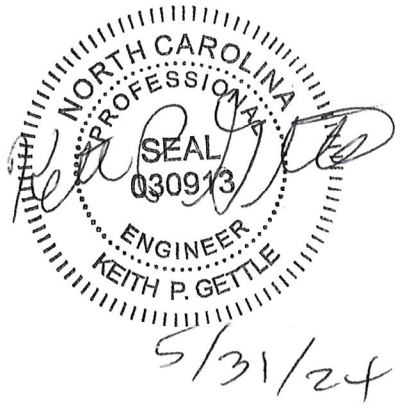
StorageMax
901 Proctor

Zebulon, NC
Wake County

STORMWATER MANAGEMENT ANALYSIS

July 5, 2023
Revised: March 8, 2024
Revised: May 31, 2024



5/31/24

Prepared for:

Robert High Development, LLC
324 Greenville Ave.
Wilmington, NC 28403

StorageMax
Stormwater Management Analysis

Project Name:	**StorageMax**
Project Address:	**901 Proctor Ave. Zebulon, NC**
Pins:	**2706217463**
Latitude: **Longitude:**	**35.840297** **-78.315683**
Zoning:	**Heavy Commercial (HC)**
River Basin:	**Neuse**
Watershed:	**Moccasin Creek**
HUC:	**03020203**
Developer:	**Robert High Development, LLC 324 Greenville Ave. Wilmington, NC 28403**
Telephone:	**(919) 604-0505**
Email:	**Storit@AOL.com**

Site Description

The project consists of a single parcel located at the intersection of Proctor Avenue and Shepard School Road near downtown Zebulon. The lot is approximately 6.40 acres (278,836 sq feet). The parcel is vacant with grassy vegetation and wooded area along the property lines. There is 0 sq ft of existing impervious area on the site. The project will consist of commercial buildings and the impervious area will be 3.64 acres, or approximately 57% of the gross site.

Road widening along Shepard School Road is included with the project as a requirement of the Town of Zebulon and the impervious area is approximately 0.40 acres. The BMP design accounts for the impervious area within the right of way.

The site is in the Neuse River Basin, Moccasin Creek Watershed and subject to those rules regarding nutrient management and post storm water runoff.

The site does not have an area of wetlands and is not located within a flood zone as noted per FEMA map 3720270600K, Dated July 19, 2022. However, there is an intermittent stream located along the Southeast portion of the site and an offsite pond on an adjacent north parcel. No grading activities or disturbance is planned within the buffers.

Based on the Wake County SCS soils map (attached) the onsite soils are primarily Appling Series (ApB2), soil group B, throughout the tract. The Appling Series soil type is considered to have fair infiltration and surface runoff medium based on information in the Soil Survey.

Seasonal High Water Table (SHWT)

A soils investigation was done to determine the SHWT and the results attached within the report from Protocol Sampling Services, Inc.

The BMP Manual note the following.

BIORETENTION MDC 1. SEPARATION FROM THE SHWT. The lowest point of the bioretention cell shall be a minimum of two feet above the SHWT. However, the separation may be reduced to no less than one foot if the applicant provides a hydrogeologic evaluation prepared by a licensed professional

The area below the bioretention device will be over excavated to provide the allowed separation as noted in the BMP manual.

Proposed Development

The stormwater analysis considers a proposed development that will include commercial buildings on the site.

The proposed stormwater facility for the project consists of one bioretention device. Drainage from the majority of the property will be collected within the storm pipe system and routed towards the BMP. The device is designed in accordance with NCDEQ BMP (MDC) Manual, and will manage the 1,2, and 10 year, 24-hour storm events as noted below. The post development runoff from the noted storm events is less than the pre-development rates for the site.

The proposed BMP will capture the runoff from the majority of impervious area from the lot. However, a small portion of the site's impervious area, at the driveway entrance, does not drain towards the device; however, the device has been designed to treat all the impervious area as a part of the WQV and right of

way. The total impervious associated with the development has been accounted for treatment within the Bioretention device.

Methodology (Peak Flow and Nutrient Management)

The project is located within the Town of Zebulon's / Wake County permitting authority, and within the Neuse River watershed and the project is subjected to those rules. The Town of Zebulon's stormwater requirements as noted below. The project is considered a High-Density project.

"*(D) Development standards for high-density projects. High-density projects shall implement stormwater control measures that comply with each of the following standards, in addition to the general standards found in § 151.36.*

(1) The measures shall control and treat runoff from the first inch of rain. Runoff volume drawdown time shall be a minimum of 48 hours, but not more than 120 hours.

(2) All structural stormwater treatment systems used to meet these requirements shall be designed to have a minimum of 85% average annual removal for total suspended solids (TSS).

(3) All development and redevelopment projects shall provide permanent on-site BMPs to lower the nitrogen export amounts as part of the stormwater management plan and accompany the land-disturbing plan submittal. BMPs are to be in accordance with and as specified in the Design Manual.

(4) Structural and non-structural BMPs shall be used to ensure there is no net increase in peak flow leaving the site from the pre-development conditions for the one-year, 24-hour storm. Runoff volume drawdown time shall be a minimum of 48 hours, but not more than 120 hours.

(5) General engineering design criteria for all projects shall be in accordance with 15A NCAC 2H .1008(c), as explained in the Design Manual.

(6) All development and redevelopment shall be located outside the riparian buffer zone and the flood protection zone. These zones shall be in accordance with the following provisions:

(a) Except where other applicable buffer standards are more restrictive, the riparian buffer zone shall extend a minimum of 50 feet landward of all perennial and intermittent surface waters. The most restrictive standards shall apply.

(b) The riparian buffer zone shall remain undisturbed unless otherwise permitted by this section.

(c) The flood protection zone shall extend throughout the FEMA 100-year floodplain as identified on the current Flood Insurance Rate Map (FIRM) published by FEMA. The flood protection zone shall remain undisturbed unless otherwise permitted by this section.

(d) No development or redevelopment is permitted within the riparian buffer zone or the flood protection zone except for stream bank or shoreline restoration or stabilization, water dependent structures, and public or private projects such as road crossings and installations, utility crossings and installations, and greenways, where no practical alternatives exist.

(e) Permitted activities within the riparian buffer zone and the flood protection zone shall minimize impervious coverage, direct runoff away from surface waters to achieve diffuse flow, and maximize the utilization of non-structural BMPs.

(f) Where the riparian buffer zone and the flood protection zone both are present adjacent to surface waters, the more restrictive shall apply.

(7) The approval of the stormwater permit shall require an enforceable restriction on property usage that runs with the land, such as recorded deed restrictions or protective covenants, to ensure that future development and redevelopment maintains the site consistent with the approved project plans. Buffer widths and locations shall be clearly delineated on all plans, final plat, and as-builts."

Peak flow – The methodology used to determine the runoff is the SCS method.

Time of Concentration used in the analysis is 5 minutes.
Per Kirpich Equation the pre development Tc rates are below the 5 minute min. The post to the BMP is approximately 8 minutes. However, 5 minutes was used to be conservative in the BMP design and flow rates (see attached graph).

The POI (point of interest) for the project site is at the southwest corner of the site at the stream crossing Shepard School Road.

Based on the proposed stormwater management for the project no adverse impact is anticipated on adjacent parcels. The BMP system and drainage point from the project does not encroach on another property with new development and grading operations. The impacted property is owned by the same company involved with this projected.

Using the SCS Method, the modeling of the BMP at the POI provides the following results in peak flow management.

Total site peak runoff in cfs without the BMP (as noted in the attached Hydraflow report) is as follows.

Storm Event	Pre	Post
Q1	6.47	17.10
Q2	10.29	22.51
Q10	23.44	38.89
Q100	45.59	63.04

Total site peak runoff in cfs through the BMP is as follows.

Storm Event	**Pre**	**Post**
Q1	**6.47**	**6.04**
Q2	**10.29**	**7.70**
Q10	**23.44**	**20.43**
Q100	**45.59**	**42.38**

Nutrient Management

The BMP provides treatment for drainage area within the project and also provides the TSS removal of 85%.

O&M Manual

A copy of the project's O&M manual is attached for the Bioretention device.

Flood Hazard Area (Soils)

There are Flood Hazard Soils located on site (see attached GIS map) and are located within the stream buffered area. However, no grading or development is planned within the NRB area.

Wetlands

There are no wetlands located on site. However there is a buffered pond (north and offsite) and a stream along the southern edge (see attached Stream Determination Letter)

Q100 Backwater Effect at BMP (13. Z Wake County Checklist)

There is no storm pipe from the project that will discharge into the ROW. The BMP discharges directly towards a stream on the southern portion of the project site.

Downstream Impact Analysis (DIA)

The Town of Zebulon requires a DIA to be performed with the 10% rule.

(A) Downstream impact analysis.

(1) The downstream impact analysis must be performed in accordance with the "10% rule," and a copy of the analysis must be provided with the permit application. The purpose of the downstream impact analysis is to determine if the project will cause any impacts on flooding or channel degradation downstream of the project site. The analysis must include the assumptions, results and supporting calculations to show safe passage of post-development design flows downstream. This analysis shall be performed at the outlet(s) of the site, and downstream at each tributary junction to the point(s) in the conveyance system where the area of the portion of the site draining into the system is less than or equal to 10% of the total drainage area above that point.

(2) The typical steps in the application of the 10% rule are:

(a) Using a topographic map, determine the point downstream where the proposed site equals 10% of the total drainage area, called the 10% point. Identify all tributary junctions between the downstream site boundary and the 10% point. All points identified, as well as the outlet of the site, are known as 10% rule comparison points.

(b) Using a hydrologic model with existing land uses, determine the pre-development peak runoff rate (cfs) for the ten-year design storm event at each comparison point.

(c) Insert the proposed site design and proposed BMPs into the land uses and determine the post-development peak runoff rate for the ten-year design storm at each comparison point.

(d) If the post-development peak discharge rate is equal to or less than pre-development conditions at all comparison points, no further analysis is required.

(e) If the ten-year post-development peak discharge rate is greater than the pre-development peak discharge rate at any comparison point, then one of the following actions must be taken:

DIA Results

The POI for is located downstream from the parcel and as shown on the attached maps there are two farm ponds prior to the evaluated stream ditch. Using the SCS method; see attached for supporting calculations.

The entire drainage area to the POI is 1564 acres and the area in review is approximately 65.16 acres and project site encompass 6.5 acres.

Based on the Hydraflow anaylsis the flow rate for the initial evaluation is 283.61 cfs.

Removing the site area from the total acreage in review is 58.66 ac with a flow rate of 247.06 cfs.

Incorporating the Q10 flow rate after the BMP is 20.60 cfs.

Total Post flow at the POI is 247.06 + 20.60 = 267.66 cfs.

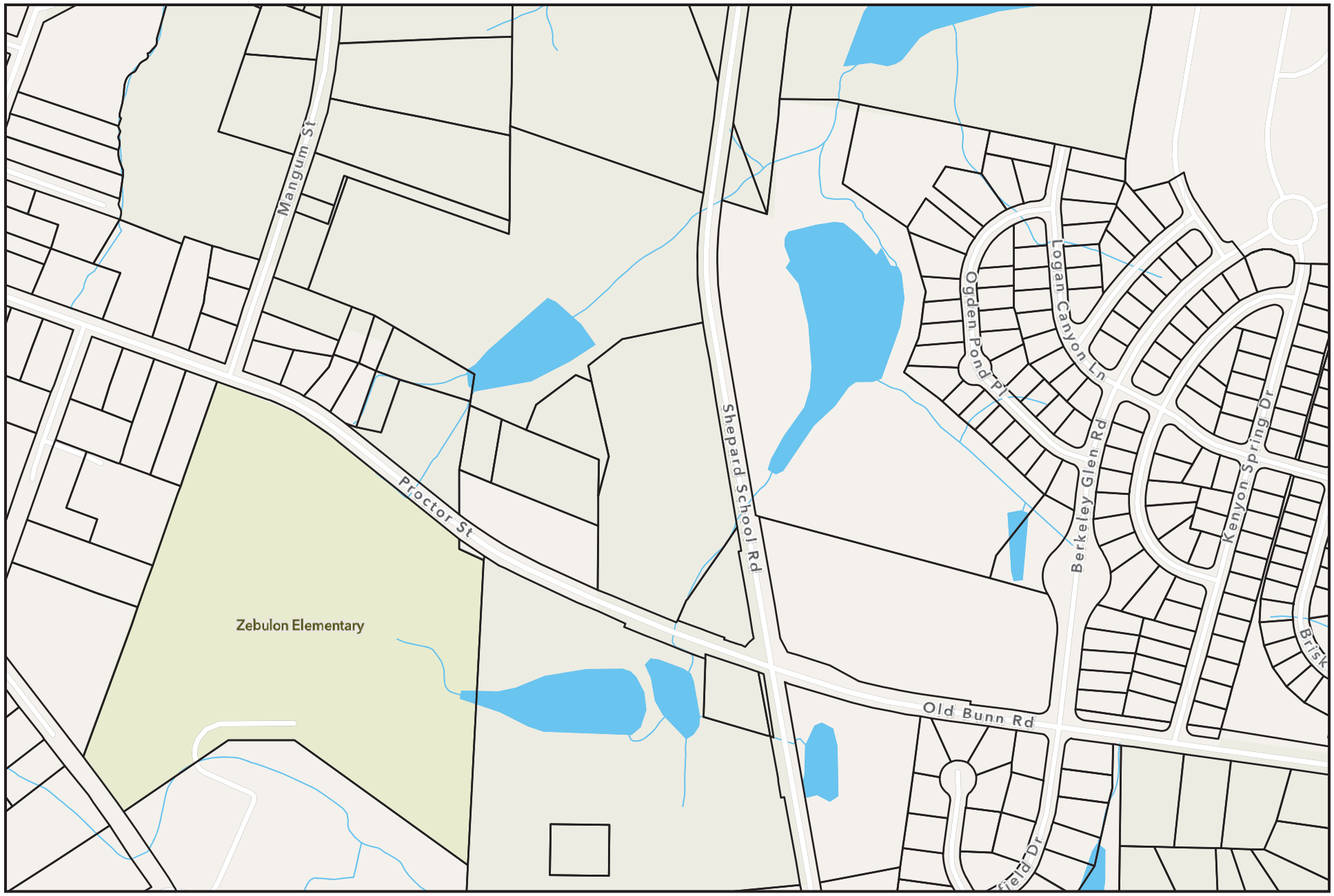
Results: 267.66 cfs < 283.61 cfs.

As a result, the flow rate after development is less than predevelopment.

Attachments.

Stormwater Summary

	Square Feet	Acres
Overal Site Gross Area	294,161.00	6.75
ROW Shepard	12,756.00	0.29
ROW Proctor	2,569.00	0.06
Site (Net)	**278,836.00**	**6.40**
Pre Development		
Impervious	0.00	0.00
Managed Pervious	283,140.00	6.50
Total		**6.50**
Post		
Parking Lot / Sidewalk Site	52,685.00	1.21
Roof	106,000.00	2.43
Open Landscape	120,000.00	2.75
Total	**278,685.00**	**6.40**



Site Map GIS

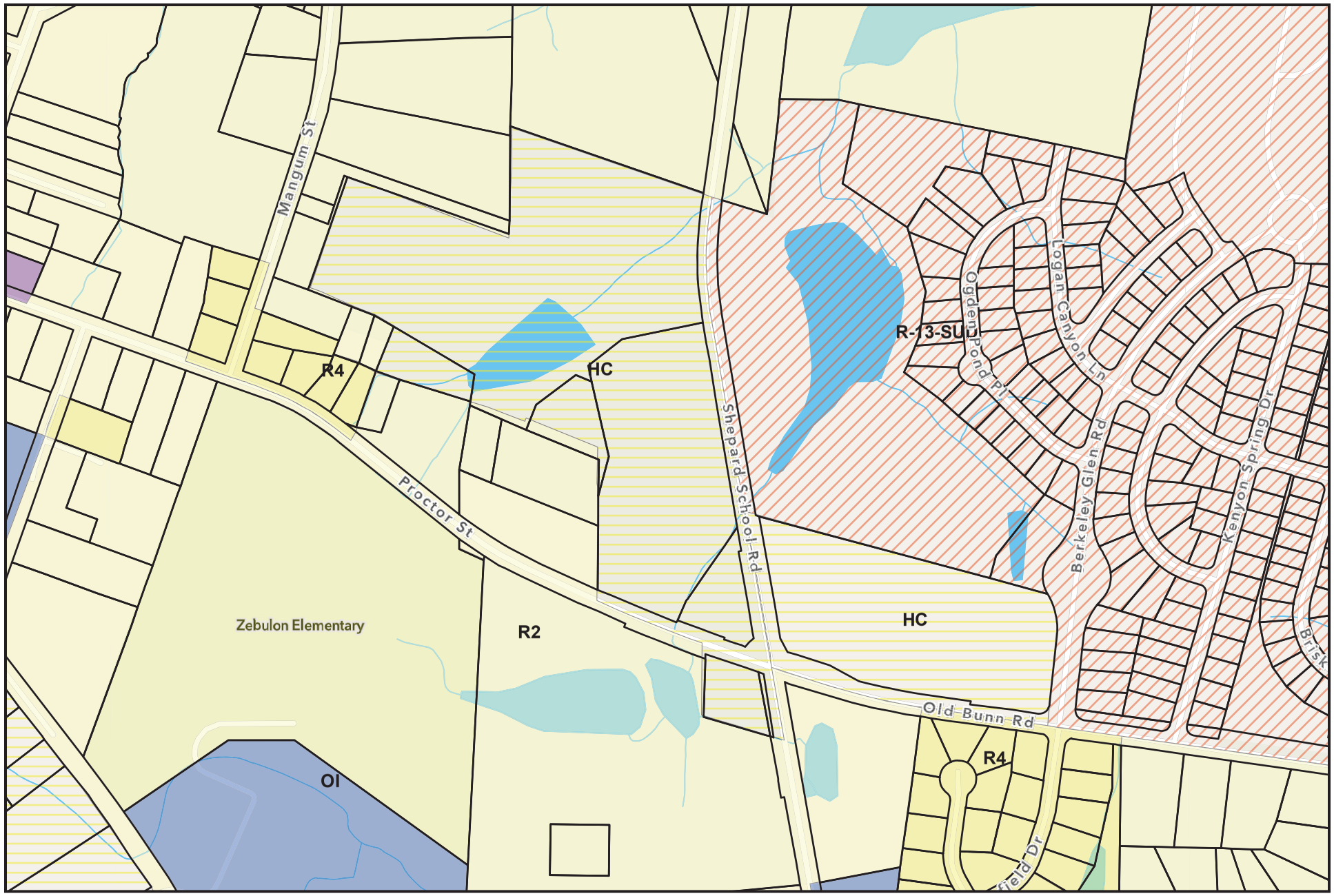
N

0 200 400 800 ft

1 inch equals 400 feet

Disclaimer

*iMaps makes every effort to produce and publish the most current and accurate information possible. However, the maps are produced for information purposes, and are **NOT** surveys. No warranties, expressed or implied ,are provided for the data therein, its use,or its interpretation.*



Site Zoning

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0 200 400 800 ft

1 inch equals 400 feet

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Aerial Map

N

0 100 200 400 ft

1 inch equals 200 feet

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44
N
(Joins sheet 34)
(Joins sheet 43)
1 Mile
5000 Feet
Scale 1:15840
SITE
Beaver Chapel
Wakefield Ch
Beaverdam
Sherwood School
ApB2
ApC2
ApC
ApB
DuB
DuC
DuB2
Cn
Wo
Wy
Me
LoC
LoD
LoB
WmC2
WmB2
WwC
WwE
WkE
CeB2
CeC2
ClC3
NoA
NoB
WaB
WaC
Gu
Au
ApD
AgB2
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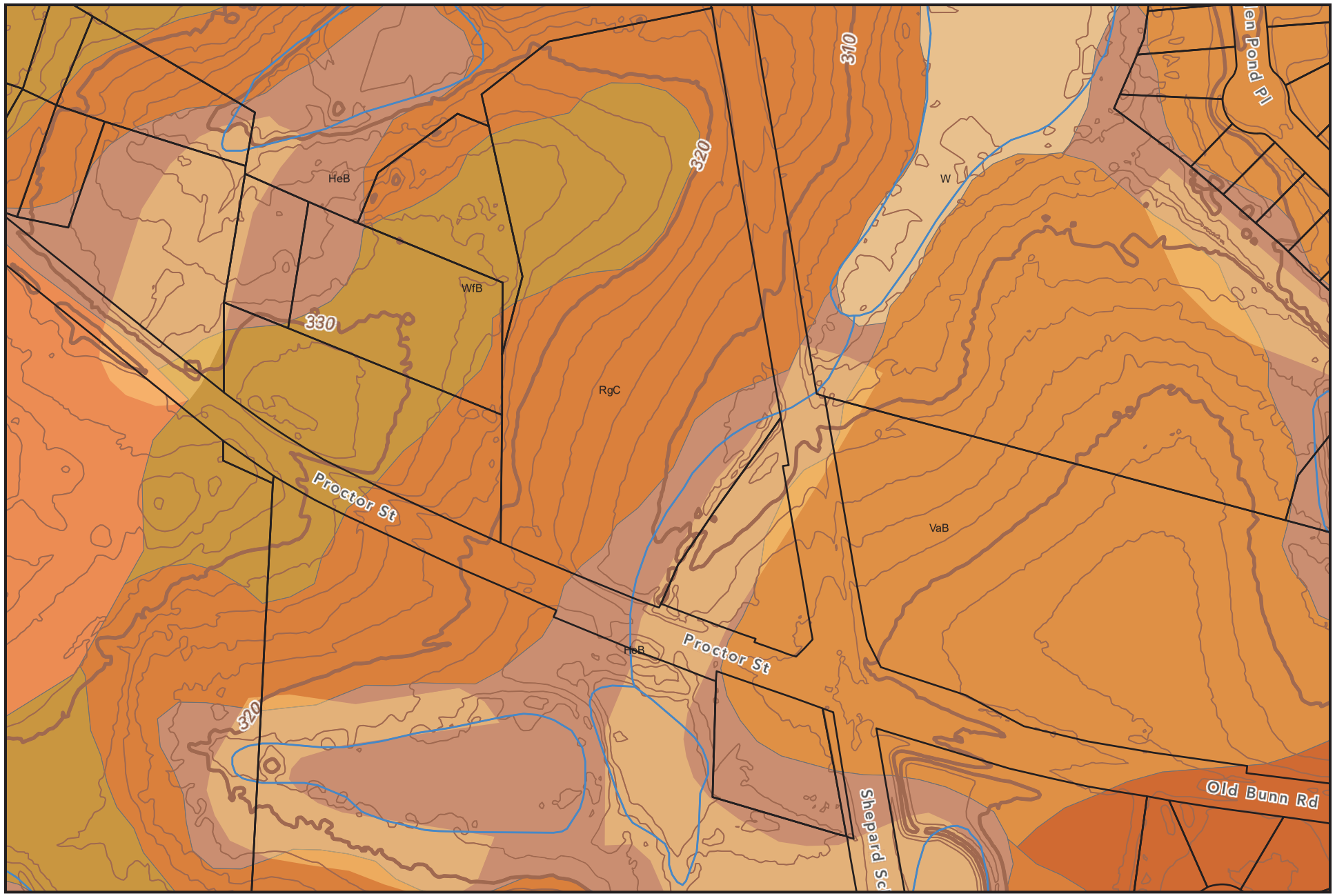

Flood Prone Soils

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0 100 200 400 ft

1 inch equals 200 feet

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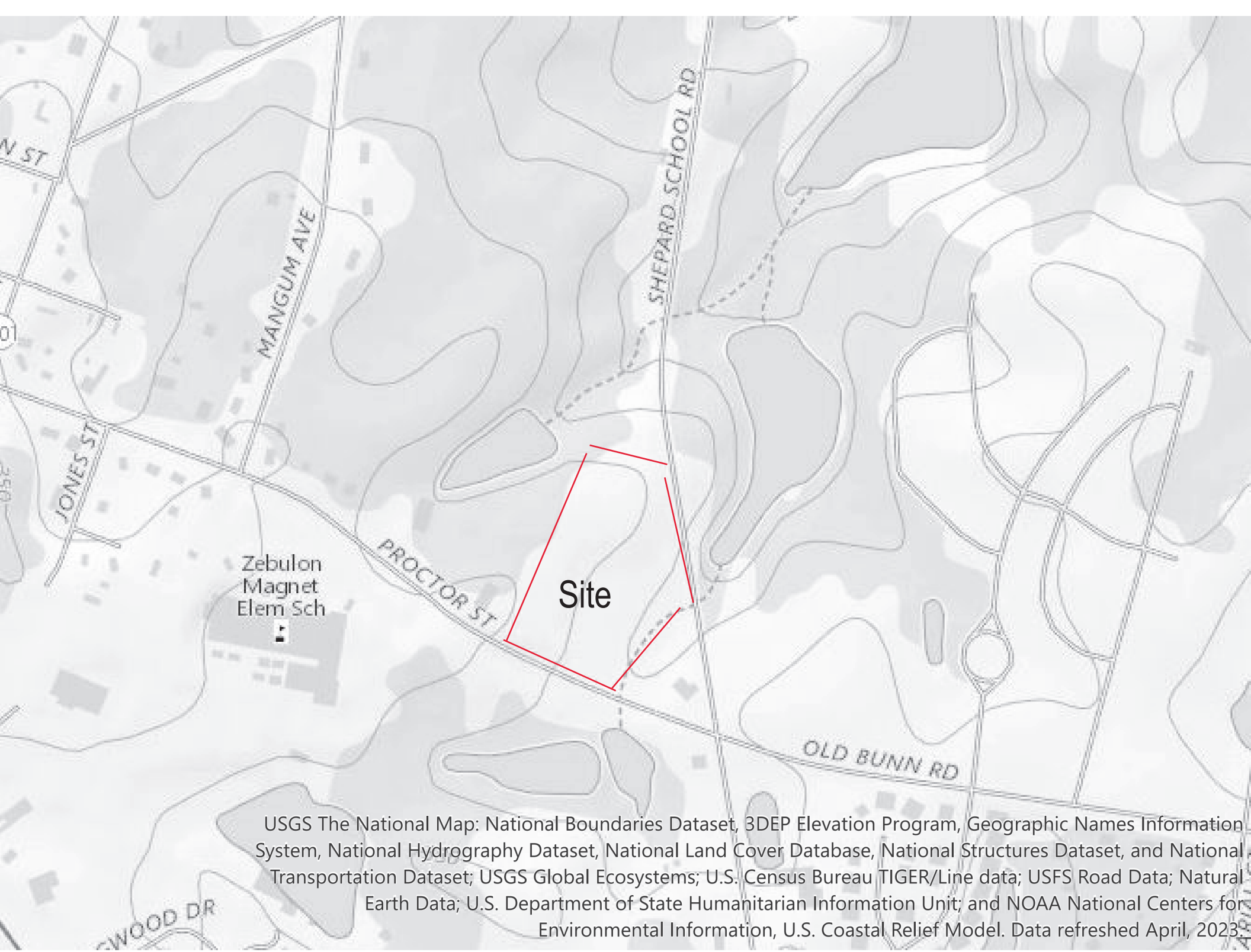
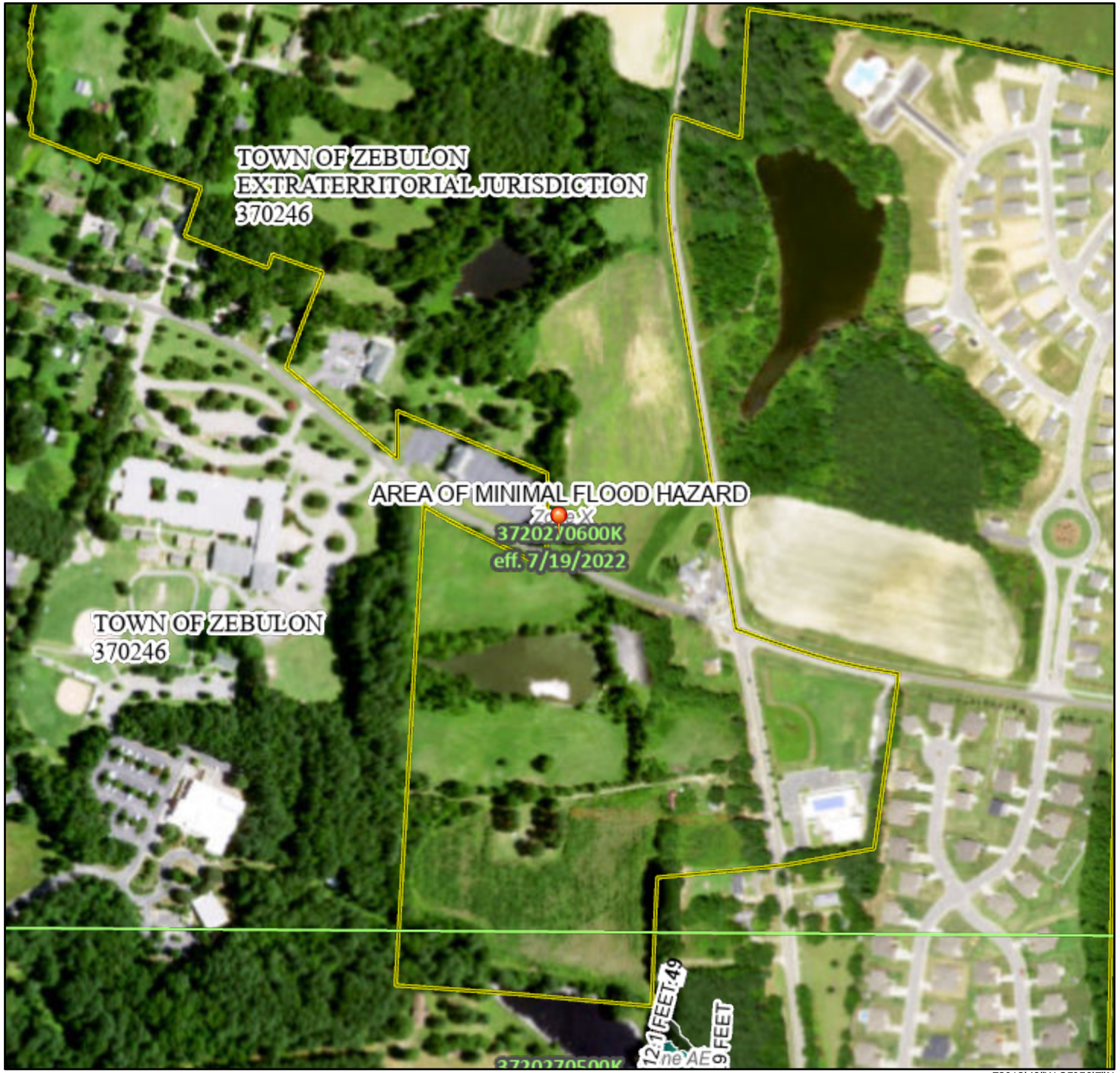


USGS The National Map: National Boundaries Dataset, 3DEP Elevation Program, Geographic Names Information System, National Hydrography Dataset, National Land Cover Database, National Structures Dataset, and National Transportation Dataset; USGS Global Ecosystems; U.S. Census Bureau TIGER/Line data; USFS Road Data; Natural Earth Data; U.S. Department of State Humanitarian Information Unit; and NOAA National Centers for Environmental Information, U.S. Coastal Relief Model. Data refreshed April, 2023.

National Flood Hazard Layer FIRMette

78°19'18"W 35°50'36"N



0 250 500 1,000 1,500 2,000 Feet

1:6,000

78°18'40"W 35°50'7"N

Basemap Imagery Source: USGS National Map 2023

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 6/4/2024 at 8:49 AM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

Reports

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ROY COOPER
Governor
ELIZABETH S. BISER
Secretary
RICHARD E. ROGERS, JR.
Director

NORTH CAROLINA
Environmental Quality

December 15, 2023

DWR Project RR0 23-401
Wake County

StorageMax
Shepard School, LLC
2700 Gresham Lake Road
Raleigh, NC 27615

Subject: On-Site Determination for Applicability to the Neuse Buffer Rules (15A NCAC 02B .0714)

Project Name: StorageMax
Site Address / Location: 901 Proctor St., Zebulon, NC 27597

Dear Owners:

On December 15, 2023, Cheng Zhang conducted an on-site review of features located on the subject property with the request of Dylan Warren of Terracon Consultants to determine the applicability of the above-noted state regulations.

