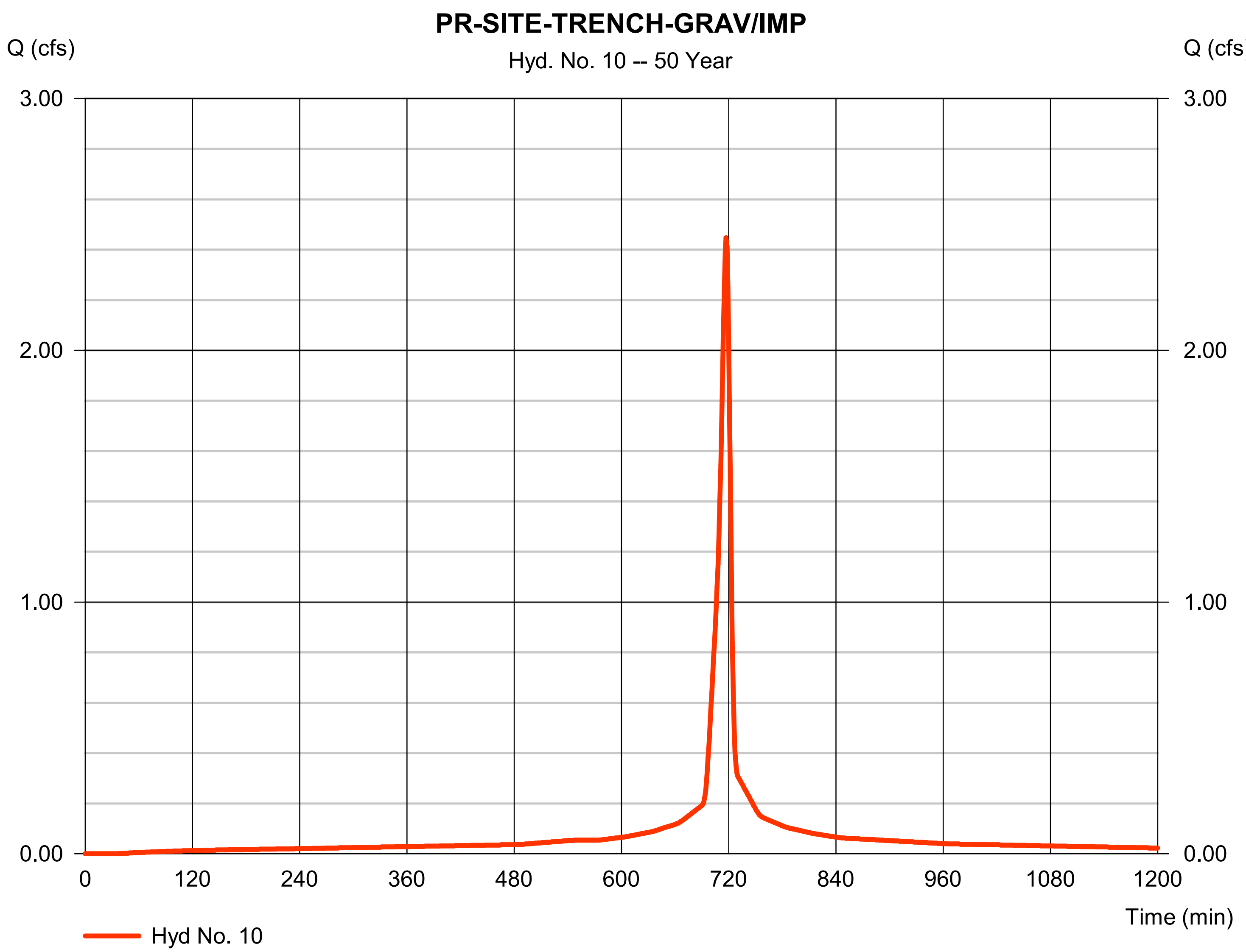
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 10

PR-SITE-TRENCH-GRAV/IMP

Hydrograph type	= SCS Runoff	Peak discharge	= 2.448 cfs
Storm frequency	= 50 yrs	Time to peak	= 717 min
Time interval	= 1 min	Hyd. volume	= 5,990 cuft
Drainage area	= 0.210 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

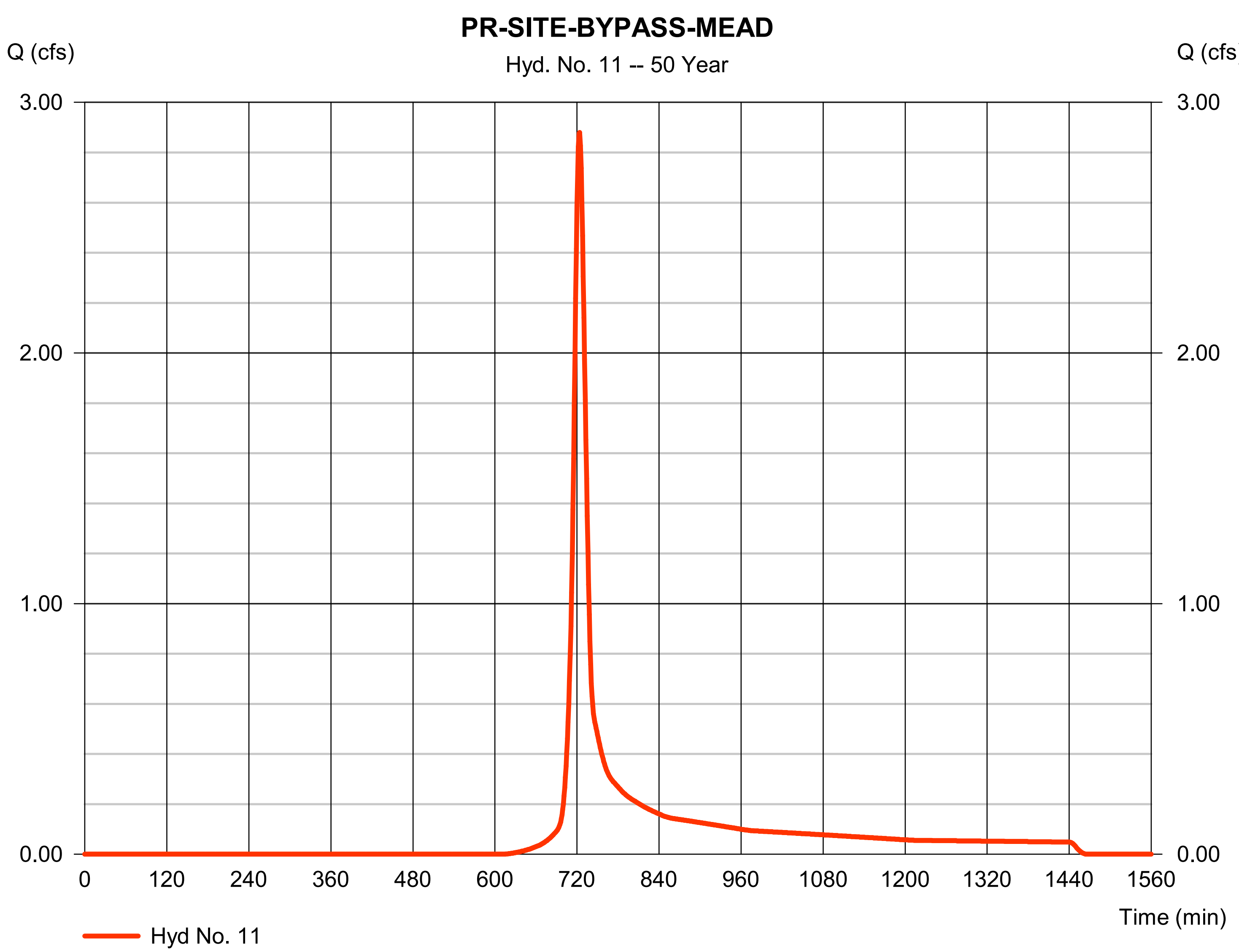


Hydrograph Report

Hyd. No. 11

PR-SITE-BYPASS-MEAD

Hydrograph type	= SCS Runoff	Peak discharge	= 2.880 cfs
Storm frequency	= 50 yrs	Time to peak	= 724 min
Time interval	= 1 min	Hyd. volume	= 8,378 cuft
Drainage area	= 0.757 ac	Curve number	= 58
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 16.10 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



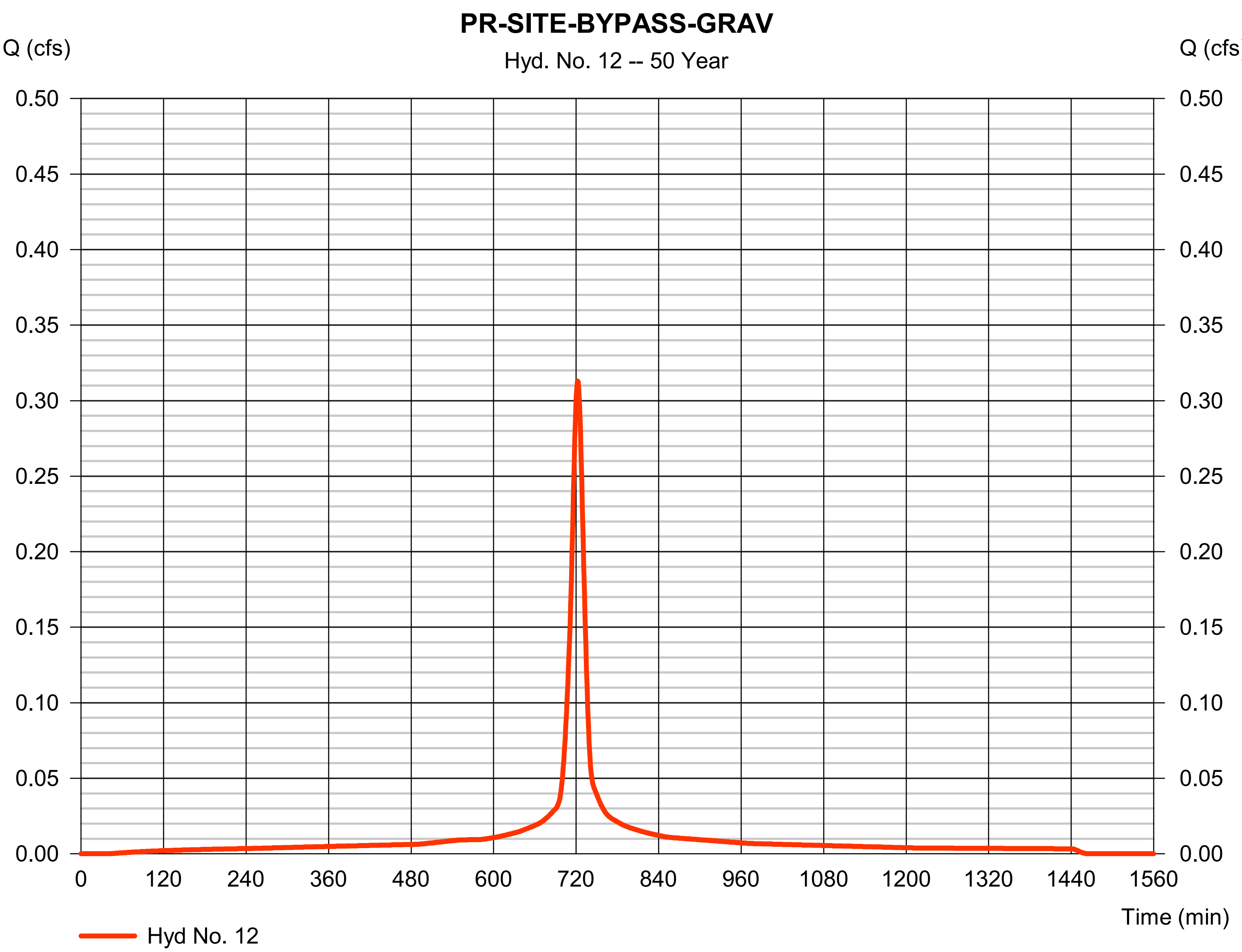
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 | Thursday, 02 / 20 / 2020

Hyd. No. 12

PR-SITE-BYPASS-GRAV

Hydrograph type	= SCS Runoff	Peak discharge	= 0.313 cfs
Storm frequency	= 50 yrs	Time to peak	= 722 min
Time interval	= 1 min	Hyd. volume	= 1,036 cuft
Drainage area	= 0.037 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 16.10 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



