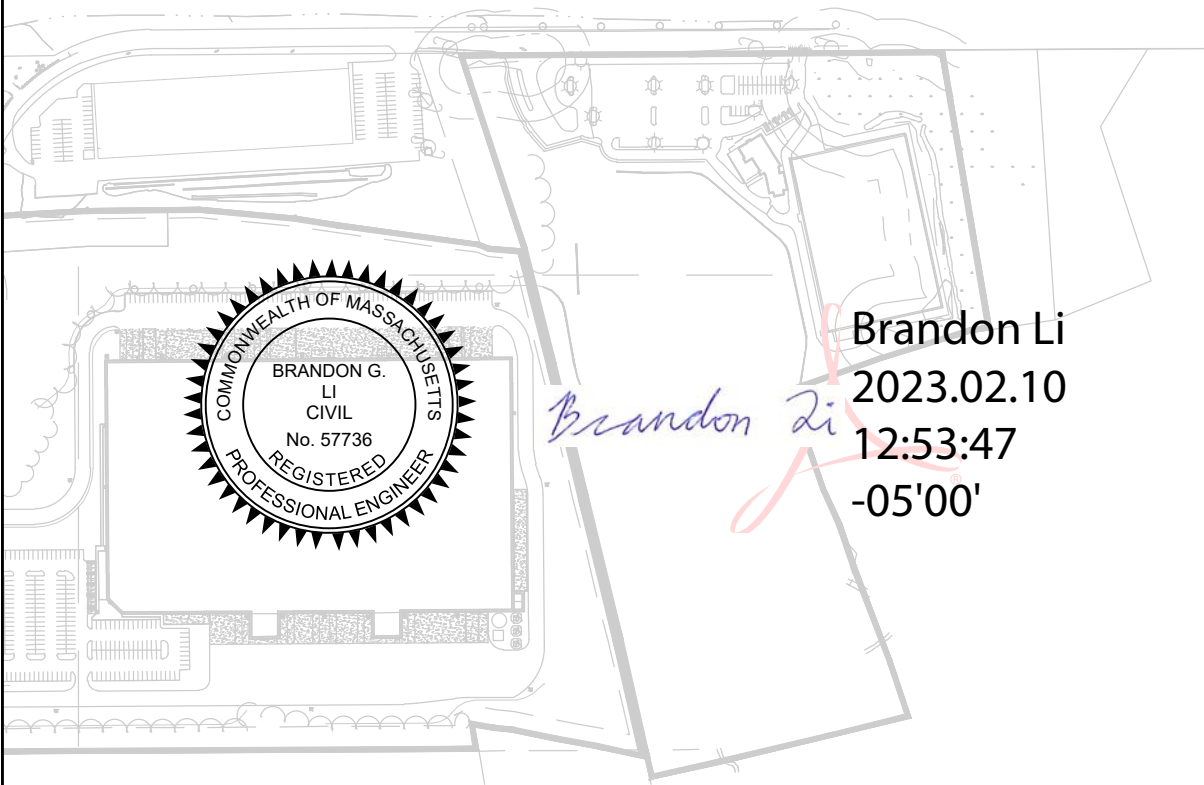


STORMWATER MANAGEMENT REPORT

02/09/23

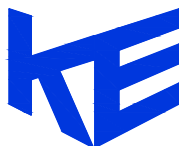
12-14 SOUTH HUNT ROAD
AMESBURY, MA



PREPARED FOR:

GLOBAL PROPERTY DEVELOPERS CORPORATION
80 FIRST STREET
BRIDGEWATER, MA 02324

PREPARED BY:



KELLY ENGINEERING GROUP
civil engineering consultants
0 Campanelli Drive, Braintree, MA 02184
Phone: 781-843-4333 www.kellyengineeringgroup.com

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INTRODUCTION

The purpose of this report is to analyze the pre-development and post-development drainage conditions for the proposed project and to demonstrate that the project will have no negative impacts on the surrounding properties and resource areas. The design incorporates many low impact development and best management practices recommended by the Massachusetts Stormwater Management Handbook.

In preparation of this report, prior approved reports by Weston & Sampson for 12-14 & 24 South Hunt Road were reviewed and referenced.

The site at 12-14 South Hunt Road has an approved drainage system to accommodate a total of 461,952 s.f. of impervious area. Under this current submission no new impervious area is proposed on 12-14 South Hunt Road. The record report by Weston & Sampson last revised March 28, 2022 evaluated and referenced throughout the preparation of this report.

EXISTING SITE

The site is located on 12-14 South Hunt Road in Amesbury, MA. The site is currently partially developed under per existing approved plans. The site is actively under construction. The existing site contains approximately 21 acres and is bordered by South Hunt Road and abutting properties. For the purposes of this analysis the record approved Drainage Report prepared by Weston & Sampson was referenced and used to establish existing conditions analysis as the site is actively under construction.

Currently runoff from the site splits into several drainage areas. Area A flows to the drainage system within South

Hutn Road and ultimately to a BVW system across the street. Area B flows to an existing BVW system at the northeastern portion of the site. Area C flows offsite to the south and east. See Existing Drainage Exhibit in **Attachment A.**

PROPOSED SITE

The proposed project will entail modifying the approved plans. The dome, YMCA building, and parking lot will be completed per approved plans. The roadway connection to 24 and impervious pad sites will be replaced with open space grading. 12-14 will be regarded to support excess material from the proposed development at 24 South Hunt Road. The approved plans had 461,952 s.f. of impervious surfaces. The proposed plans result in 269,200 s.f. of impervious area. This a reduction of 192,752 s.f. from the approved plans. All Stormwater BMPs used for mitigation as a part of the previous approval will still be constructed. 2 of the subsurface systems have been completed. The basin and subsurface system near the curb cut to be completed to South Hunt Road will be completed per approved plans.

A stormwater management system has been designed to comply with Massachusetts Department of Environmental Protection Standards for stormwater management.

The Stormwater management system will incorporate many Best Management Practices (BMPs), which will include street sweeping, deep sump catch basins, stormtech isolator row, subsurface recharge system, and an operations and maintenance program designed to treat, recharge, and detain all of the runoff generated from the proposed development of the site. All BMPs to be constructed per the approved plans.

See Proposed Conditions Drainage Exhibit in **Attachment B.**

STORMWATER MANAGEMENT STANDARDS

The following is a discussion of the Massachusetts Stormwater Management Standards

STANDARD 1: NO NEW UNTREATED DISCHARGES

The proposed project has been designed for no new untreated discharges from the site. The revised proposal has a reduction of 192,752 s.f.. All paved surfaces will be treated per BMPs on the approved plans.

STANDARD 2: PEAK RATE ATTENUATION

Existing and developed sites were modeled using Hydraflow Hydrographs Extension for AutoCAD Civil 3D by Autodesk, Inc. v2020. This computer software uses the TR55/TR20 tabular method of computing peak flows, hydrograph addition, and pond routing. The curve numbers for the existing conditions analysis were determined using soil survey maps which show hydrologic group A,B and C soils. See soil survey map in **Attachment D**. For the purposes of the proposed conditions analysis, a conservative estimate of time of concentration of 6 minutes was assumed for the proposed conditions analysis.

As can be seen from the summary charts below, the peak flows from the design storm on the site will be reduced as a result of this project. Peak flow mitigation will be provided within the subsurface systems and basin

The entire TR55 analysis is included in **Attachment A** (existing conditions) **and B** (proposed conditions) of this report.

Peak Runoff Chart-DP A

<u>Storm</u>	<u>Existing</u>	<u>Proposed</u>	<u>Difference</u>
(yr, inches)	(cfs)	(cfs)	(cfs)
2,3.37	14.99	10.13	-4.86
10,5.33	37.01	26.81	-10.2
25,6.55	52.19	40.56	-11.63
50,7.45	62.24	49.13	-13.11
100,8.43	73.38	57.77	-15.61

Peak Runoff Chart-DP B

<u>Storm</u>	<u>Existing</u>	<u>Proposed</u>	<u>Difference</u>
(yr, inches)	(cfs)	(cfs)	(cfs)
2,3.37	26.87	5.26	-21.61
10,5.33	47.51	17.15	-30.36
25,6.55	60.08	29.26	-30.82
50,7.45	69.43	36.93	-32.5
100,8.43	79.54	40.71	-38.83

Peak Runoff Chart-DP-C

<u>Storm</u>	<u>Existing</u>	<u>Proposed</u>	<u>Difference</u>
(yr, inches)	(cfs)	(cfs)	(cfs)
2,3.37	3.07	2.3	-0.77
10,5.33	8.19	5.69	-2.5
25,6.55	11.78	8	-3.78
50,7.45	14.53	9.76	-4.77
100,8.43	17.58	11.71	-5.87

Peak Runoff Chart-TOTAL SITE

<u>Storm</u>	<u>Existing</u>	<u>Proposed</u>	<u>Difference</u>
(yr, inches)	(cfs)	(cfs)	(cfs)
2,3.37	40.59	15.95	-24.64
10,5.33	85.16	42.91	-42.25
25,6.55	118.49	68.35	-50.14
50,7.45	139.98	86.98	-53
100,8.43	163.37	107.07	-56.3

STANDARD 3: RECHARGE

The approved project provided 20,834 CF of dedicated recharge volume for the proposed impervious surfaces. The revised project has maintained the outlets associated with these recharge volumes. 7,747 cu ft. was previously required. This revised project results in a decrease of 192,752 s.f. The BMPs per the approved report drain under 72 hours.

STANDARD 4: STORMWATER QUALITY

TSS Removal has been provided within the BMPs on the approved plans. 80% TSS removal has been demonstrated in the record report.

STANDARD 5: Land Uses with Higher Potential Pollutant Loads (LUHPPL's)

The approved report assume the traffic volumes could be sufficient enough to classify the site as a LUHPPL. The approved report provided 44% pre treatment and 1" Water Quality Volume.

STANDARD 6: CRITICAL AREAS

There will be no new discharge to critical areas.

STANDARD 7: REDEVELOPMENT

The proposed project is a mix of redevelopment and new development. All Stormwater Standards have been met.

STANDARD 8: CONSTRUCTION PERIOD POLLUTION PREVENTION AND EROSION CONTROL

A construction phasing plan and erosion and sedimentation control has been prepared and has been submitted. A draft SWPPP has also been prepared and submitted.

STANDARD 9: OPERATIONS AND MAINTENANCE PLAN

A long term operation and maintenance plan is approved for this site. The revised plans just incorporate grading and new catch basins. An updated BMP Map is provided. No different BMPs are proposed as a result of the project and all constructed BMPs will be maintained per the approved O and M plan for the site. BMP Location Map are provided in **Attachment C**.

STANDARD 10: ILLICIT DISCHARGES

An Illicit Discharge Statement is attached and can be found in the Table of Contents.

CONCLUSION

An extensive stormwater management system has been designed for the project. The stormwater management system has been designed to comply with current (DEP) standards and will incorporate a number of Best Management Practices (“BMP’s”) that will ensure that the runoff will be treated prior to leaving the site.

The construction of the stormwater management system will ensure that stormwater runoff from this site will be of high quality and that there will be no adverse impacts on surrounding properties or resource areas.



Checklist for Stormwater Report

A. Introduction

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.



A Stormwater Report must be submitted with the Notice of Intent permit application to document compliance with the Stormwater Management Standards. The following checklist is NOT a substitute for the Stormwater Report (which should provide more substantive and detailed information) but is offered here as a tool to help the applicant organize their Stormwater Management documentation for their Report and for the reviewer to assess this information in a consistent format. As noted in the Checklist, the Stormwater Report must contain the engineering computations and supporting information set forth in Volume 3 of the [Massachusetts Stormwater Handbook](#). The Stormwater Report must be prepared and certified by a Registered Professional Engineer (RPE) licensed in the Commonwealth.

The Stormwater Report must include:

- The Stormwater Checklist completed and stamped by a Registered Professional Engineer (see page 2) that certifies that the Stormwater Report contains all required submittals.¹ This Checklist is to be used as the cover for the completed Stormwater Report.
- Applicant/Project Name
- Project Address
- Name of Firm and Registered Professional Engineer that prepared the Report
- Long-Term Pollution Prevention Plan required by Standards 4-6
- Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan required by Standard 8²
- Operation and Maintenance Plan required by Standard 9

In addition to all plans and supporting information, the Stormwater Report must include a brief narrative describing stormwater management practices, including environmentally sensitive site design and LID techniques, along with a diagram depicting runoff through the proposed BMP treatment train. Plans are required to show existing and proposed conditions, identify all wetland resource areas, NRCS soil types, critical areas, Land Uses with Higher Potential Pollutant Loads (LUHPPL), and any areas on the site where infiltration rate is greater than 2.4 inches per hour. The Plans shall identify the drainage areas for both existing and proposed conditions at a scale that enables verification of supporting calculations.

As noted in the Checklist, the Stormwater Management Report shall document compliance with each of the Stormwater Management Standards as provided in the Massachusetts Stormwater Handbook. The soils evaluation and calculations shall be done using the methodologies set forth in Volume 3 of the Massachusetts Stormwater Handbook.

To ensure that the Stormwater Report is complete, applicants are required to fill in the Stormwater Report Checklist by checking the box to indicate that the specified information has been included in the Stormwater Report. If any of the information specified in the checklist has not been submitted, the applicant must provide an explanation. The completed Stormwater Report Checklist and Certification must be submitted with the Stormwater Report.

¹ The Stormwater Report may also include the Illicit Discharge Compliance Statement required by Standard 10. If not included in the Stormwater Report, the Illicit Discharge Compliance Statement must be submitted prior to the discharge of stormwater runoff to the post-construction best management practices.

² For some complex projects, it may not be possible to include the Construction Period Erosion and Sedimentation Control Plan in the Stormwater Report. In that event, the issuing authority has the discretion to issue an Order of Conditions that approves the project and includes a condition requiring the proponent to submit the Construction Period Erosion and Sedimentation Control Plan before commencing any land disturbance activity on the site.



Checklist for Stormwater Report

B. Stormwater Checklist and Certification

The following checklist is intended to serve as a guide for applicants as to the elements that ordinarily need to be addressed in a complete Stormwater Report. The checklist is also intended to provide conservation commissions and other reviewing authorities with a summary of the components necessary for a comprehensive Stormwater Report that addresses the ten Stormwater Standards.

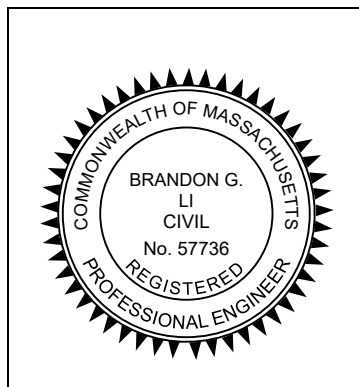
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the item is not applicable (N.A.) and provide the reasons for that determination.

A complete checklist must include the Certification set forth below signed by the Registered Professional Engineer who prepared the Stormwater Report.

Registered Professional Engineer's Certification

I have reviewed the Stormwater Report, including the soil evaluation, computations, Long-term Pollution Prevention Plan, the Construction Period Erosion and Sedimentation Control Plan (if included), the Long-term Post-Construction Operation and Maintenance Plan, the Illicit Discharge Compliance Statement (if included) and the plans showing the stormwater management system, and have determined that they have been prepared in accordance with the requirements of the Stormwater Management Standards as further elaborated by the Massachusetts Stormwater Handbook. I have also determined that the information presented in the Stormwater Checklist is accurate and that the information presented in the Stormwater Report accurately reflects conditions at the site as of the date of this permit application.

Registered Professional Engineer Block and Signature



Brandon Li
2023.02.10
12:12:08 -05'00'

Signature and Date

Checklist

Project Type: Is the application for new development, redevelopment, or a mix of new and redevelopment?

- ☐ New development
- ☐ Redevelopment
- ☒ Mix of New Development and Redevelopment



Checklist for Stormwater Report

Checklist (continued)

LID Measures: Stormwater Standards require LID measures to be considered. Document what environmentally sensitive design and LID Techniques were considered during the planning and design of the project:

- ☐ No disturbance to any Wetland Resource Areas
- ☐ Site Design Practices (e.g. clustered development, reduced frontage setbacks)
- ☐ Reduced Impervious Area (Redevelopment Only)
- ☒ Minimizing disturbance to existing trees and shrubs
- ☐ LID Site Design Credit Requested:
 - ☐ Credit 1
 - ☐ Credit 2
 - ☐ Credit 3
- ☐ Use of "country drainage" versus curb and gutter conveyance and pipe
- ☐ Bioretention Cells (includes Rain Gardens)
- ☐ Constructed Stormwater Wetlands (includes Gravel Wetlands designs)
- ☐ Treebox Filter
- ☐ Water Quality Swale
- ☐ Grass Channel
- ☐ Green Roof
- ☐ Other (describe): _____

Standard 1: No New Untreated Discharges

- ☒ No new untreated discharges
- ☐ Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth
- ☐ Supporting calculations specified in Volume 3 of the Massachusetts Stormwater Handbook included.



Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

- ☐ Standard 2 waiver requested because the project is located in land subject to coastal storm flowage and stormwater discharge is to a wetland subject to coastal flooding.
- ☐ Evaluation provided to determine whether off-site flooding increases during the 100-year 24-hour storm.
- ☒ Calculations provided to show that post-development peak discharge rates do not exceed pre-development rates for the 2-year and 10-year 24-hour storms. If evaluation shows that off-site flooding increases during the 100-year 24-hour storm, calculations are also provided to show that post-development peak discharge rates do not exceed pre-development rates for the 100-year 24-hour storm.

Standard 3: Recharge

- ☒ Soil Analysis provided.
- ☒ Required Recharge Volume calculation provided.
- ☐ Required Recharge volume reduced through use of the LID site Design Credits.
- ☒ Sizing the infiltration, BMPs is based on the following method: Check the method used.
 - ☒ Static
 - ☐ Simple Dynamic
 - ☐ Dynamic Field¹
- ☐ Runoff from all impervious areas at the site discharging to the infiltration BMP.
- ☒ Runoff from all impervious areas at the site is *not* discharging to the infiltration BMP and calculations are provided showing that the drainage area contributing runoff to the infiltration BMPs is sufficient to generate the required recharge volume.
- ☒ Recharge BMPs have been sized to infiltrate the Required Recharge Volume.
- ☐ Recharge BMPs have been sized to infiltrate the Required Recharge Volume *only* to the maximum extent practicable for the following reason:
 - ☐ Site is comprised solely of C and D soils and/or bedrock at the land surface
 - ☐ M.G.L. c. 21E sites pursuant to 310 CMR 40.0000
 - ☐ Solid Waste Landfill pursuant to 310 CMR 19.000
 - ☐ Project is otherwise subject to Stormwater Management Standards only to the maximum extent practicable.
- ☒ Calculations showing that the infiltration BMPs will drain in 72 hours are provided.
- ☐ Property includes a M.G.L. c. 21E site or a solid waste landfill and a mounding analysis is included.

Required Recharge Volume provided,
per record report, proposed report
reduces impervious area

¹ 80% TSS removal is required prior to discharge to infiltration BMP if Dynamic Field method is used.



Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

- ☐ The infiltration BMP is used to attenuate peak flows during storms greater than or equal to the 10-year 24-hour storm and separation to seasonal high groundwater is less than 4 feet and a mounding analysis is provided.
- ☐ Documentation is provided showing that infiltration BMPs do not adversely impact nearby wetland resource areas.

Water Quality provided per record report, Proposed revised report reduces paved surfaces.

Standard 4: Water Quality

The Long-Term Pollution Prevention Plan typically includes the following:

- Good housekeeping practices;
 - Provisions for storing materials and waste products inside or under cover;
 - Vehicle washing controls;
 - Requirements for routine inspections and maintenance of stormwater BMPs;
 - Spill prevention and response plans;
 - Provisions for maintenance of lawns, gardens, and other landscaped areas;
 - Requirements for storage and use of fertilizers, herbicides, and pesticides;
 - Pet waste management provisions;
 - Provisions for operation and management of septic systems;
 - Provisions for solid waste management;
 - Snow disposal and plowing plans relative to Wetland Resource Areas;
 - Winter Road Salt and/or Sand Use and Storage restrictions;
 - Street sweeping schedules;
 - Provisions for prevention of illicit discharges to the stormwater management system;
 - Documentation that Stormwater BMPs are designed to provide for shutdown and containment in the event of a spill or discharges to or near critical areas or from LUHPPL;
 - Training for staff or personnel involved with implementing Long-Term Pollution Prevention Plan;
 - List of Emergency contacts for implementing Long-Term Pollution Prevention Plan.
- ☒ A Long-Term Pollution Prevention Plan is attached to Stormwater Report and is included as an attachment to the Wetlands Notice of Intent.
 - ☒ Treatment BMPs subject to the 44% TSS removal pretreatment requirement and the one inch rule for calculating the water quality volume are included, and discharge:
 - ☐ is within the Zone II or Interim Wellhead Protection Area
 - ☐ is near or to other critical areas
 - ☐ is within soils with a rapid infiltration rate (greater than 2.4 inches per hour)
 - ☒ involves runoff from land uses with higher potential pollutant loads.
 - ☐ The Required Water Quality Volume is reduced through use of the LID site Design Credits.
 - ☒ Calculations documenting that the treatment train meets the 80% TSS removal requirement and, if applicable, the 44% TSS removal pretreatment requirement, are provided.



Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

- ☒ The BMP is sized (and calculations provided) based on:
 - ☐ The ½" or 1" Water Quality Volume or
 - ☒ The equivalent flow rate associated with the Water Quality Volume and documentation is provided showing that the BMP treats the required water quality volume.
- ☒ The applicant proposes to use proprietary BMPs, and documentation supporting use of proprietary BMP and proposed TSS removal rate is provided. This documentation may be in the form of the propriety BMP checklist found in Volume 2, Chapter 4 of the Massachusetts Stormwater Handbook and submitting copies of the TARP Report, STEP Report, and/or other third party studies verifying performance of the proprietary BMPs.
- ☐ A TMDL exists that indicates a need to reduce pollutants other than TSS and documentation showing that the BMPs selected are consistent with the TMDL is provided.

Standard 5: Land Uses With Higher Potential Pollutant Loads (LUHPPLs)

- ☒ The NPDES Multi-Sector General Permit covers the land use and the Stormwater Pollution Prevention Plan (SWPPP) has been included with the Stormwater Report.
- ☐ The NPDES Multi-Sector General Permit covers the land use and the SWPPP will be submitted **prior to** the discharge of stormwater to the post-construction stormwater BMPs.
- ☐ The NPDES Multi-Sector General Permit does **not** cover the land use.
- ☐ LUHPPLs are located at the site and industry specific source control and pollution prevention measures have been proposed to reduce or eliminate the exposure of LUHPPLs to rain, snow, snow melt and runoff, and been included in the long term Pollution Prevention Plan.
- ☐ All exposure has been eliminated.
- ☐ All exposure has **not** been eliminated and all BMPs selected are on MassDEP LUHPPL list.
- ☐ The LUHPPL has the potential to generate runoff with moderate to higher concentrations of oil and grease (e.g. all parking lots with >1000 vehicle trips per day) and the treatment train includes an oil grit separator, a filtering bioretention area, a sand filter or equivalent.

Standard 6: Critical Areas

- ☐ The discharge is near or to a critical area and the treatment train includes only BMPs that MassDEP has approved for stormwater discharges to or near that particular class of critical area.
- ☐ Critical areas and BMPs are identified in the Stormwater Report.



Checklist for Stormwater Report

Checklist (continued)

Standard 7: Redevelopments and Other Projects Subject to the Standards only to the maximum extent practicable

- ☒ The project is subject to the Stormwater Management Standards only to the maximum Extent Practicable as a:
 - ☐ Limited Project
 - ☐ Small Residential Projects: 5-9 single family houses or 5-9 units in a multi-family development provided there is no discharge that may potentially affect a critical area.
 - ☐ Small Residential Projects: 2-4 single family houses or 2-4 units in a multi-family development with a discharge to a critical area
 - ☐ Marina and/or boatyard provided the hull painting, service and maintenance areas are protected from exposure to rain, snow, snow melt and runoff
 - ☐ Bike Path and/or Foot Path
 - ☐ Redevelopment Project
- ☒ Redevelopment portion of mix of new and redevelopment.
- ☐ Certain standards are not fully met (Standard No. 1, 8, 9, and 10 must always be fully met) and an explanation of why these standards are not met is contained in the Stormwater Report.
- ☐ The project involves redevelopment and a description of all measures that have been taken to improve existing conditions is provided in the Stormwater Report. The redevelopment checklist found in Volume 2 Chapter 3 of the Massachusetts Stormwater Handbook may be used to document that the proposed stormwater management system (a) complies with Standards 2, 3 and the pretreatment and structural BMP requirements of Standards 4-6 to the maximum extent practicable and (b) improves existing conditions.

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control

A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan must include the following information:

- Narrative;
 - Construction Period Operation and Maintenance Plan;
 - Names of Persons or Entity Responsible for Plan Compliance;
 - Construction Period Pollution Prevention Measures;
 - Erosion and Sedimentation Control Plan Drawings;
 - Detail drawings and specifications for erosion control BMPs, including sizing calculations;
 - Vegetation Planning;
 - Site Development Plan;
 - Construction Sequencing Plan;
 - Sequencing of Erosion and Sedimentation Controls;
 - Operation and Maintenance of Erosion and Sedimentation Controls;
 - Inspection Schedule;
 - Maintenance Schedule;
 - Inspection and Maintenance Log Form.
- ☒ A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan containing the information set forth above has been included in the Stormwater Report.



Checklist for Stormwater Report

Checklist (continued)

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control (continued)

- ☐ The project is highly complex and information is included in the Stormwater Report that explains why it is not possible to submit the Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan with the application. A Construction Period Pollution Prevention and Erosion and Sedimentation Control has **not** been included in the Stormwater Report but will be submitted **before** land disturbance begins.
- ☐ The project is **not** covered by a NPDES Construction General Permit.
- ☒ The project is covered by a NPDES Construction General Permit and a copy of the SWPPP is in the Stormwater Report.
- ☐ The project is covered by a NPDES Construction General Permit but no SWPPP been submitted. The SWPPP will be submitted BEFORE land disturbance begins.

Standard 9: Operation and Maintenance Plan

- ☒ The Post Construction Operation and Maintenance Plan is included in the Stormwater Report and includes the following information:
 - ☒ Name of the stormwater management system owners;
 - ☒ Party responsible for operation and maintenance;
 - ☒ Schedule for implementation of routine and non-routine maintenance tasks;
 - ☒ Plan showing the location of all stormwater BMPs maintenance access areas;
 - ☒ Description and delineation of public safety features;
 - ☒ Estimated operation and maintenance budget; and
 - ☒ Operation and Maintenance Log Form.
- ☐ The responsible party is **not** the owner of the parcel where the BMP is located and the Stormwater Report includes the following submissions:
 - ☐ A copy of the legal instrument (deed, homeowner's association, utility trust or other legal entity) that establishes the terms of and legal responsibility for the operation and maintenance of the project site stormwater BMPs;
 - ☐ A plan and easement deed that allows site access for the legal entity to operate and maintain BMP functions.

O & M provided per approved report. No different BMPs provided. A new location map has been provided.

Standard 10: Prohibition of Illicit Discharges

- ☒ The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;
- ☒ An Illicit Discharge Compliance Statement is attached;
- ☐ NO Illicit Discharge Compliance Statement is attached but will be submitted **prior to** the discharge of any stormwater to post-construction BMPs.

ILLICIT DISCHARGE STATEMENT

This statement has been prepared to comply with Stormwater Management Standard #10 as referenced in the Massachusetts Stormwater Handbook, Volume One, Chapter One, Page 25. This handbook has been issued by the Massachusetts Department of Environmental Protection for compliance with revised Regulations for Wetlands 310 CMR 10.00.

As detailed in the Site Development Plans accompanying this application this project will not involve any illicit discharge to the stormwater management system. Furthermore, to the best of my knowledge there are no illicit discharges to the stormwater management system of the existing site.