The Division of Water Resources has determined that streams listed in the table below and identified on the attached maps are shown on either the most recently *published* NRCS Soil Survey of Wake County and the USGS National Map at a scale that incorporates the National Hydrography Dataset High Resolution data at 1:24,000 scale. Streams that are listed as "Subject" on the below table have been located on the ground at the site and possess characteristics that qualify them to be at least intermittent streams in accordance with the NC Stream Identification Manual v.4.11 and therefore subject to the Neuse Buffer Rules. **Please be aware that features identified as "not subject" may be considered jurisdictional according to the US Army Corps of Engineers and subject to the Clean Water Act.**

Closest Stream: Little Lick Creek

Feature ID	E/I/P/ Other	Subject to Buffer Rules	Start @	Stop @	Depicted on Soil Survey	Depicted on USGS Topo
Feature A	I	Yes			Yes	No
Pond 1		Yes			Yes	Yes

E = Ephemeral, I = Intermittent, P = Perennial, NP = Not Present, N/A=Not Applicable

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This on-site determination shall expire five (5) years from the date of this letter. The owner (or future owners) should notify the Division (and other relevant agencies) of this decision in any future correspondences concerning this property. Landowners or affected parties that dispute this determination made by the Division may request a determination by the Director of Water Resources. **This determination is final and binding, unless an appeal request is made within sixty (60) calendar days of the date of this letter to the Director in writing.**

If sending via U.S. Postal Service:	*If sending via delivery service (UPS, FedEx, etc.)*
Stephanie Goss - DWR 401 & Buffer Permitting Branch Supervisor 1617 Mail Service Center Raleigh, NC 27699-1617	Stephanie Goss -DWR 401 & Buffer Permitting Branch Supervisor 512 N Salisbury St. Raleigh, NC 27604

This letter only addresses the applicability of the stated regulations on the features identified on the subject property and/or within the proposed project area. This letter does not approve any activity within buffers or within waters of the state. There may be other regulated waters, streams or other features located on the property that do not appear on the maps or table referenced above. Any waters, streams, or other features on the site, including the features identified in this letter, may be considered jurisdictional according to the US Army Corps of Engineers and subject to the Clean Water Act. If you have any additional questions or require additional information, please contact Cheng Zhang at 919-791-4259 or cheng.zhang@deq.nc.gov. This determination is subject to review as provided in Articles 3 & 4 of G.S. 150B.

Sincerely,

DocuSigned by:
Vanessa E. Manuel
B2916E6AB32144F...

Vanessa E. Manuel, Assistant Regional Supervisor
Water Quality Regional Operations Section
Raleigh Regional Office
Division of Water Resources

Enclosures: USGS Topographical Map
published NRCS Soil Survey

Electronic cc: Dylan Warren- Terracon Consultants
USACE Raleigh Regulatory Field Office
Laserfiche

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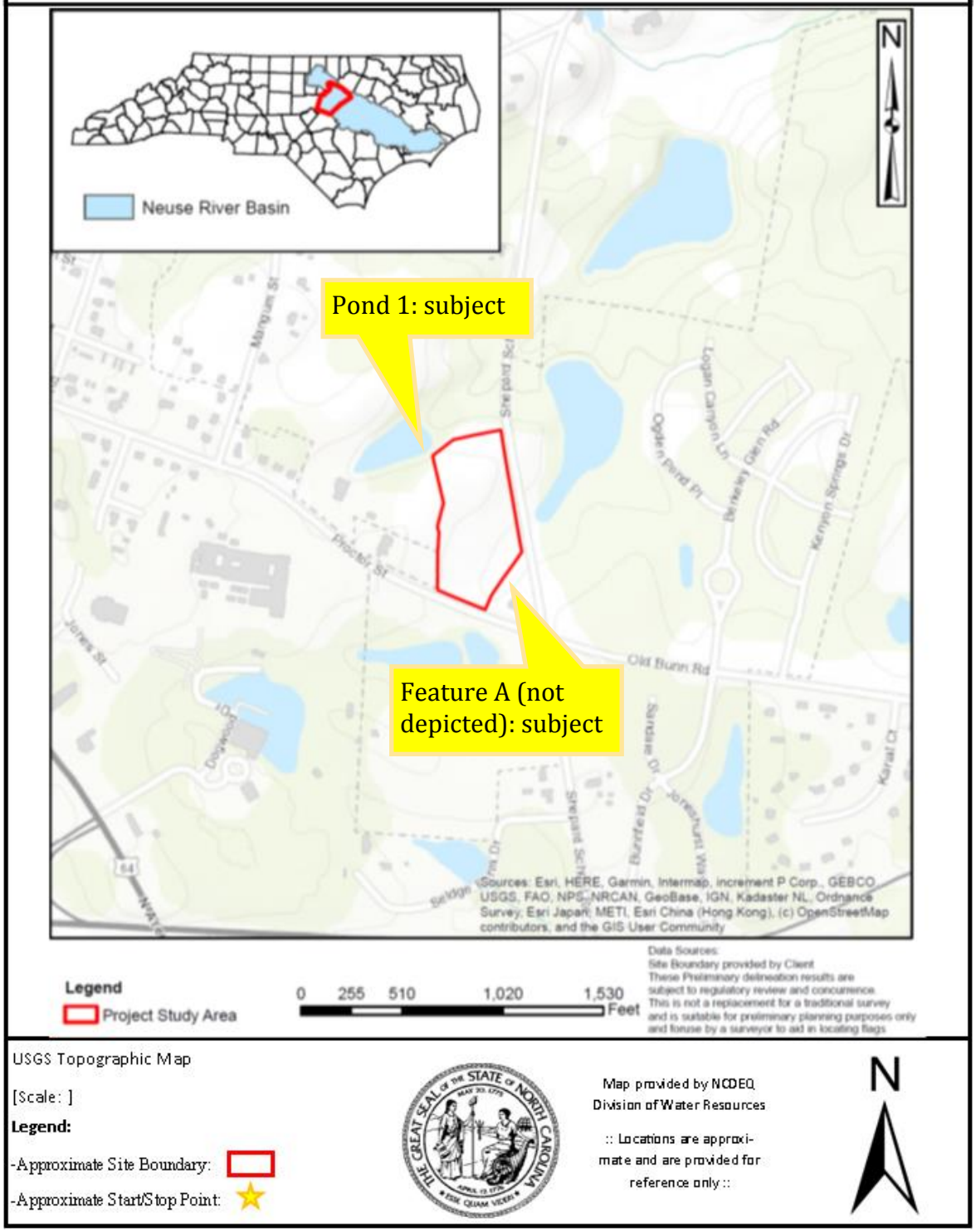
23-401

StorageMax/Durham County



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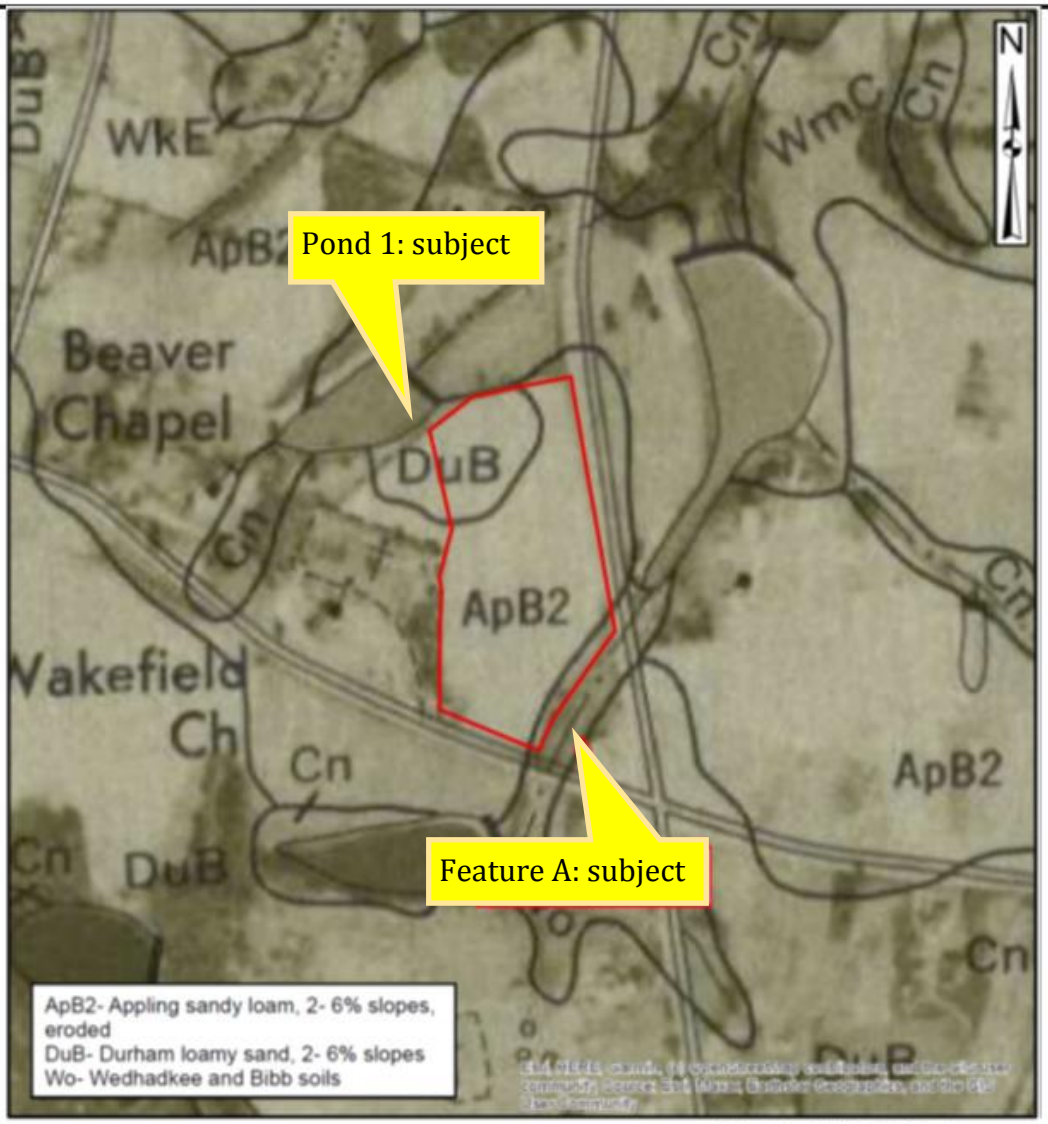
23-401

StorageMax/Durham County



Soil Survey Map –Wake County

[Scale:]

Legend:

-Approximate Site Boundary:

-Approximate Start/Stop Point:

Map provided by NCDEQ Division of Water Resources

:: Locations are approximate and are provided for reference only ::

N

Protocol Sampling Service, Inc.
"Experts in Environmental Compliance"

4114 Laurel Ridge Drive
Raleigh, North Carolina 27612

(919) 210-6547

Protocolsampling@yahoo.com
Environmentalservicesnc.com

October 2, 2023

Mr. Keith P. Gettle, P.E.
Gettle Engineering & Design, PLLC
3616 Waxwing Court
Wake Forest, North Carolina 27587

Re: **Storm Water Management Soil Investigation**
Storage Max
901 Proctor Street
Zebulon, Wake County, North Carolina
Protocol Project #23-67

Dear Mr. Gettle:

The following Soil Investigation is submitted to assist in a site assessment for storm water management improvements for a Storage Max facility located at 901 Proctor Street in Zebulon, Wake County, North Carolina.

SITE HISTORY AND PHYSICAL CHARACTERISTICS

The subject property was formerly occupied by a residential structure and is now pasture. Light residential development and farmland surrounds the subject property. Protocol Sampling Service, Inc. of Raleigh, North Carolina was hired to perform an investigation to identify the depth to seasonal high-water table in the location of the proposed storm water Bioretention BMP.

SOIL INVESTIGATION

The field survey was conducted on Wednesday May 31, 2023. One (1) soil boring was advanced in the center of the proposed Bioretention BMP to a depth of 60-inches below land surface (bls) with a hand auger (Site Plan – attached). Soil color was determined with a Munsell Soil Color Chart. The presence of fill or other disturbances, the depth to the seasonal high-water table, soil structure and consistence were noted. The boring was also checked for reduced colors, an anaerobic smell or obvious soil wetness.

FINDINGS - Soil

- The proposed Bioretention Basin is located on the southern section of the property and was found to have an apparent depth to seasonal high-water table of 46-inches bls.

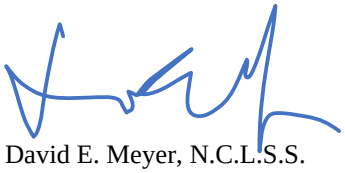
- Saprolite (weathered rock) was encountered at a depth of 50-inches bls in the proposed Bioretention Basin. Ground water was not encountered in the soil boring.

- By excavating into the saprolite and backfilling with clean sand a seasonal high-water table of 5.0-feet bls should be considered the depth to SHWT at an elevation of 306.0’ (311.00’ estimated surface elevation) with a depth to rock and groundwater of greater than 6-feet bls.

The findings presented herein are based on the site conditions observed during performance of the field survey on May 31, 2023.

Please call me at (919) 210-6547 if you have any questions or need further assistance.

Sincerely,
Protocol Sampling Service, Inc.



David E. Meyer, N.C.L.S.S.
President

cc: file

Storage Max
Soil Profile Description – Durham

Soil Profile Description

A1 0-9 inches; grayish brown (10YR 5/2) loamy sand; granular structure, very friable

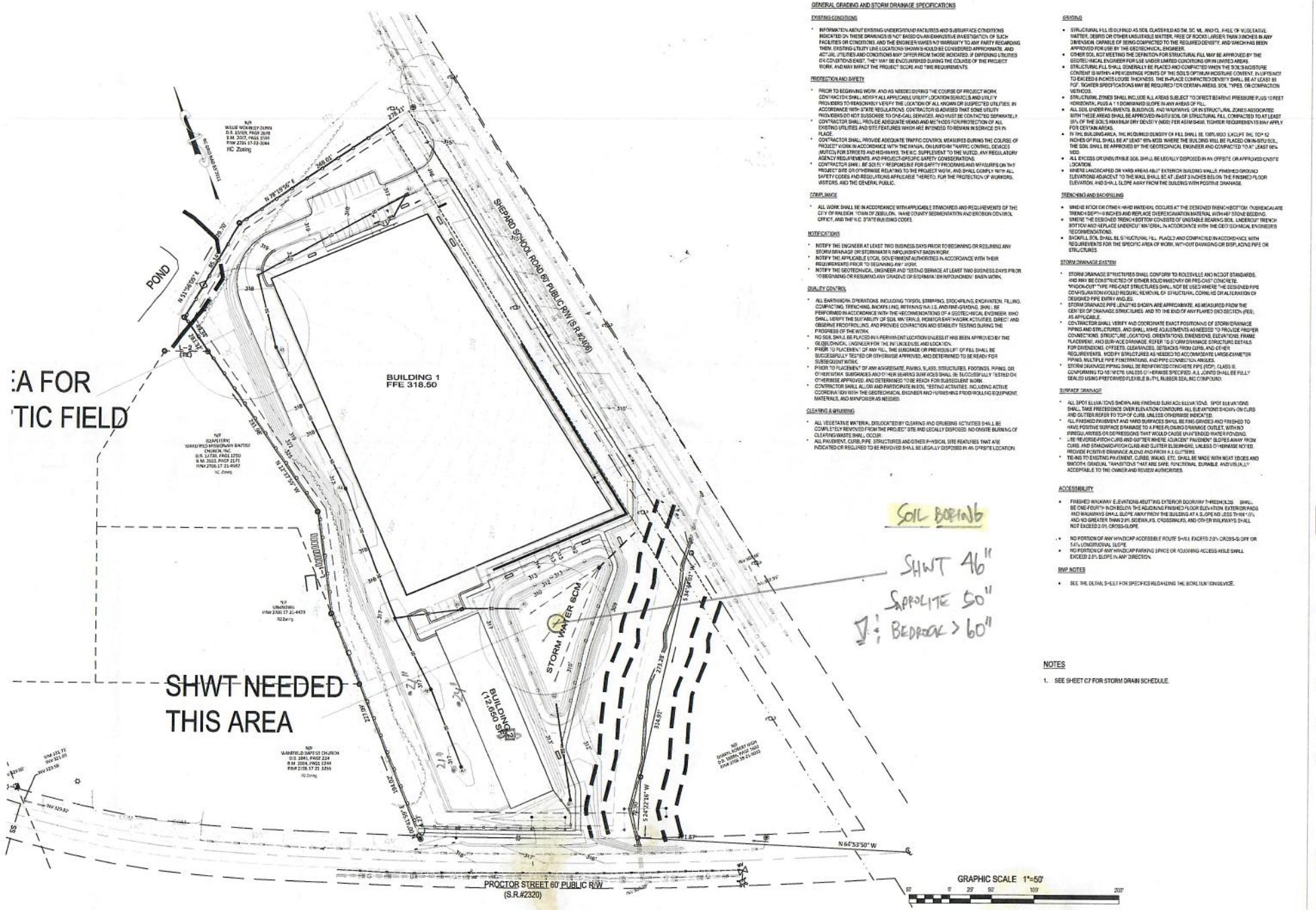
A2 9-15 inches; brown (10YR 5/3) loamy sand; granular structure, very friable

Bt1 15-33 inches; strong brown (7.5YR 5/8) sandy clay loam; subangular blocky structure; friable

Bt2 33-50 inches; brownish yellow (10YR 6/6) clay loam; subangular blocky structure; friable

C 50-60 inches; gray and black sandy loam saprolite

Soil Series: Durham
Landscape: Piedmont
Landform: upland divide
Parent Material: Gneiss & schist
Drainage Class: Well drained
Particle Size Class: clay
Temperature Regime: thermic
Subgroup Classification: thermic Typic Hapludult
Examination Method: auger boring
Date: May 31, 2023
Weather: 75◦ and sunny
Investigator: David Meyer
Shwt: 46”
Measured water table depth: >60”



GENERAL GRADING AND STORM DRAINAGE SPECIFICATIONS

EXISTING CONDITIONS

- INFORMATION ABOUT EXISTING UNDERGROUND FACILITIES AND SUBSURFACE CONDITIONS INDICATED ON THESE DRAWINGS IS NOT BASED ON AN EXHAUSTIVE INVESTIGATION OF SUCH FACILITIES OR CONDITIONS, AND THE ENGINEER MAKES NO WARRANTY TO ANY PARTY REGARDING THEM. EXISTING UTILITY LINE LOCATIONS SHOWN SHOULD BE CONSIDERED APPROXIMATE, AND ACTUAL UTILITIES AND CONDITIONS MAY DIFFER FROM THOSE INDICATED. IF DIFFERING UTILITIES OR CONDITIONS EXIST, THEY MAY BE ENCOUNTERED DURING THE COURSE OF THE PROJECT WORK, AND MAY IMPACT THE PROJECT SCOPE AND TIME REQUIREMENTS.

PROTECTION AND SAFETY

- PRIOR TO BEGINNING WORK, AND AS NEEDED DURING THE COURSE OF PROJECT WORK, CONTRACTOR SHALL NOTIFY ALL APPLICABLE UTILITY LOCATION SERVICES AND UTILITY PROVIDERS TO REASONABLY VERIFY THE LOCATION OF ALL KNOWN OR SUSPECTED UTILITIES IN ACCORDANCE WITH STATE REGULATIONS. CONTRACTOR IS ADVISED THAT SOME UTILITY PROVIDERS DO NOT SUBSCRIBE TO ONE-CALL SERVICES, AND MUST BE CONTACTED SEPARATELY.
- CONTRACTOR SHALL PROVIDE ADEQUATE MEANS AND METHODS FOR PROTECTION OF ALL EXISTING UTILITIES AND SITE FEATURES WHICH ARE INTENDED TO REMAIN IN SERVICE OR IN PLACE.
- CONTRACTOR SHALL PROVIDE ADEQUATE TRAFFIC CONTROL MEASURES DURING THE COURSE OF PROJECT WORK IN ACCORDANCE WITH THE MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES (MUTCD) FOR STREETS AND HIGHWAYS, THE N.C. SUPPLEMENT TO THE MUTCD, ANY REGULATORY AGENCY REQUIREMENTS, AND PROJECT-SPECIFIC SAFETY CONSIDERATIONS.
- CONTRACTOR SHALL BE SOLELY RESPONSIBLE FOR SAFETY PROGRAMS AND PRECAUTIONS ON THE PROJECT SITE OR OTHERWISE RELATING TO THE PROJECT WORK, AND SHALL COMPLY WITH ALL SAFETY CODES AND REGULATIONS APPLICABLE THERETO, FOR THE PROTECTION OF WORKERS, VISITORS, AND THE GENERAL PUBLIC.

COMPLIANCE

- ALL WORK SHALL BE IN ACCORDANCE WITH APPLICABLE STANDARDS AND REQUIREMENTS OF THE CITY OF RALEIGH, TOWN OF ZEBULON, WAKE COUNTY SEDIMENTATION AND EROSION CONTROL OFFICE, AND THE N.C. STATE BUILDING CODES.

NOTIFICATIONS

- NOTIFY THE ENGINEER AT LEAST TWO BUSINESS DAYS PRIOR TO BEGINNING OR RESUMING ANY STORM DRAINAGE OR STORMWATER IMPOUNDMENT BASIN WORK.
- NOTIFY THE APPLICABLE LOCAL GOVERNMENT AUTHORITIES IN ACCORDANCE WITH THEIR REQUIREMENTS PRIOR TO BEGINNING ANY WORK.
- NOTIFY THE GEOTECHNICAL ENGINEER AND TESTING SERVICE AT LEAST TWO BUSINESS DAYS PRIOR TO BEGINNING OR RESUMING ANY GRADING OR STORMWATER IMPOUNDMENT/ BASIN WORK.

QUALITY CONTROL

- ALL EARTHWORK OPERATIONS, INCLUDING TOPSOIL STRIPPING, STOCKPILING, EXCAVATION, FILLING, COMPACTING, TRENCHING, BACKFILLING, RETAINING WALLS, AND FINE-GRADING, SHALL BE PERFORMED IN ACCORDANCE WITH THE RECOMMENDATIONS OF A GEOTECHNICAL ENGINEER, WHO SHALL VERIFY THE SUITABILITY OF SOIL MATERIALS, MONITOR EARTHWORK ACTIVITIES, DIRECT, AND OBSERVE PROOFROLLING, AND PROVIDE COMPACTION AND STABILITY TESTING DURING THE PROGRESS OF THE WORK.
- NO SOIL SHALL BE PLACED IN A PERMANENT LOCATION UNLESS IT HAS BEEN APPROVED BY THE GEOTECHNICAL ENGINEER FOR THE INTENDED USE AND LOCATION.
- PRIOR TO PLACEMENT OF ANY FILL, THE SUBGRADE OR PREVIOUS LIFT OF FILL SHALL BE SUCCESSFULLY TESTED OR OTHERWISE APPROVED, AND DETERMINED TO BE READY FOR SUBSEQUENT WORK.
- PRIOR TO PLACEMENT OF ANY AGGREGATE, PAVING, SLABS, STRUCTURES, FOOTINGS, PIPING, OR OTHER WORK, SUBGRADES AND OTHER BEARING SURFACES SHALL BE SUCCESSFULLY TESTED OR OTHERWISE APPROVED, AND DETERMINED TO BE READY FOR SUBSEQUENT WORK.
- CONTRACTOR SHALL ALLOW AND PARTICIPATE IN SOIL TESTING ACTIVITIES, INCLUDING ACTIVE COORDINATION WITH THE GEOTECHNICAL ENGINEER AND FURNISHING PROOFROLLING EQUIPMENT, MATERIALS, AND MANPOWER AS NEEDED.

CLEARING & GRUBBING

- ALL VEGETATIVE MATERIAL, DISLOCATED BY CLEARING AND GRUBBING ACTIVITIES SHALL BE COMPLETELY REMOVED FROM THE PROJECT SITE AND LEGALLY DISPOSED. NO ONSITE BURNING OF CLEARING WASTE SHALL OCCUR.
- ALL PAVEMENT, CURB, PIPE, STRUCTURES AND OTHER PHYSICAL SITE FEATURES THAT ARE INDICATED OR REQUIRED TO BE REMOVED SHALL BE LEGALLY DISPOSED IN AN OFFSITE LOCATION.

GRADING

- STRUCTURAL FILL IS DEFINED AS SOIL CLASSIFIED AS SW, SC, ML, AND/OR CL, FREE OF VEGETATIVE MATTER, DEBRIS OR OTHER UNSUITABLE MATTER, FREE OF ROCKS LARGER THAN 3 INCHES IN ANY DIMENSION, CAPABLE OF BEING COMPACTED TO THE REQUIRED DENSITY, AND WHICH HAS BEEN APPROVED FOR USE BY THE GEOTECHNICAL ENGINEER.
- OTHER SOIL NOT MEETING THE DEFINITION FOR STRUCTURAL FILL MAY BE APPROVED BY THE GEOTECHNICAL ENGINEER FOR USE UNDER LIMITED CONDITIONS OR IN LIMITED AREAS.
- STRUCTURAL FILL SHALL GENERALLY BE PLACED AND COMPACTED WHEN THE SOIL'S MOISTURE CONTENT IS WITHIN 4 PERCENTAGE POINTS OF THE SOIL'S OPTIMUM MOISTURE CONTENT. IN LIFTS NOT TO EXCEED 8 INCHES LOOSE THICKNESS. THE IN-PLACE COMPACTED DENSITY SHALL BE AT LEAST 95 PCF. TIGHTER SPECIFICATIONS MAY BE REQUIRED FOR CERTAIN AREAS, SOIL TYPES, OR COMPACTION METHODS.
- STRUCTURAL ZONES SHALL INCLUDE ALL AREAS SUBJECT TO DIRECT BEARING PRESSURE PLUS 10 FEET HORIZONTAL, PLUS A 1:1 DOWNWARD SLOPE IN ANY AREAS OF FILL.
- ALL SOIL UNDER PAVEMENTS, BUILDINGS, AND WALKWAYS, OR IN STRUCTURAL ZONES ASSOCIATED WITH THESE AREAS SHALL BE APPROVED IN-SITU SOIL OR STRUCTURAL FILL COMPACTED TO AT LEAST 95% OF THE SOIL'S MAXIMUM DRY DENSITY (MDD) PER ASTM D698. TIGHTER REQUIREMENTS MAY APPLY FOR CERTAIN AREAS.
- IN THE BUILDING AREA, THE REQUIRED DENSITY OF FILL SHALL BE 100% MDD EXCEPT THE TOP 12 INCHES OF FILL SHALL BE AT LEAST 98% MDD. WHERE THE BUILDING WILL BE PLACED ON IN-SITU SOIL, THE SOIL SHALL BE APPROVED BY THE GEOTECHNICAL ENGINEER AND COMPACTED TO AT LEAST 98% MDD.
- ALL EXCESS OR UNSUITABLE SOIL SHALL BE LEGALLY DISPOSED IN AN OFFSITE OR APPROVED ONSITE LOCATION.
- WHERE LANDSCAPED OR YARD AREAS ABUT EXTERIOR BUILDING WALLS, FINISHED GROUND ELEVATIONS ADJACENT TO THE WALL SHALL BE AT LEAST 3 INCHES BELOW THE FINISHED FLOOR ELEVATION, AND SHALL SLOPE AWAY FROM THE BUILDING WITH POSITIVE DRAINAGE.

TRENCHING AND BACKFILLING

- WHERE ROCK OR OTHER HARD MATERIAL OCCURS AT THE DESIGNED TRENCH BOTTOM, OVEREXCAVATE TRENCH DEPTH 6 INCHES AND REPLACE OVEREXCAVATION MATERIAL WITH #57 STONE BEDDING.
- WHERE THE DESIGNED TRENCH BOTTOM CONSISTS OF UNSTABLE BEARING SOIL, UNDERCUT TRENCH BOTTOM AND REPLACE UNDERCUT MATERIAL IN ACCORDANCE WITH THE GEOTECHNICAL ENGINEERS RECOMMENDATIONS.
- BACKFILL SOIL SHALL BE STRUCTURAL FILL, PLACED AND COMPACTED IN ACCORDANCE WITH REQUIREMENTS FOR THE SPECIFIC AREA OF WORK, WITHOUT DAMAGING OR DISPLACING PIPE OR STRUCTURES.

STORM DRAINAGE SYSTEM

- STORM DRAINAGE STRUCTURES SHALL CONFORM TO ROLESVILLE AND NCDOT STANDARDS, AND MAY BE CONSTRUCTED OF EITHER SOLID MASONRY OR PRE-CAST CONCRETE. "KNOCK-OUT" TYPE PRE-CAST STRUCTURES SHALL NOT BE USED WHERE THE DESIGNED PIPE CONFIGURATION WOULD REQUIRE REMOVAL OF STRUCTURAL CORNERS OR ALTERATION OF DESIGNED PIPE ENTRY ANGLES.
- STORM DRAINAGE PIPE LENGTHS SHOWN ARE APPROXIMATE, AS MEASURED FROM THE CENTER OF DRAINAGE STRUCTURES, AND TO THE END OF ANY FLARED END SECTION (FES), AS APPLICABLE.
- CONTRACTOR SHALL VERIFY AND COORDINATE EXACT POSITIONING OF STORM DRAINAGE PIPING AND STRUCTURES, AND SHALL MAKE ADJUSTMENTS AS NEEDED TO PROVIDE PROPER CONNECTIONS. STRUCTURE LOCATIONS, ORIENTATIONS, DIMENSIONS, ELEVATIONS, FRAME PLACEMENT, AND SURFACE DRAINAGE. REFER TO STORM DRAINAGE STRUCTURE DETAILS FOR DIMENSIONS, OFFSETS, CLEARANCES, SETBACKS FROM CURB, AND OTHER REQUIREMENTS. MODIFY STRUCTURES AS NEEDED TO ACCOMMODATE LARGE-DIAMETER PIPING, MULTIPLE PIPE PENETRATIONS, AND PIPE CONNECTION ANGLES.
- STORM DRAINAGE PIPING SHALL BE REINFORCED CONCRETE PIPE (RCP), CLASS III, CONFORMING TO ASTM C76, UNLESS OTHERWISE SPECIFIED. ALL JOINTS SHALL BE FULLY SEALED USING PREFORMED FLEXIBLE BUTYL RUBBER SEALING COMPOUND.

SURFACE DRAINAGE

- ALL SPOT ELEVATIONS SHOWN ARE FINISHED SURFACE ELEVATIONS. SPOT ELEVATIONS SHALL TAKE PRECEDENCE OVER ELEVATION CONTOURS. ALL ELEVATIONS SHOWN ON CURB AND GUTTER REFER TO TOP OF CURB, UNLESS OTHERWISE INDICATED.
- ALL FINISHED PAVEMENT AND YARD SURFACES SHALL BE FINE-GRADED AND FINISHED TO HAVE POSITIVE SURFACE DRAINAGE TO A FREE-FLOWING DRAINAGE OUTLET, WITH NO IRREGULARITIES OR DEPRESSIONS THAT WOULD CAUSE UNINTENDED WATER PONDING.
- USE REVERSE-PITCH CURB AND GUTTER WHERE ADJACENT PAVEMENT SLOPES AWAY FROM CURB, AND STANDARD-PITCH CURB AND GUTTER ELSEWHERE, UNLESS OTHERWISE NOTED. PROVIDE POSITIVE DRAINAGE ALONG AND FROM ALL GUTTERS.
- TIE-INS TO EXISTING PAVEMENT, CURBS, WALKS, ETC. SHALL BE MADE WITH NEAT EDGES AND SMOOTH, GRADUAL TRANSITIONS THAT ARE SAFE, FUNCTIONAL, DURABLE AND VISUALLY ACCEPTABLE TO THE OWNER AND REVIEW AUTHORITIES.

ACCESSIBILITY

- FINISHED WALKWAY ELEVATIONS ABUTTING EXTERIOR DOORWAY THRESHOLDS SHALL BE ONE-FOURTH INCH BELOW THE ADJOINING FINISHED FLOOR ELEVATION. EXTERIOR PADS AND WALKWAYS SHALL SLOPE AWAY FROM THE BUILDING AT A SLOPE NO LESS THAN 1.0% AND NO GREATER THAN 2.0%. SIDEWALKS, CROSSWALKS, AND OTHER WALKWAYS SHALL NOT EXCEED 2.0% CROSS-SLOPE.
- NO PORTION OF ANY HANDICAP ACCESSIBLE ROUTE SHALL EXCEED 2.0% CROSS-SLOPE OR 5.0% LONGITUDINAL SLOPE.
- NO PORTION OF ANY HANDICAP PARKING SPACE OR ADJOINING ACCESS AISLE SHALL EXCEED 2.0% SLOPE IN ANY DIRECTION.

BMP NOTES

- SEE THE DETAIL SHEET FOR SPECIFICS REGARDING THE BIORETENTION DEVICE.