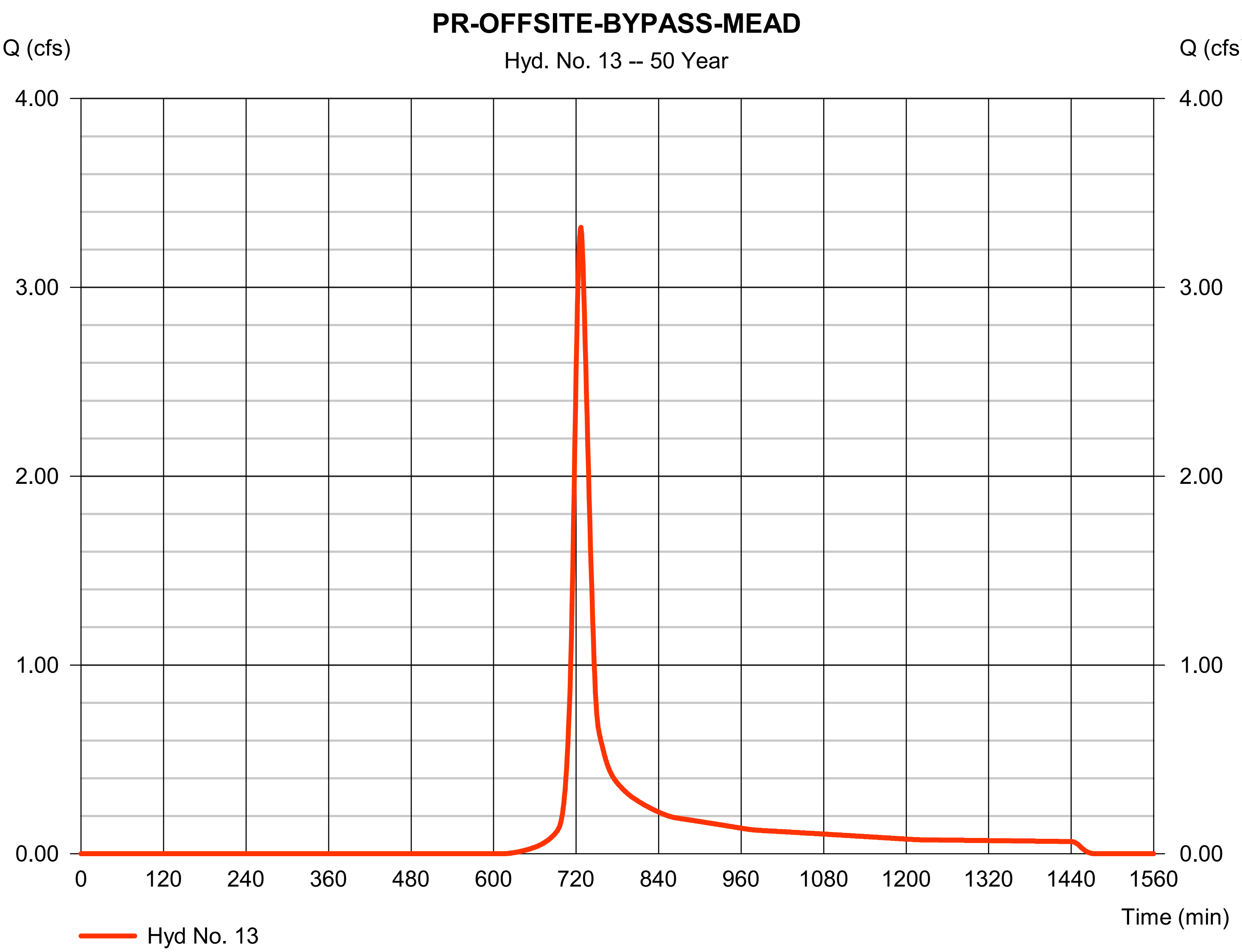
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 13

PR-OFFSITE-BYPASS-MEAD

Hydrograph type	= SCS Runoff	Peak discharge	= 3.317 cfs
Storm frequency	= 50 yrs	Time to peak	= 727 min
Time interval	= 1 min	Hyd. volume	= 11,201 cuft
Drainage area	= 1.015 ac	Curve number	= 58
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 20.90 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



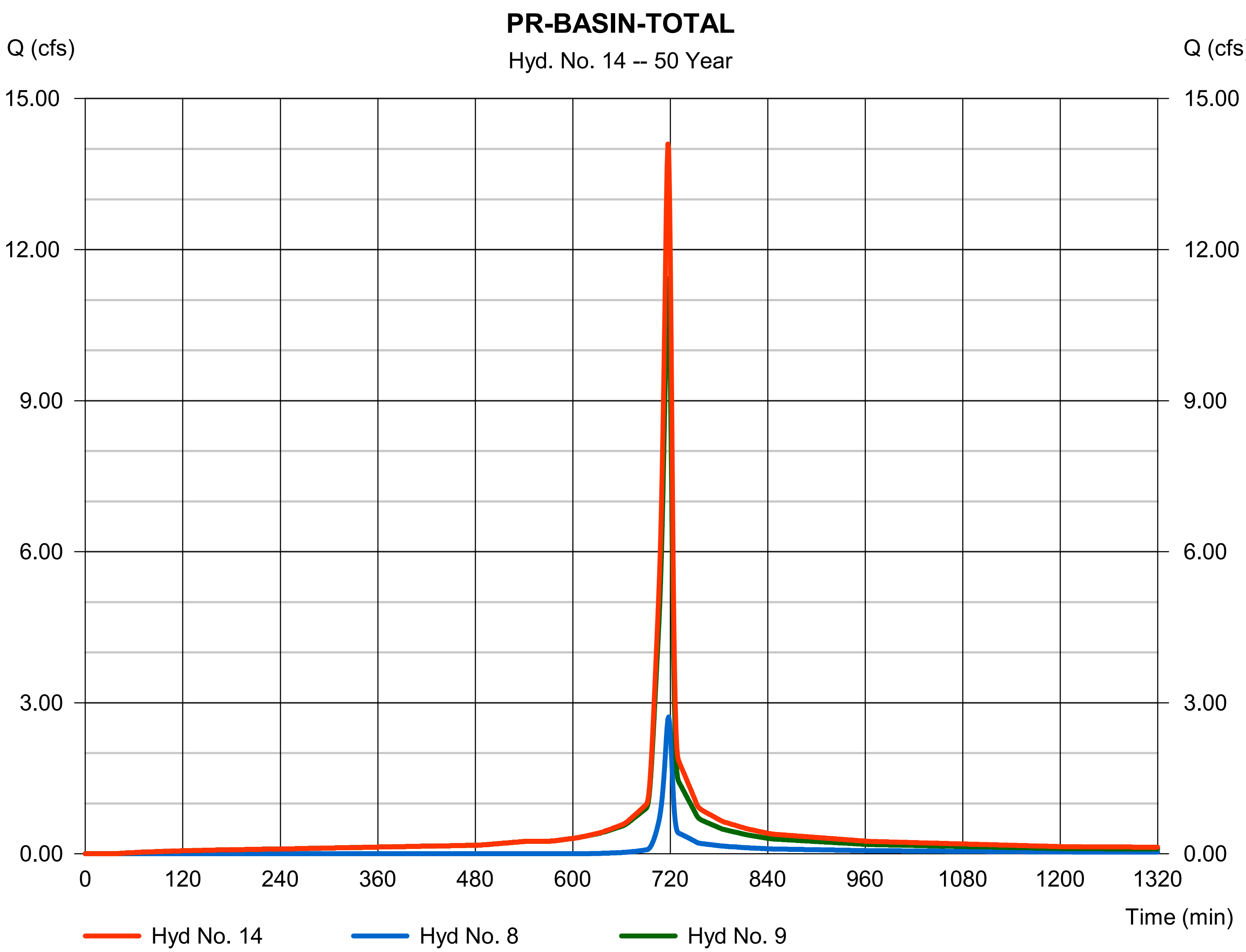
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 14

PR-BASIN-TOTAL

Hydrograph type	= Combine	Peak discharge	= 14.10 cfs
Storm frequency	= 50 yrs	Time to peak	= 717 min
Time interval	= 1 min	Hyd. volume	= 33,422 cuft
Inflow hyds.	= 8, 9	Contrib. drain. area	= 1.465 ac



Hydrograph Report

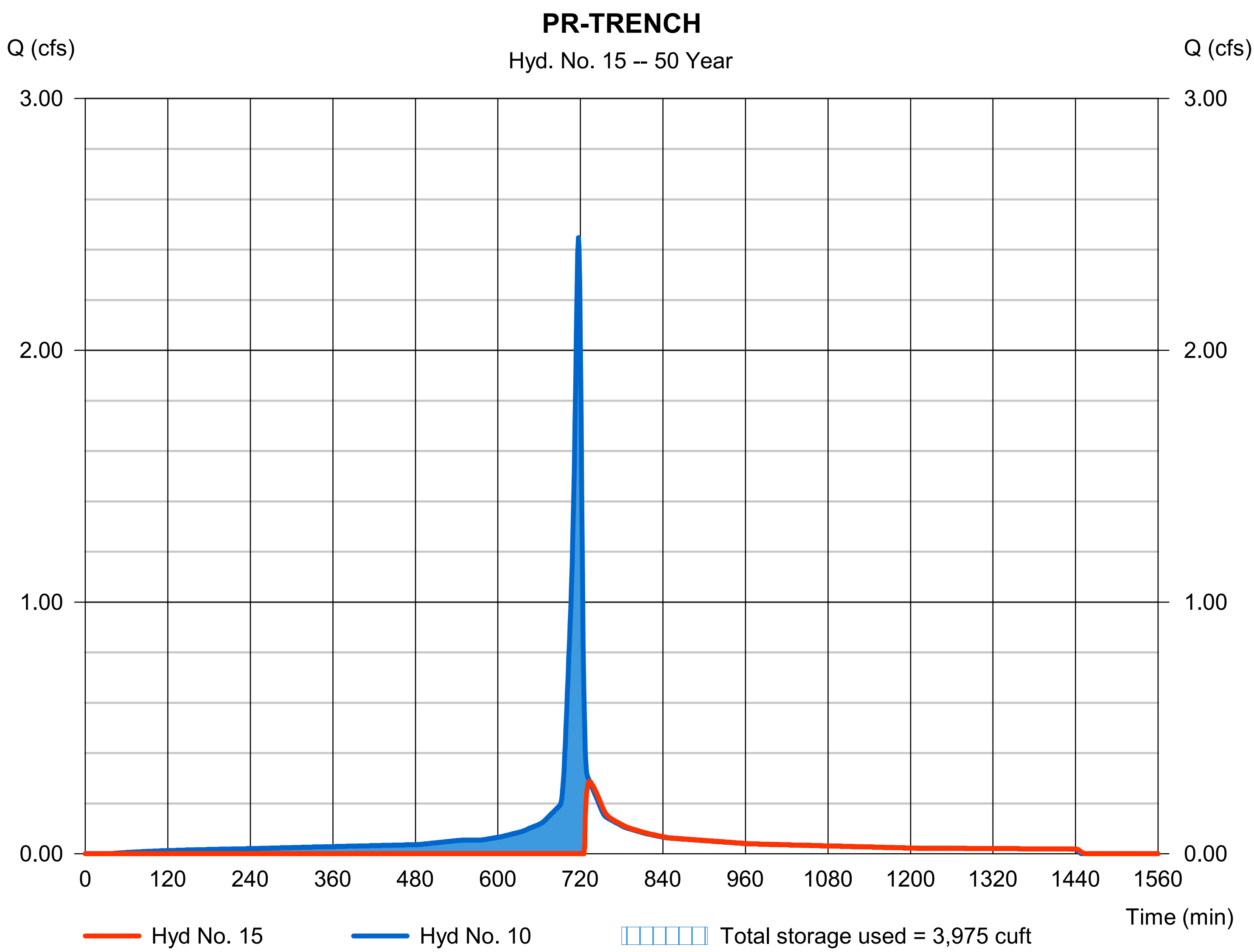
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 15

PR-TRENCH

Hydrograph type	= Reservoir	Peak discharge	= 0.288 cfs
Storm frequency	= 50 yrs	Time to peak	= 733 min
Time interval	= 1 min	Hyd. volume	= 2,069 cuft
Inflow hyd. No.	= 10 - PR-SITE-TRENCH-GRAVITY	Max. Elevation	= 402.52 ft
Reservoir name	= TRENCH	Max. Storage	= 3,975 cuft

Storage Indication method used.