Owner and Responsible Party for Operating and
Managing the site:

Amesbury Sports Ventures LLC
80 First Street
Bridgewater, MA 02324



Garrett Horsfall
For: Amesbury Sports Ventures LLC

2/9/23
Date

RUNOFF SUMMARY

Peak Runoff Chart-DP A

<u>Storm</u>	<u>Existing</u>	<u>Proposed</u>	<u>Difference</u>
(yr, inches)	(cfs)	(cfs)	(cfs)
2,3.37	14.99	10.13	-4.86
10,5.33	37.01	26.81	-10.2
25,6.55	52.19	40.56	-11.63
50,7.45	62.24	49.13	-13.11
100,8.43	73.38	57.77	-15.61

Peak Runoff Chart-DP B

<u>Storm</u>	<u>Existing</u>	<u>Proposed</u>	<u>Difference</u>
(yr, inches)	(cfs)	(cfs)	(cfs)
2,3.37	26.87	5.26	-21.61
10,5.33	47.51	17.15	-30.36
25,6.55	60.08	29.26	-30.82
50,7.45	69.43	36.93	-32.5
100,8.43	79.54	40.71	-38.83

Peak Runoff Chart-DP-C

<u>Storm</u>	<u>Existing</u>	<u>Proposed</u>	<u>Difference</u>
(yr, inches)	(cfs)	(cfs)	(cfs)
2,3.37	3.07	2.3	-0.77
10,5.33	8.19	5.69	-2.5
25,6.55	11.78	8	-3.78
50,7.45	14.53	9.76	-4.77
100,8.43	17.58	11.71	-5.87

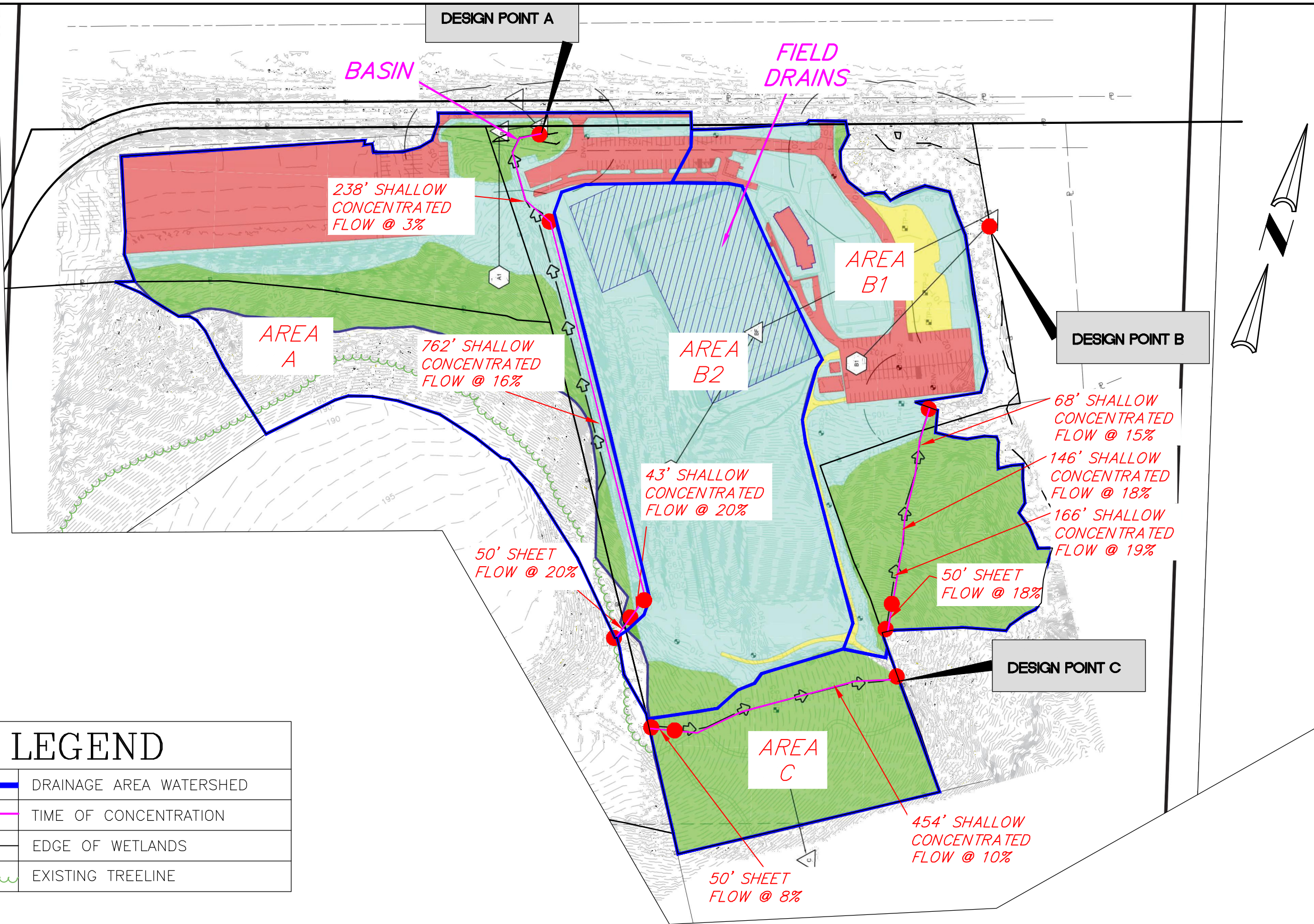
Peak Runoff Chart-TOTAL SITE

<u>Storm</u>	<u>Existing</u>	<u>Proposed</u>	<u>Difference</u>
(yr, inches)	(cfs)	(cfs)	(cfs)
2,3.37	40.59	15.95	-24.64
10,5.33	85.16	42.91	-42.25
25,6.55	118.49	68.35	-50.14
50,7.45	139.98	86.98	-53
100,8.43	163.37	107.07	-56.3

KELLY ENGINEERING GROUP, INC.

Zero Campanelli Drive-Braintree-MA 02184 Phone 781 843 4333

Attachment A
Existing Conditions



LEGEND

	DRAINAGE AREA WATERSHED
	TIME OF CONCENTRATION
	EDGE OF WETLANDS
	EXISTING TREELINE

MARCUS PARTNERS
12-14 SOUTH HUNT RD.
AMESBURY, MA

SCALE: 1" = 200'
DATE: 02/09/23
2021-194-EXDR-12 SH

EXISTING
DRAINAGE
EXHIBIT



KELLY ENGINEERING GROUP
civil engineering consultants
0 Campanelli Drive, Braintree, MA 02184
Phone: 781-843-4333 www.kellyengineeringgroup.com

Runoff Curve Number and Runoff

Name: Marcus Partners By: BGL Date: 02/09/23
Location : 12-14 South Hunt Rd. Amesbury, MA
Description: Existing Conditions - Area A

Circle One: Pre or Post

Runoff Curve Number (CN):

Surface Description	Soil Name; hydrologic group; hydrologic condition	<u>CN</u>	s.f.	Product of CN x Area
Pavement	Hydrologic Group A; Good Condition	98	2086	204428
Pavement	Hydrologic Group B; Good Condition	98	21587	2115526
Pavement	Hydrologic Group C; Good Condition	98	127293	1.2E+07
Grass	Hydrologic Group A; Good Condition	39	6610	257790
Grass	Hydrologic Group B; Good Condition	61	1891	115351
Grass	Hydrologic Group C; Good Condition	74	139345	1E+07
Woods	Hydrologic Group C; Good Condition	70	231196	1.6E+07
Woods	Hydrologic Group B; Good Condition	55	4712	259160
Totals =			534720.00	4.2E+07
Acres =			12.2754821	

CN or C (weighted) = total product/total area =

78.4

Reference: *Urban Hydrology for Small Watersheds*
Technical Release 55, Soil Conservation Service
U.S. Department of Agriculture, June 1986

Runoff Curve Number and Runoff

Name: Marcus Partners By: BGL Date: 02/09/23
Location : 12-14 South Hunt Rd. Amesbury, MA
Description: Existing Conditions - Area B-1

Circle One: Pre or Post

Runoff Curve Number (CN):

Surface Description	Soil Name; hydrologic group; hydrologic condition	<u>CN</u>	s.f.	Product of CN x Area
Grass	Hydrologic Group A; Good Condition	39	5355	208845
Pavement	Hydrologic Group A; Good Condition	98	1040	101920
Woods	Hydrologic Group A; Good Condition	30	716	21480
Grass	Hydrologic Group B; Good Condition	61	59756	3645116
Pavement	Hydrologic Group B; Good Condition	98	29073	2849154
Gravel Roads	Hydrologic Group B; Good Condition	85	16401	1394085
Woods	Hydrologic Group B; Good Condition	55	788	43340
Grass	Hydrologic Group C; Good Condition	74	47801	3537274
Woods	Hydrologic Group C; Good Condition	70	142347	9964290
Pavement	Hydrologic Group C; Good Condition	98	38174	3741052
Gravel Roads	Hydrologic Group C; Good Condition	89	11821	1052069
Totals =			353272.00	2.7E+07
Acres =			8.11000918	

CN or C (weighted) = total product/total area =

75.2

Reference: *Urban Hydrology for Small Watersheds*
Technical Release 55, Soil Conservation Service
U.S. Department of Agriculture, June 1986

Runoff Curve Number and Runoff

Name: Marcus Partners By: BGL Date: 02/09/23
Location : 12-14 South Hunt Rd. Amesbury, MA
Description: Existing Conditions - Area B-2

Circle One: Pre or Post

Runoff Curve Number (CN):

Surface Description	Soil Name; hydrologic group; hydrologic condition	<u>CN</u>	s.f.	Product of CN x Area
Grass	Hydrologic Group B; Good Condition	61	6942	423462
Grass	Hydrologic Group C; Good Condition	74	253877	1.9E+07
Woods	Hydrologic Group C; Good Condition	70	14937	1045590
Gravel Roads	Hydrologic Group C; Good Condition	89	2275	202475
Sports Fields	Hydrologic Group B; Good Condition	98	36663	3592974
Sports Fields	Hydrologic Group C; Good Condition	98	78217	7665266
Totals =			392911.00	3.2E+07
Acres =			9.0199954	

CN or C (weighted) = total product/total area =

80.7

Reference: *Urban Hydrology for Small Watersheds*
Technical Release 55, Soil Conservation Service
U.S. Department of Agriculture, June 1986

Runoff Curve Number and Runoff

Name: Marcus Partners By: BGL Date: 02/09/23
Location : 12-14 South Hunt Rd. Amesbury, MA
Description: Existing Conditions - Area C

Circle One: Pre or Post

Runoff Curve Number (CN):

Surface Description	Soil Name; hydrologic group; hydrologic condition	<u>CN</u>	s.f.	Product of CN x Area
Woods	Hydrologic Group C; Good Condition	70	147538	1E+07
Grass	Hydrologic Group C; Good Condition	74	697	51578
Gravel Roads	Hydrologic Group C; Good Condition	89	371	33019
Totals =			148606.00	1E+07

Acres = 3.41152433

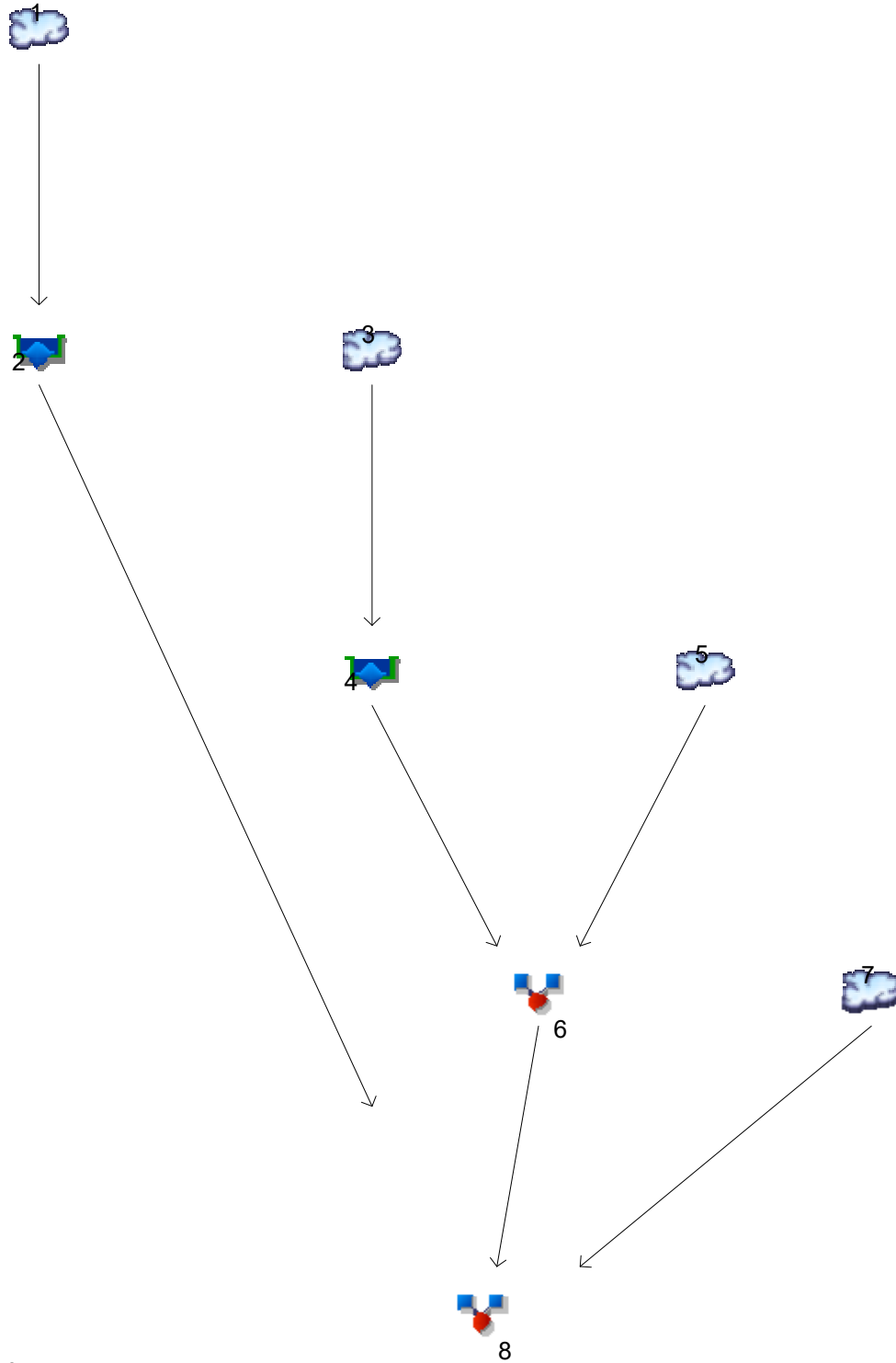
CN or C (weighted) = total product/total area =

70.1

Reference: *Urban Hydrology for Small Watersheds*
Technical Release 55, Soil Conservation Service
U.S. Department of Agriculture, June 1986

Watershed Model Schematic

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



Legend

Hyd.	Origin	Description
1	SCS Runoff	Area A
2	Reservoir	Route thru Basin
3	SCS Runoff	Area B1
4	Reservoir	Route thru Field Drain
5	SCS Runoff	Area B2
6	Combine	SUM OF AREA B
7	SCS Runoff	Area C
8	Combine	TOTAL SITE RUNOFF

Hydrograph Return Period Recap

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 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	-----	-----	18.29	-----	-----	39.56	53.47	63.85	75.20	Area A
2	Reservoir	1	-----	14.99	-----	-----	37.01	52.19	62.24	73.38	Route thru Basin
3	SCS Runoff	-----	-----	10.94	-----	-----	25.27	34.84	42.04	49.96	Area B1
4	Reservoir	3	-----	10.68	-----	-----	15.33	17.51	19.10	20.76	Route thru Field Drain
5	SCS Runoff	-----	-----	16.19	-----	-----	33.26	44.23	52.37	61.23	Area B2
6	Combine	4, 5	-----	26.87	-----	-----	47.51	60.08	69.43	79.54	SUM OF AREA B
7	SCS Runoff	-----	-----	3.073	-----	-----	8.192	11.78	14.53	17.58	Area C
8	Combine	2, 6, 7	-----	40.59	-----	-----	85.16	118.49	139.98	163.37	TOTAL SITE RUNOFF
Proj. file: Pre-Existing Conditions-12 -14 S Hunt.gpw										Wednesday, 02 / 8 / 2023	

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 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	18.29	2	726	63,524	-----	-----	-----	Area A
2	Reservoir	14.99	2	732	59,478	1	100.60	10,237	Route thru Basin
3	SCS Runoff	10.94	2	724	33,746	-----	-----	-----	Area B1
4	Reservoir	10.68	2	724	33,716	3	102.18	78.1	Route thru Field Drain
5	SCS Runoff	16.19	2	724	48,583	-----	-----	-----	Area B2
6	Combine	26.87	2	724	82,299	4, 5	-----	-----	SUM OF AREA B
7	SCS Runoff	3.073	2	728	11,569	-----	-----	-----	Area C
8	Combine	40.59	2	726	153,346	2, 6, 7	-----	-----	TOTAL SITE RUNOFF
Pre-Existing Conditions-12 -14 S Hunt.gpw					Return Period: 2 Year			Wednesday, 02 / 8 / 2023	

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 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	39.56	2	726	135,073	-----	-----	-----	Area A
2	Reservoir	37.01	2	728	131,027	1	101.31	14,932	Route thru Basin
3	SCS Runoff	25.27	2	724	75,552	-----	-----	-----	Area B1
4	Reservoir	15.33	2	730	75,522	3	102.77	4,893	Route thru Field Drain
5	SCS Runoff	33.26	2	724	99,755	-----	-----	-----	Area B2
6	Combine	47.51	2	724	175,277	4, 5	-----	-----	SUM OF AREA B
7	SCS Runoff	8.192	2	726	28,396	-----	-----	-----	Area C
8	Combine	85.16	2	726	334,700	2, 6, 7	-----	-----	TOTAL SITE RUNOFF
Pre-Existing Conditions-12 -14 S Hunt.gpw					Return Period: 10 Year			Wednesday, 02 / 8 / 2023	

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 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	53.47	2	726	183,178	-----	-----	-----	Area A
2	Reservoir	52.19	2	728	179,131	1	101.47	16,247	Route thru Basin
3	SCS Runoff	34.84	2	724	104,221	-----	-----	-----	Area B1
4	Reservoir	17.51	2	732	104,192	3	103.02	10,132	Route thru Field Drain
5	SCS Runoff	44.23	2	724	133,710	-----	-----	-----	Area B2
6	Combine	60.08	2	724	237,902	4, 5	-----	-----	SUM OF AREA B
7	SCS Runoff	11.78	2	726	40,350	-----	-----	-----	Area C
8	Combine	118.49	2	726	457,383	2, 6, 7	-----	-----	TOTAL SITE RUNOFF
Pre-Existing Conditions-12 -14 S Hunt.gpw					Return Period: 25 Year			Wednesday, 02 / 8 / 2023	

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 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	63.85	2	726	219,678	-----	-----	-----	Area A
2	Reservoir	62.24	2	728	215,632	1	101.56	17,100	Route thru Basin
3	SCS Runoff	42.04	2	724	126,146	-----	-----	-----	Area B1
4	Reservoir	19.10	2	734	126,117	3	103.20	14,823	Route thru Field Drain
5	SCS Runoff	52.37	2	724	159,343	-----	-----	-----	Area B2
6	Combine	69.43	2	724	285,460	4, 5	-----	-----	SUM OF AREA B
7	SCS Runoff	14.53	2	726	49,623	-----	-----	-----	Area C
8	Combine	139.98	2	726	550,714	2, 6, 7	-----	-----	TOTAL SITE RUNOFF
Pre-Existing Conditions-12 -14 S Hunt.gpw					Return Period: 50 Year			Wednesday, 02 / 8 / 2023	

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 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	75.20	2	726	260,117	-----	-----	-----	Area A
2	Reservoir	73.38	2	728	256,071	1	101.66	18,017	Route thru Basin
3	SCS Runoff	49.96	2	724	150,559	-----	-----	-----	Area B1
4	Reservoir	20.76	2	736	150,530	3	103.39	20,652	Route thru Field Drain
5	SCS Runoff	61.23	2	724	187,649	-----	-----	-----	Area B2
6	Combine	79.54	2	724	338,179	4, 5	-----	-----	SUM OF AREA B
7	SCS Runoff	17.58	2	726	60,044	-----	-----	-----	Area C
8	Combine	163.37	2	726	654,292	2, 6, 7	-----	-----	TOTAL SITE RUNOFF
Pre-Existing Conditions-12 -14 S Hunt.gpw					Return Period: 100 Year			Wednesday, 02 / 8 / 2023	

Hydrograph Report

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

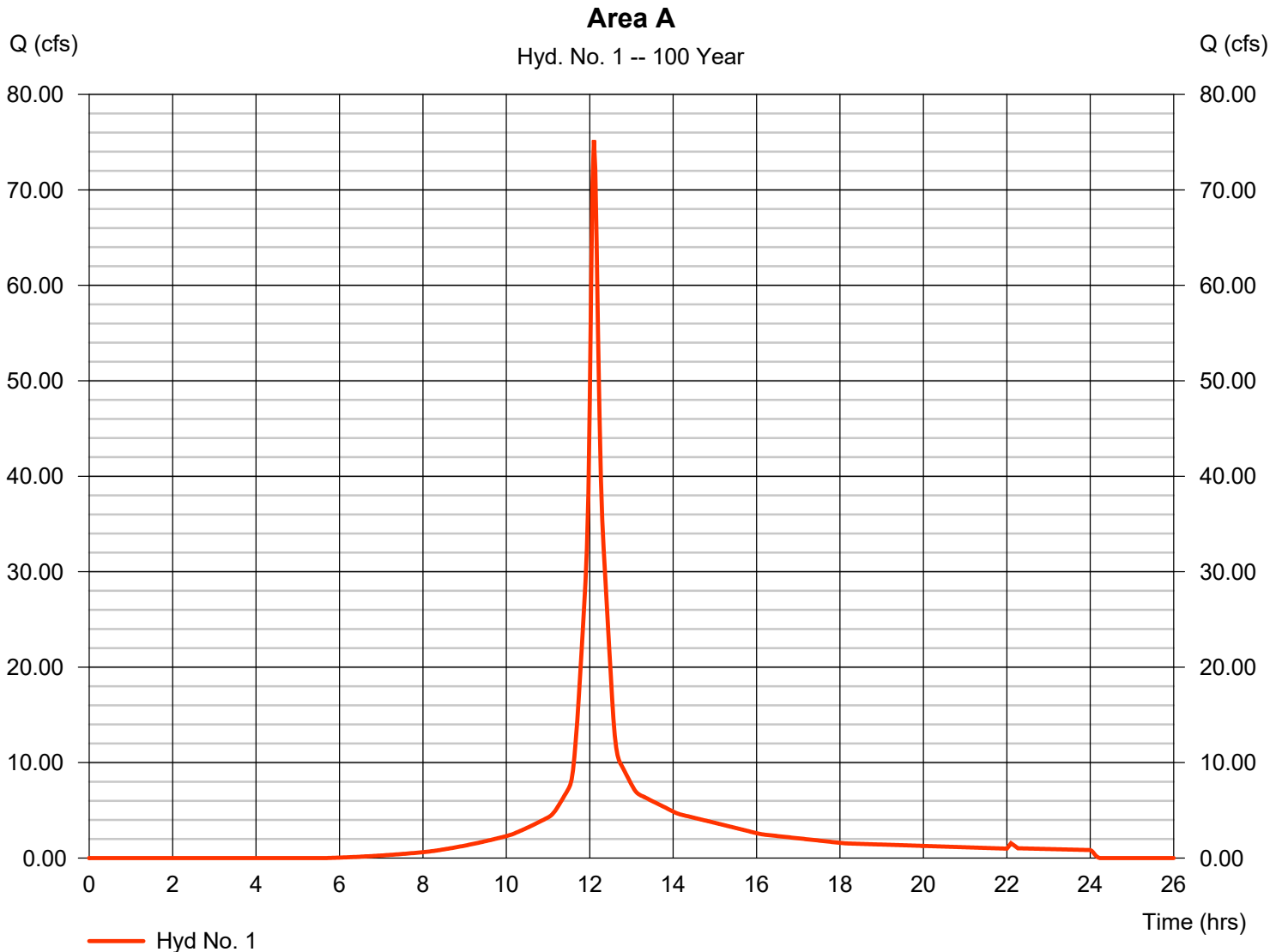
Wednesday, 02 / 8 / 2023

Hyd. No. 1

Area A

Hydrograph type = SCS Runoff
 Storm frequency = 100 yrs
 Time interval = 2 min
 Drainage area = 12.275 ac
 Basin Slope = 0.0 %
 Tc method = TR55
 Total precip. = 8.43 in
 Storm duration = 24 hrs

Peak discharge = 75.20 cfs
 Time to peak = 12.10 hrs
 Hyd. volume = 260,117 cuft
 Curve number = 78.4
 Hydraulic length = 0 ft
 Time of conc. (Tc) = 8.30 min
 Distribution = Type III
 Shape factor = 484



TR55 Tc Worksheet

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

Hyd. No. 1

Area A

<u>Description</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>Totals</u>			
Sheet Flow							
Manning's n-value	= 0.400	0.011	0.011				
Flow length (ft)	= 50.0	0.0	0.0				
Two-year 24-hr precip. (in)	= 3.37	0.00	0.00				
Land slope (%)	= 20.00	0.00	0.00				
Travel Time (min)	= 4.78	+	0.00	+	0.00	=	4.78
Shallow Concentrated Flow							
Flow length (ft)	= 43.00	762.00	238.00				
Watercourse slope (%)	= 20.00	16.00	3.00				
Surface description	= Unpaved	Unpaved	Unpaved				
Average velocity (ft/s)	=7.22	6.45	2.79				
Travel Time (min)	= 0.10	+	1.97	+	1.42	=	3.49
Channel Flow							
X sectional flow area (sqft)	= 0.00	0.00	0.00				
Wetted perimeter (ft)	= 0.00	0.00	0.00				
Channel slope (%)	= 0.00	0.00	0.00				
Manning's n-value	= 0.015	0.015	0.015				
Velocity (ft/s)	=0.00	0.00	0.00				
Flow length (ft)	((0})0.0	0.0	0.0				
Travel Time (min)	= 0.00	+	0.00	+	0.00	=	0.00
Total Travel Time, Tc				8.30 min			

Hydrograph Report

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

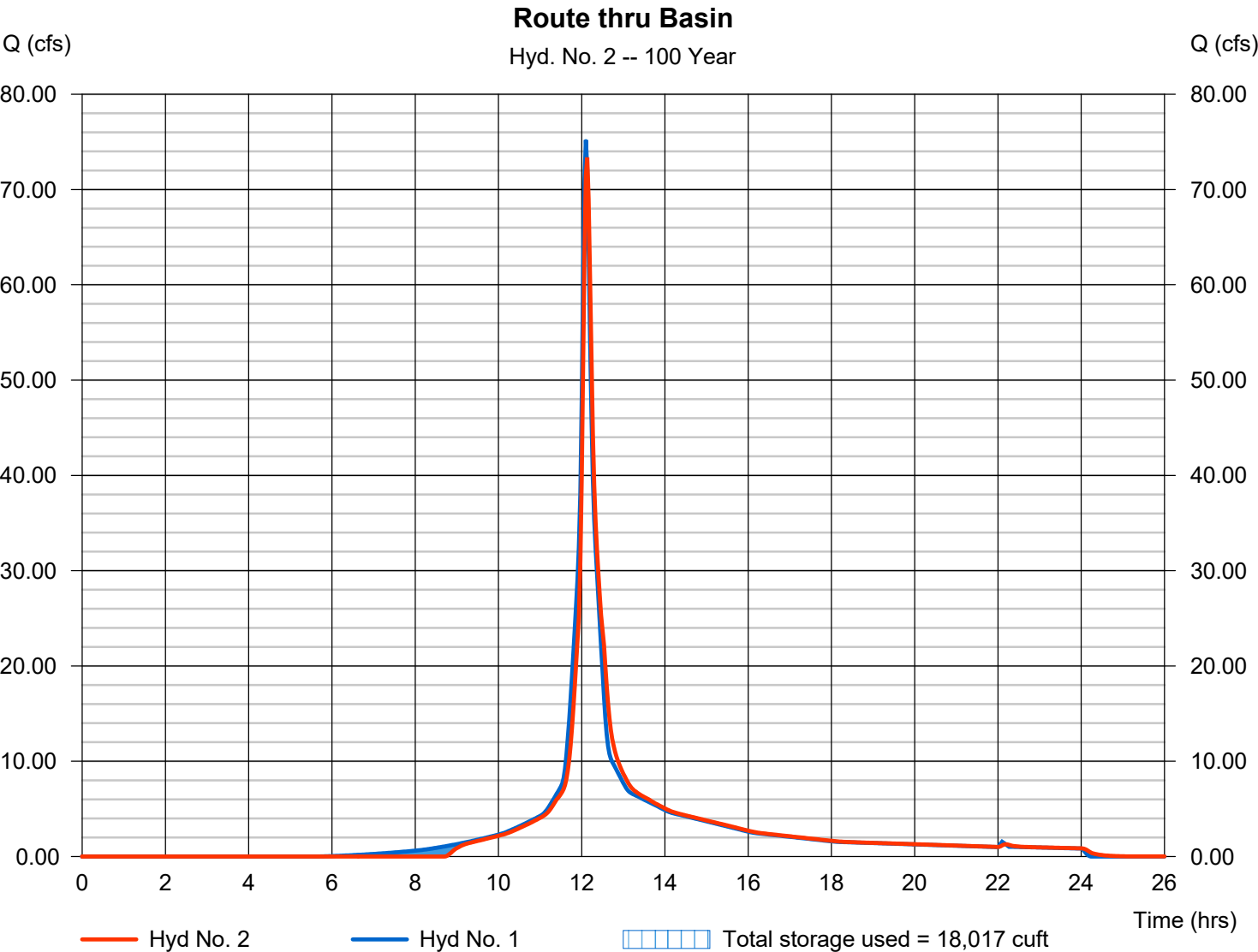
Wednesday, 02 / 8 / 2023

Hyd. No. 2

Route thru Basin

Hydrograph type	= Reservoir	Peak discharge	= 73.38 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 256,071 cuft
Inflow hyd. No.	= 1 - Area A	Max. Elevation	= 101.66 ft
Reservoir name	= Exist. Basin	Max. Storage	= 18,017 cuft

Storage Indication method used.