NOTES

1. SEE SHEET C7 FOR STORM DRAIN SCHEDULE.

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Wake Forest, North Carolina 27587
(919) 210-3934 Firm License P-2538

NO.	DATE	REVISION DESCRIPTION	BY
1	DATE	COMMENT	BY
2	DATE	COMMENT	BY
3	DATE	COMMENT	BY
4	DATE	COMMENT	BY
5	DATE	COMMENT	BY
6	DATE	COMMENT	BY
7	DATE	COMMENT	BY
8	DATE	COMMENT	BY

PRELIMINARY
DO NOT USE FOR CONSTRUCTION

Grading Overall
StorageMax
901 Proctor Street
Zebulon, Wake County, North Carolina

Project No. 23001
Dwg No. C5

Bioretention Design

Curve Number Analysis

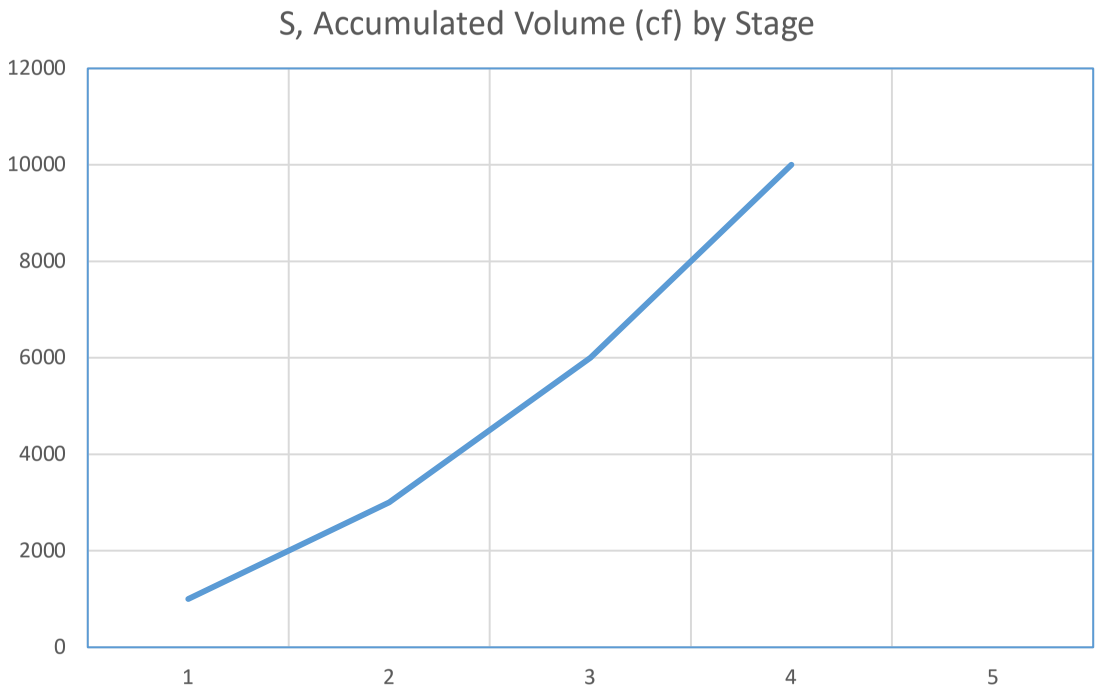
Project **Calculated By** **Date**

Location **Checked By** **Revised**

	Soils Data			Total Site CN (no offsite)				Drainage to BMP (inc offsite drainage)			
				Pre-Develpoment		Post Development		Bypass		To BMP	
	Soil Group	Cover Description	CN	Area	CN x Area	Area	CN x Area	Area	CN x Area	Area	CN x Area
	NA	**Impervious Cover**									
		Roof/Concrete	98	0.00		2.30	225			2.30	225
		Asphalt Pavement	98	0.00		1.34	131	0.05	5	1.29	126
	B	**Pervious/Semi-Perv Cover**									
		Lawn, Good Condition	61					1.21	74		
		Woods, Fair Condition	60	0.40	24	0.40	24	0.40	24		
		Grass, Fair Condition	69	6.00	414	2.36	163			1.71	118
· 1 acre lots (with 11% connected, 89% unconnected)			65								
		Gravel	85								
	C	**Pervious/Semi-Perv Cover**									
		Lawn, Good Condition	74								
		Woods, Fair Condition	73								
		Brush, Good Condition	65								
		Grass, Fair Condition	79								
· 1 acre lots (with 11% connected, 89% unconnected)			76								
		Gravel	89								
	D	**Pervious/Semi-Perv Cover**									
		Lawn, Good Condition	80								
		Woods, Good Condition	77								
		Brush, Good Condition	73	0.00		0.00					
		Landscape	79								
		Gravel	91								
		Total		6.40	438	6.40	544	1.66	103	5.30	470
		Weighted Curve Number			68		85		62		89

Calculate Stage-Storage of Bioretention Basin

Stage	Contour	Contour Area (sf)	Incremental Volume (cf)	S, Accumulated Volume (cf)	
Media Volume					
0.0	0	14,465	0	0	*Top of Media = 311*
1.0	1	13,274	13,870	13,870	*El 310*
2.0	2	12,116	12,695	26,565	*El 309*
Water Volume					
0.0	311	14,465	0	0	*Top of Media*
1.0	312	16,310	15,388	15,388	*1" storm volume pool elevation*
1.5	312.5	17,254	8,391	23,779	*Top of Riser*
2.0	313	18,213	8,867	32,645	*Emergency Spillway*
2.0		-	(2,850,335)	-2,817,689	*Top Of Dam*



Calculate the runoff coefficient, Rv

Impervious portion of drainage area	4.04	acres	**Includes .40 Acres impervious in the Righ of Way**
Drainage area	5.76	acres	$I\_A=(Impervious\ portion\ of\ drainage\ area\ (acre)$
IA	70%		
Rv	0.68		$R\_v=0.05+0.9\times I\_A$

Calculate the volume of runoff to be controlled, V

RD	1	inch	*Design storm rainfall depth*	
A	5.76	acres	*Watershed area*	19.51
V required	14,244	cf	$V=3630\times R\_D\times R\_v\times A$	
V provided	15,388	cf		

Underdrain

Media Volume	26,565	cu ft	
Q (1" /hr)	3.07	cfs	1" / hour (safety factor of 10)
D	12.09	in	Diameter of pipe
n	0.011		Roughness factor
s	0.005	ft/ft	internal slope
# of Pipes Req'd	**14 (4" pipes req)**		See table 5-1

if D is less than	# of 4" pipes	If D is less than	# of 6" pipes
5.13	2	7.84	2
5.95	3	9.11	3
6.66	4	10.13	4
7.22	5		
7.75	6		
8.2	7		

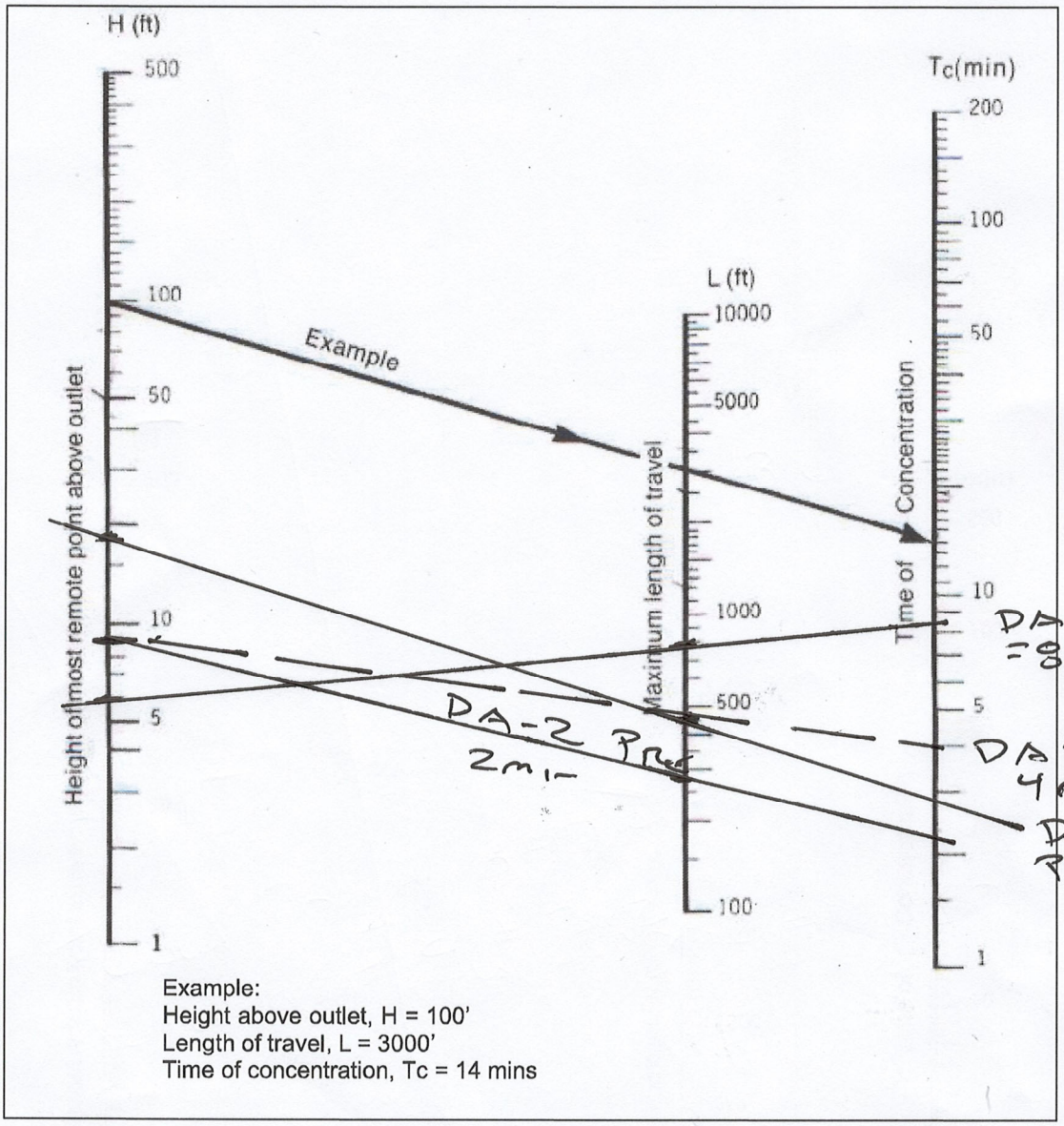
StorageMax
Riser forBioretention Device

Buoyancy Protection

Ground elevation at wet well (feet)	311.0	
Maximum groundwater elevation (feet)	306.0	
Wet well top elevation (feet)	312.5	
Wet well invert elevation (feet)	308.0	
Thickness of wet well wall (inches)	0.5	
Thickness of wet well top (inches)	0.1	
Percent of top deducted for hatch opening	85	
Thickness of wet well floor (inches)	18.0	
Length of wet well base extension (inches)	12.0	
Dry unit weight of soil (pcf)	120.0	
Unit weight of water (pcf)	62.4	
Unit weight of concrete (pcf)	150.0	
Buoyant force, with empty wet well		
Submerged volume of wet well interior (cf)	-157	
Submerged volume of wet well walls (cf)	-3	
Submerged volume of floor & base ext. (cf)	172	
Submerged volume of wet well top (cf)	0	
Total volume of displaced water (cf)	12	
Total weight of displaced water (lbs)		**768**
Downward forces		
Volume of wet well structure (cf)	178	
Volume of concrete added for invert (cf)	27	
Total volume of concrete (cf)	205	
Total weight of concrete (lbs)		30,752
Volume of wet soil over base extension (cf)	-70	
Buoyant weight of wet soil column (lbs)		-4,011
Volume of dry soil over base extension (cf)	25	
Dead weight of dry soil column (lbs)	1000	3,000
Total downward force (lbs)		**29,741**
Factor of safety against flotation	**38.74**	

ZEBULON STORAGE MAP

Figure 2.4 Kirpich Equation
(Source: North Carolina Erosion and Sediment Control Planning and Design Manual)



DA-1 T_c (PRE) = 3 MIN SAY 5 min

DA-1 T_c (POST) = 8.5 min SAY 5min

DA-2 T_c (PRE) = 2 min SAY 5 min

DA-2 T_c (POST) = 4 min SAY 5 min

Pre and Post Design Calculations (Hydraflow)

NOAA Atlas 14, Volume 2, Version 3
Location name: Zebulon, North Carolina, USA*
Latitude: 35.8479°, Longitude: -78.309°
Elevation: 266 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

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

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

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

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.404** (0.369-0.444)	**0.466** (0.427-0.511)	**0.529** (0.483-0.578)	**0.599** (0.547-0.655)	**0.668** (0.607-0.730)	**0.726** (0.657-0.794)	**0.778** (0.700-0.849)	**0.825** (0.738-0.902)	**0.878** (0.779-0.962)	**0.929** (0.817-1.02)
10-min	**0.645** (0.589-0.709)	**0.746** (0.683-0.817)	**0.847** (0.774-0.926)	**0.958** (0.874-1.05)	**1.06** (0.968-1.16)	**1.16** (1.05-1.26)	**1.24** (1.11-1.35)	**1.31** (1.17-1.43)	**1.39** (1.23-1.52)	**1.46** (1.29-1.60)
15-min	**0.807** (0.736-0.886)	**0.938** (0.858-1.03)	**1.07** (0.979-1.17)	**1.21** (1.11-1.33)	**1.35** (1.23-1.48)	**1.46** (1.32-1.60)	**1.56** (1.40-1.71)	**1.65** (1.48-1.80)	**1.75** (1.55-1.92)	**1.84** (1.61-2.02)
30-min	**1.11** (1.01-1.22)	**1.30** (1.18-1.42)	**1.52** (1.39-1.66)	**1.76** (1.60-1.92)	**2.00** (1.82-2.18)	**2.21** (2.00-2.41)	**2.39** (2.15-2.61)	**2.57** (2.30-2.81)	**2.78** (2.47-3.05)	**2.98** (2.61-3.26)
60-min	**1.38** (1.26-1.52)	**1.62** (1.49-1.78)	**1.95** (1.78-2.13)	**2.29** (2.09-2.50)	**2.66** (2.42-2.91)	**2.99** (2.70-3.27)	**3.30** (2.96-3.60)	**3.60** (3.22-3.94)	**3.99** (3.54-4.37)	**4.34** (3.82-4.76)
2-hr	**1.61** (1.46-1.78)	**1.91** (1.74-2.09)	**2.32** (2.10-2.55)	**2.75** (2.49-3.02)	**3.26** (2.94-3.58)	**3.73** (3.34-4.08)	**4.18** (3.72-4.58)	**4.66** (4.12-5.10)	**5.28** (4.63-5.78)	**5.86** (5.09-6.43)
3-hr	**1.71** (1.55-1.90)	**2.02** (1.84-2.24)	**2.47** (2.24-2.73)	**2.95** (2.67-3.25)	**3.53** (3.18-3.89)	**4.08** (3.64-4.48)	**4.61** (4.09-5.07)	**5.19** (4.57-5.70)	**5.96** (5.19-6.56)	**6.70** (5.77-7.39)
6-hr	**2.05** (1.86-2.27)	**2.43** (2.21-2.68)	**2.96** (2.69-3.26)	**3.54** (3.22-3.90)	**4.26** (3.84-4.67)	**4.93** (4.42-5.40)	**5.61** (4.98-6.14)	**6.33** (5.57-6.92)	**7.33** (6.36-8.01)	**8.28** (7.09-9.07)
12-hr	**2.41** (2.20-2.66)	**2.86** (2.62-3.14)	**3.50** (3.20-3.85)	**4.22** (3.83-4.63)	**5.10** (4.61-5.58)	**5.95** (5.34-6.49)	**6.81** (6.04-7.42)	**7.75** (6.80-8.43)	**9.05** (7.81-9.85)	**10.3** (8.76-11.2)
24-hr	**2.85** (2.65-3.08)	**3.45** (3.20-3.73)	**4.38** (4.06-4.73)	**5.13** (4.74-5.54)	**6.19** (5.70-6.68)	**7.06** (6.47-7.62)	**7.99** (7.28-8.63)	**8.98** (8.14-9.71)	**10.4** (9.34-11.3)	**11.6** (10.3-12.6)
2-day	**3.30** (3.07-3.56)	**3.98** (3.70-4.29)	**5.01** (4.65-5.40)	**5.84** (5.41-6.30)	**7.01** (6.47-7.56)	**7.97** (7.32-8.60)	**8.98** (8.20-9.70)	**10.1** (9.13-10.9)	**11.6** (10.4-12.6)	**12.9** (11.4-14.0)
3-day	**3.50** (3.26-3.76)	**4.22** (3.93-4.53)	**5.28** (4.91-5.67)	**6.14** (5.70-6.59)	**7.34** (6.78-7.88)	**8.32** (7.66-8.94)	**9.35** (8.56-10.1)	**10.4** (9.50-11.3)	**12.0** (10.8-13.0)	**13.3** (11.9-14.4)
4-day	**3.71** (3.46-3.97)	**4.45** (4.16-4.77)	**5.55** (5.18-5.94)	**6.43** (5.98-6.88)	**7.66** (7.10-8.20)	**8.67** (8.00-9.29)	**9.72** (8.92-10.4)	**10.8** (9.88-11.6)	**12.4** (11.2-13.4)	**13.7** (12.3-14.8)
7-day	**4.31** (4.03-4.61)	**5.15** (4.82-5.51)	**6.34** (5.93-6.78)	**7.30** (6.80-7.81)	**8.63** (8.02-9.23)	**9.70** (8.98-10.4)	**10.8** (9.97-11.6)	**12.0** (11.0-12.9)	**13.6** (12.4-14.7)	**15.0** (13.5-16.2)
10-day	**4.91** (4.61-5.24)	**5.86** (5.49-6.25)	**7.11** (6.66-7.58)	**8.10** (7.58-8.63)	**9.46** (8.82-10.1)	**10.6** (9.81-11.2)	**11.7** (10.8-12.5)	**12.8** (11.8-13.7)	**14.4** (13.2-15.5)	**15.7** (14.3-16.9)
20-day	**6.60** (6.21-7.02)	**7.81** (7.35-8.31)	**9.32** (8.76-9.91)	**10.5** (9.87-11.2)	**12.2** (11.4-12.9)	**13.5** (12.6-14.3)	**14.8** (13.7-15.8)	**16.2** (15.0-17.2)	**18.0** (16.6-19.3)	**19.5** (17.8-20.9)
30-day	**8.19** (7.73-8.69)	**9.66** (9.12-10.2)	**11.3** (10.7-12.0)	**12.7** (11.9-13.4)	**14.4** (13.5-15.3)	**15.8** (14.8-16.7)	**17.1** (16.0-18.2)	**18.5** (17.2-19.7)	**20.4** (18.9-21.7)	**21.8** (20.1-23.3)
45-day	**10.4** (9.89-11.0)	**12.2** (11.6-12.9)	**14.1** (13.4-14.9)	**15.6** (14.8-16.5)	**17.5** (16.6-18.5)	**19.0** (17.9-20.1)	**20.5** (19.3-21.7)	**22.0** (20.6-23.3)	**23.9** (22.3-25.4)	**25.4** (23.6-27.0)
60-day	**12.5** (11.9-13.2)	**14.6** (13.9-15.4)	**16.7** (15.9-17.6)	**18.3** (17.4-19.3)	**20.4** (19.3-21.5)	**22.0** (20.8-23.2)	**23.6** (22.2-24.9)	**25.1** (23.6-26.5)	**27.1** (25.4-28.7)	**28.6** (26.7-30.3)

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

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

Please refer to NOAA Atlas 14 document for more information.

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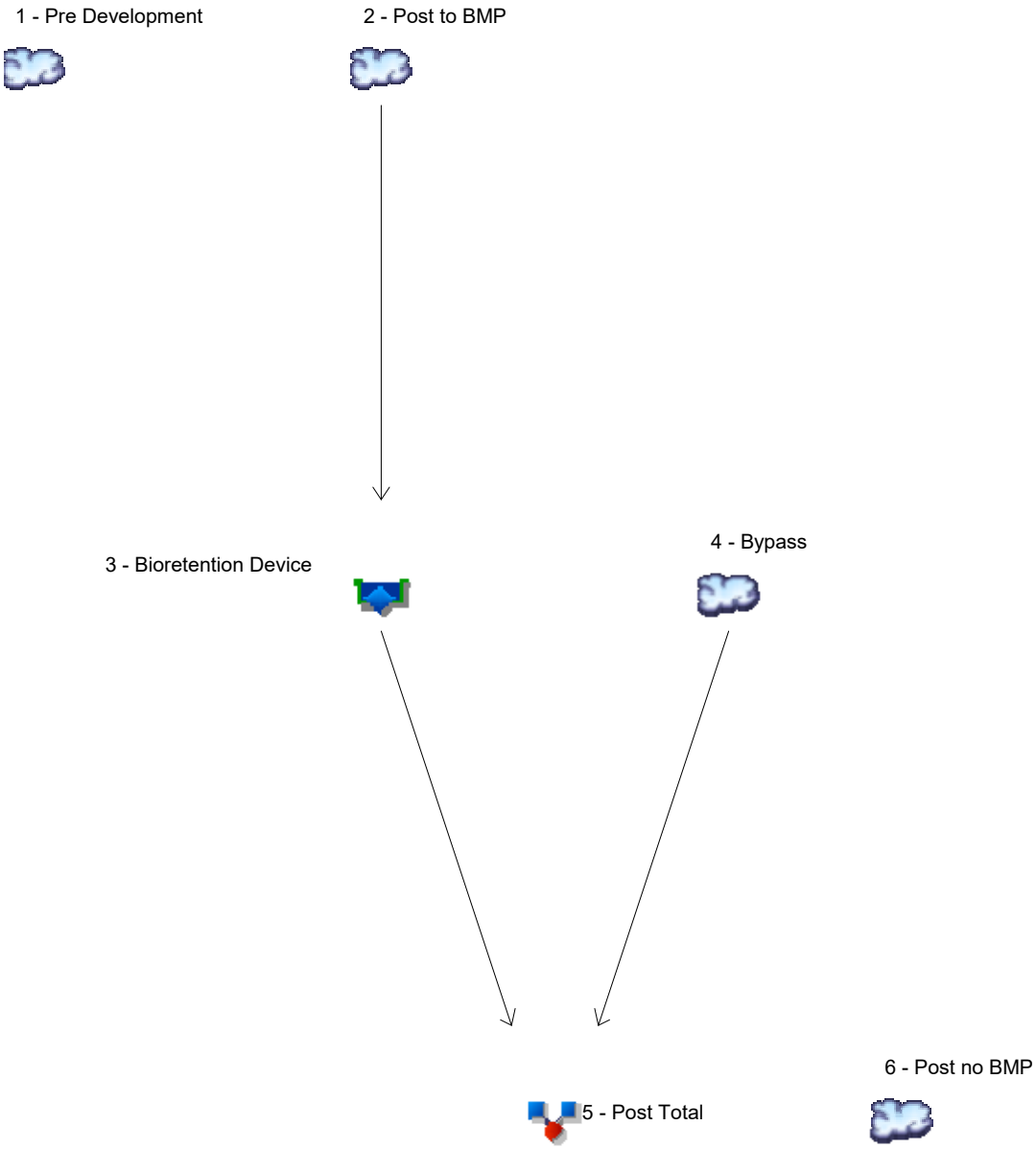
PF graphical

Watershed Model Schematic



Hydrograph Return Period Recap

Hyd. No.	Hydrograph type (origin)	Inflow hyd(s)	Peak Outflow (cfs)							Hydrograph Description
			1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
1	SCS Runoff	------	6.471	10.29	-------	-------	23.44	-------	-------	45.59	Pre Development
2	SCS Runoff	------	16.68	21.27	-------	-------	34.87	-------	-------	54.64	Post to BMP
3	Reservoir	2	5.463	6.502	-------	-------	17.88	-------	-------	34.32	Bioretention Device
4	SCS Runoff	------	0.901	1.721	-------	-------	4.722	-------	-------	9.994	Bypass
5	Combine	3, 4	6.040	7.707	-------	-------	20.43	-------	-------	42.38	Post Total
6	SCS Runoff	------	17.10	22.51	-------	-------	38.89	-------	-------	63.04	Post no BMP

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

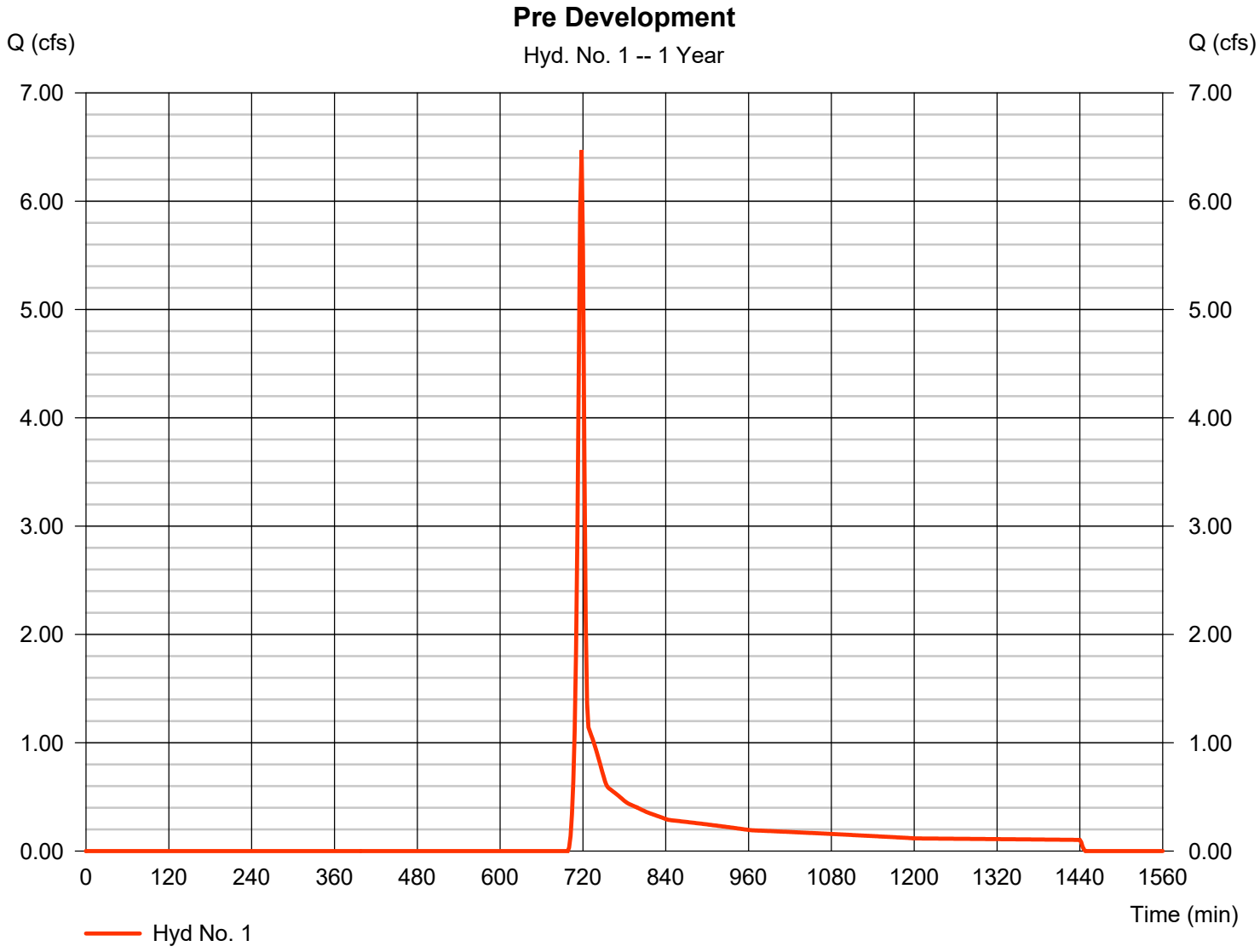
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	6.471	2	718	13,646	------	------	------	Pre Development
2	SCS Runoff	16.68	2	716	34,266	------	------	------	Post to BMP
3	Reservoir	5.463	2	724	34,249	2	312.60	12,041	Bioretention Device
4	SCS Runoff	0.901	2	718	2,249	------	------	------	Bypass
5	Combine	6.040	2	720	36,498	3, 4	------	------	Post Total
6	SCS Runoff	17.10	2	716	34,592	------	------	------	Post no BMP

Hydrograph Report

Hyd. No. 1

Pre Development

Hydrograph type	=	SCS Runoff	Peak discharge	=	6.471 cfs
Storm frequency	=	1 yrs	Time to peak	=	718 min
Time interval	=	2 min	Hyd. volume	=	13,646 cuft
Drainage area	=	6.400 ac	Curve number	=	68
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	3.00 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

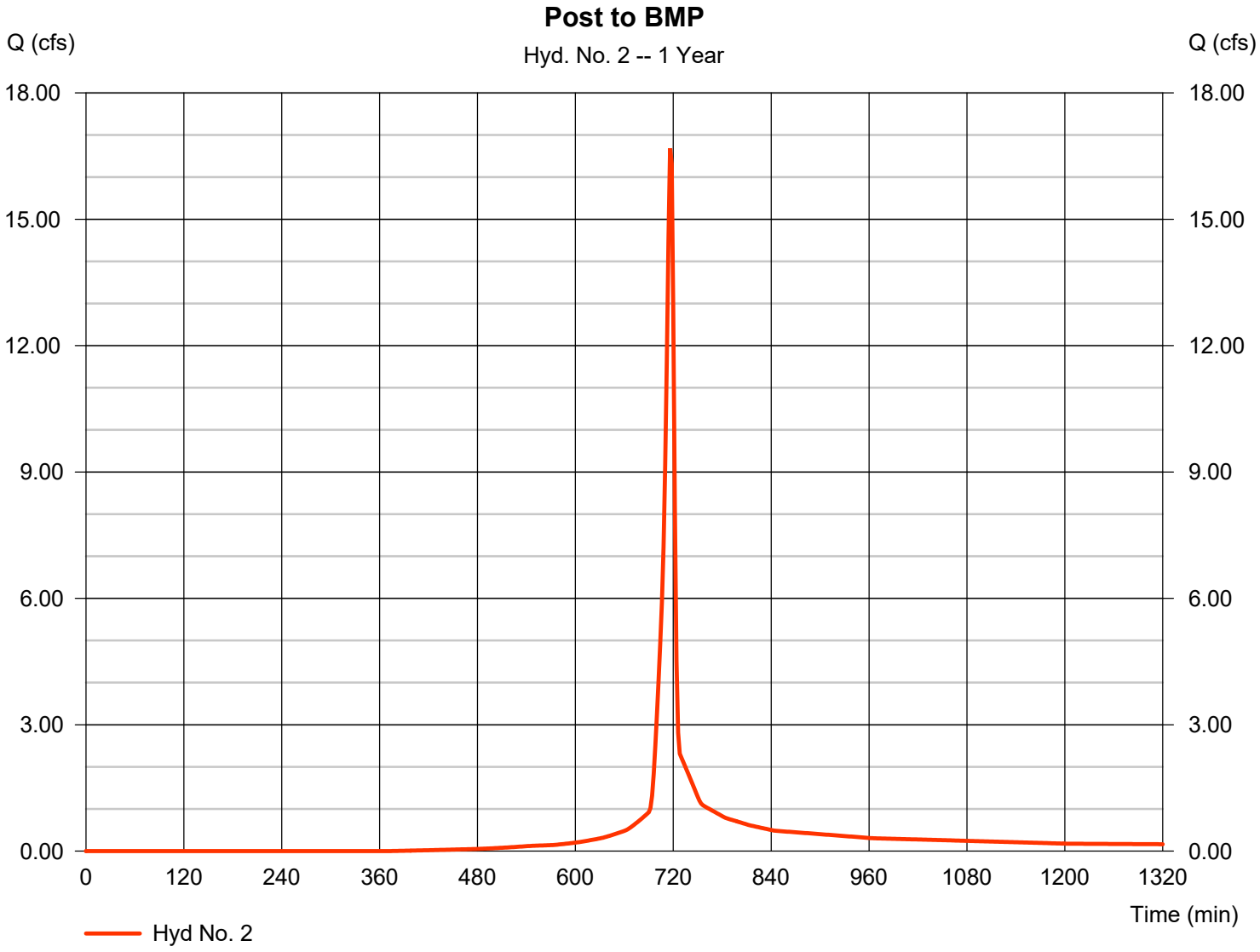


Hydrograph Report

Hyd. No. 2

Post to BMP

Hydrograph type	=	SCS Runoff	Peak discharge	=	16.68 cfs
Storm frequency	=	1 yrs	Time to peak	=	716 min
Time interval	=	2 min	Hyd. volume	=	34,266 cuft
Drainage area	=	5.300 ac	Curve number	=	89
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	3.00 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484



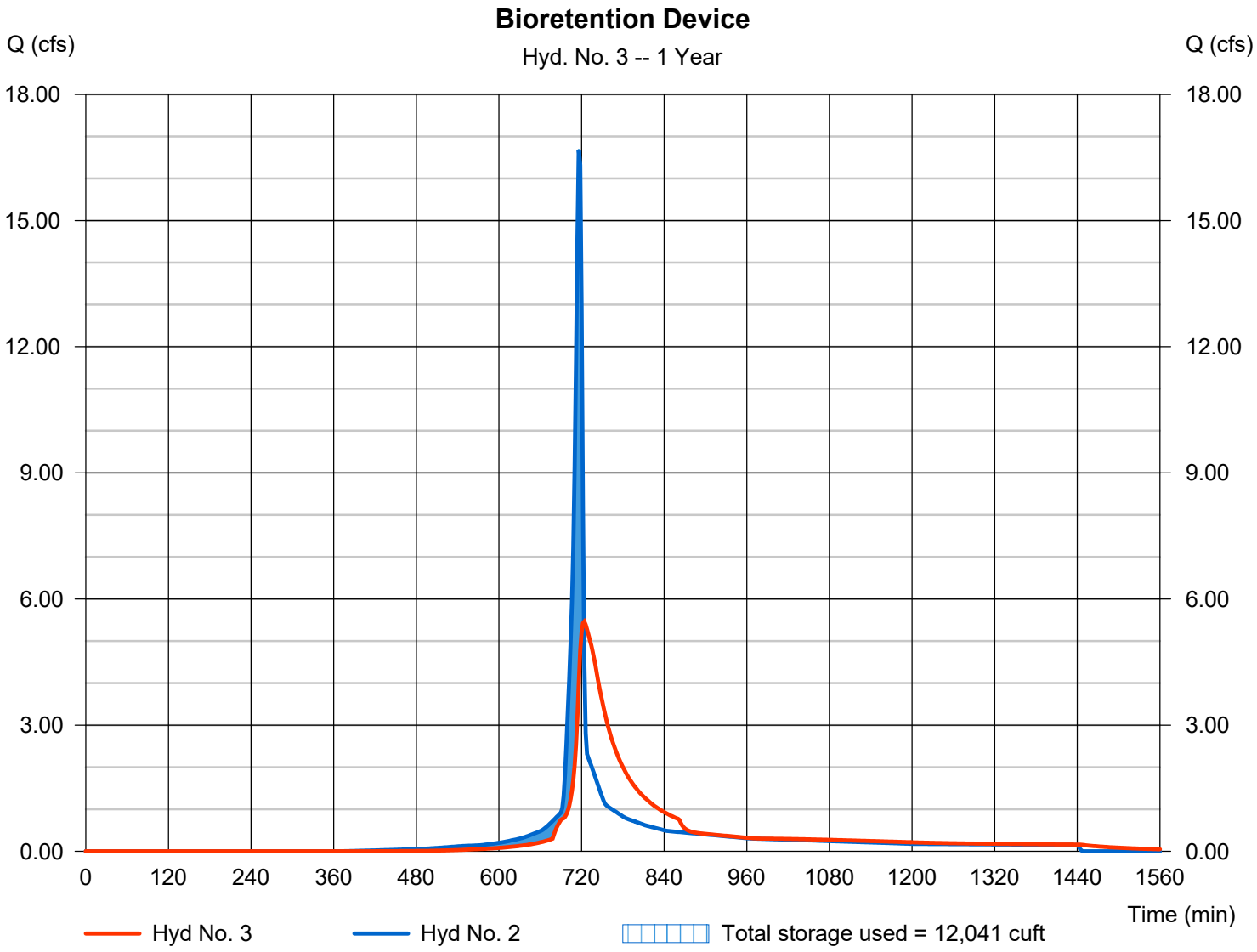
Hydrograph Report

Hyd. No. 3

Bioretention Device

Hydrograph type	=	Reservoir	Peak discharge	=	5.463 cfs
Storm frequency	=	1 yrs	Time to peak	=	724 min
Time interval	=	2 min	Hyd. volume	=	34,249 cuft
Inflow hyd. No.	=	2 - Post to BMP	Max. Elevation	=	312.60 ft
Reservoir name	=	Bioretention	Max. Storage	=	12,041 cuft

Storage Indication method used.