Hydrograph Report

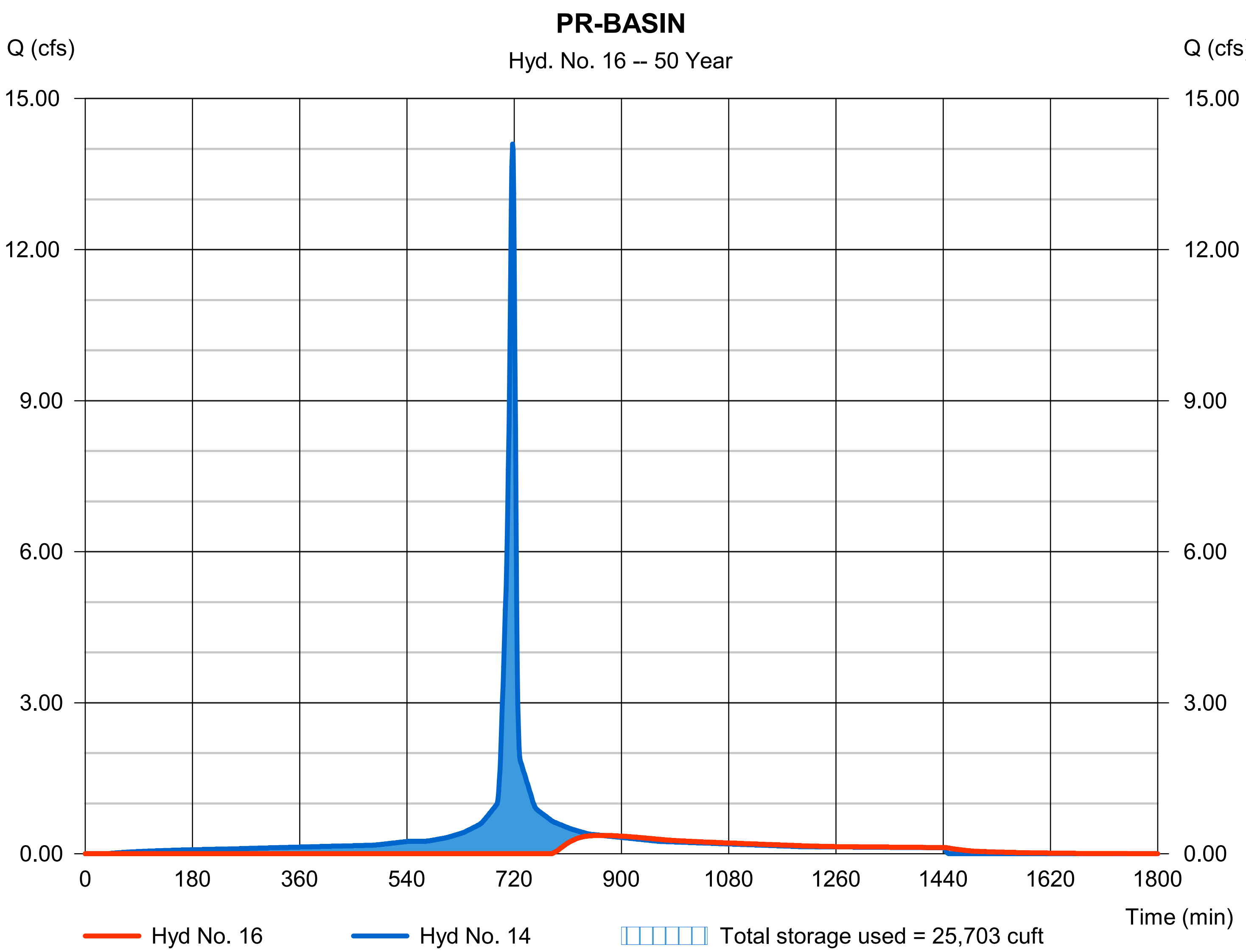
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 16

PR-BASIN

Hydrograph type	= Reservoir	Peak discharge	= 0.365 cfs
Storm frequency	= 50 yrs	Time to peak	= 867 min
Time interval	= 1 min	Hyd. volume	= 8,820 cuft
Inflow hyd. No.	= 14 - PR-BASIN-TOTAL	Max. Elevation	= 399.84 ft
Reservoir name	= BASIN	Max. Storage	= 25,703 cuft

Storage Indication method used.



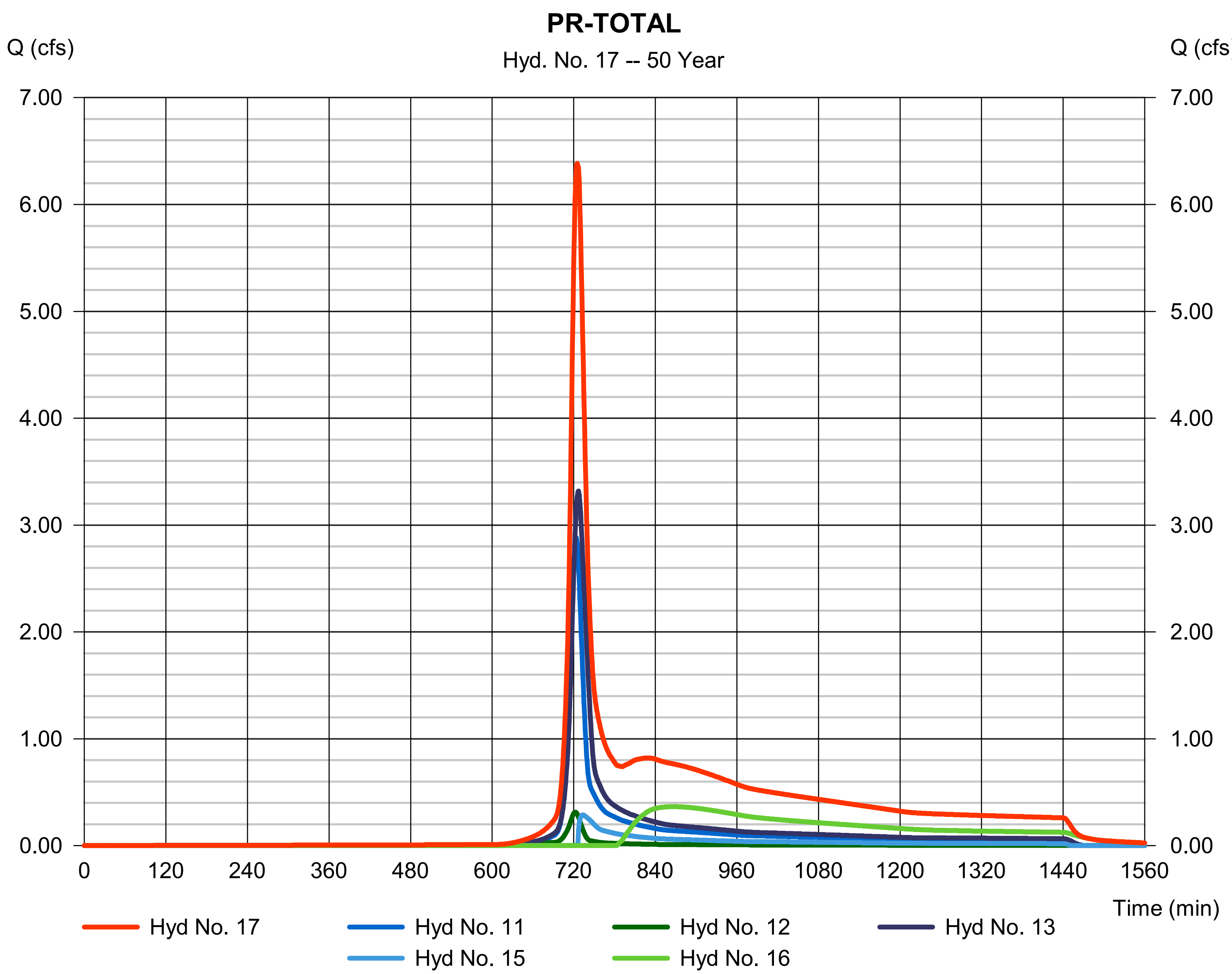
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 17

PR-TOTAL

Hydrograph type	= Combine	Peak discharge	= 6.386 cfs
Storm frequency	= 50 yrs	Time to peak	= 725 min
Time interval	= 1 min	Hyd. volume	= 31,504 cuft
Inflow hyds.	= 11, 12, 13, 15, 16	Contrib. drain. area	= 1.809 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

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	3.253	1	746	19,694	------	------	------	EX-SITE-BASIN-MEAD
2	SCS Runoff	0.518	1	745	3,434	------	------	------	EX-SITE-BASIN-IMP 80%
3	SCS Runoff	4.822	1	721	11,698	------	------	------	EX-SITE-BYPASS-MEAD
4	SCS Runoff	0.046	1	720	132	------	------	------	EX-SITE-BYPASS-IMP 80%
5	SCS Runoff	1.076	1	723	3,093	------	------	------	EX-SITE-TRENCH
6	SCS Runoff	4.479	1	726	14,908	------	------	------	EX-OFFSITE-BYPASS
7	Combine	11.51	1	723	52,960	1, 2, 3, 4, 5, 6	------	------	EX-TOTAL
8	SCS Runoff	3.622	1	718	7,276	------	------	------	PR-SITE-BASIN-MEAD
9	SCS Runoff	13.38	1	717	32,869	------	------	------	PR-SITE-BASIN-GRAV
10	SCS Runoff	2.867	1	717	7,043	------	------	------	PR-SITE-TRENCH-GRAV/IMP
11	SCS Runoff	3.880	1	723	11,151	------	------	------	PR-SITE-BYPASS-MEAD
12	SCS Runoff	0.367	1	722	1,218	------	------	------	PR-SITE-BYPASS-GRAV
13	SCS Runoff	4.479	1	726	14,908	------	------	------	PR-OFFSITE-BYPASS-MEAD
14	Combine	16.96	1	717	40,145	8, 9,	------	------	PR-BASIN-TOTAL
15	Reservoir	1.898	1	721	3,122	10	402.57	4,108	PR-TRENCH
16	Reservoir	1.044	1	758	15,543	14	399.94	26,834	PR-BASIN
17	Combine	10.05	1	723	45,942	11, 12, 13, 15, 16	------	------	PR-TOTAL

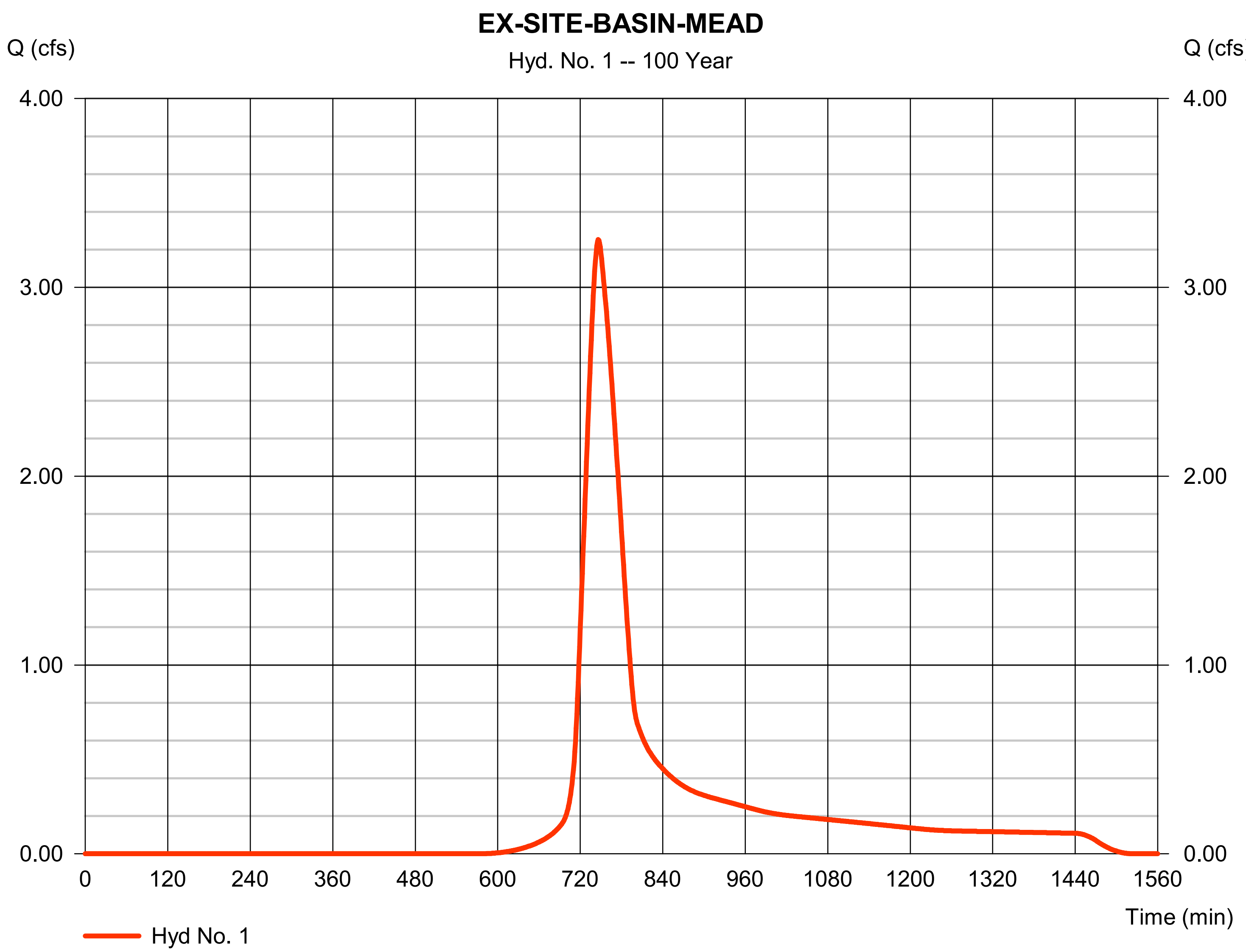
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 1

EX-SITE-BASIN-MEAD

Hydrograph type	= SCS Runoff	Peak discharge	= 3.253 cfs
Storm frequency	= 100 yrs	Time to peak	= 746 min
Time interval	= 1 min	Hyd. volume	= 19,694 cuft
Drainage area	= 1.359 ac	Curve number	= 58
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 53.40 min
Total precip.	= 9.20 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