Pond No. 1 - Exist. Basin

Pond Data

Contours -User-defined contour areas. Average end area method used for volume calculation. Beginning Elevation = 95.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	95.00	10	0	0
1.00	96.00	200	105	105
2.00	97.00	570	385	490
3.00	98.00	1,120	845	1,335
4.00	99.00	2,790	1,955	3,290
5.00	100.00	4,410	3,600	6,890
6.00	101.00	6,730	5,570	12,460
6.50	101.50	9,350	4,020	16,480
7.00	102.00	10,000	4,838	21,318

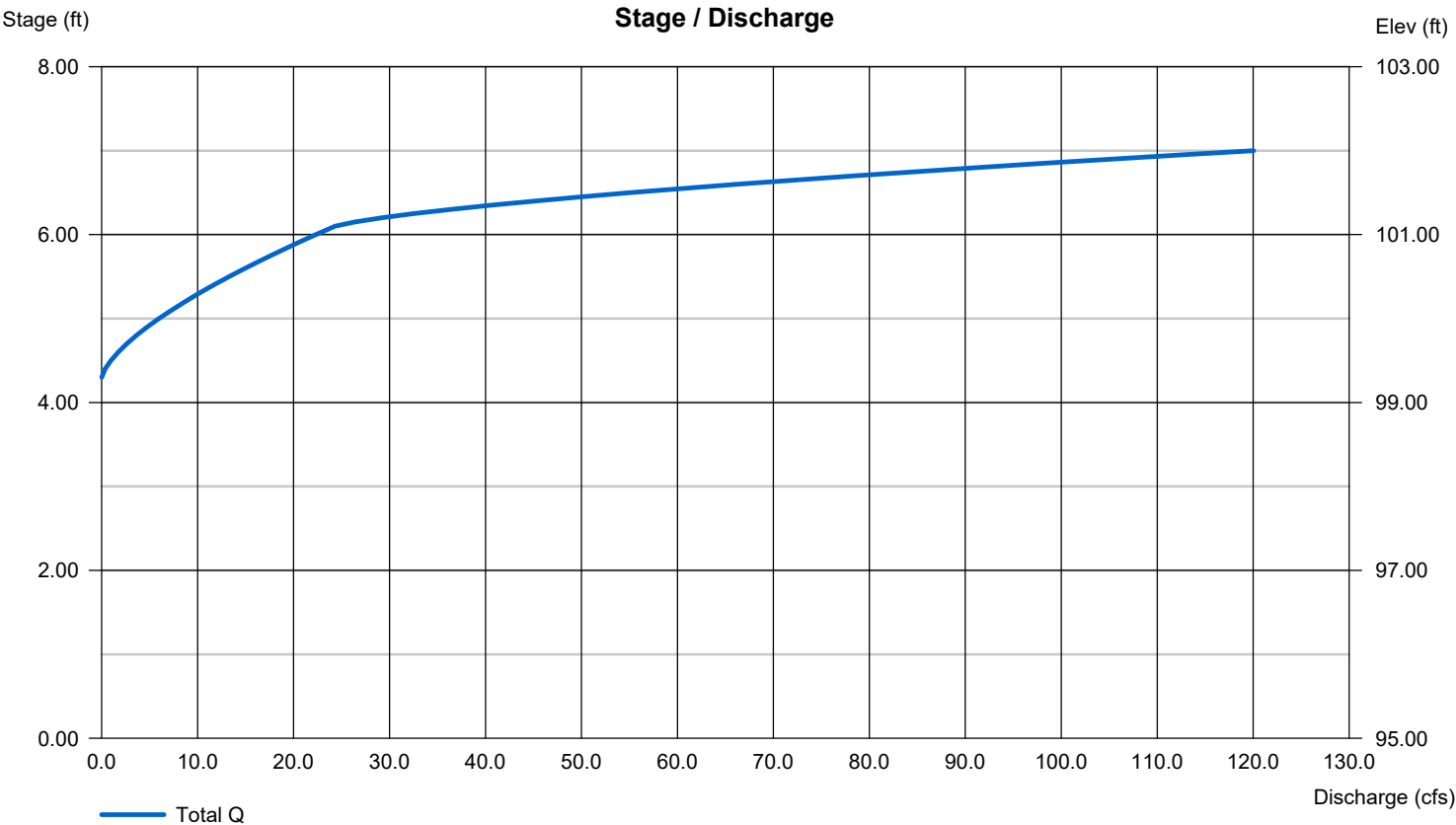
Culvert / Orifice Structures

	[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)	= 3.00	34.00	0.00	0.00
Crest El. (ft)	= 99.29	101.10	0.00	0.00
Weir Coeff.	= 3.33	2.60	3.33	3.33
Weir Type	= Rect	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).

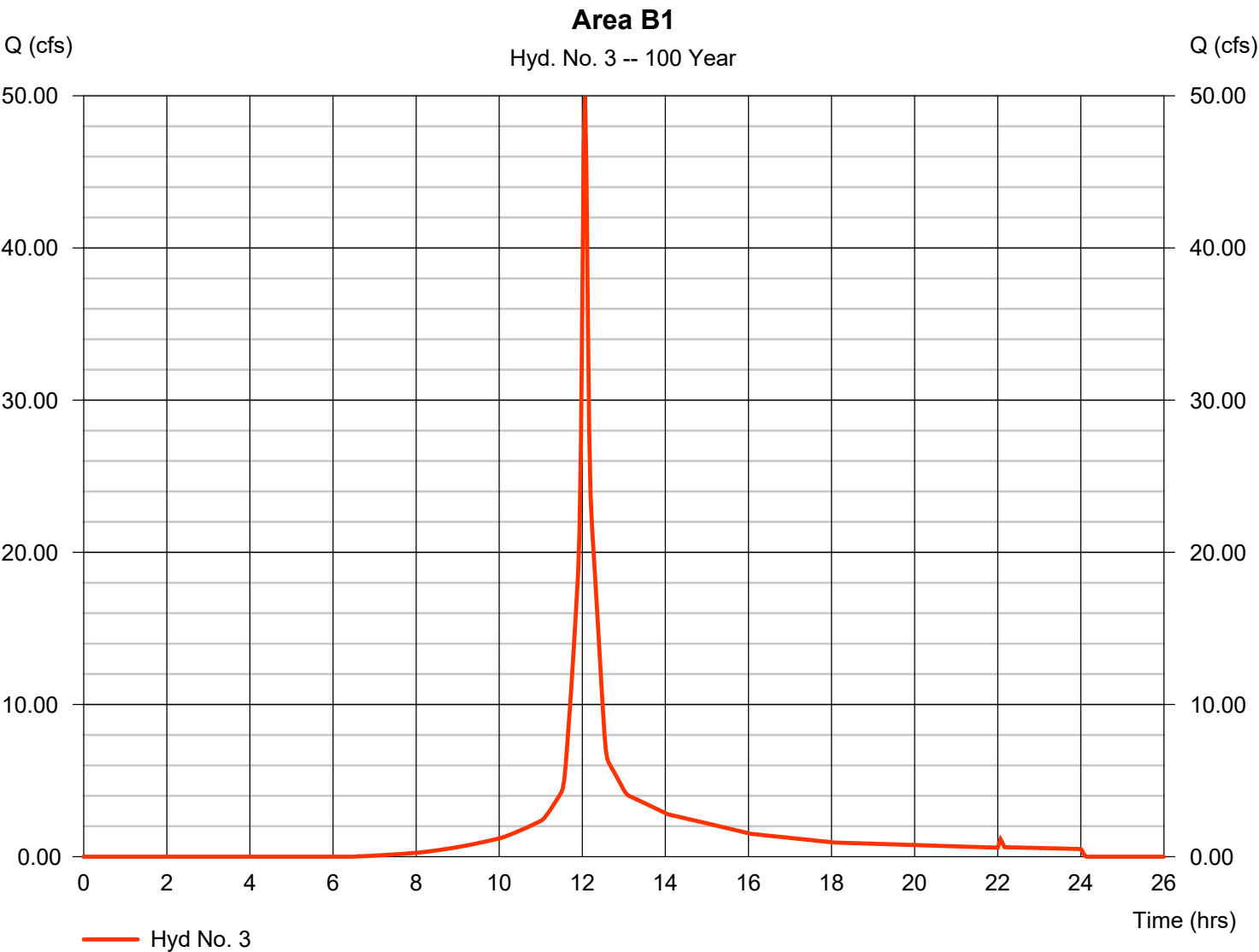


Hydrograph Report

Hyd. No. 3

Area B1

Hydrograph type	=	SCS Runoff	Peak discharge	=	49.96 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.07 hrs
Time interval	=	2 min	Hyd. volume	=	150,559 cuft
Drainage area	=	8.110 ac	Curve number	=	75.2
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	5.90 min
Total precip.	=	8.43 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484



TR55 Tc Worksheet

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

Hyd. No. 3

Area B1

<u>Description</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>Totals</u>			
Sheet Flow							
Manning's n-value	= 0.400	0.011	0.011				
Flow length (ft)	= 50.0	0.0	0.0				
Two-year 24-hr precip. (in)	= 3.37	0.00	0.00				
Land slope (%)	= 18.00	0.00	0.00				
Travel Time (min)	= 4.99	+	0.00	+	0.00	=	4.99
Shallow Concentrated Flow							
Flow length (ft)	= 166.00	146.00	68.00				
Watercourse slope (%)	= 19.00	18.00	15.00				
Surface description	= Unpaved	Unpaved	Unpaved				
Average velocity (ft/s)	=7.03	6.85	6.25				
Travel Time (min)	= 0.39	+	0.36	+	0.18	=	0.93
Channel Flow							
X sectional flow area (sqft)	= 0.00	0.00	0.00				
Wetted perimeter (ft)	= 0.00	0.00	0.00				
Channel slope (%)	= 0.00	0.00	0.00				
Manning's n-value	= 0.015	0.015	0.015				
Velocity (ft/s)	=0.00	0.00	0.00				
Flow length (ft)	((0})0.0	0.0	0.0				
Travel Time (min)	= 0.00	+	0.00	+	0.00	=	0.00
Total Travel Time, Tc				5.90 min			

Hydrograph Report

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

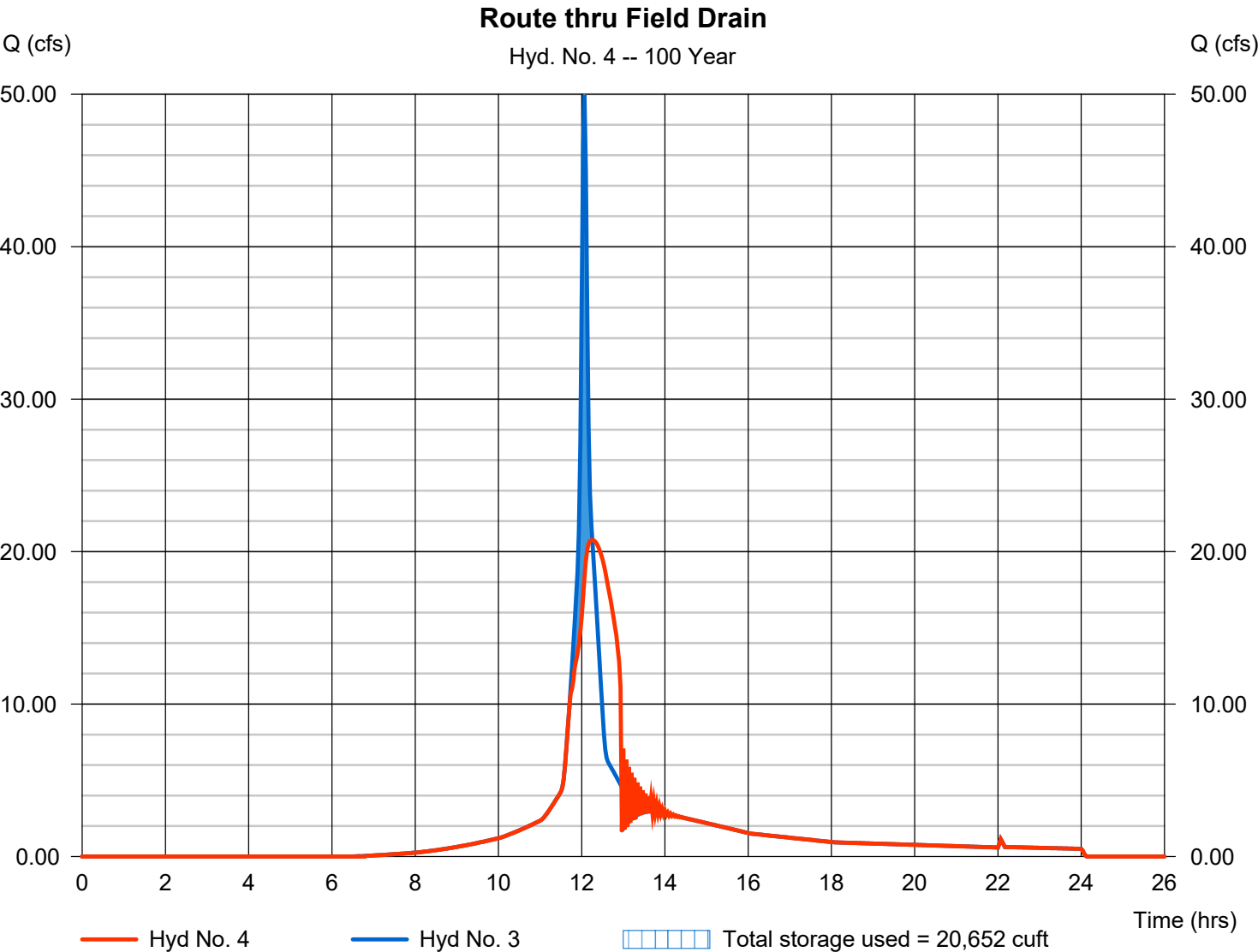
Wednesday, 02 / 8 / 2023

Hyd. No. 4

Route thru Field Drain

Hydrograph type	= Reservoir	Peak discharge	= 20.76 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.27 hrs
Time interval	= 2 min	Hyd. volume	= 150,530 cuft
Inflow hyd. No.	= 3 - Area B1	Max. Elevation	= 103.39 ft
Reservoir name	= Existing Field Drains	Max. Storage	= 20,652 cuft

Storage Indication method used.



Pond No. 2 - Existing Field Drains

Pond Data

Pond storage is based on user-defined values.

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	98.00	n/a	0	0
1.00	99.00	n/a	10	10
2.00	100.00	n/a	20	30
3.00	101.00	n/a	20	50
4.00	102.00	n/a	10	60
4.17	102.17	n/a	3	63
4.42	102.42	n/a	741	804
4.67	102.67	n/a	2,410	3,214
4.92	102.92	n/a	4,312	7,526
5.17	103.17	n/a	6,262	13,788
5.27	103.27	n/a	3,025	16,813
5.50	103.50	n/a	7,507	24,320
5.70	103.70	n/a	6,747	31,067

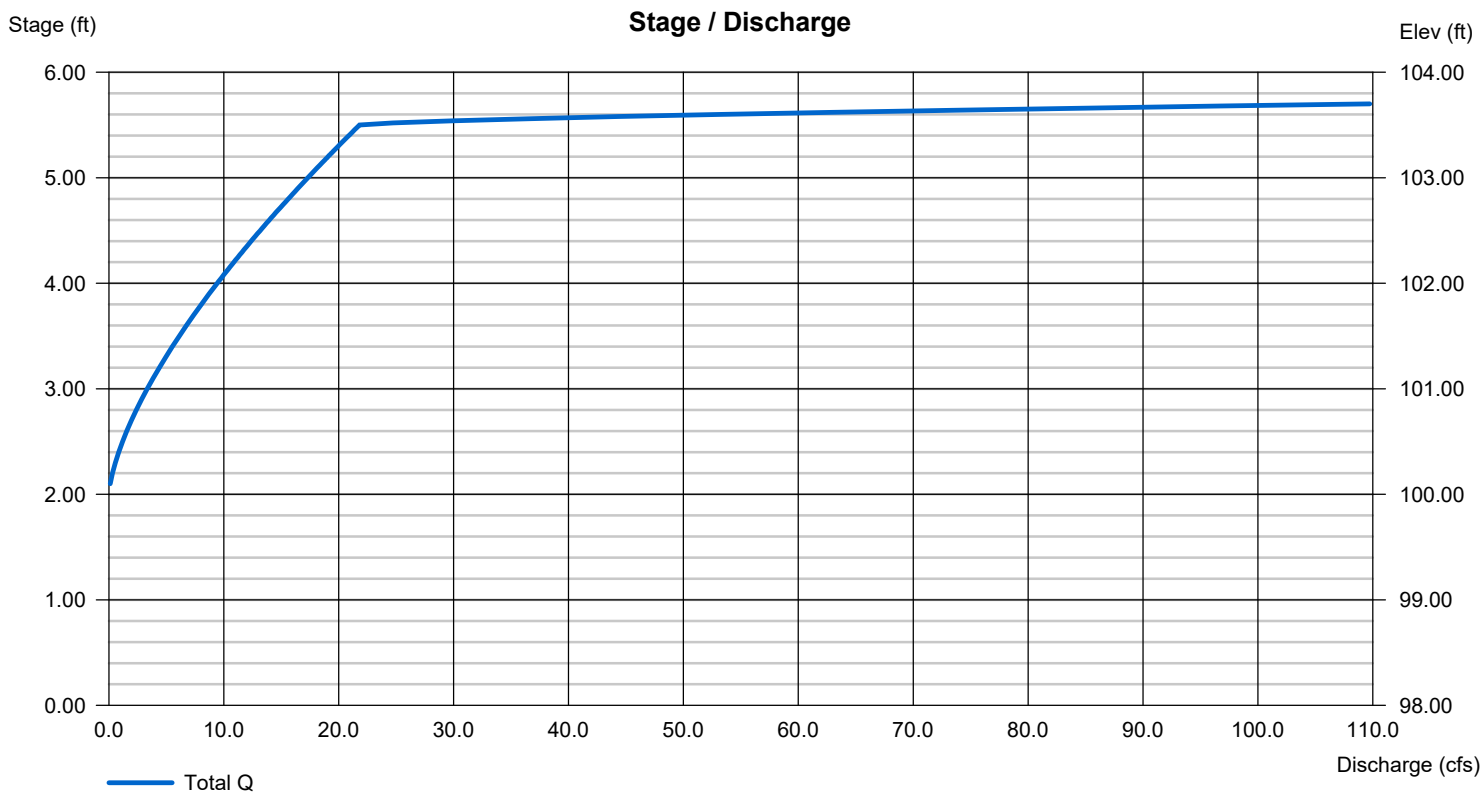
Culvert / Orifice Structures

	[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)	= 0.83	1.00	370.00	0.00
Crest El. (ft)	= 98.50	100.00	103.50	0.00
Weir Coeff.	= 3.33	3.33	2.60	3.33
Weir Type	= 1	Rect	Broad	---
Multi-Stage	= Yes	No	No	No
Exfil.(in/hr)	= 0.000 (by Wet area)			
TW Elev. (ft)	= 0.00			

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



Hydrograph Report

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

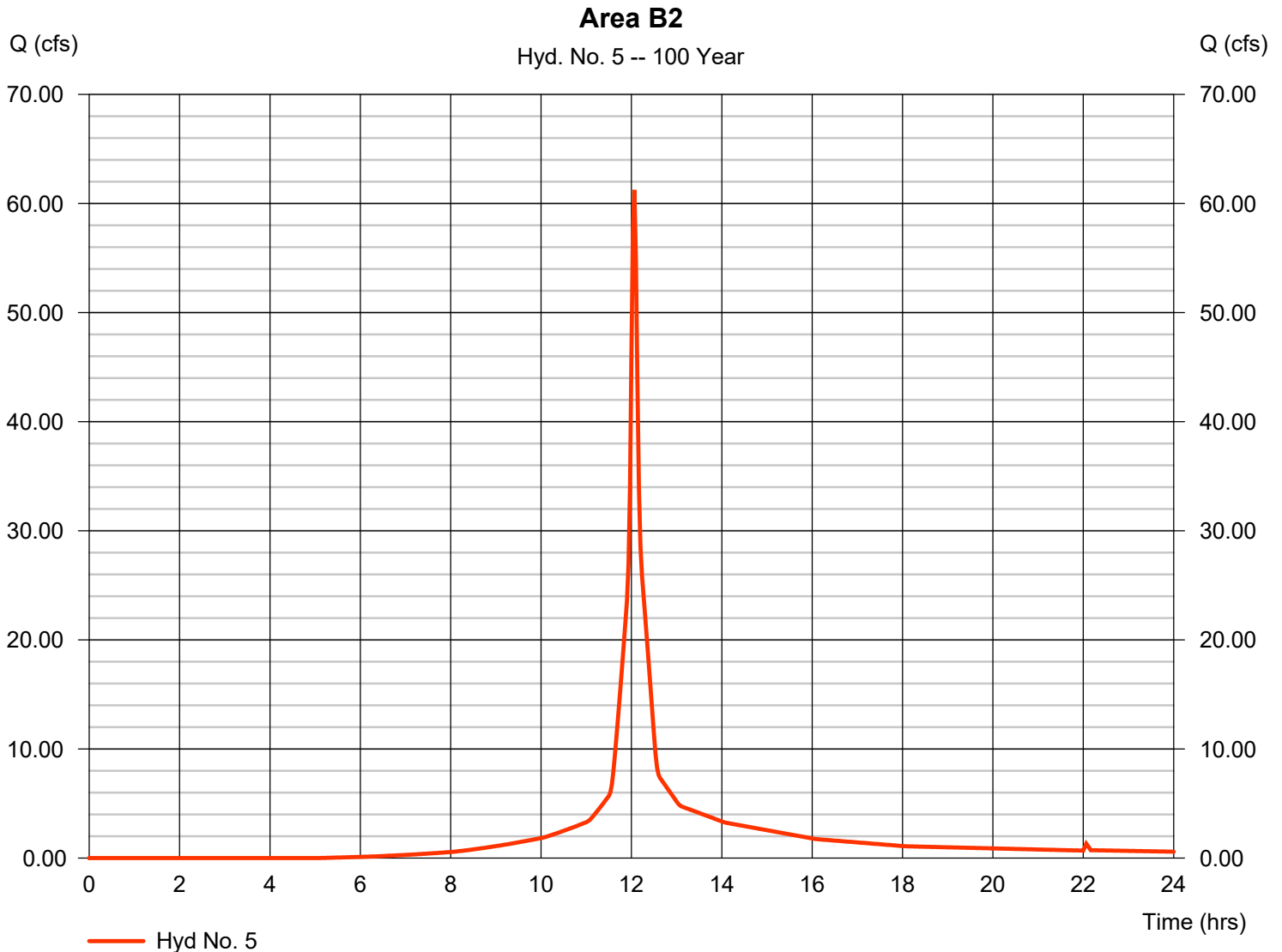
Wednesday, 02 / 8 / 2023

Hyd. No. 5

Area B2

Hydrograph type = SCS Runoff
Storm frequency = 100 yrs
Time interval = 2 min
Drainage area = 9.020 ac
Basin Slope = 0.0 %
Tc method = TR55
Total precip. = 8.43 in
Storm duration = 24 hrs

Peak discharge = 61.23 cfs
Time to peak = 12.07 hrs
Hyd. volume = 187,649 cuft
Curve number = 80.7
Hydraulic length = 0 ft
Time of conc. (Tc) = 5.90 min
Distribution = Type III
Shape factor = 484



TR55 Tc Worksheet

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

Hyd. No. 5

Area B2

<u>Description</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>Totals</u>			
Sheet Flow							
Manning's n-value	= 0.400	0.011	0.011				
Flow length (ft)	= 50.0	0.0	0.0				
Two-year 24-hr precip. (in)	= 3.37	0.00	0.00				
Land slope (%)	= 18.00	0.00	0.00				
Travel Time (min)	= 4.99	+	0.00	+	0.00	=	4.99
Shallow Concentrated Flow							
Flow length (ft)	= 166.00	146.00	68.00				
Watercourse slope (%)	= 19.00	18.00	15.00				
Surface description	= Unpaved	Unpaved	Unpaved				
Average velocity (ft/s)	=7.03	6.85	6.25				
Travel Time (min)	= 0.39	+	0.36	+	0.18	=	0.93
Channel Flow							
X sectional flow area (sqft)	= 0.00	0.00	0.00				
Wetted perimeter (ft)	= 0.00	0.00	0.00				
Channel slope (%)	= 0.00	0.00	0.00				
Manning's n-value	= 0.015	0.015	0.015				
Velocity (ft/s)	=0.00	0.00	0.00				
Flow length (ft)	((0})0.0	0.0	0.0				
Travel Time (min)	= 0.00	+	0.00	+	0.00	=	0.00
Total Travel Time, Tc				5.90 min			

Hydrograph Report

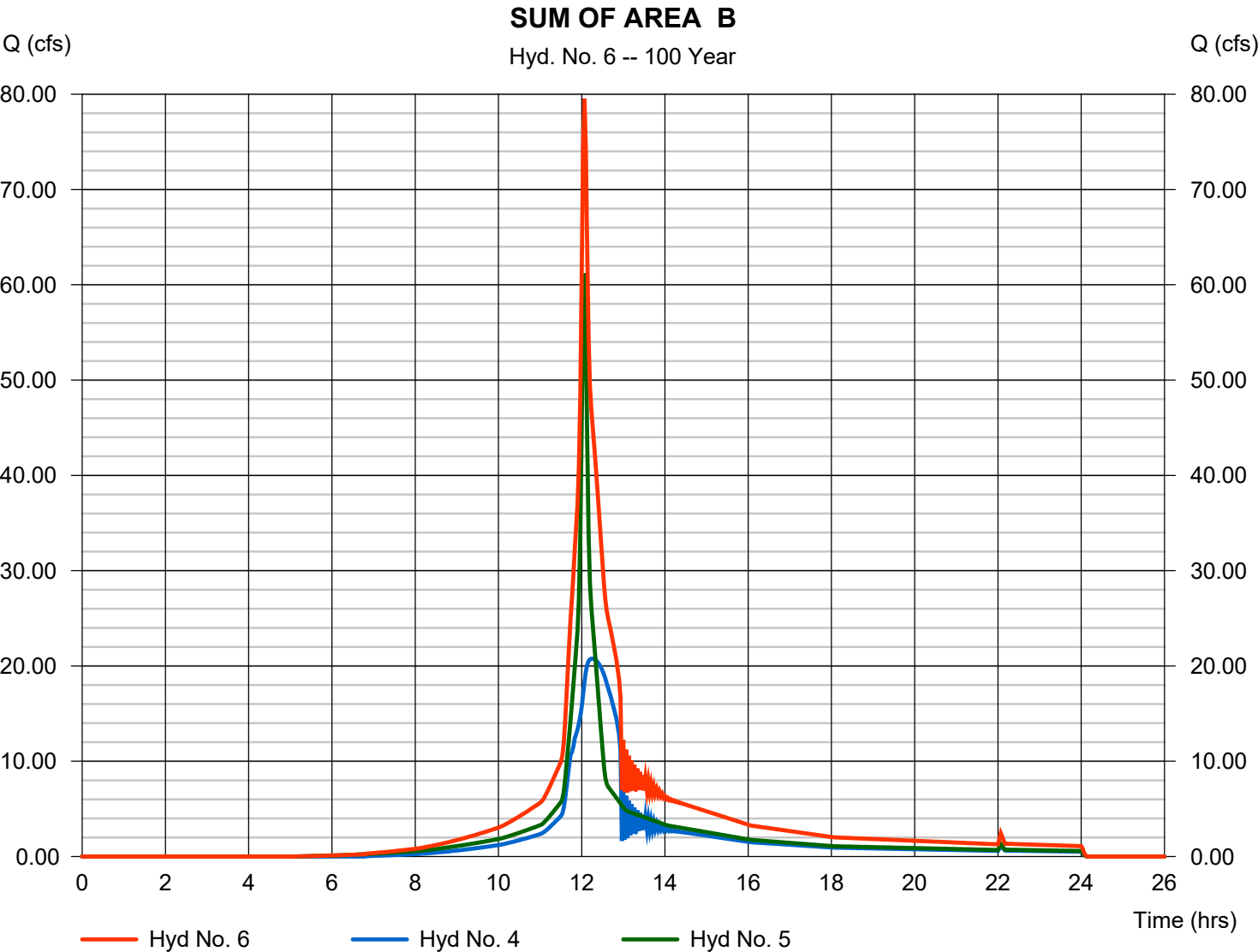
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020

Wednesday, 02 / 8 / 2023

Hyd. No. 6

SUM OF AREA B

Hydrograph type	= Combine	Peak discharge	= 79.54 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.07 hrs
Time interval	= 2 min	Hyd. volume	= 338,179 cuft
Inflow hyds.	= 4, 5	Contrib. drain. area	= 9.020 ac



Hydrograph Report

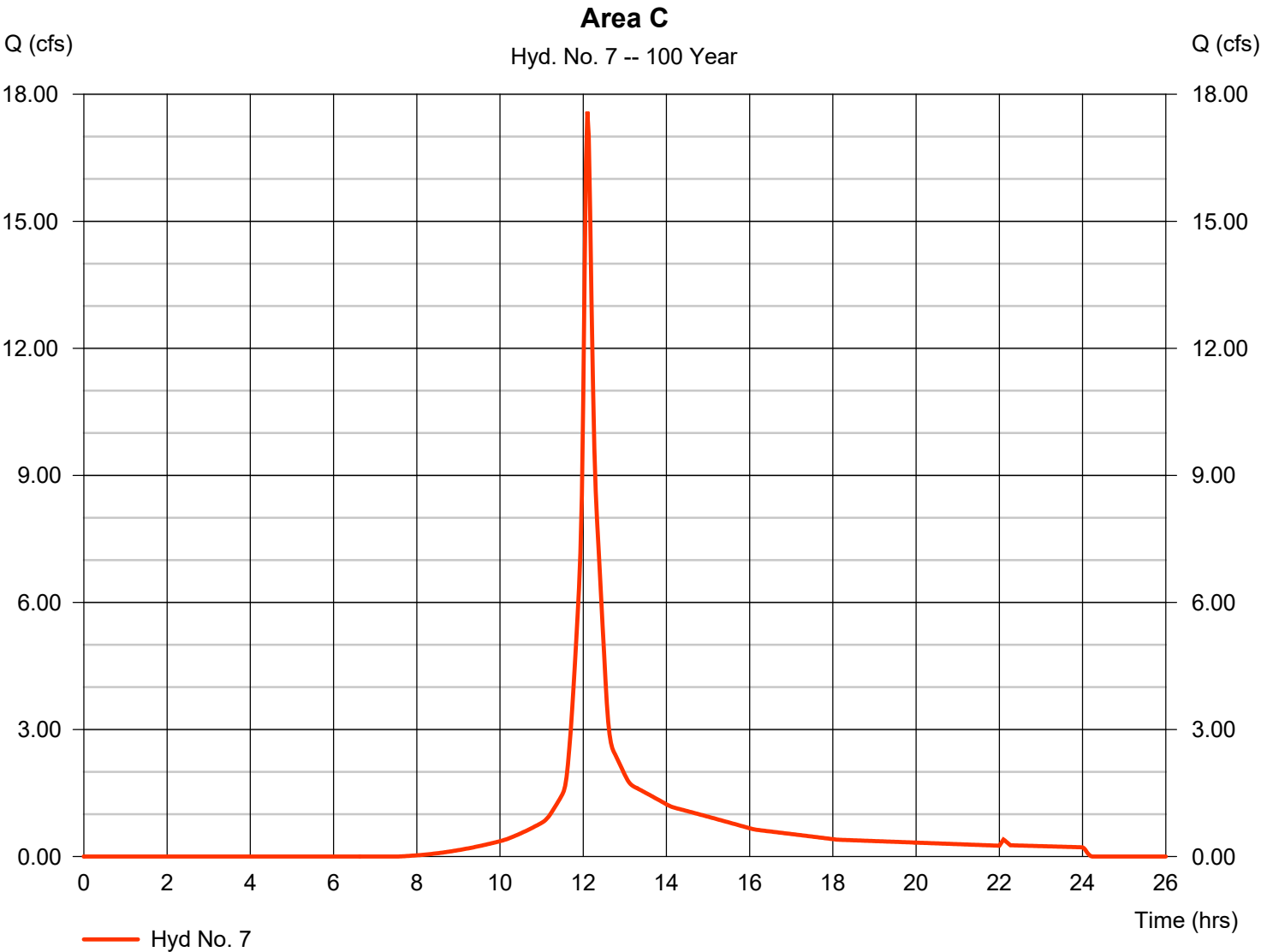
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020