Pond Report

Pond No. 1 - Bioretention

Pond Data

Contours -User-defined contour areas. Average end area method used for volume calculation. Begining Elevation = 311.80 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	311.80	15,908	0	0
0.12	312.00	16,310	1,933	1,933
0.62	312.50	17,258	8,392	10,325
1.12	313.00	18,213	8,868	19,193
2.10	313.90	18,700	18,087	37,280

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	8.00	Inactive	0.00
Span (in)	= 24.00	30.00	0.00	0.00
No. Barrels	= 1	1	1	0
Invert El. (ft)	= 308.00	311.80	0.00	0.00
Length (ft)	= 100.00	0.50	0.00	0.00
Slope (%)	= 0.50	0.50	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	Yes	No	No

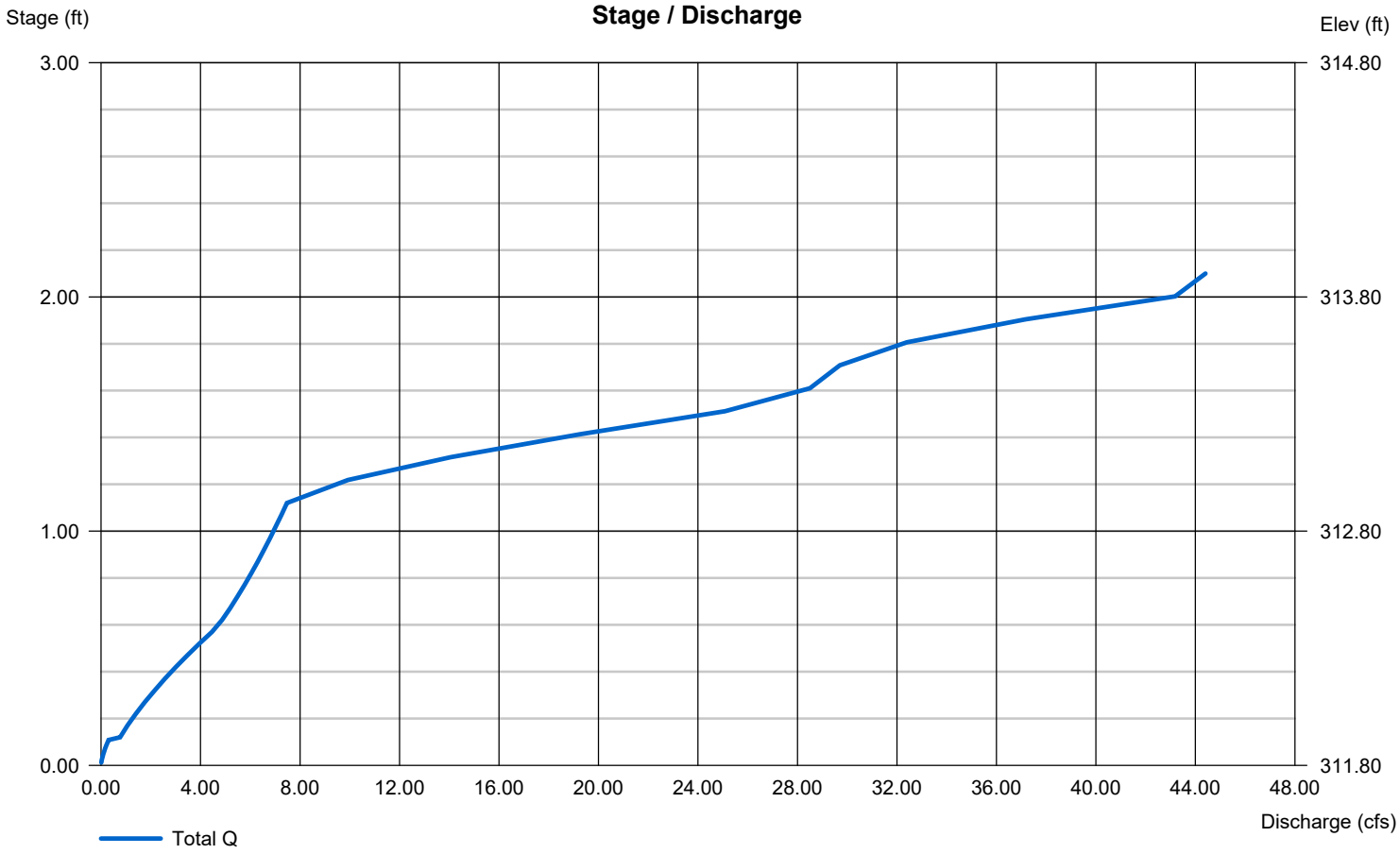
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 20.00	30.00	0.00	0.00
Crest El. (ft)	= 313.00	313.60	0.00	0.00
Weir Coeff.	= 3.33	2.60	3.33	3.33
Weir Type	= 1	Broad	---	---
Multi-Stage	= Yes	No	No	No

Exfil.(in/hr) = 0.000 (by Contour)

TW Elev. (ft) = 0.00

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

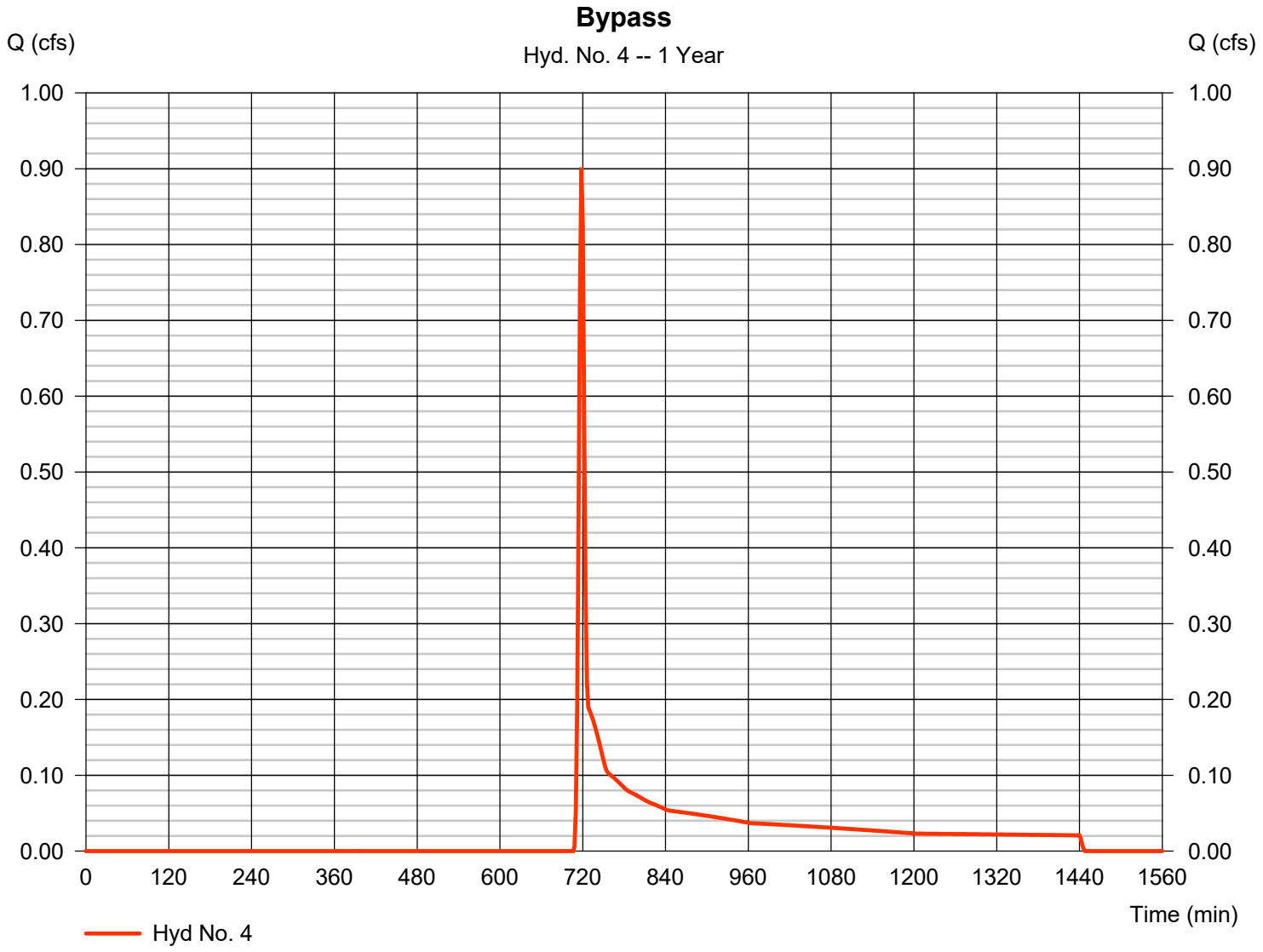


Hydrograph Report

Hyd. No. 4

Bypass

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.901 cfs
Storm frequency	=	1 yrs	Time to peak	=	718 min
Time interval	=	2 min	Hyd. volume	=	2,249 cuft
Drainage area	=	1.660 ac	Curve number	=	62
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	3.00 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

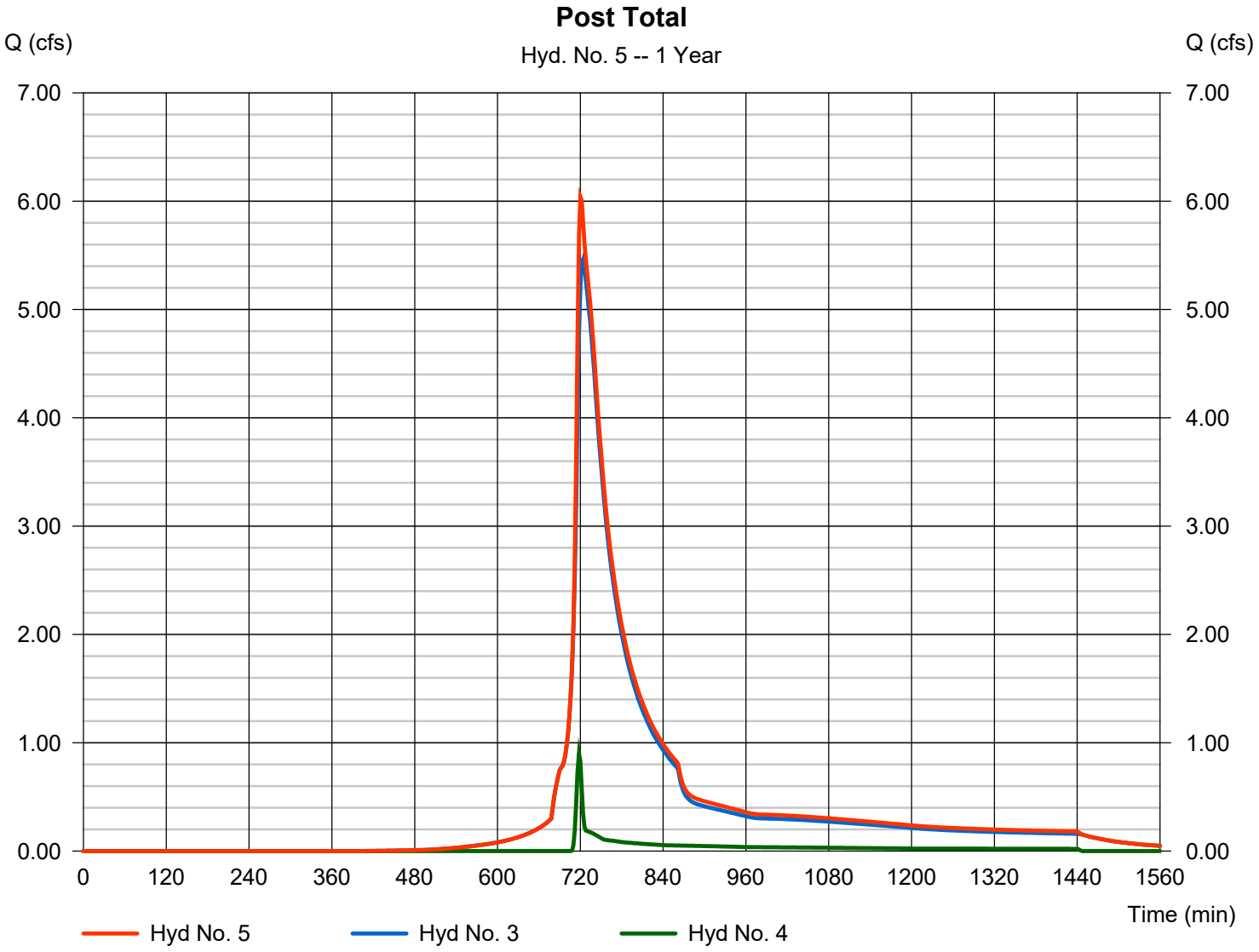


Hydrograph Report

Hyd. No. 5

Post Total

Hydrograph type	= Combine	Peak discharge	= 6.040 cfs
Storm frequency	= 1 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 36,498 cuft
Inflow hyds.	= 3, 4	Contrib. drain. area	= 1.660 ac

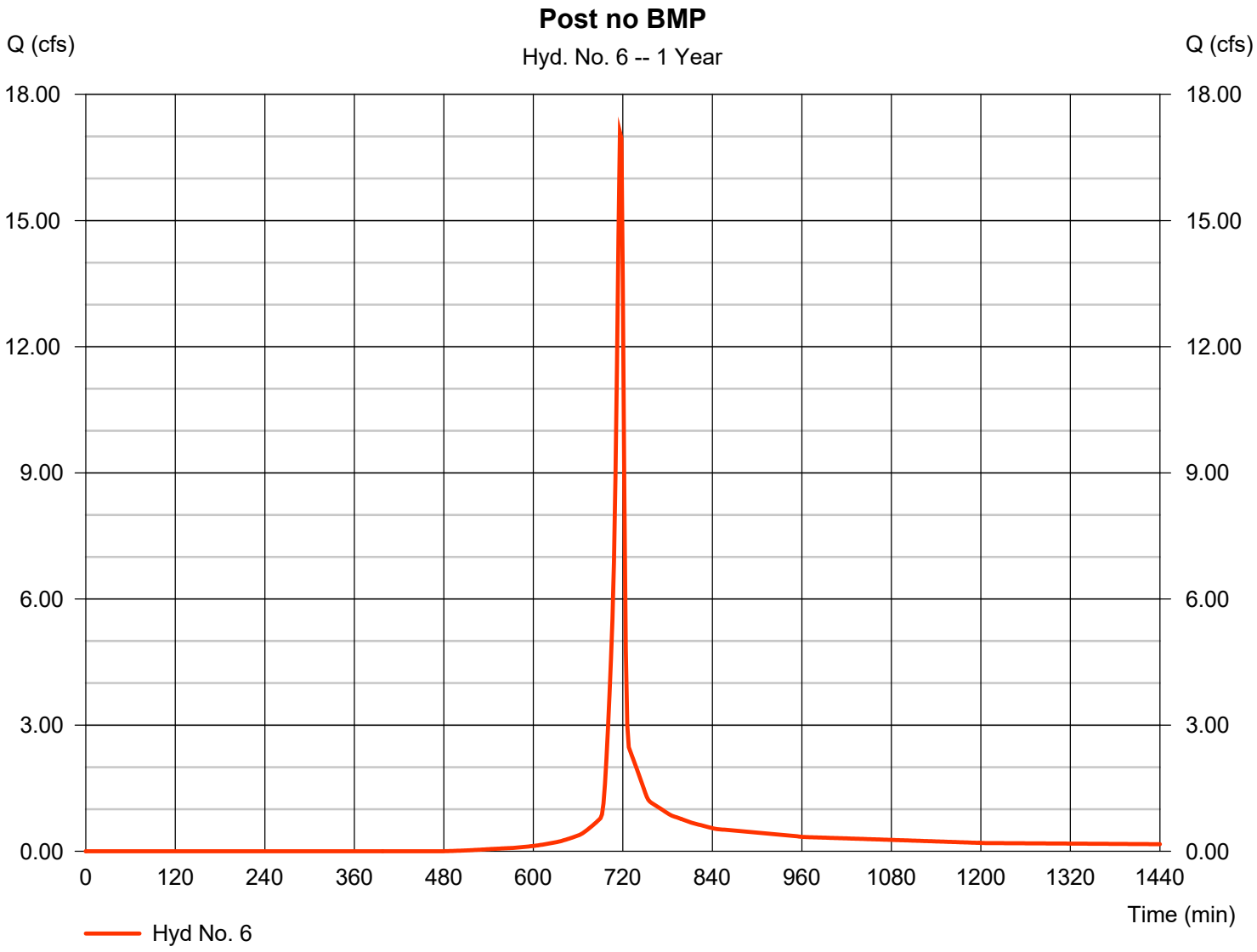


Hydrograph Report

Hyd. No. 6

Post no BMP

Hydrograph type	=	SCS Runoff	Peak discharge	=	17.10 cfs
Storm frequency	=	1 yrs	Time to peak	=	716 min
Time interval	=	2 min	Hyd. volume	=	34,592 cuft
Drainage area	=	6.400 ac	Curve number	=	85
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	3.00 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

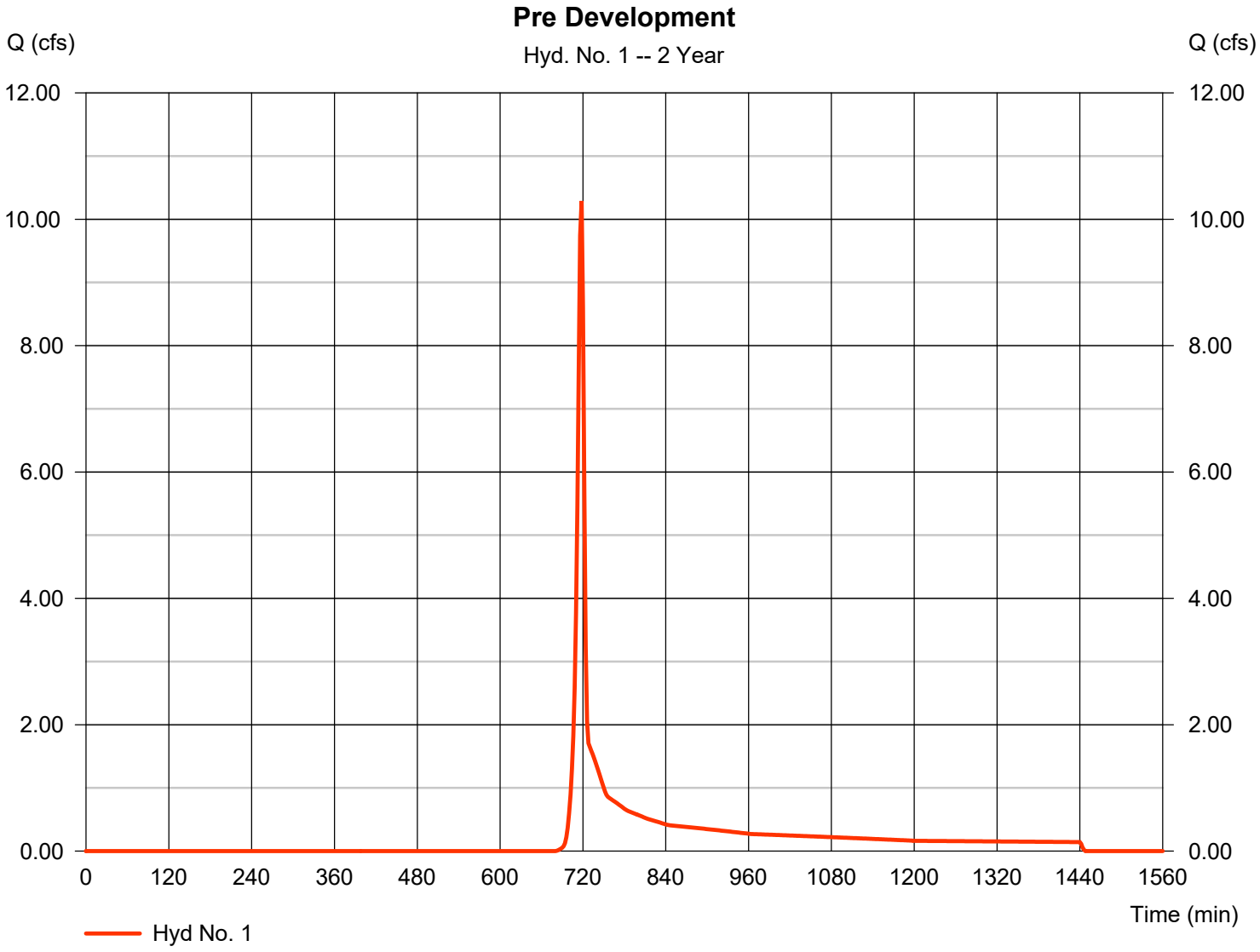
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	10.29	2	718	20,906	------	------	------	Pre Development
2	SCS Runoff	21.27	2	716	44,185	------	------	------	Post to BMP
3	Reservoir	6.502	2	724	44,168	2	312.79	15,471	Bioretention Device
4	SCS Runoff	1.721	2	718	3,745	------	------	------	Bypass
5	Combine	7.707	2	720	47,912	3, 4	------	------	Post Total
6	SCS Runoff	22.51	2	716	45,819	------	------	------	Post no BMP

Hydrograph Report

Hyd. No. 1

Pre Development

Hydrograph type	=	SCS Runoff	Peak discharge	=	10.29 cfs
Storm frequency	=	2 yrs	Time to peak	=	718 min
Time interval	=	2 min	Hyd. volume	=	20,906 cuft
Drainage area	=	6.400 ac	Curve number	=	68
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	3.60 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

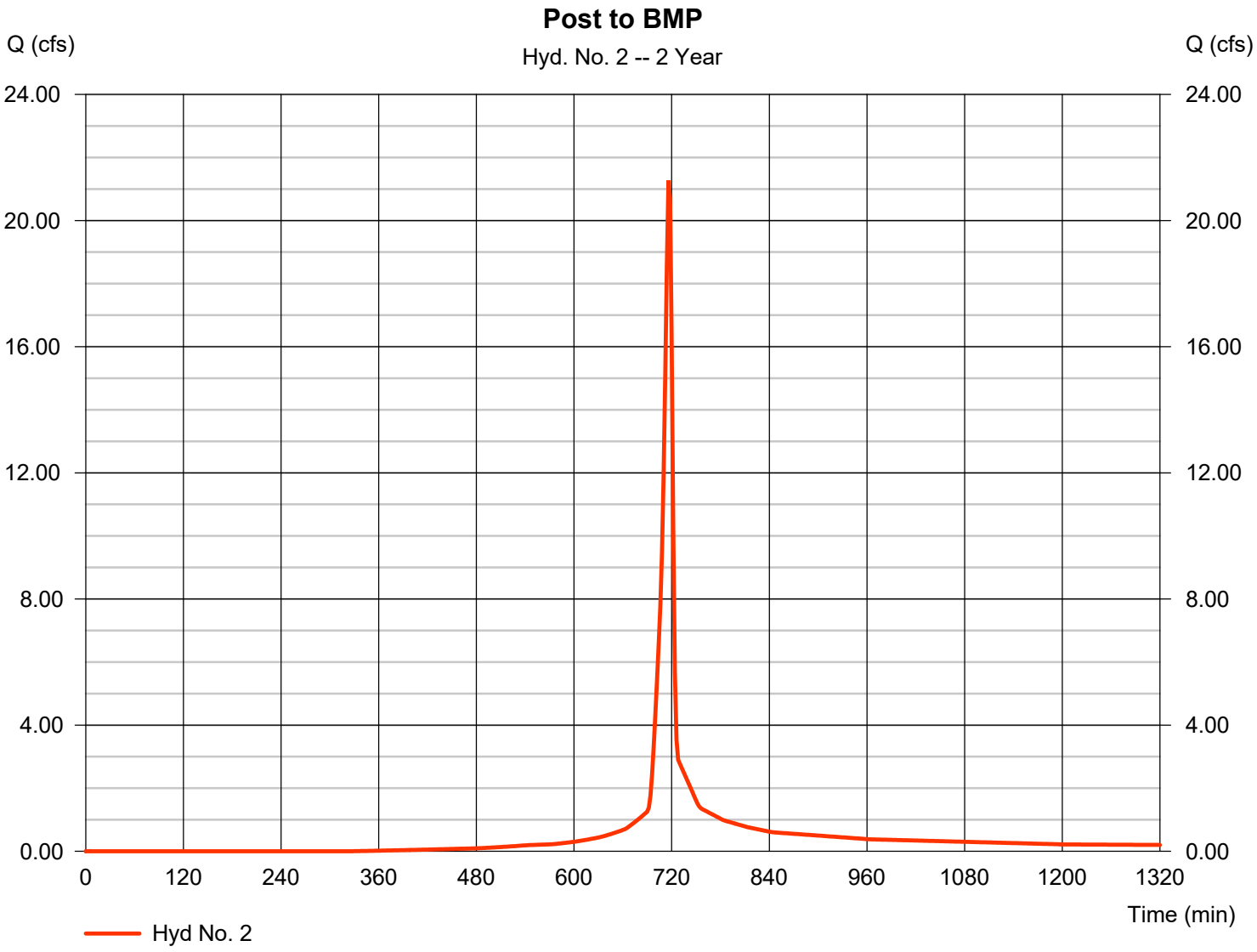


Hydrograph Report

Hyd. No. 2

Post to BMP

Hydrograph type	=	SCS Runoff	Peak discharge	=	21.27 cfs
Storm frequency	=	2 yrs	Time to peak	=	716 min
Time interval	=	2 min	Hyd. volume	=	44,185 cuft
Drainage area	=	5.300 ac	Curve number	=	89
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	3.60 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484



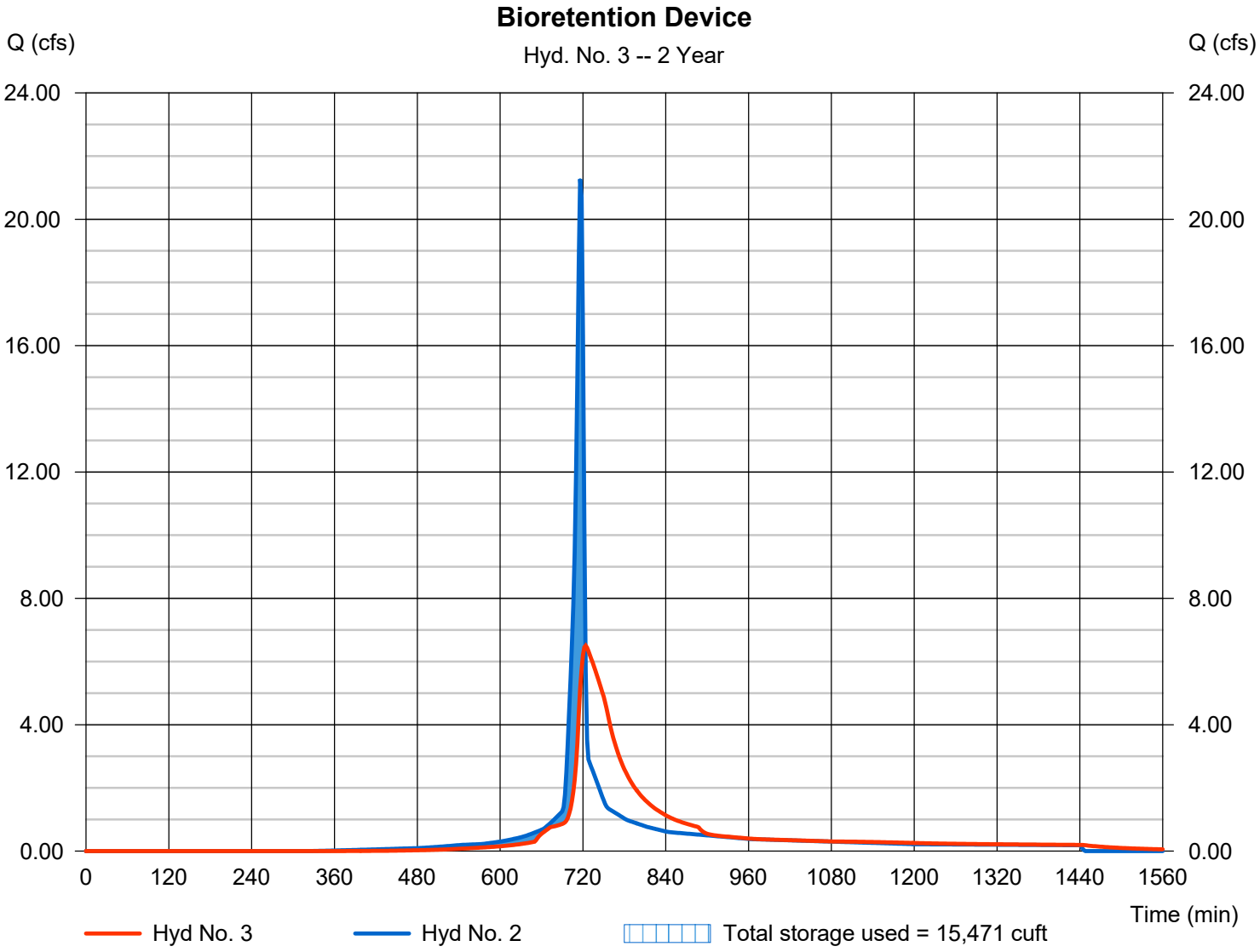
Hydrograph Report

Hyd. No. 3

Bioretention Device

Hydrograph type	=	Reservoir	Peak discharge	=	6.502 cfs
Storm frequency	=	2 yrs	Time to peak	=	724 min
Time interval	=	2 min	Hyd. volume	=	44,168 cuft
Inflow hyd. No.	=	2 - Post to BMP	Max. Elevation	=	312.79 ft
Reservoir name	=	Bioretention	Max. Storage	=	15,471 cuft

Storage Indication method used.