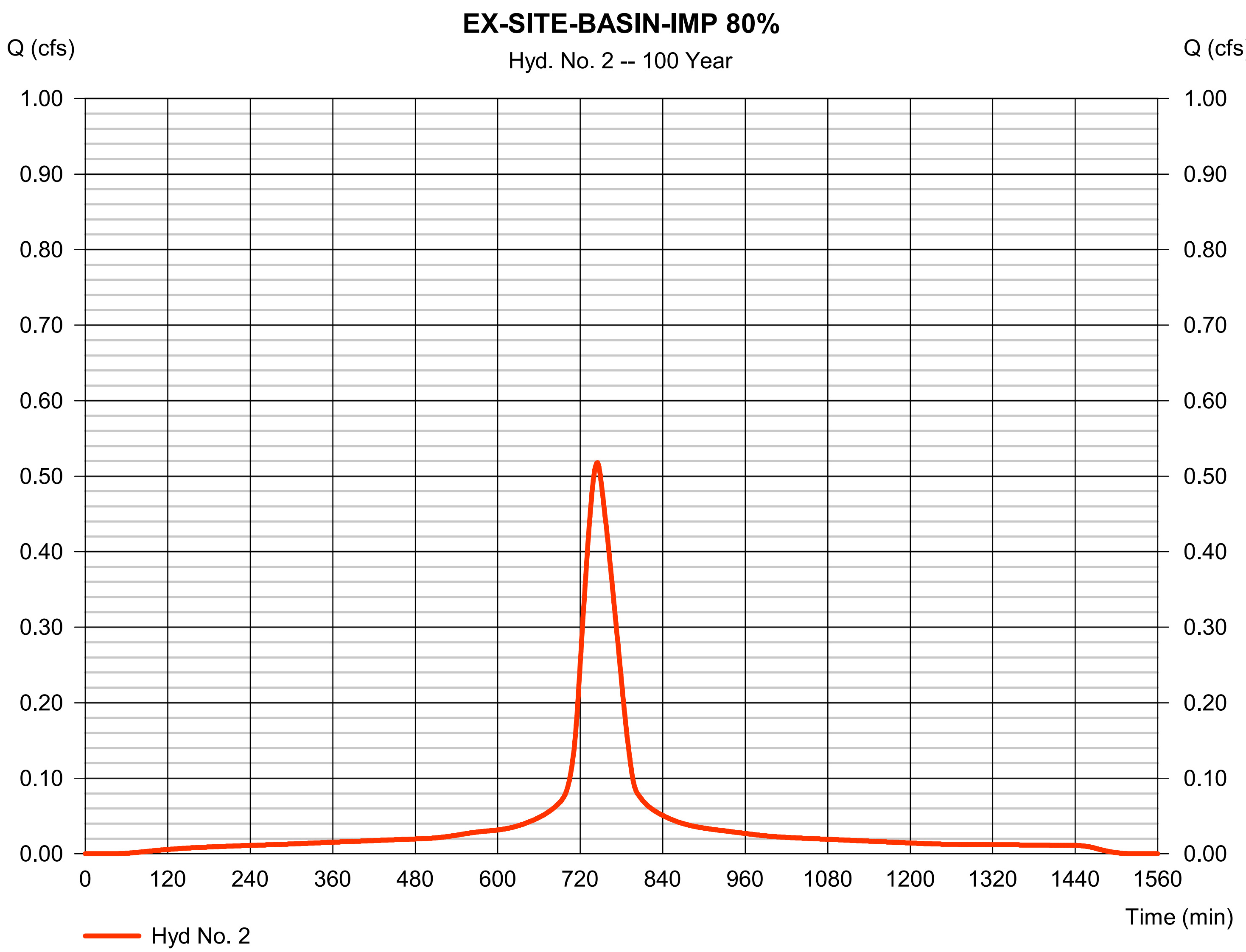
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 2

EX-SITE-BASIN-IMP 80%

Hydrograph type	= SCS Runoff	Peak discharge	= 0.518 cfs
Storm frequency	= 100 yrs	Time to peak	= 745 min
Time interval	= 1 min	Hyd. volume	= 3,434 cuft
Drainage area	= 0.106 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 53.40 min
Total precip.	= 9.20 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



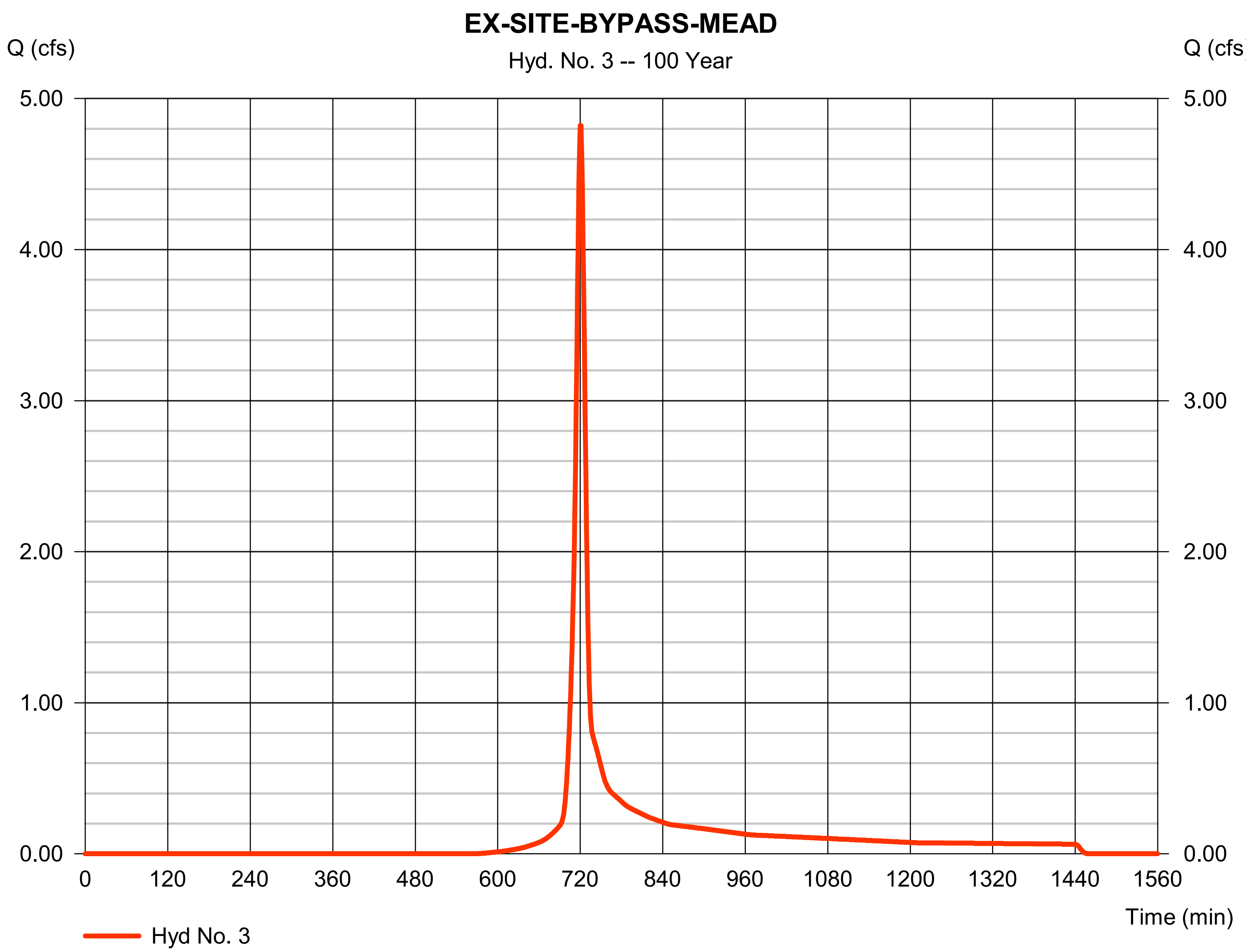
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 3

EX-SITE-BYPASS-MEAD

Hydrograph type	= SCS Runoff	Peak discharge	= 4.822 cfs
Storm frequency	= 100 yrs	Time to peak	= 721 min
Time interval	= 1 min	Hyd. volume	= 11,698 cuft
Drainage area	= 0.790 ac	Curve number	= 58
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 11.70 min
Total precip.	= 9.20 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



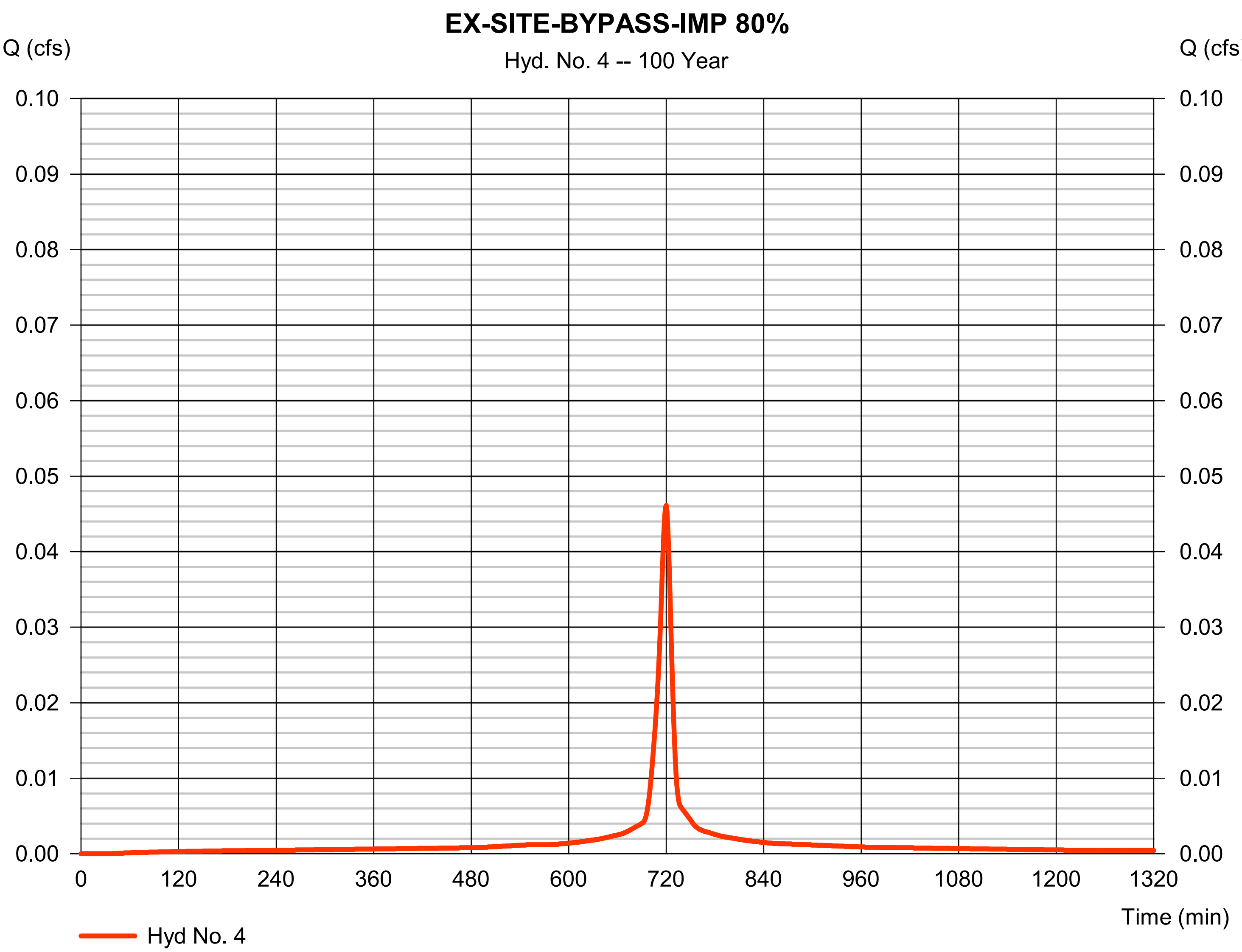
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 — Thursday, 02 / 20 / 2020

Hyd. No. 4

EX-SITE-BYPASS-IMP 80%

Hydrograph type	= SCS Runoff	Peak discharge	= 0.046 cfs
Storm frequency	= 100 yrs	Time to peak	= 720 min
Time interval	= 1 min	Hyd. volume	= 132 cuft
Drainage area	= 0.004 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 11.70 min
Total precip.	= 9.20 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