Wednesday, 02 / 8 / 2023

Hyd. No. 7

Area C

Hydrograph type	= SCS Runoff	Peak discharge	= 17.58 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.10 hrs
Time interval	= 2 min	Hyd. volume	= 60,044 cuft
Drainage area	= 3.412 ac	Curve number	= 70.1
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 8.40 min
Total precip.	= 8.43 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



TR55 Tc Worksheet

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

Hyd. No. 7

Area C

<u>Description</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>Totals</u>			
Sheet Flow							
Manning's n-value	= 0.400	0.011	0.011				
Flow length (ft)	= 50.0	0.0	0.0				
Two-year 24-hr precip. (in)	= 3.37	0.00	0.00				
Land slope (%)	= 8.00	0.00	0.00				
Travel Time (min)	= 6.90	+	0.00	+	0.00	=	6.90
Shallow Concentrated Flow							
Flow length (ft)	= 454.00	0.00	0.00				
Watercourse slope (%)	= 10.00	0.00	0.00				
Surface description	= Unpaved	Paved	Paved				
Average velocity (ft/s)	=5.10	0.00	0.00				
Travel Time (min)	= 1.48	+	0.00	+	0.00	=	1.48
Channel Flow							
X sectional flow area (sqft)	= 0.00	0.00	0.00				
Wetted perimeter (ft)	= 0.00	0.00	0.00				
Channel slope (%)	= 0.00	0.00	0.00				
Manning's n-value	= 0.015	0.015	0.015				
Velocity (ft/s)	=0.00	0.00	0.00				
Flow length (ft)	((0})0.0	0.0	0.0				
Travel Time (min)	= 0.00	+	0.00	+	0.00	=	0.00
Total Travel Time, Tc				8.40 min			

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020
Wednesday, 02 / 8 / 2023

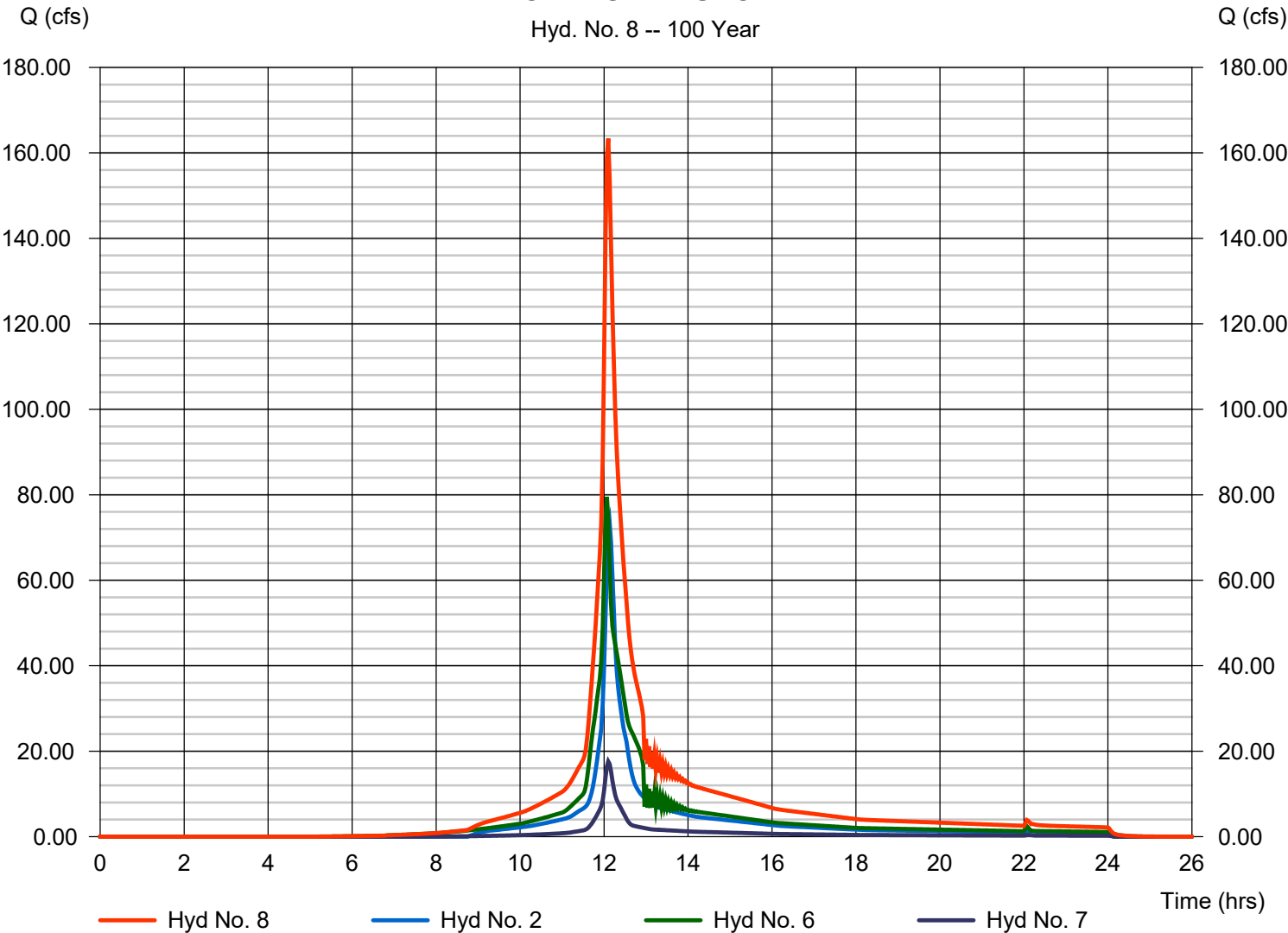
Hyd. No. 8

TOTAL SITE RUNOFF

Hydrograph type	= Combine	Peak discharge	= 163.37 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.10 hrs
Time interval	= 2 min	Hyd. volume	= 654,292 cuft
Inflow hyds.	= 2, 6, 7	Contrib. drain. area	= 3.412 ac

TOTAL SITE RUNOFF

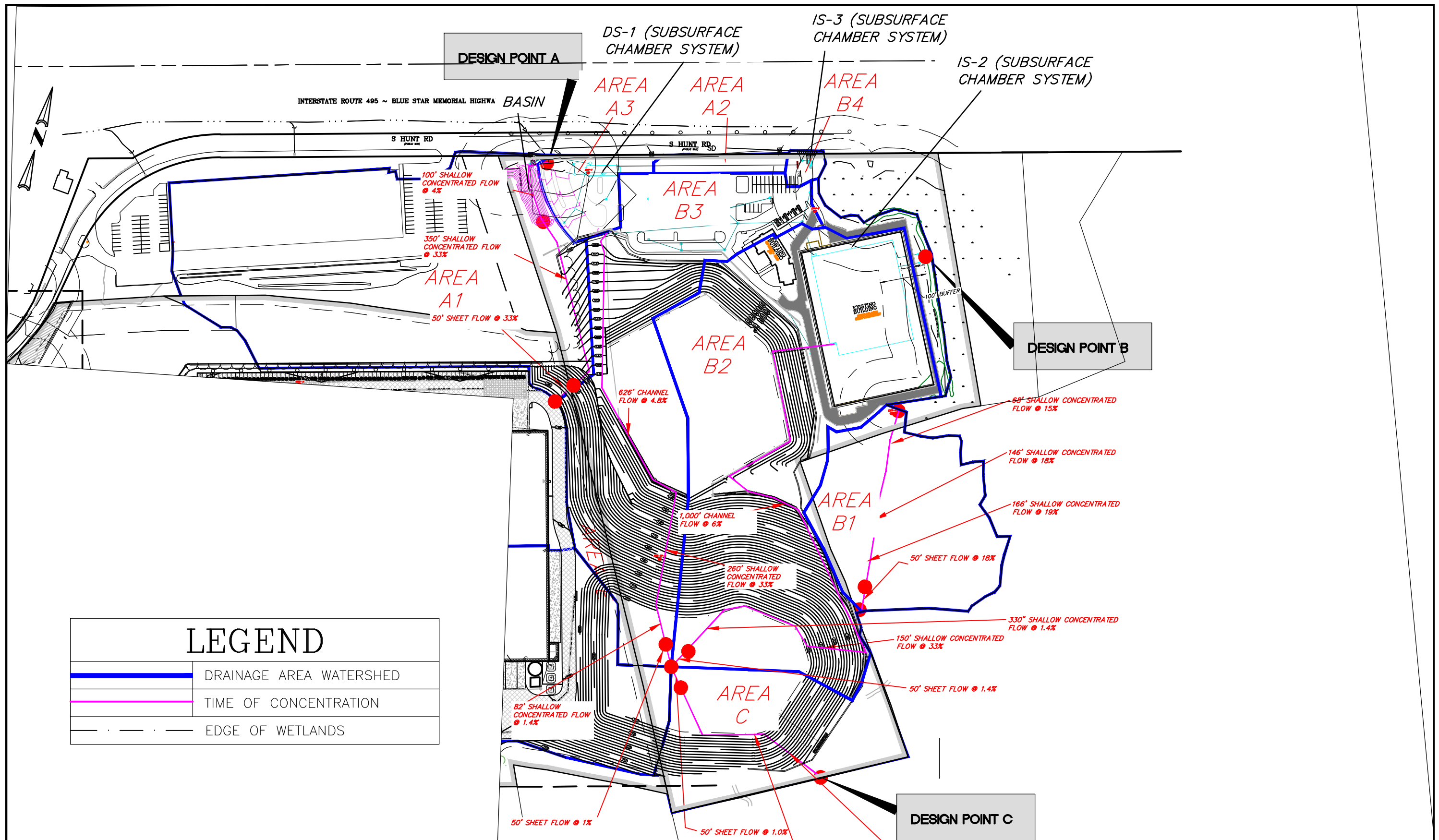
Hyd. No. 8 -- 100 Year



KELLY ENGINEERING GROUP, INC.

Zero Campanelli Drive-Braintree-MA 02184 Phone 781 843 4333

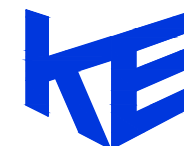
Attachment B
Proposed Conditions



MARCUS PARTNERS
12-14 SOUTH HUNT RD.
AMESBURY, MA

SCALE: 1" = 200'
DATE: 02/09/23
2021-194-PRDR

PROPOSED
DRAINAGE
EXHIBIT



KELLY ENGINEERING GROUP
civil engineering consultants
0 Campanelli Drive, Braintree, MA 02184
Phone: 781-843-4333 www.kellyengineeringgroup.com

Runoff Curve Number and Runoff

Name: Marcus Partners By: BGL Date: 02/09/23
Location : 12-14 South Hunt Rd. Amesbury, MA
Description: Proposed Conditions - Area A-1

Circle One: Pre or Post

Runoff Curve Number (CN):

Surface Description	Soil Name; hydrologic group; hydrologic condition	<u>CN</u>	s.f.	Product of CN x Area
Pavement	Hydrologic Group C; Good Condition	98	124581	1.2E+07
Grass	Hydrologic Group C; Good Condition	74	100180	7413320
Woods	Hydrologic Group C; Good Condition	70	138584	9700880
Totals =			363345.00	2.9E+07
Acres =			8.34125344	

CN or C (weighted) = total product/total area =

80.7

Reference: *Urban Hydrology for Small Watersheds*
Technical Release 55, Soil Conservation Service
U.S. Department of Agriculture, June 1986

Runoff Curve Number and Runoff

Name: Marcus Partners By: BGL Date: 02/09/23
Location : 12-14 South Hunt Rd. Amesbury, MA
Description: Proposed Conditions - Area A-2

Circle One: Pre or Post

Runoff Curve Number (CN):

Surface Description	Soil Name; hydrologic group; hydrologic condition	<u>CN</u>	s.f.	Product of CN x Area
Pavement	Hydrologic Group A; Good Condition	98	4934	483532
Grass	Hydrologic Group A; Good Condition	39	3597	140283
Totals =			8531.00	623815
Acres =			0.19584481	

CN or C (weighted) = total product/total area =

73.1

Reference: *Urban Hydrology for Small Watersheds*
Technical Release 55, Soil Conservation Service
U.S. Department of Agriculture, June 1986

Runoff Curve Number and Runoff

Name: Marcus Partners By: BGL Date: 02/09/23
Location : 12-14 South Hunt Rd. Amesbury, MA
Description: Proposed Conditions - Area A-3

Circle One: Pre or Post

Runoff Curve Number (CN):

Surface Description	Soil Name; hydrologic group; hydrologic condition	<u>CN</u>	s.f.	Product of CN x Area
Pavement	Hydrologic Group A; Good Condition	98	2540	248920
Pavement	Hydrologic Group B; Good Condition	98	11113	1089074
Pavement	Hydrologic Group C; Good Condition	98	12556	1230488
Grass	Hydrologic Group A; Good Condition	39	1424	55536
Grass	Hydrologic Group B; Good Condition	61	3610	220210
Grass	Hydrologic Group C; Good Condition	74	5225	386650
Totals =			36468.00	3230878
Acres =			0.83719008	

CN or C (weighted) = total product/total area =

88.6

Reference: *Urban Hydrology for Small Watersheds*
Technical Release 55, Soil Conservation Service
U.S. Department of Agriculture, June 1986

Runoff Curve Number and Runoff

Name: Marcus Partners By: BGL Date: 02/09/23
Location : 12-14 South Hunt Rd. Amesbury, MA
Description: Proposed Conditions - Area B-1

Circle One: Pre or Post

Runoff Curve Number (CN):

Surface Description	Soil Name; hydrologic group; hydrologic condition	<u>CN</u>	s.f.	Product of CN x Area
Grass	Hydrologic Group A; Good Condition	39	417	16263
Woods	Hydrologic Group A; Good Condition	30	405	12150
Grass	Hydrologic Group B; Good Condition	61	12929	788669
Woods	Hydrologic Group B; Good Condition	55	629	34595
Grass	Hydrologic Group C; Good Condition	74	19739	1460686
Woods	Hydrologic Group C; Good Condition	70	126886	8882020
Totals =			161005.00	1.1E+07
Acres =			3.69616621	

CN or C (weighted) = total product/total area = 69.5

Reference: *Urban Hydrology for Small Watersheds*
Technical Release 55, Soil Conservation Service
U.S. Department of Agriculture, June 1986

Runoff Curve Number and Runoff

Name: Marcus Partners By: BGL Date: 02/09/23
Location : 12-14 South Hunt Rd. Amesbury, MA
Description: Proposed Conditions - Area B-2

Circle One: Pre or Post

Runoff Curve Number (CN):

Surface Description	Soil Name; hydrologic group; hydrologic condition	<u>CN</u>	s.f.	Product of CN x Area
Grass	Hydrologic Group B; Good Condition	61	14506	884866
Grass	Hydrologic Group C; Good Condition	74	311909	2.3E+07
Gravel Roads	Hydrologic Group B; Good Condition	85	14053	1194505
Sports Fields	Hydrologic Group B; Good Condition	98	49171	4818758
Totals =			389639.00	3E+07
Acres =			8.9448806	

CN or C (weighted) = total product/total area = 76.9

Reference: *Urban Hydrology for Small Watersheds*
Technical Release 55, Soil Conservation Service
U.S. Department of Agriculture, June 1986

Runoff Curve Number and Runoff

Name: Marcus Partners By: BGL Date: 02/09/23
Location : 12-14 South Hunt Rd. Amesbury, MA
Description: Proposed Conditions - Area B-3

Circle One: Pre or Post

Runoff Curve Number (CN):

Surface Description	Soil Name; hydrologic group; hydrologic condition	<u>CN</u>	s.f.	Product of CN x Area
Grass	Hydrologic Group B; Good Condition	61	9189	560529
Grass	Hydrologic Group C; Good Condition	74	183988	1.4E+07
Sports Fields	Hydrologic Group B; Good Condition	98	61371	6014358
Totals =			254548.00	2E+07
Acres =			5.843618	

CN or C (weighted) = total product/total area = 79.3

Reference: *Urban Hydrology for Small Watersheds*
Technical Release 55, Soil Conservation Service
U.S. Department of Agriculture, June 1986

Runoff Curve Number and Runoff

Name: Marcus Partners By: BGL Date: 02/09/23
Location : 12-14 South Hunt Rd. Amesbury, MA
Description: Proposed Conditions - Area B-4

Circle One: Pre or Post

Runoff Curve Number (CN):

Surface Description	Soil Name; hydrologic group; hydrologic condition	<u>CN</u>	s.f.	Product of CN x Area
Grass	Hydrologic Group A; Good Condition	39	684	26676
Grass	Hydrologic Group B; Good Condition	61	70	4270
Sports Fields	Hydrologic Group A; Good Condition	98	1761	172578
Sports Fields	Hydrologic Group B; Good Condition	98	1172	114856
Totals =			3687.00	318380
Acres =			0.0846419	

CN or C (weighted) = total product/total area = 86.4

Reference: *Urban Hydrology for Small Watersheds*
Technical Release 55, Soil Conservation Service
U.S. Department of Agriculture, June 1986

Runoff Curve Number and Runoff

Name: Marcus Partners By: BGL Date: 02/09/23
Location : 12-14 South Hunt Rd. Amesbury, MA
Description: Proposed Conditions - Area C

Circle One: Pre or Post

Runoff Curve Number (CN):

Surface Description	Soil Name; hydrologic group; hydrologic condition	<u>CN</u>	s.f.	Product of CN x Area
Woods	Hydrologic Group C; Good Condition	70	43733	3061310
Grass	Hydrologic Group C; Good Condition	74	77161	5709914
Totals =			120894.00	8771224
Acres =			2.77534435	

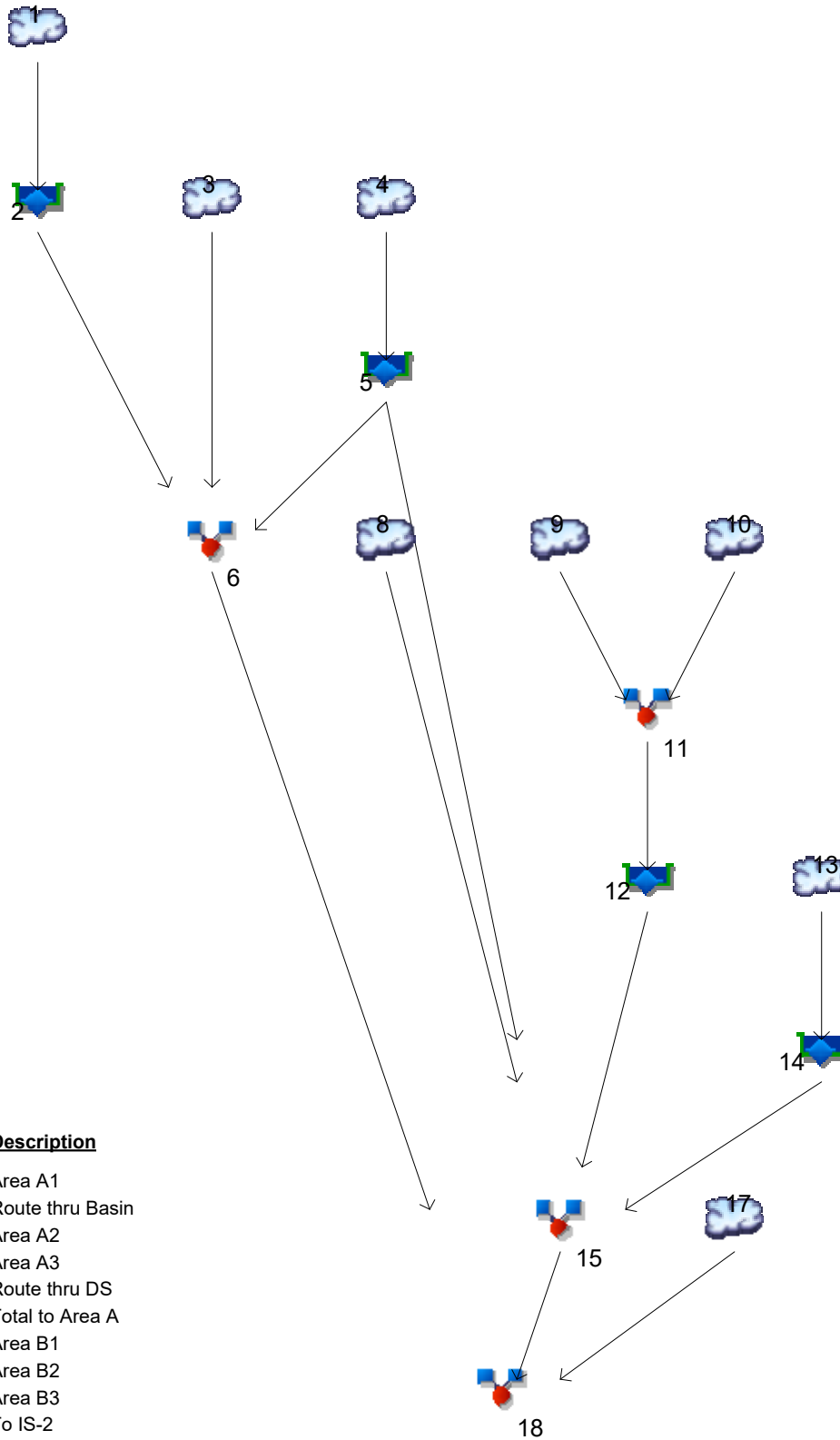
CN or C (weighted) = total product/total area =

72.6

Reference: *Urban Hydrology for Small Watersheds*
Technical Release 55, Soil Conservation Service
U.S. Department of Agriculture, June 1986

Watershed Model Schematic

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



Legend

Hyd.	Origin	Description
1	SCS Runoff	Area A1
2	Reservoir	Route thru Basin
3	SCS Runoff	Area A2
4	SCS Runoff	Area A3
5	Reservoir	Route thru DS
6	Combine	Total to Area A
8	SCS Runoff	Area B1
9	SCS Runoff	Area B2
10	SCS Runoff	Area B3
11	Combine	To IS-2
12	Reservoir	Route thru IS-2
13	SCS Runoff	Area B4
14	Reservoir	Route thru IS-3
15	Combine	Total to Area B
17	SCS Runoff	Area C
18	Combine	TOTAL SITE RUNOFF

Hydrograph Return Period Recap

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 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	-----	-----	13.94	-----	-----	28.76	38.31	45.40	53.12	Area A1
2	Reservoir	1	-----	8.883	-----	-----	23.81	35.97	43.83	51.64	Route thru Basin
3	SCS Runoff	-----	-----	0.233	-----	-----	0.568	0.795	0.967	1.156	Area A2
4	SCS Runoff	-----	-----	2.079	-----	-----	3.723	4.739	5.485	6.293	Area A3
5	Reservoir	4	-----	1.841	-----	-----	3.408	4.393	5.109	5.859	Route thru DS
6	Combine	2, 3, 5	-----	10.13	-----	-----	26.81	40.56	49.13	57.77	Total to Area A
8	SCS Runoff	-----	-----	3.434	-----	-----	9.316	13.43	16.58	20.09	Area B1
9	SCS Runoff	-----	-----	9.552	-----	-----	21.26	29.00	34.86	41.30	Area B2
10	SCS Runoff	-----	-----	7.067	-----	-----	14.95	20.12	23.98	28.20	Area B3
11	Combine	9, 10	-----	16.62	-----	-----	36.21	49.12	58.84	69.50	To IS-2
12	Reservoir	11	-----	1.908	-----	-----	14.55	24.75	30.09	32.25	Route thru IS-2
13	SCS Runoff	-----	-----	0.195	-----	-----	0.361	0.465	0.541	0.624	Area B4
14	Reservoir	13	-----	0.154	-----	-----	0.351	0.456	0.534	0.616	Route thru IS-3
15	Combine	5, 8, 12, 14	-----	5.261	-----	-----	17.15	29.26	36.93	40.71	Total to Area B
17	SCS Runoff	-----	-----	2.300	-----	-----	5.689	8.003	9.759	11.71	Area C
18	Combine	6, 15, 17	-----	15.95	-----	-----	42.91	68.35	86.98	107.07	TOTAL SITE RUNOFF
Proj. file: Proposed Conditions-12 -14 S Hunt.gpw										Thursday, 02 / 9 / 2023	

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 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	13.94	2	726	47,915	-----	-----	-----	Area A1
2	Reservoir	8.883	2	734	43,223	1	100.25	12,329	Route thru Basin
3	SCS Runoff	0.233	2	724	733	-----	-----	-----	Area A2
4	SCS Runoff	2.079	2	724	6,273	-----	-----	-----	Area A3
5	Reservoir	1.841	2	726	6,207	4	95.61	446	Route thru DS
6	Combine	10.13	2	732	50,163	2, 3, 5	-----	-----	Total to Area A
8	SCS Runoff	3.434	2	724	11,355	-----	-----	-----	Area B1
9	SCS Runoff	9.552	2	734	43,131	-----	-----	-----	Area B2
10	SCS Runoff	7.067	2	734	31,523	-----	-----	-----	Area B3
11	Combine	16.62	2	734	74,654	9, 10	-----	-----	To IS-2
12	Reservoir	1.908	2	778	16,843	11	99.82	30,186	Route thru IS-2
13	SCS Runoff	0.195	2	724	583	-----	-----	-----	Area B4
14	Reservoir	0.154	2	728	250	13	98.60	169	Route thru IS-3
15	Combine	5.261	2	726	34,654	5, 8, 12, 14	-----	-----	Total to Area B
17	SCS Runoff	2.300	2	734	10,782	-----	-----	-----	Area C
18	Combine	15.95	2	730	95,599	6, 15, 17	-----	-----	TOTAL SITE RUNOFF
Proposed Conditions-12 -14 S Hunt.gpw					Return Period: 2 Year			Thursday, 02 / 9 / 2023	

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 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	28.76	2	726	98,384	-----	-----	-----	Area A1
2	Reservoir	23.81	2	730	93,692	1	101.09	18,862	Route thru Basin
3	SCS Runoff	0.568	2	724	1,701	-----	-----	-----	Area A2
4	SCS Runoff	3.723	2	724	11,526	-----	-----	-----	Area A3
5	Reservoir	3.408	2	726	11,459	4	95.83	672	Route thru DS
6	Combine	26.81	2	730	106,852	2, 3, 5	-----	-----	Total to Area A
8	SCS Runoff	9.316	2	724	28,203	-----	-----	-----	Area B1
9	SCS Runoff	21.26	2	734	93,910	-----	-----	-----	Area B2
10	SCS Runoff	14.95	2	734	66,104	-----	-----	-----	Area B3
11	Combine	36.21	2	734	160,014	9, 10	-----	-----	To IS-2
12	Reservoir	14.55	2	754	84,698	11	100.61	56,013	Route thru IS-2
13	SCS Runoff	0.361	2	724	1,104	-----	-----	-----	Area B4
14	Reservoir	0.351	2	724	722	13	98.70	179	Route thru IS-3
15	Combine	17.15	2	748	125,082	5, 8, 12, 14	-----	-----	Total to Area B
17	SCS Runoff	5.689	2	734	25,254	-----	-----	-----	Area C
18	Combine	42.91	2	730	257,188	6, 15, 17	-----	-----	TOTAL SITE RUNOFF
Proposed Conditions-12 -14 S Hunt.gpw					Return Period: 10 Year			Thursday, 02 / 9 / 2023	

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 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	38.31	2	726	131,872	-----	-----	-----	Area A1
2	Reservoir	35.97	2	728	127,180	1	101.25	20,272	Route thru Basin
3	SCS Runoff	0.795	2	724	2,375	-----	-----	-----	Area A2
4	SCS Runoff	4.739	2	724	14,881	-----	-----	-----	Area A3
5	Reservoir	4.393	2	726	14,815	4	95.95	794	Route thru DS
6	Combine	40.56	2	728	144,370	2, 3, 5	-----	-----	Total to Area A
8	SCS Runoff	13.43	2	724	40,225	-----	-----	-----	Area B1
9	SCS Runoff	29.00	2	732	128,361	-----	-----	-----	Area B2
10	SCS Runoff	20.12	2	732	89,233	-----	-----	-----	Area B3
11	Combine	49.12	2	732	217,594	9, 10	-----	-----	To IS-2
12	Reservoir	24.75	2	750	134,846	11	101.09	71,047	Route thru IS-2
13	SCS Runoff	0.465	2	724	1,440	-----	-----	-----	Area B4
14	Reservoir	0.456	2	724	1,042	13	98.74	183	Route thru IS-3
15	Combine	29.26	2	746	190,928	5, 8, 12, 14	-----	-----	Total to Area B
17	SCS Runoff	8.003	2	734	35,353	-----	-----	-----	Area C
18	Combine	68.35	2	728	370,651	6, 15, 17	-----	-----	TOTAL SITE RUNOFF
Proposed Conditions-12 -14 S Hunt.gpw					Return Period: 25 Year			Thursday, 02 / 9 / 2023	

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 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	45.40	2	726	157,152	-----	-----	-----	Area A1
2	Reservoir	43.83	2	728	152,461	1	101.34	21,034	Route thru Basin
3	SCS Runoff	0.967	2	724	2,893	-----	-----	-----	Area A2
4	SCS Runoff	5.485	2	724	17,379	-----	-----	-----	Area A3
5	Reservoir	5.109	2	726	17,312	4	96.02	874	Route thru DS
6	Combine	49.13	2	728	172,666	2, 3, 5	-----	-----	Total to Area A
8	SCS Runoff	16.58	2	724	49,568	-----	-----	-----	Area B1
9	SCS Runoff	34.86	2	732	154,595	-----	-----	-----	Area B2
10	SCS Runoff	23.98	2	732	106,747	-----	-----	-----	Area B3
11	Combine	58.84	2	732	261,342	9, 10	-----	-----	To IS-2
12	Reservoir	30.09	2	744	174,295	11	101.41	89,279	Route thru IS-2
13	SCS Runoff	0.541	2	724	1,691	-----	-----	-----	Area B4
14	Reservoir	0.534	2	724	1,283	13	98.77	186	Route thru IS-3
15	Combine	36.93	2	744	242,459	5, 8, 12, 14	-----	-----	Total to Area B
17	SCS Runoff	9.759	2	734	43,130	-----	-----	-----	Area C
18	Combine	86.98	2	728	458,254	6, 15, 17	-----	-----	TOTAL SITE RUNOFF
Proposed Conditions-12 -14 S Hunt.gpw					Return Period: 50 Year			Thursday, 02 / 9 / 2023	