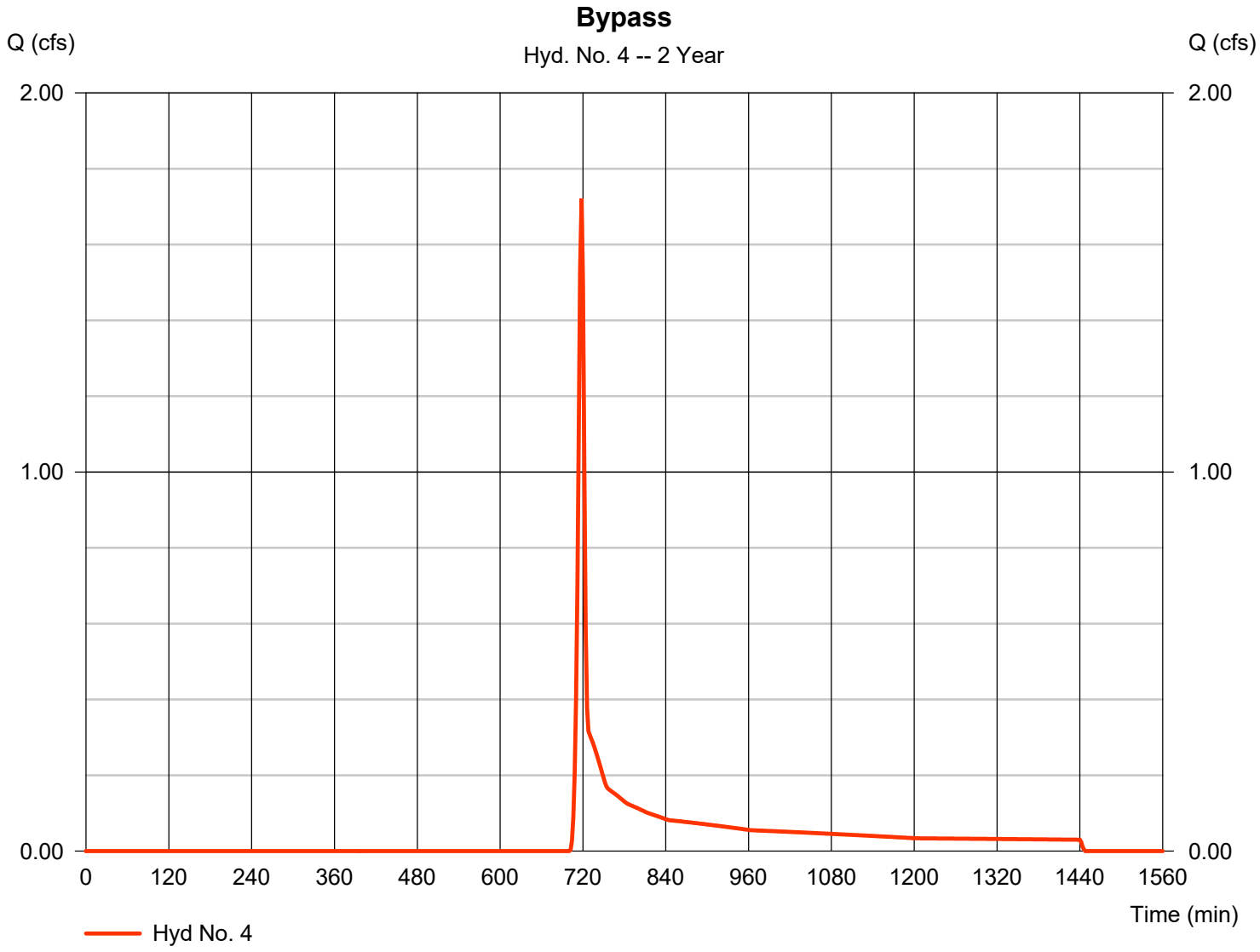


Hydrograph Report

Hyd. No. 4

Bypass

Hydrograph type	=	SCS Runoff	Peak discharge	=	1.721 cfs
Storm frequency	=	2 yrs	Time to peak	=	718 min
Time interval	=	2 min	Hyd. volume	=	3,745 cuft
Drainage area	=	1.660 ac	Curve number	=	62
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	3.60 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

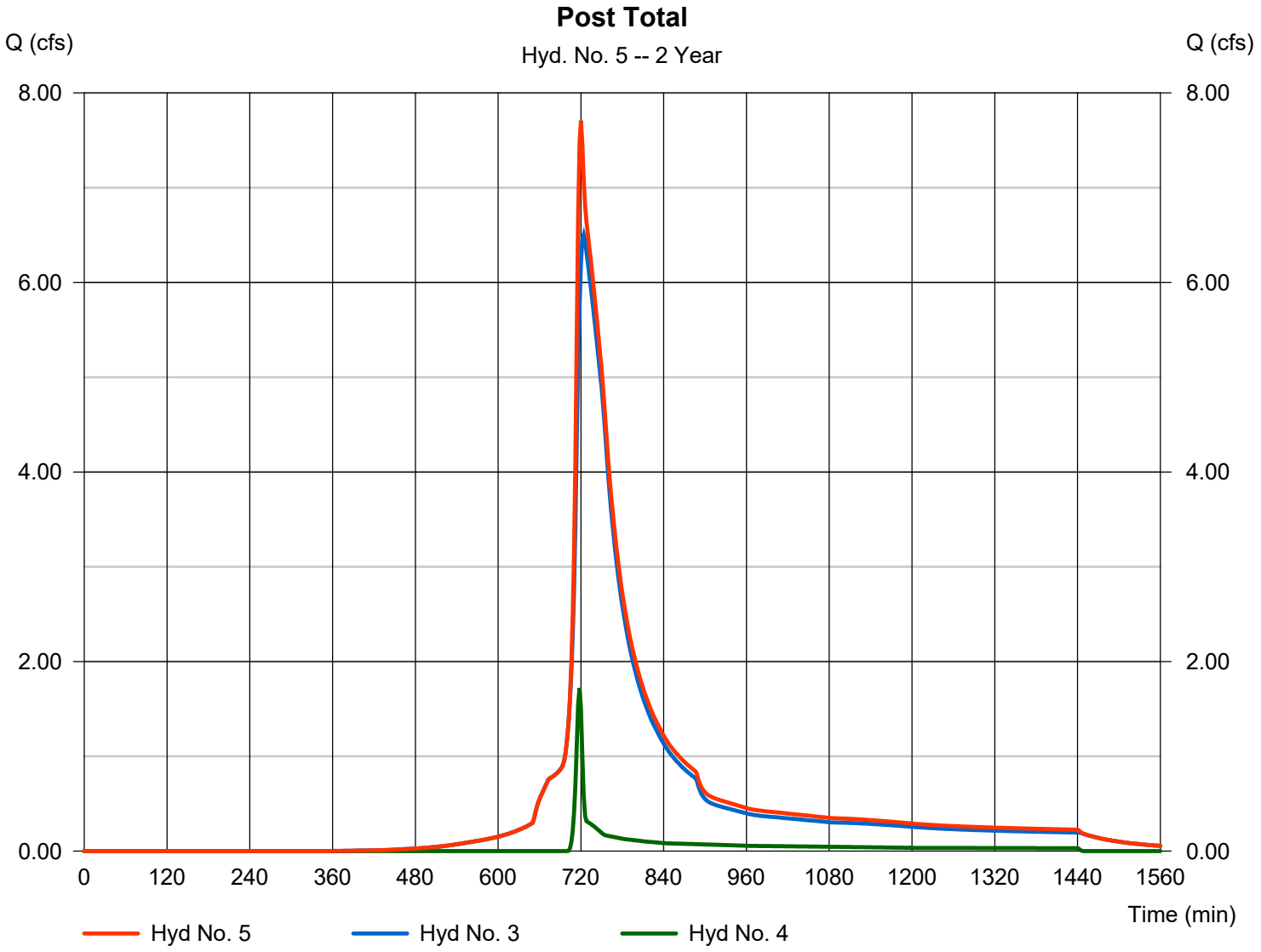


Hydrograph Report

Hyd. No. 5

Post Total

Hydrograph type	= Combine	Peak discharge	= 7.707 cfs
Storm frequency	= 2 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 47,912 cuft
Inflow hyds.	= 3, 4	Contrib. drain. area	= 1.660 ac

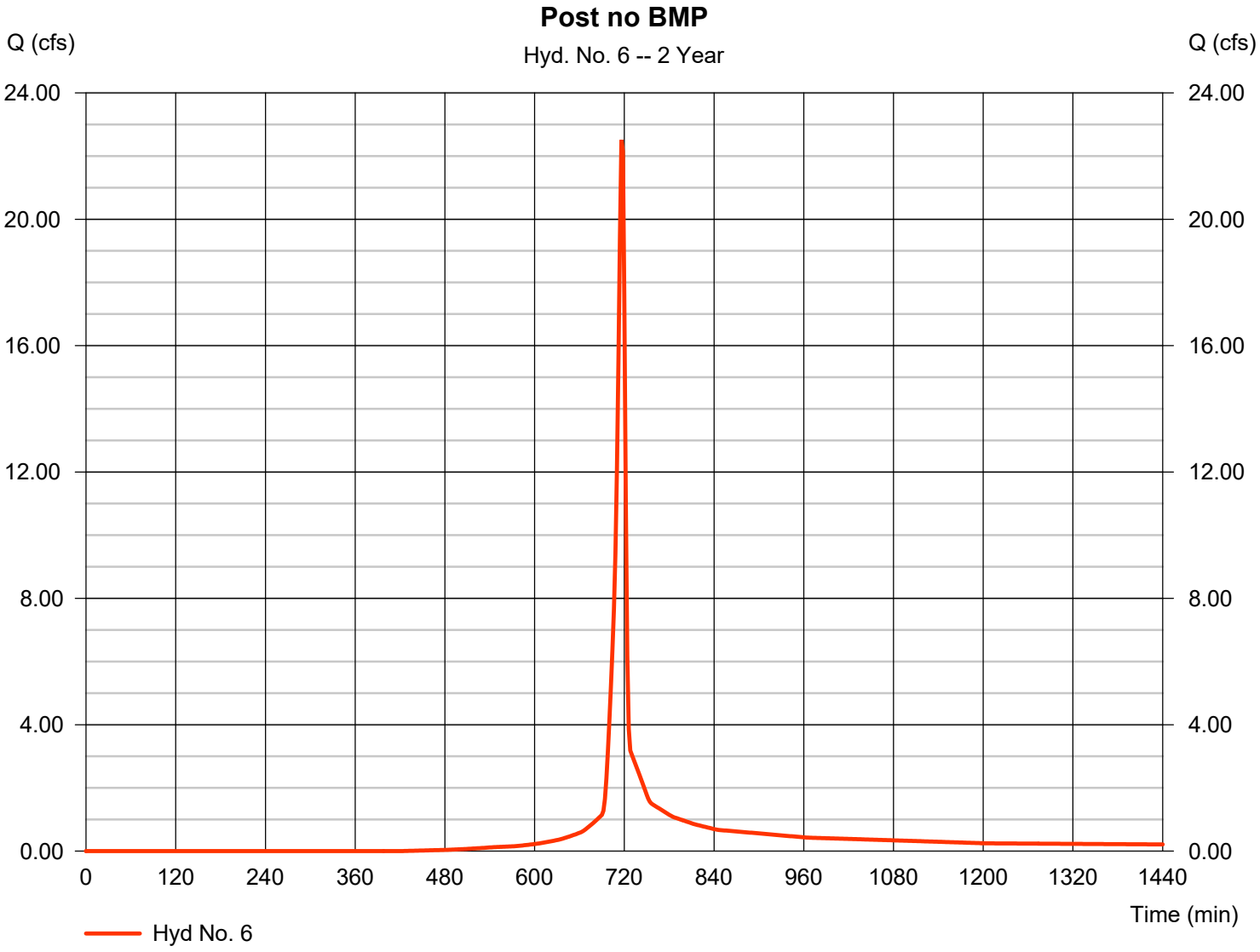


Hydrograph Report

Hyd. No. 6

Post no BMP

Hydrograph type	=	SCS Runoff	Peak discharge	=	22.51 cfs
Storm frequency	=	2 yrs	Time to peak	=	716 min
Time interval	=	2 min	Hyd. volume	=	45,819 cuft
Drainage area	=	6.400 ac	Curve number	=	85
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	3.60 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

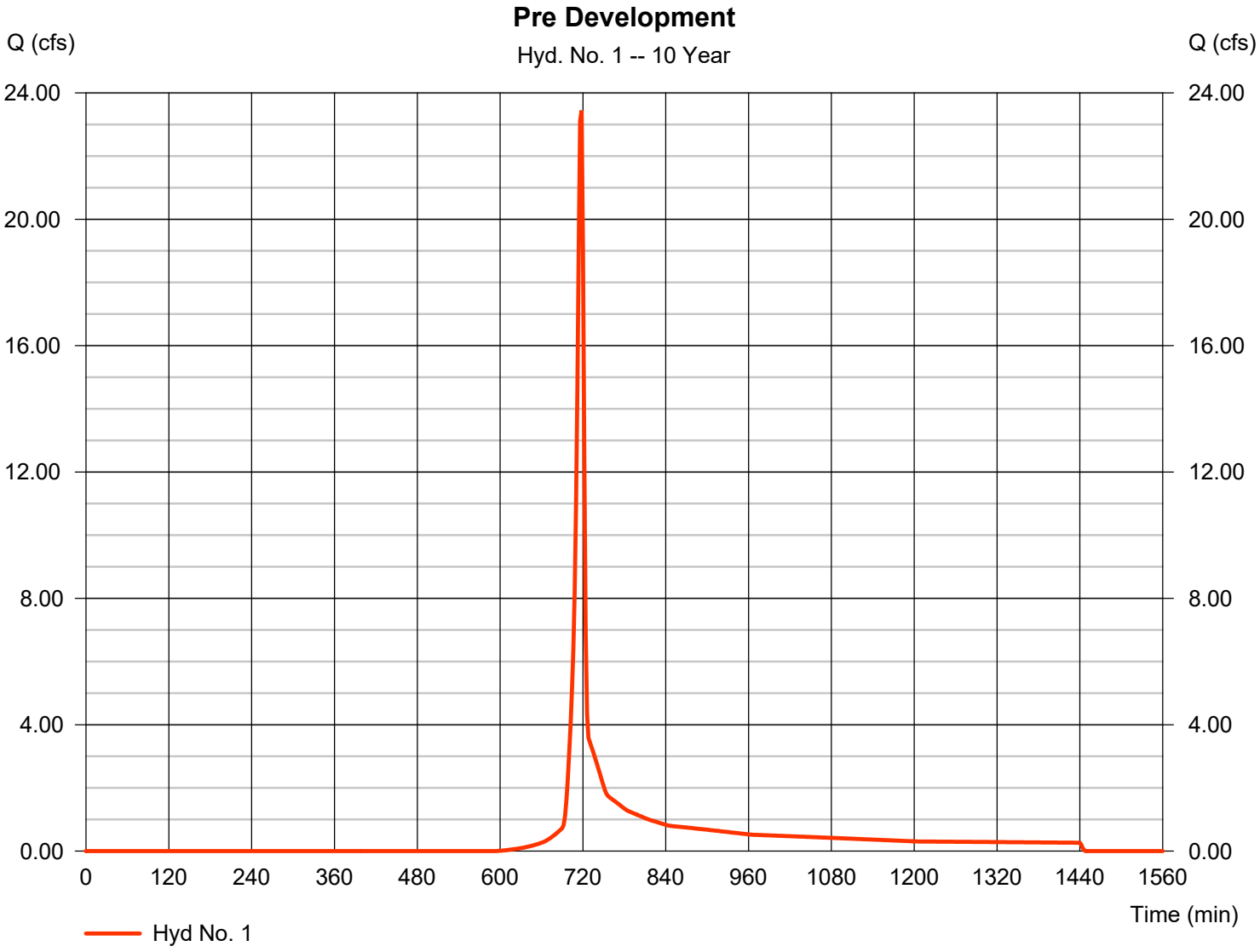
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	23.44	2	718	46,927	------	------	------	Pre Development
2	SCS Runoff	34.87	2	716	74,612	------	------	------	Post to BMP
3	Reservoir	17.88	2	722	74,595	2	313.27	24,141	Bioretention Device
4	SCS Runoff	4.722	2	718	9,480	------	------	------	Bypass
5	Combine	20.43	2	722	84,075	3, 4	------	------	Post Total
6	SCS Runoff	38.89	2	716	81,041	------	------	------	Post no BMP

Hydrograph Report

Hyd. No. 1

Pre Development

Hydrograph type	=	SCS Runoff	Peak discharge	=	23.44 cfs
Storm frequency	=	10 yrs	Time to peak	=	718 min
Time interval	=	2 min	Hyd. volume	=	46,927 cuft
Drainage area	=	6.400 ac	Curve number	=	68
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	5.38 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

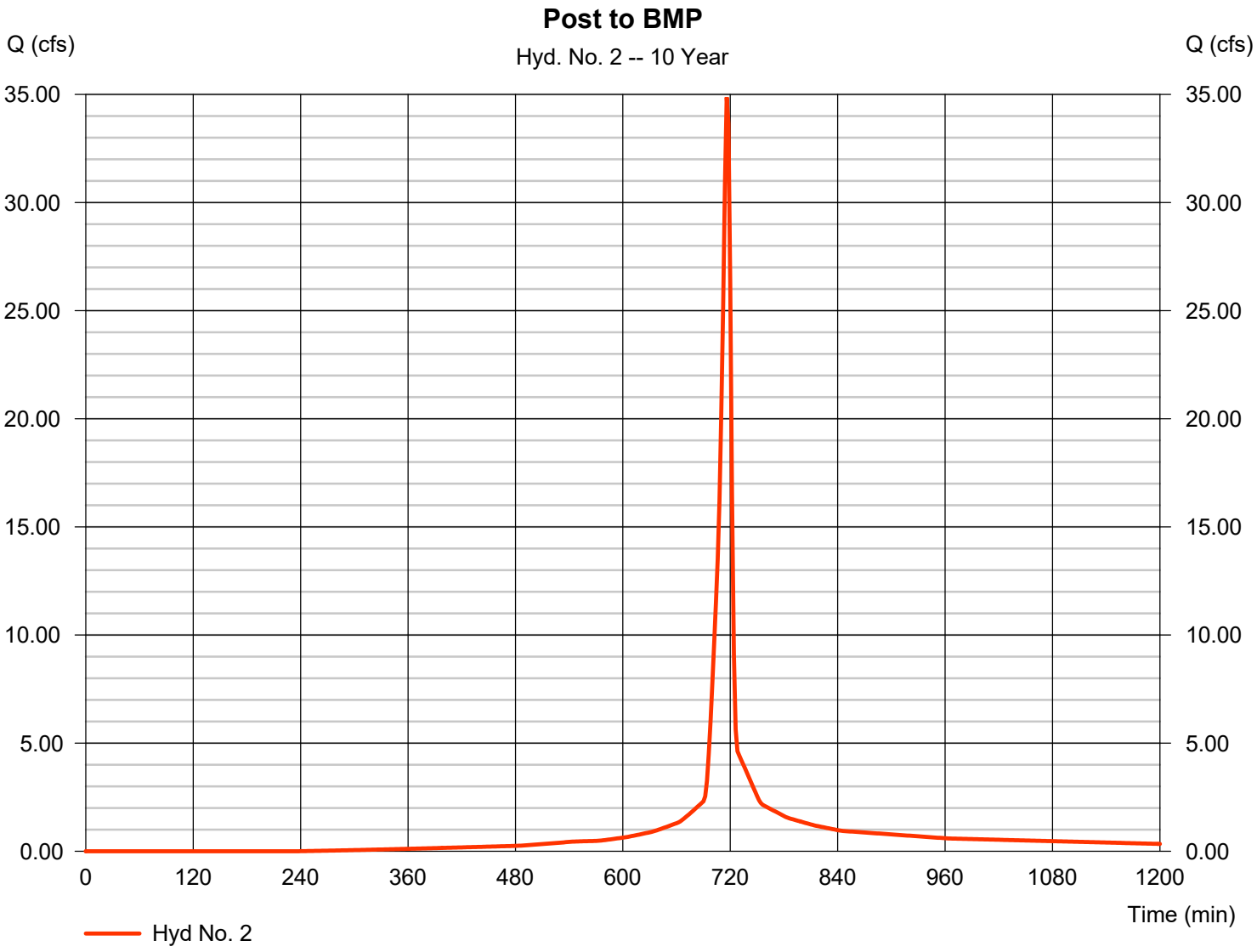


Hydrograph Report

Hyd. No. 2

Post to BMP

Hydrograph type	=	SCS Runoff	Peak discharge	=	34.87 cfs
Storm frequency	=	10 yrs	Time to peak	=	716 min
Time interval	=	2 min	Hyd. volume	=	74,612 cuft
Drainage area	=	5.300 ac	Curve number	=	89
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	5.38 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484



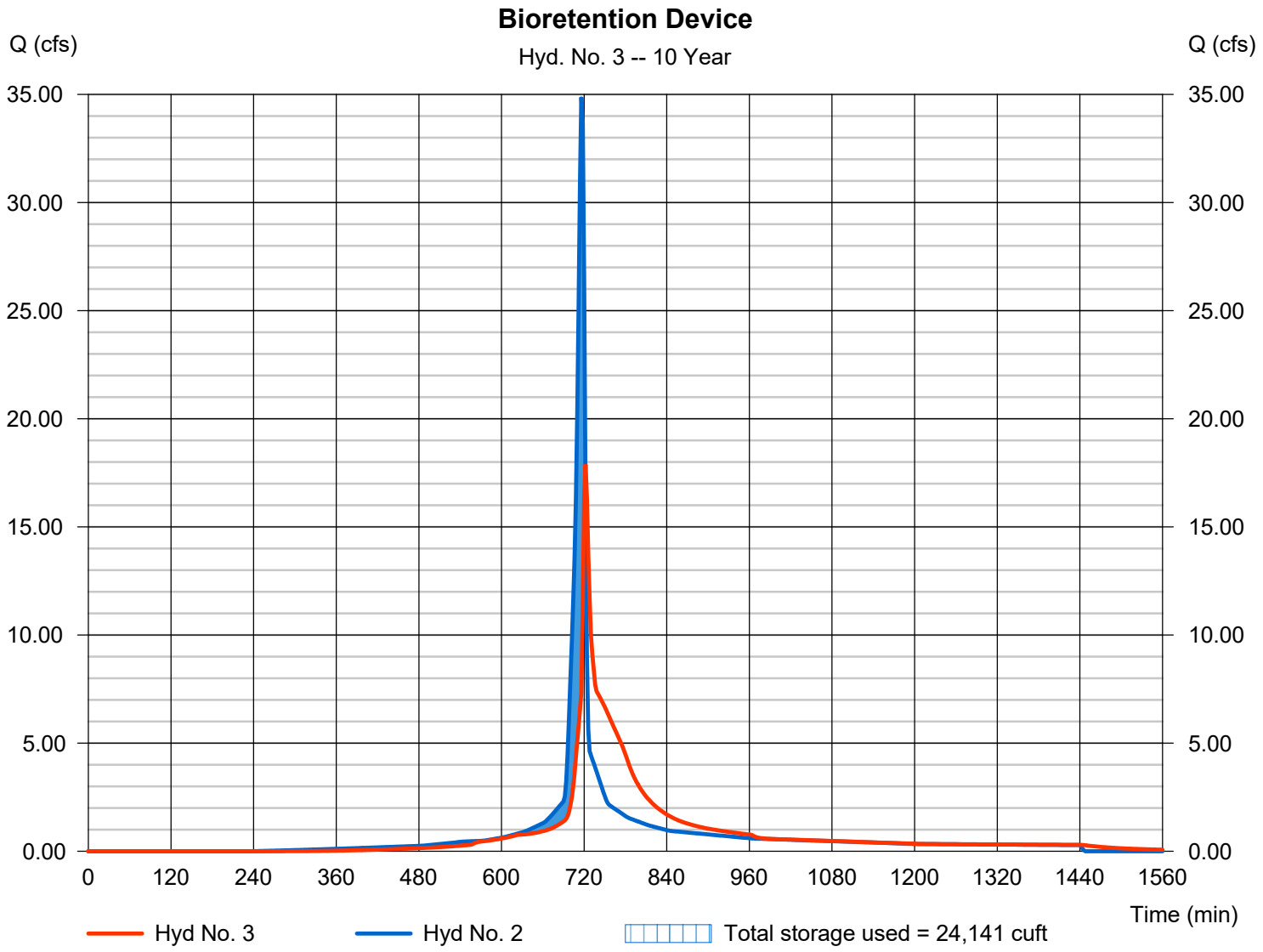
Hydrograph Report

Hyd. No. 3

Bioretention Device

Hydrograph type	=	Reservoir	Peak discharge	=	17.88 cfs
Storm frequency	=	10 yrs	Time to peak	=	722 min
Time interval	=	2 min	Hyd. volume	=	74,595 cuft
Inflow hyd. No.	=	2 - Post to BMP	Max. Elevation	=	313.27 ft
Reservoir name	=	Bioretention	Max. Storage	=	24,141 cuft

Storage Indication method used.

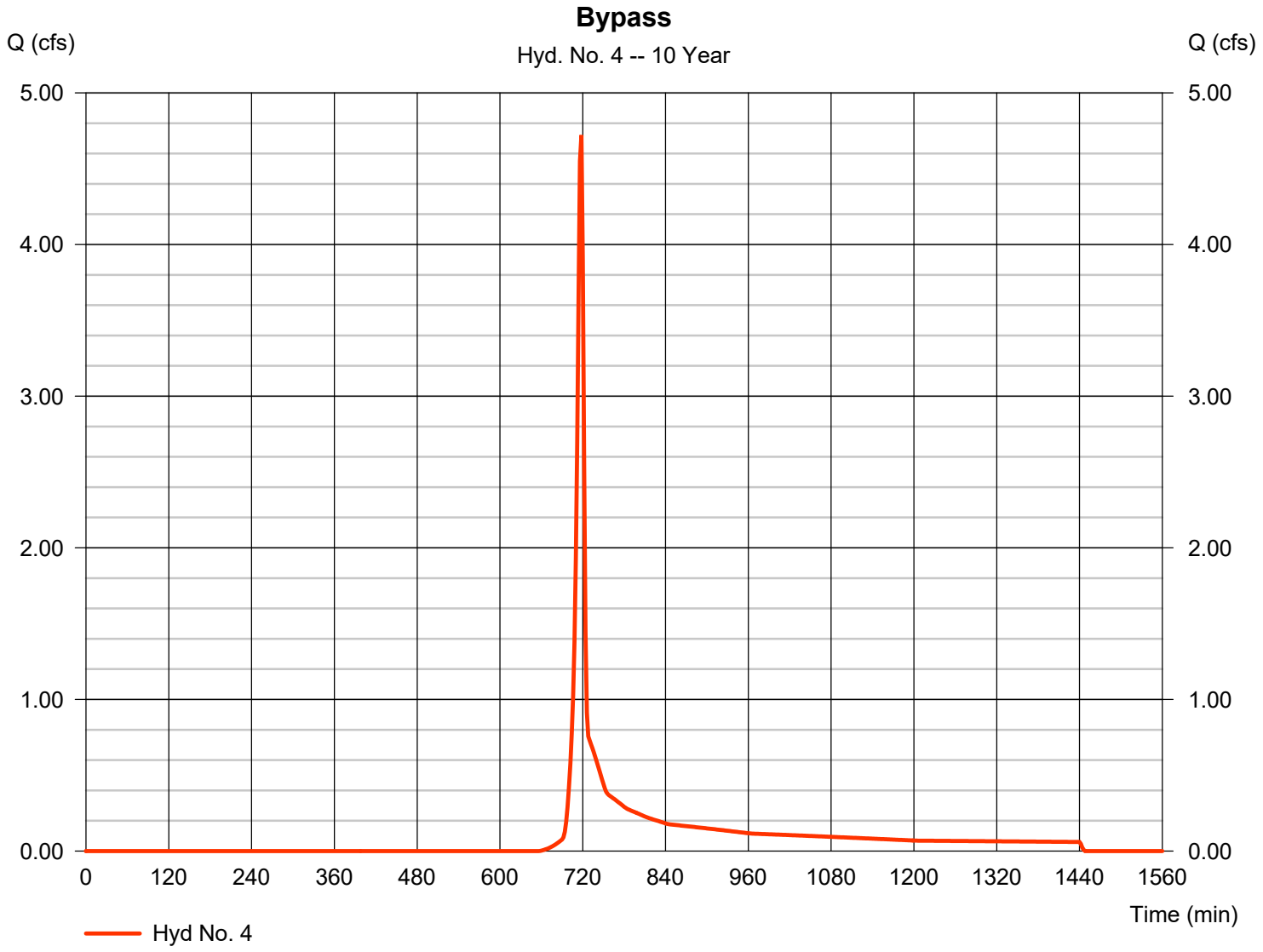


Hydrograph Report

Hyd. No. 4

Bypass

Hydrograph type	=	SCS Runoff	Peak discharge	=	4.722 cfs
Storm frequency	=	10 yrs	Time to peak	=	718 min
Time interval	=	2 min	Hyd. volume	=	9,480 cuft
Drainage area	=	1.660 ac	Curve number	=	62
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	5.38 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

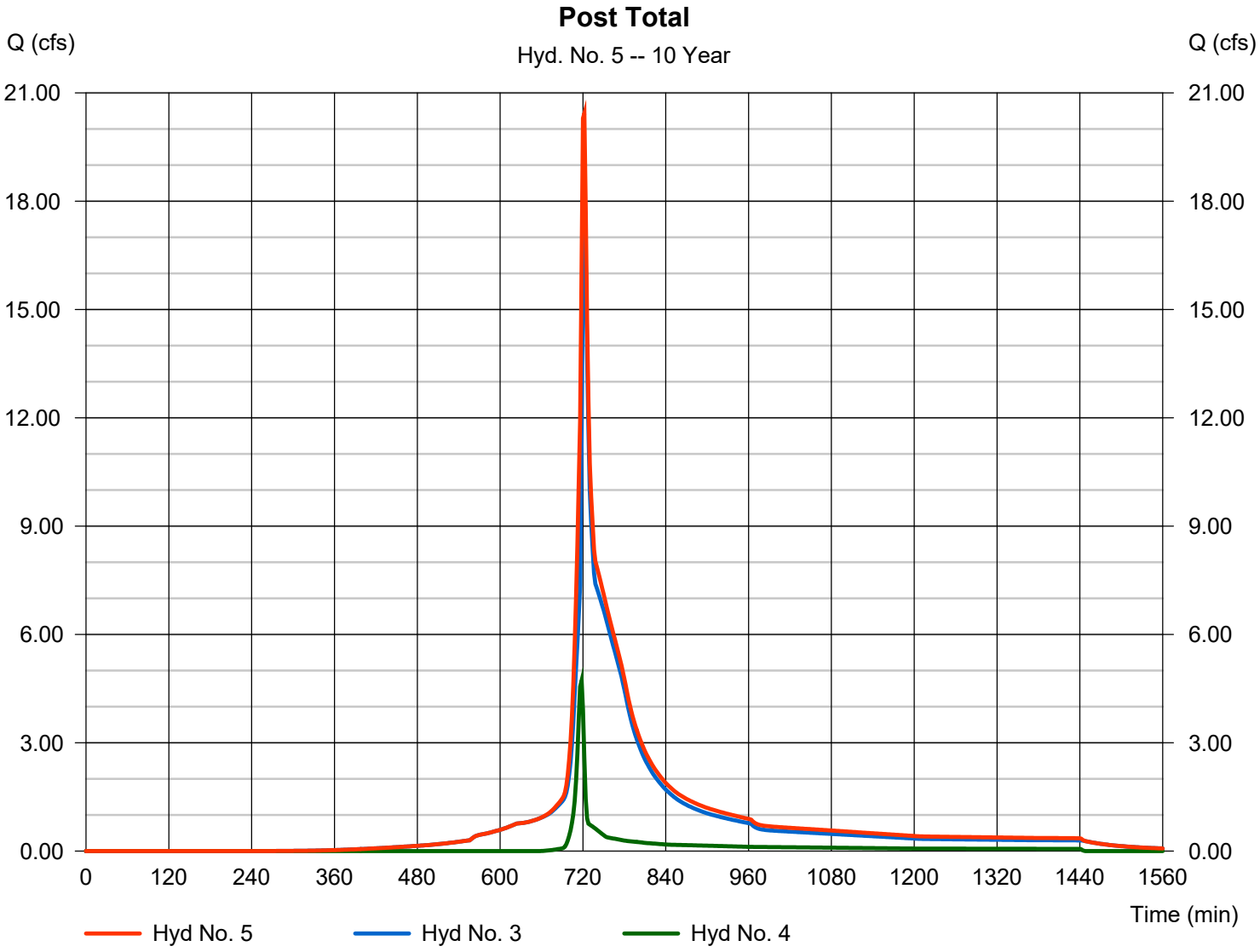


Hydrograph Report

Hyd. No. 5

Post Total

Hydrograph type	= Combine	Peak discharge	= 20.43 cfs
Storm frequency	= 10 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 84,075 cuft
Inflow hyds.	= 3, 4	Contrib. drain. area	= 1.660 ac