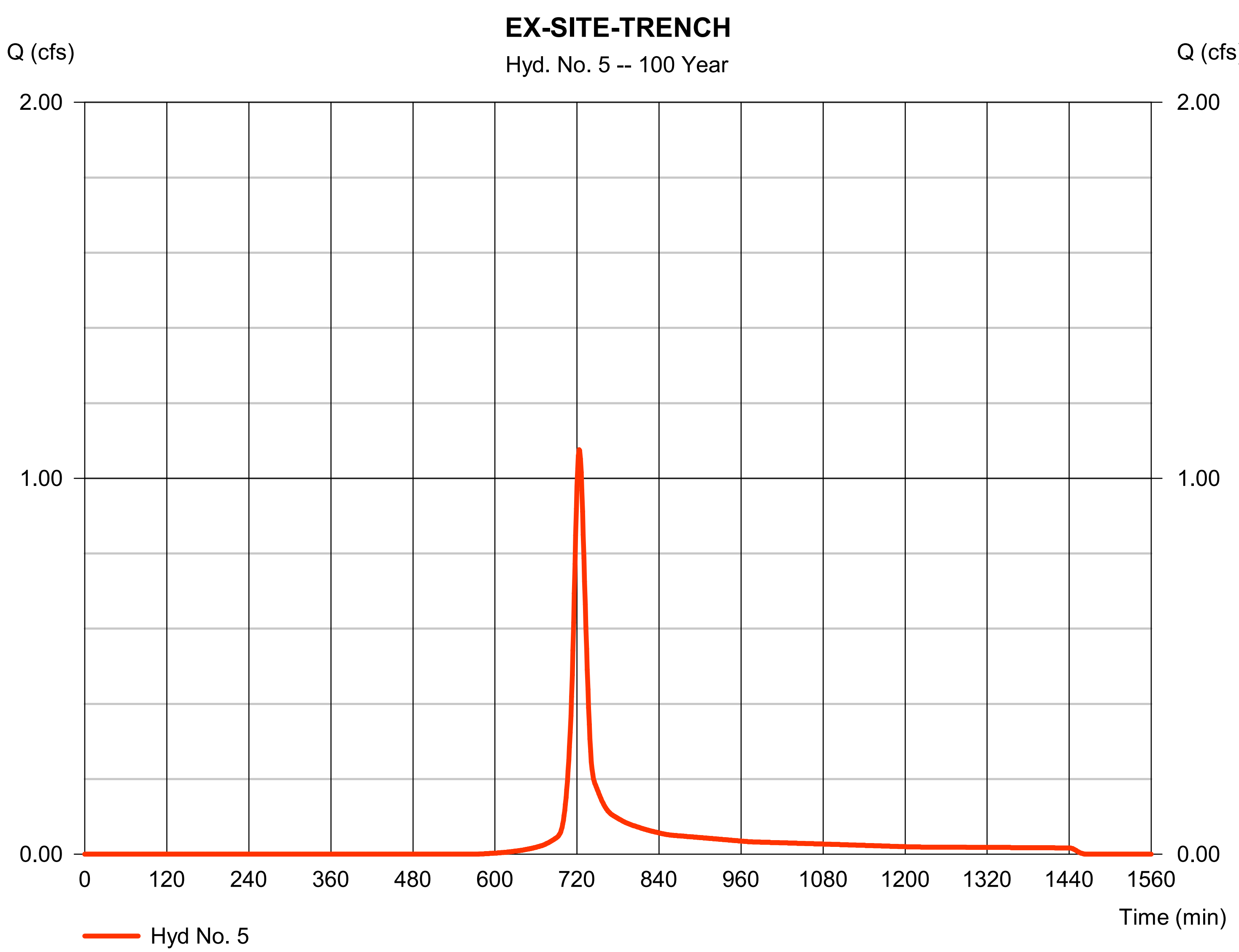
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 5

EX-SITE-TRENCH

Hydrograph type	= SCS Runoff	Peak discharge	= 1.076 cfs
Storm frequency	= 100 yrs	Time to peak	= 723 min
Time interval	= 1 min	Hyd. volume	= 3,093 cuft
Drainage area	= 0.210 ac	Curve number	= 58
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 15.90 min
Total precip.	= 9.20 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



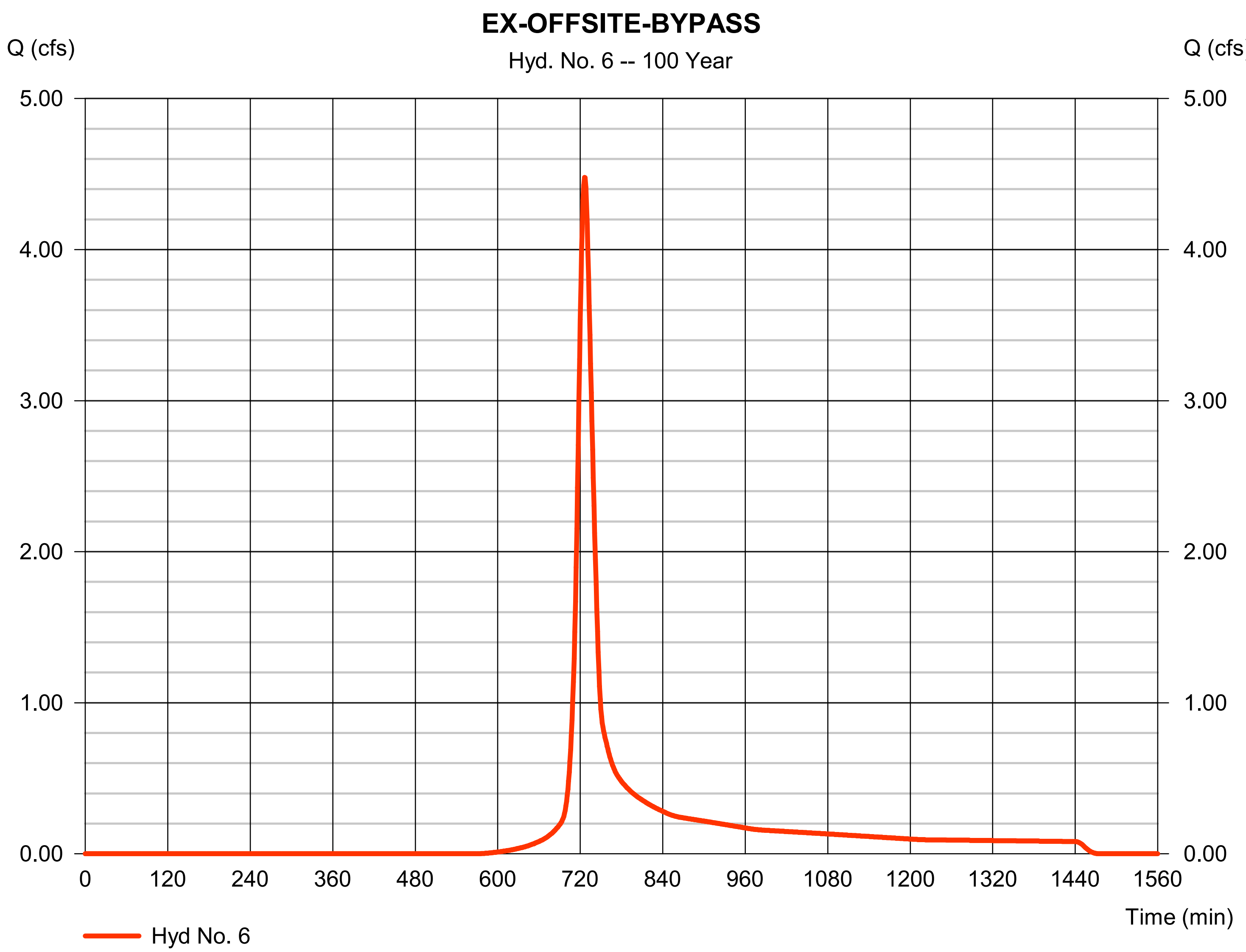
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 — Thursday, 02 / 20 / 2020

Hyd. No. 6

EX-OFFSITE-BYPASS

Hydrograph type	= SCS Runoff	Peak discharge	= 4.479 cfs
Storm frequency	= 100 yrs	Time to peak	= 726 min
Time interval	= 1 min	Hyd. volume	= 14,908 cuft
Drainage area	= 1.015 ac	Curve number	= 58
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 20.90 min
Total precip.	= 9.20 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



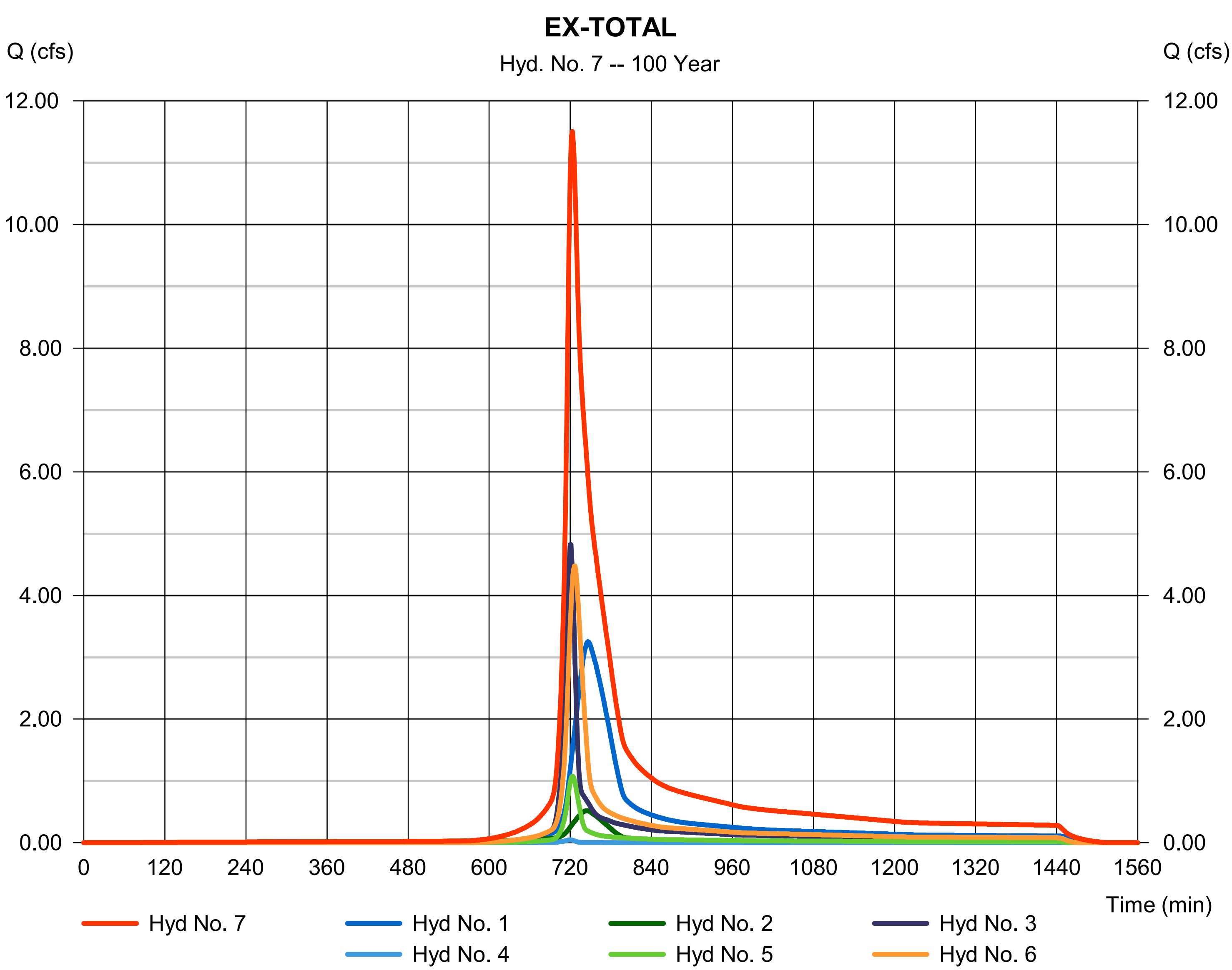
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 — Thursday, 02 / 20 / 2020

Hyd. No. 7

EX-TOTAL

Hydrograph type	= Combine	Peak discharge	= 11.51 cfs
Storm frequency	= 100 yrs	Time to peak	= 723 min
Time interval	= 1 min	Hyd. volume	= 52,960 cuft
Inflow hyds.	= 1, 2, 3, 4, 5, 6	Contrib. drain. area	= 3.484 ac



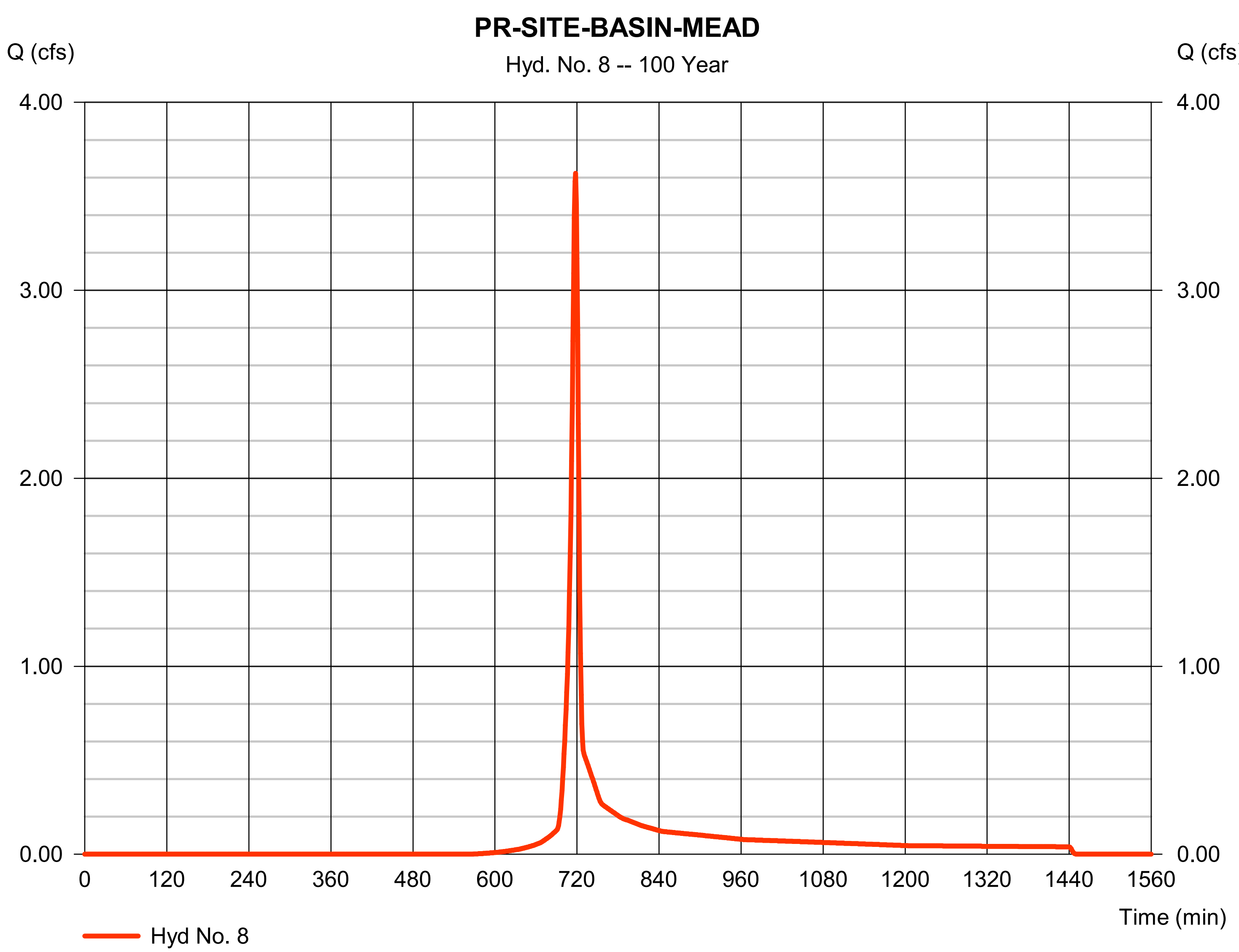
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 — Thursday, 02 / 20 / 2020