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 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	53.12	2	726	185,069	-----	-----	-----	Area A1
2	Reservoir	51.64	2	728	180,377	1	101.42	21,729	Route thru Basin
3	SCS Runoff	1.156	2	724	3,472	-----	-----	-----	Area A2
4	SCS Runoff	6.293	2	724	20,113	-----	-----	-----	Area A3
5	Reservoir	5.859	2	726	20,046	4	96.10	965	Route thru DS
6	Combine	57.77	2	728	203,895	2, 3, 5	-----	-----	Total to Area A
8	SCS Runoff	20.09	2	724	60,081	-----	-----	-----	Area B1
9	SCS Runoff	41.30	2	732	183,726	-----	-----	-----	Area B2
10	SCS Runoff	28.20	2	732	126,124	-----	-----	-----	Area B3
11	Combine	69.50	2	732	309,850	9, 10	-----	-----	To IS-2
12	Reservoir	32.25	2	752	218,705	11	102.25	104,260	Route thru IS-2
13	SCS Runoff	0.624	2	724	1,966	-----	-----	-----	Area B4
14	Reservoir	0.616	2	724	1,550	13	98.80	188	Route thru IS-3
15	Combine	40.71	2	734	300,382	5, 8, 12, 14	-----	-----	Total to Area B
17	SCS Runoff	11.71	2	732	51,828	-----	-----	-----	Area C
18	Combine	107.07	2	728	556,106	6, 15, 17	-----	-----	TOTAL SITE RUNOFF
Proposed Conditions-12 -14 S Hunt.gpw					Return Period: 100 Year			Thursday, 02 / 9 / 2023	

Hydrograph Report

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

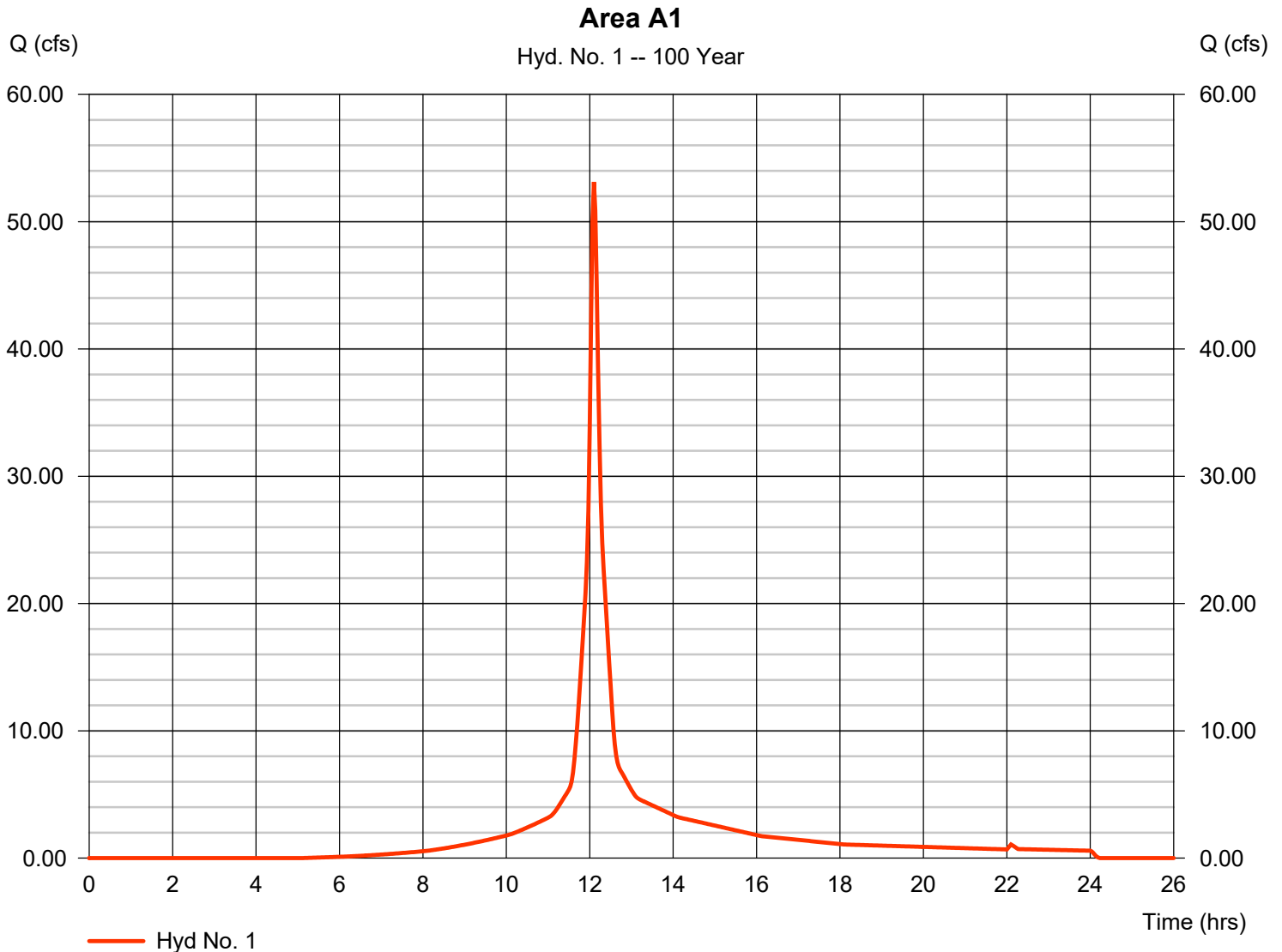
Thursday, 02 / 9 / 2023

Hyd. No. 1

Area A1

Hydrograph type = SCS Runoff
 Storm frequency = 100 yrs
 Time interval = 2 min
 Drainage area = 8.340 ac
 Basin Slope = 0.0 %
 Tc method = TR55
 Total precip. = 8.43 in
 Storm duration = 24 hrs

Peak discharge = 53.12 cfs
 Time to peak = 12.10 hrs
 Hyd. volume = 185,069 cuft
 Curve number = 80.7
 Hydraulic length = 0 ft
 Time of conc. (Tc) = 6.60 min
 Distribution = Type III
 Shape factor = 484



TR55 Tc Worksheet

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

Hyd. No. 1

Area A1

<u>Description</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>Totals</u>			
Sheet Flow							
Manning's n-value	= 0.400	0.011	0.011				
Flow length (ft)	= 50.0	0.0	0.0				
Two-year 24-hr precip. (in)	= 3.37	0.00	0.00				
Land slope (%)	= 33.00	0.00	0.00				
Travel Time (min)	= 3.92	+	0.00	+	0.00	=	3.92
Shallow Concentrated Flow							
Flow length (ft)	= 350.00	100.00	0.00				
Watercourse slope (%)	= 33.00	4.00	0.00				
Surface description	= Unpaved	Unpaved	Unpaved				
Average velocity (ft/s)	=9.27	3.23	0.00				
Travel Time (min)	= 0.63	+	0.52	+	0.00	=	1.15
Channel Flow							
X sectional flow area (sqft)	= 0.78	0.00	0.00				
Wetted perimeter (ft)	= 6.00	0.00	0.00				
Channel slope (%)	= 4.80	0.00	0.00				
Manning's n-value	= 0.012	0.015	0.015				
Velocity (ft/s)	=6.93	0.00	0.00				
Flow length (ft)	(\{0\})626.0	0.0	0.0				
Travel Time (min)	= 1.50	+	0.00	+	0.00	=	1.50
Total Travel Time, Tc				6.60 min			

Hydrograph Report

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

Thursday, 02 / 9 / 2023

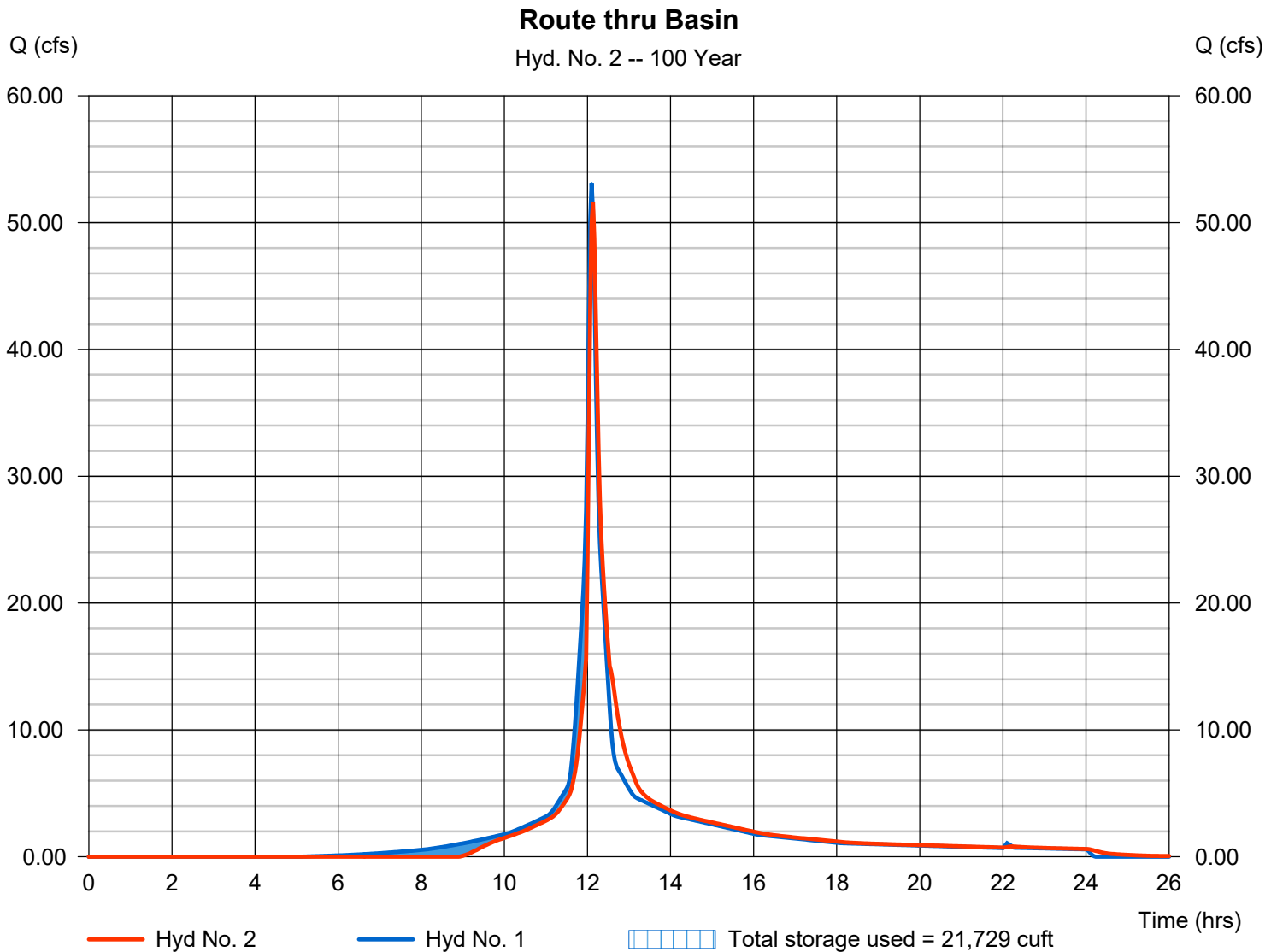
Hyd. No. 2

Route thru Basin

Hydrograph type = Reservoir
 Storm frequency = 100 yrs
 Time interval = 2 min
 Inflow hyd. No. = 1 - Area A1
 Reservoir name = Basin

Peak discharge = 51.64 cfs
 Time to peak = 12.13 hrs
 Hyd. volume = 180,377 cuft
 Max. Elevation = 101.42 ft
 Max. Storage = 21,729 cuft

Storage Indication method used.



Pond No. 1 - Basin

Pond Data

Contours -User-defined contour areas. Average end area method used for volume calculation. Beginning Elevation = 96.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	96.00	247	0	0
1.00	97.00	624	436	436
2.00	98.00	2,090	1,357	1,793
3.00	99.00	4,342	3,216	5,009
4.00	100.00	6,547	5,445	10,453
5.00	101.00	8,715	7,631	18,084
5.50	101.50	8,716	4,358	22,442

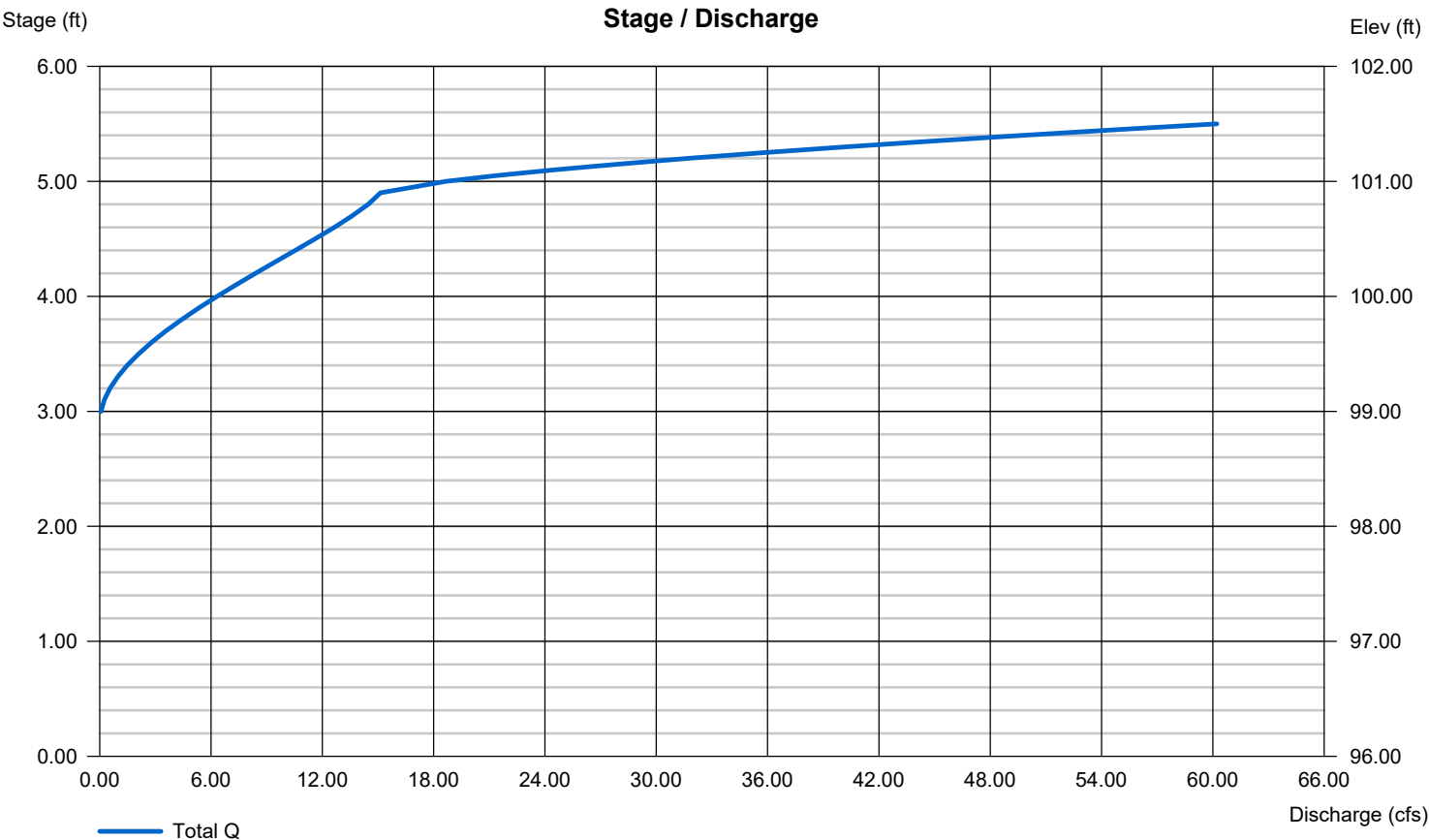
Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	0.00	0.00	0.00
Span (in)	= 24.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 98.90	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	= .012	.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)	= 34.00	0.00	0.00	0.00
Crest El. (ft)	= 100.90	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).



Hydrograph Report

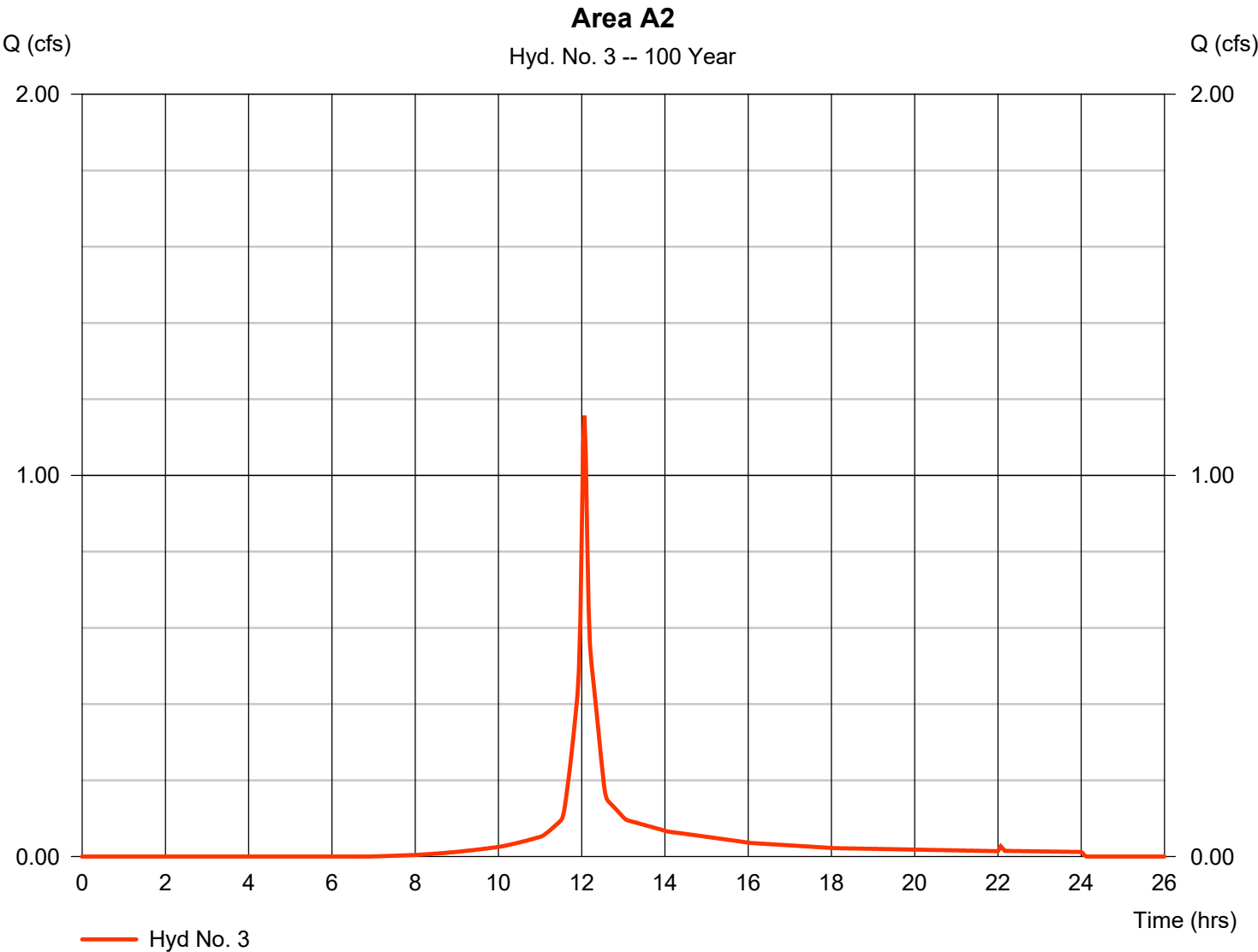
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020

Thursday, 02 / 9 / 2023

Hyd. No. 3

Area A2

Hydrograph type	= SCS Runoff	Peak discharge	= 1.156 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.07 hrs
Time interval	= 2 min	Hyd. volume	= 3,472 cuft
Drainage area	= 0.196 ac	Curve number	= 73.1
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 8.43 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

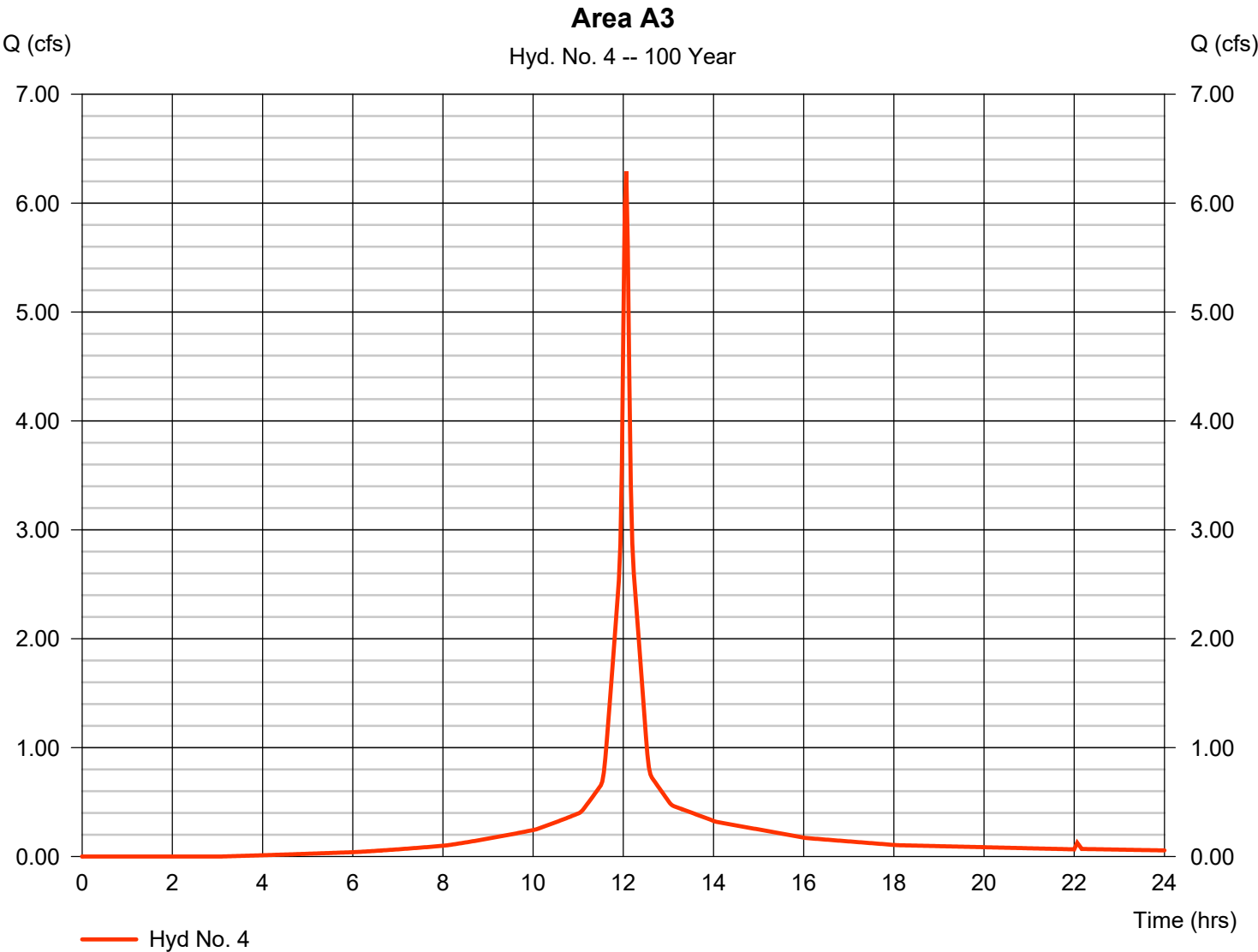
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020

Thursday, 02 / 9 / 2023

Hyd. No. 4

Area A3

Hydrograph type	= SCS Runoff	Peak discharge	= 6.293 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.07 hrs
Time interval	= 2 min	Hyd. volume	= 20,113 cuft
Drainage area	= 0.837 ac	Curve number	= 88.6
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 8.43 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

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

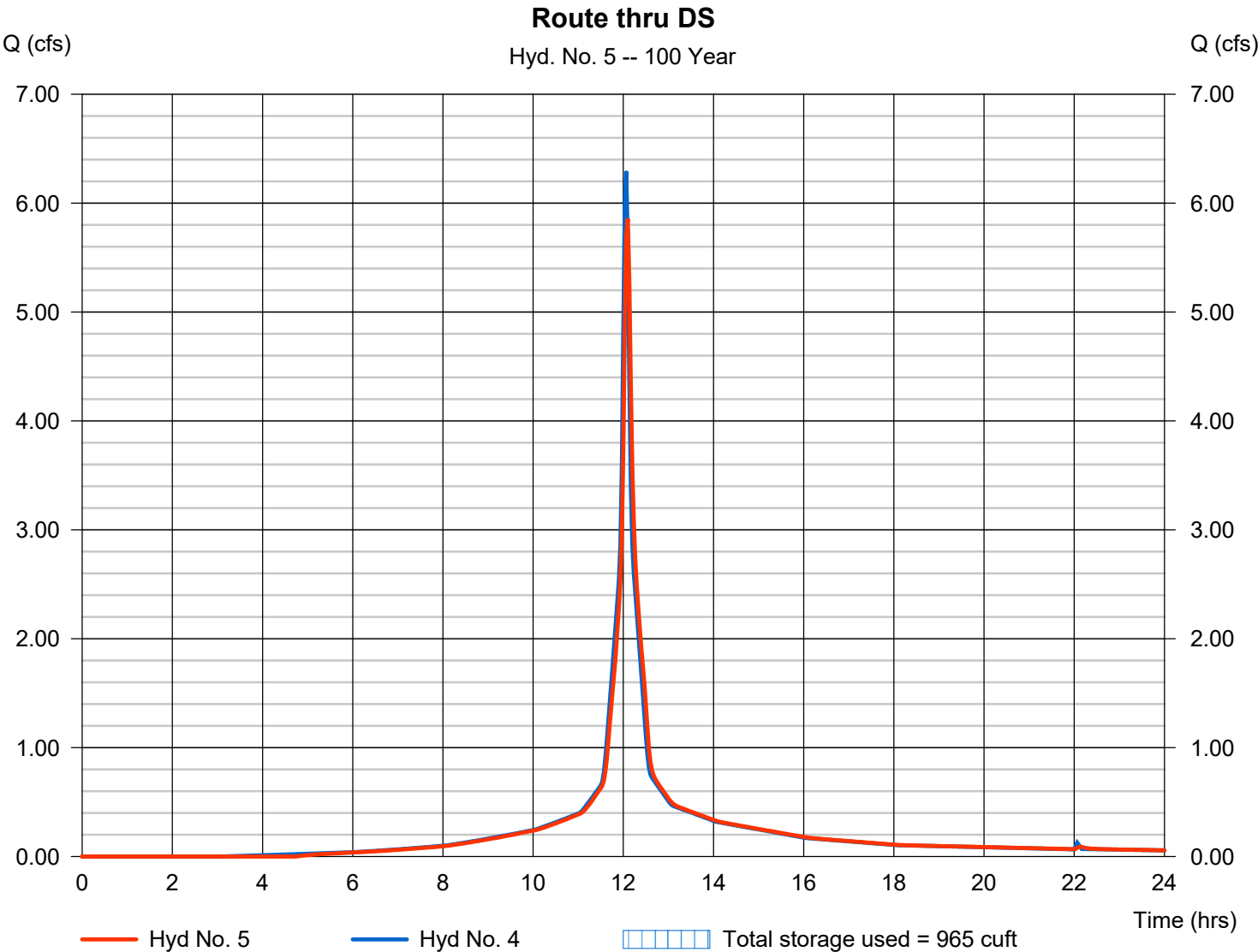
Thursday, 02 / 9 / 2023

Hyd. No. 5

Route thru DS

Hydrograph type	= Reservoir	Peak discharge	= 5.859 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.10 hrs
Time interval	= 2 min	Hyd. volume	= 20,046 cuft
Inflow hyd. No.	= 4 - Area A3	Max. Elevation	= 96.10 ft
Reservoir name	= Basin DS	Max. Storage	= 965 cuft

Storage Indication method used.