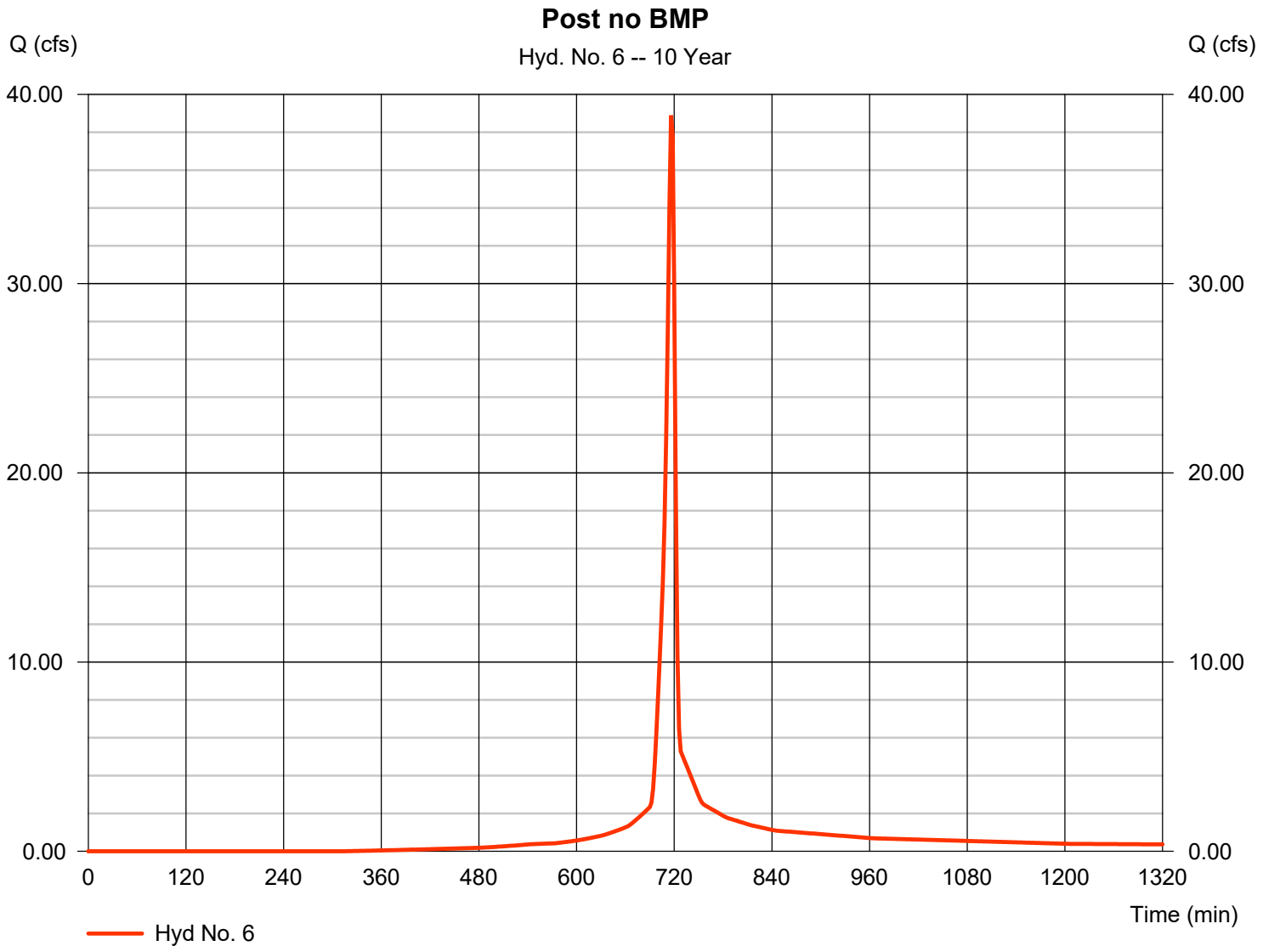


Hydrograph Report

Hyd. No. 6

Post no BMP

Hydrograph type	=	SCS Runoff	Peak discharge	=	38.89 cfs
Storm frequency	=	10 yrs	Time to peak	=	716 min
Time interval	=	2 min	Hyd. volume	=	81,041 cuft
Drainage area	=	6.400 ac	Curve number	=	85
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	5.38 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

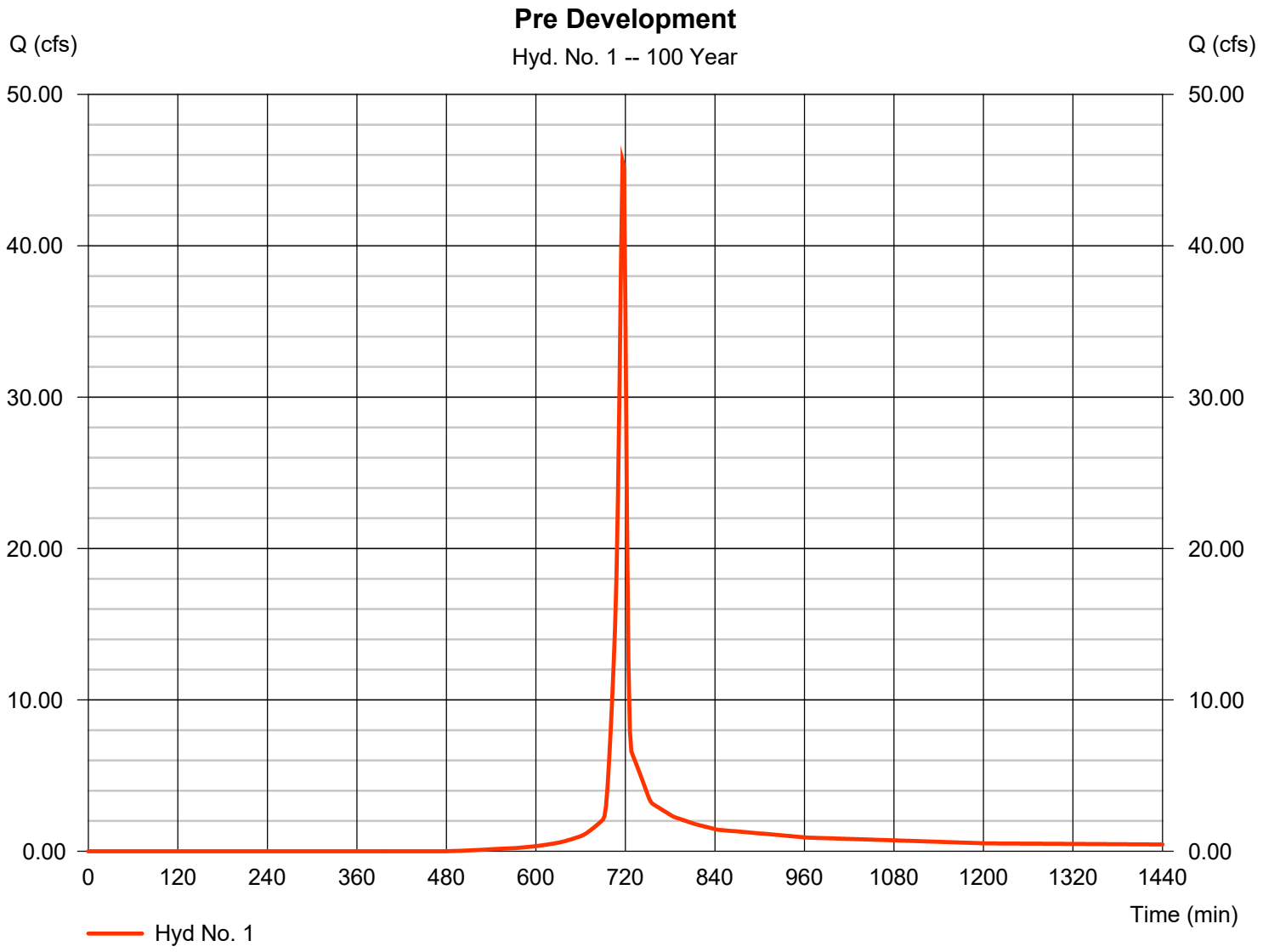
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	45.59	2	716	92,245	------	------	------	Pre Development
2	SCS Runoff	54.64	2	716	120,607	------	------	------	Post to BMP
3	Reservoir	34.32	2	720	120,590	2	313.73	32,583	Bioretention Device
4	SCS Runoff	9.994	2	718	20,091	------	------	------	Bypass
5	Combine	42.38	2	720	140,681	3, 4	------	------	Post Total
6	SCS Runoff	63.04	2	716	135,324	------	------	------	Post no BMP

Hydrograph Report

Hyd. No. 1

Pre Development

Hydrograph type	=	SCS Runoff	Peak discharge	=	45.59 cfs
Storm frequency	=	100 yrs	Time to peak	=	716 min
Time interval	=	2 min	Hyd. volume	=	92,245 cuft
Drainage area	=	6.400 ac	Curve number	=	68
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	8.00 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

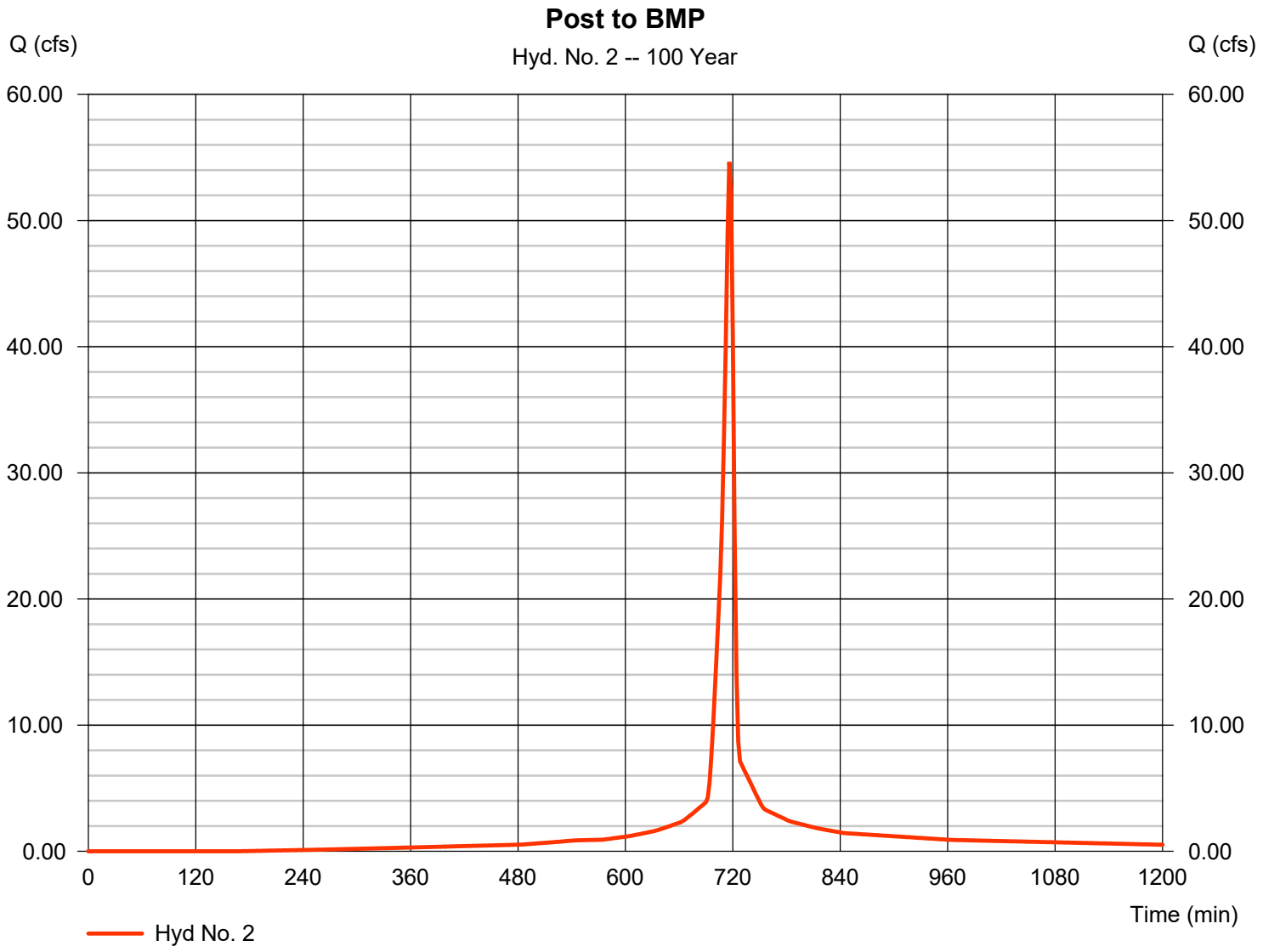


Hydrograph Report

Hyd. No. 2

Post to BMP

Hydrograph type	=	SCS Runoff	Peak discharge	=	54.64 cfs
Storm frequency	=	100 yrs	Time to peak	=	716 min
Time interval	=	2 min	Hyd. volume	=	120,607 cuft
Drainage area	=	5.300 ac	Curve number	=	89
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	8.00 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484



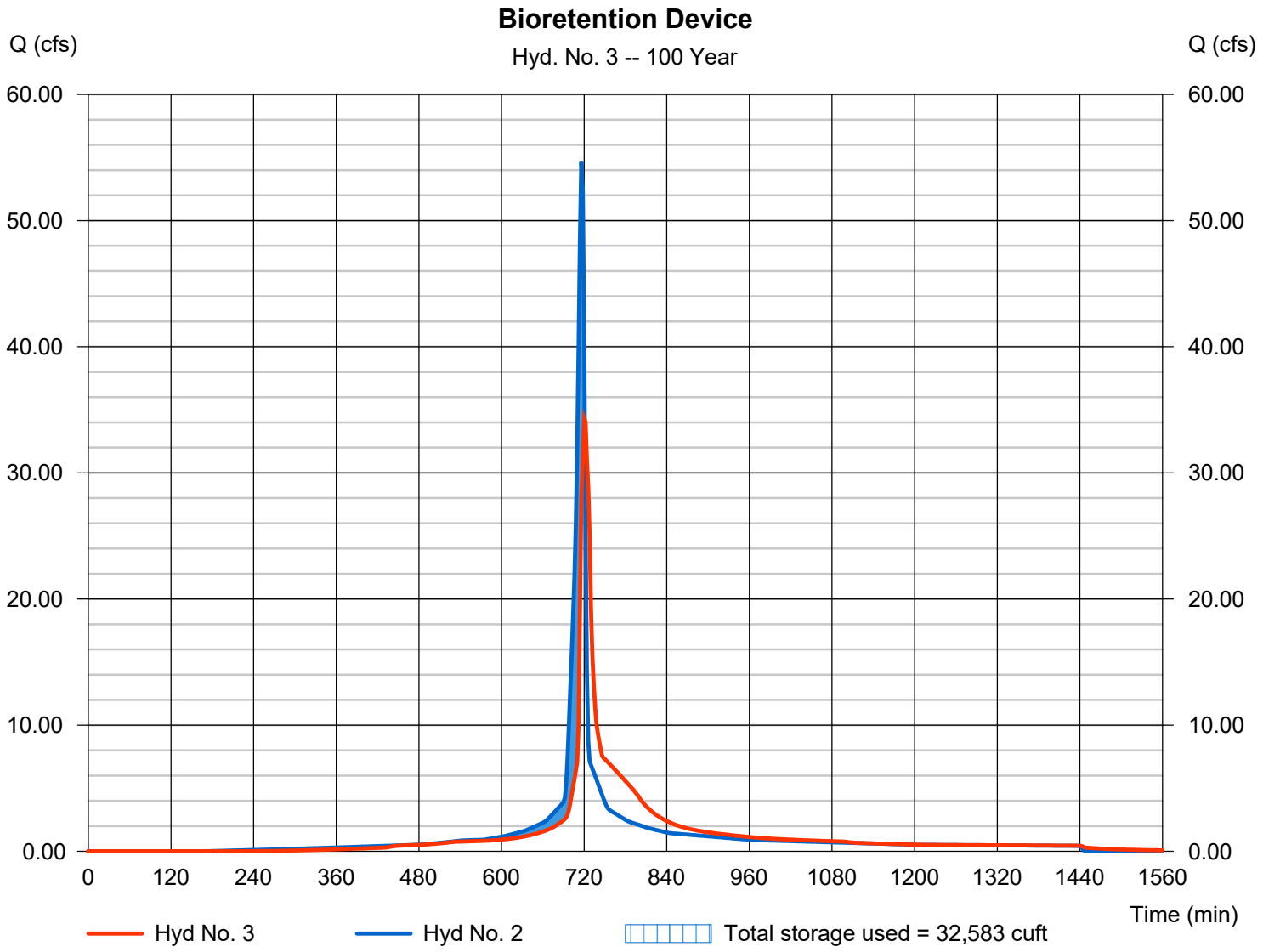
Hydrograph Report

Hyd. No. 3

Bioretention Device

Hydrograph type	=	Reservoir	Peak discharge	=	34.32 cfs
Storm frequency	=	100 yrs	Time to peak	=	720 min
Time interval	=	2 min	Hyd. volume	=	120,590 cuft
Inflow hyd. No.	=	2 - Post to BMP	Max. Elevation	=	313.73 ft
Reservoir name	=	Bioretention	Max. Storage	=	32,583 cuft

Storage Indication method used.

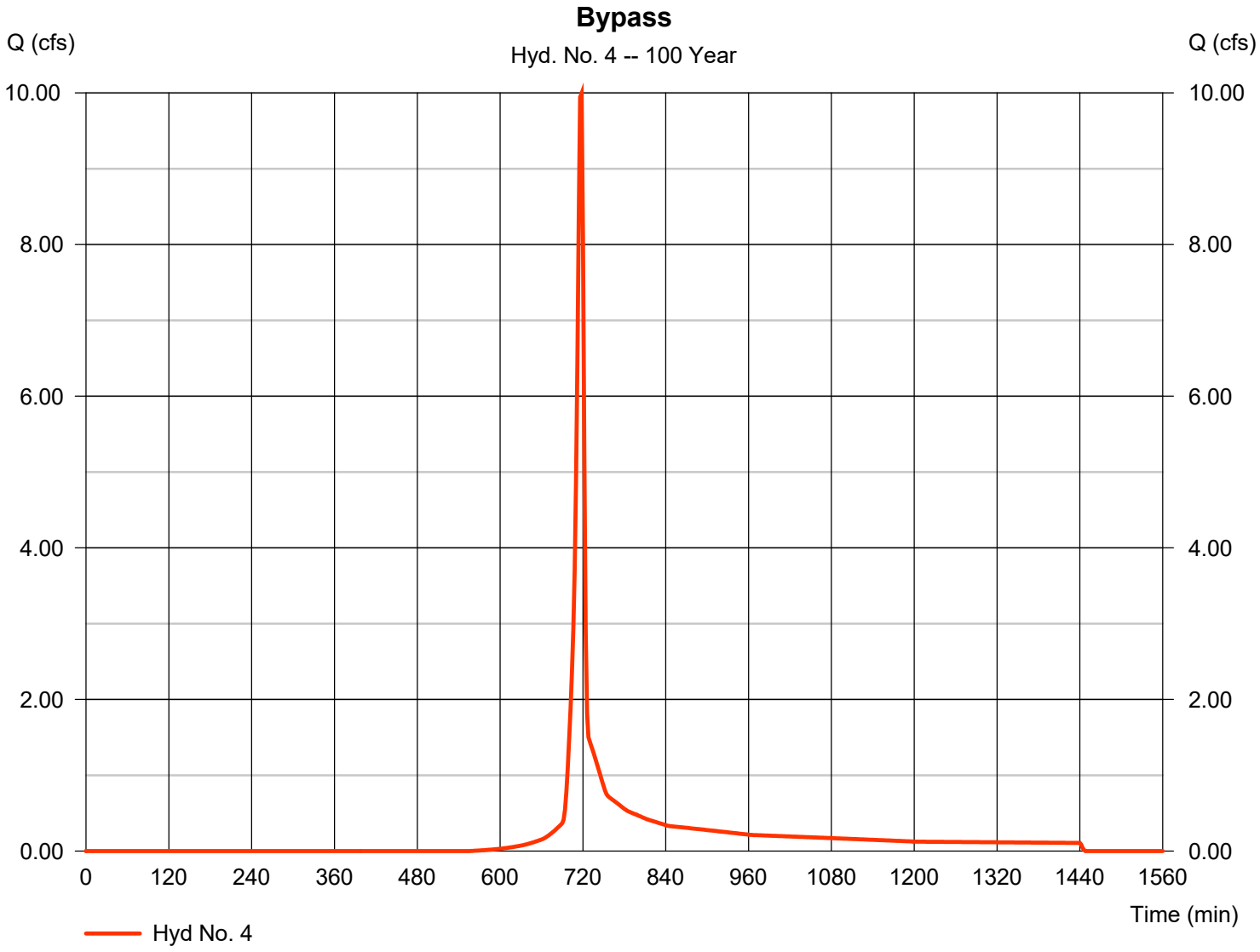


Hydrograph Report

Hyd. No. 4

Bypass

Hydrograph type	=	SCS Runoff	Peak discharge	=	9.994 cfs
Storm frequency	=	100 yrs	Time to peak	=	718 min
Time interval	=	2 min	Hyd. volume	=	20,091 cuft
Drainage area	=	1.660 ac	Curve number	=	62
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	8.00 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

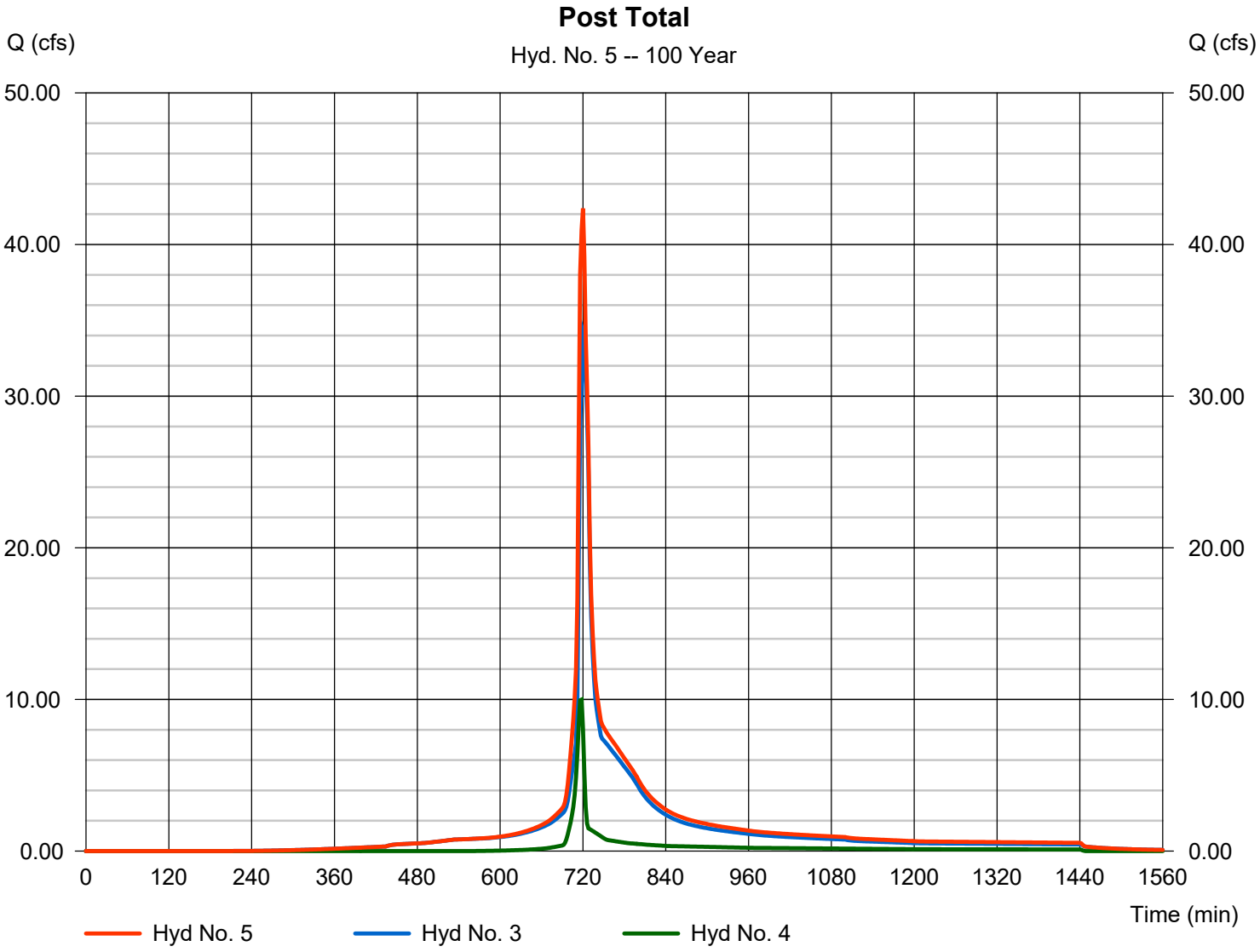


Hydrograph Report

Hyd. No. 5

Post Total

Hydrograph type	= Combine	Peak discharge	= 42.38 cfs
Storm frequency	= 100 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 140,681 cuft
Inflow hyds.	= 3, 4	Contrib. drain. area	= 1.660 ac

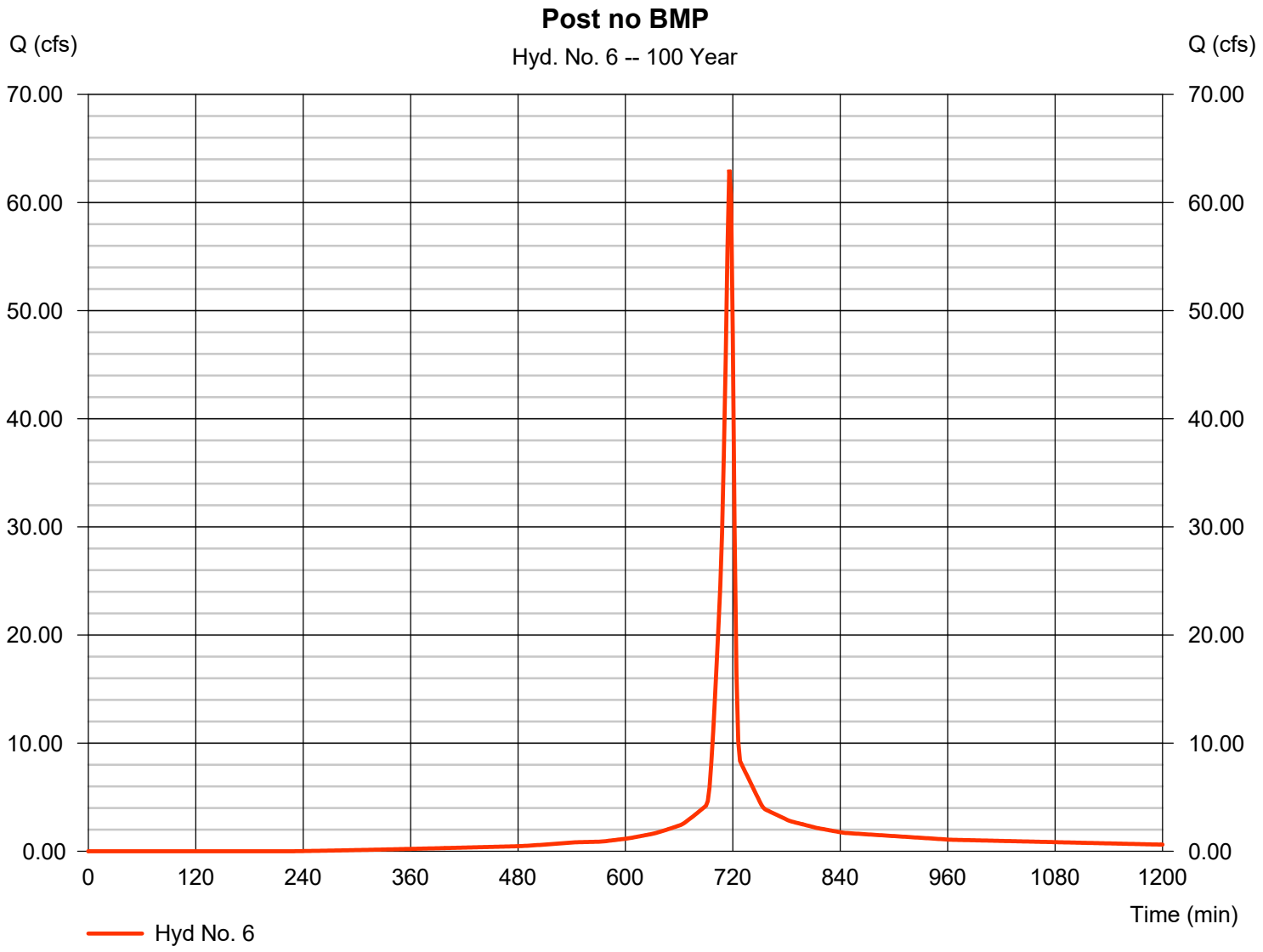


Hydrograph Report

Hyd. No. 6

Post no BMP

Hydrograph type	=	SCS Runoff	Peak discharge	=	63.04 cfs
Storm frequency	=	100 yrs	Time to peak	=	716 min
Time interval	=	2 min	Hyd. volume	=	135,324 cuft
Drainage area	=	6.400 ac	Curve number	=	85
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	8.00 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484



Wake County Stormwater Tool

WAKE COUNTY
NORTH CAROLINA

SITE DATA

Project Information	
Project Name:	**StorageMax Zebulon**
Applicant:	Shepard School LLC
Applicant Contact Name:	Allen Massey
Applicant Contact Number:	919-604-0505
Contact Email:	Storit@AOL.com
Municipal Jurisdiction (Select from dropdown menu):	Zebulon
Last Updated:	
Site Data:	
Total Site Area (Ac):	6.40
Existing Lake/Pond Area (Ac):	0.00
Proposed Disturbed Area (Ac):	5.93
Impervious Surface Area (acre):	3.64
Type of Development (Select from Dropdown menu):	Non-Residential
Percent Built Upon Area (BUA):	57%
Project Density:	High
Is the proposed project a site expansion?	No
Number of Drainage Areas on Site:	2
NOAA — **1-Year, 24-Hour Storm (inches) (See NOAA Website):**	2.85
2-Year, 24-Hour Storm (inches) (See NOAA Website):	3.45
10-Year, 24-Hour Storm (inches) (See NOAA Website):	5.38
Lot Data (if applicable):	
Total Acreage in Lots:	0.00
Number of Lots:	0
Average Lot Size (SF):	0.00
Total Impervious Surface Area on Lots (SF):	0.00
Average Impervious Surface Area Per Lot (SF):	0.00

Stormwater Narrative (limit to 1,200 characters - attach additional pages with submittal if necessary):

The project consists of a single parcel located at the intersection of Proctor Avenue and Shepard School Road near downtown Zebulon. The lot is approximately 6.40 acres. The parcel is vacant with grassy vegetation and wooded area along the property lines. There is 0 sq ft of existing impervious area on the site. The project will consist of a commercial buildings and the impervious area will be 3.64 acres, or approximately 57% of the gross site.