Hyd. No. 8

PR-SITE-BASIN-MEAD

Hydrograph type	= SCS Runoff	Peak discharge	= 3.622 cfs
Storm frequency	= 100 yrs	Time to peak	= 718 min
Time interval	= 1 min	Hyd. volume	= 7,276 cuft
Drainage area	= 0.485 ac	Curve number	= 58
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 9.20 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



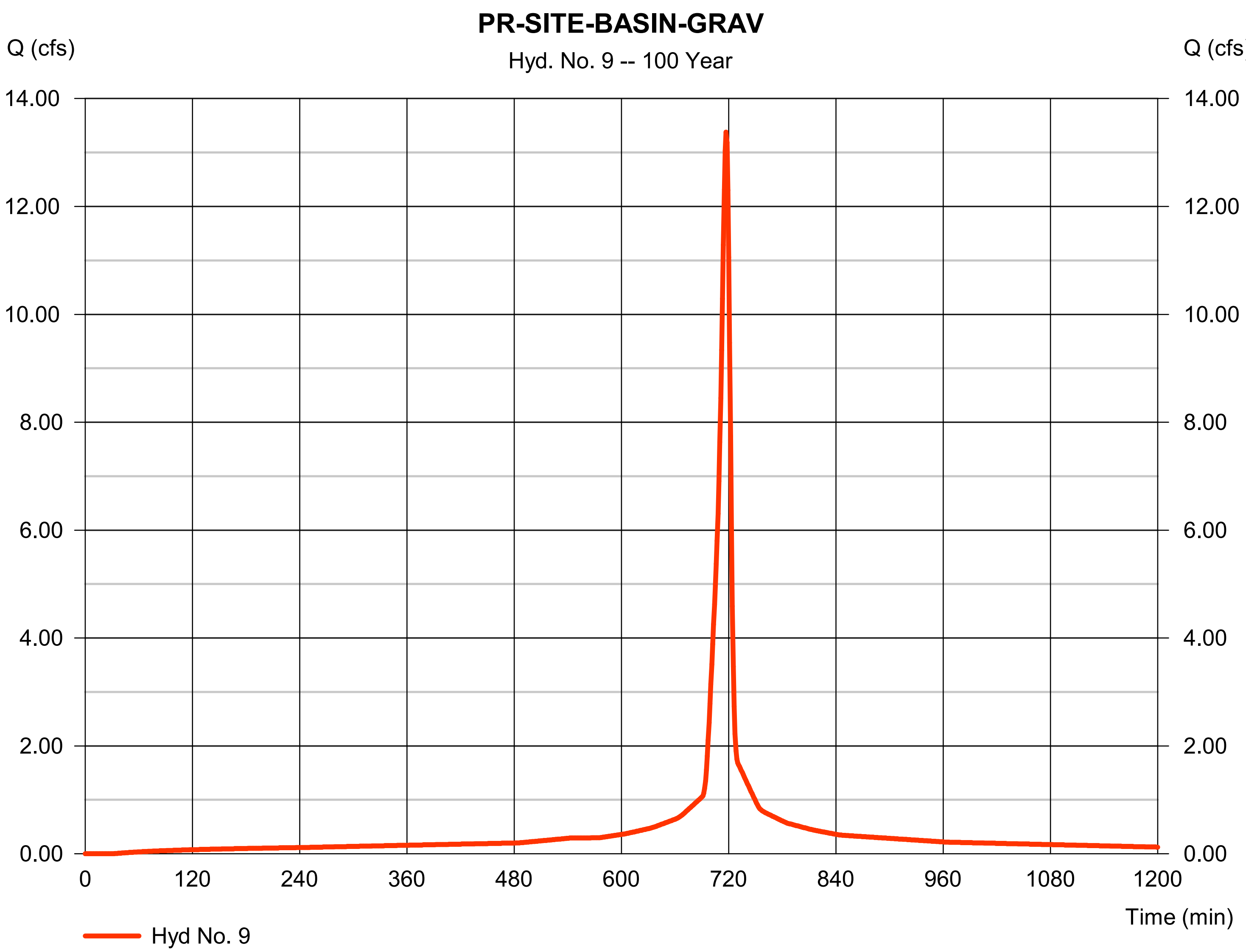
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 9

PR-SITE-BASIN-GRAV

Hydrograph type	= SCS Runoff	Peak discharge	= 13.38 cfs
Storm frequency	= 100 yrs	Time to peak	= 717 min
Time interval	= 1 min	Hyd. volume	= 32,869 cuft
Drainage area	= 0.980 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 9.20 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



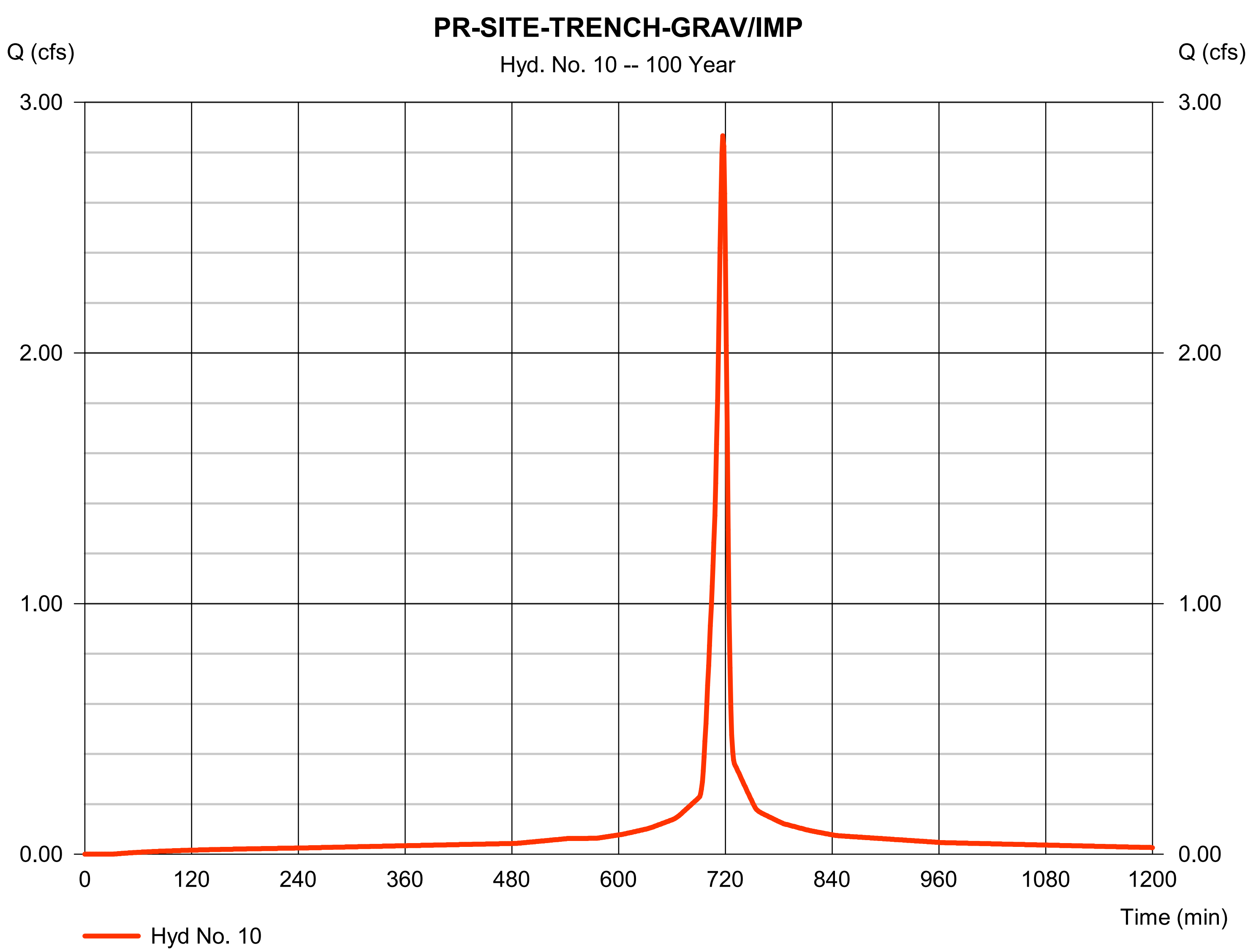
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 10

PR-SITE-TRENCH-GRAV/IMP

Hydrograph type	= SCS Runoff	Peak discharge	= 2.867 cfs
Storm frequency	= 100 yrs	Time to peak	= 717 min
Time interval	= 1 min	Hyd. volume	= 7,043 cuft
Drainage area	= 0.210 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 9.20 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

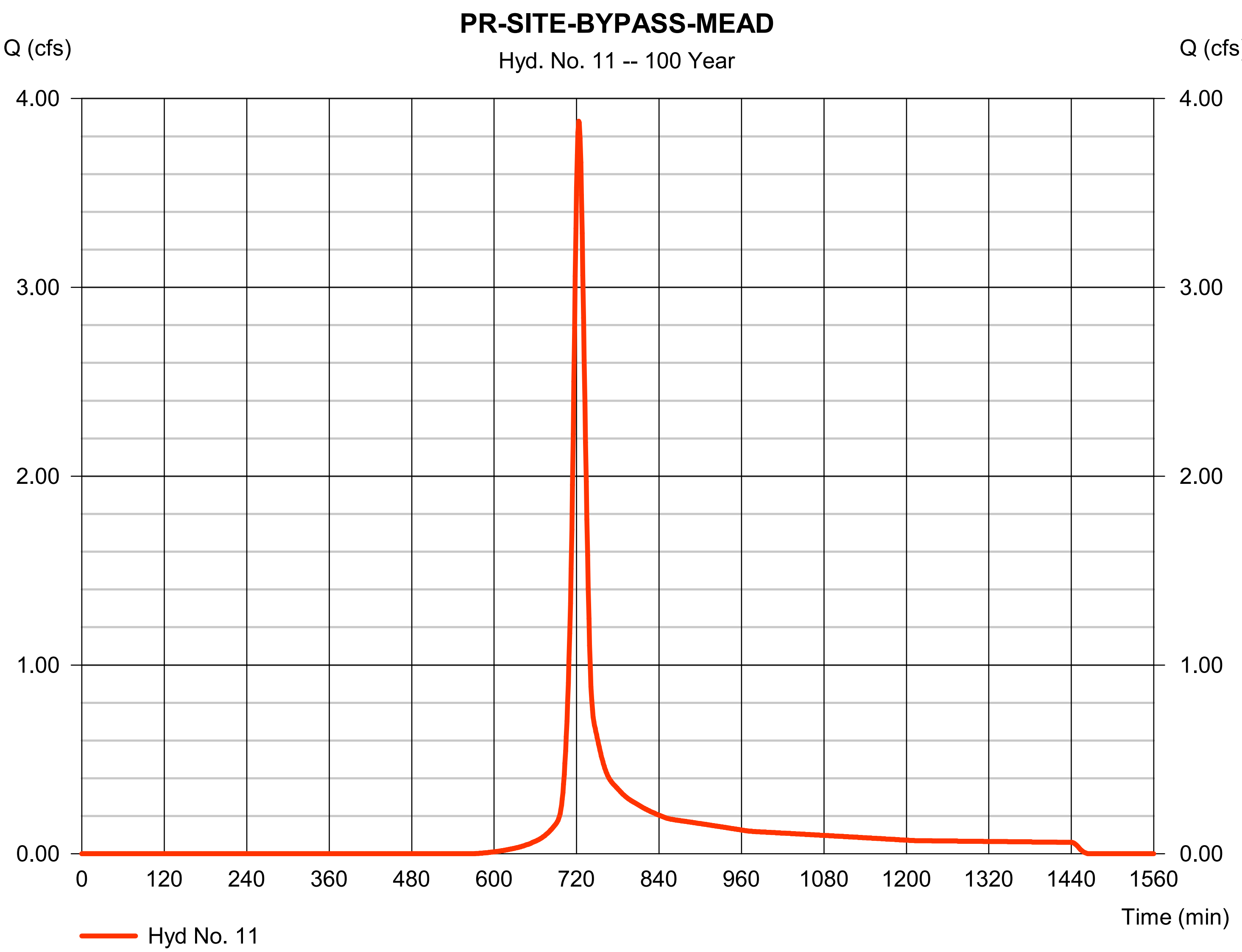


Hydrograph Report

Hyd. No. 11

PR-SITE-BYPASS-MEAD

Hydrograph type	= SCS Runoff	Peak discharge	= 3.880 cfs
Storm frequency	= 100 yrs	Time to peak	= 723 min
Time interval	= 1 min	Hyd. volume	= 11,151 cuft
Drainage area	= 0.757 ac	Curve number	= 58
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 16.10 min
Total precip.	= 9.20 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