Pond No. 4 - Basin DS

Pond Data

UG Chambers -Invert elev. = 95.70 ft, Rise x Span = 3.75 x 6.00 ft, Barrel Len = 64.50 ft, No. Barrels = 3, Slope = 0.00%, Headers = No
Encasement -Invert elev. = 94.95 ft, Width = 7.75 ft, Height = 5.50 ft, Voids = 40.00%

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	94.95	n/a	0	0
0.55	95.50	n/a	330	330
1.10	96.05	n/a	573	903
1.65	96.60	n/a	707	1,611
2.20	97.15	n/a	693	2,304
2.75	97.70	n/a	670	2,974
3.30	98.25	n/a	634	3,608
3.85	98.80	n/a	581	4,189
4.40	99.35	n/a	492	4,681
4.95	99.90	n/a	341	5,022
5.50	100.45	n/a	330	5,352

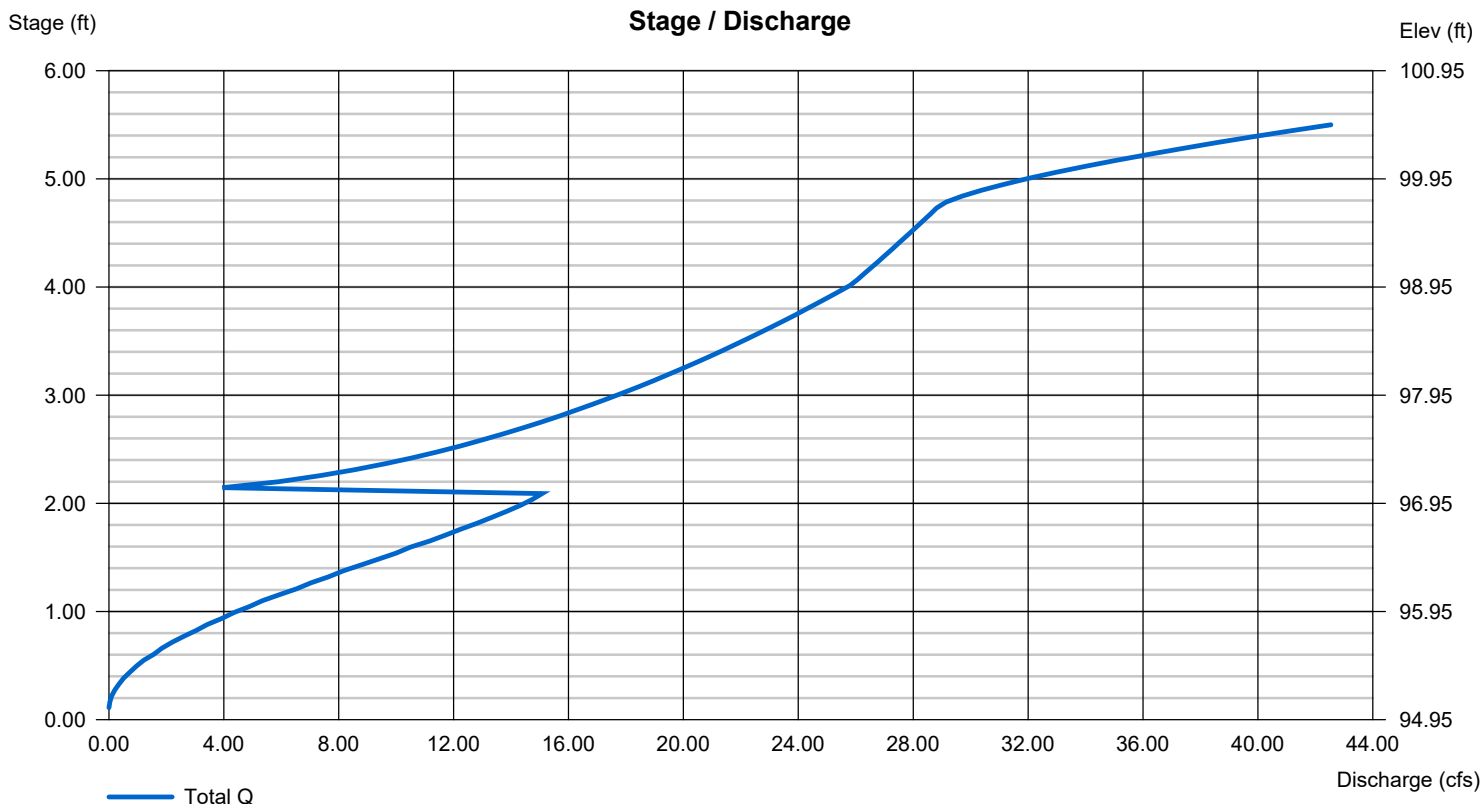
Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	0.00	0.00	0.00
Span (in)	= 24.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 95.05	0.00	0.00	0.00
Length (ft)	= 26.60	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)	= 0.42	5.00	0.00	0.00
Crest El. (ft)	= 94.95	99.70	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= 1	Rect	---	---
Multi-Stage	= Yes	No	No	No
Exfil.(in/hr)	= 0.000 (by Wet area)			
TW Elev. (ft)	= 0.00			

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

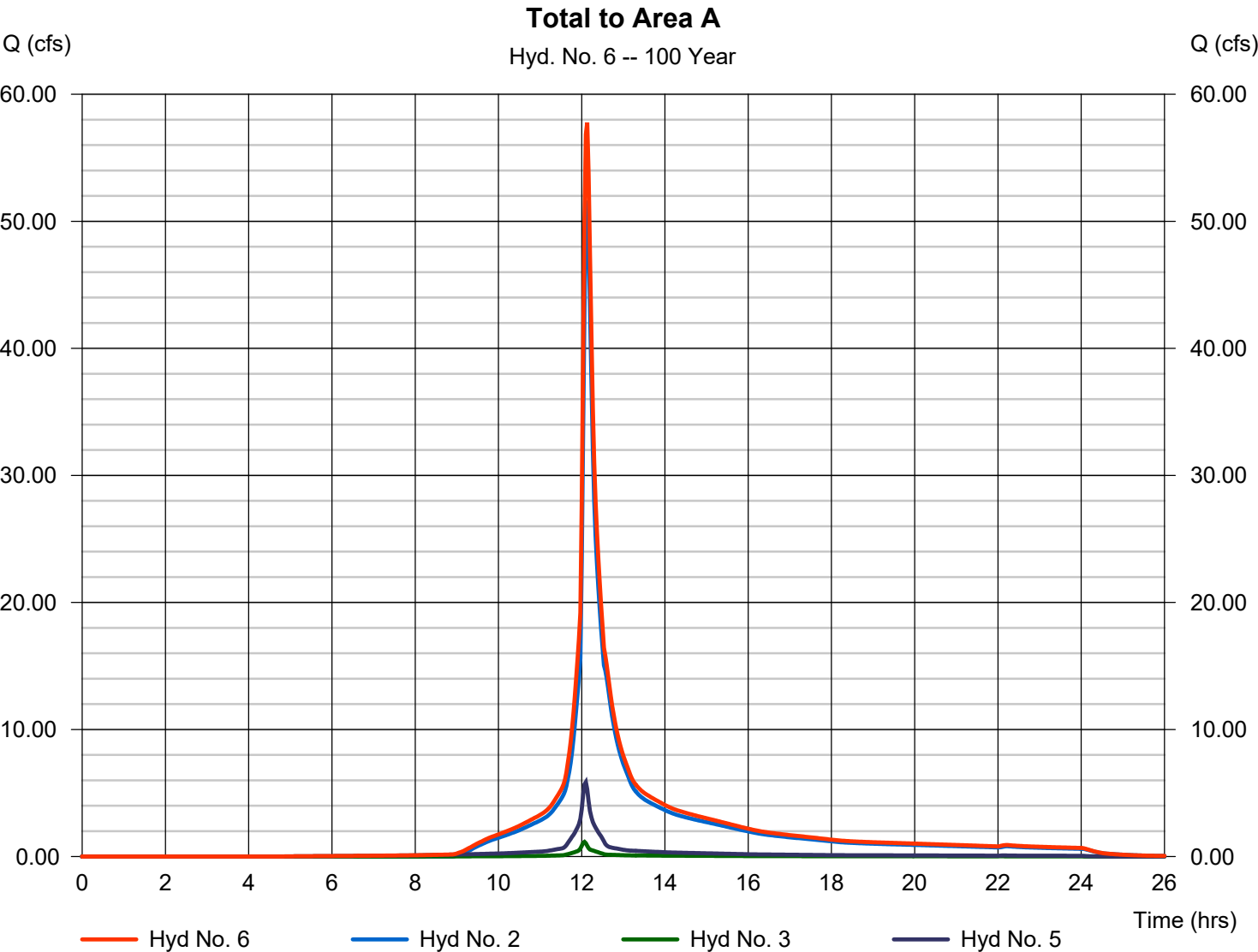


Hydrograph Report

Hyd. No. 6

Total to Area A

Hydrograph type	= Combine	Peak discharge	= 57.77 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 203,895 cuft
Inflow hyds.	= 2, 3, 5	Contrib. drain. area	= 0.196 ac

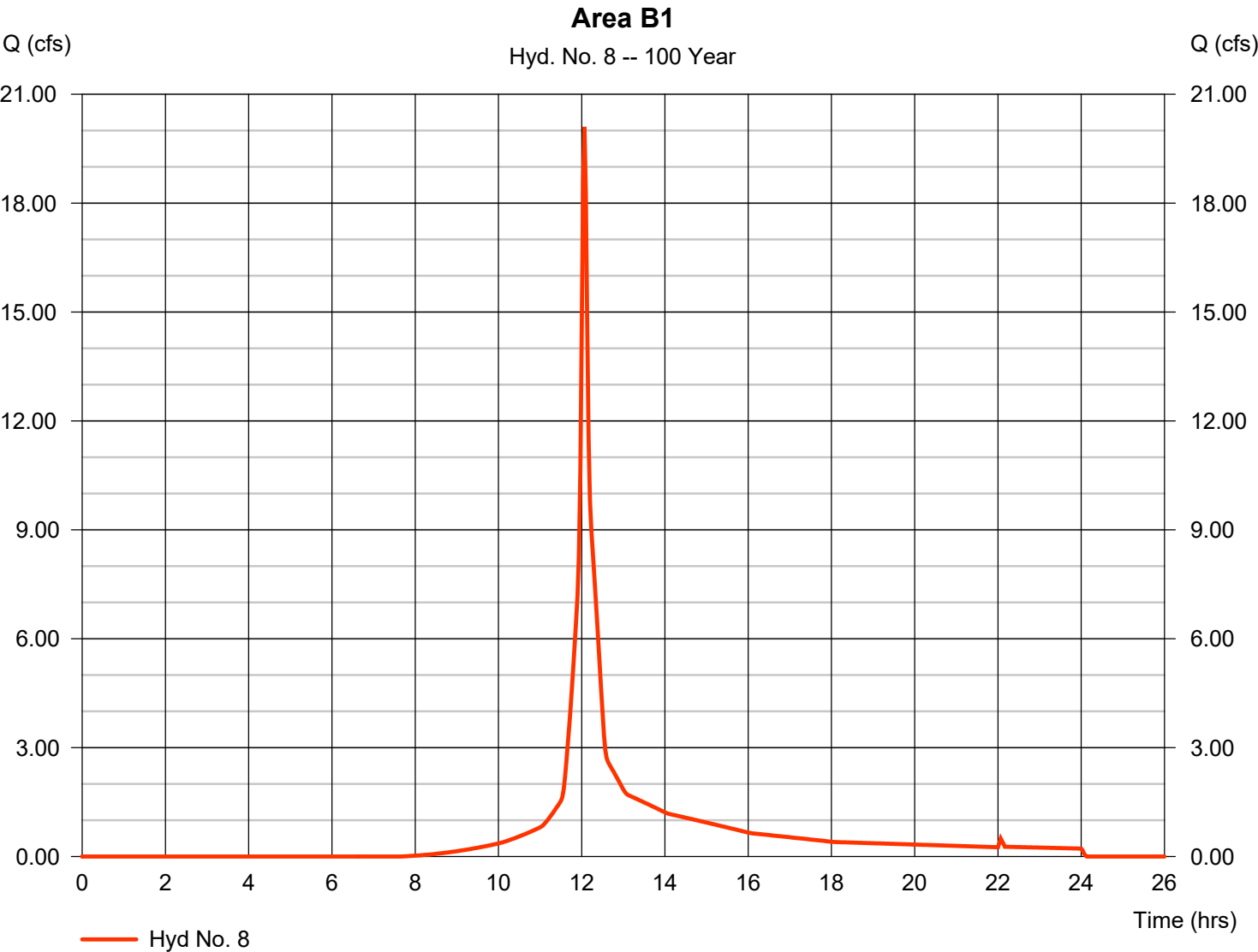


Hydrograph Report

Hyd. No. 8

Area B1

Hydrograph type	= SCS Runoff	Peak discharge	= 20.09 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.07 hrs
Time interval	= 2 min	Hyd. volume	= 60,081 cuft
Drainage area	= 3.696 ac	Curve number	= 69.5
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 5.90 min
Total precip.	= 8.43 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



TR55 Tc Worksheet

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

Hyd. No. 8

Area B1

<u>Description</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>Totals</u>			
Sheet Flow							
Manning's n-value	= 0.400	0.011	0.011				
Flow length (ft)	= 50.0	0.0	0.0				
Two-year 24-hr precip. (in)	= 3.37	0.00	0.00				
Land slope (%)	= 18.00	0.00	0.00				
Travel Time (min)	= 4.99	+	0.00	+	0.00	=	4.99
Shallow Concentrated Flow							
Flow length (ft)	= 166.00	146.00	68.00				
Watercourse slope (%)	= 19.00	18.00	15.00				
Surface description	= Unpaved	Unpaved	Unpaved				
Average velocity (ft/s)	=7.03	6.85	6.25				
Travel Time (min)	= 0.39	+	0.36	+	0.18	=	0.93
Channel Flow							
X sectional flow area (sqft)	= 0.00	0.00	0.00				
Wetted perimeter (ft)	= 0.00	0.00	0.00				
Channel slope (%)	= 0.00	0.00	0.00				
Manning's n-value	= 0.015	0.015	0.015				
Velocity (ft/s)	=0.00	0.00	0.00				
Flow length (ft)	((0})0.0	0.0	0.0				
Travel Time (min)	= 0.00	+	0.00	+	0.00	=	0.00
Total Travel Time, Tc				5.90 min			

Hydrograph Report

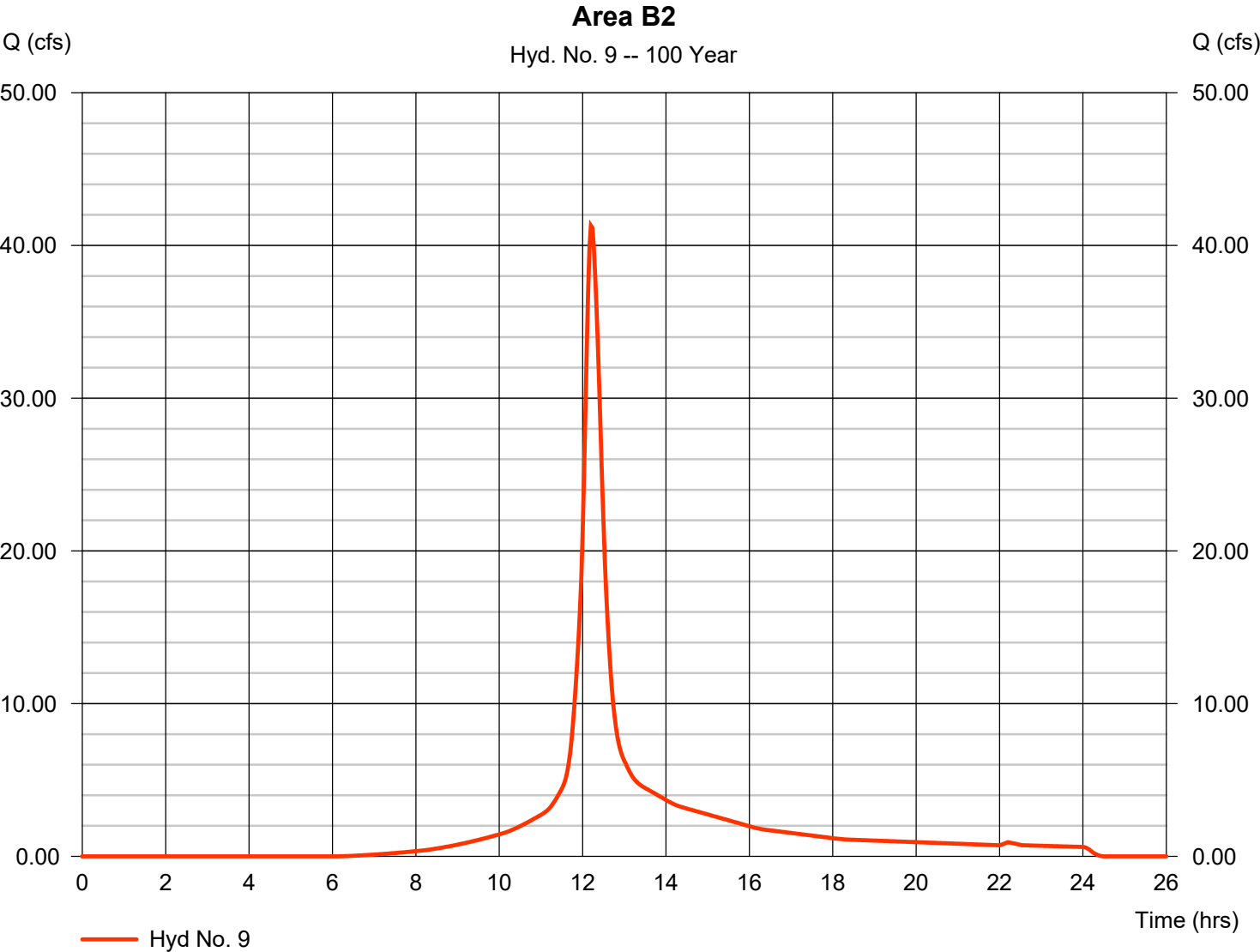
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020

Thursday, 02 / 9 / 2023

Hyd. No. 9

Area B2

Hydrograph type	= SCS Runoff	Peak discharge	= 41.30 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.20 hrs
Time interval	= 2 min	Hyd. volume	= 183,726 cuft
Drainage area	= 8.945 ac	Curve number	= 76.9
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 19.20 min
Total precip.	= 8.43 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



TR55 Tc Worksheet

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

Hyd. No. 9

Area B2

<u>Description</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>Totals</u>
Sheet Flow				
Manning's n-value	= 0.400	0.011	0.011	
Flow length (ft)	= 50.0	0.0	0.0	
Two-year 24-hr precip. (in)	= 3.37	0.00	0.00	
Land slope (%)	= 1.40	0.00	0.00	
Travel Time (min)	= 13.86	+	0.00	+
			0.00	= 13.86
Shallow Concentrated Flow				
Flow length (ft)	= 330.00	150.00	0.00	
Watercourse slope (%)	= 1.40	33.00	0.00	
Surface description	= Unpaved	Unpaved	Paved	
Average velocity (ft/s)	=1.91	9.27	0.00	
Travel Time (min)	= 2.88	+	0.27	+
			0.00	= 3.15
Channel Flow				
X sectional flow area (sqft)	= 0.78	0.00	0.00	
Wetted perimeter (ft)	= 6.00	0.00	0.00	
Channel slope (%)	= 6.00	0.00	0.00	
Manning's n-value	= 0.012	0.015	0.015	
Velocity (ft/s)	=7.75	0.00	0.00	
Flow length (ft)	(0)1000.0	0.0	0.0	
Travel Time (min)	= 2.15	+	0.00	+
			0.00	= 2.15
Total Travel Time, Tc				19.20 min

Hydrograph Report

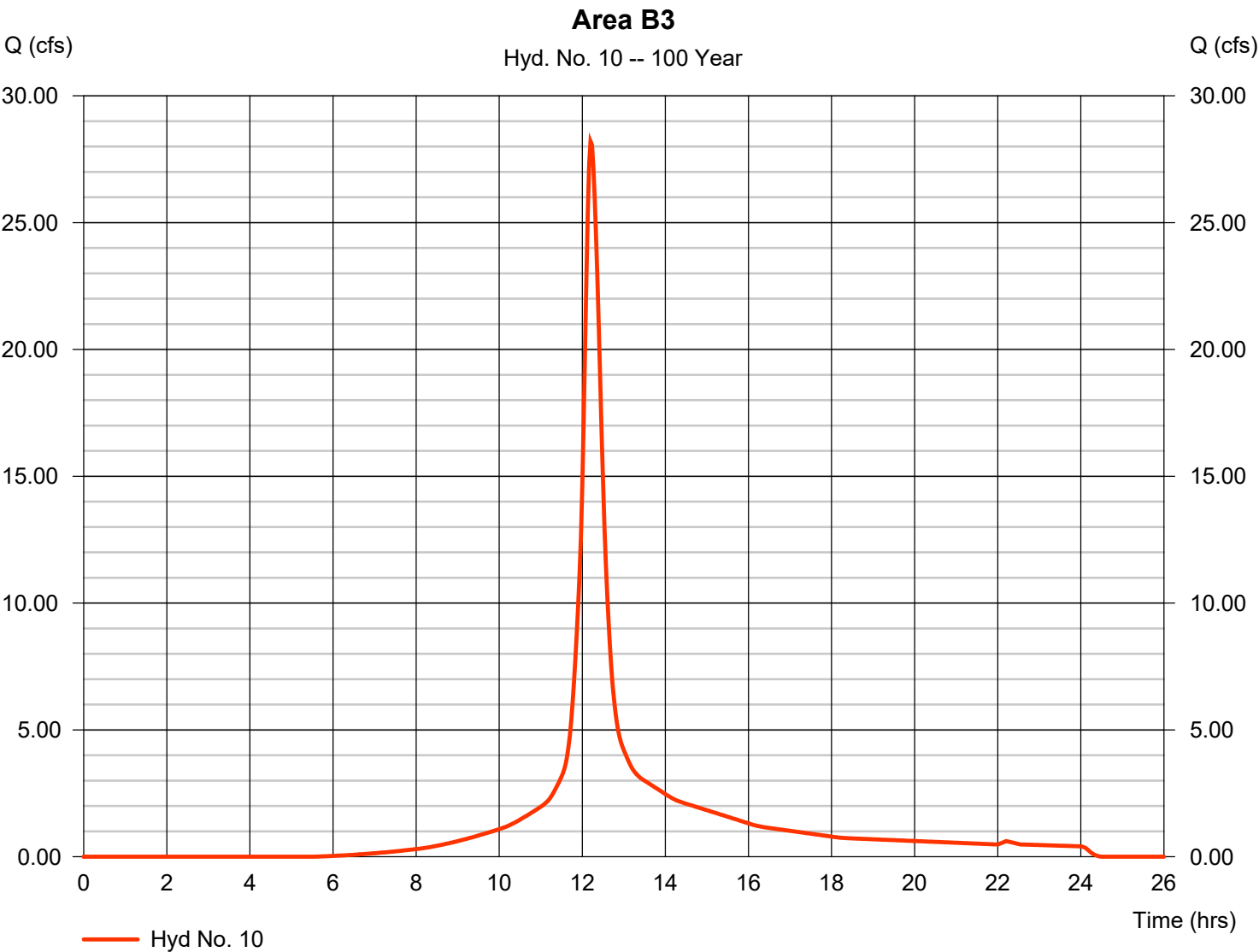
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020

Thursday, 02 / 9 / 2023

Hyd. No. 10

Area B3

Hydrograph type	= SCS Runoff	Peak discharge	= 28.20 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.20 hrs
Time interval	= 2 min	Hyd. volume	= 126,124 cuft
Drainage area	= 5.844 ac	Curve number	= 79.3
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 18.50 min
Total precip.	= 8.43 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



TR55 Tc Worksheet

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

Hyd. No. 10

Area B3

<u>Description</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>Totals</u>			
Sheet Flow							
Manning's n-value	= 0.400	0.011	0.011				
Flow length (ft)	= 50.0	0.0	0.0				
Two-year 24-hr precip. (in)	= 3.37	0.00	0.00				
Land slope (%)	= 1.00	0.00	0.00				
Travel Time (min)	= 15.86	+	0.00	+	0.00	=	15.86
Shallow Concentrated Flow							
Flow length (ft)	= 82.00	260.00	0.00				
Watercourse slope (%)	= 1.40	33.00	0.00				
Surface description	= Unpaved	Unpaved	Paved				
Average velocity (ft/s)	=1.91	9.27	0.00				
Travel Time (min)	= 0.72	+	0.47	+	0.00	=	1.18
Channel Flow							
X sectional flow area (sqft)	= 0.78	0.00	0.00				
Wetted perimeter (ft)	= 6.00	0.00	0.00				
Channel slope (%)	= 4.80	0.00	0.00				
Manning's n-value	= 0.012	0.015	0.015				
Velocity (ft/s)	=6.93	0.00	0.00				
Flow length (ft)	(0)626.0	0.0	0.0				
Travel Time (min)	= 1.50	+	0.00	+	0.00	=	1.50
Total Travel Time, Tc				18.50 min			

Hydrograph Report

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

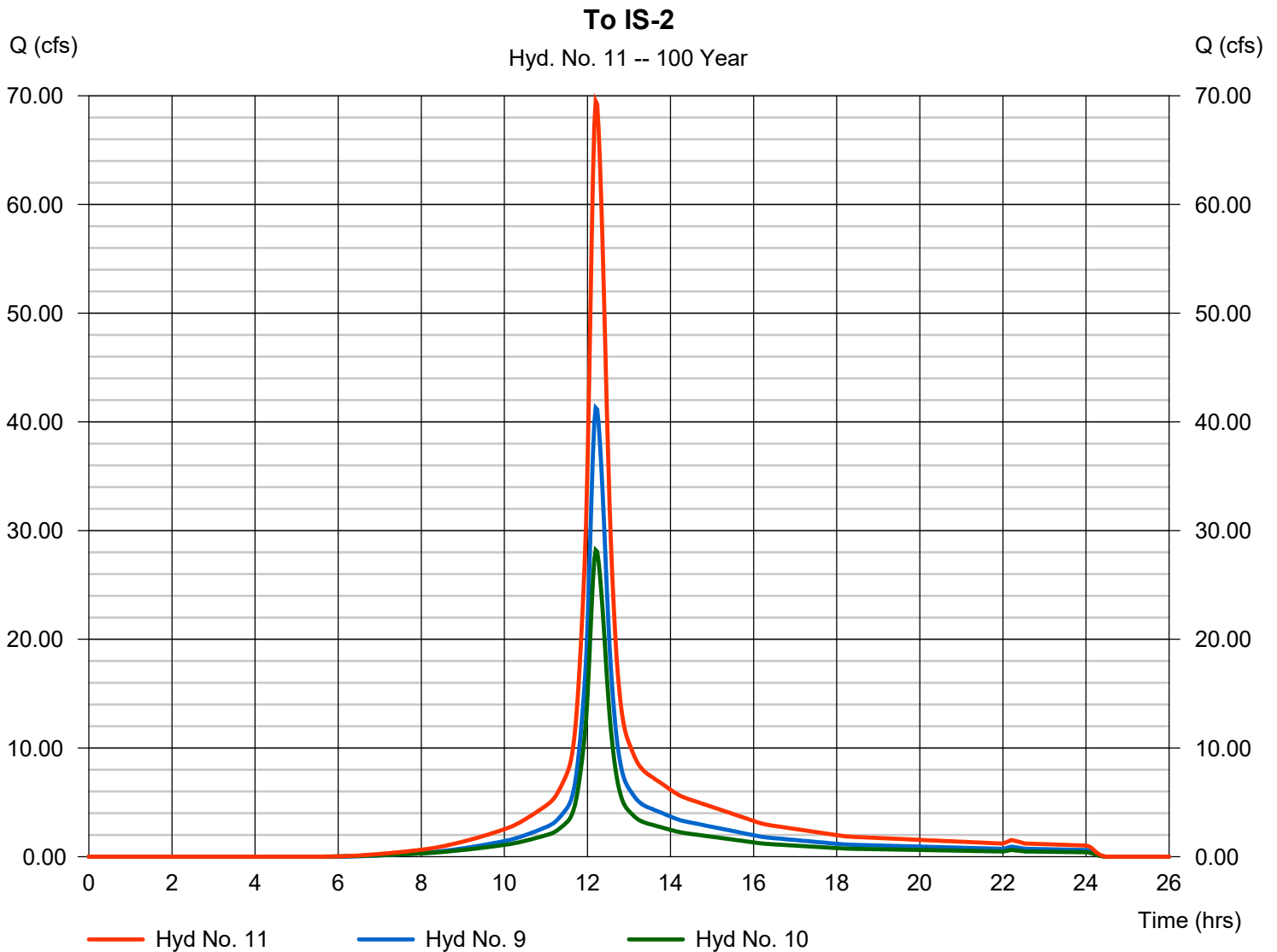
Thursday, 02 / 9 / 2023

Hyd. No. 11

To IS-2

Hydrograph type = Combine
Storm frequency = 100 yrs
Time interval = 2 min
Inflow hyds. = 9, 10

Peak discharge = 69.50 cfs
Time to peak = 12.20 hrs
Hyd. volume = 309,850 cuft
Contrib. drain. area = 14.789 ac