Project Name: StorageMax Zebulon

DRAINAGE AREA 1
STORMWATER PRE-POST CALCULATIONS

LAND USE & SITE DATA	PRE-DEVELOPMENT				POST-DEVELOPMENT			
Drainage Area (Acres)=	5.19				6.39			
Site Acreage within Drainage=	4.74				5.94			
One-year, 24-hour rainfall (in)=	2.85							
Two-year, 24-hour rainfall (in)=	3.45							
Ten-year, 24-hour storm (in)=	5.38							
Total Lake/Pond Area (Acres)=	0.00				0.00			
Lake/Pond Area not in the Tc flow path (Acres)=	0.00				0.00			
Site Land Use (acres):	A	B	C	D	A	B	C	D
Pasture	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Woods, Poor Condition	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Woods, Fair Condition	0.00	0.20	0.00	0.00	0.00	0.52	0.00	0.00
Woods, Good Condition	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Open Space, Poor Condition	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Open Space, Fair condition	0.00	4.54	0.00	0.00	0.00	0.70	0.00	0.00
Open Space, Good Condition	0.00	0.00	0.00	0.00	0.00	1.08	0.00	0.00
Reforestation (in dedicated OS)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Connected Impervious	0.00	0.00	0.00	0.00	0.00	3.64	0.00	0.00
Disconnected Impervious	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SITE FLOW	**PRE-DEVELOPMENT T_c**				**POST-DEVELOPMENT Tc**			
Sheet Flow								
Length (ft)=	50.00				50.00			
Slope (ft/ft)=	0.010				0.020			
Surface Cover:	Grass				Paved, Gravel, or Bare Soil			
n-value=	0.240				0.011			
T_t (hrs)=	0.191				0.012			
Shallow Flow								
Length (ft)=	100.00				100.00			
Slope (ft/ft)=	0.040				0.020			
Surface Cover:	Unpaved				Paved			
Average Velocity (ft/sec)=	3.23				2.87			
T_t (hrs)=	0.01				0.01			
Channel Flow 1								
Length (ft)=	310.00				657.00			
Slope (ft/ft)=	0.020				0.010			
Cross Sectional Flow Area (ft^2)=	1.00				1.24			
Wetted Perimeter (ft)=	4.12				2.81			
Channel Lining:	Grass				Concrete, finished			
n-value=	0.035				0.012			
Hydraulic Radius (ft)=	0.24				0.44			
Average Velocity (ft/sec)=	2.34				7.20			
T_t (hrs)=	0.04				0.03			

Project Name: StorageMax Zebulon

DRAINAGE AREA 1
STORMWATER PRE-POST CALCULATIONS

Channel Flow 2		
Length (ft)=	0.00	0.00
Slope (ft/ft)=	0.000	0.000
Cross Sectional Flow Area (ft^2)=	0.00	0.00
Wetted Perimeter (ft)=	0.00	0.00
Channel Lining:	Grass	Concrete, finished
n-value=	0.035	0.012
Hydraulic Radius (ft)=		
Average Velocity (ft/sec)=		
T_t (hrs)=		
Channel Flow 3		
Length (ft)=	0.00	0.00
Slope (ft/ft)=	0.000	0.000
Cross Sectional Flow Area (ft^2)=	0.00	0.00
Wetted Perimeter (ft)=	0.00	0.00
Channel Lining:	Grass	Concrete, finished
n-value=	0.035	0.012
Hydraulic Radius (ft)=		
Average Velocity (ft/sec)=		
T_t (hrs)=		
Tc (hrs)=	0.24	0.05
RESULTS	**PRE-DEVELOPMENT**	**POST-DEVELOPMENT**
Composite Curve Number=	69	85
Disconnected Impervious Adjustment		
Disconnected impervious area (acre) =		
$CN_{adjusted\ (1\text{-}year)}$=	**85**	
High Density Only		
Volume of runoff from 1" rainfall for DA HIGH DENSITY REQUIREMENT = (ft^3) =	13,052	
1-year, 24-hour storm (Peak Flow)		
Runoff (inches) = $Q^*_{1\text{-}year}$=	0.58	1.43
Volume of runoff (ft^3) =	9,903	30,839
Volume change (ft^3) =	20,936	
Peak Discharge (cfs)= $Q_{1\text{-}year}$=	3.010	17.180
2-year, 24-hour storm (LID)		
Runoff (inches) = $Q^*_{2\text{-}year}$=	0.90	1.94
Volume of runoff (ft^3) =	15,560	41,732
Peak Discharge (cfs)= $Q_{2\text{-}year}$=	4.730	23.249
10-year, 24-hour storm (DIA)		
Runoff (inches) = $Q^*_{10\text{-}year}$=	2.21	3.67
Volume of runoff (ft^3) =	37,959	63,202
Peak Discharge (cfs)= $Q_{10\text{-}year}$=	11.539	44.123

Project Name: StorageMax Zebulon

DRAINAGE AREA 2
STORMWATER PRE-POST CALCULATIONS

LAND USE & SITE DATA	PRE-DEVELOPMENT				POST-DEVELOPMENT			
Drainage Area (Acres)=	1.66				0.58			
Site Acreage within Drainage=	1.66				0.58			
One-year, 24-hour rainfall (in)=	2.85							
Two-year, 24-hour rainfall (in)=	3.45							
Ten-year, 24-hour storm (in)=	5.38							
Total Lake/Pond Area (Acres)=	0.00				0.00			
Lake/Pond Area not in the Tc flow path (Acres)=	0.00				0.00			
Site Land Use (acres):	A	B	C	D	A	B	C	D
Pasture	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Woods, Poor Condition	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Woods, Fair Condition	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Woods, Good Condition	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Open Space, Poor Condition	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Open Space, Fair condition	0.00	1.66	0.00	0.00	0.00	0.00	0.00	0.00
Open Space, Good Condition	0.00	0.00	0.00	0.00	0.00	0.53	0.00	0.00
Reforestation (in dedicated OS)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Connected Impervious	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00
Disconnected Impervious	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SITE FLOW	**PRE-DEVELOPMENT T_c**				**POST-DEVELOPMENT Tc**			
Sheet Flow								
Length (ft)=	50.00				50.00			
Slope (ft/ft)=	0.020				0.020			
Surface Cover:	Grass				Grass			
n-value=	0.240				0.240			
T_t (hrs)=	0.145				0.145			
Shallow Flow								
Length (ft)=	235.00				150.00			
Slope (ft/ft)=	0.030				0.020			
Surface Cover:	Unpaved				Unpaved			
Average Velocity (ft/sec)=	2.79				2.28			
T_t (hrs)=	0.02				0.02			
Channel Flow 1								
Length (ft)=	100.00				120.00			
Slope (ft/ft)=	0.030				0.020			
Cross Sectional Flow Area (ft^2)=	1.00				1.00			
Wetted Perimeter (ft)=	4.12				4.12			
Channel Lining:	Grass				Concrete, finished			
n-value=	0.035				0.012			
Hydraulic Radius (ft)=	0.24				0.24			
Average Velocity (ft/sec)=	2.87				6.83			
T_t (hrs)=	0.01				0.00			

Project Name: StorageMax Zebulon

DRAINAGE AREA 2
STORMWATER PRE-POST CALCULATIONS

Channel Flow 2		
Length (ft)=	0.00	0.00
Slope (ft/ft)=	0.010	0.000
Cross Sectional Flow Area (ft^2)=	0.00	0.00
Wetted Perimeter (ft)=	0.00	0.00
Channel Lining:	Weeds	Weeds
n-value=	0.040	0.040
Hydraulic Radius (ft)=		
Average Velocity (ft/sec)=		
T_t (hrs)=		
Channel Flow 3		
Length (ft)=	0.00	0.00
Slope (ft/ft)=	0.010	0.000
Cross Sectional Flow Area (ft^2)=	0.00	0.00
Wetted Perimeter (ft)=	0.00	0.00
Channel Lining:	Weeds	Weeds
n-value=	0.040	0.040
Hydraulic Radius (ft)=		
Average Velocity (ft/sec)=		
T_t (hrs)=		
Tc (hrs)=	0.18	0.17
RESULTS	**PRE-DEVELOPMENT**	**POST-DEVELOPMENT**
Composite Curve Number=	69	64
Disconnected Impervious Adjustment		
Disconnected impervious area (acre) =		
$CN_{adjusted\ (1\text{-}year)}$=	**64**	
High Density Only		
Volume of runoff from 1" rainfall for DA HIGH DENSITY REQUIREMENT = (ft^3) =	269	
1-year, 24-hour storm (Peak Flow)		
Runoff (inches) = $Q^*_{1\text{-}year}$=	0.59	0.41
Volume of runoff (ft^3) =	3,561	866
Volume change (ft^3) =		
Peak Discharge (cfs)= $Q_{1\text{-}year}$=	1.128	0.232
2-year, 24-hour storm (LID)		
Runoff (inches) = $Q^*_{2\text{-}year}$=	0.92	0.69
Volume of runoff (ft^3) =	5,569	1,450
Peak Discharge (cfs)= $Q_{2\text{-}year}$=	1.764	0.389
10-year, 24-hour storm (DIA)		
Runoff (inches) = $Q^*_{10\text{-}year}$=	2.24	1.85
Volume of runoff (ft^3) =	13,485	11,132
Peak Discharge (cfs)= $Q_{10\text{-}year}$=	4.271	1.042

Project Name: StorageMax Zebulon

DA SITE SUMMARY
STORMWATER PRE-POST CALCULATIONS

SITE SUMMARY

DRAINAGE AREA SUMMARIES

DRAINAGE AREA:	DA1	DA2	DA3	DA4	DA5	DA6	DA7	DA8	DA9	DA10
Pre-Development (1-year, 24-hour storm)										
Runoff (in) = $Q_{pre,1\text{-}year}$ =	0.58	0.59								
Peak Flow (cfs)=$Q_{1\text{-}year}$ =	3.010	1.128								
Post-Development (1-year, 24-hour storm)										
Proposed Impervious Surface (acre) =	3.64	0.05								
Runoff (in)=$Q_{1\text{-}year}$ =	1.43	0.41								
Peak Flow (cfs)=$Q_{1\text{-}year}$ =	17.180	0.232								
Increase in volume per DA (ft^3)_1-yr storm=	20,936									
Minimum Volume to be Managed for DA HIGH DENSITY REQUIREMENT = (ft^3) =	13,052	269								

TARGET CURVE NUMBER (TCN)

Site Data

SITE \SOIL COMPOSITION

HYDROLOGIC SOIL GROUP	Site Area	%	Target CN
A	0.00	0%	N/A
B	6.52	100%	N/A
C	0.00	0%	N/A
D	0.00	0%	N/A

Total Site Area (acres) =	6.52
Percent BUA (Includes Existing Lakes/Pond Areas) =	57%
Project Density =	High
Target Curve Number (TCN) =	N/A
$CN_{adjusted\ (1\text{-}year)}$=	
Minimum Volume to be Managed (Total Site) Per TCN Requirement= ft^3 =	

Site Nitrogen Loading Data

HSG	TN export coefficient (lbs/ac/yr)	Site Acreage	N Export
Pasture	1.2	0.00	0.00
Woods, Poor Condition	1.6	0.00	0.00
Woods, Fair Condition	1.2	0.52	0.62
Woods, Good Condition	0.8	0.00	0.00
Open Space, Poor Condition	1.0	0.00	0.00
Open Space, Fair Condition	0.8	0.70	0.56
Open Space, Good Condition	0.6	1.61	0.97
Reforestation (in dedicated OS)	0.6	0.00	0.00
Impervious	21.2	3.69	78.23

SITE NITROGEN LOADING RATE (lbs/ac/yr)=	12.33
Nitrogen Load (lbs/yr)=	80.38
TOTAL SITE NITROGEN TO MITIGATE (lbs/yr)_Wendell Only=	56.91

Site Nitrogen Loading Data For Expansions Only

	Existing	New
Impervious(acres)=	NA	NA
"Expansion Area" (acres=)		
Nitrogen Load (lbs/yr)=	NA	NA
SITE NITROGEN LOADING RATE (lbs/ac/yr)=	NA	NA
Total Site loading rate (lbs/ac/yr)		
TOTAL SITE NITROGEN TO MITIGATE (lbs/yr)=	NA	

Project Name: StorageMax Zebulon

DRAINAGE AREA 1
BMP CALCULATIONS

DRAINAGE AREA 1 - BMP DEVICES AND ADJUSTMENTS				
DA1 Site Acreage=	5.94			
DA1 Off-Site Acreage=	0.45			
Total Required Storage Volume for Site TCN Requirement (ft^3)=				
Total Required Storage Volume for DA1 1" Rainfall for High Density (ft^3)=	13,052			
Will site use underground detention/cistern?	No	Enter % of the year water will be reused=	0%	Note: Supporting information/details should be submitted to demonstrate water usage.

ENTER ACREAGE FOR ALL SUB-DRAINAGE AREAS IN DA

HSG	Sub-DA1(a) (Ac)		Sub-DA1(b) (Ac)		Sub-DA1(c) (Ac)		Sub-DA1(d) (Ac)		Sub-DA1(e) (Ac)	
	Site	Off-site	Site	Off-site	Site	Off-site	Site	Off-site	Site	Off-site
Pasture	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Woods, Poor Condition	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Woods, Fair Condition	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Woods, Good Condition	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Open Space, Poor Condition	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Open Space, Fair Condition	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Open Space, Good Condition	0.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Reforestation (in dedicated OS)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Impervious	3.64	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Sub-DA1(a) BMP(s)

Device Name (As Shown on Plan)	Device Type	Water Quality Volume for Sub-DA (ft^3)	Provided Volume that will drawdown 2-5 days (ft^3)	Nitrogen Removal Efficiency	Sub-DA Nitrogen (lbs)	Nitrogen Removed (lbs)	Drawdown Time (hours)
Bioretention	Bioretention with IWS	12,752	15,388	40%	78.07	31.23	48
				0%	46.84	0.00	0
				0%	46.84	0.00	0
				0%	46.84	0.00	0
				0%	46.84	0.00	0
Total Nitrogen remaining leaving the subbasin (lbs):		**46.84**					

Sub-DA1(b) BMP(s)

If Sub-DA1(b) is connected to upstream subbasin(s), enter the nitrogen leaving the most upstream subbasin(lbs):							
Device Name (As Shown on Plan)	Device Type	Water Quality Volume for Sub-DA (ft^3)	Provided Volume that will drawdown 2-5 days (ft^3)	Nitrogen Removal Efficiency	Sub-DA Nitrogen (lbs)	Nitrogen Removed (lbs)	Drawdown Time (hours)
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
Total Nitrogen remaining leaving the subbasin (lbs):							

Sub-DA1 (c) BMP(s)

If Sub-DA1(c) is connected to upstream subbasin(s), enter the nitrogen leaving the most upstream subbasin(lbs):							
Device Name (As Shown on Plan)	Device Type	Water Quality Volume for Sub-DA (ft^3)	Provided Volume that will drawdown 2-5 days (ft^3)	Nitrogen Removal Efficiency	Sub-DA Nitrogen (lbs)	Nitrogen Removed (lbs)	Drawdown Time (hours)
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
Total Nitrogen remaining leaving the subbasin (lbs):							

Project Name: StorageMax Zebulon

DRAINAGE AREA 1
BMP CALCULATIONS

Sub-DA1(d) BMP(s)							
If Sub-DA1(d) is connected to upstream subbasin(s), enter the nitrogen leaving the most upstream subbasin(lbs):							
Device Name (As Shown on Plan)	Device Type	Water Quality Volume for Sub-DA (ft^3)	Provided Volume that will drawdown 2-5 days (ft^3)	Nitrogen Removal Efficiency	Sub-DA Nitrogen (lbs)	Nitrogen Removed (lbs)	Drawdown Time (hours)
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
Total Nitrogen remaining leaving the subbasin (lbs):							

Sub-DA1(e) BMP(s)							
If Sub-DA1(e) is connected to upstream subbasin(s), enter the nitrogen leaving the most upstream subbasin(lbs):							
Device Name (As Shown on Plan)	Device Type	Water Quality Volume for Sub-DA (ft^3)	Provided Volume that will drawdown 2-5 days (ft^3)	Nitrogen Removal Efficiency	Sub-DA Nitrogen (lbs)	Nitrogen Removed (lbs)	Drawdown Time (hours)
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
Total Nitrogen remaining leaving the subbasin (lbs):							

DA1 BMP SUMMARY	
Total Volume Treated (ft^3)=	#VALUE!
Nitrogen Mitigated(lbs)=	31.23
1-year, 24-hour storm	
Post BMP Volume of Runoff (ft^3)$_{(1\text{-year})}$=	
Post BMP Runoff (inches) = $Q^*_{(1\text{-year})}$=	
Post BMP $CN_{(1\text{-year})}$=	
Post BMP Peak Discharge (cfs)= $Q_{1\text{-year}}$=	
2-year, 24-hour storm (LID)	
Post BMP Volume of Runoff (ft3)$_{(2\text{-year})}$=	
Post BMP Runoff (inches) = $Q^*_{(2\text{-year})}$=	
Post BMP $CN_{(2\text{-year})}$=	
Post BMP Peak Discharge (cfs)= $Q_{(2\text{-year})}$=	
10-year, 24-hour storm (DIA)	
Post BMP Volume of Runoff (ft^3)$_{(10\text{-year})}$=	
Post BMP Runoff (inches) = $Q^*_{(10\text{-year})}$=	
Post BMP $CN_{(10\text{-year})}$=	
Post BMP Peak Discharge (cfs)= $Q_{(10\text{-year})}$=	

Project Name: StorageMax Zebulon

DA SITE SUMMARY
BMP CALCULATIONS

BMP SUMMARY										
DRAINAGE AREA SUMMARIES										
DRAINAGE AREA:	DA1	DA2	DA3	DA4	DA5	DA6	DA7	DA8	DA9	DA10
Pre-Development (1-year, 24-hour storm)										
Runoff (in)=$Q^*_{1\text{-year}}$ =	0.58	0.59								
Peak Flow (cfs)=$Q_{1\text{-year}}$ =	3.010	1.128								
Post-Development (1-year, 24-hour storm)										
Target Curve Number (TCN) =	NA									
Post BMP Runoff (inches) = $Q^*_{(1\text{-year})}$=		0.41								
Post BMP Peak Discharge (cfs)= $Q_{1\text{-year}}$=										
Post BMP $CN_{(1\text{-year})}$=										
Post-BMP Nitrogen Loading										
TOTAL SITE NITROGEN MITIGATED (lbs)=	31.23									
SITE NITROGEN LOADING RATE (lbs/ac/yr)=	7.54									
TOTAL SITE NITROGEN LEFT TO MITIGATE_Wendell Only (lbs)=	**25.68**									

O&M Manual

Operation & Maintenance Agreement

Project Name: StorageMax
Project Location: Zebulon NC

Cover Page

Maintenance records shall be kept on the following SCM(s). This maintenance record shall be kept in a log in a known set location. Any deficient SCM elements noted in the inspection will be corrected, repaired, or replaced immediately. These deficiencies can affect the integrity of structures, safety of the public, and the pollutant removal efficiency of the SCM(s).

The SCM(s) on this project include (check all that apply & corresponding O&M sheets will be added automatically):

Infiltration Basin	Quantity:		Location(s):	
Infiltration Trench	Quantity:		Location(s):	
Bioretention Cell	Quantity:	1	Location(s):	901 Proctor Street
Wet Pond	Quantity:		Location(s):	
Stormwater Wetland	Quantity:		Location(s):	
Permeable Pavement	Quantity:		Location(s):	
Sand Filter	Quantity:		Location(s):	
Rainwater Harvesting	Quantity:		Location(s):	
Green Roof	Quantity:		Location(s):	
Level Spreader - Filter Strip	Quantity:		Location(s):	
Proprietary System	Quantity:		Location(s):	
Treatment Swale	Quantity:		Location(s):	
Dry Pond	Quantity:		Location(s):	
Disconnected Impervious Surface	Present:	No	Location(s):	
User Defined SCM	Present:	No	Location(s):	
Low Density	Present:	No	Type:	

I acknowledge and agree by my signature below that I am responsible for the performance of the maintenance procedures listed for each SCM above, and attached O&M tables. I agree to notify NCDEQ of any problems with the system or prior to any changes to the system or responsible party.

Responsible Party:	E. ALLEN MASSEY
Title & Organization:	MEMBER MANAGER - SHEPARD SCHOOL, LLC
Street address:	2700 GRESHAM LAKE RD
City, state, zip:	RALEIGH NC 27615
Phone number(s):	919 706 5766
Email:	STORIT@AOL.COM / JANETC@STORAGEMAXNC.COM

Signature: E. Allen Massey Date: 7.06.23

I, JANET C. MILLS, a Notary Public for the State of NORTH CAROLINA

County of WAKE, do hereby certify that E. ALLEN MASSEY

personally appeared before me this 6 day of JULY 2023 and

acknowledge the due execution of the Operations and Maintenance Agreement.

Witness my hand and official seal, Janet C Mills.

JANET C MILLS NOTARY PUBLIC WAKE COUNTY, NC

MY COMMISSION EXPIRES: 4.29.27

Bioretention Maintenance Requirements

Important operation and maintenance procedures:

- Immediately after the bioretention cell is established, the plants will be watered twice weekly if needed until the plants become established (commonly six weeks).
- Snow, mulch or any other material will NEVER be piled on the surface of the bioretention cell.
- Heavy equipment will NEVER be driven over the bioretention cell.
- Special care will be taken to prevent sediment from entering the bioretention cell.
- Once a year, a soil test of the soil media will be conducted.
- Remove top layer of fill media when the pool does not drain quickly. Based on the media specification, the pool should drain within 24 hours.

After the bioretention cell is established, it will be inspected **quarterly and within 24 hours after every storm event greater than 1.0 inches (or 1.5 inches if in a Coastal County)** . Records of operation and maintenance shall be kept in a known set location and shall be available upon request.

Inspection activities shall be performed as follows. Any problems that are found shall be repaired immediately.

SCM element:	Potential problem:	How to remediate the problem:
The entire bioretention cell	Trash/debris is present.	Remove the trash/debris.
The perimeter of the bioretention cell	Areas of bare soil and/or erosive gullies have formed.	Regrade the soil if necessary to remove the gully, plant ground cover and water until it is established. Provide lime and a one-time fertilizer application.
The flow diversion structure (if applicable)	The structure is clogged.	Unclog the structure and dispose of any sediment off-site.
	The structure is damaged.	Make any necessary repairs or replace if the damage is too much for repair.
The inlet device	The inlet pipe is clogged (if applicable).	Unclog the pipe and dispose of any sediment in a location where it will not cause impacts to streams or the SCM.
	The inlet pipe is cracked or otherwise damaged (if applicable).	Repair or replace the pipe.
	Erosion is occurring in the swale (if applicable).	Regrade the swale if necessary and provide erosion control devices such as reinforced turf matting or riprap to avoid future erosion problems.
	Stone verge is clogged or covered in sediment (if applicable).	Remove sediment and clogged stone and replace with clean stone.
The pretreatment area	Flow is bypassing pretreatment area and/or gullies have formed.	Regrade if necessary to route all flow to the pretreatment area. Restabilize the area after grading.
	Sediment has accumulated to a depth greater than three inches.	Search for the source of the sediment and remedy the problem if possible. Remove the sediment and dispose of it in a location where it will not cause impacts to streams or the SCM.

	Erosion has occurred.	Provide additional erosion protection such as reinforced turf matting or riprap if needed to prevent future erosion problems.
	Weeds are present.	Remove the weeds, preferably by hand. If pesticide is used, wipe it on the plants rather than spraying.

Bioretention Maintenance Requirements (continued)		
SCM element:	**Potential problem:**	**How to remediate the problem:**
Bioretention cell vegetation	Best professional practices show that pruning is needed to maintain optimal plant health.	Prune according to best professional practices. Maintain lines of sight between 2'-6'.
	Plants are dead, diseased or dying.	Determine the source of the problem: soils, hydrology, disease, etc. Remedy the problem and replace plants. Provide a one-time fertilizer application to establish the ground cover if a soil test indicates it is necessary. If sod was used, check to see that it was not grown on clay or impermeable soils. Replace sod if necessary.
	Weeds are present.	Remove the weeds, preferably by hand. If pesticide is used, wipe it on the plants rather than spraying.
	Tree stakes/wires are present six months after planting.	Remove tree stake/wires (which can kill the tree if not removed).
Bioretention cell mulch and media	Mulch is breaking down or has floated away.	Spot mulch if there are only random void areas. Replace whole mulch layer if necessary. Remove the remaining mulch and replace with triple shredded hard wood mulch at a maximum depth of four inches.
	Soils and/or mulch are clogged with sediment.	Determine the extent of the clogging - remove and replace either just the top layers or the entire media as needed. Dispose of the spoil in an appropriate off-site location. Use triple shredded hard wood mulch at a maximum depth of four inches. Search for the source of the sediment and remedy the problem if possible.
	An annual soil test shows that pH has dropped or heavy metals have accumulated in the soil media.	Dolomitic lime shall be applied as recommended per the soil te and toxic soils shall be removed, disposed of properly and replaced with new planting media.
The underdrain, filter fabric element, and outlet system	Clogging has occurred.	Wash out the underdrain system.
	Clogging has occurred.	Clean out the drop inlet. Dispose of the sediment in a location where it will not cause impacts to streams or the SCM..
	The drop inlet is damaged	Repair or replace the drop inlet.
The receiving water	Erosion or other signs of damage have occurred at the outlet.	Repair the damage and improve the flow dissipation structure.
	Discharges from the bioretention cell are causing erosion or sedimentation in the receiving water.	Contact the local NCDEQ Regional Office.

STORMWATER CONTOL STRUCTURE
BIORETENTION MAINTENANCE AGREEMENT

PROJECT: ZEBULON STORAGE MAX
RESPONSIBLE PARTY: ALLEN MASSEY **PHONE #:** 919-604-0505
ADDRESS: 2700 GRESHAM LAKE RD.
RALEIGH NC

I. **Monthly** or after every runoff producing rainfall, whichever comes first:
   a. Remove debris from bioretention area.
   b. Inspect for ponding, washed-out areas, and soil conditions.
   c. Check for eroded areas of bioretention area and repair before next rainfall.
   d. Check vegetation conditions within the bioretention area and replace if necessary any damaged plant materials.

II. **Quarterly**
   a. Inspect the collection system (i.e., catch basin, piping, grassed swales) for proper functioning.
   b. Clear accumulated trash from basin grates, and basin bottoms, and check piping for obstructions.
   c. Check bioretention inlet pipes for undercutting. Repair if necessary.
   d. Repair any broken pipes.
   e. Remulch any void areas by hand whenever needed.
   f. Replace rip rap at out let pipe that is choked with sediment.

III. **Semi-Annually**
   a. Reseed grass swale or border twice yearly.
   b. Apply new mulch twice yearly.

IV. **General**
   a. All components of bioretention area to be kept in working order.
   b. This property and bioretention area is also subject to the Operations and Maintenance Manual filed in relation to this project.
   c. The maintenance of the stormwater device(s) shall be the sole responsibility of the Owner.The responsibility for the maintenance of the stormwater device shall pass in the chain of title to the Owner's successor in interest.

I, E. ALLEN MASSEY, hereby acknowledge that I am the financially responsible party for maintenance of this stormwater device.

I will perform the maintenance as outlined above, as part of the Certificate of Compliance with Stormwater Regulations received for this project.