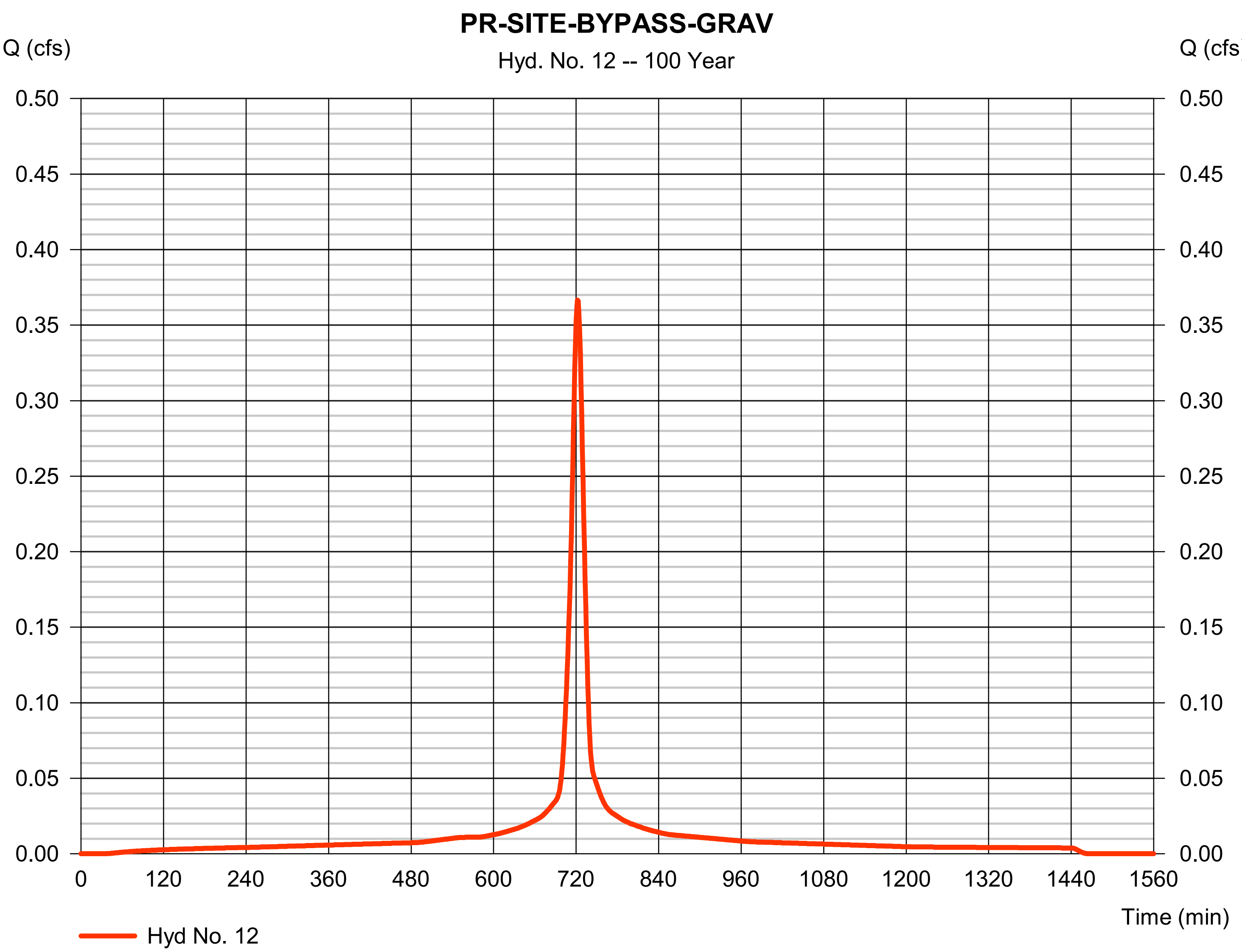
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 | Thursday, 02 / 20 / 2020

Hyd. No. 12

PR-SITE-BYPASS-GRAV

Hydrograph type	= SCS Runoff	Peak discharge	= 0.367 cfs
Storm frequency	= 100 yrs	Time to peak	= 722 min
Time interval	= 1 min	Hyd. volume	= 1,218 cuft
Drainage area	= 0.037 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 16.10 min
Total precip.	= 9.20 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



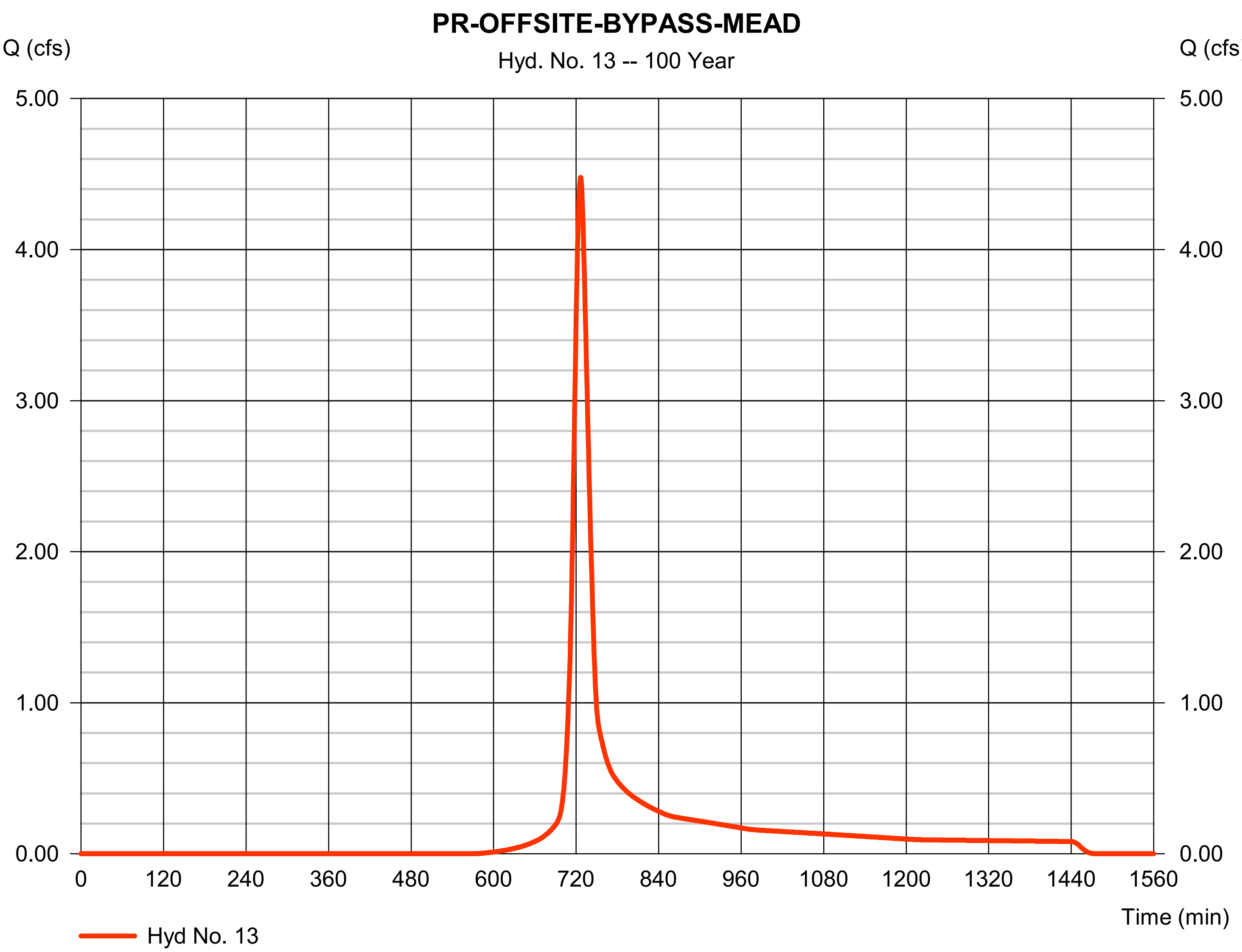
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 13

PR-OFFSITE-BYPASS-MEAD

Hydrograph type	= SCS Runoff	Peak discharge	= 4.479 cfs
Storm frequency	= 100 yrs	Time to peak	= 726 min
Time interval	= 1 min	Hyd. volume	= 14,908 cuft
Drainage area	= 1.015 ac	Curve number	= 58
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 20.90 min
Total precip.	= 9.20 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



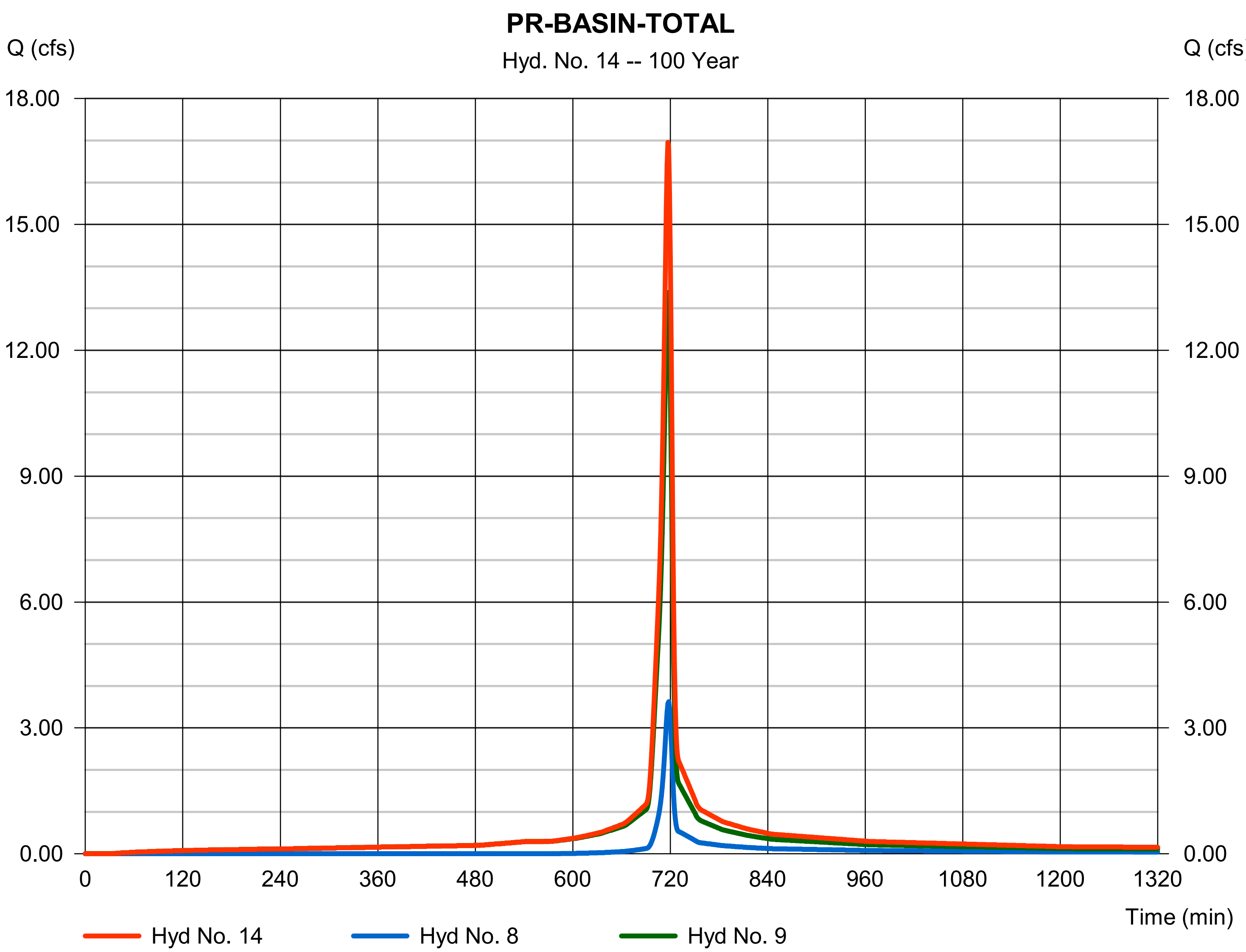
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 14