Hydrograph Report

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

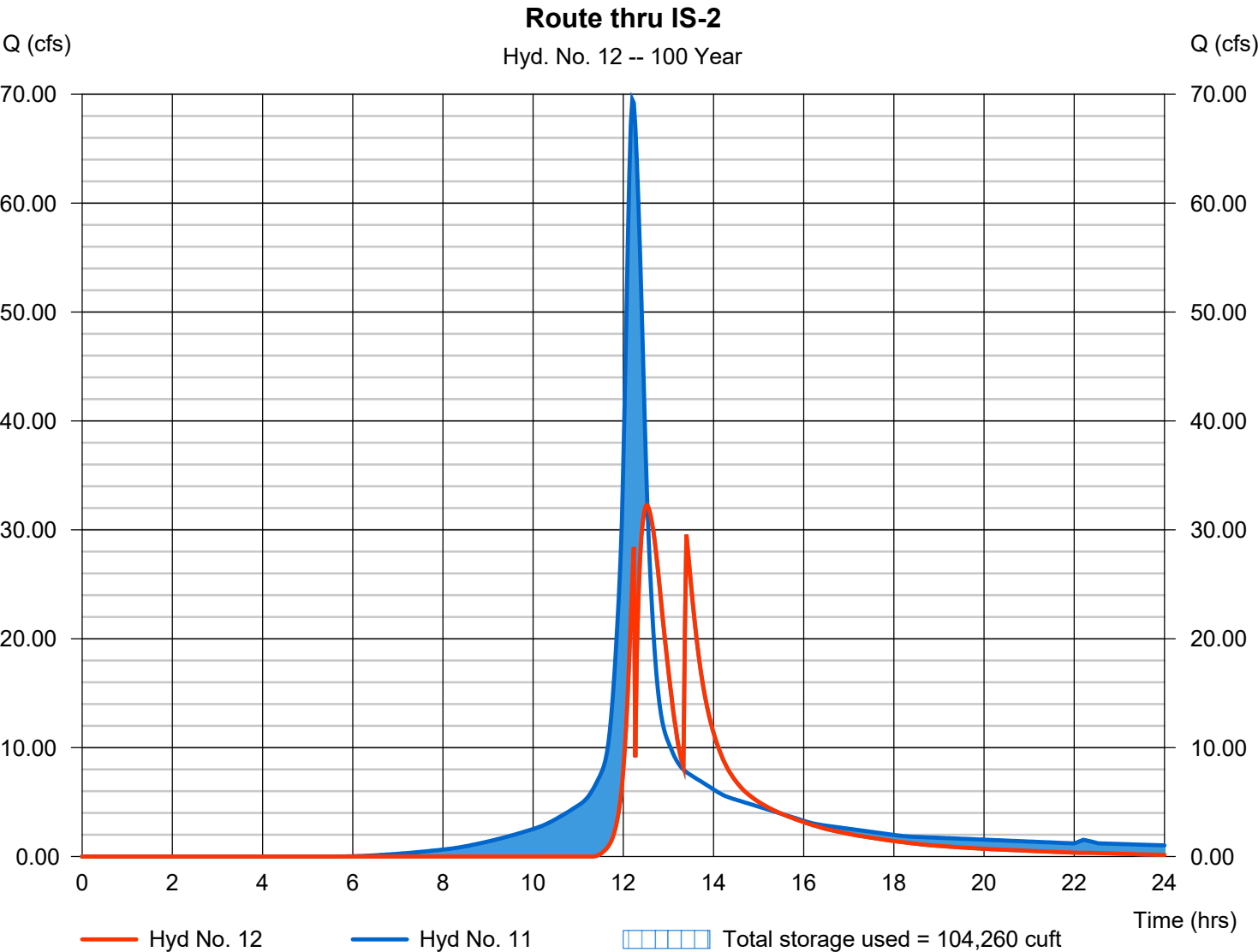
Thursday, 02 / 9 / 2023

Hyd. No. 12

Route thru IS-2

Hydrograph type	= Reservoir	Peak discharge	= 32.25 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.53 hrs
Time interval	= 2 min	Hyd. volume	= 218,705 cuft
Inflow hyd. No.	= 11 - To IS-2	Max. Elevation	= 102.25 ft
Reservoir name	= Basin IS-2	Max. Storage	= 104,260 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Pond No. 5 - Basin IS-2

Pond Data

UG Chambers -Invert elev. = 99.25 ft, Rise x Span = 3.75 x 6.00 ft, Barrel Len = 235.14 ft, No. Barrels = 21, Slope = 0.00%, Headers = No
Encasement -Invert elev. = 98.50 ft, Width = 7.75 ft, Height = 5.50 ft, Voids = 40.00%

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	98.50	n/a	0	0
0.55	99.05	n/a	8,421	8,421
1.10	99.60	n/a	14,635	23,056
1.65	100.15	n/a	18,054	41,110
2.20	100.70	n/a	17,697	58,807
2.75	101.25	n/a	17,091	75,898
3.30	101.80	n/a	16,177	92,076
3.85	102.35	n/a	14,821	106,896
4.40	102.90	n/a	12,565	119,461
4.95	103.45	n/a	8,694	128,155
5.50	104.00	n/a	8,421	136,576

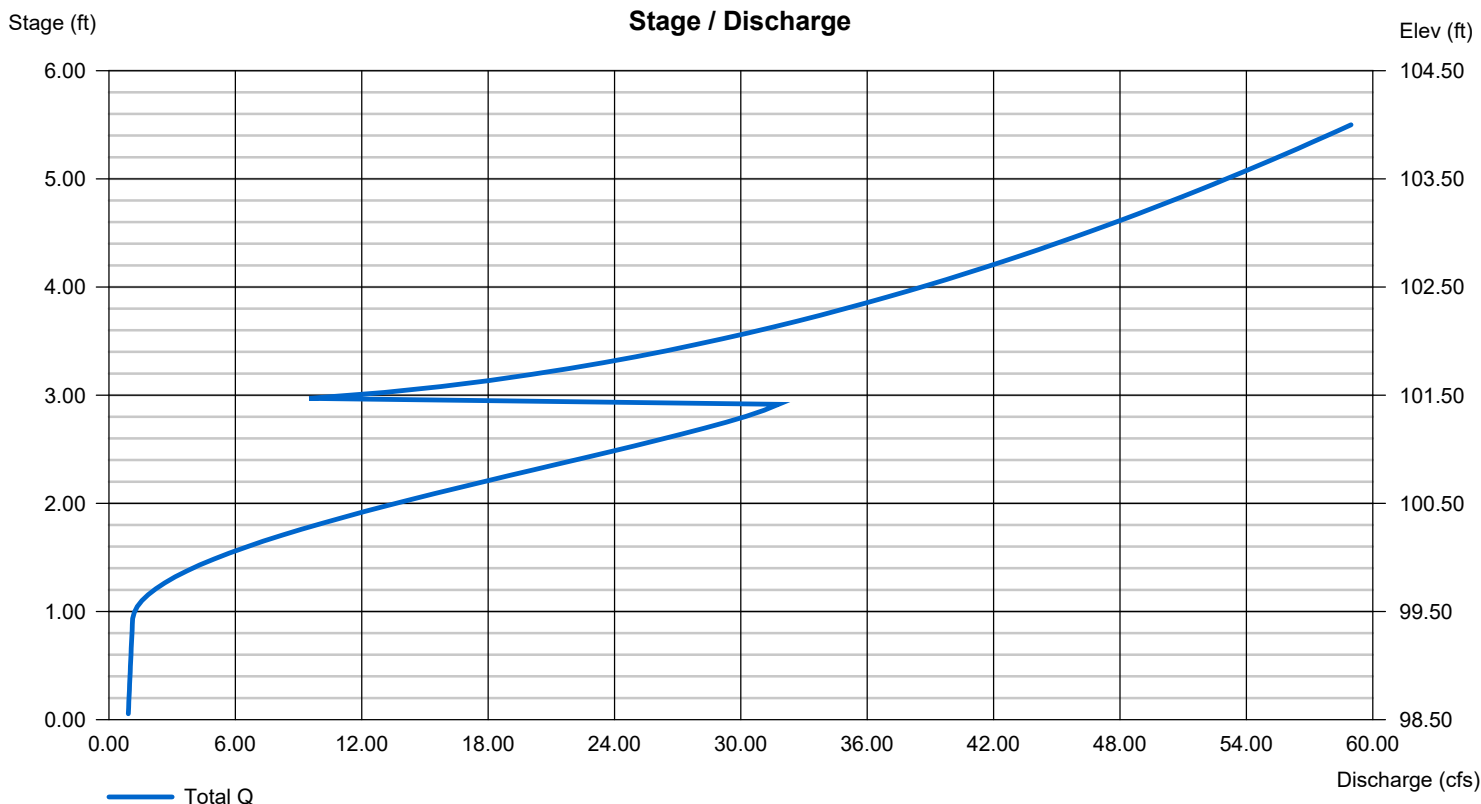
Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	0.00	0.00	0.00
Span (in)	= 24.00	0.00	0.00	0.00
No. Barrels	= 2	0	0	0
Invert El. (ft)	= 99.42	0.00	0.00	0.00
Length (ft)	= 43.30	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)	= 0.00	0.00	0.00	0.00
Crest El. (ft)	= 0.00	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= ---	---	---	---
Multi-Stage	= No	No	No	No
Exfil.(in/hr)	= 1.020 (by Wet area)			
TW Elev. (ft)	= 0.00			

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



Hydrograph Report

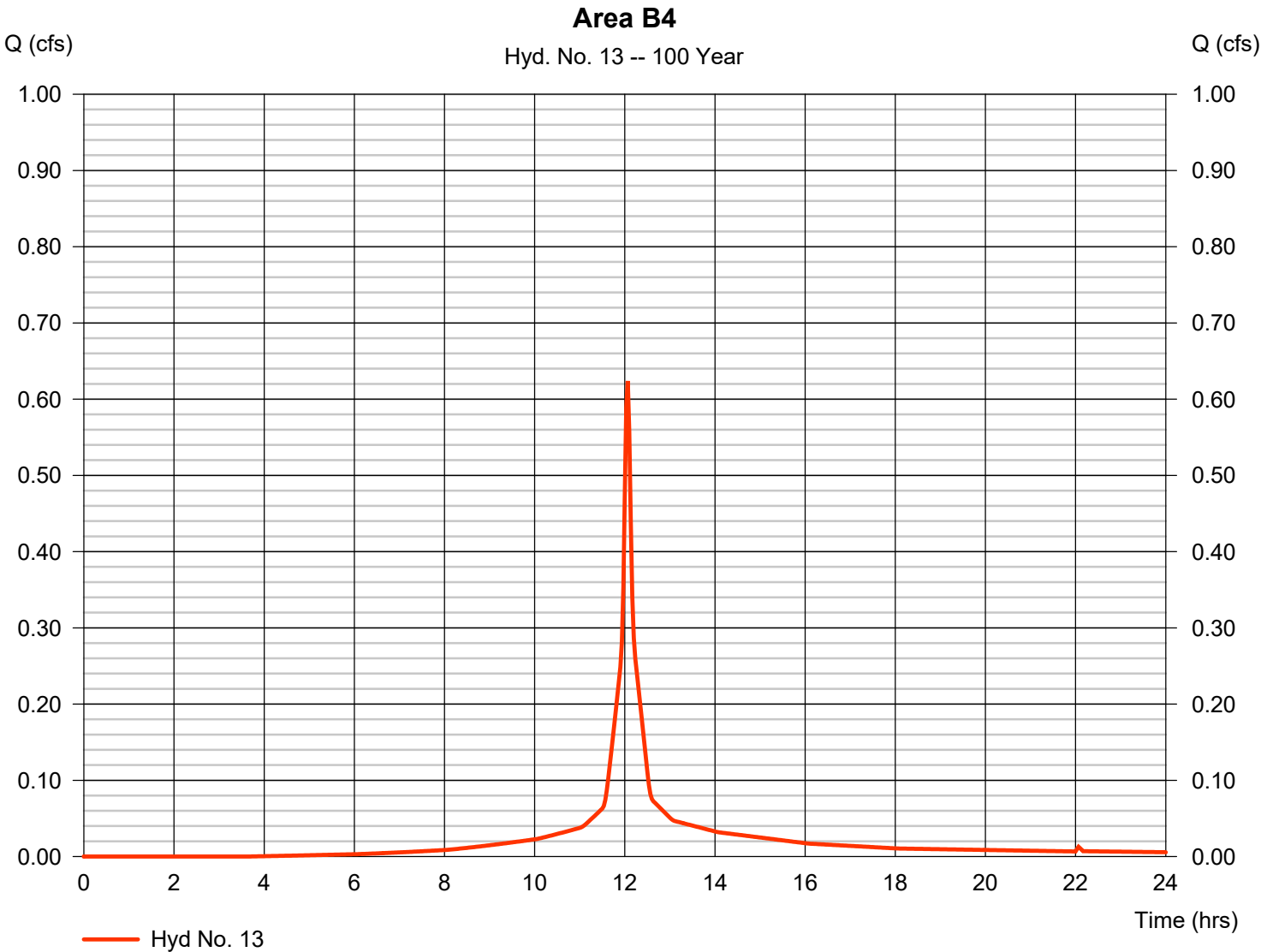
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020

Thursday, 02 / 9 / 2023

Hyd. No. 13

Area B4

Hydrograph type	= SCS Runoff	Peak discharge	= 0.624 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.07 hrs
Time interval	= 2 min	Hyd. volume	= 1,966 cuft
Drainage area	= 0.085 ac	Curve number	= 86.4
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 8.43 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

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

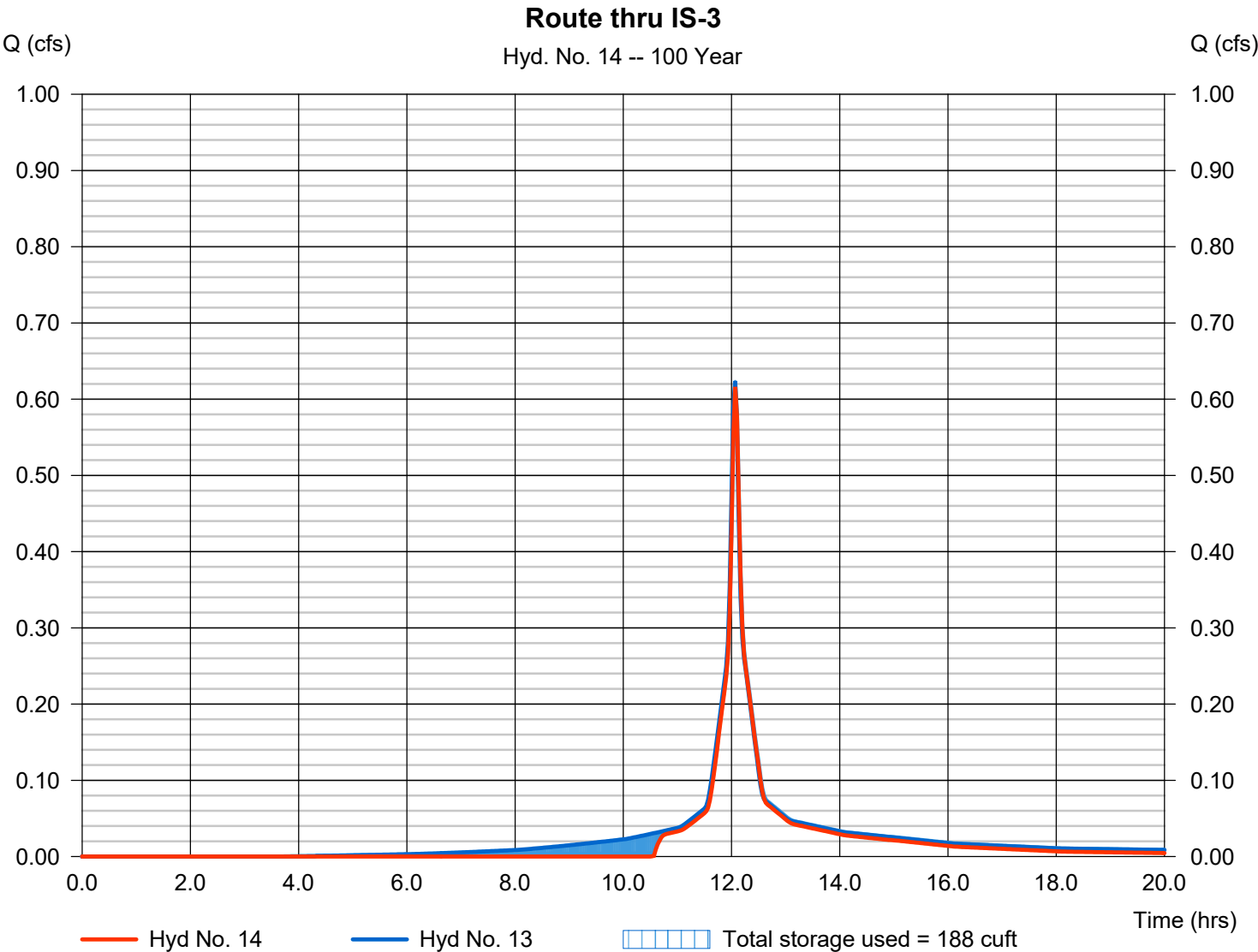
Thursday, 02 / 9 / 2023

Hyd. No. 14

Route thru IS-3

Hydrograph type	= Reservoir	Peak discharge	= 0.616 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.07 hrs
Time interval	= 2 min	Hyd. volume	= 1,550 cuft
Inflow hyd. No.	= 13 - Area B4	Max. Elevation	= 98.80 ft
Reservoir name	= Basin IS-3	Max. Storage	= 188 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Pond No. 6 - Basin IS-3

Pond Data

UG Chambers -Invert elev. = 97.25 ft, Rise x Span = 3.75 x 6.00 ft, Barrel Len = 15.00 ft, No. Barrels = 1, Slope = 0.00%, Headers = No
Encasement -Invert elev. = 96.50 ft, Width = 7.75 ft, Height = 5.50 ft, Voids = 40.00%

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	96.50	n/a	0	0
0.55	97.05	n/a	26	26
1.10	97.60	n/a	44	70
1.65	98.15	n/a	55	125
2.20	98.70	n/a	54	179
2.75	99.25	n/a	52	231
3.30	99.80	n/a	49	280
3.85	100.35	n/a	45	325
4.40	100.90	n/a	38	363
4.95	101.45	n/a	26	389
5.50	102.00	n/a	26	415

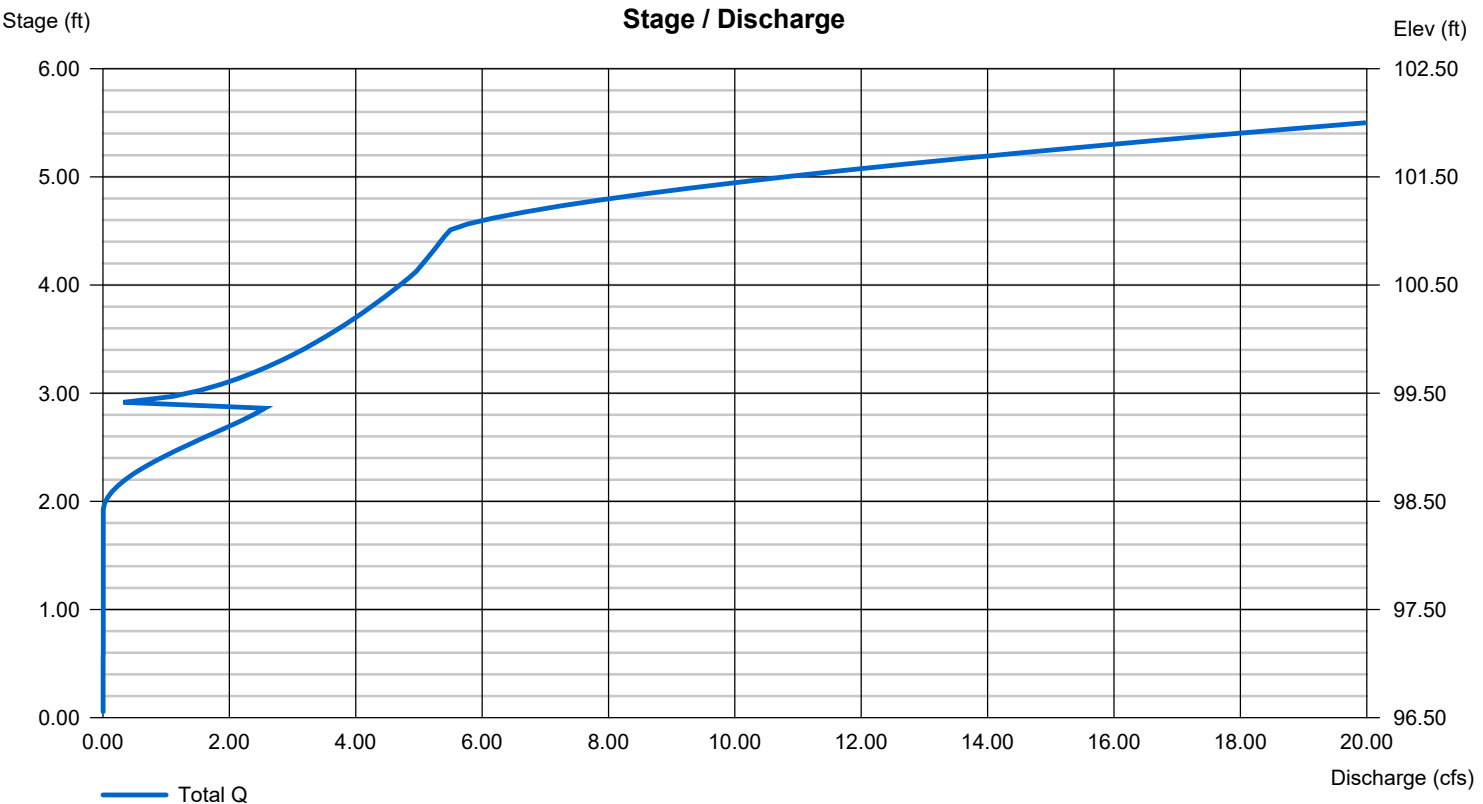
Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 12.00	0.00	0.00	0.00
Span (in)	= 12.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 98.41	0.00	0.00	0.00
Length (ft)	= 15.00	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)	= 4.00	0.00	0.00	0.00
Crest El. (ft)	= 101.00	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= Rect	---	---	---
Multi-Stage	= No	No	No	No
Exfil.(in/hr)	= 1.020 (by Wet area)			
TW Elev. (ft)	= 0.00			

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

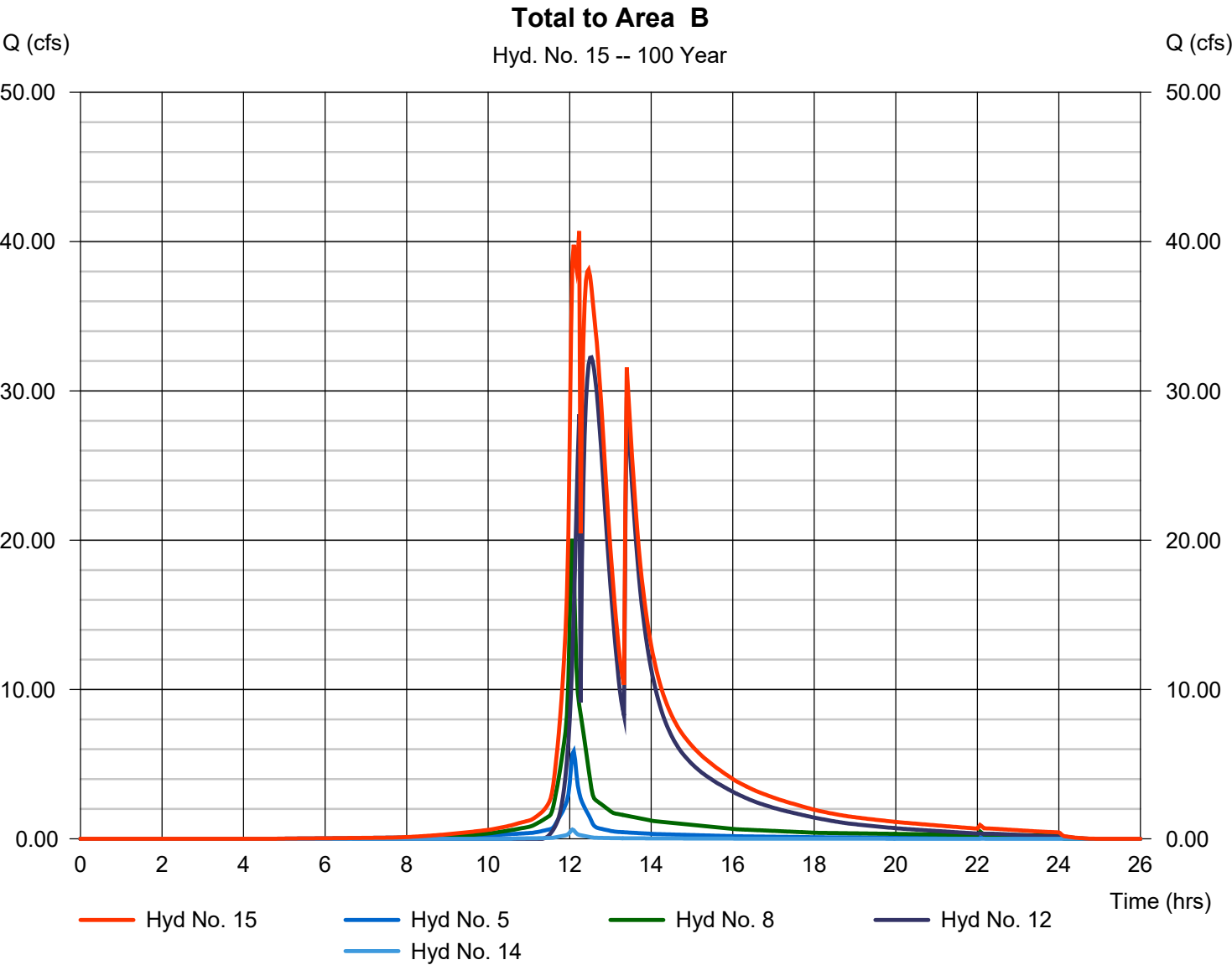


Hydrograph Report

Hyd. No. 15

Total to Area B

Hydrograph type	= Combine	Peak discharge	= 40.71 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.23 hrs
Time interval	= 2 min	Hyd. volume	= 300,382 cuft
Inflow hyds.	= 5, 8, 12, 14	Contrib. drain. area	= 3.696 ac

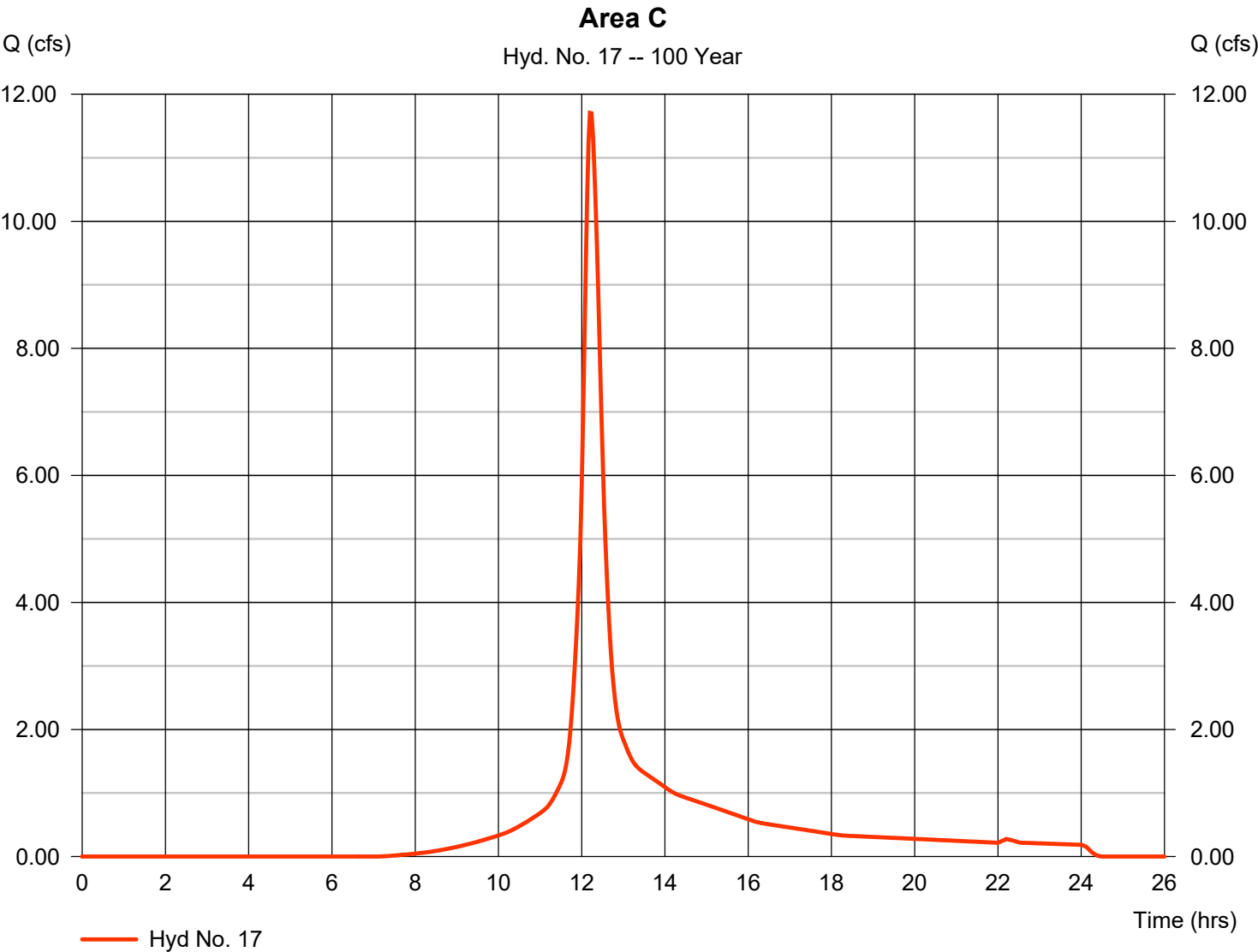


Hydrograph Report

Hyd. No. 17

Area C

Hydrograph type	=	SCS Runoff	Peak discharge	=	11.71 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.20 hrs
Time interval	=	2 min	Hyd. volume	=	51,828 cuft
Drainage area	=	2.775 ac	Curve number	=	72.6
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	18.20 min
Total precip.	=	8.43 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484



TR55 Tc Worksheet

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

Hyd. No. 17

Area C

<u>Description</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>Totals</u>			
Sheet Flow							
Manning's n-value	= 0.400	0.011	0.011				
Flow length (ft)	= 50.0	0.0	0.0				
Two-year 24-hr precip. (in)	= 3.37	0.00	0.00				
Land slope (%)	= 1.00	0.00	0.00				
Travel Time (min)	= 15.86	+	0.00	+	0.00	=	15.86
Shallow Concentrated Flow							
Flow length (ft)	= 232.00	150.00	0.00				
Watercourse slope (%)	= 1.40	33.00	0.00				
Surface description	= Unpaved	Unpaved	Paved				
Average velocity (ft/s)	=1.91	9.27	0.00				
Travel Time (min)	= 2.03	+	0.27	+	0.00	=	2.30
Channel Flow							
X sectional flow area (sqft)	= 0.00	0.00	0.00				
Wetted perimeter (ft)	= 0.00	0.00	0.00				
Channel slope (%)	= 0.00	0.00	0.00				
Manning's n-value	= 0.015	0.015	0.015				
Velocity (ft/s)	=0.00	0.00	0.00				
Flow length (ft)	(0)0.0	0.0	0.0				
Travel Time (min)	= 0.00	+	0.00	+	0.00	=	0.00
Total Travel Time, Tc				18.20 min			