Signature: E. Allen Massey Date: 7.6.23

I JANET C MILLS do hereby certify that E. ALLEN MASSEY personally appeared before me this 6 day of JULY, 2023 and acknowledge due execution of the foregoing instrument. Witness my hand and official seal,

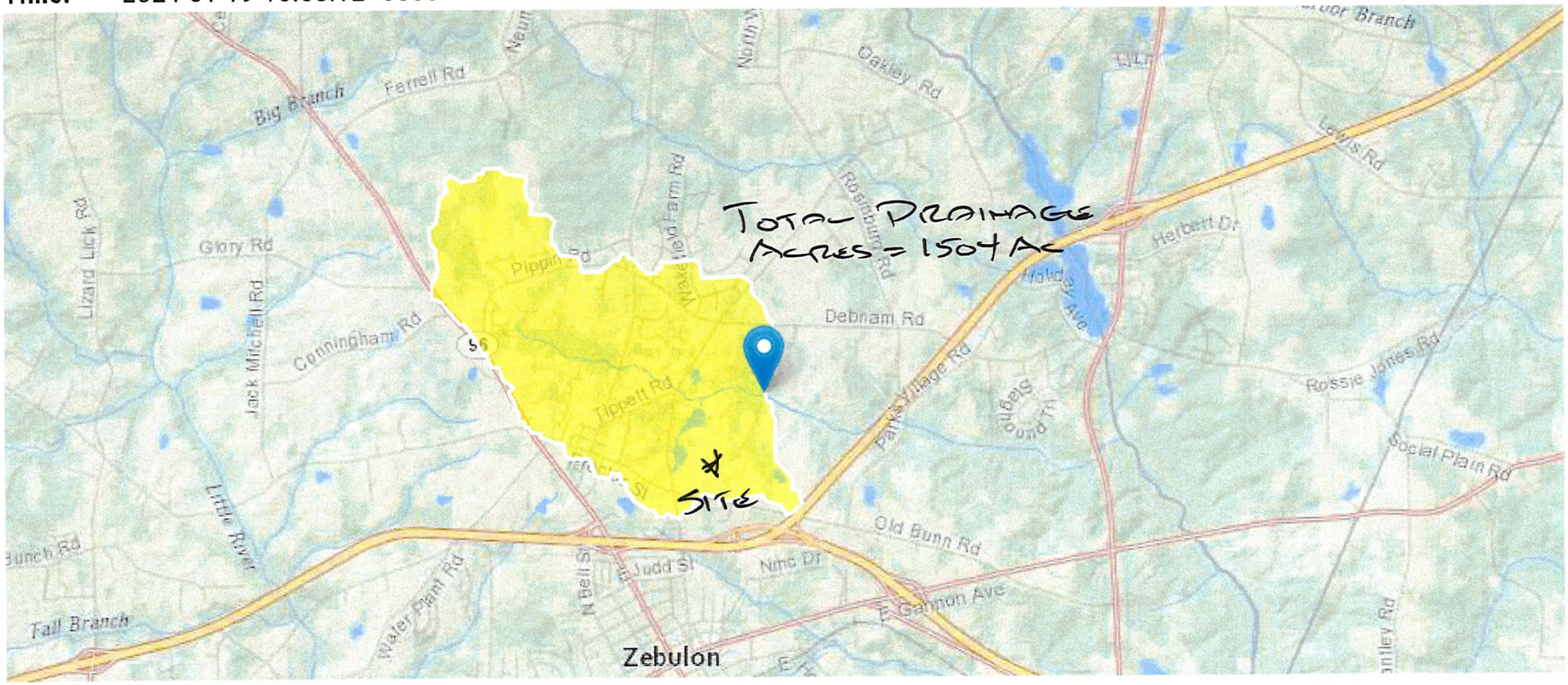
JANET C MILLS NOTARY PUBLIC WAKE COUNTY, NC

Seal _____ My commission expires: 04-29-27

Downstream Impact Analysis (DIA)

StreamStats Report

Region ID: NC
Workspace ID: NC20240119205251951000
Clicked Point (Latitude, Longitude): 35.84674, -78.30538
Time: 2024-01-19 15:53:12 -0500



Collapse All

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	2.35	square miles
LC06IMP	Percentage of impervious area determined from NLCD 2006 impervious dataset	3.26	percent
PCTREG1	Percentage of drainage area located in Region 1 - Piedmont / Ridge and Valley	100	percent
PCTREG2	Percentage of drainage area located in Region 2 - Blue Ridge	0	percent
PCTREG3	Percentage of drainage area located in Region 3 - Sandhills	0	percent
PCTREG4	Percentage of drainage area located in Region 4 - Coastal Plains	0	percent
PCTREG5	Percentage of drainage area located in Region 5 - Lower Tifton Uplands	0	percent

Bankfull Statistics

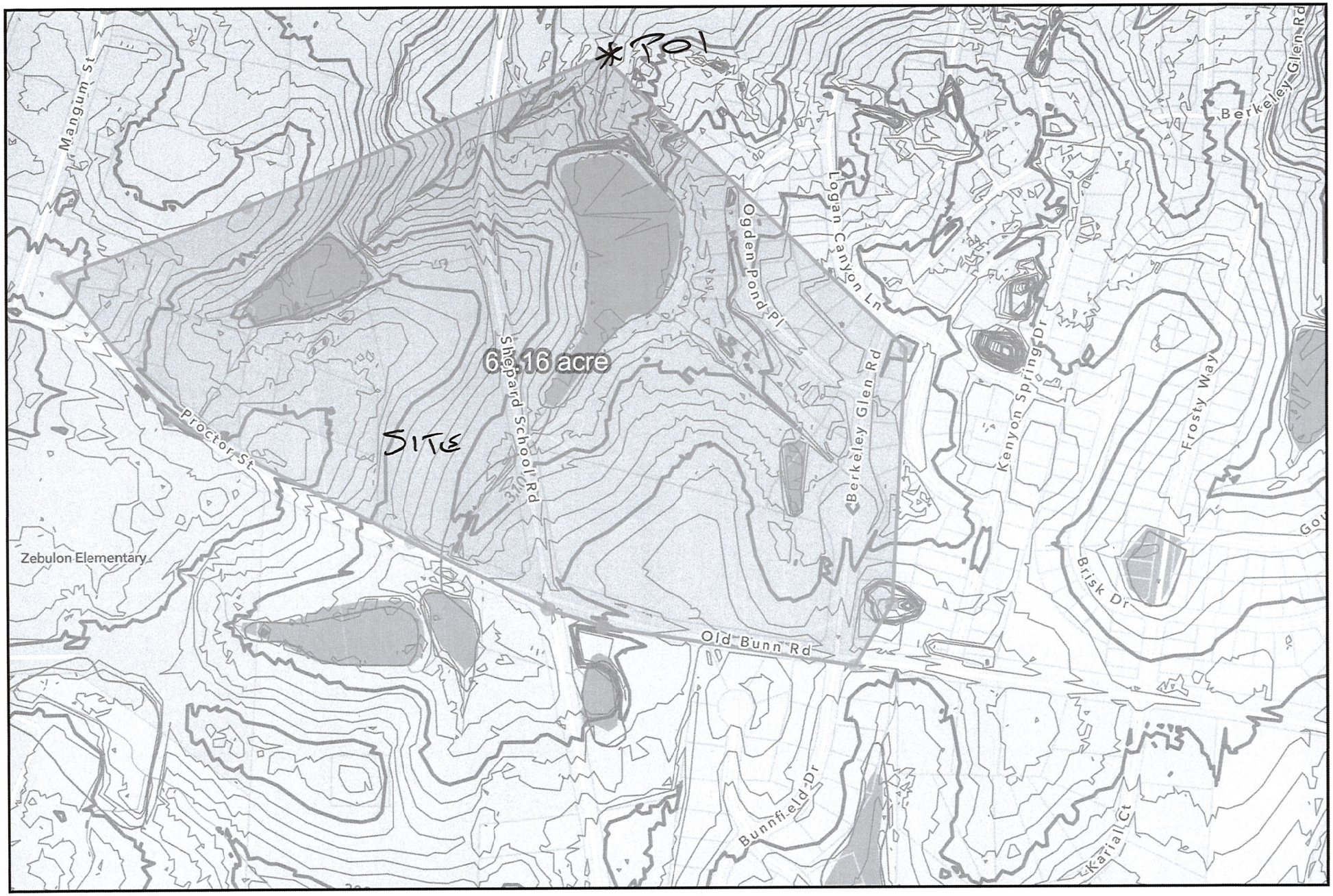
Bankfull Statistics Parameters [Appalachian Highlands D Bieger 2015]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	2.35	square miles	0.07722	940.1535

= 1504 Acres

Bankfull Statistics Parameters [Piedmont P Bieger 2015]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	2.35	square miles	0.289575	939.99906



Drainage Area 10%

N

0 200 400 800 ft

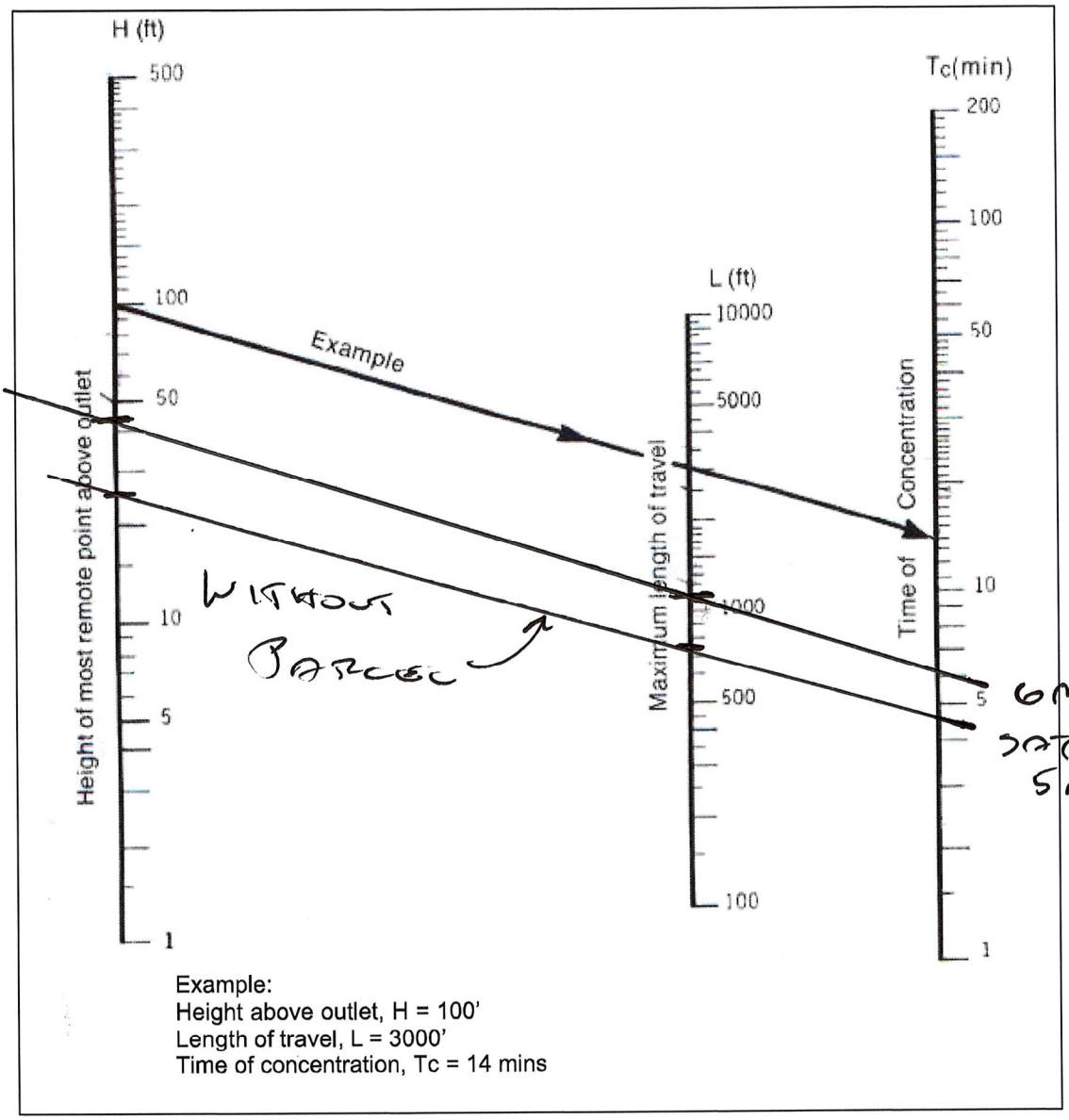
1 inch equals 400 feet

Disclaimer

*iMaps makes every effort to produce and publish the most current and accurate information possible. However, the maps are produced for information purposes, and are **NOT** surveys. No warranties, expressed or implied ,are provided for the data therein, its use,or its interpretation.*

D 1A

Figure 2.4 Kirpich Equation
(Source: North Carolina Erosion and Sediment Control Planning and Design Manual)



Example:
Height above outlet, H = 100'
Length of travel, L = 3000'
Time of concentration, Tc = 14 mins

* PRE DEVELOPMENT
FLOW PATH = 1133 FEET
HEIGHT = 44 FEET
Tc = 6 MIN

Curve Number Analysis

Project **Calculated By**

Location **Checked By**

Soils Data			DIA			
			Area with lot		Area without lot	
Soil	Cover Description	CN	Area	CN x Area	Area	CN x Area
NA	**Impervious Cover**					
	Roof/Concrete	98	11.00	1078	11.00	1078
	Asphalt Pavement	98	4.71	462	2.71	266
B	**Pervious/Semi-Perv Cover**					
	Lawn, Good Condition	61				
	Woods, Fair Condition	60	23.45	1407	23.45	1407
	Grass, Fair Condition	69	25.00	1725	20.80	1435
ith 11% connected, 89% unconnected)		65				
	Gravel	85				
C	**Pervious/Semi-Perv Cover**					
	Lawn, Good Condition	74				
	Woods, Fair Condition	73				
	Brush, Good Condition	65				
	Grass, Fair Condition	79				
ith 11% connected, 89% unconnected)		76				
	Gravel	89				
D	**Pervious/Semi-Perv Cover**					
	Lawn, Good Condition	80				
	Woods, Good Condition	77				
	Brush, Good Condition	73	1.00	73	0.70	51
	Landscape	79				
	Gravel	91				
	Total		65.16	4745	58.66	4237
	Weighted Curve Number			73		72

Total Acerage (Pre)	65.16
Total Acerage (Post)	58.66

Watershed Model Schematic

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

1 - DIA Pre

2 - DIA Without Parcel

Hydrograph Return Period Recap

Hyd. No.	Hydrograph type (origin)	Inflow hyd(s)	Peak Outflow (cfs)							Hydrograph Description
			1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
1	SCS Runoff	------	-------	-------	-------	-------	283.61	-------	-------	-------	DIA Pre
2	SCS Runoff	------	-------	-------	-------	-------	247.06	-------	-------	-------	DIA Without Parcel

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

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	283.61	2	716	572,581	------	------	------	DIA Pre
2	SCS Runoff	247.06	2	718	497,956	------	------	------	DIA Without Parcel

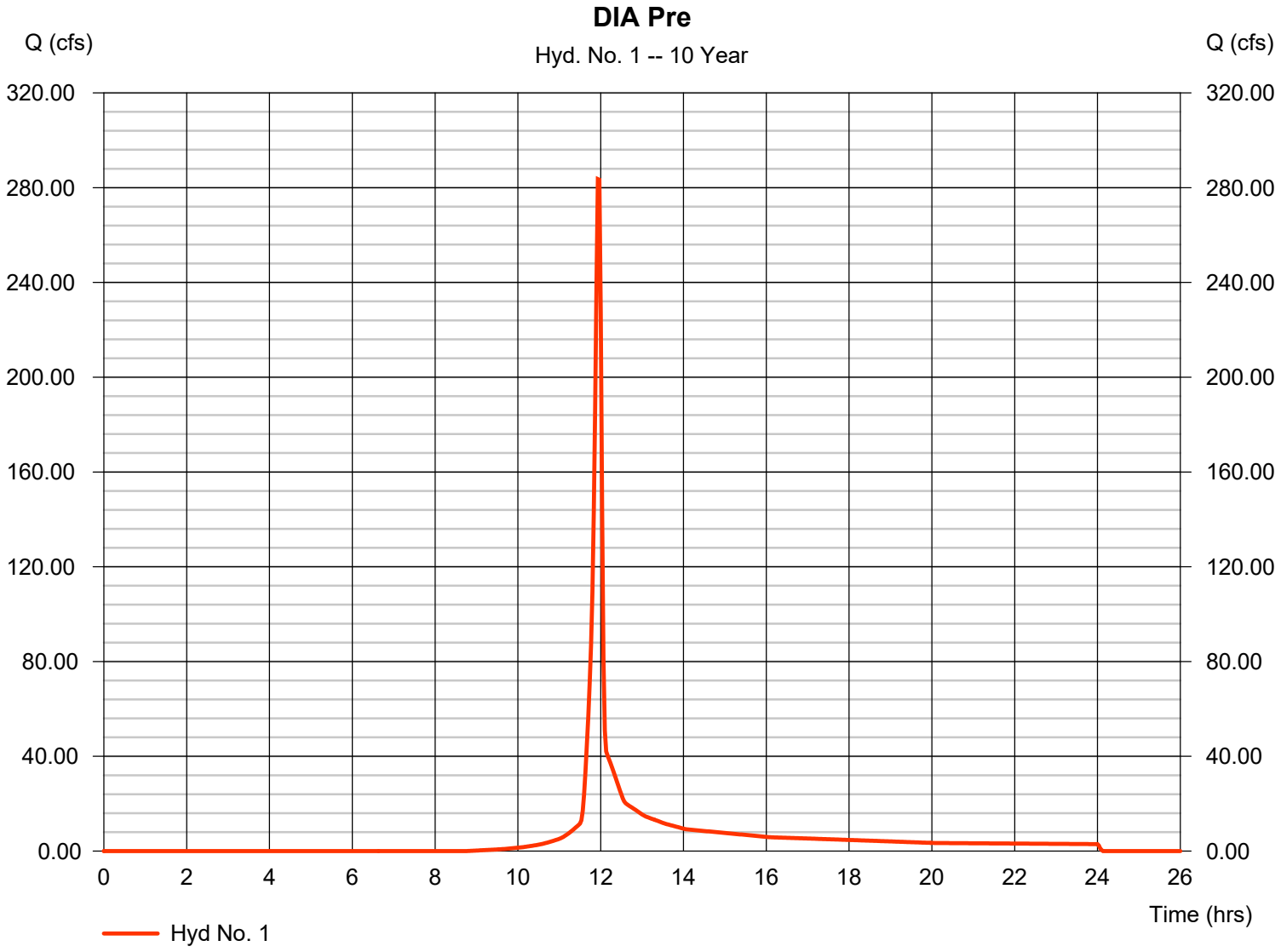
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023 Saturday, 01 / 20 / 2024

Hyd. No. 1

DIA Pre

Hydrograph type	= SCS Runoff	Peak discharge	= 283.61 cfs
Storm frequency	= 10 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 572,581 cuft
Drainage area	= 65.160 ac	Curve number	= 73
Basin Slope	= 4.0 %	Hydraulic length	= 1133 ft
Tc method	= KIRPICH	Time of conc. (Tc)	= 6.05 min
Total precip.	= 5.38 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



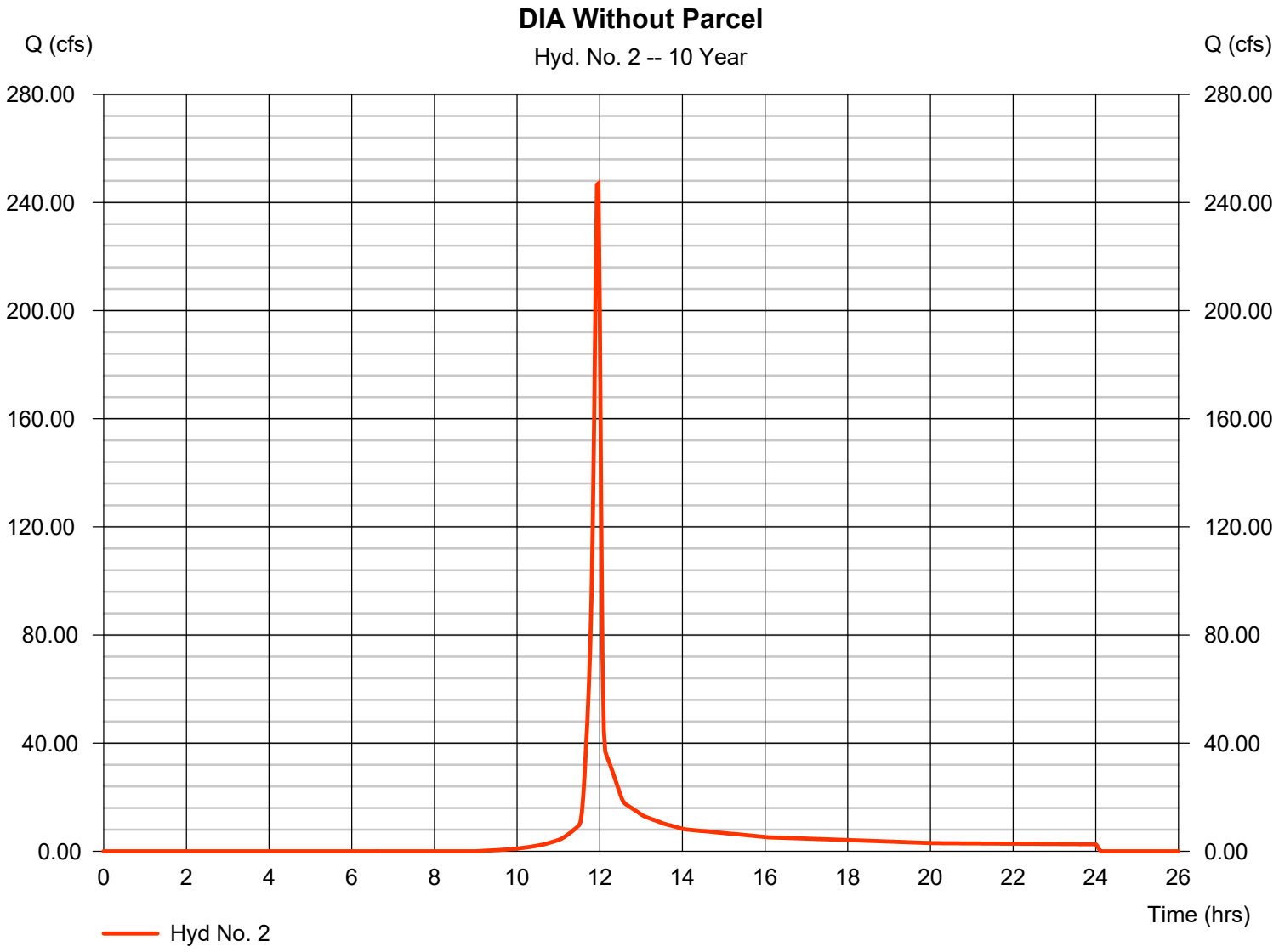
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023 Saturday, 01 / 20 / 2024

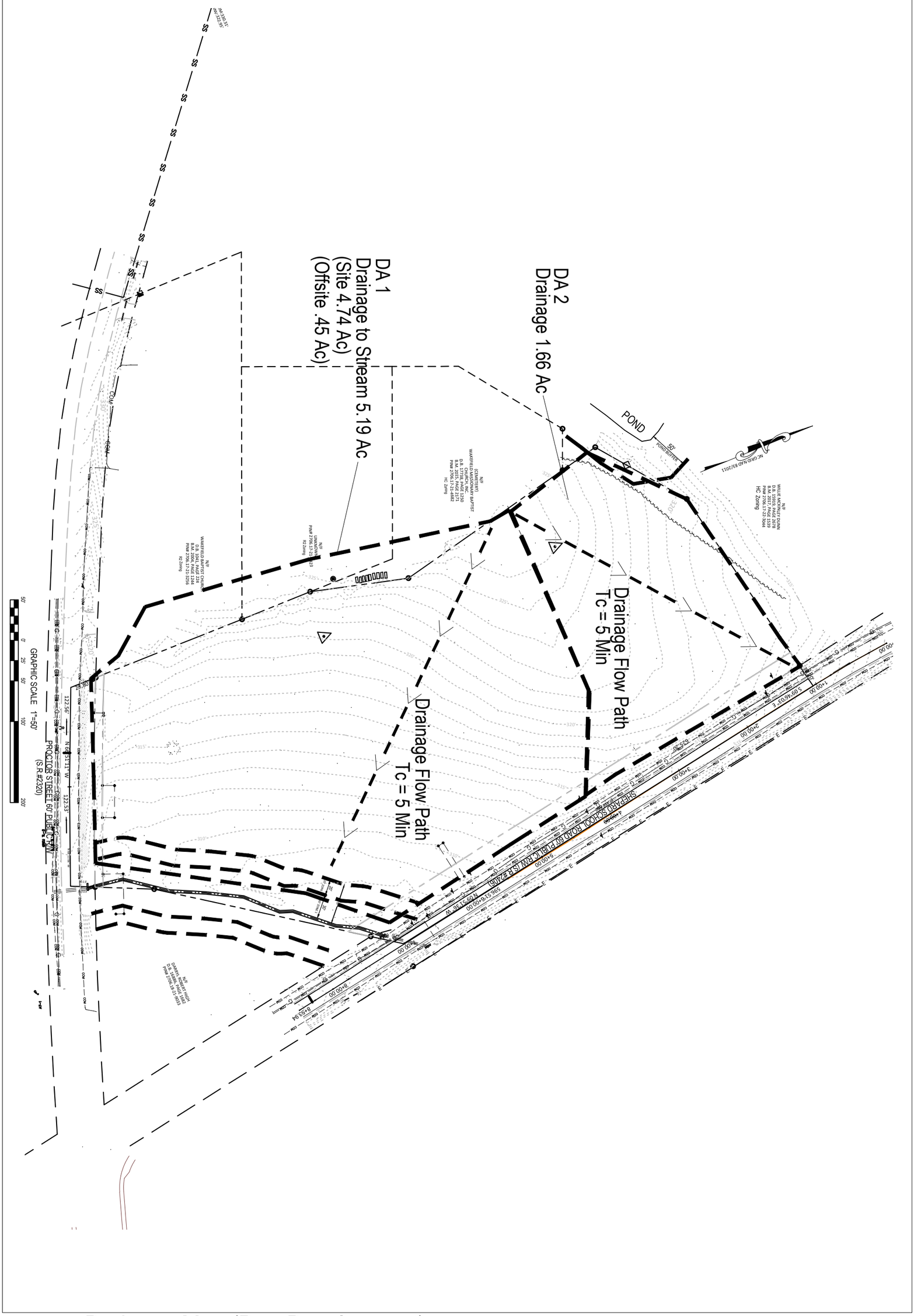
Hyd. No. 2

DIA Without Parcel

Hydrograph type	=	SCS Runoff	Peak discharge	=	247.06 cfs
Storm frequency	=	10 yrs	Time to peak	=	11.97 hrs
Time interval	=	2 min	Hyd. volume	=	497,956 cuft
Drainage area	=	58.660 ac	Curve number	=	72
Basin Slope	=	5.0 %	Hydraulic length	=	700 ft
Tc method	=	KIRPICH	Time of conc. (Tc)	=	3.83 min
Total precip.	=	5.38 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484



Drainage Maps



Drainage Map (Pre- Development)

StorageMax (1098359)
901 Proctor Street
Zebulon, Wake County, North Carolina

Project No. 23001
Dwg No.
EX1

NO.	DATE	REVISION DESCRIPTION	BY
1	01-05-2024	Per Town Comment	KPG
2	03-06-2024	Per Town Comment	KPG
3	05-31-2024	Per Town, COR AND Wake County Comment	KPG
3	DATE	COMMENT	BY
4	DATE	COMMENT	BY
5	DATE	COMMENT	BY
6	DATE	COMMENT	BY
8	Date	Comment	By

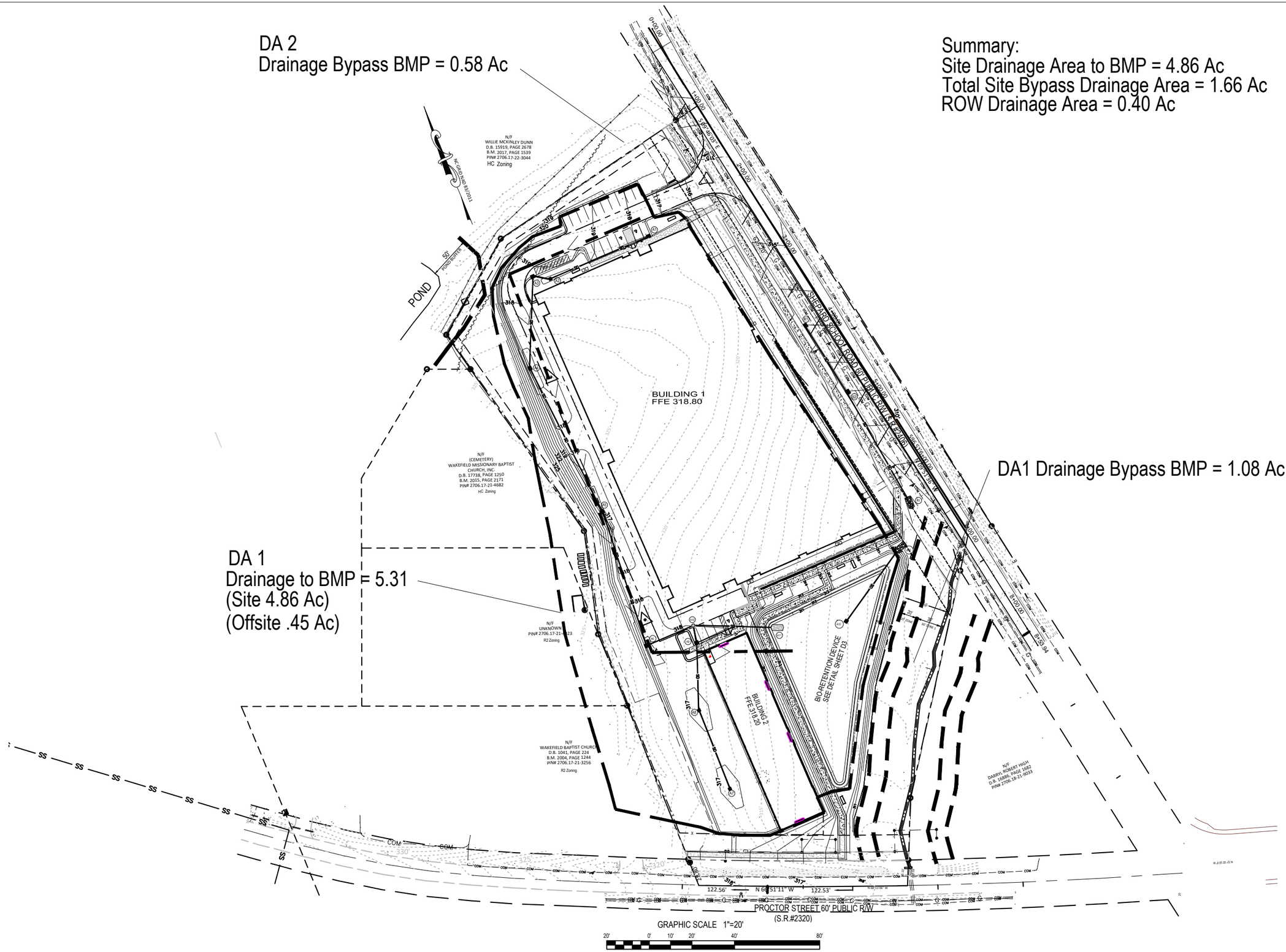
Gettle Engineering and Design, PLLC
3616 Waxwing Court,
Wake Forest, North Carolina 27587
(919) 210-3934 Firm License P-2538

DA 2
Drainage Bypass BMP = 0.58 Ac

Summary:
Site Drainage Area to BMP = 4.86 Ac
Total Site Bypass Drainage Area = 1.66 Ac
ROW Drainage Area = 0.40 Ac

DA1 Drainage Bypass BMP = 1.08 Ac

DA 1
Drainage to BMP = 5.31
(Site 4.86 Ac)
(Offsite .45 Ac)



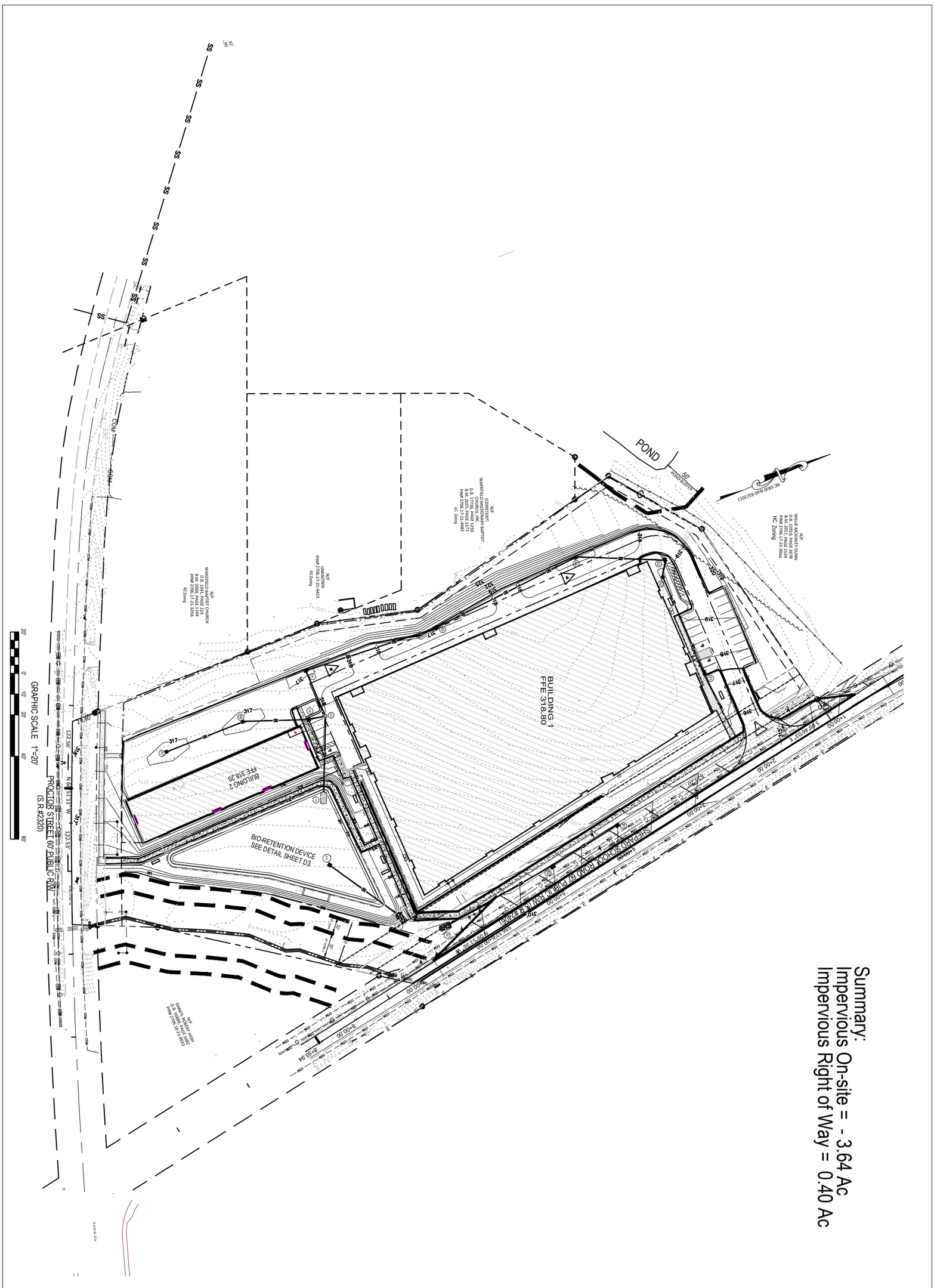
Gettle Engineering and Design, PLLC
3616 Waxwing Court,
Wake Forest, North Carolina 27587
(919) 210-3934 Firm License P-2538

NO.	DATE	REVISION DESCRIPTION	BY
1	01-05-2026	Per Town Comment	KPG
2	03-06-2026	Per Town Comment	KPG
3	03-17-2026	Per Town CDR AND Water County Comment	KPG
4	DATE	COMMENT	BY
5	DATE	COMMENT	BY
6	DATE	COMMENT	BY
8	Date	Comment	By

Drainage Map- Post Development

StorageMax (1098359)
901 Proctor Street
Zebulon, Wake County, North Carolina

Project No. 23001
Dwg No. EX2



Project No. 23001
Dwg No.
EX2A

Drainage Map - Impervious

StorageMax (1098359)
901 Proctor Street
Zebulon, Wake County, North Carolina

NO.	DATE	REVISION DESCRIPTION	BY
1	01-05-2024	Per Town Comment	KPG
2	03-06-2024	Per Town Comment	KPG
3	05-31-2024	Per Town, CDR AND Wake County Comment	KPG
3	DATE	COMMENT	BY
4	DATE	COMMENT	BY
5	DATE	COMMENT	BY
6	DATE	COMMENT	BY
8	Date	Comment	By

Gettle Engineering and Design, PLLC
3616 Waxwing Court,
Wake Forest, North Carolina 27587
(919) 210-3934 Firm License P-2538