PR-BASIN-TOTAL

Hydrograph type	= Combine	Peak discharge	= 16.96 cfs
Storm frequency	= 100 yrs	Time to peak	= 717 min
Time interval	= 1 min	Hyd. volume	= 40,145 cuft
Inflow hyds.	= 8, 9	Contrib. drain. area	= 1.465 ac



Hydrograph Report

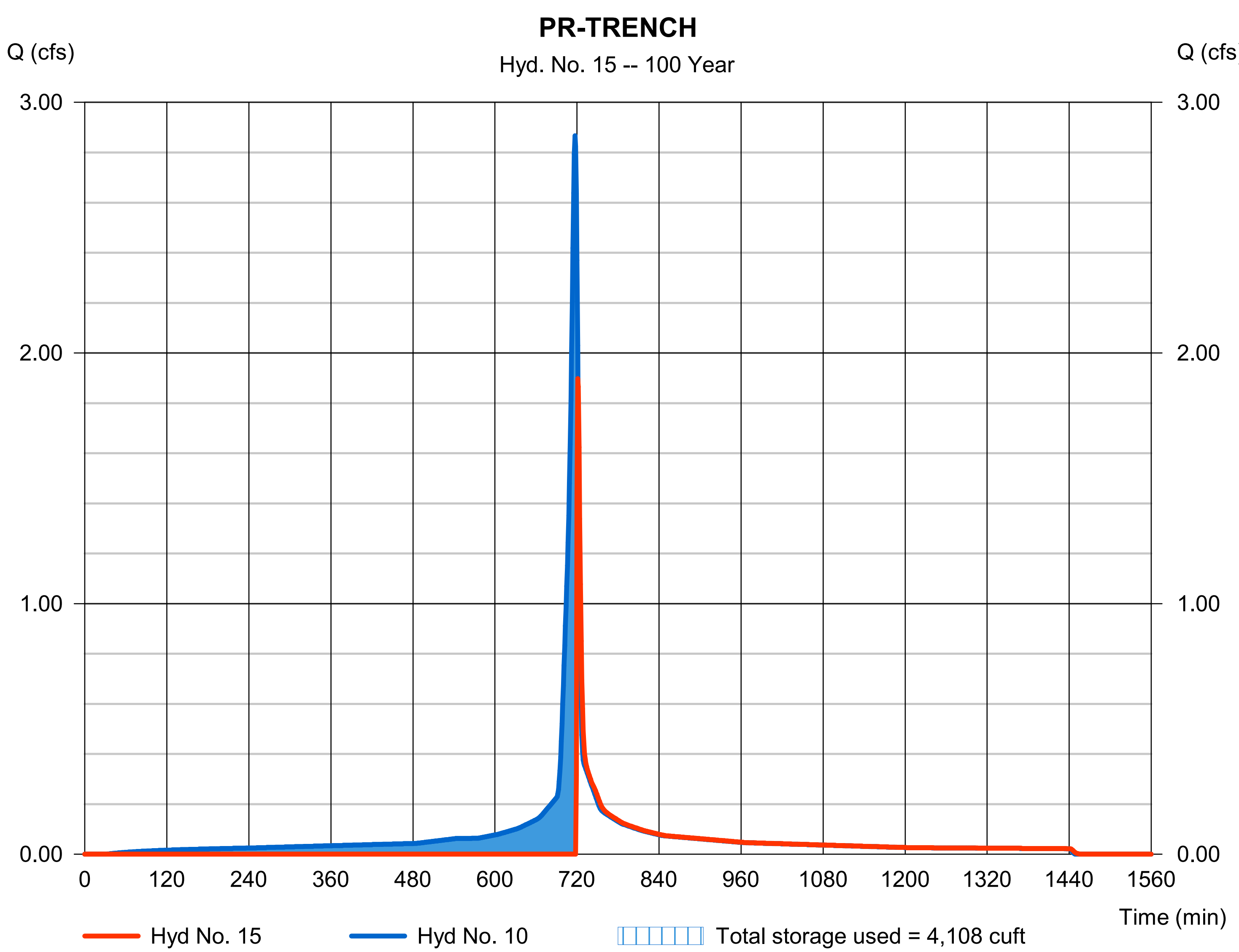
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 — Thursday, 02 / 20 / 2020

Hyd. No. 15

PR-TRENCH

Hydrograph type	= Reservoir	Peak discharge	= 1.898 cfs
Storm frequency	= 100 yrs	Time to peak	= 721 min
Time interval	= 1 min	Hyd. volume	= 3,122 cuft
Inflow hyd. No.	= 10 - PR-SITE-TRENCH-GRAVMAP	Max. Elevation	= 402.57 ft
Reservoir name	= TRENCH	Max. Storage	= 4,108 cuft

Storage Indication method used.



Hydrograph Report

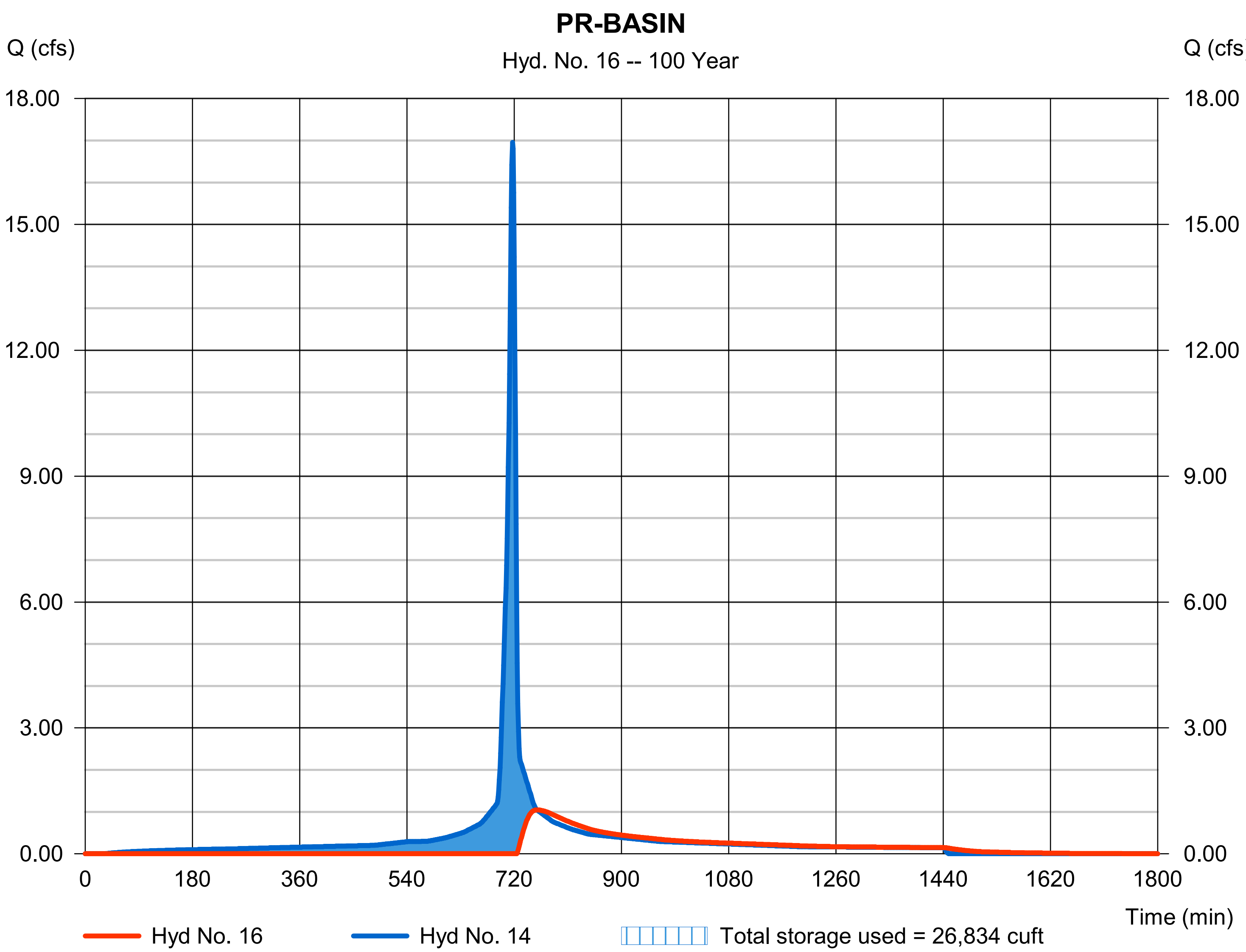
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

Hyd. No. 16

PR-BASIN

Hydrograph type	= Reservoir	Peak discharge	= 1.044 cfs
Storm frequency	= 100 yrs	Time to peak	= 758 min
Time interval	= 1 min	Hyd. volume	= 15,543 cuft
Inflow hyd. No.	= 14 - PR-BASIN-TOTAL	Max. Elevation	= 399.94 ft
Reservoir name	= BASIN	Max. Storage	= 26,834 cuft

Storage Indication method used.



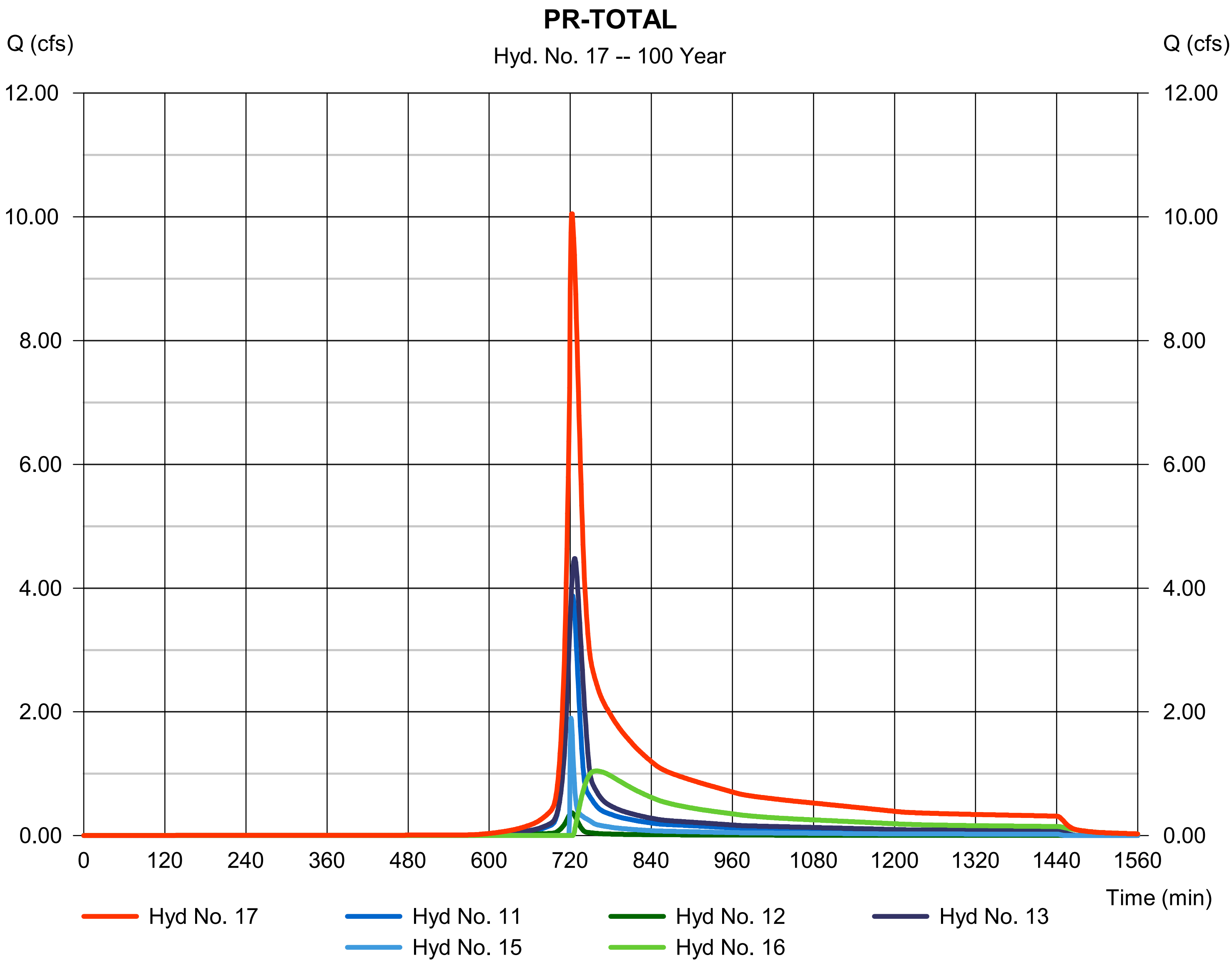
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 — Thursday, 02 / 20 / 2020

Hyd. No. 17

PR-TOTAL

Hydrograph type	= Combine	Peak discharge	= 10.05 cfs
Storm frequency	= 100 yrs	Time to peak	= 723 min
Time interval	= 1 min	Hyd. volume	= 45,942 cuft
Inflow hyds.	= 11, 12, 13, 15, 16	Contrib. drain. area	= 1.809 ac



Hydraflow Rainfall Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 02 / 20 / 2020

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 2 - Springville\SW Model\Site2.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	2.81	3.41	1.80	4.44	5.33	6.68	7.86	9.20
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

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J. Offsite Stormwater Discharge Plan (Attached)