Hydrograph Report

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

Thursday, 02 / 9 / 2023

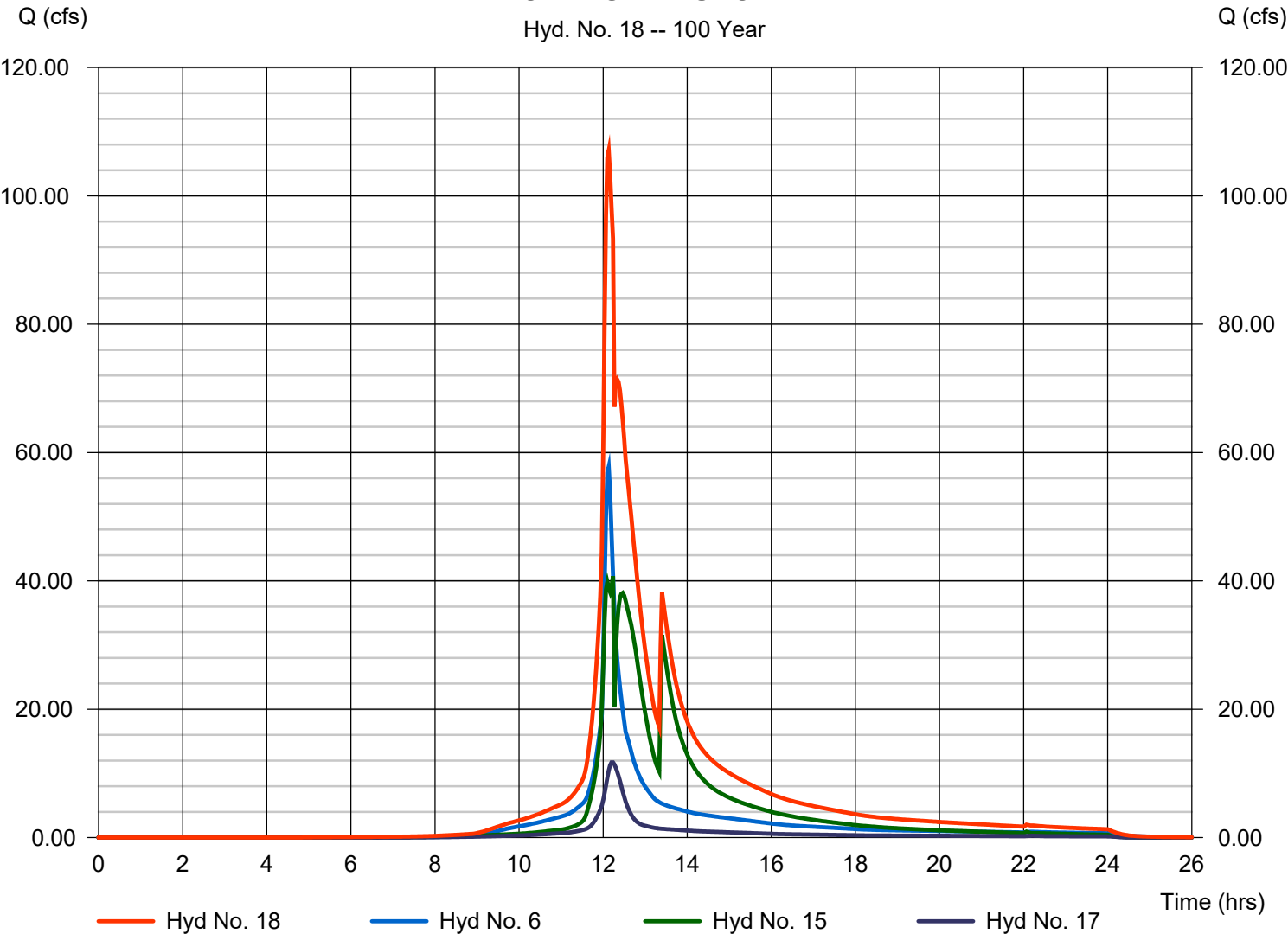
Hyd. No. 18

TOTAL SITE RUNOFF

Hydrograph type	= Combine	Peak discharge	= 107.07 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 556,106 cuft
Inflow hyds.	= 6, 15, 17	Contrib. drain. area	= 2.775 ac

TOTAL SITE RUNOFF

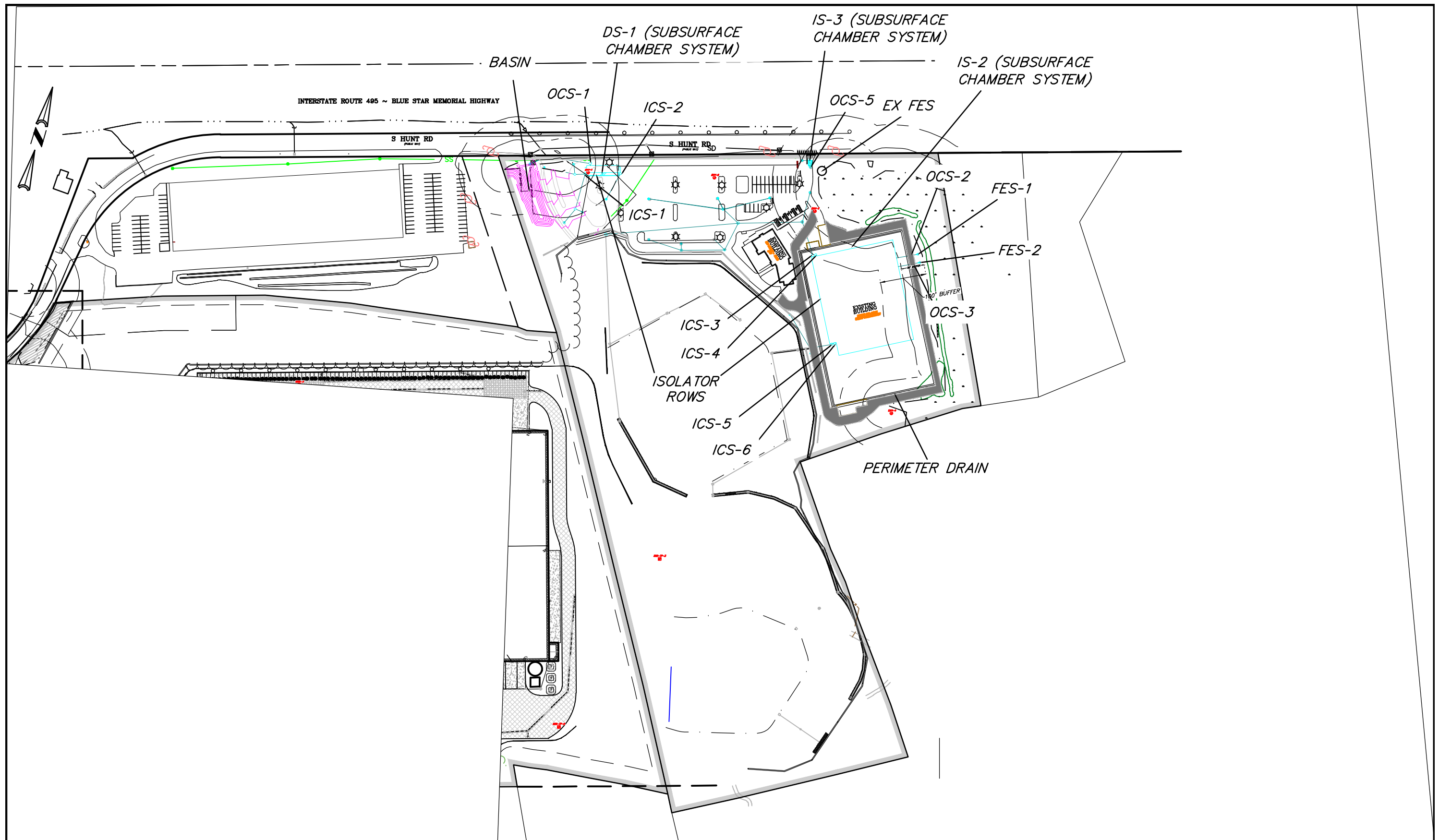
Hyd. No. 18 -- 100 Year



KELLY ENGINEERING GROUP, INC.

Zero Campanelli Drive-Braintree-MA 02184 Phone 781 843 4333

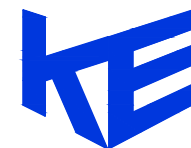
Attachment C
Best Management Practices



MARCUS PARTNERS
12-14 SOUTH HUNT RD.
AMESBURY, MA

SCALE: 1" = 200'
DATE: 02/09/23
2021-194-BMP01

BMP
LOCATION
MAP



KELLY ENGINEERING GROUP
civil engineering consultants
0 Campanelli Drive, Braintree, MA 02184
Phone: 781-843-4333 www.kellyengineeringgroup.com

KELLY ENGINEERING GROUP, INC.

Zero Campanelli Drive-Braintree-MA 02184 Phone 781 843 4333

Attachment D
Miscellaneous



NOAA Atlas 14, Volume 10, Version 3
Location name: Amesbury, Massachusetts, USA*
Latitude: 42.8343°, Longitude: -70.9476°
Elevation: 194.43 ft**
 * source: ESRI Maps
 ** source: USGS



POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sandra Pavlovic, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Orlan Wilhite

NOAA, National Weather Service, Silver Spring, Maryland

[PF tabular](#) | [PF graphical](#) | [Maps & aeriels](#)

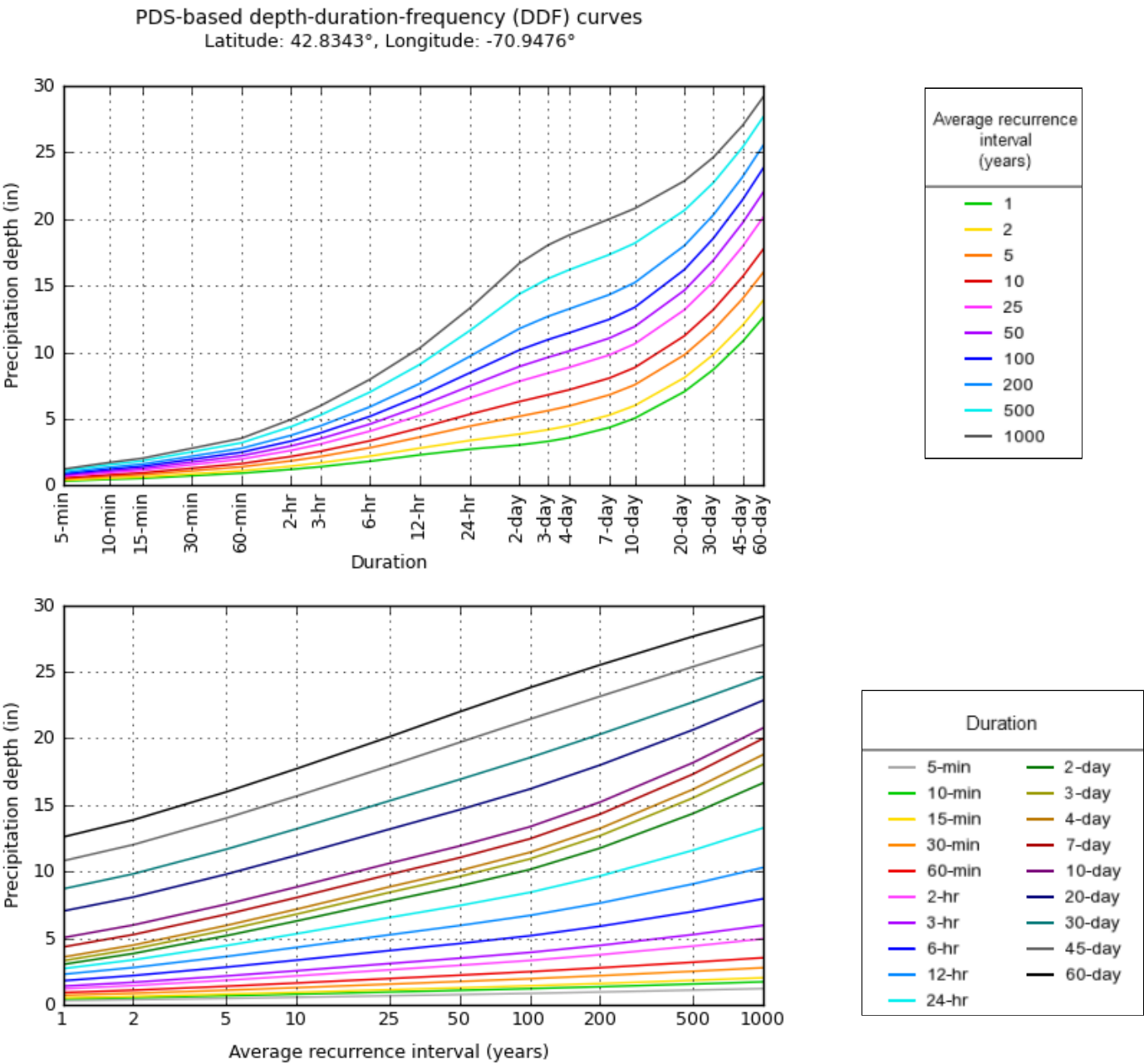
PF tabular

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	0.315 (0.252-0.393)	0.377 (0.301-0.471)	0.478 (0.380-0.600)	0.562 (0.444-0.709)	0.677 (0.516-0.889)	0.765 (0.569-1.02)	0.856 (0.615-1.19)	0.957 (0.649-1.35)	1.10 (0.715-1.61)	1.22 (0.770-1.81)
10-min	0.446 (0.357-0.557)	0.534 (0.426-0.667)	0.678 (0.539-0.850)	0.796 (0.629-1.00)	0.960 (0.731-1.26)	1.08 (0.806-1.45)	1.21 (0.872-1.68)	1.36 (0.919-1.92)	1.56 (1.01-2.28)	1.72 (1.09-2.57)
15-min	0.525 (0.420-0.655)	0.628 (0.502-0.785)	0.797 (0.634-1.00)	0.936 (0.740-1.18)	1.13 (0.860-1.48)	1.27 (0.949-1.71)	1.43 (1.02-1.98)	1.59 (1.08-2.26)	1.83 (1.19-2.68)	2.03 (1.28-3.02)
30-min	0.720 (0.576-0.899)	0.861 (0.688-1.08)	1.09 (0.869-1.37)	1.28 (1.02-1.62)	1.55 (1.18-2.03)	1.75 (1.30-2.34)	1.96 (1.41-2.71)	2.19 (1.48-3.09)	2.51 (1.63-3.67)	2.78 (1.76-4.14)
60-min	0.915 (0.732-1.14)	1.10 (0.875-1.37)	1.39 (1.11-1.74)	1.63 (1.29-2.06)	1.97 (1.50-2.58)	2.22 (1.65-2.97)	2.48 (1.79-3.44)	2.78 (1.89-3.93)	3.19 (2.08-4.67)	3.53 (2.23-5.26)
2-hr	1.20 (0.964-1.49)	1.44 (1.16-1.79)	1.84 (1.47-2.29)	2.17 (1.73-2.72)	2.62 (2.02-3.44)	2.96 (2.23-3.96)	3.32 (2.42-4.62)	3.76 (2.56-5.29)	4.40 (2.87-6.40)	4.95 (3.14-7.33)
3-hr	1.40 (1.13-1.73)	1.69 (1.36-2.09)	2.16 (1.74-2.68)	2.55 (2.04-3.19)	3.09 (2.39-4.04)	3.49 (2.64-4.67)	3.93 (2.88-5.46)	4.46 (3.04-6.25)	5.27 (3.44-7.63)	5.96 (3.79-8.79)
6-hr	1.81 (1.47-2.22)	2.19 (1.78-2.70)	2.82 (2.29-3.48)	3.35 (2.69-4.15)	4.07 (3.16-5.29)	4.60 (3.50-6.11)	5.18 (3.82-7.17)	5.89 (4.04-8.21)	7.00 (4.59-10.1)	7.96 (5.08-11.7)
12-hr	2.29 (1.88-2.79)	2.79 (2.29-3.41)	3.62 (2.95-4.44)	4.31 (3.49-5.30)	5.25 (4.11-6.78)	5.95 (4.55-7.85)	6.71 (4.97-9.22)	7.64 (5.25-10.6)	9.07 (5.96-13.0)	10.3 (6.60-15.0)
24-hr	2.71 (2.24-3.29)	3.37 (2.78-4.09)	4.44 (3.65-5.40)	5.33 (4.35-6.52)	6.55 (5.16-8.42)	7.45 (5.74-9.80)	8.43 (6.31-11.6)	9.67 (6.67-13.3)	11.6 (7.65-16.5)	13.3 (8.52-19.2)
2-day	3.03 (2.52-3.65)	3.85 (3.20-4.64)	5.18 (4.29-6.26)	6.28 (5.17-7.64)	7.81 (6.20-10.0)	8.91 (6.93-11.7)	10.2 (7.68-14.0)	11.8 (8.14-16.1)	14.4 (9.49-20.3)	16.7 (10.7-23.9)
3-day	3.31 (2.77-3.97)	4.18 (3.49-5.02)	5.61 (4.67-6.76)	6.80 (5.61-8.23)	8.43 (6.72-10.8)	9.62 (7.51-12.6)	10.9 (8.32-15.0)	12.7 (8.80-17.3)	15.5 (10.3-21.8)	18.0 (11.6-25.8)
4-day	3.58 (3.00-4.28)	4.48 (3.75-5.36)	5.95 (4.96-7.15)	7.17 (5.94-8.66)	8.85 (7.08-11.3)	10.1 (7.88-13.1)	11.4 (8.71-15.6)	13.2 (9.20-18.0)	16.2 (10.7-22.7)	18.8 (12.1-26.8)
7-day	4.34 (3.66-5.16)	5.27 (4.44-6.27)	6.79 (5.69-8.11)	8.05 (6.70-9.66)	9.78 (7.86-12.4)	11.0 (8.68-14.3)	12.5 (9.51-16.9)	14.3 (9.99-19.3)	17.3 (11.5-24.1)	20.0 (12.9-28.3)
10-day	5.03 (4.26-5.97)	5.99 (5.06-7.11)	7.54 (6.35-8.98)	8.84 (7.39-10.6)	10.6 (8.55-13.3)	11.9 (9.38-15.3)	13.4 (10.2-17.9)	15.2 (10.7-20.5)	18.2 (12.1-25.2)	20.8 (13.5-29.4)
20-day	7.03 (6.00-8.28)	8.08 (6.89-9.53)	9.80 (8.31-11.6)	11.2 (9.45-13.3)	13.2 (10.6-16.3)	14.6 (11.5-18.5)	16.2 (12.2-21.2)	18.0 (12.7-24.0)	20.6 (13.9-28.4)	22.9 (14.9-32.1)
30-day	8.70 (7.45-10.2)	9.82 (8.41-11.5)	11.7 (9.94-13.7)	13.2 (11.2-15.6)	15.3 (12.4-18.8)	16.9 (13.3-21.1)	18.6 (14.0-23.9)	20.3 (14.4-26.9)	22.7 (15.3-31.1)	24.6 (16.1-34.4)
45-day	10.8 (9.30-12.6)	12.0 (10.3-14.1)	14.0 (12.0-16.4)	15.7 (13.3-18.5)	17.9 (14.5-21.8)	19.7 (15.5-24.4)	21.4 (16.1-27.3)	23.2 (16.5-30.6)	25.4 (17.1-34.6)	27.0 (17.6-37.6)
60-day	12.6 (10.9-14.7)	13.9 (12.0-16.2)	16.0 (13.7-18.7)	17.7 (15.1-20.8)	20.1 (16.4-24.4)	22.0 (17.3-27.1)	23.8 (17.9-30.1)	25.5 (18.2-33.6)	27.7 (18.7-37.6)	29.2 (19.1-40.5)

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



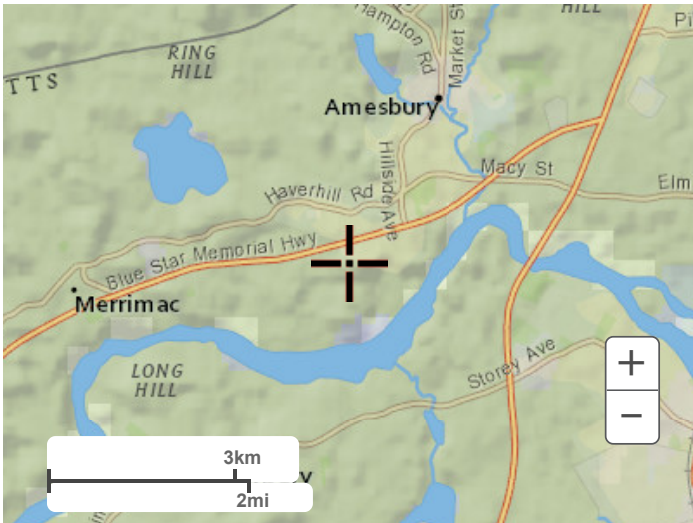
NOAA Atlas 14, Volume 10, Version 3

Created (GMT): Thu Nov 17 20:43:38 2022

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Maps & aerials

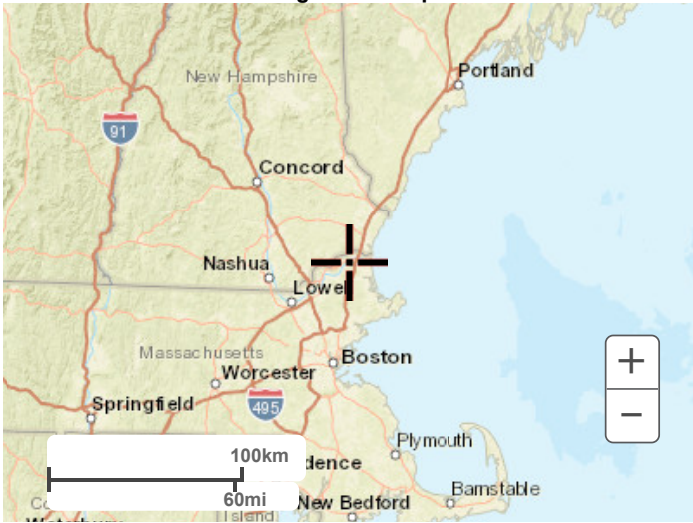
Small scale terrain



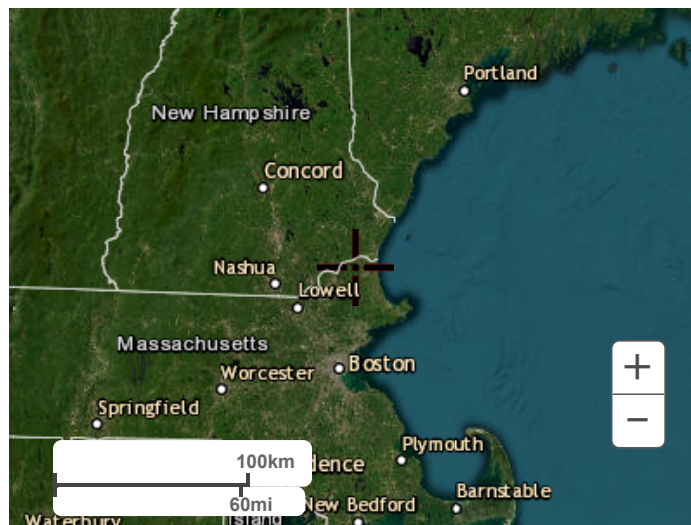
Large scale terrain



Large scale map



Large scale aerial

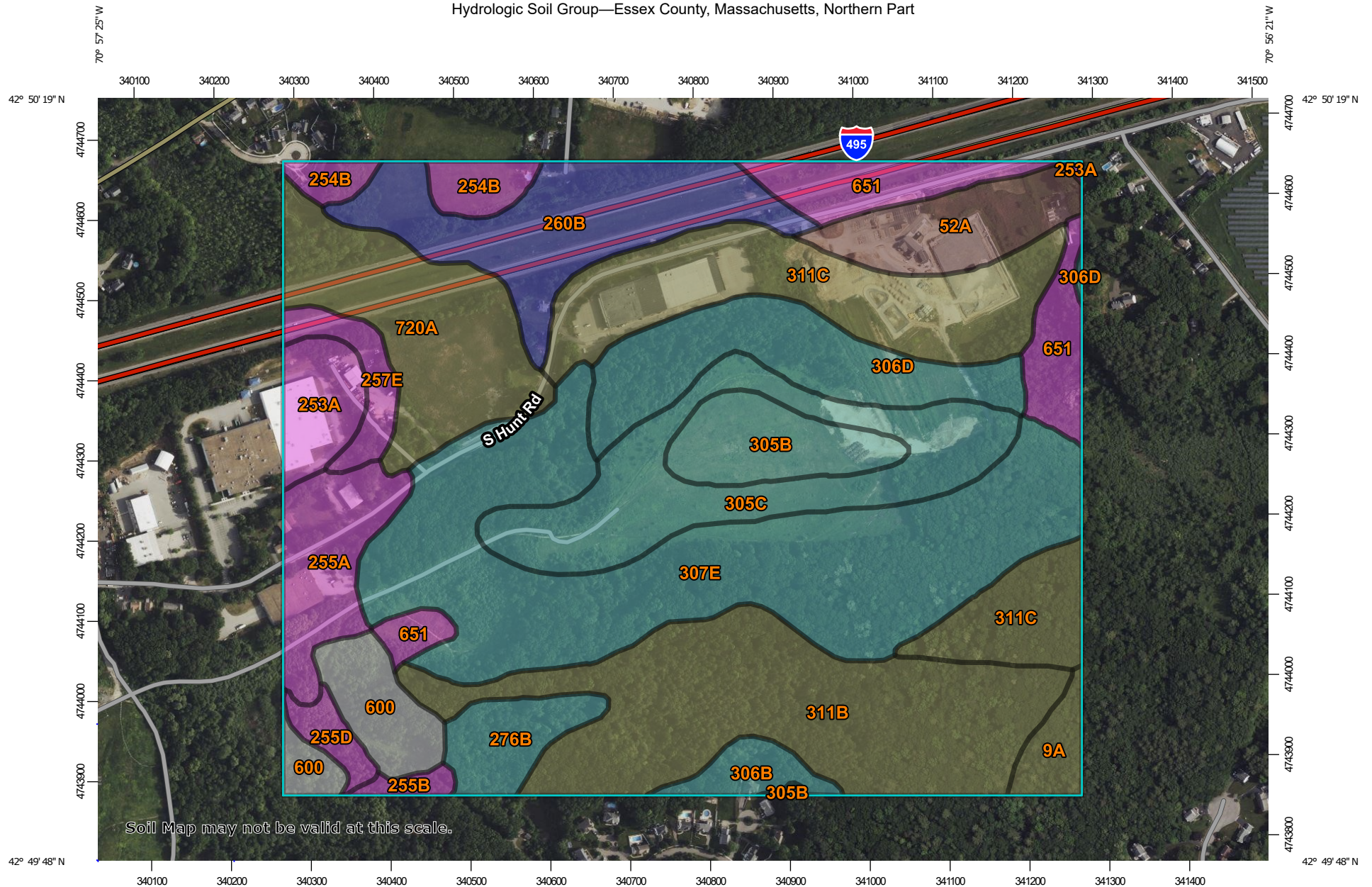


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[National Weather Service](#)
[National Water Center](#)
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

[Disclaimer](#)

Hydrologic Soil Group—Essex County, Massachusetts, Northern Part



Map Scale: 1:6,700 if printed on A landscape (11" x 8.5") sheet.

0 50 100 200 300 Meters

0 300 600 1200 1800 Feet

Map projection: Web Mercator Corner coordinates: WGS84 Edge ticks: UTM Zone 19N WGS84



**Natural Resources
Conservation Service**

Web Soil Survey
National Cooperative Soil Survey

11/17/2022
Page 1 of 4

MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

Soil Rating Polygons

 A
 A/D
 B
 B/D
 C
 C/D
 D
 Not rated or not available

Soil Rating Lines

 A
 A/D
 B
 B/D
 C
 C/D
 D
 Not rated or not available

Soil Rating Points

 A
 A/D
 B
 B/D

 C
 C/D
 D
 Not rated or not available

Water Features

 Streams and Canals

Transportation

 Rails
 Interstate Highways
 US Routes
 Major Roads
 Local Roads

Background

 Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

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: Essex County, Massachusetts, Northern Part
 Survey Area Data: Version 18, Sep 9, 2022

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

Date(s) aerial images were photographed: May 22, 2022—Jun 5, 2022

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
9A	Birdsall silt loam, 0 to 3 percent slopes	C/D	2.2	1.1%
52A	Freetown muck, 0 to 1 percent slopes	B/D	6.8	3.4%
253A	Hinckley loamy sand, 0 to 3 percent slopes	A	3.9	2.0%
254B	Merrimac fine sandy loam, 3 to 8 percent slopes	A	3.2	1.6%
255A	Windsor loamy sand, 0 to 3 percent slopes	A	6.8	3.5%
255B	Windsor loamy sand, 3 to 8 percent slopes	A	0.8	0.4%
255D	Windsor loamy sand, 15 to 25 percent slopes	A	1.6	0.8%
257E	Hinckley and Windsor soils, 25 to 35 percent slopes	A	2.7	1.4%
260B	Sudbury fine sandy loam, 3 to 8 percent slopes	B	13.9	7.1%
276B	Ninigret fine sandy loam, 3 to 8 percent slopes	C	4.1	2.1%
305B	Paxton fine sandy loam, 3 to 8 percent slopes	C	6.0	3.0%
305C	Paxton fine sandy loam, 8 to 15 percent slopes	C	16.0	8.2%
306B	Paxton fine sandy loam, 0 to 8 percent slopes, very stony	C	2.3	1.2%
306D	Paxton fine sandy loam, 15 to 25 percent slopes, very stony	C	11.3	5.8%
307E	Paxton fine sandy loam, 25 to 35 percent slopes, extremely stony	C	38.0	19.4%
311B	Woodbridge fine sandy loam, 0 to 8 percent slopes, very stony	C/D	27.2	13.9%
311C	Woodbridge fine sandy loam, 8 to 15 percent slopes, very stony	C/D	21.6	11.0%
600	Pits, gravel		5.5	2.8%

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
651	Udorthents, smoothed	A	8.8	4.5%
720A	Whately variant fine sandy loam, 0 to 3 percent slopes	C/D	13.8	7.0%
Totals for Area of Interest			196.3	100.0%

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher